

RADIO PERFORMANCE TEST REPORT

Test Report No. : OT-213-RWD-003

Reception No. : 2008003253

Applicant : PS TEC Co., Ltd.

Address : 80, HWANGGEUM 3-RO 7BEON-GIL, YANGCHON-EUP, GIMPO-SI,
GYEONGGI-DO, KOREA

Manufacturer : PS TEC Co., Ltd.

Address : 80, HWANGGEUM 3-RO 7BEON-GIL, YANGCHON-EUP, GIMPO-SI,
GYEONGGI-DO, KOREA

Type of Equipment : Autonomous Terminal

FCC ID. : 2AVSN-PSM-NGT-G01

Model Name : PSM-NGT-G01

Multiple Model Name : N/A

Serial number : N/A

Total page of Report : 42 pages (including this page)

Date of Incoming : January 08, 2021

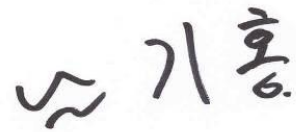
Date of issue : March 02, 2021

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.



Tested by
Youngyong Kim/ Assistant Manager
ONETECH Corp.

Reviewed by
Ha-Ram Lee / Manager
ONETECH Corp.

Approved by
Ki-Hong, Nam / General Manager
ONETECH Corp.

CONTENTS

PAGE

1. VERIFICATION OF COMPLIANCE	5
2. TEST SUMMARY.....	6
2.1 TEST ITEMS AND RESULTS FOR BLUETOOTH LE (MDBT50Q-U)	6
2.2 TEST ITEMS AND RESULTS FOR CERTIFIED BLUETOOTH LE (RN4870)	6
2.3 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS.....	7
2.4 RELATED SUBMITTAL(S) / GRANT(S)	7
2.5 PURPOSE OF THE TEST	7
2.6 TEST METHODOLOGY.....	7
2.7 TEST FACILITY.....	7
3. GENERAL INFORMATION.....	8
3.1 PRODUCT DESCRIPTION.....	8
3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT.....	9
4. EUT MODIFICATIONS.....	9
5. SYSTEM TEST CONFIGURATION	10
5.1 JUSTIFICATION.....	10
5.2 PERIPHERAL EQUIPMENT	10
5.3 MODE OF OPERATION DURING THE TEST	10
6. PRELIMINARY TEST	12
6.1 AC POWER LINE CONDUCTED EMISSIONS TESTS.....	12
6.2 GENERAL RADIATED EMISSIONS TESTS	12
7. MINIMUM 6 DB BANDWIDTH	13
7.1 OPERATING ENVIRONMENT	13
7.2 TEST SET-UP	13
7.3 TEST DATE	13
7.4 TEST DATA.....	14
8. MAXIMUM PEAK OUTPUT POWER.....	16
8.1 OPERATING ENVIRONMENT	16
8.2 TEST SET-UP	16
8.3 TEST DATE	16
8.4 TEST DATA.....	17
9. 100 KHZ BANDWIDTH OUTSIDE THE FREQUENCY BAND.....	19

9.1 OPERATING ENVIRONMENT	19
9.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	19
9.3 TEST SET-UP FOR RADIATED MEASUREMENT.....	19
9.4 TEST DATE	19
9.5 TEST DATA FOR CONDUCTED EMISSION	20
9.6 TEST DATA FOR RADIATED EMISSION.....	25
10. PEAK POWER SPECTRAL DENSITY	29
10.1 OPERATING ENVIRONMENT	29
10.2 TEST SET-UP	29
10.3 TEST DATE	29
10.4 TEST DATA.....	30
11. RADIATED EMISSION TEST	32
11.1 OPERATING ENVIRONMENT	32
11.2 TEST SET-UP	32
11.3 TEST DATE	32
11.4 TEST DATA FOR BLUETOOTH LE (MDBT50Q-U).....	33
11.4.1 Test data for 30 MHz ~ 1000 MHz.....	33
11.4.2 Test data for Below 30 MHz	34
11.4.3 Test data for above 1 GHz	34
11.5 TEST DATA FOR CERTIFIED BLUETOOTH LE (RN4870)	35
11.5.1 Test data for 30 MHz ~ 1000 MHz.....	35
11.5.2 Test data for Below 30 MHz	36
11.5.3 Test data for above 1 GHz	36
12. CONDUCTED EMISSION TEST.....	37
12.1 OPERATING ENVIRONMENT	37
12.2 TEST SET-UP	37
12.3 TEST DATE	37
12.4 TEST DATA FOR BLUETOOTH LE (MDBT50Q-U).....	38
12.5 TEST DATA FOR CERTIFIED BLUETOOTH LE (RN4870)	40
13. LIST OF TEST EQUIPMENT	42

Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-213-RWD-003	March 02, 2021	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : PS TEC Co., Ltd.

Address : 80, HWANGGEUM 3-RO 7BEON-GIL, YANGCHON-EUP, GIMPO-SI, GYEONGGI-DO, KOREA

Contact Person : Bo Young Hwang/General Manager

Telephone No. : +82-2-3408-1750

FCC ID : 2AVSN-PSM-NGT-G01

Model Name : PSM-NGT-G01

Brand Name : N/A

Serial Number : N/A

Date : March 02, 2021

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Autonomous Terminal
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
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 for Bluetooth LE (MDBT50Q-U)

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 Test items and results for Certified Bluetooth LE (RN4870)

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

Note.: This test item is not required as It has been performed on the initial certification. For more details, Please refer to the test report of certified module.

(Report No.: 10053523 001 / Model name: RN4870 / FCC ID: A8TBM70ABCDEFGH)

2.3 Additions, deviations, exclusions from standards

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

2.4 Related Submittal(s) / Grant(s)

Original submittal only

2.5 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.

2.6 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.7 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 PS TEC Co., Ltd., Model PSM-NGT-G01 (referred to as the EUT in this report) is a Autonomous Terminal. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	Autonomous Terminal	
Operating Frequency	Bluetooth LE	2 402 MHz ~ 2 480 MHz
	WLAN 2.4 GHz Band	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))
		2 422 MHz ~ 2 452 MHz (802.11n(HT40))
RF Output Power	Bluetooth LE	-2.04 dBm
	WLAN 2.4 GHz Band	802.11b (8.23 dBm) 802.11g (3.10 dBm) 802.11n(HT20) (3.11 dBm) 802.11n(HT40) (0.52 dBm)
Number of Channel	Bluetooth LE	40 Channels
	WLAN 2.4 GHz Band	11 Channels
Modulation Type	Bluetooth LE	DSSS Modulation(GFSK)
	WLAN 2.4 GHz Band	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
Antenna Type	Bluetooth LE (Model Name: MDBT50Q-U)	Dipole Antenna
	WLAN 2.4 GHz Band	
Antenna Gain	Bluetooth LE (Model Name: MDBT50Q-U)	5.33 dBi
	WLAN 2.4 GHz Band	
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	26 MHz, 32 MHz	
Rated Supply Voltage	DC 5.0 V	

Note 1: The Product has total of 3 Modules including certified Bluetooth LE Module (Model Name: RN4870), Bluetooth LE Module (MDBT50Q-U) and WLAN module. For details of Certified Module, Please refer to the report. (Report No.: 10053523 001 / Model name: RN4870 / FCC ID: A8TBM70ABCDEF GH)

Note 2: Bluetooth LE (MDBT50Q-U), Certified Bluetooth LE(RN4870) and WLAN operate simultaneously.

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

-, None

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	PS TEC 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
PSM-NGT-G01	PS TEC Co., Ltd.	Autonomous Terminal (EUT)	
Notebook PC	HP	PROBOOK	

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

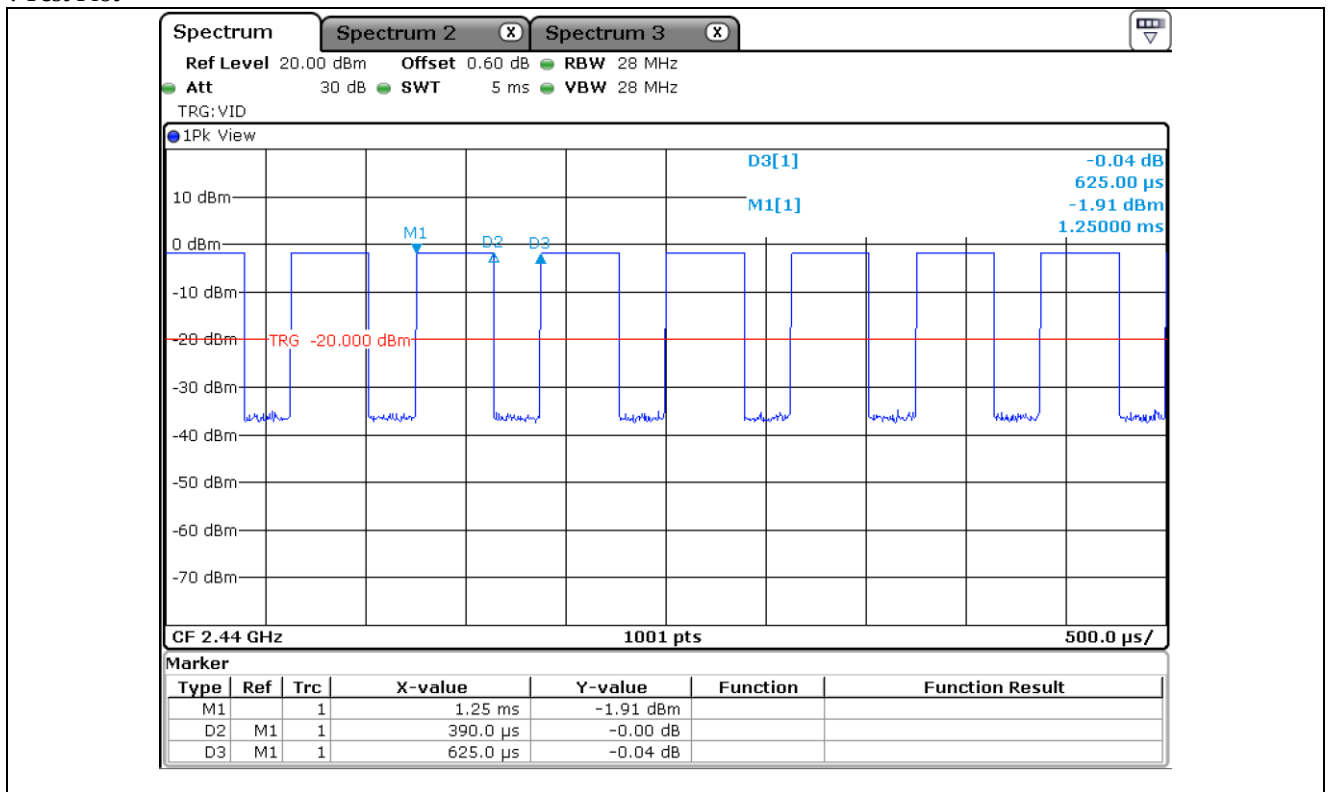
-. Duty Cycle for Bluetooth LE (Module name: MDBT50Q-U)

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Bluetooth LE	0.39	0.23	62.40	2.05

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

Correction Factor : 10 * Log(1 / (Duty Cycle / 100))

-. Test Plot



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: 2013 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 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 Dipole antenna is connected to 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

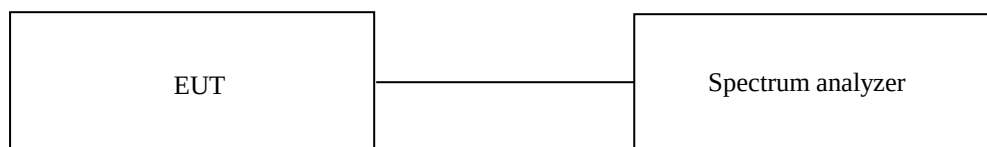
7. MINIMUM 6 dB BANDWIDTH

7.1 Operating environment

Temperature : 22.5 °C
Relative humidity : 49 % R.H.

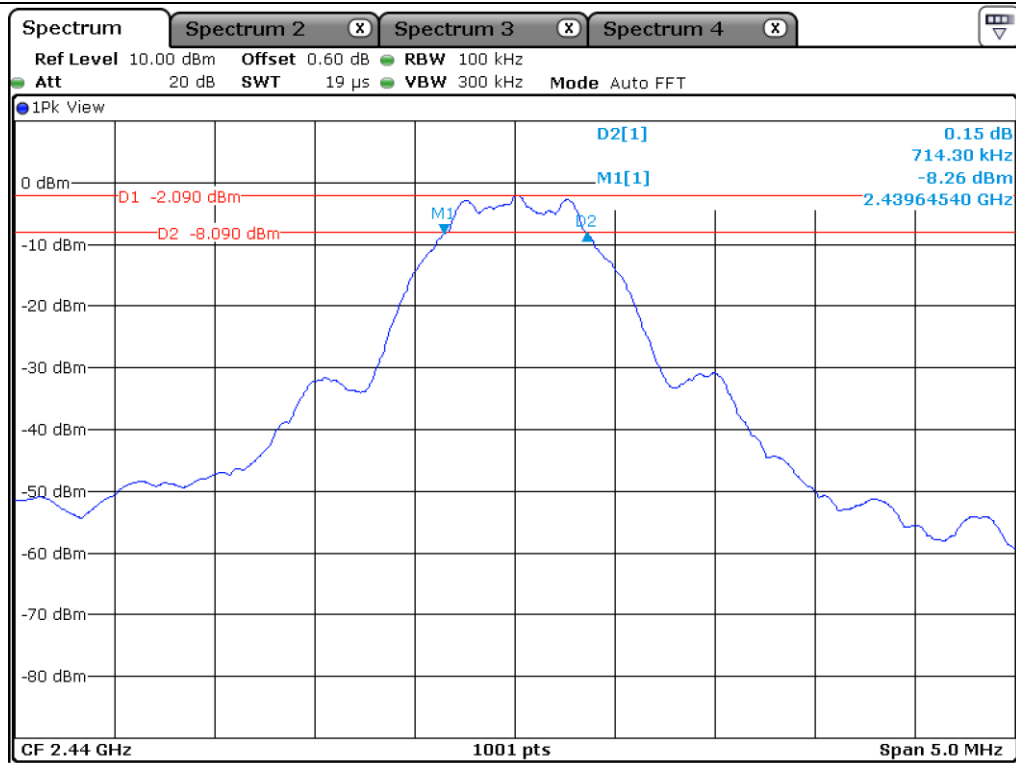
7.2 Test set-up

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.

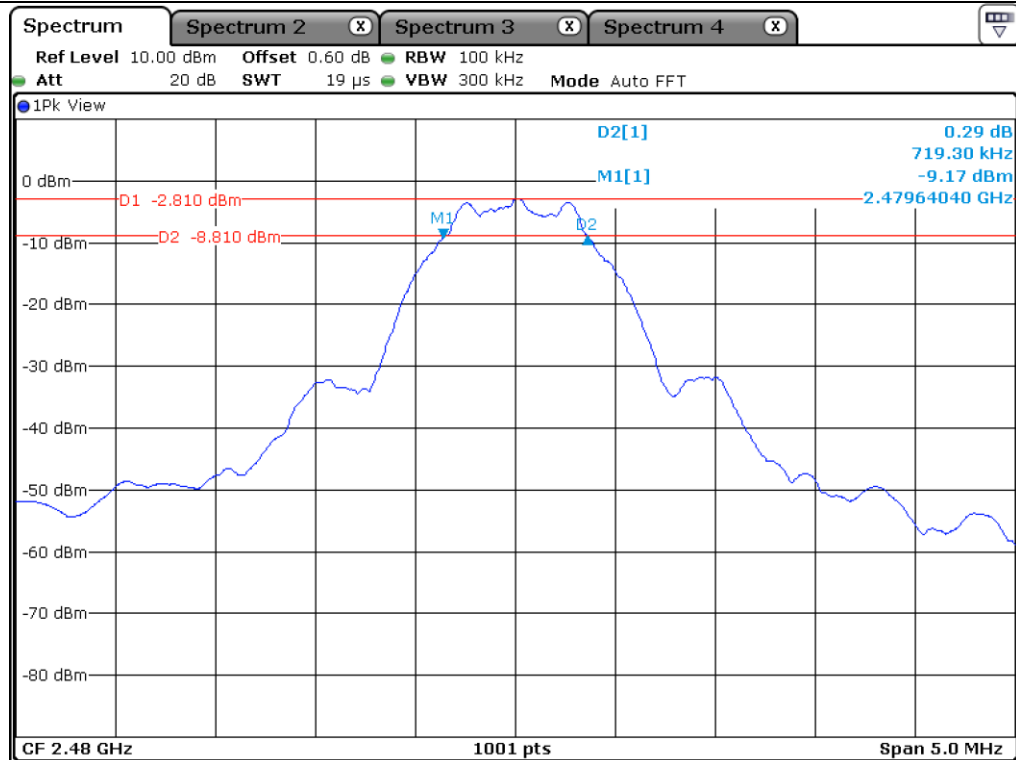


7.3 Test Date

January 06, 2021 ~ January 11, 2021



Middle Channel



High Channel

8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

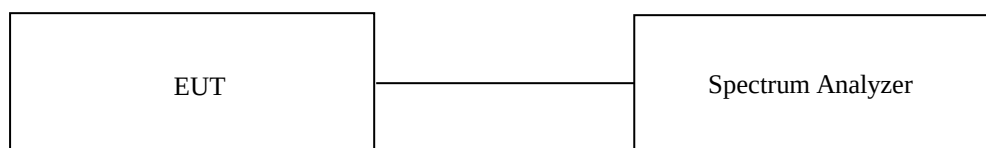
Temperature : 22.5 °C

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

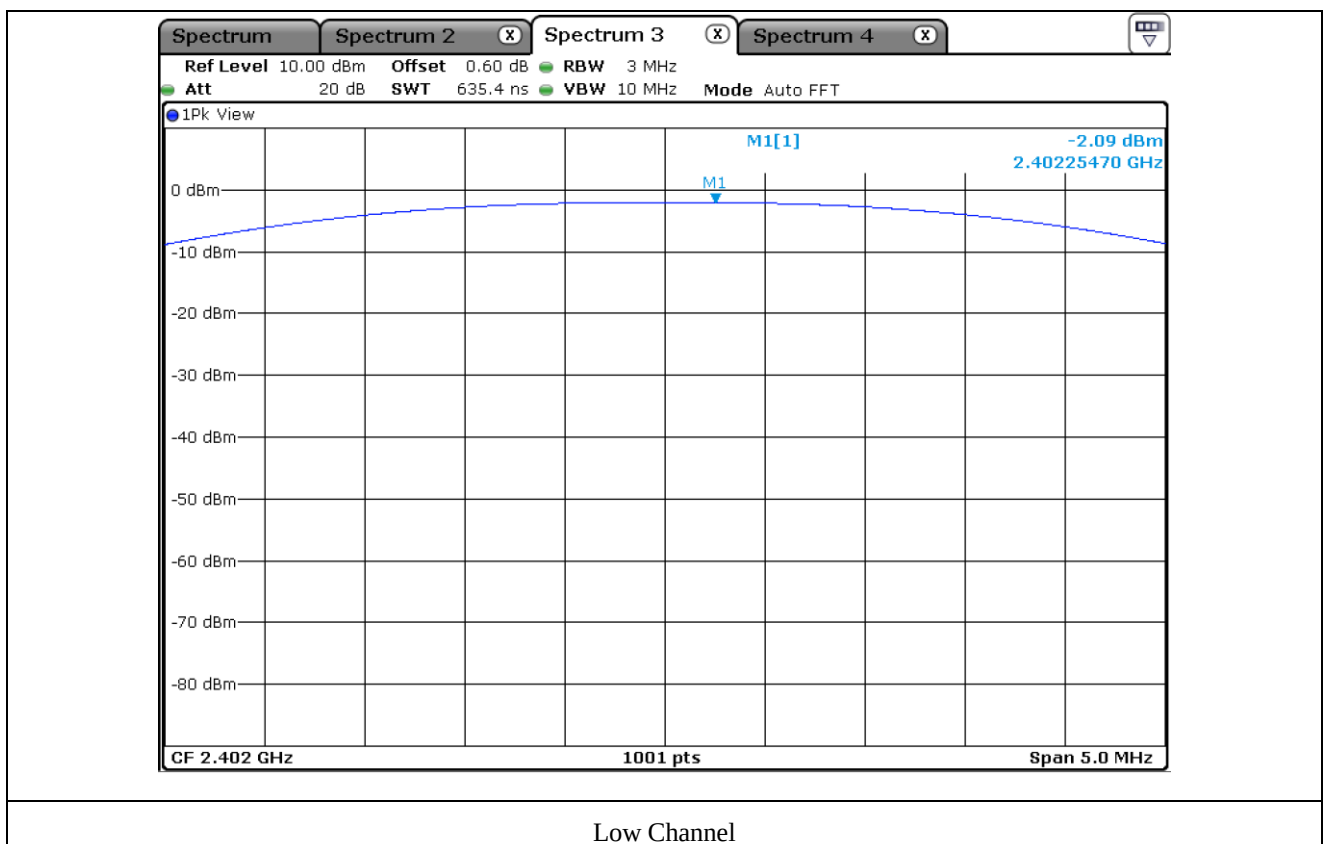
January 06, 2021 ~ January 11, 2021

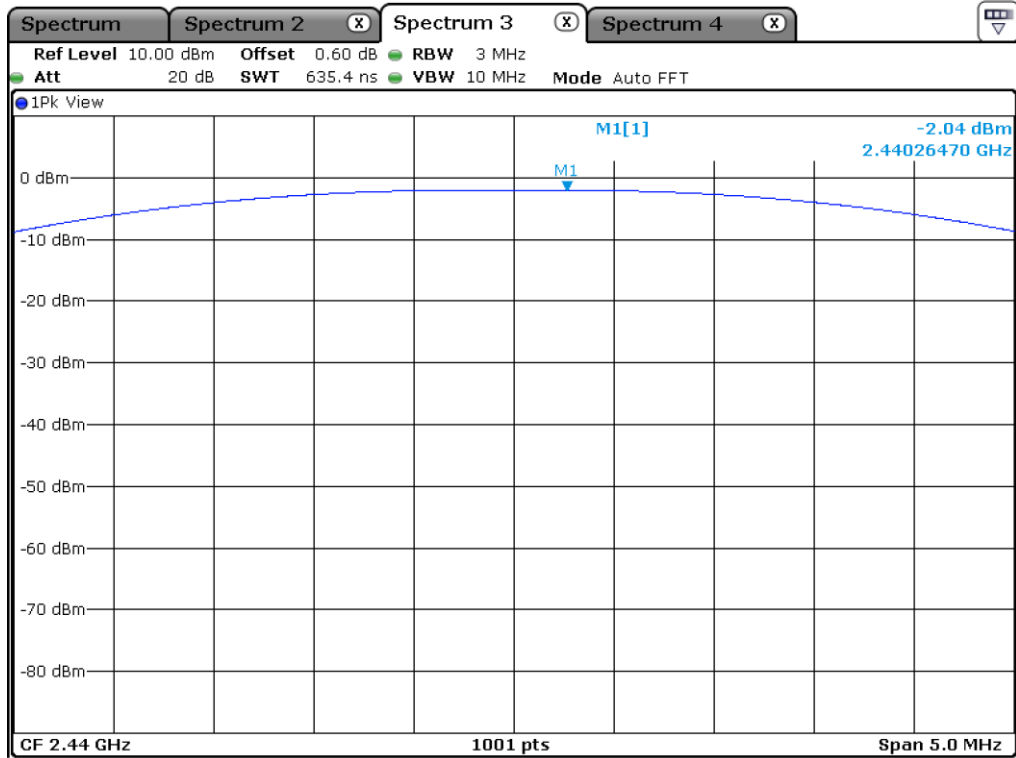
8.4 Test data

-. Test Result : Pass

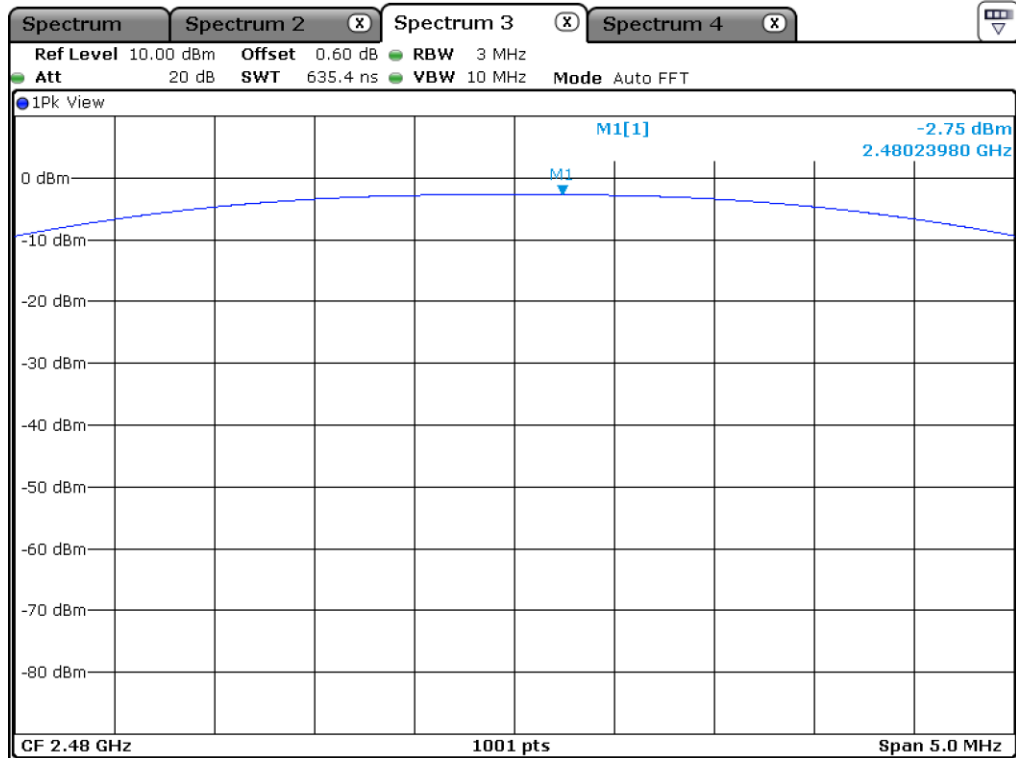
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
Low	2 402.00	-2.09	30.00	32.09
Middle	2 440.00	-2.04	30.00	32.04
High	2 480.00	-2.75	30.00	32.75

Remark. Margin = Limit – Result value (=Measured value + Duty Cycle Factor)





Middle Channel



High Channel

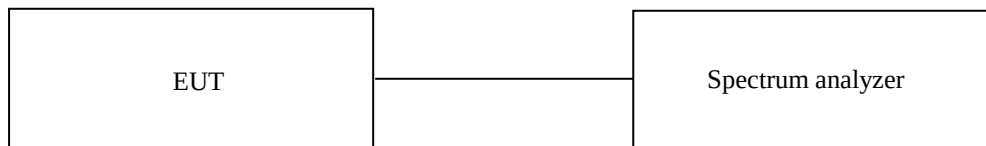
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 22.5 °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

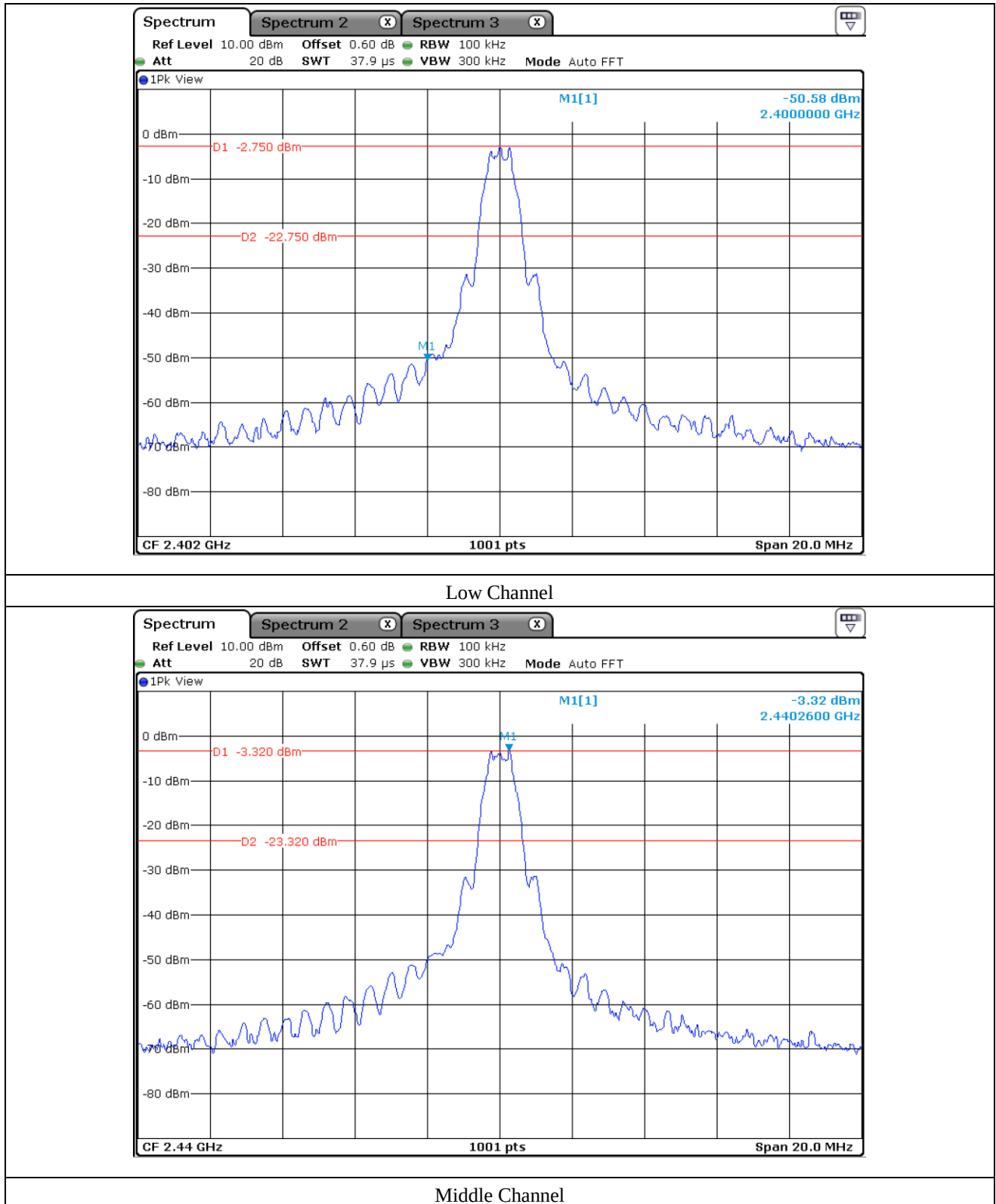
The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

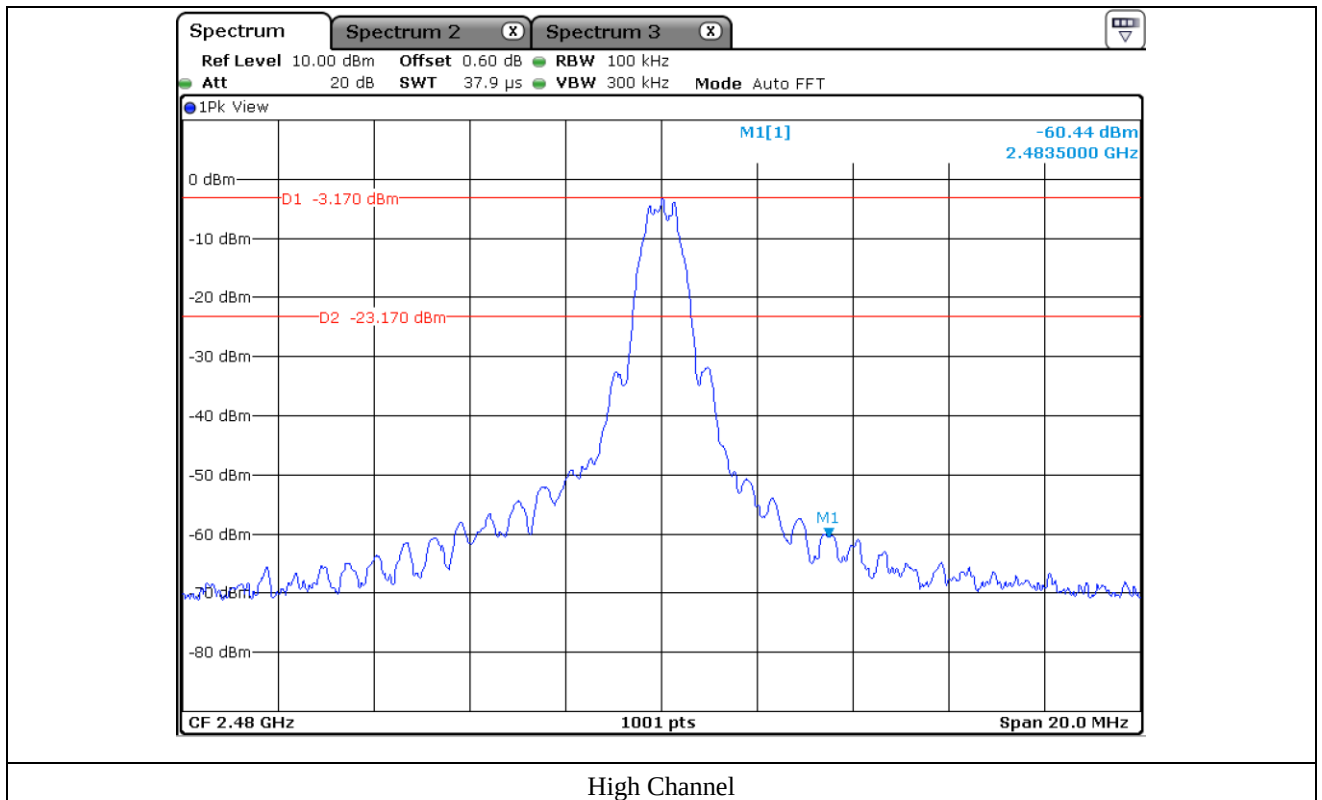
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal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

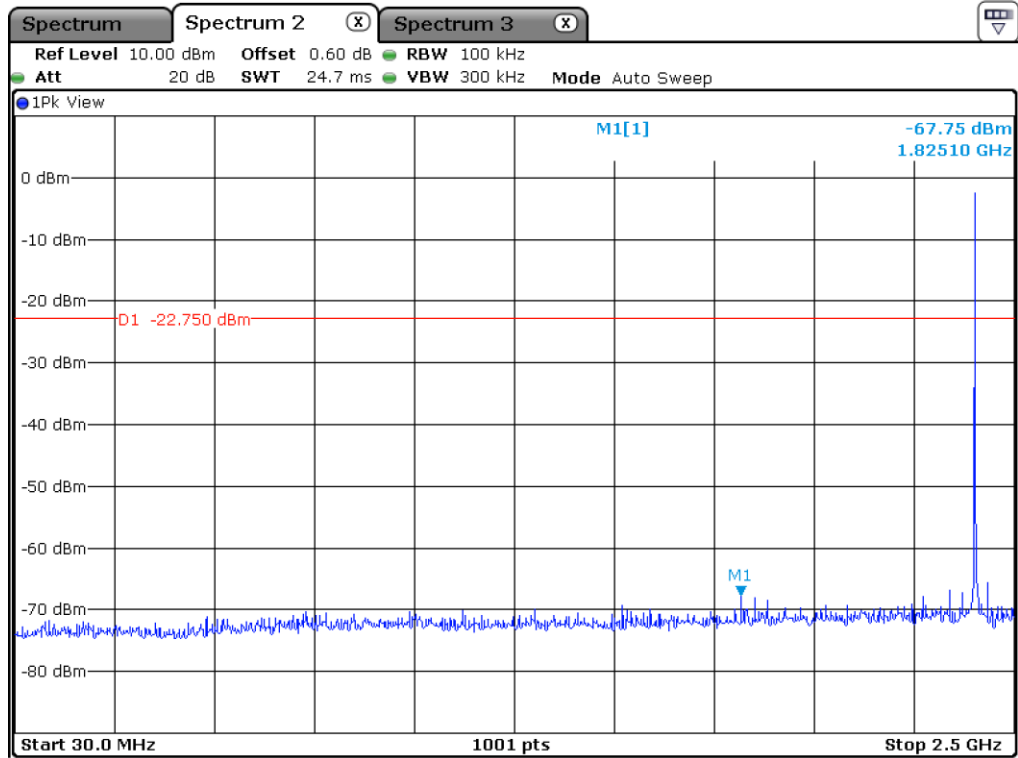
9.4 Test Date

January 06, 2021 ~ January 11, 2021

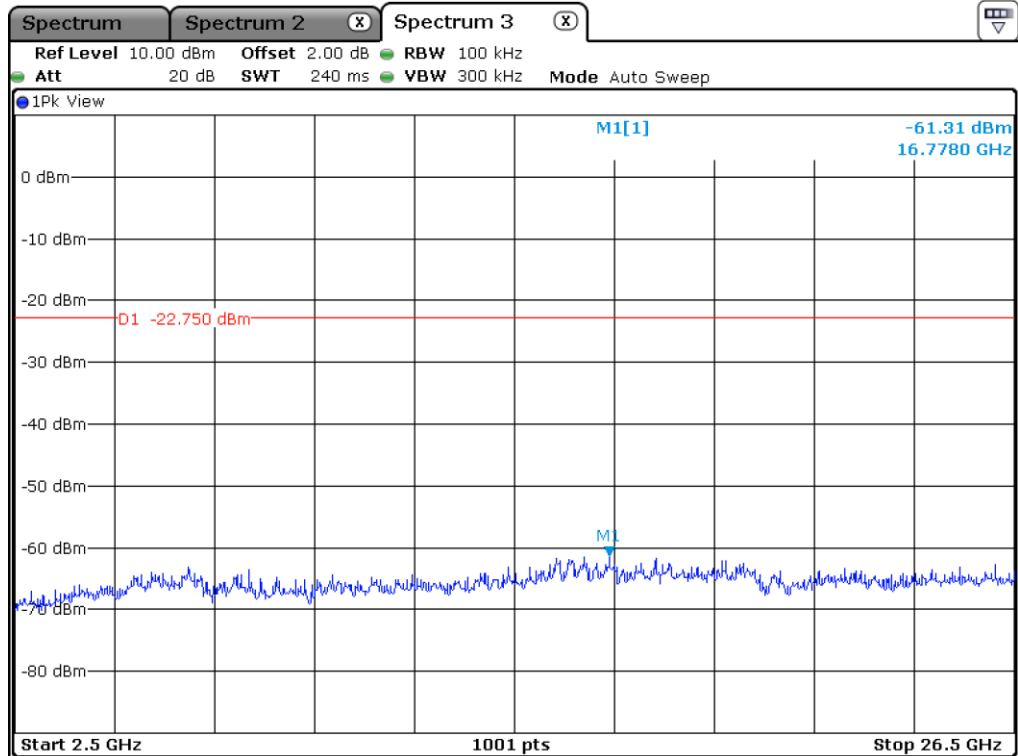
9.5 Test data for conducted emission



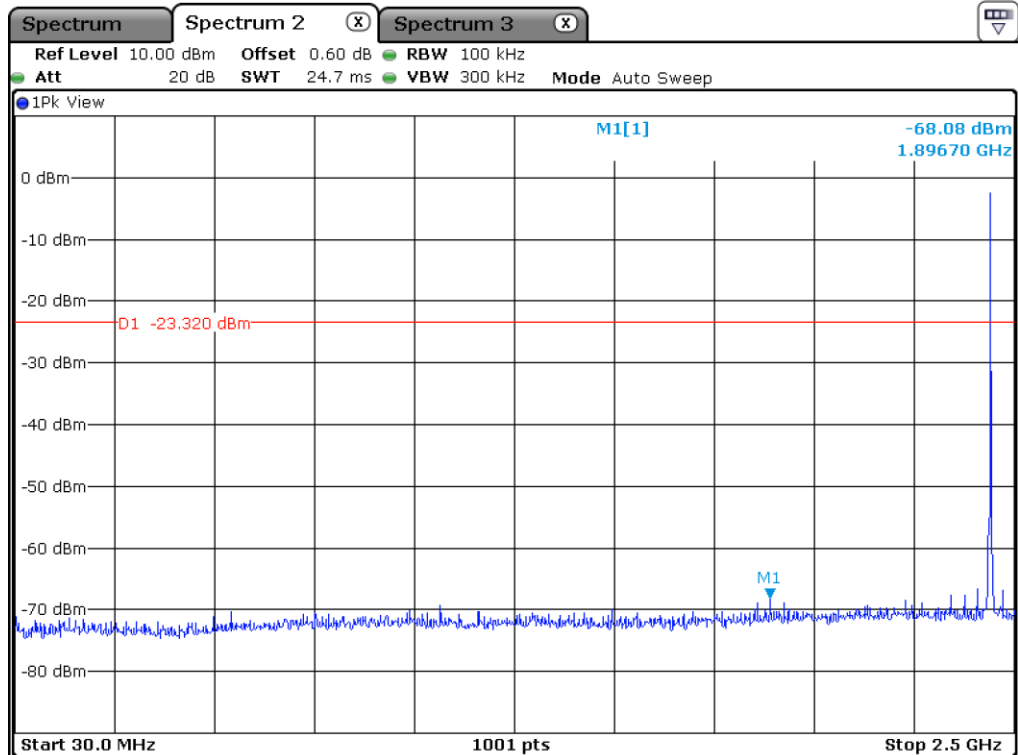




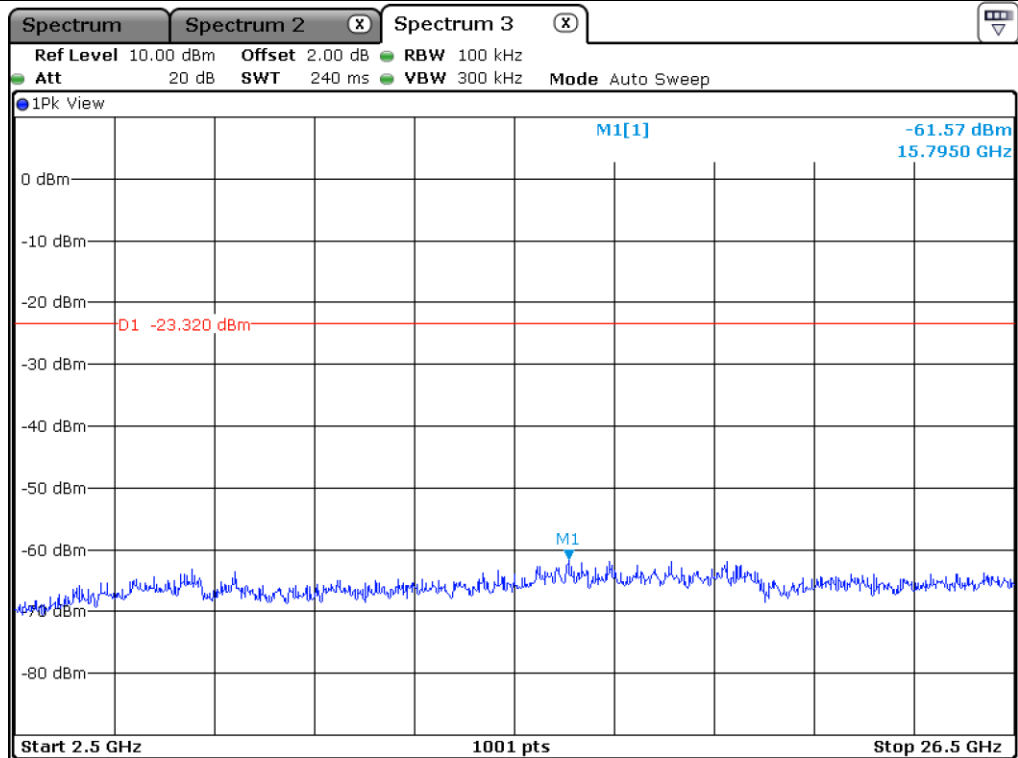
Low Channel



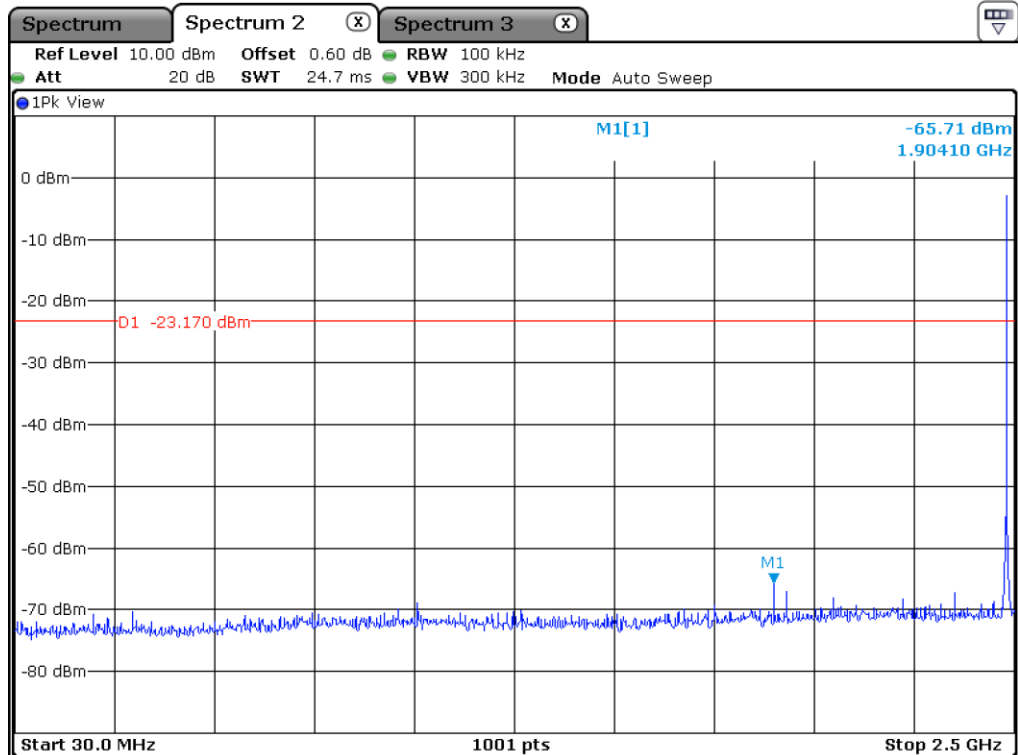
Low Channel



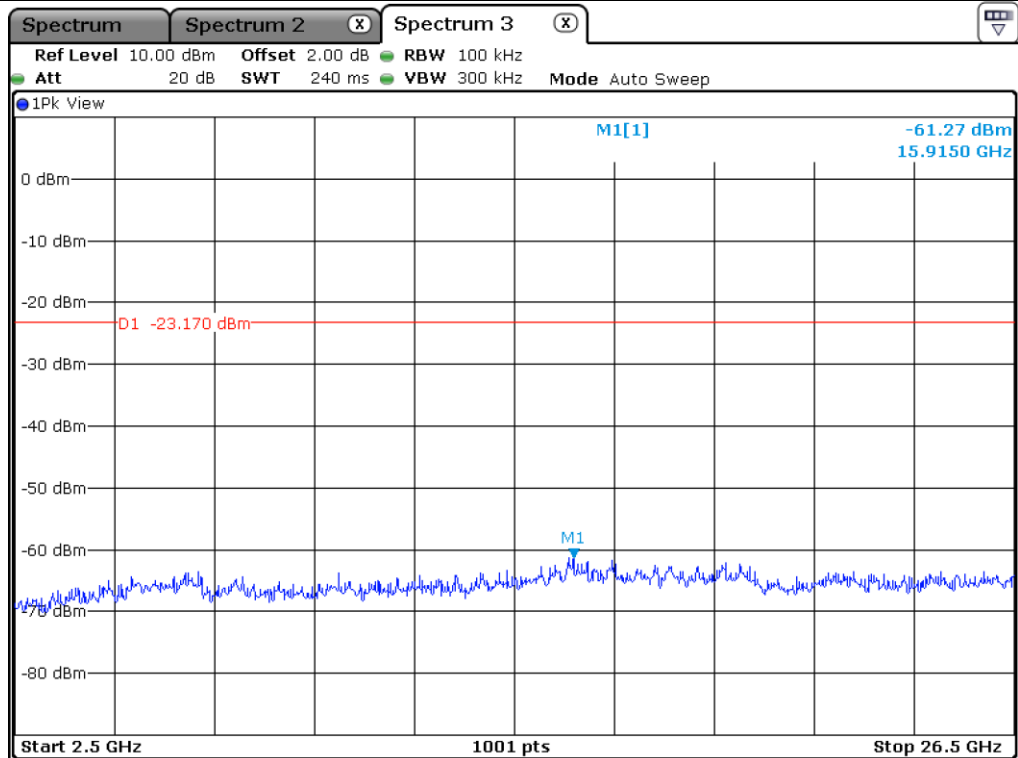
Middle Channel



Middle Channel



High Channel



High Channel

9.6 Test data for radiated emission

9.6.1 Test data for Bluetooth LE (MDBT50Q-U)

9.6.1.1 Radiated Emission which fall in the Restricted Band

- 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 : 62.40 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	AMP Gain (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
2 351.51	45.88	Peak	H	28.30	8.21	-	45.31	37.08	74.00	36.92
2 347.20	35.96	Average	H	28.30	8.21	2.05	45.31	29.21	54.00	24.79
2 389.40	51.72	Peak	V	28.30	8.21	-	45.31	42.92	74.00	31.08
2 369.98	37.78	Average	V	28.30	8.21	2.05	45.31	31.03	54.00	22.97
2 483.50	46.54	Peak	H	28.80	8.33	-	45.81	37.86	74.00	36.14
2 483.50	35.74	Average	H	28.80	8.33	2.05	45.81	29.11	54.00	24.89
2 483.50	54.50	Peak	V	28.80	8.33	-	45.81	45.82	74.00	28.18
2 483.50	43.24	Average	V	28.80	8.33	2.05	45.81	36.61	54.00	17.39

Tabulated test data for Restricted Band

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

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

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

9.6.1.2 Spurious & Harmonic Radiated Emission

- 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 : 62.40 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	AMP Gain (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
4 804	43.90	Peak	H	33.40	11.18	-	46.33	42.15	74.00	31.85
4 804	33.68	Average	H	33.40	11.18	2.05	46.33	33.98	54.00	20.02
4 804	44.07	Peak	V	33.40	11.18	-	46.33	42.32	74.00	31.68
4 804	33.93	Average	V	33.40	11.18	2.05	46.33	34.23	54.00	19.77
Test Data for Low Channel										
4 880	44.71	Peak	H	33.30	11.31	-	46.35	42.97	74.00	31.03
4 880	33.85	Average	H	33.30	11.31	2.05	46.35	34.16	54.00	19.84
4 880	45.05	Peak	V	33.30	11.31	-	46.35	43.31	74.00	30.69
4 880	33.95	Average	V	33.30	11.31	2.05	46.35	34.26	54.00	19.74
Test Data for Middle Channel										
4 960	43.75	Peak	H	33.30	11.41	-	46.35	42.11	74.00	31.89
4 960	33.71	Average	H	33.30	11.41	2.05	46.35	34.12	54.00	19.88
4 960	44.28	Peak	V	33.30	11.41	-	46.35	42.64	74.00	31.36
4 960	33.79	Average	V	33.30	11.41	2.05	46.35	34.20	54.00	19.80

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

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

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

9.6.2 Test data for Certified Bluetooth LE (RN4870)

9.6.2.1 Radiated Emission which fall in the Restricted Band

- 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 : 64.80 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	AMP Gain (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
2 389.96	51.72	Peak	H	28.30	8.21	-	45.31	42.92	74.00	31.08
2 389.96	40.00	Average	H	28.30	8.21	1.88	45.31	33.08	54.00	20.92
2 326.34	47.46	Peak	V	28.30	8.21	-	45.31	38.66	74.00	35.34
2 389.96	36.31	Average	V	27.80	8.21	1.88	45.31	29.39	54.00	24.61
2 483.50	63.81	Peak	H	28.80	8.33	-	45.81	55.13	74.00	18.87
2 483.50	54.08	Average	H	28.80	8.33	1.88	45.81	47.28	54.00	6.72
2 483.50	55.02	Peak	V	28.80	8.33	-	45.81	46.34	74.00	27.66
2 483.50	45.52	Average	V	28.80	8.33	1.88	45.81	38.72	54.00	15.28

Tabulated test data for Restricted Band

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

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

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

9.6.2.2 Spurious & Harmonic Radiated Emission

- 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 : 64.80 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	AMP Gain (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
4 804	45.65	Peak	H	33.40	11.18	-	46.33	43.90	74.00	30.10
4 804	36.22	Average	H	33.40	11.18	1.88	46.33	36.35	54.00	17.65
4 804	43.94	Peak	V	33.40	11.18	-	46.33	42.19	74.00	31.81
4 804	34.49	Average	V	33.40	11.18	1.88	46.33	34.62	54.00	19.38
Test Data for Low Channel										
4 880	44.89	Peak	H	33.30	11.31	-	46.35	43.15	74.00	30.85
4 880	34.88	Average	H	33.30	11.31	1.88	46.35	35.02	54.00	18.98
4 880	43.79	Peak	V	33.30	11.31	-	46.35	42.05	74.00	31.95
4 880	33.69	Average	V	33.30	11.31	1.88	46.35	33.83	54.00	20.17
Test Data for Middle Channel										
4 960	45.75	Peak	H	33.30	11.41	-	46.35	44.11	74.00	29.89
4 960	36.46	Average	H	33.30	11.41	1.88	46.35	36.70	54.00	17.30
4 960	44.01	Peak	V	33.30	11.41	-	46.35	42.37	74.00	31.63
4 960	34.02	Average	V	33.30	11.41	1.88	46.35	34.26	54.00	19.74

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

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

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

10. PEAK POWER SPECTRAL DENSITY

10.1 Operating environment

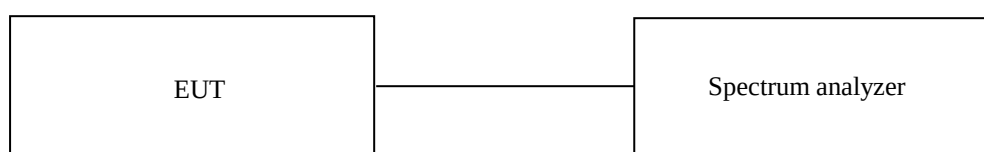
Temperature : 22.5 °C

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

January 06, 2021 ~ January 11, 2021

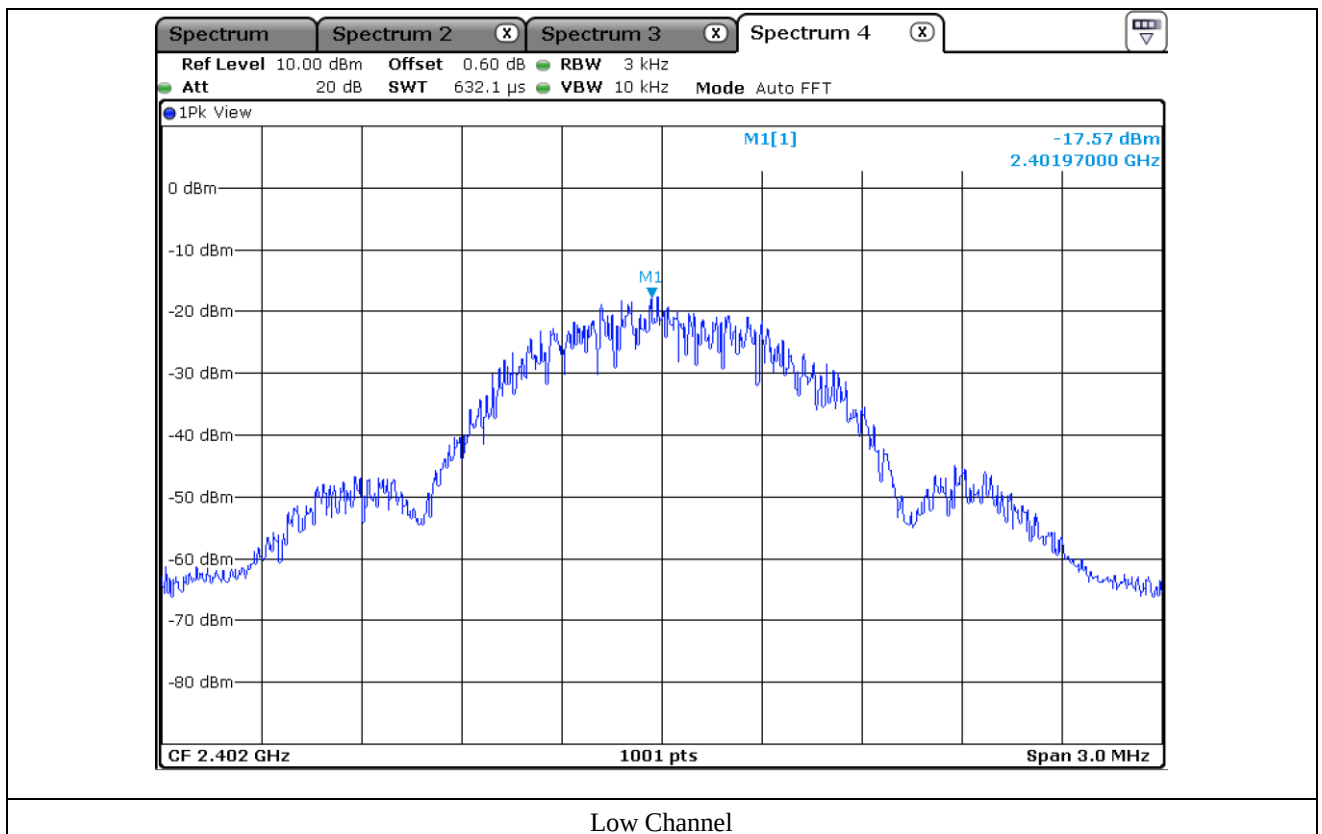
10.4 Test data

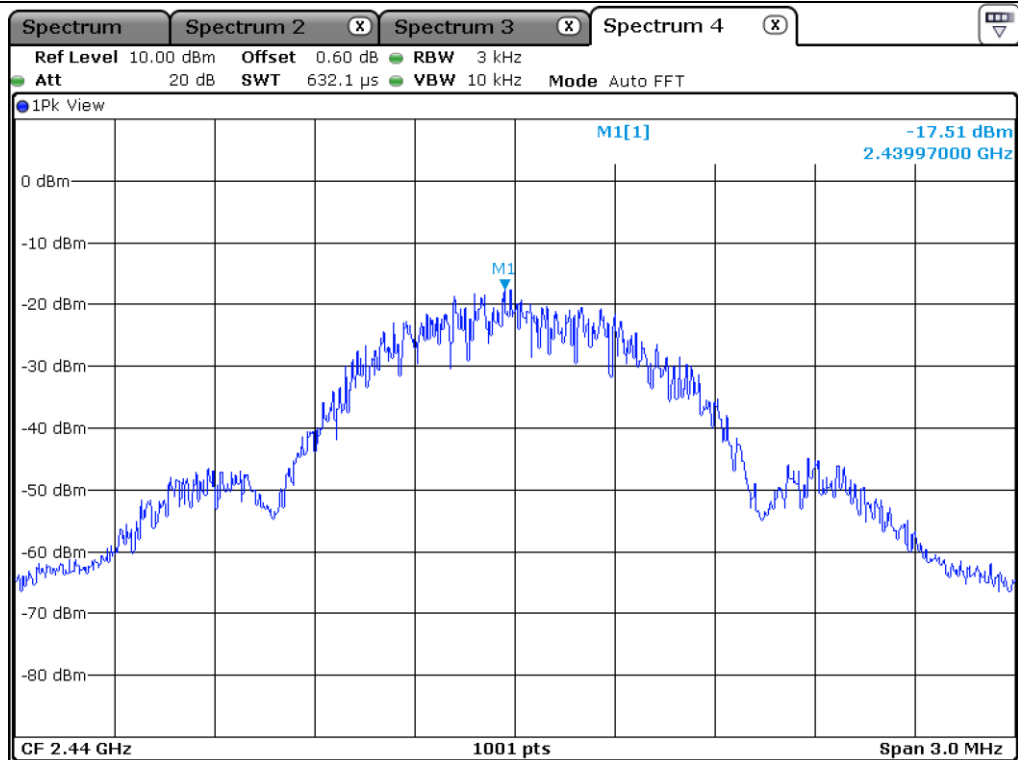
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

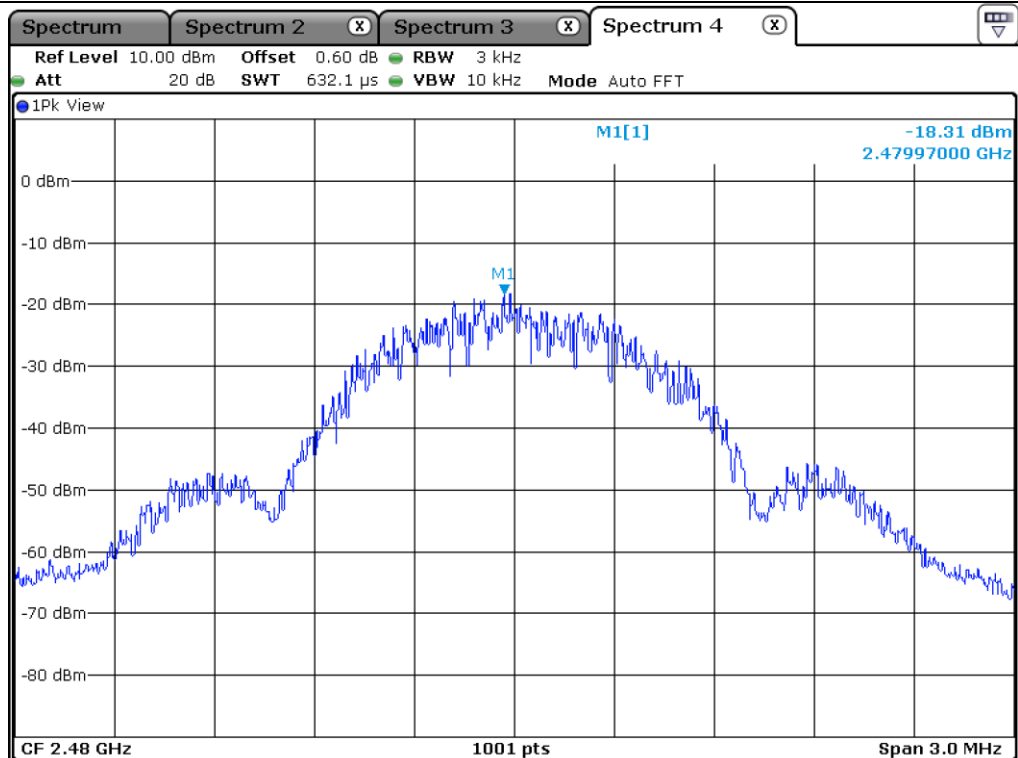
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
Low	2 402.00	-17.57	8.00	25.57
Middle	2 440.00	-17.51	8.00	25.51
High	2 480.00	-18.31	8.00	26.31

Remark. Margin = Limit – Result(=Measured value + Duty Cycle Factor)





Middle Channel



High Channel

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 22.5 °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

January 06, 2021 ~ January 11, 2021

11.4 Test data for Bluetooth LE (MDBT50Q-U)

11.4.1 Test data for 30 MHz ~ 1000 MHz

Humidity Level : 49 % R.H.

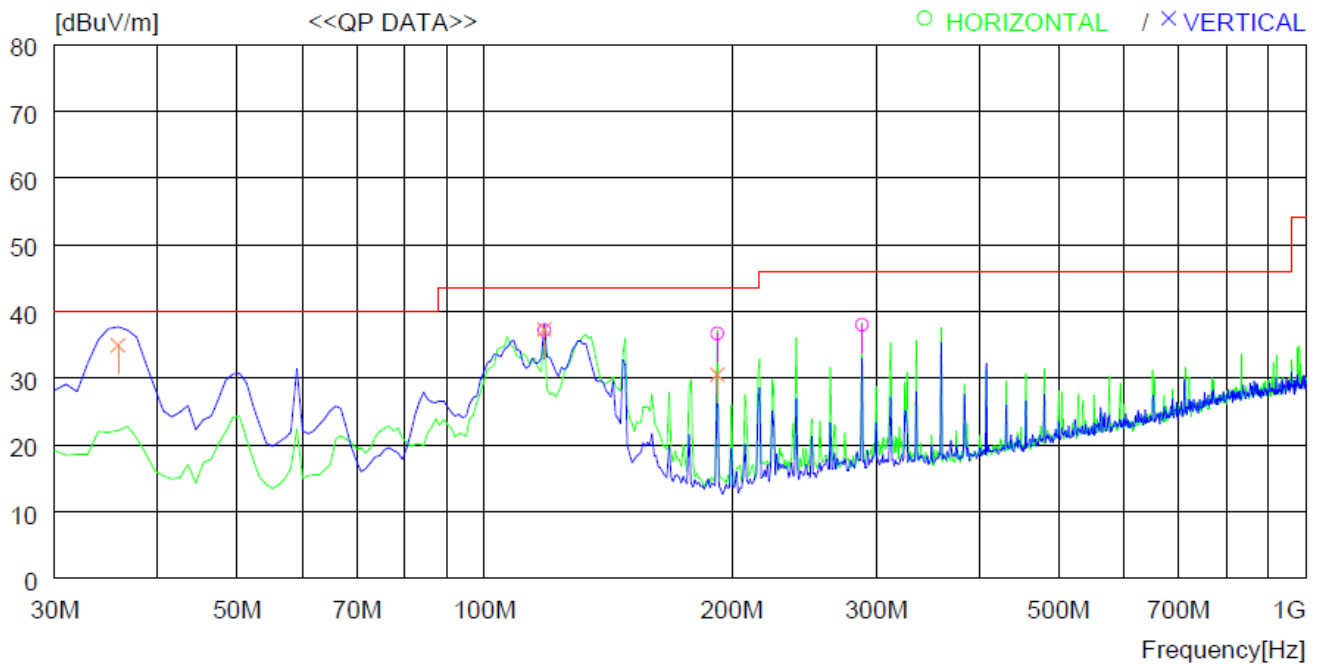
Temperature: 22.5 °C

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

Result : PASSED

EUT : Autonomous Terminal

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	118.270	49.5	18.3	1.4	32.0	37.2	43.5	6.3	400	0
2	191.990	51.0	16.0	1.7	32.0	36.7	43.5	6.8	200	0
3	288.020	49.0	18.9	2.1	32.0	38.0	46.0	8.0	100	359
----- Vertical -----										
4	35.820	47.2	18.8	0.9	32.0	34.9	40.0	5.1	100	0
5	118.270	49.6	18.3	1.4	32.0	37.3	43.5	6.2	100	248
6	191.990	44.8	16.0	1.7	32.0	30.5	43.5	13.0	100	0

11.4.2 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.									

11.4.3 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.									

11.5 Test data for Certified Bluetooth LE (RN4870)

11.5.1 Test data for 30 MHz ~ 1000 MHz

Humidity Level : 49 % R.H.

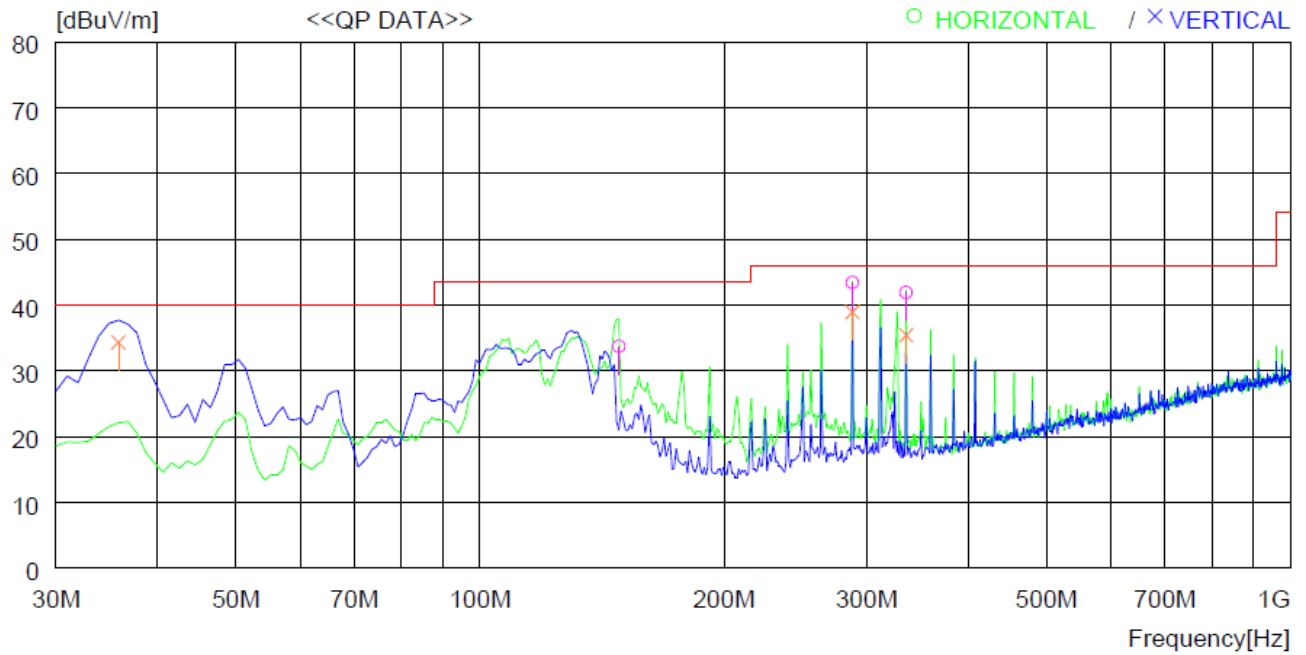
Temperature: 22.5 °C

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

Result : PASSED

EUT : Autonomous Terminal

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	148.340	45.4	18.8	1.5	32.0	33.7	43.5	9.8	200	359
2	288.020	54.4	18.9	2.1	32.0	43.4	46.0	2.6	100	0
3	335.550	52.0	19.7	2.2	32.0	41.9	46.0	4.1	100	0
----- Vertical -----										
4	35.820	46.6	18.8	0.9	32.0	34.3	40.0	5.7	100	69
5	288.020	49.9	18.9	2.1	32.0	38.9	46.0	7.1	200	0
6	335.550	45.5	19.7	2.2	32.0	35.4	46.0	10.6	200	98

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

11.5.3 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 (dB μ V)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dB μ V/m)	Limits (dB μ V/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 : 22.5 °C

Relative humidity : 49 % R.H.

12.2 Test set-up

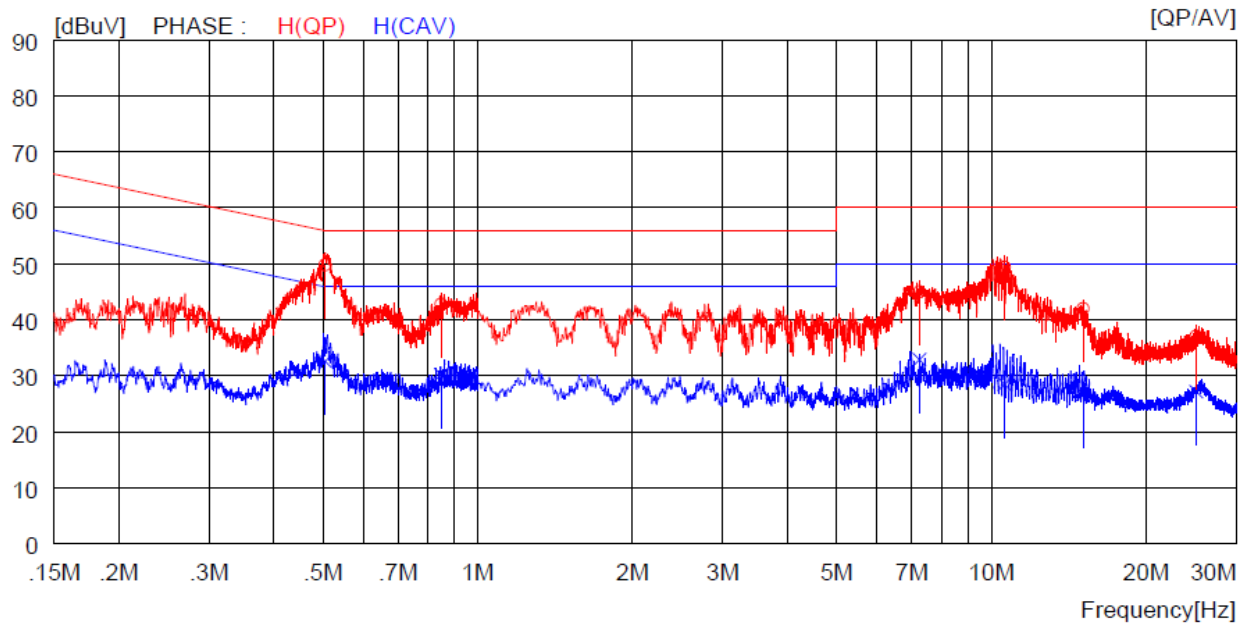
The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50 Ω / 50 μ H + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

12.3 Test Date

January 06, 2021 ~ January 11, 2021

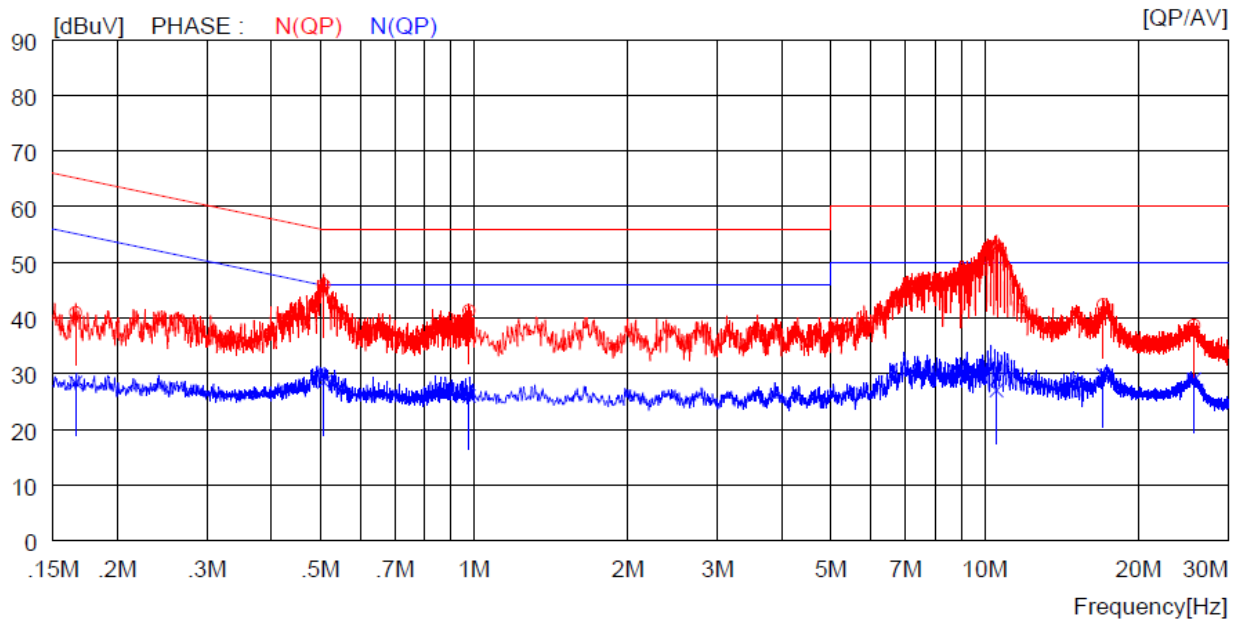
12.4 Test data for Bluetooth LE (MDBT50Q-U)

- 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	0.50500	28.3	----	21.5	49.8	----	56.0	----	6.2	----	H (QP)
2	0.84900	21.2	----	21.6	42.8	----	56.0	----	13.2	----	H (QP)
3	7.25000	23.4	----	21.6	45.0	----	60.0	----	15.0	----	H (QP)
4	10.61000	27.9	----	21.5	49.4	----	60.0	----	10.6	----	H (QP)
5	15.09000	20.6	----	21.4	42.0	----	60.0	----	18.0	----	H (QP)
6	25.06000	15.8	----	21.3	37.1	----	60.0	----	22.9	----	H (QP)
7	0.50500	----	11.1	21.5	----	32.6	----	46.0	----	13.4	H (CAV)
8	0.84900	----	8.6	21.6	----	30.2	----	46.0	----	15.8	H (CAV)
9	7.25000	----	11.3	21.6	----	32.9	----	50.0	----	17.1	H (CAV)
10	10.61000	----	7.0	21.5	----	28.5	----	50.0	----	21.5	H (CAV)
11	15.09000	----	5.3	21.4	----	26.7	----	50.0	----	23.3	H (CAV)
12	25.06000	----	5.9	21.3	----	27.2	----	50.0	----	22.8	H (CAV)

-. Tested Line : NEUTRAL LINE



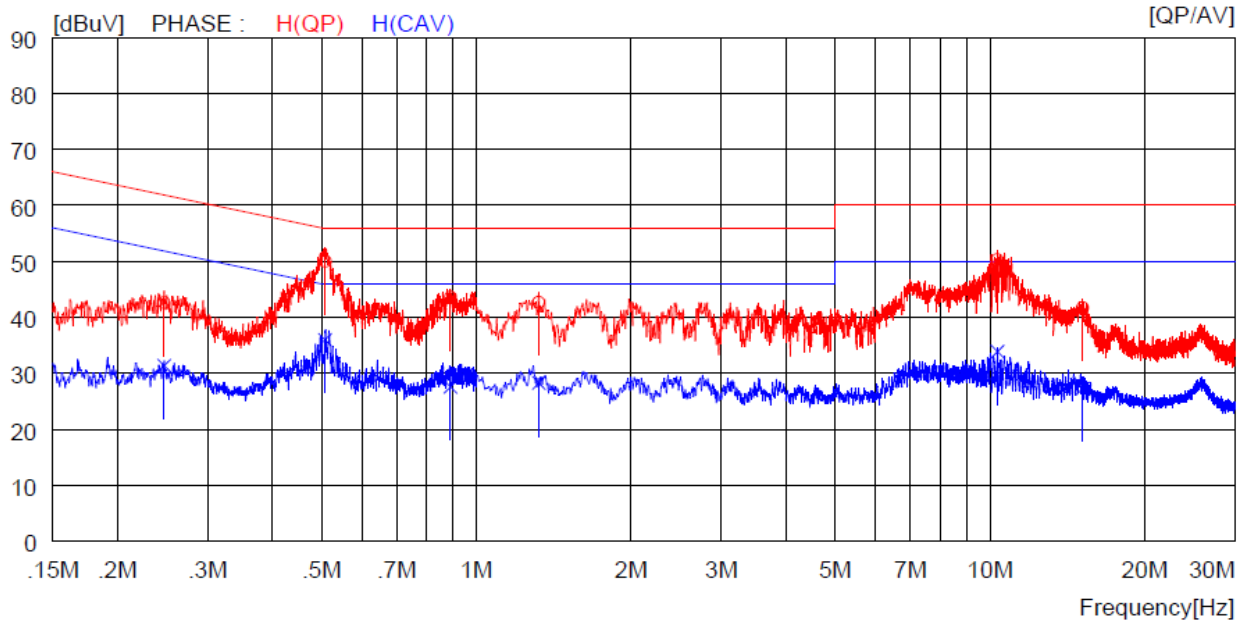
NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.16600	19.5	----	21.5	41.0	----	65.2	----	24.2	----	N (QP)
2	0.50800	24.4	----	21.5	45.9	----	56.0	----	10.1	----	N (QP)
3	0.97800	19.7	----	21.6	41.3	----	56.0	----	14.7	----	N (QP)
4	10.55000	31.3	----	21.5	52.8	----	60.0	----	7.2	----	N (QP)
5	17.06000	21.0	----	21.4	42.4	----	60.0	----	17.6	----	N (QP)
6	25.72000	17.4	----	21.3	38.7	----	60.0	----	21.3	----	N (QP)
7	0.16600	----	6.9	21.5	----	28.4	----	55.2	----	26.8	N (CAV)
8	0.50800	----	7.0	21.5	----	28.5	----	46.0	----	17.5	N (CAV)
9	0.97800	----	4.4	21.6	----	26.0	----	46.0	----	20.0	N (CAV)
10	10.55000	----	5.5	21.5	----	27.0	----	50.0	----	23.0	N (CAV)
11	17.06000	----	8.4	21.4	----	29.8	----	50.0	----	20.2	N (CAV)
12	25.72000	----	7.7	21.3	----	29.0	----	50.0	----	21.0	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.

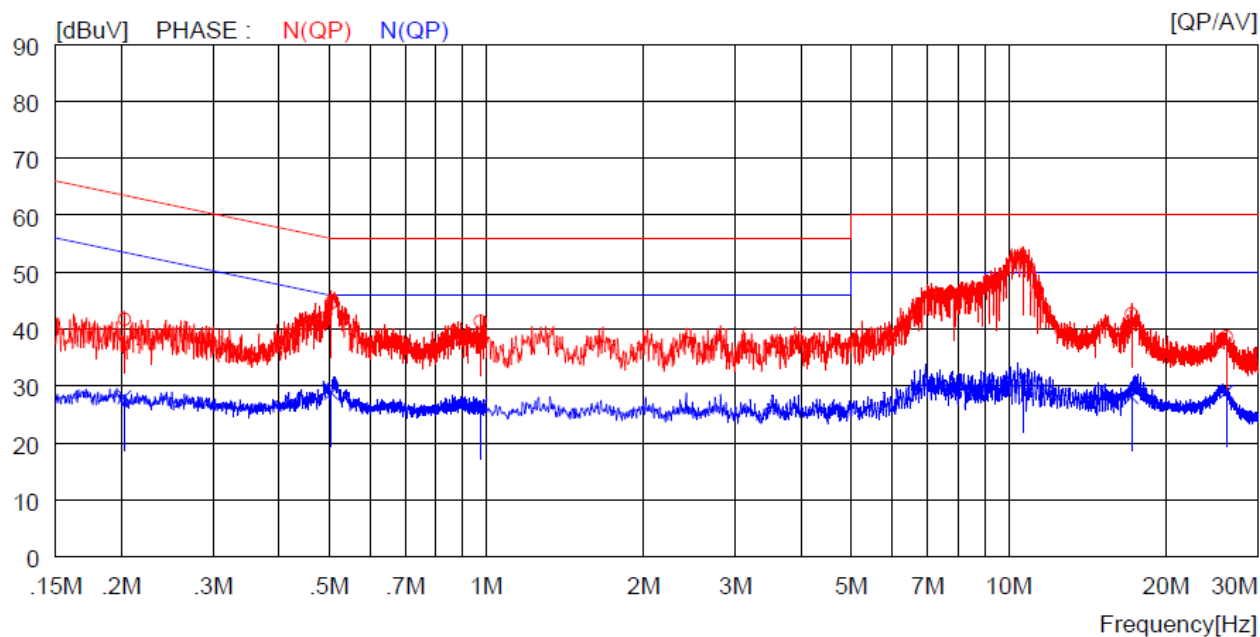
12.5 Test data for Certified Bluetooth LE (RN4870)

- . 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	0.24700	21.1	----	21.5	42.6	----	61.9	----	19.3	----	H (QP)
2	0.50800	28.5	----	21.5	50.0	----	56.0	----	6.0	----	H (QP)
3	0.89100	22.0	----	21.6	43.6	----	56.0	----	12.4	----	H (QP)
4	1.32400	21.1	----	21.6	42.7	----	56.0	----	13.3	----	H (QP)
5	10.35000	28.8	----	21.5	50.3	----	60.0	----	9.7	----	H (QP)
6	15.16000	20.3	----	21.4	41.7	----	60.0	----	18.3	----	H (QP)
7	0.24700	----	9.9	21.5	----	31.4	----	51.9	----	20.5	H (CAV)
8	0.50800	----	14.5	21.5	----	36.0	----	46.0	----	10.0	H (CAV)
9	0.89100	----	6.0	21.6	----	27.6	----	46.0	----	18.4	H (CAV)
10	1.32400	----	6.7	21.6	----	28.3	----	46.0	----	17.7	H (CAV)
11	10.35000	----	12.4	21.5	----	33.9	----	50.0	----	16.1	H (CAV)
12	15.16000	----	5.9	21.4	----	27.3	----	50.0	----	22.7	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	0.20300	20.2	----	21.5	41.7	----	63.5	----	21.8	----	N (QP)
2	0.50500	23.1	----	21.5	44.6	----	56.0	----	11.4	----	N (QP)
3	0.97500	19.8	----	21.6	41.4	----	56.0	----	14.6	----	N (QP)
4	10.68000	30.5	----	21.5	52.0	----	60.0	----	8.0	----	N (QP)
5	17.20000	21.3	----	21.4	42.7	----	60.0	----	17.3	----	N (QP)
6	26.12000	17.4	----	21.3	38.7	----	60.0	----	21.3	----	N (QP)
7	0.20300	----	6.6	21.5	----	28.1	----	53.5	----	25.4	N (CAV)
8	0.50500	----	7.3	21.5	----	28.8	----	46.0	----	17.2	N (CAV)
9	0.97500	----	5.0	21.6	----	26.6	----	46.0	----	19.4	N (CAV)
10	10.68000	----	9.8	21.5	----	31.3	----	50.0	----	18.7	N (CAV)
11	17.20000	----	6.7	21.4	----	28.1	----	50.0	----	21.9	N (CAV)
12	26.12000	----	7.7	21.3	----	29.0	----	50.0	----	21.0	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	101200	Jul. 15, 2020 (1Y)
ESCI	Rohde & Schwarz	EMI TEST RECEIVER	60239	Jul. 20, 2020 (1Y)
310N	Sonoma Instrument	Pre-Amplifier	392756	Oct. 16, 2020 (1Y)
PAM-118A	Com-Power	Pre-Amplifier	18040081	Oct. 12, 2020 (1Y)
PAM-840A	Com-Power	Pre-Amplifier	461339	Oct. 16, 2020 (1Y)
DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
LT32C	AFJ	32 A LISN	32031306157	N/A
FMZB 1513	Schwarzbeck	Loop Antenna	1513-235	Mar. 24, 2020 (2Y)
HLP-2008	TDK	Hybrid Antenna	131316	Feb. 27, 2020 (2Y)
AH-118	Com-Power	Horn Antenna	10050061	Oct. 15, 2020 (1Y)
BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 07, 2021(1Y)
11947A	HP	TRANSIENT LIMITER	3107A02762	Mar. 23 2020 (2Y)