

FCC CERTIFICATION TEST REPORT

Project Number : EA2109C-046
Test Report Number : TR-W2110-015
Type of Equipment : HelloClick
Model Name : HFB-E100
FCC ID : 2A3FN-HFB-E100
Multiple Model Name : N/A
Applicant : HelloFactory Co.,Ltd.
Address : 3th, Jeongjin Bldg. (Yeoksam-dong), 13, Seolleung-ro 107-gil,
Gangnam-gu, Seoul, Republic of Korea
Manufacturer : HelloFactory Co.,Ltd.
Address : 3th, Jeongjin Bldg. (Yeoksam-dong), 13, Seolleung-ro 107-gil,
Gangnam-gu, Seoul, Republic of Korea
Regulation : FCC Part 15 Subpart C Section 15.247
Total page of Report : 40 Pages
Date of Receipt : 2021-09-14
Date of Issue : 2021-10-27
Test Result : PASS

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.

Prepared by Kim, Do-heon / Senior Engineer

Signature

2021-10-25

Date

Reviewed by Choi, Yeong-min / Technical Manager

Signature

2021-10-25

Date

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Release Control Record

Issue Report No.	Issued Date	Details/Revisions
TR-W2110-015	2021-10-27	Initial Release
-	-	-

1. TEST SUMMARY

1.1 Regulations and results

The sample submitted for evaluation (Hereafter referred to as the EUT) has been tested in accordance with the following regulations or standards.

FCC Reference Section	Description	Result			
		P	F	N.T.	Note
15.247(a)(2)	6 dB Bandwidth	P			
15.247(b)(3)	Maximum peak output power	P			
15.247(d)	Band Edge Conducted spurious emission	P			
15.247(e)	Power spectral density	P			
15.205(a), 15.209(a)	Radiated spurious emissions	P			
15.207(a)	AC power line conducted emissions			N.T.	Note1
Remark: P means Passed F means Failed N.T. means Not Tested Note1. The EUT is operated by battery only. (used manganese dry cell as type AAA)					

1.2 Test Methodology

The tests mentioned in clause 1.1 in this test report were performed according to FCC CFR 47 Part 2, CFR 47 Part 15 and ANSI C63.10-2013.

KDB 558074 D01DTS Meas. Guidance v05r02: Measurement Procedure PK is used for power measurement.

1.3 Additions, deviations, exclusions from standards

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

1.4 Purpose of the test

The test was performed to determine whether the equipment under test fulfills the requirements of the regulation stated in FCC Part 15 Subpart C Section 15.247.

1.5 Test Facility

The measurement facilities are located at 135-60 Gyeongchung-daero, Gonjam-eup, Gwangju-si, Gyeonggi-do 12813, Korea. Our test facilities are accredited as a Conformity Assessment Body (CAB) by the FCC and ISED Canada, designated by the RRA (National Radio Research Agency), and accredited by KOLAS (Korea Laboratory Accreditation Scheme) in Korea and approved by TUV Rheinland, TUV SÜD and Korean Register of Shipping according to the requirement of ISO/IEC 17025.

Laboratory Qualification	Registration No.	Mark
FCC	KR0160	
ISED Canada	12721A	
RRA	KR0160	
TUV Rheinland	UA 50314109-0002	
TUV SÜD	CARAT 094465 0004 Rev.00	
Korean Agency for Technology and Standards	KT733	
KOREAN REGISTER OF SHIPPING	PCT40841-TL001	

Remark. This report is not related to KOLAS accreditation and relevant regulation.

2. EUT (Equipment Under Test) INFORMATION

2.1 General Description

The HelloFactory Co.,Ltd., Model HFB-E100 (referred to as the EUT in this report) is a HelloClick. The EUT is a device for transferring Bluetooth low energy signal to a Bluetooth low energy Device through wireless communication. The product specification described herein was obtained from product data sheet or user's manual.

Operating Frequency	2 402 MHz ~ 2 480 MHz
Kind of Class	DTS – Digital Transmission System
Max. RF Output Power	- 4.54 dBm
Modulation Types	GFSK
Number of Channels	40 CH
Channel Bandwidth	2 MHz
Generated or used Freq. in EUT	32.768 kHz, 32 MHz
Type of Antenna	☒ Integrated Type ☐ Dedicated Type
	☒ Chip Antenna (3.2 mm x 1.6 mm)
Antenna Gain	2.50 dBi
Normal Test Voltage	DC 3 V
Electrical Rating	DC 3 V
Test SW Version	Tera Term Version 4.91
RF power setting in TEST SW	4
Software Version	V 1.0
Hardware Version	V 1.0

2.2 Additional Model

None

2.3 Available channel number and frequency

Operating Mode: Bluetooth LE, 2 MHz Channel Spacing					
Channel	Frequency(MHz)	Channel	Frequency(MHz)	Channel	Frequency(MHz)
0	2 402	14	2 430	28	2 458
1	2 404	15	2 432	29	2 460
2	2 406	16	2 434	30	2 462
3	2 408	17	2 436	31	2 464
4	2 410	18	2 438	32	2 466
5	2 412	19	2 440	33	2 468
6	2 414	20	2 442	34	2 470
7	2 416	21	2 444	35	2 472
8	2 418	22	2 446	36	2 474
9	2 420	23	2 448	37	2 476
10	2 422	24	2 450	38	2 478
11	2 424	25	2 452	39	2 480
12	2 426	26	2 454		
13	2 428	27	2 456		

3. TEST CONDITION

3.1 Equipment Used During Test

The following peripheral devices and/or interface cables were connected during the measurement:

Description	Model No.	Serial No.	Manufacturer.
HelloClick (EUT)	HFB-E100	N/A	HelloFactory Co.,Ltd.
JIG	N/A	N/A	THOU&TECH
Notebook PC	15s-du0069TU	CND9503W22	HP
Adapter for Notebook PC	TPN-CA14	HU10436-18165	Chicony Power Technology (Chongqing) Co., Ltd.

3.2 Mode of operation during the test

Software used to control the EUT for staying in continuous transmitting mode is programmed.

The used modulation type for the testing is Bluetooth Low Energy (GFSK)

3.3 Preliminary Testing for Worst case configuration

For finding worst case configuration and operating mode, preliminary testing was performed and radiated emission and conducted emission tests were performed with the EUT set to transmit and receive at the channel with the highest output power as worst case scenario. All spurious emission tests were performed in X, Y and Z axis direction. And the **worst X-axis (Below 1 GHz), Z-axis (Above 1 GHz) test condition was recorded in this test report.**

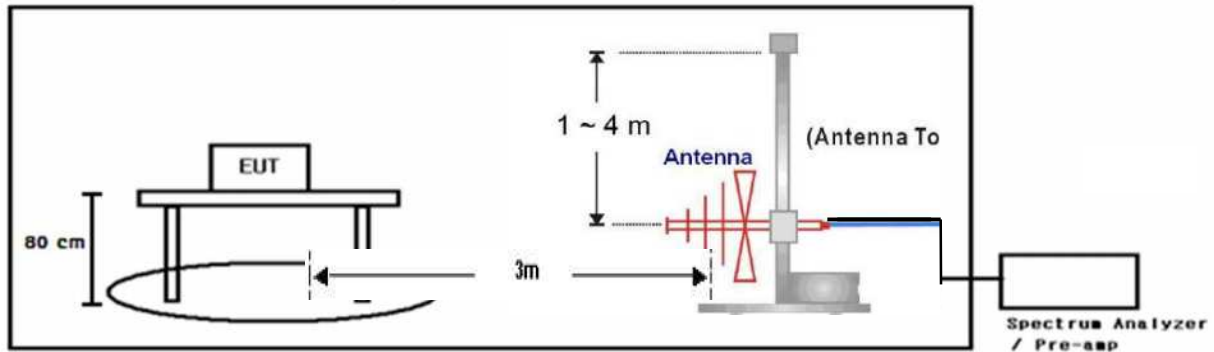
Based on preliminary testing following operating modes were selected for the final test as listed below.

3.3.1 Test Channel and Frequency

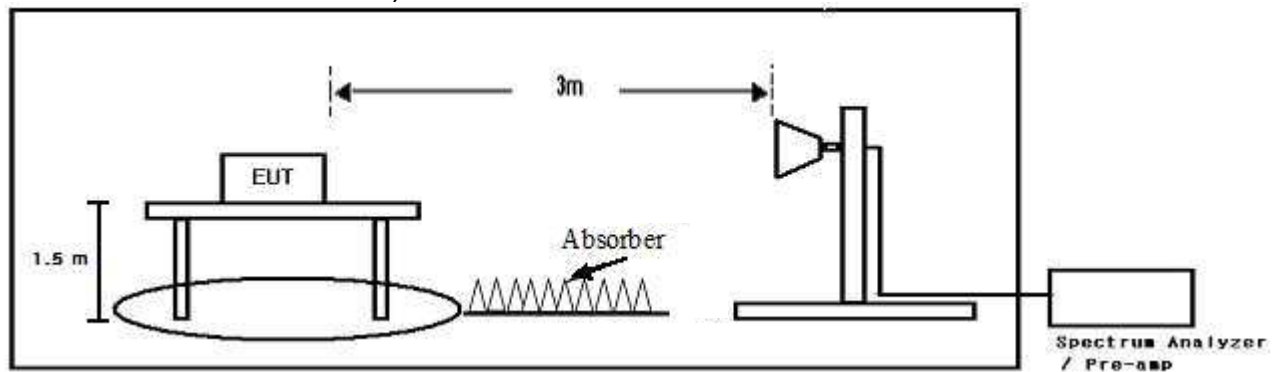
Operating Mode	Test Channel	Frequency
Bluetooth Low Energy	Low Channel	2 402 MHz
	Middle Channel	2 440 MHz
	High Channel	2 480 MHz

3.4 Test Setup Drawing

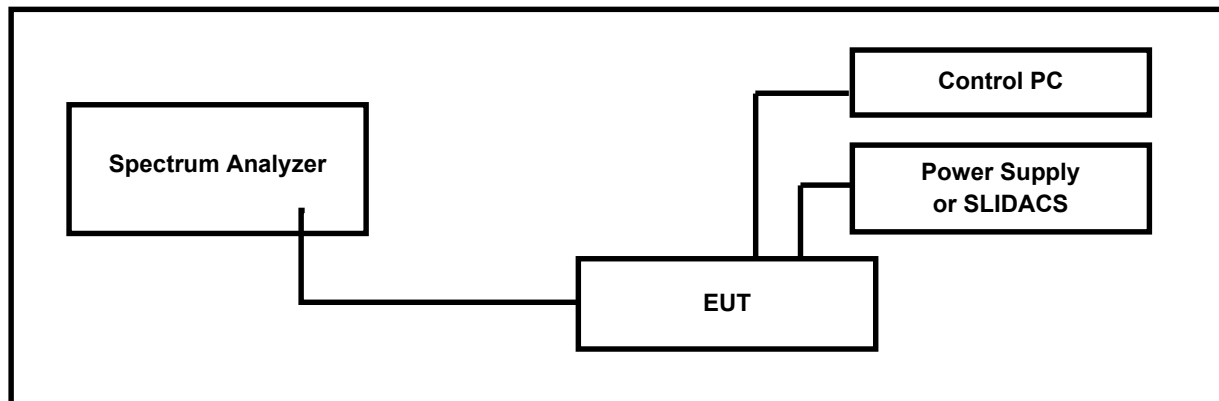
(Radiated Test below 1 GHz)



(Radiated Test above 1 GHz)



(Conducted Test)



3.5 EUT Modifications

- No EMC Relevant Modifications were performed by this test laboratory.

4. ANTENNA REQUIREMENT

According to FCC CFR 47 Part 15 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provision of this section.

4.1 Antenna Description

Frequency Band (GHz)	Antenna Type	Max Peak Gain (dBi)	Connector Type
2.4	Chip Antenna	2.50	-

4.2 Conclusion

The EUT uses an antenna permanently attached as a chip antenna, so the EUT met the requirement.

5. TEST RESULT

5.1 6 dB Bandwidth

5.1.1 Limit

The minimum 6 dB bandwidth shall be at least 500 kHz acc to Section 15.247 (a) (2).

5.1.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.2

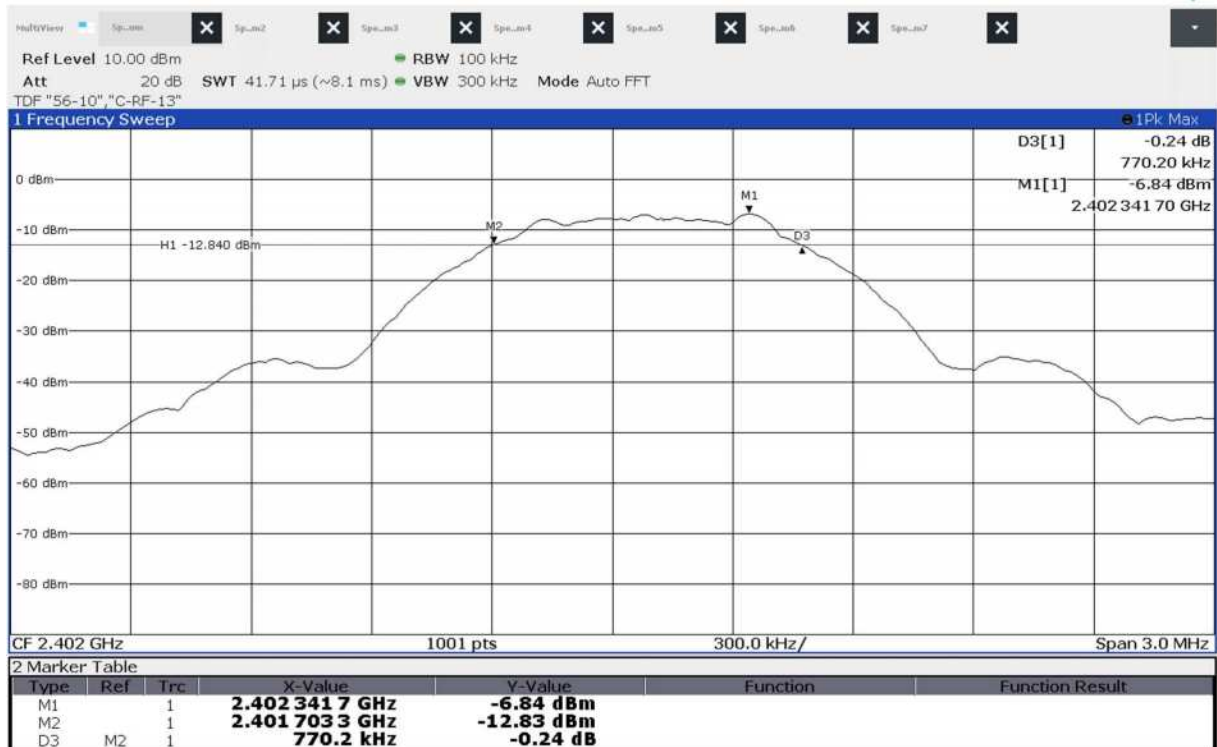
The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW $\geq 3 \times$ RBW, peak detector and max hold.

5.1.3 Test Data

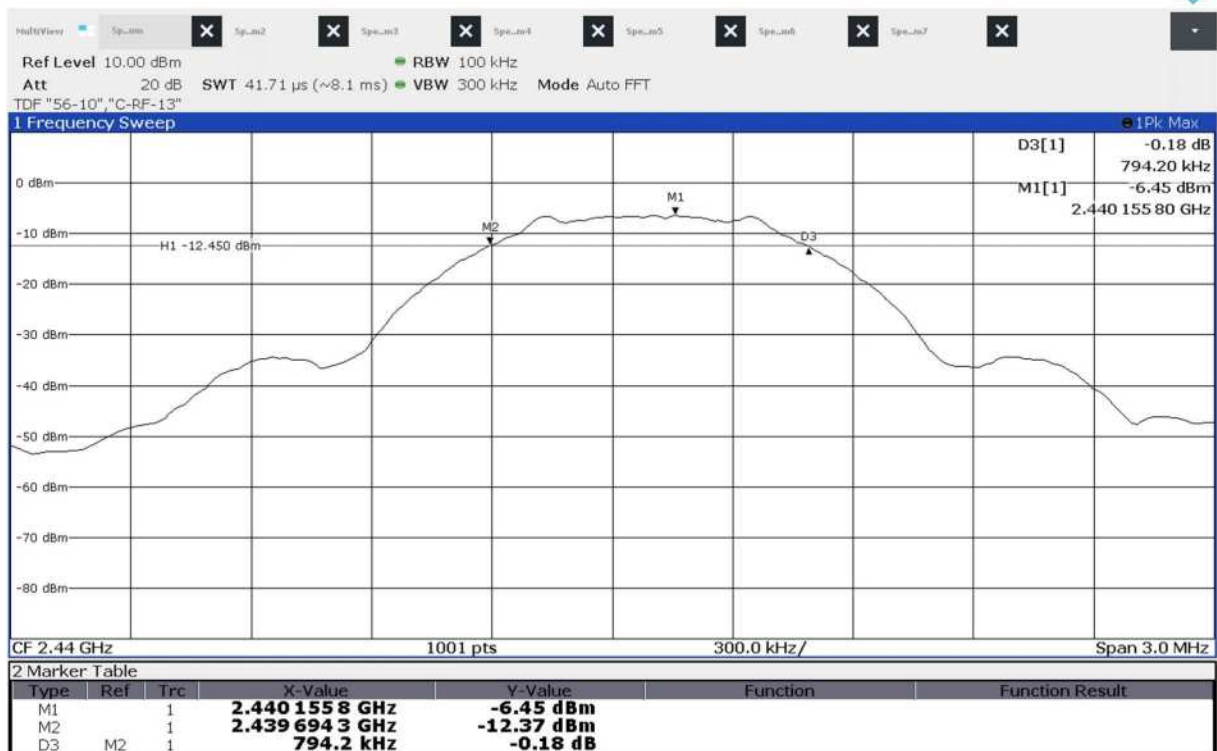
Date of Test	2021-10-21	Temperature	(22.6 $\pm$ 0.9) °C
		Relative humidity	(48.5 $\pm$ 2.2) % R.H.
Test Result	PASS	Tested by	Do-heon Kim 
Operating Mode: Bluetooth LE			
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2 402	0.77	0.5
Middle	2 440	0.79	
High	2 480	0.80	

5.1.4 Test Plots

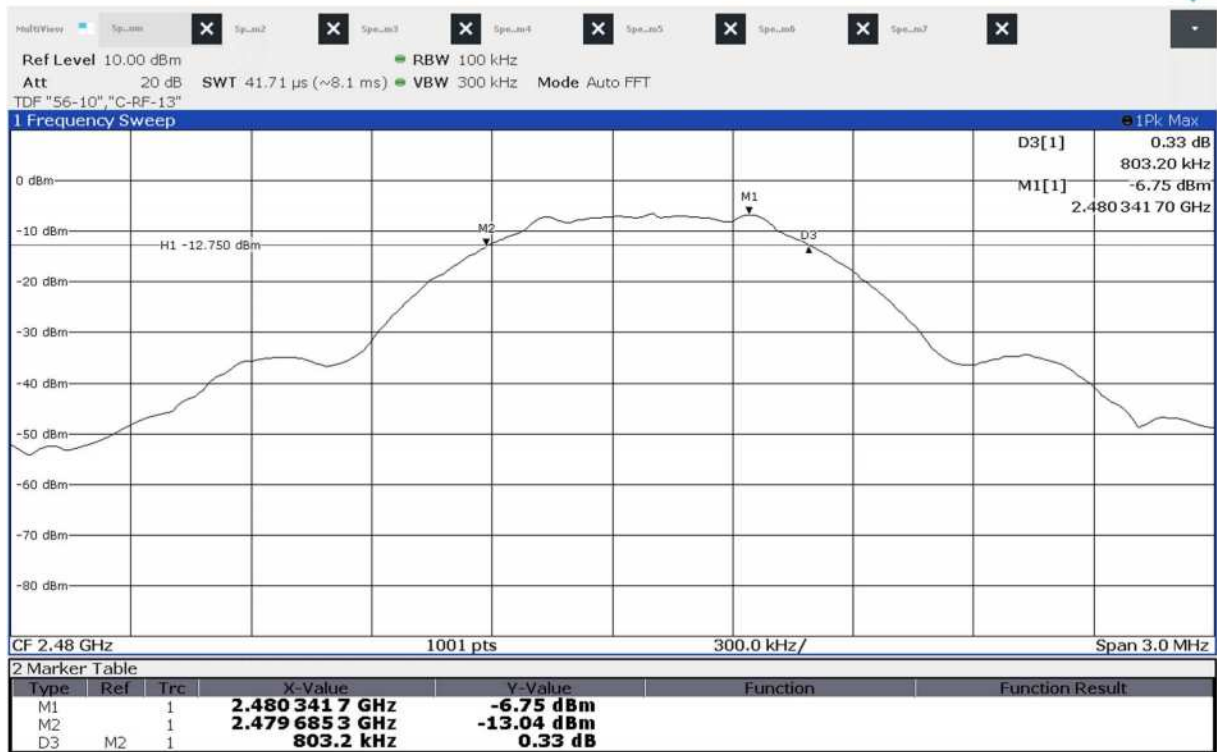
Operating Mode: Bluetooth LE (Low Channel)



Operating Mode: Bluetooth LE (Middle Channel)



Operating Mode: Bluetooth LE (High Channel)



5.2 Maximum Peak Output Power

5.2.1 Limit

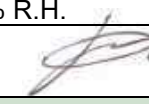
Acc. To section 15.247, For system using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.3.1.1 RBW $\geq$ DTS bandwidth

The cable assembly insertion loss was entered as an offset in the spectrum analyzer to allow for direct reading of power.

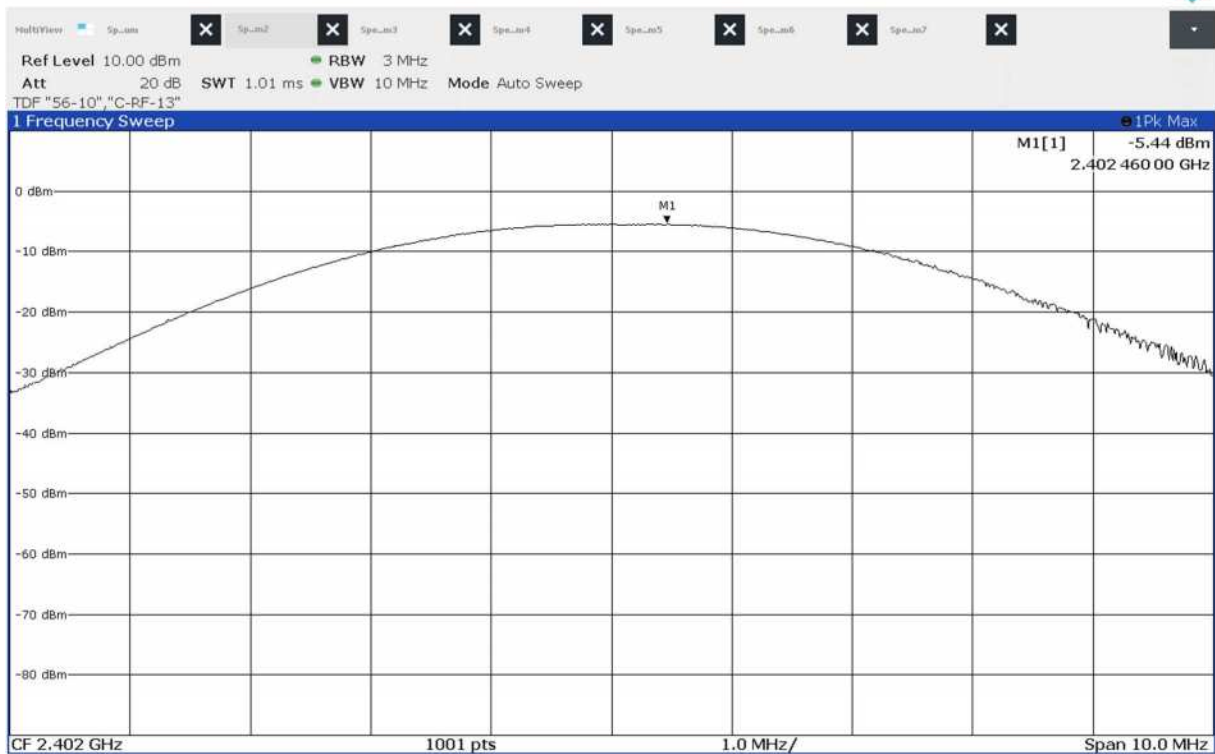
5.2.3 Test Data for Output Power

Date of Test		2021-10-21	Temperature	(22.6 ± 0.9) °C	
			Relative humidity	(48.5 ± 2.2) % R.H.	
Test Result		PASS	Tested by	Do-heon Kim 	
Operating Mode: Bluetooth LE					
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)	
Low	2 402	-5.44	30	35.44	
Middle	2 440	-4.54		34.54	
High	2 480	-5.15		35.15	

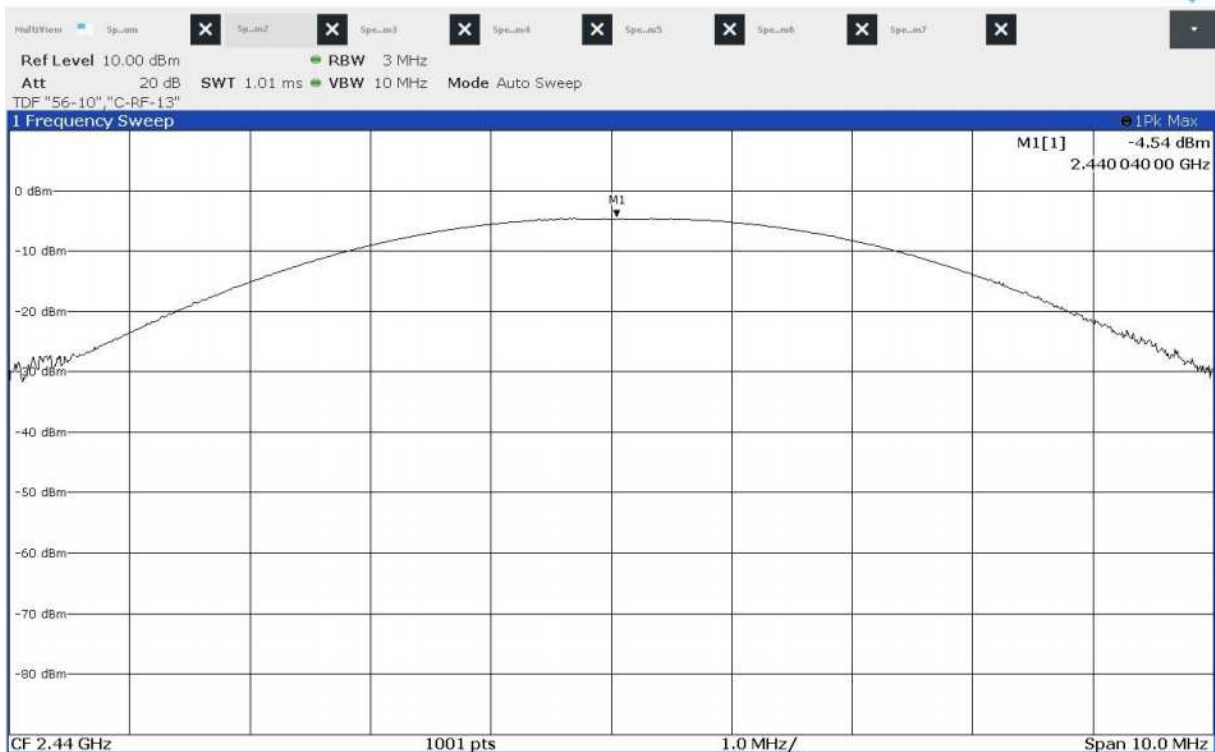
Remark. Margin = Limit – Measured Value

5.2.4 Test Plots

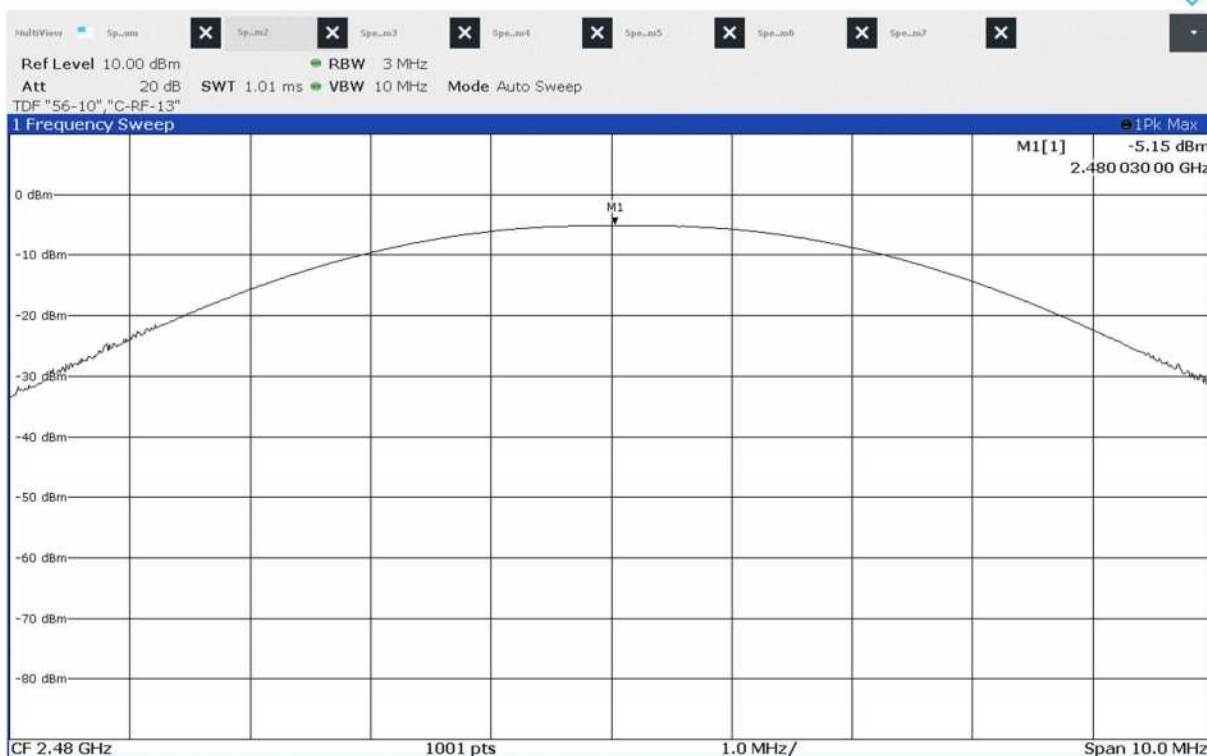
Operating Mode: Bluetooth LE (Low Channel)



Operating Mode: Bluetooth LE (Middle Channel)



Operating Mode: Bluetooth LE (**High Channel**)



5.3 Peak Power Spectral Density

5.3.1 Limit

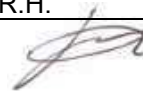
Acc. To section 15.247, the power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.3.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.4 Method PKPSD (peak PSD).

The transmitter output is connected to a spectrum analyzer with the RBW set from 3 kHz to 100 kHz,
VBW $\geq$ 3 X RBW, peak detector and max hold.

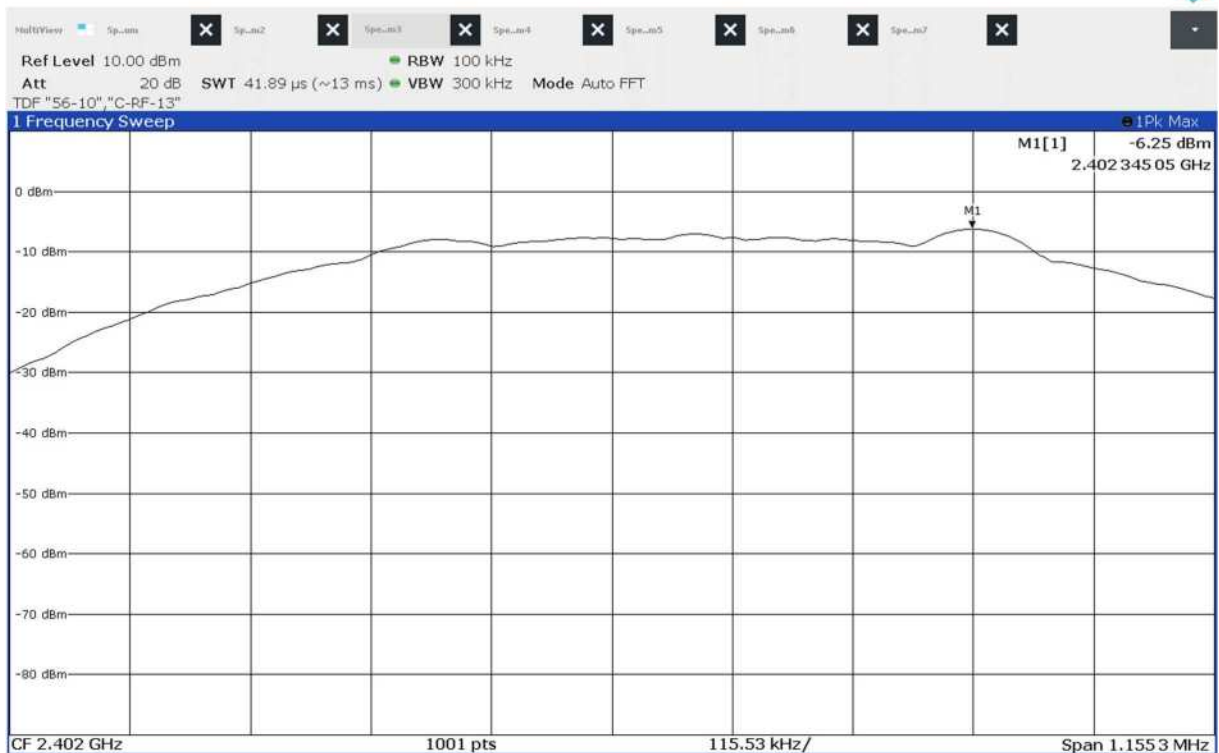
5.3.3 Test Data

Date of Test		2021-10-21	Temperature	(22.6 ± 0.9) °C
			Relative humidity	(48.5 ± 2.2) % R.H.
Test Result		PASS	Tested by	Do-heon Kim 
Operating Mode: Bluetooth LE				
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
Low	2 402	-6.25	8	14.25
Middle	2 440	-5.97		13.97
High	2 480	-6.34		14.34

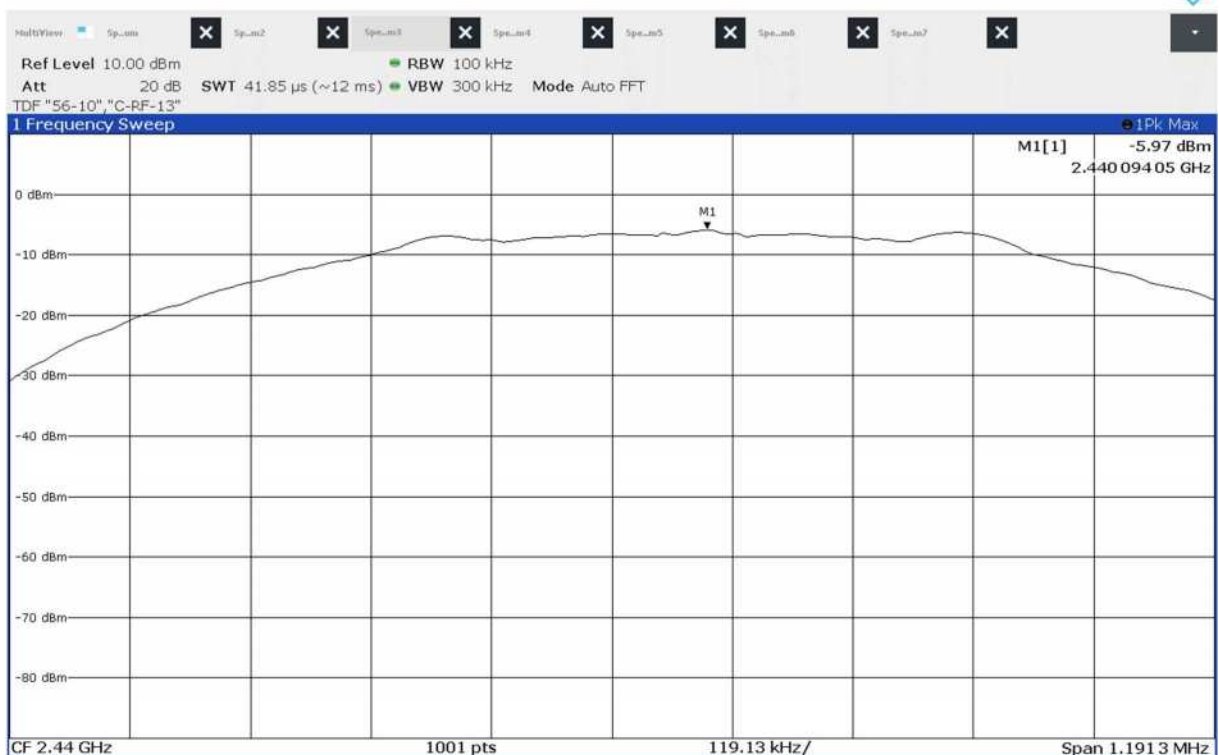
Remark. Margin = Limit – Measured Value

5.4.4 Test Plots

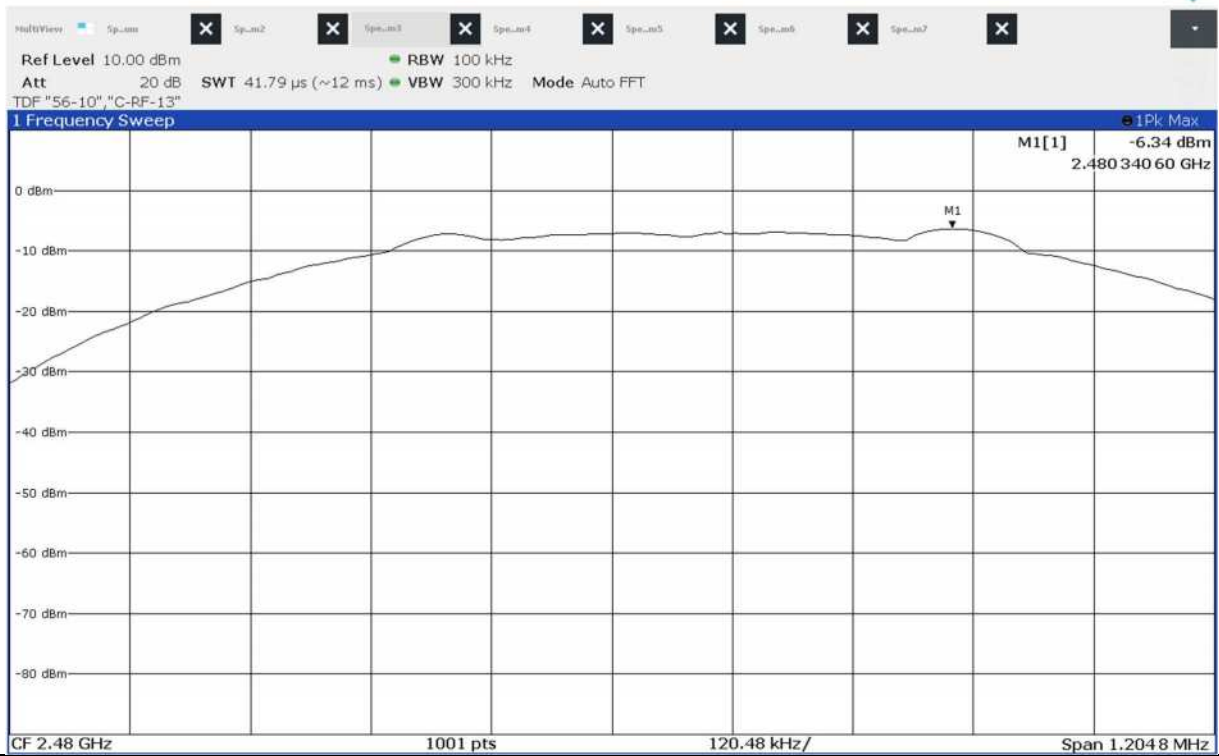
Operating Mode: Bluetooth LE (Low Channel)



Operating Mode: Bluetooth LE (Middle Channel)



Operating Mode: Bluetooth LE (High Channel)



5.4 Out of Band Emission

5.4.1 Limit

Acc. To section 15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

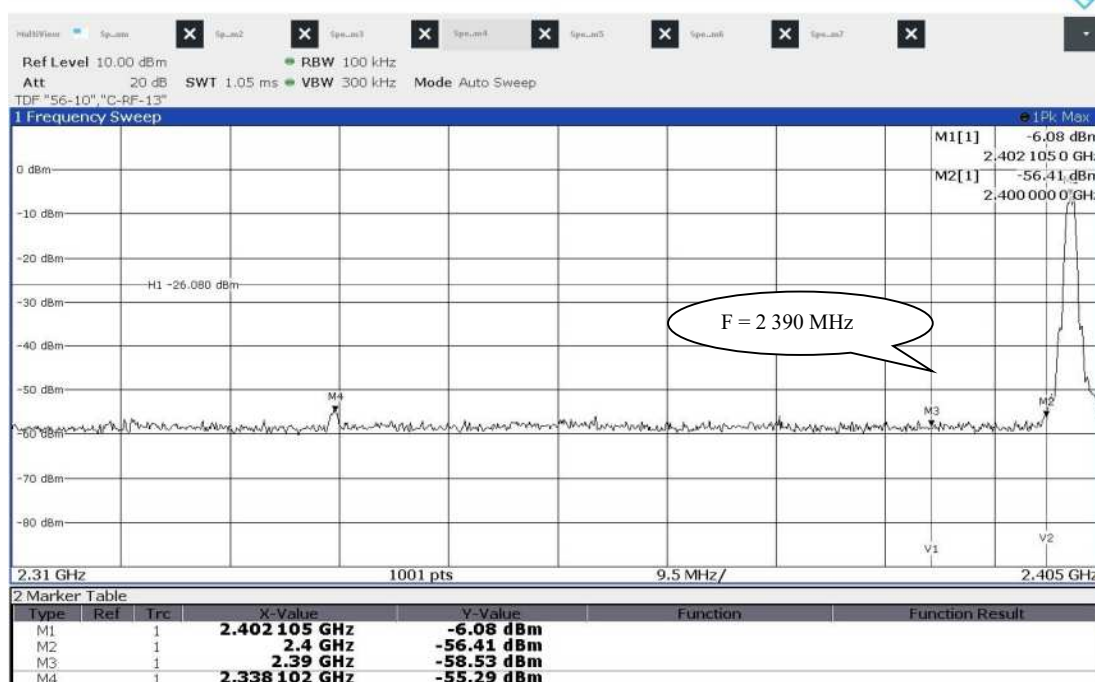
5.4.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.5 Emissions in non-restricted frequency bands. The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW $\geq 3 \times$ RBW, peak detector and max hold. Measurements utilizing these settings are made of the in-band reference level, band-edge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

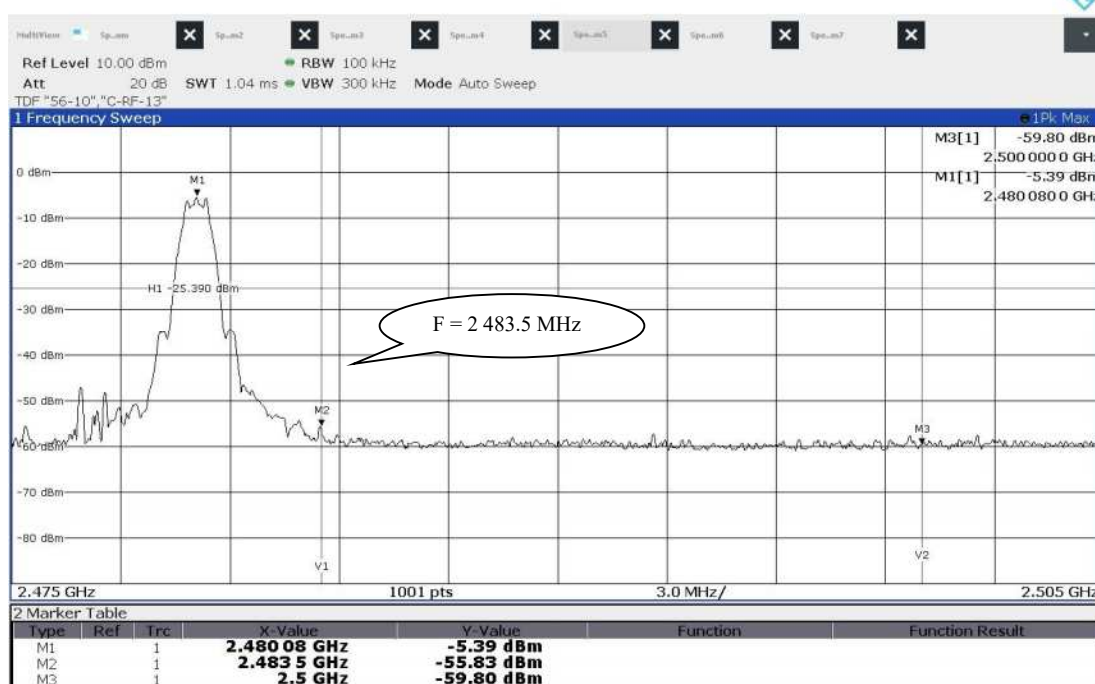
5.5.3 Test Data for Operating mode: Bluetooth LE

Date of Test	2021-10-21	Temperature	(22.6 ± 0.9) °C
		Relative humidity	(48.5 ± 2.2) % R.H.
Test Result	PASS	Tested by	Do-heon Kim 

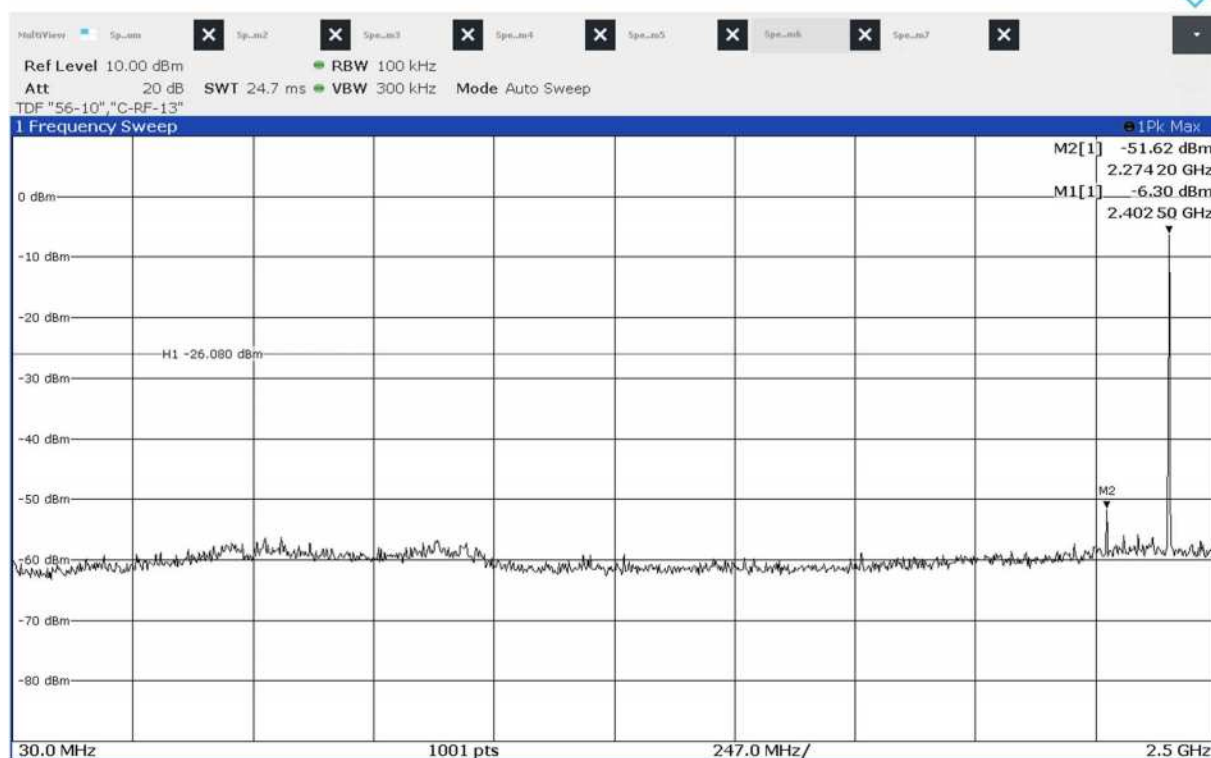
Band-edge and Restricted band – Low channel



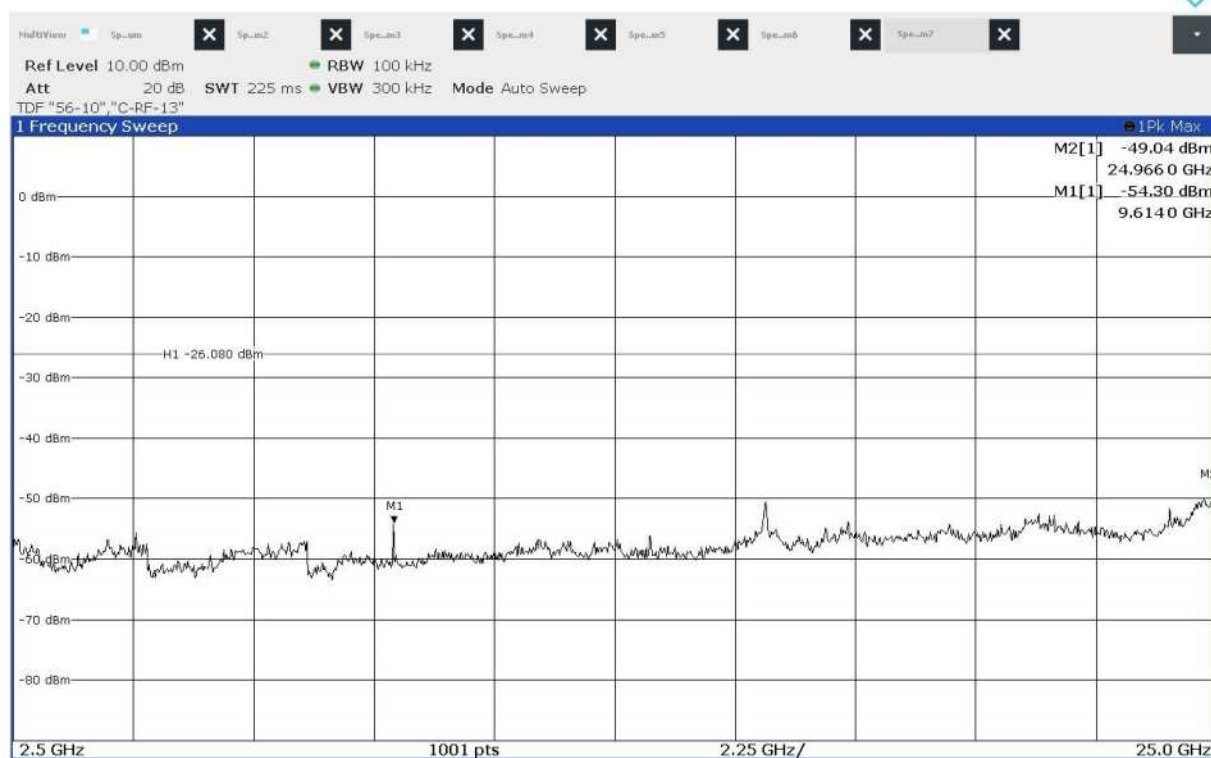
Band-edge and Restricted band – High channel



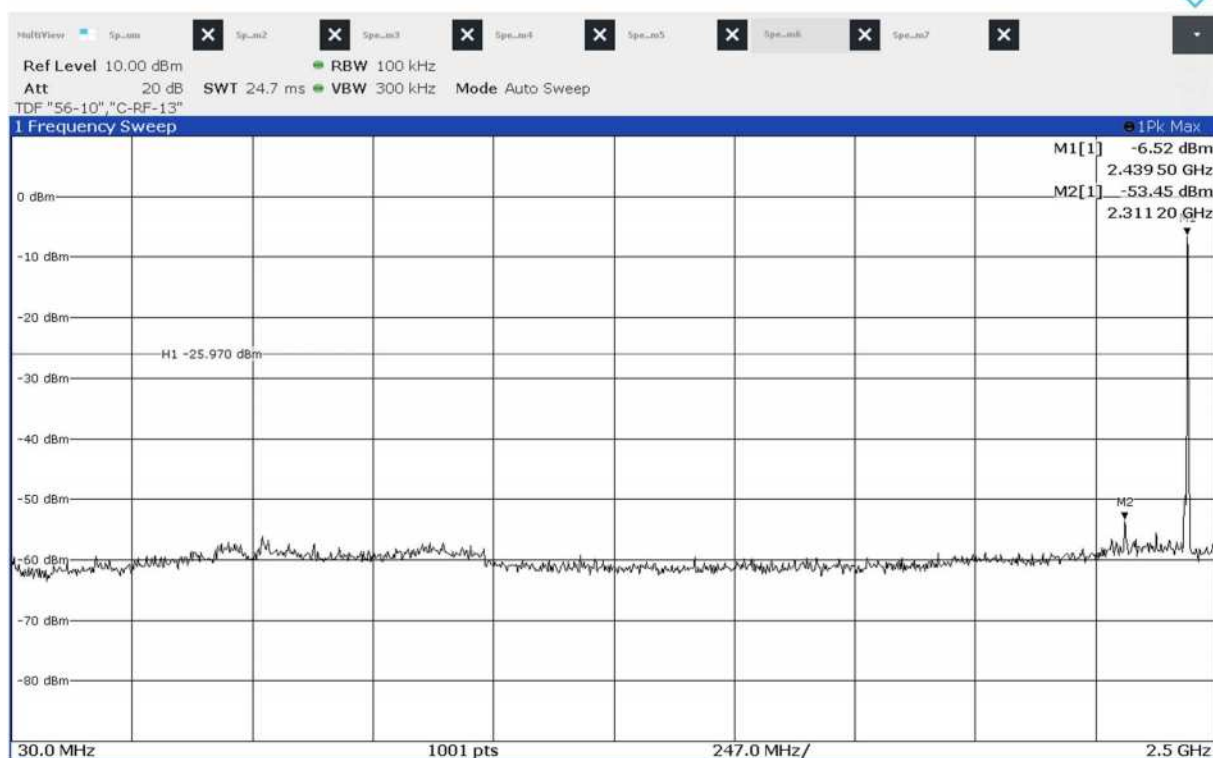
Non-restricted band – Low Channel (1)



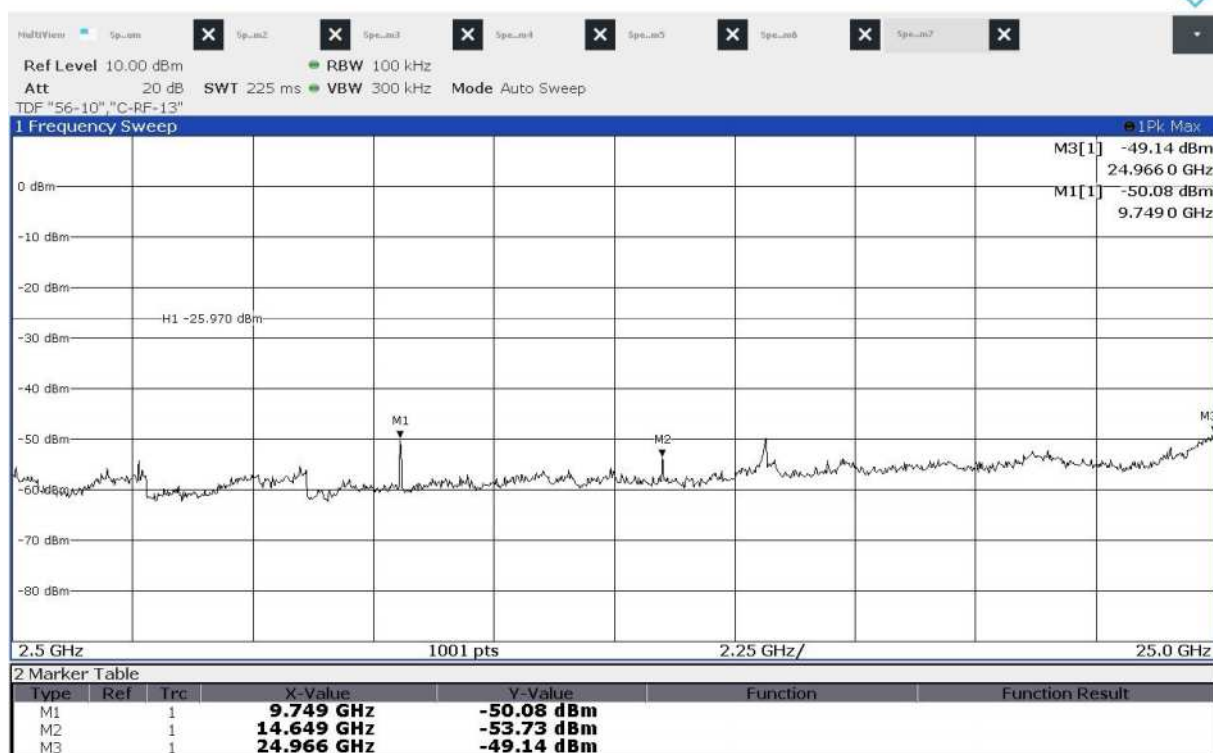
Non-restricted band – Low Channel (2)



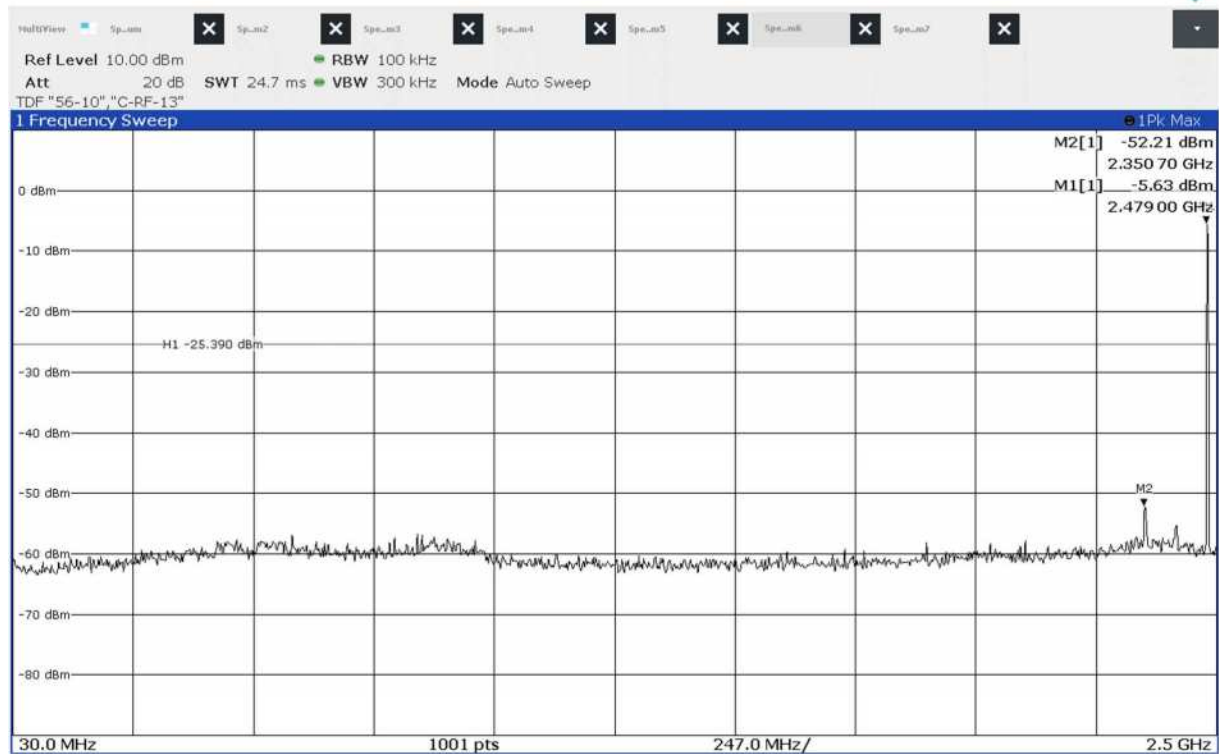
Non-restricted band – Middle Channel (1)



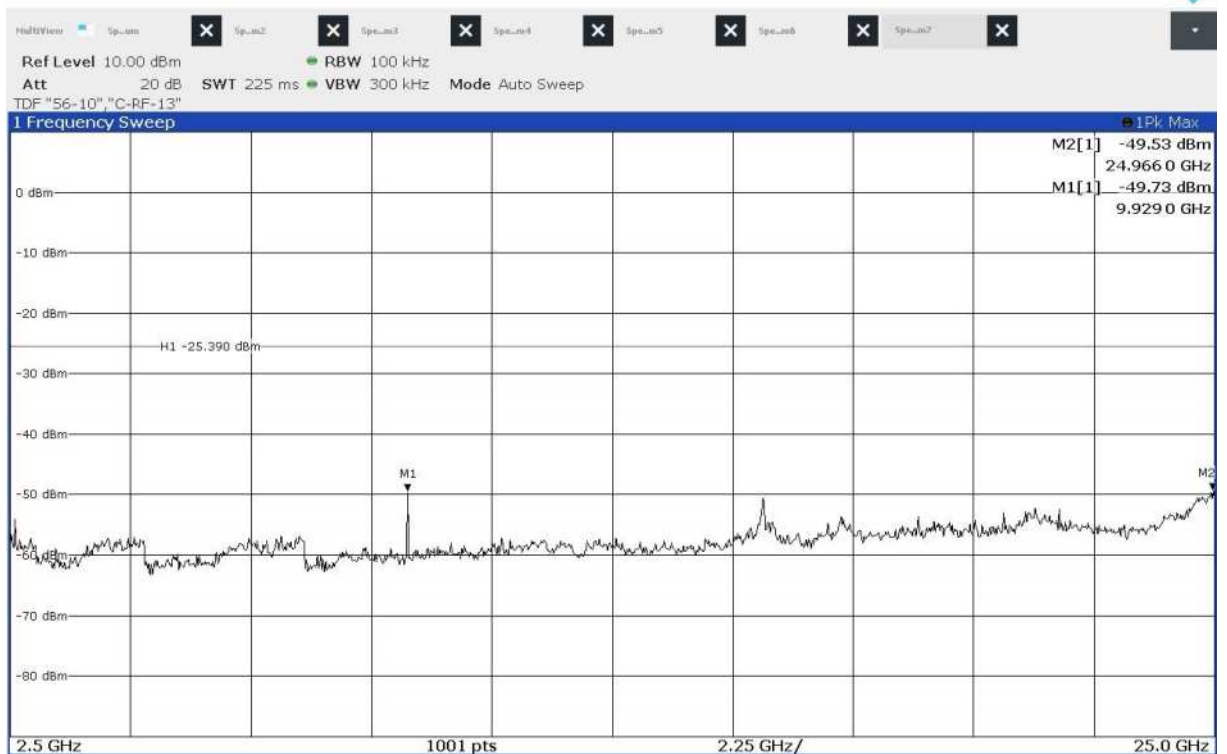
Non-restricted band – Middle Channel (2)



Non-restricted band – High Channel (1)



Non-restricted band – High Channel (2)



5.5 Radiated Emission

5.5.1 Limit

Acc. To section 15.205,15.209, following table shall be applied.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 – 88	100	40
88 – 216	150	43.5
216 – 960	200	46
Above 960	500	24

5.5.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.6 Radiated emission measurements.

The radiated emissions measurements were on 3 m, semi-anechoic chamber. The EUT and other support equipment were placed on a non-conductive table 80 cm for below 1 GHz and 1.5 m for above 1 GHz 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 25 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.

For measurement below 1 GHz, the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For peak emission measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz and for average measurement, resolution bandwidth is set to 1 MHz; and the video bandwidth is set to 10 Hz, when duty cycle is more than 98 %. If duty cycle is less than 98 %, the video bandwidth is set to $\geq 1/T$, where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz. The spectrum from 30 MHz to 25 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

5.5.3 Test Site Requirement for KDB 414788 D01

Acc. to KDB 414788 D01 Radiated Test Site v01, Semi Anechoic Chamber (SAC) shall be verified test results below 30 MHz with Open Area Test Site (OATS), so we compared test results between the measurements from our SAC and an OATS and found test results almost same, so we **declare test result for below 30 MHz from our SAC is valid and met the requirement acc. to KDB 414788 D01 Radiated Test Site v01.**

5.5.4 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus. The measurement uncertainties are given with at least 95 % confidence.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 30 MHz	± 2.9 dB	30 MHz ~ 1 GHz	± 4.6 dB
1 GHz ~ 18 GHz	± 4.8 dB	18 GHz ~ 25 GHz	± 4.4 dB

5.5.5 Sample Calculated Example

At 80 MHz

Limit = 40.0 dBuV/m

Result (dBuV/m)

= Receiver Reading (dBuV) + Antenna Factor (dB/m) - Pre-amplifier Gain (dB) + Cable Loss (dB) = 30

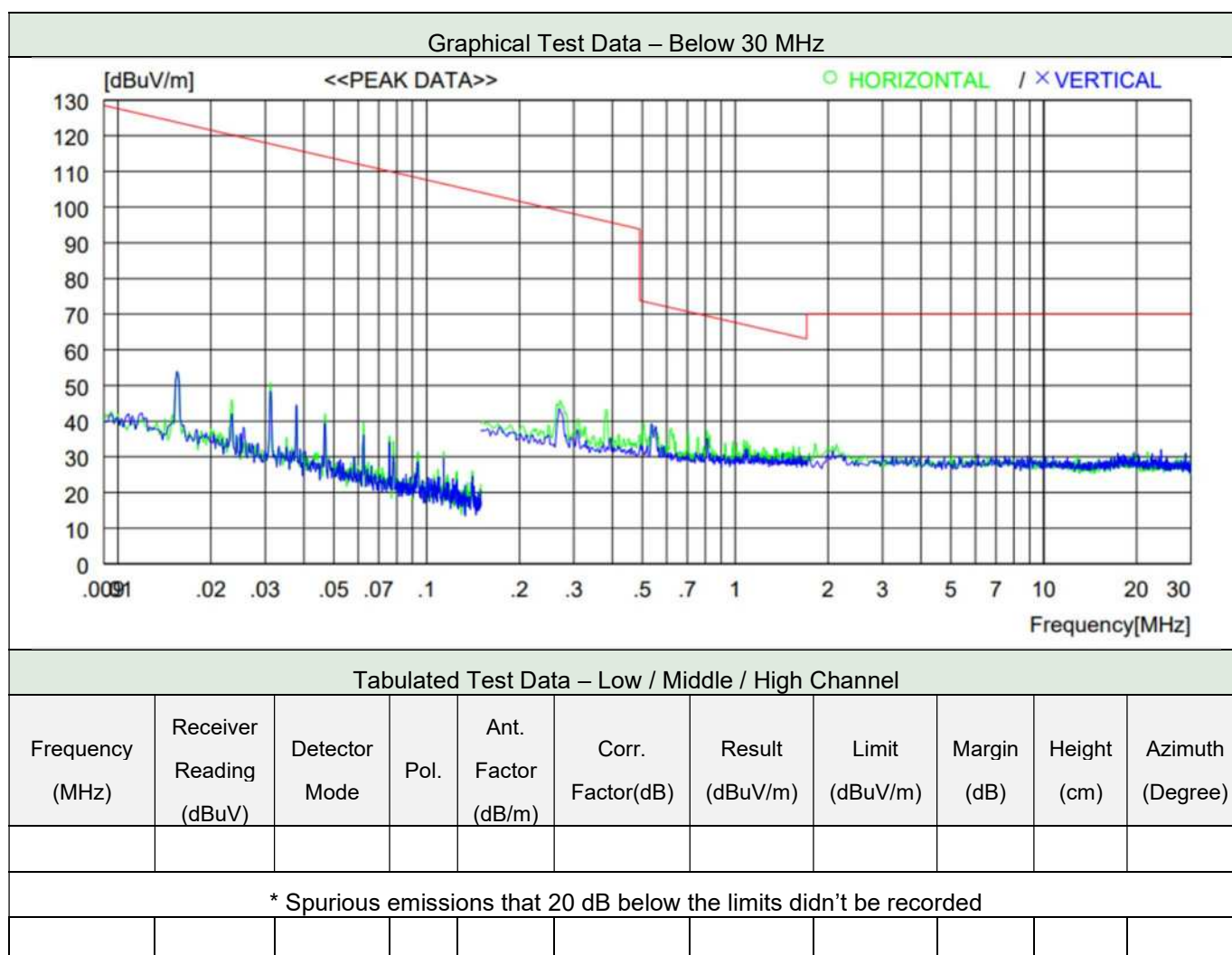
Margin = Limit – Result = 40 – 30 = 10

so the EUT has 10.0 dB margin at 80 MHz

5.5.6 Test Data

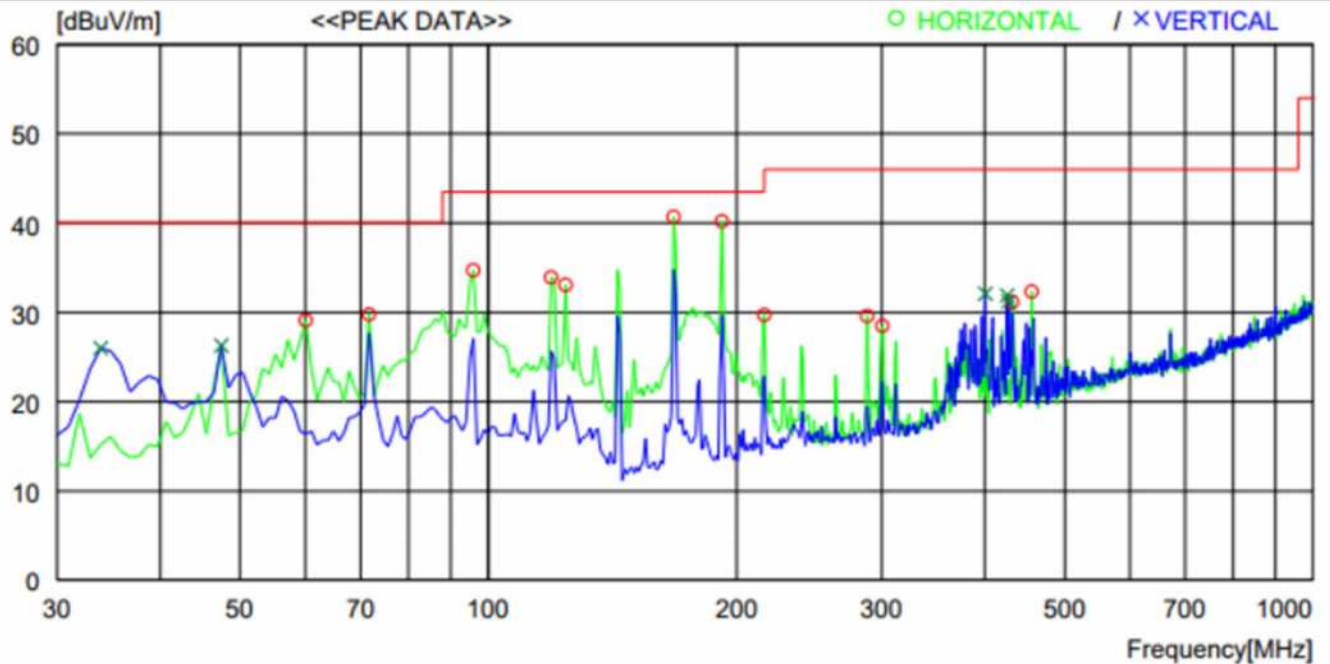
Date of Test	2021-10-20	Temperature		(22.1 ± 2.7) °C	
		Relative humidity		(40.9 ± 5.9) % R.H.	
Measurement Frequency Range		9 kHz ~ 25 GHz			
Test Result	PASS	Tested By		Do-heon Kim 	
Frequency range	Detector Mode	Resolution BW	Video BW	Video Filtering	Measurement distance
Below 30 MHz	Peak or Q.P.	9 kHz	100 kHz	-	3 m
30 MHz ~ 1 000 MHz	Peak or Q.P.	100 kHz	300 kHz	-	3 m
Above 1 GHz	Peak	1 MHz	3 MHz		3 m
	Average	1 MHz	3 MHz		3 m

5.6.6.1 Test Data below 30 MHz



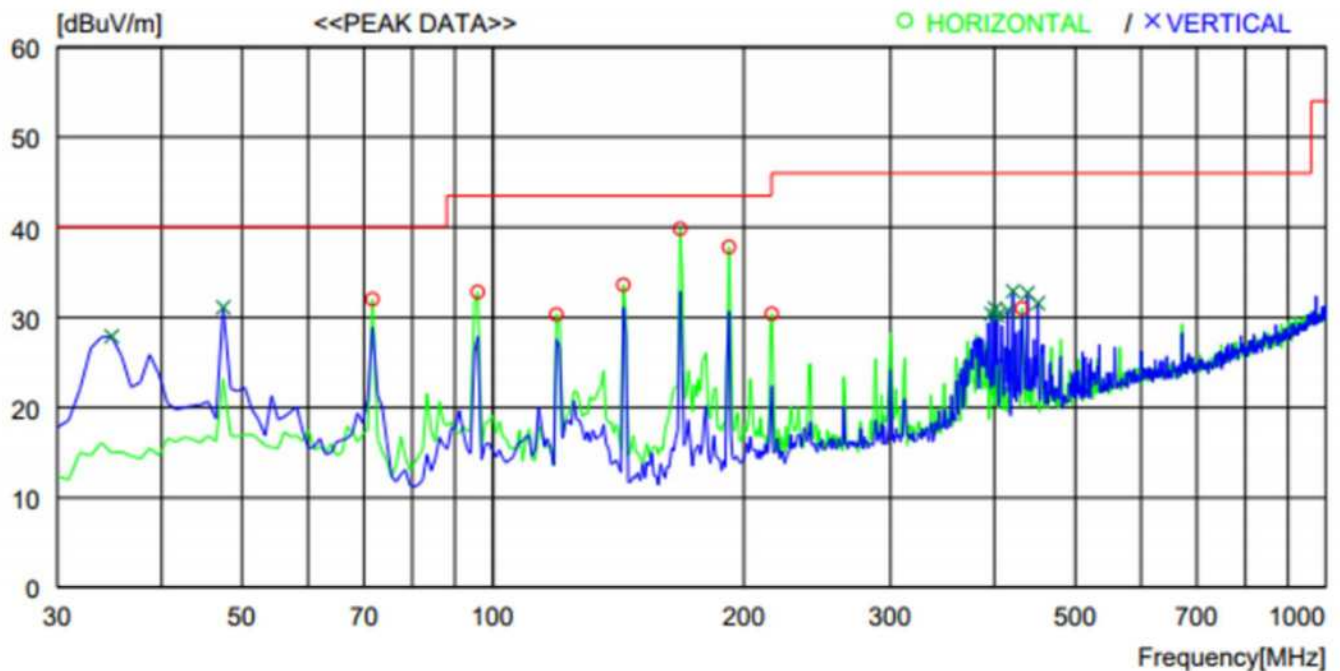
5.5.6.2 Test Data from 30 MHz to 1 GHz

Graphical Test Data – Below 1 GHz – **Low Channel (Peak)**



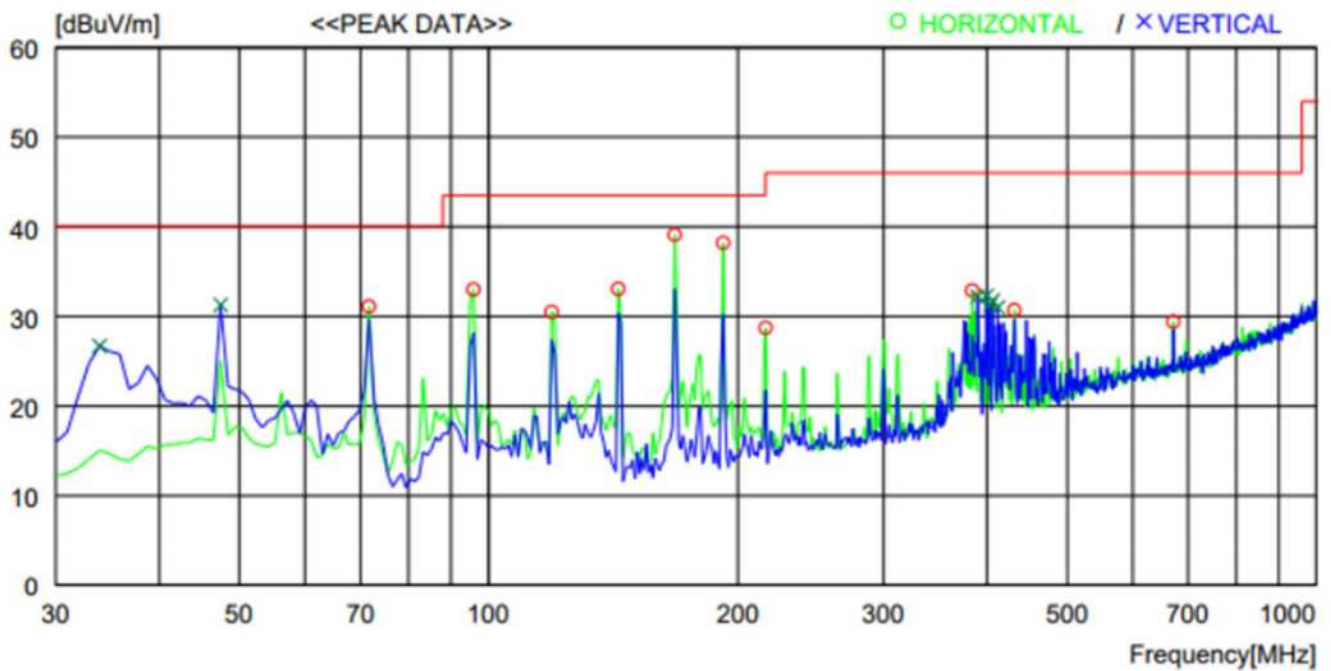
No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	60.070	41.1	13.1	7.6	32.7	29.1	40.0	10.9	200	36
2	71.710	45.5	9.3	7.7	32.7	29.8	40.0	10.2	400	0
3	95.960	48.4	11.0	8.0	32.7	34.7	43.5	8.8	400	0
4	119.240	48.5	9.8	8.3	32.7	33.9	43.5	9.6	200	44
5	124.090	48.1	9.4	8.3	32.7	33.1	43.5	10.4	200	44
6	167.740	55.9	8.8	8.7	32.7	40.7	43.5	2.8	200	0
7	191.990	53.4	10.5	9.0	32.7	40.2	43.5	3.3	200	0
8	216.240	41.5	11.7	9.2	32.7	29.7	46.0	16.3	100	359
9	288.020	39.5	13.1	9.7	32.7	29.6	46.0	16.4	100	359
10	300.630	38.2	13.2	9.8	32.7	28.5	46.0	17.5	100	97
11	431.581	37.3	16.1	10.6	32.8	31.2	46.0	14.8	100	359
12	455.831	37.8	16.5	10.8	32.8	32.3	46.0	13.7	200	28
----- Vertical -----										
13	33.880	40.4	11.2	7.1	32.7	26.0	40.0	14	100	0
14	47.460	37.3	14.4	7.3	32.7	26.3	40.0	13.7	100	0
15	400.540	38.9	15.6	10.4	32.8	32.1	46.0	13.9	100	0
16	425.761	38.1	16.0	10.6	32.8	31.9	46.0	14.1	100	197
17	427.701	37.4	16.0	10.6	32.8	31.2	46.0	14.8	100	0

Graphical Test Data – Below 1 GHz – Middle Channel (Peak)



No.	FREQ [MHz]	READING ANT PEAK FACTOR [dBuV] [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA TABLE [cm] [DEG]
----- Horizontal -----								
1	71.710	47.7 9.3	7.7	32.7	32.0	40.0	8	300 359
2	95.960	46.5 11.0	8.0	32.7	32.8	43.5	10.7	400 198
3	119.240	44.9 9.8	8.3	32.7	30.3	43.5	13.2	200 0
4	143.490	49.6 8.2	8.5	32.7	33.6	43.5	9.9	200 106
5	167.740	55.0 8.8	8.7	32.7	39.8	43.5	3.7	200 0
6	191.990	51.0 10.5	9.0	32.7	37.8	43.5	5.7	100 359
7	216.240	42.2 11.7	9.2	32.7	30.4	46.0	15.6	100 359
8	431.581	37.1 16.1	10.6	32.8	31.0	46.0	15	200 0
----- Vertical -----								
9	34.850	42.0 11.4	7.2	32.7	27.9	40.0	12.1	100 0
10	47.460	42.1 14.4	7.3	32.7	31.1	40.0	8.9	100 145
11	396.660	37.3 15.5	10.4	32.8	30.4	46.0	15.6	100 200
12	400.540	37.8 15.6	10.4	32.8	31.0	46.0	15	100 196
13	403.450	36.9 15.7	10.4	32.8	30.2	46.0	15.8	100 0
14	415.091	37.3 15.8	10.5	32.8	30.8	46.0	15.2	100 230
15	420.911	39.3 15.9	10.5	32.8	32.9	46.0	13.1	100 0
16	438.371	38.6 16.2	10.7	32.8	32.7	46.0	13.3	100 200
17	450.981	37.3 16.4	10.7	32.8	31.6	46.0	14.4	100 0

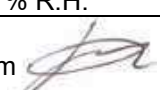
Graphical Test Data – Below 1 GHz – High Channel (Peak)



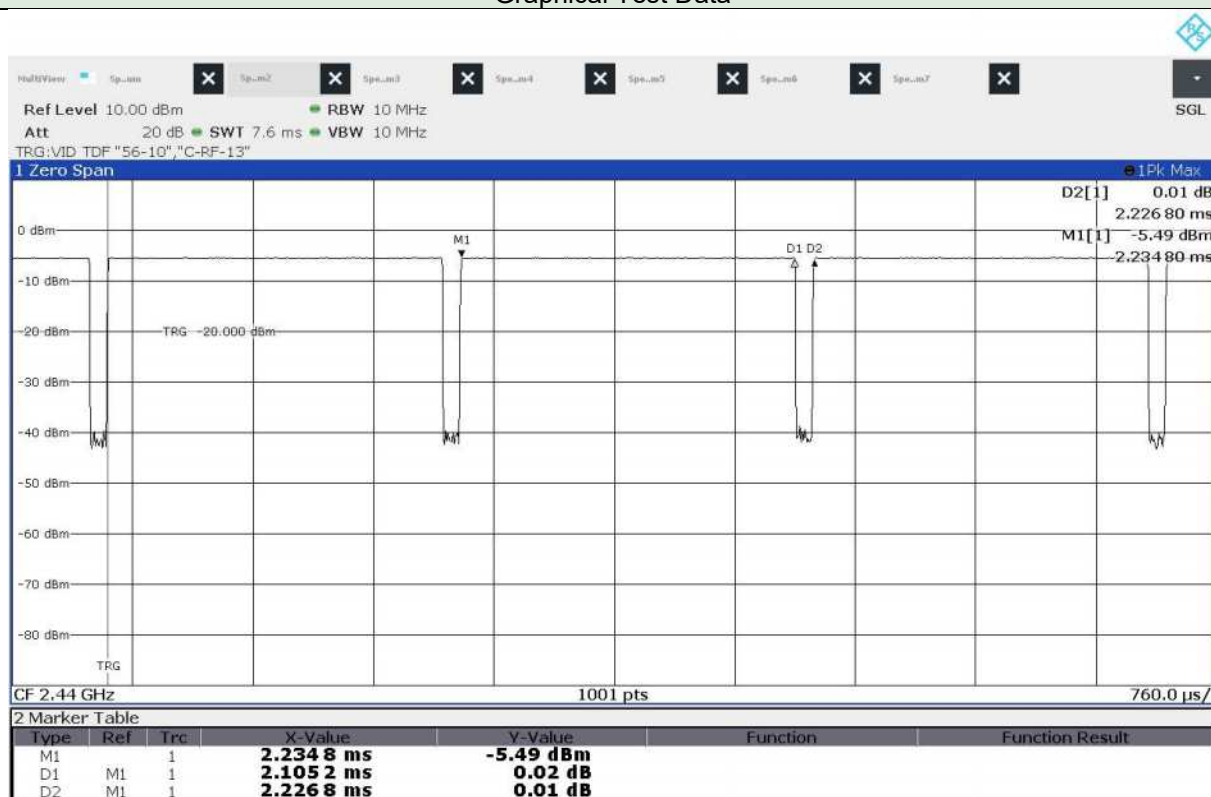
No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	71.710	46.8	9.3	7.7	32.7	31.1	40.0	8.9	300	180
2	95.960	46.7	11.0	8.0	32.7	33.0	43.5	10.5	200	0
3	119.240	45.1	9.8	8.3	32.7	30.5	43.5	13	200	211
4	143.490	49.1	8.2	8.5	32.7	33.1	43.5	10.4	200	223
5	167.740	54.3	8.8	8.7	32.7	39.1	43.5	4.4	200	223
6	191.990	51.4	10.5	9.0	32.7	38.2	43.5	5.3	100	359
7	216.240	40.5	11.7	9.2	32.7	28.7	46.0	17.3	100	359
8	384.050	40.1	15.2	10.3	32.7	32.9	46.0	13.1	100	359
9	431.581	36.8	16.1	10.6	32.8	30.7	46.0	15.3	100	302
10	672.136	31.1	19.5	11.9	33.1	29.4	46.0	16.6	100	359
----- Vertical -----										
11	33.880	41.1	11.2	7.1	32.7	26.7	40.0	13.3	100	0
12	47.460	42.3	14.4	7.3	32.7	31.3	40.0	8.7	100	113
13	389.870	39.1	15.4	10.4	32.7	32.2	46.0	13.8	100	0
14	399.570	39.1	15.6	10.4	32.8	32.3	46.0	13.7	100	201
15	403.450	38.0	15.7	10.4	32.8	31.3	46.0	14.7	100	213
16	406.360	38.4	15.7	10.5	32.8	31.8	46.0	14.2	100	213
17	412.181	37.5	15.8	10.5	32.8	31.0	46.0	15	100	218

5.5.6.3 Test Data above 1 GHz

5.5.6.3.1 Duty Cycle

Date of Test	2021-10-20	Temperature	(22.1 ± 2.7) °C
		Relative humidity	(40.9 ± 5.9) % R.H.
Measurement Distance	3 m	Tested By	Do-heon Kim 
Detector Mode	Resolution BW	Video BW	Sweep Time
PEAK	1 MHz	3 MHz	Auto
AVERAGE	1 MHz	3 MHz	Auto

Graphical Test Data



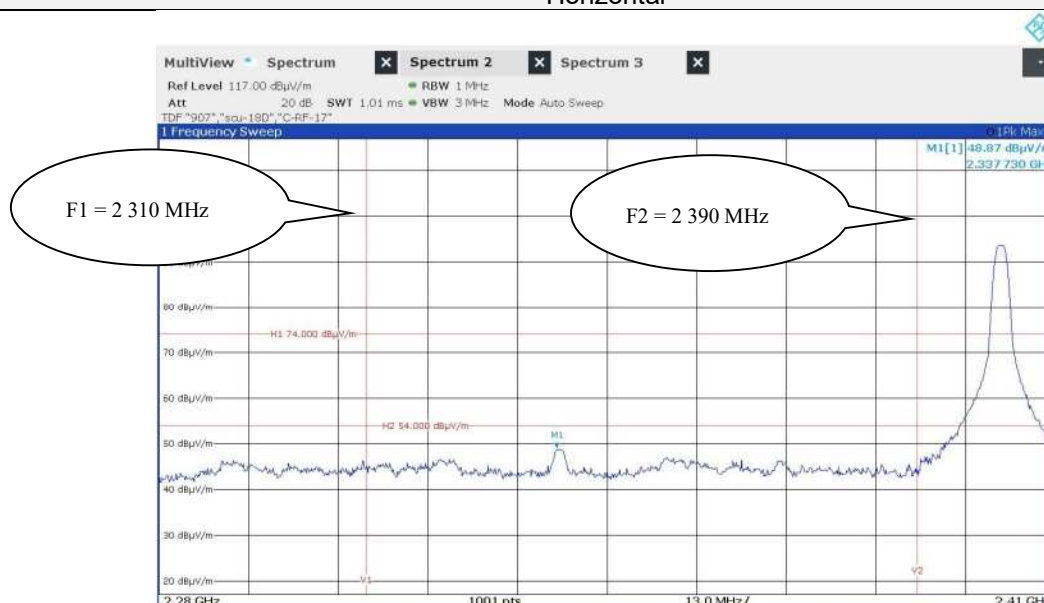
Tabulated Test Data

Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)
Bluetooth LE	2.105 2	2.226 8	94.54	0.24

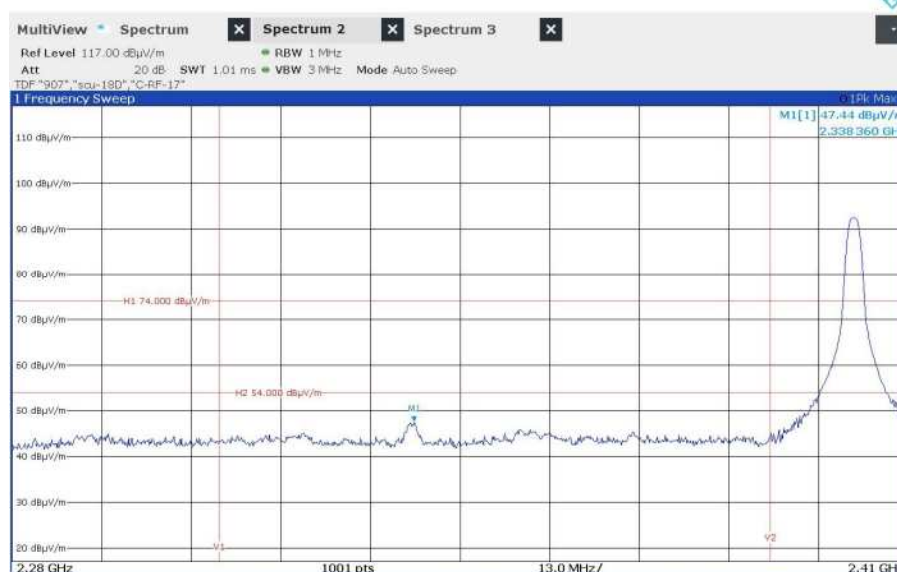
5.5.6.3.2 Test Data for Band edge (Restricted band)

Graphical Test Data – Low Channel (Peak)

Horizontal



Vertical



Tabulated Test Data – Low Channel

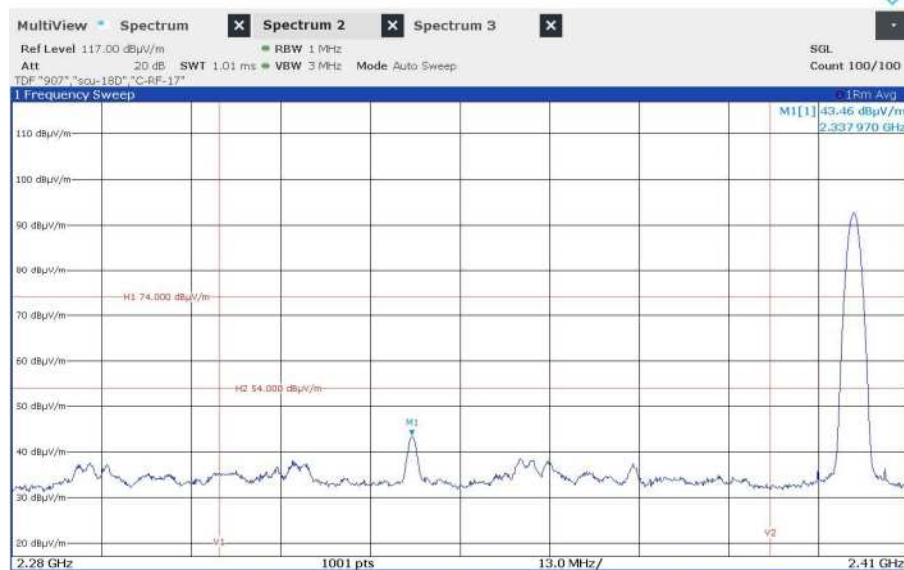
Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
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All emissions from the EUT in the restricted band have a margin more than 15 dB.

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Graphical Test Data – Low Channel (Average)

Horizontal



Vertical



Tabulated Test Data – Low Channel

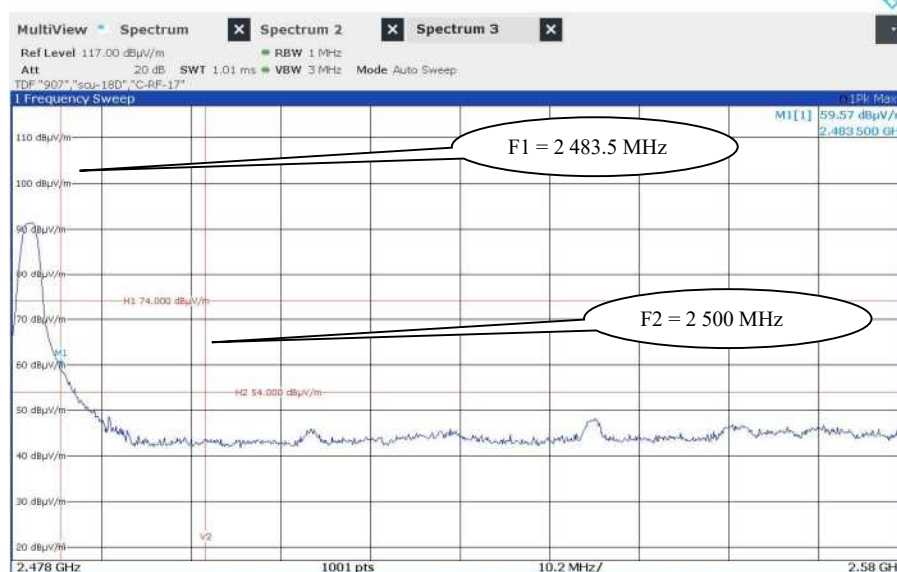
Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBμV/m)	Duty Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 338.0	RMS	H	43.46	0.24	43.70	54.00	10.30	130	360
2 338.0	RMS	V	40.33	0.24	40.57	54.00	13.43	100	252

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

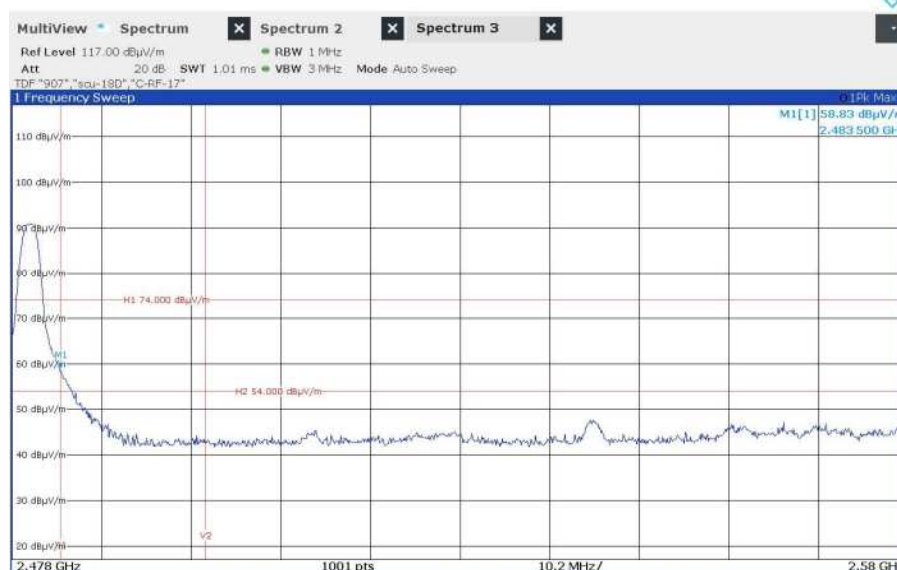
Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Peak)

Horizontal



Vertical

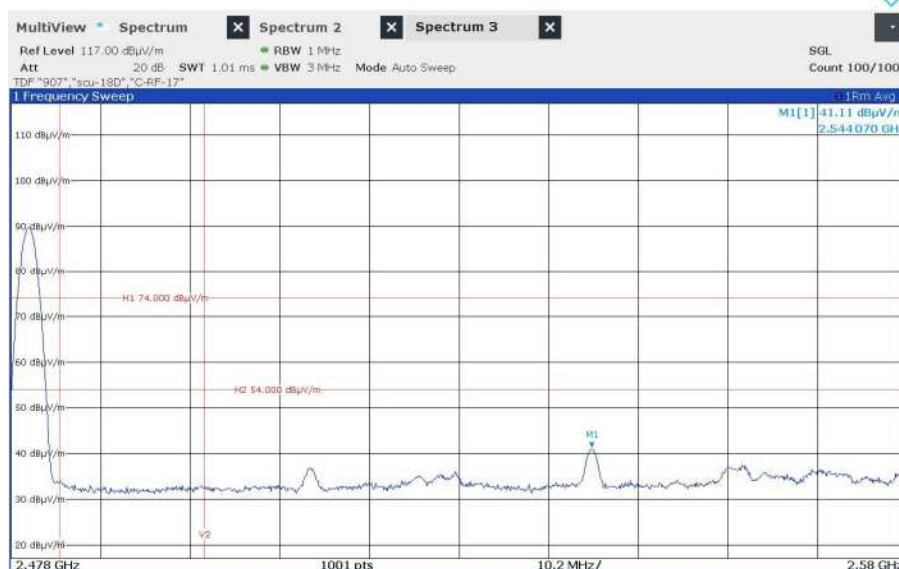


Tabulated Test Data – High Channel

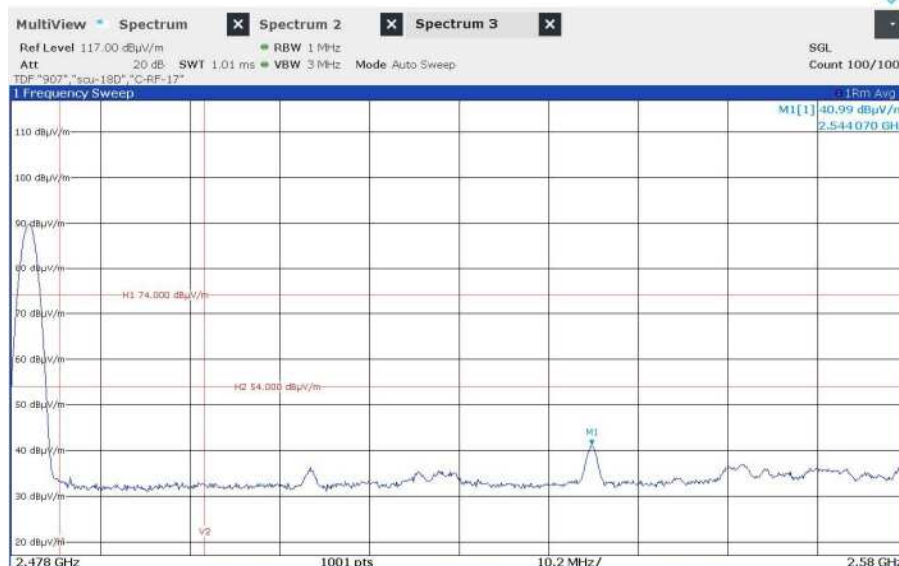
Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	H	59.57	-	59.57	74.00	14.43	140	150
2 483.5	Peak	V	58.83	-	58.83	74.00	15.17	130	293

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Graphical Test Data – High Channel (Average)_Horizontal Polarization



High Channel (Average)_Vetical Polarization



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
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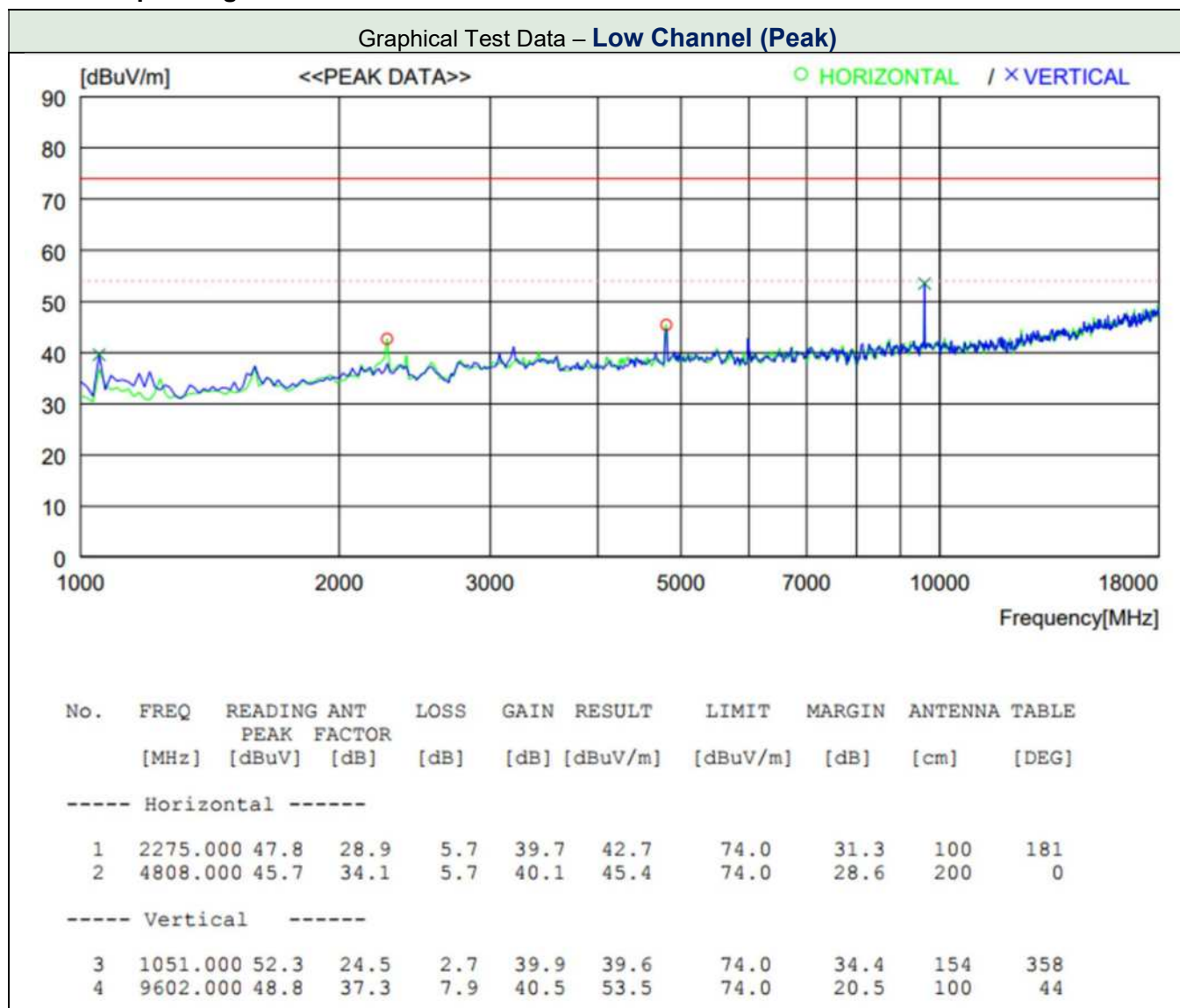
All emissions from the EUT in the restricted band have a margin more than 15 dB.

NOTE: "H" means Horizontal polarity, "V" means Vertical polarity.

Result = Measured Value + Duty Factor

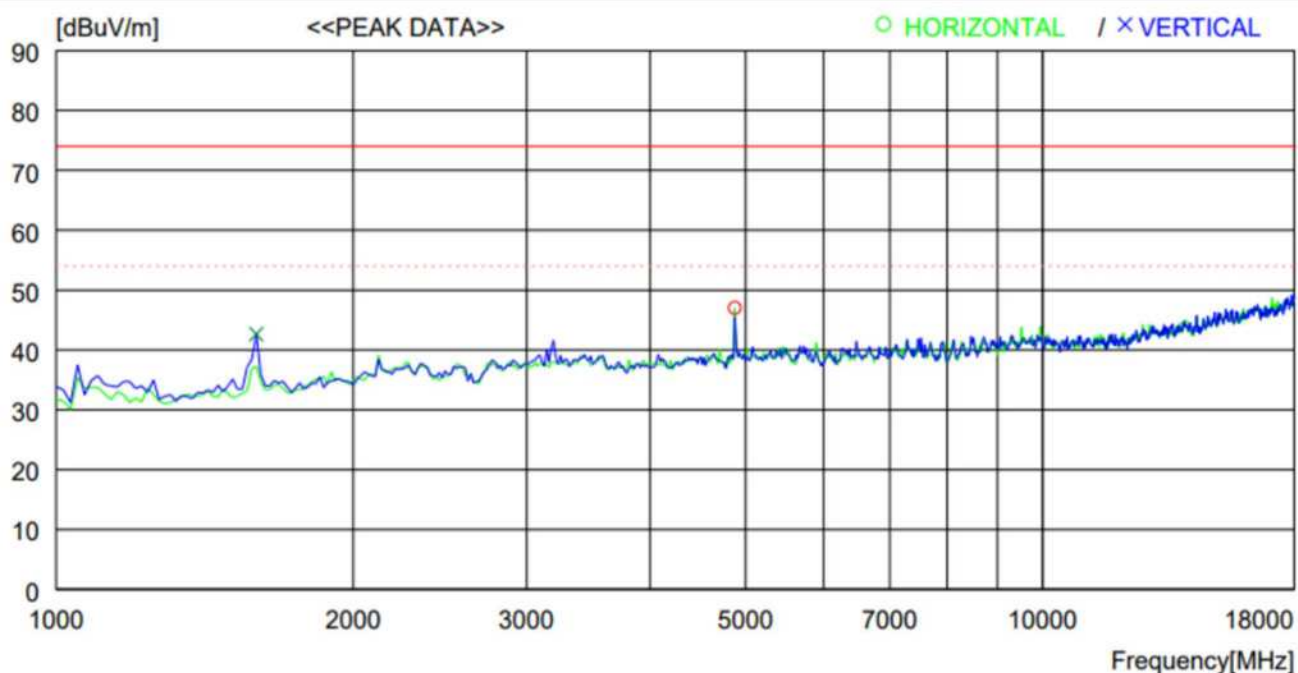
5.5.6.4 Test Data for Harmonic & Spurious emission (1 GHz to 18 GHz)

5.5.6.4.1 Operating mode: Bluetooth LE



NOTE: Notch filter was used during the test.

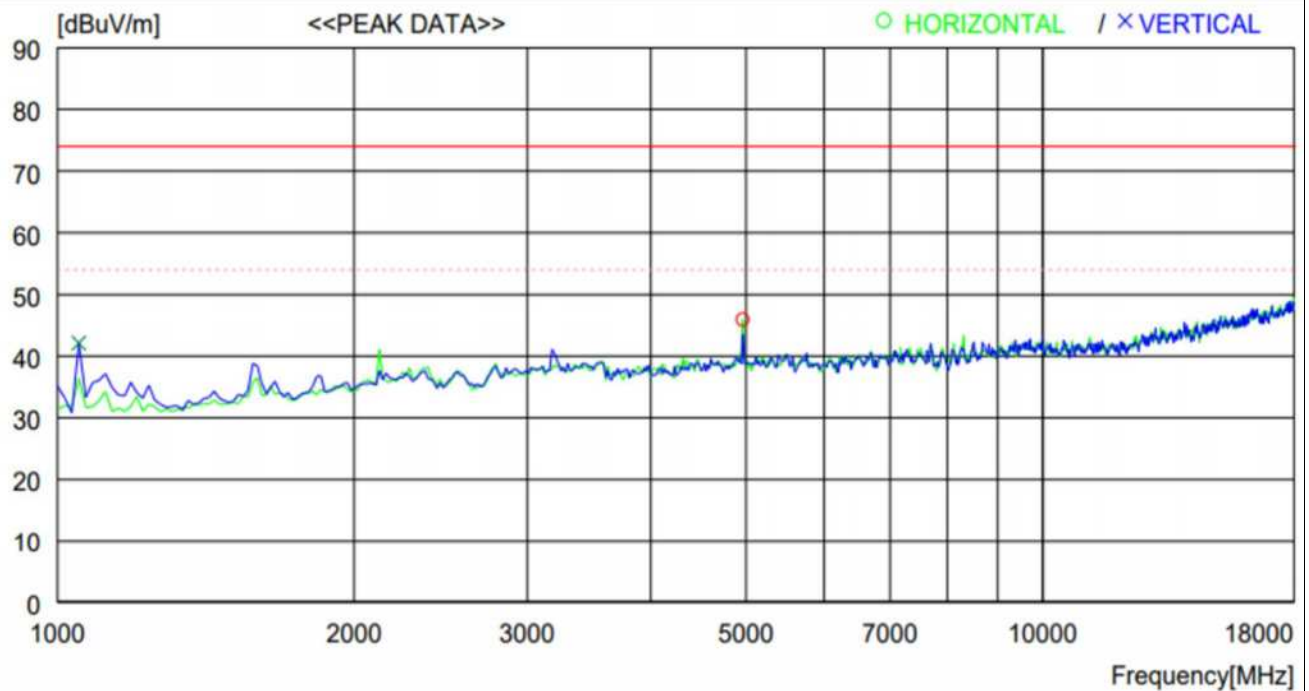
Graphical Test Data – Middle Channel (Peak)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	4876.000	47.1	34.2	5.8	40.1	47.0	74.0	27	100	359
----- Vertical -----										
2	1595.000	52.3	26.5	3.6	39.8	42.6	74.0	31.4	100	352

NOTE: Notch filter was used during the test.

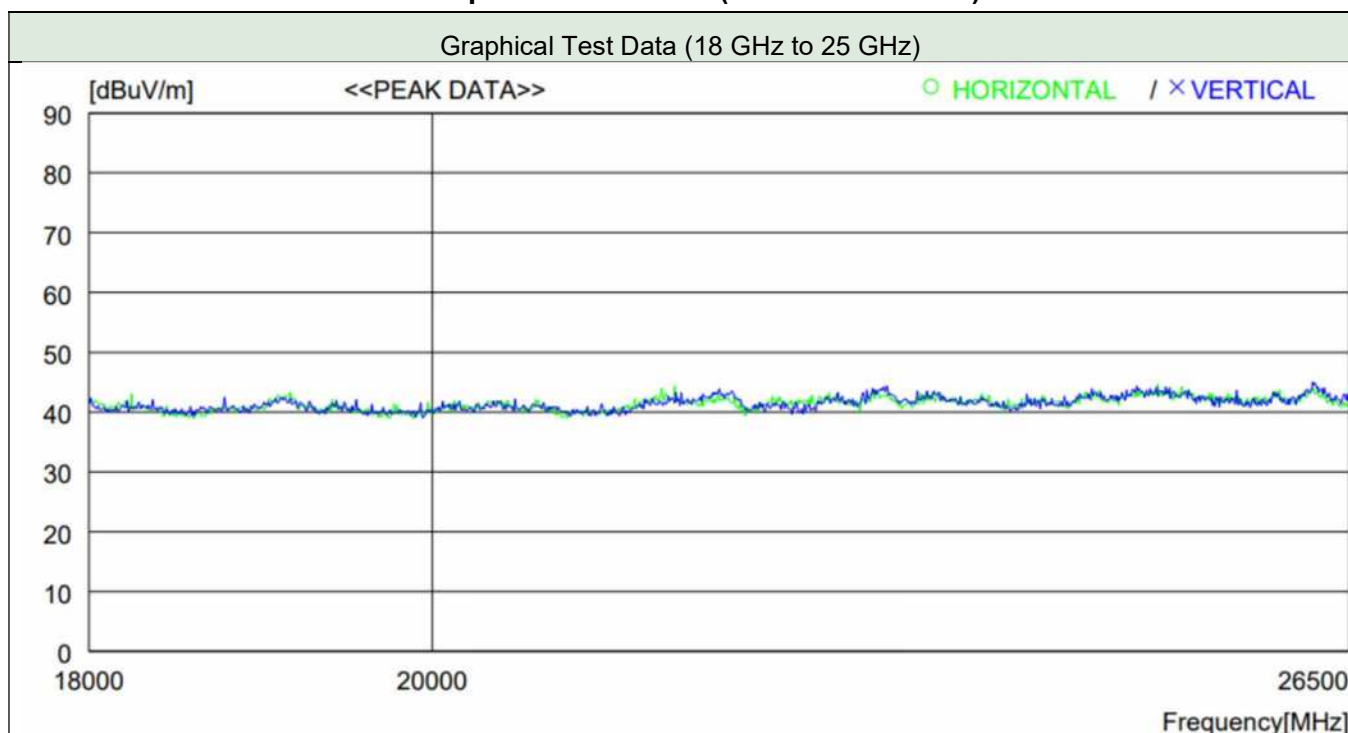
Graphical Test Data – **High Channel (Peak)**



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	4961.000	45.8	34.3	5.9	40.1	45.9	74.0	28.1	200	0
----- Vertical -----										
2	1051.000	54.8	24.5	2.7	39.9	42.1	74.0	31.9	154	357

NOTE: Notch filter was used during the test.

5.5.6.5 Test Data for Harmonic & Spurious emission (18 GHz to 25 GHz)



Frequency (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
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Low / Middle / High Channel

* Spurious emissions that 20 dB below the limits didn't be recorded.

NOTE: Peak results are met average limit, so average measurement was not performed.

Emission was scanned up to 25 GHz; No emissions were detected above the noise floor which was at least 20 dB below the specification limit

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit - Result

Appendix I – Test Instrumentation

Description	Model No.	Serial No.	Manufacturer.	Due for Cal. Date	Cal. Interval
Signal & Spectrum Analyzer	FSW 43	100578	Rohde & Schwarz	2022-04-19	1 Y
Attenuator	56-10	58769	WEINSCHL	2022-01-15	1 Y
DC POWER SUPPLY	U8001A	MY51080019	Agilent	2022-07-16	1 Y
Test Receiver	ESU 26	100303	Rohde & Schwarz	2022-01-14	1 Y
Loop Antenna	HFH2-Z2	100341	Rohde & Schwarz	2023-05-14	2 Y
TRILOG Broadband Antenna	VULB9163	9163.799	Schwarzbeck	2023-09-28	2 Y
Horn Antenna	HF 907	102426	Rohde & Schwarz	2021-10-29	1 Y
Horn Antenna	BBHA 9170	783	Schwarzbeck	2021-10-29	1 Y
Notch Filter	BRM50702	G318	MICRO-TRONICS	2021-11-04	1 Y
Attenuator	6dB	272.4110.50	Rohde & Schwarz	2022-01-14	1 Y
Pre-Amplifier	310N	344015	Sonoma Instrument	2022-01-14	1 Y
Pre-Amplifier	SCU 18D	19006450	Rohde & Schwarz	2022-04-15	1 Y
Pre-Amplifier	CBL18265035	28706	CERNEX	2022-03-09	1 Y
Turn Table	DT3000-3t	1310814	INNCO SYSTEM	N/A	N/A
Antenna Master	MA4000-EP	4600814	INNCO SYSTEM	N/A	N/A
Antenna Master	MA4000-XP-ET	-	INNCO SYSTEM	N/A	N/A
Camera Controller	HDCon4102	6531445048	PONTIS	N/A	N/A
CO3000 Controller	Co3000-4Port	CO3000/806/ 34130814/L	INNCO SYSTEM	N/A	N/A
CO3000 Controller	Co3000-4Port	CO3000/807/ 34130814/L	INNCO SYSTEM	N/A	N/A

The measuring equipment utilized to perform the tests documented in this test report has been calibrated in accordance with manufacturer's recommendations, and is traceable to recognized national standards.