LTA
Laboratory for Test & Approval Co.,Ltd.

243 Jubug-Ri,Yangji-Myeon, Yongin-Si, Gyeonggi-Do, Korea 17159
Tel: +82-31-323-6008 Fax: +82-31-323-6010
http://www.ltalab.com

Dates of Tests: September 08, 2021 ~ October 16, 2021
Test Report S/N: LR500112110G
Test Site : LTA CO., LTD.

CERTIFICATION OF COMPLIANCE

FCC ID. **2A3F4WT-1000**

APPLICANT **The Wave Talk, Inc.**

Equipment Class	**:**	**Digital Transmission System (DTS)**
Manufacturing Description	**:**	**Turbidimeter**
Manufacturer	**:**	**The Wave Talk, Inc.**
Model name	**:**	**WT-1000**
Additional model	**:**	**WT-2000**
Test Device Serial No.:	**:**	**Identical prototype**
Rule Part(s)	**:**	**FCC Part 15.247 Subpart C ; ANSI C63.10 - 2013**
Frequency Range	**:**	**2402 MHz ~ 2480 MHz(BLE)**
		2412 MHz ~ 2462 MHz(802.11 b/g/n20)
		2422 MHz ~ 2452 MHz(802.11 n40)
Max. Output Power	**:**	**Max 7.56 dBm – Conducted(BLE)**
		Max 26.00 dBm – Conducted(802.11 b)
		Max 25.42 dBm – Conducted(802.11 g)
		Max 25.48 dBm – Conducted(802.11 n20)
		Max 25.78 dBm – Conducted(802.11 n40)
Data of issue	**:**	**October 17, 2021**

This test report is issued under the authority of:

JaBeom.Koo

Ja-Beom, Koo / Manager

The test was supervised by:

Jae-hum, Yeon / Test Engineer

This test result only responds to the tested sample. It is not allowed to copy this report even partly without the allowance of the test laboratory. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

NVLAP LAB Code.: 200723-0

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1. General information

1-1 Test Performed

Company name : LTA Co., Ltd.

Address : 243, Jubug-ri,Yangji-Myeon,Youngin-Si, Kyunggi-Do, Korea. 449-822

Web site : http://www.ltalab.com

E-mail : chahn@ltalab.com

Telephone : +82-31-323-6008

Facsimile +82-31-323-6010

Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the “General requirements for the competents of calibration and testing laboratory”.

1-2 Accredited agencies

LTA Co., Ltd. is approved to perform EMC testing by the following agencies:

Agency	Country	Accreditation No.	Validity	Reference
NVLAP	U.S.A	200723-0	2021-09-30	ECT accredited Lab.
RRA	KOREA	KR0049	-	RRA accredited Lab.
	U.S.A		2023-04-08	
	CANADA		2022-10-18	
VCCI	JAPAN	C-14948	2023-09-10	VCCI registration
		T-12416	2023-09-10	
		R-14483	2023-10-15	
		G-10847	2024-12-13	
KOLAS	KOREA	KT551	Updating	KOLAS accredited Lab.

2. Information about test item

2-1 Client & Manufacturer

Client Company name	:	The Wave Talk, Inc.
Address	:	Truth Hall-T337, Daejeon, South Korea
Tel / Fax	:	TEL No : +82-010-6549-9995 / FAX No : + 82-042-867-7890
	:	
	:	

2-2 Equipment Under Test (EUT)

Model name	:	WT-1000
Serial number	:	Identical prototype
Date of receipt	:	September 08, 2021
EUT condition	:	Pre-production, not damaged
Antenna type	:	Pattern Antenna - Max Gain 3.4 dBi
Frequency Range	:	2402 MHz ~ 2480 MHz (BLE)
		2412 MHz ~ 2462 MHz (802.11 b/g/n20)
		2422 MHz ~ 2452 MHz (802.11 n40)
RF output power	:	Max 7.56 dBm – Conducted (BLE)
		Max 26.00 dBm – Conducted (802.11 b)
		Max 25.42 dBm – Conducted (802.11 g)
		Max 25.48 dBm – Conducted (802.11 n20)
		Max 25.78 dBm – Conducted (802.11 n40)
Type of Modulation	:	GFSK, QPSK, Direct Sequence Spread Spectrum(DSSS)
Power Source	:	DC 3.7 V
Firmware Version	:	V1.0.0

2-3 Tested frequency

	LOW	MID	HIGH
BLE - Frequency (MHz)	2402	2442	2480
802.11 b/g/n20 - Frequency (MHz)	2412	2437	2462
802.11 n40 - Frequency (MHz)	2422	2437	2452

2-4 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
Notebook	CR720	MS-1736	MSI

3. Test Report

3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(a)	6 dB Bandwidth	> 500 kHz	Conducted	N/A
15.247(b)	Transmitter Peak Output Power	< 1 Watt		N/A
15.247(d)	Transmitter Power Spectral Density	< 8 dBm @ 3 kHz		N/A
15.247(d)	Band Edge	> 20 dBc		N/A
15.209	Field Strength of Harmonics	Emission	Radiated	C
15.207	AC Conducted Emissions	Emissions	Conducted	NA
15.203	Antenna requirement	-	-	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The data in this test report are traceable to the national or international standards.

N/A: The product replaces this test with a certificate using an authenticated module.

→ Antenna Requirement
The Wave Talk, Inc. FCC ID: 2A3F4WT-1000 unit complies with the requirement of §15.203.
The antenna type is Pattern Antenna
The sample was tested according to the following specification:

*FCC Parts 15.247; ANSI C-63.4-2014;ANSI C-63.10-2013
*FCC KDB Publication No. 558074 D01 v05r02
*FCC TCB Workshop 2012, April

3.2 Technical Characteristics Test

3.2.1 6 dB Bandwidth

Procedure:

The bandwidth at 6 dB below the highest in-band spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate frequencies.

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 6 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 6 dB bandwidth of the emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz	Span = 3 * RBW
VBW = 3 * RBW	Sweep = auto
Trace = max hold	Detector function = peak

Measurement Data : N/A

Minimum Standard:

6 dB Bandwidth > 500 kHz

Measurement Setup

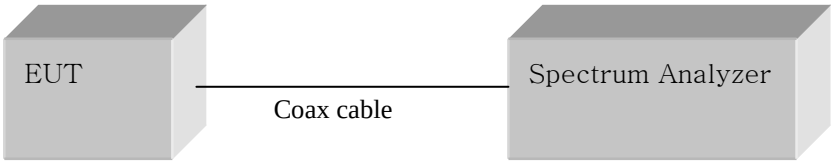


Figure 1: Measurement setup for the carrier frequency separation

3.2.2 Peak Output Power Measurement

Procedure:

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The spectrum analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth. The EUT was operating in transmit mode at the appropriate center frequency.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW ≥ DTS Bandwidth

Span ≥ 3 * RBW

VBW = 3 * RBW

Sweep = auto

Detector function = peak

Measurement Data : N/A

Minimum Standard:

Peak output power	≤ 1 W(30 dBm)

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

3.2.3 Power Spectral Density

Procedure:

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The spectrum analyzer is set to:

RBW = 3 kHz (3kHz≤RBW≤100kHz)	Span ≥ 1.5 times the DTS bandwidth
VBW = 3 * RBW	Sweep = auto
Detector function = peak	Trace = max hold

Measurement Data : N/A

Minimum Standard:

Power Spectral Density	< 8 dBm @ 3 kHz BW

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

3.2.4 Band - edge

Procedure:

The Unwanted emission from the EUT were measured according to the dictates PKPSD measurement procedure in section 11.11 of ANSI C63.10-2013.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB..

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz VBW ≥ 3 X RBW

Detector function = peak Trace = max hold

Sweep = auto

Measurement Data: Complies

- All conducted emission in any 100 kHz bandwidth outside of the spread spectrum band was at least 20 dB lower than the highest inband spectral density. Therefore the applying equipment meets the require ment.
- See next pages for actual measured spectrum plots.

Minimum Standard:	≤ 20 dBc

3.2.5 Conducted Spurious Emissions

Procedure:

The test follows KDB558074. The conducted spurious emissions were measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels..

After the trace being stable, set the marker on the peak of any spurious emission recorded.

The spectrum analyzer is set to:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions

RBW = 100 kHz Sweep = auto

VBW = 100 kHz Detector function = peak

Trace = max hold

Measurement Data: N/A

- All conducted emission in any 100 kHz bandwidth outside of the spread spectrum band was at least 20 dB lower than the highest inband spectral density. Therefore the applying equipment meets the require ment.
- See next pages for actual measured spectrum plots.

Minimum Standard:	≥ 20 dBc

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

3.2.6 Radiated Spurious Emissions

Procedure:

The EUT was placed on a 0.8 m high wooden table inside a shielded enclosure. An antenna was placed near the EUT and measurements of frequencies and amplitudes of field strengths were recorded for reference during final measurements. For final radiated testing, measurements were performed in OATS. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions.

The spectrum analyzer is set to:

Center frequency = the worst channel

Frequency Range = 9 kHz ~ 10^{th} harmonic.

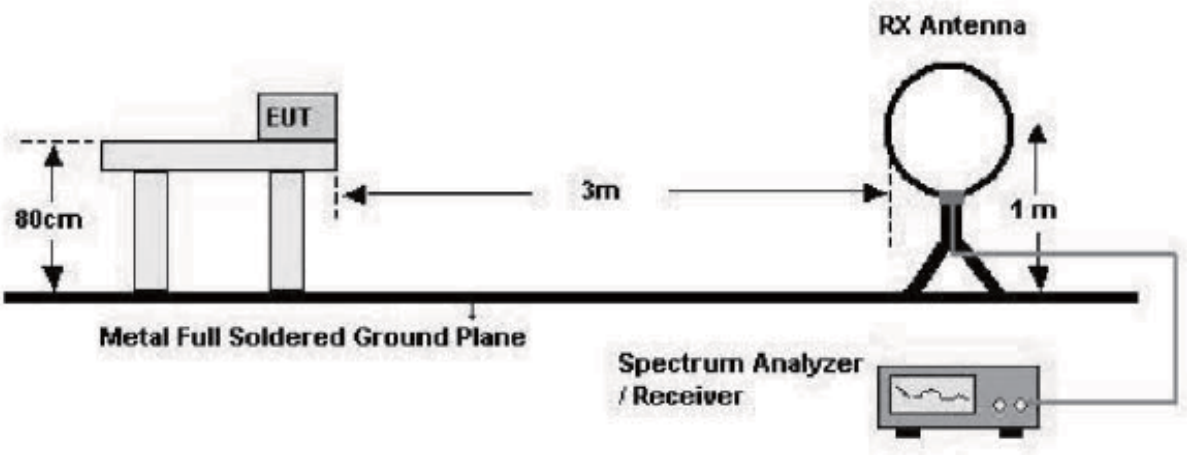
RBW = 120 kHz (30 MHz ~ 1 GHz) VBW ≥ RBW

= 1 MHz (1 GHz ~ 10^{th} harmonic)

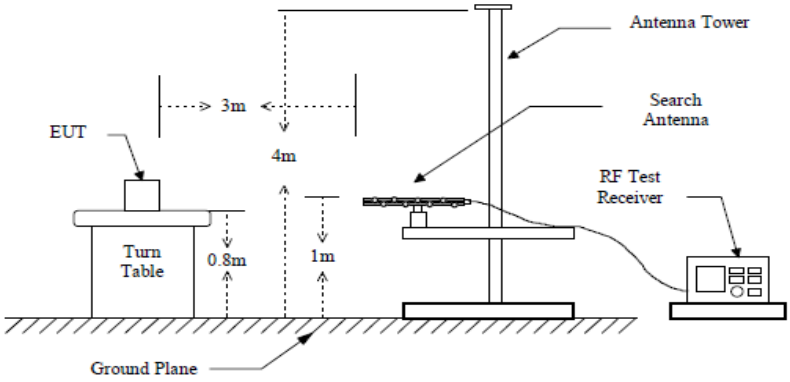
Detector function = peak Trace = max hold

Sweep = auto

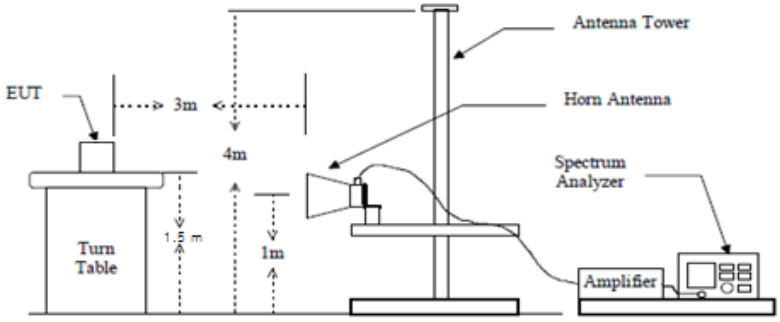
below 30 MHz



below 1 GHz (30 MHz to 1 GHz)



above 1 GHz



Measurement Data: Complies

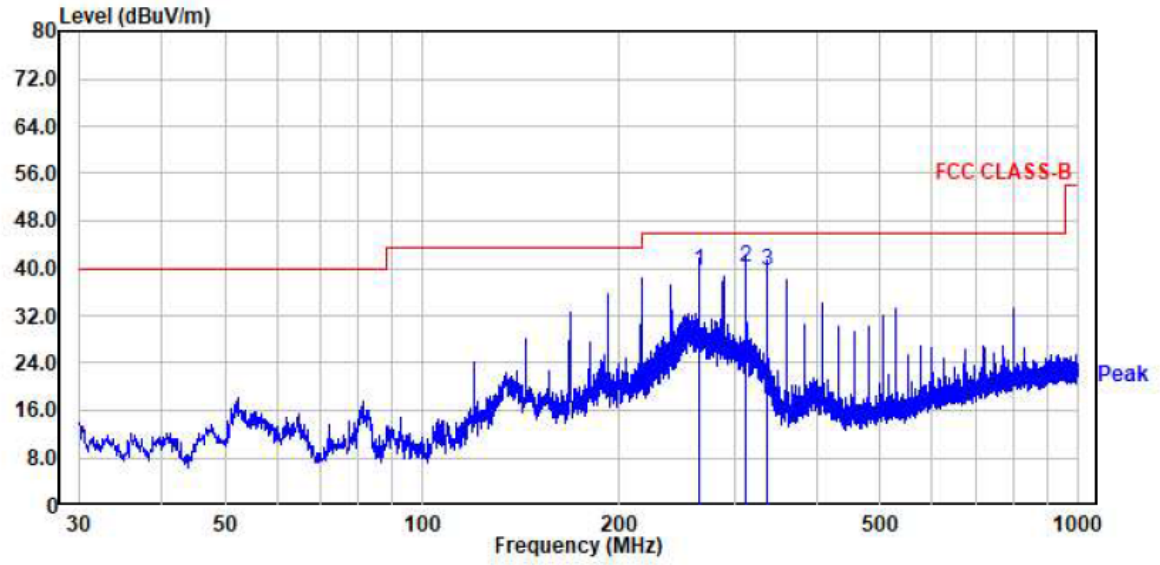
- See next pages for actual measured data.
- No other emissions were detected at a level greater than 20 dB below limit include from 9 kHz to 30 MHz.

Minimum Standard: FCC Part 15.209(a)

Frequency (MHz)	Limit (uV/m) @ 3 m
0.009 ~ 0.490	2400/F(kHz) **(@ 300 m)**
0.490 ~ 1.705	24000/F(kHz) **(@ 30 m)**
1.705 ~ 30	30**(@ 30 m)**
30 ~ 88	100 **
88 ~ 216	150 **
216 ~ 960	200 **
Above 960	500

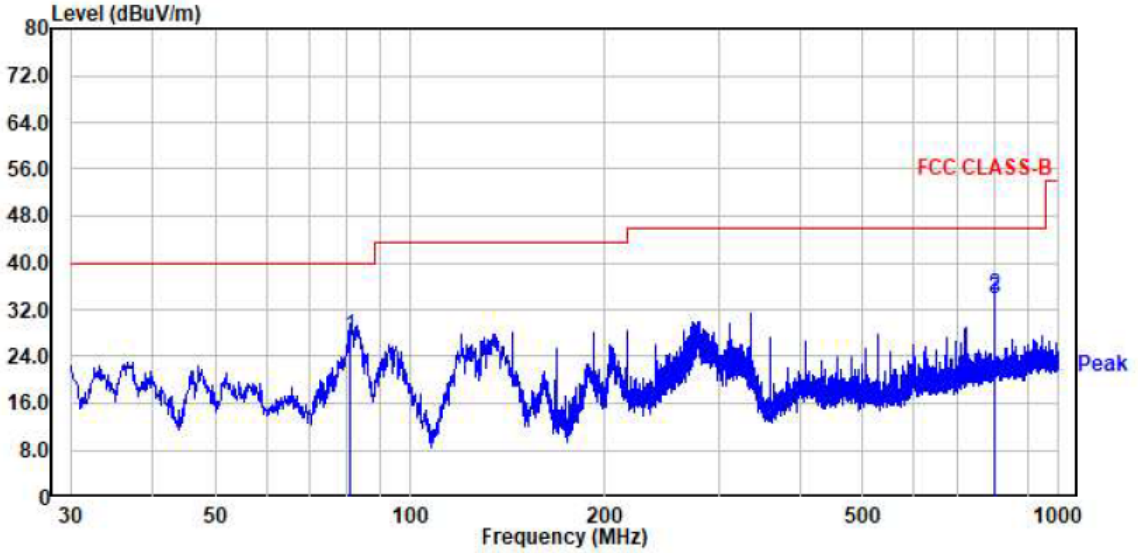
** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-80 6 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

Radiated Emissions (Below 1 GHz) – Bluetooth mode



No.	Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
	MHz	dBµV	dB	dBµV/m	dBµV/m	dB	cm	deg	
1.	264.01	56.50	-16.93	39.57	46.00	6.43	100	4	horizontal
2.	312.03	55.33	-15.06	40.27	46.00	5.73	100	4	horizontal
3.	336.04	53.73	-14.33	39.40	46.00	6.60	100	15	horizontal

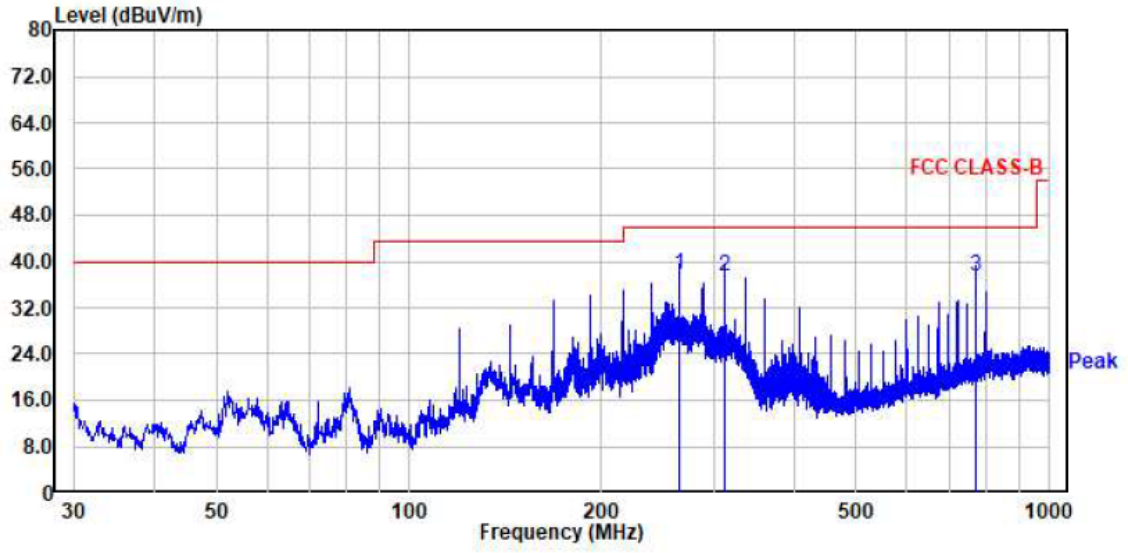
Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain



No.	Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
	MHz	dBµV	dB	dBµV/m	dBµV/m	dB	cm	deg	
1.	80.93	48.61	-21.06	27.55	40.00	12.45	100	147	vertical
2.	796.54	38.69	-4.31	34.38	46.00	11.62	150	0	vertical
3.	799.82	37.94	-4.17	33.77	46.00	12.23	150	0	vertical

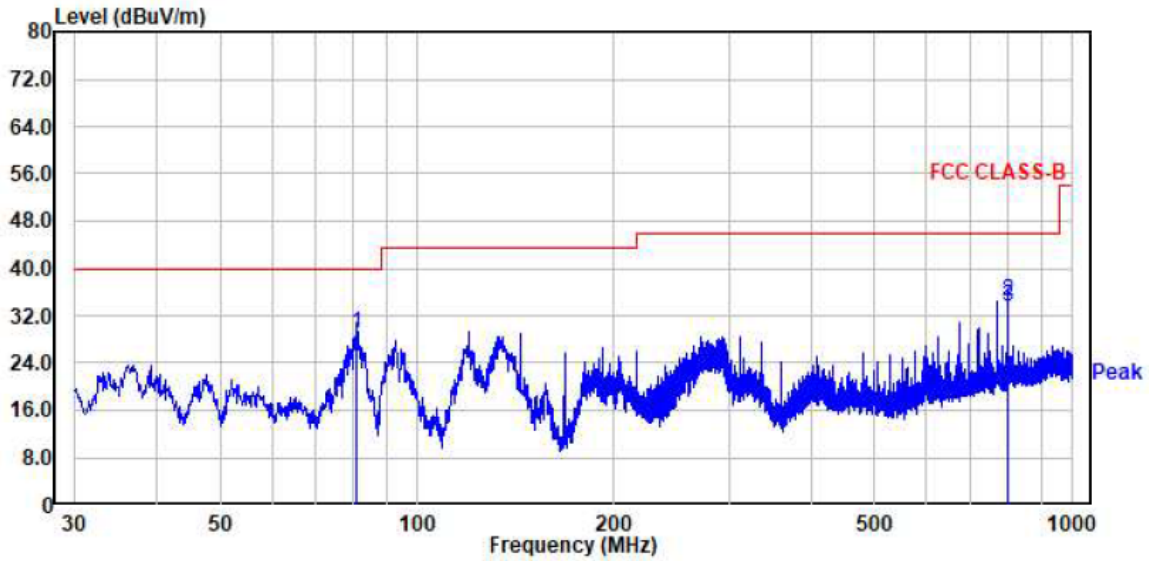
Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

Radiated Emissions (Below 1 GHz) – 802.11 mode



No.	Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
	MHz	dBµV	dB	dBµV/m	dBµV/m	dB	cm	deg	
1.	264.01	54.61	-16.93	37.68	46.00	8.32	100	0	horizontal
2.	312.03	52.56	-15.06	37.50	46.00	8.50	100	0	horizontal
3.	768.05	42.22	-4.87	37.35	46.00	8.65	100	113	horizontal

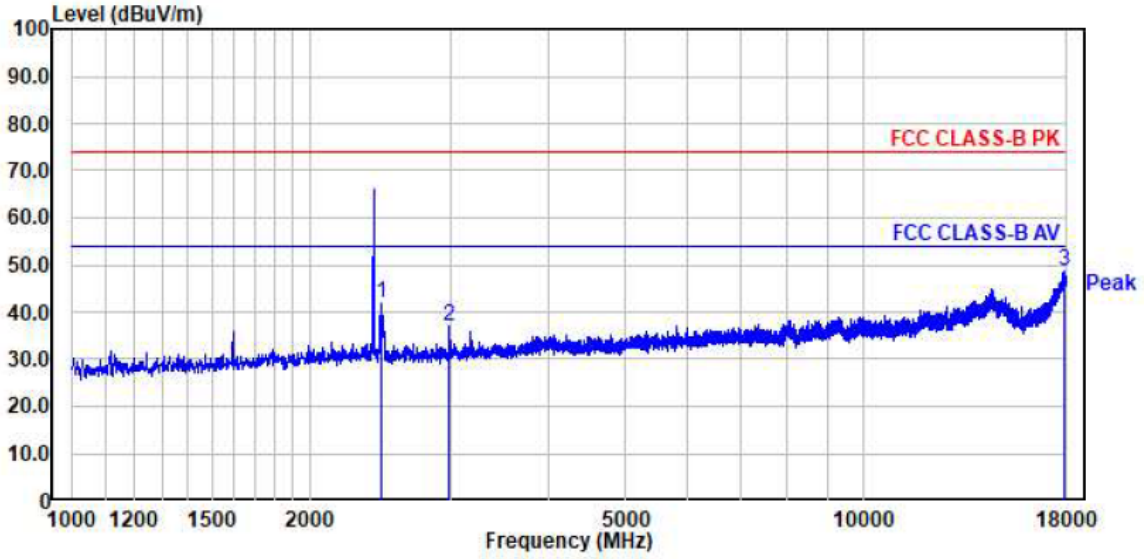
Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain



No.	Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
	MHz	dBµV	dB	dBµV/m	dBµV/m	dB	cm	deg	
1.	80.68	49.82	-20.98	28.84	40.00	11.16	100	116	vertical
2.	796.66	38.81	-4.30	34.51	46.00	11.49	161	0	vertical
3.	799.82	37.80	-4.17	33.63	46.00	12.37	161	0	vertical

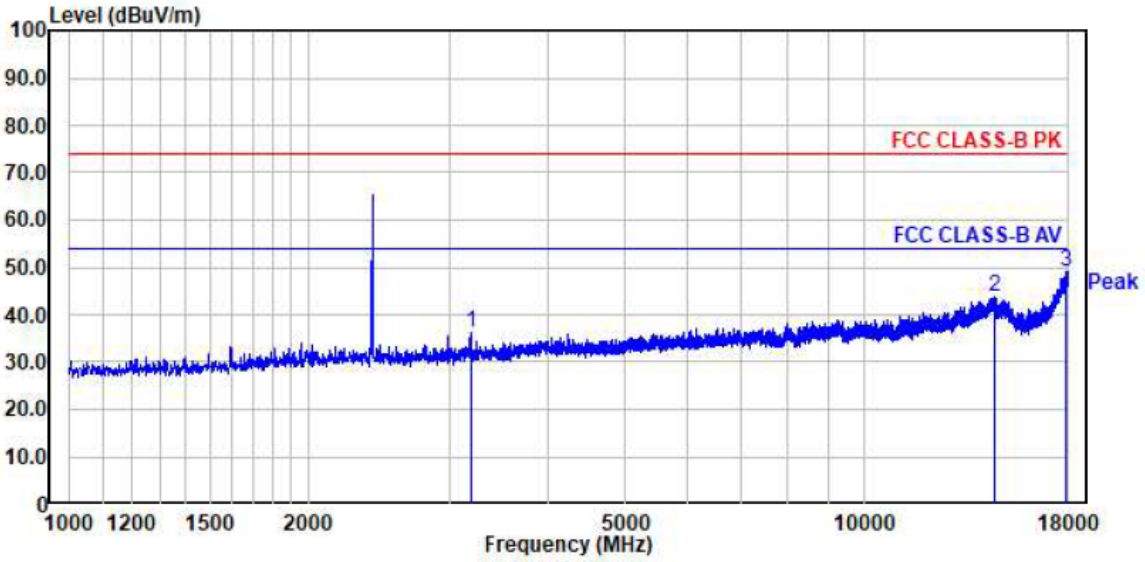
Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

Radiated Emissions (Above 1 GHz) – Bluetooth mode



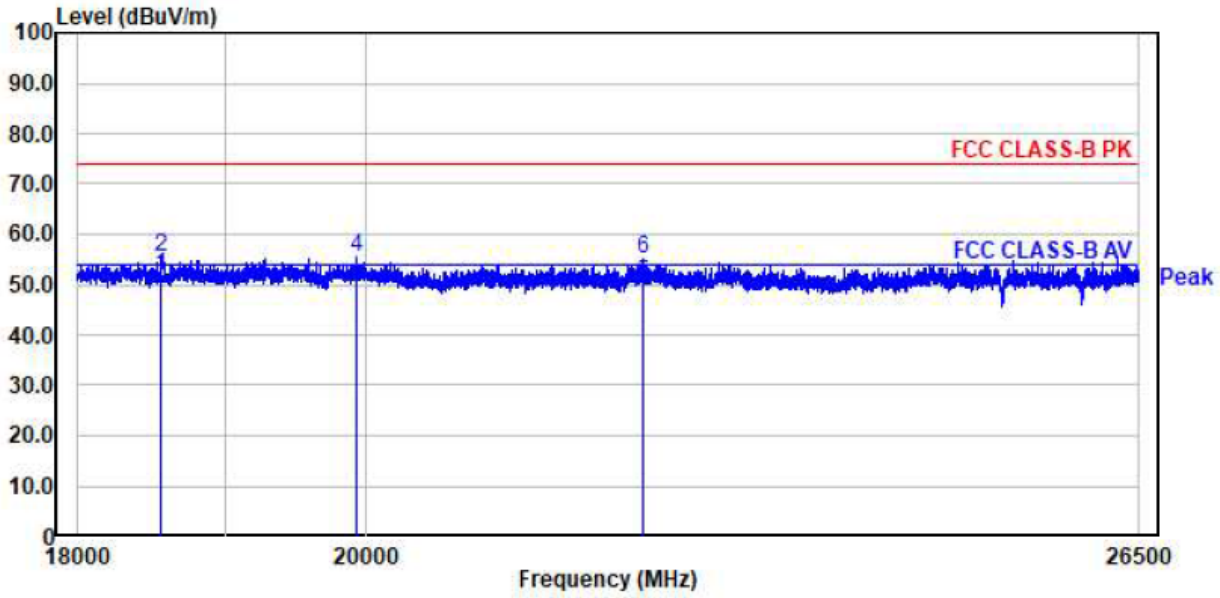
No.	Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
	MHz	dBµV	dB	dBµV/m	dBµV/m	dB	cm	deg	
1.	2457.75	49.43	-7.65	41.78	74.00	32.22	354	356	horizontal
2.	2999.63	43.05	-5.96	37.09	74.00	36.91	165	170	horizontal
3.	17893.75	34.21	14.43	48.64	74.00	25.36	360	360	horizontal

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain



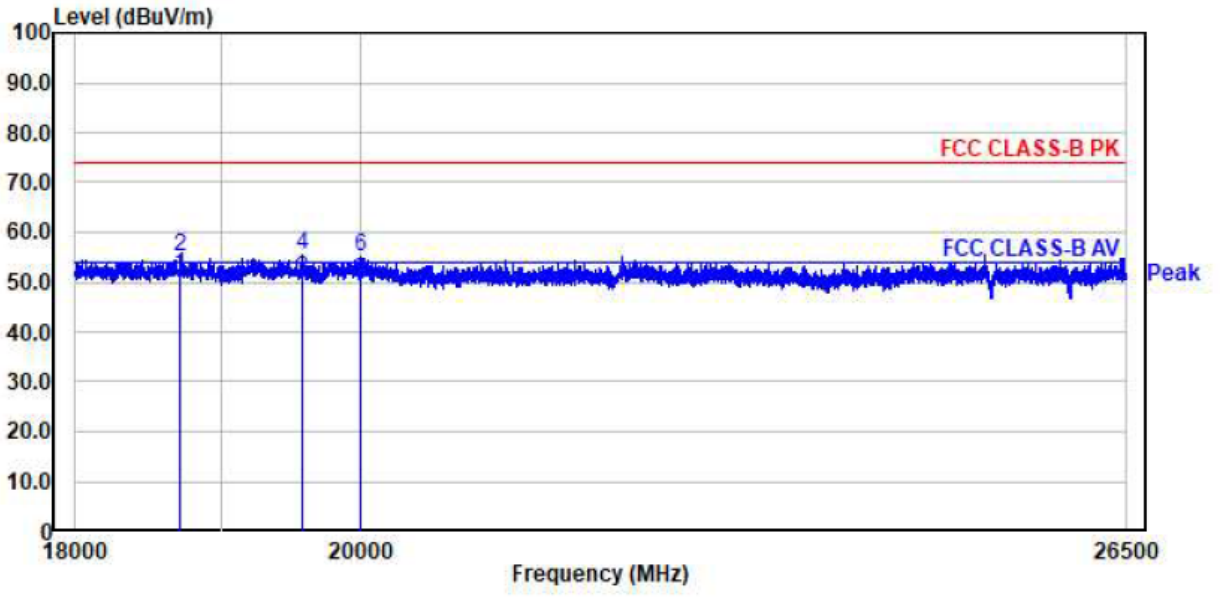
No.	Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
	MHz	dBµV	dB	dBµV/m	dBµV/m	dB	cm	deg	
1.	3195.13	41.66	-5.37	36.29	74.00	37.71	132	126	vertical
2.	14549.00	33.69	10.24	43.93	74.00	30.07	360	360	vertical
3.	17925.63	34.61	14.61	49.22	74.00	24.78	360	360	vertical

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain



No.	Freq	RD PK	RD AV	C.F	Result PK	Result AV	Limit PK	Limit AV	Margin PK	Margin AV	Height	Angle	Polarity
	MHz	dBµV	dBµV	dB	dBµV	dBµV	dBµV	dBµV	dB	dB	cm	deg	
2.	18554.63	38.71	34.71	16.95	55.66	51.66	74.00	54.00	18.34	2.34	22	29	horizontal
4.	19932.69	39.70	33.70	15.60	55.30	49.30	74.00	54.00	18.70	4.70	324	331	horizontal
6.	22118.25	39.76	34.76	15.40	55.16	50.16	74.00	54.00	18.84	3.84	117	124	horizontal

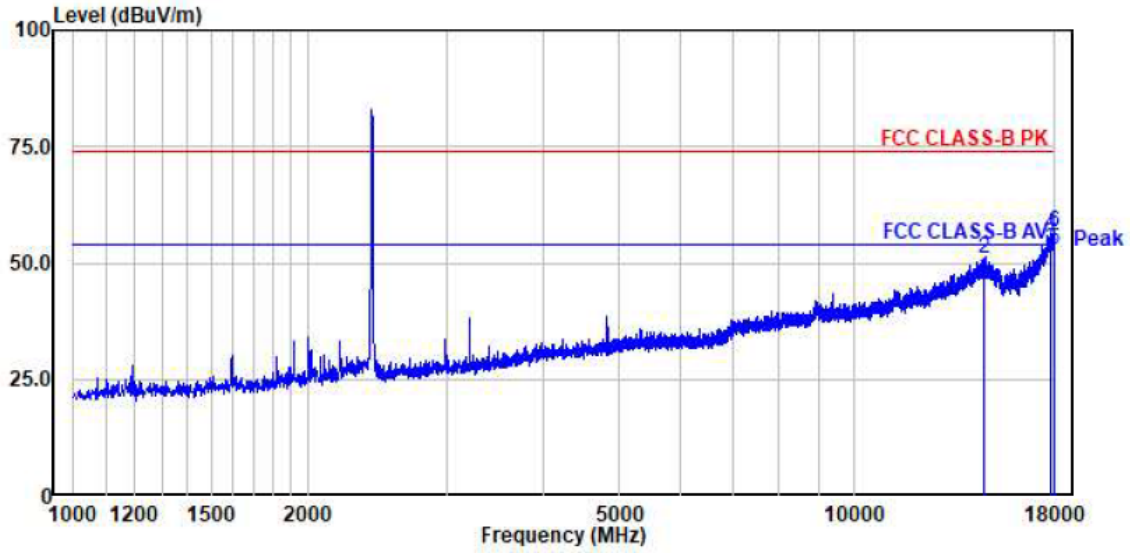
Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain



No.	Freq	RD PK	RD AV	C.F	Result PK	Result AV	Limit PK	Limit AV	Margin PK	Margin AV	Height	Angle	Polarity
	MHz	dBµV	dBµV	dB	dBµV	dBµV	dBµV	dBµV	dB	dB	cm	deg	
2.	18715.06	38.44	34.44	16.83	55.27	51.27	74.00	54.00	18.73	2.73	360	360	vertical
4.	19576.75	39.44	34.44	16.05	55.49	50.49	74.00	54.00	18.51	3.51	147	140	vertical
6.	19991.13	39.62	34.62	15.47	55.09	50.09	74.00	54.00	18.91	3.91	338	331	vertical

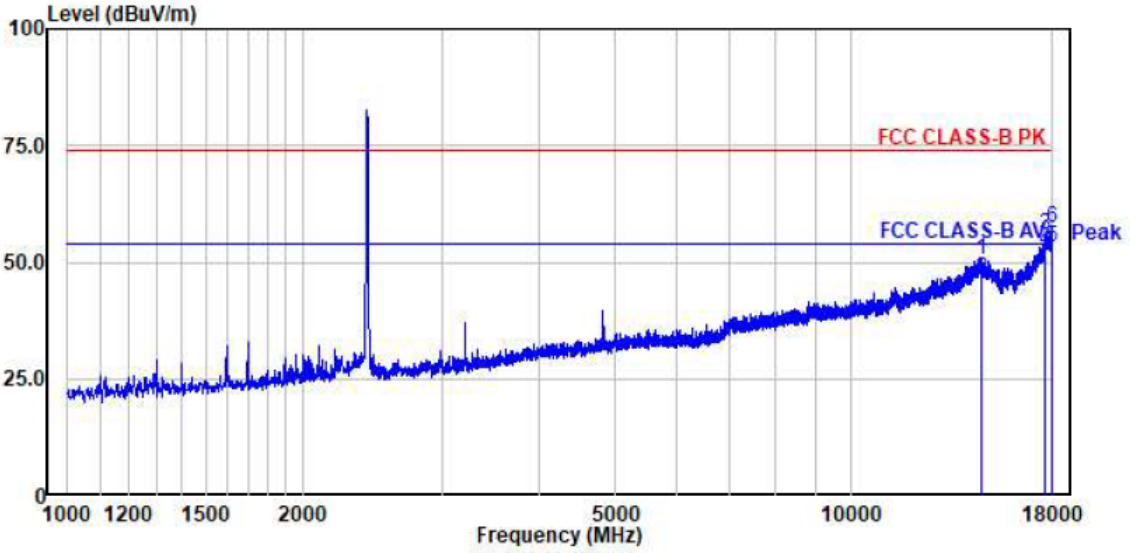
Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

Radiated Emissions (Above 1 GHz) – 802.11 mode



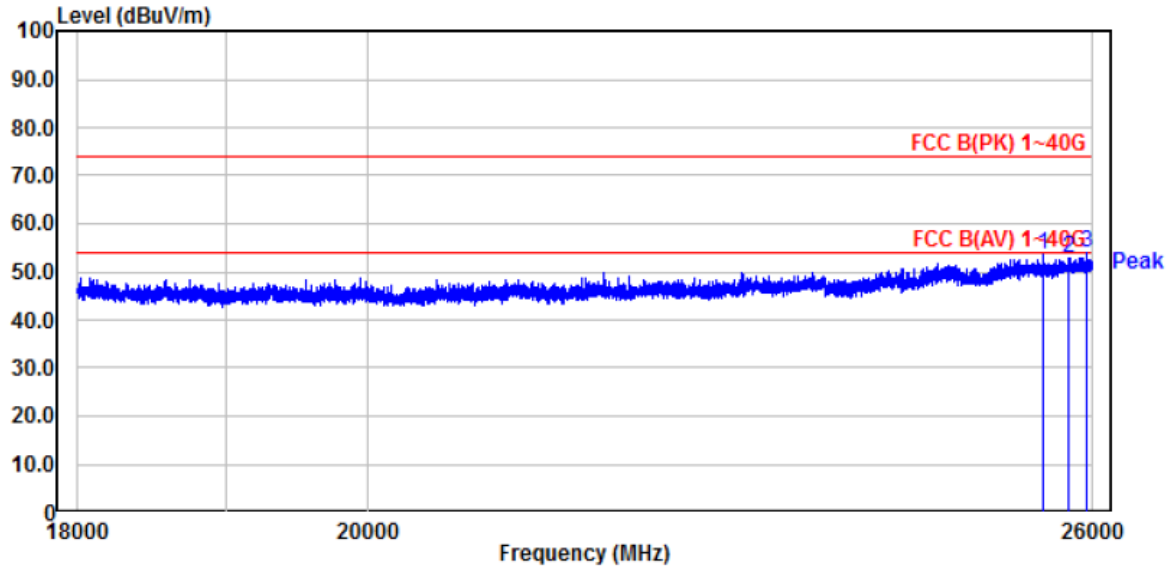
No.	Freq	RD PK	RD AV	C.F	Result PK	Result AV	Limit PK	Limit AV	Margin PK	Margin AV	Height	Angle	Polarity
	MHz	dBµV	dBµV	dB	dBµV	dBµV	dBµV	dBµV	dB	dB	cm	deg	
2.	14642.50	31.57	27.56	19.22	50.79	46.78	74.00	54.00	23.21	7.22	8	14	horizontal
4.	17791.75	31.92	28.22	24.43	56.35	52.65	74.00	54.00	17.65	1.35	86	93	horizontal
6.	17983.00	31.12	27.22	25.61	56.73	52.83	74.00	54.00	17.27	1.17	259	267	horizontal

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain



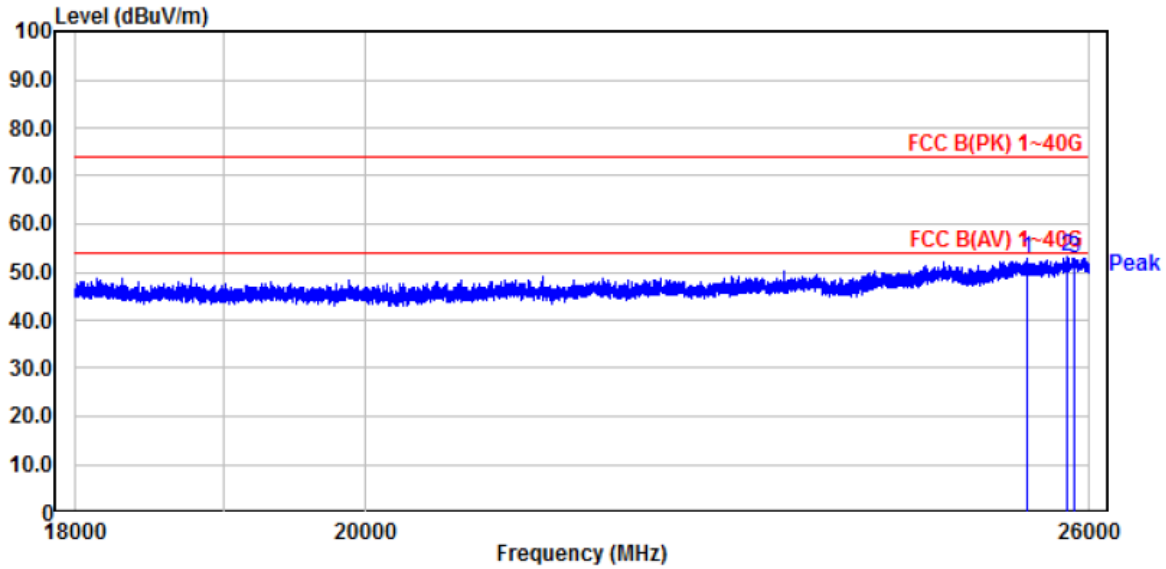
No.	Freq	RD PK	RD AV	C.F	Result PK	Result AV	Limit PK	Limit AV	Margin PK	Margin AV	Height	Angle	Polarity
	MHz	dBµV	dBµV	dB	dBµV	dBµV	dBµV	dBµV	dB	dB	cm	deg	
1.	14670.13	31.55	------	19.14	50.69	------	74.00	------	23.31	------	321	312	vertical
2.	14670.13	------	27.34	19.14	------	46.48	------	54.00	------	7.52	321	312	vertical
3.	17691.88	32.16	------	23.82	55.98	------	74.00	------	18.02	------	350	346	vertical
4.	17691.88	------	28.70	23.82	------	52.52	------	54.00	------	1.48	350	346	vertical
6.	17995.75	31.57	27.60	25.70	57.27	53.30	74.00	54.00	16.73	0.70	335	328	vertical

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain



No.	Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
	MHz	dBµV	dB	dBµV/m	dBµV/m	dB	cm	deg	
1	25538.06	35.35	18.14	53.49	74.00	20.51	100	351	horizontal
2	25781.03	34.55	18.26	52.81	74.00	21.19	100	160	horizontal
3	25959.40	35.76	18.19	53.95	74.00	20.05	100	74	horizontal

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain



No.	Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
	MHz	dBµV	dB	dBµV/m	dBµV/m	dB	cm	deg	
1	25423.28	34.90	17.90	52.80	74.00	21.20	100	360	vertical
2	25804.74	34.81	18.28	53.09	74.00	20.91	100	360	vertical
3	25867.68	34.72	18.22	52.94	74.00	21.06	100	326	vertical

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

3.2.6 AC Conducted Emissions

Procedure:

The conducted emissions are measured in the shielded room with a spectrum analyzer in peak hold. While the measurement, EUT had its hopping function disabled at the middle channels in line with Section 15.31(m). Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation and Exerciser operation. The highest emissions relative to the limit are listed.

Measurement Data: NA

Minimum Standard: FCC Part 15.207(a) / EN 55022

Class B

Frequency Range	quasi-peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

APPENDIX

TEST EQUIPMENT USED FOR TESTS

	Use	Description	Model No.	Serial No.	Manufacturer	Interval	Next Cal. Date
1		Signal Analyzer (9 kHz ~ 30 GHz)	FSV30	100757	R&S	1 year	2022-09-06
2		Signal Generator (~3.2 GHz)	8648C	3623A02597	HP	1 year	2022-03-20
3		SYNTHESIZED CW GENERATOR	83711B	US34490456	HP	1 year	2022-03-20
4		Attenuator (3 dB)	8491A	37822	HP	1 year	2022-09-06
5		Attenuator (10 dB)	8491A	63196	HP	1 year	2022-09-06
6		EMI Test Receiver (~7 GHz)	ESCI7	100722	R&S	1 year	2022-09-06
7		RF Amplifier (~1.3 GHz)	8447D OPT 010	2944A07684	HP	1 year	2022-09-06
8		RF Amplifier (1~26.5 GHz)	8449B	3008A02126	HP	1 year	2022-03-20
9	■	Horn Antenna (1~18 GHz)	3115	00114105	ETS	2 year	2022-09-06
10	■	DRG Horn (Small)	3116B	81109	ETS-Lindgren	2 year	2023-03-20
11		DRG Horn (Small)	3116B	133350	ETS-Lindgren	2 year	2023-03-20
12	■	TRILOG Antenna	VULB 9160	9160-3237	SCHWARZBECK	2 year	2023-03-20
13		Temp.Humidity Data Logger	SK-L200TH II A	00801	SATO	1 year	2022-03-20
14		Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-	-
15	■	DC Power Supply	6674A	3637A01657	Agilent	-	-
17	■	Power Meter	EPM-441A	GB32481702	HP	1 year	2022-03-20
18	■	Power Sensor	8481A	3318A94972	HP	1 year	2022-09-06
19		Audio Analyzer	8903B	3729A18901	HP	1 year	2022-09-06
20		Moduleation Analyzer	8901B	3749A05878	HP	1 year	2022-09-06
21		TEMP & HUMIDITY Chamber	YJ-500	LTAS06041	JinYoung Tech	1 year	2022-09-06
22		Stop Watch	HS-3	812Q08R	CASIO	2 year	2023-03-20
23		LISN	KNW-407	8-1430-1	Kyoritsu	1 year	2022-09-06
24		Two-Lime V-Network	ESH3-Z5	893045/017	R&S	1 year	2022-03-20
25		UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	106243	R&S	1 year	2022-03-20
26		Highpass Filter	WHKX1.5/15G-10SS	74	Wainwright Instruments	1 year	2022-03-20
27		Highpass Filter	WHKX3.0/18G-10SS	118	Wainwright Instruments	1 year	2022-03-20
28		OSP120 BASE UNIT	OSP120	101230	R&S	1 year	2022-03-20
29	■	Signal Generator(100 kHz ~ 40 GHz)	SMB100A03	177621	R&S	1 year	2022-03-20
30	■	Signal Analyzer (10 Hz ~ 40 GHz)	FSV40	101367	R&S	1 year	2022-03-20
31		Active Loop Antenna	FMZB 1519	1519-031	SCHWARZBECK	2 year	2023-03-20