

FCC Part 15.247

TEST REPORT

For

ZHEJIANG JIECANG LINEAR MOTION TECHNOLOGY CO., LTD

No.19 XinTao Road, Provincial High Tech Park, XinChang county, ZheJiang Province,
312500 China

FCC ID: 2ANKDJCB35NH2A

Report Type:
Original Report

Product Type:
control box

Report Producer : Nana Hsu

Nana Hsu

Report Number : RXZ211213002RF01

Report Date : 2022-02-17

Reviewed By: Andy Shih

Andy Shih

Prepared By: Bay Area Compliance Laboratories Corp.

(New Taipei Laboratory)

70, Lane 169, Sec. 2, Datong Road, Xizhi Dist.,
New Taipei City 22183, Taiwan, R.O.C.

Tel: +886 (2) 2647 6898

Fax: +886 (2) 2647 6895

www.bacl.com.tw

Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
0.0	RXZ211213002	RXZ211213002RF01	2022-02-17	Original Report	Nana Hsu

TABLE OF CONTENTS

1	General Information	5
1.1	Product Description for Equipment under Test (EUT)	5
1.2	Objective	6
1.3	Related Submittal(s)/Grant(s).....	6
1.4	Test Methodology.....	6
1.5	Statement of Compliance	6
1.6	Measurement Uncertainty	7
1.7	Environmental Conditions.....	7
1.8	Test Facility	7
2	System Test Configuration.....	8
2.1	Description of Test Configuration.....	8
2.2	Equipment Modifications	8
2.3	EUT Exercise Software	8
2.4	Support Equipment List and Details.....	8
2.5	External Cable List and Details	8
2.6	Test Mode.....	9
2.7	Block Diagram of Test Setup	9
2.8	Duty Cycle.....	10
3	Summary of Test Results.....	11
4	Test Equipment List and Details	12
5	FCC §15.247(i), §1.1310, § 2.1091 - Maximum Permissible Exposure (MPE).....	14
5.1	Applicable Standard	14
5.2	RF Exposure Evaluation Result.....	14
6	FCC §15.203 – Antenna Requirements.....	15
6.1	Applicable Standard	15
6.2	Antenna Information	15
7	FCC §15.207(a) – AC Line Conducted Emissions	16
7.1	Applicable Standard.....	16
7.2	EUT Setup	16
7.3	EMI Test Receiver Setup	17
7.4	Test Procedure.....	17
7.5	Corrected Factor & Margin Calculation	17
7.6	Test Results	18
8	FCC §15.209, §15.205 , §15.247(d) – Spurious Emissions	20
8.1	Applicable Standard.....	20
8.2	EUT Setup	21
8.3	EMI Test Receiver & Spectrum Analyzer Setup.....	22
8.4	Test Procedure	22
8.5	Corrected Factor & Margin Calculation	22
8.6	Test Results	23
9	FCC §15.247(a)(2) – 6 dB Emission Bandwidth.....	30
9.1	Applicable Standard.....	30
9.2	Test Procedure.....	30
9.3	Test Results	30

10	FCC §15.247(b)(3) – Maximum Output Power	33
10.1	Applicable Standard.....	33
10.2	Test Procedure	33
10.3	Test Results	33
11	FCC§15.247(d) – 100 kHz Bandwidth of Frequency Band Edge	34
11.1	Applicable Standard.....	34
11.2	Test Procedure	34
11.3	Test Results	34
12	FCC §15.247(e) – Power Spectral Density	36
12.1	Applicable Standard.....	36
12.2	Test Procedure	36
12.3	Test Results	36

1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	ZHEJIANG JIECANG LINEAR MOTION TECHNOLOGY CO., LTD
	No.19 XinTao Road, Provincial High Tech Park, XinChang county,ZheJiang Province, 312500 China
Manufacturer	ZHEJIANG JIECANG LINEAR MOTION TECHNOLOGY CO., LTD
	No.19 XinTao Road, Provincial High Tech Park, XinChang county,ZheJiang Province, 312500 China
Brand(Trade) Name	N/A
Product (Equipment)	control box
Main Model Name	JCB35NH2A
Frequency Range	BLE Mode: 2402 ~ 2480 MHz
Transmit Power	BLE Mode: 1.78 dBm
Modulation Technique	BLE Mode: GFSK
Transmit Data Rate	BLE Mode: 1 Mbps
Power Operation (Voltage Range)	☒ AC 120V/60Hz ☐ Adapter I/P: ☒ By AC Power Cord ☐ PoE
	☐ DC Type ☐ Battery ☐ DC Power Supply ☐ External from USB Cable ☐ External DC Adapter
	☐ Host System
Received Date	Dec. 14, 2021
Date of Test	Dec. 26, 2021~ Jan. 3, 2022

*All measurement and test data in this report was gathered from production sample serial number: RXZ211213002-01 (Assigned by BACL, New Taipei Laboratory).

1.2 Objective

This report is prepared on behalf of ZHEJIANG JIECANG LINEAR MOTION TECHNOLOGY CO., LTD in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's rules.

1.3 Related Submittal(s)/Grant(s)

N/A.

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

KDB 558074 D01 15.247 Meas Guidance v05r02

1.5 Statement of Compliance

Decision Rule: No, (The test results do not include MU judgment)

It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory).

Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

The determination of the test results does not require consideration of the uncertainty of the measurement, unless the assessment is required by customer agreement, regulation or standard document specification.

Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is not responsible for the authenticity of the information provided by the applicant that affects the test results.

1.6 Measurement Uncertainty

Parameter		Uncertainty
AC Mains		+/- 2.36 dB
RF output power, conducted		+/- 0.93 dB
Power Spectral Density, conducted		+/- 0.93 dBm
Occupied Bandwidth		+/- 0.35 MHz
Unwanted Emissions, conducted		+/- 1.69 dBm
Emissions, radiated	30 MHz~1GHz	+/- 5.22 dB
	1 GHz~18 GHz	+/- 6.12 dB
	18 GHz~40 GHz	+/- 4.99 dB
Temperature		+/- 1.27 °C
Humidity		+/- 3 %

1.7 Environmental Conditions

Test Site	Test Data	Temperature (°C)	Relative Humidity (%)	ATM Pressure (hPa)	Test Engineer
AC Line Conducted Emissions	2022/1/3	18.9	56	1010	Howard
Radiation Spurious Emissions	2022/1/3	18.6	74	1010	David
Conducted Spurious Emissions	2021/12/26	20.3	63	1010	Howard
6 dB Emission Bandwidth	2021/12/26	20.3	63	1010	Howard
Occupied bandwidth	2021/12/26	20.3	63	1010	Howard
Maximum Output Power	2021/12/26	20.3	63	1010	Howard
100 kHz Bandwidth of Frequency Band Edge	2021/12/26	20.3	63	1010	Howard
Power Spectral Density	2021/12/26	20.3	63	1010	Howard

1.8 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) to collect test data is located on

☒ 70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3732) and the FCC designation No.TW3732 under the Mutual Recognition Agreement (MRA) in FCC Test.

2 System Test Configuration

2.1 Description of Test Configuration

For BLE mode, there are totally 40 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	--	--
2	2406	--	--
3	2408	37	2476
--	--	38	2478
19	2440	39	2480

For BLE Modes were tested with channel 0, 19 and 39.

The system was configured for testing in engineering mode, which was provided by manufacturer.

2.2 Equipment Modifications

No modification was made to the EUT.

2.3 EUT Exercise Software

The test software was used “Broadcom Bluetool V1.4.5.4”

Test Frequency		Low	Mid	High
Power Level Setting	BLE 1M	Default	Default	Default

2.4 Support Equipment List and Details

Description	Manufacturer	Model Number	S/N
NB	DELL	E6410	8N7PXN1
fixture	N/A	N/A	N/A
DC Motor	OKIN Refined	JLDQ-10	N/A

2.5 External Cable List and Details

Cable Description	Length (m)	From	To
Type-B USB Cable	1.5	Fixture	NB
RJ11-Cable	3	EUT	NB
RJ45-Cable	2	EUT	NB
4-PIN Control Cable	8	EUT	DC Motor
6-PIN Control Cable*2	8	EUT	DC Motor

2.6 Test Mode

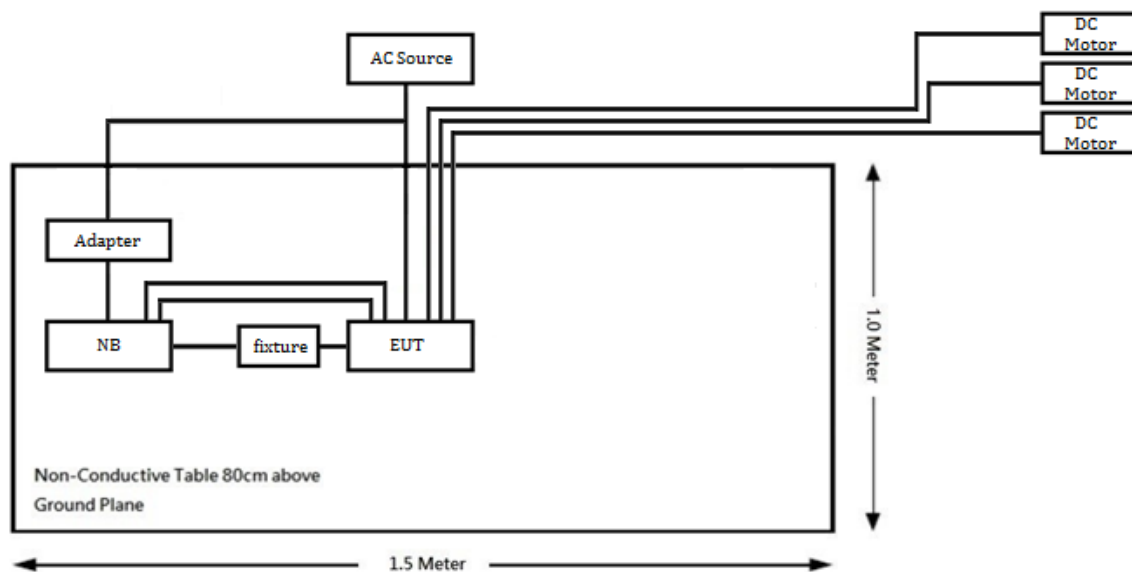
Full System (model: control box) for all test item.

2.7 Block Diagram of Test Setup

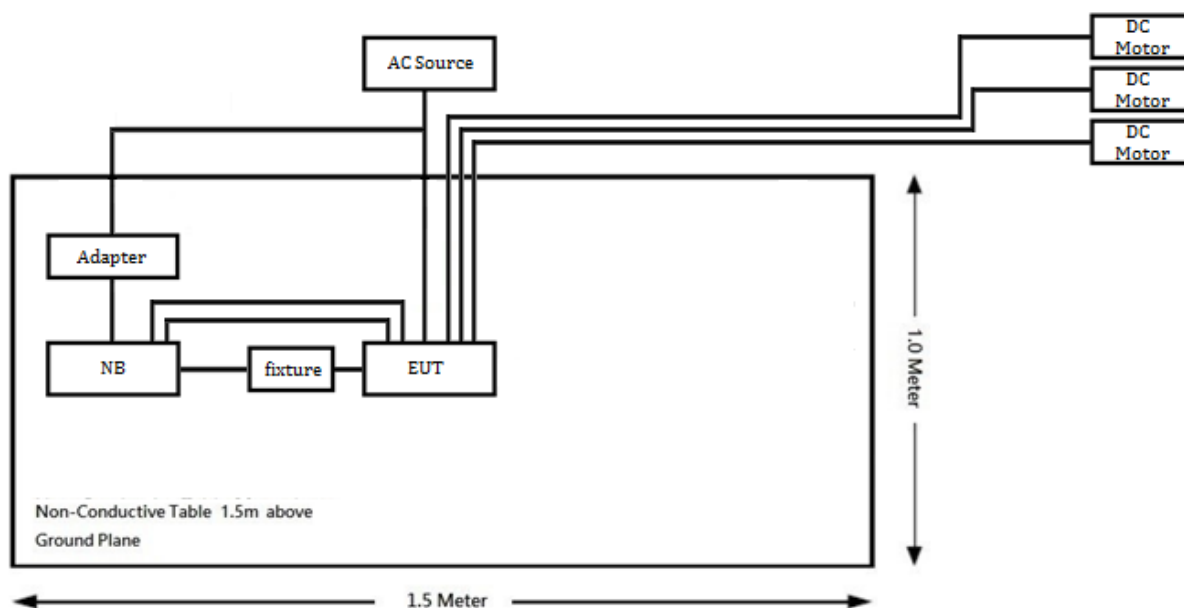
See test photographs attached in setup photos for the actual connections between EUT and support equipment.

Radiation:

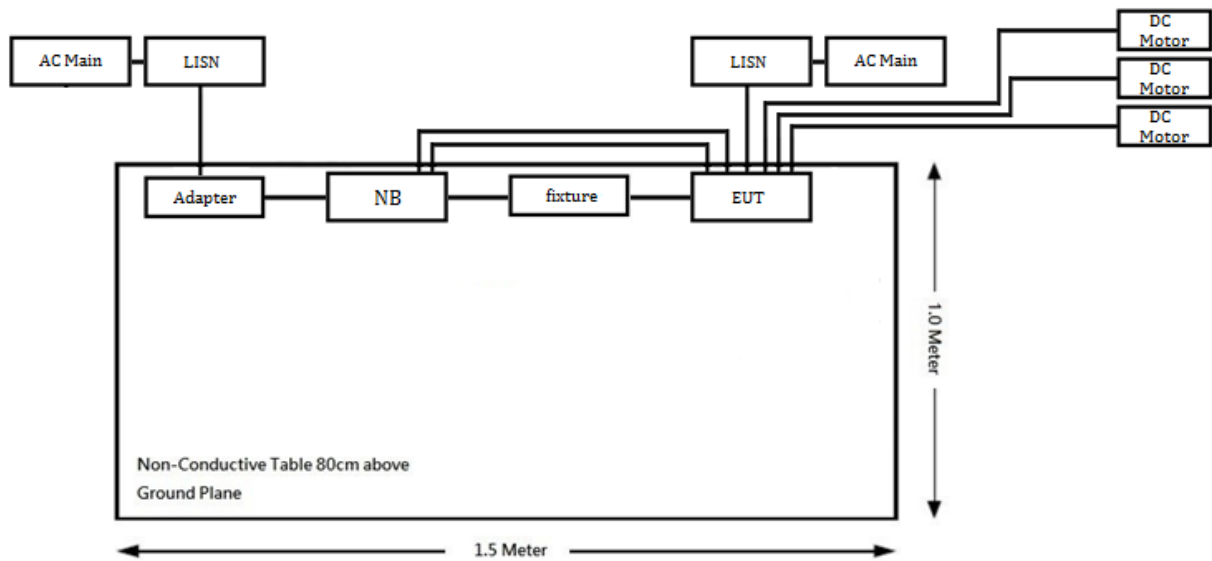
Below 1GHz:



Above 1GHz:



Conduction:



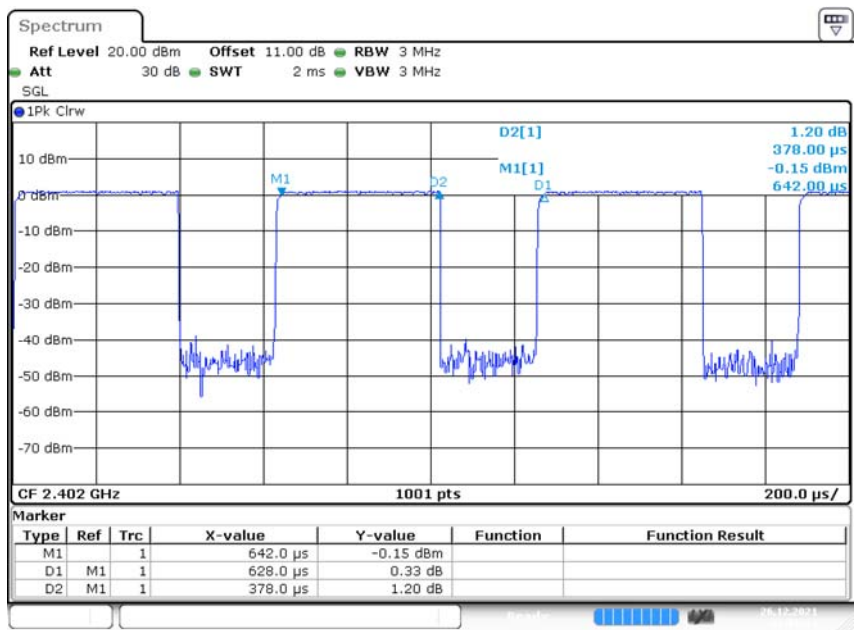
2.8 Duty Cycle

The duty cycle as below:

Radio Mode	Ton (ms)	Ton+Toff (ms)	Duty Cycle (%)
BLE	0.378	0.628	60

Please refer to the following plots.

BLE Mode



Date: 26.DEC.2021 11:06:15

3 Summary of Test Results

FCC Rules	Description of Test	Results
§15.247(i), §1.1310, §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247(a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Peak Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

4 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conduction Room (CON-A)					
LISN	Rohde & Schwarz	ENV216	101248	2021/06/08	2022/06/07
EMI Test Receiver	Rohde & Schwarz	ESW8	100947	2021/7/23	2022/7/22
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2021/7/29	2022/7/28
RF Cable	EMEC	EM-CB5D	1	2021/6/11	2022/6/10
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R
Radiated Room (966-A)					
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/15542_01	2021/1/19	2022/1/18
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2021/11/9	2022/11/8
Horn Antenna	EMCO	SAS-571	1020	2021/4/23	2022/4/22
Horn Antenna	ETS-Lindgren	3116	62638	2021/8/11	2022/8/10
Preamplifier	Sonoma	310N	130602	2021/6/8	2022/6/7
Preamplifier	A.H. system Inc.	PAM-0118P	470	2021/3/15	2022/3/14
Microwave Preamplifier	EM Electronics Corporation	EM18G40G	60656	2021/12/22	2022/12/21
Spectrum Analyzer	Rohde & Schwarz	FSV40	101435	2021/1/7	2022/1/6
Micro flex Cable	UTIFLEX	UFB197C-1-2362-70U-70U	225757-001	2021/2/1	2022/1/31
Coaxial Cable	COMMATE	PEWC	8Dr	2021/12/19	2022/12/18
Coaxial Cable	UTIFLEX	UFB311A-Q-1440-300300	220490-006	2021/2/1	2022/1/31
Coaxial Cable	JUNFLON	J12J102248-00-B-5	AUG-07-15-044	2021/12/19	2022/12/18
Cable	EMC	EMC105-SM-SM-10000	201003	2021/2/3	2022/2/2
Coaxial Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2021/2/1	2022/1/31
Coaxial Cable	ROSNOL	K1K50-UP0264-K1K50-50CM	15120-1	2021/1/28	2022/1/27

Note: It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (New Taipei Laboratory)

Software	Farad	EZ EMC	BACL-03A1	N.C.R	N.C.R
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2021/1/7	2022/1/6
Cable	UTIFLEX	UFA210A	9435	2021/10/5	2022/10/4
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2021/1/28	2022/1/27
Attenuator	MINI-CIRCUITS	BW-S10W5+	1419	2021/1/28	2022/1/27

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements.

5 FCC §15.247(i), §1.1310, § 2.1091 - Maximum Permissible Exposure (MPE)

5.1 Applicable Standard

According to subpart 15.247(i) and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

5.2 RF Exposure Evaluation Result

MPE evaluation:

Mode	Frequency Range (MHz)	Antenna Gain		Target Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	2.00	1.585	1.8	1.514	20	0.0005	1

Result: MPE evaluation meet **20cm** the requirement of standard.

6 FCC §15.203 – Antenna Requirements

6.1 Applicable Standard

According to § 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 provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna does not exceed 6dBi.

6.2 Antenna Information

Manufacturer	Model	Type	Antenna Gain
Walsin Technology Corporation	RFANT5220110A0T	Chip	2 dBi

Result: Compliance

7.3 EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150kHz to 30MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations

Frequency Range	IF B/W
150kHz – 30MHz	9kHz

7.4 Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

7.5 Corrected Factor & Margin Calculation

The factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

The “Over Limit” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over limit of -7 dB means the emission is 7 dB below the limit. The equation for Over Limit calculation is as follows:

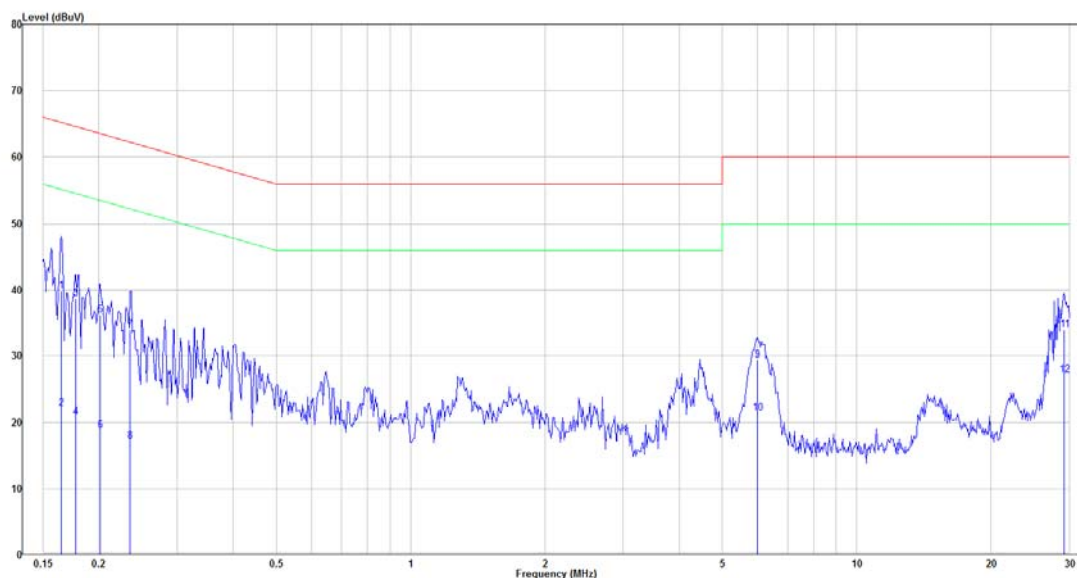
$$\text{Over Limit} = \text{Level} - \text{Limit Line}$$

7.6 Test Results

Test Mode: Transmitting

(Worst case is BLE (1M) mode, High Channel)

Main: AC120 V, 60 Hz, Line



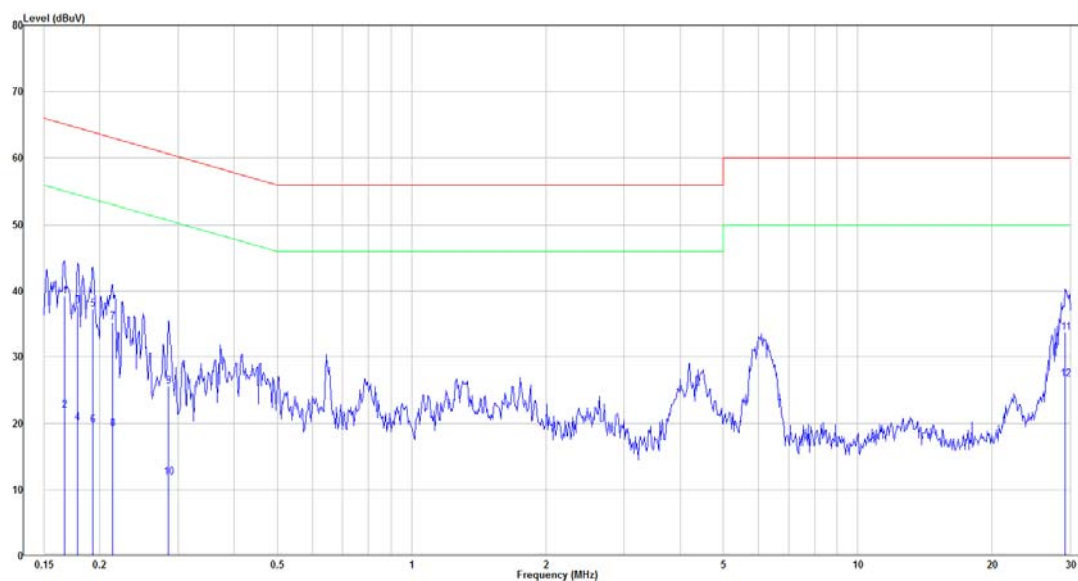
No.	Frequency (MHz)	Reading (dBμV)	Correct Factor(dB)	Result (dBμV)	Limit (dBμV)	Over limit (dB)	Remark
1	0.165	20.29	19.57	39.86	65.21	-25.35	QP
2	0.165	2.51	19.57	22.08	55.21	-33.13	Average
3	0.178	19.01	19.57	38.58	64.59	-26.01	QP
4	0.178	1.19	19.57	20.76	54.59	-33.83	Average
5	0.202	16.60	19.56	36.16	63.54	-27.38	QP
6	0.202	-0.80	19.56	18.76	53.54	-34.78	Average
7	0.235	14.33	19.56	33.89	62.26	-28.37	QP
8	0.235	-2.49	19.56	17.07	52.26	-35.19	Average
9	5.993	9.56	19.72	29.28	60.00	-30.72	QP
10	5.993	1.58	19.72	21.30	50.00	-28.70	Average
11	29.216	14.00	19.92	33.92	60.00	-26.08	QP
12	29.216	7.23	19.92	27.15	50.00	-22.85	Average

Note:

Level = Read Level + Factor

Over Limit = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

Main: AC120 V, 60 Hz, Neutral

No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark
	(MHz)	(dBμV)	Factor(dB)	(dBμV)	(dBμV)	(dB)	
1	0.167	19.59	19.55	39.14	65.12	-25.98	QP
2	0.167	2.37	19.55	21.92	55.12	-33.20	Average
3	0.179	18.07	19.55	37.62	64.55	-26.93	QP
4	0.179	0.54	19.55	20.09	54.55	-34.46	Average
5	0.193	17.61	19.54	37.15	63.89	-26.74	QP
6	0.193	0.12	19.54	19.66	53.89	-34.23	Average
7	0.214	15.59	19.54	35.13	63.05	-27.92	QP
8	0.214	-0.39	19.54	19.15	53.05	-33.90	Average
9	0.285	6.03	19.54	25.57	60.68	-35.11	QP
10	0.285	-7.72	19.54	11.82	50.68	-38.86	Average
11	29.216	13.66	20.02	33.68	60.00	-26.32	QP
12	29.216	6.54	20.02	26.56	50.00	-23.44	Average

Note:

Level = Read Level + Factor

Over Limit = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

8 FCC §15.209, §15.205 , §15.247(d) – Spurious Emissions

8.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1MHz.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	608 – 614	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	960 – 1240	5. 35 – 5. 46
2.1735 – 2.1905	16.80425 – 16.80475	1300 – 1427	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1435 – 1626.5	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1645.5 – 1646.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1660 – 1710	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1718.8 – 1722.2	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	2200 – 2300	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2310 – 2390	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2483.5 – 2500	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2690 – 2900	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	3260 – 3267	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3.332 – 3.339	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3 3458 – 3 358	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3.600 – 4.400	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4		Above 38.6
13.36 – 13.41	399.9 – 410		

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

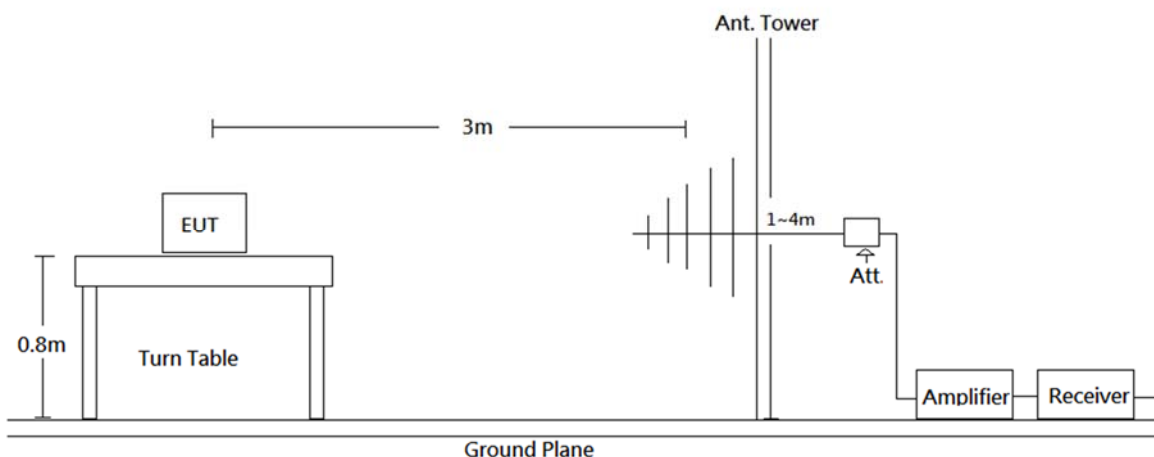
Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (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 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

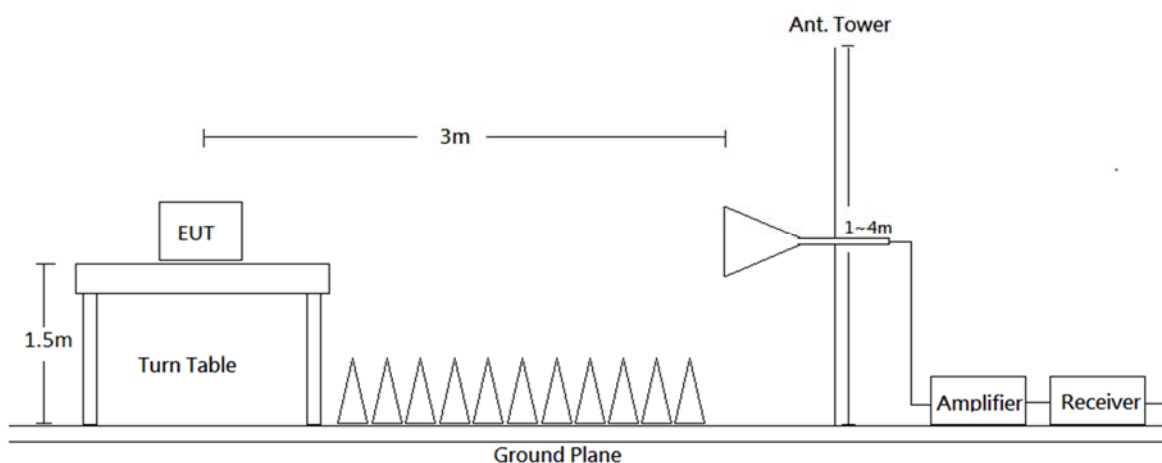
As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the 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 emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

8.2 EUT Setup

Below 1 GHz:



Above 1 GHz:



Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC Part 15.209 and FCC 15.247 Limits.

8.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Frequency Range	RBW	VBW	Duty cycle	Measurement method
30-1000 MHz	120 kHz	/	/	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	>98%	Ave
	1 MHz	1/T	<98%	Ave

Note: T is minimum transmission duration

8.4 Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

8.5 Corrected Factor & Margin Calculation

The Correct Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Correct Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Result} - \text{Limit}$$

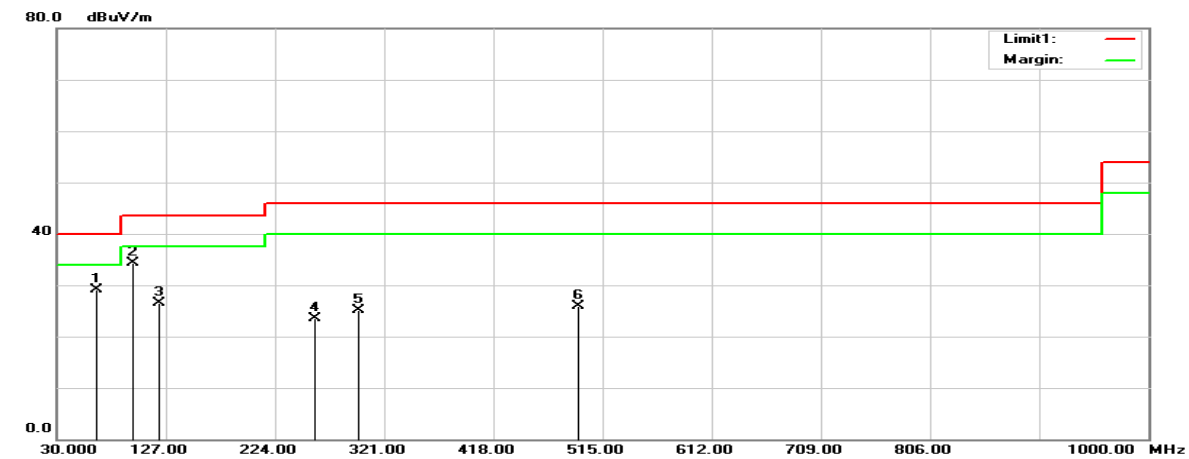
8.6 Test Results

Test Mode: Transmitting

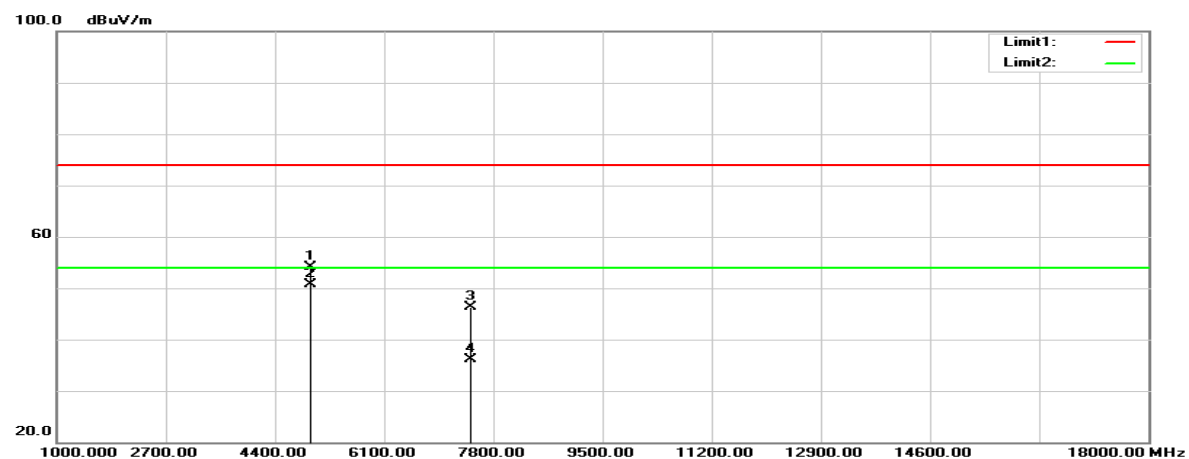
BLE Mode (Pre-scan with three orthogonal axis, and worse case as Z axis.)

Horizontal (worst case is BLE mode high channel)

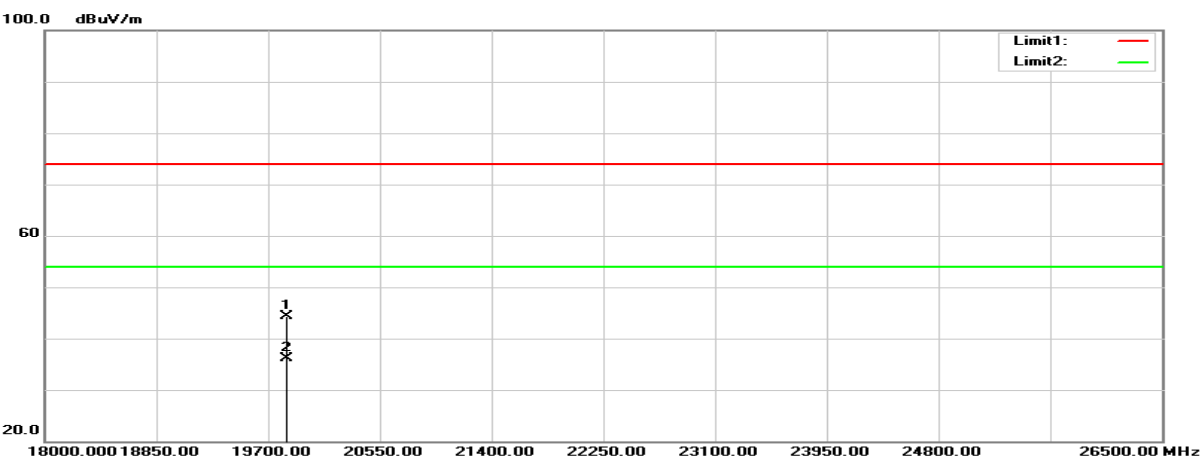
30MHz-1GHz:



1GHz-18GHz:

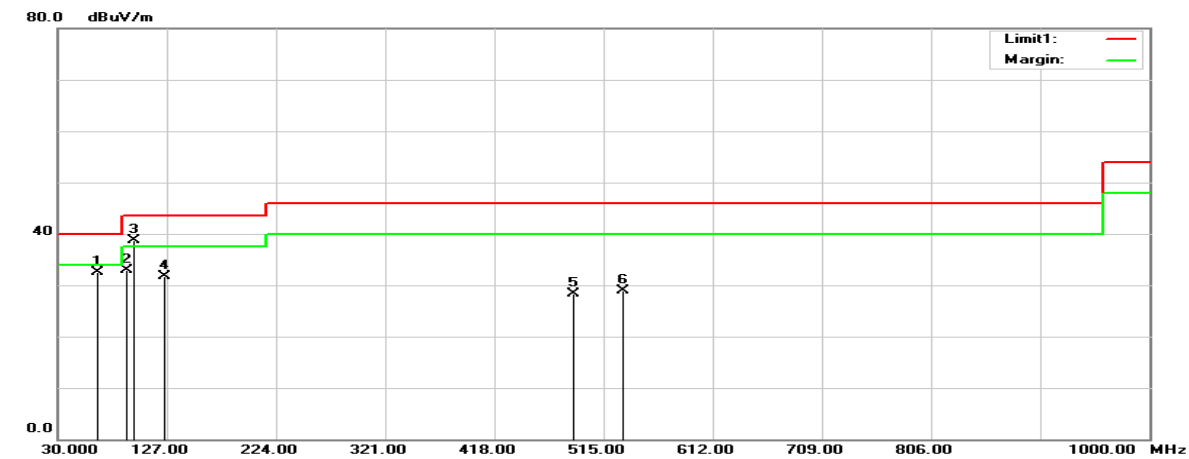


18GHz-26.5GHz:

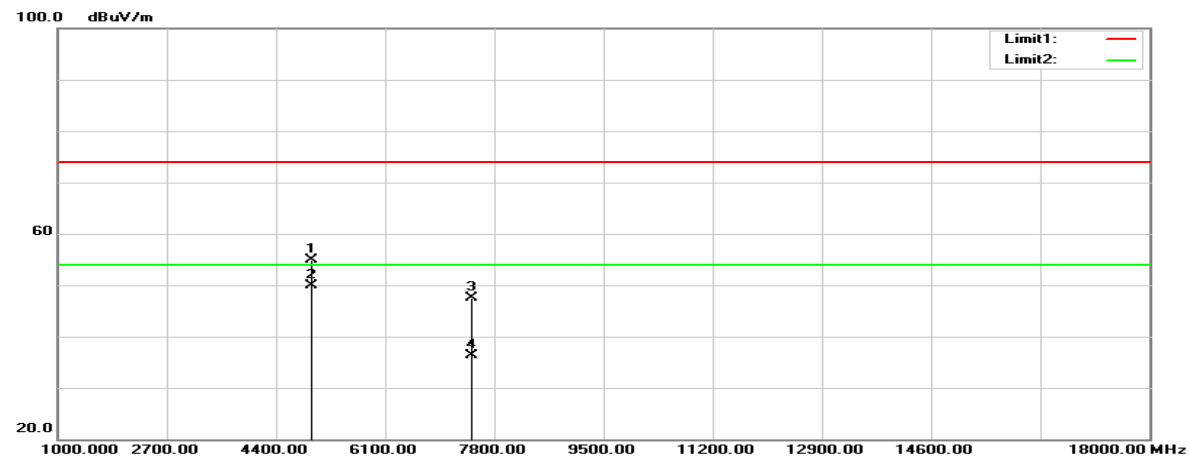


Vertical (worst case is BLE mode high channel)

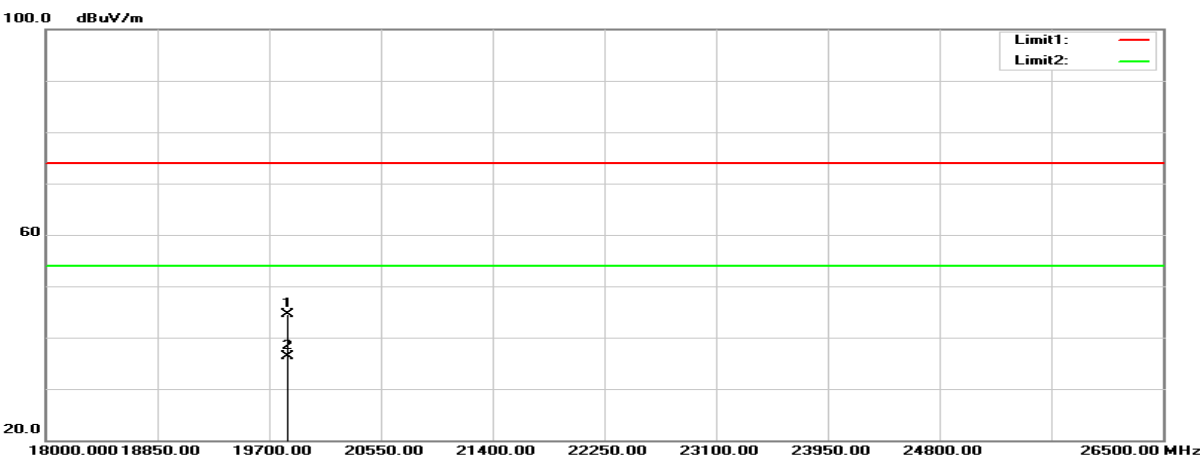
30MHz-1GHz:



1GHz-18GHz:



18GHz-26.5GHz:



Below 1GHz**Horizontal**

Frequency	Reading	Correct	Result	Limit	Margin	Height	Degree	Remark
(MHz)	(dBμV)	Factor(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	(cm)	(°)	
65.8900	45.87	-16.75	29.12	40.00	-10.88	100	185	peak
97.9000	49.08	-14.71	34.37	43.50	-9.13	100	95	peak
121.1800	36.68	-10.21	26.47	43.50	-17.03	100	41	peak
258.9200	35.28	-11.80	23.48	46.00	-22.52	100	354	peak
298.6900	35.20	-10.09	25.11	46.00	-20.89	100	15	peak
493.6600	31.63	-5.74	25.89	46.00	-20.11	100	111	peak

Vertical

Frequency	Reading	Correct	Result	Limit	Margin	Height	Degree	Remark
(MHz)	(dBμV)	Factor(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	(cm)	(°)	
65.8900	49.29	-16.75	32.54	40.00	-7.46	100	154	peak
91.1100	49.41	-16.49	32.92	43.50	-10.58	100	95	peak
97.9000	53.35	-14.71	38.64	43.50	-4.86	100	158	peak
125.0600	41.92	-10.17	31.75	43.50	-11.75	100	15	peak
487.8400	34.07	-5.83	28.24	46.00	-17.76	100	36	peak
532.4600	34.59	-5.64	28.95	46.00	-17.05	100	247	peak

Result = Reading + Correct Factor

Margin = Result – Limit

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

Spurious emissions more than 20 dB below the limit were not reported.

Above 1GHz**Horizontal**

Frequency	Reading	Correct	Result	Limit	Margin	Height	Degree	Remark
(MHz)	(dBμV)	Factor(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	(cm)	(°)	
Low channel								
2376.600	56.34	-9.57	46.77	74.00	-27.23	188	185	peak
2376.600	44.13	-9.57	34.56	54.00	-19.44	188	185	AVG
4804.000	57.12	-2.17	54.95	74.00	-19.05	159	40	peak
4804.000	50.30	-2.17	48.13	54.00	-5.87	159	40	AVG
7206.000	41.81	4.18	45.99	74.00	-28.01	150	254	peak
7206.000	30.38	4.18	34.56	54.00	-19.44	150	254	AVG
19216.000	43.60	0.00	43.60	74.00	-30.40	149	322	peak
19216.000	35.28	0.00	35.28	74.00	-38.72	149	322	peak
Middle channel								
4880.000	56.09	-1.88	54.21	74.00	-19.79	188	119	peak
4880.000	51.61	-1.88	49.73	54.00	-4.27	188	119	AVG
7320.000	42.81	5.10	47.91	74.00	-26.09	154	77	peak
7320.000	30.74	5.10	35.84	54.00	-18.16	154	77	AVG
19520.000	44.93	0.00	44.93	74.00	-29.07	145	232	peak
19520.000	36.03	0.00	36.03	54.00	-17.97	145	232	AVG
High channel								
2489.680	56.03	-8.36	47.67	74.00	-26.33	189	177	peak
2489.680	43.66	-8.36	35.30	54.00	-18.70	189	177	AVG
4960.000	55.63	-1.49	54.14	74.00	-19.86	159	117	peak
4960.000	52.11	-1.49	50.62	54.00	-3.38	159	117	AVG
7440.000	41.03	5.23	46.26	74.00	-27.74	151	168	peak
7440.000	30.88	5.23	36.11	54.00	-17.89	151	168	AVG
19840.000	44.31	0.00	44.31	74.00	-29.69	150	241	peak
19840.000	36.13	0.00	36.13	54.00	-17.87	150	241	AVG

Result = Reading + Correct Factor

Margin = Result – Limit

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency	Reading	Correct	Result	Limit	Margin	Height	Degree	Remark
(MHz)	(dBμV)	Factor(dB/m)	(dBμV/m)	(dBμV/m)	(dB)	(cm)	(°)	
Low channel								
2385.400	57.13	-9.50	47.63	74.00	-26.37	200	21	peak
2385.400	44.08	-9.50	34.58	54.00	-19.42	200	21	AVG
4804.000	54.46	-2.17	52.29	74.00	-21.71	164	259	peak
4804.000	50.12	-2.17	47.95	54.00	-6.05	164	259	AVG
7206.000	43.08	4.18	47.26	74.00	-26.74	150	77	peak
7206.000	30.33	4.18	34.51	54.00	-19.49	150	77	AVG
19216.000	43.92	0.00	43.92	74.00	-30.08	152	283	peak
19216.000	36.42	0.00	36.42	54.00	-17.58	152	283	AVG
Middle channel								
4880.000	54.85	-1.88	52.97	74.00	-21.03	164	134	peak
4880.000	50.29	-1.88	48.41	54.00	-5.59	164	134	AVG
7320.000	43.64	5.10	48.74	74.00	-25.26	157	84	peak
7320.000	30.71	5.10	35.81	54.00	-18.19	157	84	AVG
19520.000	44.70	0.00	44.70	74.00	-29.30	155	299	peak
19520.000	36.52	0.00	36.52	54.00	-17.48	155	299	AVG
High channel								
2486.650	56.14	-8.40	47.74	74.00	-26.26	211	30	peak
2486.650	43.93	-8.40	35.53	54.00	-18.47	211	30	AVG
4960.000	56.43	-1.49	54.94	74.00	-19.06	164	135	peak
4960.000	51.44	-1.49	49.95	54.00	-4.05	164	135	AVG
7440.000	42.19	5.23	47.42	74.00	-26.58	155	47	peak
7440.000	31.08	5.23	36.31	54.00	-17.69	155	47	AVG
19840.000	44.54	0.00	44.54	74.00	-29.46	143	225	peak
19840.000	36.40	0.00	36.40	54.00	-17.60	143	225	AVG

Result = Reading + Correct Factor

Margin = Result – Limit

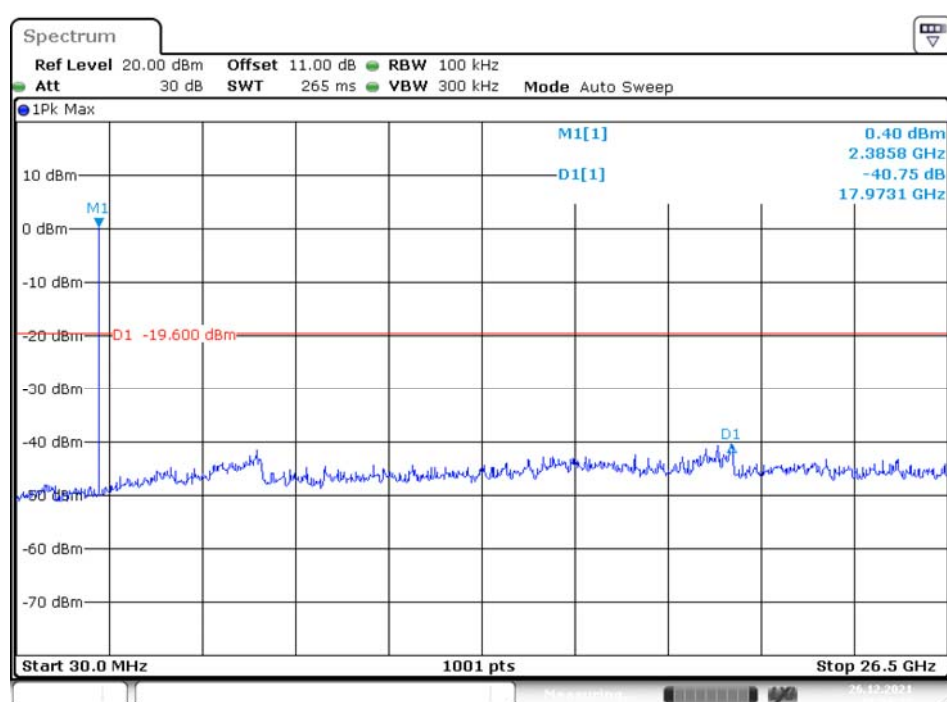
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

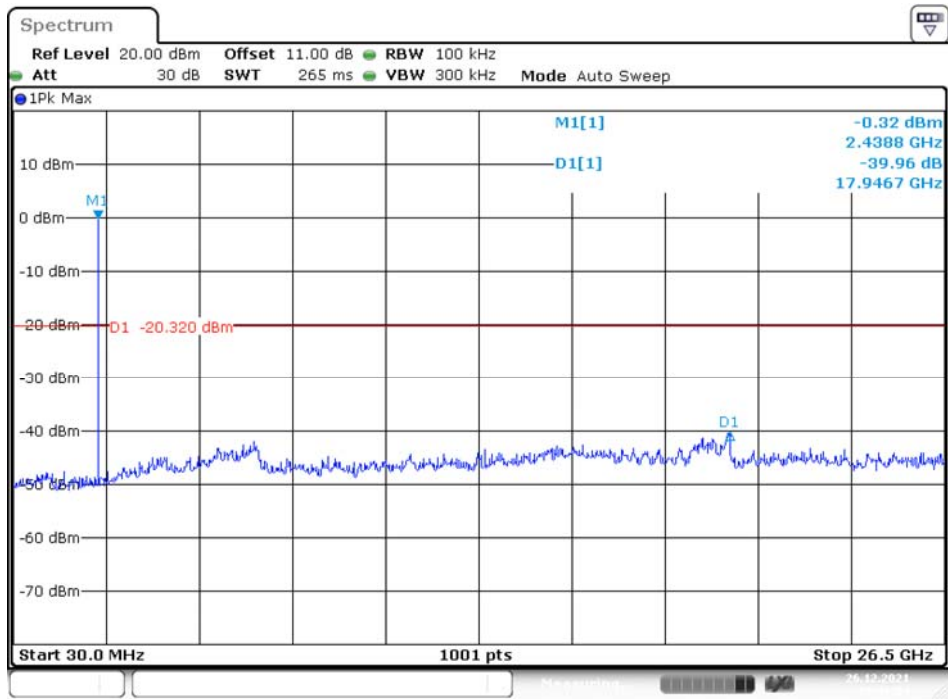
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
Low	2402	40.75	≥ 20	PASS
Middle	2440	39.96	≥ 20	PASS
High	2480	39.68	≥ 20	PASS

BLE Mode
Low Channel



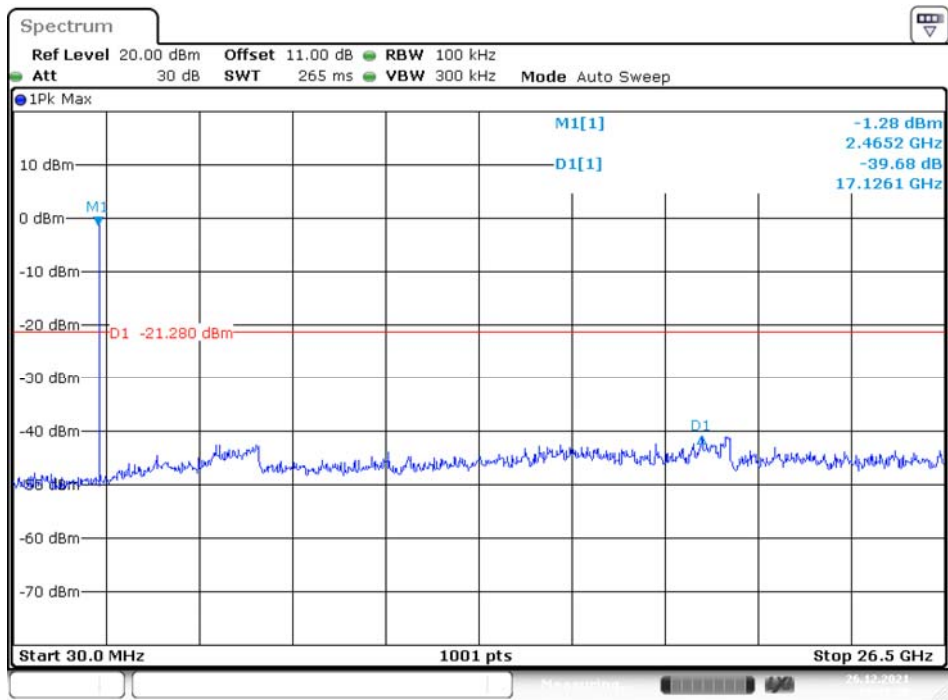
Date: 26.DEC.2021 10:36:18

Middle Channel



Date: 26.DEC.2021 10:46:54

High Channel



Date: 26.DEC.2021 10:48:39

9 FCC §15.247(a)(2) – 6 dB Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a)(2).

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

9.2 Test Procedure

The steps for the first option are as follows:

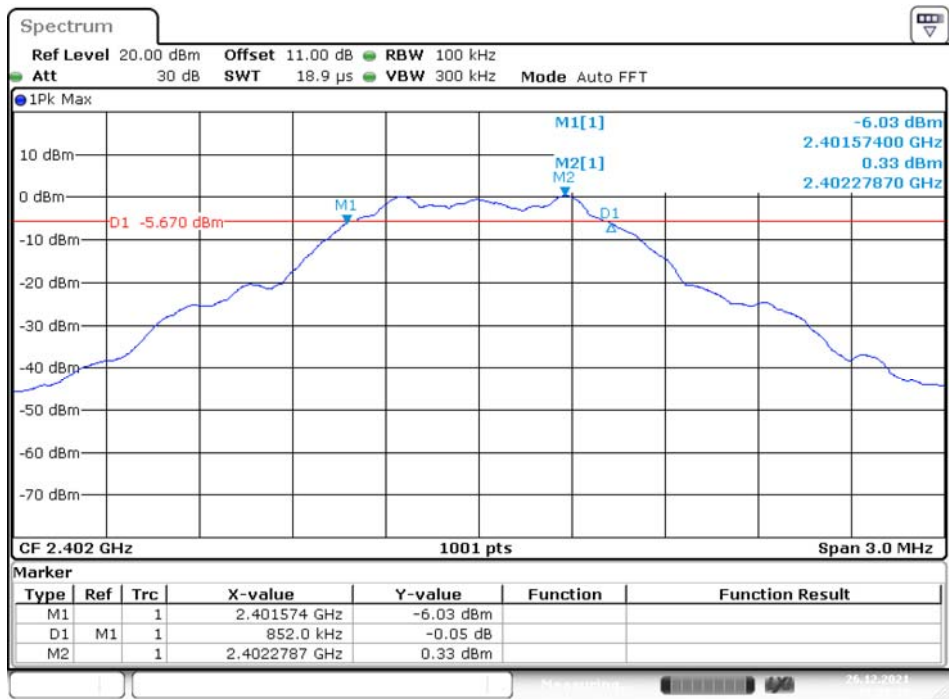
- a) Set RBW = 100 kHz.
- b) Set the VBW $\geq [3 \times \text{RBW}]$.
- c) Detector = peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

9.3 Test Results

Channel	Frequency (MHz)	6 dB Emission Bandwidth (kHz)	Limit (kHz)	Result
Low	2402	852	> 500	Pass
Middle	2440	846	> 500	Pass
High	2480	843	> 500	Pass

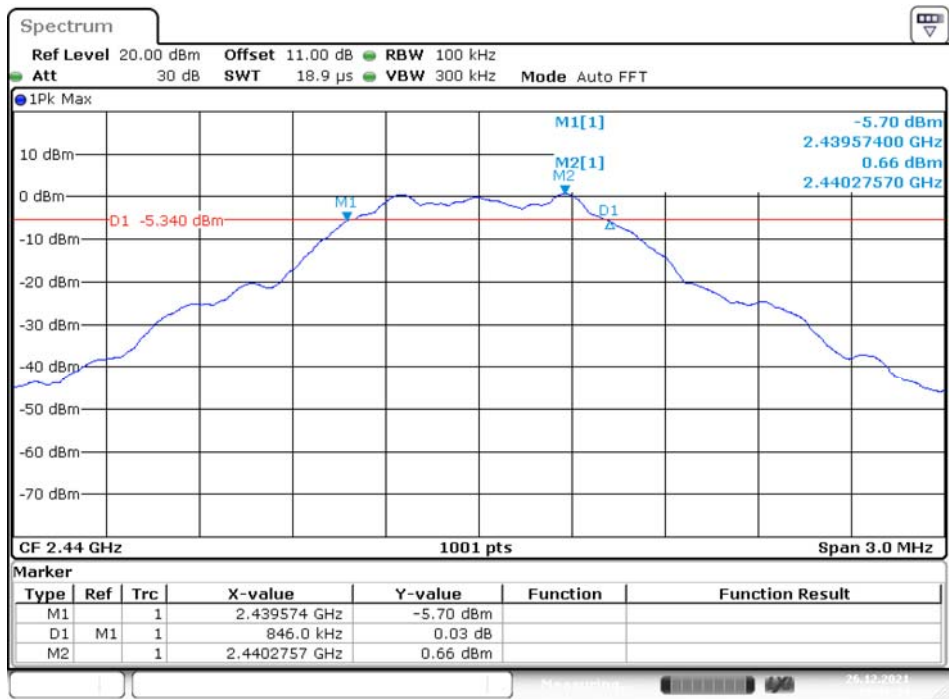
Please refer to the following plots

BLE Mode
Low Channel



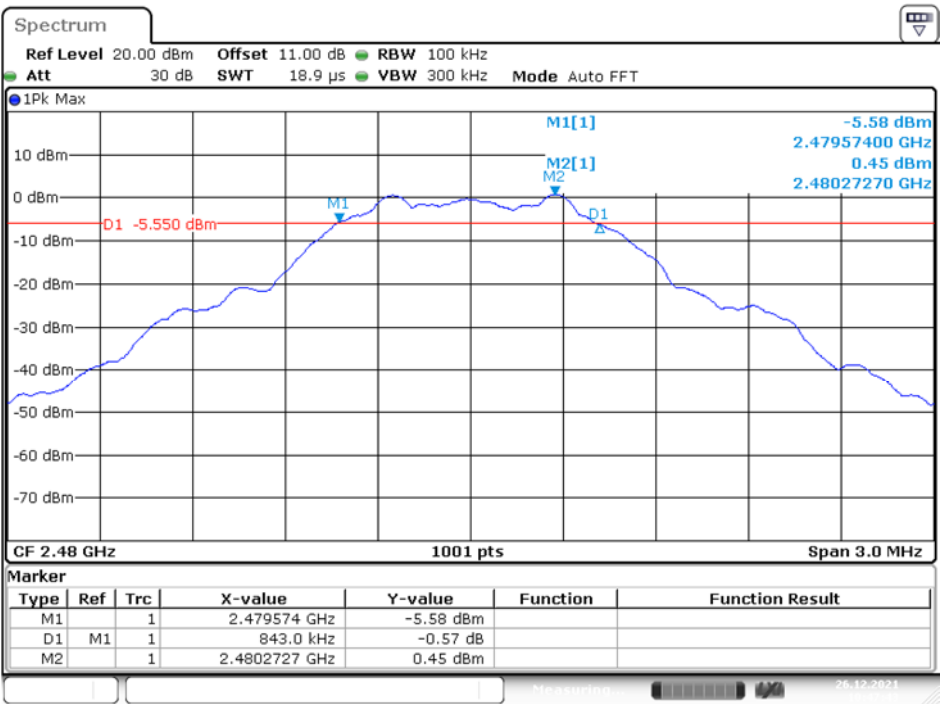
Date: 26.DEC.2021 10:35:19

Middle Channel



Date: 26.DEC.2021 10:46:14

High Channel



Date: 26.DEC.2021 10:47:43

10 FCC §15.247(b)(3) – Maximum Output Power

10.1 Applicable Standard

According to FCC §15.247(b) (3).

Systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

10.2 Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to measuring equipment.

10.3 Test Results

Conducted Peak Output Power

Channel	Frequency (MHz)	Power (dBm)	Power (W)	Limit (W)	Result
BLE Mode					
Low	2402	1.25	0.0013	1	PASS
Middle	2440	1.64	0.0015	1	PASS
High	2480	1.78	0.0015	1	PASS

11 FCC§15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

11.1 Applicable Standard

According to FCC §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 emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

11.2 Test Procedure

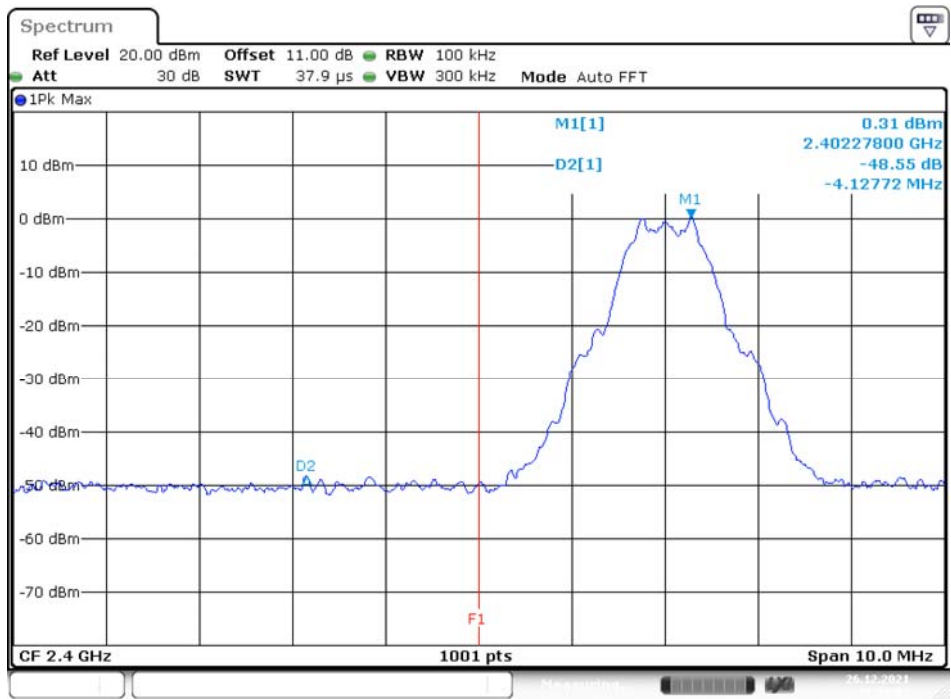
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

11.3 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
Low	2402	48.55	≥ 20	PASS
High	2480	48.82	≥ 20	PASS

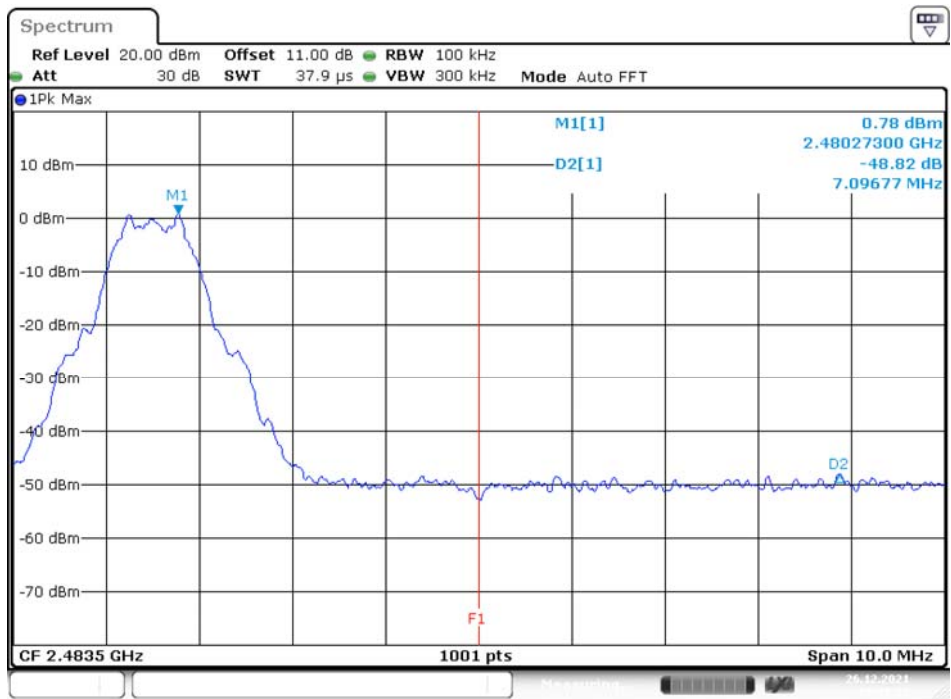
Please refer to the following plots

BLE Mode
Band Edge, Left Side



Date: 26.DEC.2021 10:36:02

Band Edge, Right Side



Date: 26.DEC.2021 10:48:23

12 FCC §15.247(e) – Power Spectral Density

12.1 Applicable Standard

According to FCC §15.247(e).

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

12.2 Test Procedure

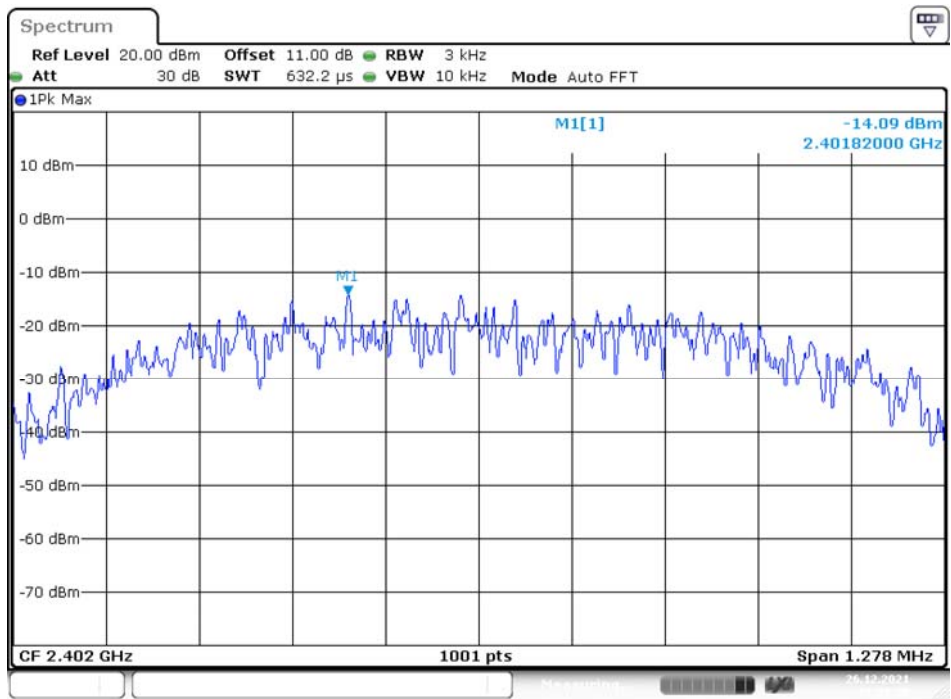
- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq [3 \times \text{RBW}]$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat

12.3 Test Results

Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
Low	2402	-14.09	8	Pass
Middle	2440	-13.75	8	Pass
High	2480	-13.59	8	Pass

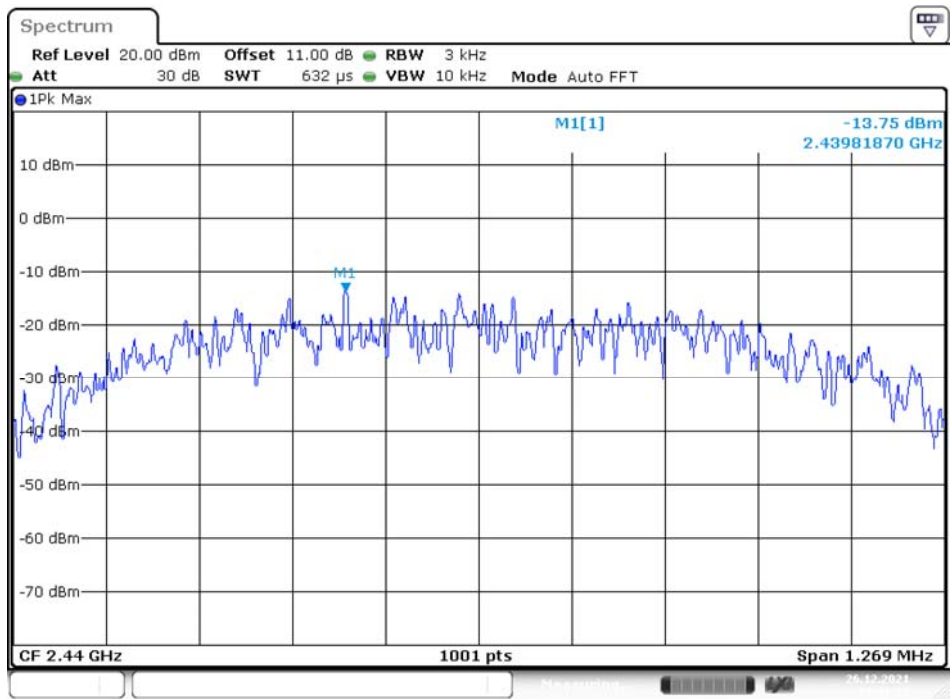
Please refer to the following plots

BLE Mode
Low Channel



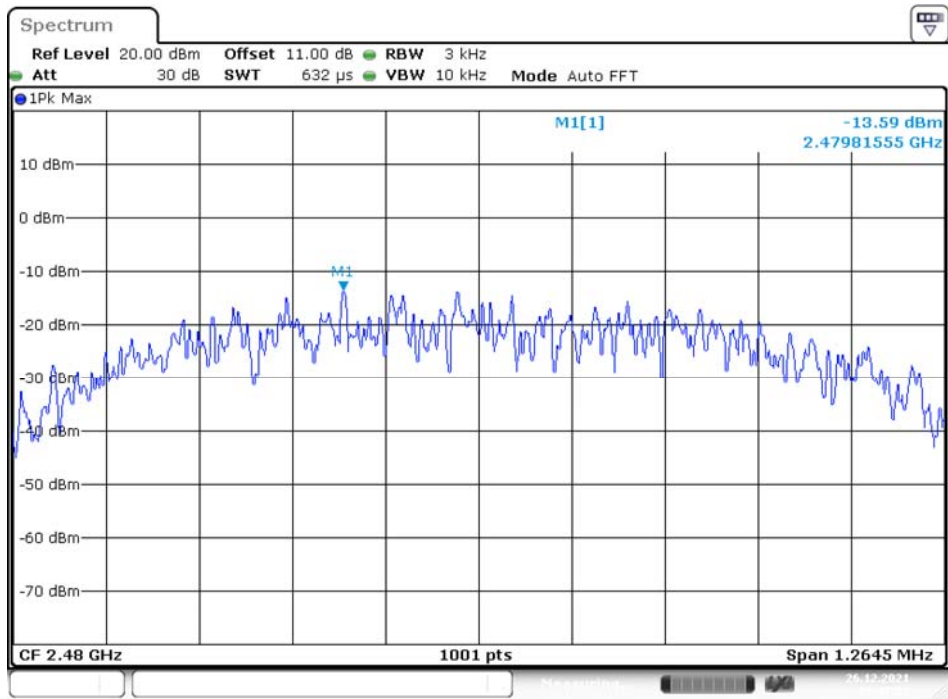
Date: 26 DEC. 2021 10:35:30

Middle Channel



Date: 26 DEC. 2021 10:46:23

High Channel



***** END OF REPORT *****