TEST REPORT
On behalf of

Abode Systems, Inc

Product Name: Abode Color Bulb

Model No.: 104062/A

FCC ID: 2ARGFACB

Prepared For: Abode Systems, Inc
2625 Middlefield Rd. #900 Palo Alto, CA 94306,
United States

Prepared By: Audix Technology (Shanghai) Co., Ltd.
3F and 4F, 34Bldg, 680 Guiping Rd.,
Caohejing Hi-Tech Park,
Shanghai 200233, China

Tel: +86-21-64955500

TESTING
NVLAP LAB CODE 200371-0

File No.	:	C1D2109042
Report No.	:	ACI-F21218
Date of Test	:	2021.09.22-10.15
Date of Report	:	2021.10.21

The statement is based on a single evaluation of one sample of the above-mentioned products. It does not imply an assessment of the whole production and does not permit the use of the test lab logo.
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.

TABLE OF CONTENTS

Page

1 SUMMARY OF STANDARDS AND RESULTS 5
1.1 Description of Standards and Results 5
2 GENERAL INFORMATION 6
2.1 Description of Equipment Under Test 6
2.2 EUT Specifications Assessed in Current Report 7
2.3 Test Information 7
2.4 Sample Description 7
2.5 Supported equipment 8
2.6 Description of Test Facility 8
3 CONDUCTED EMISSION TEST 9
3.1 Test Equipment 9
3.2 Block Diagram of Test Setup 9
3.3 Conducted Emission Limits (§15.207) 10
3.4 Test Configuration 10
3.5 Operating Condition of EUT 10
3.6 Test Procedures 10
3.7 Test Results 11
4 RADIATED EMISSION TEST 13
4.1 Test Equipment 13
4.2 Block Diagram of Test Setup 13
4.3 Radiated Emission Limit (§15.209) 14
4.4 Test Configuration 14
4.5 Operating Condition of EUT 15
4.6 Test Procedures 15
4.7 Test Results 16
5 6 DB BANDWIDTH MEASUREMENT 23
5.1 Test Equipment 23
5.2 Block Diagram of Test Setup 23
5.3 Specification Limits (§15.247(a)(2)) 23
5.4 Operating Condition of EUT 23
5.5 Test Procedure 23
5.6 Test Results 24
6 MAXIMUM PEAK OUTPUT POWER MEASUREMENT 28
6.1 Test Equipment 28
6.2 Block Diagram of Test Setup 28
6.3 Specification Limits ((§15.247(b)(3)) 28
6.4 Operating Condition of EUT 28
6.5 Test Procedure 28
6.6 Test Results 29
7 EMISSION LIMITATIONS MEASUREMENT 33
7.1 Test Equipment 33
7.2 Block Diagram of Test Setup 33
7.3 Specification Limits (§15.247(d)) 33
7.4 Operating Condition of EUT 33

7.5 Test Procedure 33
7.6 Test Results 35
8 BAND EDGES MEASUREMENT 48
8.1 Test Equipment 48
8.2 Block Diagram of Test Setup 48
8.3 Specification Limits (§15.247(d)) 48
8.4 Operating Condition of EUT 48
8.5 Test Procedure 48
8.6 Test Results 49
9 POWER SPECTRAL DENSITY MEASUREMENT 52
9.1 Test Equipment 52
9.2 Block Diagram of Test Setup 52
9.3 Specification Limits (§15.247(e)) 52
9.4 Operating Condition of EUT 52
9.5 Test Procedure 52
9.6 Test Results 53
10 DEVIATION TO TEST SPECIFICATIONS 57
11 MEASUREMENT UNCERTAINTY LIST 58

TEST REPORT

Applicant	:	Abode Systems, Inc
Manufacturer	:	Abode Systems, Inc
EUT Description	:	Abode Color Bulb
	(A) Model No.	: 104062/A
	(B) Power Supply	: 120V AC 60Hz
	(C) Test Voltage	: 120V/60Hz

Test Procedure Used:

FCC RULES AND REGULATIONS PART 15 SUBPART C
AND ANSI C63.10-2013

The device described above is tested by Audix Technology (Shanghai) Co., Ltd. to determine the maximum emission levels emanating from the device. The maximum emission levels are compared to the FCC Part 15 Subpart C limits.

The test results are contained in this test report and Audix Technology (Shanghai) Co., Ltd. is assumed full responsibility for the accuracy and completeness of these measurements. This report also shows that the EUT (M/N: Refer to Sec2.1), which was tested is technically compliance with the FCC limits.

This report applies to above tested Sample only. This report shall not be reproduced in part without written approval of Audix Technology (Shanghai) Co., Ltd.

The test results for EUT's WIFI function are contained in No.ACI-F21220 report.

Date of Test : 2021.09.22-10.15 Date of Report : 2021.10.21

Producer : Alan He
ALAN HE / Assistant

Review : Byron Wu
BYRON WU/ Deputy Assistant Manager

AUDIX® For and on behalf of
Audix Technology (Shanghai) Co., Ltd.

Signatory :
Authorized Signature(s) BYRON KWO/Assistant General Manager

1 SUMMARY OF STANDARDS AND RESULTS

1.1 Description of Standards and Results

The EUT have been tested according to the applicable standards as referenced below:

Description / Test Item	Test Standard	Results	Meets Limit
EMISSION			
Conducted Emission	FCC RULES AND REGULATIONS PART 15 SUBPART C AND ANSI C63.10:2013	Pass	15.207
Radiated Emission	FCC RULES AND REGULATIONS PART 15 SUBPART C AND ANSI C63.10:2013	Pass	15.209(a) 15.205(a)(c)
6 dB Bandwidth Measurement	FCC RULES AND REGULATIONS PART 15 SUBPART C AND ANSI C63.10:2013	Pass	15.247(a)(2)
Maximum Peak Output Power Measurement	FCC RULES AND REGULATIONS PART 15 SUBPART C AND ANSI C63.10:2013	Pass	15.247(b)(3)
Emission Limitations Measurement	FCC RULES AND REGULATIONS PART 15 SUBPART C AND ANSI C63.10:2013	Pass	15.247(d)
Band Edge Measurement	FCC RULES AND REGULATIONS PART 15 SUBPART C AND ANSI C63.10:2013	Pass	15.247(d)
Power Spectral Density Measurement	FCC RULES AND REGULATIONS PART 15 SUBPART C AND ANSI C63.10:2013	Pass	15.247(e)
N/A is an abbreviation for Not Applicable.			

2 GENERAL INFORMATION

2.1 Description of Equipment Under Test

Description	:	Abode Color Bulb
Type of EUT	:	☑ Production ☐ Pre-product ☐ Pro-type
Model Number	:	104062/A
Radio Tech	:	BLE 5.0; IEEE 802.11 b/g/n.
Channel Freq.	:	BLE: 2402MHz-2480MHz; 802.11b/g/n: 2412MHz-2462MHz.
Modulation	:	BLE: GFSK; 802.11b: DSSS (CCK, DQPSK, DBPSK); 802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK).
Antenna Info.	:	Antenna Type: Metal Monopole Antenna Antenna Gain: 1.33 dBi The Antenna was a permanently attached antenna that is comply with 15.203 requirement.
Test Mode	:	The EUT was set at continuous TX during all the test in the report.
Applicant	:	Abode Systems, Inc 2625 Middlefield Rd. #900 Palo Alto, CA 94306, United States
Manufacturer	:	same as Applicant

2.2 EUT Specifications Assessed in Current Report

Mode	Modulation	Data Rate(Mbps)
BLE 1M	GFSK	1
BLE 2M	GFSK	2

Channel List			
Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
00	2402	20	2442
01	2404	21	2444
02	2406	22	2446
…	…	…	…
…	…	…	…
…	…	…	…
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

2.3 Test Information

The test software "EspRFTestTool_v2.6_Manual.exe" was used to control EUT work in TX mode, Power Setting and select test channel.

Modulation	data rate (Mbps)	Power Setting	Test Channel		Frequency (MHz)
BLE 1M	1	Default	Low:	00	2402
		Default	Middle:	20	2442
		Default	High:	39	2480
BLE 2M	2	Default	Low:	00	2402
		Default	Middle:	20	2442
		Default	High:	39	2480

2.4 Sample Description

Test Item	Model Number	Sample Number	Date of receipted
Conducted Emission	104062/A	E21091446-01/01	2021.09.18
Radiated Emission	104062/A	E21091532-01/01	2021.09.30
Conducted RF Test	104062/A	E21091532a-01/01	2021.09.30

2.5 Supported equipment

Brand	:	Acer
Product Name:	:	Notebook PC
Model Name	:	TravelMate P238 series
Model Number	:	N15W8

2.6 Description of Test Facility

Name of Firm	:	Audix Technology (Shanghai) Co., Ltd.
Site Location	:	3F and 4F, 34Bldg, 680 Guiping Rd., Caohejing Hi-Tech Park, Shanghai 200233, China.
Accredited by NVLAP, Lab Code	:	200371-0
FCC Designation Number	:	CN5027
Test Firm Registration Number	:	954668

3 CONDUCTED EMISSION TEST

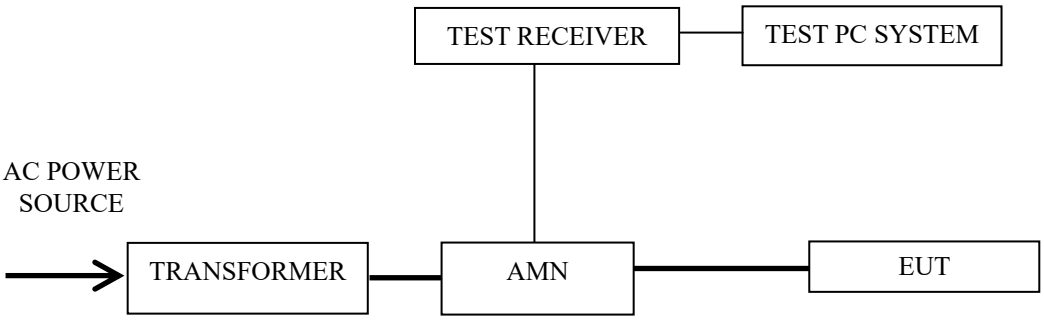
3.1 Test Equipment

The following test equipments are used during the conducted emission test in a shielded room:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Test Receiver	R&S	ESCI	101302	2021.04.26	1 Year
2.	Artificial Mains Network (AMN)	R&S	ENV4200	100125	2021.06.24	1 Year
3.	Software	Audix	e3	6.2009-1-15	--	--

3.2 Block Diagram of Test Setup

3.2.1 Conducted Disturbance Test Setup



—— : Signal Line
—— : Power Line

3.3 Conducted Emission Limits (§15.207)

Frequency Range (MHz)	Limits dB(μV)	
	Quasi-peak	Average
0.15 ~ 0.5	66~56	56~46
0.5 ~ 5	56	46
5 ~ 30	60	50

NOTE 1 – The lower limit shall apply at the transition frequencies.

NOTE 2 – The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz~0.50 MHz

3.4 Test Configuration

The EUT (listed in Sec.2.1) was installed as shown on Sec.3.2 to meet FCC requirement and operating in a manner which tends to maximize its emission level in a normal application.

3.5 Operating Condition of EUT

3.5.1 Setup the EUT as shown in Sec. 3.2.

3.5.2 Turn on the power of all equipment.

3.5.3 Turn the EUT on the test mode, and then test.

3.6 Test Procedures

The EUT was placed upon a non-metallic table, which is 0.8 m above the horizontal conducting ground plane and 0.4 m from a vertical reference plane. The EUT was connected to the power mains through an Artificial Mains Network (AMN) to provide a 50 Ω coupling impedance for the measuring equipment. Both sides of AC line (Line & Neutral) were checked to find out the maximum conducted emission according to FCC Part 15 Subpart C and ANSI C63.10: 2013 requirements during conducted disturbance test.

The I.F. bandwidth of Test Receiver ESCI was set at 9 kHz.

The frequency range from 150 kHz to 30 MHz was checked.

Test with a dummy load in lieu of the antenna to determine compliance with Section 15.207 limits within the transmitter's fundamental emission band. (According to KDB 174176 D01 Line Conducted FAQ)

The test modes were done on conducted disturbance test and all the test results are listed in Sec. 3.7

3.7 Test Results

< PASS >

The frequency and amplitude of the highest conducted emission relative the limit is reported. All the emissions not reported below are too low against the FCC limit.

Worst case emission:

No.	Operation	Modulation	Channel	Frequency (MHz)	Data Page
1.	Transmitting	--	--	--	P12

NOTE 1 – Level = Read Level + AMN Factor + Cable Loss
NOTE 2 – "QP" means "Quasi-Peak" values
NOTE 3 – The emission levels which not reported are too low against the official limit.

Worst case emission

EUT	:	Abode Color Bulb	Temperature :	22℃
Model No.	:	104062/A	Humidity :	51%RH
Test Mode	:	Transmitting	Date of Test :	2021.09.22

Polarization	Frequency (MHz)	Meter Reading dB (μV)	AMN Factor (dB)	Cable Loss (dB)	Emission Level dB (μV)	Limits dB (μV)	Margin (dB)	Remark
Line	0.2185	29.95	10.48	0.03	40.46	62.88	22.42	QP
	0.2185	9.38	10.48	0.03	19.89	52.88	32.99	Average
	0.2589	30.7	10.45	0.03	41.18	61.47	20.29	QP
	0.2589	10.33	10.45	0.03	20.81	51.47	30.66	Average
	0.5155	26.91	10.35	0.04	37.3	56	18.7	QP
	0.5155	7.67	10.35	0.04	18.06	46	27.94	Average
	0.7352	27.87	10.34	0.05	38.26	56	17.74	QP
	0.7352	10.07	10.34	0.05	20.46	46	25.54	Average
	2.309	21.21	10.35	0.08	31.64	56	24.36	QP
	2.309	7.86	10.35	0.08	18.29	46	27.71	Average
	9.352	16.82	10.34	0.17	27.33	60	32.67	QP
	9.352	4.96	10.34	0.17	15.47	50	34.53	Average
Neutral	0.1549	29.55	10.72	0.03	40.3	65.74	25.44	QP
	0.1549	9.33	10.72	0.03	20.08	55.74	35.66	Average
	0.31	26.76	10.59	0.04	37.39	59.97	22.58	QP
	0.31	6.71	10.59	0.04	17.34	49.97	32.63	Average
	0.5731	**29.71**	**10.47**	**0.04**	**40.22**	**56**	**15.78**	**QP**
	0.5731	11.28	10.47	0.04	21.79	46	24.21	Average
	0.8217	27.43	10.46	0.05	37.94	56	18.06	QP
	0.8217	9.42	10.46	0.05	19.93	46	26.07	Average
	2.213	21.99	10.46	0.08	32.53	56	23.47	QP
	2.213	9.73	10.46	0.08	20.27	46	25.73	Average
	8.916	16.35	10.46	0.17	26.98	60	33.02	QP
	8.916	5.83	10.46	0.17	16.46	50	33.54	Average

TEST ENGINEER: WESKER

4 RADIATED EMISSION TEST

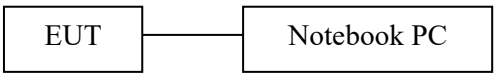
4.1 Test Equipment

The following test equipment are used during the radiated emission test in a semi-anechoic chamber:

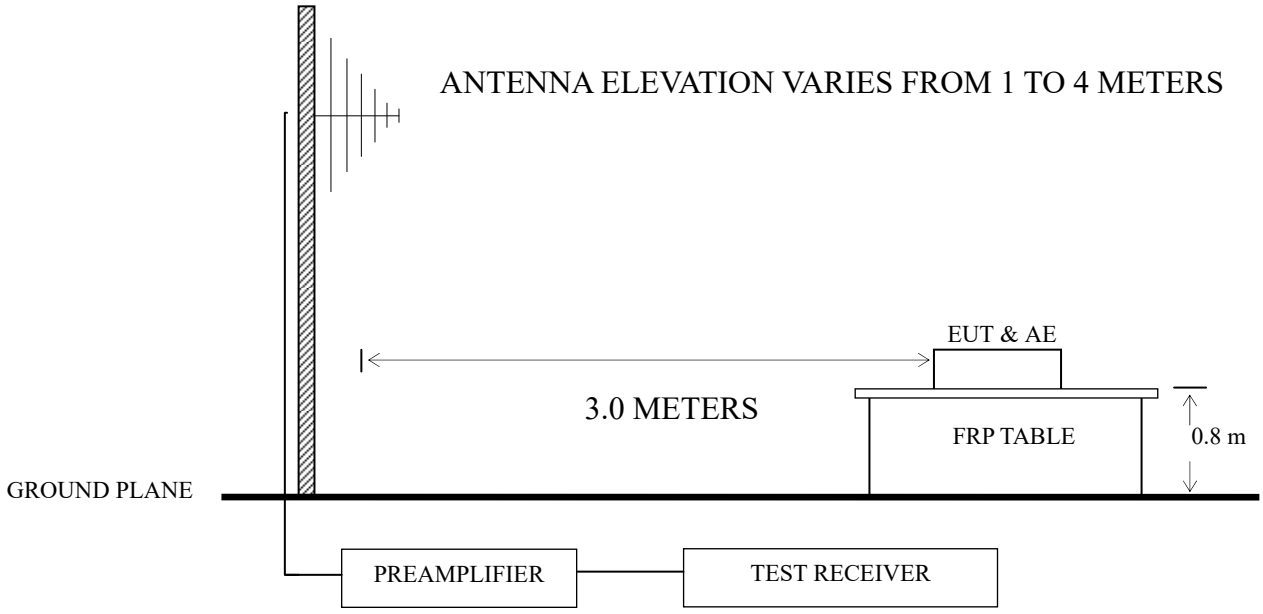
Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Preamplifier	Agilent	8447D	2944A10548	2021.03.08	1 Year
2.	Preamplifier	HP	8449B	3008A00864	2021.03.08	1 Year
3.	Spectrum Analyzer	Agilent	N9010A	MY52221182	2021.09.16	1 Year
4.	Test Receiver	R&S	ESCI	101303	2021.03.08	1 Year
5.	Bilog Antenna+6dB Attenuator	Schwarz beck	VULB 9168+EMCI-N-6-06	707+AT-N0637	2021.03.30	1 Year
6.	Horn Antenna	EMCO	3115	9607-4878	2021.07.27	1 Year
7.	Horn Antenna	EMCO	3116	00062643	2021.10.10	1 Year
8.	Cavity Band Rejection Filter	Microwave	WT-A3882-R10	WT200312-1-1	2021.09.15	1 Year
9.	Software	Audix	e3	SET00200 9912M295-2	--	--

4.2 Block Diagram of Test Setup

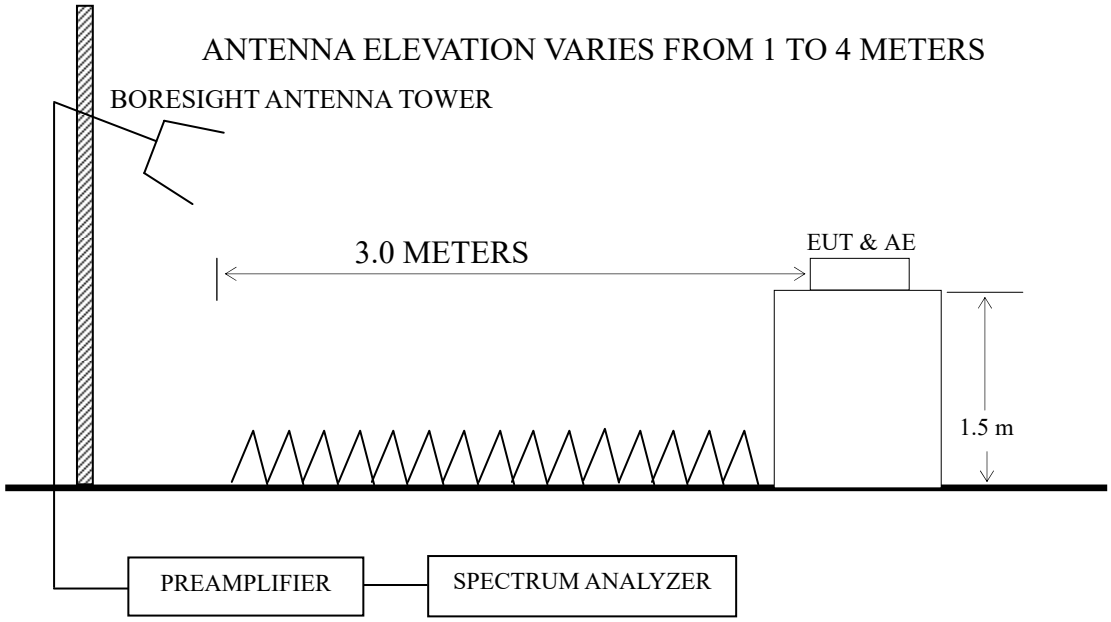
4.2.1 EUT & Peripherals



4.2.2 Below 1GHz



4.2.3 Above 1GHz



4.3 Radiated Emission Limit (§15.209)

Frequency (MHz)	Distance (m)	Field strength limits (μV/m)	
		(μV/m)	dB(μV/m)
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
Above 960	3	500	54.0

NOTE 1 - Emission Level dB (μV/m) = 20 log Emission Level (μV/m)
NOTE 2 - The tighter limit applies at the band edges.
NOTE 3 - Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
NOTE 4 - The limits shown are based on Quasi-peak value detector below or equal to 1GHz and Average value detector above 1GHz.
NOTE 5 - Above 1 GHz, the limit on peak emission is 20 dB above the maximum permitted average emission limit applicable to the EUT

4.4 Test Configuration

The EUT (listed in Sec.2.1) and the simulators (listed in Sec.2.2) were installed as shown on Sec.4.2 to meet FCC requirements and operating in a manner that tends to maximize its emission level in a normal application.

4.5 Operating Condition of EUT

4.5.1 Setup the EUT as shown in Sec. 4.2.

4.5.2 Turn on the power of all equipment.

4.5.3 Turn the EUT on the test mode, and then test.

4.6 Test Procedures

Radiated emission test applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. A pre-amp is necessary for this measurement. For measurement above 1 GHz, set RBW = 1MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation.

The EUT was placed on a turntable. Below 1 GHz, the table height is 80 cm above the reference ground plane. Above 1 GHz, the table height is 1.5 m. The turntable rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna, which was mounted on an antenna tower. The antenna moved up and down between 1 meter and 4 meters to find out the maximum emission level. Broadband antenna (Calibrated Bilog Antenna) or Horn antenna was used as receiving antenna. Both horizontal and vertical polarizations of the antenna were set on measurement. In order to find the maximum emission, all of the interference cables were manipulated according to ANSI C63.10: 2013 requirements during radiated emission test.

The bandwidth of Test Receiver R&S ESCI was set at 120 kHz from 30MHz to 1000MHz.

The bandwidth of Agilent N9010A was set at 1MHz for above 1GHz.

The frequency range from 30 MHz to 25 GHz (Up to 10^{th} harmonics from fundamental frequency) was checked.

All the test results are listed in Sec.4.7.

4.7 Test Results

<PASS>

The frequency and amplitude of the highest radiated emission relative the limit is reported. All the emissions not reported below are too low against the FCC limit.

Frequency range: below 1GHz (Worst case emission)

No.	Operation	Modulation	Channel	Frequency	Data Page
1.	Transmitting	BLE 1M	00	2402 MHz	P17
2.			20	2442 MHz	P17
3.			39	2480 MHz	P18
4.		BLE 2M	39	2480 MHz	P18

Frequency range: above 1GHz

No.	Operation	Modulation	Channel	Frequency	Data Page
1.	Transmitting	BLE 1M	00	2402 MHz	P19
2.			20	2442 MHz	P19
3.			39	2480 MHz	P20
4.		BLE 2M	39	2480 MHz	P20

Restricted bands:

No.	Operation	Modulation	Channel	Frequency	Data Page
1.	Transmitting	BLE 1M	00	2402 MHz	P21
2.			39	2480 MHz	P21
3.		BLE 2M	00	2402 MHz	P22
4.			39	2480 MHz	P22

NOTE 1 – Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
NOTE 2 – "QP" means "Quasi-Peak" values
NOTE 3 – 0°was the table front facing the antenna. Degree is calculated from 0°clockwise facing the antenna.
NOTE 4 – The emission levels which not reported are too low against the official limit.
NOTE 5 – The emission levels recorded below is data of EUT configured in Standing direction, for Standing direction was the maximum emission direction during the test. The data of Side & Lying direction are too low against the official limit to be reported.
NOTE 6 – All reading are Quasi-Peak values below or equal to 1GHz, Peak and Average values above 1GHz.
For above 1GHz test, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
NOTE 7 – The frequency range 2310-2390MHz & 2483.5-2500MHz were tested for Restricted bands.

Worst case emission < 1GHz

EUT	:	Abode Color Bulb	Temperature :	22℃
Model No.	:	104062/A	Humidity :	51%RH
Test Mode	:	Transmitting	Date of Test :	2021.10.15

BLE 1M CH2402MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	47.492	25.09	19.55	0.73	28.21	17.16	40	22.84	QP
	173.81	23.82	18.3	1.41	27.63	15.9	43.5	27.6	QP
	263.82	28.32	17.84	1.74	27.1	20.8	46	25.2	QP
	319.94	27.91	19.6	1.95	27.13	22.33	46	23.67	QP
	416.18	28.72	21.55	2.2	27.67	24.8	46	21.2	QP
	935.55	21.47	29.1	3.34	26.1	27.81	46	18.19	QP
Vertical	47.994	24.09	19.5	0.73	28.21	16.11	40	23.89	QP
	147.4	23.46	18.9	1.3	27.81	15.85	43.5	27.65	QP
	252.06	24.66	17.54	1.7	27.14	16.76	46	29.24	QP
	394.86	27.4	21.1	2.15	27.56	23.09	46	22.91	QP
	649.66	22.32	25.9	2.75	27.6	23.37	46	22.63	QP
	869.13	**22.9**	**28.3**	**3.24**	**26.5**	**27.94**	**46**	**18.06**	**QP**

BLE 1M CH2442MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	50.942	22.96	19.6	0.76	28.2	15.12	40	24.88	QP
	159.78	22.75	19	1.35	27.73	15.37	43.5	28.13	QP
	242.53	28.59	17.3	1.66	27.19	20.36	46	25.64	QP
	298.27	27.47	19.02	1.9	27	21.39	46	24.61	QP
	410.38	31.01	21.3	2.18	27.63	26.86	46	19.14	QP
	900.15	21.91	28.4	3.35	26.3	27.36	46	18.64	QP
Vertical	58.203	23.86	19.4	0.82	28.17	15.91	40	24.09	QP
	144.84	23.04	18.9	1.29	27.82	15.41	43.5	28.09	QP
	278.07	23.33	18.42	1.82	27.1	16.47	46	29.53	QP
	403.25	26.81	21.17	2.17	27.6	22.55	46	23.45	QP
	651.94	22.76	25.85	2.75	27.6	23.76	46	22.24	QP
	887.61	21.72	28.25	3.31	26.35	26.93	46	19.07	QP

BLE 1M CH2480MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	47.492	23.81	19.55	0.73	28.21	15.88	40	24.12	QP
	165.49	22.9	18.9	1.38	27.69	15.49	43.5	28.01	QP
	246.82	28.39	17.43	1.67	27.16	20.33	46	25.67	QP
	319.94	27.46	19.6	1.95	27.13	21.88	46	24.12	QP
	434.07	29.45	22.15	2.24	27.73	26.11	46	19.89	QP
	890.73	21.65	28.2	3.31	26.35	26.81	46	19.19	QP
Vertical	54.261	24	19.62	0.79	28.18	16.23	40	23.77	QP
	145.35	23.6	18.9	1.29	27.81	15.98	43.5	27.52	QP
	283.98	23.68	18.66	1.84	27.09	17.09	46	28.91	QP
	411.82	27.99	21.37	2.2	27.65	23.91	46	22.09	QP
	636.13	22.61	25.77	2.75	27.64	23.49	46	22.51	QP
	884.5	21.15	28.3	3.28	26.4	26.33	46	19.67	QP

BLE 2M CH2480MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	47.994	23.02	19.5	0.73	28.21	15.04	40	24.96	QP
	170.79	22.3	18.6	1.4	27.65	14.65	43.5	28.85	QP
	248.55	27.82	17.47	1.68	27.16	19.81	46	26.19	QP
	314.38	26.47	19.44	1.94	27.09	20.76	46	25.24	QP
	425.03	29.65	21.9	2.23	27.7	26.08	46	19.92	QP
	833.32	22.91	27.9	3.14	26.7	27.25	46	18.75	QP
Vertical	47.492	24.28	19.55	0.73	28.21	16.35	40	23.65	QP
	143.33	22.36	18.75	1.29	27.82	14.58	43.5	28.92	QP
	248.55	25.01	17.47	1.68	27.16	17	46	29	QP
	410.38	27.87	21.3	2.18	27.63	23.72	46	22.28	QP
	647.39	22.47	25.95	2.75	27.62	23.55	46	22.45	QP
	893.86	21.6	28.3	3.31	26.35	26.86	46	19.14	QP

TEST ENGINEER: AVALON

Radiated Emission > 1GHz

EUT	:	Abode Color Bulb	Temperature :	22℃
Model No.	:	104062/A	Humidity :	51%RH
Test Mode	:	Transmitting	Date of Test :	2021.10.15

BLE 1M CH2402MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	2188	42.94	27.66	5.15	36.08	39.67	74	34.33	Peak
	3484	40.95	31.28	6.36	35.14	43.45	74	30.55	Peak
	4798	38.71	33.21	7.55	34.75	44.72	74	29.28	Peak
	6607	36.03	34.64	8.93	34.76	44.84	74	29.16	Peak
	8110	35.84	37.91	10.28	34.79	49.24	74	24.76	Peak
	9613	36.3	38.32	11.15	34.64	51.13	74	22.87	Peak
Vertical	1990	44.11	27.06	4.91	36.3	39.78	74	34.22	Peak
	3493	40.26	31.3	6.36	35.14	42.78	74	31.22	Peak
	4798	38.55	33.21	7.55	34.75	44.56	74	29.44	Peak
	6202	36.83	34.34	8.6	34.72	45.05	74	28.95	Peak
	8110	35.17	37.91	10.28	34.79	48.57	74	25.43	Peak
	9595	34.86	38.32	11.15	34.64	49.69	74	24.31	Peak

BLE 1M CH2442MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	2134	42.48	27.5	5.08	36.15	38.91	74	35.09	Peak
	3925	38.89	32.32	6.71	35.02	42.9	74	31.1	Peak
	5500	36.68	34.1	8.04	34.7	44.12	74	29.88	Peak
	7084	35.69	35.8	9.37	34.8	46.06	74	27.94	Peak
	8335	35.66	38.34	10.4	34.77	49.63	74	24.37	Peak
	9892	35.76	38.38	11.33	34.61	50.86	74	23.14	Peak
Vertical	1945	42.99	26.91	4.88	36.3	38.48	74	35.52	Peak
	3385	40.53	31.05	6.27	35.17	42.68	74	31.32	Peak
	4879	38.04	33.49	7.61	34.73	44.41	74	29.59	Peak
	6409	36.58	34.38	8.76	34.74	44.98	74	29.02	Peak
	8011	35.9	37.74	10.22	34.8	49.06	74	24.94	Peak
	9559	34.62	38.31	11.06	34.64	49.35	74	24.65	Peak

BLE 1M CH2480MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	2233	43.09	27.79	5.18	36.03	40.03	74	33.97	Peak
	3466	40.35	31.23	6.31	35.15	42.74	74	31.26	Peak
	4681	38.39	32.69	7.42	34.79	43.71	74	30.29	Peak
	6022	36.85	34.3	8.43	34.7	44.88	74	29.12	Peak
	7777	36.04	37.33	10.01	34.8	48.58	74	25.42	Peak
	9640	36.34	38.33	11.15	34.64	51.18	74	22.82	Peak
Vertical	2296	43.52	27.97	5.26	35.96	40.79	74	33.21	Peak
	3817	39.42	32.07	6.62	35.05	43.06	74	30.94	Peak
	5230	36.96	34.05	7.89	34.7	44.2	74	29.8	Peak
	6760	35.84	35.02	9.01	34.78	45.09	74	28.91	Peak
	7993	36.09	37.7	10.22	34.8	49.21	74	24.79	Peak
	9613	35.75	38.32	11.15	34.64	50.58	74	23.42	Peak

BLE 2M CH2480MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	1972	43.05	27.01	4.91	36.3	38.67	74	35.33	Peak
	3538	40.51	31.4	6.4	35.13	43.18	74	30.82	Peak
	5023	37.53	34	7.73	34.7	44.56	74	29.44	Peak
	6292	36.93	34.36	8.68	34.73	45.24	74	28.76	Peak
	8209	35.62	38.09	10.34	34.78	49.27	74	24.73	Peak
	9820	35.38	38.36	11.24	34.62	50.36	74	23.64	Peak
Vertical	1936	42.42	26.89	4.84	36.3	37.85	74	36.15	Peak
	3511	40.66	31.35	6.36	35.14	43.23	74	30.77	Peak
	4798	38.37	33.21	7.55	34.75	44.38	74	29.62	Peak
	6544	36.24	34.5	8.85	34.76	44.83	74	29.17	Peak
	8398	35.17	38.43	10.4	34.76	49.24	74	24.76	Peak
	9919	36.18	38.38	11.33	34.61	51.28	74	22.72	Peak

TEST ENGINEER: AVALON

Emissions in restricted frequency bands:

EUT	:	Abode Color Bulb	Temperature :	22℃
Model No.	:	104062/A	Humidity :	51%RH
Test Mode	:	Transmitting	Date of Test :	2021.10.15

BLE 1M CH2402MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	2334.1	44.35	28.06	5.29	35.92	41.78	74	32.22	Peak
	2334.1	32.24	28.06	5.29	35.92	29.67	54	24.33	Average
	2363.9	44.91	28.15	5.32	35.89	42.49	74	31.51	Peak
	2363.9	31.7	28.15	5.32	35.89	29.28	54	24.72	Average
	2390	54.22	28.21	5.36	35.86	51.93	74	22.07	Peak
	2390	33.42	28.21	5.36	35.86	31.13	54	22.87	Average
Vertical	2334.5	46.85	28.06	5.29	35.92	44.28	74	29.72	Peak
	2334.5	34.39	28.06	5.29	35.92	31.82	54	22.18	Average
	2360	46.28	28.14	5.32	35.89	43.85	74	30.15	Peak
	2360	32.53	28.14	5.32	35.89	30.1	54	23.9	Average
	2390	57.1	28.21	5.36	35.86	54.81	74	19.19	Peak
	2390	38.41	28.21	5.36	35.86	36.12	54	17.88	Average

BLE 1M CH2480MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	2483.5	44.13	28.46	5.43	35.76	42.26	74	31.74	Peak
	2483.5	32.51	28.46	5.43	35.76	30.64	54	23.36	Average
	2491.2	45.38	28.48	5.47	35.76	43.57	74	30.43	Peak
	2491.2	31.54	28.48	5.47	35.76	29.73	54	24.27	Average
	2498.1	44.53	28.5	5.47	35.76	42.74	74	31.26	Peak
	2498.1	31.45	28.5	5.47	35.76	29.66	54	24.34	Average
Vertical	2483.5	45.51	28.46	5.43	35.76	43.64	74	30.36	Peak
	2483.5	34.35	28.46	5.43	35.76	32.48	54	21.52	Average
	2489.6	46.08	28.48	5.47	35.76	44.27	74	29.73	Peak
	2489.6	31.4	28.48	5.47	35.76	29.59	54	24.41	Average
	2498	46.24	28.5	5.47	35.76	44.45	74	29.55	Peak
	2498	32.32	28.5	5.47	35.76	30.53	54	23.47	Average

BLE 2M CH2402MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	2329.6	45.4	28.06	5.29	35.93	42.82	74	31.18	Peak
	2329.6	31.55	28.06	5.29	35.93	28.97	54	25.03	Average
	2363.3	44.72	28.15	5.32	35.89	42.3	74	31.7	Peak
	2363.3	31.78	28.15	5.32	35.89	29.36	54	24.64	Average
	2390	53.24	28.21	5.36	35.86	50.95	74	23.05	Peak
	2390	32.32	28.21	5.36	35.86	30.03	54	23.97	Average
Vertical	2326.6	47.16	28.05	5.29	35.93	44.57	74	29.43	Peak
	2326.6	33.42	28.05	5.29	35.93	30.83	54	23.17	Average
	2359.6	46.62	28.14	5.32	35.89	44.19	74	29.81	Peak
	2359.6	33.36	28.14	5.32	35.89	30.93	54	23.07	Average
	2390	**59.57**	**28.21**	**5.36**	**35.86**	**57.28**	**74**	**16.72**	**Peak**
	2390	38.46	28.21	5.36	35.86	36.17	54	17.83	Average

BLE 2M CH2480MHz

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	2483.5	43.1	28.46	5.43	35.76	41.23	74	32.77	Peak
	2483.5	31.31	28.46	5.43	35.76	29.44	54	24.56	Average
	2488.6	46.51	28.46	5.47	35.76	44.68	74	29.32	Peak
	2488.6	31.45	28.46	5.47	35.76	29.62	54	24.38	Average
	2497.3	44.95	28.5	5.47	35.76	43.16	74	30.84	Peak
	2497.3	31.39	28.5	5.47	35.76	29.6	54	24.4	Average
Vertical	2483.5	45.11	28.46	5.43	35.76	43.24	74	30.76	Peak
	2483.5	34.61	28.46	5.43	35.76	32.74	54	21.26	Average
	2491.6	44.97	28.48	5.47	35.76	43.16	74	30.84	Peak
	2491.6	31.5	28.48	5.47	35.76	29.69	54	24.31	Average
	2498.3	46.63	28.5	5.47	35.76	44.84	74	29.16	Peak
	2498.3	31.46	28.5	5.47	35.76	29.67	54	24.33	Average

TEST ENGINEER: AVALON

5 6 dB BANDWIDTH MEASUREMENT

5.1 Test Equipment

The following test equipment was used during the Emission Bandwidth measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	2021.09.15	1 Year
2.	Coaxial Cable	WOKEN	SFL402-105F LEX	F02-150819-045	2021.03.08	1 Year
3.	10 dB Attenuator	Mini-Circuits	VAT-10W2+	001	2021.08.06	1 Year

5.2 Block Diagram of Test Setup

5.3 Specification Limits (§15.247(a)(2))

The minimum 6 dB bandwidth shall be at least 500 kHz.

5.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

5.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. The bandwidth of the fundamental frequency was measure by spectrum analyzer with settings: RBW = 100kHz, VBW ≥ 3 × RBW.

The 6 dB bandwidth is defined as the total spectrum the power of which is lower than peak power minus 6 dB .

The test procedure is defined in ANSI C63.10-2013 (the 11.8.2 Measurement Procedure “Option 2” was used).

5.6 Test Results

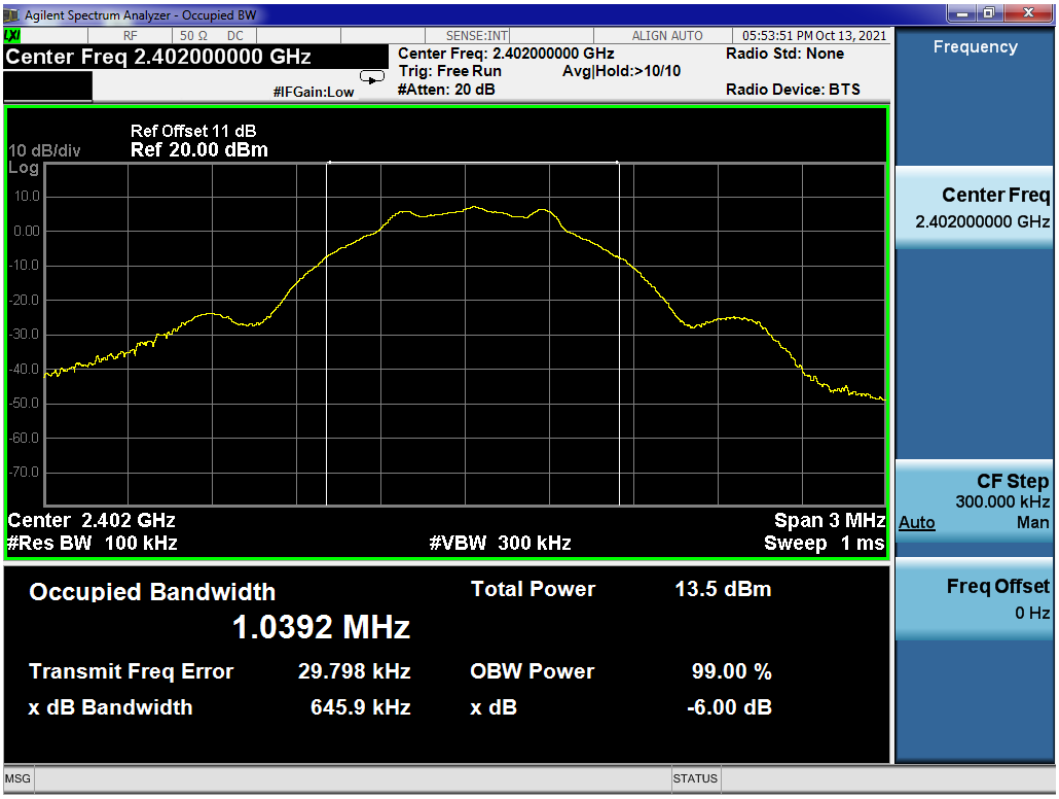
PASSED.

All the test results are attached in next pages.

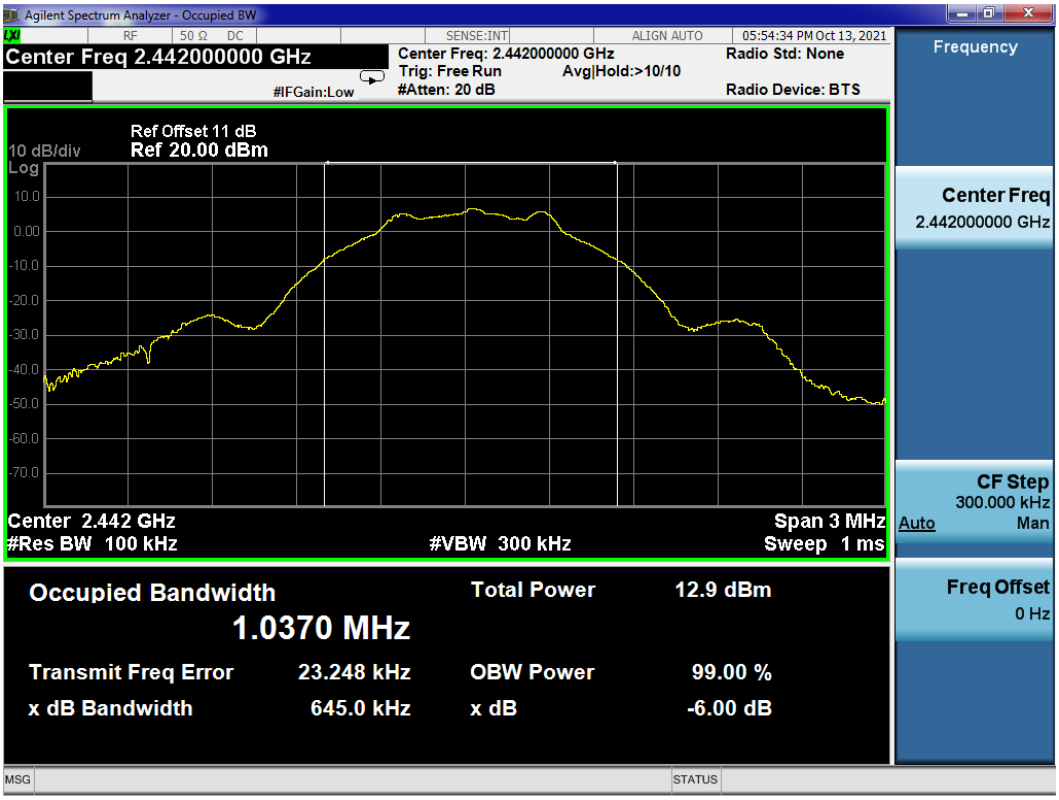
(Test Date: 2021.10.13 Temperature: 23℃ Humidity: 51 %)

Modulation	Channel	Frequency (MHz)	**6dB Bandwidth (kHz)**	Limit
BLE 1M	00	2402	**645.9**	500 kHz
	20	2442	**645**	500 kHz
	39	2480	**645.6**	500 kHz
BLE 2M	00	2402	**1113**	500 kHz
	20	2442	**1114**	500 kHz
	39	2480	**1113**	500 kHz

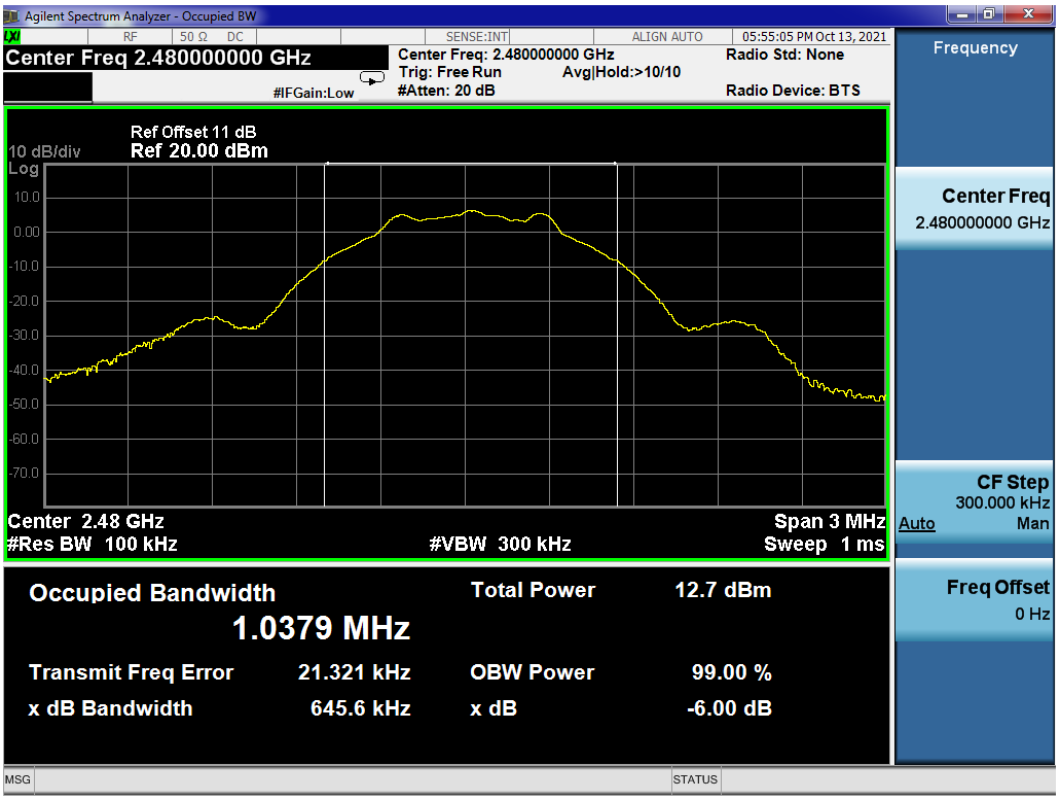
BLE 1M CH2402MHz



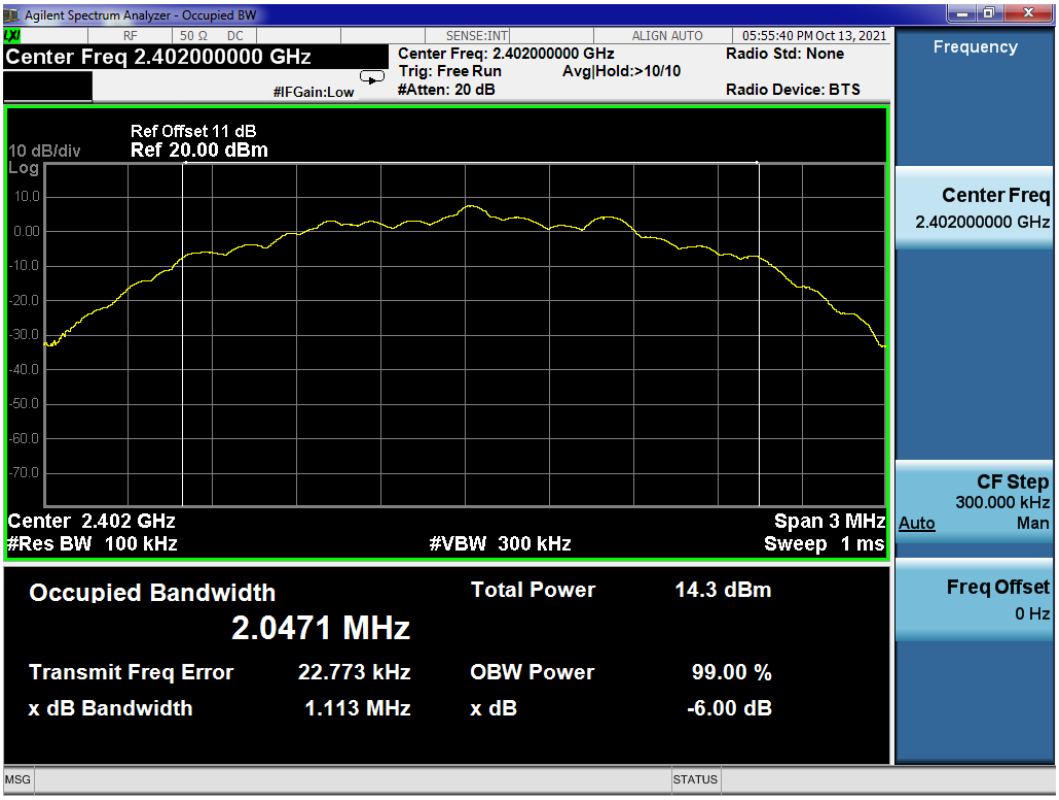
BLE 1M CH2442MHz



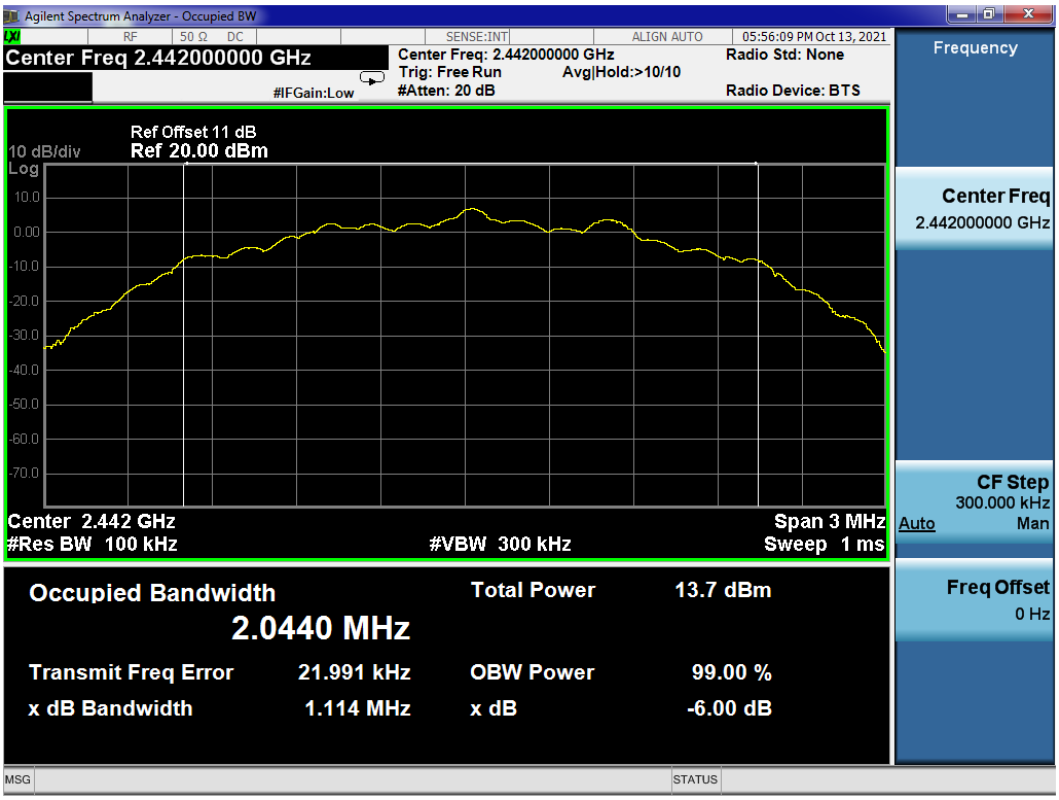
BLE 1M CH2480MHz



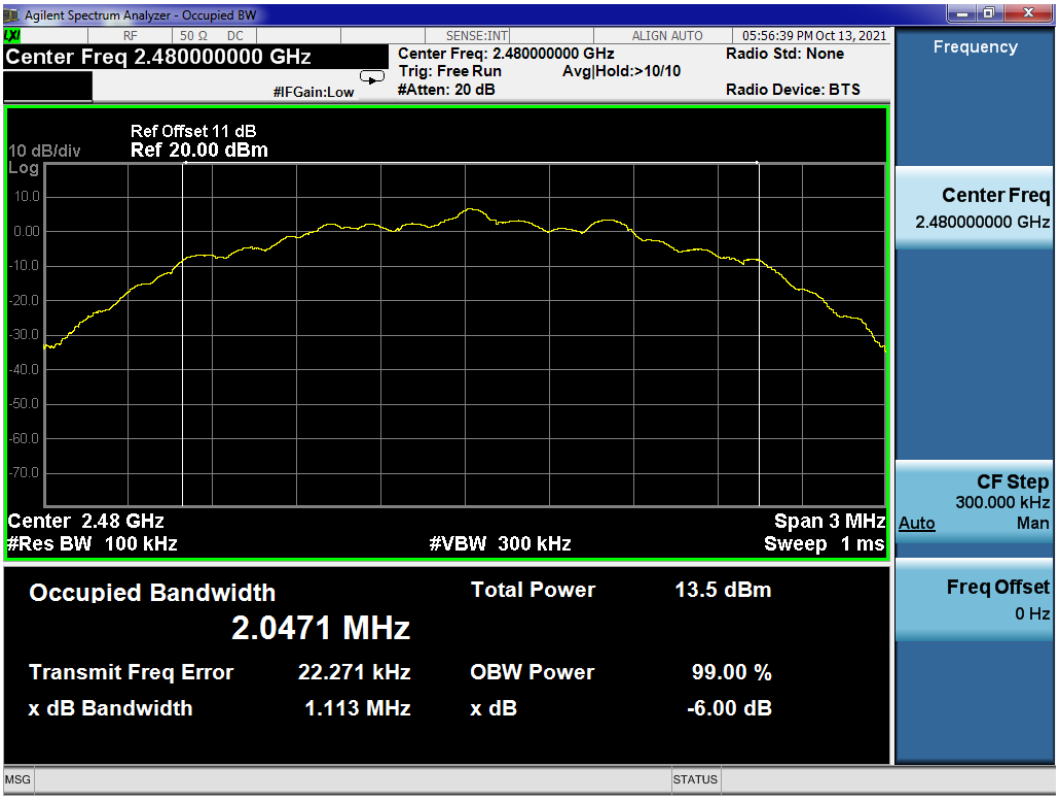
BLE 2M CH2402MHz



BLE 2M CH2442MHz



BLE 2M CH2480MHz



6 MAXIMUM PEAK OUTPUT POWER MEASUREMENT

6.1 Test Equipment

The following test equipment was used during the maximum peak output power measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	2021.10.13	1 Year
2.	Coaxial Cable	WOKEN	SFL402-105F LEX	F02-150819-045	2021.03.08	1 Year
3.	10 dB Attenuator	Mini-Circuits	VAT-10W2+	001	2021.08.06	1 Year

6.2 Block Diagram of Test Setup

The Same as Section. 5.2.

6.3 Specification Limits ((§15.247(b)(3))

The Limits of maximum Peak Output Power for digital modulation in 2400-2483.5 MHz is: 1 Watt. (30 dBm)

6.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

6.5 Test Procedure

The transmitter output was connected to the spectrum analyzer.

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:
a) RBW ≥ DTS Bandwidth.
b) VBW ≥ [3 × RBW].
c) Span ≥ [3 × RBW].
d) Sweep time = auto.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

The test procedure is defined in ANSI C63.10-2013 (11.9.1.1 Measurement Procedure " RBW ≥ DTS bandwidth" was used).

6.6 Test Results

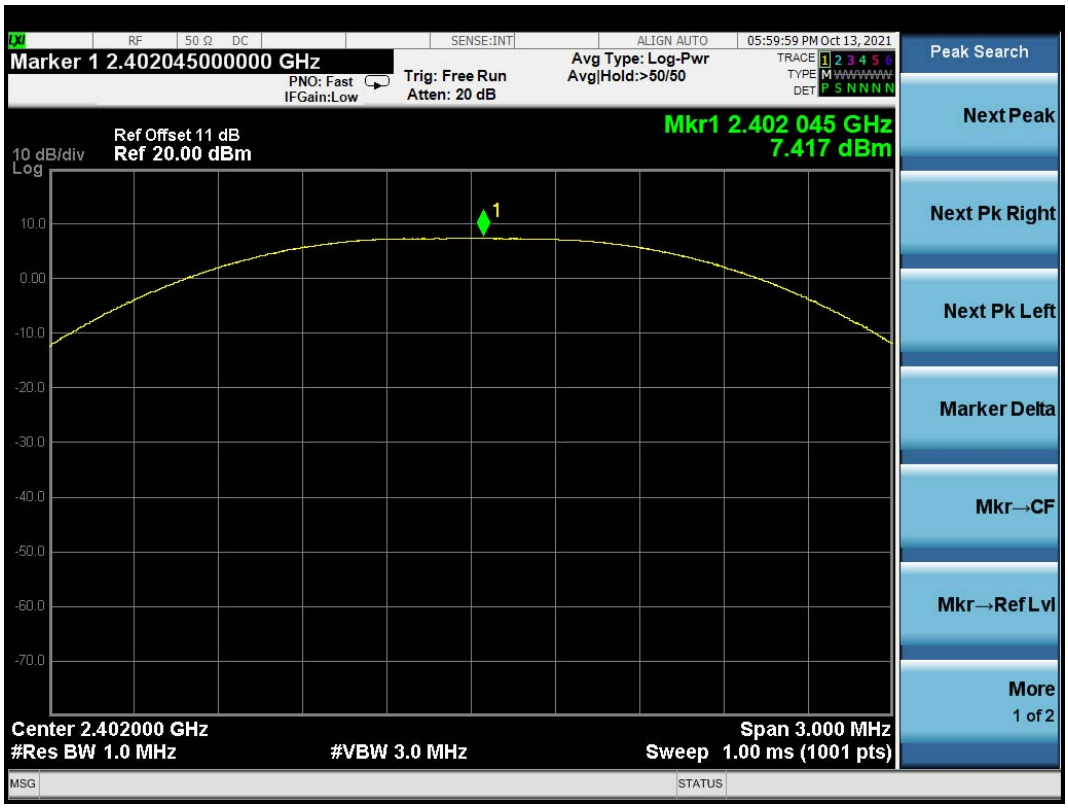
PASSED.

All the test results are listed below.

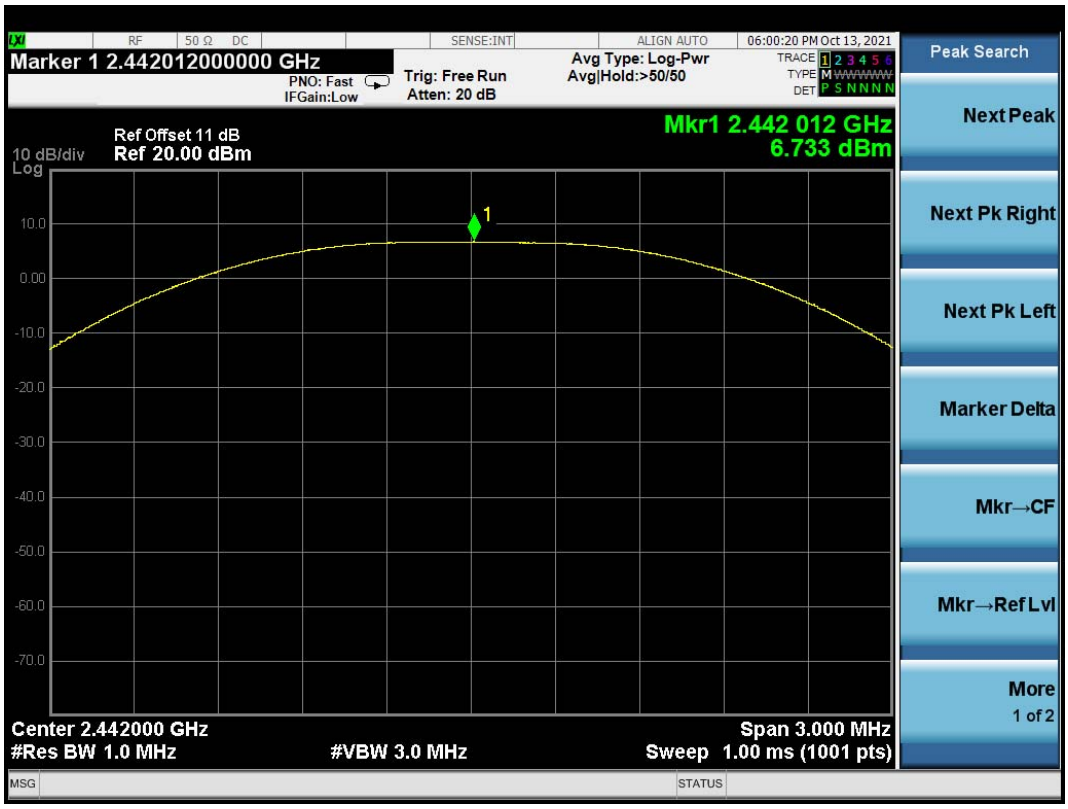
(Test Date: 2021.10.13 Temperature: 23℃ Humidity: 51 %)

Modulation	Channel	Frequency (MHz)	**Peak Output Power (dBm)**	Limit
BLE 1M	00	2402	**7.417**	30 dBm
	20	2442	**6.733**	30 dBm
	39	2480	**6.508**	30 dBm
BLE 2M	00	2402	**7.419**	30 dBm
	20	2442	**6.868**	30 dBm
	39	2480	**6.66**	30 dBm

BLE 1M CH2402MHz



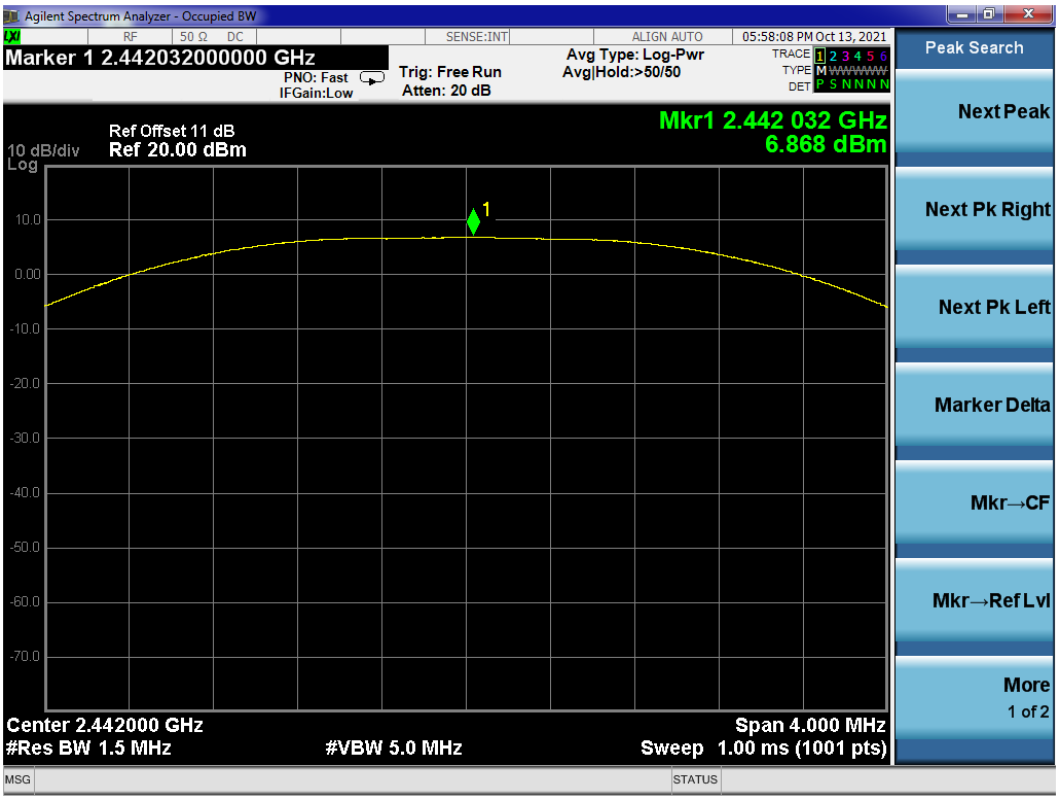
BLE 1M CH2442MHz



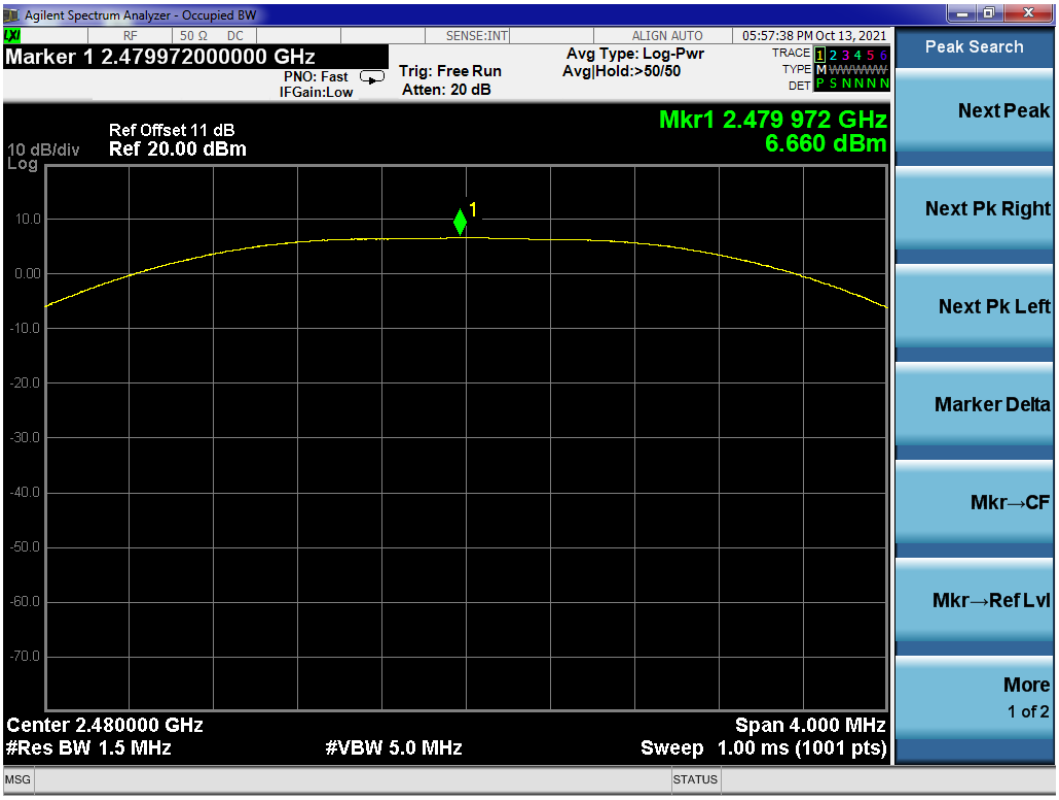
BLE 1M CH2480MHz

BLE 2M CH2402MHz

BLE 2M CH2442MHz



BLE 2M CH2480MHz



7 EMISSION LIMITATIONS MEASUREMENT

7.1 Test Equipment

The following test equipment was used during the emission limitations test:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	2021.10.13	1 Year
2.	Coaxial Cable	WOKEN	SFL402-105F LEX	F02-150819-045	2021.03.08	1 Year
3.	10 dB Attenuator	Mini-Circuits	VAT-10W2+	001	2021.08.06	1 Year

7.2 Block Diagram of Test Setup

The Same as Section. 5.2.

7.3 Specification Limits (§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)). (※This test result attaching to Section. 3.7)

7.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

7.5 Test Procedure

The transmitter output was connected to the spectrum analyzer.

Establish a reference level by using the following procedure:
a) Set instrument center frequency to DTS channel center frequency.
b) Set the span to ≥ 1.5 times the DTS bandwidth.
c) Set the RBW = 100 kHz.
d) Set the VBW ≥ [3 × 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 PSD level.
Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Establish an emission level by using the following procedure:
a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100 kHz.
c) Set the VBW ≥ [3 × RBW].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the peak marker function to determine the maximum amplitude level.
Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified in 11.11. Report the three highest emissions relative to the limit.

Scan up through 10^{th} harmonic.

The test procedure is defined in ANSI C63.10-2013 (11.11.2 Reference level measurement and 11.11.3 Emission level measurement was used).

7.6 Test Results

PASSED.

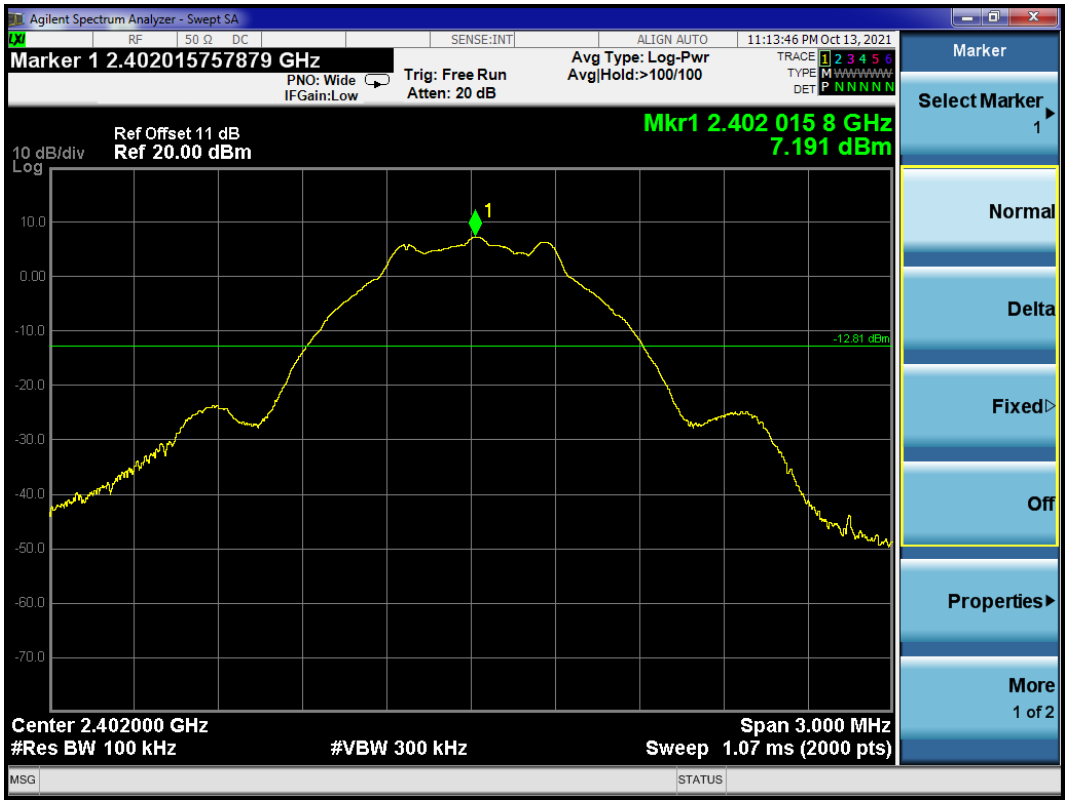
The test data was attached in the next pages.

(Test Date: 2021.10.13 Temperature: 23℃ Humidity: 51 %)

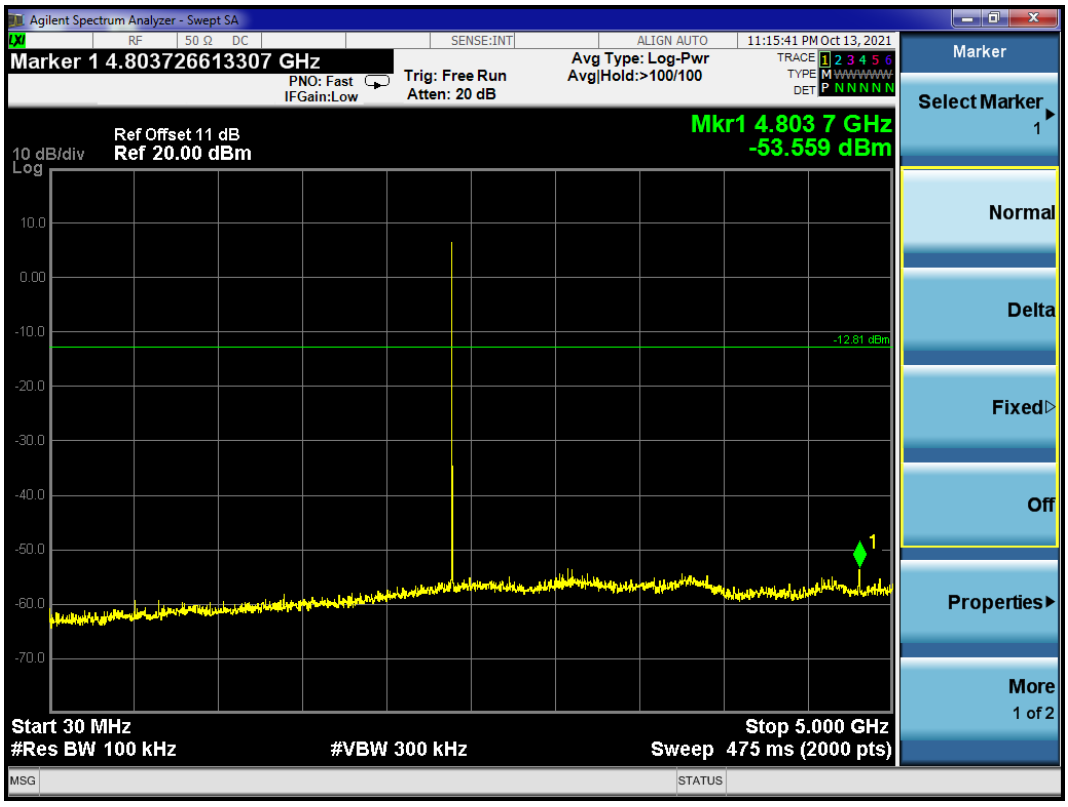
Modulation	Channel	Frequency (MHz)	Data Page
BLE 1M	00	2402	P36-P37
	20	2442	P38-P39
	39	2480	P40-P41
BLE 2M	00	2402	P42-P43
	20	2442	P44-P45
	39	2480	P46-P47

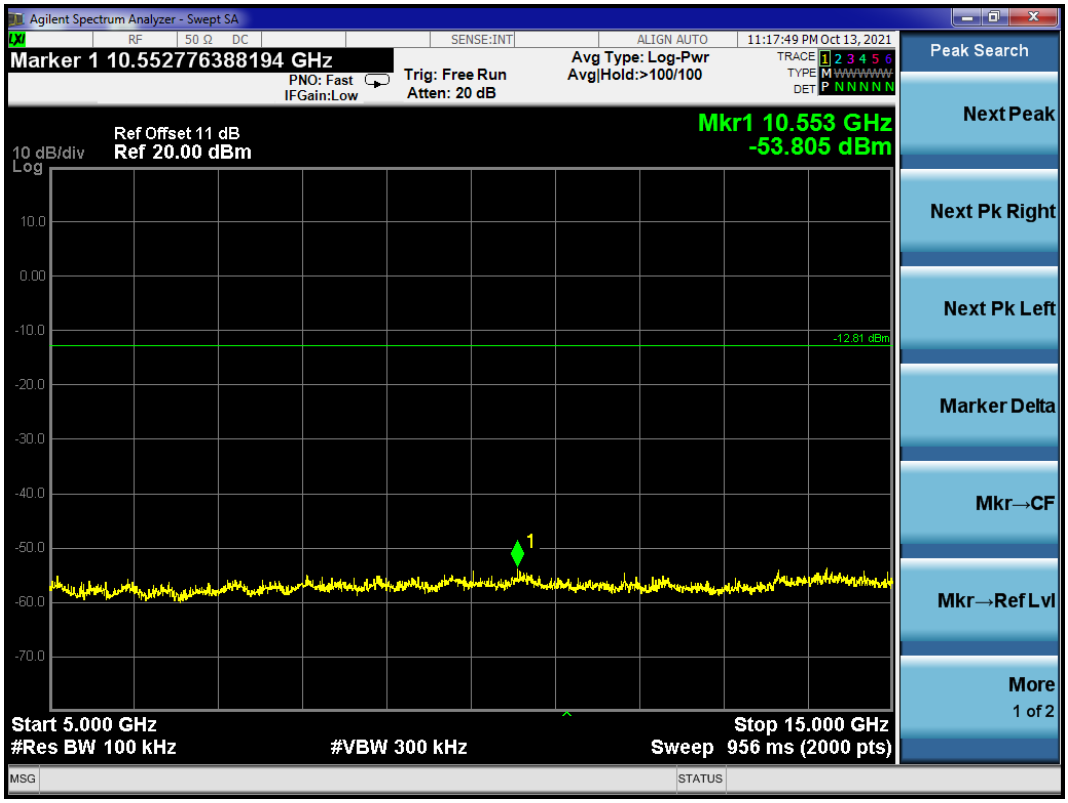
BLE 1M CH2402MHz

Reference level



Emission level

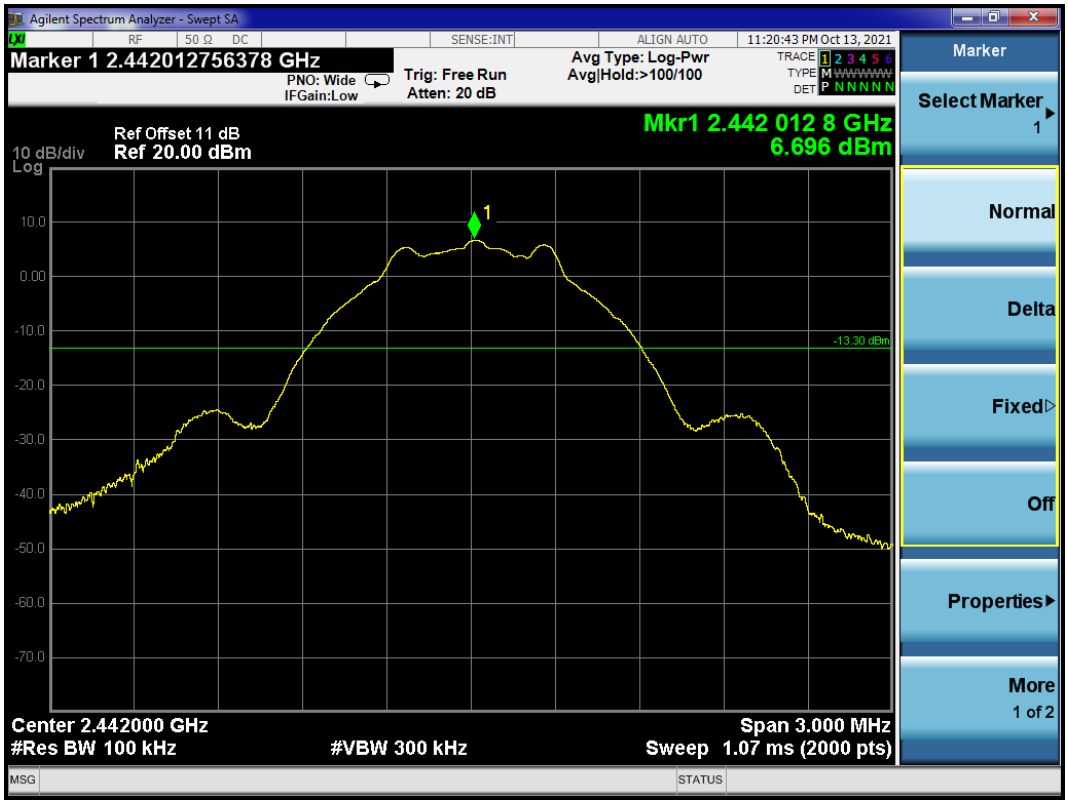



Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
11:17:49 PM Oct 13, 2021
Marker 1 10.552776388194 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 10.553 GHz
-53.805 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-12.81 dBm
1
Start 5.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 15.000 GHz
Sweep 956 ms (2000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

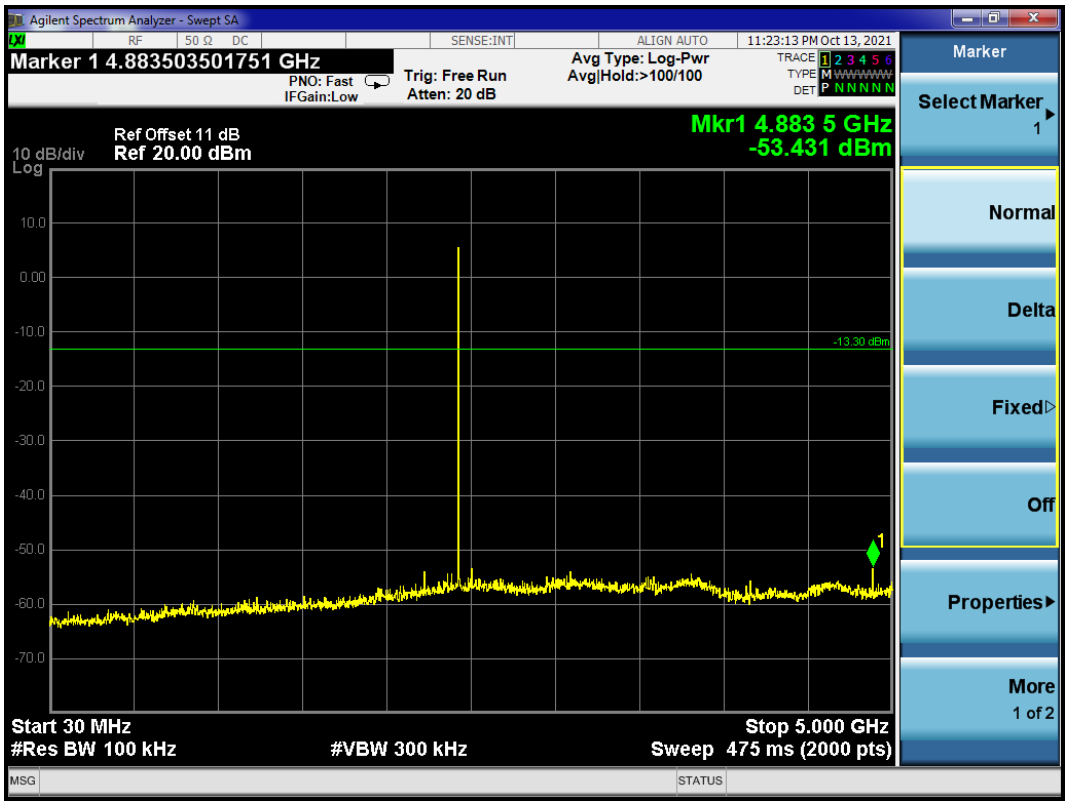

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
11:20:04 PM Oct 13, 2021
Marker 1 23.669334667334 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 23.669 GHz
-49.999 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-12.81 dBm
1
Start 15.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.000 GHz
Sweep 956 ms (2000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

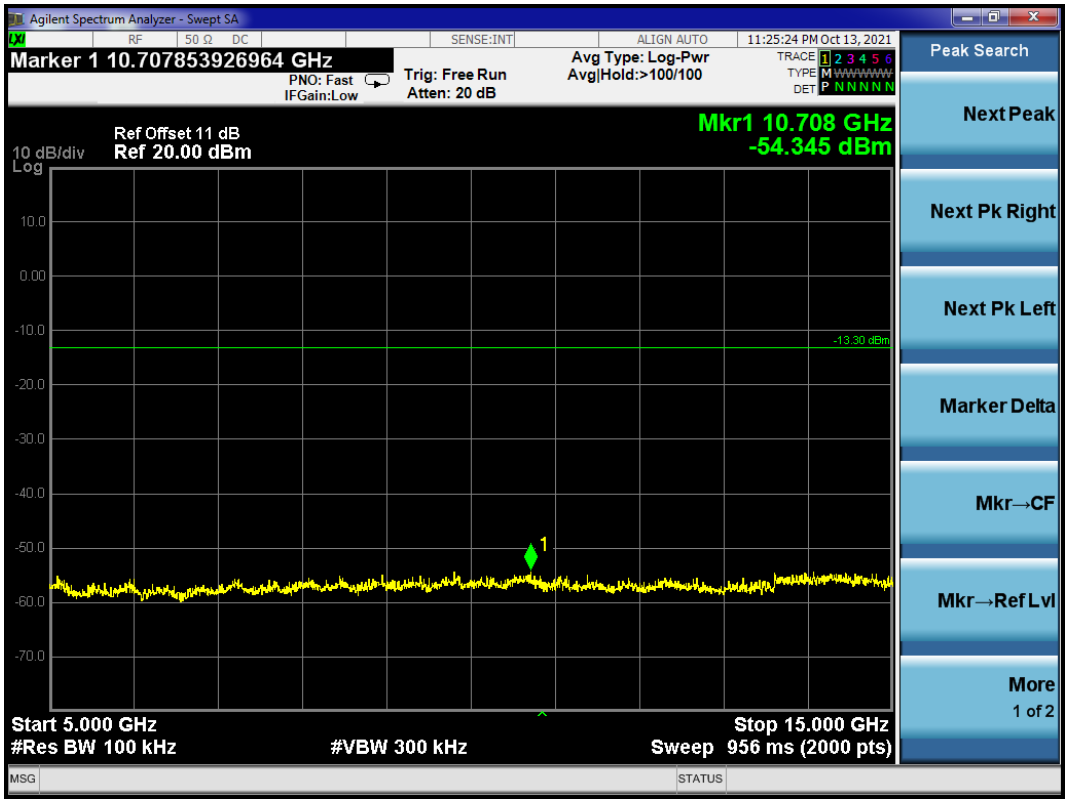
BLE 1M CH2442MHz

Reference level



Emission level

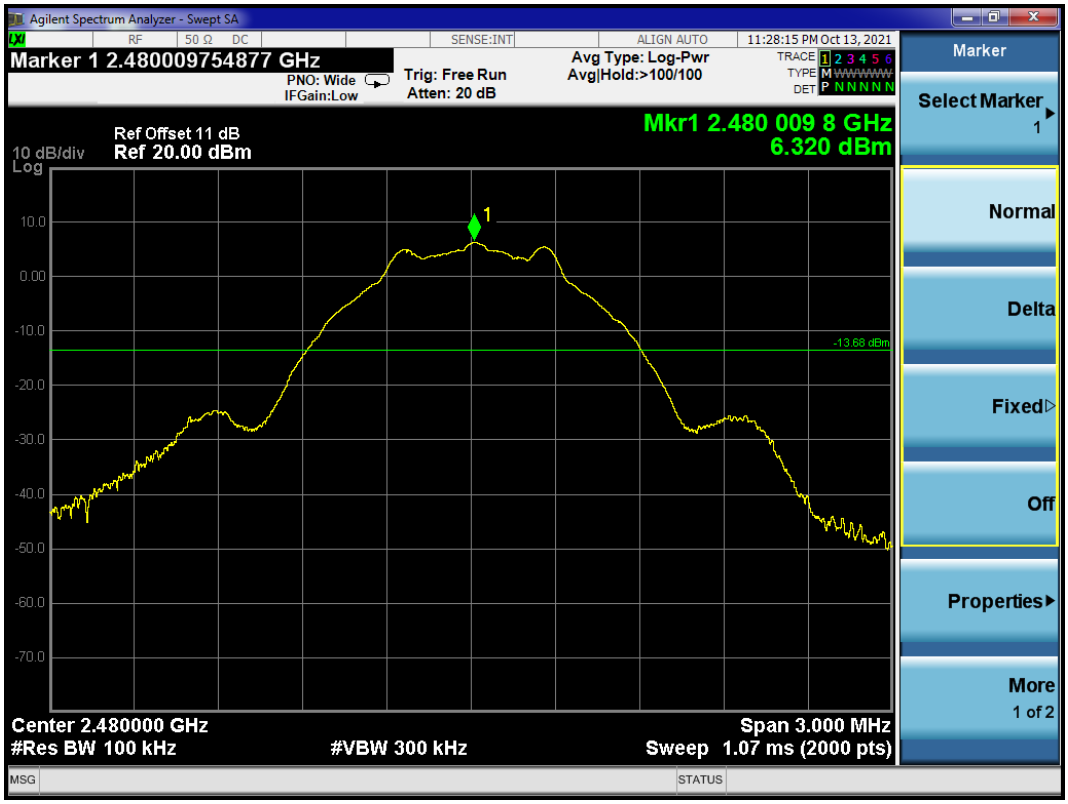



Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
11:25:24 PM Oct 13, 2021
Marker 1 10.707853926964 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 10.708 GHz
-54.345 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-13.30 dBm
1
Start 5.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 15.000 GHz
Sweep 956 ms (2000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

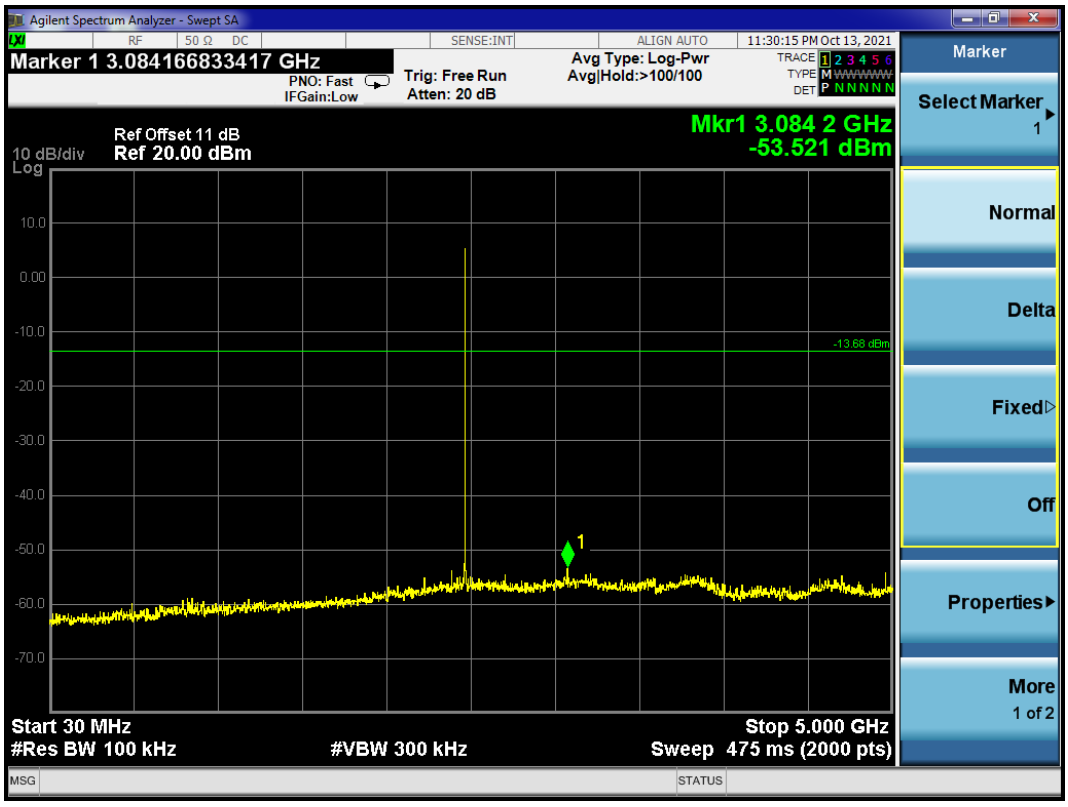

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
11:27:38 PM Oct 13, 2021
Marker 1 23.624312156078 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 23.624 GHz
-50.310 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-13.30 dBm
1
Start 15.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.000 GHz
Sweep 956 ms (2000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

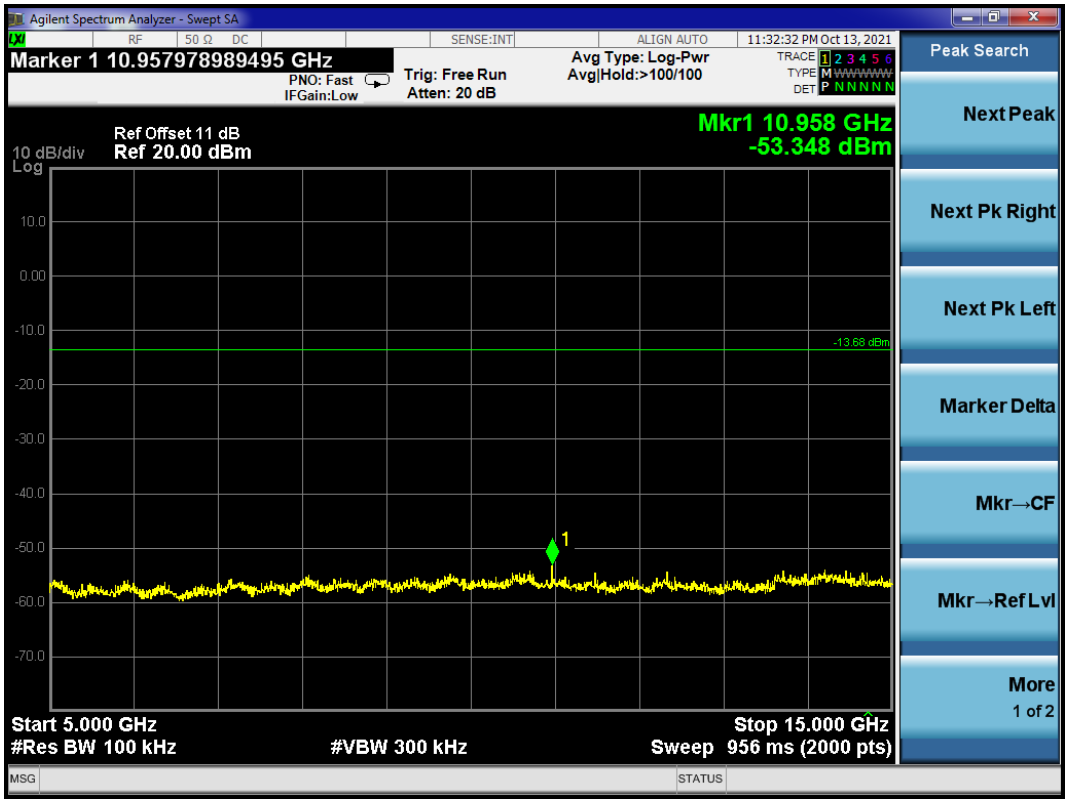
BLE 1M CH2480MHz

Reference level



Emission level



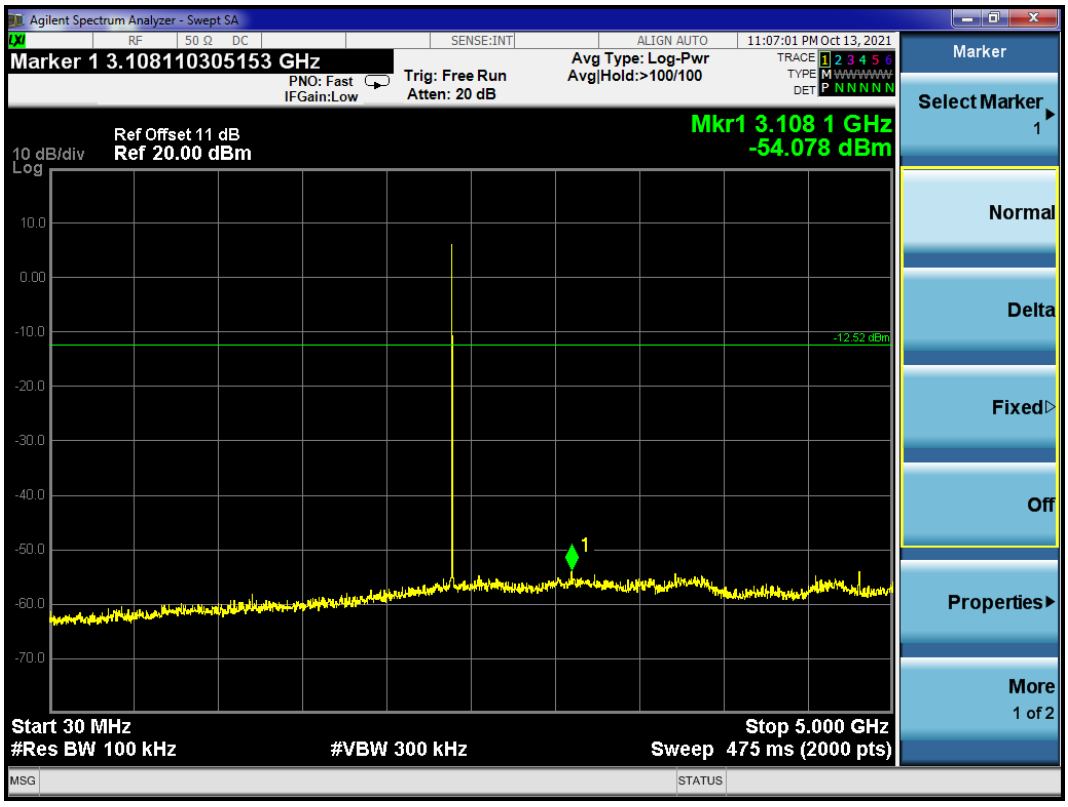

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
11:32:32 PM Oct 13, 2021
Marker 1 10.957978989495 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 10.958 GHz
-53.348 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-13.68 dBm
1
Start 5.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 15.000 GHz
Sweep 956 ms (2000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

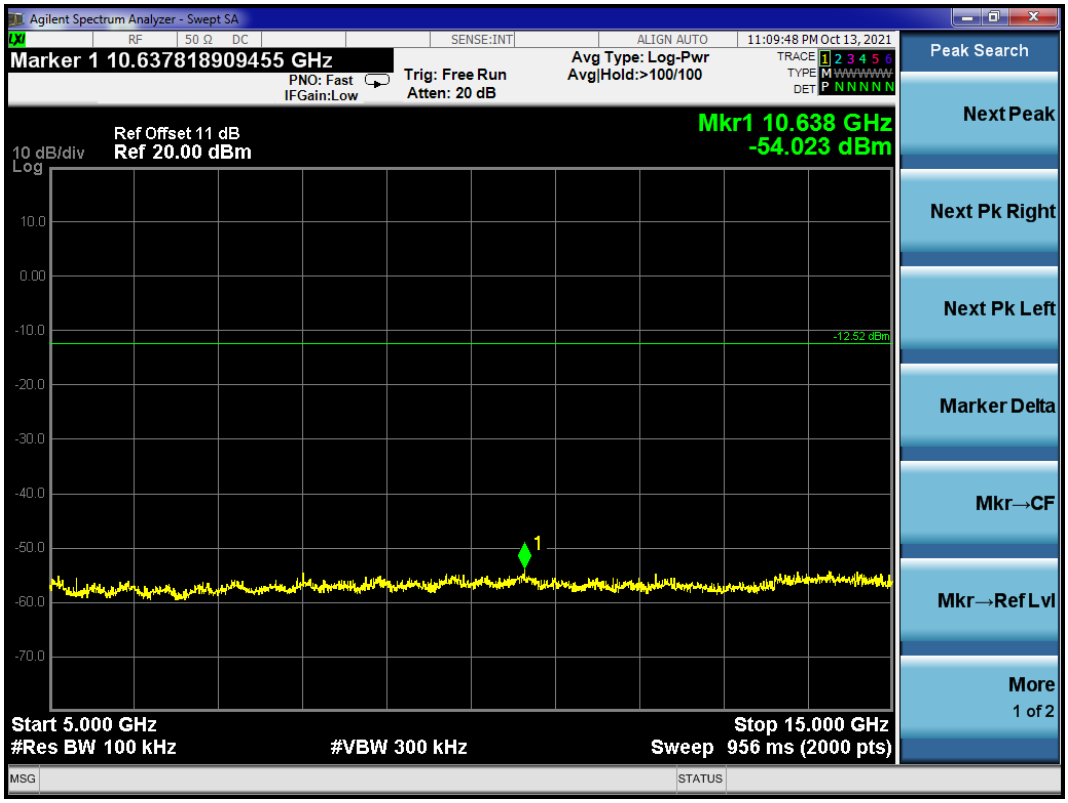

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
11:35:19 PM Oct 13, 2021
Marker 1 23.669334667334 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 23.669 GHz
-50.347 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-13.68 dBm
1
Start 15.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.000 GHz
Sweep 956 ms (2000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

BLE 2M CH2402MHz

Reference level

Emission level



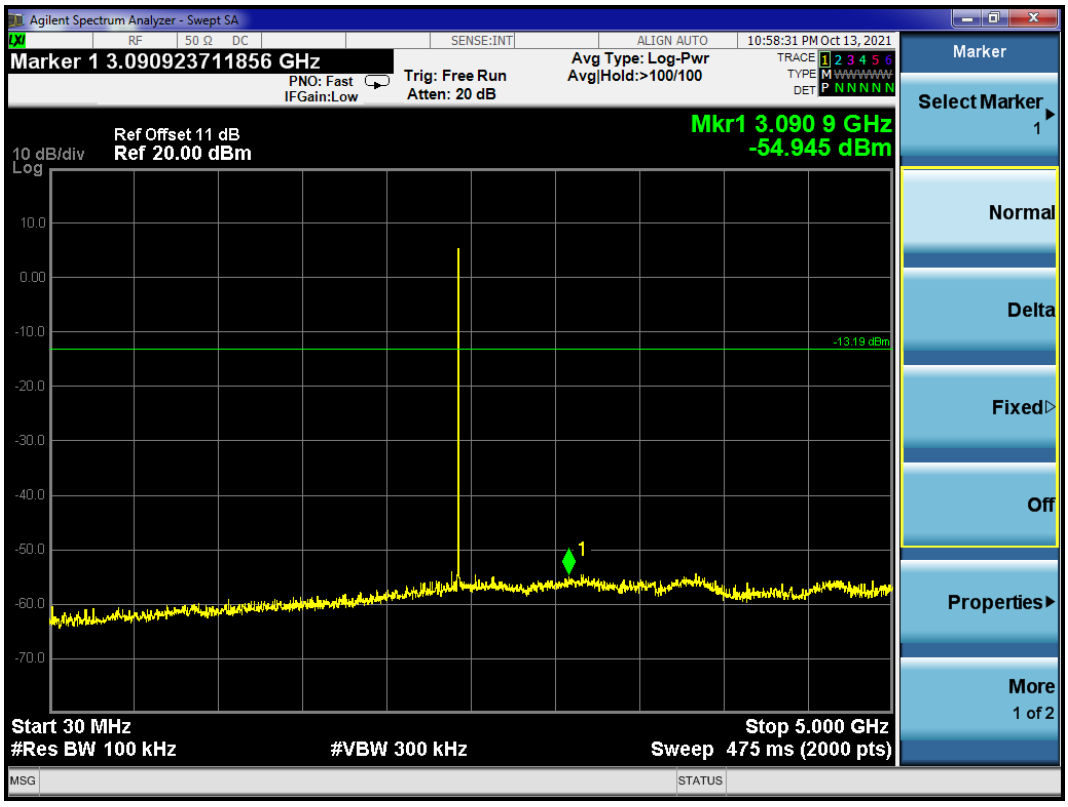

Agilent Spectrum Analyzer - Swept SA
Marker 1 10.637818909455 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:09:48 PM Oct 13, 2021
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 10.638 GHz
-54.023 dBm
-12.52 dBm
Start 5.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 15.000 GHz
Sweep 956 ms (2000 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

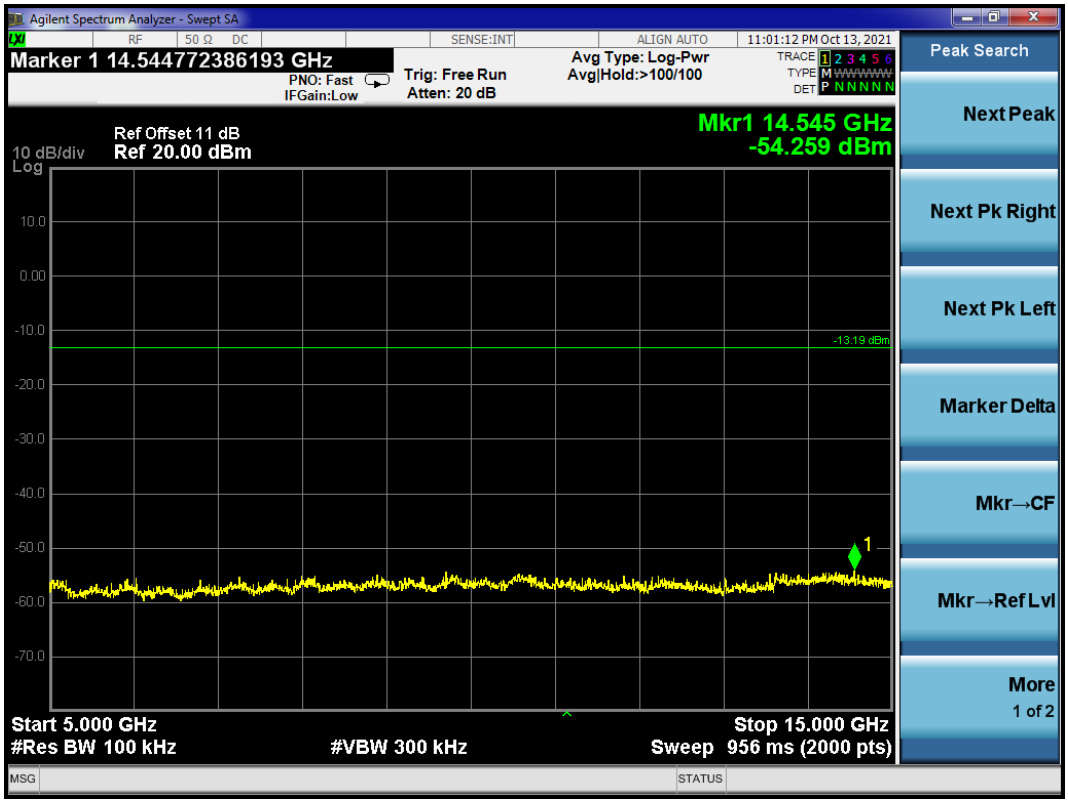

Agilent Spectrum Analyzer - Swept SA
Marker 1 23.734367183592 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
11:13:06 PM Oct 13, 2021
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 23.734 GHz
-50.339 dBm
-12.52 dBm
Start 15.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.000 GHz
Sweep 956 ms (2000 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

BLE 2M CH2442MHz

Reference level

Emission level



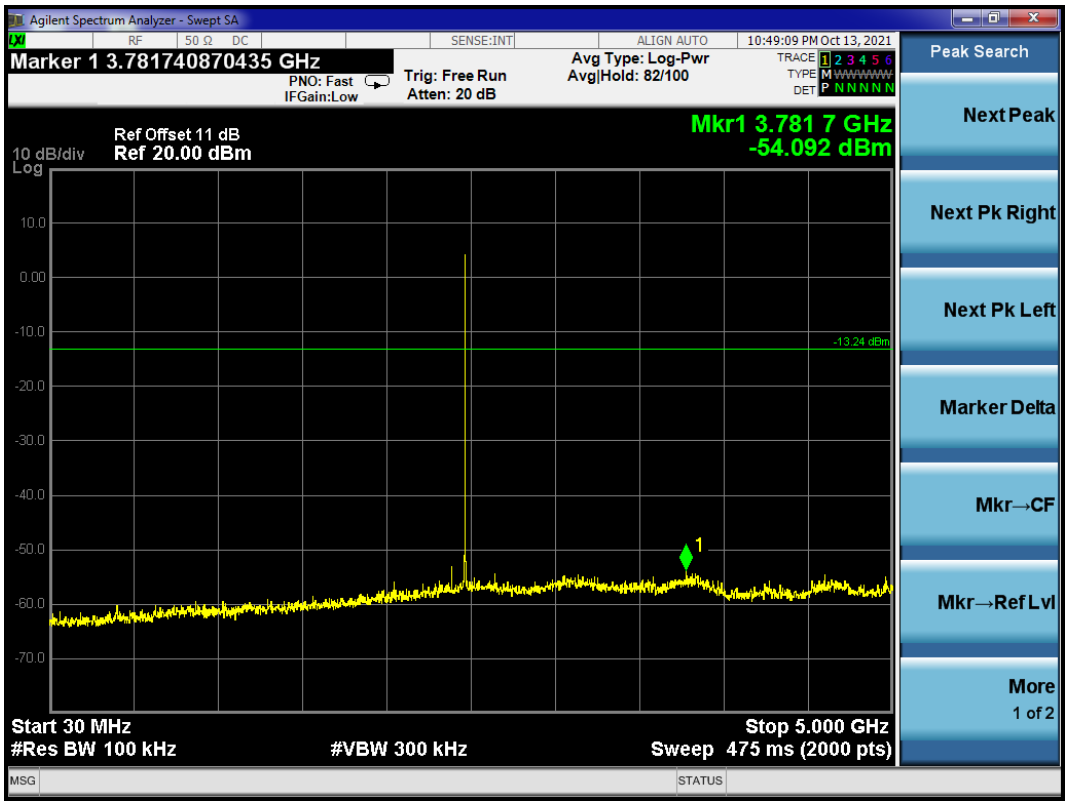

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
11:01:12 PM Oct 13, 2021
Marker 1 14.544772386193 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 14.545 GHz
-54.259 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-13.19 dBm
1
Start 5.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 15.000 GHz
Sweep 956 ms (2000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

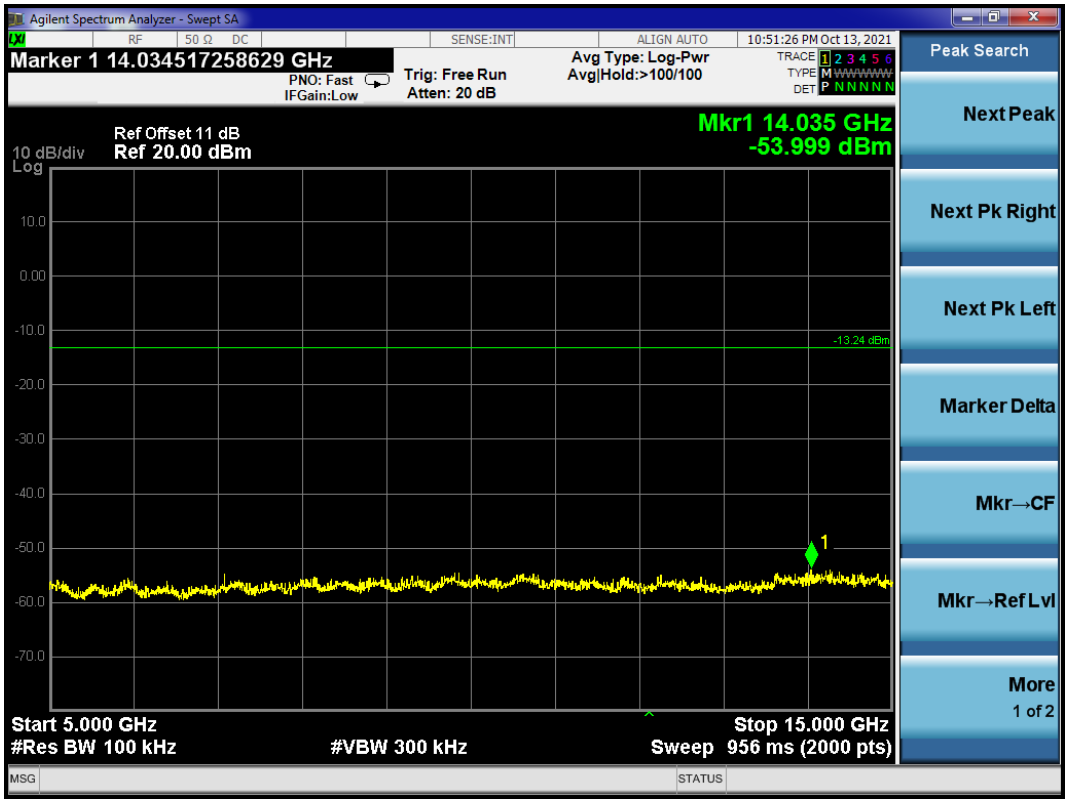

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
11:03:36 PM Oct 13, 2021
Marker 1 23.624312156078 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 23.624 GHz
-49.942 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-13.19 dBm
1
Start 15.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.000 GHz
Sweep 956 ms (2000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

BLE 2M CH2480MHz

Reference level

Emission level




Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
10:51:26 PM Oct 13, 2021
Marker 1 14.034517258629 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 14.035 GHz
-53.999 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-13.24 dBm
1
Start 5.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 15.000 GHz
Sweep 956 ms (2000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2


Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
10:55:27 PM Oct 13, 2021
Marker 1 23.624312156078 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Ref Offset 11 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 23.624 GHz
-49.708 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-13.24 dBm
1
Start 15.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.000 GHz
Sweep 956 ms (2000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

8 BAND EDGES MEASUREMENT

8.1 Test Equipment

The following test equipment was used during the band edges measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	2021.10.13	1 Year
2.	Coaxial Cable	WOKEN	SFL402-105FLEX	F02-150819-045	2021.03.08	1 Year
3.	10 dB Attenuator	Mini-Circuits	VAT-10W2+	001	2021.08.06	1 Year

8.2 Block Diagram of Test Setup

The Same as section. 5.2.

8.3 Specification Limits (§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.

8.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

8.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. Set RBW of Test Receiver to 100kHz and VBW to 300kHz with suitable frequency span including 100kHz bandwidth from band edge.
The test procedure is defined in ANSI C63.10-2013 (11.11.3 Emission level measurement was used).

8.6 Test Results

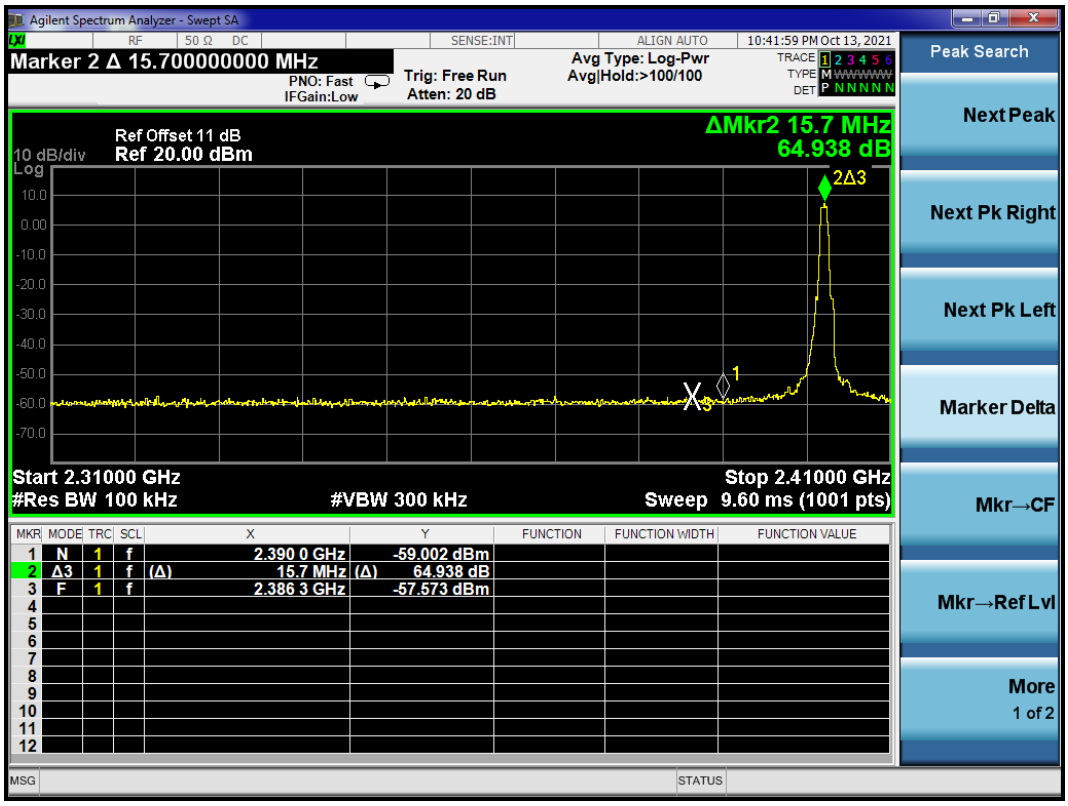
PASSED.

All the test results are attached in next pages.

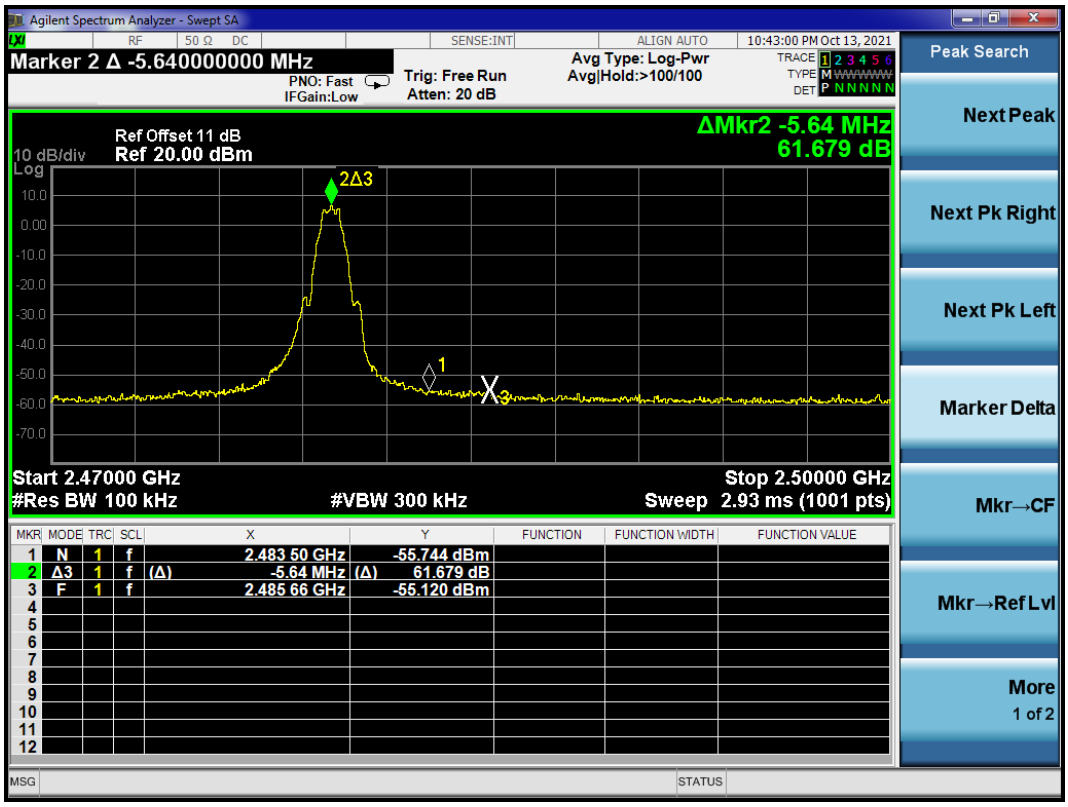
(Test Date: 2021.10.13 Temperature: 23℃ Humidity: 51 %)

Modulation	Location	Channel	Frequency (MHz)	**Delta Marker (dB)**	Result
BLE 1M	Below Band Edge	00	2402	**64.938**	More than **20 dB** below the highest level of the desired power
	Upper Band Edge	39	2480	**61.679**	
BLE 2M	Below Band Edge	00	2402	**64.943**	
	Upper Band Edge	39	2480	**60.872**	

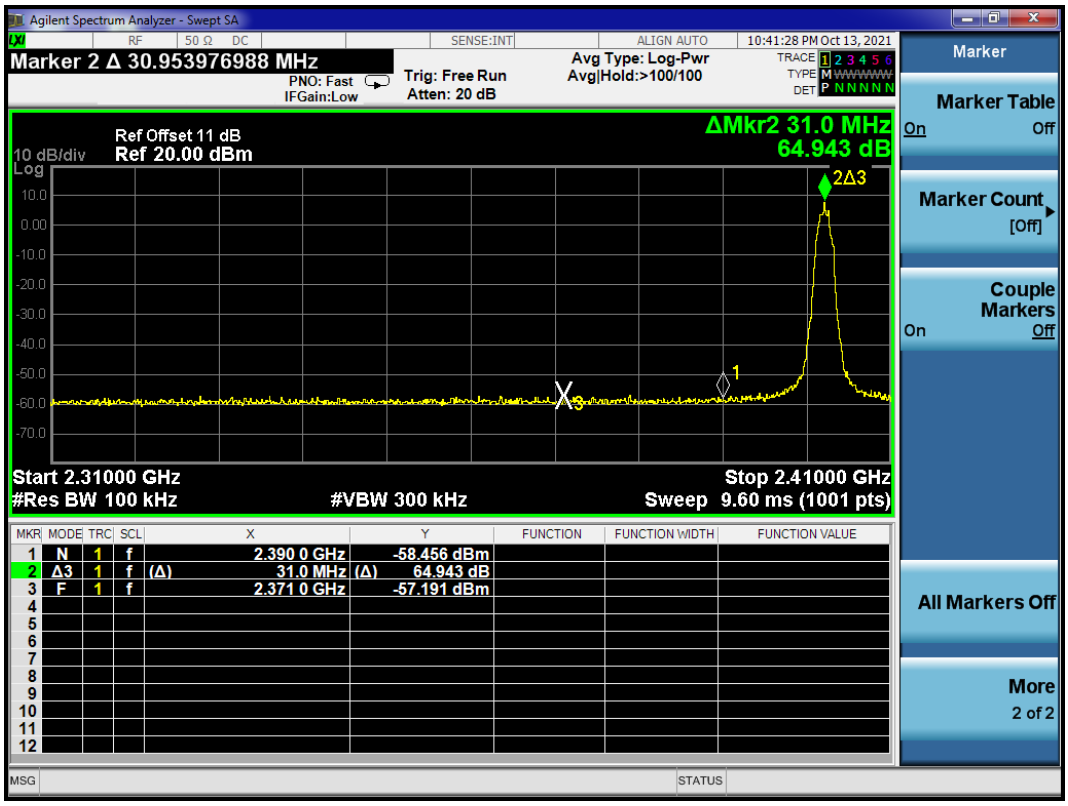
BLE 1M CH2402MHz (Below Edge 2390 MHz)



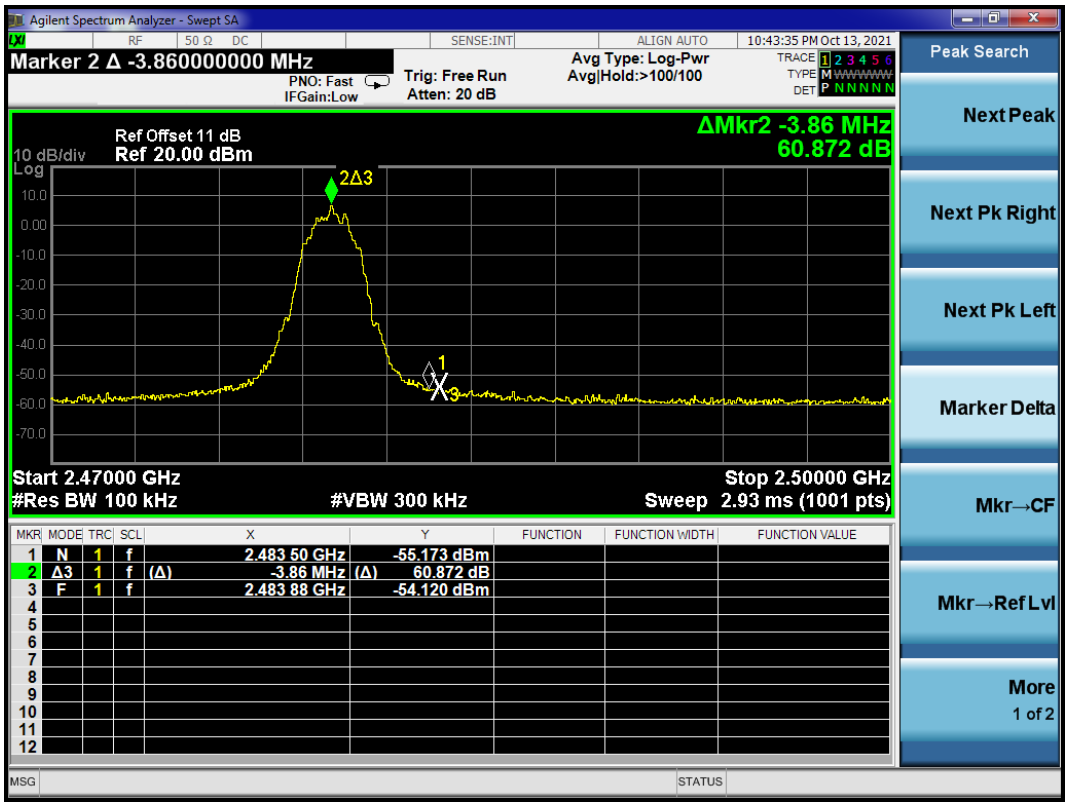
BLE 1M CH2480MHz (Upper Edge 2483.5 MHz)



BLE 2M CH2402MHz (Below Edge 2390 MHz)



BLE 2M CH2480MHz (Upper Edge 2483.5 MHz)



9 POWER SPECTRAL DENSITY MEASUREMENT

9.1 Test Equipment

The following test equipment was used during the power spectral density measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	2021.10.13	1 Year
2.	Coaxial Cable	WOKEN	SFL402-105F LEX	F02-150819-045	2021.03.08	1 Year
3.	10 dB Attenuator	Mini-Circuits	VAT-10W2+	001	2021.08.06	1 Year

9.2 Block Diagram of Test Setup

The Same as section 5.2.

9.3 Specification Limits (§15.247(e))

The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band.

9.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

9.5 Test Procedure

The transmitter output was connected to the spectrum analyzer.

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 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ [3 × 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.

The test procedure is defined in ANSI C63.10-2013 (11.10.2 Measurement Procedure “Method PKPSD (peak PSD)” was used).

9.6 Test Results

PASSED.

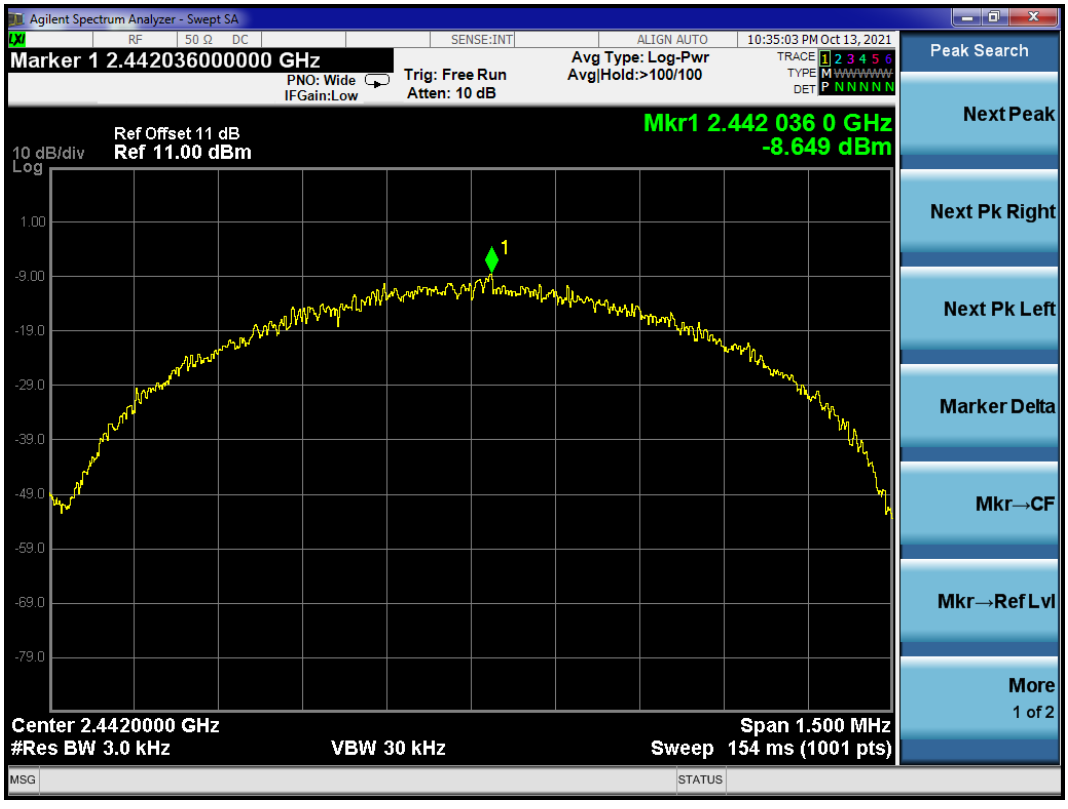
All the test results are attached in next pages.

(Test Date: 2021.10.13 Temperature: 23℃ Humidity: 51 %)

Modulation	Channel	Frequency (MHz)	**Power Spectral Density (dBm)**	Limit
BLE 1M	00	2402	**-7.779**	8 dBm
	20	2442	**-8.649**	8 dBm
	39	2480	**-8.571**	8 dBm
BLE 2M	00	2402	**-9.579**	8 dBm
	20	2442	**-10.164**	8 dBm
	39	2480	**-10.341**	8 dBm

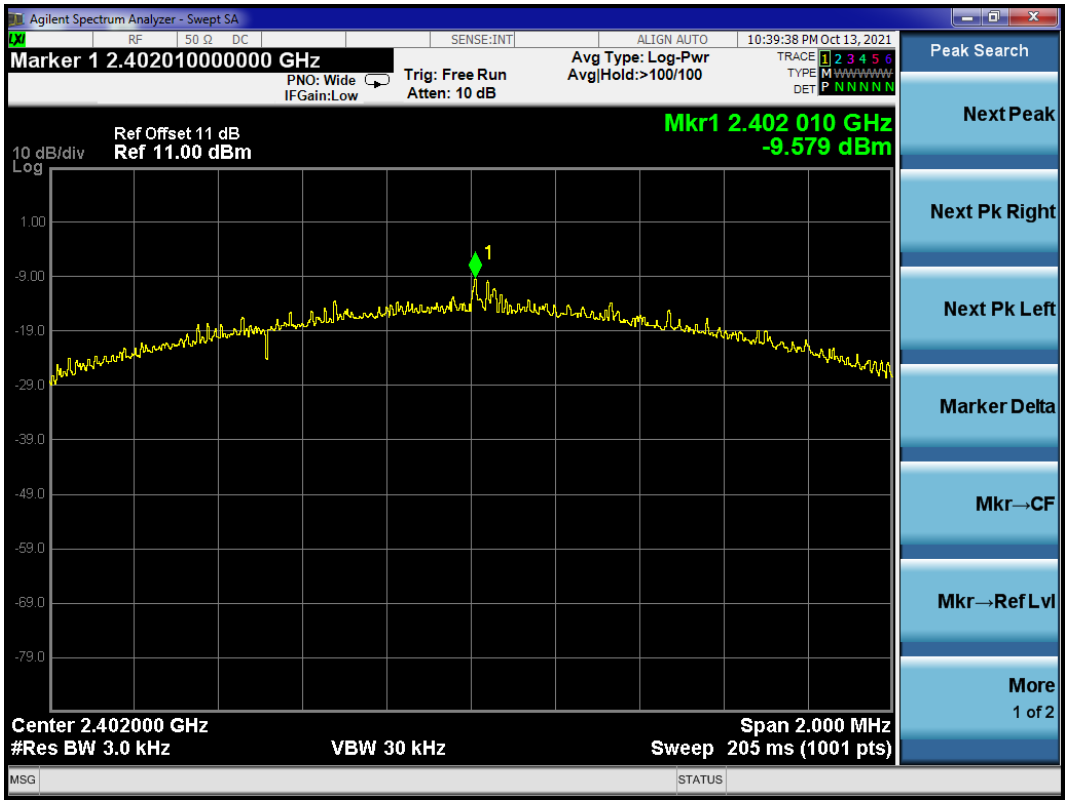
BLE 1M CH2402 MHz

BLE 1M CH2442 MHz

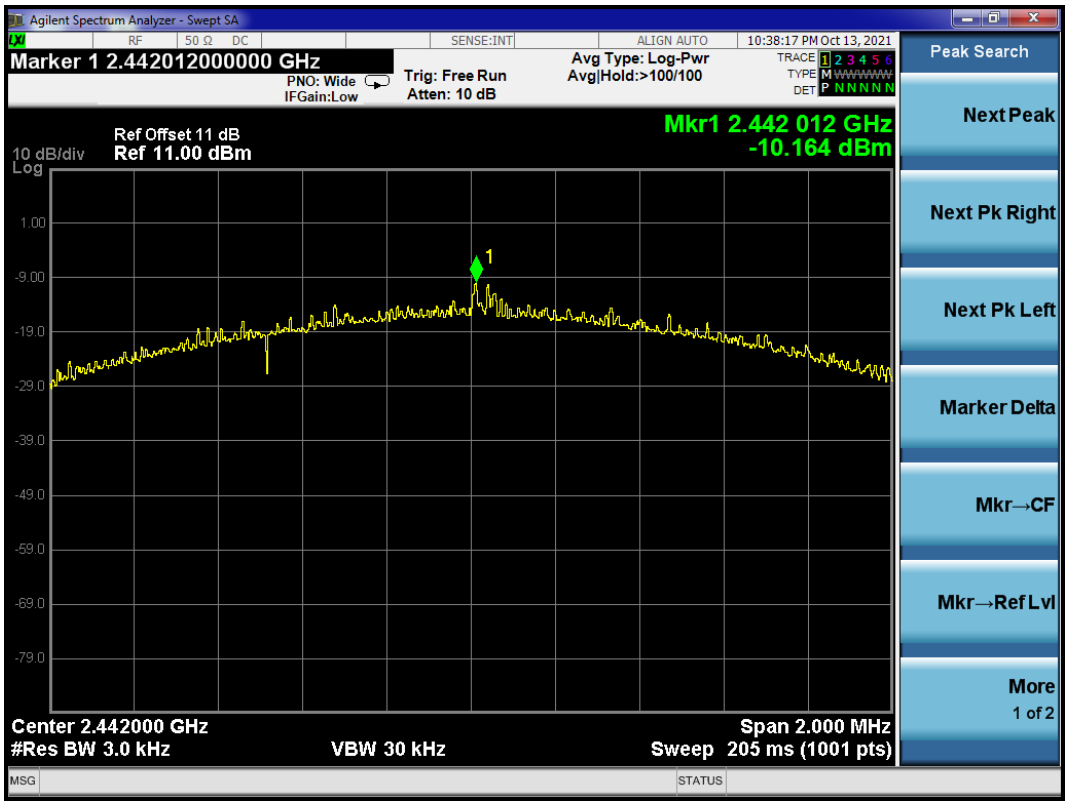


BLE 1M CH2480 MHz

BLE 2M CH2402 MHz



BLE 2M CH2442 MHz



BLE 2M CH2480 MHz

10 DEVIATION TO TEST SPECIFICATIONS

None.

11 MEASUREMENT UNCERTAINTY LIST

The measurement uncertainty was estimated for test on the EUT according to CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage of K=2.
The uncertainties value is not used in determining the PASS/FAIL results.

Test Items/Facilities	Frequency/Equipment/Unit	Uncertainty
Conducted Emission No.1 Shielded Room	9kHz~150kHz	±3.1 dB
	150kHz~30MHz	±2.6 dB
Conducted Emission No.3 Shielded Room	9kHz~150kHz	±3.1 dB
	150kHz~30MHz	±2.6 dB
Radiated Emission	30MHz~200MHz, Horizontal	±3.8 dB
	30MHz~200MHz, Vertical	±4.1 dB
	200MHz~1000MHz, Horizontal	±3.6 dB
	200MHz~1000MHz, Vertical	±5.1 dB
	1GHz~6GHz	±5.3 dB
	6GHz~18GHz	±5.3 dB
	18GHz~40GHz	±3.5 dB
Output Power Test	50MHz~18GHz	0.77 dB
Power Density Test	9kHz~6GHz	1.08 dB
RF Frequency Test	9kHz~40GHz	$6*10^{-4}$
Bandwidth Test	9kHz~6GHz	$1.5*10^{-3}$
RF Radiated Power Test	30MHz~1000MHz	3.06 dB
Conducted Output Power Test	50MHz~18GHz	0.83 dB
AC Voltage(<10kHz) Test	120V~230V	0.04 %
DC Power Test	0V~30V	0.4 %
Temperature	-40℃~+100℃	0.52 ℃
Humidity	30%~95%	2.6 %