TEST REPORT

of

FCC Part 15 Subpart C

☒ New Application; ☐ Class I PC; ☐ Class II PC

Equipment Under Test:	**WIRELESS TAG**
Brand:	**AEROSENS**
Model name:	**A20WST, A10WPT**
Product differences:	**A passive component (Reed switch) which acts a magnetic switch to detect open/close of a compartment**
FCC ID:	**2AYXGWT**
FCC Rule Part:	**§15.247, Cat: DTS**
Applicant:	**AEROSENS**
Address:	**7120 SW 47th Street, Miami, FL, 33155 United States**

Test Performed by:

International Standards Laboratory Corp. LT Lab.
TEL: +886-3-263-8888 FAX: +886-3-263-8899
No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist., Tao Yuan City 325, Taiwan

Report No.: **ISL-21LR044FC**
Issue Date : **2021/03/19**

Testing Laboratory 0997

VERIFICATION OF COMPLIANCE

Applicant:	AEROSENS
Equipment Under Test:	WIRELESS TAG
Brand:	AEROSENS
Model name:	A20WST, A10WPT01
Product differences:	A passive component (Reed switch) which acts a magnetic switch to detect open/close of a compartment
FCC ID:	2AYXGWT
Date of test:	2021/02/02 ~ 2021/03/18
Date of EUT Received:	2021/02/02

We hereby certify that:

All the tests in this report have been performed and recorded in accordance with the standards described above and performed by an independent electromagnetic compatibility consultant, International Standards Laboratory Corp.

The test results contained in this report accurately represent the measurements of the characteristics and the energy generated by sample equipment under test at the time of the test. The sample equipment tested as described in this report is in compliance with the limits of above standards.

Test By:	Barry Lee	***Date:***	2021/03/19
	Barrry Lee / Senior Engineer		
Prepared By:	Gigi yeh	***Date:***	2021/03/19
	Gigi Yeh / Senior Engineer		
Approved By:	Jerry Liu	***Date:***	2021/03/19
	Jerry Liu / Assistant Manager		

Version

Version No.	Date	Description
00	2021/03/19	Initial creation of document

Uncertainty of Measurement

Description Of Test	Uncertainty
Conducted Emission (AC power line)	2.586 dB
Field Strength of Spurious Radiation	<=30MHz: 2.96dB 30-1GHz: 4.22 dB 1-40 GHz: 4.08 dB
Conducted Power	2.412 GHz: 1.30 dB 5.805 GHz: 1.55 dB
Power Density	2.412 GHz:1.30 dB 5.805 GHz: 1.67 dB
Frequency	0.0032%

Table of Contents

1 General Information

General:

Equipment Under Test:	WIRELESS TAG
Brand:	AEROSENS
Model name:	A20WST, A10WPT01
Power Supply:	3Vdc from coin battery

Bluetooth:

Frequency Range:	2402 – 2480MHz
Bluetooth Version:	V5.0
Channel number:	40 channels, 2MHz step
Modulation type	GFSK
Tune-up power	-0.524 dBm
Power Tolerance:	+/-0 dBm
Dwell Time:	N/A
Antenna Designation:	PCB Antennas, 1.95dBi

Remark: The above DUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.1 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2AYXGWT** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

1.2 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at an antenna to EUT distance 3 meters.

KDB Document: 558074 D01 15.247 Meas Guidance v05r02.

1.3 Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of **International Standards Laboratory Corp.** <LT Lab.> No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist., Tao Yuan City 325, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.10: 2013. FCC Registration Number is: 487532; Designation Number is: TW0997, Canada Registration Number: 4067B-4.

1.4 Special Accessories

Not available for this EUT intended for grant.

1.5 Equipment Modifications

Not available for this EUT intended for grant.

2 System Test Configuration

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The EUT (Transmitter) was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 6 of ANSI C63.10: 2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR 16-1-1 Quasi-Peak and Average detector mode.

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8/1.5 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” Is still within the 3dB illumination BW of the measurement antenna. According to the requirements in Section 8 and 13 and Subclause 8.3.1.2 of ANSI C63.10: 2013.

2.4 Configuration of Tested System

Fig. 2-1 Configuration

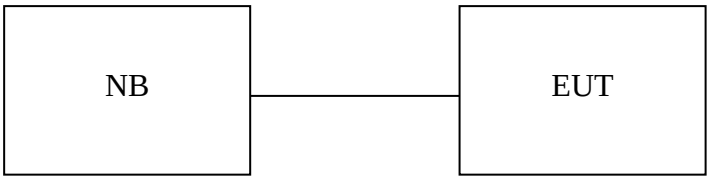


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1	NB	HP	440-G1	N/A	N/A	N/A

Note: All the above equipment/cables were placed in worse case positions to maximize emission signals during emission test.

Grounding: Grounding was in accordance with the manufacturer's requirements and conditions for the intended use.

3 Summary of Test Results

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b) (3),(4)	Peak Output Power/ EIRP	Compliant
§15.247(a)(2)	6dB & 99% Power Bandwidth	Compliant
§15.247(d)	100 kHz Bandwidth Of Frequency Band Edges	Compliant
§15.247(d)	Spurious Emission	Compliant
§15.247(e)	Peak Power Density	Compliant
§15.203	Antenna Requirement	Compliant

4 Description of Test Modes

The EUT has been tested under engineering operating condition.
Test program used to control the EUT for staying in continuous transmitting mode is programmed.

BT LE mode: Channel low (2402MHz), mid (2442MHz) and high (2480MHz) are chosen for full testing.

5 Conduced Emission Test

5.1 Standard Applicable:

According to §15.207 and RSS-Gen §7.2.4, frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

5.2 Measurement Equipment Used:

Location Con03	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Conduction 03	EMI Receiver 15	ROHDE & SCHWARZ	ESCI	101166	07/29/2020	07/29/2021
Conduction 03	ISN T4 09	Teseq GmbH	ISN T400A	49914	08/10/2020	08/10/2021
Conduction 03	ISNT8 09	Teseq GmbH	ISN T800	36190	09/20/2020	09/20/2021
Conduction 03	LISN 15	R&S	ENV216	101335	12/12/2020	12/12/2021
Conduction 03	LISN 22	R&S	ENV216	101478	08/10/2020	08/10/2021
Conduction 03	Conduction 04-3 Cable	WOKEN	CFD 300-NL	conduction 04-3	08/29/2020	08/29/2021
Conduction 03	Capacitive Voltage Probe	FCC	F-CVP-1	68	01/17/2021	01/17/2022
Conduction 03	Current Probe	SCHAFFNER	SMZ 11	18030	01/17/2021	01/17/2022

5.3 EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10-2013.
2. The AC/DC Power adaptor of PC was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

5.4 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.
4. Both 120V & 240V have been verified, and 120V/60Hz was defined as the worst-case and record in the report.

5.5 Measurement Result:

N/A, The power supply is 3Vdc.

6 Peak Output Power Measurement

6.1 Standard Applicable:

According to §15.247(b)(3),(4)(b)

(3) For 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.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

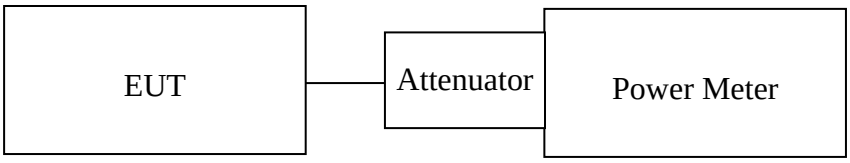
(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

6.2 Measurement Equipment Used:

Location Conducted	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Conducted	Power Meter	Anritsu	ML2495A	1116010	09/25/2020	09/25/2021
Conducted	Power Sensor	Anritsu	MA2411B	34NKF50	09/25/2020	09/25/2021
Conducted	Power Sensor	DARE	RPR3006W	13I00030SNO33	01/04/2021	01/04/2022
Conducted	Power Sensor	DARE	RPR3006W	13I00030SNO34	01/04/2021	01/04/2022
Conducted	Power Sensor	DARE	RPR3006W	14I00889SNO35	06/29/2020	06/29/2021
Conducted	Power Sensor	DARE	RPR3006W	14I00889SNO36	06/29/2020	06/29/2021
Conducted	Temperature Chamber	KSON	THS-B4H100	2287	03/11/2021	03/11/2022
Conducted	DC Power supply	ABM	8185D	N/A	01/05/2021	01/05/2022
Conducted	AC Power supply	EXTECH	CFC105W	NA	N/A	N/A
Conducted	Spectrum analyzer	Keysight	N9010A	MY56070257	09/23/2020	09/23/2021
Conducted	Spectrum analyzer	R&S	FSP40	100116	NA	NA
Conducted	Test Software	DARE	Radiation Ver:2013.1.23	NA	N/A	N/A
Conducted	Test Software	R&S	CMUGO Ver:2.0.0	N/A	11/29/2020	11/29/2021
Conducted	Radio Communication Analyzer	R&S	CMU200	111968	10/28/2020	10/28/2021
Conducted	Radio Communication Analyzer	R&S	CMW500	1201.002K50108793-JG	NA	NA
Conducted	BT Simulator	Agilent	N4010A	MY48100200	NA	NA
Conducted	GPS Simulator	Welnavigate	GS-50	701523	09/25/2020	09/25/2021

6.3 Test Set-up:



6.4 Measurement Procedure:

1. Place the EUT on the table 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 the power meter
3. Record the max. reading.
4. Repeat above procedures until all frequency measured were complete.

6.5 Measurement Result:

Peak Power

Mode	Freq. (MHz)	Output Power (dBm)	Output Power Limit (dBm)
BLE 4.0	2402	-0.524	30.00
	2442	-1.112	30.00
	2480	-1.230	30.00

Peak Power

Mode	Freq. (MHz)	Output Power (dBm)	Output Power Limit (dBm)
BLE 5.0	2402	-0.561	30.00
	2442	-1.142	30.00
	2480	-1.176	30.00

7 6dB Bandwidth & 99% Bandwidth

7.1 Standard Applicable:

According to §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 500kHz.

7.2 Measurement Equipment Used:

Refer to section 6.2 for details.

7.3 Test Set-up:

Refer to section 6.3 for details.

7.4 Measurement Procedure:

1. Place the EUT on the table 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 the spectrum analyzer.
3. Set the spectrum analyzer as RBW=100kHz, VBW = 3*RBW, Span= cover the complete power envelope of the signal of the UUT Sweep=auto
4. Mark the peak frequency and –6dB (upper and lower) frequency.
5. Repeat above procedures until all frequency measured were complete.

7.5 Measurement Result:

BT 4.0

Frequency (MHz)	6dB Bandwidth (MHz)	99% OBW (MHz)	6dB BW Limit (kHz)
2402	0.675	1.045	> 500
2442	0.678	1.049	> 500
2480	0.677	1.048	> 500

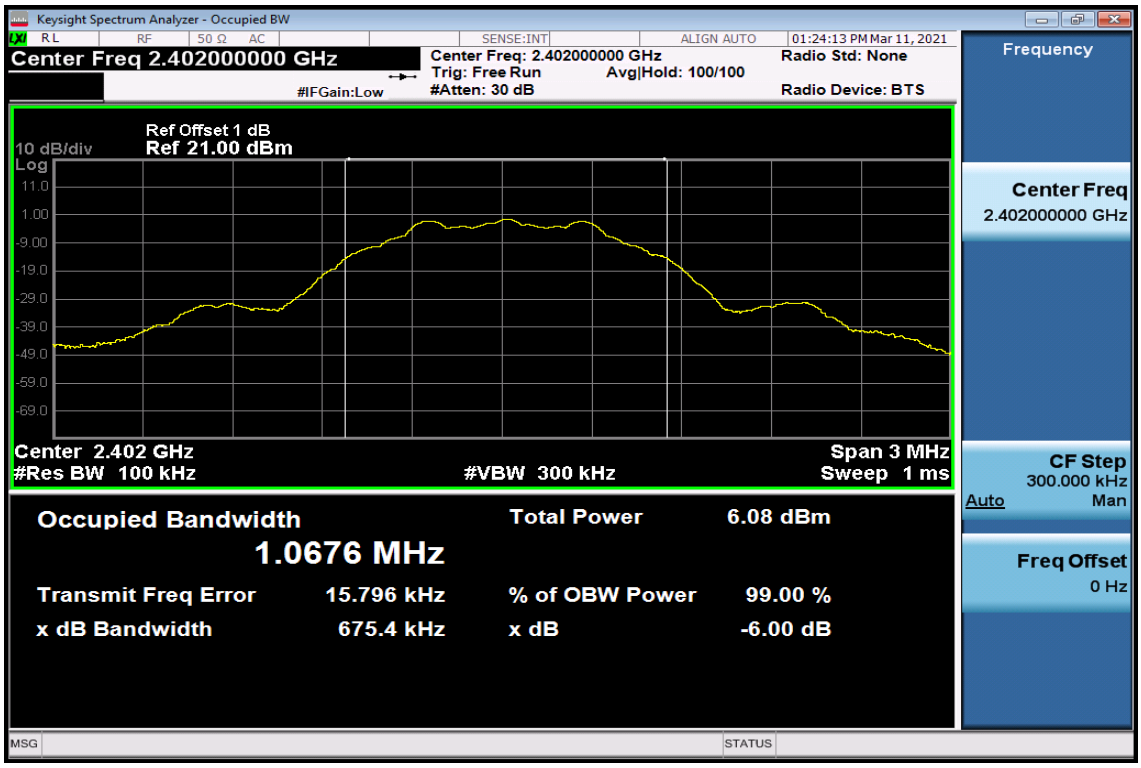
BT 5.0

Frequency (MHz)	6dB Bandwidth (MHz)	99% OBW (MHz)	6dB BW Limit (kHz)
2402	0.677	1.046	> 500
2442	0.694	1.048	> 500
2480	0.679	1.048	> 500

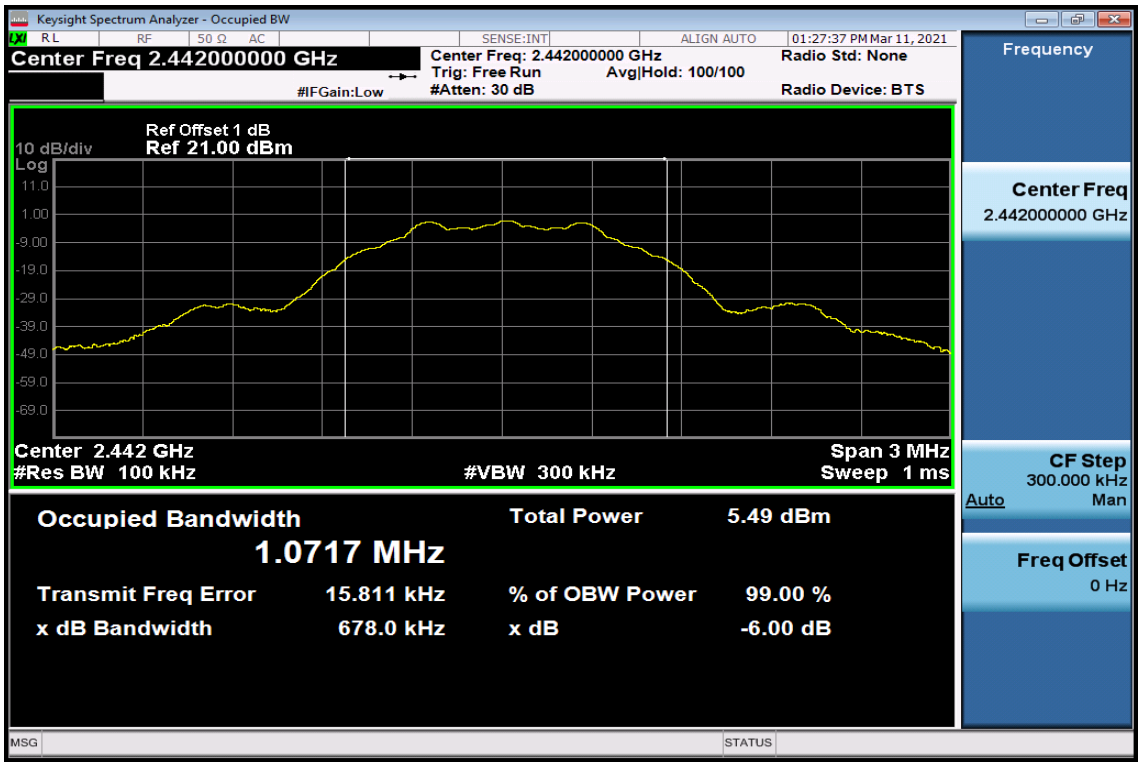
Note: Refer to next page for plots.

BLE Mode 4.0

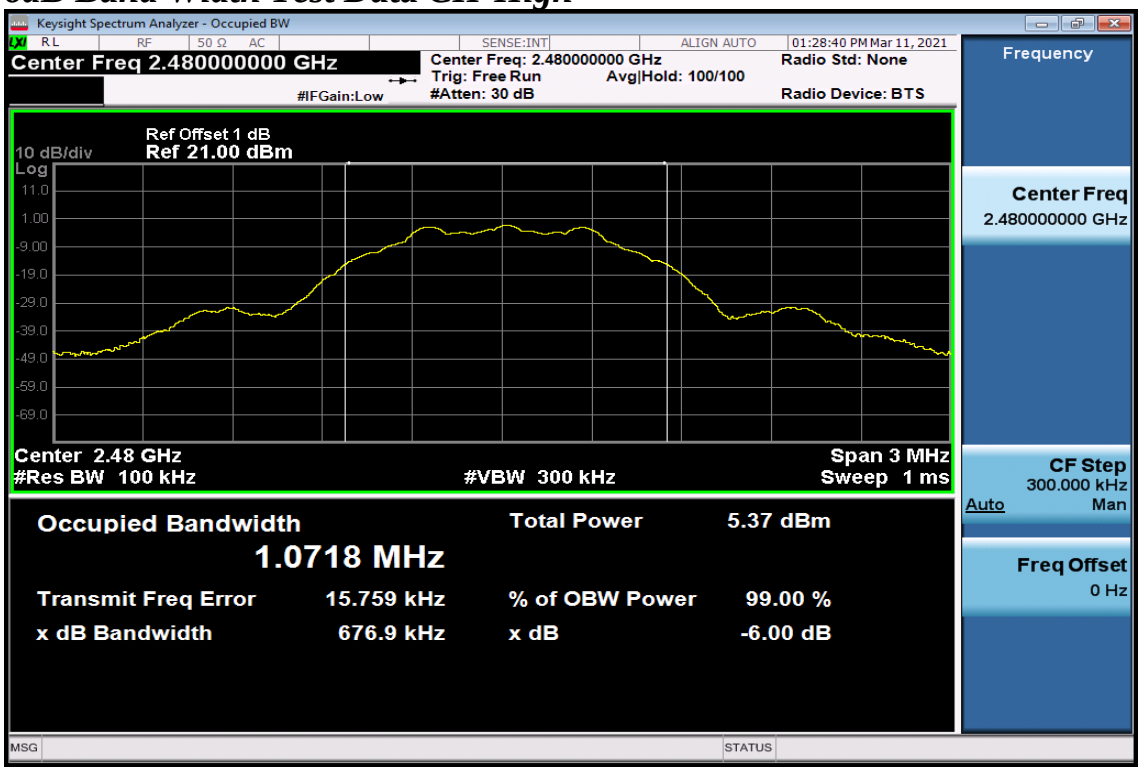
6dB Bandwidth Test Data CH-Low



6dB Band Width Test Data CH-Mid

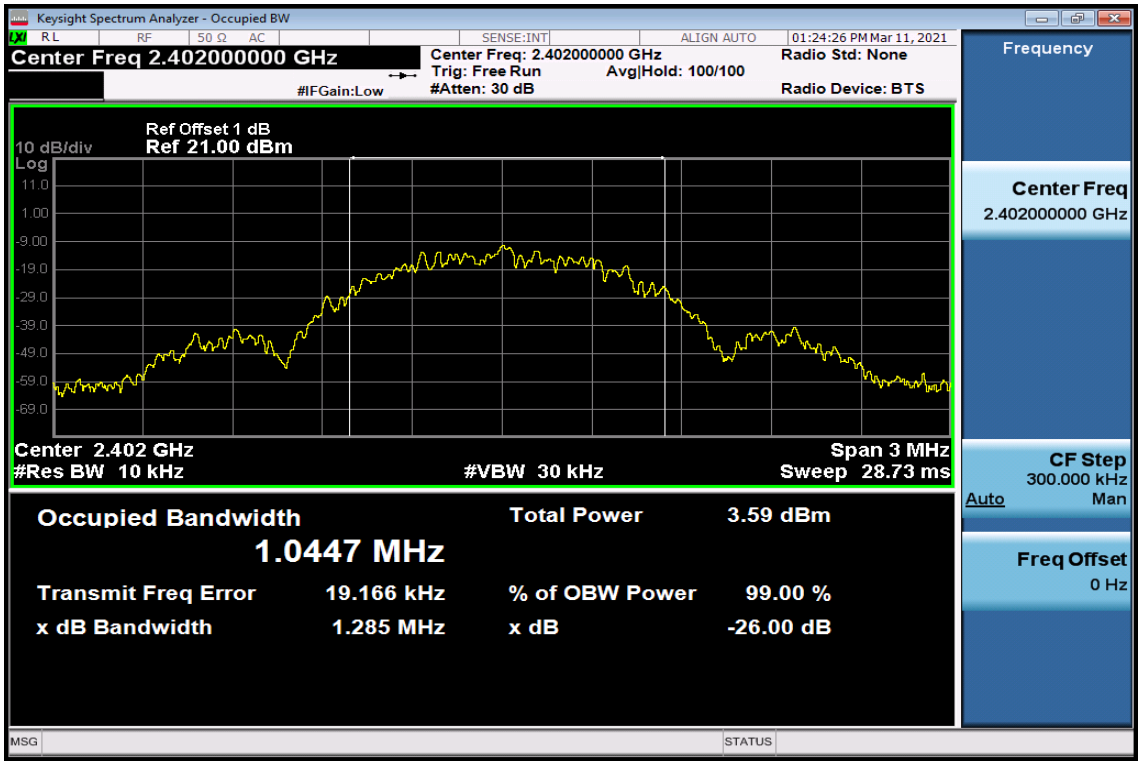


6dB Band Width Test Data CH-High

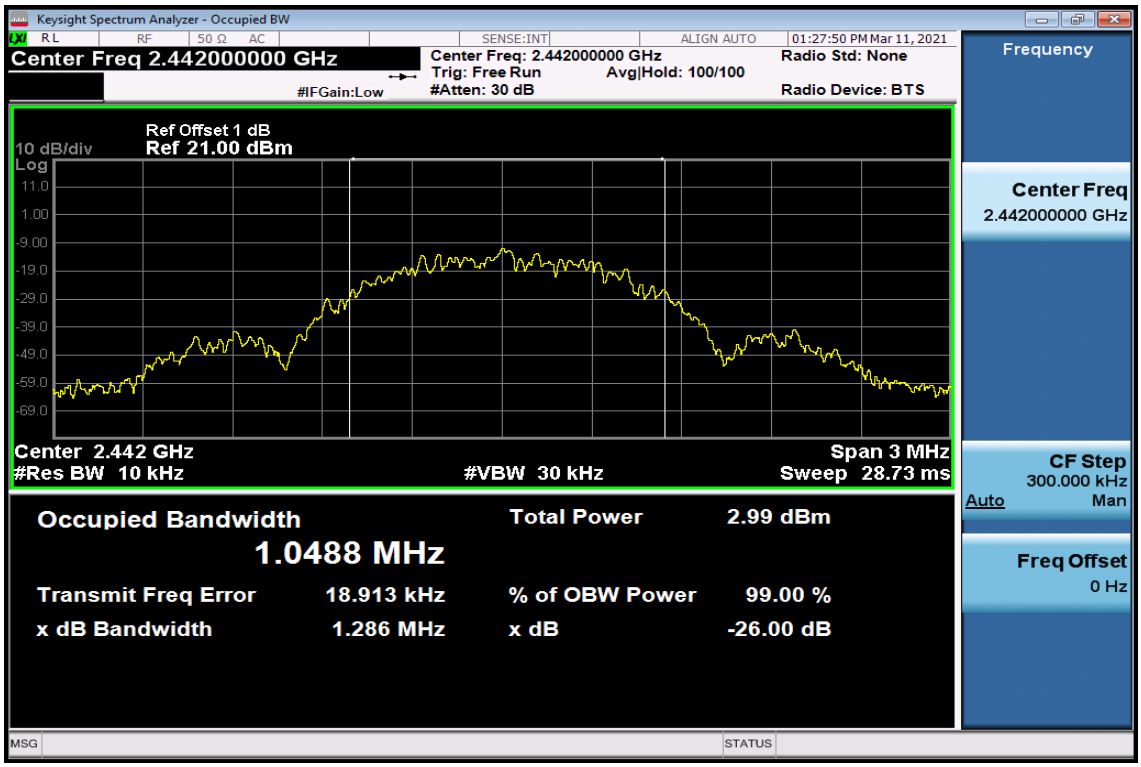


BLE Mode 4.0

99% Bandwidth Test Data CH-Low



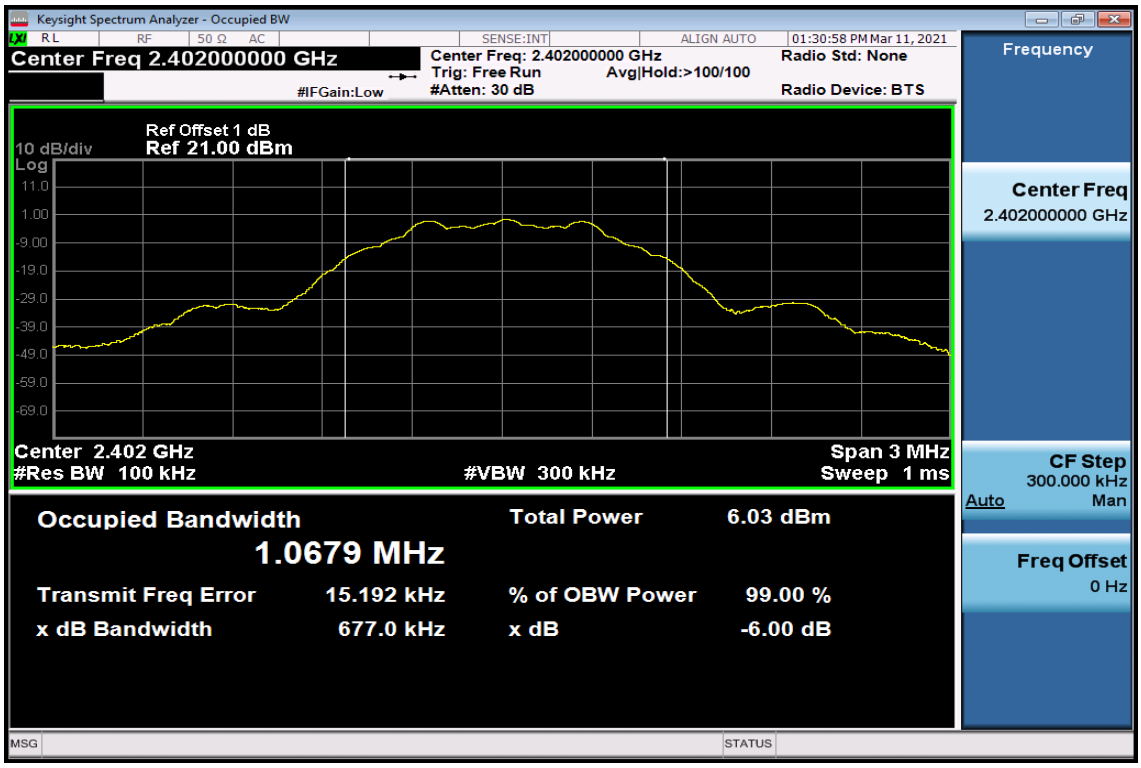
99% Band Width Test Data CH-Mid



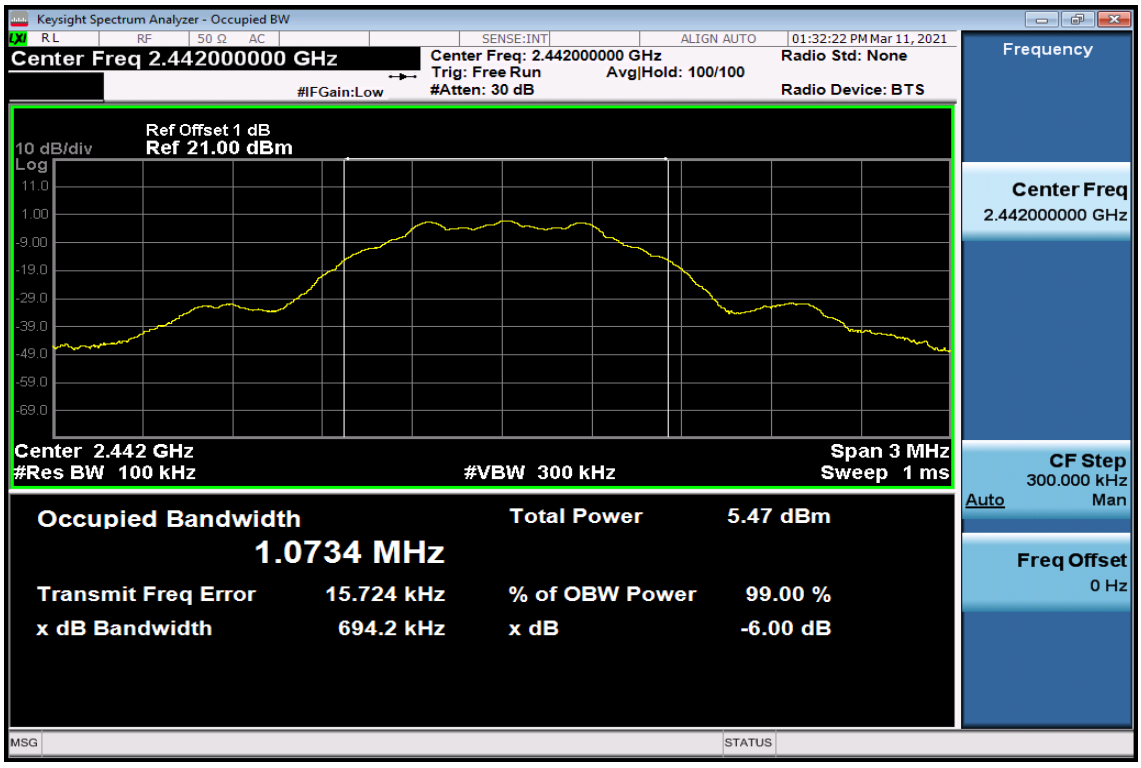
99% Band Width Test Data CH-High

BLE Mode 5.0

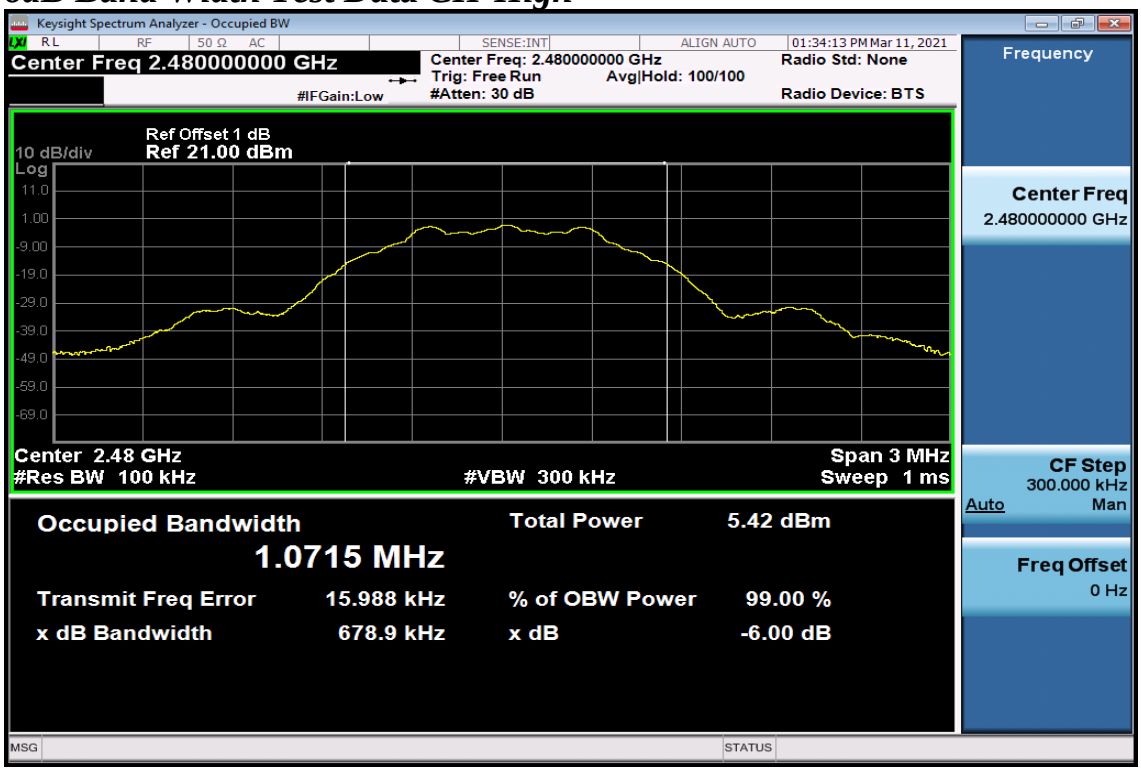
6dB Bandwidth Test Data CH-Low



6dB Band Width Test Data CH-Mid

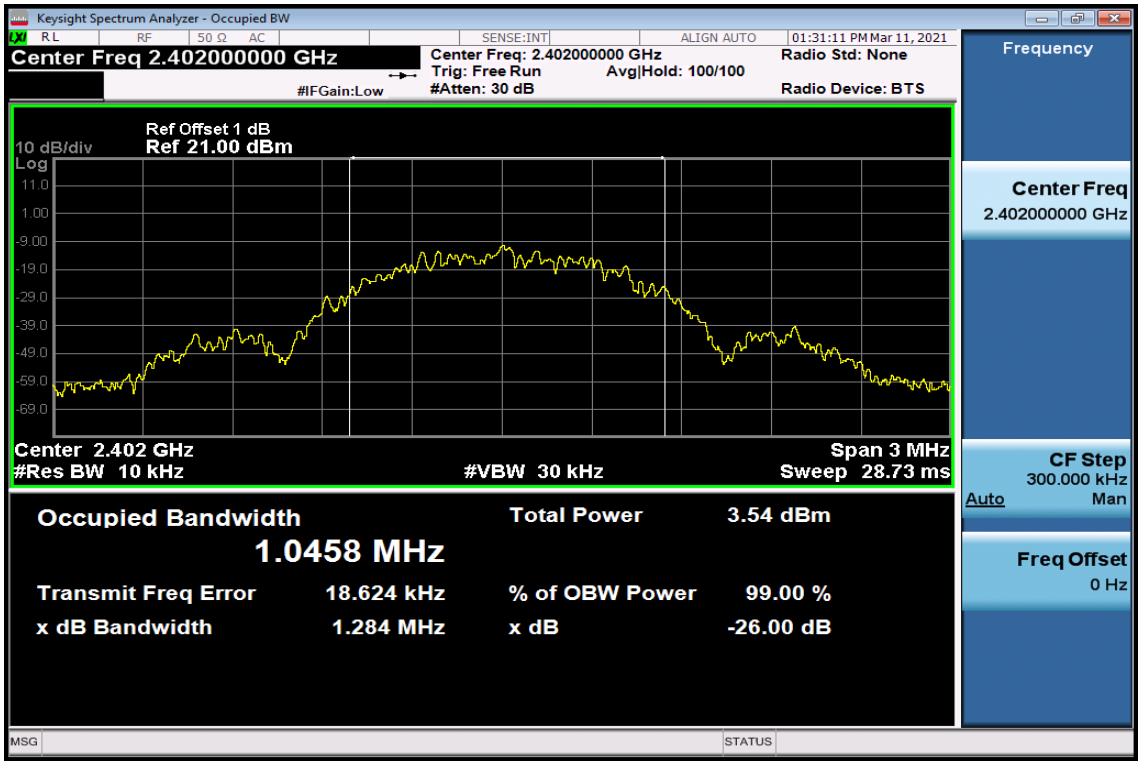


6dB Band Width Test Data CH-High

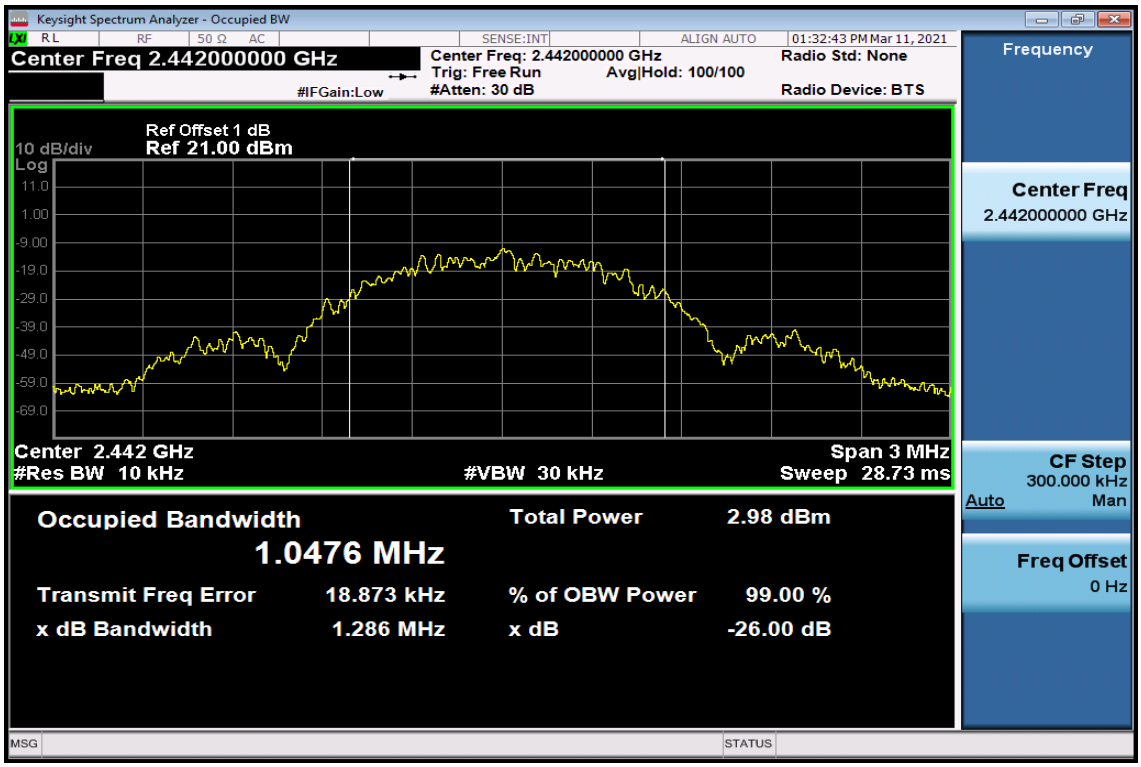


BLE Mode 5.0

99% Bandwidth Test Data CH-Low



99% Band Width Test Data CH-Mid



99% Band Width Test Data CH-High

8 Spurious Radiated Emission Test

8.1 Standard Applicable

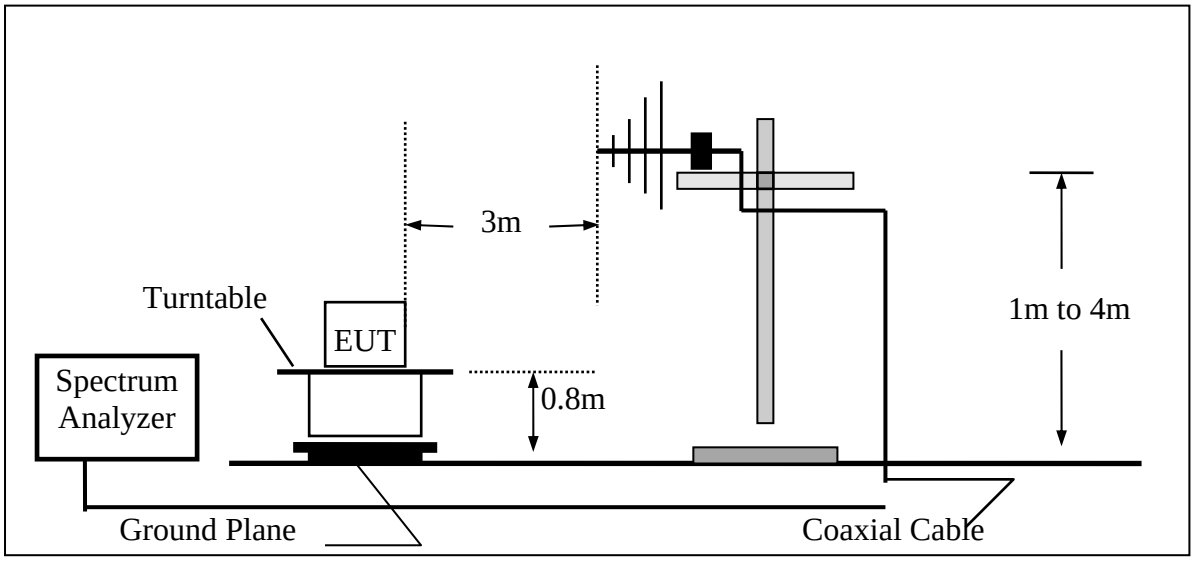
According to §15.247(c), all other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a). And according to §15.33(a)(1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

8.2 Measurement Equipment Used:

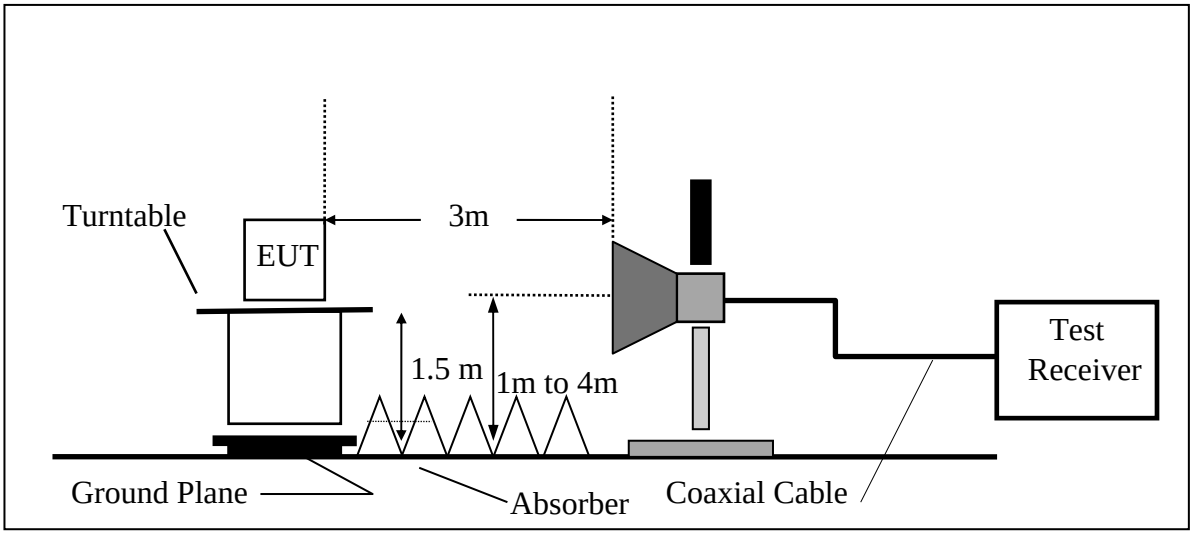
Location	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Chamber 19	Signal analyzer	R&S	FSV40	101884	11/14/2020	11/14/2021
Chamber 19	EMI Receiver	R&S	ESR3	102461	05/05/2020	05/05/2021
Chamber 19	Loop Antenna	EM	EM-6879	271	05/21/2020	05/21/2021
Chamber 19	Bilog Antenna (30MHz-1GHz)	Schwarzbeck	VULB9168 w 6dB Att.	736	02/11/2021	02/11/2022
Chamber 19	Horn antenna (1GHz-18GHz)	EM	EM-AH-10180	2011090207	03/26/2020	03/26/2021
Chamber 19	Horn antenna (18GHz-26GHz)	Com-power	AH-826	081001	11/25/2019	11/25/2020
Chamber 19	Horn antenna (26GHz-40GHz)	Com-power	AH-640	100A	03/13/2020	03/13/2021
Chamber 19	Preamplifier (9kHz-1GHz)	HP	8447F	3113A04621	06/19/2020	06/19/2021
Chamber 19	Preamplifier (1GHz - 26GHz)	EM	EM01M26G	060681	05/04/2020	05/04/2021
Chamber 19	Preamplifier (26GHz-40GHz)	MITEQ	JS4-26004000-27-5A	818471	05/04/2020	05/04/2021
Chamber 19	RF Cable (9kHz-18GHz)	HUBER SUHNER	Sucoflex 104A	MY1397/4A	01/10/2021	01/10/2022
Chamber 19	RF Cable (18GHz-40GHz)	HUBER SUHNER	Sucoflex 102	27963/2&37421/2	11/21/2020	11/21/2021
Chamber 19	Signal Generator	Anritsu	MG3692A	20311	01/06/2021	01/06/2022
Chamber 19	Test Software	Audix	E3 Ver:6.12023	N/A	N/A	N/A

8.3 Test SET-UP:

(A) Radiated Emission Test Setup for frequency below 1000MHz



(B) Radiated Emission Test Setup Frequency above 1 GHz



8.4 Measurement Procedure:

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all frequency measured were complete.

Test receiver setting	:	Blew 1GHz
Detector	:	Average(9kHz – 90kHz, 110kHz – 90kHz), Quasi-Peak
Bandwidth	:	200Hz, 120kHz
Test spectrum setting	:	Above 1GHz
Peak	:	RBW=1MHz, VBW=3MHz,Sweep=auto

Mode	ON time (ms)	Total time (ms)	Duty Cycle	Duty Factor	1/Ton (kHz)	VBW for average detector (kHz)
BLE	0.174	0.624	27.885%	5.55	5.747	10

8.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

8.6 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH Low	Test Date	2021/03/11
Fundamental Frequency	2402MHz	Test By	Barry
Temperature	25 ℃	Pol	Ver./Hor
Humidity	60 %		

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	143.49	46.67	-5.81	40.86	43.50	-2.64	Peak	VERTICAL
2	167.74	47.97	-5.61	42.36	43.50	-1.14	Peak	VERTICAL
3	191.99	45.63	-8.24	37.39	43.50	-6.11	Peak	VERTICAL
4	216.24	50.19	-8.42	41.77	46.00	-4.23	Peak	VERTICAL
5	239.52	50.52	-7.03	43.49	46.00	-2.51	Peak	VERTICAL
6	263.77	47.69	-6.13	41.56	46.00	-4.44	Peak	VERTICAL
1	95.96	50.35	-11.59	38.76	43.50	-4.74	Peak	HORIZONTAL
2	119.24	46.82	-7.99	38.83	43.50	-4.67	Peak	HORIZONTAL
3	227.88	51.63	-8.37	43.26	46.00	-2.74	Peak	HORIZONTAL
4	239.52	50.22	-7.03	43.19	46.00	-2.81	Peak	HORIZONTAL
5	252.13	48.77	-6.53	42.24	46.00	-3.76	Peak	HORIZONTAL
6	312.27	46.70	-4.31	42.39	46.00	-3.61	Peak	HORIZONTAL

Remark:

1 No further spurious emissions detected from the lowest internal frequency and 30MHz.

2 Measuring frequencies from the lowest internal frequency to the 1GHz.

3 Radiated emissions measured in frequency range from 9MHz to 1000MHz were made with an instrument detector setting 9-90kHz/110-490kHz using PK/AV and other Frequency Band using PK/QP

4 Measurement result within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH Mid	Test Date	2021/03/11
Fundamental Frequency	2442MHz	Test By	Barry
Temperature	25 ℃	Pol	Ver./Hor
Humidity	60 %		

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	119.24	45.70	-7.99	37.71	43.50	-5.79	Peak	VERTICAL
2	143.49	46.75	-5.81	40.94	43.50	-2.56	Peak	VERTICAL
3	167.74	47.43	-5.61	41.82	43.50	-1.68	Peak	VERTICAL
4	191.99	49.79	-8.24	41.55	43.50	-1.95	Peak	VERTICAL
5	215.27	49.15	-8.41	40.74	43.50	-2.76	Peak	VERTICAL
6	239.52	50.45	-7.03	43.42	46.00	-2.58	Peak	VERTICAL
1	167.74	41.77	-5.61	36.16	43.50	-7.34	Peak	HORIZONTAL
2	191.99	46.78	-8.24	38.54	43.50	-4.96	Peak	HORIZONTAL
3	216.24	49.83	-8.42	41.41	46.00	-4.59	Peak	HORIZONTAL
4	239.52	43.15	-7.03	36.12	46.00	-9.88	Peak	HORIZONTAL
5	312.27	46.31	-4.31	42.00	46.00	-4.00	Peak	HORIZONTAL
6	576.11	40.35	0.26	40.61	46.00	-5.39	Peak	HORIZONTAL

Remark:

1 No further spurious emissions detected from the lowest internal frequency and 30MHz.

2 Measuring frequencies from the lowest internal frequency to the 1GHz.

3 Radiated emissions measured in frequency range from 9MHz to 1000MHz were made with an instrument detector setting 9-90kHz/110-490kHz using PK/AV and other Frequency Band using PK/QP

4 Measurement result within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

5 The IF bandwidth of SPA between 9kHz to 30MHz was 10kHz, VBW= 30kHz; between 30MHz to 1GHz was 100kHz, VBW=300kHz.

Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH High	Test Date	2021/03/11
Fundamental Frequency	2480MHz	Test By	Barry
Temperature	25 ℃	Pol	Ver./Hor
Humidity	60 %		

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	167.74	43.90	-5.61	38.29	43.50	-5.21	Peak	VERTICAL
2	191.99	48.65	-8.24	40.41	43.50	-3.09	Peak	VERTICAL
3	216.24	50.18	-8.42	41.76	46.00	-4.24	Peak	VERTICAL
4	239.52	47.42	-7.03	40.39	46.00	-5.61	Peak	VERTICAL
5	263.77	44.59	-6.13	38.46	46.00	-7.54	Peak	VERTICAL
6	312.27	39.85	-4.31	35.54	46.00	-10.46	Peak	VERTICAL
1	167.74	42.34	-5.61	36.73	43.50	-6.77	Peak	HORIZONTAL
2	191.99	47.30	-8.24	39.06	43.50	-4.44	Peak	HORIZONTAL
3	216.24	50.84	-8.42	42.42	46.00	-3.58	Peak	HORIZONTAL
4	239.52	44.16	-7.03	37.13	46.00	-8.87	Peak	HORIZONTAL
5	576.11	40.62	0.26	40.88	46.00	-5.12	Peak	HORIZONTAL
6	587.75	39.33	0.64	39.97	46.00	-6.03	Peak	HORIZONTAL

Remark:

1 No further spurious emissions detected from the lowest internal frequency and 30MHz.

2 Measuring frequencies from the lowest internal frequency to the 1GHz.

3 Radiated emissions measured in frequency range from 9MHz to 1000MHz were made with an instrument detector setting 9-90kHz/110-490kHz using PK/AV and other Frequency Band using PK/QP

4 Measurement result within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

5 The IF bandwidth of SPA between 9kHz to 30MHz was 10kHz, VBW= 30kHz; between 30MHz to 1GHz was 100kHz, VBW=300kHz.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH Low	Test Date	2021/03/11
Fundamental Frequency	2402MHz	Test By	Barry
Temperature	25 ℃	Pol	Ver./Hor
Humidity	60 %		

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	4804.00	47.67	-6.72	40.95	74.00	-33.05	Peak	VERTICAL
2	7206.00	48.07	-2.52	45.55	74.00	-28.45	Peak	VERTICAL
1	4804.00	47.47	-6.72	40.75	74.00	-33.25	Peak	HORIZONTAL
2	7206.00	47.51	-2.52	44.99	74.00	-29.01	Peak	HORIZONTAL

Remark:

1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency

2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.

3 Measurement of data within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

4 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.

5 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW≧1/Ton , Sweep time= 200 ms.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH Mid	Test Date	2021/03/11
Fundamental Frequency	2442MHz	Test By	Barry
Temperature	25 ℃	Pol	Ver./Hor
Humidity	60 %		

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	4884.00	48.31	-6.45	41.86	74.00	-32.14	Peak	VERTICAL
2	7326.00	47.19	-2.61	44.58	74.00	-29.42	Peak	VERTICAL
1	4884.00	48.16	-6.45	41.71	74.00	-32.29	Peak	HORIZONTAL
2	7326.00	45.84	-2.61	43.23	74.00	-30.77	Peak	HORIZONTAL

Remark:

1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency

2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.

3 Measurement of data within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

4 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.

5 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW≧1/Ton , Sweep time= 200 ms.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH High	Test Date	2021/03/11
Fundamental Frequency	2480MHz	Test By	Barry
Temperature	25 ℃	Pol	Ver./Hor
Humidity	60 %		

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	4960.00	47.32	-6.19	41.13	74.00	-32.87	Peak	VERTICAL
2	7440.00	45.87	-2.61	43.26	74.00	-30.74	Peak	VERTICAL
1	4960.00	48.75	-6.19	42.56	74.00	-31.44	Peak	HORIZONTAL
2	7440.00	47.31	-2.61	44.70	74.00	-29.30	Peak	HORIZONTAL

Remark:

1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency

2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.

3 Measurement of data within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

4 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.

5 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW≧1/Ton , Sweep time= 200 ms.

9 100kHz Bandwidth of Band Edges Measurement

9.1 Standard Applicable:

According to §15.247(c), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, 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 in15.209(a).

9.2 Measurement Equipment Used:

Refer to section 8.2 for details.

9.3 Test SET-UP:

Refer to section 8.3 for details.

9.4 Measurement Procedure:

Refer to section 8.4 for details.

9.5 Field Strength Calculation:

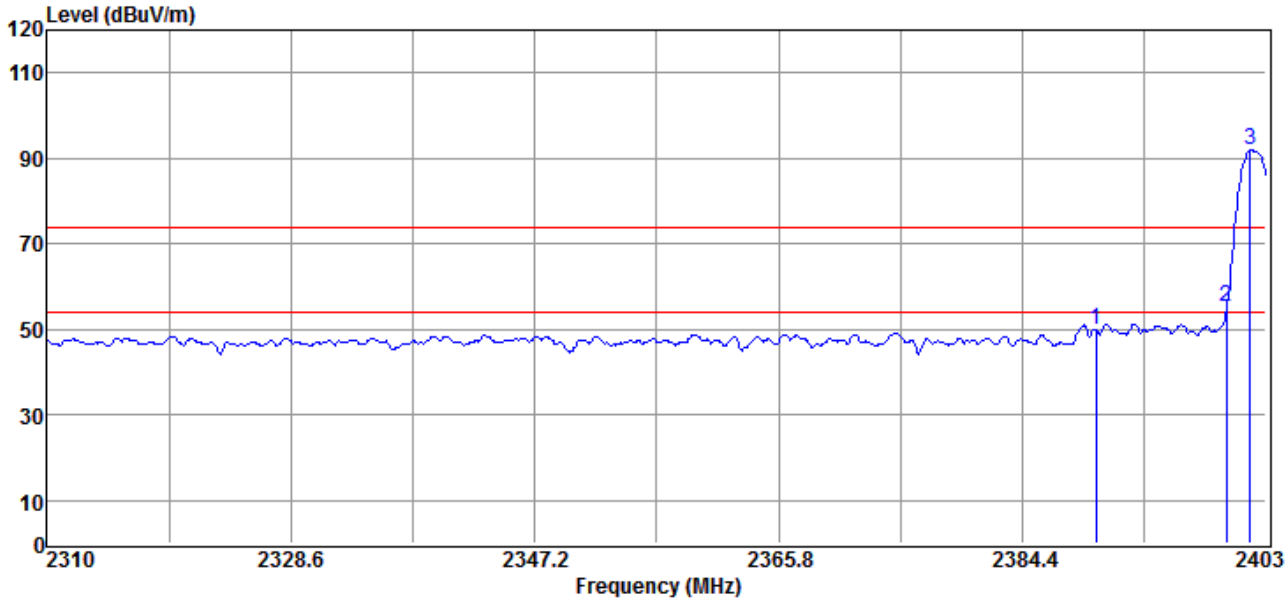
Refer to section 8.5 for details.

9.6 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

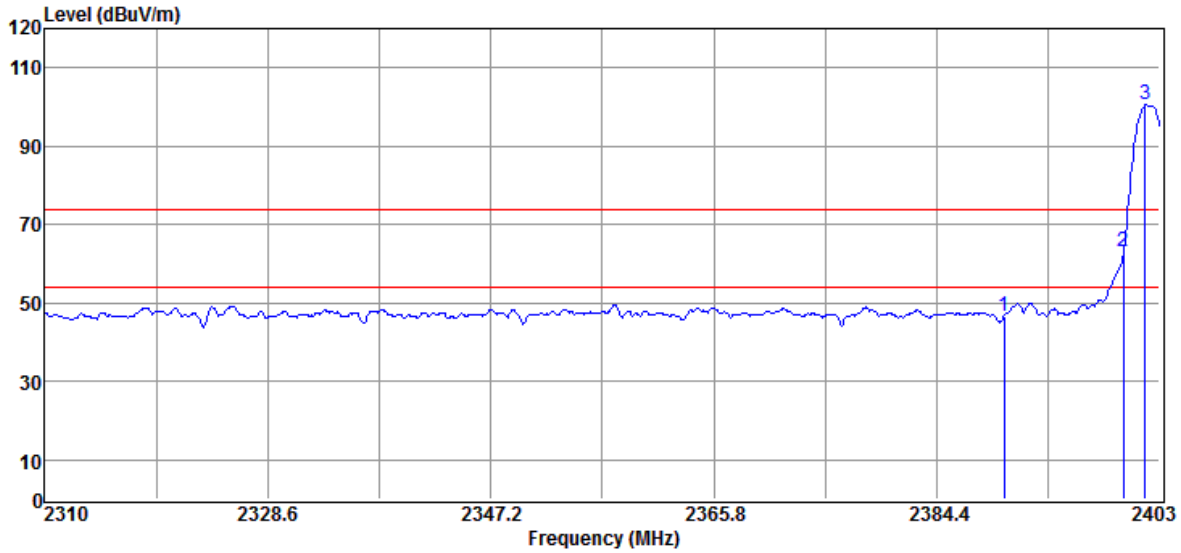
Radiated Emission:

Operation Mode	TX CH Low	Test Date	2021/03/11
Fundamental Frequency	2402 MHz	Test By	Barry
Temperature	25 ℃	Humidity	60 %



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	61.46	-11.43	50.03	74.00	-23.97	Peak	VERTICAL
2	2400.00	66.50	-11.42	55.08	71.83	-16.75	Peak	VERTICAL
3	2401.79	103.24	-11.41	91.83	F	--	Peak	VERTICAL

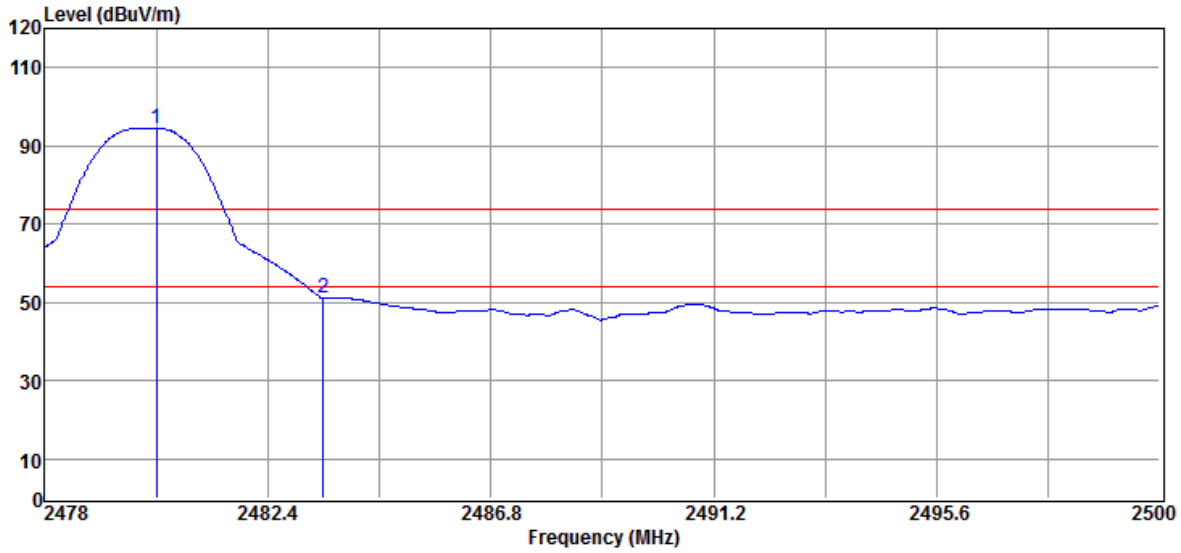
Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	57.91	-11.43	46.48	74.00	-27.52	Peak	HORIZONTAL
2	2400.00	74.54	-11.42	63.12	80.43	-17.31	Peak	HORIZONTAL
3	2401.79	111.84	-11.41	100.43	F	--	Peak	HORIZONTAL

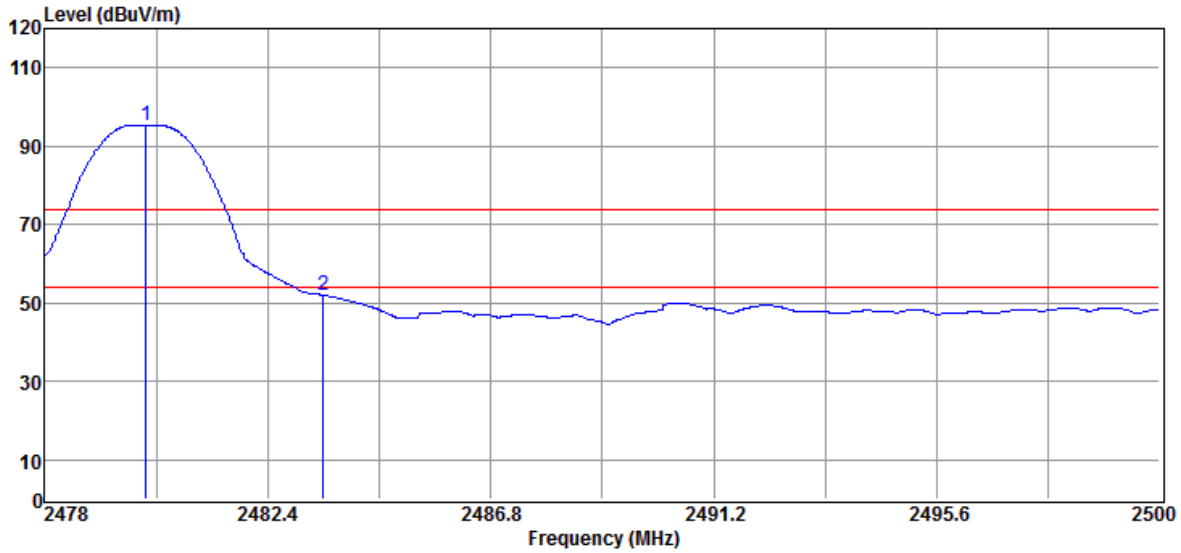
Note: “F” denotes fundamental frequency

Operation Mode	TX CH High	Test Date	2021/03/11
Fundamental Frequency	2480 MHz	Test By	Barry
Temperature	25 ℃	Humidity	60 %



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2480.20	105.65	-11.30	94.35	F	--	Peak	VERTICAL
2	2483.50	62.48	-11.29	51.19	74.00	-22.81	Peak	VERTICAL

Note: “F” denotes fundamental frequency



No	Freq MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2480.00	106.67	-11.30	95.37	F	--	Peak	HORIZONTAL
2	2483.50	63.28	-11.29	51.99	74.00	-22.01	Peak	HORIZONTAL

Note: “F” denotes fundamental frequency

10 Peak Power Spectral Density

10.1 Standard Applicable:

According to §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.

10.2 Measurement Equipment Used:

Refer to section 6.2 for details.

10.3 Test Set-up:

Refer to section 6.3 for details.

10.4 Measurement Procedure:

1. Place the EUT on the table 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 the spectrum analyzer.
3. Set the spectrum analyzer as RBW =3kHz, VBW = 10kHz, Span =5 to 30% greater than emission BW, Sweep=Auto
4. Record the max. reading.
5. Repeat above procedures until all frequency measured were complete.

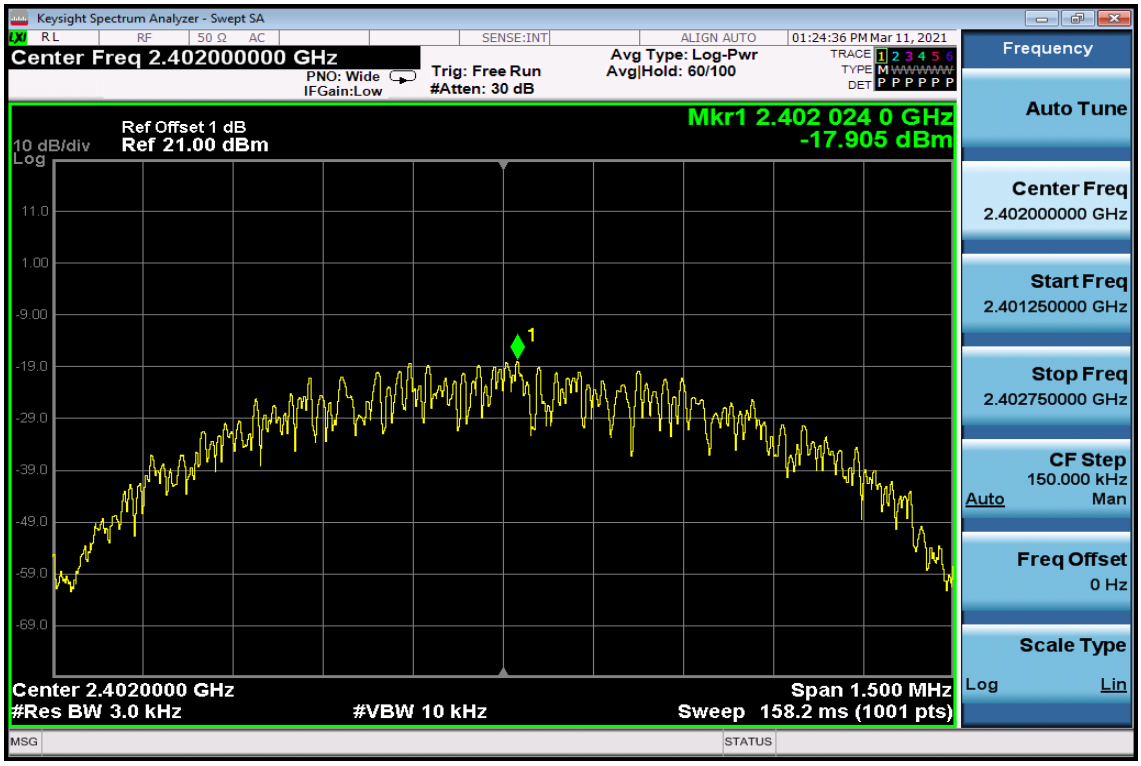
10.5 Measurement Result:

Mode	Frequency (MHz)	PSD (dBm/3kHz)	PSD Limit (dBm/3kHz)
BLE 4.0	2402	-17.905	8.00
	2442	-18.401	8.00
	2480	-18.584	8.00

Mode	Frequency (MHz)	PSD (dBm/3kHz)	PSD Limit (dBm/3kHz)
BLE 5.0	2402	-17.918	8.00
	2442	-18.464	8.00
	2480	-18.511	8.00

BLE 4.0

Power Spectral Density Test Plot (CH-Low)

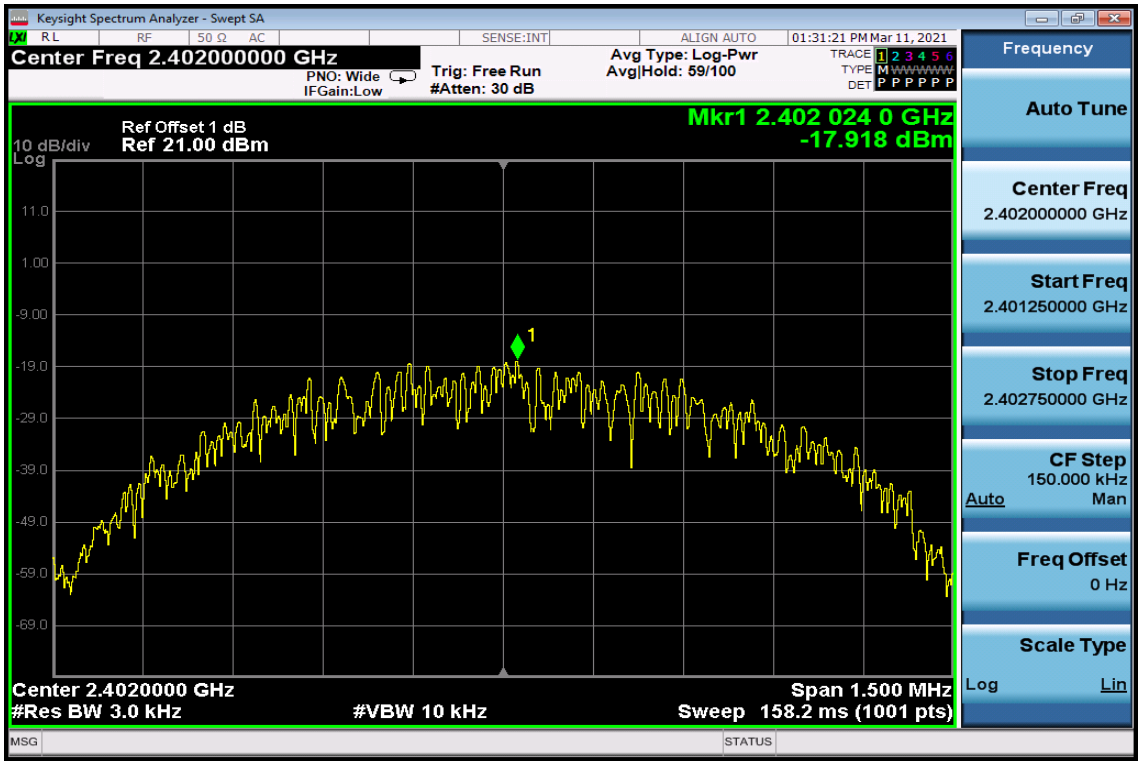


Power Spectral Density Test Plot (CH-Mid)

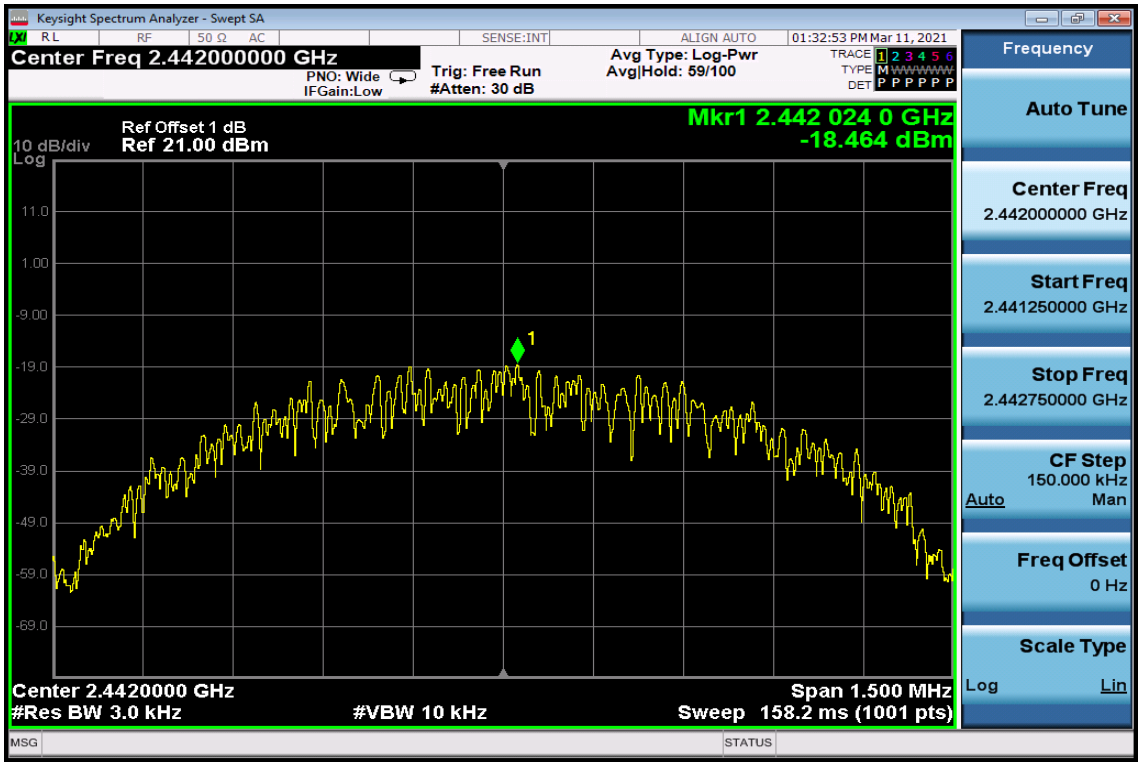
Power Spectral Density Test Plot (CH-High)

BLE 5.0

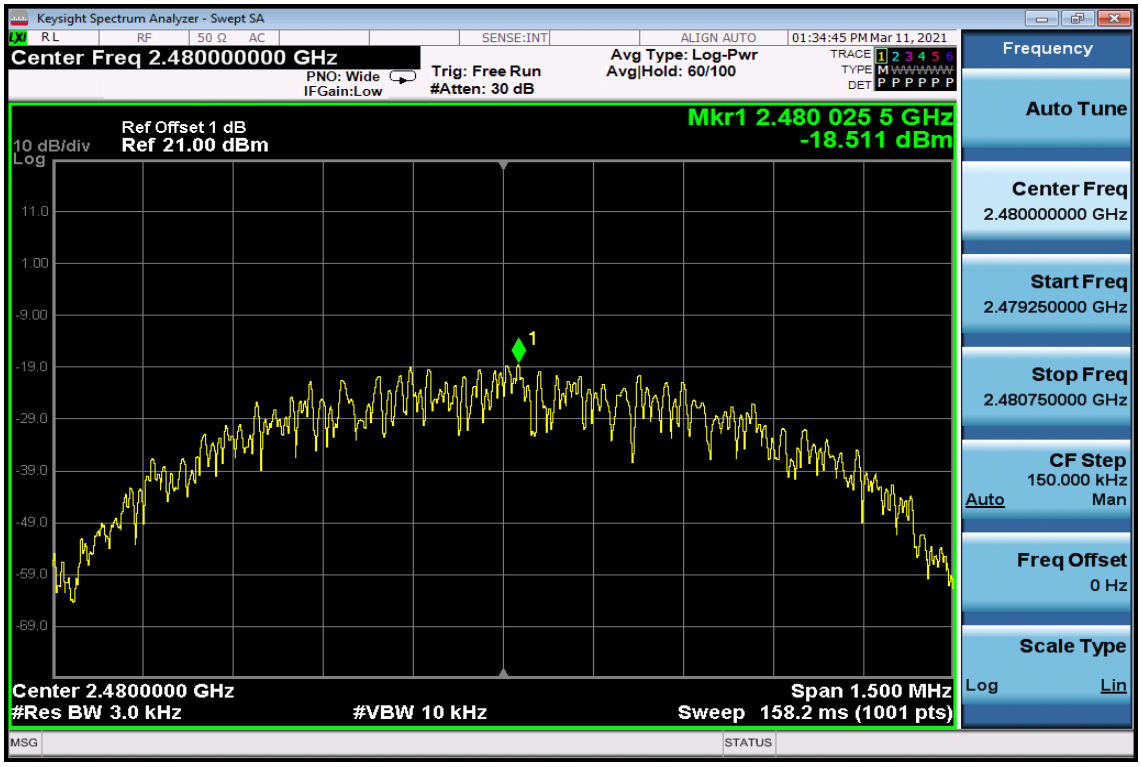
Power Spectral Density Test Plot (CH-Low)



Power Spectral Density Test Plot (CH-Mid)



Power Spectral Density Test Plot (CH-High)



11 Antenna Requirement

11.1 Standard Applicable:

According to §15.203, Antenna requirement.

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 use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

11.2 Antenna Connected Construction:

The directional gains of antenna used for transmitting is 1.95dBi. Please see EUT photo and antenna spec. for details.