TEST REPORT

of

FCC Part 15 Subpart C

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

Product :	**Infant Oximeter Module**
Brand:	**AULISA**
Model:	**GA-SM0002**
Model Difference:	**N/A**
FCC ID:	**2AI5QGA-SM0002**
FCC Rule Part:	**§15.247, Cat: DTS**
Applicant:	**Taiwan Aulisa Medical Devices Technologies, Inc**
Address:	**10F., No.3-2, YuanQu St., Nangang Dist., Taipei City, Taiwan 115**

Test Performed by:
International Standards Laboratory Corp.
<LT Lab.>
*Site Registration No.
BSMI: SL2-IN-E-0013; MRA TW0997; TAF: 0997; IC: IC4067B-4;

*Address:
No. 120, Lane 180, Hsin Ho Rd.
Lung-Tan Dist., Tao Yuan City 325, Taiwan
*Tel : 886-3-407-1718; Fax: 886-3-407-1738

Report No.: **ISL-19LR053FC**
Issue Date : **2019/04/29**

Testing laboratory
0997

VERIFICATION OF COMPLIANCE

Applicant:	Taiwan Aulisa Medical Devices Technologies, Inc
Product Description:	Infant Oximeter Module
Brand Name:	AULISA
Model No.:	GA-SM0002
Model Difference:	N/A
FCC ID:	2AI5QGA-SM0002
Date of test:	2019/02/27 ~2019/04/26
Date of EUT Received:	2019/02/27

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:	Bill Huang	***Date:***	2019/04/29
	Bill Huang / Engineer		
Prepared By:	Gigi yeh	***Date:***	2019/04/29
	Gigi Yeh / Sr. Engineer		
Approved By:	Jerry Liu	***Date:***	2019/04/29
	Jerry Liu / Technical Supervisor		

Version

Version No.	Date	Description
00	2019/04/29	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	2400-2500 MHz: 1.30 dB
Power Density	2400-2500 M Hz:1.30 dB
Frequency	0.0032%
Time	0.01%
DC Voltage	1%

Table of Contents

1 General Information

General:

Product Name:	Infant Oximeter Module
Brand Name:	AULISA
Model Name:	GA-SM0002
Model Difference:	N/A
Power Supply:	12Vdc from Battery

Bluetooth:

Frequency Range:	2402 – 2480MHz
Bluetooth Version:	V4.2
Channel number:	40 channels, 2MHz step
Modulation type:	GFSK
Tune up power	5.76 dBm
Power Tolerance:	+/- 1.0 dBm
Dwell Time:	N/A
Antenna Designation:	Chip: 2.5dBi

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: 2AI5QGA-SM0002** 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 v0.5r02.

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 . 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 and RSS-Gen issue 4: 2014. Con-ducted 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.

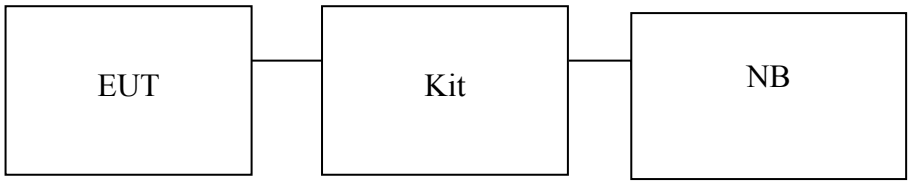
2.3.2 Radiated Emissions

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

Radiated Emission Configuration



Conduction Emission Configuration

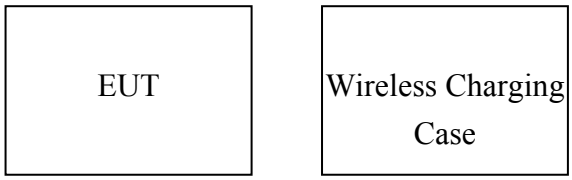


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1	Notebook	HP	440-G1	NA	shielding	Non-shielding
2	Wireless Charging Case	AULISA	GA-WS0001	NA	NA	shielding

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, 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:

AC Power Line Test Site					
Equipment Type	**MFR**	**Model Number**	**Serial Number**	**Last Cal.**	**Cal Due.**
Conduction 04-3 Cable	WOKEN	CFD 300-NL	Conduction 04 -3	08/30/2018	08/29/2019
EMI Receiver 16	Rohde & Schwarz	ESCI	101221	11/17/2018	11/16/2019
LISN 18	ROHDE & SCHWARZ	ENV216	101424	05/31/2018	05/30/2019
LISN 03	ROHDE & SCHWARZ	ESH3-Z5	828874/010	07/22/2018	07/21/2019
Test Software	Farad	EZEMC Ver:ISL-03A2	N/A	N/A	N/A

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.

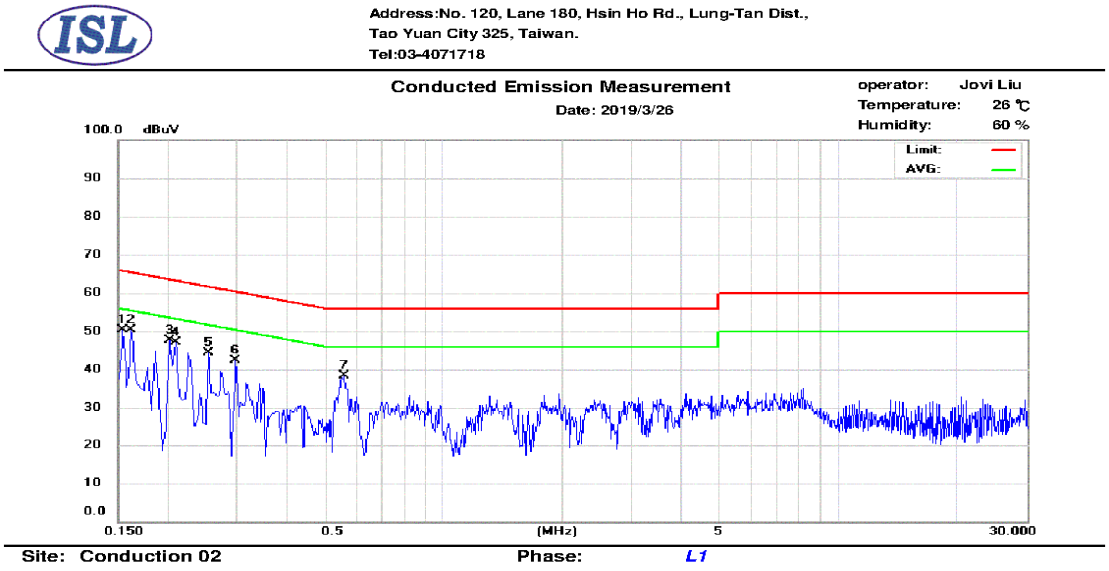
5.4 Measurement Procedure:

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.

5.5 Measurement Result:

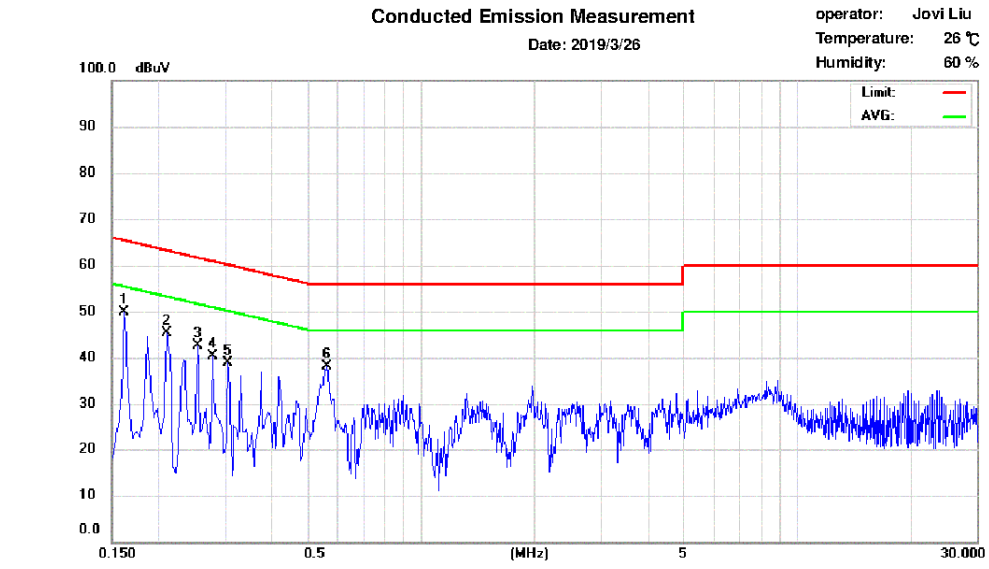
AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Full mode	Test Date:	2019/03/26
Test By:	Bill		



No.	Frequency (MHz)	QP_R (dBuV)	AVG_R (dBuV)	Correct Factor (dB)	QP Emission (dBuV)	QP Limit (dBuV)	QP Margin (dB)	AVG Emission (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
1	0.154	38.41	19.08	9.63	48.04	65.78	-17.74	28.71	55.78	-27.07
2	0.162	37.70	22.53	9.63	47.33	65.36	-18.03	32.16	55.36	-23.20
3	0.202	33.27	15.92	9.62	42.89	63.53	-20.64	25.54	53.53	-27.99
4	0.210	33.24	16.74	9.62	42.86	63.21	-20.35	26.36	53.21	-26.85
5	0.254	30.57	17.87	9.62	40.19	61.63	-21.44	27.49	51.63	-24.14
6	0.298	26.25	12.79	9.63	35.88	60.30	-24.42	22.42	50.30	-27.88
7	0.562	27.25	19.28	9.64	36.89	56.00	-19.11	28.92	46.00	-17.08

Address:No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist.,
Tao Yuan City 325, Taiwan.
Tel:03-4071718



Site: Conduction 02 Phase: N

No.	Frequency (MHz)	QP_R (dBuV)	AVG_R (dBuV)	Correct Factor (dB)	QP Emission (dBuV)	QP Limit (dBuV)	QP Margin (dB)	AVG Emission (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
1	0.162	36.80	19.62	9.64	46.44	65.36	-18.92	29.26	55.36	-26.10
2	0.210	32.38	13.25	9.64	42.02	63.21	-21.19	22.89	53.21	-30.32
3	0.254	29.31	14.07	9.64	38.95	61.63	-22.68	23.71	51.63	-27.92
4	0.278	27.03	12.52	9.64	36.67	60.88	-24.21	22.16	50.88	-28.72
5	0.306	25.40	11.64	9.64	35.04	60.08	-25.04	21.28	50.08	-28.80
6	0.562	26.25	17.49	9.65	35.90	56.00	-20.10	27.14	46.00	-18.86

6 Peak Output Power

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:

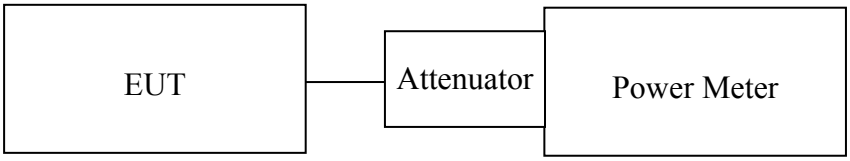
(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the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

Conducted Emission Test Site					
Equipment Type	**MFR**	**Model Number**	**Serial Num-ber**	**Last Cal.**	**Cal Due.**
Power Meter 05	Anritsu	ML2495A	1116010	10/28/2018	10/27/2019
Power Sensor 05	Anritsu	MA2411B	34NKF50	10/28/2018	10/27/2019
Power Sensor 06	DARE	RPR3006W	13I00030SNO33	01/11/2019	01/10/2020
Power Sensor 07	DARE	RPR3006W	13I00030SNO34	01/11/2019	01/10/2020
Temperature Chamber	KSON	THS-B4H100	2287	02/19/2019	02/18/2020
DC Power supply	ABM	8185D	N/A	01/10/2019	01/09/2020
AC Power supply	EXTECH	CFC105W	NA	12/25/2018	12/24/2019
Attenuator	Woken	Watt-65m3502	11051601	NA	NA
Splitter	MCLI	PS4-199	12465	12/26/2017	12/25/2019
Spectrum analyzer	keysight	N9010A	MY56070257	10/15/2018	10/14/2019
Spectrum analyzer	R&S	FSP40	100116	01/10/2019	01/09/2020
Test Software	DARE	Radiation Ver:2013.1.23	NA	NA	NA

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:

BLE Mode 4.0

Frequency (MHz)	Peak Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
Low	5.76	0.00	5.76	0.00376	1
Mid	4.98	0.00	4.98	0.00314	1
High	5.40	0.00	5.40	0.00347	1

BLE Mode 4.2

Frequency (MHz)	Peak Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
Low	5.56	0.00	5.56	0.00360	1
Mid	5.47	0.00	5.47	0.00352	1
High	5.45	0.00	5.45	0.00351	1

7 6dB 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:

BLE Mode

CH	6dB Bandwidth (MHz)	Limit (kHZ)
Lower	0.63	>500
Mid	0.66	>500
Higher	0.64	>500

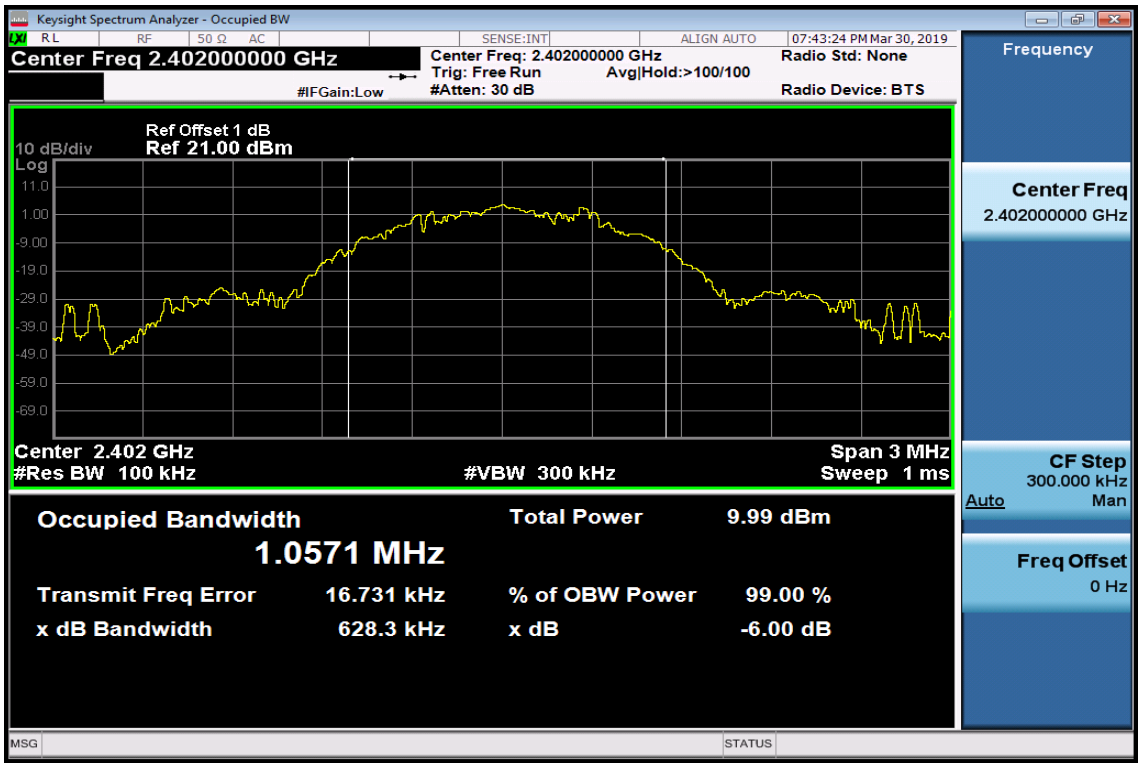
BLE 4.2 Mode

CH	6dB Bandwidth (MHz)	Limit (kHZ)
Lower	0.64	>500
Mid	0.68	>500
Higher	0.69	>500

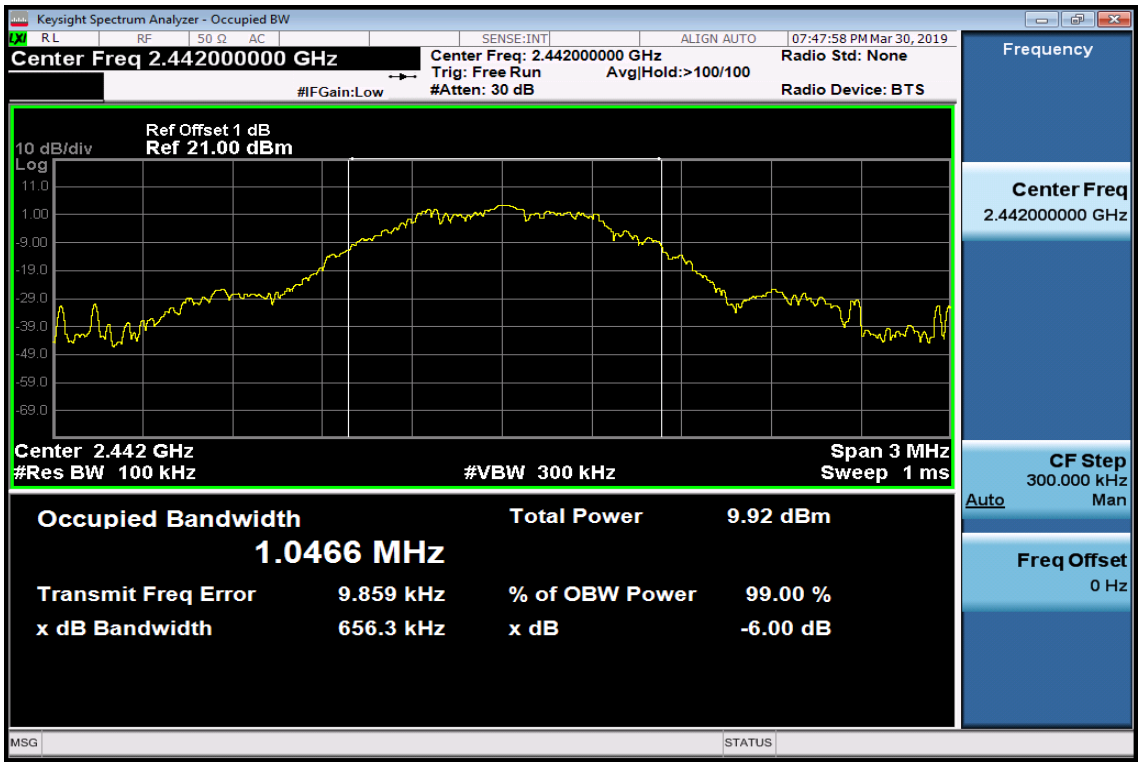
Note: Refer to next page for plots.

BLE mode:

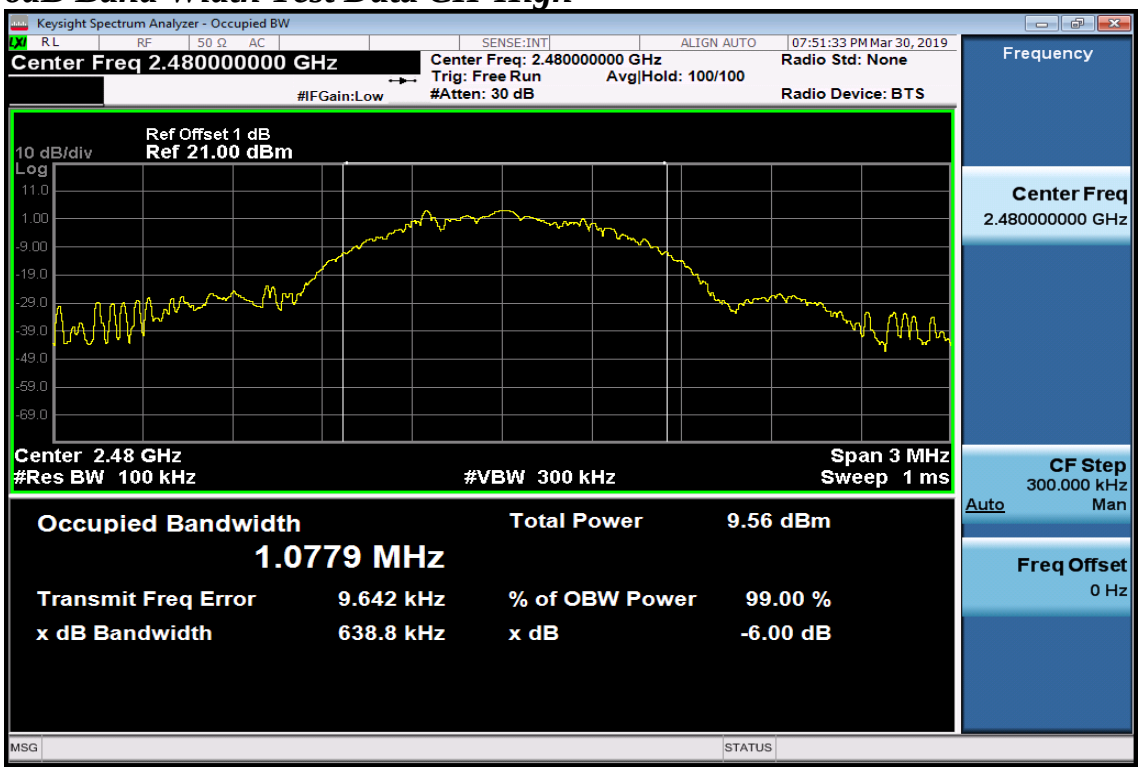
6dB Bandwidth Test Data CH-Low



6dB Band Width Test Data CH-Mid

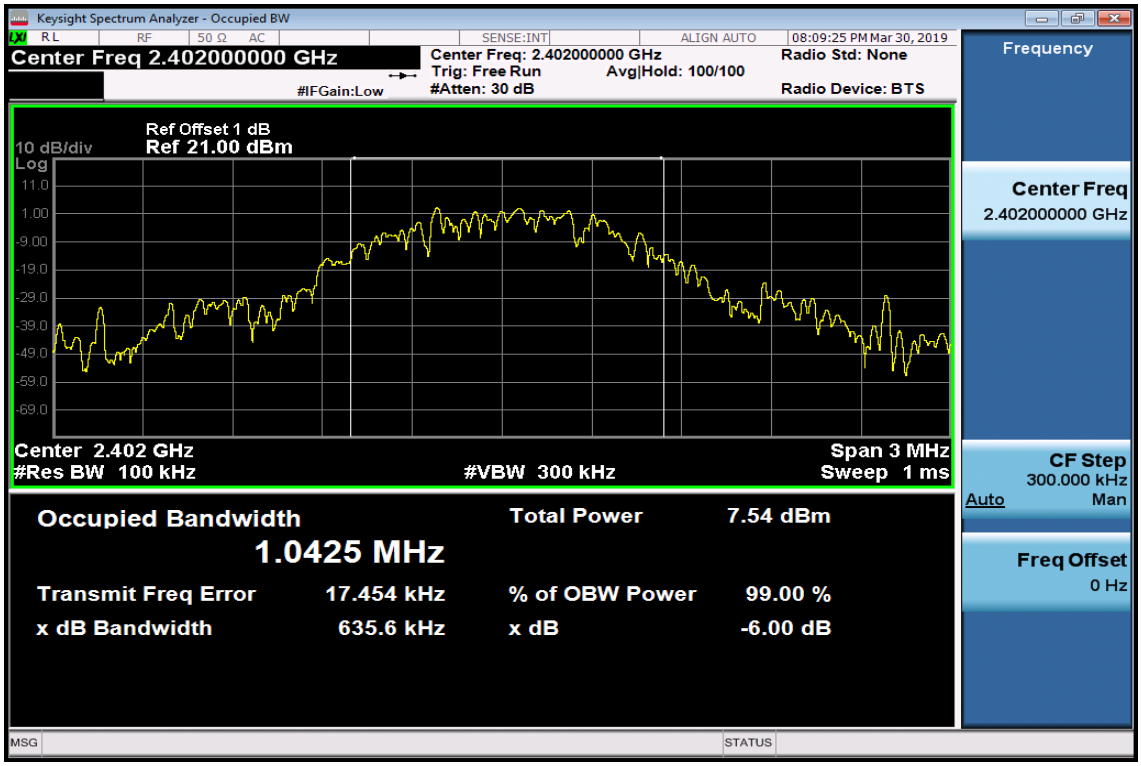


6dB Band Width Test Data CH-High

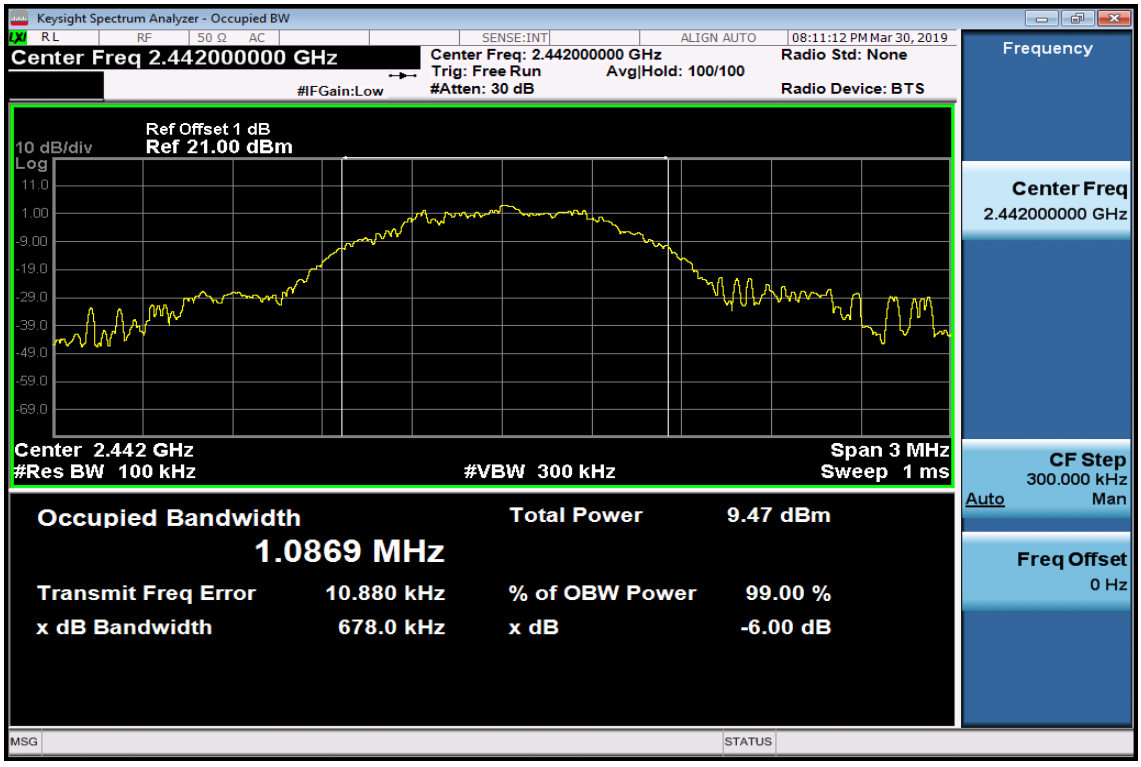


BLE 4.2 mode:

6dB Bandwidth Test Data CH-Low



6dB Band Width Test Data CH-Mid



6dB Band Width Test Data CH-High

8 100kHz Bandwidth of Band Edges Measurement

8.1 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).

8.2 Measurement Equipment Used:

8.2.1 Conducted Emission at antenna port:

Refer to section 6.2 for details.

8.2.2 Radiated emission:

Chamber 19(966)					
Equipment Type	**MFR**	**Model Number**	**Serial Num-ber**	**Last Cal.**	**Cal Due.**
966 Chamber	Chance Most	Chamber 19	N/A	08/13/2018	08/12/2019
Spectrum Analyzer 21(3Hz-44GHz)	Agilent	N9030A	MY51360021	11/18/2018	11/17/2019
EMI Receiver	SCHWARZBECK	FCVU1534	1534149	12/06/2018	12/05/2019
Loop Antenna(9K-30M)	EM	EM-6879	271	06/06/2018	06/05/2020
Bilog Antenna (30M-1G)	SCHWARZBECK	VULB9168 w 5dB Att	736	01/29/2019	01/28/2020
Horn antenna (1G-18G)	SCHWARZBECK	9120D	9120D-1627	11/27/2017	11/26/2019
Horn antenna (18G-26G)	Com-power	AH-826	081001	11/21/2017	11/20/2019
Horn antenna (26G-40G)	Com-power	AH-640	100A	03/29/2019	03/28/2021
Preamplifier (9k-1000M)	HP	8447F	3113A06362	01/14/2019	01/13/2020
Preamplifier(1G-26G)	Agilent	8449B	3008A02471	10/29/2018	10/28/2019
Preamplifier (26G-40G)	MITEQ	JS4-26004000-27-5A	818471	11/20/2017	07/21/2019
RF Cable (9k-18G)	HUBER SUHNER	SUCOFLEX 104A	MY1397/4A	01/17/2019	01/16/2020
RF cable (18G~40G)	HUBER SUHNER	Sucoflex 102	27963/2&3742 1/2	11/12/2018	11/11/2019
Turn Table	MF	Turn Table-19	Turn Table-19	N/A	N/A
Mast Tower	MF	JSDES-15A	1308283	N/A	N/A
Controller	MF	MF-7802BS	MF780208460	N/A	N/A
AC power source	T-Power	TFC-1005	40006471	N/A	N/A
Signal Generator	R&S	SMU200A	102330	03/14/2019	03/13/2020
Signal Generator	Anritsu	MG3692A	20311	01/09/2019	01/08/2020
2.4G Filter	Micro-Tronics	Brm50702	76	12/25/2018	12/24/2019
Test Software	Audix	E3 Ver:6.12023	N/A	N/A	N/A

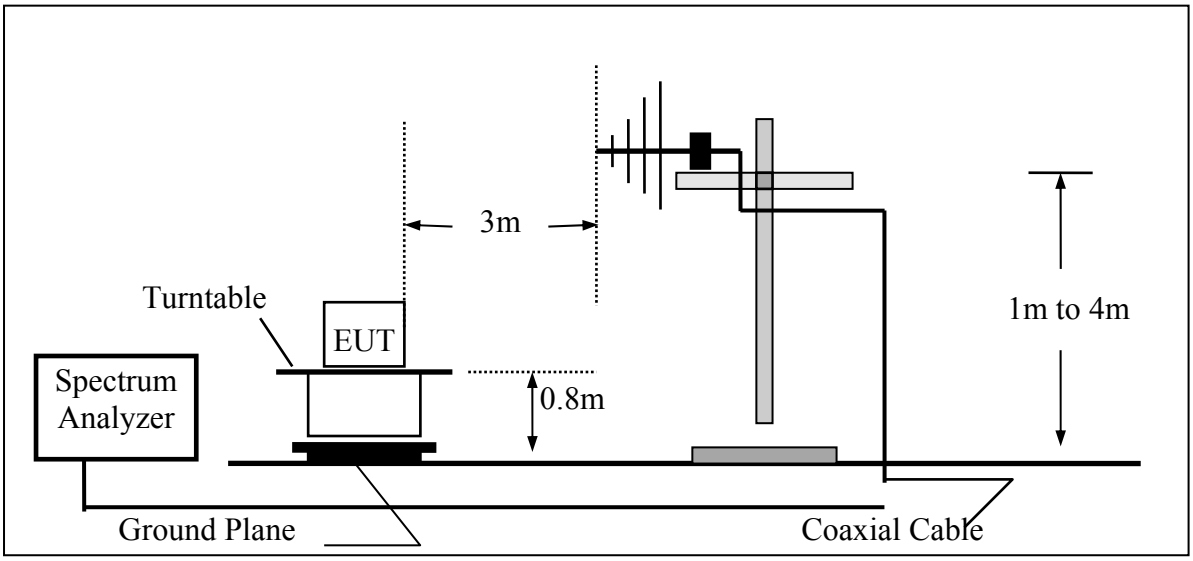
8.3 Test SET-UP:

8.3.1 Conducted Emission at antenna port:

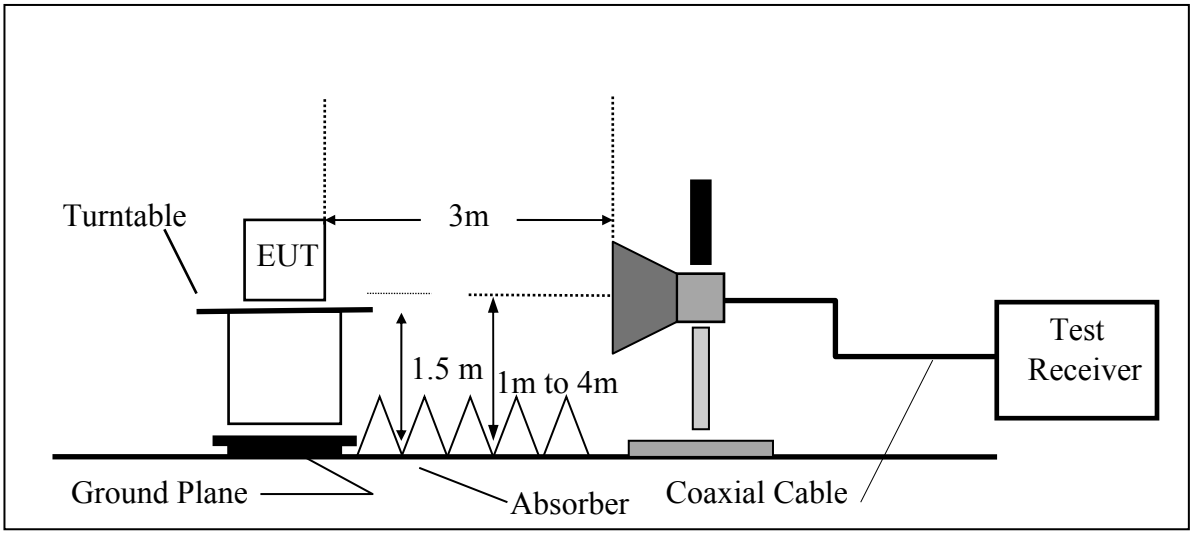
Refer to section 6.3 for details.

8.3.2 Radiated emission:

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-UP Frequency Over 1 GHz



8.4 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 center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=100kHz, Span=25MHz, Sweep = auto
5. Mark Peak, 2.390GHz and 2.4835GHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.

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 Emission:

Operation Mode	TX CH Low	Test Date	2019/04/08
Fundamental Frequency	2402 MHz	Test By	Bill
Temperature	25 ℃	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2390.00	63.96	-15.71	48.25	74.00	-25.75	Peak	VERTICAL
2	2400.00	80.65	-15.73	64.92	71.15	-6.23	Peak	VERTICAL
3	2402.44	106.88	-15.73	91.15	F	--	Peak	VERTICAL
1	2390.00	60.10	-15.71	44.39	74.00	-29.61	Peak	HORIZONTAL
2	2400.00	80.74	-15.73	65.01	68.69	-3.68	Peak	HORIZONTAL
3	2402.07	104.42	-15.73	88.69	F	--	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= 1kHz, Sweep time= 200 ms.

Note: "F" denotes fundamental frequency

Operation Mode	TX CH High	Test Date	2019/04/08
Fundamental Frequency	2480 MHz	Test By	Bill
Temperature	25 ℃	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol V/H
1	2480.07	105.97	-15.71	90.26	F	--	Peak	VERTICAL
2	2483.50	64.82	-15.71	49.11	74.00	-24.89	Peak	VERTICAL
1	2480.31	99.46	-15.71	83.75	F	--	Peak	HORIZONTAL
2	2483.50	60.96	-15.71	45.25	74.00	-28.75	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= 1kHz, Sweep time= 200 ms.

Note: "F" denotes fundamental frequency

9 Spurious Radiated Emission Test

9.1 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.

9.2 Measurement Equipment Used:

9.2.1 Conducted Emission at antenna port:

Refer to section 6.2 for details.

9.2.2 Radiated emission:

Refer to section 7.2 for details.

9.3 Test SET-UP:

The test item only performed radiated mode

Refer to section 8.3 for details.

9.4 Measurement Procedure:

1 According 414788 section 2, Either OATS or chamber for radiated emission below 30MHz, the test was done at 966 chamber, the test site was evaluated with OATS and the Chamber has test signals level greater than OATS's.

2 The EUT was placed on a turn table which is 0.8m/1.5m above ground plane in 966 chamber.

3 The turn table shall rotate 360 degrees to determine the position of maximum emission level.

4 EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.

5 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.

6 Maximum procedure was performed on the six highest emissions to ensure EUT compliance.

7 And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

8 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
Average (for BLE)	:	RBW=1MHz, VBW=1kHz, Sweep=auto

Average Measurement Setting (VBW)

Mode	Duty Cycle (%)	T_{on} (us)	T_{off} (us)	$1/T_{on}$ (kHz)	Determined VBW Setting
Bluetooth LE Ch. Low	91.49	1075	100	0.930	1kHz
Bluetooth LE Ch. Mid	91.43	1067	100	0.937	1kHz
Bluetooth LE Ch. High	90.67	1050	108	0.950	1kHz

9.5 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	

9.6 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	2019/04/08
Fundamental Frequency	2402MHz	Test By	Bill
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	35.82	44.40	-7.00	37.40	40.00	-2.60	Peak	VERTICAL
2	54.25	44.31	-6.40	37.91	40.00	-2.09	Peak	VERTICAL
3	109.54	50.08	-9.55	40.53	43.50	-2.97	Peak	VERTICAL
4	127.97	49.20	-7.75	41.45	43.50	-2.05	Peak	VERTICAL
5	700.27	41.60	1.89	43.49	46.00	-2.51	Peak	VERTICAL
6	900.09	37.65	5.31	42.96	46.00	-3.04	Peak	VERTICAL
1	53.28	45.42	-6.34	39.08	40.00	-0.92	Peak	HORIZONTAL
2	118.27	48.39	-8.71	39.68	43.50	-3.82	Peak	HORIZONTAL
3	148.34	46.47	-6.06	40.41	43.50	-3.09	Peak	HORIZONTAL
4	169.68	46.79	-6.21	40.58	43.50	-2.92	Peak	HORIZONTAL
5	271.53	49.80	-5.71	44.09	46.00	-1.91	Peak	HORIZONTAL
6	900.09	37.71	5.31	43.02	46.00	-2.98	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	2019/04/08
Fundamental Frequency	2442MHz	Test By	Bill
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	30.00	44.70	-7.20	37.50	40.00	-2.50	Peak	VERTICAL
2	54.25	42.97	-6.40	36.57	40.00	-3.43	Peak	VERTICAL
3	111.48	50.23	-9.33	40.90	43.50	-2.60	Peak	VERTICAL
4	120.21	49.46	-8.53	40.93	43.50	-2.57	Peak	VERTICAL
5	129.91	48.17	-7.57	40.60	43.50	-2.90	Peak	VERTICAL
6	900.09	36.43	5.31	41.74	46.00	-4.26	Peak	VERTICAL
1	54.25	43.92	-6.40	37.52	40.00	-2.48	Peak	HORIZONTAL
2	171.62	47.89	-6.43	41.46	43.50	-2.04	Peak	HORIZONTAL
3	177.44	47.62	-7.20	40.42	43.50	-3.08	Peak	HORIZONTAL
4	250.19	48.89	-6.67	42.22	46.00	-3.78	Peak	HORIZONTAL
5	269.59	49.35	-5.79	43.56	46.00	-2.44	Peak	HORIZONTAL
6	900.09	36.86	5.31	42.17	46.00	-3.83	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 High	Test Date	2019/04/08
Fundamental Frequency	2480MHz	Test By	Bill
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	48.43	43.34	-6.19	37.15	40.00	-2.85	Peak	VERTICAL
2	56.19	43.86	-6.52	37.34	40.00	-2.66	Peak	VERTICAL
3	109.54	51.29	-9.55	41.74	43.50	-1.76	Peak	VERTICAL
4	128.94	47.99	-7.66	40.33	43.50	-3.17	Peak	VERTICAL
5	168.71	46.52	-6.17	40.35	43.50	-3.15	Peak	VERTICAL
6	900.09	38.38	5.31	43.69	46.00	-2.31	Peak	VERTICAL
1	105.66	50.24	-10.25	39.99	43.50	-3.51	Peak	HORIZONTAL
2	127.97	48.85	-7.75	41.10	43.50	-2.40	Peak	HORIZONTAL
3	148.34	46.92	-6.06	40.86	43.50	-2.64	Peak	HORIZONTAL
4	251.16	49.40	-6.65	42.75	46.00	-3.25	Peak	HORIZONTAL
5	269.59	48.99	-5.79	43.20	46.00	-2.80	Peak	HORIZONTAL
6	900.09	38.23	5.31	43.54	46.00	-2.46	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 (above 1GHz)

Operation Mode	TX CH Low	Test Date	2019/04/08
Fundamental Frequency	2402MHz	Test By	Bill
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	49.80	-9.27	40.53	74.00	-33.47	Peak	VERTICAL
2	7206.00	44.99	-1.70	43.29	74.00	-30.71	Peak	VERTICAL
1	4804.00	45.76	-9.27	36.49	74.00	-21.75	Peak	HORIZONTAL
2	7206.00	45.56	-1.70	43.86	74.00	-30.00	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.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH Mid	Test Date	2019/04/08
Fundamental Frequency	2442MHz	Test By	Bill
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	46.03	-9.06	36.97	74.00	-37.03	Peak	VERTICAL
2	7326.00	45.58	-1.63	43.95	74.00	-30.05	Peak	VERTICAL
1	4884.00	45.83	-9.06	36.77	74.00	-37.23	Peak	HORIZONTAL
2	7326.00	44.91	-1.63	43.28	74.00	-30.72	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.

Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH High	Test Date	2019/04/08
Fundamental Frequency	2480MHz	Test By	Bill
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	46.68	-8.87	37.81	74.00	-36.19	Peak	VERTICAL
2	7440.00	45.74	-1.63	44.11	74.00	-29.89	Peak	VERTICAL
1	4960.00	45.62	-8.87	36.75	74.00	-37.25	Peak	HORIZONTAL
2	7440.00	45.26	-1.63	43.63	74.00	-30.37	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.

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:

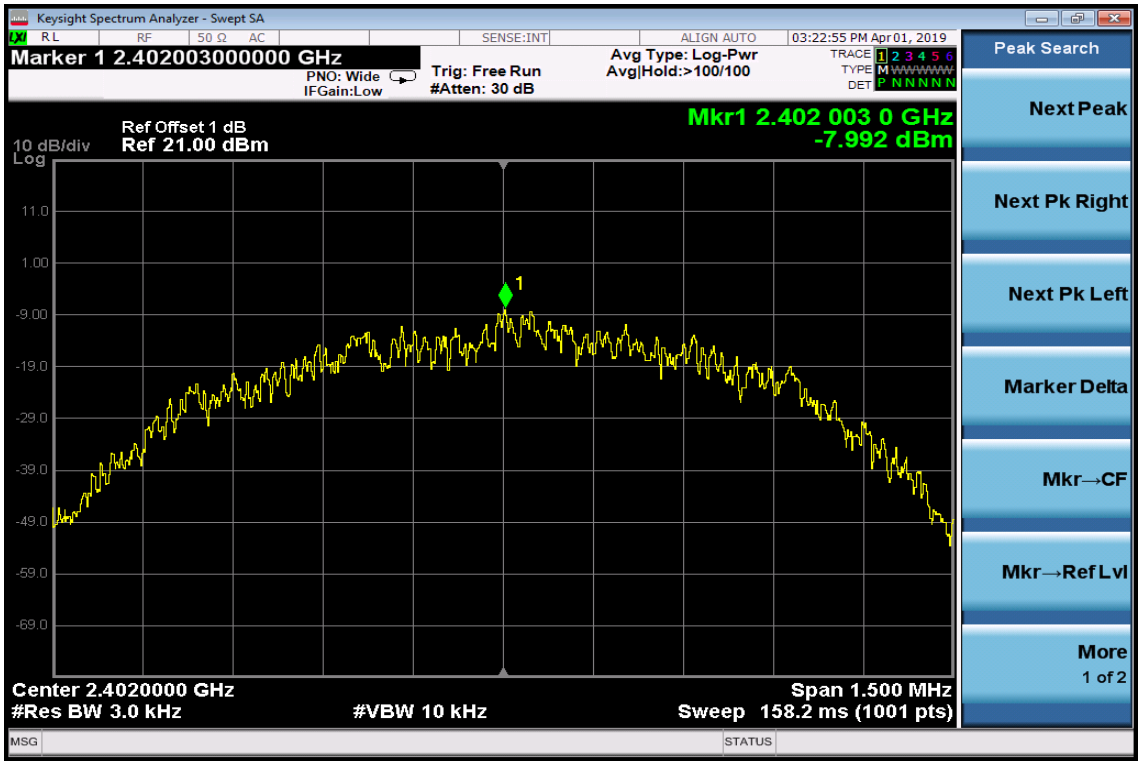
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW =100kHz, VBW = 300kHz, Span =5 to 30% greater than emission BW, Sweep=Auto
4. Record the max. reading.
5. Repeat above procedures until all frequency measured were complete.

10.5 Measurement Result:

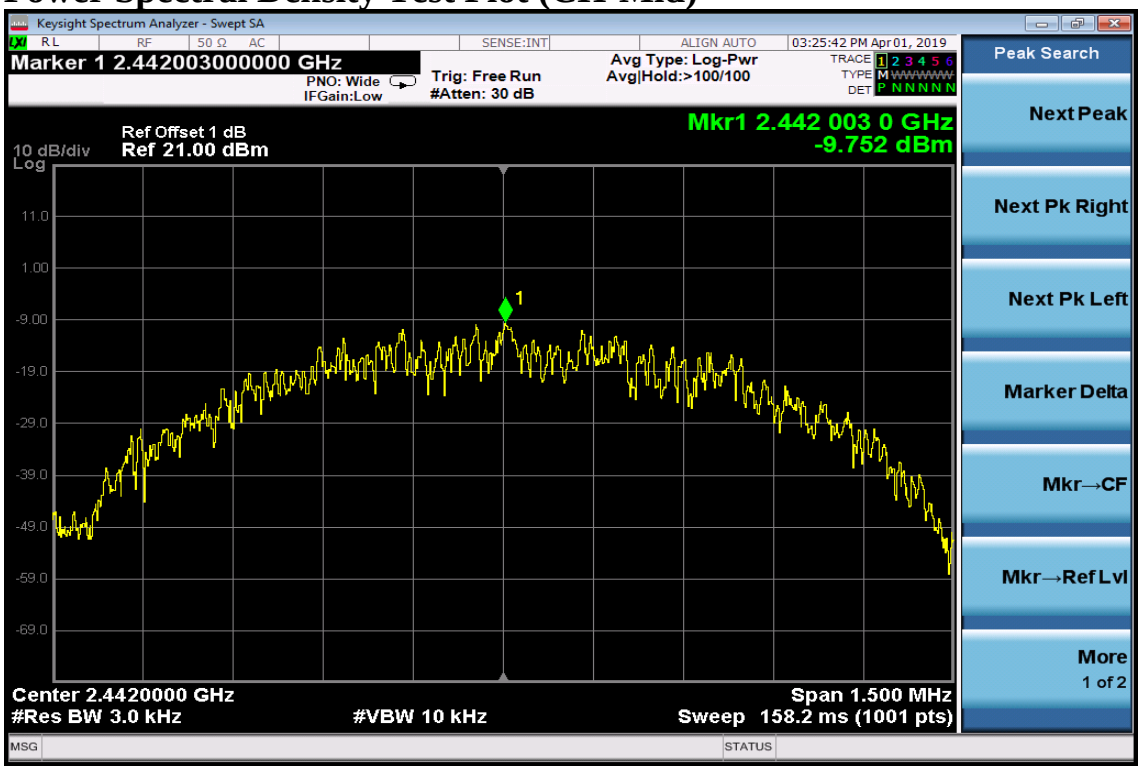
Frequency MHz	Power Density Reading (dBm)	Maximum Limit (dBm)
Low	-7.99	8
Mid	-9.75	8
High	-8.19	8

Offset: 1dB

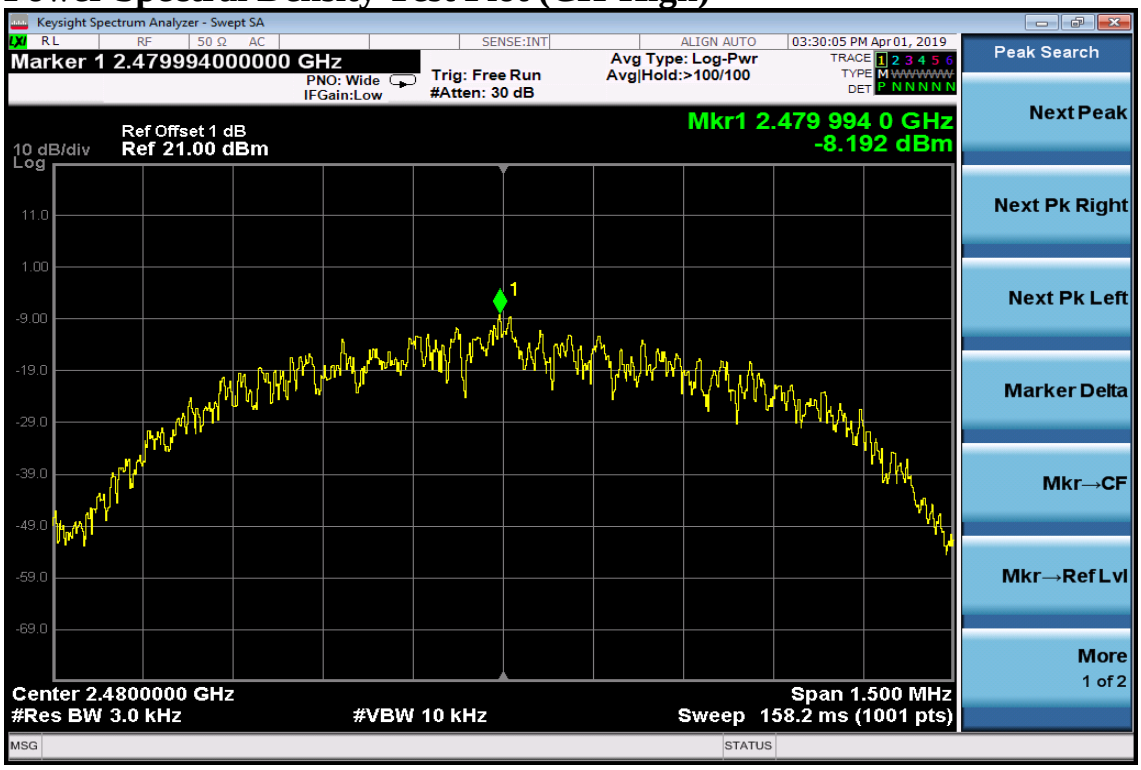
Power Spectral Density Test Plot (CH-Low)



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 gins of antenna used for transmitting is 2.5dBi, which is Chip antenna and no consideration of replacement by user. Please see EUT photo and antenna spec. for details.