

TEST REPORT

Application No.: GZCR2106020387HS
Applicant: Milwaukee Electric Tool Corporation
Address of Applicant: 13135 W Lisbon Rd, Brookfield, WI 53005
Manufacturer: Milwaukee Tool
Address of Manufacturer: 13135 W Lisbon Rd, Brookfield, WI 53005
Factory: Computime Limited
Address of Factory: Yuekenguangyu Industrial Park, Kangqiao Road 88#, Danzhutou Community, Nanwan Street Office, Longgang District, Shenzhen, Guangdong, China

Equipment Under Test (EUT):

EUT Name: ONE-KEY™ BLUETOOTH® Tracking Tag

Model No.: 48-21-2301, 48-21-2302, 48-21-2310 



Please refer to section 2 of this report which indicates which item was actually tested and which were electrically identical.

Trade Mark:

Standard(s) : 47 CFR Part 15, Subpart C 15.247

Date of Receipt: 2021-06-03

Date of Test: 2021-06-15 to 2021-06-16

Date of Issue: 2021-07-08

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards specified above.

Kobe Jian
EMC Laboratory Manager



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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2021-07-08		Original

Authorized for issue by			
Tested By		Jim Li	
		Jim Li/Project Engineer	
Reviewed By		Ricky Liu	
		Ricky Liu/Reviewer	



2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.9.1	47 CFR Part 15, Subpart C 15.247(b)(3)	Pass
Minimum 6dB Bandwidth		ANSI C63.10 (2013) Section 11.8.1	47 CFR Part 15, Subpart C 15.247a(2)	Pass
Power Spectrum Density		ANSI C63.10 (2013) Section 11.10.2	47 CFR Part 15, Subpart C 15.247(e)	Pass
Conducted Band Edges Measurement		ANSI C63.10 (2013) Section 11.13.3.2	47 CFR Part 15, Subpart C 15.247(d)	Pass
Conducted Spurious Emissions		ANSI C63.10 (2013) Section 11.11	47 CFR Part 15, Subpart C 15.247(d)	Pass
Radiated Emissions which fall in the restricted bands		ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions		ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass

Note:

E.U.T./EUT means Equipment Under Test.

N/A: Not applicable.

Pass means the test result passed the test standard requirement, please find the detailed decision rule in the report relative section.

¤ Declaration of EUT Family Grouping:

Model No.: 48-21-2301, 48-21-2302, 48-21-2310

Only the model 48-21-2301 was tested.

According to the declaration from the applicant, the electrical circuit design, layout, components used and internal wiring were identical for all models, with only difference on the number of product in the package (1 for 48-21-2301, 2 for 48-21-2302 and 10 for 48-21-2310).

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4 General Information

4.1 Details of E.U.T.

Power supply:	DC 3V=Size "CR3202" Battery x 1
Cable(s):	N/A
Operation Frequency:	2402MHz to 2480MHz
Bluetooth Version:	V5.2 LE
Function:	BLE function for tracker.
Modulation Type:	GFSK
Number of Channels:	40
Channel Spacing:	2MHz
Antenna Type:	Chip Antenna
Antenna Gain:	0dBi declared by applicant.
Firmware Version:	SW01
Hardware Version:	3899-2982 Rev EB6
Testing Software:	Open-Link Adapter Test Driver
Sample NO.:	3011034
Power Setting:	default

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Note Book PC	LENOVO	Lenovo Xiaoxinchao 5000	PF0TLJX7
Mobile Phone	APPLE	iPhone 12 mini	F71DP3NG0GQY

4.3 Measurement Uncertainty

Test Item	Measurement Uncertainty
Conducted Peak Output Power	± 0.75dB
Minimum 6dB Bandwidth	± 3%
Power Spectrum Density	± 2.84dB
Conducted Band Edges Measurement	± 0.75dB
Conducted Spurious Emissions	± 0.75dB
Radiated Emissions which fall in the restricted bands	±5.06dB (Below 1GHz); ± 4.8dB (Above 1GHz)
Radiated Spurious Emissions	±5.06dB (Below 1GHz); ± 4.8dB (Above 1GHz)

4.4 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou Branch EMC Laboratory,
198 Kezhu Road, Scientech Park, Guangzhou Economic & Technology Development District,
Guangzhou, China 510663

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No tests were sub-contracted.



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4.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **NVLAP (Lab Code: 200611-0)**

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 200611-0.

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.

- **ACMA**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian/New Zealand Regulatory Compliance Mark (RCM).

- **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FIMKO**

Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.

- **CNAS (Lab Code: L0167)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been assessed and in compliance with CNAS-CL01:2018 accreditation criteria for testing laboratories (identical to ISO/IEC 17025:2017 General Requirements) for the Competence of Testing Laboratories.

- **FCC Recognized Accredited Test Firm(Registration No.: 486818)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: CN5016, Test Firm Registration Number: 486818.

- **ISED (Registration No.: 4620B, CAB identifier: CN0052)**

SGS-CSTC Standards Technical Services Co., Ltd., has been registered by Innovation Science and Economic Development Canada for Wireless Device Testing laboratories to test to Canadian radio equipment requirements. Registration No. 4620B, CAB identifier: CN0052.

- **VCCI (Registration No.: R-12460, C-12584, G-20107 and T-11179)**

The 10m Semi-anechoic chamber, 966 Anechoic Chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-12460, C-12584, G-20107 and T-11179 respectively.

- **CBTL (Lab Code: TL129)**

SGS-CSTC Standards Technical Services Co., Ltd., E&E Laboratory has been assessed and fully comply with the requirements of ISO/IEC 17025:2017, the Basic Rules, IECEE 01 and Rules of procedure IECEE 02, and the relevant IECEE CB-Scheme Operational documents.

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4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None

4.8 Duty cycle of the EUT

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

All duty cycle is pre-scanned and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percent.

Formula:

Duty Cycle = $T_{on}/(T_{on}+T_{off})$

Measurement Procedure:

1. Set span = Zero
2. RBW=8MHz
3. VBW=8MHz
4. Detector=Peak

Mode	Channel(MHz)	Duty Cycle(%)	Correction Factor(dB)*
BLE_1M	2402	85.31	1.17
	2440	85.38	1.17
	2480	85.48	1.17
BLE_2M	2402	57.53	2.40
	2440	57.53	2.40
	2480	57.53	2.40

*Correction Factor(dB) = $10\log(1/\text{Duty Cycle})$

Please refer to appendix for details.

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5 Equipment List

Conducted Peak Output Power					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2020-09-17	2021-09-16
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Minimum 6dB Bandwidth					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2020-09-17	2021-09-16
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Power Spectrum Density					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2020-09-17	2021-09-16
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Conducted Band Edges Measurement					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2020-09-17	2021-09-16
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01

Conducted Spurious Emissions					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer(10Hz-44GHz)	Agilent Technologies	N9010A	EMC2138	2020-09-17	2021-09-16
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01



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Radiated Emissions which fall in the restricted bands					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Chamber cable(Above 1GHz)	Scoflex	KMKG-8.0m	EMC0545	2020-09-09	2022-09-08
Horn Antenna(1GHz-18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2019-09-25	2022-09-24
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2021-01-08	2022-01-07
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2021-01-08	2022-01-07
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2020-12-20	2023-12-19
MXE EMI Receiver(10Hz-8.4GHz)	Keysight	N9038A	EMC2139	2020-11-13	2021-11-12
EXA Signal Analyzer(10Hz-44GHz)	Keysight	N9010A	EMC2138	2020-09-17	2021-09-16
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A
Notch Filter (5150-5880)	Mico-Tronics	BRM50716	EMC2168	2020-07-29	2021-07-28
Signal Analyzer (20Hz-26.5GHz)	Rohde & Schwarz	FISQ 26	EMC0069	2020/11/13	2021/11/12

Radiated Spurious Emissions					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Chamber cable(Above 1GHz)	Scoflex	KMKG-8.0m	EMC0545	2020-09-09	2022-09-08
Horn Antenna(1GHz-18GHz)	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2019-09-25	2022-09-24
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2021-01-08	2022-01-07
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2021-01-08	2022-01-07
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2020-12-20	2023-12-19
MXE EMI Receiver(10Hz-8.4GHz)	Keysight	N9038A	EMC2139	2020-11-13	2021-11-12
EXA Signal Analyzer(10Hz-44GHz)	Keysight	N9010A	EMC2138	2020-09-17	2021-09-16
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A
Notch Filter (5150-5880)	Mico-Tronics	BRM50716	EMC2168	2020-07-29	2021-07-28
Signal Analyzer (20Hz-26.5GHz)	Rohde & Schwarz	FISQ 26	EMC0069	2020/11/13	2021/11/12

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General used equipment

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DMM	Fluke	73	EMC0006	2020-07-09	2021-07-08
DMM	Fluke	73	EMC0007	2020-07-09	2021-07-08

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6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)

6.1.2 Conclusion

Standard Requirement:

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

15.247(b) (4) requirement:

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 6dBi.

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 6dBi.

EUT Antenna: The antenna is integrated on the main PCB and no consideration of replacement.

The best case gain of the antenna is 0dBi.

Please refer to internal photos.



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7 Radio Spectrum Matter Test Results

7.1 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(3)

Test Method: ANSI C63.10 (2013) Section 11.9.1

Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥ 50 hopping channels
	0.25 for $25 \leq$ hopping channels < 50
	1 for digital modulation
2400-2483.5	1 for ≥ 75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

7.1.1 E.U.T. Operation

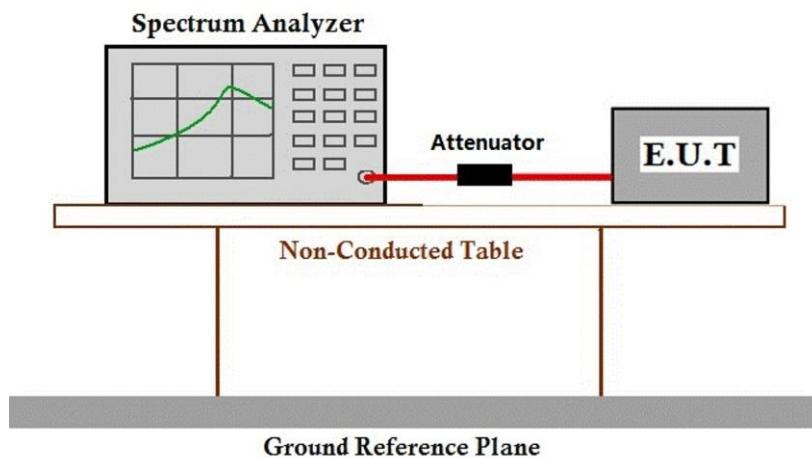
Operating Environment:

Temperature: 25.1 °C Humidity: 59.1 % RH Atmospheric Pressure: 1010 mbar

7.1.2 Test Mode Description

Pre-scan / Final test	Mode / Code	Description
Final test	01	TX mode_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.1.3 Test Setup Diagram



7.1.4 Measurement Procedure and Data

Please Refer To Appendix For Details



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7.2 Minimum 6dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247a(2)

Test Method: ANSI C63.10 (2013) Section 11.8.1

Limit: ≥ 500 kHz

7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 25.1 °C

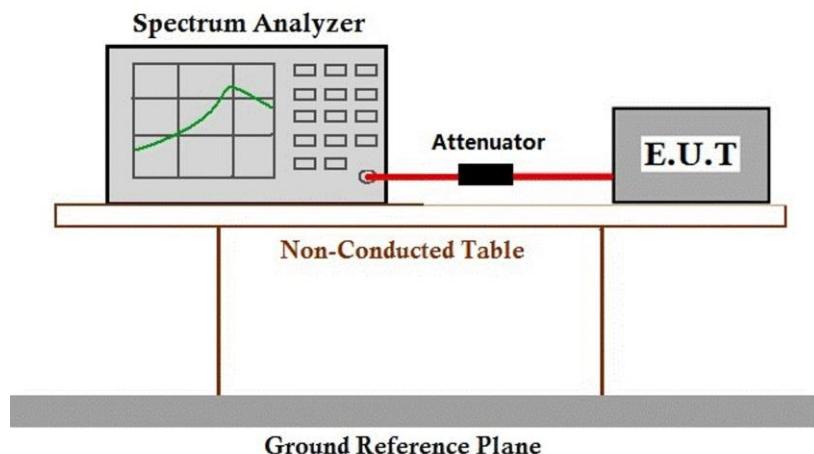
Humidity: 59.1 % RH

Atmospheric Pressure: 1010 mbar

7.2.2 Test Mode Description

Pre-scan / Final test	Mode / Code	Description
Final test	01	TX mode_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.2.3 Test Setup Diagram



7.2.4 Measurement Procedure and Data

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7.3 Power Spectrum Density

Test Requirement 47 CFR Part 15, Subpart C 15.247(e)
Test Method: ANSI C63.10 (2013) Section 11.10.2
Limit: ≤8dBm in any 3 kHz band during any time interval of continuous transmission

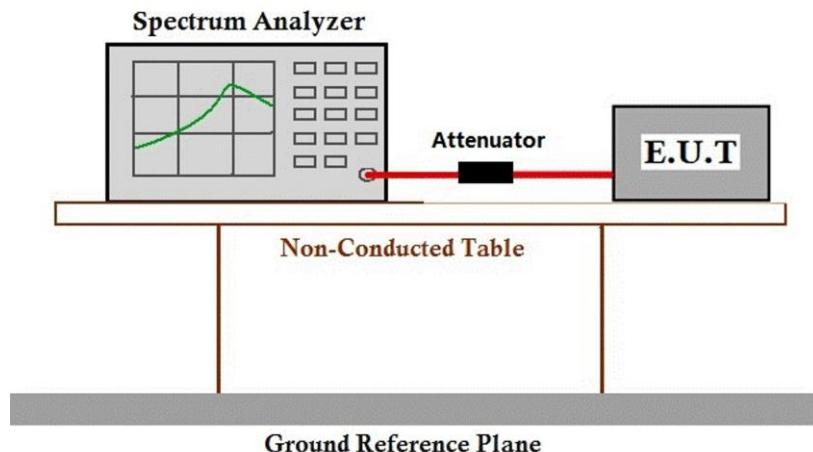
7.3.1 E.U.T. Operation

Operating Environment:
Temperature: 25.1 °C Humidity: 59.1 % RH Atmospheric Pressure: 1010 mbar

7.3.2 Test Mode Description

Pre-scan / Final test	Mode / Code	Description
Final test	01	TX mode_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.3.3 Test Setup Diagram



7.3.4 Measurement Procedure and Data

Please Refer To Appendix For Details



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7.4 Conducted Band Edges Measurement

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)

Test Method: ANSI C63.10 (2013) Section 11.13.3.2

Limit:

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)).

7.4.1 E.U.T. Operation

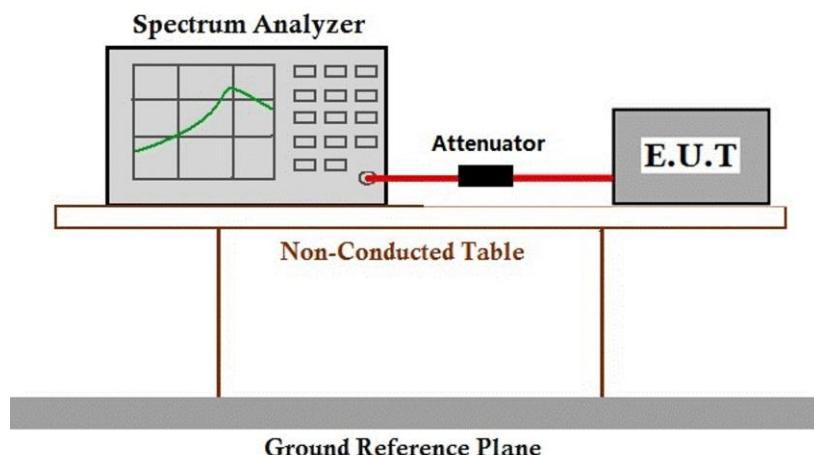
Operating Environment:

Temperature: 25.1 °C Humidity: 59.1 % RH Atmospheric Pressure: 1010 mbar

7.4.2 Test Mode Description

Pre-scan / Mode Final test	Mode Code	Description
Final test	01	TX mode_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.4.3 Test Setup Diagram



7.4.4 Measurement Procedure and Data

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7.5 Conducted Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)

Test Method: ANSI C63.10 (2013) Section 11.11

Limit:

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)).

7.5.1 E.U.T. Operation

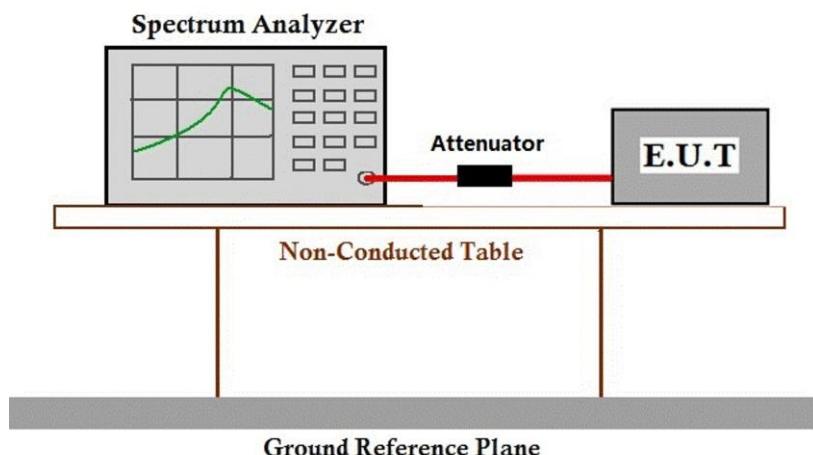
Operating Environment:

Temperature: 25.1 °C Humidity: 59.1 % RH Atmospheric Pressure: 1010 mbar

7.5.2 Test Mode Description

Pre-scan / Mode Final test	Mode Code	Description
Final test	01	TX mode_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.5.3 Test Setup Diagram



7.5.4 Measurement Procedure and Data

Please Refer To Appendix For Details



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7.6 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.10.5

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

7.6.1 E.U.T. Operation

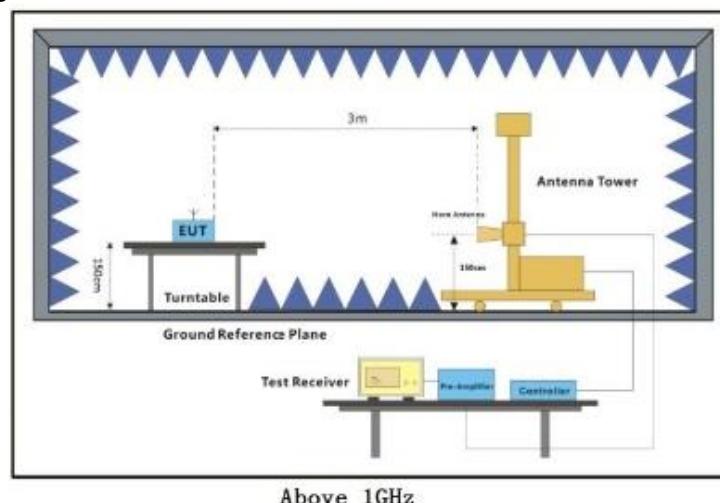
Operating Environment:

Temperature: 25.0 °C Humidity: 55.0 % RH Atmospheric Pressure: 1010 mbar

7.6.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	01	TX mode_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.6.3 Test Setup Diagram



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7.6.4 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Remark 3: Antenna: 3 denotes the type of antenna for above 1000MHz.

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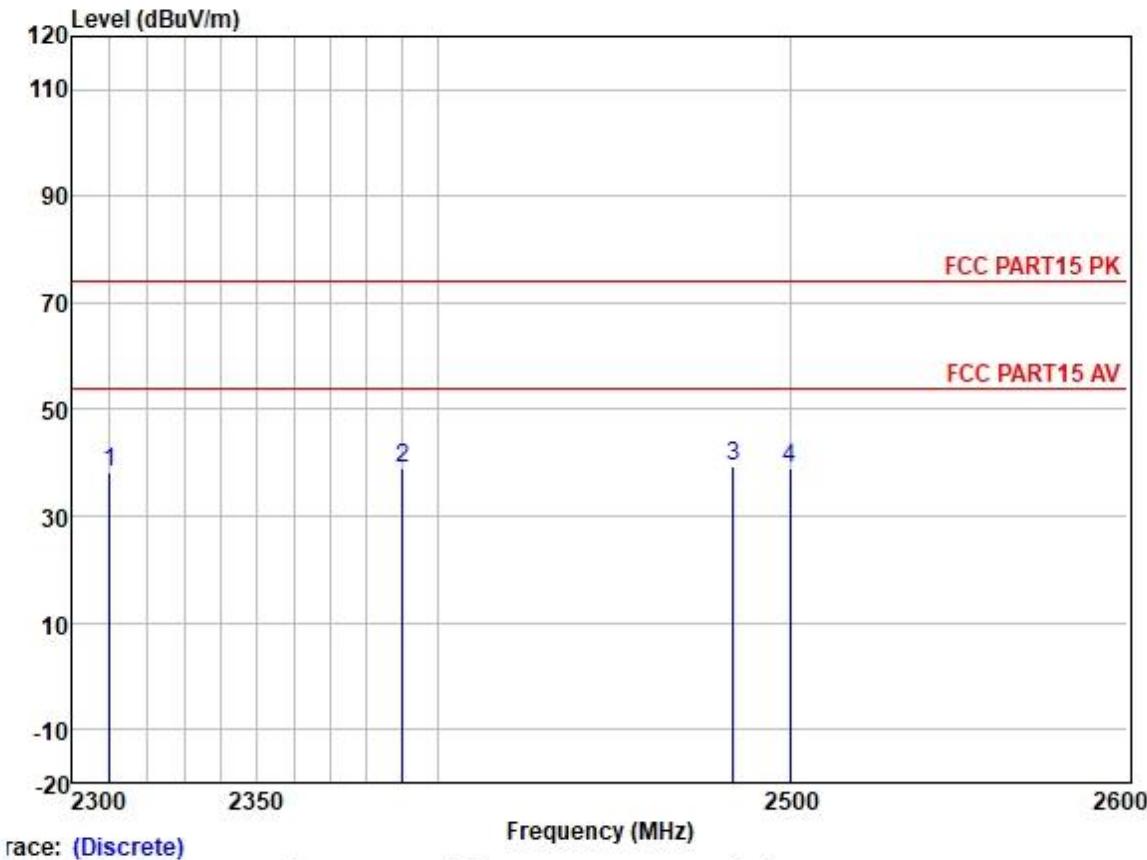


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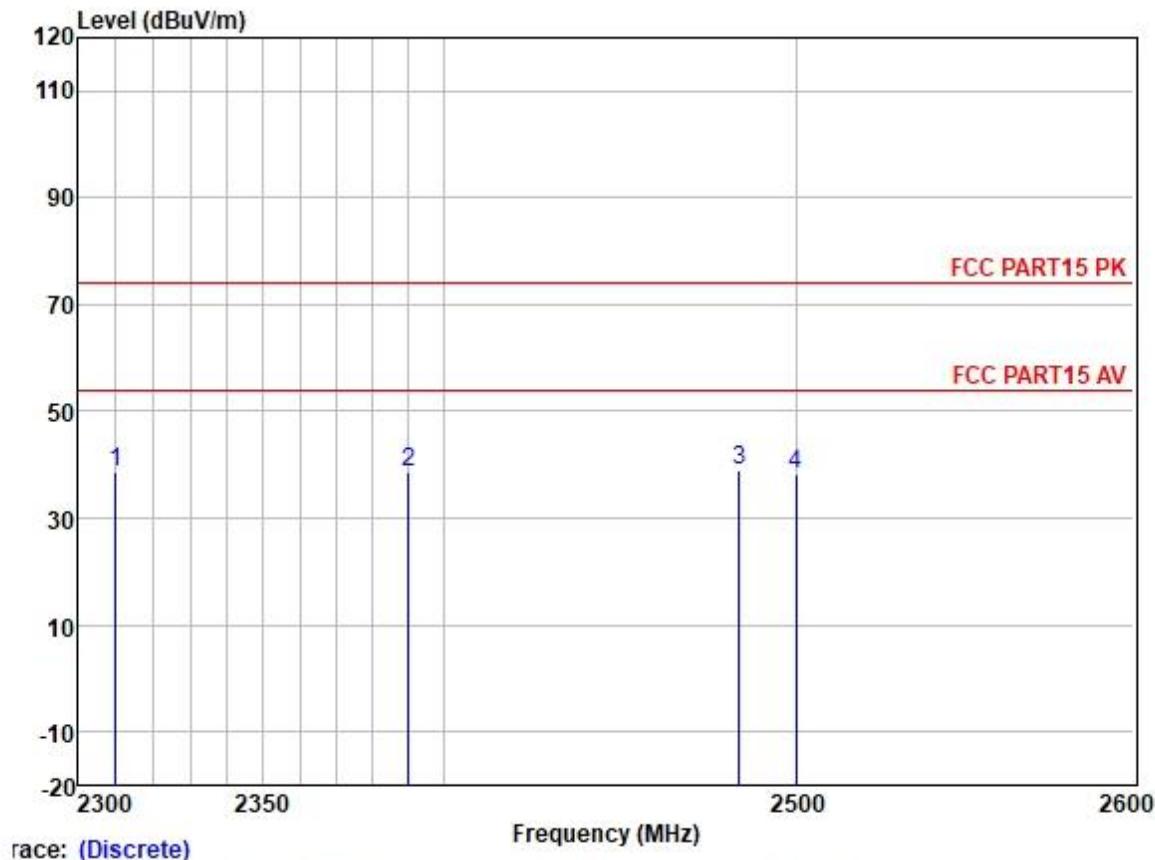
Test Mode: 01; Polarity: Horizontal; Modulation:GFSK; ; Channel:High; Antenna: 3



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Test Mode: 01; Polarity: Horizontal; Modulation:GFSK; Channel:Low; Antenna: 3

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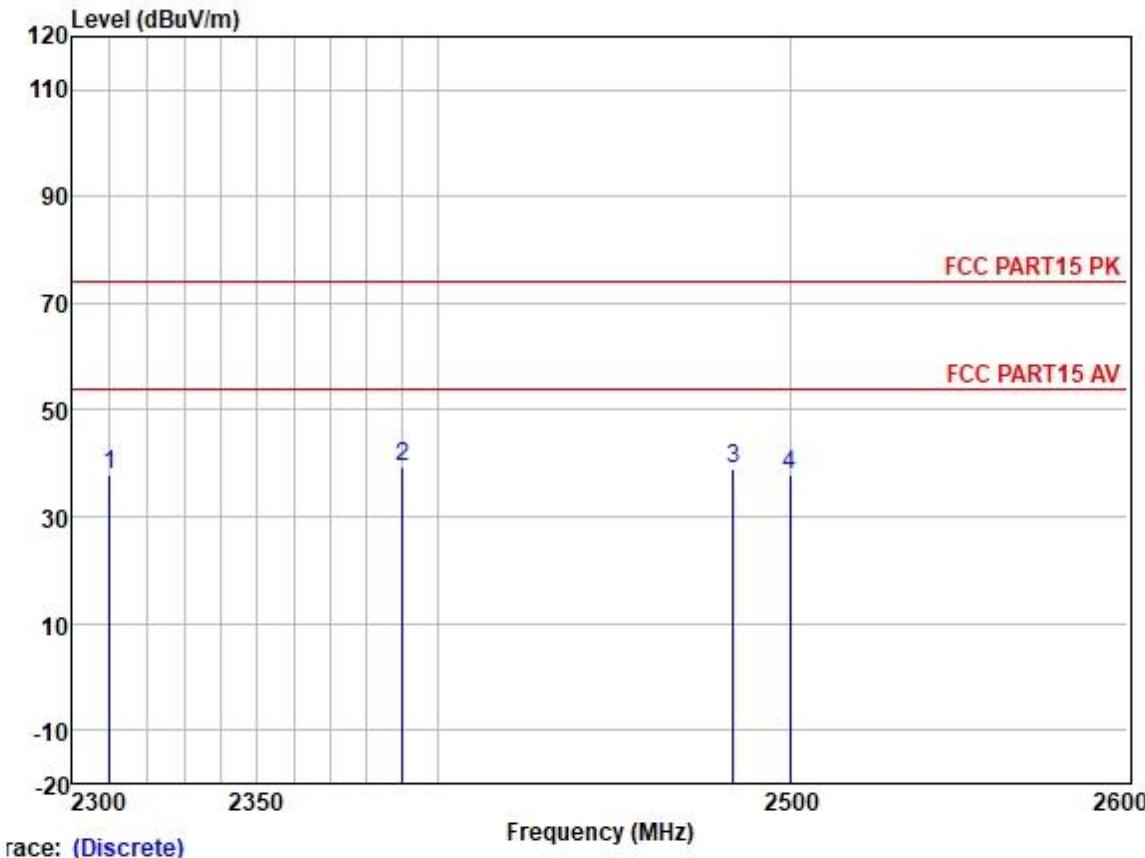
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Test Mode: 01; Polarity: Vertical; Modulation:GFSK; Channel:High; Antenna: 3



Mode: (Discrete)

Point	Freq	ReadAntenna		Cable		Preamp Level	Limit Line	Over Line	Over Limit	Pol/Phase	Remark
		Level	Factor	Loss	Factor						
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB				
1	2310.000	44.96	27.15	3.32	37.62	37.81	74.00	-36.19	VERTICAL	Peak	
2	2390.000	46.23	27.33	3.48	37.59	39.45	74.00	-34.55	VERTICAL	Peak	
3	2483.500	45.73	27.48	3.53	37.57	39.17	74.00	-34.83	VERTICAL	Peak	
4	2500.000	44.37	27.50	3.40	37.56	37.71	74.00	-36.29	VERTICAL	Peak	

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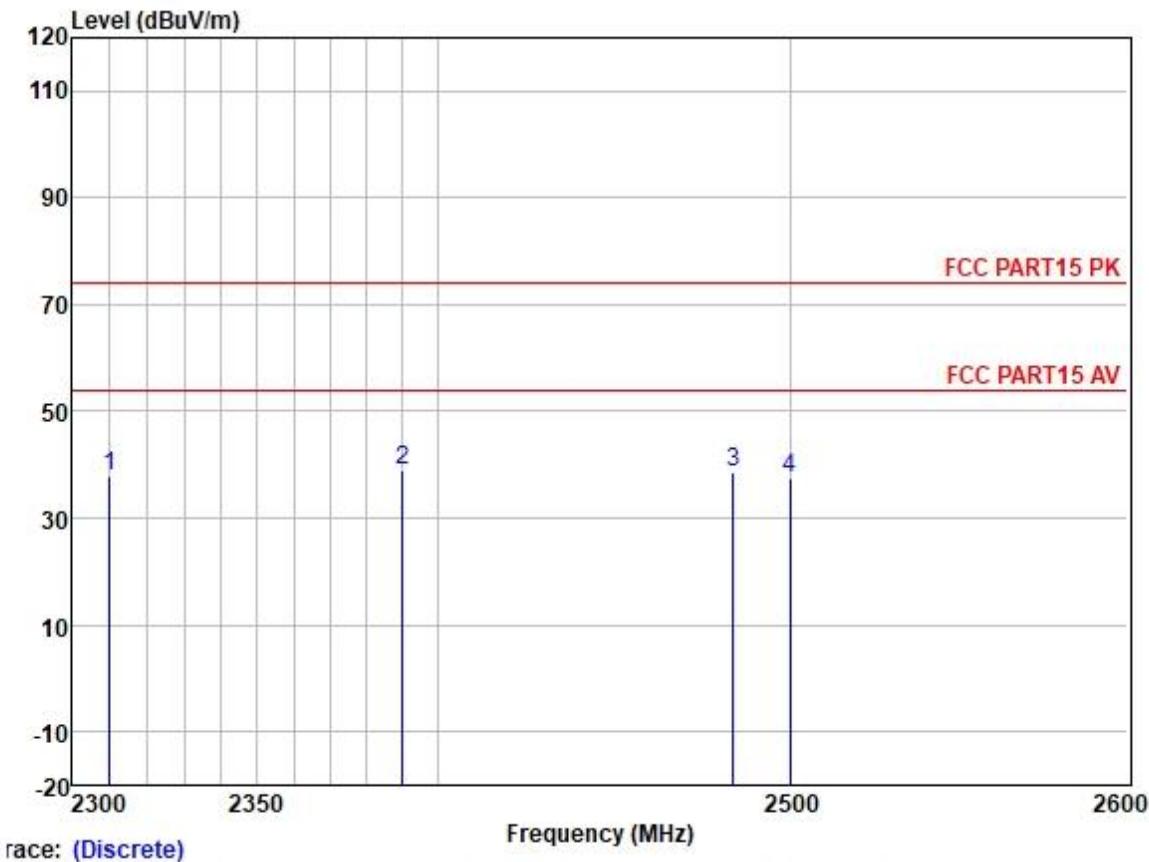
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Test Mode: 01; Polarity: Vertical; Modulation:GFSK; Channel:Low; Antenna: 3



Freq	ReadAntenna		Cable		Preamp	Limit	Over	Line	Limit	Pol/Phase	Remark
	Level	Factor	Loss	Factor							
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB				
1 2310.000	44.98	27.15	3.32	37.62	37.83	74.00	-36.17	VERTICAL	Peak		
2 2390.000	45.79	27.33	3.48	37.59	39.01	74.00	-34.99	VERTICAL	Peak		
3 2483.500	45.35	27.48	3.53	37.57	38.79	74.00	-35.21	VERTICAL	Peak		
4 2500.000	44.30	27.50	3.40	37.56	37.64	74.00	-36.36	VERTICAL	Peak		

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7.7 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 25.0 °C Humidity: 55.0 % RH Atmospheric Pressure: 1010 mbar

7.7.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	01	TX mode_Keep the EUT in continuously transmitting mode with GFSK modulation.

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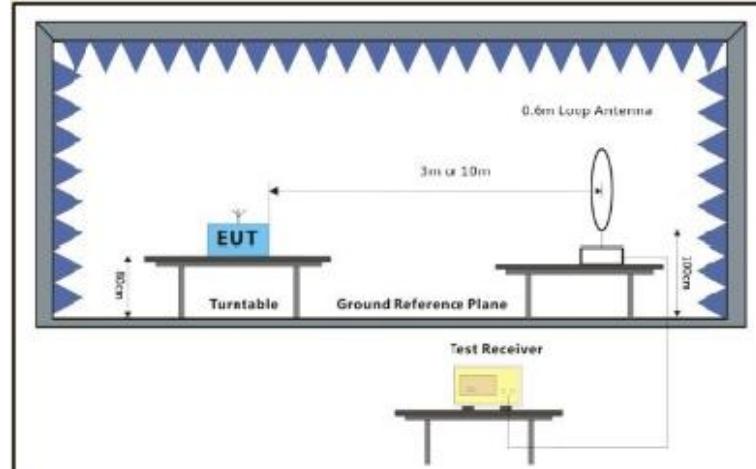


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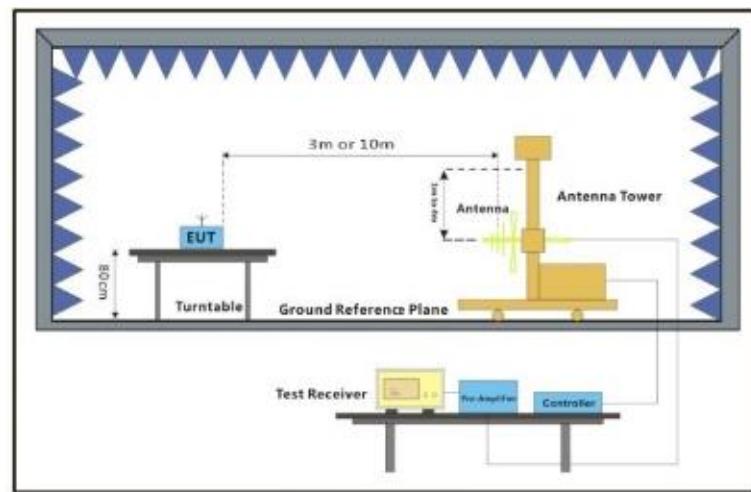
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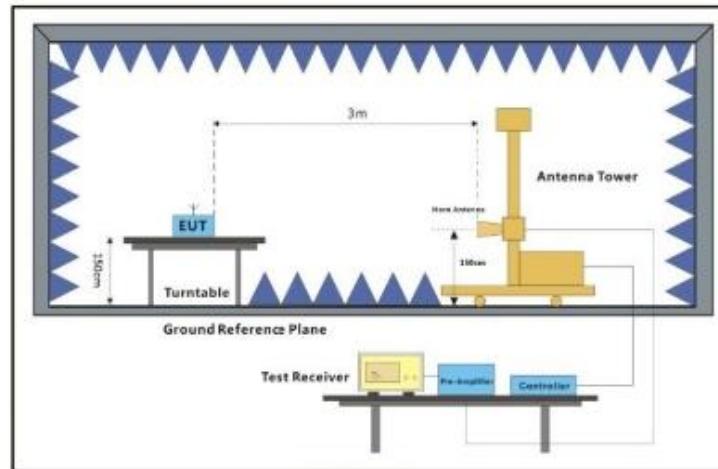
7.7.3 Test Setup Diagram



Below 30MHz



30MHz-1GHz



Above 1GHz

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7.7.4 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark:

1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.

2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor - Preamplifier Factor

3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

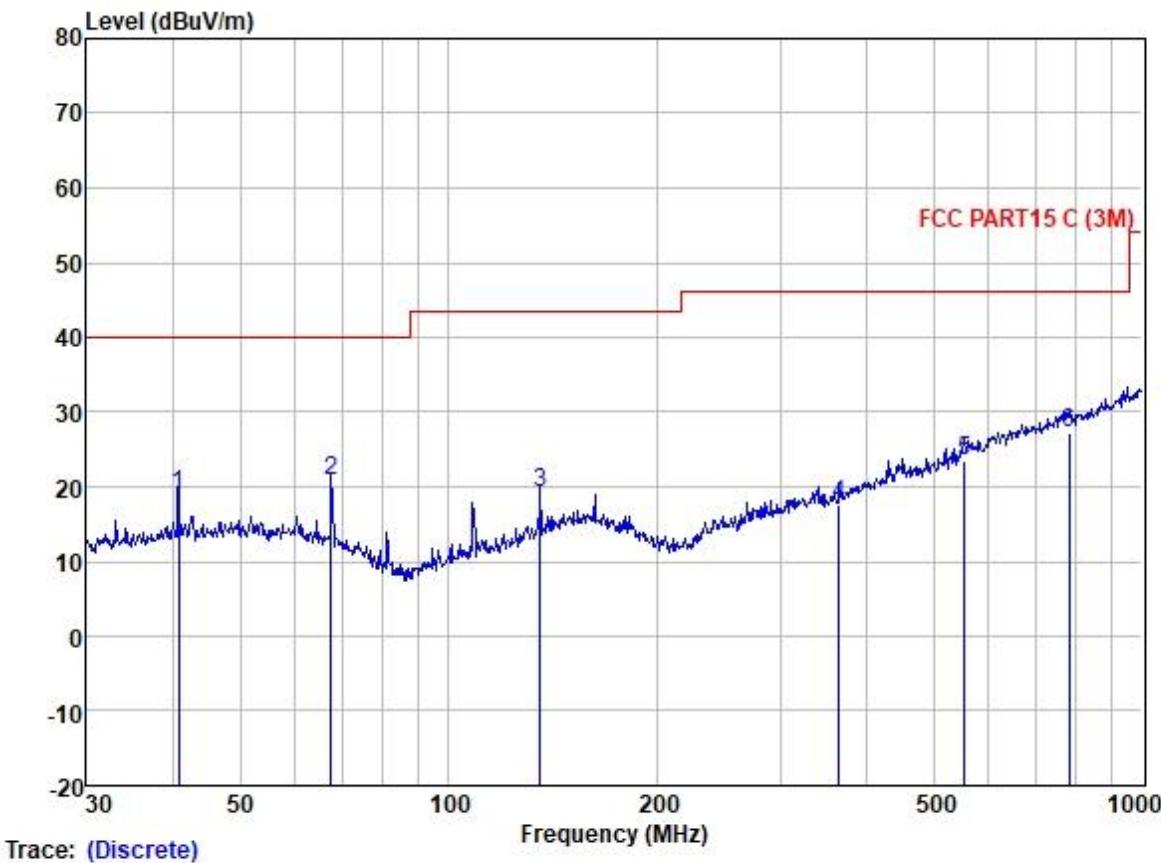
5) Antenna: 2 denotes the type of antenna for 30-1000MHz; Antenna: 3 denotes the type of antenna for above 1000MHz.

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Test Mode: 01; Polarity: Horizontal; Modulation:GFSK; Channel:Low; Antenna: 2



Site : SGS
Condition : FCC PART15 C (3M) HORIZONTAL
Job :
Model :
Power :
Test Mode :

Freq	Read	Antena	Cable	Preamp	Measured	Limit	Over	Pol/	Remark
	Level	Factor	Loss	Factor	Level	Line	Limit	Phase	
1	40.70	31.51	13.57	1.10	27.18	19.00	40.00	-21.00	HORIZONTAL QP
2	67.68	34.28	12.24	1.38	27.14	20.76	40.00	-19.24	HORIZONTAL QP
3	135.51	31.37	12.73	2.03	26.96	19.17	43.50	-24.33	HORIZONTAL QP
4	365.54	26.02	15.00	3.73	27.16	17.59	46.00	-28.41	HORIZONTAL QP
5	554.83	28.04	18.75	4.83	28.12	23.50	46.00	-22.50	HORIZONTAL QP
6	785.09	26.82	22.40	6.11	28.04	27.29	46.00	-18.71	HORIZONTAL QP

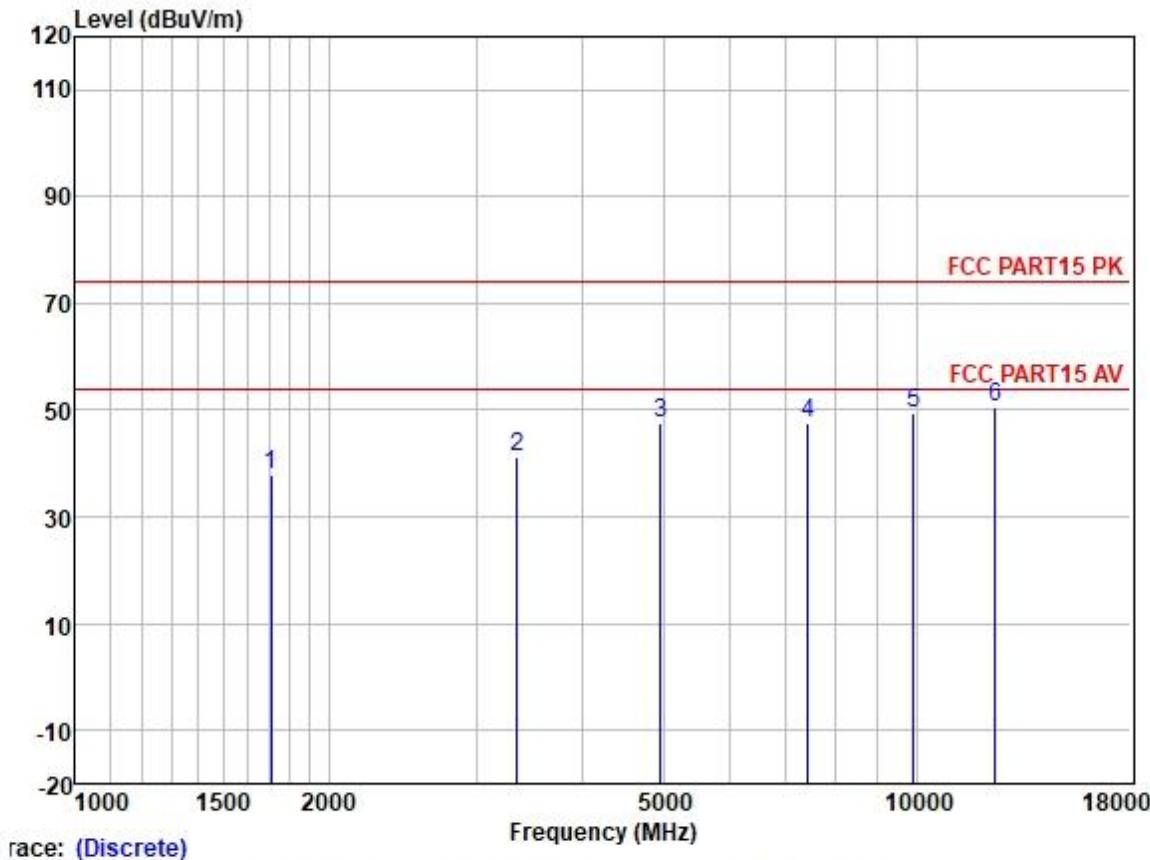
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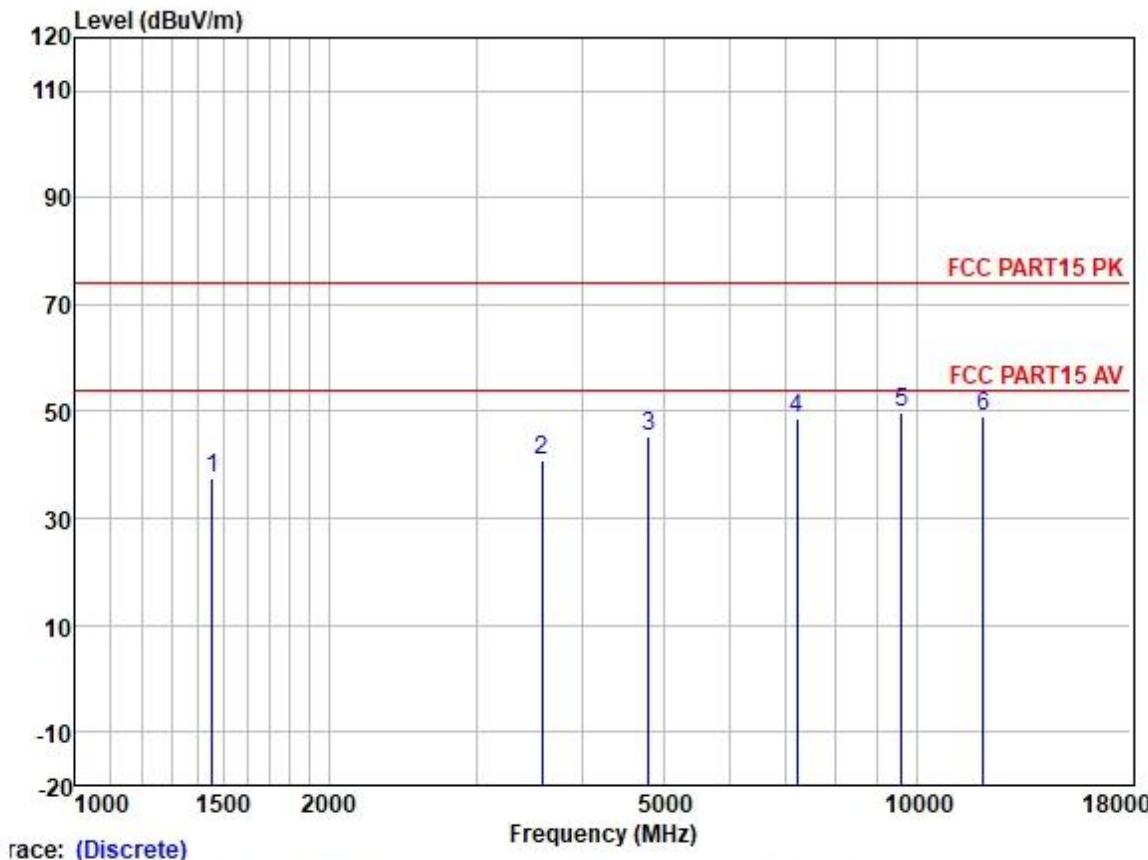
Test Mode: 01; Polarity: Horizontal; Modulation:GFSK; Channel:High; Antenna: 3



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Test Mode: 01; Polarity: Horizontal; Modulation:GFSK; Channel:Low; Antenna: 3



Freq	ReadAntenna		Cable		Preamp		Level	Limit	Over	Pol/Phase	Remark
	Level	Factor	Loss	Factor	Level	Line					
MHz	dBuV	dB/m		dB	dB	dBuV/m	dBuV/m		dB		
1	1456.081	47.60	25.46	2.72	38.17	37.61	74.00	-36.39	HORIZONTAL	Peak	
2	3587.818	44.35	29.02	4.49	36.91	40.95	74.00	-33.05	HORIZONTAL	Peak	
3	4804.190	45.45	31.42	5.40	36.83	45.44	74.00	-28.56	HORIZONTAL	Peak	
4	7206.015	44.54	35.54	5.98	37.38	48.68	74.00	-25.32	HORIZONTAL	Peak	
5	9608.818	41.94	38.37	7.07	37.42	49.96	74.00	-24.04	HORIZONTAL	Peak	
6	12010.260	38.96	38.90	8.19	37.10	48.95	74.00	-25.05	HORIZONTAL	Peak	

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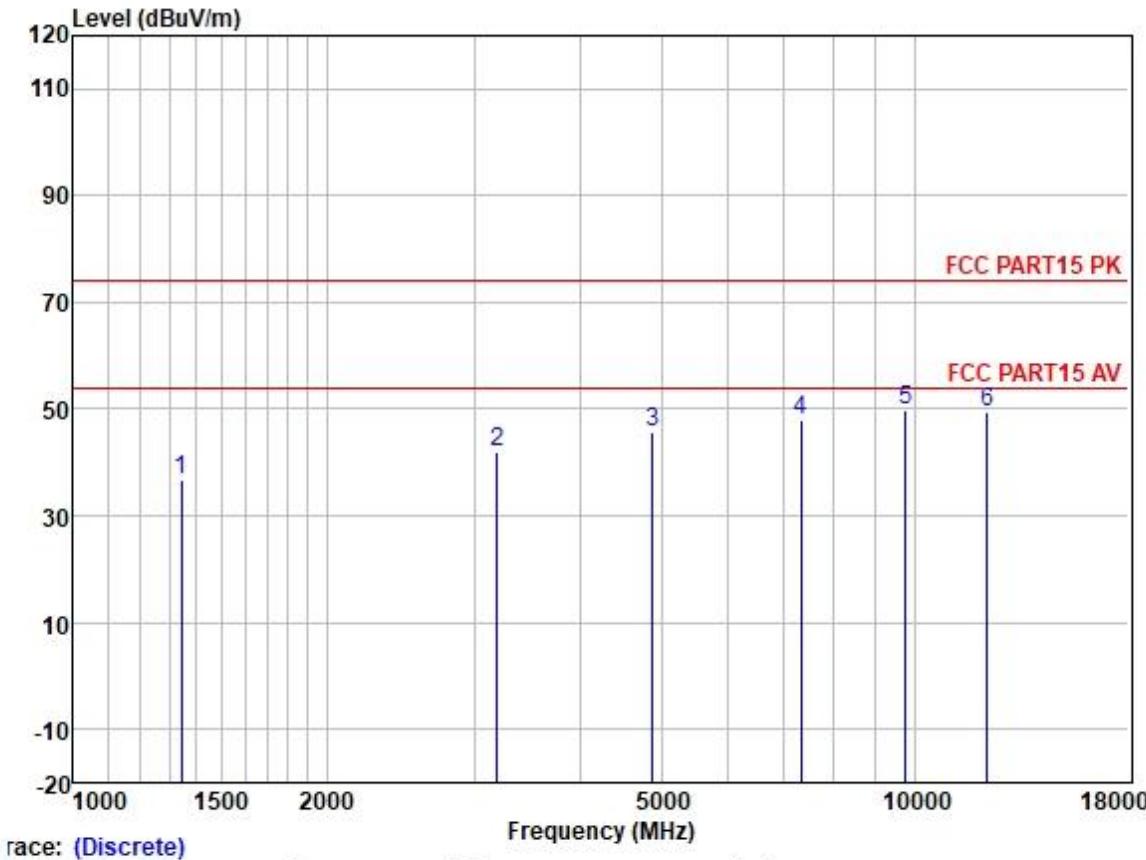
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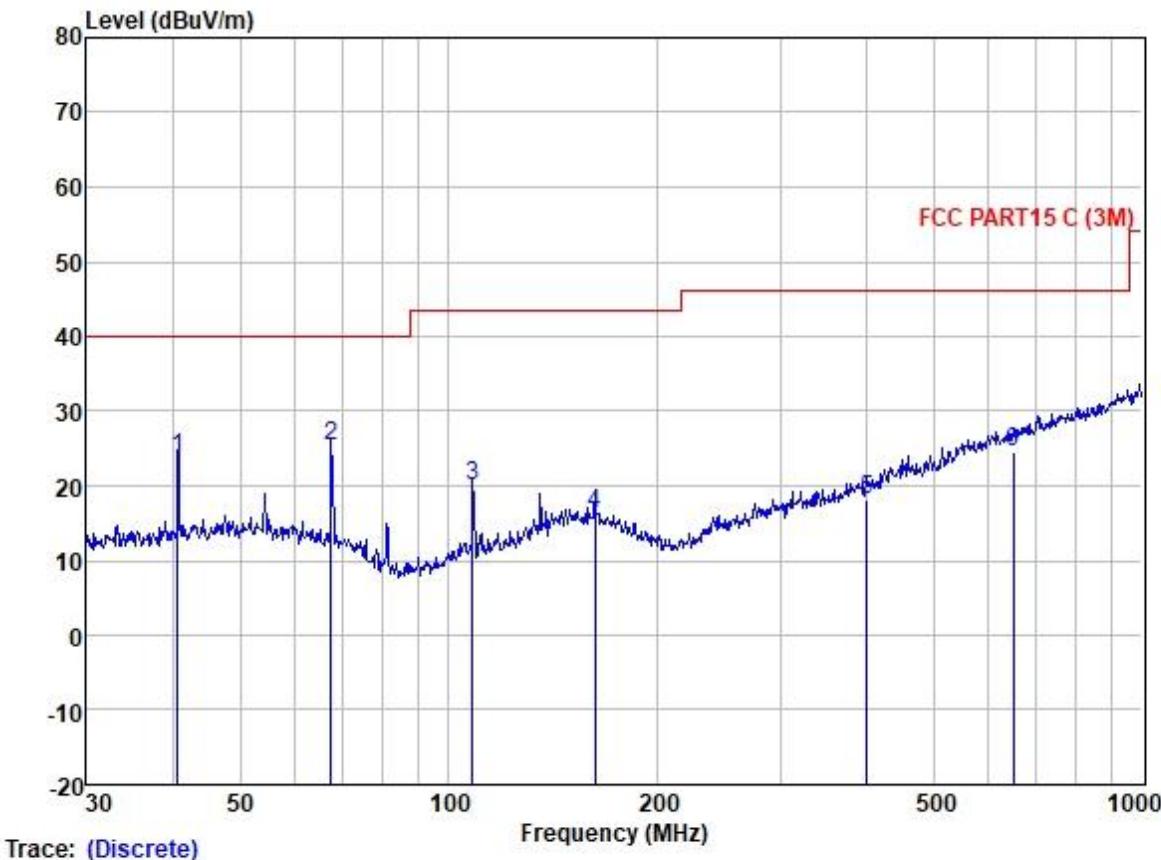
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Test Mode: 01; Polarity: Vertical; Modulation:GFSK; Channel:Low; Antenna: 2



Site : SGS
Condition : FCC PART15 C (3M) VERTICAL
Job :
Model :
Power :
Test Mode :

Freq	Read	Antenna	Cable	Preamp	Measured	Limit	Over	Pol/	Remark
	Level	Factor	Loss	Factor	Level	Line	Limit	Phase	
1	40.56	36.27	13.55	1.10	27.18	23.74	40.00	-16.26	VERTICAL QP
2	67.68	38.91	12.24	1.38	27.14	25.39	40.00	-14.61	VERTICAL QP
3	108.27	34.89	10.32	1.78	27.06	19.93	43.50	-23.57	VERTICAL QP
4	162.61	27.26	13.57	2.35	26.79	16.39	43.50	-27.11	VERTICAL QP
5	400.43	25.79	15.70	3.93	27.33	18.09	46.00	-27.91	VERTICAL QP
6	651.94	26.62	20.52	5.51	28.18	24.47	46.00	-21.53	VERTICAL QP

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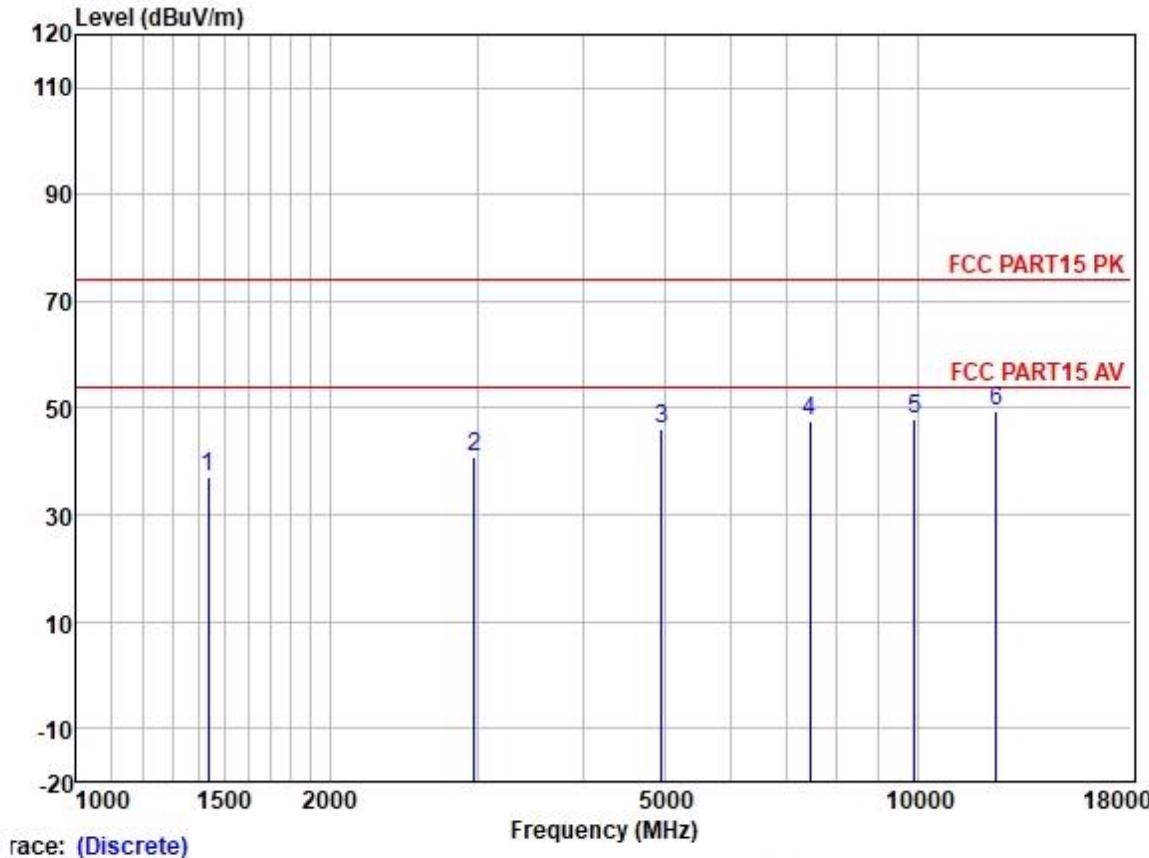
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Test Mode: 01; Polarity: Vertical; Modulation:GFSK; Channel:High; Antenna: 3



Freq	ReadAntenna		Cable		Preamp	Limit	Over	Pol/Phase	Remark
	MHz	Level	Factor	Loss					
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	1435.189	47.38	25.44	2.67	38.20	37.29	74.00	-36.71	VERTICAL Peak
2	2973.293	46.05	28.38	3.78	37.28	40.93	74.00	-33.07	VERTICAL Peak
3	4960.797	45.53	31.65	5.65	36.84	45.99	74.00	-28.01	VERTICAL Peak
4	7440.762	42.39	36.27	6.22	37.47	47.41	74.00	-26.59	VERTICAL Peak
5	9920.420	39.62	38.65	6.96	37.40	47.83	74.00	-26.17	VERTICAL Peak
6	12400.520	39.76	38.57	7.97	36.88	49.42	74.00	-24.58	VERTICAL Peak

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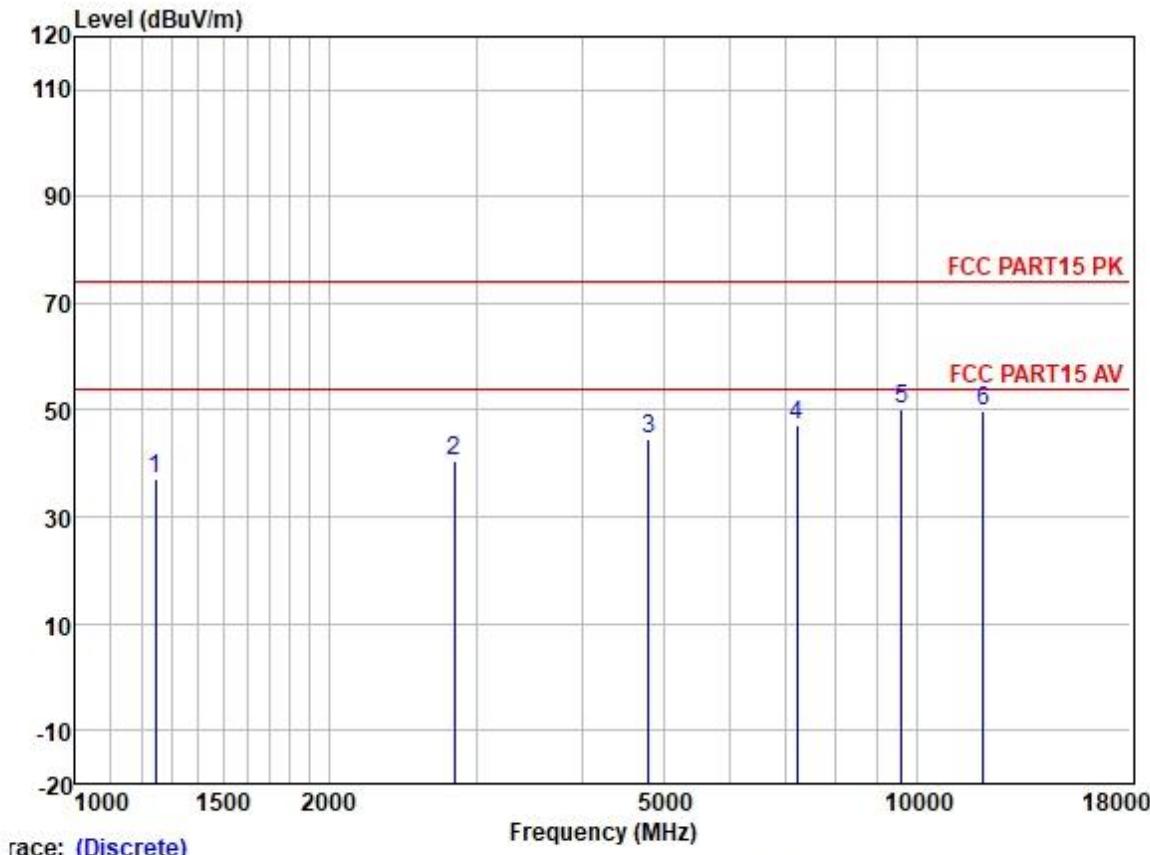
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Test Mode: 01; Polarity: Vertical; Modulation:GFSK; Channel:Low; Antenna: 3



Mode: (Discrete)

Freq	ReadAntenna		Cable Preamp		Limit	Over	Pol/Phase	Remark
	MHz	Level	Factor	Loss	Factor			
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	1245.663	47.97	25.00	2.33	38.35	36.95	74.00	-37.05 VERTICAL Peak
2	2822.558	45.96	28.18	3.70	37.40	40.44	74.00	-33.56 VERTICAL Peak
3	4804.751	44.58	31.42	5.40	36.83	44.57	74.00	-29.43 VERTICAL Peak
4	7206.464	42.89	35.54	5.98	37.38	47.03	74.00	-26.97 VERTICAL Peak
5	9608.122	42.15	38.37	7.07	37.42	50.17	74.00	-23.83 VERTICAL Peak
6	12010.470	39.78	38.90	8.19	37.10	49.77	74.00	-24.23 VERTICAL Peak

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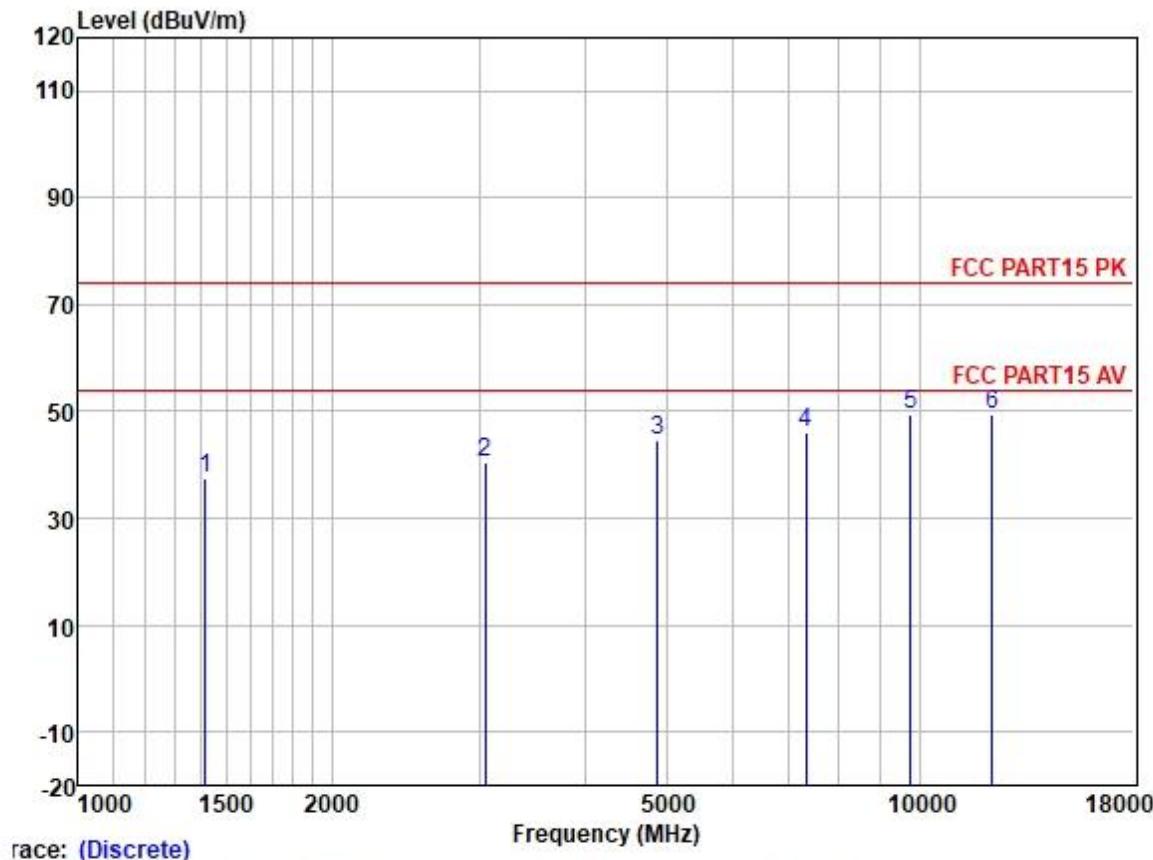


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Test Mode: 01; Polarity: Vertical; Modulation:GFSK; Channel:middle; Antenna: 3



Freq	ReadAntenna		Cable		Preamp	Limit	Over	Pol/Phase	Remark
	MHz	Level	Factor	Loss					
1	1414.597	47.53	25.41	2.63	38.20	37.37	74.00	-36.63	VERTICAL Peak
2	3042.846	45.25	28.43	3.84	37.20	40.32	74.00	-33.68	VERTICAL Peak
3	4884.515	44.34	31.56	5.52	36.84	44.58	74.00	-29.42	VERTICAL Peak
4	7326.626	41.49	36.00	6.13	37.43	46.19	74.00	-27.81	VERTICAL Peak
5	9768.052	41.28	38.53	7.01	37.41	49.41	74.00	-24.59	VERTICAL Peak
6	12210.000	39.50	38.74	8.08	37.00	49.32	74.00	-24.68	VERTICAL Peak

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8 Appendix

(cable loss=0.9dB)

8.1 Appendix A: DTS Bandwidth

8.1.1 Test Result

TestMode	Antenna	Channel	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.508	2401.668	2402.176	0.5	PASS
		2440	0.588	2439.720	2440.308	0.5	PASS
		2480	0.596	2479.708	2480.304	0.5	PASS
BLE_2M	Ant1	2402	0.956	2401.580	2402.536	0.5	PASS
		2440	0.956	2439.580	2440.536	0.5	PASS
		2480	0.948	2479.584	2480.532	0.5	PASS

8.1.2 Test Graphs



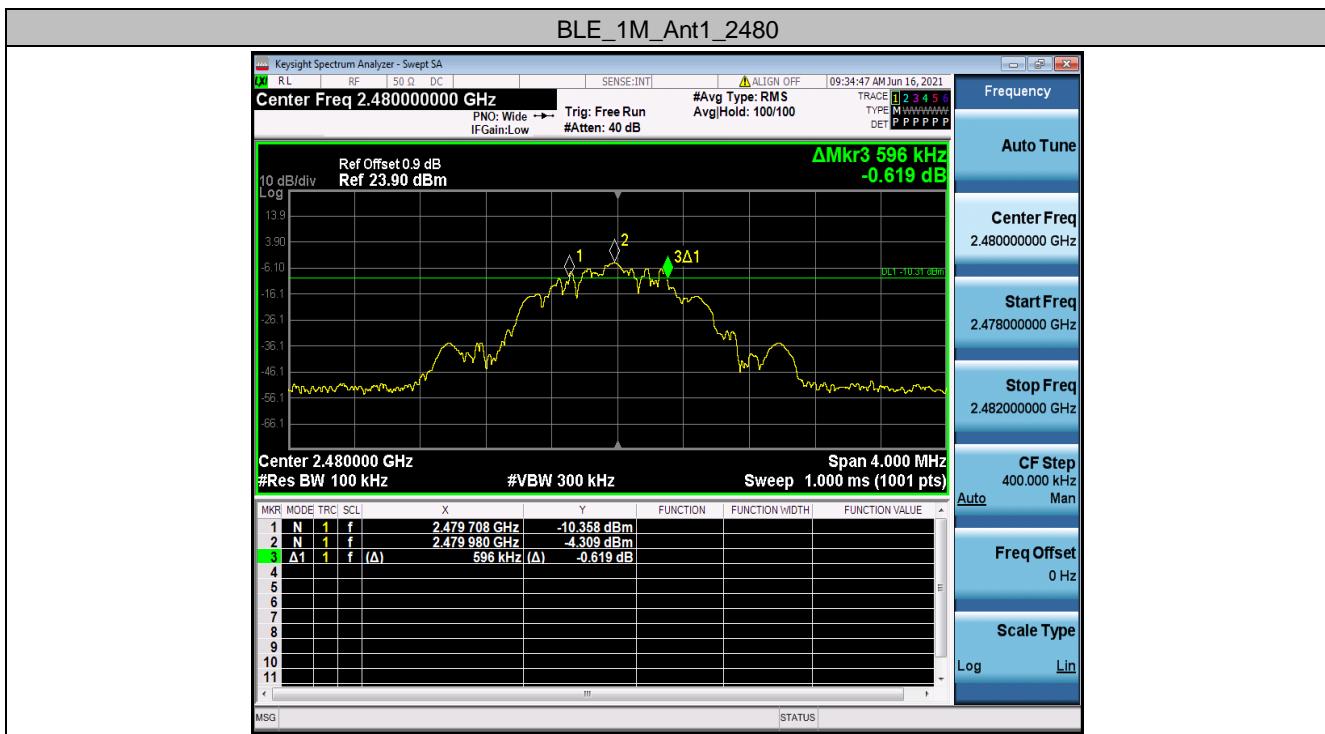
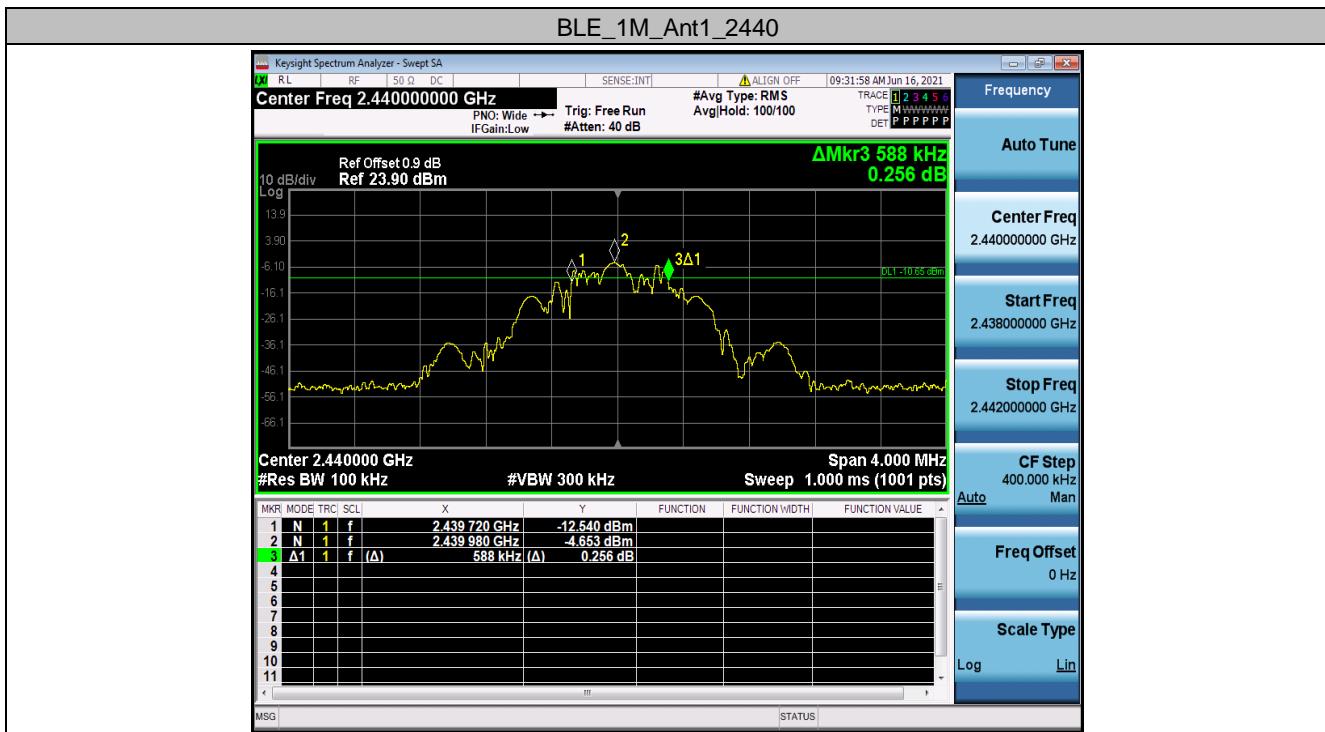
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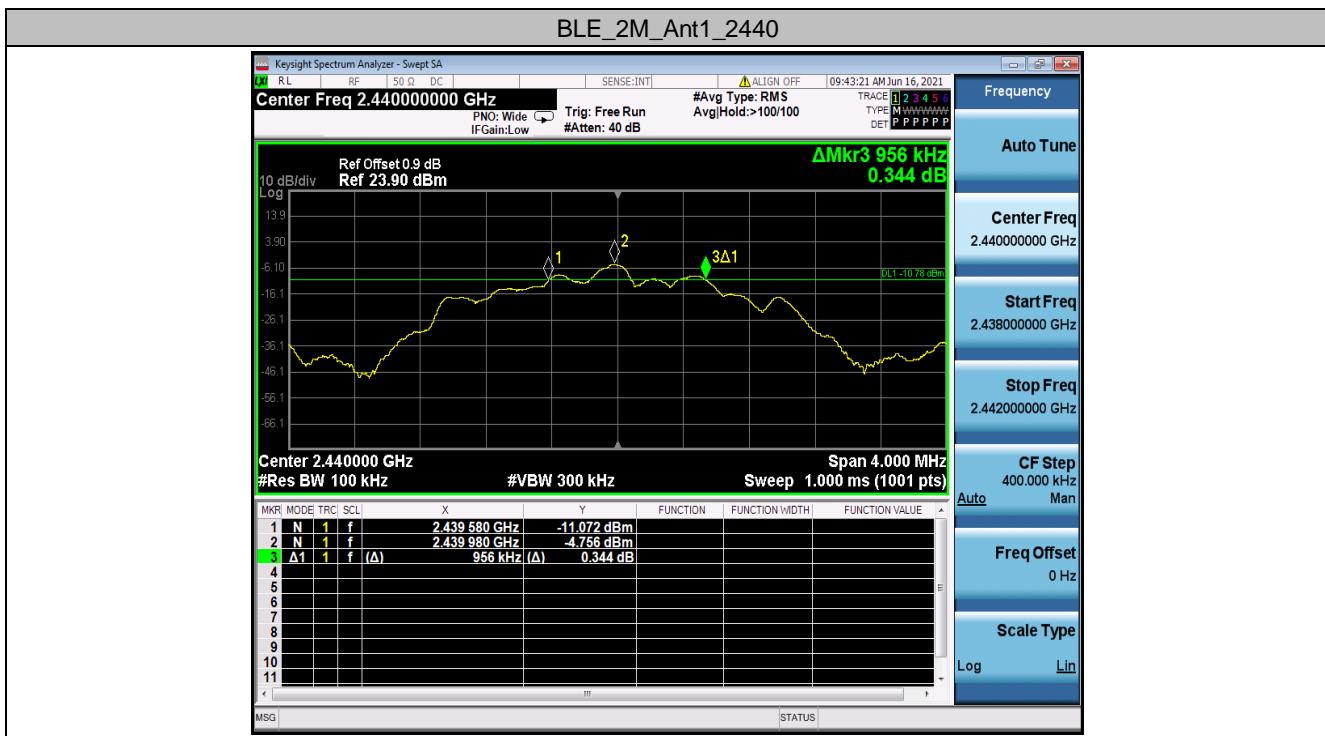
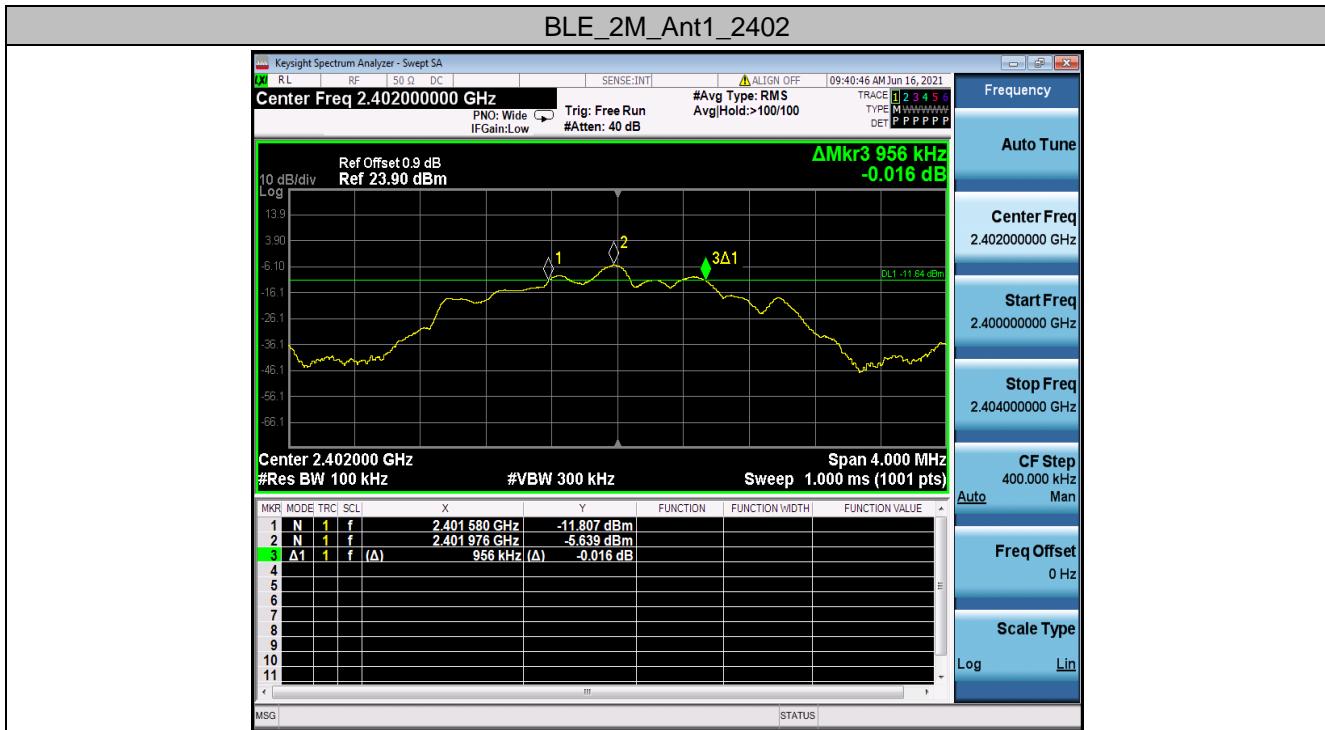
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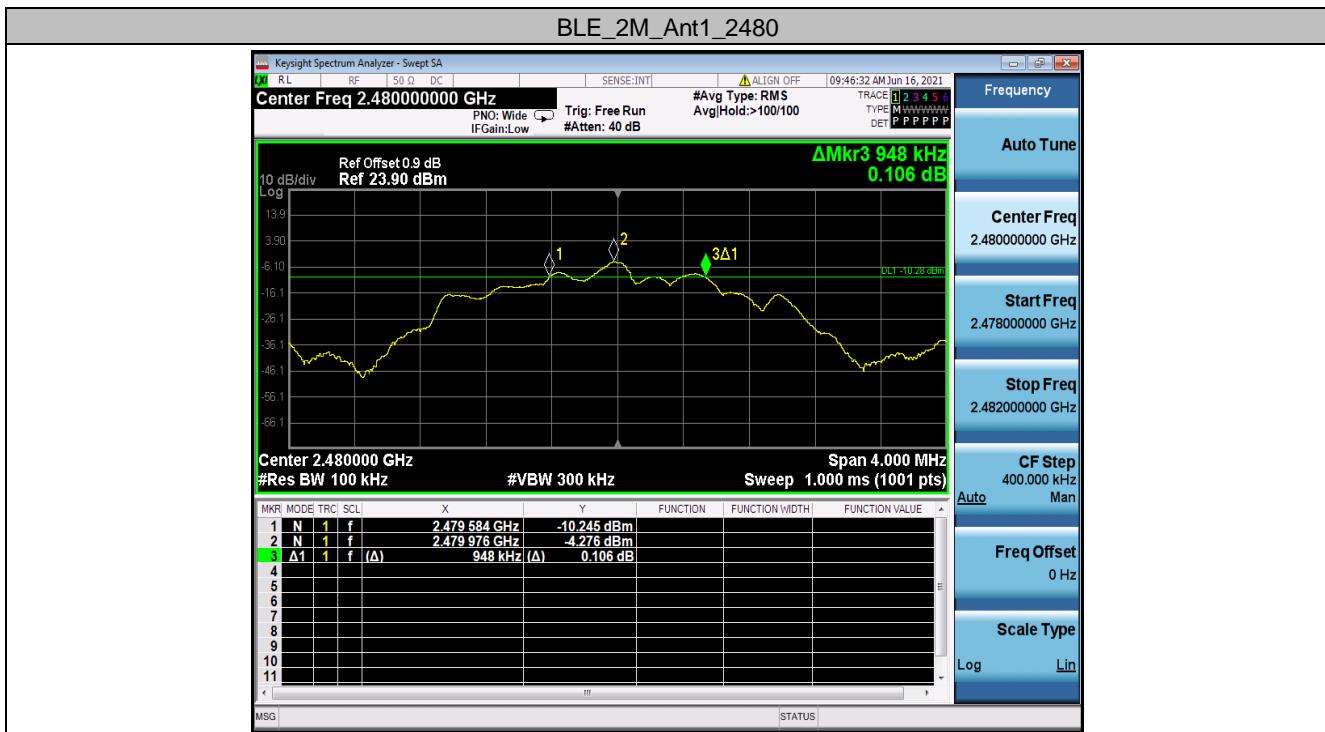




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8.2 Appendix B: Maximum conducted output power**8.2.1 Test Result**

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	-4.98	<=30	PASS
		2440	-4.01	<=30	PASS
		2480	-3.69	<=30	PASS
BLE_2M	Ant1	2402	-4.87	<=30	PASS
		2440	-4.00	<=30	PASS
		2480	-3.64	<=30	PASS

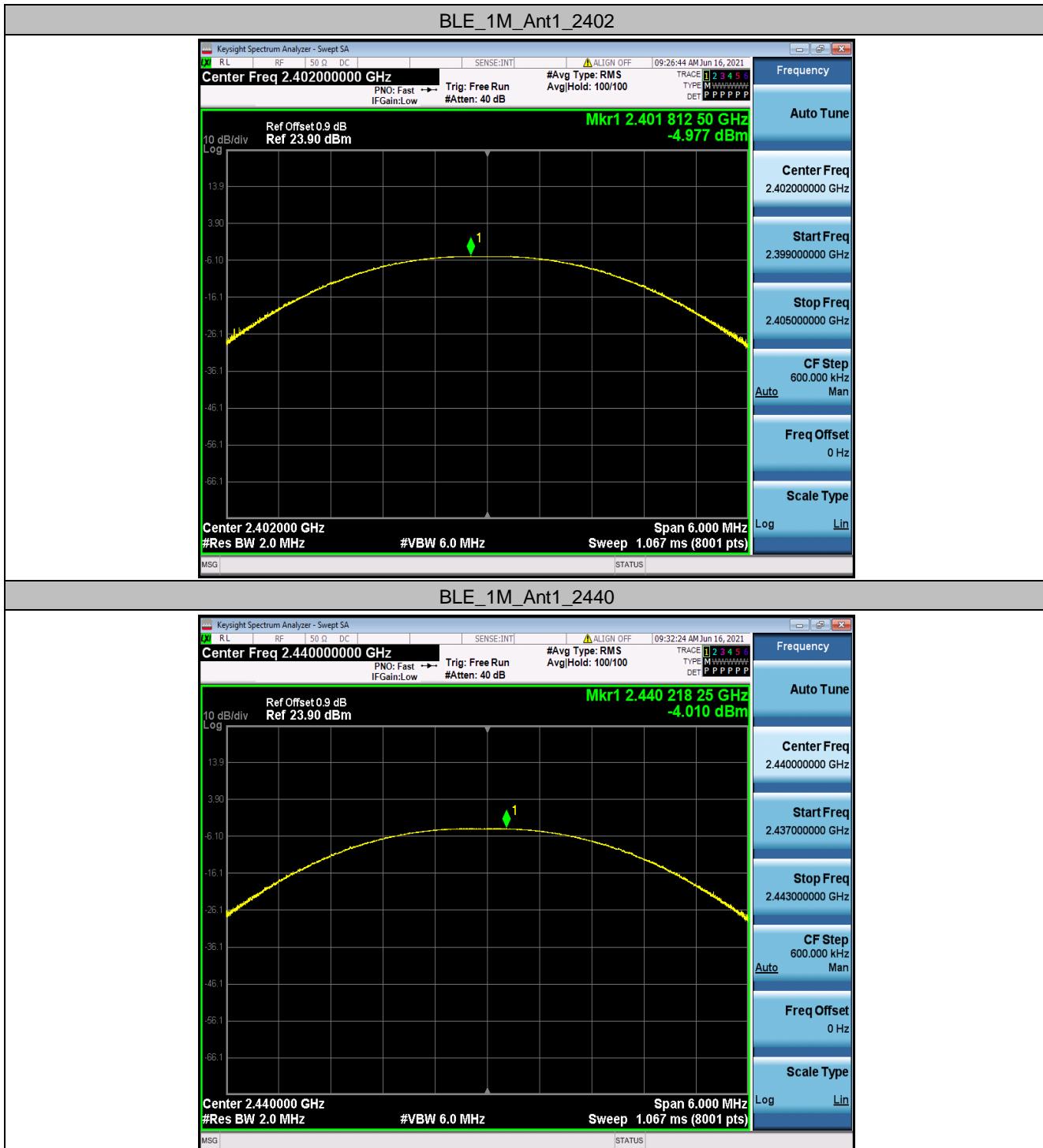
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8.2.2 Test Graphs



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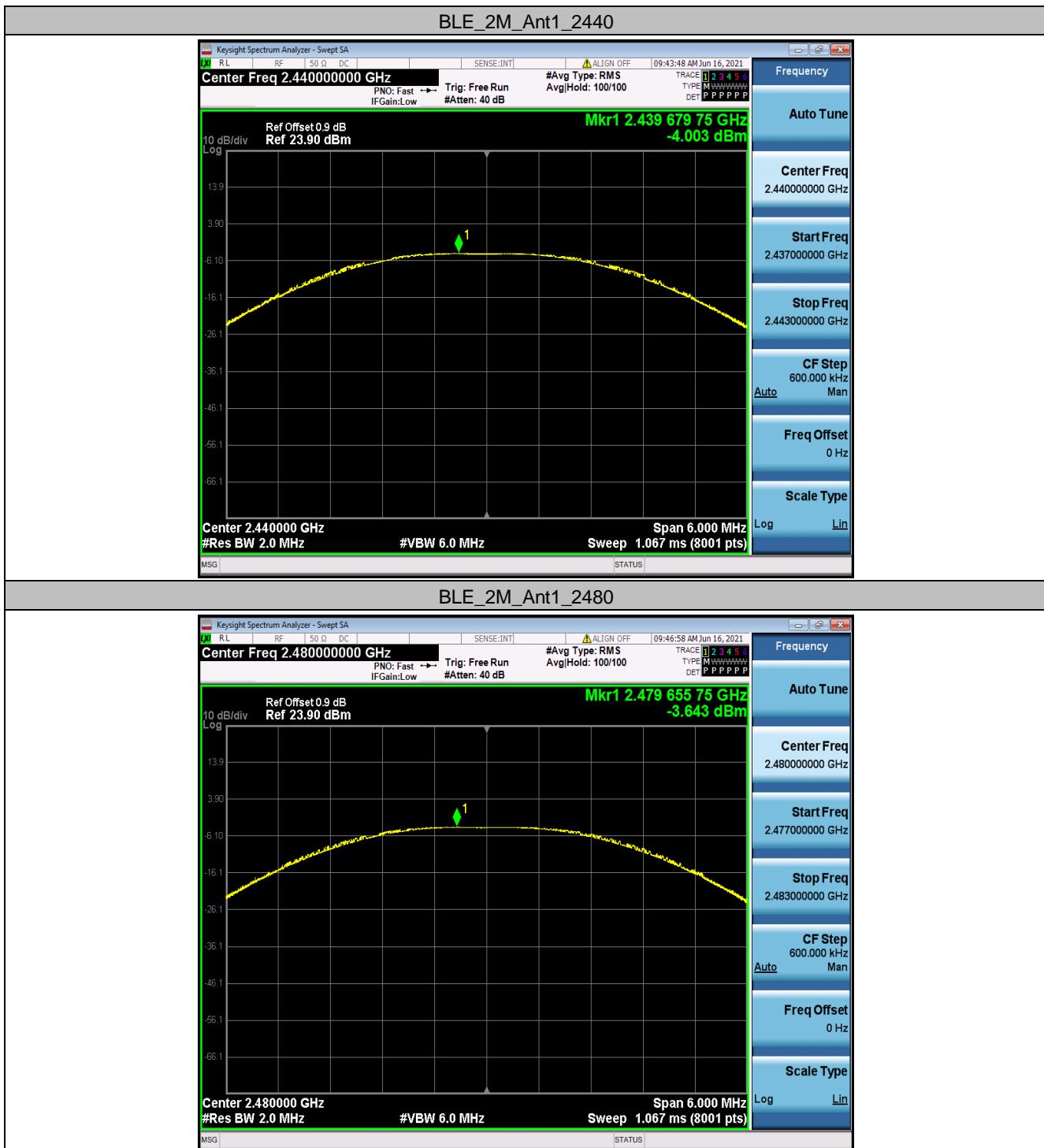




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8.3 Appendix C: Maximum power spectral density

8.3.1 Test Result

TestMode	Antenna	Channel	Result[dBm/3-100kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-5.64	<=8	PASS
		2440	-4.6	<=8	PASS
		2480	-4.35	<=8	PASS
BLE_2M	Ant1	2402	-5.75	<=8	PASS
		2440	-4.71	<=8	PASS
		2480	-4.34	<=8	PASS

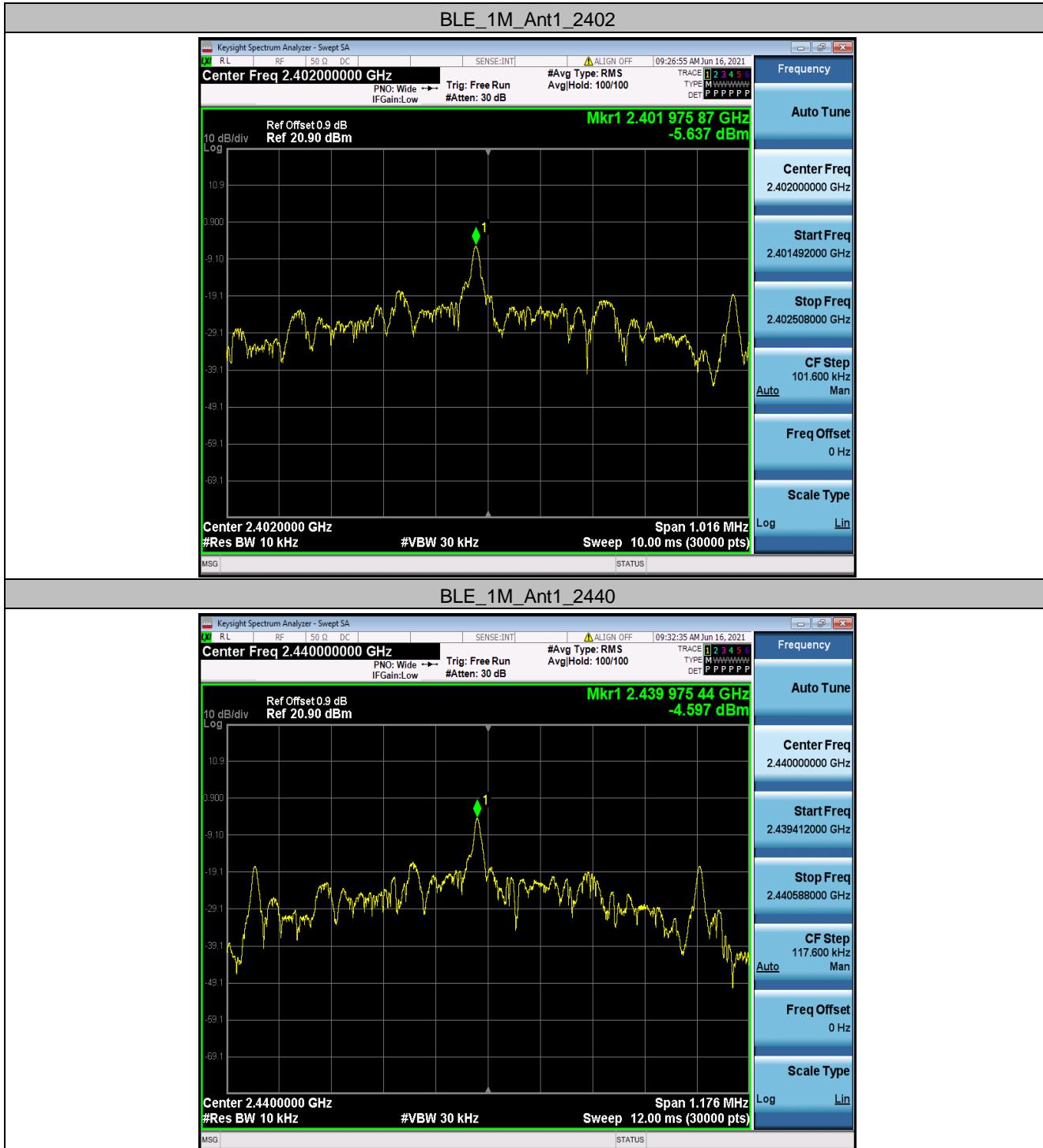
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8.3.2 Test Graphs



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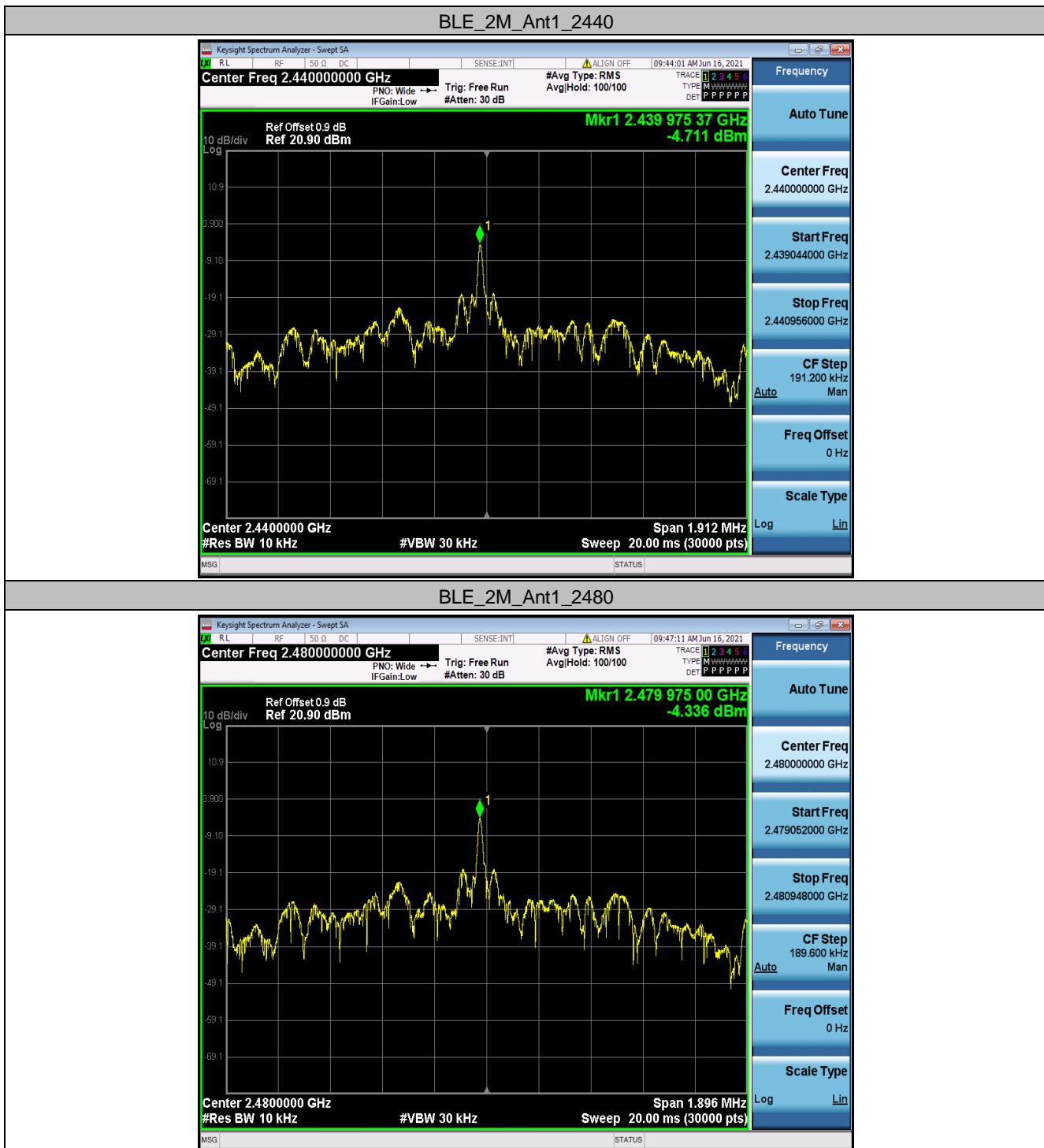
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8.4 Appendix D: Band edge measurements

8.4.1 Test Result

TestMode	Antenna	ChName	Channel	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	Low	2402	-5.53	-57.2	<=-25.53	PASS
		High	2480	-4.25	-58.35	<=-24.25	PASS
BLE_2M	Ant1	Low	2402	-5.62	-37.22	<=-25.62	PASS
		High	2480	-4.22	-57.85	<=-24.22	PASS

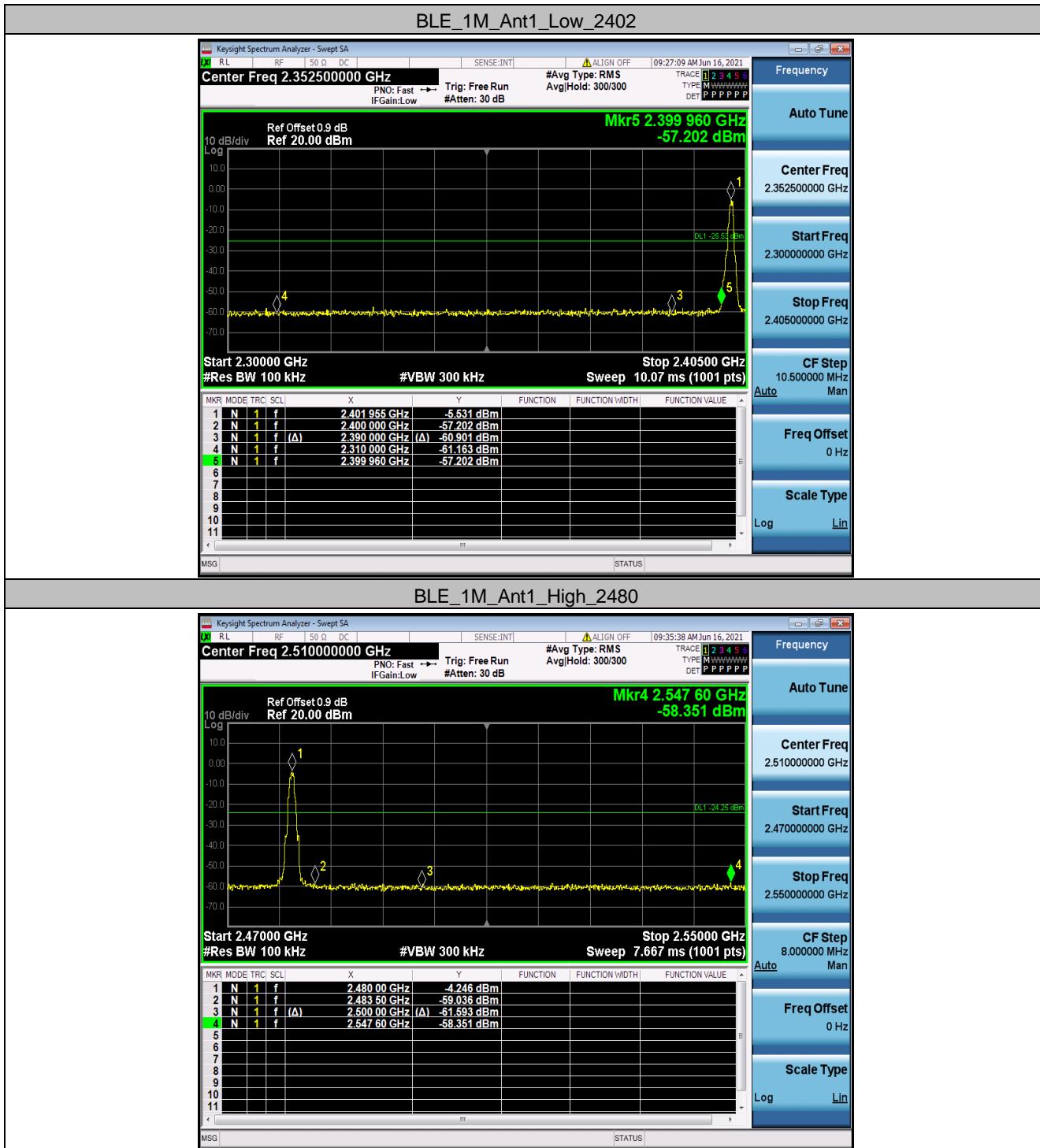
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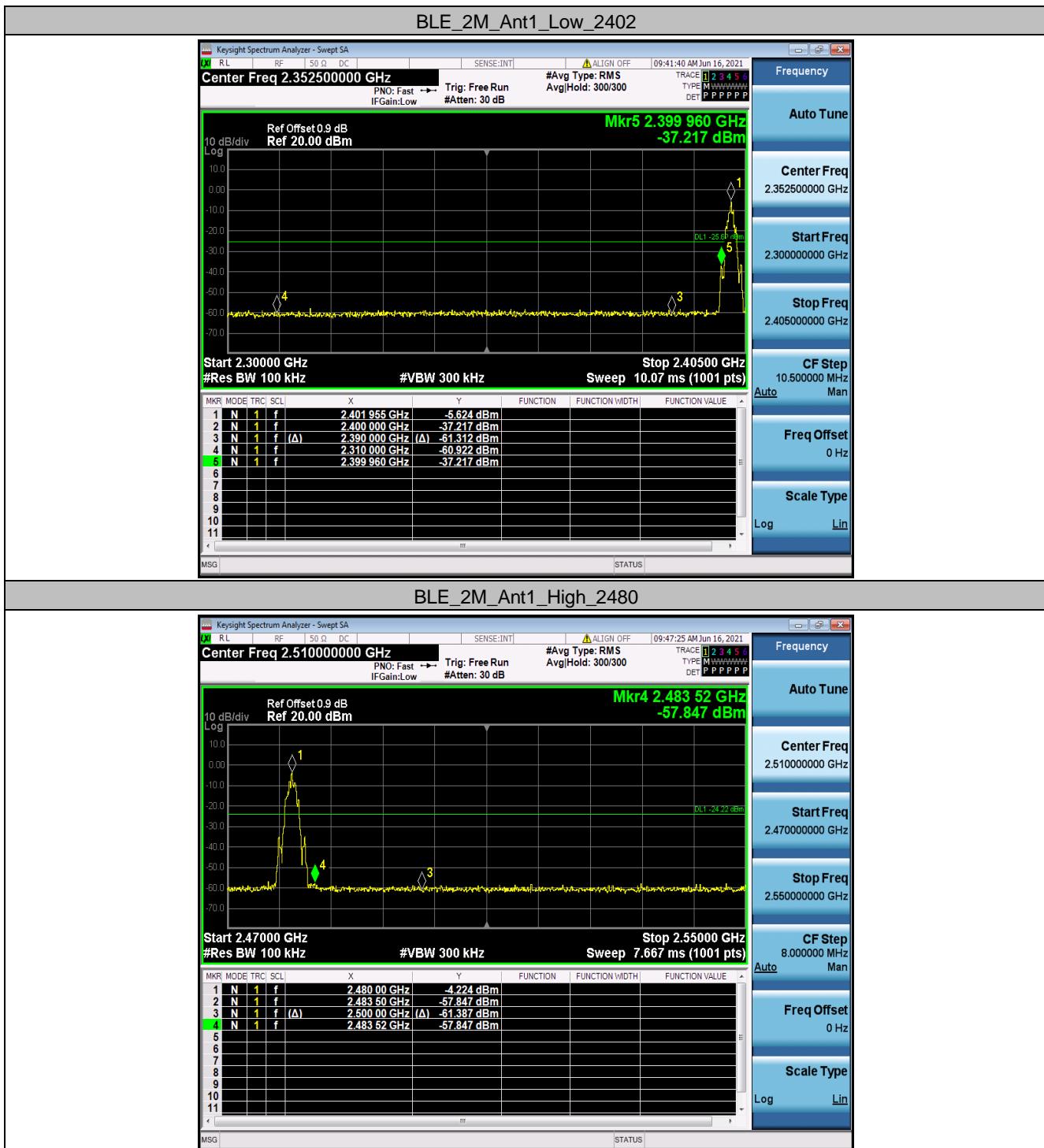
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8.4.2 Test Graphs



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8.5 Appendix E: Conducted Spurious Emission**8.5.1 Test Result**

TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	Reference	-5.58	-5.58	---	PASS
			30~1000	30~1000	-70.648	<=-25.58	PASS
			1000~26500	1000~26500	-60.304	<=-25.58	PASS
		2440	Reference	-4.54	-4.54	---	PASS
			30~1000	30~1000	-69.939	<=-24.542	PASS
			1000~26500	1000~26500	-60.72	<=-24.542	PASS
		2480	Reference	-4.26	-4.26	---	PASS
			30~1000	30~1000	-70.164	<=-24.263	PASS
			1000~26500	1000~26500	-60.377	<=-24.263	PASS
BLE_2M	Ant1	2402	Reference	-5.68	-5.68	---	PASS
			30~1000	30~1000	-70.84	<=-25.679	PASS
			1000~26500	1000~26500	-59.746	<=-25.679	PASS
		2440	Reference	-4.64	-4.64	---	PASS
			30~1000	30~1000	-70.143	<=-24.639	PASS
			1000~26500	1000~26500	-60.093	<=-24.639	PASS
		2480	Reference	-4.25	-4.25	---	PASS
			30~1000	30~1000	-70.595	<=-24.245	PASS
			1000~26500	1000~26500	-60.593	<=-24.245	PASS

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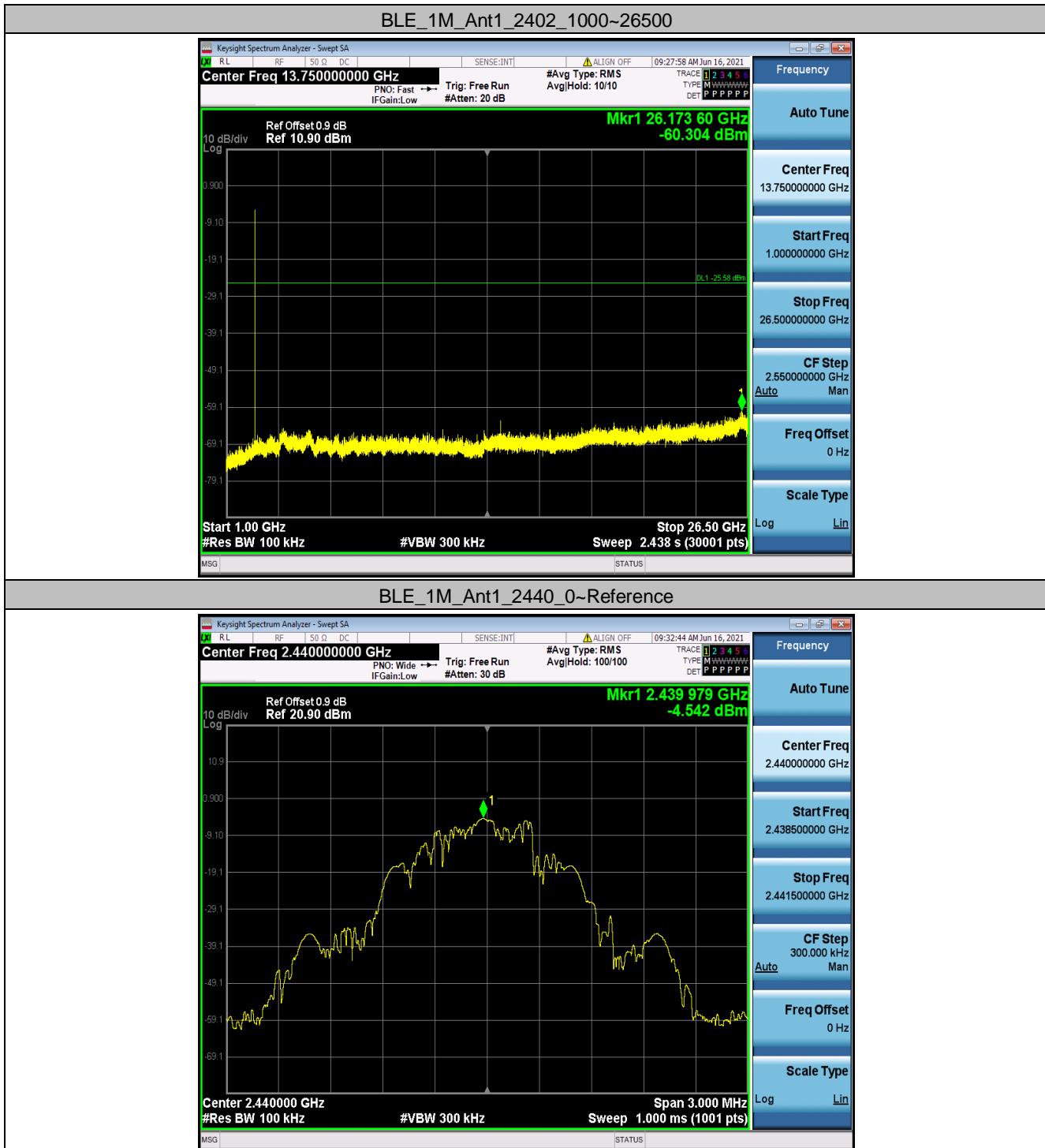
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8.5.2 Test Graphs



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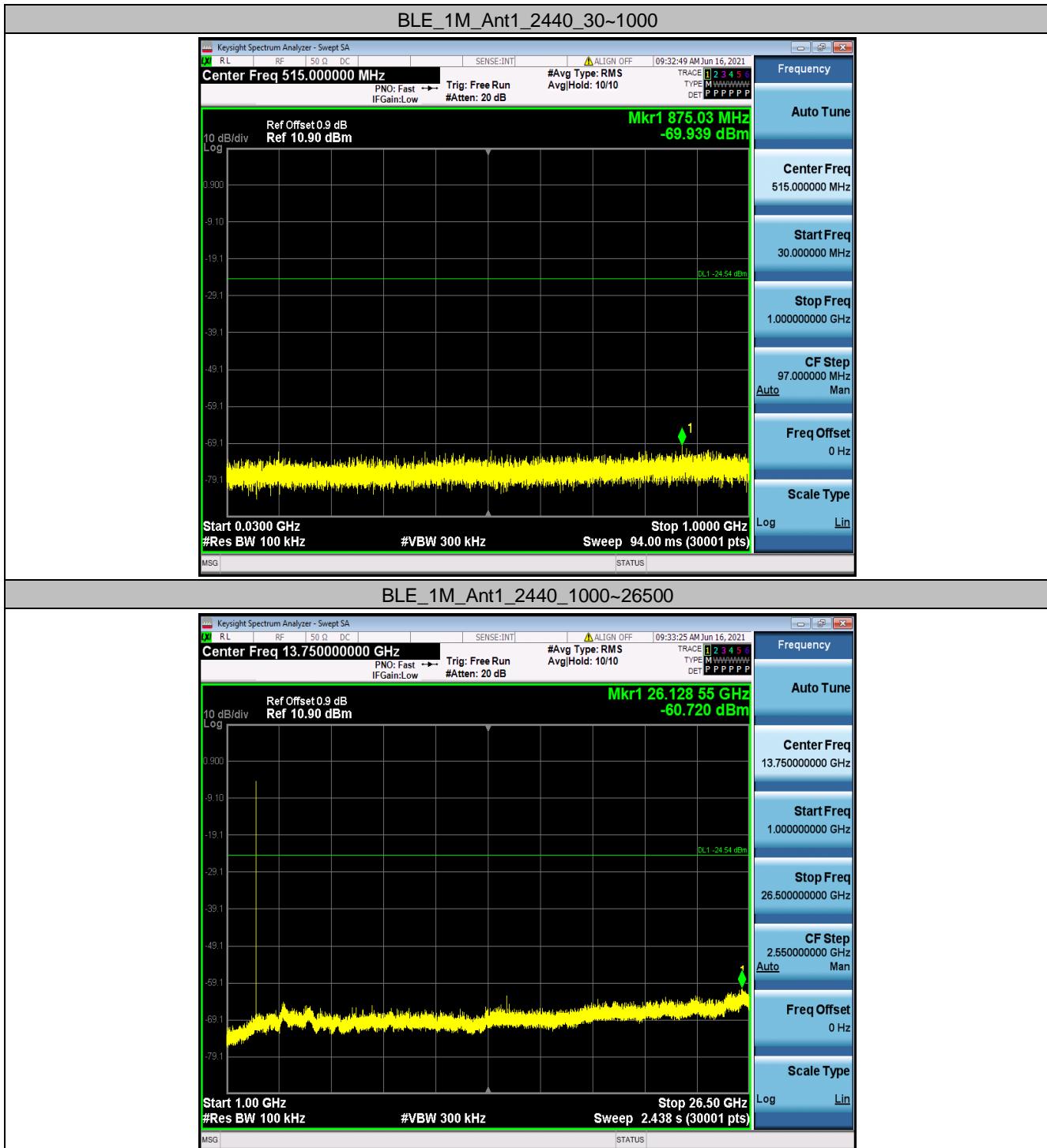
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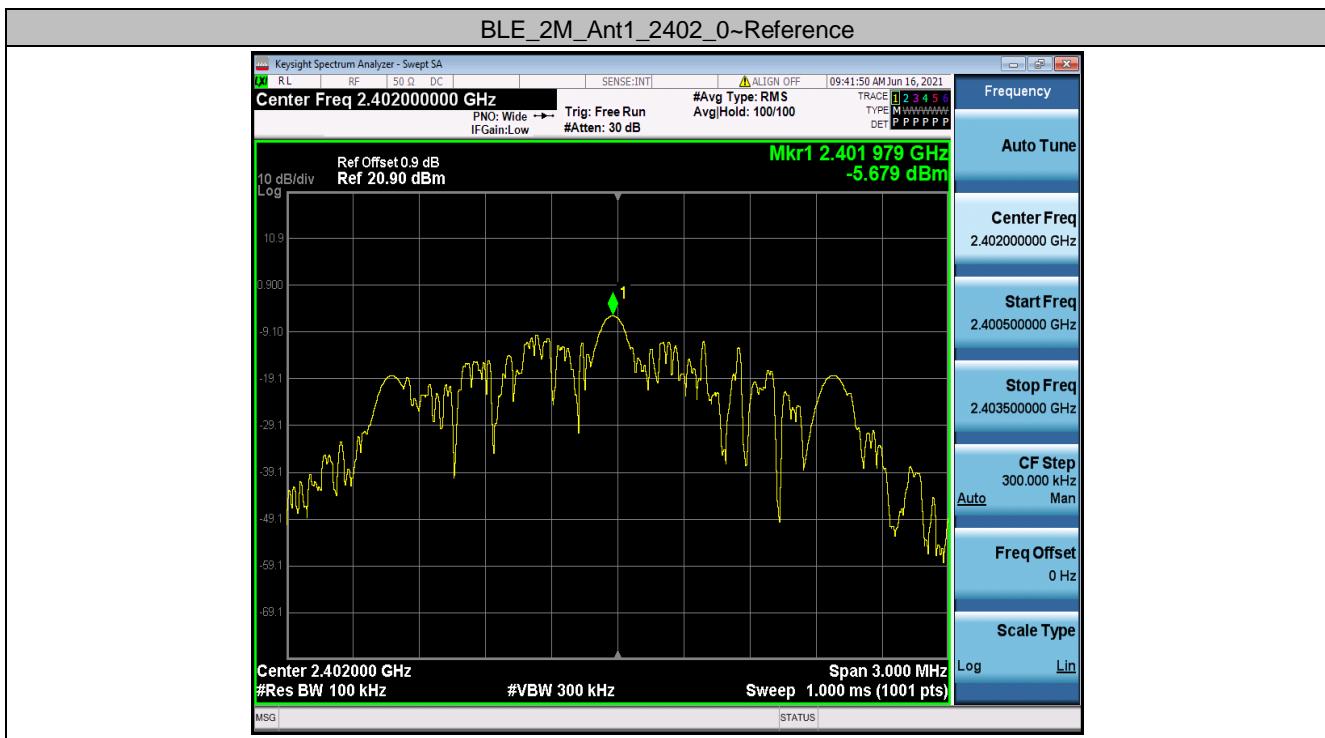
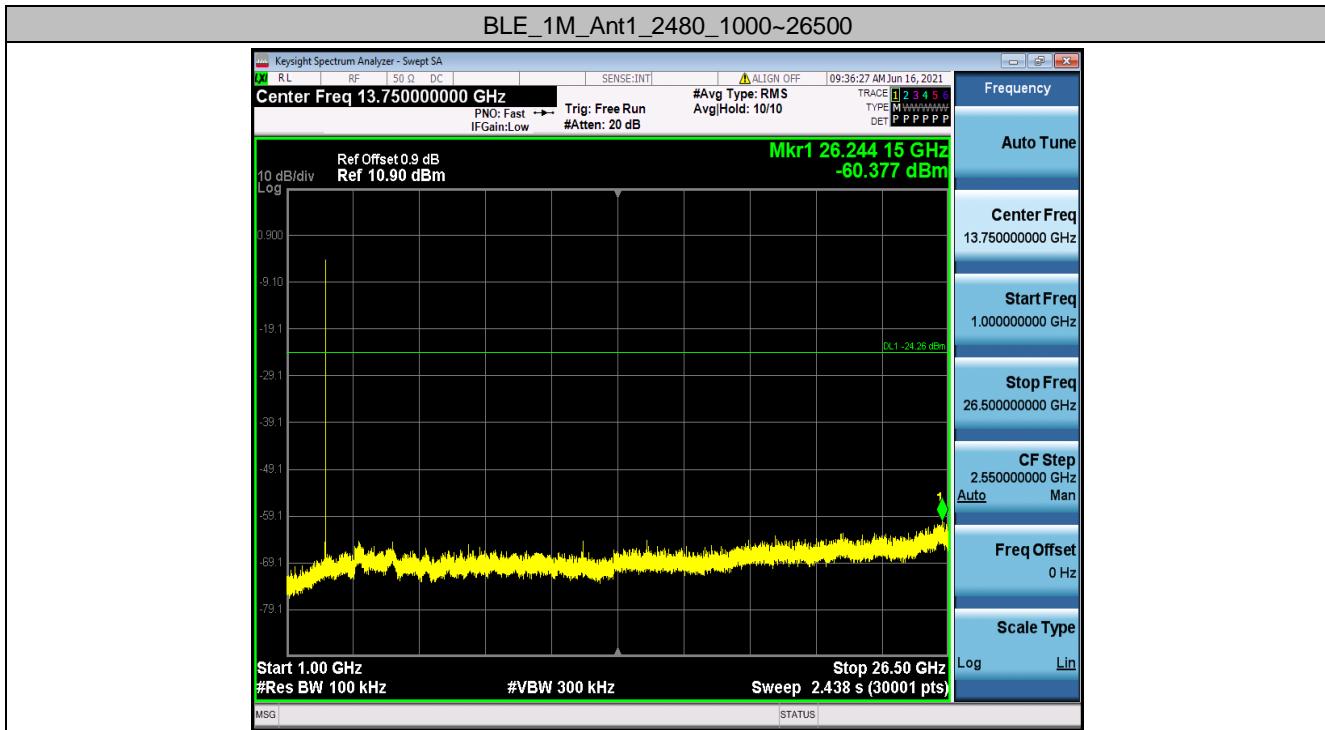


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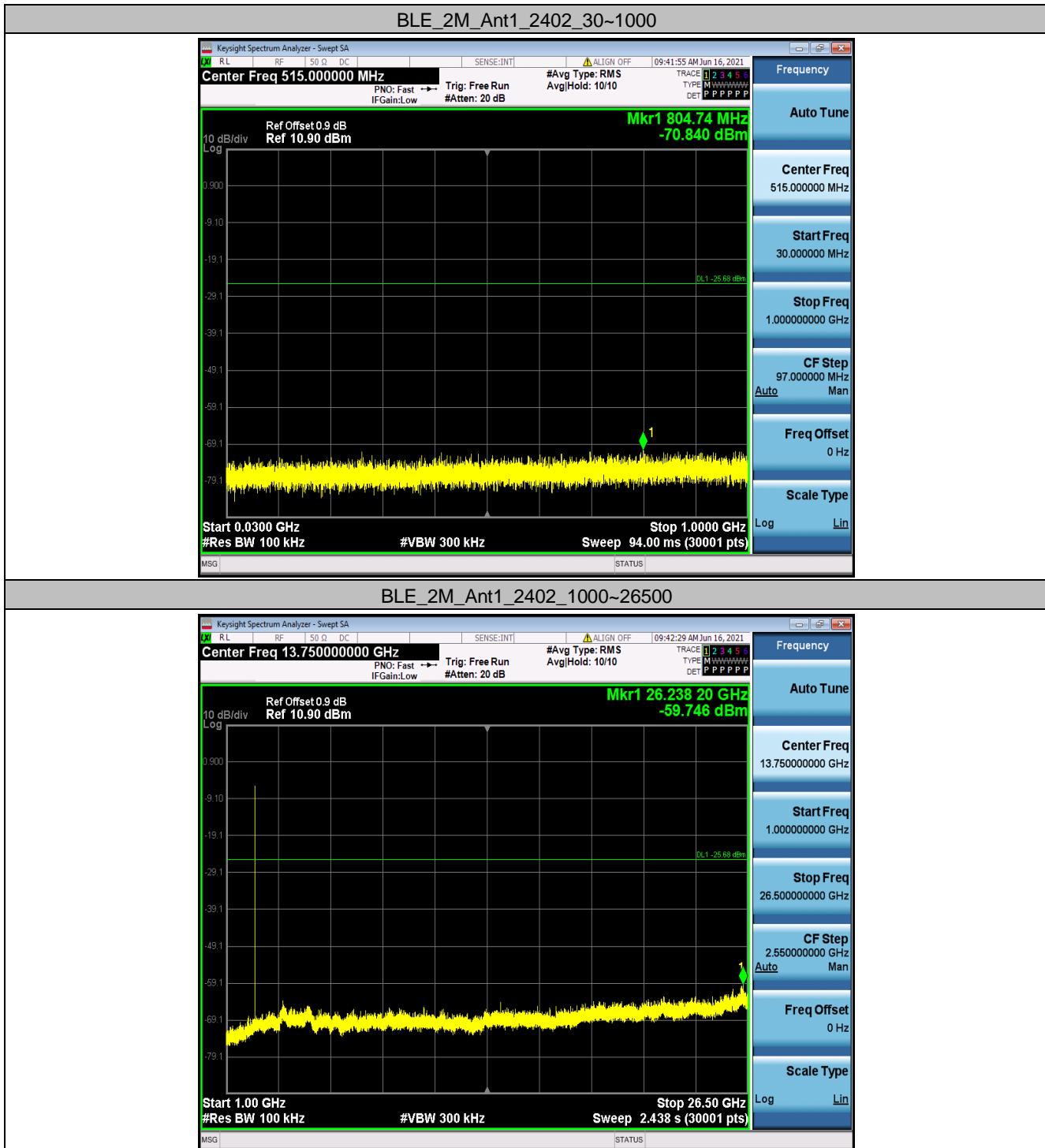


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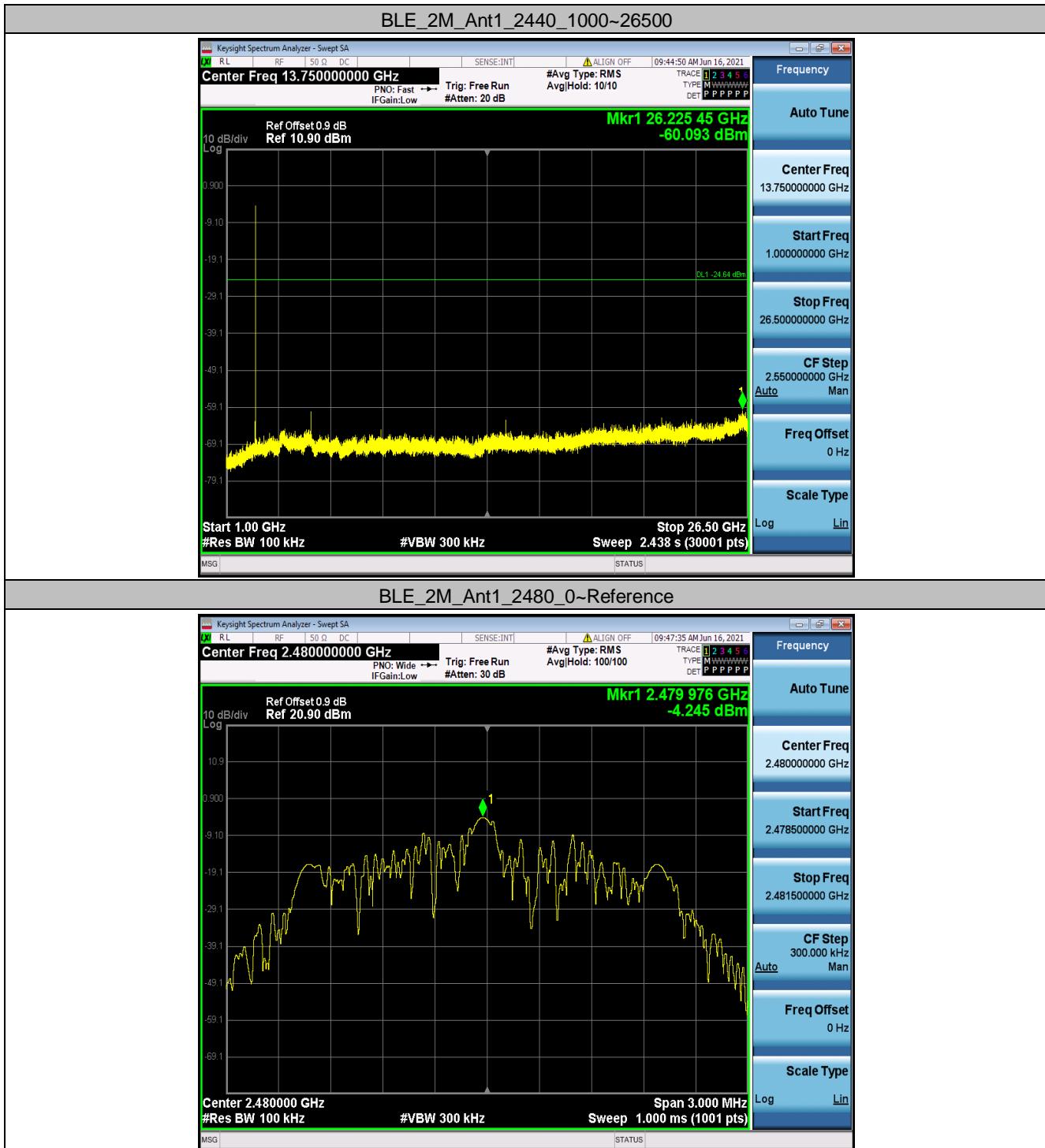
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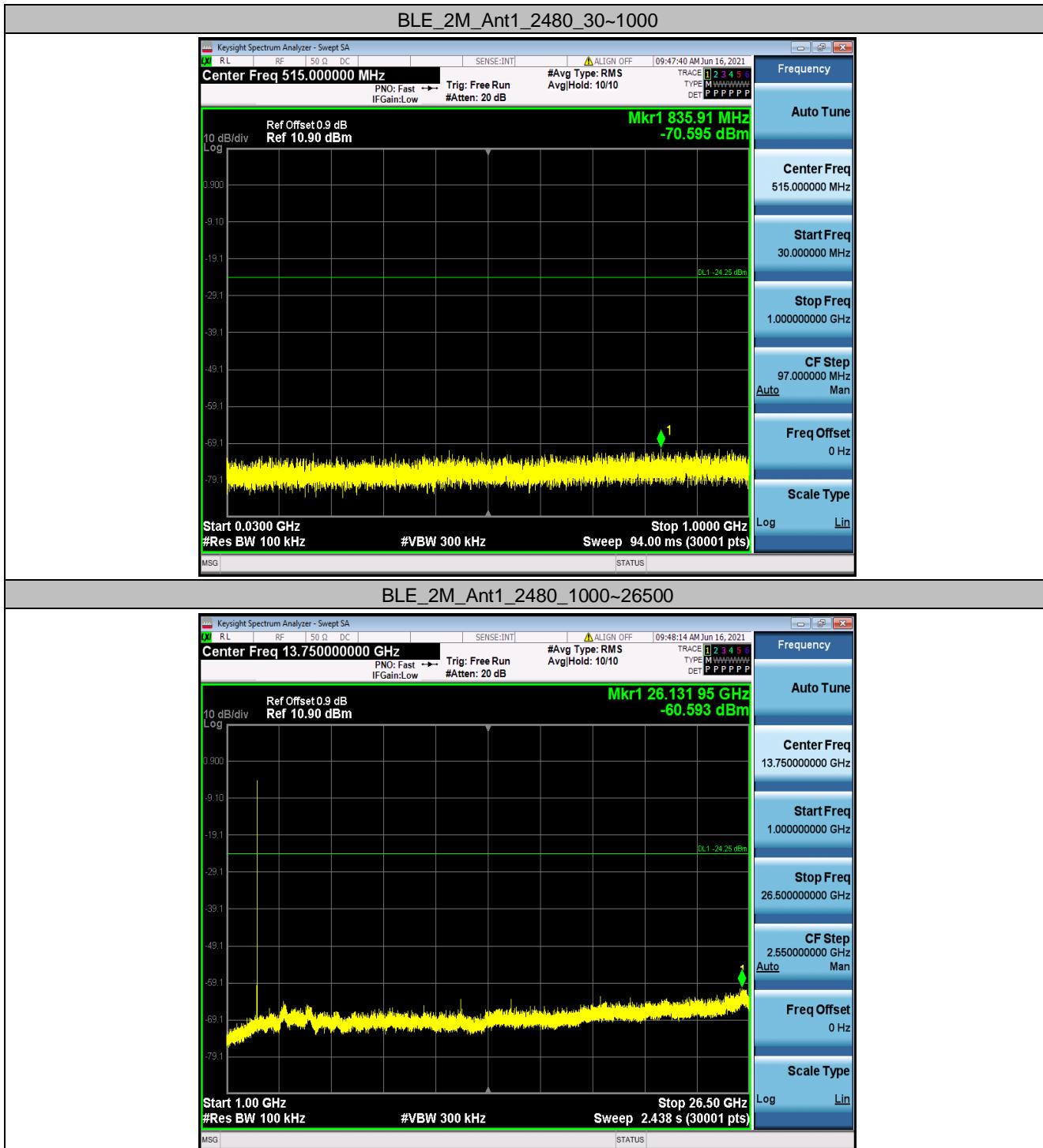
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8.6 Appendix F: Duty Cycle

8.6.1 Test Result

TestMode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
BLE_1M	Ant1	2402	2.13	2.50	85.31
		2442	2.13	2.50	85.38
		2480	2.13	2.50	85.48
BLE_2M	Ant1	2402	1.08	1.88	57.53
		2440	1.08	1.88	57.53
		2480	1.08	1.88	57.53

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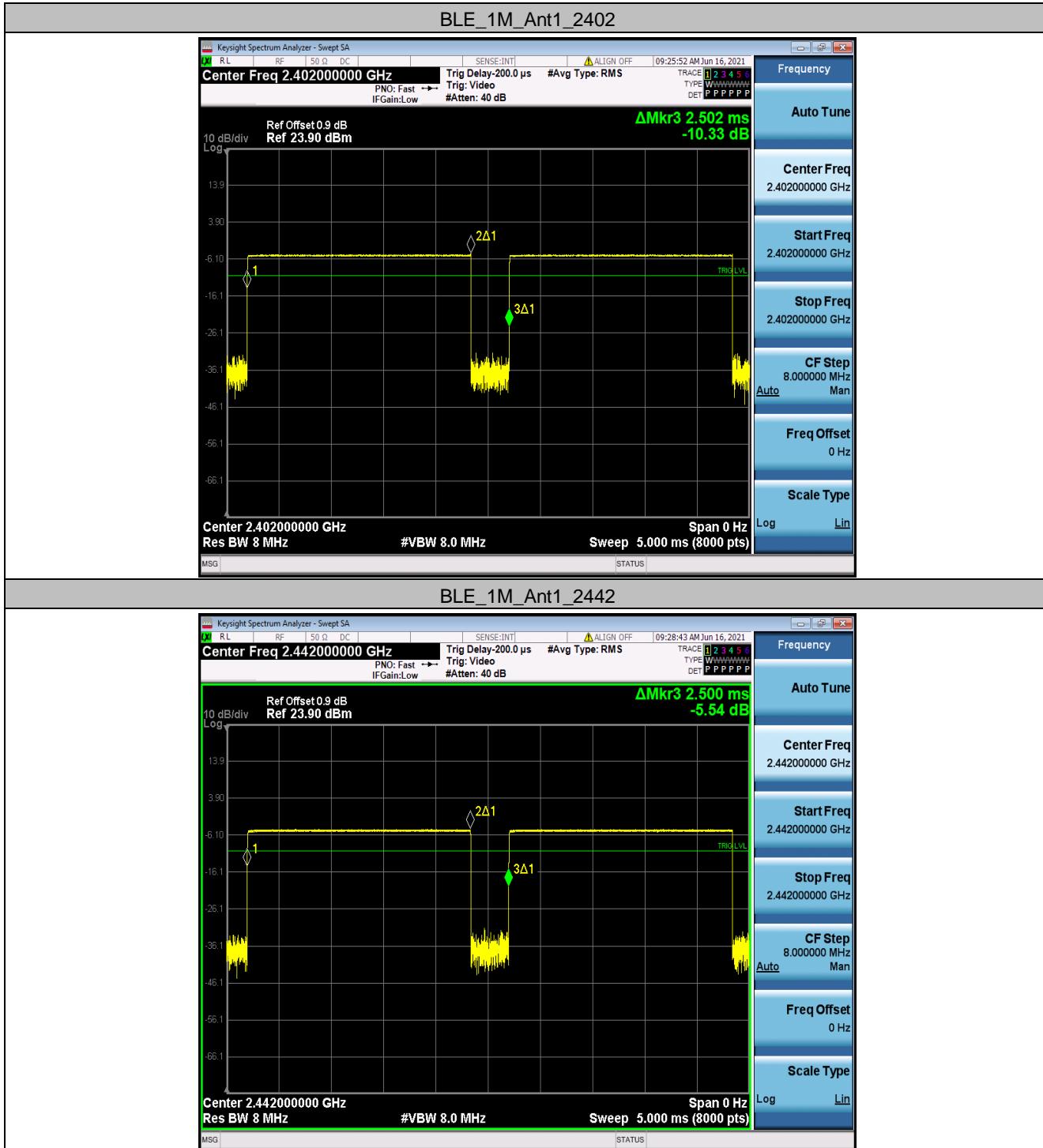
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8.6.2 Test Graphs



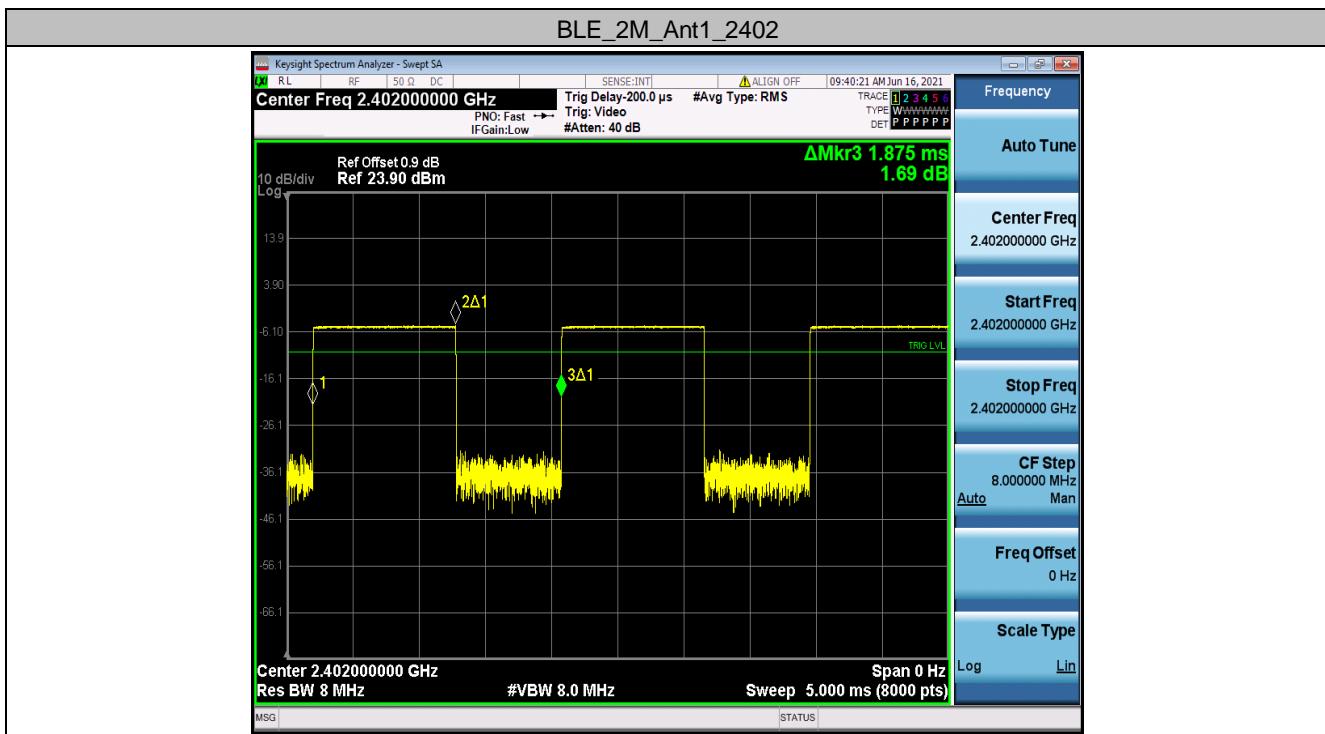
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