TEST REPORT

Application No.:	SHEM1901000081CR
FCC ID:	2ASAL0701
IC:	24697-0701
Applicant:	Ledger SAS
Address of Applicant:	1 Rue du Mail, 75002 PARIS, FRANCE
Manufacturer:	LEDGER SAS
Address of Manufacturer:	1 Rue du Mail, 75002 PARIS, FRANCE
Factory:	Ledger SAS
Address of Factory:	Parc Technologique de Sologne, Allée Georges Charpak, Vierzon, 18100, France
Equipment Under Test (EUT):	
EUT Name:	Bluetooth enabled Hardware Wallet
Model No.:	Nano X
Trade mark:	Ledger
Standard(s) :	47 CFR Part 15, Subpart C 15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5, April 2018
Date of Receipt:	2019-01-11
Date of Test:	2019-01-29 to 2019-02-14
Date of Issue:	2019-02-22
Test Result:	

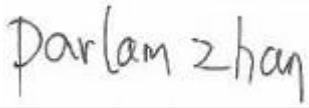
* In the configuration tested, the EUT complied with the standards specified above.

Parlam Zhan
E&E Section Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

NO.588 West Jindu Road,Songjiang District,Shanghai,China 201612 t(86-21)61915666 f(86-21)61915678 www.sgsgroup.com.cn
中国・上海・松江区金都西路588号 邮编: 201612 t(86-21)61915666 f(86-21)61915678 e sgs.china@sgs.com

Revision Record			
Version	**Description**	**Date**	**Remark**
00	Original	2019-02-22	/

Authorized for issue by:				
				
		Bill Wu / Project Engineer		
				
		Parlam Zhan / 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(c)	Pass

Radio Spectrum Matter Part				
Item	**Standard**	**Method**	**Requirement**	**Result**
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.2	47 CFR Part 15, Subpart C 15.207	Pass
Minimum 6dB Bandwidth	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.8.1	47 CFR Part 15, Subpart C 15.247a(2)	Pass
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
Power Spectrum Density	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.10.2	47 CFR Part 15, Subpart C 15.247(e)	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.13.3.2	47 CFR Part 15, Subpart C 15.247(d)	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247	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	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
99% Bandwidth	RSS-247 Issue 2, February 2017	ANSI C63.10 Section 6.9.3	RSS-Gen Section 6.6	Pass
Frequency Stability	RSS-Gen April 2018	RSS-Gen Section 6.11	RSS-Gen Section 8.11	Pass （Note1）

Note 1：Frequency stability requested in RSS GEN S8.11 has been complied since the result of bandedge can demonstrate.

3 Contents

4 General Information

4.1 Details of E.U.T.

Power supply:	DC 3.7V 100mAh rechargeable Li-ion battery
Test voltage:	DC 3.7V
Cable:	USB Cable 40cm
BT Version	BLE 5.0
Data Rate	1Mb/s & 2Mb/s
Antenna Gain	2.2dBi
Antenna Type	Ceramic Antenna
Channel Spacing	2MHz
Modulation Type	GFSK
Number of Channels	40
Operation Frequency	2402MHz to 2480MHz

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Laptop	Lenovo	ThinkPad X100e	/

4.3 Measurement Uncertainty

EMC

No.	Item	Measurement Uncertainty
1	Conducted Emission at mains port using AMN	±2.6dB (9kHz to 150kHz)
		±2.3dB (150kHz to 30MHz)
2	Conducted Emission at mains port using VP	±1.9 dB (9kHz to 30MHz)
3	Conducted Emission at telecommunication port using AAN	±4.1 dB (150kHz to 30MHz)
4	Radiated Power	±3.0dB
5	Radiated emission	±4.4dB (30MHz-1GHz)
		±4.8dB (1GHz-6GHz)
		±5.2dB (6GHz-18GHz)

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

RF

No.	Item	Measurement Uncertainty
1	Radio Frequency	±8.4 x 10-8
2	Timeout	±2s
3	Duty cycle	±0.37%
4	Occupied Bandwidth	±3%
5	RF conducted power	±0.6dB
6	RF power density	±2.84dB
7	Conducted Spurious emissions	±0.75dB
8	RF Radiated power	±4.6dB (Below 1GHz)
		±4.1dB (Above 1GHz)
9	Radiated Spurious emission test	±4.2dB (Below 30MHz)
		±4.4dB (30MHz-1GHz)
		±4.8dB (1GHz-18GHz)
		±5.2dB (Above 18GHz)
10	Temperature test	±1°C
11	Humidity test	±3%
12	Supply voltages	±1.5%
13	Time	±3%

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4.4 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. E&E Lab

588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China

Tel: +86 21 6191 5666 Fax: +86 21 6191 5678

No tests were sub-contracted.

4.5 Test Facility

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

• CNAS (No. CNAS L0599)

CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• NVLAP (Certificate No. 201034-0)

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the National Voluntary Laboratory Accreditation Program(NVLAP). Certificate No. 201034-0.

• FCC –Designation Number: CN5033

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

Designation Number: CN5033. Test Firm Registration Number: 479755.

• Industry Canada (IC) – IC Assigned Code: 8617A

The 3m Semi-anechoic chamber of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 8617A-1.

• VCCI (Member No.: 3061)

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None

5 Equipment List

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Conducted Emission at AC Power Line					
EMI test receiver	R&S	ESR7	SHEM162-1	2018-12-20	2019-12-19
LISN	Schwarzbeck	NSLK8127	SHEM061-1	2018-12-20	2019-12-19
LISN	EMCO	3816/2	SHEM019-1	2018-12-20	2019-12-19
Pulse limiter	R&S	ESH3-Z2	SHEM029-1	2018-12-20	2019-12-19
CE test Cable	/	CE01	/	2018-12-26	2019-12-25
Conducted Test					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2018-12-20	2019-12-19
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2018-08-13	2019-08-12
Signal Generator	R&S	SMR20	SHEM006-1	2018-08-13	2019-08-12
Signal Generator	Agilent	N5182A	SHEM182-1	2018-08-13	2019-08-12
Communication Tester	R&S	CMW270	SHEM183-1	2018-08-13	2019-08-12
Switcher	Tonscend	JS0806	SHEM184-1	2018-08-13	2019-08-12
Power Sensor	Keysight	U2021XA * 4	SHEM184-1	2018-08-13	2019-08-12
Splitter	Anritsu	MA1612A	SHEM185-1	/	/
Coupler	e-meca	803-S-1	SHEM186-1	/	/
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2017-09-25	2020-09-24
AC Power Stabilizer	WOCEN	6100	SHEM045-1	2018-12-26	2019-12-25
DC Power Supply	MCN	MCH-303A	SHEM210-1	2018-12-26	2019-12-25
Conducted test Cable	/	RF01~RF04	/	2018-12-26	2019-12-25
Radiated Test					
EMI test Receiver	R&S	ESU40	SHEM051-1	2018-12-20	2019-12-19
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2018-12-20	2019-12-19
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2017-04-10	2020-04-09
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2017-02-28	2020-02-27
Antenna (25MHz-3GHz)	Schwarzbeck	HL562	SHEM010-1	2017-02-28	2020-02-27
Horn Antenna (1-8GHz)	Schwarzbeck	HF906	SHEM009-1	2017-10-24	2020-10-23
Horn Antenna (1-18GHz)	Schwarzbeck	BBHA9120D	SHEM050-1	2017-01-14	2020-01-13
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2017-12-03	2020-12-02
Pre-amplifier (9KHz-2GHz)	CLAVIIO	BDLNA-0001	SHEM164-1	2018-08-13	2019-08-12
Pre-amplifier (1-18GHz)	CLAVIIO	BDLNA-0118	SHEM050-2	2018-08-13	2019-08-12
High-amplifier (14-40GHz)	Schwarzbeck	10001	SHEM049-2	2018-12-20	2019-12-19
Signal Generator	R&S	SMR40	SHEM058-1	2018-08-13	2019-08-12
Band Filter	LORCH	9BRX-875/X150	SHEM156-1	/	/
Band Filter	LORCH	13BRX-1950/X500	SHEM083-2	/	/
Band Filter	LORCH	5BRX-2400/X200	SHEM155-1	/	/
Band Filter	LORCH	5BRX-5500/X1000	SHEM157-2	/	/
High pass Filter	Wainwright	WHK3.0/18G	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2017-07-22	2020-07-21
RE test Cable	/	RE01, RE02, RE06	/	2018-12-26	2019-12-25

6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

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

6.1.2 Conclusion

Standard Requirement:

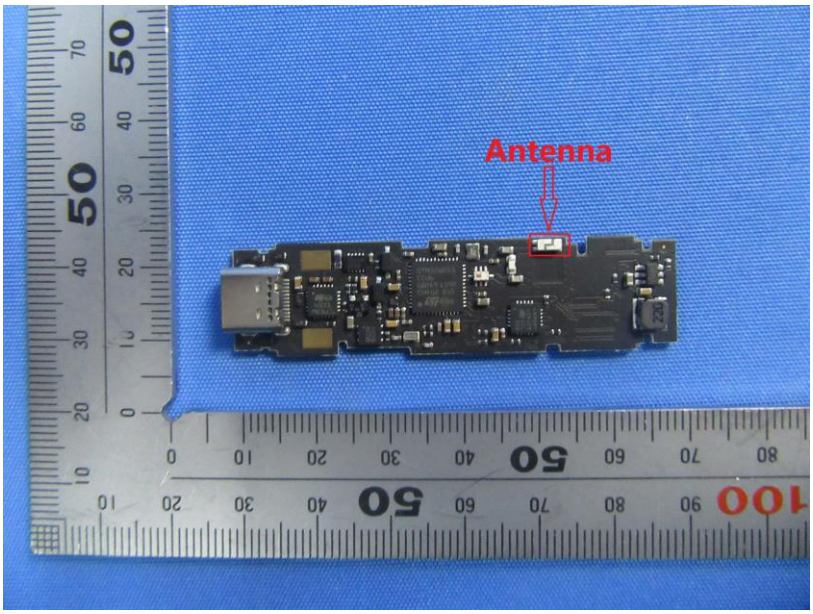
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

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 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.

EUT Antenna:

The antenna is Ceramic Antenna and no consideration of replacement. The best case gain of the antenna is 2.2dBi.



7 Radio Spectrum Matter Test Results

7.1 Conducted Emissions at AC Power Line (150kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.207
Test Method: ANSI C63.10 (2013) Section 6.2
Limit:

Frequency of emission(MHz)	Conducted limit(dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50
*Decreases with the logarithm of the frequency.		

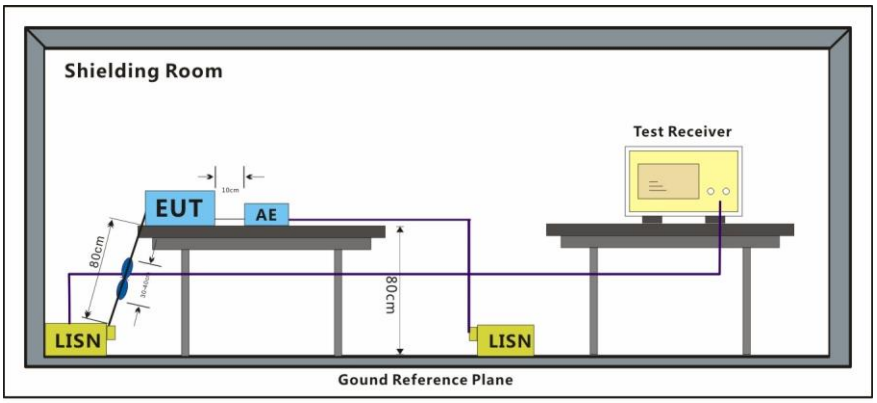
7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode a:Charge + TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation.

7.1.2 Test Setup Diagram



7.1.3 Measurement Procedure and Data

1) The mains terminal disturbance voltage test was conducted in a shielded room.

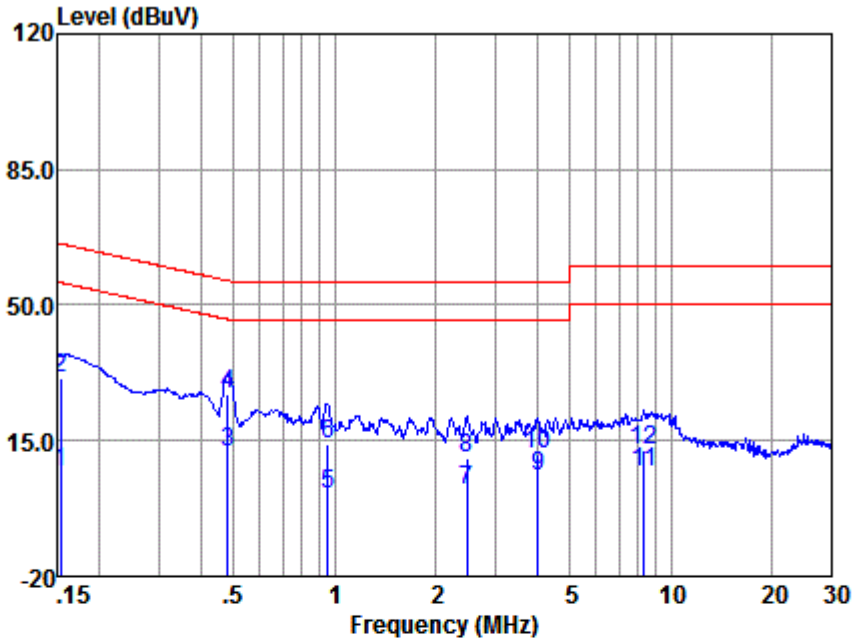
2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50μH + 5ohm linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.

3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,

4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.

5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

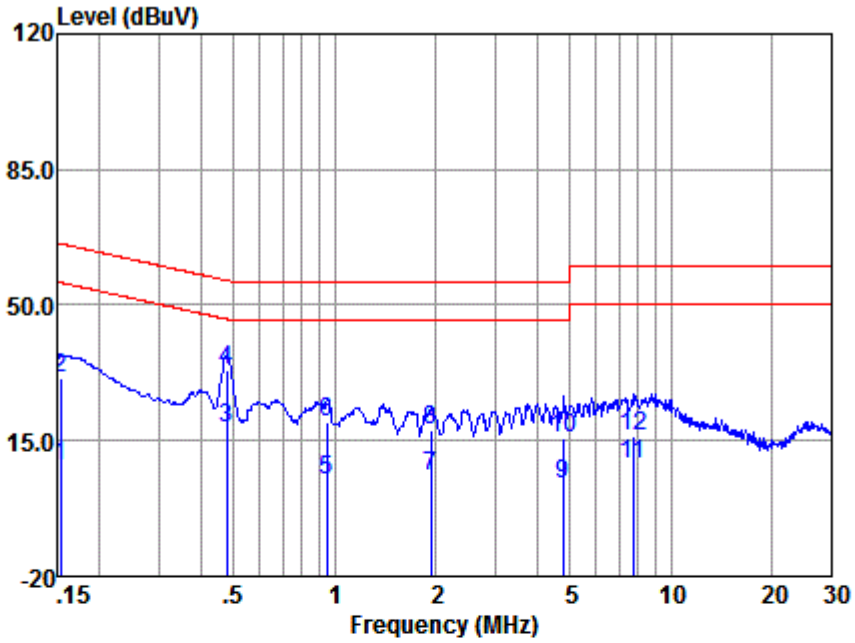
Remark: LISN=Read Level+ Cable Loss+ LISN Factor



LISN : NEUTRAL

	Freq (MHz)	Read level (dBuV)	LISN Factor (dB)	Cable Loss (dB)	Emission Level (dBuV)	Limit (dBuV)	Over Limit (dB)	Remark
1	0.15	-2.93	0.06	9.82	6.95	55.87	-48.92	Average
2	0.15	21.11	0.06	9.82	30.99	65.87	-34.88	QP
3	0.48	2.24	0.05	9.81	12.10	46.32	-34.22	Average
4	0.48	17.36	0.05	9.81	27.22	56.32	-29.10	QP
5	0.95	-8.55	0.05	9.80	1.30	46.00	-44.70	Average
6	0.95	4.44	0.05	9.80	14.29	56.00	-41.71	QP
7	2.47	-7.57	0.07	9.91	2.41	46.00	-43.59	Average
8	2.47	0.69	0.07	9.91	10.67	56.00	-45.33	QP
9	4.03	-4.00	0.08	9.89	5.97	46.00	-40.03	Average
10	4.03	1.54	0.08	9.89	11.51	56.00	-44.49	QP
11	8.32	-3.37	0.16	9.87	6.66	50.00	-43.34	Average
12	8.32	2.48	0.16	9.87	12.51	60.00	-47.49	QP

Notes: Emission Level = Read Level +LISN Factor + Cable loss



LISN : LINE

	Freq (MHz)	Read level (dBuV)	LISN Factor (dB)	Cable Loss (dB)	Emission Level (dBuV)	Limit (dBuV)	Over Limit (dB)	Remark
1	0.15	-1.34	0.05	9.82	8.53	55.87	-47.34	Average
2	0.15	21.08	0.05	9.82	30.95	65.87	-34.92	QP
3	0.48	8.41	0.05	9.82	18.28	46.36	-28.08	Average
4	0.48	23.43	0.05	9.82	33.30	56.36	-23.06	QP
5	0.95	-4.83	0.05	9.82	5.04	46.00	-40.96	Average
6	0.95	10.11	0.05	9.82	19.98	56.00	-36.02	QP
7	1.94	-3.92	0.05	9.87	6.00	46.00	-40.00	Average
8	1.94	7.68	0.05	9.87	17.60	56.00	-38.40	QP
9	4.80	-6.08	0.08	9.88	3.88	46.00	-42.12	Average
10	4.80	5.58	0.08	9.88	15.54	56.00	-40.46	QP
11	7.73	-1.20	0.14	9.85	8.79	50.00	-41.21	Average
12	7.73	6.22	0.14	9.85	16.21	60.00	-43.79	QP

Notes: Emission Level = Read Level +LISN Factor + Cable loss

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

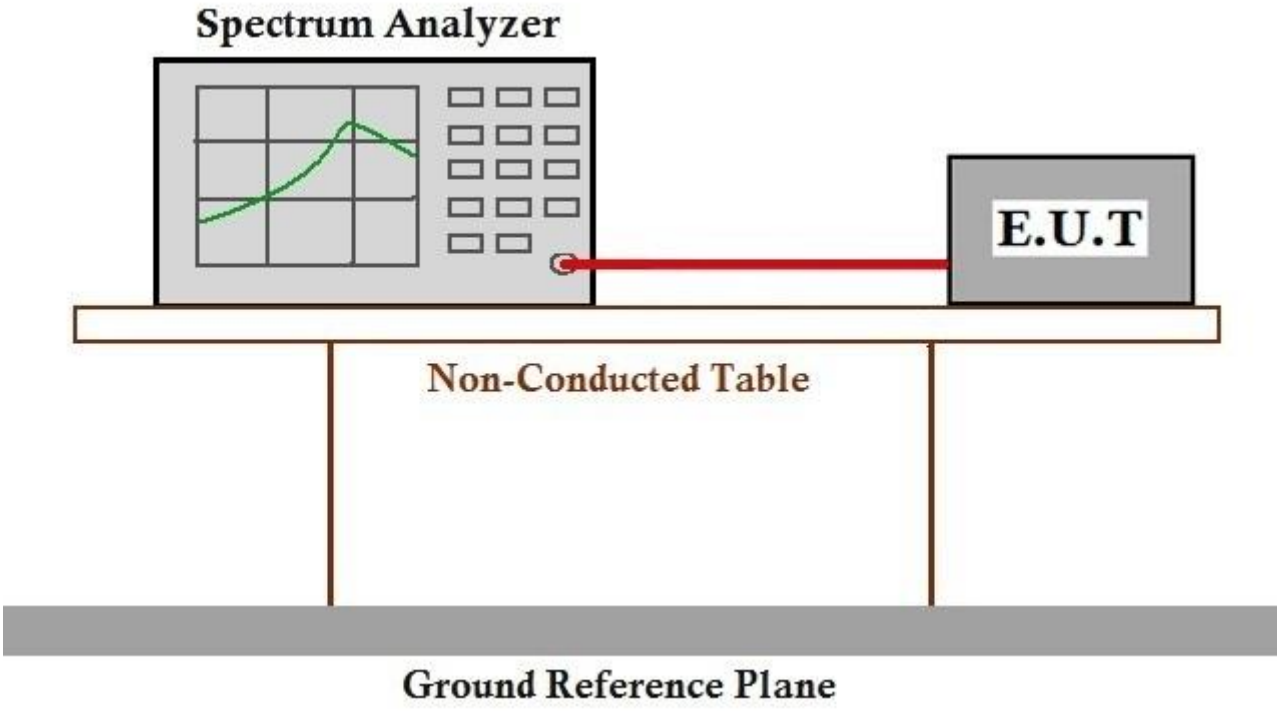
7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode a:Charge + TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation.

7.2.2 Test Setup Diagram



7.2.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM190100008101

7.3 Conducted Peak Output Power

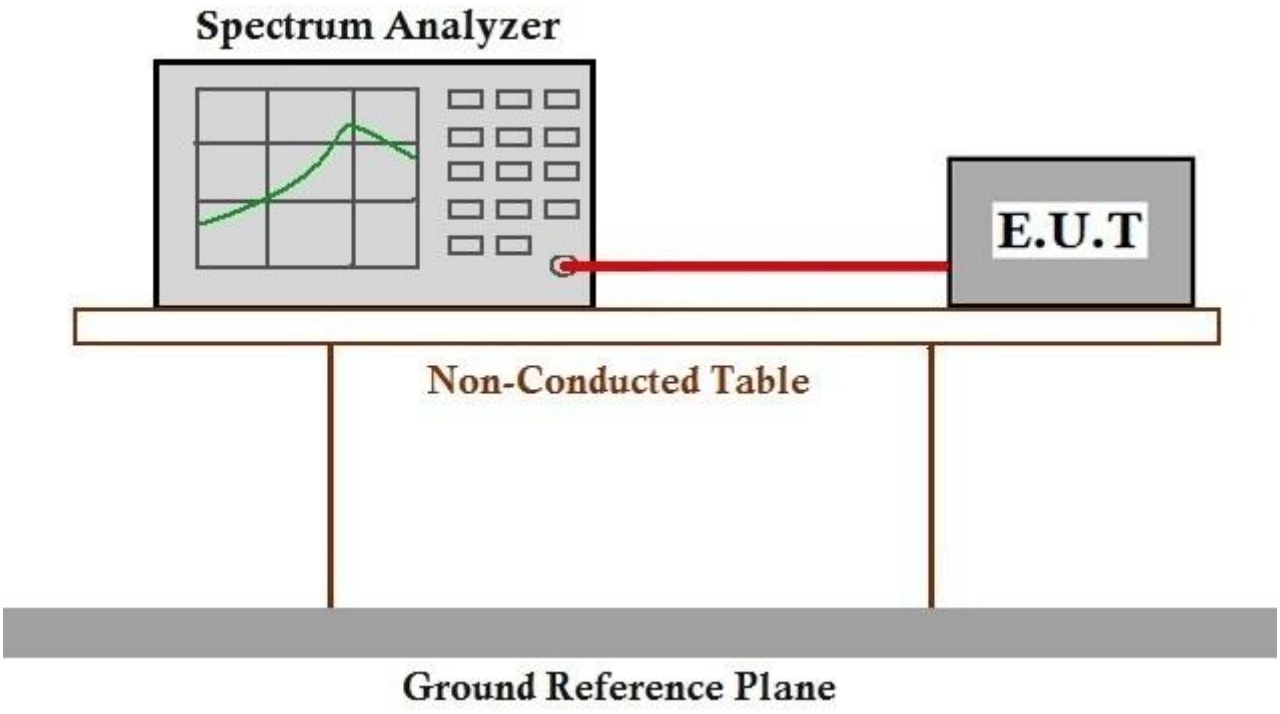
Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(3)
Test Method: ANSI C63.10 (2013) Section 11.9.1
Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥50 hopping channels
	0.25 for 25≤ 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

7.3.1 E.U.T. Operation

Operating Environment:
Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar
Test mode a:Charge + TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation.

7.3.2 Test Setup Diagram



7.3.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM190100008101

7.4 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

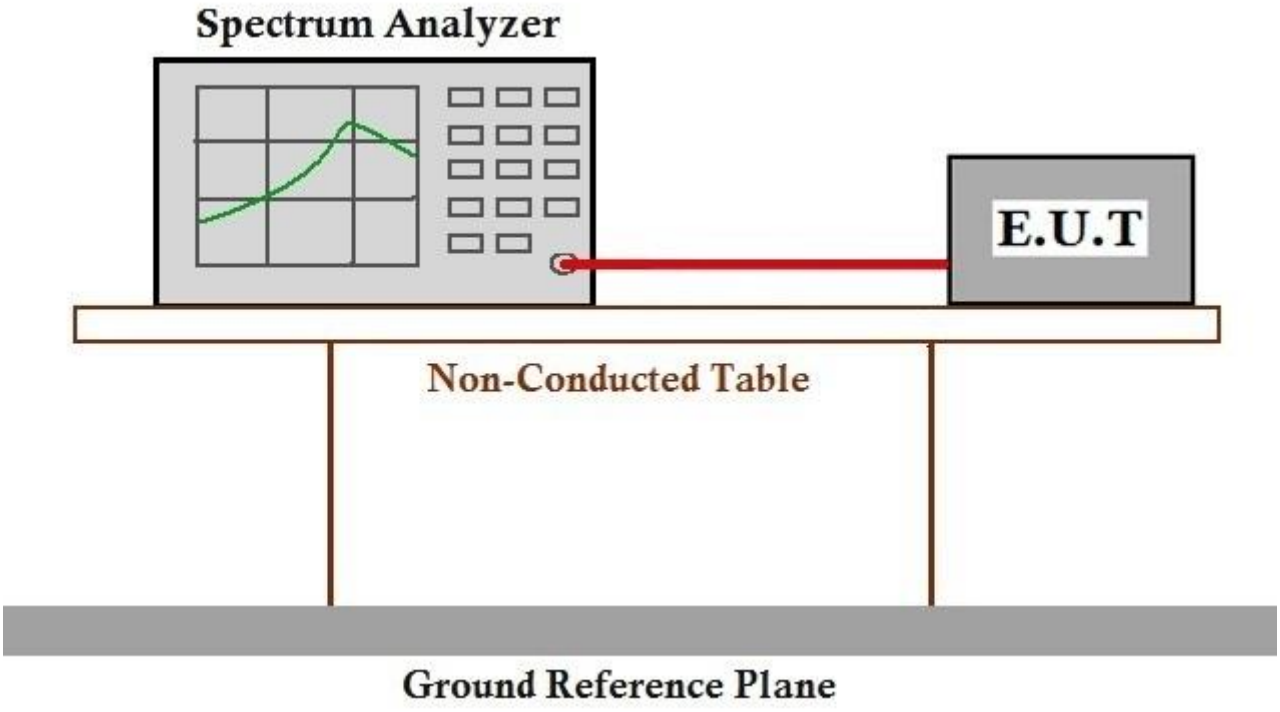
7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode a:Charge + TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation.

7.4.2 Test Setup Diagram



7.4.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM190100008101

7.5 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)

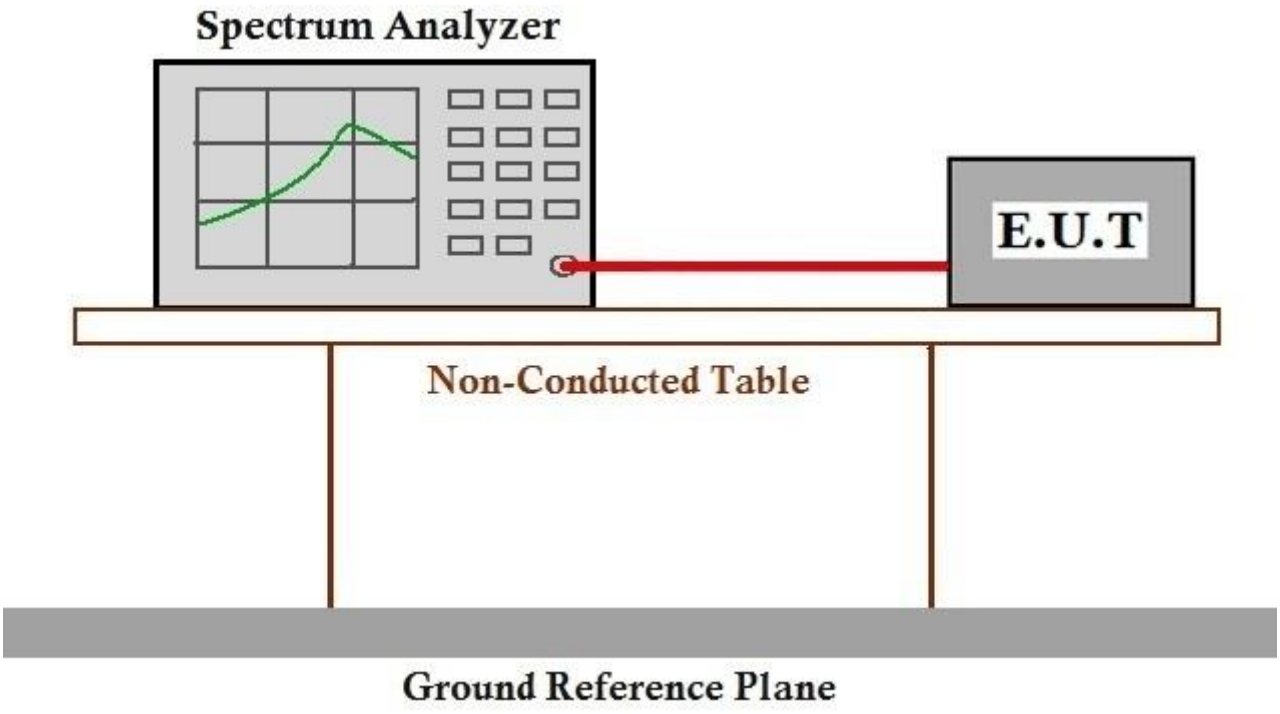
7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode a:Charge + TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation.

7.5.2 Test Setup Diagram



7.5.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM190100008101

7.6 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)

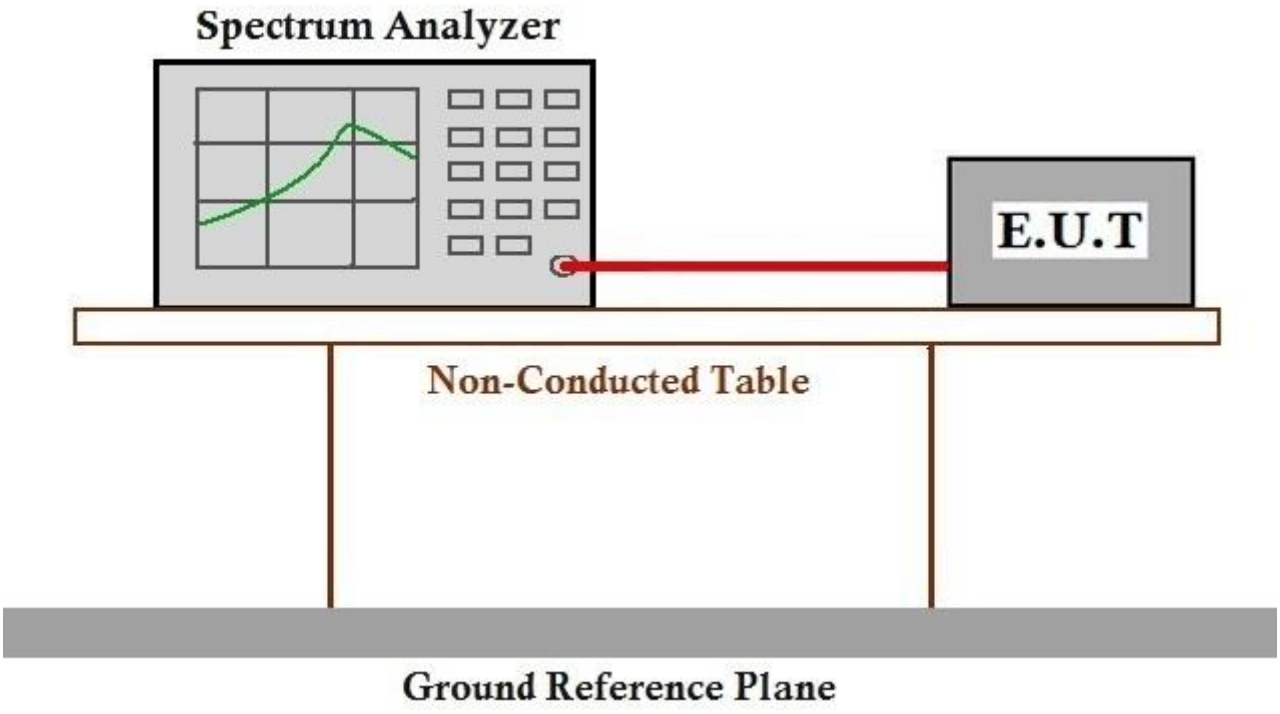
7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode a:Charge + TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation.

7.6.2 Test Setup Diagram



7.6.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM190100008101

7.7 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.		

7.7.1 E.U.T. Operation

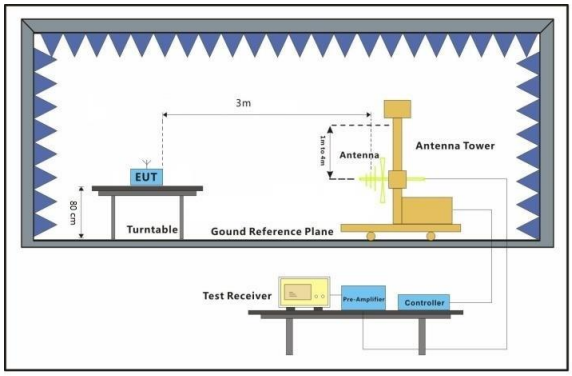
Operating Environment:

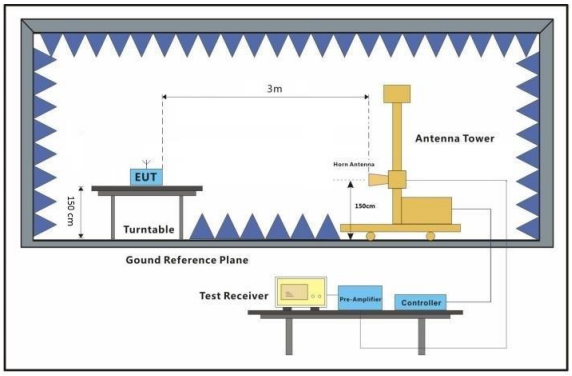
Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

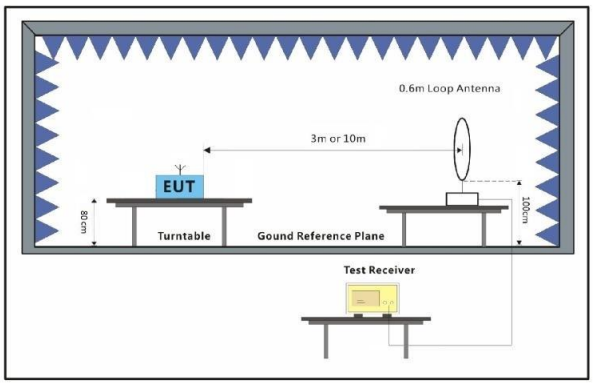
Test mode a:Charge + TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation 1M rate.

a1:Charge + TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation 2M rate.

7.7.2 Test Setup Diagram







7.7.3 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.

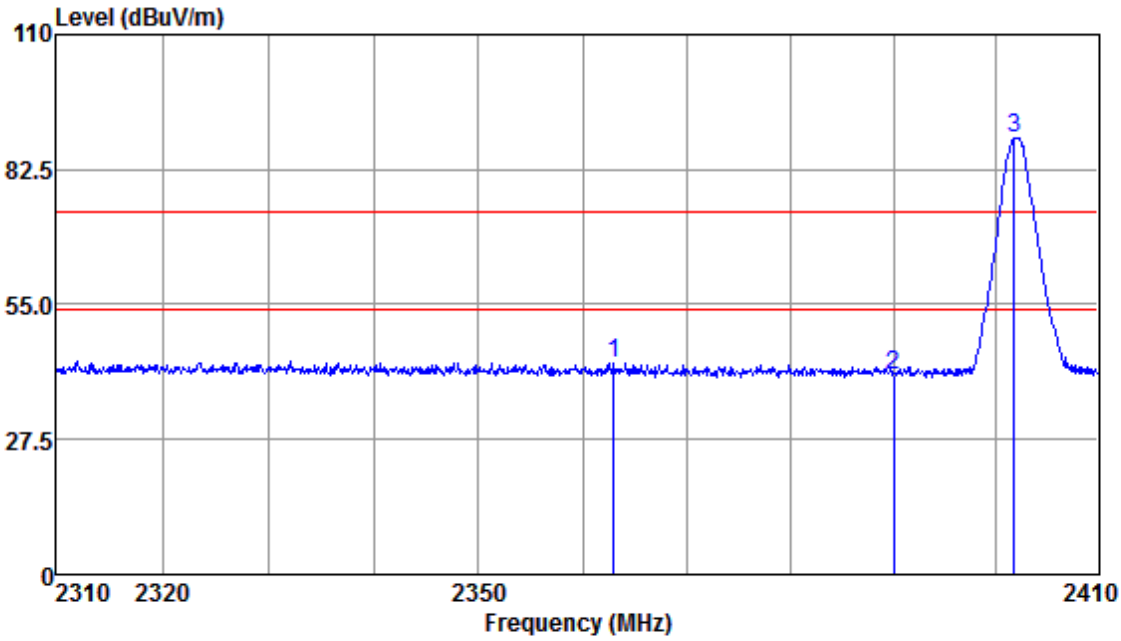
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark 1: 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.

Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

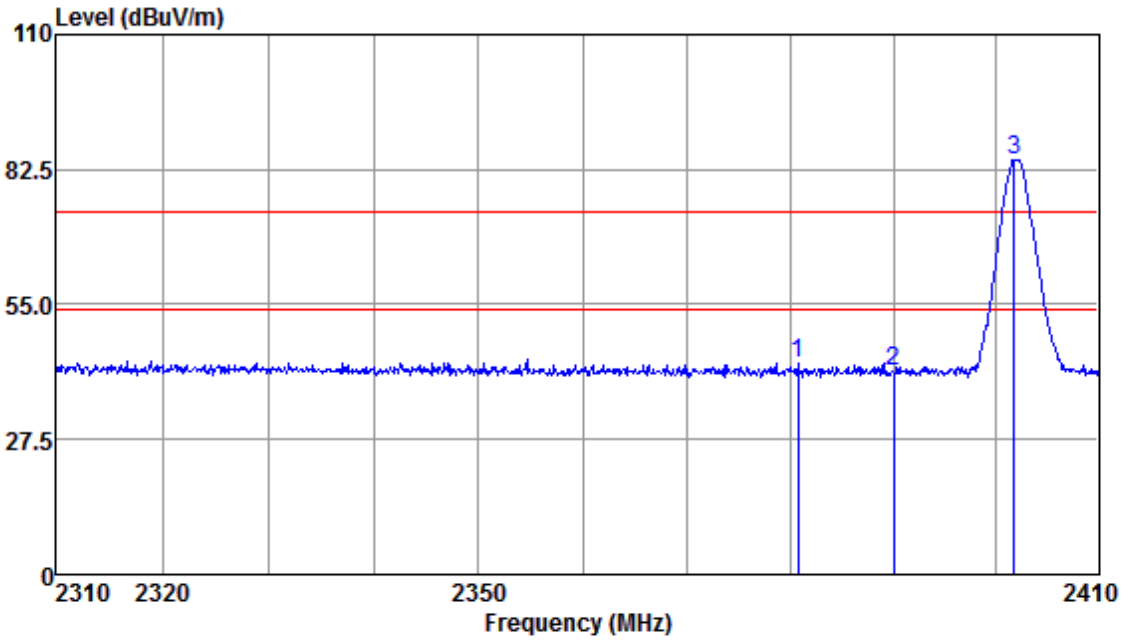


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2362.97	48.01	26.00	6.42	37.36	43.07	74.00	-30.93	Peak
2390.00	45.64	26.03	6.47	37.36	40.78	74.00	-33.22	Peak
2401.74	93.83	26.05	6.50	37.35	89.03	74.00	15.03	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

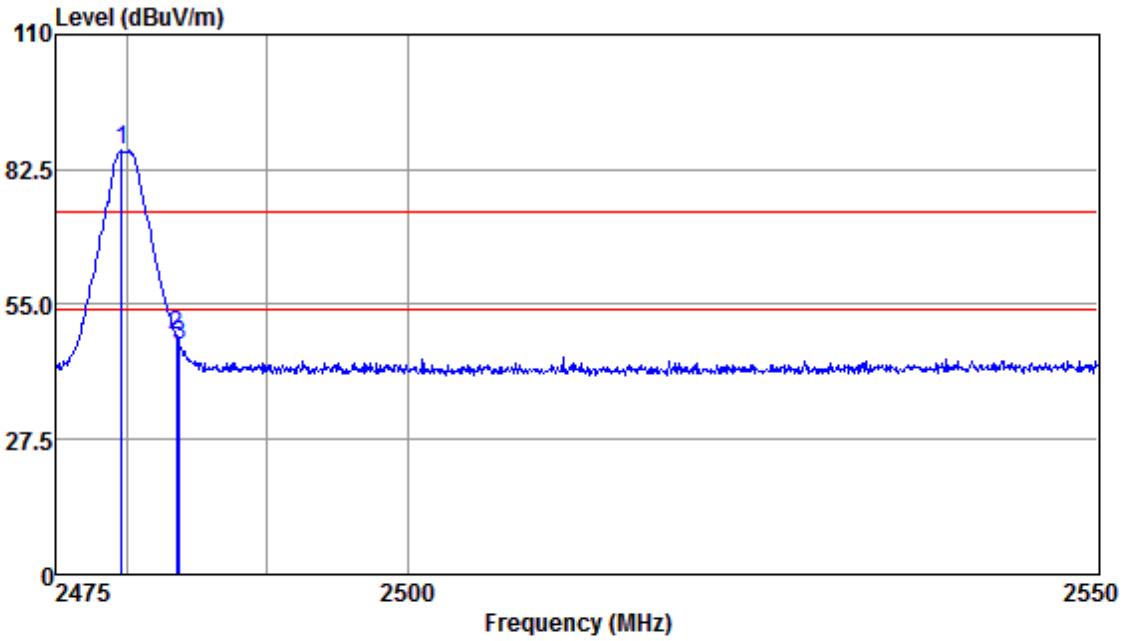


Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2380.76	47.86	26.02	6.45	37.36	42.97	74.00	-31.03	Peak
2390.00	46.33	26.03	6.47	37.36	41.47	74.00	-32.53	Peak
2401.74	89.42	26.05	6.50	37.35	84.62	74.00	10.62	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

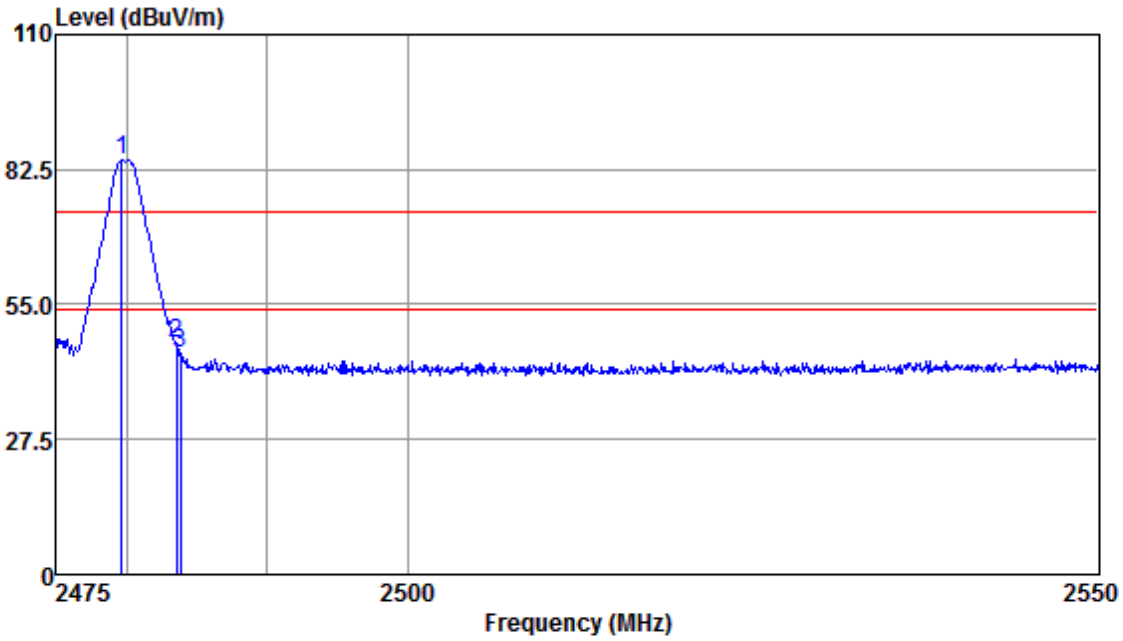


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2479.66	90.85	26.17	6.74	37.49	86.27	74.00	12.27	Peak
2483.50	53.09	26.18	6.80	37.51	48.56	74.00	-25.44	Peak
2483.73	51.23	26.18	6.80	37.51	46.70	74.00	-27.30	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:High

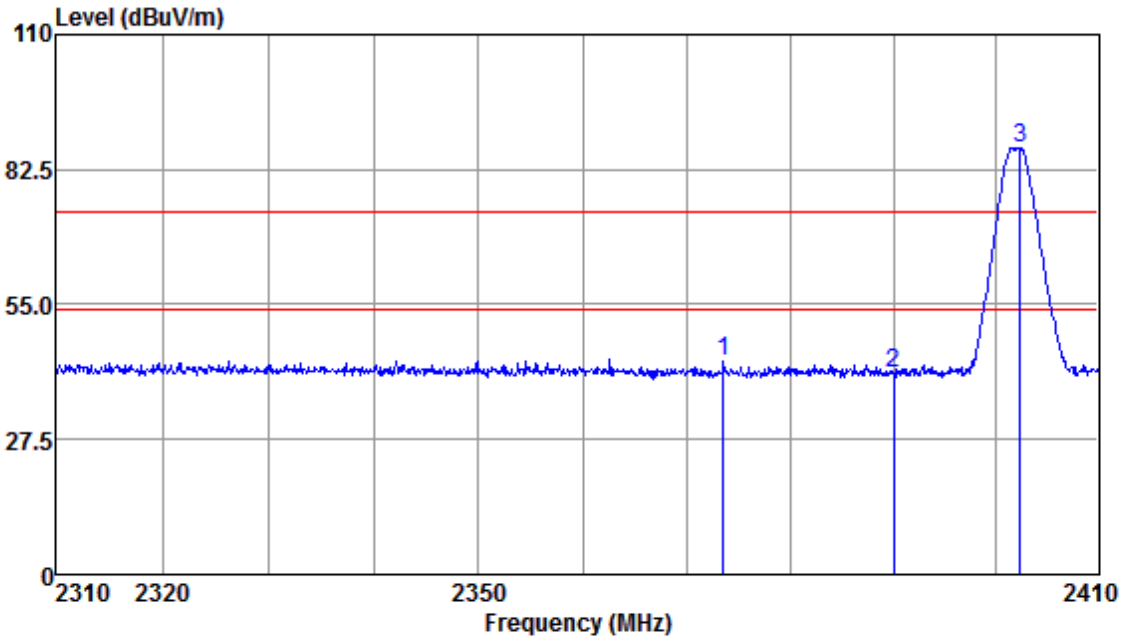


Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2479.66	88.93	26.17	6.74	37.49	84.35	74.00	10.35	Peak
2483.50	51.52	26.18	6.80	37.51	46.99	74.00	-27.01	Peak
2483.81	49.42	26.18	6.80	37.51	44.89	74.00	-29.11	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:a1; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

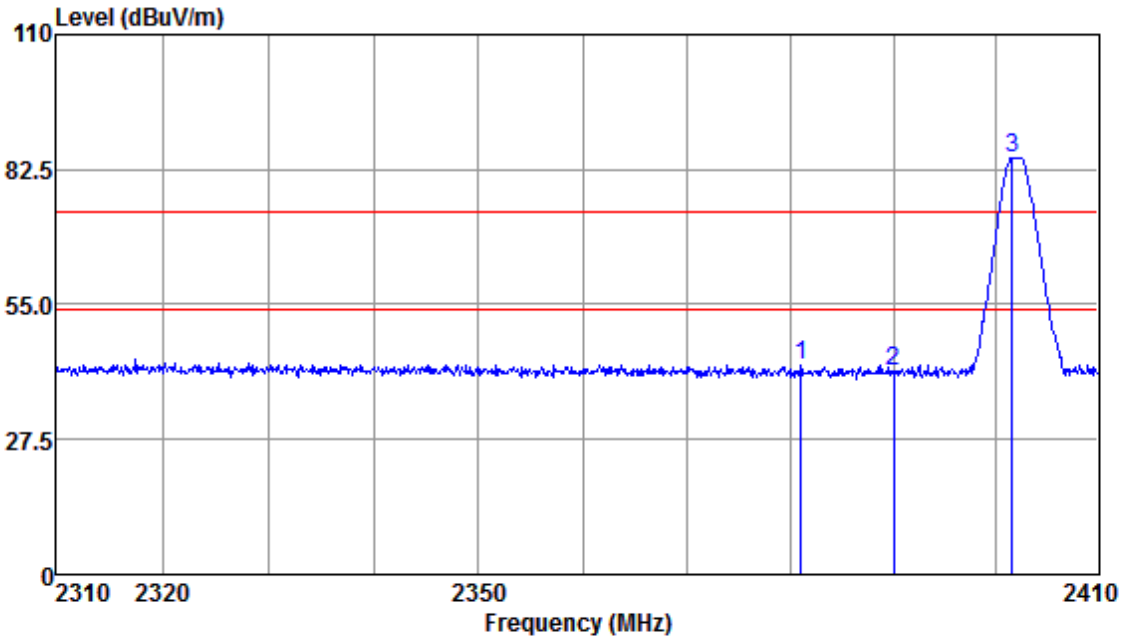


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2373.51	48.47	26.01	6.45	37.36	43.57	74.00	-30.43	Peak
2390.00	45.85	26.03	6.47	37.36	40.99	74.00	-33.01	Peak
2402.35	91.87	26.05	6.50	37.35	87.07	74.00	13.07	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:a1; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

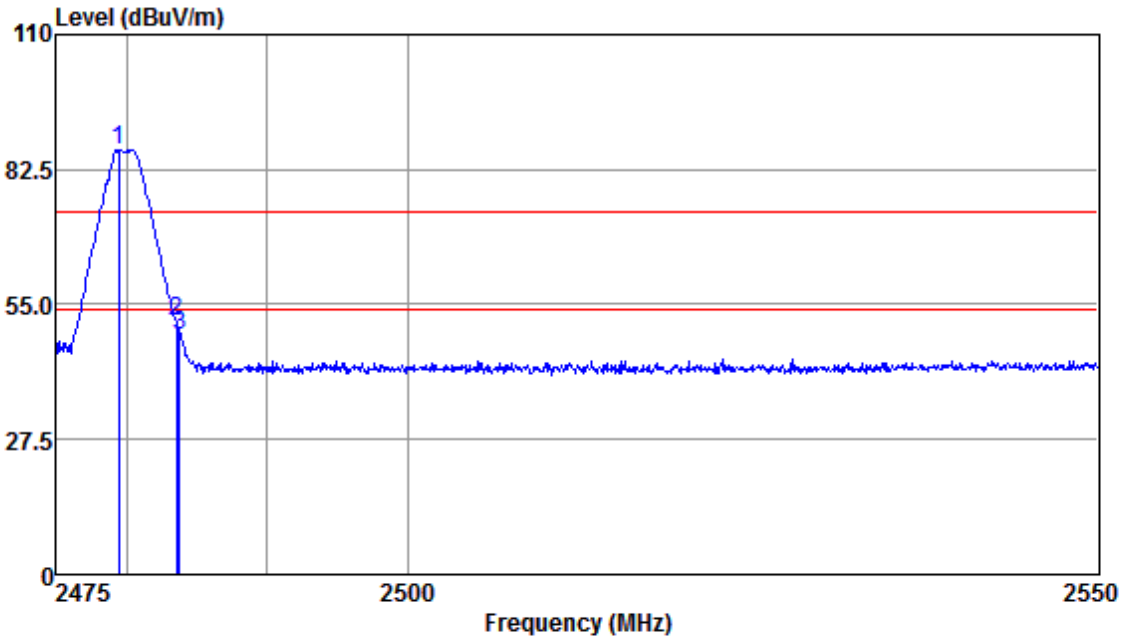


Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2381.07	47.59	26.02	6.45	37.36	42.70	74.00	-31.30	Peak
2390.00	46.32	26.03	6.47	37.36	41.46	74.00	-32.54	Peak
2401.54	89.77	26.05	6.50	37.35	84.97	74.00	10.97	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:a1; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

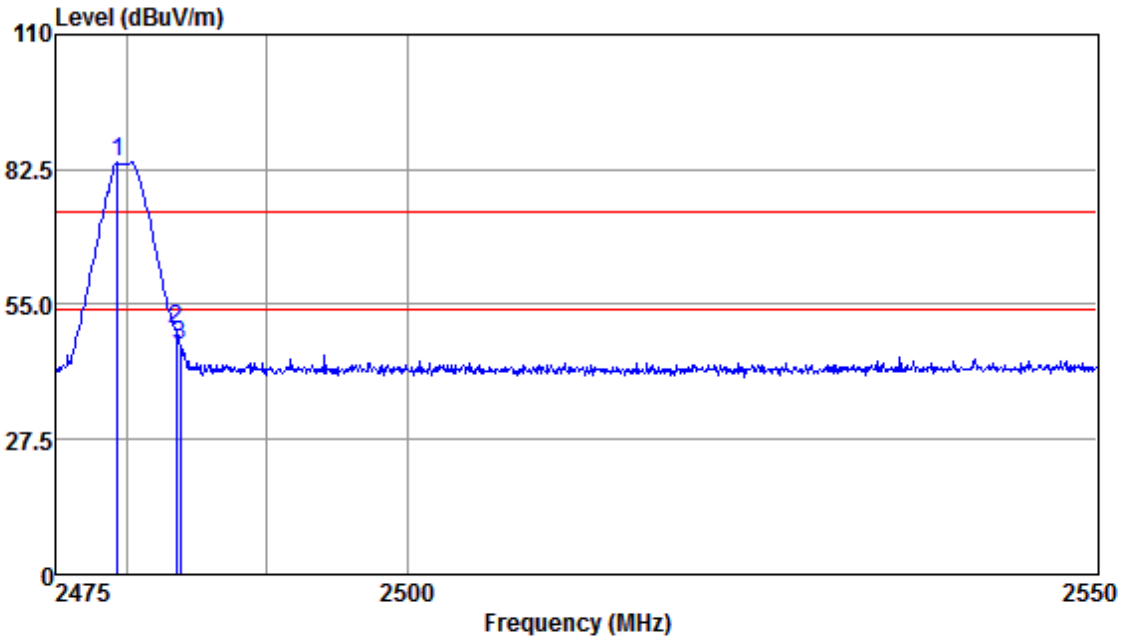


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2479.44	91.14	26.17	6.74	37.49	86.56	74.00	12.56	Peak
2483.50	56.26	26.18	6.80	37.51	51.73	74.00	-22.27	Peak
2483.73	53.32	26.18	6.80	37.51	48.79	74.00	-25.21	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:a1; Polarization:Vertical; Modulation:GFSK; ; Channel:High



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2479.36	88.57	26.17	6.74	37.49	83.99	74.00	9.99	Peak
2483.50	54.54	26.18	6.80	37.51	50.01	74.00	-23.99	Peak
2483.81	51.23	26.18	6.80	37.51	46.70	74.00	-27.30	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

7.8 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.		

7.8.1 E.U.T. Operation

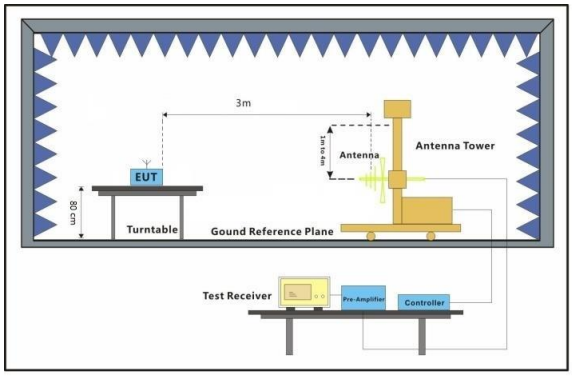
Operating Environment:

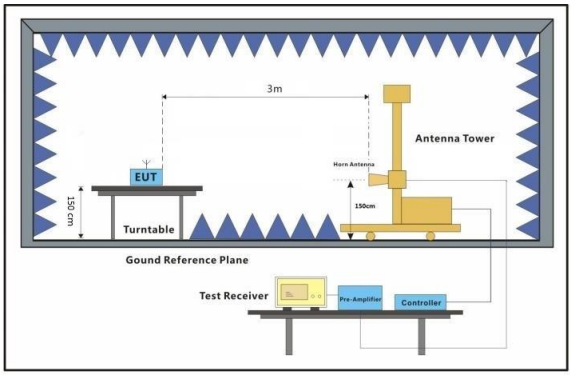
Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

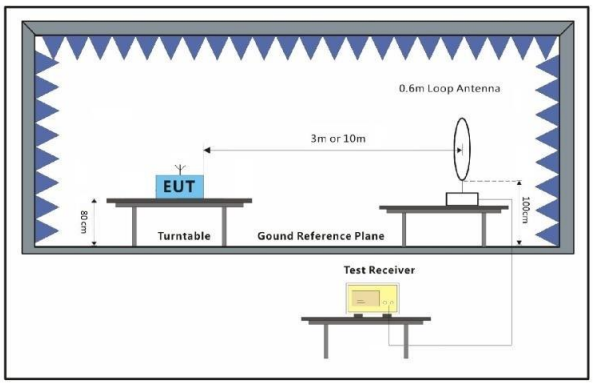
Test mode a:Charge + TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation 1M rate.

a1:Charge + TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation 2M rate.

7.8.2 Test Setup Diagram







7.8.3 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

Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4804	35.45	6.18	41.63	54	-12.37	peak
7206	35.02	10.63	45.65	54	-8.35	peak
9608	36.13	14.38	50.51	54	-3.49	peak

Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4804	37.79	6.18	43.97	54	-10.03	peak
7206	35.56	10.63	46.19	54	-7.81	peak
9608	38.07	14.38	52.45	54	-1.55	peak

Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4880	39.01	6.97	45.98	54	-8.02	peak
7320	36.47	11.12	47.59	54	-6.41	peak
9760	31.48	14.35	45.83	54	-8.17	peak

Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4880	36.52	6.97	43.49	54	-10.51	peak
7320	36.89	11.12	48.01	54	-5.99	peak
9760	34.35	14.35	48.7	54	-5.3	peak

Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4960	41.93	7.49	49.42	54	-4.58	peak
7440	38.31	11.65	49.96	54	-4.04	peak
9920	37.64	14.4	52.04	54	-1.96	peak

Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4960	36.99	7.49	44.48	54	-9.52	peak
7440	35.08	11.65	46.73	54	-7.27	peak
9920	36.88	14.4	51.28	54	-2.72	peak

Mode:a1; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4804	36.68	6.18	42.86	54	-11.14	peak
7206	33.4	10.63	44.03	54	-9.97	peak
9608	35.62	14.38	50	54	-4	peak

Mode:a1; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4804	39.09	6.18	45.27	54	-8.73	peak
7206	36.18	10.63	46.81	54	-7.19	peak
9608	38.12	14.38	52.5	54	-1.5	peak

Mode:a1; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector	
MHz	dBuV	dB	dBuV/m	dBuV/m	dB		
4880	35.28	6.97	42.25	54	-11.75	peak	
7320	35.99	11.12	47.11	54	-6.89	peak	
9760	32.45	14.35	46.8	54	-7.2	peak	

Mode:a1; Polarization:Vertical; Modulation:GFSK; ; Channel:middle

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector	
MHz	dBuV	dB	dBuV/m	dBuV/m	dB		
4880	36.11	6.97	43.08	54	-10.92	peak	
7320	39.37	11.12	50.49	54	-3.51	peak	
9760	33.28	14.35	47.63	54	-6.37	peak	

Mode:a1; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4960	38.54	7.49	46.03	54	-7.97	peak
7440	37.51	11.65	49.16	54	-4.84	peak
9920	35.77	14.4	50.17	54	-3.83	peak

Mode:a1; Polarization:Vertical; Modulation:GFSK; ; Channel:High

Frequency	RX_R	Factor	Emission	Limit	Over Limit	Detector
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
4960	37.03	7.49	44.52	54	-9.48	peak
7440	39.2	11.65	50.85	54	-3.15	peak
9920	34.38	14.4	48.78	54	-5.22	peak

7.9 99% Bandwidth

Test Requirement RSS-Gen Section 6.6

Test Method: ANSI C63.10 Section 6.9.3

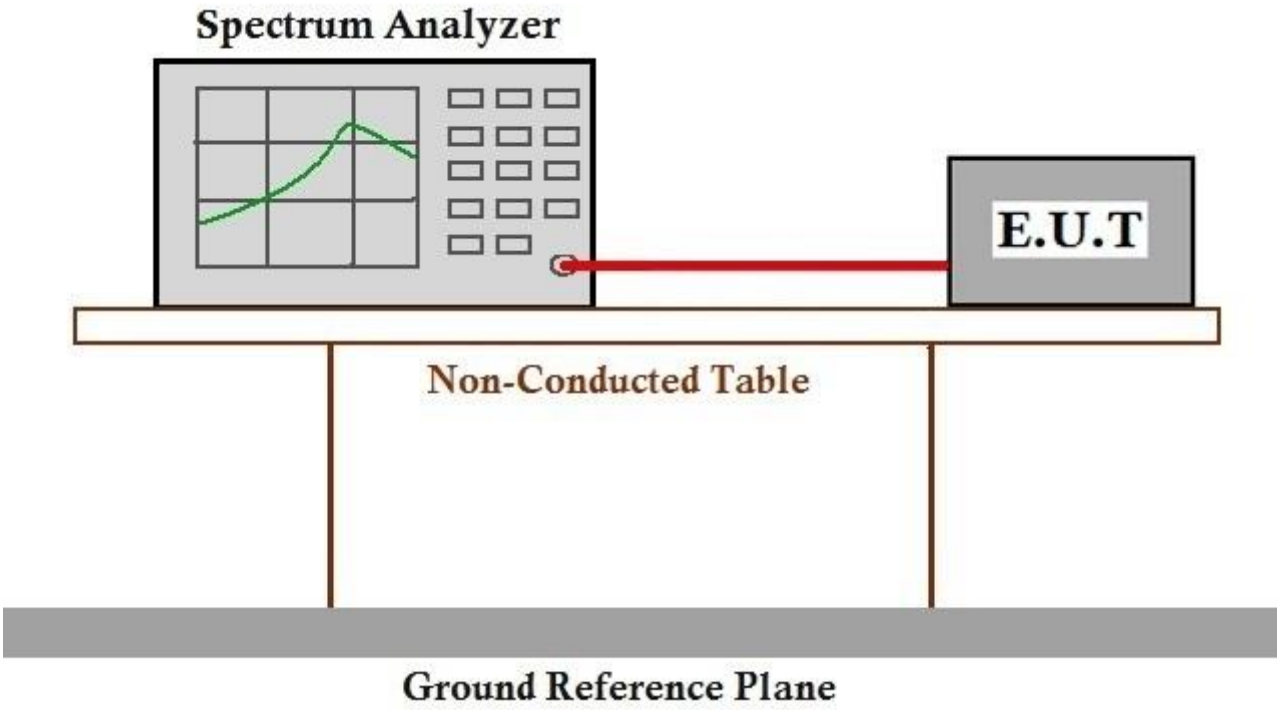
7.9.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode a:Charge + TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation.

7.9.2 Test Setup Diagram



7.9.3 Measurement Procedure and Data

The detailed test data see: Appendix A for SHEM190100008101

8 Test Setup Photographs

Refer to the < Test Setup photos-FCC>.

9 EUT Constructional Details

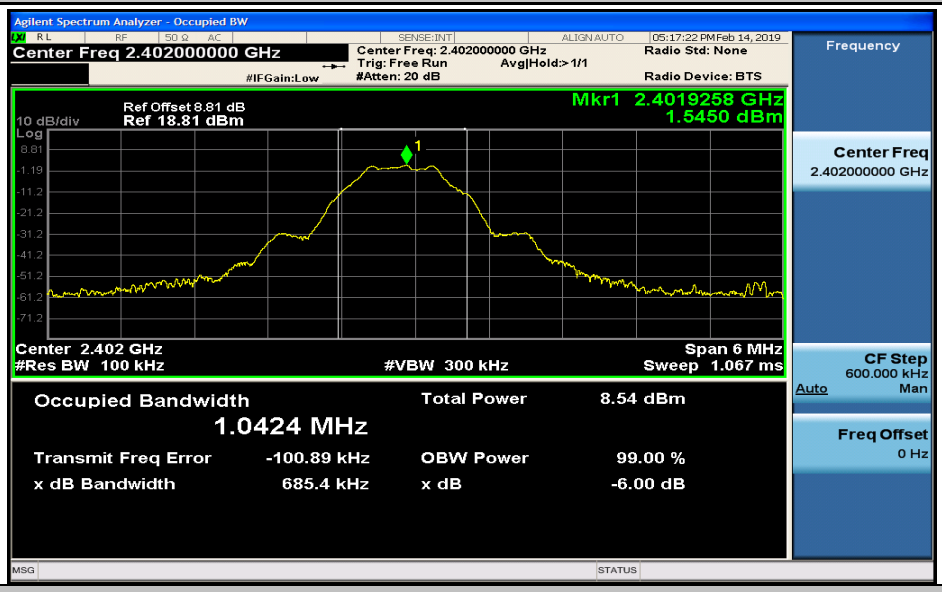
Refer to the < External Photos > & < Internal Photos >.

10 Appendix A for SHEM190100008101

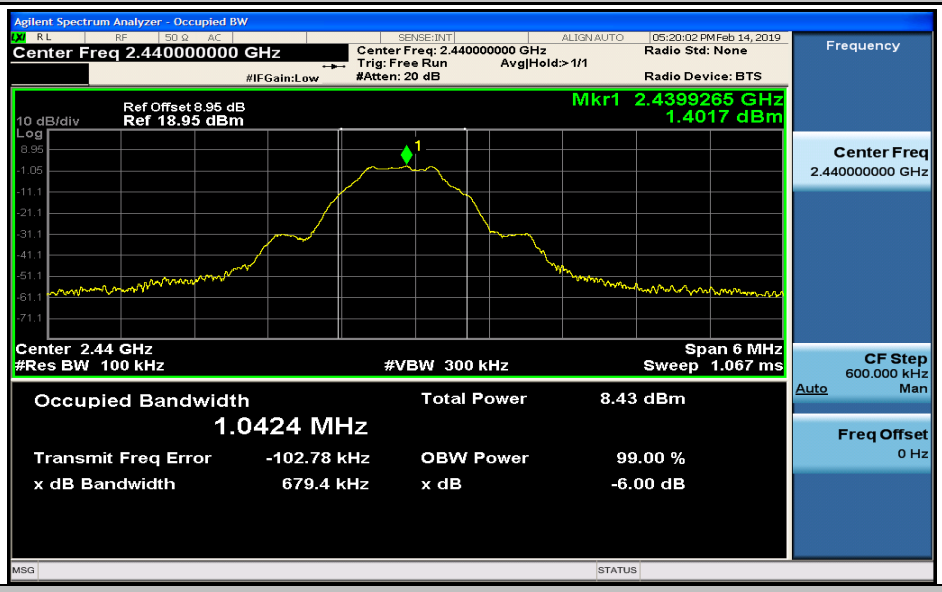
1.6dB Bandwidth

Test Mode	Test Channel	EBW[MHz]		Limit	Verdict
		1M Rate	2M Rate		
BLE	2402	0.69	1.15	0.5	PASS
BLE	2440	0.68	1.16	0.5	PASS
BLE	2480	0.69	1.18	0.5	PASS

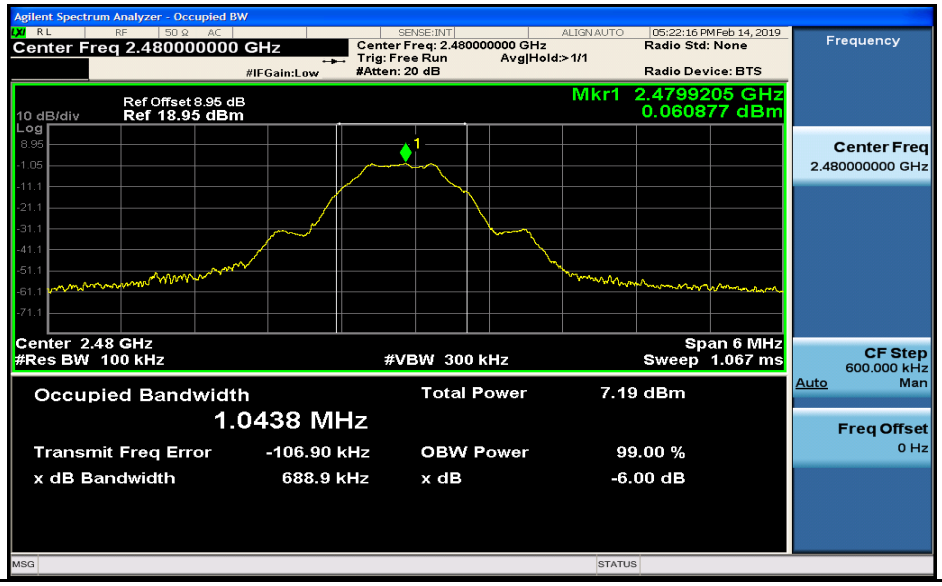
6dB Bandwidth_BLE_2402(1M Rate)



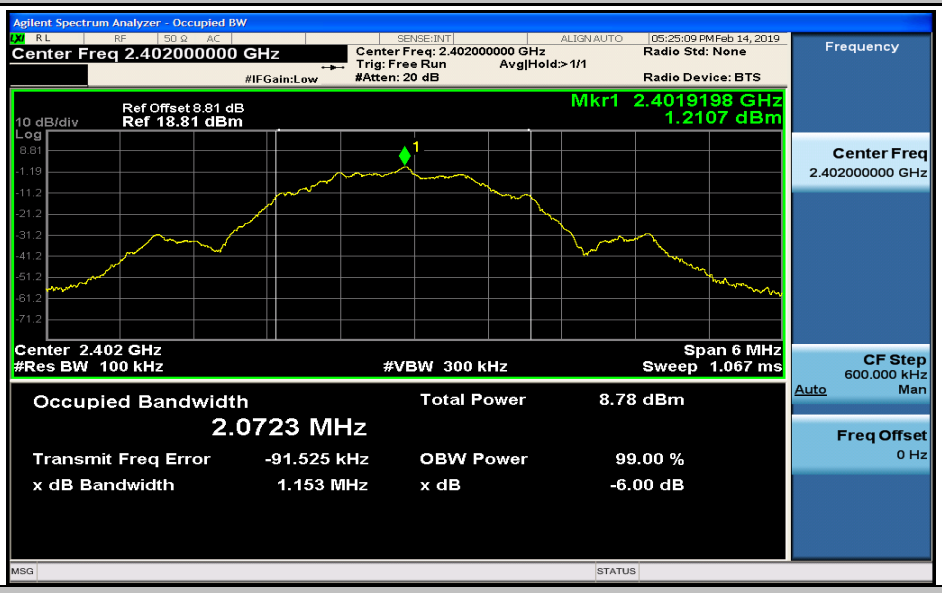
6dB Bandwidth_BLE_2440(1M Rate)



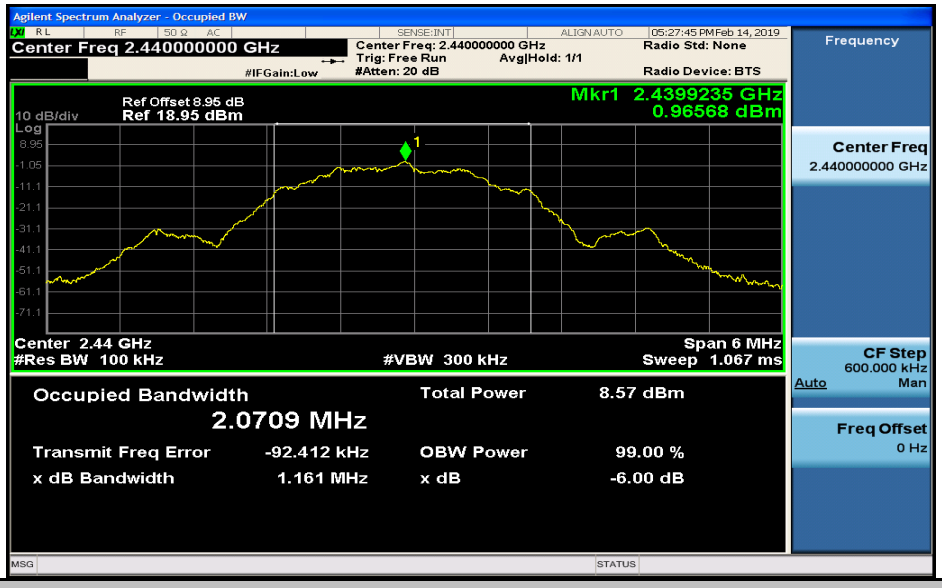
6dB Bandwidth_BLE_2480(1M Rate)


Agilent Spectrum Analyzer - Occupied BW
Center Freq 2.480000000 GHz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold:>1/1
#IFGain:Low
#Atten: 20 dB
Radio Std: None
Radio Device: BTS
Frequency
Ref Offset 8.95 dB
10 dB/div
Ref 18.95 dBm
Log
Mkr1 2.4799205 GHz
0.060877 dBm
Center 2.48 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 6 MHz
Sweep 1.067 ms
Occupied Bandwidth
1.0438 MHz
Total Power 7.19 dBm
Transmit Freq Error -106.90 kHz
OBW Power 99.00 %
x dB Bandwidth 688.9 kHz
x dB -6.00 dB
Center Freq
2.480000000 GHz
CF Step
600.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

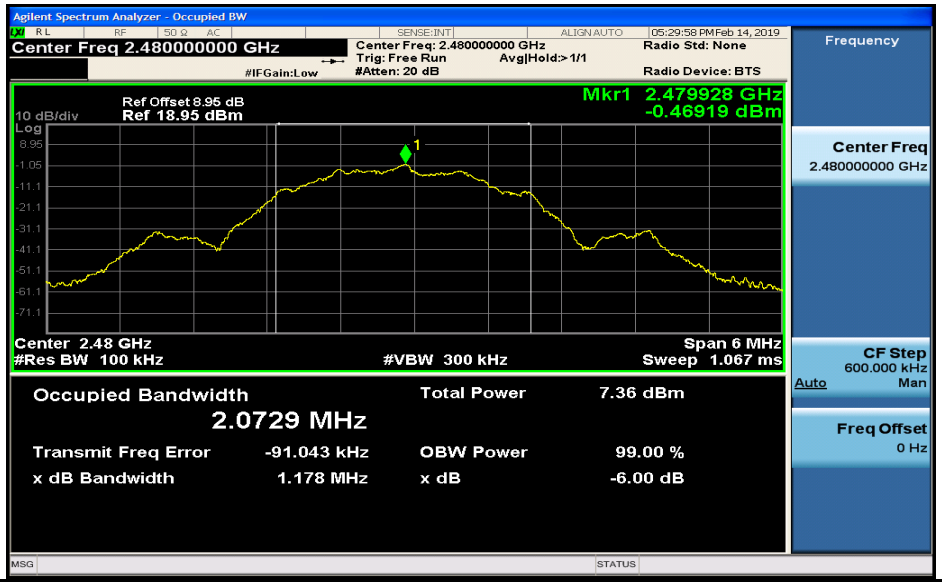
6dB Bandwidth_BLE_2402(2M Rate)



6dB Bandwidth_BLE_2440(2M Rate)



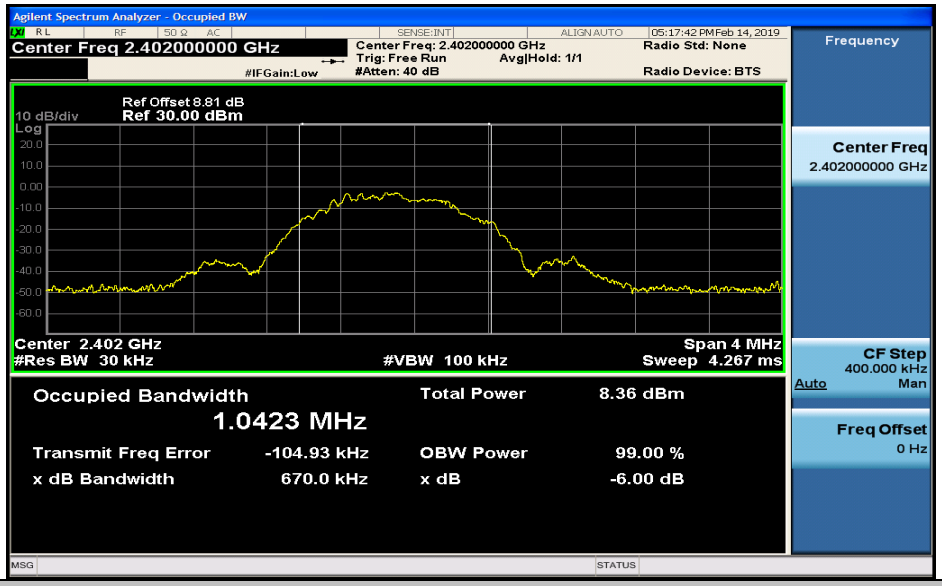
6dB Bandwidth_BLE_2480(2M Rate)


Agilent Spectrum Analyzer - Occupied BW
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
05:29:58 PM Feb 14, 2019
Center Freq 2.480000000 GHz
#IFGain:Low
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold:>1/1
#Atten: 20 dB
Radio Std: None
Radio Device: BTS
Frequency
Ref Offset 8.95 dB
10 dB/div
Ref 18.95 dBm
Log
Mkr1 2.479928 GHz
-0.46919 dBm
8.95
-1.05
-11.1
-21.1
-31.1
-41.1
-51.1
-61.1
-71.1
Center 2.48 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 6 MHz
Sweep 1.067 ms
Occupied Bandwidth
2.0729 MHz
Total Power
7.36 dBm
Transmit Freq Error
-91.043 kHz
OBW Power
99.00 %
x dB Bandwidth
1.178 MHz
x dB
-6.00 dB
Center Freq
2.480000000 GHz
CF Step
600.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

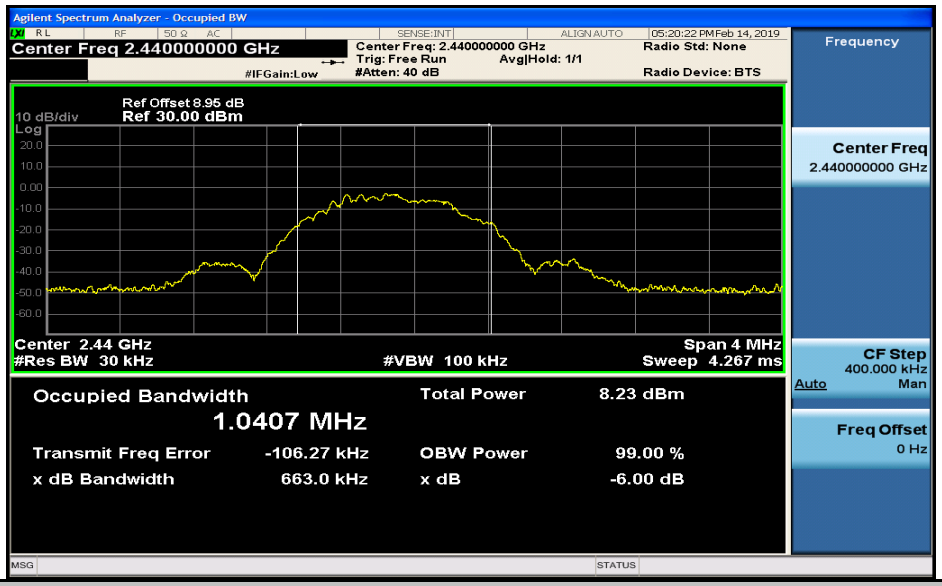
2.Occupied Bandwidth

Test Mode	Test Channel	OBW[MHz]		Limit[MHz]	Verdict
		1M Rate	2M Rate		
BLE	2402	1.04	2.07	---	PASS
BLE	2440	1.04	2.07	---	PASS
BLE	2480	1.04	2.07	---	PASS

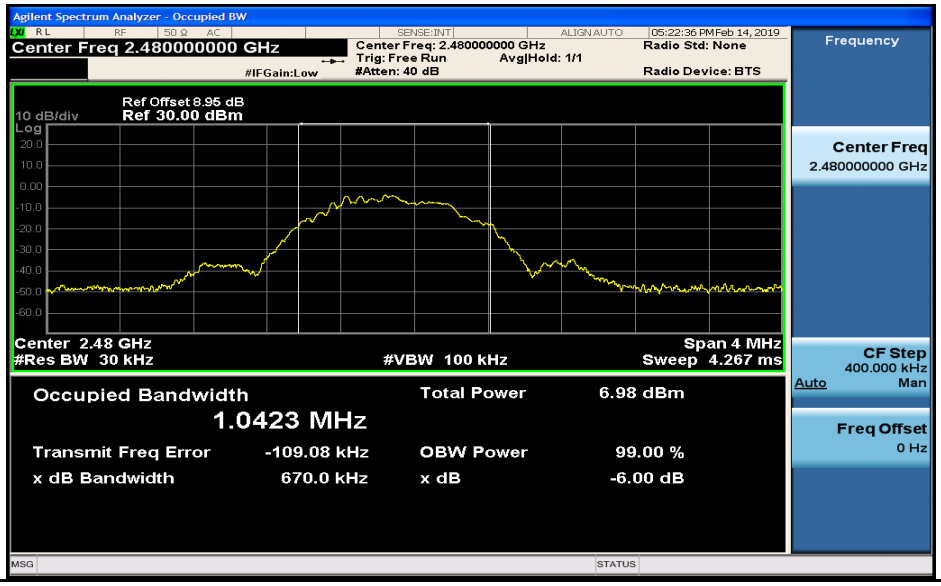
Occupied Bandwidth_BLE_2402(1M Rate)



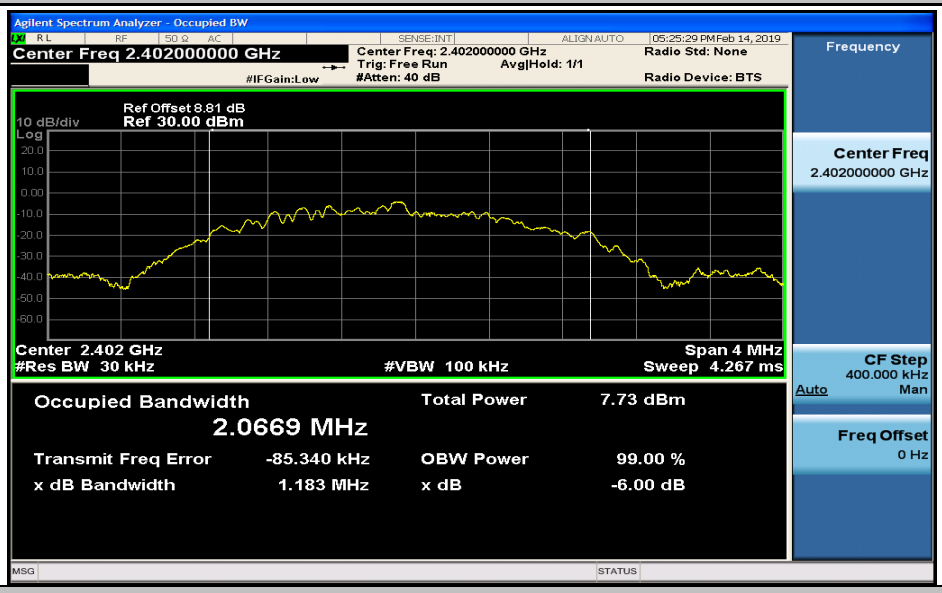
Occupied Bandwidth_BLE_2440(1M Rate)



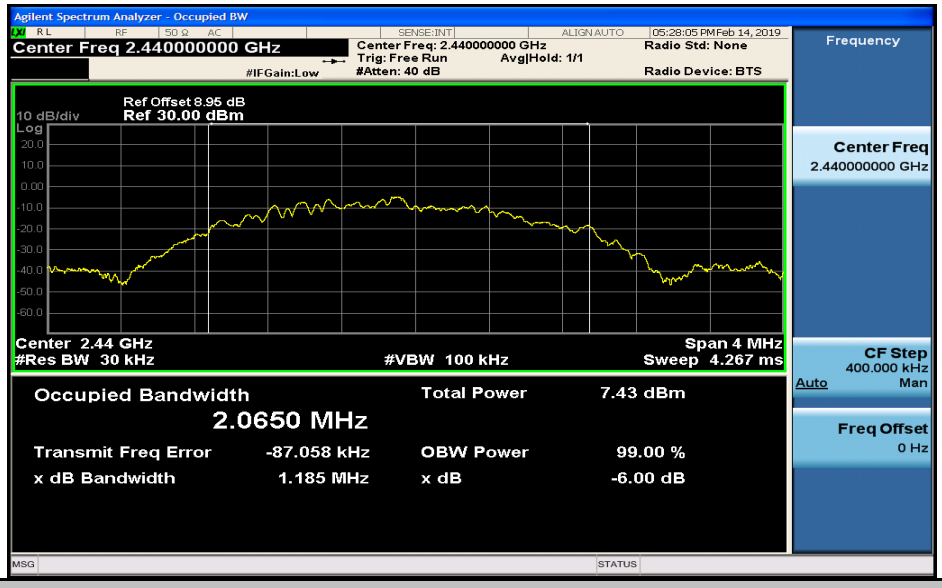
Occupied Bandwidth_BLE_2480(1M Rate)


Agilent Spectrum Analyzer - Occupied BW
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
05:22:36 PM Feb 14, 2019
Center Freq 2.480000000 GHz
#IFGain:Low
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold: 1/1
#Atten: 40 dB
Radio Std: None
Radio Device: BTS
Frequency
Ref Offset 8.95 dB
10 dB/div
Ref 30.00 dBm
Log
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Center Freq
2.480000000 GHz
Center 2.48 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 4 MHz
Sweep 4.267 ms
CF Step
400.000 kHz
Auto
Man
Occupied Bandwidth
1.0423 MHz
Total Power
6.98 dBm
Transmit Freq Error
-109.08 kHz
OBW Power
99.00 %
x dB Bandwidth
670.0 kHz
x dB
-6.00 dB
Freq Offset
0 Hz
MSG
STATUS

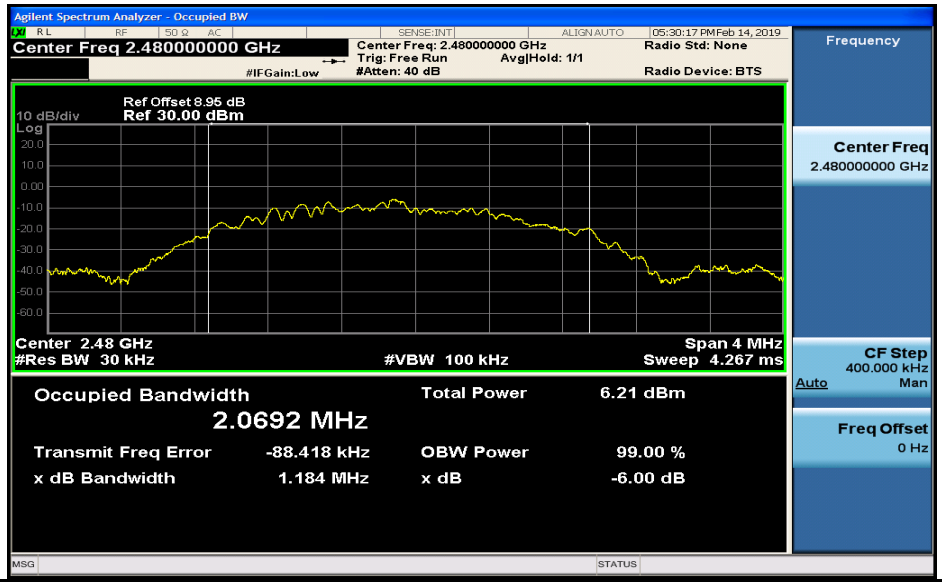
Occupied Bandwidth_BLE_2402(2M Rate)



Occupied Bandwidth_BLE_2440(2M Rate)



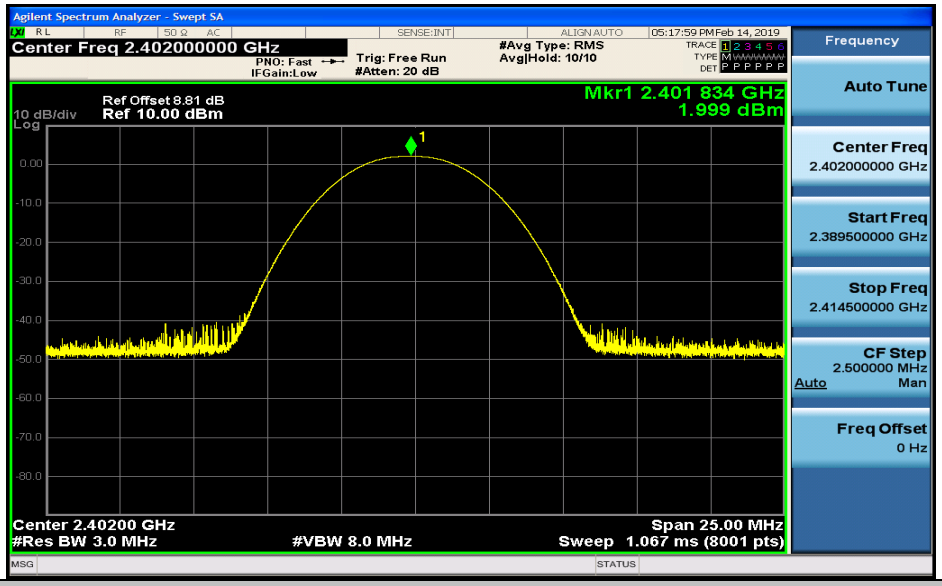
Occupied Bandwidth_BLE_2480(2M Rate)


Agilent Spectrum Analyzer - Occupied BW
RL
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
05:30:17 PM Feb 14, 2019
Center Freq 2.480000000 GHz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold: 1/1
#Atten: 40 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
Frequency
Ref Offset 8.95 dB
10 dB/div
Ref 30.00 dBm
Log
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Center Freq
2.480000000 GHz
Center 2.48 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 4 MHz
Sweep 4.267 ms
CF Step
400.000 kHz
Auto
Man
Occupied Bandwidth
2.0692 MHz
Total Power
6.21 dBm
Transmit Freq Error
-88.418 kHz
OBW Power
99.00 %
x dB Bandwidth
1.184 MHz
x dB
-6.00 dB
Freq Offset
0 Hz
MSG
STATUS

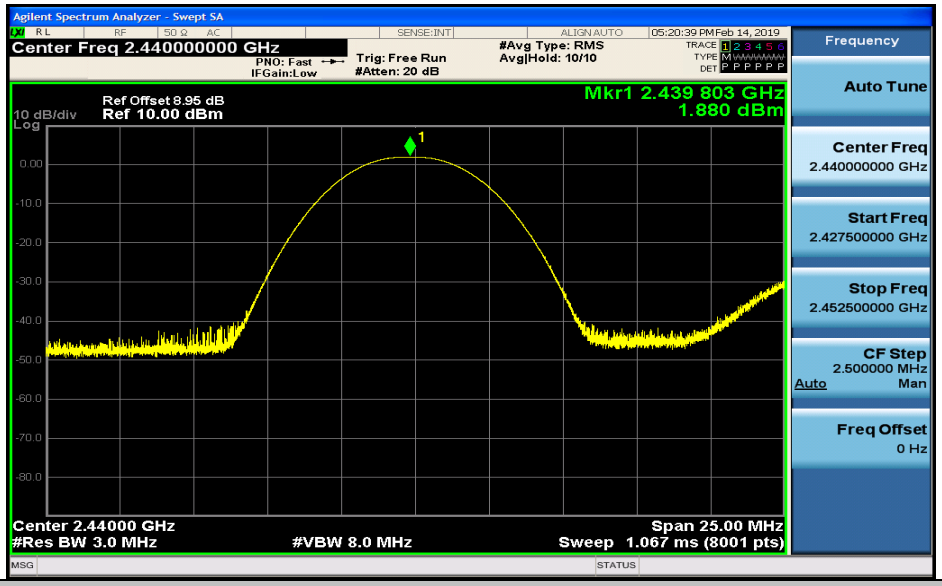
3.Maximum peak conducted output power

Test Mode	Test Channel	Power[dBm]		Limit[dBm]	Verdict
		1M Rate	2M Rate		
BLE	2402	2	1.96	30	PASS
BLE	2440	1.88	1.81	30	PASS
BLE	2480	0.68	0.6	30	PASS

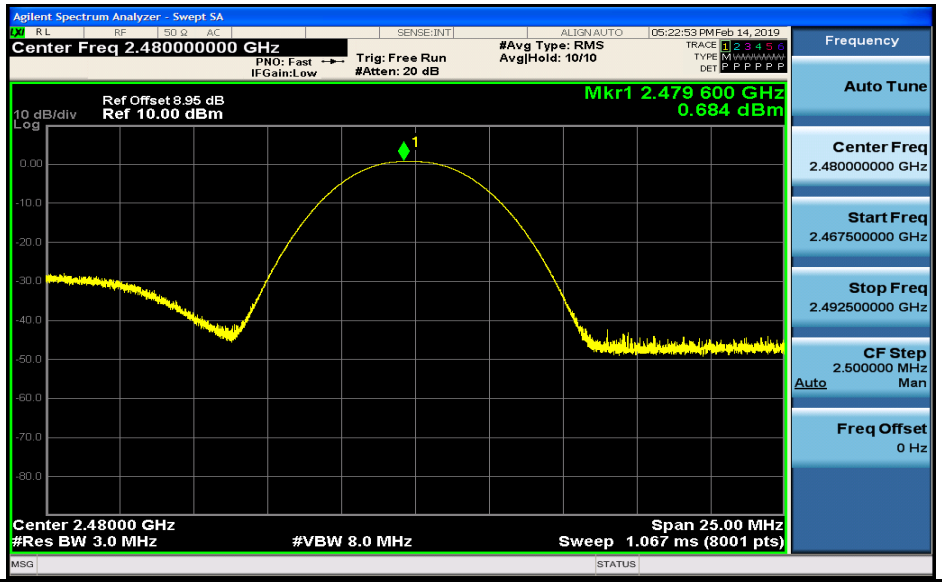
Maximum peak conducted output power_BLE_2402(1M Rate)



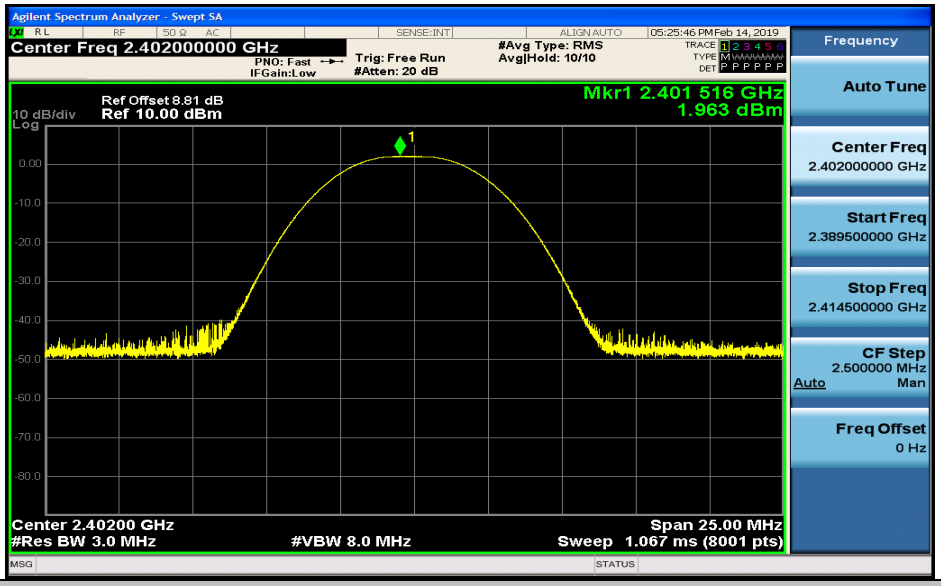
Maximum peak conducted output power_BLE_2440(1M Rate)



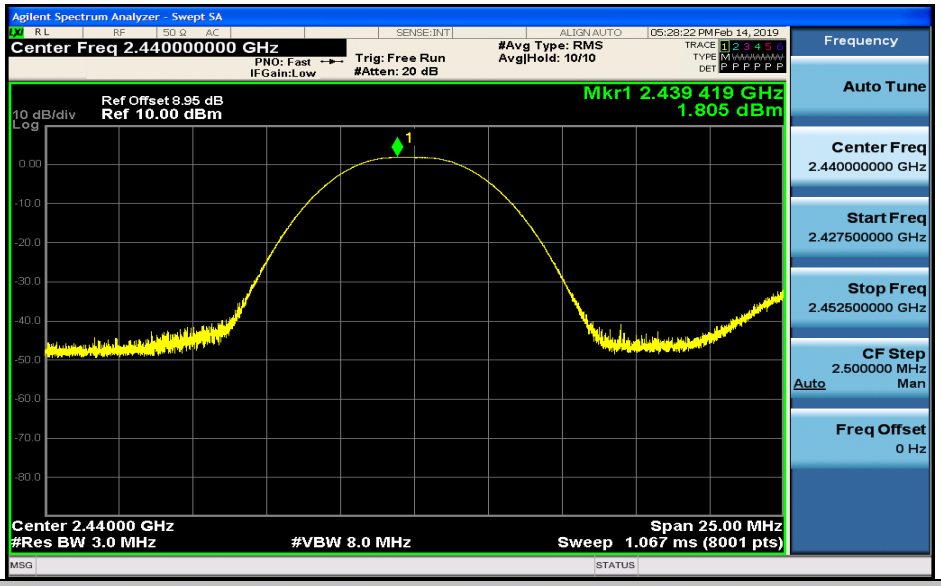
Maximum peak conducted output power_BLE_2480(1M Rate)


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 10/10
05:22:53 PM Feb 14, 2019
Ref Offset 8.95 dB
10 dB/div
Log
Ref 10.00 dBm
Mkr1 2.479 600 GHz
0.684 dBm
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
Center 2.48000 GHz
#Res BW 3.0 MHz
#VBW 8.0 MHz
Span 25.00 MHz
Sweep 1.067 ms (8001 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.467500000 GHz
Stop Freq
2.492500000 GHz
CF Step
2.500000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

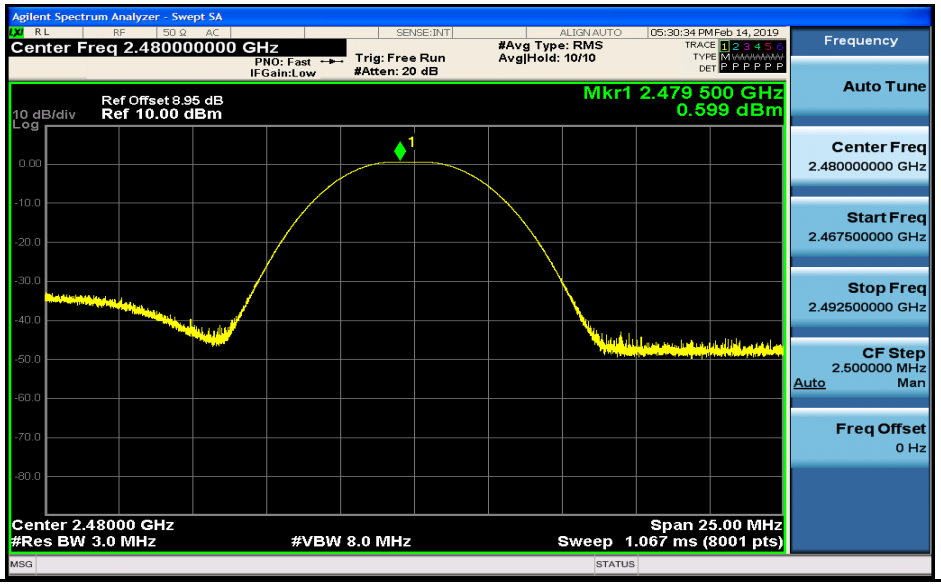
Maximum peak conducted output power_BLE_2402(2M Rate)



Maximum peak conducted output power_BLE_2440(2M Rate)



Maximum peak conducted output power_BLE_2480(2M Rate)


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 10/10
05:30:34 PM Feb 14, 2019
Ref Offset 8.95 dB
10 dB/div
Log
Ref 10.00 dBm
Mkr1 2.479 500 GHz
0.599 dBm
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
Center 2.48000 GHz
#Res BW 3.0 MHz
#VBW 8.0 MHz
Span 25.00 MHz
Sweep 1.067 ms (8001 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.467500000 GHz
Stop Freq
2.492500000 GHz
CF Step
2.500000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

4.Maximum Peak power spectral density

Test Mode	Test Channel	PSD[dBm/3kHz]		Limit[dBm/3kHz]	Verdict
		1M Rate	2M Rate		
BLE	2402	-13.21	-16.98	8.00	PASS
BLE	2440	-13.39	-17.13	8.00	PASS
BLE	2480	-14.71	-18.53	8.00	PASS

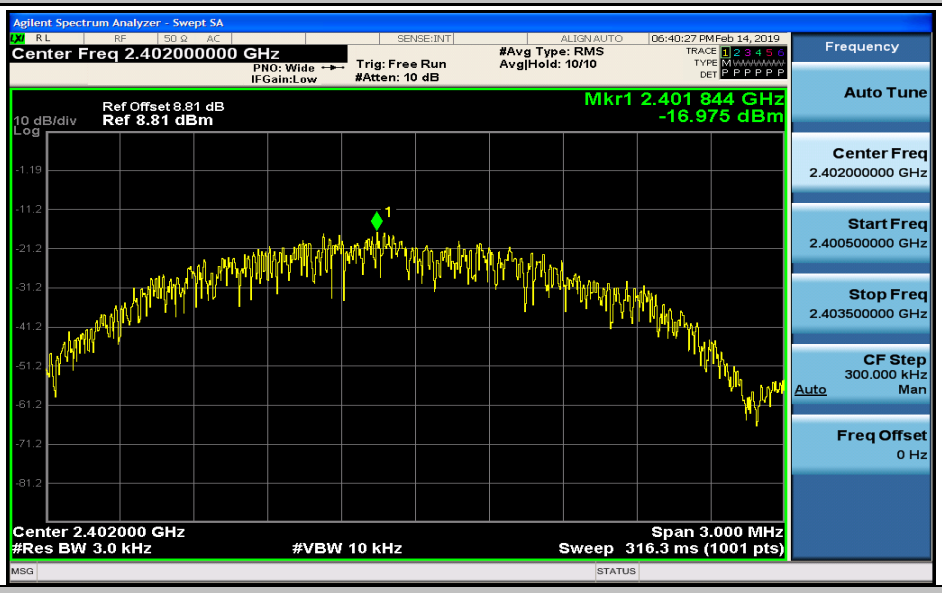
Maximum Peak power spectral density_BLE_2402(1M Rate)

Maximum Peak power spectral density_BLE_2440(1M Rate)

Maximum Peak power spectral density_BLE_2480(1M Rate)

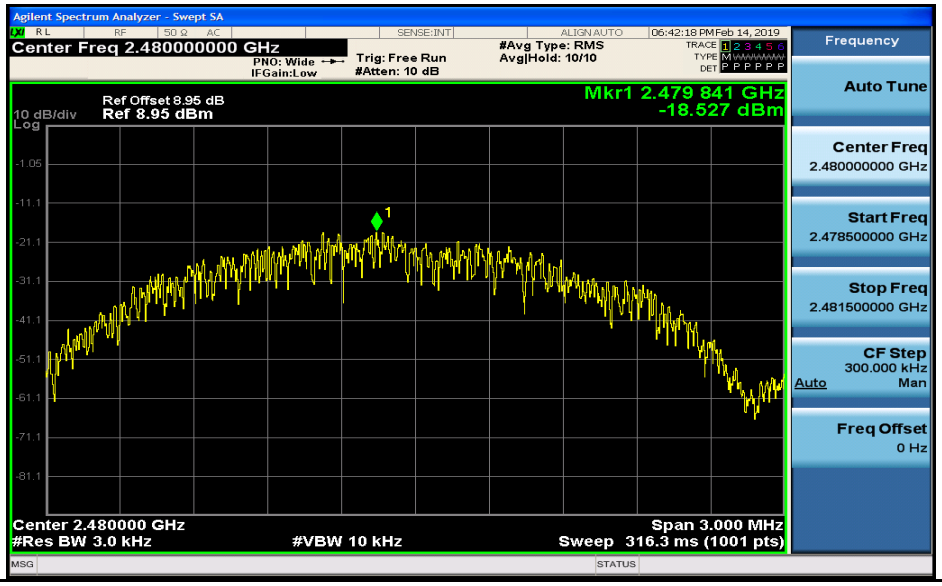

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 10 dB
#Avg Type: RMS
Avg|Hold: 10/10
05:23:12 PM Feb 14, 2019
Ref Offset 8.95 dB
10 dB/div
Log
Ref 8.95 dBm
Mkr1 2.479 782 5 GHz
-14.712 dBm
-1.05
-11.1
-21.1
-31.1
-41.1
-51.1
-61.1
-71.1
-81.1
Center 2.4800000 GHz
#Res BW 3.0 kHz
#VBW 10 kHz
Span 1.500 MHz
Sweep 158.2 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.479250000 GHz
Stop Freq
2.480750000 GHz
CF Step
150.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

Maximum Peak power spectral density_BLE_2402(2M Rate)



Maximum Peak power spectral density_BLE_2440(2M Rate)

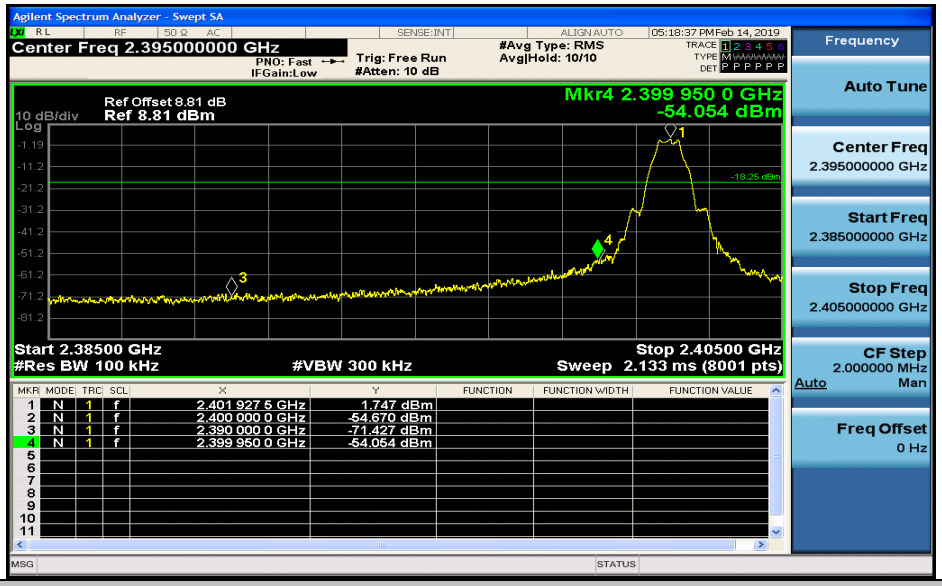
Maximum Peak power spectral density_BLE_2480(2M Rate)


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 10 dB
#Avg Type: RMS
Avg|Hold: 10/10
06:42:18 PM Feb 14, 2019
Ref Offset 8.95 dB
10 dB/div
Log
Ref 8.95 dBm
Mkr1 2.479 841 GHz
-18.527 dBm
-1.05
-11.1
-21.1
-31.1
-41.1
-51.1
-61.1
-71.1
-81.1
Center 2.480000 GHz
#Res BW 3.0 kHz
#VBW 10 kHz
Span 3.000 MHz
Sweep 316.3 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.478500000 GHz
Stop Freq
2.481500000 GHz
CF Step
300.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

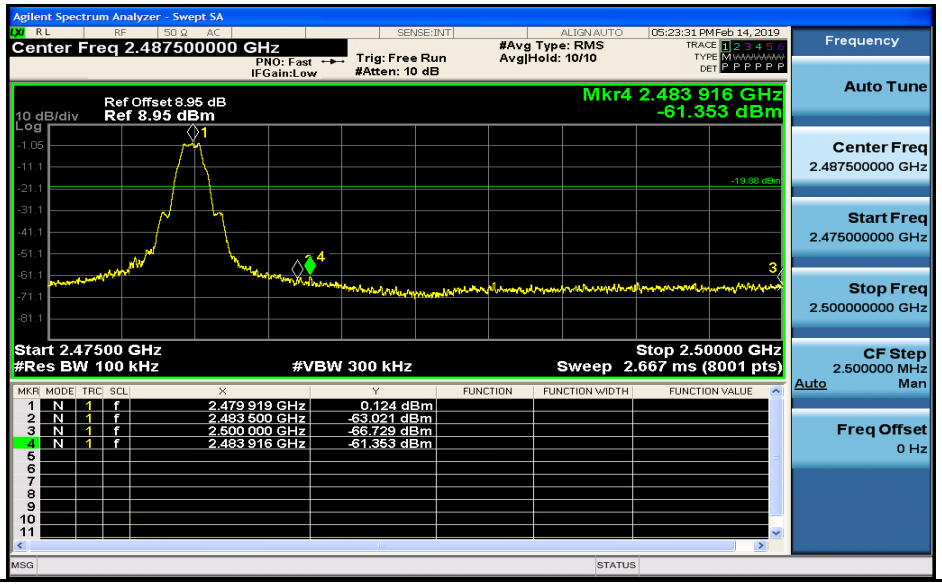
5.Band-edge for RF Conducted Emissions

Test Mode	Test Channel	Carrier Power[dBm]		Max. Spurious Level [dBm]		Limit [dBm]		Verdict
		1M Rate	2M Rate	1M Rate	2M Rate	1M Rate	2M Rate	
BLE	2402	1.75	0.87	-54.05	-30.77	-18.25	-19.13	PASS
BLE	2480	0.12	-0.56	-61.35	-62.93	-19.88	-20.56	PASS

Band-edge for RF Conducted Emissions_BLE_2402_Hopping Off(1M Rate)

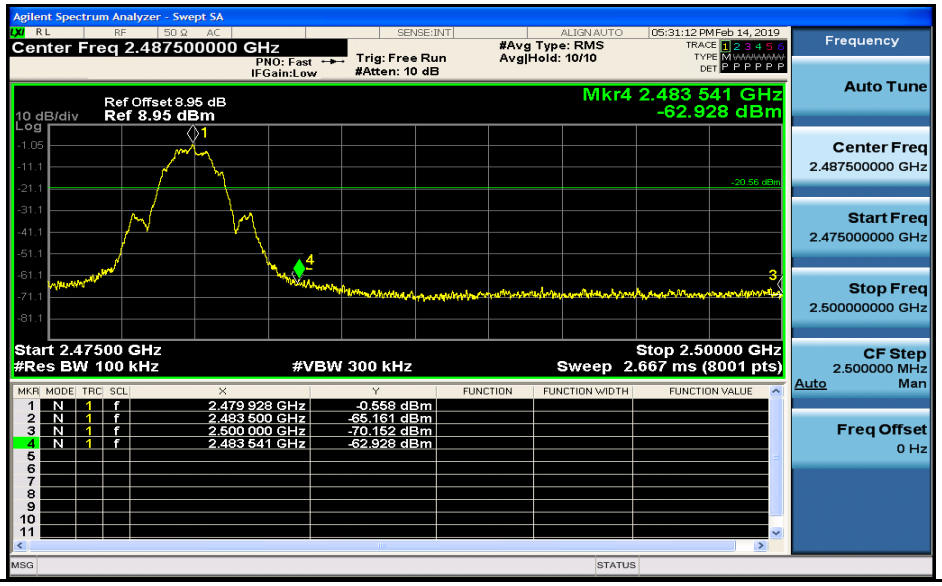


Band-edge for RF Conducted Emissions_BLE_2480_Hopping Off(1M Rate)



Band-edge for RF Conducted Emissions_BLE_2402_Hopping Off(2M Rate)

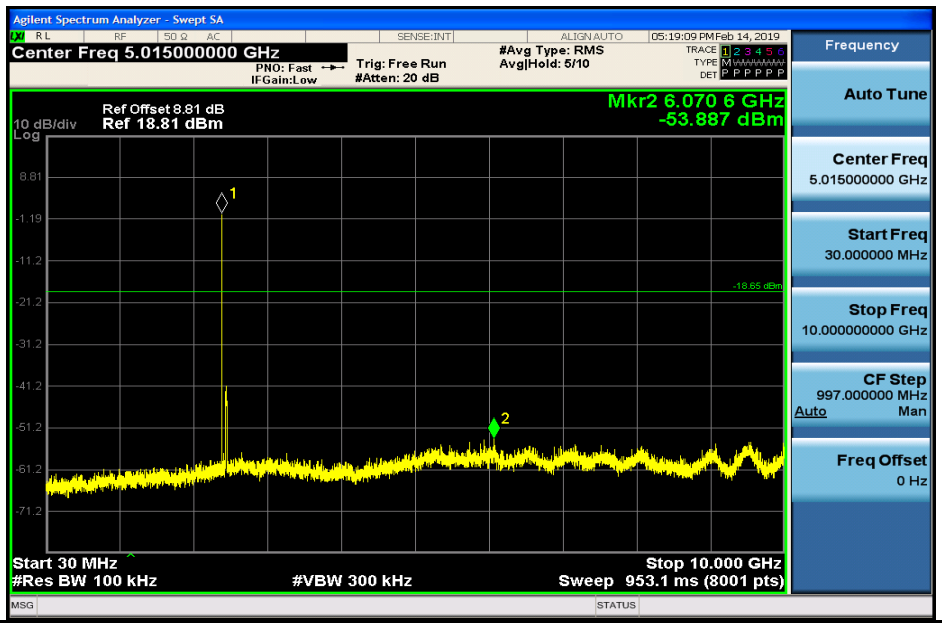
Band-edge for RF Conducted Emissions_BLE_2480_Hopping Off(2M Rate)

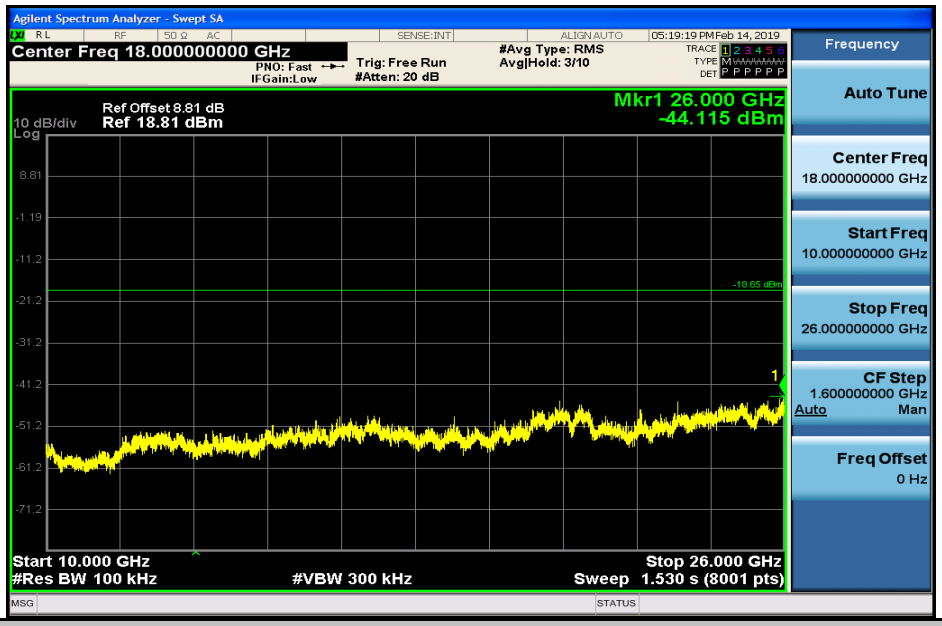


6.RF Conducted Spurious Emissions

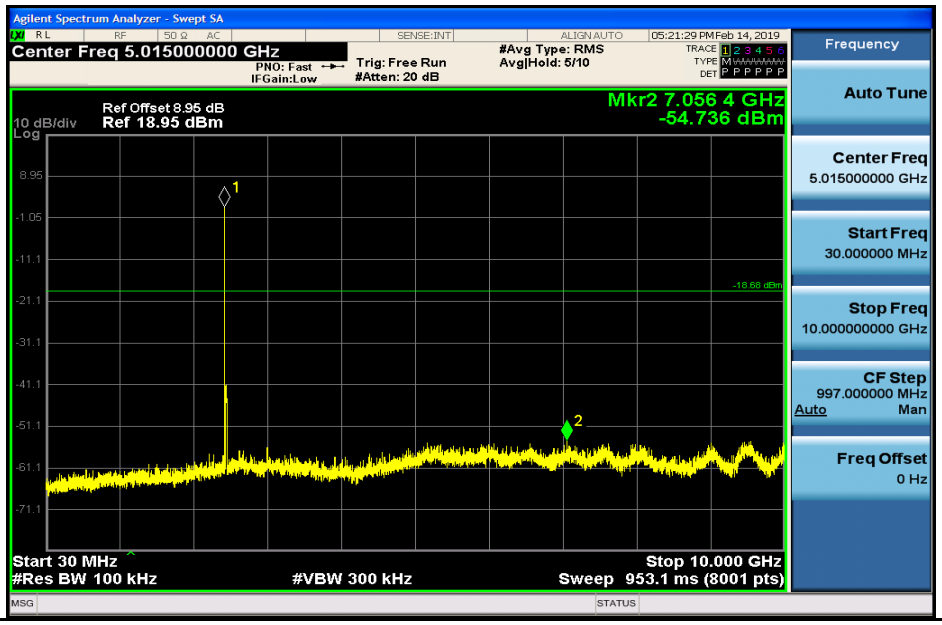
Test Mode	Test Channel	StartFre [MHz]	StopFre [MHz]	RBW [kHz]	VBW [kHz]	Pref[dBm]		Max. Level [dBm]		Limit [dBm]		Verdict
						1M Rate	2M Rate	1M Rate	2M Rate	1M Rate	2M Rate	
BLE	2402	30	10000	100	300	1.35	1.16	-53.89	-50.12	<-18.65	<-18.84	PASS
BLE	2402	10000	26000	100	300	1.351	1.163	-44.115	-44.183	<-18.649	<-18.837	PASS
BLE	2440	30	10000	100	300	1.32	0.95	-54.74	-53.25	<-18.68	<-19.05	PASS
BLE	2440	10000	26000	100	300	1.323	0.95	-44.268	-43.704	<-18.677	<-19.05	PASS
BLE	2480	30	10000	100	300	0.01	-0.27	-53.84	-53.98	<-19.99	<-20.27	PASS
BLE	2480	10000	26000	100	300	0.014	-0.27	-44.221	-44.483	<-19.986	<-20.27	PASS

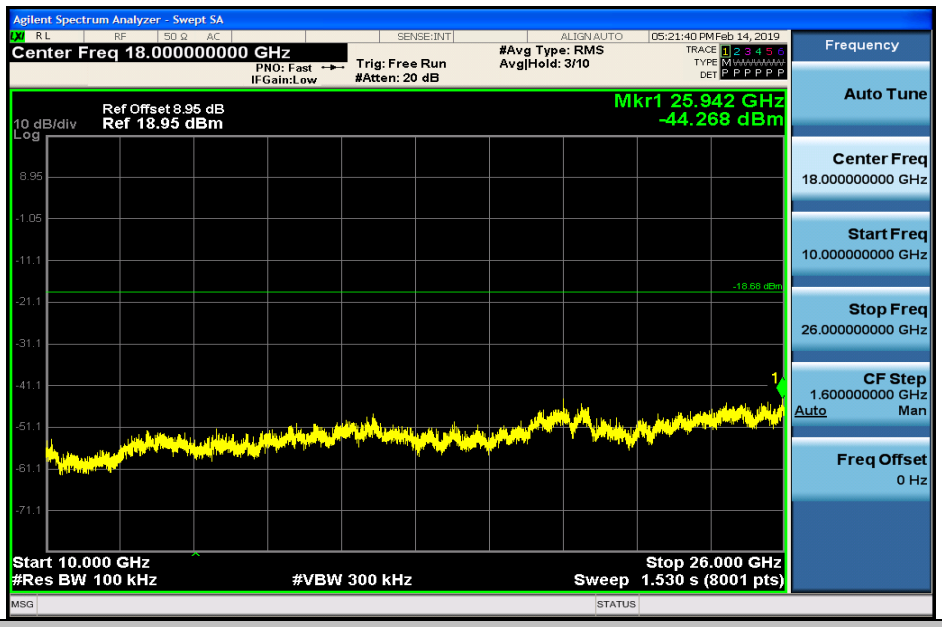
RF Conducted Spurious Emissions_BLE_2402(1M Rate)





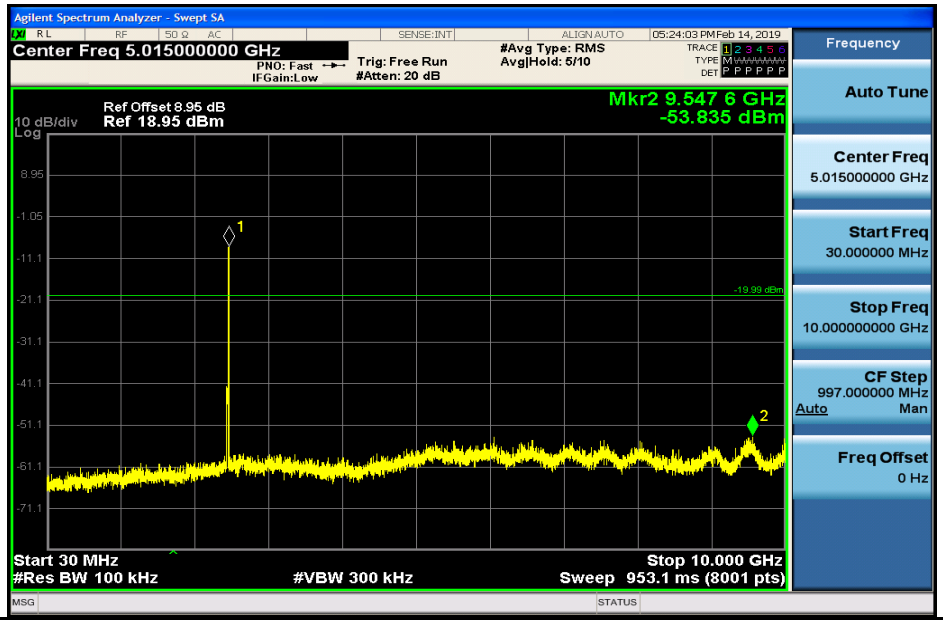
RF Conducted Spurious Emissions_BLE_2440(1M Rate)

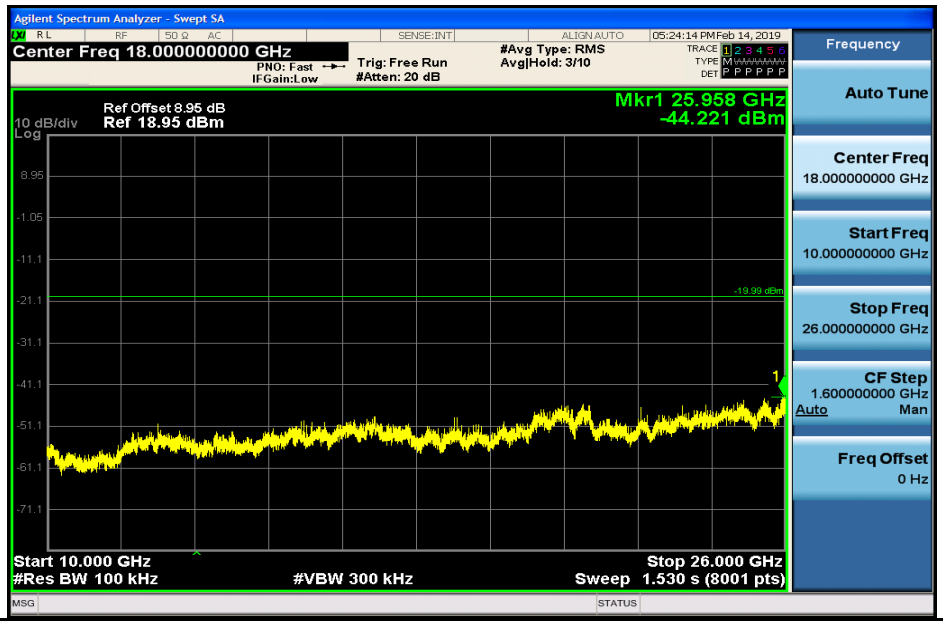




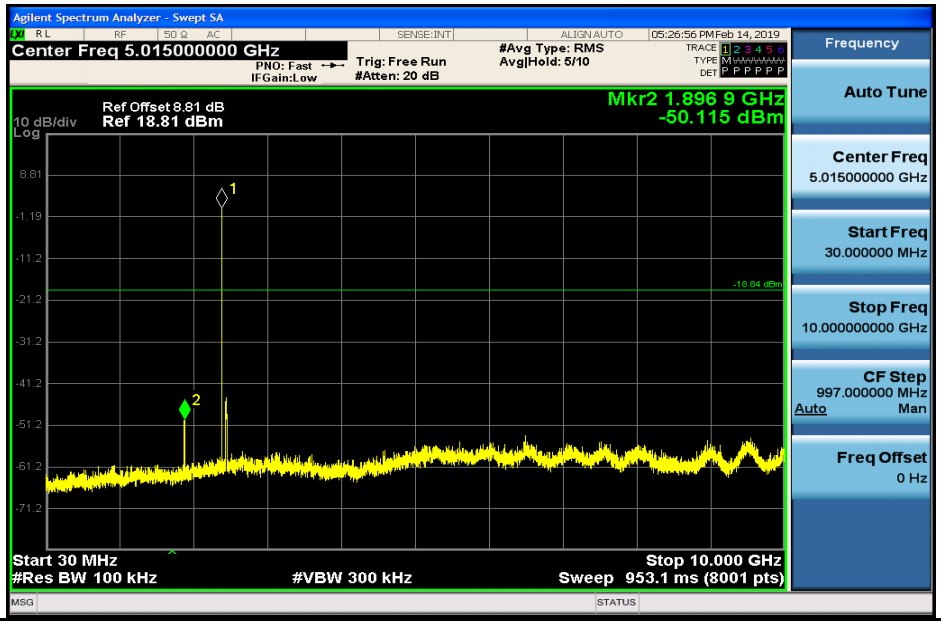
RF Conducted Spurious Emissions_BLE_2480(1M Rate)

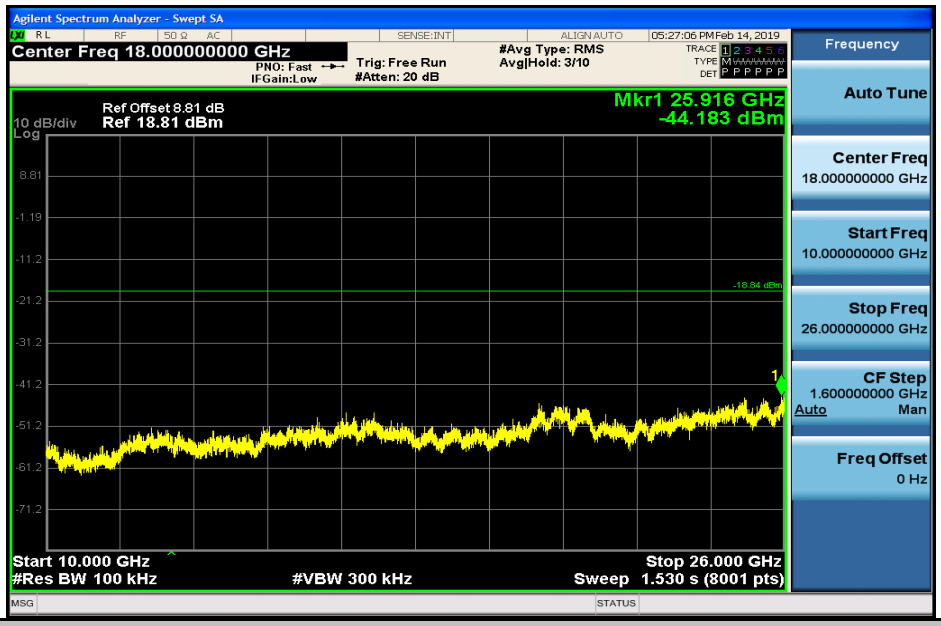

Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 10/10
05:23:49 PM Feb 14, 2019
Ref Offset 8.95 dB
10 dB/div
Ref 18.95 dBm
Log
Mkr1 2.479 925 5 GHz
0.014 dBm
-19.99 dBm
Center 2.480000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 4.000 MHz
Sweep 1.067 ms (8001 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.478000000 GHz
Stop Freq
2.482000000 GHz
CF Step
400.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
Center Freq 5.015000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 5/10
05:24:03 PM Feb 14, 2019
Ref Offset 8.95 dB
10 dB/div
Ref 18.95 dBm
Log
Mkr2 9.547 6 GHz
-53.835 dBm
-19.99 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 10.000 GHz
Sweep 953.1 ms (8001 pts)
Frequency
Auto Tune
Center Freq
5.015000000 GHz
Start Freq
30.000000 MHz
Stop Freq
10.000000000 GHz
CF Step
997.000000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

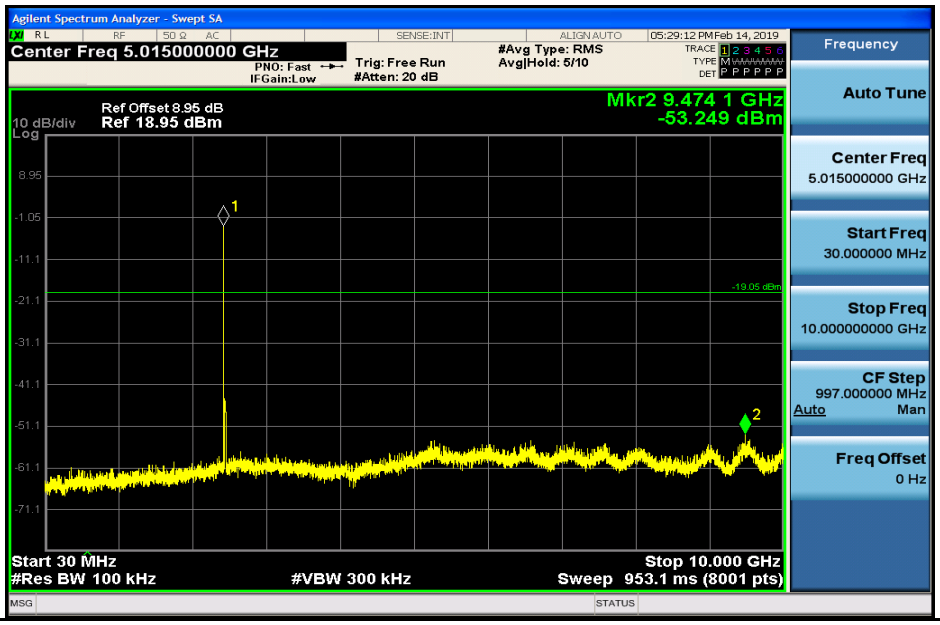

Agilent Spectrum Analyzer - Swept SA
Center Freq 18.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 3/10
05:24:14 PM Feb 14, 2019
Ref Offset 8.95 dB
10 dB/div
Ref 18.95 dBm
Log
Mkr1 25.958 GHz
-44.221 dBm
8.95
-1.05
-11.1
-21.1
-31.1
-41.1
-51.1
-61.1
-71.1
-19.99 dBm
Start 10.000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.000 GHz
Sweep 1.530 s (8001 pts)
Frequency
Auto Tune
Center Freq
18.000000000 GHz
Start Freq
10.000000000 GHz
Stop Freq
26.000000000 GHz
CF Step
1.600000000 GHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

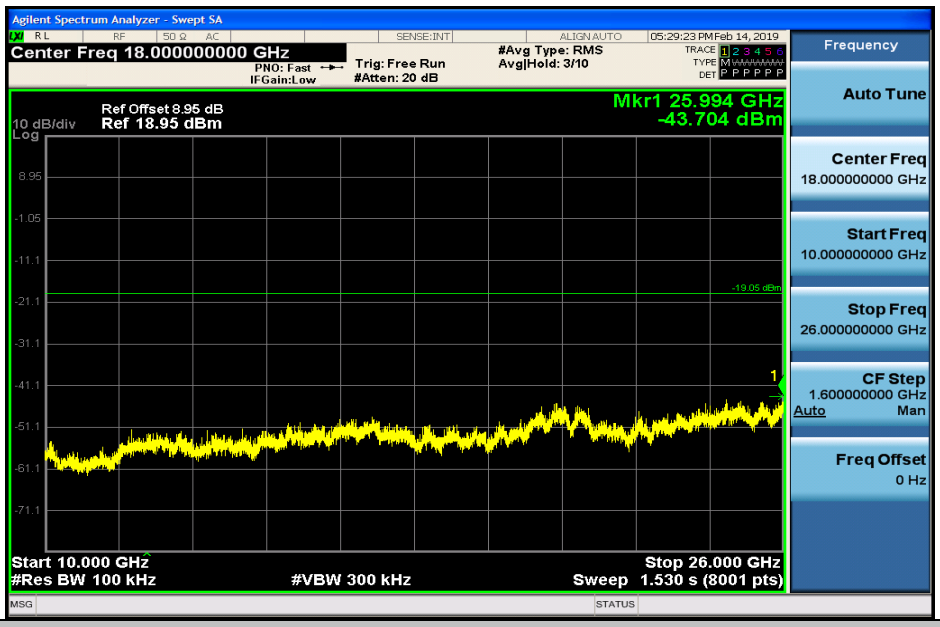
RF Conducted Spurious Emissions_BLE_2402(2M Rate)





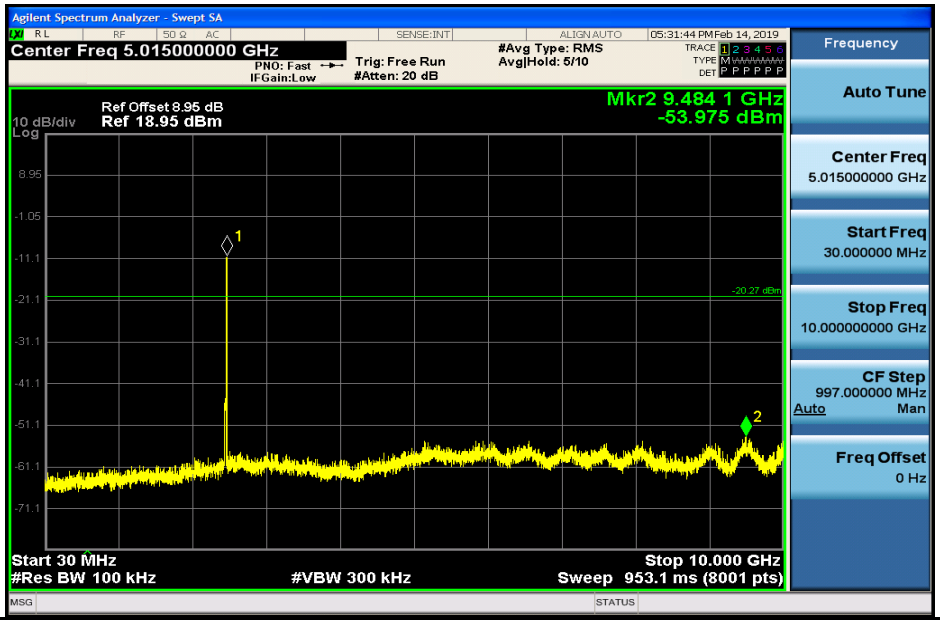
RF Conducted Spurious Emissions_BLE_2440(2M Rate)

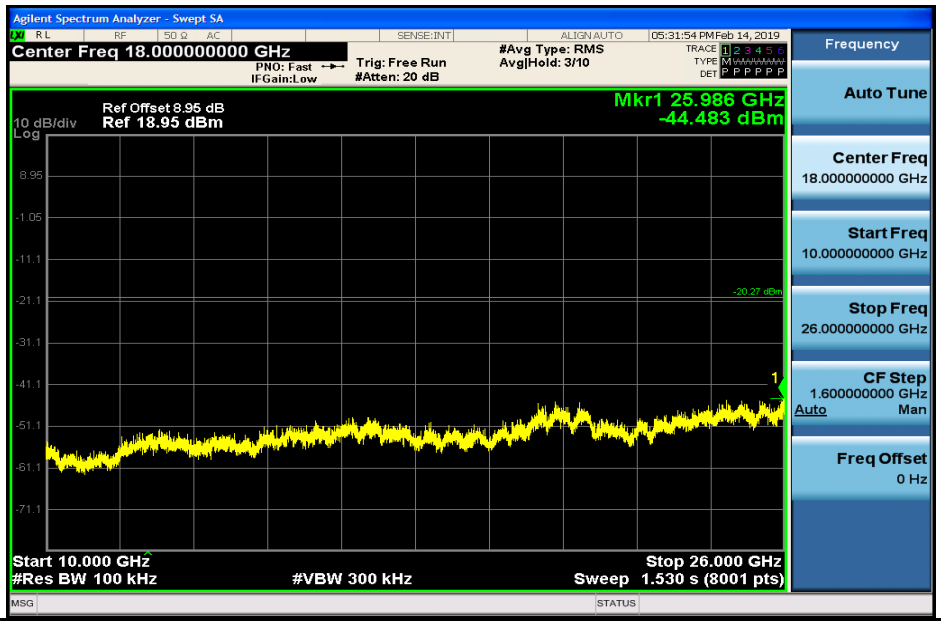




RF Conducted Spurious Emissions_BLE_2480(2M Rate)


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 10/10
05:31:29 PM Feb 14, 2019
Ref Offset 8.95 dB
10 dB/div
Ref 18.95 dBm
Log
Mkr1 2.479 916 0 GHz
-0.270 dBm
-20.27 dBm
Center 2.480000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 4.000 MHz
Sweep 1.067 ms (8001 pts)
Frequency
Auto Tune
Center Freq
2.480000000 GHz
Start Freq
2.478000000 GHz
Stop Freq
2.482000000 GHz
CF Step
400.000 kHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
Center Freq 5.015000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
#Avg Type: RMS
Avg|Hold: 5/10
05:31:44 PM Feb 14, 2019
Ref Offset 8.95 dB
10 dB/div
Ref 18.95 dBm
Log
Mkr2 9.484 1 GHz
-53.975 dBm
-20.27 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 10.000 GHz
Sweep 953.1 ms (8001 pts)
Frequency
Auto Tune
Center Freq
5.015000000 GHz
Start Freq
30.000000 MHz
Stop Freq
10.000000000 GHz
CF Step
997.000000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS



- End of the Report -