TEST REPORT

Product Name	:	Keilton LED controller
Product Description	:	Keilton LED controller
Brand Mark	:	Keilton
Model No.	:	EFS116-AUX
Extension Model	:	EFS106-IR, IFS108-IR, RM103-IR, EFS116-Z10, EFS116-AUX, EFS116-3PIN, BG01,CR01-ETC, CR01-RTC, CR02-ETC, CR02-RTC, WP1013, PPA109S, PPA102S(G2), SHLD050L, SHLD030L, SHLD060L,
FCC ID	:	2A26YLTKTVT2022
Report Number	:	BLA-EMC-202206-A4502
Date of Sample Receipt	:	2022/6/13
Date of Test	:	2022/6/13 to 2022/7/25
Date of Issue	:	2022/7/25
Test Standard	:	47 CFR Part 15, Subpart C 15.247
Test Result	:	Pass

Prepared for:

Shenzhen LiteTrace Technologies Co., Ltd
F5, Bld 1, Hongtu Industry Park, Hezhou, Hangcheng, Baoan District,Shenzhen China

Prepared by:

BlueAsia of Technical Services(Shenzhen) Co.,Ltd.
Building C, No. 107, Shihuan Road, Shiyan Sub-District, Baoan District, Shenzhen, Guangdong Province, China
TEL: +86-755-23059481

Compiled by: Charlie

Review by: Sweels

Approved by: Blue Zhong

Date: 2022/7/25

REPORT REVISE RECORD

Version No.	Date	Description
00	2022/7/25	Original

BlueAsia

TABLE OF CONTENTS

1 TEST SUMMARY **5**

2 GENERAL INFORMATION **6**

3 GENERAL DESCRIPTION OF E.U.T. **6**

4 TEST ENVIRONMENT **7**

5 TEST MODE **7**

6 MEASUREMENT UNCERTAINTY **7**

7 DESCRIPTION OF SUPPORT UNIT **8**

8 LABORATORY LOCATION **8**

9 TEST INSTRUMENTS LIST **9**

10CONDUCTED BAND EDGES MEASUREMENT **12**

10.1 LIMITS 12
10.2BLOCK DIAGRAM OF TEST SETUP 12
10.3 TEST DATA 13

11RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS **14**

11.1 LIMITS 14
11.2BLOCK DIAGRAM OF TEST SETUP 15
11.3 PROCEDURE 15
11.4 TEST DATA 17

12CONDUCTED SPURIOUS EMISSIONS **21**

12.1 LIMITS 21
12.2BLOCK DIAGRAM OF TEST SETUP 21
12.3 TEST DATA 22

13POWER SPECTRUM DENSITY **23**

13.1 LIMITS 23
13.2BLOCK DIAGRAM OF TEST SETUP 23
13.3 TEST DATA 23

14CONDUCTED PEAK OUTPUT POWER **24**

14.1 LIMITS 24
14.2BLOCK DIAGRAM OF TEST SETUP 24
14.3 TEST DATA 25

BlueAsia

15MINIMUM 6DB BANDWIDTH 26

15.1 LIMITS 26

15.2BLOCK DIAGRAM OF TEST SETUP 26

15.3 TEST DATA 26

16ANTENNA REQUIREMENT 27

16.1 CONCLUSION 27

17RADIATED SPURIOUS EMISSIONS 28

17.1 LIMITS 28

17.2BLOCK DIAGRAM OF TEST SETUP 29

17.3 PROCEDURE 29

17.4 TEST DATA 31

18 APPENDIX 39

APPENDIX A: PHOTOGRAPHS OF TEST SETUP 67

APPENDIX B: PHOTOGRAPHS OF EUT 68

BlueAsia

1 TEST SUMMARY

Test item	Test Requirement	Test Method	Class/Severity	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
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.8 & Section 11.13.3.2	47 CFR Part 15, Subpart C 15.247(d)	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 15.209 & 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 15.209 & 15.247(d)	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.6 & Section 11.11	47 CFR Part 15, Subpart C 15.247(d)	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 Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 7.8.5	47 CFR Part 15, Subpart C 15.247(b)(3)	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
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	Pass

BlueAsia

2 GENERAL INFORMATION

Applicant	Shenzhen LiteTrace Technologies Co., Ltd
Address	F5, Bld 1, Hongtu Industry Park, Hezhou, Hangcheng, Baoan District,Shenzhen China
Manufacturer	Shenzhen LiteTrace Technologies Co., Ltd
Address	305 Suite C, 3151 Shahe West Street Jianxing Technology Plaza | Nanshan, Shenzhen, China
Factory	Shenzhen LiteTrace Technologies Co., Ltd
Address	305 Suite C, 3151 Shahe West Street Jianxing Technology Plaza | Nanshan, Shenzhen, China
Product Name	Keilton LED controller
Test Model No.	EFS116-AUX
Extension Model	EFS106-IR, IFS108-IR, RM103-IR, EFS116-Z10, EFS116-AUX, EFS116-3PIN, BG01,CR01-ETC, CR01-RTC, CR02-ETC, CR02-RTC, WP1013, PPA109S, PPA102S(G2), SHLD050L, SHLD030L, SHLD060L,
Remark	All above models are identical in the same PCB layout, interior structure and electrical circuits. The differences are model name for commercial purpose.

3 GENERAL DESCRIPTION OF E.U.T.

Hardware Version	1.0
Software Version	1.0
Operation Frequency:	2402MHz-2480MHz
Data Rata	1Mbps; 2Mbps
Modulation Type:	GFSK
Channel Spacing:	2MHz
Number of Channels:	40
Antenna Type:	PCB Antenna
Antenna Gain:	2dBi (Provided by the customer)

BlueAsia

4 TEST ENVIRONMENT

Environment	Temperature	Voltage
Normal	25°C	DC12V

5 TEST MODE

TEST MODE	TEST MODE DESCRIPTION
TX	Keep the EUT in transmitting mode with modulation
Remark:Only the data of the worst mode would be recorded in this report.For radiated emission test, 1Mbps mode and 2Mbps mode all have been tested, 1Mbps was found as worse case, only worse case is reported.	

6 MEASUREMENT UNCERTAINTY

Parameter	Expanded Uncertainty (Confidence of 95%)
Radiated Emission(9kHz-30MHz)	±4.34dB
Radiated Emission(30Mz-1000MHz)	±4.24dB
Radiated Emission(1GHz-18GHz)	±4.68dB
AC Power Line Conducted Emission(150kHz-30MHz)	±3.45dB

BlueAsia

7 DESCRIPTION OF SUPPORT UNIT

Device Type	Manufacturer	Model Name	Serial No.	Remark
PC	HASEE	K610D	N/A	N/A

8 LABORATORY LOCATION

All tests were performed at:
BlueAsia of Technical Services(Shenzhen) Co., Ltd.
Building C, No. 107, Shihuan Road, Shiyan Sub-District, Baoan District, Shenzhen, Guangdong Province, China.
Telephone: TEL: +86-755-28682673 FAX: +86-755-28682673
No tests were sub-contracted.

BlueAsia

9 TEST INSTRUMENTS LIST

Test Equipment Of Conducted Emissions at AC Power Line (150kHz-30MHz)					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Shield room	SKET	833	N/A	25/11/2020	24/11/2023
Receiver	R&S	ESPI3	101082	24/9/2021	23/9/2022
LISN	R&S	ENV216	3560.6550.15	24/9/2021	23/9/2022
LISN	AT	AT166-2	AKK1806000003	26/9/2021	25/9/2022
EMI software	EZ	EZ-EMC	N/A	N/A	N/A

Test Equipment Of Conducted Band Edges Measurement					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Spectrum	R&S	FSP40	100817	24/9/2021	23/9/2022
Spectrum	Agilent	N9020A	MY49100060	24/9/2021	23/9/2022
Signal Generator	Agilent	N5182A	MY49060650	24/9/2021	23/9/2022
Signal Generator	Agilent	E8257D	MY44320250	24/9/2021	23/9/2022

Test Equipment Of Radiated Spurious Emissions					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Chamber	SKET	966	N/A	10/11/2020	9/11/2023
Spectrum	R&S	FSP40	100817	24/9/2021	23/9/2022
Receiver	R&S	ESR7	101199	24/9/2021	23/9/2022
broadband Antenna	Schwarzbeck	VULB9168	00836 P:00227	26/9/2020	25/9/2022
Horn Antenna	Schwarzbeck	9120D	01892 P:00331	26/9/2020	25/9/2022

BlueAsia

Amplifier	SKET	LNPA-0118-45	N/A	24/9/2021	23/9/2022
EMI software	EZ	EZ-EMC	N/A	N/A	N/A
Loop antenna	SCHNARZBECK	FMZB1519B	00102	26/9/2020	25/9/2022

Test Equipment Of Radiated Emissions which fall in the restricted bands					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Chamber	SKET	966	N/A	10/11/2020	9/11/2023
Spectrum	R&S	FSP40	100817	24/9/2021	23/9/2022
Receiver	R&S	ESR7	101199	24/9/2021	23/9/2022
broadband Antenna	Schwarzbeck	VULB9168	00836 P:00227	26/9/2020	25/9/2022
Horn Antenna	Schwarzbeck	9120D	01892 P:00331	26/9/2020	25/9/2022
Amplifier	SKET	LNPA-0118-45	N/A	24/9/2021	23/9/2022
EMI software	EZ	EZ-EMC	N/A	N/A	N/A
Loop antenna	SCHNARZBECK	FMZB1519B	00102	26/9/2020	25/9/2022

Test Equipment Of Conducted Spurious Emissions					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Spectrum	R&S	FSP40	100817	24/9/2021	23/9/2022
Spectrum	Agilent	N9020A	MY49100060	24/9/2021	23/9/2022
Signal Generator	Agilent	N5182A	MY49060650	24/9/2021	23/9/2022
Signal Generator	Agilent	E8257D	MY44320250	24/9/2021	23/9/2022

Test Equipment Of Power Spectrum Density					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**

BlueAsia

Spectrum	R&S	FSP40	100817	24/9/2021	23/9/2022
Spectrum	Agilent	N9020A	MY49100060	24/9/2021	23/9/2022
Signal Generator	Agilent	N5182A	MY49060650	24/9/2021	23/9/2022
Signal Generator	Agilent	E8257D	MY44320250	24/9/2021	23/9/2022

Test Equipment Of Conducted Peak Output Power					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Spectrum	R&S	FSP40	100817	24/9/2021	23/9/2022
Spectrum	Agilent	N9020A	MY49100060	24/9/2021	23/9/2022
Signal Generator	Agilent	N5182A	MY49060650	24/9/2021	23/9/2022
Signal Generator	Agilent	E8257D	MY44320250	24/9/2021	23/9/2022

Test Equipment Of Minimum 6dB Bandwidth					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**
Spectrum	R&S	FSP40	100817	24/9/2021	23/9/2022
Spectrum	Agilent	N9020A	MY49100060	24/9/2021	23/9/2022
Signal Generator	Agilent	N5182A	MY49060650	24/9/2021	23/9/2022
Signal Generator	Agilent	E8257D	MY44320250	24/9/2021	23/9/2022

Test Equipment Of Antenna Requirement					
Equipment	**Manufacturer**	**Model**	**S/N**	**Cal.Date**	**Cal.Due**

BlueAsia

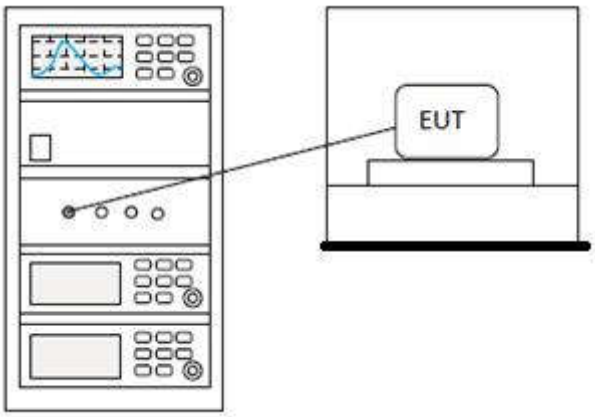
10 CONDUCTED BAND EDGES MEASUREMENT

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.8 & Section 11.13.3.2
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Charlie
Temperature	25℃
Humidity	55%

10.1 LIMITS

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)).

10.2 BLOCK DIAGRAM OF TEST SETUP



10.3 TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

BlueAsia

11 RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.10.5
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Charlie
Temperature	25℃
Humidity	55%

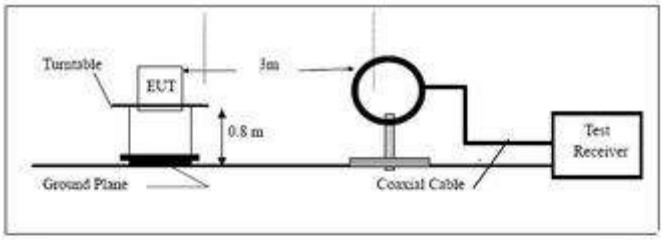
11.1 LIMITS

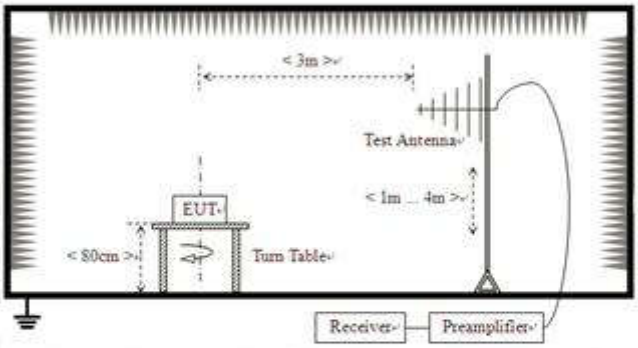
Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

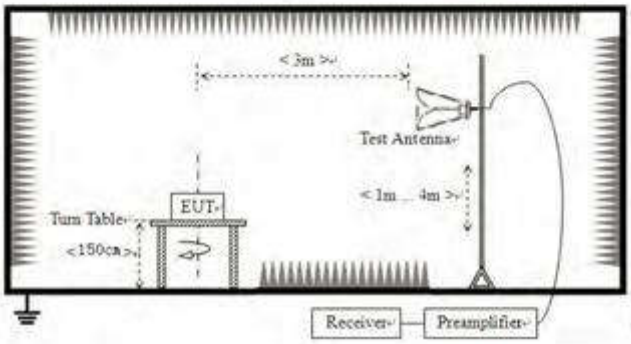
Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field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

BlueAsia

11.2 BLOCK DIAGRAM OF TEST SETUP







11.3 PROCEDURE

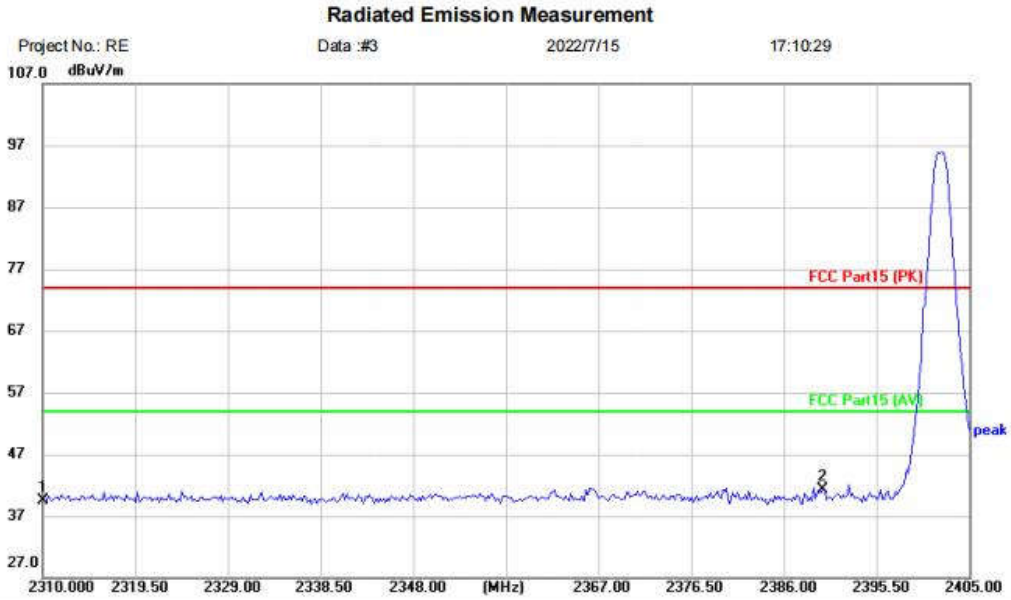
a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters 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.

BlueAsia

11.4 TEST DATA

[TestMode: TX low channel]; [Polarity: Horizontal]



Site
Limit: FCC Part15 (PK)
EUT: Kelton LED controller
M/N: EFS116-AUX
Mode: BLE 1M TX-L
Note:

Polarization: ***Horizontal***
Power:

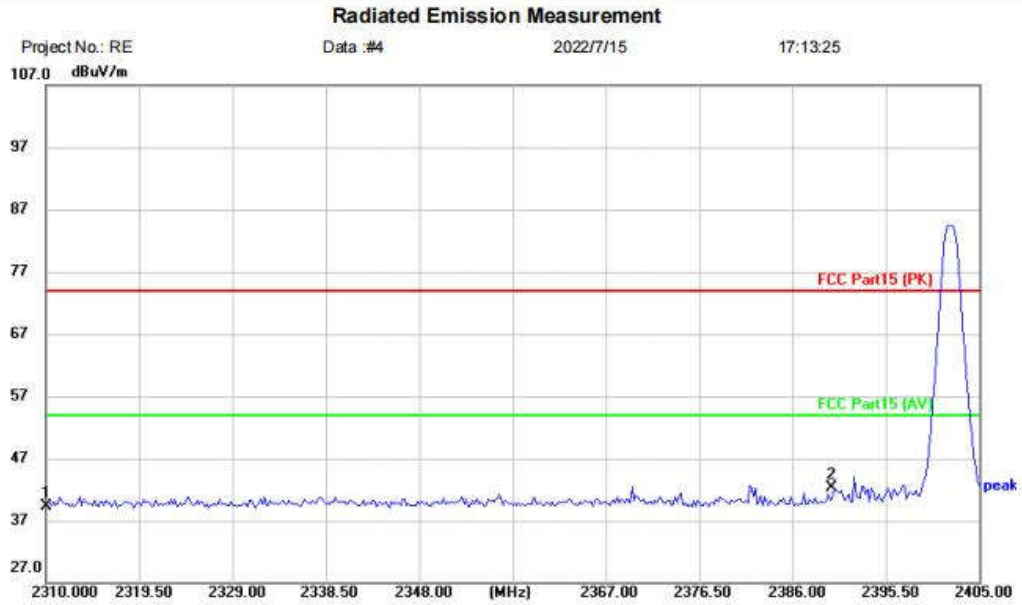
Temperature: (C)
Humidity: %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		2310.000	43.48	-3.93	39.55	74.00	-34.45	peak	
2	*	2390.000	44.94	-3.58	41.36	74.00	-32.64	peak	

*:Maximum data x:Over limit !:over margin (Reference Only

Test Result: Pass

[TestMode: TX low channel]; [Polarity: Vertical]



Site
Limit: FCC Part15 (PK)
EUT: Kelton LED controller
M/N: EFS116-AUX
Mode: BLE 1M TX-L
Note:

Polarization: *Vertical*
Power:

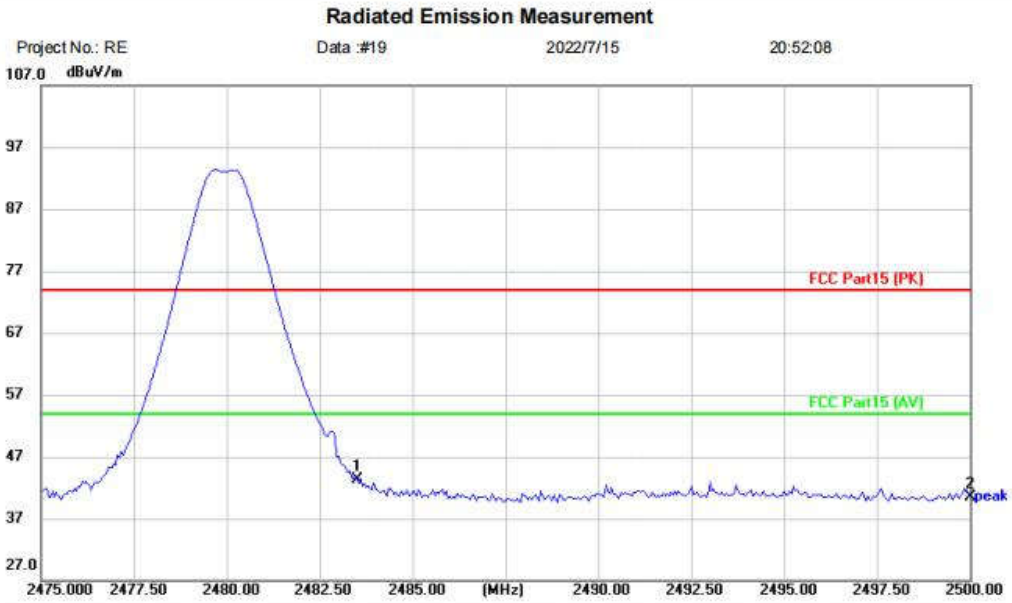
Temperature: (C)
Humidity: %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		2310.000	43.30	-3.93	39.37	74.00	-34.63	peak	
2	*	2390.000	45.80	-3.58	42.22	74.00	-31.78	peak	

*:Maximum data x:Over limit !:over margin (Reference Only

Test Result: Pass

[TestMode: TX High channel]; [Polarity: Horizontal]



Site
Limit: FCC Part15 (PK)
EUT: Kelton LED controller
M/N: EFS116-AUX
Mode: BLE 1M TX-H
Note:

Polarization: ***Horizontal***
Power:

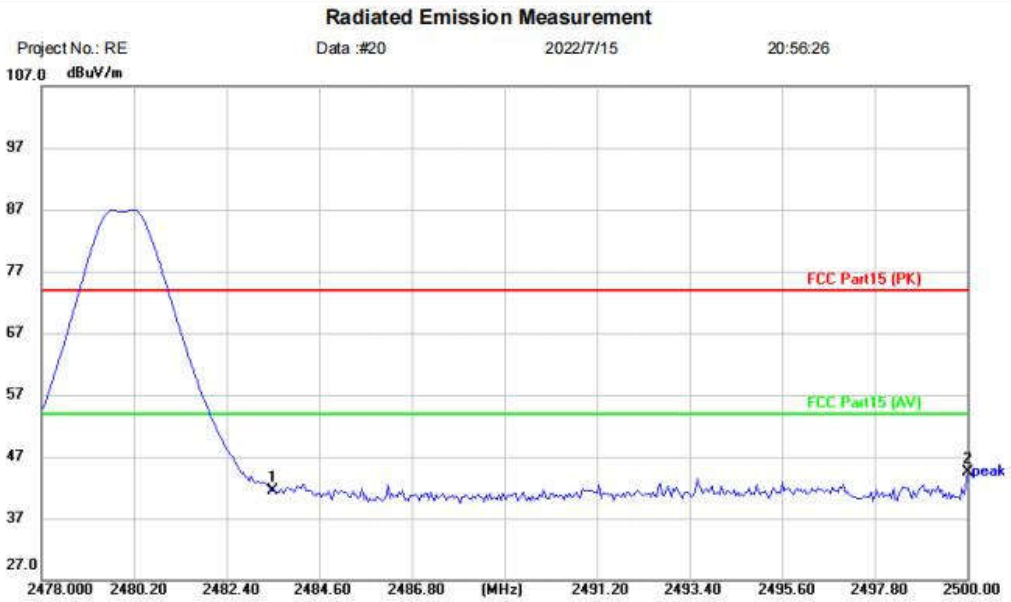
Temperature: (C)
Humidity: %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	2483.500	46.35	-3.14	43.21	74.00	-30.79	peak	
2		2500.000	43.58	-3.08	40.50	74.00	-33.50	peak	

*:Maximum data x:Over limit !:over margin (Reference Only

Test Result: Pass

[TestMode: TX High channel]; [Polarity: Vertical]



Site
Limit: FCC Part15 (PK)
EUT: Kelton LED controller
M/N: EFS116-AUX
Mode: BLE 1M TX-H
Note:

Polarization: *Vertical*
Power:

Temperature: (C)
Humidity: %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		2483.500	44.59	-3.14	41.45	74.00	-32.55	peak	
2	*	2500.000	47.60	-3.08	44.52	74.00	-29.48	peak	

*:Maximum data x:Over limit !:over margin (Reference Only

Test Result: Pass

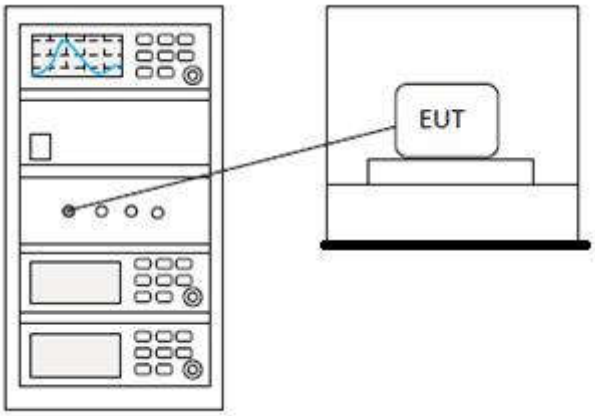
12 CONDUCTED SPURIOUS EMISSIONS

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.6 & Section 11.11
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Charlie
Temperature	25℃
Humidity	55%

12.1 LIMITS

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)).

12.2 BLOCK DIAGRAM OF TEST SETUP



12.3 TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

BlueAsia

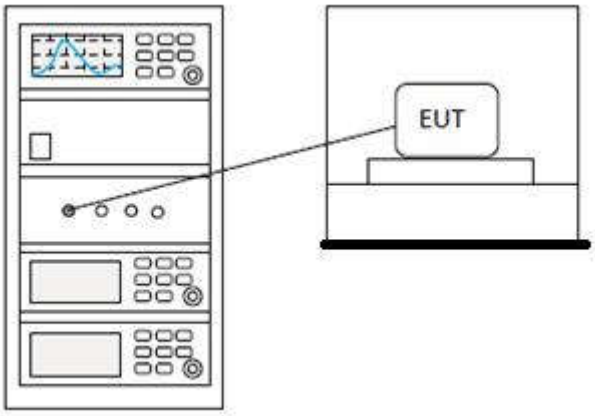
13 POWER SPECTRUM DENSITY

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 11.10.2
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Charlie
Temperature	25℃
Humidity	55%

13.1 LIMITS

Limit:	≤8dBm in any 3 kHz band during any time interval of continuous transmission

13.2 BLOCK DIAGRAM OF TEST SETUP



13.3 TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

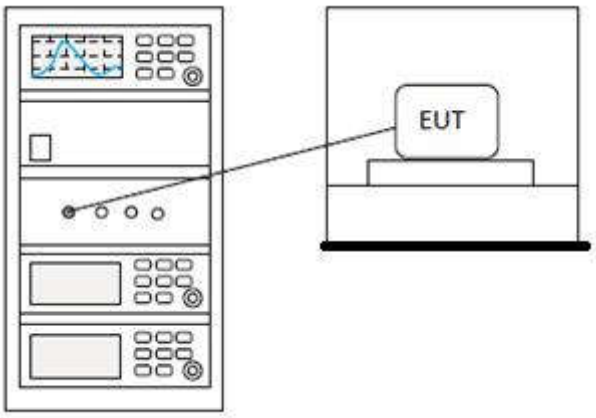
14 CONDUCTED PEAK OUTPUT POWER

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 7.8.5
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Charlie
Temperature	25℃
Humidity	55%

14.1 LIMITS

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

14.2 BLOCK DIAGRAM OF TEST SETUP



14.3 TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

BlueAsia

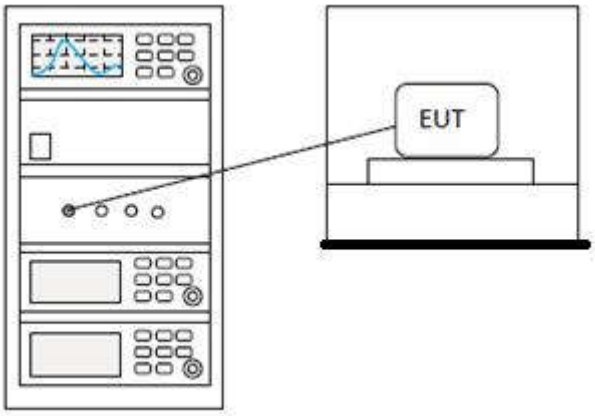
15 MINIMUM 6DB BANDWIDTH

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 11.8.1
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Charlie
Temperature	25℃
Humidity	55%

15.1 LIMITS

Limit:	≥500 kHz

15.2 BLOCK DIAGRAM OF TEST SETUP



15.3 TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

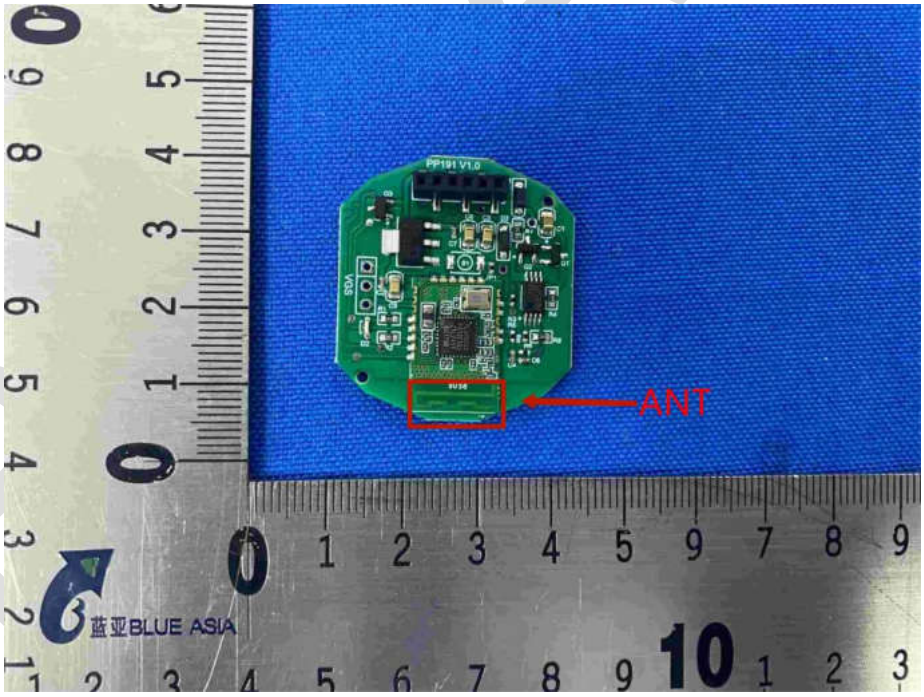
16 ANTENNA REQUIREMENT

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	N/A

16.1 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 antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit permanently attached antenna or of an so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

EUT Antenna:
The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 2dBi.



17 RADIATED SPURIOUS EMISSIONS

Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.4,6.5,6.6
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Charlie
Temperature	25℃
Humidity	55%

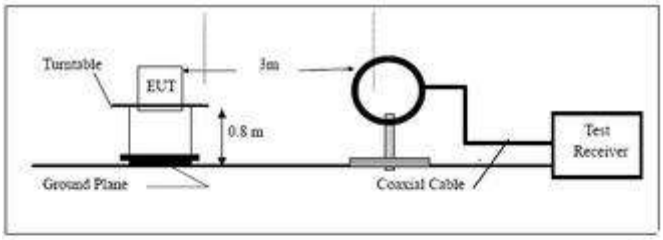
17.1 LIMITS

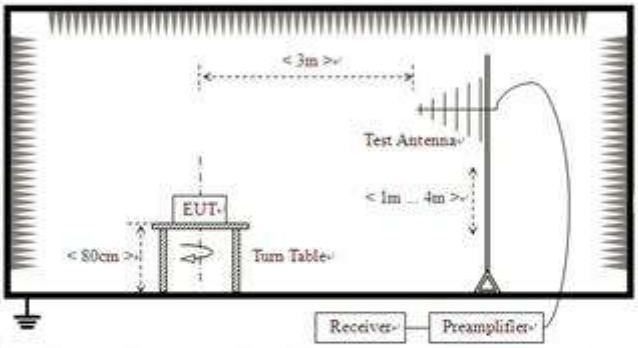
Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

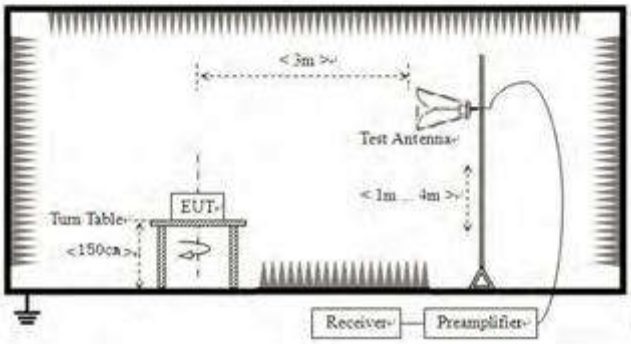
Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field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

BlueAsia

17.2 BLOCK DIAGRAM OF TEST SETUP







17.3 PROCEDURE

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.

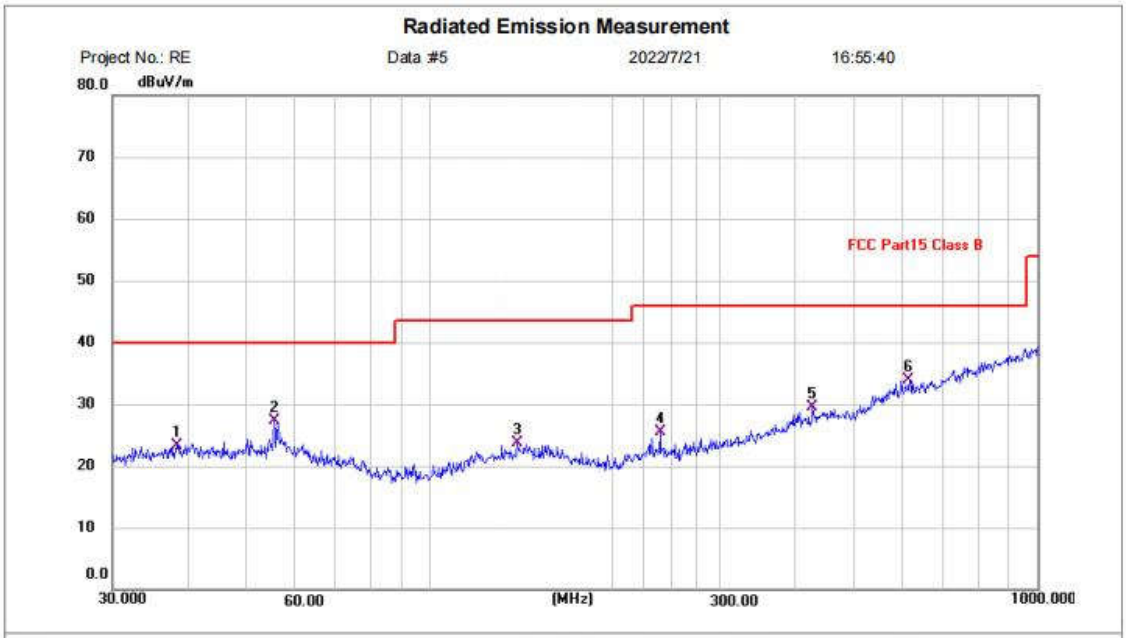
Remark:
1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level =Receiver Reading + Antenna Factor + Cable Factor - Preamplifier Factor
3) Scan from 9kHz to 25GHz, the disturbance above 12.75GHz 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.fundamental frequency is blocked by filter, and only spurious emission is shown.
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.

BlueAsia

17.4 TEST DATA

Below 1GHz

[TestMode: TX]; [Polarity: Horizontal]



Site
Limit: FCC Part15 Class B
EUT: Keilton LED controller
M/N: EFS116-AUX
Mode: BLE-TX
Note:

Polarization: *Horizontal*
Power:

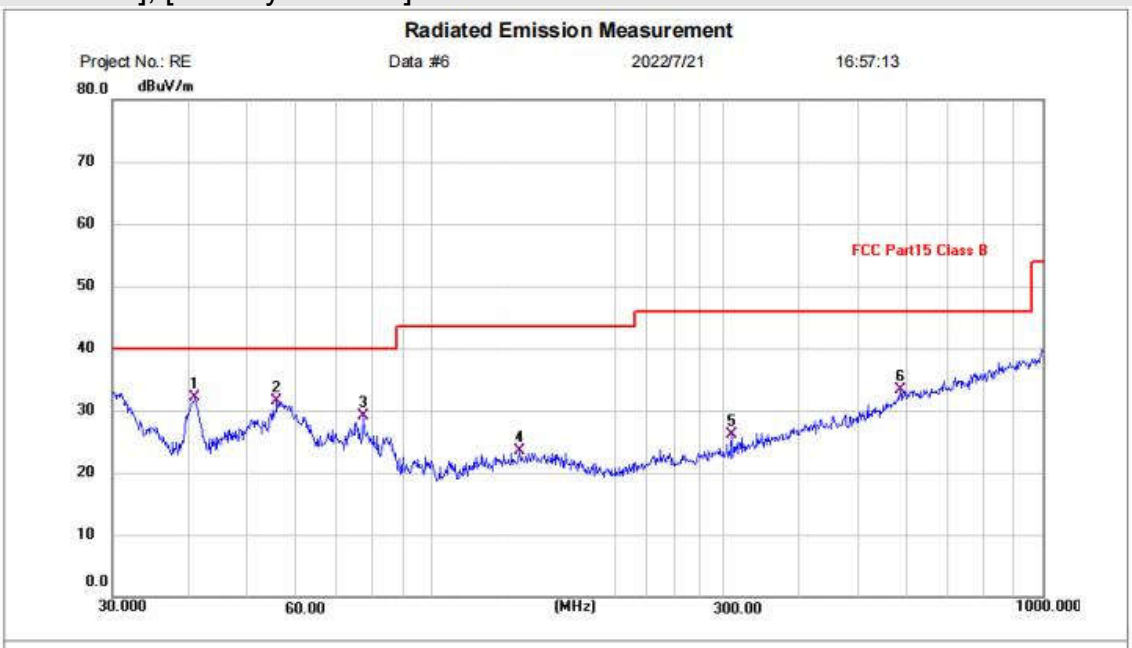
Temperature: (C)
Humidity: %RH

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	38.3462	-0.45	23.77	23.32	40.00	-16.68	QP	P	
2	55.4147	3.62	23.59	27.21	40.00	-12.79	QP	P	
3	139.3611	-0.22	23.90	23.68	43.50	-19.82	QP	P	
4	239.1472	2.11	23.41	25.52	46.00	-20.48	QP	P	
5	426.5210	1.17	28.37	29.54	46.00	-16.46	QP	P	
6 *	616.3716	1.41	32.52	33.93	46.00	-12.07	QP	P	

*:Maximum data x:Over limit !:over margin

Test Result:

[TestMode: TX]; [Polarity: Vertical]



Site
Limit: FCC Part15 Class B
EUT: Keilton LED controller
M/N: EFS116-AUX
Mode: BLE-TX
Note:

Polarization: *Vertical*
Power:

Temperature: (C)
Humidity: %RH

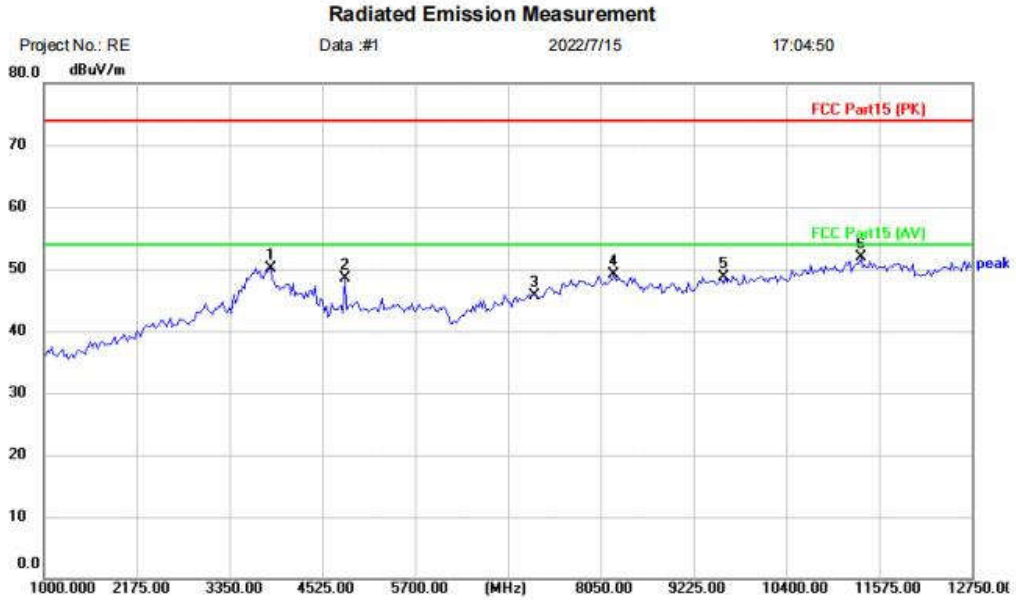
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1 *	40.9881	8.17	23.93	32.10	40.00	-7.90	QP	P	
2	55.8047	7.90	23.59	31.49	40.00	-8.51	QP	P	
3	77.3212	8.84	20.33	29.17	40.00	-10.83	QP	P	
4	139.3613	-0.42	23.90	23.48	43.50	-20.02	QP	P	
5	309.9977	1.12	24.89	26.01	46.00	-19.99	QP	P	
6	584.7895	1.33	31.95	33.28	46.00	-12.72	QP	P	

*:Maximum data x:Over limit !:over margin

Test Result:

Above 1GHz

[TestMode: TX low channel]; [Polarity: Horizontal]



Site
Limit: FCC Part15 (PK)
EUT: Kelton LED controller
M/N: EFS116-AUX
Mode: BLE 1M TX-L
Note:

Polarization: *Horizontal*
Power:

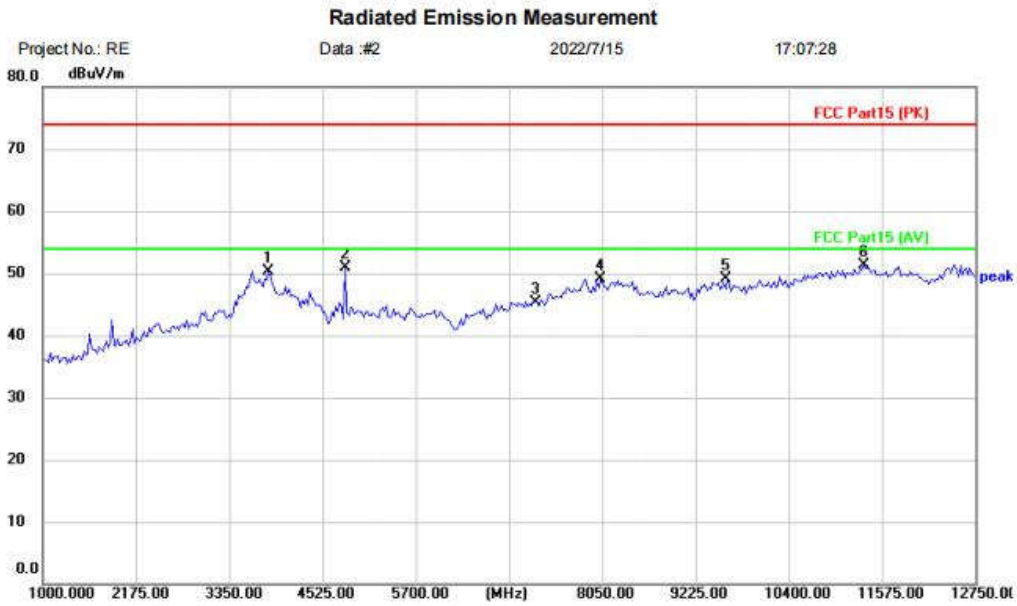
Temperature: (C)
Humidity: %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		3867.000	43.35	6.82	50.17	74.00	-23.83	peak	
2		4807.000	44.73	3.71	48.44	74.00	-25.56	peak	
3		7206.000	39.67	5.96	45.63	74.00	-28.37	peak	
4		8214.500	40.99	8.21	49.20	74.00	-24.80	peak	
5		9608.000	39.34	9.29	48.63	74.00	-25.37	peak	
6	*	11340.000	40.12	11.85	51.97	74.00	-22.03	peak	

*:Maximum data x:Over limit !:over margin (Reference Only

Test Result:

[TestMode: TX low channel]; [Polarity: Vertical]



Site
Limit: FCC Part15 (PK)
EUT: Kelton LED controller
M/N: EFS116-AUX
Mode: BLE 1M TX-L
Note:

Polarization: *Vertical*
Power:

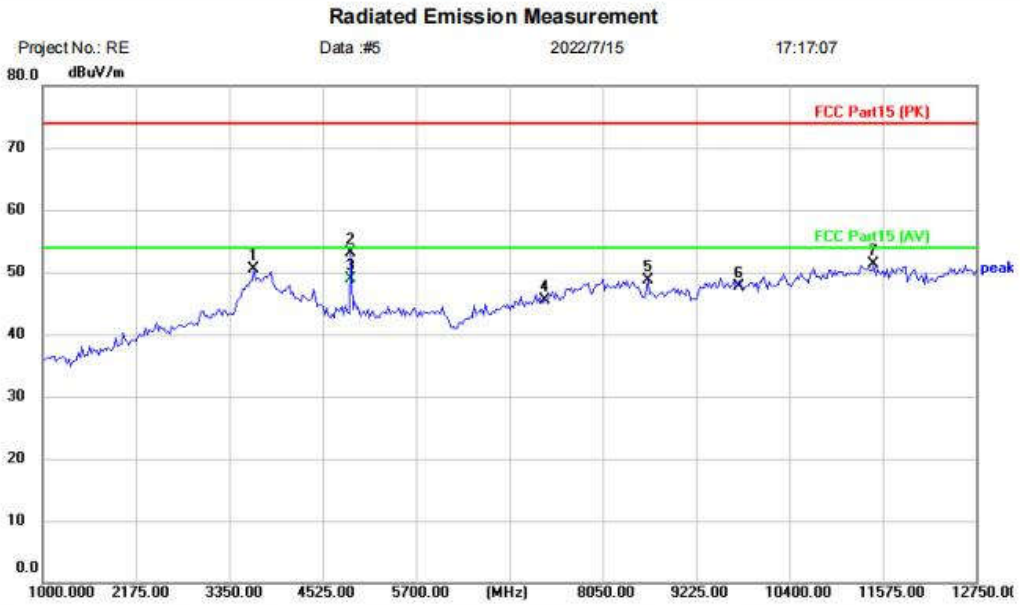
Temperature: (C)
Humidity: %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		3843.500	43.25	7.12	50.37	74.00	-23.63	peak	
2		4807.000	47.12	3.71	50.83	74.00	-23.17	peak	
3		7206.000	39.36	5.96	45.32	74.00	-28.68	peak	
4		8026.500	41.21	7.98	49.19	74.00	-24.81	peak	
5		9608.000	39.73	9.29	49.02	74.00	-24.98	peak	
6	*	11340.000	39.52	11.85	51.37	74.00	-22.63	peak	

*:Maximum data x:Over limit !:over margin (Reference Only

Test Result:

[TestMode: TX middle channel]; [Polarity: Horizontal]



Site
Limit: FCC Part15 (PK)
EUT: Kelton LED controller
M/N: EFS116-AUX
Mode: BLE 1M TX-M
Note:

Polarization: ***Horizontal***
Power:

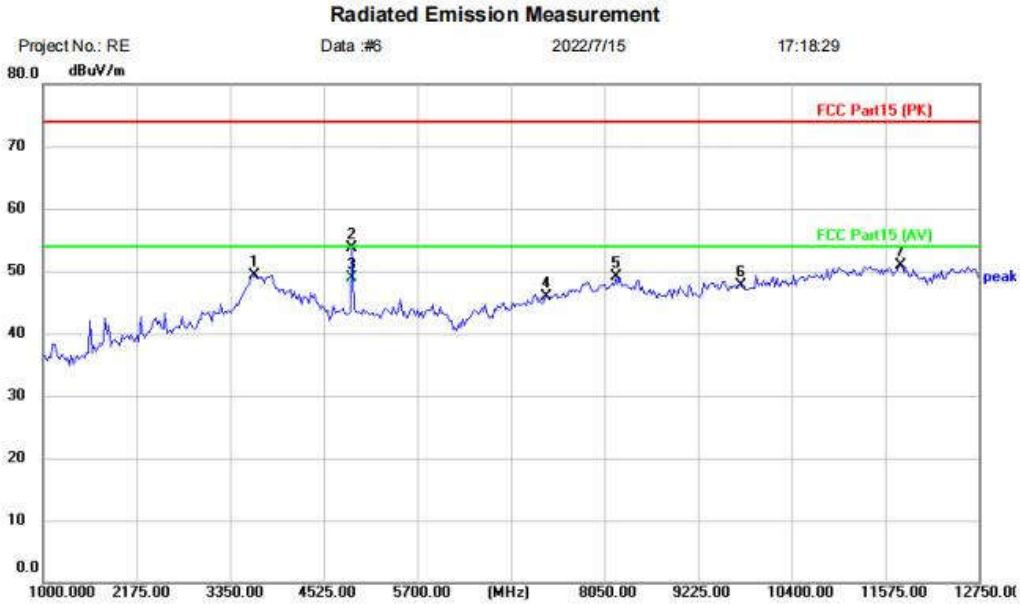
Temperature: (C)
Humidity: %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		3655.500	42.66	7.76	50.42	74.00	-23.58	peak	
2		4877.500	49.70	3.37	53.07	74.00	-20.93	peak	
3	*	4877.500	45.63	3.37	49.00	54.00	-5.00	AVG	
4		7326.000	39.06	6.44	45.50	74.00	-28.50	peak	
5		8614.000	40.79	7.97	48.76	74.00	-25.24	peak	
6		9768.000	38.03	9.63	47.66	74.00	-26.34	peak	
7		11457.500	39.42	11.84	51.26	74.00	-22.74	peak	

*:Maximum data x:Over limit !:over margin (Reference Only

Test Result:

[TestMode: TX middle channel]; [Polarity: Vertical]



Site
Limit: FCC Part15 (PK)
EUT: Kelton LED controller
M/N: EFS116-AUX
Mode: BLE 1M TX-M
Note:

Polarization: *Vertical*
Power:

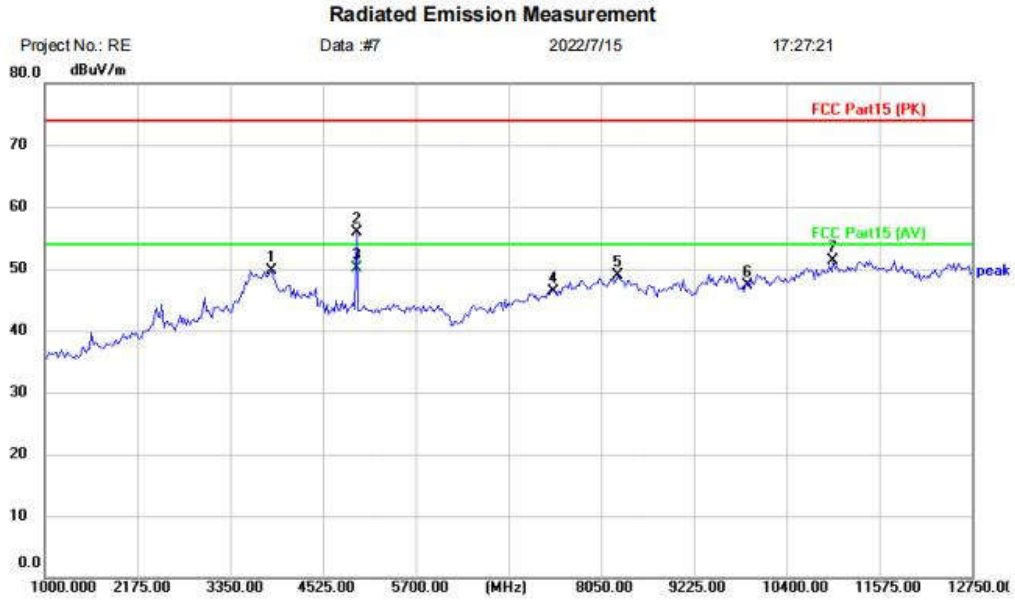
Temperature: (C)
Humidity: %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		3655.500	41.59	7.76	49.35	74.00	-24.65	peak	
2		4877.500	50.25	3.37	53.62	74.00	-20.38	peak	
3	*	4877.500	45.61	3.37	48.98	54.00	-5.02	AVG	
4		7326.000	39.50	6.44	45.94	74.00	-28.06	peak	
5		8191.000	40.90	8.20	49.10	74.00	-24.90	peak	
6		9768.000	38.09	9.63	47.72	74.00	-26.28	peak	
7		11763.000	39.34	11.63	50.97	74.00	-23.03	peak	

*:Maximum data x:Over limit !:over margin (Reference Only

Test Result:

[TestMode: TX High channel]; [Polarity: Horizontal]



Site
Limit: FCC Part15 (PK)
EUT: Kelton LED controller
M/N: EFS116-AUX
Mode: BLE 1M TX-H
Note:

Polarization: ***Horizontal***
Power:

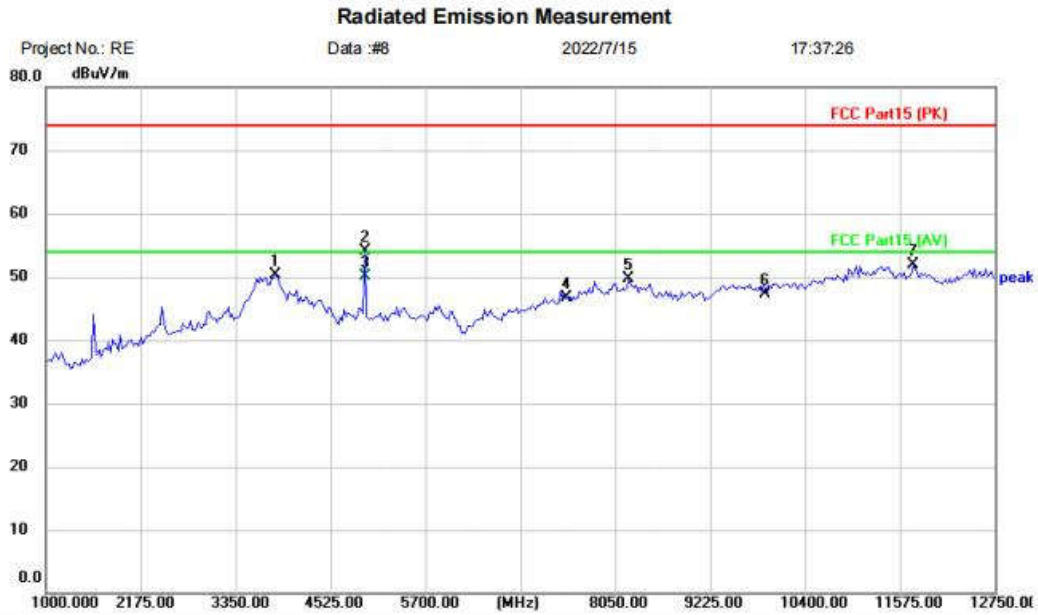
Temperature: (C)
Humidity: %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		3867.000	42.85	6.82	49.67	74.00	-24.33	peak	
2		4948.000	52.34	3.65	55.99	74.00	-18.01	peak	
3	*	4948.000	46.37	3.65	50.02	54.00	-3.98	AVG	
4		7440.000	39.48	6.86	46.34	74.00	-27.66	peak	
5		8261.500	40.70	8.23	48.93	74.00	-25.07	peak	
6		9920.000	37.17	10.16	47.33	74.00	-26.67	peak	
7		10987.500	39.39	11.98	51.37	74.00	-22.63	peak	

*:Maximum data x:Over limit !:over margin (Reference Only

Test Result:

[TestMode: TX High channel]; [Polarity: Vertical]



Site
Limit: FCC Part15 (PK)
EUT: Kelton LED controller
M/N: EFS116-AUX
Mode: BLE 1M TX-H
Note:

Polarization: *Vertical*
Power:

Temperature: (C)
Humidity: %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1		3843.500	43.20	7.12	50.32	74.00	-23.68	peak	
2		4948.000	50.39	3.65	54.04	74.00	-19.96	peak	
3	*	4948.000	46.46	3.65	50.11	54.00	-3.89	AVG	
4		7440.000	39.86	6.86	46.72	74.00	-27.28	peak	
5		8214.500	41.50	8.21	49.71	74.00	-24.29	peak	
6		9920.000	37.20	10.16	47.36	74.00	-26.64	peak	
7		11739.500	40.18	11.70	51.88	74.00	-22.12	peak	

*:Maximum data x:Over limit !:over margin (Reference Only

Test Result:

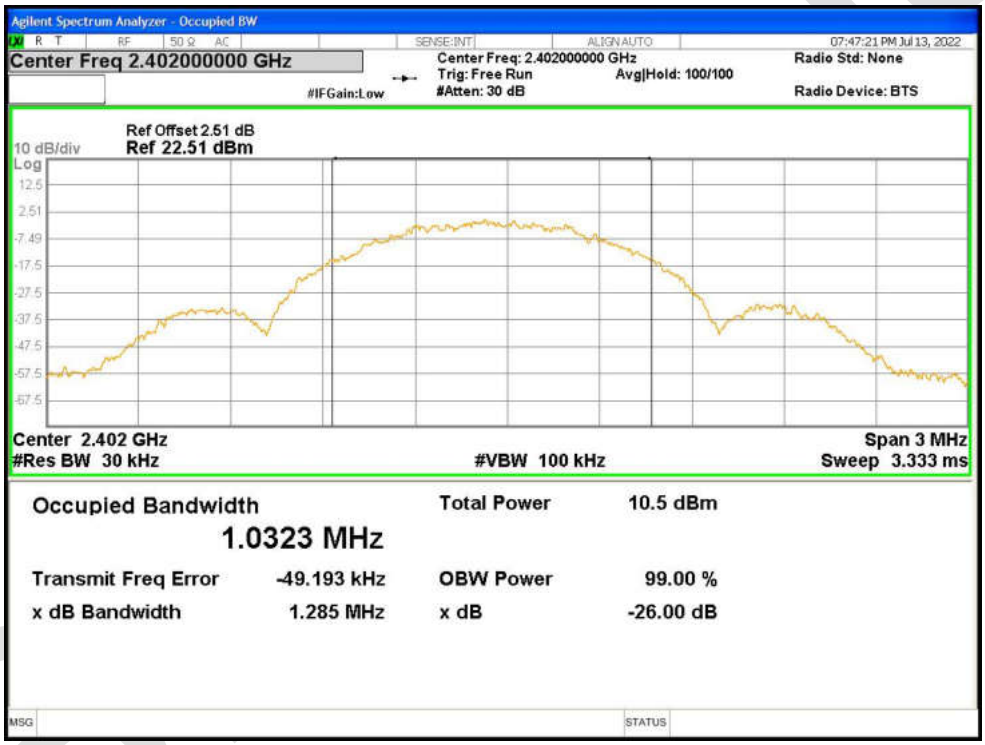
18 APPENDIX

Appendix1

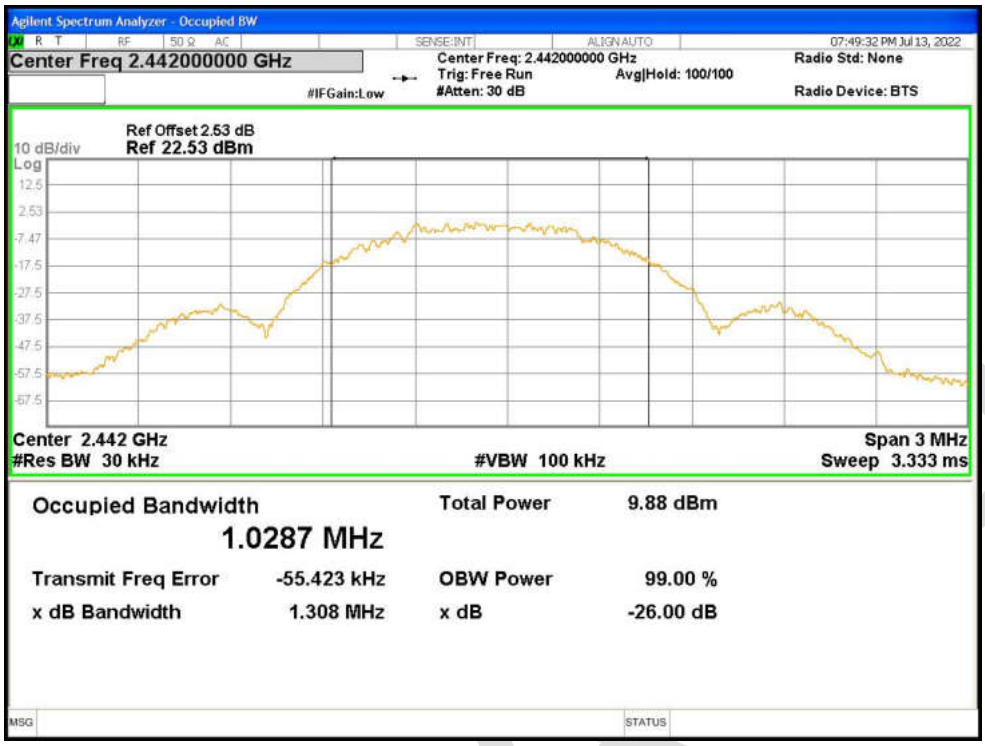
Occupied Channel Bandwidth

Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)
NVNT	BLE 1M	2402	Ant1	1.0323
NVNT	BLE 1M	2442	Ant1	1.0286
NVNT	BLE 1M	2480	Ant1	1.0307
NVNT	BLE 2M	2402	Ant1	2.0460
NVNT	BLE 2M	2442	Ant1	2.0603
NVNT	BLE 2M	2480	Ant1	2.0484

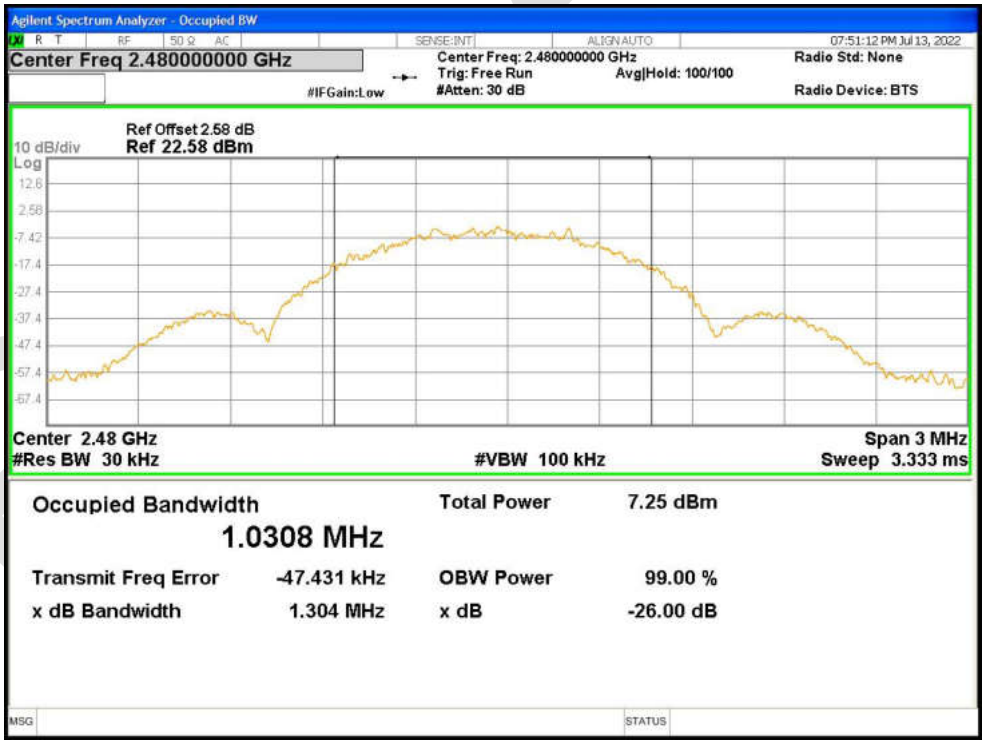
OBW NVNT BLE 1M 2402MHz Ant1



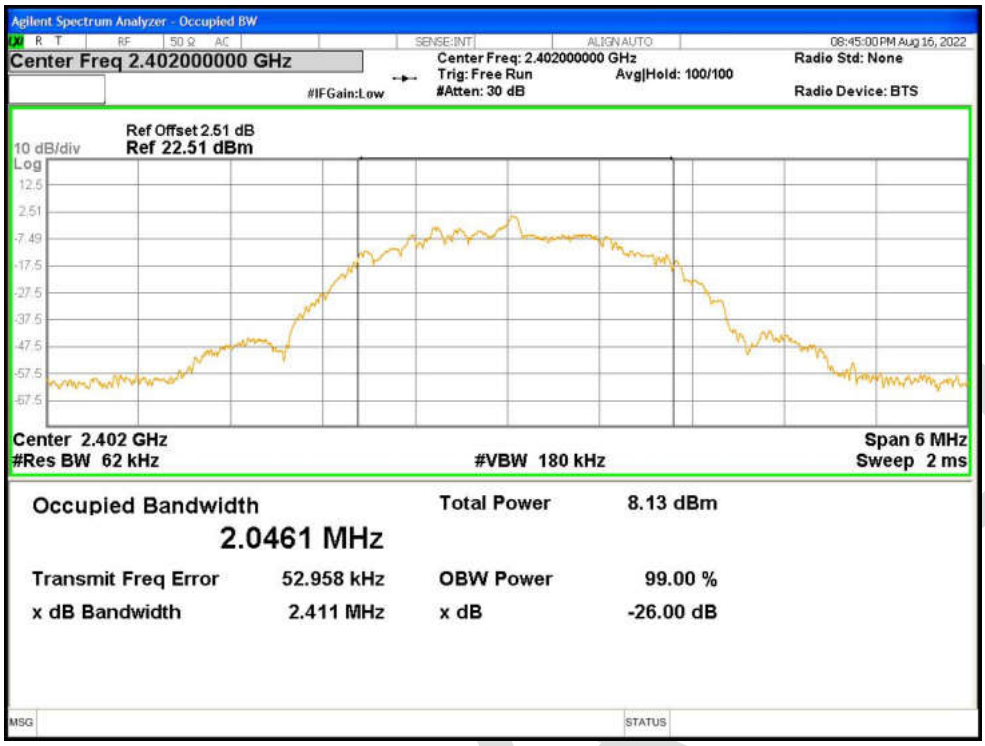
OBW NVNT BLE 1M 2442MHz Ant1



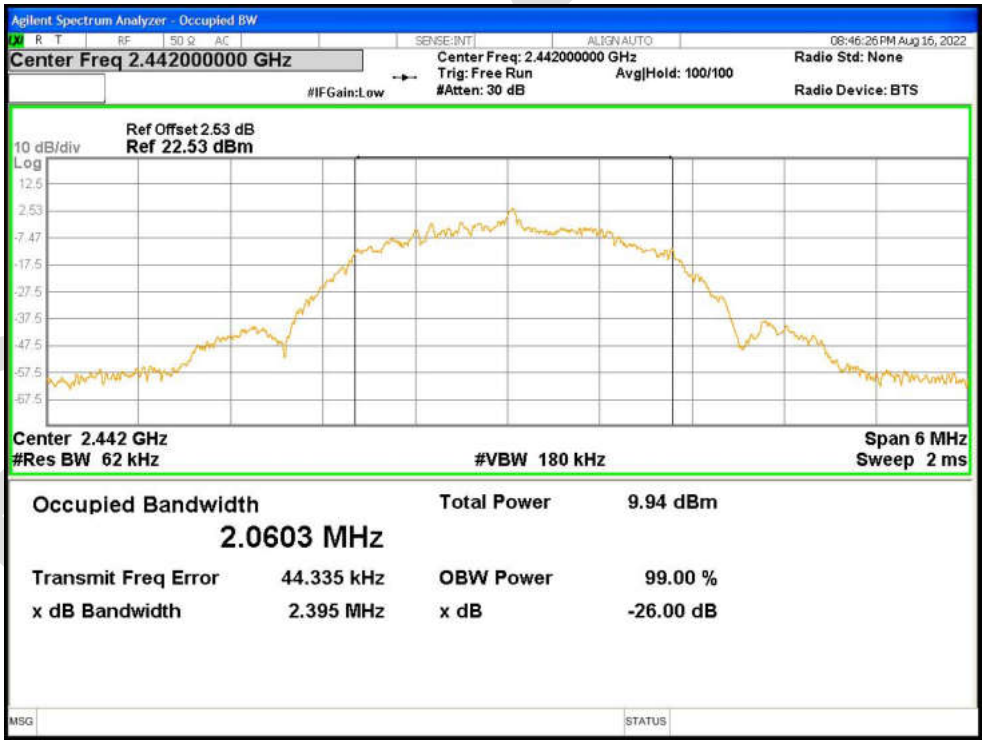
OBW NVNT BLE 1M 2480MHz Ant1



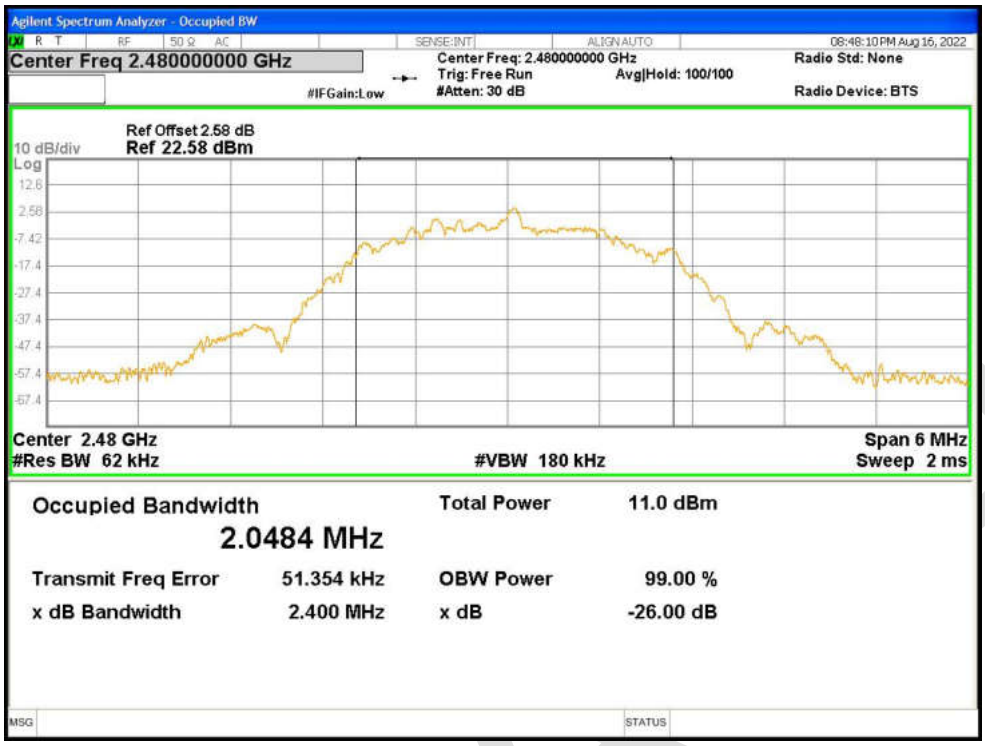
OBW NVNT BLE 2M 2402MHz Ant1



OBW NVNT BLE 2M 2442MHz Ant1



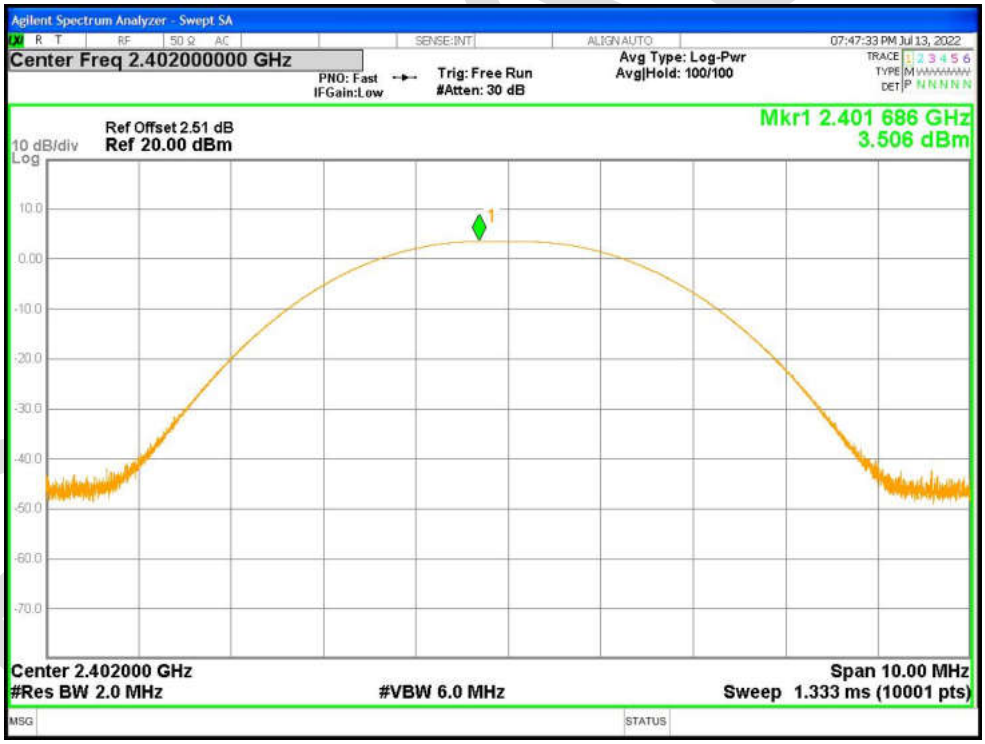
OBW NVNT BLE 2M 2480MHz Ant1


Agilent Spectrum Analyzer - Occupied BW
Center Freq 2.480000000 GHz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold: 100/100
#Atten: 30 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
08:48:10 PM Aug 16, 2022
Ref Offset 2.58 dB
10 dB/div
Ref 22.58 dBm
Log
12.6
2.58
-7.42
-17.4
-27.4
-37.4
-47.4
-57.4
-67.4
Center 2.48 GHz
#Res BW 62 kHz
#VBW 180 kHz
Span 6 MHz
Sweep 2 ms
Occupied Bandwidth
2.0484 MHz
Total Power 11.0 dBm
Transmit Freq Error 51.354 kHz
OBW Power 99.00 %
x dB Bandwidth 2.400 MHz
x dB -26.00 dB
MSG
STATUS

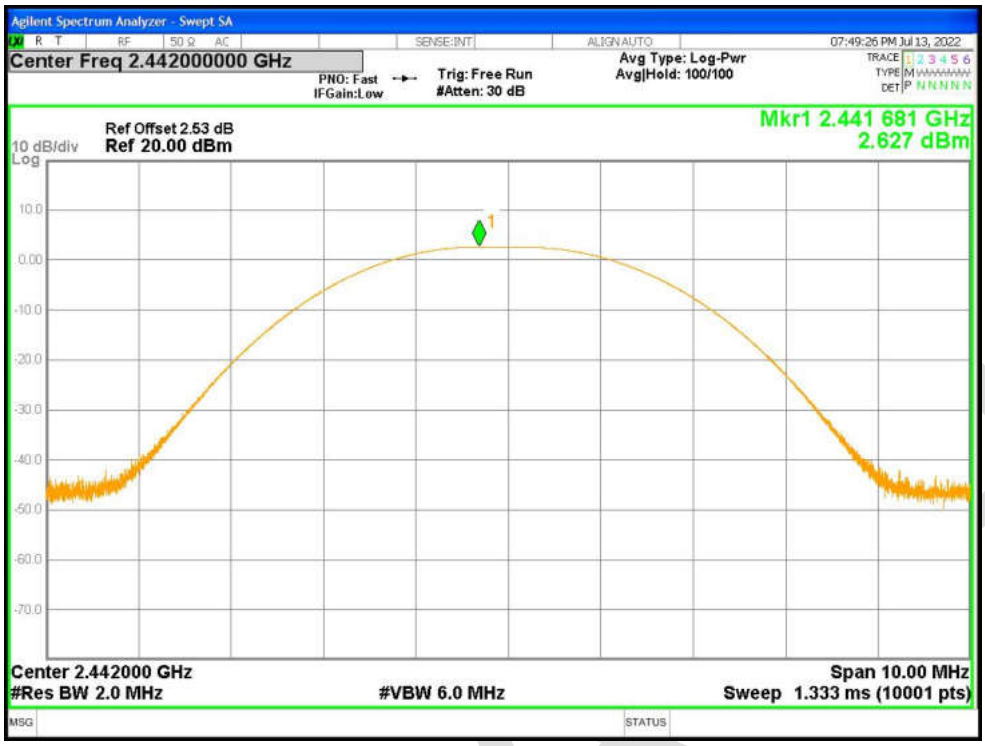
Maximum Conducted Output Power

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Limit (dBm)	Verdict
NVNT	BLE 1M	2402	Ant1	3.506	30	Pass
NVNT	BLE 1M	2442	Ant1	2.627	30	Pass
NVNT	BLE 1M	2480	Ant1	0.023	30	Pass
NVNT	BLE 2M	2402	Ant1	3.461	30	Pass
NVNT	BLE 2M	2442	Ant1	2.49	30	Pass
NVNT	BLE 2M	2480	Ant1	-0.112	30	Pass

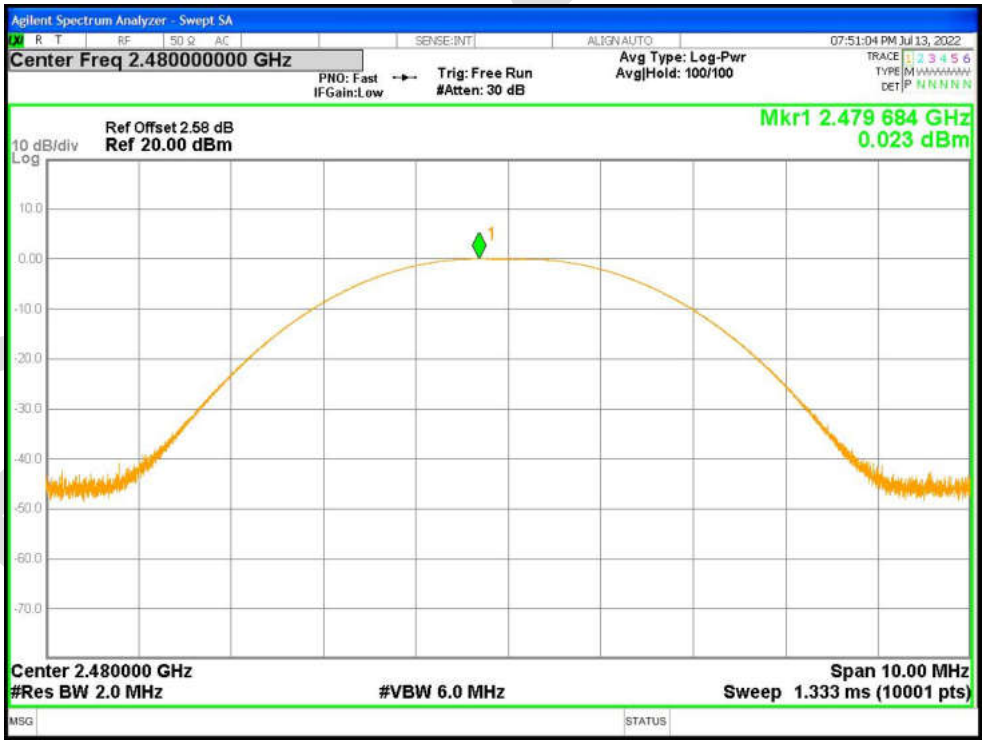
Power NVNT BLE 1M 2402MHz Ant1



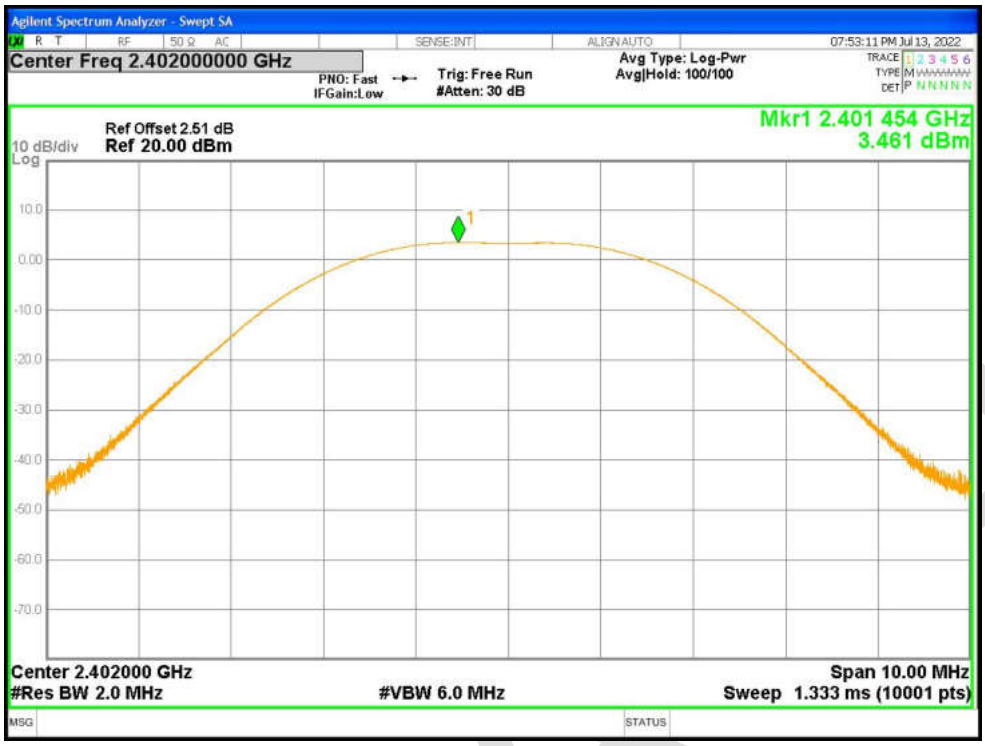
Power NVNT BLE 1M 2442MHz Ant1



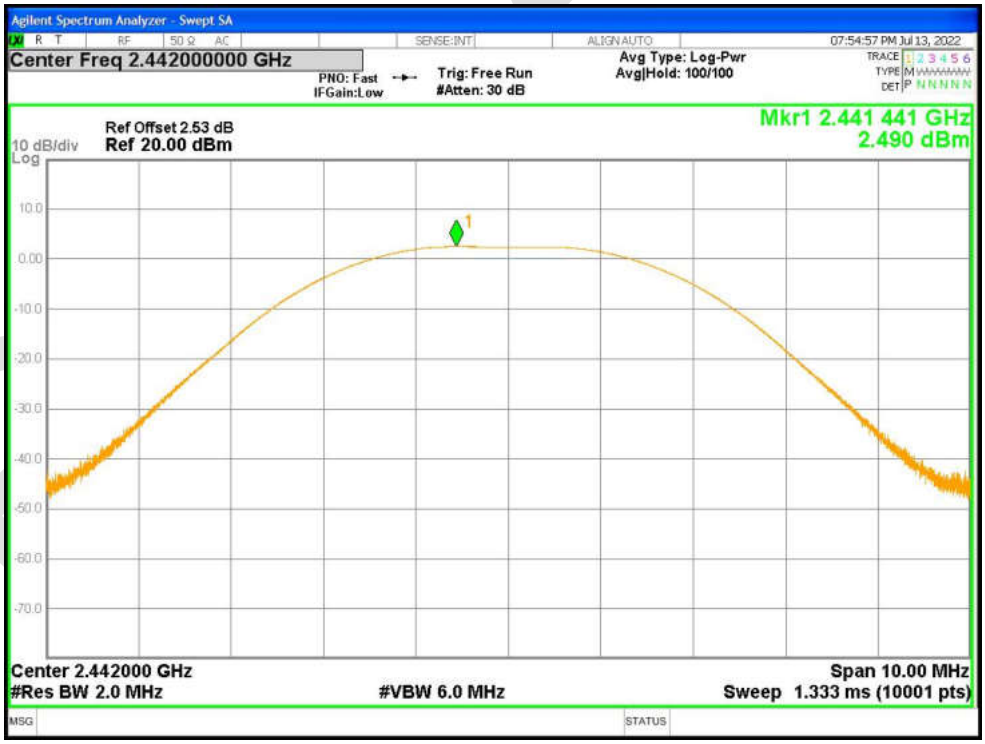
Power NVNT BLE 1M 2480MHz Ant1



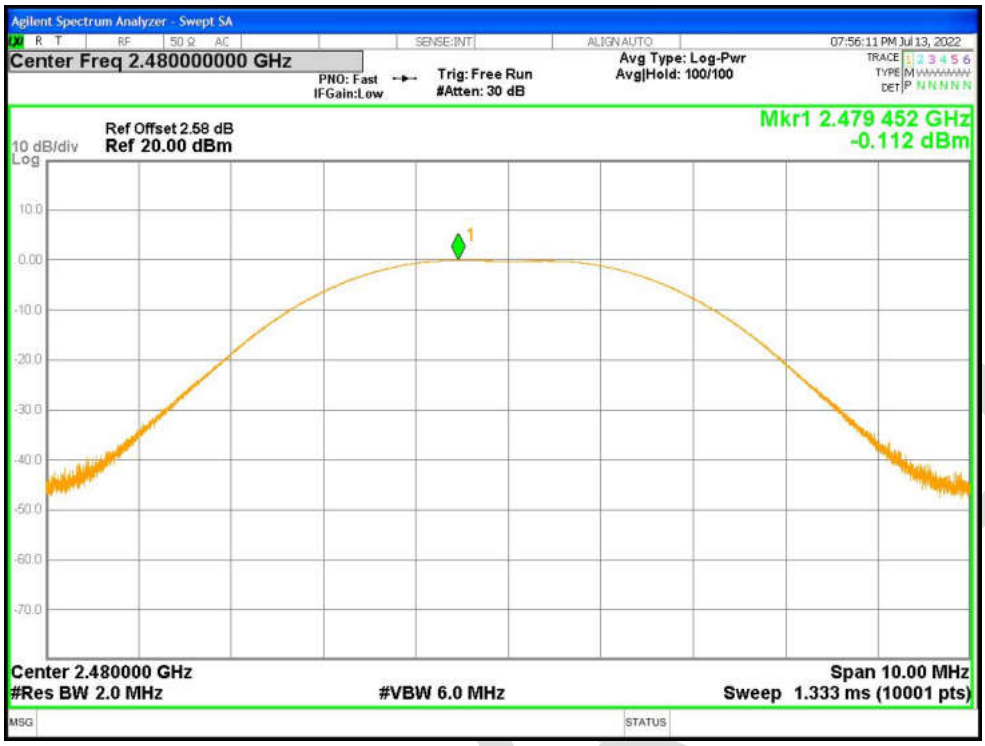
Power NVNT BLE 2M 2402MHz Ant1



Power NVNT BLE 2M 2442MHz Ant1



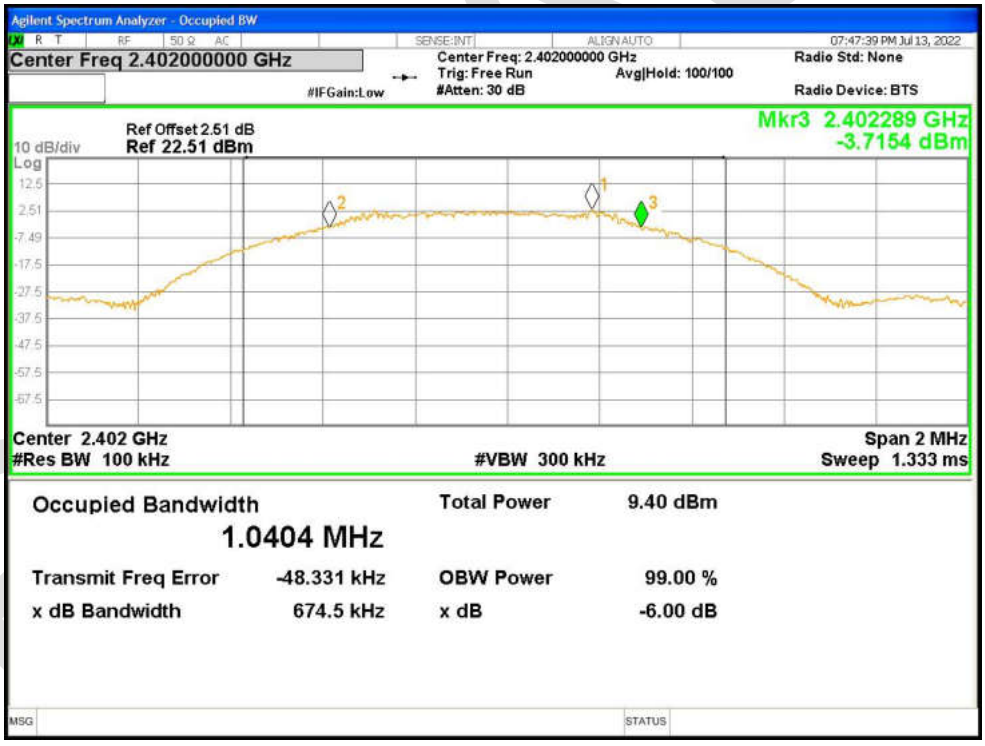
Power NVNT BLE 2M 2480MHz Ant1


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
07:56:11 PM Jul 13, 2022
Ref Offset 2.58 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 2.479 452 GHz
-0.112 dBm
Center 2.480000 GHz
#Res BW 2.0 MHz
#VBW 6.0 MHz
Span 10.00 MHz
Sweep 1.333 ms (10001 pts)

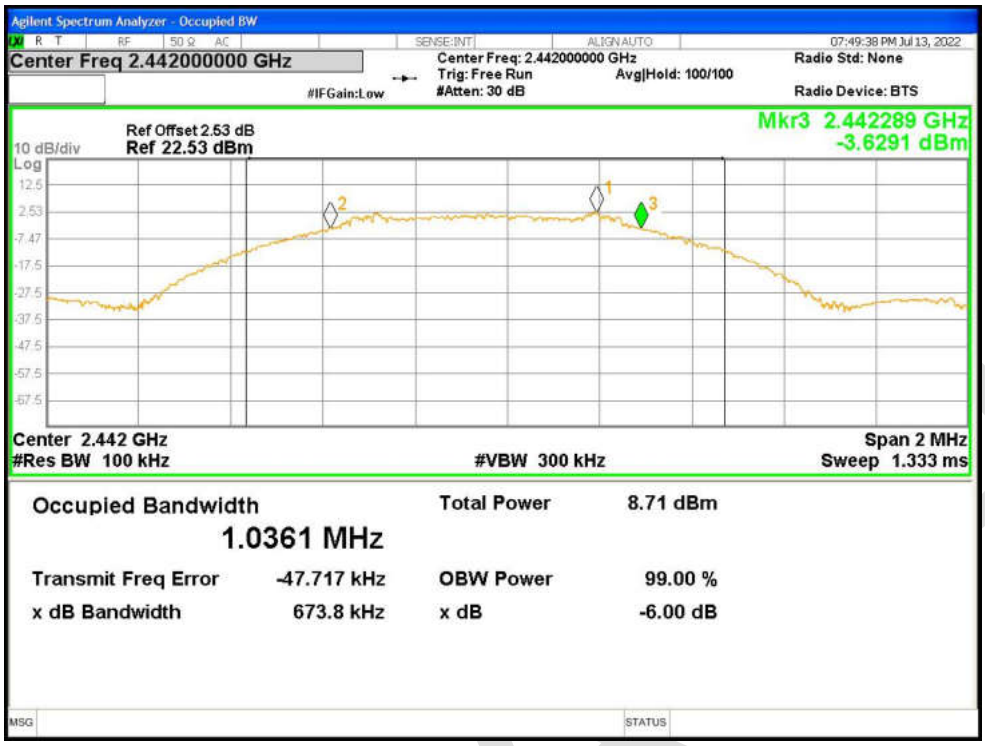
-6dB Bandwidth

Condition	Mode	Frequency (MHz)	Antenna	-6 dB Bandwidth (MHz)	Limit -6 dB Bandwidth (MHz)	Verdict
NVNT	BLE 1M	2402	Ant1	0.674	0.5	Pass
NVNT	BLE 1M	2442	Ant1	0.674	0.5	Pass
NVNT	BLE 1M	2480	Ant1	0.66	0.5	Pass
NVNT	BLE 2M	2402	Ant1	1.322	0.5	Pass
NVNT	BLE 2M	2442	Ant1	1.331	0.5	Pass
NVNT	BLE 2M	2480	Ant1	1.086	0.5	Pass

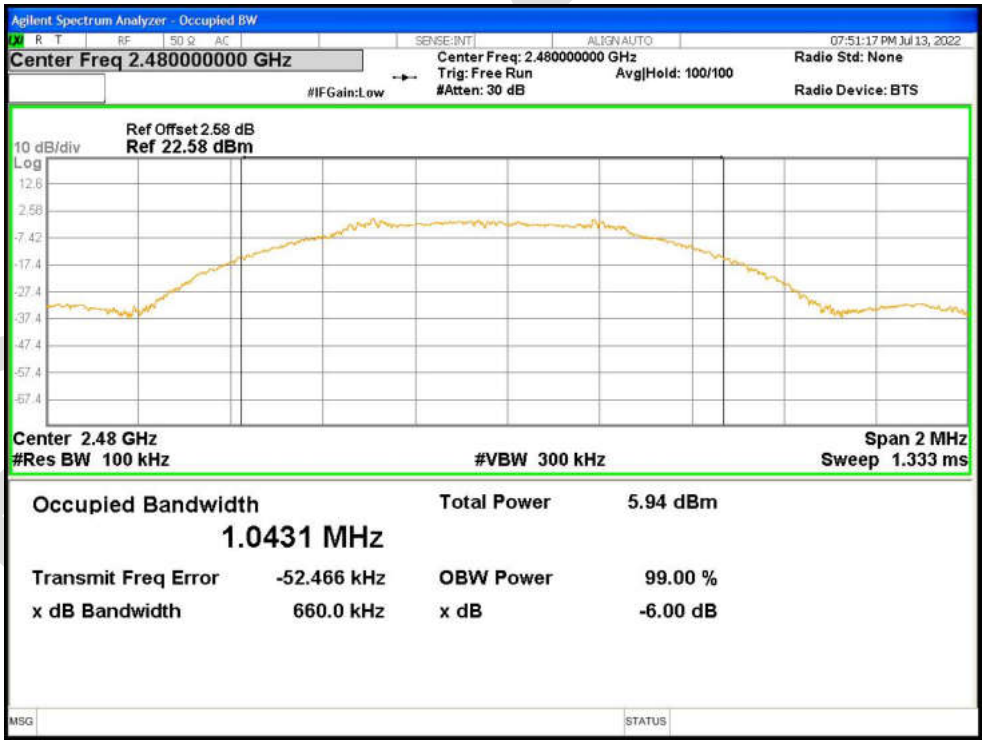
-6dB Bandwidth NVNT BLE 1M 2402MHz Ant1



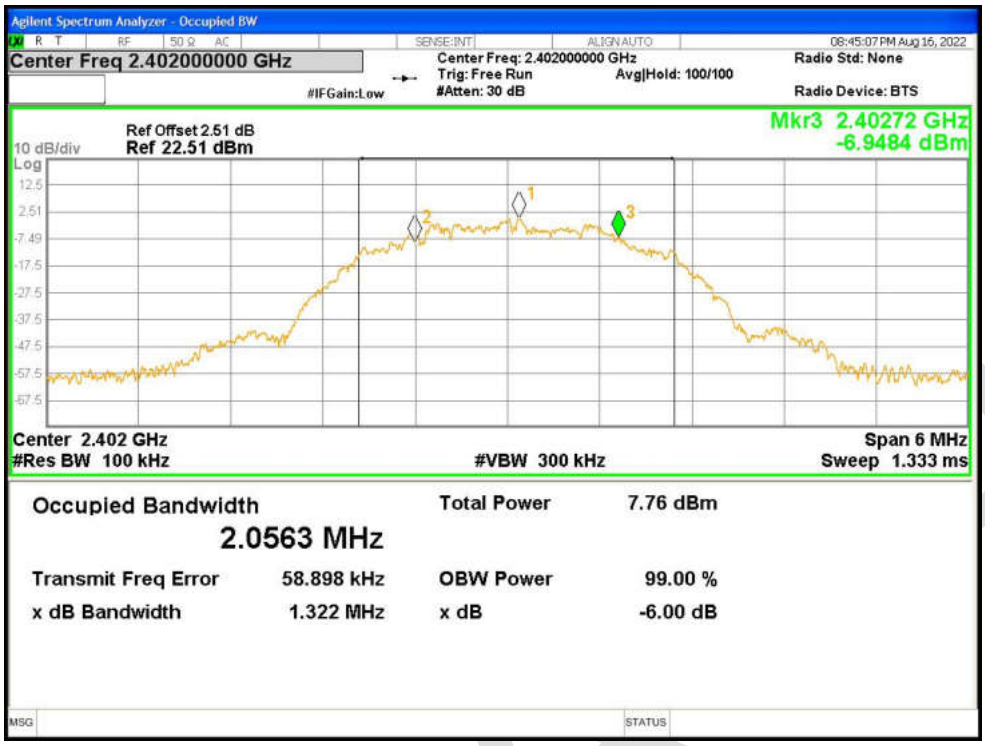
-6dB Bandwidth NVNT BLE 1M 2442MHz Ant1



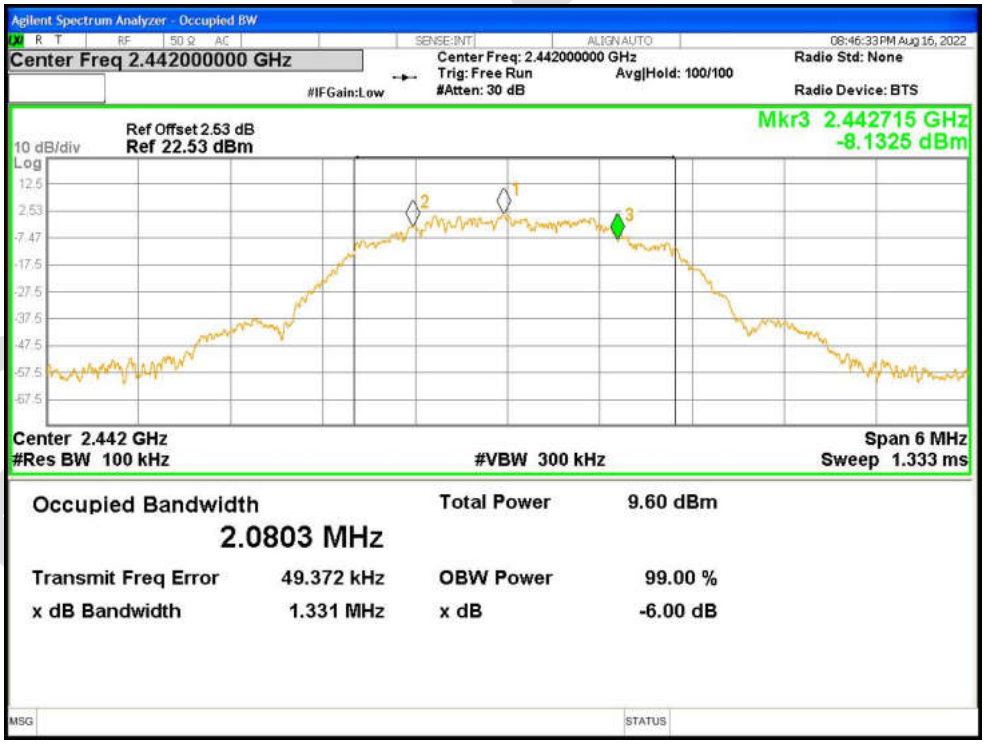
-6dB Bandwidth NVNT BLE 1M 2480MHz Ant1



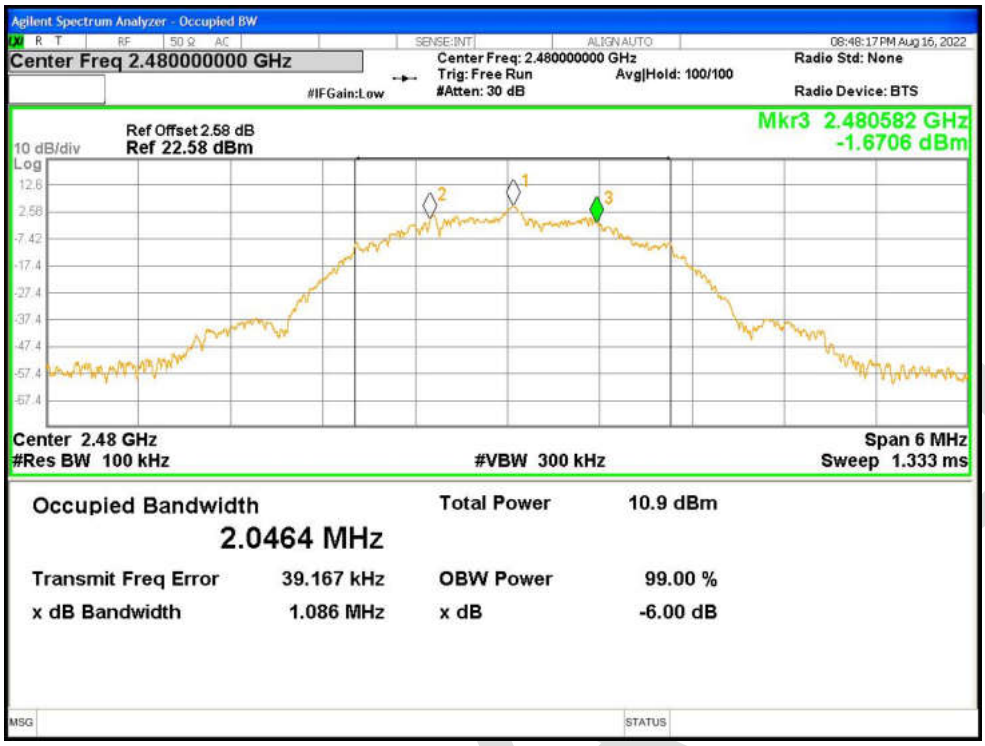
-6dB Bandwidth NVNT BLE 2M 2402MHz Ant1



-6dB Bandwidth NVNT BLE 2M 2442MHz Ant1



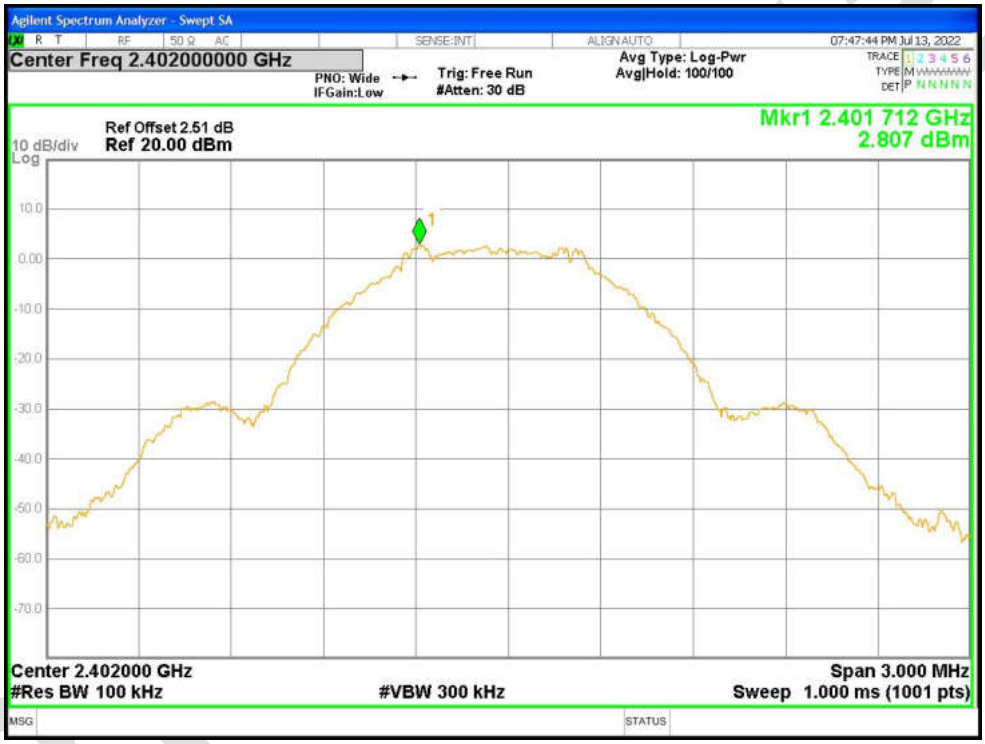
-6dB Bandwidth NVNT BLE 2M 2480MHz Ant1


Agilent Spectrum Analyzer - Occupied BW
Center Freq 2.480000000 GHz
Center Freq: 2.480000000 GHz
Trig: Free Run
Avg|Hold: 100/100
#Atten: 30 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
08:48:17 PM Aug 16, 2022
Ref Offset 2.58 dB
10 dB/div
Ref 22.58 dBm
Log
Mkr3 2.480582 GHz
-1.6706 dBm
Center 2.48 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 6 MHz
Sweep 1.333 ms
Occupied Bandwidth
2.0464 MHz
Total Power 10.9 dBm
Transmit Freq Error 39.167 kHz
OBW Power 99.00 %
x dB Bandwidth 1.086 MHz
x dB -6.00 dB
MSG
STATUS

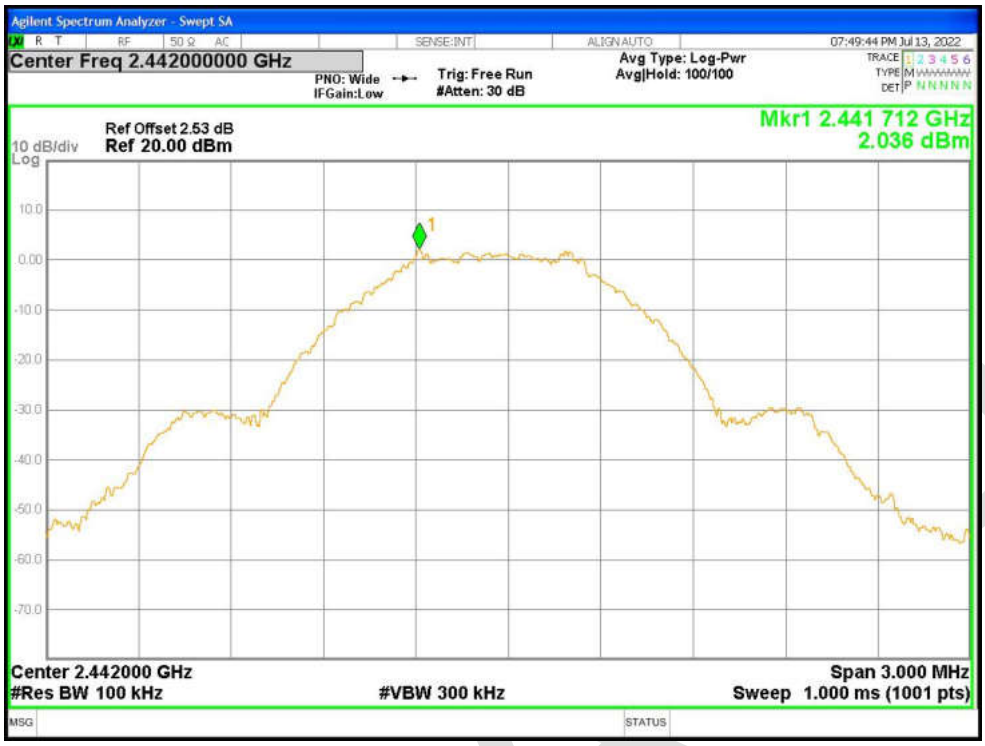
Maximum Power Spectral Density Level

Condition	Mode	Frequency (MHz)	Antenna	Max PSD (dBm)	Limit (dBm)	Verdict
NVNT	BLE 1M	2402	Ant1	2.807	8	Pass
NVNT	BLE 1M	2442	Ant1	2.036	8	Pass
NVNT	BLE 1M	2480	Ant1	-0.507	8	Pass
NVNT	BLE 2M	2402	Ant1	1.403	8	Pass
NVNT	BLE 2M	2442	Ant1	0.856	8	Pass
NVNT	BLE 2M	2480	Ant1	-2.289	8	Pass

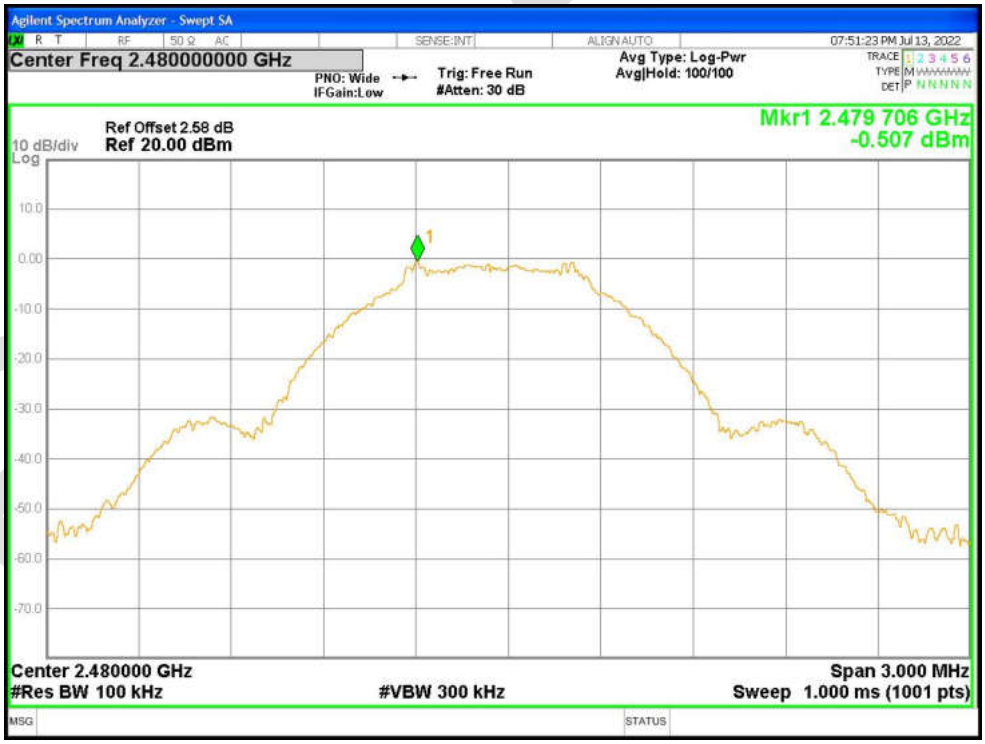
PSD NVNT BLE 1M 2402MHz Ant1



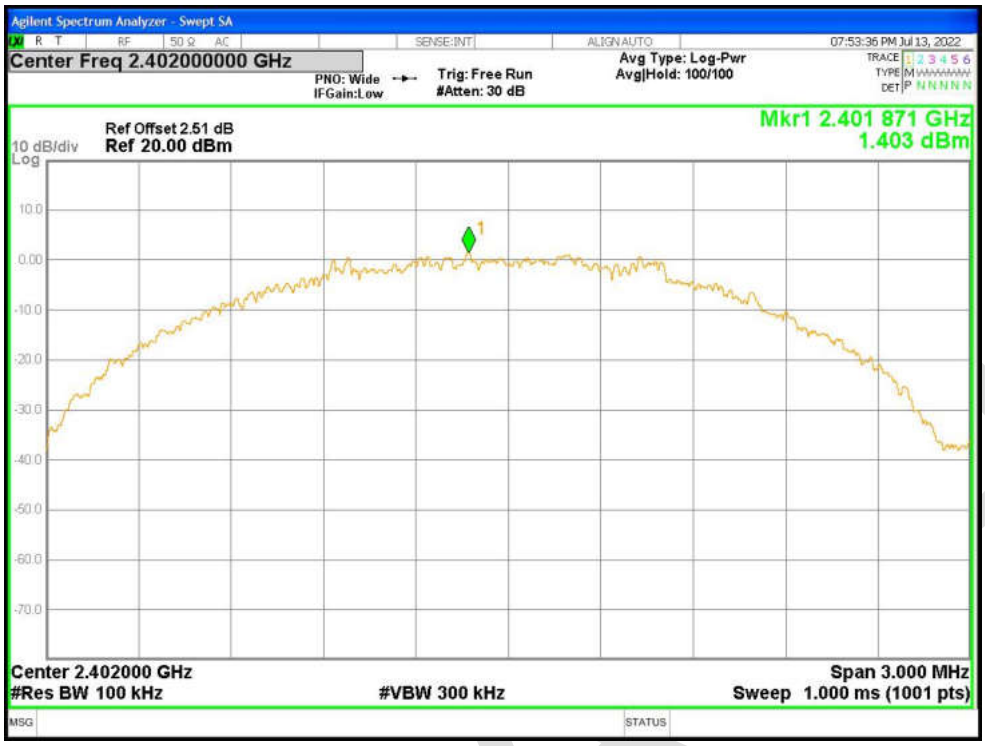
PSD NVNT BLE 1M 2442MHz Ant1



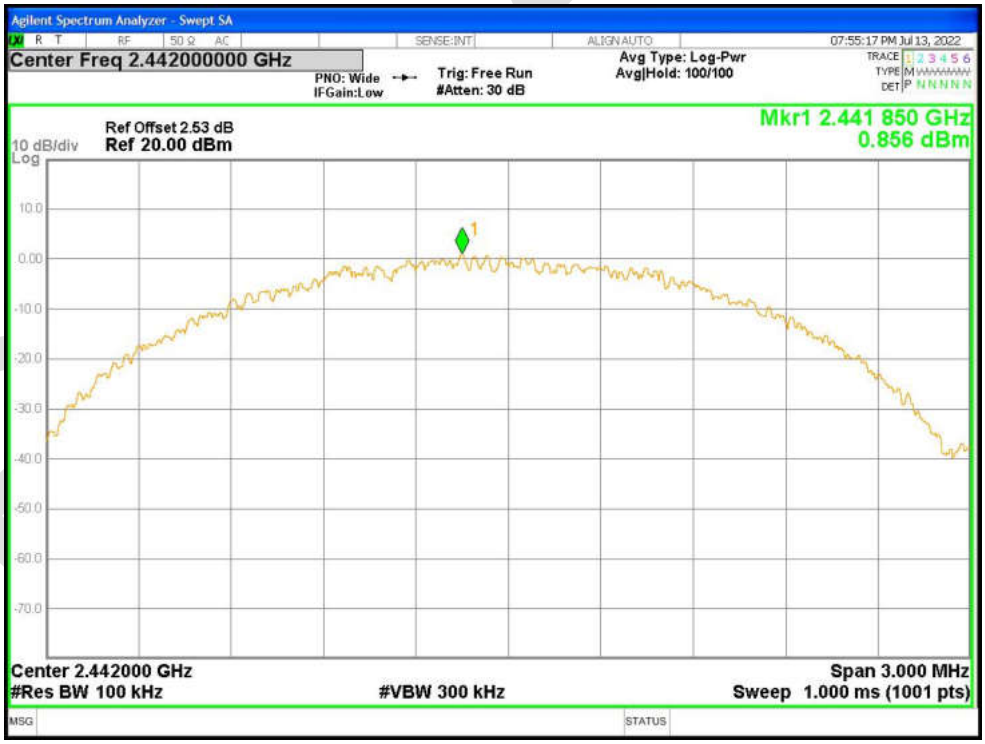
PSD NVNT BLE 1M 2480MHz Ant1



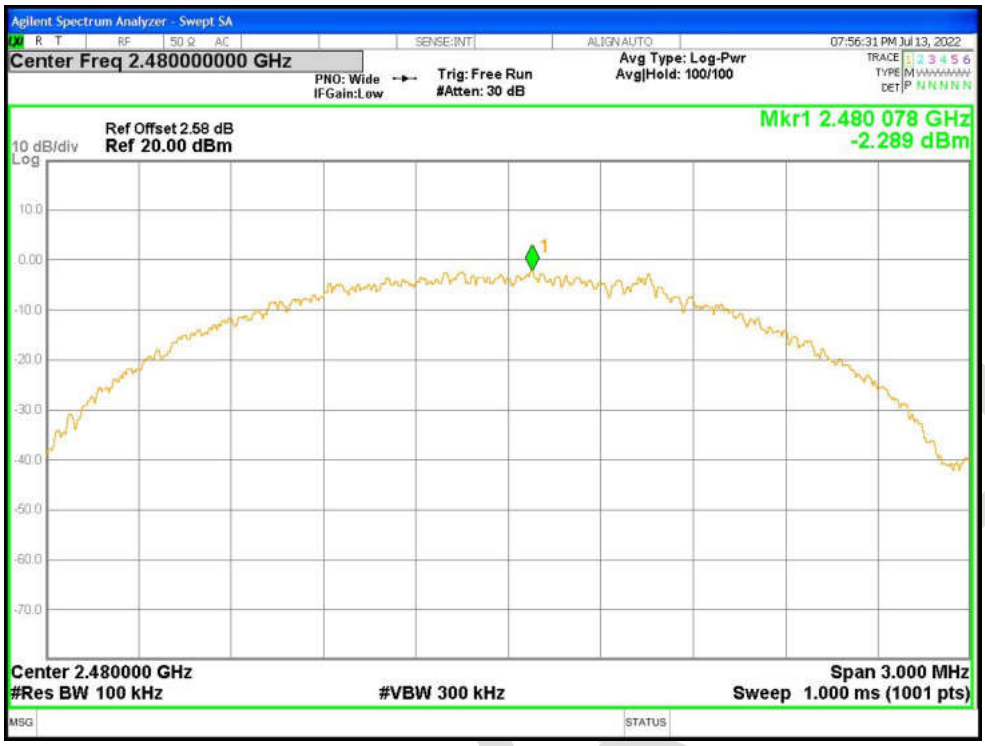
PSD NVNT BLE 2M 2402MHz Ant1



PSD NVNT BLE 2M 2442MHz Ant1



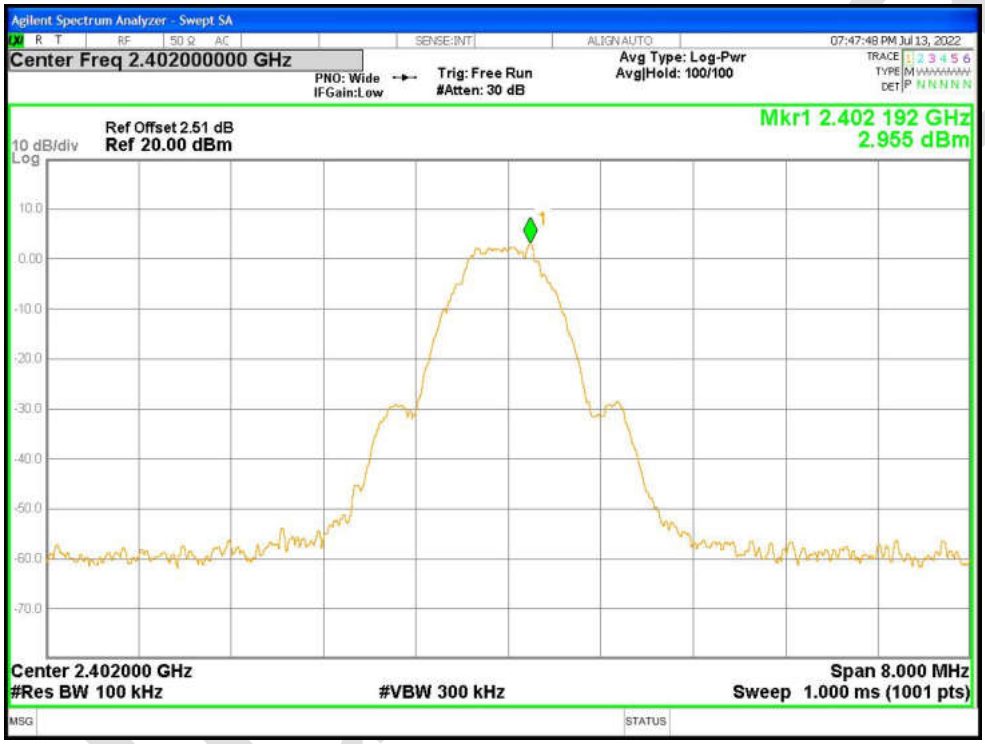
PSD NVNT BLE 2M 2480MHz Ant1


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.480000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
07:56:31 PM Jul 13, 2022
Ref Offset 2.58 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 2.480 078 GHz
-2.289 dBm
Center 2.480000 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 3.000 MHz
Sweep 1.000 ms (1001 pts)

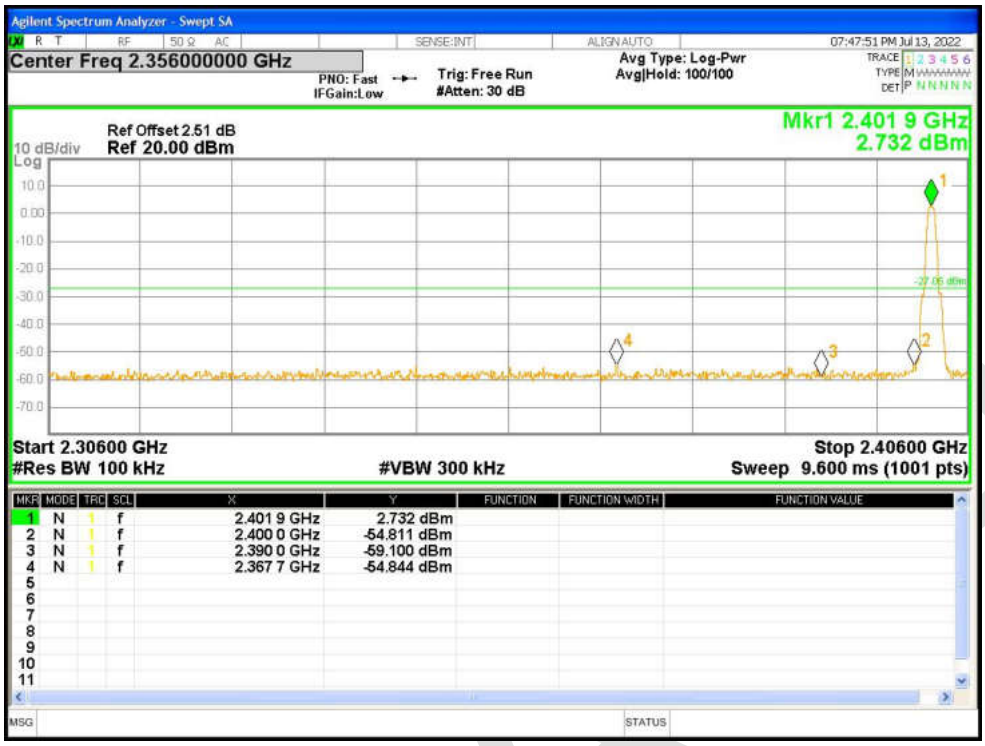
Band Edge

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	Ant1	-57.80	-30	Pass
NVNT	BLE 1M	2480	Ant1	-54.17	-30	Pass
NVNT	BLE 2M	2402	Ant1	-56.87	-30	Pass
NVNT	BLE 2M	2480	Ant1	-52.62	-30	Pass

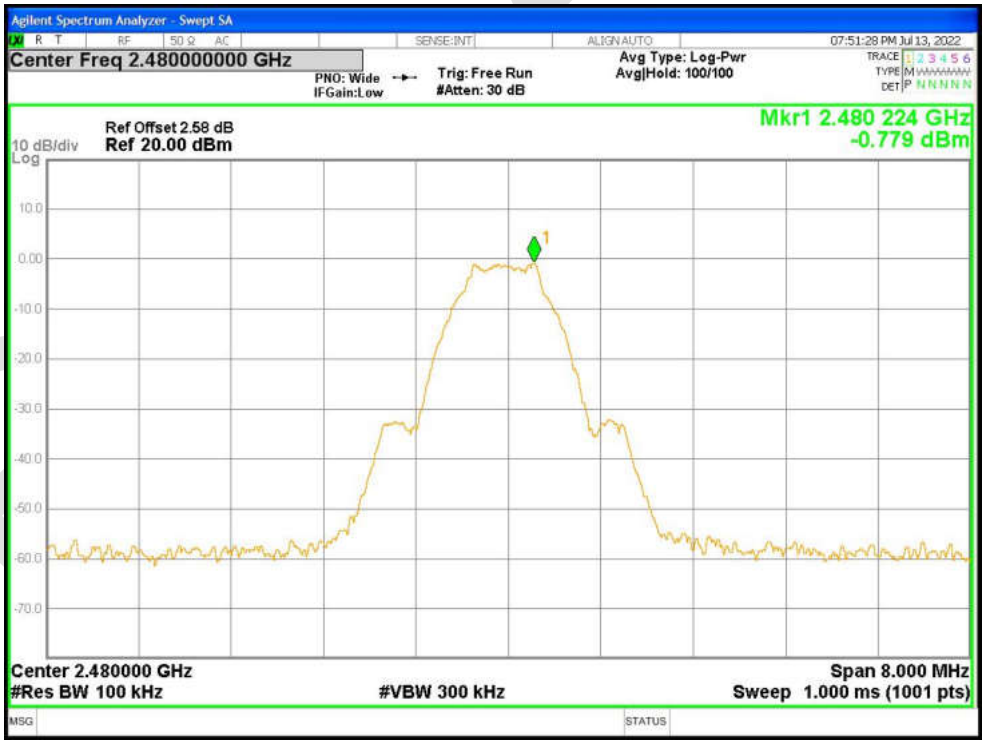
Band Edge NVNT BLE 1M 2402MHz Ant1 Ref



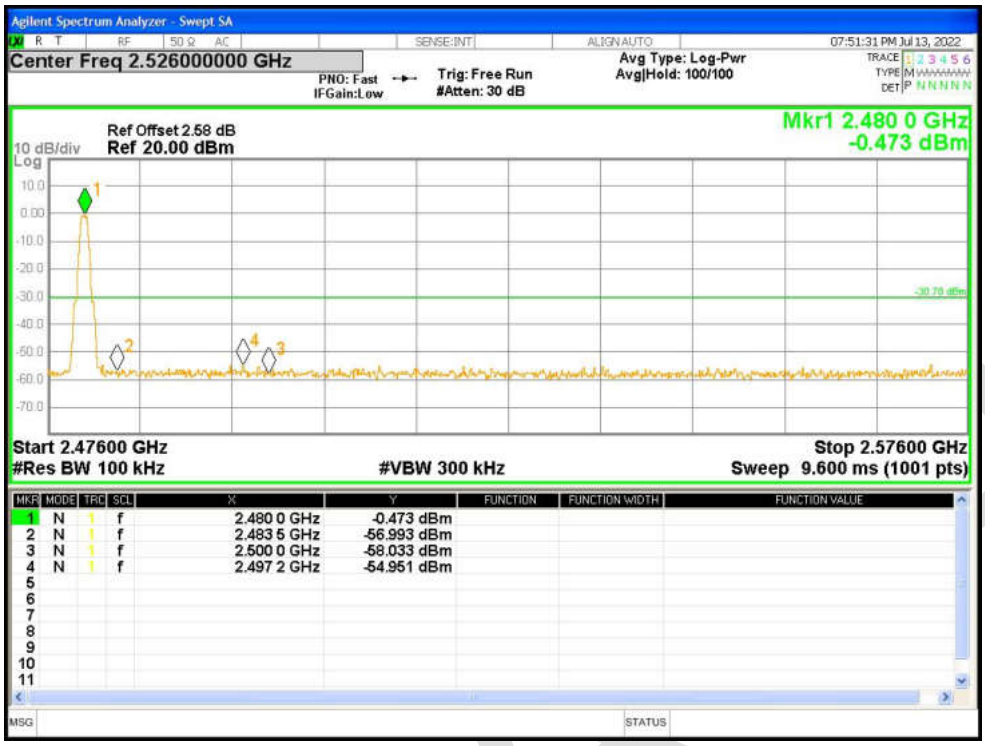
Band Edge NVNT BLE 1M 2402MHz Ant1 Emission



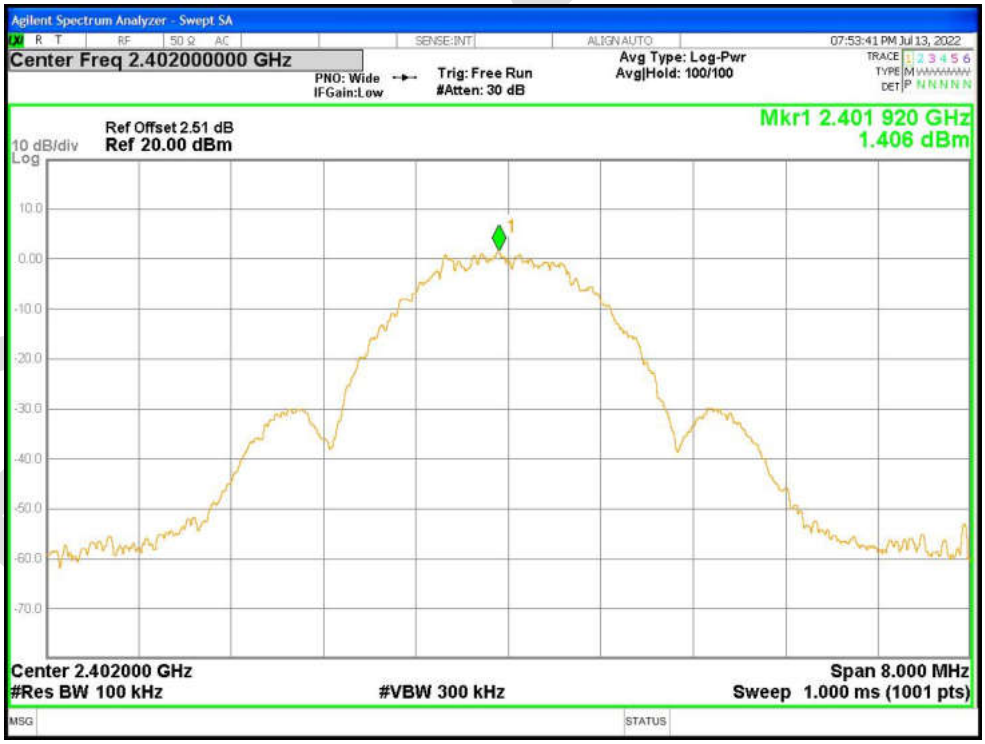
Band Edge NVNT BLE 1M 2480MHz Ant1 Ref



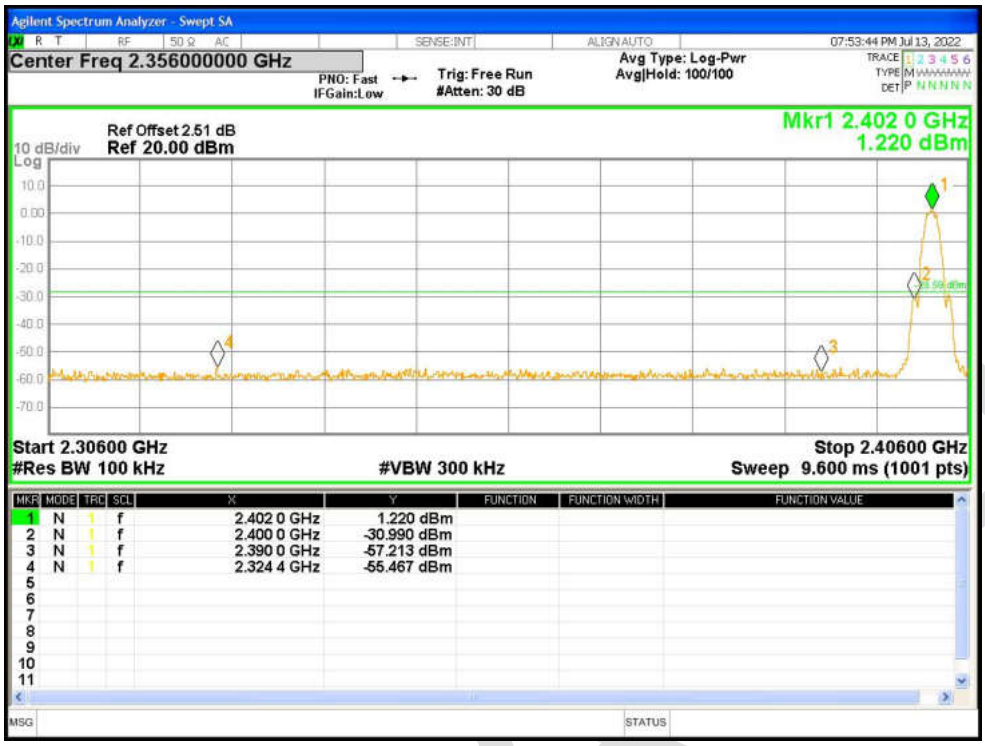
Band Edge NVNT BLE 1M 2480MHz Ant1 Emission



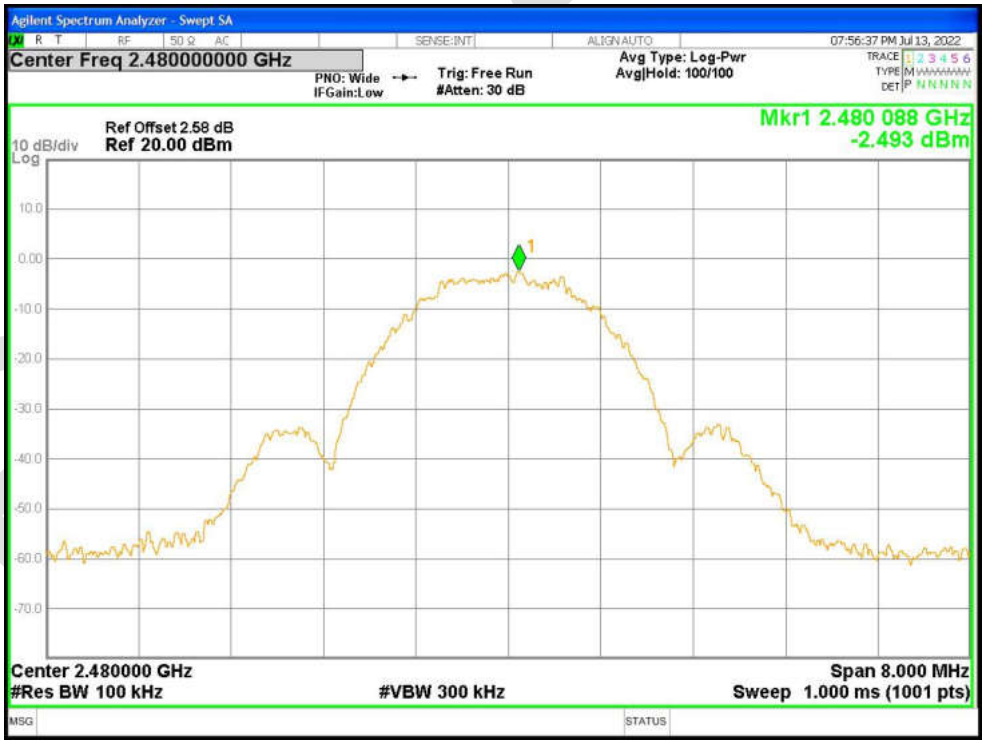
Band Edge NVNT BLE 2M 2402MHz Ant1 Ref



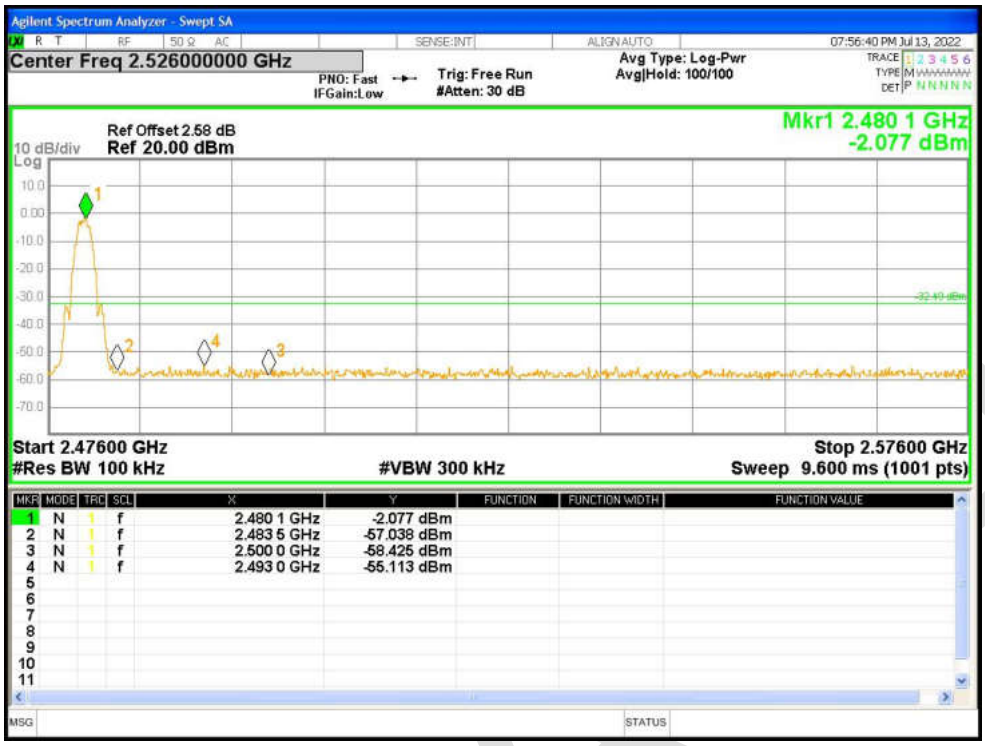
Band Edge NVNT BLE 2M 2402MHz Ant1 Emission



Band Edge NVNT BLE 2M 2480MHz Ant1 Ref



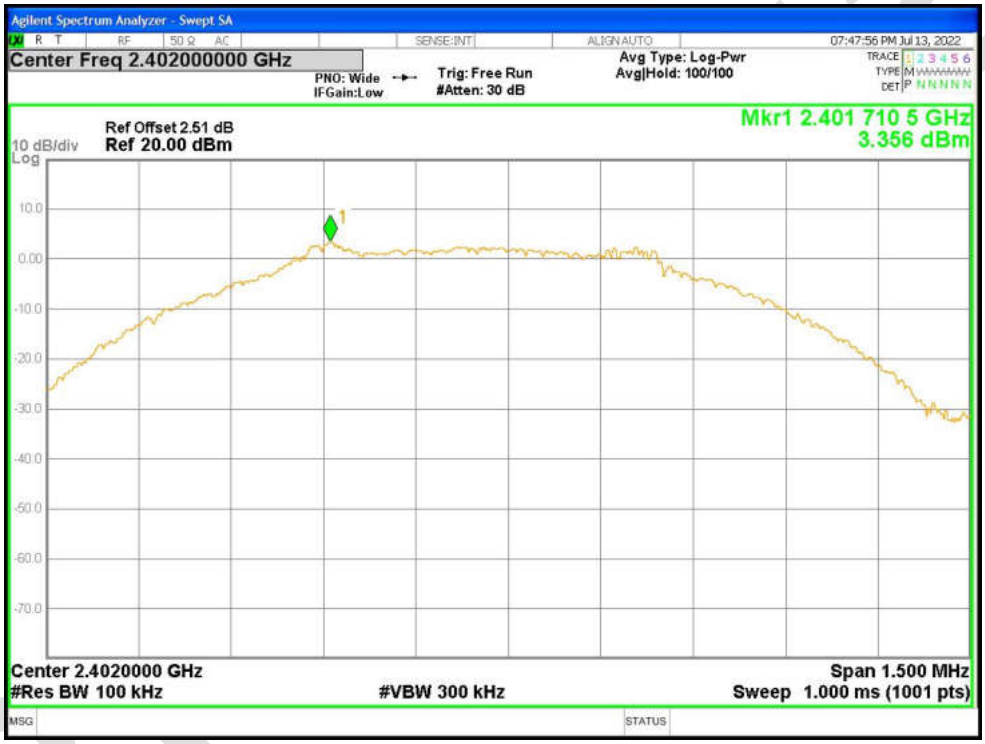
Band Edge NVNT BLE 2M 2480MHz Ant1 Emission


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.526000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 100/100
07:56:40 PM Jul 13, 2022
Ref Offset 2.58 dB
10 dB/div
Ref 20.00 dBm
Mkr1 2.480 1 GHz
-2.077 dBm
Start 2.47600 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.57600 GHz
Sweep 9.600 ms (1001 pts)
1 N 1 f 2.480 1 GHz -2.077 dBm
2 N 1 f 2.483 5 GHz -57.038 dBm
3 N 1 f 2.500 0 GHz -58.425 dBm
4 N 1 f 2.493 0 GHz -55.113 dBm

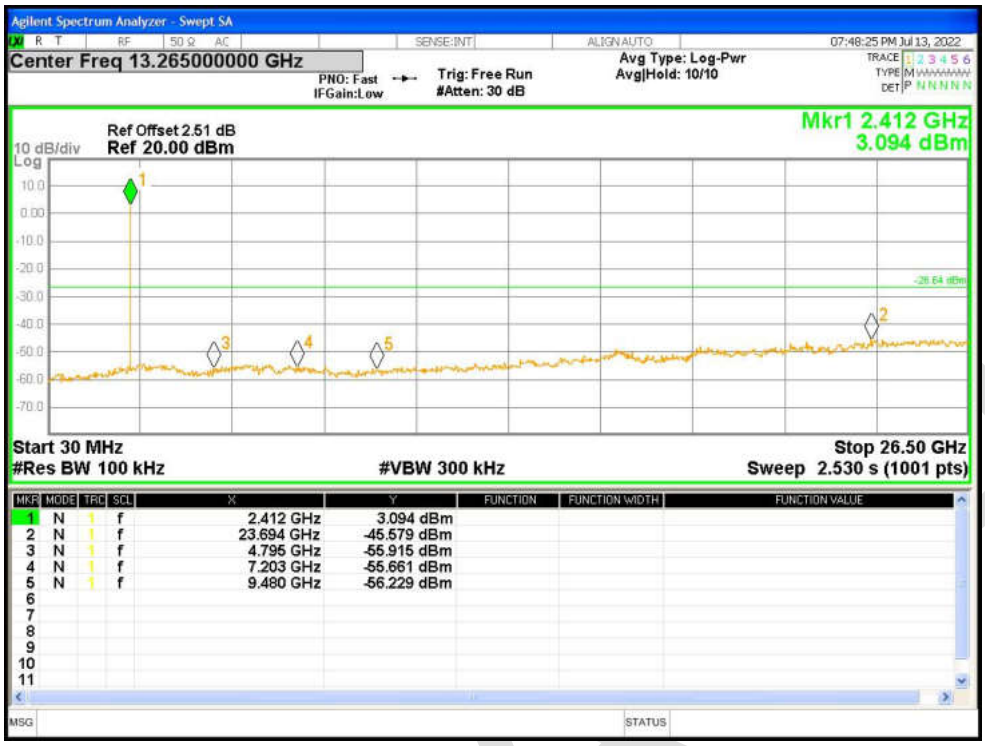
Conducted RF Spurious Emission

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	Ant1	-48.93	-30	Pass
NVNT	BLE 1M	2442	Ant1	-47.03	-30	Pass
NVNT	BLE 1M	2480	Ant1	-44.26	-30	Pass
NVNT	BLE 2M	2402	Ant1	-46.43	-30	Pass
NVNT	BLE 2M	2442	Ant1	-45.3	-30	Pass
NVNT	BLE 2M	2480	Ant1	-42.13	-30	Pass

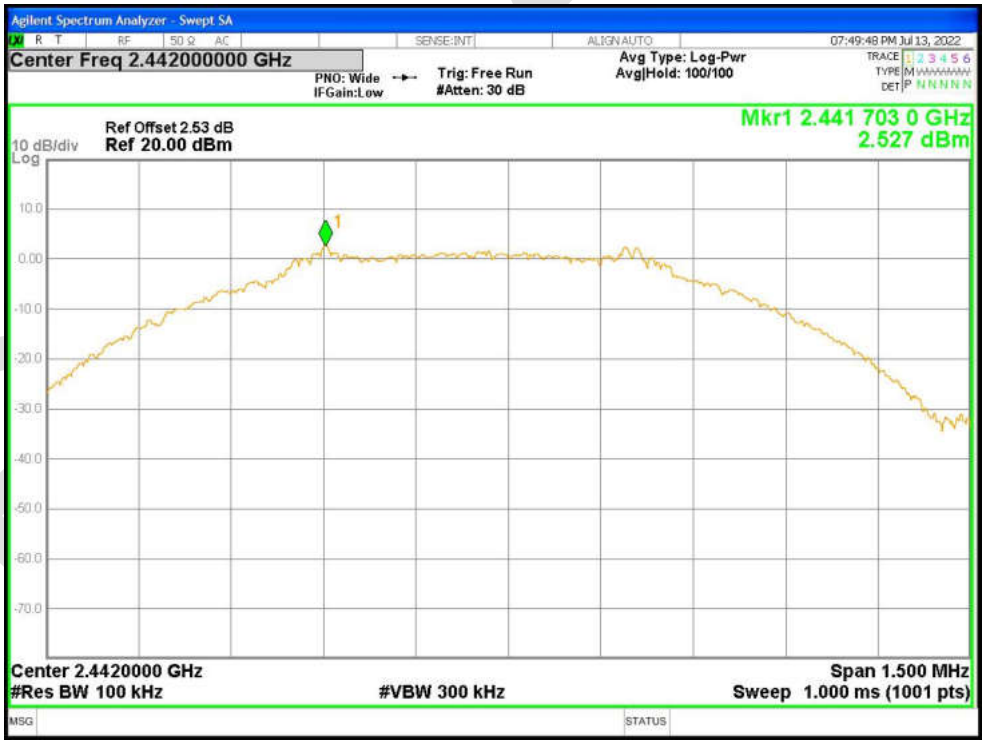
Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Ref



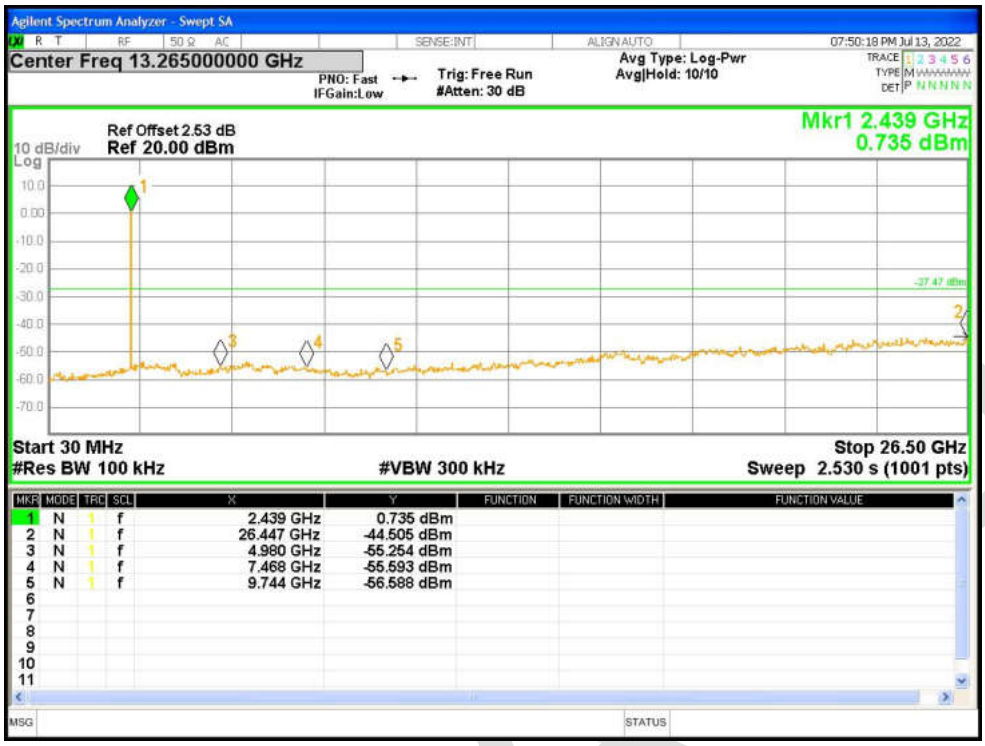
Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Emission



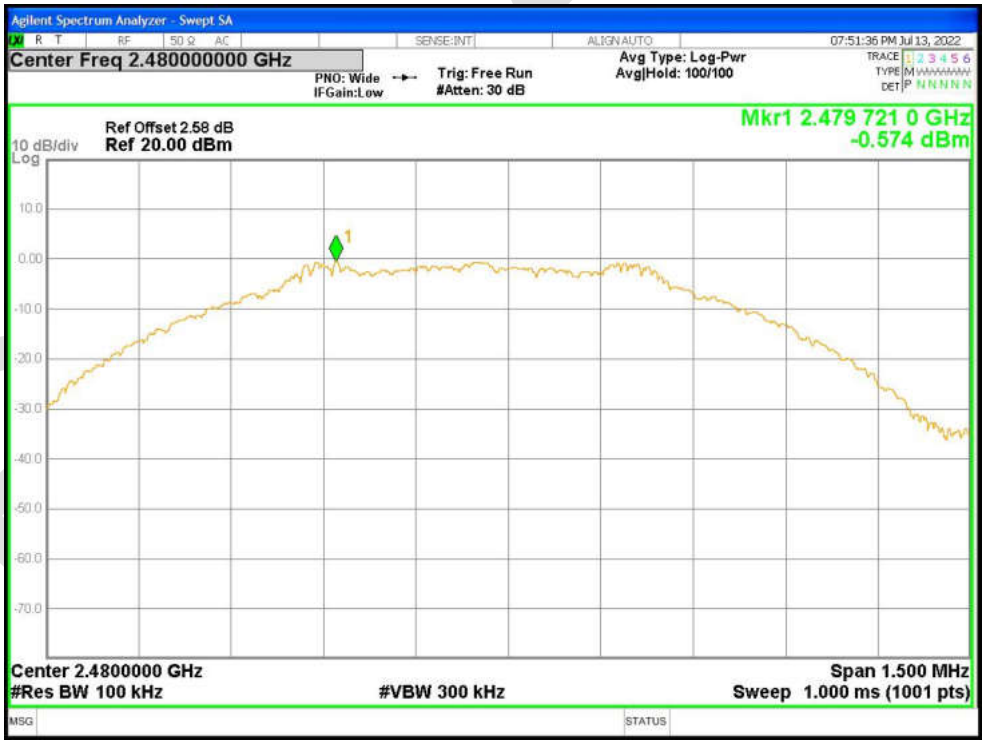
Tx. Spurious NVNT BLE 1M 2442MHz Ant1 Ref



Tx. Spurious NVNT BLE 1M 2442MHz Ant1 Emission

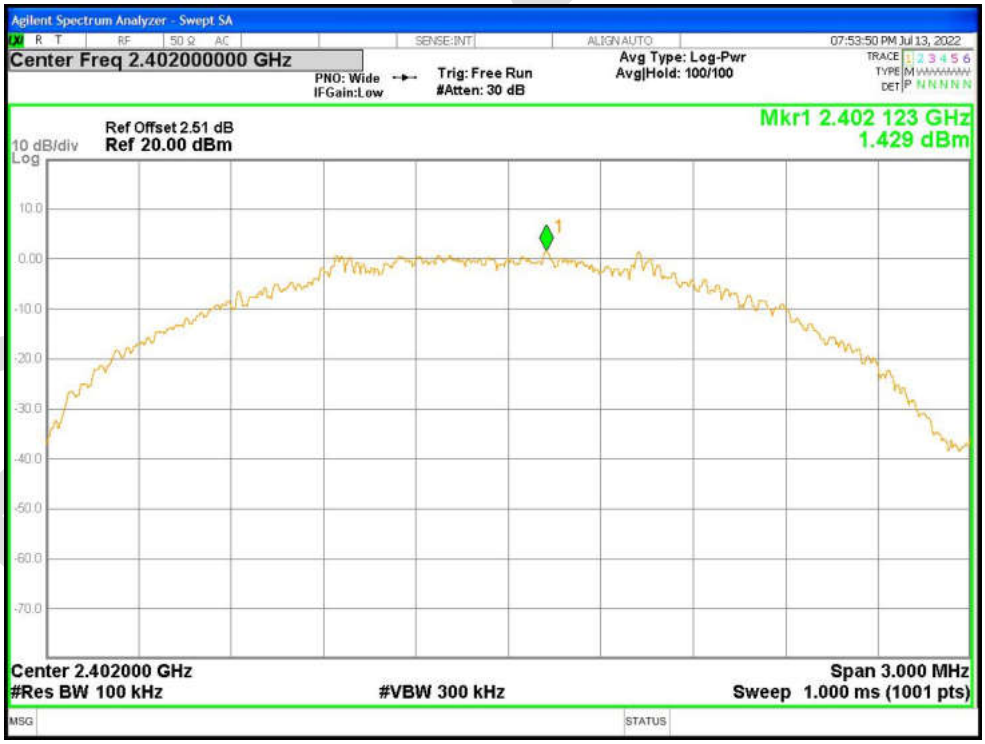


Tx. Spurious NVNT BLE 1M 2480MHz Ant1 Ref



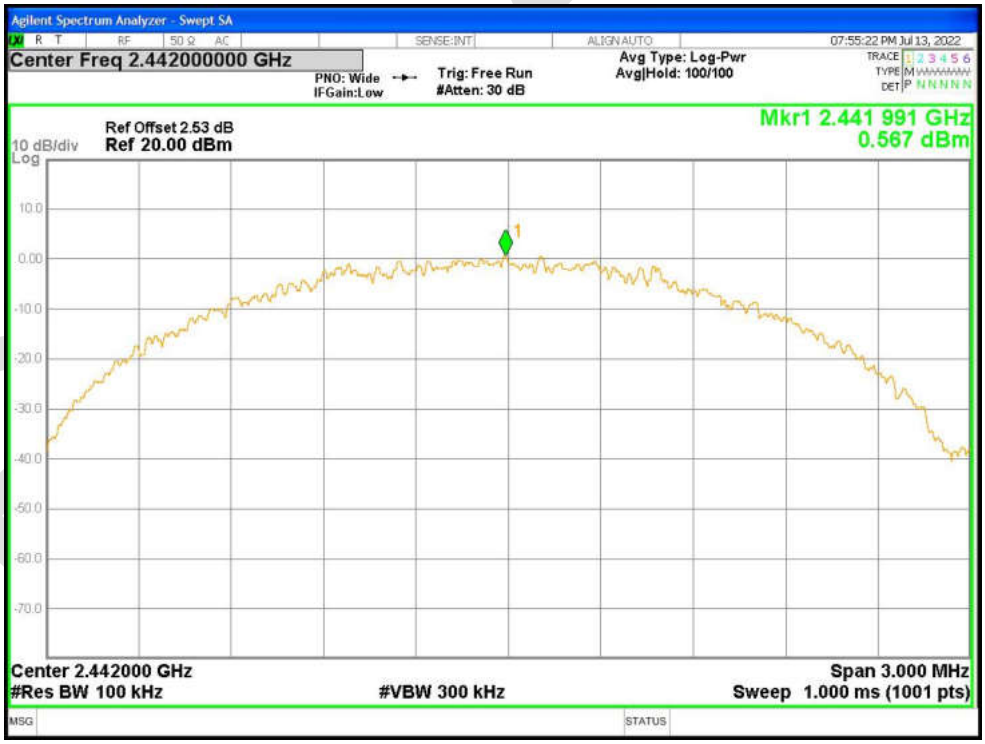
Tx. Spurious NVNT BLE 1M 2480MHz Ant1 Emission

Tx. Spurious NVNT BLE 2M 2402MHz Ant1 Ref



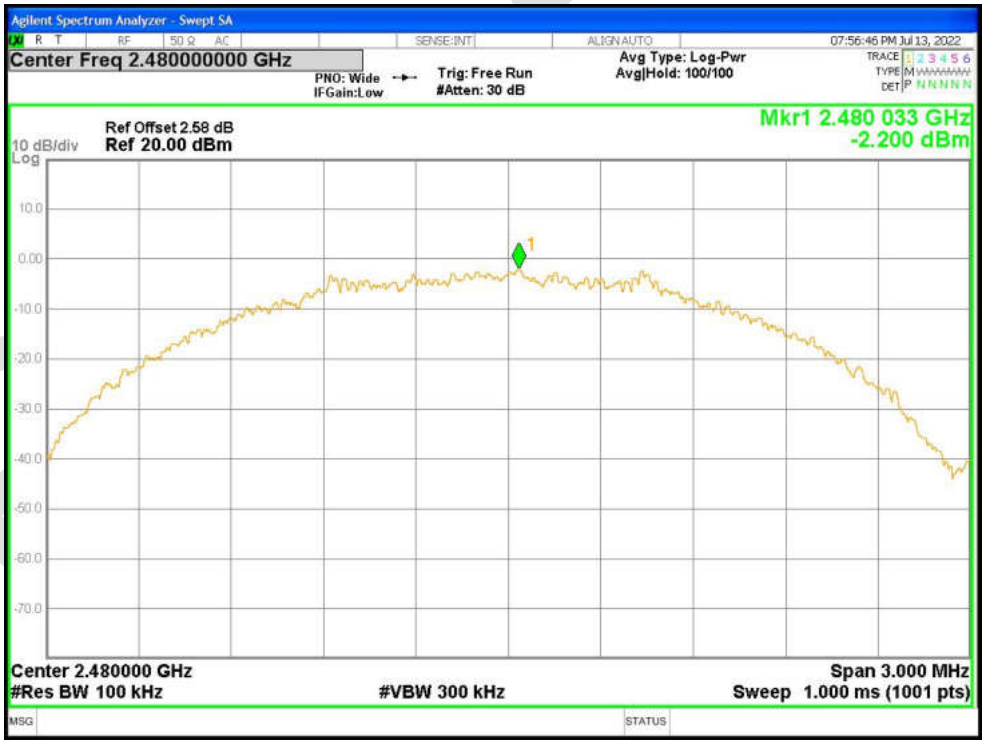
Tx. Spurious NVNT BLE 2M 2402MHz Ant1 Emission

Tx. Spurious NVNT BLE 2M 2442MHz Ant1 Ref

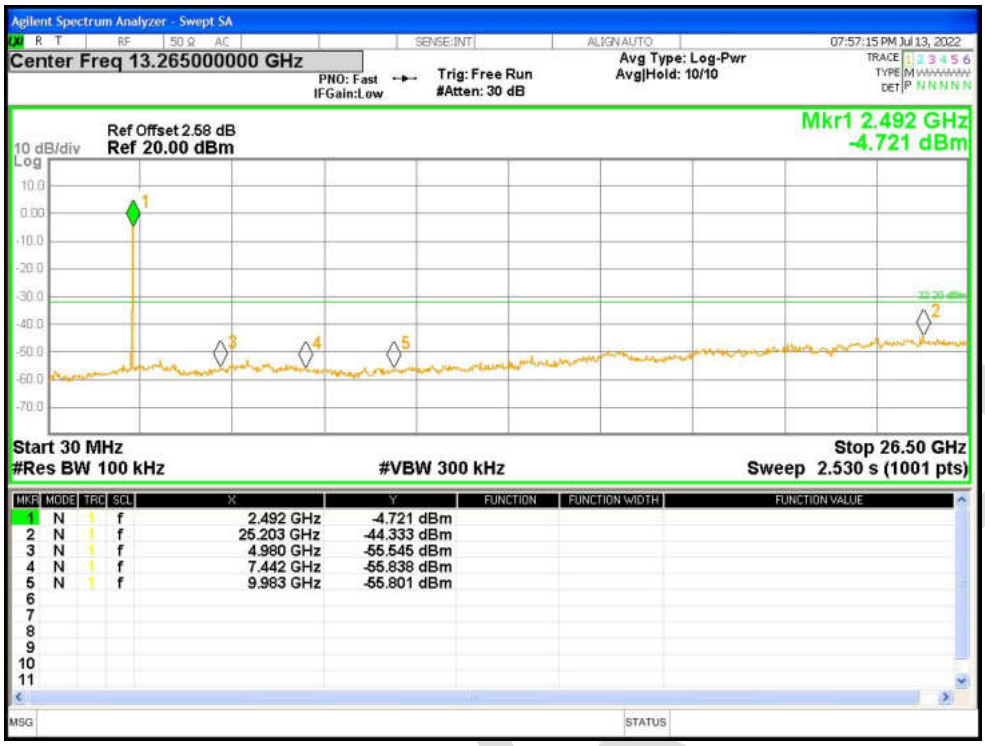


Tx. Spurious NVNT BLE 2M 2442MHz Ant1 Emission

Tx. Spurious NVNT BLE 2M 2480MHz Ant1 Ref

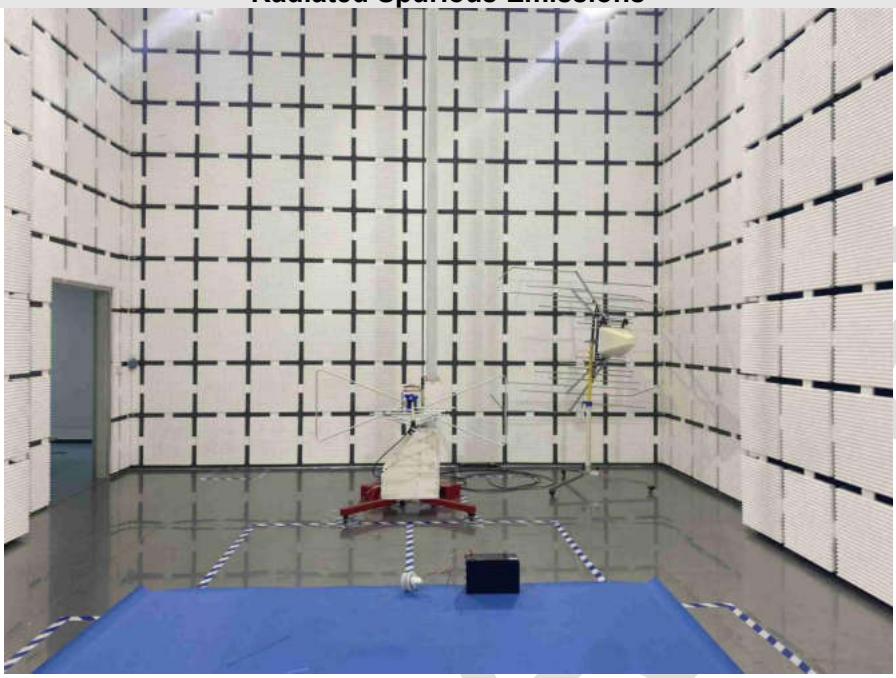


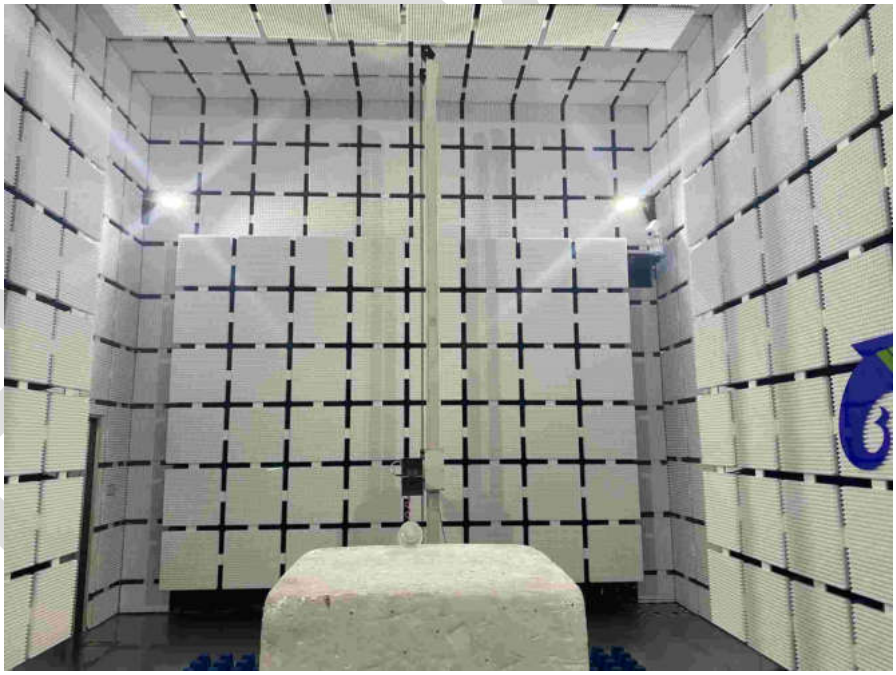
Tx. Spurious NVNT BLE 2M 2480MHz Ant1 Emission


Agilent Spectrum Analyzer - Swept SA
Center Freq 13.265000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 10/10
07:57:15 PM Jul 13, 2022
Ref Offset 2.58 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 2.492 GHz
-4.721 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 26.50 GHz
Sweep 2.530 s (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.492 GHz -4.721 dBm
2 N 1 f 25.203 GHz -44.333 dBm
3 N 1 f 4.980 GHz -55.545 dBm
4 N 1 f 7.442 GHz -55.838 dBm
5 N 1 f 9.983 GHz -55.801 dBm
MSG
STATUS

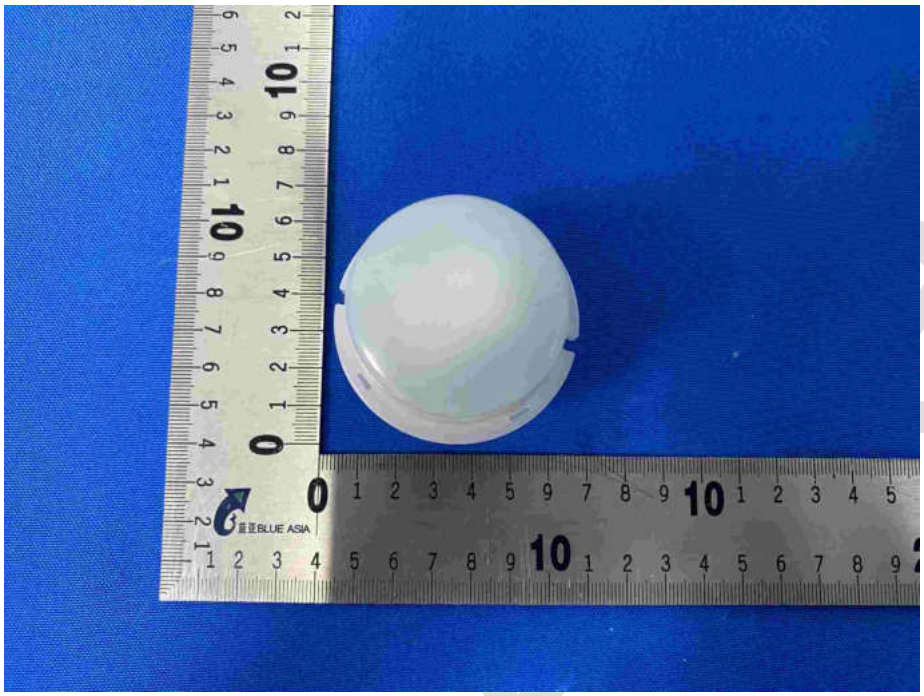
APPENDIX A: PHOTOGRAPHS OF TEST SETUP

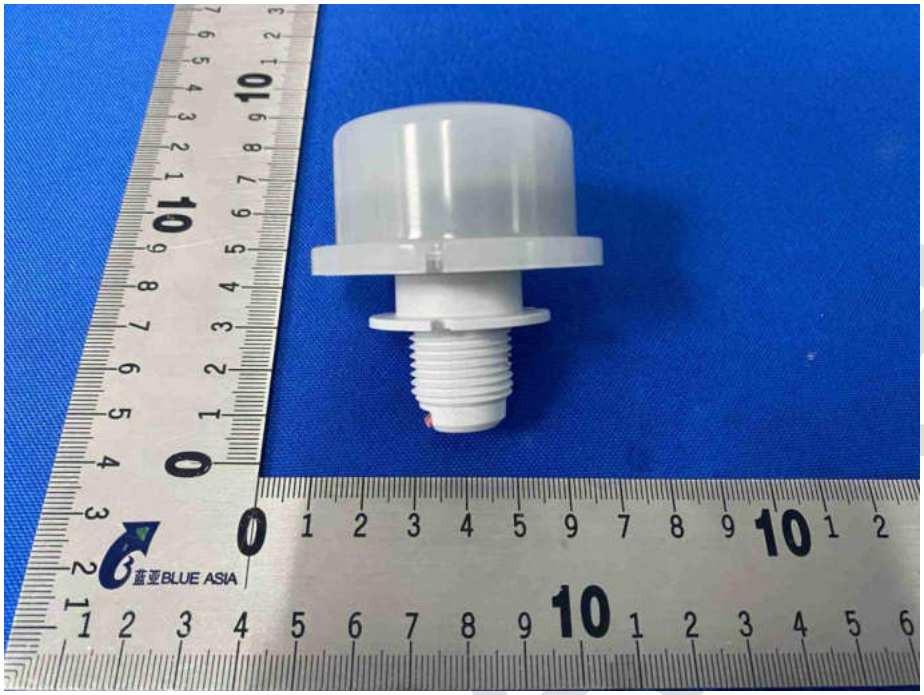
Radiated Spurious Emissions

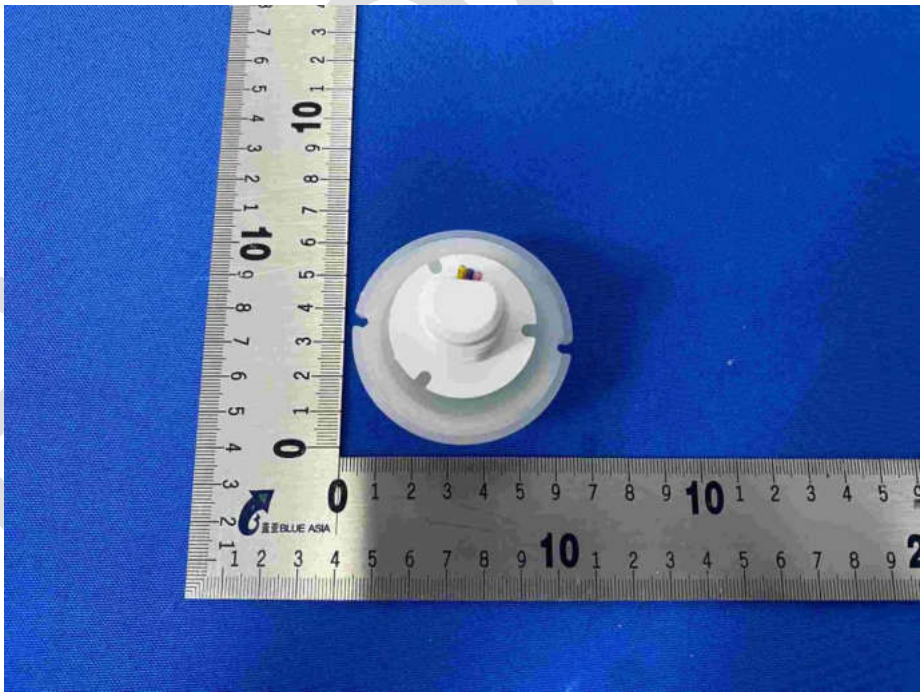


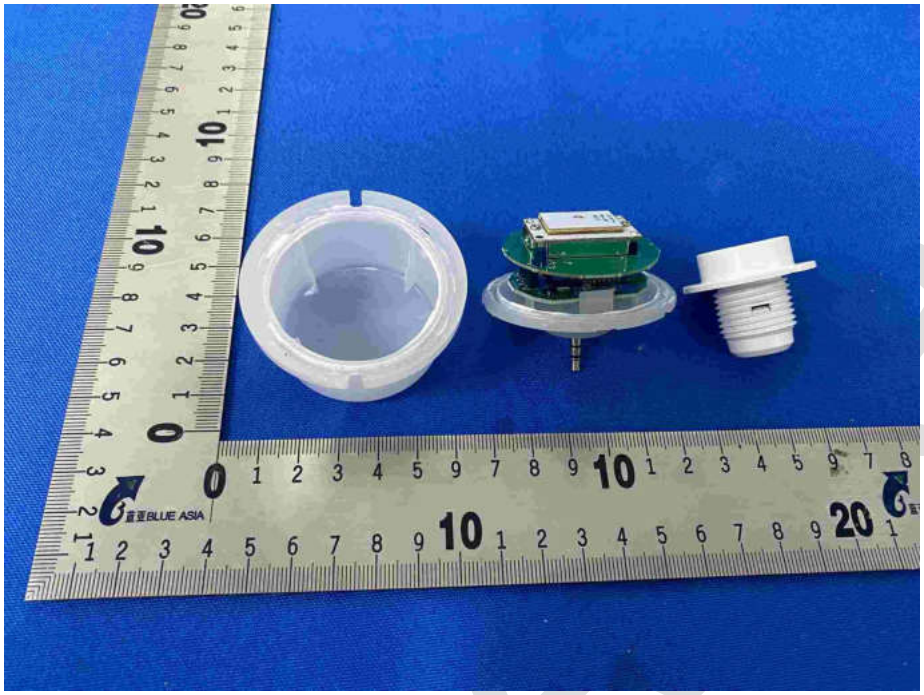


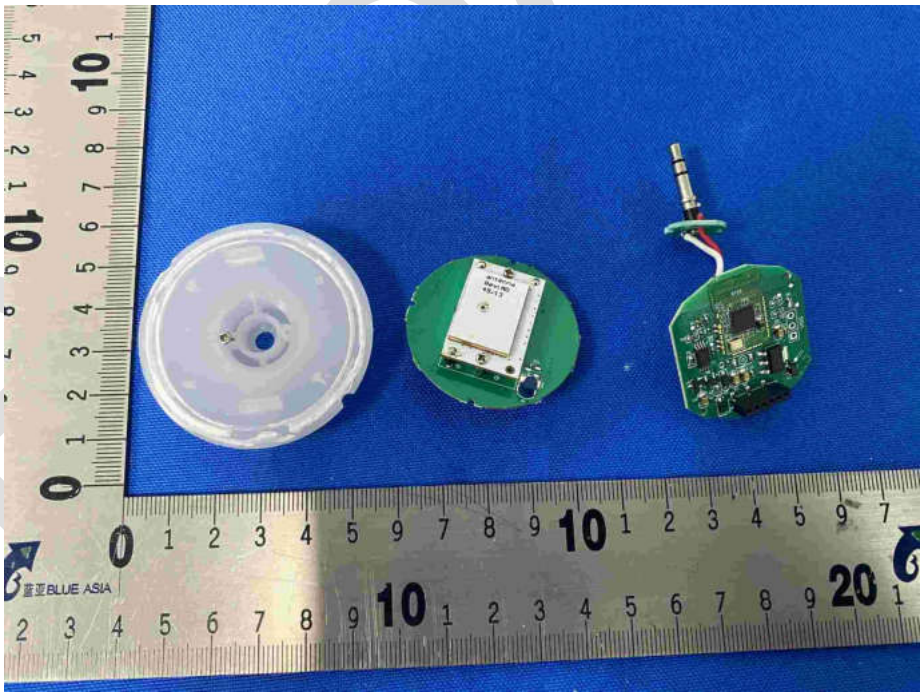
APPENDIX B: PHOTOGRAPHS OF EUT

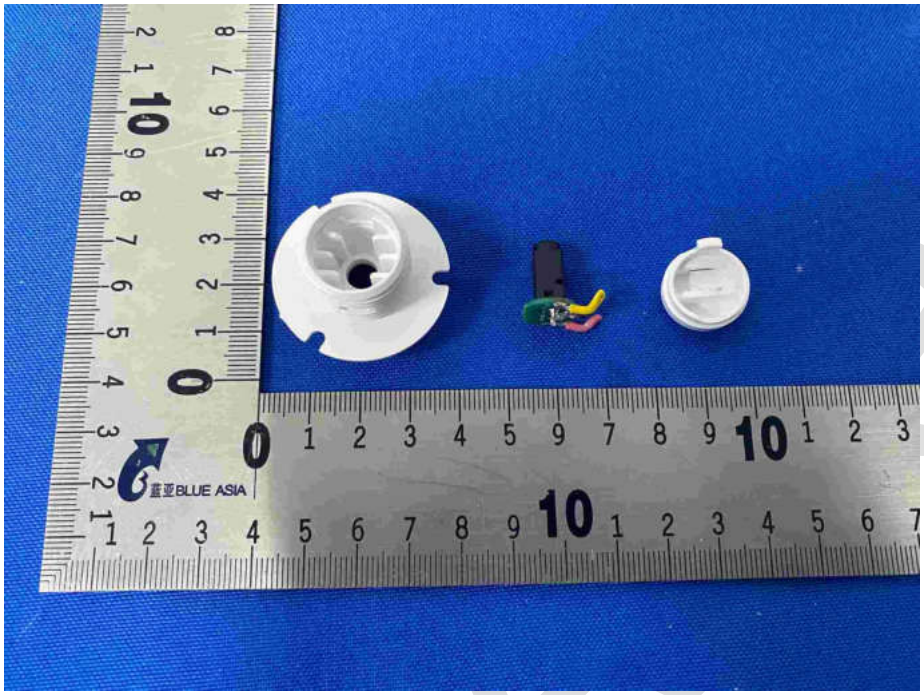


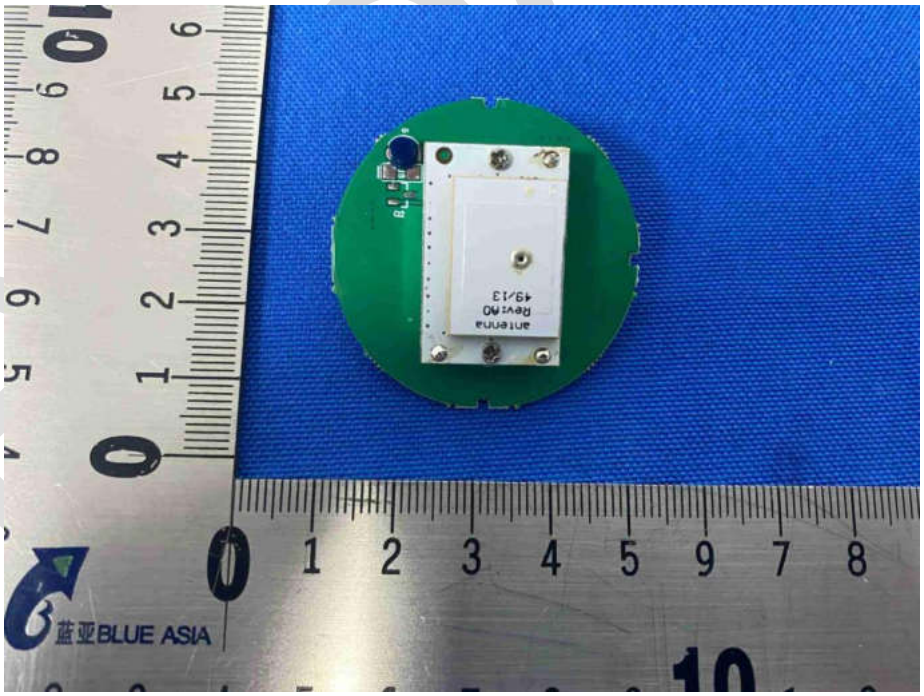


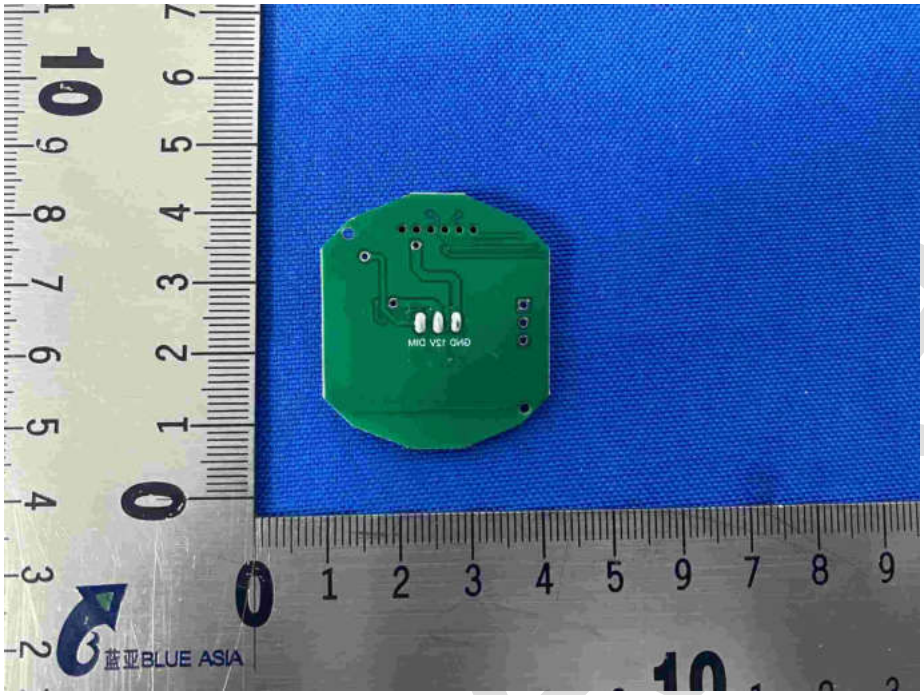


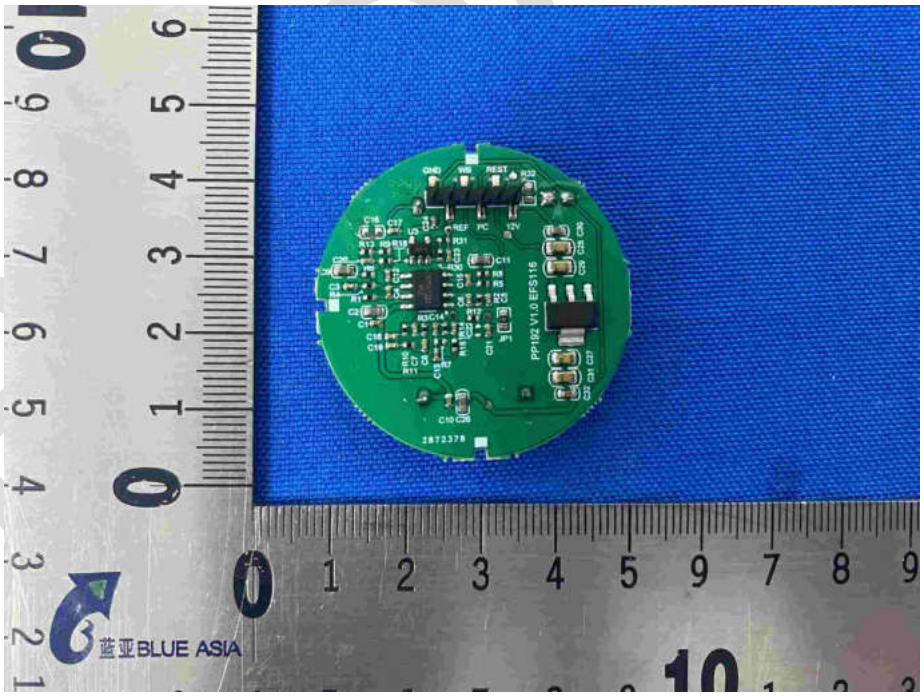


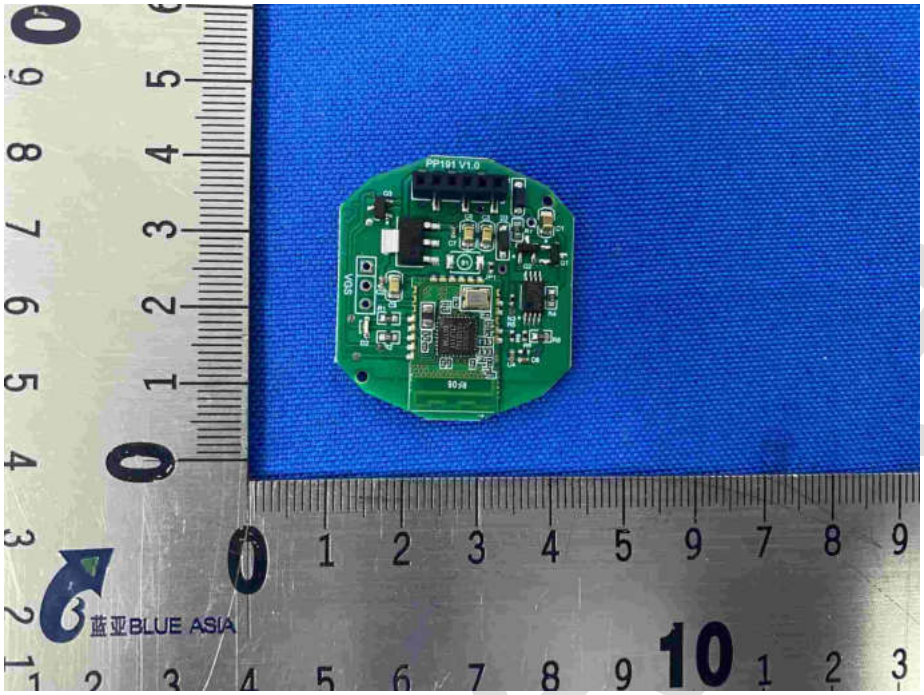


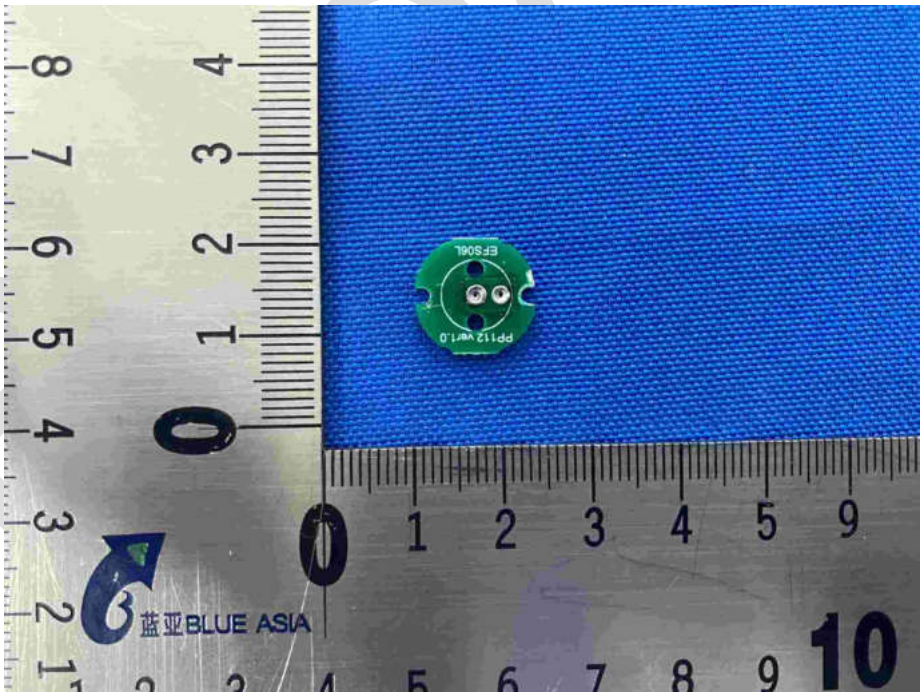


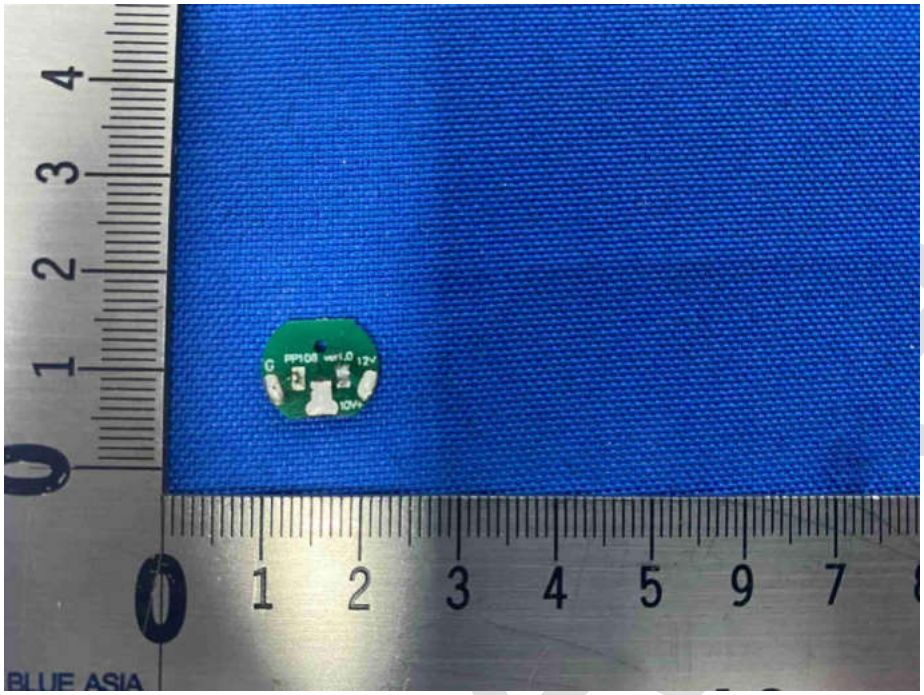


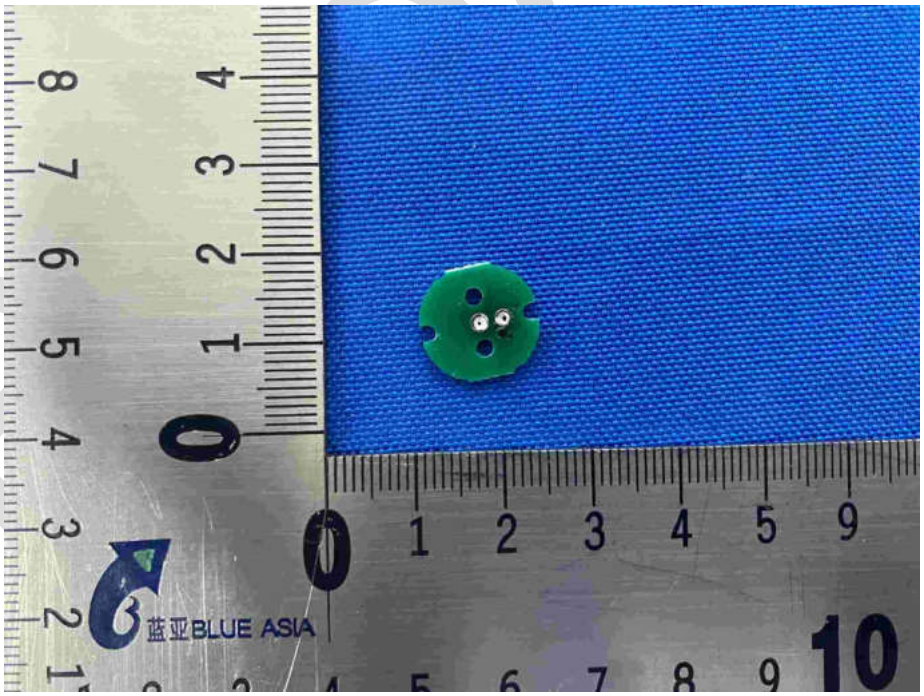

MIC VCC GND

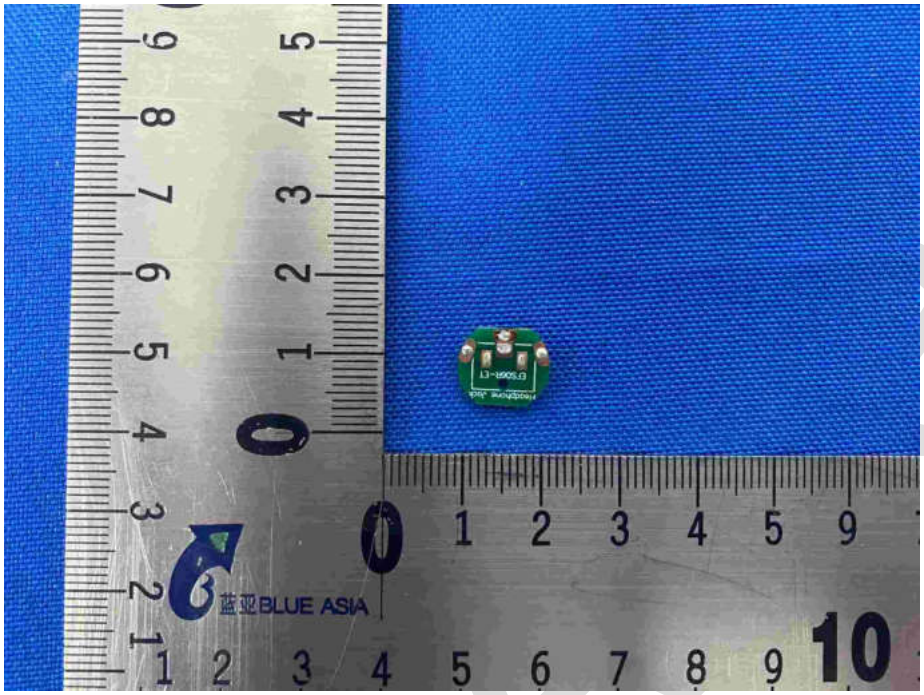



PP191 V1.0
蓝亚BLUE ASIA


蓝亚BLUE ASIA


BLUE ASIA


蓝亚BLUE ASIA



----END OF REPORT----

The test report is effective only with both signature and specialized stamp, The result(s) shown in this report refer only to the sample(s) tested. Without written approval of BlueAsia, this report can't be reproduced except in full.

BlueAsia