

TEST REPORT

Product Name : Bluetooth low energy module
Brand Mark : MINEW
Model No. : MS88SF3
FCC ID : 2ABU6-MS88SF3
Report Number : BLA-RF-202004-A7301
Date of Sample Receipt : 2020/4/22
Date of Test : 2020/4/22 to 2020/5/7
Date of Issue : 2020/5/7
Test Standard : 47 CFR Part 15, Subpart C 15.247
Test Result : Pass

Prepared for:

SHENZHEN MINEW TECHNOLOGIES CO., LTD.

3rd Floor, I Building, Gangzhilong Science Park, Qinglong Road, Longhua District,
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Prepared by:

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2020/5/7



REPORT REVISE RECORD

Version No.	Date	Description
00	2020/5/7	Original

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1 TEST SUMMARY

Test item	Test Requirement	Test Method	Class/Severity	Result
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
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

2 GENERAL INFORMATION

Applicant	SHENZHEN MINEW TECHNOLOGIES CO., LTD.
Address	3rd Floor, I Building, Gangzhilong Science Park, Qinglong Road, Longhua District, Shenzhen City, China
Manufacturer	SHENZHEN MINEW TECHNOLOGIES CO., LTD.
Address	3rd Floor, I Building, Gangzhilong Science Park, Qinglong Road, Longhua District, Shenzhen City, China
Product Name	Bluetooth low energy module
Test Model No.	MS88SF3

3 GENERAL DESCRIPTION OF E.U.T.

Hardware Version	1.X.X
Software Version	1.X.X
Spectrum Spread Technology:	DTS
Operation Frequency:	2402MHz-2480MHz
Modulation Type:	GFSK
Channel Spacing:	2MHz
Number of Channels:	40
Antenna Type:	PCB Antenna
Antenna Gain:	0.158dBi

4 TEST ENVIRONMENT

Environment	Temperature	Voltage
Normal	25°C	DC3.3V

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.	

6 MEASUREMENT UNCERTAINTY

Parameter	Expanded Uncertainty (Confidence of 95%)
Radiated Emission	±4.34dB
Radiated Emission	±4.24dB
Radiated Emission	±4.68dB
AC Power Line Conducted Emission	±3.45dB

Parameter	Expanded Uncertainty (Confidence of 95%)
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±1.5 dB
Power Spectral Density, conducted	±3.0 dB
Unwanted Emissions, conducted	±3.0 dB
Temperature	±3 °C
Supply voltages	±3 %
Time	±5 %
Radiated Emission (30MHz ~ 1000MHz)	±4.35 dB
Radiated Emission (1GHz ~ 18GHz)	±4.44 dB

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.
IOT Test Centre of BlueAsia
No. 448 Bulong Road, Bantian Street, Longgang District, Shenzhen, China
Telephone: TEL: +86-755-28682673 FAX: +86-755-28682673
No tests were sub-contracted.

9 TEST INSTRUMENTS LIST

Test Equipment Of Conducted Band Edges Measurement					
Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Spectrum	Agilent	N9020A	MY49100060	12/18/2018	12/17/2019
Signal Generator	Agilent	N5182A	MY49060650	12/18/2018	12/17/2019
Signal Generator	Agilent	E8257D	MY44320250	5/7/2019	5/6/2020

Test Equipment Of Radiated Spurious Emissions					
Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Chamber	SKET	966	N/A	5/8/2018	5/7/2021
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Receiver	R&S	ESR7	101199	5/7/2019	5/6/2020
broadband Antenna	Schwarzbeck	VULB9168	00836 P:00227	7/14/2018	7/13/2020
Horn Antenna	Schwarzbeck	9120D	01892 P:00331	7/14/2018	7/13/2020
Amplifier	SKET	LNPA-0118-45	N/A	7/4/2019	7/3/2020
EMI software	EZ	EZ-EMC	N/A	N/A	N/A
Loop antenna	SCHNARZBECK	FMZB1519B	00102	2/14/2019	2/13/2020
Controller	SKET	N/A	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-02	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-03	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-01	N/A	N/A	N/A

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	5/8/2018	5/7/2021
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Receiver	R&S	ESR7	101199	5/7/2019	5/6/2020
broadband Antenna	Schwarzbeck	VULB9168	00836 P:00227	7/14/2018	7/13/2020
Horn Antenna	Schwarzbeck	9120D	01892 P:00331	7/14/2018	7/13/2020
Amplifier	SKET	LNPA-0118-45	N/A	7/4/2019	7/3/2020
EMI software	EZ	EZ-EMC	N/A	N/A	N/A
Loop antenna	SCHNARZBECK	FMZB1519B	00102	2/14/2020	2/13/2021
Controller	SKET	N/A	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-02	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-03	N/A	N/A	N/A
Coaxial Cable	BlueAsia	BLA-XC-01	N/A	N/A	N/A

Test Equipment Of Conducted Spurious Emissions

Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Spectrum	Agilent	N9020A	MY49100060	12/18/2019	12/17/2020
Signal Generator	Agilent	N5182A	MY49060650	12/18/2019	12/17/2020
Signal Generator	Agilent	E8257D	MY44320250	5/7/2019	5/6/2020

Test Equipment Of Power Spectrum Density

Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Spectrum	Agilent	N9020A	MY49100060	12/18/2019	12/17/2020

Signal Generator	Agilent	N5182A	MY49060650	12/18/2019	12/17/2020
Signal Generator	Agilent	E8257D	MY44320250	5/7/2019	5/6/2020

Test Equipment Of Conducted Peak Output Power

Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Spectrum	Agilent	N9020A	MY49100060	12/18/2018	12/17/2019
Signal Generator	Agilent	N5182A	MY49060650	12/18/2018	12/17/2019
Signal Generator	Agilent	E8257D	MY44320250	5/7/2019	5/6/2020

Test Equipment Of Minimum 6dB Bandwidth

Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	7/4/2019	7/3/2020
Spectrum	Agilent	N9020A	MY49100060	12/18/2019	12/17/2020
Signal Generator	Agilent	N5182A	MY49060650	12/18/2019	12/17/2020
Signal Generator	Agilent	E8257D	MY44320250	5/7/2019	5/6/2020

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	6/10/2018	6/9/2021
Receiver	R&S	ESPI3	101082	5/7/2019	5/7/2020
LISN	R&S	ENV216	3560.6550.15	7/4/2019	7/3/2020
LISN	安泰信	AT166-2	AKK1806000003	12/18/2019	12/17/2020
EMI software	EZ	EZ-EMC	N/A	N/A	N/A

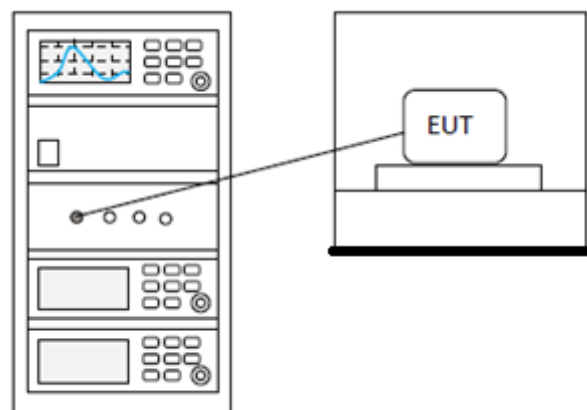
CONDUCTED BAND EDGES MEASUREMENT

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	Jozu
Temperature	25°C
Humidity	60%

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)).
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BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

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RADIATED SPURIOUS EMISSIONS

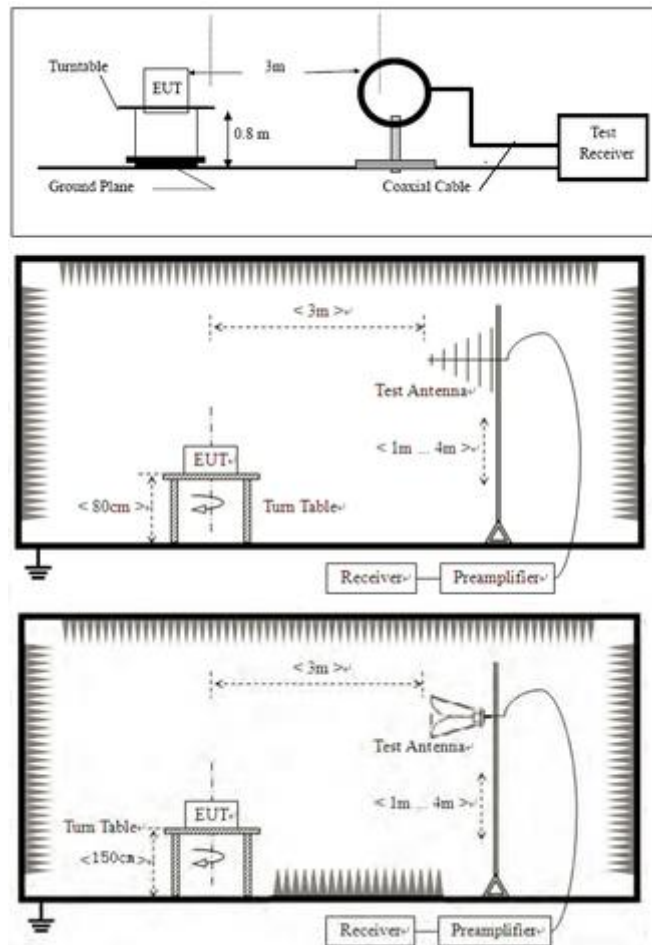
Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.4,6.5,6.6
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	23℃
Humidity	55%

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.

BLOCK DIAGRAM OF TEST SETUP



PROCEDURE

- 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.
- 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.
- 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.
- 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.
- 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.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 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.

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- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark:

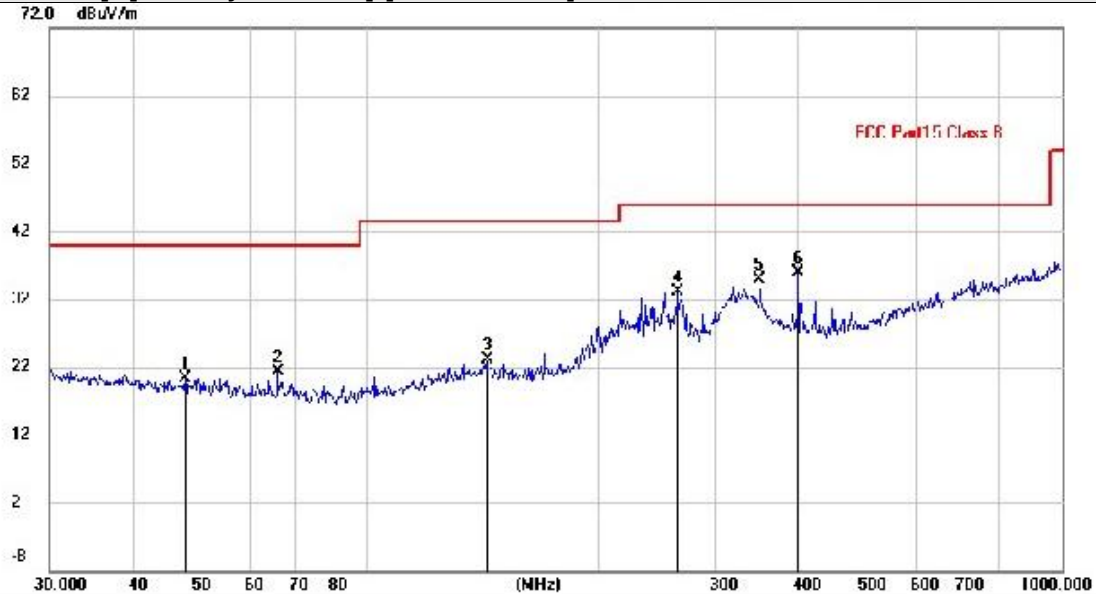
- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor + Preamplifier Factor
- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

TEST DATA

[TestMode: TX] [above 1GHz]						
Test channel:lowest						
Peak value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4804.00	42.06	2.38	44.44	74	-29.56	Vertical
7206.00	46.37	2.17	48.54	74	-25.46	Vertical
9608.00	47.02	2.06	49.08	74	-24.92	Vertical
12010.00	*			74		Vertical
14412.00	*			74		Vertical
4804.00	41.88	2.38	44.26	74	-29.74	Horizontal
7206.00	46.69	2.17	48.86	74	-25.14	Horizontal
9608.00	45.51	2.06	47.57	74	-26.43	Horizontal
12010.00	*			74		Horizontal
14412.00	*			74		Horizontal
Test channel:Middle						
Peak value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4882.00	42.41	0.17	42.58	74	-31.42	Vertical
7323.00	47.25	1.43	48.68	74	-25.32	Vertical
9764.00	46.69	1.26	47.95	74	-26.05	Vertical
12205.00	*			74		Vertical
14646.00	*			74		Vertical
4882.00	41.3	0.17	41.47	74	-32.53	Horizontal
7323.00	46.68	1.43	48.11	74	-25.89	Horizontal
9764.00	48.02	1.26	49.28	74	-24.72	Horizontal
12205.00	*			74		Horizontal
14646.00	*			74		Horizontal
Test channel:Highest						
Peak value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4960.00	42.37	1.04	43.41	74	-30.59	Vertical

7440.00	45.58	2.59	48.17	74	-25.83	Vertical
9920.00	47.76	2.74	50.50	74	-23.50	Vertical
12400.00	*			74		Vertical
14880.00	*			74		Vertical
4960.00	40.83	1.04	41.87	74	-32.13	Horizontal
7440.00	46.58	2.59	49.17	74	-24.83	Horizontal
9920.00	47.03	2.74	49.77	74	-24.23	Horizontal
12400.00	*			74		Horizontal
14880.00	*			74		Horizontal
Test Result: Pass						

[TestMode: TX]; [Polarity: Vertical];[below 1GHz]

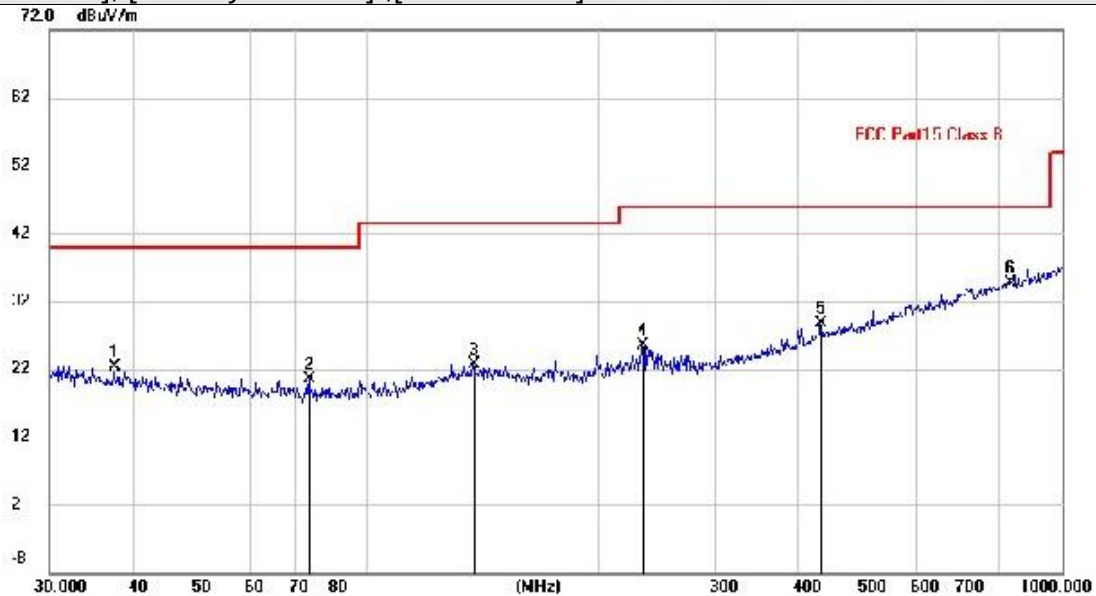


Site: Polarization: **Horizontal** Temperature:
Limit: FCC Part15 Class B Power: Humidity: %
EUT: Bluetooth low energy module Distance:
M/N: MS88SF3
Mode: BT mode
Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree
1		47.9940	-4.05	24.45	20.40	40.00	-19.60	QP		
2		66.0342	-0.82	22.05	21.23	40.00	-18.77	QP		
3		135.9822	-0.12	23.18	23.06	43.50	-20.44	QP		
4		263.8190	10.05	23.03	33.08	46.00	-12.92	QP		
5		350.4768	9.54	25.44	34.98	46.00	-11.02	QP		
6	*	400.4319	8.85	27.01	35.86	46.00	-10.14	QP		

Test Result: Pass

[TestMode: TX]; [Polarity: Vertical] ;[below 1GHz]



Site: Polarization: **Vertical** Temperature:
Limit: FCC Part15 Class B Power: Humidity: %
EUT: Bluetooth low energy module Distance:
M/N: MS88SF3
Mode: BT mode
Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		37.5479	-1.50	23.75	22.25	40.00	-17.75	QP		
2		73.6170	0.18	20.42	20.60	40.00	-19.40	QP		
3		129.9226	-0.21	22.99	22.78	43.50	-20.72	QP		
4		233.3487	2.97	22.54	25.51	46.00	-20.49	QP		
5		432.5457	1.01	27.73	28.74	46.00	-17.26	QP		
6	*	830.4002	0.24	34.51	34.75	46.00	-11.25	QP		

Test Result: Pass

RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS

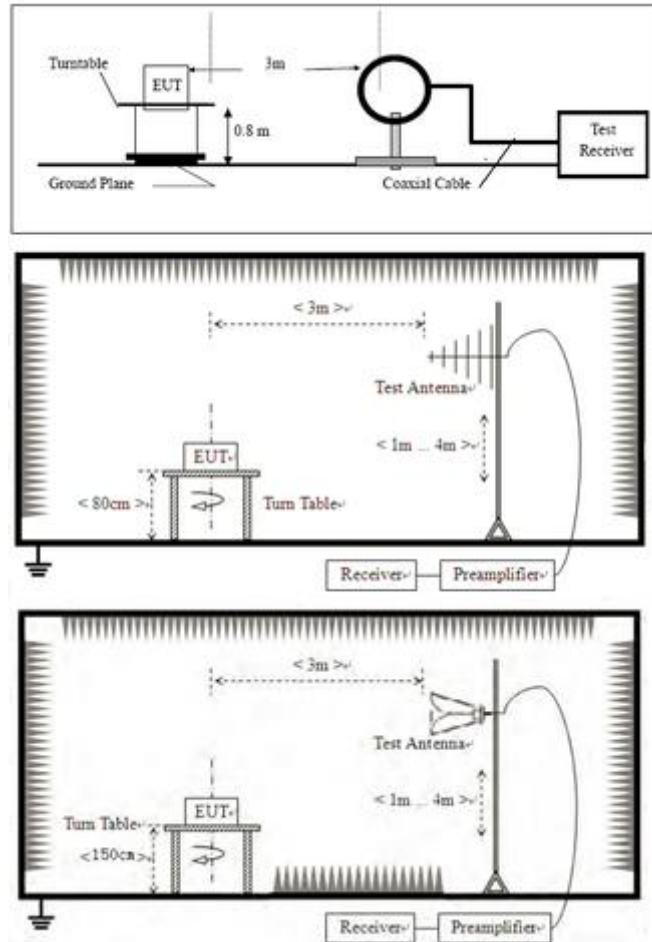
Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.10.5
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	25℃
Humidity	60%

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.

BLOCK DIAGRAM OF TEST SETUP



PROCEDURE

- 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.
- 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.
- 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.
- 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.
- 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.
- The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 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.

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Email:marketing@cblueasia.com

- 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: $\text{Level} = \text{Read Level} + \text{Cable Loss} + \text{Antenna Factor} - \text{Preamp Factor}$

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.

TEST DATA

[TestMode: TX]						
Test channel:lowest						
Peak value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2310	46.78	-4.2	42.58	74	-31.42	Horizontal
2390	49.27	-3.88	45.39	74	-28.61	Horizontal
2310	47.31	-4.49	42.82	74	-31.18	Vertical
2390	48.45	-4.21	44.24	74	-29.76	Vertical
Average value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor(dB /m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2310	32.74	-4.2	28.54	54	-25.46	Horizontal
2390	32.6	-3.88	28.72	54	-25.28	Horizontal
2310	33.22	-4.49	28.73	54	-25.27	Vertical
2390	40.23	-4.21	36.02	54	-17.98	Vertical
Test channel:Highest						
Peak value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.5	45.91	-3.39	42.52	74	-31.48	Horizontal
2500	45.55	-3.3	42.25	74	-31.75	Horizontal
2483.5	50.93	-3.78	47.15	74	-26.85	Vertical
2500	46.5	-3.7	42.8	74	-31.2	Vertical
Average value:						
Frequency (MHz)	Read Level (dBuV)	Correct factor(dB /m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.5	33.46	-3.39	30.07	54	-23.93	Horizontal
2500	33.47	-3.3	30.17	54	-23.83	Horizontal
2483.5	33.72	-3.78	29.94	54	-24.06	Vertical

2500	33.76	-3.7	30.06	54	-23.94	Vertical
Test Result: Pass						

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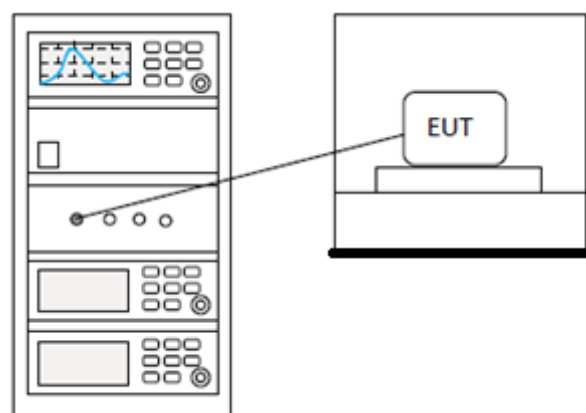
CONDUCTED SPURIOUS EMISSIONS

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	Jozu
Temperature	25°C
Humidity	56%

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)).
---------------	--

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

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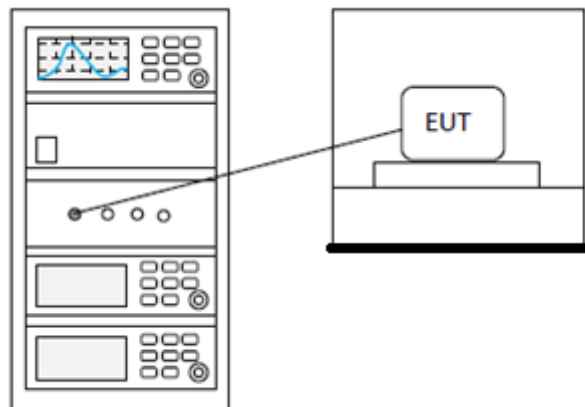
POWER SPECTRUM DENSITY

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	Jozu
Temperature	25°C
Humidity	60%

LIMITS

Limit:	$\leq 8\text{dBm}$ in any 3 kHz band during any time interval of continuous transmission
---------------	--

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

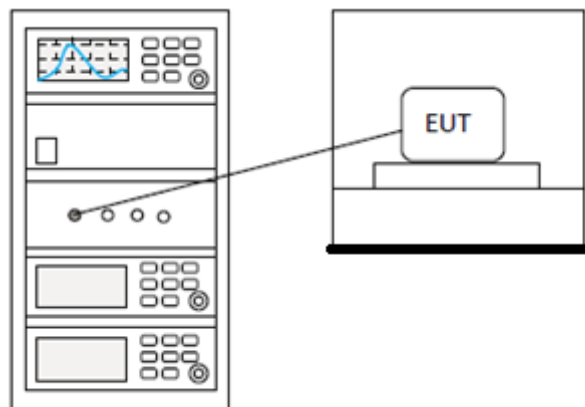
CONDUCTED PEAK OUTPUT POWER

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	Jozu
Temperature	25°C
Humidity	60%

LIMITS

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥ 50 hopping channels
	0.25 for $25 \leq \text{hopping channels} < 50$
	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

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details
--

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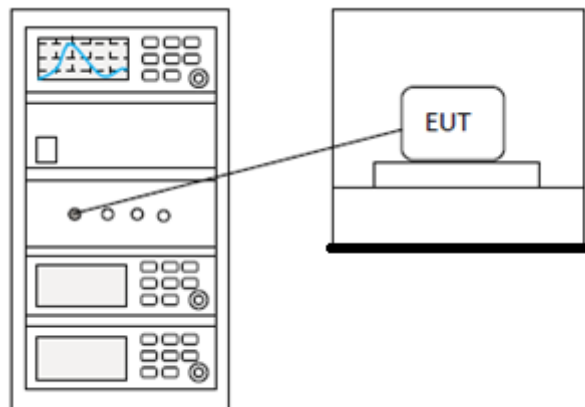
MINIMUM 6DB BANDWIDTH

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	Jozu
Temperature	25°C
Humidity	60%

LIMITS

Limit:	≥ 500 kHz
--------	----------------

BLOCK DIAGRAM OF TEST SETUP



TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

ANTENNA REQUIREMENT

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

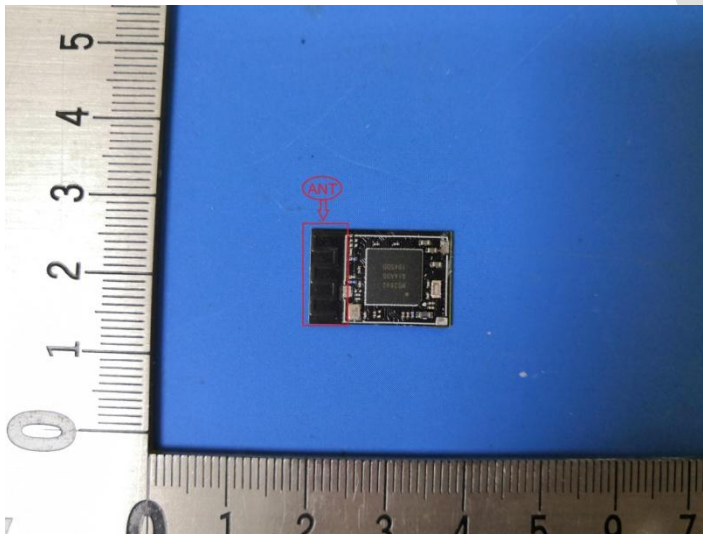
CONCLUSION

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 an 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 0.158dBi.



CONDUCTED EMISSIONS AT AC POWER LINE (150KHZ-30MHZ)

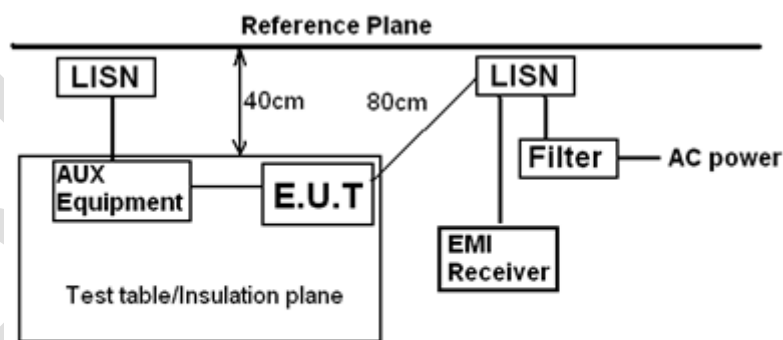
Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.2
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	24℃
Humidity	55%

LIMITS

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.

BLOCK DIAGRAM OF TEST SETUP



Remark
E.U.T: Equipment Under Test
LISN: Line Impedance Stabilization Network
Test table height=0.8m

PROCEDURE

- 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/50?H + 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.

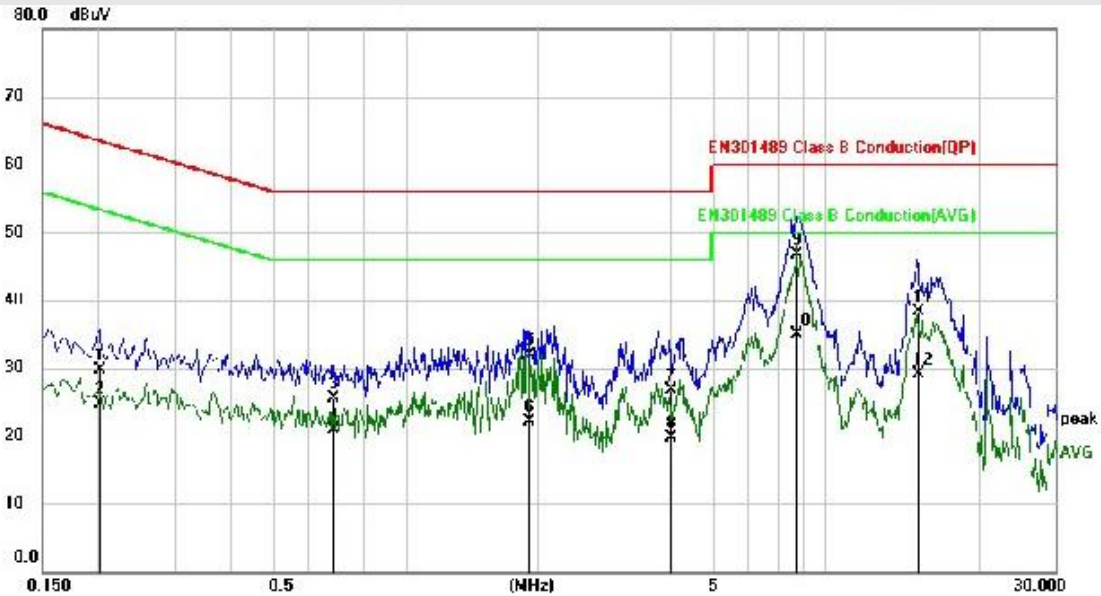
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

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

TEST DATA

[TestMode: TX]; [Line: Line]

Power: AC120V/60Hz



Site: Phase: **L1** Temperature: 26
Limit: EN301489 Class B Conduction(QP) Power: Humidity: 60 %
EUT: Bluetooth low energy module
M/N: MS88SF3
Mode: BT mode
Note:

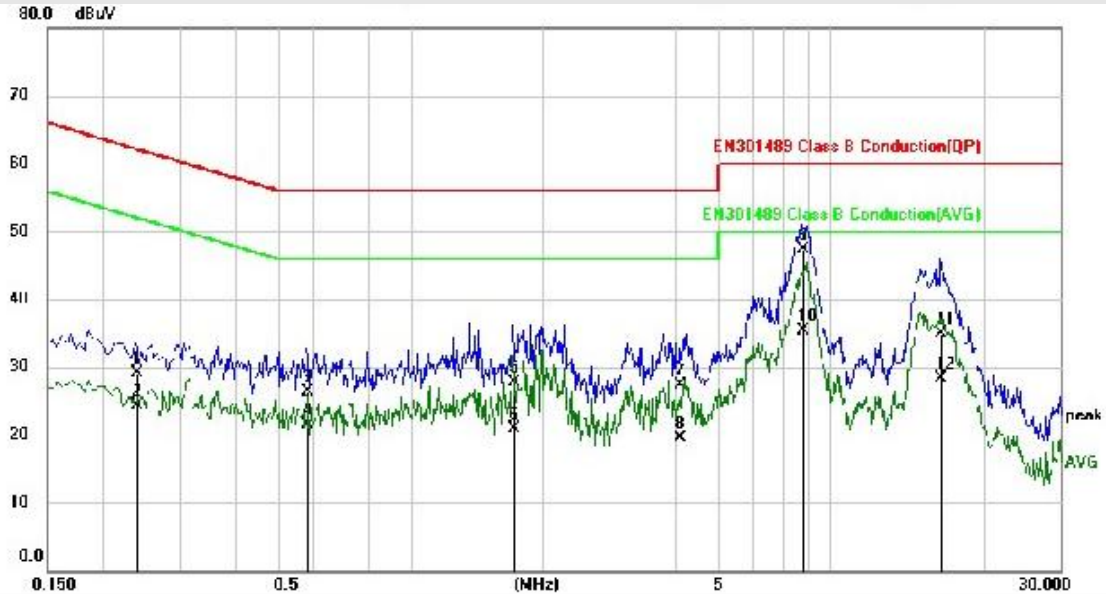
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.2020	19.89	9.87	29.76	63.53	-33.77	QP	
2		0.2020	14.92	9.87	24.79	53.53	-28.74	AVG	
3		0.6860	15.82	9.68	25.50	56.00	-30.50	QP	
4		0.6860	11.14	9.68	20.82	46.00	-25.18	AVG	
5		1.9060	22.16	9.82	31.98	56.00	-24.02	QP	
6		1.9060	12.32	9.82	22.14	46.00	-23.86	AVG	
7		4.0020	16.85	9.83	26.68	56.00	-29.32	QP	
8		4.0020	9.90	9.83	19.73	46.00	-26.27	AVG	
9	*	7.7420	36.84	9.87	46.71	60.00	-13.29	QP	
10		7.7420	24.96	9.87	34.83	50.00	-15.17	AVG	
11		14.5260	28.25	9.97	38.22	60.00	-21.78	QP	
12		14.5260	19.23	9.97	29.20	50.00	-20.80	AVG	

Test Result: Pass

BlueAsia

[TestMode: TX]; [Line: Nutral]

Power: AC120V/60Hz



Site: Phase: **N** Temperature: 26
Limit: EN301489 Class B Conduction(QP) Power: Humidity: 60 %
EUT: Bluetooth low energy module
M/N: MS88SF3
Mode: BT mode
Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.2380	19.34	9.85	29.19	62.17	-32.98	QP	
2		0.2380	14.40	9.85	24.25	52.17	-27.92	AVG	
3		0.5820	16.59	9.74	26.33	56.00	-29.67	QP	
4		0.5820	11.77	9.74	21.51	46.00	-24.49	AVG	
5		1.7140	17.84	9.84	27.68	56.00	-28.32	QP	
6		1.7140	11.16	9.84	21.00	46.00	-25.00	AVG	
7		4.1100	17.38	9.84	27.22	56.00	-28.78	QP	
8		4.1100	9.66	9.84	19.50	46.00	-26.50	AVG	
9	*	7.8020	37.54	9.86	47.40	60.00	-12.60	QP	
10		7.8020	25.35	9.86	35.21	50.00	-14.79	AVG	
11		16.0419	24.91	10.00	34.91	60.00	-25.09	QP	
12		16.0419	18.39	10.00	28.39	50.00	-21.61	AVG	

Test Result: Pass

10 APPENDIX

Appendix1

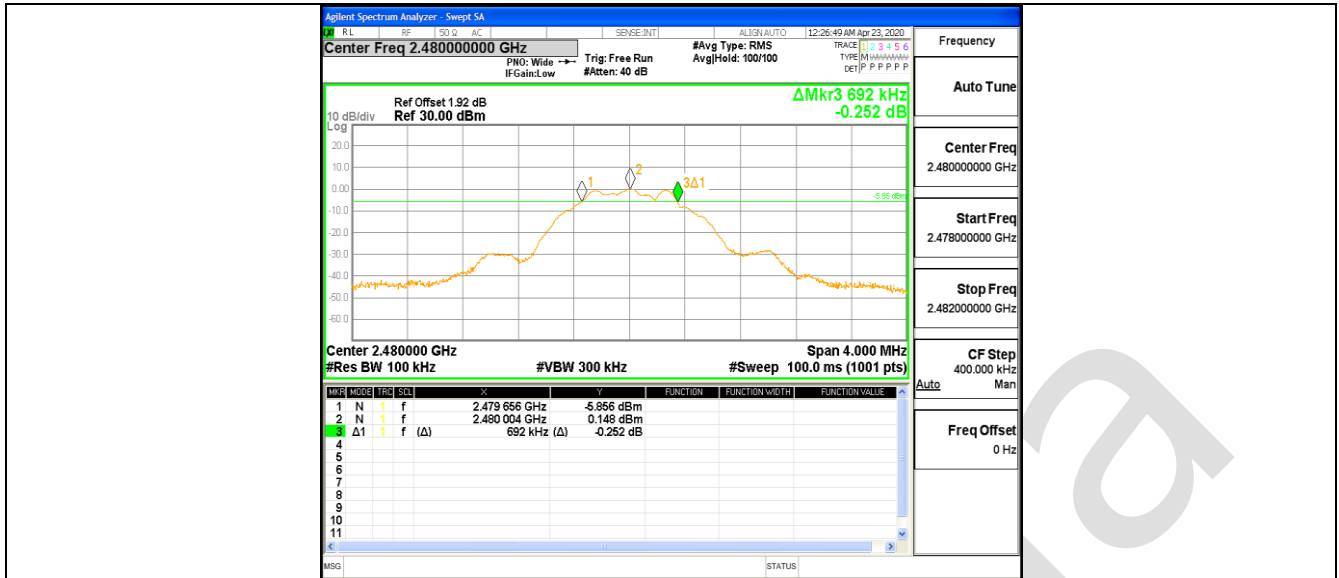
10.1 APPENDIX A: DTS BANDWIDTH

Test Result

TestMode	Antenna	Channel	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE	Ant1	2402	0.696	2401.652	2402.348	≥ 0.5	PASS
		2442	0.696	2441.652	2442.348	≥ 0.5	PASS
		2480	0.692	2479.656	2480.348	≥ 0.5	PASS

Test Graphs

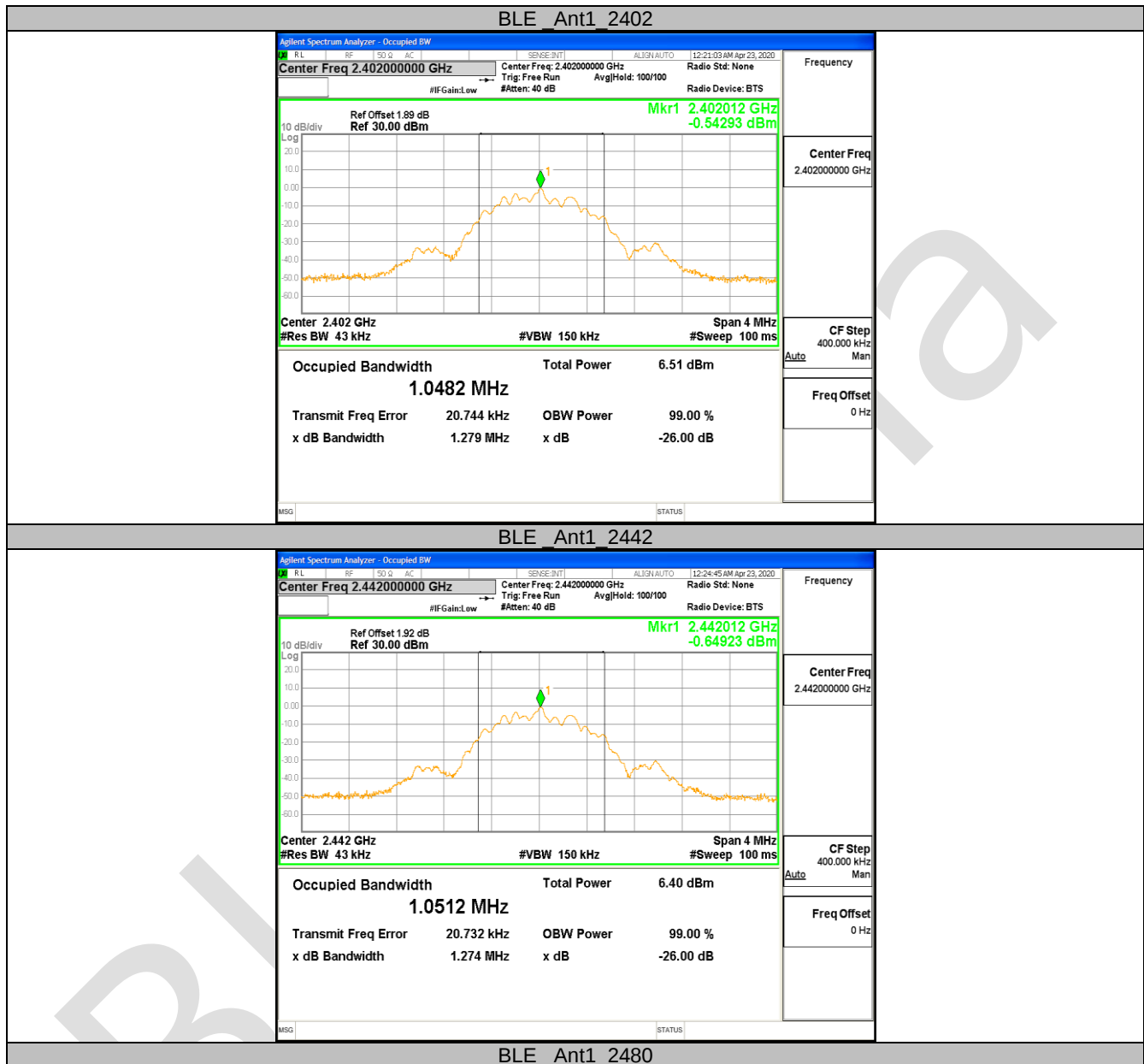


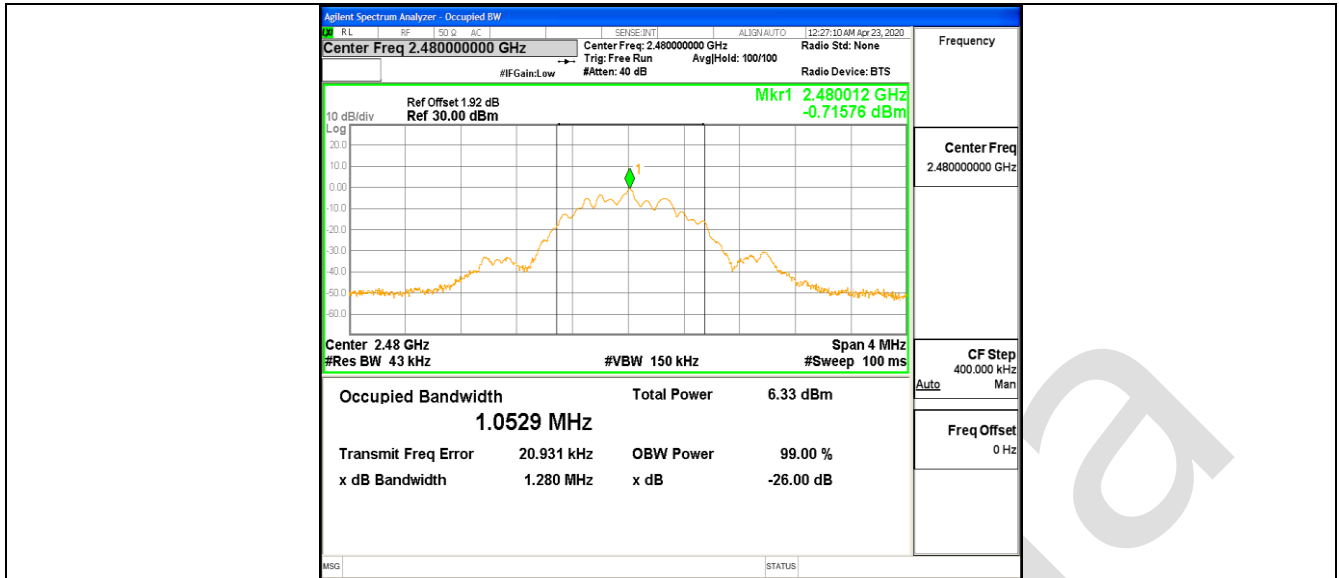


10.2 APPENDIX B: OCCUPIED CHANNEL BANDWIDTH**Test Result**

TestMode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE	Ant1	2402	1.0482	2401.497	2402.545	---	PASS
		2442	1.0512	2441.495	2442.546	---	PASS
		2480	1.0529	2479.494	2480.547	---	PASS

Test Graphs

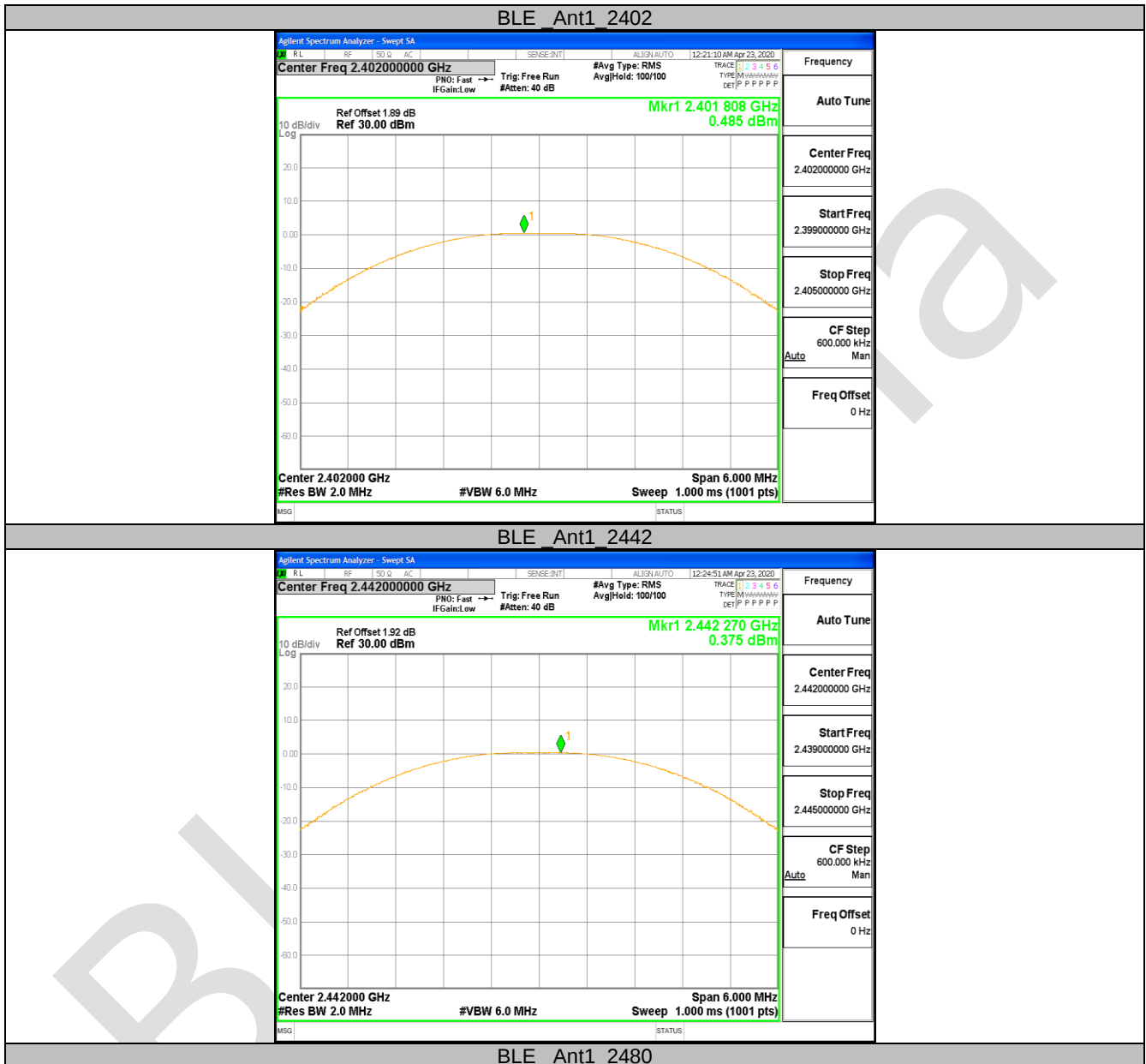


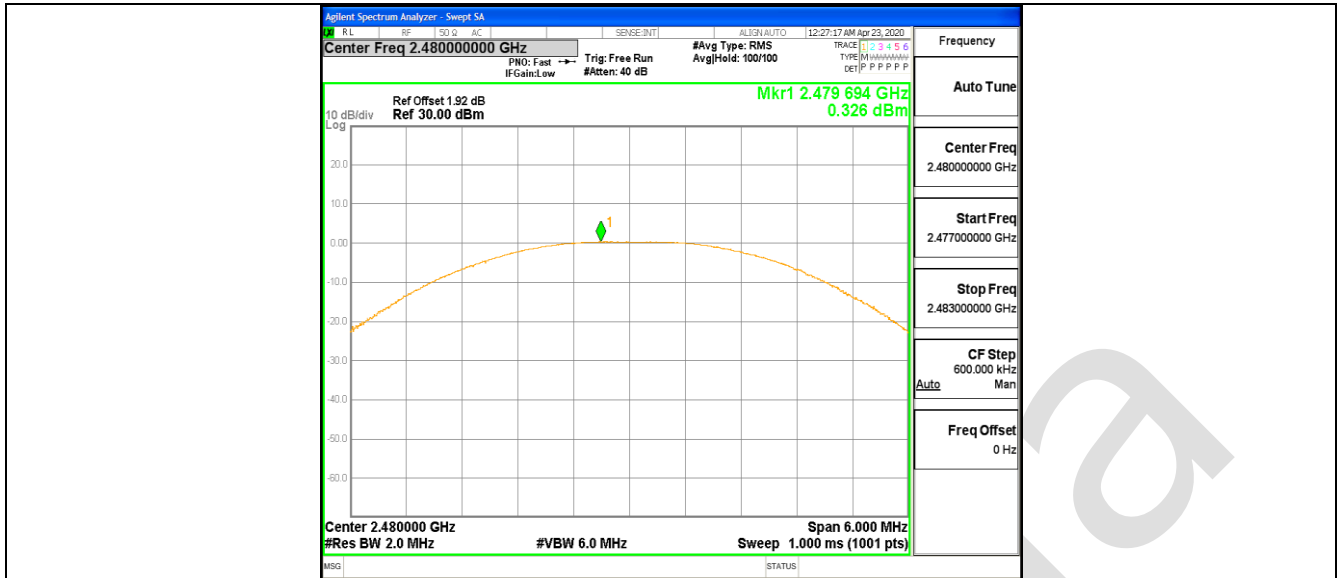


10.3 APPENDIX C: MAXIMUM CONDUCTED OUTPUT POWER**Test Result**

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
BLE	Ant1	2402	0.49	<=30	PASS
		2442	0.38	<=30	PASS
		2480	0.33	<=30	PASS

Test Graphs



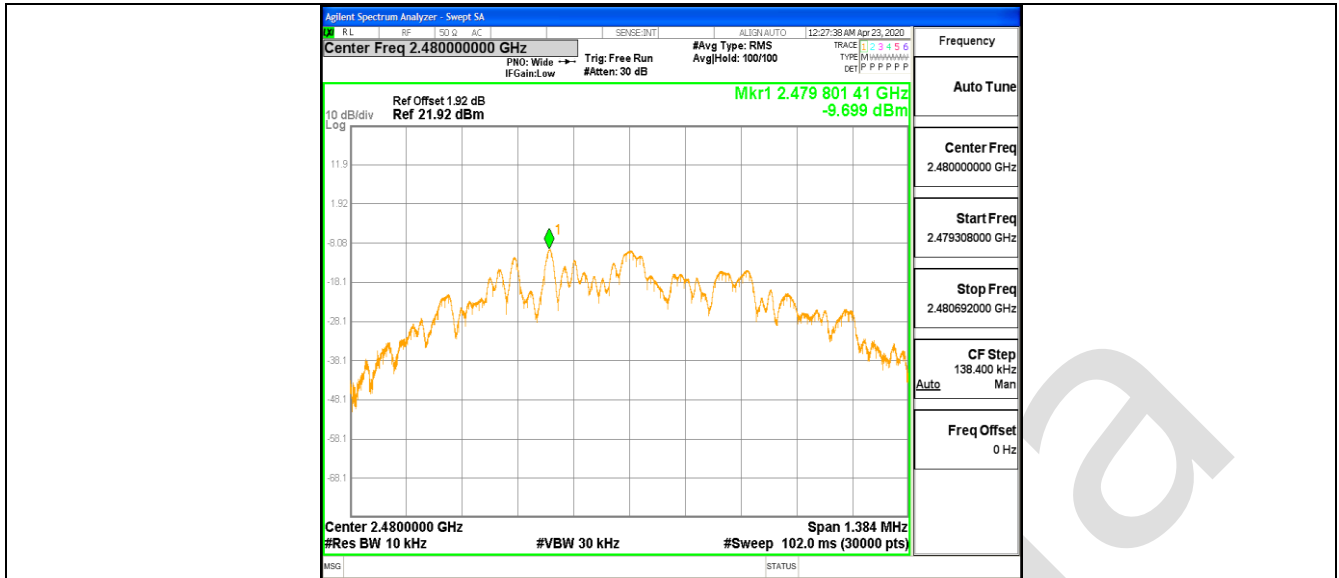


10.4 APPENDIXD: MAXIMUM POWER SPECTRAL DENSITY**Test Result**

TestMode	Antenna	Channel	Result[dBm/3-100kHz]	Limit[dBm/3kHz]	Verdict
BLE	Ant1	2402	-9.44	<=8	PASS
		2442	-9.63	<=8	PASS
		2480	-9.7	<=8	PASS

Test Graphs





10.5 APPENDIX E: BAND EDGE MEASUREMENTS**Test Result**

TestMode	Antenna	ChName	Channel	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE	Ant1	Low	2402	0.23	-53.66	≤ -19.77	PASS
		High	2480	0.13	-53.64	≤ -19.87	PASS

Test Graphs



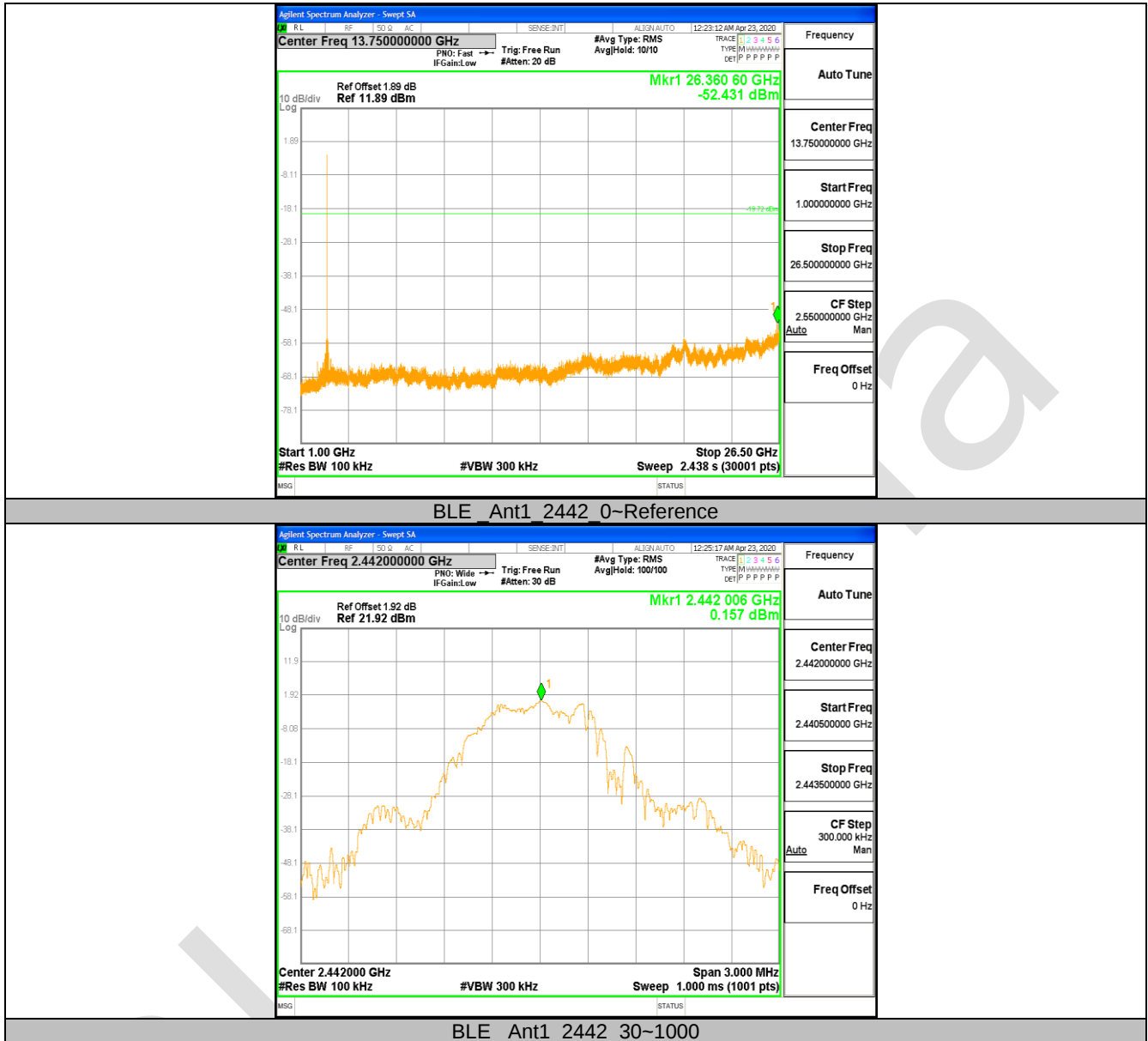
10.6 APPENDIX F: CONDUCTED SPURIOUS EMISSION

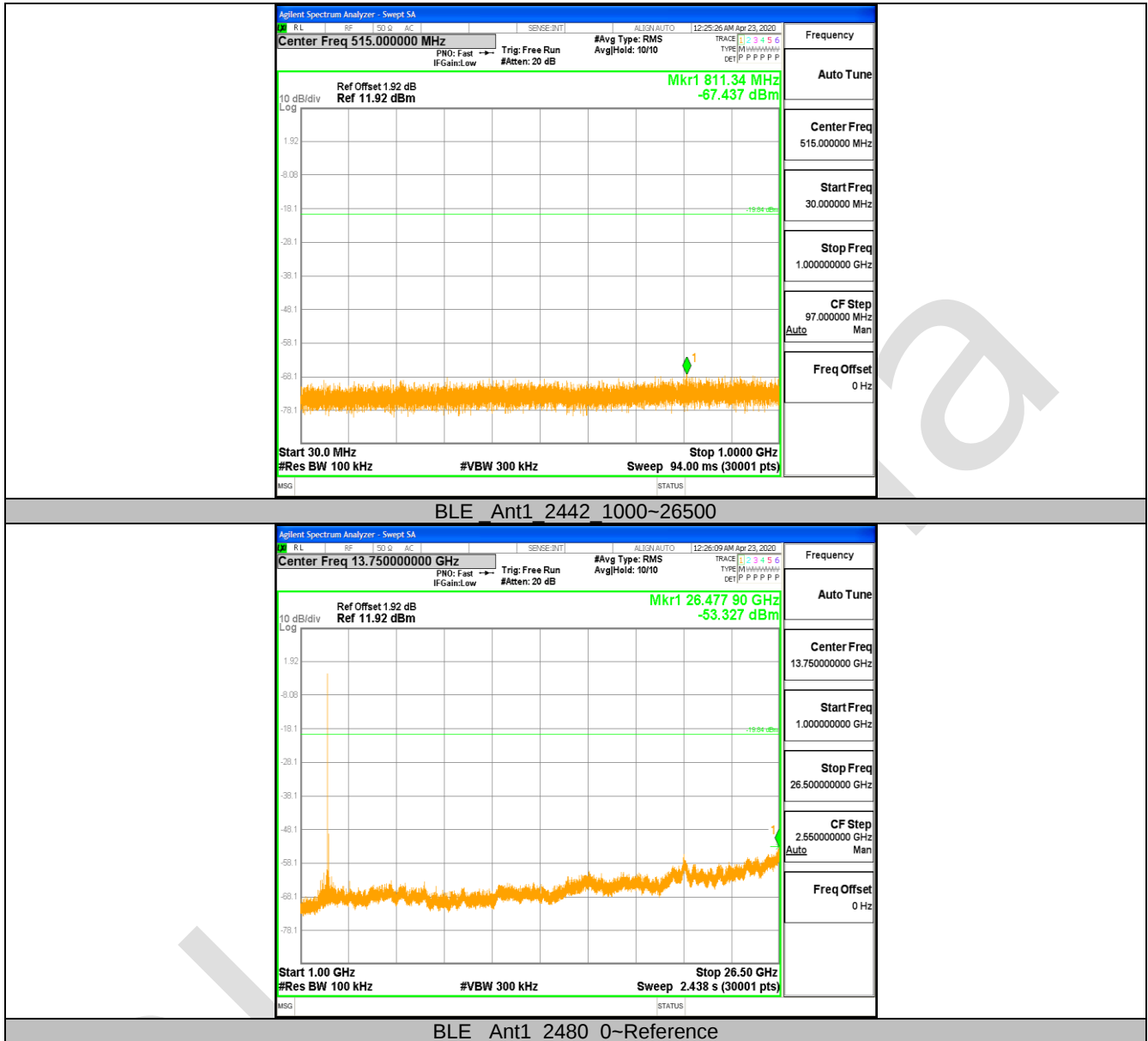
Test Result

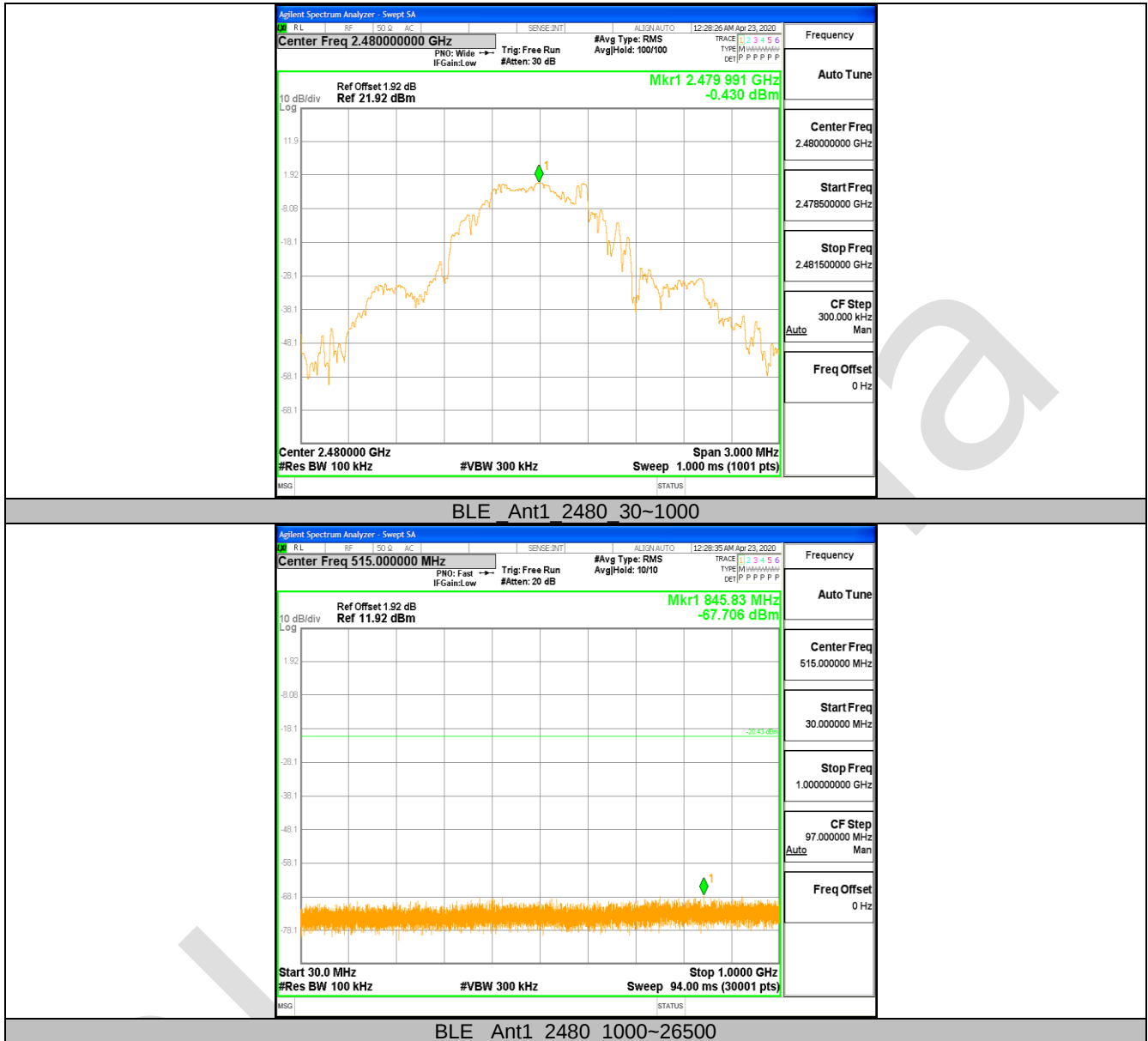
TestMode	Antenna	Channel	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE	Ant1	2402	Reference	0.28	0.28	---	PASS
			30~1000	30~1000	-67.171	<=-19.724	PASS
			1000~26500	1000~26500	-52.431	<=-19.724	PASS
		2442	Reference	0.16	0.16	---	PASS
			30~1000	30~1000	-67.437	<=-19.843	PASS
			1000~26500	1000~26500	-53.327	<=-19.843	PASS
		2480	Reference	-0.43	-0.43	---	PASS
			30~1000	30~1000	-67.706	<=-20.43	PASS
			1000~26500	1000~26500	-53.502	<=-20.43	PASS

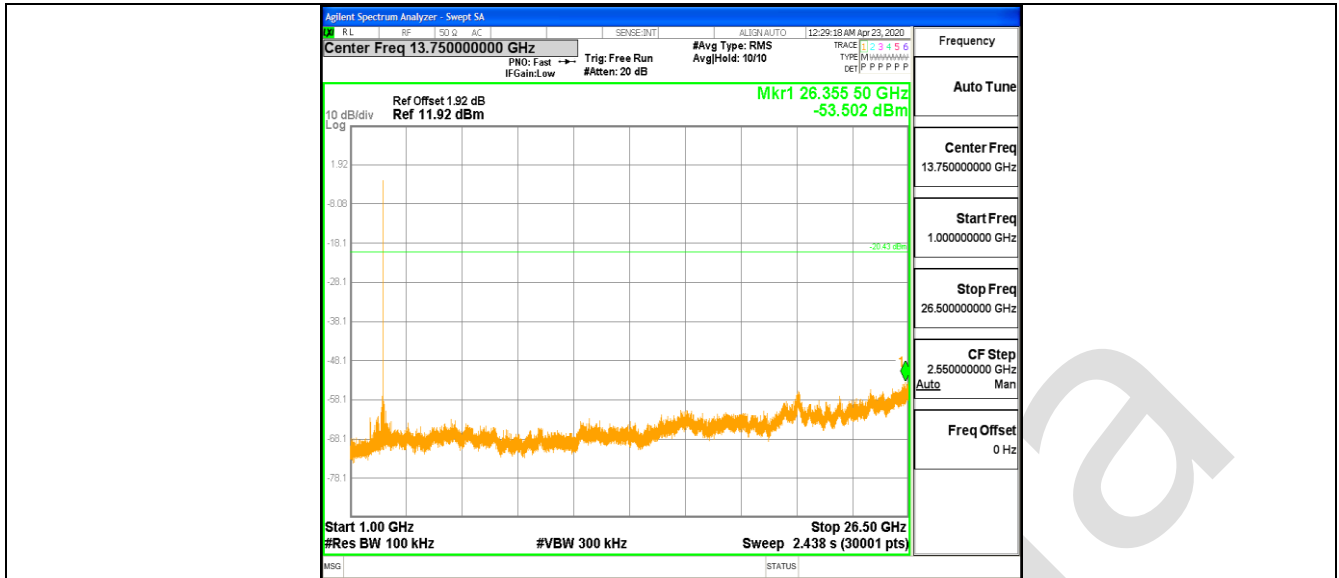
Test Graphs





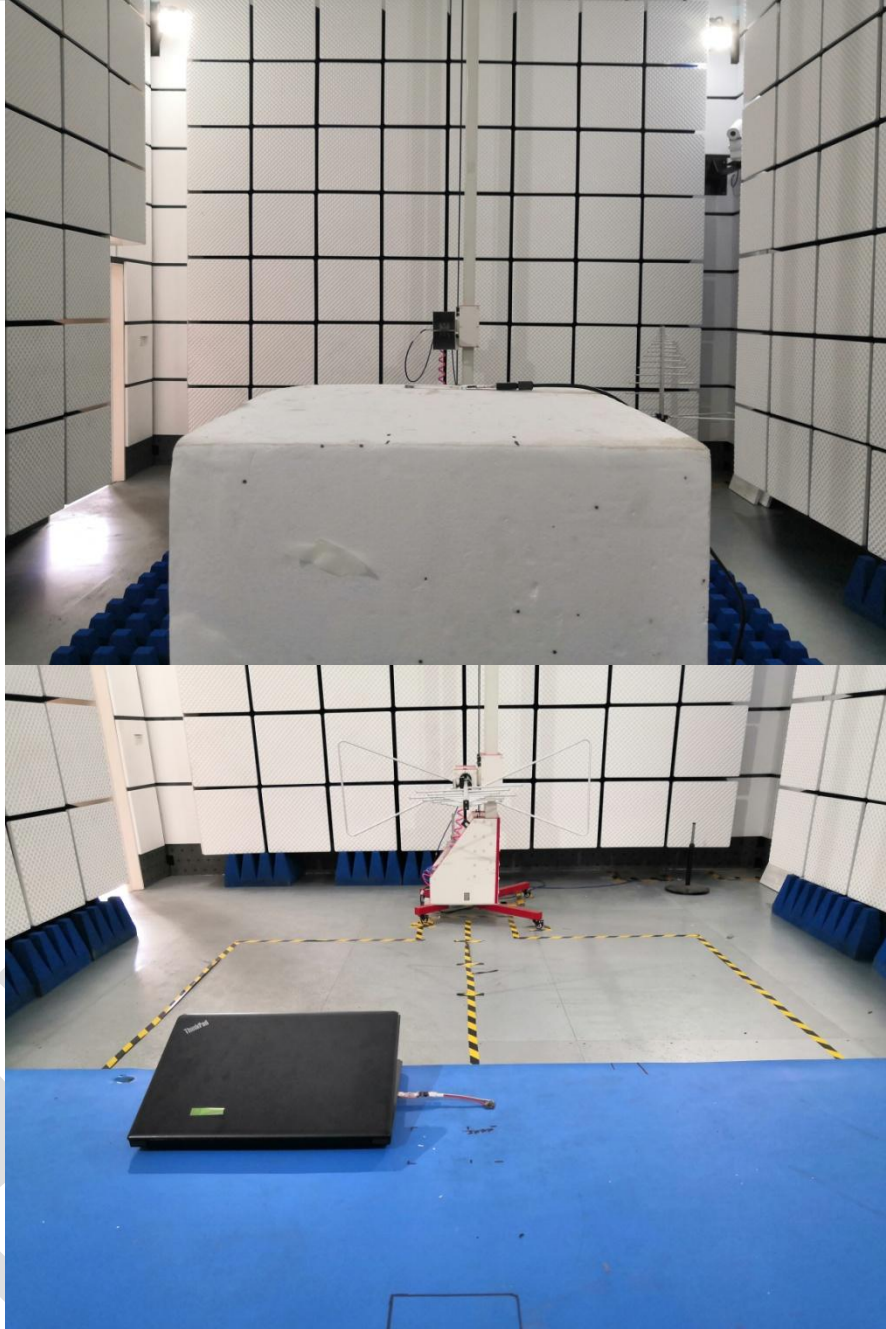






APPENDIX A: PHOTOGRAPHS OF TEST SETUP

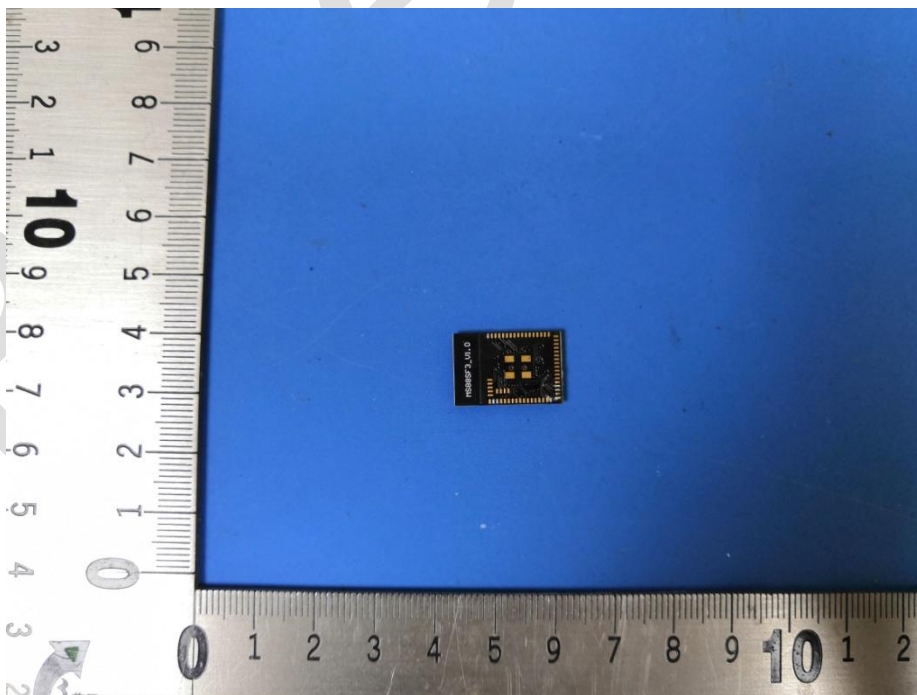
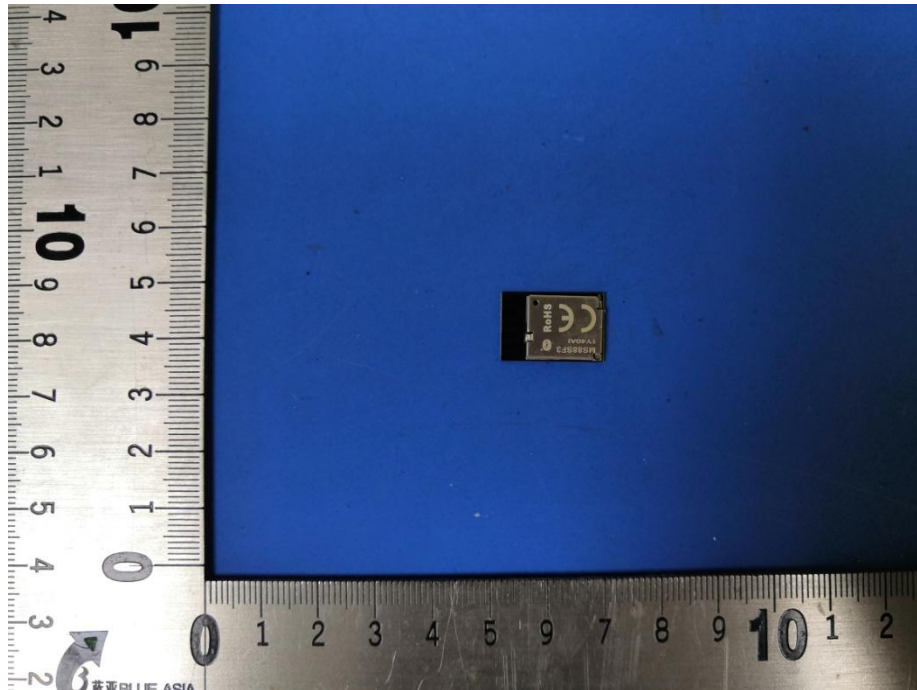
Radiated Spurious Emissions

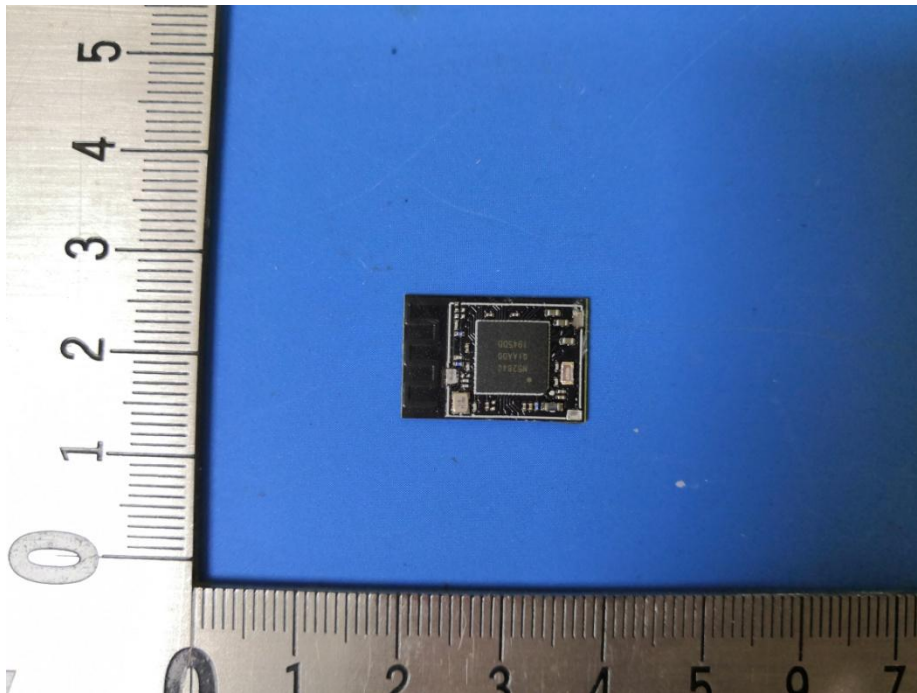


Conducted Emissions at AC Power Line (150kHz-30MHz)

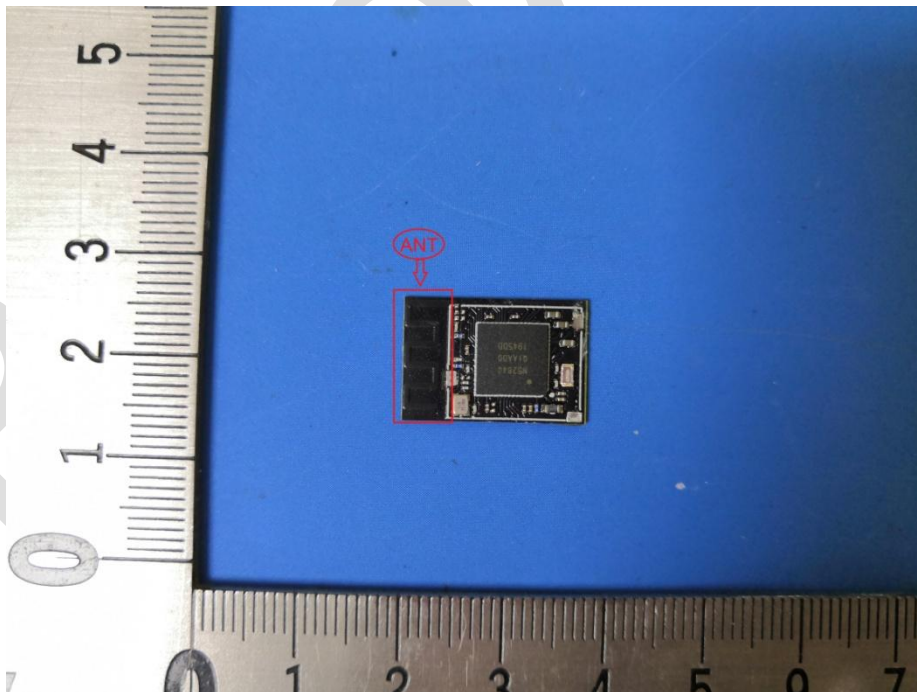


APPENDIX B: PHOTOGRAPHS OF EUT





ANT



----END OF REPORT----

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