

TEST REPORT

Product Name : BLE module
Brand Mark : N.E.T
Model No. : BT829-2
Report Number : BLA-EMC-202303-A8101
FCC ID : 2BAMT-BT829-2
Date of Sample Receipt : 2023/3/20
Date of Test : 2023/3/20 to 2023/3/27
Date of Issue : 2023/3/27
Test Standard : 47 CFR Part 15, Subpart C 15.247
Test Result : Pass

Prepared for:

Nebula Electronic Technology Corporation

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Prepared by:

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Review by:

Sueels

Date:

2023/3/27



REPORT REVISE RECORD

Version No.	Date	Description
00	2023/3/27	Original

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
10	CONDUCTED BAND EDGES MEASUREMENT	11
10.1	LIMITS	11
10.2	BLOCK DIAGRAM OF TEST SETUP	11
10.3	TEST DATA	12
11	RADIATED SPURIOUS EMISSIONS	13
11.1	LIMITS	13
11.2	BLOCK DIAGRAM OF TEST SETUP	14
11.3	PROCEDURE	14
11.4	TEST DATA	16
12	RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS	24
12.1	LIMITS	24
12.2	BLOCK DIAGRAM OF TEST SETUP	25
12.3	PROCEDURE	25
12.4	TEST DATA	27
13	CONDUCTED SPURIOUS EMISSIONS	31
13.1	LIMITS	31
13.2	BLOCK DIAGRAM OF TEST SETUP	31
13.3	TEST DATA	32
14	POWER SPECTRUM DENSITY	33
14.1	LIMITS	33
14.2	BLOCK DIAGRAM OF TEST SETUP	33

14.3	TEST DATA	33
15	CONDUCTED PEAK OUTPUT POWER	34
15.1	LIMITS	34
15.2	BLOCK DIAGRAM OF TEST SETUP	34
15.3	TEST DATA	35
16	MINIMUM 6DB BANDWIDTH	36
16.1	LIMITS	36
16.2	BLOCK DIAGRAM OF TEST SETUP	36
16.3	TEST DATA	36
17	ANTENNA REQUIREMENT	37
17.1	CONCLUSION	37
18	CONDUCTED EMISSIONS AT AC POWER LINE (150KHZ-30MHZ)	38
18.1	LIMITS	38
18.2	BLOCK DIAGRAM OF TEST SETUP	38
18.3	PROCEDURE	38
18.4	TEST DATA	40
19	APPENDIX	43
APPENDIX A: PHOTOGRAPHS OF TEST SETUP		58
APPENDIX B: PHOTOGRAPHS OF EUT		60

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	Nebula Electronic Technology Corporation
Address	Room 1002, No.570 ShengXia RD, Pudong district, Shanghai, China
Manufacturer	Nebula Electronic Technology Corporation
Address	Room 1002, No.570 ShengXia RD, Pudong district, Shanghai, China
Factory	Nebula Electronic Technology Corporation
Address	Room 1002, No.570 ShengXia RD, Pudong district, Shanghai, China
Product Name	BLE module
Test Model No.	BT829-2

3 GENERAL DESCRIPTION OF E.U.T.

Hardware Version	N/A
Software Version	N/A
Operation Frequency:	2402MHz-2480MHz
Modulation Type:	GFSK
Channel Spacing:	2MHz
Number of Channels:	40
Antenna Type:	Chip Antenna
Antenna Gain:	-0.6dBi (Provided by the applicant)

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
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(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

7 DESCRIPTION OF SUPPORT UNIT

Device Type	Manufacturer	Model Name	Serial No.	Remark
PC	HASEE	N/A	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, Shiyao Sub-District, Baoan District, Shenzhen, Guangdong Province,
China
Telephone: TEL: +86-755-28682673 FAX: +86-755-28682673

9 TEST INSTRUMENTS LIST

Test Equipment Of Radiated Spurious Emissions					
Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Chamber 1	SKET	966	N/A	2020/11/10	2023/11/9
Chamber 2	SKET	966	N/A	2021/07/20	2024/07/19
Spectrum	R&S	FSP40	100817	2022/09/15	2023/09/14
Receiver	R&S	ESR7	101199	2022/09/15	2023/09/14
Receiver	R&S	ESPI7	101477	2022/07/16	2023/07/15
broadband Antenna	Schwarzbeck	VULB9168	00836 P:00227	2022/09/15	2023/09/14
Horn Antenna	Schwarzbeck	BBHA9120D	01892 P:00331	2022/09/13	2025/09/12
Amplifier	SKET	LNPA_30M01G-30	SK2021060801	2022/07/16	2023/07/15
Amplifier	SKET	PA-000318G-45	N/A	2022/09/13	2023/09/12
Amplifier	SKET	LNPA_18G40G-50	SK2022071301	2022/07/14	2023/07/13
Filter group	SKET	2.4G/5G Filter group r	N/A	2022/07/16	2023/07/15
EMI software	EZ	EZ-EMC	EEMC-3A1	N/A	N/A
Loop antenna	SCHNARZBECK	FMZB1519B	00102	2022/9/14	2025/9/13
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 Emissions at AC Power Line (150kHz-30MHz)

Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Shield room	SKET	833	N/A	2020/11/25	2023/11/24
Receiver	R&S	ESPI3	101082	2022/09/14	2023/09/13
LISN	R&S	ENV216	3560.6550.15	2022/09/14	2023/09/13
LISN	AT	AT166-2	AKK1806000003	2022/09/14	2023/09/13
ISN	TESEQ	ISNT8-cat6	53580	2022/09/14	2023/09/13
Single-channel vehicle artificial power network	Schwarzbeck	NNBM 8124	01045	2022/08/17	2023/08/16
Single-channel vehicle artificial power network	Schwarzbeck	NNBM 8124	01075	2022/08/17	2023/08/16
EMI software	EZ	EZ-EMC	EEMC-3A1	N/A	N/A

Test Equipment Of RF Conducted Test

Equipment	Manufacturer	Model	S/N	Cal.Date	Cal.Due
Spectrum	R&S	FSP40	100817	2022/09/15	2023/09/14
Spectrum	Agilent	N9020A	MY49100060	2022/09/07	2023/09/06
Spectrum	KEYSIGHT	N9030A	MY52350152	2022/07/01	2023/06/30
Spectrum	KEYSIGHT	N9010A	MY54330814	2022/07/01	2023/06/30
Signal Generator	Agilent	N5182A	MY47420955	2022/09/07	2023/09/06
Signal Generator	Agilent	E8257D	MY44320250	2022/07/01	2023/06/30
Signal Generator	Agilent	N5181A	MY46240904	2022/08/02	2023/08/01
Signal Generator	R&S	CMW500	132429	2022/09/07	2023/09/06
BluetoothTester	Anritsu	MT8852B	06262047872	2022/09/07	2023/09/06
Power probe	DARE	RPR3006W	14I00889SN042	2022/09/07	2023/09/06
DCPowersupply	zhaoxin	KXN-305D	20K305D1221363	2022/09/14	2023/09/13
DCPowersupply	zhaoxin	RXN-1505D	19R1505D050168	2022/09/14	2023/09/13
2.4GHz/5GHz RF Test software	MTS	MTS 8310	Version 2.0.0.0	N/A	N/A
Audio Analyzer	Audioprecision	N/A	ATSI-41094	2022/7/1	2023/6/30

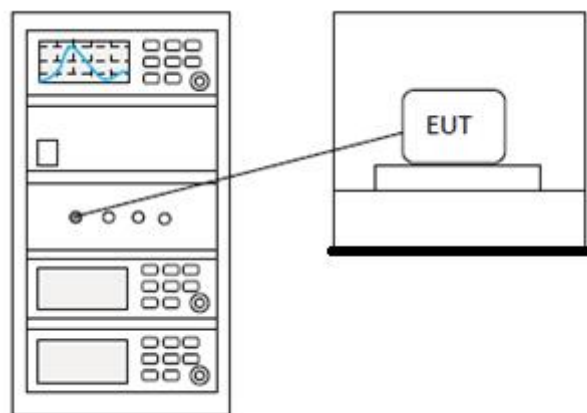
10 CONDUCTED BAND EDGES MEASUREMENT

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	Jozu
Temperature	25°C
Humidity	60%

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)).
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10.2 BLOCK DIAGRAM OF TEST SETUP



10.3 TEST DATA

Pass: Please Refer To Appendix: Appendix1 For Details

BlueAsia

11 RADIATED SPURIOUS EMISSIONS

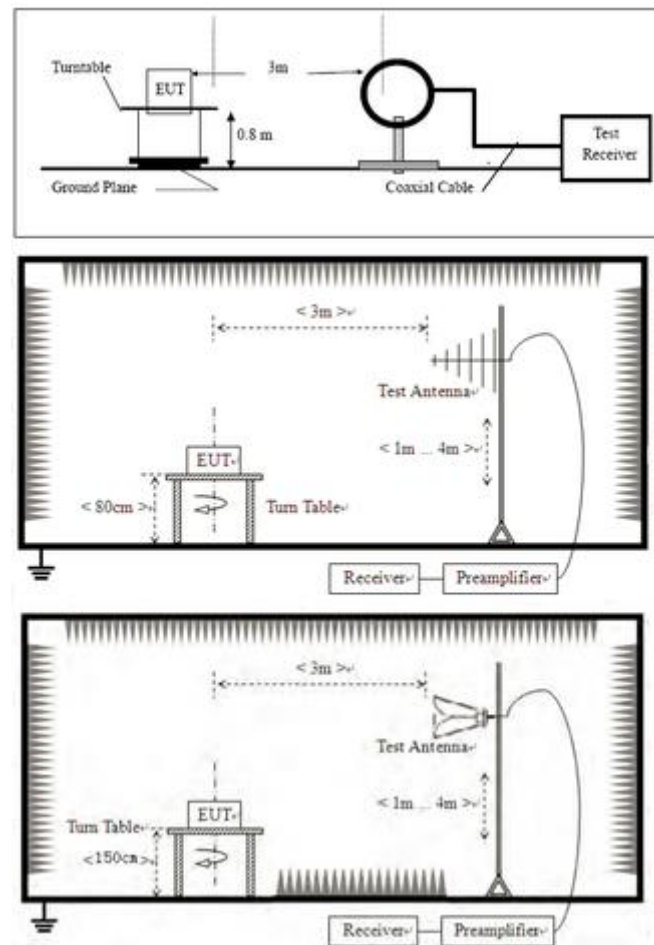
Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.4,6.5,6.6
Test Mode (Pre-Scan)	TX mode (SE) below 1G;TX mode (SE) Above 1G
Test Mode (Final Test)	TX mode (SE) below 1G;TX mode (SE) Above 1G
Tester	Jozu
Temperature	25℃
Humidity	60%

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.

11.2 BLOCK DIAGRAM OF TEST SETUP



11.3 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.

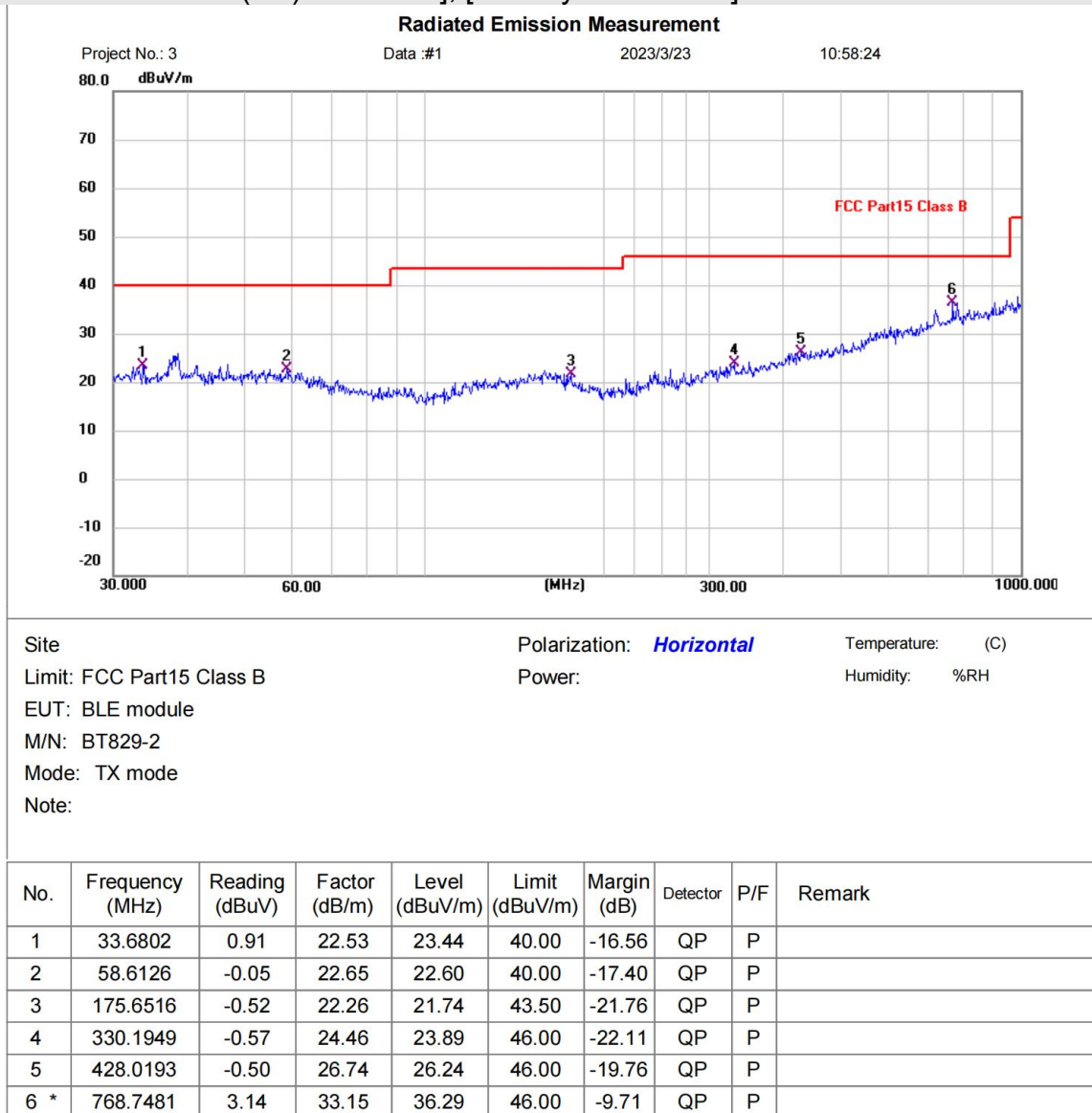
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was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

11.4 TEST DATA

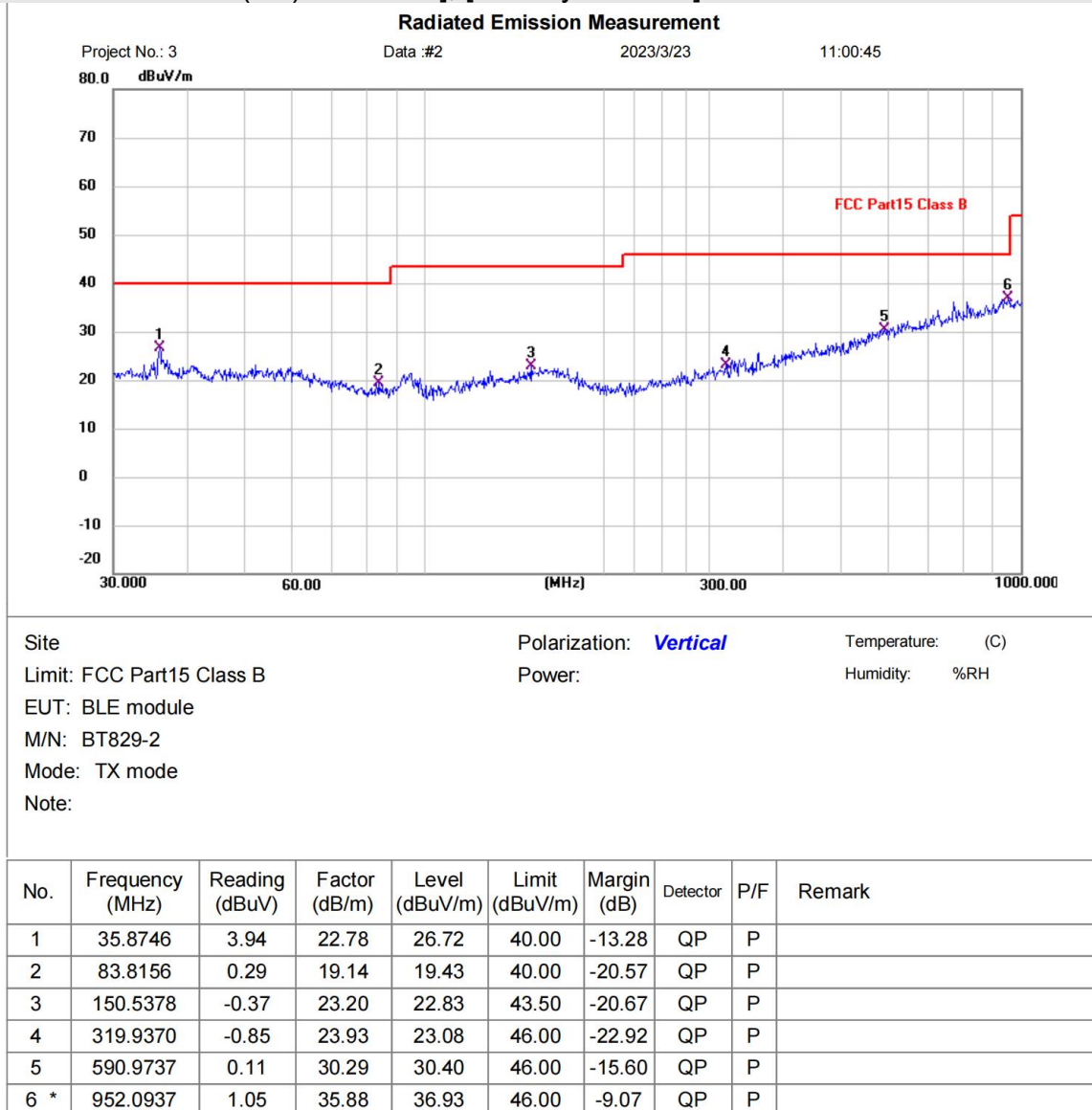
[TestMode: TX mode (SE) below 1G]; [Polarity: Horizontal]



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

Test Result: Pass

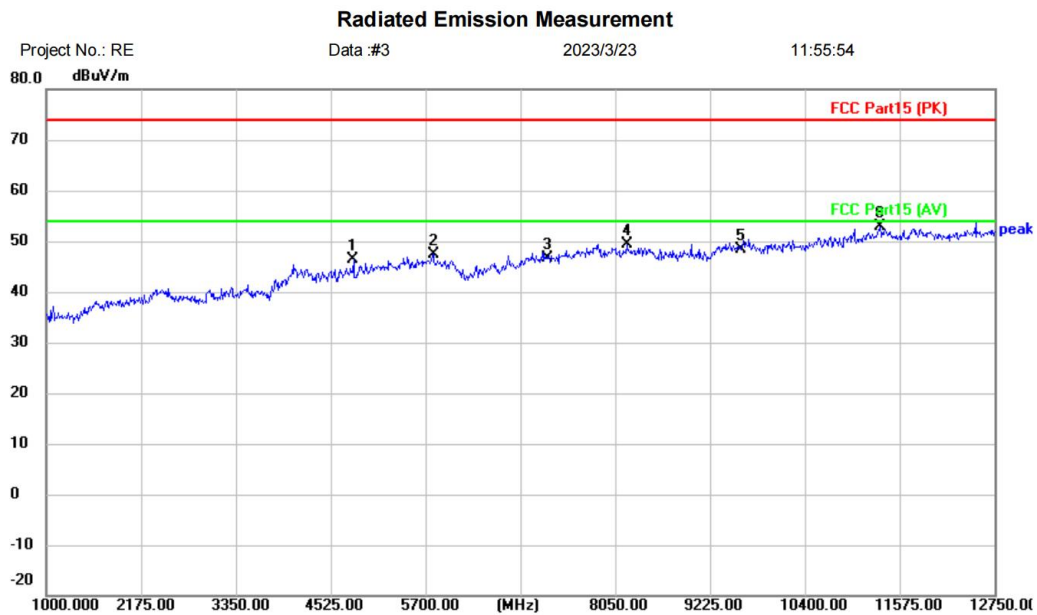
[TestMode: TX mode (SE) below 1G]; [Polarity: Vertical]



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

Test Result: Pass

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



Site: Polarization: **Horizontal** Temperature: (C)
Limit: FCC Part15 (PK) Power: Humidity: %RH
EUT: BLE module
M/N: BT829-2
Mode: TX-L
Note:

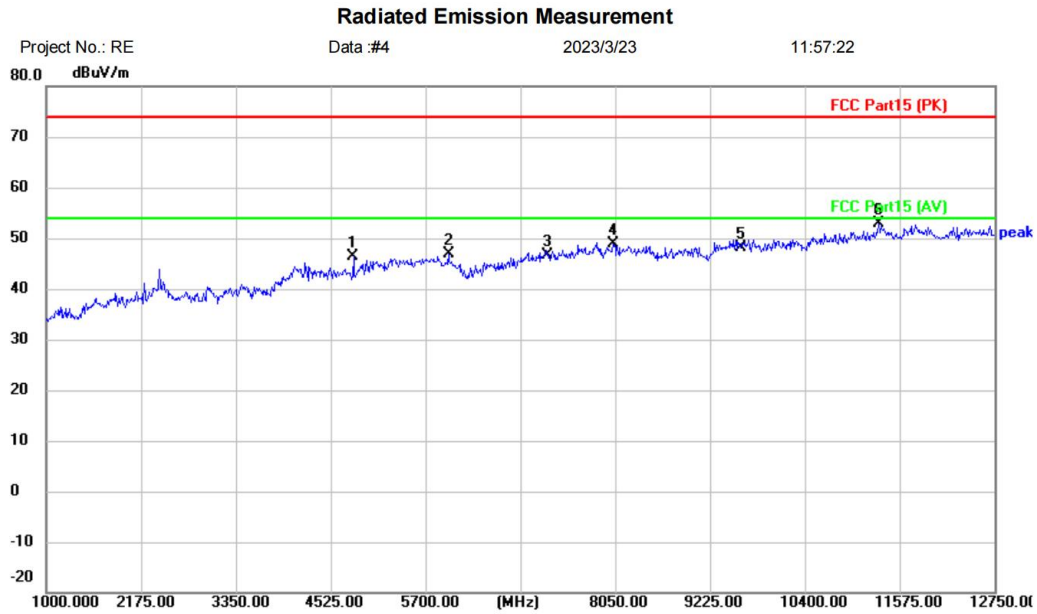
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4804.000	42.27	4.05	46.32	74.00	-27.68	peak	
2		5794.000	40.67	6.77	47.44	74.00	-26.56	peak	
3		7206.000	38.68	7.93	46.61	74.00	-27.39	peak	
4		8191.000	40.31	8.99	49.30	74.00	-24.70	peak	
5		9608.000	37.60	10.90	48.50	74.00	-25.50	peak	
6	*	11328.250	39.37	13.59	52.96	74.00	-21.04	peak	

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

(Reference Only)

Test Result: Pass

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



Site: Polarization: **Vertical** Temperature: (C)
Limit: FCC Part15 (PK) Power: Humidity: %RH
EUT: BLE module
M/N: BT829-2
Mode: TX-L
Note:

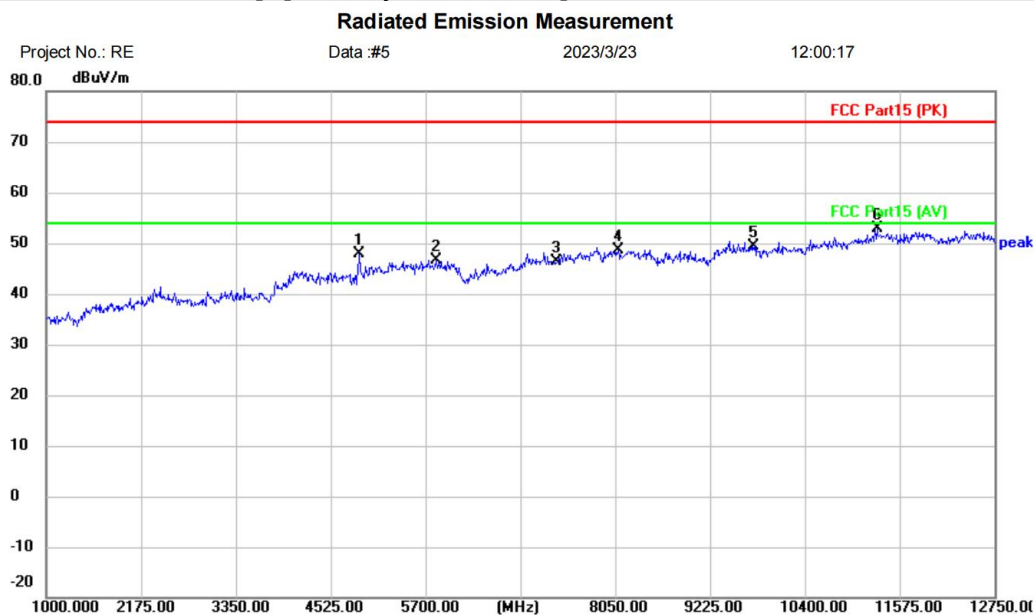
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4804.000	42.42	4.05	46.47	74.00	-27.53	peak	
2		5982.000	39.87	7.01	46.88	74.00	-27.12	peak	
3		7206.000	38.60	7.93	46.53	74.00	-27.47	peak	
4		8026.500	39.85	8.91	48.76	74.00	-25.24	peak	
5		9608.000	37.25	10.90	48.15	74.00	-25.85	peak	
6	*	11316.500	39.21	13.59	52.80	74.00	-21.20	peak	

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

(Reference Only)

Test Result: Pass

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



Site: Polarization: **Horizontal** Temperature: (C)
Limit: FCC Part15 (PK) Power: Humidity: %RH
EUT: BLE module
M/N: BT829-2
Mode: TX-M
Note:

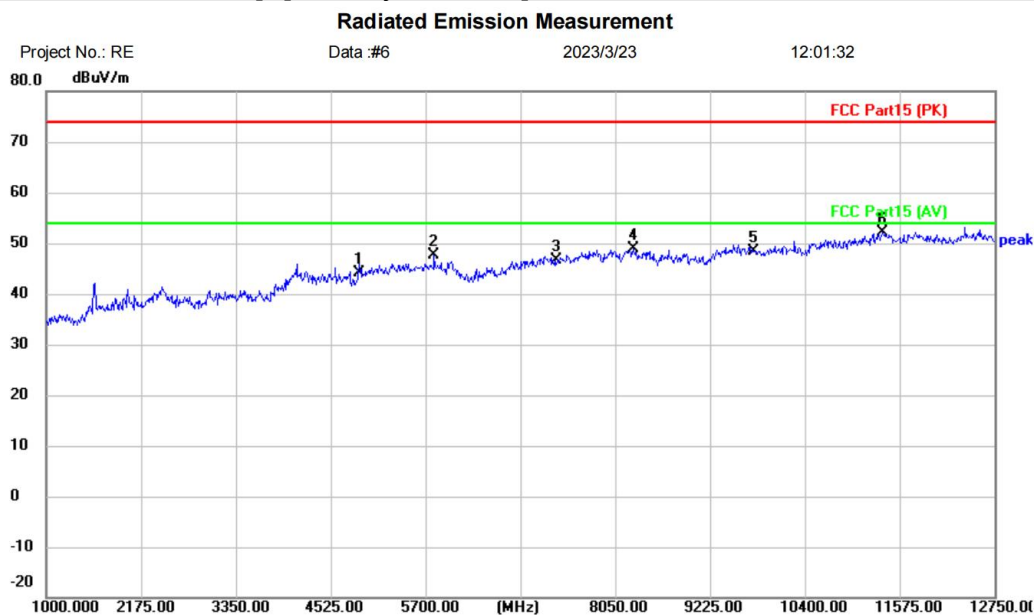
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4877.500	43.49	4.35	47.84	74.00	-26.16	peak	
2		5829.250	39.88	6.78	46.66	74.00	-27.34	peak	
3		7326.000	38.22	8.21	46.43	74.00	-27.57	peak	
4		8085.250	39.66	8.94	48.60	74.00	-25.40	peak	
5		9768.000	38.06	11.31	49.37	74.00	-24.63	peak	
6	*	11293.000	39.25	13.58	52.83	74.00	-21.17	peak	

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

⟨Reference Only

Test Result: Pass

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



Site: Polarization: **Vertical** Temperature: (C)
Limit: FCC Part15 (PK) Power: Humidity: %RH
EUT: BLE module
M/N: BT829-2
Mode: TX-M
Note:

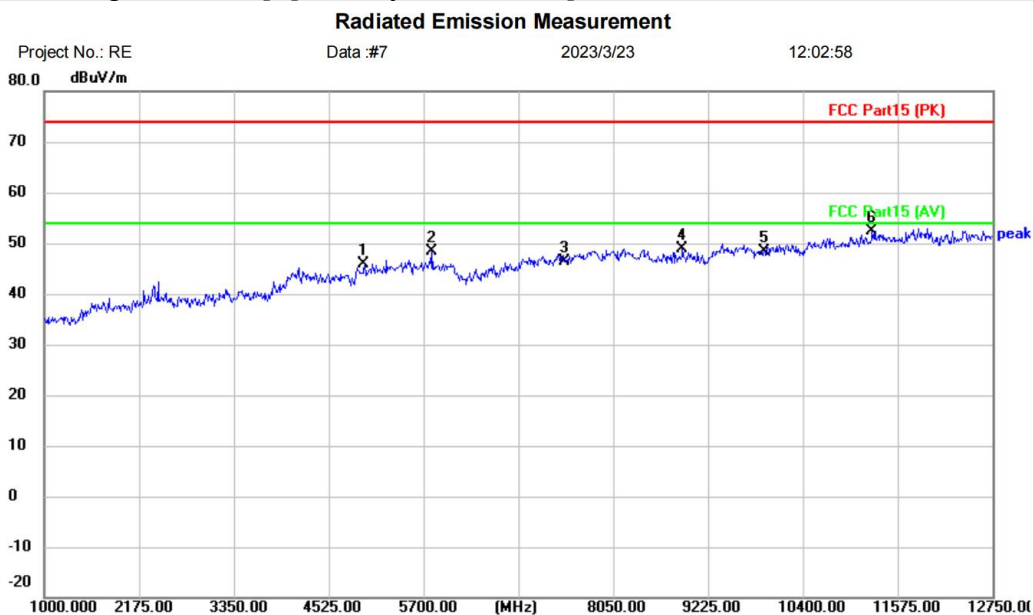
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4884.000	39.70	4.37	44.07	74.00	-29.93	peak	
2		5805.750	40.89	6.76	47.65	74.00	-26.35	peak	
3		7326.000	38.45	8.21	46.66	74.00	-27.34	peak	
4		8273.250	39.86	9.03	48.89	74.00	-25.11	peak	
5		9768.000	37.03	11.31	48.34	74.00	-25.66	peak	
6	*	11363.500	38.49	13.62	52.11	74.00	-21.89	peak	

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

⟨Reference Only

Test Result: Pass

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



Site: Polarization: **Horizontal** Temperature: (C)

Limit: FCC Part15 (PK) Power: Humidity: %RH

EUT: BLE module

M/N: BT829-2

Mode: TX-H

Note:

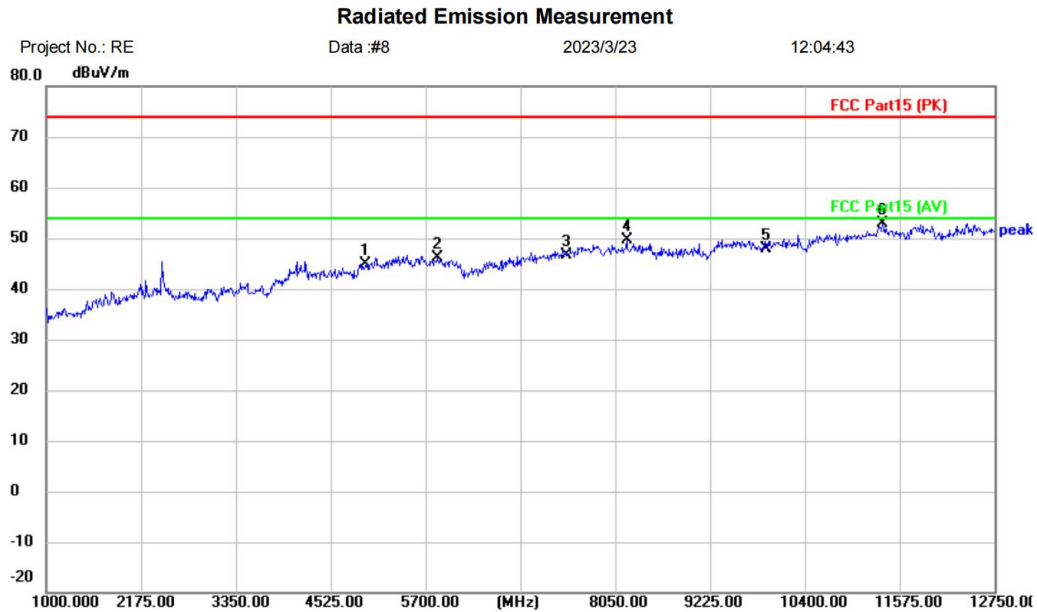
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4960.000	40.42	5.42	45.84	74.00	-28.16	peak	
2		5805.750	41.58	6.76	48.34	74.00	-25.66	peak	
3		7440.000	37.92	8.48	46.40	74.00	-27.60	peak	
4		8907.750	39.67	9.31	48.98	74.00	-25.02	peak	
5		9920.000	36.68	11.69	48.37	74.00	-25.63	peak	
6	*	11257.750	38.85	13.57	52.42	74.00	-21.58	peak	

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

(Reference Only)

Test Result: Pass

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



Site: Polarization: **Vertical** Temperature: (C)

Limit: FCC Part15 (PK) Power: Humidity: %RH

EUT: BLE module

M/N: BT829-2

Mode: TX-H

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		4960.000	39.49	5.42	44.91	74.00	-29.09	peak	
2		5852.750	39.34	6.80	46.14	74.00	-27.86	peak	
3		7440.000	38.23	8.48	46.71	74.00	-27.29	peak	
4		8191.000	40.52	8.99	49.51	74.00	-24.49	peak	
5		9920.000	36.18	11.69	47.87	74.00	-26.13	peak	
6	*	11363.500	39.15	13.62	52.77	74.00	-21.23	peak	

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

(Reference Only)

Test Result: Pass

12 RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS

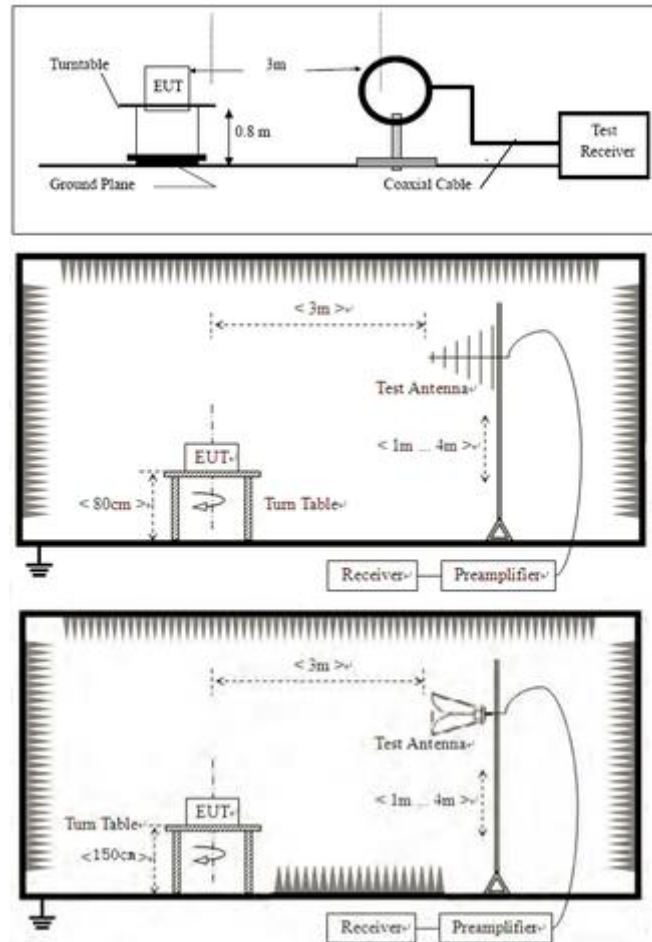
Test Standard	47 CFR Part 15, Subpart C 15.247
Test Method	ANSI C63.10 (2013) Section 6.10.5
Test Mode (Pre-Scan)	TX
Test Mode (Final Test)	TX
Tester	Jozu
Temperature	25℃
Humidity	60%

12.1 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.

12.2 BLOCK DIAGRAM OF TEST SETUP



12.3 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.

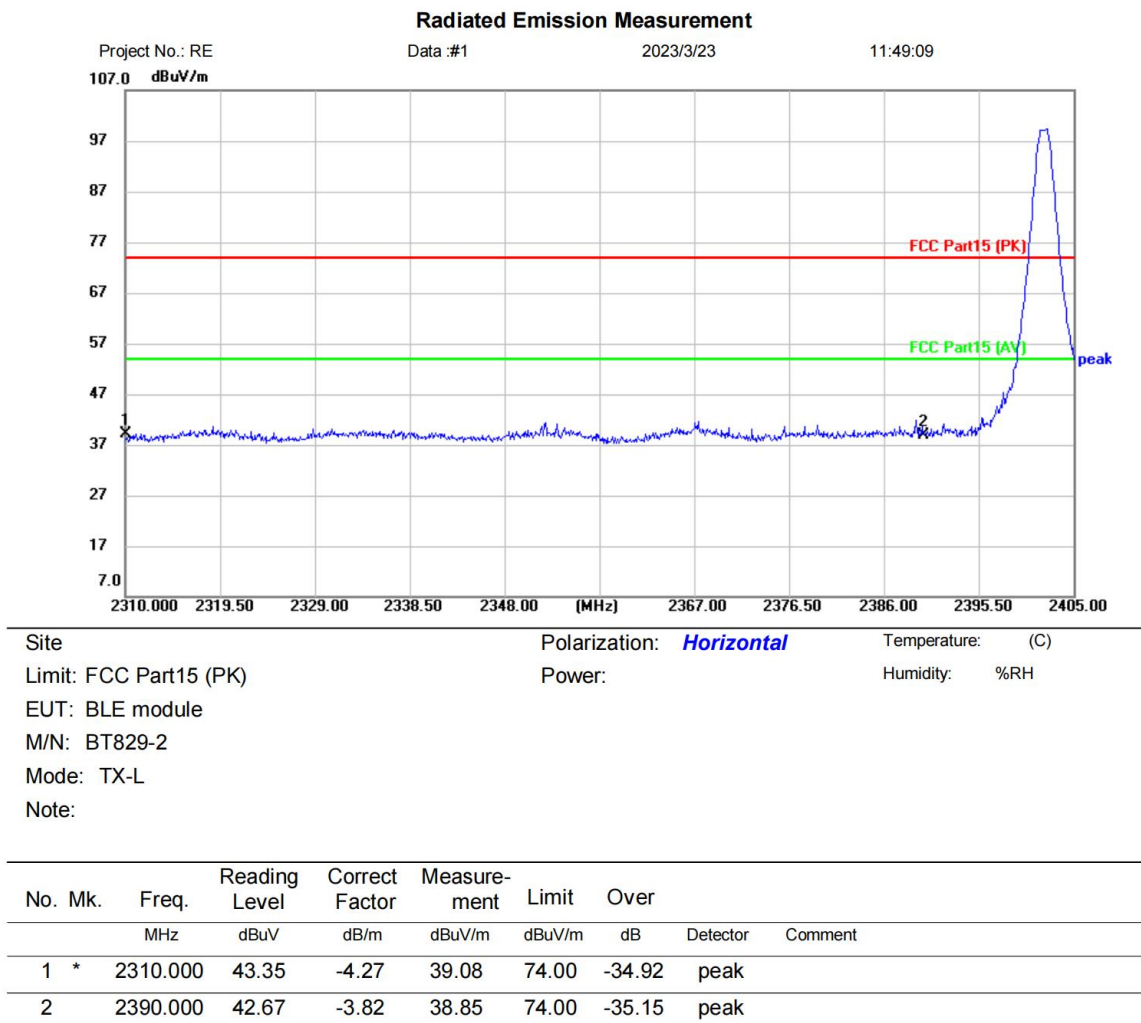
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was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

12.4 TEST DATA

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

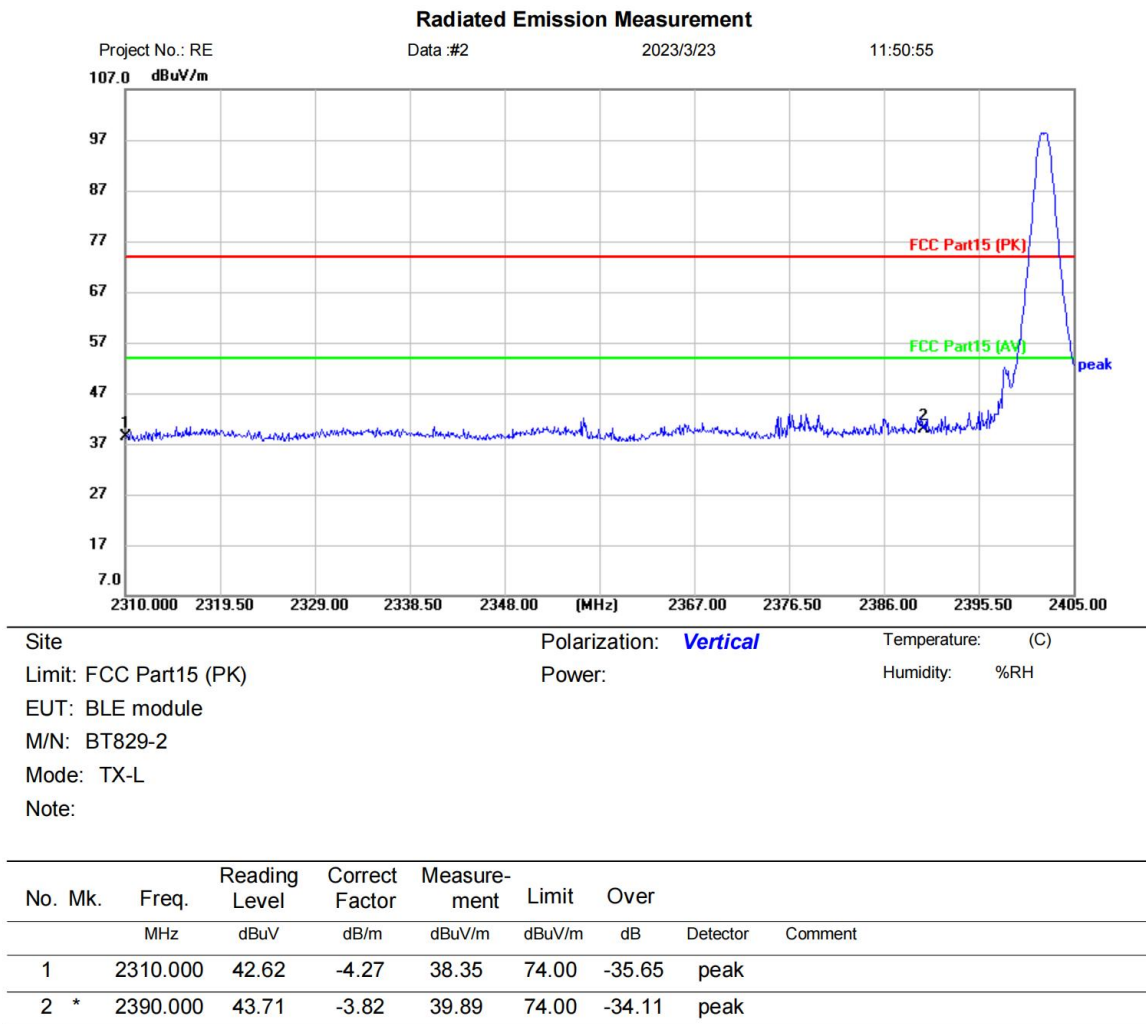


*:Maximum data x:Over limit !:over margin

⟨Reference Only

Test Result: Pass

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

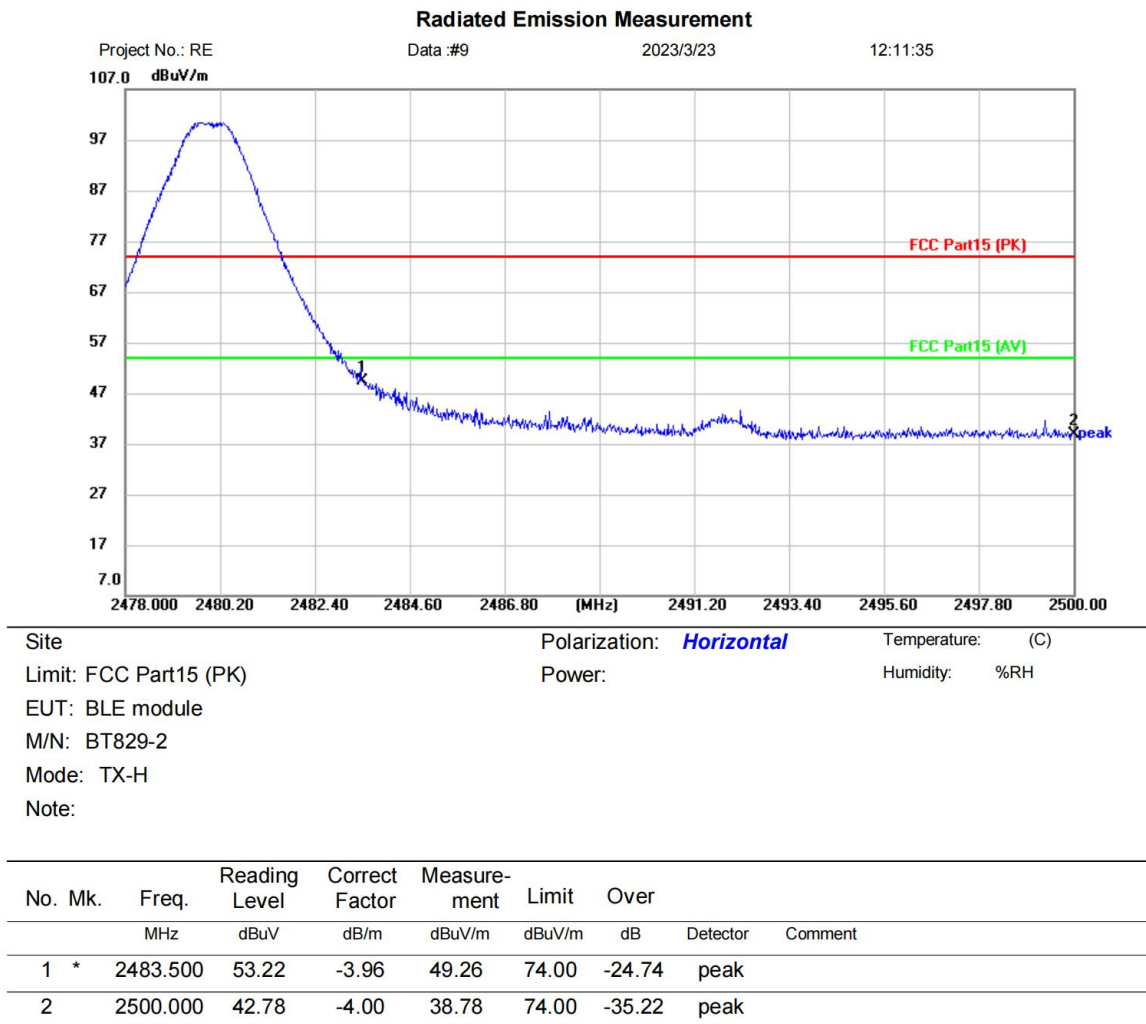


*:Maximum data x:Over limit !:over margin

(Reference Only)

Test Result: Pass

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

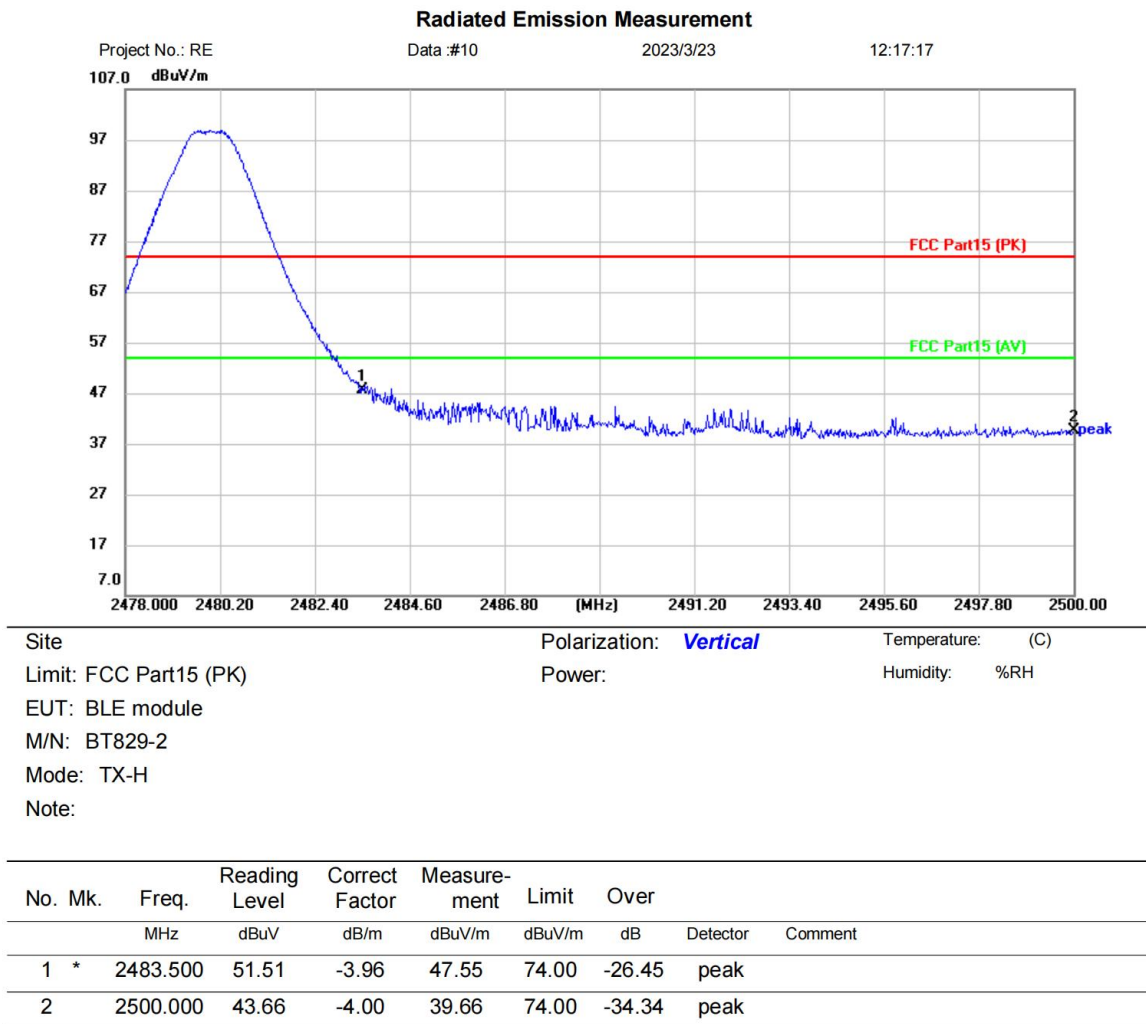


*:Maximum data x:Over limit !:over margin

⟨Reference Only

Test Result: Pass

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



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

⟨Reference Only

Test Result: Pass