

## ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT FCC PART 15 SUBPART C REQUIREMENT

OF

**Bluetooth Module** 

## Model No.: HM-BT4531

## Trademark: N/A

## FCC ID: 2ASEO-HM-BT4531

## Report No.: E01A23040015F00101

Issue Date: March 24, 2023

Prepared for

Shenzhen Hope Microelectronics Co., Ltd

# 30th floor of 8th Building, C Zone, Vanke Cloud City, Xili Sub-district, Nanshan, Shenzhen, GD, P.R. China

Prepared by

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TRF No.: 01-R001-3A-LE Web: www.gtggroup.com TRF Originator: GTG E-mail: info@gtggroup.com TRF Date: 2022-06-29 Tel.: 86-400 755 8988

## **VERIFICATION OF COMPLIANCE**

Applicant:	Shenzhen Hope Microelectronics Co., Ltd 30th floor of 8th Building, C Zone, Vanke Cloud City, Xili Sub-district, Nanshan, Shenzhen, GD, P.R. China	
Manufacturer:	Shenzhen Hope Microelectronics Co., Ltd 30th floor of 8th Building, C Zone, Vanke Cloud City, Xili Sub-district, Nanshan, Shenzhen, GD, P.R. China	
Product Description:	Bluetooth Module	
Trade Mark:	N/A	
Model/Type reference:	HM-BT4531	
Sample number:	A23040015 001	

## We hereby certify that:

The above equipment was tested by Dong Guan Anci Electronic Technology Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this Bluetooth Module report were made in accordance with the procedures given in ANSI C63.10-2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247(2022).

Date of Test :	April 20, 2023 to May 05, 2023
Prepared by :	Duke LUE JC
Approved & Authorized Signer :	Tiger Xu / Supervisor

## <sup>3 of 53</sup> Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	/	E01A23040015F00101

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## **1. GENERAL INFORMATION**

#### **1.1 Product Description**

Characteristics	Description	
Product Name	Bluetooth Module	
Model number	HM-BT4531	
Power Supply	DC 1.8V-3.6V	
Kind of Device	Bluetooth Ver.5.1 BLE	
Modulation	GFSK, π/4-DQPSK	
Operating Frequency Range	2402-2480MHz	
Number of Channels	40	
Transmit Power Max(PK)	8.15dBm(0.0065W)	
Antenna Type	Internal PCB antenna	
Antenna Gain	0.5dBi	
Date of Sample Received	April 20, 2023	

#### 1.2 Test Methodology

All the test program has follow FCC new test procedure KDB 558074 D01 DTS Meas Guidance v05 and in accordance with the procedures given in ANSI C63.10-2013.

# 2. Test Facility

Site Description		
EMC Lab.	:	Accredited by FCC, May 30, 2019 Designation Number: CN1230 Test Firm Registration Number: 991798
Name of Firm	:	Dong Guan Anci Electronic Technology Co., Ltd.
Site Location	:	1-2 Floor, Building A, No.11, Headquarters 2 Road, Songshan, Lake Hi-tech Industrial Development Zone, Dongguan City, Guangdong Pr., China.

## 3. Description of test modes

The EUT has been tested under its typical operating condition and fully-charged battery for EUT tested alone. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

For Radiated: The EUT's antenna was pre-tested under the following modes:

Test Mode	Description
Mode A	X-Y axis
Mode B	Y-Z axis
Mode C	X-Z axis

From the above modes, the worst case was found in Mode C. Therefore only the test data of the mode was recorded in this report.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonics of the highest fundamental frequency or to 40 GHz, whichever is lower).

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting mode is programmed. EUT is connected by com port, and transmit the control instruction via test software(BK RF Test\_V1.8.exe). The test software power value is set to the maximum.

Configuration of Tested System



Equipment Used in Tested System

Item	Equipment	Trademark	Manufacturer	Model No.	FCC ID	Note
1.	Bluetooth Module	N/A	Shenzhen Hope Microelectronics Co., Ltd	HM-BT4531	2ASEO-HM-BT4531	EUT
2	PC	N/A	N/A	PC-1Q9JRC	/	Support System

nnel	List:					
	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
	00	2402	14	2430	28	2458
	01	2404	15	2432	29	2460
	02	2406	16	2434	30	2462
	03	2408	17	2436	31	2464
	04	2410	18	2438	32	2466
	05	2412	19	2440	33	2468
	06	2414	20	2442	34	2470
	07	2416	21	2444	35	2472
	08	2418	22	2446	36	2474
	09	2420	23	2448	37	2476
	10	2422	24	2450	38	2478
	11	2424	25	2452	39	2480
	12	2426	26	2454		
	13	2428	27	2456		

The EUT has been tested under TX operating condition. Channel List:

Note:

1. Test of channel was included the lowest 2402MHz, middle 2440MHz and highest frequency 2480MHz in highest data rate and to perform the test, then record on this report.

## 4. Summary of Test Results

FCC Rules	Description Of Test	Result		
§15.207	AC Power Conducted	N/A		
§15.207	Emission	(See Remark)		
§15.247(d),§15.209	Radiated Emission	Compliant		
§15.247(a)(2)	6dB Bandwidth	Compliant		
915.247 (a)(z)	Measurement	Compliant		
§15.247(b)	MAXIMUM PEAK OUTPUT	Compliant		
915.247 (b)	POWER TEST			
§15.247(e)	Power Spectral Density	Compliant		
§15.247(e)	Measurement			
§15.247(d)	Band EDGE test	Compliant		
§15.203	Antenna Requirement Compliant			
Remark:				
N/A :The EUT is supplied by Battery, so this item does not applicable.				
According to FCC OET KDB 558074, the report use radiated				

measurements in the restricted frequency bands. In addition, the radiated test is also performed to ensure the emissions emanating from the device cabinet also comply with the applicable limits.

# 5. TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Radio Frequency	±1x10^-5
Maximum Peak Output Power Test	±1.0dB
Conducted Emissions Test	±2.0dB
Radiated Emission Test	±2.0dB
Power Density	±2.0dB
Occupied Bandwidth Test	±1.0dB
Band Edge Test	±3dB
All emission, radiated	±3dB
Antenna Port Emission	±3dB
Temperature	±0.5℃
Humidity	±3%

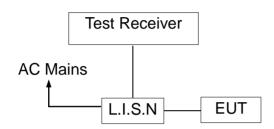
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%

## 6. Conducted Emissions Test

### 6.1 Measurement Procedure:

- 1. The EUT was placed on a table, which is 0.8m above ground plane.
- 2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 3. Repeat above procedures until all frequency measured was complete.

### 6.2 Test SET-UP (Block Diagram of Configuration)



#### 6.3 Measurement Equipment Used:

С	Instr.Code	Kind of Equipment	Manufacturer	Туре No.	Serial No.	Calibrated until
1	AN-E010	L.I.S.N	SCHWARZBECK	NSLK 8127	8127-669	2023-05-12
2	AN-E078	TRANSIENT LIMITER	CYBERTEK	EM5010A	E1950100113	2023-05-12
3	AN-E022	RF Cable	N/A	ZT06S-BNCJ-NJ-7.5M	19044020	2023-05-12
4	AN-E020	EMI Test Receiver	ROHDE&SCHWARZ	ESCI	101358	2023-05-12
5	AN-E058	1# Shielded Room	chengyu	8m*4m*3.3m	N/A	2024-11-12
6	AN-E046	Test Software	Farad	EZ-EMC (Ver.ANCI-3A1)	N/A	N/A

#### 6.4 Conducted Emission Limit

(7) Conducted Emission		
Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

#### Note:

1. The lower limit shall apply at the transition frequencies

2.The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

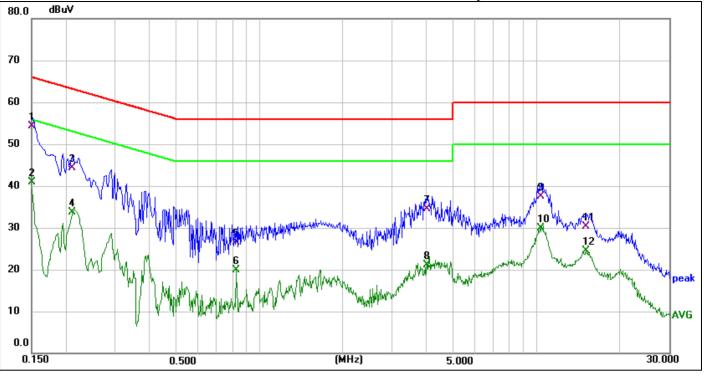
#### 6.5 Measurement Result:

Operation Mode:	ТХ	Test Date :	April 26, 2023
Frequency Range:	0.15MHz~30MHz	Temperature :	<b>23.5</b> ℃
Test Result:	PASS	Humidity :	52.6 %
Test By:	Sunshine		

All the modulation modes were tested the data of the worst mode (Pi/4-DQPSK TX 2402MHz) are recorded in the following pages and the others modulation methods do not exceed the limits.

Please refer to the following data.

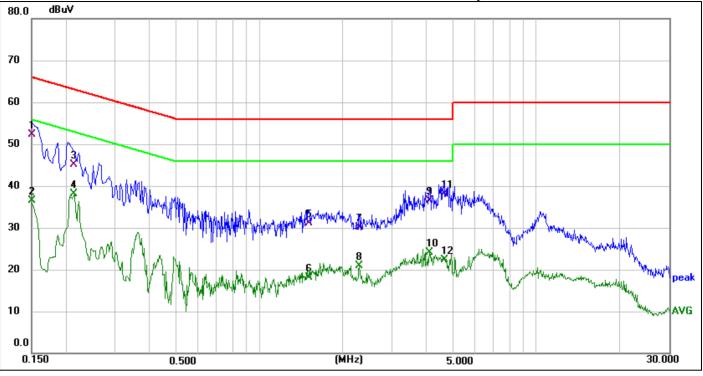




Site:	843	Phase:L1	Temperature(C):23.5(C)
Limit:	FCC PART 15C Conduction(QP)		Humidity(%):52.6%
EUT:	Bluetooth Module	Test Time:	2023-05-04
M/N.:	HM-BT4531	Power Rating:	DC 3.6V
Mode:	Pi/4-DQPSK TX 2402MHz	Test Engineer:	Sunshine
Note:		•	

No.	Frequency (MHz)	Reading Level(dBuV)	Factor (dB)	Measure- ment(dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1	0.1500	44.44	9.93	54.37	66.00	-11.63	QP	
2	0.1500	31.05	9.93	40.98	56.00	-15.02	AVG	
3	0.2100	34.20	10.13	44.33	63.21	-18.88	QP	
4	0.2100	23.49	10.13	33.62	53.21	-19.59	AVG	
5	0.8260	16.58	9.88	26.46	56.00	-29.54	QP	
6	0.8260	9.95	9.88	19.83	46.00	-26.17	AVG	
7	4.0180	24.48	9.97	34.45	56.00	-21.55	QP	
8	4.0180	11.13	9.97	21.10	46.00	-24.90	AVG	
9	10.3100	27.58	9.98	37.56	60.00	-22.44	QP	
10	10.3100	19.97	9.98	29.95	50.00	-20.05	AVG	
11	15.0180	20.15	10.21	30.36	60.00	-29.64	QP	
12	15.0180	14.24	10.21	24.45	50.00	-25.55	AVG	





Site:	843	Phase:N	Temperature(C):23.5(C)
Limit:	FCC PART 15C Conduction(QP)		Humidity(%):52.6%
EUT:	Bluetooth Module	Test Time:	2023-05-04
M/N.:	HM-BT4531	Power Rating:	DC 3.6V
Mode:	Pi/4-DQPSK TX 2402MHz	Test Engineer:	Sunshine
Note:		•	

No.	Frequency (MHz)	Reading Level(dBuV)	Factor (dB)	Measure- ment(dBuV)	Limit (dBuV)	Over (dB)	Detector	Comment
1	0.1500	42.29	9.93	52.22	66.00	-13.78	QP	
2	0.1500	26.54	9.93	36.47	56.00	-19.53	AVG	
3	0.2139	35.03	10.14	45.17	63.05	-17.88	QP	
4	0.2139	27.90	10.14	38.04	53.05	-15.01	AVG	
5	1.5100	21.15	10.05	31.20	56.00	-24.80	QP	
6	1.5100	8.00	10.05	18.05	46.00	-27.95	AVG	
7	2.2860	20.15	10.05	30.20	56.00	-25.80	QP	
8	2.2860	10.94	10.05	20.99	46.00	-25.01	AVG	
9	4.1060	26.47	9.98	36.45	56.00	-19.55	QP	
10	4.1060	14.10	9.98	24.08	46.00	-21.92	AVG	
11	4.6380	28.22	9.96	38.18	56.00	-17.82	QP	
12	4.6380	12.40	9.96	22.36	46.00	-23.64	AVG	



## 6.6 Conducted Measurement Photos:

## 7. Radiated Emission Test

#### 7.1 Measurement Procedure

- 1. The testing follows the guidelines in ANSI C63.10-2013.
- 2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
- 3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 4. The EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
- 5. For measurement below 1GHz, if the emission level of the EUT measured by the peak detector is 3dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
- 6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.
- 7. Test Procedure of measurement (For Above 1GHz):
  - 1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).
  - 2) Change the antenna polarization and repeat 1) with vertical polarization.
  - 3) Make a hardcopy of the spectrum.
  - 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
  - 5) Change the analyser mode to Clear/Write and found the cone of emission.
  - 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.
  - 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.
  - 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.

Use the following spectrum analyzer settings:

When spectrum scanned from 30MHz to 1GHz setting resolution bandwidth 120KHz and video bandwidth 300KHz:

EMI Test Receiver	Setting
Attenuation	Auto
RB	120KHz
VB	300KHz
Detector	QP
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 10Hz:

EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Average
Trace	Max hold

For Average Measurement:

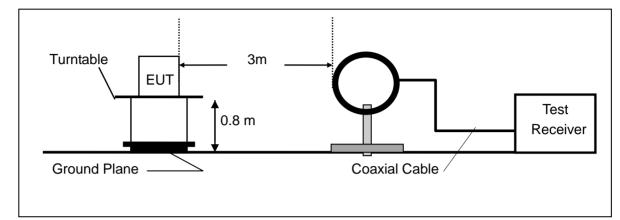
VBW=10Hz, when duty cycle is no less than 98 percent.

VBW ≥1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

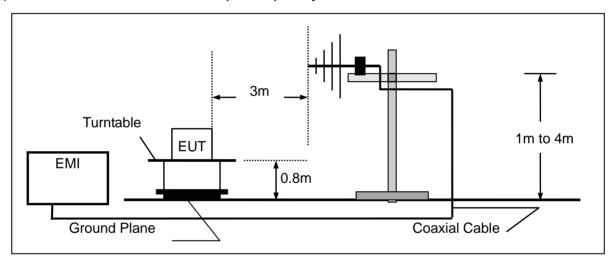
Band	Duty Cycle(%)	<b>Τ(</b> μ <b>s)</b>	1/T(KHz)	Average Correction Factor	VBW Setting
2402-2480	100	-	-	0	10Hz

#### 7.2 Test SET-UP (Block Diagram of Configuration)

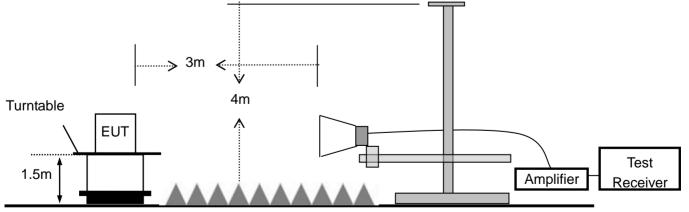
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



#### 7.3 Measurement Equipment Used:

Item	Instr.Code	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	AN-E023	EMI Test Receiver	Rohde & Schwarz	ESPI7	100502	2023-10-07
2	AN-E061	Pre-Amplifier	Anritsu	MH648A	M57886	2023-05-12
3	AN-E076	Bilog Antenna	Schwarzbeck	VULB9163	VULB9163-1290	2023-12-11
4	AN-E062	RF Cable	N/A	ZT06S-NJ-NJ-11M	19060398	2023-05-12
5	AN-E063	RF Cable	N/A	ZT06S-NJ-NJ-0.5M	19060400	2023-05-12
6	AN-E064	RF Cable	N/A	ZT06S-NJ-NJ-2.5M	19060404	2023-05-12
7	AN-E056	3m Semi-anechoic Chamber	chengyu	9m*6m*6m	N/A	2024-11-11
8	AN-E069	Test Software	Farad	EZ-EMC (Ver.FA-03A2 RE)	N/A	N/A

3m Radiated Emission Measurement 30M-1G

3m Radiated Emission Measurement 1G-18G

Item	Instr.Code	Kind of Equipment	Manufacturer Type No.		Serial No.	Calibrated until
1	AN-E023	EMI Test Receiver	Rohde & Schwarz	ESPI7	100502	2023-10-07
2	AN-E015	Low noise Amplifiers	A-INFO	LA1018N4009	J1013130524001	2023-05-12
3	AN-E014	Horn antenna	A-INFO	LB-10180-SF	J2031090612123	2024-05-14
4	AN-E065	RF Cable	N/A	ZT26-NJ-NJ-11M	19060401	2023-05-12
5	AN-E067	RF Cable	N/A	ZT26-NJ-NJ-2.5M	19060402	2023-05-12
6	AN-E068	RF Cable	N/A	ZT26-NJ-NJ-0.5M	19060403	2023-05-12
7	AN-E056	3m Semi-anechoic Chamber	chengyu	9m*6m*6m	N/A	2024-11-12
8	AN-E069	Test Software	Farad	EZ-EMC (Ver.FA-03A2 RE)	N/A	N/A

#### 7.4 Radiated emission limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table 15.209(a):

Frequencies	Field Strength	Measurement Distance
(MHz)	(micorvolts/meter)	(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

#### 15.205 Restricted bands of operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)

Remark 1. Emission level in dBuV/m=20 log (uV/m)

2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of  $\xi$  15.205, and the emissions located in restricted bands also comply with 15.209 limit.

:

#### 7.5 Measurement Result

#### Below 30MHz:

Operation Mode:	ТХ	Test Date :	2023-4-26
Frequency Range:	9KHz~30MHz	Temperature :	<b>25</b> ℃
Test Result:	PASS	Humidity :	58 %
Measured Distance:	3m	Test By:	Best

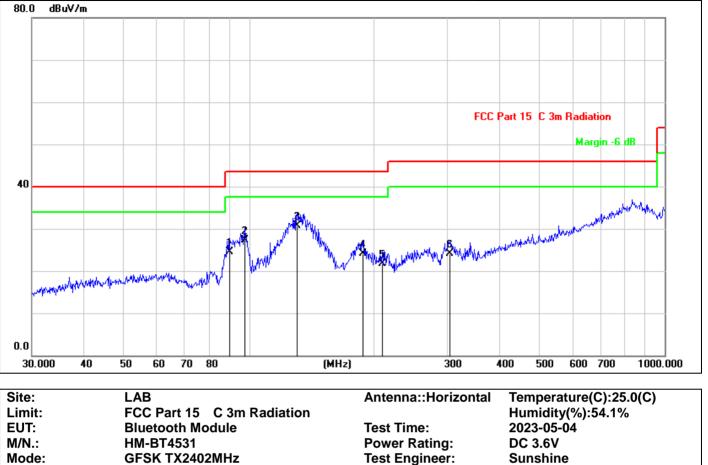
Freq.	Ant.Pol.	Emission	Limit 3m	Over
		Level		
(MHz)	H/V	(dBuV/m)	(dBuV/m)	(dB)

Note: The low frequency, which started from 9KHz-30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

## Below 1000MHz:

Pass.

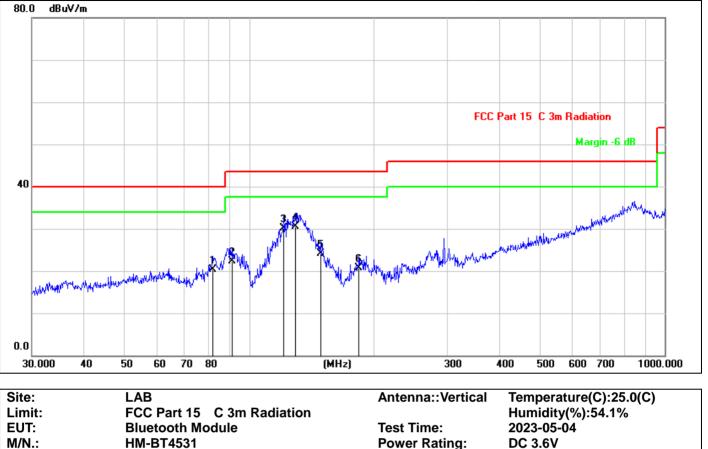
The data of the mode (GFSK 2402MHz) are recorded in the following pages.



No.	Frequency	Reading	Factor	Level	Limit	Margin	Det.	Remark
	(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	( <b>dB</b> )		
1	89.9047	37.79	-13.19	24.60	43.50	-18.90	QP	
2	97.4560	39.38	-12.05	27.33	43.50	-16.17	QP	
3 *	130.3789	42.41	-11.68	30.73	43.50	-12.77	QP	
4	187.7530	35.42	-11.37	24.05	43.50	-19.45	QP	
5	209.3129	32.93	-11.18	21.75	43.50	-21.75	QP	
6	304.6099	30.76	-6.68	24.08	46.00	-21.92	QP	

Note: 1. Result Level = Read Level+ Antenna Factor+ Cable Loss- Amp. Factor

Note:



**Test Engineer:** 

-19.40

-22.80

QP

QP

Sunshine

Limit Det. Remark No. Frequency Reading Factor Level Margin (MHz) (dBuV) (dB/m)(dBuV/m) (dBuV/m)  $(\mathbf{dB})$ 20.40 1 81.7833 32.77 -12.37 40.00 -19.60 QP 35.48 22.40 43.50 -21.10 2 90.8554 -13.08OP 121.1231 30.10 43.50 -13.40 3 41.64 -11.54 QP 4 \* 42.37 -11.77 30.60 43.50 -12.90 129.4677 QP

43.50

43.50

24.10

20.70

Note: 1. Result Level = Read Level+ Antenna Factor+ Cable Loss- Amp. Factor

GFSK TX2402MHz

-11.33

-11.10

35.43

31.80

Mode:

Note:

5

6

148.4410

183.8440

### Above 1000MHz~10<sup>th</sup> Harmonics:

Operation Mode:	TX Mode (CH00: 2402MHz)	Test Date :	2023-4-26
Frequency Range:	1-25GHz	Temperature :	<b>25</b> ℃
Test Result:	PASS	Humidity :	58 %
Measured Distance:	3m	Test By:	Best

Freq.	Ant. Pol.	Rea Level(d	ding BuV/m)	Correct Factor	Emis Level(d			mit BuV/m)	Ove	r(dB)
(MHz)	H/V	PK	AV	dB	PK	AV	PK	AV	PK	AV
4804	V	94.37	73.21	-32.3	62.07	40.91	74	54	-11.93	-13.09
7206	V	95.18	73.64	-37.2	57.98	36.44	74	54	-16.02	-17.56
9608	V	94.28	73.29	-39.8	54.48	33.49	74	54	-19.52	-20.51
12010	V	96.31	74.28	-40.5	55.81	33.78	74	54	-18.19	-20.22
14412	V	97.28	75.33	-41.7	55.58	33.63	74	54	-18.42	-20.37
16814	V	95.36	74.86	-40	55.36	34.86	74	54	-18.64	-19.14
4804	Н	93.35	74.57	-31.6	61.75	42.97	74	54	-12.25	-11.03
7206	H	94.28	74.38	-35.5	58.78	38.88	74	54	-15.22	-15.12
9608	Н	93.27	74.69	-38.3	54.97	36.39	74	54	-19.03	-17.61
12010	Н	94.88	74.29	-39	55.88	35.29	74	54	-18.12	-18.71
14412	Н	96.85	74.38	-42	54.85	32.38	74	54	-19.15	-21.62
16814	Н	92.35	73.05	-39.3	53.05	33.75	74	54	-20.95	-20.25

#### Other harmonics emissions are lower than 20dB below the allowable limit.

**Note:** (1) All Readings are Peak Value and AV.

- (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
- (3) The average measurement was not performed when the peak measured data under the limit of average detection.
- (4) Measuring frequencies from 1GHz to 25GHz.

Operation Mode:	TX Mode (CH19: 2440MHz)	Test Date :	2023-4-26
Frequency Range:	1-25GHz	Temperature :	<b>25</b> ℃
Test Result:	PASS	Humidity :	58 %
Measured Distance:	3m	Test By:	Best

Freq.	Ant. Pol.	Rea Level(d	ding BuV/m)	Correct Factor	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Marg	in(dB)
(MHz)	H/V	PK	AV	dB	PK	AV	PK	AV	PK	AV
4880	V	96.58	76.65	-32.3	64.28	44.35	74	54	-9.72	-9.65
7320	V	96.25	77.59	-37.2	59.05	40.39	74	54	-14.95	-13.61
9760	V	97.68	78.02	-39.8	57.88	38.22	74	54	-16.12	-15.78
12200	V	96.58	77.35	-40.5	56.08	36.85	74	54	-17.92	-17.15
14640	V	96.35	78.2	-41	55.35	37.2	74	54	-18.65	-16.8
17080	V	94.36	76.88	-41.1	53.26	35.78	74	54	-20.74	-18.22
4880	Η	94.52	75.35	-31.6	62.92	43.75	74	54	-11.08	-10.25
7320	Η	94.68	74.62	-35.5	59.18	39.12	74	54	-14.82	-14.88
9760	Η	95.36	77.22	-38.3	57.06	38.92	74	54	-16.94	-15.08
12200	Η	94.68	75.96	-39	55.68	36.96	74	54	-18.32	-17.04
14640	Н	95.31	77.21	-42	53.31	35.21	74	54	-20.69	-18.79
17080	Η	96.13	76.83	-41.5	54.63	35.33	74	54	-19.37	-18.67

#### Other harmonics emissions are lower than 20dB below the allowable limit.

**Note:** (1) All Readings are Peak Value and AV.

- (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
- (3) The average measurement was not performed when the peak measured data under the limit of average detection.
- (4) Measuring frequencies from 1GHz to 25GHz.

Operation Mode:	TX Mode (CH39: 2480MHz)	Test Date :	2023-4-26
Frequency Range:	1-25GHz	Temperature :	<b>25</b> ℃
Test Result:	PASS	Humidity :	58 %
Measured Distance:	3m	Test By:	Best

Freq.	Ant. Pol.	Rea Level(d	ding BuV/m)	Correct Factor	Emis Level(d			mit BuV/m)	Margin(dB)	
(MHz)	H/V	PK	AV	dB	PK	AV	PK	AV	PK	AV
4960	V	96.32	77.58	-32.3	64.02	45.28	74	54	-9.98	-8.72
7440	V	96.48	77.35	-37.2	59.28	40.15	74	54	-14.72	-13.85
9920	V	97.01	78.25	-39.8	57.21	38.45	74	54	-16.79	-15.55
12400	V	96.58	77.02	-40.5	56.08	36.52	74	54	-17.92	-17.48
14880	V	96.86	78.12	-41	55.86	37.12	74	54	-18.14	-16.88
17360	V	95.21	76.14	-41.1	54.11	35.04	74	54	-19.89	-18.96
4960	Н	95.35	74.59	-31.6	63.75	42.99	74	54	-10.25	-11.01
7440	Н	94.56	74.68	-35.5	59.06	39.18	74	54	-14.94	-14.82
9920	Н	94.36	75.28	-38.3	56.06	36.98	74	54	-17.94	-17.02
12400	Н	94.63	75.12	-39	55.63	36.12	74	54	-18.37	-17.88
14880	Н	95.02	75.21	-42	53.02	33.21	74	54	-20.98	-20.79
17360	Н	94.61	76.32	-41.5	53.11	34.82	74	54	-20.89	-19.18

#### Other harmonics emissions are lower than 20dB below the allowable limit.

**Note:** (1) All Readings are Peak Value and AV.

- (2) Emission Level= Reading Level+ Probe Factor +Cable Loss.
- (3) The average measurement was not performed when the peak measured data under the limit of average detection.
- (4) Measuring frequencies from 1GHz to 25GHz.



## 7.5 Radiated Measurement Photos:

## 8. 6dB Bandwidth Measurement

#### 8.1 Measurement Procedure

The EUT was operating in Bluetooth mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

### 8.2 Test SET-UP (Block Diagram of Configuration)



#### 8.3 Measurement Equipment Used:

Item	Instr.Code	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	AN-E037	Spectrum Analyzer	KEYSIGHT	N9020A	MY61250185	2023-10-07
2	AN-E040	WIDEBAND RADIO COMMUNICATION	Rohde & Schwarz	CMW500	157423	2023-10-07
3	AN-E039	MXG Vector Signal Generator	KEYSIGHT	N5182B	MY61250185	2023-10-07
4	AN-E038	EXG Analog Signal Generator	KEYSIGHT	N5173B	My61252603	2023-10-07
5	AN-E041	USB RF Power sensor	RadiPower	RPR3006W	17100015SNO88	2023-10-07
6	AN-E042	USB RF Power sensor	RadiPower	RPR3006W	17100015SNO89	2023-10-07
7	/	RF Test Software	MWRF-test	MTS 8310	N/A	N/A
8	AN-E092	Radio Frequency control box	MWRF-test	MW200-RFCB	MW220111ANCI	2023-05-12
9	AN-E093	Radio Frequency control box	MWRF-test	MW200-RFCB 2#	/	2023-05-12

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

#### 8.4 Limit

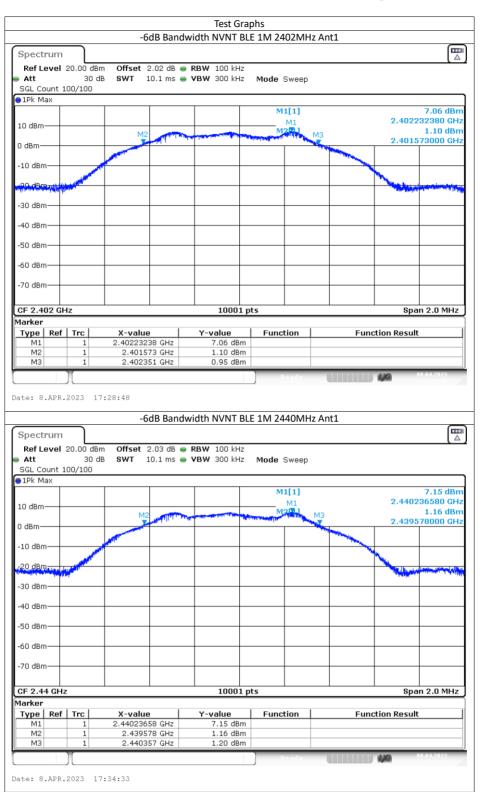
The minimum 6dB bandwidth shall be at least 500kHz.

#### 8.5 Measurement Results:

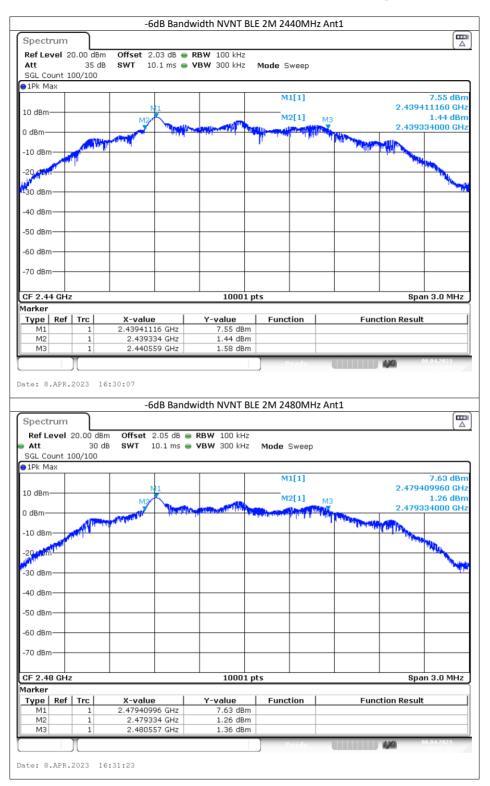
Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	2023-4-26
Test By:	Best	Temperature :	24 °C
Test Result:	PASS	Humidity :	53 %

Mode	Frequency (MHz)	Antenna	-6 dB Bandwidth (MHz)	Limit -6 dB Bandwidth (MHz)	Verdict
BLE 1M	2402	Ant1	0.778	0.5	Pass
BLE 1M	2440	Ant1	0.779	0.5	Pass
BLE 1M	2480	Ant1	0.771	0.5	Pass
BLE 2M	2402	Ant1	1.225	0.5	Pass
BLE 2M	2440	Ant1	1.225	0.5	Pass
BLE 2M	2480	Ant1	1.222	0.5	Pass



Spectrum				E 1M 2480MH			Ē
Ref Level 20.00	dBm Offset	2.05 dB 👄	RBW 100 kHz				L 🛆
			VBW 300 kHz	Mode Sweep			
SGL Count 100/10	00						
1Pk Max				M1[1]			7.31 dBn
10 dBm				M1		2.480	233580 GH
	M	2	Contraction of the local division of the loc	M201	мз	0.470	1.09 dBn
) dBm					No. of Concession, Name	2.479	576000 GH:
10 dBm					and the second		
						The second se	
20.dBm							M MANAGEMENT
-30 dBm							
40 dBm							
40 UBIII							
-50 dBm							
60 dBm							
-70 dBm							1
CF 2.48 GHz Iarker			10001 p	ots		sp	an 2.0 MHz
Type   Ref   Trc	X-valu	e	Y-value	Function	Fu	nction Resu	lt
M1 1			7.31 dBm				
M2 1 M3 1		576 GHz 347 GHz	1.09 dBm 1.59 dBm				
				Dondu		4.96	08.04.2023
ate: 8.APR.2023		5dB Bandw	vidth NVNT BL	E 2M 2402MH	z Ant1		(
Spectrum	-6			E 2M 2402MH	z Ant1		
Spectrum Ref Level 20.00	-6 I dBm Offset	2.02 dB 👄	vidth NVNT BL RBW 100 kHz VBW 300 kHz		z Ant1		
Spectrum Ref Level 20.00 Att 3 SGL Count 100/10	-6 dBm Offset 30 dB SWT	2.02 dB 👄	RBW 100 kHz	-	z Ant1		
Spectrum Ref Level 20.00 Att	-6 dBm Offset 30 dB SWT	2.02 dB 👄	RBW 100 kHz	Mode Sweep	z Ant1		
Spectrum Ref Level 20.00 Att SGL Count 100/10 1Pk Max	-6 dBm Offset 30 dB SWT	2.02 dB 👄	RBW 100 kHz VBW 300 kHz	-	z Ant1	2.401	( △ 7.60 dBn
Spectrum Ref Level 20.00 Att 3 SGL Count 100/10	-6 dBm Offset 30 dB SWT	2.02 dB 👄 10.1 ms 🖷	RBW 100 kHz VBW 300 kHz	Mode Sweep	z Ant1		(∆ 7.60 dBn 410060 GH 1.67 dBn
Spectrum Ref Level 20.00 Att SGL Count 100/10 1Pk Max	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[3]			(∆ 7.60 dBn 410060 GH 1.67 dBn
Spectrum Ref Level 20.00 Att 5 SGL Count 100/10 01Pk Max 10 dBm-10	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[3]	z Ant1		(∆ 7.60 dBn 410060 GH 1.67 dBn
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           1Pk Max           10 dBm           -10 dBm	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[3]			(∆ 7.60 dBn 410060 GH 1.67 dBn
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           1Pk Max           10 dBm           -10 dBm	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[3]			(∆ 7.60 dBn 410060 GH 1.67 dBn
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           11Pk Max           10 dBm           10 dBm           20 dBm	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[3]			(∆ 7.60 dBn 410060 GH 1.67 dBn
Spectrum Ref Level 20.00 Att SGL Count 100/10 PPK Max 10 dBm 10 dBm 20 dBm 30 dBm 30 dBm	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[3]			(∆ 7.60 dBn 410060 GH 1.67 dBn
Spectrum Ref Level 20.00 Att SGL Count 100/10 PIPK Max 10 dBm	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[3]			(∆ 7.60 dBn 410060 GH 1.67 dBn
Spectrum Ref Level 20.00 Att SGL Count 100/10 PPK Max 10 dBm 10 dBm 20 dBm 30 dBm 30 dBm	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[3]			(∆ 7.60 dBn 410060 GH 1.67 dBn
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           1Pk Max           10 dBm           10 dBm           20 dBm           -10 dBm           -20 dBm           -30 gbm           -40 dBm	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[3]			(∆ 7.60 dBn 410060 GH: 1.67 dBn
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           1Pk Max           10 dBm           -0 dBm           -10 dBm           -20 dBm           -30 sbm           -40 dBm           -50 dBm           -60 dBm	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[3]			(∆ 7.60 dBn 410060 GH: 1.67 dBn
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           1Pk Max           10 dBm           -10 dBm           -20 dBm           -30 dBm           -40 dBm           -50 dBm	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[3]			7.60 dBn 410060 GH: 1.67 dBn 340000 GH:
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           1Pk Max           10 dBm           -10 dBm           -20 dBm           -30 gBm           -40 dBm           -50 dBm           -60 dBm	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[1		2.401	[ △ 7.60 dBn 410060 GH: 340000 GH:
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           10 HP Max           10 dBm           10 dBm           20 dBm           40 dBm           50 dBm           50 dBm           60 dBm           70 dBm           CF 2.402 GHz	-6 dBm Offset 30 dB SWT	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[1		2.401	(∆ 7.60 dBn 410060 GH: 1.67 dBn
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           1PK Max           10 dBm           -10 dBm           -20 dBm           -30 gBm           -40 dBm           -50 dBm           -60 dBm	-6	2.02 dB • 10.1 ms • 10.1 m	RBW 100 kHz VBW 300 kHz	Mode Sweep M1[1] M2[1		2.401	7.60 dBn 410060 GH: 1.67 dBn 340000 GH: 40000
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           10 dBm           50 dBm           60 dBm           10 dBm           10 dBm           10 dBm           10 dBm           10 dBm	-6	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz 	Mode Sweep 		2.401	7.60 dBn 410060 GH: 1.67 dBn 340000 GH: 40000
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           10 dBm           10 dBm           -10 dBm           -20 dBm           -30 dBm           -30 dBm           -70 dBm	-6	2.02 dB  10.1 ms  M1 M2	RBW 100 kHz VBW 300 kHz 	Mode Sweep 		2.401	7.60 dBn 410060 GH: 1.67 dBn 340000 GH: 40000
Spectrum           Ref Level 20.00           Att           SGL Count 100/10           10 dBm           50 dBm           60 dBm           10 dBm           10 dBm           10 dBm           10 dBm           10 dBm	-6	2.02 dB 10.1 ms	RBW 100 kHz VBW 300 kHz 	Mode Sweep 		2.401	7.60 dBn 410060 GH: 1.67 dBn 340000 GH: 40000



# 9. MAXIMUM PEAK OUTPUT POWER TEST

#### 9.1 Measurement Procedure

a. The Transmitter output (antenna port) was connected to the spectrum Analyzer.

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- b. Turn on the EUT and then record the peak power value.
- c. Repeat above procedures on all channels needed to be tested.

#### 9.2 Test SET-UP (Block Diagram of Configuration)



Spectrum Analyzer

#### 9.3 Measurement Equipment Used:

Item	Instr.Code	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	AN-E037	Spectrum Analyzer	KEYSIGHT	N9020A	MY61250185	2023-10-07
2	AN-E040	WIDEBAND RADIO COMMUNICATION	Rohde & Schwarz	CMW500	157423	2023-10-07
3	AN-E039	MXG Vector Signal Generator	KEYSIGHT	N5182B	MY61250185	2023-10-07
4	AN-E038	EXG Analog Signal Generator	KEYSIGHT	N5173B	My61252603	2023-10-07
5	AN-E041	USB RF Power sensor	RadiPower	RPR3006W	17100015SNO88	2023-10-07
6	AN-E042	USB RF Power sensor	RadiPower	RPR3006W	17100015SNO89	2023-10-07
7	/	RF Test Software	MWRF-test	MTS 8310	N/A	N/A
8	AN-E092	Radio Frequency control box	MWRF-test	MW200-RFCB	MW220111ANCI	2023-05-12
9	AN-E093	Radio Frequency control box	MWRF-test	MW200-RFCB 2#	/	2023-05-12

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

#### 9.4 Peak Power output limit

The maximum peak power shall be less 1Watt.

#### 9.5 Measurement Results:

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	2023-4-26
Test By:	Best	Temperature :	24 °C
Test Result:	PASS	Humidity :	53 %

Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Antenna Gain	EIRP (dBm)	EIRP Limit (dBm)	Verdict
BLE 1M	2402	Ant1	7.9	0.5	8.4	30	Pass
BLE 1M	2440	Ant1	7.99	0.5	8.49	30	Pass
BLE 1M	2480	Ant1	8.15	0.5	8.65	30	Pass
BLE 2M	2402	Ant1	7.65	0.5	8.15	30	Pass
BLE 2M	2440	Ant1	7.66	0.5	8.16	30	Pass
BLE 2M	2480	Ant1	7.68	0.5	8.18	30	Pass

		Power	Test Gr NVNT BLE 11	M 2402MHz Ant	1		
Spectrum					-		
Ref Level 20.00 dB		2.02 dB 👄					( <sup>Δ</sup>
Att 30 a SGL Count 100/100	IB SWT	10.1 ms 👄	VBW 10 MHz	Mode Sweep			
1Pk Max							
				M1[1]			7.90 dBm
10 dBm			M1			2.4010	597000 GHa
0 dBm							
-10 dBm							
-20 dBm							
-30 dBm							
-40 dBm							
-50 dBm							
-60 dBm							
-70 dBm							
CF 2.402 GHz			10001			Spar	10.0 MHz
	7:26:34	Power		Ready	1	4,44	08.04.2023 17:26:34
ate: 8.APR.2023 1	7:26:34	Power		pts Pondy M 2440MHz Ant	1		08.04.2023
				Ready	1		08.04.2023
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 d	m Offset	2.03 dB 👄	NVNT BLE 11	Beady M 2440MHz Ant	1		08.04.2023
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 o SGL Count 100/100	m Offset	2.03 dB 👄	NVNT BLE 1	Beady M 2440MHz Ant	1		08.04.2023
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 o SGL Count 100/100	m Offset	2.03 dB 👄	NVNT BLE 1	Beady M 2440MHz Ant	1	448	09.04.2023 ∭∑ 7.99 dBn
Spectrum Ref Level 20.00 dB Att 30 of SGL Count 100/100 1Pk Max	m Offset	2.03 dB 👄	NVNT BLE 1	M 2440MHz Ant Mode Sweep	1	448	09.04.2023 ∭∑ 7.99 dBn
Spectrum Ref Level 20.00 dB Att 30 of SGL Count 100/100 1Pk Max	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	09.04.2023 ∭∑ 7.99 dBn
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 o SGL Count 100/100 PIPk Max 10 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	09.04.2023 ∭∑ 7.99 dBn
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 o SGL Count 100/100 PIPk Max 10 dBm 0 dBm 0 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	09.04.2023 ∭∑ 7.99 dBn
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 o SGL Count 100/100 PPk Max 10 dBm 0 dBm 0 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	7.99 dBn
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 o SGL Count 100/100 PPk Max 10 dBm 0 dBm 0 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	09.04.2023 ∭∑ 7.99 dBn
Att: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 c SGL Count 100/100 IPk Max 10 dBm 0 dBm -10 dBm -20 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	7.99 dBn
Att: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 c SGL Count 100/100 IPk Max 10 dBm 0 dBm -10 dBm -20 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	7.99 dBn
ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 c SGL Count 100/100 PPk Max 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	7.99 dBn
ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 c SGL Count 100/100 PPk Max 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -30 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	7.99 dBn
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 of SGL Count 100/100 PIPk Max 10 dBm 10 dBm -10 dBm -30 dBm -30 dBm -40 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	7.99 dBn
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 o SGL Count 100/100 PIPk Max 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -50 dBm -50 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	7.99 dBn
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 o SGL Count 100/100 PIPk Max 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -50 dBm -50 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	7.99 dBn
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 of SGL Count 100/100 PIPk Max 10 dBm 10 dBm -10 dBm -30 dBm -30 dBm -40 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	7.99 dBm
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 of SGL Count 100/100 PIPk Max 10 dBm 10 dBm 10 dBm -10 dBm -30 dBm -30 dBm -50 dBm -60 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	M 2440MHz Ant Mode Sweep		448	7.99 dBm
Ate: 8.APR.2023 1 Spectrum Ref Level 20.00 dB Att 30 of SGL Count 100/100 PIPk Max 10 dBm 10 dBm 10 dBm -10 dBm -30 dBm -30 dBm -50 dBm -60 dBm	m Offset	2.03 dB 👄	NVNT BLE 11 RBW 3 MHz VBW 10 MHz	Mode Sweep M1[1]		2.4397	7.99 dBm

		Power N	IVNT BLE 1	M 2480M	Hz Ant1			
Spectrum								
Ref Level 20.00 di	Bm Offset 2	2.05 dB 🖷 R	BW 3 MHz	:				( )
■ Att 30		0.1 ms 👄 <b>V</b>		Mode 9	Sweep			
SGL Count 100/100 Pk Max								
				М	1[1]			8.15 dBm
10 dBm				M1	1	I	2.4801	92000 GHz
10 aBm								
0 dBm								
	1							
-10 dBm								
-20 dBm								
-30 dBm								
-50 ubm								
-40 dBm								
-50 dBm								
-60 dBm								
-70 dBm								
-/U ubiii—								
25.0.40.00			1000	·				10.0 Milia
CF 2.48 GHz			10001	l pts			Span 100	10.0 MHz
							light	
ate: 8.APR.2023 1	17:36:37							
		Power N	IVNT BLE 2	M 2402M	Hz Ant1			
Spectrum		Power N	IVNT BLE 2	M 2402M	Hz Ant1			Ē
Spectrum	Bm Offset 2				Hz Ant1			
Ref Level 20.00 df		Power N 2.02 dB • R 0.1 ms • V	BW 3 MHz	:				
Ref Level 20.00 df Att 30 SGL Count 100/100		2.02 dB 👄 R	BW 3 MHz	:				
Ref Level 20.00 df Att 30 SGL Count 100/100		2.02 dB 👄 R	BW 3 MHz	: Mode S	Sweep			
Ref Level 20.00 d8 Att 30 SGL Count 100/100 1Pk Max		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S			2.4014	(Ⅲ → 7.65 dBm 92100 GHz
Ref Level         20.00 dt           Att         30           SGL Count         100/100           1Pk Max         100/100		2.02 dB 👄 R	BW 3 MHz	: Mode S	Sweep		2.4014	( ∆ ) 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           IPk Max         10 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	( ∆ ) 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           IPk Max         10 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	( ∆ ) 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           IPk Max         10 dBm           0 dBm         0 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	( ∆ ) 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           1Pk Max         10 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	( ∆ ) 7.65 dBm
Ref Level         20.00 dl           Att         30           SGL Count         100/100           1Pk Max         30           10 dBm         0 dBm           -10 dBm         -10 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	(∆ 7.65 dBm
Ref Level         20.00 dl           Att         30           SGL Count         100/100           1Pk Max         30           10 dBm         30           -10 dBm         30           -20 dBm         30		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	(∆ 7.65 dBm
Ref Level         20.00 dl           Att         30           SGL Count         100/100           IPk Max         10 dBm           0 dBm         0 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	(∆) 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           1Pk Max         10           0 dBm         0           -10 dBm         -0           -20 dBm         -30 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	(∆) 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           IPk Max         10           0 dBm         -0           -10 dBm         -20 dBm           -30 dBm         -30 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	(∆ 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           IPk Max         10           0 dBm         -0           -10 dBm         -20 dBm           -30 dBm         -40 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	(∆) 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           IPk Max         10           0 dBm         -0           -10 dBm         -20 dBm           -30 dBm         -40 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	(∆ 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           1Pk Max         10           10 dBm         -0           -10 dBm         -20 dBm           -30 dBm         -30 dBm           -50 dBm         -50 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	(∆ 7.65 dBm
Ref Level         20.00 dl           Att         30           SGL Count         100/100           IPk Max         10           0 dBm         -0           -20 dBm         -20 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	(∆ 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           1Pk Max         10           0 dBm         -0           -10 dBm         -0           -20 dBm         -30 dBm           -30 dBm         -50 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	(∆) 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           1Pk Max         10           10 dBm         -0           -10 dBm         -0           -20 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	: Mode S	Sweep		2.4014	(∆ 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           1Pk Max         10           10 dBm         -0           -10 dBm         -0           -20 dBm		2.02 dB 👄 R	BW 3 MH2 BW 10 MH2	Mode S	Sweep			(∆) 7.65 dBm
Ref Level         20.00 df           Att         30           SGL Count         100/100           1Pk Max         10           10 dBm         -0           -10 dBm		2.02 dB 👄 R	BW 3 MHz BW 10 MHz	Mode S	Sweep		Span	7.65 dBm 92100 GHz
Ref Level         20.00 df           Att         30           SGL Court         100/100           1Pk Max         10           10 dBm         10           -10 dBm	dB SWT 1	2.02 dB 👄 R	BW 3 MHz BW 10 MHz	Mode S	Sweep		Span	[ △ 7.65 dBm 92100 GHz

Spectrum				NVNT BLE 2				
Ref Level : Att	20.00 dBm 30 dB			RBW 3 MHz VBW 10 MHz				( \
SGL Count 1		3991	10.1 IIIS 🖶	YBW 10 MH2	Mode Swe	eep		
1Pk Max								a co dan
					M1[1	1]	2.439	7.66 dBn 449100 GH:
LO dBm				M1				
) dBm								
10 dBm								
20 dBm								
30 dBm								
40 dBm								
50 dBm								
60 dBm								
70 dBm								
CF 2.44 GHz							Spar	n 10.0 MHz
	)[	28:18	Power	10001	M 2480MHz	dv 2 Ant1	4,49	
bte: 8.APR.	2023 16:			NVNT BLE 2	M 2480MHz	dv 2 Ant1	4,454	
Spectrum Ref Level 3 Att	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MHz	M 2480MHz		4,44	
Spectrum Ref Level : Att SGL Count 1	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MHz	M 2480MHz		aya	
Spectrum Ref Level : Att SGL Count 1	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MHz	M 2480MHz	вер	199	
Spectrum Ref Level : Att SGL Count 1 )1Pk Max	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MHz	M 2480MHz	вер	4,45	( △
Spectrum Ref Level : Att SGL Count 1 )1Pk Max	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum Ref Level : Att SGL Count 1 )1Pk Max	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum Ref Level : Att SGL Count 1 1Pk Max 10 dBm 0 dBm	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum Ref Level : Att SGL Count 1 1Pk Max 10 dBm 0 dBm	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	09.04.2023 (□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
Spectrum Ref Level : Att SGL Count 1 11Pk Max 10 dBm 10 dBm 10 dBm	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum Ref Level : Att SGL Count 1 IPP Max I0 dBm 0 dBm 10 dBm 20 dBm	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum Ref Level : Att SGL Count 1 )PR Max O dBm	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum Ref Level : Att SGL Count 1 IPP Max I0 dBm 0 dBm 10 dBm 20 dBm	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum Ref Level : Att SGL Count 1 )PR Max O dBm	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum Ref Level : Att SGL Count 1 )1Pk Max 10 dBm 10 dBm 20 dBm 30 dBm 40 dBm 50 dBm	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum Ref Level : Att SGL Count 1 )1Pk Max 0 dBm 10 dBm 20 dBm 30 dBm 40 dBm	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum Ref Level : Att SGL Count 1 )1Pk Max 10 dBm 10 dBm 20 dBm 30 dBm 40 dBm 50 dBm	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum           Ref Level :           Att           SGL Count 1           )1Pk Max           10 dBm           ) dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm           60 dBm	2023 16: 20.00 dBm 30 dB	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	4,45	( △
Spectrum           Ref Level :           Att           SGL Count 1           )1Pk Max           10 dBm           ) dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm           60 dBm	)(	Offset	2.05 dB 👄	NVNT BLE 2 RBW 3 MH2 VBW 10 MH2	M 2480MHz	вер	2.479	( △

# **10.** Power Spectral Density Measurement

## **10.1Measurement Procedure**

The EUT was operating in Bluetooth mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

## 10.2 Test SET-UP (Block Diagram of Configuration)

EUT

Spectrum Analyzer

### **10.3 Measurement Equipment Used:**

Item	Instr.Code	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	AN-E037	Spectrum Analyzer	KEYSIGHT	N9020A	MY61250185	2023-10-07
2	AN-E040	WIDEBAND RADIO COMMUNICATION	Rohde & Schwarz	CMW500	157423	2023-10-07
3	AN-E039	MXG Vector Signal Generator	KEYSIGHT	N5182B	MY61250185	2023-10-07
4	AN-E038	EXG Analog Signal Generator	KEYSIGHT	N5173B	My61252603	2023-10-07
5	AN-E041	USB RF Power sensor	RadiPower	RPR3006W	17100015SNO88	2023-10-07
6	AN-E042	USB RF Power sensor	RadiPower	RPR3006W	17100015SNO89	2023-10-07
7	/	RF Test Software	MWRF-test	MTS 8310	N/A	N/A
8	AN-E092	Radio Frequency control box	MWRF-test	MW200-RFCB	MW220111ANCI	2023-05-12
9	AN-E093	Radio Frequency control box	MWRF-test	MW200-RFCB 2#	/	2023-05-12

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

### **10.4 Measurement Procedure**

10.4.1 The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

10.4.2. Set to the maximum power setting and enable the EUT transmit continuously.

10.4.3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)

10.4.4. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.

10.4.5. Measure and record the results in the test report.

10.4.6. The Measured power density (dBm)/ 100KHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

### **10.5 Measurement Results:**

Spectrum analyzer	Setting
Attenuation	Auto
Span Frequency	Set the span to 1.5 times the DTS bandwidth.
RB	3KHz
VB	10KHz
Detector	Peak
Trace	Max hold
Sweep Time	Automatic

The following table is the setting of spectrum analyzer.

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	2023-4-26
Test By:	Best	Temperature :	<b>24</b> °C
Test Result:	PASS	Humidity :	53 %

Mode	Frequency (MHz)	Antenna	Conducted PSD (dBm/3kHz)	Duty Factor (dB)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
BLE 1M	2402	Ant1	-7.52	0	-7.52	8	Pass
BLE 1M	2440	Ant1	-7.09	0	-7.09	8	Pass
BLE 1M	2480	Ant1	-6.91	0	-6.91	8	Pass
BLE 2M	2402	Ant1	-5.55	0	-5.55	8	Pass
BLE 2M	2440	Ant1	-5.69	0	-5.69	8	Pass
BLE 2M	2480	Ant1	-5.6	0	-5.6	8	Pass

Note:

- 1. Measured power density(dBm) has offset with cable loss.
- 2. The measured power density(dBm)/100KHz is reference level and used as 20dBc down for Conducted Band Edges and Conducted Spurious Emission limit line.

			VNT BLE 1	raphs	lz Ant1			
Spectrum		FJDIN	VINI DLL II	12402111				Ē
Ref Level 20.00 dB	m Offset 2	2.02 dB 👄 R	BW 3 kHz					
Att 30 (		13 ms 😑 🎙	<b>'BW</b> 10 kHz	Mode St	weep			
SGL Count 100/100 ●1Pk Max								
				М	1[1]			-7.52 dBm
10 dBm	_					l	2.401	78080 GH2
0 dBm								
10 10 -		M1 X A A	A 1.					
-10 dBm	h AMur	WWW A MAN	MATHAM.	1 M MA	Mana	A A ABRINE A		
-2010BAMALAMAN	WY W	1 1 1 1	lleg Ande	<u>WY (* 81</u>	1 1 HO-1.	h hulball	haldre	uh.
M	ľ					, in the second s	- VV V	MMAN
-30 dBm								· • •
-40 dBm								
-+o ubiii								
-50 dBm								
-60 dBm								
-70 dBm								
CF 2.402 GHz			1001	pts			Span 1	.167 MHz
				R	teady		1,70	8.04.2023
					teady		4,40	18.04.2023 17:29:55
ate: 8.APR.2023 1	7:29:54				teady		440	18.04.2023
ate: 8.APR.2023 1	7:29:54	PSD N	VNT BLE 1	и 2440МН	leady		AJAGA	18.04.2023
	7:29:54	PSD N'	VNT BLE 1	м 2440MH	leady Iz Ant1		aya -	18. n4.2023
Spectrum Ref Level 20.00 dB	m Offset 2	2.03 dB 😑 R	BW 3 kHz					18.04.2023
Spectrum Ref Level 20.00 dB Att 30 d	m Offset 2	2.03 dB 😑 R		M 2440MH Mode St				18.04.2023 ■ ■
Spectrum Ref Level 20.00 dB Att 30 0 SGL Count 100/100	m Offset 2	2.03 dB 😑 R	BW 3 kHz	Mode S <sup>a</sup>	weep			
Spectrum Ref Level 20.00 dB Att 30 of SGL Count 100/100	m Offset 2	2.03 dB 😑 R	BW 3 kHz	Mode S <sup>a</sup>			2.439	(∆ -7.09 dBn
Spectrum Ref Level 20.00 dB Att 30 ( SGL Count 100/100 1Pk Max	m Offset 2	2.03 dB 😑 R	BW 3 kHz	Mode S <sup>a</sup>	weep		2.439	(∆ -7.09 dBr
Spectrum Ref Level 20.00 de Att 30 0 SGL Count 100/100 1Pk Max 10 dBm	m Offset 2	2.03 dB 😑 R	BW 3 kHz	Mode S <sup>a</sup>	weep		2.439	(∆ -7.09 dBr
Spectrum Ref Level 20.00 de Att 30 0 SGL Count 100/100 1Pk Max 10 dBm	m Offset 2	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep		2.439	(∆ -7.09 dBr
Spectrum Ref Level 20.00 dB Att 30 d SGL Count 100/100 1Pk Max 10 dBm 0 dBm	m Offset 2 B SWT	2.03 dB 😑 R	BW 3 kHz	Mode S <sup>a</sup>	weep		2.439	(∆ -7.09 dBr
Spectrum Ref Level 20.00 dB Att 30 d SGL Count 100/100 1Pk Max 10 dBm 0 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep	м Ллани н	2.439	(∆ -7.09 dBr
Spectrum Ref Level 20.00 de Att 30 0 SGL Count 100/100 1Pk Max 10 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep		2.439	(∆ -7.09 dBr
Spectrum Ref Level 20.00 dB Att 30 ( SGL Count 100/100 1Pk Max 10 dBm -10 dBm -20 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep	"Mymy	2.439	-7.09 dBr 93345 GH
Att         30 m           SGL Count 100/100         100/100           1Pk Max         10 dBm           0 dBm         0 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep	"Mymy	2.439	-7.09 dBn 93345 GH
Spectrum Ref Level 20.00 dB Att 30 ( SGL Count 100/100 PIPK Max 10 dBm -10 dBm -20 dBm -20 dBm -30 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep	1. M.	2.439	-7.09 dBn 93345 GH
Spectrum Ref Level 20.00 dB Att 30 ( SGL Count 100/100 1Pk Max 10 dBm -10 dBm -20 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep		2.439	-7.09 dBn 93345 GH
Spectrum Ref Level 20.00 dB Att 30 ( SGL Count 100/100 PIPK Max 10 dBm -10 dBm -20 dBm -20 dBm -30 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep		2.439	-7.09 dBn 93345 GH
Spectrum Ref Level 20.00 dB Att 30 d SGL Count 100/100 1Pk Max 10 dBm -10 dBm -10 dBm -20 dBm -20 dBm -40 dBm -50 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep		2.439	-7.09 dBn 93345 GH
Spectrum Ref Level 20.00 dB Att 30 SGL Count 100/100 IPk Max 10 dBm -10 dBm -20,dBm -20,dBm -30 dBm -40 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep		2.439	-7.09 dBn 93345 GH
Spectrum           Ref Level 20.00 dB           Att 30 of SGL Count 100/100           SGL Count 100/100           IPk Max           10 dBm           -10 dBm           -20 dBm           -30 dBm           -50 dBm           -60 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep		2.439	-7.09 dBn 93345 GH
Spectrum Ref Level 20.00 dB Att 30 d SGL Count 100/100 1Pk Max 10 dBm -10 dBm -10 dBm -20 dBm -20 dBm -40 dBm -50 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode S <sup>a</sup>	weep		2.439	-7.09 dBn 93345 GH
Spectrum           Ref Level 20.00 dB           Att         30 dSGL Count 100/100           SGL Count 100/100           IPk Max           10 dBm           -10 dBm           -20 dBm           -30 dBm           -50 dBm           -60 dBm	m Offset 2 B SWT	2.03 dB 😑 R	RBW 3 kHz YBW 10 kHz	Mode Si	weep		W.	-7.09 dBn 93345 GH

			PSD N	VNT BLE 1	V 2480MF	lz Ant1			
<u> </u>			1301		12400111				
Spectrun									
	20.00 dBm		2.05 dB 👄 F						
Att CCL Count	30 dB	SWT	12.9 ms 😑 <b>\</b>	<b>/BW</b> 10 kHz	Mode S	weep			
SGL Count	100/100								
TER Man					м	1[1]			-6.91 dBm
						-1-1			93295 GHz
10 dBm									
0 dBm									
				M1					
-10 dBm			A AA	- ad at	1	<b>b</b> . A			
	A MA	APProv	MMA N	MNY **YMM	በለጣላሴ	MANAAA	M Arren 1		
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-30 ubiii									, ,
-40 dBm									
-40 ubm									
-50 dBm—									
-60 dBm									
-70 dBm									
CF 2.48 G	l			1001	nts			Span 1.	1565 MHz
(	1							4.96	18.04.2023
						(eauy		ayer.	
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			PSD N	VNT BLE 21	M 2402MF	lz Ant1			
Spectrun	n		PSD N	VNT BLE 21	M 2402MF	lz Ant1			
Spectrum		Offcet				Iz Ant1			
-	n I 20.00 dBm 30 dB		2.02 dB 👄 🖡	RBW 3 kHz	:				
Ref Leve	l 20.00 dBm 30 dB			RBW 3 kHz	:				
Ref Leve Att	l 20.00 dBm 30 dB		2.02 dB 👄 🖡	RBW 3 kHz	:				
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Ref Leve Att SGL Count 1Pk Max	l 20.00 dBm 30 dB		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	
Ref Leve Att SGL Count	l 20.00 dBm 30 dB		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	△
Ref Leve Att SGL Count 1Pk Max 10 dBm-	l 20.00 dBm 30 dB		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	△
Ref Leve Att SGL Count 1Pk Max	l 20.00 dBm 30 dB		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	△
Ref Leve Att SGL Count 1Pk Max 10 dBm-	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	
Ref Leve Att SGL Count 1Pk Max 10 dBm-	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	
Ref Leve Att SGL Count PIPK Max 10 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	
Ref Leve Att SGL Count PIPK Max 10 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep	Annald A	2.401	
Ref Leve Att SGL Count PIPK Max 10 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	
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Ref Leve Att SGL Count PIPK Max 10 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep	And the second s	2.401	△
Ref Leve Att SGL Count IPK Max 10 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep	And the second s	2.401	△
Ref Leve Att SGL Count PIPK Max 10 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep	havan politik (	2.401	△
Ref Leve Att SGL Count 1Pk Max 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep	haven	2.401	△
Ref Leve Att SGL Count IPK Max 10 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep	have mystary f	2.401	△
Ref Leve Att SGL Count 1Pk Max 10 dBm 0 dBm -10 dBm -20 tBm -30 cBm -40 dBm -50 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	
Ref Leve Att SGL Count 1Pk Max 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	
Ref Leve           Att           SGL Count           IPk Max           10 dBm           -10 dBm           -20 dBm           -30 dBm           -40 dBm           -50 dBm           -60 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	
Ref Leve Att SGL Count 1Pk Max 10 dBm 0 dBm -10 dBm -20 tBm -30 cBm -40 dBm -50 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	
Ref Leve           Att           SGL Count           IPk Max           10 dBm           -10 dBm           -20 dBm           -30 dBm           -40 dBm           -50 dBm           -60 dBm	I 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep		2.401	
Ref Leve           Att           SGL Count           IPk Max           10 dBm           -10 dBm           -20 dBm           -30 dBm           -40 dBm           -50 dBm           -60 dBm	M1 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡	RBW 3 kHz	Mode S	weep			△
Ref Leve           Att           SGL Count           IPk Max           10 dBm           0 dBm           -10 dBm           -20 dBm           -30 dBm           -40 dBm           -50 dBm           -60 dBm           -70 dBm	M1 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡		Mode S	weep		Span 1.	-5.55 dBm 41445 GHz
Ref Leve           Att           SGL Count           IPk Max           10 dBm           0 dBm           -10 dBm           -20 dBm           -30 dBm           -40 dBm           -50 dBm           -60 dBm           -70 dBm	M1 20.00 dBm 30 dB 100/100		2.02 dB 👄 🖡		Mode S	weep		Span 1.	-5.55 dBm 41445 GHz

Spectrun									
Ref Level Att SGL Count	20.00 dBm 35 dB		.03 dB 👄 RI ).5 ms 👄 VI		Mode Sv	veep			
1Pk Max	100,100								
					м	1[1]		9,490	-5.69 dBn 941445 GH
10 dBm								2.435	941443 GH
) dBm	M1								
-10 dBm	H-A		A.u.1						
20 #8m	y y www.	where	MANA		MuniMu			Malally	my
40 dBm							v		
-50 dBm									
-60 dBm									
-70 dBm									
CF 2.44 GI	-			1001					0075 MU
5F 2.44 Gr	12			1001	prs			ana ana	.8375 MHz
te: 8.APP	R.2023 16	:30:21	PSD N	VNT BLE 21	и 2480MF	lz Ant1			(
Spectrun Ref Leve	n I 20.00 dBm	Offset 2	2.05 dB 👄 F	RBW 3 kHz					
Spectrun Ref Leve Att SGL Count	n I 20.00 dBm 30 dB	Offset 2	2.05 dB 👄 F						
Spectrun Ref Leve Att SGL Count	n I 20.00 dBm 30 dB	Offset 2	2.05 dB 👄 F	RBW 3 kHz	Mode S	weep			
Spectrun Ref Leve Att SGL Count 1Pk Max	n I 20.00 dBm 30 dB	Offset 2	2.05 dB 👄 F	RBW 3 kHz	Mode S			2.479	(∆ -5.60 dBn
Spectrun Ref Leve Att SGL Count IPk Max	n I 20.00 dBm 30 dB	Offset 2	2.05 dB 👄 F	RBW 3 kHz	Mode S	weep		2.479	( ∆ -5.60 dBn
Spectrum Ref Leve Att SGL Count ) IPk Max 10 dBm	n I 20.00 dBm 30 dB	Offset 2	2.05 dB 👄 F	RBW 3 kHz	Mode S	weep		2.479	( ∆ -5.60 dBn
Spectrum Ref Leve Att SGL Count ) IPk Max 10 dBm	n I 20.00 dBm 30 dB 100/100	Offset 2	2.05 dB 👄 F	RBW 3 kHz	Mode S	weep	ан алан ан а	2.479	( ∆ -5.60 dBn
Spectrum Ref Leve Att SGL Count ) IPk Max 10 dBm	n I 20.00 dBm 30 dB 100/100	Offset 2	2.05 dB 👄 F	RBW 3 kHz	Mode S	weep		2.479	(∆ -5.60 dBn
Spectrun Ref Leve Att SGL Count 10 dBm	n I 20.00 dBm 30 dB 100/100	Offset 2	2.05 dB 👄 F	RBW 3 kHz	Mode S	weep	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	2.479	-5.60 dBn 941400 GH
Spectrun Ref Leve Att SGL Count 10 dBm	n I 20.00 dBm 30 dB 100/100	Offset 2	2.05 dB 👄 F	RBW 3 kHz	Mode S	weep		2.475	-5.60 dBn )41400 GH:
Spectrun Ref Leve Att SGL Count 10 dBm	n I 20.00 dBm 30 dB 100/100	Offset 2	2.05 dB 👄 F	RBW 3 kHz	Mode S	weep		2.475	-5.60 dBn )41400 GH:
Spectrun Ref Leve Att SGL Count 1PK Max 0 dBm 10 dBm 10 dBm 20 kBm 40 dBm 50 dBm 50 dBm 60 dBm	n I 20.00 dBm 30 dB 100/100	Offset 2	2.05 dB 👄 F	RBW 3 kHz	Mode S	weep		2.475	-5.60 dBn )41400 GH:
Spectrun	M 1 20.00 dBm 30 dE 100/100	Offset 2	2.05 dB 👄 F	RBW 3 kHz	Mode S	weep		Mur MyA	-5.60 dBn 041400 GH

## **11.1 Measurement Procedure**

## For Conducted Test

- 1. The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100KHz. The video bandwidth is set to 300KHz.
- 2. The spectrum from 30MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

EMI Test Receiver	Setting
Attenuation	Auto
RBW	100KHz
VBW	300KHz
Detector	Peak
Trace	Max hold

## For Radiated emission Test

The EUT was placed on a styrofoam table which is 1.5m above ground plane.

The measurement procedure at the ban edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission were be encompassed by the span. After trace stabilization, the maximum peak was be determined by a peak detector and the value was marked by an appropriate limit line. The second limit line, which is 20dB below the first, marks the limit for the emissions in the unrestricted band. A maximum-peak-detector marks the highest emission in the unrestricted band next to the band edge.

The measurements were performed at the lower end of the 2.4GHz band. Use the following spectrum analyzer settings:

For Restricted Band, When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

Setting
Auto
1MHz
3MHz
Peak
Max hold

For Non-Restricted Band, When spectrum scanned above 1GHz setting resolution bandwidth 100KHz, video bandwidth 300KHz:

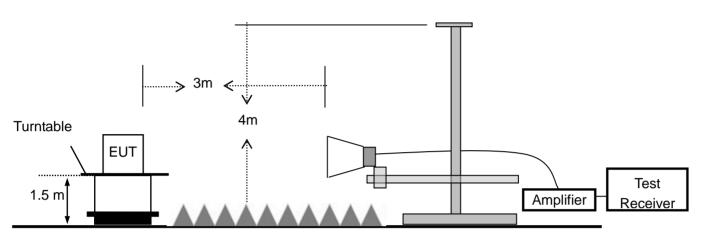
EMI Test Receiver	Setting
Attenuation	Auto
RBW	100KHz
VBW	300KHz
Detector	Peak
Trace	Max hold

## 11.2 Test SET-UP (Block Diagram of Configuration)

For Conducted Test



For Radiated emission Test



# 11.3 Measurement Equipment Used:

## For Conducted Test

Remark: The temporary antenna connector is soldered on the PCB board in order to perform

Item	Instr.Code	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	AN-E037	Spectrum Analyzer	KEYSIGHT	N9020A	MY61250185	2023-10-07
2	AN-E040	WIDEBAND RADIO COMMUNICATION	Rohde & Schwarz	CMW500	157423	2023-10-07
3	AN-E039	MXG Vector Signal Generator	KEYSIGHT	N5182B	MY61250185	2023-10-07
4	AN-E038	EXG Analog Signal Generator	KEYSIGHT	N5173B	My61252603	2023-10-07
5	AN-E041	USB RF Power sensor	RadiPower	RPR3006W	17100015SNO88	2023-10-07
6	AN-E042	USB RF Power sensor	RadiPower	RPR3006W	17100015SNO89	2023-10-07
7	/	RF Test Software	MWRF-test	MTS 8310	N/A	N/A
8	AN-E092	Radio Frequency control box	MWRF-test	MW200-RFCB	MW220111ANCI	2023-05-12
9	AN-E093	Radio Frequency control box	MWRF-test	MW200-RFCB 2#	/	2023-05-12

conducted tests and this temporary antenna connector is listed in the equipment list.

## **11.4 Measurement Results:**

Refer to attached data chart.

Spectrum Detector:	PK	Test Date :	2023-4-26
Test By:	Best	Temperature :	24 °C
Test Result:	PASS	Humidity :	53 %

#### 1. Conducted Test

Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
BLE 1M	2402	Ant1	-47.77	-20	Pass
BLE 1M	2480	Ant1	-51.22	-20	Pass
BLE 2M	2402	Ant1	-27.38	-20	Pass
BLE 2M	2480	Ant1	-51.07	-20	Pass

	Dened E.J.	Test Graph		Dof	
	Band Edg	ge NVNT BLE 1M 2	402IVIHZ Ant1	кет	ſ
Spectrum					[
Ref Level 20.00 dBm Att 30 dB			<b>Node</b> Sweep		
SGL Count 100/100					
1Pk Max					
			M1[1]		6.85 dE 2.40222380 G
10 dBm				+	
		many			
0 dBm					
			$\lambda$		
-10 dBm					
-20 dBm		1			
20 4011	1	M	March 1		
30 dBm	ſ		<b>`</b> }		
			L.		
40 dBm	AN N IN MY NOT		h	ALAM 18	
Asiana da AMA - A	Mille Mille Ia				M MAA MMM A A.A
╡╣╣ᡖ┉┼╱╢╟╢╱┈┉┉╱╌	Y				
60 dBm					
-70 dBm					
CF 2.402 GHz		1001 pts			Span 8.0 M⊦
1		1			00.04.2022
ate: 8.APR.2023 17		NVNT BLE 1M 240	Peady 2MHz Ant1 Em	nission	17:16:11
Ate: 8.APR.2023 17		NVNT BLE 1M 240	Ready 2MHz Ant1 Em	hission	05.04.20.3 17139-31
Ref Level 20.00 dBr	Band Edge I		Roody 2MHz Ant1 Em	hission	
Spectrum Ref Level 20.00 dBm Att 30 dE	Band Edge I	• <b>RBW</b> 100 kHz	Ready 2MHz Ant1 Em Mode Sweep	nission	1999 [1
Spectrum Ref Level 20.00 dBm Att 30 dE SGL Count 100/100	Band Edge I	• <b>RBW</b> 100 kHz		nission	1999 [1
Spectrum Ref Level 20.00 dBm Att 30 dE SGL Count 100/100	Band Edge I	• <b>RBW</b> 100 kHz	Mode Sweep	iission	l
Spectrum Ref Level 20.00 dBm Att 30 dE SGL Count 100/100 p1Pk Max	Band Edge I	• <b>RBW</b> 100 kHz	Mode Sweep M1[1]	aission	6.95 dt 2.4017500ស្ន
Spectrum Ref Level 20.00 dBm Att 30 dE SGL Count 100/100 01Pk Max 10 dBm	Band Edge I	• <b>RBW</b> 100 kHz	Mode Sweep	aission	6.95 dt 2.4017500M G -44.02 կե
Spectrum Ref Level 20.00 dBm Att 30 dE SGL Count 100/100 01Pk Max 10 dBm	Band Edge I	• <b>RBW</b> 100 kHz	Mode Sweep M1[1]	ission	6.95 dt 2.4017500ស្ន
Spectrum           Ref Level 20.00 dBm           Att 30 dE           SGL Count 100/100           D1Pk Max           L0 dBm           10 dBm	Band Edge I	<b>RBW</b> 100 kHz	Mode Sweep M1[1]	ission	6.95 dt 2.4017500M G -44.02 կե
Spectrum           Ref Level 20.00 dBm           Att 30 dE           SGL Count 100/100           D1Pk Max           L0 dBm           10 dBm           D1 -13.148	Band Edge I	<b>RBW</b> 100 kHz	Mode Sweep M1[1]	ission	6.95 dt 2.4017500M G -44.02 կե
Spectrum Ref Level 20.00 dBm Att 30 dE SGL Count 100/100 11Pk Max 10 dBm -10 dBm D1 -13.148	Band Edge I	<b>RBW</b> 100 kHz	Mode Sweep M1[1]	ission	6.95 dt 2.4017500M G -44.02 կե
Spectrum Ref Level 20.00 dBm Att 30 dE SGL Count 100/100 10 HM Max 10 dBm 10 dBm 10 dBm 10 dBm 10 dBm 11 -13.148	Band Edge I	<b>RBW</b> 100 kHz	Mode Sweep M1[1]		6.95 dt 2.40175000 g -44.02 tt 2.40000000 g
Spectrum           Ref Level         20.00 dBm           Att         30 dE           SGL Count         100/100           1Pk Max         10 dBm           10 dBm         0 dBm           -10 dBm         D1 -13.148           -20 dBm         -30 dBm	Band Edge I	<b>RBW</b> 100 kHz	Mode Sweep M1[1]		6.95 dt 2.4017500M G -44.02 կե
Spectrum           Ref Level 20.00 dBm           Att 30 dE           SGL Count 100/100           01Pk Max           10 dBm           10 dBm           10 dBm           20 dBm           30 dBm           40 dBm	Band Edge I	<b>RBW</b> 100 kHz	Mode Sweep M1[1]		6.95 dd 2.40175000 g -44.02 dd 2.4000000 g 
Spectrum           Ref Level 20.00 dBm           Att 30 dE           SGL Count 100/100           01Pk Max           10 dBm           10 dBm           10 dBm           20 dBm           30 dBm           40 dBm	Band Edge I	RBW 100 kHz VBW 300 kHz	Mode Sweep		6.95 dd 2.40175000 g -44.02 dd 2.4000000 g 
Spectrum           Ref Level 20.00 dBm           Att 30 dE           SGL Count 100/100           PIPk Max           10 dBm           10 dBm           10 dBm           20 dBm           30 dBm           30 dBm           30 dBm           30 dBm           50 dBm	Band Edge I	RBW 100 kHz VBW 300 kHz	Mode Sweep		6.95 dd 2.40175000 g -44.02 dd 2.4000000 g 
Spectrum  Ref Level 20.00 dBm  Att 30 dE SGL Count 100/100  IPF Max  0 dBm  10 dBm  10 dBm  10 dBm  30 dBm  40 dBm  50 dBm  50 dBm  50 dBm	Band Edge I	RBW 100 kHz VBW 300 kHz	Mode Sweep		6.95 dt 2.40175000 g -44.02 tt 2.40000000 g
Spectrum  Ref Level 20.00 dBm  Att 30 dE SGL Count 100/100  IPF Max  0 dBm  10 dBm  10 dBm  10 dBm  30 dBm  40 dBm  50 dBm  50 dBm  50 dBm	Band Edge I	RBW 100 kHz VBW 300 kHz	Mode Sweep		6.95 dd 2.40175000 g -44.02 dd 2.4000000 g 
Spectrum  Ref Level 20.00 dBm  Att 30 dB  SGL Count 100/100  IPK Max  0 dBm  10 dBm  20 dBm  20 dBm  50 dBm  50 dBm  70 dBm  70 dBm  70 dBm	Band Edge I	RBW 100 kHz VBW 300 kHz	Mode Sweep		6.95 dd 2.40175000 g -44.02 dd 2.4000000 g 
Spectrum           Ref Level 20.00 dBm           Att 30 dE           SGL Count 100/100           10 HR Max           10 dBm           50 dBm           40 dBm           50 dBm           70 dBm           31 dBm           32 dBm           33 dBm           44 dBm           50 dBm           37 dBm           38 dBm           39 dBm           30 dBm           40 dBm           50 dBm           31 dBm           32 dBm           33 dBm           34 dBm           35 dBm           36 dBm           37 dBm           38 dBm           39 dBm           30 dBm           30 dBm           30 dBm	Band Edge I	RBW 100 kHz VBW 300 kHz	Mode Sweep 	Line of the state	6.95 df 2.40175000 G -44.02 H 2.4000000 G M M M M M M M M M M M M M M M M M M M
Spectrum           Ref Level         20.00 dBm           Att         30 dE           SGL Count         100/100           1Pk Max         10 dBm           10 dBm         0           10 dBm         0           -10 dBm         01 -13.148           -20 dBm	Band Edge I	RBW 100 kHz VBW 300 kHz	Mode Sweep	Line of the state	6.95 de 2.40175000 G -44.02 H 2.4000000 G M M M M M M
Spectrum         Ref Level       20.00 dBm         Att       30 dE         SGL Count       100/100         IPK Max       100         IPK Max       100         ID dBm       10         -10 dBm       01         -10 dBm       01         -20 dBm	Band Edge I Offset 2.02 dB SWT 1 ms	RBW 100 kHz VBW 300 kHz VBW 300 kHz NBW 100 kHz NBW 100 kHz NBW 100 kHz NBW 100 kHz NBZ NBW 100 kHz NBW 100 kH	Mode Sweep 	Line of the state	6.95 df 2.40175000 G -44.02 H 2.4000000 G M M M M M M M M M M M M M M M M M M M
Spectrum       Ref Level 20.00 dBm       Att     30 dE       SGL Count 100/100       10 dBm       11 dT       12 dT       11 dT       12 dT	Band Edge I           Offset 2.02 dB           SWT         1 ms           SWT         1 ms           dBm         1           dBm         1           dBm         1           dBm         1           2.40175 GHz         2.4 GHz           2.40175 GHz         2.4 GHz	RBW 100 kHz VBW 300 kHz I I I I I I I I I I I I I I I I I I I	Mode Sweep 	Line of the state	6.95 df 2.40175000 G -44.02 H 2.4000000 G M M M M M M M M M M M M M M M M M M M
Spectrum       Ref Level 20.00 dBm       Att     30 dE       SGL Count 100/100       PIPk Max       10 dBm       10 dBm       10 dBm       10 dBm       20 dBm       30 dBm       40 dBm       50 dBm       40 dBm       50 dBm       40 dBm       50 dBm       51 dBm       52 dBm       53 dBm       54 dBm       55 dBm       56 dBm       57 dBm       58 dBm       59 dBm       50 dBm       50 dBm       51 dBm       52 dBm       53 dBm       54 dBm       55 dBm       56 dBm       57 dBm       58 dBm       59 dBm       50 dBm <tr< td=""><td>Band Edge I Offset 2.02 dB SWT 1 ms</td><td>RBW 100 kHz VBW 300 kHz VBW 300 kHz NBW 100 kHz NBW 100 kHz NBW 100 kHz NBW 100 kHz NBZ NBW 100 kHz NBW 100 kH</td><td>Mode Sweep </td><td>Line of the state of the state</td><td>6.95 df 2.40175000 G -44.02 H 2.4000000 G M M M M M M M M M M M M M M M M M M M</td></tr<>	Band Edge I Offset 2.02 dB SWT 1 ms	RBW 100 kHz VBW 300 kHz VBW 300 kHz NBW 100 kHz NBW 100 kHz NBW 100 kHz NBW 100 kHz NBZ NBW 100 kHz NBW 100 kH	Mode Sweep 	Line of the state	6.95 df 2.40175000 G -44.02 H 2.4000000 G M M M M M M M M M M M M M M M M M M M

	Band Ed	ge NVNT BLE 1M	2480MHz Ant1 F	Ref	
Spectrum					
Ref Level 20.00 dBn					
Att 30 df SGL Count 100/100	B SWT 1 ms (	😑 <b>VBW</b> 300 kHz	Mode Sweep		
1Pk Max					
			M1[1]		7.37 dBr 2.48023180 GH
10 dBm		M.	1	+ +	
		m			
) dBm			$\mathbf{x}$		
-10 dBm					
20 dBm		m	Wry		
30 dBm	<i>f</i>				
	. no Black		~~ NA	m.	
40 dBm	Man Mana			MA MAMAA	MARINA
MMA MMNNV					1/1/10/00/00/00
ad colored to					0 ° 1 V IW
60 dBm	<u> </u>				
70 40					
-70 dBm					
CF 2.48 GHz		1001 pts	-		Span 8.0 MHz
JF 2.48 GH2		1001 pts	Poady		08.04.2023
			J		1/3734
Spectrum		NVNT BLE 1M 248		1551011	
Ref Level 20.00 dBn Att 30 dB			Mode Sweep		
SGL Count 100/100					
1Pk Max			M1[1]		7.38 dBr
			CONTRACT.		
Lo dam					2.47995000 GH
A			M2[1]		2.47995000 GH -48.25 dBr 2.48350000 GH
) dBm			M2[1]		2.47995000 GH -48.25 dBr
) dBm	dBm		M2[1]		2.47995000 GH -48.25 dBr
) dBm	. dBm		M2[1]		2.47995000 GH -48.25 dBr
) dBm 10 cBm 20 cBm 20 cBm	dBm		M2[1]		2.47995000 GH -48.25 dBr
) dBm 10 cBm 20 cBm 20 cBm	. dBm		M2[1]		2.47995000 GH -48.25 dBr
0 dBm 10 dBm 20 dBm 20 dBm 40 dBm 50 dBm	M3		M2[1]		2.47995000 GH -48.25 dBr
0 dBm 10 dBm 20 dBm 20 dBm 40 dBm 50 dBm 10 -12.631 0 1 -12.631 0 -12.63	M3				2.47995000 GH -48.25 dB 2.48350000 GH
) dBm 10 cBm D1 -12.631 20 cBm 30 dBm 40 dBm 50 dBm 60 dBm	M3	Marine and Angles	M2[1]	l	2.47995000 GH -48.25 dBr
0 dBm 10 cBm D1 -12.631 20 cBm 30 dBm 40 dBm 50 dBm 60 dBm	M3			internet int	2.47995000 GH -48.25 dB 2.48350000 GH
0 dBm 10 dBm	M3	1001 pts		i i i i i i i i i i i i i i i i i i i	2.47995000 GH -48.25 dB 2.48350000 GH
0 dBm 10 cBm 10 cBm 20 cBm 20 dBm 30 dBm 50 dBm 50 dBm 70 dBm 51 dBm	M3		میں اور		2.47995000 GH -48.25 dB 2.48350000 GH
0 dBm 10 cBm 10 cBm 20 cBm 20 dBm 30 dBm 50 dBm 50 dBm 70 dBm 51 dBm	M3	<u>المحمد المحمد المحم المحمد المحمد المحم محمد المحمد المحم المحمد المحمد المحمد المحمد المحمد المحم المحمد المحمد المحم المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحم المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحمد المحم المحمد المحمد المحم المحمد المحمد المحمد المحمد المحمد المحمد المحمد ال</u>			2.47995000 GH -48.25 dB 2.48350000 GH
0 dBm         D1 -12.631           20 dBm         D1 -12.631           20 dBm	M3 X-value 2.47995 GHz 2.4835 GHz	<b>Y-value</b> 7.38 dBm -48.25 dBm	میں اور		2.47995000 GH -48.25 dB 2.48350000 GH
0 dBm 10 cBm 10 cBm 10 cBm 10 cBm 10 cBm 10 dBm 10 dBm	M3 M3 X-value 2.47995 GHz	Y-value 7.38 dBm	میں اور		2.47995000 GH -48.25 dB 2.48350000 GH
20 dBm -30 dBm -30 dBm -50 dBm -50 dBm -70	M3 X-value 2.47995 GHz 2.4835 GHz 2.5 GHz	Y-value 7.38 dBm -48.25 dBm -50.71 dBm	میں اور		2.47995000 Gi -48.25 dB 2.48350000 Gi

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specului	n							
	1 20.00 dBr			RBW 100 kHz				
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Spectrum Ref Level	n I 20.00 dBr	m Offset		RBW 100 kHz	U2IMHz Ant'i Ei	mission		
Ref Level Att	l 20.00 dBr 30 d		2.02 dB 🖷		Mode Sweep			
Ref Level Att GGL Count	l 20.00 dBr 30 d		2.02 dB 🖷	<b>RBW</b> 100 kHz				
Ref Level Att GGL Count	l 20.00 dBr 30 d		2.02 dB 🖷	<b>RBW</b> 100 kHz				3 dB
Ref Level Att GGL Count 1Pk Max	l 20.00 dBr 30 d		2.02 dB 🖷	<b>RBW</b> 100 kHz	Mode Sweep M1[1]		2.4014500	3 dBi ğlGH
Ref Level Att GGL Count 1Pk Max 0 dBm	l 20.00 dBr 30 d		2.02 dB 🖷	<b>RBW</b> 100 kHz	Mode Sweep			3 dB V <sup>1</sup> GF 3 dB
Ref Level Att SGL Count 1Pk Max 0 dBm dBm	I 20.00 dBr 30 d 100/100	B SWT	2.02 dB 🖷	<b>RBW</b> 100 kHz	Mode Sweep M1[1]		2.4014500 -19.48	3 dBi V <sup>1</sup> GF 3 dBi
Ref Level Att GGL Count 1Pk Max 0 dBm dBm 10 dBm	l 20.00 dBr 30 d	B SWT	2.02 dB 🖷	<b>RBW</b> 100 kHz	Mode Sweep M1[1]		2.4014500 -19.48	3 dB Ø <sup>1</sup> GF 3 dB
Ref Level Att SGL Count 1Pk Max 0 dBm dBm 10 dBm	I 20.00 dBr 30 d 100/100	B SWT	2.02 dB 🖷	<b>RBW</b> 100 kHz	Mode Sweep M1[1]		2.4014500 -19.48 2.4000000	3 dB Ø <sup>1</sup> GF 3 dB
Ref Level Att SGL Count 1Pk Max 0 dBm dBm 10 dBm 20 dBm	I 20.00 dBr 30 d 100/100	B SWT	2.02 dB 🖷	<b>RBW</b> 100 kHz	Mode Sweep M1[1]		2.4014500 -19.48 2.4000000	3 dB 9 GF 3 dB 0 GF
Ref Level Att GGL Count 1Pk Max 0 dBm dBm 10 dBm 20 dBm 30 dBm	I 20.00 dBr 30 d 100/100	B SWT	2.02 dB 🖷	<b>RBW</b> 100 kHz	Mode Sweep M1[1]		2.4014500 -19.48 2.4000000	3 dB 9 GF 3 dB 0 GF
Ref Level           Att           GGL Count           IPk Max           0 dBm           dBm           10 dBm           20 dBm           30 dBm           40 dBm	I 20.00 dBr 30 d 100/100	B SWT	2.02 dB 🖷	<b>RBW</b> 100 kHz	Mode Sweep M1[1]		2.4014500 -19.48 2.4000000	3 dB 9 GF 3 dB 0 GF
Ref Level           Att           SGL Count           IPk Max           0 dBm           dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm	0 20.00 dBr 30 d 100/100	B SWT	2.02 dB  1 ms	RBW         100 kHz           VBW         300 kHz	Mode Sweep M1[1] M2[1] 		2.4014500 -19.46 2.4000000	3 dB 9 GF 3 dB 0 GF
Ref Level           Att           SGL Count           IPk Max           0 dBm           dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm	I 20.00 dBr 30 d 100/100	B SWT	2.02 dB 🖷	RBW         100 kHz           VBW         300 kHz	Mode Sweep M1[1] M2[1] 		2.4014500 -19.46 2.4000000	3 dB Ø <sup>1</sup> GF 3 dB
Ref Level           Att           GGL Count           1Pk Max           0 dBm           dBm           1D dBm           20 dBm           30 dBm           40 dBm           50 dBm           50 dBm           50 dBm           50 dBm	0 20.00 dBr 30 d 100/100	B SWT	2.02 dB  1 ms	RBW         100 kHz           VBW         300 kHz	Mode Sweep M1[1] M2[1] 		2.4014500 -19.46 2.4000000	3 dB Ø <sup>1</sup> GF 3 dB
Ref Level           Att           SGL Count           IPK Max           0 dBm           dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm           50 dBm           70 dBm           tart 2.300	0 20.00 dBr 30 d 100/100	B SWT	2.02 dB  1 ms	RBW         100 kHz           VBW         300 kHz	Mode Sweep		2.4014500 -19.46 2.4000000	3 dBi
Ref Level           Att           SGL Count           IPk Max           0 dBm           dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm           50 dBm           70 dBm           rtart 2.300           arker	1 20.00 dBr 30 d 100/100	B <b>SWT</b>	2.02 dB 1 ms 1 m	RBW 100 kHz VBW 300 kHz	Mode Sweep	Lucuto,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	2.4014500 -19.40 2.4000000 Mi Mi Mi Mi Mi Stop 2.406	3 dBi
Ref Level Att GGL Count 1Pk Max 0 dBm	1 20.00 dBr 30 d 100/100	B SWT	2.02 dB 1 ms 1 m	RBW         100 kHz           VBW         300 kHz	Mode Sweep	Lucuto,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	2.4014500 -19.40 2.4000000 MM MM MM	3 dBi
Ref Level           Att           SGL Count           IPk Max           0 dBm           dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm           50 dBm           70 dBm           itart 2.300           arker           Type Ret           M1           M2	I 20.00 dBr 30 d 100/100 D1 -12.097 D1 -12.097 G GHz G GHz	B SWT	2.02 dB 1 ms 1 m	RBW         100 kHz           VBW         300 kHz             Image: state sta	Mode Sweep	Lucuto,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	2.4014500 -19.40 2.4000000 Mi Mi Mi Mi Mi Stop 2.406	3 dBi
Ref Level           Att           SGL Count           IPK Max           0 dBm           0 dBm           10 dBm           20 dBm           30 dBm           40 dBm           50 dBm           60 dBm           70 dBm           ftart 2.30           arker           Type           M1	I 20.00 dBr 30 d 100/100	B SWT	2.02 dB 1 ms 1 m	RBW         100 kHz           VBW         300 kHz	Mode Sweep	Lucuto,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	2.4014500 -19.40 2.4000000 Mi Mi Mi Mi Mi Stop 2.406	

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Ate: 8.APR. Ref Level : Att SGL Count 1 1Pk Max 10 dBm -10 dBm -20 dBm -20 dBm -20 dBm -30 dBm	2023 16: 20,00 dBm 30 dB 00/100	Ban Offset : SWT	2.05 dB 👄 I	<b>(NT BLE 2M 24</b> <b>RBW</b> 100 kHz	Boo Mode Swa M1[1	eep L]	sion	2.47	00.042023
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Ate: 8.APR. Ref Level 3 Att SGL Count 1 PIPk Max 10 dBm -10 dBm -10 dBm -20 dBm -20 dBm -30 dBm -60 dBm	2023 16: 20,00 dBm 30 dB 00/100	Ban Offset : SWT	2.05 dB 👄 I	VNT BLE 2M 24	00000000000000000000000000000000000000	eep [] []		2.47 2.48	7.36 dBr 945000 GH -47.89 dBr 350000 GH
Ate:         8.APR.           Spectrum         Ref Level :           Att         SGL Count 1           SGL Count 1         Pressor           10 dBm         D           10 dBm         D           20 dBm         D           30 dBm         D           40 dBm         D           50 dBm         D           40 dBm         D           50 dBm         D           60 dBm         D           70 dBm         D	2023 16: 20.00 dBm 30 dB 00/100	Ban Offset : SWT	2.05 dB 👄 I	VNT BLE 2M 24	Bos     B	eep [] []		2.47 2.48	08.04.2023
Ate: 8.APR. Spectrum Ref Level 3 Att SGL Count 1 1Pk Max 10 dBm 10 dBm 10 dBm 20 dBm 40 dBm	2023 16: 20.00 dBm 30 dB 00/100	Ban Offset : SWT dBm	2.05 dB  1 ms	2NT BLE 2M 24 RBW 100 kHz VBW 300 kHz VBW 300 kHz I I I I I I I I I I I I I I I I I I I	Box     Box     Box     Box     Box     Box     Mode Swi      M1[1     M2[1	eep	ل للقار ان مقام المراجع الم	2.47 2.48	7.36 dBr 945000 GH -47.89 dBr 35000 GH
Ate: 8.APR. Spectrum Ref Level 3 Att SGL Count 1 1Pk Max 10 dBm 10 dBm 10 dBm 20 dBm 40 dBm	2023 16: 20.00 dBm 30 dB 00/100	Ban Offset : SWT dBm MANBrugut	2.05 dB  1 ms	/NT BLE 2M 24	Bos     B	eep	ل للقار ان مقام المراجع الم	2.47 2.48	7.36 dBr 945000 GH -47.89 dBr 35000 GH
Ate: 8.APR. Spectrum Ref Level 3 Att SGL Count 1 PR Max 10 dBm 10 dBm 20 dBm 20 dBm 40 dBm	2023 16: 20.00 dBm 30 dB 00/100 11 -12.325 GHz GHz 1 1	Ban Offset : SWT dBm dBm	2.05 dB 1 ms 1 ms 1 ms	2NT BLE 2M 24 RBW 100 kHz VBW 300 kHz VBW 300 kHz VBW 300 kHz VBW 300 kHz VBW 300 kHz VBW 300 kHz VE VBW 300 kHz VBW 300 kH	Box     Box     Box     Box     Box     Box     Mode Swi      M1[1     M2[1	eep	ل للقار ان مقام المراجع الم	2.47 2.48	7.36 dBr 945000 GH -47.89 dBr 35000 GH
Atte:       8.APR.         Ref Level       Atte         SGL Count 1       1         10 dBm       0         10 dBm       0         -10 dBm       0         -20 dBm       0         -30 dBm       0         -40 dBm       0         -50 dBm       -60 dBm         -60 dBm       -70 dBm         -70 dBm       -70 dBm         -70 dBm       -70 dBm         -70 dBm       -70 dBm	2023 16: 20.00 dBm 30 dB 00/100 1 -12.325 1 -12.325 GHz GHz	Ban Offset : SWT dBm MANA-uuu MANA-uuu Z.479 2.48 2	2.05 dB  1 ms 1 ms 1 1 ms 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	/NT BLE 2M 24 RBW 100 kHz yBW 300 kHz	Box     Box     Box     Box     Box     Box     Mode Swi      M1[1     M2[1	eep	ل للقار ان مقام المراجع الم	2.47 2.48	7.36 dBr 945000 GH -47.89 dBr 350000 GH

2.	Radiated emission Test			
	Spectrum Detector:	PK/AV	Test Date :	2023-4-26
	Test By:	Sunshine	Temperature :	<b>28</b> °C
	Humidity :	65 %		

	BLE 1M 2402MHz													
Freq.	Ant. Pol.		ReadingCorrectEmissionLimitLevel(dBuV/m)FactorLevel(dBuV/m)3m(dBuV/m)			Margin(d	B)							
(MHz)	H/V	PK	AV	dB	PK	AV	PK	AV	PK	AV				
<2400	Н	85.67	67.54	-26.3	59.37	41.24	74	54	-14.63	-12.76				
<2400	V	84.58	64.95	-26.1	58.48	38.85	74	54	-15.52	-15.15				
>2483.5	Н	84.96	67.31	-26.3	58.66	41.01	74	54	-15.34	-12.99				
>2483.5	V	86.31	64.86	-26.1	60.21	38.76	74	54	-13.79	-15.24				

	BLE 1M 2480MHz												
Frag	Ant.	Reading Correct Emission Limit						Margin(dB)					
Freq.	Pol.	Level(d	BuV/m)			3m(dB	uV/m	Margin(u	D)				
(MHz)	H/V	PK	AV	dB	PK	AV	PK	AV	PK	AV			
<2400	H	85.46	65.87	-26.3	59.16	39.57	74	54	-14.84	-14.43			
<2400	V	84.63	65.21	-26.1	58.53	39.11	74	54	-15.47	-14.89			
>2483.5	Н	86.31	65.94	-26.3	60.01	39.64	74	54	-13.99	-14.36			
>2483.5	V	86.23	66.23	-26.1	60.13	40.13	74	54	-13.87	-13.87			

# **12** Antenna Application

## 12.1 Antenna requirement

The EUT'S antenna is met the requirement of FCC part 15C section 15.203 and 15.247.

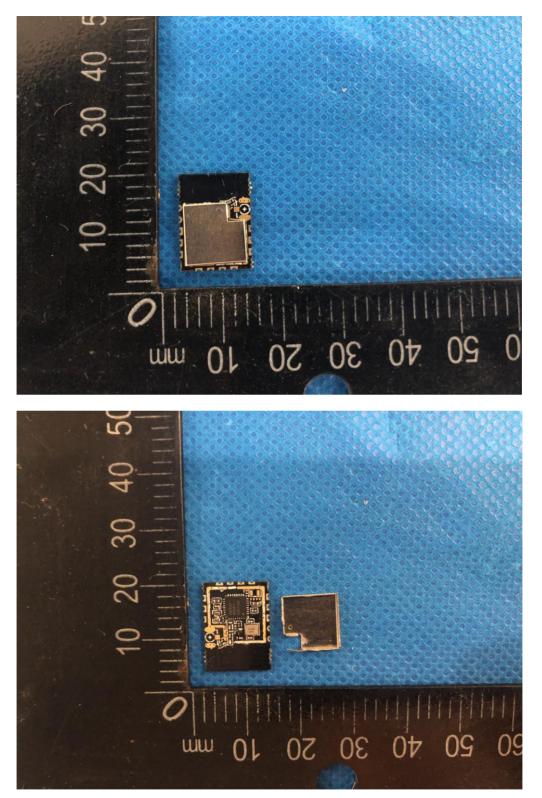
FCC part 15C section 15.247 requirements:

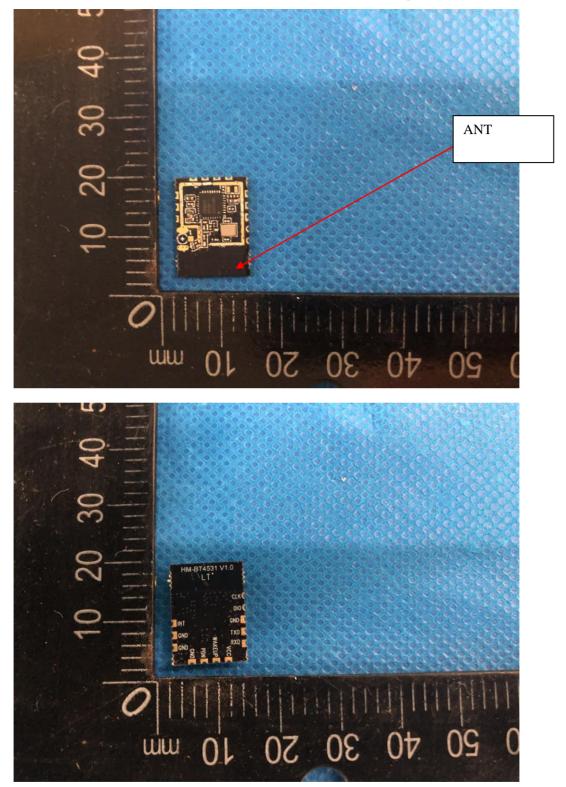
Systems operating in the 2402-2480MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

## 12.2 Result

The EUT's antenna, permanent attached antenna, used a ceramic antenna and integrated on PCB, The antenna's gain is 4.16dBi and meets the requirement.

# APPENDIX I (Photos of EUT)





--- End of Report ---