



# FCC/ISED RF Test Report

**APPLICANT** : Motorola Solutions Inc.  
**EQUIPMENT** : WAVE PTX TWO-WAY RADIO  
**BRAND NAME** : MOTOROLA  
**FCC MODEL NAME** : TLK 25  
**FCC MODEL NUMBER** : HK2197A  
**HVIN** : HK2199A  
**IC MODEL NUMBER** : HK2199A  
**PMN** : TLK 25  
**FCC ID** : AZ499FT7171  
**IC** : 109U-99FT7171  
**STANDARD** : FCC Part 15 Subpart C §15.247  
                   ISED RSS-247 Issue 3  
**CLASSIFICATION** : (DTS) Digital Transmission System  
**TEST DATE(S)** : Feb. 01, 2024 ~ Feb. 26, 2024

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

*Jason Jia*



Approved by: Jason Jia

**Sporton International Inc. (Kunshan)**

**No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300  
People's Republic of China**



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### SUMMARY OF TEST RESULT

Report Section	FCC Rule	ISED Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	RSS-247 5.2(a)	6dB Bandwidth	≥ 0.5MHz	Pass	-
3.1	-	RSS-Gen 6.7	Emission Designator	-	Report only	1M04F1D
3.2	15.247(b)(3)	RSS-247 5.4(d)	Peak Output Power	≤ 30dBm	Pass	6.14dBm (0.0041W)
3.3	15.247(e)	RSS-247 5.2(b)	Power Spectral Density	≤ 8dBm/3kHz	Pass	-
3.4	15.247(d)	RSS-247 5.5	Conducted Band Edges and Spurious Emission	≤ 20dBc	Pass	-
3.5	15.247(d)	RSS-247 5.5	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d) / RSS-Gen [8.9 Table 5, Table 6 and Table 7]	Pass	Under limit 7.84 dB at 2485.24 MHz for Band Edge, Under limit 28.67 dB at 7320.00 MHz for Harmonic, Under limit 7.17 dB at 49.40 MHz for LF
3.6	15.207	RSS-GEN 8.8	AC Conducted Emission	15.207(a) / RSS-Gen [8.8 Table 4]	Pass	Under limit 10.64 dB at 0.163 MHz
3.7	15.203 & 15.247(b)	N/A	Antenna Requirement	15.203 & 15.247(b)	Pass	-

**Conformity Assessment Condition:**

- The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
- The measurement uncertainty please refer to each test result in the section "Measurement Uncertainty"

**Disclaimer:**

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.



# 1 General Description

## 1.1 Applicant

**Motorola Solutions Inc.**

Plot 2A, Medan Bayan Lepas, Mukim 12 S.W.D, 11900 Bayan Lepas, Penang, Malaysia.

## 1.2 Manufacturer

**Motorola Solutions Malaysia SDN BHD**

Plot 2A, Medan Bayan Lepas, Mukim 12 S.W.D, 11900 Bayan Lepas, Penang, Malaysia.

## 1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	WAVE PTX TWO-WAY RADIO
Brand Name	MOTOROLA
FCC Model Name	TLK 25
FCC Model Number	HK2197A
HVIN	HK2199A
IC Model Number	HK2199A
PMN	TLK 25
FCC ID	AZ499FT7171
IC	109U-99FT7171
IMEI Code	Conducted: 354667800018580 Conduction: 354667800018143 Radiation: 354958440023837/354958440023845
HW Version	P2A
SW Version/FVIN	VANGOGH_BASE_ENG_D01.01.01_AP_D01.02.06_LNA
EUT Stage	Identical Prototype

**Remark:** The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

## 1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	40
Carrier Frequency of Each Channel	40 Channel(37 hopping + 3 advertising channel)
Maximum Output Power to Antenna	6.14 dBm (0.0041 W)
99% Occupied Bandwidth	1.035MHz
Antenna Type / Gain	PIFA Antenna type with gain -2.4 dBi
Type of Modulation	Bluetooth LE : GFSK

Note: The device supports Bluetooth LE data rate 1Mbps only.



### 1.5 Modification of EUT

No modifications are made to the EUT during all test items.

### 1.6 Specification of Accessory

Accessories Information				
AC Adapter	Brand Name	MOTOROLA	Model Name	PS000150A31
MUC	Brand Name	MOTOROLA	Model Name	PMPN4659A
MUC power supply (US plug)	Brand Name	MOTOROLA	Model Name	PS000580A01
Battery	Brand Name	MOTOROLA	Model Name	PMNN4602A
Earphone 1	Brand Name	MOTOROLA	Model Name	PMLN8536A
Earphone 2	Brand Name	MOTOROLA	Model Name	PMLN8536B
Earphone 4	Brand Name	MOTOROLA	Model Name	PMLN8123A
USB Cable	Brand Name	MOTOROLA	Model Name	PMKN4294A

Note: Earphone 1 and Earphone 2 are only different in model name.

### 1.7 Testing Location

<FCC>

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	CO01-KS 03CH06-KS TH01-KS	CN1257	314309



<IC>

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<b>Test Firm</b>	Sporton International Inc. (KunShan)		
<b>Test Site Location</b>	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL: +86-512-57900158		
<b>Test Site No.</b>	<b>Sporton Site No.</b>	<b>Company Number</b>	<b>CAB identifier</b>
	CO01-KS 03CH06-KS TH01-KS	4086E	CN0050

### 1.8 Test Software

Item	Site	Manufacturer	Name	Version
1.	TH01-KS	Tonscend	JS1120-3 test system China_210602	3.3.10
2.	03CH06-KS	AUDIX	E3	210616
3.	CO01-KS	AUDIX	E3	6.2009-8-24

### 1.9 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ 47 CFR Part 15 Subpart C §15.247
- ♦ FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ♦ ANSI C63.10-2013
- ♦ ISED RSS-247 Issue 3
- ♦ ISED RSS-Gen Issue 5

**Remark:** All test items were verified and recorded according to the standards and without any deviation during the test.



## 2 Test Configuration of Equipment Under Test

### 2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
	15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
	18	2438	39	2480
	19	2440	-	-
20	2442	-	-	





## 2.2 Test Mode

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Z plane) were recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth – LE / GFSK
Conducted TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps
Radiated TCs	Mode 1: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps Mode 2: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps Mode 3: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps
AC Conducted Emission	Mode 1: Bluetooth Link + USB Cable (Charging from MUC)

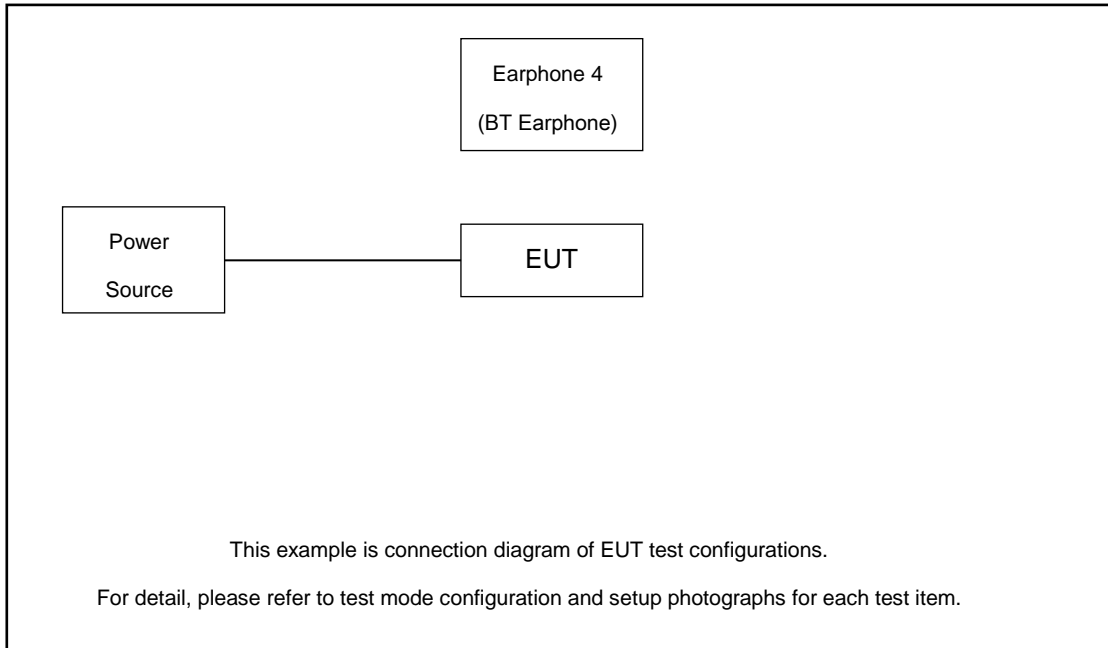
**Remark:** For Radiated Test Cases, The tests were performed with Adapter, Earphone1 and USB Cable.

Simultaneous transmission
Bluetooth LE 1Mbps Tx CH39_2480MHz + LTE Band 13 Tx BW 5M

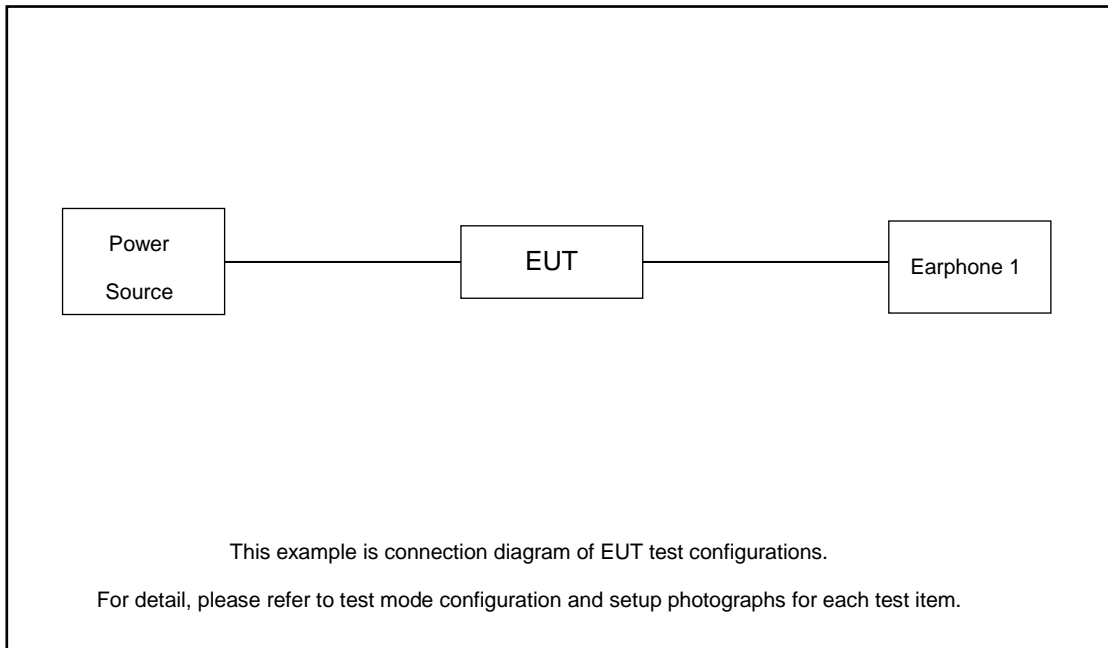
**Remark:** For radiated simultaneous transmission test mode, the combination testing was assessed from the worst RSE link mode of WWAN 4G & Bluetooth.

## 2.3 Connection Diagram of Test System

For Conducted Emission:



For Radiated Emission:





## 2.4 EUT Operation Test Setup

For BLE function, the engineering test program was provided and enabled to make EUT continuous transmit.

For AC power line conducted emissions, the EUT was set to connect with the BT Earphone under large package sizes transmission.

## 2.5 Measurement Results Explanation Example

### For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

*Offset = RF cable loss + attenuator factor.*

Following shows an offset computation example with cable loss 1.66 dB and 10dB attenuator.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\ &= 1.66 + 10 = 11.66 \text{ (dB)} \end{aligned}$$

### 3 Test Result

#### 3.1 6dB and 99% Bandwidth Measurement

##### 3.1.1 Limit of 6dB and 99% Bandwidth

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

##### 3.1.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

##### 3.1.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 11.8
2. 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.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1% to 5% of the 99% OBW and the VBW is set to 3 times of the RBW.
6. Measure and record the results in the test report.

##### 3.1.4 Test Setup



##### 3.1.5 Test Result of 6dB and 99% Bandwidth

Please refer to Appendix A.

## 3.2 Output Power Measurement

### 3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

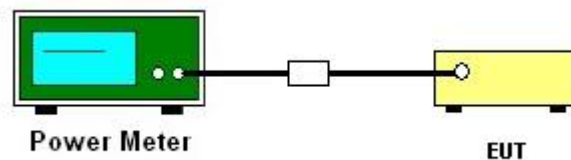
### 3.2.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

### 3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter or ANSI C63.10-2013 clause 11.9.2.3.1 Method AVGPM method.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

### 3.2.4 Test Setup



### 3.2.5 Test Result of Peak Output Power

Please refer to Appendix A.

### 3.2.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.

### 3.3 Power Spectral Density Measurement

#### 3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

#### 3.3.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

#### 3.3.3 Test Procedures

1. The testing follows Measurement Procedure of ANSI C63.10-2013 clause 11.10.2 Method PKPSD.
2. 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.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. 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)
5. 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.
6. Measure and record the results in the test report.
7. 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.

#### 3.3.4 Test Setup



#### 3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

## 3.4 Conducted Band Edges and Spurious Emission Measurement

### 3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

### 3.4.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

### 3.4.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 11.13
2. 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.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

### 3.4.4 Test Setup



### 3.4.5 Test Result of Conducted Band Edges Plots

Please refer to Appendix A.

### 3.4.6 Test Result of Conducted Spurious Emission Plots

Please refer to Appendix A.



### 3.5 Radiated Band Edges and Spurious Emission Measurement

#### 3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

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

#### 3.5.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.



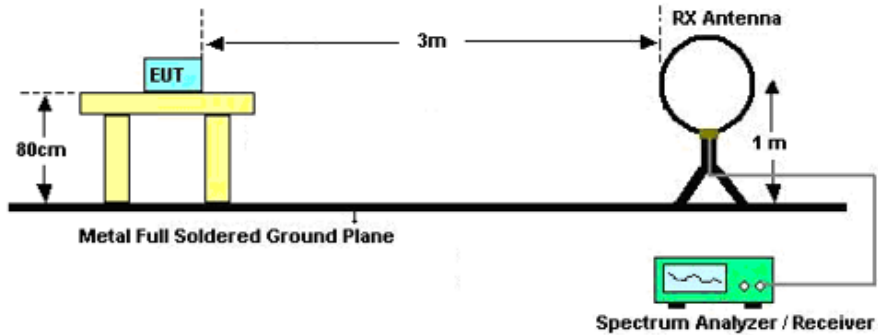


### 3.5.3 Test Procedures

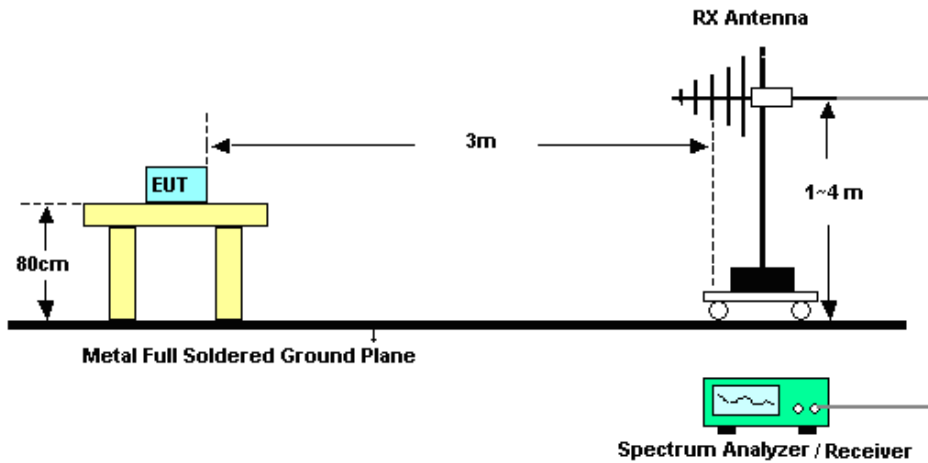
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW=100 kHz for  $f < 1$  GHz;  $VBW \geq RBW$ ; Sweep = auto; Detector function = peak; Trace = max hold;
  - (3) Set RBW = 1 MHz, VBW= 3MHz for  $f \geq 1$  GHz for peak measurement.  
For average measurement:
    - $VBW = 10$  Hz, when duty cycle is no less than 98 percent.
    - $VBW \geq 1/T$ , 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.

### 3.5.4 Test Setup

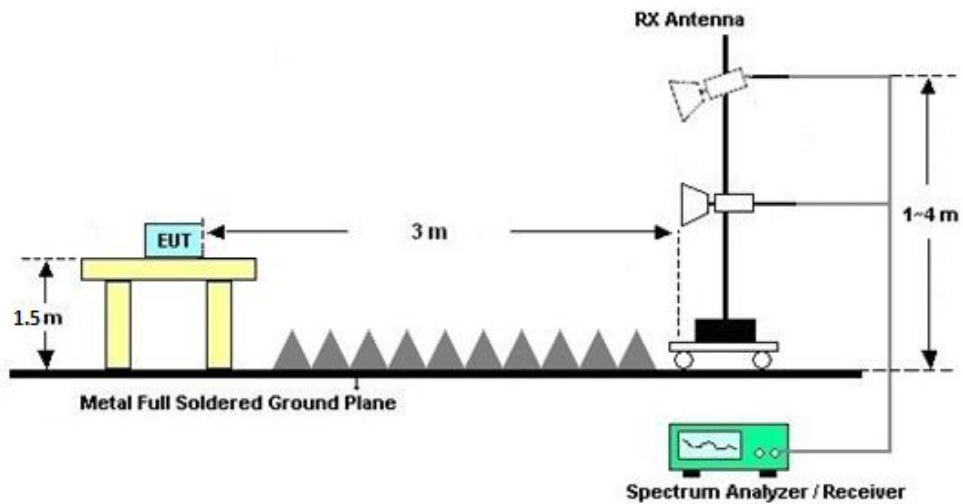
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz





### **3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)**

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

### **3.5.6 Test Result of Radiated Spurious at Band Edges**

Please refer to Appendix C.

### **3.5.7 Duty Cycle**

Please refer to Appendix D.

### **3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)**

Please refer to Appendix C.



### 3.6 AC Conducted Emission Measurement

#### 3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

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

\*Decreases with the logarithm of the frequency.

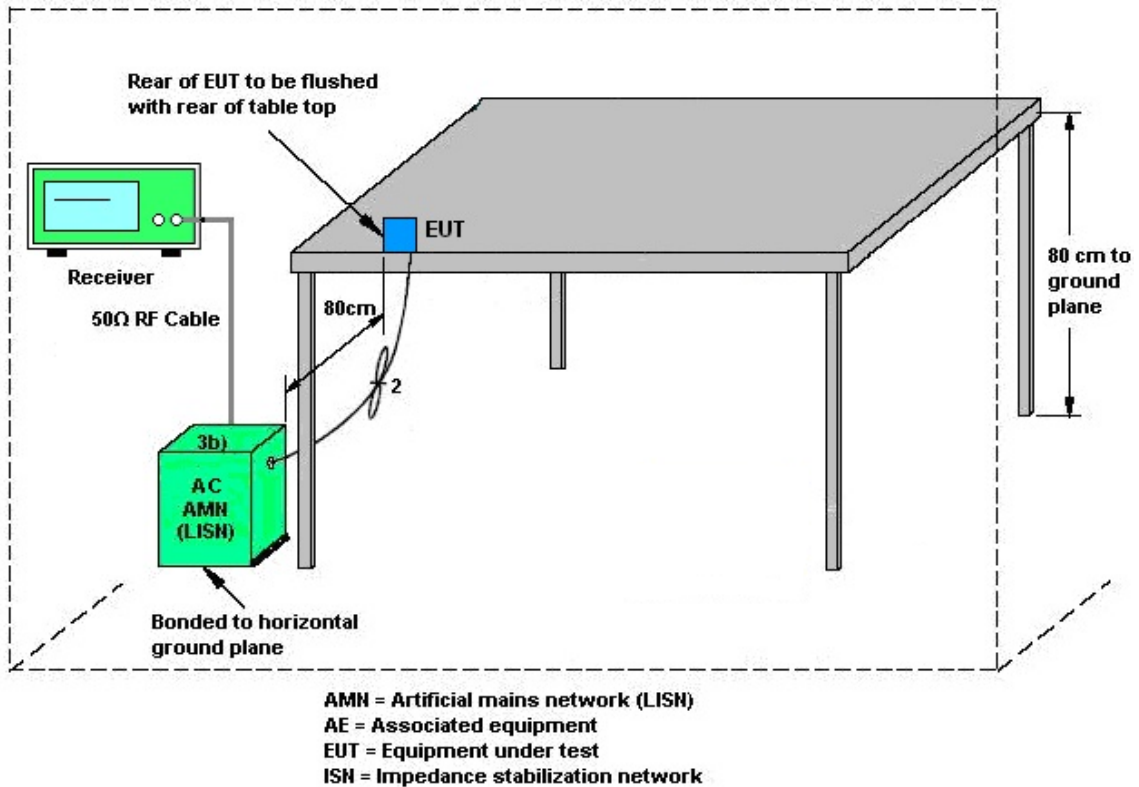
#### 3.6.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

#### 3.6.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

### 3.6.4 Test Setup



### 3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



## **3.7 Antenna Requirements**

### **3.7.1 Standard Applicable**

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

### **3.7.2 Antenna Anti-Replacement Construction**

An embedded-in antenna design is used.

### **3.7.3 Antenna Gain**

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



## 4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 11, 2023	Feb. 01, 2024	Oct. 10, 2024	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 02, 2024	Feb. 01, 2024	Jan. 01, 2025	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 02, 2024	Feb. 01, 2024	Jan. 01, 2025	Conducted (TH01-KS)
RF Cable	HUBER+SUHNER	SUCOFLEX 104	TH01KS001	30MHz~40GHz	Jun. 17, 2023	Feb. 01, 2024	Jun. 16, 2024	Conducted (TH01-KS)
RF Cable	HUBER+SUHNER	SUCOFLEX 104	TH01KS002	30MHz~40GHz	Jun. 17, 2023	Feb. 01, 2024	Jun. 16, 2024	Conducted (TH01-KS)
RF Cable	HUBER+SUHNER	SUCOFLEX 104	TH01KS003	30MHz~40GHz	Jun. 17, 2023	Feb. 01, 2024	Jun. 16, 2024	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz;Max 30dBm	Oct. 10, 2023	Feb. 26, 2024	Oct. 09, 2024	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY60242126	10Hz-44GHz	Oct. 10, 2023	Feb. 26, 2024	Oct. 09, 2024	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 10, 2023	Feb. 26, 2024	Oct. 09, 2024	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz-1GHz	Apr. 09, 2023	Feb. 26, 2024	Apr. 08, 2024	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 06, 2023	Feb. 26, 2024	Apr. 05, 2024	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101093	18GHz~40GHz	Jan. 05, 2024	Feb. 26, 2024	Jan. 04, 2025	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	380827	9KHz ~1GHZ	Jul. 06, 2023	Feb. 26, 2024	Jul. 05, 2024	Radiation (03CH06-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 04, 2024	Feb. 26, 2024	Jan. 03, 2025	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2082395	1Ghz-18Ghz	Jan. 04, 2024	Feb. 26, 2024	Jan. 03, 2025	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270319	500MHz~26.5GHz	Oct. 10, 2023	Feb. 26, 2024	Oct. 09, 2024	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Feb. 26, 2024	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Feb. 26, 2024	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Feb. 26, 2024	NCR	Radiation (03CH06-KS)
RF Cable	HUBER+SUHNER	SUCOFLEX126E	03CH06KS001	30Mhz-18Ghz	Aug. 02, 2023	Feb. 26, 2024	Aug. 01, 2024	Radiation (03CH06-KS)
RF Cable	HUBER+SUHNER	SUCOFLEX126E	03CH06KS002	30Mhz-18Ghz	Aug. 02, 2023	Feb. 26, 2024	Aug. 01, 2024	Radiation (03CH06-KS)
Low Pass Filter	Wainwright Instruments GmbH	WLK4-1000-1530-8000-40SS	2	1G Low Pass	Aug. 02, 2023	Feb. 26, 2024	Aug. 01, 2024	Radiation (03CH06-KS)
EMI Receiver	R&S	ESC17	100768	9kHz~7GHz;	May 16, 2023	Feb. 23, 2024	May 15, 2024	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 11, 2023	Feb. 23, 2024	Oct. 10, 2024	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	May 16, 2023	Feb. 23, 2024	May 15, 2024	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP00000811	AC 0V~300V, 45Hz~1000Hz	Oct. 11, 2023	Feb. 23, 2024	Oct. 10, 2024	Conduction (CO01-KS)
RF Cable	WOKEN	Y5T	00100N1Q3N1	9kHz~30MHz	Sep. 15, 2023	Feb. 23, 2024	Sep. 14, 2024	Conduction (CO01-KS)
Transient limiter	COM-POWER	LIT-153	531040	150kHz~30MHz	Sep. 15, 2023	Feb. 23, 2024	Sep. 14, 2024	Conduction (CO01-KS)

NCR: No Calibration Required



## 5 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

### Uncertainty of Conducted Measurement

Test Item	Uncertainty
Conducted Spurious Emission & Bandedge	±2.26 dB
Occupied Channel Bandwidth	±0.1%
Conducted Power	±0.46 dB
Conducted Power Spectral Density	±0.88 dB
Frequency	±0.4 ppm

### Uncertainty of AC Conducted Emission Measurement (0.15 MHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.84 dB
---	---------

### Uncertainty of Radiated Emission Measurement (9 KHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.32 dB
---	---------

### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	6.26 dB
---	---------

### Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.02 dB
---	---------

### Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.26 dB
---	---------

----- THE END -----





## **Appendix A. Conducted Test Results**



Case No. : <u>341404</u>
Ambient Condition: <u>25</u> °C, <u>45</u> %RH
Test Date: <u>2024.2.1</u> Test Engineer: <u>Jiang Jun</u>

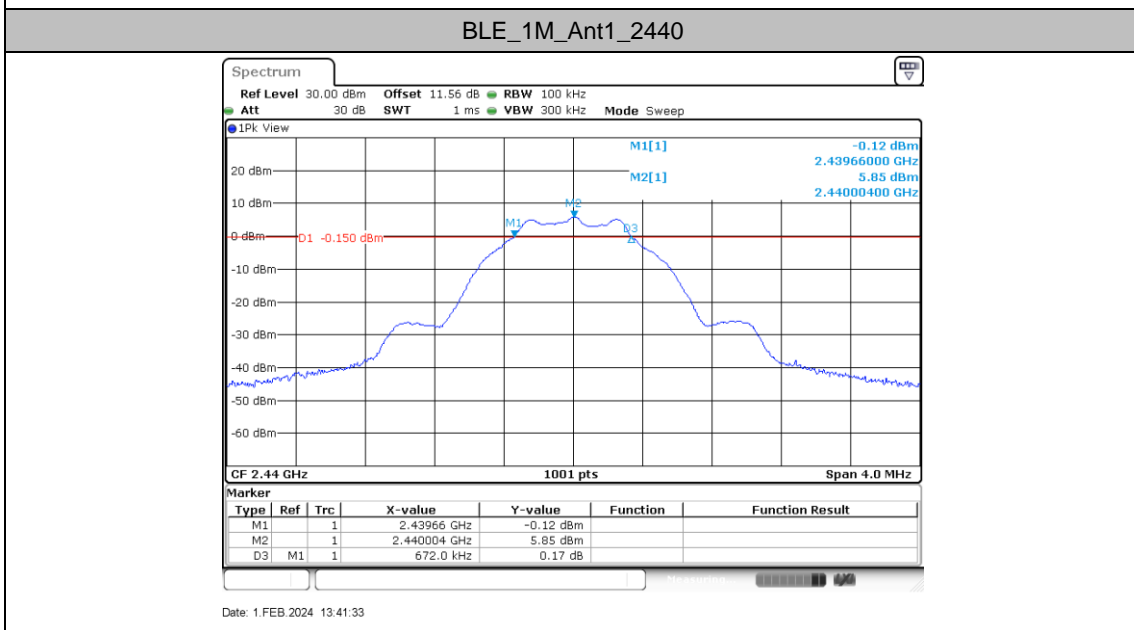
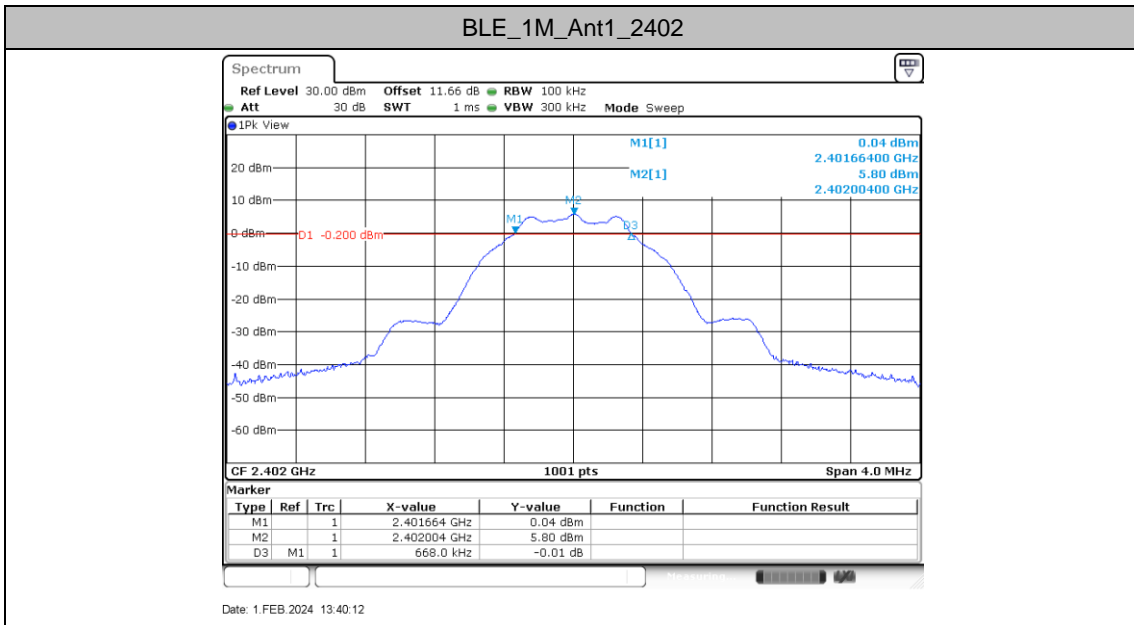
### 6dB Bandwidth

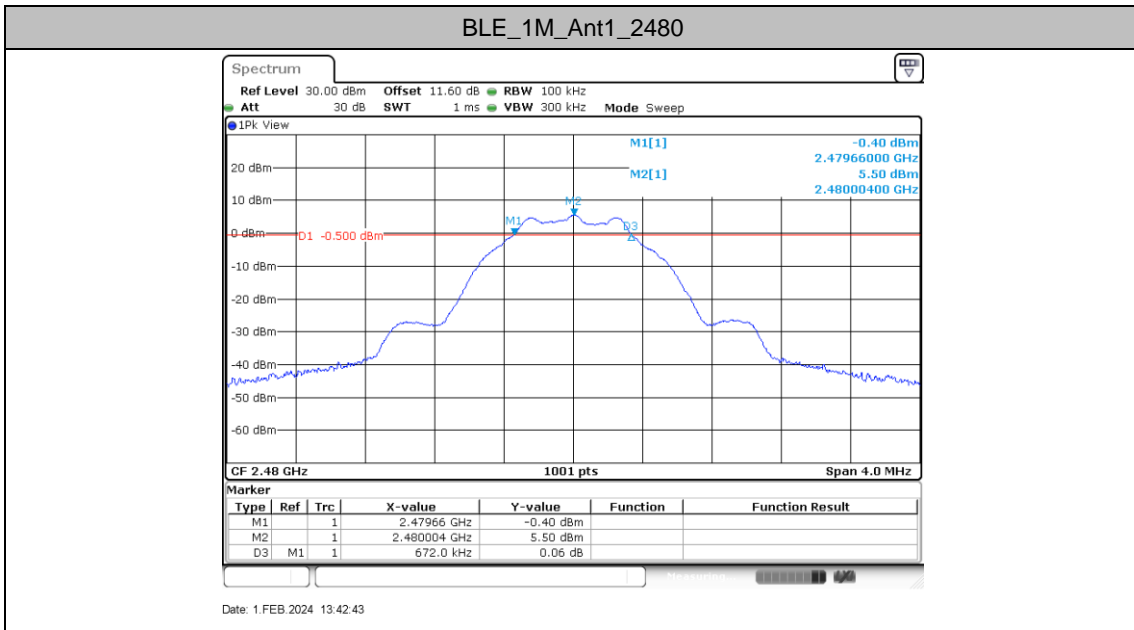
#### Test Result

TestMode	Antenna	Freq(MHz)	6dB BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	0.67	2401.66	2402.33	0.5	PASS
		2440	0.67	2439.66	2440.33	0.5	PASS
		2480	0.67	2479.66	2480.33	0.5	PASS



### Test Graphs







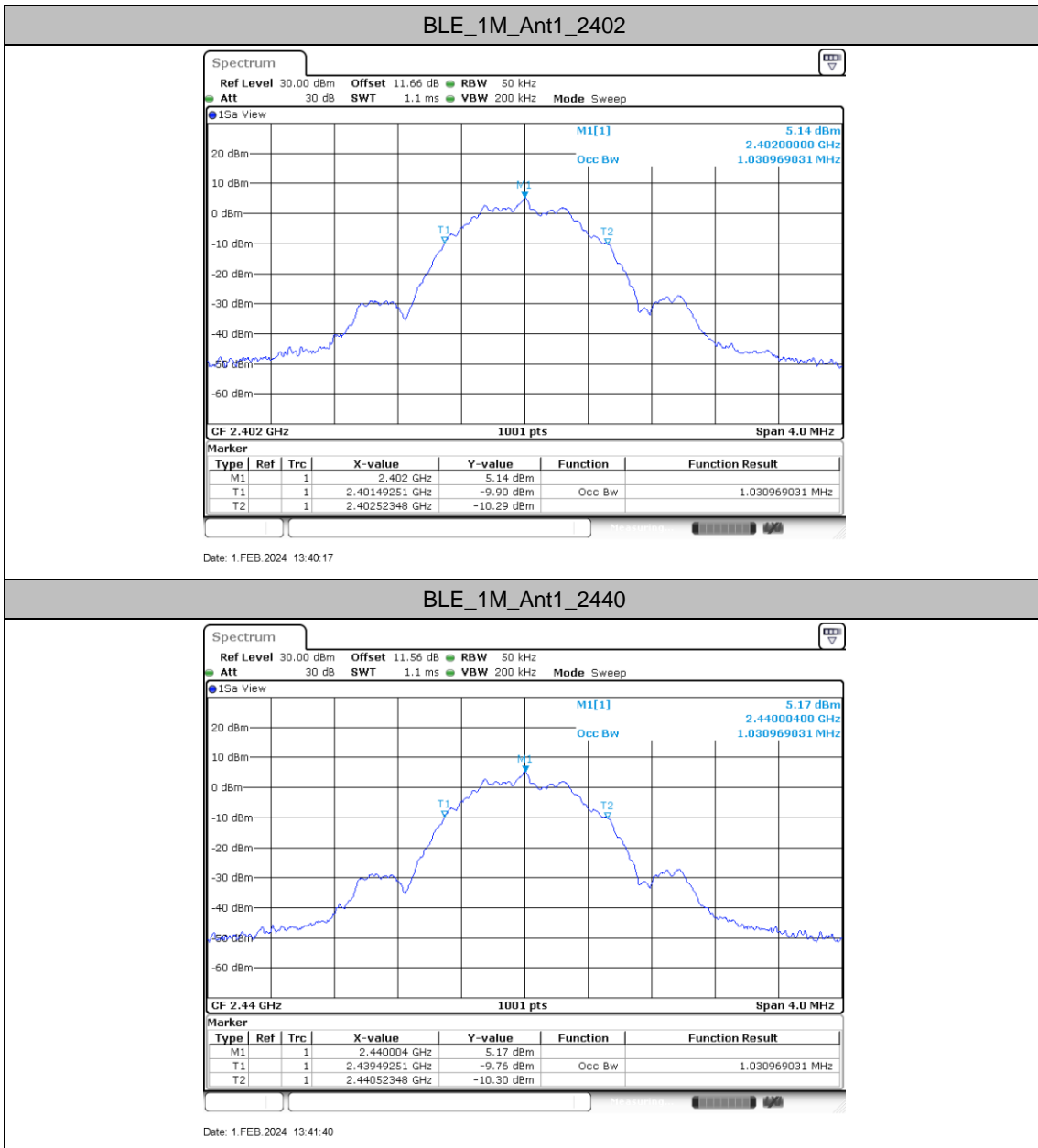
## Occupied Channel Bandwidth

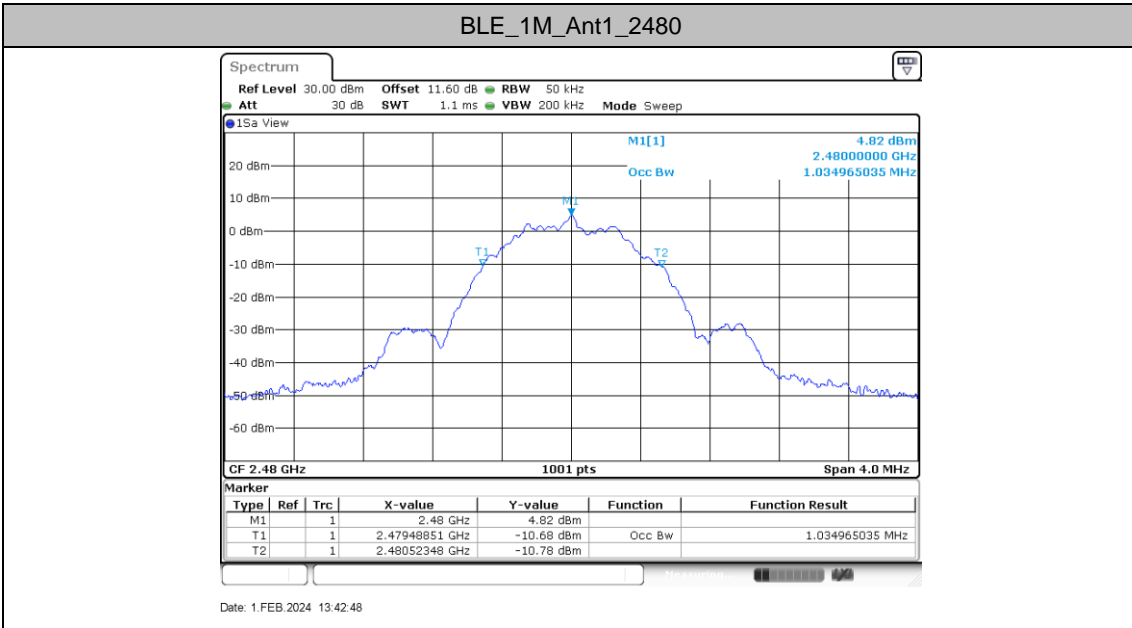
### Test Result

TestMode	Antenna	Freq(MHz)	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
BLE_1M	Ant1	2402	1.031	2401.4925	2402.5235	---	---
		2440	1.031	2439.4925	2440.5235	---	---
		2480	1.035	2479.4885	2480.5235	---	---



### Test Graphs







### Maximum conducted output power

#### Test Result Peak

TestMode	Antenna	CH.	Peak Conducted Power (dBm)	Conducted Power Limit	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit	Pass/Fail
BLE1M	Ant1	0	5.88	30.00	-2.4	3.48	36.00	Pass
		19	<b>6.14</b>	30.00	-2.4	3.74	36.00	Pass
		39	5.56	30.00	-2.4	3.16	36.00	Pass

#### Test Result Average

TestMode	Antenna	CH.	Duty Factor (dB)	Average Conducted Power (dBm)
BLE1M	Ant1	0	2.03	5.81
		19	2.03	<b>5.94</b>
		39	2.03	5.38

Note: Power setting is the default.





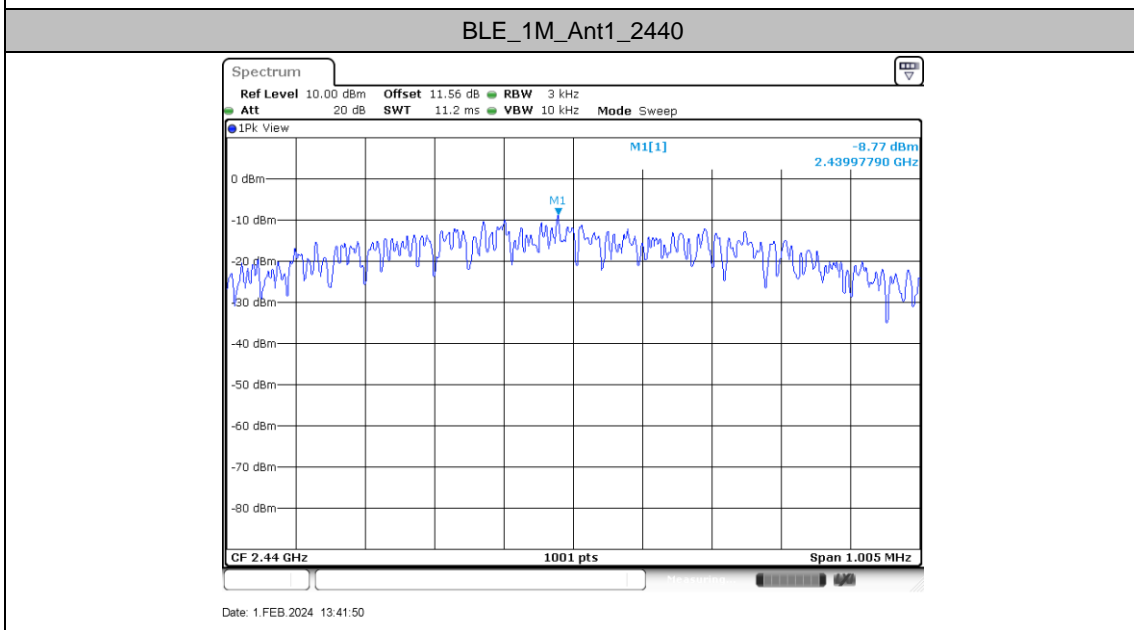
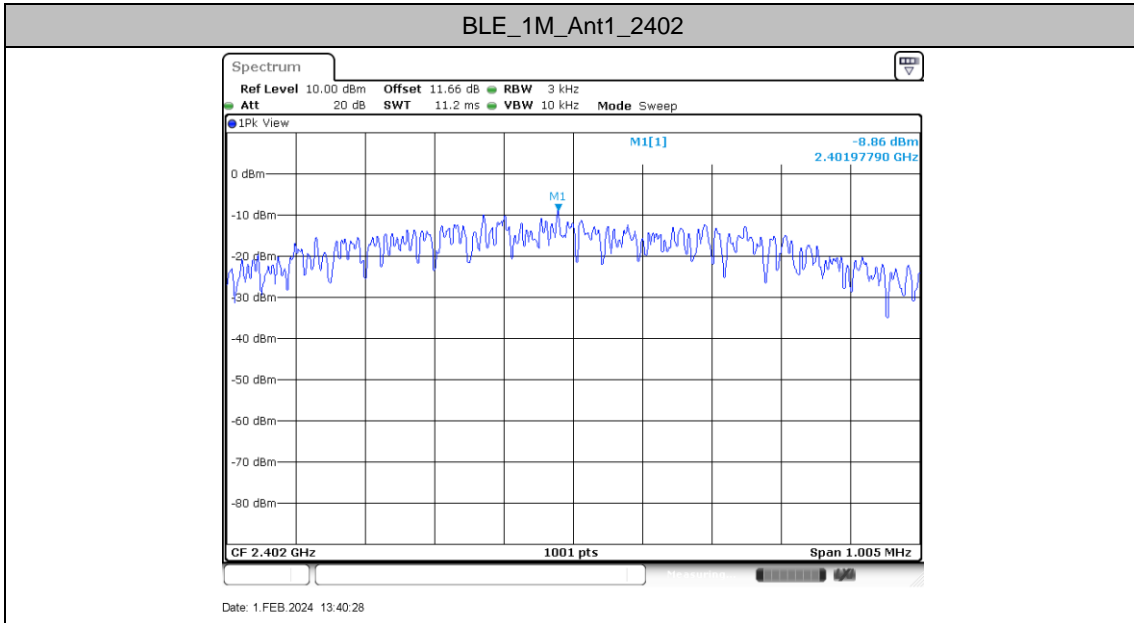
## Maximum power spectral density

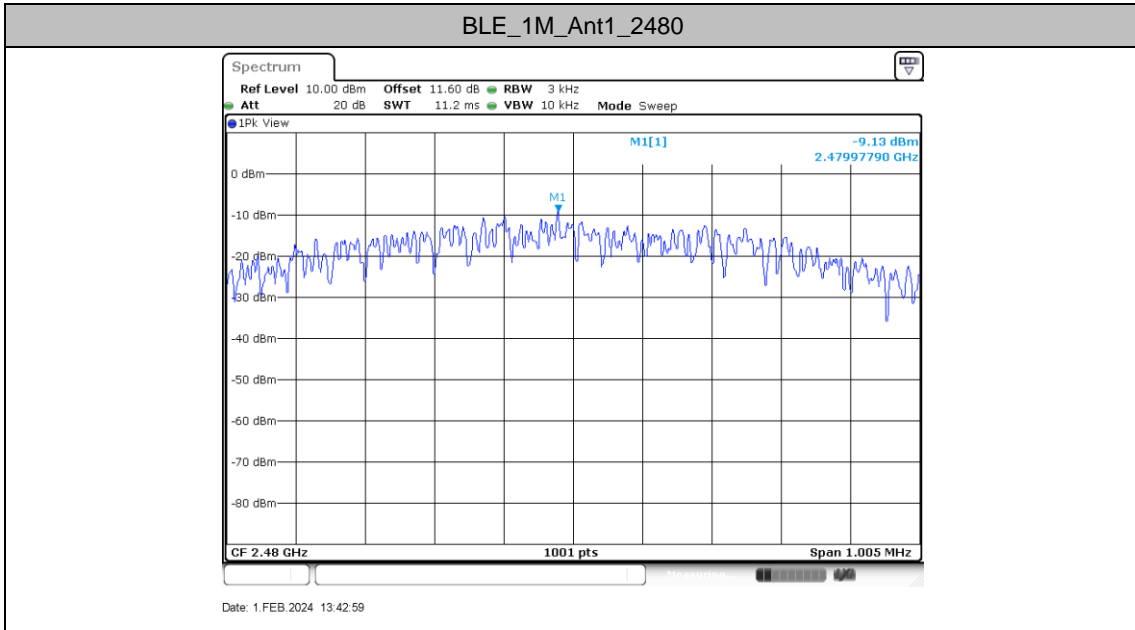
### Test Result

TestMode	Antenna	Freq(MHz)	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	Ant1	2402	-8.86	≤8.00	PASS
		2440	-8.77	≤8.00	PASS
		2480	-9.13	≤8.00	PASS



### Test Graphs







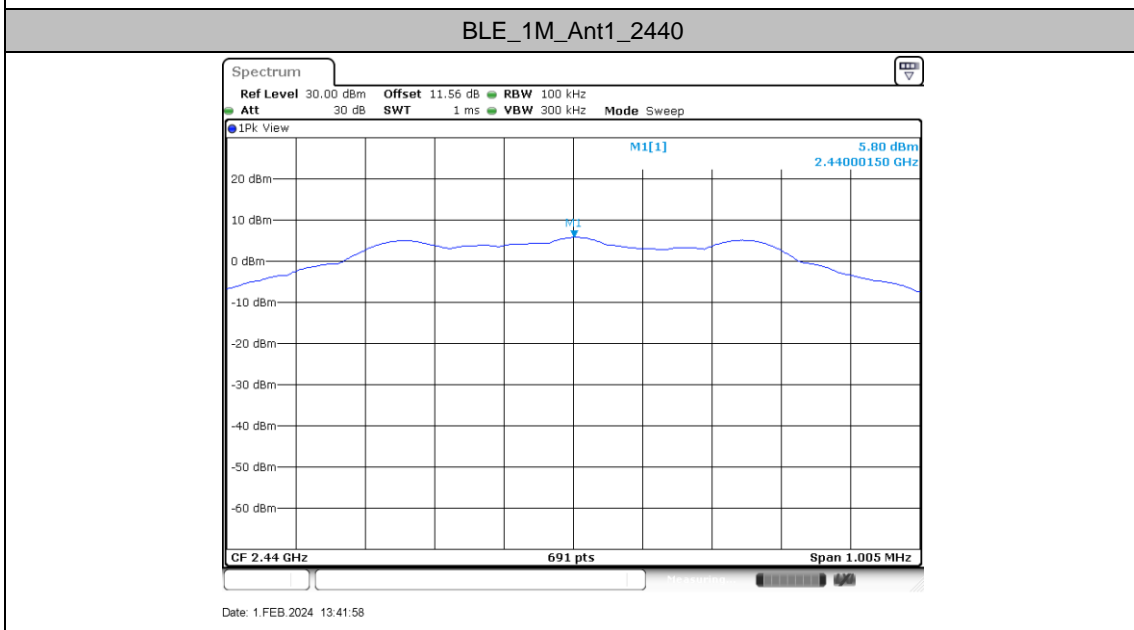
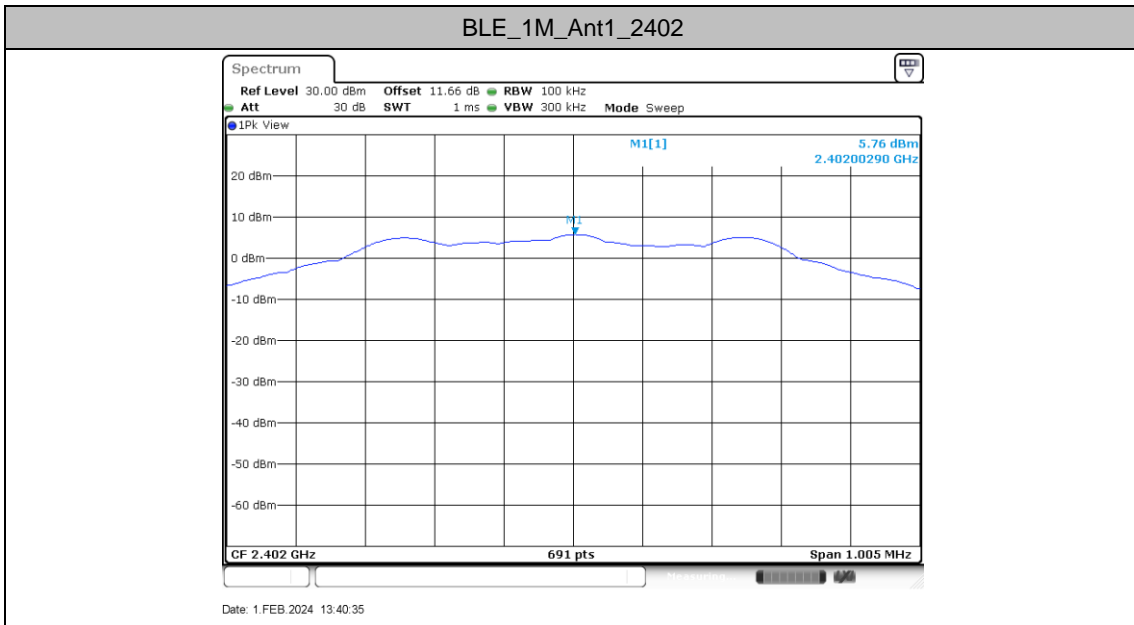
## Reference level measurement

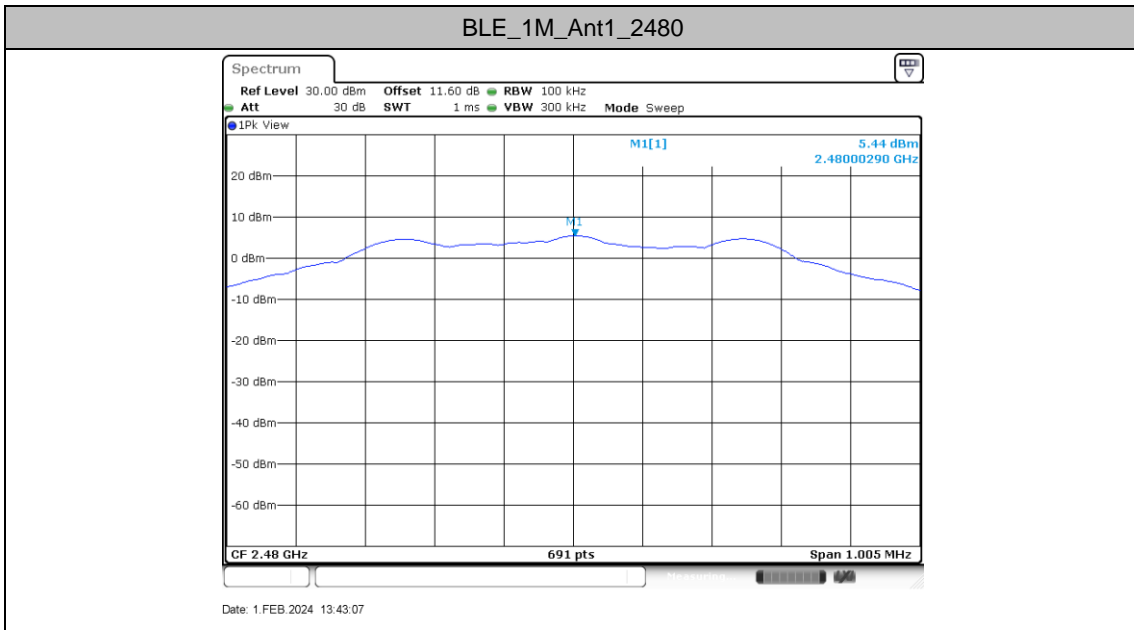
### Test Result

TestMode	Antenna	Freq(MHz)	Max.Point[MHz]	Result[dBm/100KHz]
BLE_1M	Ant1	2402	2402.00	5.76
		2440	2440.00	5.80
		2480	2480.00	5.44



### Test Graphs







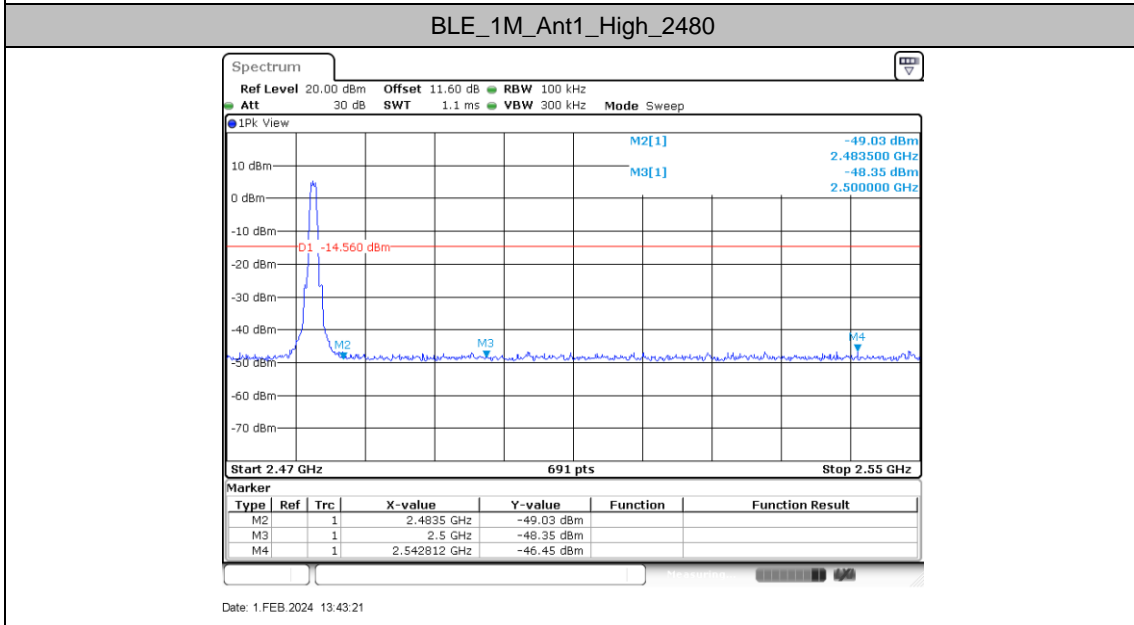
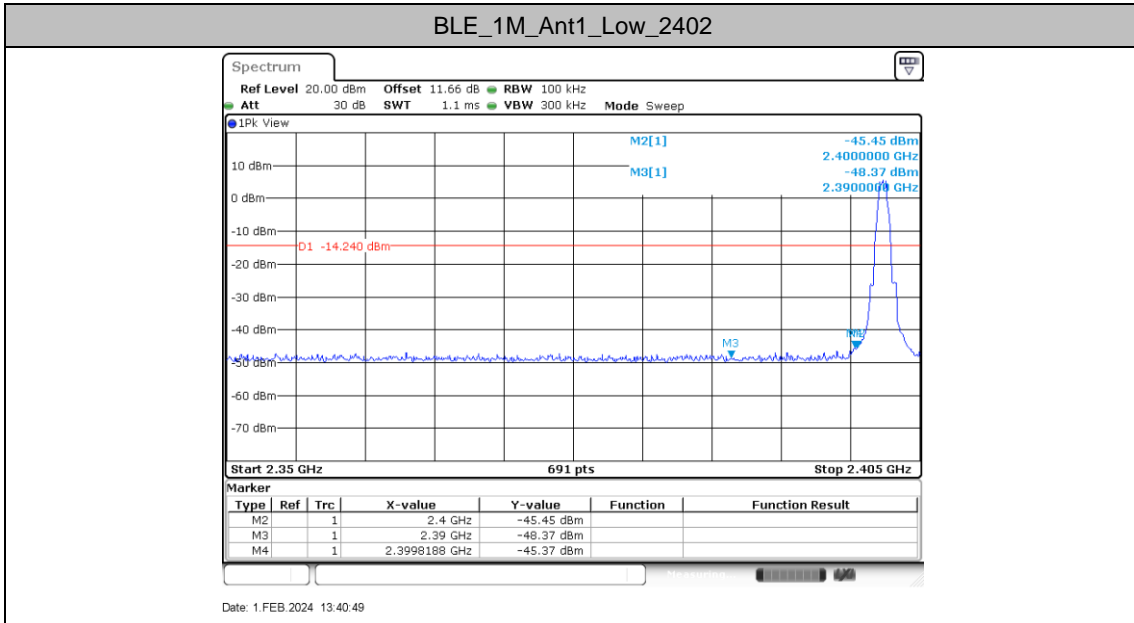
## Band edge measurements

### Test Result

TestMode	Antenna	ChName	Freq (MHz)	RefLevel[dBm /100KHz]	Result[dBm /100KHz]	Limit[dBm /100KHz]	Verdict
BLE_1M	Ant1	Low	2402	5.76	-45.37	≤-14.24	PASS
		High	2480	5.44	-46.45	≤-14.56	PASS



Test Graphs







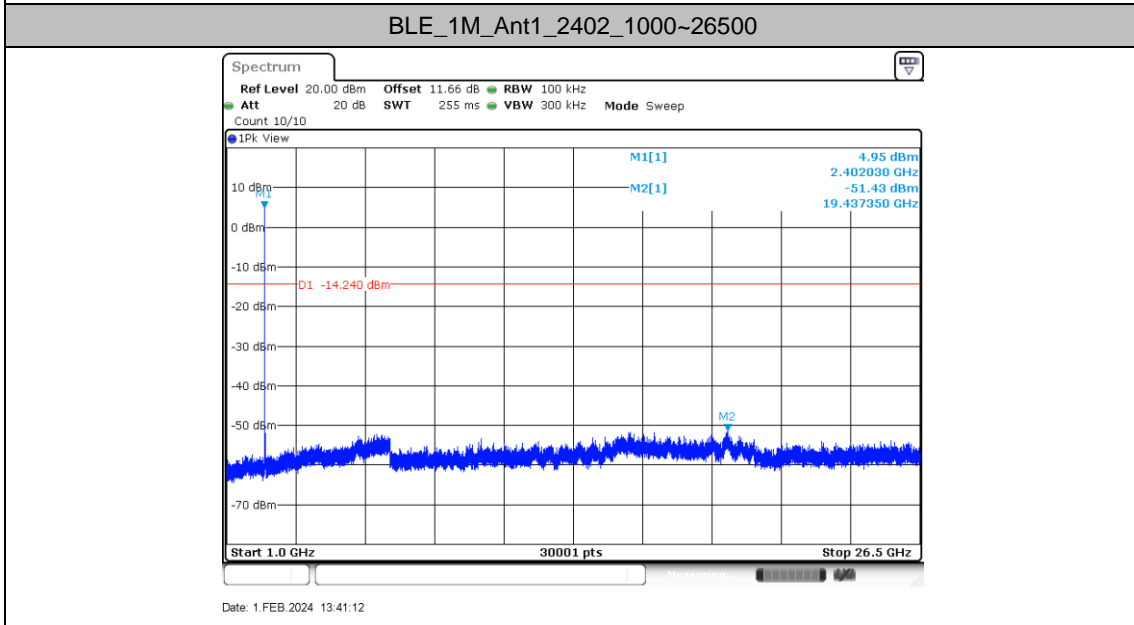
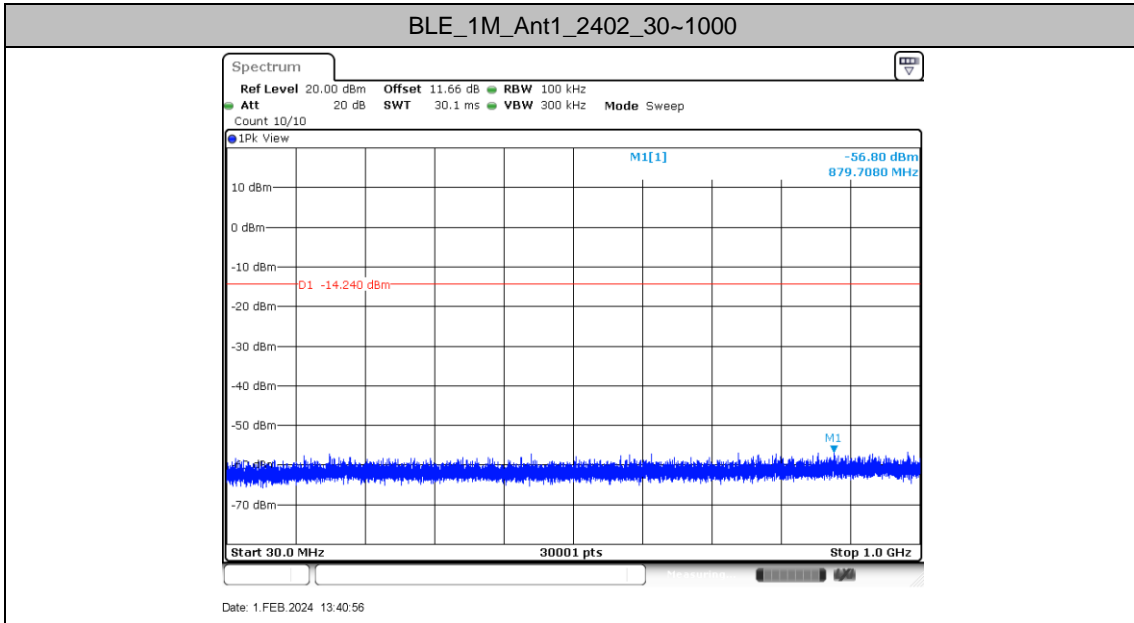
## Conducted Spurious Emission

### Test Result

TestMode	Antenna	Freq(MHz)	FreqRange [MHz]	RefLevel [dBm/100KHz]	Result [dBm/100KHz]	Limit [dBm/100KHz]	Verdict
BLE_1M	Ant1	2402	30~1000	5.76	-56.8	≤-14.24	PASS
			1000~26500	5.76	-51.43	≤-14.24	PASS
		2440	30~1000	5.80	-56.24	≤-14.2	PASS
			1000~26500	5.80	-51.35	≤-14.2	PASS
		2480	30~1000	5.44	-56.23	≤-14.56	PASS
			1000~26500	5.44	-51.54	≤-14.56	PASS

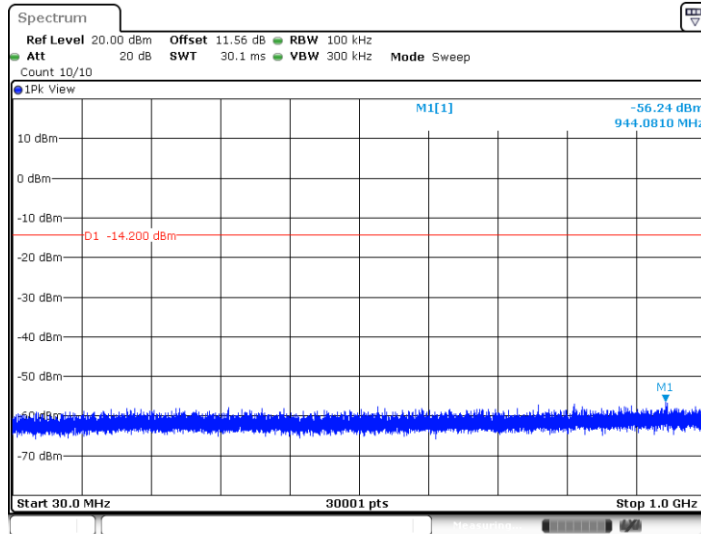


Test Graphs



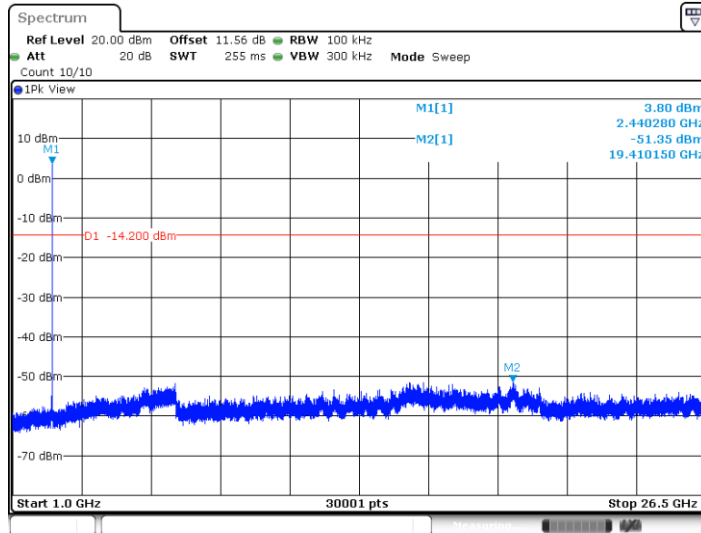


BLE\_1M\_Ant1\_2440\_30~1000



Date: 1.FEB.2024 13:42:04

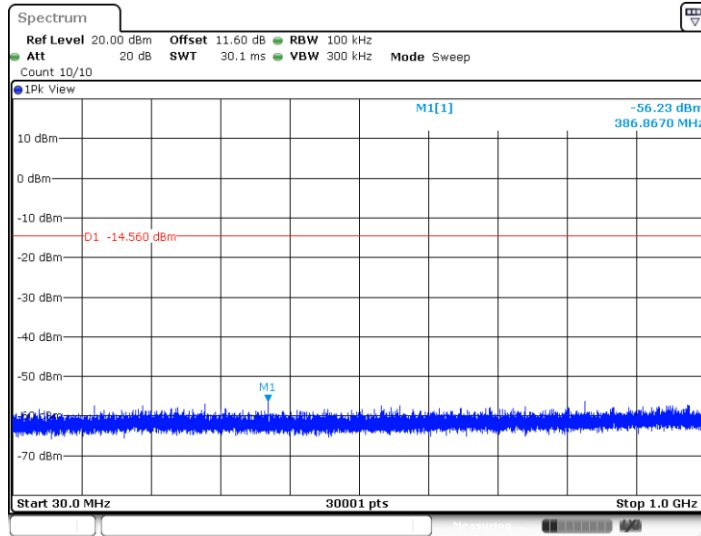
BLE\_1M\_Ant1\_2440\_1000~26500



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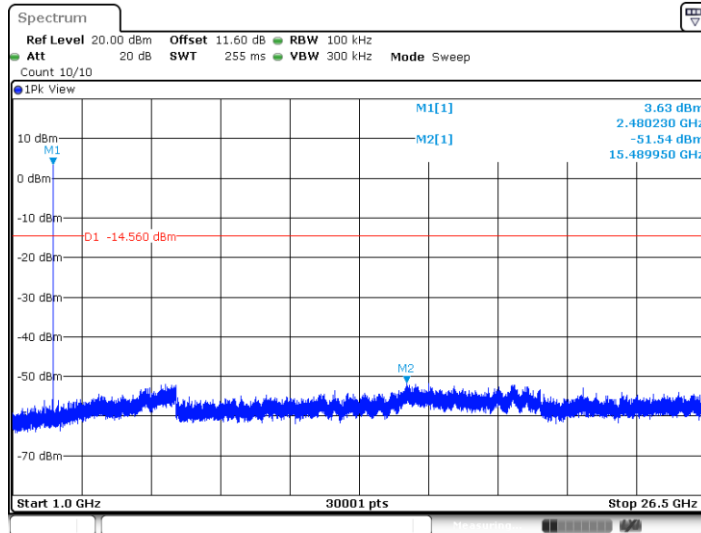


BLE\_1M\_Ant1\_2480\_30~1000



Date: 1.FEB.2024 13:43:28

BLE\_1M\_Ant1\_2480\_1000~26500

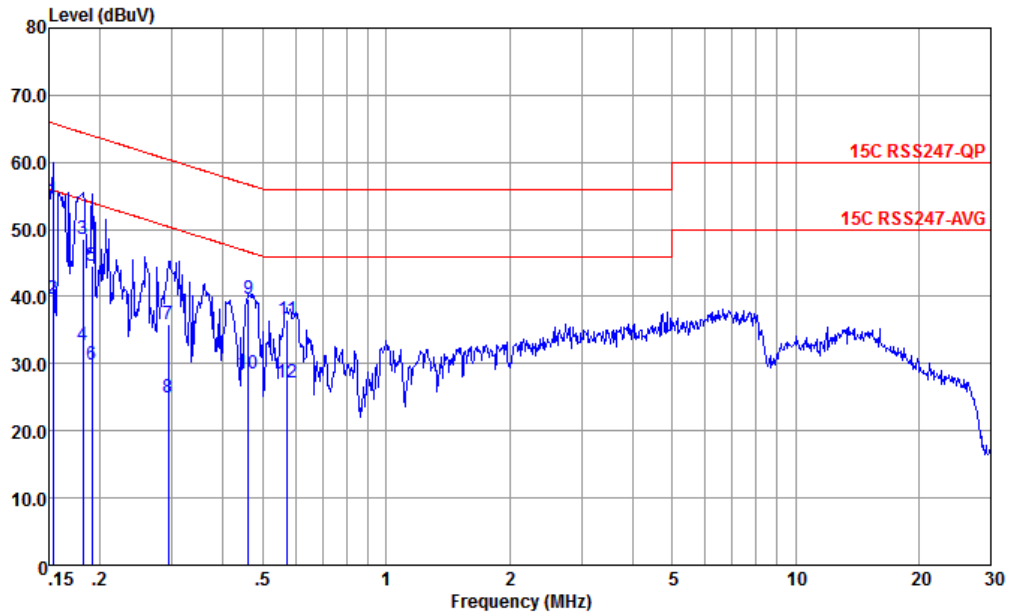


Date: 1.FEB.2024 13:43:44



## Appendix B. AC Conducted Emission Test Results

Test Engineer :	Amos Zhang	Temperature :	25.3~26.2°C
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		

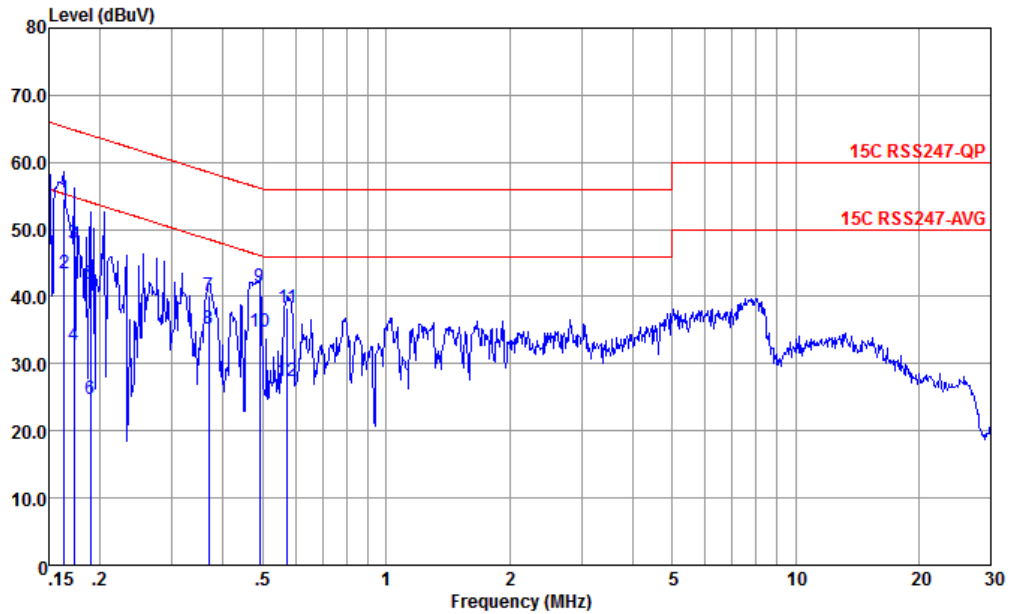


Site : CO01-KS  
 Condition : 15C RSS247-QP LISN-060105-L 2023 LINE

	Freq	Level	Over	Limit	Read	LISN	Cable	Remark
	MHz	dBuV	Limit	Line	Level	Factor	Loss	
			dB	dBuV	dBuV	dB	dB	
1 *	0.153	54.37	-11.45	65.82	43.90	0.05	10.42	QP
2	0.153	39.67	-16.15	55.82	29.20	0.05	10.42	Average
3	0.182	48.65	-15.77	64.42	38.20	0.04	10.41	QP
4	0.182	32.65	-21.77	54.42	22.20	0.04	10.41	Average
5	0.191	44.64	-19.34	63.98	34.20	0.03	10.41	QP
6	0.191	29.94	-24.04	53.98	19.50	0.03	10.41	Average
7	0.294	35.88	-24.53	60.41	25.50	0.04	10.34	QP
8	0.294	24.98	-25.43	50.41	14.60	0.04	10.34	Average
9	0.461	39.72	-16.95	56.67	29.50	-0.02	10.24	QP
10	0.461	28.52	-18.15	46.67	18.30	-0.02	10.24	Average
11	0.573	36.64	-19.36	56.00	26.50	-0.05	10.19	QP
12	0.573	27.16	-18.84	46.00	17.02	-0.05	10.19	Average



Test Engineer :	Amos Zhang	Temperature :	25.3~26.2°C
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS  
 Condition : 15C RSS247-QP LISN-060105-N 2023 NEUTRAL

	Freq	Level	Over	Limit	Read	LISN	Cable	
	MHz	dBuV	Limit	Line	Level	Factor	Loss	Remark
			dB	dBuV	dBuV	dB	dB	
1 *	0.163	54.66	-10.64	65.30	44.20	0.04	10.42	QP
2	0.163	43.36	-11.94	55.30	32.90	0.04	10.42	Average
3	0.173	47.96	-16.86	64.81	37.51	0.04	10.41	QP
4	0.173	32.66	-22.15	54.81	22.21	0.04	10.41	Average
5	0.189	41.96	-22.10	64.06	31.50	0.05	10.41	QP
6	0.189	24.66	-29.40	54.06	14.20	0.05	10.41	Average
7	0.369	40.04	-18.48	58.52	29.80	-0.05	10.29	QP
8	0.369	35.14	-13.38	48.52	24.90	-0.05	10.29	Average
9	0.491	41.36	-14.78	56.14	31.21	-0.07	10.22	QP
10	0.491	34.76	-11.38	46.14	24.61	-0.07	10.22	Average
11	0.573	38.32	-17.68	56.00	28.20	-0.07	10.19	QP
12	0.573	27.32	-18.68	46.00	17.20	-0.07	10.19	Average

Note:

- Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
- Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)



## Appendix C. Radiated Spurious Emission Test Data

Test Engineer :	Ryan Xu	Relative Humidity :	41~42 %
		Temperature :	22~23 °C

Note: All RSE test points are spurious by EUT, not noise floor.

### Radiated Spurious Emission Test Modes

Mode	Band (MHz)	Antenna	Modulation	Channel	Frequency	Data Rate	RU	Remark
Mode 1	2400-2483.5	1	Bluetooth-LE_GSKF	00	2402	1Mbps	-	-
Mode 2	2400-2483.5	1	Bluetooth-LE_GSKF	19	2440	1Mbps	-	-
Mode 3	2400-2483.5	1	Bluetooth-LE_GSKF	39	2480	1Mbps	-	-
	2400-2483.5	1	Bluetooth-LE_GSKF	39	2480	1Mbps		LF

### Summary of each worse mode

Mode	Modulation	Ch.	Freq. (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol.	Peak Avg.	Result	Remark
1	Bluetooth-LE_GSKF	00	2386.83	45.59	54.00	-8.41	H	AVERAGE	Pass	Band Edge
1	Bluetooth-LE_GSKF	00	6405.00	47.70	76.58	-28.88	H	PEAK	Pass	Harmonic
2	Bluetooth-LE_GSKF	19	-	-	-	-	-	-	-	Band Edge
2	Bluetooth-LE_GSKF	19	7320.00	45.33	74.00	-28.67	V	PEAK	Pass	Harmonic
3	Bluetooth-LE_GSKF	39	2485.24	46.16	54.00	-7.84	V	AVERAGE	Pass	Band Edge
	Bluetooth-LE_GSKF	39	7440.00	44.87	74.00	-29.13	V	PEAK	Pass	Harmonic
	Bluetooth-LE_GSKF	39	49.40	32.83	40.00	-7.17	V	PEAK	Pass	LF



Mode	1																																																																																			
	Band Edge																																																																																			
	2400-2483.5_Bluetooth-LE_GSKF_CH00_2402MHz																																																																																			
ANT	1																																																																																			
Pol.	Horizontal	Fundamental																																																																																		
Peak	<table border="1"> <thead> <tr> <th>Limit</th> <th>Read</th> <th>Ant</th> <th>Cable</th> <th>Preamp</th> <th>Aux</th> <th>APos</th> <th>TPos</th> <th>Remark</th> </tr> <tr> <th>Freq</th> <th>Level</th> <th>Line Margin</th> <th>Level Factor</th> <th>Loss Factor</th> <th>Factor</th> <th></th> <th></th> <th></th> </tr> <tr> <th>MHz</th> <th>dBuV/m</th> <th>dBuV/m</th> <th>dB</th> <th>dBuV</th> <th>dB/m</th> <th>dB</th> <th>dB</th> <th>cm</th> <th>deg</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2386.83</td> <td>56.54</td> <td>74.00</td> <td>-17.46</td> <td>44.10</td> <td>32.02</td> <td>6.60</td> <td>32.18</td> <td>6.00</td> <td>202</td> <td>163</td> <td>PEAK</td> </tr> </tbody> </table>	Limit	Read	Ant	Cable	Preamp	Aux	APos	TPos	Remark	Freq	Level	Line Margin	Level Factor	Loss Factor	Factor				MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	cm	deg	1	2386.83	56.54	74.00	-17.46	44.10	32.02	6.60	32.18	6.00	202	163	PEAK	<table border="1"> <thead> <tr> <th>Limit</th> <th>Read</th> <th>Ant</th> <th>Cable</th> <th>Preamp</th> <th>Aux</th> <th>APos</th> <th>TPos</th> <th>Remark</th> </tr> <tr> <th>Freq</th> <th>Level</th> <th>Line Margin</th> <th>Level Factor</th> <th>Loss Factor</th> <th>Factor</th> <th></th> <th></th> <th></th> </tr> <tr> <th>MHz</th> <th>dBuV/m</th> <th>dBuV/m</th> <th>dB</th> <th>dBuV</th> <th>dB/m</th> <th>dB</th> <th>dB</th> <th>cm</th> <th>deg</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2402.00</td> <td>103.97</td> <td>-----</td> <td>-----</td> <td>91.32</td> <td>32.21</td> <td>6.62</td> <td>32.18</td> <td>6.00</td> <td>202</td> <td>163</td> <td>PEAK</td> </tr> </tbody> </table>	Limit	Read	Ant	Cable	Preamp	Aux	APos	TPos	Remark	Freq	Level	Line Margin	Level Factor	Loss Factor	Factor				MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	cm	deg	1	2402.00	103.97	-----	-----	91.32	32.21	6.62	32.18	6.00	202	163	PEAK
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### <Simultaneous transmission>

## Radiated Spurious Emission Test Modes

Mode	Band (MHz)	Antenna	Modulation	Channel	Frequency	Data Rate	RU	Remark
Mode 4	2400-2483.5	1	Bluetooth-LE_GSKF	39	2480	1Mbps	-	-
	WWAN Part 27F Band 13 BW=5M							

## Summary of each worse mode

Mode	Modulation	Ch.	Freq. (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol.	Peak Avg.	Result	Remark
4	Bluetooth-LE_GSKF	39	2483.50	46.04	54.00	-7.96	H	AVERAGE	Pass	Band Edge
4	Bluetooth-LE_GSKF	39	7440.00	44.45	74.00	-29.55	H	PEAK	Pass	Harmonic





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### Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
Bluetooth LE 1Mbps	62.59	0.393	2.546	2.7kHz

Bluetooth LE 1Mbps

