JAPAN MIC

TEST REPORT

Applicant: SHENZHEN LOFREE CULTURE CO., LTD

Address: F8 Building, F518 IDEA LAND，Baoyuan Road, Xixiang, Baoan District, Shenzhen, China

Product Name: **FLOW 84-Key Dual Mode Low-Profile Mechanical Keyboard**

Model Number: **OE915**

Standard(s): **Radio Law of Japan item 19 of Article 2 Paragraph 1**

The above equipment has been tested and found compliant with the requirement of the relative standards by China Certification ICT Co., Ltd (Dongguan)

Report Number: **CR230739858-07**

Date Of Issue: **2023/7/13**

Reviewed By: **Calvin Chen**

Title: RF Engineer

Approved By: **Sun Zhong**

Title: Manager

Test Laboratory: China Certification ICT Co., Ltd (Dongguan)
No. 113, Pingkang Road, Dalang Town, Dongguan, Guangdong, China
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Test Facility

The Test site used by China Certification ICT Co., Ltd (Dongguan) to collect test data is located on the No. 113, Pingkang Road, Dalang Town, Dongguan, Guangdong, China.

Declarations

China Certification ICT Co., Ltd (Dongguan) is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol "▲". Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1.0	CR230739858-07	Original Report	2023/7/13

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Name:	FLOW 84-Key Dual Mode Low-Profile Mechanical Keyboard
Trade Name:	LOFREE
EUT Model:	OE915
Frequency Range:	2402-2480 MHz
Nominal RF Output Power (Conducted):	1.2 mW
Number of TX Chain(s):	1
Number of RX Chain(s):	1
Antenna Gain (dBi)▲:	-1.66
Modulation Type:	GFSK
Rated Input Voltage:	DC 3.7V from battery
Serial Number:	283P-1
EUT Received Date:	2023/7/12
EUT Received Status:	Good

Operation Frequency Detail:
For BLE:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	…	…
…	…	…	…
…	…	…	…
…	…	38	2478
19	2440	39	2480

The test frequencies were performed the test as below:	
Test Channel	**Frequency (MHz)**
Lowest	2402
Middle	2440
Highest	2480

Accessary Information:

No.

1.2 Description of Test Configuration

1.2.1 EUT Operation Condition:

EUT Operation Mode:	The system was configured for testing in Engineering Mode, which was provided by the manufacturer.
Equipment Modifications:	No
EUT Exercise Software:	Bk32xxRFTest.exe

The software was provided by manufacturer. The maximum power was configured as below, that was provided by the manufacturer▲:

Test Modes	Power Level Setting		
	Lowest	Middle	Highest
1Mbps	7	7	7

The extreme voltage test conditions which were declared by the manufacturer and the normal conditions are as below:

NV, Normal Voltage (Vdc):3.7
LV, Low Voltage (Vdc): 3.5
HV, High Voltage (Vdc): 4.25

1.2.2 Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Lenovo	Laptop	T460S	60PDTEK8
ZHAOXIN	DC Power Supply	RXN-6010D	21R6010D0912386
Unknown	USB Debug	Unknown	Unknown

1.2.3 Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
Data Cable	NO	ON	0.8	EUT	USB Debug
Power Cable	NO	ON	1.2	DC Power Supply	EUT

1.2.4 Block Diagram of Test Setup
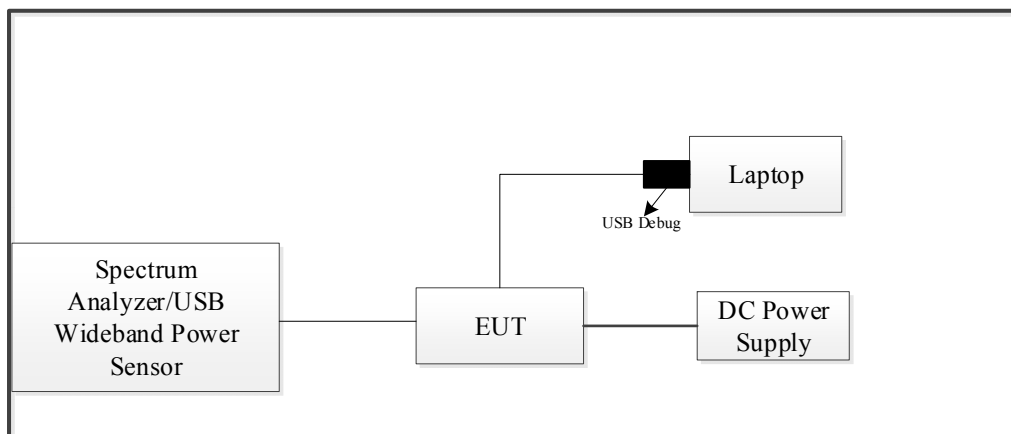
1.3 Measurement Uncertainty

Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

Parameter	Measurement Uncertainty
Frequency Error	±0,5 ppm
Occupied bandwidth and spreading bandwidth	±5 %
RF output power, conducted	±0.61dB
Unwanted Emissions (TX&RX), conducted	±2.47 dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%

2. SUMMARY OF TEST RESULTS

MIC Notice No.88 Appendix No.43 Article 2, Paragraph 1, Item 19 Rules Section	Description of Test	Result
3	Frequency Error	Compliant
4	Occupied Bandwidth	Compliant
5	Transmitter Spurious Emission and Unwanted Emission Intensity	Compliant
6	Antenna Output Power and Output Power Tolerance	Compliant
7	Receiver Spurious Emission and Unwanted Emission Intensity	Compliant
8	Carrier sense capability (1)	Not Applicable*
9	Carrier sense capability (2)	Not Applicable**
10	Transmission Antenna Gain	Not Applicable***
11	Transmission Radiation Angle Width	Not Applicable***
12	Interference Prevention Function	Compliant
13	Frequency Hopping Dwell Time	Not Applicable****
Note 1	Construction Protection Confirmation	Compliant

Note:

Not Applicable: Only required for OBW between 26MHz and 40MHz with OFDM modulation type.*
*Not Applicable**: Only required for outdoor use radio control of model airplanes.*
*Not Applicable***: This item not applicable when the EIRP less than the limit.*
*Not Applicable****: Testing is only required for FHSS system devices.*

3. REQUIREMENTS AND TEST PROCEDURES

3.1 Frequency Error

3.1.1 Limit

Within ±50ppm.

3.1.2 Test Procedure

Set the EUT to the measurement frequency without modulation.
Setting of SA is following as: Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: MAX Hold.
Record the peak spot frequency.

If the EUT can`t set at un-modulation mode, measure the 10dBc center frequency.

3.2 Occupied Bandwidth

3.2.1 Limit

- Occupied bandwidth: ≤ 26 MHz

3.2.2 Test Procedure

1. Setting of SA is following as: RB: 30 kHz/VB: 30 kHz / Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold
2. EUT have transmitted the maximum modulation signal and fixed channelize. SA set to 99% of occupied bandwidth to measure occupied bandwidth.

3.3 Transmitter Spurious Emission Strength and Unwanted Emission Intensity

3.3.1 Limit

- 30MHz ≤ f＜2387 MHz: ≤ 2.5μW/ MHz
- 2387 MHz ≤ f ≤ 2400 MHz: ≤ 25μW/ MHz;
- 2483.5 MHz＜f ≤ 2496.5 MHz: ≤ 25μW/ MHz
- 2496.5 MHz＜f ≤ 12500MHz: ≤ 2.5μW/ MHz

3.3.2 Test Procedure

❖ Conditions of Application Equipment (EUT)

- The modulation state shall be in continuously transmitting mode.

❖ Spectrum Analyzer Conditions

- Setting of SA start 30MHz and stop frequency 1000MHz,RB:100kHz/VB:100kHz,Sweep time: Auto. Sweep mode: continuous sweep .Detect mode: Positive peak/Trace mode: max hold. Then to mark peak. reading value + cable loss shall be less than 0.25μW/100kHz.
- Setting of SA start 1000MHz and stop frequency 2387MHz,RB:1MHz/VB:1MHz,Sweep time: Auto. Sweep mode: continuous sweep .Detect mode: Positive peak/Trace mode: max hold. Then to mark peak. reading value + cable loss shall be less than 2.5μW/MHz.
- Setting of SA start 2387MHz and stop frequency 2400MHz,RB:1MHz/VB:1MHz,Sweep time: Auto. Sweep mode: continuous sweep .Detect mode: Positive peak/Trace mode: max hold. Then to mark peak. reading value + cable loss shall be less than 25μW/MHz.
- Setting of SA start 2483.5MHz and stop frequency 2496.5MHz,RB:1MHz/VB:1MHz,Sweep time: Auto. Sweep mode: continuous sweep .Detect mode: Positive peak/Trace mode: max hold. Then to mark peak. reading value + cable loss shall be less than 25μW/MHz.
- Setting of SA start 2496.5MHz and stop frequency 12500MHz,RB:1MHz/VB:1MHz,Sweep time: Auto. Sweep mode: continuous sweep .Detect mode: Positive peak/Trace mode: max hold. Then to mark peak. reading value + cable loss shall be less than 2.5μW/MHz.

If above test over the limit, the below test procedure should be used:

Step 1:

Center the frequency which was want to investigate, search the peak frequency.

Step 2:
Center frequency: Searched Frequency
Span: 0Hz
RBW: 1MHz(Above 1GHz), VBW: Same as RBW.
Sweep time: Auto(Minimum time to ensure measurement accuracy. *In case of burst wave, one burst shall be included per data point) Data points: 400 points or more. Sweep mode: Single Sweep.
Detection Mode: Sample

3.4 Antenna Output Power and Antenna Power Tolerance

3.4.1 Limit

Antenna output power:
- ≤ 10 mW

- The Output Power Tolerance must be within +20% ~ -80%.

- EIRP ≤ 12.14dBm (other from 2400-2483.5 MHz)

3.4.2 Test Procedure

Set the EUT Frequency to measure
Detector: Average

3.5 Receiver Spurious Emission and Unwanted Emission Intensity

3.5.1 Limit

- ≤ 4 nW (30 MHz ≤ f ≤ 1000 MHz)
- ≤ 20 nW (1 GHz ≤ f ≤ 12.5 GHz)

3.5.2 Test Procedure

❖ Conditions of Application Equipment (EUT)

- The modulation state shall be "continuous receiving mode".

❖ Spectrum Analyzer Conditions

- Start Frequency: Start Frequency of frequency range to measure (30MHz to 1GHz)
- Stop Frequency: Stop Frequency of frequency range to measure (1GHz to 12.5GHz)
- Span: AUTO (Measurement Range)
- RBW: 100 kHz, VBW: 100 kHz for Frequency < 1 GHz
- RBW: 1MHz, VBW: 1MHz for Frequency > 1 GHz
- Sweep time: AUTO or more
- Sweep mode: Auto Sweep
- Detection: Positive Peak
- Reference Level: Enough level for maximum dynamic range
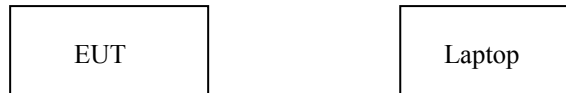
3.6 Interference Prevention Function

3.6.1 Requirement

The EUT shall have the interference prevention capability to transmit or to receive the identification automatically, so that sender and receiver shall exclude other equipment.

3.6.2 Test Procedure

Measurement System Diagram:

EUT		Laptop

In the case that the EUT has the function of automatically transmitting the identification code:
1. Transmit the predetermined identification codes from EUT
2. Check the transmitted identification codes with the demodulator.

In the case of receiving the identification codes:
1. Transmit the predetermined identification codes from the counterpart.
2. Check if communication is normal
3. Transmit the signal other than predetermined ID codes from the counterpart.
4. Check if the EUT stops the transmission, or if it displays that identification codes are different from the predetermined ones.

3.6.3 Measurement Result

Result: Compliant.

3.7 Note 1 - Construction Protection Confirmation

3.7.1 Limit

The high-frequency section and modulation section of the radio equipment except for the antenna system shall not be capable of being opened easily.

3.7.2 Confirmation Method

The RF part(include antenna) covered by EUT case with superglue, it can`t be opened easily. Please refer the EUT photo.

4. TEST DATA AND RESULTS

4.1 Test Environmental Conditions & Test Equipment List and Details

Test Date:	2023/7/12~2023/7/13				
Tester:	LingLing Li				
Environmental Conditions:					
Temperature: (℃)	25.2~25.3	Relative Humidity: (%)	60~62	ATM Pressure: (kPa)	100.2~100.3

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date	Calibration Agency	Calibration Method [Note]
R&S	Spectrum Analyzer	FSU26	100147	2023/03/31	2024/03/30	BACL	C
zhuoxiang	Coaxial Cable	SMA-178	211002	Each time	N/A	/	/
UNI-T	Multimeter	UT39A+	C210582554	2022/09/29	2023/09/28	BACL	C
Agilent	USB Wideband Power Sensor	U2021XA	MY54080015	2022/07/15	2023/07/14	CCIC	C
* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).							

Note:

A. Calibration conducted by the National Institute of Information and Communications Technology (NICT) (hereinafter referred to as "NICT") or a designated calibration agency under Article 102-18 paragraph (1).

B. Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992).

C. Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1).

D. Calibration conducted by using measuring instruments and other equipment which shall have been given any of calibration, etc. listed above from a) to c)

4.2 Frequency Error

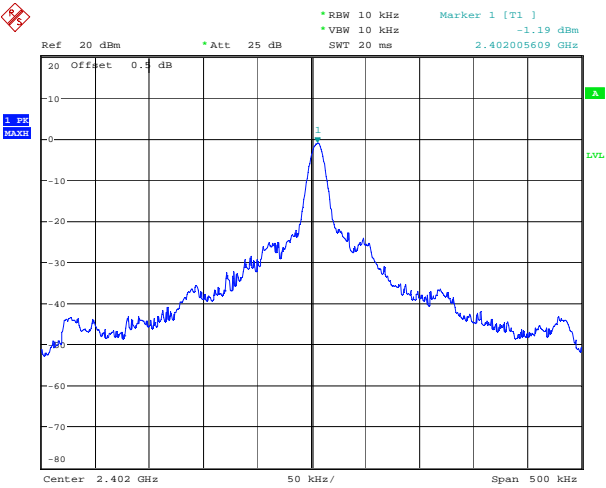**Test Result:** Compliant

Test Mode: Transmitting

Test Condition	Mode	Channel	Fc (MHz)	Measured Frequency (MHz)	Result (ppm)	Limit (ppm)
NV	Single Carrier	Low	2402	2402.005609	2.34	
		Middle	2440	2440.005609	2.30	
		High	2480	2480.005609	2.26	
LV	Single Carrier	Low	2402	2402.005619	2.34	≤ 50
		Middle	2440	2440.005611	2.30	
		High	2480	2480.005614	2.26	
HV	Single Carrier	Low	2402	2402.0056	2.33	
		Middle	2440	2440.005605	2.30	
		High	2480	2480.005606	2.26	

Note:
Tolerance = (Measured Frequency - Test Frequency)/Test Frequency*10^6

Please refer to the plots for normal voltage test:

2402MHz

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2440MHz
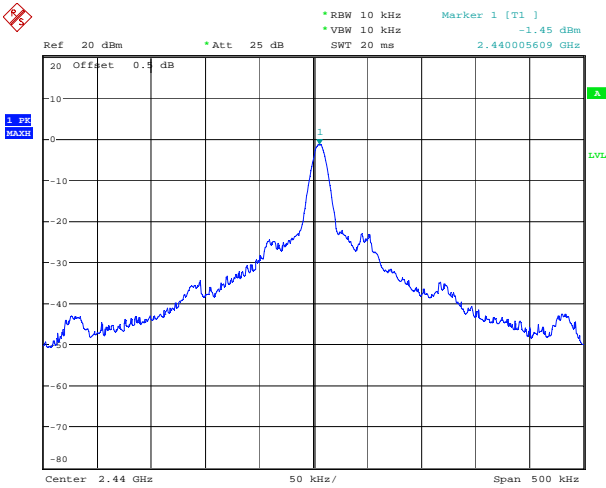
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2480MHz
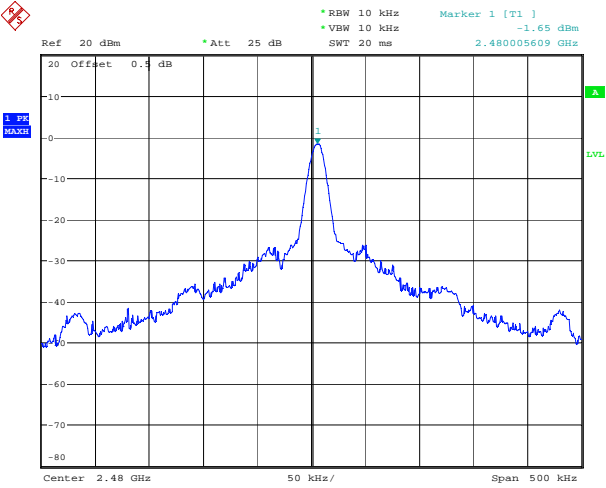
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4.3 Occupied Bandwidth

Test Result: Compliant

Test Mode: Transmitting

Test Condition	Occupied bandwidth (MHz)				
	Mode	Low Channel	Middle Channel	High Channel	Limit
NV	BLE 1Mbps	1.019	1.016	1.019	≤ 26
LV	BLE 1Mbps	1.026	1.033	1.028	≤ 26
HV	BLE 1Mbps	1.010	1.011	1.008	≤ 26

Please refer to the below plots for normal voltage test:

Occupied bandwidth:

BLE 1Mbps, Low Channel
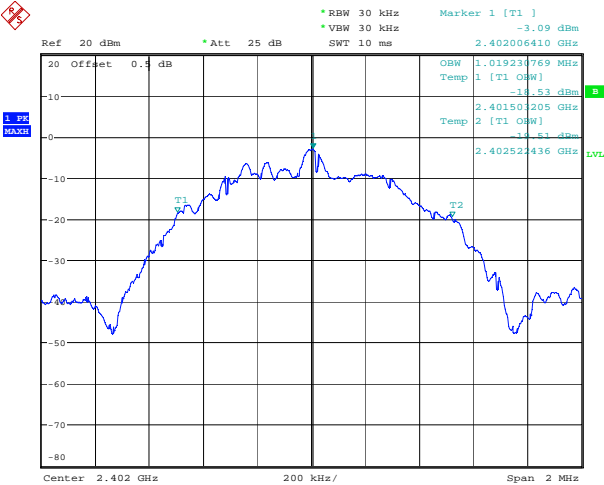
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BLE 1Mbps, Middle Channel
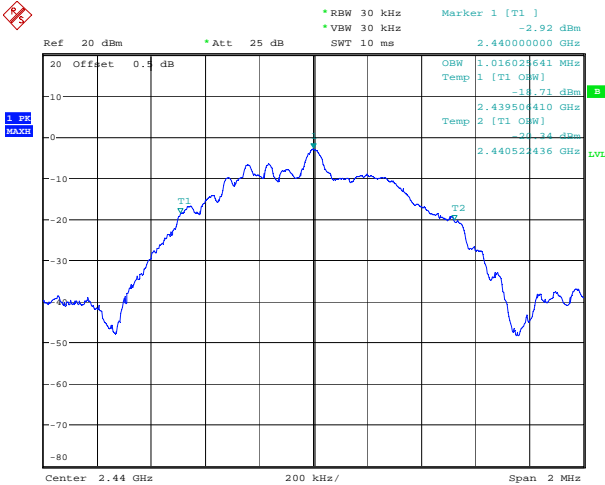
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BLE 1Mbps, High Channel
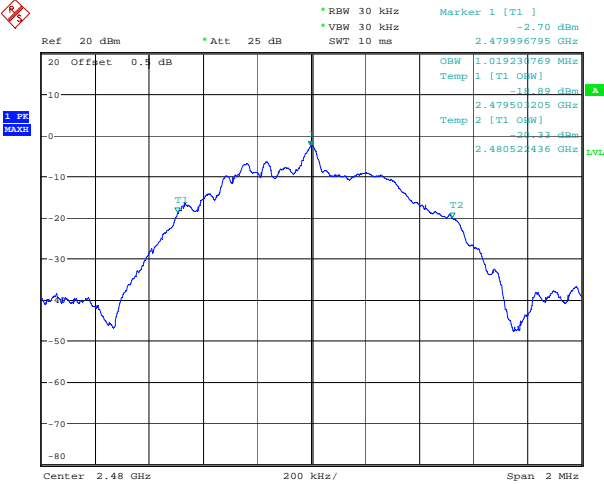
Date:　　12.JUL.2023 17:18:50

4.4 Transmitter Spurious Emission Strength and Unwanted Emission Intensity

Test Result: Compliant

Test Mode: Transmitting

Test Condition	Mode	Test Band (RBW)	Result (dBm)			Limit (dBm/RBW)	Limit (µW/RBW)
			Low Channel	Middle Channel	High Channel		
NV	BLE 1Mpbs	Band I (100kHz)	-51.67	-41.97	-50.65	-36	0.25
		Band II (1MHz)	-41.90	-44.86	-45.14	-26	2.5
		Band III (1MHz)	-23.54	-44.34	-44.20	-16	25
		Band IV (1MHz)	-44.26	-43.81	-42.74	-16	25
		Band V (1MHz)	-42.32	-42.70	-40.24	-26	2.5
LV	BLE 1Mpbs	Band I (100kHz)	-51.07	-41.76	-50.38	-36	0.25
		Band II (1MHz)	-40.99	-44.61	-45.12	-26	2.5
		Band III (1MHz)	-22.96	-44.01	-43.82	-16	25
		Band IV (1MHz)	-43.93	-43.03	-42.64	-16	25
		Band V (1MHz)	-41.94	-42.40	-39.40	-26	2.5
HV	BLE 1Mpbs	Band I (100kHz)	-52.23	-42.76	-51.20	-36	0.25
		Band II (1MHz)	-42.49	-45.26	-45.82	-26	2.5
		Band III (1MHz)	-24.09	-45.26	-44.81	-16	25
		Band IV (1MHz)	-44.79	-44.67	-43.46	-16	25
		Band V (1MHz)	-43.10	-43.39	-40.66	-26	2.5

Note:
   Band I:30MHz~1000MHz
   Band II:1000MHz~2387MHz
   Band III:2387MHz~2400MHz
   Band IV:2483.5MHz~2496.5MHz
   Band V:2496.5MHz~12500MHz

Please refer to the below plots for normal voltage test.
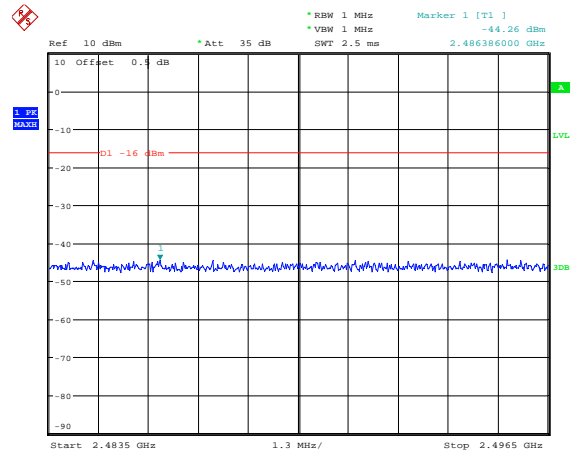
BLE 1Mbps Low Channel
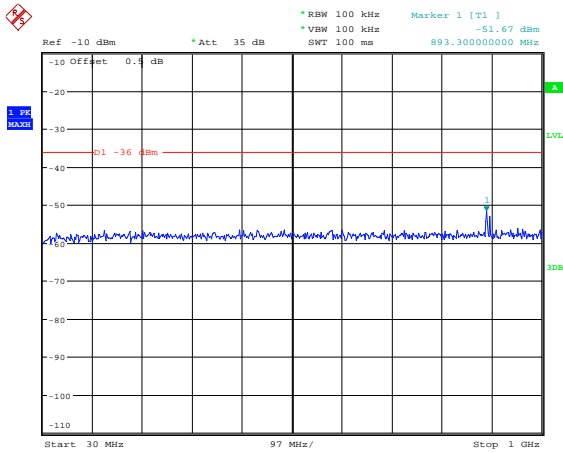
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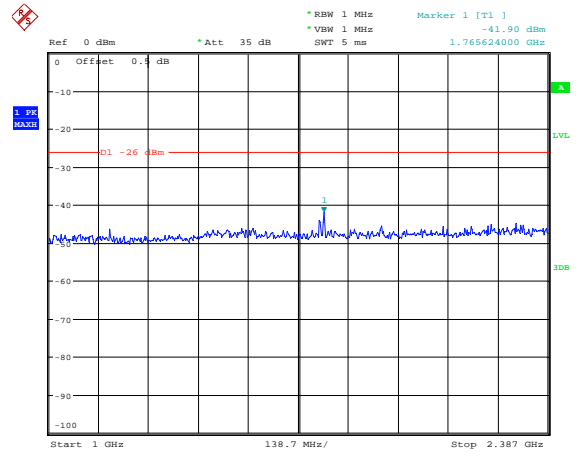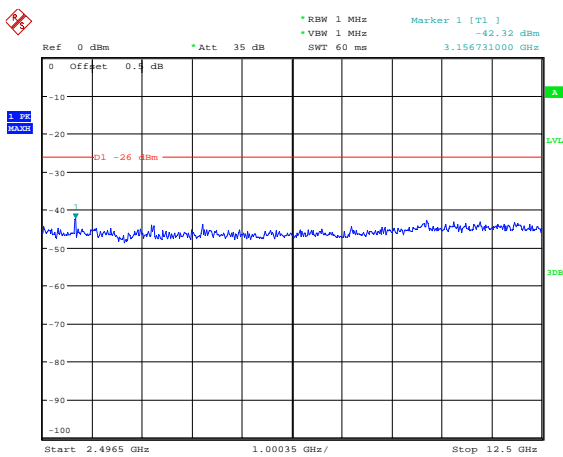

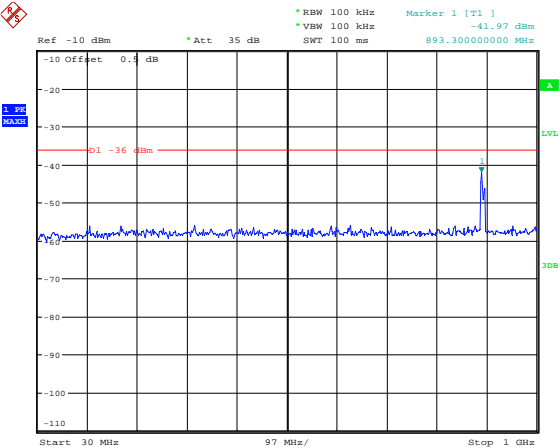
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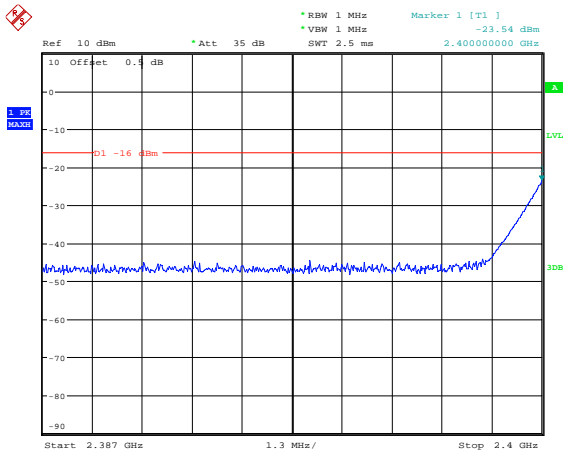
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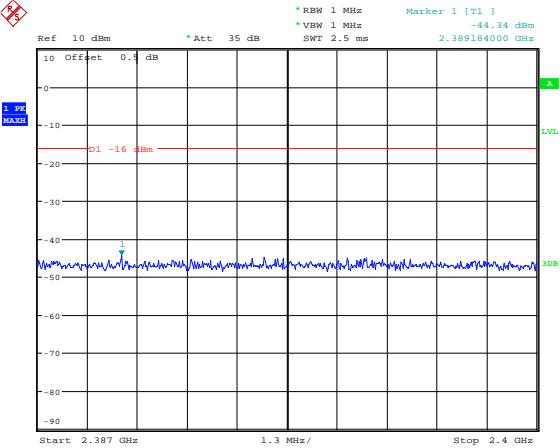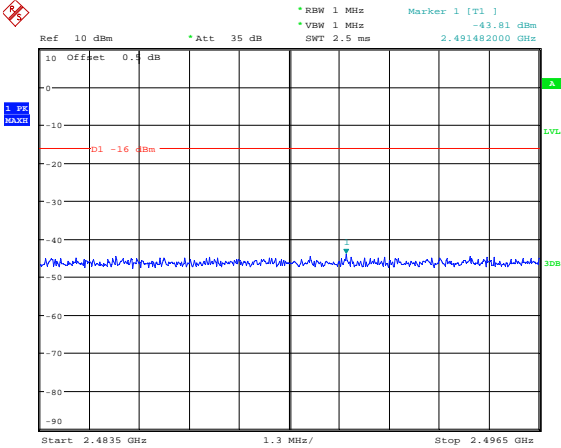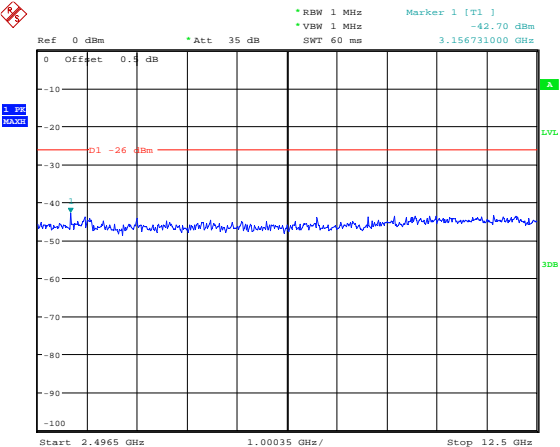
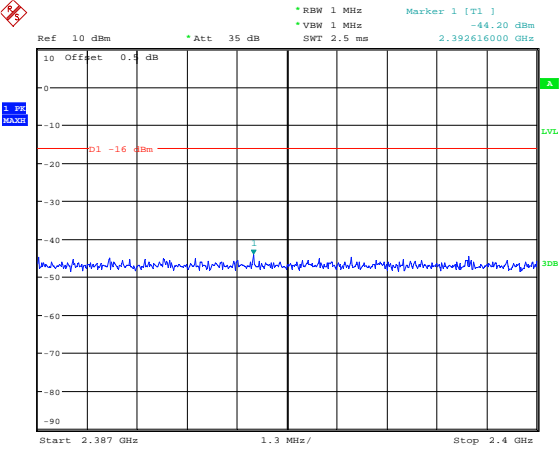## BLE 1Mbps Middle Channel
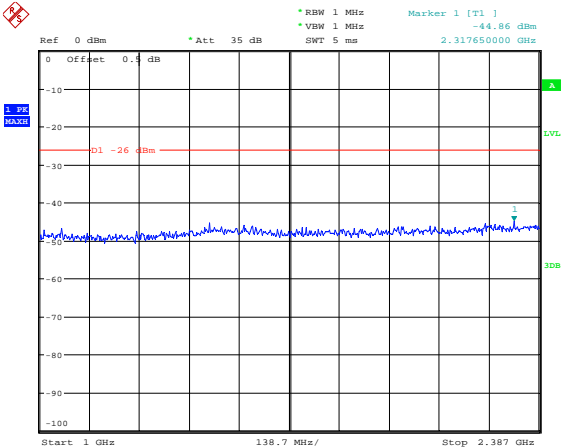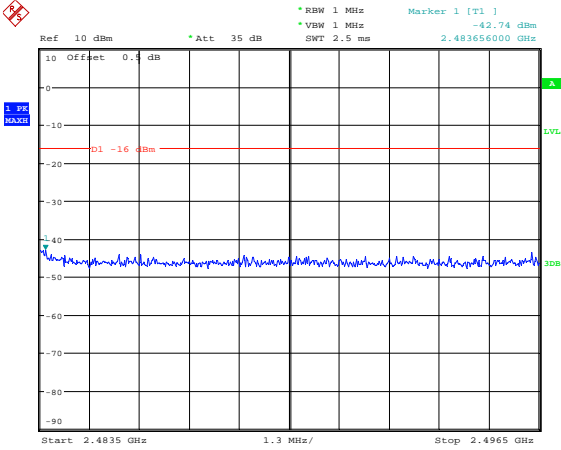
BLE 1Mbps High Channel
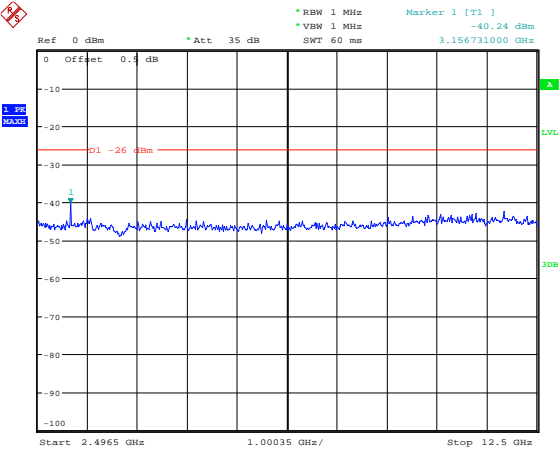

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4.5 Antenna Output Power and Antenna Power Tolerance

Test Result: Compliant

Test Mode: Transmitting

Duty Cycle and Declared Power:

Mode	Ton (ms)	Ton+Toff (ms)	Duty cycle (%)
BLE 1Mbps	0.449	0.637	70.49

Mode	Antenna gain (dBi)	Declared power (mW)
BLE 1Mbps	-1.66	1.20

Output power

| Test Condition	Mode	Channel	Conducted power (dBm)	Antenna Output Power (mW)		Antenna Power Tolerance (%)		EIRP (dBm)	
				Result	Limit	Result	Limit	Result	Limit
NV	BLE 1Mbps	Low	-0.95	1.140	≤ 10	-5.00	-80~ +20	-1.09	≤ 12.14
		Middle	-1.24	1.066		-11.17		-1.38	
		High	-1.41	1.025		-14.58		-1.55	
LV	BLE 1Mbps	Low	-0.84	1.169	≤ 10	-2.58	-80~ +20	-0.98	≤ 12.14
		Middle	-1.11	1.099		-8.42		-1.25	
		High	-1.29	1.054		-12.17		-1.43	
HV	BLE 1Mbps	Low	-0.99	1.129	≤ 10	-5.92	-80~ +20	-1.13	≤ 12.14
		Middle	-1.54	0.995		-17.08		-1.68	
		High	-1.61	0.979		-18.42		-1.75	

Note:
*1.Antenna Output Power Tolerance = (Antenna Output power - Declared Power)/Declared Power*100%*
2.Antenna output power (mW) = Conducted power(mW)/Duty cycle= (10^(Conducted power(dBm)/10)/Duty cycle
*3.EIRP (dBm) = 10*log(Antenna output power (mW))+Antenna Gain*

Duty Cycle:

2440MHz
BLE 1Mpbs
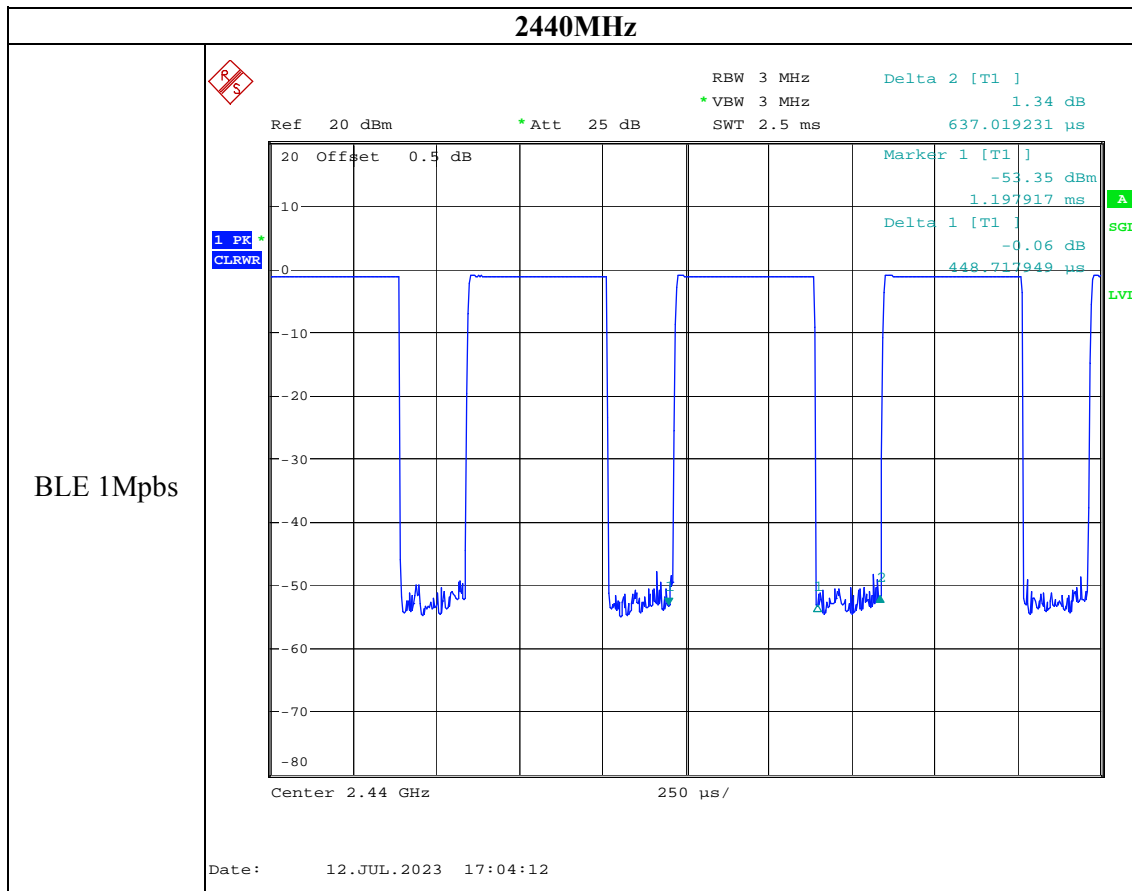
4.6 Receiver Spurious Emission and Unwanted Emission Intensity

Test Result: Compliant, please see the below tables and plots

Test Mode: Receiving

| Test Condition	Mode	Test Band (RBW)	Result (dBm)			Limit (dBm)	Limit (nW)
			Low Channel	Middle Channel	High Channel		
NV	BLE 1Mbps	Band I (100kHz)	-84.24	-80.65	-84.44	-54	4
		Band II (1MHz)	-65.97	-58.44	-66.37	-47	20
LV	BLE 1Mbps	Band I (100kHz)	-83.68	-80.01	-84.41	-54	4
		Band II (1MHz)	-65.24	-58.27	-66.30	-47	20
HV	BLE 1Mbps	Band I (100kHz)	-84.34	-81.59	-85.34	-54	4
		Band II (1MHz)	-66.63	-58.90	-66.40	-47	20

Note:
    Band I:30MHz～1000MHz
    Band II:1000MHz～12500MHz

Please refer to the below plots for normal voltage test.
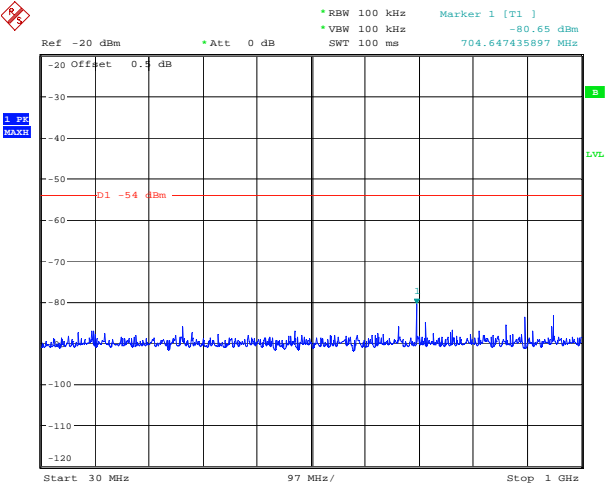
BLE 1Mbps, Low Channel
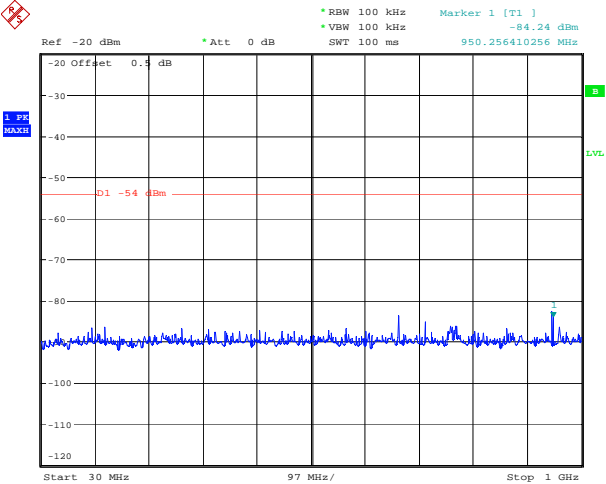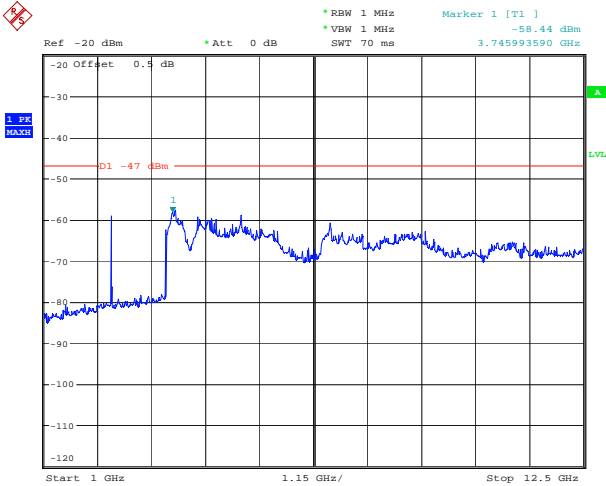

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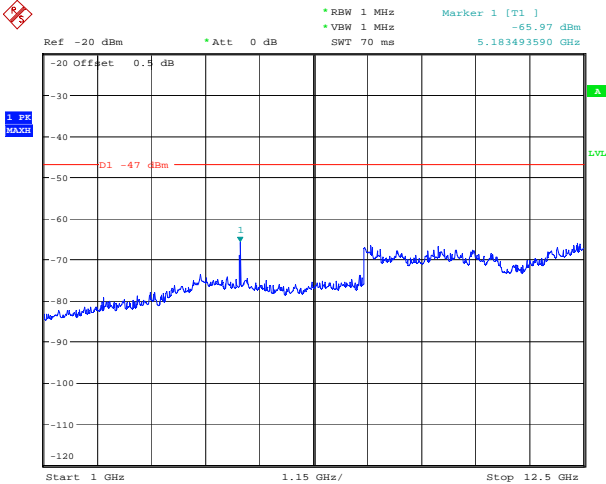
Date:　　　12.JUL.2023　17:35:15
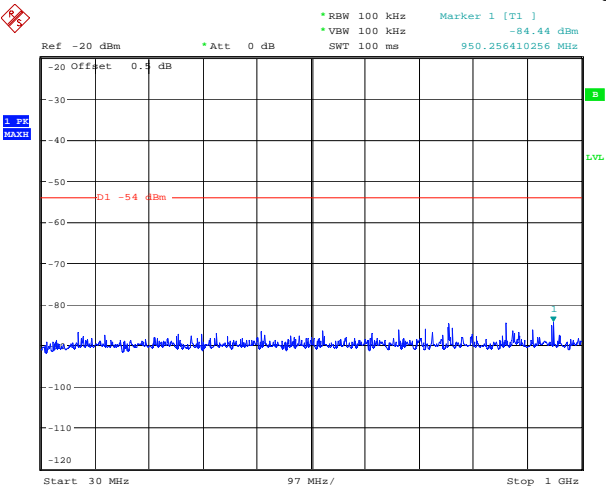
BLE 1Mbps, Middle Channel

Date:　　　12.JUL.2023　17:37:42

Date:　　　12.JUL.2023　17:37:28

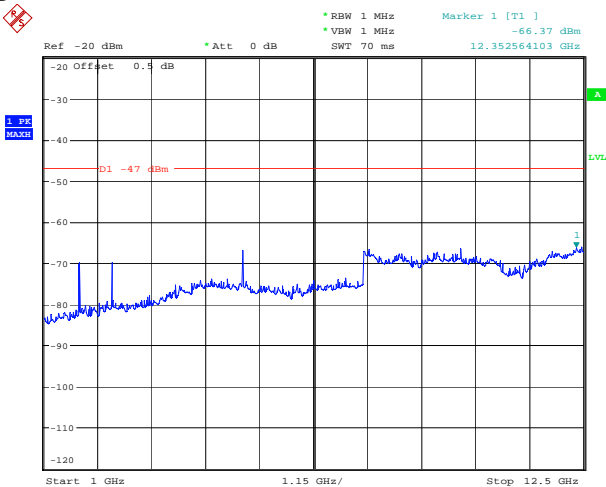## BLE 1Mbps, High Channel

Date:　　　12.JUL.2023　17:38:36

Date:　　　12.JUL.2023　17:48:50

***** END OF REPORT *****