



JAPAN Radio Test Report

Low Energy

APPLICANT : Inseego Corp.

PRODUNCT NAME : 5G Enterprise Gateway

BRAND NAME : Inseego

MODEL NAME : S2000e-4

TYPE EMISSIONS : 1M08F1D(4.0 LE) ;
2M10F1D(5.0 LE)

DECLARATION : 1.500 mW (4.0 LE);

OUTPUT POWER : 1.500 mW (5.0 LE)

STANDARD : Article 49-20 and the relevant articles of the
Ordinance Regulating Radio Equipment

TEST PROCEDURE : MIC Notice No.88 Appendix No.43

TEST DATE(S) : Jul. 01, 2021~Jul. 09, 2021



We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the procedures given in MIC Notice No.88 Appendix No.43 and shown to be compliant with the applicable technical standards. Article 2 Paragraph 1 Item 19 of the Certificate Ordinance of the Radio Law indicates the classification of the specified radio equipment.

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

Jason Jia

Reviewed by: Jason Jia / Supervisor

Alex Wang

Approved by: Alex Wang / Manager



Sporton International (Kunshan) Inc.

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



TABLE OF CONTENTS

REVISION HISTORY.....	4
SUMMARY OF TEST RESULT	5
1 GENERAL DESCRIPTION.....	6
1.1 Applicant.....	6
1.2 Manufacturer.....	6
1.3 Feature of Equipment Under Test	7
1.4 Modification of EUT	9
1.5 Testing Site.....	9
1.6 Applied Standards	9
1.7 Ancillary Equipment List	10
2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST.....	11
2.1 Carrier Frequency Channel	11
2.2 EUT Operation Test Setup	11
3 TEST RESULT	12
3.1 Frequency Tolerance Measurement.....	12
3.2 Occupied Bandwidth and Spread-spectrum Bandwidth / Spread Factor Measurement.....	13
3.3 Unwanted Emission Intensity Measurement	14
3.4 RF Output Power / Tolerance.....	16
3.5 Limitation of Collateral Emission of Receiver Measurement.....	18
3.6 Transmission Antenna Gain (EIRP Antenna Power) Measurement	19
3.7 Transmission Radiation Angle Width (3dB Beamwidth) Measurement.....	21
3.8 Radio Interference Prevention Capability Measurement.....	23
3.9 Hopping Frequency Dwell Time Measurement	24
3.10 Construction Protection Confirmation Method.....	25
4 LIST OF MEASURING EQUIPMENT.....	26
APPENDIX A. SETUP PHOTOGRAPHS	
APPENDIX B. TEST RESULTS	
APPENDIX C. TEST PLOTS	



REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
JR162522	Rev. 01	Initial issue of report	Jul. 10, 2021
JR162522	Rev. 02	Update model name	Jul. 14, 2021

SUMMARY OF TEST RESULT

Report Section	Description	Result
3.1	Frequency Tolerance	Pass
3.2	Occupied Bandwidth and Spread-spectrum Bandwidth / Spread Factor	Pass
3.3	Unwanted Emission Intensity	Pass
3.4	RF Output Power / Tolerance	Pass
3.5	Limitation of Collateral Emission of Receiver	Pass
3.6	Transmission Antenna Gain (EIRP Antenna Power)	NA
3.7	Transmission Radiation Angle Width (3dB Beam width)	NA
3.8	Radio Interference Prevention Capability	Pass
3.9	Hopping Frequency Dwell Time	N/A
3.10	Construction Protection Confirmation	Pass

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.



1 General Description

1.1 Applicant

Inseego Corp.

9710 Scranton Road Suite 200, San Diego, CA 92121

1.2 Manufacturer

MeiG Smart Technology Co., Ltd

Floor 2, Office Building No.5, Lingxia Road, Fenghuang Community, Fuyong Street, Bao 'an District, Shenzhen

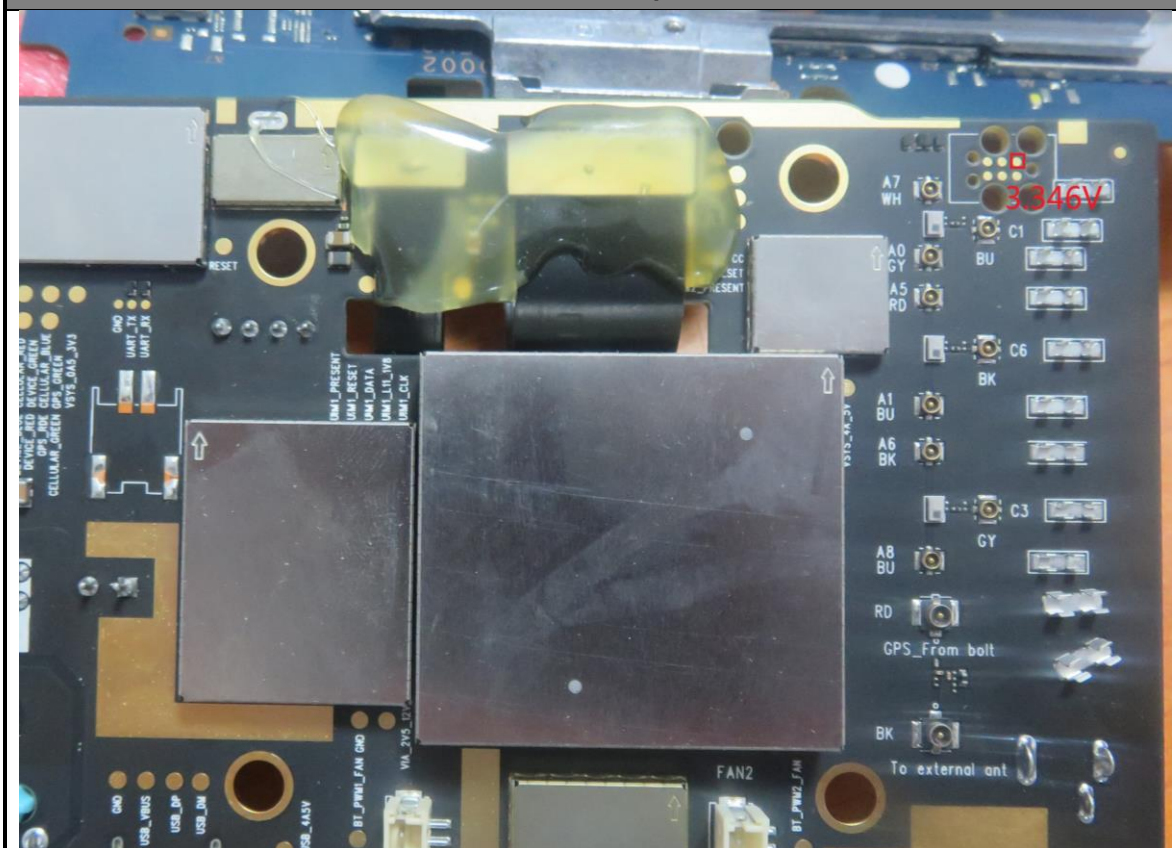
1.3 Feature of Equipment Under Test

Product Feature & Specification		
Product Name	5G Enterprise Gateway	
Brand Name	Inseego	
Model Name	S2000e-4	
Support Category / Frequency Range	Article 2-1-19 / 2400MHz ~ 2483.5MHz	
Type of Modulation	☐ Direct Spreading (DS) ☐ Orthogonal frequency-division multiplexing (OFDM) ☐ Frequency Hopping (FH) ☒ Other :GFSK	
Number of Channels	BT 4.0/5.0	40
Channel Spacing	BT 4.0/5.0	2MHz
Declaration RF Output Power	1.500 mW(4.0 LE mode) 1.500 mW (5.0 LE mode)	
Antenna Power (E.I.R.P)	5.76 dBm (4.0 LE mode) 5.76 dBm (5.0 LE mode)	
Modulation	☒ GFSK ☐ $\pi/4$ -DQPSK ☐ 8-DPSK ☐ Other : FSK	
Power Source ^{NOTE}	☒ Commercial power	AC 100 ~ 240V
	☒ External Power Source	DC 24V or DC 12V
	☐ Lithium battery	DC 3.7V, mAh
	☐ UM battery	DC 1.2V

NOTE: When EUT be operated at $\pm 10\%$ from the normal supply voltage, the supply voltage of RF part was varied within $\pm 1\%$. All test cases were done under the normal supply voltage.

Power Supply voltage 12/24Vdc (Nominal)	Power Supply voltage 13.2/26.4Vdc (+10%)	Power Supply voltage 10.8/21.6Vdc (-10%)
3.346	3.346	3.346

Measurement point



Antenna Information			
Brand Name :	N/A	Model Name :	N/A
Antenna Type :	PCB	Antenna Gain :	4.00 dBi

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 Modification of EUT

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

1.5 Testing Site

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

Test Site	Sporton International (Kunshan) Inc.
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958
Test Site No.	Sporton Site No.: TH01-KS

Test Items	Uncertainty	Remark
Occupied Channel Bandwidth	± 0.414 ppm	Confidence 95%
RF output power, conducted	± 0.56 dB	Confidence 95%
Frequency Tolerance	± 0.414 ppm	Confidence 95%
Power density, conducted	± 0.54 dB	Confidence 95%
Unwanted Emission	± 0.92 dB	Confidence 95%
Temperature	± 0.8 °C	Confidence 95%
Humidity	± 3 %	Confidence 95%
Time	± 0.33 %	Confidence 95%

1.6 Applied Standards

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

- ♦ Article 49-20 and the relevant articles of the Ordinance Regulating Radio Equipment

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The measurement was implemented in accordance with MIC Notice No. 88 Appendix No. 43.



1.7 Ancillary Equipment List

None.

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

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

2.2 EUT Operation Test Setup

The equipment under test (EUT) was linked with Bluetooth simulator or operated by commands in order to make the EUT into the engineering modes for transmitting, receiving signals continuously, and hopping mode.

3 Test Result

3.1 Frequency Tolerance Measurement

3.1.1 Limit

Item	Limits
Frequency Tolerance	$\leq \pm 50\text{ppm}$

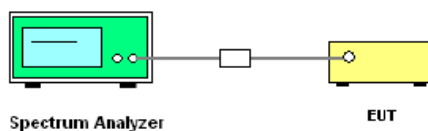
3.1.2 Measuring Instruments

See list of measuring instruments of this test report.

3.1.3 Test Procedure

1. Frequency accuracy of instrument shall be less than 10% of limits tolerance (5ppm).
2. Three testing methods
 - a. Measure frequency tolerance by the system simulator.
 - b. CW Tone method
 - i. Setting of SA is following as: RBW:1kHz / VBW:30kHz.
 - ii. Maker Max. level to get measuring frequency f.
 - c. 10dB down method
 - i. Setting of SA is following as: RBW:30kHz / VBW: 30kHz / Trace: MaxHold
 - ii. Display line Level = Max. level – 10dB to place two markers, highest(fH) and lowest(fL) frequency
 - iii. Determine measuring frequency $f = (fH - fL)/2$
3. The frequency tolerance test case is directly measured using the frequency accuracy function of Bluetooth tester or spectrum analyzer. Then the frequency error formula is $(f - f_c)/f_c \times 10^6$ ppm and the limit is less than $\pm 50\text{ppm}$.

3.1.4 Test Setup



3.1.5 Test Result of Frequency Tolerance

Please refer to Appendix B.

3.2 Occupied Bandwidth and Spread-spectrum Bandwidth / Spread Factor Measurement

3.2.1 Limit

Item	Limits
Occupied Band Width	$\leq 83.5\text{MHz}$ (FH)
	$\leq 26\text{MHz}$ (OFDM, DS and Others)
Spreading Bandwidth	$\geq 500\text{ kHz}$ (FH, DS)

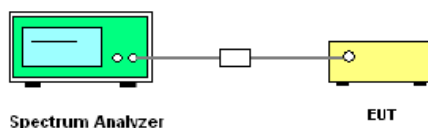
3.2.2 Measuring Instruments

See list of measuring instruments of this test report.

3.2.3 Test Procedures

1. Setting of SA is following as: RBW $\leq 3\%$ of bandwidth / VBW = RBW / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
2. EUT have transmitted each modulation signal and fixed channelize (For DSSS or OFDM Device) or continuous maximum power of hopping mode (For FHSS Device). SA set to 99% of occupied bandwidth to measure occupied bandwidth. The limit is less than 26MHz (For DSSS or OFDM Device) or 83.5MHz (For FHSS Device).
3. SA set to 90% of occupied bandwidth to measure Spread Spectrum Bandwidth and must greater than 500kHz.
4. Spread Spectrum Factor = Spread Spectrum Bandwidth / modulation rate of EUT.
5. Spread Spectrum Factor limit is greater than 5.

3.2.4 Test Setup



3.2.5 Test Result of Occupied Bandwidth and Spread-spectrum Bandwidth / Spread Factor Measurement

Please refer to Appendix B.

3.3 Unwanted Emission Intensity Measurement

3.3.1 Limit

Item	Limits
Tx Spurious Emission	$\leq 2.5 \mu\text{W}$ ($2387\text{MHz} > f ; 2496.5\text{MHz} < f$)
	$\leq 25 \mu\text{W}$ ($2387\text{MHz} \leq f < 2400\text{MHz}$) and ($2483.5\text{MHz} < f \leq 2496.5\text{MHz}$)

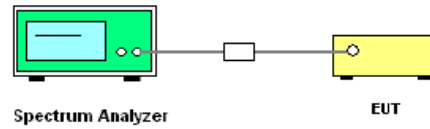
3.3.2 Measuring Instruments

See list of measuring instruments of this test report.

3.3.3 Test Procedures

1. EUT have transmitted the maximum power and fixed channelize.
2. Setting of SA is following as: RBW:1MHz / VBW:1MHz above 1GHz, Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
3. Setting of SA is following as: RBW:100KHz / VBW:100KHz under 1GHz, Sweep time: Auto / Sweep Mode: Continuous sweep / Detect mode: Positive peak / Trace mode: Max hold.
4. Setting of SA is following as 30MHz and stop frequency 2387MHz Then to mark peak reading value + cable loss shall be less than 2.5 μW .
5. SA adjusted to start frequency 2387MHz and stop frequency 2400MHz. Then to mark peak reading value + cable loss shall be less than 25 μW .
6. SA adjusted to start frequency 2483.5MHz and stop frequency 2496.5MHz Then to mark peak reading value + cable loss shall be less than 25 μW .
7. SA adjusted to start frequency 2496.5MHz and stop frequency 12500MHz Then to mark peak reading value + cable loss shall be less than 2.5 μW .
8. If the Result_Value is over the requirement, take total sum of 1MHz band centered at the spur frequency like ACLP measurement as Result_Value.

3.3.4 Test Setup



3.3.5 Test Result of Unwanted Emission Intensity

Please refer to Appendix B.

3.4 RF Output Power / Tolerance

3.4.1 Limit

Item	Limits
Antenna Power Density	$\leq 3\text{mW/MHz}$ (FH form 2400~2483.5MHz)
	$\leq 10\text{mW/MHz}$ (OFDM,DS from 2400~2483.5MHz)
	$\leq 10\text{mW}$ (Other from 2400~2483.5MHz)
Antenna Power Error	+20%, -80% (Base on manufacturer declare antenna power density)

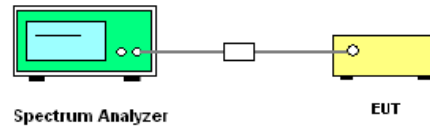
3.4.2 Measuring Instruments

See list of measuring instruments of this test report.

3.4.3 Test Procedures

1. EUT have transmitted continuous maximum power on hopping mode (For FHSS Device).
2. Frequency hopping system or combined systems of direct spread and frequency hopping:
 - i. Connect the high frequency power meter to the output of the attenuator and measure the total power (without bandwidth limitation)
 - ii. Divide the total power by the spread bandwidth to find the “average” power per MHz.
The average power per MHz is equal to the power meter value dBm + cable loss dB + $10 \log_{10} (1/\text{Duty Cycle})$ dB + $10 \log_{10} (1/\text{Spread Bandwidth})$ dB.
 - iii. Confirm that frequency distribution of the hopping frequencies is homogeneous according to the supporting data.
If frequency distribution of the frequencies is not homogeneous, consider other measurement or correction methods based on the supporting data.
 - iv. Set the antenna power as follows:
 - Continuous waves: value in ii.
3. Antenna RF Output Power Tolerance is definition that actual measure antenna power tolerance between + 20% to - 80% power range that manufacturer declare the conducted power density.

3.4.4 Test Setup



3.4.5 Test Result of RF Output Power / Tolerance

Please refer to Appendix B.

3.5 Limitation of Collateral Emission of Receiver Measurement

3.5.1 Limit

Item	Limits
Rx Spurious Emission	$\leq 4\text{nW}$ ($f < 1\text{GHz}$)
	$\leq 20\text{nW}$ ($1\text{GHz} \leq f$)

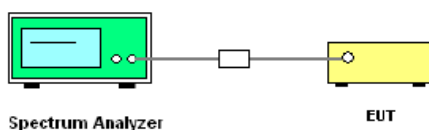
3.5.2 Measuring Instruments

See list of measuring instruments of this test report.

3.5.3 Test Procedures

1. EUT have the continuous reception mode and fixed only one channelize.
2. SA set RBW: 100KHz and VBW: 100KHz. Then adjust to start frequency 30MHz and stop frequency 1GHz. Search to mark peak reading value + cable loss shall be less than 4nW.
3. SA set RBW: 1MHz and VBW: 1MHz. Then adjust to start frequency 1000MHz and stop frequency 12.5GHz. Search to mark peak reading value + cable loss shall be less than 20nW.
4. If power level of lower emissions are more than 1/10 of limit (.0.4nW for $f < 1\text{GHz}$, 2nW for $f \geq 1\text{GHz}$), all those are to be indicated in the 2nd and 3rd lines. If others are 1/10 or less more of the limit, no necessary to be indicated.

3.5.4 Test Setup



3.5.5 Test Result of Limitation of Collateral Emission of Receiver

Please refer to Appendix B.

3.6 Transmission Antenna Gain (EIRP Antenna Power) Measurement

3.6.1 Limit

Item	Limits
EIRP Power Density	$\leq 6.91\text{dBm/MHz}$ (FH form 2400~2483.5MHz)
	$\leq 12.14\text{dBm/MHz}$ (OFDM,DS from 2400~2483.5MHz)
	$\leq 12.14\text{dBm}$ (Other from 2400~2483.5MHz)
Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz.	

3.6.2 Measuring Instruments

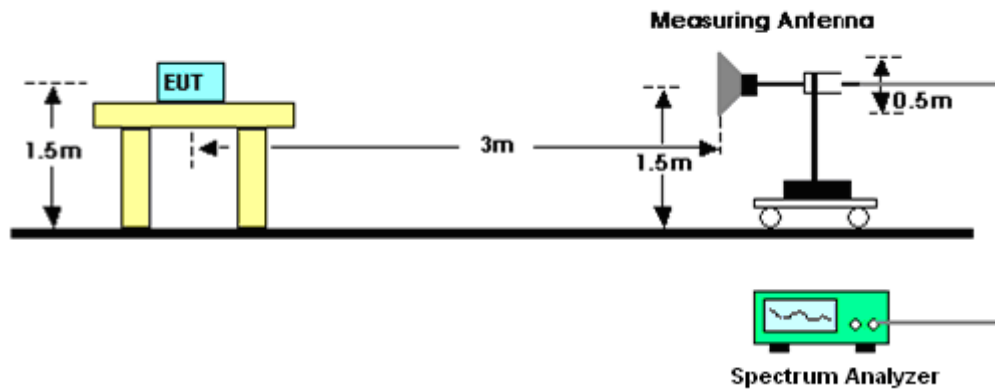
See list of measuring instruments of this test report.

3.6.3 Test Procedures

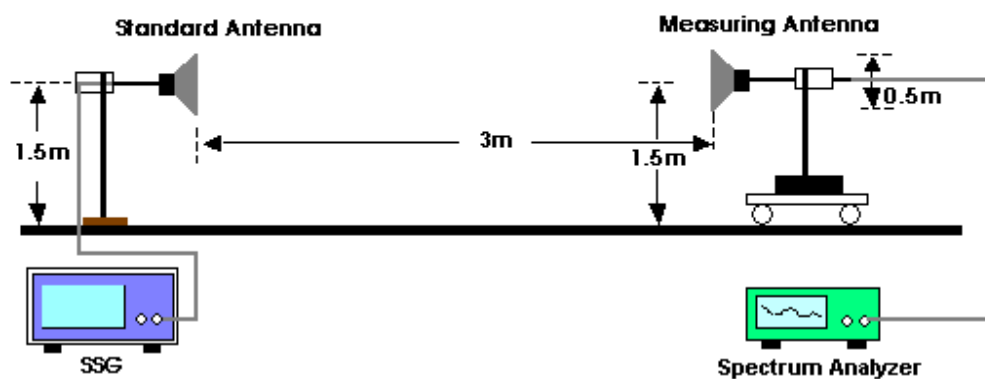
1. Set EUT ad measuring antenna at the same height and roughly facing each other.
2. Move the measuring antenna height up and down within $\pm 50\text{cm}$ of EUT height and swing it to find the maximum output of the measuring antenna. The output level at the spectrum analyzer is read as "E".
3. Remove the EUT from the turn table and put the replacing antenna facing to measuring antenna at same height. Set the standard signal generator (SSG) at same frequency and transmit on then receive the signal.
4. Swing the replacing antenna give a maximum receiving level.
5. Move the measuring antenna height up and down within $\pm 50\text{cm}$ of replacing antenna height and swing it to find the maximum receiving level.
6. Set SSG output power at P_t to give the equivalent output level of "E" or calculate P_t with SSG output which gives the nearest of "E" and difference ($\pm 1\text{dB}$). Record the P_t .
7. Calculate EIRP by the formula below $\text{EIRP} = G_t - L + P_t$.
 G_t : gain of replacing antenna (dBi)
 L : feeder loss between SSG and replacing antenna
 P_t : Output power of the SSG
8. If the antenna for the EUT has circular polarization, sum of V-field and H-field will be result if measuring antenna is linear polarization.

3.6.4 Test Setup

<For EUT radiation measurement>



<For standard antenna measurement>



3.6.5 Test Result of Transmission Antenna Gain (EIRP Antenna Power)

Please refer to Appendix B. For the antenna gain, please refer to antenna test report.

Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz.

3.7 Transmission Radiation Angle Width (3dB Beamwidth) Measurement

3.7.1 Limit

Item	Limits
3dB antenna beamwidth	$360/A$ (If $A < 1$; then $A = 1$) $A = \{\text{EIRP Power [mW]} / 16.36 \text{ for DS, OFDM}\}$ or $A = \{\text{EIRP Power [mW]} / 4.9 \text{ for FH}\}$
Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz.	

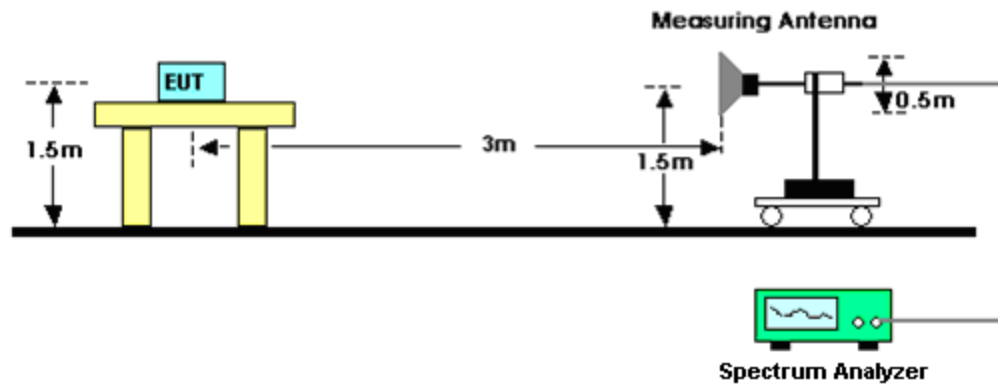
3.7.2 Measuring Instruments

See list of measuring instruments of this test report.

3.7.3 Test Procedures

1. Set EUT and measuring antenna at the same height and roughly facing each other.
2. Set spectrum analyzer with condition in section 3.7.2 and tune reference level to observe receiving signal position.
3. Rotate directions of the EUT horizontally and vertically to find the maximum receiving power.
4. Move the measuring antenna height up and down within $\pm 50\text{cm}$ of EUT height and swing it to find the maximum output of measuring antenna. The output level at the spectrum analyzer is read as "E".
5. Calculate permitted radiation angle in horizontal and vertical using EIRP measured in another test method.
6. Calculate 3dB antenna beam width by the formula below $360/A$ (If $A < 1$; then $A = 1$).
 $A = \{\text{EIRP Power [mW]} / 16.36 \text{ for DS, OFDM}\}$ or
 $A = \{\text{EIRP Power [mW]} / 4.9 \text{ for FH}\}$

3.7.4 Test Setup



3.7.5 Test Result of Transmission Radiation Angle Width (3dB Beamwidth)

Please refer to Appendix B.

For the antenna gain, please refer to antenna test report.

Remark: This test item will not be applied to EIRP power of EUT is lower than 12.14dBm/MHz.

3.8 Radio Interference Prevention Capability Measurement

3.8.1 Limit

Item	Limits
Identification code	≥ 48 bits

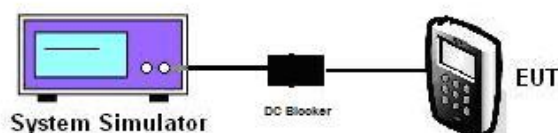
3.8.2 Measuring Instruments

See list of measuring instruments of this test report.

3.8.3 Test Procedures

1. In the case that the EUT has the function of automatically transmitting the identification code: a. Transmit the predetermined identification codes form EUT. b. Check the transmitted identification codes with the demodulator.
2. In the case of receiving the identification code: a. Transmit the predetermined identification codes form the counterpart. b . Check if communication is normal. c. Transmit the signals other than predetermined ID codes form the counterpart. d. check if the EUT stops the transmission, or if it displays that identification codes are different from the predetermined ones.

3.8.4 Test Setup



3.8.5 Test Result of Radio Interference Prevention Capability

Please refer to Appendix B.

3.9 Hopping Frequency Dwell Time Measurement

3.9.1 Limit

Item	Limits
Hopping Freq. Dwell Time	≤ 0.4 seconds

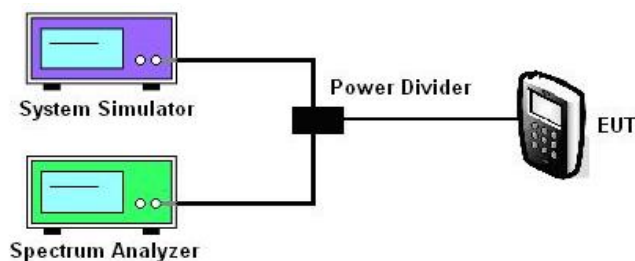
3.9.2 Measuring Instruments

See list of measuring instruments of this test report.

3.9.3 Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Set RBW of spectrum analyzer to 1MHz and VBW to 1MHz.
3. Use a video trigger with the trigger level set to enable triggering only on full pulses.
4. Sweep Time is more than once pulse time.
5. Set the center frequency on any frequency would be measured and set the frequency span to zero span.
6. Measure the maximum time duration of one single pulse.
7. Set the EUT in continuous transmitting for each supported maximum packet format.
8. Measure the maximum time duration of one single pulse.
9. Use the marker-delta function to calculate the dwell time.
10. Dwell Time = Total Number of channels x 0.4(s) x Average Hopping Channel x package transfer time
11. Average Hopping Channel = Total Number of hopping / sweep time

3.9.4 Test Setup



3.9.5 Test Result of Hopping Frequency Dwell Time

Not Applicable.

3.10 Construction Protection Confirmation Method

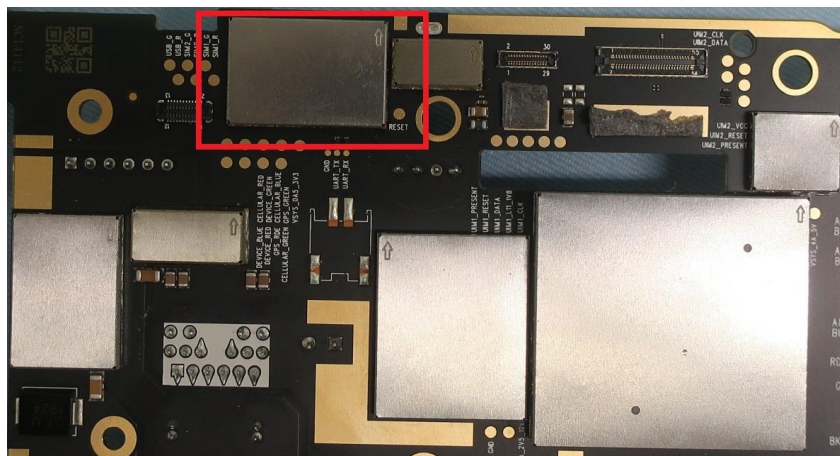
3.10.1 Limit

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

3.10.2 Confirmation Method

☐	Sealed with special screws.
☐	Plastic chassis is being welded using ultrasonic waves.
☐	Chassis is glued using a special adhesive.
☐	Metal covers are spot-fused.
☐	Cover is specially interlocked.
☒	RF and Modulation components are covered with shielding case and this shielding case is soldered.
☐	Shield case is welded at RF and modulation parts, and ID-ROM is welded using the BGA Method.
☐	Shield case is welded at RF and modulation parts, and ID-ROM is glued at its lead with a special adhesive.
☐	Shield case is welded at RF and modulation parts, and ID-ROM is glued with a non-transparent laminating agent.
☐	Other :

3.10.3 The Photos of Construction Protection



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Periods of Test	Due Date	Calibration Body	Calibration Method
Spectrum Analyzer	R&S	FSV30	101338	10Hz~30GHz	Apr. 13, 2021	Jul. 01, 2021~ Jul. 09, 2021	Apr. 12, 2022	CEPREI Calibration and Testing Center	C
Pulse Power Sensor	Anritsu	MA2411B	1339163	300MHz~40GHz	Oct. 27, 2020	Jul. 01, 2021~ Jul. 09, 2021	Oct. 26, 2021	CEPREI Calibration and Testing Center	C
Power Meter	Anritsu	ML2495A	1435004	50MHz Bandwidth	Oct. 27, 2020	Jul. 01, 2021~ Jul. 09, 2021	Oct. 26, 2021	CEPREI Calibration and Testing Center	C
DC Power Supply	GW INSTEK	GPD-2303S	GEO861339	Max 31	Nov. 01, 2020	Jul. 01, 2021~ Jul. 09, 2021	Oct. 31, 2021	CEPREI Calibration and Testing Center	C
Multi-meter	YFE	YF-303	YF-303-01	-	Apr. 13, 2021	Jul. 01, 2021~ Jul. 09, 2021	Apr. 12, 2022	CEPREI Calibration and Testing Center	C

Note: Above test equipment was used and kept valid calibration period during test.

Calibration Method :

a) : Calibration conducted by the National Institute of Information and Communications Technology~
NICT~ or a designated calibration agency under Article 102-18 paragraph

(1) TELEC Engineering Center, Intertek Japan K.K., Keysight Technologies, Inc~.

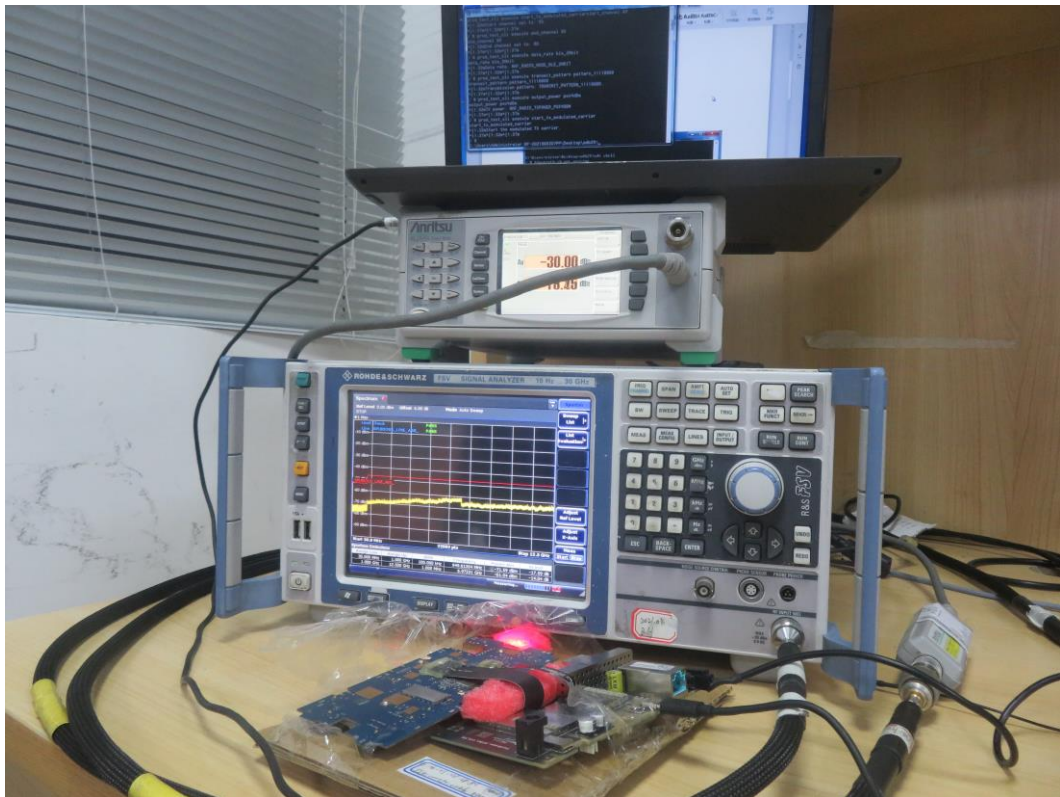
b) : Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992)~Japan Calibration Service System~

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)~ TELEC Engineering Center, Intertek Japan K.K., Keysight Technologies, Inc~.

Appendix A. Setup Photographs

Front View



Near View





Appendix B. Test Results

Please refer to the following pages for test results.

1. TEST RESULTS DATA **BLUETOOTH - LE**

Environment of Test Room	Temperature	21-25 °C
	Humidity	51-55 %
Test Engineer	Albert shi	

Modulatoin Type :	GFSK
Type Emissions :	1M08F1D

Declaration Output Power	1.500	mW
Declaration Output Power	1.76	dBm
Antenna Power (E.I.R.P)	5.76	dBm
Input Power Voltage	24.000	Vdc

Path Loss		6.00	dB
Burst	ON TIME	100.000	msec
	OFF TIME	-Not applicable-	msec
	Ratio	100.00	%
Packet Type (Mode)		Low Energy	mode

Antenna Information:

Antenna Model	Antenna Type	Gain(dBi)
Refer to antenna report	PCB	4.00

1.1. Test Results (Normal Voltage)

Measurement Frequency	MHz	2402	2440	2480	Limit	Result			Note
Channel Number	Ch.	0	19	39		0	19	39	
Reading Frequency	MHz	2401.945	2439.945	2479.945		-----	-----	-----	
Frequency Tolerance	ppm	-22.898	-22.541	-22.177	$-50 \leq x \leq +50$	PASS	PASS	PASS	

Occupied Bandwidth	MHz	1.08	1.08	1.08	26	PASS			
Spreading Bandwidth	MHz	N/A			0.5	N/A			
RF Output Power	mW	1.216	1.146	1.476		-----			
RF Output Power Tolerance	%	-18.92	-23.63	-1.62	$-80 \leq x \leq +20$	PASS			
Output Power (With burst ratio)	dBm	0.85	0.59	1.69		-----			

Unwanted Emission Intensity	Under 2387MHz	μW/MHz	0.05754	0.05236	0.04603	2.5	PASS	PASS	PASS	
		MHz	990.058	900.924	805.195		-----	-----	-----	
	2387MHz - 2400MHz	μW/MHz	0.37068	0.00802	0.00841	25	PASS	PASS	PASS	
		MHz	2400.000	2398.460	2389.980		-----	-----	-----	
	2483.5MHz - 2496.5MHz	μW/MHz	0.00889	0.00904	0.00893	25	PASS	PASS	PASS	
		MHz	2485.650	2489.430	2483.710		-----	-----	-----	
Limitation of Collateral Emission of Receiver	2496.5MHz - 12.5GHz	μW/MHz	0.05433	0.06012	0.05794	2.5	PASS	PASS	PASS	
		MHz	6279.950	6665.040	6456.990		-----	-----	-----	
	Under 1GHz	nW	0.076	0.066	0.069	4	PASS	PASS	PASS	
		MHz	996.169	927.015	949.614		-----	-----	-----	
	1 - 12.5GHz	nW	1.007	0.824	0.787	20	PASS	PASS	PASS	
		MHz	6876.490	6842.950	6972.310		-----	-----	-----	

Spread Factor	-----	N/A			5	N/A			
Dwell Time	mSec	N/A			400	N/A			
Radio Interference Prevention Capability	-----	good				PASS			

2. TEST RESULTS DATA **BLUETOOTH - LE**

Environment of Test Room	Temperature	21-25 °C
	Humidity	51-55 %
Test Engineer	Albert shi	

Modulatoin Type :	GFSK
Type Emissions :	2M10F1D

Declaration Output Power	1.500	mW
Declaration Output Power	1.76	dBm
Antenna Power (E.I.R.P)	5.76	dBm
Input Power Voltage	24.000	Vdc

Path Loss		6.00	dB
Burst	ON TIME	100.000	msec
	OFF TIME	-Not applicable-	msec
	Ratio	100.00	%
Packet Type (Mode)		Low Energy	mode

Antenna Information:

Antenna Model	Antenna Type	Gain(dBi)
Refer to antenna report	PCB	4.00

2.1. Test Results (Normal Voltage)

Measurement Frequency	MHz	2402	2440	2480	Limit	Result			Note
Channel Number	Ch.	0	19	39		0	19	39	
Reading Frequency	MHz	2401.951	2439.951	2479.933		-----	-----	-----	
Frequency Tolerance	ppm	-20.504	-20.164	-26.835	$-50 \leq x \leq +50$	PASS	PASS	PASS	

Occupied Bandwidth	MHz	2.10	2.10	2.10	26	PASS			
Spreading Bandwidth	MHz	N/A			0.5	N/A			
RF Output Power	mW	1.189	1.164	1.459		-----			
RF Output Power Tolerance	%	-20.77	-22.39	-2.75	$-80 \leq x \leq +20$	PASS			
Output Power (With burst ratio)	dBm	0.75	0.66	1.64		-----			

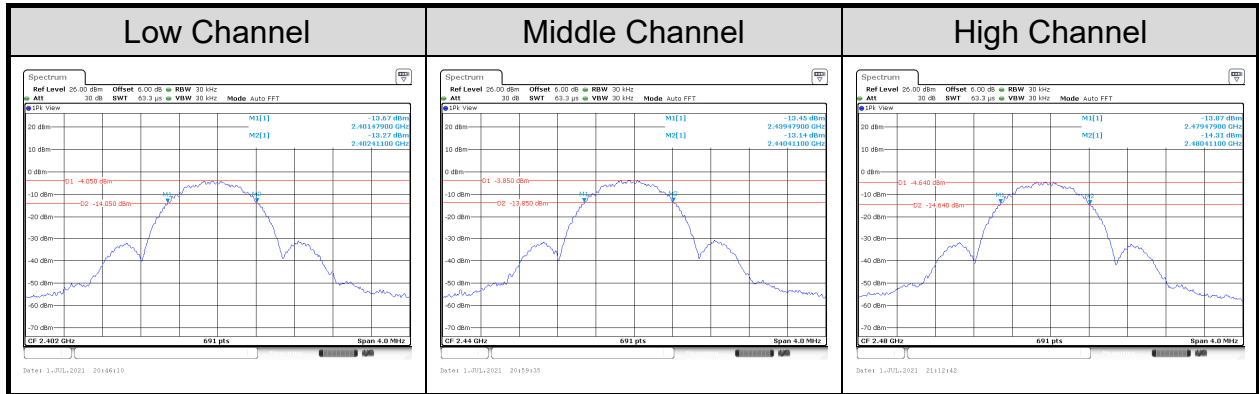
Unwanted Emission Intensity	Under 2387MHz	$\mu\text{W}/\text{MHz}$	0.05395	0.06209	0.05284	2.5	PASS	PASS	PASS	
		MHz	738.854	819.162	849.035		-----	-----	-----	
	2387MHz - 2400MHz	$\mu\text{W}/\text{MHz}$	4.76431	0.00820	0.00832	25	PASS	PASS	PASS	
		MHz	2400.000	2394.880	2391.580		-----	-----	-----	
	2483.5MHz - 2496.5MHz	$\mu\text{W}/\text{MHz}$	0.00891	0.00910	0.01102	25	PASS	PASS	PASS	
		MHz	2492.440	2484.060	2483.540		-----	-----	-----	
Limitation of Collateral Emission of Receiver	2496.5MHz - 12.5GHz	$\mu\text{W}/\text{MHz}$	0.05957	0.06592	0.05794	2.5	PASS	PASS	PASS	
		MHz	6859.090	6833.080	6942.111		-----	-----	-----	
	Under 1GHz	nW	0.078	0.064	0.064	4	PASS	PASS	PASS	
		MHz	996.557	986.761	965.694		-----	-----	-----	
	1 - 12.5GHz	nW	0.942	0.805	0.828	20	PASS	PASS	PASS	
		MHz	6633.090	6803.660	6872.660		-----	-----	-----	

Spread Factor	-----	N/A			5	N/A			
Dwell Time	mSec	N/A			400	N/A			
Radio Interference Prevention Capability	-----	good				PASS			

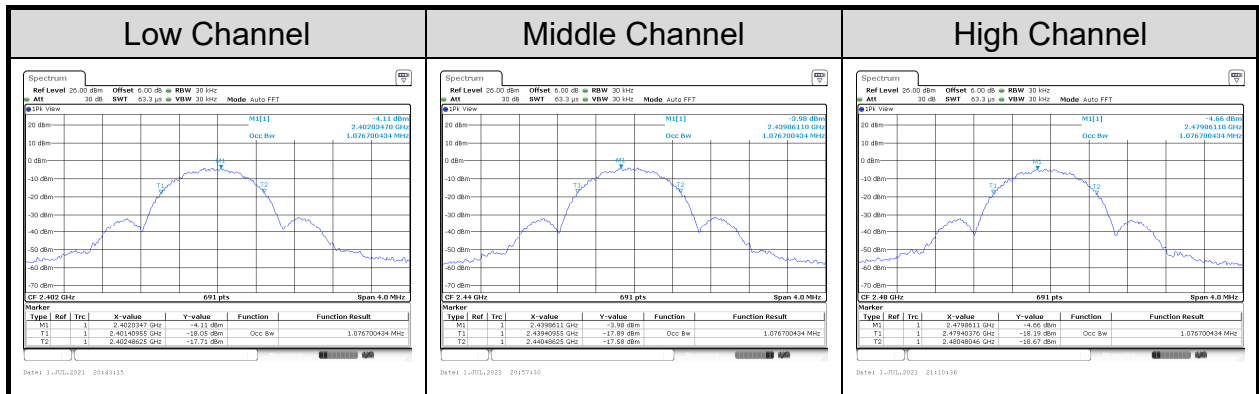
Appendix C. Test Plots

C.1. LE v4.0(Low Energy)

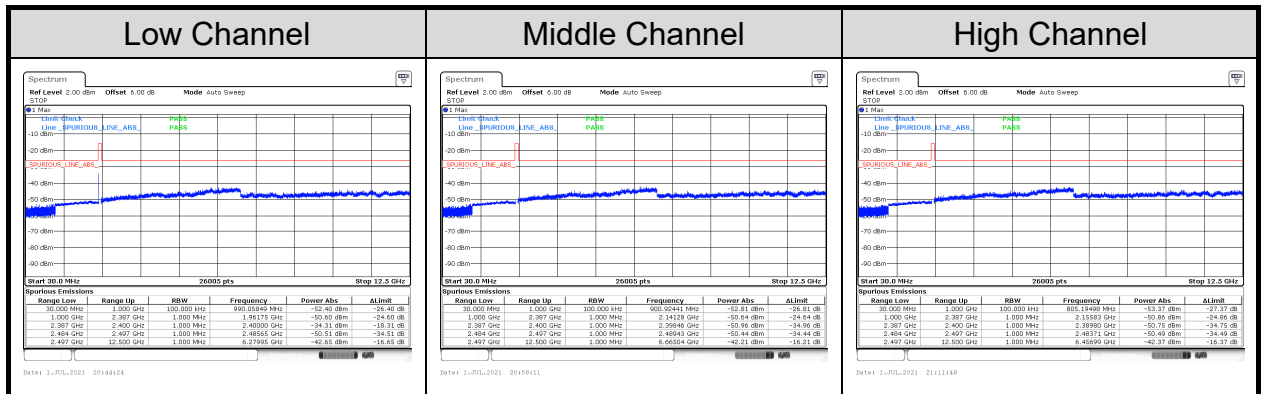
C.1.1. Frequency Tolerance



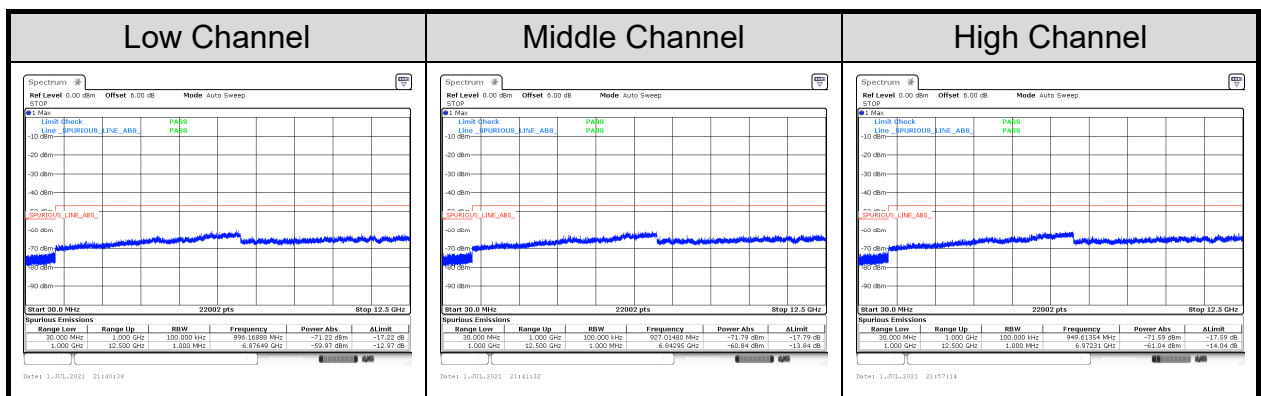
C.1.2. Occupied Bandwidth



C.1.3. Unwanted Emission Intensity

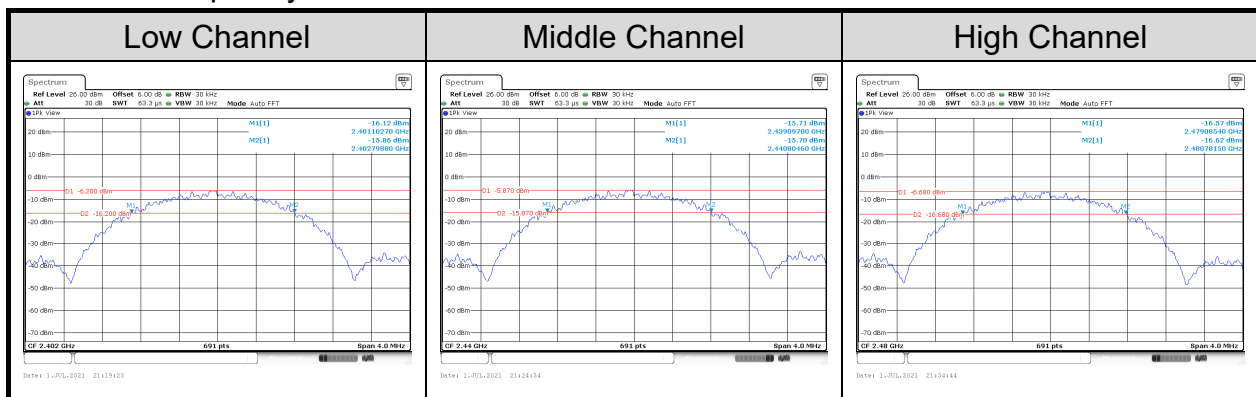


C.1.4. Limitation of Collateral Emission of Receiver

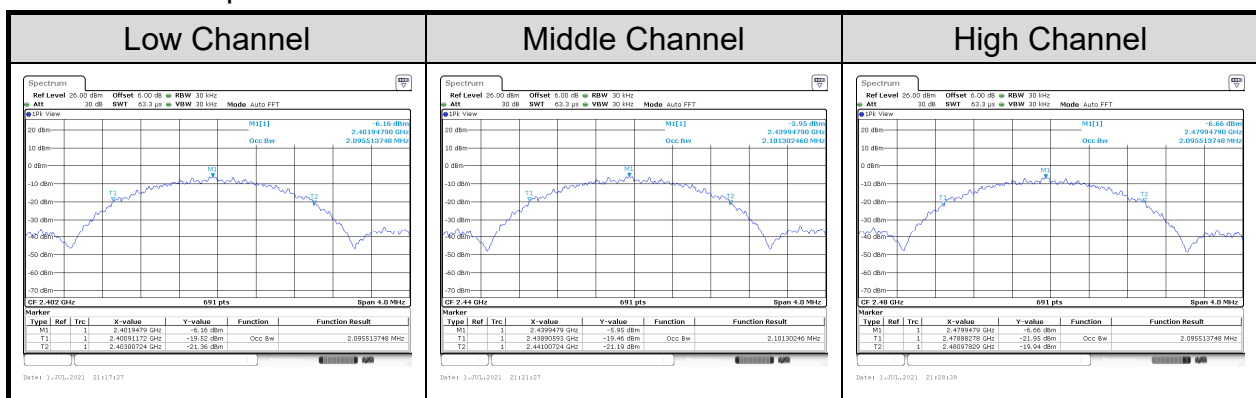


C.2. LE v5.0 (Low Energy)

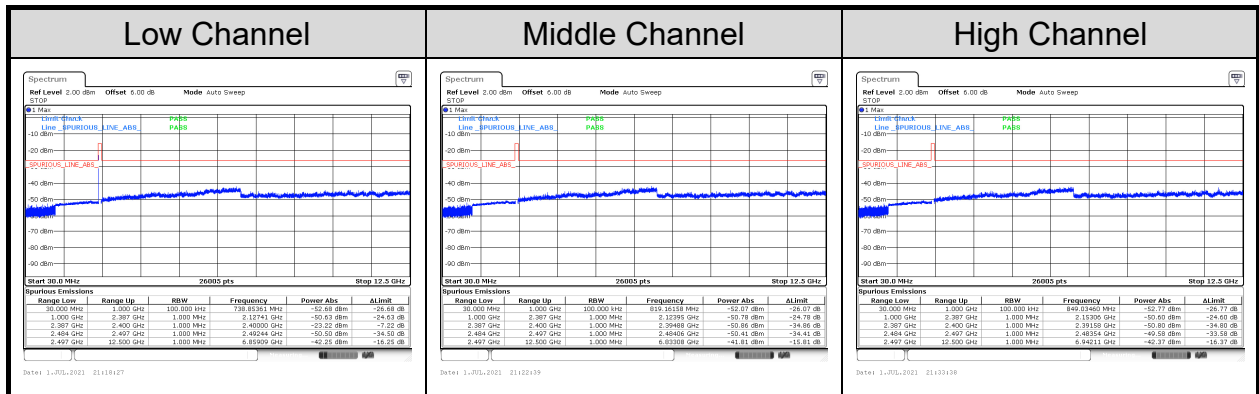
C.2.1. Frequency Tolerance



C.2.2. Occupied Bandwidth



C.2.3. Unwanted Emission Intensity



C.2.4. Limitation of Collateral Emission of Receiver

