

Radio Test Report

Report Number : KR0140-JMIC-2021-0001

Client Name : SENA TECHNOLOGIES,Inc

Client Address : 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea

Receipt Date : 2021-10-19

Test Date : 2021-11-10 ~ 2021-11-11

Test method : MIC notice 88 Appendix 43

Testing Environment : Temperature : (24 ± 2)℃, Humidity : (45 ~ 50) % R.H.

Issued Date : 2021-11-12

Test Results : Refer to the test results

This test report must not be reproduced or reproduced in any way.

The results shown in this test report are the results of testing the samples provided.

This test report is prepared according to the requirements of ISO / IEC 17025.

Tested by Dae-Seong,Choi		Technical Manager Yong-Min, WON	
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November 12, 2021

EMC Labs Co., Ltd.



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1. General Information

1.1 Test center information

Laboratory : EMC Labs Co., Ltd.
Address : 100, Jangjateo-ro, Hobeop-myeon, Icheon-si, Gyeonggi-do,
17396, Korea
Telephone : +82-31-637-8895
Facsimile : +82-0505-116-8895

1.2 Applicant Information

Company name : SENA TECHNOLOGIES.Inc
Address : 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea
Telephone : -
Facsimile : -

2. Information's about Test Item

2.1 Description of the equipment under test

Test item particulars : 50S
Model and/or type reference : SP75
Additional model name : -
Antenna type : Chip Antenna (0.93 dBi)
Date (s) of performance of tests : 2021-10-20 ~ 2021-10-29
Date of receipt of test item : 2021-10-19
Number of channel : 40
EUT Power Source : DC 3.7 V Battery
Type of Modulation : BLE(GFSK)
Note : -

2.2 Tested Frequency

	Low Frequency	Middle Frequency	High Frequency
Frequency(MHz) (BLE)	2402	2440	2480

2.3 Tested Voltage

Test Voltage	Voltage tolerance
3.70 V	-
4.07 V	+10 %
3.33 V	-10 %
Note : All tests are performed at normal voltage and +/-10% voltages.	

3. Test Report

3.1 Test Summary

Applied standard : Radio equipment regulations and ARIB STD-T66		
Test item	Reference: Clause	Results
Frequency Tolerance	STD-T66.3.2	Pass
Occupied Bandwidth (99 %)	STD-T66.3.2	Pass
Spurious Emission Intensity	STD-T66.3.2	Pass
Antenna Power	STD-T66.3.2	Pass
Secondary Radiated Emissions	STD-T66.3.2	Pass
Interference Prevention Function	STD-T66.3.4	Pass

4. Transmitter requirements

4.1 Frequency Tolerance

Test procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. Set the EUT as un-modulated
3. The EUT should be transmitting at low, middle and high channel.
4. Set the spectrum analyzer to below.

Frequency	Operating frequency
Span	150 kHz
RBW	1 kHz
VBW	Auto
Sweep data points	1 001 pts or greater
Sweep time	Auto
Detector mode	Positive peak
Indication mode	Max Hold

5. Find the peak carrier signal and measure its frequency.

Measurement Data : BLE

Measured item	Frequency tolerance		
	Low frequency	Middle frequency	High frequency
Measured value (MHz)	2401.986 189	2439.985 708	2479.986 310
Tolerance (ppm)	-5.75	-5.86	-5.52

Remark

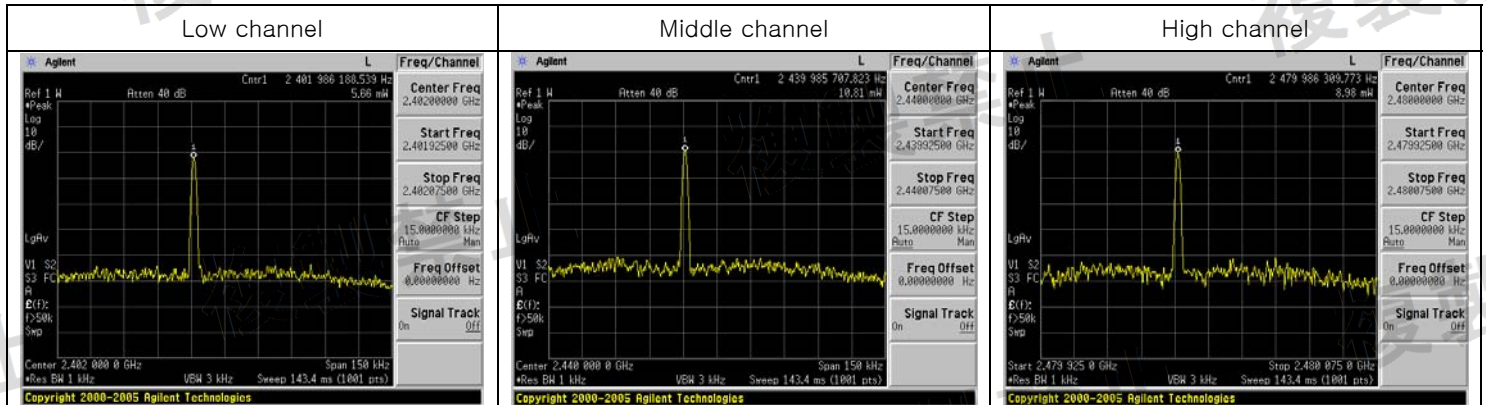
FT (ppm) = [(Measured value(MHz) - Operating frequency(MHz)) / Operating frequency(MHz)] × 10⁶

FT: Frequency Tolerance

Limit :

±50 × 10⁻⁶ (50 ppm or below)

Test Plot : BLE



4.2 Occupied Bandwidth (99 %)

Test procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. Measure the signal bandwidth using a spectrum analyzer.
3. Set the spectrum analyzer to below.

Frequency	Operating frequency
Span	100 MHz
RBW	300 kHz
VBW	Auto
Sweep data points	1 001 pts or greater
Sweep time	Auto
Detector mode	Positive peak
Indication mode	Max Hold
BW setting (Occupied Bandwidth)	99 %

4. Measure the signal bandwidth using a spectrum analyzer.

Measurement Data : BLE

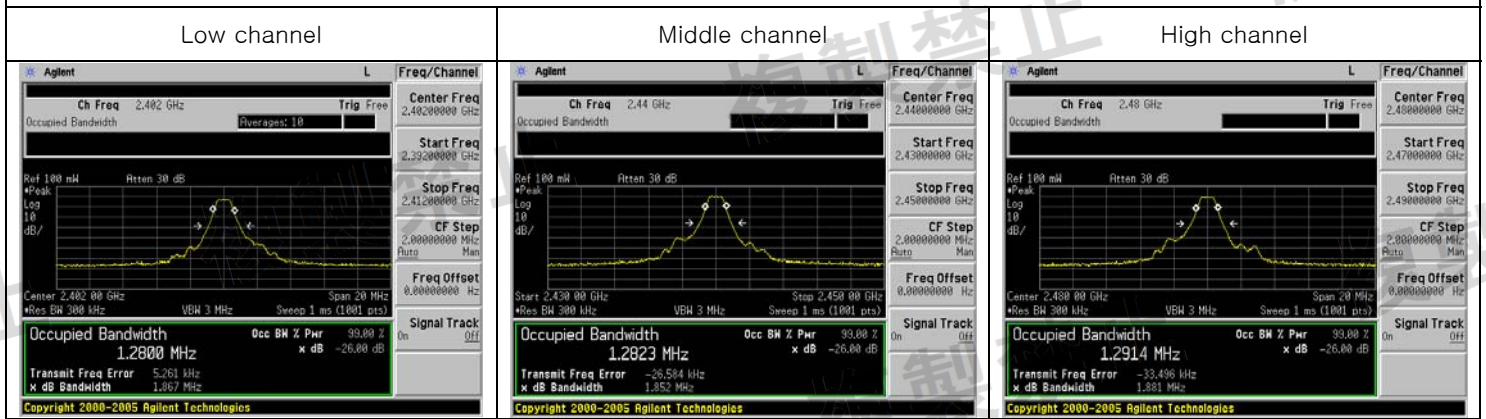
Measured item	Occupied Bandwidth (MHz)		
	Low frequency	Middle frequency	High frequency
Measured value (MHz)	1.28	1.28	1.29

Limit :

Occupied Bandwidth (99%): 26 MHz or below

Test Plot : BLE

Occupied Bandwidth (99 %)



4.3 Spurious Emission Intensity

Test procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. The EUT should be transmitting at low, middle and high channel.
3. Set the spectrum analyzer to below.

Frequency range	30 MHz to 2 387 MHz 2 387 MHz to 2 400 MHz 2 483.5 MHz to 2 496.5 MHz 2 483.5 MHz to 12 500 MHz
RBW	1 MHz
VBW	Auto
Sweep data points	1 001 pts or greater
Sweep time	Auto
Detector mode	Positive peak
Indication mode	Max Hold

Measurement Data : BLE

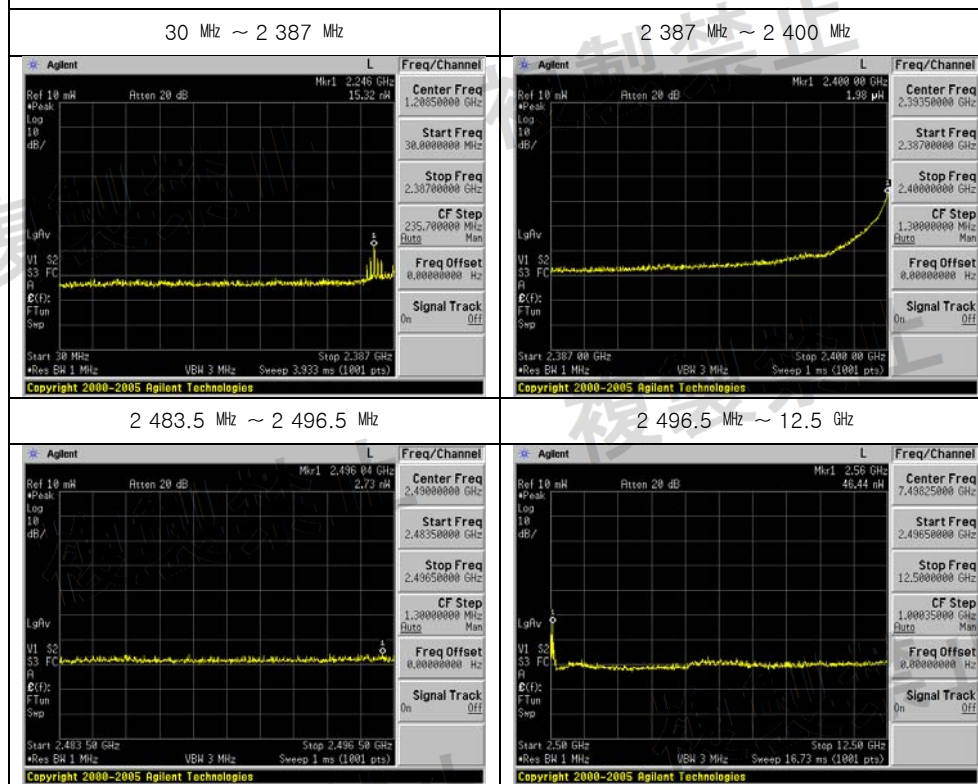
Frequency (MHz)	Test mode		Max emission value			
			Low Frequency	Middle Frequency	High Frequency	
30 MHz ~ 2 387 MHz	Normal Hopping	3.7 V	Value(μW)	0.015	0.028	0.035
			Frequency(MHz)	2 246.00	2 283.00	2 323.00
2 387 MHz ~ 2 400 MHz			Value(μW)	1.980	0.004	0.003
			Frequency(MHz)	2 400.00	2 387.58	2 399.79
2 483.5 MHz ~ 2 496.5 MHz			Value(μW)	0.003	0.004	0.074
			Frequency(MHz)	2 496.04	2 491.68	2 483.50
2 496.5 MHz ~ 12.5 GHz			Value(μW)	0.046	0.018	0.009
			Frequency(MHz)	2 560.00	2 600.00	2 640.00

Limit :

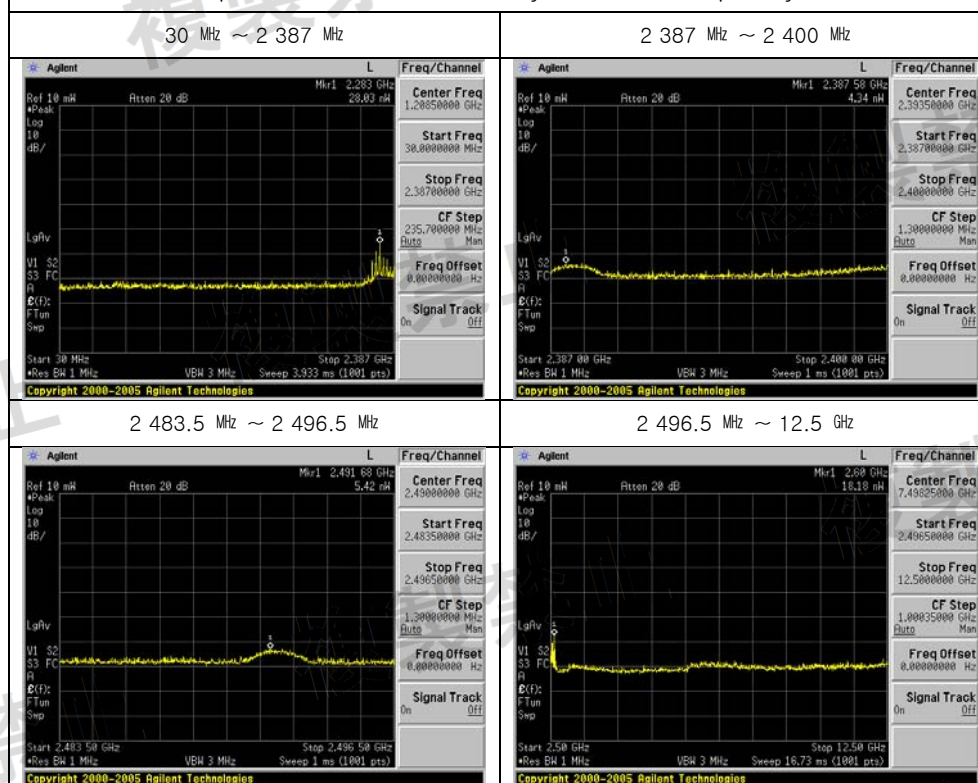
Below 2 387 MHz, Over 2 496.5 MHz : 2.5 μ W/MHz or less
 2 387 MHz to 2 400 MHz, 2 483.5 MHz to 2 496.5 MHz : 25.0 μ W/MHz or less

Test Plot : BLE

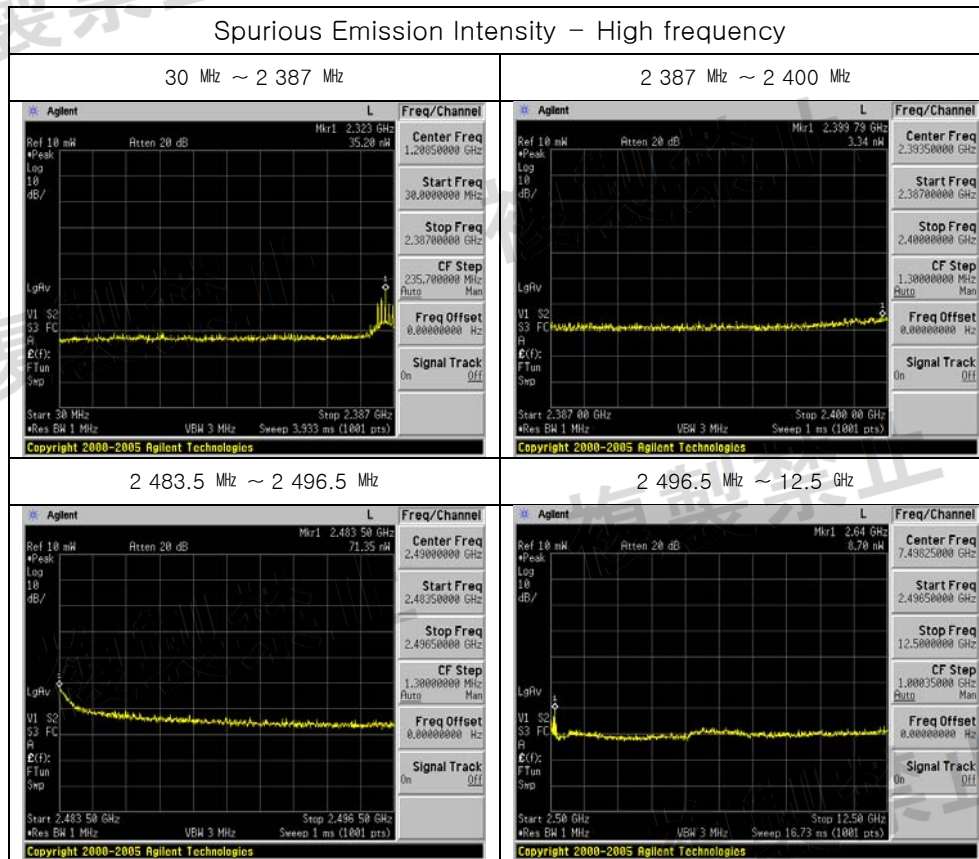
Spurious Emission Intensity – Low frequency



Spurious Emission Intensity – Middle frequency



Spurious Emission Intensity – High frequency



4.4 Antenna Power

Test procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. The EUT should be transmitting at low, middle and high channel.
3. Set the spectrum analyzer to below.

Frequency	2 402, 2 440, 2 480 (MHz)
Span	0 Hz
RBW	1 MHz
VBW	1 MHz
Sweep data points	1 001 pts or greater
Sweep time	1.533 ms
Detector mode	Positive peak
Indication mode	Max Hold

4. Measure the Average Burst Power of the frequency.

Measurement Data : BLE

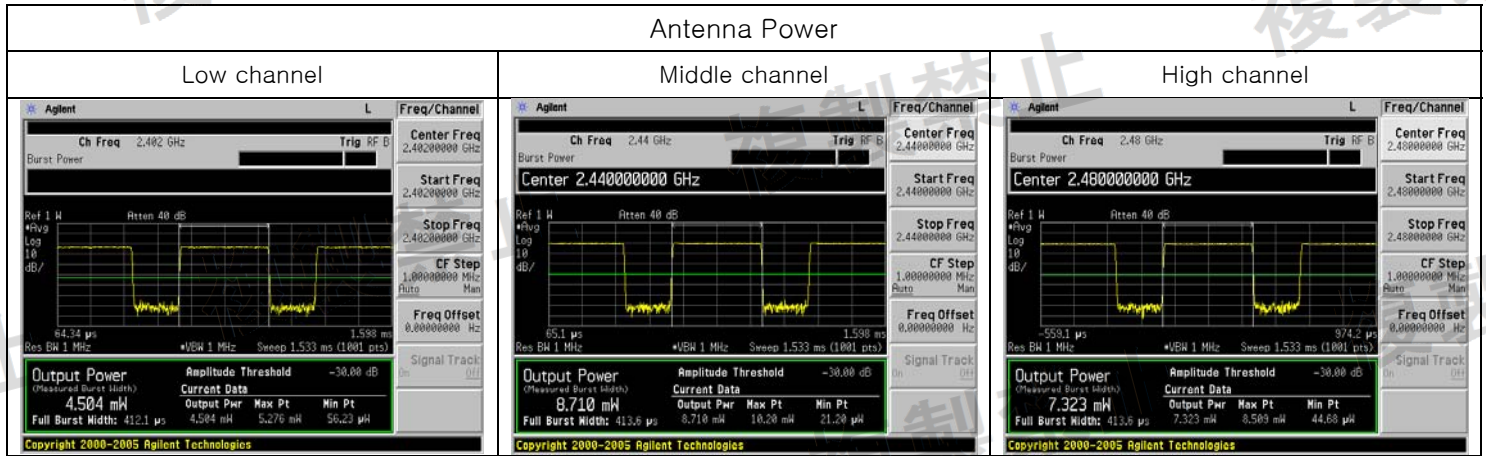
Test mode	Test voltage	Measured item	Antenna power		
			Low Frequency	Middle Frequency	High Frequency
Normal Hopping	3.7 V	Antenna power(mW)	4.504	8.710	7.323
		Power tolerance(%)	-54.96	-12.9	-26.77
Declared power(dBm, mW)			10.0, 10.0		
Antenna gain(dBi)			0.44		
E.I.R.P(dBm)			10.93		

Limit :

Output power: 10 mW or Below

Output power tolerance: Maximum +20 %, Minimum -80 %

Test Plot : BLE



4.5 Receiving equipment

Test procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. The EUT should be receiver at low, middle and high channel
3. Set the spectrum analyzer to below.

Frequency range	30 MHz~12.5 GHz
RBW	Below 1 GHz 100 kHz Above 1 GHz 1 MHz
VBW	Below 1 GHz 100 kHz Above 1 GHz 1 MHz
Sweep data points	1 001 pts or greater
Sweep time	Auto
Detector mode	Positive peak
Indication mode	Max Hold

4. Search for spurious emissions from 30 MHz to 12.5 GHz

Measurement Data : BLE

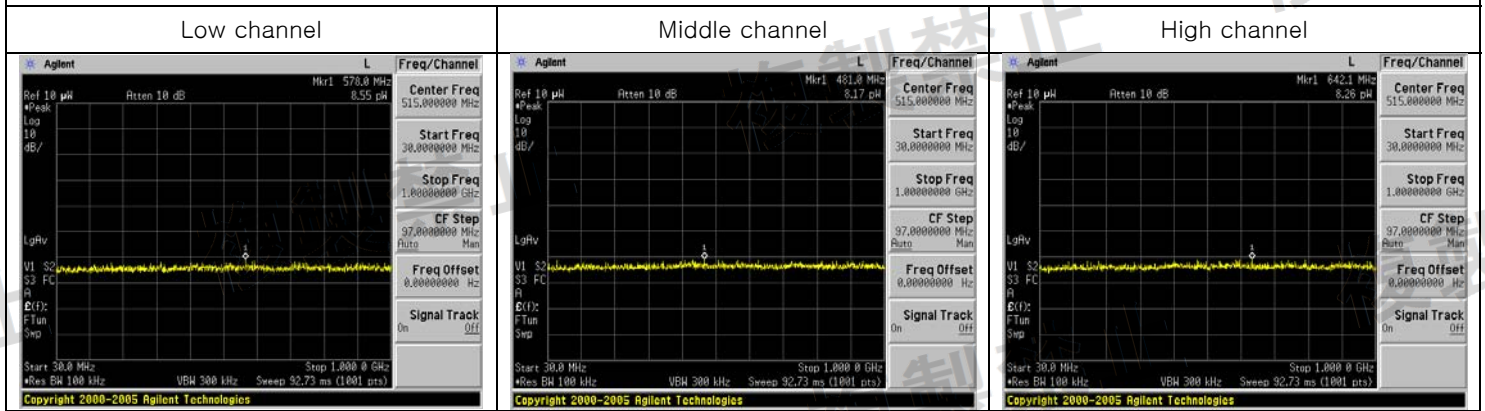
Frequency (MHz)	Test mode		Max emission value		
			Low Frequency	Middle Frequency	High Frequency
30 MHz ~ 1 000 MHz	3.7 V	Value(nW)	0.009	0.008	0.008
		Frequency(MHz)	578.00	481.00	642.10
1 000 MHz ~ 12.5 GHz		Value(nW)	0.162	0.172	0.178
		Frequency(MHz)	12 3000.00	7 350.00	7 750.00

Limit :

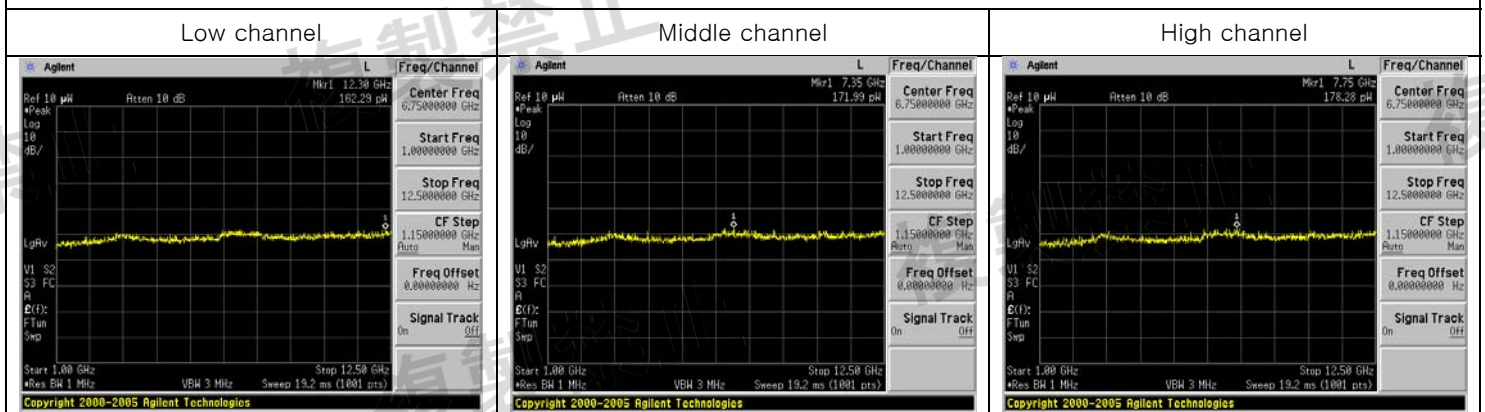
Below 1 GHz : 4 nW or less
Above 1 GHz : 20 nW or less

Test Plot : BLE

Receiving equipment – 30 MHz ~ 1 000 MHz



Receiving equipment – 1 000 MHz ~ 12.5 MHz



4.6 Interference Prevention Function

Measurement Data : BLE

Low frequency	Middle frequency	High frequency
Pass	Pass	Pass

Limit :

Radio equipment used mainly on the same premises and automatically transmits or receives identification code

5. Equipment used for tests.

	Equipment	Manufacturer	Model No.	Serial No.	Next Cal. Date	Cal. Method
1	EPM SERIES POWER METER	AGILENT	E4419B	MY41291980	2022.05.14	c)
2	E-SERIES AVG POWER SENSOR	H.P	E9301A	US39210340	2022.05.14	c)
3	E-SERIES AVG POWER SENSOR	AGILENT	E9301A	US39212396	2022.05.14	c)
4	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW44	101952	2022.04.09	c)
5	TEMP & HUMID CHAMBER	JFM Engineering	JFMA-001	20200929-01	2021.12.18	c)
6	CONTROLLER	SAMWON TECHNOLOGY	TEMI2500	S7800VK191 0707	2021.12.18	c)
7	PSA SERIES SPECTRUM ANALYZER	AGILENT	E4440A	MY45304057	2021.12.15	c)
8	MXG ANALOG SIGNAL GENERATOR	AGILENT	N5183A	MY50141890	2021.12.15	c)
9	SYSTEM DC POWER SUPPLY	AGILENT	6674A	MY53000118	2021.12.16	c)
10	VECTOR SIGNAL GENERATOR	ROHDE & SCHWARZ	SMBV100A	257524	2021.12.15	c)
11	BLUETOOTH TESTER	TESCOM	TC-3000A	3000A480088	2021.12.15	c)
12	DIRECTIONAL COUPLER	AGILENT	773D	2839A01855	2021.12.15	c)
13	ATTENUATOR	AGILENT	8493C	73193	2021.12.15	c)
14	TERMINATION	HEWLETT PACKARD	909D	07492	2021.12.15	c)
15	POWER DIVIDER	HEWLETT PACKARD	11636A	06916	2021.12.15	c)
16	SLIDE-AC	DAEKWANG T&M CO.,LTD.	SV-1023	-	-	-
17	DIGITAL MULTIMETER	humantechstore	15B+	50561541WS	2021.12.15	c)
18	Temperature and Humidity Datalogger	CEM	DT-172	201000251	2022.01.14	c)
19	DFS MASTER DEVICE	NETGEAR	RAX50	6AJ10B7RA007E	-	-
20	DFS SLAVE DEVICE	ipTIME	A1000U	A1000U 09BC02862	-	-
21	ATTENUATOR	ACE RF COM	ATT SMA 20W 20dB 8G	A-0820.SM20.2	2022.04.15	c)
22	TERMINATION	ACE RF COM	TERM SMA F 20W 8G	A-0008.SM20.2	2022.04.15	c)
23	ATTENUATOR	ACE RF COM	ATT 2.92 2W 20dB 40G	A-4020.2902.1	2022.04.15	c)

24	ATTENUATOR	ACE RF COM	ATT 2.92 2W 20dB 40G	A-4020.2902.1	2022.04.15	c)
25	ATTENUATOR	ACE RF COM	ATT 2.92 2W 20dB 40G	A-4020.2902.1	2022.04.15	c)
26	TERMINATION	ACE RF COM	TERM 2.92 F 2W 40G	A-0040.2920.2	2022.04.15	c)
27	TERMINATION	ACE RF COM	TERM 2.92 F 2W 40G	A-0040.2920.2	2022.04.15	c)
28	TERMINATION	ACE RF COM	TERM 2.92 F 2W 40G	A-0040.2920.2	2022.04.15	c)

※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) (HCT CO.,LTD.)