



243 Jubug-Ri, Yangji-Myeon, Yongin-Si, Gyeonggi-Do, Korea 17159

Tel: +82-31-444-7270 Fax: +82-31-444-7271

<http://www.ltalab.com>

Dates of Tests: Dec 17, 2020 ~ Jan 25, 2021

Test Report S/N: LR500172102E

Test Site : LTA CO., LTD.

JAPAN MIC Test Report

Equipment Under Test	Wearable Haptic Vest
Model Name	BHTV40D000
Serial Number	N/A
Applicant	bHaptics Inc.
Manufacturer	bHaptics Inc.
Date of Test(s)	Dec 17, 2020 ~ Jan 25, 2021
Date of Issue	February 03, 2021

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

In the configuration tested, the EUT complied with the standards specified above.

Issue to	Issue by
bHaptics Inc. Bldg 3-Unit 503, 70, Yuseong-daero 1689beon-gil, Yuseong-gu, Daejeon, Republic of Korea Tel: +82-42-867-2468 Fax: +82- 42-867-2467	LTA 243 Jubug-Ri, Yangji-Myeon, Yongin-Si, Gyeonggi-Do, Korea 17159 Tel: +82-31-444-7270 Fax: +82-31-444-7271

This test report is issued under the authority of:

JaBeom.Koo

Ja-Beom Koo, Manager

The test was supervised by:

Eun-Hwan Jung

Eun-Hwan Jung, Test Engineer

Revision history

Revision	Date of issue	Description	Revised by
--	Feb 03, 2021	Initial	-

TABLE OF CONTENTS

1.	Applicant Information-----	4
2.	Summary of test results-----	5
3.	Frequency tolerance-----	6
4.	Occupied bandwidth (99%) & Spread Bandwidth (90%)-----	8
5.	Antenna power-----	11
6.	Unwanted emission strength-----	13
7.	RX spurious emission-----	19
8.	Interference prevention function-----	21
9.	CONSTRUCTION PROTECTION CONFIRMATION METHOD-----	22
APPENDIX	-----	23
APPENDIX	TEST EQUIPMENT USED FOR TESTS-----	23

1. Applicant Information

1.1. Details of applicant

Applicant : bHaptics Inc.
 Address : Bldg 3-Unit 503, 70, Yuseong-daero 1689beon-gil, Yuseong-gu,
 Daejeon, Republic of Korea
 TEL / FAX : +82-42-867-2468 / +82- 42-867-2467

1.2. Manufacturer Information

Manufacturer : bHaptics Inc.
 Address : Bldg 3-Unit 503, 70, Yuseong-daero 1689beon-gil, Yuseong-gu, Daejeon,
 Republic of Korea

1.3. EUT Description

Kind of product	Wearable Haptic Vest
Model name	BHTV40D000
Serial Number	N/A
Power supply	DC 3.63 V
Frequency range	2 402 MHz ~ 2 480 MHz (Bluetooth LE)
RF output power	0.00007 W
Moduleation technique	GFSK
Number of channels	LE : 40 ch.
Antenna gain	1.3 dBi (Max)

2. Summary of Test results

The EUT has been tested according to the following specifications

Section in Radio equipment regulations	Description of Test	Results
RE 5 Table No. 1	Frequency Tolerance	C
RE 6 Table No. 2	Occupied Bandwidth (99%) & Spread Bandwidth (90%)	C
RE 14, RE 49.20	Antenna power	C
RE 7	Unwanted emission strength	C
RE 24	RX spurious emission	C
RE 11	Dwell Time	C
RLE 6-2, RE 9-4	Interference Prevention Function	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Standard: Article 2, Paragraph 1, item 19.

3 Frequency tolerance

3.1 Test setup



3.2 Limit

$\pm 50 \times 10^{-6}$ (50 ppm or below)

3.3 Test procedure

The transmitter output is connected to the Spectrum analyzer	
Setting the spectrum analyzer is as follows.	
Center frequency	Operating frequency
Resolution BW	10 KHz
Video BW	10 KHz
Span	1 MHz
Sweep time	Auto
Detector mode	Positive peak
Trace mode	Max. hold

3.4 Test results

Ambient temperature: 24 °C Relative humidity: 50% R.H

Test mode : LE

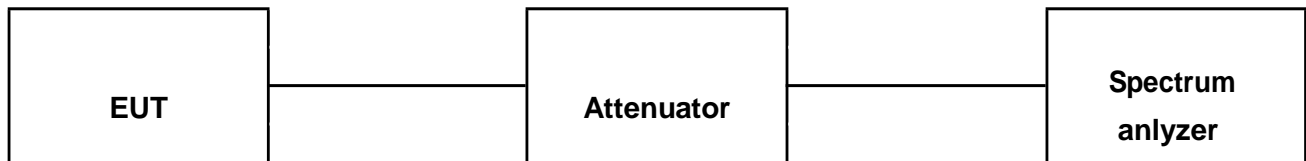
Test voltage	Test voltage (DC)	Measured value (MHz)	Tolerance (ppm)	Result	Limit
Normal Voltage	Low frequency	2,401.97580	-10.07	Pass	± 50 ppm
	Middle frequency	2,442.00001	0.00	Pass	
	High frequency	2,479.96994	-12.12	Pass	
Low Voltage	Low frequency	2,401.97610	-9.95	Pass	
	Middle frequency	2,441.97540	-10.07	Pass	
	High frequency	2,479.97950	-8.27	Pass	
High Voltage	Low frequency	2,401.98875	-4.68	Pass	
	Middle frequency	2,441.97801	-9.00	Pass	
	High frequency	2,479.97669	-9.40	Pass	

*** Remark**

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

4. Occupied bandwidth (99%) & Spread Bandwidth (90%)

4.1 Test setup



4.2 Limit

LE

Occupied Bandwidth (99%):	26 MHz or less
Spread Bandwidth (90%)	500 kHz more

4.3 Test procedure

The transmitter output is connected to the Spectrum analyzer	
Setting the spectrum analyzer is as follows.	
Center frequency	Operating frequency
Resolution BW	300 KHz
Video BW	300 KHz
Span	5 MHz
Sweep time	Auto
Detector mode	Positive peak
Trace mode	Max. hold

4.4 Test results

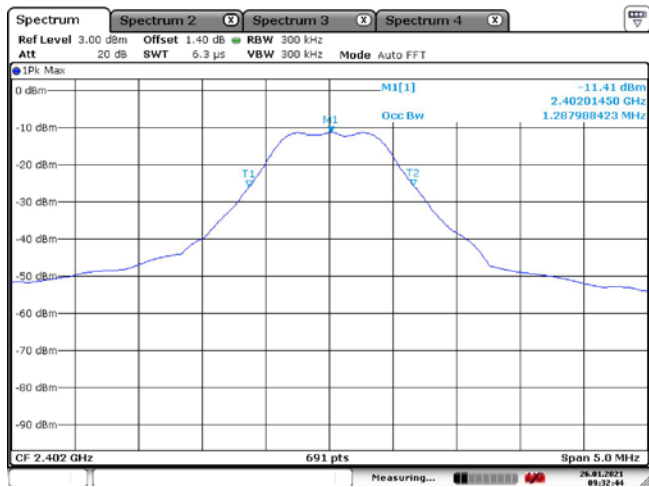
Ambient temperature: 24 °C Relative humidity: 50% R.H.

Test mode : LE

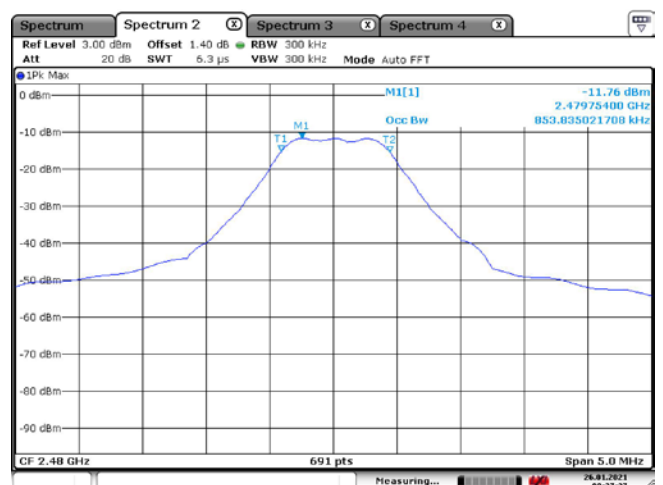
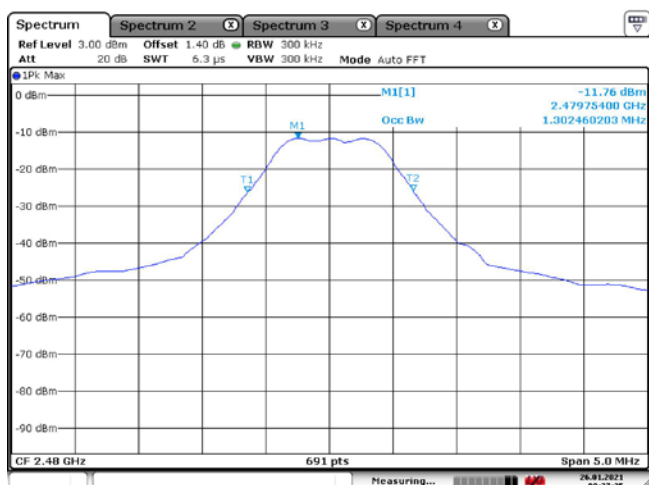
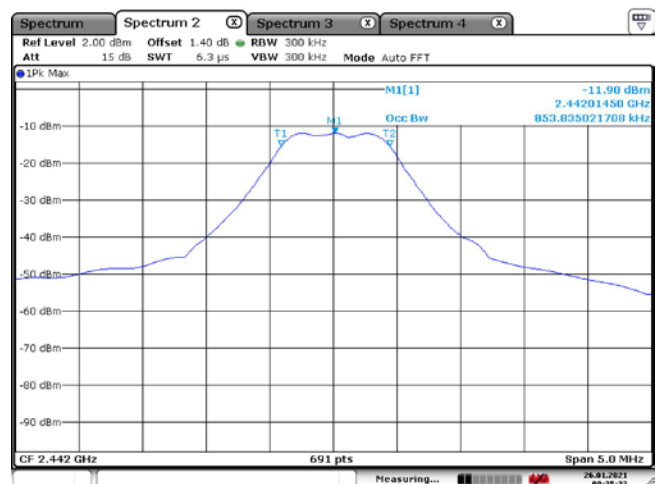
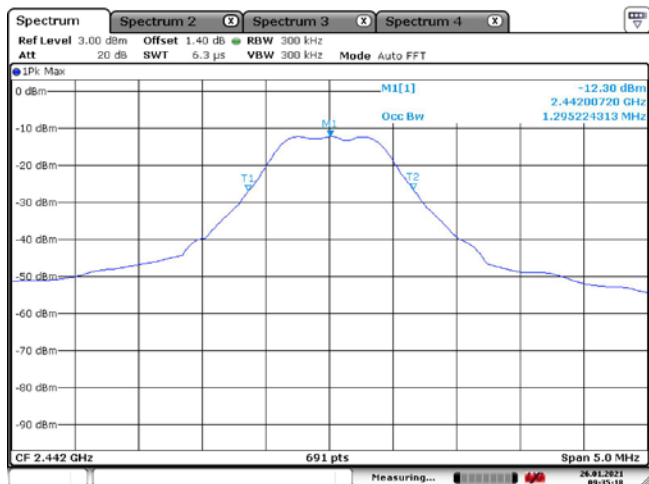
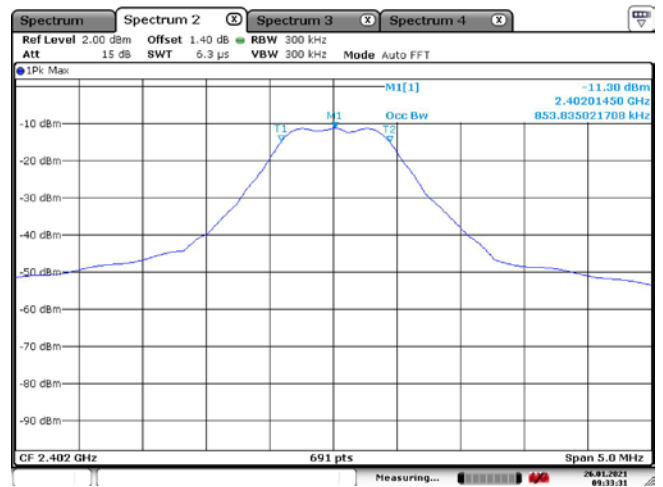
Test voltage	2,402 MHz	2,442 MHz	2,480 MHz	Result	Limit
	99% (MHz)	99% (MHz)	99% (MHz)		
High Voltage	1.30	1.30	1.30	Pass	26 MHz or less
Normal Voltage	1.29	1.30	1.30	Pass	
Low Voltage	1.30	1.30	1.30	Pass	
Test	90% (MHz)	90% (MHz)	90% (MHz)		
High Voltage	0.854	0.854	0.854	Pass	500 kHz or more
Normal Voltage	0.854	0.854	0.854	Pass	
Low Voltage	0.854	0.854	0.854	Pass	

Test Mode : LE / CH01,CH20,CH40 (Nomal Voltage)

99 % OBW



90 % OBW



5. Antenna power

5.1 Test setup



5.2 Limit

Output power: 0.01 W or Below

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

5.3 Test procedure

1. The transmitter output is connected to the Power meter
2. Setting the EUT is operating frequency.

5.4 Test resultsAmbient temperature: 24℃ Relative humidity: 50% R.H.

Test mode : LE

Result : Pass

Test voltage (DC)	Frequency (MHz)	Measure value	Power tolerance(%)
		(mW)	
Low Voltage	2 402	0.08	17.29
	2 442	0.08	13.19
	2 480	0.08	17.95
Normal Voltage	2 402	0.07	5.90
	2 442	0.07	3.97
	2 480	0.07	4.45
High Voltage	2 402	0.07	6.05
	2 442	0.08	13.99
	2 480	0.08	9.86
Declared power(mW)		0.07 (0.014 ~ 0.084)	
Antenna gain(dBi)		1.3 dBi	
Limit		-80 ~ 20 %	

Remark: Power tolerance (%) = {[Output power- Declared power] ÷ Declared power} ×100

6. Unwanted emission strength

6.1 Test setup



6.2 Limit

Spurious Emission / Unwanted Emission Strength, Spurious area	<p>30MHz - 2387MHz ; 2.5μW/MHz or less</p> <p>2387MHz - 2400MHz ; 25μW/MHz or less</p> <p>2483.5MHz - 2496.5MHz ; 25μW/MHz or less</p> <p>2496.5MHz - 12.5GHz ; 2.5μW/MHz or less</p>
---	---

6.3 Test procedure

1. Connect transmitter output to the spectrum analyzer input port.
2. The EUT should be transmitting at hopping mode
3. Unwanted emission strength is measured by following setting:
4. Set the spectrum analyzer RBW: 1 MHz, VBW: same as RBW
Sweep time : auto, Start : 30 MHz, Stop : 2387 MHz. Sweep mode: single and mark highest level.
5. Set the spectrum analyzer RBW: 1 MHz, VBW: 1 MHz, Sweep time: auto, Start: 2 387 MHz, Stop: 2 400 MHz. Sweep mode: single and mark highest level.
6. Set the spectrum analyzer RBW: 1 MHz, VBW: 1 MHz, Sweep time: auto, Start: 2 483.5 MHz, Stop: 2 496.5 MHz Sweep mode: single and mark highest level.
7. Set the spectrum analyzer RBW: 1 MHz, VBW: 1 MHz, Sweep time: auto, Start: 2 496.5 MHz, Stop: 12.5 GHz. Sweep mode: single and mark highest level.
8. Detector mode: Peak mode.

6.4 Test results

Ambient temperature: 24°C Relative humidity: 50% R.H.

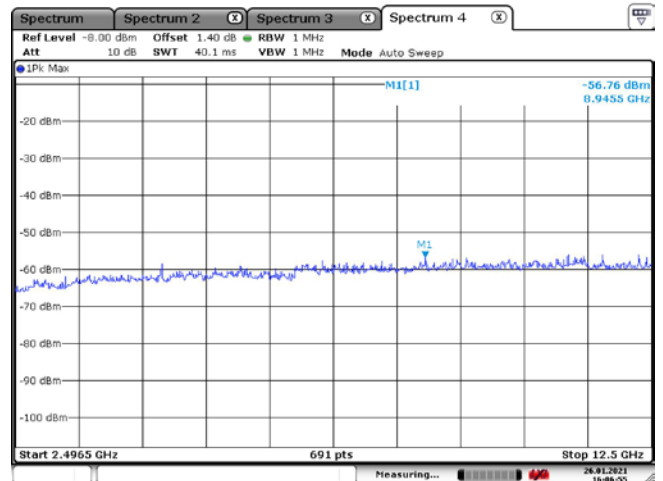
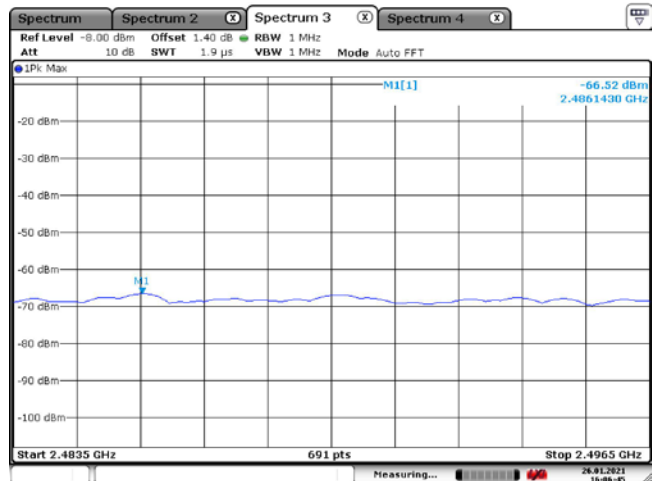
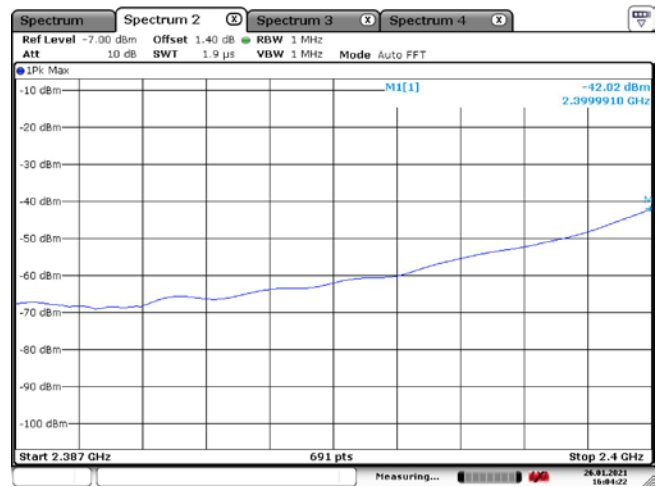
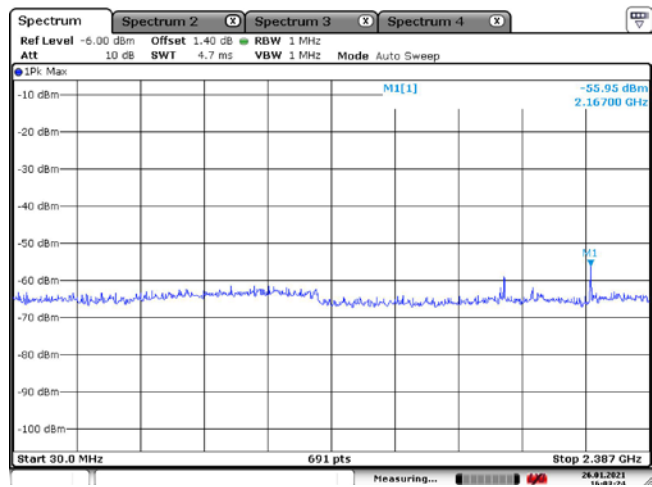
Result : Pass

mode : LE

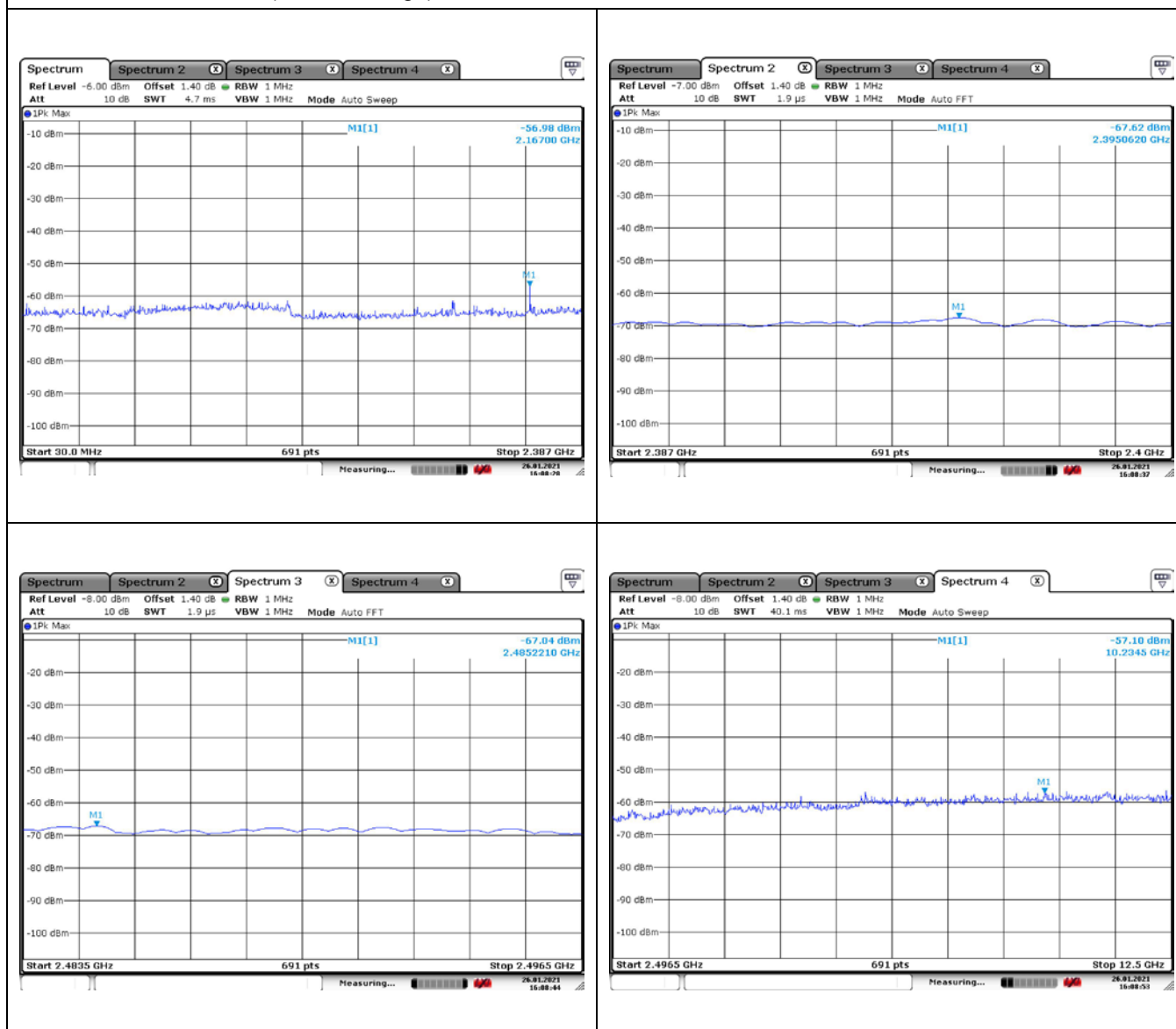
Voltage	Frequency	Frequency Range	Result			Limit
V	MHz	MHz	MHz	dBm	uW	uW
-10 % Low Voltage	2402	30 ~ 2387	2167.44	-55.75	0.0027	2.5
		2387 ~ 2400	2400.55	-41.80	0.0660	25
		2483.5 ~ 2496.5	2486.70	-66.30	0.0002	25
		2496.5 ~ 12500	8945.68	-56.67	0.0022	2.5
	2442	30 ~ 2387	2167.29	-56.87	0.0021	2.5
		2387 ~ 2400	2395.19	-67.49	0.0002	25
		2483.5 ~ 2496.5	2485.35	-66.91	0.0002	25
		2496.5 ~ 12500	10234.66	-56.97	0.0020	2.5
	2480	30 ~ 2387	1833.13	-60.16	0.0010	2.5
		2387 ~ 2400	2394.88	-67.37	0.0002	25
		2483.5 ~ 2496.5	2483.99	-60.43	0.0009	25
		2496.5 ~ 12500	11364.10	-55.13	0.0031	2.5
0 % Nomal Voltage	2402	30 ~ 2387	2167.000	-55.95	0.0025	2.5
		2387 ~ 2400	2399.991	-42.02	0.0628	25
		2483.5 ~ 2496.5	2486.143	-66.52	0.0002	25
		2496.5 ~ 12500	8945.500	-56.76	0.0021	2.5
	2442	30 ~ 2387	2167.000	-56.98	0.0020	2.5
		2387 ~ 2400	2395.062	-67.62	0.0002	25
		2483.5 ~ 2496.5	2485.221	-67.04	0.0002	25
		2496.5 ~ 12500	10234.500	-57.10	0.0019	2.5
	2480	30 ~ 2387	1832.700	-60.24	0.0009	2.5
		2387 ~ 2400	2394.403	-67.51	0.0002	25
		2483.5 ~ 2496.5	2483.509	-60.57	0.0009	25
		2496.5 ~ 12500	11363.500	-55.21	0.0030	2.5

+10 % High Voltage	2402	30 ~ 2387	2167.33	-55.87	0.0026	2.5
		2387 ~ 2400	2399.99	-42.02	0.0628	25
		2483.5 ~ 2496.5	2486.61	-66.42	0.0002	25
		2496.5 ~ 12500	8946.06	-56.69	0.0021	2.5
	2442	30 ~ 2387	2167.49	-56.89	0.0020	2.5
		2387 ~ 2400	2395.06	-67.62	0.0002	25
		2483.5 ~ 2496.5	2485.57	-66.89	0.0002	25
		2496.5 ~ 12500	10234.78	-56.94	0.0020	2.5
	2480	30 ~ 2387	1833.03	-60.11	0.0010	2.5
		2387 ~ 2400	2394.40	-67.51	0.0002	25
		2483.5 ~ 2496.5	2483.77	-60.47	0.0009	25
		2496.5 ~ 12500	11363.98	-55.02	0.0031	2.5

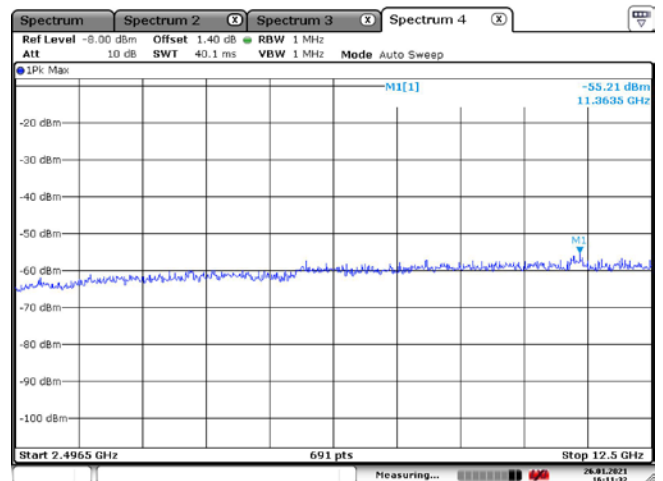
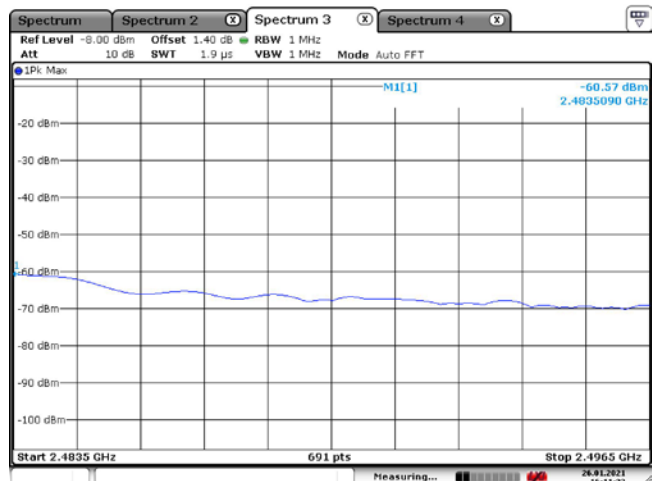
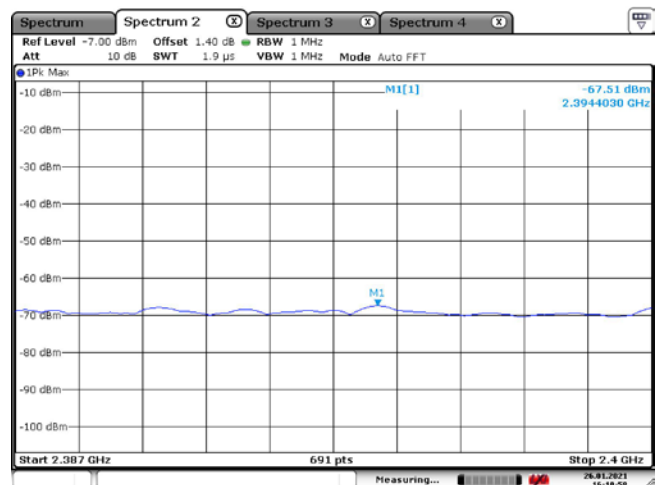
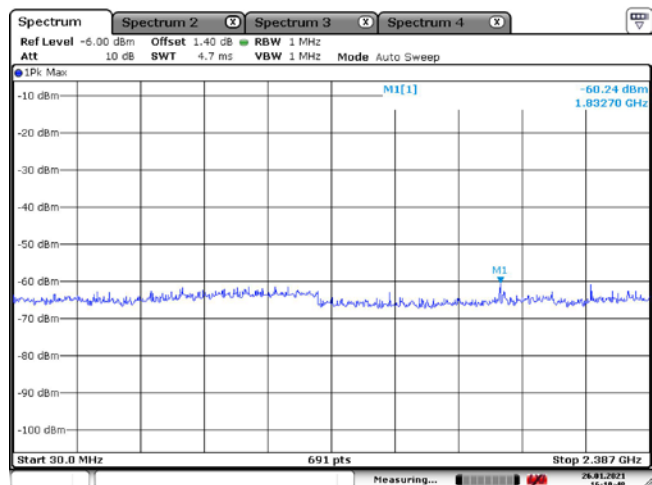
Test Mode :LE / CH1 (Nomal Voltage)



Test Mode :LE / CH20 (Nomal Voltage)



Test Mode :LE / CH40 (Nomal Voltage)



7. RX spurious emission

7.1 Test setup



7.2 Limit

Below 1 GHz: 4 nW (- 55 dBm) or less

Above 1 GHz: 20 nW (- 48 dBm) or less

7.3 Test procedure

1. Connecy transmitter output to the sppectrum analyzer input port
2. The EUT should be transmitting at low, middle and high channel.
3. RX spurious emission is measured by following setting:
4. Set the spectrum analyzer RBW: 100 kHz, VBW: 100 kHz, Sweep: Auto, Start: 30 MHz, Stop: 1 000 MHz
Max hold view, mark highest level.
5. Set the spectrum analyzer RBW: 1 MHz, VBW: 1 MHz, Sweep: Auto, Start: 1 000 MHz, Stop: 12.5 GHz.
Max hold view, mark highest level.
6. Detector mode: Peak mode

7.4 Test resultsAmbient temperature: 24℃ Relative humidity: 50% R.H

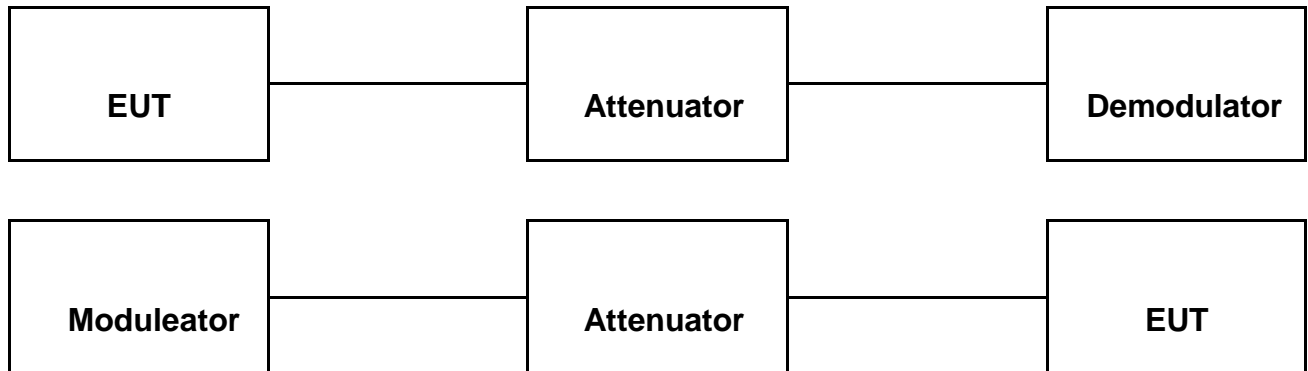
Test mode : LE

Result : Pass

Voltage	Measurement Frequency	Frequency Range	Result			Limit
V	MHz	MHz	MHz	dBm	nW	nW
-10 % Low Voltage	2402	30 ~ 1000	952.40	-74.66	0.000034	4
		1000 ~ 12750	1842.11	-67.59	0.000174	20
	2442	30 ~ 1000	953.41	-71.09	0.000078	4
		1000 ~ 12750	2460.66	-69.08	0.000124	20
	2480	30 ~ 1000	913.01	-80.22	0.000010	4
		1000 ~ 12750	2461.21	-70.17	0.000096	20
0 % Nomal Voltage	2402	30 ~ 1000	951.801	-74.78	0.000033	4
		1000 ~ 12750	1841.752	-67.71	0.000169	20
	2442	30 ~ 1000	952.286	-71.32	0.000074	4
		1000 ~ 12750	2460.281	-69.15	0.000122	20
	2480	30 ~ 1000	912.353	-80.45	0.000009	4
		1000 ~ 12750	2460.819	-70.28	0.000094	20
+10 % High Voltage	2402	30 ~ 1000	952.18	-74.69	0.000034	4
		1000 ~ 12750	1842.31	-67.57	0.000175	20
	2442	30 ~ 1000	953.38	-71.09	0.000078	4
		1000 ~ 12750	2460.97	-68.95	0.000127	20
	2480	30 ~ 1000	912.93	-80.33	0.000009	4
		1000 ~ 12750	2461.07	-70.10	0.000098	20

8 Interference prevention function

8.1 Test Setup



8.2 Limit

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

8.3 Test results

Ambient temperature: 24℃ Relative humidity: 50% R.H.

Test Power:	Normal Voltage
Test Mode:	LE
Test Result:	Good (identification code: [C1:F2:C3:2E:B3:C3] 48 bit

9. CONSTRUCTION PROTECTION CONFIRMATION METHOD

9.1 Limit

(See Article 49-20, Item1-a of the Ordinance Regulating Radio Equipment)

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

9.2 CONFIRMATION METHOD

The RF and modulation portions are protected against illegal modification as following method:

Tick the appropriate box	
	1. Sealed with special screws.
	2. Plastic chassis is being welded using ultrasonic waves.
	3. Chassis is glued using a special adhesive.
	4. Metal covers are spot-fused.
X	5. Cover is specially interlocked.
	6. RF and Modulation components are covered with shielding case and this shielding case is soldered.
	7. Shield case is welded at RF and modulation parts, and ID-ROM is welded using the BGA Method.
	8. Shield case is welded at RF and modulation parts, and ID-ROM is glued at its lead with a special adhesive
	9. Shield case is welded at RF and modulation parts, and ID-ROM is guled with a non-transparent laminating agent.
X	10. RF and Modulation parts are mounted on PCB with surface mount technology, and there is no any adjustable part on PCB or adjustable parts are not exposed.

APPENDIX

TEST EQUIPMENT USED FOR TESTS

	Use	Description	Model No.	Serial No.	Manufacturer	Interval	Next Cal. Date
1	■	Signal Analyzer (9 kHz ~ 30 GHz)	FSV30	100757	R&S	1 year	2021-09-07
2	■	Signal Generator (~3.2 GHz)	8648C	3623A02597	HP	1 year	2021-03-16
3		SYNTHESIZED CW GENERATOR	83711B	US34490456	HP	1 year	2021-03-16
4		Attenuator (3 dB)	8491A	37822	HP	1 year	2021-09-07
5		Attenuator (10 dB)	8491A	63196	HP	1 year	2021-09-07
6		EMI Test Receiver (~7 GHz)	ESC17	100722	R&S	1 year	2021-09-07
7		RF Amplifier (~1.3 GHz)	8447D OPT 010	2944A07684	HP	1 year	2021-09-07
8		RF Amplifier (1~26.5 GHz)	8449B	3008A02126	HP	1 year	2021-03-16
9		Horn Antenna (1~18 GHz)	3115	00114105	ETS	2 year	2022-09-10
10		DRG Horn (Small)	3116B	81109	ETS-Lindgren	2 year	2022-03-18
11		DRG Horn (Small)	3116B	133350	ETS-Lindgren	2 year	2022-03-18
12		TRILOG Antenna	VULB 9160	9160-3237	SCHWARZBECK	2 year	2021-03-20
13		Temp.Humidity Data Logger	SK-L200TH II A	00801	SATO	1 year	2021-03-16
14		Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-	-
15	■	DC Power Supply	6674A	3637A01657	Agilent	-	-
17	■	Power Meter	EPM-441A	GB32481702	HP	1 year	2021-03-16
18	■	Power Sensor	8481A	3318A94972	HP	1 year	2021-09-07
19		Audio Analyzer	8903B	3729A18901	HP	1 year	2021-09-07
20		Modulation Analyzer	8901B	3749A05878	HP	1 year	2021-09-07
21	■	TEMP & HUMIDITY Chamber	YJ-500	LTAS06041	JinYoung Tech	1 year	2021-09-07
22		Stop Watch	HS-3	812Q08R	CASIO	2 year	2022-03-18
23		LISN	KNW-407	8-1430-1	Kyoritsu	1 year	2021-03-16
24		Two-Lime V-Network	ESH3-Z5	893045/017	R&S	1 year	2021-03-16
25		UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	106243	R&S	1 year	2021-03-16
26		Highpass Filter	WHKX1.5/15G-10SS	74	Wainwright Instruments	1 year	2021-03-16
27		Highpass Filter	WHKX3.0/18G-10SS	118	Wainwright Instruments	1 year	2021-03-16
28		OSP120 BASE UNIT	OSP120	101230	R&S	1 year	2021-03-16
29		Signal Generator(100 kHz ~ 40 GHz)	SMB100A03	177621	R&S	1 year	2021-03-16
30		Signal Analyzer (10 Hz ~ 40 GHz)	FSV40	101367	R&S	1 year	2021-02-26
31		Active Loop Antenna	FMZB 1519	1519-031	SCHWARZBECK	2 year	2021-09-07