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Dates of Tests: Jun 07 ~ Jun 18, 2021

Test Report S/N: LR500172106AL

Test Site : LTA CO., LTD.

JAPAN MIC Test Report

Equipment Under Test	RFID Reader equipment
Modle Name	a611
Serial Number	N/A
Applicant	Apulsetechnology Co.,Ltd.
Manufacturer	Apulsetechnology Co.,Ltd.
Date of Test(s)	Jun 07 ~ Jun 18, 2021
Date of Issue	June 21, 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
<p>Apulsetechnology Co.,Ltd.</p> <p>A-1403, Gwangmyeongtechnopark, 60, Haan-ro, Gwangmyeong-si, Gyeonggi-do, Korea</p> <p>+82-10-5526-0605</p>	<p>LTA</p> <p>243 Jubug-Ri, Yangji-Myeon, Yongin-Si, Gyeonggi-Do, Korea 17159</p> <p>Tel: +82-31-444-7270 Fax: +82-31-444-7271</p>

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
--	June 21, 2021	Initial	-

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1. Applicant Information

1.1. Details of applicant

Applicant : Apulsetechnology Co.,Ltd.
Address : A-1403, Gwangmyeongtechnopark, 60, Haan-ro, Gwangmyeong-si, Gyeonggi-do, Korea
Contact Person : KIM NAM JOONG
TEL / FAX : +82-10-5526-0605 / +82-70-4222-5686

1.2. Manufacturer Information

Manufacturer : Apulsetechnology Co.,Ltd.
Address : A-1403, Gwangmyeongtechnopark, 60, Haan-ro, Gwangmyeong-si, Gyeonggi-do, Korea

1.3. EUT Description

Kind of product	RFID Smart Reader
Model name	a611
Serial Number	N/A
Power supply	DC 4.2 V
Frequency range	2 412 MHz ~ 2 462 MHz (802.11 b)
Moduleation technique	802.11b:DSSS
Number of channels	11 ch. (802.11 b)
Antenna gain	0.07 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
Article 5, Table 1	Frequency Error/ Frequency Tolerance	C
Article 6, Table 2 & Article 49-20, Item1-h & 1-i	Occupied Bandwidth (99%) and Spread-spectrum Bandwidth (90%) / Spreading Factor (diffusion rate)	C
Article 7, Table 3	Unwanted Emission Intensity	C
Article 14	Antenna Power Error/Tolerance	C
Article 24, Paragraph 2	Limitation of Collateral Emission of Receiver	C
Article 9-4, Item 9-C Article 6-2, Item 3 of the Regulation for Enforcement of the Radio Law	Radio Interference Prevention Capability	C
Article 49-20, Item1-a	Construction Protection Confirmation	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	30 kHz
Span	5 kHz
Sweep time	Auto
Detector mode	Positive peak
Trace mode	Max. hold

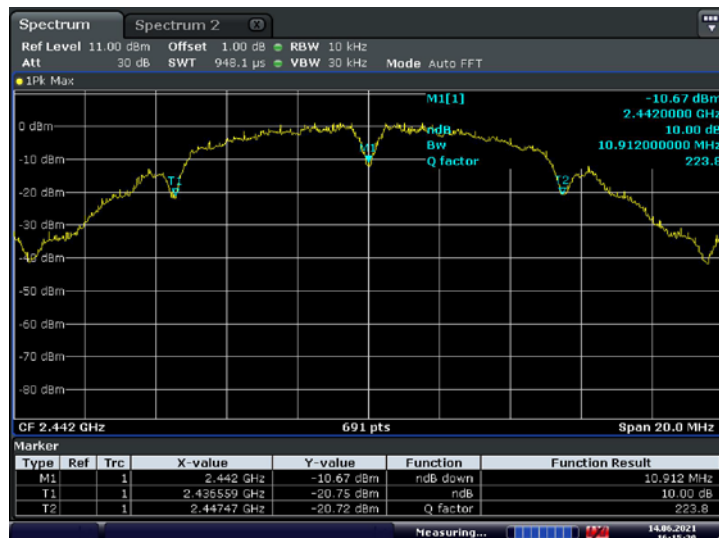
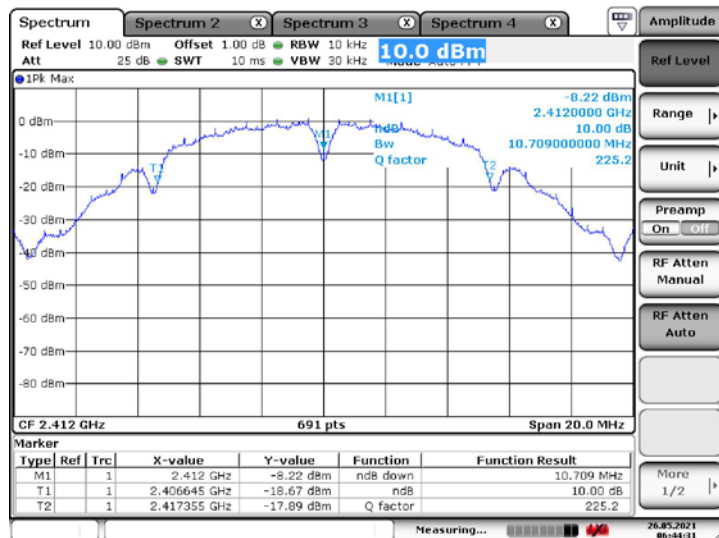
3.4 Test results

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

Test mode : 802.11 b

Test voltage	Test voltage (DC)	Measured value (MHz)	Tolerance (ppm)	Result	Limit
Normal Voltage	Low frequency	2,412.00001	0.00	Pass	± 50 ppm
	Middle frequency	2,442.01450	5.94	Pass	
	High frequency	2,461.98550	-5.89	Pass	
Low Voltage	Low frequency	2,411.99997	-0.01	Pass	
	Middle frequency	2,442.01403	5.75	Pass	
	High frequency	2,461.98527	-5.98	Pass	
High Voltage	Low frequency	2,412.00041	0.17	Pass	
	Middle frequency	2,442.01492	6.11	Pass	
	High frequency	2,461.98592	-5.72	Pass	

Test Mode : 802.11b / CH01,CH07,CH11 (Nomal Voltage)



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

4.1 Test setup



4.2 Limit

Occupied Bandwidth (99%):	FHSS \leq 83.5MHz; OFDM, DSSS \leq 26MHz; Others \leq 26MHz HT40 \leq 38 MHz
Spread Bandwidth (90%):	\geq 500 kHz (FHSS, DSSS)
Spreading Factor	\geq 5 , Operating Frequency 2400 -2483.5 MHz \geq 10 , Operating Frequency 2471-2497 MHz

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	50 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 : 802.11 b

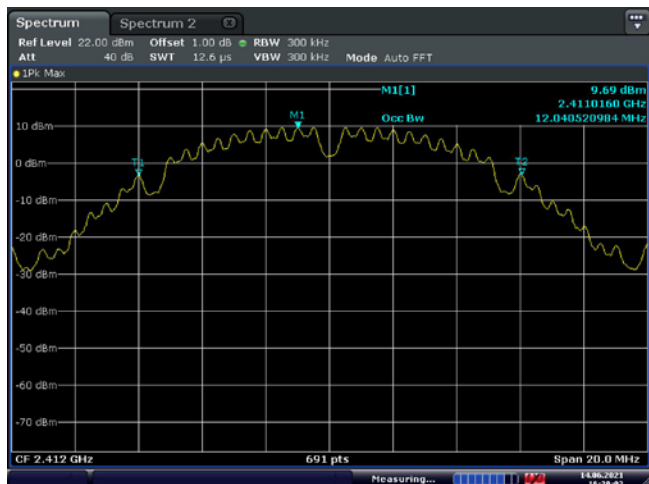
Test Voltage (V)	Normal Voltage			Remarks
Test Frequency (MHz)	2412	2442	2462	Low/Mid/High of test frequency range
Occupied bandwidth (MHz)	12.04	12.04	12.10	Limit \leq 26 MHz (RBW/VBW :300kHz)
Spreading Bandwidth (MHz)	8.05	8.05	8.10	\geq 500 kHz (FHSS, DSSS)
Spread-factor=Spreading Bandwidth/1.375	5.85	5.85	5.89	Spread Factor Limit \geq 5 (DSSS and FHSS)

Test Voltage (V)	High Voltage			Remarks
Test Frequency (MHz)	2412	2442	2462	Low/Mid/High of test frequency range
Occupied bandwidth (MHz)	12.04	12.04	12.05	Limit \leq 26 MHz (RBW/VBW :300kHz)
Spreading Bandwidth (MHz)	8.05	8.05	8.05	\geq 500 kHz (FHSS, DSSS)
Spread-factor=Spreading Bandwidth/1.375	5.85	5.85	5.85	Spread Factor Limit \geq 5 (DSSS and FHSS)

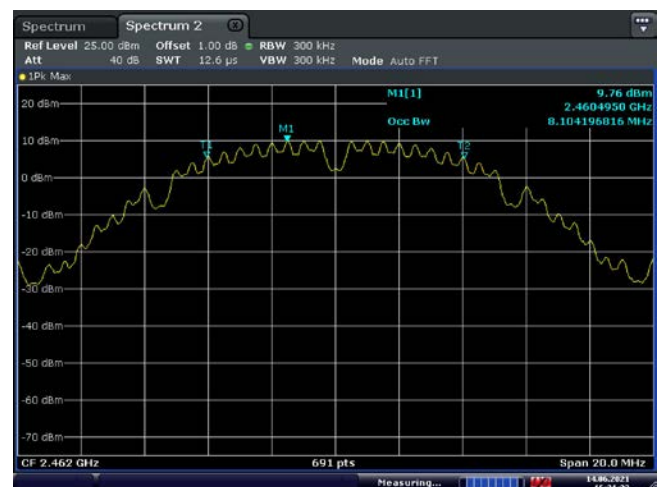
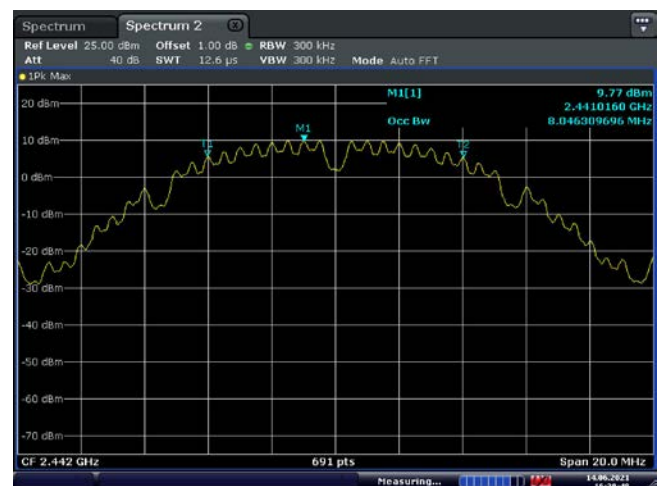
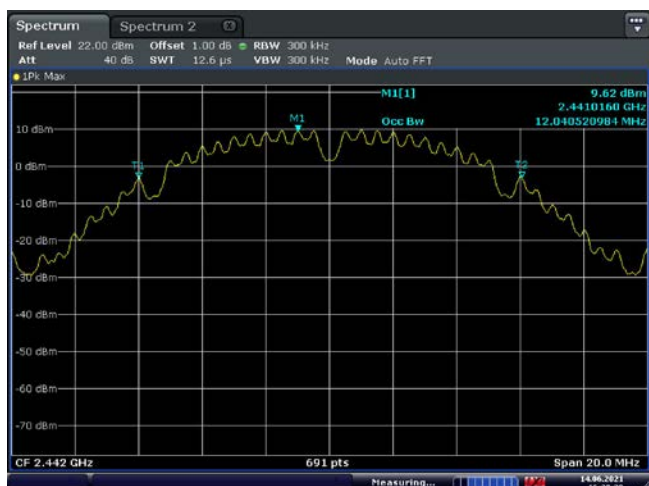
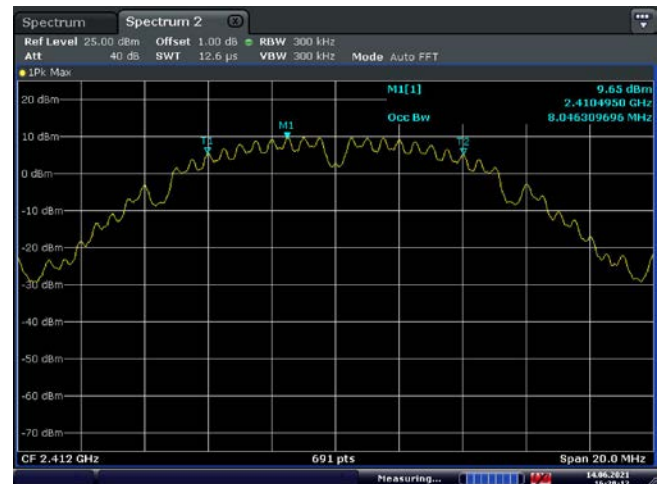
Test Voltage (V)	Low Voltage			Remarks
Test Frequency (MHz)	2412	2442	2462	Low/Mid/High of test frequency range
Occupied bandwidth (MHz)	12.04	12.04	12.04	Limit \leq 26 MHz (RBW/VBW :300kHz)
Spreading Bandwidth (MHz)	8.05	8.05	8.05	\geq 500 kHz (FHSS, DSSS)
Spread-factor=Spreading Bandwidth/1.375	5.85	5.85	5.85	Spread Factor Limit \geq 5 (DSSS and FHSS)

Test Mode : 802.11 b / CH01,CH07,CH11 (Nomal Voltage)

99 % OBW

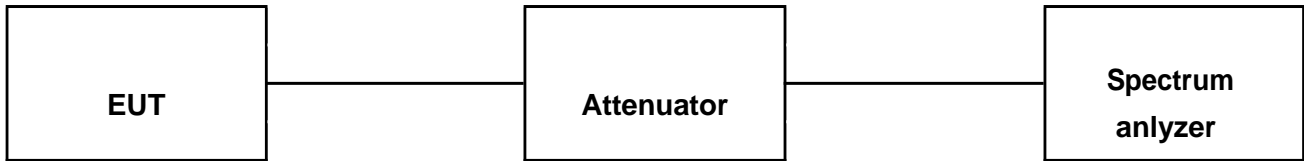


90 % OBW



5. Unwanted emission strength

5.1 Test setup



5.2 Limit

Item	Limits
	(See Article 7, Table 3 of the Ordinance Regulating Radio Equipment)
TX	$\leq 2.5 \mu\text{W/MHz} (-26 \text{ dBm/MHz})$ ($30\text{MHz} \leq f \leq 1000\text{MHz}$)
Spurious Emission	$\leq 2.5 \mu\text{W/MHz}$ ($1000\text{MHz} \leq f < 2387\text{MHz}$; $2496.5\text{MHz} < f$)
	$\leq 25 \mu\text{W/MHz} (-16 \text{ dBm/MHz})$ ($2387\text{MHz} \leq f < 2400\text{MHz}$) and ($2483.5\text{MHz} < f \leq 2496.5\text{MHz}$)
Measurement range: 30MHz - 5 th harmonics	

5.3 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 (above 1 GHz), 1 MHz (below 1 GHz), VBW: same as RBW
Sweep time : auto, Start : 30 MHz, Stop : 1 000 MHz. Sweep mode: single and mark highest level.
5. Set the spectrum analyzer RBW: 1 MHz, VBW: 1 MHz, Sweep time: auto, Start: 1 000 MHz, Stop: 2 387 MHz Sweep mode: single and mark highest level.
6. 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.
7. 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.
8. Set the spectrum analyzer RBW: 1 MHz, VBW: 1 MHz, Sweep time: auto, Start: 2 496.5 MHz, Stop: 26 GHz Sweep mode: single and mark highest level.
9. Detector mode: Peak mode.

5.4 Test results

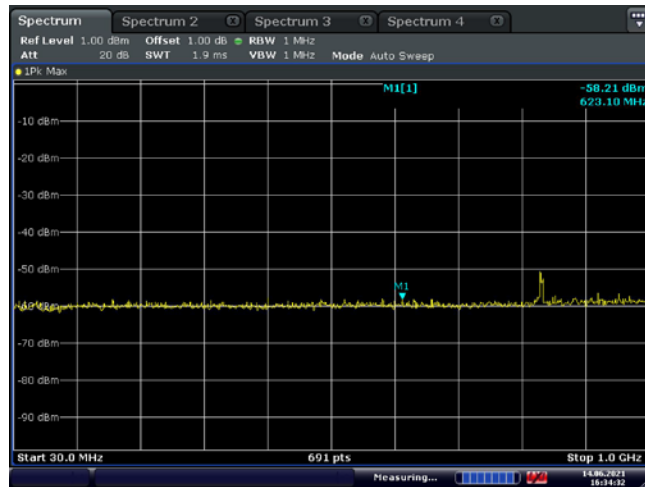
Ambient temperature: 24℃ Relative humidity: 50% R.H.

Test mode : 802.11 b

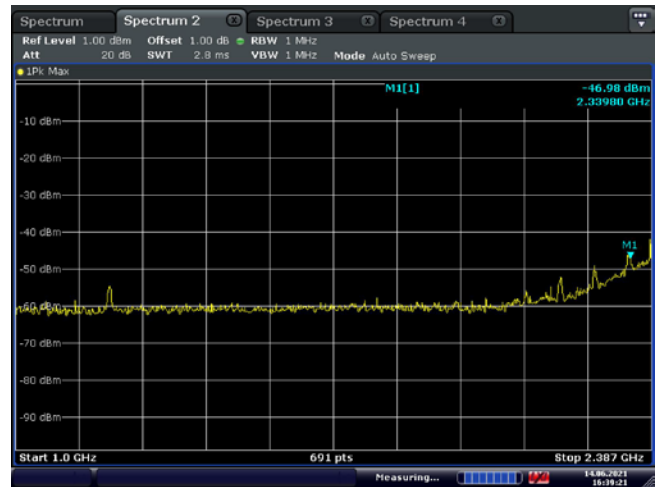
Voltage	Measurement Frequency	Frequency Range	Result			Limit
V	MHz	MHz	MHz	dBm	uW	uW
Low Voltage	2412	30 ~ 1000	623.23	-58.05	0.0016	2.5
		1000 ~ 2387	2339.96	-46.86	0.0206	2.5
		2387 ~ 2400	2400.15	-27.00	1.9973	25
		2483.5 ~ 2496.5	2485.88	-46.41	0.0228	25
		2496.5 ~ 12500	2518.67	-51.57	0.0070	2.5
	2442	30 ~ 1000	692.04	-57.74	0.0017	2.5
		1000 ~ 2387	2368.10	-47.97	0.0160	2.5
		2387 ~ 2400	2394.70	-46.34	0.0232	25
		2483.5 ~ 2496.5	2492.76	-47.80	0.0166	25
		2496.5 ~ 12500	4877.82	-47.97	0.0160	2.5
	2462	30 ~ 1000	887.32	-57.75	0.0017	2.5
		1000 ~ 2387	2312.12	-48.65	0.0136	2.5
		2387 ~ 2400	2389.39	-45.66	0.0272	25
		2483.5 ~ 2496.5	2483.92	-41.83	0.0657	25
		2496.5 ~ 12500	4922.11	-46.32	0.0233	2.5
Normal Voltage	2412	30 ~ 1000	623.10	-58.21	0.0015	2.5
		1000 ~ 2387	2339.80	-46.98	0.0200	2.5
		2387 ~ 2400	2399.99	-27.12	1.9409	25
		2483.5 ~ 2496.5	2485.62	-46.66	0.0216	25
		2496.5 ~ 12500	2518.50	-51.79	0.0066	25
	2442	30 ~ 1000	691.90	-57.89	0.0016	2.5
		1000 ~ 2387	2367.90	-48.09	0.0155	2.5
		2387 ~ 2400	2394.50	-46.46	0.0226	25
		2483.5 ~ 2496.5	2492.15	-48.05	0.0157	25
		2496.5 ~ 12500	4877.50	-48.08	0.0156	2.5
	2462	30 ~ 1000	887.00	-57.98	0.0016	2.5
		1000 ~ 2387	2311.70	-48.81	0.0132	2.5
		2387 ~ 2400	2388.97	-45.82	0.0262	25
		2483.5 ~ 2496.5	2483.53	-41.95	0.0638	25
		2496.5 ~ 12500	4921.50	-46.52	0.0223	2.5

High Voltage	2412	30 ~ 1000	623.33	-58.06	0.0016	2.5
		1000 ~ 2387	2339.80	-46.98	0.0200	2.5
		2387 ~ 2400	2400.35	-26.88	2.0496	25
		2483.5 ~ 2496.5	2485.92	-46.52	0.0223	25
		2496.5 ~ 12500	2518.97	-51.68	0.0068	2.5
	2442	30 ~ 1000	692.51	-57.78	0.0017	2.5
		1000 ~ 2387	2367.90	-48.09	0.0155	2.5
		2387 ~ 2400	2394.98	-46.39	0.0229	25
		2483.5 ~ 2496.5	2492.36	-47.96	0.0160	25
		2496.5 ~ 12500	4877.88	-47.99	0.0159	2.5
	2462	30 ~ 1000	887.40	-57.93	0.0016	2.5
		1000 ~ 2387	2311.70	-48.81	0.0132	2.5
		2387 ~ 2400	2389.52	-45.72	0.0268	25
		2483.5 ~ 2496.5	2483.83	-41.74	0.0670	25
		2496.5 ~ 12500	4921.66	-46.32	0.0233	2.5

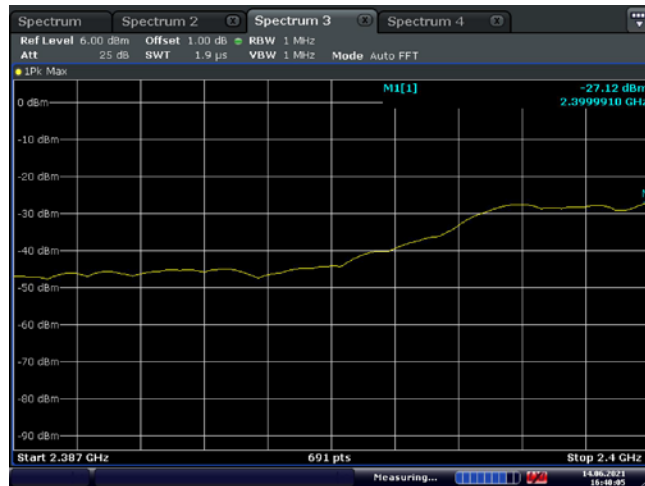
Test Mode : 802.11 b / CH01 (Nomal Voltage)



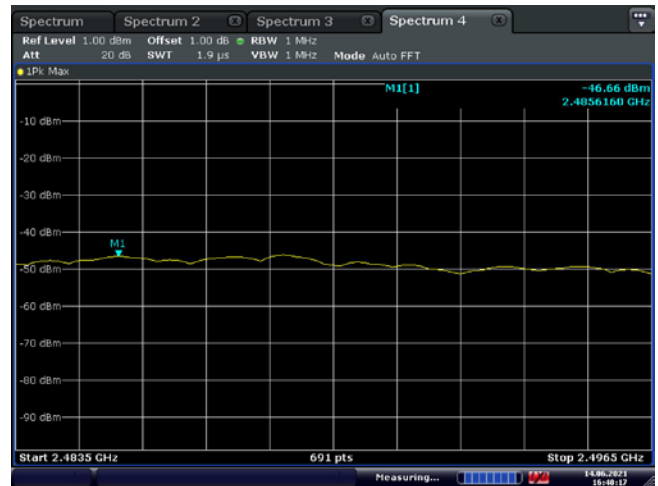
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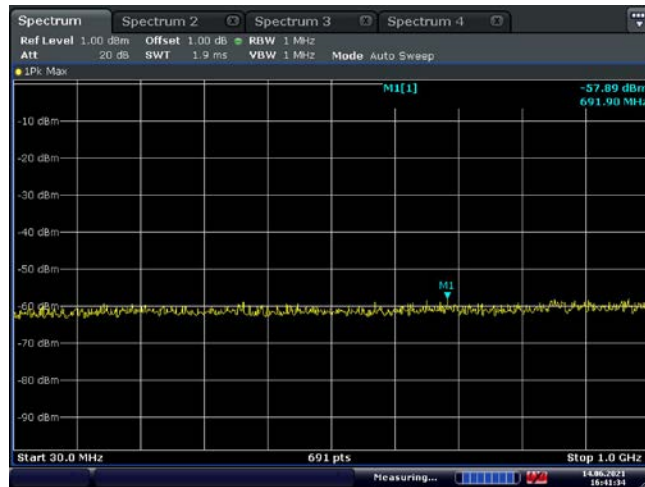


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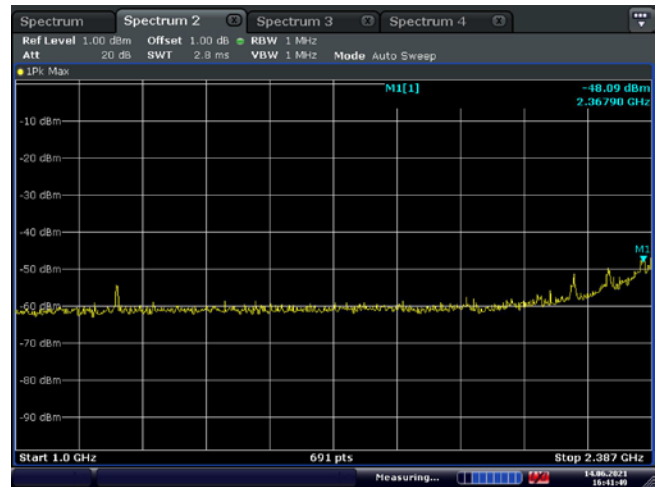


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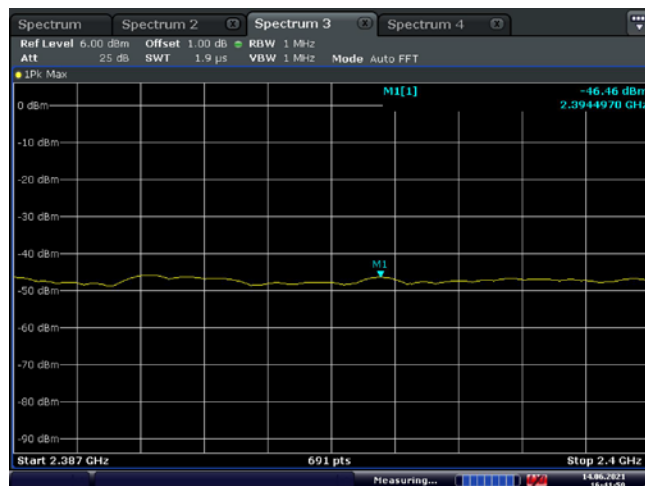
Test Mode : 802.11 b / CH07 (Nomal Voltage)



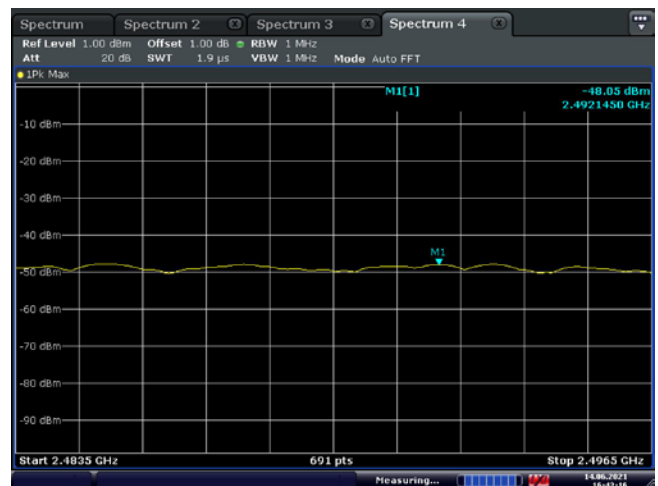
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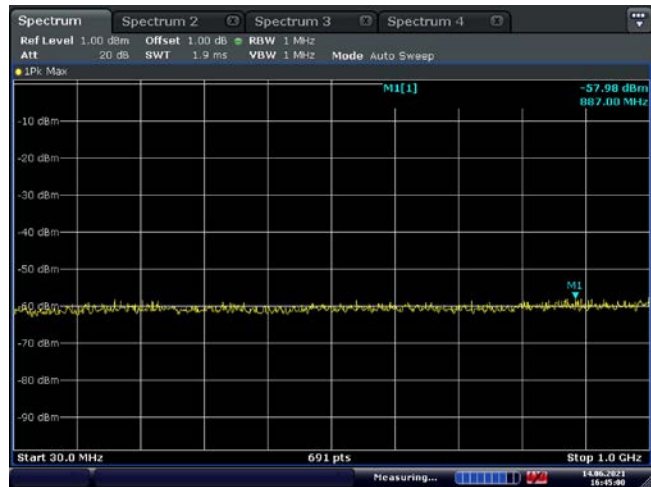


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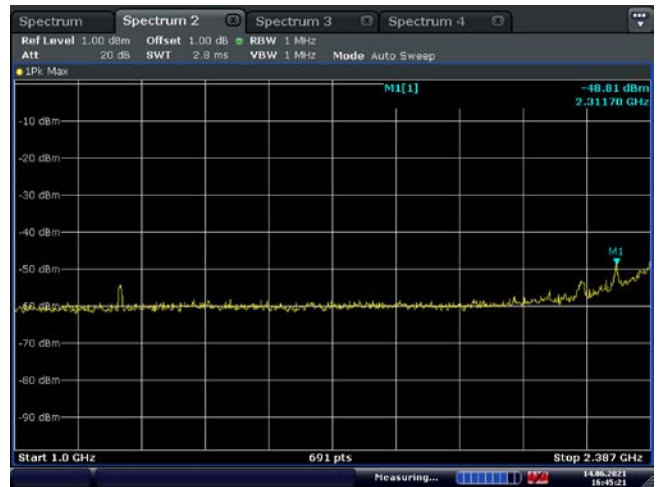


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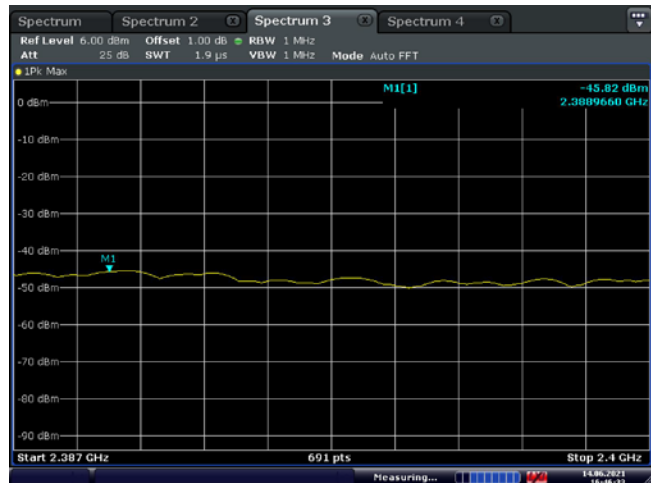
Test Mode : 802.11 b / CH11 (Nomal Voltage)



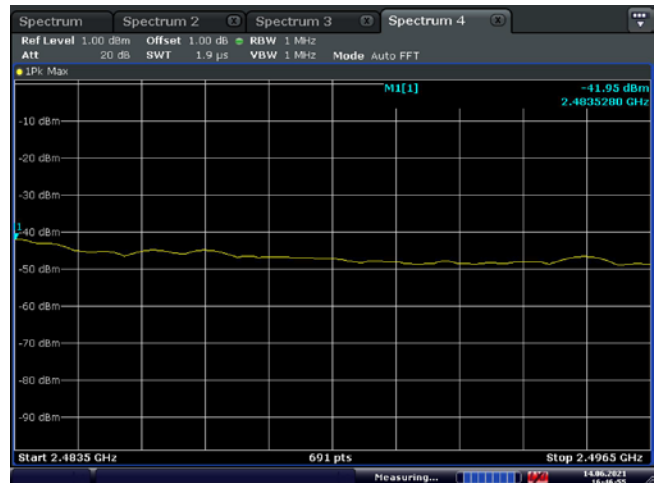
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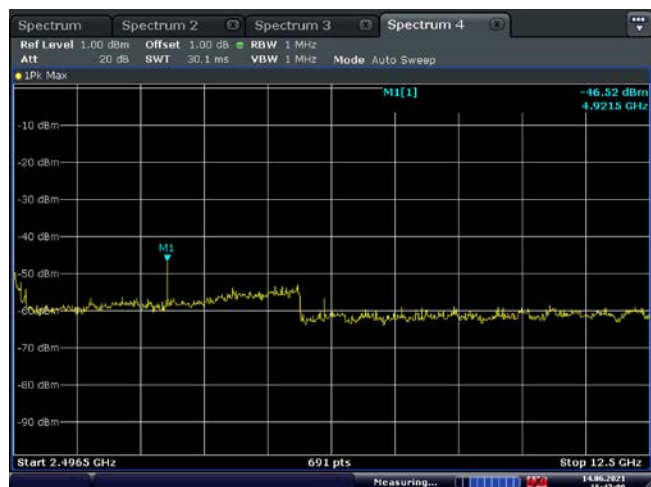
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Date: 14.JUN.2021 16:46:33



Date: 14.JUN.2021 16:46:55



Date: 14.JUN.2021 16:47:09

6. Antenna power

6.1 Test setup



6.2 Limit

Item	Limits
Antenna Power Density	$\leq 3\text{mW/MHz}$ (FHSS 2427 - 2470.75 MHz) $\leq 5\text{mW/MHz}$ (OFDM,DSSS 2400~2483.5MHz) (HT40) $\leq 10\text{mW/MHz}$ (OFDM,DSSS 2400~2483.5MHz) (HT20) $\leq 10\text{mW}$ (Other modulation method 2400~2483.5MHz)
Antenna Power Error	+20%, -80% (Base on manufacturer declare antenna power density)

6.3 Test procedure

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

Spectrum Analyzer	Setting
Attenuation	30dB
Span	Zero
RBW	1 MHz
VBW	1 MHz
Detector	Positive Peak
Trace	Max Hold
Sweep Time	Auto

Declaration Output Power

G1D 2412~2462MHz(5MHz, 11CH) 0.01W/MHz

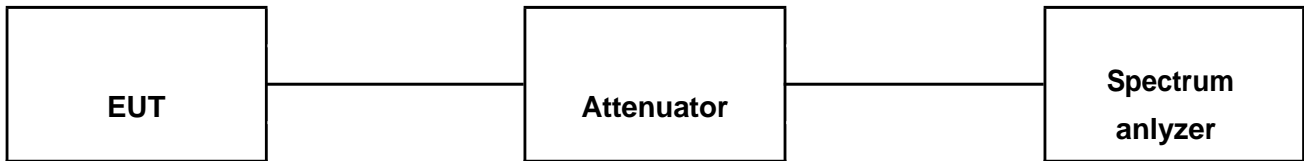
6.4 Test resultsAmbient temperature: 24℃ Relative humidity: 50% R.H.

Test mode : 802.11 b

Voltage	Measurement Frequency	Result			Limit	
V	MHz	dBm	mW/MHz	Tolerance %	10 mW/MHz (-80 ~ +20 %)	
Normal Voltage	2412	10.62	11.53	15		
	2442	10.6	11.48	15		
	2462	10.68	11.70	17		
Low Voltage	2412	10.13	10.30	3		
	2442	10.65	11.61	16		
	2462	10.31	10.74	7		
High Voltage	2412	10.17	10.40	4		
	2442	10.74	11.85	18		
	2462	10.61	11.51	15		
Declared power(W)			0.01 (0.002 ~0.012)			
Antenna gain(dBi)			0.07 dBi			
Limit			-80 ~ 20 %			

7. RX spurious emission

7.1 Test setup



7.2 Limit

Below 1 GHz: 4 nW or less (-54 dBm)

Above 1 GHz: 20 nW or less (-47 dBm)

7.3 Test procedure

1. Connecy transmitter output to the spcectrum 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

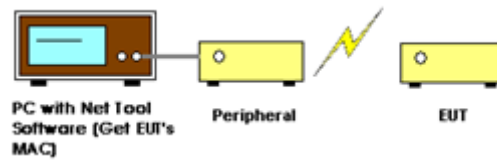
7.4 Test resultsAmbient temperature: 24℃ Relative humidity: 50% R.H

Test mode : 802.11 b

Voltage	Measurement Frequency	Frequency Range	Result			Limit
V	MHz	MHz	MHz	dBm	nW	nW
Normal Voltage	2412	30 ~ 1000	320.46	-78.63	0.000014	4
		1000 ~ 12750	2471.26	-57.44	0.001801	20
	2442	30 ~ 1000	320.44	-79.27	0.000012	4
		1000 ~ 12750	2437.79	-62.88	0.000515	20
	2462	30 ~ 1000	320.78	-79.66	0.000011	4
		1000 ~ 12750	2472.13	-60.02	0.000996	20
High Voltage	2412	30 ~ 1000	319.90	-78.87	0.000013	4
		1000 ~ 12750	2471.00	-57.56	0.001754	20
	2442	30 ~ 1000	319.90	-79.38	0.000012	4
		1000 ~ 12750	2437.00	-62.93	0.000509	20
	2462	30 ~ 1000	319.90	-79.75	0.000011	4
		1000 ~ 12750	2471.00	-60.07	0.000984	20
Low Voltage	2412	30 ~ 1000	320.59	-78.67	0.000014	4
		1000 ~ 12750	2472.14	-57.35	0.001843	20
	2442	30 ~ 1000	320.70	-79.16	0.000012	4
		1000 ~ 12750	2437.64	-62.84	0.000520	20
	2462	30 ~ 1000	320.67	-79.69	0.000011	4
		1000 ~ 12750	2471.58	-59.97	0.001007	20

8. RADIO INTERFERENCE PREVENTION CAPABILITY MEASUREMENT

8.1 Test Setup



8.2 Limit

Item	Limits (See Article 9-4, Item9-C of the Ordinance Regulating Radio Equipment)
Identification code	≥ 48 bits

8.3 Test procedure

PC with NetTool	Setting
MAC IP List	MAC Scan

8.4 Test results

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

Test Power:	Normal Voltage
Test Mode:	802.11b
Test Result:	Good (identification code: [60:01:94:81:E2:FA])

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	
X	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.
	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 glued with a non-transparent laminating agent.
	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	2022-03-16
3		SYNTHESIZED CW GENERATOR	83711B	US34490456	HP	1 year	2022-03-16
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	2022-03-16
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	2023-03-20
13		Temp.Humidity Data Logger	SK-L200TH II A	00801	SATO	1 year	2022-03-16
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	2022-03-16
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	2022-03-16
24		Two-Lime V-Network	ESH3-Z5	893045/017	R&S	1 year	2022-03-16
25		UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	106243	R&S	1 year	2022-03-16
26		Highpass Filter	WHKX1.5/15G-10SS	74	Wainwright Instruments	1 year	2022-03-16
27		Highpass Filter	WHKX3.0/18G-10SS	118	Wainwright Instruments	1 year	2022-03-16
28		OSP120 BASE UNIT	OSP120	101230	R&S	1 year	2022-03-16
29		Signal Generator(100 kHz ~ 40 GHz)	SMB100A03	177621	R&S	1 year	2022-03-16
30		Signal Analyzer (10 Hz ~ 40 GHz)	FSV40	101367	R&S	1 year	2022-03-16
31		Active Loop Antenna	FMZB 1519	1519-031	SCHWARZBECK	2 year	2023-09-07