

RF TEST REPORT

Report number		RAPA21-O-018	
	Name	IOT WARE Co., Ltd	
Applicant	Logo	N/A	
	Address	#1303-1, Gasan Hansin IT Tower 2cha, 47, Digital-ro 9-gil, Geumcheno-gu, Seoul, Korea	
Manufashuran	Name	IOT WARE Co., Ltd	
Manufacturer	Address	#1303-1, Gasan Hansin IT Tower 2cha, 47, Digital-ro 9-gil, Geumcheno-gu, Seoul, Korea	
Type of equipment		RFID reader	
Basic model name		I9-2000W	
Multi model name		U9-2000W	
Serial number		N/A	
FCC ID		2A2RE-I9-2000W	
Test duration		August 3, 2021 to August 23, 2021	
Date of issue		August 23, 2021	
Total page		35 Pages (including this page)	

SUMMARY

The equipment complies with the regulation; FCC Part 15 Subpart C Section 15.247

This test report only contains the result of a single test of the sample supplied for the examination. It is not a general valid assessment of the features of the respective products of the mass-production.

August 23, 2021

Tested by MinGu Ji

Tester

August 23, 2021

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Reviewed by Hyun Soo Lee Executive Managing Director



Test Report Version History

Version	Date	Reason for revision
1.0	August 23, 2021	Original Document





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1. Description of EUT

1.1 Applicant

- Company name : IOT WARE Co., Ltd
- Address : #1303-1, Gasan Hansin IT Tower 2cha, 47, Digital-ro 9-gil, Geumcheno-gu, Seoul, Korea
- Contact person : Rack Eon Koo / Header of research center / rekoo@iotware.net
- Phone/Fax : +82-2-866-1150 / +82-2-866-0512

1.2 Manufacturer

- Company name : IOT WARE Co., Ltd
- Address : 76, Hanam-daero, Hanam-si, Gyeonggi-do, Republic of Korea
- Phone/Fax : +82-2-866-1150 / +82-2-866-0512

1.3 Basic description

 Product name 	: RFID reader
 Basic model name 	: 19-2000W

• Alternative model name : U9-2000W

1.4 General description

- EQUIPMENT CLASS : DSS SPREAD SPECTRUM TRANSMITTER
- Frequency Range : 911.3 MHz ~ 925.7 MHz
 Output Power : 29.6 dBm
 Modulation Type : ASK
 Number of Channel : 73
 Antenna Type : Pacth Antenna
 Antenna Gain : 2.45 dBi
 Power Supply : DC 12.0 V
- Note 1: The RF test items are substituted with the test results of the granted WLAN Module (contain FCC ID: 2ATUB-WIZFI360PA). The test reports No. is (STS1906023W02). Refer to the test reports for the detailed results.



nannel List					
Number	Freq(MHz)	Number	Freq(MHz)	Number	Freq(MHz)
1	911.3	26	916.3	51	921.3
2	911.5	27	916.5	52	921.5
3	911.7	28	916.7	53	921.7
4	911.9	29	916.9	54	921.9
5	912.1	30	917.1	55	922.1
6	912.3	31	917.3	56	922.3
7	912.5	32	917.5	57	922.5
8	912.7	33	917.7	58	922.7
9	912.9	34	917.9	59	922.9
10	913.1	35	918.1	60	923.1
11	913.3	36	918.3	61	923.3
12	913.5	37	918.5	62	923.5
13	913.7	38	918.7	63	923.7
14	913.9	39	918.9	64	923.9
15	914.1	40	919.1	65	924.1
16	914.3	41	919.3	66	924.3
17	914.5	42	919.5	67	924.5
18	914.7	43	919.7	68	924.7
19	914.9	44	919.9	69	924.9
20	915.1	45	920.1	70	925.1
21	915.3	46	920.3	71	925.3
22	915.5	47	920.5	72	925.5
23	915.7	48	920.7	73	925.7
24	915.9	49	920.9		1
25	916.1	50	921.1		

1.5 Alternative type(s)/model(s)

The Following Lists Consist to of the added model and their differences.

Model name	Differences	Tested
19-2000W	Basic Model(RFID Reader with WLAN Module (contain FCC ID: 2ATUB-WIZFI360PA)	
U9-2000W	It is the same as the I9-2000W model, only the model name is added.	



2. General information of test

2.1 Test standards and results

Applied Standards : FCC Part 15 Subpart C			
Section	Description of Test	Result	
15.247 (a) (1)	Carrier Frequency Separation	Pass	
15 247 (c) (1) (iii)	Minimum Number of Hopping Channels	Pass	
15.247 (a) (1) (III)	Average Time of Occupancy	Pass	
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Pass	
	Radiated Emission which fall in the Restricted Band	Pass	
15.247 (b) (1) Maximum Peak Conducted Output Power		Pass	
15.207 Conducted Limits		N/A	
15.209	15.209 Radiated Emission Limits, General Requirement		
15.203	Antenna Requirement	Pass	

2.2 Description of EUT during the test

During the test, keep the EUT in continuously transmitting mode.

There was no mechanical or circuitry modification to improve RF and spurious characteristic, and any RF and spurious suppression device(s) was not added against the device tested.

The EUT was moved throughout the X, Y, and Z axis and worst case data was recorded in this report.

2.3 Test configuration

Type of peripheral equipment used

Model	Manufacturer	Description	Connected to
19-2000W	IOT WARE Co., Ltd	USB	EUT
15UD50N	LG Electronics	Notebook	EUT
A18-045N2A	LG Electronics	Power Adapter	Notebook
B05-24-12	Daygreen	DC IN	EUT

2.4 Test Facility

- FCC Registration No: 931589
- IC Company address code: 9355B
- RRA Designation Number: KR0027
- Place of Test

Anyang Test Site(RF Test Room)

#101 & B104 Anyang Megavalley, 268, Hagui-ro, Dongan-gu, Anyang-si, Gyeonggi-do, 14056, Korea



2.5 PRELIMINARY TEST

2.5.1 AC Power line Conducted Emissions Tests

Not tested as it is a DC power supply and is not intended for use in vehicles.

2.5.2 General Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting mode.	X

2.5.3 Special conditions for testing

This product uses 4 antenna ports, but does not support MIMO mode operation and operates in sequential SISO mode.

Antenna Port	Conducted Power (dBm)
1	32.4
2	31.1
3	31.0
4	32.3

As a result of the test for each port, port 1 was the worst, so the wired test was conducted with port 1.



3. Measurement data

3.1 Minimum 20 dB Bandwidth

3.1.1 Requirement

• FCC Part15 subpart C Section 15.247

3.1.2 Test Procedure



The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 20 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 dB.

3.1.3 Test environment

• 24 °C, 48 % R.H.

3.1.4 Test results

Frequency [MHz]		Measured Value [kHz]	Limit [kHz]	Result
Low	911.3	93.4	500	
Middle	918.5	94.2	500	PASS
High	925.7	93.6	500	



3.1.5 Test Plots











3.2 Hopping Frequency Separation

3.2.1 Requirement

• FCC Part15 subpart C Section 15.247

3.2.2 Test Procedure



The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 5 MHz. The analyzer is set to peak hold then a pseudo-random hopping sequence of the transmitter is captured. The mark delta function was used to measure the frequency separation between two adjacent hopping channels.

3.2.3 Test environment

• 24 °C, 48 % R.H.

3.2.4 Test results

Frequency [MHz]	Measured Value [kHz]	Limit [dBm]	Result
918.50	199.5	Minimum of 25 kHz or the 20 dB Bandwidth	PASS



3.2.5 Test Plots





3.3 Number Of Hopping Chanels

3.3.1 Requirement

• FCC Part15 subpart C Section 15.247

3.3.2 Test Procedure



The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to frequency band of operation and the resolution bandwidth is set to 100 kHz. The analyzer is set to peak hold and then complete pseudo-random hopping sequence of the transmitter is captured.

3.3.3 Test environment

• 24 °C, 48 % R.H.

3.3.4 Test results

Frequency [MHz]	Measured Value [Number]	Limit [dBm]	Result
902 ~ 928	73	≥ 50	PASS



3.2.5 Test Plots





3.3 Time Of Occupancy

3.3.1 Requirement

• FCC Part15 subpart C Section 15.247

3.3.2 Test Procedure



The antenna output of the EUT was connected to the spectrum analyzer. The transmitter is set to operate in its normal frequency hopping mode. The center frequency of the spectrum analyzer is set to one of hopping channels near the center of the operating band and span is set to zero Hz. The sweep time is set to display one complete pulse. The mark delta function is used to measure the duration of the pulses.

3.3.3 Test environment

• 24 °C, 48 % R.H.

3.3.4 Test results

Frequency Range	Pulse Time	Number of Pulse in 20	Average Occupancy Time	Limit
(MHz)	(ms)	seconds	(ms)	(ms)
918.5	10.30	10	103.0	

* Average Occupancy Time = Pulse Time * Number of Pulse in 20 seconds



3.2.5 Test Plots







3.3 Maximum Peak Output Power

3.3.1 Requirement

• FCC Part15 subpart C Section 15.247

3.3.2 Test Procedure



The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The EUT was operating in transmit mode at the appropriate center frequency.

3.3.3 Test environment

• 24 °C, 48 % R.H.

3.3.4 Test results

Frequer	ncy [MHz]	Measured Value [dBm]	Limit [dBm]	Result
Low	911.3	29.6		PASS
Middle	918.5	29.5	30.0	PASS
High	925.7	29.1		PASS



3.2.5 Test Plots











3.3 100 kHz Bandwidth Outside the Frequency Band

3.3.1 Requirement

• FCC Part15 subpart C Section 15.247

3.3.2 Test Procedure



The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth and video bandwidth is set to 100 kHz, and peak detection was used.

3.3.3 Test environment

• 24 °C, 48 % R.H.



3.3.4 Test Plots









3.4 Radiated Emission

3.4.1 Requirement

• FCC Part15 subpart C Section 15.247

3.4.2 Test Procedure

The radiated emissions measurements were performed on the 3 m anechoic chamber. The EUT was placed on a non-conductive turntable above the ground plane. The frequency spectrum from 30 kHz to 10.0 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

3.4.3 Test environment

• 24 °C, 45 % R.H.

3.4.4 Test results 3.4.4.1 Radiated Emission which fall in the Restricted Band

- •.Resolution bandwidth : 1 MHz
- Video bandwidth : 3 MHz
- •.Detector : Peak Mode(Peak), Average Mode(RMS)

: PASS

- •.Measurement distance : 3 m
- •.Operating Condition : Highest Output Power Transmitting Mode(Low Channel and High Channel)
- Result

Frequency Detector Cable Limits Reading Ant. Pol. Ant. Amp Total Margin (MHz) (dBµV) Mode (H/V) Factor Loss Gain (dBµV/m) (dBµV/m) (dB) Low Channel 2733.89 49.40 53.80 74.00 20.20 Peak Н 2733.89 44.70 49.10 54.00 4.90 Average н 29.20 10.10 34.90 48.09 V 52.49 74.00 2733.68 Peak 21.51 2733.89 43.10 V 47.50 54.00 6.50 Average Middle Channel 2755.31 50.35 Peak Н 54.75 74.00 19.25 2755.52 45.35 н 49.75 54.00 4.25 Average 29.20 10.10 34.90 2755.94 46.38 V 50.78 74.00 Peak 23.22 2755.52 38.94 43.34 54.00 10.66 V Average **High Channel** 2777.15 50.94 55.34 74.00 18.66 Peak Н 2777.15 46.69 54.00 51.09 2.91 Average Н 34.90 29.20 10.10 2777.15 45.48 V 49.88 74.00 24.12 Peak 2777.15 36.23 V 40.63 54.00 13.37 Average

Note 1. Total = Reading + Ant.Factor + Cable Loss – Amp Gain

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3.4.4.2 Spurious & Harmonic Radiated Emission

- •.Resolution bandwidth : 1 MHz
- Video bandwidth : 3 MHz
- •.Detector : Peak Mode(Peak), Average Mode(RMS)

: 3 m

: PASS

- Measurement distance
- •.Frequency range : 1 GHz ~ 10.0 GHz
- •.Operating Condition : Highest Output Power Transmitting Mode
- •.Result

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)			
	Low Channel											
1822.60	51.66	Peak	Н				49.96	74.00	24.04			
1822.60	46.01	Average	Н	26.30	7.60	35.60	44.31	54.00	9.69			
1822.60	52.95	Peak	V		7.00	35.00	51.25	74.00	22.75			
1822.60	48.16	Average	V				46.46	54.00	7.54			
Middle Channel												
1837.00	48.98	Peak	Н				47.48	74.00	26.52			
1837.00	43.39	Average	Н	26.40	7.60	35.50	41.89	54.00	12.11			
1837.00	52.41	Peak	V	20.40	7.00		50.91	74.00	23.09			
1837.00	48.64	Average	V				47.14	54.00	6.86			
			н	igh Chan	nel							
1851.40	48.72	Peak	Н				47.42	74.00	26.58			
1851.40	41.43	Average	Н	26.60	7.60	25 50	40.13	54.00	13.87			
1851.40	52.61	Peak	V	20.00	1.00	35.50	51.31	74.00	22.69			
1851.40	48.74	Average	V				47.44	54.00	6.56			

Note 1. Total = Reading + Ant.Factor + Cable Loss – Amp Gain

3.4.4.3 Spurious Radiated Emission

3.4.4.3.1 Test Data for Below 30 MHz for RFID Mode

Detector	: Quasi-Peak (6 dB Bandwidth: 200 Hz, 9 kHz)
 Measurement distance 	: 3 m
 Frequency range 	: 9 kHz ~ 30 MHz
 Operating Condition 	: Highest Output Power Transmitting Mode
•.Result	: PASS

Frequency	Reading	Ant. Pol.	Ant. Factor	Cable	Amp	Emission	Limits	Margin			
(MHz)	(dBµV)	(H/V)	(dB/m)	Loss	Gain	Level(dBµV/m)	(dBµV/m)	(dB)			
Emissions observed were 20dB below the limit and thus not reported											

3.4.4.3.2 Test Data for Below 30 MHz for RFID + WLAN Mode

 Detector 	: Quasi-Peak (6 dB Bandwidth: 200 Hz, 9 kHz)
------------------------------	--

- •.Measurement distance : 3 m
- •.Frequency range : 9 kHz ~ 30 MHz
- •.Operating Condition : Highest Output Power Transmitting Mode
- •.Result : PASS

(MHz) (dBµV) (H/V) (dB/m) Loss Gain Level(dBµV/m) (dBµV/m) (dB)	Frequency	Reading	Ant. Pol.	Ant. Factor	Cable	Amp	Emission	Limits	Margin
	(MHz)	(dBµV)	(H/V)	(dB/m)	Loss	Gain	Level(dBµV/m)	(dBµV/m)	(dB)
Emissions observed were 20dB below the limit and thus not reported									

3.4.4.3.3 Test Data for 30 MHz ~ 1000 MHz for RFID Mode

- •. Detector
- : Quasi-Peak (6 dB Bandwidth: 120 kHz) •.Measurement distance : 3 m
- •.Frequency range
- : 30 MHz ~ 1000 MHz
- •.Operating Condition
- •.Result
- : Highest Output Power Transmitting Mode
- : PASS

RE Test Report

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
83.35	24.49	40.00	15.51	15000.0	400.0	H	223.0	-26.0
95.96	35.96	43.50	7.54	15000.0	99.8	Н	338.0	-23.5
120.21	35.24	43.50	8.26	15000.0	99.7	V	171.0	-22.9
131.85	34.90	43.50	8.60	15000.0	200.1	Н	188.0	-20.0
348.16	35.38	46.00	10.62	15000.0	99.8	H	154.0	-17.7
372.41	44.37	46.00	1.63	15000.0	99.8	Н	140.0	-16.7

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3.4.4.3.4 Test Data for 30 MHz ~ 1000 MHz for RFID + WLAN Mode

•. Detector

•.Result

: Quasi-Peak (6 dB Bandwidth: 120 kHz)

- •.Measurement distance
 - : 30 MHz ~ 1000 MHz
- •.Operating Condition

•.Frequency range

- : Highest Output Power Transmitting Mode
- : PASS

: 3 m

Final Result QPK

30 MHz ~ 1 000 MHz_FCC_CLASS B

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
83.35	24.47	40.00	15.53	15000.0	300.0	Н	344.0	-26.0
95.96	41.34	43.50	2.16	15000.0	200.1	Η	326.0	-23.5
107.60	27.33	43.50	16.17	15000.0	200.1	Η	111.0	-22.6
119.24	27.80	43.50	15.70	15000.0	300.0	H	95.0	-23.0
131.85	28.28	43.50	15.22	15000.0	200.1	Η	233.0	-20.0
263.77	24.23	46.00	21.77	15000.0	99.8	Н	169.0	-20.0
396.66	36.94	46.00	9.06	15000.0	99.8	Н	137.0	-16.2

RE Test Report

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3.4.4.3.5 Test Data for Avove 1 GHz for RFID + WLAN Mode

: PASS

- •. Detector : Peak, Average (6 dB Bandwidth: 1 MHz)
- •.Measurement distance : 3 m
- •.Frequency range : 1 GHz ~ 6 GHz
- •.Operating Condition : Highest Output Power Transmitting Mode
- •.Result : PASS
- •.Result
- •. 1 GHz ~ 6 GHz

EMI TEST Report

1 GHz above_FCC CLASS B_AV Final_Result CAV

Critical Freqs

Frequency (MHz)	MaxPeak (dBuV/m)	CAverage (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1820.00	46.52		74.00	27.48	-	100.0	н	267.0	-8.0
1978.13	50.52	-	74.00	23.48	-	400.0	v	18.0	-7.4
1978.13		48.66	54.00	5.34		400.0	v	18.0	-7.4
2410.63		39.49	54.00	14.51	-	100.0	v	2.0	-7.1
5678.75	47.18		74.00	26.82	-	400.0	н	159.0	0.2
5685.63	1	40.08	54.00	13.92	1	100.0	н	61.0	0.2

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3.4.4.3.6 Test Data for Avove 1 GHz for RFID Mode

- •. Detector: Peak, Average (6 dB Bandwidth: 1 MHz)•.Measurement distance: 3 m•.Frequency range: 1 GHz ~ 26.5 GHz
- •.Operating Condition : Highest Output Power Transmitting Mode
- •.Result : PASS
- •.Result : PASS

Frequency	Reading	Ant. Pol.	Ant. Factor	Cable	Amp	Emission	Limits	Margin			
(MHz)	(dBµV)	(H/V)	(dB/m)	Loss	Gain	Level(dBµV/m)	(dBµV/m)	(dB)			
	Emissions observed were 20dB below the limit and thus not reported										

3.6 Conducted Emission Test

3.6.1 Requirement

• FCC Part15 subpart C Section 15.207

3.6.2 Test Procedure

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50 Ω / 50 μ H + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

3.6.3 Test data

- Not tested as it is a DC power supply and is not intended for use in vehicles.

3.7 Antenna Requirement

3.7.1 Requirement

• FCC Part15 subpart C Section 15.203

• An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

3.7.2 Result

• The antenna of the EUT is a Patch Antenna on the board in the EUT.

4. Test equipment list

Use	Model Number	Manufacturer	Description	Serial Number	Cal. Date.(Interval)
\boxtimes	AMP 20-1000	INFINITECH	BROADBAND PRE-AMP	2013 05 00003	Jan 14, 2021(1Y)
\boxtimes	GP-4303DU	EZ Digital Co.,Ltd.	DC Power Supply	2100196	Jan 14, 2021(1Y)
\boxtimes	DS 2000S	Innco GmbH	Turn Table	N/A	N/A
\boxtimes	MA4000-EP-HS	Innco GmbH	Antenna Mast	N/A	N/A
\boxtimes	MA4640-XP-ET	Innco GmbH	Tilt Antenna Mast	N/A	N/A
\boxtimes	CO3000	Innco GmbH	Controller	N/A	N/A
\boxtimes	CO3000	Innco GmbH	Controller	N/A	N/A
\boxtimes	N9020A	Agilent	Spectrum Analyzer	MY50200260	Jan 14, 2021(1Y)
\boxtimes	6502	EMCO	Loop Antenna	9609-3087	Nov 12, 2019(2Y)
\boxtimes	VULB 9168	SCHWARZBECK	Trilog-Broadband Antenna	9168-735	Nov 19, 2019(2Y)
\boxtimes	8449B	Agilent	Preamplifier	3008A02013	Jan 14, 2021(1Y)
\boxtimes	3115	ETS	Horn Antenna	9402-4229	July 28, 2020(2Y)
\boxtimes	ESCI7	Rohde & Schwarz	EMI Test Receiver	100938	Jan 14, 2021(1Y)
	ESH-Z2	Rohde & Schwarz	Pulse Limter	101631	Jan 14, 2021(1Y)
	ENV216	Rohde & Schwarz	LISN	101264	July 14, 2021(1Y)
	ES-SCAN	Rohde & Schwarz	EMI Software	N/A	N/A
\boxtimes	EMC32	Rohde & Schwarz	EMI Software	N/A	N/A
\boxtimes	FSV	Rohde & Schwarz	Spectrum Analyzer	101673	Jan 14, 2021(1Y)