

ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No. : OT-206-RWD-003
AGR No. : A204A-242
Applicant : SEONG JI INDUSTRIAL CO., LTD
Address : 54-33, Dongtanhana 1-gil, Gyeonggi-do, Hwaseong-si, South Korea
Manufacturer : SEONG JI INDUSTRIAL CO., LTD
Address : 54-33, Dongtanhana 1-gil, Gyeonggi-do, Hwaseong-si, South Korea
Type of Equipment : Asset Tracker
FCC ID. : 2AS8LIET10MO
Model Name : IET10MO
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 24 pages (including this page)
Date of Incoming : May 20, 2020
Date of issue : June 01, 2020

SUMMARY

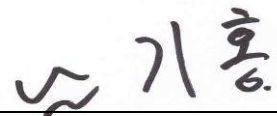
The equipment complies with the regulation; *FCC PART 15 SUBPART C Section 15.247*
 This test report only contains the result of a single test of the sample supplied for the examination.
 It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by:



Tae-Ho, Kim / Senior Manager
ONETECH Corp.

Approved by:



Ki-Hong, Nam / Chief Engineer
ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-206-RWD-003	June 01, 2020	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : SEONG JI INDUSTRIAL CO., LTD
 Address : 54-33, Dongtanhana 1-gil, Gyeonggi-do, Hwaseong-si, South Korea
 Manufacturer : SEONG JI INDUSTRIAL CO., LTD
 Address : 54-33, Dongtanhana 1-gil, Gyeonggi-do, Hwaseong-si, South Korea
 Contact Person : Sangyoung, Lee / Senior researcher
 Telephone No. : +82-70-7837-2853
 FCC ID : 2AS8LIET10MO
 Model Name : IET10MO
 Brand Name : -
 Serial Number : N/A
 Date : June 01, 2020

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Asset Tracker
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 558074 D01 15.247 Meas Guidance v05r02
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	Minimum 6 dB Bandwidth	N/A (See Note)
15.247 (b) (3)	Maximum Peak Conducted Output Power	N/A (See Note)
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	N/A (See Note)
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (e)	Peak Power Spectral Density	N/A (See Note)
15.209	Radiated Emission Limits	Met the Limit / PASS
15.207	Conducted Limits	N/A (See Note)
15.203	Antenna Requirement	N/A (See Note)

Note: The EUT have a RF Test already approved. (Model: SRM200A / FCC ID: 2AS8LSRM200A)

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247.

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea.

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666/ T-11842

ISED (Innovation, Science and Economic Development Canada) – Registration No. Site# 3736A-3

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The SEONG JI INDUSTRIAL CO., LTD, Model IET10MO (referred to as the EUT in this report) is a Asset Tracker. The product specification described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	Asset Tracker			
Temperature Range	-30 °C ~ 60 °C			
OPERATING FREQUENCY	Sig Fox	902.137 5 MHz ~ 904.662 5 MHz (RC2) 920.737 5 MHz ~ 923.262 5 MHz (RC4)		
	Bluetooth LE	2 402 MHz ~ 2 480 MHz		
	WLAN 2.4 GHz	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))		
MODULATION TYPE	Sig Fox	DBPSK		
	Bluetooth LE	GFSK		
	WLAN 2.4 GHz	802.11b: DSSS Modulation(DBPSK/DQPSK/CCK) 802.11g/n(HT20): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)		
RF OUTPUT POWER	Sig Fox	25.364 dBm		
	Bluetooth LE	Peak	3.68 dBm	
		Average	3.60 dBm	
	WLAN 2.4 GHz	Peak	17.38 dBm(802.11b) 20.05 dBm(802.11g) 19.91 dBm(802.11n_HT20)	
			Average	11.55 dBm(802.11b) 12.17 dBm(802.11g) 12.09 dBm(802.11n_HT20)
		ANTENNA TYPE		Sig Fox : Metal Antenna Bluetooth LE / WLAN 2.4 GHz : Chip Antenna GPS : Ceramic Patch Antenna
ANTENNA GAIN		Sig Fox: 2.50 dBi Bluetooth LE: 2.50 dBi WLAN 2.4 GHz: 2.50 dBi		
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	32.768 kHz, 26 MHz, 32 MHz			

3.2 Alternative type(s)/model(s); also covered by this test report.

-. None

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	SEONG JI INDUSTRIAL CO., LTD	IET10MO Rev0.9b	N/A
Module	SEONG JI INDUSTRIAL CO., LTD	SRM200A	2AS8LSRM200A

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
IET10MO	SEONG JI INDUSTRIAL CO., LTD	Asset Tracker(EUT)	-
nRF52840-Preview-DK	NORDIC SEMICONDUCTOR	Jig Board	EUT
T10 DL Board V3	N/A	Jig Board	EUT
HP Probook	HP	Notebook PC	-
PPP009C	LIE-ON TECHNOLOGY (CHANGZHOU)CO.,LTD.	AC Adapter	-

5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting mode is programmed.

- The worse case data rate for each modulation is determined 1 Mbps for IEEE 802.11b, 6 Mbps for IEEE 802.11g, 6.5 Mbps for HT20.
- To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XY” axis.
- Channel List(WLAN 2.4 GHz)

Channel	Frequency[MHz]	Channel	Frequency[MHz]	Channel	Frequency[MHz]
1	2 412.00	5	2 432.00	9	2 452.00
2	2 417.00	6	2 437.00	10	2 457.00
3	2 422.00	7	2 442.00	11	2 462.00
4	2 427.00	8	2 447.00		

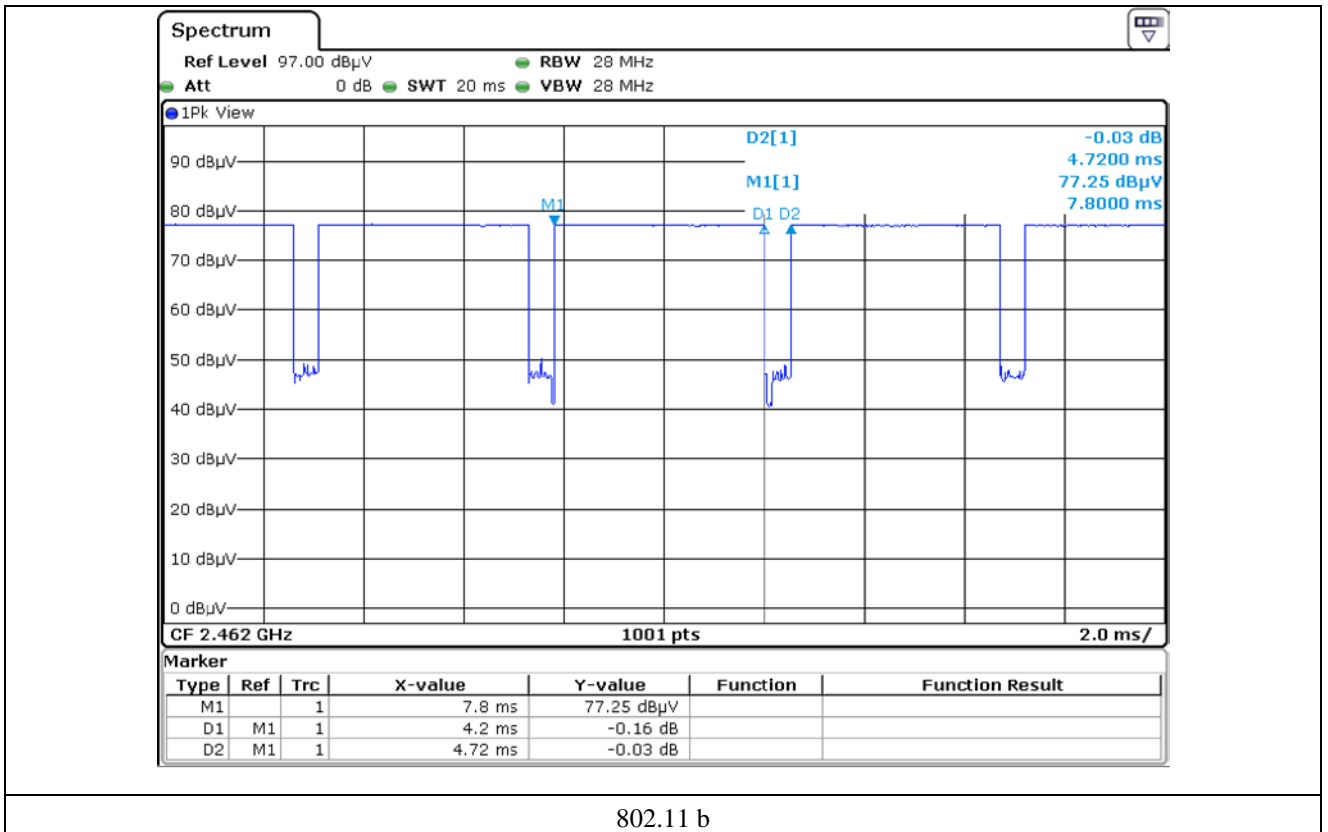
- Duty Cycle

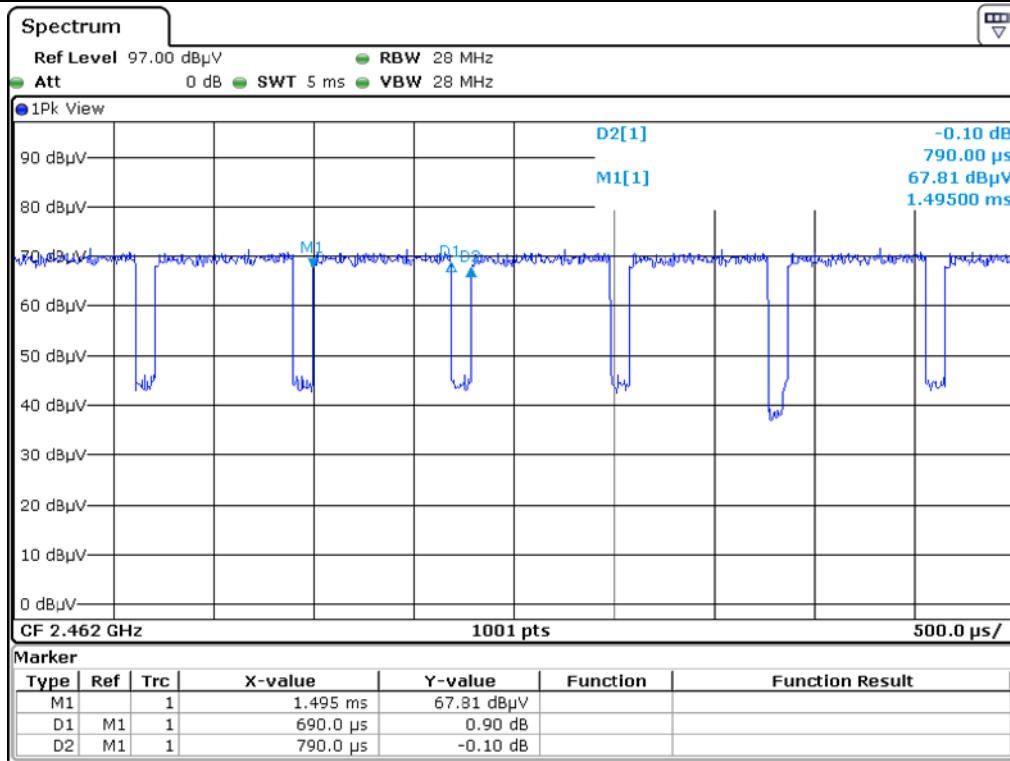
Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
802.11 b	4.200	0.520	88.98	0.51
802.11 g	0.690	0.100	87.34	0.59
802.11 n(HT20)	0.655	0.105	86.18	0.65

Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) * 100

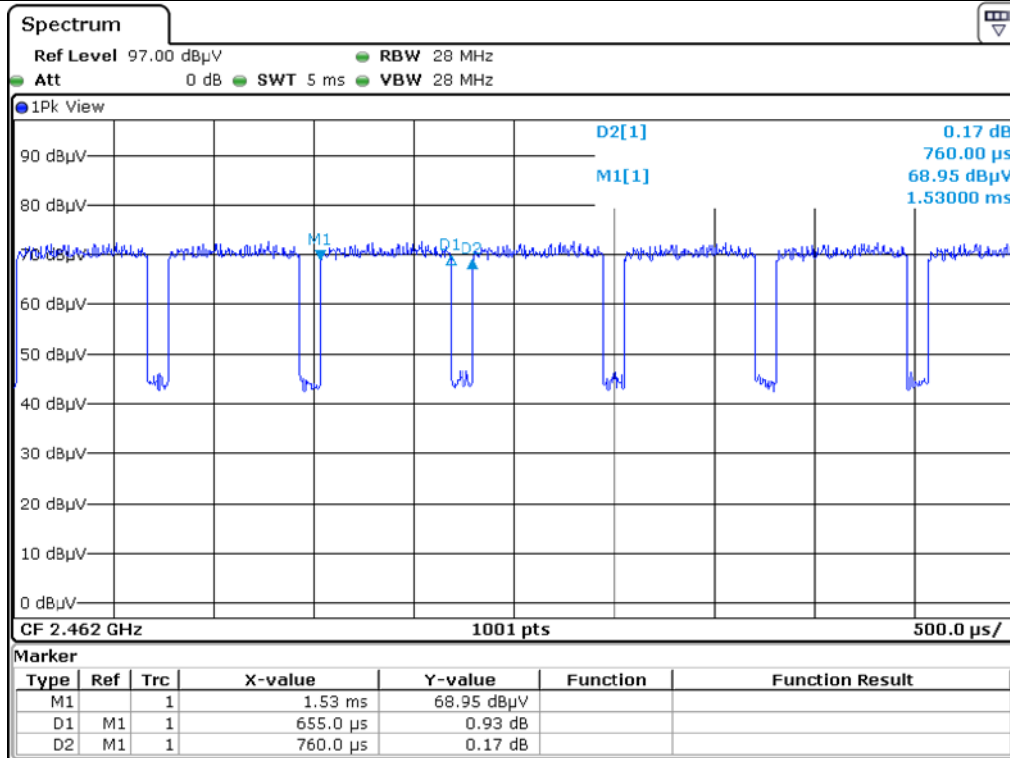
Correction Factor : 10 * Log(1 / (Duty Cycle / 100))

- Test Plot





802.11 g



802.11 n(HT20)

5.4 Configuration of Test System

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

For intentional device, according to 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 the device.

Antenna Construction:

The antenna of the EUT is Chip Antenna on the main board in the EUT, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

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

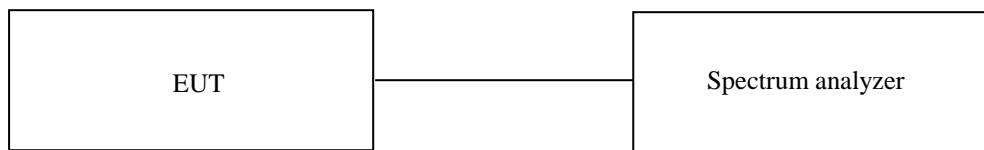
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 24.3 °C
 Relative humidity : 43.9 % R.H.

9.2 Test set-up for conducted measurement

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



9.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

The frequency spectrum from 30 MHz to 26.5 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.

9.4 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Feb. 21, 2020 (1Y)
■ - ESW	Rohde & Schwarz	EMI Test Receiver	101851	Aug. 07, 2019 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 16, 2020 (1Y)
■ - BBV 9718B	Schwarzbeck	Broadband Preamplifier	00009	Mar. 16, 2020 (1Y)
■ - SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Feb. 20, 2020 (1Y)
■ - SCU18	Rohde & Schwarz	Signal Conditioning unit	102266	Jul. 24, 2019 (1Y)
■ - DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ - MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	777	Apr. 08, 2020 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1366	Jul. 16, 2019 (1Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 07, 2020 (1Y)

All test equipment used is calibrated on a regular basis.

9.6 Test data for radiated emission

9.6.1 Radiated Emission which fall in the Restricted Band

9.6.1.1 Test data for 802.11b WLAN Mode

- Test Date : May 21, 2020 ~ May 25, 2020
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : 88.98 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 387.243	16.83	Peak	H	26.94	9.20	-	52.97	74.00	21.03
2 387.163	8.92	Average	H	26.94	9.20	0.51	45.57	54.00	8.43
2 387.003	14.35	Peak	V	26.94	9.20	-	50.49	74.00	23.51
2 387.163	6.98	Average	V	26.94	9.20	0.51	43.63	54.00	10.37
Test Data for High Channel									
2 487.398	17.49	Peak	H	27.47	9.49	-	54.45	74.00	19.55
2 487.712	8.36	Average	H	27.47	9.49	0.51	45.83	54.00	8.17
2 488.025	15.11	Peak	V	27.47	9.49	-	52.07	74.00	21.93
2 487.613	7.11	Average	V	27.47	9.49	0.51	44.58	54.00	9.42

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} + \text{Correction Factor}$$



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.1.2 Test data for 802.11g WLAN Mode

- Test Date : May 21, 2020 ~ May 25, 2020
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : 87.34 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 389.960	27.19	Peak	H	26.94	9.20	-	63.33	74.00	10.67
2 389.960	13.97	Average	H	26.94	9.20	0.59	50.70	54.00	3.30
2 389.960	26.56	Peak	V	26.94	9.20	-	62.70	74.00	11.30
2 389.960	13.18	Average	V	26.94	9.20	0.59	49.91	54.00	4.09
Test Data for High Channel									
2 484.563	26.98	Peak	H	27.47	9.49	-	63.94	74.00	10.06
2 483.508	12.40	Average	H	27.47	9.49	0.59	49.95	54.00	4.05
2 484.662	25.75	Peak	V	27.47	9.49	-	62.71	74.00	11.29
2 483.508	12.10	Average	V	27.47	9.49	0.59	49.65	54.00	4.35

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} + \text{Correction Factor}$$



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.1.3 Test data for 802.11n_HT20 WLAN Mode

- Test Date : May 21, 2020 ~ May 25, 2020
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : 86.18 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 389.960	26.08	Peak	H	26.94	9.20	-	62.22	74.00	11.78
2 389.960	12.93	Average	H	26.94	9.20	0.65	49.72	54.00	4.28
2 389.960	25.70	Peak	V	26.94	9.20	-	61.84	74.00	12.16
2 389.960	12.19	Average	V	26.94	9.20	0.65	48.98	54.00	5.02
Test Data for High Channel									
2 483.508	26.17	Peak	H	27.47	9.49	-	63.13	74.00	10.87
2 483.508	12.56	Average	H	27.47	9.49	0.65	50.17	54.00	3.83
2 483.558	25.86	Peak	V	27.47	9.49	-	62.82	74.00	11.18
2 483.508	12.19	Average	V	27.47	9.49	0.65	49.80	54.00	4.20

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} + \text{Correction Factor}$$



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.2 Spurious & Harmonic Radiated Emission

9.6.2.1 Test data for 802.11b WLAN Mode

- Test Date : May 21, 2020 ~ May 25, 2020
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : 88.98 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	17.98	Peak	H	28.84	10.31	-	57.13	74.00	16.87
4 824.00	9.50	Average	H	28.84	10.31	0.51	49.16	54.00	4.84
4 824.00	18.10	Peak	V	28.84	10.31	-	57.25	74.00	16.75
4 824.00	9.48	Average	V	28.84	10.31	0.51	49.14	54.00	4.86
Test Data for Middle Channel									
4 884.00	17.56	Peak	H	28.01	10.43	-	56.00	74.00	18.00
4 884.00	8.91	Average	H	28.01	10.43	0.51	47.86	54.00	6.14
4 884.00	17.65	Peak	V	28.01	10.43	-	56.09	74.00	17.91
4 884.00	9.09	Average	V	28.01	10.43	0.51	48.04	54.00	5.96
Test Data for High Channel									
4 924.00	17.41	Peak	H	29.15	10.81	-	57.37	74.00	16.63
4 924.00	9.05	Average	H	29.15	10.81	0.51	49.52	54.00	4.48
4 924.00	17.74	Peak	V	29.15	10.81	-	57.70	74.00	16.30
4 924.00	9.41	Average	V	29.15	10.81	0.51	49.88	54.00	4.12

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} + \text{Correction Factor}$$



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.2.2 Test data for 802.11g WLAN Mode

- . Test Date : May 21, 2020 ~ May 25, 2020
- . Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Duty Cycle : 87.34 %
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	17.30	Peak	H	28.84	10.31	-	56.45	74.00	17.55
4 824.00	9.24	Average	H	28.84	10.31	0.59	48.98	54.00	5.02
4 824.00	18.07	Peak	V	28.84	10.31	-	57.22	74.00	16.78
4 824.00	9.36	Average	V	28.84	10.31	0.59	49.10	54.00	4.90
Test Data for Middle Channel									
4 884.00	16.98	Peak	H	28.01	10.43	-	55.42	74.00	18.58
4 884.00	8.97	Average	H	28.01	10.43	0.59	48.00	54.00	6.00
4 884.00	16.53	Peak	V	28.01	10.43	-	54.97	74.00	19.03
4 884.00	8.56	Average	V	28.01	10.43	0.59	47.59	54.00	6.41
Test Data for High Channel									
4 924.00	16.97	Peak	H	29.15	10.81	-	56.93	74.00	17.07
4 924.00	8.92	Average	H	29.15	10.81	0.59	49.47	54.00	4.53
4 924.00	17.25	Peak	V	29.15	10.81	-	57.21	74.00	16.79
4 924.00	9.10	Average	V	29.15	10.81	0.59	49.65	54.00	4.35

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} + \text{Correction Factor}$$



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.2.3 Test data for 802.11n_HT20 WLAN Mode

- . Test Date : May 21, 2020 ~ May 25, 2020
- . Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Duty Cycle : 86.18 %
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Correction Factor	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	17.22	Peak	H	28.84	10.31	-	56.37	74.00	17.63
4 824.00	9.48	Average	H	28.84	10.31	0.65	49.28	54.00	4.72
4 824.00	16.95	Peak	V	28.84	10.31	-	56.10	74.00	17.90
4 824.00	9.26	Average	V	28.84	10.31	0.65	49.06	54.00	4.94
Test Data for Middle Channel									
4 884.00	16.32	Peak	H	28.01	10.43	-	54.76	74.00	19.24
4 884.00	8.97	Average	H	28.01	10.43	0.65	48.06	54.00	5.94
4 884.00	17.08	Peak	V	28.01	10.43	-	55.52	74.00	18.48
4 884.00	8.46	Average	V	28.01	10.43	0.65	47.55	54.00	6.45
Test Data for High Channel									
4 924.00	16.98	Peak	H	29.15	10.81	-	56.94	74.00	17.06
4 924.00	8.87	Average	H	29.15	10.81	0.65	49.48	54.00	4.52
4 924.00	16.50	Peak	V	29.15	10.81	-	56.46	74.00	17.54
4 924.00	8.26	Average	V	29.15	10.81	0.65	48.87	54.00	5.13

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} + \text{Correction Factor}$$



Tested by: Hyung-Kwon, Oh / Assistant Manager

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 24 °C
 Relative humidity : 43 % R.H.

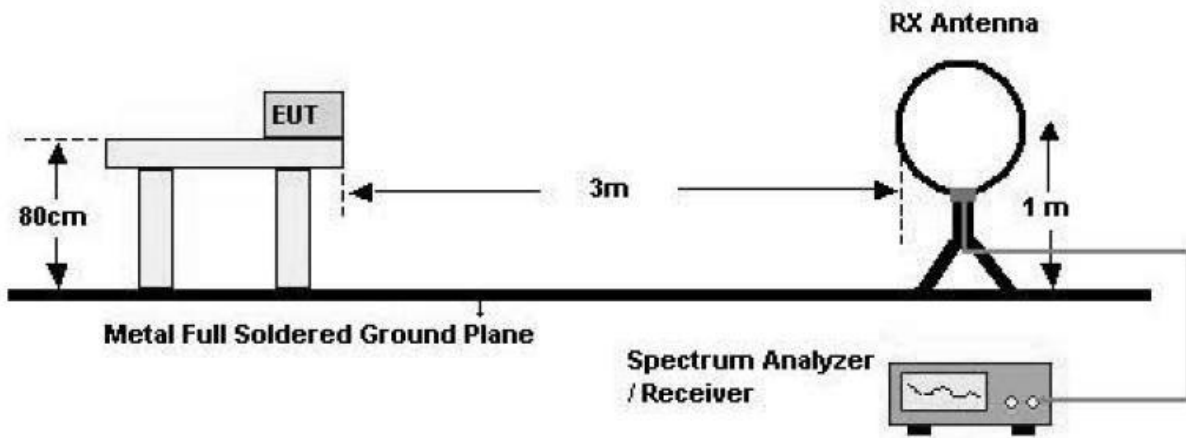
11.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

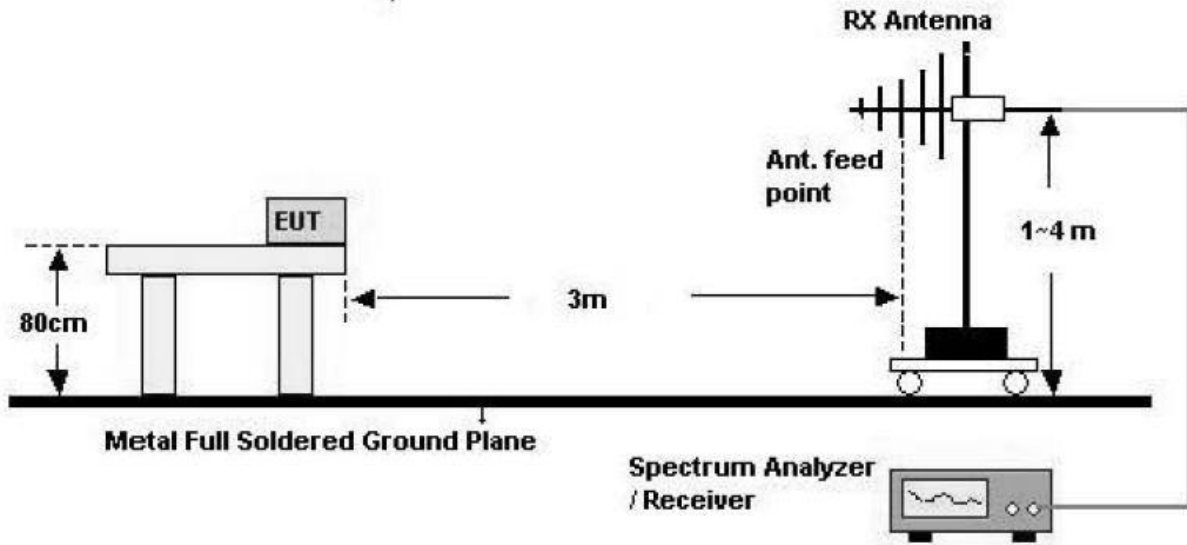
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

- Test Configuration

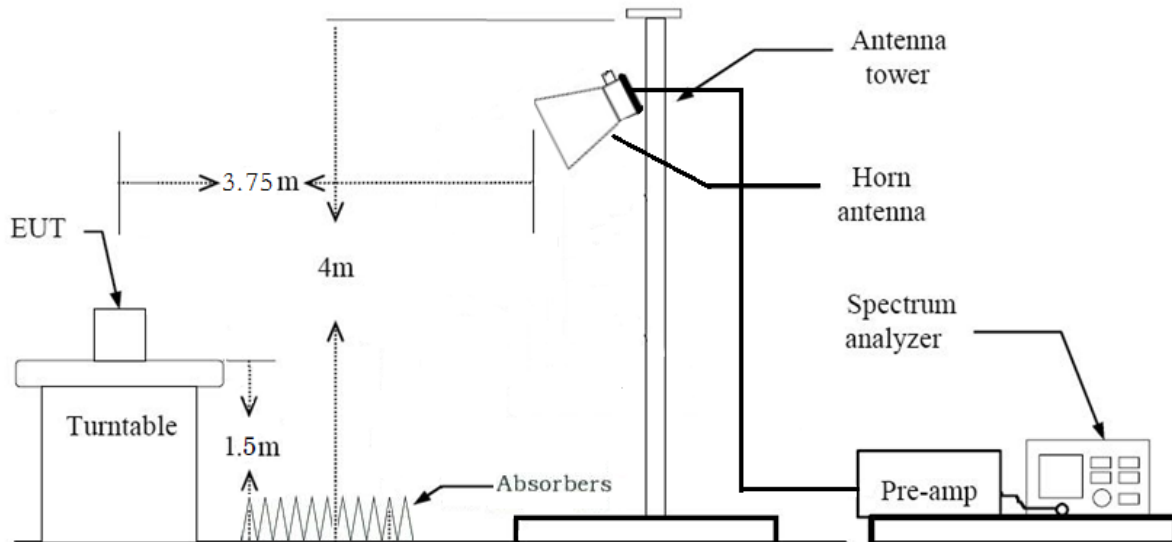
1. Below 30 MHz



2. 30 MHz - 1 GHz



3. Above 1 GHz



11.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Feb. 21, 2020 (1Y)
■ - ESW	Rohde & Schwarz	EMI Test Receiver	101851	Aug. 07, 2019 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 16, 2020 (1Y)
■ - BBV 9718B	Schwarzbeck	Broadband Preamplifier	00009	Mar. 16, 2020 (1Y)
■ - SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Feb. 20, 2020 (1Y)
■ - SCU18	Rohde & Schwarz	Signal Conditioning unit	102266	Jul. 24, 2019 (1Y)
■ - DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ - MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	777	Apr. 08, 2020 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1366	Jul. 16, 2019 (1Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 07, 2020 (1Y)

All test equipment used is calibrated on a regular basis.

11.4 Test data

11.4.1 Test data for 30 MHz ~ 1 GHz

Humidity Level : 43 % R.H. Temperature: 24 °C

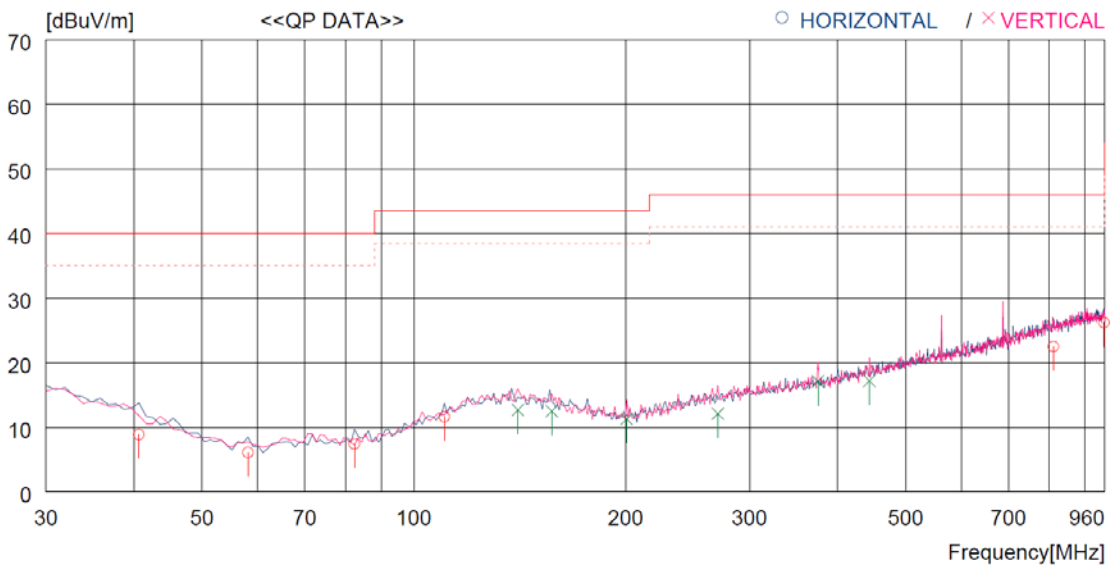
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : Asset Tracker Date: May 21, 2020 ~ May 25, 2020

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

Operating mode : Transmitting mode



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	40.670	21.0	19.0	1.4	32.5	8.9	40.0	31.1	200	320
2	58.130	17.7	19.2	1.7	32.5	6.1	40.0	33.9	100	94
3	82.380	23.3	14.7	1.9	32.5	7.4	40.0	32.6	300	359
4	110.510	26.1	15.8	2.2	32.5	11.6	43.5	31.9	400	2
5	811.812	21.0	28.3	5.4	32.2	22.5	46.0	23.5	200	216
6	957.307	21.5	29.5	6.4	31.2	26.2	46.0	19.8	300	33
----- Vertical -----										
7	140.580	24.5	18.4	2.3	32.5	12.7	43.5	30.8	300	351
8	157.070	23.6	19.0	2.4	32.5	12.5	43.5	31.0	400	256
9	200.720	25.2	15.8	2.8	32.5	11.3	43.5	32.2	100	0
10	270.560	22.9	18.4	3.2	32.4	12.1	46.0	33.9	100	0
11	375.320	24.8	21.0	3.8	32.5	17.1	46.0	28.9	100	0
12	444.191	22.7	22.8	4.1	32.4	17.2	46.0	28.8	200	359

Tested by: Hyung-Kwon, Oh / Assistant Manager

11.4.2 Test data for Below 30 MHz

- . Test Date : May 21, 2020 ~ May 25, 2020
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

Frequency (MHz)	Reading (dB μ V)	Ant. Pol. (H/V)	Ant. Height (m)	Angle ($^{\circ}$)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.									

11.4.3 Test data for above 1 GHz

- . Test Date : May 21, 2020 ~ May 25, 2020
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

Frequency (MHz)	Reading (dB μ V)	Ant. Pol. (H/V)	Ant. Height (m)	Angle ($^{\circ}$)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.									



Tested by: Hyung-Kwon, Oh / Assistant Manager