

RADIO PERFORMANCE TEST REPORT (CLASS I Permissive Change)

Test Report No. : OT-227-RWD-022

Reception No. : 2207002152

Applicant : SJI Co., Ltd.

Address : 54-33, Dongtanhana 1-gil, Gyeonggi-do, Hwaseong-si, South Korea

Manufacturer : SJI 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 : 21 pages (including this page)

Date of Incoming : May 20, 2020

Date of issue : July 08, 2022

SUMMARY

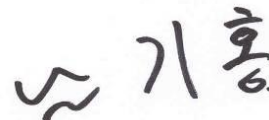
The equipment complies with the regulation; ***FCC PART 15 SUBPART C Section 15.247***

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 / General Manager
ONETECH Corp.



Approved by
Ki-Hong, Nam / General Manager
ONETECH Corp.

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OTC-TRF-RF-001(0)

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

CONTENTS

PAGE

1. VERIFICATION OF COMPLIANCE	5
2. TEST SUMMARY	6
2.1 TEST ITEMS AND RESULTS	6
2.2 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS	6
2.3 RELATED SUBMITTAL(S) / GRANT(S)	6
2.4 PURPOSE OF THE TEST	6
2.5 TEST METHODOLOGY	6
2.6 TEST FACILITY	7
3. GENERAL INFORMATION	8
3.1 PRODUCT DESCRIPTION	8
3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT	8
4. EUT MODIFICATIONS	9
5. SYSTEM TEST CONFIGURATION	10
5.1 JUSTIFICATION	10
5.2 PERIPHERAL EQUIPMENT	10
5.3 MODE OF OPERATION DURING THE TEST	10
5.4 CONFIGURATION OF TEST SYSTEM	13
6. PRELIMINARY TEST	13
6.1 GENERAL RADIATED EMISSIONS TESTS	13
7. 100 KHZ BANDWIDTH OUTSIDE THE FREQUENCY BAND	14
7.1 OPERATING ENVIRONMENT	14
7.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	14
7.3 TEST SET-UP FOR RADIATED MEASUREMENT	14
7.4 TEST EQUIPMENT USED	14
7.5 TEST DATA FOR RADIATED EMISSION	15
7.5.1 Radiated Emission which fall in the Restricted Band	15
7.5.2 Spurious & Harmonic Radiated Emission	16
8. RADIATED EMISSION TEST	17
8.1 OPERATING ENVIRONMENT	17
8.2 TEST SET-UP	17
8.4 TEST DATA	20
8.4.1 Test data for 30 MHz ~ 1 GHz	20

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OTC-TRF-RF-001(0)

<i>8.4.2 Test data for Below 30 MHz</i>	21
<i>8.4.3 Test data for above 1 GHz</i>	21

Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-206-RWD-002	June 01, 2020	Initial Release	All
1	OT-227-RWD-022	July 08, 2022	Changed company name. (Class I Permissive Change)	All

1. VERIFICATION OF COMPLIANCE

Applicant : SJI Co., Ltd.
Address : 54-33, Dongtanhana 1-gil, Gyeonggi-do, Hwaseong-si, South Korea
Manufacturer : SJI 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 : July 08, 2022

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Asset Tracker
THIS REPORT CONCERNS	Class I Permissive Change
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)

-. CLASS I Permissive Change:

The EUT was granted on June 03, 2020 but only following modifications and/or changed items are implemented into the device.

Changed item	Changed company name.
--------------	-----------------------

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-20122/ 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 SJI 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

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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	SJI Co., Ltd.	IET10MO Rev0.9b	N/A
Module	SJI 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	SJI 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 is programmed.

For final testing, the EUT was set at 2 402 MHz, 2 440 MHz, and 2 480 MHz 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 “XZ” axis, but the worst data was recorded in this report.

-. Channel List(Bluetooth LE)

Channel	Frequency[MHz]	Channel	Frequency[MHz]	Channel	Frequency[MHz]
0	2 402.00	14	2 430.00	28	2 458.00
1	2 404.00	15	2 432.00	29	2 460.00
2	2 406.00	16	2 434.00	30	2 462.00
3	2 408.00	17	2 436.00	31	2 464.00
4	2 410.00	18	2 438.00	32	2 466.00
5	2 412.00	19	2 440.00	33	2 468.00
6	2 414.00	20	2 442.00	34	2 470.00
7	2 416.00	21	2 444.00	35	2 472.00
8	2 418.00	22	2 446.00	36	2 474.00
9	2 420.00	23	2 448.00	37	2 476.00
10	2 422.00	24	2 450.00	38	2 478.00
11	2 424.00	25	2 452.00	39	2 480.00
12	2 426.00	26	2 454.00		
13	2 428.00	27	2 456.00		

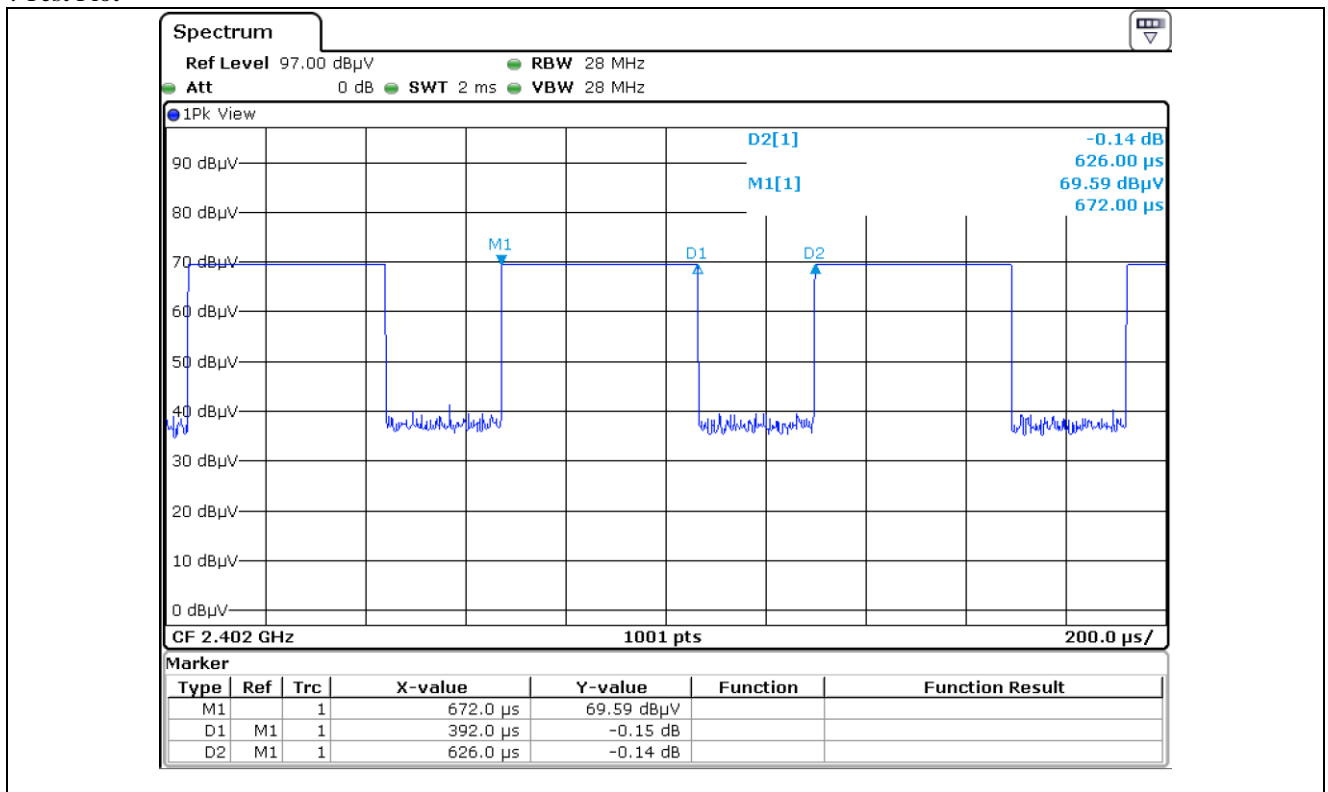
-. Duty Cycle

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Bluetooth LE	0.392	0.234	62.62	2.03

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

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

-. Test Plot



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

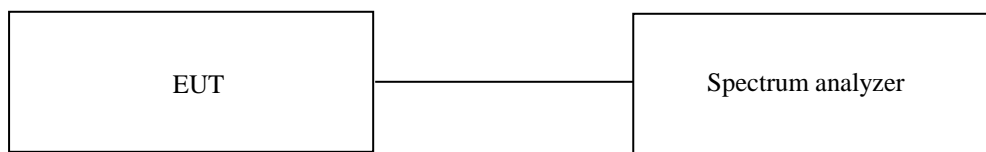
7. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

7.1 Operating environment

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

7.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, the video bandwidth is set to 3 times the resolution bandwidth and peak detection was used.



7.3 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.

7.4 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.

7.5 Test data for radiated emission

7.5.1 Radiated Emission which fall in the Restricted Band

- 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 : 62.62 %
- 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									
2 390.000	17.69	Peak	H	26.94	9.20	-	53.83	74.00	20.17
2 390.000	6.15	Average	H	26.94	9.20	2.03	44.32	54.00	9.68
2 390.000	17.42	Peak	V	26.94	9.20	-	53.56	74.00	20.44
2 390.000	5.97	Average	V	26.94	9.20	2.03	44.14	54.00	9.86
Test Data for High Channel									
2 483.508	33.87	Peak	H	27.47	9.49	-	70.83	74.00	3.17
2 483.508	10.23	Average	H	27.47	9.49	2.03	49.22	54.00	4.78
2 483.508	33.21	Peak	V	27.47	9.49	-	70.17	74.00	3.83
2 483.508	10.10	Average	V	27.47	9.49	2.03	49.09	54.00	4.91

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

7.5.2 Spurious & Harmonic Radiated Emission

- Test Date : May 21, 2020 ~ May 25, 2020
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
1 MHz 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 : 62.62 %
- Result : PASSED

Frequency (GHz)	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									
4 804.00	14.32	Peak	H	28.84	10.31	-	53.47	74.00	20.53
4 804.00	5.12	Average	H	28.84	10.31	2.03	46.30	54.00	7.70
4 804.00	14.17	Peak	V	28.84	10.31	-	53.32	74.00	20.68
4 804.00	5.22	Average	V	28.84	10.31	2.03	46.40	54.00	7.60
Test Data for Middle Channel									
4 880.00	14.36	Peak	H	28.01	10.43	-	52.80	74.00	21.20
4 880.00	4.89	Average	H	28.01	10.43	2.03	45.36	54.00	8.64
4 880.00	14.26	Peak	V	28.01	10.43	-	52.70	74.00	21.30
4 880.00	5.35	Average	V	28.01	10.43	2.03	45.82	54.00	8.18
Test Data for High Channel									
4 960.00	14.46	Peak	H	29.15	10.81	-	54.42	74.00	19.58
4 960.00	5.03	Average	H	29.15	10.81	2.03	47.02	54.00	6.98
4 960.00	14.09	Peak	V	29.15	10.81	-	54.05	74.00	19.95
4 960.00	4.96	Average	V	29.15	10.81	2.03	46.95	54.00	7.05

Tabulated test data for Restricted Band

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

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

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


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8. RADIATED EMISSION TEST

8.1 Operating environment

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

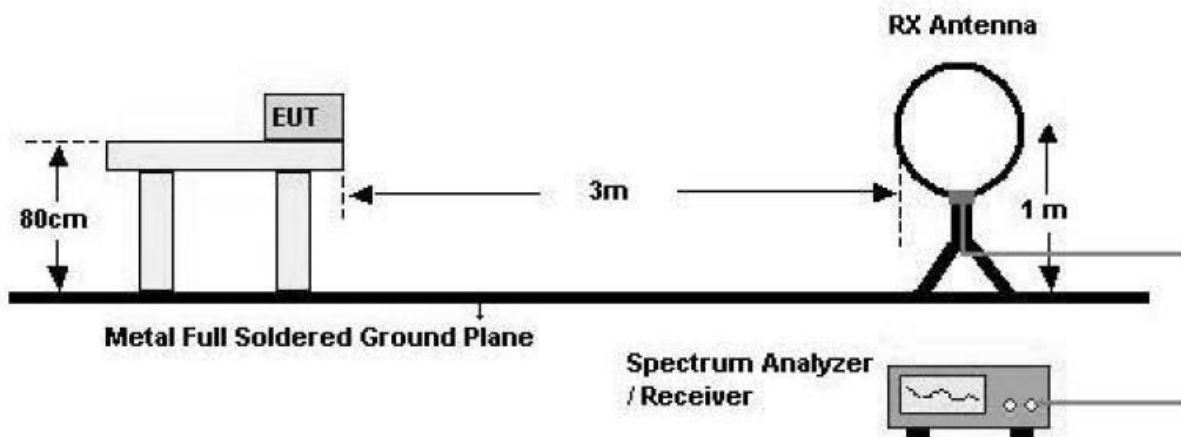
8.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive 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.

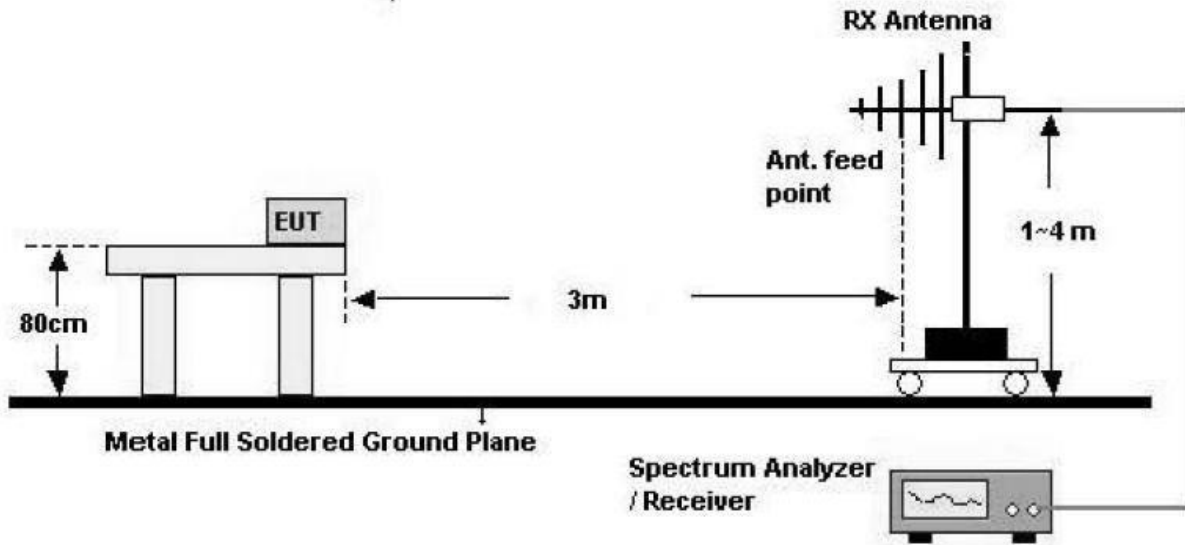
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal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

- Test Configuration

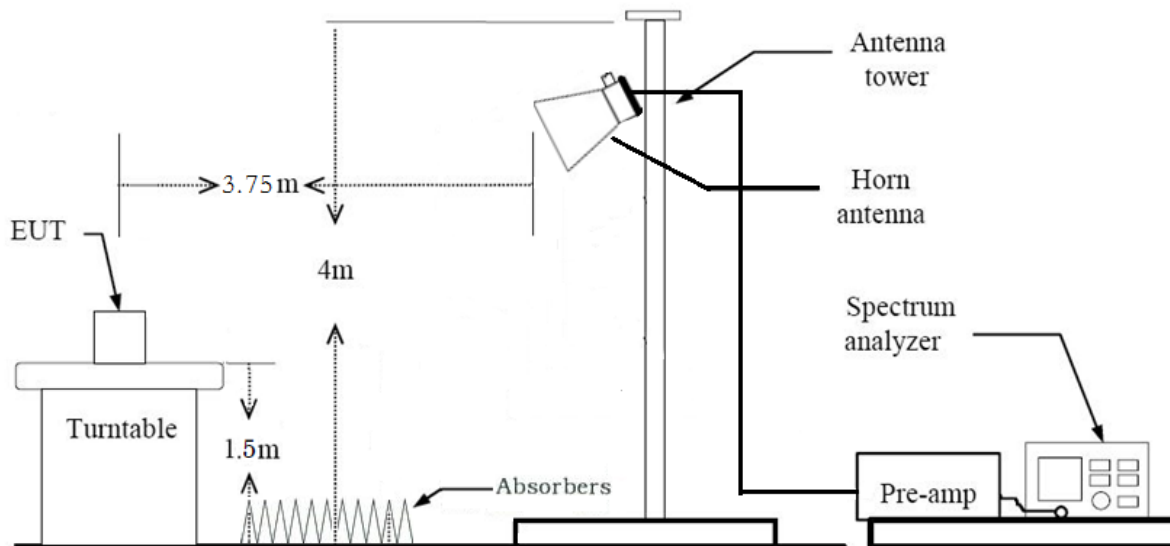
1. Below 30 MHz



2. 30 MHz - 1 GHz



3. Above 1 GHz



8.3 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.

8.4 Test data

8.4.1 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

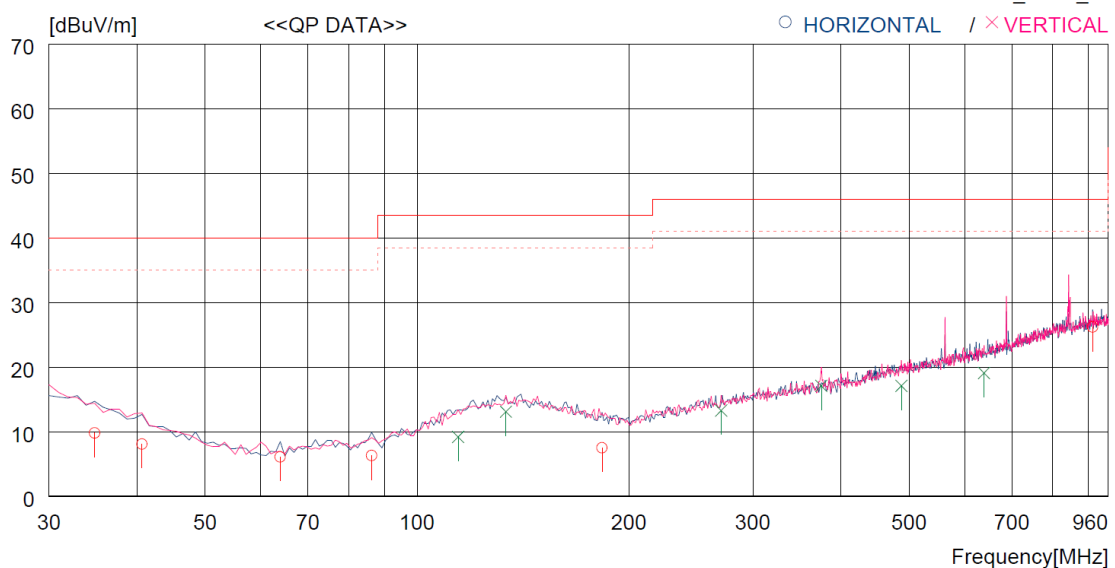
Result : PASSED

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	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	34.850	22.9	18.1	1.3	32.5	9.8	40.0	30.2	400	0
2	40.670	20.2	19.0	1.4	32.5	8.1	40.0	31.9	400	0
3	63.950	18.3	18.6	1.7	32.5	6.1	40.0	33.9	400	60
4	86.260	22.9	14.0	1.9	32.5	6.3	40.0	33.7	400	338
5	183.260	20.2	17.2	2.6	32.5	7.5	43.5	36.0	100	359
6	911.719	22.8	29.1	5.9	31.6	26.2	46.0	19.8	100	359
----- Vertical -----										
7	114.390	23.3	16.2	2.2	32.5	9.2	43.5	34.3	300	0
8	133.790	25.5	17.9	2.2	32.5	13.1	43.5	30.4	300	330
9	270.560	24.1	18.4	3.2	32.4	13.3	46.0	32.7	100	83
10	375.320	24.8	21.0	3.8	32.5	17.1	46.0	28.9	100	191
11	487.841	22.0	23.5	4.2	32.6	17.1	46.0	28.9	300	0
12	639.157	20.7	26.1	4.9	32.6	19.1	46.0	26.9	100	108


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8.4.2 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 (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.									

8.4.3 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 (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/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