

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

Test Report No. : OT-206-RWD-007
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 : 10 pages (including this page)
Date of Incoming : May 20, 2020
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SUMMARY

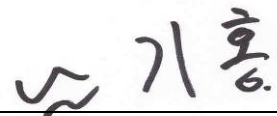
The equipment complies with the regulation; *FCC PART 15 SUBPART C Section 15.247*
 This test report only contains the result of a single test of the sample supplied for the examination.
 It is not a generally valid assessment of the features of the respective products of the mass-production.

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-007	June 03, 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 03, 2020

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM DSS – PART 15 SPREAD SPECTRUM TRANSMITTER
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. GENERAL INFORMATION

2.1 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		
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	

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

-. None

3. EUT MODIFICATIONS

-. None

4. MAXIMUM PERMISSIBLE EXPOSURE

4.1 RF Exposure Calculation

According to the FCC rule 1.1310 table 1B, the limit for the maximum permissible RF exposure for an uncontrolled environment are $f/1500$ mW/cm² for the frequency range between 300 MHz and 1 500 MHz and 1.0 mW/cm² for the frequency range between 1 500 MHz and 100 000 MHz.

The electric field generated for a 1 mW/cm² exposure is calculated as follows:

$$E = \sqrt{(30 * P * G) / d}, \text{ and } S = E^2 / Z = E^2 / 377, \text{ because } 1 \text{ mW/cm}^2 = 10 \text{ W/m}^2$$

Where

S = Power density in mW/cm², Z = Impedance of free space, 377 Ω

E = Electric field strength in V/m, G = Numeric antenna gain, and d = distance in meter

Combining equations and rearranging the terms to express the distance as a function of the remaining variable

$$d = \sqrt{(30 * P * G) / (377 * 10 S)}$$

Changing to units of mW and cm, using P (mW) = P (W) / 1 000, d (cm) = 0.01 * d (m)

$$d = 0.282 * \sqrt{(P * G) / S}$$

Where

d = distance in cm, P = Power in mW, G = Numeric antenna gain, and S = Power density in mW/cm²

Kind of EUT	Asset Tracker
Device Category	<input type="checkbox"/> Portable (< 20 cm separation) <input type="checkbox"/> Mobile (> 20 cm separation) <input checked="" type="checkbox"/> Others
Exposure Evaluation Applied	<input checked="" type="checkbox"/> MPE <input type="checkbox"/> SAR <input type="checkbox"/> N/A



Tested by: Hyung-Kwon, Oh / Assistant Manager

4.2 Test Result for Bluetooth LE

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance [Average]	Max tune up power [Average]		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2 402 ~ 2 480	Bluetooth LE	3.0 ± 2.0	5.00	3.16	2.50	1.78	0.67	0.001 1	1.00

According to above table, for 2 402 MHz ~ 2 480 MHz Band, safe distance,

$$D = 0.282 * \sqrt{(3.16 * 1.78)} / 1.00 = 0.67 \text{ cm}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 3.16 * 1.78 / (4 * 3.14 * 20^2) = 0.001 1$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna



Tested by: Hyung-Kwon, Oh / Assistant Manager

4.3 Test Result for WLAN 2.4 GHz

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance [Average]	Max tune up power [Average]		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11 b	12.0 ± 2.0	14.00	25.12	2.50	1.78	1.88	0.008 9	1.00

Note. The worse MPE data for each Mode(802.11 b / g / n20) is determined for IEEE 802.11b.

So, MPE data is Calculated only mode for 802.11 b.

According to above table, for 2 400 ~ 2 483.5 MHz Band(802.11b), safe distance,

$$D = 0.282 * \sqrt{(25.12 * 1.78)/1.00} = 1.88 \text{ cm}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 25.12 * 1.78 / (4 * 3.14 * 20^2) = 0.008 9$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna



Tested by: Hyung-Kwon, Oh / Assistant Manager

4.4 Test Result for Sig Fox

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
902.00 ~ 928.00	RC4	23.5 ± 2.0	25.50	354.8 1	2.50	1.78	7.08	0.125 6	1.00

Note. The worse MPE data for each Mode(RC2 / RC4) is determined for RC2.

So, MPE data is Calculated only mode for RC2.

According to above table, for 902.00 ~ 928.00 MHz Band, safe distance,

$$D = 0.282 * \sqrt{(354.81 * 1.78)/1.00} = 7.08 \text{ cm}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 354.81 * 1.78 / (4 * 3.14 * 20^2) = 0.125 6$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna

4.5 Test Result for Intermodulation Mode

According to above equation, the following result was obtained.

- ➔ WLAN 2.4 GHz(0.008 9/1.0) + Bluetooth LE(0.001 1/1.0) = 0.010 0 < 1.00
- ➔ Sig Fox(0.125 6/1.0) + Bluetooth LE(0.001 1/1.0) = 0.126 7 < 1.00



Tested by: Hyung-Kwon, Oh / Assistant Manager