243 Jubug-Ri,Yangji-Myeon, Yongin-Si, Gyeonggi-Do, Korea 17159
Tel: +82-31-323-6008 Fax: +82-31-323-6010
http://www.ltalab.com

Dates of Tests: September 13 - 15, 2018
Test Report S/N: LR500121809U
Test Site : LTA CO., LTD.

EMC TEST REPORT

Model No. **IET10RC1**

APPLICANT **ieThings Co., Ltd.**

Equipment name	**:**	**Asset Tracker**
Manufacturer	**:**	**ieThings Co., Ltd.**
Model name	**:**	**IET10RC1**
Test Device Serial No.	**:**	**Identical prototype**
ETSI Rule Part(s)	**:**	**ETSI EN 301 489-1 V2.1.1(2017.02)**
		ETSI EN 301 489-3 V1.6.1(2013.08)
		ETSI EN 301 489-17 V3.1.1(2017.02)
		EN 61000-3-2:2014
		EN 61000-3-3:2013
Frequency Range	**:**	**2.4 GHz**
Date of issue	**:**	**September 17, 2018**

This test report is issued under the authority of:

Young Kyu Shin, Technical Manager

The test was supervised by:

Jin Ho Seo, Technical Manager

This test result only responds to the tested sample. It is not allowed to copy this report even partly without the allowance of the test laboratory. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

NVLAP LAB CODE 200723-0

Revision	Date of issue	Test report No.	Description
0	17.09.2018	LR500121809U	Initial

TABLE OF CONTENTS

1. General information's

1-1 Test Performed

Company name : LTA Co., Ltd.

Address : 243, Jubug-ri,Yangji-Myeon,Youngin-Si, Kyunggi-Do, Korea. 17159

Web site : http://www.ltalab.com

E-mail : chahn@ltalab.com

Telephone : +82-31-323-6008

Facsimile : +82-31-323-6010

Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the "General requirements for the competents of calibration and testing laboratory".

1-2 Accredited agencies

LTA Co., Ltd. is approved to perform EMC testing by the following agencies:

Agency	Country	Accreditation No.	Validity	Reference
NVLAP	U.S.A	200723-0	2018-09-30	ECT accredited Lab.
RRA	KOREA	KR0049	-	EMC accredited Lab.
FCC	U.S.A	649054	2019-04-13	FCC CAB
VCCI	JAPAN	C-4948, T-2416, R-4483(10 m), G-847	2020-09-10 2020-09-10 2020-10-15 2018-12-13	VCCI registration
IC	CANADA	5799A-1	2019-11-07	IC filing
KOLAS	KOREA	NO.551	2021-08-20	KOLAS accredited Lab.

2. Information's about test item

2-1 Client / Manufacturer

Company name : ieThings Co., Ltd.

Address : 86-5 Banwollam-gil Hwaseong-si, Gyeonggi-do,18383, South Korea

Telephone / Facsimile : +82-42-867-2468 / +82-42-867-2467

Factory

Company name : ieThings Co., Ltd.

Address : 86-5 Banwollam-gil Hwaseong-si, Gyeonggi-do,18383, South Korea

2-2 Equipment Under Test (EUT)

Equipment name : Asset Tracker

Model name : IET10RC1

Serial number : Identification

Date of receipt : August 22, 2018

EUT condition : Pre-production, not damaged

Interface ports : DC IN

Power Source : DC 3.6 V

2-3 Modification

-NONE

2-4 Model Specification

-NONE

2-5 Tested Condition

Temp. / Humid. / Pressure : (21 - 23) ℃ / (48 - 52) % R.H. / (101.2 – 101.3) kPa

Tested Model : IET10RC1

Test mode : Sigfox mode, WiFi mode, Bluetooth LE mode, GPS mode

Tested Voltage : DC 3.6 V

2-6 EUT

Equipment	Model No.	Serial No.	Manufacturer
Asset Tracker	**IET10RC1**	**N/A**	**ieThings Co., Ltd.**

2-7 Accessary

Equipment	Model No.	Serial No.	Manufacturer
Notebook Computer	P56	NKW650RB0006A02845	Hansung
Sigfox Receiver	N/A	N/A	N/A
Wireless AP	IPTIME A1004	N/A	IPTIME
Mobile Phone	N/A	N/A	Samsung
GPS SIGNAL GENERATOR	MSG-2051	N/A	MEGURO

2-8 Cable List

From		To		Length	Shielding	
Type	I/O Port	Type	I/O Port	(m)	Cable	backshell
EUT	-	-	-	-	-	-
Notebook Computer	DC IN	Adapter #1	DC OUT	1.0	NO	Plastic
	USB	Sigfox Receiver	Micro USB	0.8	YES	Metal
Adapter #1	AC IN	AC Power Source	3 Pin AC Line	1.2	NO	Plastic
Wireless AP	DC IN	Adapter #2	DC OUT	1.2	NO	Plastic
Adapter #2	AC IN	AC Power Source	2 Pin AC Line	-	-	-
Mobile Phone	-	-	-	-	-	-
GPS SIGNAL GENERATOR	AC IN	AC Power Source	3 Pin AC Line	1.2	NO	Plastic

3. Test Report

3.1 Summary of tests

Reference	Parameter	Status (note)
I. Emission		
Conducted Emission	ETSI EN 301 489-1 V2.1.1(2017.02) EN 55032 :2015	NA
Conducted Emission (Telecommunication port)	ETSI EN 301 489-1 V2.1.1(2017.02) EN 55032 :2015	NA
Radiated Emission	ETSI EN 301 489-1 V2.1.1(2017.02) EN 55032 :2015	C
Harmonic Current Emission (AC port)	EN 61000-3-2:2014	NA
Voltage Fluctuations and Flicker (AC port)	EN 61000-3-3:2013	NA
II. Immunity		
Electrostatic Discharge	EN 61000-4-2:2009	C
Radio Frequency Electromagnetic field	EN 61000-4-3:2006/A1 :2008/A2:2010	C
Electric Fast Transient Pulse Group Immunity	EN 61000-4-4:2012	NA
Surges	EN 61000-4-5:2014/A1:2017	NA
Radio Frequency, common mode	EN 61000-4-6:2014/AC :2015	NA
Main supply voltage dips and Interruptions	EN 61000-4-11:2004/A1:2017	NA
C=Complies NC=Not Complies NA=Not Applicable		

Note 1 The sample was tested according to the following specification:

ETSI Standards; ETSI EN 301 489-1 V2.1.1(2017.02), ETSI EN 301 489-3 V1.6.1(2013.08),

ETSI EN 301 489-17 V3.1.1(2017.02)

Note 2 The following table shows the highest frequency up to which radiated emission measurements shall be performed.

Required highest frequency for radiated measurement

Highest internal frequency (F_x)	Highest measured frequency
$F_x \leq$ 108 MHz	1 GHz
108 MHz < $F_x \leq$ 500 MHz	2 GHz
500 MHz < $F_x \leq$ 1 GHz	5 GHz
F_x > 1 GHz	5 × F_x up to a maximum of 6 GHz
Note 1 For FM and TV Broadcast receivers, Fx is determined from the highest frequency generated or used excluding the local oscillator and tuned frequencies. Note 2 Fx is defined in 3.1.18. Note 3 Fro outdoor units of home satellite receiving systems highest measured frequency shall be 18 GHz.	

Where F_x is unknown, the radiated emission measurements shall be performed up to 6 GHz.

3.2 EMISSION

3.2.1 Radiated Emission

Definition:

The test assesses the ability of ancillary equipment to limit their internal noise from being radiated from the enclosure.

We were performed the test according to LTA procedure LTA-QI-04.

Test method	:	ETSI EN 301 489-1 V2.1.1(2017.02) EN 55032 :2015
Measuring Distance	:	10 m for below 1 GHz / 3 m for above 1 GHz
Measurement Frequency range	:	30 MHz – 6 000 MHz
Measurement RBW	:	120 kHz @ 10 m / 1 MHz @ 3 m
Test mode	:	Sigfox mode, WiFi mode, Bluetooth LE mode, GPS mode
Result	:	**Complies**

Measurement Data:

- Refer to the Next page (Maximum emission configuration)

Limit of 10 m for below 1 GHz

CLASS A

Frequency Range	EN 55022 @ 10 m (Quasi-peak)
(30 – 230) MHz	40 dBµV/m
(230 – 1 000) MHz	47 dBµV/m
NOTE:	The lower limit applies at the transition frequency.

CLASS B

Frequency Range	EN 55022 @ 10 m (Quasi-peak)
(30 – 230) MHz	30 dBµV/m
(230 – 1 000) MHz	37 dBµV/m
NOTE:	The lower limit applies at the transition frequency.

Limit of 3m for above 1 GHz

CLASS A

Frequency Range	Average Limit @ 3 m (dBµV/m)	Peak limit @ 3 m (dBµV/m)
(1 000 – 3 000) MHz	56	76
(3 000 – 6 000) MHz	60	80
NOTE:	The lower limit applies at the transition frequency.	

CLASS B

Frequency Range	Average Limit @ 3 m (dBµV/m)	Peak limit @ 3 m (dBµV/m)
(1 000 – 3 000) MHz	50	70
(3 000 – 6 000) MHz	54	74
NOTE:	The lower limit applies at the transition frequency.	

Radiated Emission (Below 1 GHz) / V _ Sigfox mode

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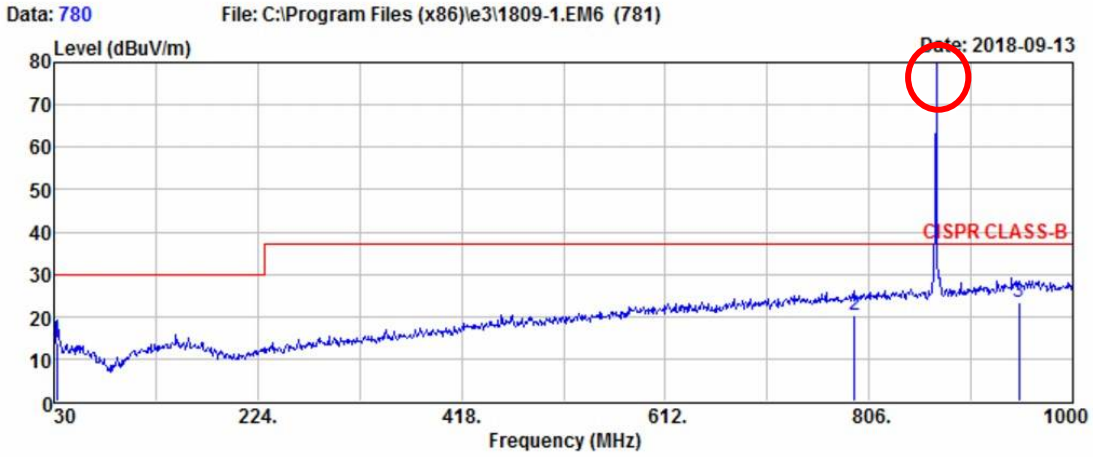
Fax : +82-31-3236010
www.ltalab.com

EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : Sigfox Mode Tested by: J H SEO



Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	deg	
32.91	32.62	-18.86	13.76	30.00	16.24	100	204	VERTICAL
792.42	24.52	-4.36	20.16	37.00	16.84	210	156	VERTICAL
948.59	24.30	-0.84	23.46	37.00	13.54	100	321	VERTICAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

※ 869.13 MHz is EUT's Sigfox frequency.

Radiated Emission (Below 1 GHz) / H _ Sigfox mode

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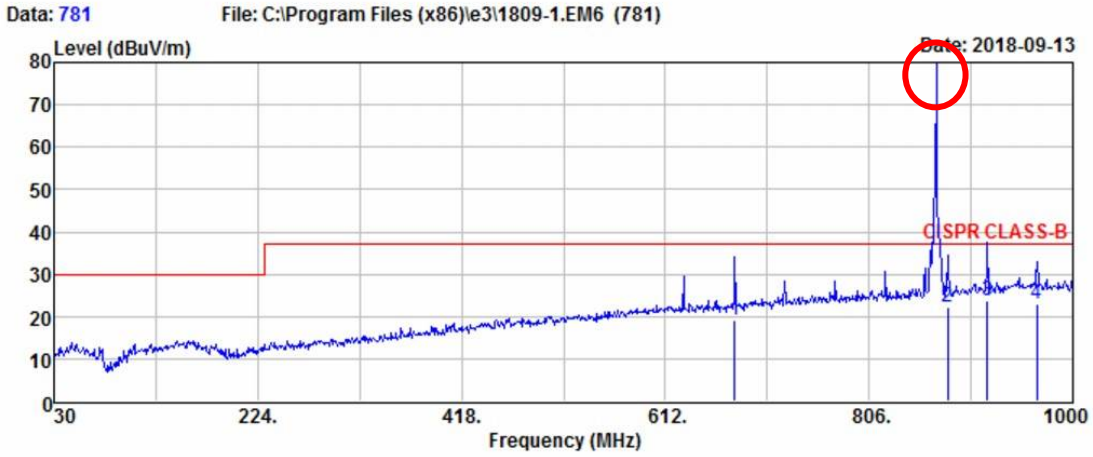
www.ltalab.com

EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : Sigfox Mode Tested by: J H SEO



Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	deg	
677.96	25.84	-6.85	18.99	37.00	18.01	150	174	HORIZONTAL
880.69	24.98	-2.76	22.22	37.00	14.78	360	244	HORIZONTAL
918.52	25.48	-1.79	23.69	37.00	13.31	100	315	HORIZONTAL
966.05	23.64	-0.79	22.85	37.00	14.15	280	146	HORIZONTAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

※ 869.13 MHz is EUT's Sigfox frequency.

Radiated Emission (Below 1 GHz) / V _ WiFi mode

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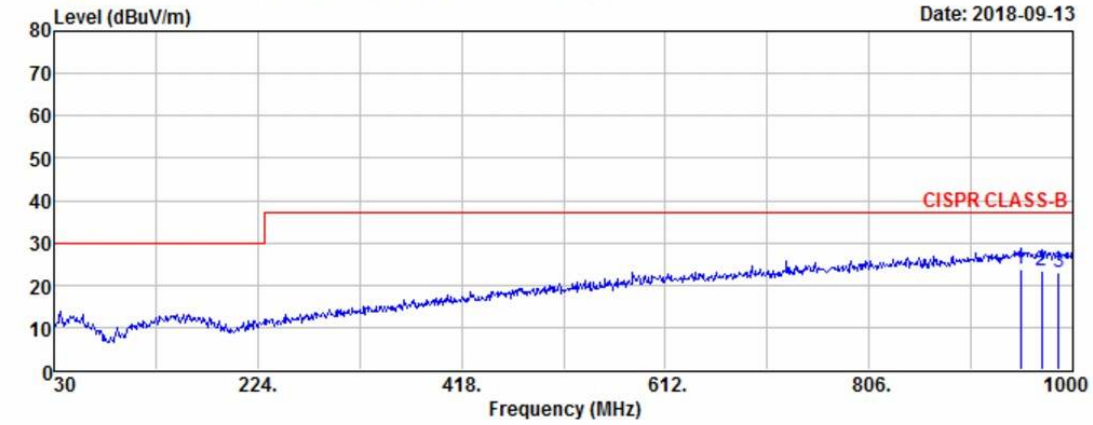
www.ltalab.com

EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : WiFi Mode Tested by: J H SEO

Data: 784 File: C:\Program Files (x86)\e3\1809-1.EM6 (784)



Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	deg	
950.53	24.63	-0.82	23.81	37.00	13.19	100	46	VERTICAL
969.93	23.97	-0.76	23.21	37.00	13.79	240	168	VERTICAL
986.42	23.47	-0.65	22.82	37.00	14.18	100	168	VERTICAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

Radiated Emission (Below 1 GHz) / H _ WiFi mode

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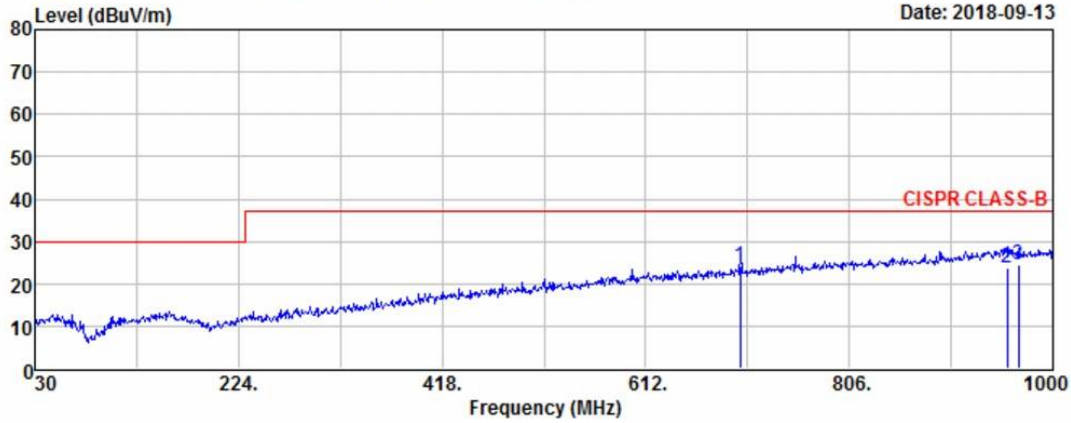
EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : WiFi Mode Tested by: J H SEO

Data: 785 File: C:\Program Files (x86)\e3\1809-1.EM6 (785)



Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	deg	
702.21	30.55	-6.34	24.21	37.00	12.79	400	247	HORIZONTAL
956.35	24.42	-0.83	23.59	37.00	13.41	340	138	HORIZONTAL
967.02	25.24	-0.79	24.45	37.00	12.55	160	311	HORIZONTAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

Radiated Emission (Below 1 GHz) / V _ Bluetooth LE mode

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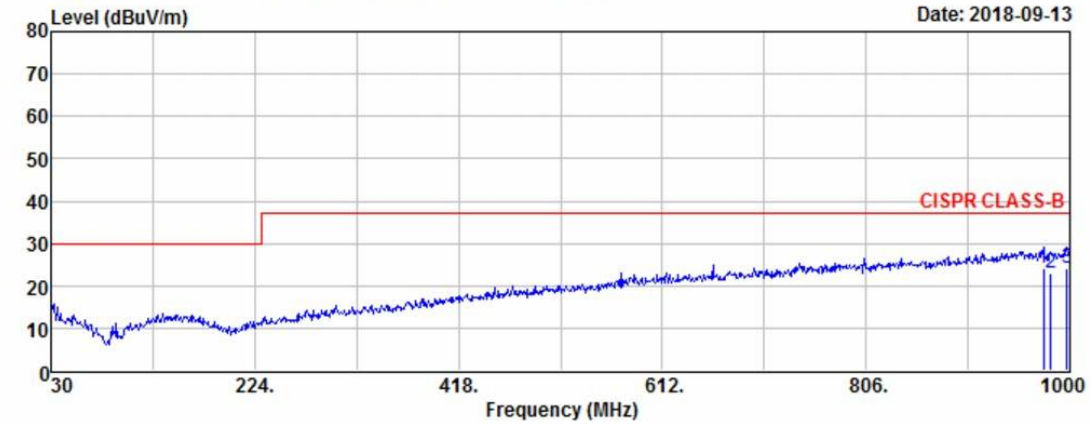
Fax : +82-31-3236010
www.ltalab.com

EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : Bluetooth LE Mode Tested by: J H SEO

Data: 788 File: C:\Program Files (x86)\e3\1809-1.EM6 (788)



Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	deg	
974.78	24.73	-0.73	24.00	37.00	13.00	100	42	VERTICAL
981.57	23.77	-0.68	23.09	37.00	13.91	150	321	VERTICAL
997.09	24.65	-0.49	24.16	37.00	12.84	230	119	VERTICAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

Radiated Emission (Below 1 GHz) / H _ Bluetooth LE mode

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Yongin-si, Gyeonggi-do, Korea
Tel : +82-31-3236008,9
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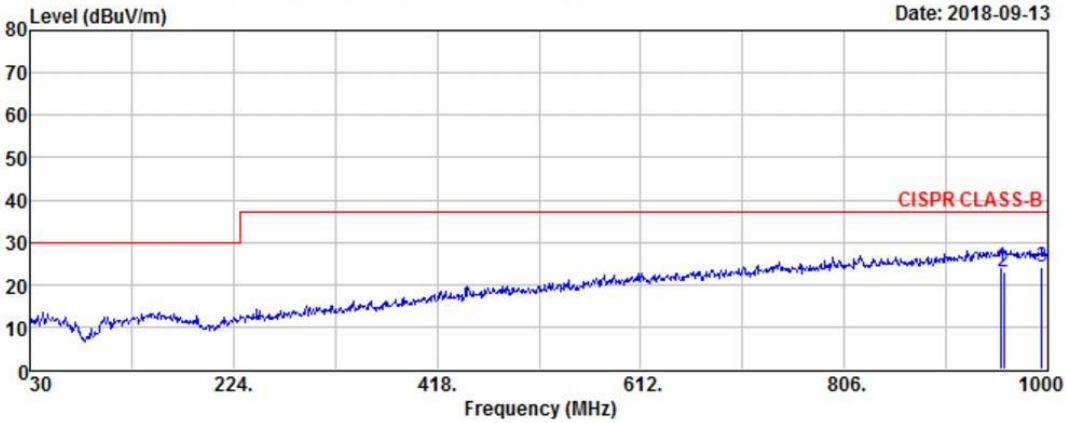
www.ltalab.com

EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : Bluetooth LE Mode Tested by: J H SEO

Data: 789 File: C:\Program Files (x86)\e3\1809-1.EM6 (789)



Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	deg	
955.38	24.85	-0.82	24.03	37.00	12.97	310	64	HORIZONTAL
958.29	23.96	-0.83	23.13	37.00	13.87	130	251	HORIZONTAL
994.18	24.70	-0.55	24.15	37.00	12.85	270	167	HORIZONTAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

Radiated Emission (Below 1 GHz) / V _ GPS mode

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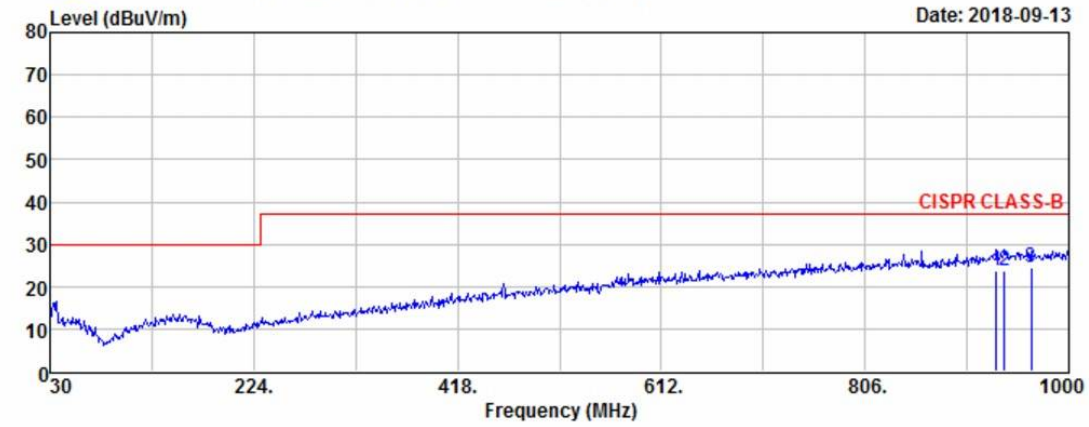
www.ltalab.com

EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : GPS Mode Tested by: J H SEO

Data: 792 File: C:\Program Files (x86)\e3\1809-1.EM6 (792)



Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	deg	
931.13	25.09	-1.42	23.67	37.00	13.33	100	217	VERTICAL
938.89	24.68	-1.04	23.64	37.00	13.36	130	318	VERTICAL
964.11	25.12	-0.81	24.31	37.00	12.69	100	278	VERTICAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

Radiated Emission (Below 1 GHz) / H _ GPS mode

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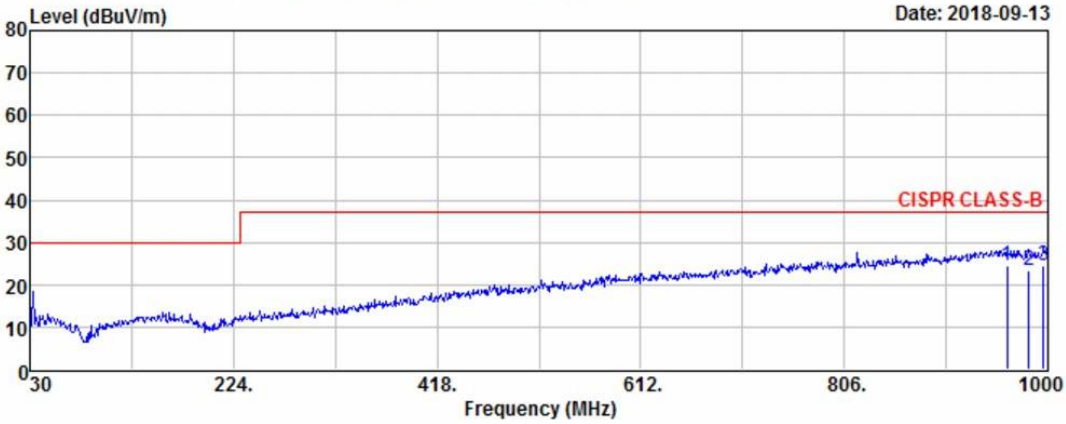
www.ltalab.com

EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : GPS Mode Tested by: J H SEO

Data: 793 File: C:\Program Files (x86)\e3\1809-1.EM6 (793)



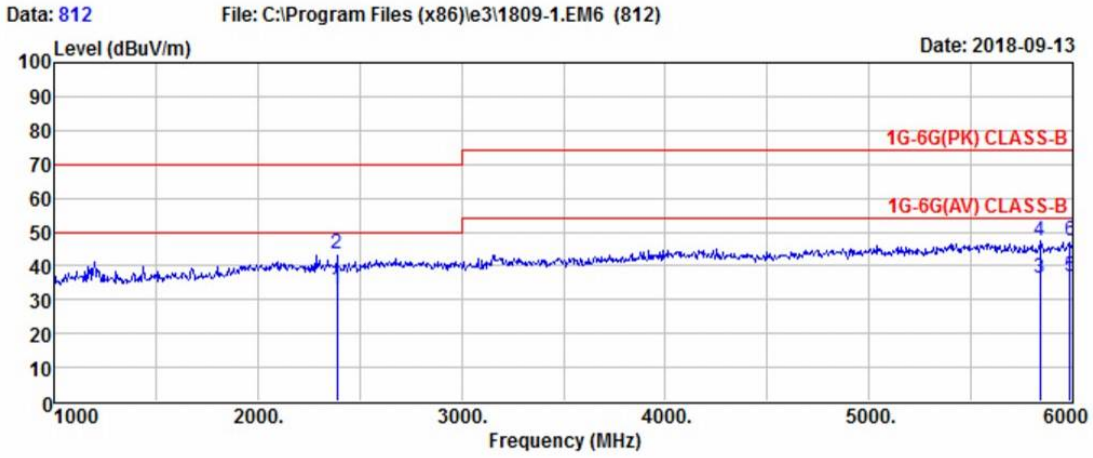
Freq	Reading	C.F	Result QP	Limit	Margin	Height	Angle	Polarity
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	deg	
961.20	25.22	-0.83	24.39	37.00	12.61	240	318	HORIZONTAL
981.57	24.03	-0.68	23.35	37.00	13.65	210	47	HORIZONTAL
996.12	25.06	-0.51	24.55	37.00	12.45	100	183	HORIZONTAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

Radiated Emission (Above 1 GHz) _ Sigfox mode

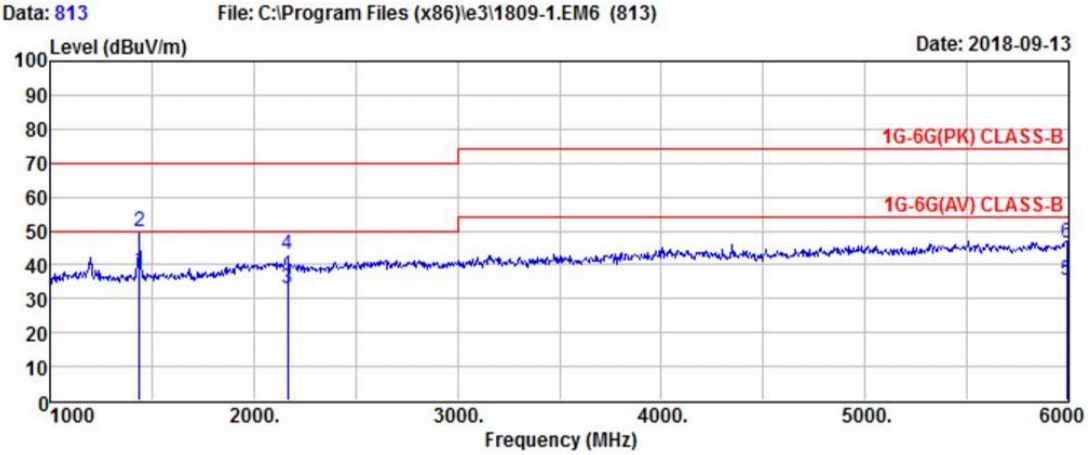
EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : Sigfox Mode Tested by: J H SEO



EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : Sigfox Mode Tested by: J H SEO



Manufacture : ieThings Co., Ltd

Model : IET10RC1

TEST mode : Sigfox Mode

Ver Data: 812 Hor Data: 813

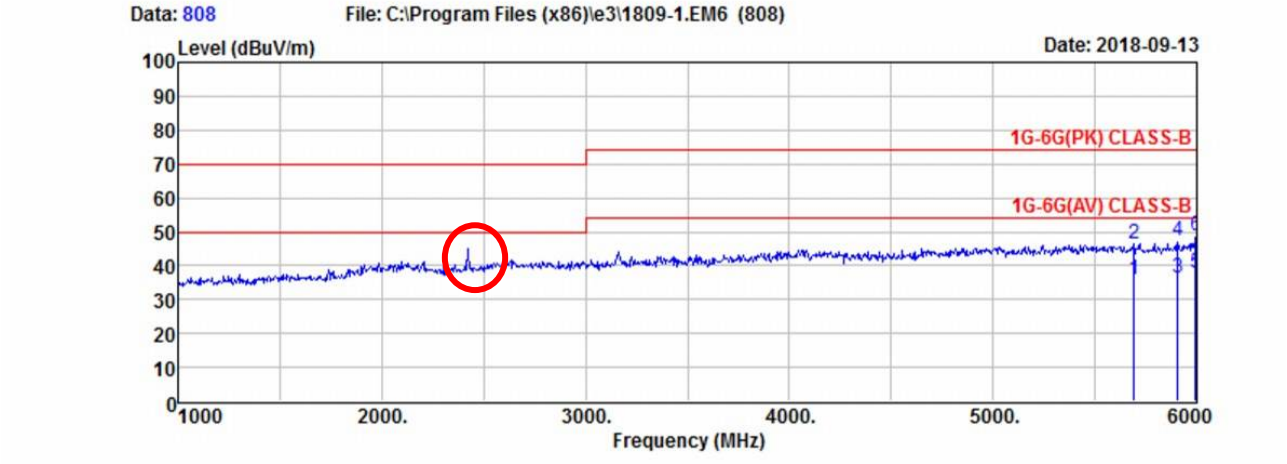
Test Date	Temp.: [℃]	Humidity : [%]	Distance (m)
2018-09-13	22	48	3.8

Freq.(MHz) MHz	Reading(PK) dBuV	Reading(AV) dBuV	C.F dB	Result(PK) dBuV/m	Result(AV) dBuV/m	Limit(PK) dBuV/m	Limit(AV) dBuV/m	Margin(PK) dB	Margin(AV) dB	Height cm	Angle deg	Polarity Hor/Ver
1440.0	56.7	45.2	-4.79	51.87	40.42	70.0	50.0	18.13	9.58	100	217	H
2165.0	43.8	33.8	1.14	44.98	34.98	70.0	50.0	25.02	15.02	100	253	H
5990.0	33.6	22.6	14.99	48.58	37.58	74.0	54.0	25.42	16.42	100	147	H
2390.0	44.9	34.3	0.81	45.73	35.09	70.0	50.0	24.27	14.91	100	278	V
5840.0	35.1	24.0	14.40	49.53	38.35	74.0	54.0	24.47	15.65	100	341	V
5985.0	34.5	24.1	14.98	49.45	39.05	74.0	54.0	24.55	14.95	100	168	V

Radiated Emission (Above 1 GHz) _ WiFi mode

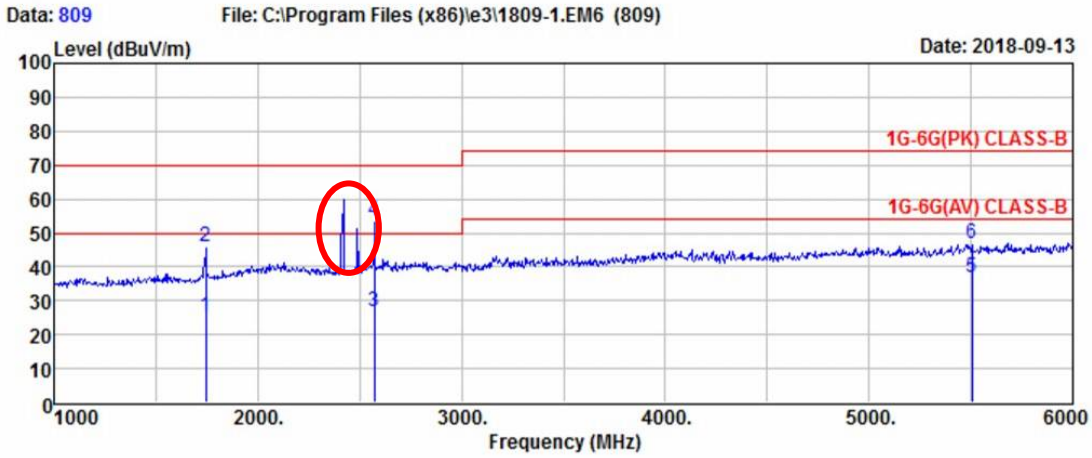
EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : WiFi Mode Tested by: J H SEO



EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : WiFi Mode Tested by: J H SEO



Manufacture : ieThings Co., Ltd

Model : IET10RC1

TEST mode : WiFi Mode

Ver Data: 808 Hor Data: 809

Test Date	Temp.: [℃]	Humidity : [%]	Distance (m)
2018-09-13	22	48	3.8

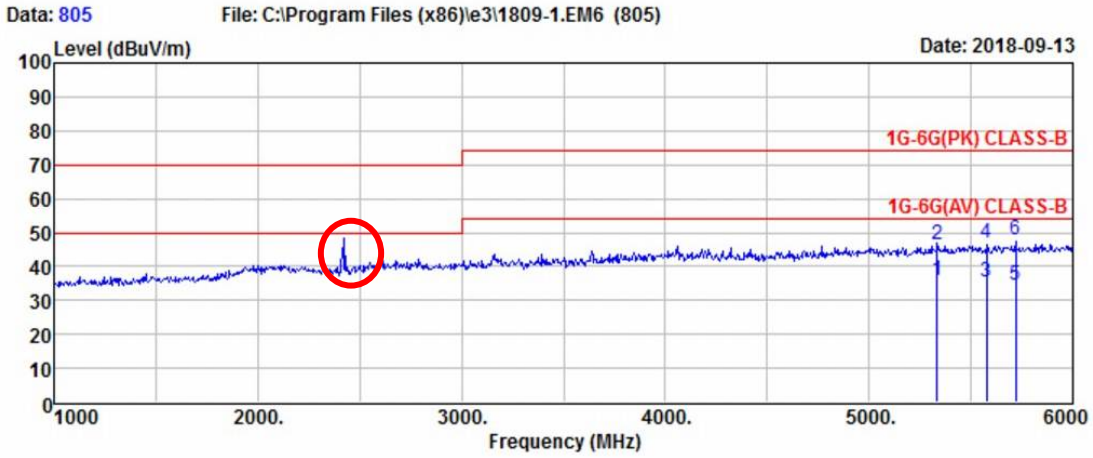
Freq.(MHz)	Reading(PK)	Reading(AV)	C.F	Result(PK)	Result(AV)	Limit(PK)	Limit(AV)	Margin(PK)	Margin(AV)	Height	Angle	Polarity
MHz	dBuV	dBuV	dB	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB	dB	cm	deg	Hor/Ver
1745.0	51.6	30.7	-3.37	48.22	27.29	70.0	50.0	21.78	22.71	100	199	H
2570.0	53.4	26.5	2.38	55.79	28.90	70.0	50.0	14.21	21.10	100	13	H
5505.0	35.0	25.0	13.85	48.83	38.83	74.0	54.0	25.17	15.17	100	132	H
5690.0	34.6	24.3	13.83	48.44	38.12	74.0	54.0	25.56	15.88	100	184	V
5905.0	34.9	23.7	14.67	49.54	38.40	74.0	54.0	24.46	15.60	100	69	V
5995.0	35.8	24.8	15.01	50.76	39.76	74.0	54.0	23.24	14.24	100	271	V

※ (2,412 ~ 2,472) MHz is WiFi frequency.

Radiated Emission (Above 1 GHz) _ Bluetooth LE mode

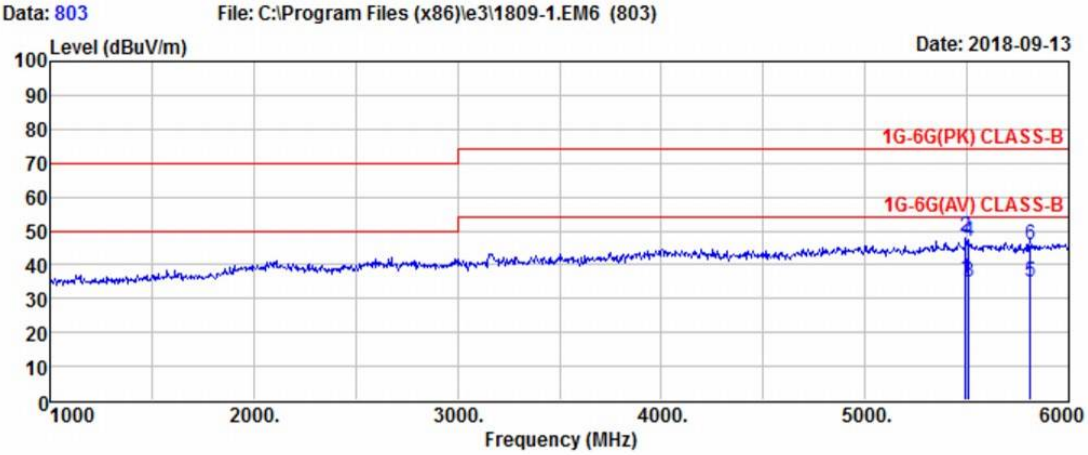
EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : Bluetooth LE Mode Tested by: J H SEO



EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : Bluetooth LE Mode Tested by: J H SEO



Manufacture : ieThings Co., Ltd

Model : IET10RC1

TEST mode : Bluetooth LE Mode

Ver Data: 805 Hor Data: 803

Test Date	Temp.: [℃]	Humidity : [%]	Distance (m)
2018-09-13	22	48	3.8

Freq.(MHz)	Reading(PK)	Reading(AV)	C.F	Result(PK)	Result(AV)	Limit(PK)	Limit(AV)	Margin(PK)	Margin(AV)	Height	Angle	Polarity
MHz	dBuV	dBuV	dB	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB	dB	cm	deg	Hor/Ver
5495.0	36.4	24.1	13.83	50.27	37.96	74.0	54.0	23.73	16.04	100	184	H
5510.0	35.1	23.1	13.85	48.98	36.93	74.0	54.0	25.02	17.07	100	315	H
5810.0	34.0	22.9	14.23	48.19	37.16	74.0	54.0	25.81	16.84	100	249	H
5335.0	35.6	25.0	13.07	48.67	38.07	74.0	54.0	25.33	15.93	100	315	V
5575.0	34.9	23.4	13.88	48.77	37.26	74.0	54.0	25.23	16.74	100	49	V
5720.0	35.8	22.8	13.88	49.69	36.69	74.0	54.0	24.31	17.31	100	91	V

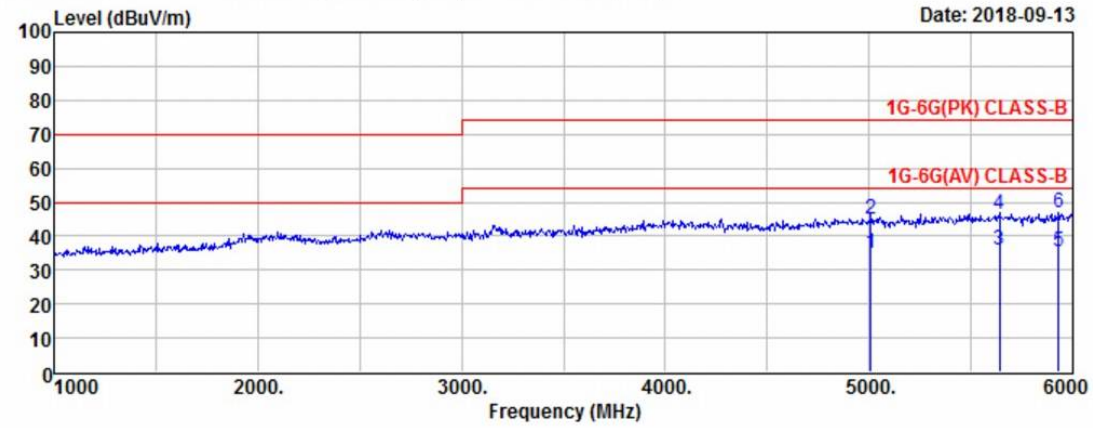
※ (2,402 ~ 2,480) MHz is Bluetooth frequency.

Radiated Emission (Above 1 GHz) _ GPS mode

EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : GPS Mode Tested by: J H SEO

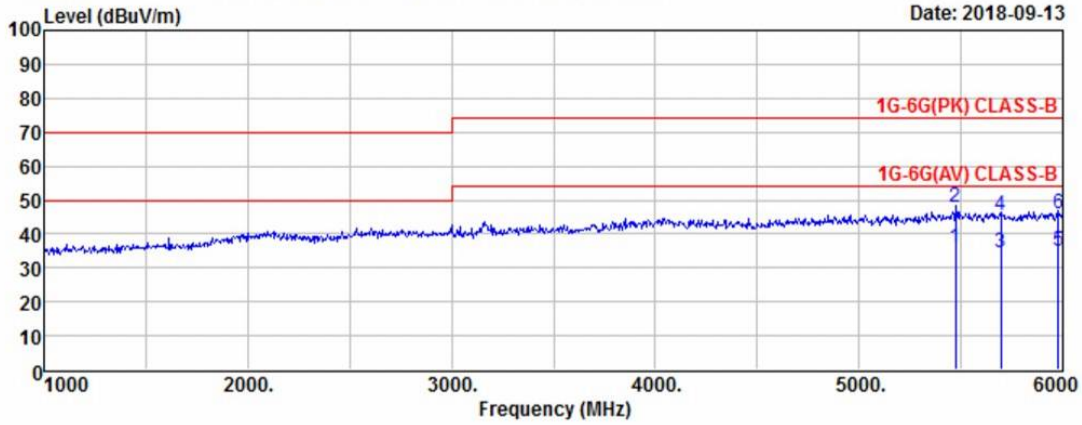
Data: 796 File: C:\Program Files (x86)\e3\1809-1.EM6 (796)



EUT/Model No.: IET10RC1 Temp/Humi: 22 / 48

Test Mode : GPS Mode Tested by: J H SEO

Data: 797 File: C:\Program Files (x86)\e3\1809-1.EM6 (797)



Manufacture : ieThings Co., Ltd

Model : IET10RC1

TEST mode : GPS Mode

Ver Data: 796 Hor Data: 797

Test Date	Temp.: [℃]	Humidity : [%]	Distance (m)
2018-09-13	22	48	3.8

Freq.(MHz)	Reading(PK)	Reading(AV)	C.F	Result(PK)	Result(AV)	Limit(PK)	Limit(AV)	Margin(PK)	Margin(AV)	Height	Angle	Polarity
MHz	dBuV	dBuV	dB	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB	dB	cm	deg	Hor/Ver
5475.0	36.1	24.2	13.76	49.87	38.00	74.0	54.0	24.13	16.00	100	217	H
5695.0	33.8	22.8	13.81	47.61	36.61	74.0	54.0	26.39	17.39	100	314	H
5980.0	33.2	22.2	14.96	48.15	37.15	74.0	54.0	25.85	16.85	100	178	H
5010.0	34.2	24.2	12.64	46.85	36.85	74.0	54.0	27.15	17.15	100	41	V
5640.0	34.6	23.9	13.91	48.49	37.76	74.0	54.0	25.51	16.24	100	146	V
5930.0	34.4	22.5	14.76	49.13	37.27	74.0	54.0	24.87	16.73	100	213	V

3.3 IMMUNITY

3.3.1 Electrostatic Discharge

Definition:

The test assesses the ability of the EUT to operate as intended in the event of an electrostatic discharge.

We were performed the test according to LTA procedure LTA-QI-04.

Test date	:	2018. 09. 14.
Test method	:	EN 61000-4-2:2009
Temperature / Humidity / Pressure	:	21 ℃ / 51 % R.H. / 101.2 kPa
Discharge Impedance	:	(330 ±10 %) Ω / (150 ±10 %) pF
Type of Discharge (air discharge)	:	± 2, 4, 8 kV
Type of Discharge (contact discharge)	:	± 4 kV
Polarity of Output Voltage	:	Positive and Negative
Number of discharges at each point	:	10 of each polarity
Discharge Repetition on Rate	:	1 / sec
Test mode	:	Sigfox mode, WiFi mode, Bluetooth LE mode, GPS mode
Performance Criteria	:	B (Refer to the appendix B)
Result	:	**Complies**

Measurement Data:

ESD Test Point and Result

1. Indirect Discharge

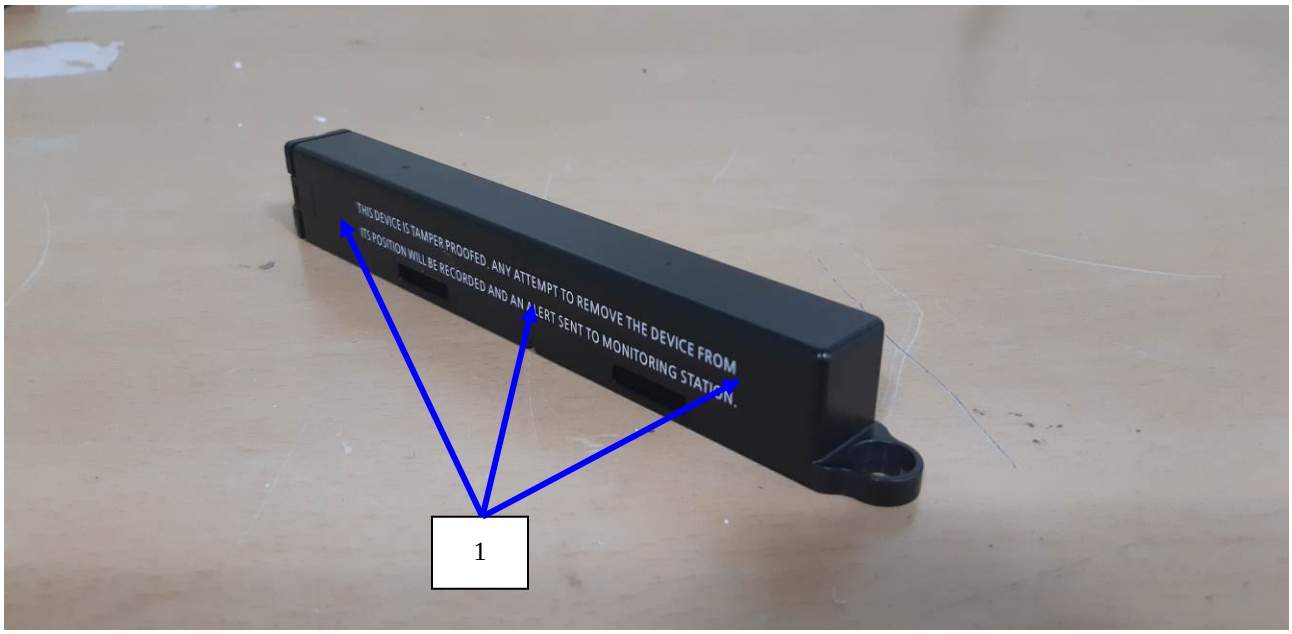
No.	Position	Kind of Discharge	Results	Remarks
1	HCP	Contact	Complies (A)	No reaction recognized
2	VCP	Contact	Complies (A)	No reaction recognized

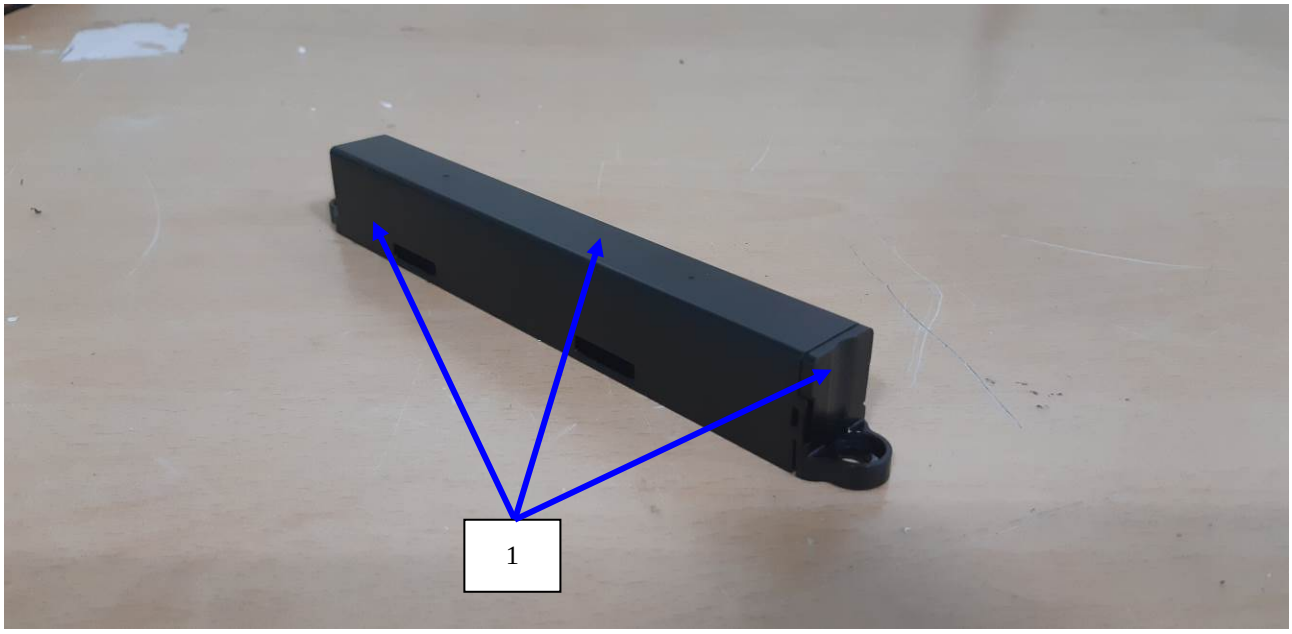
2. Direct Discharge

Position No.	Position	Kind of Discharge	Result	Remarks
1	Enclosure	Air	Complies (A)	No reaction recognized

Air discharge
Contact discharge

ESD TEST POINT





3.3.2 Radio Frequency Electromagnetic field

Definition:

The test assesses the ability of the EUT to operate as intended in the presence of a radio frequency electromagnetic field disturbance.

Test date	:	2018. 09. 15.
Test method	:	EN 61000-4-3:2006/A1:2008/A2:2010
Temperature / Humidity / Pressure	:	23 ℃ / 50 % R.H. / 101.3 kPa
Frequency range	:	80 MHz to 6 GHz
Test level	:	3 V/m (measured unmodulated)
Amplitude Modulation	:	AM, 80 %, 1 kHz Audio signal
Step size	:	1 % of fundamental
Test mode	:	Sigfox mode, WiFi mode, Bluetooth LE mode, GPS mode
Performance Criteria	:	A (Refer to the appendix B)
Result	:	**Complies**

Measurement Data:

MODE : Sigfox mode

Pol	Side	Result	Remark
Horizontal	Front	Complies (A)	No reaction recognized
	Left	Complies (A)	No reaction recognized
	Rear	Complies (A)	No reaction recognized
	Right	Complies (A)	No reaction recognized
	Top	Complies (A)	No reaction recognized
	Bottom	Complies (A)	No reaction recognized
Vertical	Front	Complies (A)	No reaction recognized
	Left	Complies (A)	No reaction recognized
	Rear	Complies (A)	No reaction recognized
	Right	Complies (A)	No reaction recognized
	Top	Complies (A)	No reaction recognized
	Bottom	Complies (A)	No reaction recognized

MODE : WiFi mode

Pol	Side	Result	Remark
Horizontal	Front	Complies (A)	No reaction recognized
	Left	Complies (A)	No reaction recognized
	Rear	Complies (A)	No reaction recognized
	Right	Complies (A)	No reaction recognized
	Top	Complies (A)	No reaction recognized
	Bottom	Complies (A)	No reaction recognized
Vertical	Front	Complies (A)	No reaction recognized
	Left	Complies (A)	No reaction recognized
	Rear	Complies (A)	No reaction recognized
	Right	Complies (A)	No reaction recognized
	Top	Complies (A)	No reaction recognized
	Bottom	Complies (A)	No reaction recognized

MODE : Bluetooth LE mode

Pol	Side	Result	Remark
Horizontal	Front	Complies (A)	No reaction recognized
	Left	Complies (A)	No reaction recognized
	Rear	Complies (A)	No reaction recognized
	Right	Complies (A)	No reaction recognized
	Top	Complies (A)	No reaction recognized
	Bottom	Complies (A)	No reaction recognized
Vertical	Front	Complies (A)	No reaction recognized
	Left	Complies (A)	No reaction recognized
	Rear	Complies (A)	No reaction recognized
	Right	Complies (A)	No reaction recognized
	Top	Complies (A)	No reaction recognized
	Bottom	Complies (A)	No reaction recognized

MODE : GPS mode

Pol	Side	Result	Remark
Horizontal	Front	Complies (A)	No reaction recognized
	Left	Complies (A)	No reaction recognized
	Rear	Complies (A)	No reaction recognized
	Right	Complies (A)	No reaction recognized
	Top	Complies (A)	No reaction recognized
	Bottom	Complies (A)	No reaction recognized
Vertical	Front	Complies (A)	No reaction recognized
	Left	Complies (A)	No reaction recognized
	Rear	Complies (A)	No reaction recognized
	Right	Complies (A)	No reaction recognized
	Top	Complies (A)	No reaction recognized
	Bottom	Complies (A)	No reaction recognized

※ Results are complies in each test mode.

APPENDIX A

TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment are identified by the Test Laboratory.

Radiated Emission – Below 1 GHz

	Item	Model Name	Manufacturer	Serial No.	Next Cal.	Interval
☒	EMI TEST Receiver	ESCI7	Rohde & Schwarz	100772	2019.09.06	1 year
☒	Amplifier (25 dB)	8447D	HP	2944A07684	2019.09.06	1 year
☒	TRILOG Antenna	VULB9160	SCHWARZBECK	9160-3237	2019.05.16	2 year
☒	TEST PROGRAM	e3_Ver: 6.2009-10-12a	AUDIX	-	-	-

Radiated Emission – Above 1 GHz

	Item	Model Name	Manufacturer	Serial No.	Next Cal.	Interval
☒	EMI TEST Receiver	ESCI7	Rohde & Schwarz	100772	2019.09.06	1 year
☒	Amplifier	8449B	HP	3008A00671	2019.09.06	1 year
☒	HORN ANTENNA	3115	ETS	114105	2019.11.03	2 year
☒	TEST PROGRAM	e3_Ver: 6.2009-10-12a	AUDIX	-	-	-

Electrostatic Discharge

	Item	Model Name	Manufacturer	Serial No.	Next Cal.	Interval
☒	ESD Simulator	ESS-2000	NOISEKEN	8000C03241	2019.09.11	1 year

Radio Frequency Electromagnetic field

	Item	Model Name	Manufacturer	Serial No.	Next Cal.	Interval
☒	Signal Generator	E4432B	Agilent	MY41310632	2019.05.15	1 year
☒	Power Meter	E4419B	Agilent	GB38410133	2019.05.15	1 year
☒	RF POWER AMPLIFIER	ITA0300KL-300	INFINITECH	0300KL 1507 001	-	-
☒	RF POWER AMPLIFIER	ITA2000KL-120	INFINITECH	200KL 1507 001	-	-
☒	RF POWER AMPLIFIER	ITA4500KL-70	INFINITECH	4500KL 1507 001	-	-
☒	RF POWER AMPLIFIER	ITA0750KL-300	INFINITECH	0750KL 1507 001	-	-
☒	Log.-Per.Antenna (80 MHz ~ 3 GHz)	K9128	RAPA	NONE	-	-
☒	Signal Generator	SMB 100A	R&S	177621	2019.03.19	1 year
☒	HORN ANTENNA	3115	ETS	00055005	-	1 year

APPENDIX B

PERFORMANCE CRITERIA FOR IMMUNITY

1. ETSI EN 301 489-1/3

Classification of SRD equipment

The product family of Short Range Devices is divided by device type, each having its own set of performance criteria. This classification is based upon the impact on persons and/or goods in case the equipment does not operate above the specified performance level under EMC stress.

Table 3: Risk assessment of communication link performance per device type

Device Type	Risk assessment of communication link performance
1	Highly reliable SRD communication media; e.g. serving human life inherent systems (may result in a physical risk to a person)
2	Medium reliable SRD communication media; e.g. causing inconvenience to persons, which cannot simply be overcome by other means
3	Standard reliable SRD communication media; e.g. inconvenience to persons, which can simply be overcome by other means (e.g. manual)

General performance criteria

The performance criteria for SRD equipment with different device types (see table 3) in combination with the different primary function types (see table 1) during and after immunity test are specified in this clause:

- performance criteria A for immunity tests with phenomena of a continuous nature;
- performance criteria B for immunity tests with phenomena of a transient nature;
- performance criteria for immunity tests with power interruptions exceeding a certain time are specified in clause 7.2.2, table 6.

The equipment shall meet the performance criteria as specified in the following clauses, for the appropriate device type.

Performance table

Table 4: Performance Requirements of Device Types

Device Type 1		
Criteria	**During test**	**After test**
A	Operate as intended No loss of function For equipment with primary function type II the minimum performance shall be 12 dB SINAD No unintentional responses	Operate as intended For equipment with primary function type II the communication link shall be maintained No loss of function No degradation of performance No loss of stored data or user programmable functions
B	May be loss of function (one or more) No unintentional responses	Operate as intended Lost function(s) shall be self-recoverable No degradation of performance No loss of stored data or user programmable functions
Device Type 2		
Criteria	**During test**	**After test**
A	Operate as intended No loss of function For equipment with primary function type II the minimum performance shall be 6 dB SINAD No unintentional responses	Operate as intended For equipment with primary function type II the communication link shall be maintained No loss of function No degradation of performance No loss of stored data or user programmable functions
B	May be loss of function (one or more) No unintentional responses	Operate as intended Lost function(s) shall be self-recoverable No degradation of performance No loss of stored data or user programmable functions
Device Type 3		
Criteria	**During test**	**After test**
A and B	May be loss of function (one or more) No unintentional responses	Operate as intended, for equipment with primary function type II the communication link may be lost, but shall be recoverable by user No degradation of performance Lost functions shall be self-recoverable

Performance criteria for Continuous phenomena applied to Transmitters (CT)

For equipment with primary function type I or II including ancillary equipment tested on a stand alone basis, the performance criteria A of the applicable device type as given in clause 6.3 shall apply.

For equipment with primary function type II or III that requires a communication link that is maintained during the test, it shall be verified by appropriate means supplied by the manufacturer that the communication link is maintained during each individual exposure in the test sequence.

Where the EUT is a transmitter, tests shall be repeated with the EUT in standby mode to ensure that any unintentional transmission does not occur.

Performance criteria for Transient phenomena applied to Transmitters (TT)

For equipment with primary function type I or II, including ancillary equipment tested on a stand alone basis, the performance criteria B of the applicable device type as given in clause 6.3 shall apply, except for power interruptions exceeding a certain time the performance criteria deviations are specified in clause 7.2.2.

For equipment with primary function type II or III that requires a communication link that is maintained during the test, this shall be verified by appropriate means supplied by the manufacturer during each individual exposure in the test sequence.

Where the EUT is a transmitter, tests shall be repeated with the EUT in standby mode to ensure that any unintentional transmission does not occur.

Performance criteria for Continuous phenomena applied to Receivers (CR)

For equipment with primary function type I or II, including ancillary equipment tested on a stand alone basis, the performance criteria A of the applicable device type as given in clause 6.3 shall apply.

For equipment with primary function type II or III that requires a communication link that is maintained during the test, it shall be verified by appropriate means supplied by the manufacturer that the communication link is maintained during each individual exposure in the test sequence.

Where the EUT is a transceiver, under no circumstances shall the transmitter operate unintentionally during the test.

Performance criteria for Transient phenomena applied to Receivers (TR)

For equipment with primary function type I or II, including ancillary equipment tested on a stand alone basis, the performance criteria B of the applicable device type as given in clause 6.3 shall apply, except for power interruptions exceeding a certain time the performance criteria deviations are specified in clause 7.2.2.

For equipment with primary function type II or III that requires a communication link that is maintained during the test, this shall be verified by appropriate means supplied by the manufacturer during each individual exposure in the test sequence.

Where the EUT is a transceiver, under no circumstances shall the transmitter operate unintentionally during the test.

Performance criteria for ancillary equipment tested on a stand alone basis

The provision of EN 301 489-1 [1], clause 6.4, shall apply.

2. ETSI EN 301 489-1/17

The performance criteria are:

- performance criteria A for immunity tests with phenomena of a continuous nature;
- performance criteria B for immunity tests with phenomena of a transient nature;
- performance criteria C for immunity tests with power interruptions exceeding a certain time.

The equipment shall meet the minimum performance criteria as specified in the following clauses.

Table 1: Performance criteria

Criteria	During	After test
A	Shall operate as intended. (see note 1). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance (see note 3). Shall be no loss of function. Shall be no loss of stored data or user programmable functions.
B	May show loss of function (one or more). May show degradation of performance (see note 2). Shall be no unintentional transmissions.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no degradation of performance (see note 3). Shall be no loss of stored data or user programmable functions.
C	May be loss of function (one or more).	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no degradation of performance (see note 3).

NOTE 1: Operate as intended during the test allows a level of degradation not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.
If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

NOTE 2: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.
If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

NOTE 3: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.
If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

Performance criteria for Continuous phenomena applied to Transmitters (CT)

The performance criteria A shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACKnowledgement (ACK) or Not ACKnowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Transient phenomena applied to Transmitters (TT)

The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration, for which performance criteria C shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an acknowledgement (ACK) or not-acknowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Continuous phenomena applied to Receivers (CR)

The performance criteria A shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Transient phenomena applied to Receivers (TR)

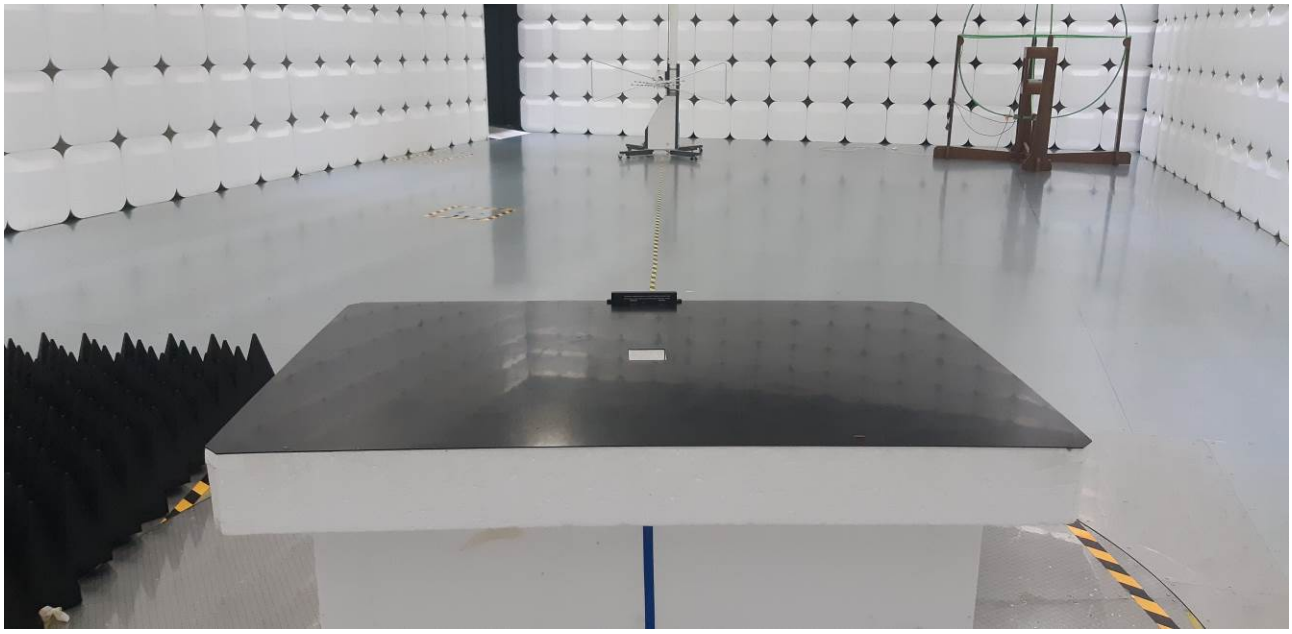
The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration for which performance criteria C shall apply.

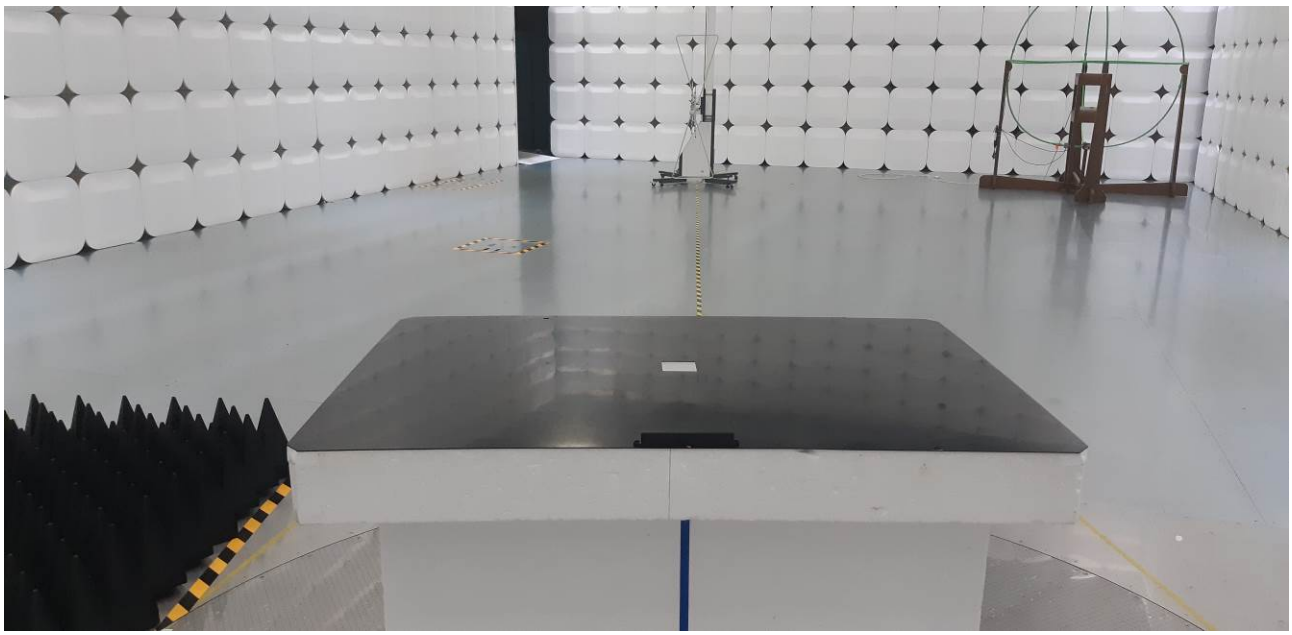
Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

APPENDIX C

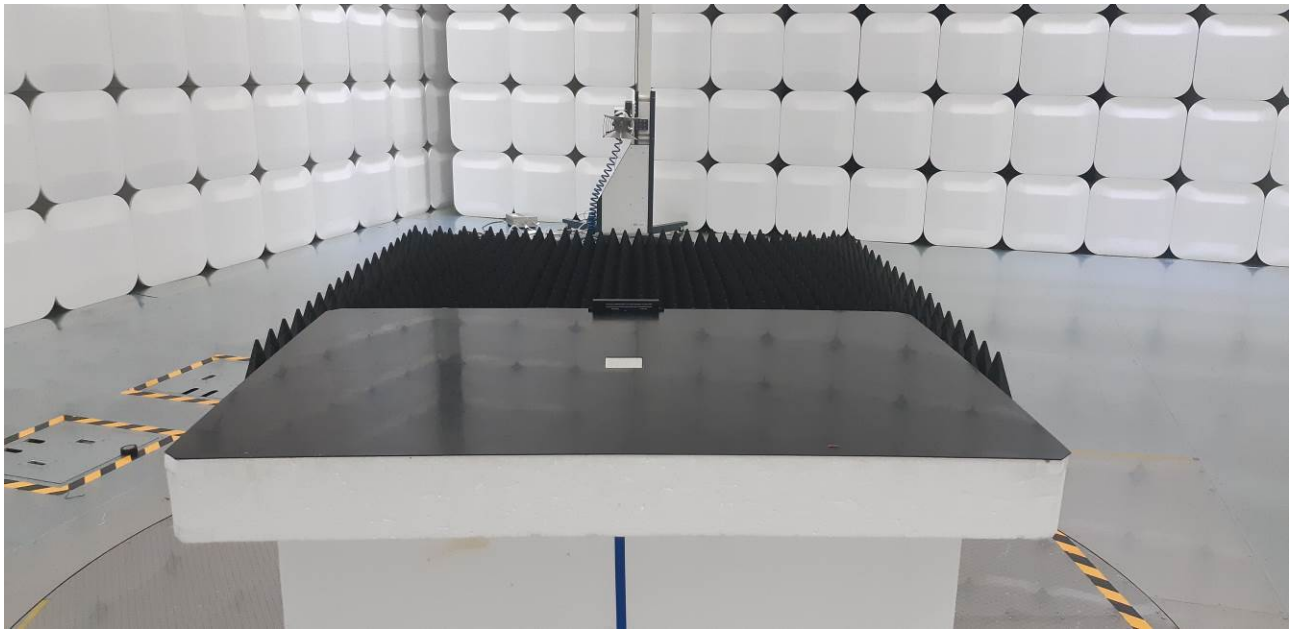
PHOTOGRAPHS

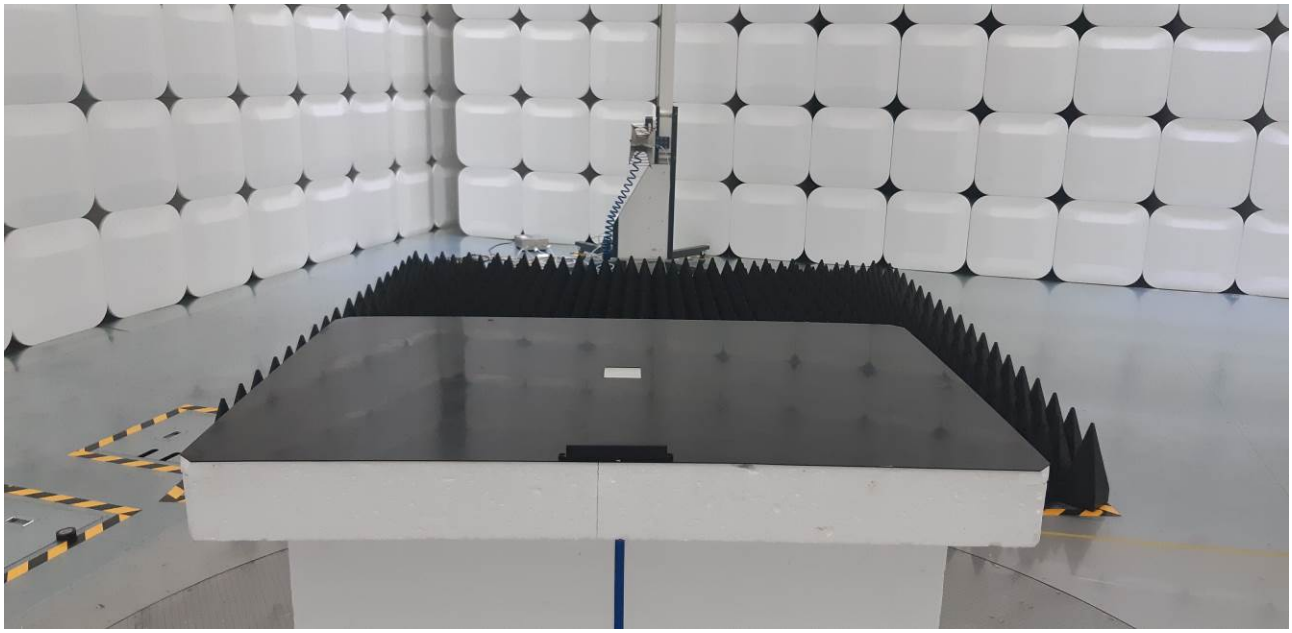
Radiated emission (Maximum emission configuration)-Below 1 GHz





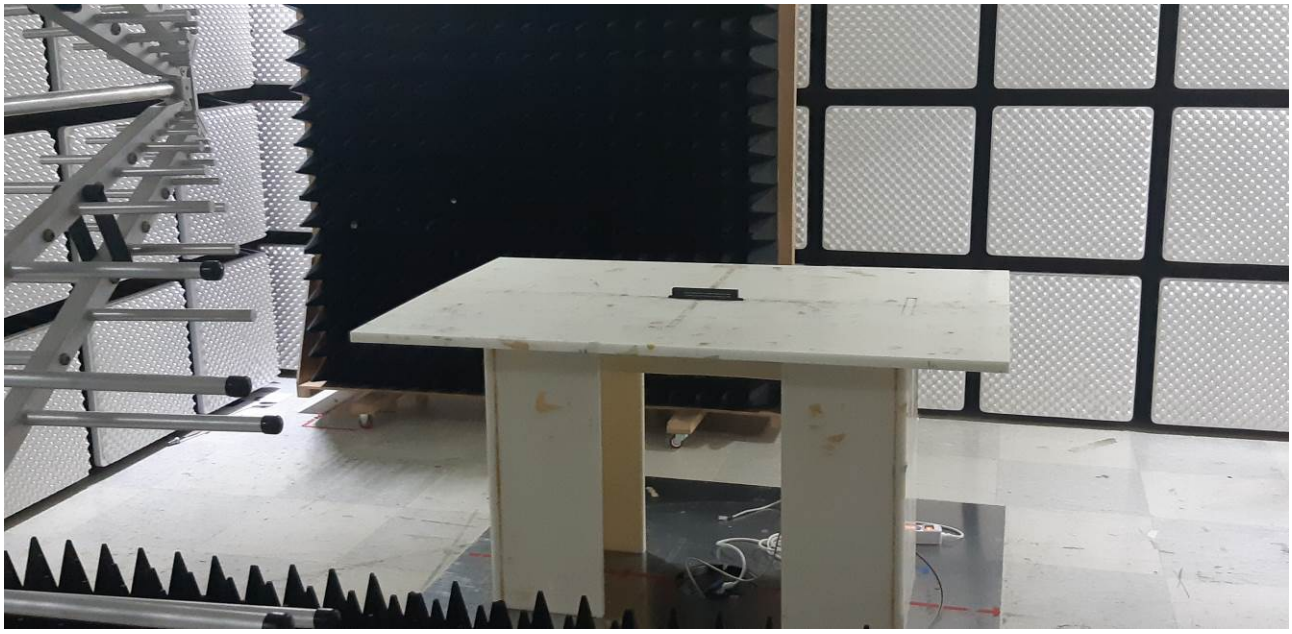
Radiated emission (Maximum emission configuration) – Above 1GHz





Electrostatic discharge

Radio Frequency Electromagnetic field



EUT

EUT