RF TEST REPORT

Report No.: 18020176-FCC-R1
Supersede Report No.: N/A

Applicant	Great American Merchandise & Events (GAME)
Product Name	Pool & Spa Thermometer with Indoor Display
Main Model	15900-4PK-E-01
Serial Model	N/A
Test Standard	FCC Part 15.231: 2017, ANSI C63.10: 2013
Test Date	February 6 to February 7, 2018
Issue Date	February 9, 2018
Test Result	☑ **Pass** ☐ **Fail**
Equipment complied with the specification	☑
Equipment did not comply with the specification	☐

Louise Tu	Deon Dai	
Louise Tu **Test Engineer**	**Deon Dai** **Engineer Reviewer**	

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Test result presented in this test report is applicable to the tested sample only

Issued by:
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Laboratories Introduction

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Hong Kong	RF/Wireless ,Telecom
Australia	EMC, RF, Telecom , Safety
Korea	EMI, EMS, RF , Telecom, Safety
Japan	EMI, RF/Wireless, Telecom
Singapore	EMC , RF , Telecom
Europe	EMC, RF, Telecom , Safety

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1. Report Revision History

Report No.	Report Version	Description	Issue Date
18020176-FCC-R1	NONE	Original	February 9, 2018

2. Customer information

Applicant Name	Great American Merchandise & Events (GAME)
Applicant Add	16444 N 91st Street, Scottsdale, AZ 85260,USA
Manufacturer Name	Great American Merchandise & Events (GAME)
Manufacturer Add	16444 N 91st Street, Scottsdale, AZ 85260,USA

3. Test site information

Lab performing tests	SIEMIC (Nanjing-China) Laboratories
Lab Add	2-1 Longcang Avenue Yuhua Economic and Technology Development Park, Nanjing, China
FCC Test Site No.	694825
IC Test Site No.	4842B-1
Test Software	EZ_EMC

4. Equipment Under Test (EUT) Information

Description of EUT:	Pool & Spa Thermometer with Indoor Display
Main Model:	15900-4PK-E-01
Serial Model:	N/A
Date EUT received:	February 6, 2018
Test Date(s):	February 6 to February 7, 2018
Antenna Gain:	0 dBi
Type of Modulation:	ASK
RF Operating Frequency (ies):	Tx:433.92 MHz
Number of Channels:	1 CH
Port:	N/A
Input Power:	2.7-3.3V
Trade Name :	N/A
FCC ID:	2AKBO-15900-2

5. Test Summary

The product was tested in accordance with the following specifications.
All testing has been performed according to below product classification:

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207	Conducted Emissions Voltage	N/A
§15.231(b)	Fundamental & Radiated Spurious Emission	Compliance
§15.231(c)	20dB Bandwidth	Compliance
§15.231(a)(1)	Deactivation	Compliance

Note: Preliminary radiated emission testing has been performed on X, Y, Z axis, only worst case test result is presented in this test report.

"N/A" means the EUT is powered by the battery.

Measurement Uncertainty

Emissions		
Test Item	**Description**	**Uncertainty**
Conducted Emissions & Radiated Spurious Emissions	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	1.634dB / 3.952dB

6. Measurements, Examination And Derived Results

6.1 Antenna Requirement

Applicable Standard

Requirement(s): 47 CFR §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 requirement must meet at least one of the following:

a) Antenna must be permanently attached to the device.

b) Antenna must use a unique type of connector to attach to the device.

c) Device must be professionally installed. Installer shall be responsible for ensuring that the correct antenna is employed with the device.

The antenna is permanently attached to the device which meets the requirement.

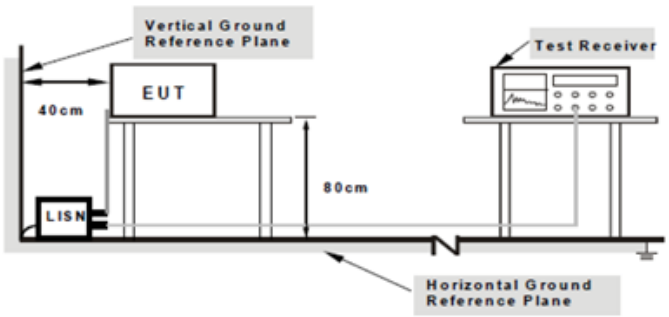
Result: Compliance.

6.2 AC Conducted Emissions Voltage

Temperature	---
Relative Humidity	---
Atmospheric Pressure	---
Test date :	---
Tested By :	---

Conducted Emission Limit

Frequency ranges (MHz)	Limit (dBμV)	
	QP	Average
0.15 ~ 0.5	66 – 56	56 – 46
0.5 ~ 5	56	46
5 ~ 30	60	50

Spec	Item	Requirement	Applicable
47CFR§15.207	a)	For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 [mu]H/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges.	☐
Test Setup	 Note: 1.Support units were connected to second LISN. 2.Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.		
Procedure	- The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table, as shown in Annex B. - The power supply for the EUT was fed through a 50W/50mH EUT LISN, connected to filtered mains. - The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable. - All other supporting equipment were powered separately from another main supply.		
Remark	"N/A" means the EUT is powered by the battery.		
Result	☑ N/A ☐ Fail		

Test Data ☑ N/A ☐ Fail

Test Plot ☑ N/A ☐ Fail

Data sample

No.	Frequency	Reading	Detector	Lisn/Isn	Ps_Lmt	Cab_L	Result	Limit	Margin
	(MHz)	(dBμV)		(dB}	(dB)	(dB)	(dBμV)	(dBμV)	(dB)

Frequency (MHz) = Emission frequency in MHz

Reading (dBμV) = Receiver Reading Value

Detector=Quasi Peak Detector or Average Detector

Lisn/ISN= Insertion loss of LISN

Ps_Lmt= Insertion loss of transient limiter (The transient limiter included 10dB attenuation)

Cab_L= cable loss

Result (dBμV) = Reading Value + Corrected Value

Limit (dBμV) = Limit stated in standard

Calculation Formula:

Margin (dB) = Result (dBμV) – limit (dBμV)

6.3 20dB Occupied Bandwidth

Temperature	18°C
Relative Humidity	50%
Atmospheric Pressure	1018mbar
Test date :	February 7, 2018
Tested By :	Louise Tu

Requirement(s):

Spec	Item	Requirement	Applicable
§15.231(c)	a)	The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz.	☑
	b)	For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.	☐
Test Setup	Spectrum Analyzer — EUT		
Test Procedure	20dB Emission bandwidth measurement procedure - Set RBW = 100 kHz. - Set the video bandwidth (VBW) ≥3*RBW. - Detector = Peak. - Trace mode = max hold. - Sweep = auto couple. - Allow the trace to stabilize. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.		
Remark			
Result	☑ Pass ☐ Fail		

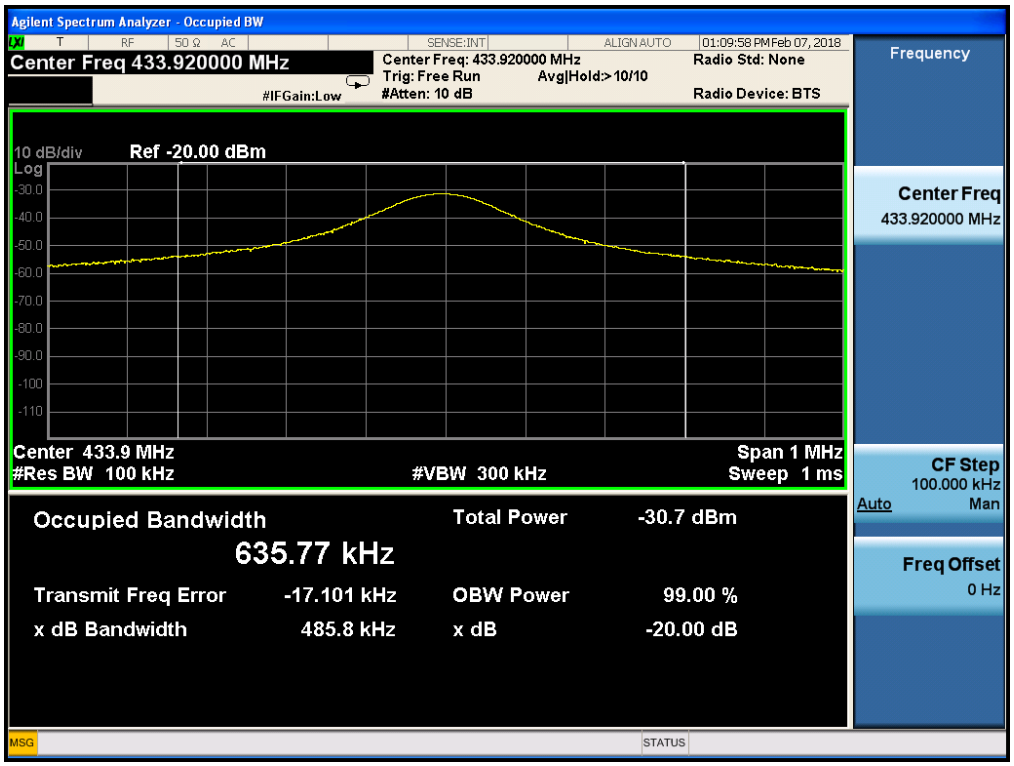
Test Data ☑ Yes ☐ N/A

Test Plot ☑ Yes ☐ N/A

20dB Bandwidth measurement result

Type	Freq (MHz)	CH	Measured 20dB Bandwidth (kHz)	Limit (kHz)	Result
20dB BW	433.92	1 CH	485.8	1084.8	Pass

Test Plots
20dB Bandwidth measurement result



20dB Bandwidth

6.4 Radiated Fundamental and Spurious Emission

Temperature	18°C
Relative Humidity	50%
Atmospheric Pressure	1018mbar
Test date :	February 6 to February 7, 2018
Tested By :	Louise Tu

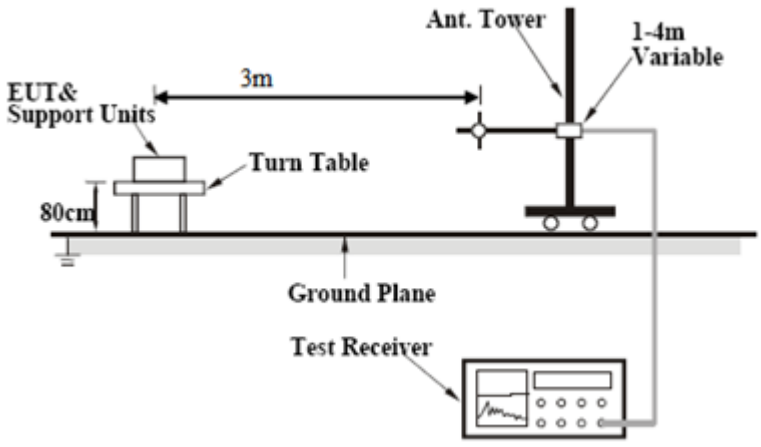
Requirement(s):

Spec	Item	Requirement	Applicable
§15.231(b)	a)	Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:	☑

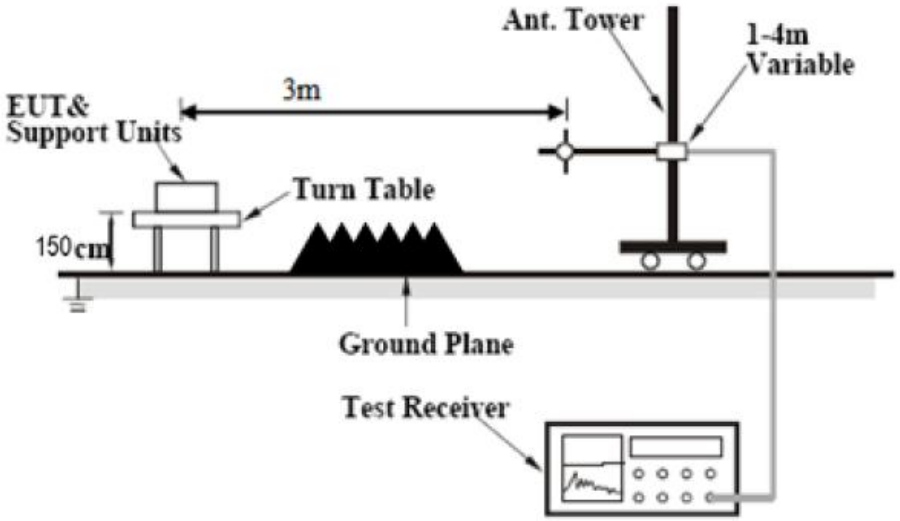
Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	1000	100
70-130	500	50
130-174	500 to 1500[1]	50 to 150[1]
174-260	1500	150
260-470	1500 to 5000[1]	150 to 500[1]
Above 470	5000	500

Test Setup

A: < 1GHz



B: >1GHz

	
Procedure	1. The EUT was switched on and allowed to warm up to its normal operating condition. 2. The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner: a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen. b. The EUT was then rotated to the direction that gave the maximum emission. c. Finally, the antenna height was adjusted to the height that gave the maximum emission. 3. A Quasi-peak measurement was then made for that frequency point. 4. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.
Result	☑ Pass ☐ Fail

Test Data ☑ Yes ☐ N/A

Test Plot ☑ Yes (See below) ☐ N/A

Data Sample

No.	Frequency	Reading	Detector	Ant_F	PA_G	Cab_L	Result	Limit	Margin	Height	Degree
	(MHz)	(dBμV/m)		(dB/m)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(cm)	(°)

Frequency (MHz) = Emission frequency in MHz

Reading (dBμV/m) = Receiver Reading Value

Detector= Peak Detector or Quasi Peak Detector

Ant_F=Antenna Factor

PA_G=Pre-Amplifier Gain

Cab_L=Cable Loss

Result (dBμV/m) = Read ing Value + Corrected Value

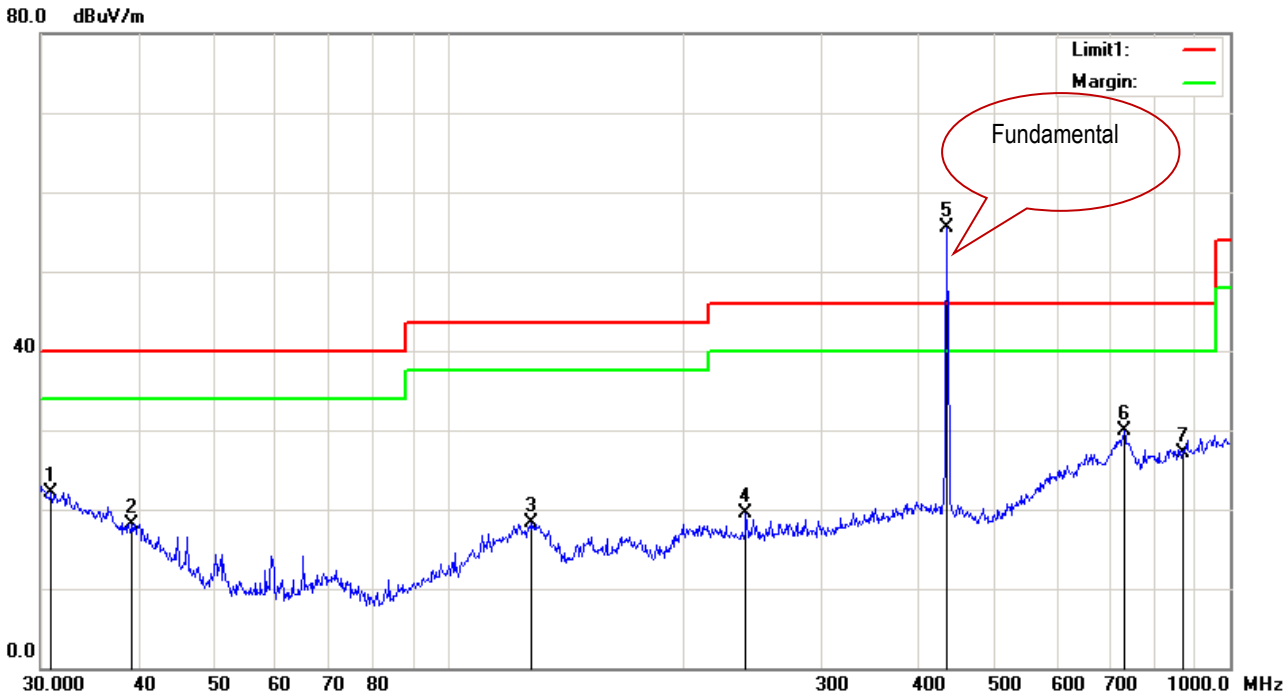
Limit (dBμV/m) = Limit stated in standard

Height (cm) = Height of Receiver antenna

Degree = Turn table degree

Calculation Formula:

Margin (dB) = Result (dBμV/m) – limit (dBμV/m)



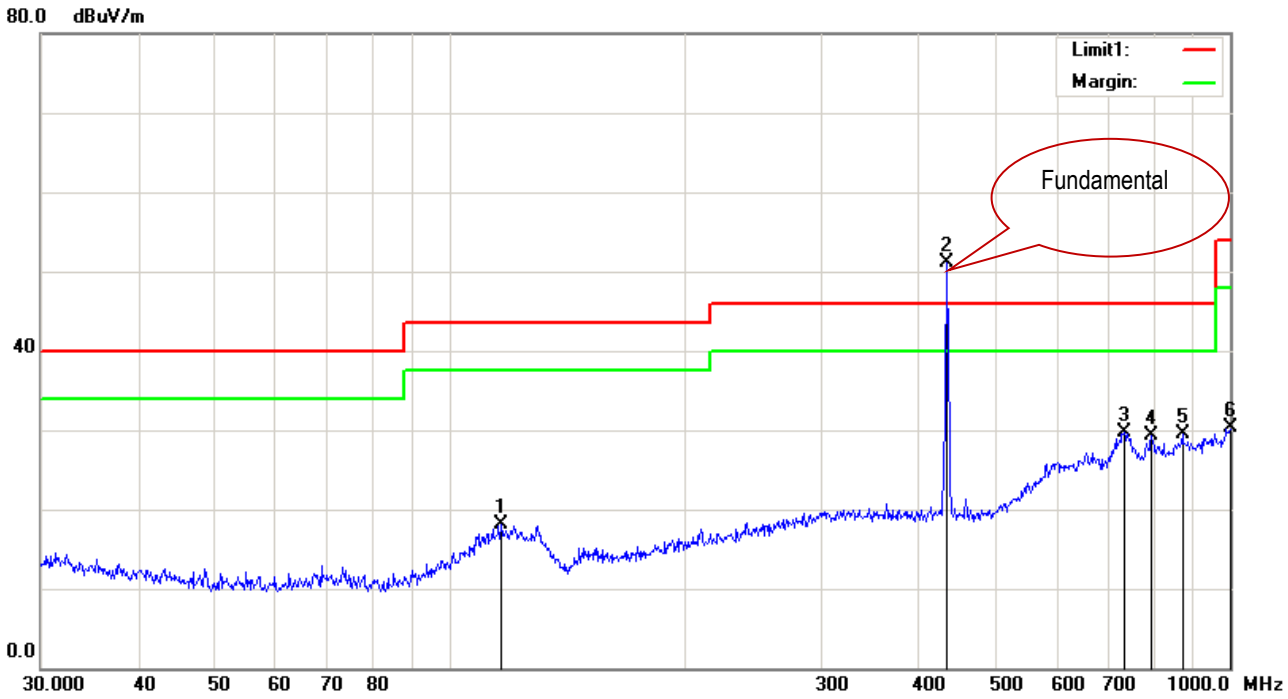
Vertical Polarity Plot @3m

Field strength of fundamental Result

Frequency (MHz)	Reading (dBμV/m)	Factors (dB)	Azimuth	Polarity	Height (m)	correct (dBμV/m)	Limit (dBμV)	Margin (dB)	Comments
433.92	84.84	-29.35	27.00	V	1.00	55.49	92.87	-37.38	Pk
433.92	-	-	-	V	-	44.71	72.87	-28.16	Ave

Field strength of spurious emissions Result

Frequency (MHz)	Reading (dBμV/m)	Factors (dB)	Azimuth	Polarity	Height (m)	correct (dBμV/m)	Limit (dBμV)	Margin (dB)	Comments
867.84	45.6	-18.40	360.00	V	1.00	27.2	72.87	-45.67	Pk
867.84	-	-	-	V	-	16.42	52.87	-36.45	Ave



Horizontal Polarity Plot @3m

Field strength of fundamental Result

Frequency (MHz)	Reading (dBµV/m)	Factors (dB)	Azimuth	Polarity	Height (m)	correct (dBµV/m)	Limit (dBµV)	Margin (dB)	Comments
433.92	80.79	-29.35	270.00	H	2.00	51.44	92.87	-41.43	Pk
433.92	-	-	-	H	-	40.66	72.87	-32.21	Ave

Field strength of spurious emissions Result

Frequency (MHz)	Reading (dBµV/m)	Factors (dB)	Azimuth	Polarity	Height (m)	correct (dBµV/m)	Limit (dBµV)	Margin (dB)	Comments
433.92	80.79	-29.35	270.00	H	2.00	51.44	92.87	-41.43	Pk
433.92	-	-	-	H	-	40.66	72.87	-32.21	Ave

Spurious Emissions (< 1GHz) Measurement Result

Vertical Polarity Plot @3m

No.	Frequency	Reading	Detector	Ant_F	PA_G	Cab_L	Result	Limit	Margin	Height	Degree
	(MHz)	(dBμV/m)		(dB/m)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(cm)	(°)
1	30.9619	45.93	peak	21.04	45.68	0.89	22.18	40.00	-17.82	100	14
2	39.2991	46.62	peak	16.19	45.69	1.04	18.16	40.00	-21.84	200	169
3	127.6645	47.42	peak	16.25	47.13	1.84	18.38	43.50	-25.12	100	147
4	239.9873	49.39	peak	14.89	47.33	2.46	19.41	46.00	-26.59	200	235
6	731.9203	48.74	peak	22.26	45.38	4.34	29.96	46.00	-16.04	100	299
7	867.8400	45.60	peak	22.99	46.15	4.76	27.20	46.00	-18.80	100	360

Horizontal Polarity Plot @3m

No.	Frequency	Reading	Detector	Ant_F	PA_G	Cab_L	Result	Limit	Margin	Height	Degree
	(MHz)	(dBμV/m)		(dB/m)	(dB)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	(cm)	(°)
1	116.5401	47.04	peak	15.69	46.45	1.75	18.03	43.50	-25.47	300	27
3	731.9203	48.24	peak	22.59	45.38	4.34	29.79	46.00	-16.21	300	160
4	793.3960	48.06	peak	22.96	46.29	4.53	29.26	46.00	-16.74	199	359
5	869.1302	48.01	peak	22.79	46.12	4.76	29.44	46.00	-16.56	199	91
6	1000.0000	46.23	peak	25.10	46.17	5.06	30.22	54.00	-23.78	199	162

Notes:

1. Duty cycle is 28.89%, 20log (duty cycle) = -10.78dB correction was used to determine the average level from the peak reading. Average = peak reading + 20log (duty cycle), Final Average= peak reading -10.78dB

2. All the data measurement of peak values.

3. FCC Limit for Average Measurement=16.67* (434.04-260)+1500=4401.2468μV/m=72.87dBμV/m

4. Average pulsed signal over one complete pulse train or 100 ms time frame if pulse train exceeds 100 ms

5. Maximum average in 100 ms

6. Calculate duty cycle for pulse train or 100 ms

7. Duty cycle = (t1 + t2 + t3+…tn)/T where tn = pulse width, T = pulse train length or 100 ms

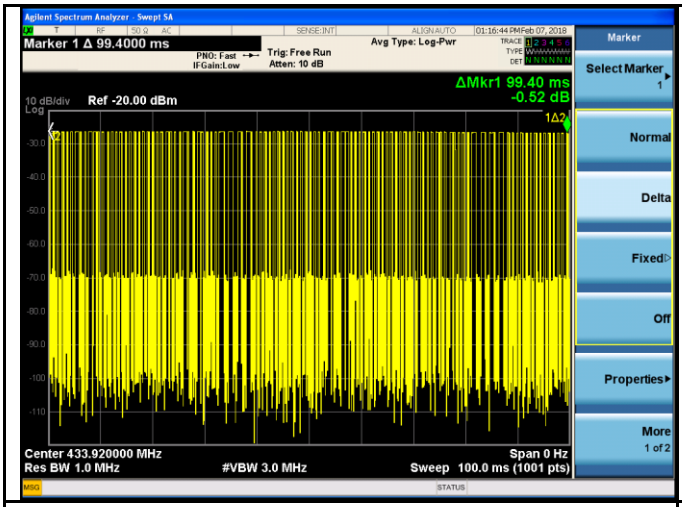
Spurious Emissions (> 1GHz) Measurement Result

Frequency GHz	Reading (dBµV/m)	Direction Degree	Height Meter	Polar H/V	Factors (dB)	correct (dBµV/m)	FCC15.231 Limit (dBµV/m)	Margin	Comments
1.302	61.22	126.00	1.00	V	-19.10	42.12	74	-31.88	Peak
1.302	-	-	-	V	-	31.34	54	-22.66	*Ave*
1.736	63.77	134.00	1.00	V	-17.22	46.55	72.87	-26.32	Peak
1.736	-	-	-	V	-	35.77	52.87	-17.1	*Ave*
2169	63.7	6.00	1.00	V	-16.81	46.89	72.87	-25.98	Peak
2169	-	-	-	V	-	36.11	52.87	-16.76	*Ave*
2.603	63.76	214.00	2.00	V	-16.96	46.8	72.87	-26.07	Peak
2.603	-	-	-	V	-	36.02	52.87	-16.85	*Ave*
3.037	59.47	249.00	1.00	V	-16.77	42.7	72.87	-30.17	Peak
3.037	-	-	-	V	-	31.92	52.87	-20.95	*Ave*
3.471	58.5	19.00	2.00	V	-16.37	42.13	72.87	-30.74	Peak
3.471	-	-	-	V	-	31.35	52.87	-21.52	*Ave*
3.905	56.9	299.00	1.00	V	-15.97	40.93	72.87	-31.94	Peak
3.905	-	-	-	V	-	30.15	52.87	-22.72	*Ave*
4.338	57.78	267.00	2.00	V	-14.26	43.52	74	-30.48	Peak
4.338	-	-	-	V	-	32.74	54	-21.26	*Ave*
1.302	61.05	5.00	1.00	H	-19.10	41.95	74	-32.05	Peak
1.302	-	-	-	H	-	31.17	54	-22.83	*Ave*
1.736	62.15	128.00	1.00	H	-17.22	44.93	72.87	-27.94	Peak
1.736	-	-	-	H	-	34.15	52.87	-18.72	*Ave*
2169	68.46	293.00	1.00	H	-16.81	51.65	72.87	-21.22	Peak
2169	-	-	-	H	-	40.87	52.87	-12	*Ave*
2.603	64.87	337.00	2.00	H	-16.96	47.91	72.87	-24.96	Peak
2.603		-	-	H	-	37.13	52.87	-15.74	*Ave*
3.037	58.42	144.00	1.00	H	-16.77	41.65	72.87	-31.22	Peak
3.037	-	-	-	H	-	30.87	52.87	-22	*Ave*
3.471	57.7	359.00	2.00	H	-16.37	41.33	72.87	-31.54	Peak
3.471	-	-	-	H	-	30.55	52.87	-22.32	*Ave*
3.905	56.9	257.00	1.00	H	-15.97	40.93	72.87	-31.94	Peak
3.905	-	-	-	H	-	30.15	52.87	-22.72	*Ave*
4.338	56.29	198.00	1.00	H	-14.26	42.03	74	-31.97	Peak
4.338	-	-	-	H	-	31.25	54	-22.75	*Ave*

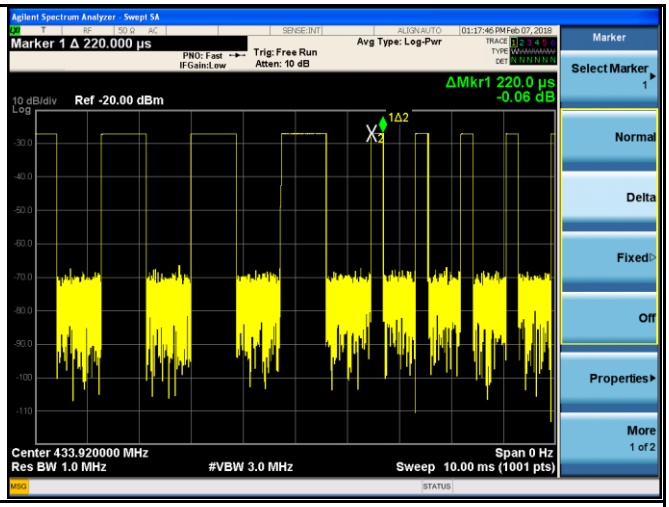
Note: Duty cycle is 28.89%, 20log (duty cycle) = -10.78dB correction was used to determine the average level from the peak reading.
Average = peak reading + 20log (duty cycle), final Average= peak reading -10.78dB

Note:
Narrow Pulse: 0.22ms
2/NP = 2/0.22ms =9.09 kHz
RBW > 2/NP (9.09 kHz)
Therefore PDCF is not needed.

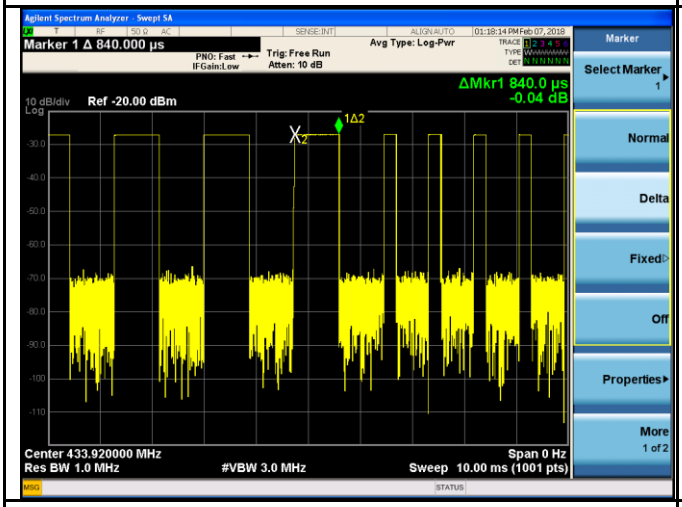
Duty Cycle Measurement Result



Duty Cycle 1#



Duty Cycle 2#



Duty Cycle 3#

Wide Pulse: 0.84ms
Narrow Pulse: 0.22ms
Duty cycle= (0.84*8+0.22*100)/99.4*100%=28.89%
Average Duty Factor: 20*log (Duty Cycle) = -10.78 dB

Pulse Duty Cycle

6.5 Deactivation

Temperature	18°C
Relative Humidity	50%
Atmospheric Pressure	1018mbar
Test date :	March 05, 2018
Tested By :	Louise Tu

Requirement(s):

Spec	Item	Requirement	Applicable
§15.231	e)	In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.	☑
Test Setup	Spectrum Analyzer — EUT		
Test Procedure	measurement procedure - Set analyzer center frequency to channel center frequency. - Set the span to 0Hz. - Set the VBW ≥ 3 ´ RBW. - Detector = peak. - Sweep time = auto couple. - Trace mode = max hold. - Allow trace to fully stabilize.		
Remark			
Result	☑ Pass	☐ Fail	

Test Data ☐ Yes ☑ N/A

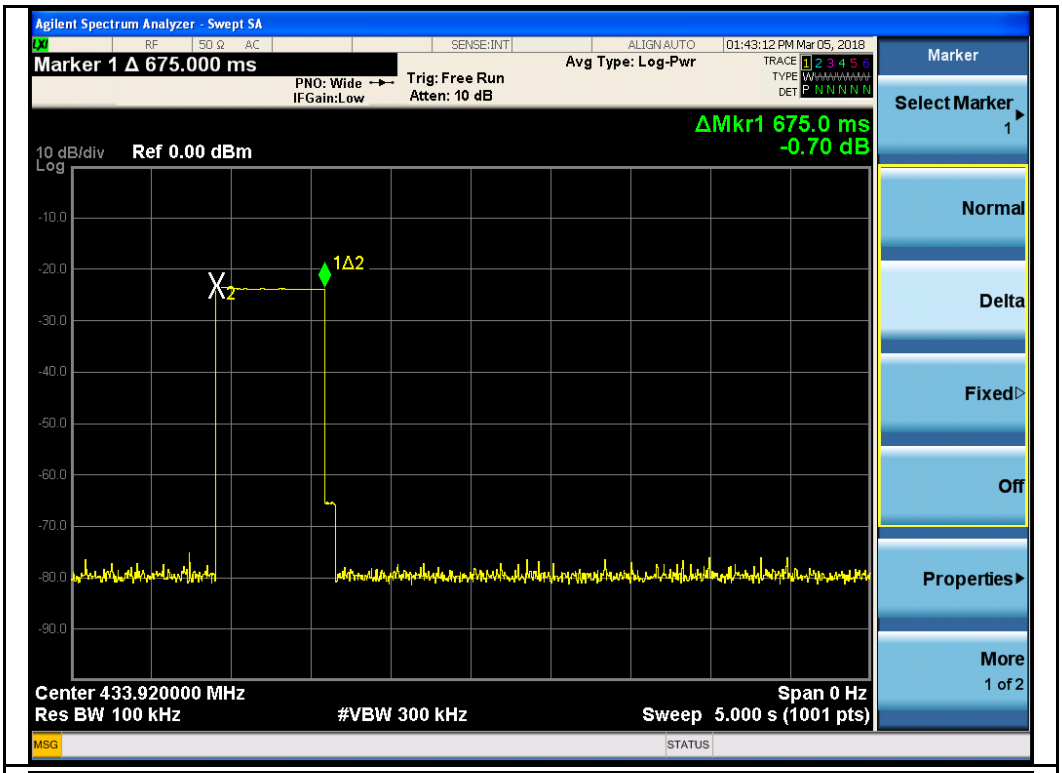
Test Plot ☑ Yes (See below) ☐ N/A

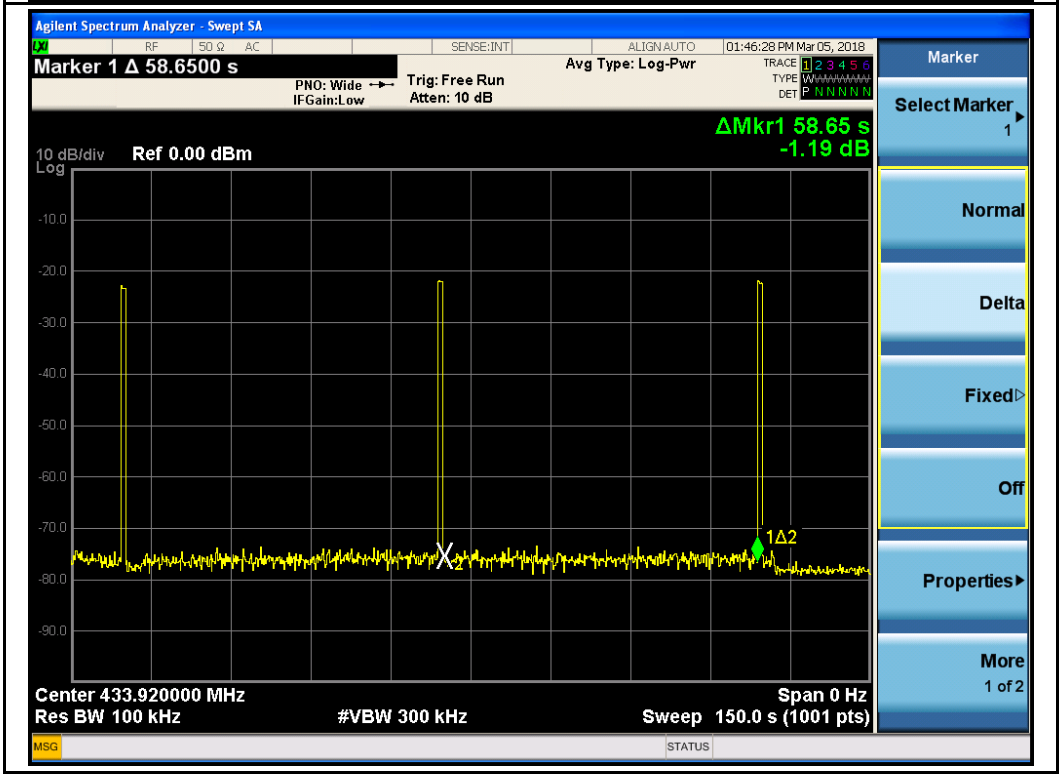
Test Plots
Deactivation Measurement Result

Duration time=0.675s < 1s

Silent time=58.65s > 10s

Silent time=58.65s > 30*0.675s=20.25s





Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Due	In use
AC Line Conducted Emissions					
R&S EMI Test Receiver	ESPI3	101216	05/03/2017	05/02/2018	☐
V-LISN	ESH3-Z5	838979/005	05/15/2017	05/14/2018	☐
SIEMIC EZ_EMC software Conducted Emissions	Ver.ICP-03A1	N/A	N/A	N/A	☐
RF conducted test					
Agilent Technologies Spectrum Analyzer	N9010A	MY47191130	05/03/2017	05/02/2018	☒
Radiated Emissions					
Agilent Technologies Spectrum Analyzer	N9010A	MY47191130	05/03/2017	05/02/2018	☒
R&S EMI Receiver	ESPI3	101216	05/03/2017	05/02/2018	☒
Antenna (30MHz~6GHz)	JB6	A121411	10/31/2017	10/30/2018	☒
EMCO Horn Antenna (1 ~18GHz)	3115	N/A	11/15/2017	11/14/2018	☒
Hp Agilent Pre-Amplifier	8447F	1937A01160	10/31/2017	10/30/2018	☒
Pre-Amplifier	8449B	3008A02224	10/30/2017	10/29/2018	☒
SIEMIC EZ_EMC software Radiated Emissions	Ver.ICP-03A1	N/A	N/A	N/A	☒

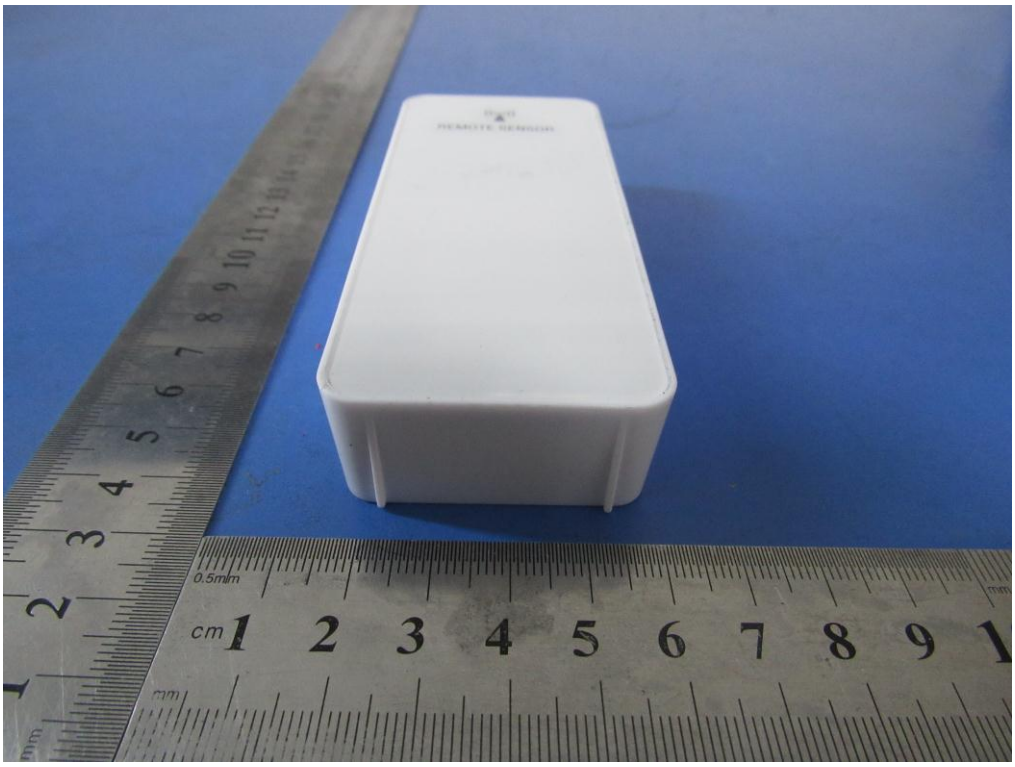
Annex B. EUT And Test Setup Photographs

Annex B.i. Photograph: EUT External Photos

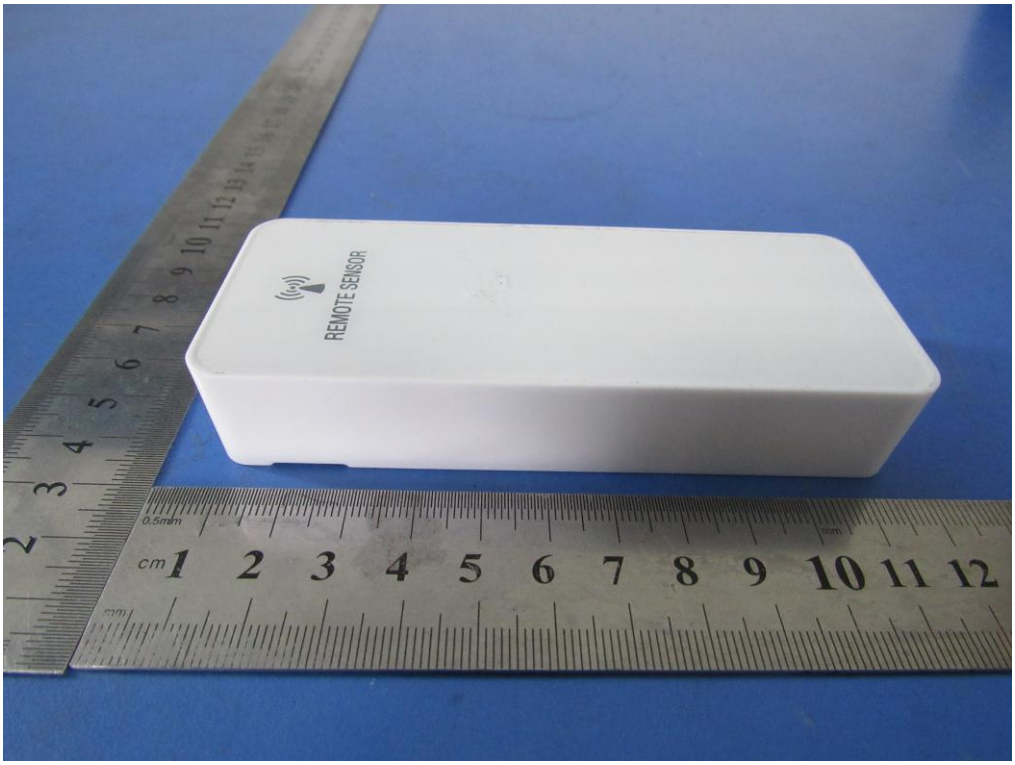
Top View of EUT

Bottom View of EUT

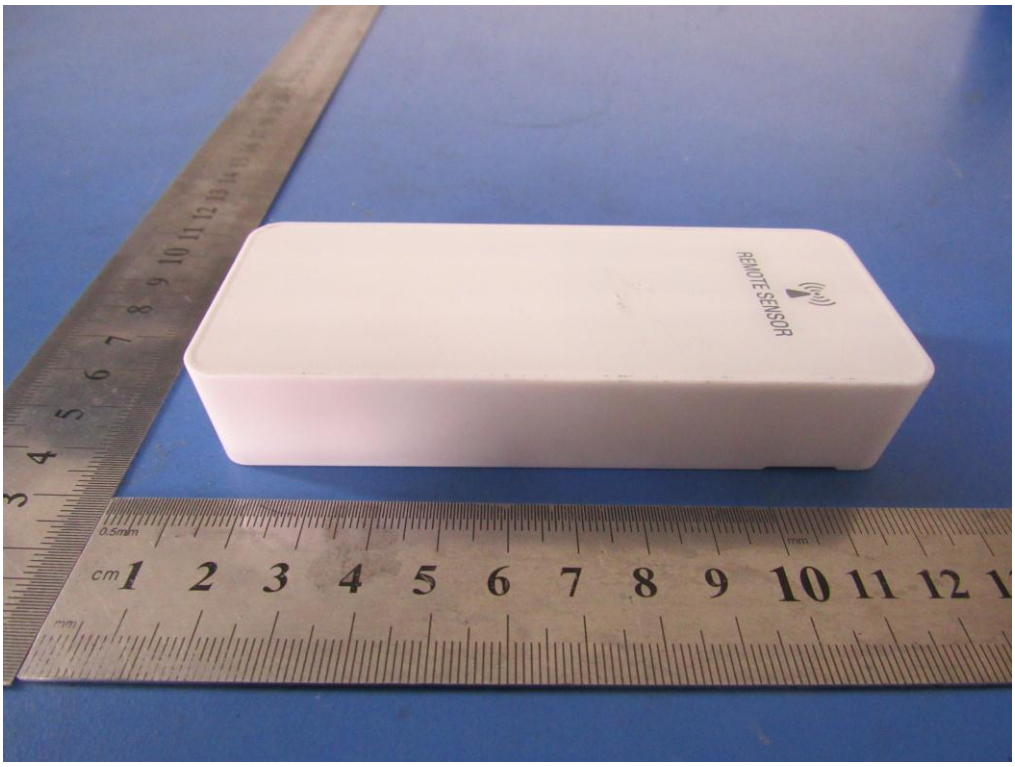
Front View of EUT



Rear View of EUT



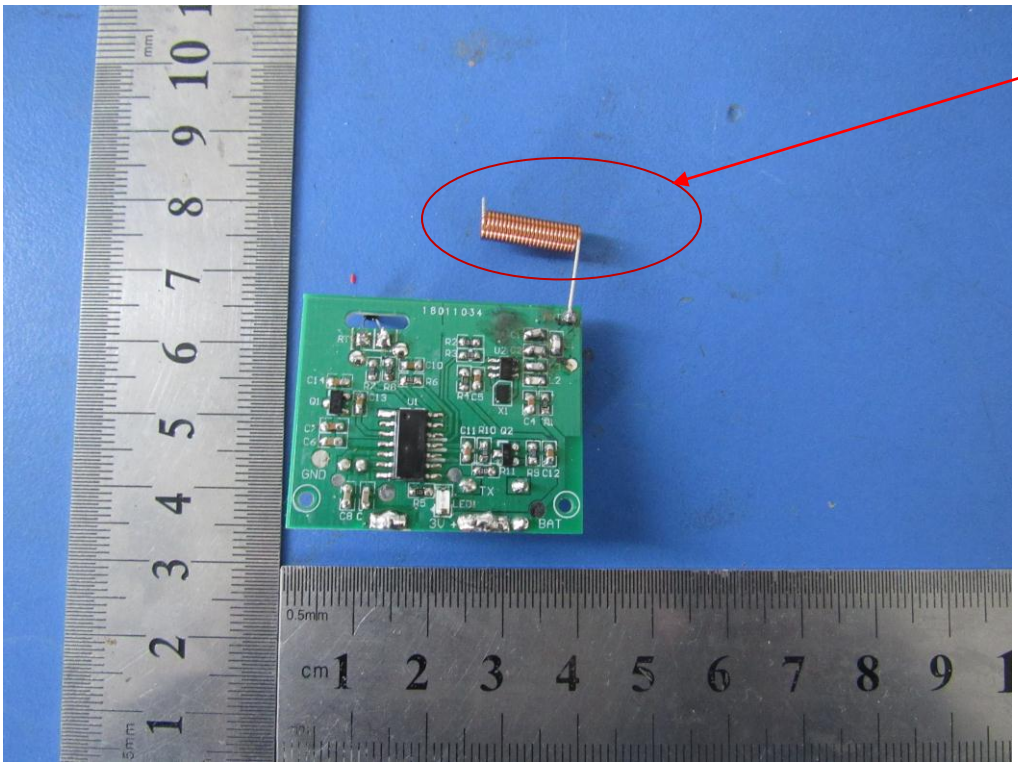
Left View of EUT



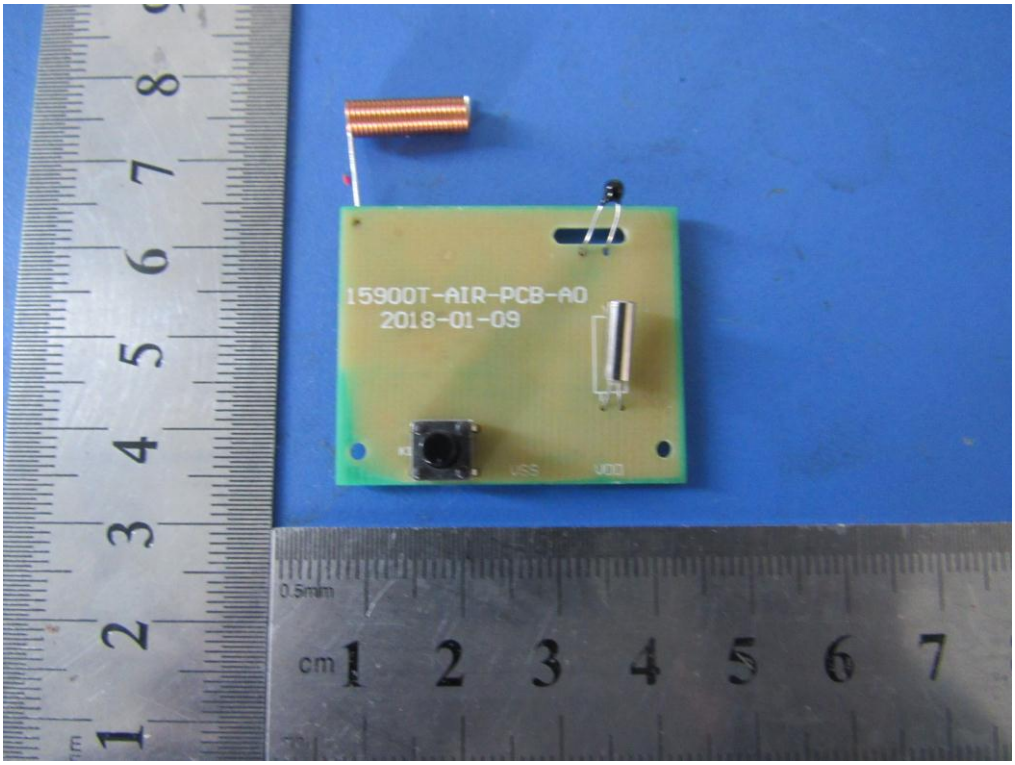
Right View of EUT

Annex B.ii. Photograph EUT Internal Photos

Uncover - Front View

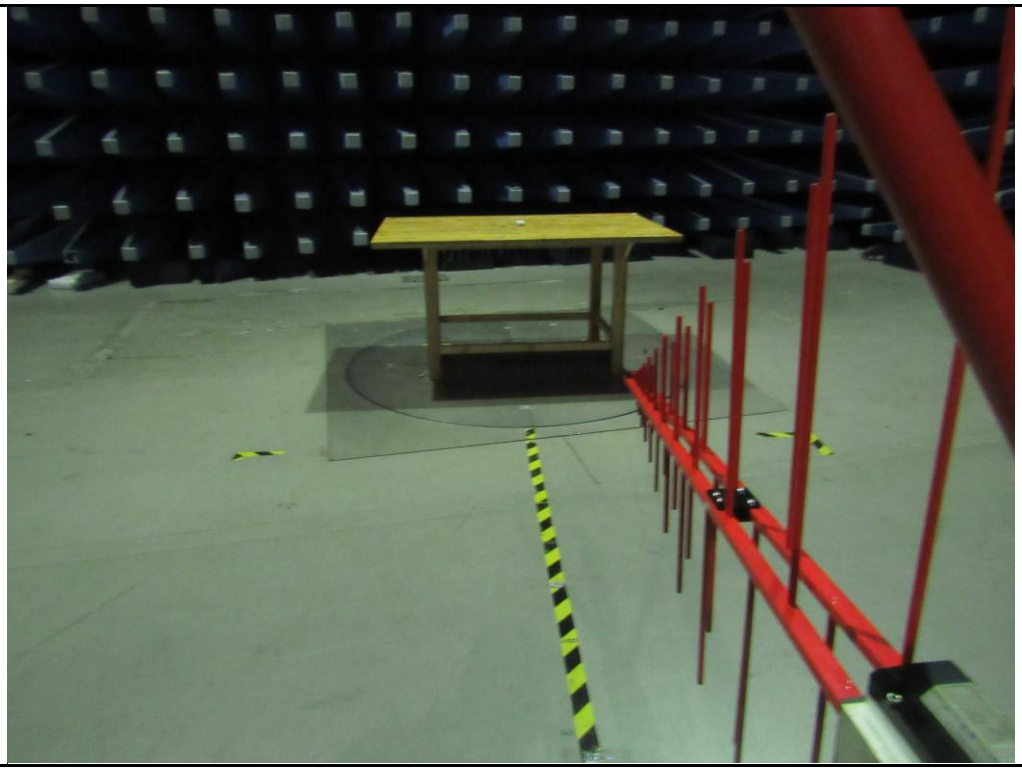


EUT PCB– Front View

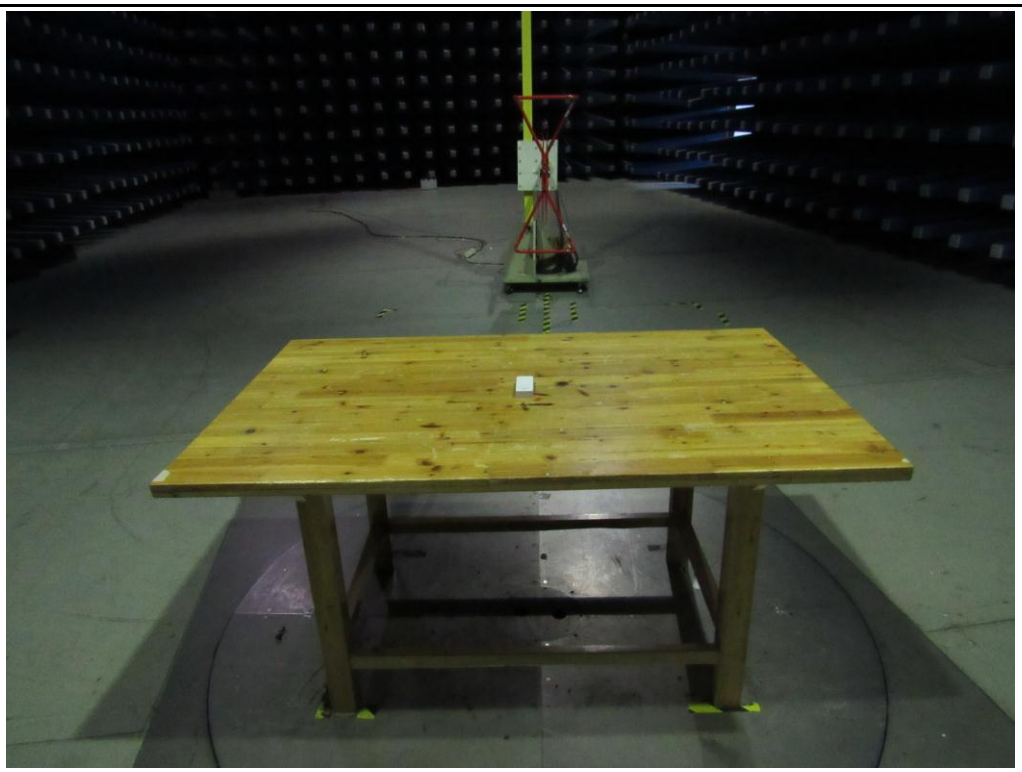


EUT PCB – Rear View

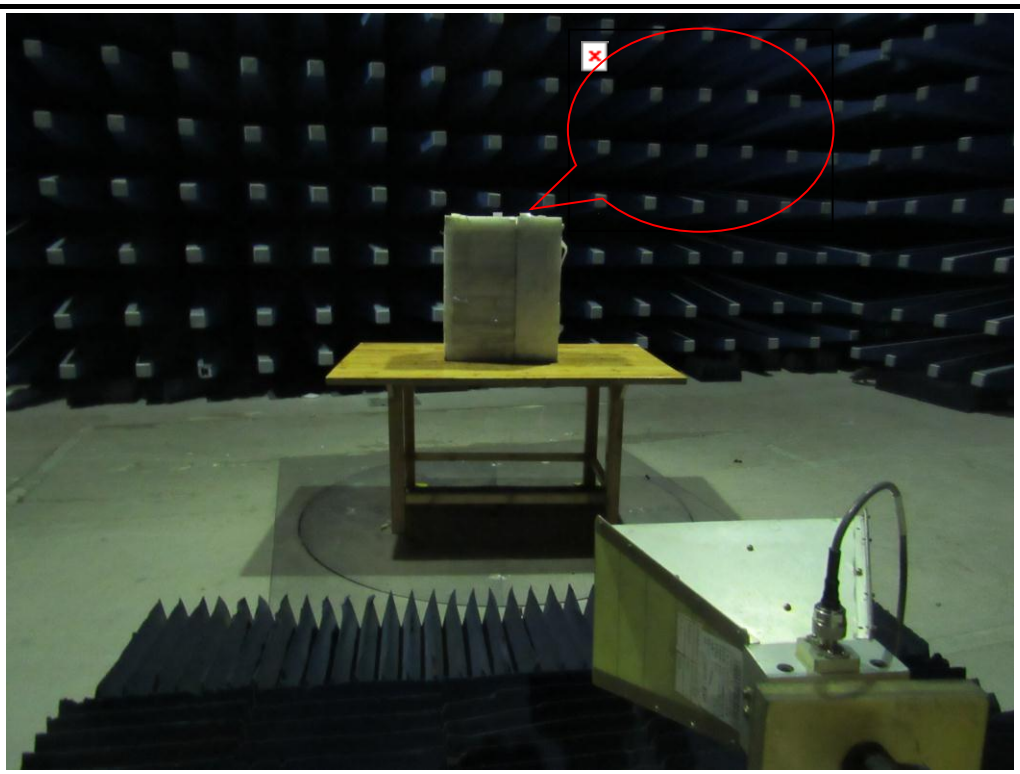
Annex B.iii. Photograph: Test Setup Photo



Radiated Emissions Test Setup Below 1GHz Front View



Radiated Emissions Test Setup Below 1GHz Rear View

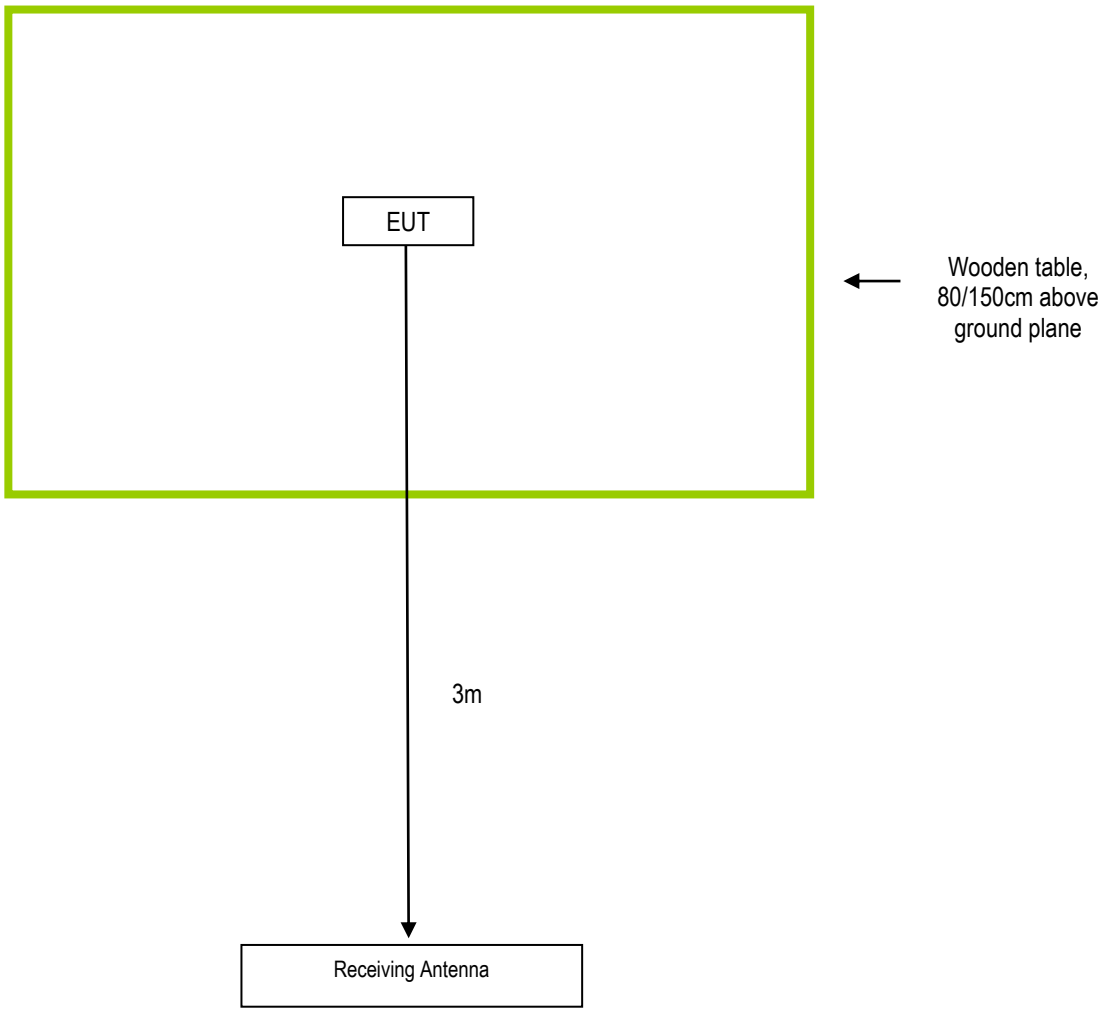


Radiated Emissions Test Setup Above 1GHz

Annex C. TEST SETUP AND SUPPORTING EQUIPMENT

Annex C.ii. TEST SET UP BLOCK

Block Configuration Diagram for Radiated Emissions



Annex C. ii. SUPPORTING EQUIPMENT DESCRIPTION

The following is a description of supporting equipment and details of cables used with the EUT.

Manufacturer	Equipment Description	Model	Calibration Due Date
N/A	N/A	N/A	N/A

Annex D. User Manual / Block Diagram / Schematics / Partlist

Please see attachment

Annex E. DECLARATION OF SIMILARITY

N/A