

TEST REPORT

FCC ID: 2AJWWFUT089LS2

Product: LED Smart Controller

Model No.: FUT089/LS2

**Additional Model: FUT043/FUT088;FUT044/B8;
FUT045/B0;LS1/B3;LS2/B4;LS3/B2;**

Trade Mark: Mi·Light[®]

Report No.: TCT180201E012

Issued Date: February 02, 2018

Issued for:

Futlight Optoelectronics Co Ltd
Floor 2, Building D, Fusen Technology Park,
Hangcheng Road, Bao'an District, Shenzhen City, Guangdong Province

Issued By:

Shenzhen Tongce Testing Lab.
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TABLE OF CONTENTS

1. Test Certification	3
2. Test Result Summary	4
3. EUT Description.....	5
4. Genera Information.....	6
4.1. TEST ENVIRONMENT AND MODE	6
4.2. DESCRIPTION OF SUPPORT UNITS	6
5. Facilities and Accreditations	7
5.1. FACILITIES	7
5.2. LOCATION	7
5.3. MEASUREMENT UNCERTAINTY	7
6. Test Results and Measurement Data	8
6.1. ANTENNA REQUIREMENT	8
6.2. CONDUCTED EMISSION	9
6.3. RADIATED EMISSION MEASUREMENT.....	10
6.4. 20dB OCCUPIED BANDWIDTH	19
7. Appendix A: Photographs of Test Setup	23
8. Appendix B: Photographs of EUT	24

1. Test Certification

Product:	LED Smart Controller
Model No.:	FUT089/LS2
Additional Model:	FUT043/FUT088;FUT044/B8;FUT045/B0;LS1/B3;LS2/B4;LS3/B2;
Trade Mark:	Mi·Light[®]
Applicant:	Futlight Optoelectronics Co Ltd
Address:	Floor 2, Building D, Fusen Technology Park, Hangcheng Road, Bao'an District, Shenzhen City, Guangdong Province
Manufacturer:	Futlight Optoelectronics Co Ltd
Address:	Floor 2, Building D, Fusen Technology Park, Hangcheng Road, Bao'an District, Shenzhen City, Guangdong Province
Date of Test:	December 26, 2017 to January 10, 2018
Applicable Standards:	FCC CFR Title 47 Part 15 Subpart C Section 15.249

The above equipment has been tested by Shenzhen Tongce Testing Lab. and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Tested By:

Garen

Date:

Jan. 10, 2018

Reviewed By:

Beryl Zhao

Date:

Feb. 02, 2018

Approved By:



Tomsin

Date:

Feb. 02, 2018

2. Test Result Summary

Requirement	CFR 47 Section	Result
Antenna Requirement	§15.203	PASS
AC Power Line Conducted Emission	§15.207	N/A
Field Strength of Fundamental	§15.249 (a)	PASS
Spurious Emissions	§2.1053 §15.249 (a) (d)/ §15.209	PASS
Band Edge	§2.1053 §15.249 (d)/ §15.205	PASS
20dB Occupied Bandwidth	§2.1049 §15.215 (c)	PASS

Note:

1. Pass: Test item meets the requirement.
2. Fail: Test item does not meet the requirement.
3. N/A: Test case does not apply to the test object.
4. The test result judgment is decided by the limit of test standard.

3. EUT Description

Product:	LED Smart Controller
Model No.:	FUT089/LS2
Additional Model:	FUT043/FUT088;FUT044/B8;FUT045/B0;LS1/B3;LS2/B4;LS3/B2;
Trade Mark:	Mi·Light [®]
Operation Frequency:	2410MHz - 2472MHz
Number of Channel:	3
Modulation Technology:	GFSK
Antenna Type:	Integral Antenna
Antenna Gain:	2.0dBi
Power Supply:	External battery power supply Voltage: 3V

Operation Frequency Each of Channel

Channel	Frequency
1	2410MHz
2	2441MHz
3	2472MHz

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The lowest channel	2410MHz
The middle channel	2441MHz
The Highest channel	2472MHz

4. General Information

4.1. Test Environment and Mode

Operating Environment:	
Temperature:	25.0 °C
Humidity:	54 % RH
Atmospheric Pressure:	1010 mbar
Test Mode:	
Engineering mode:	Keep the EUT in continuous transmitting by select channel
<p>The sample was placed (0.8m below 1GHz, 1.5m above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.</p>	

4.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
1	Adapter	/	/	/	/
2	USB port	/	/	/	/

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

5. Facilities and Accreditations

5.1. Facilities

The test facility is recognized, certified, or accredited by the following organizations:

- FCC - Registration No.: 645098

Shenzhen Tongce Testing Lab

The 3m Semi-anechoic chamber has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

- IC - Registration No.: 10668A-1

The 3m Semi-anechoic chamber of Shenzhen TCT Testing Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing

5.2. Location

Shenzhen Tongce Testing Lab

Address: 1B/F., Building 1, Yibaolai Industrial Park, Qiaotou, Fuyong, Baoan District, Shenzhen, Guangdong, China

TEL: +86-755-27673339

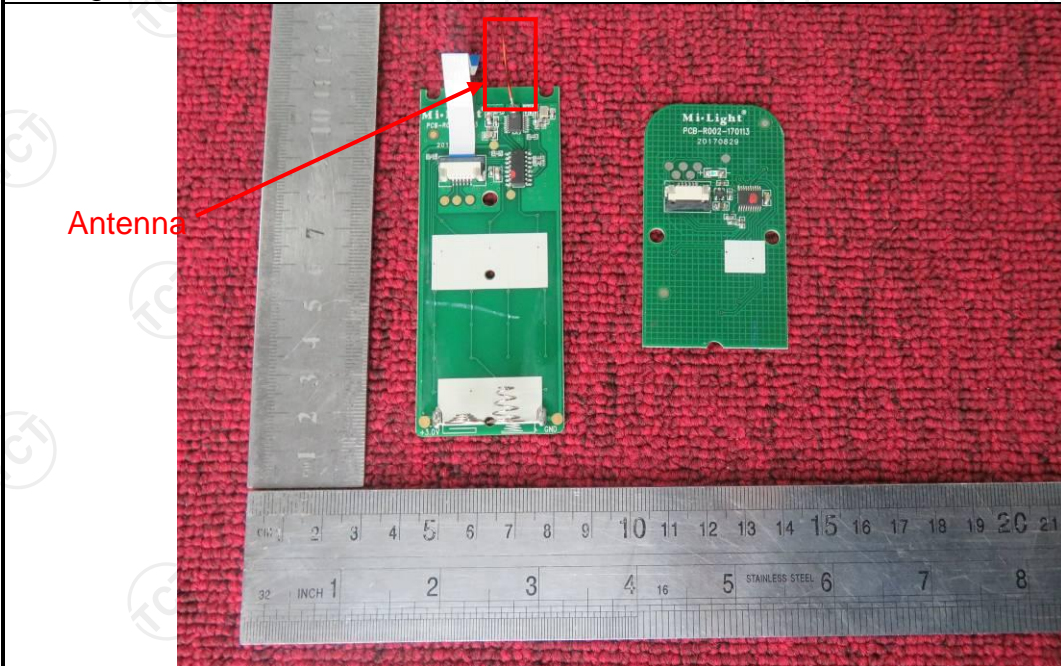
5.3. Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

No.	Item	MU
1	Conducted Emission	$\pm 2.56\text{dB}$
2	RF power, conducted	$\pm 0.12\text{dB}$
3	Spurious emissions, conducted	$\pm 0.11\text{dB}$
4	All emissions, radiated(<1GHz)	$\pm 3.92\text{dB}$
5	All emissions, radiated(>1GHz)	$\pm 4.28\text{dB}$
6	Temperature	$\pm 0.1^{\circ}\text{C}$
7	Humidity	$\pm 1.0\%$

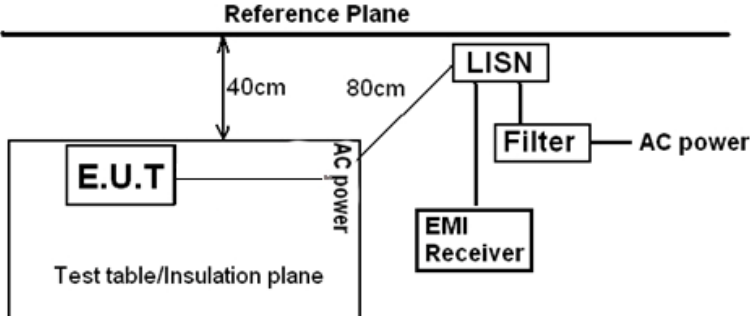
6. Test Results and Measurement Data

6.1. Antenna Requirement

Standard requirement:	FCC Part15 C Section 15.203
<p>15.203 requirement: 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.</p>	
E.U.T Antenna:	
<p>The EUT antenna is an integral antenna which permanently attached, and the best case gain of the antenna is 2.0dBi.</p>	
 <p>The photograph shows two green PCBs. The left PCB has a white antenna patch and a red box highlighting a specific component. A red arrow points from the word 'Antenna' to this box. The right PCB is labeled 'Mi-Light PCB-802-77013 20170626'. A metal ruler is placed below the PCBs for scale.</p>	

6.2. Conducted Emission

6.2.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.207		
Test Method:	ANSI C63.10:2013		
Frequency Range:	150 kHz to 30 MHz		
Receiver setup:	RBW=9 kHz, VBW=30 kHz, Sweep time=auto		
Limits:	Frequency range (MHz)	Limit (dBuV)	
		Quasi-peak	Average
	0.15-0.5	66 to 56*	56 to 46*
	0.5-5	56	46
	5-30	60	50
Test Setup:	 <p>Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</p>		
Test Mode:	Transmitting mode with modulation		
Test Procedure:	<ol style="list-style-type: none"> 1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement. 		
Test Result:	N/A		

6.3. Radiated Emission Measurement

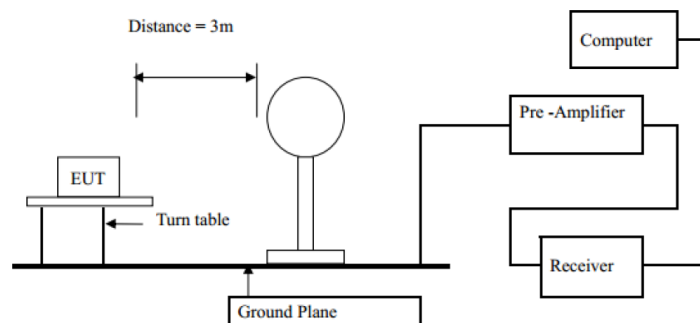
6.3.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.209/ Part 2 J Section 2.1053				
Test Method:	ANSI C63.10:2013				
Frequency Range:	9 kHz to 25 GHz				
Measurement Distance:	3 m				
Antenna Polarization:	Horizontal & Vertical				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	9kHz- 150kHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
	150kHz- 30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
	30MHz-1GHz	Quasi-peak	120kHz	300kHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
Limit(Field strength of the fundamental signal):	Frequency		Limit (dBuV/m @3m)		Remark
	2400MHz-2483.5MHz		94.00		Average Value
			114.00		Peak Value
Limit(Spurious Emissions):	Frequency		Limit (dBuV/m @3m)		Remark
	0.009-0.490		2400/F(KHz)		Quasi-peak Value
	0.490-1.705		24000/F(KHz)		Quasi-peak Value
	1.705-30		30		Quasi-peak Value
	30MHz-88MHz		40.0		Quasi-peak Value
	88MHz-216MHz		43.5		Quasi-peak Value
	216MHz-960MHz		46.0		Quasi-peak Value
	960MHz-1GHz		54.0		Quasi-peak Value
	Above 1GHz		54.0		Average Value
Limit (band edge) :			74.0		Peak Value
	Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.				
Test Procedure:	<div>1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber in below 1GHz, 1.5m above the ground in above 1GHz. The table was rotated 360 degrees to determine the position of the highest radiation.</div> <div>2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.</div> <div>3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and</div>				

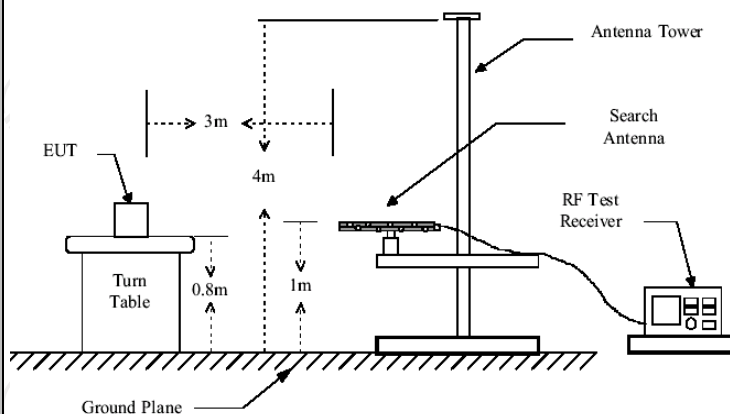
Test setup:

- vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
 6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

For radiated emissions below 30MHz

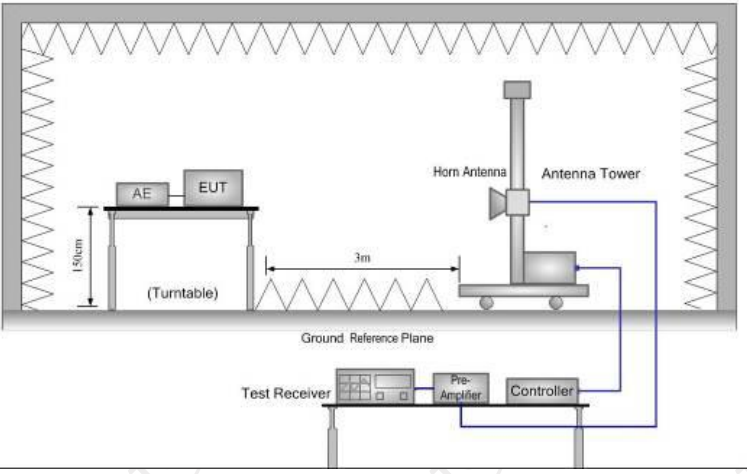


30MHz to 1GHz



Above 1GHz

(The diagram below shows the test setup that is utilized to make the measurements for emission from 1GHz to the tenth harmonic of the highest fundamental frequency or to 40GHz emissions, whichever is lower.)

	
Test results:	PASS

6.3.2. Test Instruments

Radiated Emission Test Site (966)				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Test Receiver	ROHDE&SCHW ARZ	ESVD	100008	Sep. 27, 2018
Spectrum Analyzer	ROHDE&SCHW ARZ	FSQ	200061	Sep. 27, 2018
Pre-amplifier	EM Electronics Corporation CO.,LTD	EM30265	07032613	Sep. 27, 2018
Pre-amplifier	HP	8447D	2727A05017	Sep. 27, 2018
Loop antenna	ZHINAN	ZN30900A	12024	Sep. 27, 2018
Broadband Antenna	Schwarzbeck	VULB9163	340	Sep. 27, 2018
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Sep. 27, 2018
Horn Antenna	Schwarzbeck	BBH 9170	582	Jun. 07, 2018
Antenna Mast	Keleto	CC-A-4M	N/A	N/A
Coax cable (9KHz-1GHz)	TCT	RE-low-01	N/A	Sep. 27, 2018
Coax cable (9KHz-40GHz)	TCT	RE-high-02	N/A	Sep. 27, 2018
Coax cable (9KHz-1GHz)	TCT	RE-low-03	N/A	Sep. 27, 2018
Coax cable (9KHz-40GHz)	TCT	RE-high-04	N/A	Sep. 27, 2018
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.3.3. Test Data

Field Strength of Fundamental

Frequency (MHz)	Reading PK/AV (dBuV/m)	Correct Factor (dB/m)	Horizontal /Vertical	Limits PK/AV (dBuV/m)	Margin (dB)
2410	93.21	-8.67	H	114	-29.46
2410	91.91	-8.67	H	94	-10.76
2441	95.08	-8.4	H	114	-27.32
2441	92.49	-8.4	H	94	-9.91
2472	94.44	-8.25	H	114	-27.81
2472	91.71	-8.25	H	94	-10.54
2410	93.88	-8.67	V	114	-28.79
2410	92.43	-8.67	V	94	-10.24
2441	94.09	-8.4	V	114	-28.31
2441	90.50	-8.4	V	94	-11.90
2472	93.26	-8.25	V	114	-28.99
2472	91.60	-8.25	V	94	-10.65

Spurious Emissions

Frequency Range (9 kHz-30MHz)

Frequency (MHz)	Level@3m (dBuV/m)	Limit@3m (dBuV/m)
--	--	--
--	--	--
--	--	--
--	--	--

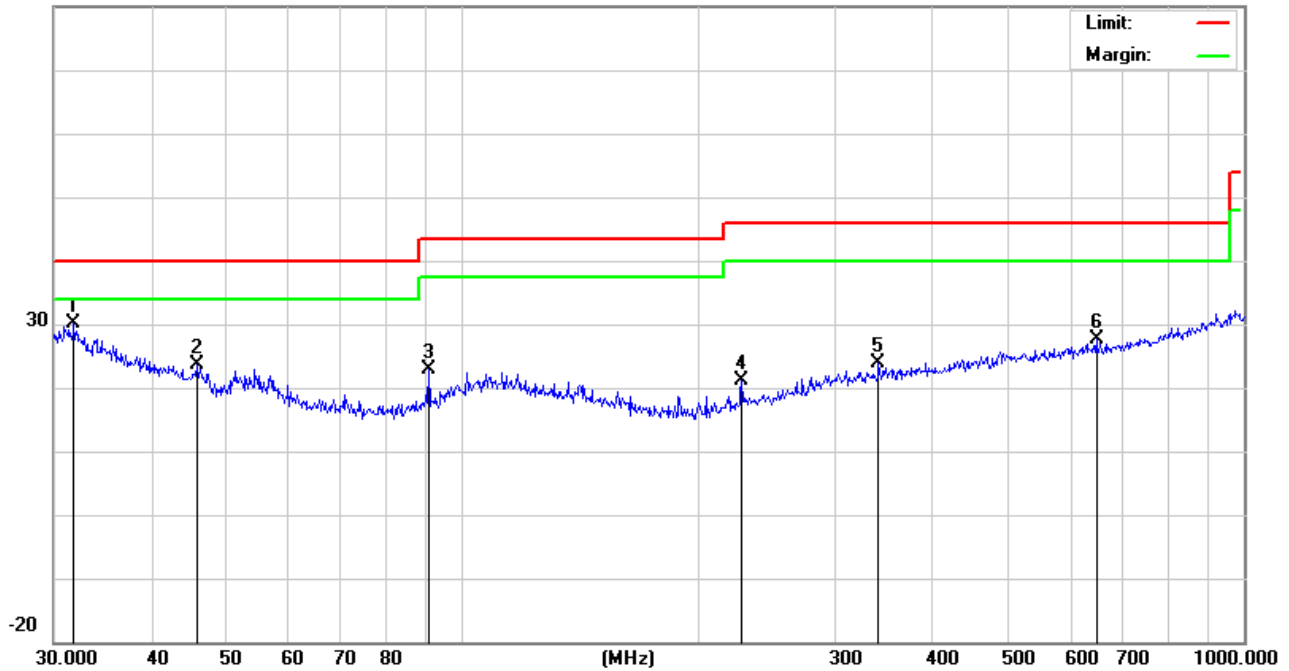
Note: 1. Emission Level=Reading+ Cable loss-Antenna factor-Amp factor

2. The emission levels are 20 dB below the limit value, which are not reported. It is deemed to comply with the requirement

Frequency Range (30MHz-1GHz)

Horizontal:

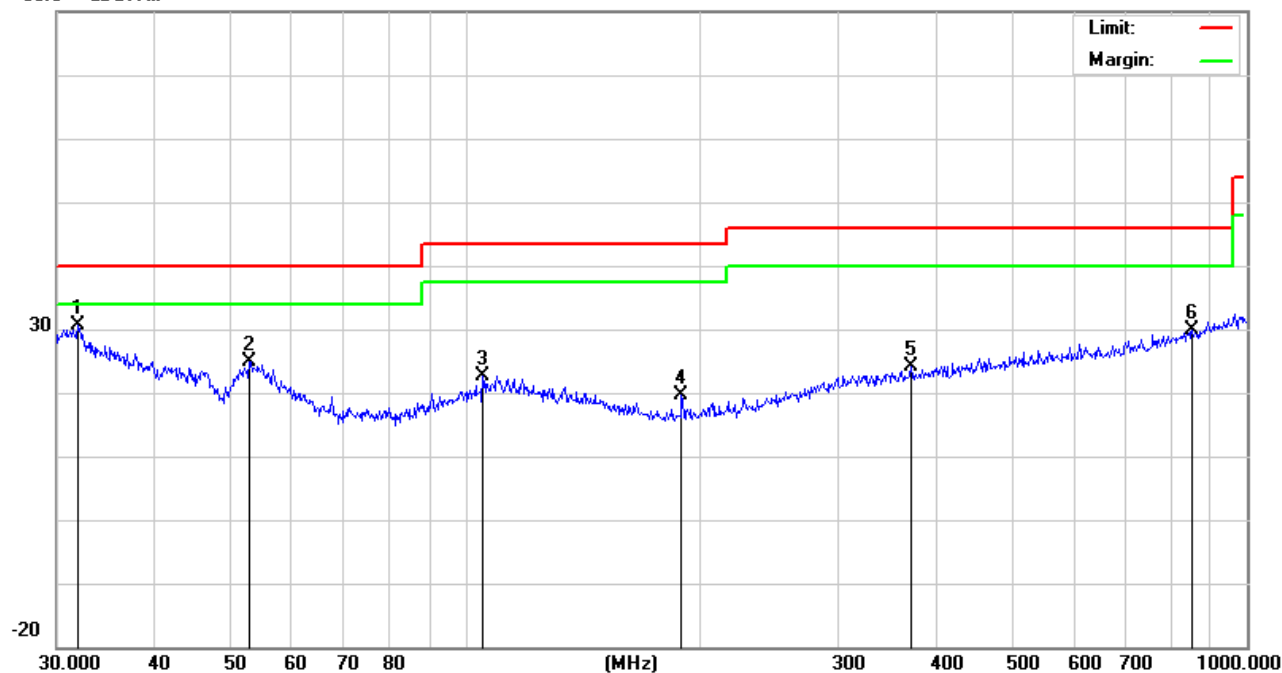
80.0 dBuV/m



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	*	31.8427	26.00	4.08	30.08	40.00	-9.92	QP
2		45.8553	26.10	-2.54	23.56	40.00	-16.44	QP
3		90.5374	28.58	-5.80	22.78	43.50	-20.72	QP
4		227.6906	26.94	-5.74	21.20	46.00	-24.80	QP
5		340.7817	25.85	-1.92	23.93	46.00	-22.07	QP
6		647.3856	26.07	1.50	27.57	46.00	-18.43	QP

Vertical:

80.0 dBuV/m



No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	
		MHz	Level	Factor	ment			
			dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	*	31.9546	26.64	4.05	30.69	40.00	-9.31	QP
2		52.9453	30.21	-5.37	24.84	40.00	-15.16	QP
3		105.2718	25.53	-2.80	22.73	43.50	-20.77	QP
4		189.0743	26.80	-7.18	19.62	43.50	-23.88	QP
5		372.0045	25.51	-1.28	24.23	46.00	-21.77	QP
6		851.0353	25.15	4.75	29.90	46.00	-16.10	QP

Note: Measurements were conducted in all channels (high, middle, low), and the worst case (low channel) was submitted only.

Above 1GHz

Frequency	Reading	Correct Factor	Emission Level	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2410MHz							
4820	56.07	-1.29	54.78	74	-19.22	H	PK
4820	41.87	-1.29	40.58	54	-13.42	H	AV
7230	49.91	6.51	56.42	74	-17.58	H	PK
7230	33.31	6.51	39.82	54	-14.18	H	AV
4820	55.25	-1.29	53.96	74	-20.04	V	PK
4820	41.35	-1.29	40.06	54	-13.94	V	AV
7230	47.62	6.51	54.13	74	-19.87	V	PK
7230	30.28	6.51	36.79	54	-17.21	V	AV
Middle Channel-2441MHz							
4882	59.58	-0.98	58.60	74	-15.40	H	PK
4882	46.60	-0.98	45.62	54	-8.38	H	AV
7323	45.57	6.83	52.40	74	-21.60	H	PK
7323	33.60	6.83	40.43	54	-13.57	H	AV
4882	57.05	-0.98	56.07	74	-17.93	V	PK
4882	40.18	-0.98	39.20	54	-14.80	V	AV
7323	45.60	6.83	52.43	74	-21.57	V	PK
7323	33.74	6.83	40.57	54	-13.43	V	AV
High Channel-2472MHz							
4944	58.17	-0.8	57.37	74	-16.63	H	PK
4944	41.17	-0.8	40.37	54	-13.63	H	AV
7416	43.53	6.94	50.47	74	-23.53	H	PK
7416	31.56	6.94	38.50	54	-15.50	H	AV
4944	55.33	-0.8	54.53	74	-19.47	V	PK
4944	41.97	-0.8	41.17	54	-12.83	V	AV
7416	43.30	6.94	50.24	74	-23.76	V	PK
7416	33.14	6.94	40.08	54	-13.92	V	AV

Note:

1. All emissions not reported were more than 20dB below the specified limit or in the noise floor.
2. Emission Level= Reading Level+Probe Factor +Cable Loss.
3. Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.


Frequency	Reading	Correct Factor	Emission Level	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2410MHz							
2390	65.07	-8.73	56.34	74	-17.66	H	PK
2390	47.44	-8.73	38.71	54	-15.29	H	AV
2390	69.11	-8.73	60.38	74	-13.62	V	PK
2390	47.18	-8.73	38.45	54	-15.55	V	AV
High Channel-2472MHz							
2483.5	68.86	-8.17	60.69	74	-13.31	H	PK
2483.5	47.24	-8.17	39.07	54	-14.93	H	AV
2483.5	65.78	-8.17	57.61	74	-16.39	V	PK
2483.5	45.81	-8.17	37.64	54	-16.36	V	AV

Note:

1. All emissions not reported were more than 20dB below the specified limit or in the noise floor.
2. Emission Level= Reading Level+Probe Factor +Cable Loss.
3. Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

6.4.20dB Occupied Bandwidth

6.4.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.215(c)/ Part 2 J Section 2.1049
Test Method:	ANSI C63.10: 2013
Limit:	N/A
	<ol style="list-style-type: none"> 1. According to the follow Test-setup, keep the relative position between the artificial antenna and the EUT. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement. Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel; RBW\geq1% of the 20 dB bandwidth; VBW\geqRBW; Sweep = auto; Detector function = peak; Trace = max hold. 4. Measure and record the results in the test report.
Test setup:	 <p>The diagram illustrates the test setup. On the left is a green Spectrum Analyzer with a screen and two knobs. A cable connects it to a yellow rectangular box on the right labeled 'EUT'.</p>
Test Mode:	Transmitting mode with modulation
Test results:	PASS

6.4.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	R&S	FSU	200054	Oct. 13, 2018

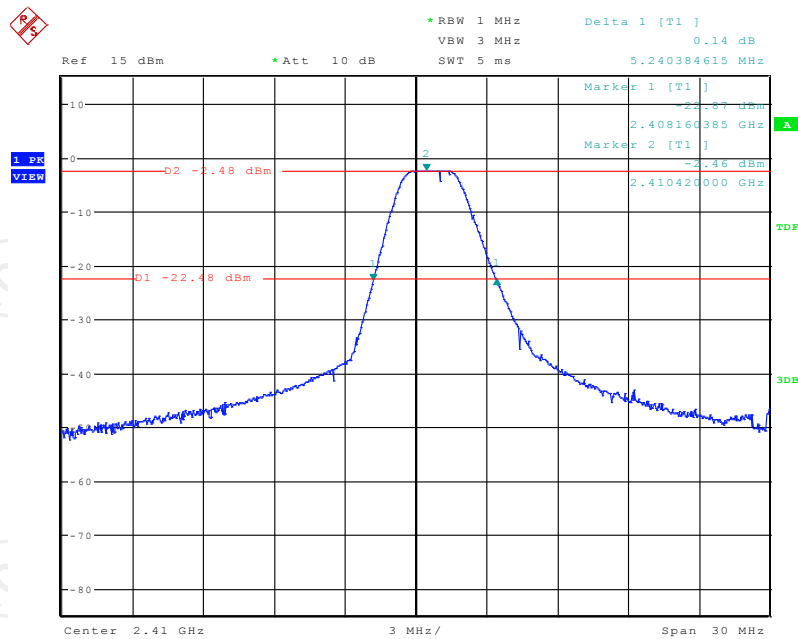
Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.4.3. Test data

Test Channel	20dB Occupy Bandwidth (MHz)	Conclusion
Lowest	5.24	PASS
Middle	4.13	PASS
Highest	4.69	PASS

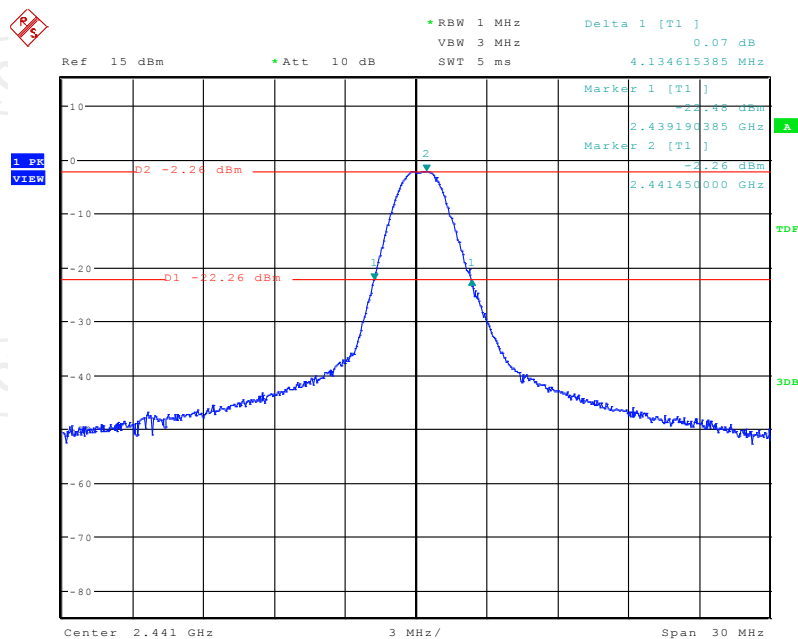
Test plots as follows:

Lowest channel



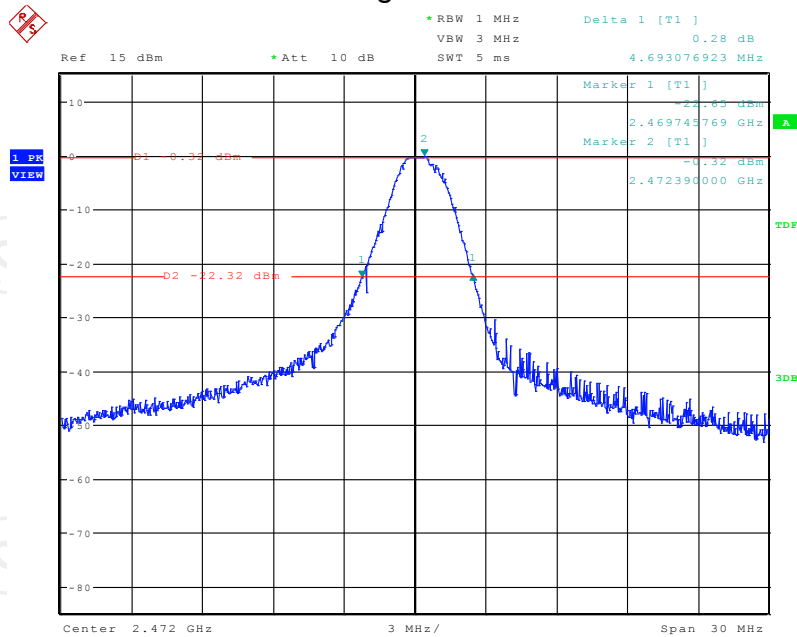
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Middle channel



Date: 8.JAN.2018 16:33:13

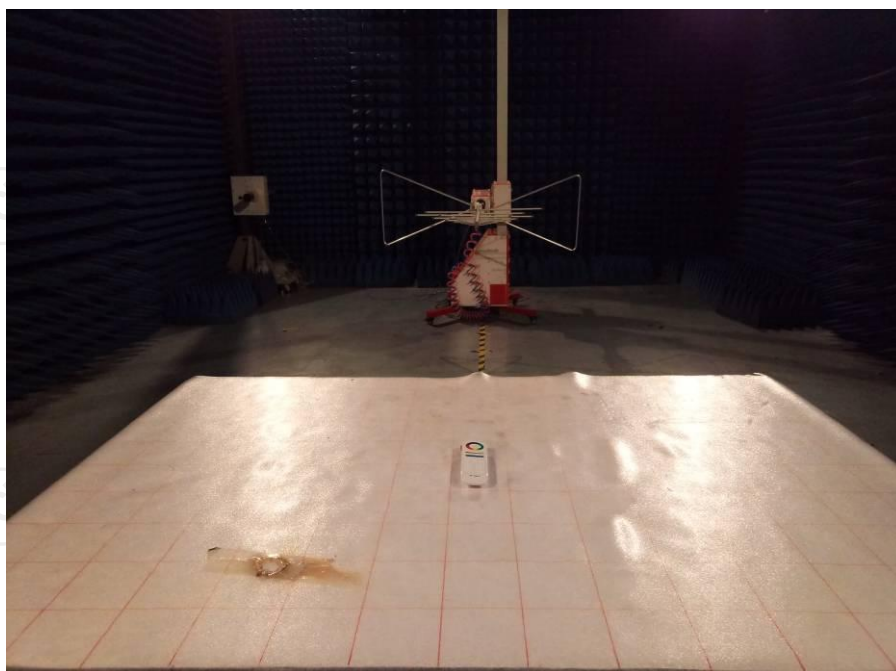
Highest channel



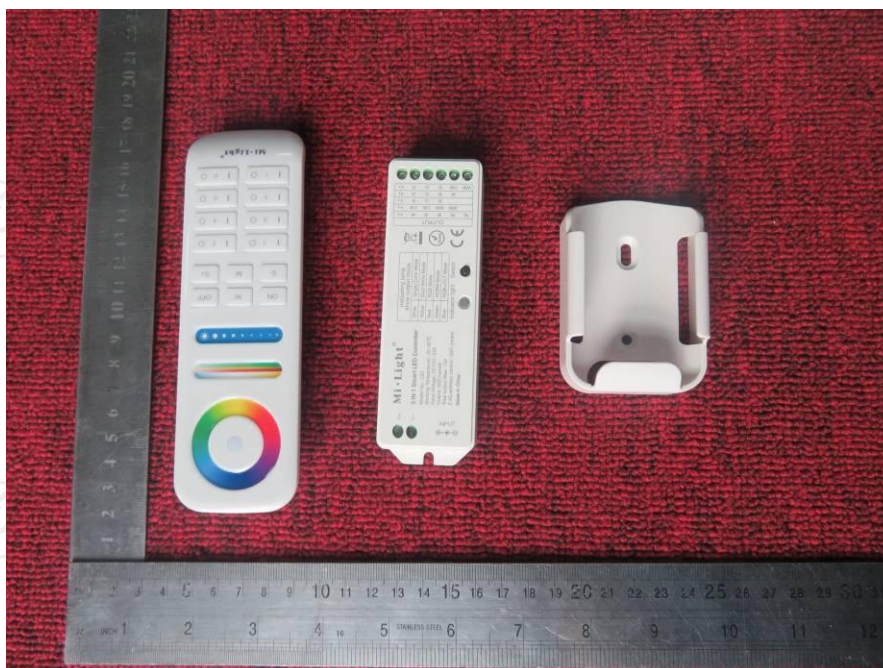
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7. Appendix A: Photographs of Test Setup

Radiated Emission

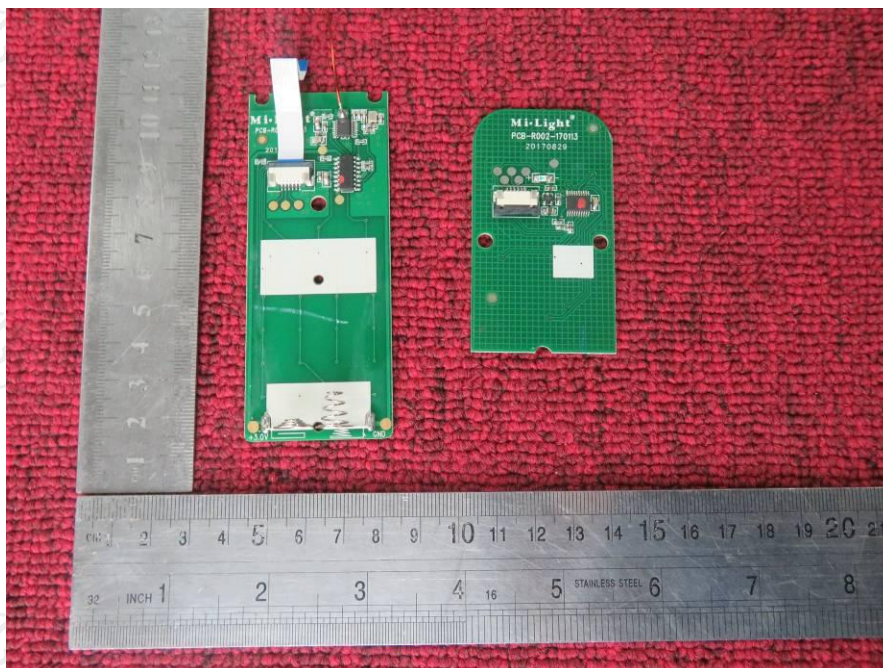
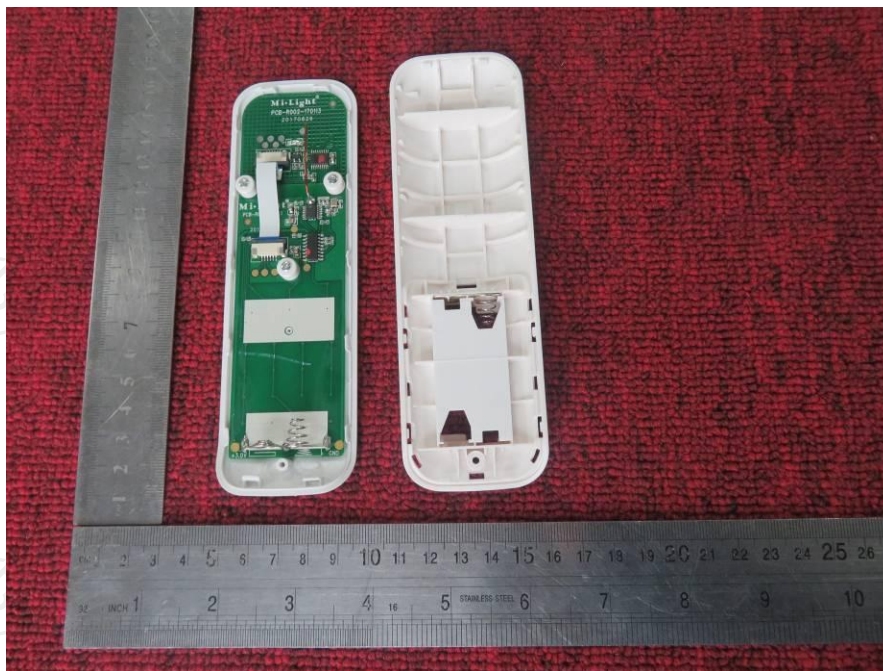


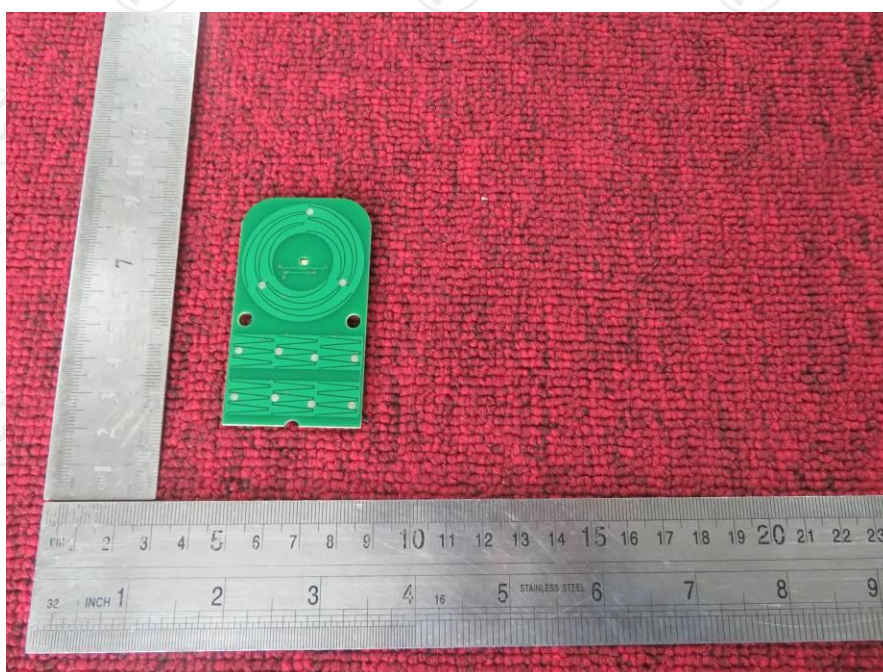
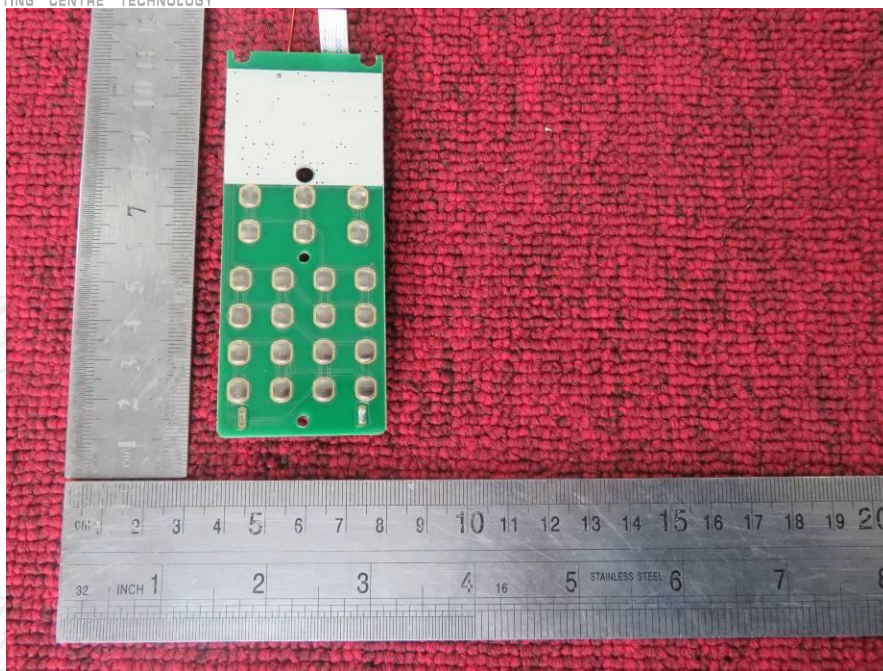
8. Appendix B: Photographs of EUT











*******END OF REPORT*******