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Website: www.cqa-cert.com Report Template Revision Date: 2018-07-06

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TEST REPORT

Report No.: CQASZ20200600609E-01

Applicant: **RNG International Inc**

Address of Applicant: 17534 Von Karman Avenue, Irvine, CA 92614 -6208, USA

Equipment Under Test (EUT):

EUT Name: Renogy Bluetooth Module

RCM-BT1, RCM-BT2 Model No.:

Test Model No. RCM-BT1

Brand Name: RENOGY

FCC ID: 2ANPBBT-1A1

Standards: 47 CFR Part 15, Subpart C

Date of Receipt: 2020-07-13

Date of Test: 2020-07-13 to 2020-07-23

Date of Issue: 2020-07-23 **Test Result:** PASS*

*In the configuration tested, the EUT complied with the standards specified above

Tested By:

(Martin Lee)

Reviewed By:

Approved By:





Report No.: CQASZ20200600609E-01

1 Version

Revision History Of Report

Report No.	Version	Description	Issue Date
CQASZ20200600609E-01	Rev.01	Initial report	2020-07-23





2 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15, Subpart C Section 15.203/15.247 (c)	ANSI C63.10 2013	PASS
AC Power Line Conducted Emission	47 CFR Part 15, Subpart C Section 15.207	ANSI C63.10 2013	N/A
Conducted Peak Output Power	47 CFR Part 15, Subpart C Section 15.247 (b)(3)	ANSI C63.10 2013	PASS
6dB Occupied Bandwidth	47 CFR Part 15, Subpart C Section 15.247 (a)(2)	ANSI C63.10 2013	PASS
Power Spectral Density	47 CFR Part 15, Subpart C Section 15.247 (e)	ANSI C63.10 2013	PASS
Band-edge for RF Conducted Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	ANSI C63.10 2013	PASS
RF Conducted Spurious Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	ANSI C63.10 2013	PASS
Radiated Spurious Emissions	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10 2013	PASS
Restricted bands around fundamental frequency (Radiated Emission)	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10 2013	PASS

N/A: The EUT powered by DC, So Not Applicable

Model No.: RCM-BT1, RCM-BT2

Only the model RCM-BT1 was tested, since the electrical circuit design, layout, components used and internal wiring were identical for the above models, with difference being of appearance and model name.



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4 General Information

4.1 Client Information

Applicant:	RNG International Inc
Address of Applicant:	17534 Von Karman Avenue, Irvine, CA 92614 -6208, USA
Manufacturer:	Renogy Suzhou Co., Ltd
Address of Manufacturer:	No.1 Peiyuan Rd., BLDG 5, 4th floor, New District, Suzhou, Jiangsu Province, 215000
Factory:	Renogy Suzhou Co., Ltd
Address of Factory:	No.1 Peiyuan Rd., BLDG 5, 4th floor, New District, Suzhou, Jiangsu Province, 215000

4.2 General Description of EUT

Product Name:	Renogy Bluetooth Module
Model No.:	RCM-BT1, RCM-BT2
Trade Mark:	RENOGY
Hardware Version:	1.0
Software Version:	1.0
Operation Frequency:	2402MHz~2480MHz
Bluetooth Version:	V5.0
Modulation Type:	GFSK
Transfer Rate:	1Mbps
Number of Channel:	40
Product Type:	☐ Mobile ☐ Portable ☐ Fix Location
Test Software of EUT:	SmartRF Studio 7 (manufacturer declare)
Antenna Type:	PCB antenna
Antenna Gain:	1.5dBi
EUT Power Supply:	DC5V



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Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	10	2422MHz	20	2442MHz	30	2462MHz
1	2404MHz	11	2424MHz	21	2444MHz	31	2464MHz
2	2406MHz	12	2426MHz	22	2446MHz	32	2466MHz
3	2408MHz	13	2428MHz	23	2448MHz	33	2468MHz
4	2410MHz	14	2430MHz	24	2450MHz	34	2470MHz
5	2412MHz	15	2432MHz	25	2452MHz	35	2472MHz
6	2414MHz	16	2434MHz	26	2454MHz	36	2474MHz
7	2416MHz	17	2436MHz	27	2456MHz	37	2476MHz
8	2418MHz	18	2438MHz	28	2458MHz	38	2478MHz
9	2420MHz	19	2440MHz	29	2460MHz	39	2480MHz

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 (CH0)	2402MHz
The middle channel (CH19)	2440MHz
The highest channel (CH39)	2480MHz

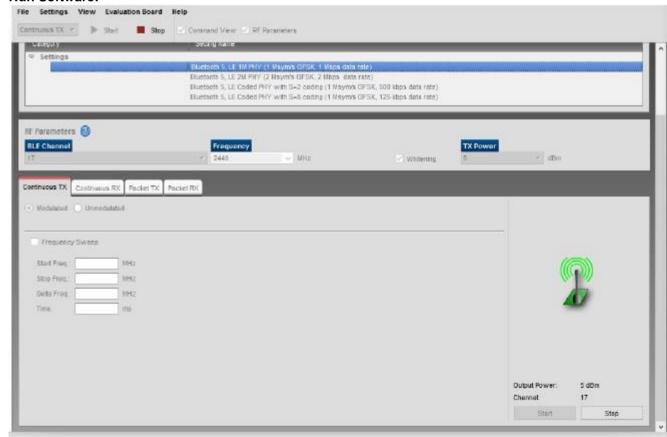


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4.3 Additional Instructions

EUT Test Software Settings:				
Mode:	⊠Special software is used.			
	☐Through engineering command into	the engineering mode.		
	engineering command: *#*#3646633#	*#*		
EUT Power level:	Class 2 (Power level is built-in set par selected)	ameters and cannot be changed and		
Use test software to set the lov	Use test software to set the lowest frequency, the middle frequency and the highest frequency keep			
transmitting of the EUT.				
Mode	Channel Frequency(MHz)			
CH0 2402				
GFSK	CH19 2440			
	CH39	2480		

Run Software:





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4.4 Test Environment

Operating Environment	:		
Radiated Emissions:			
Temperature:	25.7 °C		
Humidity:	55 % RH		
Atmospheric Pressure:	1009 mbar		
Radio conducted item t	est (RF Conducted test room):		
Temperature:	28.8 °C		
Humidity:	62 % RH		
Atmospheric Pressure:	1009 mbar		
Test mode:	Test mode:		
Transmitting mode:	Use test software to set the lowest frequency, the middle frequency and the highest frequency keep transmitting of the EUT. Note: In the process of transmitting of EUT, the duty cycle >98%.		

4.5 Description of Support Units

The EUT has been tested with associated equipment below.

1) Support equipment

Description	Manufacturer	Model No.	Certification	Supplied by
PC	Lenovo	ThinkPad E450c	FCC ID	CQA

2) Cable

Cable No.	Description	Manufacturer	Cable Type/Length	Supplied by
/	/	/	/	/





4.6 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate.

The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities.

The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements" and is documented in the **Shenzhen Huaxia Testing Technology Co., Ltd.** guality system acc. to DIN EN ISO/IEC 17025.

Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CQA laboratory is reported:

No.	Item	Uncertainty	Notes
1	Radiated Emission (Below 1GHz)	5.12dB	(1)
2	Radiated Emission (Above 1GHz)	4.60dB	(1)
3	Conducted Disturbance (0.15~30MHz)	3.34dB	(1)
4	Radio Frequency	3×10 ⁻⁸	(1)
5	Duty cycle	0.6 %.	(1)
6	Occupied Bandwidth	1.1%	(1)
7	RF conducted power	0.86dB	(1)
8	RF power density	0.74	(1)
9	Conducted Spurious emissions	0.86dB	(1)
10	Temperature test	0.8℃	(1)
11	Humidity test	2.0%	(1)
12	Supply voltages	0.5 %.	(1)
13	Frequency Error	5.5 Hz	(1)

⁽¹⁾This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.



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4.7 Test Location

Shenzhen Huaxia Testing Technology Co., Ltd,

1F., Block A of Tongsheng Technology Building, Huahui Road, Dalang Street, Longhua District, Shenzhen, China

4.8 Test Facility

• A2LA (Certificate No. 4742.01)

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 4742.01.

• FCC Registration No.: 522263

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No.:522263

4.9 Deviation from Standards

None.

4.10Other Information Requested by the Customer

None.





4.11 Equipment List

			Instrument	Calibration	Calibration
Test Equipment	Manufacturer	Model No.	No.	Date	Due Date
EMI Test Receiver	R&S	ESR7	CQA-005	2019/10/25	2020/10/24
Spectrum analyzer	R&S	FSU26	CQA-038	2019/10/25	2020/10/24
Preamplifier	MITEQ	AMF-6D-02001800-29- 20P	CQA-036	2019/10/25	2020/10/24
Loop antenna	Schwarzbeck	FMZB1516	CQA-060	2019/10/21	2020/10/20
Bilog Antenna	R&S	HL562	CQA-011	2019/9/26	2020/9/25
Horn Antenna	R&S	HF906	CQA-012	2019/9/26	2020/9/25
Horn Antenna	Schwarzbeck	BBHA 9170	CQA-088	2019/9/25	2020/9/24
Coaxial Cable (Above 1GHz)	CQA	N/A	C007	2019/9/26	2020/9/25
Coaxial Cable					
(Below 1GHz)	CQA	N/A	C013	2019/9/26	2020/9/25
Antenna Connector	CQA	RFC-01	CQA-080	2019/9/26	2020/9/25
RF cable(9KHz~40GHz)	CQA	RF-01	CQA-079	2019/9/26	2020/9/25
Power divider	MIDWEST	PWD-2533-02-SMA-79	CQA-067	2019/9/26	2020/9/25
EMI Test Receiver	R&S	ESR7	CQA-005	2019/10/25	2020/10/24
LISN	R&S	ENV216	CQA-003	2019/10/23	2020/10/22
Coaxial cable	CQA	N/A	CQA-C009	2019/9/26	2020/9/25
DC power	KEYSIGHT	E3631A	CQA-028	2019/9/26	2020/9/25

Note:

The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.





5 Test results and Measurement Data

5.1 Antenna Requirement

Standard requirement: 47 CFR Part 15C Section 15.203 /247(c)

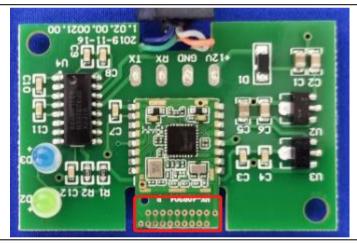
15.203 requirement:

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.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

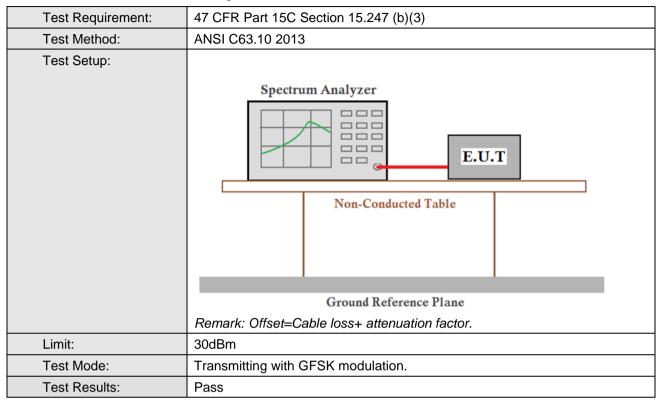
EUT Antenna:



The antenna is PCB antenna. The best case gain of the antenna is 1.5dBi.



5.2 Conducted Peak Output Power

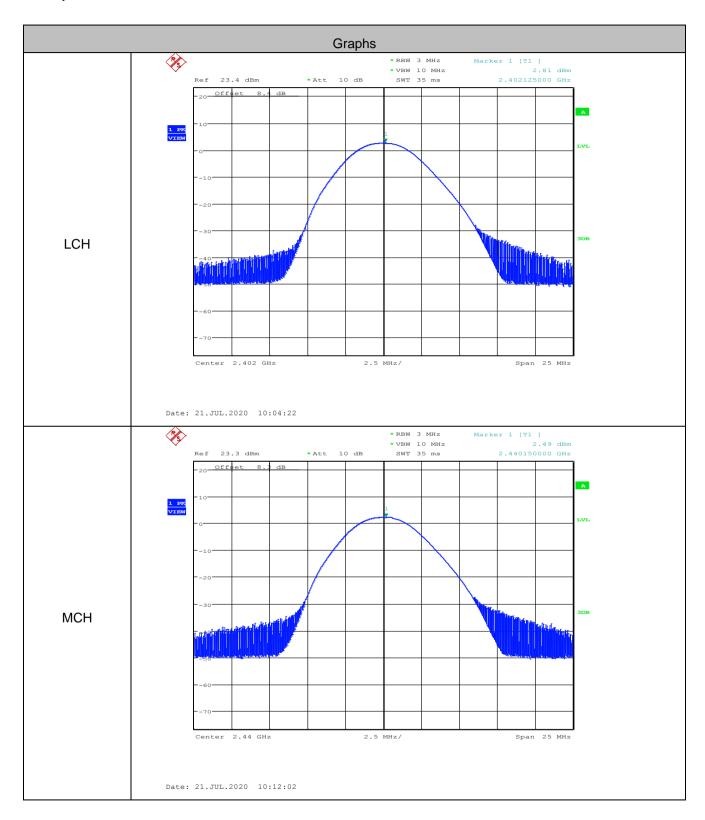


Measurement Data

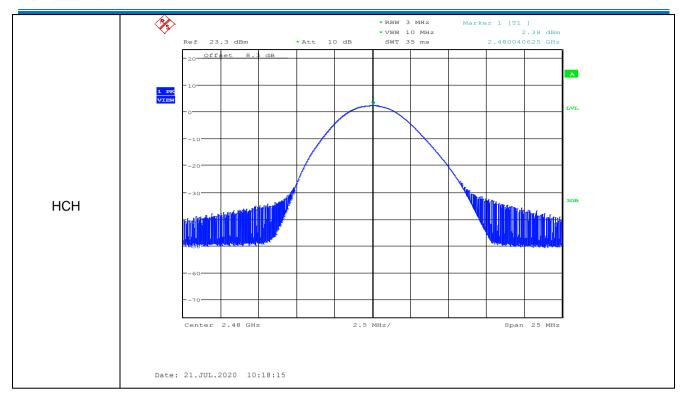
mododiomont Bata										
	GFSK mode									
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result							
Lowest	2.81	30.00	Pass							
Middle	2.49	30.00	Pass							
Highest	2.38	30.00	Pass							



Test plot as follows:

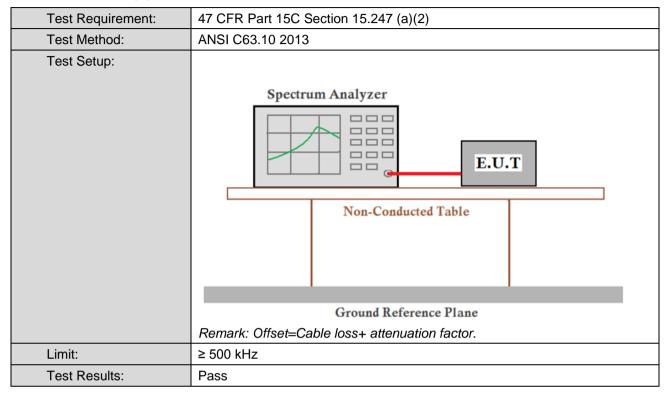








5.3 6dB Occupy Bandwidth

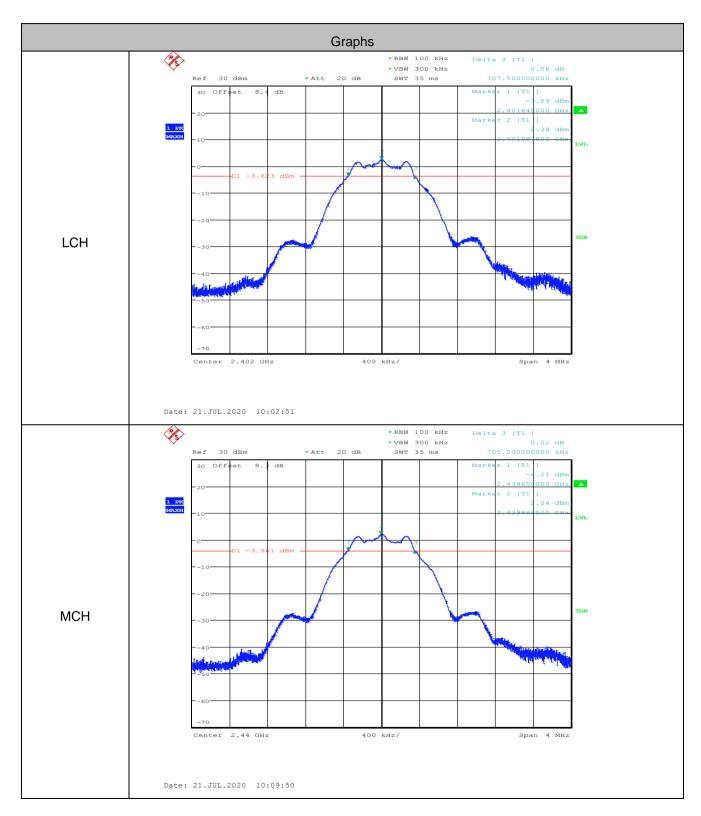


Measurement Data

GFSK mode							
Test channel	6dB Occupy Bandwidth (MHz)	Limit (MHz)	Result				
Lowest	0.707	≥0.5	Pass				
Middle	0.705	≥0.5	Pass				
Highest	0.714	≥0.5	Pass				



Test plot as follows:

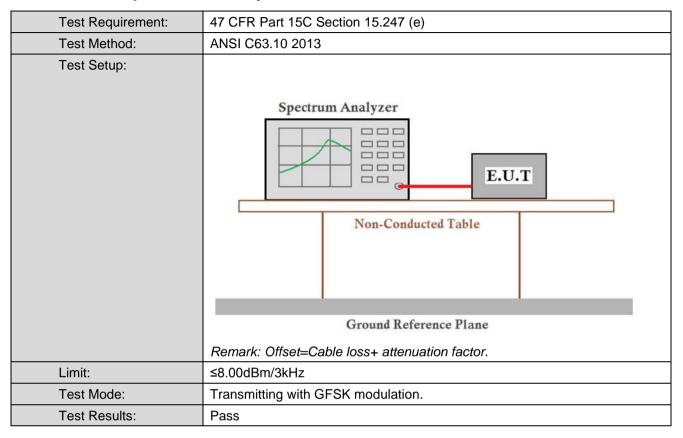








5.4 Power Spectral Density

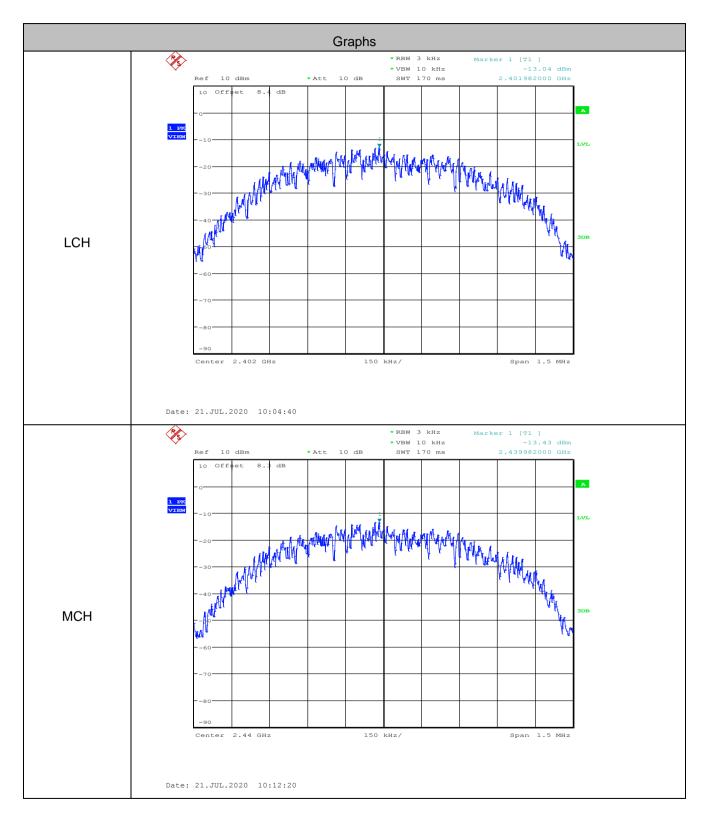


Measurement Data

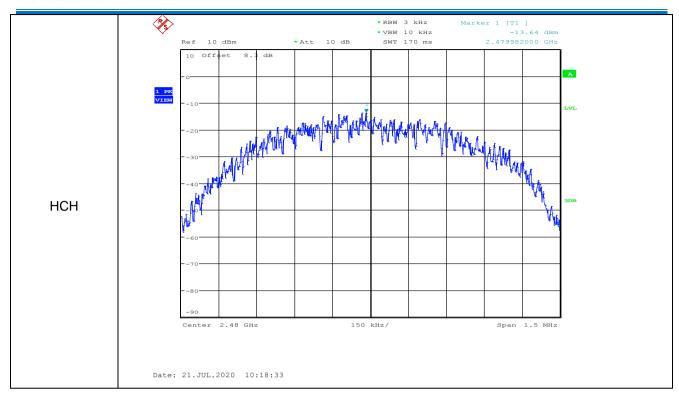
GFSK mode								
Test channel	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result					
Lowest	-13.040	≤8.00	Pass					
Middle	-13.430	≤8.00	Pass					
Highest	-13.640	≤8.00	Pass					



Test plot as follows:



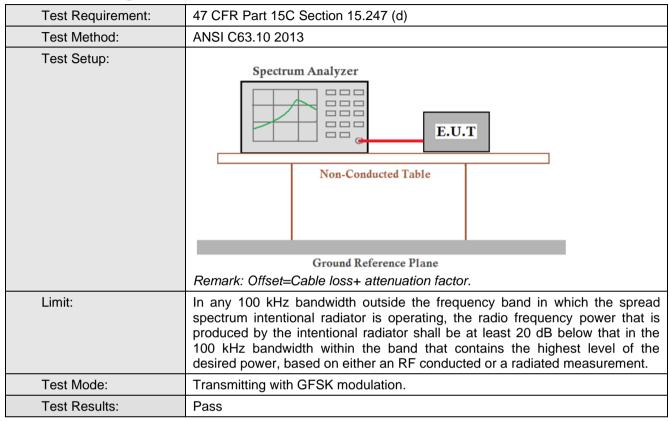








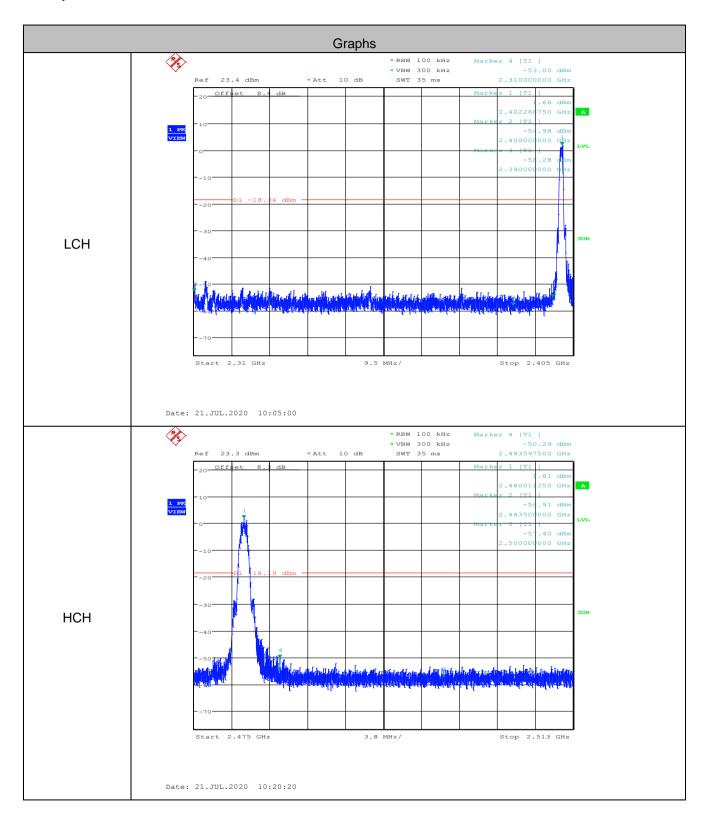
5.5 Band-edge for RF Conducted Emissions



GFSK mode				
Test				
channel	Frequency(MHz)	Emission Level(dBm)	Limit(dBm)	Result
Lowest	2400	-54.980	-18.34	Pass
Highest	2483.5	-54.910	-18.19	Pass



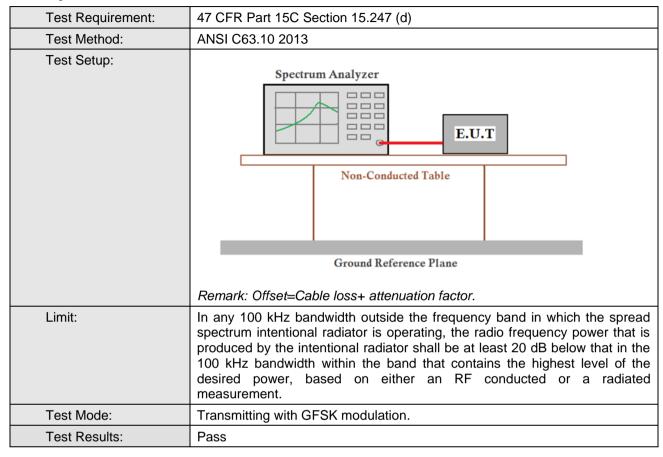
Test plot as follows:





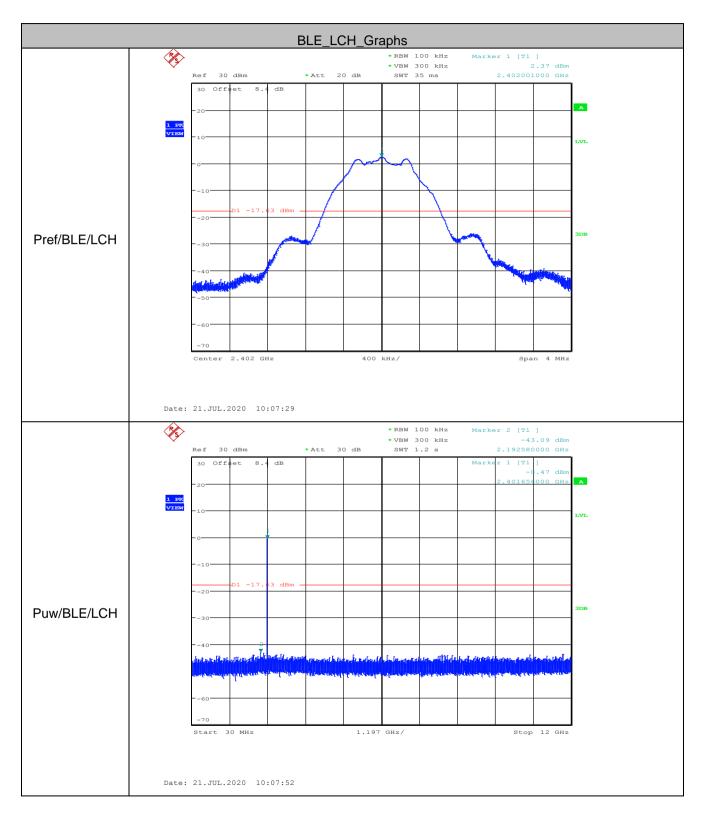


5.6 Spurious RF Conducted Emissions

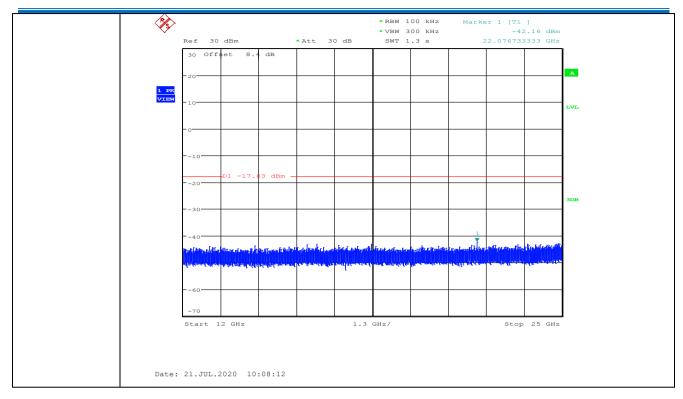


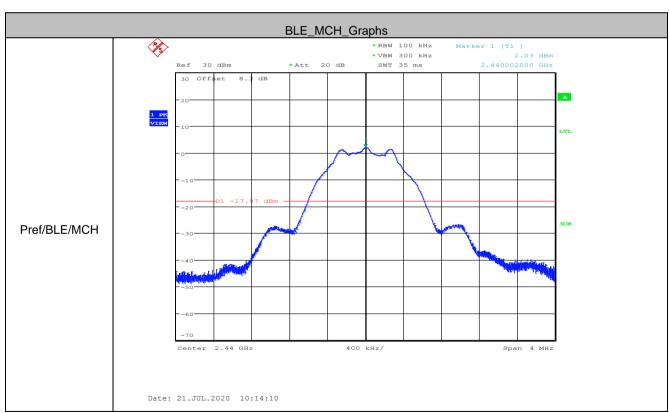


Test plot as follows:

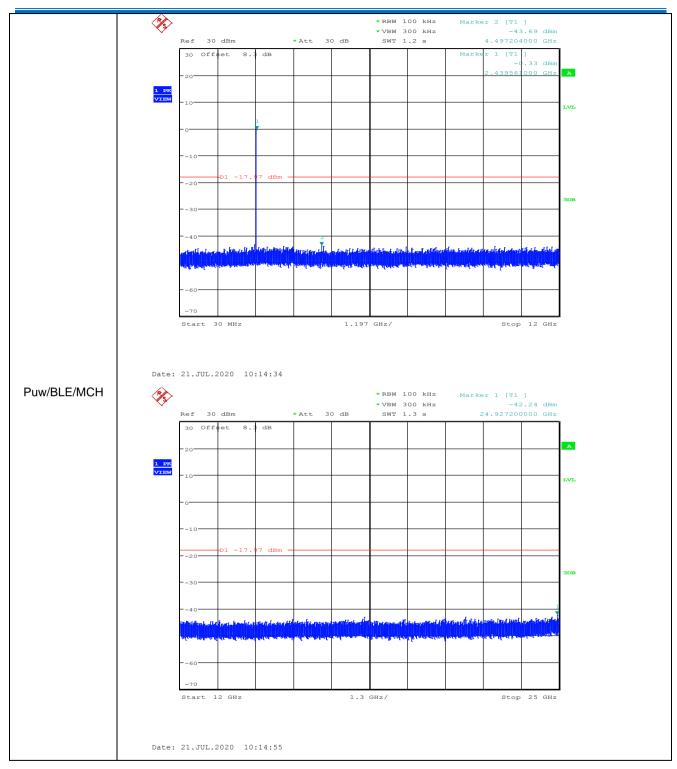




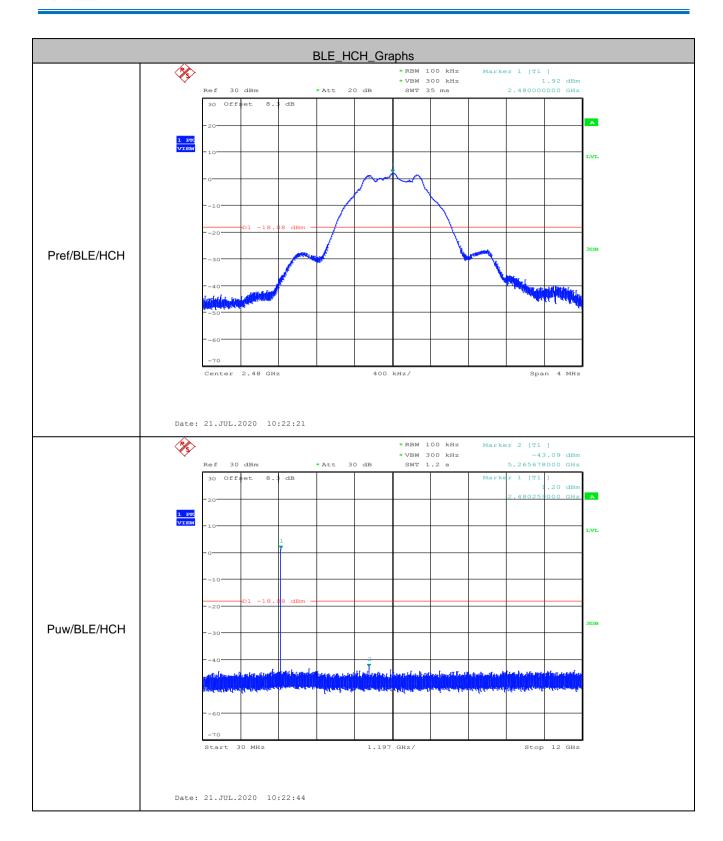






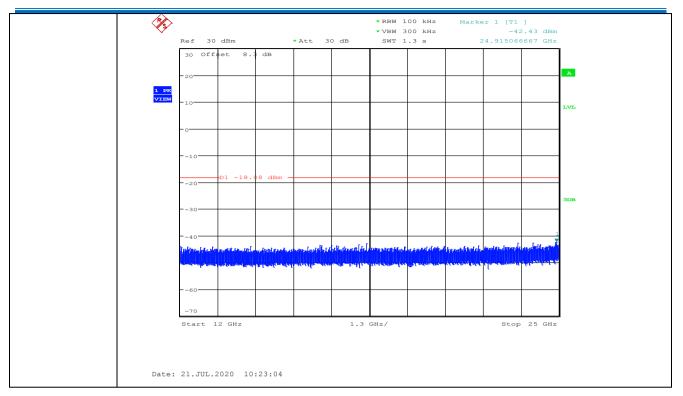








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Remark:

Pretest 9kHz to 25GHz, find the highest point when testing, so only the worst data were shown in the test report. Per FCC Part 15.33 (a) and 15.31 (o) ,The amplitude of spurious emissions from intentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

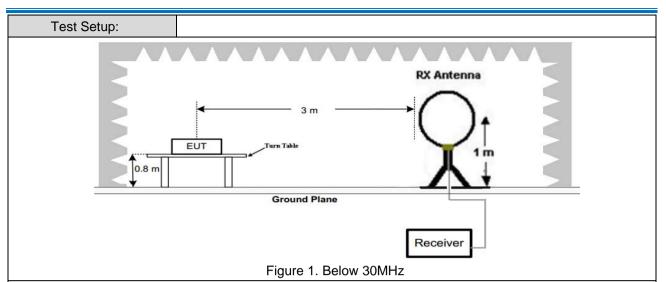


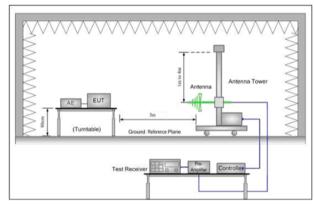
5.7 Radiated Spurious Emission & Restricted bands

5.7.1 Spurious Emissions										
Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205									
Test Method:	ANSI C63.10 2013									
Test Site:	Measurement Distance	: 3n	n (Semi-Anech	noic Cham	ber)					
Receiver Setup:	Frequency		Detector	RBW	VBW	Remark				
	0.009MHz-0.090MH	z	Peak	10kHz	z 30kHz	Peak				
	0.009MHz-0.090MH	z	Average	10kHz	30kHz	Average				
	0.090MHz-0.110MH	z	Quasi-peak	10kHz	30kHz	Quasi-peak				
	0.110MHz-0.490MH	z	Peak	10kHz	30kHz	Peak				
	0.110MHz-0.490MH	z	Average	10kHz	30kHz	Average				
	0.490MHz -30MHz		Quasi-peak	10kHz	30kHz	Quasi-peak				
	30MHz-1GHz		Quasi-peak	100 kH	z 300kHz	Quasi-peak				
	Above 1GHz		Peak	1MHz	3MHz	Peak				
	Above IGHZ		Peak	1MHz	10Hz	Average				
Limit:	Frequency	Field strength (microvolt/meter)		Limit (dBuV/m)	Remark	Measuremen distance (m)				
	0.009MHz-0.490MHz	2	400/F(kHz)	-	-	300				
	0.490MHz-1.705MHz	24	1000/F(kHz)	-	-	30				
	1.705MHz-30MHz		30	-	-	30				
	30MHz-88MHz		100	40.0	Quasi-peak	3				
	88MHz-216MHz		150	43.5	Quasi-peak	3				
	216MHz-960MHz		200	46.0	Quasi-peak	3				
	960MHz-1GHz	960MHz-1GHz		54.0	Quasi-peak	3				
	Above 1GHz		500	54.0	Average	3				
	Note: 15.35(b), frequency emissions is limit applicable to the epeak emission level race	20c quip	dB above the oment under to	maximum est. This p	permitted ave	erage emission				



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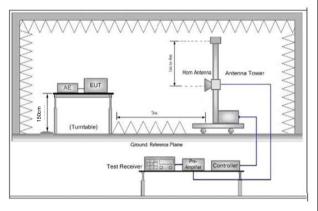


Figure 2. 30MHz to 1GHz

Figure 3. Above 1 GHz

Test Procedure:

- a. 1) Below 1G: The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
 - 2) Above 1G: The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.

Note: For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. 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 vertical polarizations of the antenna are set to make the

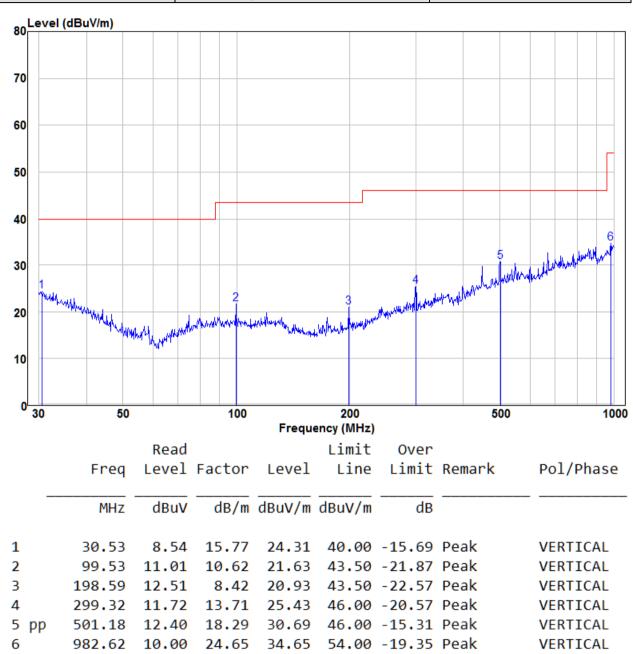


	measurement.
	d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
	e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
	f. 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.
	g. Test the EUT in the lowest channel (2402MHz),the middle channel (2440MHz),the Highest channel (2480MHz)
	h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
	i. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Transmitting with GFSK modulation. Transmitting mode.
Final Test Mode:	For below 1GHz part, through pre-scan, the worst case is the lowest channel. Only the worst case is recorded in the report.
Test Results:	Pass





Radiated Emission below 1GHz						
30MHz~1GHz, the worst case	30MHz~1GHz, the worst case					
Test mode:	Transmitting mode	Vertical				







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0MHz~1GHz, the v	vorst case								
est mode:		Transm	Transmitting mode Horizontal						
80 Level (dBuV/m))								
70									
60									
50									
40									
								6	

						•		
	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	31.18	8.66	15.61	24.27	40.00	-15.73	Peak	HORIZONTAL
2	99.53	10.20	10.62	20.82	43.50	-22.68	Peak	HORIZONTAL
3	198.59	12.23	8.42	20.65	43.50	-22.85	Peak	HORIZONTAL
4	300.37	13.96	13.74	27.70	46.00	-18.30	Peak	HORIZONTAL
5	399.03	12.29	15.13	27.42	46.00	-18.58	Peak	HORIZONTAL
6 pp	881.41	9.67	23.92	33.59	46.00	-12.41	Peak	HORIZONTAL

Frequency (MHz)



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Transmitter Emission above 1GHz

Worse case m	ode:	GFSK		Test channel:		Lowest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)		H/V
2390	54.71	-9.2	45.51	74	-28.49	Peak	Н
2400	55.38	-9.39	45.99	74	-28.01	Peak	Н
4804	53.08	-4.33	48.75	74	-25.25	Peak	Н
7206	49.7	1.01	50.71	74	-23.29	Peak	Н
2390	52.46	-9.2	43.26	74	-30.74	Peak	V
2400	51.17	-9.39	41.78	74	-32.22	Peak	V
4804	54.57	-4.33	50.24	74	-23.76	Peak	V
7206	49.33	1.01	50.34	74	-23.66	Peak	V

Worse case m	ode:	GFSK		Test chann	st channel: Mic		
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)		H/V
4882	53.23	-4.11	49.12	74	-24.88	peak	Н
7323	50.44	1.51	51.95	74	-22.05	peak	Н
4882	51.81	-4.11	47.7	74	-26.3	peak	V
7323	48.58	1.51	50.09	74	-23.91	peak	V

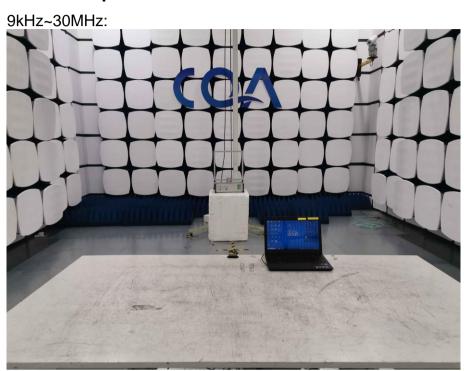
Worse case mode:		GFSK		Test channel:		Highest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBµV)	(dB)	(dBµV/m)	(dBµV/m)	(dB)		H/V
2483.5	54.31	-9.29	45.02	74	-28.98	Peak	Н
4960	50.71	-4.04	46.67	74	-27.33	Peak	Н
7440	49.03	1.57	50.6	74	-23.4	Peak	Н
2483.5	55.67	-9.29	46.38	74	-27.62	Peak	V
4960	51.26	-4.04	47.22	74	-26.78	Peak	V
7440	48.96	1.57	50.53	74	-23.47	Peak	V

Remark:

- 1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
 - Final Test Level = Receiver Reading + Antenna Factor + Cable Factor Preamplifier Factor
- 2) Scan from 9kHz to 25GHz, the disturbance above 10GHz and below 30MHz was very low. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the peak measurements were shown in the report.

6 Photographs - EUT Test Setup

6.1 Radiated Spurious Emission













Photographs - EUT Constructional Details 7

Test Model No.: RCM-BT1

















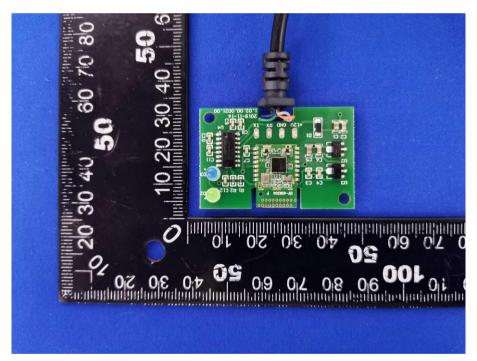




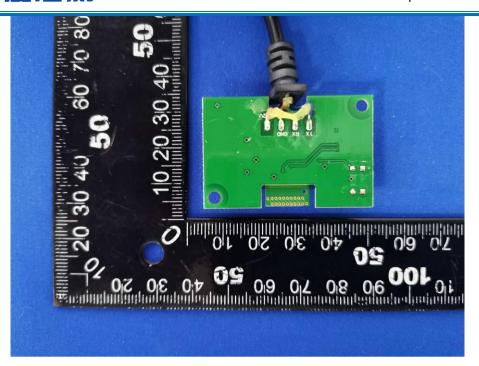














The End