

FCC REPORT

Applicant: SHENZHEN FCAR TECHNOLOGY CO.,LTD

Address of Applicant: 8th floor, Chuangyi Building, No. 3025 Nanhai Ave., Nanshan, Shenzhen, Guangdong, China

Manufacturer: SHENZHEN FCAR TECHNOLOGY CO.,LTD

Address of Manufacturer: 8th floor, Chuangyi Building, No. 3025 Nanhai Ave., Nanshan, Shenzhen, Guangdong, China

Factory: SHENZHEN FCAR TECHNOLOGY CO.,LTD

Address of Factory: West 1F, Bldg. B, Hengchao Industrial Park, Tangtou North Ave., Bao'an, Shenzhen, China

Equipment Under Test (EUT)

Product Name: F-Sensor

Model No.: FS-315, FS-315A,FS-315B, FS-315C,FS-315D

FCC ID: 2AJDD-IDIAGS315

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.231:2016

Date of sample receipt: June 22, 2017

Date of Test: June 22-27, 2017

Date of report issued: June 27, 2017

Test Result : PASS *

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

Authorized Signature:

A circular blue stamp for GTS Global United Technology Services Co., Ltd. is visible. The stamp contains the text "GTS", "GLOBAL TESTING", and "GLOBAL UNITED TECHNOLOGY SERVICES CO., LTD.". A handwritten signature in black ink is written over the stamp.

Robinson Lo

Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

2 Version

Version No.	Date	Description
01	June 27, 2017	Original

Prepared By:

Tiger Chen

Date:

June 27, 2017

Project Engineer

Check By:

Andy Wu

Date:

June 27, 2017

Reviewer

3 Contents

	Page
1 COVER PAGE	1
2 VERSION	2
3 CONTENTS	3
4 TEST SUMMARY	4
4.1 MEASUREMENT UNCERTAINTY	4
5 GENERAL INFORMATION	5
5.1 GENERAL DESCRIPTION OF EUT	5
5.2 TEST MODE	6
5.3 DESCRIPTION OF SUPPORT UNITS	6
5.4 TEST FACILITY.....	6
5.5 TEST LOCATION	6
5.6 OTHER INFORMATION REQUESTED BY THE CUSTOMER	6
6 TEST INSTRUMENTS LIST	7
7 TEST RESULTS AND MEASUREMENT DATA.....	8
7.1 ANTENNA REQUIREMENT	8
7.2 RADIATED EMISSION METHOD	9
7.2.1 Field Strength of The Fundamental Signal	11
7.2.2 Spurious emissions.....	13
7.3 20dB OCCUPY BANDWIDTH	18
7.4 DWELL TIME	19
8 TEST SETUP PHOTO	21
9 EUT CONSTRUCTIONAL DETAILS	22

4 Test Summary

Test Item	Section in CFR 47	Result
Antenna requirement	15.203	Pass
Field strength of the fundamental signal	15.231 (e)	Pass
Spurious emissions	15.231 (e)/15.209	Pass
20dB Bandwidth	15.231 (c)	Pass
Dwell time	15.231 (e)	Pass

Pass: The EUT complies with the essential requirements in the standard.

4.1 Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	9kHz ~ 30MHz	$\pm 4.34\text{dB}$	(1)
Radiated Emission	30MHz ~ 1000MHz	$\pm 4.24\text{dB}$	(1)
Radiated Emission	1GHz ~ 26.5GHz	$\pm 4.68\text{dB}$	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	$\pm 3.45\text{dB}$	(1)
Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.			

5 General Information

5.1 General Description of EUT

Product Name:	F-Sensor
Model No.:	FS-315, FS-315A,FS-315B, FS-315C,FS-315D
Test Model No. :	FS-315
<i>Remark: All above models are identical in the same PCB layout, interior structure and electrical circuits. The only difference is the model name for commercial purpose.</i>	
Operation Frequency:	315MHz
Modulation technology:	FSK or ASK
Antenna Type:	Integrated Antenna
Antenna gain:	0dBi (declare by applicant)
Power supply:	DC 3V by Button battery

5.2 Test mode

Transmitting mode	Keep the EUT in transmitting mode.
-------------------	------------------------------------

Per-test mode.

We have verified the construction and function in typical operation, The EUT was placed on three different polar directions; i.e. X axis, Y axis, Z axis. Which only the worst case was shown in this test report and defined as follows:

Axis	X	Y	Z
Field Strength(dBuV/m)	66.48	66.72	64.35

5.3 Description of Support Units

Manufacturer	Description	Model	Serial Number
N/A	Adapter	CW1201500	N/A
Hamaton	TPMS Reset Tool	HTT0110A	N/A

5.4 Test Facility

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

- **FCC —Registration No.: 600491**

Global United Technology Services 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 files. Registration 600491, June 22, 2016.

- **Industry Canada (IC) —Registration No.: 9079A-2**

The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A-2, August 15, 2016

5.5 Test Location

All tests were performed at:

Global United Technology Services Co., Ltd.
No. 301-309, 3/F., Jinyuan Business Building, No.2, Laodong Industrial Zone,
Xixiang Road, Baoan District, Shenzhen, Guangdong, China
Tel: 0755-27798480
Fax: 0755-27798960

5.6 Other Information Requested by the Customer

None.

6 Test Instruments list

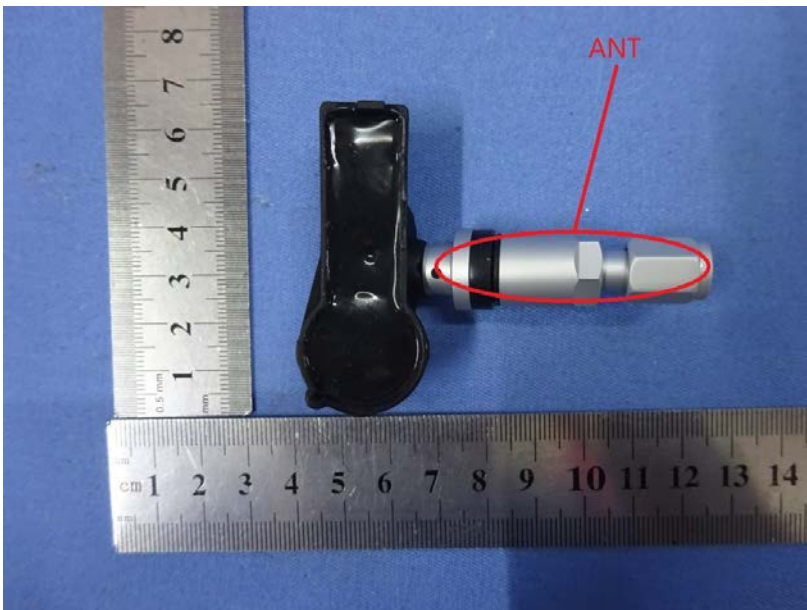
Radiated Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July 03 2015	July 02 2020
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	Spectrum Analyzer	Agilent	E4440A	GTS533	June 29 2016	June 28 2017
4	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June 29 2016	June 28 2017
5	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June 29 2016	June 28 2017
6	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	9120D-829	GTS208	June 29 2016	June 28 2017
7	Horn Antenna	ETS-LINDGREN	3160	GTS217	June 29 2016	June 28 2017
8	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
9	Coaxial Cable	GTS	N/A	GTS213	June 29 2016	June 28 2017
10	Coaxial Cable	GTS	N/A	GTS211	June 29 2016	June 28 2017
11	Coaxial cable	GTS	N/A	GTS210	June 29 2016	June 28 2017
12	Coaxial Cable	GTS	N/A	GTS212	June 29 2016	June 28 2017
13	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June 29 2016	June 28 2017
14	Amplifier(2GHz-20GHz)	HP	8349B	GTS206	June 29 2016	June 28 2017
15	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June 29 2016	June 28 2017
16	Band filter	Amindeon	82346	GTS219	June 29 2016	June 28 2017
17	Power Meter	Anritsu	ML2495A	GTS540	June 29 2016	June 28 2017
18	Power Sensor	Anritsu	MA2411B	GTS541	June 29 2016	June 28 2017

Conducted Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Shielding Room	ZhongYu Electron	7.3(L)x3.1(W)x2.9(H)	GTS252	May.16 2014	May.15 2019
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 29 2016	June. 28 2017
3	Coaxial Switch	ANRITSU CORP	MP59B	GTS225	June. 29 2016	June. 28 2017
4	Artificial Mains Network	SCHWARZBECK MESS	NSLK8127	GTS226	June. 29 2016	June. 28 2017
5	Coaxial Cable	GTS	N/A	GTS227	N/A	N/A
6	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
7	Thermo meter	KTJ	TA328	GTS233	June. 29 2016	June. 28 2017

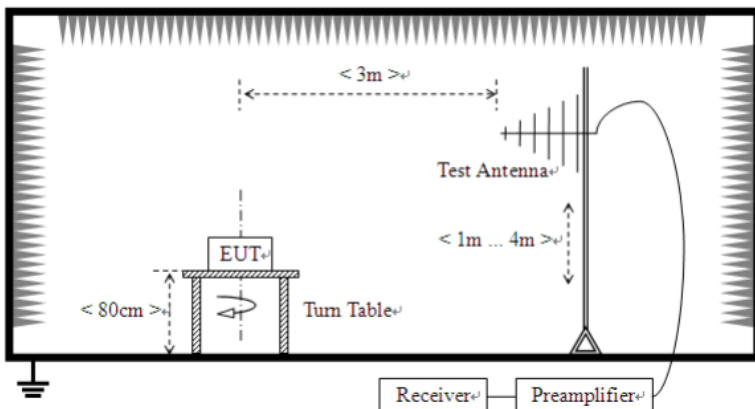
General used equipment:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Barometer	ChangChun	DYM3	GTS257	June 29 2016	June 28 2017

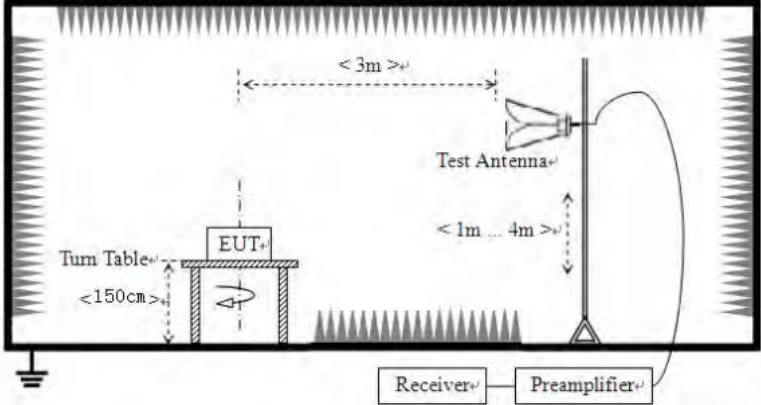
7 Test results and Measurement Data

7.1 Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203
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.	
EUT Antenna:	
The antenna is integral antenna, the best case gain of the antenna is 0dBi.	
	

7.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	30MHz to 6000MHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Remark
	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	
	315MHz	67.66		Average Value	
		87.66		Peak Value	
Limit: (Spurious Emissions)	Frequency	Limit (dBuV/m @3m)		Remark	
	30MHz-88MHz	40.00		Quasi-peak Value	
	88MHz-216MHz	43.50		Quasi-peak Value	
	216MHz-960MHz	46.00		Quasi-peak Value	
	960MHz-1GHz	54.00		Quasi-peak Value	
	Above 1GHz	54.00		Average Value	
		74.00		Peak Value	
Or The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level whichever limit permits a higher field strength.					
Test setup:	Below 1GHz				
					
	Above 1GHz				

	
Test Procedure:	1. The EUT was placed on the top of a rotating table (0.8 meters for below 1GHz and 1.5 meters for above 1GHz) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 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. 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 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 rota 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.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement data:

7.2.1 Field Strength of The Fundamental Signal

ASK

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
315	79.25	13.79	2.44	30.11	65.37	87.66	-22.29	Horizontal
315	80.60	13.79	2.44	30.11	66.72	87.66	-20.94	Vertical

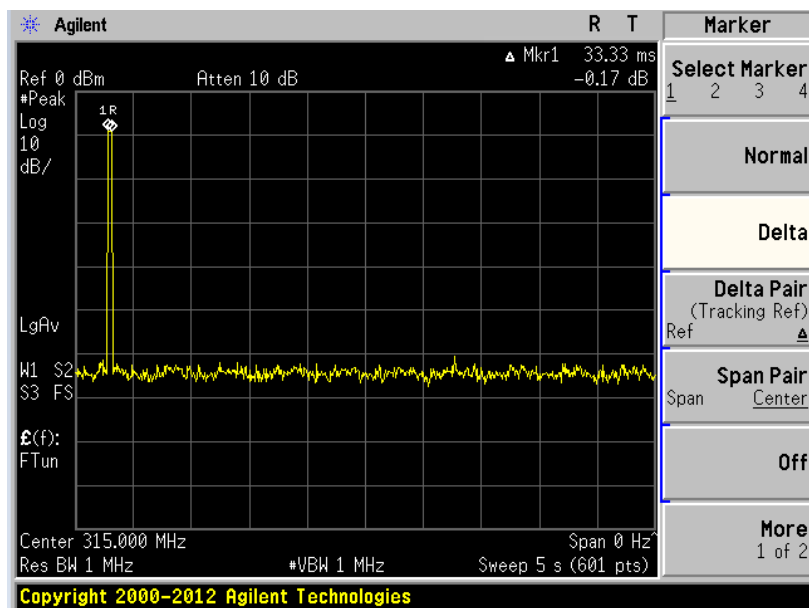
Average value:

Frequency (MHz)	Peak Value (dBuV/m)	Duty cycle factor	Average value (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
315	65.37	-9.54	55.83	67.66	-11.83	Horizontal
315	66.72	-9.54	57.18	67.66	-10.48	Vertical

Average value:

Calculate Formula:	Average value=Peak value + Duty Cycle Factor
	Duty cycle factor=20 log(Duty cycle)
	Duty cycle=on time/100 milliseconds or period, whichever is less
Test data:	T on time =33.33(ms)
	T period =100ms
	Duty cycle=0.3333
	duty cycle factor= -9.54

Test plot as follows:



FSK

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
315	80.37	13.79	2.44	30.11	66.49	87.66	-21.17	Horizontal
315	79.26	13.79	2.44	30.11	65.38	87.66	-22.28	Vertical

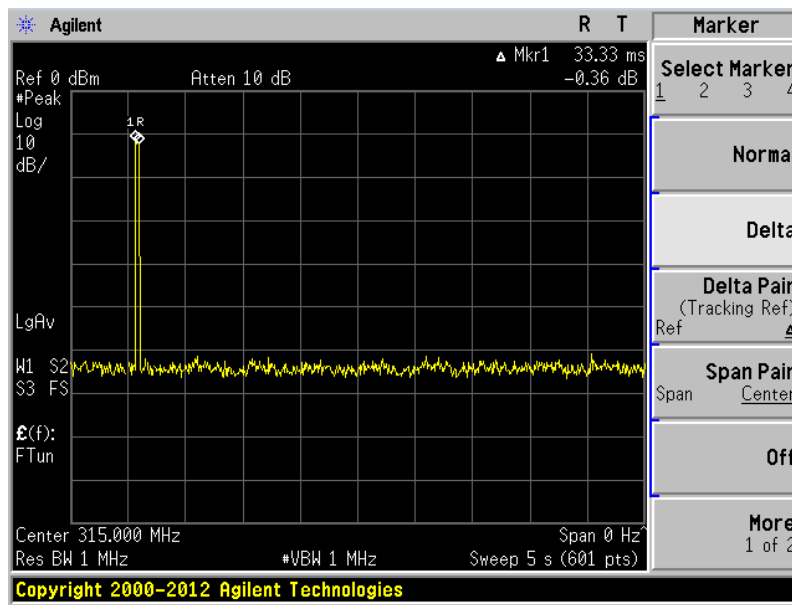
Average value:

Frequency (MHz)	Peak Value (dBuV/m)	Duty cycle factor	Average value (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
315	66.49	-9.54	56.95	67.66	-10.71	Horizontal
315	65.38	-9.54	55.84	67.66	-11.82	Vertical

Average value:

Calculate Formula:	Average value=Peak value + Duty Cycle Factor
	Duty cycle factor=20 log(Duty cycle)
	Duty cycle=on time/100 milliseconds or period, whichever is less
Test data:	T on time =33.33(ms)
	T period =100ms
	Duty cycle=0.3333
	duty cycle factor=-9.54

Test plot as follows:



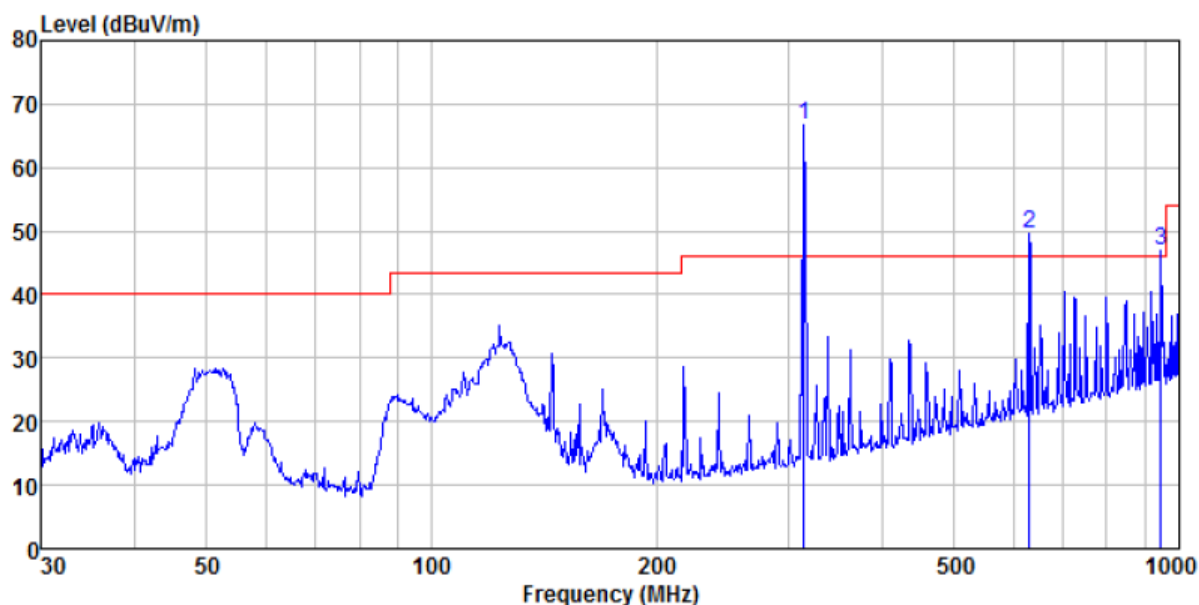
7.2.2 Spurious emissions

Below 1GHz:

Vertical:

ASK:

Peak value:

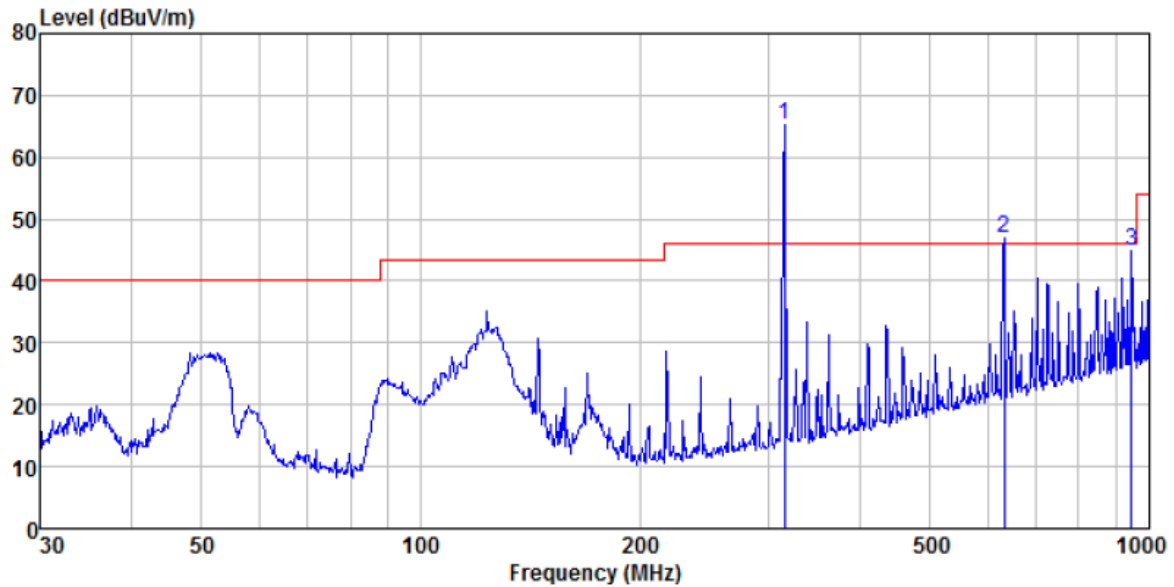


Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
630.000	55.56	19.45	3.84	29.34	49.51	67.66	-18.15	Vertical
945.000	48.34	22.46	5.03	29.25	46.58	67.66	-21.08	Vertical

Note: AV of 630MHz=PK-9.54=49.51-9.54=39.97<47.66dBuV/m

FSK:

Peak value:

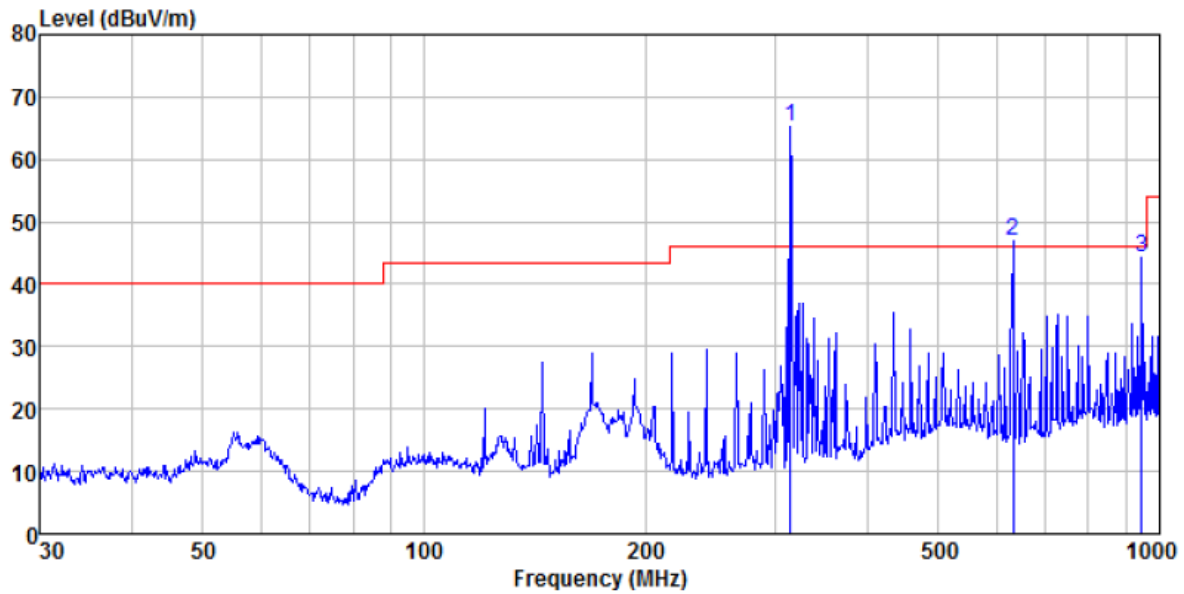


Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
630.000	52.96	19.45	3.84	29.34	46.91	67.66	-20.75	Vertical
945.000	46.47	22.46	5.03	29.25	44.71	67.66	-22.95	Vertical

Horizontal:

ASK:

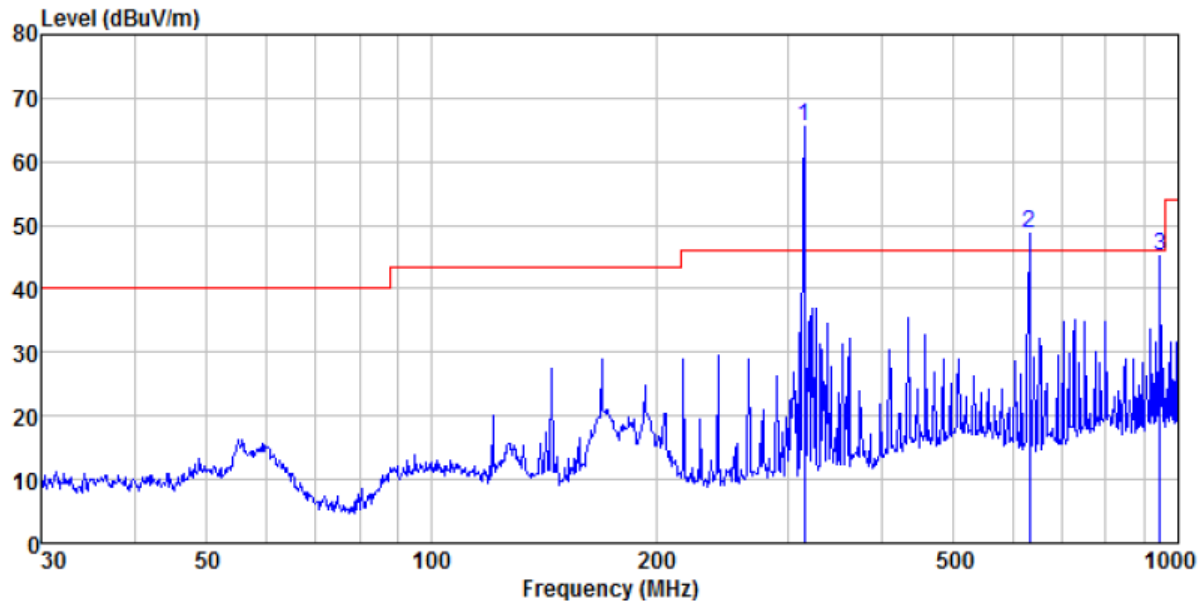
Peak value:



Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
630.000	52.78	19.45	3.84	29.34	46.73	67.66	-20.93	Horizontal
945.000	46.02	22.46	5.03	29.25	44.26	67.66	-23.40	Horizontal

FSK :

Peak value:



Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
630.000	54.88	19.45	3.84	29.34	48.83	67.66	-18.83	Horizontal
945.000	47.34	22.46	5.03	29.25	45.58	67.66	-22.08	Horizontal

Note: $AV \text{ of } 630\text{MHz} = PK - 9.54 = 48.83 - 9.54 = 39.29 < 47.66 \text{ dBuV/m}$

Above 1G:

Peak value:

ASK:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1260.00	56.25	25.55	4.51	35.95	50.36	74.00	-23.64	Vertical
1575.00	55.24	25.02	4.73	36.15	48.84	74.00	-25.16	Vertical
1890.00	50.42	25.70	4.90	36.33	44.69	74.00	-29.31	Vertical
2520.00	43.68	27.58	5.51	36.81	39.96	74.00	-34.04	Vertical
3465.00	42.37	28.87	6.89	37.34	40.79	74.00	-33.21	Vertical
3780.00	39.61	29.34	7.48	37.44	38.99	74.00	-35.01	Vertical
1260.00	56.42	25.55	4.51	35.95	50.53	74.00	-23.47	Horizontal
1575.00	58.51	25.02	4.73	36.15	52.11	74.00	-21.89	Horizontal
1890.00	47.73	25.70	4.90	36.33	42.00	74.00	-32.00	Horizontal
2520.00	45.51	27.58	5.51	36.81	41.79	74.00	-32.21	Horizontal
3465.00	46.91	28.87	6.89	37.34	45.33	74.00	-28.67	Horizontal
3780.00	48.52	29.34	7.48	37.44	47.90	74.00	-26.10	Horizontal

FSK:

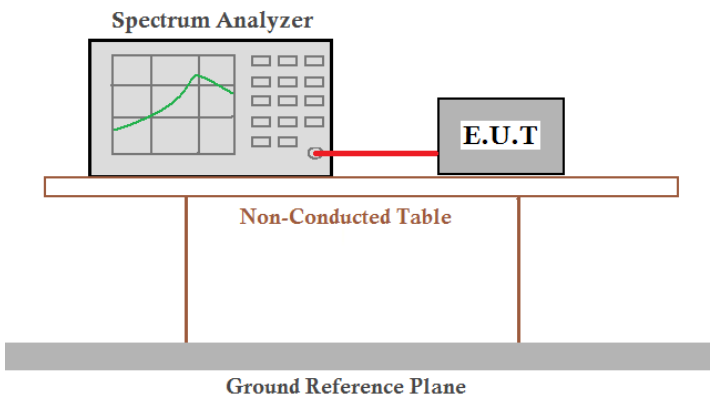
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1260.00	55.87	25.55	4.51	35.95	49.98	74.00	-24.02	Vertical
1575.00	56.03	25.02	4.73	36.15	49.63	74.00	-24.37	Vertical
1890.00	51.32	25.70	4.90	36.33	45.59	74.00	-28.41	Vertical
2520.00	42.58	27.58	5.51	36.81	38.86	74.00	-35.14	Vertical
3465.00	41.73	28.87	6.89	37.34	40.15	74.00	-33.85	Vertical
3780.00	40.02	29.34	7.48	37.44	39.40	74.00	-34.60	Vertical
1260.00	56.33	25.55	4.51	35.95	50.44	74.00	-23.56	Horizontal
1575.00	57.58	25.02	4.73	36.15	51.18	74.00	-22.82	Horizontal
1890.00	46.42	25.70	4.90	36.33	40.69	74.00	-33.31	Horizontal
2520.00	46.31	27.58	5.51	36.81	42.59	74.00	-31.41	Horizontal
3465.00	47.25	28.87	6.89	37.34	45.67	74.00	-28.33	Horizontal
3780.00	49.13	29.34	7.48	37.44	48.51	74.00	-25.49	Horizontal

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. Average value = Peak value + Duty cycle factor

Note: Worse case of AV is 52.11-9.54=42.57dBuV/m<46.67dBuV/m

7.3 20dB Occupy Bandwidth

Test Requirement:	FCC Part15 C Section 15.231 (c)
Test Method:	ANSI C63.10:2013
Limit:	The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

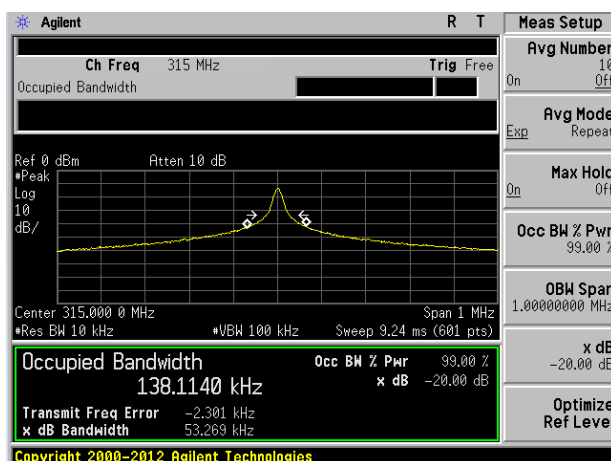
Measurement Data

Modulation	Test Frequency (MHz)	20dB bandwidth (MHz)	Limit (MHz)	Result
ASK	315	0.053	0.7875	Pass
FSK	315	0.116	0.7875	Pass

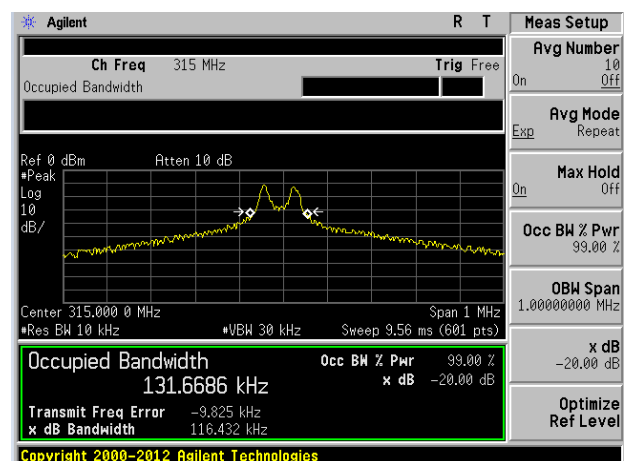
Note: Limit= Fundamental frequency×0.25%=315×0.25%=0.7875MHz

Test plot as follows:

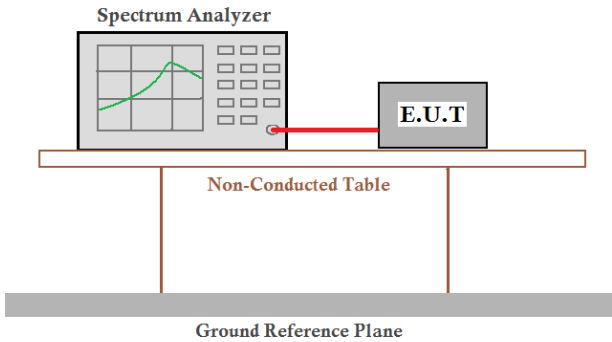
ASK



FSK



7.4 Dwell time

Test Requirement:	FCC Part15 C Section 15.231 (e)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100KHz, VBW=300KHz, span=0Hz, detector: Peak
Limit:	Each transmit Not more than 1 second , Silence period>10S
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both are placed on a Non-Conducted Table, which is supported by a Ground Reference Plane.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

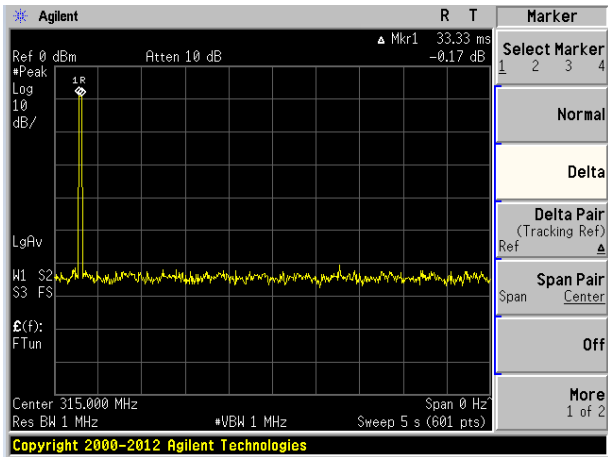
Measurement data:

Modulation	Duration of each TX(second):	Limit (second)	Result
ASK	0.03333	<1.0	Pass
FSK	0.03333	<1.0	Pass

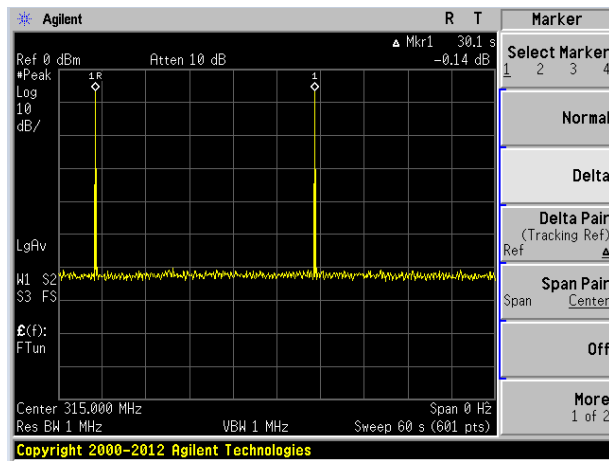
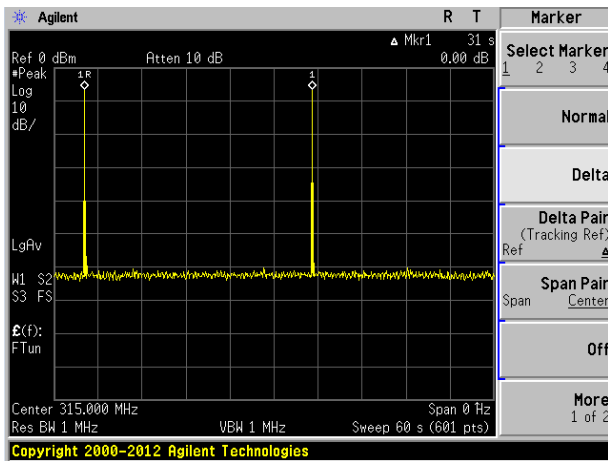
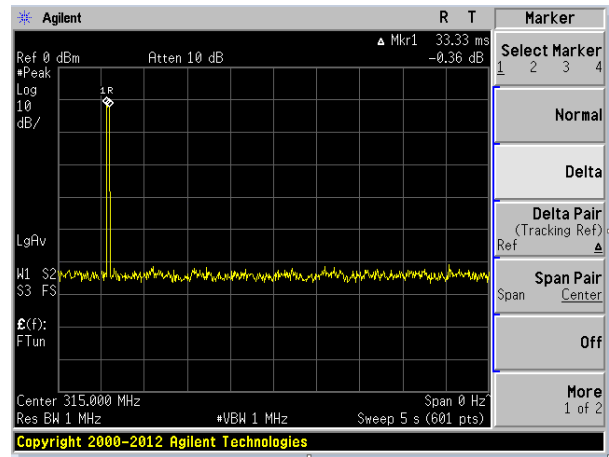
Silence period of ASK :31S>10S

Silence period of FSK :30.1S>10S

ASK

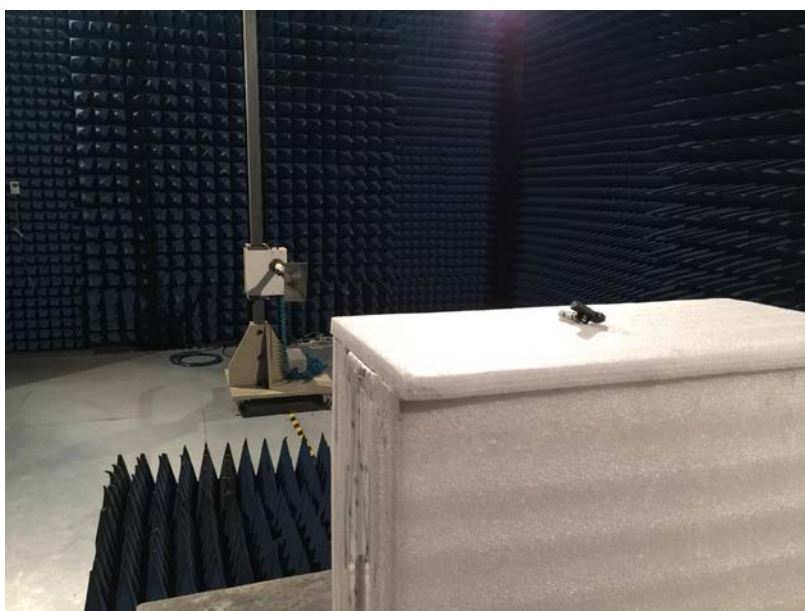
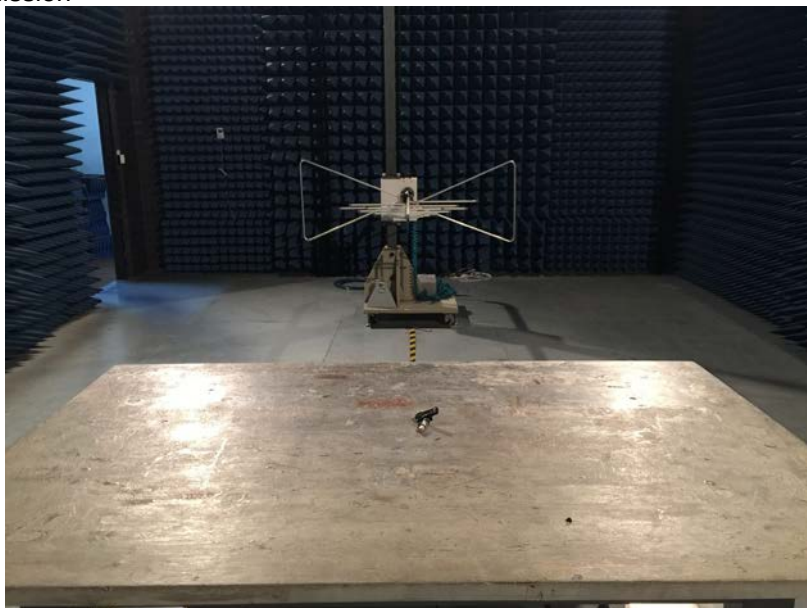


FSK



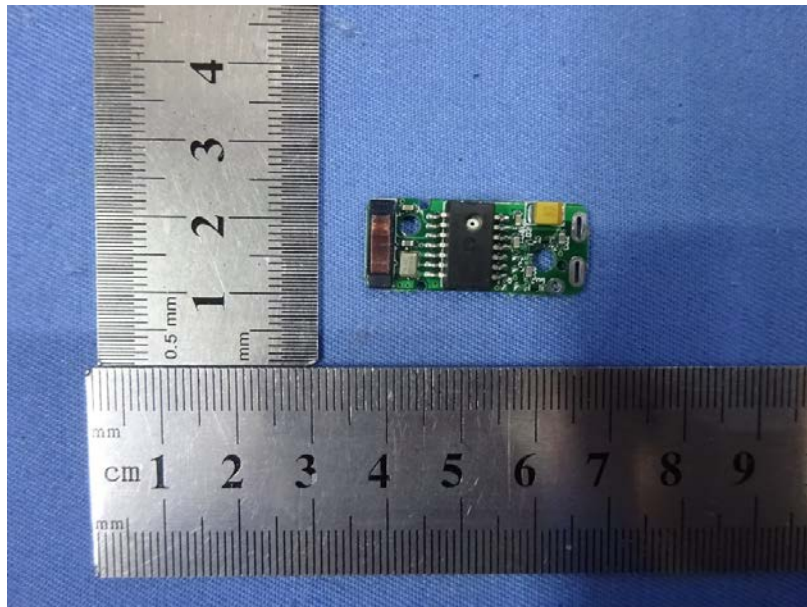
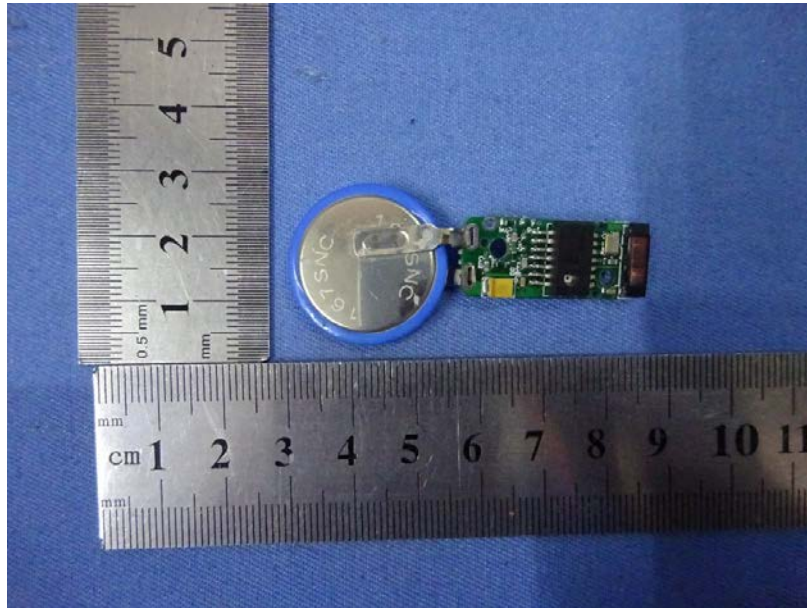
8 Test Setup Photo

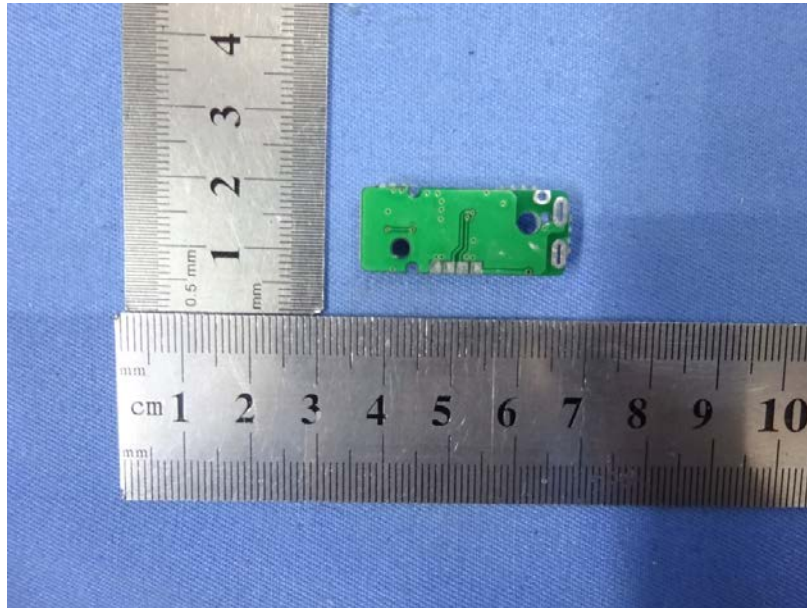
Radiated Emission



9 EUT Constructional Details









----- End -----