FCC RF TEST REPORT

ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

SwipSense Dispenser

ISSUED TO
SwipeSense, Inc

1107 Lake Street #3N Evanston, IL

Prepared by: _____
(Reporting Specialist)
Date 2014.7.10

Approved by: _____
(Chief Engineer)
Date 2014.07.10

Report No.:	BL-SZ1430082-601
EUT Type:	SwipSense Dispenser
Model Name:	DIS001
Brand Name:	SwipeSense
Test Standard:	47 CFR Part 15 Subpart C
FCC ID:	2AB5RDIS001
Test conclusion:	PASS
Test Date:	2014.05.20 – 2014.06.28
Date of Issue:	2014.07.10

Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong, P. R. China 518055
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Revision History

Version	Issue Date	Revisions
Rev. 01	2014.06.30	Initial Issue
Rev. 02	2014.07.10	The Second Issue

TABLE OF CONTENTS

1 ADMINISTRATIVE DATA (GENERAL INFORMATION)

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6683 3402
Fax Number	+86 755 6182 4271

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1. The laboratory has been listed by US Federal Communications Commission to perform electromagnetic emission measurements. The recognition numbers of test site are 832625. The laboratory has met the requirements of the IAS Accreditation Criteria for Testing Laboratories (AC89), has demonstrated compliance with ISO/IEC Standard 17025:2005. The accreditation certificate number is TL-588. The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Test Environment Condition

Ambient Temperature	15 to 35℃
Ambient Relative Humidity	30 to 60%
Ambient Pressure	86 to106kPa

1.4 Announce

(1) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

(2) The test report is invalid if there is any evidence and/or falsification.

(3) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.

(4) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.

(5) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

2 PRODUCT INFORMATION

2.1 Applicant

Applicant	SwipeSense, Inc
Address	1107 Lake Street #3N Evanston, IL

2.2 Manufacturer

Manufacturer	Nordic Semiconductor
Address	Nordic Semiconductor ASA P.O. Box 436, Skøyen 0213 Oslo Norway

2.3 General Description for Equipment under Test (EUT)

EUT Type	SwipSense Dispenser
Model Name	DIS001
Hardware Version	nRF24L01+
Software Version	1.0
Network and Wireless connectivity	2.4G ISM Band, GFSK modulation
Input Voltage	High4.2V, Normal 3.6V, Low 3.3V
Input Rated Current	18 mA
Input Frequency	8 MHz
About the Product	The equipment is SwipSense Dispenser, it at 2.4GHz ISM band.

2.4 Technical Information

TX/ RX Operating Range	2462MHz
Modulation Type	GFSK
Antenna Type	PCB Antenna
Antenna Gain	0dBi

2.5 Ancillary Equipment

N/A

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C (12-30-13 Edition)	Intentional Radiators
3	ANSI C63.4-2009	American National Standard for Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
4	ANSI C63.10-2009	American National Standard for Testing Unlicensed Wireless Devices

3.2 Verdict

No.	Description	FCC Part No.	Test Result	Verdict
1	Antenna Requirement	15.203	--	Pass Note1
2	20dB Bandwidth	15.215(c)	ANNEX A.1	Pass
3	Conducted Emission	15.207	ANNEX A.2	N/A Note2
4	Radiated Spurious Emission	15.249(a)	ANNEX A.3	Pass
5	Band Edge	15.249(a)	ANNEX A.4	Pass
Note 1: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203. Note 2:The EUT is supported by battery only.				

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity (%)	30 -60	
Atmospheric Pressure (kPa)	86-106	
Temperature	NT (Normal Temperature)	+20℃ to +25℃
	LT (Low Temperature)	-20℃
	HT (High Temperature)	+55℃
Working Voltage of the EUT	NV (Normal Voltage)	3. 0V

4.2 Test Equipment List

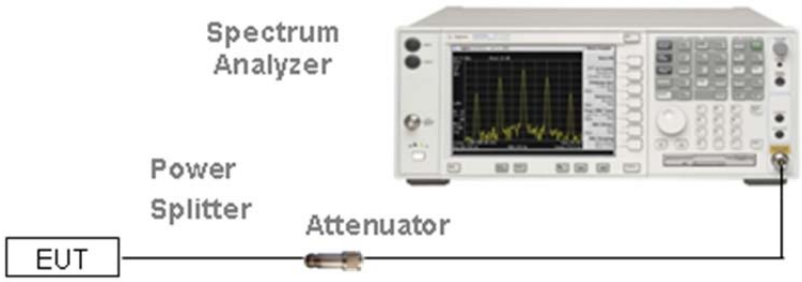
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	AGILENT	E4440A	MY45304434	2014.05.10	2015.05.09
Spectrum Analyzer	ROHDE&SCHWARZ	FSL3	103640/003	2014.05.02	2015.05.01
Bluetooth Tester	ROHDE&SCHWARZ	CBT	101005	2014.05.14	2015.05.13
Power Splitter	KMW	DCPD-LDC	1305003215	2014.05.14	2015.05.13
Power Sensor	ROHDE&SCHWARZ	NRP-Z21	103971	2014.05.08	2015.05.07
Attenuator (20dB)	KMW	ZA-S1-201	110617091	--	--
Attenuator (6dB)	KMW	ZA-S1-61	1305003189	--	--
DC Power Supply	ROHDE&SCHWARZ	HMP2020	018141664	2013.07.06	2014.07.07
Temperature Chamber	ANGELANTIONI SCIENCE	NTH64-40A	1310	2013.07.06	2014.07.07
Test Antenna-Loop(9kHz-30MHz)	SCHWARZBECK	FMZB 1519	1519-037	2013.07.02	2014.07.01
Test Antenna-Bi-Log(30MHz-3GHz)	SCHWARZBECK	VULB 9163	9163-624	2013.07.03	2014.07.02
Test Antenna-Horn(1-18GHz)	SCHWARZBECK	BBHA 9120D	9120D-1148	2013.07.02	2014.07.01
Test Antenna-Horn(15-26.5GHz)	SCHWARZBECK	BBHA 9170	9170-305	2013.07.02	2014.07.01
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2013.10.07	2014.10.06

4.3 Test Configurations

Test Configurations (TC) NO.	Description	
	Signal Description	Operating Frequency
Transmitter		
TC01	GFSK modulation	2462MHz

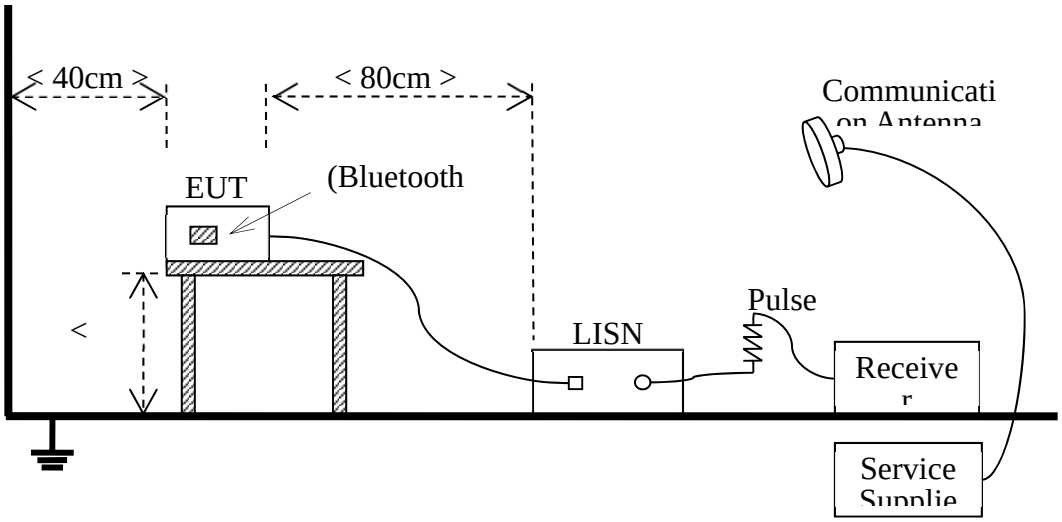
4.4 Description of Test Setup

4.4.1 For Antenna Port Test



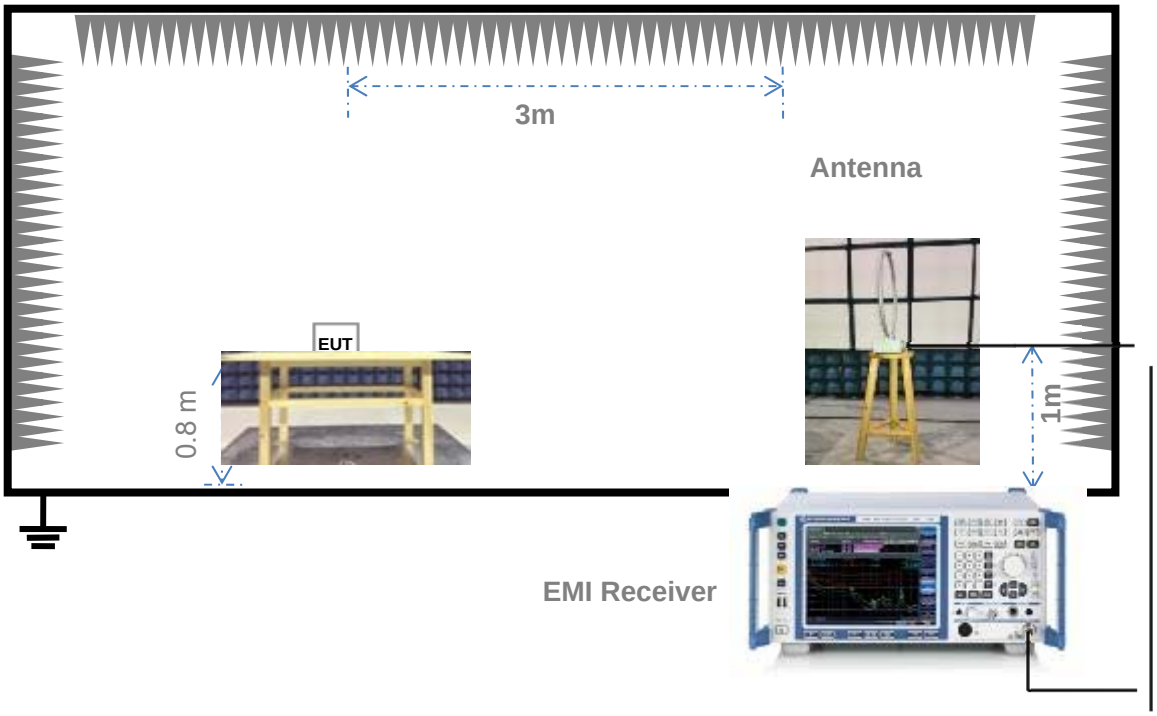
(Diagram 1)

4.4.2 For AC Power Supply Port Test



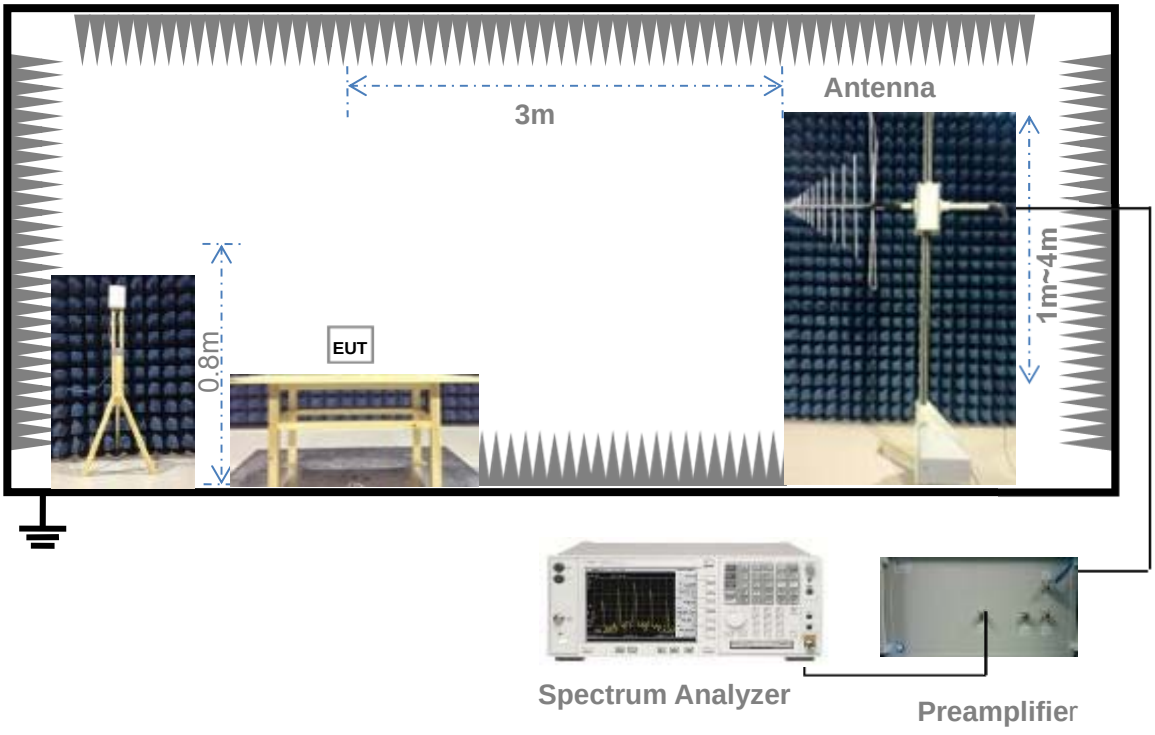
(Diagram 2)

4.4.3 For Radiated Test (Below 30MHz)



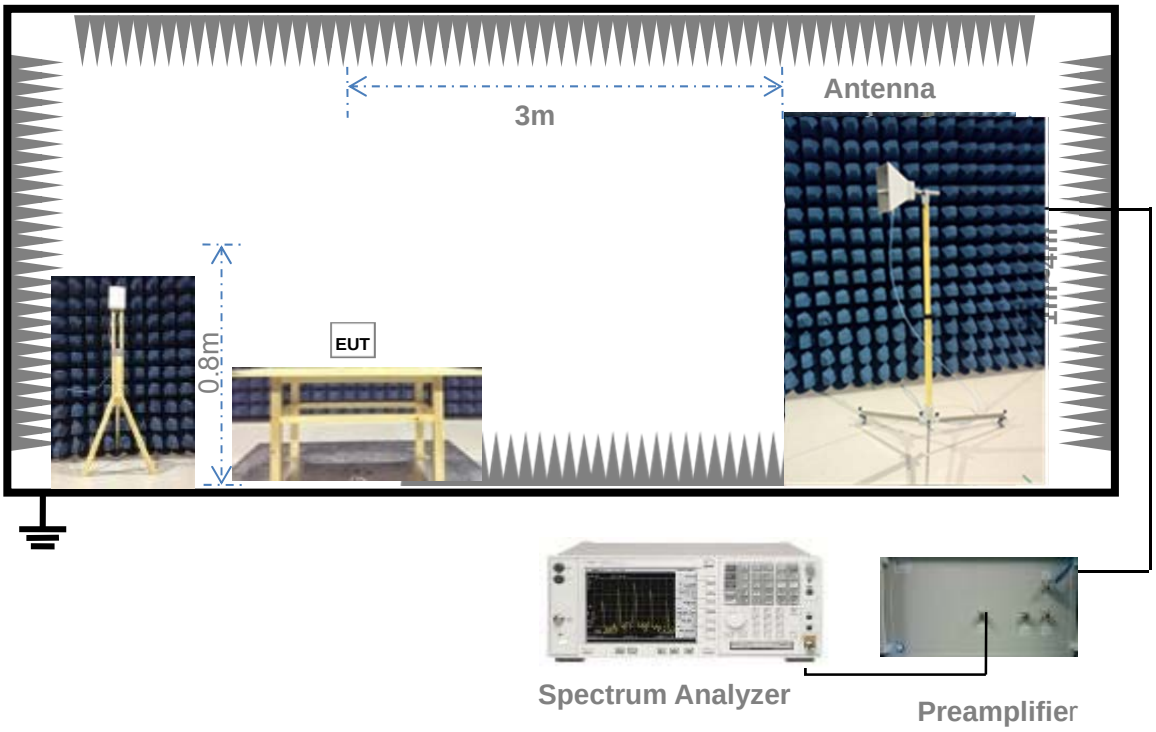
(Diagram 3)

4.4.4 For Radiated Test (30MHz-1GHz)



(Diagram 4)

4.4.5 For Radiated Test (Above 1GHz)



(Diagram 5)

4.5 Test Conditions

Test Case	Test Conditions		
	Test Env.	Test Setup Note 1	Test Configuration Note 2
20dB Bandwidth	NTNV	Test Setup 1	TC01
Radiated Emission	NTNV	Test Setup 3 Test Setup 4 Test Setup 5	TC01
Band Edge	NTNV	Test Setup 5	TC01
Note: 1. Please refer to section 4.4 for test setup details. 2. Please refer to section 4.3 for test setup details.			

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Standard Applicable

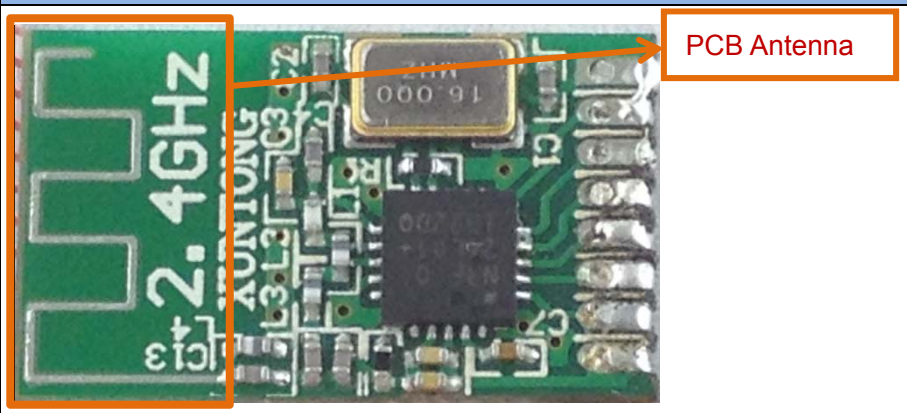
FCC §15.203)

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is An embedded-in	An embedded-in antenna design is used.

Reference Documents	Item
Photo	

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 20dB Bandwidth

5.2.1 Limit

FCC §15.215(c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

5.2.2 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW ≥ 1% of the 20 dB bandwidth

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

5.3 Conducted Emission

5.3.1 Limit

FCC §15.207

For an intentional radiator 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 within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.3.2 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed.

Note: this device powered by battery, conducted emission at main port is not request.

5.4 Radiated Spurious Emission

5.4.1 Limit

FCC §15.249(a)

Except as provided in paragraph (a) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Frequency (MHz)	Field Strength of Fundamental (mV/m)	Field Strength of Harmonics (μV/m)
902-928	50	500
2400-2483.5	50	500
5725-5875	50	500
24000-24250	250	2500

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Note:

1. For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.

2. For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

5.4.2 Test Procedure

The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented. The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak

Trace = max hold

5.5 Band Edge

5.5.1 Limit

FCC §15.249(a)

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.5.2 Test Procedure

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = auto

Detector function = peak /AV

Trace = max hold

Allow the trace to stabilize.

E [dBμV/m] =UR + AT + AFactor [dB]; AT =LCable loss [dB]-Gpreamp [dB]

AT: Total correction Factor except Antenna

UR: Receiver Reading

Gpreamp: Preamplifier Gain

AFactor: Antenna Factor at 3m

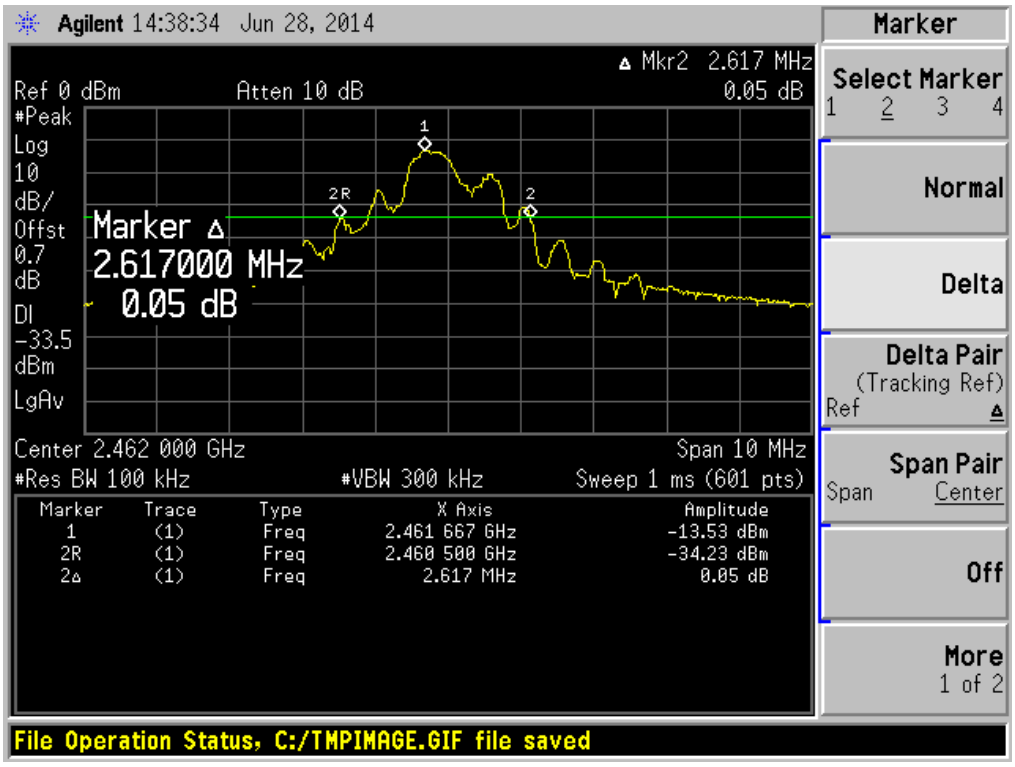
ANNEX A TEST RESULT

A.1 20dB bandwidth

Test Data

Frequency (MHz)	20 dB Bandwidth (MHz)
2462	2.617

Test plots

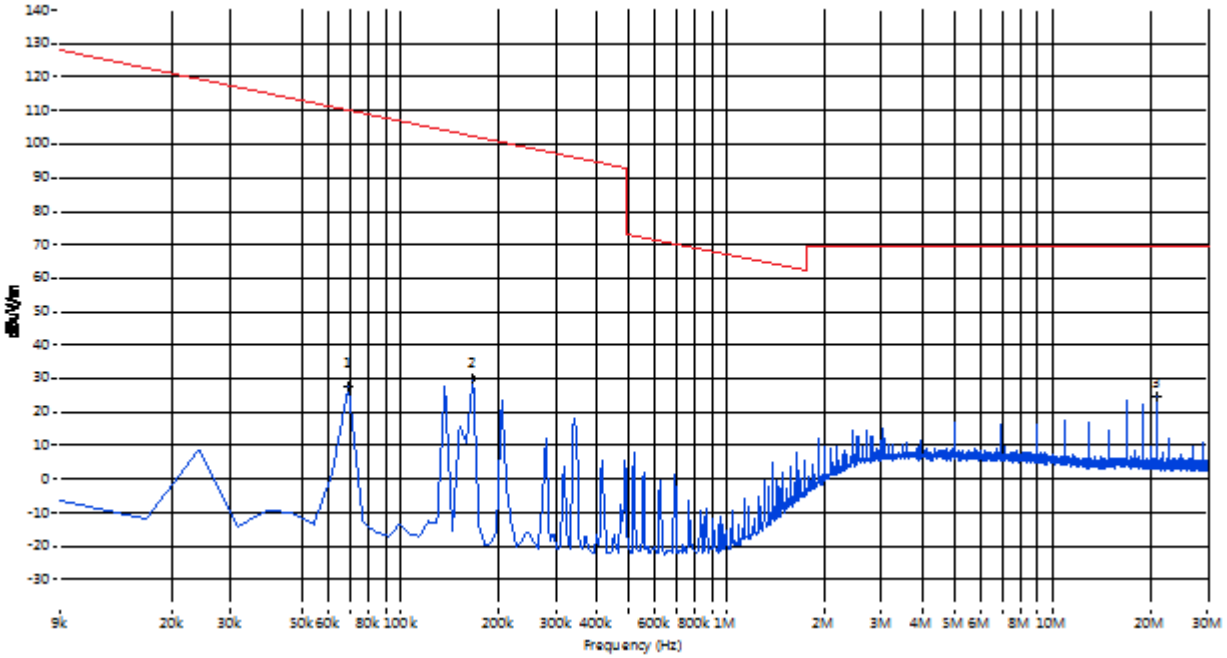


A.2 Radiated Emission

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

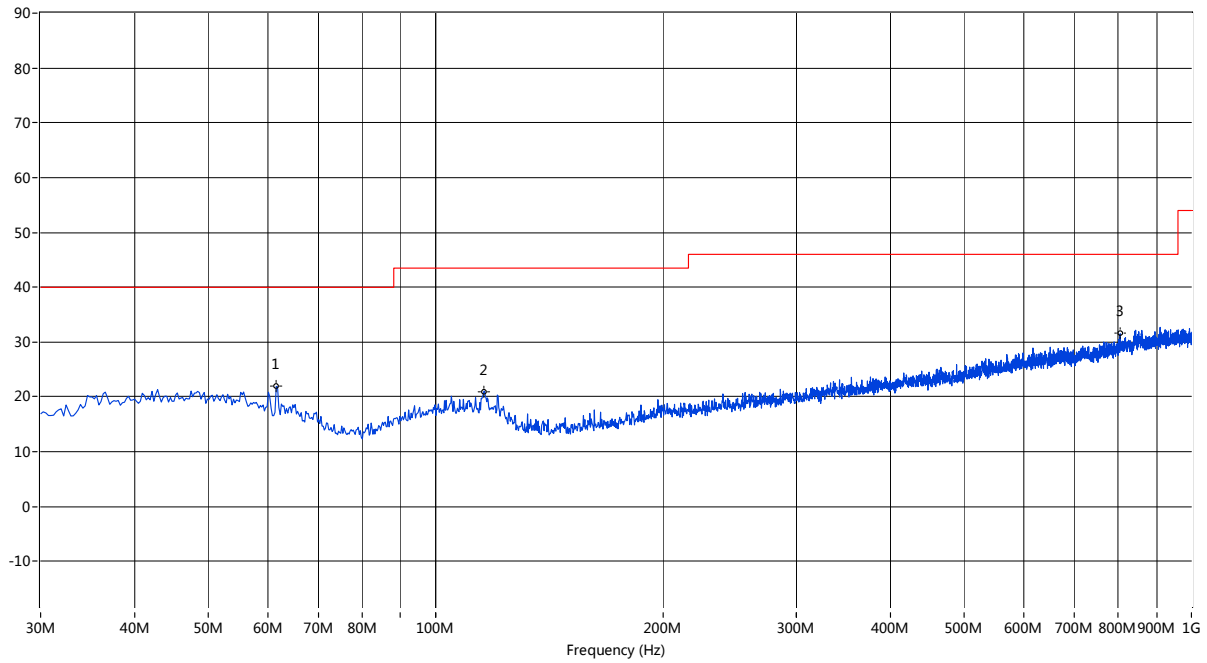
The data of 9 kHz to 1GHz

Below 30MHz



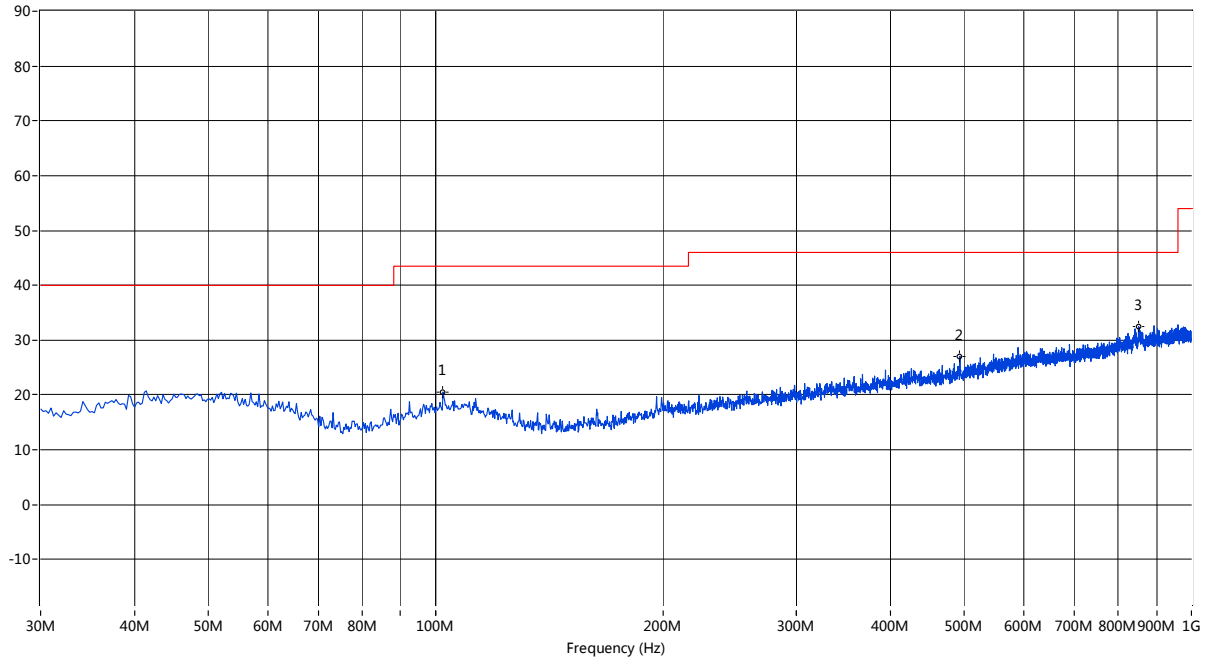
Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Degree	Verdict
0.069	28.71	--	--	--	101.8	--	314.2	Pass
0.166	31.45	--	--	--	151.2	--	300	Pass
20.997	25.14	--	--	--	49.4	--	195.4	Pass

30MHz to 1GHz, ANT V



Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Degree	Antenna	Verdict
61.517	21.93	--	--	--	40.0	--	223.4	Vertical	Pass
115.824	21.04	--	--	--	43.5	--	313.2	Vertical	Pass
804.594	31.54	--	--	--	46.0	--	43.6	Vertical	Pass

30MHz to 1GHz, ANT H



Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Degree	Antenna	Verdict
102.247	20.53	--	--	--	43.5	--	147.0	Horizontal	Pass
493.787	27.05	--	--	--	46.0	--	168.7	Horizontal	Pass
851.385	32.53	--	--	--	46.0	--	300.8	Horizontal	Pass

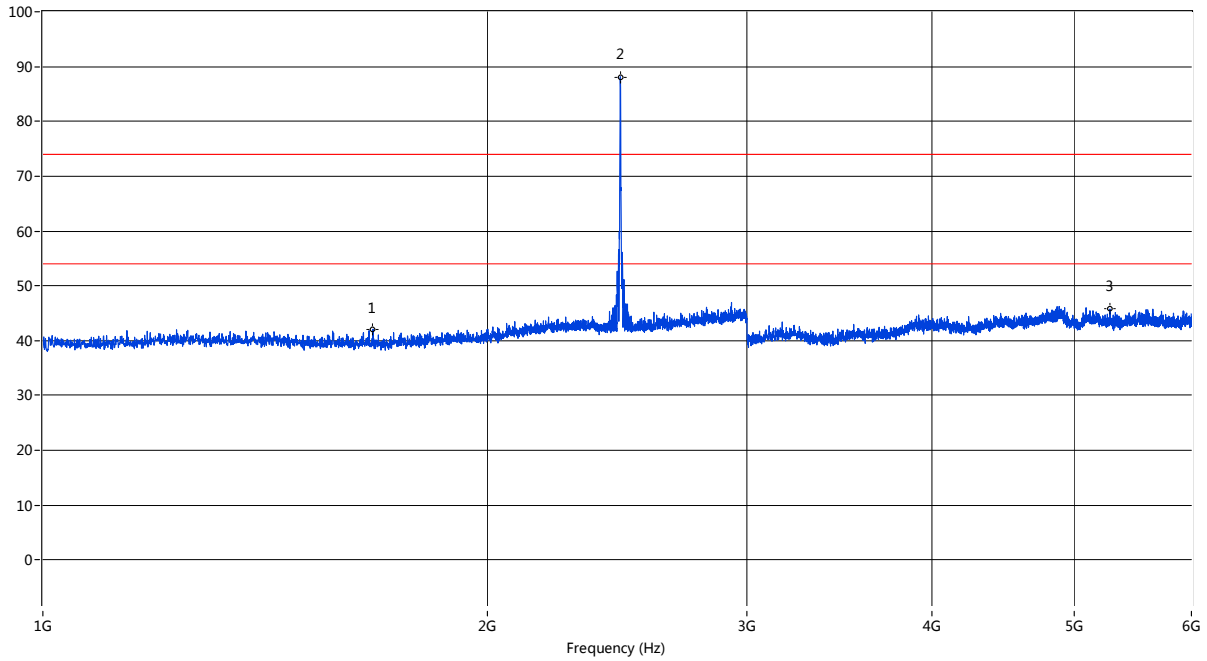
Test Data and Plots(1GHz ~ 10th Harmonic)

Fre. (MHz)		Pk	AV	Limit-PK	Limit-AV	Degree	Antenna	Verdict
Fundamental	2461.635	88.13	--	114.0	94.0	224.8	Vertical	Pass
Harmonic	N/A	--	--	74.0	54.0	--	Vertical	--
	N/A	--	--	74.0	54.0	--	Vertical	--
Spurious	1673.332	42.07	--	74.0	54.0	214.5	Vertical	Pass
	5284.679	45.78	--	74.0	54.0	356.3	Vertical	Pass
	7865.225	45.34	--	74.0	54.0	0	Vertical	Pass
	14219.634	47.54	--	74.0	54.0	0	Vertical	Pass
	20194.676	48.15	--	74.0	54.0	0	Vertical	Pass
Fundamental	2461.635	87.71	--	114.0	94.0	334.3	Horizontal	Pass
Harmonic	N/A	--	--	74.0	54.0	--	Horizontal	--
	N/A	--	--	74.0	54.0	--	Horizontal	--
Spurious	3880.280	44.56	--	74.0	54.0	101.9	Horizontal	Pass
	5168.458	45.92	--	74.0	54.0	65.2	Horizontal	Pass
	7074.875	44.94	--	74.0	54.0	0	Horizontal	Pass
	16116.473	49.35	--	74.0	54.0	0	Horizontal	Pass
	24494.176	49.52	--	74.0	54.0	0	Horizontal	Pass

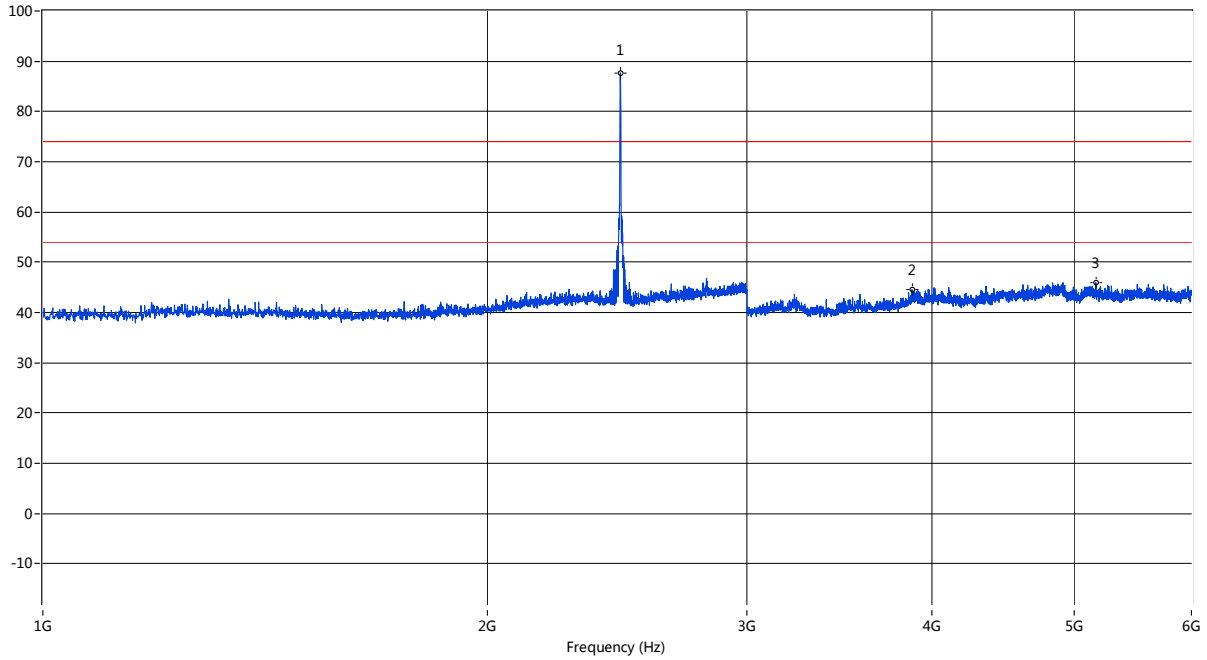
Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.

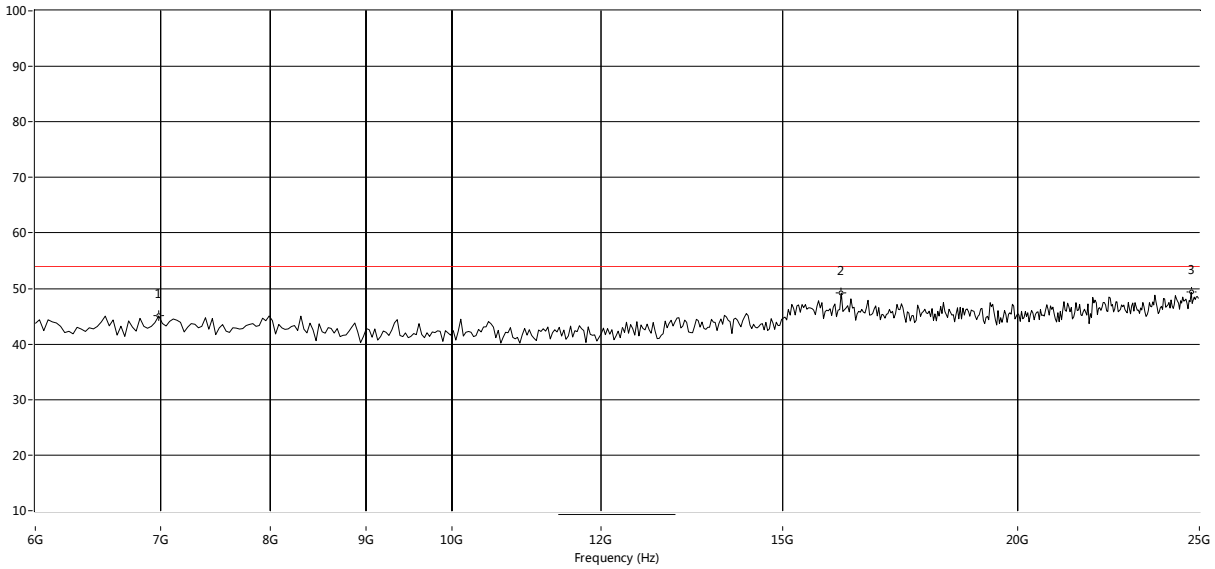
1GHz to 6GHz, ANT V



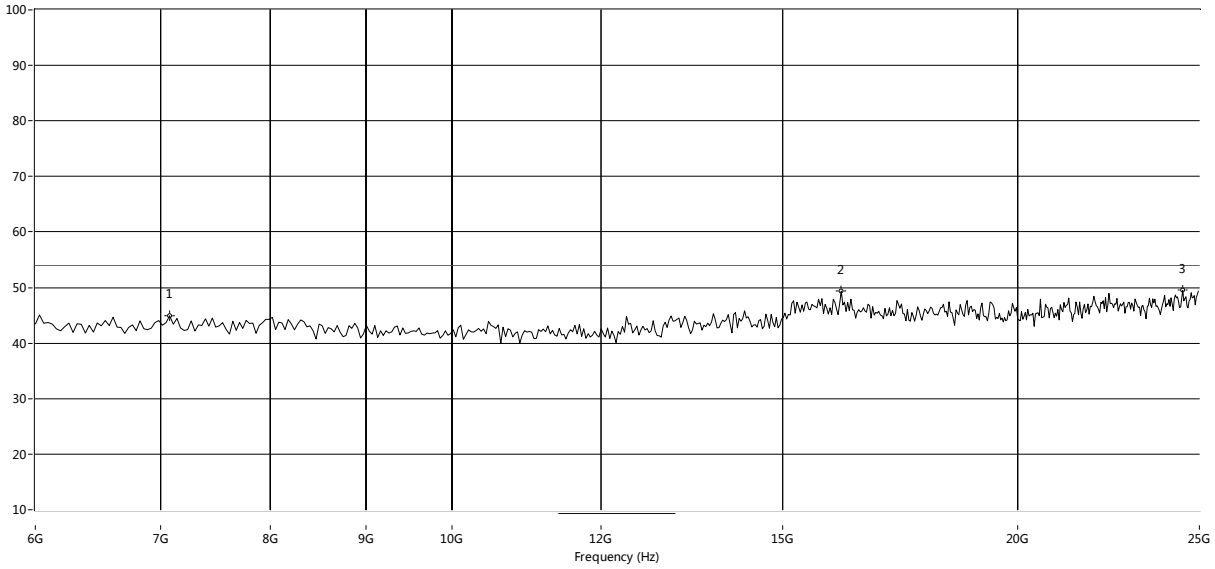
1GHz to 6GHz, ANT H



6GHz to 25GHz, ANT V



6GHz to 25GHz, ANT H



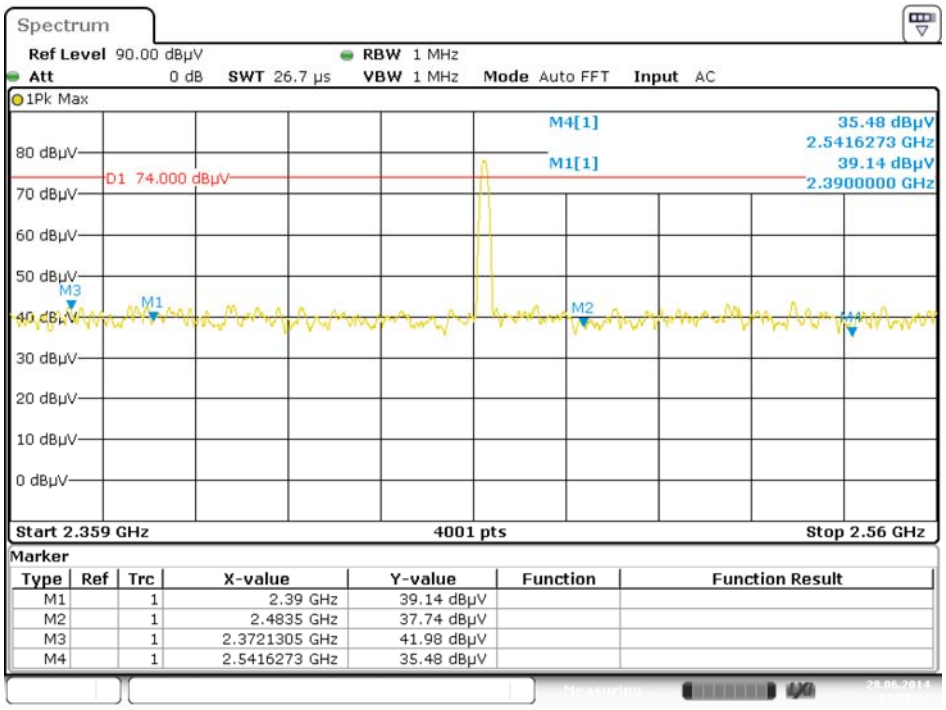
A.3 Band Edge

Test Data

The channel is tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

Test Plots

ANT V, PEAK



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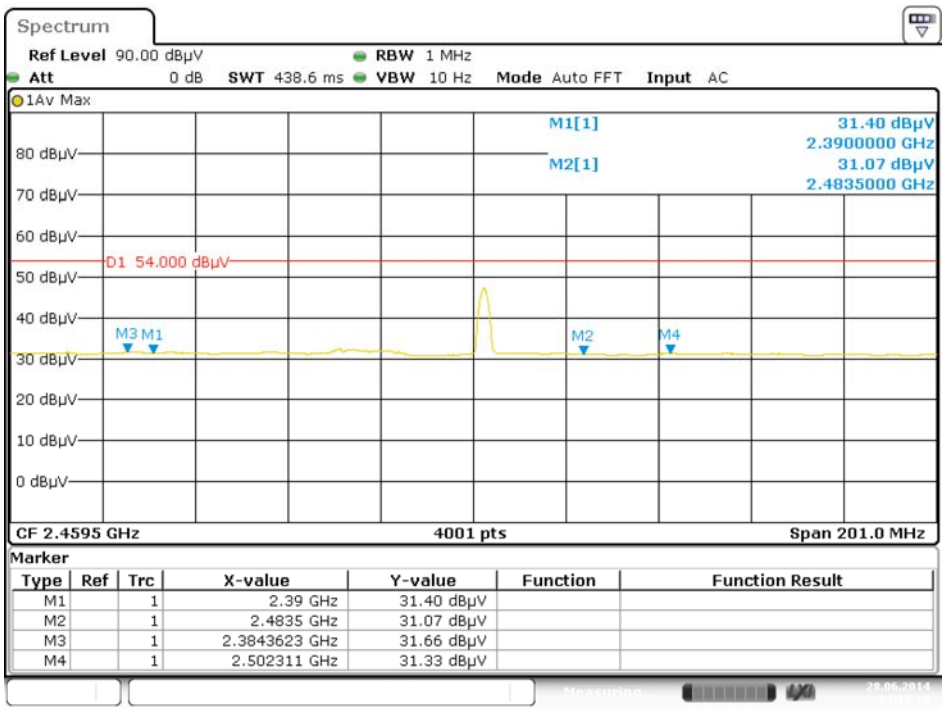
ANT V, AVERAGE



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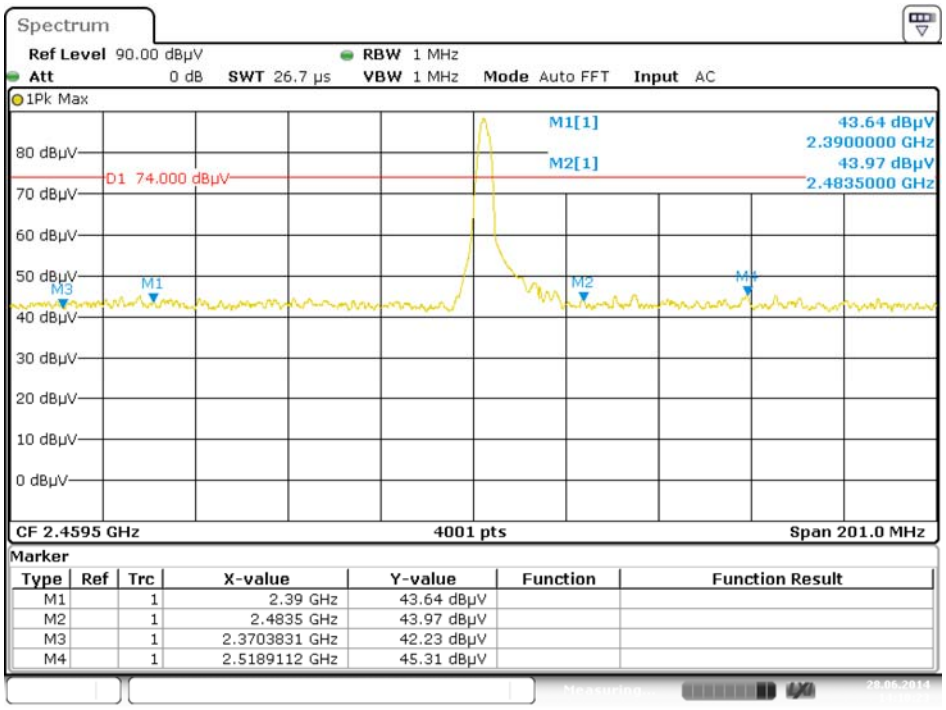
ANT H, PEAK



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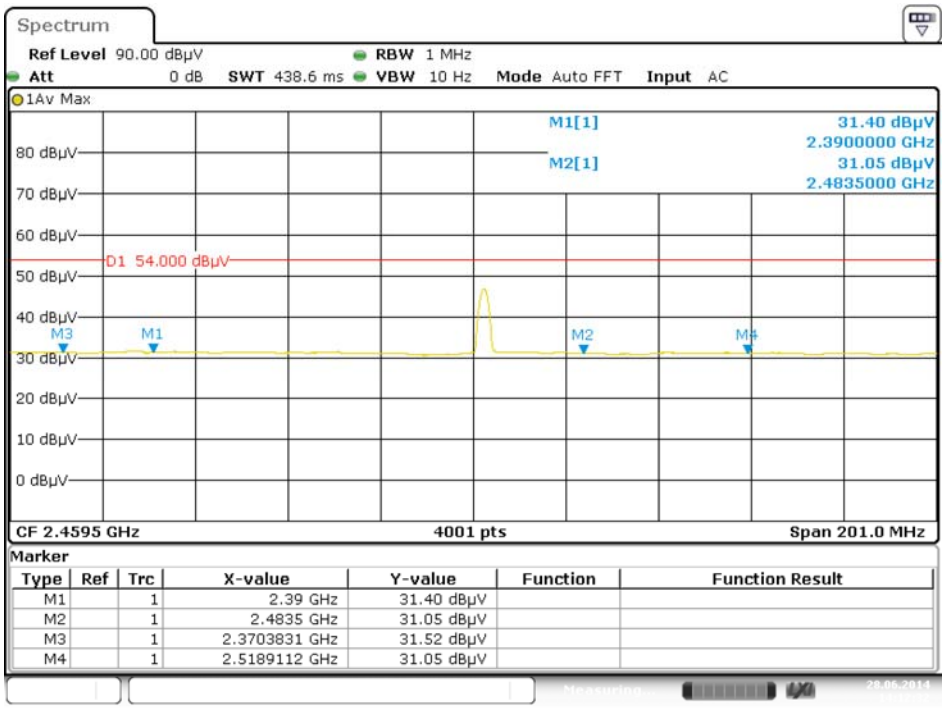
ANT H, AVERAGE



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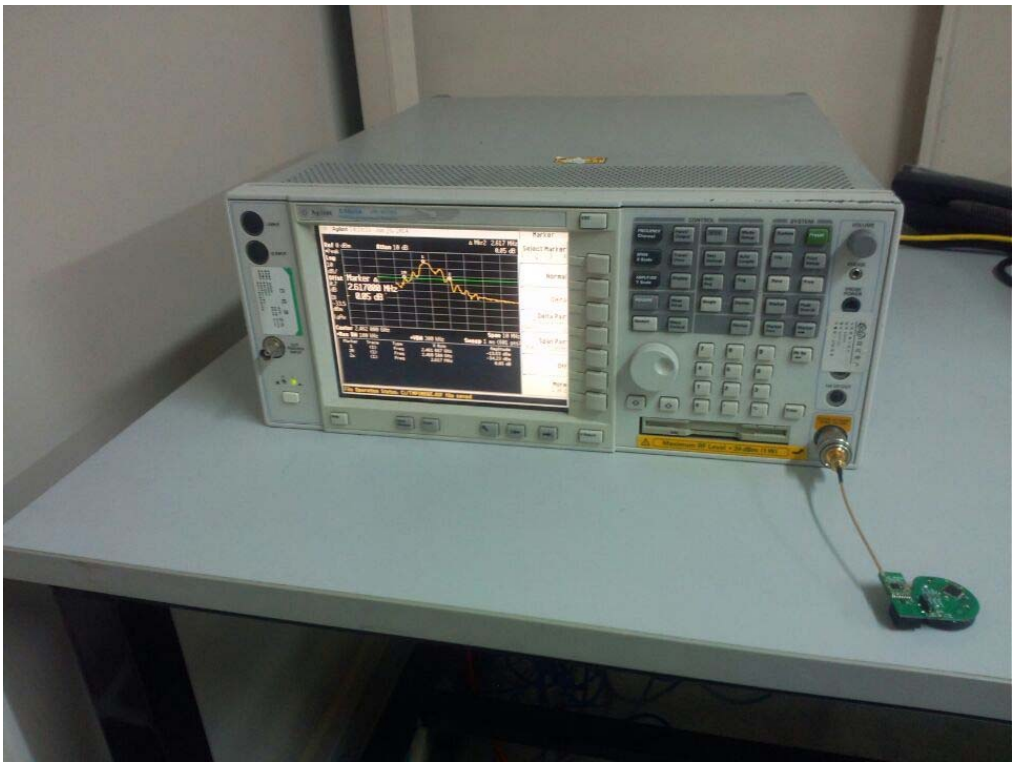
ANNEX B TEST SETUP PHOTOS

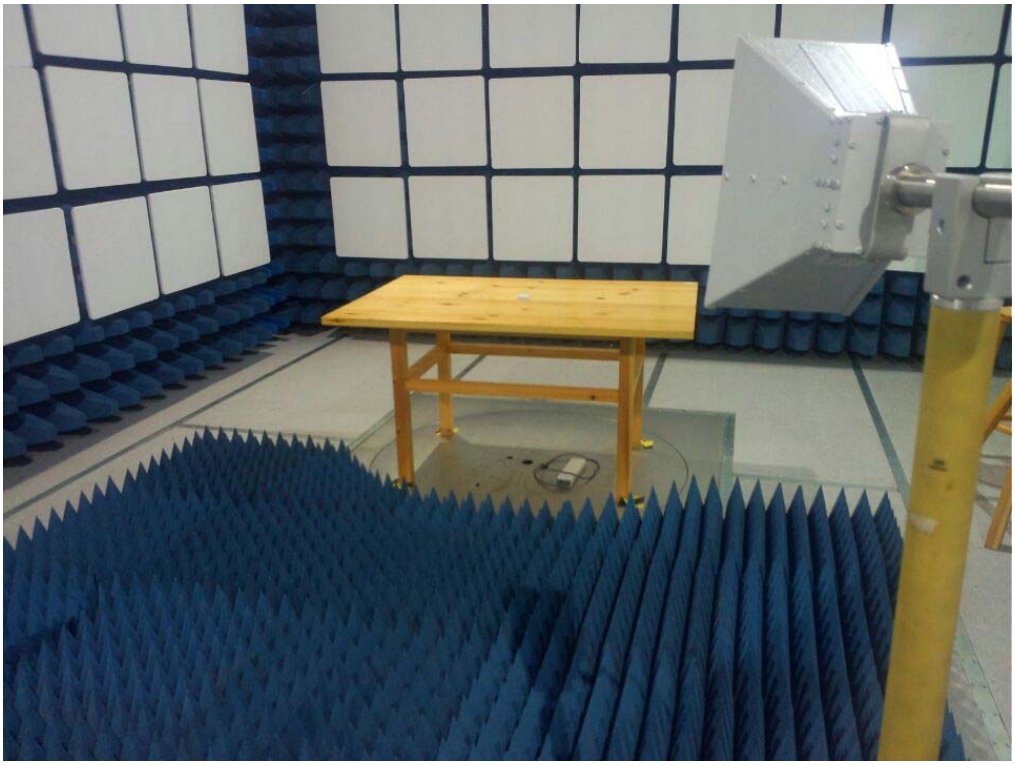
B.1 Conducted Test Photo



B.2 Radiated Test Photo

Below 30MHz

30MHz to 1GHz



Above 1GHz

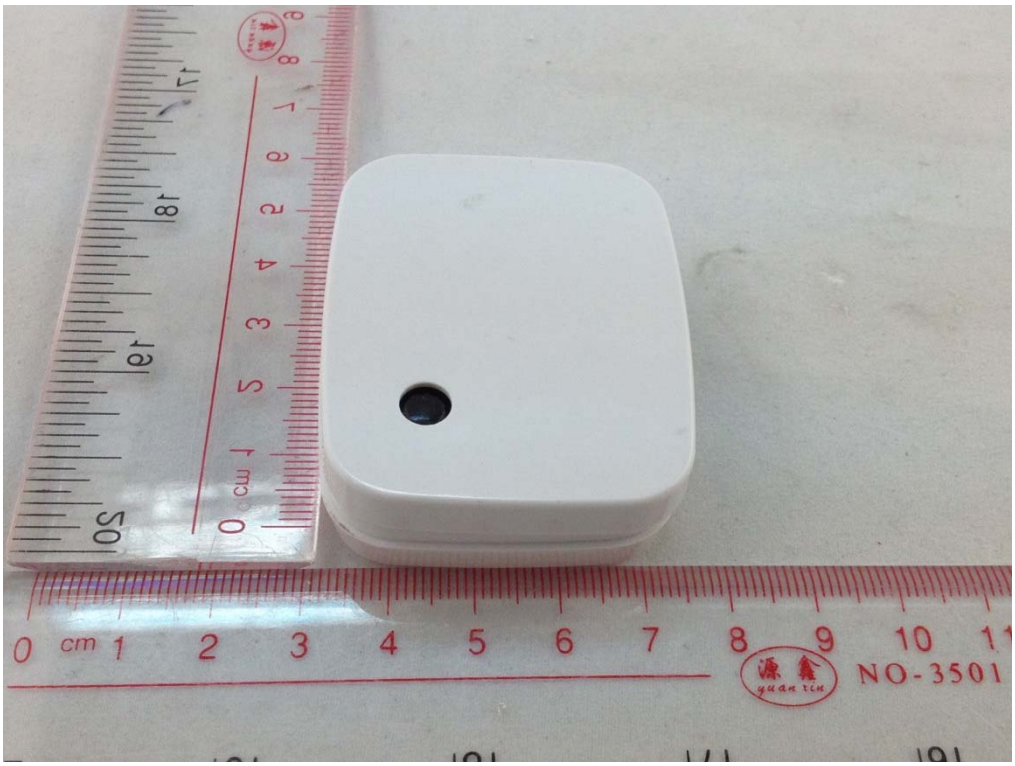
ANNEX C EUT PHOTOS

C.1 Appearance of the EUT

THE FRONT OF EUT

THE BACK OF EUT

THE DOWN OF EUT

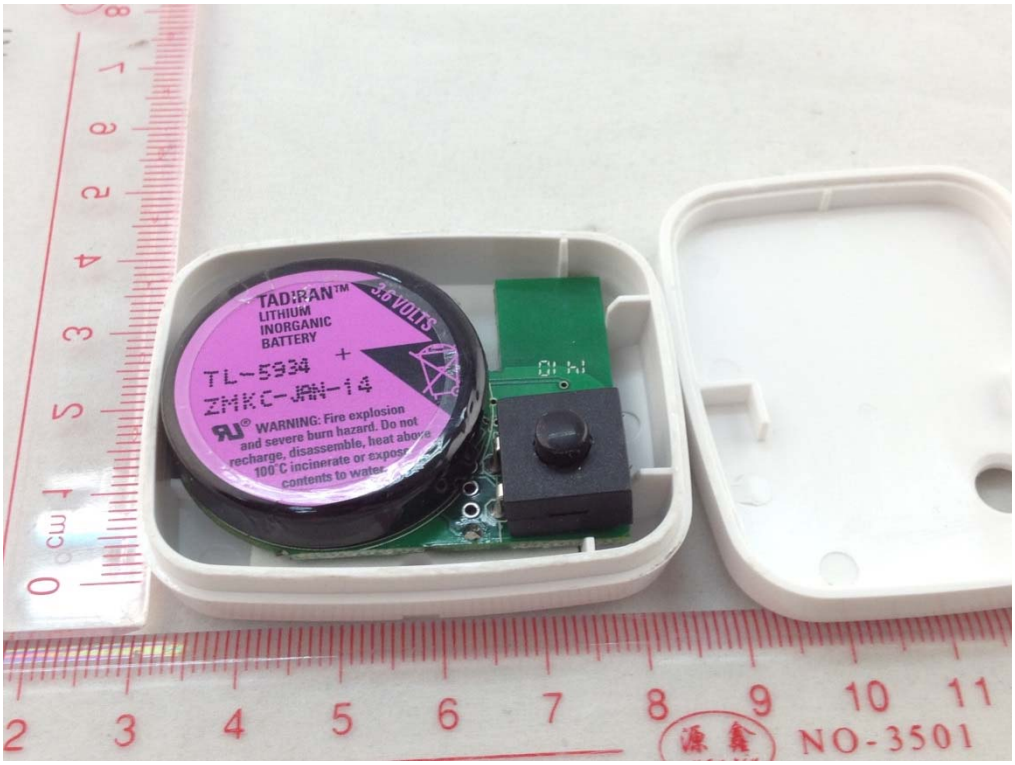


THE UP OF EUT

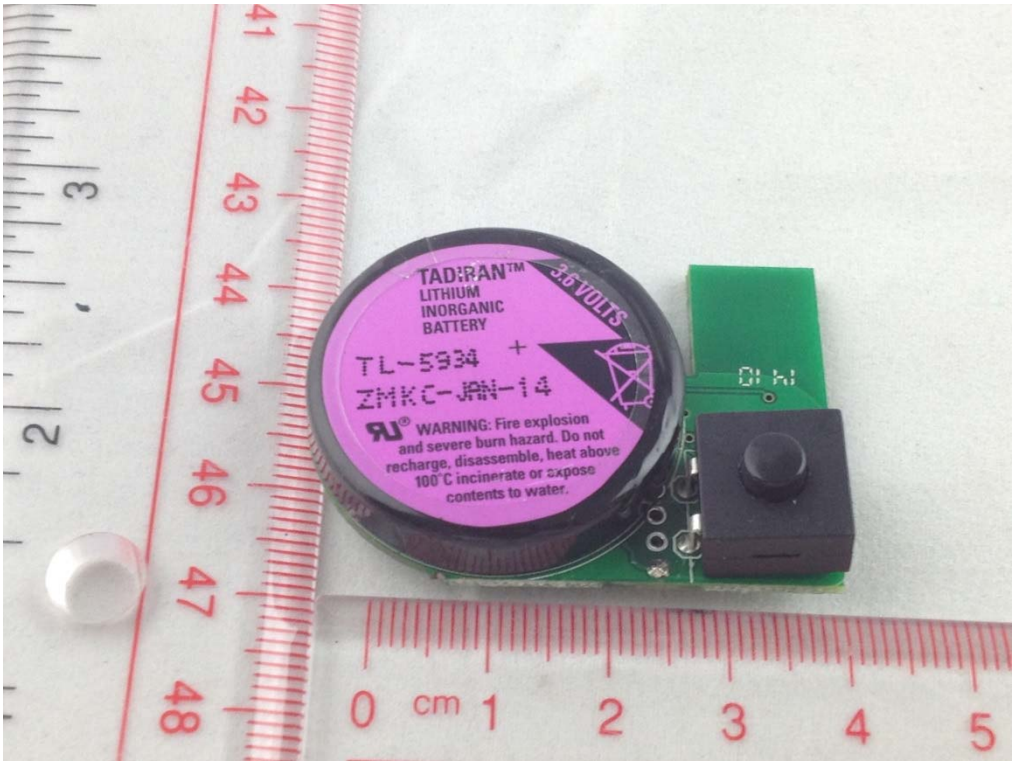
THE LEFT OF EUT

THE RIGHT OF EUT

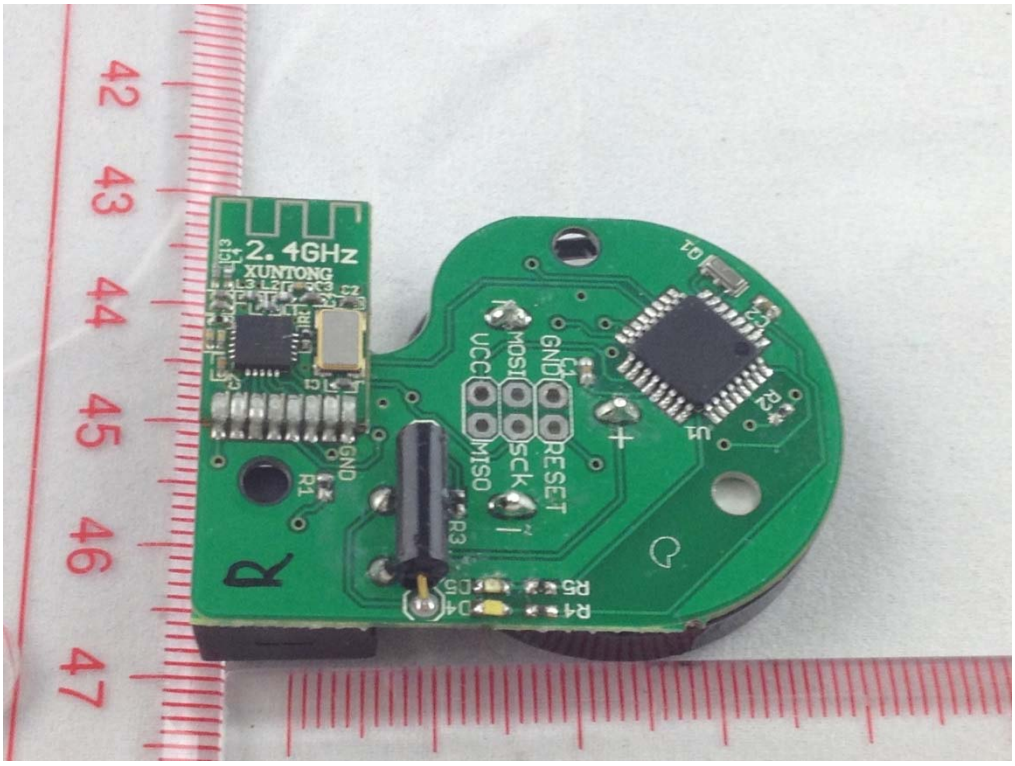
C.2 Inside of the EUT



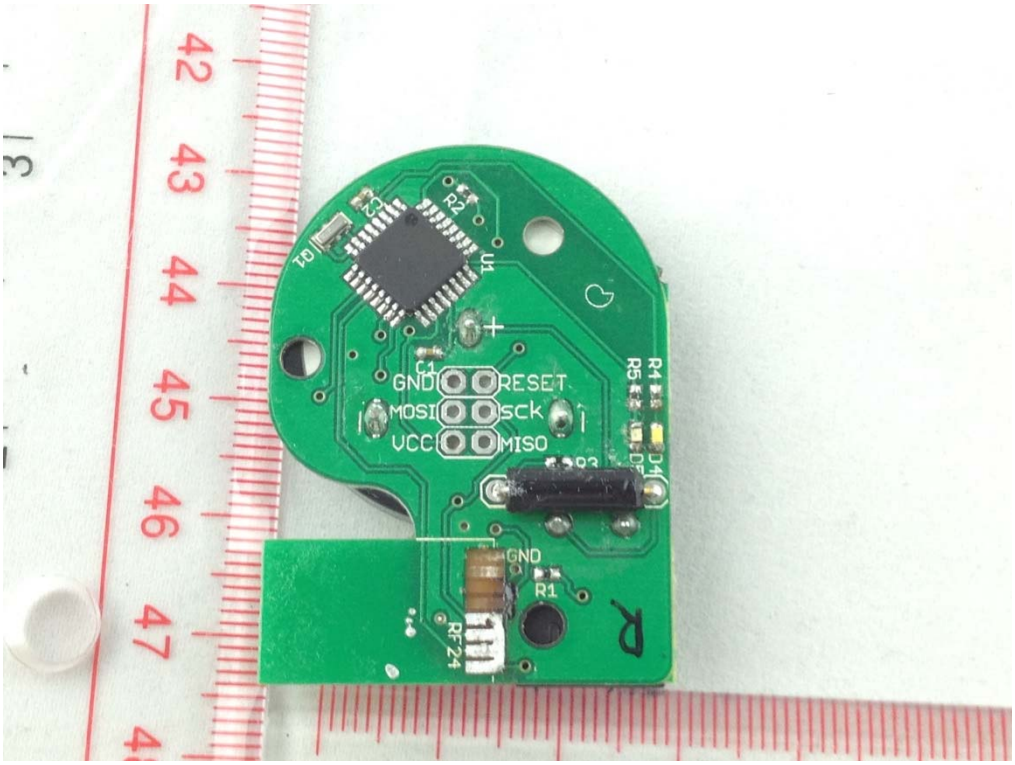
EUT UNCOVER VIEW



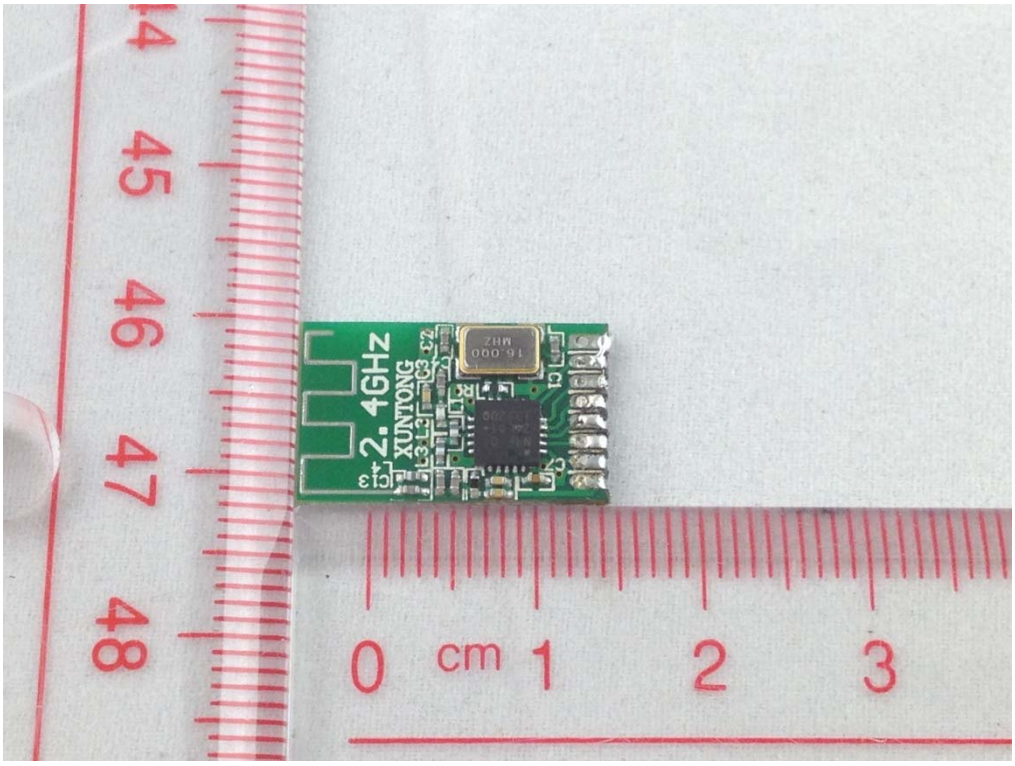
MAIN BOARD TOP VIEW 1



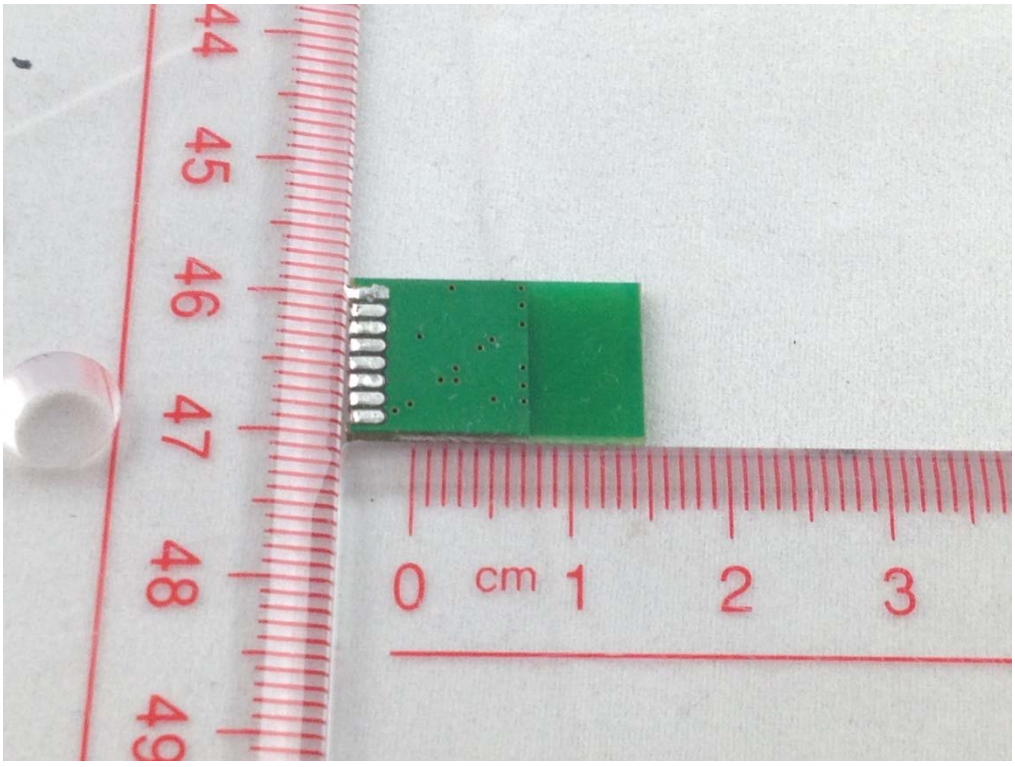
MAIN BOARD BACK VIEW 1



MAIN BOARD BACK VIEW 2



RF BOARD NEAR VIEW



RF BOARD BACK VIEW

--END OF REPORT--