

FCC Test Report

FCC Rule(s): FCC Part 15.247

Applicant: Shenzhen Tilv Technology Co., Ltd.

Product Name: AR GUN

Model: AR-002

FCC ID: 2AGAJ-AR-002

Report No.: ZKS170900143E

Tested Date: 2017-07-08

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Tested By : Lieber Ouyang (Engineer)



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Prepared By:

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Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen ZRLK Testing Technology Co., Ltd.

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1. General Information

1.1 Product Information

Applicant and Manufacturer	
Applicant:	Shenzhen Tilv Technology Co., Ltd.
Address of Applicant:	4/F Dongshan No.8 factory, Difu Rd., Gushu Community, Xixiang St., Baoan District, Shenzhen, China
Manufacturer:	Shenzhen Tilv Technology Co., Ltd.
Address of Manufacturer:	4/F Dongshan No.8 factory, Difu Rd., Gushu Community, Xixiang St., Baoan District, Shenzhen, China

General Description of EUT	
Product Name:	AR GUN
Model No.:	AR-002
Trade Name:	--
Adding Model(s):	--
Class of Equipment:	DTS
Rated Voltage:	DC 3.0V
Hardware Version:	V1.0
Software Version:	V1.0
Frequency Range:	2402-2480MHz
Bluetooth Version:	V4.0 BLE
Modulation:	GFSK
Type of Antenna:	PCB Antenna
Antenna Gain:	-3dBi
Note 1: The test data is gathered from a production sample, provided by the manufacturer.	

1.2 Compliance Standards

Compliance Standards or Rules	
FCC Part 15 Subpart C	FEDERAL COMMUNICATIONS COMMISSION, RADIO FREQUENCY DEVICES, Intentional Radiators
FCC Part 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz.
The objective of the manufacturer or applicant is to demonstrate compliance with the above standards.	
According to standards for test methodology	
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices Accredited Standards Committee C63®—Electromagnetic Compatibility
All measurements contained in this report were conducted with all above standards	
Maintenance of compliance is the responsibility of the manufacturer or applicant. Any modification of the product, which result is lowering the emission, should be checked to ensure compliance has been maintained.	

1.3 Test Facilities

Testing Lab: Global United Technology Services Co., Ltd.
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 L5775 .
The laboratory has been listed by US Federal Communications Commission to perform electromagnetic emission measurements. The recognition numbers of test site are 600491 .
The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 9079A-2 .
All measurement facilities used to collect the measurement data are located at No.301-309, 3/F., Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102

1.4 Test Setup Information

List of Test Modes			
Test Mode	Description	Remark	
TM1	Low Channel	2402MHz	
TM2	Middle Channel	2442MHz	
TM3	High Channel	2480MHz	
List and Details of Auxiliary Equipment			
Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	E40	--
Conversion Board	ZRLK	CH340	--
Note 1: The equipment under test (EUT) was configured to measure its highest possible emission level. Note 2: The equipment under test (EUT) was tested under new battery. Note 3: The Bluetooth has been tested under continuous transmission mode, and set the duty cycle of 99%. Note 4: The Bluetooth is connected to notebook through a serial to USB conversion board, and to use a test set software to control the Bluetooth device work in test modes.			

1.5 Measurement Uncertainty

Parameter	Conditions	Uncertainty
Conducted Emissions	9kHz ~30MHz	± 2.79 dB
Radiated Emissions	9kHz ~ 30MHz	± 4.12 dB
	30MHz ~ 1GHz	± 4.16 dB
	1GHz ~ 18GHz	± 5.97 dB
	18GHz ~ 26.5GHz	± 6.71 dB

1.6 List of Test and Measurement Instruments

Description	Manufacturer	Model	Cal. Date	Due. Date
ESU EMI Test Receiver	R&S	ESU26	April. 25 2017	April. 24 2018
BiConiLog Antenna	SCHWARZBECK	VULB9163	April. 25 2017	April. 24 2018
Double-ridged horn antenna	SCHWARZBECK	9120D	April. 25 2017	April. 24 2018
Horn Antenna	ETS-LINDGREN	3160-09	April. 25 2017	April. 24 2018
Loop Antenna	SCHWARZBECK	FMZB 1519	April. 25 2017	April. 24 2018
RF Amplifier	HP	8347A	April. 25 2017	April. 24 2018
Broadband Preamplifier	SCHWARZBECK	BBV9718	April. 25 2017	April. 24 2018
EMI Test Software	AUDIX	E3	N/A	N/A
Coaxial Cable	GTS	9kHz-1GHz	April. 25 2017	April. 24 2018
Coaxial Cable	GTS	1GHz-18GHz	April. 25 2017	April. 24 2018
Coaxial Cable	GTS	18GHz-40GHz	April. 25 2017	April. 24 2018
Spectrum Analyzer	Agilent	E4407B	April. 25 2017	April. 24 2018
Temporary Antenna Connector	ZRLK	SMA-01	April. 25 2017	April. 24 2018
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.				

2. Summary of Test Results

FCC Rules	Description of Test Items	Result
FCC Part 2.1093	RF Exposure	Passed
FCC Part 15.203, FCC Part 15.247(b)(4)(i)	Antenna Requirement	Passed
FCC Part 15.205	Restricted Band of Operation	Passed
FCC Part 15.207(a)	Conducted Emission	N/A ^(Note)
FCC Part 15.209(a)	Radiated Spurious Emissions	Passed
FCC Part 15.247(a)(2)	6dB Bandwidth	Passed
FCC Part 15.247(e)	Power Spectral Density	Passed
FCC Part 15.247(b)(3)	RF Power Output	Passed
FCC Part 15.247(d)	Band Edge (Out of Band Emissions)	Passed
Passed: The EUT complies with the essential requirements in the standard		
Failed: The EUT does not comply with the essential requirements in the standard		
N/A: Not applicable		
Note: Because EUT is only powered by 2xAAA batteries, the AC power line conducted test is not required.		

3. Antenna Requirement

3.1 Standard and Limit

According to FCC Part 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.

3.2 Test Result

This product has a permanent antenna (PCB antenna), fulfill the requirement of this section.

4. Power Spectral Density

4.1 Standard and Limit

According to 15.247(a)(1)(iii), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.2 Test Procedure

According to the KDB 558074 D01 V04, the test method of power spectral density as below:

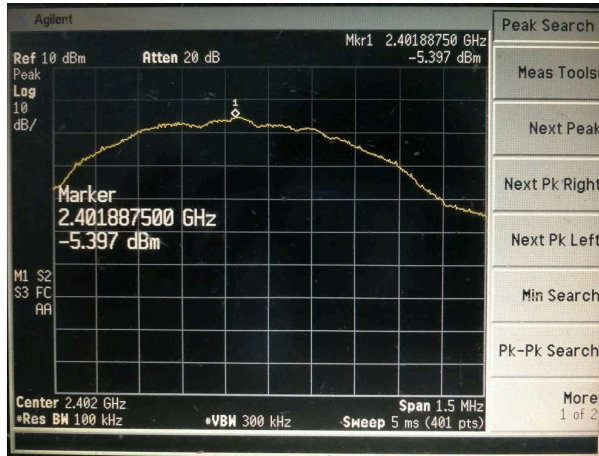
- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \times \text{RBW}$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

4.3 Test Data and Results

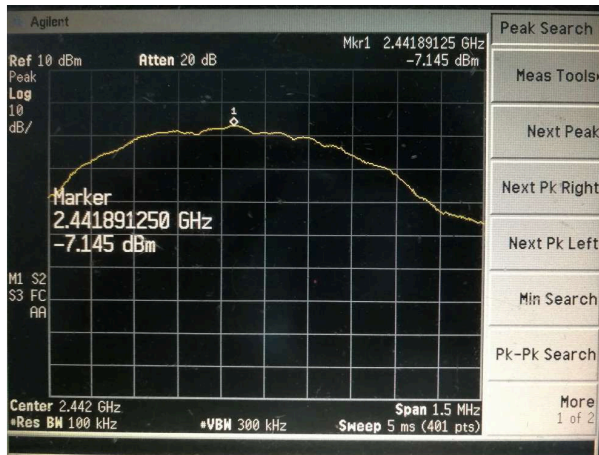
Test Mode	Test Channel MHz	Power Spectral Density dBm/100kHz	Limit dBm/3kHz
GFSK(BLE)	2402	-5.397	8
	2442	-7.145	8
	2480	-6.813	8

GFSK(BLE)

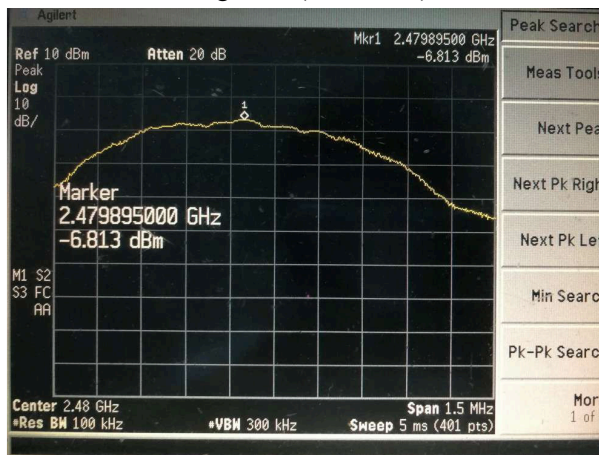
Low CH (2402MHz)



Middle CH (2442MHz)



High CH (2480MHz)



5. 6dB Bandwidth

5.1 Standard and Limit

According to 15.247(a)(2). Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.2 Test Procedure

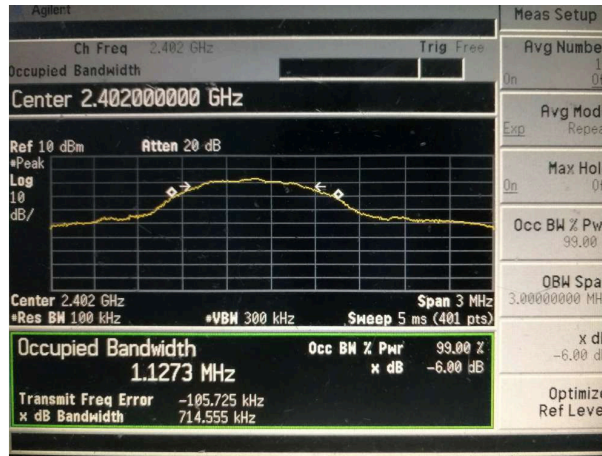
- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.3 Test Data and Results

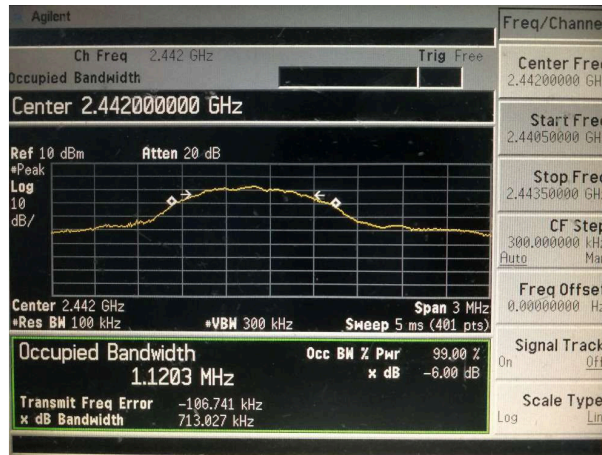
Test Mode	Test Channel MHz	6dB Bandwidth kHz	99% Bandwidth kHz
GFSK(BLE)	2402	714.555	1127.3
	2442	713.027	1120.3
	2480	742.332	1134.1

GFSK(BLE)

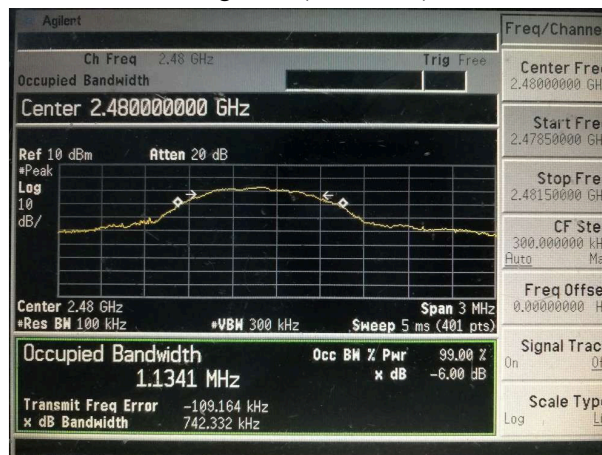
Low CH (2402MHz)



Middle CH (2442MHz)



High CH (2480MHz)



6. RF Output Power

6.1 Standard and Limit

According to 15.247(b)(3). For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

6.2 Test Procedure

According to the ANSI C63.10, the peak output power test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, the indicated level is the peak output power (the external attenuation and cable loss shall be considered).

6.3 Test Data and Results

Channel	Frequency MHz	Measured Value dBm	Output Power mW	Limit mW
Low Channel	2402	-6.224	0.239	1000
Middle Channel	2442	-6.399	0.229	1000
High Channel	2480	-5.853	0.260	1000

Note: the antenna gain of -3dBi less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.

7. Field Strength of Spurious Emissions

7.1 Standard and Limit

According to §15.247(d), in any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious radiated emissions measurements starting below or at the lowest crystal frequency.

The general limits in FCC Part 15.209

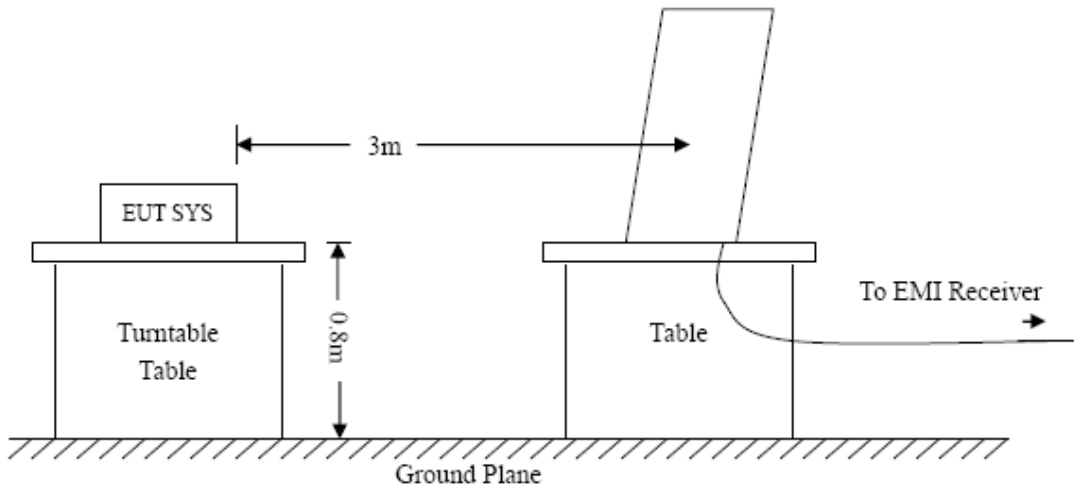
Frequency of Emission (MHz)	Field Strength (uV/m)		Field Strength (dBuV/m)	
	QP		QP	AV
30-88	100		40	--
88-216	150		43.5	--
216-960	200		46	--
Above 960	500		54	74
Limits at a measurement distance of 3 m				

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious radiated emissions measurements starting below or at the lowest crystal frequency.

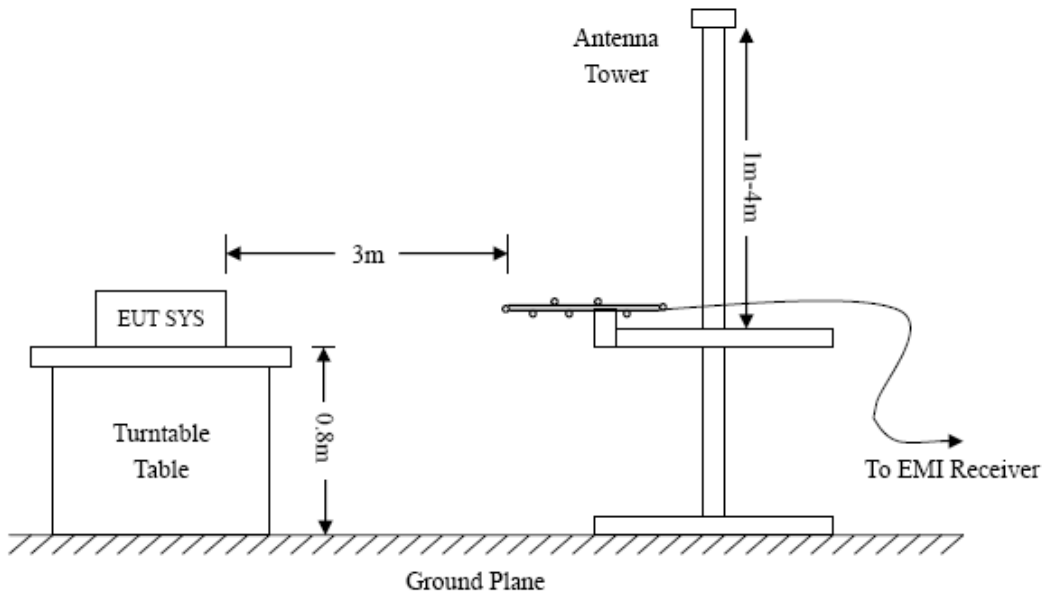
Compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

7.2 Test Procedure

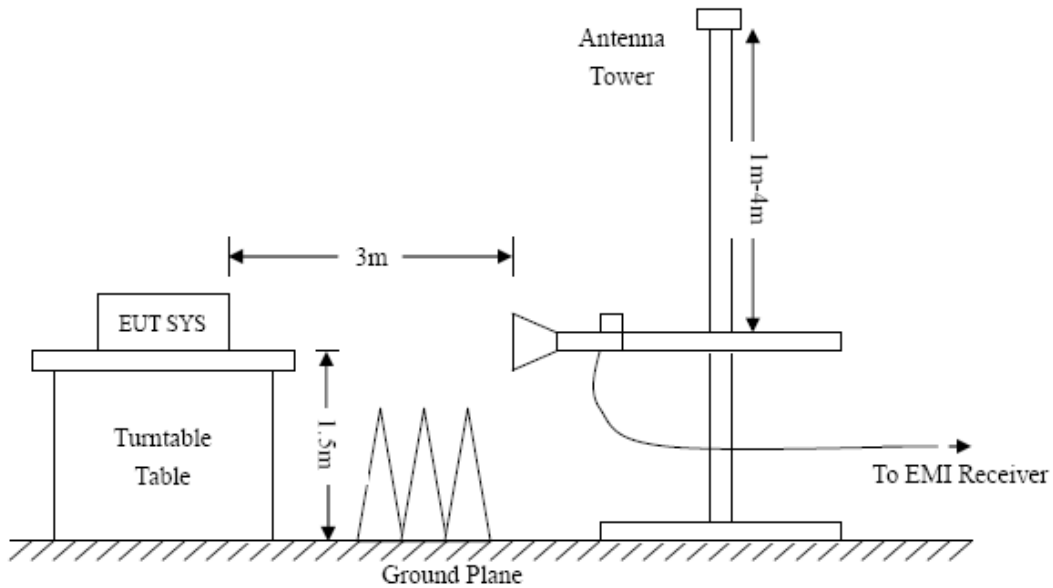
The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.



Test Setup Block Diagram below 30MHz



Test Setup Block Diagram for 30MHz-1GHz



Test Setup Block Diagram above 1GHz

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.

Frequency: 9kHz-30MHz

RBW=10KHz,

VBW =30KHz

Sweep time= Auto

Trace = max hold

Detector function = peak

Frequency: 30MHz-1GHz

RBW=120KHz,

VBW=300KHz

Sweep time= Auto

Trace = max hold

Detector function = peak, QP

Frequency: Above 1GHz

RBW=1MHz,

VBW=3MHz(Peak), 10Hz(AV)

Sweep time= Auto

Trace = max hold

Detector function = peak, AV

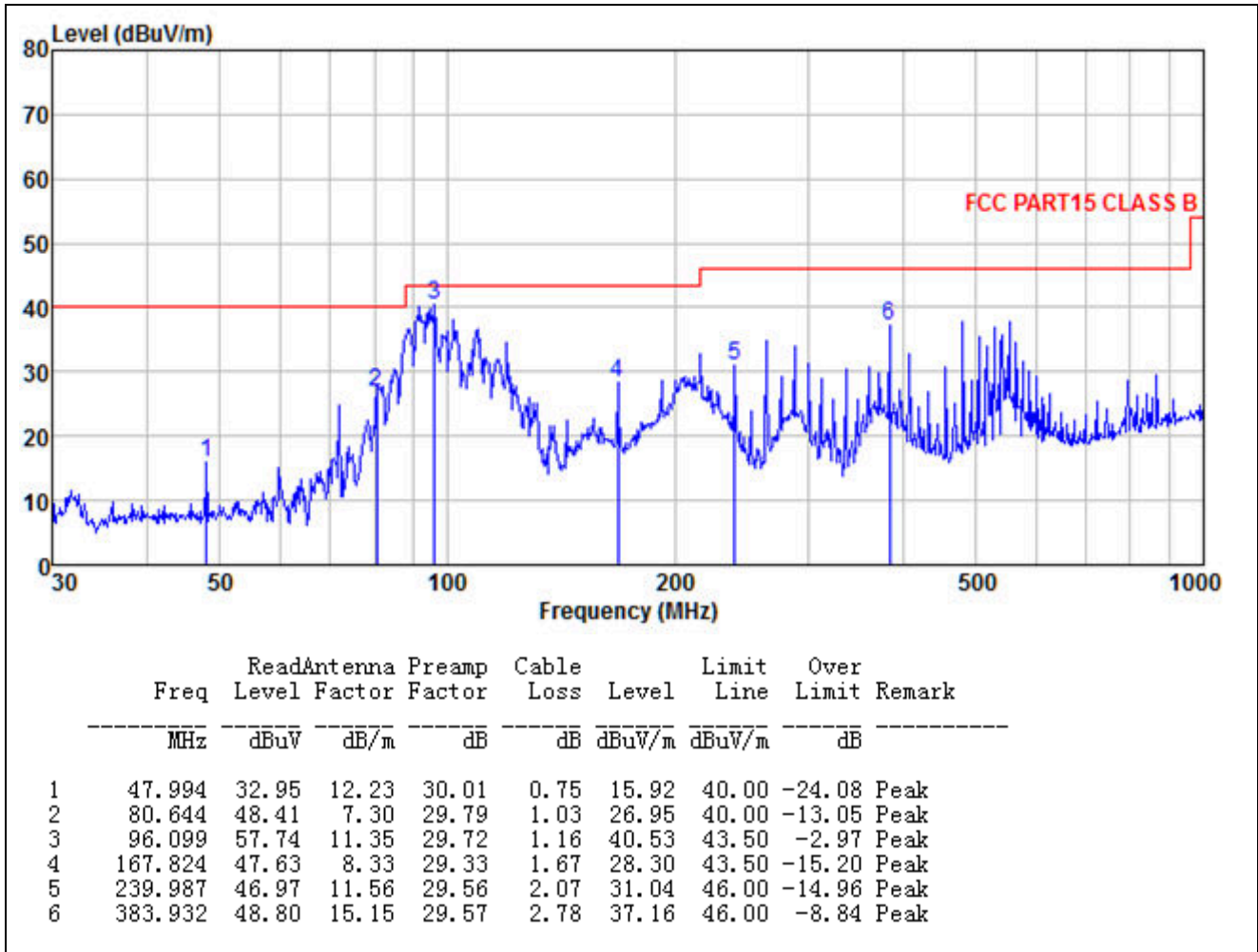
7.3 Test Data and Results

According to the data below, the FCC Part 15.205, 15.209 and 15.247 standards, and had the worst case:

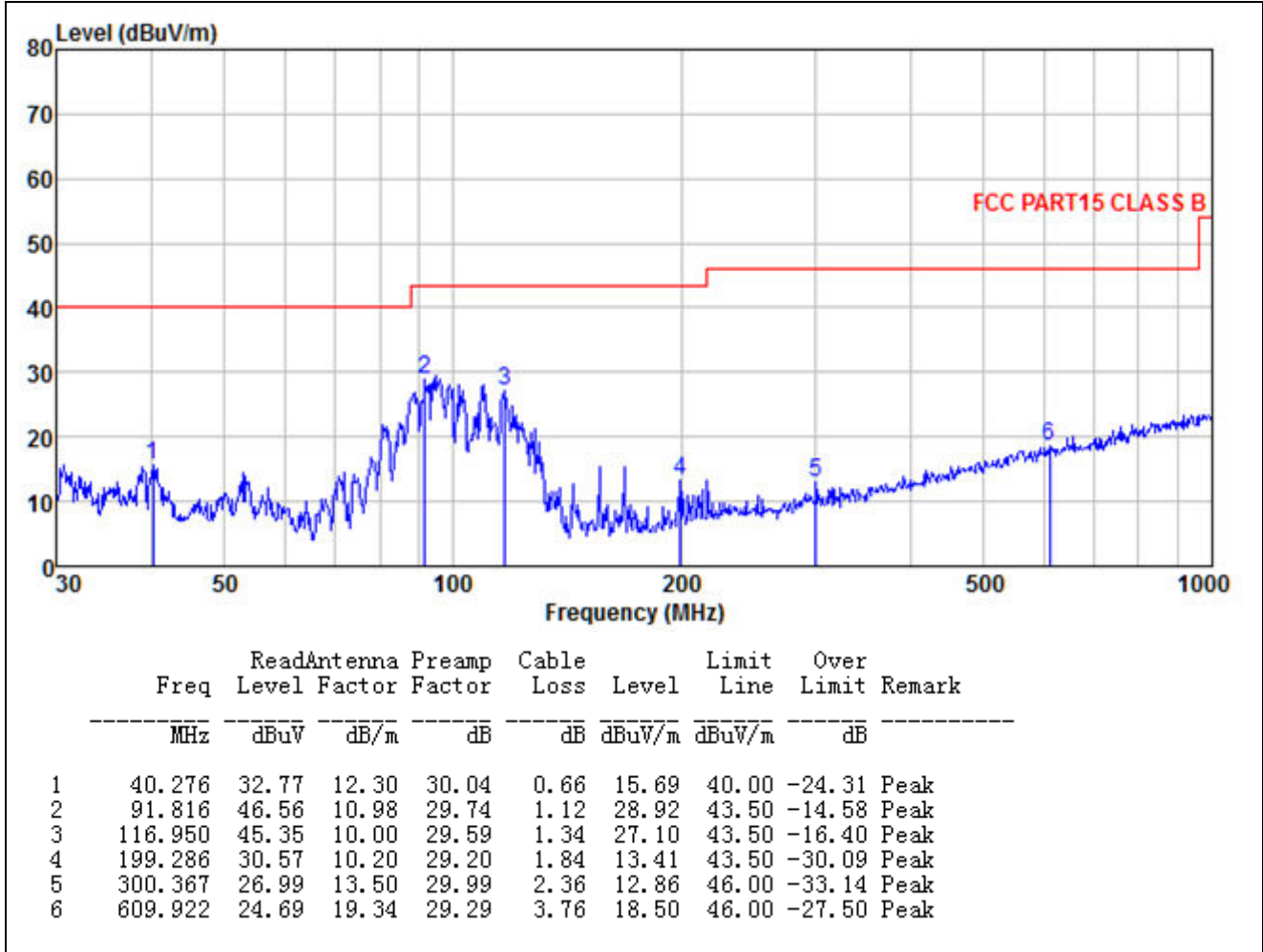
Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

Worst case_TM3 mode (High CH)

Test Plots and Data of Radiated Emissions (30MHz to 1GHz)	
Tested Model:	AR-002
Tested Mode:	TM3
Test Power Specification:	DC 3V
Test Antenna Polarization:	Horizontal



Test Plots and Data of Radiated Emissions (30MHz to 1GHz)	
Tested Model:	AR-002
Tested Mode:	TM3
Test Power Specification:	DC 3V
Test Antenna Polarization:	Vertical



Test Plots and Data of Radiated Emissions (1GHz to 25GHz)	
Tested Model:	AR-002
Tested Mode:	TM1/TM2/TM3
Test Power Specification:	DC 3V
Remark:	

Frequency (MHz)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector PK/AV	Polar H/V
Low Channel (2402MHz)						
4804	8.29	35.66	74	-38.34	PK	H
4804	8.29	26.21	54	-27.79	AV	H
4804	8.29	33.02	74	-40.98	PK	V
4804	8.29	24.89	54	-29.11	AV	V
Middle Channel (2442MHz)						
4884	8.40	35.69	74	-38.31	PK	H
4884	8.40	25.88	54	-28.12	AV	H
4884	8.40	34.57	74	-39.43	PK	V
4884	8.40	23.97	54	-30.03	AV	V
High Channel (2480MHz)						
4960	8.50	36.09	74	-37.91	PK	H
4960	8.50	25.77	54	-28.23	AV	H
4960	8.50	34.79	74	-39.21	PK	V
4960	8.50	25.43	54	-28.57	AV	V

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, which above 3th Harmonics are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured. The measurements greater than 20dB below the limit from 9kHz to 30MHz.

8. Out of Band Emissions

8.1 Standard and Limit

According to §15.247 (d) In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

8.2 Test Procedure

According to the ANSI C63.10, the band-edge radiated test method as follows.

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2410MHz for low bandedge, 2470MHz to 2500MHz for the high bandedge)

RBW = 1MHz, VBW = 3MHz for peak value measured

RBW = 1MHz, VBW = 10Hz for average value measured

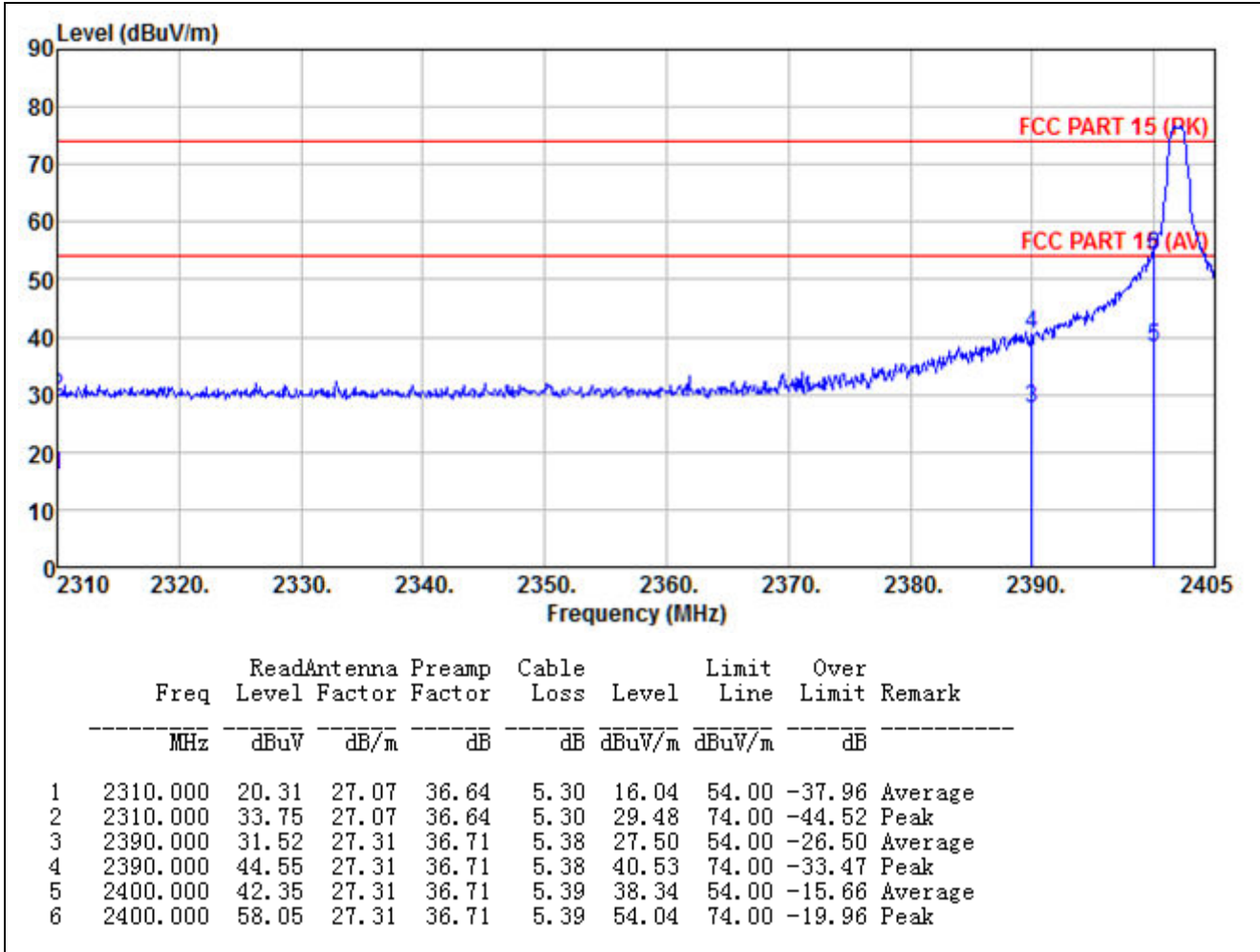
Sweep = auto; Detector function = peak; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated bandedge measurements.

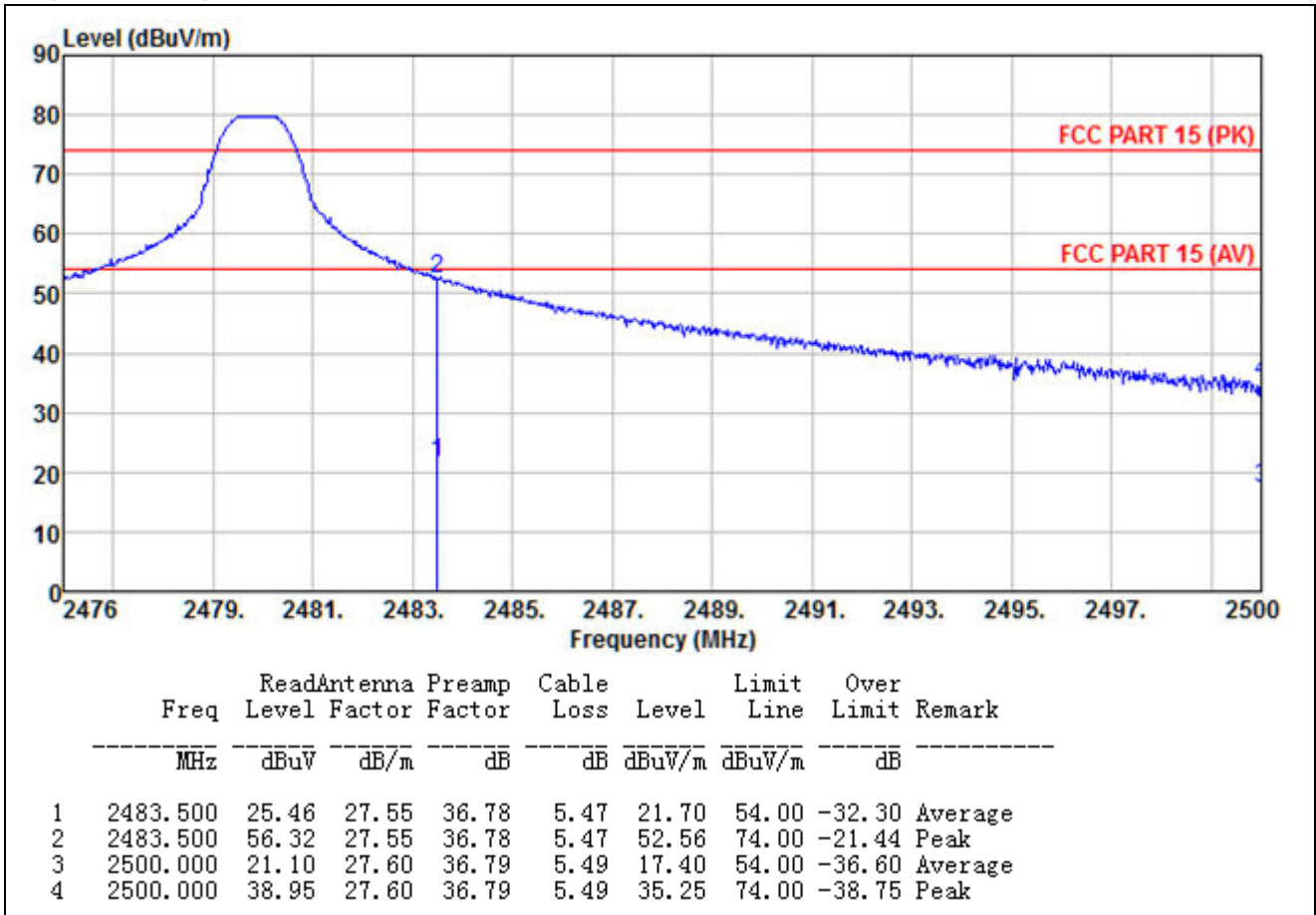
8.3 Test Data and Results

Radiated Bandedge (Worst case)

Lowest Bandedge (Vertical)



Highest Bandedge (Vertical)



Annex A. EUT External Photos

EUT View 1



EUT View 2



EUT View 3



EUT View 4



EUT View 5



EUT View 6



EUT View 7



EUT View 8

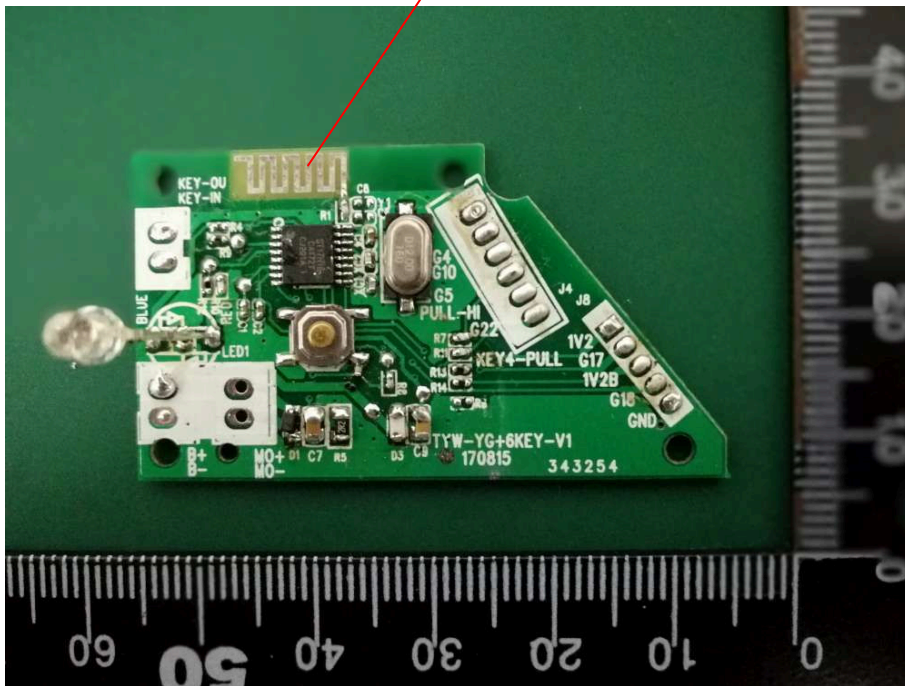


Annex B. EUT Internal Photos

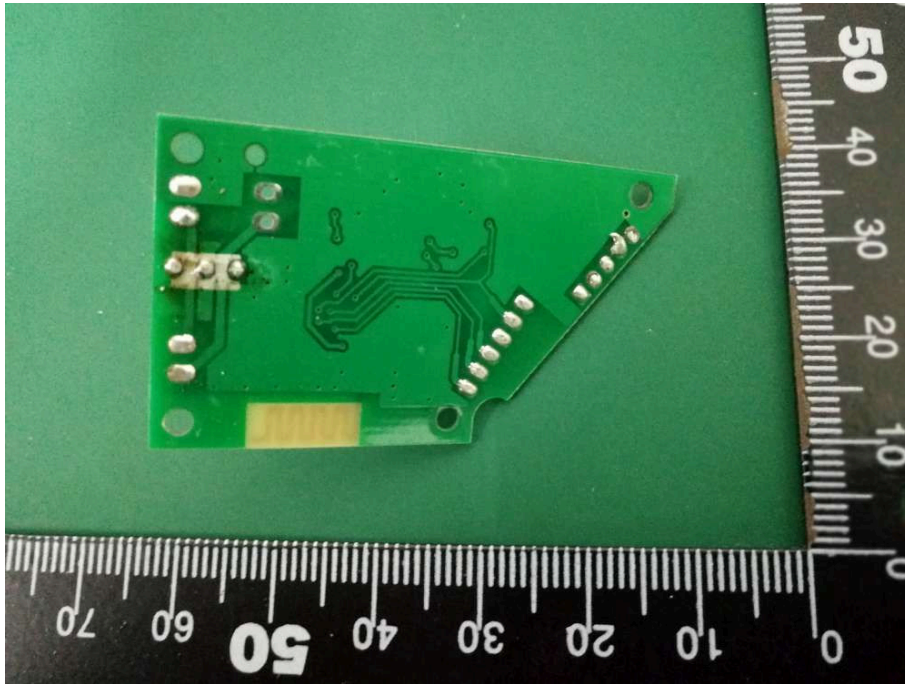
EUT Internal View 1



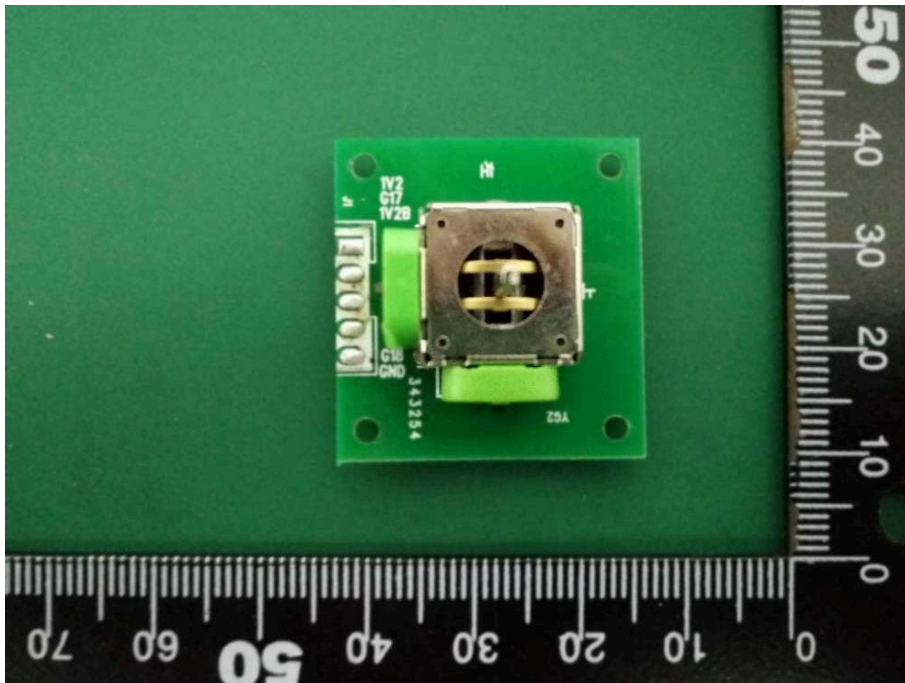
EUT Internal View 2



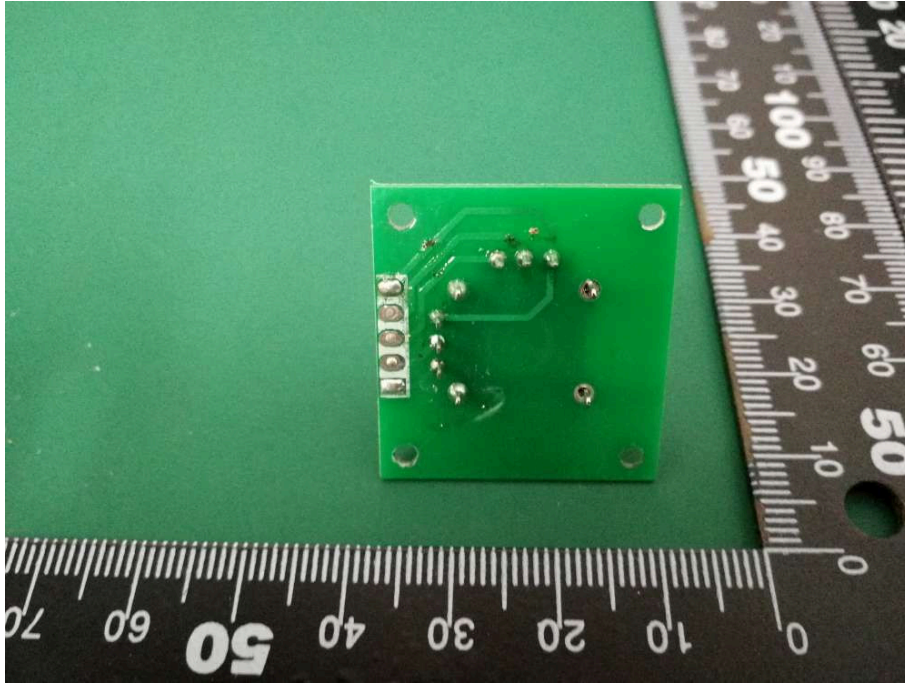
EUT Internal View 3



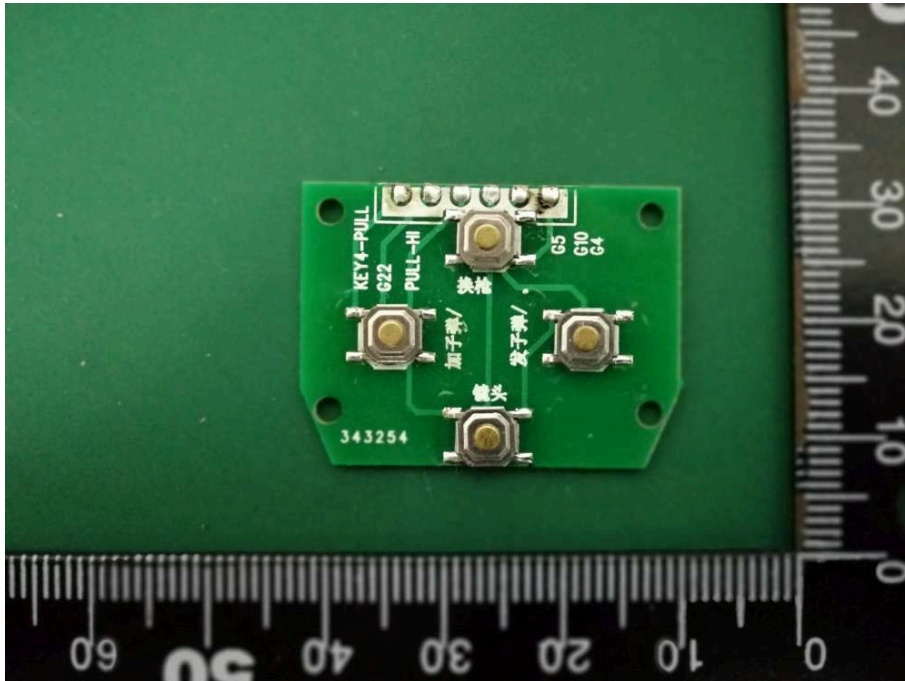
EUT Internal View 4



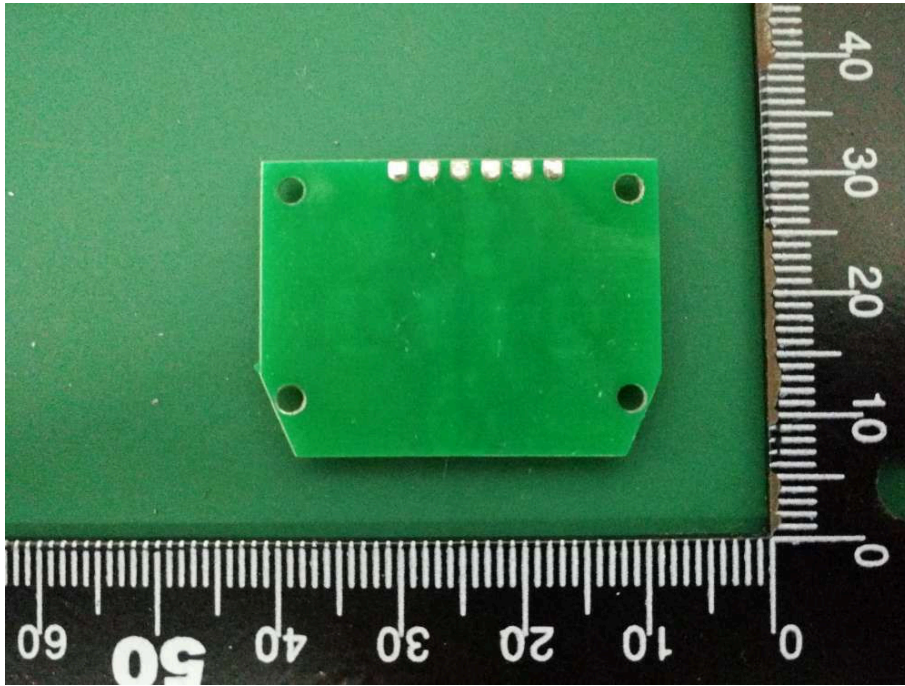
EUT Internal View 5



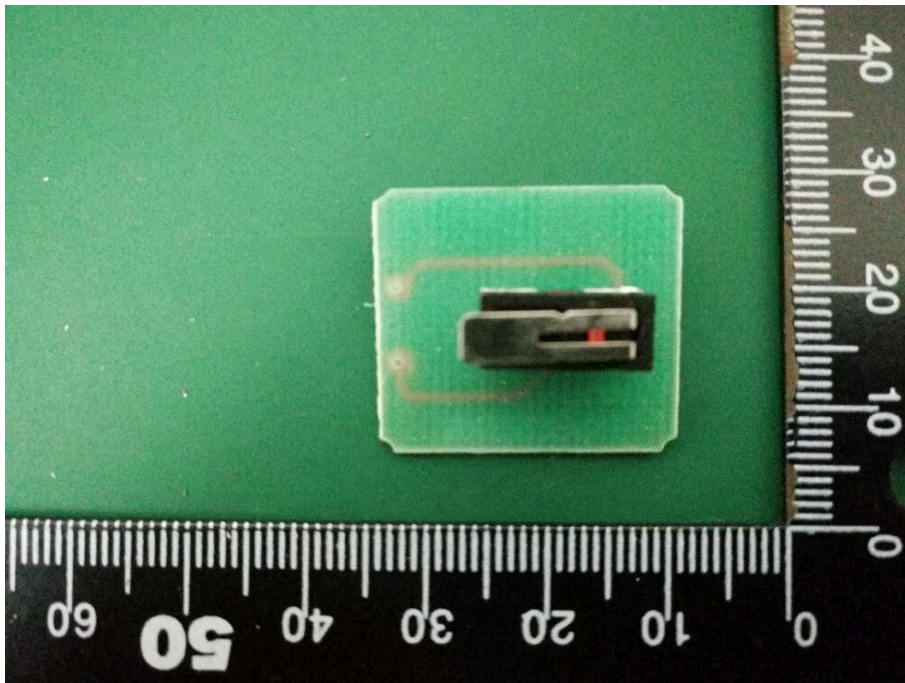
EUT Internal View 6



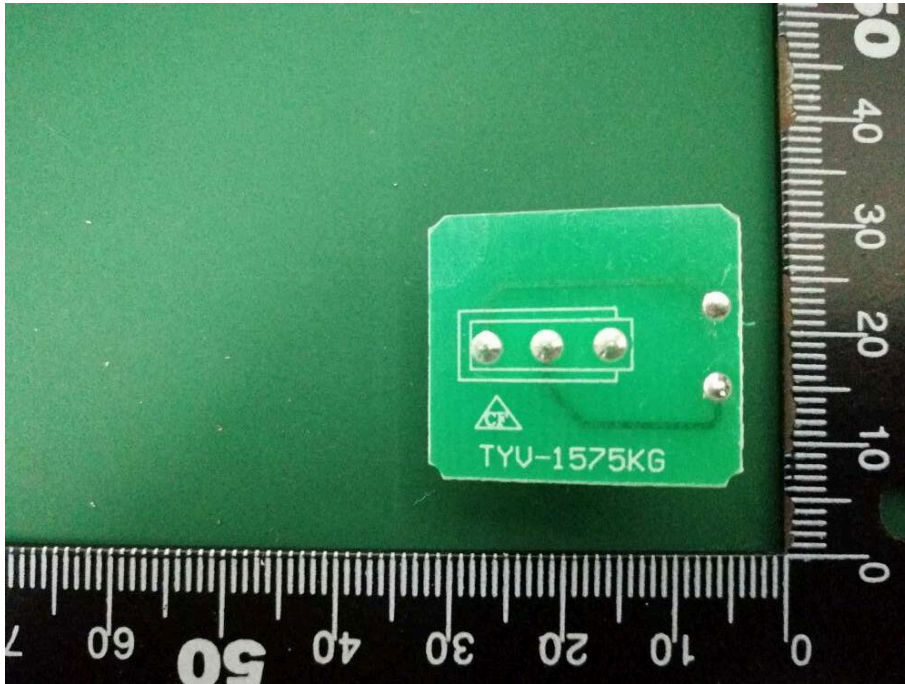
EUT Internal View 7



EUT Internal View 8

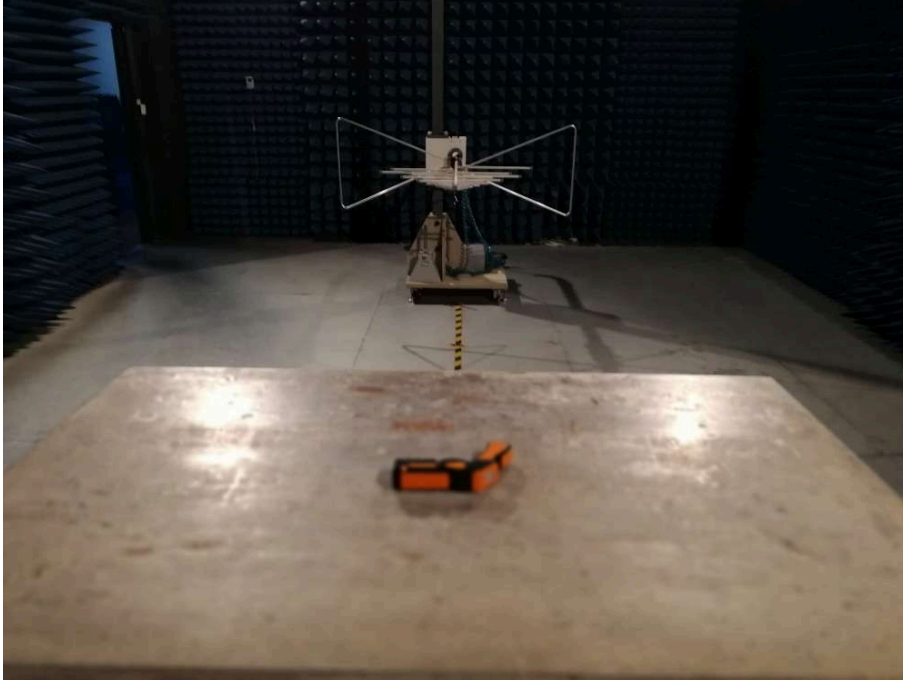


EUT Internal View 9

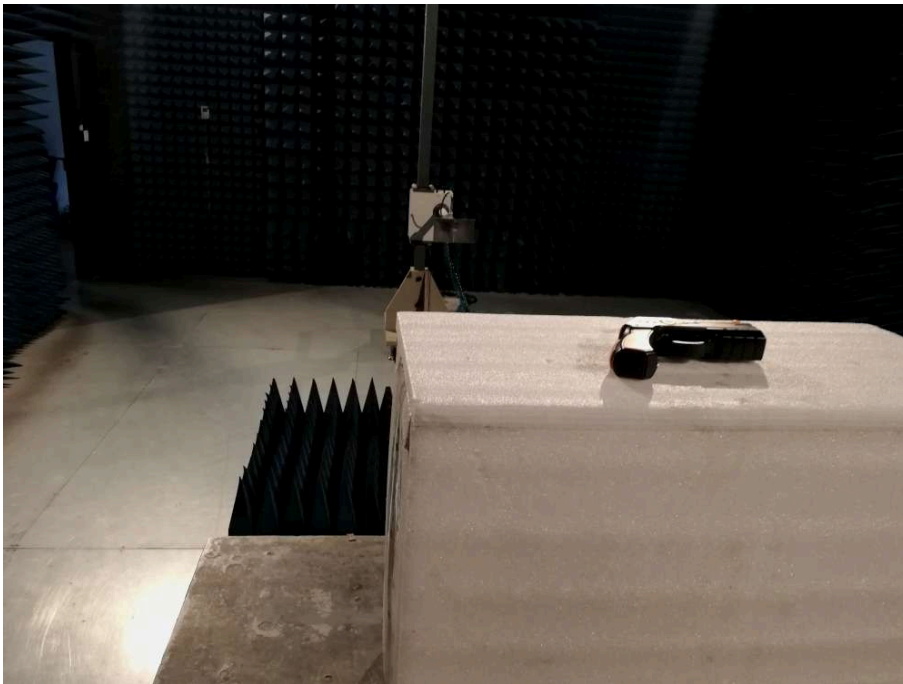


Annex C. Test Photos

Radiated Emissions (30MHz to 1GHz)



Radiated Emissions (Above 1GHz)



Annex D. Label and Information

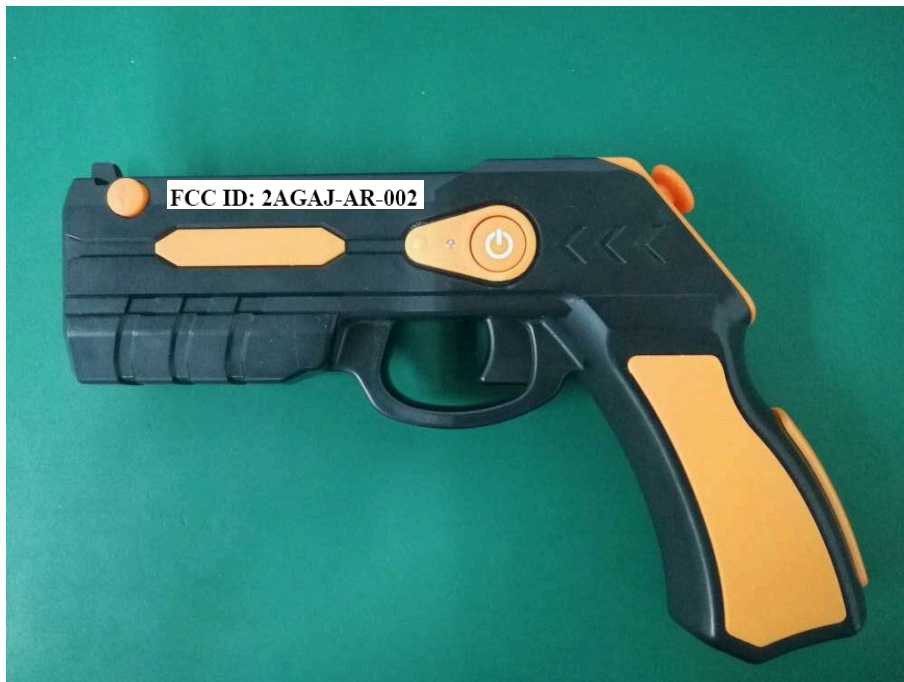
FCC Label Sample

FCC ID: 2AGAJ-AR-002

FCC Label Specifications

Text is Black in color and is justified. Labels are printed in indelible ink on permanent adhesive backing or silk-screened onto the EUT or shall be affixed at a conspicuous location on the EUT. Where the EUT is constructed in two or more sections connected by wires and marketed together, the above statement is required to be affixed only to the main control unit. When the EUT is so small or for such use that it is not practicable to place the statement on it, the above information shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed.

FCC Label Location



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