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TEST REPORT

Report No.: CTC20192244E05
FCC ID.....: PADWF130
IC.....: 10563A-WF130
Applicant.....: Wahoo Fitness LLC
Address.....: 90 W WIEUCA RD NE STE 110 ATLANTA GA 30342
Manufacturer.....: Wahoo Fitness LLC
Address.....: 90 W WIEUCA RD NE STE 110 ATLANTA GA 30342
Product Name.....: TICKR2
Trade Mark.....: N.A.
Model/Type reference.....: WFBTHR04
Listed Model(s): WFBTHR04X, WFBTHR04G
Standard.....: FCC Rules Part 15.249
RSS-GEN Issue 5
RSS-210 Issue 9
ANSI C63.10-2013
Date of receipt of test sample....: Nov. 19, 2019
Date of testing.....: Nov. 19, 2019 to Nov. 27, 2019
Date of issue.....: Nov. 27, 2019
Result.....: PASS

Compiled by:

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Torny Fang

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Approved by:

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Walter Chen

Walter Chen

Testing Laboratory Name : CTC Laboratories, Inc.

Address : 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park,
Shenzhen, Guangdong, China

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1. TEST SUMMARY

1.1. Test Standards

The tests were performed according to following standards:

[FCC Rules Part 15.249](#): Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz.

[RSS-GEN Issue 5](#): General Requirements for Compliance of Radio Apparatus

[RSS-210](#): Licence-Exempt Radio Apparatus: Category I Equipment

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices.

1.2. Report version

Version No.	Date of issue	Description
00	Nov. 27, 2019	Original



1.3. Test Description

Test Item	Section in CFR 47	RSS-210& RSS-Gen	Result	Test Engineer
AC Power Line Conducted Emissions	15.207	RSS-Gen	N/A	N/A
20dB Occupied Bandwidth	15.215/15.249	RSS-Gen	PASS	Lucy Lan
Field strength of the Fundamental signal	15.249(a)	RSS-210 Annex B	PASS	Lucy Lan
Spurious Emissions	15.209/15.249(a)	RSS-210 Annex B	PASS	Lucy Lan
Band edge Emissions	15.205/15.249(d)	RSS-210 Annex B	PASS	Lucy Lan
Antenna requirement	15.203	RSS-Gen	PASS	Lucy Lan

Note: The measurement uncertainty is not included in the test result.

This device is only powered battery ,no need for part 15.207.



1.4. Test Facility

Address of the report laboratory

CTC Laboratories, Inc.

Add: 2/F., Building 1 and 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Longhua District, Shenzhen, Guangdong, China

Laboratory accreditation

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

CNAS-Lab Code: L5365

CTC Laboratories, Inc. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation. Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA-Lab Cert. No.: 4340.01

CTC Laboratories, Inc. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

Industry Canada (Registration No.: 9783A,CAB Identifier:CN0029)

CTC Laboratories, Inc. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: 9783A on Jan, 2016.

FCC (Registration No.: 951311, Designation Number CN1208)

CTC Laboratories, Inc. 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 951311, Aug 26, 2017.



1.5. 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 TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2" and is documented in the Shenzhen General Testing & Inspection Technology Co., Ltd. quality 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.

Below is the best measurement capability for Shenzhen General Testing & Inspection Technology Co., Ltd.

Test Items	Measurement Uncertainty	Notes
Transmitter power conducted	0.42 dB	(1)
Transmitter power Radiated	2.14 dB	(1)
Conducted spurious emissions 9kHz~40GHz	1.60 dB	(1)
Radiated spurious emissions 9kHz~40GHz	2.20 dB	(1)
Conducted Emissions 9kHz~30MHz	3.20 dB	(1)
Radiated Emissions 30~1000MHz	4.70 dB	(1)
Radiated Emissions 1~18GHz	5.00 dB	(1)
Radiated Emissions 18~40GHz	5.54 dB	(1)
Occupied Bandwidth	-----	(1)

Note (1): This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=1.96$.

1.6. Environmental conditions

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

Temperature:	15~35°C
Relative Humidity:	30~60 %
Air Pressure:	101kPa



2. GENERAL INFORMATION

2.1. Client Information

Applicant:	Wahoo Fitness LLC
Address:	90 W WIEUCA RD NE STE 110 ATLANTA GA 30342
Manufacturer:	Wahoo Fitness LLC
Address:	90 W WIEUCA RD NE STE 110 ATLANTA GA 30342

2.2. General Description of EUT

Product Name:	TICKR2
Model/Type reference:	WFBTHR04
Adding Model(s):	WFBTHR04X, WFBTHR04G
Model difference:	Only the appearance and color are different, the others are exactly the same
Power supply:	Lithium battery power supply 3.7V
Hardware version:	/
Software version:	/
ANT+:	
Supported type:	ANT+
Modulation:	GFSK
Operation frequency:	2457MHz
Antenna type:	Ceramic Antenna
Antenna gain:	1.57dBi

3.Description of Test Modes

Operation Frequency

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) mode for testing.

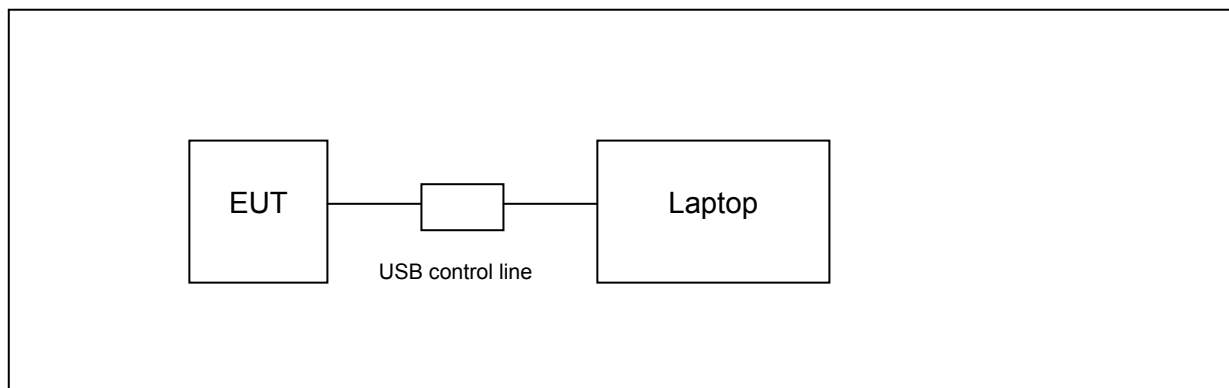
ANT+

Channel	Frequency (MHz)
00	2457

TEST MODE:

For RF test items
The engineering test program was provided and enabled to make EUT continuous transmit.
For AC power line conducted emissions:
The EUT was set to connect with large package sizes transmission.

SETUP DIAGRAM FOR TESTS



**SUPPORT EQUIPMENT**

Item	Equipment	Brand Name	Model Name	P/N
1	Laptop	ASUS	K555L	/

I/O CABLES

Cable No	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
1	USB	/	/	0.15	/

ACCESSORY

Item	Accessory	Brand Name	Model Name	Description
1	N/A	/	/	/



4.Measurement Instruments List

Tonscend JS0806-2 Test system						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated until
1	Spectrum Analyzer	Rohde & Schwarz	FSU26	100105	Jan. 07, 2017	Dec. 28 2019
2	Spectrum Analyzer	Rohde & Schwarz	FUV40-N	101331	Jan. 07, 2017	Dec. 28 2019
3	MXG Vector Signal Generator	Agilent	N5182A	MY47420864	Jan. 07, 2017	Dec. 28 2019
4	Signal Generator	Agilent	E8257D	MY46521908	Jan. 07, 2017	Dec. 28 2019
5	Power Sensor	Agilent	U2021XA	MY5365004	Jan. 07, 2017	Dec. 28 2019
6	Power Sensor	Agilent	U2021XA	MY5365006	Jan. 07, 2017	Dec. 28 2019
7	Simultaneous Sampling DAQ	Agilent	U2531A	TW54493510	Jan. 07, 2017	Dec. 28 2019
8	Climate Chamber	TABAI	PR-4G	A8708055	Jan. 07, 2017	Dec. 28 2019
9	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	116410	Jan. 06, 2018	Dec. 28 2019
10	Climate Chamber	ESPEC	MT3065	/	Jan. 04,2018	Dec. 28 2019
11	300328 v2.1.1 test system	TONSCEND	v2.6	/	/	/

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	EMI Test Receiver	Rohde & Schwarz	ESCI	100658	Dec. 28 2019
2	High pass filter	micro-tranics	HPM50111	142	Dec. 28 2019
3	Log-Bicon Antenna	Schwarzbeck	CBL6141A	4180	Dec. 28 2019
4	Ultra-Broadband Antenna	ShwarzBeck	BBHA9170	25841	Dec. 28 2019
5	Loop Antenna	LAPLAC	RF300	9138	Dec. 28 2019
6	Spectrum Analyzer	Rohde & Schwarz	FSU26	100105	Dec. 28 2019
7	Horn Antenna	Schwarzbeck	BBHA 9120D	647	Dec. 28 2019
8	Pre-Amplifier	HP	8447D	1937A03050	Dec. 28 2019
9	Pre-Amplifier	EMCI	EMC051835	980075	Dec. 28 2019
10	Antenna Mast	UC	UC3000	N/A	N/A
11	Turn Table	UC	UC3000	N/A	N/A
12	Cable Below 1GHz	Schwarzbeck	AK9515E	33155	Dec. 28 2019
13	Cable Above 1GHz	Hubersuhner	SUCOFLEX102	DA1580	Dec. 28 2019
14	Splitter	Mini-Circuit	ZAPD-4	400059	Dec. 28 2019
15	RF Connection Cable	HUBER+SUHNER	RE-7-FL	N/A	Dec. 28 2019

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16	RF Connection Cable	Chengdu E-Microwave	---	---	Dec. 28 2019
17	High pass filter	Compliance Direction systems	BSU-6	34202	Dec. 28 2019
18	Attenuator	Chengdu E-Microwave	EMCAXX-10R NZ-3	---	Dec. 28 2019
19	High and low temperature box	ESPEC	MT3065	12114019	Dec. 28 2019

Note:1. The Cal. Interval was one year.

2. The cable loss has calculated in test result which connection between each test instruments.

5. TEST ITEM AND RESULTS

5.1. AC Power Line Conducted Emissions

Limit

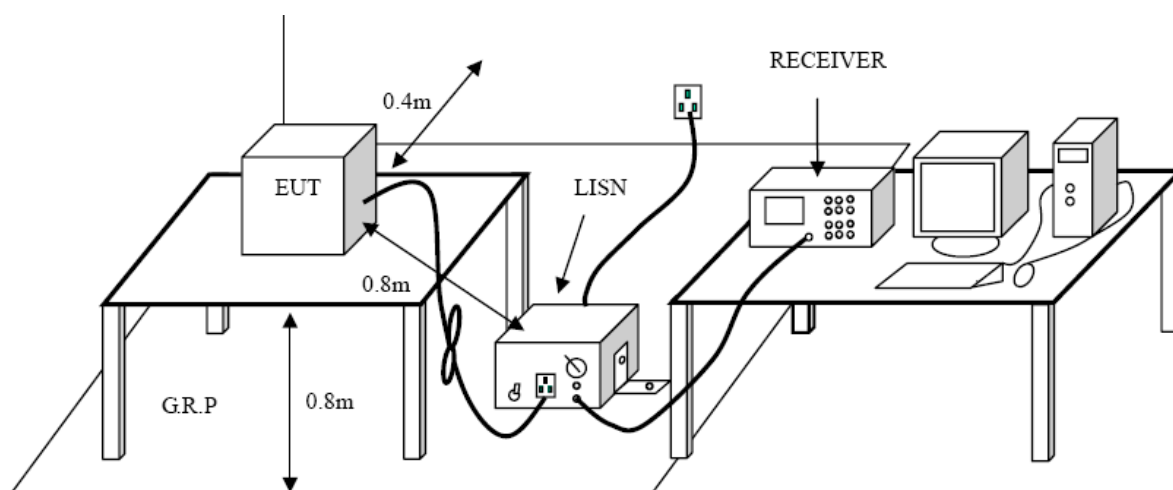
Conducted Emission Test Limit

Frequency	Maximum RF Line Voltage (dB μ V)	
	Quasi-peak Level	Average Level
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
500kHz~5MHz	56	46
5MHz~30MHz	60	50

Notes:

- (1) *Decreasing linearly with logarithm of the frequency.
- (2) The lower limit shall apply at the transition frequencies.
- (3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

Test Configuration



Test Procedure

1. The EUT was setup according to ANSI C63.10:2013 requirements.
2. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface.
3. The EUT and simulators are connected to the main power through a line impedances stabilization network (LISN). The LISN provides a 50ohm /50uH coupling impedance for the measuring equipment.
The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)
4. Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.
5. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.
6. Conducted Emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.
7. During the above scans, the emissions were maximized by cable manipulation.



Test Mode:

Please refer to the clause 3

Test Results

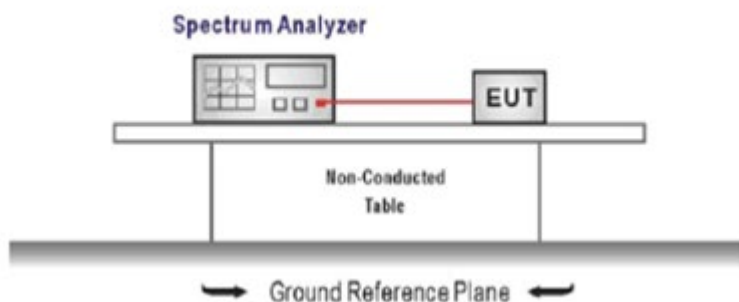
This device is only powered battery ,no need for part 15.207

5.2. 20 dB Occupied Bandwidth

Limit

Operation frequency range 2400MHz~2483.5MHz.

TEST CONFIGURATION



TEST PROCEDURE

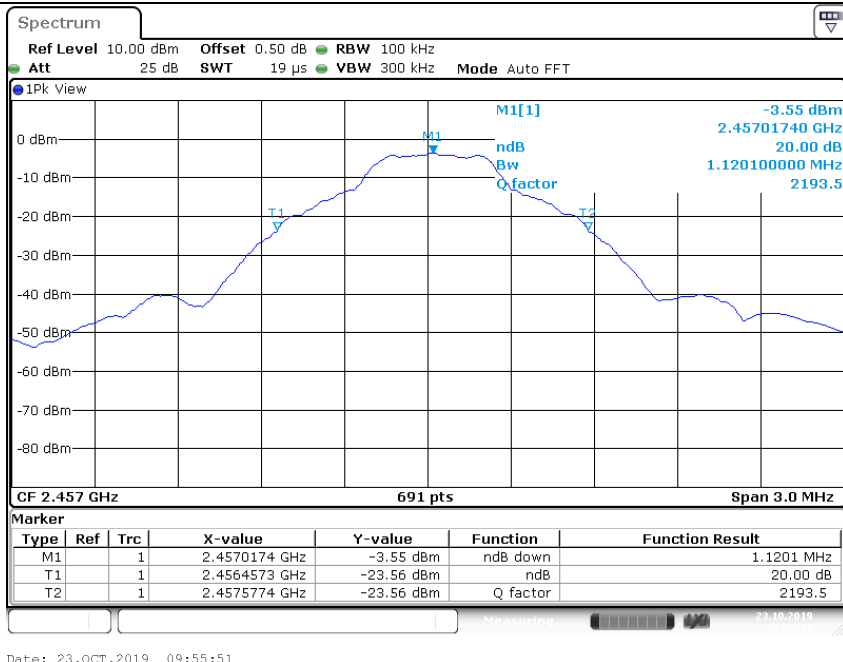
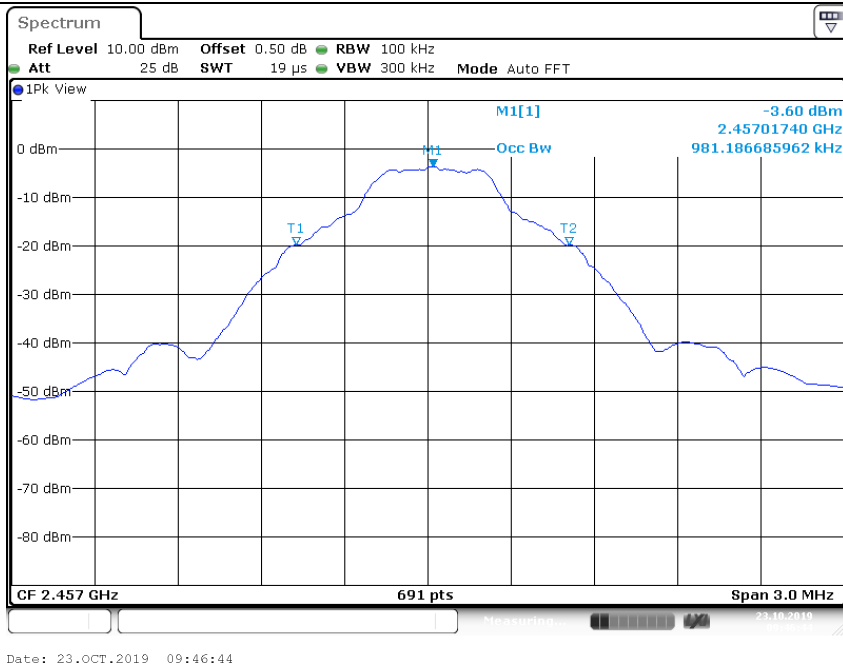
1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW $\geq$ 1% of the 20 dB bandwidth, VBW $\geq$ RBW
Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

TEST MODE:

Please refer to the clause 3

TEST RESULTS

Type	Channel	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
GFSK	00	1.1201	0.9811	Pass

**20dB
Bandwidth****99%
Bandwidth**

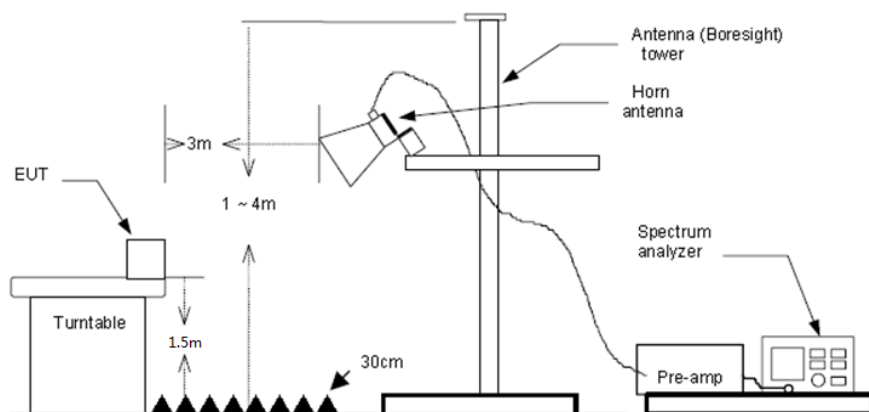
5.3. Radiated field strength of the fundamental signal

LIMIT

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50 (94dBuV/m @3m)	500 (54dBuV/m @3m)
2400-2483.5 MHz	50 (94dBuV/m @3m)	500 (54dBuV/m @3m)
5725-5875 MHz	50 (94dBuV/m @3m)	500 (54dBuV/m @3m)
24.0-24.25 GHz	250 (108dBuV/m @3m)	2500 (68dBuV/m @3m)

Frequencies above 1000 MHz, the field strength limits are based on average limits

TEST CONFIGURATION



TEST PROCEDURE

1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.
2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
5. The receiver set as follow:
RBW=1MHz, VBW=3MHz Peak detector for Peak value.
RBW=1MHz, VBW=3MHz RMS detector for Average value.

TEST MODE:

Please refer to the clause 3

**TEST RESULTS**

Frequency (MHz)	Read Level (dBuV)	Correction Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin	Polarization	Test value
					(dB)		
2457	61.69	3.23	64.92	114	-49.08	Vertical	Peak
2457	63.83	3.23	67.06	114	-46.94	Horizontal	Peak

Remark:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) - Pre-amplifier Factor
3. Margin value = Limit value - Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

5.4. Radiated Spurious Emissions and Bandedge Emission

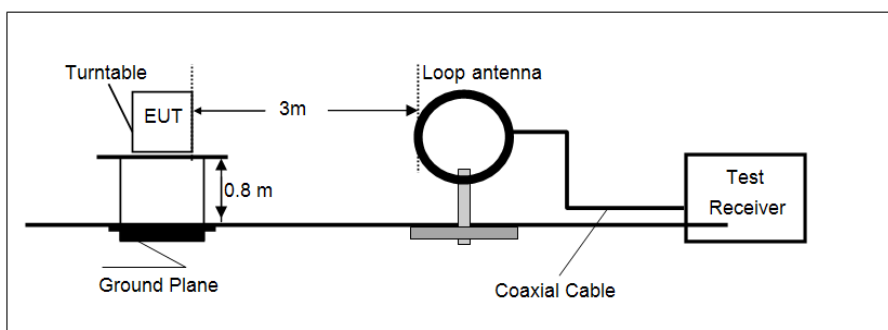
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.209/ RSS-210 Annex B

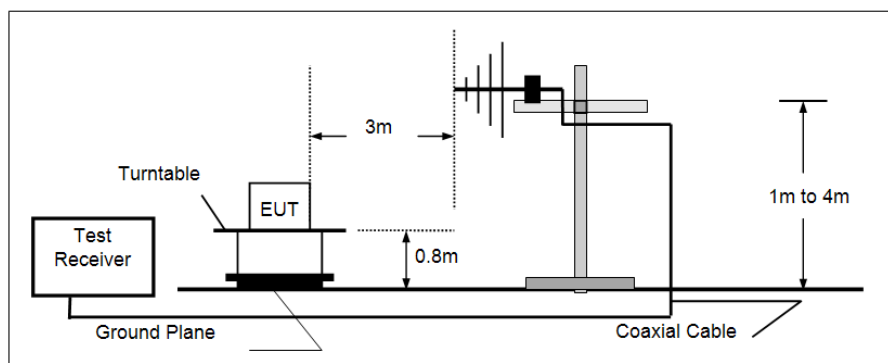
Frequency	Limit (dBuV/m @3m)	Value
30MHz~88MHz	40.00	Quasi-peak
88MHz~216MHz	43.50	Quasi-peak
216MHz~960MHz	46.00	Quasi-peak
960MHz~1GHz	54.00	Quasi-peak
Above 1GHz	54.00	Average
	74.00	Peak

TEST CONFIGURATION

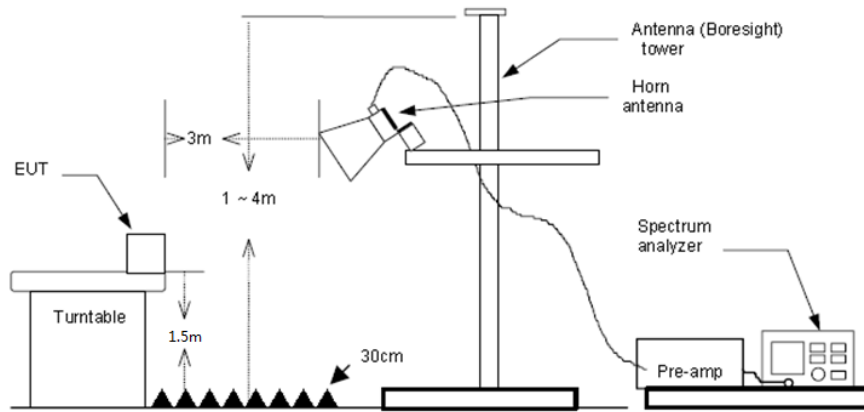
- 9 kHz ~ 30 MHz



- 30 MHz ~ 1 GHz



- Above 1 GHz



TEST PROCEDURE

1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.
2. The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, and 1.5 m for above 1 GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Below 1 GHz:

RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold;

If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
 - (3) From 1 GHz to 10th harmonic:

RBW=1MHz, VBW=3MHz Peak detector for Peak value.

RBW=1MHz, VBW=3MHz RMS detector for Average value.

TEST MODE:

Please refer to the clause 3

TEST RESULTS

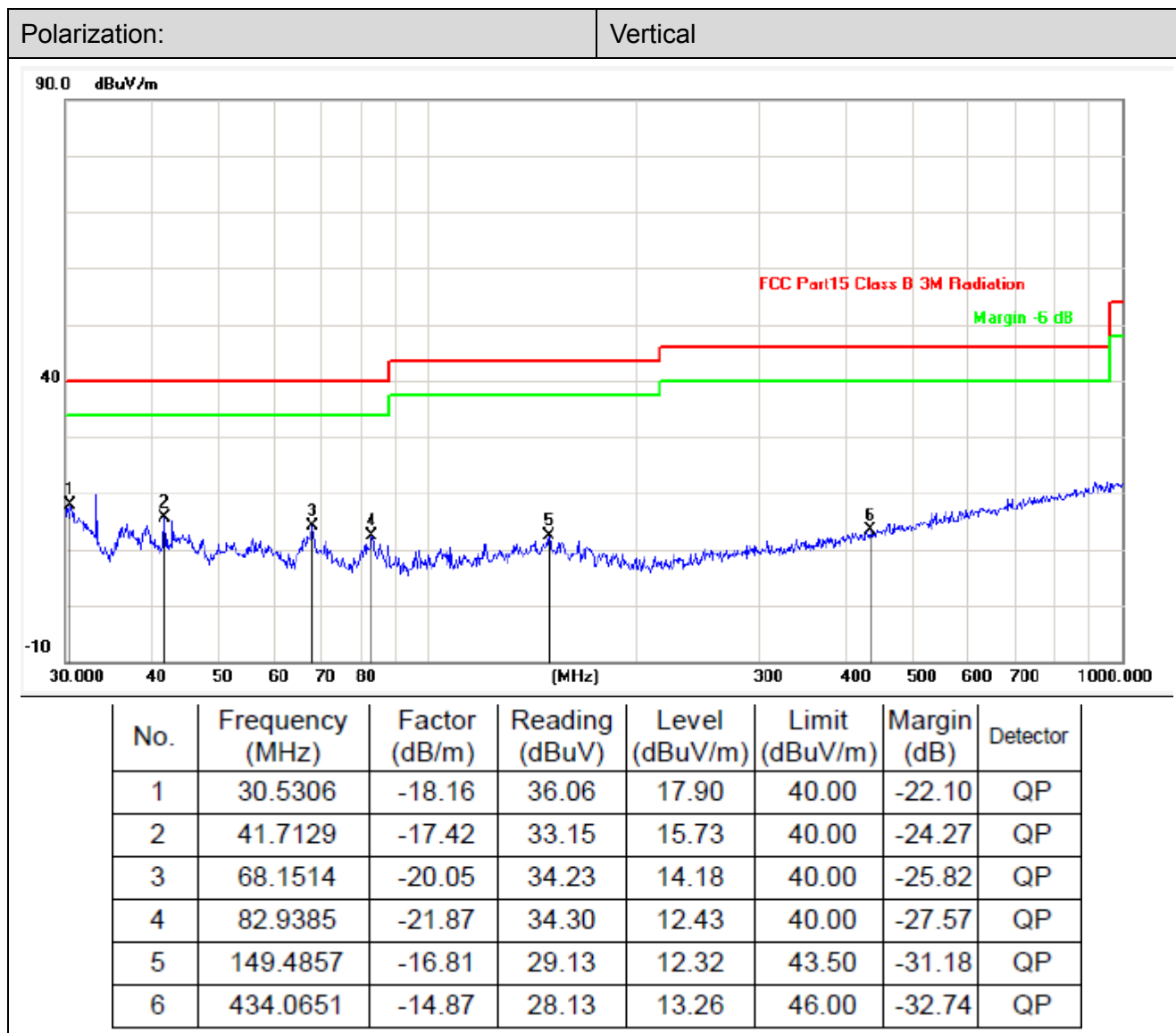


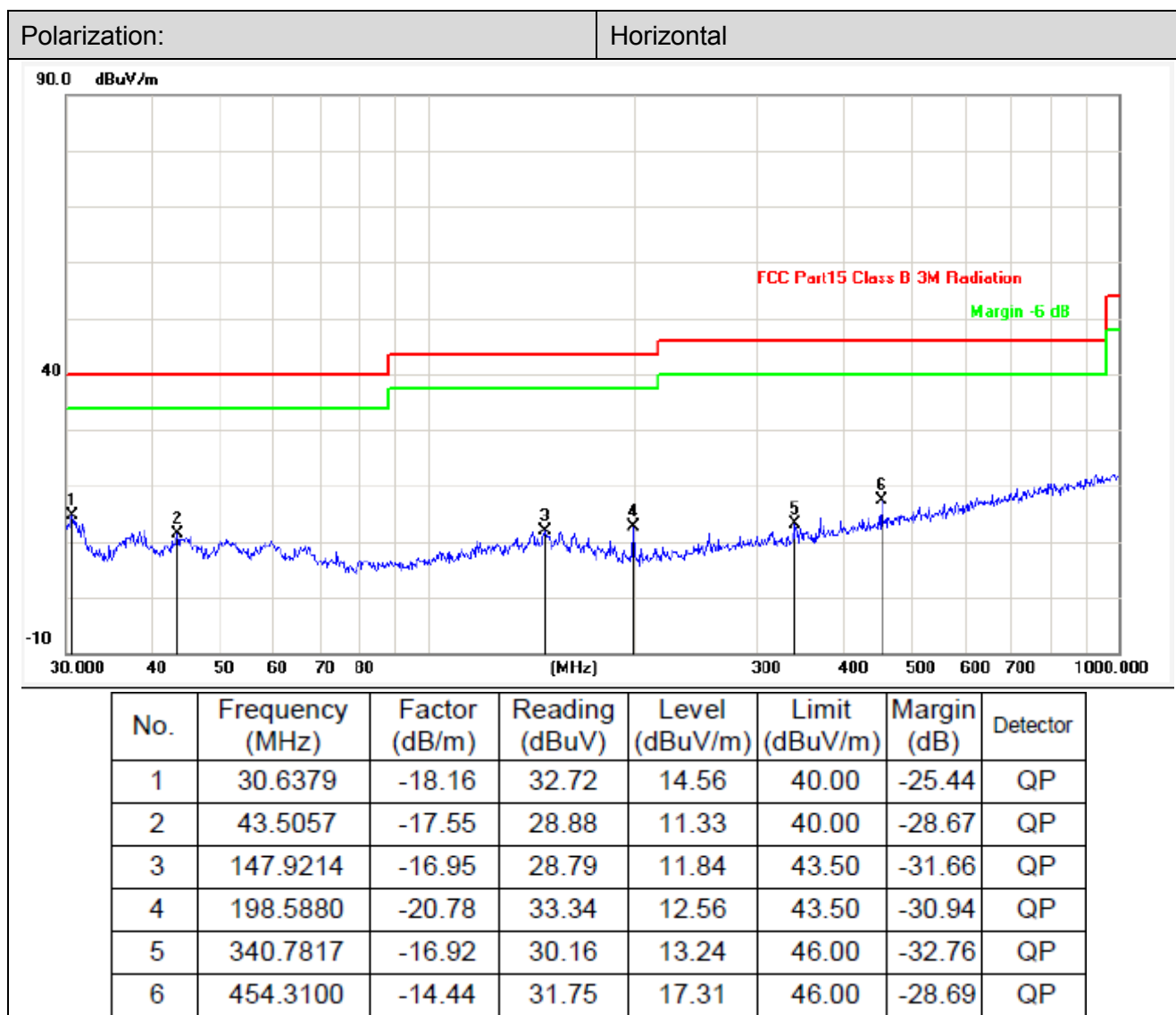
Radiated Spurious Emissions

■ 9 kHz ~ 30 MHz

The EUT was pre-scanned the frequency band (9 kHz ~ 30 MHz), found the radiated level lower than the limit, so don't show on the report.

■ 30 MHz ~ 1 GHz



**Remark:**

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) - Pre-amplifier Factor
3. Margin value = Limit value - Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

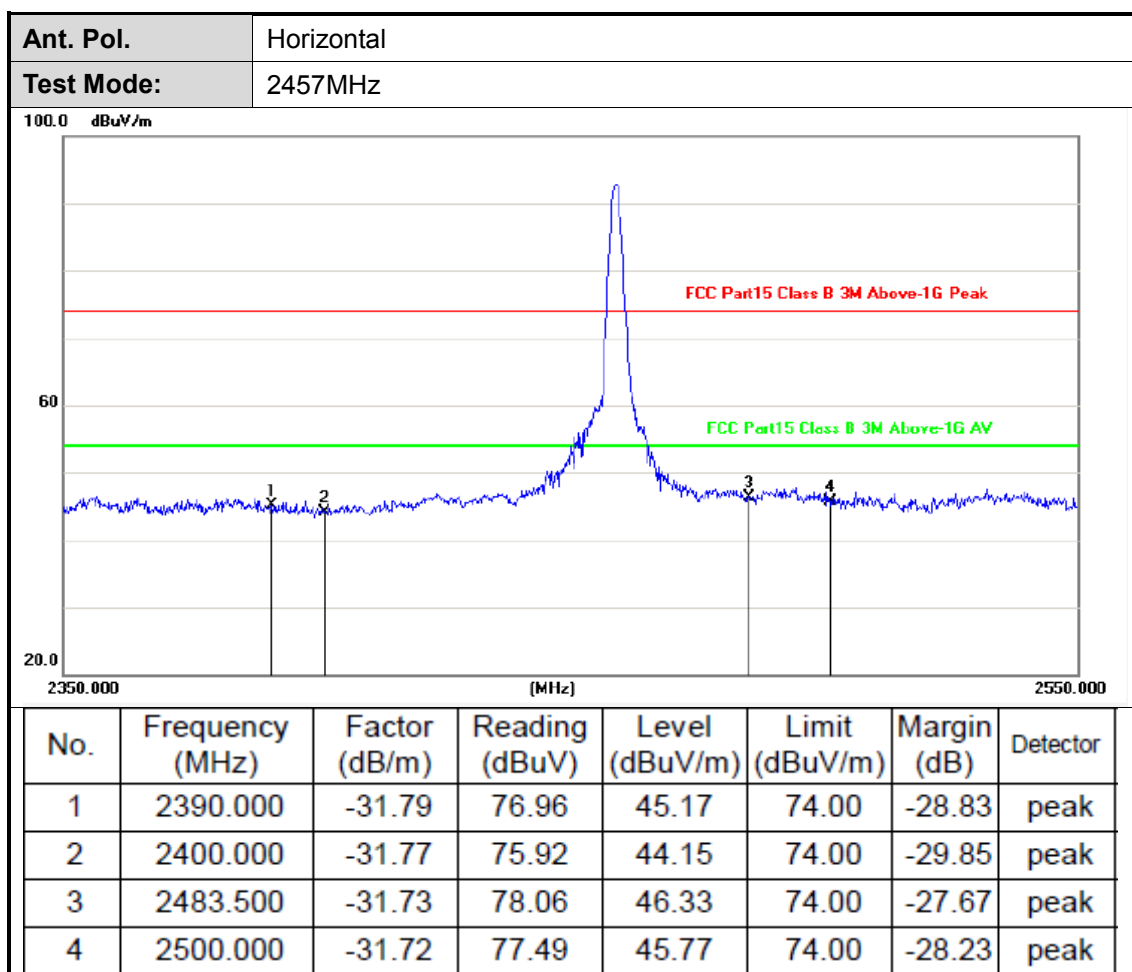


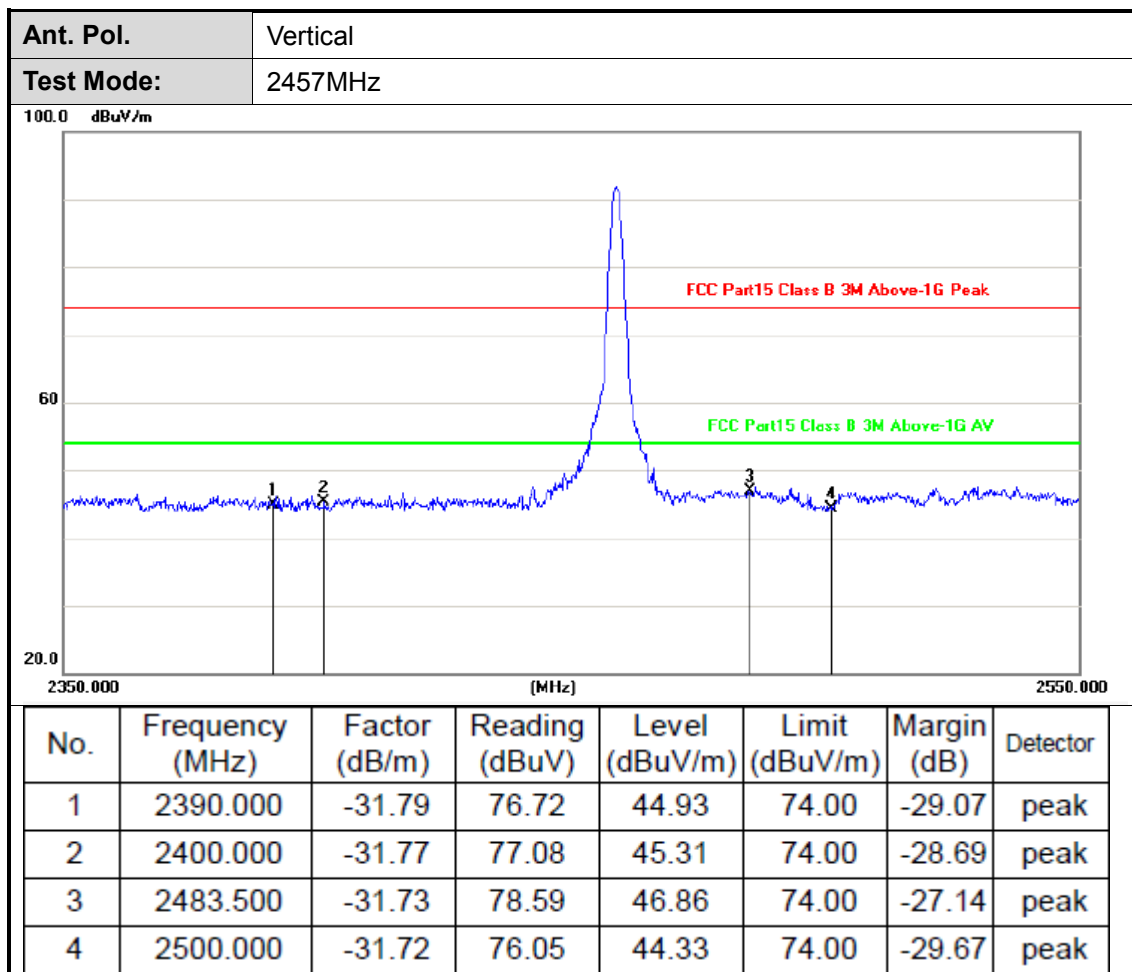
■ Above 1 GHz

Frequency (MHz)	Read Level (dBuV)	Correction Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin	Polarization	Test value
					(dB)		
4914	42.11	3.04	45.15	74	-28.85	Vertical	Peak
7371	39.42	5.01	44.43	74	-29.57	Vertical	Peak
4914	43.26	3.04	46.3	74	-27.7	Horizontal	Peak
7371	39.26	5.01	44.27	74	-29.73	Horizontal	Peak

Remark:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) - Pre-amplifier Factor
3. Margin value = Limit value - Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

**Bandedge Emission**

**Remark:**

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) - Pre-amplifier Factor
3. Margin value = Limit value - Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.



5.5. Antenna requirement

Requirement

FCC CFR Title 47 Part 15 Subpart C Section 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, 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.

FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):

(i) Systems operating in the 2400~2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

Test Result

The EUT's antenna is soldered to the PCB using a ceramic antenna. The gain of the antenna is 1.57dBi.

Please reference to the annex: Internal Photographs



6.EUT TEST PHOTOS

Please refer to: Test Photo.



7. PHOTOGRAPHS OF EUT CONSTRUCTIONAL

Please refer to: External Photographs and Internal Photographs.

*****THE END*****