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TEST REPORT

FCC PART 15 SUBPART E 15.407

Report Reference No. ..... : **CTL2203251061-WF04**

Compiled by: (position+printed name+signature)	Happy Guo (File administrators)	Happy Guo
Tested by: (position+printed name+signature)	Gary Gao (Test Engineer)	Gary Gao
Approved by: (position+printed name+signature)	Ivan Xie (Manager)	Ivan Xie

Product Name ..... :	Industrial Microcomputer
Model/Type reference ..... :	FRD-WS-HD
List Model(s)..... :	FRD-WS-HD1, FRD-WS-HD2, FRD-WS-HD3, FRD-WS-HD4
Trade Mark..... :	N/A
FCC ID..... :	**2AW8S-FRDWSHD**
Applicant's name ..... :	**FACESEC PTE.LTD.**
Address of applicant ..... :	1 Maritime Square #09-04 Harbourfront Centre Singapore 099253
Test Firm..... :	**Shenzhen CTL Testing Technology Co., Ltd.**
Address of Test Firm ..... :	Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055
Test specification..... :	
Standard ..... :	**47 CFR FCC Part 15 Subpart E 15.407**
TRF Originator ..... :	Shenzhen CTL Testing Technology Co., Ltd.
Master TRF..... :	Dated 2011-01
Date of receipt of test item ..... :	Apr.02, 2022
Date of Test Date..... :	Apr.02, 2022- Apr.25, 2022
Date of Issue ..... :	Apr.26, 2022
Result..... :	**Pass**

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TEST REPORT

Test Report No. :	CTL2203251061-WF04	Oct. 26, 2021 Date of issue

Equipment under Test	:	Industrial Microcomputer
Sample No	:	CTL220325106-1-S001
Model /Type	:	FRD-WS-HD
Listed Models	:	FRD-WS-HD1, FRD-WS-HD2, FRD-WS-HD3, FRD-WS-HD4
Applicant	:	**FACESEC PTE.LTD.**
Address	:	1 Maritime Square #09-04 Harbourfront Centre Singapore 099253
Manufacturer	:	**FACESEC PTE.LTD.**
Address	:	1 Maritime Square #09-04 Harbourfront Centre Singapore 099253

Test result	Pass *

∗ In the configuration tested, the EUT complied with the standards specified page 5.

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the issuing testing laboratory.

** Modified History **

Revisions	Description	Issued Data	Report No.	Remark
Version 1.0	Initial Test Report Release	2022-04-26	CTL2203251061-WF04	Tracy Qi

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1. SUMMARY

1.1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15 Subpart E—Unlicensed National Information Infrastructure Devices

ANSI C63.10: 2013: American National Standard for Testing Unlicensed Wireless Devices

KDB789033 D02: General UNII Test Procedures New Rules v02r01

1.2. Test Description

FCC Requirement		
FCC Part 15.207	AC Power Conducted Emission	PASS
FCC Part 15.407(a)	Emission Bandwidth(26dBm Bandwidth)	PASS$_{Note1}$
FCC Part 15.407(e)	Minimum Emission Bandwidth(6dBm Bandwidth)	PASS$_{Note2}$
FCC Part 15.407(a)	Maximum Conducted Output Power	PASS
FCC Part 15.407(a)	Peak Power Spectral Density	PASS
FCC Part 15.407(g)	Frequency Stability	PASS
FCC Part 15.407(b)	Undesirable emission	PASS
FCC Part 15.407(b)/15.205/15.209	Radiated Emissions	PASS
FCC Part 15.203	Antenna Requirement	PASS

1.3. Test Facility

1.3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co.,Ltd.
Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.3.2 Laboratory accreditation

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

CNAS-Lab Code: L7497

Shenzhen CTL Testing Technology Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA-Lab Cert. No. 4343.01

Shenzhen CTL Testing Technology Co., Ltd, 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: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

IC Registration No.: 9618B

CAB identifier: CN0041

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements with Registration No.: 9618B on Jan. 22, 2019.

FCC-Registration No.: 399832

Designation No.: CN1216

Shenzhen CTL Testing Technology Co., Ltd. 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 399832, December 08, 2017.

1.4. 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 CTL Testing 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.

Hereafter the best measurement capability for CTL laboratory is reported:

Test	Measurement Uncertainty	Notes
Transmitter power conducted	±0.57 dB	(1)
Transmitter power Radiated	±2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	±2.20 dB	(1)
Occupied Bandwidth	±0.01ppm	(1)
Radiated Emission9KHz~30MHz	±3.40dB	(1)
Radiated Emission 30~1000MHz	±4.10dB	(1)
Radiated Emission Above 1GHz	±4.32dB	(1)
Conducted Disturbance0.15~30MHz	±3.20dB	(1)

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

2. GENERAL INFORMATION

2.1. Environmental conditions

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

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

2.2. General Description of EUT

Product Name:	Industrial Microcomputer			
Model/Type reference:	FRD-WS-HD			
Power supply:	Input: 100-240V~, 50/60Hz, 1.5A Output: 12.0V⎓4.16A MAX(50W MAX)			
Hardware version:	BXMJ_2G_DVT_2.6.2.63.d.s.u_02241012			
Software version:	unknown			
5G WIFI :				
Supported type:	20MHz system	40MHz system	80MHz system	160MHz system
	802.11a 802.11n	802.11n	N/A	N/A
Operation frequency:	5180-5240MHz 5260-5320MHz 5500-5700MHz 5745-5825MHz	5190 - 5795MHz 5270 - 5310MHz 5510 - 5670MHz 5755MHz,5795MHz	N/A	N/A
Modulation:	OFDM	OFDM	N/A	N/A
Channel number:	24	11	N/A	N/A
Channel separation:	20MHz	40MHz	N/A	N/A
Antenna type:	PIFA Antenna			
Antenna gain:	3.0dBi			

Note1: For more details, please refer to the user's manual of the EUT.
Note2: Antenna gain provided by the applicant.

2.3. Description of Test Modes and Test Frequency

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

All test performed at the low, middle and high of operational frequency range of each mode.

Operation Frequency List WIFI on 5G Band：

Operating band	20MHz		40MHz		80MHz	
	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
U-NII 1 (5150MHz-5250MHz)	36	5180	38	5190	--	--
	40	5200				
	44	5220	46	5230		
	48	5240				
U-NII 2A (5120MHz-5350MHz)	52	5260	54	5270	--	--
	56	5280				
	60	5300	62	5310		
	64	5320				
U-NII 2C (5470MHz-5725MHz)	100	5500	102	5510	--	--
	104	5520				
	108	5540	110	5550		
	112	5560				
	116	5580	118	5590	--	--
	132	5660	134	5670	--	--
	136	5680			--	--
	140	5700	--	--	--	--
U-NII 3 (5725MHz-5850MHz)	149	5745	151	5755	--	--
	153	5765				
	157	5785	159	5795		
	161	5805				
	165	5825	--	--	--	--

Note:

1. “--“Means no channel(s) available any more.
2. The line display in grey is those Channels/Frequencies select to test in this report for each operation mode.

Data Rate Used:

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate
Maximum Conducted Output Power Power Spectral Density Emission Bandwidth(26dBm Bandwidth) Minimum Emission Bandwidth(6dBm Bandwidth) Undesirable emission Frequency Stability	11a/OFDM	6 Mbps
	11n(20MHz), /OFDM	7.2 Mbps
	11n(40MHz), /OFDM	15.0Mbps

2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ESH2-Z5	860014/010	2021/05/10	2022/05/09
Double cone logarithmic antenna	Schwarzbeck	VULB 9168	824	2020/04/07	2023/04/06
Horn Antenna	Ocean Microwave	OBH100400	26999002	2021/11/26	2022/11/25
EMI Test Receiver	R&S	ESCI	1166.5950.03	2021/05/18	2022/05/17
Spectrum Analyzer	Agilent	E4407B	MY41440676	2021/05/14	2022/05/13
Spectrum Analyzer	Agilent	N9020A	US46220290	2021/05/19	2022/05/18
Spectrum Analyzer	Keysight	N9020A	MY53420874	2021/05/19	2022/05/18
Controller	EM Electronics	EM 1000	060859	2021/05/22	2022/05/21
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2021/05/13	2022/05/12
Active Loop Antenna	Da Ze	ZN30900A	/	2021/05/24	2022/05/23
Amplifier	Agilent	8449B	3008A02306	2021/05/13	2022/05/12
Amplifier	Agilent	8447D	2944A10176	2021/05/11	2022/05/10
Amplifier	Brief&Smart	LNA-4018	2104197	2021/05/19	2022/05/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2021/05/16	2022/05/15
Power Sensor	Agilent	U2021XA	MY55130004	2021/05/19	2022/05/18
Power Sensor	Agilent	U2021XA	MY55130006	2021/05/19	2022/05/18
Power Sensor	Agilent	U2021XA	MY54510008	2021/05/19	2022/05/18
Power Sensor	Agilent	U2021XA	MY55060003	2021/05/19	2022/05/18
Spectrum Analyzer	RS	FSP	1164.4391.38	2021/05/19	2022/05/18

Test Software

Name of Software	Version
TST-PASS	1.0.5
ES-K1(Below 1GHz)	V1.71
e3(Above 1GHz)	6.111221a

The calibration interval was one year

2.5. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with Section 15.407 of the FCC Part 15, Subpart E Rules.

2.6. Modifications

No modifications were implemented to meet testing criteria.

3. TEST CONDITIONS AND RESULTS

3.1. Conducted Emissions Test

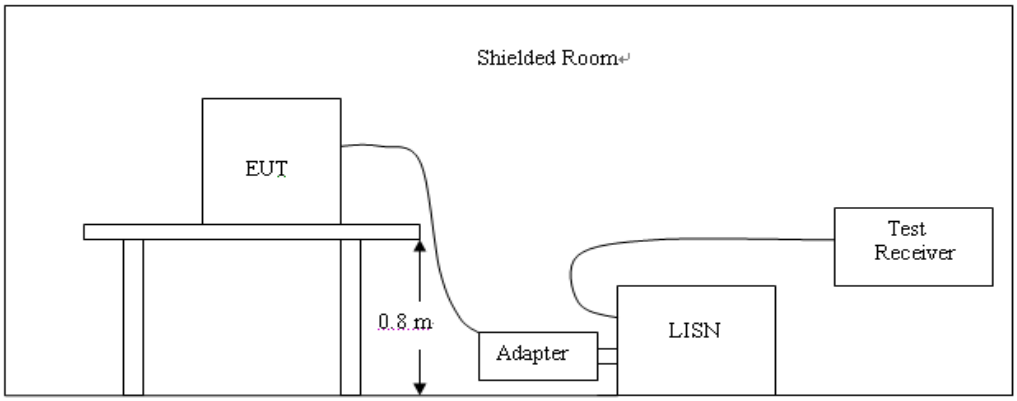
LIMIT

According to FCC CFR Title 47 Part 15 Subpart C Section 15.207, AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus as below:

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST CONFIGURATION



TEST PROCEDURE

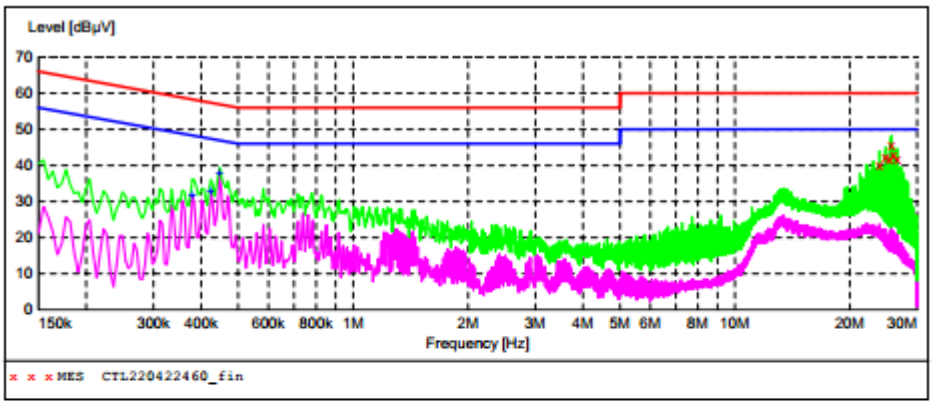
1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a Industrial Microcomputer op system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as per ANSI C63.10:2013.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
4. The adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

TEST RESULTS

Remark: 802.11a / 802.11n (HT20) / 802.11n (HT40) mode all have been tested, only worse case is reported

Test Mode	WIFI	Line:	L

SCAN TABLE: "Voltage (9K-30M)FIN"
Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "CTL220422460_fin"

4/24/2022 8:51AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
23.932500	40.00	11.4	60	20.0	QP	L1	GND
24.828000	42.20	11.5	60	17.8	QP	L1	GND
25.426500	41.70	11.5	60	18.3	QP	L1	GND
25.723500	45.50	11.5	60	14.5	QP	L1	GND
26.011500	42.70	11.5	60	17.3	QP	L1	GND
26.623500	41.60	11.6	60	18.4	QP	L1	GND

MEASUREMENT RESULT: "CTL220422460_fin2"

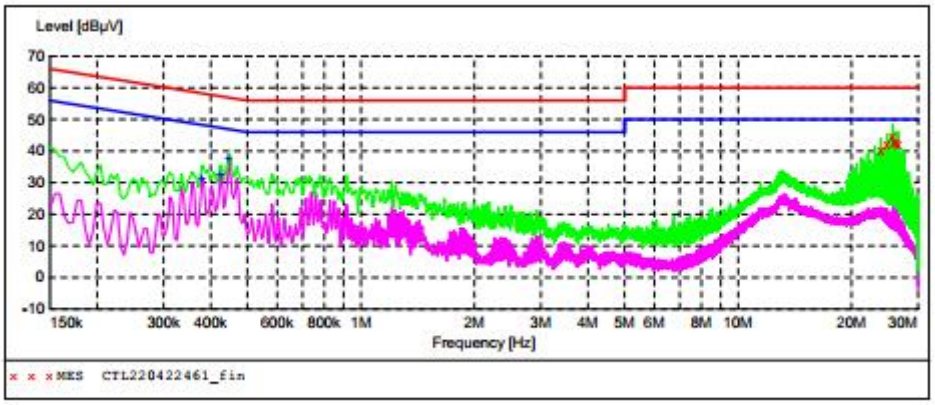
4/24/2022 8:51AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.379500	31.90	10.0	48	16.4	AV	L1	GND
0.424500	33.00	10.0	47	14.4	AV	L1	GND
0.447000	37.60	10.0	47	9.3	AV	L1	GND

Test Mode	WIFI	Line:	N

SCAN TABLE: "Voltage (9K-30M)FIN"

Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "CTL220422461_fin"

4/24/2022 8:53AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
23.923500	40.30	11.4	60	19.7	QP	N	GND
24.823500	42.40	11.5	60	17.6	QP	N	GND
25.723500	44.90	11.5	60	15.1	QP	N	GND
26.007000	42.60	11.5	60	17.4	QP	N	GND
26.317500	42.80	11.6	60	17.2	QP	N	GND
26.614500	42.40	11.6	60	17.6	QP	N	GND

MEASUREMENT RESULT: "CTL220422461_fin2"

4/24/2022 8:53AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.379500	31.50	10.0	48	16.8	AV	N	GND
0.424500	32.40	10.0	47	15.0	AV	N	GND
0.447000	37.60	10.0	47	9.3	AV	N	GND

3.2. Radiated Emissions

Limit

The maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.
(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.
(3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.
(4) For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

Undesirable emission limits

Requirement	Limit(EIRP)	Limit (Field strength at 3m) Note1
15.407(b)(1)	PK:-27(dBm/MHz)	PK:68.2(dBμV/m)
15.407(b)(2)		
15.407(b)(3)		
15.407(b)(4)		

Note1: The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

$$E = \frac{1000000\sqrt{30P}}{3}$$ μV/m, where P is the eirp (Watts)

(5) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209

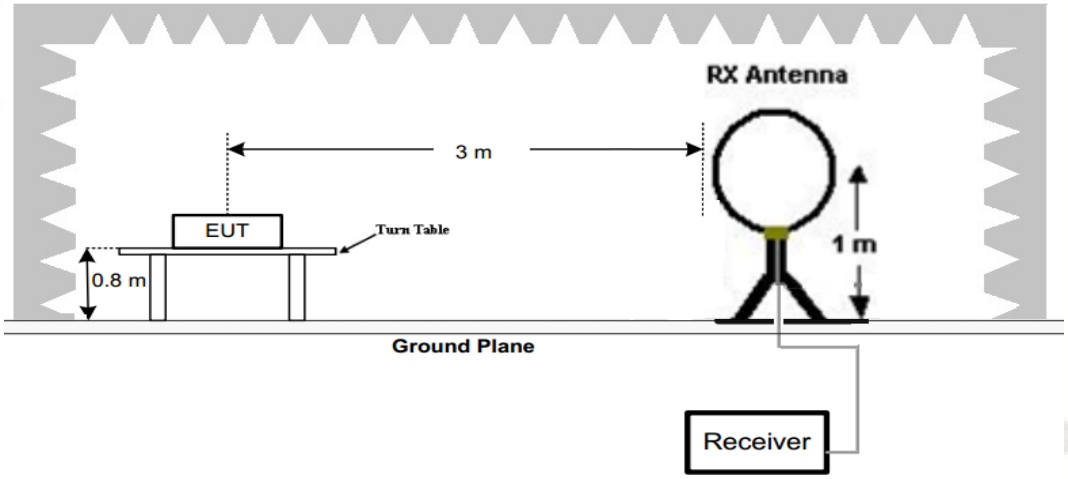
(6)In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

Radiated emission limits

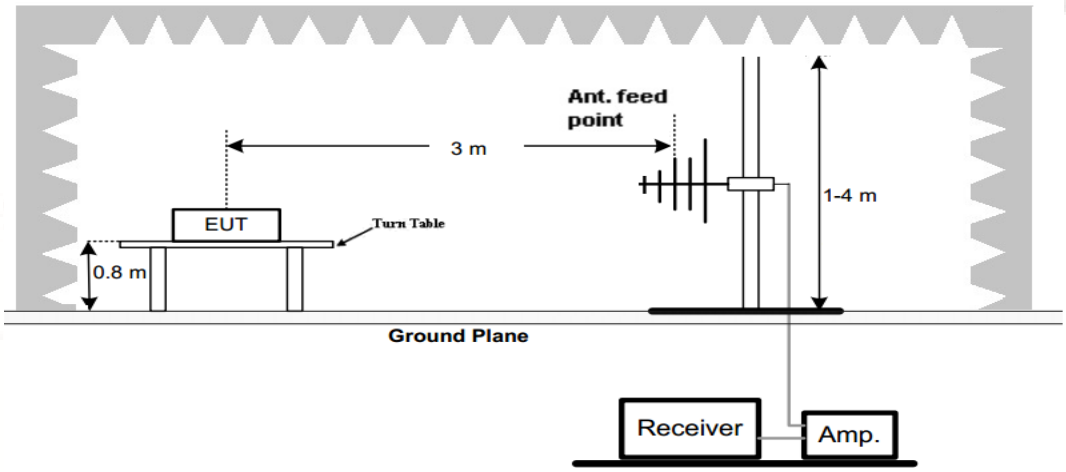
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

TEST CONFIGURATION

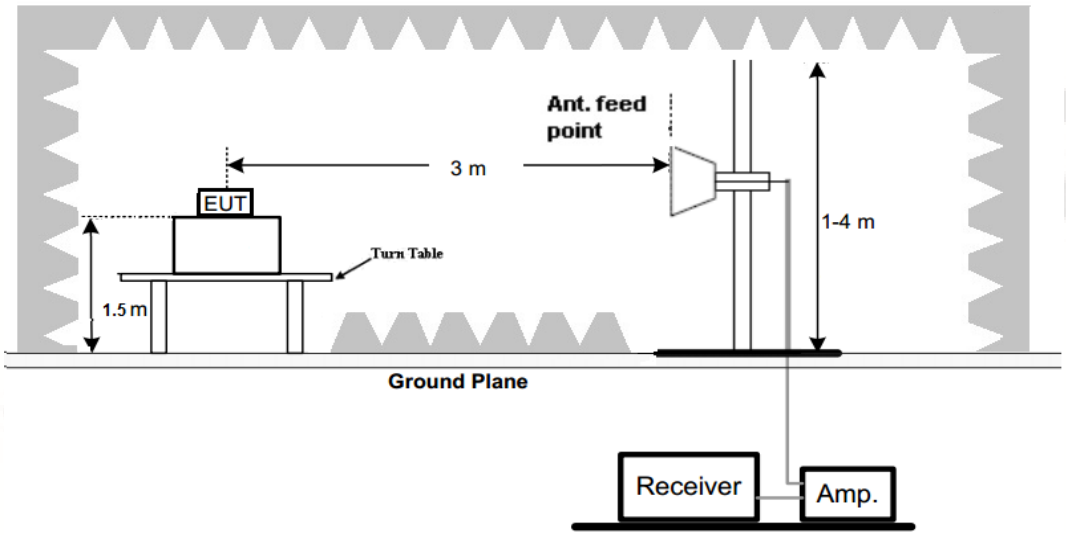
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



Test Procedure

1. Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 9KHz to 40GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Bilog Antenna	3
1GHz-18GHz	Horn Antenna	3
18GHz-25GHz	Horn Anternna	1

7. Setting test receiver/spectrum as following table states:

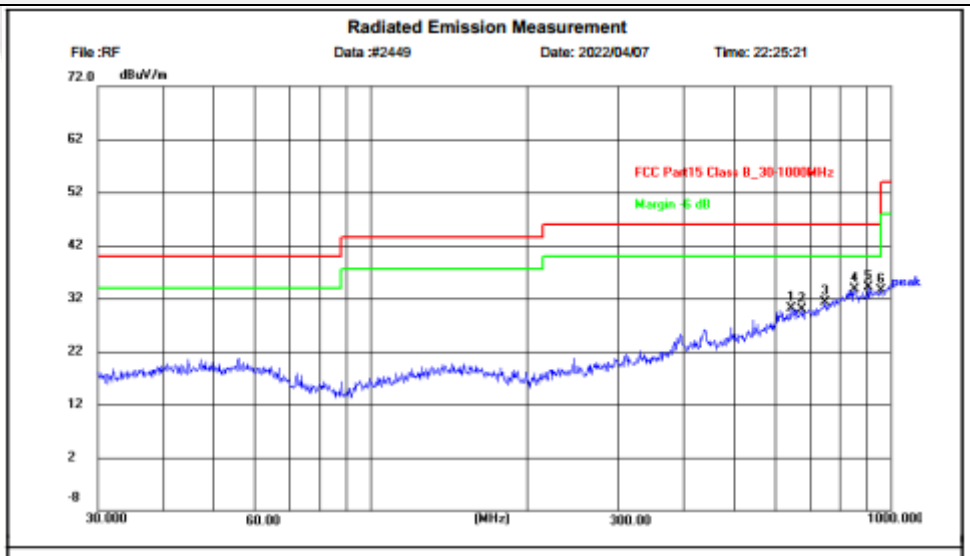
Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

TEST RESULTS

Remark:
1. This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.
2. All 802.11a / 802.11n (HT20) / 802.11n (HT40) modes have been tested for below 1GHz test, only the worst case 802.11n (HT20) low channel of U-NII 1 band was recorded.
3. All 802.11a / 802.11n (HT20) / 802.11n (HT40) modes have been tested for above 1GHz test, only the worst case 802.11n (HT20) was recorded.
4. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

For 30MHz-1GHz

Horizontal



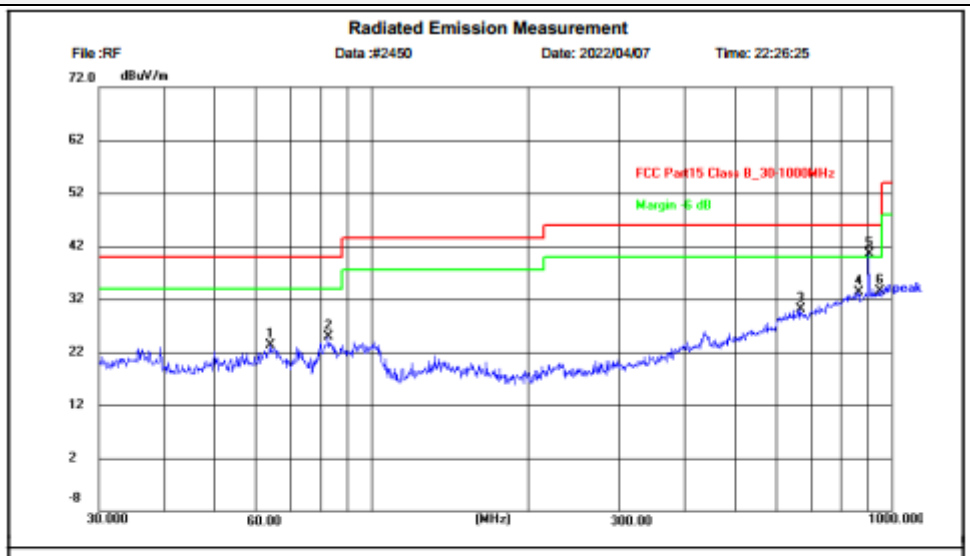
Site LAB Chamber 2
Limit: FCC Part15 Class B_30-1000MHz
EUT: /
M/N: FRD-WS-HD
Mode: WORKING
Note: SHI HUAN TONG CE
5G

Polarization: *Horizontal*
Power: AC120/60Hz
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	645.1194	7.89	22.28	30.17	46.00	15.83	peak	100	291	P	
2	675.2080	7.61	22.36	29.97	46.00	16.03	peak	100	203	P	
3	747.4825	7.23	24.05	31.28	46.00	14.72	peak	100	176	P	
4	854.0247	7.62	26.09	33.71	46.00	12.29	peak	100	305	P	
5	906.4824	7.72	26.40	34.12	46.00	11.88	peak	100	318	P	
6	958.7943	6.52	26.90	33.42	46.00	12.58	peak	100	55	P	

Vertical



Site LAB Chamber 2
Limit: FCC Part15 Class B_30-1000MHz
EUT: /
M/N: FRD-WS-HD
Mode: WORKING
Note: SHI HUAN TONG CE
5G

Polarization: *Vertical*
Power: AC120/60Hz
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	63.9828	10.00	13.40	23.40	40.00	16.60	peak	100	198	P	
2	82.6482	14.90	10.04	24.94	40.00	15.06	peak	100	293	P	
3	668.1423	7.70	22.34	30.04	46.00	15.96	peak	100	307	P	
4	863.0562	7.15	26.19	33.34	46.00	12.66	peak	100	137	P	
5	903.3094	14.07	26.40	40.47	46.00	5.53	peak	100	212	P	
6	948.7610	6.82	26.78	33.60	46.00	12.40	peak	100	29	P	

For 1GHz to 40GHz

Note: All 802.11a / 802.11n (HT20) / 802.11n (HT40) modes have been tested for above 1GHz test, only the worst case 802.11n (HT20) was recorded.

U-NII 1 & 802.11n (HT20) Mode (above 1GHz)

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
36 (5180MHz)	5150.00	48.78	PK	H	68.20	19.42	37.42	37.64	9.28	35.56	11.36
	10360.00	50.69	PK	H	68.20	17.51	34.96	39.20	11.45	34.92	15.73
	--	--	--	--	--	--	--	--	--	--	--
40 (5200MHz)	10400.00	49.98	PK	H	68.20	18.22	34.17	39.22	11.48	34.89	15.81
	--	--	--	--	--	--	--	--	--	--	--
48 (5240MHz)	5350.50	48.57	PK	H	68.20	19.63	37.16	37.64	9.28	35.51	11.41
	10480.00	50.89	PK	H	68.20	17.31	34.90	39.27	11.55	34.83	15.99
	--	--	--	--	--	--	--	--	--	--	--

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
36 (5180MHz)	5150.00	47.98	PK	V	68.20	20.22	36.62	37.64	9.28	35.56	11.36
	10360.00	50.54	PK	V	68.20	17.66	34.81	39.20	11.45	34.92	15.73
	--	--	--	--	--	--	--	--	--	--	--
40 (5200MHz)	10400.00	49.35	PK	V	68.20	18.85	33.54	39.22	11.48	34.89	15.81
	--	--	--	--	--	--	--	--	--	--	--
48 (5240MHz)	5350.50	48.14	PK	V	68.20	20.06	36.73	37.64	9.28	35.51	11.41
	10480.00	51.24	PK	V	68.20	16.96	35.25	39.27	11.55	34.83	15.99
	--	--	--	--	--	--	--	--	--	--	--

U-NII 2A & 802.11ac (HT20) Mode (above 1GHz)

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
52 (5260MHz)	5250.00	52.69	PK	H	68.20	15.51	41.31	37.64	9.28	35.54	11.38
	10520.00	48.54	PK	H	68.20	19.66	32.45	39.29	11.59	34.79	16.09
	--	--	--	--	--	--	--	--	--	--	--
56 (5280MHz)	10560.00	48.84	PK	H	68.20	19.36	32.67	39.31	11.62	34.76	16.17
	--	--	--	--	--	--	--	--	--	--	--
64 (5320MHz)	5350.50	47.79	PK	H	68.20	20.41	36.38	37.64	9.28	35.51	11.41
	10640.00	50.86	PK	H	68.20	17.34	34.51	39.36	11.69	34.70	16.35
	--	--	--	--	--	--	--	--	--	--	--

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
52 (5260MHz)	5250.00	53.98	PK	V	68.20	14.22	42.60	37.64	9.28	35.54	11.38
	10520.00	49.74	PK	V	68.20	18.46	33.65	39.29	11.59	34.79	16.08
	--	--	--	--	--	--	--	--	--	--	--
56 (5280MHz)	10560.00	50.63	PK	V	68.20	17.57	34.46	39.31	11.62	34.76	16.17
	--	--	--	--	--	--	--	--	--	--	--
64 (5320MHz)	5350.50	48.85	PK	V	68.20	19.35	37.44	37.64	9.28	35.51	11.41
	10640.00	50.29	PK	V	68.20	17.91	33.94	39.36	11.69	34.70	16.35
	--	--	--	--	--	--	--	--	--	--	--

U-NII 2C & 802.11ac (HT20) Mode (above 1GHz)

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
100 (5500MHz)	5470.00	46.78	PK	H	68.20	21.42	35.34	37.64	9.28	35.48	11.44
	11000.00	49.63	PK	H	68.20	18.57	32.47	39.56	12.01	34.41	17.16
	--	--	--	--	--	--	--	--	--	--	--
120 (5600MHz)	11200.00	48.89	PK	H	68.20	19.31	31.29	39.61	12.37	34.38	17.6
	--	--	--	--	--	--	--	--	--	--	--
140 (5700MHz)	5725.00	51.63	PK	H	68.20	16.57	40.12	37.64	9.28	35.41	11.51
	11400.00	49.18	PK	H	68.20	19.02	31.12	39.66	12.74	34.34	18.06
	--	--	--	--	--	--	--	--	--	--	--

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
100 (5500MHz)	5470.00	47.39	PK	V	68.20	20.81	35.95	37.64	9.28	35.48	11.44
	11000.00	50.52	PK	V	68.20	17.68	33.36	39.56	12.01	34.41	17.16
	--	--	--	--	--	--	--	--	--	--	--
120 (5600MHz)	11200.00	48.28	PK	V	68.20	19.92	30.68	39.61	12.37	34.38	17.6
	--	--	--	--	--	--	--	--	--	--	--
140 (5700MHz)	5725.00	52.32	PK	V	68.20	15.88	40.81	37.64	9.28	35.41	11.51
	11400.00	49.54	PK	V	68.20	18.66	31.48	39.66	12.74	34.34	18.06
	--	--	--	--	--	--	--	--	--	--	--

U-NII 3 & 802.11n (HT20) Mode (above 1GHz)

Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
149 (5745MHz)	5720.00	63.66	PK	H	110.80	34.56	76.78	37.64	9.28	35.41	11.51
	5725.00	69.11	PK	H	122.20	35.85	86.88	37.64	9.28	35.41	11.51
	11490.00	51.09	PK	H	68.20	17.11	32.83	39.69	12.90	34.33	18.26
	--	--	--	--	--	--	--	--	--	--	--
157 (5785MHz)	11570.00	50.55	PK	H	68.20	17.65	32.10	39.71	13.05	34.31	18.45
	--	--	--	--	--	--	--	--	--	--	--
165 (5825MHz)	5850.00	58.62	PK	H	122.50	30.23	80.73	37.64	9.28	35.38	11.54
	5855.00	56.04	PK	H	110.80	22.99	76.27	37.64	9.28	35.38	11.54
	11650.00	50.57	PK	H	68.20	17.63	31.95	39.73	13.19	34.30	18.62
	--	--	--	--	--	--	--	--	--	--	--

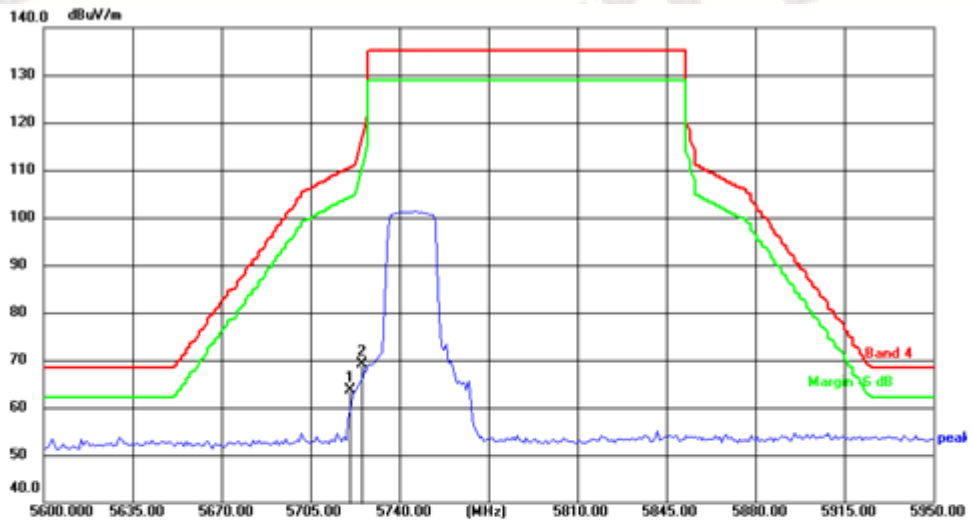
Tested Channel	Frequency (MHz)	Emission Level (dBuV/m)	Detector Mode	ANT Pol	Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre amplifier (dB)	Correction Factor (dB/m)
149 (5745MHz)	5720.00	63.29	PK	V	110.80	21.65	77.64	37.64	9.28	35.41	11.51
	5725.00	68.70	PK	V	122.20	23.22	87.47	37.64	9.28	35.41	11.51
	11490.00	50.23	PK	V	68.20	17.97	31.97	39.69	12.90	34.33	18.26
	--	--	--	--	--	--		--	--	--	--
157 (5785MHz)	11570.00	51.00	PK	V	68.20	17.20		39.71	13.05	34.31	18.45
	--	--	--	--	--	--		--	--	--	--
165 (5825MHz)	5850.00	62.30	PK	V	122.50	17.61	81.65	37.64	9.28	35.38	11.54
	5855.00	56.34	PK	V	110.80	33.77	76.89	37.64	9.28	35.38	11.54
	11650.00	51.52	PK	V	68.20	16.68	32.90	39.73	13.19	34.30	18.62
	--	--	--	--	--	--	--	--	--	--	--

REMARKS:

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 other emission levels were very low against the limit.
5. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.
6. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20;

Band Edge Test Plots

5745MHz 802.11n (HT20)

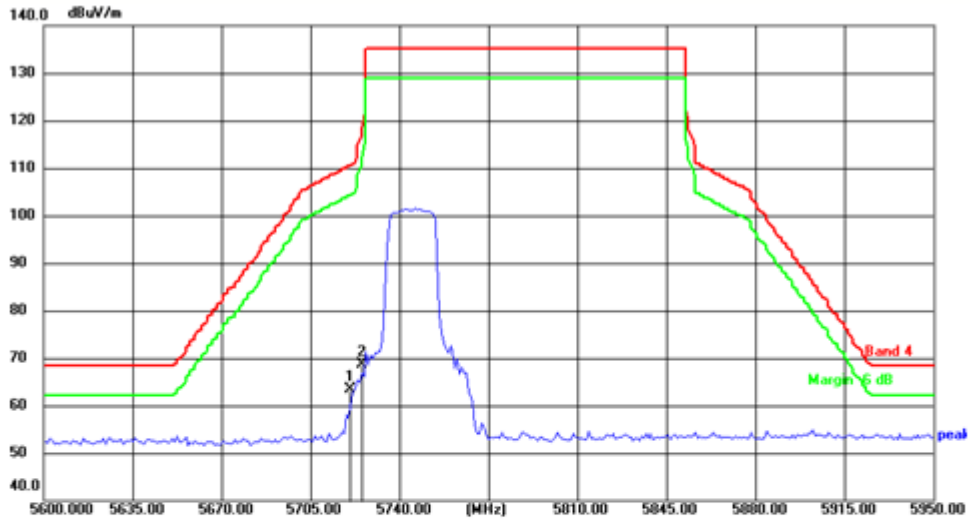


Site CTL 966 Chamber 1
Limit: Band 4
EUT:
M/N:
Mode: WORKING
Note: 5745
Company name:

Polarization: *Horizontal*
Power: AC230V/50Hz
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	5720.000	75.71	-12.05	63.66	110.80	-47.14	peak	P	
2	5725.000	81.15	-12.04	69.11	122.20	-53.09	peak	P	



Site CTL 966 Chamber 1
Limit: Band 4
EUT:
M/N:
Mode: WORKING
Note: 5745
Company name:

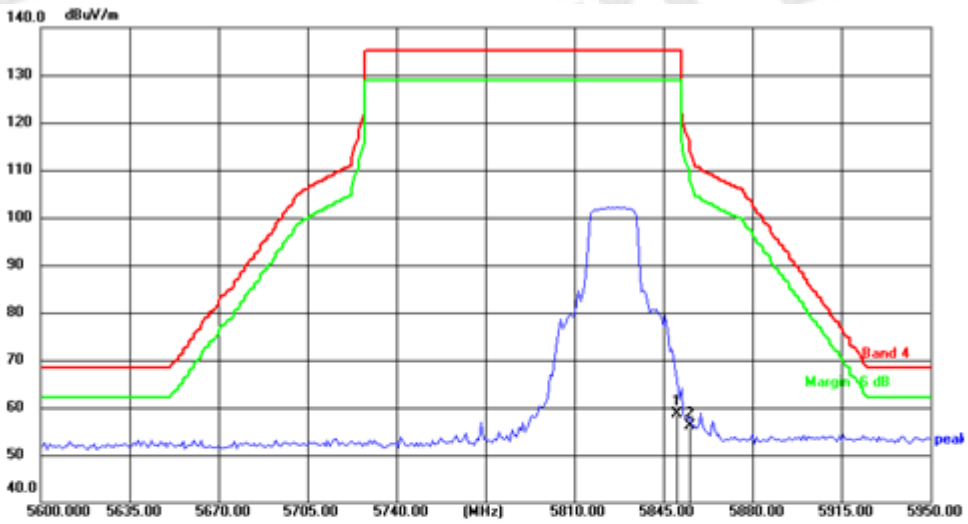
Polarization: *Vertical*
Power: AC230V/50Hz
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	5720.000	75.34	-12.05	63.29	110.80	-47.51	peak	P	
2	5725.000	80.74	-12.04	68.70	122.20	-53.50	peak	P	

Band Edge Test Plots

5825MHz 802.11n (HT20)

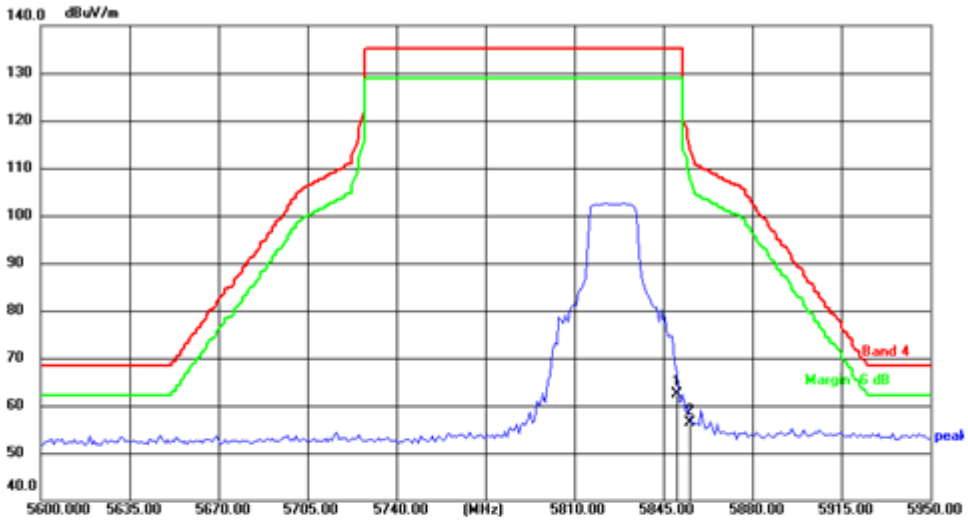


Site CTL 966 Chamber 1
Limit: Band 4
EUT:
M/N:
Mode: WORKING
Note: 5825
Company name:

Polarization: *Horizontal*
Power: AC230V/50Hz
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	5850.000	70.23	-11.61	58.62	122.50	-63.88	peak	P	
2	5855.000	67.64	-11.60	56.04	110.80	-54.76	peak	P	



Site CTL 966 Chamber 1
Limit: Band 4
EUT:
M/N:
Mode: WORKING
Note: 5825
Company name:

Polarization: *Vertical*
Power: AC230V/50Hz
Distance: 3m

Temperature: 25(C)
Humidity: 50 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	5850.000	73.91	-11.61	62.30	122.50	-60.20	peak	P	
2	5855.000	67.94	-11.60	56.34	110.80	-54.46	peak	P	

3.3. Maximum Conducted Average Output Power

Limit

FCC requirement:
For the band 5.15-5.25 GHz.
(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6dBi.

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

(iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250mW provided the maximum antenna gain does not exceed 6dBi.

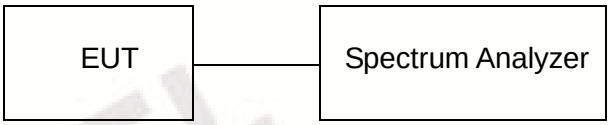
For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250mW or 11dBm + 10log B, where B is the 26 dB emission bandwidth in megahertz.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W

Test Procedure

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

Test Configuration



Test Results

Raw data reference to Section 2 from Appendix.

3.4. Power Spectral Density

Limit

FCC requirement:
For the band 5.15-5.25 GHz.

(i) For an outdoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17dBm in any 1 MHz band.[note1]

(ii) For an indoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17dBm in any 1 MHz band.[note1]

(iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 GHz, transmitters that employ a directional antenna gain greater than 23dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23dBi.

(iv) For mobile and portable client devices in the 5.15 - 5.25 GHz band, the maximum power spectral density shall not exceed 11dBm in any 1 MHz band. [note1]

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands

The maximum power spectral density shall not exceed 11dBm in any 1 megahertz band.

IC requirement:

For the band 5.15-5.25 GHz.

The e.i.r.p. spectral density shall not exceed 10dBm in any 1.0 MHz band.

Frequency band 5250-5350 MHz

The power spectral density shall not exceed 11dBm in any 1.0 MHz band

Frequency bands 5470-5600 MHz and 5650-5725 MHz

The power spectral density shall not exceed 11dBm in any 1.0 MHz band.

For the band 5.725 - 5.85 GHz

The maximum power spectral density shall not exceed 30dBm in any 500 kHz band. [note1, note2]

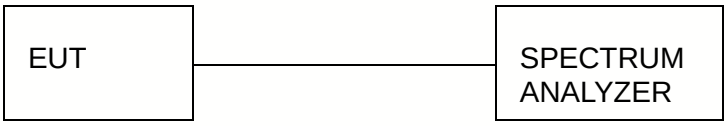
Note1: If transmitting antennas of directional gain greater than 6dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Note2: Fixed point - to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information.

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 1MHz for U-NII 1, U-NII 2A, U-NII C band and 510KHz for U-NII 3 band.
3. Set the VBW ≥ 3× RBW.
4. Set the span to encompass the entire EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level.

Test Configuration



Test Results

Raw data reference to Section 3 from Appendix.

3.5. Emission Bandwidth (26dBm Bandwidth)

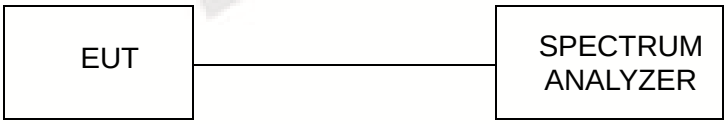
Limit

N/A

Test Procedure

1. Set resolution bandwidth (RBW) = approximately 1 % of the EBW.
2. Set the video bandwidth (VBW) > RBW.
3. Detector = Peak.
4. Trace mode = Max hold.
5. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW / EBW ratio is approximately 1 %.

Test Configuration



Test Results

Raw data reference to Section 1 from Appendix.

3.6. Minimum Emission Bandwidth (6dBm Bandwidth)

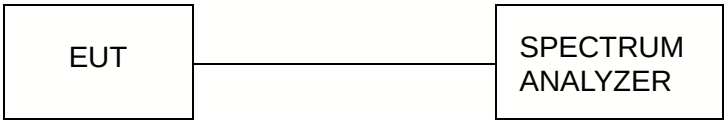
Limit

Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 kHz for the band 5.725-5.85 GHz

Test Procedure

1. Set resolution bandwidth (RBW) = 100 kHz
2. Set the video bandwidth 3 x RBW.
3. Detector = Peak.
4. Trace mode = Max hold.
5. 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.

Test Configuration



Test Results

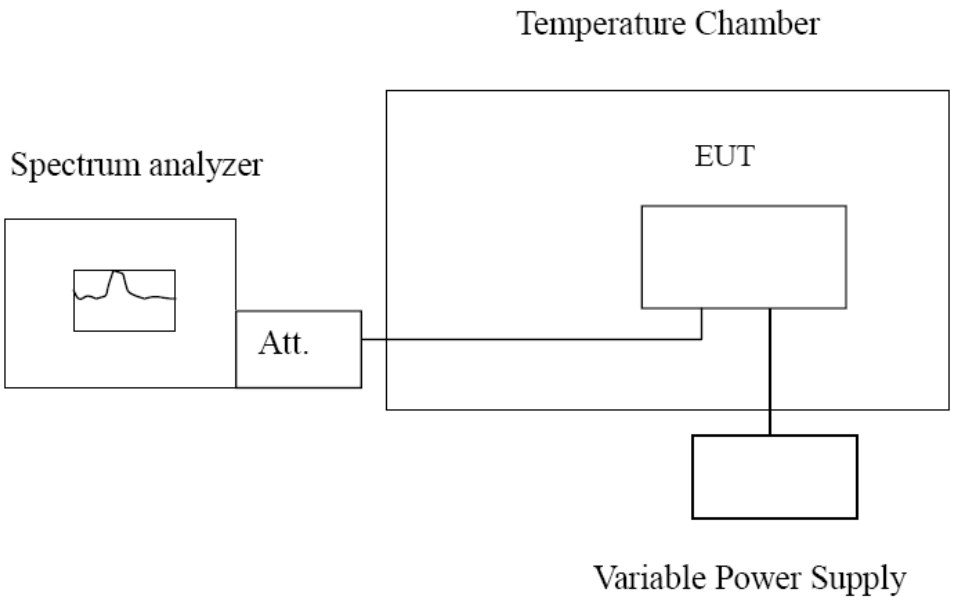
Raw data reference to Section 1 from Appendix.

3.7. Frequency Stability

LIMIT

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

TEST CONFIGURATION



TEST PROCEDURE

Frequency Stability under Temperature Variations:
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20℃ operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30℃. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10℃ increased per stage until the highest temperature of +50℃ reached.

Frequency Stability under Voltage Variations:
Set chamber temperature to 20℃. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.
Reduce the input voltage to specify extreme voltage variation (±15%) and endpoint, record the maximum frequency change.

TEST RESULTS

Raw data reference to Section 4 from Appendix.

3.8. Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR 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

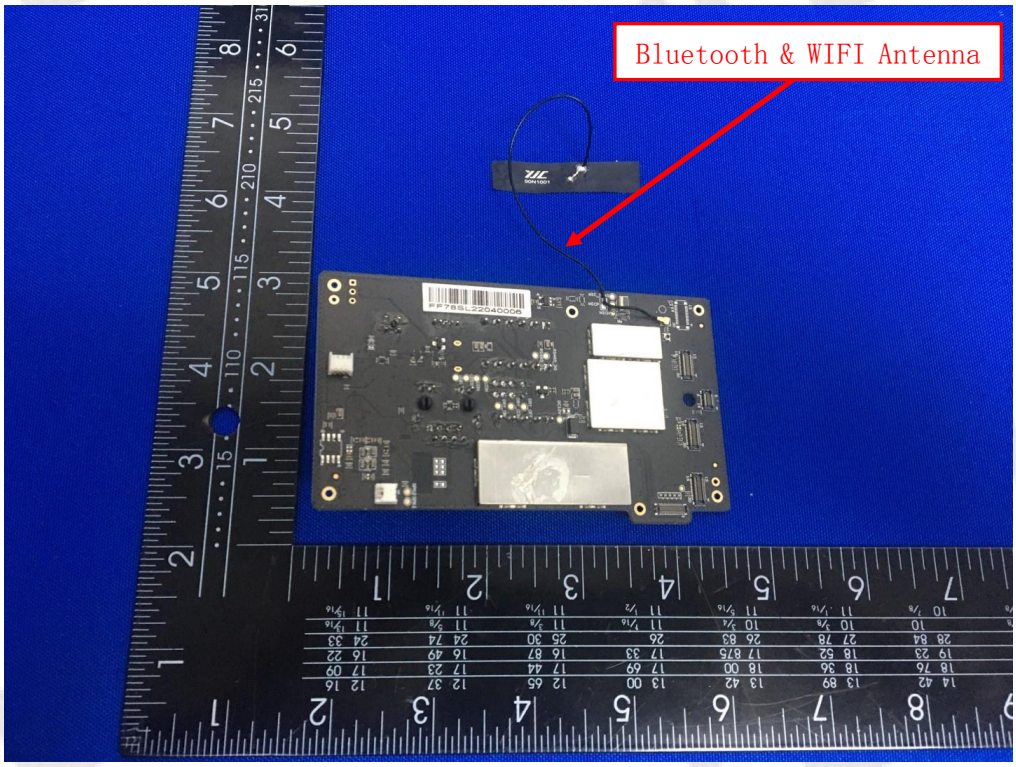
And according to FCC 47 CFR Section 15.407 (a), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Refer to statement below for compliance

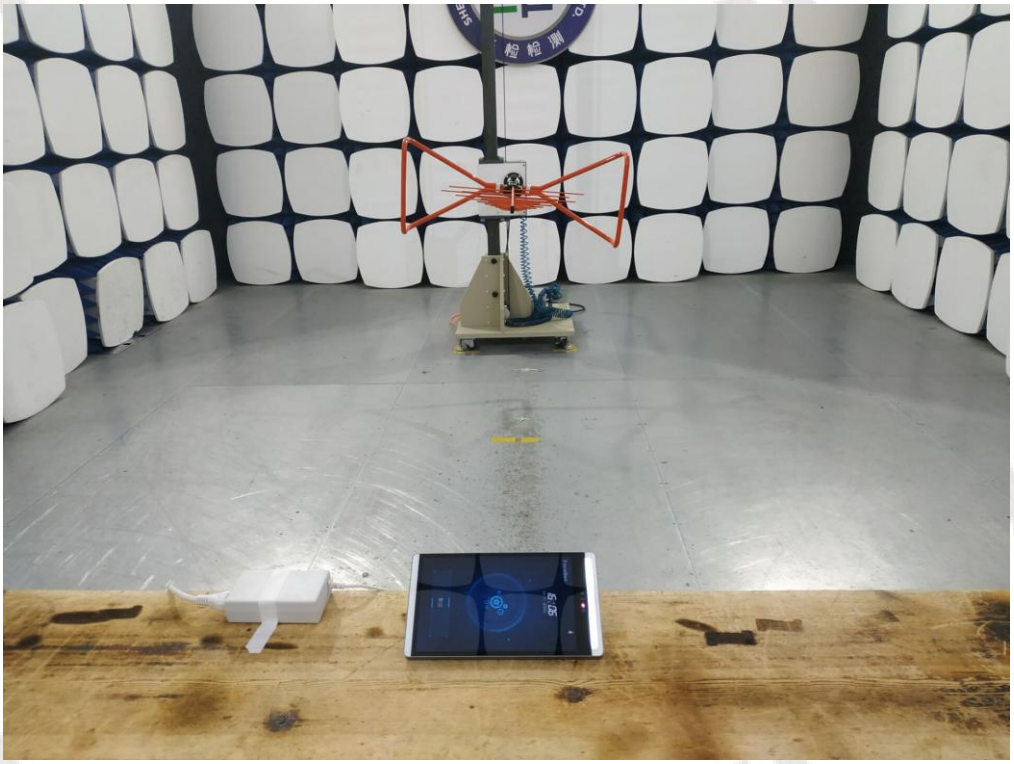
The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

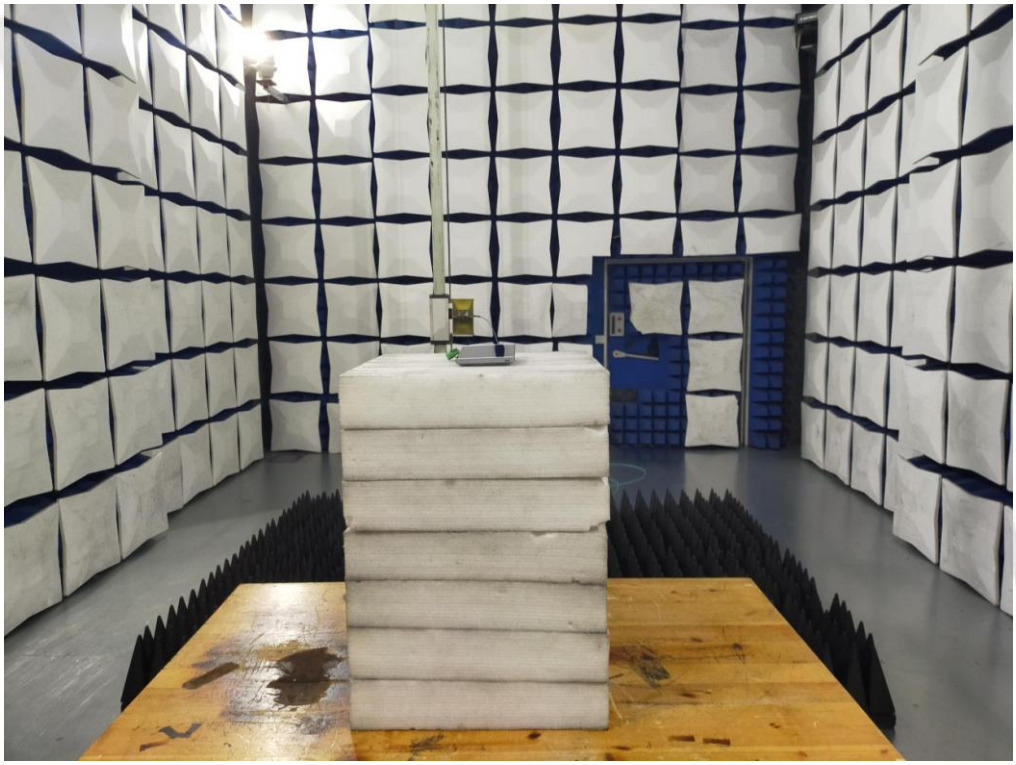
Antenna Connected Construction

The maximum gain of antenna was 3.0dBi



4. Test Setup Photos of the EUT





5. Photos of the EUT

Reference to the test report No. CTL2203251061-WF01

**********End of Report**********