

## FCC Test Report (Co-Located)

**Report No.:** RFBCKS-WTW-P22040223-3

**FCC ID:** UXX-S5A235A

**Test Model:** S5A235A

**Received Date:** Apr. 08, 2022

**Test Date:** Aug. 13, 2022

**Issued Date:** Aug. 16, 2022

**Applicant:** Cradlepoint, Inc.

**Address:** 1111 West Jefferson Street ,Boise ,Idaho, United States 83702

**Issued By:** Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch  
Lin Kou Laboratories

**Lab Address:** No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

**Test Location:** No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City  
33383, Taiwan

**FCC Registration/  
Designation Number:** 788550 / TW0003



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### Release Control Record

Issue No.	Description	Date Issued
RFBCKS-WTW-P22040223-3	Original release	Aug. 16, 2022

## 1 Certificate of Conformity

**Product:** Ruggedized LTE Router

**Brand:** Cradlepoint, Inc.

**Test Model:** S5A235A

**Sample Status:** Engineering sample

**Applicant:** Cradlepoint, Inc.

**Test Date:** Aug. 13, 2022

**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.247)

47 CFR FCC Part 15, Subpart E (Section 15.407)

FCC Part 22, Subpart H

FCC Part 24, Subpart E

FCC Part 27, Subpart F, H, L, M, Q

FCC Part 90, Subpart R, S

FCC Part 96

ANSI 63.26-2015

ANSI C63.10-2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

**Prepared by :** , **Date:** Aug. 16, 2022  
Polly Chien / Specialist

**Approved by :** , **Date:** Aug. 16, 2022  
Jeremy Lin / Project Engineer

## 2 Summary of Test Results

Applied Standard	47 CFR FCC Part 15, Subpart C (Section 15.247) 47 CFR FCC Part 15, Subpart E (Section 15.407) FCC Part 22, Subpart H FCC Part 24, Subpart E FCC Part 27, Subpart F, H, L, M, Q FCC Part 90, Subpart R, S FCC Part 96 ANSI 63.26-2015 ANSI C63.10-2013		
FCC Clause	Test Item	Result	Remarks
15.205 / 15.209 / 15.247(d) 15.407(b) (1/2/3/4(i/ii)/9) 2.1053 22.917 24.238 27.53(a) 27.53(c) 27.53(h) 27.53(m) 90.691 96.41(e)	Radiated Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -1.30dB at 7311.00MHz.

Note:

- Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
- For U-NII-3 band compliance with rule part 15.407(b)(4)(i), the OOB test plots were recorded in Annex A.

### 2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.04 dB
	30MHz ~ 200MHz	3.59 dB
	200MHz ~ 1000MHz	3.60 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

Product	Ruggedized LTE Router		
Brand	Cradlepoint, Inc.		
Test Model	S5A235A		
Sample Status	Engineering sample		
Power Supply Rating	12Vdc from adapter		
Modulation Type	WLAN	CCK, DQPSK, DBPSK for DSSS 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM 1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDMA	
	BT LE	GFSK	
	WCDMA	BPSK, QPSK	
	LTE	QPSK, 16QAM	
Modulation Technology	WLAN	DSSS, OFDM, OFDMA	
Transfer Rate	WLAN	802.11b:11/5.5/2/1Mbps 802.11g/a: 54/48/36/24/18/12/9/6Mbps 802.11n: up to 300Mbps 802.11ac: up to 886.7Mbps 802.11ax: up to 1201Mbps	
	BT LE	Bluetooth LE 1M: 1Mbps Bluetooth LE 2M: 2Mbps	
Operating Frequency	WLAN	2.4GHz: 2412~2462MHz 5.0GHz: 5180~5240MHz, 5745~5825MHz	
	BT LE	2402~2480MHz	
	WCDMA	WCDMA Band 2	1850 ~ 1910 MHz
WCDMA Band 4		1710 ~ 1755 MHz	
WCDMA Band 5		824 ~ 849 MHz	
Operating Frequency	LTE	LTE Band 2	1850 ~ 1910 MHz
		LTE Band 4	1710 ~ 1755 MHz
		LTE Band 5	824 ~ 849 MHz
		LTE Band 7	2500 ~ 2570 MHz
		LTE Band 12	699 ~ 716 MHz
		LTE Band 13	777 ~ 787 MHz
		LTE Band 14	788 ~ 798 MHz
		LTE Band 25	1850 ~ 1915 MHz
		LTE Band 26	814 ~ 849 MHz
		LTE Band 41	2496 ~ 2690 MHz
		LTE Band 42	3400 ~ 3600 MHz
		LTE Band 43	3600 ~ 3800 MHz
		LTE Band 48	3550 ~ 3700 MHz
		LTE Band 66	1710 ~ 1780 MHz
LTE Band 71	663 ~ 698 MHz		

Antenna Type	WLAN/BT	Refer to note
	WCDMA	Refer to note
	LTE	Refer to note
Antenna Connector	WLAN/BT	Refer to Note
	WCDMA	Refer to note
	LTE	Refer to note
Accessory Device	Refer to note	
Cable Supplied	Refer to Note	
Contains FCC ID (WWAN module)	N7NEM74B	

Note:

1. The EUT incorporates a MIMO function. Physically, the EUT provides 2 completed transmitters and 2 receivers.

Band	Modulation Mode	Beamforming Mode	TX Function
2.4GHz Band	802.11b	Not Support	2TX
	802.11g	Not Support	2TX
	802.11n (HT20)	Support	2TX
	802.11n (HT40)	Support	2TX
	VHT20	Support	2TX
	VHT40	Support	2TX
	802.11ax (HE20)	Support	2TX
	802.11ax (HE40)	Support	2TX
5GHz Band	802.11a	Not Support	2TX
	802.11n (HT20)	Support	2TX
	802.11n (HT40)	Support	2TX
	802.11ac (VHT20)	Support	2TX
	802.11ac (VHT40)	Support	2TX
	802.11ac (VHT80)	Support	2TX
	802.11ax (HE20)	Support	2TX
	802.11ax (HE40)	Support	2TX
	802.11ax (HE80)	Support	2TX

\* The bandwidth and modulation are similar for 802.11n mode for 20MHz (40MHz), 802.11ac mode for 20MHz (40MHz, 80MHz) and 802.11ax mode for 20MHz (40MHz, 80MHz). Therefore the investigated worst case is the representative mode in test report. (Final test mode refer section 3.2.1)

\* For 802.11n/ax, CDD mode and Beamforming mode are presented in power output test item. For other test items, CDD mode is the worst case for final tests after pretesting.

\*After pretest OFDMA mode, the Full RU is the worst case and record in this report.

2. The following antennas were provided to the EUT.

Ant. No.	RF Chain No.	Brand	Model	Antenna Net Gain (dBi)	Frequency Range (MHz)	Antenna Type	Connector Type
Wi-Fi Set1	1	Cradlepoint	test antenna 1	5.5069	2400-2483.5	Monopole	R-SMA
				5.8125	5150-5250	Monopole	R-SMA
				5.7725	5250-5350	Monopole	R-SMA
				5.7133	5425-5725	Monopole	R-SMA
	2	Cradlepoint	test antenna 1	5.9957	5725-5850	Monopole	R-SMA
				5.5069	2400-2483.5	Monopole	R-SMA
				5.8125	5150-5250	Monopole	R-SMA
				5.7725	5250-5350	Monopole	R-SMA
Wi-Fi Set2	1	PANORAMA	LG-IN2457	2	2400-2483.5	Monopole	R-SMA
				1.1	5150-5250	Monopole	R-SMA
				2.4	5250-5350	Monopole	R-SMA
				3.1	5425-5725	Monopole	R-SMA
	2	PANORAMA	LG-IN2457	3.5	5725-5850	Monopole	R-SMA
				2.4	2400-2483.5	Monopole	R-SMA
				0.9	5150-5250	Monopole	R-SMA
				1.7	5250-5350	Monopole	R-SMA
Wi-Fi Set3	1	WNC	170836-000	2.9	5425-5725	Monopole	R-SMA
				3.5	5725-5850	Monopole	R-SMA
				2.47	2400-2483.5	Dipole	R-SMA
				2.18	5150-5250	Dipole	R-SMA
	2	WNC	170836-000	2.19	5250-5350	Dipole	R-SMA
				2.14	5425-5725	Dipole	R-SMA
				2.47	5725-5850	Dipole	R-SMA
				2.47	2400-2483.5	Dipole	R-SMA
BT	1	Cradlepoint	170847-000	2.16	2400-2500	Dipole	R-SMA
GPS	1	PANORAMA	LG-IN2457	26	1562-1612	Dipole	SMA
GPS	2	Taoglas	AA.162	30	1562-1612	Dipole	SMA
LTE Set1	1	Cradlepoint	170801-000	1.42	619-790	Dipole	SMA
				0.88	1445-1515	Dipole	SMA
				2.69	1710-2700	Dipole	SMA
				4.13	3400-3700	Dipole	SMA
				4.29	5150-5925	Dipole	SMA
LTE Set2	2	Cradlepoint	170801-000	1.42	619-790	Dipole	SMA
				0.88	1445-1515	Dipole	SMA
				2.69	1710-2700	Dipole	SMA
				4.13	3400-3700	Dipole	SMA
				4.29	5150-5925	Dipole	SMA



Ant. No.	RF Chain No.	Brand	Model	Antenna Net Gain (dBi)	Frequency Range (MHz)	Antenna Type	Connector Type
LTE Set1	1	PANORAMA	LG-IN2457	0.5	617-698	Monopole	SMA
				1.3	699-798	Monopole	SMA
				1.9	807- 862	Monopole	SMA
				1.6	880-960	Monopole	SMA
				1.5	1427-1518	Monopole	SMA
				2	1625-1661	Monopole	SMA
				1.6	1710-1920	Monopole	SMA
				2.2	1920-2170	Monopole	SMA
				1.2	2300-2400	Monopole	SMA
				1.3	2496-2690	Monopole	SMA
				2.2	3300-4200	Monopole	SMA
LTE Set2	2	PANORAMA	LG-IN2457	0.15	617-698	Monopole	SMA
				1.5	699-798	Monopole	SMA
				2	807- 862	Monopole	SMA
				2	880-960	Monopole	SMA
				2.6	1427-1518	Monopole	SMA
				1.8	1625-1661	Monopole	SMA
				1.6	1710-1920	Monopole	SMA
				2	1920-2170	Monopole	SMA
				1.5	2300-2400	Monopole	SMA
				1.4	2496-2690	Monopole	SMA
				2.6	3300-4200	Monopole	SMA
1.7	4400-5000	Monopole	SMA				

\*Detail antenna specification please refer to antenna datasheet.

\*After the monopole antennas pre-test, the worst case is the Wi-Fi Set1 antenna with maximum antenna gain, so it was finally selected for testing. Therefore the investigated worst case is the representative mode in test report. (Final test mode refer section 3.2.1)

3. The EUT contains following accessory devices.

Product	Brand	Model	Description
Adapter 1	ADP	WA-36N12R	I/P: 100-240Vac, 50-60Hz, 0.9A O/P: 12.0Vdc, 3.0A Power cable: 1.5m without core
Adapter 2	Ktec	KSA-36W-120300D5	I/P: 100-240V~50/60Hz, 1.0A O/P: 12.0Vdc, 3.0A, 36.0W Power cable: 1.42m without core
Nebula dock (Expansion dock) Support Unit	Cradlepoint, Inc.	S0A235A	-

4. The EUT has two different configuration, after pretest the original one was the worst case for final test.

Configuration		
PCBA	PHY IC	eMMC
Original	QCA-8081	MTFC8GAMALGT-AAT
2nd Source	QCA-8080	THGBMJG6C1LBAU7

### 3.2 Description of Test Modes

For WLAN:

For 2.4GHz

11 channels are provided for 802.11b, 802.11g, 802.11n (HT20), VHT20, 802.11ax (HE20):

Channel	Frequency	Channel	Frequency
1	2412MHz	7	2442MHz
2	2417MHz	8	2447MHz
3	2422MHz	9	2452MHz
4	2427MHz	10	2457MHz
5	2432MHz	11	2462MHz
6	2437MHz		

7 channels are provided for 802.11n (HT40), VHT40, 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
3	2422MHz	7	2442MHz
4	2427MHz	8	2447MHz
5	2432MHz	9	2452MHz
6	2437MHz		

**For 5180 ~ 5240MHz:**

4 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

Channel	Frequency	Channel	Frequency
36	5180 MHz	44	5220 MHz
40	5200 MHz	48	5240 MHz

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz

1 channel is provided for 802.11ac (VHT80), 802.11ax (HE80):

Channel	Frequency
42	5210MHz

**For 5745 ~ 5825MHz:**

5 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

Channel	Frequency	Channel	Frequency
149	5745MHz	161	5805MHz
153	5765MHz	165	5825MHz
157	5785MHz		

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
151	5755MHz	159	5795MHz

1 channel is provided for 802.11ac (VHT80), 802.11ax (HE80):

Channel	Frequency
155	5775MHz

**BT LE:**

40 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

### 3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to		Description
	RE $\geq$ 1G	RE<1G	
-	√	√	-

Where RE $\geq$ 1G: Radiated Emission above 1GHz & Bandedge Measurement RE<1G: Radiated Emission below 1GHz

Note:

1. The EUT's antenna was positioned and tested under the listed conditions:
  - a.) The Monopole Antenna Parallel
  - b.) The Dipole Antenna's angle of 90 degrees

#### Radiated Emission Test (Above 1GHz):

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Frequency Band (MHz)	Available Channel	Tested Channel	Modulation Technology
-	802.11b + 802.11a + Bluetooth LE 2M + WCDMA Band 5	2412-2462	1 to 11	6 + 157+ 19 + 4182	OFDM
		5745-5825	149 to 165		OFDM
		2402-2480	0 to 39		GFSK
		824-849	4132 to 4233		BPSK

#### Radiated Emission Test (Below 1GHz):

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Frequency Band (MHz)	Available Channel	Tested Channel	Modulation Technology
-	802.11b + 802.11a + Bluetooth LE 2M + WCDMA Band 5	2412-2462	1 to 11	6 + 157+ 19 + 4182	OFDM
		5745-5825	149 to 165		OFDM
		2402-2480	0 to 39		GFSK
		824-849	4132 to 4233		BPSK

#### Test Condition:

Applicable to	Environmental Conditions	Input Power (System)	Tested by
RE $\geq$ 1G	23 deg. C, 73% RH	120Vac, 60Hz	Rex Wang
RE<1G	23 deg. C, 73% RH	120Vac, 60Hz	Rex Wang

### 3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

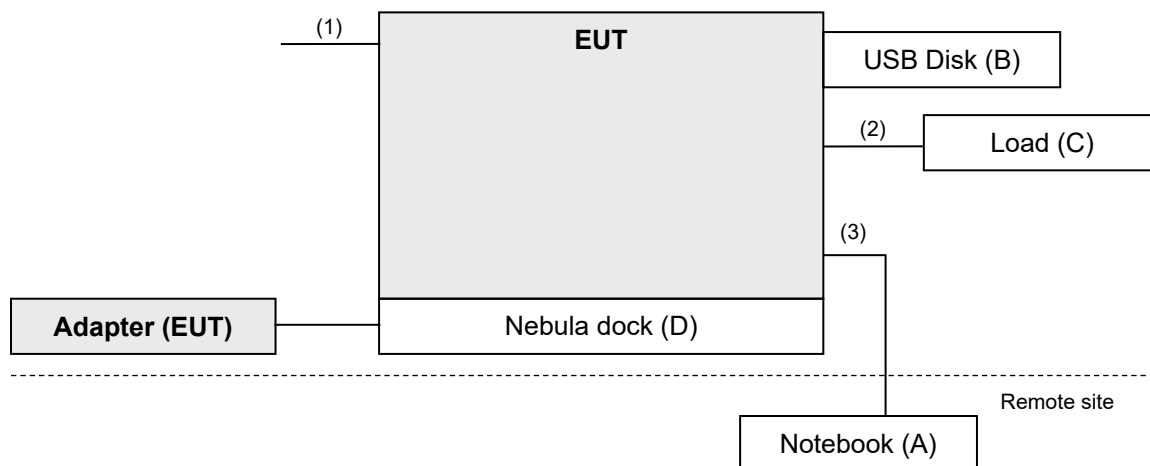
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Notebook	DELL	Inspiron 14R	8LRKKW1	FCC DoC Approved	Provided by Lab
B.	USB Disk	SanDisk	SDDDC3	NA	NA	Provided by Lab
C.	Load	NA	NA	NA	NA	Provided by Lab
D.	Nebula dock (Expansion dock)	Cradlepoint, Inc.	S0A235A	NA	NA	Provided by client

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item A acted as a communication partner to transfer data.

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	RS232 Cable	1	1	N	0	Provided by Lab
2.	LAN Cable	1	1.5	N	0	Provided by Lab RJ45, Cat.5e
3.	LAN Cable	1	10	N	0	Provided by Lab RJ45, Cat.5e

#### 3.3.1 Configuration of System under Test



### **3.4 General Description of Applied Standards**

The EUT is a RF Product. According to the specification of the EUT declared by the manufacturer, it must comply with the requirements of the following standards:

**47 CFR FCC Part 15, Subpart C (Section 15.247)**

**47 CFR FCC Part 15, Subpart E (Section 15.407)**

**FCC Part 22, Subpart H**

**FCC Part 24, Subpart E**

**FCC Part 27, Subpart C, F, H, L, M**

**FCC Part 90, Subpart I, S**

**FCC Part 96**

ANSI 63.26-2015

ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

## 4 Test Types and Results

### 4.1 Radiated Emission and Bandedge Measurement

#### 4.1.1 Limits of Radiated Emission and Bandedge Measurement

##### For WLAN/BT:

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
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. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

##### Limits of unwanted emission out of the restricted bands

Applicable To		Limit	
789033 D02 General UNII Test Procedure New Rules v02r01		Field Strength at 3m	
		PK: 74 (dBµV/m)	AV: 54 (dBµV/m)
Frequency Band	Applicable To	EIRP Limit	Equivalent Field Strength at 3m
5150~5250 MHz	15.407(b)(1)	PK: -27 (dBm/MHz)	PK: 68.2(dBµV/m)
5250~5350 MHz	15.407(b)(2)		
5470~5725 MHz	15.407(b)(3)		
5725~5850 MHz	<input checked="" type="checkbox"/> 15.407(b)(4)(i)	PK: -27 (dBm/MHz) <sup>*1</sup> PK: 10 (dBm/MHz) <sup>*2</sup> PK: 15.6 (dBm/MHz) <sup>*3</sup> PK: 27 (dBm/MHz) <sup>*4</sup>	PK: 68.2(dBµV/m) <sup>*1</sup> PK: 105.2 (dBµV/m) <sup>*2</sup> PK: 110.8(dBµV/m) <sup>*3</sup> PK: 122.2 (dBµV/m) <sup>*4</sup>
	<input type="checkbox"/> 15.407(b)(4)(ii)	Emission limits in section 15.247(d)	
<sup>*1</sup> beyond 75 MHz or more above of the band edge.		<sup>*2</sup> below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above.	
<sup>*3</sup> below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above.		<sup>*4</sup> from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.	

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

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

**For WWAN**

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB. The emission limit equal to  $-13\text{dBm}$ .



#### 4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer ROHDE & SCHWARZ	FSV40	100979	Mar. 25, 2022	Mar. 24, 2023
Test Receiver KEYSIGHT	N9038A	MY55420137	Apr. 27, 2022	Apr. 26, 2023
Spectrum Analyzer ROHDE & SCHWARZ	FSW43	101867	Jan. 07, 2022	Jan. 06, 2023
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-1169	Nov. 14, 2021	Nov. 13, 2022
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Oct. 26, 2021	Oct. 25, 2022
Loop Antenna TESEQ	HLA 6121	45745	Jul. 27, 2022	Jul. 26, 2023
Preamplifier Agilent (Below 1GHz)	8447D	2944A10638	May 14, 2022	May 13, 2023
Preamplifier Agilent (Above 1GHz)	8449B	3008A01962	Oct. 05, 2021	Oct. 04, 2022
RF signal cable HUBER+SUHNER&EMCI	SUCOFLEX 104 & EMC104-SM-SM8 000	CABLE-CH9-02 (248780+171006)	Jan. 15, 2022	Jan. 14, 2023
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-(250795/4)	Jan. 15, 2022	Jan. 14, 2023
RF signal cable Woken	8D-FB	Cable-CH9-01	May 14, 2022	May 13, 2023
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower &Turn BV ADT	AT100	AT93021705	NA	NA
Turn Table BV ADT	TT100	TT93021705	NA	NA
Turn Table Controller BV ADT	SC100	SC93021705	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Pre-amplifier (18GHz-40GHz) EMC	EMC184045B	980175	Sep. 04, 2021	Sep. 03, 2022
Peak Power Analyzer KEYSIGHT	8990B	MY51000485	Jan. 18, 2022	Jan. 17, 2023
Wideband Power Sensor KEYSIGHT	N1923A	MY58020002	Jan. 17, 2022	Jan. 16, 2023

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.  
2. The test was performed in HwaYa Chamber 9.

### 4.1.3 Test Procedures

#### For WLAN/BT

##### For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

##### Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

##### For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

##### Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98%) or 10Hz (Duty cycle  $\geq 98\%$ ) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

#### For WWAN

- a. In the semi-anechoic chamber, EUT placed on the 0.8m (below or equal 1GHz) and/or 1.5m (above 1GHz) height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power. The “Read Value” is the spectrum reading the maximum power value.
- b. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- c. Perform a field strength measurement and record the worse read value, is the field strength value via a spectrum reading obtained corrected for antenna factor, cable loss and pre-amplifier factor and then mathematically convert the measured field strength level to EIRP/ERP level.
- d. Following C63.26 section 5.5 and 5.2.7
  - $EIRP (dBm) = E (dB\mu V/m) + 20\log(D) - 104.8$ ; where D is the measurement distance (in the far field region) in m.
  - $ERP (dBm) = E (dB\mu V/m) + 20\log(D) - 104.8 - 2.15$ ; where D is the measurement distance (in the far field region) in m.

Note:

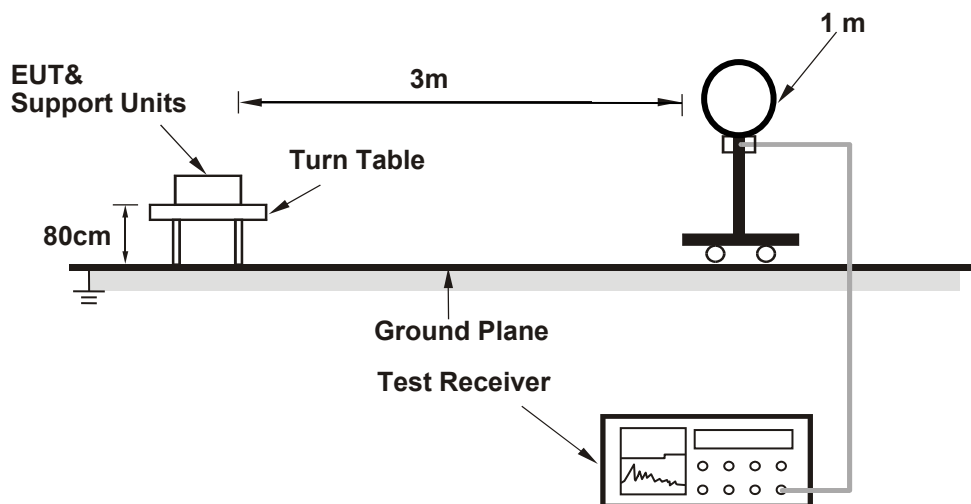
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.
2. The emission levels were against the limit of frequency range 9 kHz ~ 30 MHz:  
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

#### 4.1.4 Deviation from Test Standard

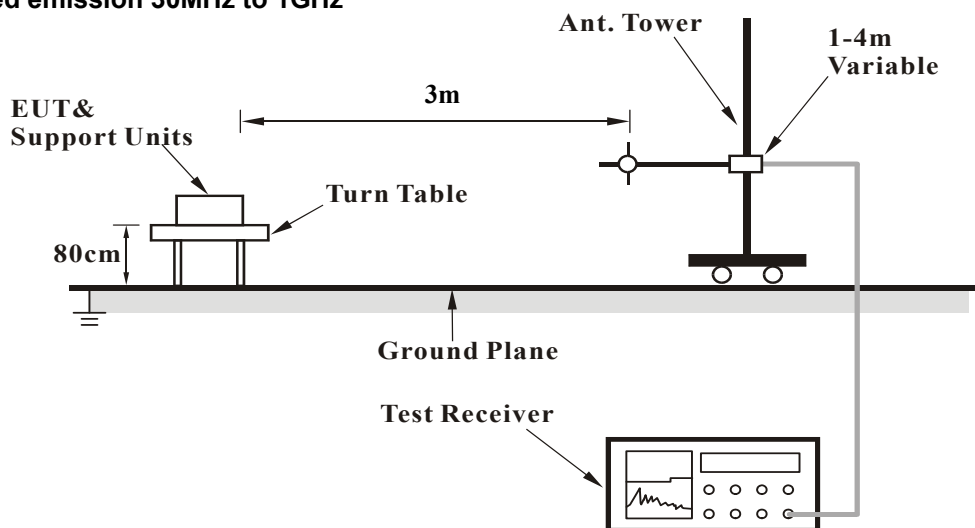
No deviation.

#### 4.1.5 Test Setup

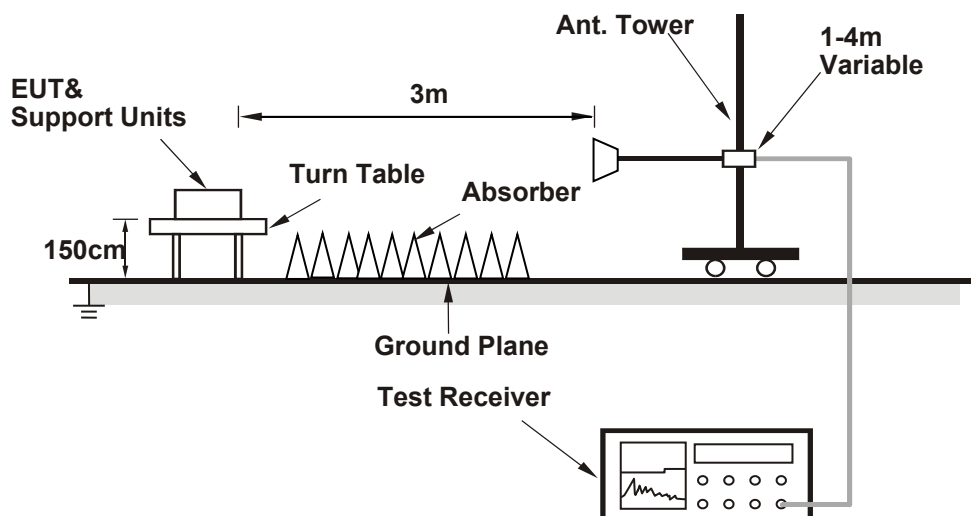
##### For Radiated emission below 30MHz



##### For Radiated emission 30MHz to 1GHz



### For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.1.6 EUT Operating Conditions

- a. Placed the EUT on the testing table.
- b. Prepared a notebook to act as a communication partner and placed it outside of testing area.
- c. The communication partner connected with EUT via a RJ45 cable and ran a test program (provided by manufacturer) to enable EUT under transmission condition continuously at specific channel frequency.

#### 4.1.7 Test Results

Above 1GHz Data:

802.11b + 802.11a + Bluetooth LE 2M + WCDMA Band 5

RF Mode	TX 802.11b	Channel	CH 6 : 2437 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	117.00 PK			1.66 H	319	84.20	32.80
2	*2437.00	114.30 AV			1.66 H	319	81.50	32.80
3	4874.00	49.60 PK	74.00	-24.40	3.11 H	245	44.00	5.60
4	4874.00	40.60 AV	54.00	-13.40	3.11 H	245	35.00	5.60
5	7311.00	58.20 PK	74.00	-15.80	1.68 H	327	45.90	12.30
6	7311.00	52.40 AV	54.00	-1.60	1.68 H	327	40.10	12.30

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	107.10 PK			1.51 V	186	74.30	32.80
2	*2437.00	104.60 AV			1.51 V	186	71.80	32.80
3	4874.00	50.10 PK	74.00	-23.90	1.64 V	77	44.50	5.60
4	4874.00	42.20 AV	54.00	-11.80	1.64 V	77	36.60	5.60
5	7311.00	58.60 PK	74.00	-15.40	1.80 V	33	46.30	12.30
<b>6</b>	<b>7311.00</b>	<b>52.70 AV</b>	<b>54.00</b>	<b>-1.30</b>	<b>1.80 V</b>	<b>33</b>	<b>40.40</b>	<b>12.30</b>

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(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.

RF Mode	TX 802.11a	Channel	CH 157 : 5785 MHz
Frequency Range	1GHz ~ 40GHz	Detector Function	Peak (PK) Average (AV)

**Antenna Polarity & Test Distance : Horizontal at 3 m**

No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	#5635.60	56.10 PK	68.20	-12.10	1.05 H	86	50.08	6.02
2	*5785.00	117.50 PK			1.05 H	86	76.50	41.00
3	*5785.00	108.30 AV			1.05 H	86	67.30	41.00
4	#5973.60	57.00 PK	68.20	-11.20	1.05 H	86	50.09	6.91
5	11570.00	59.10 PK	74.00	-14.90	3.34 H	213	40.70	18.40
6	11570.00	45.30 AV	54.00	-8.70	3.34 H	213	26.90	18.40

**Antenna Polarity & Test Distance : Vertical at 3 m**

No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	#5624.40	56.10 PK	68.20	-12.10	3.95 V	11	50.11	5.99
2	*5785.00	113.80 PK			3.95 V	11	72.80	41.00
3	*5785.00	104.30 AV			3.95 V	11	63.30	41.00
4	#5972.40	57.10 PK	68.20	-11.10	3.95 V	11	50.19	6.91
5	11570.00	58.70 PK	74.00	-15.30	2.86 V	324	40.30	18.40
6	11570.00	44.90 AV	54.00	-9.10	2.86 V	324	26.50	18.40

**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(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.

RF Mode	TX BT-LE 2M	Channel	CH 19 : 2440 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2440.00	109.20 PK			1.18 H	288	76.40	32.80
2	*2440.00	106.40 AV			1.18 H	288	73.60	32.80
3	4880.00	47.80 PK	74.00	-26.20	2.57 H	334	42.30	5.50
4	4880.00	35.10 AV	54.00	-18.90	2.57 H	334	29.60	5.50

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2440.00	117.40 PK			2.33 V	157	84.60	32.80
2	*2440.00	114.30 AV			2.33 V	157	81.50	32.80
3	4880.00	50.20 PK	74.00	-23.80	1.65 V	204	44.70	5.50
4	4880.00	40.40 AV	54.00	-13.60	1.65 V	204	34.90	5.50

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(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.



CHANNEL		CH 4182						
Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1672.80	-54.13	-13.00	-41.13	2.08 H	296	48.36	-102.49
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1672.80	-47.54	-13.00	-34.54	1.55 V	169	52.80	-100.34

Remarks:

1.  $ERP(dBm) = Raw\ Value(dBuV) + Correction\ Factor(dB/m)$
2.  $Correction\ Factor(dB/m) = Antenna\ Factor(dB/m) + Cable\ Factor(dB) - Pre-Amplifier\ Factor(dB) + 20\log(D) - 104.8 - 2.15$
3.  $Margin\ value = ERP - Limit\ value$
4. The other ERP levels were very low against the limit.

Below 1GHz data

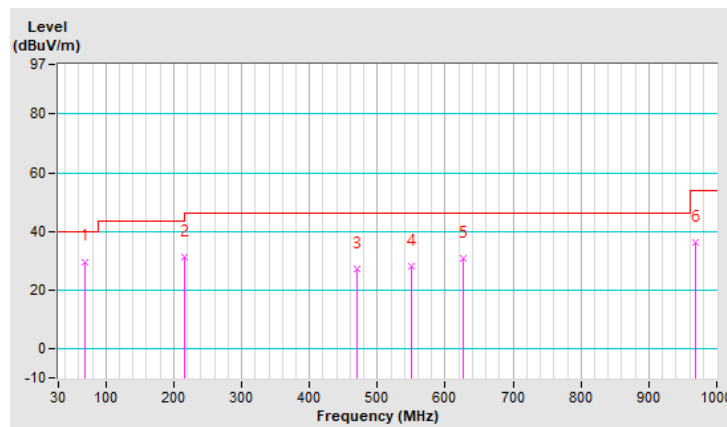
802.11b + 802.11a + Bluetooth LE 2M + WCDMA Band 5

CHANNEL	CH 6 + CH 157 + CH 19	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 m								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	68.80	29.70 QP	40.00	-10.30	1.00 H	81	40.70	-11.00
2	216.24	31.10 QP	46.00	-14.90	1.25 H	109	42.30	-11.20
3	470.38	27.00 QP	46.00	-19.00	1.00 H	124	30.10	-3.10
4	549.92	28.30 QP	46.00	-17.70	2.00 H	338	29.90	-1.60
5	625.58	30.60 QP	46.00	-15.40	2.00 H	134	30.60	0.00
6	967.99	36.20 QP	54.00	-17.80	1.00 H	280	29.90	6.30

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(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report

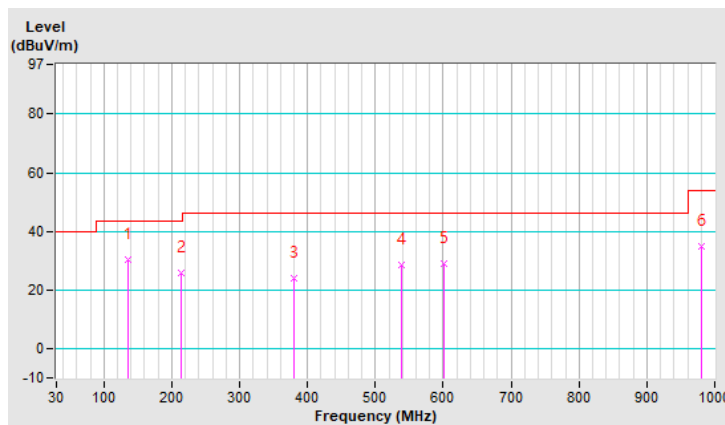


CHANNEL	CH 6 + CH 157 + CH 19	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 m								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	135.73	30.20 QP	43.50	-13.30	1.00 V	29	39.90	-9.70
2	214.30	25.80 QP	43.50	-17.70	1.50 V	75	37.00	-11.20
3	380.17	24.00 QP	46.00	-22.00	1.50 V	38	29.40	-5.40
4	538.28	28.70 QP	46.00	-17.30	1.00 V	285	30.50	-1.80
5	600.36	29.00 QP	46.00	-17.00	1.50 V	82	29.40	-0.40
6	979.63	35.10 QP	54.00	-18.90	2.00 V	10	28.80	6.30

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(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report

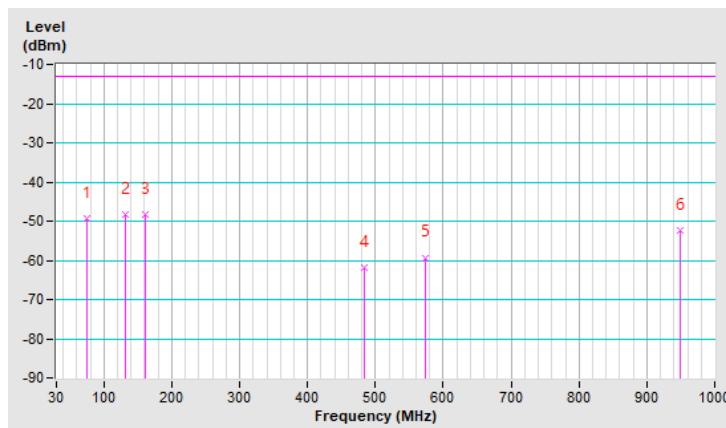


CHANNEL	CH 4182	FREQUENCY RANGE	Below 1000 MHz
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Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	75.59	-49.31	-13.00	-36.31	1.50 H	158	60.55	-109.86
2	130.88	-48.21	-13.00	-35.21	1.50 H	139	59.31	-107.52
3	160.95	-48.34	-13.00	-35.34	1.00 H	255	57.80	-106.14
4	483.96	-62.00	-13.00	-49.00	1.00 H	223	38.31	-100.31
5	574.17	-59.32	-13.00	-46.32	1.00 H	349	39.09	-98.41
6	948.59	-52.35	-13.00	-39.35	2.00 H	19	38.96	-91.31

Remarks:

1.  $ERP(dBm) = Raw\ Value(dBuV) + Correction\ Factor(dB/m)$
2.  $Correction\ Factor(dB/m) = Antenna\ Factor(dB/m) + Cable\ Factor(dB) - Pre-Amplifier\ Factor(dB) + 20\log(D) - 104.8 - 2.15$
3.  $Margin\ value = ERP - Limit\ value$
4. The other ERP levels were very low against the limit.

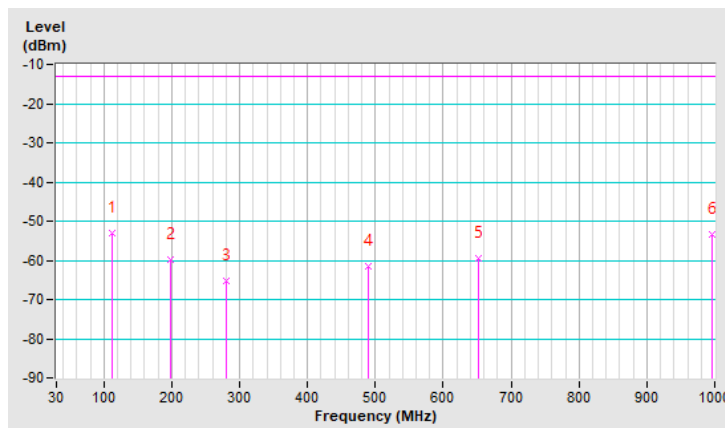


CHANNEL	CH 4182	FREQUENCY RANGE	Below 1000 MHz
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Antenna Polarity & Test Distance : Vertical at 3m								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	112.45	-53.01	-13.00	-40.01	1.50 V	294	56.33	-109.34
2	197.81	-59.81	-13.00	-46.81	1.00 V	52	49.21	-109.02
3	280.26	-65.18	-13.00	-52.18	1.50 V	63	39.68	-104.86
4	489.78	-61.67	-13.00	-48.67	1.25 V	10	38.48	-100.15
5	651.77	-59.38	-13.00	-46.38	1.00 V	347	37.76	-97.14
6	995.15	-53.43	-13.00	-40.43	1.25 V	176	37.97	-91.40

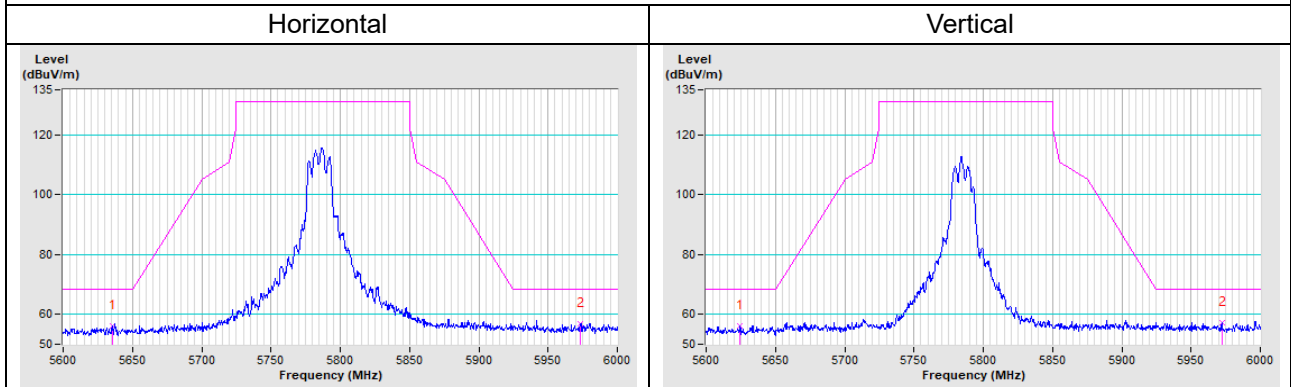
Remarks:

1.  $ERP(dBm) = Raw\ Value(dBuV) + Correction\ Factor(dB/m)$
2.  $Correction\ Factor(dB/m) = Antenna\ Factor(dB/m) + Cable\ Factor(dB) - Pre-Amplifier\ Factor(dB) + 20\log(D) - 104.8 - 2.15$
3.  $Margin\ value = ERP - Limit\ value$
4. The other ERP levels were very low against the limit.



### Annex A - Radiated Out of Band Emission (OOBE) Measurement (For U-NII-3 band)

802.11a CH 157 : 5785 MHz



## 5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

## Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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### Hsin Chu EMC/RF/Telecom Lab

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**Web Site:** [www.bureauveritas-adt.com](http://www.bureauveritas-adt.com)

The address and road map of all our labs can be found in our web site also.

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