Report No.:	RF190122E02-3
FCC ID:	PKRNVWSKR5MD8800
Test Model:	SKR5MD8800
Received Date:	Jan. 15, 2019
Test Date:	Jan. 19 to 25, 2019
Issued Date:	Mar. 06, 2019
Applicant:	Inseego Corp.
Address:	9605 Scranton Road Suite 300, San Diego, CA 92121 United States
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
Lab Address:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.
Test Location:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.
FCC Registration / Designation Number:	723255 / TW2022

Table of Contents

Release Control Record

Issue No.	Description	Date Issued
RF190122E02-3	Original release.	Mar. 06, 2019

1 Certificate of Conformity

Product:	4G LTE Wireless Router
Brand:	Inseego
Test Model:	SKR5MD8800
Sample Status:	ENGINEERING SAMPLE
Applicant:	Inseego Corp.
Test Date:	Jan. 19 to 25, 2019
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) 47 CFR FCC Part 15, Subpart E (Section 15.407) 47 CFR FCC Part 22, Subpart H 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 EMC characteristics under the conditions specified in this report.

Prepared by : Phoenix Huang , **Date:** Mar. 06, 2019

Phoenix Huang / Specialist

Approved by : , **Date:** Mar. 06, 2019

May Chen / Manager

2 Summary of Test Results

FCC Part 15, Subpart C, E (SECTION 15.247, 15.407), Part 22, Subpart H			
FCC Clause	Test Item	Result	Remarks
15.207 15.407(b)(6)	AC Power Conducted Emission	PASS	Meet the requirement of limit. Minimum passing margin is -12.64dB at 0.42734MHz.
15.205 / 15.209 / 15.247(d) 15.407(b) (1/2/3/4(i/ii)/6)	Radiated Emissions and Band Edge Measurement	PASS	Meet the requirement of limit. Minimum passing margin is -6.2dB at 64.20MHz.
2.1053 22.917	Radiated Spurious Emissions	PASS	Meet the requirement of limit. Minimum passing margin is -36.84dB at 2474.1MHz.

Note:
Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.84 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	4.87 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	5.12 dB
	6GHz ~ 18GHz	4.86 dB
	18GHz ~ 40GHz	5.24 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	4G LTE Wireless Router
Brand	Inseego
Test Model	SKR5MD8800
Status of EUT	ENGINEERING SAMPLE
Power Supply Rating	12Vdc ~ 24Vdc
Modulation Type	**For WLAN:** CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 256QAM for OFDM in 11ac mode and VHT (20/40) mode in 2.4GHz **For BT-LE:** DTS
Modulation Technology	**For WLAN:** DSSS, OFDM **For BT-LE:** GFSK
Transfer Rate	**For WLAN:** 802.11b: up to 11Mbps 802.11a/g: up to 54Mbps 802.11n: up to 300Mbps 802.11ac: up to 866.7Mbps **For BT-LE:** up to 2Mbps
Operating Frequency	**For WLAN:** **2.4GHz:** 2.412 ~ 2.462GHz **5GHz:** 5.18~ 5.24GHz, 5.745 ~ 5.825GHz **For BT-LE:** 2.402 ~ 2.480GHz
Number of Channel	**For WLAN:** **2.4GHz:** 802.11b, 802.11g, 802.11n (HT20), VHT20: 11 802.11n (HT40), VHT40: 7 **5GHz:** 802.11a, 802.11n (HT20), 802.11ac (VHT20): 9 802.11n (HT40), 802.11ac (VHT40): 4 802.11ac (VHT80): 2 **For BT-LE:** 40
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. The EUT has below radios as following table:

Radio 1	Radio 2	Radio 3
WLAN (2.4GHz + 5GHz)	Bluetooth + GPS	WWAN

2. Simultaneously transmission condition.

Condition	Technology			
1	WLAN (2.4GHz)	WLAN (5GHz)	Bluetooth	WWAN

3. The EUT inside has one WWAN module which FCC ID: PKRNVWMD8800.

4. The antennas and antenna RF cables (option) provided to the EUT, please refer to the following table:

Antenna No.	Brand Name	Model Name	Antenna Gain (dBi)	Frequency Range	Antenna Type	Antenna Connector Type
WLAN_1	RF link	RF21S00506AX1	4.11	2.4~2.4835 GHz	Dipole	R-SMA
			6.12	5.15~5.85 GHz		
WLAN_2	M.gear	C037-511343-A	4.11	2.4~2.4835 GHz	Dipole	R-SMA
			6.12	5.15~5.85 GHz		
BT_ANT	RF link	RF21S00506AX1	4.11	2,402~2,480 GHz	Dipole	R-SMA
WWAN_1_1	-	SWX-614XRSXX-999	2.1	1850 MHz to 1910 MHz	Dipole	SMA
			1.8	1710 MHz to 1755 MHz		
			1.8	824 MHz to 849 MHz		
			2.7	2500 MHz to 2570 MHz		
			0.4	777 MHz to 787 MHz		
			0.4	788 MHz to 798 MHz		
			1.8	1710 MHz to 1780 MHz		
WWAN_1_2	-	SWX-614XRSXX-999	2.1	1850 MHz to 1910 MHz	Dipole	SMA
			1.8	1710 MHz to 1755 MHz		
			1.8	824 MHz to 849 MHz		
			2.7	2500 MHz to 2570 MHz		
			0.4	777 MHz to 787 MHz		
			0.4	788 MHz to 798 MHz		
			1.8	1710 MHz to 1780 MHz		
WWAN_2_1	-	SWX-6141SAXX-508	3.56	3550 MHz to 3700 MHz	Dipole	SMA
WWAN_2_2	-	SWX-6141SAXX-508	3.56	3550 MHz to 3700 MHz	Dipole	SMA
WWAN_3_1 (Rx only)	-	RF21S00773A	3.5	5.15~5.85 GHz	Dipole	SMA
WWAN_3_2 (Rx only)	-	RF21S00773A	3.5	5.15~5.85 GHz	Dipole	SMA
GPS_ANT	-	-	2.4	1575.4	Dipole	SMA

Antenna RF Cable (Option)			
	Cable Loss (dB)	Frequency Range	Cable Connector Type
For WLAN & BT	3.5	1850 MHz to 1910 MHz	R-SMA
	3.5	1710 MHz to 1755 MHz	
	2.5	824 MHz to 849 MHz	
	4.5	2.4~2.4835 GHz	
	4.5	2500 MHz to 2570 MHz	
	2.5	777 MHz to 787 MHz	
	2.5	788 MHz to 798 MHz	
	3.5	1710 MHz to 1780 MHz	
	4.5	3550 MHz to 3700 MHz	
	6.93	5.15~5.85GHz	
	Cable Loss (dB)	Frequency Range	Cable Connector Type
For WWAN & GPS	3.5	1850 MHz to 1910 MHz	SMA
	3.5	1710 MHz to 1755 MHz	
	2.5	824 MHz to 849 MHz	
	4.5	2.4~2.4835 GHz	
	4.5	2500 MHz to 2570 MHz	
	2.5	777 MHz to 787 MHz	
	2.5	788 MHz to 798 MHz	
	3.5	1710 MHz to 1780 MHz	
	4.5	3550 MHz to 3700 MHz	
	6.93	5.15~5.85GHz	

5. The EUT was pre-tested under the following modes:

For Radiated Emission test	
Pre-test Mode	Description
Mode A	**EUT (Y plane) without antenna cable: 12Vdc power from adapter**
Mode B	EUT (X plane) without antenna cable: 12Vdc power from adapter
Mode C	EUT (X plane) without antenna cable: 12Vdc power from power supply
Mode D	EUT (X plane) without antenna cable: 24Vdc power from power supply
Mode E	EUT (Y plane) with antenna cable: 12Vdc power from adapter
From the above modes, the worst case was found in **Mode A**. Therefore only the test data of the mode was recorded in this report.	
For AC Power Conducted Emission test	
Pre-test Mode	Description
Mode F	**12Vdc power from adapter**
Mode G	12Vdc power from power supply
Mode H	24Vdc power from power supply
From the above modes, the worst case was found in **Mode F**. Therefore only the test data of the mode was recorded in this report.	

6. The EUT incorporates a MIMO function.

2.4GHz Band		
MODULATION MODE	**TX & RX CONFIGURATION**	
802.11b	2TX	2RX
802.11g	2TX	2RX
802.11n (HT20)	2TX	2RX
802.11n (HT40)	2TX	2RX
VHT20	2TX	2RX
VHT40	2TX	2RX
5GHz Band		
MODULATION MODE	**TX & RX CONFIGURATION**	
802.11a	2TX	2RX
802.11n (HT20)	2TX	2RX
802.11n (HT40)	2TX	2RX
802.11ac (VHT20)	2TX	2RX
802.11ac (VHT40)	2TX	2RX
802.11ac (VHT80)	2TX	2RX
Note: All of modulation mode support beamforming function except 802.11a/b/g modulation mode.		

7. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.1.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE≥1G	RE<1G	PLC	OB	
-	√	√	√	√	-

Where **RE≥1G:** Radiated Emission above 1GHz & Bandedge Measurement **RE<1G:** Radiated Emission below 1GHz

PLC: Power Line Conducted Emission **OB:** Conducted Out-Band Emission Measurement

Note: The EUT had been pre-tested on the positioned of each 2 axis. The worst case was found when positioned on **Y-plane**.

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.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
802.11b + 802.11ac (VHT40) + Technology LE 1M (BT 4.0) + LTE Band 5 (1.4MHz)	1 to 11	6	DSSS	DBPSK
	36 to 48, 149 to 165	159	OFDM	BPSK
	0 to 39	19	DTS	GFSK
	20407 to 20643	20407	OFDMA	QPSK

Radiated Emission Test (Below 1GHz):

☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
802.11b + 802.11ac (VHT40) + Technology LE 1M (BT 4.0) + LTE Band 5 (1.4MHz)	1 to 11	6	DSSS	DBPSK
	36 to 48, 149 to 165	159	OFDM	BPSK
	0 to 39	19	DTS	GFSK
	20407 to 20643	20407	OFDMA	QPSK

Power Line Conducted Emission Test:

☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
802.11b + 802.11ac (VHT40) + Technology LE 1M (BT 4.0) + LTE Band 5 (1.4MHz)	1 to 11	6	DSSS	DBPSK
	36 to 48, 149 to 165	159	OFDM	BPSK
	0 to 39	19	DTS	GFSK
	20407 to 20643	20407	OFDMA	QPSK

Conducted Out-Band Emission Measurement:

☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
802.11b + 802.11ac (VHT40)	1 to 11	6	DSSS	DBPSK
	36 to 48, 149 to 165	159	OFDM	BPSK

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER (SYSTEM)	TESTED BY
RE≥1G	22deg. C, 67%RH	120Vac, 60Hz	Rey Chen
	23deg. C, 68%RH	120Vac, 60Hz	Andy Ho
RE<1G	22deg. C, 69%RH	120Vac, 60Hz	Rey Chen
PLC	23deg. C, 74%RH	120Vac, 60Hz	Andy Ho
OB	25deg. C, 60%RH	120Vac, 60Hz	Anderson Chen

3.2 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.

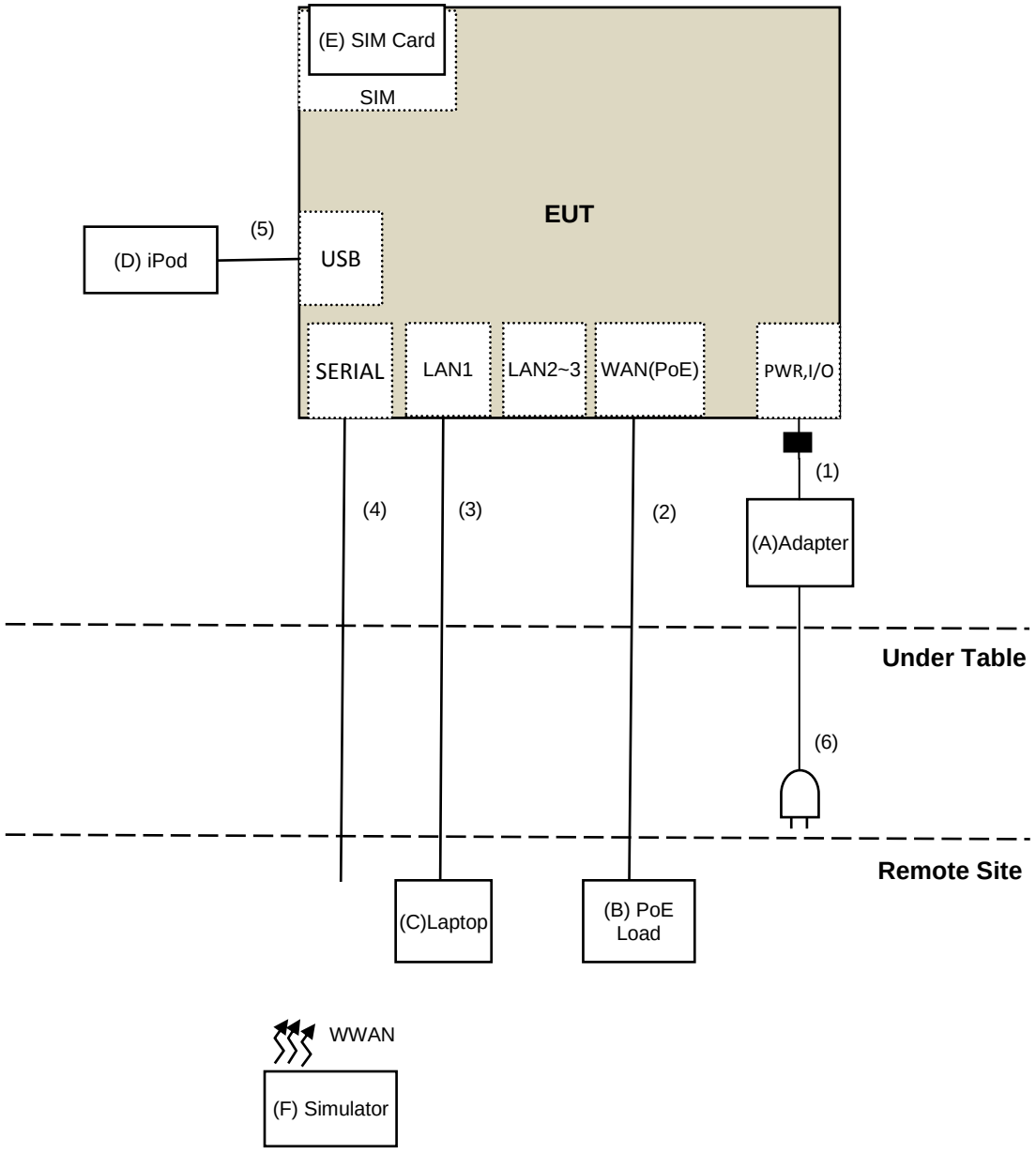
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Adapter	CWT	2ABF060F	NA	NA	Supplied by client
B.	PoE Load	Luxul	XAP-1440	NA	NA	Supplied by client
C.	Laptop	DELL	E6420	B92T3R1	FCC DoC	Provided by Lab
D.	iPod	Apple	MC749TA/A	CC4DN25WDFDM	NA	Provided by Lab
E.	SIM Card	R&S	CRT-Z3	NA	NA	Provided by Lab
F.	Simulator	Anritsu	MT8820C	6201127458	NA	Provided by Lab

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	DC Cable	1	1.2	No	1	Supplied by client
2.	RJ-45 Cable	1	10	No	0	Provided by Lab
3.	RJ-45 Cable	1	10	No	0	Provided by Lab
4.	RJ-45 Cable	1	10	No	0	Provided by Lab
5.	USB Cable	1	0.1	Yes	0	Provided by Lab
6.	AC Cable	1	0.8	No	0	Supplied by client

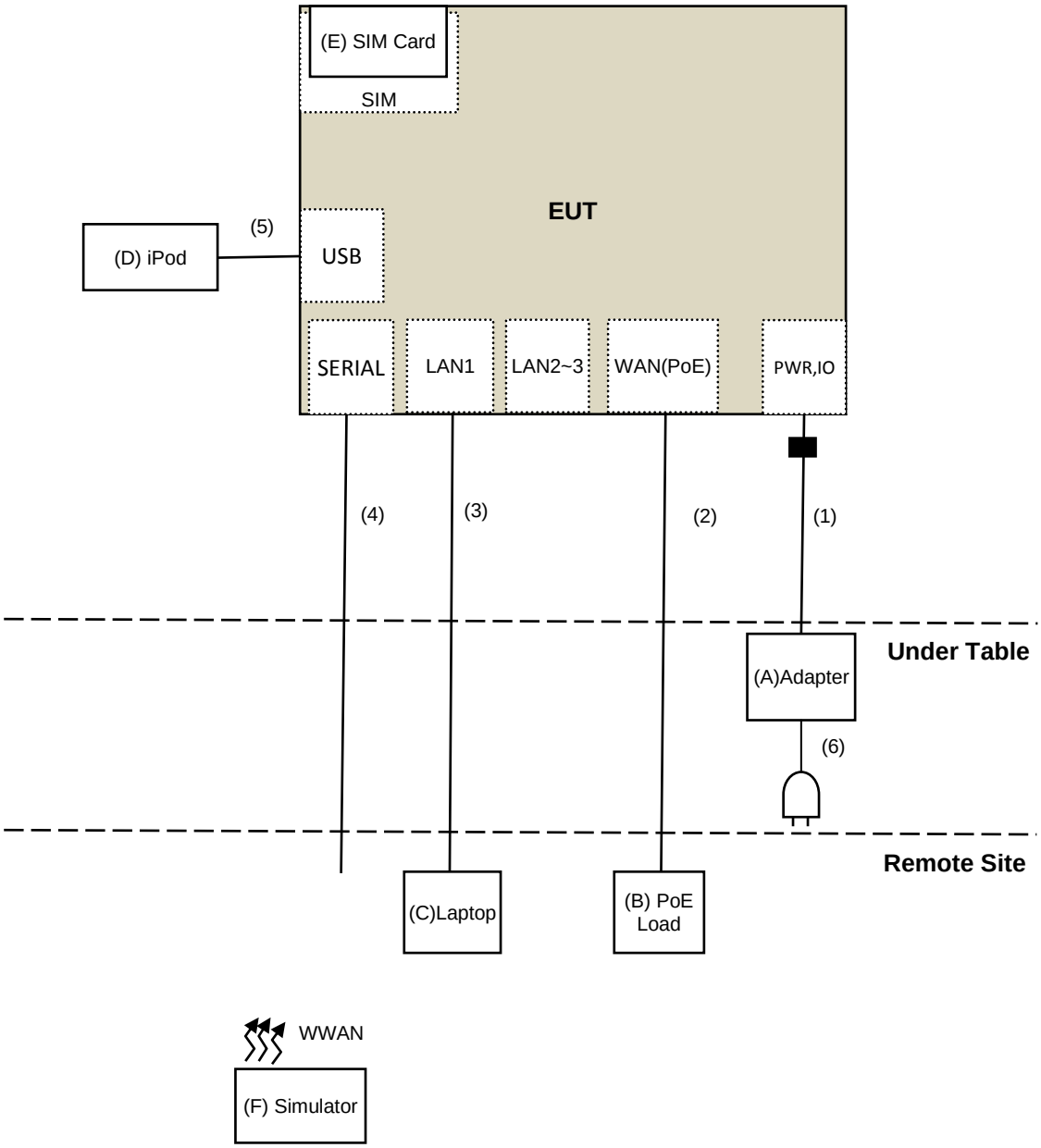
Note: The core(s) is(are) originally attached to the cable(s).

3.2.1 Configuration of System under Test

For Power Line Conducted Emission test:



For other test:



4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

For 47 CFR FCC Part 15:

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

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

Note:

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).

For 47 CFR FCC Part 22:

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 –13dBm.

4.1.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Keysight	N9038A	MY54450088	July 05, 2018	July 04, 2019
Pre-Amplifier EMCI	EMC001340	980142	Feb. 09, 2018	Feb. 08, 2019
Loop Antenna Electro-Metrics	EM-6879	269	Sep. 07, 2018	Sep. 06, 2019
RF Cable	NA	LOOPCAB-001	Jan. 14, 2019	Jan. 13, 2020
RF Cable	NA	LOOPCAB-002	Jan. 14, 2019	Jan. 13, 2020
Pre-Amplifier Mini-Circuits	ZFL-1000VH2B	AMP-ZFL-01	Oct. 30, 2018	Oct. 29, 2019
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-406	Nov. 22, 2018	Nov. 21, 2019
RF Cable	8D	966-4-1	Mar. 21, 2018	Mar. 20, 2019
RF Cable	8D	966-4-2	Mar. 21, 2018	Mar. 20, 2019
RF Cable	8D	966-4-3	Mar. 21, 2018	Mar. 20, 2019
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-3m-4-01	Sep. 27, 2018	Sep. 26, 2019
Horn_Antenna SCHWARZBECK	BBHA 9120D	9120D-783	Nov. 25, 2018	Nov. 24, 2019
Pre-Amplifier Mini-Circuits	ZVA-183-S+	AMP-ZVA-03	May 10, 2018	May 09, 2019
RF Cable	EMC104-SM-SM-1200	160923	Jan. 29, 2018	Jan. 28, 2019
RF Cable	EMC104-SM-SM-2000	150318	Jan. 29, 2018	Jan. 28, 2019
RF Cable	EMC104-SM-SM-5000	150321	Jan. 29, 2018	Jan. 28, 2019
Pre-Amplifier EMCI	EMC184045SE	980387	Jan. 29, 2018	Jan. 28, 2019
Horn_Antenna SCHWARZBECK	BBHA 9170	BBHA9170608	Nov. 25, 2018	Nov. 24, 2019
RF Cable	EMC102-KM-KM-1200	160925	Jan. 29, 2018	Jan. 28, 2019
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Boresight Antenna Tower & Turn Table Max-Full	MF-7802BS	MF780208530	NA	NA
Spectrum Analyzer R&S	FSV40	100964	June 20, 2018	June 19, 2019
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	Apr. 16, 2018	Apr. 15, 2019

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 966 Chamber No. 4.
3. The CANADA Site Registration No. is 20331-2
4. Tested Date: Jan. 19 to 25, 2019

4.1.3 Test Procedures

For 47 CFR FCC Part 15:

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 ≥ 1/T (Duty cycle < 98%) or 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

For 47 CFR FCC Part 22:

a. The power was measured with Spectrum Analyzer.

b. Substitution method is used for EIRP measurement. In the semi-anechoic chamber, EUT placed on the 0.8m/1.5m 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.

c. The substitution antenna is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a TX cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to “Read Value “ of step b. Record the power level of S.G

d. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution antenna.

e. ERP power can be calculated form EIRP power by subtracting the gain of dipole, ERP power = EIRP power - 2.15dBi.

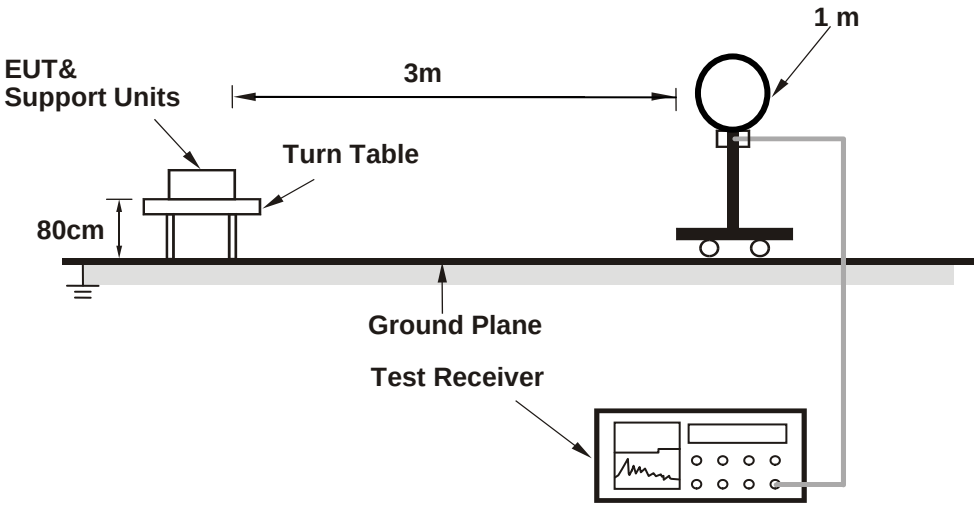
Note: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.

4.1.4 Deviation from Test Standard

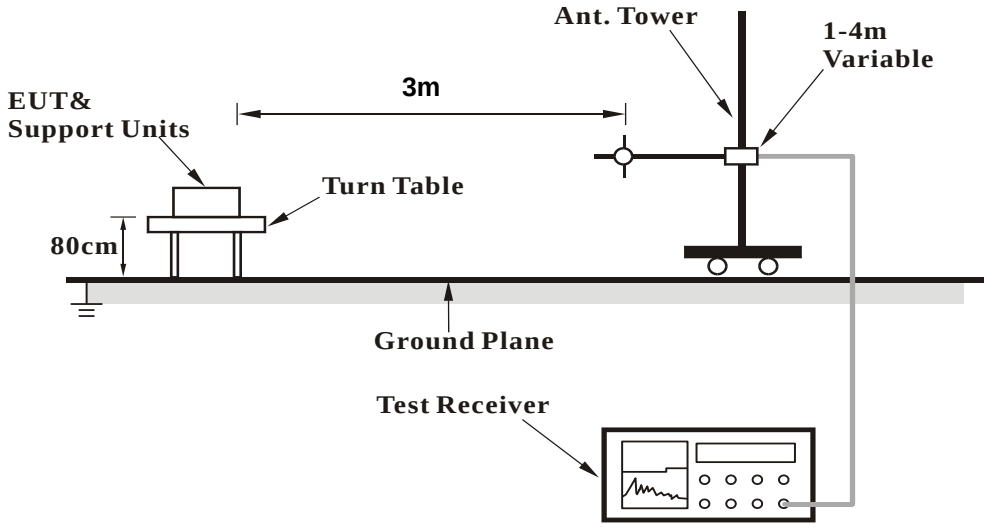
No deviation.

4.1.5 Test Setup

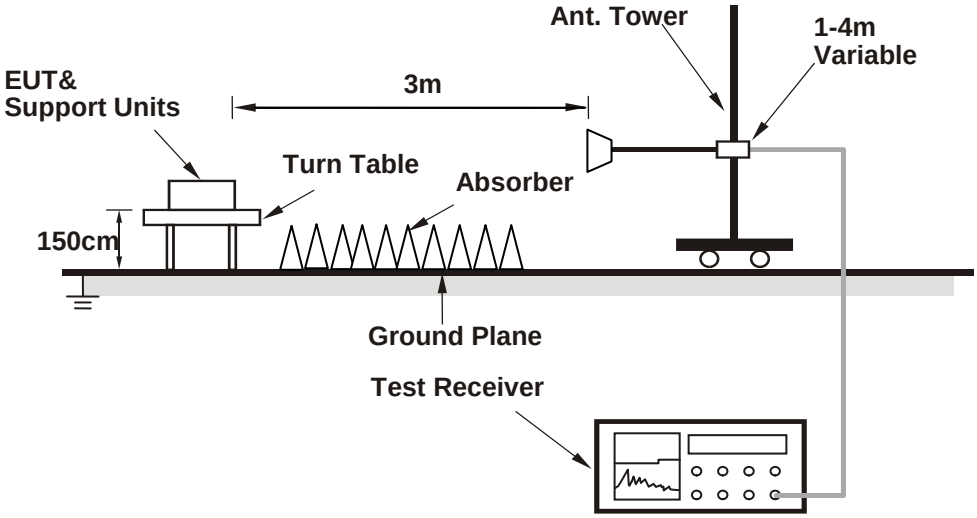
For Radiated emission below 30MHz



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. Connected the EUT with the Laptop which is placed on remote site.
b. Contorlling software (WLAN: QDART-Connectivity (1.0.38), BT 4.0: nRFgo Studio (1.21.2) / BT 5.0: termite 3.4) has been activated to set the EUT on specific status.

4.1.7 Test Results

Above 1GHz Data:

FREQUENCY RANGE	1GHz ~ 40GHz	DETECTOR FUNCTION	Peak (PK) Average (AV)

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	4874.00	40.3 PK	74.0	-33.7	1.59 H	325	38.3	2.0
2	4874.00	34.2 AV	54.0	-19.8	1.59 H	325	32.2	2.0
3	4880.00	37.9 PK	74.0	-36.1	1.60 H	292	35.9	2.0
4	4880.00	27.3 AV	54.0	-26.7	1.60 H	292	25.3	2.0
5	7311.00	42.6 PK	74.0	-31.4	1.32 H	311	34.1	8.5
6	7311.00	34.7 AV	54.0	-19.3	1.32 H	311	26.2	8.5
7	7320.00	44.1 PK	74.0	-29.9	2.45 H	283	35.6	8.5
8	7320.00	32.4 AV	54.0	-21.6	2.45 H	283	23.9	8.5
9	11590.00	46.5 PK	74.0	-27.5	2.23 H	242	32.9	13.6
10	11590.00	34.8 AV	54.0	-19.2	2.23 H	242	21.2	13.6
11	17385.00	47.7 PK	68.2	-20.5	2.56 H	359	29.8	17.9
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	4874.00	44.1 PK	74.0	-29.9	1.14 V	360	42.1	2.0
2	4874.00	40.5 AV	54.0	-13.5	1.14 V	360	38.5	2.0
3	4880.00	39.4 PK	74.0	-34.6	1.42 V	316	37.4	2.0
4	4880.00	28.2 AV	54.0	-25.8	1.42 V	316	26.2	2.0
5	7311.00	44.8 PK	74.0	-29.2	2.40 V	327	36.3	8.5
6	7311.00	36.6 AV	54.0	-17.4	2.40 V	327	28.1	8.5
7	7320.00	43.7 PK	74.0	-30.3	1.19 V	73	35.2	8.5
8	7320.00	31.4 AV	54.0	-22.6	1.19 V	73	22.9	8.5
9	11590.00	47.2 PK	74.0	-26.8	1.82 V	108	33.6	13.6
10	11590.00	35.7 AV	54.0	-18.3	1.82 V	108	22.1	13.6
11	17385.00	47.9 PK	68.2	-20.3	1.43 V	247	30.0	17.9

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.
4. Margin value = Emission Level – Limit value

Mode	TX channel 20407	Frequency Range	Above 1000 MHz

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	Emission Value (dBm)	Limit (dBm)	Margin (dB)
1	1649.4	45.94	-56.64	6.27	-50.38	-13	-37.38
2	**2474.1**	**42.02**	**-56.50**	**6.66**	**-49.84**	**-13**	**-36.84**
3	3298.8	36.94	-66.00	7.56	-58.44	-13	-45.44
4	6597.6	42.52	-73.61	18.37	-55.24	-13	-42.24
5	7422.3	45.36	-63.66	10.92	-52.74	-13	-39.74
6	8247	47.5	-53.60	2.66	-50.94	-13	-37.94
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	Emission Value (dBm)	Limit (dBm)	Margin (dB)
1	1649.4	41.62	-60.96	6.27	-54.70	-13	-41.70
2	2474.1	41.07	-57.45	6.66	-50.79	-13	-37.79
3	3298.8	36.77	-66.17	7.56	-58.61	-13	-45.61
4	6597.6	41.3	-74.83	18.37	-56.46	-13	-43.46
5	7422.3	43.27	-65.75	10.92	-54.83	-13	-41.83
6	8247	46.83	-54.27	2.66	-51.61	-13	-38.61

Remarks:
1. Emission Value (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

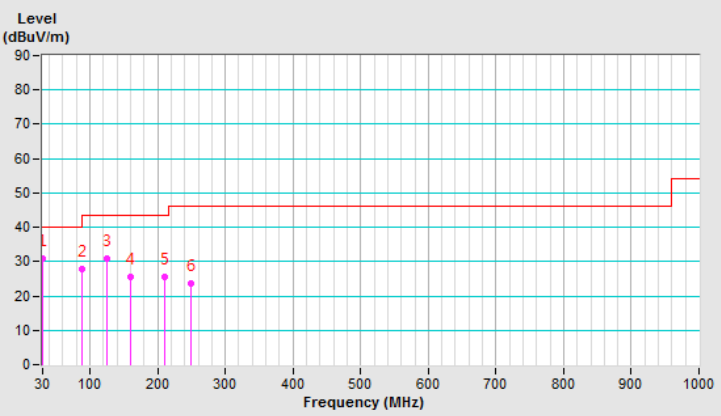
Below 1GHz Data:

FREQUENCY RANGE	9kHz ~ 1GHz	DETECTOR FUNCTION	Quasi-Peak (QP)

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	30.85	30.7 QP	40.0	-9.3	1.50 H	278	40.4	-9.7
2	88.49	27.9 QP	43.5	-15.6	1.00 H	345	41.3	-13.4
3	124.75	31.0 QP	43.5	-12.5	3.00 H	137	40.5	-9.5
4	160.78	25.6 QP	43.5	-17.9	1.50 H	157	33.5	-7.9
5	209.47	25.5 QP	43.5	-18.0	2.00 H	276	35.9	-10.4
6	249.99	23.6 QP	46.0	-22.4	1.50 H	115	32.3	-8.7

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 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.

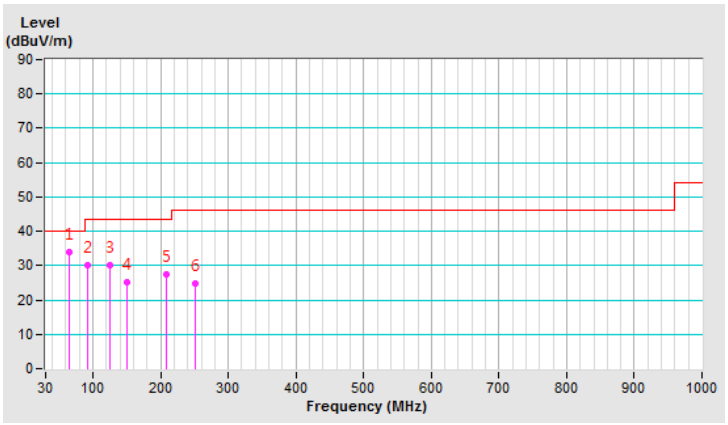


FREQUENCY RANGE	9kHz ~ 1GHz	DETECTOR FUNCTION	Quasi-Peak (QP)

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	**64.20**	**33.8 QP**	**40.0**	**-6.2**	**1.00 V**	**127**	**43.3**	**-9.5**
2	92.44	30.2 QP	43.5	-13.3	2.00 V	347	43.2	-13.0
3	124.93	30.1 QP	43.5	-13.4	1.50 V	301	39.5	-9.4
4	149.95	25.1 QP	43.5	-18.4	1.00 V	267	33.0	-7.9
5	209.13	27.5 QP	43.5	-16.0	1.50 V	229	37.9	-10.4
6	250.34	24.6 QP	46.0	-21.4	1.00 V	17	33.3	-8.7

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 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.



4.2 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1.The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.2.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver R&S	ESCS 30	847124/029	Oct. 24, 2018	Oct. 23, 2019
Line-Impedance Stabilization Network (for EUT) R&S	ESH3-Z5	848773/004	Oct. 22, 2018	Oct. 21, 2019
Line-Impedance Stabilization Network (for Peripheral) R&S	ENV216	100072	June 04, 2018	June 03, 2019
50 ohms Terminator	N/A	3	Oct. 22, 2018	Oct. 21, 2019
RF Cable	5D-FB	COCCAB-001	Sep. 28, 2018	Sep. 27, 2019
Fixed attenuator EMCI	STI02-2200-10	003	Mar. 16, 2018	Mar. 15, 2019
Software BVADT	BVADT_Cond_ V7.3.7.4	NA	NA	NA

Note:

1. The calibration interval of the above test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in Conduction 1.
3 Tested Date: Jan. 23, 2019

4.2.3 Test Procedures

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

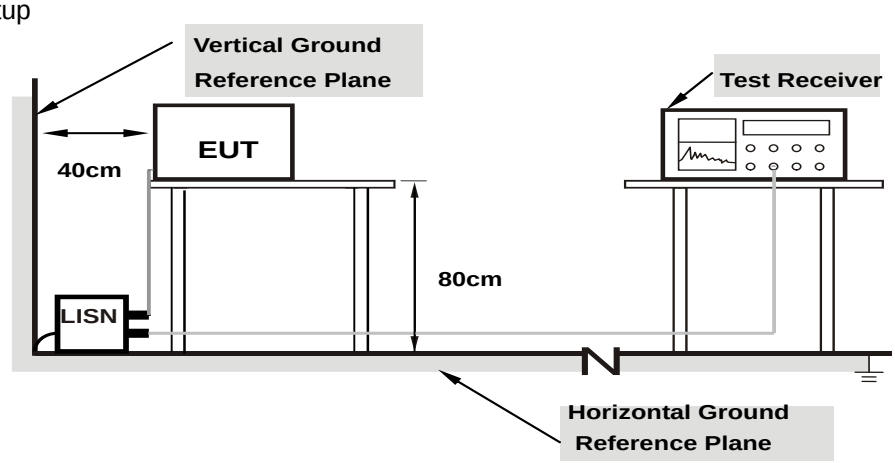
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



Note: 1.Support units were connected to second LISN.

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

4.2.6 EUT Operating Conditions

Same as 4.1.6.

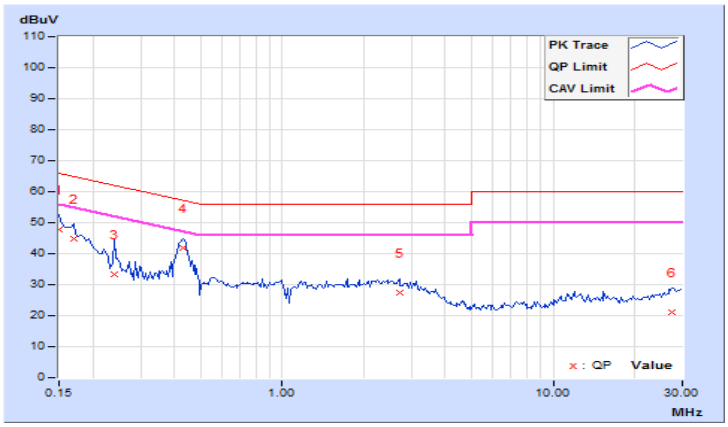
4.2.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.02	37.92	24.38	47.94	34.40	66.00	56.00	-18.06	-21.60
2	0.16953	10.03	34.65	22.43	44.68	32.46	64.98	54.98	-20.30	-22.52
3	0.23984	10.05	23.13	12.75	33.18	22.80	62.10	52.10	-28.92	-29.30
4	0.43125	10.07	31.82	24.51	41.89	34.58	57.23	47.23	-15.34	-12.65
5	2.71875	10.19	17.33	10.38	27.52	20.57	56.00	46.00	-28.48	-25.43
6	27.34766	11.18	9.94	4.32	21.12	15.50	60.00	50.00	-38.88	-34.50

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

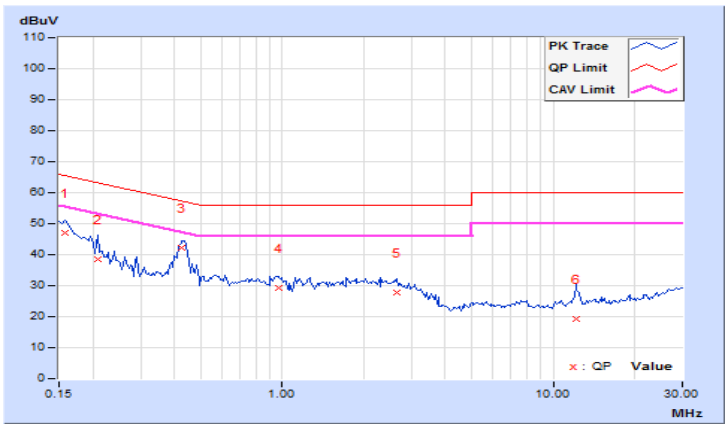


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15781	9.93	36.99	22.77	46.92	32.70	65.58	55.58	-18.66	-22.88
2	0.20859	9.94	28.66	15.04	38.60	24.98	63.26	53.26	-24.66	-28.28
3	**0.42734**	**9.96**	**32.09**	**24.70**	**42.05**	**34.66**	**57.30**	**47.30**	**-15.25**	**-12.64**
4	0.96641	9.99	19.18	12.29	29.17	22.28	56.00	46.00	-26.83	-23.72
5	2.64063	10.07	17.59	11.04	27.66	21.11	56.00	46.00	-28.34	-24.89
6	12.15234	10.49	8.69	1.78	19.18	12.27	60.00	50.00	-40.82	-37.73

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

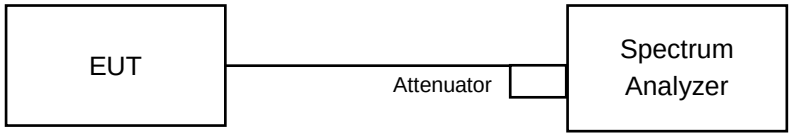


4.3 Conducted Out of Band Emission Measurement

4.3.1 Limits of Conducted Out of Band Emission Measurement

Below 30dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedures

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOBE

1. Set RBW = 100 kHz.
2. Set VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

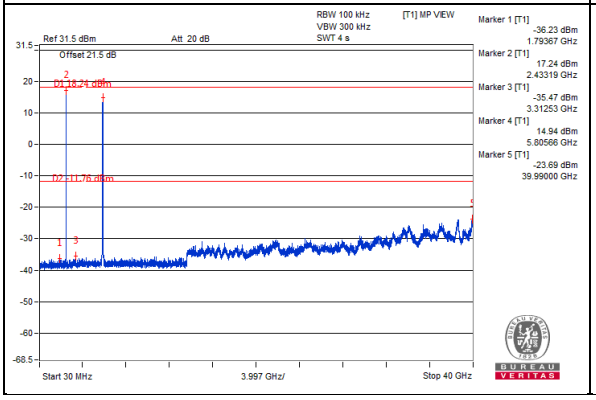
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.3.7 Test Results

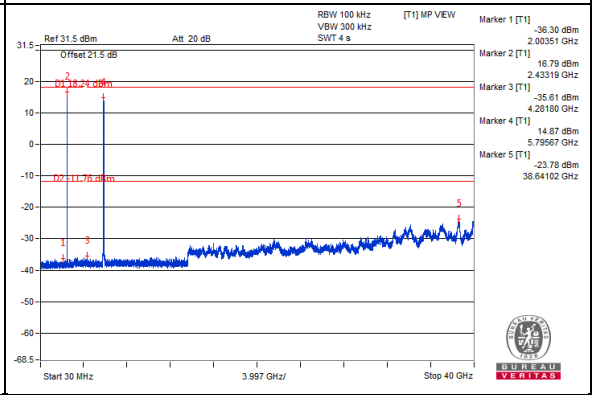
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 30dB offset below D1. It shows compliance with the requirement.

2.4GHz_802.11b CH6 + 5GHz_802.11ac (VHT40) CH159

Chain 0



Chain 1



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 according to ISO/IEC 17025.

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

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Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab
Tel: 886-3-6668565
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Web Site: 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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