Supplemental “Transmit Simultaneously” Test Report

Report No.:	RF160923E02G-2
FCC ID:	U8G-P1811AC
Test Model:	MAX HD2
Series Model:	MAX HD2 LTEA, MAX HD1 LTEA, Pismo 811AC, Pismo 811ac with 4SIMs Piggy, MAX-HD2-LTEA-R-T, MAX-HD1-LTEA-R-T, MAX HD1, Pepwave MAX HD2, Pepwave MAX HD2 LTEA, Pepwave MAX HD1, Pepwave MAX HD1 LTEA, Peplink MAX HD2, Peplink MAX HD2 LTEA, Peplink MAX HD1, Peplink MAX HD1 LTEA
Received Date:	Jan. 09, 2020
Test Date:	Jan. 25 to Mar. 03, 2020
Issued Date:	Mar. 11, 2020
Applicant:	PISMO LABS TECHNOLOGY LIMITED
Address:	A8, 5/F, HK Spinners Industrial Building, Phase 6, 481 Castle Peak Road, Cheung Sha Wan, Hong Kong
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.
Test Location:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan.
FCC Registration / Designation Number:	723255 / TW2022

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Release Control Record

Issue No.	Description	Date Issued
RF160923E02G-2	Original release.	Mar. 11, 2020

1 Certificate of Conformity

Product:	PEPWAVE / peplink Wireless Product
Brand:	PEPWAVE / peplink
Test Model:	MAX HD2
Series Model:	MAX HD2 LTEA, MAX HD1 LTEA, Pismo 811AC, Pismo 811ac with 4SIMs Piggy, MAX-HD2-LTEA-R-T, MAX-HD1-LTEA-R-T, MAX HD1, Pepwave MAX HD2, Pepwave MAX HD2 LTEA, Pepwave MAX HD1, Pepwave MAX HD1 LTEA, Peplink MAX HD2, Peplink MAX HD2 LTEA, Peplink MAX HD1, Peplink MAX HD1 LTEA
Sample Status:	PROTOTYPE
Applicant:	PISMO LABS TECHNOLOGY LIMITED
Test Date:	Jan. 25 to Mar. 03, 2020
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) 47 CFR FCC Part 15, Subpart E (Section 15.407) FCC Part 90, Subpart R 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 : _____ , **Date:** Mar. 11, 2020

Claire Kuan / Specialist

Approved by : _____ , **Date:** Mar. 11, 2020

Clark Lin / Technical Manager

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C, E (SECTION 15.247, 15.407) FCC Part 90 R & Part 2			
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 -17.33dB at 0.15000MHz.
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 -3.1dB at 866.67MHz.
2.1053 90.543	Radiated Spurious Emissions	PASS	Meet the requirement of limit. Minimum passing margin is -33.74dB at 3162MHz.

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	1.8 dB
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.0 dB
	30MHz ~ 1GHz	4.9 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	5.1 dB
	6GHz ~ 18GHz	4.9 dB
	18GHz ~ 40GHz	5.2 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	PEPWAVE / peplink Wireless Product
Brand	PEPWAVE / peplink
Test Model	MAX HD2
Series Model	MAX HD2 LTEA, MAX HD1 LTEA, Pismo 811AC, Pismo 811ac with 4SIMs Piggy, MAX-HD2-LTEA-R-T, MAX-HD1-LTEA-R-T, MAX HD1, Pepwave MAX HD2, Pepwave MAX HD2 LTEA, Pepwave MAX HD1, Pepwave MAX HD1 LTEA, Peplink MAX HD2, Peplink MAX HD2 LTEA, Peplink MAX HD1, Peplink MAX HD1 LTEA
Status of EUT	PROTOTYPE
Power Supply Rating	12Vdc from power adapter
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 256QAM for OFDM in 11ac mode only
Operating Frequency	**2.4GHz:** 2.412GHz ~ 2.462GHz **5GHz:** 5.18GHz ~ 5.24GHz, 5.745GHz ~ 5.825GHz
Number of Channel	**2.4GHz:** 802.11b, 802.11g, 802.11n (HT20): 11 802.11n (HT40): 7 **5GHz:** 802.11a, 802.11n (HT20), 802.11ac (VHT20): 9 802.11n (HT40), 802.11ac (VHT40): 4 802.11ac (VHT80): 2
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	Adapter x1
Data Cable Supplied	NA

Note:

1. This is a supplementary report no.: RF160923E02. The differences between them are as below information:

◆ Added product name, model name and brand as below table:

Original					
Product name	Brand	Model	Difference	Purpose	Hardware/Software
Pepwave	Pepwave	MAX HD2 LTE	(1) MAX HD2 LTE contains two N7NMC7355 modules. (2) MAX HD2 LTEA contain two N7NMC7455 modules	For marketing requirement	All of hardware and software are identical.
		MAX HD2 LTEA			
Peplink		Pismo 811AC			
Pismo Labs Wireless Product		Pepwave Express			

Newly			
Product name	Brand	model	Description
PEPWAVE / peplink Wireless Product	PEPWAVE / peplink	MAX HD2 LTEA MAX HD1 LTEA Pismo 811ac with 4SIMs Piggy MAX HD2 MAX HD1 MAX-HD2-LTEA-R-T MAX-HD1-LTEA-R-T Pepwave MAX HD2 Pepwave MAX HD2 LTEA Pepwave MAX HD1 Pepwave MAX HD1 LTEA Peplink MAX HD2 Peplink MAX HD2 LTEA Peplink MAX HD1 Peplink MAX HD1 LTEA	For marketing requirement (1) HD2 contains two Sierra EM7511 modules. (2) HD1 contain one Sierra EM7511 module

From the above models, model: **MAX HD2** was selected as representative model for the test and its data was recorded in this report.

◆ Added antennas as below table:

Original							
For WLAN							
Antenna No.	Brand	Model	Antenna Net Gain(dBi)	Frequency range	Antenna Type	Connector Type	Cable Length (mm)
WAN(2.4G)-1	SmartAnt	SAA06-220690	3	2400 ~ 2500 MHz	Dipole	R-SMA	150
WAN(2.4G)-2	SmartAnt	SAA06-220690	3	2400 ~ 2500 MHz	Dipole	R-SMA	150
AP(5G)-1	SmartAnt	SAA06-220690	5.5	5150 ~ 5350 MHz	Dipole	R-SMA	260
			6	5350 ~ 5875 MHz			260
AP(5G)-2	SmartAnt	SAA06-220690	5.5	5150 ~ 5350 MHz	Dipole	R-SMA	260
			6	5350 ~ 5875 MHz			260
For GPS							
Antenna No.	Brand	Model	Antenna Net Gain(dBi)	Frequency range	Antenna Type	Connector Type	
1	MASTER WAVE TECHNOLOGY CO., LTD.	98335KSAF000	4.5 ±0.5	1575.42 MHz	Magnetic	SMA	

For WWAN(LTE)						
Antenna No.	Brand	Model	Antenna Net Gain(dBi)	Frequency range	Antenna Type	Connector Type
Cellular 1 Main	MASTER WAVE TECHNOLOGY CO., LTD.	98619ZSAX025	1.99	699~960 MHz	Dipole	SMA
Cellular 1 Diversity/Aux			4	1575~2170 MHz		
Cellular 2 Main			1	2300~2320 MHz		
Cellular 2 Diversity/Aux			2.8	2325~2690 MHz		
Newly						
For WLAN						
Antenna No.	Brand	Model	Antenna Net Gain(dBi)	Frequency range	Antenna Type	Connector Type
WLAN(2.4G)	Master Wave Technology Co., Ltd.	98614PRSX000	2.44	2.4~2.4835 GHz	Omni-directional	R-SMA
WLAN(5G)-1	Master Wave Technology Co., Ltd.	98614PRSX000	4.1	5.15~5.25 GHz	Omni-directional	R-SMA
WLAN(5G)-2	Master Wave Technology Co., Ltd.	98614PRSX000	4.73	5.725~5.85 GHz	Omni-directional	R-SMA
For GPS						
Antenna No.	Brand	Model	Antenna Net Gain(dBi)	Frequency range	Antenna Type	Connector Type
GPS	Master Wave Technology Co., Ltd.	98335KSAF000	4.5	1575.42 MHz	Magnetic	SMA
For For WWAN(LTE)						
Antenna No.	Brand	Model	Antenna Net Gain(dBi)	Frequency range	Antenna Type	Connector Type
Cellular 1 Main	Master Wave Technology Co., Ltd.	98619ZSAX052	2.77	699~960	Dipole	SMA
Cellular 1 Diversity/Aux			3.58	1575~2170	Dipole	SMA
Cellular 2 Main			4.38	2325~2690	Dipole	SMA
Cellular 2 Diversity/Aux			2.16	3400~3800	Dipole	SMA
Note: WLAN was test with original antenna						

2. According to above conditions, all test items has to be performed. And all data are verified to meet the requirements.
3. There are WLAN, GPS, WWAN(LTE) technology used for the EUT.
4. EUT contains two WiFi chip as same model, this chip model support dual band operation, but it will be locked to single band operation by firmware. One chip is supported 2.4GHz, other is supported 5GHz.
5. EUT contains two same certified LTE module which FCC ID: N7NEM75S.
6. EUT could be applied with a plug in USB cellular device.

7. Simultaneously transmission condition.

Condition	Technology				
1	WLAN (2.4GHz)	WLAN (5GHz)	WWAN(LTE) module (FCC ID: N7NEM75S)	WWAN(LTE) module (FCC ID: N7NEM75S)	-
2	WLAN (2.4GHz)	WLAN (5GHz)	WWAN(LTE) module (FCC ID: N7NEM75S)	WWAN(LTE) module (FCC ID: N7NEM75S)	3G/LTE (USB cellular device)

Note:
1. Condition 2 was selected as representative for the test.
2. The emission of the simultaneous operation has been evaluated and no non-compliance was found.

8. The EUT must be supplied with a power adapter as following table:

Brand	Model No.	Spec.
DVE	DSA-36PFH-12 FUS 120300AN	Input: 100-240Vac, 50/60Hz, 1A Output: 12Vdc, 3A DC output cable (Unshielded, 1.5m)

9. The EUT incorporates a MIMO function.

2.4GHz Band			
MODULATION MODE	**DATA RATE (MCS)**	**TX & RX CONFIGURATION**	
802.11b	1 ~ 11Mbps	2TX	2RX
802.11g	6 ~ 54Mbps	2TX	2RX
802.11n (HT20)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
802.11n (HT40)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
5GHz Band			
MODULATION MODE	**DATA RATE (MCS)**	**TX & RX CONFIGURATION**	
802.11a	6 ~ 54Mbps	2TX	2RX
802.11n (HT20)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
802.11n (HT40)	MCS 0~7	2TX	2RX
	MCS 8~15	2TX	2RX
802.11ac (VHT20)	MCS0~8 Nss=1	2TX	2RX
	MCS0~8 Nss=2	2TX	2RX
802.11ac (VHT40)	MCS0~9 Nss=1	2TX	2RX
	MCS0~9 Nss=2	2TX	2RX
802.11ac (VHT80)	MCS0~9 Nss=1	2TX	2RX
	MCS0~9 Nss=2	2TX	2RX

10. 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	
-	√	√	√	-

Where **RE≥1G:** Radiated Emission above 1GHz **RE<1G:** Radiated Emission below 1GHz
PLC: Power Line Conducted Emission

Radiated Emission Test (Above 1GHz):

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

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
802.11g + 802.11a + LTE Band 14 + LTE Band 14 + 2G GPRS	1 to 11	6	OFDM	BPSK
	38 to 46 149 to 165	157	OFDM	BPSK
	23305 to 23355	23305	QPSK	-
	23305 to 23355	23305	QPSK	-
	128 to 251	128	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
802.11g + 802.11a + LTE Band 14 + LTE Band 14 + 2G GPRS	1 to 11	6	OFDM	BPSK
	38 to 46 149 to 165	157	OFDM	BPSK
	23305 to 23355	23305	QPSK	-
	23305 to 23355	23305	QPSK	-
	128 to 251	128	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
802.11g + 802.11a + LTE Band 14 + LTE Band 14 + 2G GPRS	1 to 11	6	OFDM	BPSK
	38 to 46 149 to 165	157	OFDM	BPSK
	23305 to 23355	23305	QPSK	-
	23305 to 23355	23305	QPSK	-
	128 to 251	128	QPSK	-

Test Condition

Applicable To	Environmental Conditions	Input Power	Tested By
RE≥1G	25deg. C, 75%RH	120Vac, 60Hz	Tom Yang
RE<1G	22deg. C, 67%RH	120Vac, 60Hz	Kevin Ko
PLC	23deg. C, 75%RH	120Vac, 60Hz	Kevin Ko

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.	Laptop	DELL	E6420	482T3R1	FCC DoC	Provided by Lab
B.	HUB	ZyXEL	NBG4115	S090A4200153	FCC DoC	Provided by Lab
C.	3G / LTE Wireless Dongle	D-LINK	DWM-221	RD271F8000411	KA2WM221B1	Provided by Lab
D.	SIM Card A	R&S	CRT-Z3	NA	NA	Provided by Lab
E.	SIM Card B	R&S	CRT-Z3	NA	NA	Provided by Lab
F.	Simulator	Anritsu	MT8820C	6201127458	NA	Provided by Lab
G.	Simulator	Anritsu	MT8820C	6201127458	NA	Provided by Lab
H.	Simulator	Anritsu	MT8820C	6201240431	NA	Provided by Lab

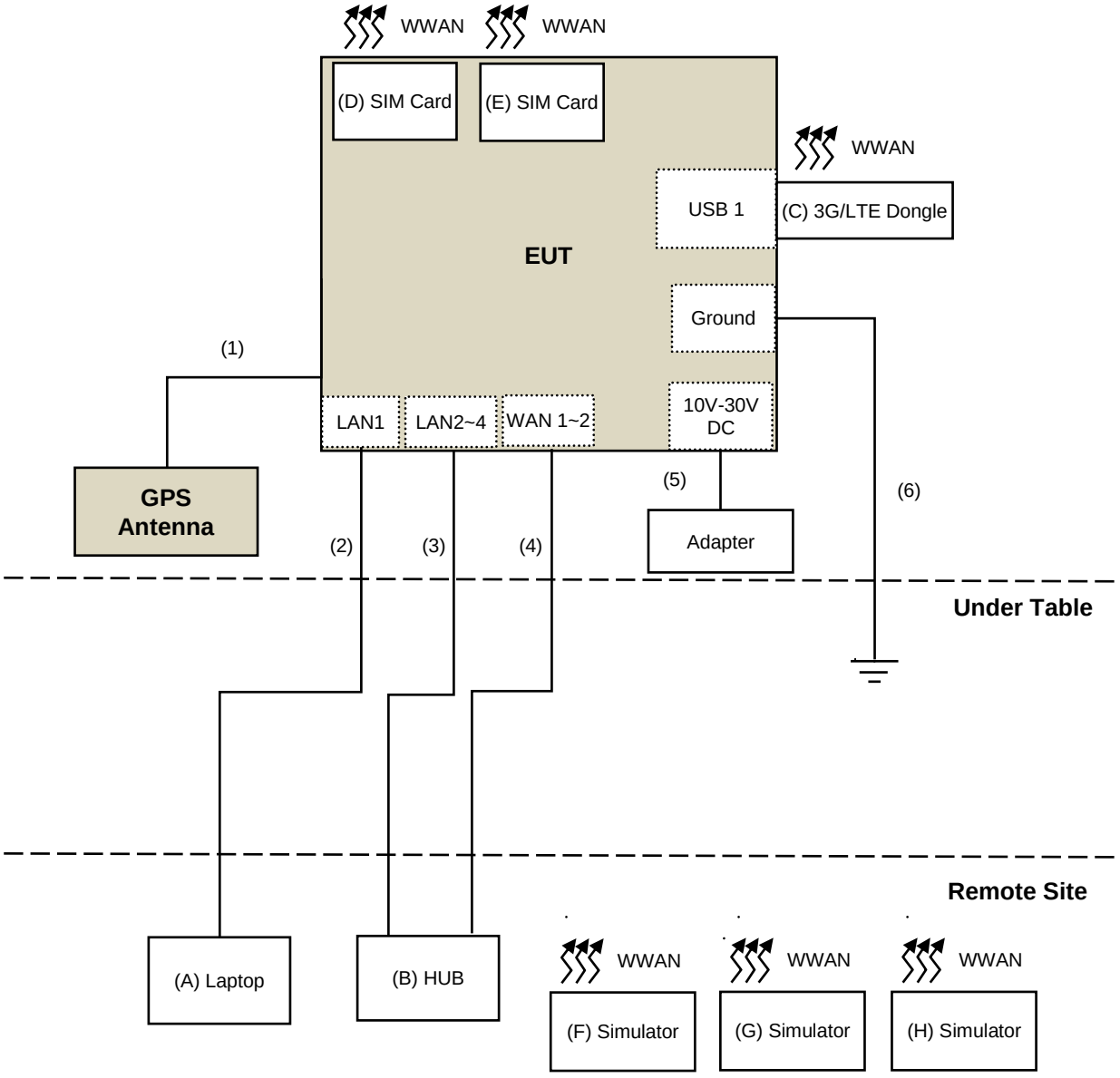
Note:

1. All power cords of the above support units are non-shielded (1.8m).

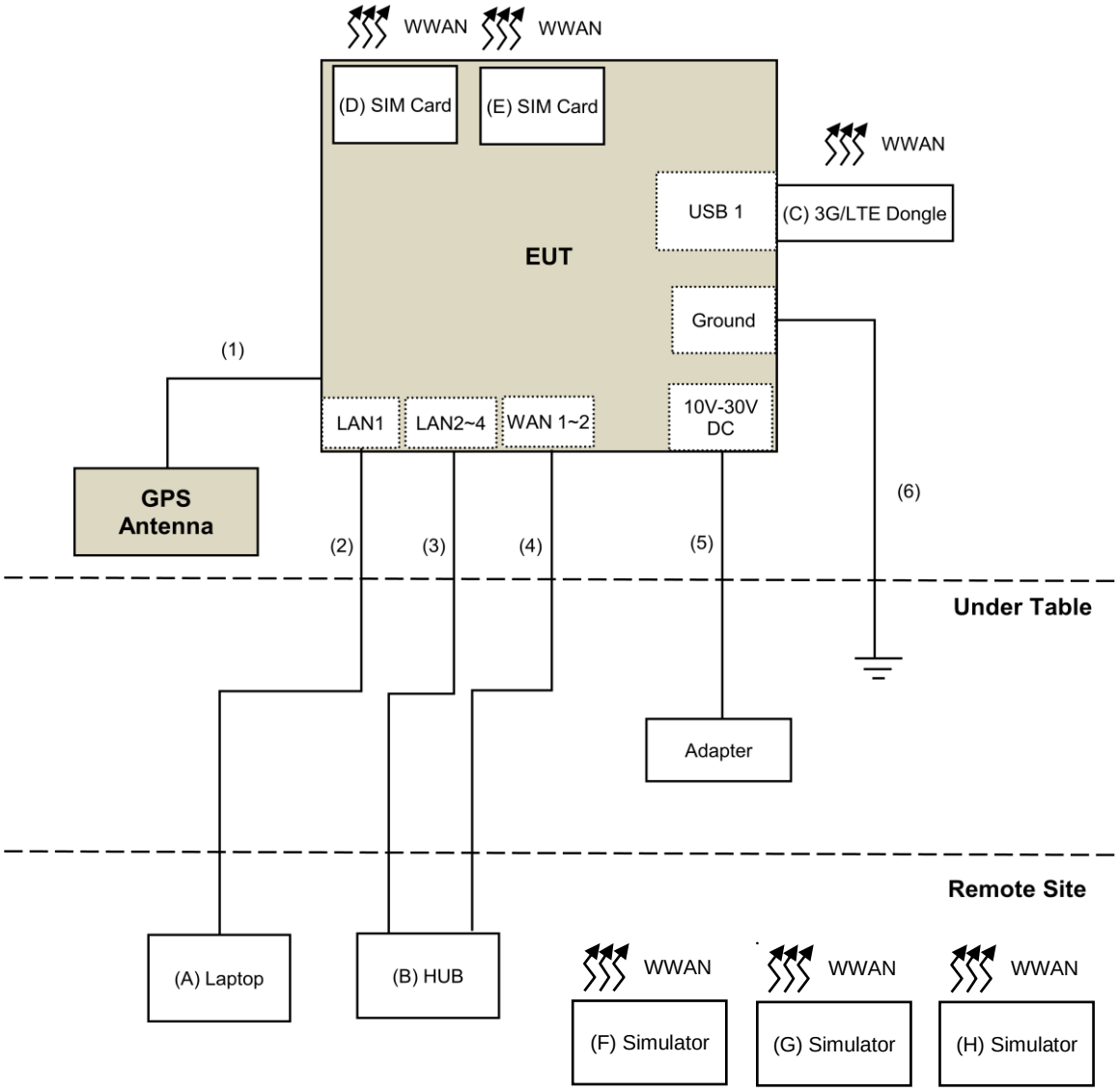
ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	GPS Antenna Cable	1	5	No	0	Supplied by Client
2.	RJ-45 Cable	1	10	No	0	Provided by Lab
3.	RJ-45 Cable	3	3	No	0	Provided by Lab
4.	RJ-45 Cable	2	3	No	0	Provided by Lab
5.	DC Cable	1	1.5	No	0	Supplied by Client
6.	Ground wire	1	1.5	No	0	Provided by Lab

3.2.1 Configuration of System under Test

For conducted emission test:



For other test items:



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).

FCC Part 90R:
The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 +10 log10(P) dB. The limit of emission equal to –13dBm

For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals.

4.1.2 Test Instruments

Below 1GHz:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Agilent	N9038A	MY51210202	Dec. 13, 2019	Dec. 12, 2020
Pre-Amplifier EMCI	EMC001340	980142	May 30, 2019	May 29, 2020
Loop Antenna Electro-Metrics	EM-6879	269	Sep. 16, 2019	Sep. 15, 2020
RF Cable	NA	LOOPCAB-001	Jan. 08, 2020	Jan. 07, 2021
RF Cable	NA	LOOPCAB-002	Jan. 08, 2020	Jan. 07, 2021
Pre-Amplifier Mini-Circuits	ZFL-1000VH2B	AMP-ZFL-01	Oct. 23, 2019	Oct. 22, 2020
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-406	Nov. 11, 2019	Nov. 10, 2020
RF Cable	8D	966-4-1	Mar. 19, 2019	Mar. 18, 2020
RF Cable	8D	966-4-2	Mar. 19, 2019	Mar. 18, 2020
RF Cable	8D	966-4-3	Mar. 19, 2019	Mar. 18, 2020
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-3m-4-01	Sep. 26, 2019	Sep. 25, 2020

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. Loop antenna was used for all emissions below 30 MHz.
4. Tested Date: Jan. 25, 2020

Other test items:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Agilent	N9038A	MY51210202	Dec. 13, 2019	Dec. 12, 2020
Horn_Antenna SCHWARZBECK	BBHA 9120D	9120D-783	Nov. 24, 2019	Nov. 23, 2020
Pre-Amplifier EMCI	EMC12630SE	980385	Aug. 15, 2019	Aug. 14, 2020
RF Cable	EMC104-SM-SM-1200	160923	Jan. 15, 2020	Jan. 14, 2021
RF Cable	104 RF cable	131215	Jan. 09, 2020	Jan. 08, 2021
RF Cable	EMC104-SM-SM-6000	180418	May 03, 2019	May 02, 2020
Pre-Amplifier EMCI	EMC184045SE	980387	Jan. 15, 2020	Jan. 14, 2021
Horn_Antenna SCHWARZBECK	BBHA 9170	BBHA9170519	Nov. 24, 2019	Nov. 23, 2020
RF Cable	EMC102-KM-KM-1200	160924	Jan. 15, 2020	Jan. 14, 2021
RF Cable	EMC102-KM-KM-4500	181205	Aug. 26, 2019	Aug. 25, 2020
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 04, 2019	June 03, 2020
Spectrum Analyzer Agilent	E4446A	MY48250253	July 24, 2019	July 23, 2020
Power meter Anritsu	ML2495A	1014008	May 13, 2019	May 12, 2020
Power sensor Anritsu	MA2411B	0917122	May 13, 2019	May 12, 2020
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	Apr. 15, 2019	Apr. 14, 2020

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. Tested Date: Feb. 11 to Mar. 03, 2020

4.1.3 Test Procedures

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 detects 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:

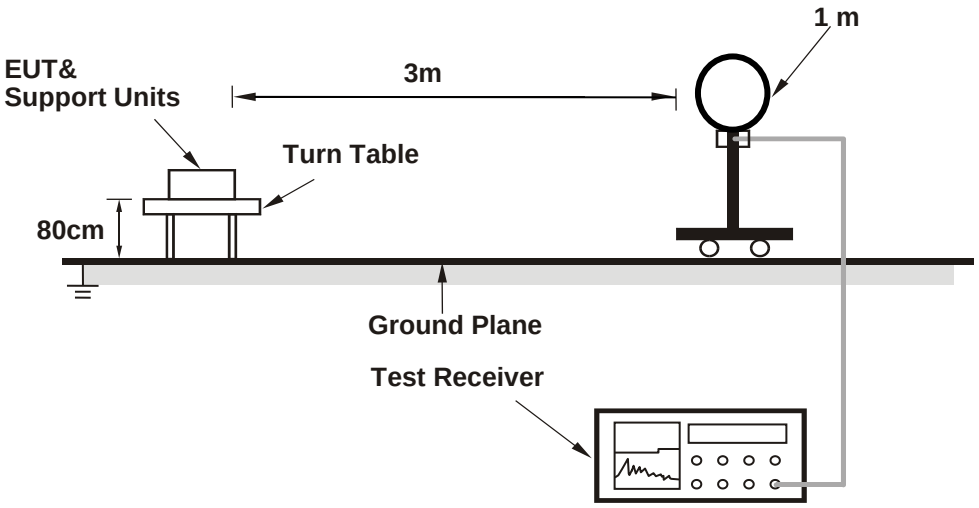
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
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.

4.1.4 Deviation from Test Standard

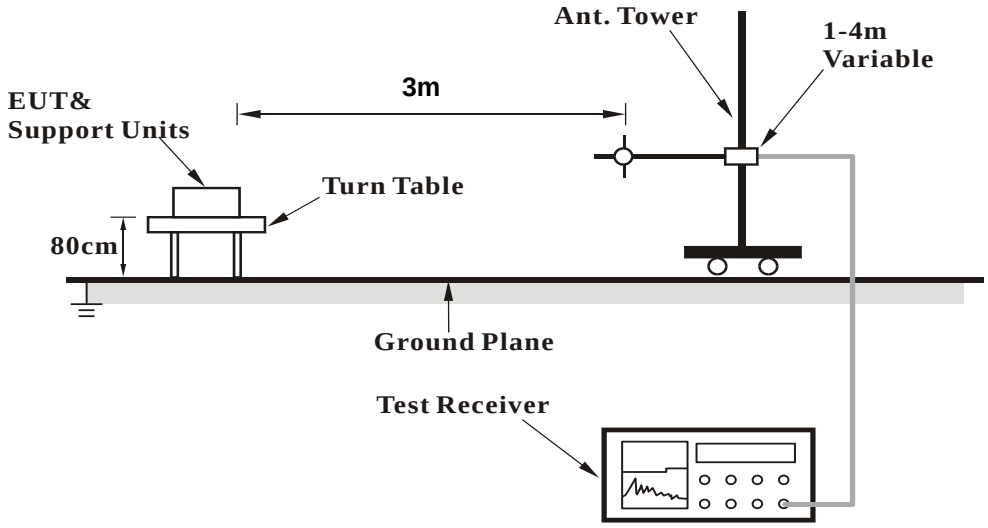
No deviation.

4.1.5 Test Setup

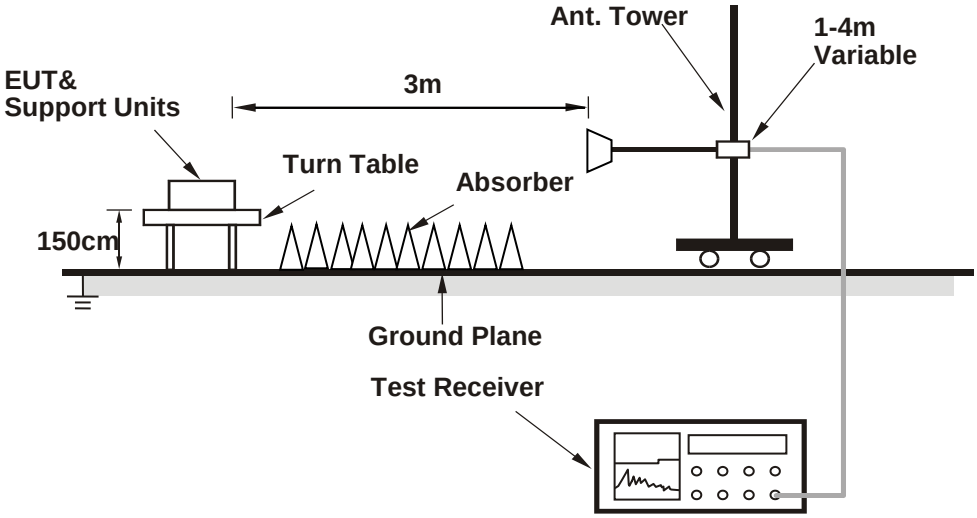
For Radiated emission below 30MHz



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. Controlling software (Atheros Radio Test 2(ART2-GUI) Version:2.3) has been activated to set the EUT under transmission condition continuously.

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	34.2 PK	74.0	-39.8	1.69 H	127	32.0	2.2
2	4874.00	30.5 AV	54.0	-23.5	1.69 H	127	28.3	2.2
3	7311.00	38.8 PK	74.0	-35.2	2.05 H	190	29.7	9.1
4	7311.00	35.9 AV	54.0	-18.1	2.05 H	190	26.8	9.1
5	11570.00	43.6 PK	74.0	-30.4	1.29 H	121	30.1	13.5
6	11570.00	40.2 AV	54.0	-13.8	1.29 H	121	26.7	13.5
7	#17335.00	46.3 PK	68.2	-21.9	1.92 H	100	29.2	17.1
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	34.2 PK	74.0	-39.8	1.65 V	126	32.0	2.2
2	4874.00	30.3 AV	54.0	-23.7	1.65 V	126	28.1	2.2
3	7311.00	38.6 PK	74.0	-35.4	2.01 V	200	29.5	9.1
4	7311.00	35.6 AV	54.0	-18.4	2.01 V	200	26.5	9.1
5	11570.00	43.6 PK	74.0	-30.4	1.22 V	200	30.1	13.5
6	11570.00	40.3 AV	54.0	-13.7	1.22 V	200	26.8	13.5
7	#17355.00	46.5 PK	68.2	-21.7	1.84 V	130	29.2	17.3

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
5. " # ": The radiated frequency is out of the restricted band.

Mode	TX channel 23205	Frequency Range	Above 1GHz

Antenna Polarity & Test Distance: Horizontal at 3 M						
No.	Freq. (MHz)	Reading (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	1581	42.94	-95.26	-52.32	-13	-39.32
2	2371.5	40.76	-95.26	-54.50	-13	-41.50
3	**3162**	**48.52**	**-95.26**	**-46.74**	**-13**	**-33.74**
Antenna Polarity & Test Distance: Vertical at 3 M						
No.	Freq. (MHz)	Reading (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	1581	33.05	-95.26	-62.21	-13	-49.21
2	2371.5	38.06	-95.26	-57.20	-13	-44.20
3	3162	36.61	-95.26	-58.65	-13	-45.65

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

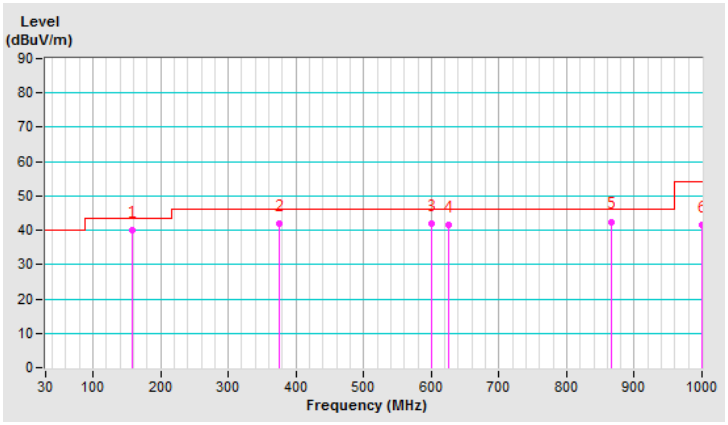
Below 1GHz Data:

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	157.51	39.9 QP	43.5	-3.6	2.00 H	161	47.5	-7.6
2	375.00	41.8 QP	46.0	-4.2	1.00 H	229	46.6	-4.8
3	600.00	41.9 QP	46.0	-4.1	1.50 H	240	41.0	0.9
4	625.02	41.7 QP	46.0	-4.3	1.00 H	292	40.3	1.4
5	866.65	42.5 QP	46.0	-3.5	2.00 H	223	37.3	5.2
6	1000.00	41.4 QP	54.0	-12.6	1.50 H	225	33.4	8.0

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 of frequency range 30MHz~1000MHz.
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.

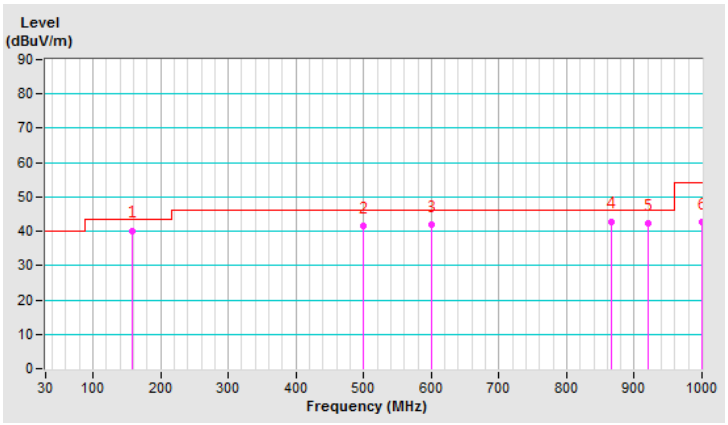


FREQUENCY RANGE	9kHz ~ 1GHz	DETECTOR FUNCTION	Quasi-Peak (QP)

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	157.51	40.2 QP	43.5	-3.3	1.00 V	331	47.8	-7.6
2	500.01	41.7 QP	46.0	-4.3	1.00 V	160	43.4	-1.7
3	600.02	41.8 QP	46.0	-4.2	1.50 V	30	40.9	0.9
4	**866.67**	**42.9 QP**	**46.0**	**-3.1**	**1.00 V**	**192**	**37.7**	**5.2**
5	920.00	42.2 QP	46.0	-3.8	1.00 V	29	35.9	6.3
6	999.98	42.8 QP	54.0	-11.2	1.00 V	191	34.8	8.0

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 of frequency range 30MHz~1000MHz.
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.



Mode	TX channel 23205	Frequency Range	Above 1GHz

Antenna Polarity & Test Distance: Horizontal at 3 M						
No.	Freq. (MHz)	Reading (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	90.27	36.95	-95.26	-58.31	-13	-45.31
2	103.13	40.1	-95.26	-55.16	-13	-42.16
3	269.26	29.85	-95.26	-65.41	-13	-52.41
4	333.1	37.55	-95.26	-57.71	-13	-44.71
5	400.09	33.42	-95.26	-61.84	-13	-48.84
6	803.04	35.48	-95.26	-59.78	-13	-46.78
Antenna Polarity & Test Distance: Vertical at 3 M						
No.	Freq. (MHz)	Reading (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	90.38	37.12	-95.26	-58.14	-13	-45.14
2	103.23	43.2	-95.26	-52.06	-13	-39.06
3	269.24	29.95	-95.26	-65.31	-13	-52.31
4	333.29	37.51	-95.26	-57.75	-13	-44.75
5	400.07	33.46	-95.26	-61.80	-13	-48.80
6	802.83	35.46	-95.26	-59.80	-13	-46.80

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

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. 23, 2019	Oct. 22, 2020
Line-Impedance Stabilization Network (for EUT) R&S	ESH3-Z5	848773/004	Oct. 23, 2019	Oct. 22, 2020
Line-Impedance Stabilization Network (for Peripheral) R&S	ESH3-Z5	835239/001	Mar. 17, 2019	Mar. 16, 2020
50 ohms Terminator	50	3	Oct. 23, 2019	Oct. 22, 2020
RF Cable	5D-FB	COCCAB-001	Sep. 27, 2019	Sep. 26, 2020
Fixed attenuator EMCI	STI02-2200-10	003	Mar. 14, 2019	Mar. 13, 2020
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. 25, 2020

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.

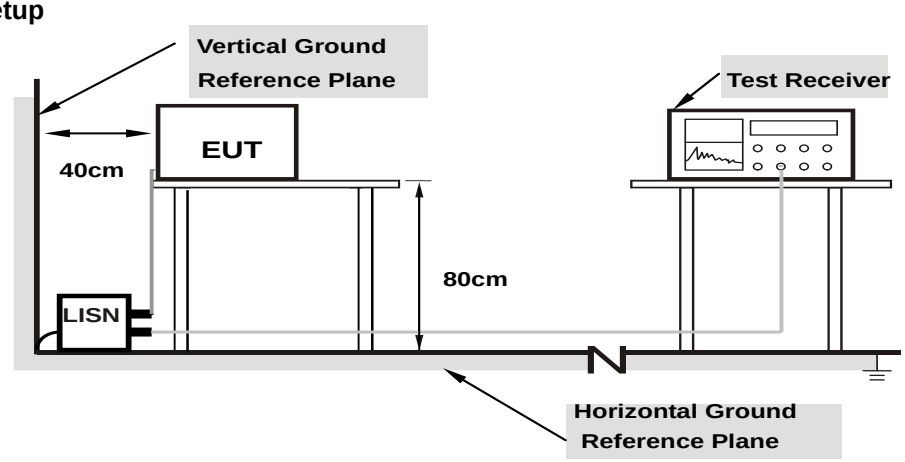
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

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.

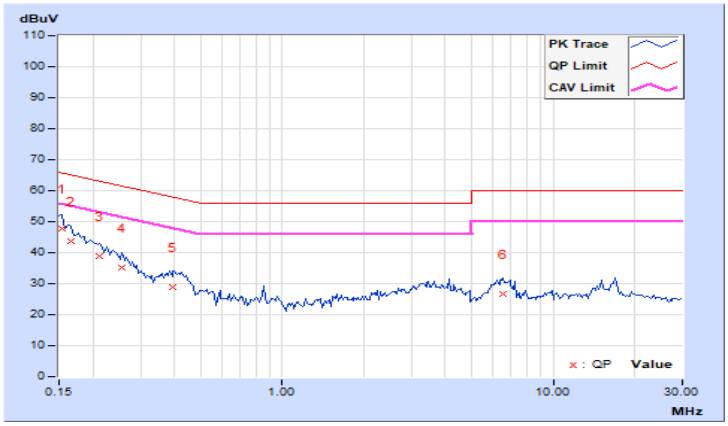
4.2.7 Test Results

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

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	9.99	37.78	17.33	47.77	27.32	65.79	55.79	-18.02	-28.47
2	0.16562	9.99	33.73	12.96	43.72	22.95	65.18	55.18	-21.46	-32.23
3	0.21250	9.99	28.80	10.30	38.79	20.29	63.11	53.11	-24.32	-32.82
4	0.25547	9.99	25.26	7.47	35.25	17.46	61.58	51.58	-26.33	-34.12
5	0.39609	10.00	18.95	7.98	28.95	17.98	57.93	47.93	-28.98	-29.95
6	6.54688	10.43	16.29	10.95	26.72	21.38	60.00	50.00	-33.28	-28.62

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

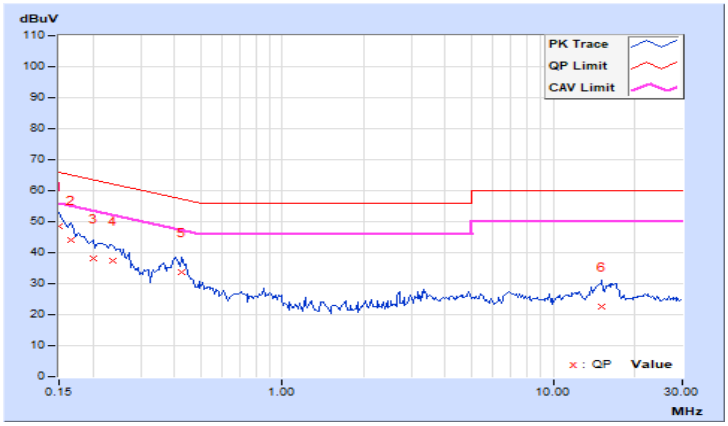


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	**0.15000**	**9.99**	**38.68**	**18.36**	**48.67**	**28.35**	**66.00**	**56.00**	**-17.33**	**-27.65**
2	0.16562	9.99	33.95	13.95	43.94	23.94	65.18	55.18	-21.24	-31.24
3	0.20078	9.99	28.15	9.10	38.14	19.09	63.58	53.58	-25.44	-34.49
4	0.23594	9.99	27.34	10.55	37.33	20.54	62.24	52.24	-24.91	-31.70
5	0.42734	10.01	23.70	14.75	33.71	24.76	57.30	47.30	-23.59	-22.54
6	15.12891	10.86	11.60	1.94	22.46	12.80	60.00	50.00	-37.54	-37.20

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



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 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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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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