Supplemental “Transmit Simultaneously” Test Report

Report No.:	RF190912E02E-2
FCC ID:	2AHBN-AP33
Test Model:	AP32E
Series Model:	AP32, AP33
Received Date:	Mar. 17, 2020
Test Date:	June 07 to 12, 2020
Issued Date:	June 29, 2020
Applicant:	Juniper Networks, Inc.
Address:	1133 Innovation Way Sunnyvale, CA 94089 USA
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
RF190912E02E-2	Original release.	June 29, 2020

1 Certificate of Conformity

Product:	Wi-Fi & BLE Array AP
Brand:	Mist
Test Model:	AP32E
Series Model:	AP32, AP33
Applicant:	Juniper Networks, Inc.
Test Date:	June 07 to 12, 2020
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) 47 CFR FCC Part 15, Subpart E (Section 15.407) 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:** June 29, 2020

Claire Kuan / Specialist

Approved by : _____ , **Date:** June 29, 2020

Clark Lin / Technical Manager

2 Summary of Test Results

FCC Part 15, Subpart C, E (SECTION 15.247, 15.407)			
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 -7.23dB 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 -4.3dB at 17235.00MHz.

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	1.9 dB
Conducted emissions	-	2.5 dB
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.1 dB
	30MHz ~ 1GHz	5.4 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	5.0 dB
	18GHz ~ 40GHz	5.3 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Wi-Fi & BLE Array AP
Brand	Mist
Test Model	AP32E
Series Model	AP32, AP33
Power Supply Rating	55Vdc from PoE
Modulation Type	**WLAN:** CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 256QAM for OFDM in 11ac mode and VHT20/40 in 2.4GHz mode 1024QAM for OFDMA in 11ax HE mode **BT-LE:** GFSK
Modulation Technology	**WLAN:** DSSS, OFDM, OFDMA **BT-LE:** GFSK
Operating Frequency	**WLAN:** **2.4GHz:** 2.412 ~ 2.462GHz **5GHz:** 5.18~ 5.24GHz, 5.26 ~ 5.32GHz, 5.50 ~ 5.72GHz, 5.745 ~ 5.825GHz **BT-LE:** 2402~ 2480MHz
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. This report is prepared for FCC Class II permissive change. The difference compared with the Report No.: RF190912E02A-2 design is as the following information:
   - ◆ Add DFS band <5250~5350 MHz & 5470~5725 MHz> by software.
   - ◆ Add external antenna (Model: ATS-OP-245-810-4RPSP-36) for model AP32E (New antenna only used for WLAN Radio, Scanning Radio and Bluetooth are no impact).
2. According to above condition, all test has to be performed. And all data are verified to meet the requirements.
3. All models are listed as below.

Brand	Model	Difference
Mist	AP32	For marketing request 1) Internal antenna 2) BT with omnidirectional antenna
	AP33	For marketing request 1) Internal antenna 2) BT with directional antenna
	AP32E	For marketing request 1) External antenna 2) BT with omnidirectional antenna
Note: Output power is same for all three models except for the AP32E model collocate new antenna (ATS-OP-245-810-4RPSP-36), and only antenna configurations are different.		

4. There are WLAN and Bluetooth technology used for the EUT. The EUT has four radios as following table:

Radio 1	Radio 2	Radio 3	Radio 4
WLAN - 2.4GHz	(Scanning Radio) WLAN 2.4GHz + 5GHz	WLAN - 5GHz	Bluetooth

5. Simultaneously transmission condition.

Condition	Technology			
1	WLAN - 2.4GHz	(Scanning Radio) WLAN 2.4GHz + 5GHz	WLAN - 5GHz	Bluetooth
Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.				

6. The EUT power needs to be supplied from a PoE (only for test, not for sale), the information is as below table:

Brand	Model No.	Spec.
PowerDsine	PD-9001GR/AC	Input: 100-240Vac, 50/60Hz, 0.67A Output: 55Vdc, 0.6A

7. The antennas provided to the EUT, please refer to the following table:

Model: AP32						
Antenna No.	Brand	Model	Antenna Net Gain (dBi)	Frequency Range	Antenna Type	Connector Type
Int Dual Ant 3 (WiFi 5G+BT)	-	-	5 6	2.4~2.4835GHz 5.15~5.85GHz	PIFA	Ipex
Int WiFi Dual Ant 1	-	-	4.5 5.4	2.4~2.4835GHz 5.15~5.85GHz	PIFA	Ipex
Int WiFi Dual Ant 0	-	-	4.6 5.7	2.4~2.4835GHz 5.15~5.85GHz	PIFA	Ipex
Int WiFi 5G Ant 2	-	-	5.8	5.15~5.85GHz	PIFA	Ipex
Scanning Ant	-	-	5 6	2.4~2.4835GHz 5.15~5.85GHz	PIFA	Ipex
Model: AP32E						
Original						
Antenna No.	Brand	Model	Antenna Net Gain (dBi)	Frequency Range	Antenna Type	Connector Type
Ext WiFi Dual Ant (2.4+5G)	AccelTex	ATS-OO-245-46-6RPSP-36	4 6	2.4~2.4835GHz 5.15~5.85GHz	omnidirectional	RPSMA Plug
Ext WiFi Dual Ant (2.4+5G)			4 6	2.4~2.4835GHz 5.15~5.85GHz	omnidirectional	RPSMA Plug
Ext WiFi Dual Ant (5G)			4 6	2.4~2.4835GHz 5.15~5.85GHz	omnidirectional	RPSMA Plug
Ext WiFi Dual Ant (5G)			4 6	2.4~2.4835GHz 5.15~5.85GHz	omnidirectional	RPSMA Plug
Ext WiFi Dual Ant (Scanning)			4 6	2.4~2.4835GHz (Scanning) 5.15~5.85GHz (Scanning)	omnidirectional	RPSMA Plug
Int Scanning Ant	-	-	5 6	2.4~2.4835GHz (Scanning) 5.15~5.85GHz (Scanning)	PIFA	Ipex
Int BT Ant	-	-	5	2.4~2.4835GHz	PIFA	Ipex

Newly

Antenna No.	Brand	Model	Antenna Net Gain (dBi)	Frequency Range	Antenna Type	Connector Type
Ext WiFi PATCH Ant (2.4+5G)	AccelTex	ATS-OP-245-810-4RPSP-36	8 10	2.4~2.4835GHz 5.15~5.85GHz	PATCH	RPSMA Plug
Ext WiFi PATCH Ant (2.4+5G)			8 10	2.4~2.4835GHz 5.15~5.85GHz	PATCH	RPSMA Plug
Ext WiFi PATCH Ant (5G)			8 10	2.4~2.4835GHz 5.15~5.85GHz	PATCH	RPSMA Plug
Ext WiFi PATCH Ant (5G)			8 10	2.4~2.4835GHz 5.15~5.85GHz	PATCH	RPSMA Plug

Model: AP33

Antenna No.	Brand	Model	Antenna Net Gain (dBi)	Frequency Range	Antenna Type	Connector Type
Int WiFi Dual Ant 0	-	-	3.7 6	2.4~2.4835GHz 5.15~5.85GHz	PIFA	Ipex
Int WiFi Dual Ant 1	-	-	4.6 6	2.4~2.4835GHz 5.15~5.85GHz	PIFA	Ipex
Int WiFi 5G Ant 2	-	-	6	5.15~5.85GHz	PIFA	Ipex
Int WiFi 5G Ant 3	-	-	5.9	5.15~5.85GHz	PIFA	Ipex
Scanning Ant	-	-	5 6	2.4~2.4835GHz 5.15~5.85GHz	PIFA	Ipex
BT Slot_Direct Antenna	-	-	6	2.402~2.480GHz	Slot_Direct	Ipex
BT Array Antenna	-	-	Beam 1 :3.9 Beam 2 :3.9 Beam 3 :4.7 Beam 4 :4.4 Beam 5 :4.8 Beam 6 :5.1 Beam 7 :5.1 Beam 8 :4.2	2.402~2.480GHz	Array Antenna	Ipex

Note: The max. antenna gain was selected for the final test of Antenna Port Conducted test items.

8. The newly external antenna for WLAN 2.4G only support 2Tx configuration / for WLAN 5G only support 4Tx configuration.

9. The EUT incorporates a MIMO function.

MODULATION MODE	Radio 1 - 2.4GHz Band		Radio 2 - 2.4GHz Band	
	TX & RX CONFIGURATION		TX & RX CONFIGURATION	
802.11b	2TX	2RX	1TX	1RX
802.11g	2TX	2RX	1TX	1RX
802.11n (HT20)	2TX	2RX	1TX	1RX
802.11n (HT40)	2TX	2RX	1TX	1RX
VHT20	2TX	2RX	1TX	1RX
VHT40	2TX	2RX	1TX	1RX
802.11ax (HE20)	2TX	2RX	1TX	1RX
802.11ax (HE40)	2TX	2RX	1TX	1RX
MODULATION MODE	Radio 3 - 5GHz Band		Radio 2 - 5GHz Band	
	TX & RX CONFIGURATION		TX & RX CONFIGURATION	
802.11a	4TX	4RX	1TX	1RX
802.11n (HT20)	4TX	4RX	1TX	1RX
802.11n (HT40)	4TX	4RX	1TX	1RX
802.11ac (VHT20)	4TX	4RX	1TX	1RX
802.11ac (VHT40)	4TX	4RX	1TX	1RX
802.11ac (VHT80)	4TX	4RX	1TX	1RX
802.11ax (HE20)	4TX	4RX	1TX	1RX
802.11ax (HE40)	4TX	4RX	1TX	1RX
802.11ax (HE80)	4TX	4RX	1TX	1RX

Note:
1. All of modulation mode support beamforming function except 802.11a/b/g modulation mode.
2. The EUT support Beamforming and non-beamforming mode, therefore both mode were investigated and the worst case scenario was identified. The worst case data were presented in test report.

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	OB	
-	√	√	√	√	-

Where **RE≥1G:** Radiated Emission above 1GHz **RE<1G:** Radiated Emission below 1GHz
PLC: Power Line Conducted Emission **OB:** Conducted Out-Band Emission Measurement

Radiated Emission Test (Above 1GHz):

☒ The tested configurations represent the worst-case mode from all possible combinations by the maximum power.

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

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
802.11b + 802.11ax (HE20) + BT-LE 2M + Scanning Radio_ 802.11b + Scanning Radio_ 802.11ax (HE40)	1 to 11	6	OFDM	BPSK
	36 to 48 52 to 64 100 to 140 149 to 165	149	OFDMA	BPSK
	0 to 39	0	DTS	GFSK
	1 to 11	11	OFDM	BPSK
	38 to 46 151 to 159	159	OFDMA	BPSK

Radiated Emission Test (Below 1GHz):

☒ The tested configurations represent the worst-case mode from all possible combinations by the maximum power.

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

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
802.11b + 802.11ax (HE20) + BT-LE 2M + Scanning Radio_ 802.11b + Scanning Radio_ 802.11ax (HE40)	1 to 11	6	OFDM	BPSK
	36 to 48 52 to 64 100 to 140 149 to 165	149	OFDMA	BPSK
	0 to 39	0	DTS	GFSK
	1 to 11	11	OFDM	BPSK
	38 to 46 54 to 62 102 to 134 151 to 159	159	OFDMA	BPSK

Power Line Conducted Emission Test:

☒ The tested configurations represent the worst-case mode from all possible combinations by the maximum power.

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

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
802.11b + 802.11ax (HE20) + BT-LE 2M + Scanning Radio_ 802.11b + Scanning Radio_ 802.11ax (HE40)	1 to 11	6	OFDM	BPSK
	36 to 48 52 to 64 100 to 140 149 to 165	149	OFDMA	BPSK
	0 to 39	0	DTS	GFSK
	1 to 11	11	OFDM	BPSK
	38 to 46 54 to 62 102 to 134 151 to 159	159	OFDMA	BPSK

Conducted Out-Band Emission Measurement:

☒ The tested configurations represent the worst-case mode from all possible combinations by the maximum power.

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

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
802.11b + 802.11ax (HE20)	1 to 11	6	OFDM	BPSK
	36 to 48 52 to 64 100 to 140 149 to 165	149	OFDMA	BPSK

Test Condition:

Applicable To	Environmental Conditions	Input Power (System)	Tested By
RE≥1G	24deg. C, 68%RH	120Vac, 60Hz	Tom Yang
RE<1G	22deg. C, 68%RH	120Vac, 60Hz	Ryan Du
PLC	21deg. C, 60%RH	120Vac, 60Hz	Nick Lo
OB	25deg. C, 60%RH	120Vac, 60Hz	Jyunchun Lin

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	E5430	HYV4VY1	FCC DoC	Provided by Lab
B.	Laptop	DELL	E6420	B92T3R1	FCC DoC	Provided by Lab
C.	PoE Adapter	PowerDsine	PD-9001GR/AC	NA	NA	Supplied by client
D.	Ipod	Apple	MC749TA/A	CC4DN25WDFDM	NA	Provided by Lab

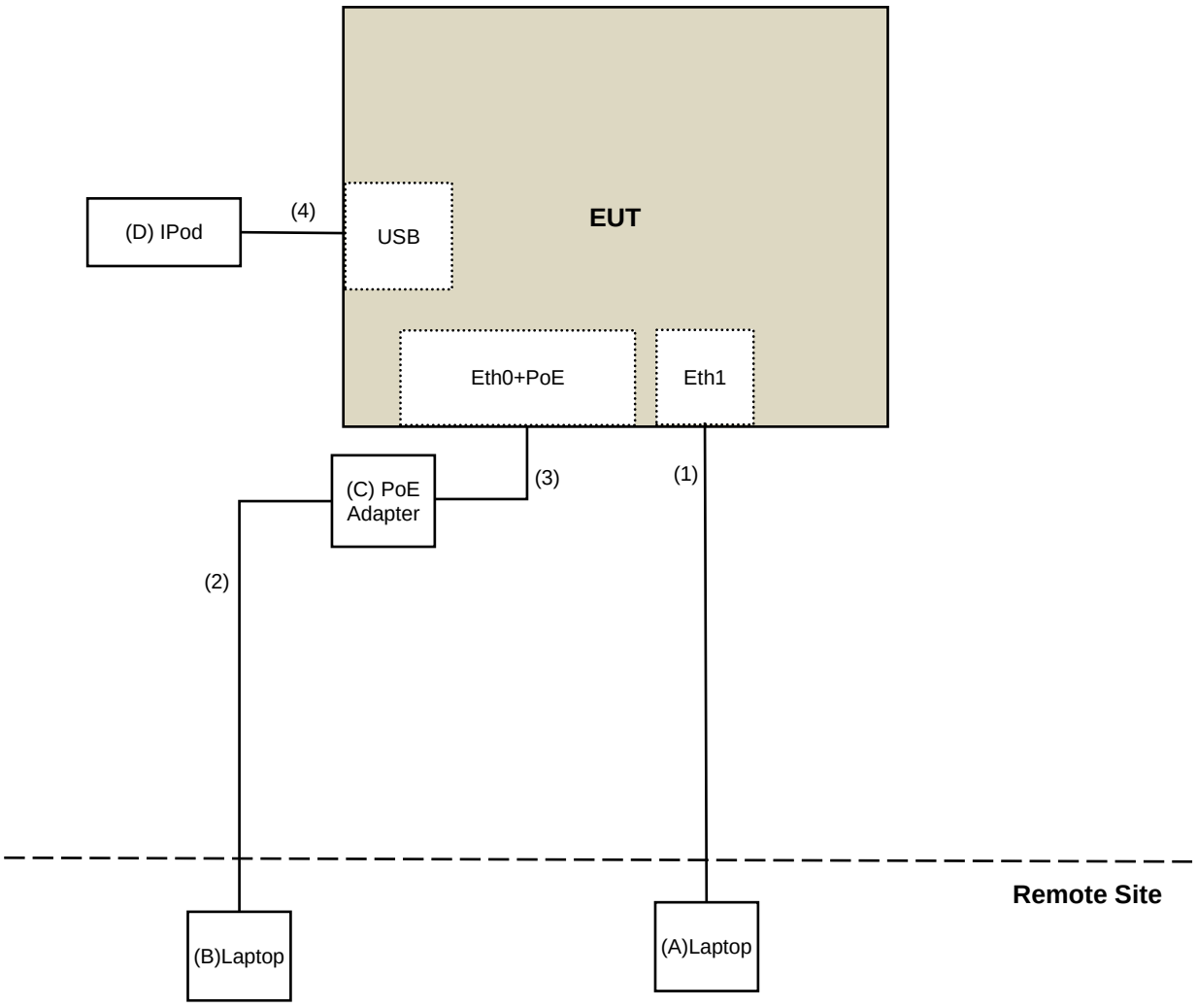
Note:

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

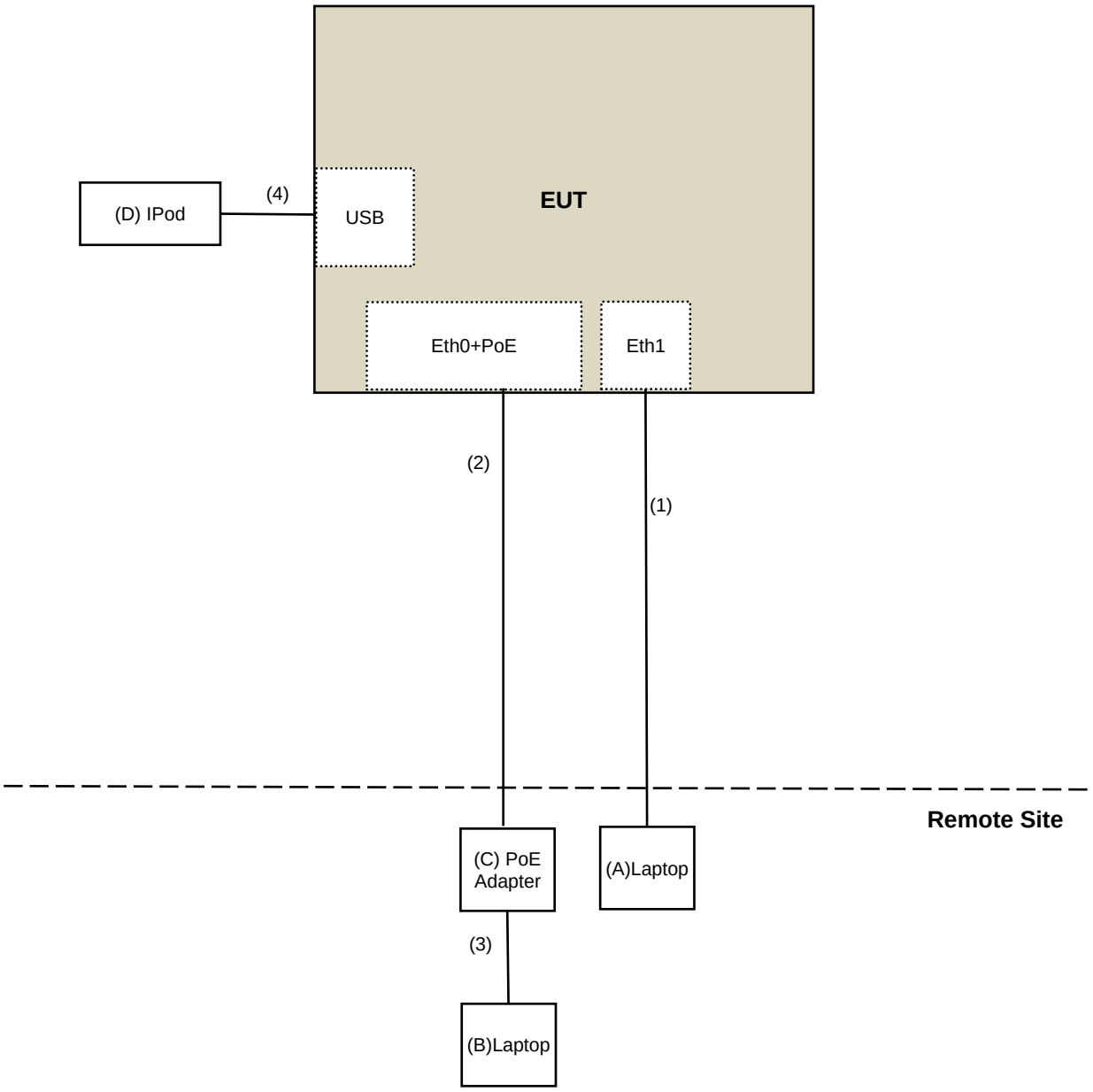
ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	RJ-45 Cable	1	10	No	0	Provided by Lab
2.	RJ-45 Cable	1	10	No	0	Provided by Lab
3.	RJ-45 Cable	1	1.5	No	0	Provided by Lab
4.	USB Cable	1	0.1	Yes	0	Provided by Lab

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

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	15.407(b)(4)(i)	PK:-27 (dBm/MHz) *1 PK:10 (dBm/MHz) *2 PK:15.6 (dBm/MHz) *3 PK:27 (dBm/MHz) *4	PK: 68.2(dBµV/m) *1 PK:105.2 (dBµV/m) *2 PK: 110.8(dBµV/m) *3 PK:122.2 (dBµV/m) *4

*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.

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).

4.1.2 Test Instruments

For radiated emission test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Keysight	N9038A	MY54450088	July 03, 2019	July 02, 2020
Pre-Amplifier EMCI	EMC001340	980142	May 25, 2020	May 24, 2021
Loop Antenna Electro-Metrics	EM-6879	264	Feb. 18, 2020	Feb. 17, 2021
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-05	Apr. 28, 2020	Apr. 27, 2021
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-361	Nov. 11, 2019	Nov. 10, 2020
RF Cable	8D	966-3-1	Mar. 17, 2020	Mar. 16, 2021
RF Cable	8D	966-3-2	Mar. 17, 2020	Mar. 16, 2021
RF Cable	8D	966-3-3	Mar. 17, 2020	Mar. 16, 2021
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-3m-3-01	Sep. 26, 2019	Sep. 25, 2020
Horn_Antenna SCHWARZBECK	BBHA9120-D	9120D-406	Nov. 24, 2019	Nov. 23, 2020
Pre-Amplifier EMCI	EMC12630SE	980384	Jan. 15, 2020	Jan. 14, 2021
RF Cable	EMC104-SM-SM-1200	160922	Jan. 15, 2020	Jan. 14, 2021
RF Cable	EMC104-SM-SM-2000	180601	June 10, 2019	June 09, 2020
RF Cable	EMC104-SM-SM-6000	180602	June 10, 2019	June 09, 2020
Spectrum Analyzer Keysight	N9030A	MY54490679	July 17, 2019	July 16, 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	EMC-KM-KM-4000	200214	Mar. 11, 2020	Mar. 10, 2021
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Antenna Tower & Turn Table Max-Full	MF-7802	MF780208406	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA

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. 3.
3. Tested Date: June 07 to 09, 2020

For other test items:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Spectrum Analyzer R&S	FSV40	100964	May 29, 2020	May 28, 2021
Power meter Anritsu	ML2495A	1529002	July 26, 2019	July 25, 2020
Power sensor Anritsu	MA2411B	1339443	July 26, 2019	July 25, 2020
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	Apr. 14, 2020	Apr. 13, 2021
Software	ADT_RF Test Software V6.6.5.4	NA	NA	NA

NOTE: 1. The test was performed in Oven room 2.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Tested Date: June 12, 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:

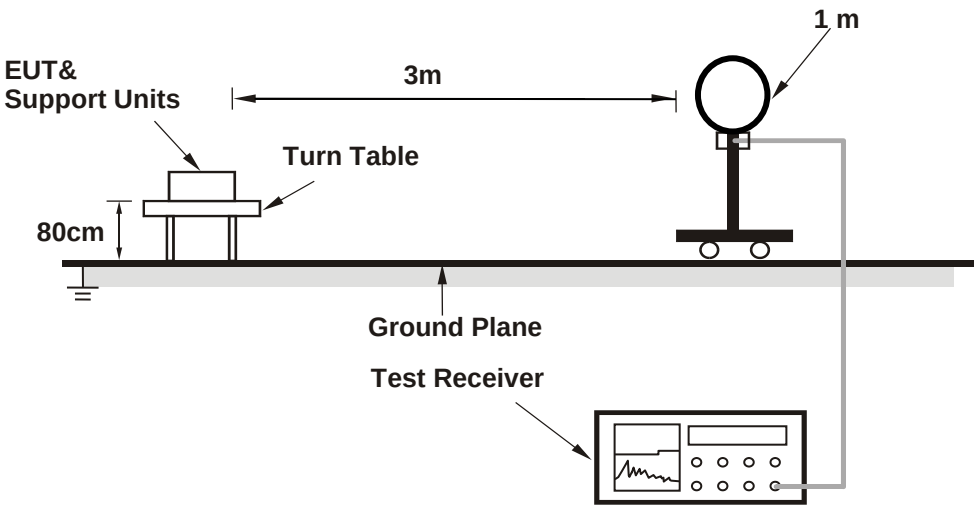
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

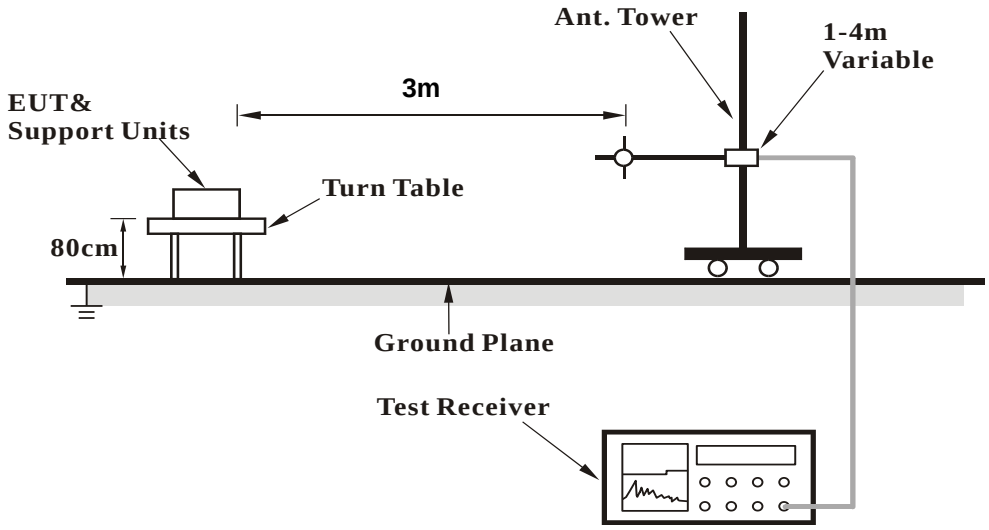
No deviation.

4.1.5 Test Setup

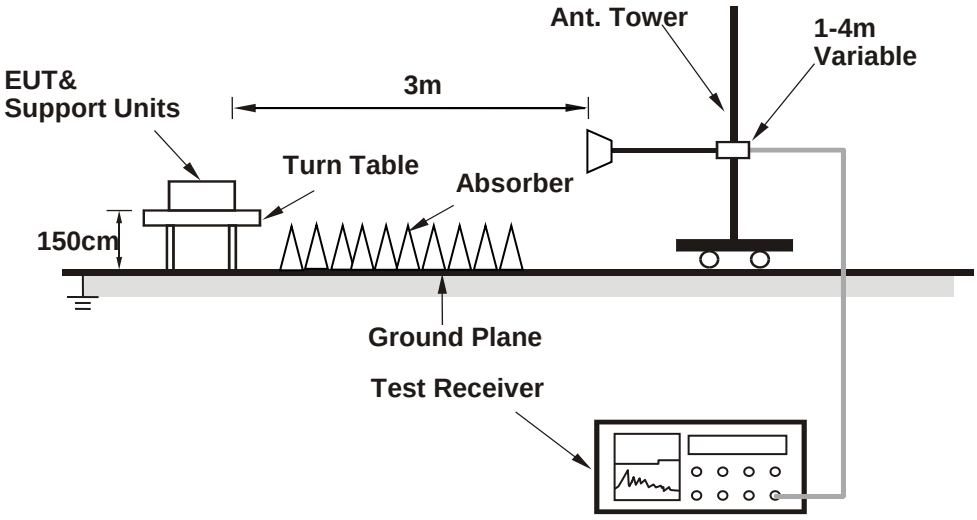
For Radiated emission below 30MHz



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. Connected the EUT with the Laptop which is placed on remote site.
b. Contorlling software (accessMTool_REL_3_1_0_3) has been activated to set the EUT under transmission condition continuously at specific channel frenquency.

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	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	4874.00	49.5 PK	74.0	-24.5	3.99 H	270	46.7	2.8
2	4874.00	46.9 AV	54.0	-7.1	3.99 H	270	44.1	2.8
3	4924.00	42.6 PK	74.0	-31.4	1.75 H	166	39.9	2.7
4	4924.00	38.6 AV	54.0	-15.4	1.75 H	166	35.9	2.7
5	4960.00	41.3 PK	74.0	-32.7	1.81 H	171	38.5	2.8
6	4960.00	34.7 AV	54.0	-19.3	1.81 H	171	31.9	2.8
7	7311.00	52.8 PK	74.0	-21.2	1.56 H	68	43.9	8.9
8	7311.00	47.6 AV	54.0	-6.4	1.56 H	68	38.7	8.9
9	7386.00	53.9 PK	74.0	-20.1	1.70 H	109	44.9	9.0
10	7386.00	48.8 AV	54.0	-5.2	1.70 H	109	39.8	9.0
11	7440.00	47.0 PK	74.0	-27.0	1.44 H	115	38.0	9.0
12	7440.00	35.9 AV	54.0	-18.1	1.44 H	115	26.9	9.0
13	11490.00	48.7 PK	74.0	-25.3	1.45 H	240	35.4	13.3
14	11490.00	38.6 AV	54.0	-15.4	1.45 H	240	25.3	13.3
15	11590.00	55.5 PK	74.0	-18.5	1.13 H	150	42.2	13.3
16	11590.00	43.6 AV	54.0	-10.4	1.13 H	150	30.3	13.3
17	17235.00	60.3 PK	68.2	-7.9	2.69 H	147	42.7	17.6
18	17385.00	50.4 PK	68.2	-17.8	1.46 H	165	32.7	17.7
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	4874.00	49.7 PK	74.0	-24.3	2.19 V	255	46.9	2.8
2	4874.00	47.3 AV	54.0	-6.7	2.19 V	255	44.5	2.8
3	4924.00	42.4 PK	74.0	-31.6	1.55 V	208	39.7	2.7
4	4924.00	36.7 AV	54.0	-17.3	1.55 V	208	34.0	2.7
5	4960.00	43.6 PK	74.0	-30.4	2.46 V	277	40.8	2.8
6	4960.00	37.8 AV	54.0	-16.2	2.46 V	277	35.0	2.8
7	7311.00	53.5 PK	74.0	-20.5	2.56 V	169	44.6	8.9
8	7311.00	48.6 AV	54.0	-5.4	2.56 V	169	39.7	8.9
9	7386.00	50.3 PK	74.0	-23.7	1.30 V	130	41.3	9.0
10	7386.00	45.1 AV	54.0	-8.9	1.30 V	130	36.1	9.0
11	7440.00	47.2 PK	74.0	-26.8	1.73 V	173	38.2	9.0
12	7440.00	37.8 AV	54.0	-16.2	1.73 V	173	28.8	9.0
13	11490.00	49.6 PK	74.0	-24.4	1.19 V	98	36.3	13.3
14	11490.00	39.2 AV	54.0	-14.8	1.19 V	98	25.9	13.3
15	11590.00	55.8 PK	74.0	-18.2	1.48 V	126	42.5	13.3
16	11590.00	43.1 AV	54.0	-10.9	1.48 V	126	29.8	13.3
17	**17235.00**	**63.9 PK**	**68.2**	**-4.3**	**3.99 V**	**108**	**46.3**	**17.6**
18	17385.00	51.8 PK	68.2	-16.4	1.36 V	214	34.1	17.7

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. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

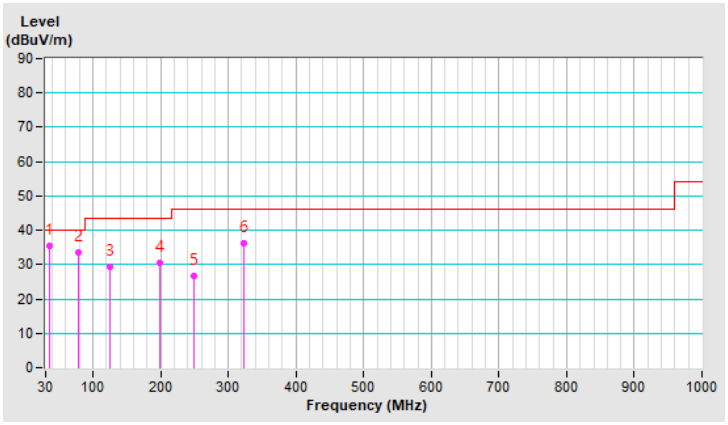
Below 1GHz Data:

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

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	36.62	35.6 QP	40.0	-4.4	2.00 H	186	44.1	-8.5
2	78.20	33.4 QP	40.0	-6.6	2.00 H	143	45.6	-12.2
3	125.01	29.2 QP	43.5	-14.3	2.00 H	167	38.1	-8.9
4	198.26	30.5 QP	43.5	-13.0	2.00 H	238	40.9	-10.4
5	250.00	26.7 QP	46.0	-19.3	1.50 H	244	35.1	-8.4
6	323.32	36.2 QP	46.0	-9.8	1.50 H	241	41.7	-5.5

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.

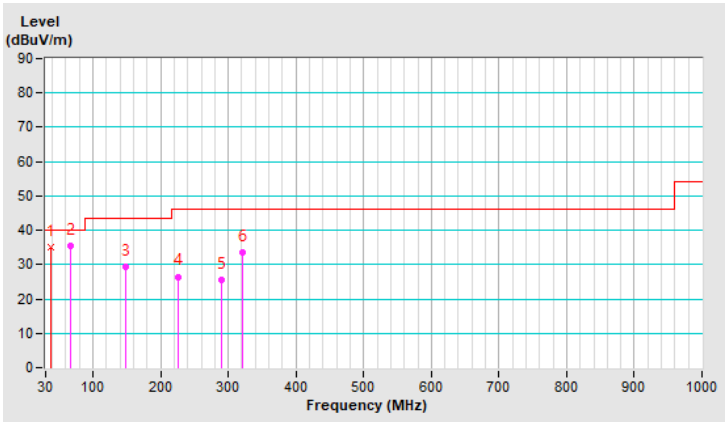


FREQUENCY RANGE	9kHz ~ 1GHz	DETECTOR FUNCTION	Quasi-Peak (QP)

Antenna Polarity & Test Distance : Vertical at 3 m								
No	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	38.48	35.1 QP	40.0	-4.9	1.42 V	216	43.4	-8.3
2	67.20	35.3 QP	40.0	-4.7	1.00 V	138	44.7	-9.4
3	148.09	29.5 QP	43.5	-14.0	1.00 V	241	36.6	-7.1
4	225.84	26.5 QP	46.0	-19.5	1.00 V	168	36.4	-9.9
5	289.07	25.6 QP	46.0	-20.4	1.50 V	238	32.3	-6.7
6	320.99	33.6 QP	46.0	-12.4	2.00 V	196	39.1	-5.5

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.



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. 19, 2020	Mar. 18, 2021
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	005	Aug. 30, 2019	Aug. 29, 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: June 09, 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.

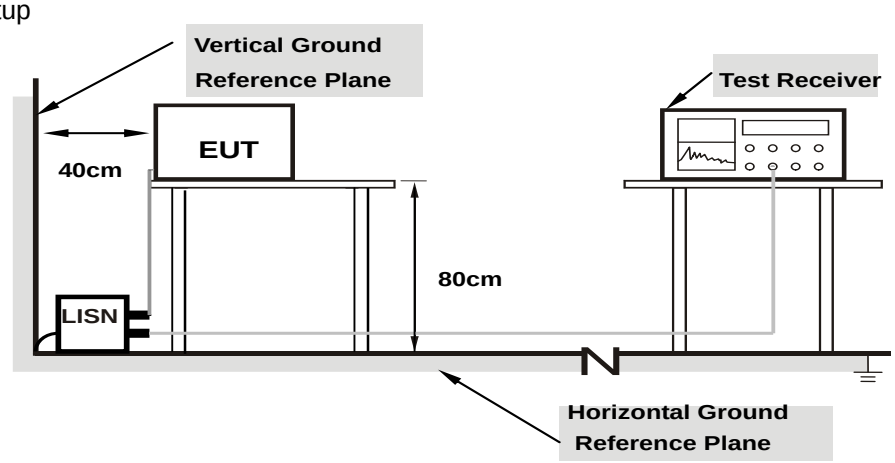
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

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.

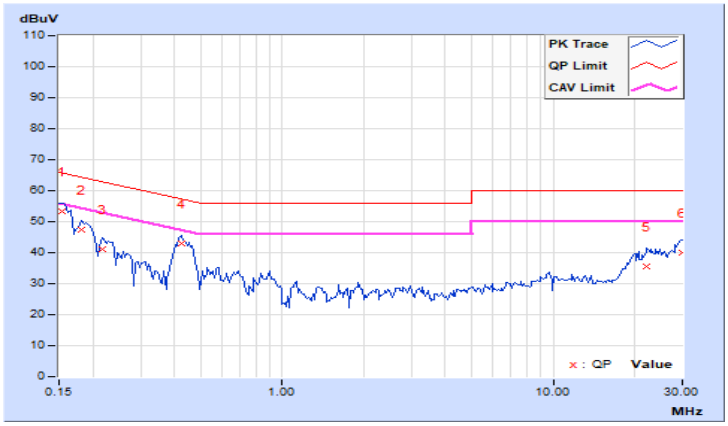
4.2.7 Test Results

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	10.01	43.39	33.28	53.40	43.29	65.79	55.79	-12.39	-12.50
2	0.18125	10.02	37.34	17.49	47.36	27.51	64.43	54.43	-17.07	-26.92
3	0.21641	10.02	31.24	13.30	41.26	23.32	62.96	52.96	-21.70	-29.64
4	0.42344	10.03	32.90	28.46	42.93	38.49	57.38	47.38	-14.45	-8.89
5	22.23047	11.22	24.29	19.13	35.51	30.35	60.00	50.00	-24.49	-19.65
6	29.85547	11.50	28.48	23.54	39.98	35.04	60.00	50.00	-20.02	-14.96

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

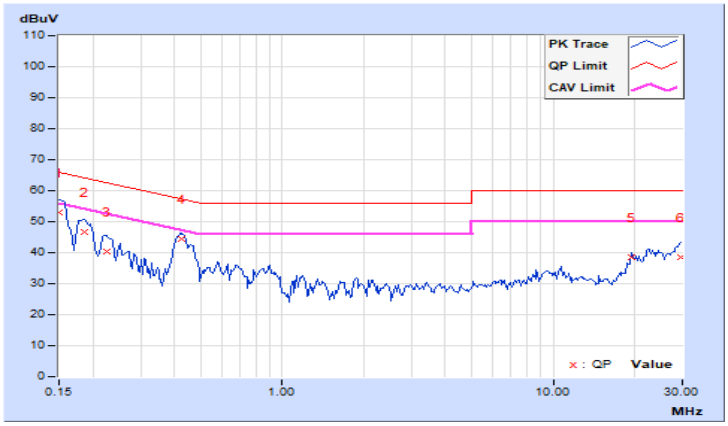


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)

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	10.00	43.10	32.67	53.10	42.67	66.00	56.00	-12.90	-13.33
2	0.18516	10.01	36.50	21.32	46.51	31.33	64.25	54.25	-17.74	-22.92
3	0.22422	10.01	30.35	16.36	40.36	26.37	62.66	52.66	-22.30	-26.29
4	**0.42734**	**10.01**	**34.42**	**30.06**	**44.43**	**40.07**	**57.30**	**47.30**	**-12.87**	**-7.23**
5	19.39453	10.86	27.81	26.45	38.67	37.31	60.00	50.00	-21.33	-12.69
6	29.50000	11.11	27.59	22.73	38.70	33.84	60.00	50.00	-21.30	-16.16

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

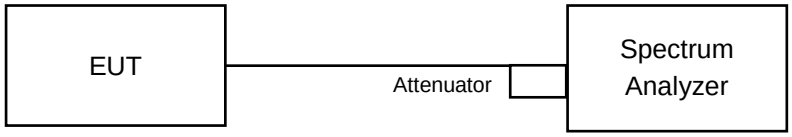


4.3 Conducted Out of Band Emission Measurement

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

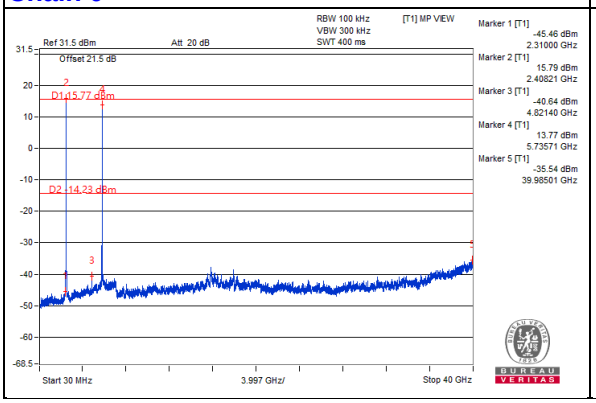
The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.

4.3.7 Test Results

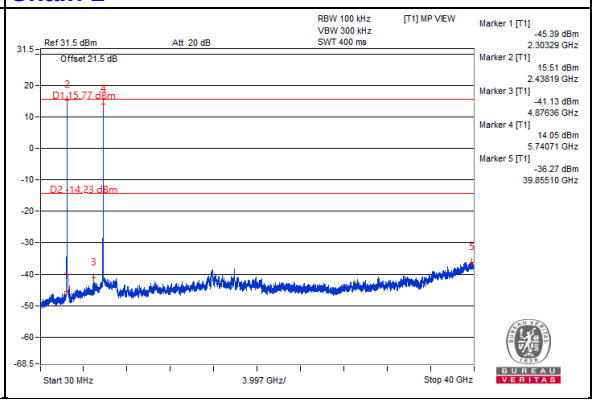
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 30dB offset below D1. It shows compliance with the requirement.

2.4GHz_802.11b CH6 + 5GHz_802.11ax (HE20) CH149

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

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