

Supplemental “Transmit Simultaneously” Test Report

Report No.: RF171204E07-4

FCC ID: Q87-03331

Test Model: WHW01

Series Model: VLP01, A01

Received Date: Dec. 04, 2017

Test Date: Dec. 09, 2017 to Jan. 23, 2018

Issued Date: Feb. 06, 2018

Applicant: Linksys LLC

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Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
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**FCC Registration /
Designation Number:** 723255 / TW2022



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Release Control Record

Issue No.	Description	Date Issued
RF171204E07-4	Original release.	Feb. 06, 2018

1 Certificate of Conformity

Product: Velop

Brand: Linksys

Test Model: WHW01

Series Model: VLP01, A01

Sample Status: ENGINEERING SAMPLE

Applicant: Linksys LLC

Test Date: Dec. 09, 2017 to Jan. 23, 2018

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 : Wendy Wu , **Date:** Feb. 06, 2018
Wendy Wu / Specialist

Approved by : May Chen , **Date:** Feb. 06, 2018
May Chen / Manager

2 Summary of Test Results

47 CFR 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 -3.03dB at 0.49862MHz.
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 -2.9dB at 17475.00MHz.

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	5.53 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	5.08 dB
	6GHz ~ 18GHz	4.98 dB
	18GHz ~ 40GHz	5.19 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Velop	
Brand	Linksys	
Test Model	WHW01	
Series Model	VLP01, A01	
Status of EUT	ENGINEERING SAMPLE	
Driver version	1.1.3.186486	
Power Supply Rating	12Vdc from power adapter	
Modulation Type	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
	BT-EDR	GFSK, $\pi/4$ -DQPSK, 8DPSK
	BT-LE	GFSK
Modulation Technology	WLAN	DSSS, OFDM
	BT-EDR	FHSS
	BT-LE	DTS
Transfer Rate	WLAN	802.11b: up to 11Mbps 802.11a/g: up to 54Mbps 802.11n: up to 300Mbps 802.11ac: up to 866.7Mbps
	BT-EDR	Up to 3Mbps
	BT-LE	Up to 1Mbps
Operating Frequency	WLAN	2.4GHz: 2.412 ~ 2.462GHz 5GHz: 5.18~ 5.24GHz, 5.745 ~ 5.825GHz
	BT-EDR	2402MHz ~ 2480MHz
	BT-LE	2402MHz ~ 2480MHz
Number of Channel	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
	BT-EDR	79
	BT-LE	40
Antenna Type	Refer to Note	
Antenna Connector	Refer to Note	
Accessory Device	Adapter x 1	
Data Cable Supplied	NA	

Note:

1. There are WLAN and Bluetooth technology used for the EUT.
2. The EUT has below model names, which are identical to each other in all aspects except for the following table:

Brand	Model Name	Different
Linksys	WHW01	For maketing request Color : Black & White
	VLP01	
	A01	

From the above models, model: **WHW01** was selected as representative model for the test and its data was recorded in this report.

3. Simultaneously transmission condition.

Condition	Technology		
1	WLAN 2.4GHz	WLAN 5GHz	Bluetooth

Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.

4. The EUT must be supplied with a power adapter and following different models could be chosen as following table:

No.	Brand	Model No.	Spec.	Plug	Remark
1	APD	WA-12M12R	Input: 100-240Vac, 0.5A, 50-60Hz Output: 12V, 1A Output cable: Unshielded, 1.5m	Universal	Black & White
2	APD	WB-12G12FU	Input: 100-240Vac, 0.3A, 50-60Hz Output: 12V, 1A Output cable: Unshielded, 1.5m	FCC	Black & White
3	Ktec	KSAS0121200100D5	Input: 100-240Vac, 0.4A, 50-60Hz Output: 12V, 1A Output cable: Unshielded, 1.5m	Universal	Black & White
4	Ktec	KSA-12W-120100VU	Input: 100-240Vac, 0.4A, 50/60Hz Output: 12V, 1A Output cable: Unshielded, 1.5m	FCC	Black & White

Note: From the above models, the worst radiated emission test was found in **Adapter 4**. Therefore only the test data of the modes were recorded in this report.

5. The DDR3 Memory of EUT as following table

Item	Brand	Model No.	Different
Main source	Winbond	W632GU6MB-12	1. For maketing request. 2. DDR3 Memory.
Second source	Nanya	NT5CC128M16IP-DI	

Note: From the above models, the worst case was found in **Main source**. Therefore only the test data of the modes were recorded in this report.

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

WLAN						
Ant No.	Brand	Model	Antenna Gain (dBi)	Frequency rang (GHz)	Antenna type	Connector type
1	ARISTOTLE	AP571-P11-P2	2.4	2.4~2.4835	PCB	i-pex(MHF)
			3.6	5.15~5.85		
2	ARISTOTLE	AP571-P22-P5	1.36	2.4~2.4835	PCB	i-pex(MHF)
			3.5	5.15~5.85		
Bluetooth						
Ant No.	Brand	Model	Antenna Gain (dBi)	Frequency rang (GHz)	Antenna type	Connector type
1	ARISTOTLE	AP571-BT-1	1.48	2.4~2.4835	PCB	i-pex(MHF)

7. 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
VHT20	MCS0~8 Nss=1	2TX	2RX
	MCS0~8 Nss=2	2TX	2RX
VHT40	MCS0~9 Nss=1	2TX	2RX
	MCS0~9 Nss=2	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

Note:

1. All of modulation mode support beamforming function except 802.11a/b/g modulation mode.
2. The modulation and bandwidth are similar for 802.11n mode for 20MHz (40MHz) and 802.11ac mode for 20MHz (40MHz), therefore investigated worst case to representative mode in test report. (Final test mode refer section 3.2.1)

8. 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	
1	-	-	√	-	Power from Adapter 1
2	-	-	√	-	Power from Adapter 2
3	-	-	√	-	Power from Adapter 3
4	√	√	√	√	Power from Adapter 4

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

NOTE: “-” means no effect.

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 (VHT20) + BT-EDR	1 to 11	1	DSSS	DBPSK
	36 to 48 149 to 165	165	OFDM	BPSK
	0 to 78	78	FHSS	GFSK

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 (VHT20) + BT-EDR	1 to 11	1	DSSS	DBPSK
	36 to 48 149 to 165	165	OFDM	BPSK
	0 to 78	78	FHSS	GFSK

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 (VHT20) + BT-EDR	1 to 11	1	DSSS	DBPSK
	36 to 48 149 to 165	165	OFDM	BPSK
	0 to 78	78	FHSS	GFSK

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 (VHT20)	1 to 11	1	DSSS	DBPSK
	36 to 48 149 to 165	165	OFDM	BPSK

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE \geq 1G	23deg. C, 68%RH	120Vac, 60Hz	Weiwei Lo
RE<1G	23deg. C, 68%RH	120Vac, 60Hz	Frank Chuang
PLC	25deg. C, 75%RH	120Vac, 60Hz	Andy Ho
OB	25deg. C, 65%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	E6420	B92T3R1	FCC DoC	Provided by Lab

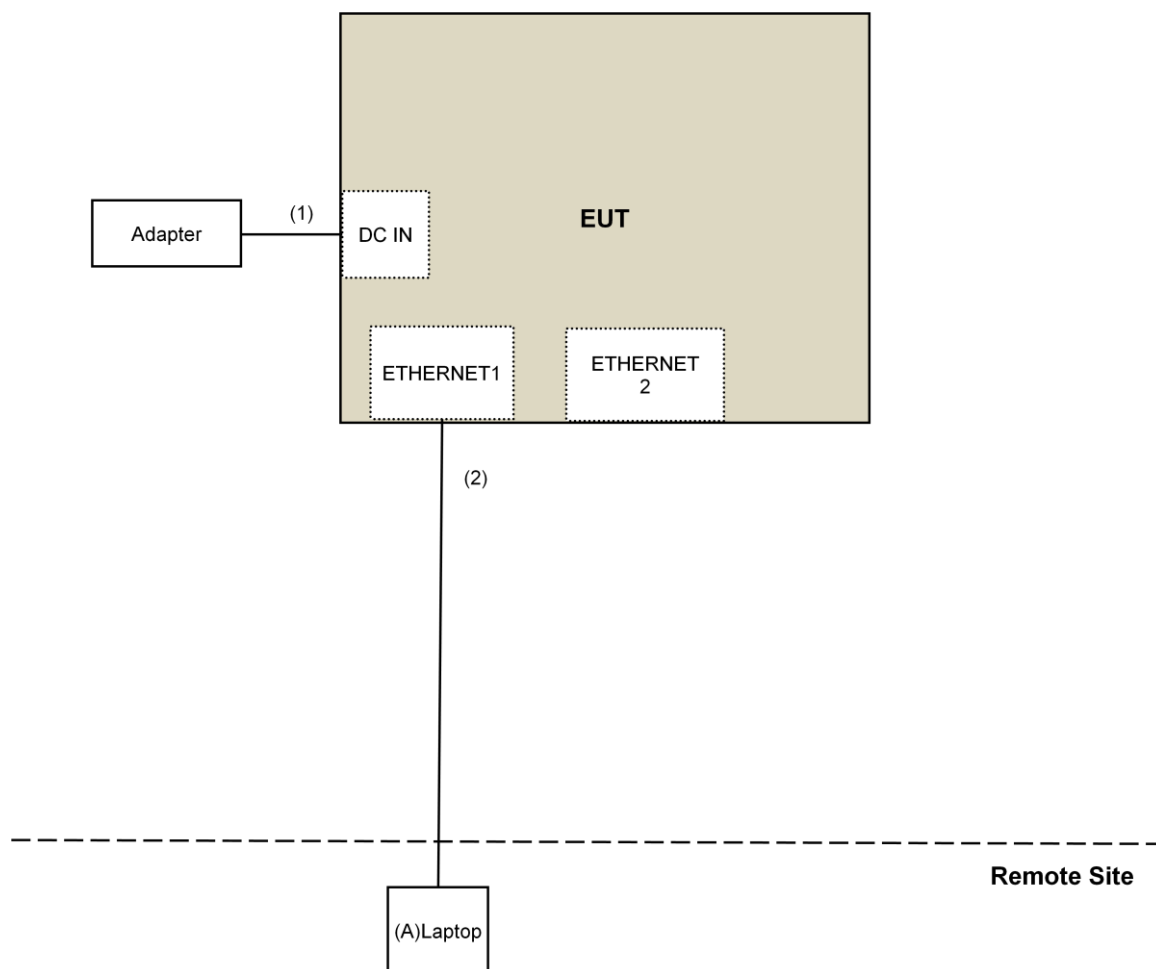
Note:

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.	DC Cable	1	1.5	No	0	Supplied by client
2.	RJ-45 Cable	1	10	No	0	Provided by Lab

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

3.2.1 Configuration of System under Test



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	<input checked="" type="checkbox"/>	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}
	<input type="checkbox"/>	15.407(b)(4)(ii)	Emission limits in section 15.247(d)	
^{*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:

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

4.1.2 Test Instruments

For below 1GHz test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Agilent	N9038A	MY50010156	July 12, 2017	July 11, 2018
Loop Antenna ^(*) TESEQ	HLA 6121	45745	May 19, 2017	May 18, 2018
Pre-Amplifier Mini-Circuits	ZFL-1000VH2B	AMP-ZFL-05	May 06, 2017	May 05, 2018
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-361	Nov. 29, 2017	Nov. 28, 2018
RF Cable	8D	966-3-1 966-3-2 966-3-3	Apr. 01, 2017	Mar. 31, 2018
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-3m-3-01	Oct. 03, 2017	Oct. 02, 2018
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Antenna Tower & Turn Table Max-Full	MF-7802	MF780208406	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 calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. The test was performed in 966 Chamber No. 3.
4. The CANADA Site Registration No. is 20331-1
5. Loop antenna was used for all emissions below 30 MHz.
6. Tested Date: Jan. 23, 2018

For other test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Agilent	N9038A	MY50010156	July 12, 2017	July 11, 2018
Horn_Antenna SCHWARZBECK	BBHA9120-D	9120D-406	Dec. 28, 2016	Dec. 27, 2017
Pre-Amplifier EMCI	EMC12630SE	980384	Feb. 02, 2017	Feb. 01, 2018
RF Cable	EMC104-SM-SM-1200	160922	Feb. 02, 2017	Feb. 01, 2018
	EMC104-SM-SM-2000	150317	Mar. 29, 2017	Mar. 28, 2018
	EMC104-SM-SM-5000	150322	Mar. 29, 2017	Mar. 28, 2018
Spectrum Analyzer Keysight	N9030A	MY54490679	July 25, 2017	July 24, 2018
Pre-Amplifier EMCI	EMC184045SE	980386	Feb. 02, 2017	Feb. 01, 2018
Horn_Antenna SCHWARZBECK	BBHA 9170	BBHA9170608	Dec. 15, 2016	Dec. 14, 2017
RF Cable	SUCOFLEX 102	36432/2 36433/2	Jan. 15, 2017	Jan. 14, 2018
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
Spectrum Analyzer R&S	FSv40	100964	July 1, 2017	June 30, 2018
Power meter Anritsu	ML2495A	1014008	May 11, 2017	May 10, 2018
Power sensor Anritsu	MA2411B	0917122	May 11, 2017	May 10, 2018

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 calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. The test was performed in 966 Chamber No. 3.
4. The CANADA Site Registration No. is 20331-1
5. Loop antenna was used for all emissions below 30 MHz.
6. Tested Date: Dec. 12, 2017

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. Both X and Y axes 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:

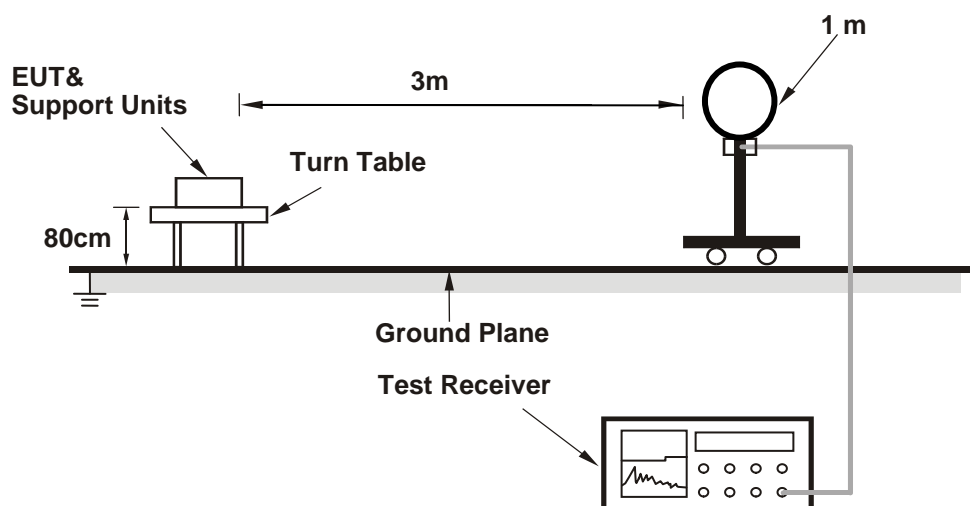
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

4.1.4 Deviation from Test Standard

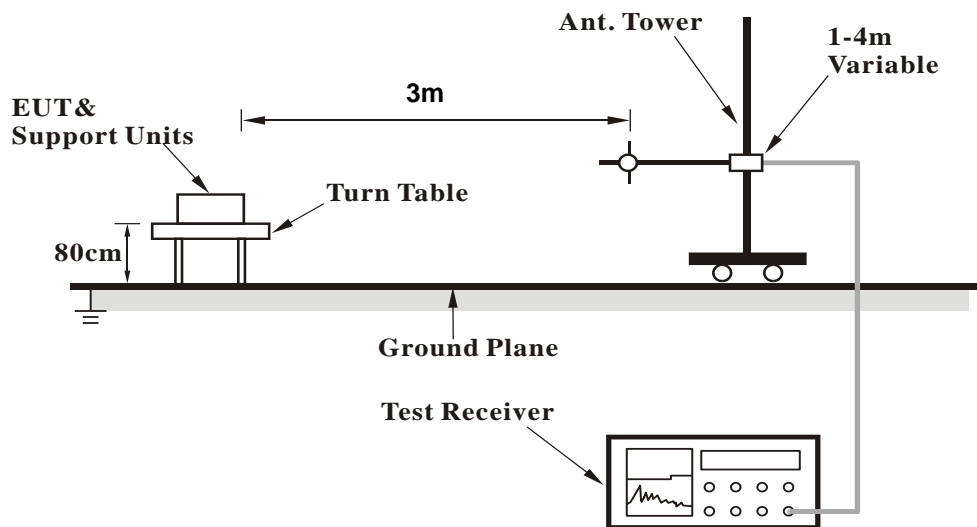
No deviation.

4.1.5 Test Setup

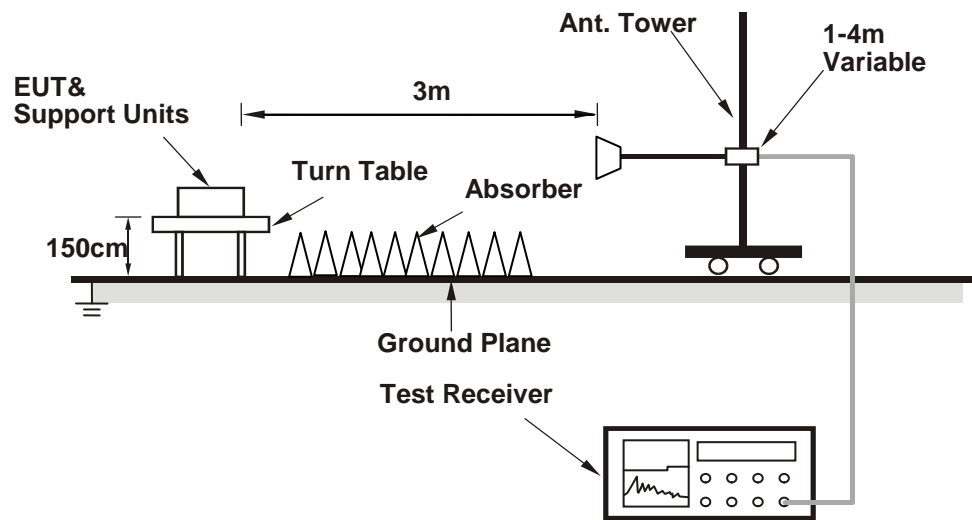
For Radiated emission below 30MHz



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

- Connected the EUT with the laptop which is placed on remote site.
- Contorlling software (WLAN: QARCT.EXE V3.0.210.0, Bluetooth: BT+LE Command.txt) 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	4824.00	44.0 PK	74.0	-30.0	1.39 H	205	41.0	3.0
2	4824.00	40.7 AV	54.0	-13.3	1.39 H	205	37.7	3.0
3	4960.00	46.0 PK	74.0	-28.0	2.54 H	183	42.8	3.2
4	4960.00	39.1 AV	54.0	-14.9	2.54 H	183	35.9	3.2
5	7440.00	43.8 PK	74.0	-30.2	1.68 H	32	34.6	9.2
6	7440.00	33.3 AV	54.0	-20.7	1.68 H	32	24.1	9.2
7	11650.00	49.3 PK	74.0	-24.7	1.70 H	263	35.6	13.7
8	11650.00	37.7 AV	54.0	-16.3	1.70 H	263	24.0	13.7
9	17475.00	64.2 PK	74.0	-9.8	1.64 H	106	45.6	18.6
10	17475.00	51.1 AV	54.0	-2.9	1.64 H	106	32.5	18.6
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	4824.00	43.7 PK	74.0	-30.3	1.81 V	182	40.7	3.0
2	4824.00	39.5 AV	54.0	-14.5	1.81 V	182	36.5	3.0
3	4960.00	44.9 PK	74.0	-29.1	2.47 V	81	41.7	3.2
4	4960.00	39.0 AV	54.0	-15.0	2.47 V	81	35.8	3.2
5	7440.00	42.2 PK	74.0	-31.8	1.56 V	359	33.0	9.2
6	7440.00	32.1 AV	54.0	-21.9	1.56 V	359	22.9	9.2
7	11650.00	52.9 PK	74.0	-21.1	2.57 V	67	39.2	13.7
8	11650.00	40.0 AV	54.0	-14.0	2.57 V	67	26.3	13.7
9	17475.00	56.4 PK	74.0	-17.6	1.49 V	191	37.8	18.6
10	17475.00	44.2 AV	54.0	-9.8	1.49 V	191	25.6	18.6

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.	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	125.24	33.5 QP	43.5	-10.0	1.00 H	75	43.2	-9.7
2	143.09	33.7 QP	43.5	-9.8	3.00 H	321	42.0	-8.3
3	250.13	31.5 QP	46.0	-14.5	2.00 H	214	41.0	-9.5
4	356.36	31.3 QP	46.0	-14.7	1.50 H	153	37.7	-6.4
5	447.29	28.9 QP	46.0	-17.1	2.50 H	174	32.6	-3.7
6	649.84	30.0 QP	46.0	-16.0	1.00 H	261	30.1	-0.1
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	50.78	36.5 QP	40.0	-3.5	1.00 V	232	44.8	-8.3
2	102.09	35.4 QP	43.5	-8.1	1.50 V	140	47.5	-12.1
3	125.21	37.3 QP	43.5	-6.2	2.00 V	129	47.0	-9.7
4	249.89	29.0 QP	46.0	-17.0	3.00 V	214	38.5	-9.5
5	356.47	32.6 QP	46.0	-13.4	1.50 V	110	39.0	-6.4
6	611.09	30.9 QP	46.0	-15.1	1.50 V	249	31.7	-0.8

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

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	Nov. 01, 2017	Oct. 31, 2018
Line-Impedance Stabilization Network (for EUT) R&S	ESH3-Z5	848773/004	Nov. 15, 2017	Nov. 14, 2018
Line-Impedance Stabilization Network (for Peripheral) R&S	ENV216	100072	June 03, 2017	June 02, 2018
50 ohms Terminator	N/A	EMC-02	Sep. 22, 2017	Sep. 21, 2018
RF Cable	5D-FB	COCCAB-001	Sep. 29, 2017	Sep. 28, 2018
10 dB PAD Mini-Circuits	HAT-10+	CONATT-004	June 18, 2017	June 17, 2018
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 Shielded Room No. 1.
3. Tested Date: Dec. 12, 2017

4.2.3 Test Procedures

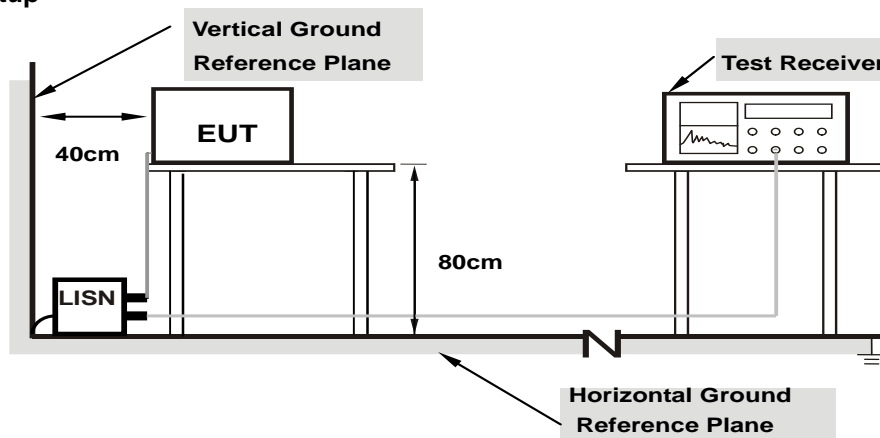
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

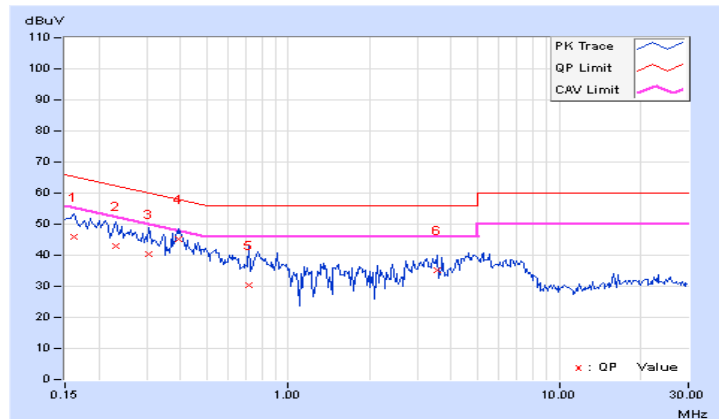
4.2.7 Test Results (Mode 1)

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
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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	0.16172	10.08	35.85	23.12	45.93	33.20	65.38	55.38	-19.45	-22.18
2	0.23203	10.08	32.98	20.53	43.06	30.61	62.38	52.38	-19.32	-21.77
3	0.30625	10.10	30.13	16.67	40.23	26.77	60.07	50.07	-19.84	-23.30
4	0.39609	10.12	35.07	26.16	45.19	36.28	57.93	47.93	-12.74	-11.65
5	0.71250	10.15	20.27	10.23	30.42	20.38	56.00	46.00	-25.58	-25.62
6	3.56250	10.32	24.87	16.49	35.19	26.81	56.00	46.00	-20.81	-19.19

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

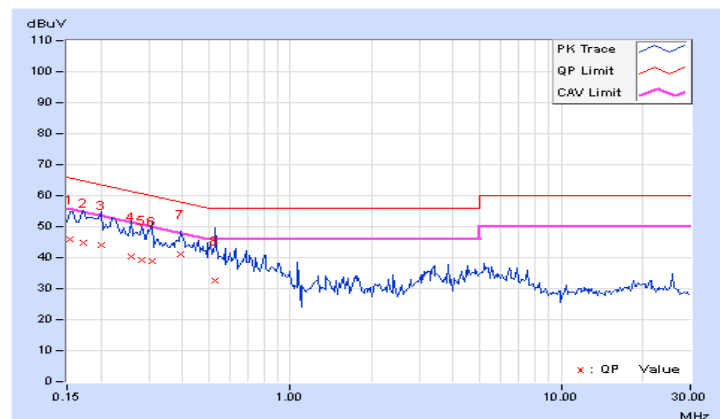


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
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Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	10.07	35.83	24.74	45.90	34.81	65.79	55.79	-19.89	-20.98
2	0.17344	10.06	34.76	23.29	44.82	33.35	64.79	54.79	-19.97	-21.44
3	0.20078	10.04	33.92	20.74	43.96	30.78	63.58	53.58	-19.62	-22.80
4	0.25938	10.06	30.29	18.33	40.35	28.39	61.45	51.45	-21.10	-23.06
5	0.28281	10.07	29.30	16.51	39.37	26.58	60.73	50.73	-21.36	-24.15
6	0.31016	10.08	28.91	14.24	38.99	24.32	59.97	49.97	-20.98	-25.65
7	0.39219	10.12	30.81	21.84	40.93	31.96	58.02	48.02	-17.09	-16.06
8	0.52891	10.12	22.43	10.55	32.55	20.67	56.00	46.00	-23.45	-25.33

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



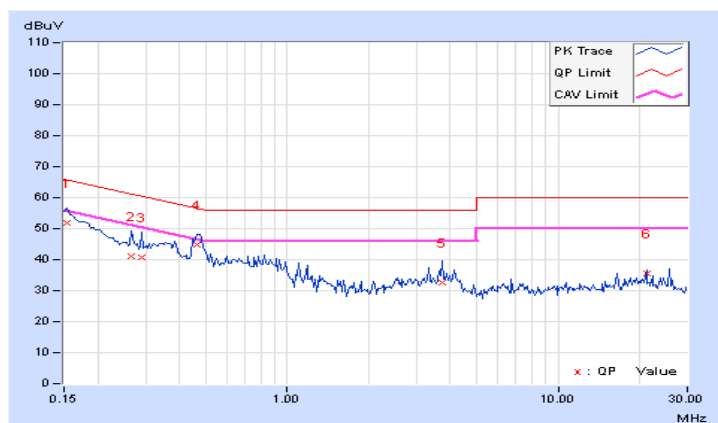
4.2.8 Test Results (Mode 2)

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
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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	10.08	41.83	29.68	51.91	39.76	65.79	55.79	-13.88	-16.03
2	0.26719	10.09	31.13	21.91	41.22	32.00	61.20	51.20	-19.98	-19.20
3	0.29063	10.09	30.66	19.74	40.75	29.83	60.51	50.51	-19.76	-20.68
4	0.46641	10.13	34.68	29.45	44.81	39.58	56.58	46.58	-11.77	-7.00
5	3.73828	10.34	22.10	14.65	32.44	24.99	56.00	46.00	-23.56	-21.01
6	21.16797	11.61	23.86	19.52	35.47	31.13	60.00	50.00	-24.53	-18.87

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

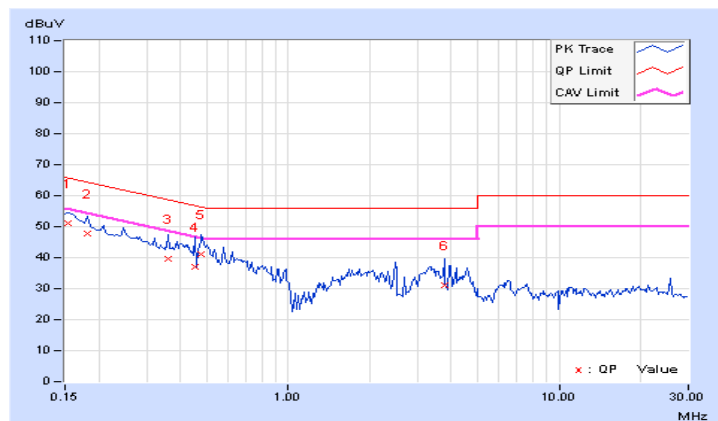


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
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Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBUV)		Emission Level (dBUV)		Limit (dBUV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	10.07	41.06	29.16	51.13	39.23	65.79	55.79	-14.66	-16.56
2	0.18125	10.05	37.56	24.66	47.61	34.71	64.43	54.43	-16.82	-19.72
3	0.36094	10.10	29.39	14.23	39.49	24.33	58.71	48.71	-19.22	-24.38
4	0.45078	10.12	26.88	17.15	37.00	27.27	56.86	46.86	-19.86	-19.59
5	0.47813	10.12	31.16	20.45	41.28	30.57	56.37	46.37	-15.09	-15.80
6	3.79297	10.25	20.86	10.16	31.11	20.41	56.00	46.00	-24.89	-25.59

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



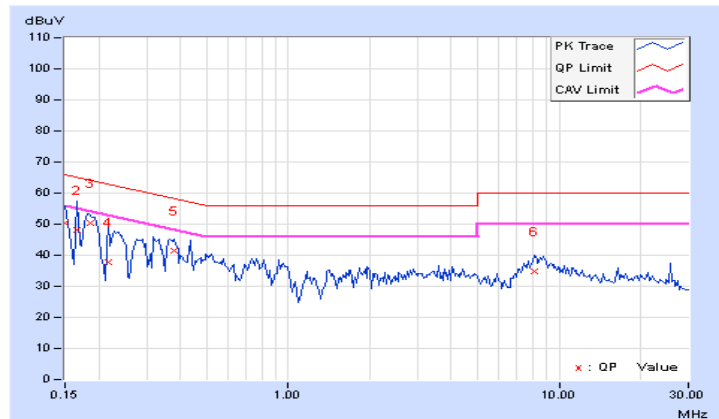
4.2.9 Test Results (Mode 3)

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
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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	0.15000	10.09	40.31	25.27	50.40	35.36	66.00	56.00	-15.60	-20.64
2	0.16562	10.08	37.94	13.80	48.02	23.88	65.18	55.18	-17.16	-31.30
3	0.18516	10.07	40.47	28.64	50.54	38.71	64.25	54.25	-13.71	-15.54
4	0.21641	10.07	27.78	9.70	37.85	19.77	62.96	52.96	-25.11	-33.19
5	0.38047	10.12	31.18	25.68	41.30	35.80	58.27	48.27	-16.97	-12.47
6	8.14453	10.66	24.21	16.74	34.87	27.40	60.00	50.00	-25.13	-22.60

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

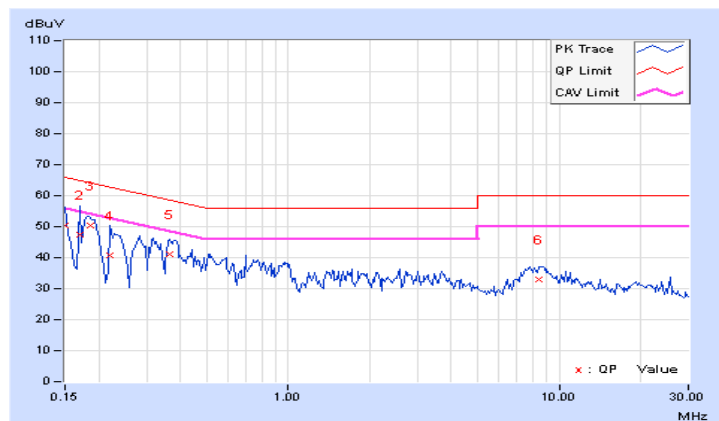


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
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Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.08	40.20	25.69	50.28	35.77	66.00	56.00	-15.72	-20.23
2	0.16953	10.06	37.20	14.14	47.26	24.20	64.98	54.98	-17.72	-30.78
3	0.18516	10.05	40.47	29.28	50.52	39.33	64.25	54.25	-13.73	-14.92
4	0.22031	10.05	30.64	13.05	40.69	23.10	62.81	52.81	-22.12	-29.71
5	0.36484	10.11	31.03	23.20	41.14	33.31	58.62	48.62	-17.48	-15.31
6	8.40234	10.59	22.43	16.15	33.02	26.74	60.00	50.00	-26.98	-23.26

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



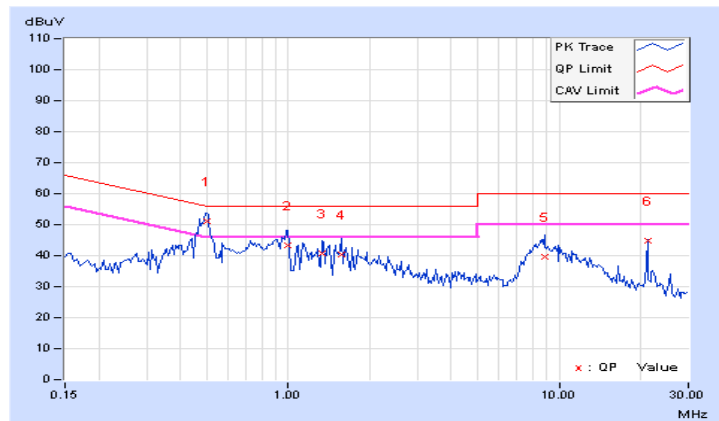
4.2.10 Test Results (Mode 4)

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
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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	0.49862	10.13	41.06	32.86	51.19	42.99	56.02	46.02	-4.83	-3.03
2	0.99766	10.17	33.02	21.72	43.19	31.89	56.00	46.00	-12.81	-14.11
3	1.33984	10.17	30.52	19.88	40.69	30.05	56.00	46.00	-15.31	-15.95
4	1.57031	10.17	30.32	20.41	40.49	30.58	56.00	46.00	-15.51	-15.42
5	8.85156	10.71	29.10	19.46	39.81	30.17	60.00	50.00	-20.19	-19.83
6	21.16775	11.61	33.26	24.72	44.87	36.33	60.00	50.00	-15.13	-13.67

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

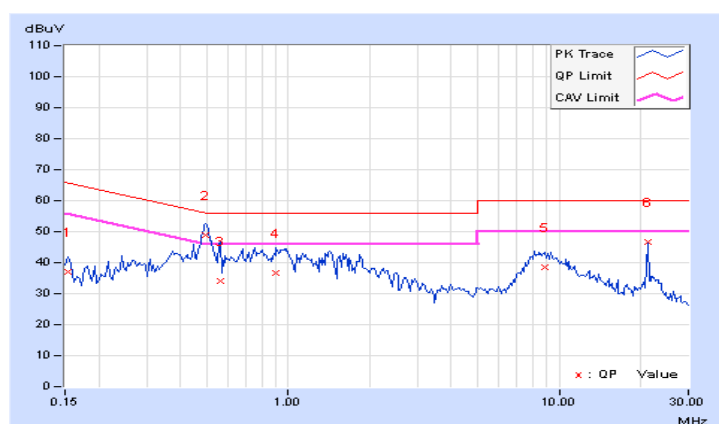


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
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Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	10.07	26.94	18.28	37.01	28.35	65.79	55.79	-28.78	-27.44
2	0.49494	10.12	38.73	27.51	48.85	37.63	56.08	46.08	-7.23	-8.45
3	0.56016	10.12	23.99	11.19	34.11	21.31	56.00	46.00	-21.89	-24.69
4	0.90000	10.13	26.72	14.13	36.85	24.26	56.00	46.00	-19.15	-21.74
5	8.85938	10.62	28.06	17.28	38.68	27.90	60.00	50.00	-21.32	-22.10
6	21.16969	11.29	35.28	24.39	46.57	35.68	60.00	50.00	-13.43	-14.32

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

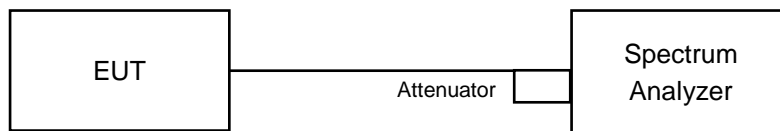


4.3 Conducted Out of Band Emission Measurement

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 \geq 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 \geq 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

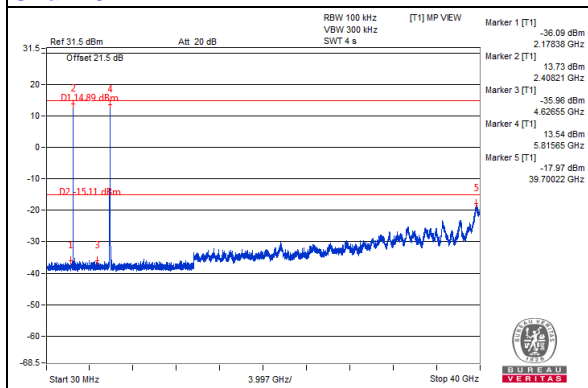
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.3.7 Test Results

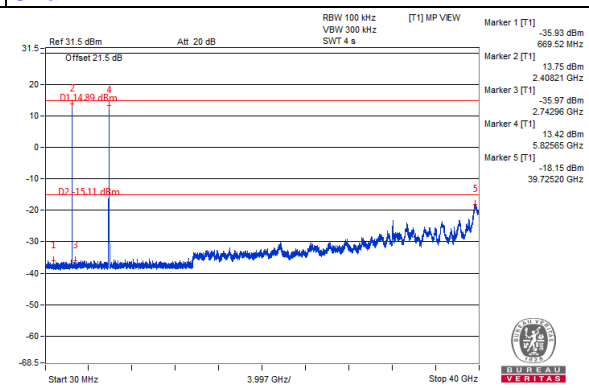
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 30dB offset below D1. It shows compliance with the requirement.

2.4GHz_802.11b CH1+5GHz_802.11ac (VHT20) CH165

Chain 0



Chain 1



5 Pictures of Test Arrangements

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

Appendix – Information on 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:

Linko EMC/RF Lab

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565

Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab

Tel: 886-3-3183232

Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

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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