

## FCC Test Report

**Report No.:** RF170720C12-2

**FCC ID:** TVE-291BB033

**Test Model:** FortiAP U422EV

**Series Model:** FortiAP U422EVxxxxxx, FAP-U422EVxxxxxx, FORTIAP-U422EVxxxxxx  
(where "x" can be used as "A-Z", or "0-9", or "-", or blank for marketing purposes only) (refer to item 3.1 for more details)

**Received Date:** Jul. 20, 2017

**Test Date:** Oct. 03 ~ Oct. 05, 2017

**Issued Date:** Oct. 13, 2017

**Applicant:** Fortinet Inc.

**Address:** 899 Kifer Road Sunnyvale, CA 94086 USA

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

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

**Test Location:** No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN (R.O.C.)



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## Table of Contents

<b>Release Control Record</b>	<b>4</b>
<b>1 Certificate of Conformity</b>	<b>5</b>
<b>2 Summary of Test Results</b>	<b>6</b>
2.1 Measurement Uncertainty	6
2.2 Modification Record	6
<b>3 General Information</b>	<b>7</b>
3.1 General Description of EUT	7
3.2 Description of Test Modes	8
3.2.1 Test Mode Applicability and Tested Channel Detail	9
3.3 Duty Cycle of Test Signal	10
3.4 Description of Support Units	11
3.4.1 Configuration of System under Test	11
3.5 General Description of Applied Standards	11
<b>4 Test Types and Results</b>	<b>12</b>
4.1 Radiated Emission and Bandedge Measurement	12
4.1.1 Limits of Radiated Emission and Bandedge Measurement	12
4.1.2 Test Instruments	13
4.1.3 Test Procedures	14
4.1.4 Deviation from Test Standard	14
4.1.5 Test Setup	15
4.1.6 EUT Operating Conditions	16
4.1.7 Test Results	17
4.2 Conducted Emission Measurement	21
4.2.1 Limits of Conducted Emission Measurement	21
4.2.2 Test Instruments	21
4.2.3 Test Procedures	22
4.2.4 Deviation from Test Standard	22
4.2.5 Test Setup	22
4.2.6 EUT Operating Conditions	22
4.2.7 Test Results	23
4.3 6dB Bandwidth Measurement	25
4.3.1 Limits of 6dB Bandwidth Measurement	25
4.3.2 Test Setup	25
4.3.3 Test Instruments	25
4.3.4 Test Procedure	25
4.3.5 Deviation from Test Standard	25
4.3.6 EUT Operating Conditions	25
4.3.7 Test Result	26
4.4 Conducted Output Power Measurement	27
4.4.1 Limits of Conducted Output Power Measurement	27
4.4.2 Test Setup	27
4.4.3 Test Instruments	27
4.4.4 Test Procedures	27
4.4.5 Deviation from Test Standard	27
4.4.6 EUT Operating Conditions	27
4.4.7 Test Results	27
4.5 Power Spectral Density Measurement	28
4.5.1 Limits of Power Spectral Density Measurement	28
4.5.2 Test Setup	28
4.5.3 Test Instruments	28
4.5.4 Test Procedure	28
4.5.5 Deviation from Test Standard	28
4.5.6 EUT Operating Condition	28

4.5.7 Test Results .....	29
4.6 Conducted Out of Band Emission Measurement.....	30
4.6.1 Limits of Conducted Out of Band Emission Measurement .....	30
4.6.2 Test Setup.....	30
4.6.3 Test Instruments .....	30
4.6.4 Test Procedure .....	30
4.6.5 Deviation from Test Standard .....	30
4.6.6 EUT Operating Condition .....	30
4.6.7 Test Results .....	30
<b>5 Pictures of Test Arrangements.....</b>	<b>32</b>
<b>Appendix – Information on the Testing Laboratories .....</b>	<b>33</b>

### Release Control Record

Issue No.	Description	Date Issued
RF170720C12-2	Original release.	Oct. 13, 2017

## 1 Certificate of Conformity

**Product:** Secured Wireless Access Point

**Brand:** Fortinet Inc.

**Test Model:** FortiAP U422EV

**Series Model:** FortiAP U422EVxxxxxx, FAP-U422EVxxxxxx, FORTIAP-U422EVxxxxxx (where "x" can be used as "A-Z", or "0-9", or "-", or blank for marketing purposes only) (refer to item 3.1 for more details)

**Sample Status:** Engineering sample

**Applicant:** Fortinet Inc.

**Test Date:** Oct. 03 ~ Oct. 05, 2017

**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.247)  
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 :** Celine Chou , **Date:** Oct. 13, 2017  
Celine Chou / Specialist

**Approved by :** Ken Liu , **Date:** Oct. 13, 2017  
Ken Liu / Senior Manager

## 2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit. Minimum passing margin is -6.81dB at 0.45216MHz.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -4.0dB at 30.18MHz.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.247(a)(2)	6dB bandwidth	Pass	Meet the requirement of limit.
15.247(b)	Conducted power	Pass	Meet the requirement of limit.
15.247(e)	Power Spectral Density	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	Antenna connector is MMCX not a standard connector.

### 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) ( $\pm$ )
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.94 dB
Radiated Emissions up to 1 GHz	30MHz ~ 200MHz	3.63 dB
	200MHz ~ 1000MHz	3.64 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

Product	Secured Wireless Access Point
Brand	Fortinet Inc.
Test Model	FortiAP U422EV
Series Model	FortiAP U422EVxxxxxx, FAP-U422EVxxxxxx, FORTIAP-U422EVxxxxxx (where “x” can be used as “A-Z”, or “0-9”, or “-”, or blank for marketing purposes only)
Model Difference	Refer to note
Sample Status	Engineering sample
Power Supply Rating	54Vdc from POE
Modulation Type	GFSK
Transfer Rate	1Mbps
Operating Frequency	2402 ~ 2480MHz
Number of Channel	40
Channel Spacing	2MHz
Output Power	2.259mW
Antenna Type	Refer to note
Antenna Connector	Refer to note
Accessory Device	POE, Wall mount
Cable Supplied	1.75m non-shielded Grounding cable without core connected EUT

Note:

1. The following models are provided to this EUT.

Brand	Model	Description
Fortinet Inc.	FortiAP U422EVxxxxxx	where “x” can be used as “A-Z”, or “0-9”, or “-”, or blank for marketing purposes only
	FAP-U422EVxxxxxx	
	FORTIAP-U422EVxxxxxx	

\* The model FortiAP U422EV was chosen for final test.

2. The EUT consumes power from the following POE.

Brand	SENAO
Model	PIN060-54PR
Input Power	100-240Vac, 50/60Hz, 1.5A
Output Power	54Vdc / 1.11A PIN 3,4,5,6: 54Vdc PIN 1,2,7,8 RETURN
Power Line	0.5m non-shielded without core

3. The following antenna was provided to the EUT.

Antenna Type	Printed	Antenna Connector	MMCX
Gain (dBi)	Frequency (MHz)		
	2400	2450	2500
BT Ant.	5.77	5.52	5.57

4. 2.4GHz, 5GHz & BT or 2.4GHz, 5GHz & BT LE technology can transmit at same time. BT and BT LE cannot transmit simultaneously.
5. Spurious emission of the simultaneous operation (2.4GHz, 5GHz & BT or 2.4GHz, 5GHz & BT LE) has been evaluated and no non-compliance was found.

### 3.2 Description of Test Modes

40 channels are provided to this EUT:

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



### 3.2.1 Test Mode Applicability and Tested Channel Detail

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

Where RE $\geq$ 1G: Radiated Emission above 1GHz & Bandedge Measurement  
 RE<1G: Radiated Emission below 1GHz  
 PLC: Power Line Conducted Emission  
 APCM: Antenna Port Conducted Measurement

Note: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Z-plane**.

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

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

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	1

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

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

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	19	GFSK	1

#### **Power Line Conducted Emission Test:**

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

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	19	GFSK	1

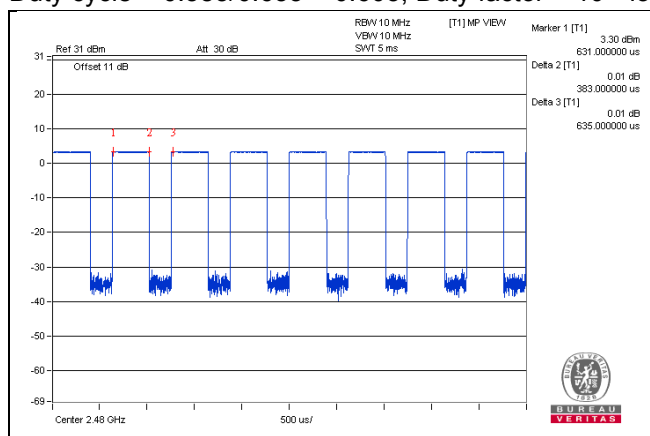
#### **Antenna Port Conducted Measurement:**

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

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	1

Applicable to	Environmental Conditions	Input Power	Tested by
RE≥1G	27 deg. C, 61% RH	120Vac, 60Hz	Matthew Yang
RE<1G	27 deg. C, 61% RH	120Vac, 60Hz	Matthew Yang
PLC	25 deg. C, 75% RH	120Vac, 60Hz	Matthew Yang
APCM	25 deg. C, 60% RH	120Vac, 60Hz	Credic Wu

Duty cycle =  $0.383/0.635 = 0.603$ , Duty factor =  $10 * \log(1/0.603) = 2.20$



### 3.4 Description of Support Units

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

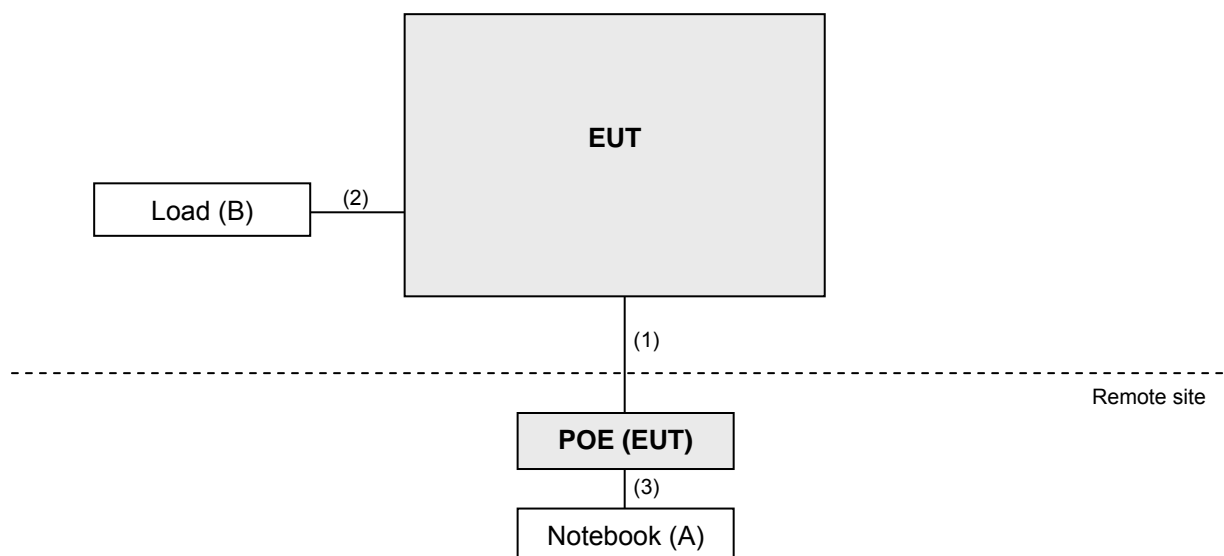
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Notebook	DELL	E5410	6RP2YM1	FCC DoC Approved	-
B.	Load	NA	NA	NA	NA	-

Note:

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

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	RJ45, Cat5e	1	3	N	0	-
2.	RJ45, Cat5e	2	1.8	N	0	-
3.	RJ45, Cat5e	1	1.8	N	0	-

#### 3.4.1 Configuration of System under Test



### 3.5 General Description of Applied Standards

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

**FCC Part 15, Subpart C (15.247)**

**KDB 558074 D01 DTS Meas Guidance v04**

ANSI C63.10:2013

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

Note: The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC). The test report has been issued separately.

## 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. Other emissions shall be at least 30dB below the highest level of the desired power:

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 30dB under any condition of modulation.

#### 4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESCI	100424	Oct. 24, 2016	Oct. 23, 2017
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100040	Aug. 18, 2017	Aug. 17, 2018
BILOG Antenna SCHWARZBECK	VULB9168	9168-155	Dec. 28, 2016	Dec. 27, 2017
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-1170	Dec. 15, 2016	Dec. 14, 2017
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Dec. 14, 2016	Dec. 13, 2017
Loop Antenna EMCI	EM-6879	269	Aug. 11, 2017	Aug. 10, 2018
Preamplifier Agilent	8449B	3008A01960	Aug. 08, 2017	Aug. 07, 2018
Preamplifier Agilent	8447D	2944A10631	Aug. 08, 2017	Aug. 07, 2018
RF signal cable HUBER+SUHNER	SUCOFLEX 104	MY 13380+295012/04	Aug. 08, 2017	Aug. 07, 2018
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-CH4-03 (250724)	Aug. 08, 2017	Aug. 07, 2018
Software BV ADT	ADT_Radiated_ V7.6.15.9.4	NA	NA	NA
Antenna Tower inn-co GmbH	MA 4000	010303	NA	NA
Antenna Tower Controller BV ADT	AT100	AT93021703	NA	NA
Turn Table BV ADT	TT100	TT93021703	NA	NA
Turn Table Controller BV ADT	SC100	SC93021703	NA	NA
High Speed Peak Power Meter	ML2495A	0824012	Aug. 18, 2017	Aug. 17, 2018
Power Sensor	MA2411B	0738171	Aug. 18, 2017	Aug. 17, 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 test was performed in HwaYa Chamber 4.
  3. The horn antenna and preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
  4. The FCC Designation Number is TW0003. The number will be varied with the Lab location and scope as attached.
  5. The IC Site Registration No. is IC7450F-4.

#### 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 detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

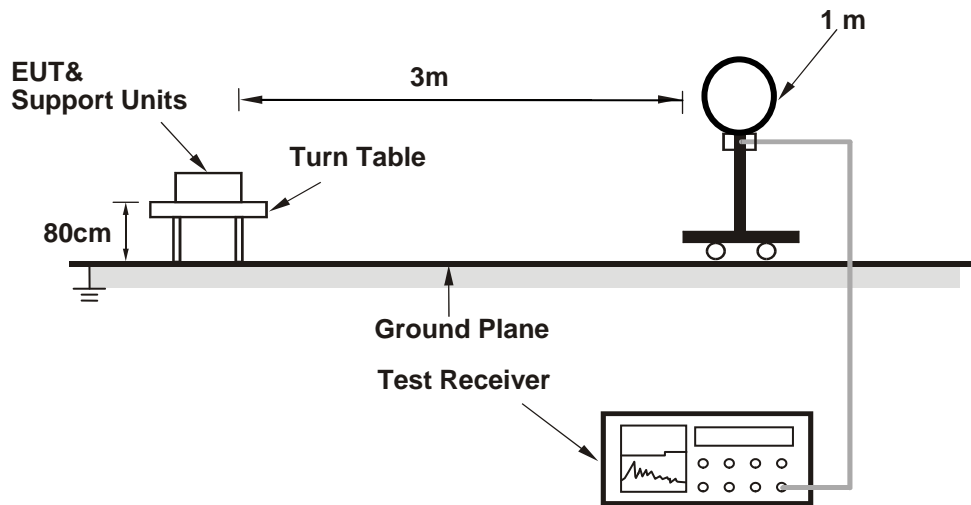
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98%) or 10 Hz (Duty cycle  $\geq 98\%$ ) for Peak detection 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

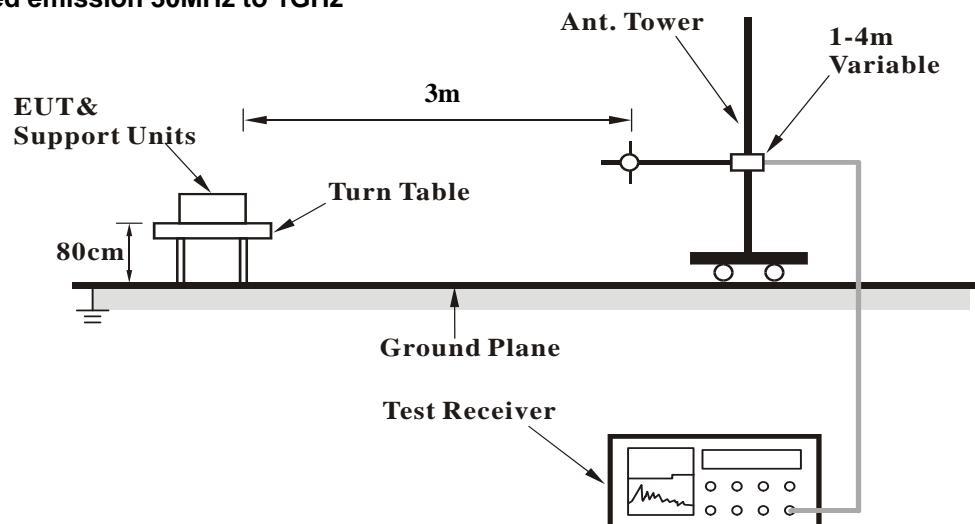
No deviation.

#### 4.1.5 Test Setup

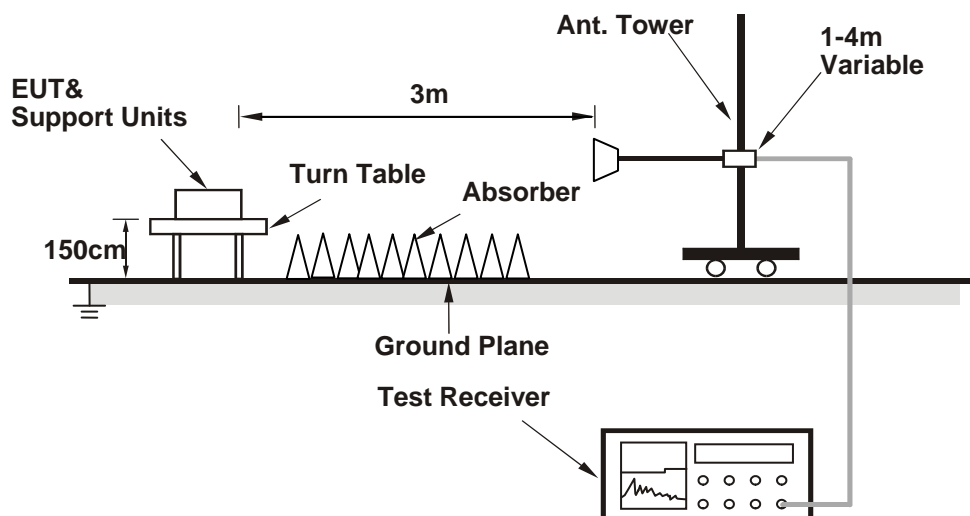
##### For Radiated emission below 30MHz



##### 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

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



#### 4.1.7 Test Results

Above 1GHz Data:

CHANNEL	TX Channel 0	DETECTOR	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	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	2390.00	57.1 PK	74.0	-16.9	2.33 H	33	23.6	33.5
2	2390.00	46.1 AV	54.0	-7.9	2.33 H	33	12.6	33.5
3	*2402.00	103.3 PK			2.27 H	28	69.8	33.5
4	*2402.00	98.2 AV			2.27 H	28	64.7	33.5
5	4804.00	48.7 PK	74.0	-25.3	2.11 H	327	40.7	8.0
6	4804.00	36.2 AV	54.0	-17.8	2.11 H	327	28.2	8.0
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	2390.00	56.9 PK	74.0	-17.1	1.44 V	30	23.4	33.5
2	2390.00	46.0 AV	54.0	-8.0	1.44 V	30	12.5	33.5
3	*2402.00	101.9 PK			1.50 V	25	68.4	33.5
4	*2402.00	96.8 AV			1.50 V	25	63.3	33.5
5	4804.00	48.1 PK	74.0	-25.9	1.15 V	47	40.1	8.0
6	4804.00	35.8 AV	54.0	-18.2	1.15 V	47	27.8	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. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.

CHANNEL	TX Channel 19	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		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	*2440.00	101.8 PK			2.68 H	32	68.2	33.6
2	*2440.00	96.8 AV			2.68 H	32	63.2	33.6
3	4880.00	49.1 PK	74.0	-24.9	2.07 H	318	41.0	8.1
4	4880.00	36.6 AV	54.0	-17.4	2.07 H	318	28.5	8.1
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	*2440.00	100.7 PK			1.88 V	23	67.1	33.6
2	*2440.00	95.6 AV			1.88 V	23	62.0	33.6
3	4880.00	48.4 PK	74.0	-25.6	1.19 V	50	40.3	8.1
4	4880.00	36.3 AV	54.0	-17.7	1.19 V	50	28.2	8.1

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. " \* ": Fundamental frequency.

CHANNEL	TX Channel 39	DETECTOR	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz	FUNCTION	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	*2480.00	101.0 PK			2.41 H	21	67.1	33.9
2	*2480.00	96.0 AV			2.41 H	21	62.1	33.9
3	2483.50	57.7 PK	74.0	-16.3	2.47 H	18	23.8	33.9
4	2483.50	46.7 AV	54.0	-7.3	2.47 H	18	12.8	33.9
5	4960.00	49.4 PK	74.0	-24.6	2.02 H	332	40.9	8.5
6	4960.00	36.8 AV	54.0	-17.2	2.02 H	332	28.3	8.5
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	*2480.00	99.2 PK			1.68 V	22	65.3	33.9
2	*2480.00	94.5 AV			1.68 V	22	60.6	33.9
3	2483.50	57.5 PK	74.0	-16.5	1.71 V	27	23.6	33.9
4	2483.50	46.5 AV	54.0	-7.5	1.71 V	27	12.6	33.9
5	4960.00	48.9 PK	74.0	-25.1	1.22 V	58	40.4	8.5
6	4960.00	36.4 AV	54.0	-17.6	1.22 V	58	27.9	8.5

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

Below 1GHz worst-case data:

CHANNEL	TX Channel 19	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	97.95	32.0 QP	43.5	-11.5	2.00 H	79	50.7	-18.7
2	167.94	30.6 QP	43.5	-12.9	1.01 H	217	44.4	-13.8
3	323.49	24.6 QP	46.0	-21.4	1.01 H	339	36.0	-11.4
4	700.68	27.5 QP	46.0	-18.5	1.51 H	352	31.7	-4.2
5	799.84	29.1 QP	46.0	-16.9	2.00 H	310	31.0	-1.9
6	935.94	40.4 QP	46.0	-5.6	2.00 H	6	40.2	0.2
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	30.18	36.0 QP	40.0	-4.0	1.00 V	113	52.0	-16.0
2	45.45	33.9 QP	40.0	-6.1	1.00 V	85	48.6	-14.7
3	167.94	32.9 QP	43.5	-10.6	1.00 V	155	46.7	-13.8
4	333.21	28.3 QP	46.0	-17.7	1.50 V	7	39.5	-11.2
5	741.51	31.5 QP	46.0	-14.5	2.00 V	0	34.5	-3.0
6	937.88	41.0 QP	46.0	-5.0	1.50 V	104	40.7	0.3

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

## 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.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Nov. 21, 2016	Nov. 20, 2017
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond1-01	Dec. 22, 2016	Dec. 21, 2017
LISN ROHDE & SCHWARZ (EUT)	ESH3-Z5	835239/001	Mar. 10, 2017	Mar. 09, 2018
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Aug. 15, 2017	Aug. 14, 2018
Software ADT	BV ADT_Conc_ V7.3.7.3	NA	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 HwaYa Shielded Room 1.

3. The VCCI Site Registration No. is C-2040.

#### 4.2.3 Test Procedures

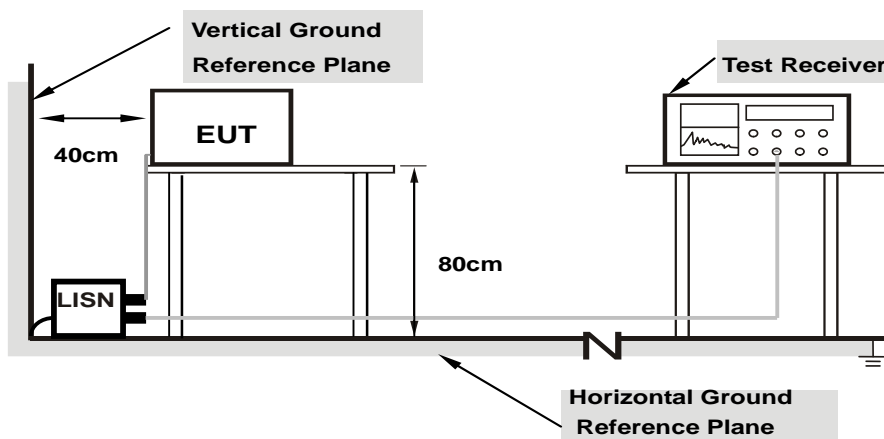
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

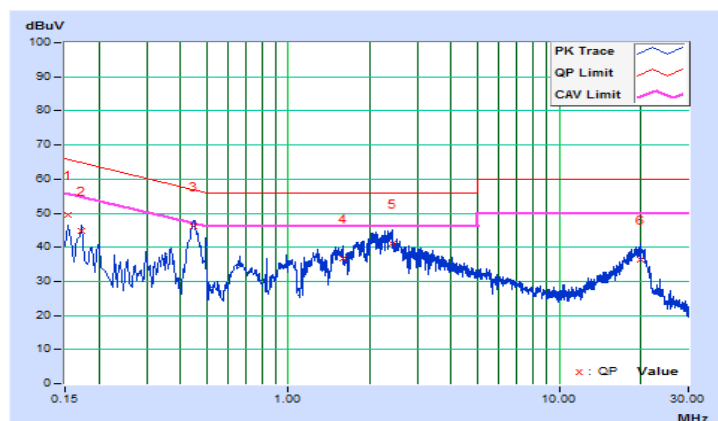
#### 4.2.7 Test Results

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

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	10.45	39.10	29.73	49.55	40.18	65.79	55.79	-16.24	-15.61
2	0.17328	10.45	34.29	24.74	44.74	35.19	64.80	54.80	-20.06	-19.61
3	0.44978	10.51	35.52	29.01	46.03	39.52	56.88	46.88	-10.85	-7.36
4	1.59279	10.51	26.15	20.92	36.66	31.43	56.00	46.00	-19.34	-14.57
5	2.40998	10.55	30.57	23.35	41.12	33.90	56.00	46.00	-14.88	-12.10
6	19.87986	11.42	24.95	18.36	36.37	29.78	60.00	50.00	-23.63	-20.22

#### Remarks:

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

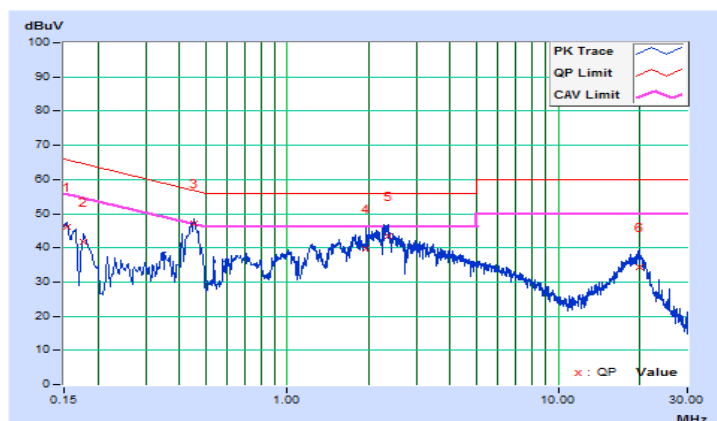


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
-------	-------------	-------------------	--------------------------------

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	10.21	35.75	29.27	45.96	39.48	65.79	55.79	-19.83	-16.31
2	0.17744	10.21	31.51	23.94	41.72	34.15	64.60	54.60	-22.88	-20.45
<b>3</b>	<b>0.45216</b>	<b>10.24</b>	<b>36.76</b>	<b>29.79</b>	<b>47.00</b>	<b>40.03</b>	<b>56.84</b>	<b>46.84</b>	<b>-9.84</b>	<b>-6.81</b>
4	1.95675	10.31	29.46	22.13	39.77	32.44	56.00	46.00	-16.23	-13.56
5	2.35915	10.33	33.27	26.33	43.60	36.66	56.00	46.00	-12.40	-9.34
6	19.98543	11.05	23.40	16.43	34.45	27.48	60.00	50.00	-25.55	-22.52

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.



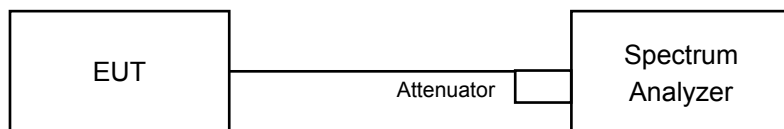


### 4.3 6dB Bandwidth Measurement

#### 4.3.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

#### 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 Procedure

- Set resolution bandwidth (RBW) = 100kHz.
- Set the video bandwidth (VBW)  $\geq 3 \times$  RBW, Detector = average.
- Trace mode = max hold.
- Sweep = auto couple.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

#### 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.

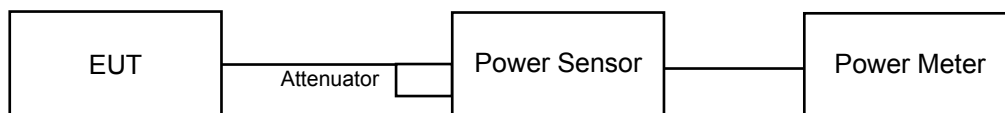


#### 4.4 Conducted Output Power Measurement

##### 4.4.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

##### 4.4.2 Test Setup



##### 4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

##### 4.4.4 Test Procedures

An average power sensor was used on the output port of the EUT. A power meter was used to read the response of the average power sensor. Record the power level.

##### 4.4.5 Deviation from Test Standard

No deviation.

##### 4.4.6 EUT Operating Conditions

Same as item 4.3.6.

##### 4.4.7 Test Results

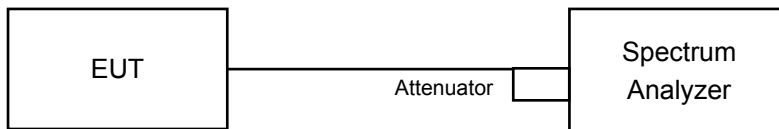
Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
0	2402	2.084	3.19	30.00	Pass
19	2440	<b>2.259</b>	3.54	30.00	Pass
39	2480	2.065	3.15	30.00	Pass

## 4.5 Power Spectral Density Measurement

### 4.5.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm.

### 4.5.2 Test Setup



### 4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.5.4 Test Procedure

- Measure the duty cycle (x).
- Set instrument center frequency to DTS channel center frequency.
- Set span to at least 1.5 times the OBW.
- Set RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- Set VBW  $\geq 3 \times \text{RBW}$ .
- Detector = power averaging (RMS) or sample detector (when RMS not available).
- Ensure that the number of measurement points in the sweep  $\geq 2 \times \text{span/RBW}$ .
- Sweep time = auto couple.
- Do not use sweep triggering. Allow sweep to "free run".
- Employ trace averaging (RMS) mode over a minimum of 100 traces.
- Use the peak marker function to determine the maximum amplitude level.
- Add  $10 \log (1/x)$ , where x is the duty cycle measured in step (a), to the measured PSD to compute the average PSD during the actual transmission time.

### 4.5.5 Deviation from Test Standard

No deviation.

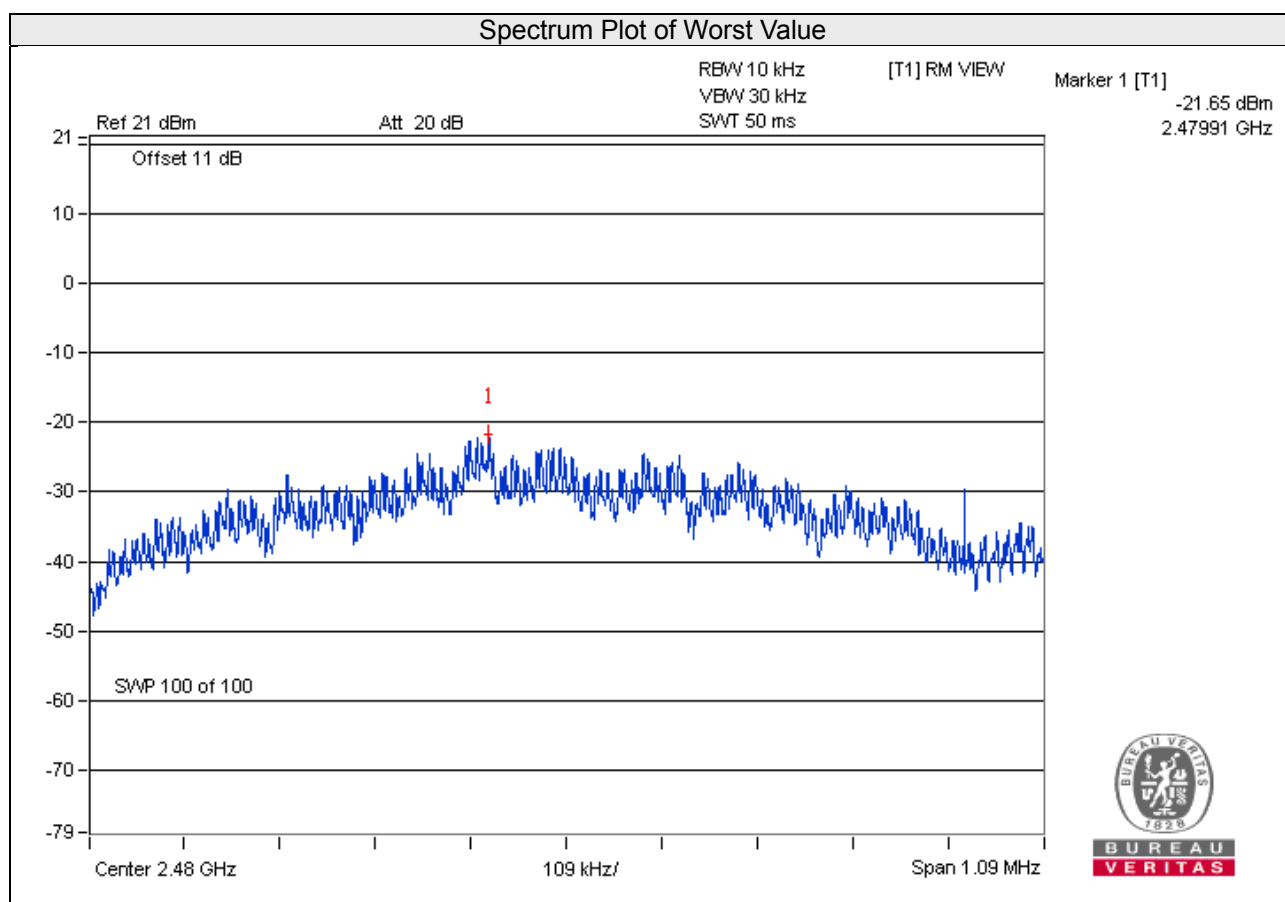
### 4.5.6 EUT Operating Condition

Same as item 4.3.6

#### 4.5.7 Test Results

Channel	Frequency (MHz)	PSD w/o Duty Factor (dBm/10kHz)	Duty Factor (dB)	Total PSD With Duty Factor (dBm/10kHz)	Limit (dBm/3kHz)	Pass / Fail
0	2402	-22.28	2.20	-20.08	8.00	Pass
19	2440	-22.38	2.20	-20.18	8.00	Pass
39	2480	-21.65	2.20	-19.45	8.00	Pass

Note: Refer to section 3.3 for duty cycle spectrum plot.



## 4.6 Conducted Out of Band Emission Measurement

### 4.6.1 Limits of Conducted Out of Band Emission Measurement

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

### 4.6.2 Test Setup



### 4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.6.4 Test Procedure

#### MEASUREMENT PROCEDURE REF

- Set the RBW = 100 kHz.
- Set the VBW  $\geq$  300 kHz.
- Detector = average.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

#### MEASUREMENT PROCEDURE OOB

- Set RBW = 100 kHz.
- Set VBW  $\geq$  300 kHz.
- Detector = average.
- Sweep = auto couple.
- Trace Mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

### 4.6.5 Deviation from Test Standard

No deviation.

### 4.6.6 EUT Operating Condition

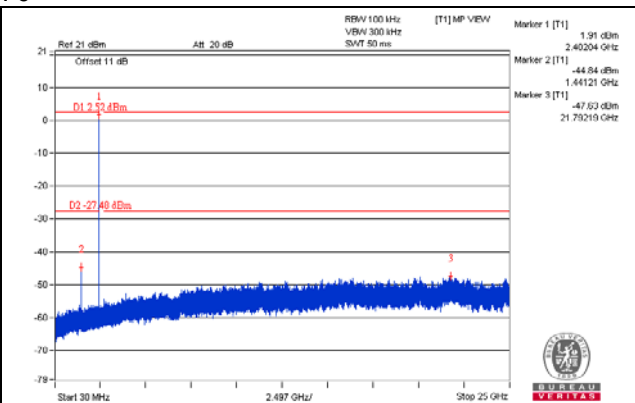
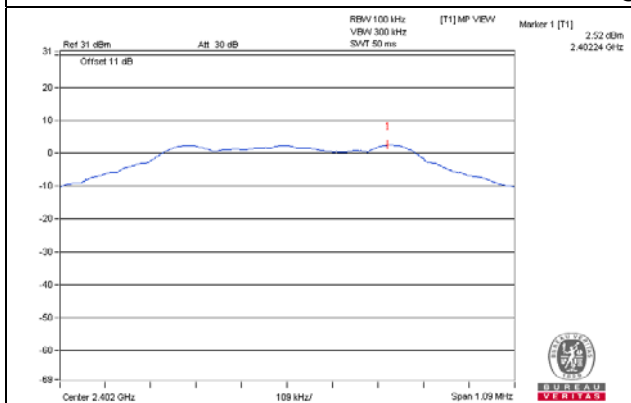
Same as item 4.3.6

### 4.6.7 Test Results

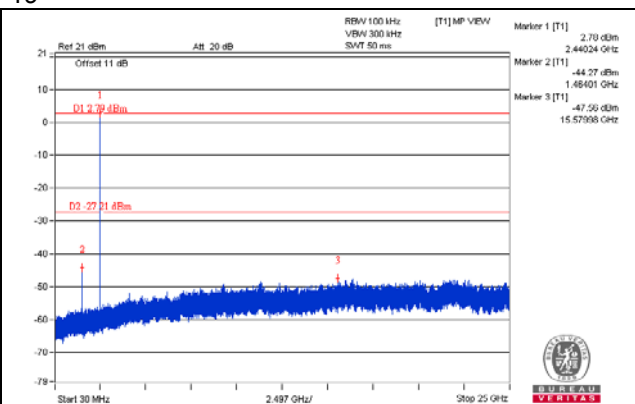
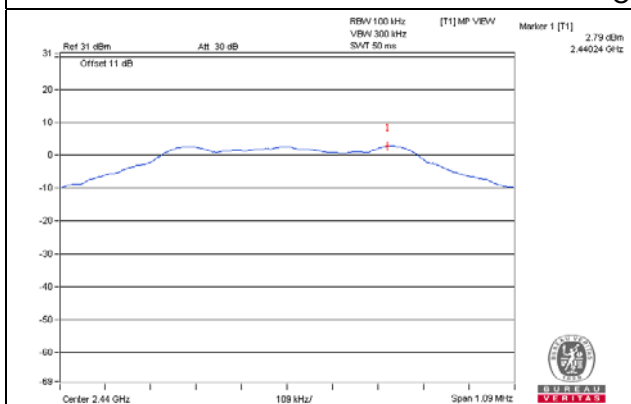
The conducted emission test is performed on each TX port of operating mode without summing or adding 10log (N) since the limit is relative emission limit.

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.

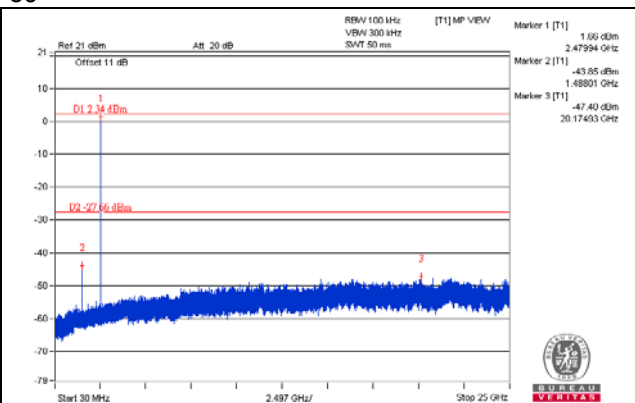
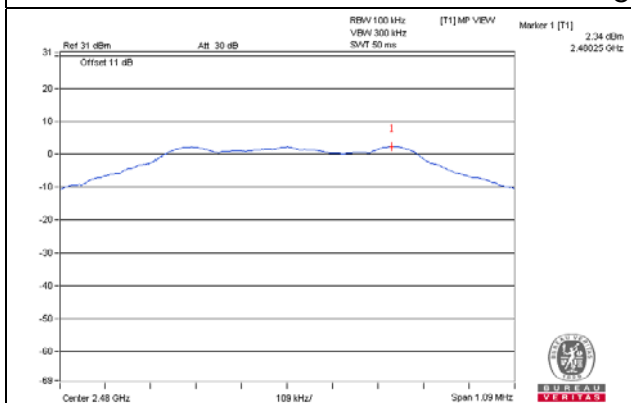
### CH 0



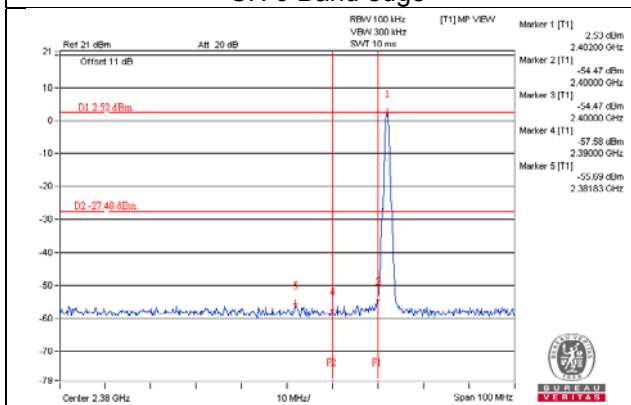
### CH 19



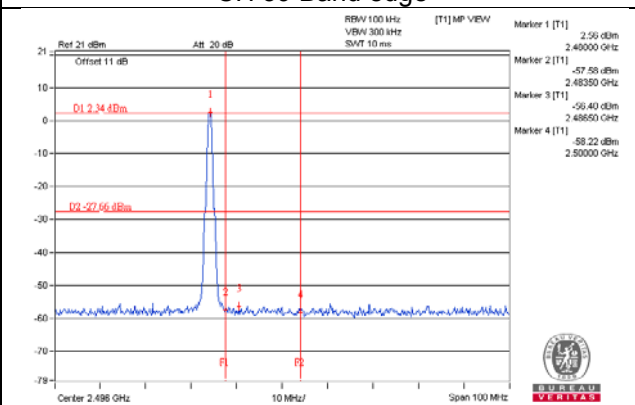
### CH 39



### CH 0 Band edge



### CH 39 Band edge



## 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 FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

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

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

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