

## FCC/IC Test Report (BT-LE)

**Report No.:** RF150226E05-3

**FCC ID:** PPD-QCA9008-TBD1

**IC:** 4104A-QCA9008TBD1

**Test Model:** QCA9008-TBD1

**Received Date:** Feb. 26, 2015

**Test Date:** Mar. 21 to June 18, 2015

**Issued Date:** July 15, 2015

**Applicant:** Qualcomm Atheros, Inc.

**Address:** 1700 Technology Drive, San Jose, CA 95110

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

**Lab Address:** No. 81-1, Lu Liao Keng, 9th Ling, Wu Lung Tsuen, Chiung Lin Hsiang, Hsin  
Chu Hsien 307, Taiwan R.O.C.

**Test Location (1):** No. 81-1, Lu Liao Keng, 9th Ling, Wu Lung Tsuen, Chiung Lin Hsiang, Hsin  
Chu Hsien 307, Taiwan R.O.C.

**Test Location (2):** No. 49, Ln. 206, Wende Rd., Shangshan Tsuen, Chiung Lin Hsiang, Hsin  
Chu Hsien 307, Taiwan R.O.C.



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A D T

### Release Control Record

Issue No.	Description	Date Issued
RF150226E05-3	Original release.	July 15, 2015




### 1 Certificate of Conformity

**Product:** 802.11abgn/ac/ad+BT module  
**Brand:** Qualcomm Atheros  
**Test Model:** QCA9008-TBD1  
**Sample Status:** ENGINEERING SAMPLE  
**Applicant:** Qualcomm Atheros, Inc.  
**Test Date:** Mar. 21 to June 18, 2015  
**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.247)  
ANSI C63.10: 2013  
Canada RSS-247 Issue 1 (2015-05)  
Canada RSS-Gen Issue 4 (2014-11)

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:** July 15, 2015  
Lori Chung / Specialist

**Approved by :**  , **Date:** July 15, 2015  
May Chen / Manager

## 2 Summary of Test Results

APPLIED STANDARD: 47 CFR FCC Part 15, Subpart C (SECTION 15.247) ; RSS-247; RSS-Gen				
STANDARD SECTION		Test Item	Result	Remarks
FCC Clause	RSS-Gen RSS-247			
15.207	RSS-Gen 8.8	AC Power Conducted Emission	Pass	Meet the requirement of limit. Minimum passing margin is -12.01dB at 0.19297MHz.
-	RSS-Gen 6.6	Occupied Bandwidth Measurement	Pass	Meet the requirement
15.205 / 15.209 / 15.247(d)	RSS-247 5.5	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -4.2dB at 156.12MHz & 171.42MHz.
15.247(a)(2)	RSS-247 5.2 (1)	6dB bandwidth	Pass	Meet the requirement of limit.
15.247(b)	RSS-247 5.4 (4)	Conducted power	Pass	Meet the requirement of limit.
15.247(e)	RSS-247 5.2 (2)	Power Spectral Density	Pass	Meet the requirement of limit.
15.203	-	Antenna Requirement	Pass	Antenna connector is IPEX 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	2.86 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.43 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.72 dB
	6GHz ~ 18GHz	4.00 dB
	18GHz ~ 40GHz	4.11 dB

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT (BT-LE)

Product (PMN)	802.11abgn/ac/ad+BT module
Brand	Qualcomm Atheros
Test Model (HVIN)	QCA9008-TBD1
Status of EUT	ENGINEERING SAMPLE
Test Software Version	QCRT-CONN30033.exe
Power Supply Rating	3.3Vdc from host equipment
Modulation Type	GFSK
Modulation Technology	DTS
Transfer Rate	Up to 1Mbps
Operating Frequency	2402MHz ~ 2480MHz
Number of Channel	40
Output Power	2.023mW
Antenna Type	See item 3.2
Antenna Connector	See item 3.2
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. There are Bluetooth technology and WLAN (2.4GHz, 5GHz & 60GHz) technology used for the EUT.
2. The EUT support multiple function, therefore the WLAN OFDM will be cover BT OFDM (low power) scenario.
3. The power setting are list as below:

Modulation Mode	Frequency (MHz)	Power Setting	Frequency (MHz)	Power Setting	Frequency (MHz)	Power Setting
<b>GFSK</b>	2402	default	2440	default	2480	default

4. WLAN/BT coexistence mode:

◆ 2x2 WLAN + BT:

- 5GHz 802.11a/an (or 11ac) transmit concurrent with BT.
- 2.4GHz: timely shared coexistence. (2.4GHz & BT technology can't transmit at same time.)
- 2.4GHz & 5GHz technology can't transmit at same time.

5. The emission (conducted & radiated emission) of the simultaneous operation (WiFi <5GHz> & Bluetooth) have been evaluated and no non-compliance found. The detail combinations of transmitters / frequencies / modes as below table

Mode	Available Channel	Tested Channel	Modulation Technology
5 GHz (802.11a) + Bluetooth (GFSK)	36 to 165	157	OFDM
	0 to 78	0	FHSS

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

### 3.2 Description of Antenna

The antenna gain was declared by client; please refer to the following table:

Transmitter Circuit	Brand	Model	Ant. Type	2.4GHz Gain with cable loss (dBi)	5GHz Gain with cable loss (dBi)	2.4GHz Cable Loss (dBi)	5GHz Cable Loss (dBi)	Connector Type	Cable Length (mm)
Chain (0)	WNC	81-EBJ15.005	PIFA	3.00	5.15~5.35GHz: 2.56	1.15	5.15~5.35GHz: 1.70	IPEX	300
					5.47~5.725GHz: 4.76		5.47~5.725GHz: 1.74		
					5.725~5.85GHz: 4.76		5.725~5.85GHz: 1.79		
Chain (1)	WNC	81-EBJ15.005	PIFA	3.62	5.15~5.35GHz: 3.08	1.15	5.15~5.35GHz: 1.70	IPEX	300
					5.47~5.725GHz: 3.31		5.47~5.725GHz: 1.74		
					5.725~5.85GHz: 2.42		5.725~5.85GHz: 1.79		

Note: 1. Above antenna gains of antenna are Total (H+V).

For Testing, we select the highest gain on each frequency band for calculation and testing  
The detail information as below:

Transmitter Circuit	Brand	Model	Ant. Type	2.4GHz Gain with cable loss (dBi)	5GHz Gain with cable loss (dBi)	2.4GHz Cable Loss (dBi)	5GHz Cable Loss (dBi)	Connector Type	Cable Length (mm)
Chain (0)+(1)	WNC	81-EBJ15.005	PIFA	3.62	5.15~5.35GHz: 3.08	1.15	5.15~5.35GHz: 1.70	IPEX	300
					5.47~5.725GHz: 4.76		5.47~5.725GHz: 1.74		
					5.725~5.85GHz: 4.76		5.725~5.85GHz: 1.79		



### 3.3 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

### 3.3.1 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      **RE<1G**: Radiated Emission below 1GHz  
**PLC**: Power Line Conducted Emission      **APCM**: Antenna Port Conducted Measurement

**NOTE:** The EUT's antenna 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.

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.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	39	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.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	39	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.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	0, 19, 39	GFSK	1

**Test Condition:**

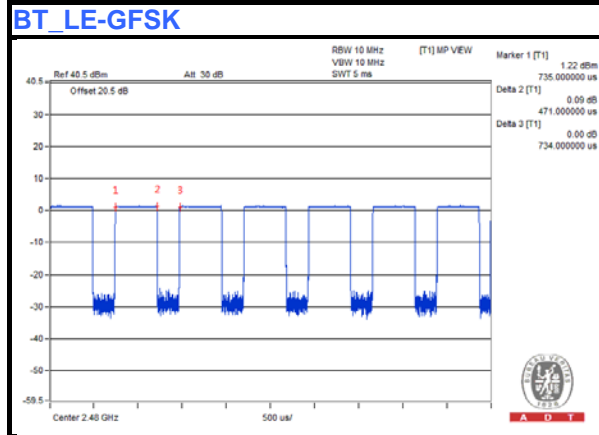
APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER (SYSTEM)	TESTED BY
RE $\geq$ 1G	23deg. C, 67%RH	120Vac, 60Hz	Gary Cheng
RE $<$ 1G	24deg. C, 66%RH	120Vac, 60Hz	Robert Cheng
PLC	23deg. C, 65%RH	120Vac, 60Hz	Wythe Lin
APCM	25deg. C, 60%RH	120Vac, 60Hz	Robert Cheng

### 3.4 Duty Cycle of Test Signal

Duty cycle of test signal is < 98 %, duty factor shall be considered.

For **BT\_LE-GFSK**:

Duty cycle =  $0.471 \text{ ms} / 0.734 \text{ ms} = 0.642$ , Duty factor =  $10 * \log(1/0.642) = 1.9$



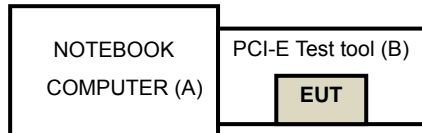
### 3.5 Description of Support Units

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.

No.	Product	Brand	Model No.	Serial No.	FCC ID	Remark
A	NOTEBOOK COMPUTER	Lenovo	0769	NA	NA	Supplied by Client
B	PCI-E Test tool	Qualcomm Atheros	NA	NA	NA	Supplied by Client

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

#### 3.5.1 Configuration of System under Test



### 3.6 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)**  
**558074 D01 DTS Meas Guidance v03r02**  
**Canada RSS-247 Issue 1 (2015-05)**  
**Canada RSS-Gen Issue 4 (2014-11)**  
**ANSI C63.10-2013**

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

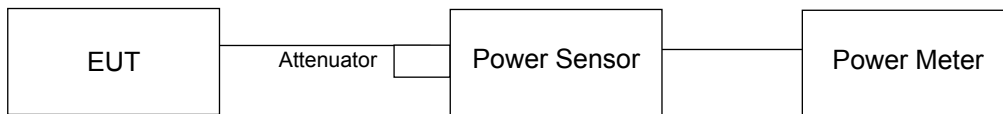
## 4 Test Types and Results

### 4.1 Conducted Output Power Measurement

#### 4.1.1 Limits of Conducted Output Power Measurement

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

#### 4.1.2 Test Setup



#### 4.1.3 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Power Meter Anritsu	ML2495A	1014008	Apr. 28, 2015	Apr. 27, 2016
Power Sensor Anritsu	MA2411B	0917122	Apr. 28, 2015	Apr. 27, 2016

- NOTE:**
1. The test was performed in Oven room B.
  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 18, 2015

#### 4.1.4 Test Procedures

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

#### 4.1.5 Deviation from Test Standard

No deviation.

#### 4.1.6 EUT Operating Conditions

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

## 4.1.7 Test Results

**FOR PEAK POWER**

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass/Fail
0	2402	1.875	2.73	30	Pass
19	2440	1.995	3.00	30	Pass
39	2480	2.023	3.06	30	Pass

**FOR AVERAGE POWER**

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
0	2402	1.545	1.89
19	2440	1.679	2.25
39	2480	1.671	2.23

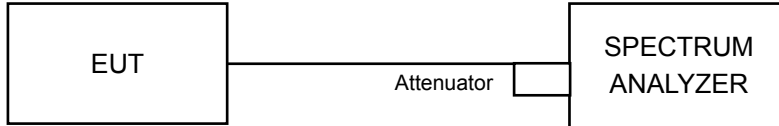


**4.2 Power Spectral Density Measurement**

4.2.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm.

4.2.2 Test Setup



4.2.3 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSP 40	100060	May 08, 2015	May 07, 2016

- NOTE:**
1. The test was performed in Oven room B.
  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 18, 2015

4.2.4 Test Procedure

- a. Set analyzer center frequency to DTS channel center frequency.
- b. Set the span to 1.5 times the DTS bandwidth.
- c. Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- d. Set the VBW  $\geq 3 \times \text{RBW}$ .
- e. Detector = peak.
- f. Sweep time = auto couple.
- g. Trace mode = max hold.
- h. Allow trace to fully stabilize.
- i. Use the peak marker function to determine the maximum amplitude level within the RBW.

4.2.5 Deviation from Test Standard

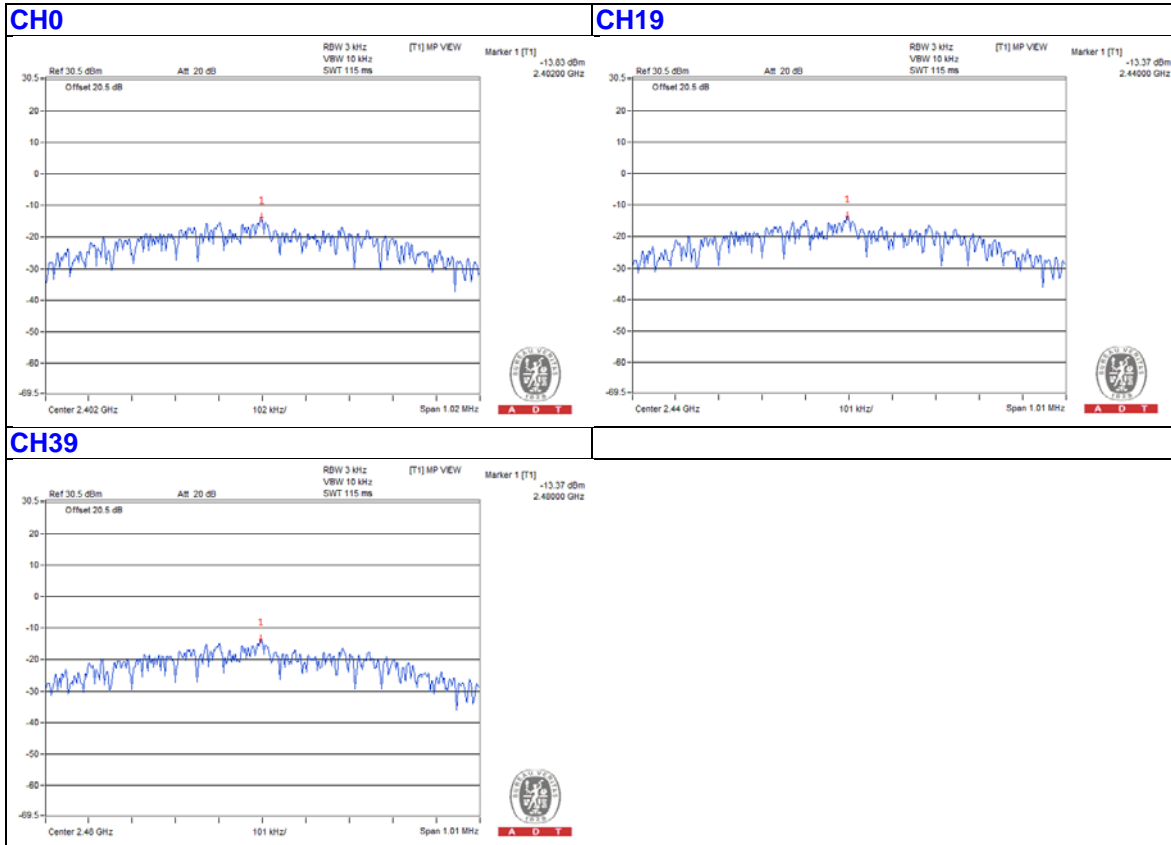
No deviation.

4.2.6 EUT Operating Condition

Same as Item 4.1.6

### 4.2.7 Test Results

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Pass /Fail
0	2402	-13.83	8	Pass
19	2440	-13.37	8	Pass
39	2480	-13.37	8	Pass

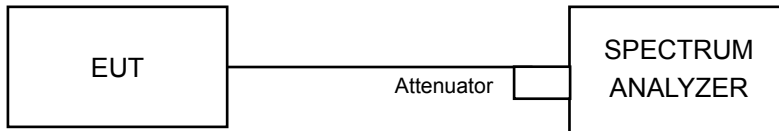


**4.3 6dB Bandwidth Measurement**

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

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSP 40	100060	May 08, 2015	May 07, 2016

- NOTE:**
1. The test was performed in Oven room B.
  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 18, 2015

4.3.4 Test Procedure

- a. Set resolution bandwidth (RBW) = 100kHz
- b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
- c. Trace mode = max hold.
- d. Sweep = auto couple.
- e. 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

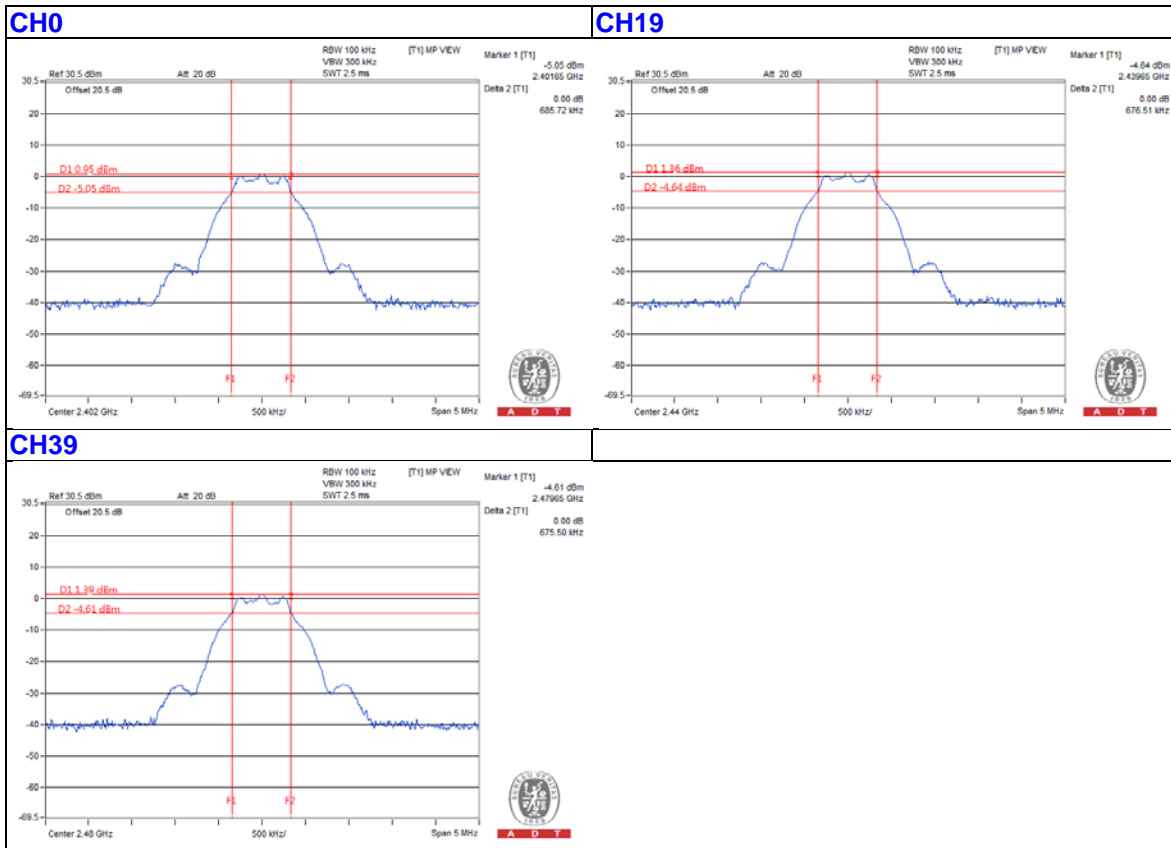
No deviation.

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.

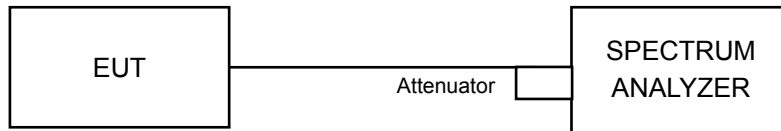
### 4.3.7 Test Result

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	0.69	0.5	Pass
19	2440	0.68	0.5	Pass
39	2480	0.68	0.5	Pass



#### 4.4 Occupied Bandwidth Measurement

##### 4.4.1 Test Setup



##### 4.4.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSP 40	100060	May 08, 2015	May 07, 2016

- NOTE:**
1. The test was performed in Oven room B.
  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 18, 2015

##### 4.4.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to PEAK. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 %of the total mean power of a given emission.

##### 4.4.4 Deviation from Test Standard

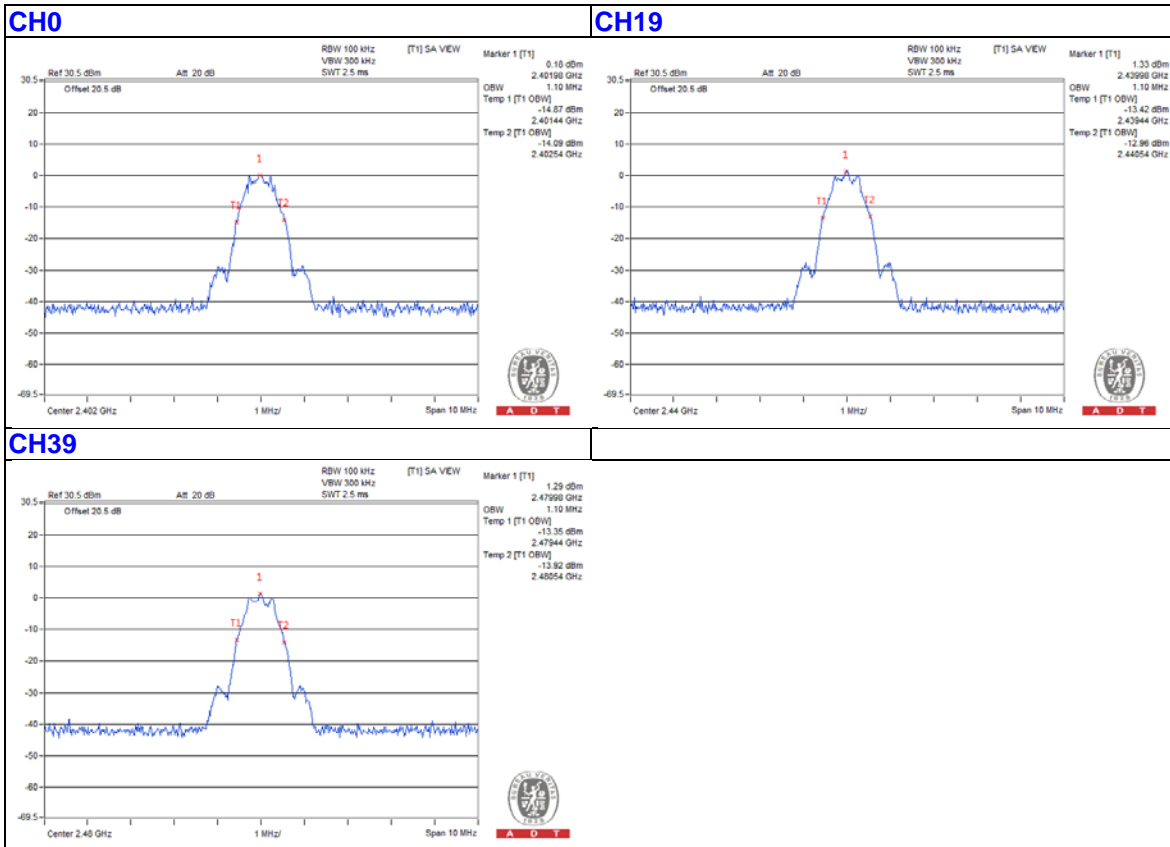
No deviation.

##### 4.4.5 EUT Operating Conditions

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

### 4.4.6 Test Results

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)
0	2402	1.10
19	2440	1.10
39	2480	1.10

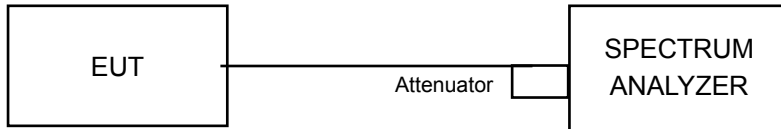


**4.5 Conducted Out of Band Emission Measurement**

**4.5.1 Limits of Conducted Out of Band Emission Measurement**

Below -20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

**4.5.2 Test Setup**



**4.5.3 Test Instruments**

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSP 40	100060	May 08, 2015	May 07, 2016

- NOTE:**
1. The test was performed in Oven room B.
  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 18, 2015

**4.5.4 Test Procedure**

**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 OOB**

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.

**4.5.5 Deviation from Test Standard**

No deviation.

#### 4.5.6 EUT Operating Condition

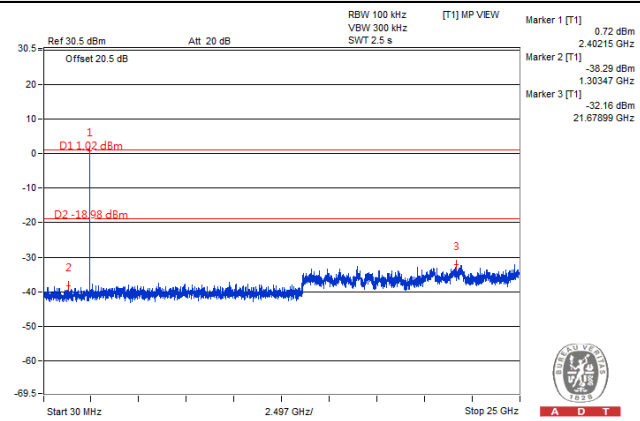
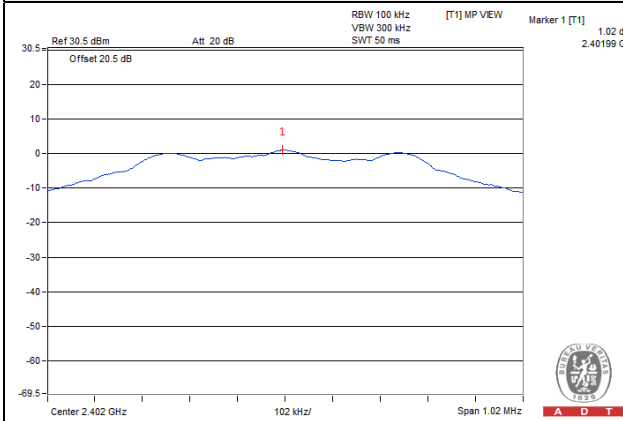
Same as Item 4.1.6

#### 4.5.7 Test Results

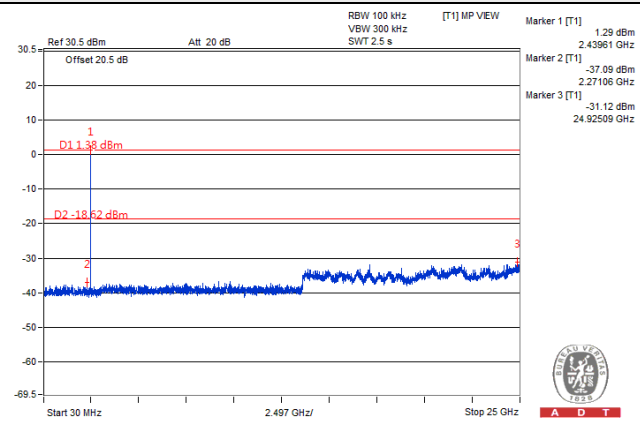
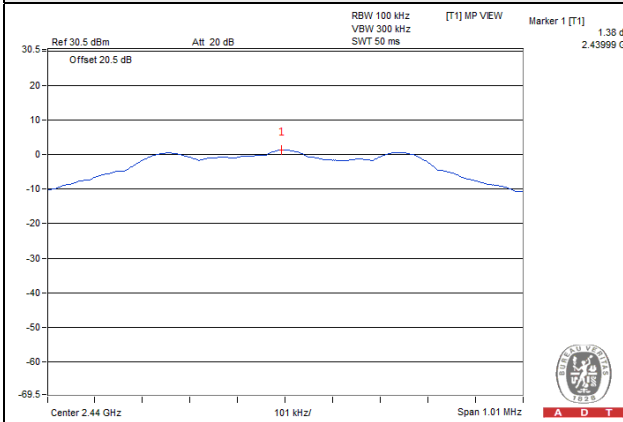
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.



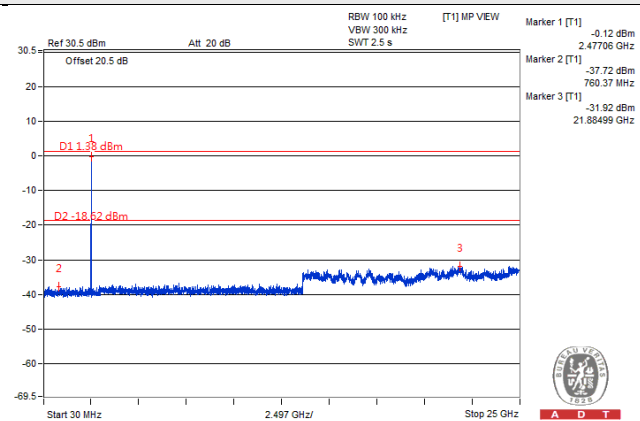
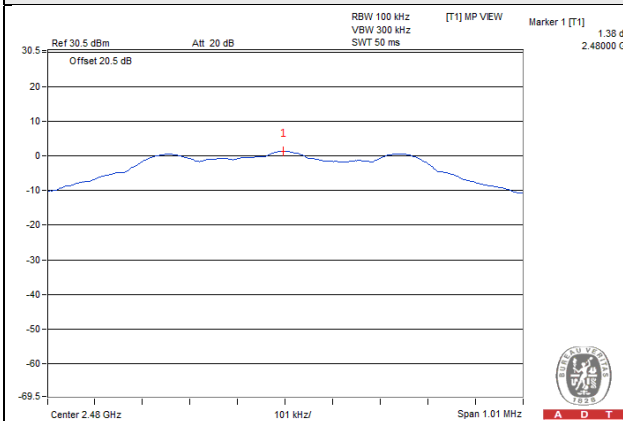
### CH 0



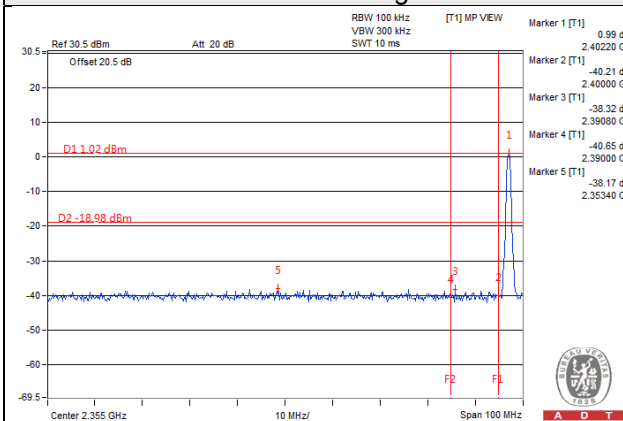
### CH 19



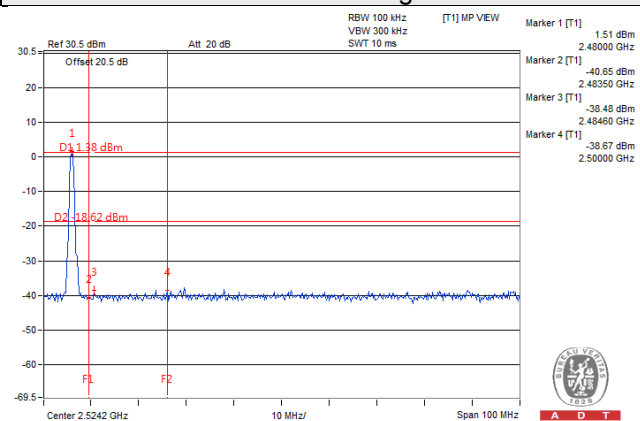
### CH 39



### CH 0 Band edge



### CH 39 Band edge



## 4.6 Radiated Emission and Bandedge Measurement

### 4.6.1 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 20dB 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 20dB under any condition of modulation.

#### 4.6.2 Test Instruments

##### For above 1GHz test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Agilent	N9038A	MY50010156	Aug. 11, 2014	Aug. 10, 2015
Horn_Antenna AISI	AIH.8018	0000220091110	Feb. 06, 2015	Feb. 05, 2016
Pre-Amplifier Agilent	8449B	3008A01923	Oct. 28, 2014	Oct. 27, 2015
RF Cable	NA	131206 131213 131215 SNMY23685/4	Jan. 16, 2015	Jan. 15, 2016
Spectrum Analyzer R&S	FSV40	100964	July 05, 2014	July 04, 2015
Pre-Amplifier SPACEK LABS	SLKKa-48-6	9K16	Dec. 12, 2014	Dec. 11, 2015
Horn_Antenna SCHWARZBECK	BBHA 9170	9170-424	Feb. 05, 2015	Feb. 04, 2016
RF Cable	NA	329751/4 RF104-204	Dec. 11, 2014	Dec. 10, 2015
Software	ADT_Radiated _V8.7.07	NA	NA	NA
Antenna Tower & Turn Table CT	NA	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 966 Chamber No. H.
3. The FCC Site Registration No. is 797305.
4. The CANADA Site Registration No. is IC 7450H-3.
5. Tested Date: June 18, 2015

**For below 1GHz test:**

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Agilent	N9038A	MY50010156	Aug. 11, 2014	Aug. 10, 2015
Pre-Amplifier Mini-Circuits	ZFL-1000VH2 B	AMP-ZFL-04	Nov. 12, 2014	Nov. 11, 2015
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-361	Feb. 09, 2015	Feb. 08, 2016
RF Cable	8D-FB	CHHCAB-001- 1 CHHCAB-001- 2	Oct. 05, 2014	Oct. 04, 2015
	RF-141	CHHCAB-004	Oct. 05, 2014	Oct. 04, 2015
Software	ADT_Radiated _V8.7.07	NA	NA	NA
Antenna Tower & Turn Table CT	NA	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 966 Chamber No. H.
3. The FCC Site Registration No. is 797305.
4. The CANADA Site Registration No. is IC 7450H-3.
5. Tested Date: Mar. 21, 2015

#### 4.6.3 Test Procedures

- a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

#### Note:

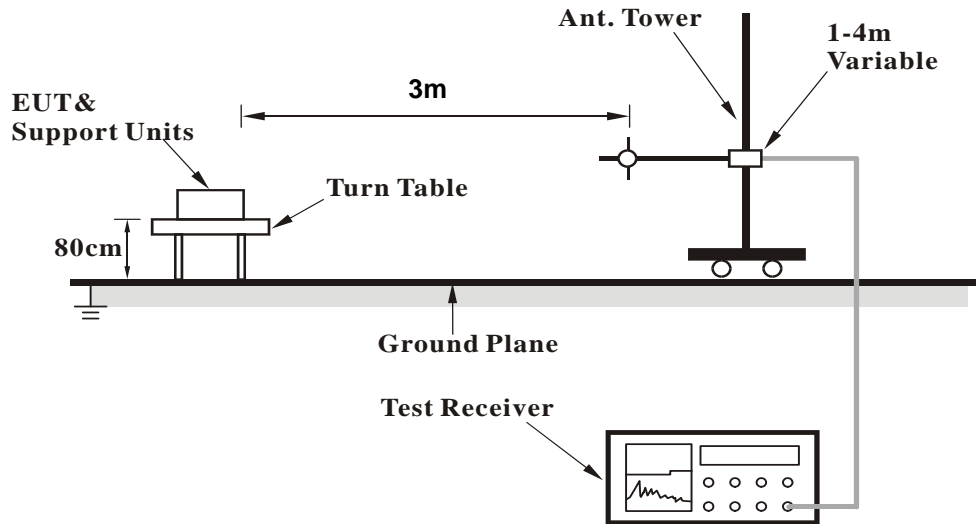
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

#### 4.6.4 Deviation from Test Standard

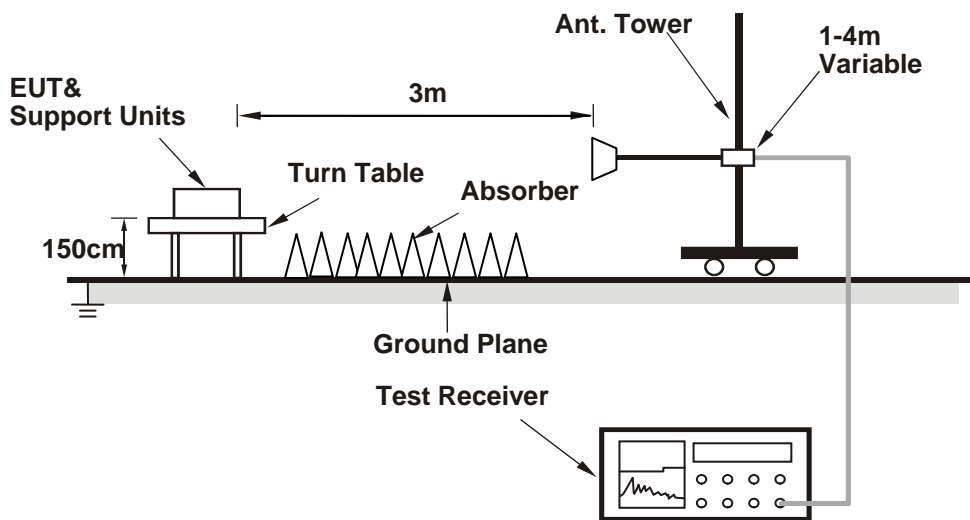
No deviation.

#### 4.6.5 Test Setup

##### <Frequency Range below 1GHz>



##### <Frequency Range above 1GHz>



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

#### 4.6.6 EUT Operating Conditions

1. Connect the EUT with the support unit A (Notebook Computer) which is placed on a testing table.
2. The communication partner run test program "QCRT-CONN30033.exe" to enable EUT under transmission/receiving condition continuously at specific channel frequency.

#### 4.6.7 Test Results

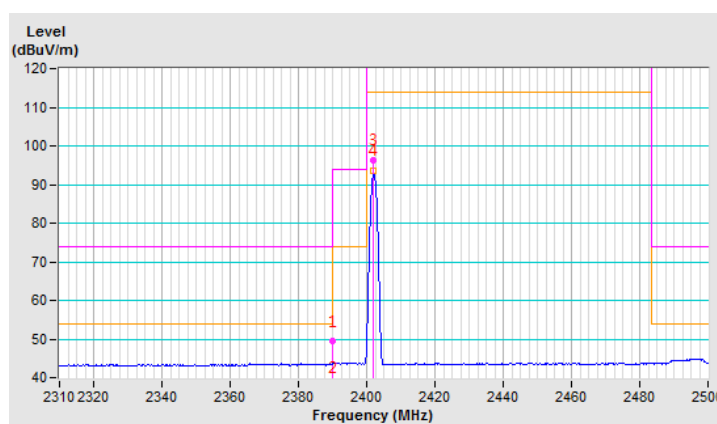
##### Above 1GHz Data:

<b>CHANNEL</b>	TX Channel 0	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	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	2390.00	49.4 PK	74.0	-24.6	1.29 H	170	52.16	-2.76
2	2390.00	37.4 AV	54.0	-16.6	1.29 H	170	40.16	-2.76
3	*2402.00	96.2 PK			1.29 H	170	98.92	-2.72
4	*2402.00	93.7 AV			1.29 H	170	96.42	-2.72

#### 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.
6. The resolution bandwidth of test receiver is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98%) for Average detection (AV). Emission AV measured by RBW/VBW= 1MHz/3kHz



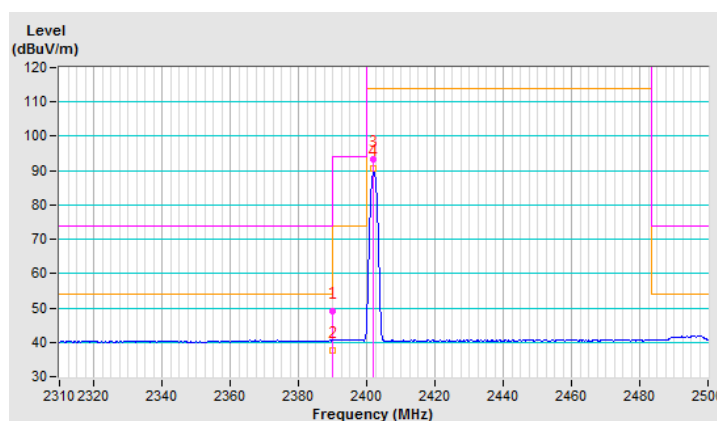
<b>CHANNEL</b>	TX Channel 0	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	1GHz ~ 25GHz		Average (AV)

**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	48.9 PK	74.0	-25.1	2.09 V	239	51.66	-2.76
2	2390.00	37.7 AV	54.0	-16.3	2.09 V	239	40.46	-2.76
3	*2402.00	93.3 PK			2.09 V	239	96.02	-2.72
4	*2402.00	90.5 AV			2.09 V	239	93.22	-2.72

**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.
6. The resolution bandwidth of test receiver is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98%) for Average detection (AV). Emission AV measured by  $RBW/VBW= 1MHz/3kHz$





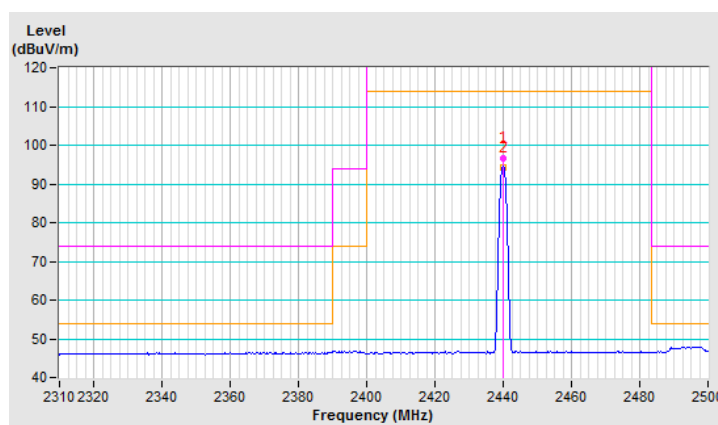
<b>CHANNEL</b>	TX Channel 19	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	1GHz ~ 25GHz		Average (AV)

**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	96.6 PK			1.22 H	146	99.21	-2.61
2	*2440.00	94.3 AV			1.22 H	146	96.91	-2.61

**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.
6. The resolution bandwidth of test receiver is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98%) for Average detection (AV). Emission AV measured by  $RBW/VBW= 1MHz/3kHz$

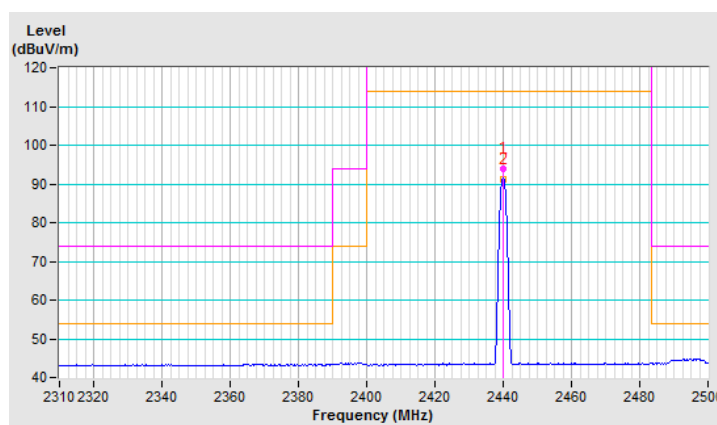


<b>CHANNEL</b>	TX Channel 19	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	1GHz ~ 25GHz		Average (AV)

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	93.9 PK			2.58 V	360	96.51	-2.61
2	*2440.00	91.2 AV			2.58 V	360	93.81	-2.61

**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.
6. The resolution bandwidth of test receiver is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98%) for Average detection (AV). Emission AV measured by  $RBW/VBW= 1MHz/3kHz$

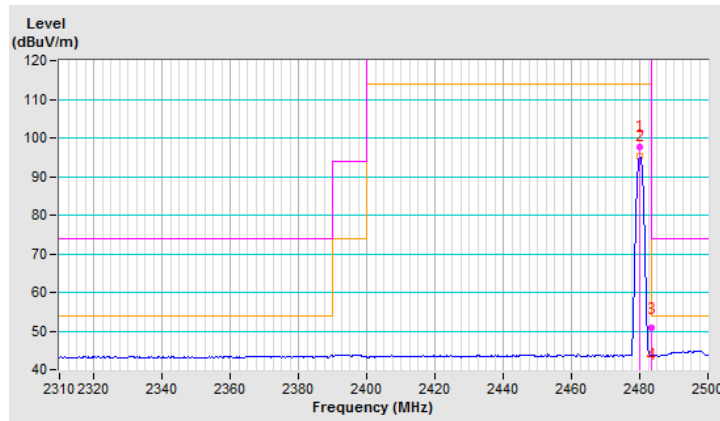


<b>CHANNEL</b>	TX Channel 39	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	1GHz ~ 25GHz		Average (AV)

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	*2480.00	97.7 PK			1.09 H	171	100.19	-2.49
2	*2480.00	95.2 AV			1.09 H	171	97.69	-2.49
3	2483.50	50.7 PK	74.0	-23.3	1.09 H	171	53.18	-2.48
4	2483.50	38.8 AV	54.0	-15.2	1.09 H	171	41.28	-2.48

**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.
6. The resolution bandwidth of test receiver is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98%) for Average detection (AV). Emission AV measured by  $RBW/VBW= 1MHz/3kHz$

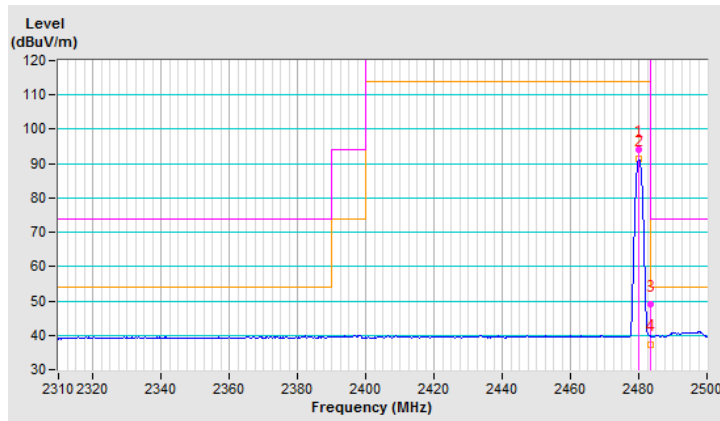


<b>CHANNEL</b>	TX Channel 39	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	1GHz ~ 25GHz		Average (AV)

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	94.2 PK			2.04 V	243	96.69	-2.49
2	*2480.00	91.4 AV			2.04 V	243	93.89	-2.49
3	2483.50	49.2 PK	74.0	-24.8	2.04 V	243	51.68	-2.48
4	2483.50	37.4 AV	54.0	-16.6	2.04 V	243	39.88	-2.48

**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.
6. The resolution bandwidth of test receiver is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98%) for Average detection (AV). Emission AV measured by  $RBW/VBW= 1MHz/3kHz$



**Below 1GHz Data:**

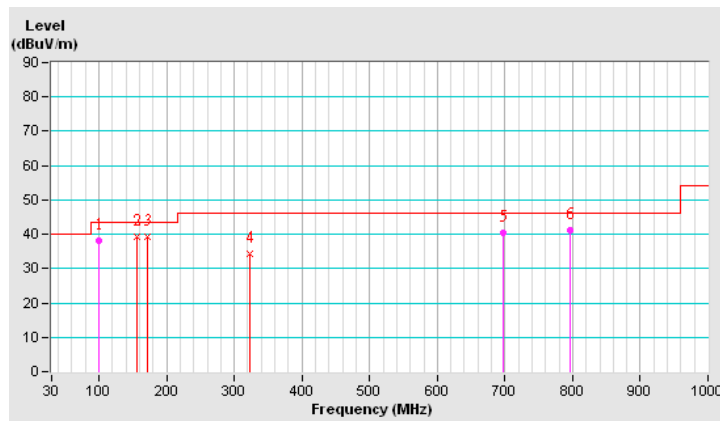
**TX\_Low**

<b>CHANNEL</b>	TX Channel 39	<b>DETECTOR FUNCTION</b>	Quasi-Peak (QP)
<b>FREQUENCY RANGE</b>	Below 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	99.78	38.1 QP	43.5	-5.4	1.24 H	241	55.42	-17.31
2	156.12	39.3 QP	43.5	-4.2	1.24 H	99	52.30	-12.99
<b>3</b>	<b>171.42</b>	<b>39.3 QP</b>	<b>43.5</b>	<b>-4.2</b>	<b>1.24 H</b>	<b>99</b>	<b>52.92</b>	<b>-13.58</b>
4	323.78	34.2 QP	46.0	-11.8	1.33 H	87	45.20	-10.96
5	697.30	40.2 QP	46.0	-5.8	1.24 H	77	43.63	-3.39
6	796.34	41.3 QP	46.0	-4.7	1.50 H	55	42.82	-1.51

**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

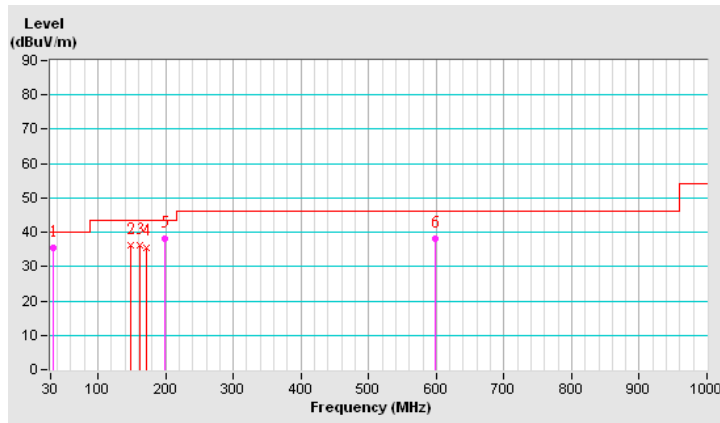


<b>CHANNEL</b>	TX Channel 39	<b>DETECTOR FUNCTION</b>	Quasi-Peak (QP)
<b>FREQUENCY RANGE</b>	Below 1GHz		

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	34.12	35.5 QP	40.0	-4.5	1.37 V	245	49.91	-14.37
2	149.24	36.2 QP	43.5	-7.3	1.34 V	98	49.02	-12.81
3	162.35	36.1 QP	43.5	-7.4	1.74 V	360	49.12	-13.00
4	171.51	35.6 QP	43.5	-7.9	1.78 V	89	49.23	-13.59
5	199.35	38.1 QP	43.5	-5.4	1.47 V	69	54.10	-15.99
6	599.30	38.2 QP	46.0	-7.8	1.88 V	64	42.95	-4.71

**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



## 4.7 Conducted Emission Measurement

### 4.7.1 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.

### 4.7.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver R&S	ESCS 30	100375	Apr. 29, 2014	Apr. 28, 2015
Line-Impedance Stabilization Network (for EUT) SCHWARZBECK	NSLK-8127	8127-522	Sep. 15, 2014	Sep. 14, 2015
Line-Impedance Stabilization Network (for Peripheral) ROHDE & SCHWARZ	ENV216	100071	Nov. 10, 2014	Nov. 09, 2015
RF Cable	5D-FB	COCCAB-001	Mar. 09, 2015	Mar. 08, 2016
50 ohms Terminator	N/A	EMC-03	Sep. 22, 2014	Sep. 21, 2015
50 ohms Terminator	N/A	EMC-02	Sep. 30, 2014	Sep. 29, 2015
Software BVADT	BVADT_Cond_ V7.3.7.3	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. C.
3. The VCCI Con C Registration No. is C-3611.
4. Tested Date: Mar. 25, 2015

#### 4.7.3 Test Procedures

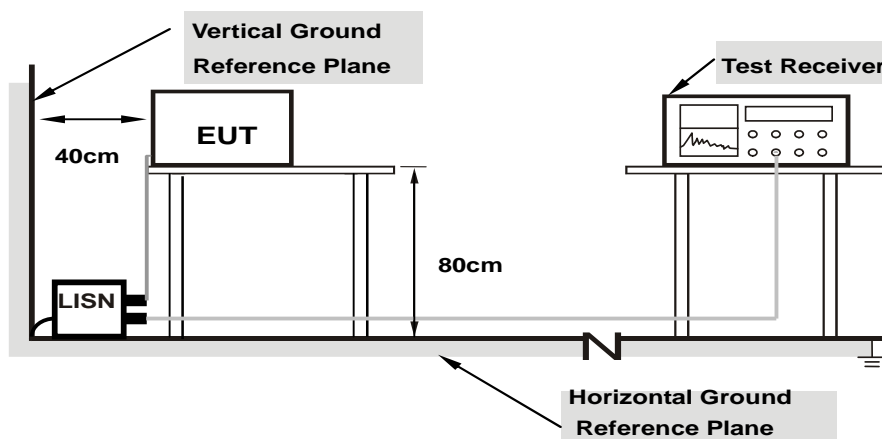
- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling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

#### 4.7.4 Deviation from Test Standard

No deviation.

#### 4.7.5 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).

#### 4.7.6 EUT Operating Conditions

Same as 4.6.6.



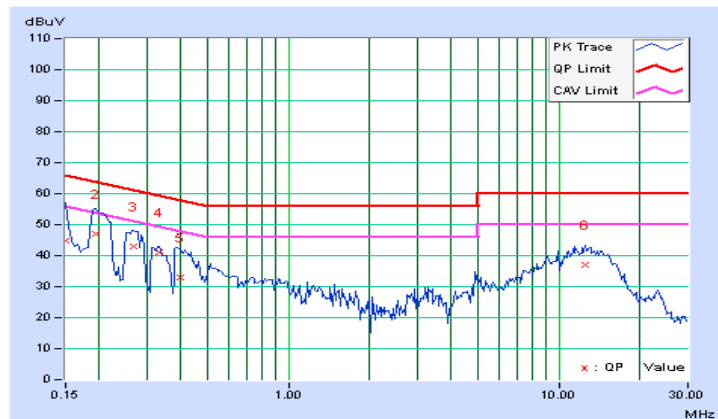
#### 4.7.7 Test Results

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

No	Freq. [MHz]	Corr.	Reading Value		Emission Level		Limit		Margin	
		Factor	[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	
1	0.15000	0.08	44.86	16.17	44.94	16.25	66.00	56.00	-21.06	-39.75
2	0.19297	0.09	47.07	33.14	47.16	33.23	63.91	53.91	-16.75	-20.68
3	0.26719	0.09	42.98	34.97	43.07	35.06	61.20	51.20	-18.13	-16.14
4	0.33359	0.10	40.84	33.92	40.94	34.02	59.36	49.36	-18.42	-15.34
5	0.39609	0.10	32.85	24.88	32.95	24.98	57.93	47.93	-24.99	-22.96
6	12.57422	0.51	36.56	28.87	37.07	29.38	60.00	50.00	-22.93	-20.62

#### REMARKS:

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

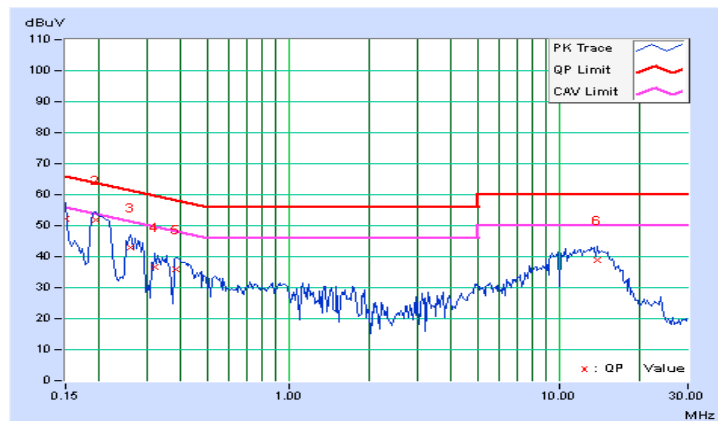


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
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No	Freq. [MHz]	Corr.	Reading Value		Emission Level		Limit		Margin	
		Factor (dB)	[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	0.08	52.26	30.55	52.34	30.63	66.00	56.00	-13.66	-25.37
<b>2</b>	<b>0.19297</b>	<b>0.08</b>	<b>51.82</b>	<b>36.23</b>	<b>51.90</b>	<b>36.31</b>	<b>63.91</b>	<b>53.91</b>	<b>-12.01</b>	<b>-17.60</b>
3	0.25938	0.09	42.93	29.36	43.02	29.45	61.45	51.45	-18.44	-22.01
4	0.32188	0.09	36.63	24.11	36.72	24.20	59.66	49.66	-22.94	-25.46
5	0.38438	0.10	35.65	19.95	35.75	20.05	58.18	48.18	-22.44	-28.14
6	13.85156	0.57	38.16	31.22	38.73	31.79	60.00	50.00	-21.27	-18.21

**REMARKS:**

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





## 5 Pictures of Test Arrangements

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

## Appendix – Information 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.

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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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