



# FCC TEST REPORT (15.247)

**REPORT NO.:** RF130726E06B

**MODEL NO.:** AW-AM691NF

**FCC ID:** TLZ-AM691NF

**RECEIVED:** Oct. 28, 2013

**TESTED:** Oct. 28 to 29, 2013

**ISSUED:** Oct. 29, 2013

**APPLICANT:** AzureWave Technologies, Inc.

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**ISSUED BY:** Bureau Veritas Consumer Products Services  
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## Table of Contents

RELEASE CONTROL RECORD .....	4
1. CERTIFICATION .....	5
2. SUMMARY OF TEST RESULTS .....	6
2.1 MEASUREMENT UNCERTAINTY .....	7
3. GENERAL INFORMATION.....	8
3.1 GENERAL DESCRIPTION OF EUT .....	8
3.2 DESCRIPTION OF TEST MODES.....	10
3.2.1 TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL.....	11
3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS .....	13
3.4 Duty cycle of test signal.....	14
3.5 DESCRIPTION OF SUPPORT UNITS .....	15
3.6 CONFIGURATION OF SYSTEM UNDER TEST .....	15
4. TEST TYPES AND RESULTS .....	16
4.1 CONDUCTED EMISSION MEASUREMENT .....	16
4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT.....	16
4.1.2 TEST INSTRUMENTS .....	16
4.1.3 TEST PROCEDURES .....	17
4.1.4 DEVIATION FROM TEST STANDARD .....	17
4.1.5 TEST SETUP .....	17
4.1.6 EUT OPERATING CONDITIONS .....	18
4.1.7 TEST RESULTS .....	19
4.2 RADIATED EMISSION AND BANDEDGE MEASUREMENT.....	21
4.2.1 LIMITS OF RADIATED EMISSION AND BANDEDGE MEASUREMENT .....	21
4.2.2 TEST INSTRUMENTS .....	22
4.2.3 TEST PROCEDURES .....	24
4.2.4 DEVIATION FROM TEST STANDARD .....	24
4.2.5 TEST SETUP .....	25
4.2.6 EUT OPERATING CONDITIONS .....	25
4.2.7 TEST RESULTS .....	26
4.3 6dB BANDWIDTH MEASUREMENT .....	30
4.3.1 LIMITS OF 6dB BANDWIDTH MEASUREMENT .....	30
4.3.2 TEST INSTRUMENTS .....	30
4.3.3 TEST PROCEDURE .....	30
4.3.4 DEVIATION FROM TEST STANDARD .....	30
4.3.5 TEST SETUP .....	30
4.3.6 EUT OPERATING CONDITIONS .....	30
4.3.7 TEST RESULTS .....	31
4.4 CONDUCTED OUTPUT POWER MEASUREMENT .....	32
4.4.1 LIMITS OF MAXIMUM PEAK OUTPUT POWER MEASUREMENT.....	32
4.4.2 INSTRUMENTS.....	32
4.4.3 TEST PROCEDURES .....	32
4.4.4 DEVIATION FROM TEST STANDARD .....	33
4.4.5 TEST SETUP .....	33
4.4.6 EUT OPERATING CONDITIONS .....	33
4.4.7 TEST RESULTS .....	33
4.5 Average Output Power .....	34
4.5.1 FOR REFERENCE.....	34
4.5.2 TEST INSTRUMENTS .....	34
4.5.3 TEST PROCEDURES .....	34
4.5.4 TEST SETUP .....	34



A D T

4.5.5	EUT OPERATING CONDITIONS .....	34
4.5.6	TEST RESULTS .....	35
4.6	POWER SPECTRAL DENSITY MEASUREMENT .....	36
4.6.1	LIMITS OF POWER SPECTRAL DENSITY MEASUREMENT .....	36
4.6.2	TEST INSTRUMENTS .....	36
4.6.3	TEST PROCEDURE .....	36
4.6.4	DEVIATION FROM TEST STANDARD .....	36
4.6.5	TEST SETUP .....	36
4.6.6	EUT OPERATING CONDITION .....	36
4.6.7	TEST RESULTS .....	37
4.7	CONDUCTED OUT-BAND EMISSION MEASUREMENT .....	38
4.7.1	LIMITS OF CONDUCTED OUT-BAND EMISSION MEASUREMENT .....	38
4.7.2	TEST INSTRUMENTS .....	38
4.7.3	TEST PROCEDURE .....	38
4.7.4	DEVIATION FROM TEST STANDARD .....	39
4.7.5	TEST SETUP .....	39
4.7.6	EUT OPERATING CONDITION .....	39
4.7.7	TEST RESULTS .....	39
5.	PHOTOGRAPHS OF THE TEST CONFIGURATION .....	42
6.	INFORMATION ON THE TESTING LABORATORIES .....	43
7.	APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB .....	44



## RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF130726E06B	Original release	Oct. 29, 2013

## 1. CERTIFICATION

**PRODUCT:** IEEE 802.11 a/b/g/n Wireless LAN and Bluetooth  
Combo LGA Module

**BRAND NAME:** AzureWave

**MODEL NO.:** AW-AM691NF

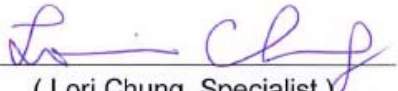
**TEST SAMPLE:** ENGINEERING SAMPLE

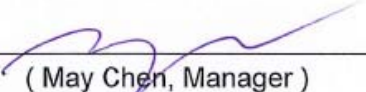
**APPLICANT:** AzureWave Technologies, Inc.

**TESTED:** Oct. 28 to 29, 2013

**STANDARDS:** **FCC Part 15, Subpart C (Section 15.247)**  
ANSI C63.10-2009

The above equipment (Model: AW-AM691NF) 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:** Oct. 29, 2013  
( Lori Chung, Specialist )

**APPROVED BY** : , **DATE:** Oct. 29, 2013  
( May Chen, Manager )



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## 2. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC PART 15, SUBPART C (SECTION 15.247)			
STANDARD SECTION	TEST TYPE	RESULT	REMARK
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit. Minimum passing margin is -12.62dB at 0.15000MHz.
15.247(d) 15.209	Radiated Emissions	PASS	Meet the requirement of limit. Minimum passing margin is -2.6dB at 663.10MHz
15.247(d)	Band Edge Measurement	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 I-PEX not a standard connector.



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## 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:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

<b>Measurement</b>	<b>Value</b>
Conducted emissions	2.98 dB
Radiated emissions (30MHz-1GHz)	5.46 dB
Radiated emissions (1GHz -6GHz)	3.73 dB
Radiated emissions (6GHz -18GHz)	3.90 dB
Radiated emissions (18GHz -40GHz)	4.11 dB



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### 3. GENERAL INFORMATION

#### 3.1 GENERAL DESCRIPTION OF EUT

<b>PRODUCT</b>	IEEE 802.11 a/b/g/n Wireless LAN and Bluetooth Combo LGA Module
<b>MODEL NO.</b>	AW-AM691NF
<b>POWER SUPPLY</b>	DC 3.3V
<b>MODULATION TYPE</b>	DTS
<b>MODULATION TECHNOLOGY</b>	DTS
<b>TRANSFER RATE</b>	BT-LE (GFSK): 1Mbps
<b>OPERATING FREQUENCY</b>	2.402 ~ 2.480GHz
<b>NUMBER OF CHANNEL</b>	40 for BT-LE(GFSK)
<b>MAXIMUM OUTPUT POWER</b>	6.668mW
<b>ANTENNA TYPE</b>	Please see NOTE
<b>DATA CABLE</b>	NA
<b>I/O PORTS</b>	Refer to user's manual
<b>ASSOCIATED DEVICES</b>	NA

#### NOTE:

1. This report is prepared for FCC Class II change. The difference compared with the Report No.: RF130726E06 design is as the following:
  - ◆ Upgrade Bluetooth technology to BT 4.0.
2. According to above condition, all test items of the BT-LE mode need to be performed. And all data was verified to meet the requirements.
3. There are Bluetooth technology and WLAN technology used for the EUT (WLAN and Bluetooth technology cannot transmit at same time).
4. 2.4GHz and 5GHz technology cannot transmit at same time.
5. 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.





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

Ant.	Brand	Model	Antenna Type	Connector	Antenna Gain <include cable lose> (dB)	Antenna Cable Loss (dB)	Cable Length (mm)	Frequency range (MHz to MHz)
1	MAGLAYERS	MSA-4008-25GC1-A1	PIFA	I-PEX	2.98	0.5	150	2400 ~ 2500
					5.16			4900 ~ 5900
2	INPAQ	WA-C-XT-02-001	PIFA	I-PEX	2.40	1	721	2400 ~ 2500
					2.06			5150 ~ 5850
3	INPAQ	WA-P-LB-02-035	PIFA	I-PEX	2.97	1	440	2400 ~ 2500
					2.77			5150 ~ 5850
4	WHA YU	SSR-31604	PIFA	I-PEX	2.6	0.5	125	2400 ~ 2500
					4.3			4900 ~ 5825
5	Smart Approach Co., Ltd	SE-ECJH0-001	PIFA	I-PEX	-0.56	0.66	206	2400 ~ 2500
					1.25	0.98		5150 ~ 5350
					0.08	1.03		5740 ~ 5725
					0.75	1.06		5725 ~ 5850
6	Smart Approach Co., Ltd	SE-ECJH0-002	PIFA	I-PEX	-0.57	0.14	43	2400 ~ 2500
					-0.64	0.20		5150 ~ 5350
					1.79	0.22		5740 ~ 5725
					1.27	0.22		5725 ~ 5850
7	JiengtaiCorporation	JT1301209Y0311	PIFA	I-PEX	1.82	0.76	208	2400 ~ 2500
					0.45	1.22		5150 ~ 5350
					0.76	1.27		5740 ~ 5725
					0.38	1.32		5725 ~ 5850
8	JiengtaiCorporation	JT1301209Y1511	PIFA	I-PEX	-0.44	0.13	48	2400 ~ 2500
					2.08	0.25		5150 ~ 5350
					2.48	0.26		5740 ~ 5725
					1.66	0.33		5725 ~ 5850
9	Hua Chen Technology Co.,Ltd	OACCN013008N	PIFA	I-PEX	-1.04	0.12	213	2400 ~ 2500
					-1.67	0.19		5150 ~ 5350
					-0.64	0.20		5740 ~ 5725
					-0.75	0.21		5725 ~ 5850
10	Hua Chen Technology Co.,Ltd	OACCN013009N	PIFA	I-PEX	-5.82	0.5	49	2400 ~ 2500
					0.54	0.77		5150 ~ 5350
					2.33	0.80		5740 ~ 5725
					2.33	0.82		5725 ~ 5850

From the above antennas, antenna 1 was selected for the test and its data was recorded in this report.



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### 3.2 DESCRIPTION OF TEST MODES

40 channels are provided for Bluetooth LE mode:

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
	PLC	RE < 1G	RE ≥ 1G	APCM	OB	
-	√	√	√	√	√	-

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

**NOTE:** 1. “-” means no effect.  
2. The EUT’s antenna had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **X-plane**.

#### 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.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
BT-LE	0 to 39	39	DTS	GFSK	1

#### RADIATED EMISSION TEST (BELOW 1 GHz):

- 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	DATA RATE (Mbps)
BT-LE	0 to 39	39	DTS	GFSK	1



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**RADIATED EMISSION TEST (ABOVE 1 GHz):**

- 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	DATA RATE (Mbps)
BT-LE	0 to 39	0, 19, 39	DTS	GFSK	1

**ANTENNA PORT CONDUCTED MEASUREMENT:**

- 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	DATA RATE (Mbps)
BT-LE	0 to 39	0, 19, 39	DTS	GFSK	1

**CONDUCTED OUT-BAND EMISSION MEASUREMENT:**

- 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	DATA RATE (Mbps)
BT-LE	0 to 39	0, 19, 39	DTS	GFSK	1

**TEST CONDITION:**

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER (SYSTEM)	TESTED BY
PLC	24deg. C, 68%RH	120Vac, 60Hz	Andy Ho
RE<1G	24deg. C, 65%RH	120Vac, 60Hz	Andy Ho
RE≥1G	22deg. C, 66%RH	120Vac, 60Hz	Andy Ho
APCM	25deg. C, 60%RH	120Vac, 60Hz	Robert Cheng
OB	25deg. C, 60%RH	120Vac, 60Hz	Robert Cheng

### **3.3 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 v03r01**

**ANSI C63.10-2009**

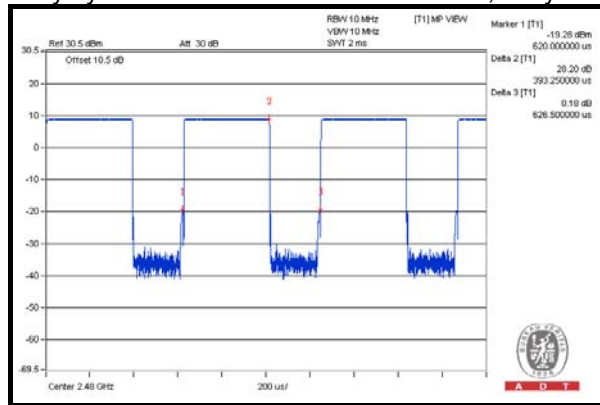
All test items have been performed and recorded as per the above standards.

### 3.4 DUTY CYCLE OF TEST SIGNAL

#### BT-LE mode

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

Duty cycle = 0.393 ms/0.627 ms = 0.627, Duty factor =  $10 \cdot \log(1/0.627) = 2$



### 3.5 DESCRIPTION OF SUPPORT UNITS

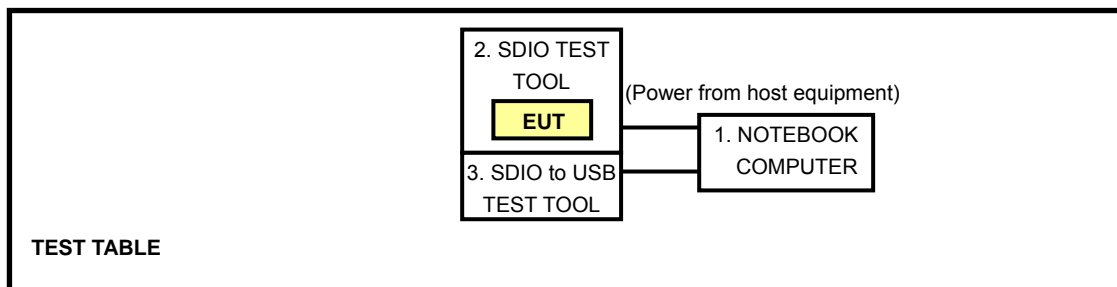
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	NOTEBOOK COMPUTER	ASUS	NA	NA	NA
2	SDIO TEST TOOL	AzureWave	NA	NA	NA
3	SDIO to USB TEST TOOL	AzureWave	NA	NA	NA

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	USB cable, 1.8m
2	NA
3	NA

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

### 3.6 CONFIGURATION OF SYSTEM UNDER TEST





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## 4. TEST TYPES AND RESULTS

### 4.1 CONDUCTED EMISSION MEASUREMENT

#### 4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	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 0.50 MHz.

#### 4.1.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver ROHDE & SCHWARZ	ESCS 30	100375	Mar. 08, 2013	Mar. 07, 2014
Line-Impedance Stabilization Network (for EUT) SCHWARZBECK	NSLK8127	8127-522	Sep. 05, 2013	Sep. 04, 2014
Line-Impedance Stabilization Network (for Peripheral)	ENV216	100072	June 06, 2013	June 05, 2014
RF Cable (JYEBAO)	5DFB	COCCAB-001	Mar. 11, 2013	Mar. 10, 2014
50 ohms Terminator	50	EMC-03	Sep. 24, 2013	Sep. 23, 2014
Software ADT	BV ADT_Cond_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 Shielded Room No. C.
3. The VCCI Con C Registration No. is C-3611.
4. Tested Date: Oct. 28, 2013



#### 4.1.3 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.
- b. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- c. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- d. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) were not recorded.

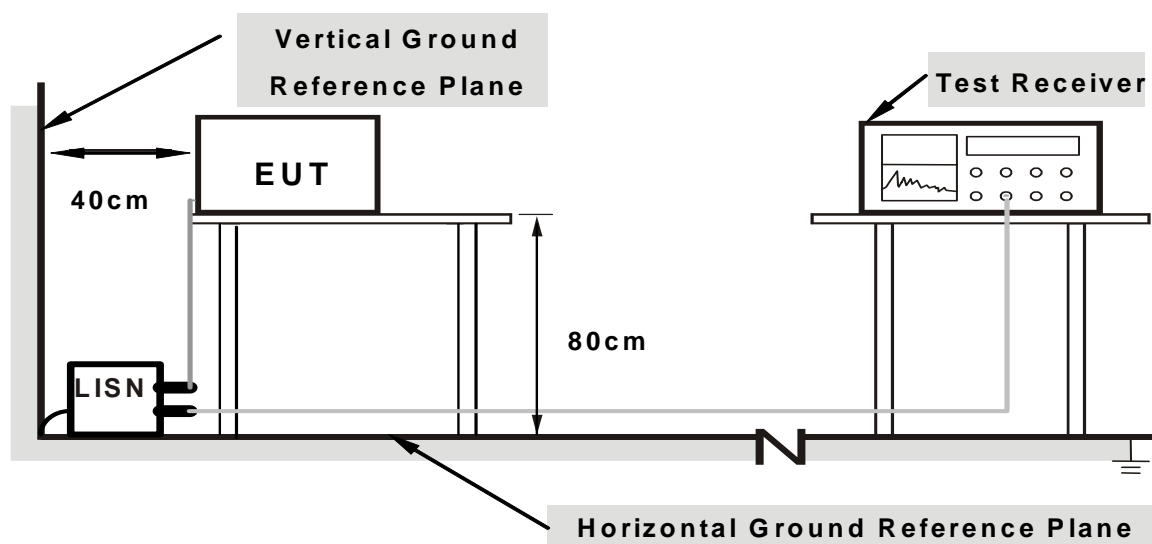
#### NOTE:

1. The resolution bandwidth of test receiver is 9kHz for Quasi-peak detection (QP) & Average detection (AV).

#### 4.1.4 DEVIATION FROM TEST STANDARD

No deviation

#### 4.1.5 TEST SETUP



**Note: 1. Support units were connected to second LISN.**

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

#### 4.1.6 EUT OPERATING CONDITIONS

1. Connect the EUT with the support unit 1 (Notebook Computer) which is placed on a testing table.
2. The communication partner run test program “Braodcom command (Linux)” to enable EUT under transmission/receiving condition continuously at specific channel frequency.

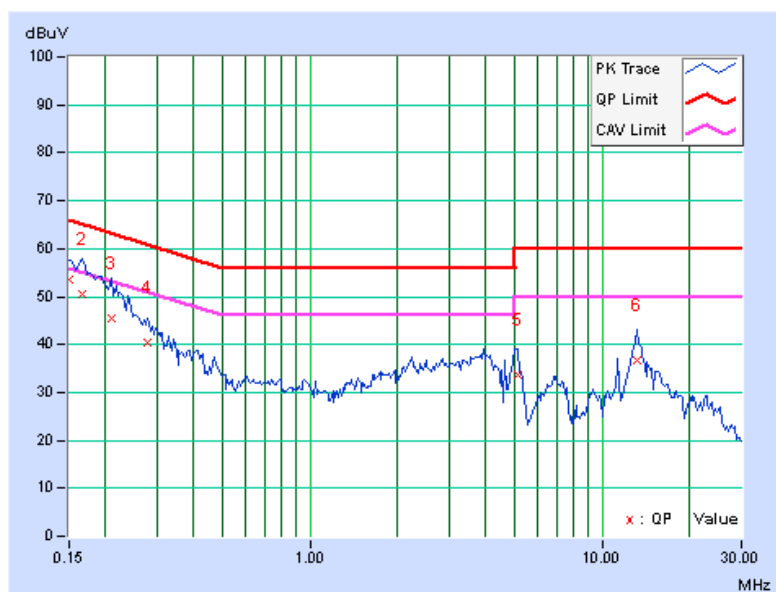
### 4.1.7 TEST RESULTS

<b>PHASE</b>	Line (L)	<b>DETECTOR FUNCTION</b>	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	0.15000	0.10	53.28	35.08	53.38	35.18	66.00
2	0.16563	0.11	50.53	34.26	50.64	34.37	65.18	55.18	-14.54	-20.81
3	0.20861	0.12	45.28	29.43	45.40	29.55	63.26	53.26	-17.86	-23.71
4	0.27890	0.14	40.32	25.78	40.46	25.92	60.85	50.85	-20.39	-24.93
5	5.17193	0.36	33.39	27.13	33.75	27.49	60.00	50.00	-26.25	-22.51
6	13.21876	0.71	36.03	29.41	36.74	30.12	60.00	50.00	-23.26	-19.88

#### 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

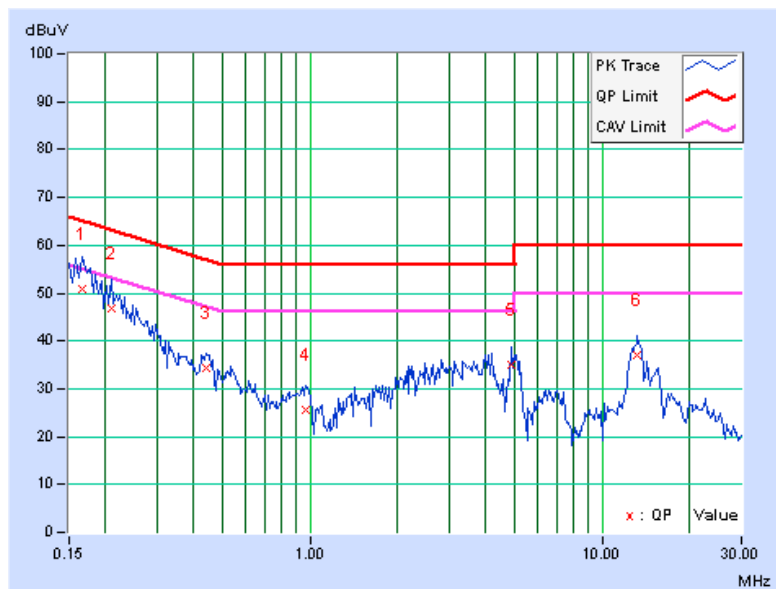


<b>PHASE</b>	Neutral (N)	<b>DETECTOR FUNCTION</b>	Quasi-Peak (QP) / Average (AV)
--------------	-------------	--------------------------	--------------------------------

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	0.16565	0.15	50.64	36.53	50.79	36.68	65.18	55.18	-14.38	-18.49
2	0.20857	0.16	46.58	31.49	46.74	31.65	63.26	53.26	-16.52	-21.61
3	0.44295	0.19	34.32	30.35	34.51	30.54	57.01	47.01	-22.49	-16.46
4	0.97425	0.23	25.28	21.41	25.51	21.64	56.00	46.00	-30.49	-24.36
5	4.89846	0.37	34.59	27.05	34.96	27.42	56.00	46.00	-21.04	-18.58
6	13.25390	0.63	36.41	30.11	37.04	30.74	60.00	50.00	-22.96	-19.26

**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 RADIATED EMISSION AND BANDEGE MEASUREMENT

### 4.2.1 LIMITS OF RADIATED EMISSION AND BANDEGE 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.



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## 4.2.2 TEST INSTRUMENTS

For below 1GHz test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
MXE EMI Receiver Agilent	N9038A	MY50010156	Jan. 16, 2013	Jan. 15, 2014
Pre-Amplifier Mini-Circuits	ZFL-1000VH2 B	AMP-ZFL-04	Nov. 14, 2012	Nov. 13, 2013
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-361	Mar. 25, 2013	Mar. 24, 2014
RF Cable	NA	CHHCAB_001	Oct. 06, 2013	Oct. 05, 2014
Horn_Antenna AISI	AIH.8018	0000220091110	Nov. 27, 2012	Nov. 26, 2013
Pre-Amplifier Agilent	8449B	3008A01923	Oct. 30, 2012	Oct. 29, 2013
RF Cable	NA	RF104-205 RF104-207 RF104-202	Dec. 26, 2012	Dec. 25, 2013
Spectrum Analyzer Agilent	E4446A	MY48250253	Aug. 28, 2013	Aug. 27, 2014
Pre-Amplifier SPACEK LABS	SLKKa-48-6	9K16	Nov. 14, 2012	Nov. 13, 2013
Horn_Antenna SCHWARZBECK	BBHA 9170	9170-424	Oct. 08, 2013	Oct. 07, 2014
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 horn antenna, preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
- 3 The test was performed in 966 Chamber No. H.
4. The FCC Site Registration No. is 797305.
- 5 The CANADA Site Registration No. is IC 7450H-3.
- 6 Tested Date: Oct. 28, 2013



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**For above 1GHz test:**

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
MXE EMI Receiver Agilent	N9038A	MY51210105	Jan. 29,2013	Jan. 28,2014
Pre-Amplifier Mini-Circuits	ZFL-1000VH2 B	AMP-ZFL-03	Nov. 14, 2012	Nov. 13, 2013
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-360	Mar. 19, 2013	Mar. 18, 2014
RF Cable	NA	CHGCAB_001	Oct. 05, 2013	Oct. 04, 2014
Horn_Antenna AISI	AIH.8018	0000320091110	Nov. 19, 2012	Nov. 18, 2013
Pre-Amplifier Agilent	8449B	3008A02578	June 25, 2013	June 24, 2014
RF Cable	NA	RF104-201 RF104-203 RF104-204	Dec. 25, 2012	Dec. 24, 2013
Spectrum Analyzer Agilent	E4446A	MY48250253	Aug. 28, 2013	Aug. 27, 2014
Pre-Amplifier SPACEK LABS	SLKKa-48-6	9K16	Nov. 14, 2012	Nov. 13, 2013
Horn_Antenna SCHWARZBECK	BBHA 9170	9170-424	Oct. 08, 2013	Oct. 07, 2014
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 horn antenna, preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
- 3 The test was performed in 966 Chamber No. G.
4. The FCC Site Registration No. is 966073.
- 5 The VCCI Site Registration No. is G-137.
- 6 The CANADA Site Registration No. is IC 7450H-2.
- 7 Tested Date: Oct. 29, 2013

#### 4.2.3 TEST PROCEDURES

- a. The EUT was placed on the top of a rotating table 0.8 meters 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:**

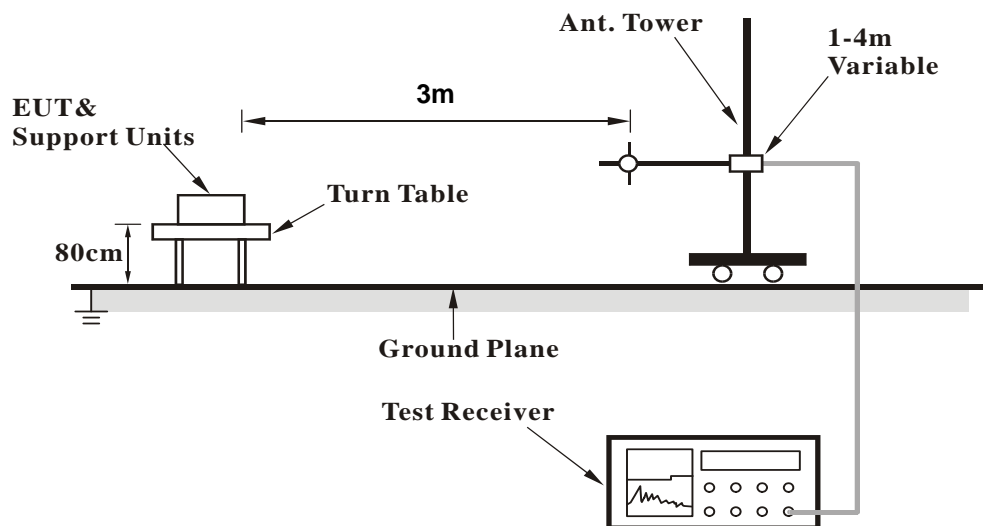
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1GHz.
4. If the EUT transiting at duty cycle is < 98%, the duty cycle correction is required that emission.
5. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.2.4 DEVIATION FROM TEST STANDARD

No deviation



#### 4.2.5 TEST SETUP



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

#### 4.2.6 EUT OPERATING CONDITIONS

Same as 4.1.6

## 4.2.7 TEST RESULTS

### BELOW 1GHz WORST-CASE DATA

#### BT\_LE-GFSK

<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	96.08	30.1 QP	43.5	-13.5	1.64 H	211	48.55	-18.50
2	272.91	41.2 QP	46.0	-4.9	1.00 H	203	54.35	-13.20
3	542.15	41.6 QP	46.0	-4.4	1.00 H	162	48.60	-7.02
4	555.00	39.4 QP	46.0	-6.7	1.00 H	197	46.02	-6.67
5	<b>663.10</b>	<b>43.4 QP</b>	<b>46.0</b>	<b>-2.6</b>	<b>1.24 H</b>	<b>173</b>	<b>47.76</b>	<b>-4.38</b>
6	863.43	38.5 QP	46.0	-7.5	1.22 H	259	39.49	-1.01
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	142.11	39.2 QP	43.5	-4.4	1.28 V	261	52.70	-13.55
2	213.25	39.2 QP	43.5	-4.3	1.80 V	211	55.21	-16.04
3	431.12	40.6 QP	46.0	-5.4	1.49 V	261	49.28	-8.70
4	638.05	38.1 QP	46.0	-7.9	1.32 V	211	42.55	-4.49
5	710.22	40.1 QP	46.0	-5.9	1.02 V	209	44.04	-3.93
6	853.31	38.2 QP	46.0	-7.8	1.38 V	103	39.37	-1.19

#### 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



## ABOVE 1GHz DATA

### BT\_LE-GFSK

<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	53.5 PK	74.0	-20.5	1.11 H	309	55.65	-2.15
2	2390.00	41.4 AV	54.0	-12.6	1.11 H	309	43.55	-2.15
3	*2402.00	104.2 PK			1.11 H	309	106.31	-2.11
4	*2402.00	91.4 AV			1.11 H	309	93.51	-2.11
5	4804.00	53.8 PK	74.0	-20.2	1.00 H	205	47.78	6.02
6	4804.00	41.5 AV	54.0	-12.5	1.00 H	205	35.48	6.02

#### 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	53.7 PK	74.0	-20.3	1.50 V	162	55.85	-2.15
2	2390.00	41.5 AV	54.0	-12.5	1.50 V	162	43.65	-2.15
3	*2402.00	96.2 PK			1.50 V	162	98.31	-2.11
4	*2402.00	85.3 AV			1.50 V	162	87.41	-2.11
5	4804.00	54.1 PK	74.0	-19.9	1.00 V	210	48.08	6.02
6	4804.00	41.7 AV	54.0	-12.3	1.00 V	210	35.68	6.02

#### 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.

<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	104.0 PK			1.00 H	307	105.97	-1.97
2	*2440.00	91.2 AV			1.00 H	307	93.17	-1.97
3	4880.00	53.5 PK	74.0	-20.5	1.00 H	218	47.22	6.28
4	4880.00	41.4 AV	54.0	-12.6	1.00 H	218	35.12	6.28
5	7320.00	61.3 PK	74.0	-12.7	1.04 H	91	47.28	14.02
6	7320.00	49.9 AV	54.0	-4.1	1.04 H	91	35.88	14.02

**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	96.2 PK			1.00 V	172	98.17	-1.97
2	*2440.00	85.0 AV			1.00 V	172	86.97	-1.97
3	4880.00	54.2 PK	74.0	-19.8	1.00 V	221	47.92	6.28
4	4880.00	41.8 AV	54.0	-12.2	1.00 V	221	35.52	6.28
5	7320.00	61.3 PK	74.0	-12.7	1.04 V	281	47.28	14.02
6	7320.00	49.8 AV	54.0	-4.2	1.04 V	281	35.78	14.02

**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.

<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	101.0 PK			1.09 H	324	102.84	-1.84
2	*2480.00	87.0 AV			1.09 H	324	88.84	-1.84
3	4960.00	53.5 PK	74.0	-20.5	1.00 H	202	46.91	6.59
4	4960.00	41.2 AV	54.0	-12.8	1.00 H	202	34.61	6.59
5	7440.00	61.4 PK	74.0	-12.6	1.00 H	105	47.59	13.81
6	7440.00	49.7 AV	54.0	-4.3	1.00 H	105	35.89	13.81

**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	93.9 PK			1.00 V	268	95.74	-1.84
2	*2480.00	77.7 AV			1.00 V	268	79.54	-1.84
3	4960.00	53.8 PK	74.0	-20.2	1.02 V	235	47.21	6.59
4	4960.00	41.5 AV	54.0	-12.5	1.02 V	235	34.91	6.59
5	7440.00	61.5 PK	74.0	-12.5	1.00 V	105	47.69	13.81
6	7440.00	49.8 AV	54.0	-4.2	1.00 V	105	35.99	13.81

**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.

### 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 INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
R&S SPECTRUM ANALYZER	FSP40	100037	Nov. 01, 2012	Oct. 31, 2013

**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. Tested date : Oct. 29, 2013

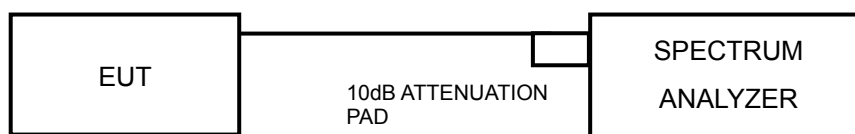
#### 4.3.3 TEST PROCEDURE

1. Set resolution bandwidth (RBW) = 100kHz
2. Set the video bandwidth (VBW)  $\geq 3 \times$  RBW, Detector = Peak.
3. Trace mode = max hold.
4. Sweep = auto couple.
5. 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

#### 4.3.4 DEVIATION FROM TEST STANDARD

No deviation

#### 4.3.5 TEST SETUP



#### 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

##### BT\_LE-GFSK

CHANNEL	FREQUENCY (MHz)	6dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
0	2402	0.71	0.5	PASS
19	2440	0.71	0.5	PASS
39	2480	0.71	0.5	PASS

## 4.4 CONDUCTED OUTPUT POWER MEASUREMENT

### 4.4.1 LIMITS OF MAXIMUM PEAK OUTPUT POWER MEASUREMENT

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

### 4.4.2 INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Power Meter	ML2495A	1014008	Apr. 23, 2013	Apr. 22, 2014
Power Sensor	MA2411B	0917122	Apr. 23, 2013	Apr. 22, 2014

**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. Tested date : Oct. 29, 2013

### 4.4.3 TEST PROCEDURES

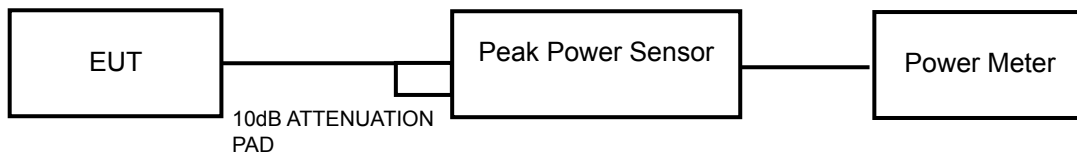
The peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the peak power level.



#### 4.4.4 DEVIATION FROM TEST STANDARD

No deviation.

#### 4.4.5 TEST SETUP



#### 4.4.6 EUT OPERATING CONDITIONS

Same as Item 4.3.6

#### 4.4.7 TEST RESULTS

##### BT\_LE-GFSK

CHANNEL	FREQUENCY (MHz)	PEAK POWER (mW)	PEAK POWER (dBm)	LIMIT (dBm)	PASS/FAIL
0	2402	5.702	7.56	30	PASS
19	2440	6.324	8.01	30	PASS
39	2480	6.668	8.24	30	PASS

## 4.5 AVERAGE OUTPUT POWER

### 4.5.1 FOR REFERENCE.

### 4.5.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Power Meter	ML2495A	1014008	Apr. 23, 2013	Apr. 22, 2014
Power Sensor	MA2411B	0917122	Apr. 23, 2013	Apr. 22, 2014

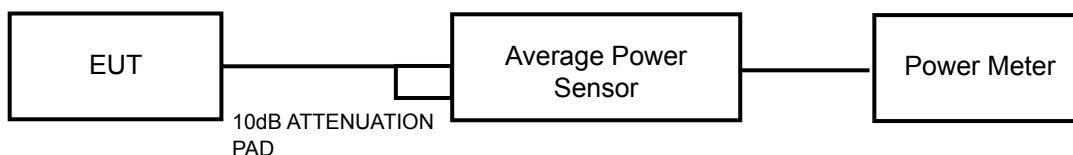
**Note:**

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. Tested date : Oct. 29, 2013

### 4.5.3 TEST PROCEDURES

Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

### 4.5.4 TEST SETUP



### 4.5.5 EUT OPERATING CONDITIONS

Same as Item 4.3.6



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## 4.5.6 TEST RESULTS

### BT\_LE-GFSK

CHANNEL	FREQUENCY (MHz)	AVERAGE POWER (mW)	AVERAGE POWER (dBm)
0	2402	5.483	7.39
19	2440	6.067	7.83
39	2480	6.427	8.08

## 4.6 POWER SPECTRAL DENSITY MEASUREMENT

### 4.6.1 LIMITS OF POWER SPECTRAL DENSITY MEASUREMENT

The Maximum of Power Spectral Density Measurement is 8dBm.

### 4.6.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
R&S Spectrum Analyzer	FSP40	100037	Nov. 01, 2012	Oct. 31, 2013

**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. Tested date : Oct. 29, 2013

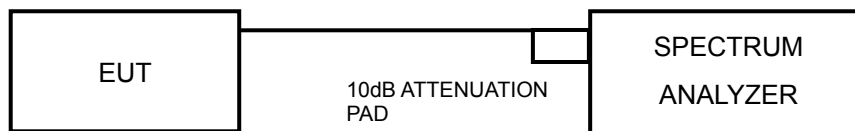
### 4.6.3 TEST PROCEDURE

1. Set the RBW = 3 kHz, VBW =10 kHz, Detector = peak.
2. Sweep time = auto couple, Trace mode = max hold, allow trace to fully stabilize.
3. Use the peak marker function to determine the maximum amplitude level.

### 4.6.4 DEVIATION FROM TEST STANDARD

No deviation

### 4.6.5 TEST SETUP



### 4.6.6 EUT OPERATING CONDITION

Same as Item 4.3.6



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## 4.6.7 TEST RESULTS

### BT\_LE-GFSK

Channel	FREQUENCY (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	PASS /FAIL
0	2402	-6.23	8	PASS
19	2440	-5.93	8	PASS
39	2480	-5.36	8	PASS

## 4.7 CONDUCTED OUT-BAND EMISSION MEASUREMENT

### 4.7.1 LIMITS OF CONDUCTED OUT-BAND EMISSION MEASUREMENT

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

### 4.7.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
R&S Spectrum Analyzer	FSP40	100037	Nov. 01, 2012	Oct. 31, 2013

**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. Tested date : Oct. 29, 2013

### 4.7.3 TEST PROCEDURE

**Measurement Procedure - Reference Level**

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.

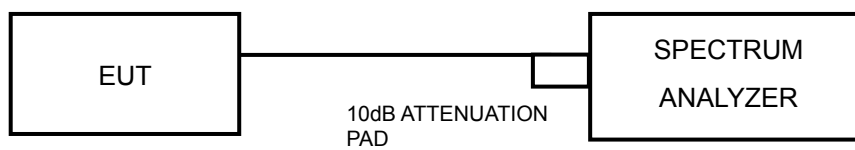
**Measurement Procedure –Unwanted Emission Level**

1. Set RBW = 100 kHz.
2. Set VBW  $\geq$  300 kHz.
3. Set span to encompass the spectrum to be examined
4. Detector = peak.
5. Trace Mode = max hold.
6. Sweep = auto couple.

#### 4.7.4 DEVIATION FROM TEST STANDARD

No deviation

#### 4.7.5 TEST SETUP



#### 4.7.6 EUT OPERATING CONDITION

Same as Item 4.3.6

#### 4.7.7 TEST RESULTS

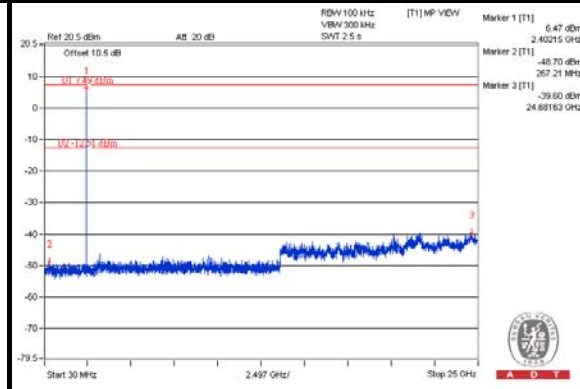
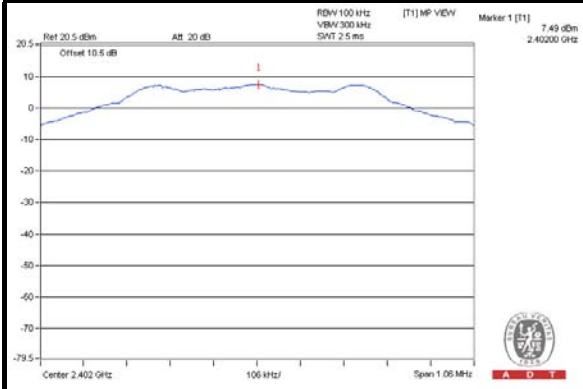
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.



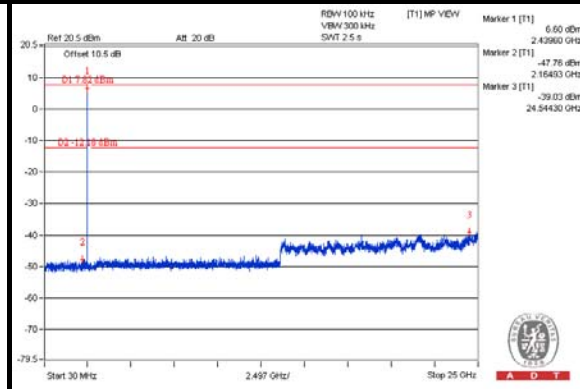
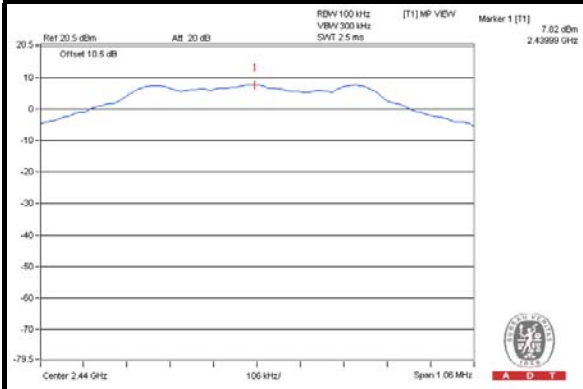
A D T

### BT\_LE-GFSK:

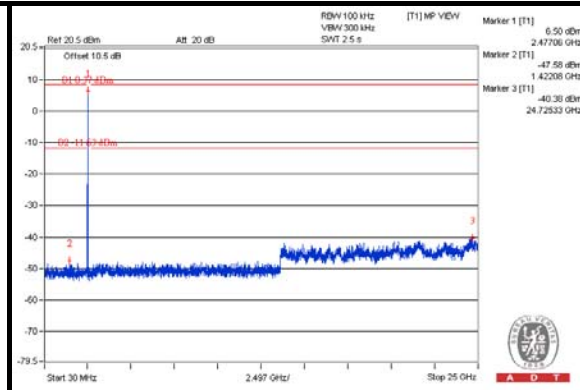
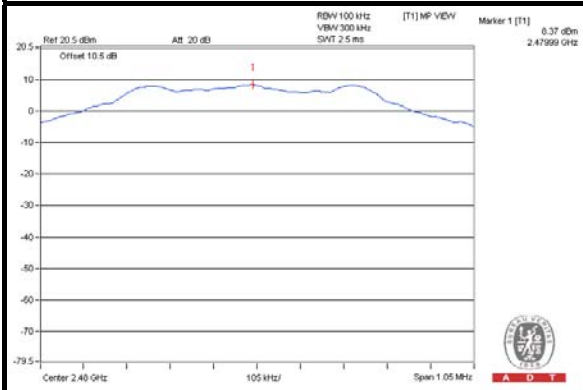
#### CH 0



#### CH 19



#### CH 39

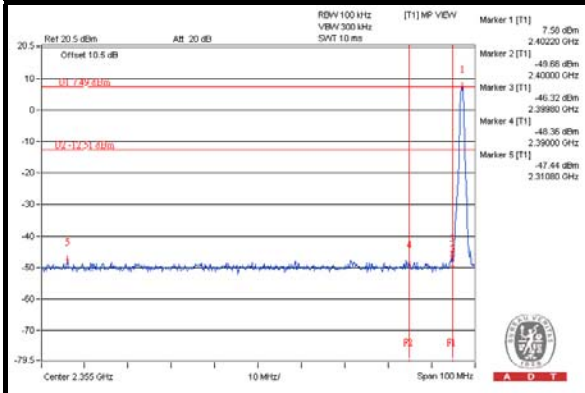




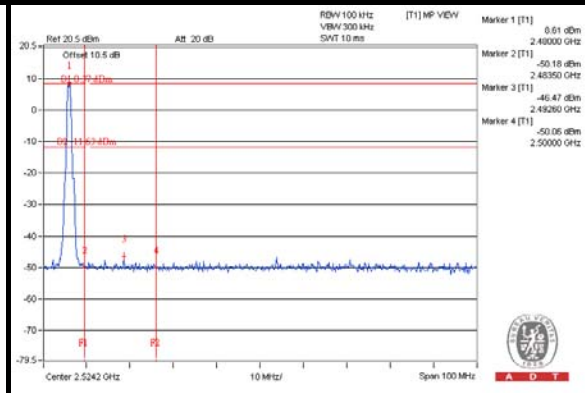


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### CH 0 Band edge



### CH 39 Band edge



## 5. PHOTOGRAPHS OF THE TEST CONFIGURATION

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



## 6. 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:

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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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## **7. APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB**

No modifications were made to the EUT by the lab during the test.

**--- END ---**