

## **FCC 47 CFR PART 15 SUBPART C**

### **TEST REPORT**

**Report Number: BATT20120201E-RF**

**FCC ID: ZK8-I12316GY**

**For**

**IP-CAM**

**Model: CM-I12316GY**

**Trade Name: Zmodo**

*Prepared for*

**ZMOD0 Technology Corp. Ltd.**

**1201 Sangda Building High Technology Park Shenzhen, P.R.China**

**Prepared by**

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# 1. TEST CERTIFICATION

**Applicant:** ZMOD0 Technology Corp. Ltd.  
1201 Sangda Building High Technology Park Shenzhen, P.R.China

**Equipment Under Test:** IP-CAM

**Trade Name:** Zmodo

**Model:** CM-I12316GY

APPLICABLE STANDARDS			
Standard	Test Type	Standard	Test Type
§15.247(a)(2)	6dB Bandwidth Measurement	§15.247(e)	Peak Power Spectral Density
§15.247(b)(3) §15.247(b)(4)	Peak Power Measurement	§15.247(d) §15.209(a) §15.205	Spurious Emissions ● Conducted Measurement ● Radiated Emissions
§15.247(d)	Band Edges Measurement	§15.207(a)	Power Line Conducted Emissions
§15.203	Antenna Requirement	§15.247 (i) §1.1307 (b)(1) §2.1091	Maximum Permissible exposure (MPE)

Deviation from Applicable Standard
None

The above equipment was tested by SHENZHEN BATT TESTING TECHNOLOGY CO.,LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4: 2003 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.

**Tested By:** Simon Mo  
(Simon Mo)

**Date:** 2012-03-02

**Check By:** Mike Yong  
(Mike Yong)

**Date:** 2012-03-02

## 2. TEST RESULT SUMMARY

APPLICABLE STANDARDS			
Standard	Test Type	Result	Remark
§15.247(a)(2)	6dB Bandwidth Measurement	Pass	Meet the requirement of limit.
§15.247(b)(3) §15.247(b)(4)	Peak Power Measurement	Pass	Meet the requirement of limit.
§15.247(d)	Band Edges Measurement	Pass	Meet the requirement of limit.
§15.247(e)	Peak Power Spectral Density	Pass	Meet the requirement of limit.
§15.247(d) §15.209(a) §15.205	Spurious Emissions ● Conducted Measurement ● Radiated Emissions	Pass	Meet the requirement of limit.
§15.207(a)	Power line Conducted Emissions	Pass	Meet the requirement of limit.
§15.203	Antenna Requirement	Pass	Meet the requirement of limit.
§15.247(i) §1.1307 (b)(1) §2.1091	Maximum Permissible exposure (MPE)	Pass	Meet the requirement of limit.

Note: 1. The test result judgment is decided by the limit of test standard  
2. The information of measurement uncertainty is available upon the customer's request.

### 3. EUT DESCRIPTION

<b>Product</b>	IP-CAM
<b>Trade Name</b>	Zmodo
<b>Model Number</b>	CM-I12316GY
<b>Model Difference</b>	N/A
<b>Power Supply</b>	DC 12V POWERED BY SWITCHING AC/DC POWER ADAPTER MODEL: GEO151UB-1215 I/P: AC 100-240V 50/60Hz 0.3A O/P: DC 12V, 1.5A
<b>Frequency Range</b>	802.11b mode: 2412 ~ 2462 MHz 802.11g mode: 2412 ~ 2462 MHz
<b>Transmit Power</b>	802.11b mode: 18.44 dBm (Conducted output power) 802.11g mode: 15.26 dBm (Conducted output power)
<b>Modulation Technique</b>	802.11b: DSSS (CCK; DQPSK; DBPSK) 802.11g: OFDM
<b>Transmit Data Rate</b>	IEEE 802.11b: 11, 5.5, 2, 1 Mbps IEEE 802.11g: 54, 48, 36, 24, 18, 12, 9, 6 Mbps
<b>Number of Channels</b>	11 Channels
<b>Antenna Specification</b>	Omni-directional dipole antenna ; Gain: 2.5dBi (Max)

*Note: This submittal(s) (test report) comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.*

## **4. TEST METHODOLOGY**

The tests documented in this report were performed in accordance with ANSI C63.4: 2003 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.

### **EUT CONFIGUTATION**

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

### **EUT EXERCISE**

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

## **GENERAL TEST PROCEDURES**

### **Conducted Emissions**

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4: 2003 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

### **Radiated Emissions**

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

## **FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS**

- (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
<sup>1</sup> 0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
2. 17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
2. 20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 –	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.52525	2655 – 2900	22.01 – 23.12
8.41425 – 8.41475	156.7 – 156.9	3260 – 3267	23.6 – 24.0
12.29 – 12.293	162.0125 – 167.17	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	167.72 – 173.2	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	240 – 285	3600 – 4400	( <sup>2</sup> )
13.36 – 13.41	322 – 335.4		

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

- (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

## **DESCRIPTION OF TEST MODES**

The EUT has been tested under operating condition.

Software (RT3x7xQA) used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

IEEE802.11b: Channel 1(2412MHz), Channel 6(2437MHz) and Channel 11(2462MHz) with 1Mbps highest data rate (worst case) are chosen for the final testing.

IEEE802.11g: Channel 1(2412MHz), Channel 6(2437MHz) and Channel 11(2462MHz) with 6Mbps data rate (worst case) are chosen for the final testing.

## **5. INSTRUMENT CALIBRATION**

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.



## **6. FACILITIES AND ACCREDITATIONS**

### **FACILITIES**

The Test site used by ShenZhen Emttek Co.,Ltd to collect test data is located in Bldg. 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China.

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4: 2003 and CISPR Publication 22.

### **EQUIPMENT**

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

### **LABORATORY ACCREDITATIONS AND LISTING**

Test site at ShenZhen Emttek Co.,Ltd has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on March 18, 2008 and October 28, 2010. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 709623 and 406365. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

## 7. SETUP OF EQUIPMENT UNDER TEST

### SETUP CONFIGURATION OF EUT

See test photographs for the actual connections between EUT and support equipment.

### REMOTE SUPPORT EQUIPMENT

Manufacturer	Description	Model	Serial Number	FCC ID
DELL	Notebook	D600	S2-B012	DOC

### EXTERNAL I/O CABLE

Cable Description	Length (m)	From/Port	To
Unshielded Detachable Power Cable	1.5	Notebook	LISN
Unshielded Detachable RJ45 Cable	10	EUT	Notebook

#### **Notes:**

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

## 8. FCC PART 15.247 REQUIREMENTS

### 6 DB BANDWIDTH

#### LIMIT

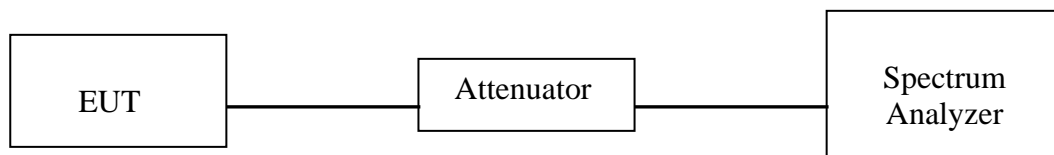
For the direct sequence systems, the minimum 6dB bandwidth shall be at least 500 kHz.

### MEASUREMENT EQUIPMENT USED

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	100005	2011-11-03	2012-11-02

*Remark: Each piece of equipment is scheduled for calibration once a year.*

### TEST CONFIGURATION



### TEST PROCEDURE

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW = 100 kHz, VBW  $\geq$  RBW, Span = 40MHz, Sweep = auto.
4. Mark the peak frequency and -6dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

## Test Data

### Environmental Conditions

Temperature:	25 ° C
Relative Humidity:	50 %
ATM Pressure:	100.0 kPa

The testing was performed by Simon Mo on 2012-02-04.

Test Mode: Transmitting

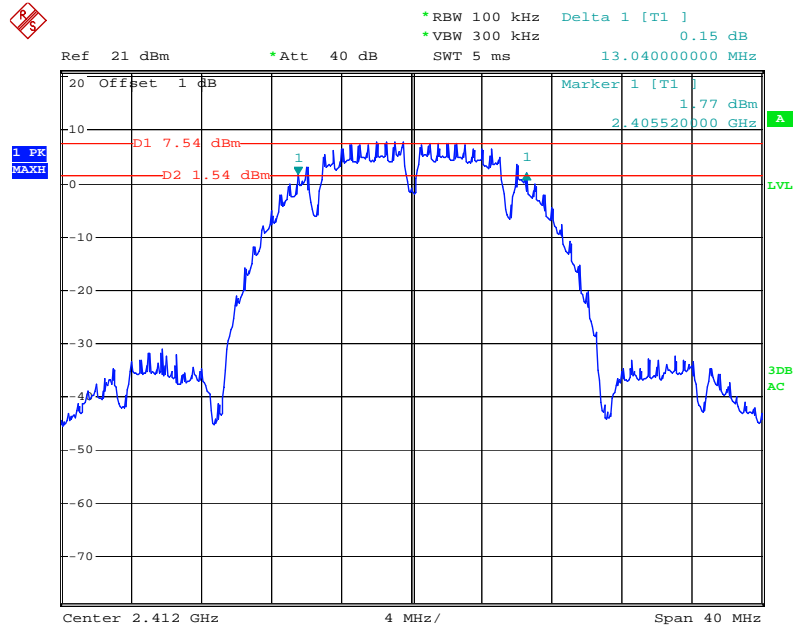
Test Result: Pass.

Please refer to the following table and plots:

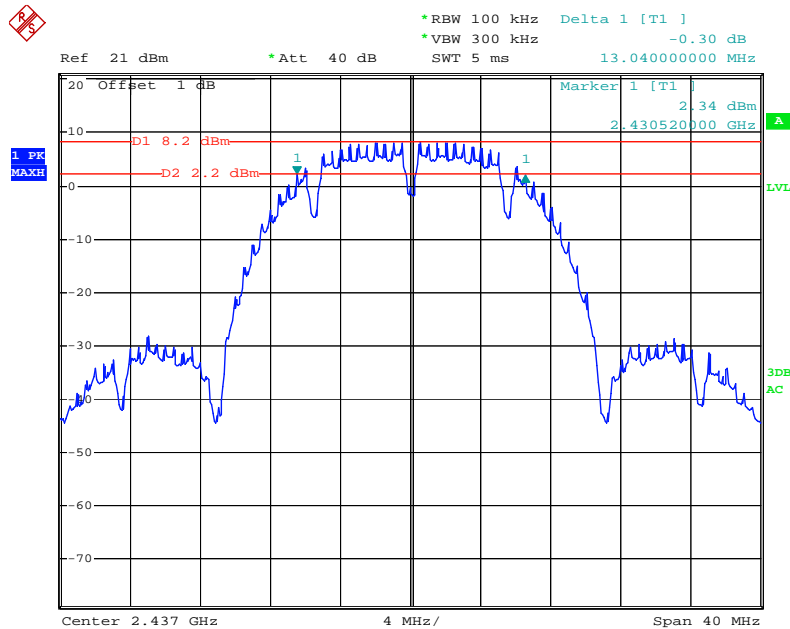
Channel	Frequency (MHz)	Data Rate (Mbps)	6 dB Bandwidth (MHz)	Limit (kHz)
802.11b mode				
Low	2412	1	13.04	>500
Middle	2437	1	13.04	>500
High	2462	1	13.04	>500
802.11g mode				
Low	2412	6	16.56	>500
Middle	2437	6	16.48	>500
High	2462	6	16.48	>500

## Test Plot

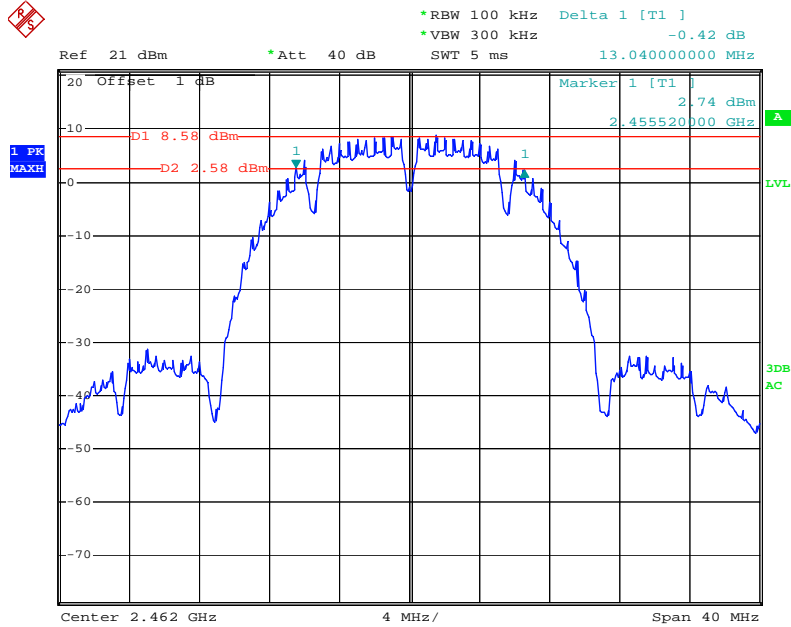
### 802.11b Low Channel



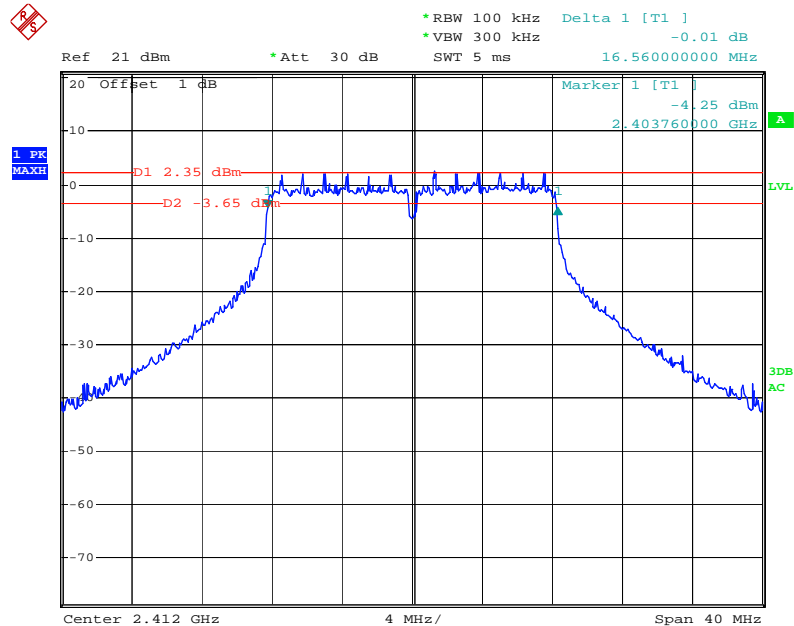
### 802.11b Middle Channel



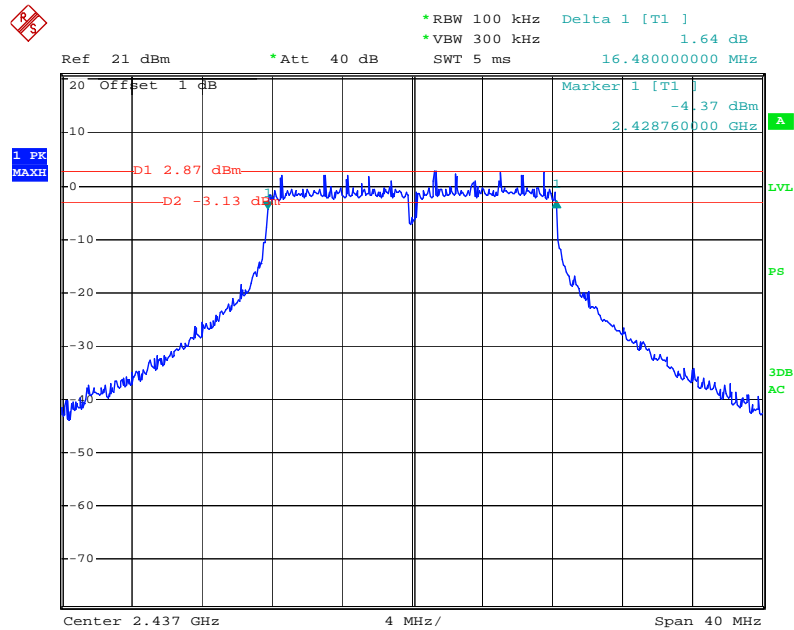
## 802.11b High Channel



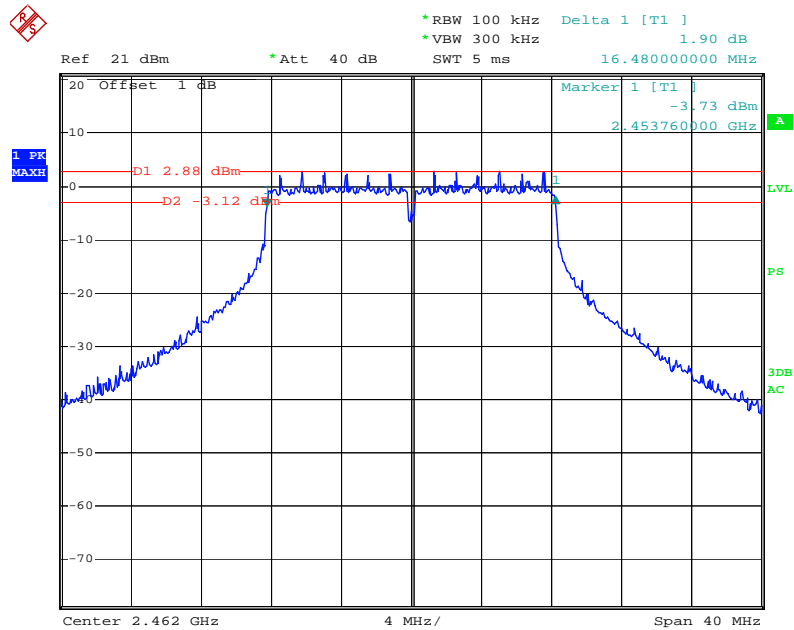
## 802.11g Low Channel



## 802.11g Middle Channel



## 802.11g High Channel



## **PEAK POWER**

### **LIMIT**

The maximum peak output power of the intentional radiator shall not exceed the following:

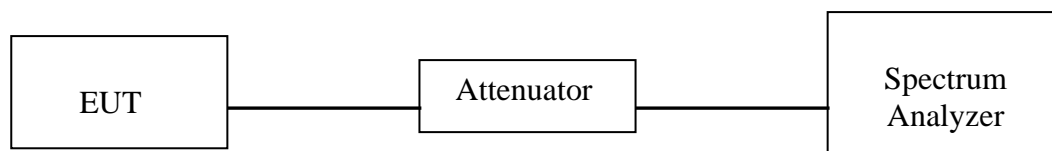
1. According to §15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 Watt.
2. According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

## **MEASUREMENT EQUIPMENT USED**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	100005	2011-11-03	2012-11-02

**Remark:** Each piece of equipment is scheduled for calibration once a year.

## **TEST CONFIGURATION**



## **TEST PROCEDURE**

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to an EMI Test Receiver.
3. Add a correction factor to the display.



## **Test Data**

### **Environmental Conditions**

<b>Temperature:</b>	25 ° C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	100.0 kPa

*The testing was performed by Simon Mo on 2012-02-04.*

*Test Mode: Transmitting*

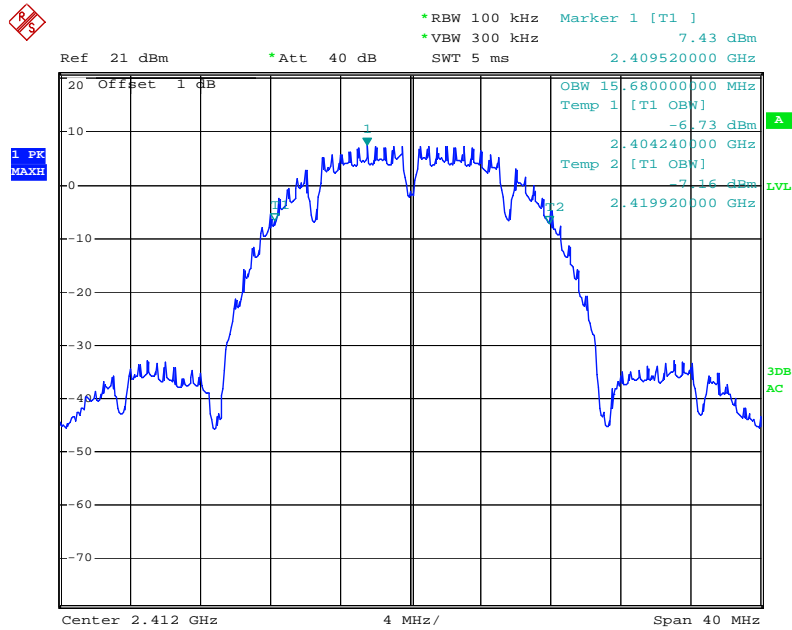
*Test Result: Pass.*

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Data Rate (Mbps)</b>	<b>Output Power (dBm)</b>	<b>Limit (dBm)</b>
802.11b				
Low	2412	1	18.36	30
Middle	2437	1	18.15	30
High	2462	1	18.44	30
802.11g				
Low	2412	6	15.26	30
Middle	2437	6	15.10	30
High	2462	6	15.17	30

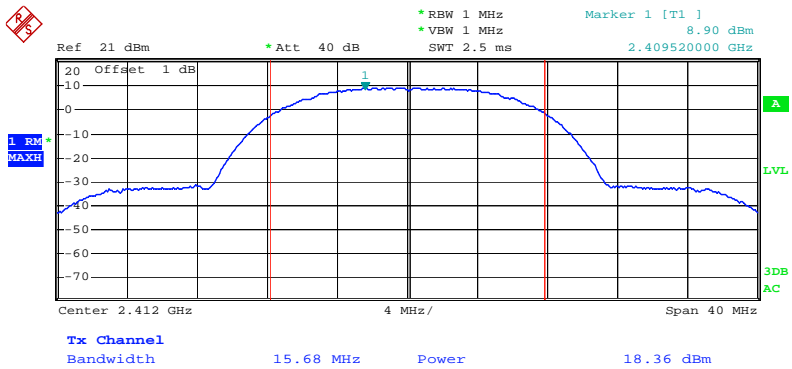
## Test Plot

### 802.11b mode

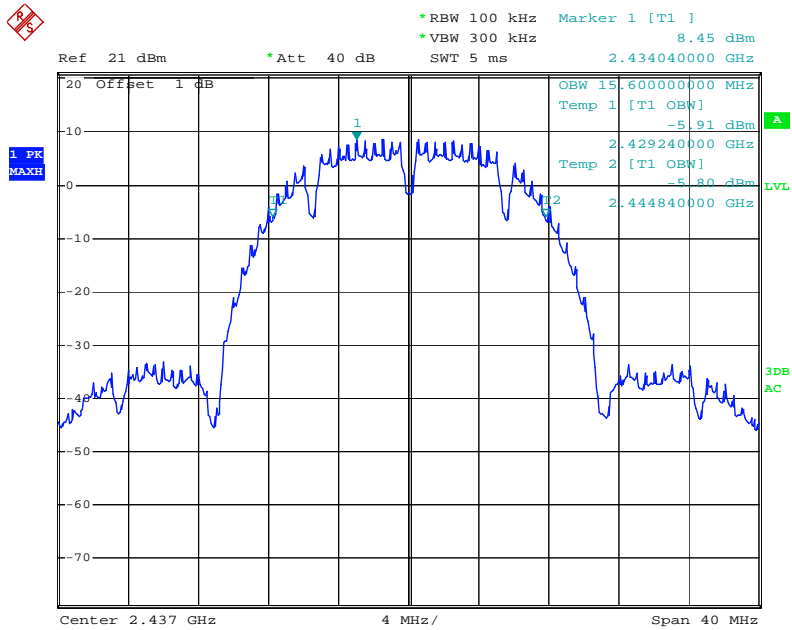
#### 99% Occupied Bandwidth, Low Channel



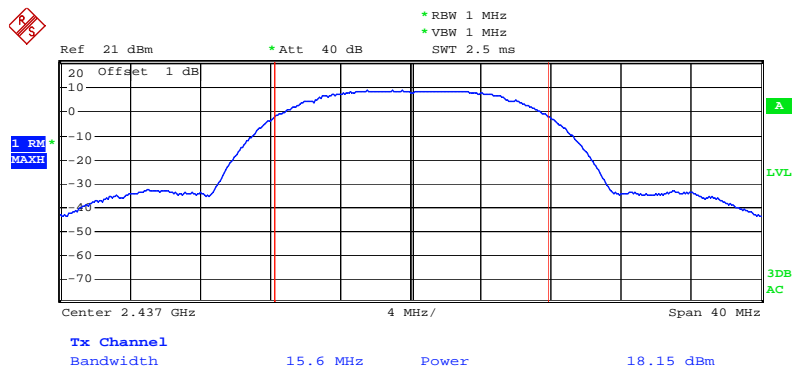
#### RF Output Power, Low Channel



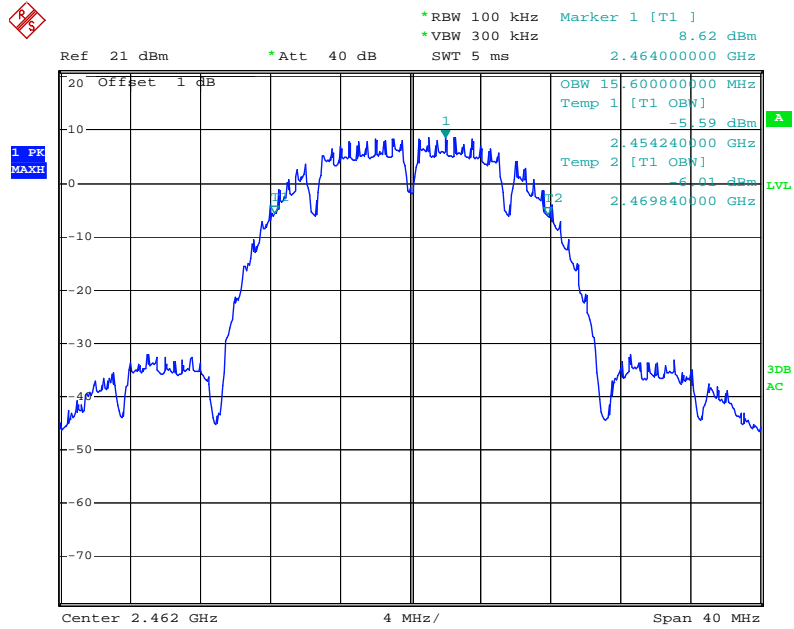
## 99% Occupied Bandwidth, Middle Channel



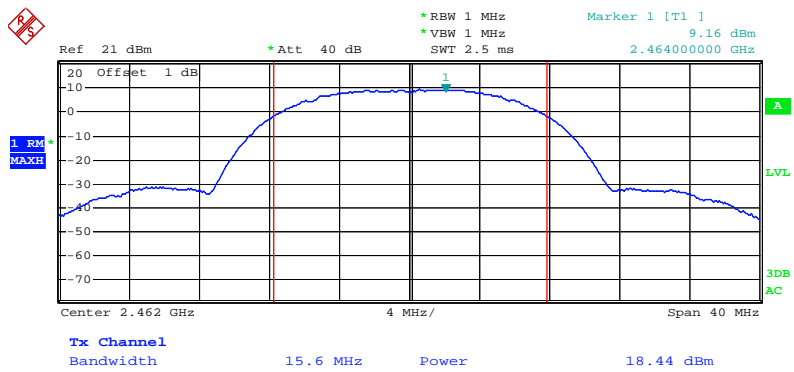
## RF Output Power, Middle Channel



## 99% Occupied Bandwith, High Channel

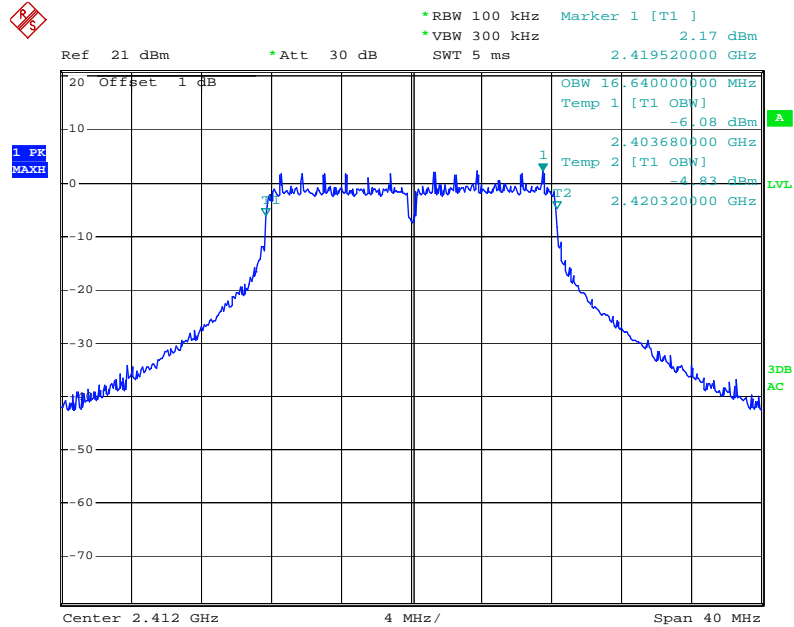


## RF Output Power, High Channel

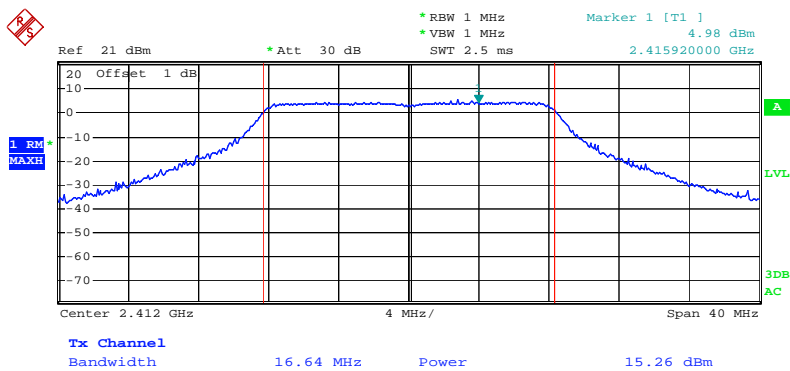


## 802.11g Mode:

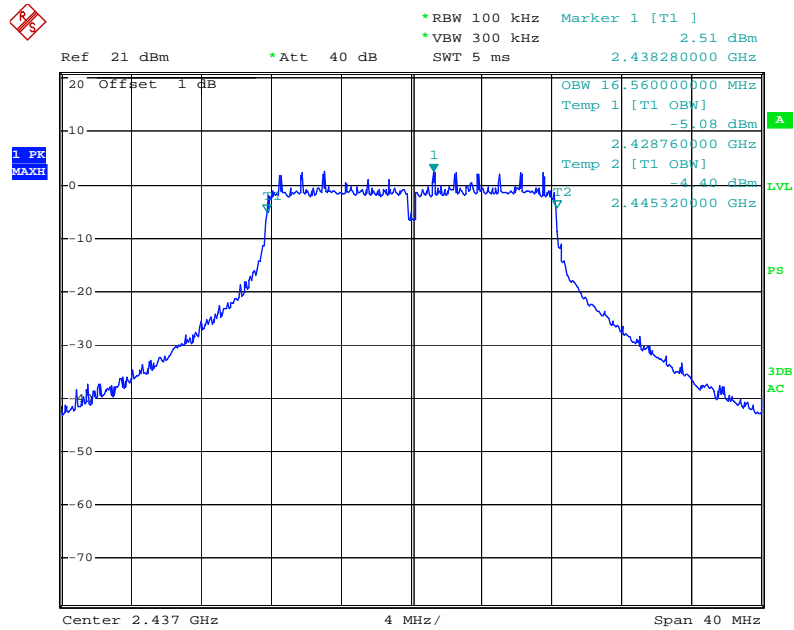
### 99% Occupied Bandwidth, Low Channel



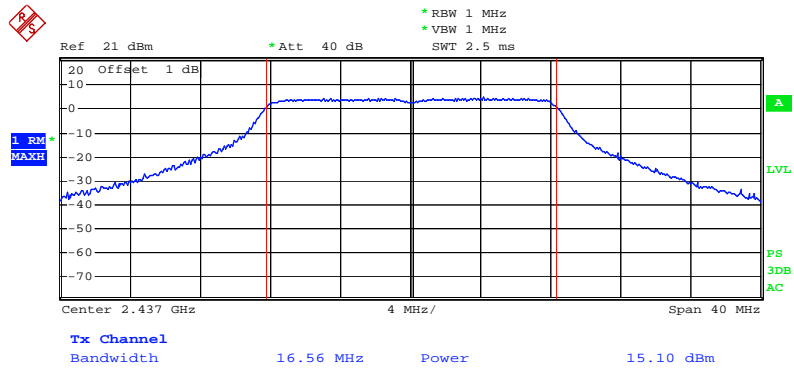
### RF Output Power, Low Channel



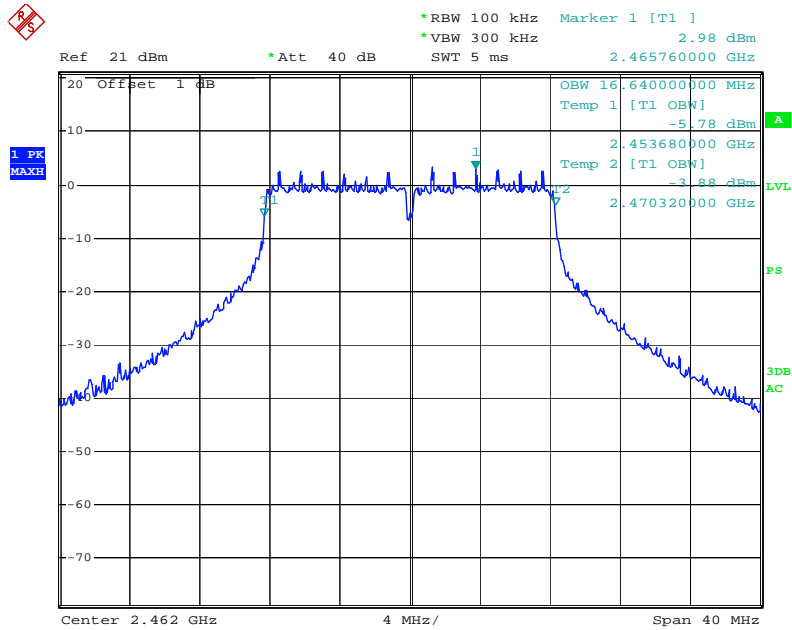
## 99% Occupied Bandwidth, Middle Channel



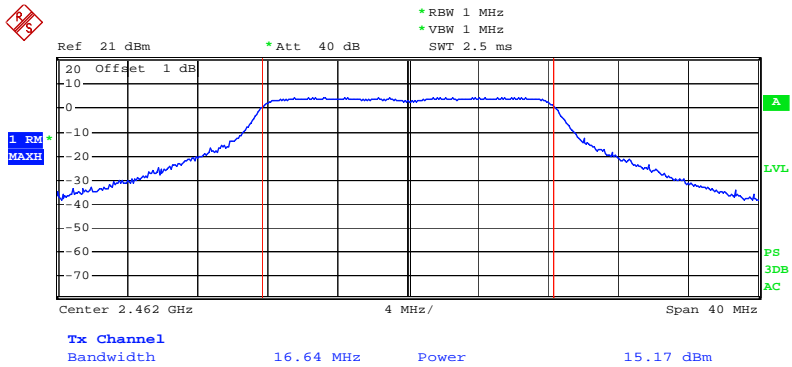
## RF Output Power, Middle Channel



## 99% Occupied Bandwith, High Channel



## RF Output Power, High Channel



## **BAND EDGES MEASUREMENT**

### **LIMIT**

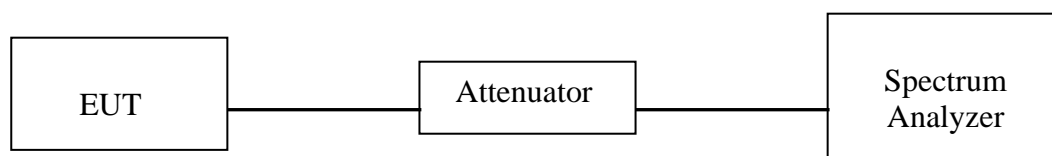
According to §15.247(c), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

### **MEASUREMENT EQUIPMENT USED**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	100005	2011-11-03	2012-11-02

**Remark:** Each piece of equipment is scheduled for calibration once a year.

### **TEST CONFIGURATION**



### **TEST PROCEDURE**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.



## **Test Data**

### **Environmental Conditions**

<b>Temperature:</b>	26 ° C
<b>Relative Humidity:</b>	48 %
<b>ATM Pressure:</b>	100.0 kPa

*The testing was performed by Simon Mo on 2012-02-04.*

*Test Mode: Transmitting*

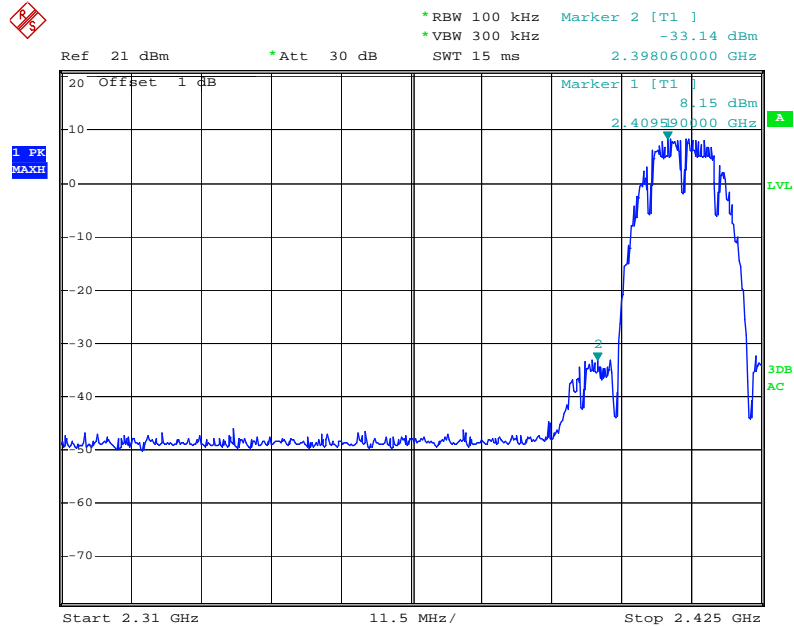
*Test Result: Pass.*

*Please refer to following table and plots:*

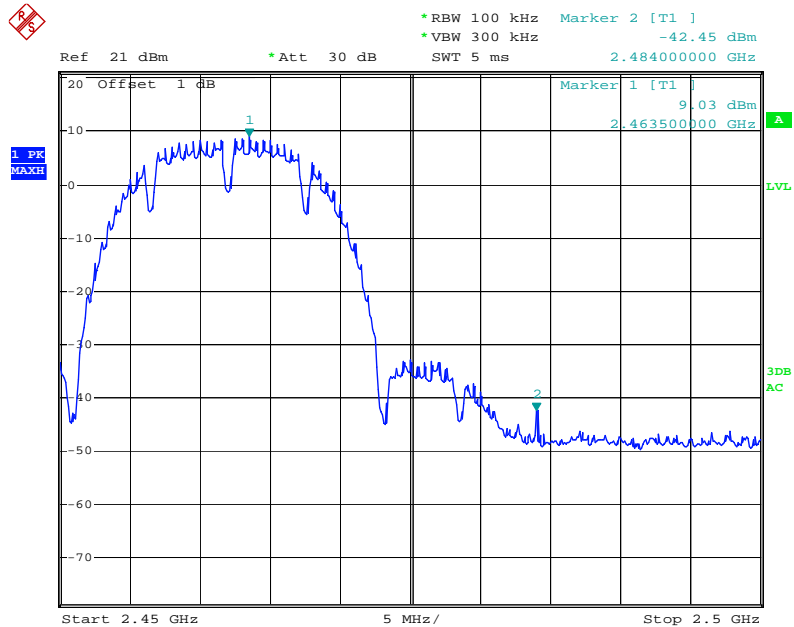
<b>Frequency (MHz)</b>	<b>Delta Peak to band emission (dBc)</b>	<b>Delta Limit (dBc)</b>
802.11b mode		
2398.06	41.29	20
2484.00	51.48	20
802.11g mode		
2399.9	29.64	20
2483.9	46.21	20

## 802.11b mode

### 802.11b: Band Edge, Left Side

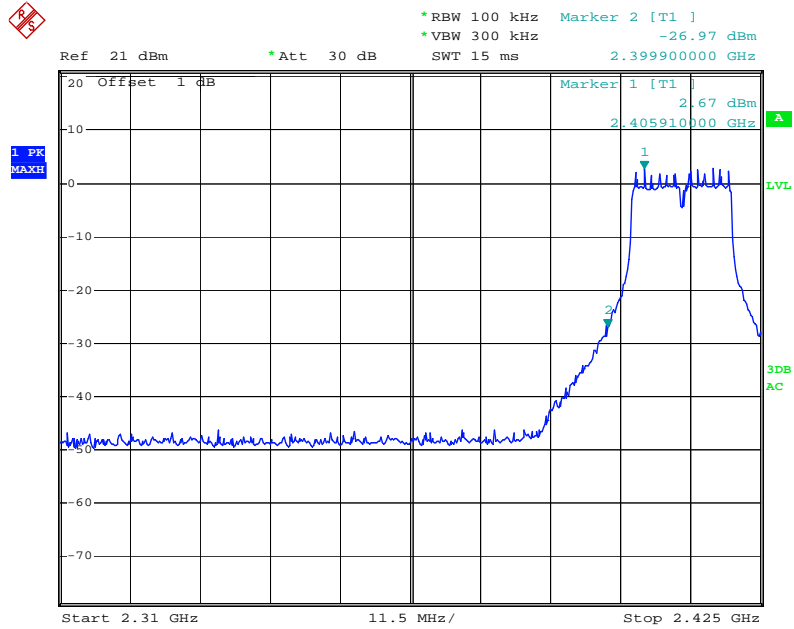


### 802.11b: Band Edge, Right Side

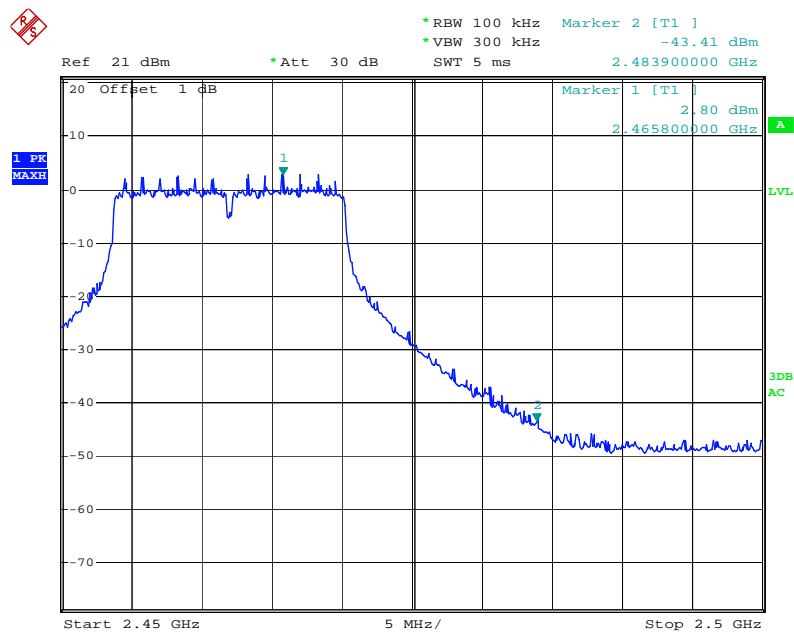


## 802.11g mode

### Band Edge, Left Side,



### Band Edge, Right Side



## **PEAK POWER SPECTRAL DENSITY**

### **LIMIT**

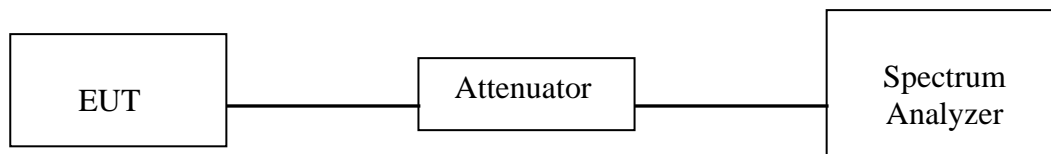
1. For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.
2. The direct sequence operating of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements of paragraph (d) of this section.

### **MEASUREMENT EQUIPMENT USED**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	100005	2011-11-03	2012-11-02

**Remark:** Each piece of equipment is scheduled for calibration once a year.

### **TEST CONFIGURATION**



### **TEST PROCEDURE**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to 1.5MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value. (DTS)
4. Repeat above procedures until all frequencies measured were complete.

## Test Data

### Environmental Conditions

Temperature:	26 ° C
Relative Humidity:	48 %
ATM Pressure:	100.0 kPa

The testing was performed by Simon Mo on 2012-02-04.

Test Mode: Transmitting

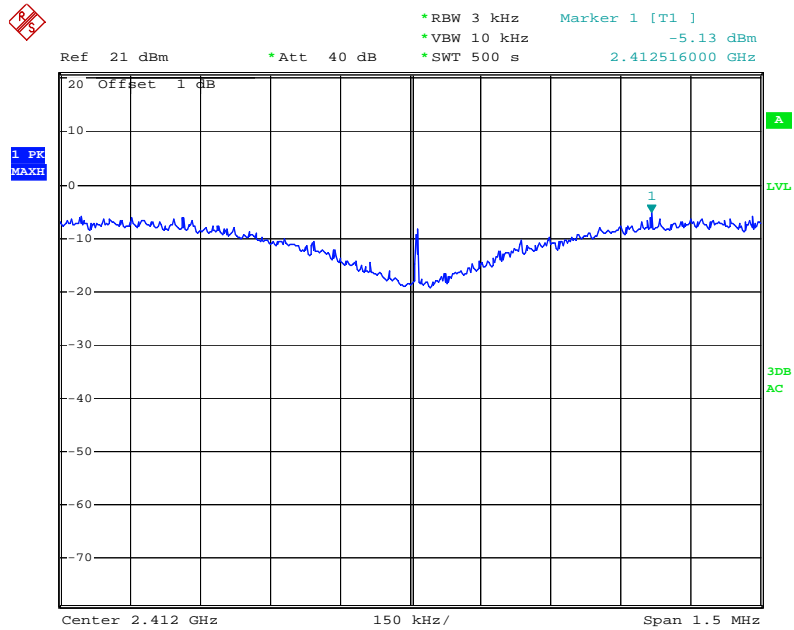
Test Result: Pass.

Please refer to following table and plots:

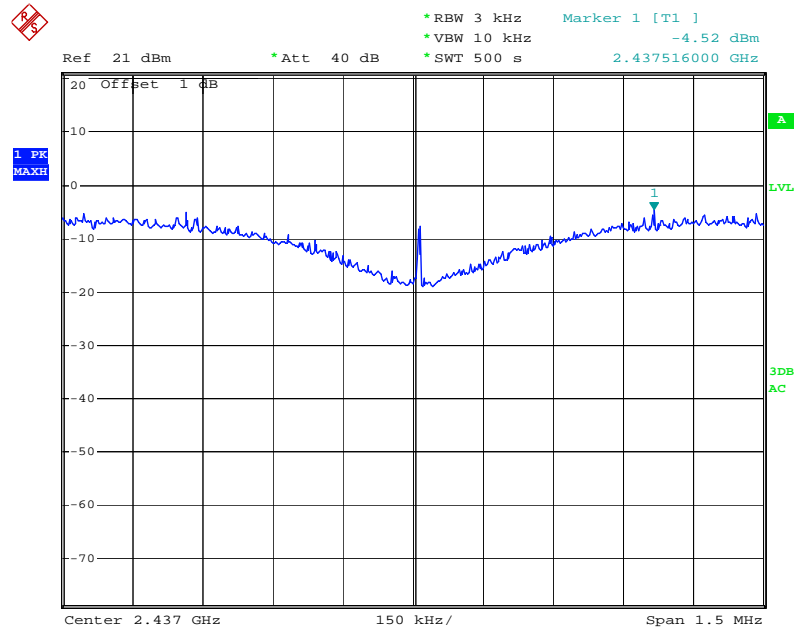
Channel	Frequency (MHz)	Data Rate	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
802.11b mode					
Low	2412	1	-5.13	8	Pass
Middle	2437	1	-4.52	8	Pass
High	2462	1	-4.20	8	Pass
802.11g mode					
Low	2412	6	-10.76	8	Pass
Middle	2437	6	-10.94	8	Pass
High	2462	6	-10.70	8	Pass

## Test Plot

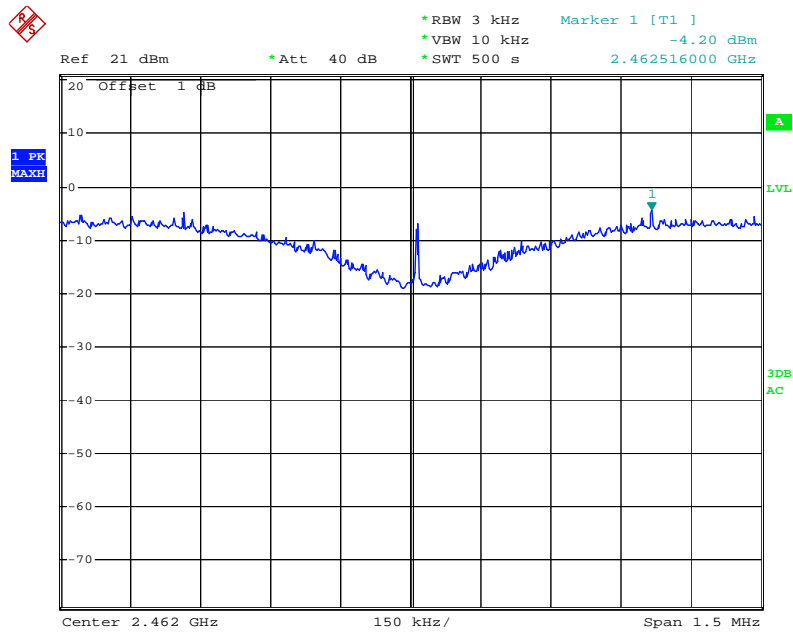
### Power Spectral Density, 802.11b Low Channel



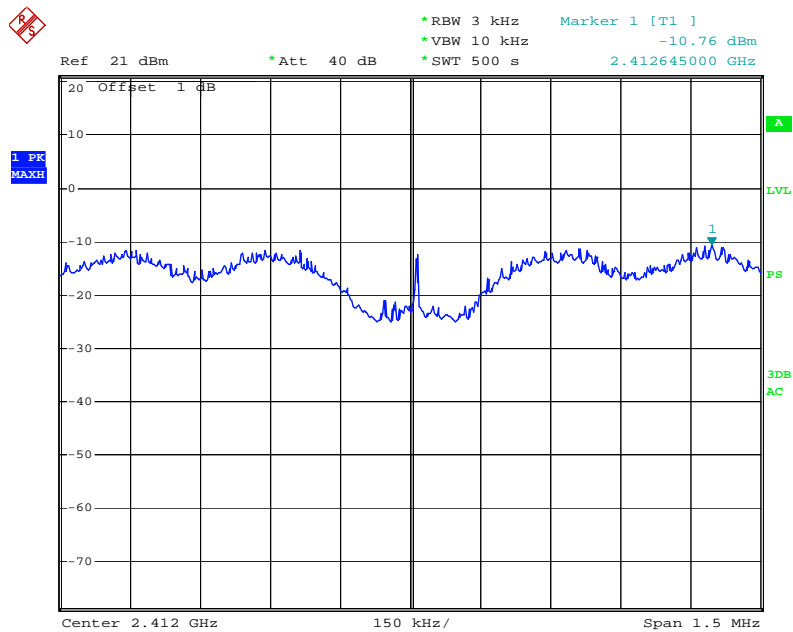
### Power Spectral Density, 802.11b Middle Channel



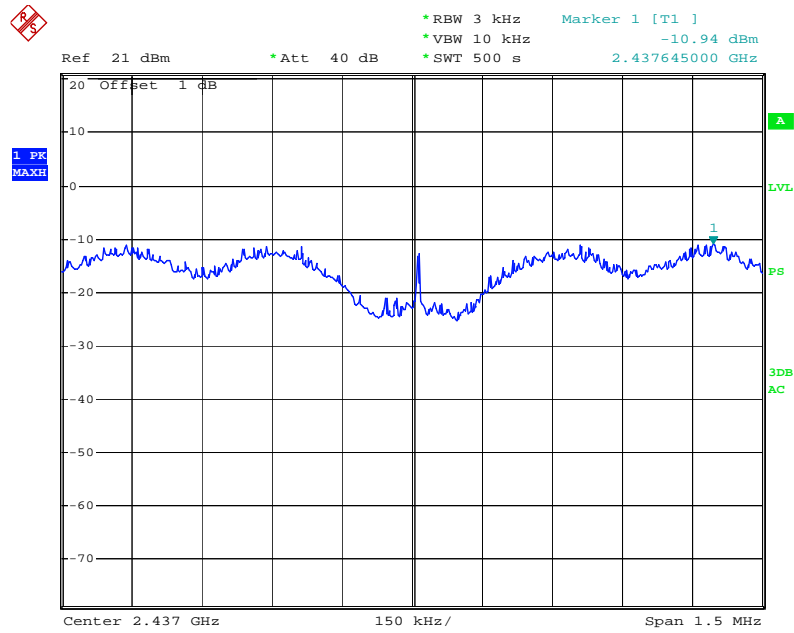
### Power Spectral Density, 802.11b High Channel



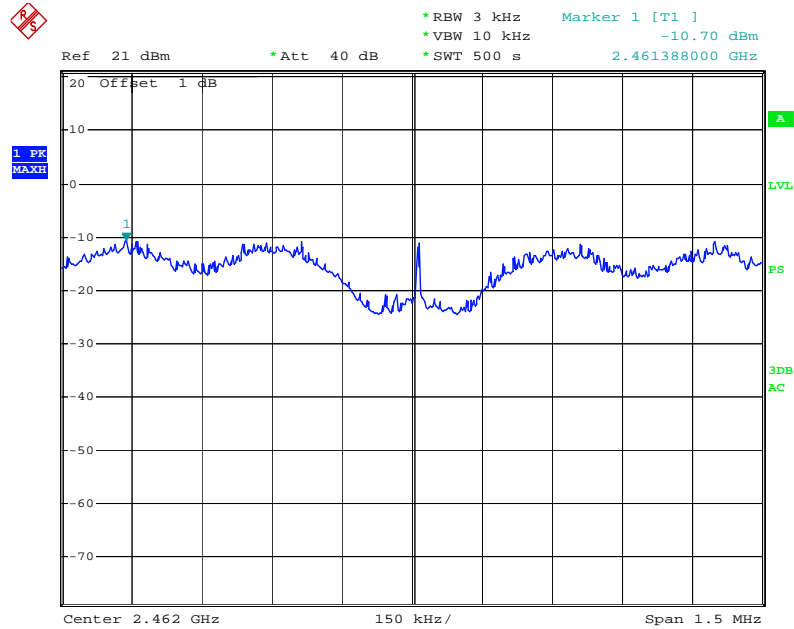
### Power Spectral Density, 802.11g Low Channel



### Power Spectral Density, 802.11g Middle Channel



### Power Spectral Density, 802.11g High Channel





## **SPURIOUS EMISSIONS**

### **7.6.1 Conducted Measurement**

#### **LIMIT**

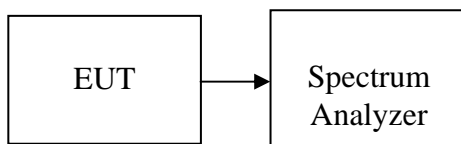
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

#### **MEASUREMENT EQUIPMENT USED**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSP30	839511/010	2010-09-26	2011-09-25

*Remark: Each piece of equipment is scheduled for calibration once a year.*

## **TEST CONFIGURATION**



## **TEST PROCEDURE**

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

Measurements are made over the 30 MHz to 25 GHz range with the transmitter set to the lowest, middle, and highest channels.

## Test Data

### Environmental Conditions

Temperature:	26 ° C
Relative Humidity:	48 %
ATM Pressure:	100.0 kPa

The testing was performed by Simon Mo on 2012-02-11.

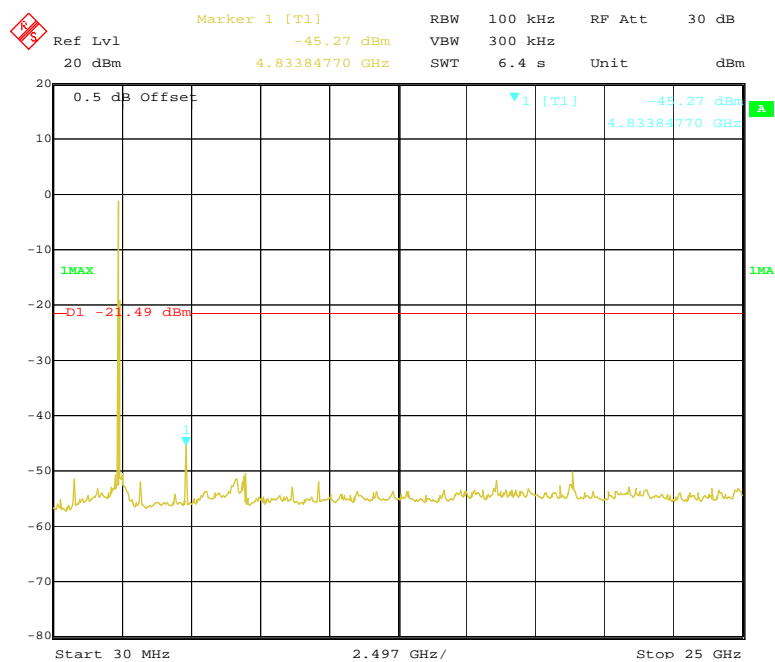
Test Mode: Transmitting

Test Result: Pass.

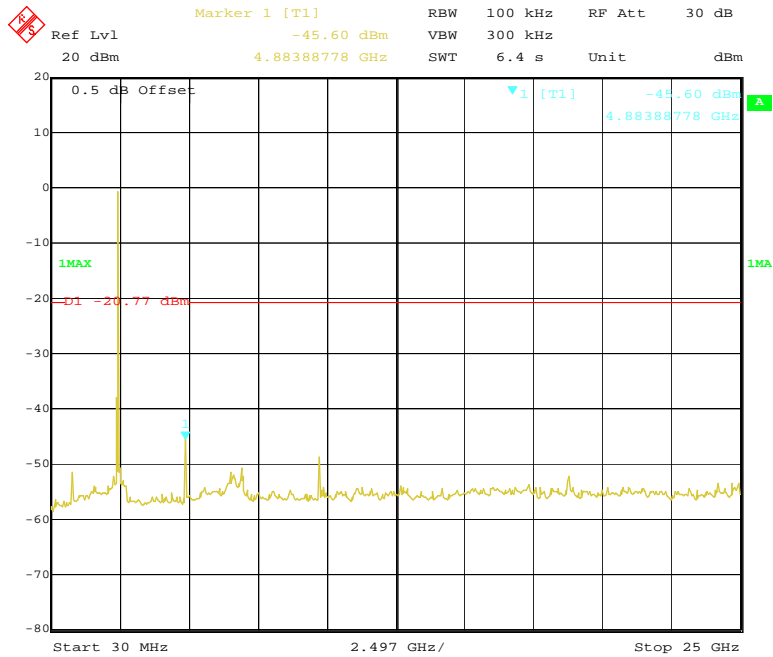
### Spurious Emissions at Antenna Terminal

Please refer to the following plots

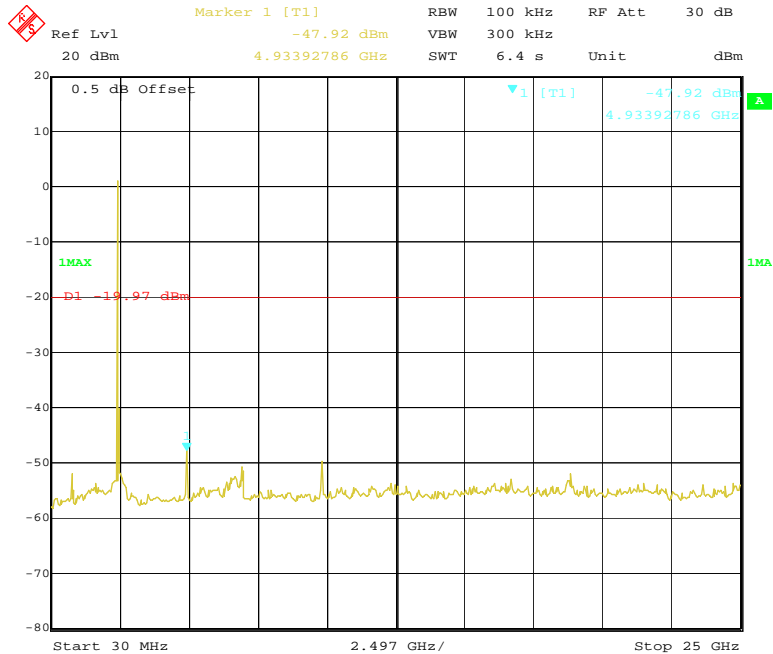
#### 802.11b Low Channel



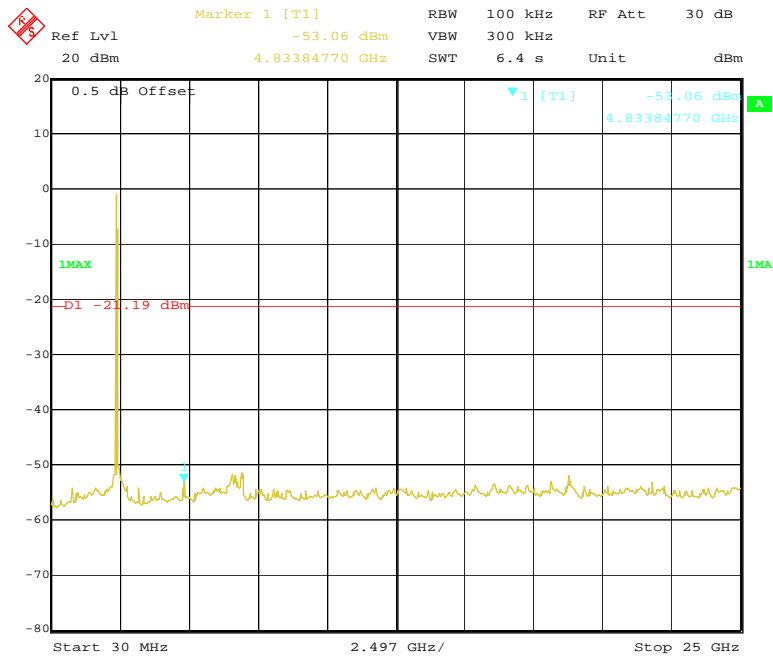
### 802.11b Middle Channel



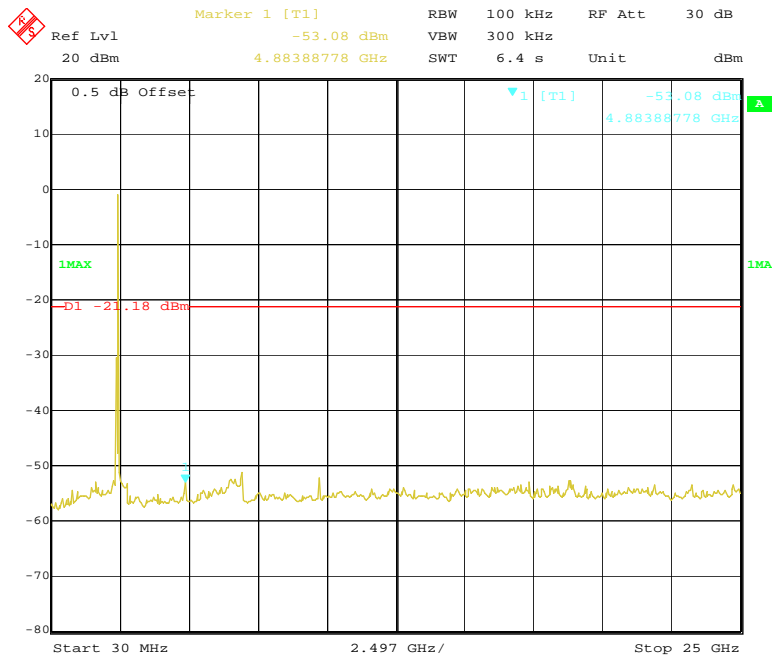
### 802.11b High Channel



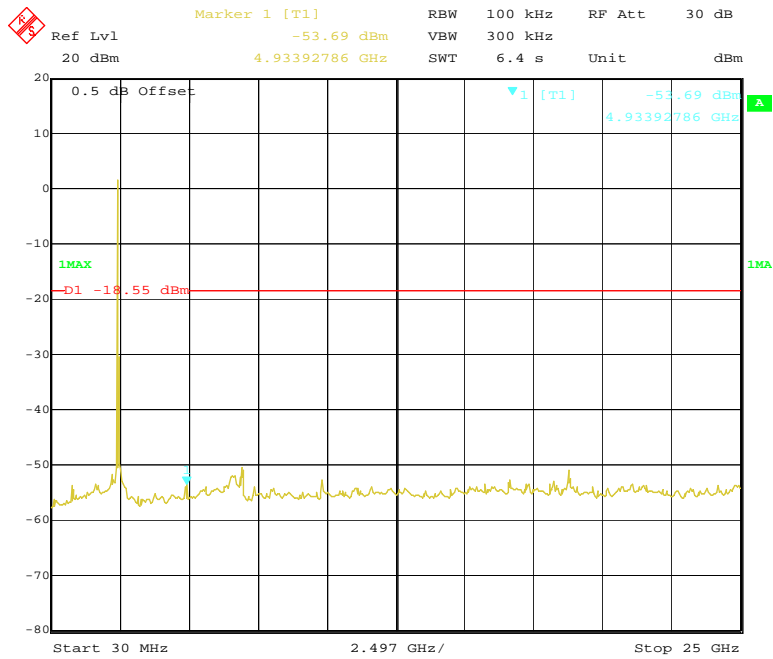
### 802.11g Low Channel



### 802.11g Middle Channel



### 802.11g High Channel



## 7.6.2 Radiated Emissions

### LIMIT

1. Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (mV/m)	Measurement Distance (m)
30-88	100*	3
88-216	150*	3
216-960	200*	3
Above 960	500	3

**Note:** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

2. In the above emission table, the tighter limit applies at the band edges.

Frequency (Hz)	Field Strength ( $\mu\text{V/m}$ at 3-meter)	Field Strength (dB $\mu\text{V/m}$ at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

### MEASUREMENT UNCERTAINTY

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at ShenZhen Emtex Co.,Ltd is  $\pm 4.0$  dB.

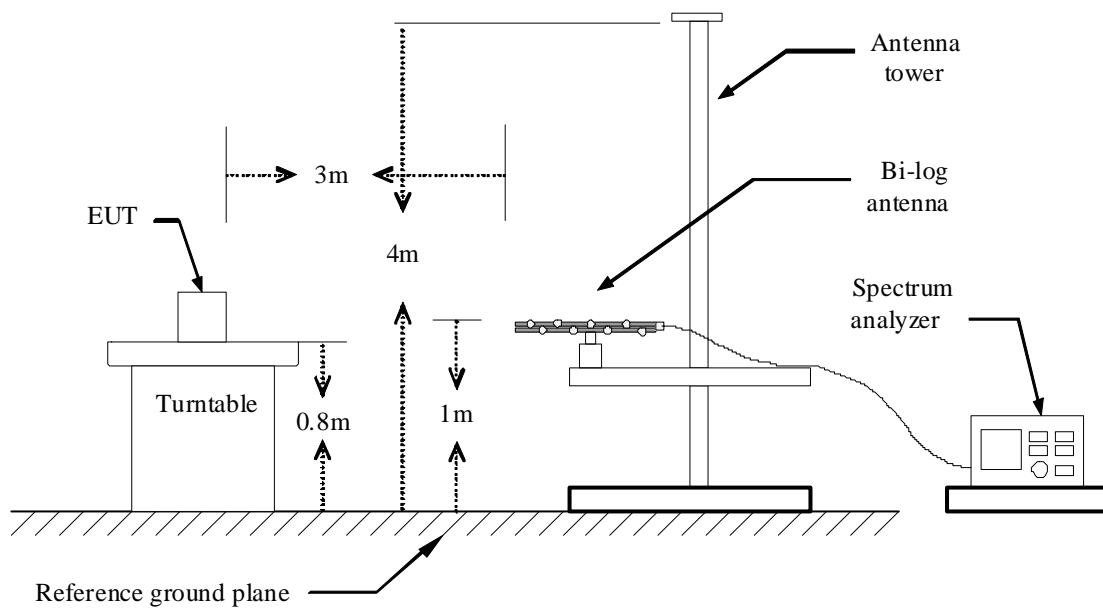
## MEASUREMENT EQUIPMENT USED

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSP30	839511/010	2011-09-26	2012-09-25
Rohde & Schwarz	EMI Test Receiver	ESCI	100005	2011-11-03	2012-11-02
HP	Amplifier	8447D	2944A07999	2011-10-02	2012-10-02
HP	Amplifier	8449B	2624A00116	2011-03-03	2012-03-02
Schwarzbeck	Horn Antenna	BBHA 9120	D143	2011-09-02	2012-09-01
Schwarzbeck	Bilog Antenna	VULB9163	142	2011-04-12	2012-04-12
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2011-03-11	2012-03-10

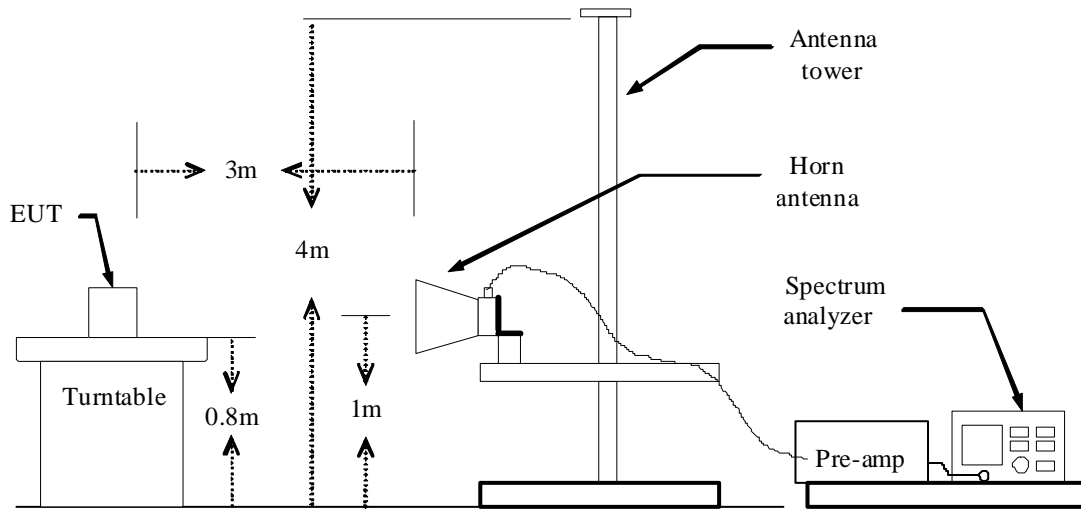
**Remark:** Each piece of equipment is scheduled for calibration once a year.

### Test Configuration

Below 1 GHz



## Above 1 GHz



The radiated emission tests were performed in the 3 meters chamber 966 test site, using the setup accordance with the ANSI C63.4-2003. The specification used was the FCC 15.209, and FCC 15.247 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

The adapter was connected to a 120 VAC/60 Hz power source.

## EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

<u>Frequency Range</u>	<u>RBW</u>	<u>VBW</u>	<u>Detector</u>
30 MHz – 1000 MHz	120 kHz	300 kHz	QP
1000 MHz – 25 GHz	1 MHz	3 MHz	PK
1000 MHz – 25 GHz	1 MHz	10 Hz	PK



## **TEST PROCEDURE**

For the radiated emissions test, the adapter was connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1GHz and peak and Average detection modes for frequencies above 1GHz.

## **CORRECTED AMPLITUDE & MARGIN CALCULATION**

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

## Test Data

### Environmental Conditions

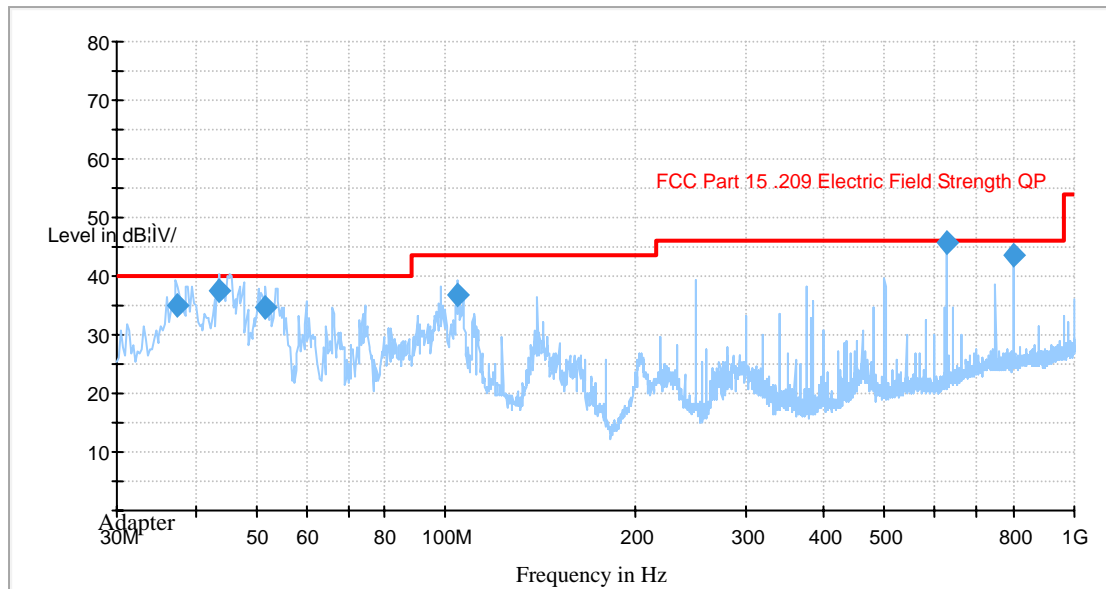
Temperature:	26 ° C
Relative Humidity:	50 %
ATM Pressure:	100.0 kPa

The testing was performed by Simon Mo on 2012-02-11.

Test Result: Pass.

### 30-1000 MHz:

Test Mode: Transmitting (802.11b worst case)

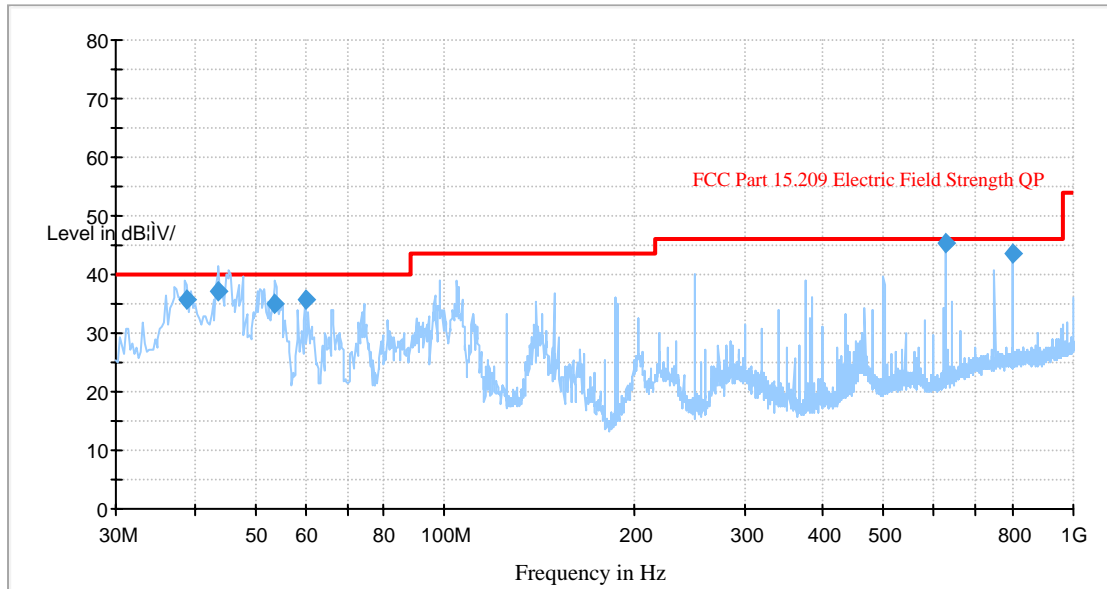


Frequency (MHz)	Corrected Amplitude (dBμV/m)	Ant. Height (cm)	Antenna Polarity (H/V)	Turntable Position (degree)	Correction Factor (dB)	Limit (dBμV/m)	Margin (dB)
624.997500	45.7	101.0	V	337.0	-5.7	46.0	0.3*
43.804500	37.6	100.0	V	194.0	-14.4	40.0	2.4*
799.994250	43.6	304.0	H	207.0	-1.8	46.0	2.4*
37.542250	35.1	101.0	V	306.0	-10.5	40.0	4.9
51.829500	34.7	100.0	V	311.0	-17.5	40.0	5.3
104.756000	36.9	100.0	V	130.0	-14.0	43.5	6.6

\*Within measurement uncertainty.

Test Mode: Transmitting (802.11g worst case)

Auto test FCC 15.209



Frequency (MHz)	Corrected Amplitude (dBμV/m)	Ant. Height (cm)	Antenna Polarity (H/V)	Turntable Position (degree)	Correction Factor (dB)	Limit (dBμV/m)	Margin (dB)
624.984000	45.3	100.0	V	335.0	-5.7	46.0	0.7*
799.992500	43.5	308.0	H	218.0	-1.8	46.0	2.5*
43.769250	37.0	100.0	V	203.0	-14.4	40.0	3.0*
38.945250	35.9	100.0	V	294.0	-11.4	40.0	4.1
60.227250	35.6	101.0	V	176.0	-18.7	40.0	4.4
53.858750	34.8	101.0	V	332.0	-17.8	40.0	5.2

\*Within measurement uncertainty.

**Above 1 GHz:**

**802.11b Mode:**

Indicated		Detector (PK/Ave)	Table Angle Degree	Test Antenna		Correction Factor			FCC Part 15.247/15.209/205		
Frequency (MHz)	S.A. Reading (dBμV)			Height (m)	Polar (H/V)	Ant. Loss (dB/m)	Cable Loss (dB)	Amplifier (dB)	Correction Data (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Low Channel (2412 MHz)											
4824	37.82	AV	250	1.3	H	36.6	4.30	26.75	51.97	54	2.03
4824	37.09	AV	272	1.5	V	35.4	4.30	26.75	50.04	54	3.96
3216	32.89	AV	285	1.5	V	31.0	3.49	26.68	40.70	54	13.30
3216	31.43	AV	160	1.2	H	32.0	3.49	26.88	40.04	54	13.96
4824	42.85	PK	250	1.3	H	36.6	4.30	26.75	57.00	74	17.00
2384.8	29.34	AV	216	1.0	V	30.6	2.98	26.83	36.09	54	17.91
4824	41.65	PK	272	1.5	V	35.4	4.30	26.75	54.60	74	19.40
2384.8	27.01	AV	230	1.2	H	30.6	2.98	26.83	33.76	54	20.24
2384.8	41.68	PK	130	1.4	V	30.6	2.98	26.83	48.43	74	25.57
3216	39.33	PK	285	1.5	V	31.0	3.49	26.88	46.94	74	27.06
2384.8	39.40	PK	230	1.2	H	30.6	2.98	26.83	46.15	74	27.85
3216	36.75	PK	160	1.2	H	32.0	3.49	26.88	45.36	74	28.64
Middle Channel (2437 MHz)											
4874	37.51	AV	130	1.5	H	36.6	4.36	26.75	51.72	54	2.28
4874	36.86	AV	65	1.5	V	35.4	4.36	26.75	49.87	54	4.13
1696	42.33	AV	95	1.5	V	29.8	2.44	26.83	47.74	54	6.26
1696	41.53	AV	240	1.5	H	29.7	2.44	26.83	46.84	54	7.16
4874	42.25	PK	130	1.5	H	36.6	4.36	26.75	56.46	74	17.54
4874	41.23	PK	65	1.5	V	35.4	4.36	26.75	54.24	74	19.76
1696	47.15	PK	95	1.5	V	29.8	2.44	26.83	52.56	74	21.44
1696	46.75	PK	240	1.5	H	29.7	2.44	26.83	52.06	74	21.94
High Channel (2462 MHz)											
4924	36.70	AV	130	1.5	H	36.6	4.40	26.75	50.95	54	3.05
4924	37.24	AV	196	1.5	V	35.4	4.40	26.75	50.29	54	3.71
1732	43.78	AV	50	1.6	V	29.8	2.52	26.83	49.27	54	4.73
1732	39.42	AV	250	1.5	H	29.7	2.52	26.83	44.81	54	9.19
2488.5	33.65	AV	40	1.5	V	30.6	3.11	26.88	40.48	54	13.52
2488.3	30.55	AV	260	1.6	H	30.6	3.11	26.88	37.38	54	16.62
1732	50.59	PK	50	1.6	V	29.8	2.52	26.83	56.08	74	17.92
4924	41.40	PK	130	1.5	H	36.6	4.40	26.75	55.65	74	18.35
4924	41.86	PK	196	1.5	V	35.4	4.40	26.75	54.91	74	19.09
1732	46.23	PK	250	1.5	H	29.7	2.52	26.83	51.62	74	22.38
2488.5	39.40	PK	40	1.5	V	30.6	3.11	26.88	46.23	74	27.77
2488.3	39.34	PK	260	1.6	H	30.6	3.11	26.88	46.17	74	27.83

\*Within measurement uncertainty.

## 802.11g Mode:

Indicated		Detector (PK/Ave)	Table Angle Degree	Test Antenna		Correction Factor			FCC Part 15.247/15.209/205		
Frequency (MHz)	S.A. Reading (dBμV)			Height (m)	Polar (H/V)	Ant. Loss (dB/m)	Cable Loss (dB)	Amplifier (dB)	Correction Data (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Low Channel (2412 MHz)											
3216	34.47	AV	40	1.5	V	31.0	3.49	26.68	42.28	54	11.72
3216	31.01	AV	250	1.5	H	32.0	3.49	26.88	39.62	54	14.38
4824	22.97	AV	130	1.5	H	36.6	4.30	26.75	37.12	54	16.88
4824	22.86	AV	60	1.8	V	35.4	4.30	26.75	35.81	54	18.19
2390	48.89	PK	54	1.5	V	30.6	2.98	26.83	55.64	74	18.36
2390	27.60	AV	250	1.8	H	30.6	2.98	26.83	34.35	54	19.65
2390	27.35	AV	54	1.5	V	30.6	2.98	26.83	34.10	54	19.90
2390	47.22	PK	250	1.8	H	30.6	2.98	26.83	53.97	74	20.03
4824	38.83	PK	130	1.5	H	36.6	4.30	26.75	52.98	74	21.02
4824	38.38	PK	60	1.8	V	35.4	4.30	26.75	51.33	74	22.67
3216	40.18	PK	40	1.5	V	31.0	3.49	26.88	47.79	74	26.21
3216	38.46	PK	250	1.5	H	32.0	3.49	26.88	47.07	74	26.93
Middle Channel (2437 MHz)											
4874	22.88	AV	130	1.5	H	36.6	4.36	26.75	37.09	54	16.91
4874	22.68	AV	60	1.8	V	35.4	4.36	26.75	35.69	54	18.31
4874	38.72	PK	130	1.5	H	36.6	4.36	26.75	52.93	74	21.07
1696	46.83	PK	90	1.5	V	29.8	2.44	26.83	52.24	74	21.76
4874	38.86	PK	60	1.8	V	35.4	4.36	26.75	51.87	74	22.13
1696	45.76	PK	260	1.5	H	29.7	2.44	26.83	51.07	74	22.93
1696	20.36	AV	90	1.0	V	29.8	2.44	26.83	25.77	54	28.23
1696	20.40	AV	260	1.5	H	29.7	2.44	26.83	25.71	54	28.29
High Channel (2462 MHz)											
2483.6	52.80	PK	90	1.5	V	30.6	3.11	26.88	59.63	74	14.37
2483.6	50.91	PK	220	1.5	H	30.6	3.11	26.88	57.74	74	16.26
4924	23.12	AV	250	1.8	H	36.6	4.40	26.75	37.37	54	16.63
4924	22.75	AV	60	1.8	V	35.4	4.40	26.75	35.80	54	18.20
4924	39.08	PK	250	1.8	H	36.6	4.40	26.75	53.33	74	20.67
2483.6	26.33	AV	90	1.5	V	30.6	3.11	26.88	33.16	54	20.84
2483.6	25.67	AV	220	1.5	H	30.6	3.11	26.88	32.50	54	21.50
4924	38.87	PK	60	1.8	V	35.4	4.40	26.75	51.92	74	22.08
1732	46.33	PK	90	1.5	V	29.8	2.52	26.83	51.82	74	22.18
1732	46.06	PK	260	1.5	H	29.7	2.52	26.83	51.45	74	22.55
1732	20.44	AV	260	1.5	H	29.7	2.52	26.83	25.83	54	28.17
1732	20.03	AV	90	1.5	V	29.8	2.52	26.83	25.52	54	28.48

\*Within measurement uncertainty.

## **POWERLINE CONDUCTED EMISSIONS**

### **LIMIT**

For an intentional radiator which is designed to be connected to the public utility (AC) power Line, the radio frequency voltage that is conducted back onto the AC power Line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases Linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power Line (LINE and NEUTRAL) and ground at the power terminals.

### **MEASUREMENT UNCERTAINTY**

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, and LISN.

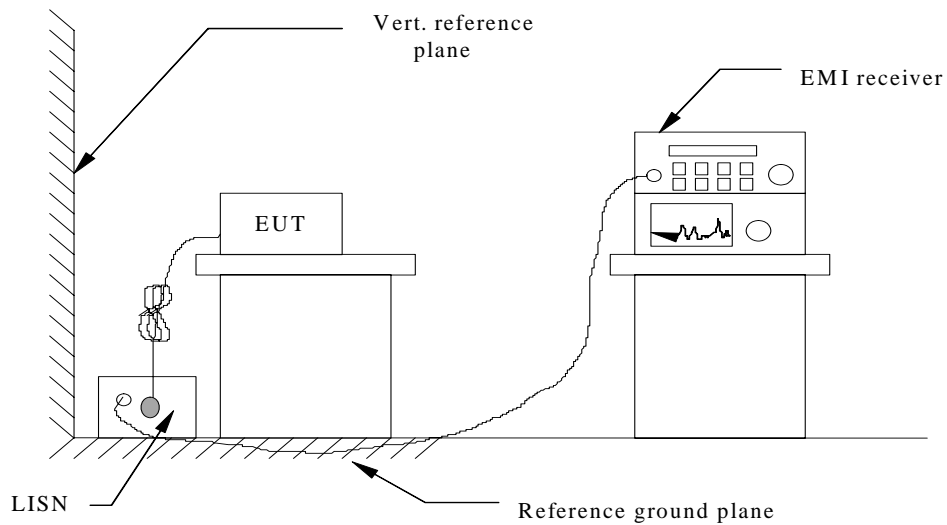
Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at ShenZhen Emtex Co.,Ltd is  $\pm 2.4$  dB.

### **MEASUREMENT EQUIPMENT USED**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	L.I.S.N.	ESH2-Z5	834549/006	2011-09-02	2012-09-01
Rohde & Schwarz	L.I.S.N.	ENV216	834548/112	2011-09-02	2012-09-01
Rohde & Schwarz	EMI Test Receiver	ESCS30	828985/018	2011-09-02	2012-09-01

**Remark:** Each piece of equipment is scheduled for calibration once a year.

## **Test Configuration**



See test photographs for the actual connections between EUT and support equipment.

## **TEST PROCEDURE**

During the conducted emission test, the adapter of laptop was connected to the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

## Test Data

### Environmental Conditions

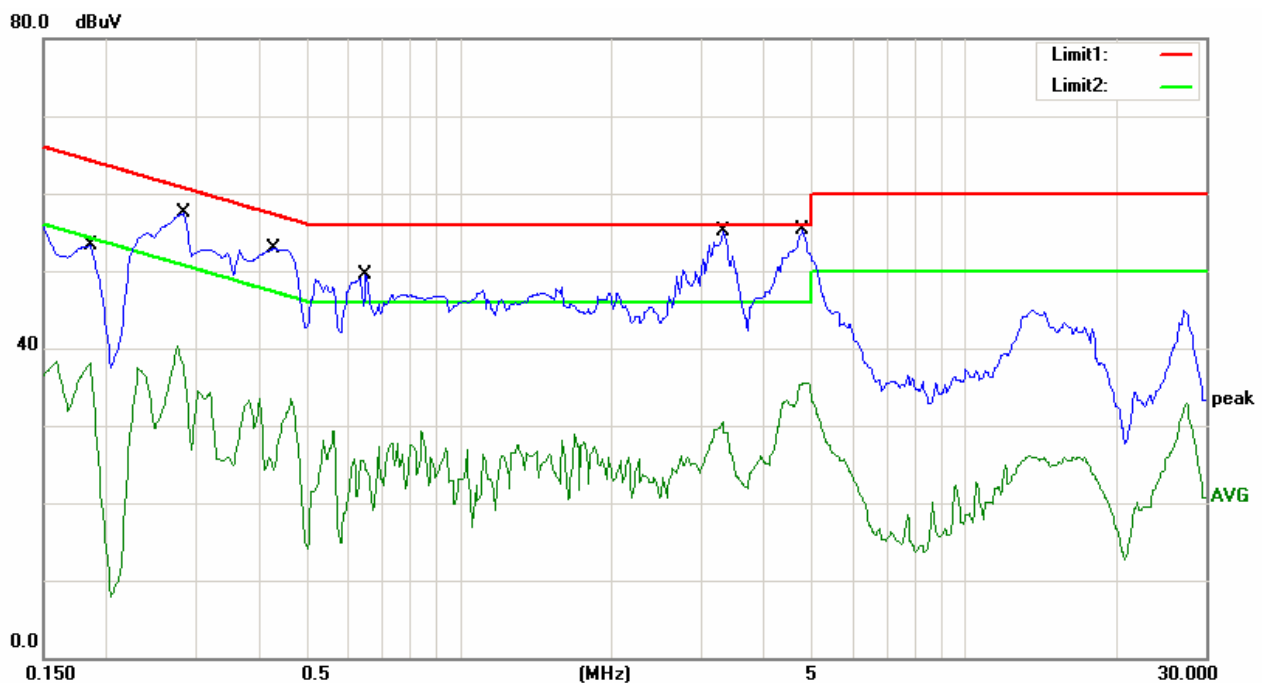
Temperature:	26 ° C
Relative Humidity:	48 %
ATM Pressure:	100.0 kPa

The testing was performed by Simon Mo on 2012-02-11.

Test Result: Pass

Test Mode: Transmitting (802.11b)

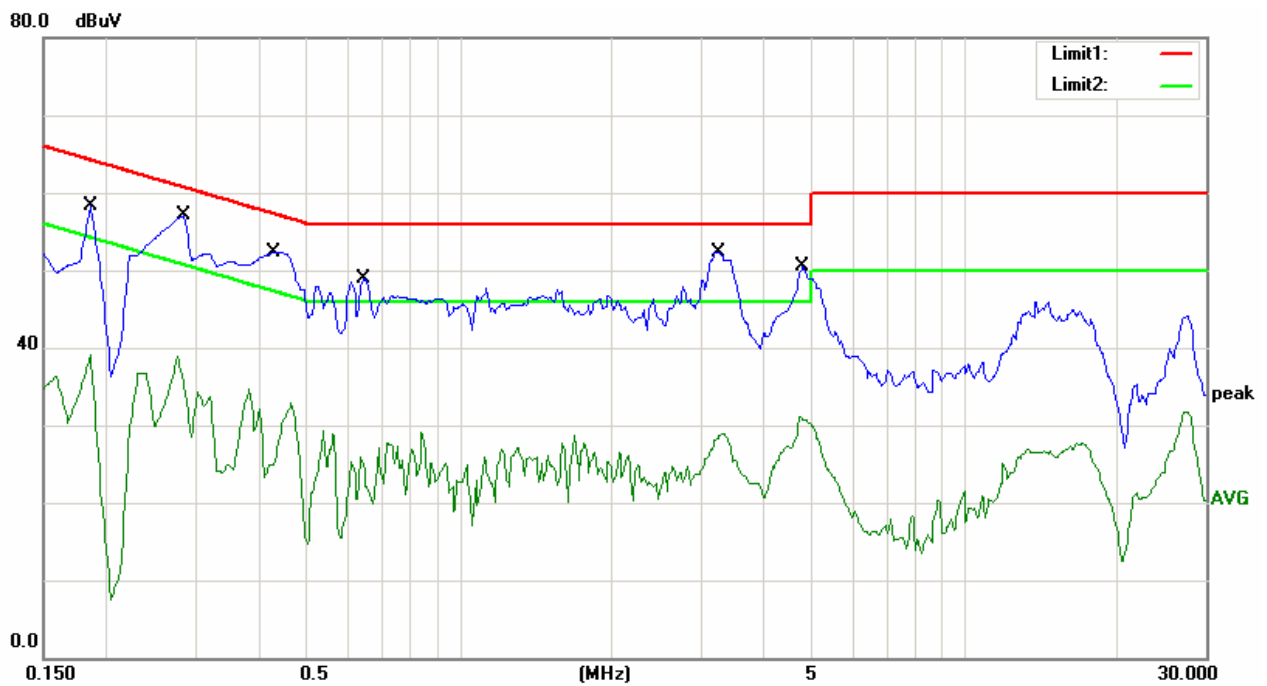
### AC 120 V/60 Hz, Line



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1860	41.52	10.10	51.62	64.21	12.59	QP
2	0.1860	28.14	10.10	38.24	54.21	15.97	AVG
3	0.2850	44.47	10.10	54.57	60.67	6.10	QP
4	0.2850	25.76	10.10	35.86	50.67	14.81	AVG
5	0.4290	39.74	10.10	49.84	57.27	7.43	QP
6	0.4290	16.32	10.10	26.42	47.27	20.85	AVG
7	0.6540	29.77	10.10	39.87	56.00	16.13	QP
8	0.6540	10.43	10.10	20.53	46.00	25.47	AVG
9	3.3360	35.34	10.20	45.54	56.00	10.46	QP
10	3.3360	17.75	10.20	27.95	46.00	18.05	AVG
11	4.7850	37.94	10.20	48.14	56.00	7.86	QP
12	4.7850	22.97	10.20	33.17	46.00	12.83	AVG



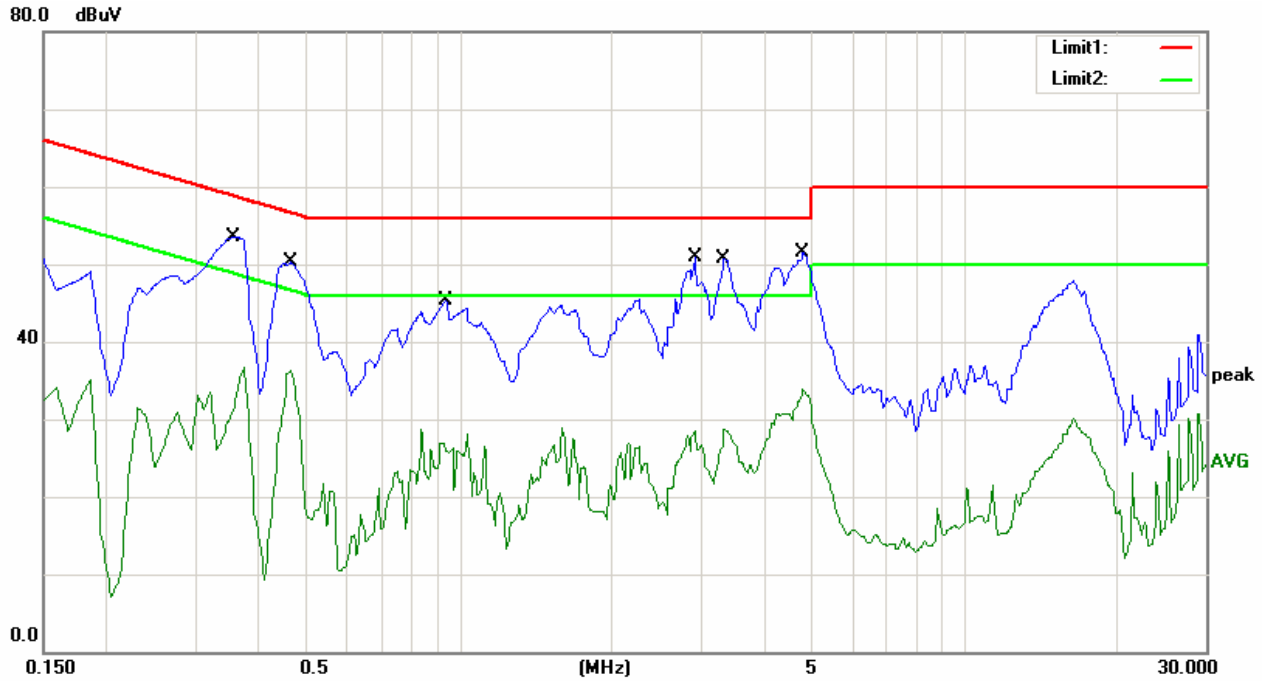
## AC 120 V/ 60 Hz, Neutral



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1860	44.75	10.10	54.85	64.21	9.36	QP
2	0.1860	29.08	10.10	39.18	54.21	15.03	AVG
3	0.2850	43.42	10.10	53.52	60.67	7.15	QP
4	0.2850	24.71	10.10	34.81	50.67	15.86	AVG
5	0.4290	38.69	10.10	48.79	57.27	8.48	QP
6	0.4290	15.16	10.10	25.26	47.27	22.01	AVG
7	0.6450	29.53	10.10	39.63	56.00	16.37	QP
8	0.6450	14.77	10.10	24.87	46.00	21.13	AVG
9	3.2730	35.58	10.20	45.78	56.00	10.22	QP
10	3.2730	17.77	10.20	27.97	46.00	18.03	AVG
11	4.7850	33.15	10.20	43.35	56.00	12.65	QP
12	4.7850	19.67	10.20	29.87	46.00	16.13	AVG

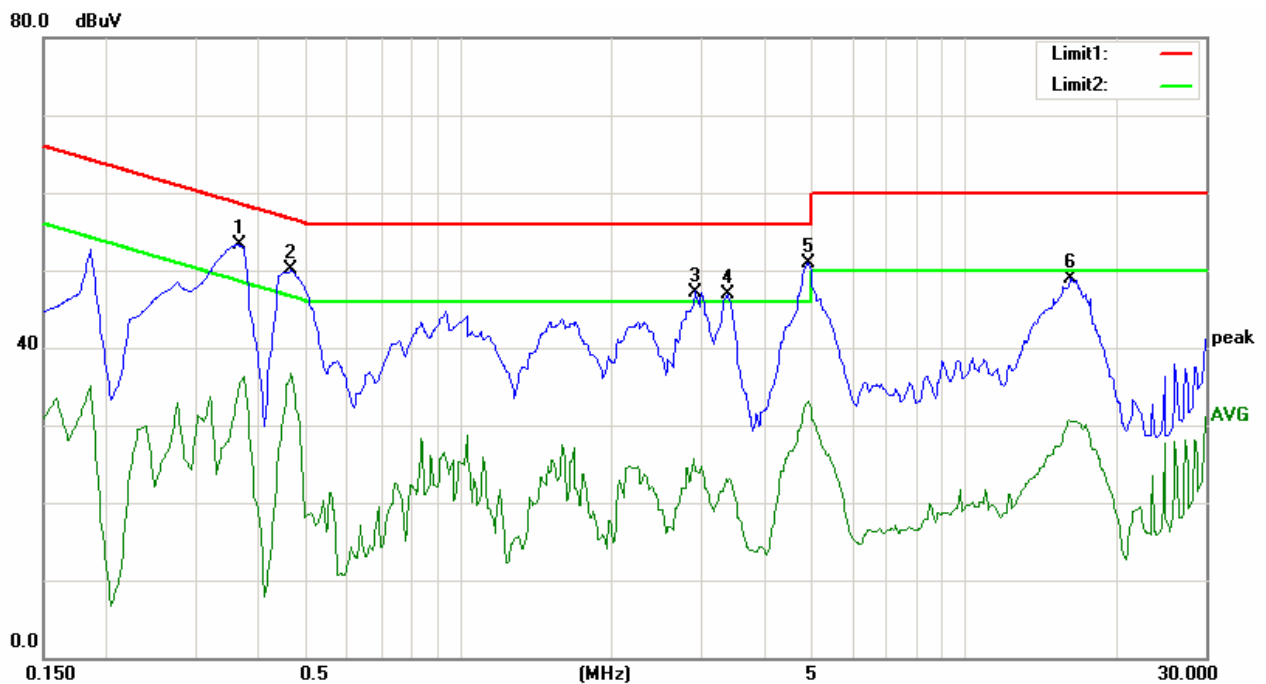
Test Mode: Transmitting (802.11g)

AC 120 V/60 Hz, Line



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.3569	40.76	10.10	50.86	58.80	7.94	QP
2	0.3569	20.53	10.10	30.63	48.80	18.17	AVG
3	0.4650	38.67	10.10	48.77	56.60	7.83	QP
4	0.4650	25.71	10.10	35.81	46.60	10.79	AVG
5	0.9419	33.34	10.10	43.44	56.00	12.56	QP
6	0.9419	15.96	10.10	26.06	46.00	19.94	AVG
7	2.9219	35.43	10.20	45.63	56.00	10.37	QP
8	2.9219	18.26	10.20	28.46	46.00	17.54	AVG
9	3.3450	34.76	10.20	44.96	56.00	11.04	QP
10	3.3450	17.07	10.20	27.27	46.00	18.73	AVG
11	4.7850	37.35	10.20	47.55	56.00	8.45	QP
12	4.7850	23.19	10.20	33.39	46.00	12.61	AVG

## AC 120 V/ 60 Hz, Neutral



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.3659	43.14	10.10	53.24	58.59	5.35	peak
2	0.4650	39.98	10.10	50.08	56.60	6.52	peak
3	2.9219	37.10	10.10	47.20	56.00	8.80	peak
4	3.3900	36.82	10.10	46.92	56.00	9.08	peak
5	4.9020	40.81	10.10	50.91	56.00	5.09	peak
6	16.2149	38.73	10.20	48.93	60.00	11.07	peak
7	0.3659	40.52	10.10	50.62	58.59	7.97	QP
8	0.3659	23.70	10.10	33.80	48.59	14.79	AVG
9	0.4650	38.65	10.10	48.75	56.60	7.85	QP
10	0.4650	25.45	10.10	35.55	46.60	11.05	AVG
11	2.9219	32.98	10.20	43.18	56	12.82	QP
12	2.9219	15.59	10.20	25.79	46	20.21	AVG
13	3.3900	31.19	10.20	41.39	56	14.61	QP
14	3.3900	13.97	10.20	24.17	46	21.83	AVG
15	4.9020	36.55	10.20	46.75	56	9.25	QP
16	4.9020	22.79	10.20	32.99	46	13.01	AVG
17	16.2149	32.09	10.20	42.29	60	17.71	QP
18	16.2149	19.91	10.20	30.11	50	19.89	AVG

## 9. ANTENNA REQUIREMENT

### APPLICABLE STANDARD

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### ANTENNA CONNECTOR CONSTRUCTION

### ANTENNA CONNECTOR CONSTRUCTION

The EUT use a dipole antenna which has a unique type of connector and the maximum antenna gain is 2.5dBi, which complies with the Part 15.203. Please see EUT photo for details.

**Result:** Compliant.