



## FCC PART 15.247

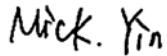
### MEASUREMENT AND TEST REPORT

For

**Shanghai KOHLER Electronics, Ltd.**

Building E, 18 Jindian road, Pudong New area, Shanghai, the PRC

**FCC ID: A2PSKE-KOHLER7421**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Hospitality Remote
<b>Test Engineer:</b> <u>Mick Yin</u> 	
<b>Report Number:</b> <u>RSZ120628001-00</u>	
<b>Report Date:</b> <u>2012-07-19</u>	
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**Note:** This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by NVLAP\*, NIST, or any agency of the Federal Government.

\* This report contains data that are not covered by the NVLAP accreditation and are marked with an asterisk “★” (Rev.2)

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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

The *Shanghai KOHLER Electronics, Ltd.* 's product, model number: *K-7421 (FCC ID: A2PSKE-KOHLER7421)* or the "EUT" as referred to in this report is a *Hospitality Remote*, which measures approximately: 13.1 cm (L) x 9.2 cm (W) x 3.5 cm (H), rated input voltage: DC 1.5V\*4 alkaline Battery.

*\* All measurement and test data in this report was gathered from production sample serial number: 1206116 (Assigned by BACL, Shenzhen). The EUT was received on 2012-06-28.*

### Objective

This type approval report is prepared on behalf of *Shanghai KOHLER Electronics, Ltd.* in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

### Related Submittal(s)/Grant(s)

N/A.

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

### Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located in the 6/F, the 3rd Phase of WanLi Industrial Building, Shihua Road, Futian Free Trade Zone Shenzhen, Guangdong, China.

Test site at Bay Area Compliance Laboratories Corp. (Shenzhen) 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 December 06, 2010. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2009.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 382179. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, Bay Area Compliance Laboratories Corp. (Shenzhen) is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200707-0).



The current scope of accreditations can be found at <http://ts.nist.gov/Standards/scopes/2007070.htm>

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

For Zigbee mode, 16 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2405	9	2445
2	2410	10	2450
3	2415	11	2455
4	2420	12	2460
5	2425	13	2465
6	2430	14	2470
7	2435	15	2475
8	2440	16	2480

EUT was tested with Channel 1 Channel 8 and Channel 16.

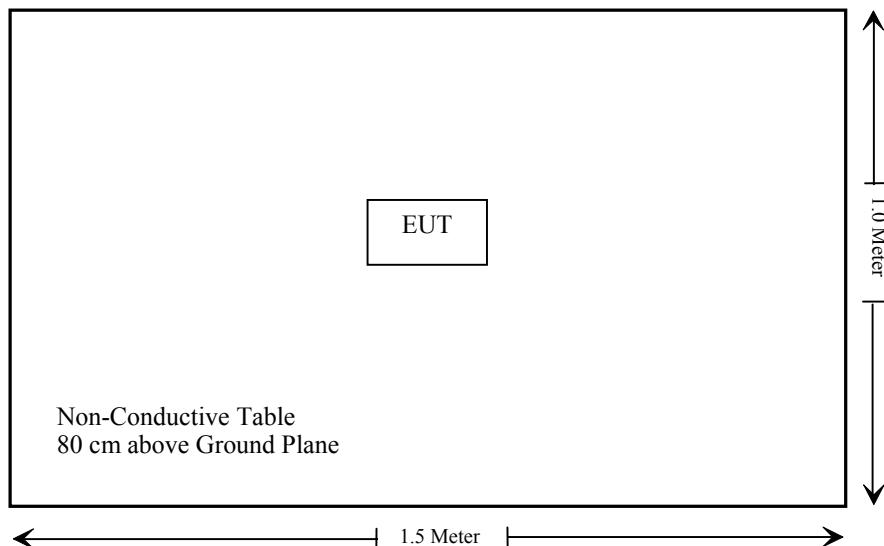
### EUT Exercise Software

No Exercise Software.

### Equipment Modifications

No modification was made to the unit tested.

### Block Diagram of Test Setup



## SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §2.1093	RF exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a),	Conducted Emissions	N/A*
§15.247(d)	Spurious Emissions at Antenna Port	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Bandwidth	Compliance
§15.247(b)(3)	Maximum Peak Output Power	Compliance
§15.247(d)	100kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

Note: EUT is powered by battery only.

**§15.247 (i) and §1.1307 (b) (1), §2.1093 – RF EXPOSURE****Applicable Standard**

According to FCC §15.247 (i) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See §1.1307(b)(1) of this chapter.

According to KDB 447498 D01 Mobile Portable RF Exposure v04 1) c): Unless excluded by specific FCC test procedures, portable devices with output power  $> 60/f$  (GHz) mW shall include SAR data for equipment approval.

**RF Exposure Evaluation**

Max Peak output power: 2480 MHz:  $7.25 \text{ dBm} = 5.309 \text{ mW}$   
SAR exclusion threshold  $= 60/f(\text{GHz}) = 60/2.48 = 24.19 \text{ mW}$   
The Max peak output power of EUT is less than 24.19 mW.

**So the SAR measurement is not necessary.**

## **FCC §15.203 - 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**

This product has an integral FPC antenna with gain 2.5 dBi arrangement which was soldered on PCB, fulfill the requirement of this section, and please refer to the internal photos.

**Result:** Compliance.

## FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

### Applicable Standard

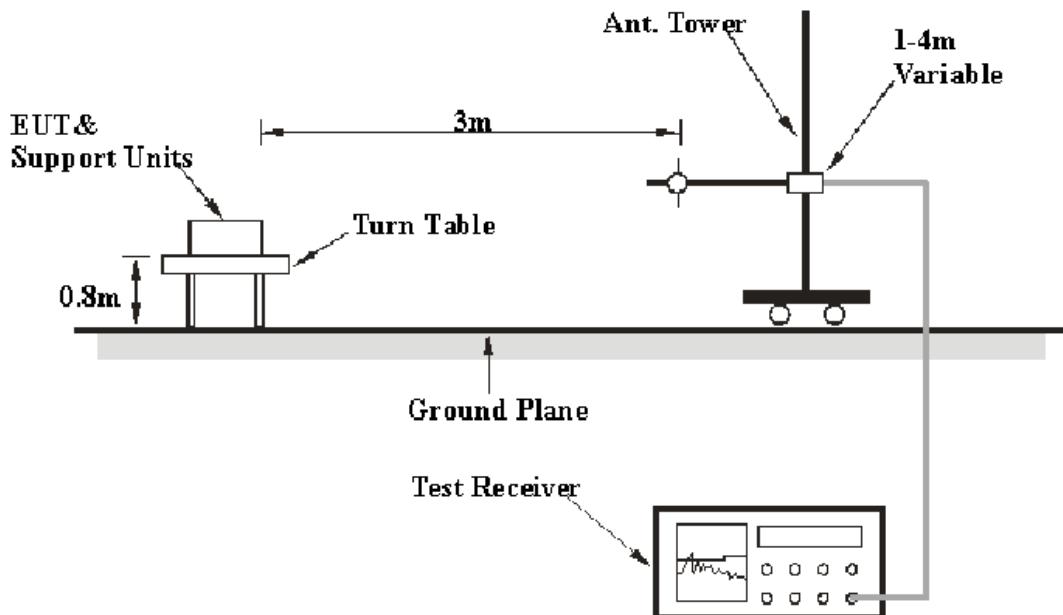
FCC §15.247 (d); §15.209; §15.205;

### 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 CISPR 16-4-4, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at Bay Area Compliance Laboratories Corp. (Shenzhen) is 4.0 dB( $k=2$ , 95% level of confidence) .

### EUT Setup



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.4-2009. 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.

## 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:

Frequency Range	RBW	Video B/W	Detector
30MHz – 1000 MHz	100 kHz	300 kHz	QP
1000 MHz – 25 GHz	1 MHz	3 MHz	PK
1000 MHz – 25 GHz	1 MHz	10 Hz	Ave.

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	Amplifier	HP8447D	2944A09795	2011-11-24	2012-11-23
Rohde & Schwarz	EMI Test Receiver	ESCI	101122	2011-11-17	2012-11-16
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2012-03-17	2013-03-16
Mini-Circuits	Amplifier	ZVA-213+	T-E27H	2012-03-08	2013-03-08
Sunol Sciences	Horn Antenna	DRH-118	A052304	2011-12-01	2012-11-30
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2011-11-24	2012-11-23
the electro-Mechanics Co.	Horn Antenna	3116	9510-2270	2011-10-14	2012-10-13
R&S	Auto test Software	EMC32	V6.30	-	-

**\* Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

## Test Procedure

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-1 GHz and peak and Average detection modes for frequencies above 1 GHz.

## 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 Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247, with the worst margin reading of:

**7.32 dB at 2483.8 MHz** in the **Vertical** polarization

## Test Data

### Environmental Conditions

<b>Temperature:</b>	25 ° C
<b>Relative Humidity:</b>	56 %
<b>ATM Pressure:</b>	100.0 kPa

*The testing was performed by Mick Yin on 2012-06-29.*

*Test Mode: Transmitting*

## 30 MHz-25 GHz

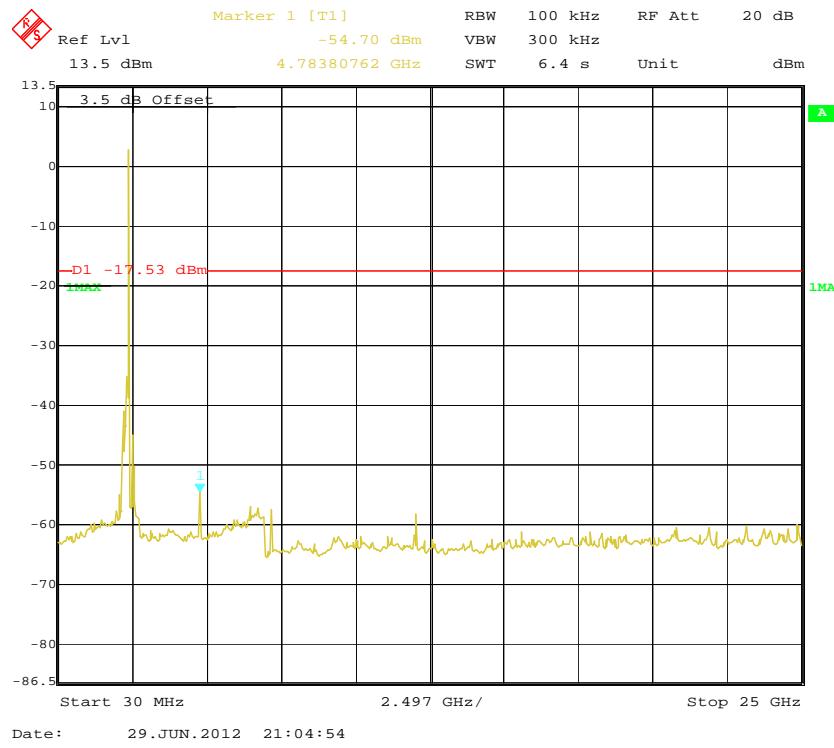
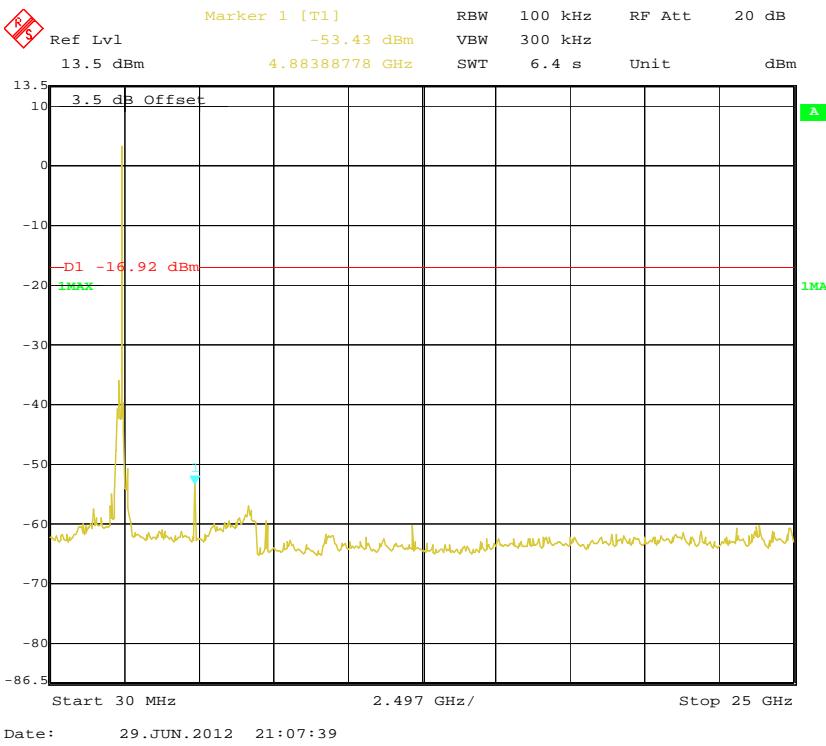
Indicated		Detector (PK/QP/Ave.)	Table Angle Degree	Antenna		Correction Factor			FCC Part 15.247/15.205/15.209		
Frequency (MHz)	S.A. Reading (dB $\mu$ V)			Height (m)	Polar (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord. Amp. (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
Low Channel (2405 MHz)											
2405	81.35	PK	31	1.2	V	29.6	3.03	26.50	87.48	N/A	N/A
2405	48.52	Ave.	31	1.2	V	29.6	3.03	26.50	54.65	N/A	N/A
9620	32.05	PK	241	1.2	V	39.8	5.98	26.50	51.33	67.48	16.15
7215	32.93	PK	177	1.1	V	37.9	5.22	26.50	49.55	67.48	17.93
2397.5	47.99	PK	35	1.3	V	29.6	3.03	26.50	54.12	74.00	19.88
2341.6	45.25	PK	224	1.3	V	29.0	2.98	26.50	50.73	74.00	23.27
4810	37.43	PK	177	1.1	H	34.6	4.3	26.50	49.83	74.00	24.17
2397.5	21.46	Ave.	178	1.2	V	29.6	3.03	26.50	27.59	54.00	26.41
2498.6	35.17	PK	86	1.0	V	30.8	3.29	26.50	42.76	74.00	31.24
Middle Channel (2440 MHz)											
2440	81.95	PK	45	1.3	V	30.2	3.11	26.50	88.76	N/A	N/A
2440	48.13	Ave.	45	1.3	V	30.2	3.11	26.50	54.94	N/A	N/A
9760	31.89	PK	35	1.2	V	39.8	6.10	26.50	51.29	68.76	17.47
4880	39.01	PK	134	1.3	H	34.6	4.36	26.50	51.47	74.00	22.53
2375.1	42.78	PK	36	1.1	V	29.6	3.03	26.50	48.91	74.00	25.09
7320	31.64	PK	34	1.1	H	37.9	5.09	26.50	48.13	74.00	25.87
2311.6	41.77	PK	78	1.2	V	29.0	2.98	26.50	47.25	74.00	26.75
2483.1	34.89	PK	224	1.0	V	30.2	3.11	26.50	41.70	74.00	32.30
High Channel (2480 MHz)											
2480	81.14	PK	34	1.1	V	29.6	3.03	26.50	87.27	N/A	N/A
2480	48.11	Ave.	34	1.1	V	29.6	3.03	26.50	54.24	N/A	N/A
2483.8	59.87	PK	114	1.2	V	30.2	3.11	26.50	66.68	74.00	7.32
2487.5	51.12	PK	247	1.1	H	30.6	3.11	26.50	58.33	74.00	15.67
9920	31.78	PK	96	1.3	V	39.8	6.08	26.50	51.16	67.27	16.11
2483.8	30.65	Ave.	114	1.2	V	30.2	3.11	26.50	37.46	54.00	16.54
2487.5	27.32	Ave.	247	1.1	H	30.6	3.11	26.50	34.53	54.00	19.47
7440	34.56	PK	28	1.2	V	37.2	5.20	26.50	50.46	74.00	23.54
4960	36.83	PK	154	1.2	V	34.6	4.40	26.50	49.33	74.00	24.67
2351.7	42.67	PK	25	1.3	H	29.0	2.98	26.50	48.15	74.00	25.85

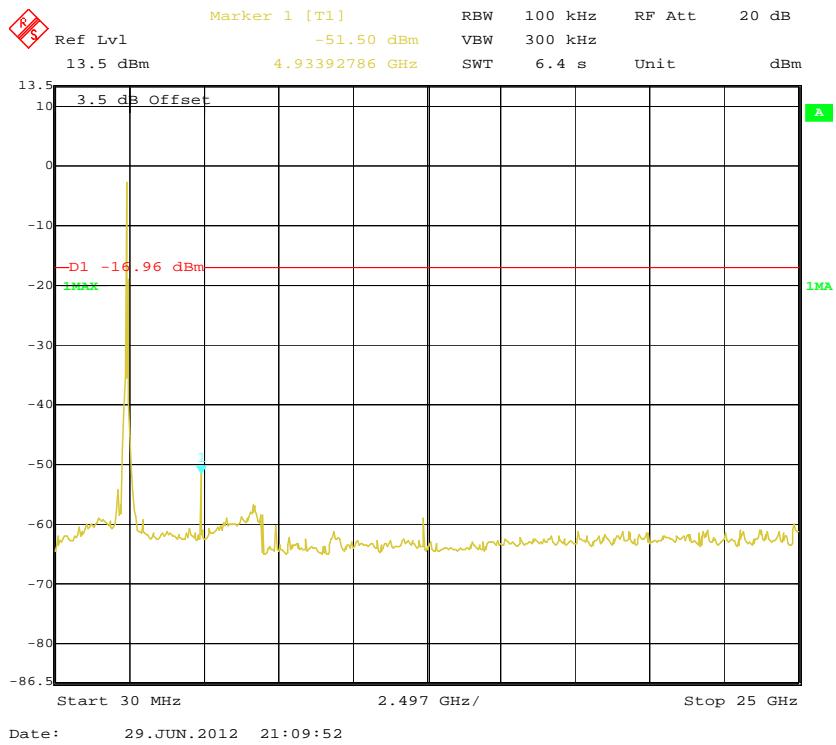
Corrected Amplitude = Receiver Reading + Cable loss + Antenna Factor – Amplifier Gain

Margin = Limit- Corr. Amplitude

Note 1: For 30 MHz -1 GHz, all spurious emissions which below the limit 20 dB or on the system noise floor level are not recorded.

Note 2: For above 1 GHz, if the peak (or quasi-peak) measured value complied with the average limit, it is unnecessary to perform an average measurement.

**Antenna Port Conducted Spurious Emissions:****Low Channel****Middle Channel**

**High Channel**

## FCC §15.247(a) (2) – 6 dB BANDWIDTH TESTING

### Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

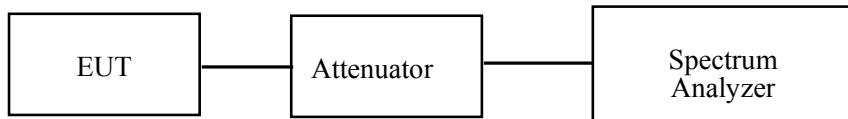
### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101122	2011-11-17	2012-11-16

**\* Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

### 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 it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.



### Test Data

#### Environmental Conditions

Temperature:	25 °C
Relative Humidity:	56%
ATM Pressure:	100.0kPa

The testing was performed by Mick Yin on 2012-07-18.

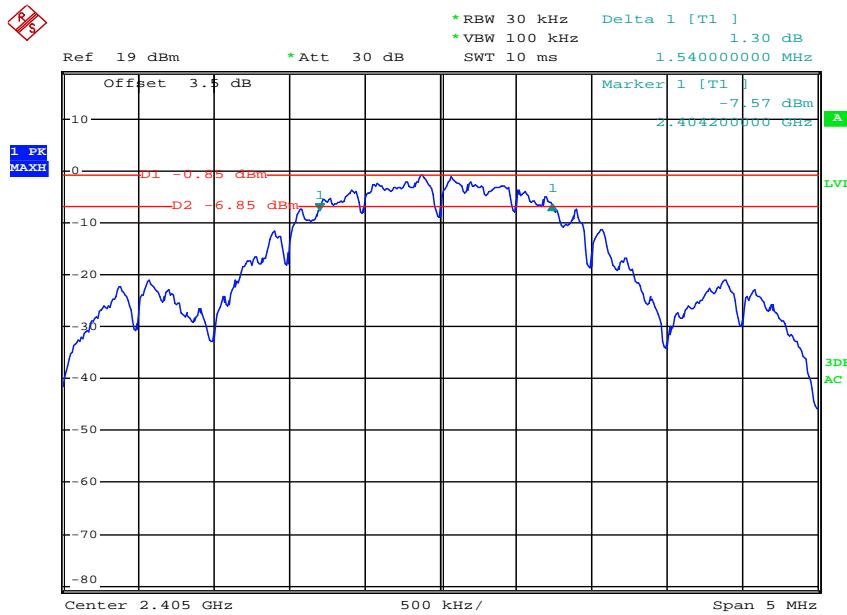
Test Mode: Transmitting

**Test Result:** Pass.

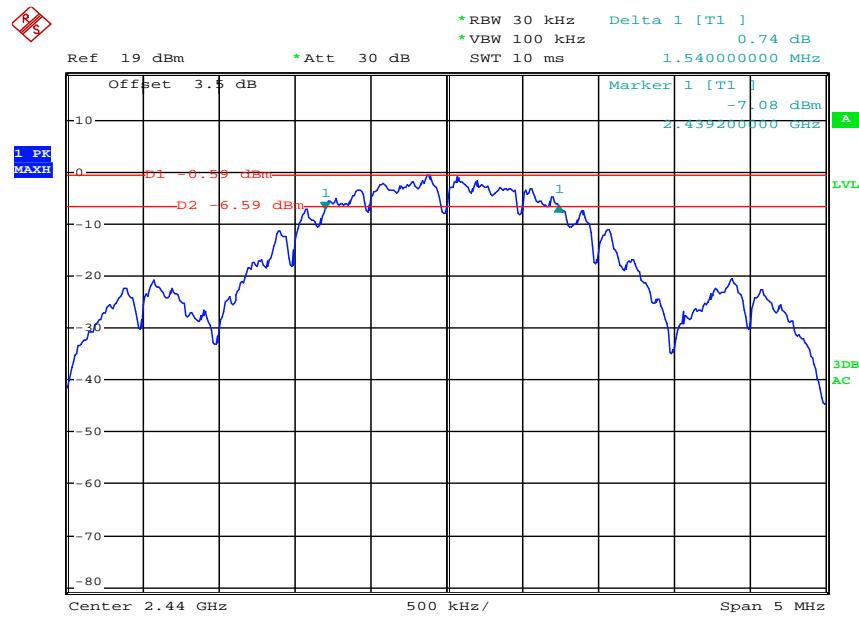
Please refer to the following tables and plots.

Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
Low	2405	1.54	≥500	Pass
Middle	2440	1.54	≥500	Pass
High	2480	1.54	≥500	Pass

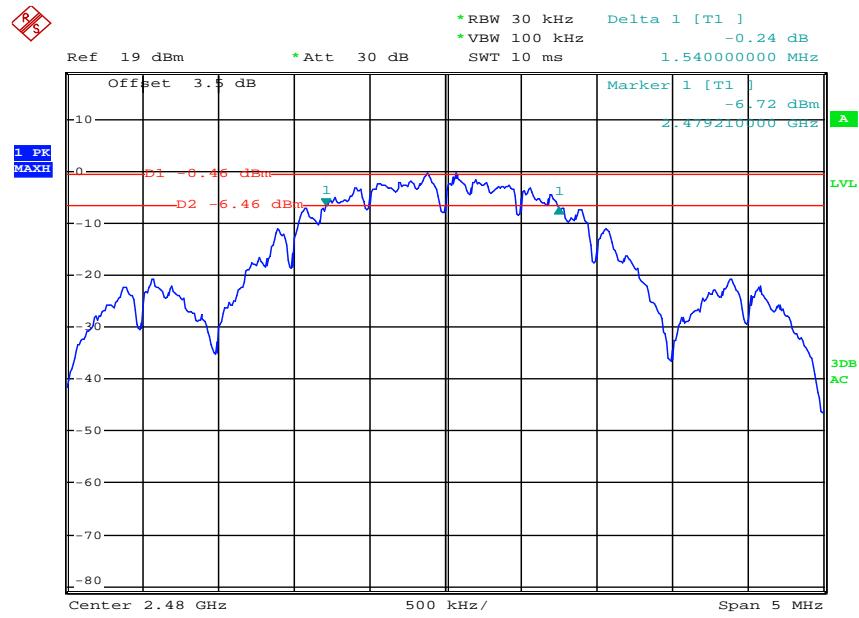
### Low Channel



Date: 18.JUL.2012 21:43:26

**Middle Channel**

Date: 18.JUL.2012 21:44:10

**High Channel**

Date: 18.JUL.2012 21:45:17

## FCC §15.247(b) (3) - MAXIMUM PEAK OUTPUT POWER

### Applicable Standard

According to §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

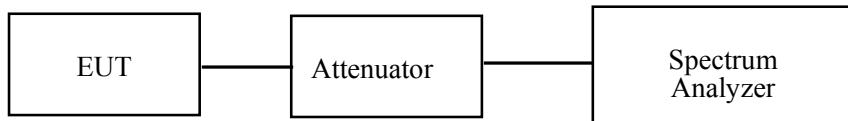
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Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101122	2011-11-17	2012-11-16

**\* Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

### 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

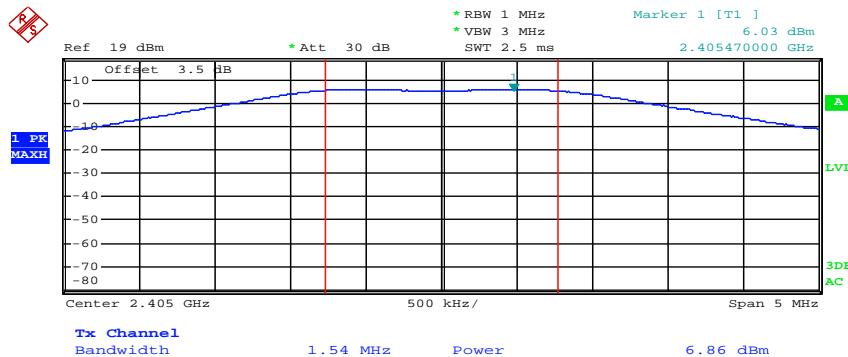
Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.0 kPa

The testing was performed by Mick Yin on 2012-07-18.

Test Mode: Transmitting

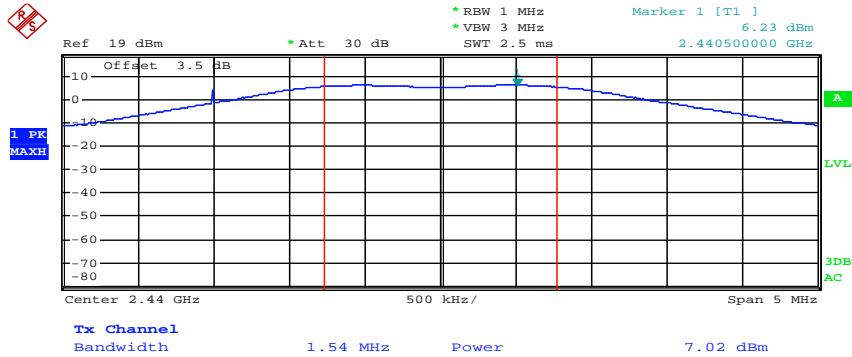
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (mW)	Limit (dBm)	Result
Low	2405	6.86	4.85	30	Pass
Middle	2440	7.02	5.04	30	Pass
High	2480	7.25	5.31	30	Pass

### RF Output Power, Low Channel



Date: 18.JUL.2012 23:47:50

## RF Output Power, Middle Channel



Date: 18.JUL.2012 23:48:08

## RF Output Power, High Channel



Date: 18.JUL.2012 23:48:27

## FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

### Applicable Standard

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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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) (see §15.205(c)).

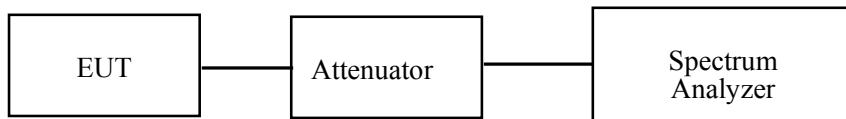
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Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101122	2011-11-17	2012-11-16

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

### 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

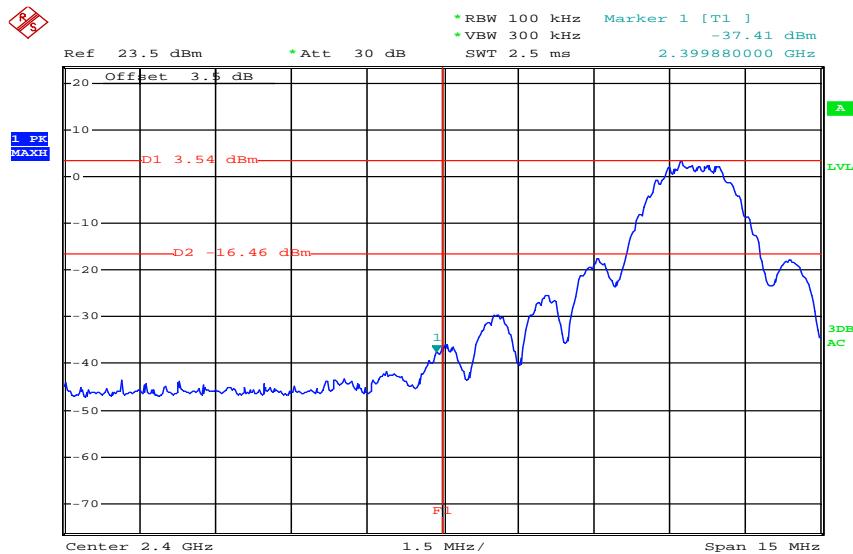
Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.0 kPa

The testing was performed by Mick Yin on 2012-06-29.

*Test Mode: Transmitting*

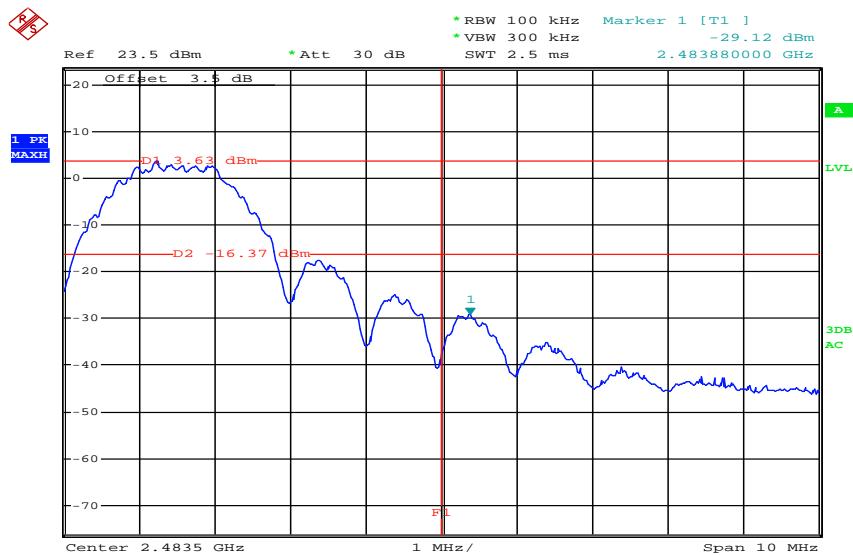
*Test Result: Compliance. Please refer to following plots.*

### Band Edge, Left Side



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### Band Edge, Right Side



Date: 29.JUN.2012 15:28:05

## FCC §15.247(e) - POWER SPECTRAL DENSITY

### Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

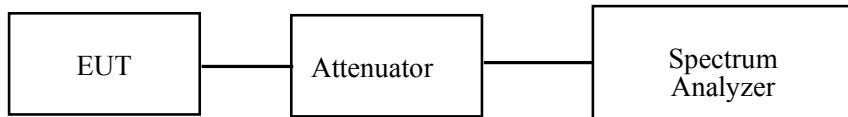
### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCI	101122	2011-11-17	2012-11-16

\* **Statement of Traceability:** Bay Area Compliance Lab Corp. (Shenzhen) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

### Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 100 kHz.
3. Set the VBW  $\geq$  300 kHz.
4. Set the span to 5-30 % greater than the EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
10. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where  $BWCF = 10\log(3\text{ kHz}/100\text{ kHz}) = -15.2\text{ dB}$ .
11. The resulting peak PSD level must be  $\leq 8\text{ dBm}$ .



### Test Data

#### Environmental Conditions

Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.0 kPa

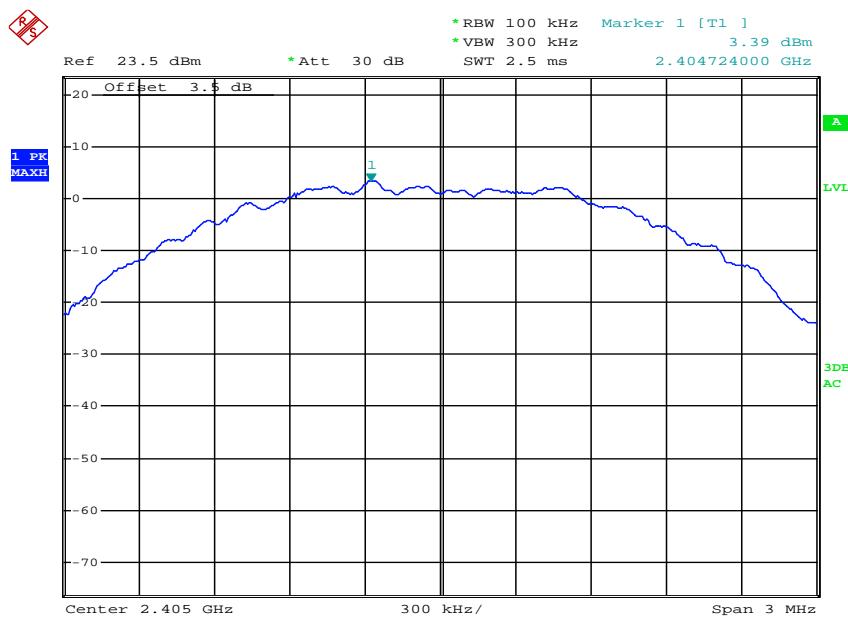
The testing was performed by Mick Yin on 2012-06-29.

Test Mode: Transmitting

Test Result: Pass

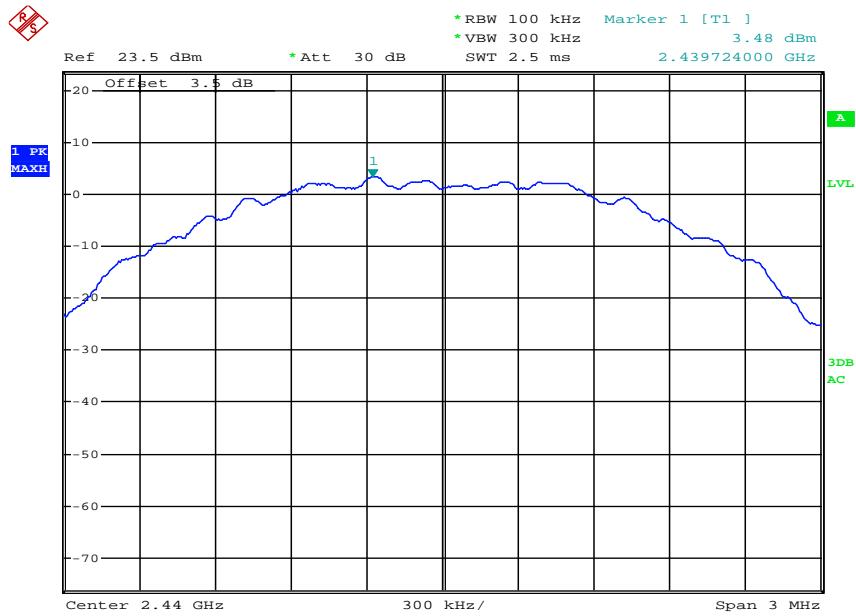
Channel	Frequency (MHz)	Power spectral density (dBm/100kHz)	BWCF (dB)	Power spectral density (dBm/3kHz)	Limit (dBm/3kHz)
Low	2405	3.39	-15.2	-11.81	8
Middle	2440	3.48	-15.2	-11.72	8
High	2480	3.58	-15.2	-11.62	8

### Power Spectral Density, Low Channel



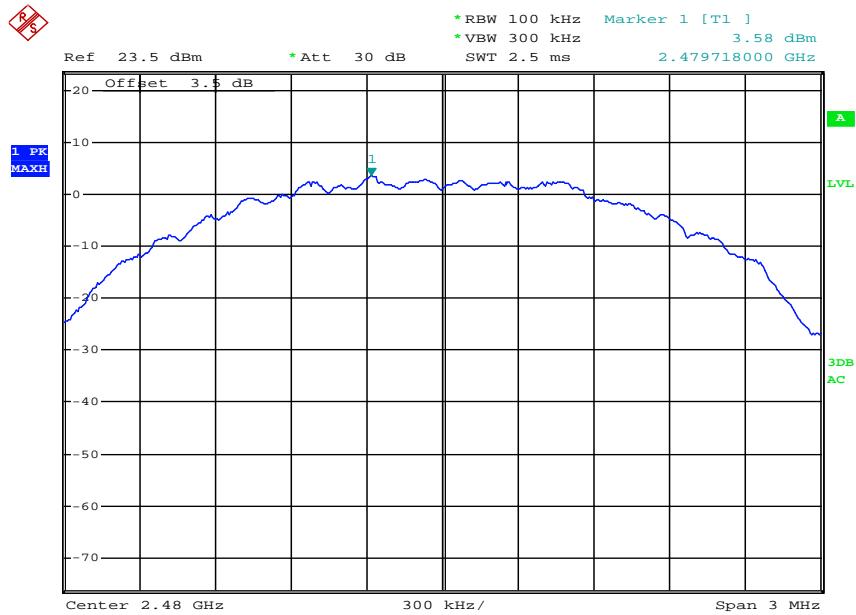
Date: 29.JUN.2012 15:12:28

## Power Spectral Density, Middle Channel



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## Power Spectral Density, High Channel



Date: 29.JUN.2012 15:15:26

\*\*\*\*\* END OF REPORT \*\*\*\*\*