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## CERTIFICATION TEST REPORT

**Report Number:** 2009 11137867 FCC 15.247

**Project Number:** 36382

**Nex Number:** 137867

**Applicant:** CALAMP CORP (MN)  
117 PEAVY CIRCLE  
Chaska, MN 55318


**Equipment Under Test (EUT):** TRANSCEIVER MODULE

**Model:** WPAN

**FCC ID:** J26-500005

**In Accordance With:** FCC Part 15 Subpart C, 15.247

**Tested By:** Nemko USA Inc.  
11696 Sorrento Valley Road, Suite F  
San Diego, CA 92121

**Authorized By:**   
Alan Laudani, EMC/RF Test Engineer

**Date:** November 9, 2009

**Total Number of Pages:** 51



## **Section1: Summary of Test Results**

### **General**

#### **All measurements are traceable to national standards**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15; Subpart C. Radiated tests were conducted in accordance with ANSI C63.4-2003. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC and IC.

The assessment summary is as follows:

<b>Apparatus Assessed:</b>	Transceiver Module
<b>Model:</b>	WPAN
<b>Specification:</b>	FCC Part 15 Subpart C, 15.247
<b>Date Received in Laboratory:</b>	November 2, 2009
<b>Compliance Status:</b>	Complies
<b>Exclusions:</b>	None
<b>Non-compliances:</b>	None





### 1.1 Report Release History

REVISION	DATE	COMMENTS
-	November 9, 2009	Prepared By: Ferdinand Custodio
-	November 9, 2009	Initial Release: Alan Laudani


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Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025.

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TESTED BY:   
Ferdinand Custodio, EMC Test Engineer

Date: November 9, 2009



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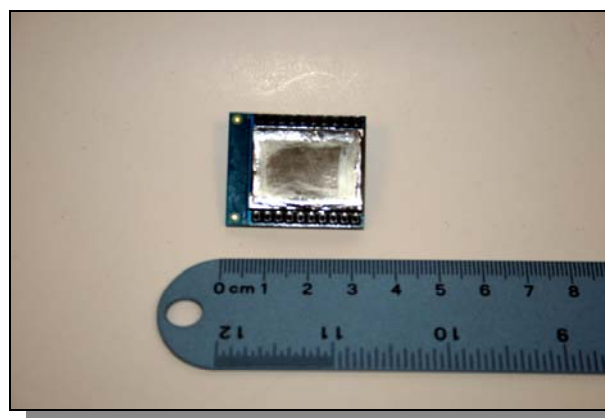
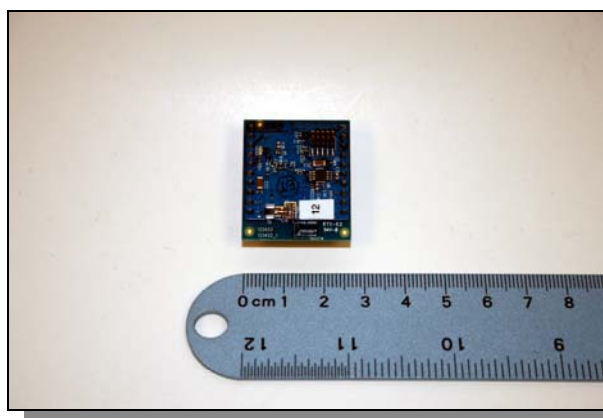


## Section 2: Equipment Under Test

### 2.1 Product Identification

The Equipment Under Test was indentified as follows:

*CalAmp Corp (MN) WPAN Transceiver Module*



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### 2.2 Samples Submitted for Assessment

The following sample of the apparatus has been submitted for type assessment:

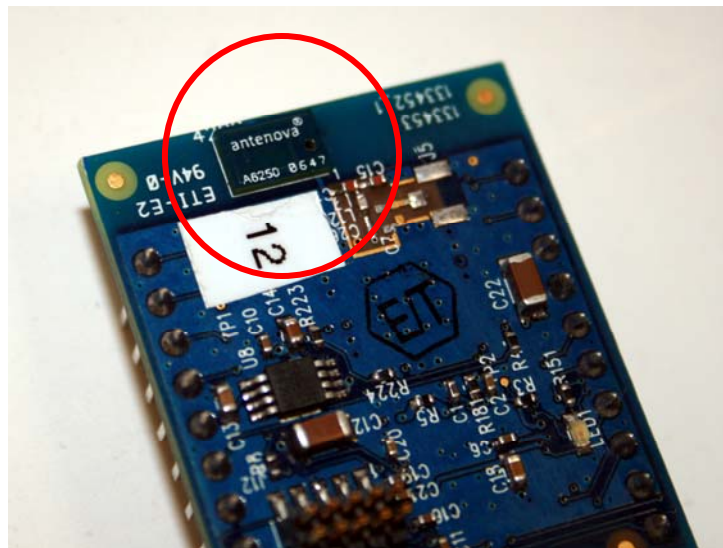
Sample No.	Description	Serial No.
137867-1	WPAN with internal antenna	N/A
137867-2	WPAN with external antenna	N/A



### 2.3 Antenna used during Assessment



**External Antenna type:** Pulse W1010 (equivalently W1030) Wireless External Antenna for 2.4 GHz Application (2dBi gain)



**Internal Antenna type:** Antennova Impexa 2.4 GHz SMD Antenna (0.9dBi gain).



## 2.4 Theory of Operation

The WPAN is a Transceiver Module. The EUT provides short range wireless communication between a coordinator and multiple end devices. The WPAN module is based on the IEEE 802.15.4 standard and can act as the coordinator, router or end device in the network. Its function is to collect data from and provide control for, third party remote devices.

The WPAN Module's modular design, small form factor, and flexible communication interface allow it to be easily integrated into multiple end devices.

The WPAN Module was exercised by running the Ember Rangetest Application. The Rangetest Application allows the user to change the channel and power of the module while outputting a constant tone for the purpose of transceiver testing. For this test, the WPAN transceiver was set to output at max transmit power.





## 2.5 Technical Specifications of the EUT

<b>Manufacturer:</b>	CalAmp Corp (MN)
<b>Operating Frequency:</b>	2405 MHz to 2470 MHz in the 2400-2483.5 MHz Band (Channel 11 to 24)
<b>Number of Operating Frequencies:</b>	14
<b>Rated Power:</b>	78.88 mW
<b>Modulation:</b>	802.15.4 Standard Compliant
<b>Antenna Connector:</b>	U.FL
<b>Power Source:</b>	5VDC (External Power Supply Nemko Asset # 936 or direct from the Test Board provided to control the EUT, the board is powered by 5VDC from an AC adapter supplying 5VDC through a USB connector)

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## **Section 3: Test Conditions**

### **3.1 Specifications**

The apparatus was assessed against the following specifications:

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

Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz

### **3.2 Deviations From Laboratory Test Procedures**

No deviations from Laboratory Test Procedure

### **3.3 Test Environment**

All tests were performed under the following environmental conditions:

Temperature range	18 – 24 °C
Humidity range	49-70 %
Pressure range	87 – 101.2 kPa
Power supply range	4.25 VDC to 5.75VDC



### 3.4 Test Equipment

Nemko ID	Device	Manu.	Model	Serial Number	Cal Date	Cal Due Date
911	Spectrum Analyzer	Agilent	E4440A	US41421266	11/6/2008	11/6/2009
835	Spectrum Analyzer	Rohde & Schwarz	RHDFSEK	829058/005	3/31/2009	3/31/2010
946	Peak Power Sensor	HP	84815A 0.05-18GHz (-40 to 20dBm)	3318A01726	9/16/2009	9/16/2010
947	Peak Power Analyzer	HP	8991A	3621A00906	9/16/2009	9/16/2010
114	Antenna, Bicon	EMCO	3104	2997	2/10/2009	2/10/2010
110	Antenna, LPA	Electrometrics	LPA-25	1217	1/10/2009	2/10/2011
877	Antenna, DRG Horn, .7-18GHz	AH Systems	SAS-571	688	7/28/2008	7/28/2010
317	Preamplifier	HP	8449A	2749A00167	4/16/2009	4/16/2010
746	Signal Generator	HP	8648B	3642U1905	1/22/2009	1/22/2010
674	Spectrum Analyzer	HP	8568B	2007A00910	4/15/2009	4/15/2010
675	Spectrum Analyzer Display	HP	85662A	2005A01282	4/15/2009	4/15/2010
676	Quasi-Peak Adapter	HP	85650A	2430A00576	4/15/2009	4/15/2010
681	Transient Limiter	HP	11947A	3107A02634	10/9/2009	10/9/2010
805	LISN	Solar	9348-50-R-24-BNC	992823	1/21/2009	1/21/2010
564	High Pass Filter	Solar	7801-5.0	853130	8/14/2009	8/14/2010
936	DC Power Supply 0-50V 0-10A 200W	Hewlett Packard	6002A	unreadable	NCR	NCR
815	Multimeter	Fluke	111	78130066	8/4/2009	8/4/2010

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Registration of the OATS are on file with the Federal Communications Commission, under Registration Number 90579, the VCCI under registration number R-3027, and are also registered with Industry Canada under Site Numbers 2040B-1 and 2040B-2.



## **Section 4: Observations**

### **4.1 Modifications Performed During Assessment**

No modifications were performed during assessment.

### **4.2 Record Of Technical Judgements**

No technical judgements were made during the assessment.

### **4.3 EUT Parameters Affecting Compliance**

The user of the apparatus could not alter parameters that would affect compliance.

### **4.4 Test Deleted**

No Tests were deleted from this assessment.

### **4.5 Additional Observations**

There were no additional observations made during this assessment.





## Section 5: Results Summary

This section contains the following:

FCC Part 15 Subpart C:

The column headed “Required” indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

N No: not applicable / not relevant

Y Yes: Mandatory i.e. the apparatus shall conform to these tests.

N/T Not Tested, mandatory but not assessed. (See section 4.4 Test deleted)

The results contained in this section are representative of the operation of the apparatus as originally submitted.

### 5.1 Test Results

Part 15C	Test Description	Required	Result
15.207 (a)	Conducted Emission Limit	Y	Pass
15.215(c)	20 dB Bandwidth	Y	Pass
15.247(a)(2)	Minimum 6dB RF Bandwidth	Y	Pass
15.247(b)(3)	Peak Output Power	Y	Pass
15.247(d)	Band-edge Compliance of RF Conducted Emissions	Y	Pass
15.247 (d)	Spurious RF Conducted Emissions	Y	Pass
15.247 (d)	Spurious Radiated Emissions	Y	Pass
15.247(e)	Power Spectral Density for Digitally Modulated Devices	Y	Pass





## Appendix A: Test Results

### Section 15.207(a) – Power Line Conducted Emissions

15.207(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that 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 the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

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

\*Decreases with the logarithm of the frequency.

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#### Test Conditions:

<b>Sample Number:</b>	WPAN	<b>Temperature:</b>	24°C
<b>Date:</b>	November 4, 2009	<b>Humidity:</b>	49 %
<b>Modification State:</b>	High Channel	<b>Tester:</b>	FSCustodio
		<b>Laboratory:</b>	Shield Room #1

#### Test Results:

See attached plots.

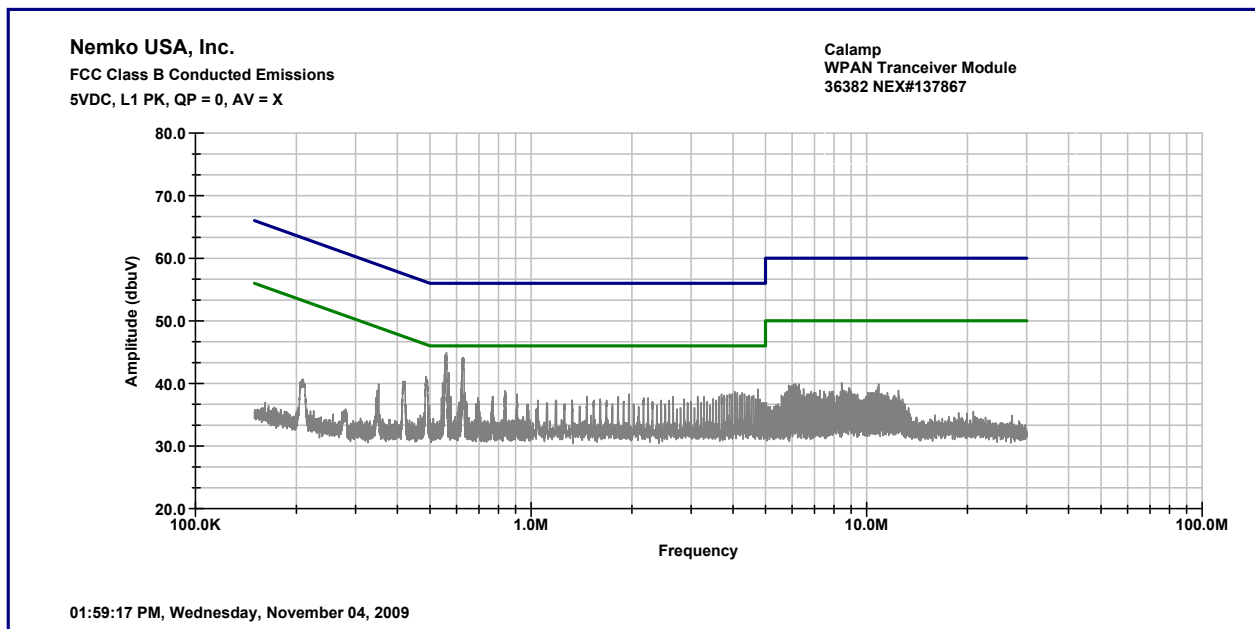
#### Additional Observations:

- Test parameters: Peak RBW/VBW is 100kHz/100kHz, Quasi-Peak and Average is 9kHz/30kHz.
- Blue line is Quasi Peak limit while green line is Average limit.
- ○ represents quasi peak measurement while X represent average measurement. However no such measurements were performed because the Peak measurements are below the Average limits.
- Test was performed using worst case configuration base from power measurements (Section 15.247(b)(3)).
- Once configured and transmitting, the EUT was disconnected from the test board.

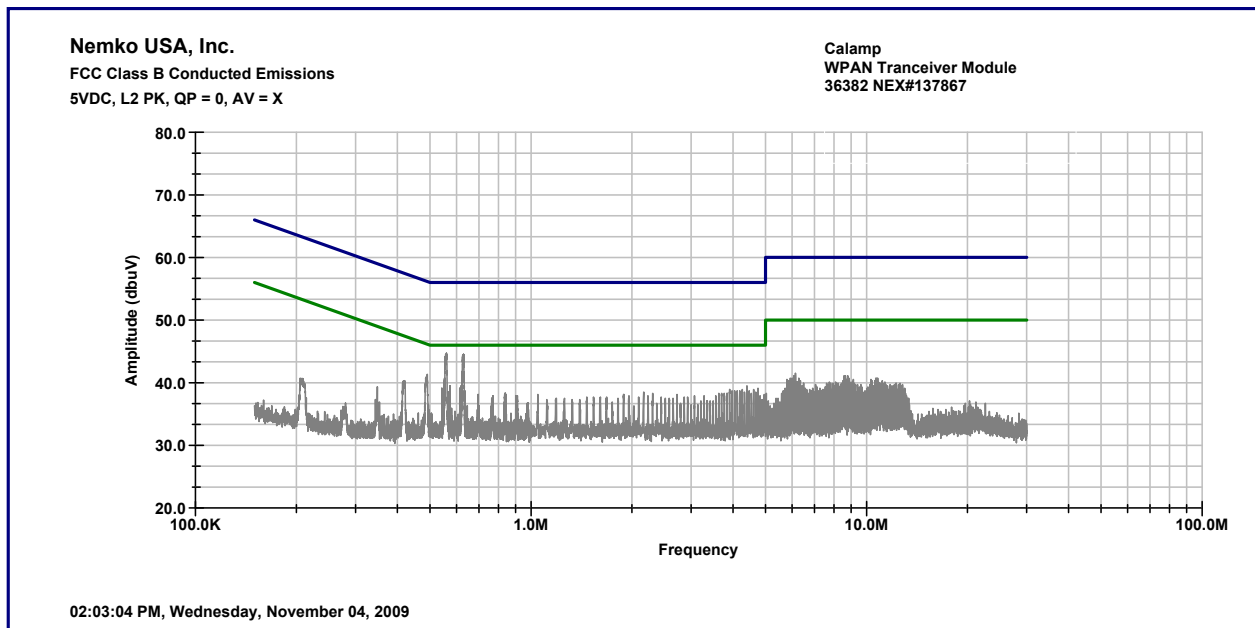




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Line 1



Line 2





**Section 15.215(c) – 20 dB Bandwidth**

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

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**Test Conditions:**

<b>Sample Number:</b>	WPAN	<b>Temperature:</b>	23°C
<b>Date:</b>	November 4, 2009	<b>Humidity:</b>	49 %
<b>Modification State:</b>	Low ,Mid and High Channel	<b>Tester:</b>	FSCustodio
		<b>Laboratory:</b>	Nemko

**Test Results:**

See attached plots.

**Additional Observations:**

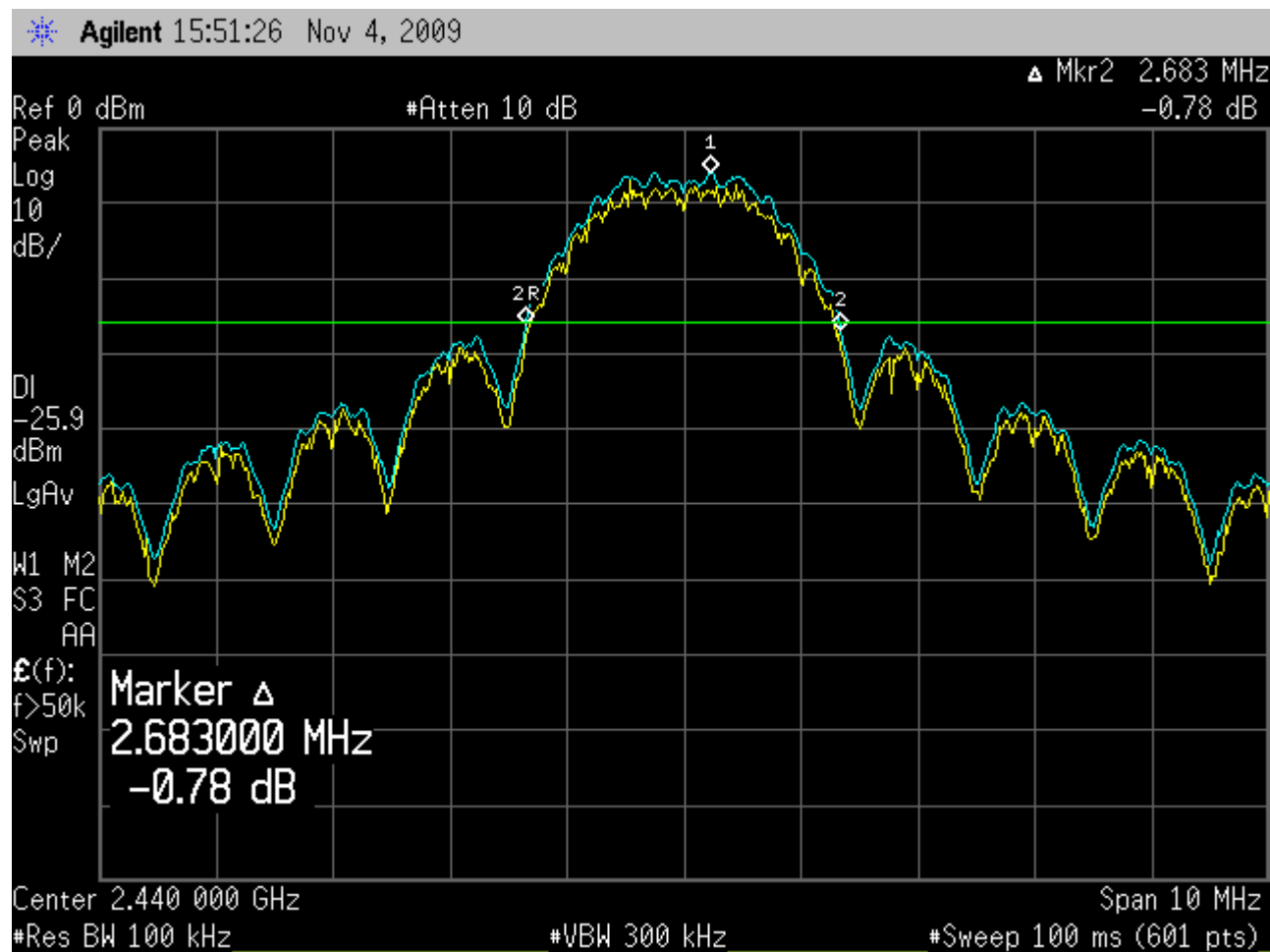
- Span is wide enough to capture the channel transmission
- RBW is 1% of the span
- VBW is 3X RBW
- Sweep is auto
- Detector is Peak
- Trace is Max Hold
- A peak output max hold reading was taken, a display line was drawn 20 dB lower than peak level. The 20 dB bandwidth was determined from where the channel output spectrum intersected the display line.
- Observed 20 dB BW is 2.7 MHz.
- 2405 MHz – 2.7 MHz = 2402.3 MHz (within the frequency band)
- 2470 MHz + 2.7 MHz = 2472.7 MHz (within the frequency band)





(Low Channel) Observed 20 dB Bandwidth is **2.7 MHz**





(Mid Channel) Observed 20 dB Bandwidth is **2.683 MHz**



(High Channel) Observed 20 dB Bandwidth is **2.7 MHz**



**Section 15.247(a)(2) – Minimum 6dB RF Bandwidth**

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 Conditions:**

<b>Sample Number:</b>	WPAN	<b>Temperature:</b>	22°C
<b>Date:</b>	November 5, 2009	<b>Humidity:</b>	49 %
<b>Modification State:</b>	Low ,Mid and High Channel	<b>Tester:</b>	FSCustodio
		<b>Laboratory:</b>	Nemko

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**Test Results:**

See attached plots.

**Additional Observations:**

- This is a conducted test
- RBW is set to 100kHz
- VBW is 3X RBW
- Sweep is auto
- Detector is Peak
- Trace is Max Hold
- For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was plotted; a DISPLAY line was drawn 6 dB lower than PEAK level. The 6 dB bandwidth was determined from where the channel output spectrum intersected the display line.

Channel Range	6 dB Bandwidth
Low (2405 MHz)	1.90 MHz
Mid (2440 MHz)	1.83 MHz
High (2470 MHz)	1.83 MHz



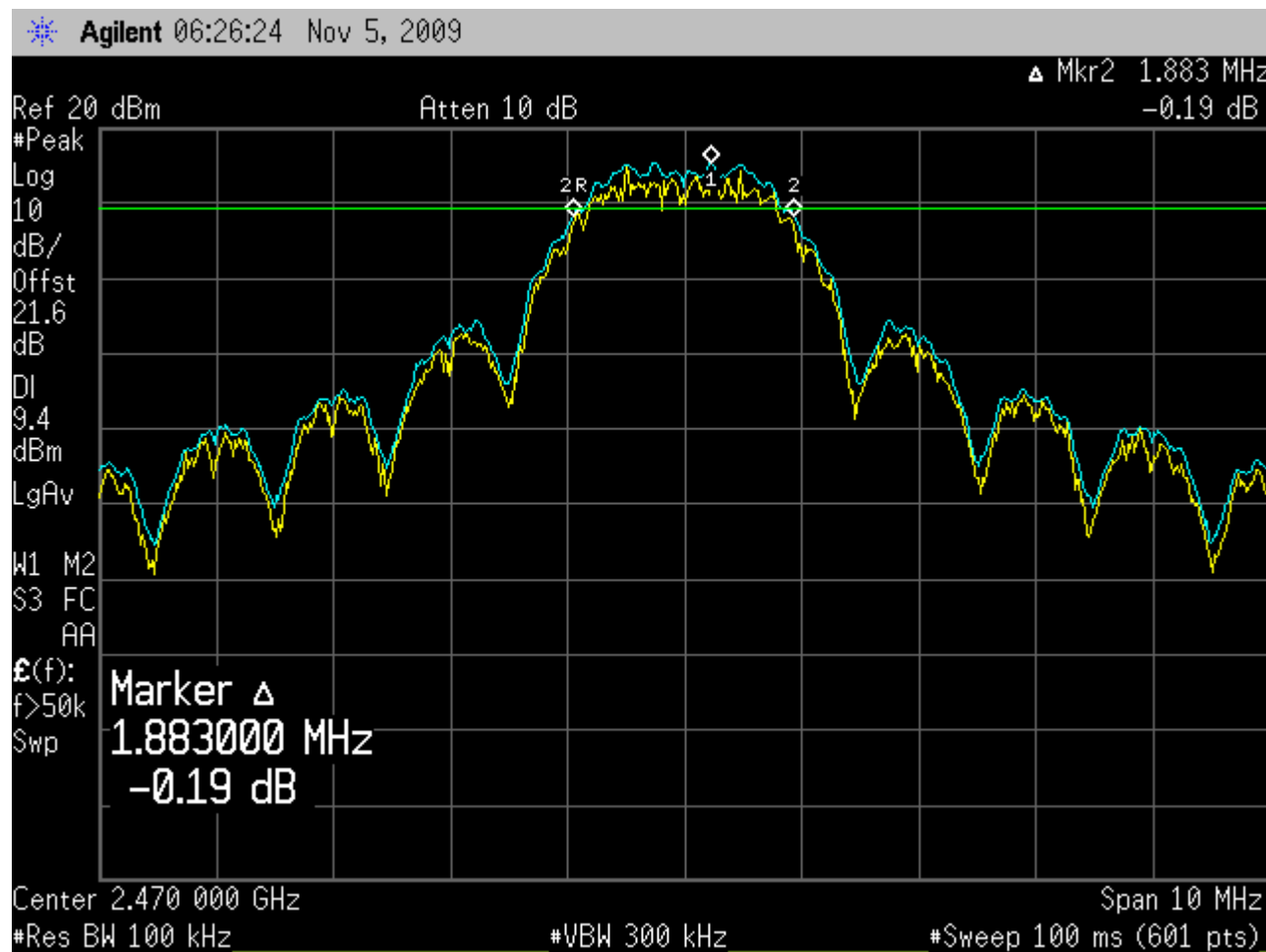


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(Low Channel) Observed 6 dB Bandwidth is **1.9 MHz**



(Mid Channel) Observed 6 dB Bandwidth is **1.833 MHz**



(High Channel) Observed 6 dB Bandwidth is **1.883 MHz**



**Section 15.247(b)(1) – Peak Output Power**

(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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**Test Conditions:**

<b>Sample Number:</b>	WPAN	<b>Temperature:</b>	23°C
<b>Date:</b>	November 4, 2009	<b>Humidity:</b>	49 %
<b>Modification State:</b>	Low ,Mid and High Channel	<b>Tester:</b>	FSCustodio
		<b>Laboratory:</b>	Nemko

**Test Results:**

Peak Power Analyzer used on this test

**Additional Observations:**

- This is a conducted test. A 20dB attenuator was placed between the sensor and the antenna port. Additional 0.5 dB was added for the cable assembly used.. Total offset used is 20.5 dB.
- The EUT was configured to transmit modulated during investigation.
- Measurements were made at 4.25VDC, 5VDC and 5.75VDC, however no difference on result was observed.

Channel Range	Peak Power Output dBm @ 1.5VDC
Low (2405 MHz)	18.28
Mid (2440 MHz)	18.59
High (2470 MHz)	18.97

Peak Output Power = 18.97 dBm or **78.88 mW**





**Section 15.247(d) – Band-edge Compliance of RF Conducted Emissions**

(d) 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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**Test Conditions:**

<b>Sample Number:</b>	WPAN	<b>Temperature:</b>	22°C
<b>Date:</b>	November 6, 2009	<b>Humidity:</b>	50 %
<b>Modification State:</b>	Low and High Channel	<b>Tester:</b>	FSCustodio
		<b>Laboratory:</b>	Nemko

**Test Results:**

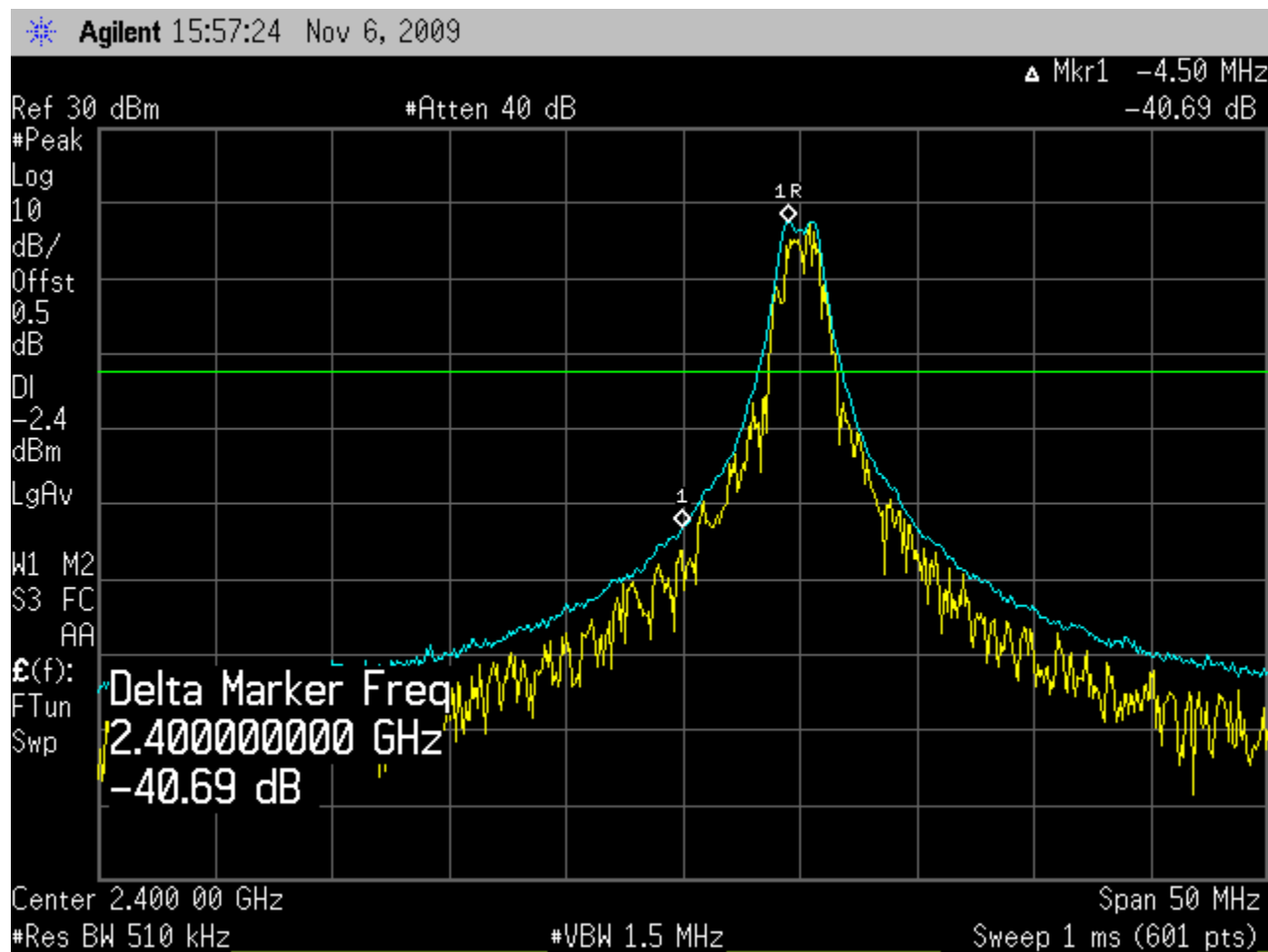
See attached plots.

**Additional Observations:**

- This is a conducted test. The 0.5dB offset is from the cable assembly used.
- Span is wide enough to capture the peak level of the emission operating on the channel closest to the band edges (Lower and Upper).
- RBW is 1% of the span
- VBW is 3X RBW
- Sweep is auto.
- Detector is Peak
- Trace is Max Hold
- For each investigation, the peak level reading was taken and a display line was drawn 20 dBc below this level which will be the limit for this test.



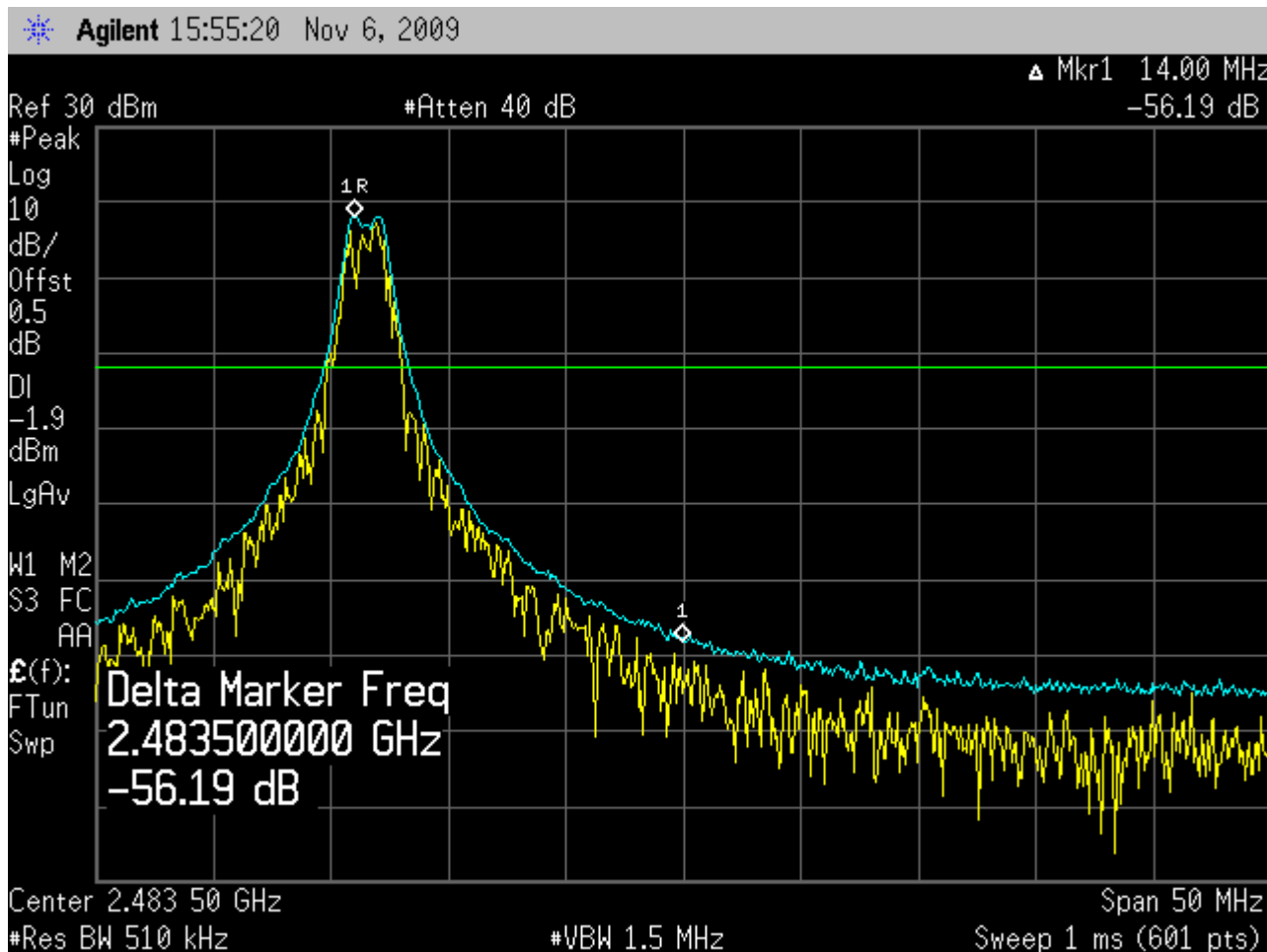




Low Channel centered at 2400 MHz



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High Channel centered at 2483.5 MHz



**Section 15.247(d) – Spurious RF Conducted Emissions**

(d) 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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**Test Conditions:**

<b>Sample Number:</b>	WPAN	<b>Temperature:</b>	22°C
<b>Date:</b>	November 9, 2009	<b>Humidity:</b>	43 %
<b>Modification State:</b>	Low ,Mid and High Channel	<b>Tester:</b>	FSCustodio
		<b>Laboratory:</b>	Nemko

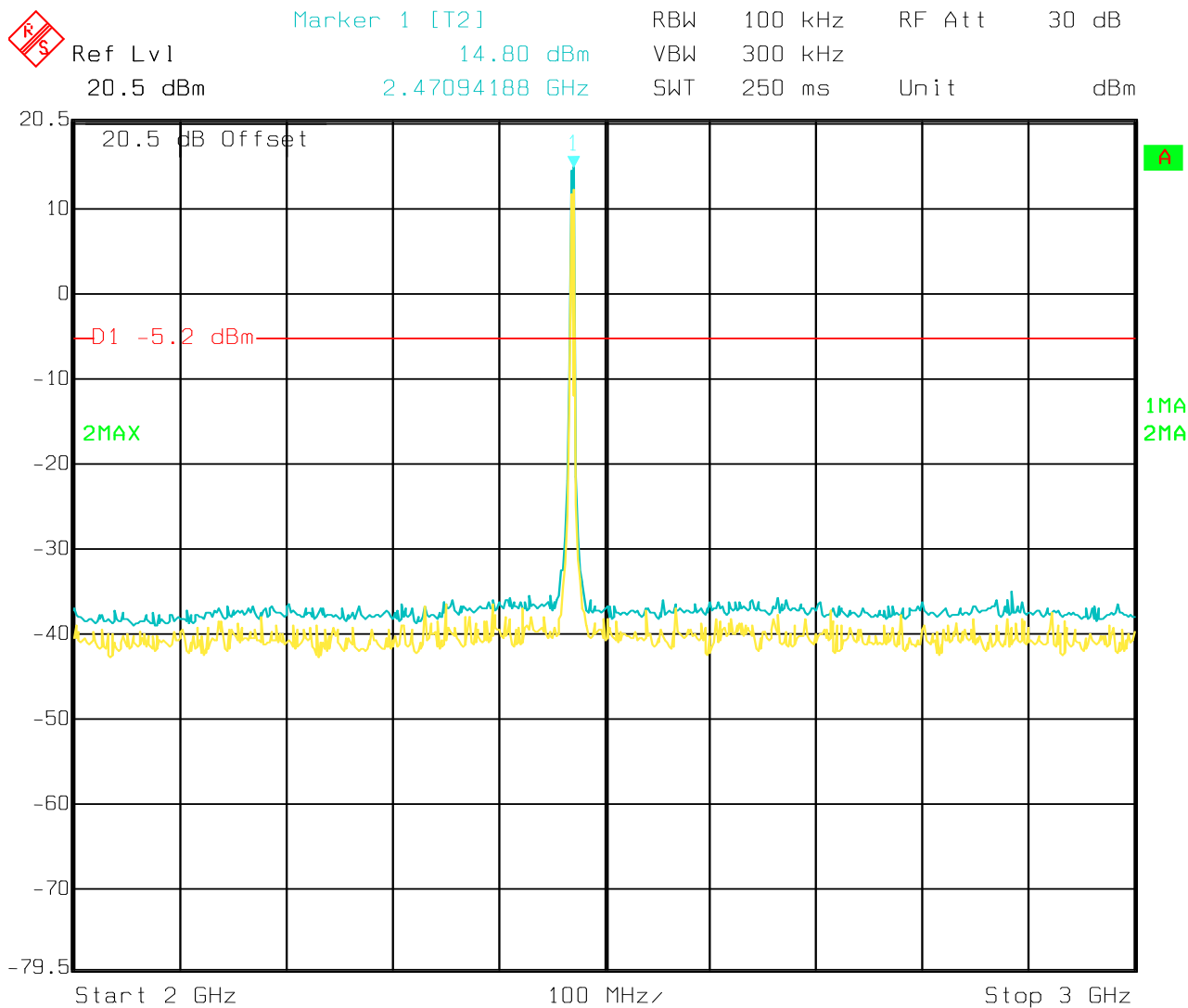
**Test Results:**

See attached plots.

**Additional Observations:**

- This is a conducted test. The 0.5dB offset is from the cable assembly used.
- The peak level reading was taken at the carrier frequency then a display line was drawn 20 dBc below this level which will be the limit for this test.
- A 20dB external attenuator is added when evaluating the range that includes the fundamental frequency.
- VBW is 3X RBW
- Sweep is auto.
- Detector is Peak
- Trace is Max Hold
- EUT complies.
- High Channel data presented, Low and Mid Channel data located in Appendix B.





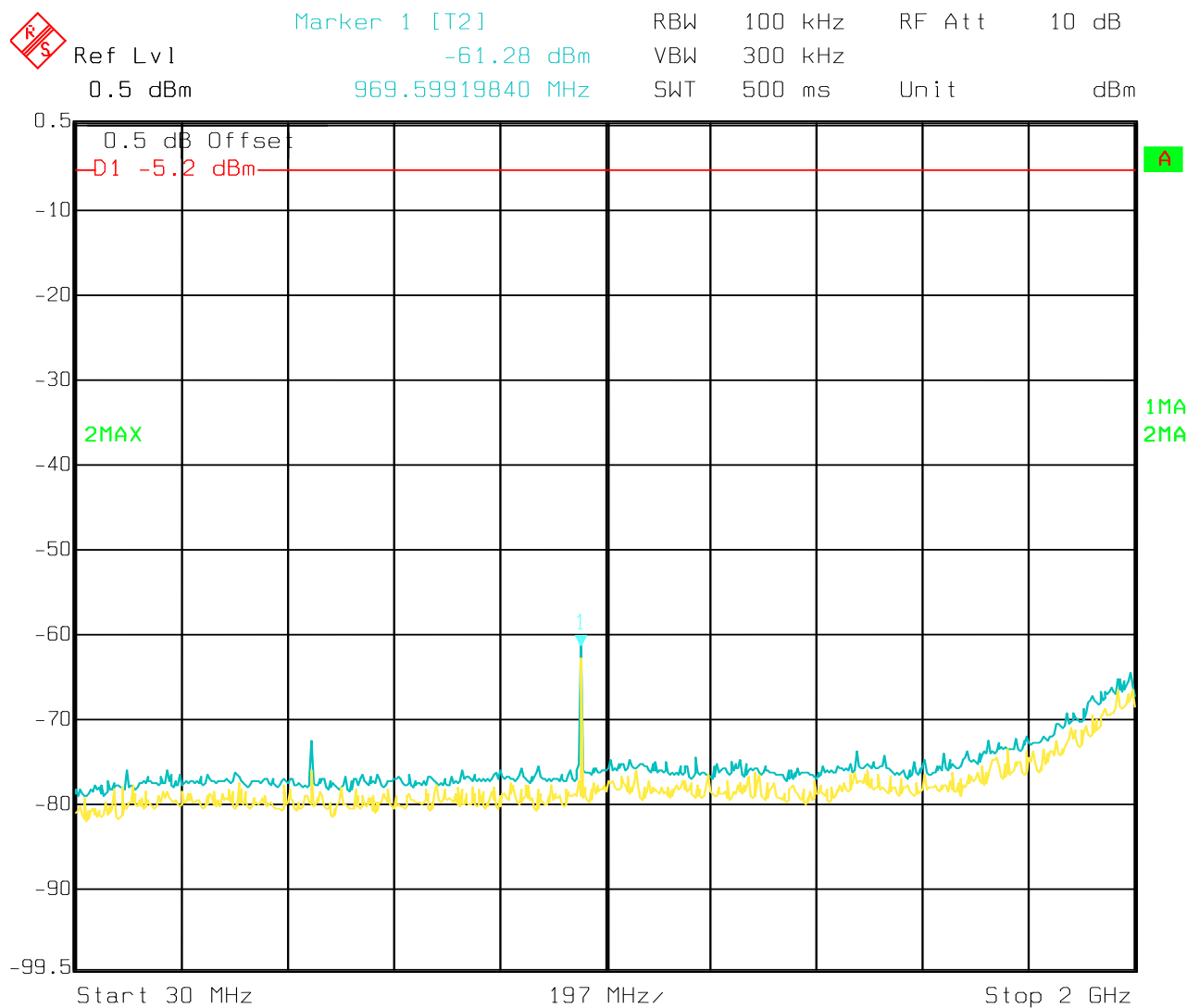
Date: 09.NOV.2009 09:30:28

**High Channel - Plots from 2 GHz to 3 GHz , Display Line is -5.2 dBm which is 20dB below the highest in band emission.**



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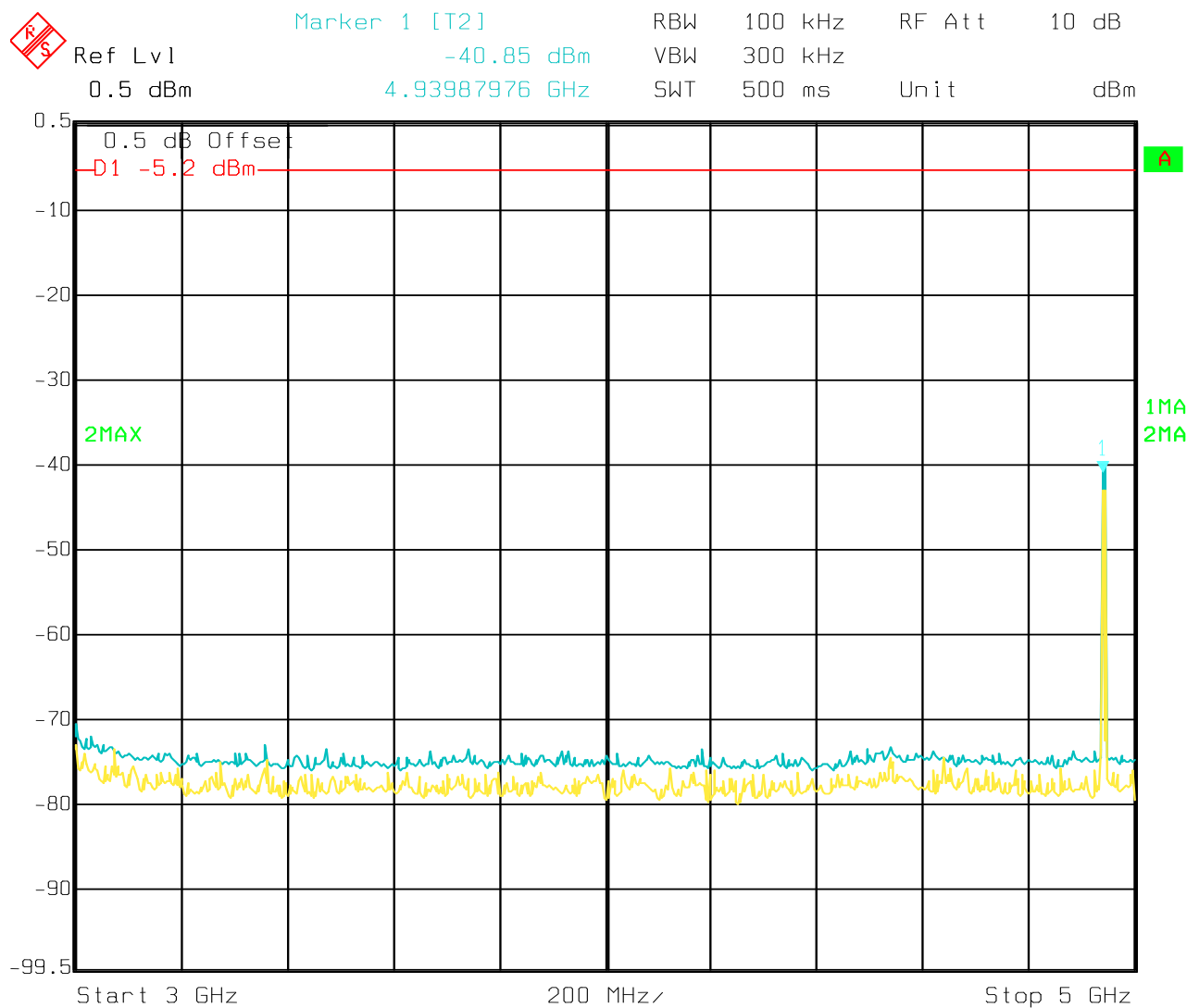




Date: 09.NOV.2009 09:36:36

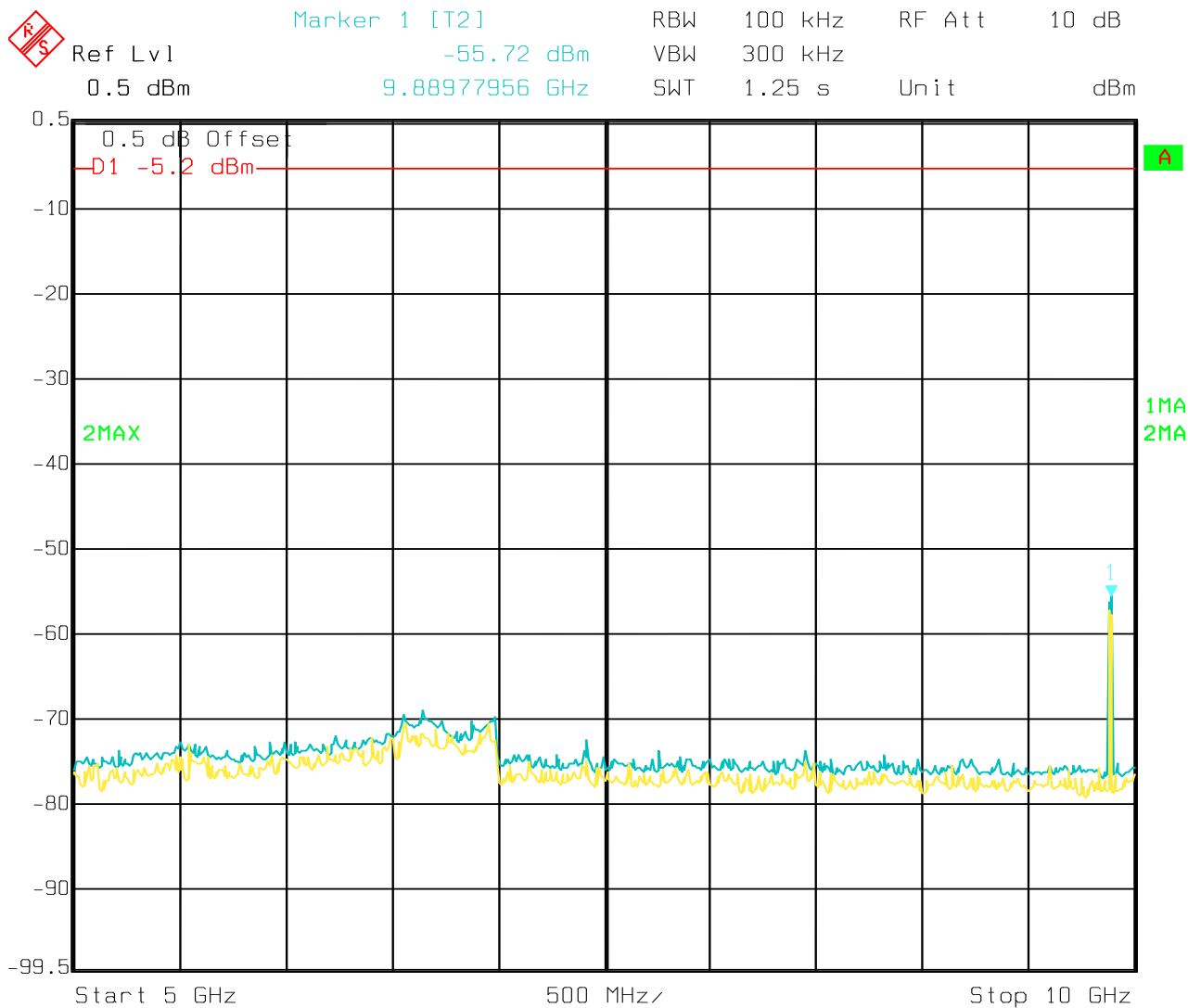
**High Channel - Plots from 30 MHz to 2 GHz , Display Line is -5.2 dBm which is 20dB below the highest in band emission.**

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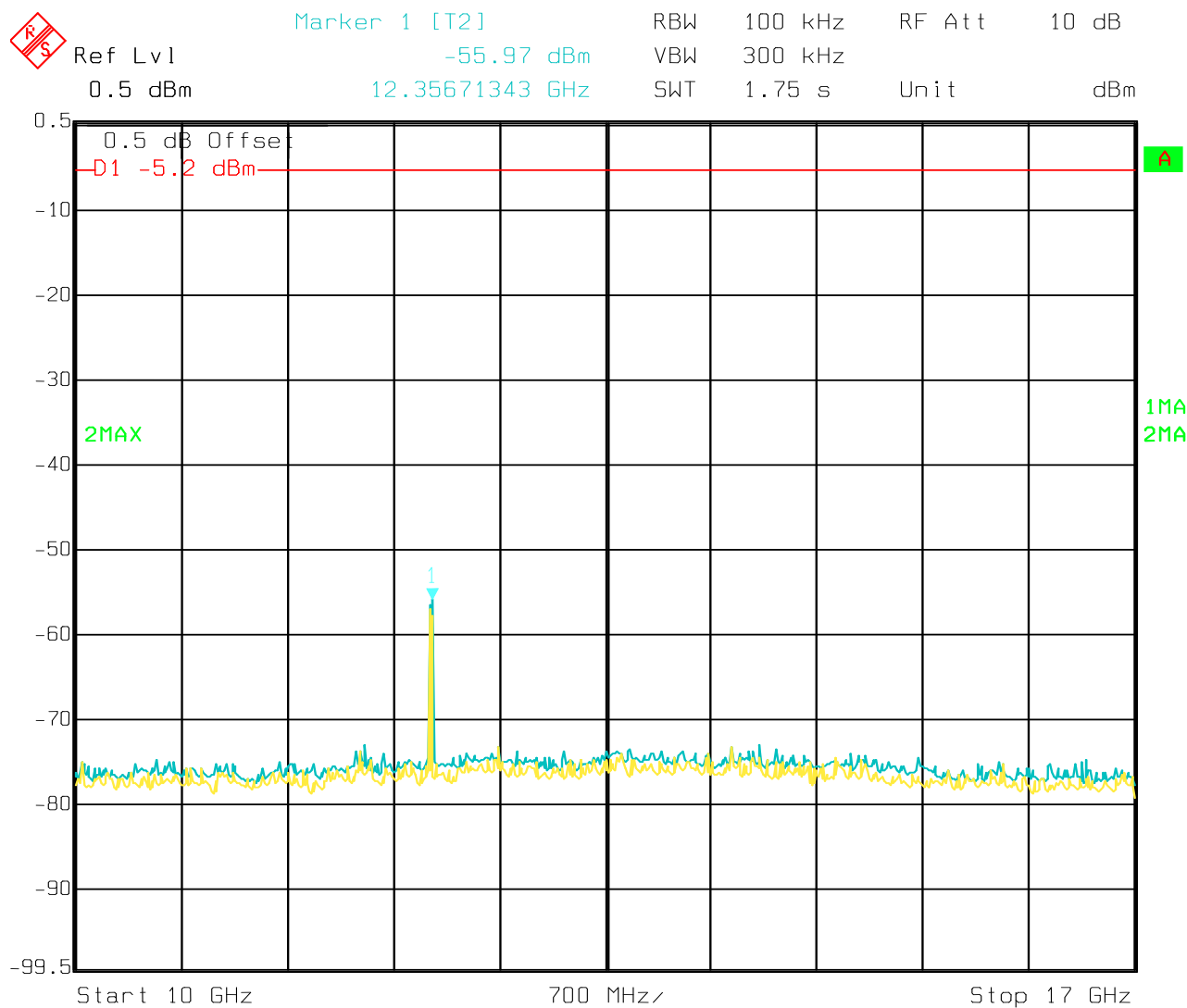
Date: 09.NOV.2009 09:40:38

**High Channel - Plots from 3 GHz to 5 GHz , Display Line is -5.2 dBm which is 20dB below the highest in band emission.**



Date: 09.NOV.2009 09:42:19

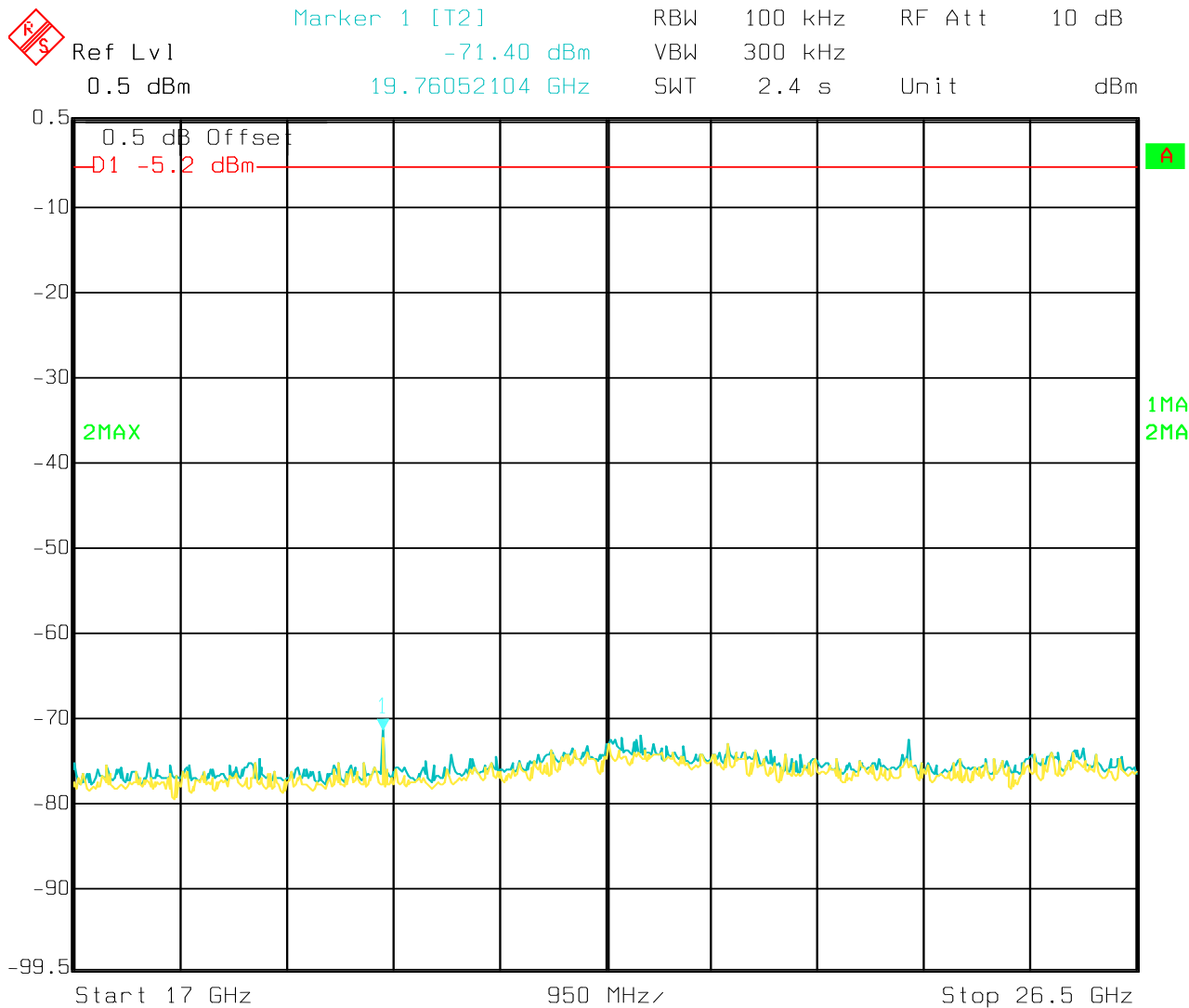
**High Channel - Plots from 5 GHz to 10 GHz , Display Line is -5.2 dBm which is 20dB below the highest in band emission.**



Date: 09.NOV.2009 09:43:16

**High Channel - Plots from 10 GHz to 17 GHz , Display Line is -5.2 dBm which is 20dB below the highest in band emission.**





Date: 09.NOV.2009 09:44:12

**High Channel - Plots from 17 GHz to 26.5 GHz , Display Line is -5.2 dBm which is 20dB below the highest in band emission.**



**Section 15.247(d) – Spurious Radiated Emissions**

(d) 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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**Test Conditions:**

<b>Sample Number:</b>	WPAN	<b>Temperature:</b>	18°C
<b>Date:</b>	November 6, 2009	<b>Humidity:</b>	64~70%
<b>Modification State:</b>	Low, Mid and High Channels	<b>Tester:</b>	FSCustodio
		<b>Laboratory:</b>	SOATS

**Test Results:**

See attached plots.

**Additional Observations:**

- The Spectrum was searched from 30MHz to 26500 MHz.  
There are no emissions found that do not comply to the restricted bands defined in **FCC Part 15 Subpart C, 15.205** or **Part 15.247(d)**.
- The EUT was measured on three orthogonal axes.
- Verifications were made at 4.25VDC, 5VDC and 5.75VDC, however no difference on measurement was observed.
- EUT disconnected from test board once configured and transmitting.

**Sample Computation (following page data):**

$$\begin{aligned}
 \text{Correction factor @ 33.6MHz} &= -14.4 \\
 &= \text{Antenna factor} + \text{Cable loss} - \text{Preamp gain} \\
 &= 13.5 + 0.9 - 0 \\
 \text{Corrected reading} &= \text{Max. reading} + \text{Correction factor} \\
 &= 9.3 + (14.4) \\
 &= 23.7 \text{ dB}\mu\text{V/m}
 \end{aligned}$$





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**Radiated Emissions Data**

Job # : 36382 Date : 11/6/2009 Page 1 of 1  
 NEX # : 137867 Time : 8AM  
 Staff : FSC

Client Name : CalAmp Corp (MN) EUT Voltage : 5VDC  
 EUT Name : Transceiver Module EUT Frequency : \_\_\_\_\_  
 EUT Model # : WPAN Phase: \_\_\_\_\_  
 EUT Serial # : N/A NOATS \_\_\_\_\_  
 EUT Config. : High Channel with internal antenna (max. power and modulated) SOATS X  
 Distance < 1000 MHz: 3 m  
 Distance > 1000 MHz: 3 m

Specification : CFR47 Part 15, Subpart B, Class B

Loop Ant. # : NA  
 Bicon Ant.#: 114\_3m Temp. (°C) : 18  
 Log Ant.#: 110\_3m Humidity (%) : 70  
 DRG Ant. # : NA Spec Analyzer #: 898/899  
 Cable LF#: SOATS Analyzer Display #: N/A  
 Cable HF#: NA Quasi-Peak Detector #: 898/899  
 Preamp LF#: NA Preselector #: N/A  
 Preamp HF# : NA

Quasi-Peak	RBW: 120 kHz
	Video Bandwidth 300 kHz
Peak	RBW: 1 MHz
	Video Bandwidth 3 MHz
Average	RBW: 1 MHz
	Video Bandwidth 10 Hz

Measurements below 1 GHz are Quasi-Peak values, unless otherwise stated.  
 Measurements above 1 GHz are Average values, unless otherwise stated.

Meas. Freq. (MHz)	Meter Reading Vertical	Meter Reading Horizontal	Det.	EUT Side F/L/R/B	Ant. Height m	Max. Reading (dBµV)	Corrected Reading (dBµV/m)	Spec. limit (dBµV/m)	CR/SL Diff. (dB)	Pass Fail	Comment
33.6	9.3	6.4	Q		1.0	9.3	23.7	40.0	-16.3	Pass	Ambent Noise
123.6	6.4	6.3	Q		1.0	6.4	23.9	43.5	-19.6	Pass	Noise Floor
146.2	6.2	6.2	Q		1.0	6.2	20.0	43.5	-23.5	Pass	Noise Floor
154.0	6.1	6.5	Q		1.0	6.5	21.4	43.5	-22.1	Pass	Noise Floor
179.7	7.6	5.8	Q		1.0	7.6	25.9	43.5	-17.6	Pass	Ambent Noise
191.9	7.8	10.6	Q		1.0	10.6	30.1	43.5	-13.4	Pass	Ambent Noise

**Below 1GHz Emissions Data (Internal Antenna)**



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**Radiated Emissions Data**

Job # :	<u>36382</u>	Date :	<u>11/6/2009</u>	Page	<u>1</u>	of	<u>1</u>
NEX #:	<u>137867</u>	Time :	<u>9:23AM</u>				
		Staff :	<u>FSC</u>				
Client Name :	<u>CalAmp Corp (MN)</u>			EUT Voltage :	<u>5VDC</u>		
EUT Name :	<u>Transceiver Module</u>			EUT Frequency :	<u>          </u>		
EUT Model # :	<u>WPAN</u>			Phase:	<u>          </u>		
EUT Serial # :	<u>N/A</u>			NOATS	<u>          </u>		
EUT Config. :	<u>High Channel with external antenna (max. power and modulated)</u>			SOATS	<u>X</u>		
				Distance < 1000 MHz:	<u>3 m</u>		
				Distance > 1000 MHz:	<u>3 m</u>		
Specification :	<u>CFR47 Part 15, Subpart B, Class B</u>						
Loop Ant. #:	<u>NA</u>						
Bicon Ant.#:	<u>114_3m</u>	Temp. (°C) :	<u>18</u>				
Log Ant.#:	<u>110_3m</u>	Humidity (%) :	<u>70</u>				
DRG Ant. #	<u>NA</u>	Spec Analyzer #:	<u>898/899</u>				
Cable LF#:	<u>SOATS</u>	Analyzer Display #:	<u>N/A</u>				
Cable HF#:	<u>NA</u>	Quasi-Peak Detector #:	<u>898/899</u>				
Preamp LF#:	<u>NA</u>	Preselector #:	<u>N/A</u>				
Preamp HF#	<u>NA</u>						

Quasi-Peak	RBW: 120 kHz
	Video Bandwidth 300 kHz
Peak	RBW: 1 MHz
	Video Bandwidth 3 MHz
Average	RBW: 1 MHz
	Video Bandwidth 10 Hz

Measurements below 1 GHz are Quasi-Peak values, unless otherwise stated.  
Measurements above 1 GHz are Average values, unless otherwise stated.

Meas. Freq. (MHz)	Meter Reading Vertical	Meter Reading Horizontal	Det.	EUT Side F/L/R/B	Ant. Height m	Max. Reading (dBµV)	Corrected Reading (dBµV/m)	Spec. limit (dBµV/m)	CR/SL Diff. (dB)	Pass Fail	Comment
35.3	10.7	6.8	Q		1.0	10.7	23.4	40.0	-16.6	Pass	Ambient Noise
153.3	8.3	6.7	Q		1.0	8.3	23.2	43.5	-20.3	Pass	Ambient Noise
204.0	11.6	7.7	Q		1.0	11.6	26.0	43.5	-17.5	Pass	
216.0	13.4	15.7	Q		1.0	15.7	29.8	46.0	-16.2	Pass	
228.0	6.3	8.3	Q		1.0	8.3	22.1	46.0	-23.9	Pass	
472.4	5.8	6.0	Q		1.0	6.0	26.8	46.0	-19.2	Pass	Noise Floor

**Below 1GHz Emissions Data (External Antenna)**



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Radiated Emissions Data

Job #: 36382 Date: 11/6/2009 Page 1 of 1  
NEX#: 137867 Time: 11:15AM  
Staff: FSC

Client Name: CalAmp Corp (MN)  
EUT Name: Transceiver Module  
EUT Model #: WPAN  
EUT Serial #: N/A  
EUT Config.: High Channel with external antenna (max. power and modulated)

EUT Voltage: 5VDC  
EUT Frequency: \_\_\_\_\_  
Phase: \_\_\_\_\_  
NOATS \_\_\_\_\_  
SOATS X  
Distance < 1000 MHz: 3 m  
Distance > 1000 MHz: 3 m

Specification: CFR47 Part 15, Subpart B, Class B  
Loop Ant. #: NA  
Bicon Ant. #: NA Temp. (°C): 18  
Log Ant. #: NA Humidity (%): 64  
DRG Ant. #: 877 Spec Analyzer #: 911  
Cable LF#: NA Analyzer Display #: N/A  
Cable HF#: 40ft\_Blue Quasi-Peak Detector #: 911  
Preamp LF#: NA Preselector #: N/A  
Preamp HF#: 317 DCCF: 20

Peak	RBW: 1 MHz
Video Bandwidth 3 MHz	
Average = Peak- DCCF	
Average (NF)	RBW: 1 MHz
Video Bandwidth 10 Hz	

Meas. Freq. (MHz)	Meter Reading Vertical	Meter Reading Horizontal	Det.	EUT Side F/L/R/B	Ant. Height m	Max. Reading (dBµV)	Corrected Reading (dBµV/m)	Spec. limit (dBµV/m)	CR/SL Diff. (dB)	Pass Fail	Comment
2483.5	59.4	55.8	P	FR	1.0	59.4	62.2	74.0	-11.8	Pass	
2483.5	39.4	35.8	A	FR	1.0	39.4	42.2	54.0	-11.8	Pass	
4810.0	58.8	53.2	P	FR	1.0	58.8	69.6	74.0	-4.3	Pass	
4810.0	38.8	33.2	A	FR	1.0	38.8	49.6	54.0	-4.3	Pass	
7215.0	40.4	40.0	P		1.0	40.4	59.2	74.0	-14.8	Pass	Noise Floor
7215.0	29.6	29.7	A		1.0	29.7	48.5	54.0	-5.5	Pass	Noise Floor
9620.0	38.4	38.9	P		1.0	38.9	61.2	74.0	-12.8	Pass	Noise Floor
9620.0	28.2	28.3	A		1.0	28.3	50.6	54.0	-3.4	Pass	Noise Floor
4880.0	59.7	55.7	P	FR	1.0	59.7	70.5	74.0	-3.5	Pass	
4880.0	39.7	35.7	A	FR	1.0	39.7	50.5	54.0	-3.5	Pass	
7320.0	38.9	39.6	P		1.0	39.6	58.7	74.0	-15.2	Pass	Noise Floor
7320.0	29.0	28.8	A		1.0	29.0	48.1	54.0	-5.8	Pass	Noise Floor
9760.0	39.1	39.3	P		1.0	39.3	61.9	74.0	-12.1	Pass	Noise Floor
9760.0	28.8	28.9	A		1.0	28.9	51.5	54.0	-2.5	Pass	Noise Floor
4940.0	61.2	52.0	P	FR	1.0	61.2	72.1	74.0	-1.9	Pass	
4940.0	41.2	32.0	A	FR	1.0	41.2	52.1	54.0	-1.9	Pass	
7410.0	39.4	40.3	P		1.0	40.3	59.4	74.0	-14.6	Pass	Noise Floor
7410.0	29.7	29.2	A		1.0	29.7	48.8	54.0	-5.2	Pass	Noise Floor
9880.0	39.9	39.8	P		1.0	39.9	62.3	74.0	-11.7	Pass	Noise Floor
9880.0	29.5	29.4	A		1.0	29.5	51.9	54.0	-2.1	Pass	Noise Floor

Above 1GHz Emissions Data (External Antenna)



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**Radiated Emissions Data**

Job # : 36382 Date : 11/6/2009 Page 1 of 1  
NEX # : 137867 Time : 11:15AM  
Staff : FSC

Client Name : CalAmp Corp (MN)  
EUT Name : Transceiver Module  
EUT Model # : WPAN  
EUT Serial # : N/A  
EUT Config. : High Channel with internal antenna (max. power and modulated)

EUT Voltage : 5VDC  
EUT Frequency : \_\_\_\_\_  
Phase: \_\_\_\_\_  
NOATS \_\_\_\_\_  
SOATS X  
Distance < 1000 MHz: 3 m  
Distance > 1000 MHz: 3 m

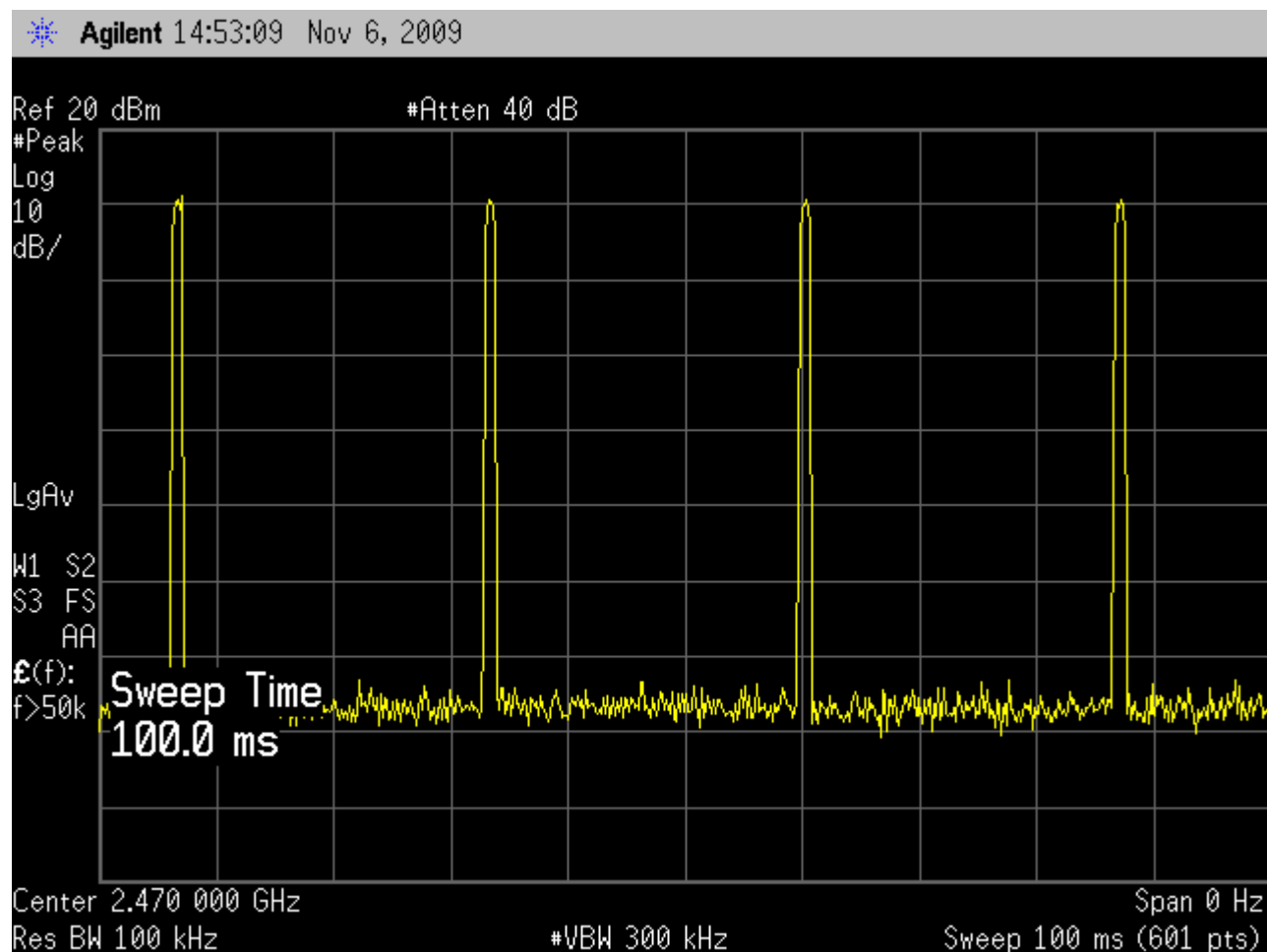
Specification : CFR47 Part 15, Subpart B, Class B  
Loop Ant. #: NA  
Bicon Ant. #: NA Temp. (°C) : 18  
Log Ant. #: NA Humidity (%) : 64  
DRG Ant. # : 877 Spec Analyzer #: 911  
Cable LF#: NA Analyzer Display #: N/A  
Cable HF#: 40ft\_Blue Quasi-Peak Detector #: 911  
Preamp LF#: NA Preselector #: N/A  
Preamp HF# : 317 DCCF: 20

Peak	RBW: 1 MHz
Video Bandwidth 3 MHz	
Average (EUT) = Peak- DCCF	
Average (NF)	RBW: 1 MHz
Video Bandwidth 10 Hz	

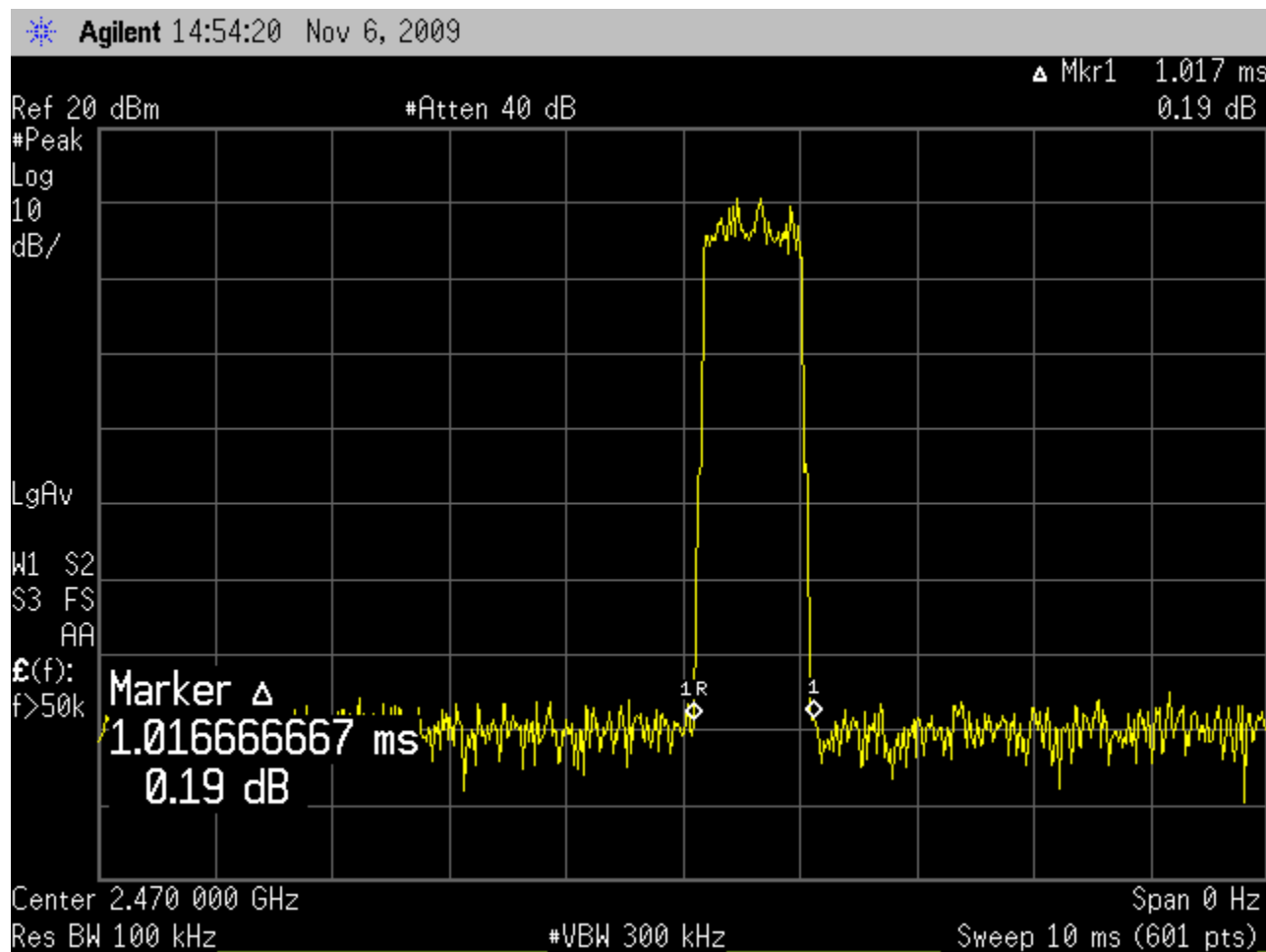
Meas. Freq. (MHz)	Meter Reading Vertical	Meter Reading Horizontal	Det.	EUT Side F/L/R/B	Ant. Height m	Max. Reading (dBµV)	Corrected Reading (dBµV/m)	Spec. limit (dBµV/m)	CR/SL Diff. (dB)	Pass Fail	Comment
2483.5	55.4	54.6	P	FR	1.0	55.4	58.2	74.0	-15.8	Pass	
2483.5	35.4	34.6	A	FR	1.0	35.4	38.2	54.0	-15.8	Pass	
4810.0	53.8	53.1	P	FR	1.0	53.8	64.6	74.0	-9.3	Pass	
4810.0	33.8	33.1	A	FR	1.0	33.8	44.6	54.0	-9.3	Pass	
7215.0	40.4	40.0	P		1.0	40.4	59.2	74.0	-14.8	Pass	Noise Floor (NF)
7215.0	29.6	29.7	A		1.0	29.7	48.5	54.0	-5.5	Pass	Noise Floor (NF)
9620.0	38.4	38.9	P		1.0	38.9	61.2	74.0	-12.8	Pass	Noise Floor (NF)
9620.0	28.2	28.3	A		1.0	28.3	50.6	54.0	-3.4	Pass	Noise Floor (NF)
4880.0	54.2	53.3	P	FR	1.0	54.2	65.1	74.0	-8.9	Pass	
4880.0	34.2	33.3	A	FR	1.0	34.2	45.1	54.0	-8.9	Pass	
7320.0	38.9	39.6	P		1.0	39.6	58.7	74.0	-15.2	Pass	Noise Floor (NF)
7320.0	29.0	28.8	A		1.0	29.0	48.1	54.0	-5.8	Pass	Noise Floor (NF)
9760.0	39.1	39.3	P		1.0	39.3	61.9	74.0	-12.1	Pass	Noise Floor (NF)
9760.0	28.8	28.9	A		1.0	28.9	51.5	54.0	-2.5	Pass	Noise Floor (NF)
4940.0	55.4	52.4	P	FR	1.0	55.4	66.3	74.0	-7.7	Pass	
4940.0	35.4	32.4	A	FR	1.0	35.4	46.3	54.0	-7.7	Pass	
7410.0	39.4	40.3	P		1.0	40.3	59.4	74.0	-14.6	Pass	Noise Floor (NF)
7410.0	29.7	29.2	A		1.0	29.7	48.8	54.0	-5.2	Pass	Noise Floor (NF)
9880.0	39.9	39.8	P		1.0	39.9	62.3	74.0	-11.7	Pass	Noise Floor (NF)
9880.0	29.5	29.4	A		1.0	29.5	51.9	54.0	-2.1	Pass	Noise Floor (NF)

**Above 1GHz Emissions Data (Internal Antenna)**

### Duty Cycle Correction Factor Computation



Four (4) Transmissions per 100 ms



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**1.0167ms per transmission**

**Duty Cycle** = (1.0167 ms) x 4  
 = 4.0668 ms/100 ms  
 = 4.0668%

**DCCF** = 20 log (0.040668)  
 = -27.81; limited to -20





**Section 15.247(e) – Power Spectral Density for Digitally Modulated Devices**

(e) 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.

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**Test Conditions:**

<b>Sample Number:</b>	WPAN	<b>Temperature:</b>	22°C
<b>Date:</b>	November 6, 2009	<b>Humidity:</b>	50 %
<b>Modification State:</b>	Low ,Mid and High Channel	<b>Tester:</b>	FSCustodio
		<b>Laboratory:</b>	Nemko

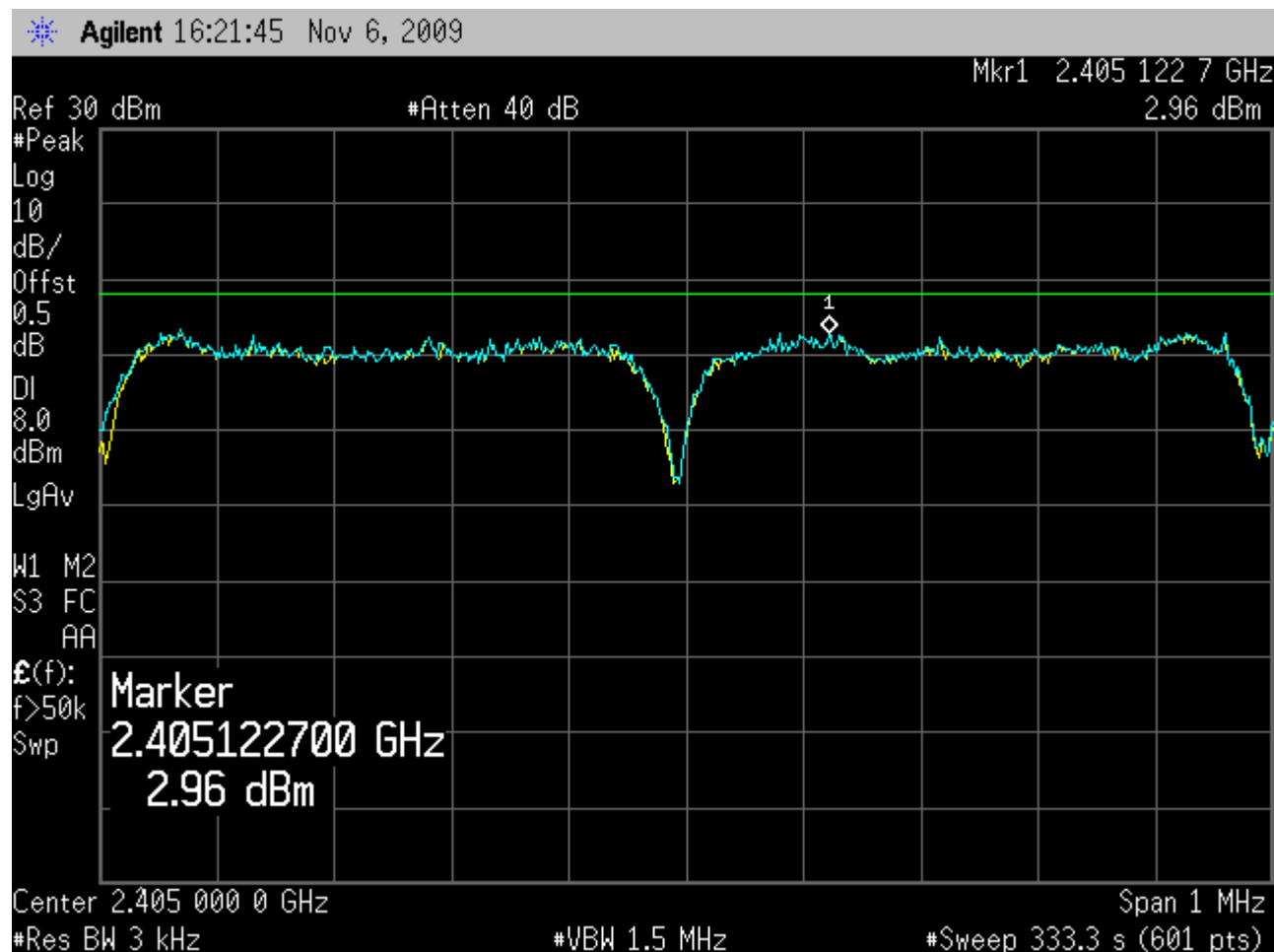
**Test Results:**

See attached plots.

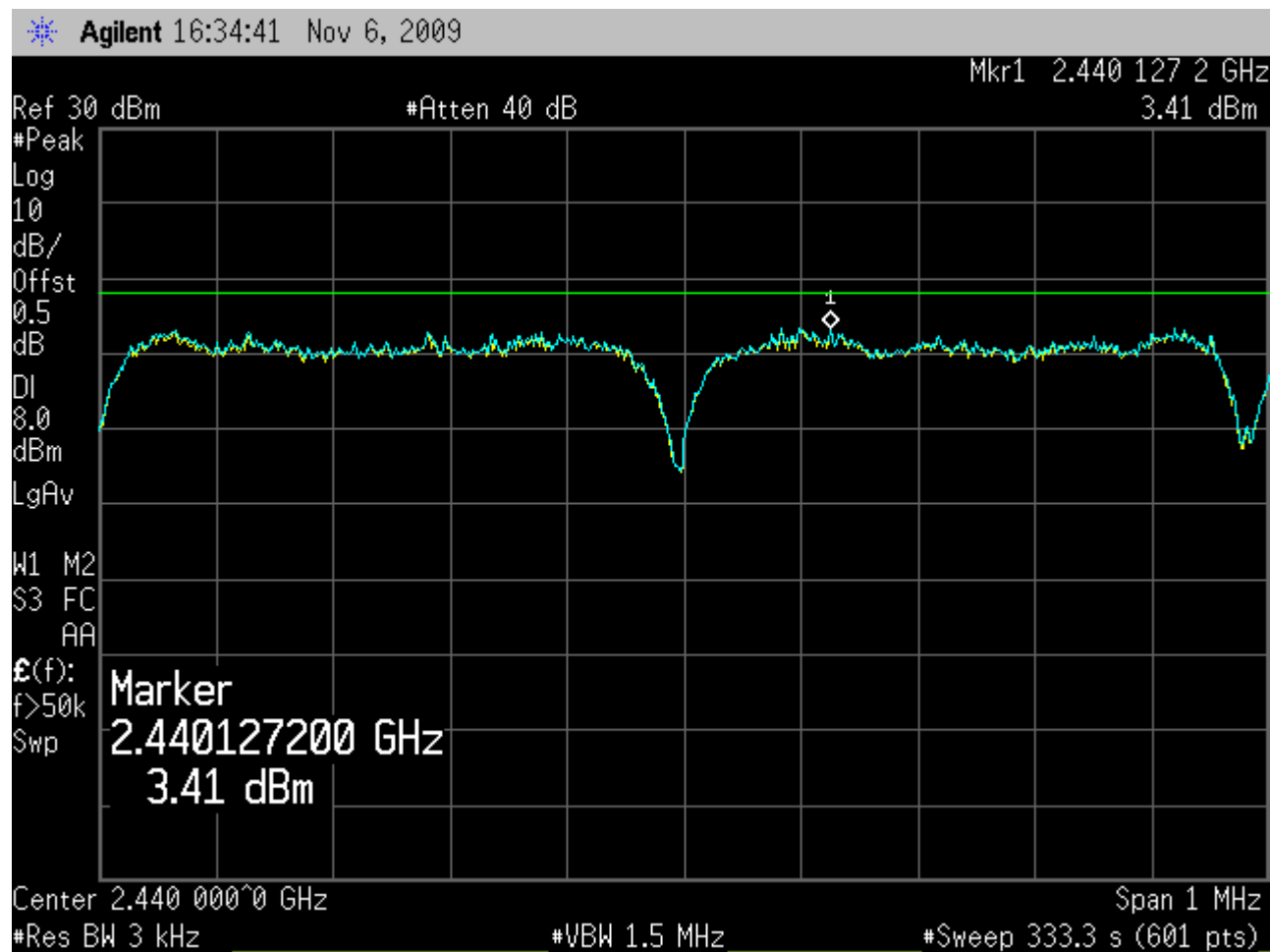
**Additional Observations:**

- This is a conducted test. The 0.5dB offset is from the cable assembly used.
- Span is wide enough to capture the peak level of the emission.
- RBW is 3kHz
- VBW is > RBW
- Sweep is Span/RBW (1MHz/3kHz = 333.3 seconds).
- Detector is Peak
- Trace is Max Hold



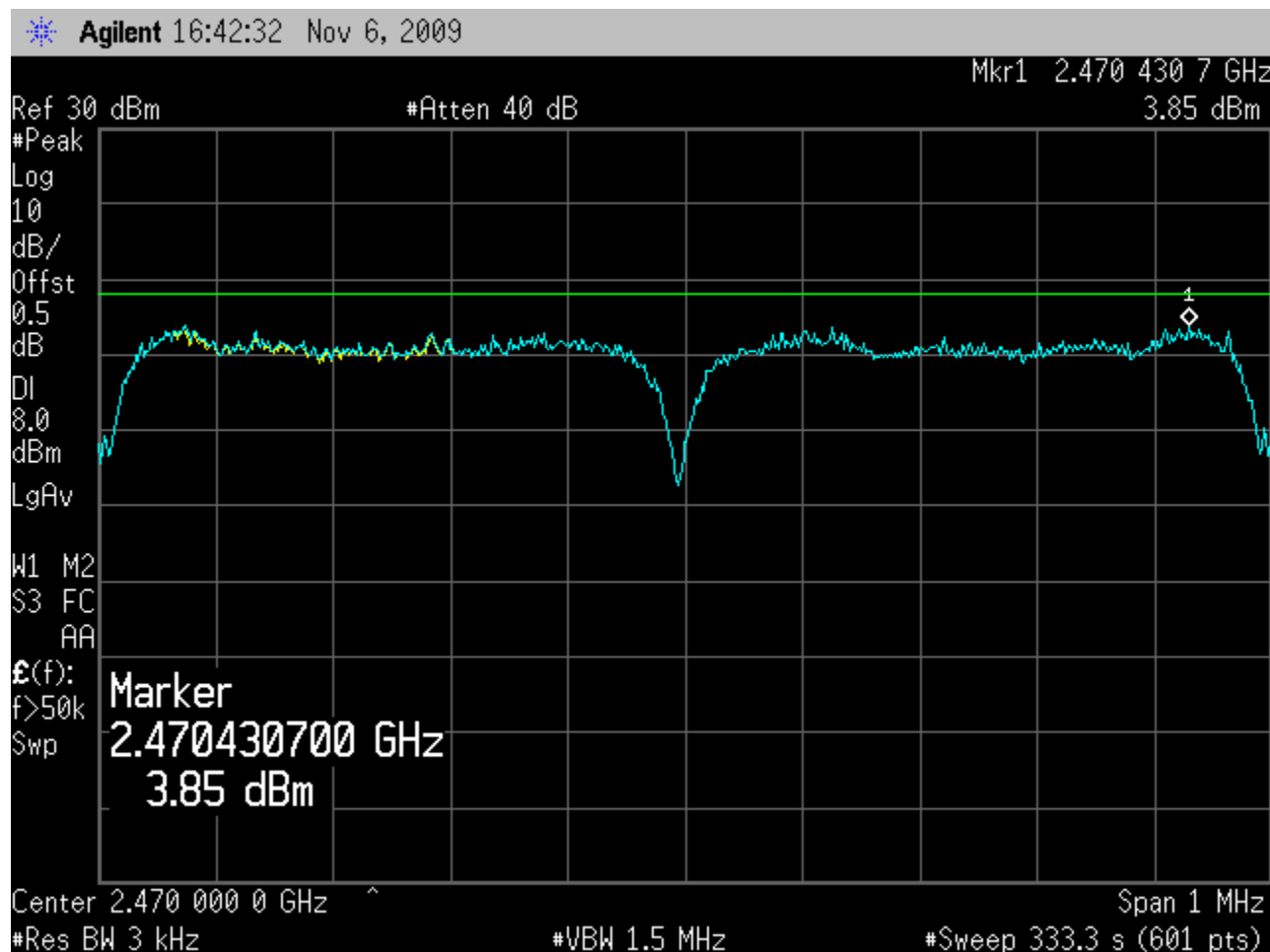


Low Channel – Peak level is 2.96 dBm



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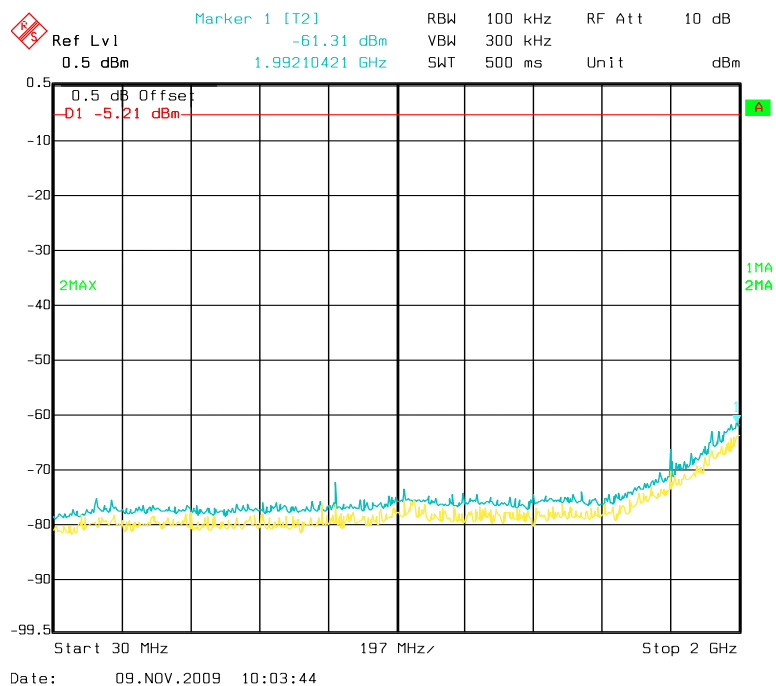
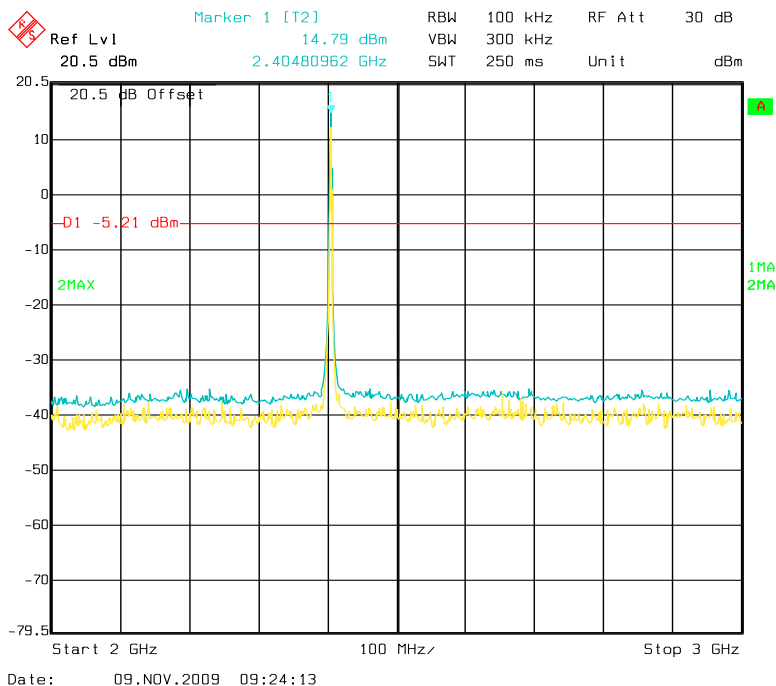
Mid Channel – Peak level is 3.41 dBm



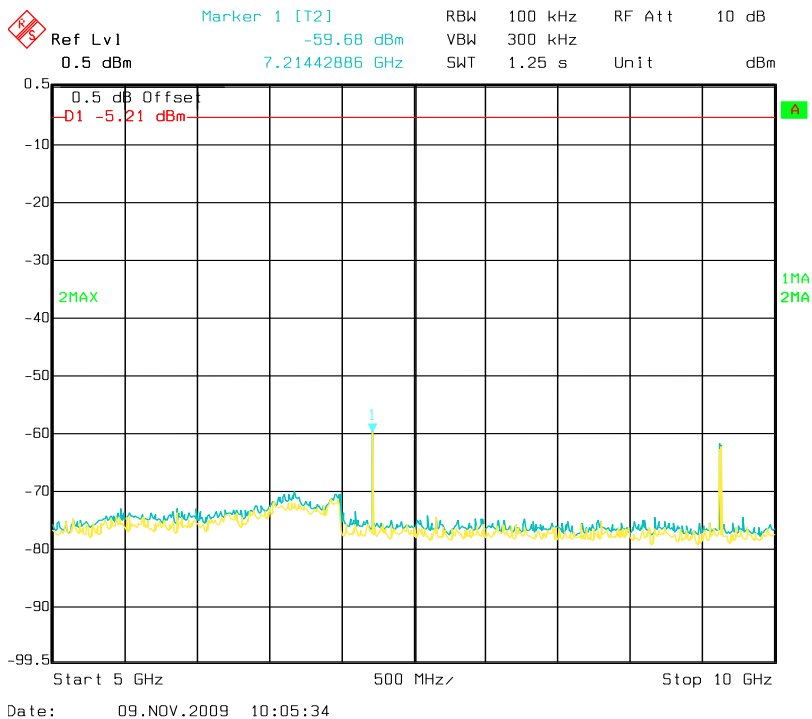
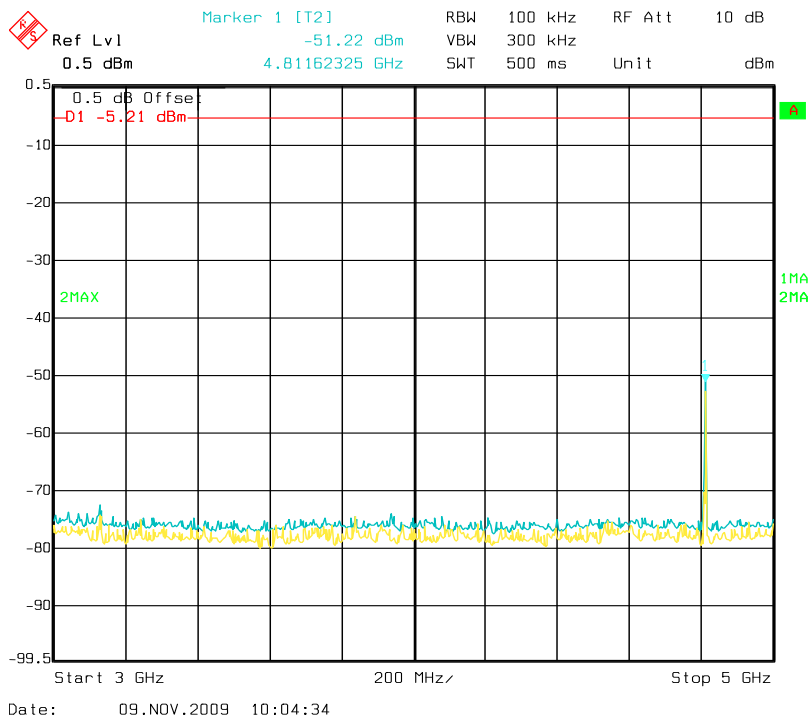
High Channel – Peak level is 3.85 dBm

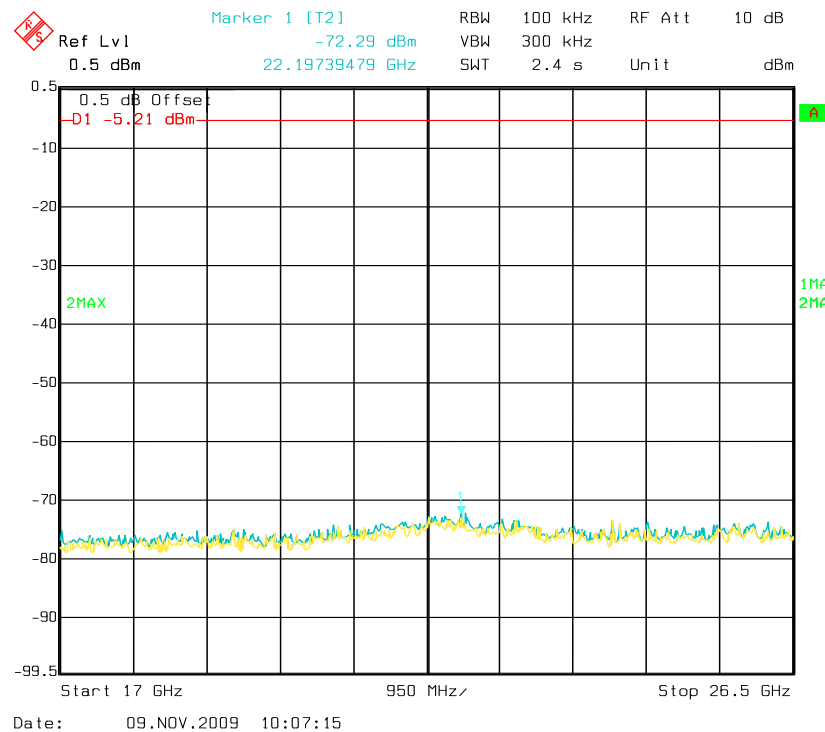
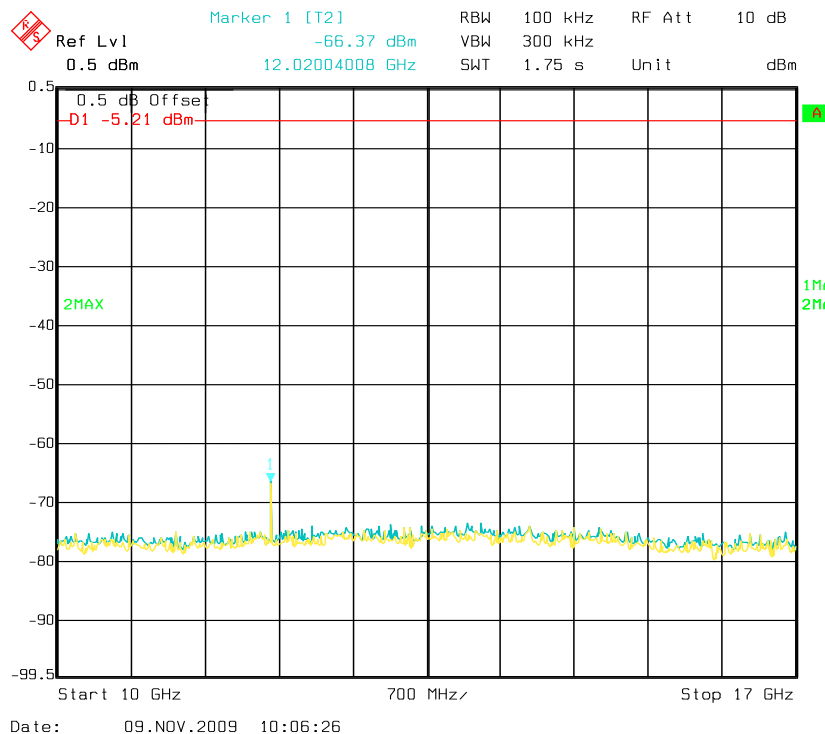
### Appendix B: Section 15.247(d) – Spurious Emissions (RF Antenna Conducted Test) data for Low and Mid Channels

#### Low Channel



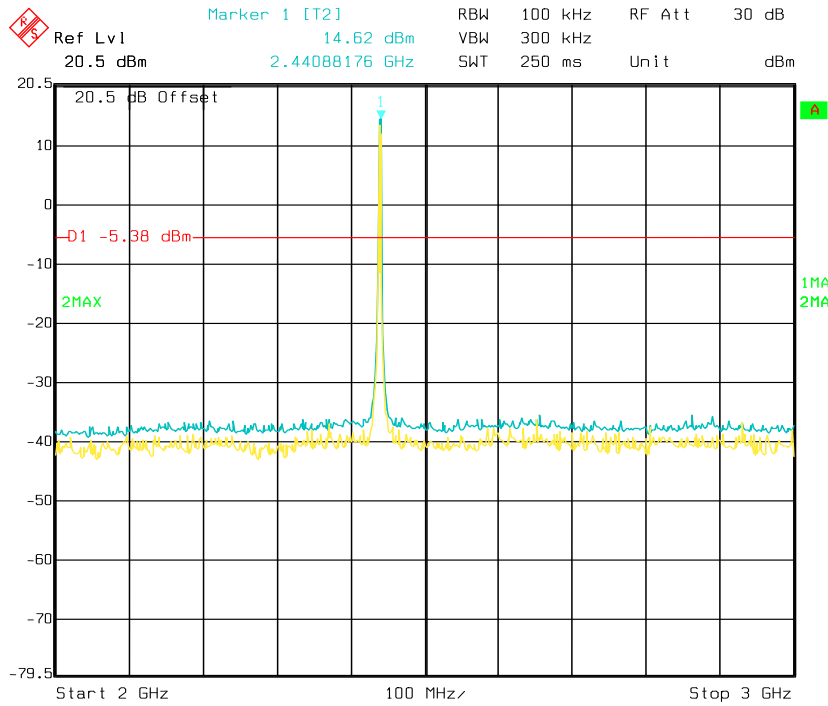
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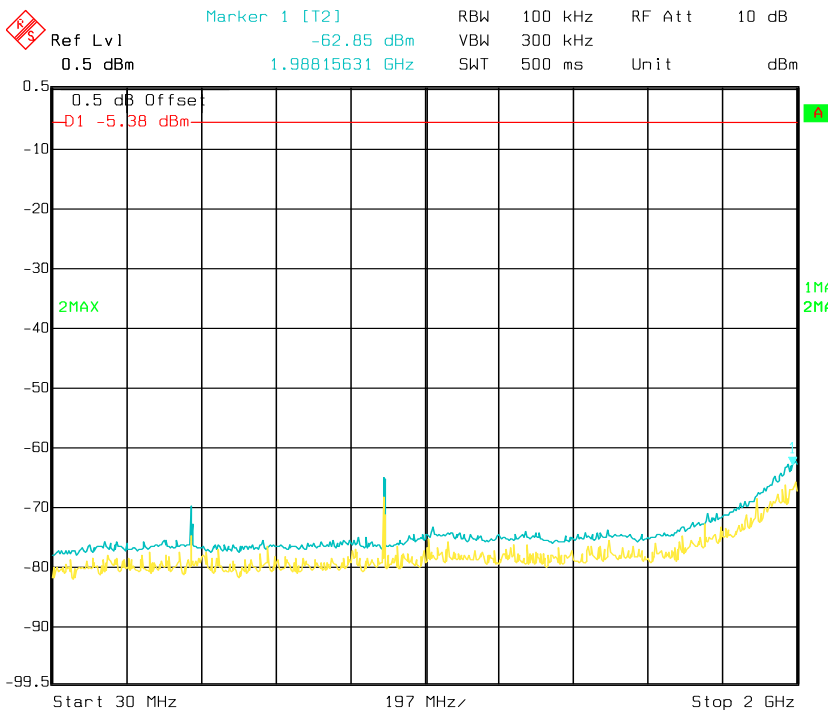


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### Mid Channel



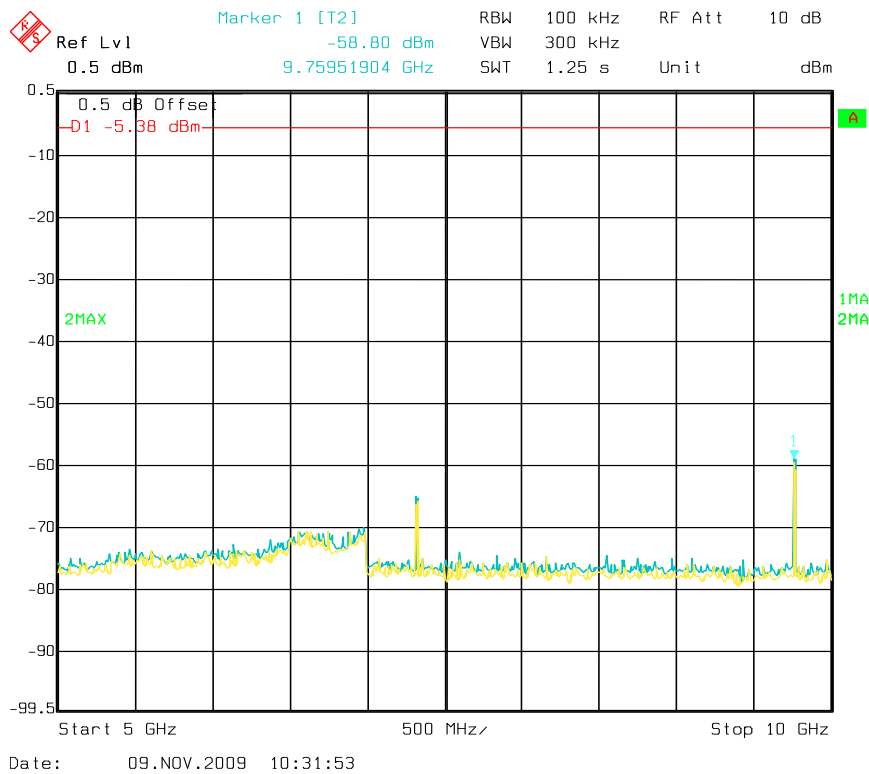
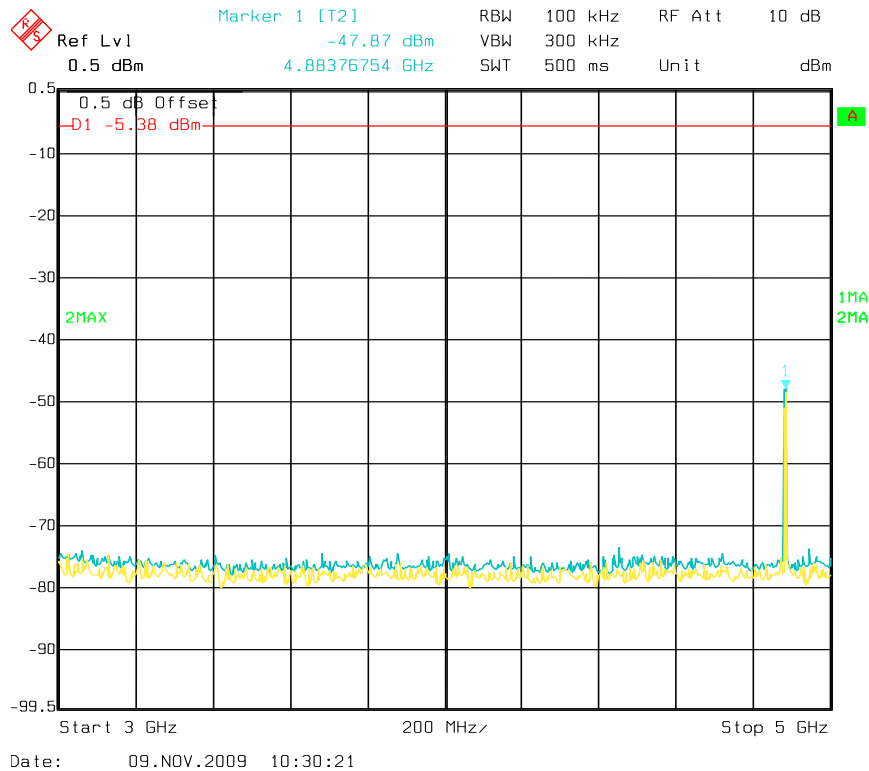
Date: 09.NOV.2009 09:28:43

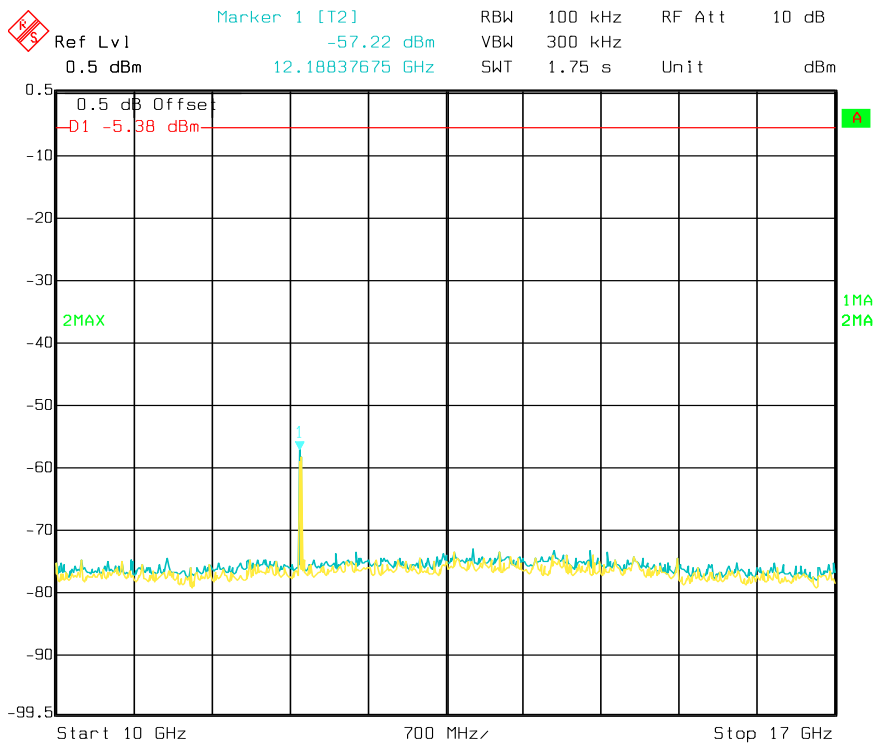


Date: 09.NOV.2009 10:29:49

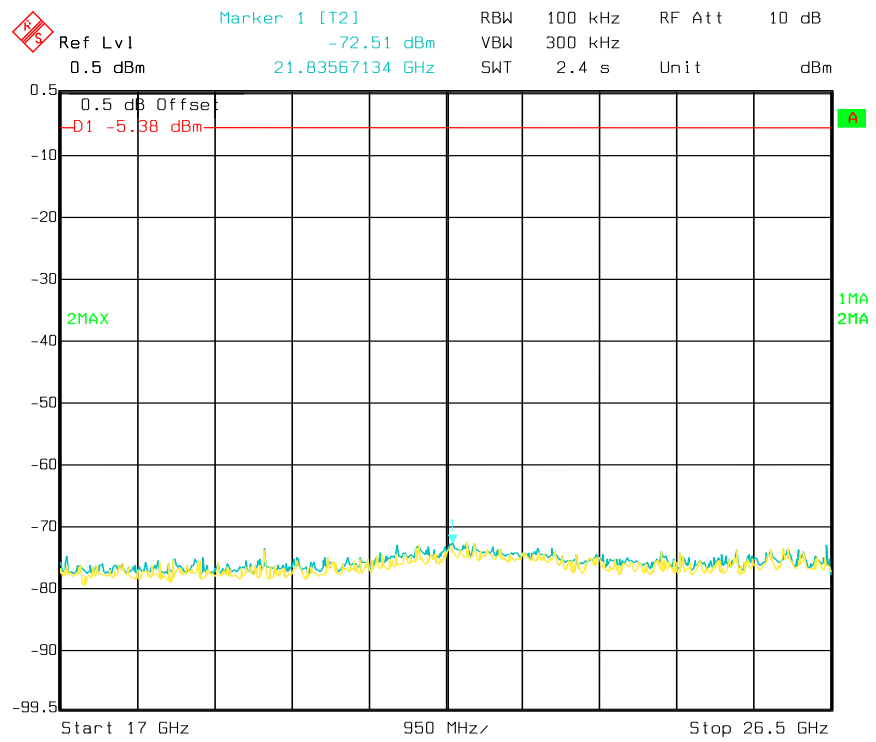
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Date: 09.NOV.2009 10:32:39



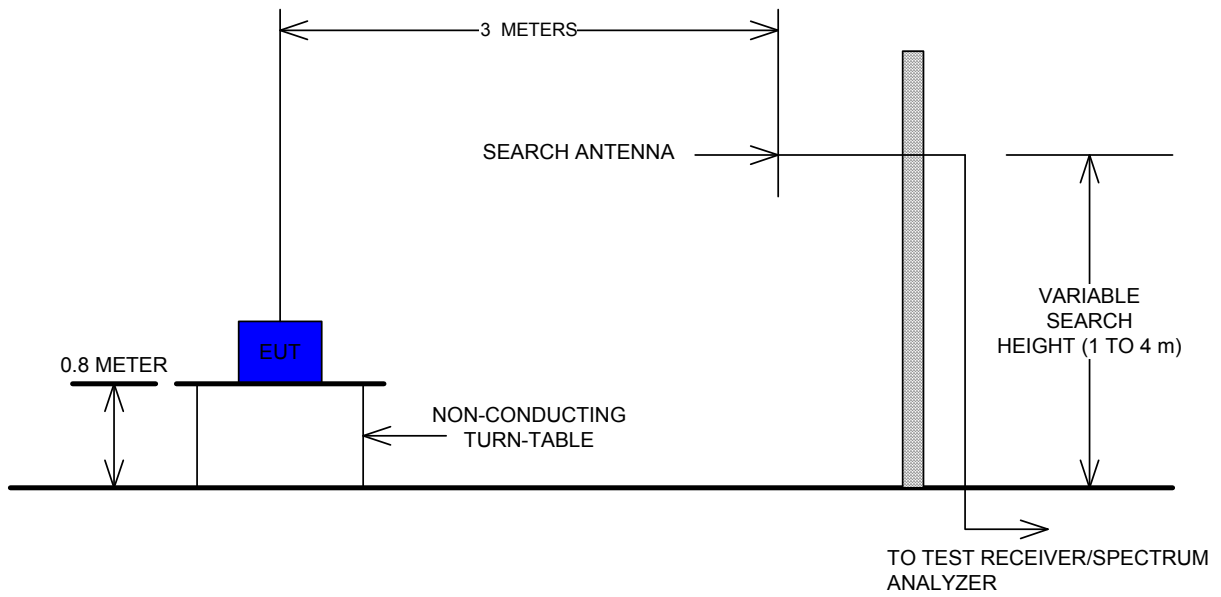
Date: 09.NOV.2009 10:33:42



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## Appendix C: Block Diagram of Test Setups

### Test Site For Radiated Emissions



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