



# Wireless Transceiver Test Report



FCC id: A94403155M

IC: 3232A-403155M

Certificate # 1514.1


**Report number:** EMC.403155.09.315.1

**Prepared for:** Bose Corporation  
DCE - EMC  
1 New York Ave, Framingham MA 01701


**Product Tested:** Bose RF remote control model RC35T-A

**Standards:** FCC part 15.B, FCC 15.C (15.249)  
RSS210 issue 7 (June 2007),  
ICES-003 issue 4, CAN/CSA-CIE/IEC CISPR22:02

**Report prepared by:** Peter Boefs

**Signature:** 

**Report reviewed by:** Brent DeWitt

**Signature:** 

**Report issue date:** January 11 ,2010

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## 1 Report Summary

**1.1 Product :** Bose RF remote control  
models RC35T-A, RC35T-L and RC20T

**1.2 Client :** Bose Corporation  
1 New York Ave, Framingham MA 01701

**1.3 Applicable Standards:** FCC part 15.B  
FCC 15.C (15.249), ANSI C63.10 (2009)  
RSS210 issue 7 (June 2007),  
ICES-003 issue 4, CAN/CSA-CIE/IEC CISPR22:02

Test Results: Pass  Fail

**1.4 Test Laboratory** Bose DCE laboratories  
1 New York Ave  
Framingham, MA 01701.  
IC registration : 3232A  
FCC site registration under A2LA cert. #1514

This report relates only to the items tested.

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## 2 Product description

The Bose RF remote control models RC35T-A, RC35T-L and RC20T are battery operated, hand-held RF remote controls for the Lifestyle® series of home theater consoles. They operate in the 2.4 GHz ISM band and differ in the following attributes, with model RC35T-A as the superset and base for comparison.

The RC35T-A is a multi-function IR and RF remote with a 2-line LCD display and flash memory.

Model RC35T-L has reduced functionality that does not require flash memory. Flash memory chip U200 (see schematic) and associated parts are not populated.

Model RC20T does not have the extra flash memory and does not have a LCD display. Flash memory chip U200, connector J400, LCD backlight driver (U450) and the LCD display are not present in this version.

## 3. Applicable standards, requirements and tests

RSS gen	RSS 210	ICES-003 CSA-CISPR22	FCC part	Test references.	Status/ Test reference
5.3			15.15(b)	There are no user-accessible controls in the device under test.	
			15.27	There are no special devices such as shielded cables or special connectors required for compliance to the applicable standards.	
			15.203	The device uses a unique connector in line to the permanently attached antenna.	
	2.2		15.205	The device does not operate in either the US or Canadian restricted bands.	
7.2.2		5.1	15.207	Conducted emissions	Not applicable, battery operated
		6	15.109	Radiated emissions, un-intentional device	Complies, See section 6.1
	A2.9 (a)		15.249 (a)	Transmitter field strength	Complies, see section 6.2
	A2.9 (a)		15.249 (a)	Transmitter harmonics	Complies, see section 6.3
				Occupied Bandwidth	for reference only see Section 6.4
6(b)	2.3		15.111	Receiver conducted spurious emissions	Not required for permanently attached antenna's
	2.2		15.249 (b) 15.209	Transmitter spurious (unwanted) emissions	Complies See section 6.5

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## 4 Environmental Conditions

All testing is performed under the following conditions, unless otherwise defined in the detail test report section.

Temperature:  $22 \pm 4$  °C

Humidity: 30 – 60 % RH

## 5 EUT configuration.

The EUT is a stand-alone, battery operated product without any attached cables or connectors for users to attach cables to. It is a 2.4 GHz ISM band low power transmitter with an integral, non detachable antenna. Tests to determine the maximum output power (field strength) are made with the EUT in 3 orthogonal positions.

The EUT is controlled via a serial interface cable (19200 baud, 8 bit, no parity) to a test connector.

The commands to set the channel and duty cycle are:

PTcc ; The channel designation cc in hex.

The low channel is 05, the mid channel is 7B and the high channel is F6.

PL ; this locks the channel being used

Py1; this sets the duty cycle

The duty cycle is set to the highest the remote can achieve with a continued keypress, for instance a continual “volume up” command.

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## 6. Detailed Test Results.

### 6.1. Radiated emissions 30 MHz – 1 GHz

#### 6.1.1. Requirements

FCC rules part 15.109 (g), CAN-CSA-CISPR22 section 6 class B\*

Frequency	Limit in dB $\mu$ V/m @3m
MHz	Quasi-peak
30 – 230	40
230 - 1000	47

\* The 10 meter limits as defined in CAN-CSA-CISPR22 have been scaled to 3 meters using the 1/d formula

#### 6.1.2. Test setup details

The EUT is placed in the center of an 80 cm high non-conductive turntable and programmed to constantly transmit. The EUT is scanned in both H and V polarizations, the turntable is rotated over 360 degrees and the antenna height is varied from 1 to 4 meters at a distance of 3 meters in order to find the maximum emissions in the pre-scan. After the maximum emissions are determined in this mode, each point within 6 dB from the limit is manually re-measured with the receiver in quasi-peak mode.

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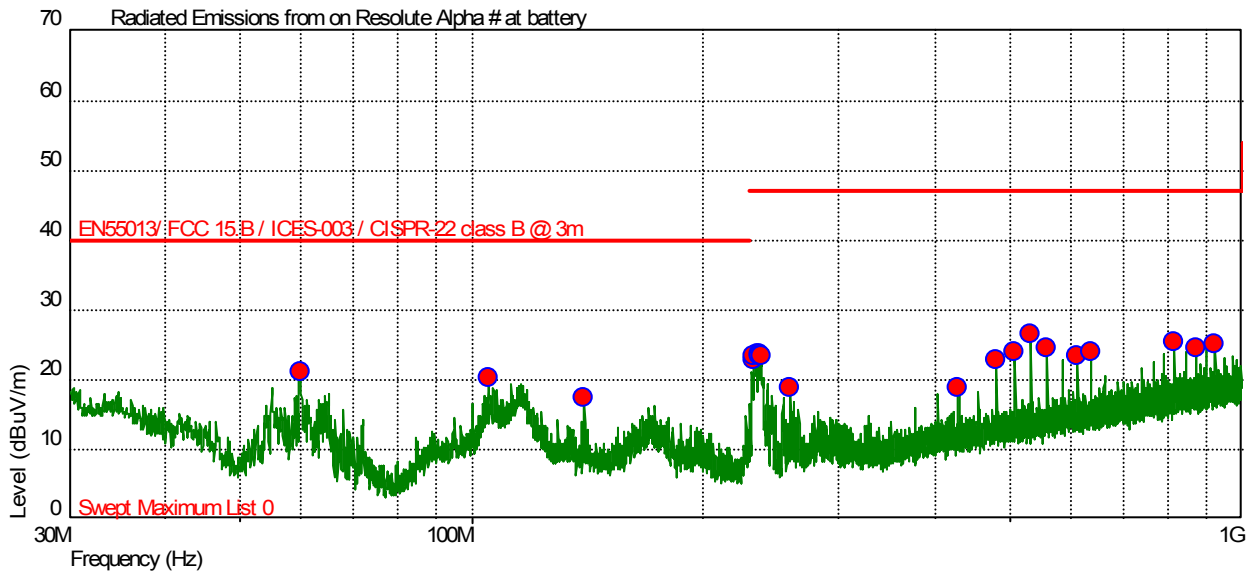
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### 6.1.3. Test data

Pre-scan data with peak detector. Antenna factors, pre-amp gain and cable losses are included in the measurement results by the measurement software.



The 6 highest emissions relative to the limit line:

Frequency (MHz)	Level (dBuV/m)	Antenna Height (m)	Polar	Table Angle Deg)	Limit (dBuV/m)	Margin (dB)	Comment
59.8	21.21	1	V	0	40	-18.79	
105.0	20.38	1.5	V	314	40	-19.62	
533.0	26.68	1.5	H	270	47	-20.32	
558.95	24.75	1.5	H	90	47	-22.25	
818.95	25.42	1	H	224	47	-21.58	
922.95	25.28	2.5	H	225	47	-21.72	

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## 6.1.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
Antenna	Sunol Sciences	JB6	TN1541	8/6/2009	8/6/2010
Pre-Amp	Rohde & Schwarz	TS-PR8	TN1669	3/5/2009	3/5/2010
Receiver	Rohde & Schwarz	ESU40	TN1663	7/29/2009	7/29/2010
8 GHz cable set	-	-	TN1445	122/2008	2/1/2010

## 6.1.5. Test information

<b>Date of test:</b>	10-29-2009	<b>EUT serial:</b>	A-23
<b>Test Location:</b>	Maxwell House	<b>Test result:</b>	Pass
<b>Tested by:</b>	Peter Boers		

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## 6.2. Output Field Strength

### 6.2.1. Requirements.

FCC 15.249 (a), RSS-210 section A2.9(a):

The maximum field strength in the frequency range of 2400 – 2483.5 MHz shall be 50mV/m (94dB $\mu$ V/m) with an average detector @ 3 meters distance. There is an implied peak limit 20 dB above the average limit

### 6.2.2. Test setup details.

The EUT is placed on a 80 cm non-conductive table according to ANSI C63.10.

It is operated in an artificial test mode simulating continual key presses at a 100 ms interval.

The EUT is tested in 3 orthogonal planes to measure the highest output field strength.

### 6.2.3. Test data.

EUT orientation	Position in frequency band	Maximum field strength (dB $\mu$ V/m @ 3m)		Antenna Polarization	Limit (dB $\mu$ V/m @ 3m)		Margin (dB)
		Average	Peak		Average	Peak	
Normal	Low	88.3	103.7	H	94	114	-5.7
	Mid	85.6	100.8	H	94	114	-8.4
	High	86.7	102.0	H	94	114	-7.3
Sideways	Low	85.8	101.0	V	94	114	-8.2
	Mid	84.9	100.1	V	94	114	-9.1
	High	84.7	99.9	V	94	114	-9.3
Upright	Low	86.5	101.7	H	94	114	-7.5
	Mid	85.3	100.6	H	94	114	-8.7
	High	85.1	100.2	H	94	114	-8.9

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## 6.2.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
Antenna	Sunol Sciences	JB6	TN1541	8/6/2009	8/6/2010
Receiver	Rohde & Schwarz	ESU40	TN1663	7/29/2009	7/29/2010
Antenna cable set	-	-	TN1445	122/2008	2/1/2010

## 6.2.5. Test information

<b>Date of test:</b>	1/08/2010	<b>EUT serial:</b>	Alpha2 #201
<b>Test Location:</b>	Maxwell	<b>Test result:</b>	Pass
<b>Tested by:</b>	Peter Boers		

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## 6.3. Harmonics

### 6.3.1. Requirements.

FCC 15.249 (a), RSS-210 section A2.9(a):

The maximum field strength outside the frequency range of 2400 – 2483.5 MHz shall be 500  $\mu\text{V/m}$  (54dB $\mu\text{V/m}$ ) with an average detector @ 3 meters distance. There is an implied peak limit 20 dB above the average limit.

### 6.3.2. Test setup details.

The EUT is placed in the center of a 80 cm non-conductive table according to ANSI C63.10 The position of the highest (worst case) output field strength determined previously is used to measure the harmonics.

### 6.3.3. Test data.

Carrier [MHz]	Measured Level [dB $\mu\text{V/m}$ ]						Limit [dB $\mu\text{V/m}$ ]		Margin dB	Notes
	2401.759		2440.999		2482.073		av	pk		
Harmonic order	av	pk	av	pk	av	pk	av	pk		
2 <sup>nd</sup>	31.7	47.1	31.1	45.4	33.1	46.1	54	74	-20.9	Low: Hpol 117 cm, Table 188 Mid: Hpol 105cm, Table 188 High: Hpol 127cm, Table 179
3 <sup>rd</sup>	-	-	-	-	-	-	54	74		Not measureable, system noise floor below 26 dBuV/m average
4 <sup>th</sup>	-	-	-	-	-	-	54	74		Noise floor = 33.8
5 <sup>th</sup>	-	-	-	-	-	-	54	74		Noise floor = 36.8
6 <sup>th</sup>	-	-	-	-	-	-	54	74		Noise floor = 40.9
7 <sup>th</sup>	-	-	-	-	-	-	54	74		Noise floor = 43.7
8 <sup>th</sup>	-	-	-	-	-	-	54	74		* Noise floor = 37
9 <sup>th</sup>	-	-	-	-	-	-	54	74		* Noise floor = 38.5
10 <sup>th</sup>	-	-	-	-	-	-	54	74		* Noise floor = 40

\* measurements are made at 1 meter distance above 18 GHz

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## 6.3.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
Receiver	Rohde & Schwarz	ESU40	TN1663	7/29/2009	7/29/2010
Antenna 4 – 8G	AR	AT4003	TN727	11/24/2008	11/24/2011
8 GHz pre-amp	Rohde & Schwarz	TS-PR8	TN1669	3/5/2009	3/5/2010
8 GHz cable set	-	-	TN1445	122/2008	2/1/2010
Antenna 8 – 18G	AR	AT4004	TN728	11/24/2008	11/24/2011
Antenna cable 18GHz	Rohde & Schwarz	HFE160D	TN1692	3/5/2009	3/5/2010
20 GHz Pre-amp	MITEQ	AFS4-00102000-30-10P-4	TN1672	4/27/2009	4/27/2010
Antenna 18 – 26.5G	ETS	3160-09	TN1307	2/18/2008	2/18/2010
40 GHz pre-amp	MITEQ	JS4018004000-30-8P-A1	TN1757	Verify before use	
40 GHz cable	-	-	TN1277	Verify before use	

## 6.3.5. Test information

<b>Date of test:</b>	Jan 9, 2010	<b>EUT serial:</b>	A2-201
<b>Test Location:</b>	Maxwell	<b>Test result:</b>	Pass
<b>Tested by:</b>	Peter Boers		

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## 6.4. Occupied Bandwidth

### 6.4.1. Requirements

The 99% Bandwidth to be measured in the low, mid and high channels.

### 6.4.2. Test setup details

The EUT is connected via the build-in switch/connector to a spectrum analyzer. The Spectrum Analyzer's build-in function to measure the 99% occupied bandwidth is used.

The conducted output power in the low, middle and high end of the band is also measured for reference in other tests.

### 6.4.3. Test data

	Low	Middle	High
Actual frequency (MHz)	2401.810	2440.877	2482.004
Output power (dBm)	1.09	1.16	0.78
99% Occupied bandwidth (kHz)	775.5	781.5	757.5

### 6.4.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
Receiver	Rohde & Schwarz	ESIB40	TN1560	3/3/2009	3/3/2010
TS7 adapter cable	SMK	-	TN1808	Verify before use	

### 6.4.5. Test information

<b>Date of test:</b>	1/10/2010	<b>EUT serial:</b>	Alpha – L01
<b>Test Location:</b>	TX test bench	<b>Test result:</b>	NA
<b>Tested by:</b>	Peter Boers		

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## 6.5. Radiated spurious emissions

### 6.5.1. Requirements

FCC 15.249(d) & : Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209 or RSS210 Table 2, whichever is the lesser attenuation.

### 6.5.2. Test setup details

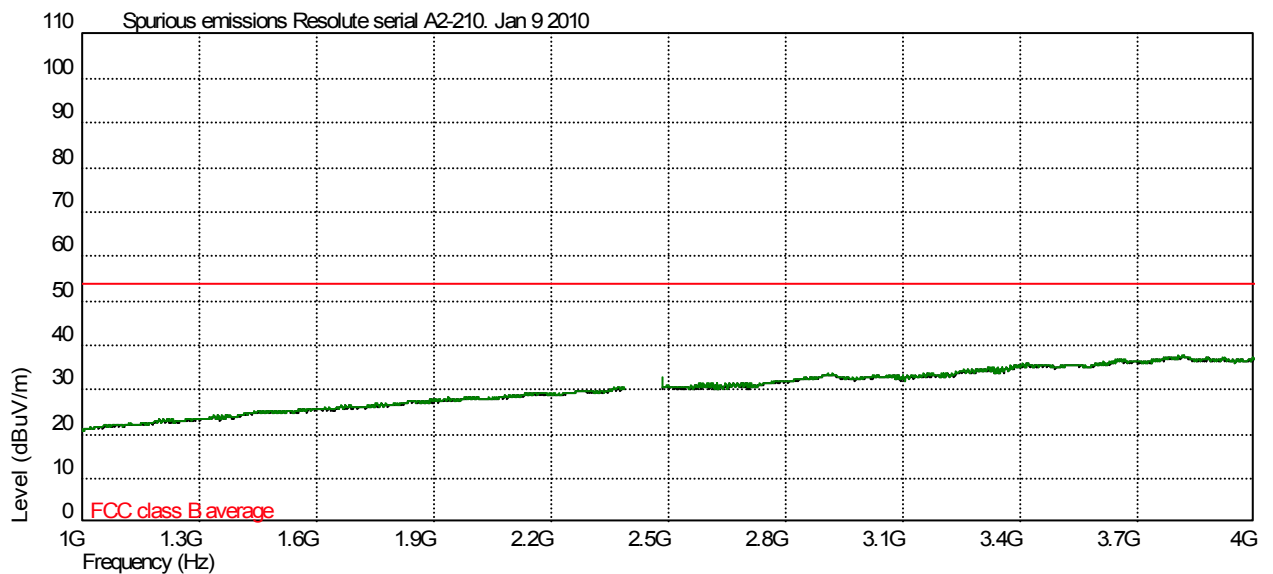
The EUT was placed in a simulated repeated key press mode and placed in a typical user position on a 80 cm non-conducted table according to ANSI C63.4. The EUT was scanned in the frequency range of 1 – 25 GHz (covering the 10<sup>th</sup> harmonic of the transmit frequency) in both Horizontal and vertical polarizations of the measurement antenna.

Measurements below 1 GHz are covered in section 1. The applied limit is FCC 15.209 and RSS210 table 2.

### 6.5.3. Test data

#### 1-4 GHz

Average detector, omitting the 2.4 GHz band



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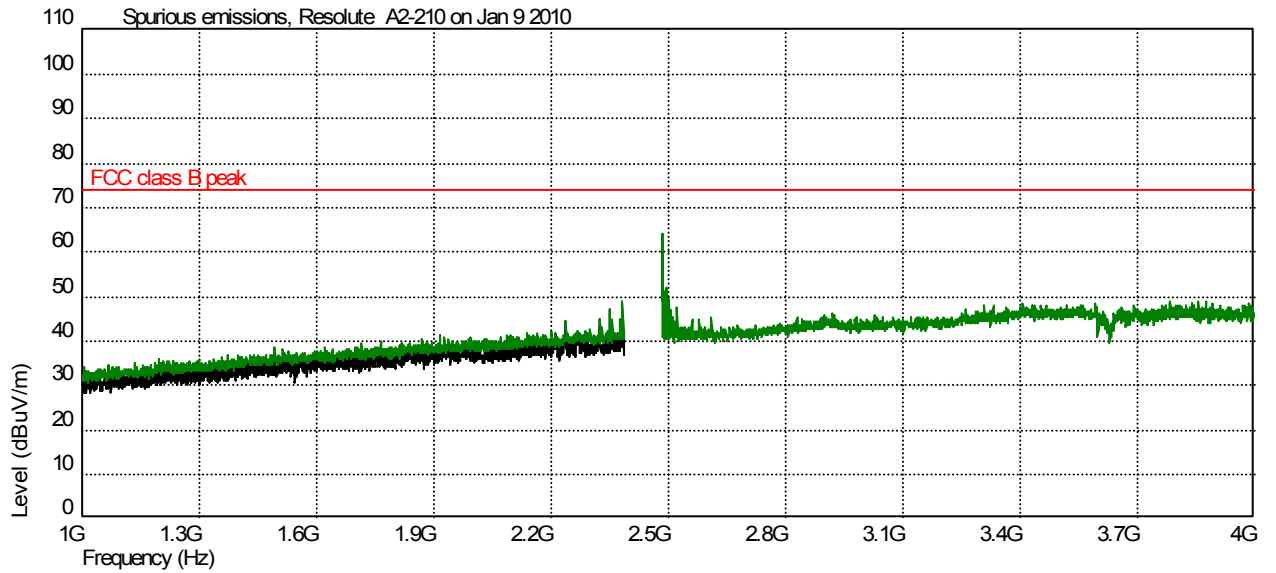


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Peak detector, omitting the 2.4 GHz Band



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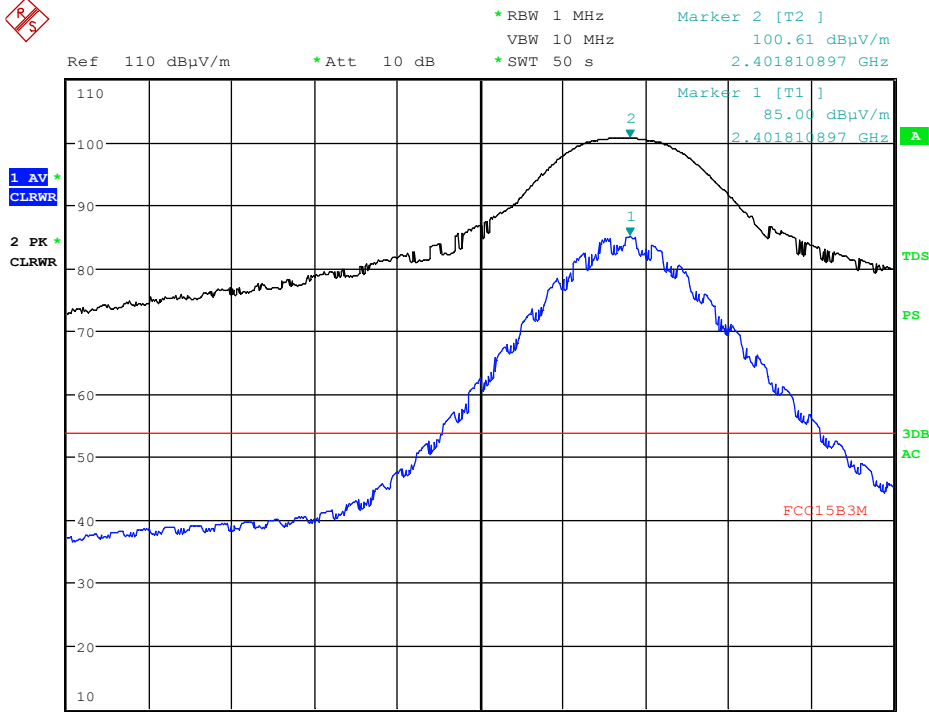


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Lower band edge measurement, marker-delta method. Center = 2400MHz  
1 MHz rbw data: maximum peak = 100.6 , maximum average = 85.0



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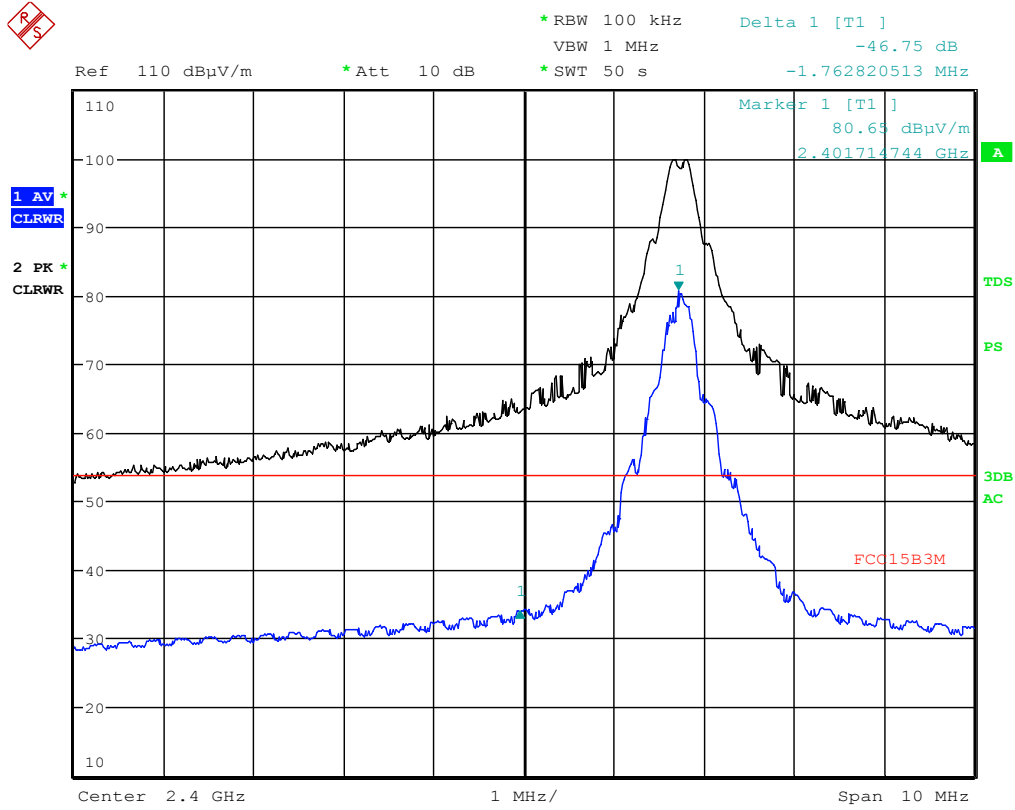


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100 KHz rbw – delta for average detector is 46.7 dB



Date: 9.JAN.2010 18:11:43

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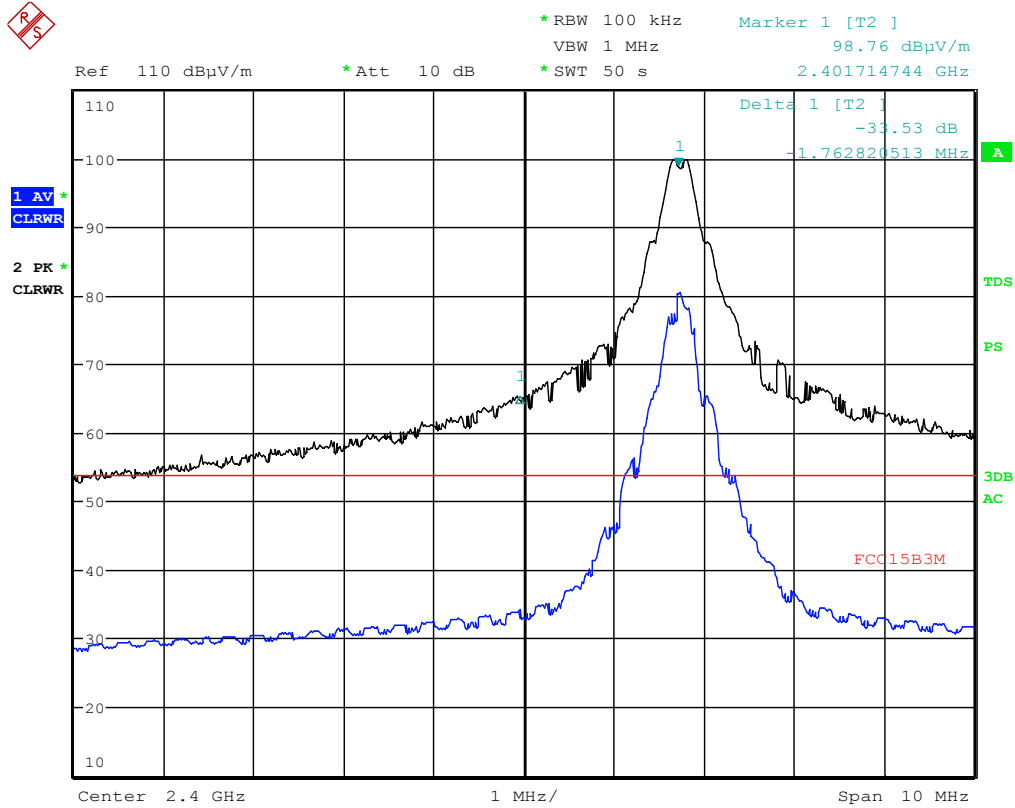
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100 kHz rbw – delta for peak detector is 33.5 dB



Date: 9.JAN.2010 18:13:53

Band edge calculation:

Average value @ band edge: 85 – 46.7 = 38.3 dBμV/m. Limit is 54

Peak value @ band edge: 100.8 -33.5 = 67.3 dBμV/m. Limit is 74

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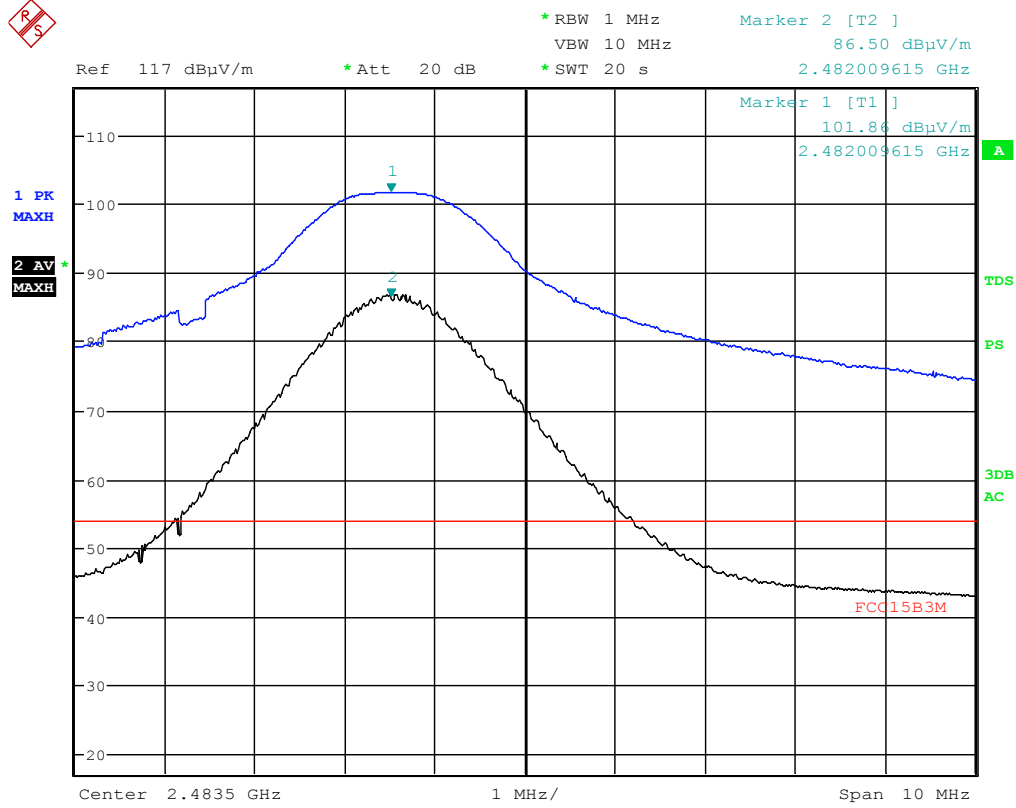
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Upper band edge measurement, marker delta method

Center = 2483.5 MHz

1 MHz rbw data: maximum peak = 101.7 , maximum average = 86.5



Date: 9.JAN.2010 18:42:46

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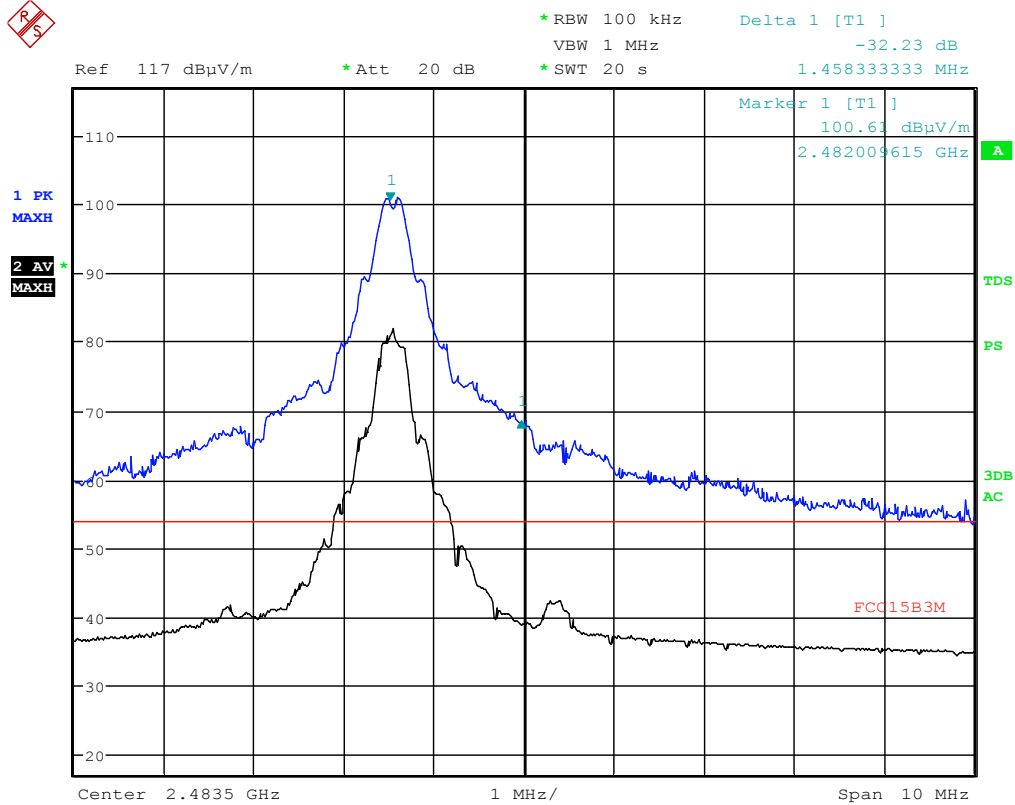


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100kHz rbw, Peak delta is 32.2 dB



Date: 9.JAN.2010 18:43:41

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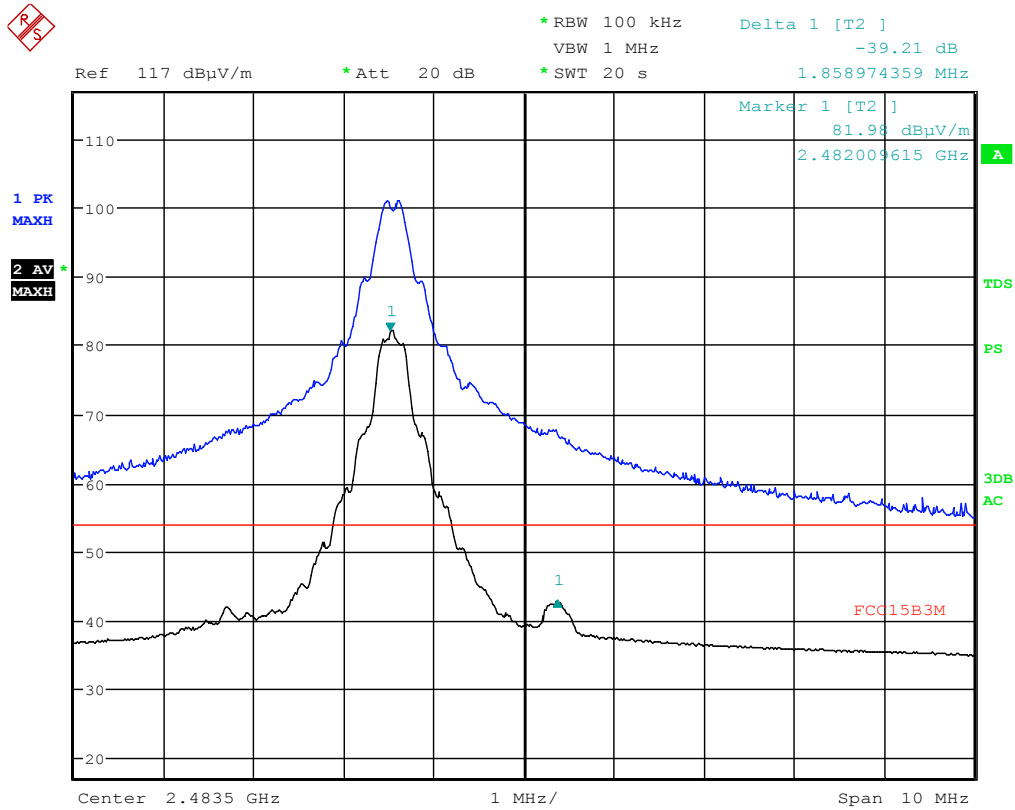


FCC id: A94403155M

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100 kHz average, delta is 39.2 dB



Date: 9.JAN.2010 18:46:56

Band edge calculation:

Average value @ band edge:  $86.5 - 39.2 = 47.3$  dBμV/m. Limit is 54

Peak value @ band edge:  $101.7 - 32.2 = 69.5$  dBμV/m. Limit is 74

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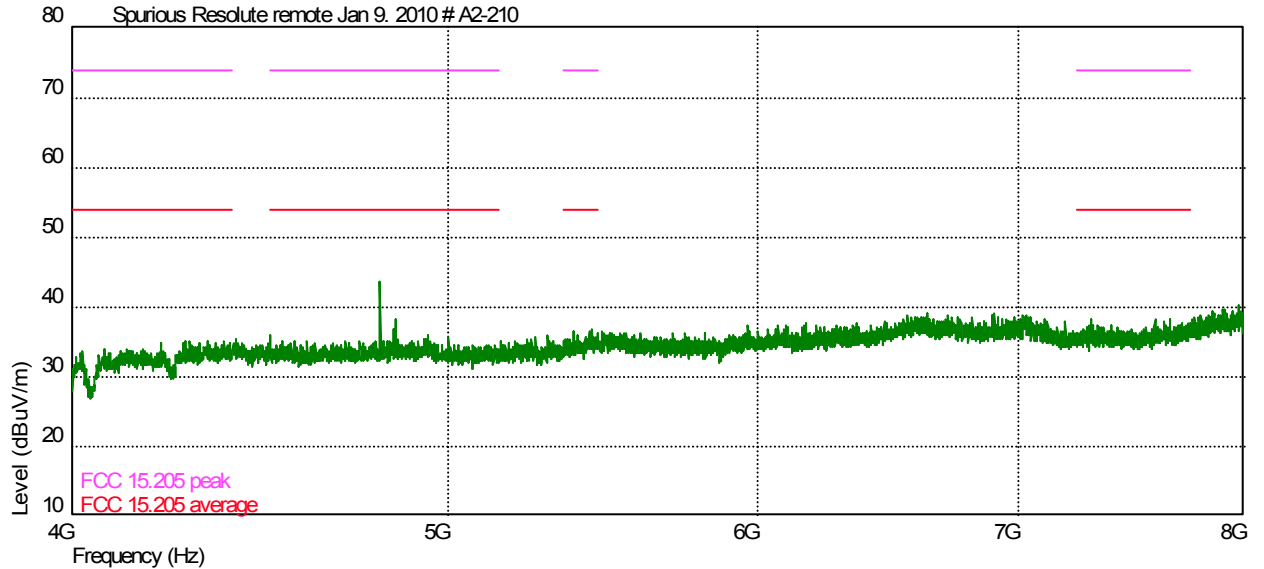


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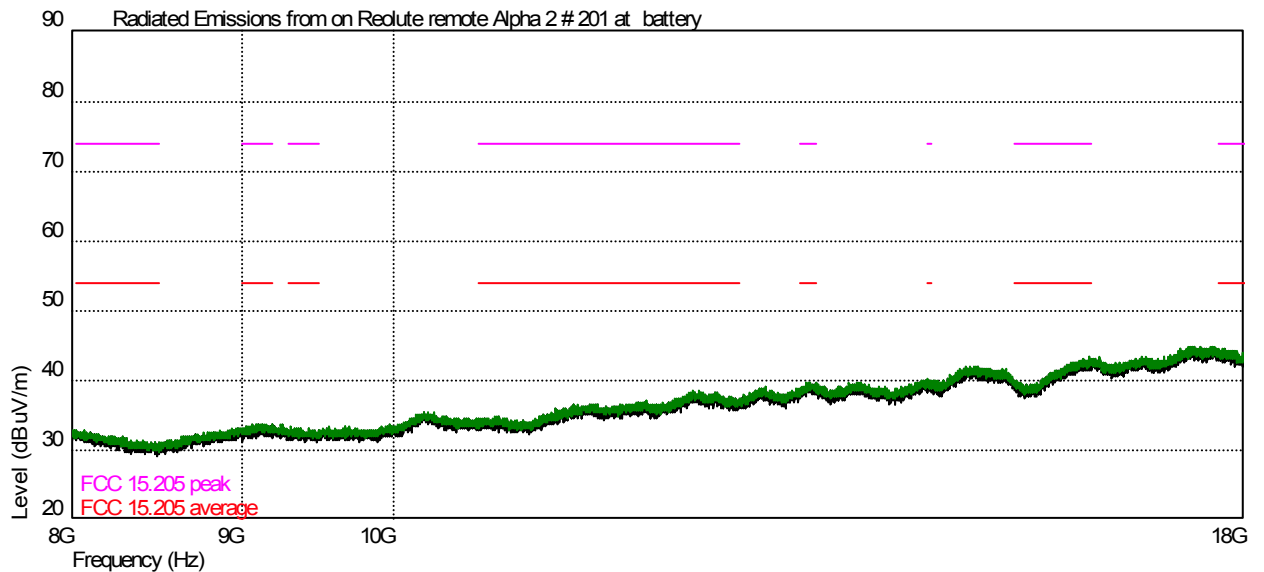
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## 4-8 GHz, peak detector



## 8-18 GHz

### Average detector



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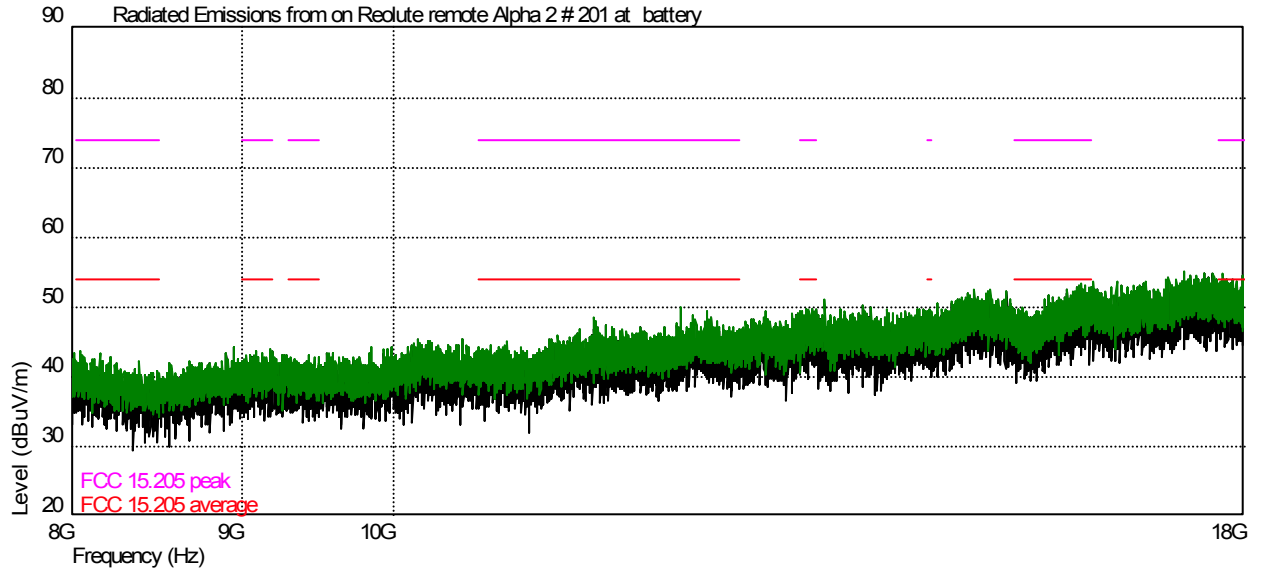


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Peak detector



## 18-25 GHz

The units were manually scanned at close distances. No emissions above the instrumentation noise floor were found. The instrumentation noise floor is > 10dB below the limit

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## 6.5.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
Receiver	Rohde & Schwarz	ESU40	TN1663	7/29/2009	7/29/2010
Antenna 4 – 8G	AR	AT4003	TN727	11/24/2008	11/24/2011
8 GHz pre-amp	Rohde & Schwarz	TS-PR8	TN1669	3/5/2009	3/5/2010
8 GHz cable set	-	-	TN1445	122/2008	2/1/2010
Antenna 8 – 18G	AR	AT4004	TN728	11/24/2008	11/24/2011
Antenna cable 18GHz	Rohde & Schwarz	HFE160D	TN1692	3/5/2009	3/5/2010
20 GHz Pre-amp	MITEQ	AFS4-00102000-30-10P-4	TN1672	4/27/2009	4/27/2010
Antenna 18 – 26.5G	ETS	3160-09	TN1307	2/18/2008	2/18/2010
40 GHz pre-amp	MITEQ	JS4018004000-30-8P-A1	TN1757	Verify before use	
40 GHz cable	-	-	TN1277	Verify before use	

## 6.5.5. Test information

<b>Date of test:</b>	Jan 9, 2010	<b>EUT serial:</b>	A2-210
<b>Test Location:</b>	Maxwell	<b>Test result:</b>	pass
<b>Tested by:</b>	Peter Boers		

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