Wireless Transceiver Test Report

FCC ID: A94403151 IC: 3232A-403151

Certificate # 1514.1

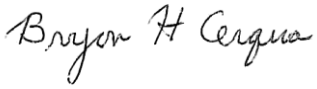
Report number: EMC.403151.10.141.1

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

Product Tested: Bose RF remote control model 403151

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: Bryan Cerqua

Signature: 

Report reviewed by: Brent G DeWitt

Signature: 

Report issue date: 5-21-2010

Bose Corporation, 1 New York Ave, Framingham, MA 01701, USA
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Bose Corporation, 1 New York Ave, Framingham, MA 01701, USA
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1 Report **Summary**

1.1 Product Bose RF remote control
Model 403151

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 model 403151 is a battery powered hand-held RF remote control for the Lifestyle® series of home theater consoles. It operates in the 2.4 GHz ISM band.

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 has no external antenna connections.	
	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 powered
		6	15.109	Radiated emissions, unintentional 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 ± 4 °C

Humidity 30 – 60 % RH

5 EUT configuration

The EUT is a stand-alone, battery powered product, with no attached cables or connectors for users to attach cables. It is a 2.4 GHz ISM band low power transmitter with an integral, non-detachable antenna. Tests to determine the maximum output field strength are made with the EUT in 3 orthogonal positions.

The EUT is controlled via a serial interface cable to an internal test connector. Test commands are sent using a serial terminal emulation program to place the remote in transmit mode simulating repetitive “mute” command button press at the fastest possible rate.

New batteries are installed prior to each test.

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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 dBµV/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 horizontal and vertical 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.

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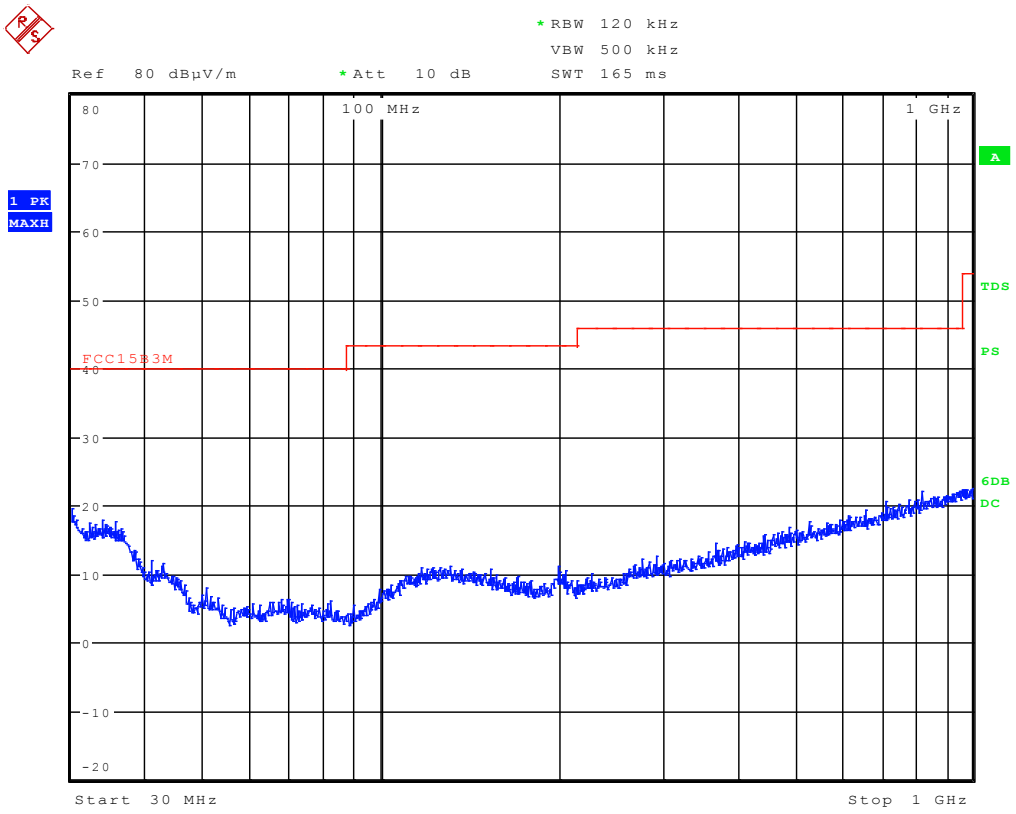
6.1.3. Test data

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



Date: 19.MAR.2010 07:25:03

Emissions are more than 20dB below the limit line.

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6.1.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
Antenna	Sunol Sciences	JB5	TN1397	5/29/2009	5/29/2010
Pre-Amp	Rohde & Schwarz	TS-PR8	TN1669	3/5/2009	4/5/2010
Receiver	Rohde & Schwarz	ESU40	TN1663	7/29/2008	7/29/2010
8 GHz cable set	-	-	TN1445	Verify before use	
Antenna cable			TN1692	4/27/2009	4/27/2010

6.1.5. Test information

Date of test:	3/19/2010	**EUT serial:**	SN0032
Test Location:	Maxwell House	**Test result:**	Pass
Tested by:	Bryan Cerqua		

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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 50 mV/m (94 dBµV/m) with an average detector at 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 an 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

Programmed frequency channel list used for the following measurements.

Low = channel 5 = 2041.765 MHz
Mid = channel 123 = 2441.058 MHz
High = channel 246 = 2481.019 MHz

EUT orientation	Position in frequency band	Maximum field strength (dBµV/m @ 3m)		Antenna Polarization	Limit (dBµV/m @ 3m)		Margin (dB)
		Average	Peak		Average	Peak	
Normal	Low	83.5	105.1	H	94	114	-8.9
	Mid	85.0	105.9	H	94	114	-8.1
	High	80.9	101.2	H	94	114	-12.8
Sideways	Low	83.3	103.9	H	94	114	-10.1
	Mid	83.1	103.4	H	94	114	-10.6
	High	81.3	101.5	V	94	114	-12.5
Upright	Low	79.2	100.6	V	94	114	-13.4
	Mid	79.7	99.8	H	94	114	-14.2
	High	79.1	99.1	H	94	114	-14.9

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6.2.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
Antenna	Sunol Sciences	JB5	TN1397	5/29/2009	5/29/2010
Receiver	Rohde & Schwarz	ESU40	TN1663	7/29/2009	7/29/2010
Antenna cable set	-	-	TN1445	5/19/2009	5/19/2010

6.2.5. Test information

Date of test:	3/9/2010	**EUT serial:**	SN0032
Test Location:	Maxwell	**Test result:**	Pass
Tested by:	Bryan Cerqua		

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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 µV/m (54dBµV/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

6.3.3. Test data (* Measurements are made at a 3 meter distance for frequencies below 18 GHz. Above 18 GHz the measurement distance is 1 meter)

	Measured Level [dBµV/m]									
Carrier [GHz]	2.402		2.441		2.482		Limit [dBµV/m]		Margin dB	
Harmonic order	av	pk	av	pk	av	pk	av	pk	av / pk	Equipment and notes
2nd	38.3	51.5	36.4	50.4	37.0	49.3	54	74	15.7 / 22.5	AR4003 & TS-PR8 (TN1669)
3rd	38.3	61.1	57.3	37.2	35.3	54.9	54	74	15.7 / 12.9	AR4003 & TS-PR8 (TN1669)
4th	-	-	-	-	-	-	54	74		AR4004 & MITEQ TN1672 Noise floor 16.8 (dBuV/m) av
5th	-	-	-	-	-	-	54	74		AR4004 & MITEQ TN1672 Noise floor 16.8 (dBuV/m) av
6th	-	-	-	-	-	-	54	74		AR4004 & MITEQ TN1692 Noise floor 17.0 (dBuV/m) av
7th	-	-	-	-	-	-	54	74		AR4004 & MITEQ TN1672 Noise floor 17.2 (dBuV/m) av
8th	-	-	-	-	-	-	54	74		TN1307 & MITEQ TN1757 * Noise floor >10dB below limit
9th	-	-	-	-	-	-	54	74		TN1307 & MITEQ TN1757 * Noise floor >10dB below limit
10th	-	-	-	-	-	-	54	74		TN1307 & MITEQ TN1757 * Noise floor >10dB below limit

Measurements done in ESU receiver mode, tuned for maximum, RBW=1MHz, MT=1S, ATTN=0dB

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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	7/29/2008	7/29/2010
Antenna 4 – 8G	AR	AT4003	TN727	8/24/2008	8/24/2010
8 GHz pre-amp	Rohde & Schwarz	TS-PR8	TN1669	3/5/2009	6/5/2010
Antenna 8 – 18G	AR	AT4004	TN728	11/24/2008	11/24/2011
Antenna cable 18 GHz	Rohde & Schwarz	HFE160D	TN1692	4/27/2009	5/27/2010
20 GHz Pre-amp	MITEQ	AFS4-00102000-30-10P-4	TN1672	4/27/2009	5/27/2010
Antenna 18 – 26.5G	ETS	3160-09	TN1307	2/18/2008	2/18/2011
40 GHz pre-amp	MITEQ	JS4018004000-30-8P-A1	TN1757	Verify before use	

6.3.5. Test information

Date of test:	5/20/2010	**EUT serial:**	SN A3
Test Location:	Maxwell	**Test result:**	Pass
Tested by:	Bryan Cerqua		

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6.4. Occupied Bandwidth

6.4.1. Requirements

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

6.4.2. Test setup details

The EUT is connected via the internal circuit board mounted switch/connector to a spectrum analyzer. The Spectrum Analyzer's built in function to measure the 99% occupied bandwidth is used.

The conducted output power at 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
Channel number (decimal)	5	123	246
Program center frequency (MHz) [1]	2041.765	2441.058	2481.019
Measured center frequency (MHz)	2041.8	2441.1	2482.1
Output power (dBm) [2]	1.38	1.25	0.98
99% Occupied bandwidth (kHz)	911	992	852

1 Center frequency = 2400.1 + (channel number)*333 KHz (MHz)
2 Output power was adjusted to account for loss of test cable of 1.05 dB at 2441 MHz (TN1277-18)

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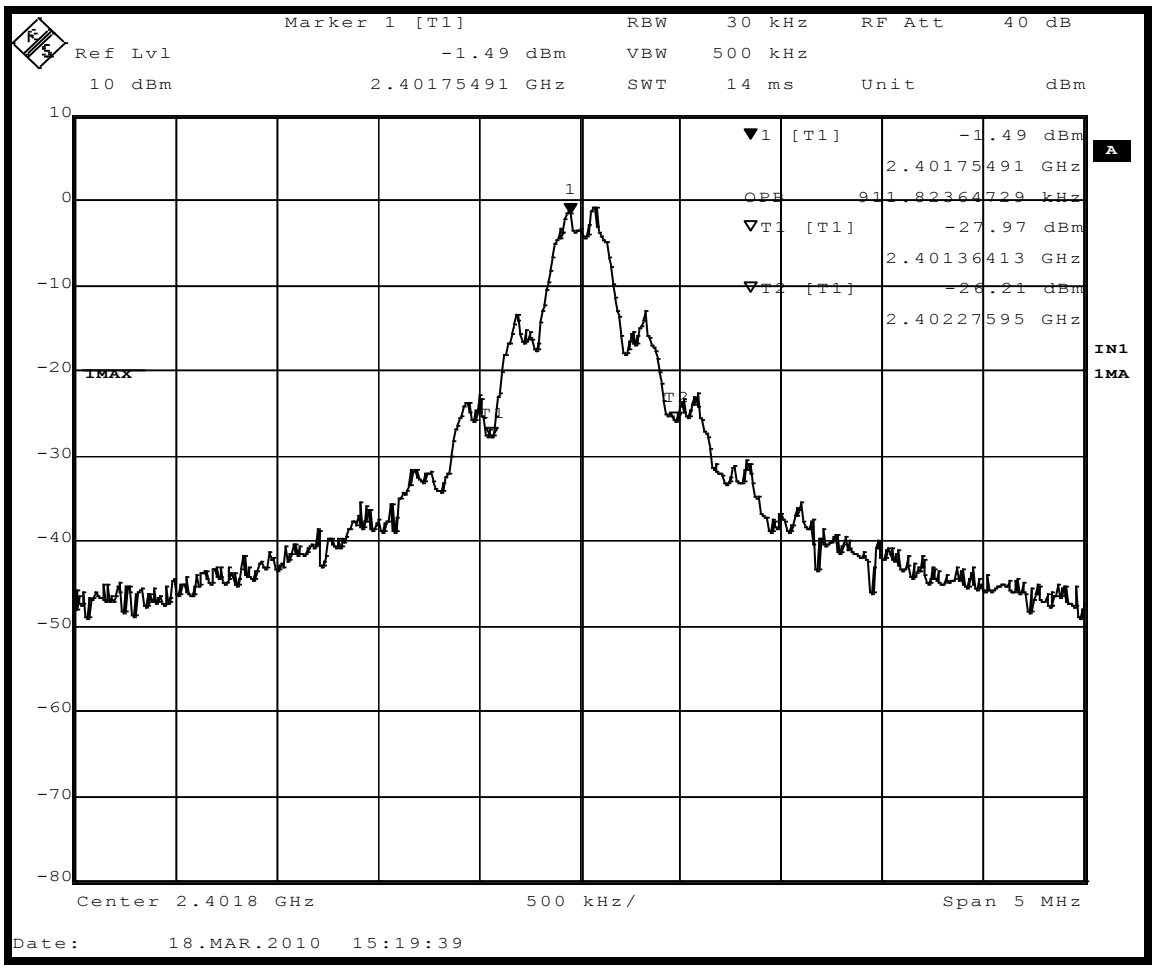
Sample 99% occupied bandwidth measurement (911 KHz) for channel 5.



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6.4.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
Receiver	Rohde & Schwarz	ESIB40	TN1560	4/9/2009	4/9/2011
TS7 adapter cable	SMK	-	TN1808	Verify before use	
1 meter test cable	Cage	-	TN1277-18	Verify before use	

6.4.5. Test information

Date of test:	3/10/2010	**EUT serial:**	SN0042
Test Location:	TX test bench	**Test result:**	NA
Tested by:	Bryan Cerqua		

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6.5. Radiated spurious emissions

6.5.1. Requirements

FCC 15.249(d) & RSS210: 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

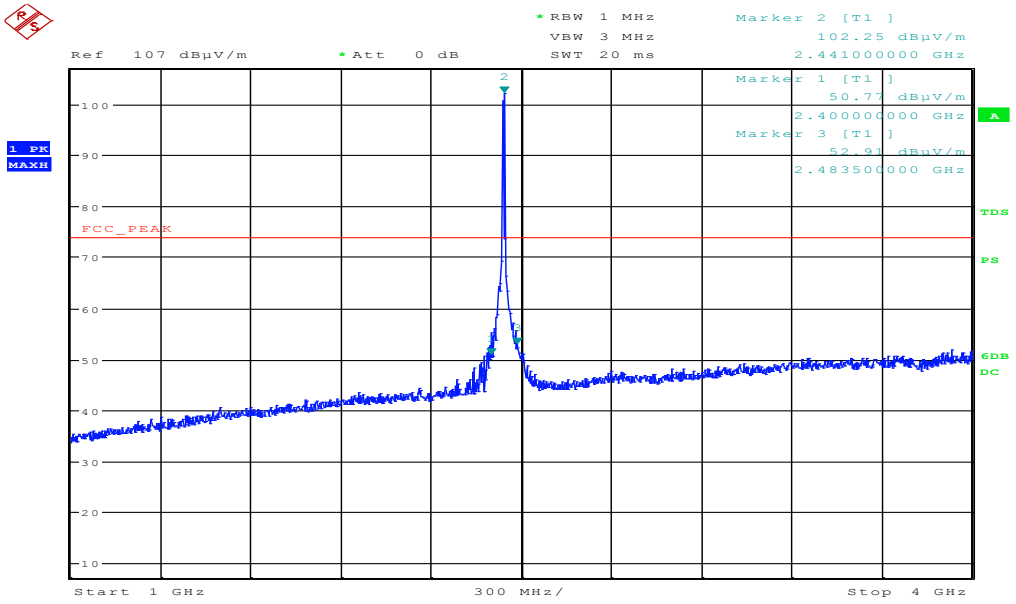
The EUT was placed in a simulated repeated key press mode and placed in a typical user position on an 80 cm non-conducted table according to ANSI C63.4. The EUT was scanned in the frequency range of 1 – 25 GHz (covering the 10th harmonic of the transmit frequency) in both horizontal and vertical polarizations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

Measurements below 1 GHz are covered in section 6.1. The applied limit is FCC 15.209 and RSS210 table 2.

6.5.3. Test data

1 - 4 GHz

Peak detector



Date: 19.MAR.2010 08:13:57

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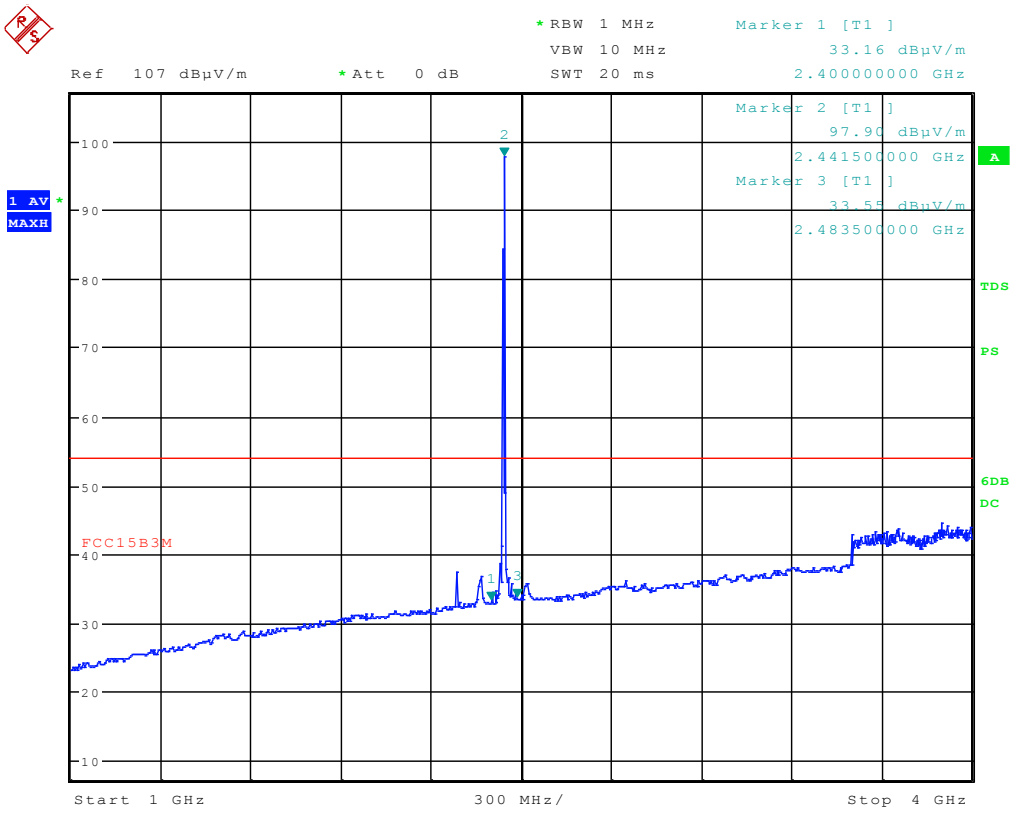
1 – 4 GHz

Average detector



Date: 19.MAR.2010 08:01:48

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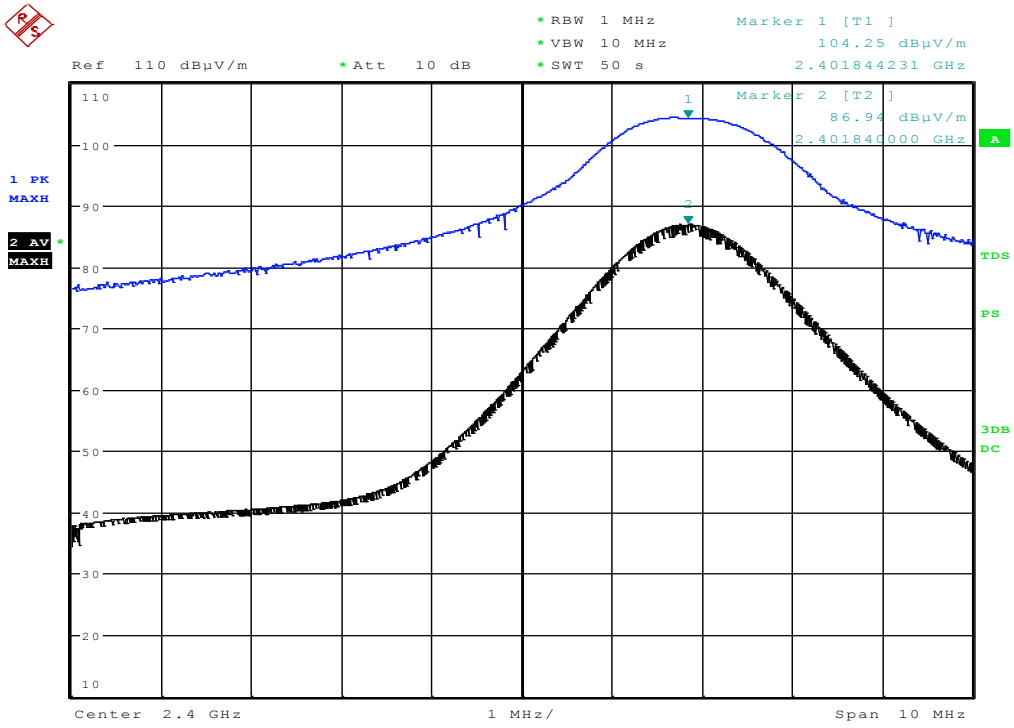
Band edge measurement using marker delta method.

Lower band edge

2.4017 GHz (channel 5)

Center frequency = 2400 MHz, RBW=1 MHz

Maximum peak 104.25, maximum average 86.94 (dBuV/m)



Date: 27.FEB.2010 10:10:56

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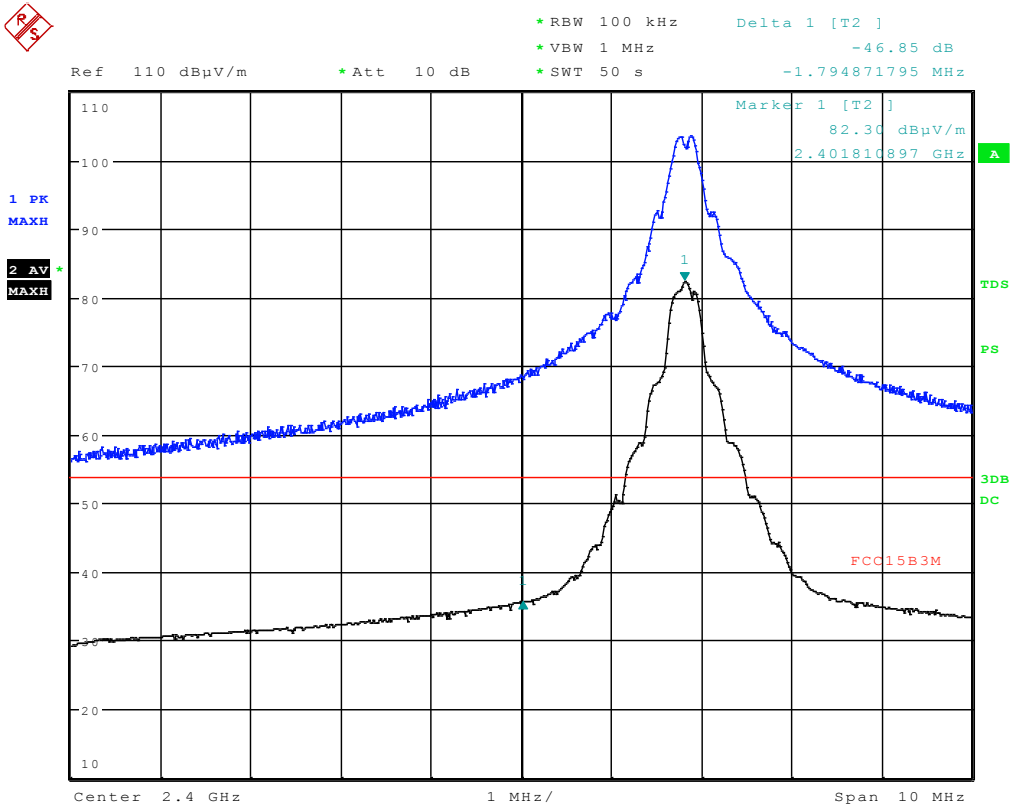
Center frequency is 2.400 GHz

100 kHz delta for average detector is 46.85 dB



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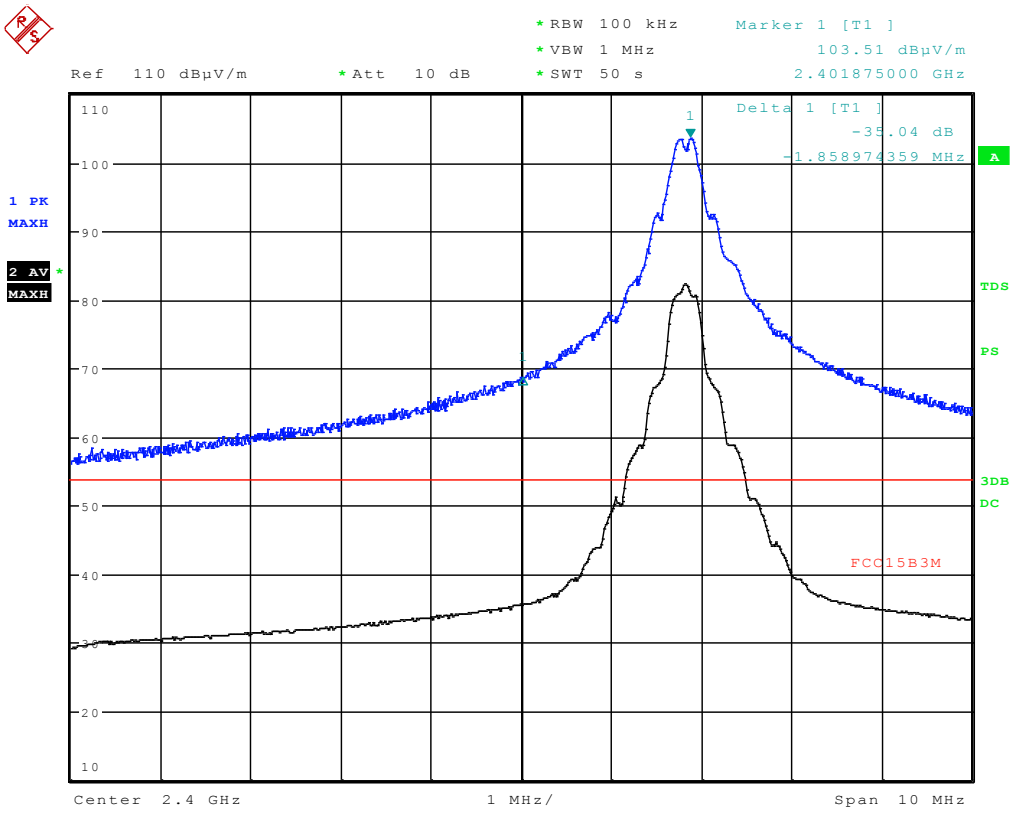
100 kHz RBW delta for peak detector is 35.04 dB
Center frequency is 2.400 GHz



Date: 27.FEB.2010 10:27:02

Average value at lower band edge (CH5): 86.94 – 46.85 = 40.09. Limit is 54.
Peak value at lower band edge (CH5): 104.25 – 35.04 = 69.21. Limit is 74.

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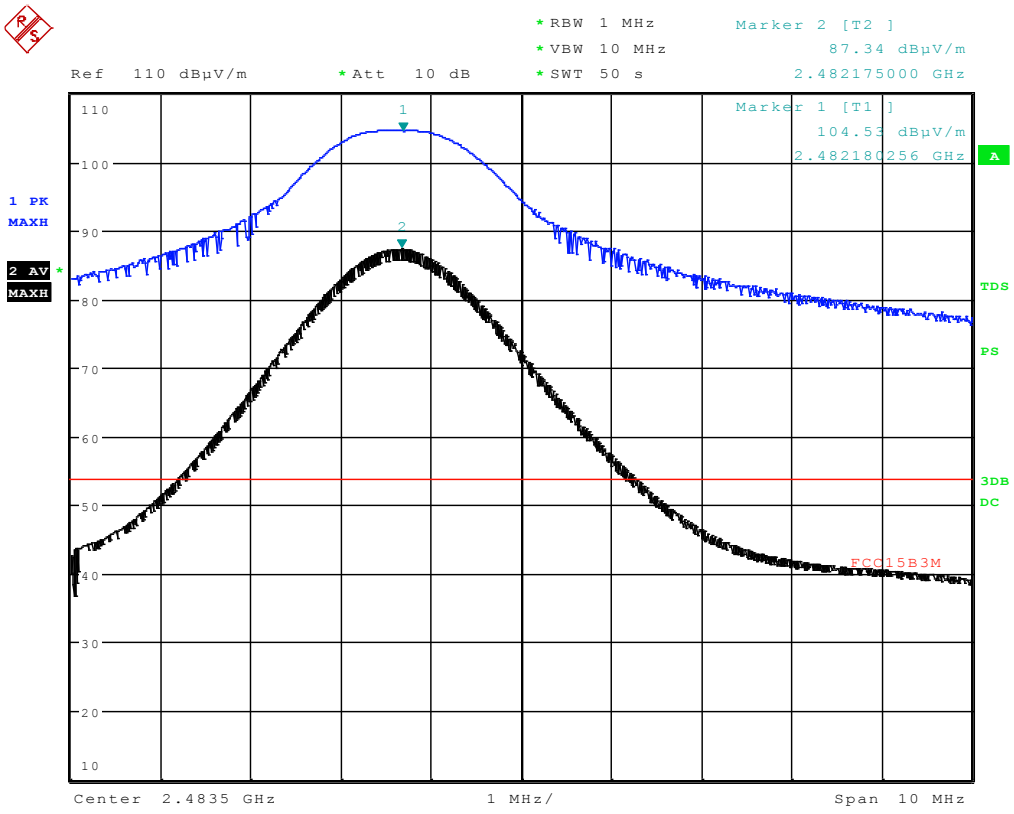
Upper band edge

2.482 GHz (channel 246 = 0xF6)

Center frequency is 2.4835 GHz, RBW = 1 MHz

Maximum peak 104.53, maximum average 87.34 (dBuV/m)



Date: 27.FEB.2010 10:41:14

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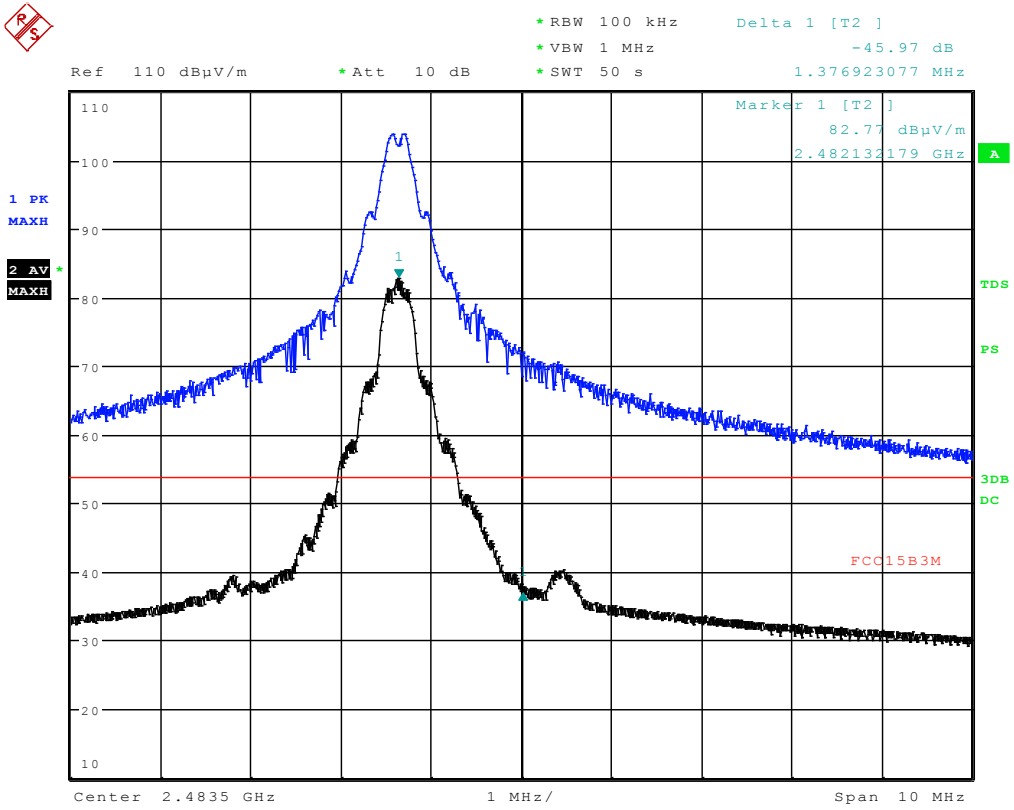
RBW=100 kHz
100 kHz delta for average detector is 45.97 dB.
Center frequency is 2.4835 GHz



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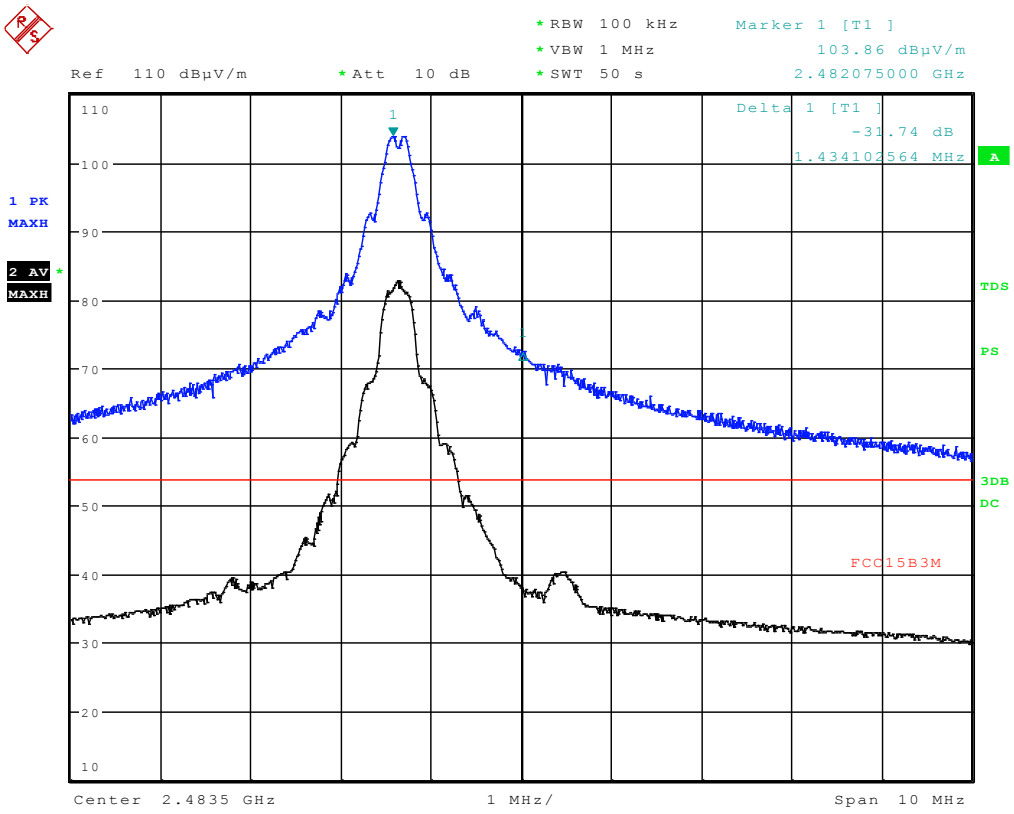
RBW=100 kHz
100 kHz delta for peak detector is 31.74 dB.
Center frequency is 2.4835 GHz



Date: 27.FEB.2010 10:51:22

Average value at upper band edge (CH 0xF6): 87.34 – 45.97 = 41.37 Limit is 54.
Peak value at upper band edge (CH 0xF6): 104.53 – 31.74 = 72.79 Limit is 74.

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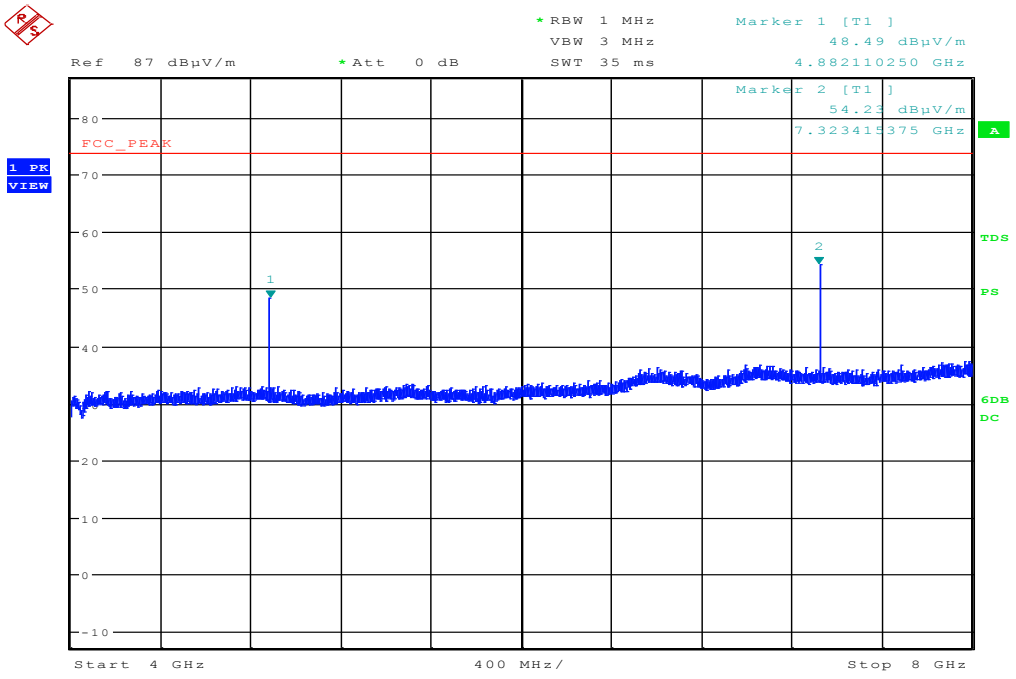
Spurious emissions 4 - 8 GHz, peak detector

(EUT programmed to channel 123, center frequency = 2441.058 MHz)

Measurement distance is 3 meters.



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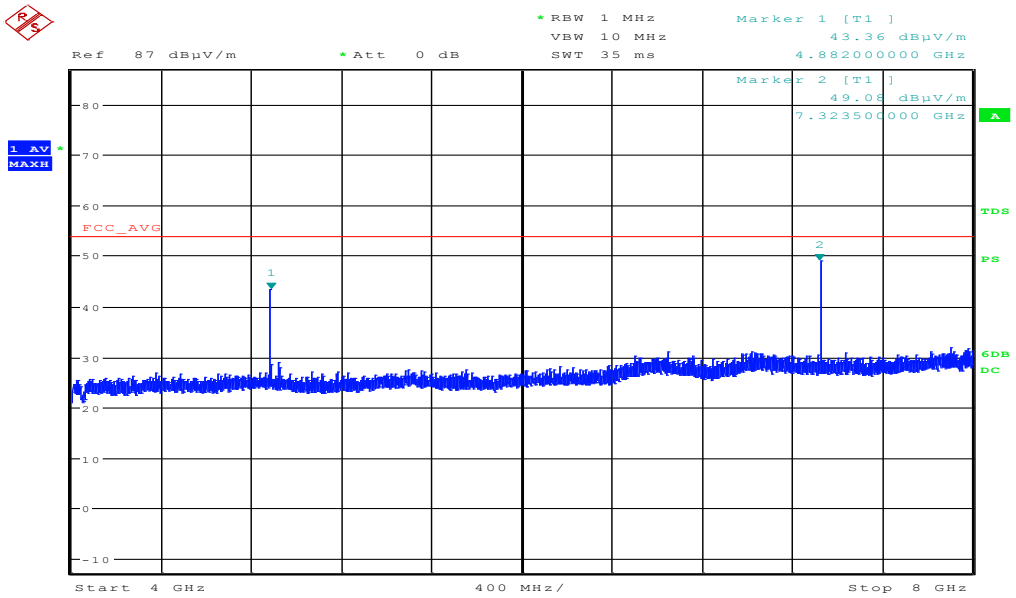
Spurious emissions 4 - 8 GHz, average detector

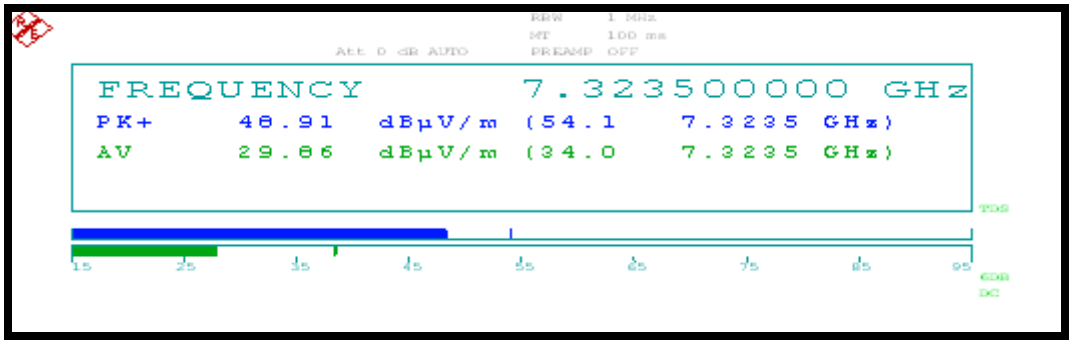
(EUT programmed to channel 123, center frequency = 2441.058 MHz)

Measurement distance is 3 meters.



Date: 18.MAY.2010 13:42:06

Marker 2 re- measured in ESU receiver mode for higher accuracy.



Peak margin = 74 – 54.1 = 19.9 dB

Average margin = 54 – 34.0 = 20 dB

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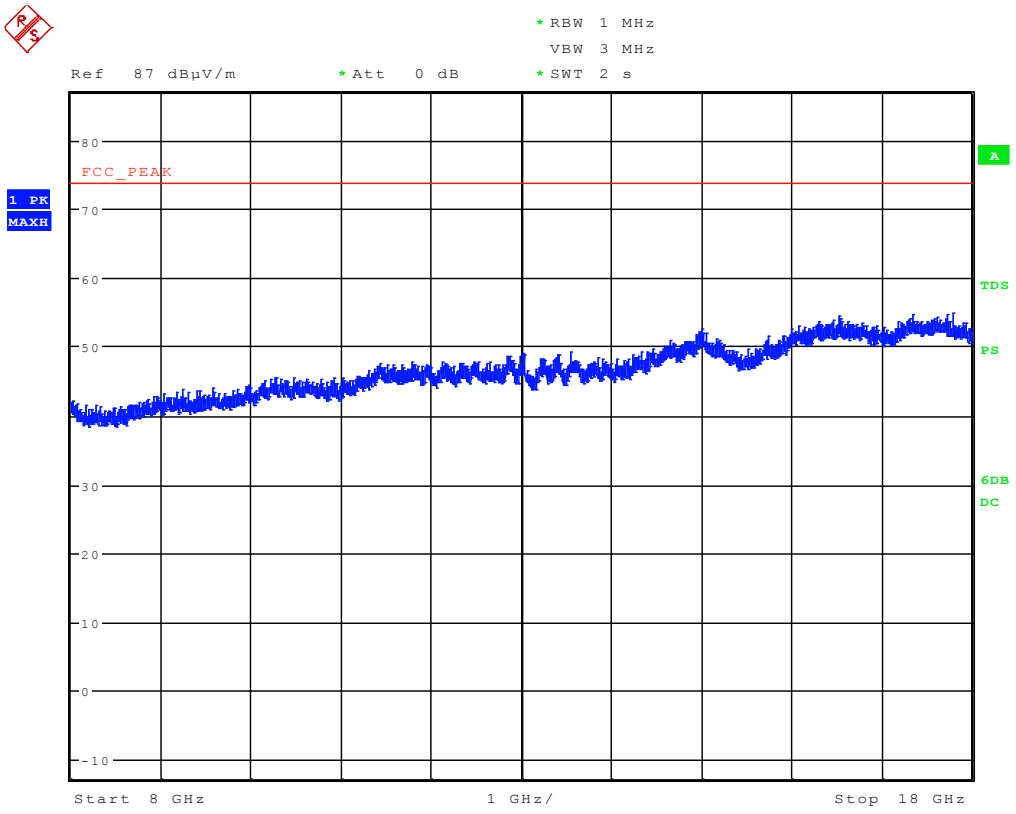
Spurious emissions 8 - 18 GHz, peak detector

(EUT programmed to channel 123, center frequency = 2441.058 MHz)

The peak limit line shown is for a distance of 3 meters; however the actual measurement distance is 1 meter.

Placed EUT on foam blocks to raise it up 110 cm to be in line with TN728 horn antenna.



Date: 18.MAY.2010 15:57:47

No emissions found above the measurement noise floor.

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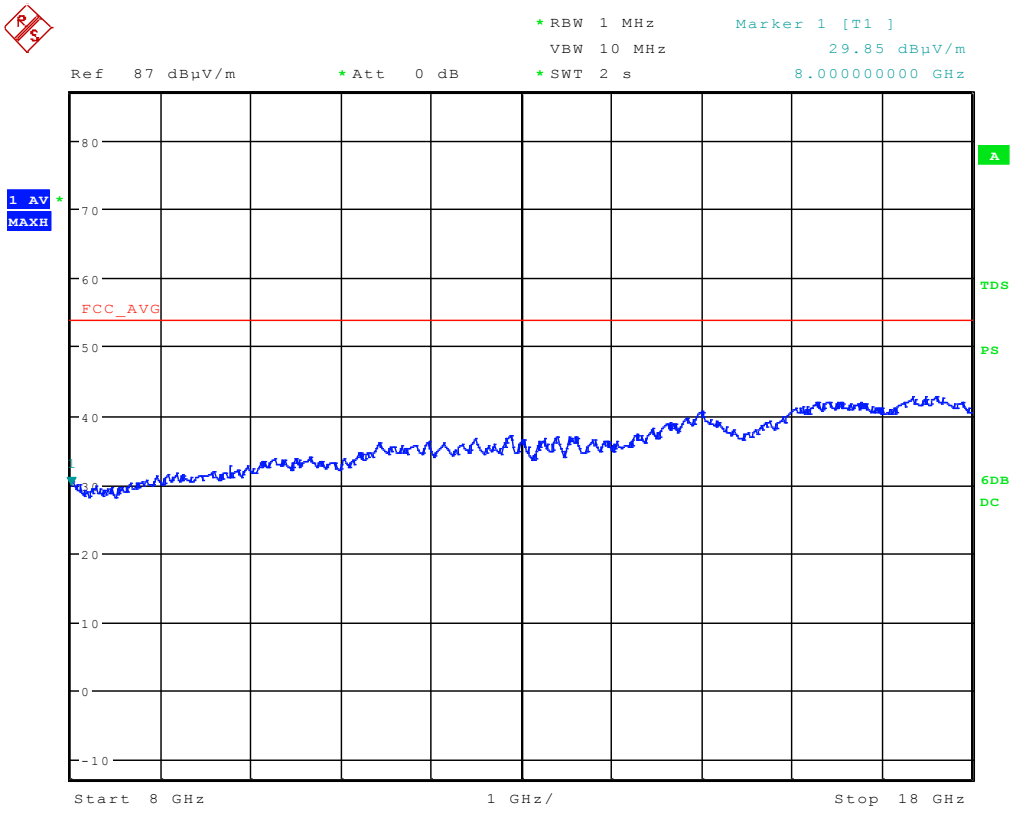
Spurious emissions 8 - 18 GHz, average detector

(EUT programmed to channel 123, center frequency = 2441.058 MHz)

The average limit line shown is for a distance of 3 meters; however the actual measurement distance is 1 meter.

Placed EUT on foam blocks to raise it up 110 cm to be in line with TN728 horn antenna.



Date: 18.MAY.2010 16:18:58

No emissions found above the measurement noise floor.

18-25 GHz.

The units were manually scanned at close distances. No emissions above the instrumentation noise floor were found. The instrument noise floor is > 10 dB 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	7/29/2008	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	6/5/2010
8 GHz cable set	-	-	TN1445	5/19/2009	5/19/2010
Antenna 8 – 18G	AR	AT4004	TN728	11/24/2008	11/24/2011
Antenna cable 18GHz	Rohde & Schwarz	HFE160D	TN1692		
20 GHz Pre-amp	MITEQ	AFS4-00102000-30-10P-4	TN1672		
Antenna 18 – 26.5G	ETS	3160-09	TN1307	2/18/2008	2/18/2011
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

Date of test:	2/27/2010-3/19/2010, 5/18/2010	**EUT serial:**	SN0032 SN A1
Test Location:	Maxwell house	**Test result:**	pass
Tested by:	Bryan Cerqua		

Bose Corporation, 1 New York Ave, Framingham, MA 01701, USA
Tel: (508) 766-6000 Fax: (508) 766-1145

6.6. Receiver spurious emissions RSS-Gen

6.6.1. Requirements

Receiver spurious emissions at any discrete frequency shall not exceed 2 nanowatts (-56dBm) in the band 30-1000 MHz, or 5 nanowatts (-53 dBm) above 1 GHz.

6.6.2. Test setup detail.

The remote is programmed to channel 123 (2441.058) GHz then placed in receive mode.

Measurements are performed directly connected to the remote using the SM7 RF test connector located on the remote PCB. The adapter test cable has a 2.2 dB loss at 2.4 GHz.

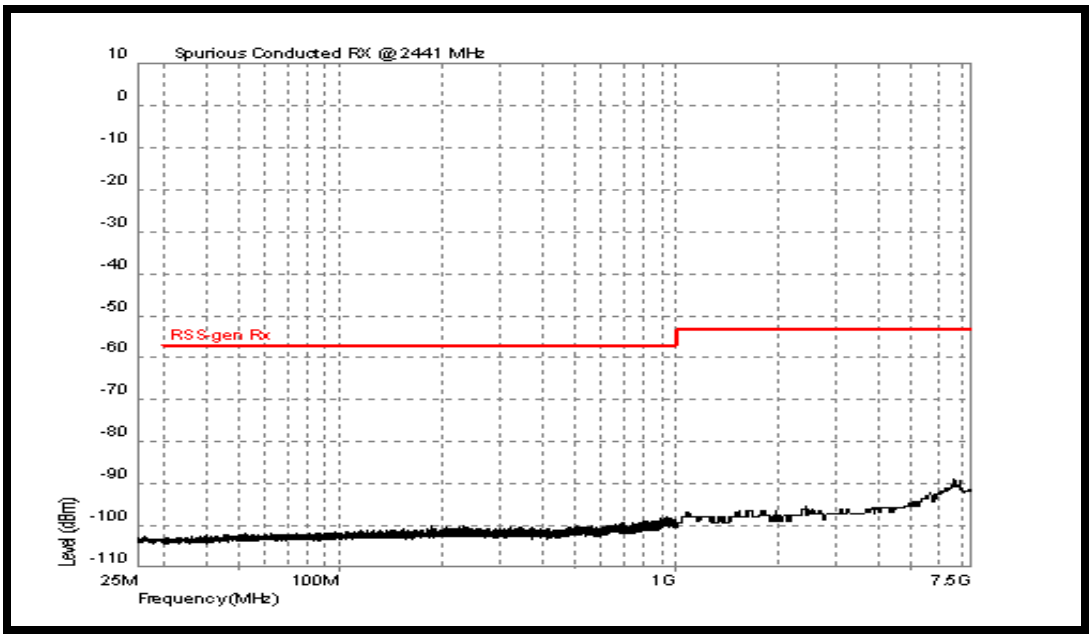
The measured frequency range is from 25 MHz to 7.5 GHz*

* (7.5 GHz ~= 3 * 2.4 GHz). Radio circuitry is a direct conversion receiver with LO at ~2.4 GHz

For 25 MHz to 1 GHz, 25 MHz span window and a peak detector with RBW=100 kHz.
For 1 GHz to 7.5 GHz, 75 MHz span window and an average detector with RBW=300 kHz

6.6.3. Test data

Emissions are more than 30 dB below the limit line.



6.6.4. Test Equipment

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Tel: (508) 766-6000 Fax: (508) 766-1145

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
Receiver	Rohde & Schwarz	ESIB 40	TN1560	4/9/2009	4/9/2011
RF Adapter cable.	SMK	-	TN1808	Verify before use	

6.6.5. Test information

Date of test:	5/18/2010	**EUT serial:**	SN A1
Test Location:	Maxwell house	**Test result:**	pass
Tested by:	Bryan Cerqua		

Bose Corporation, 1 New York Ave, Framingham, MA 01701, USA
Tel: (508) 766-6000 Fax: (508) 766-1145