



Wireless Transceiver Test Report



Certificate # 1514.1

Report number: EMC.YZU.06.315.1

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

Product Tested: Bose Wireless Surround Link (SL2)

Standards: FCC part 15.247, RSS210

Report prepared by: Peter Boers

Signature:

Report reviewed by: Joe Garwood

Signature:

Report issue date: Nov 16, 2006

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1 Report Summary

1.1 Product : Bose Wireless Surround Link (SL2)

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

1.3 Applicable Standards: FCC part 15.247
RSS210 issue 6 (Nov 2005)

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

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2 Product description

The Bose SL2 wireless surround sound link is an existing product, certified to both FCC and Industry Canada's requirement for hybrid devices in the 5.8GHz band under FCC id: A94YZUR and A94YZUT and IC: 3232A-YZUR and 3232A-YZUT.

The TX unit operates as a master, and the RX unit operates as a slave. While the designations TZ and RX are used in this report, both unit communicate in a bi-directional mode and incorporate a transceiver. The RF transceiver sections in the TX and RX unit are identical.

This report details the continued compliance after a production change is the following operating parameters and construction of these devices:

1. A change in internal clock from 12.288 MHz to 6.144 MHz. This clock frequency is the reference clock for the transceiver as well as the master clock for the digital sound processing part of the circuitry
2. A change in lead length for the antenna feed for the TX unit from approx 4.5" to 2". The antenna lead is 50 Ohm coax.
3. A change in grounding method of the shield can on the RX unit.

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3. Applicable standards, requirements and tests

RSS-GEN	RSS210	FCC part 15	Test references.
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.
	2.6	15.205	The device does not operate in either the US or Canadian restricted bands.
7.2.2		15.207	Conducted emissions: Complies. Measurement results are detailed in section 6.1
		15.209	Radiated emissions, un-intentional device: Complies. Measurement results are detailed in section 6.2
	A8.4 (4)	15.247 (b)(1)	Transmitter output power: Complies. Measurement results are detailed in section 6.3
			Occupied Bandwidth: Determine value. Measurement results are detailed in section 6.4
	A8.3(2)	15.247(e)	Power spectral density: Complies. Measurement results are detailed in section 6.5
	A8.3 (1)	15.247 (f)	Time occupancy of a frequency hopper: Complies. Measurement results are detailed in section 6.6
6(b)	2.3		Receiver spurious emissions: Complies. Measurement results are detailed in section 6.7
7.2.3		15.209 15.109	Transmitter spurious emissions: Complies. Measurement results are detailed in section 6.8.

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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 Bose Wireless Surround Link is configured for normal use. It is provided with external power supplies (6 V DC @ 0.5A linear supply for the TX unit and 24 V @ 3.5A switching supply for the RX unit). Audio input cables to the TX unit are (audio grade) shielded cables with RCA connectors on the far end of the cable and a 3.5 mm stereo jack on the TX end. The output connectors of the RX unit are RCA , with unshielded unterminated leads for the speaker connections.

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6. Detailed Test Results.

6.1. Conducted emissions.

6.1.1. Requirements

47CFR15.207 and RSS-GEN Section 7.2.2

Frequency	Limits dB(μV)	
MHz	Quasi-peak	Average
0.15 -0.5	66-56	56-46
0.5 – 1.6	56	46
1.6 – 30	60	50

6.1.2. Test setup details

Conducted emissions were tested on both the TX and RX unit when pink noise was transmitted at maximum volume. This setup results in the worst case conducted emissions for the RX unit; the audio volume has no measurable effect on the conducted emissions of the TX unit.

The EUT was tested in accordance with ANSI C63.4 test setup conditions in a typical user configuration.

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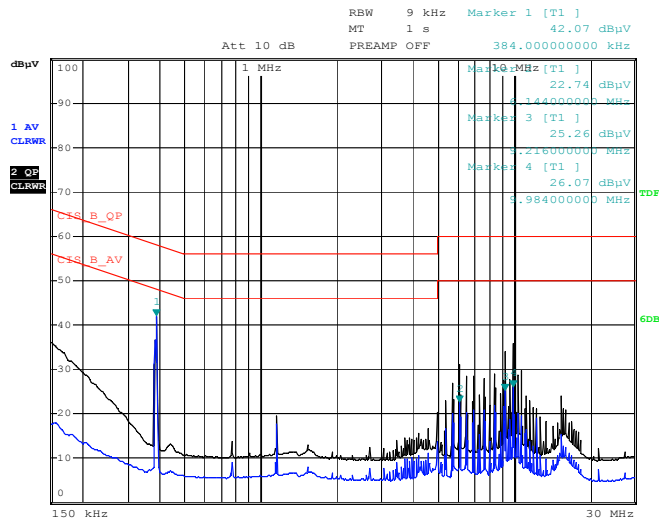
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6.1.3. Test data

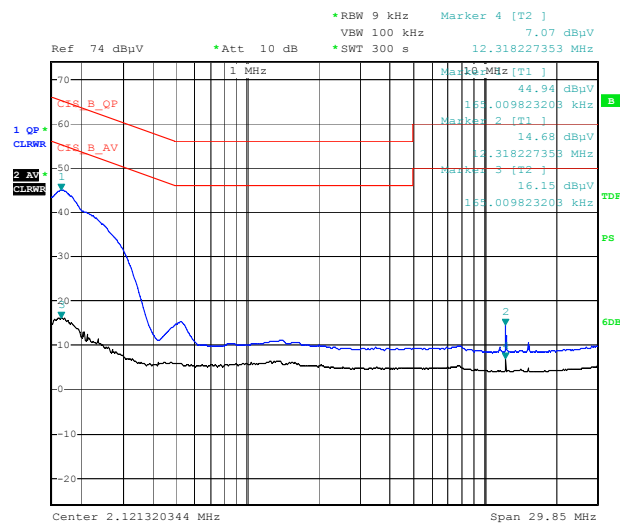
RX unit:



QP/AVG

Date: 3.NOV.2006 23:59:39

TX unit:



QP/AVG

Date: 13.NOV.2006 17:11:00

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6.1.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service due date
LISN	EMCO	3810/2	TN600	10-26-2007
Receiver	Rohde & Schwarz	ESCI	TN1452	5-2-2007

6.1.5. Test information

Date of test:	Nov 3 & Nov 13 2006	Test location :	DCE lab – Henry room
EUT serial:	2270A &B	Test result, RX:	Pass, worst case margin 6.1 dB at 384 kHz
Tested by:	Peter Boers	Test result, TX:	Pass, worst case margin 20 dB at 165 kHz

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6.2. Radiated emissions 30 MHz – 1 GHz

6.2.1. Requirements

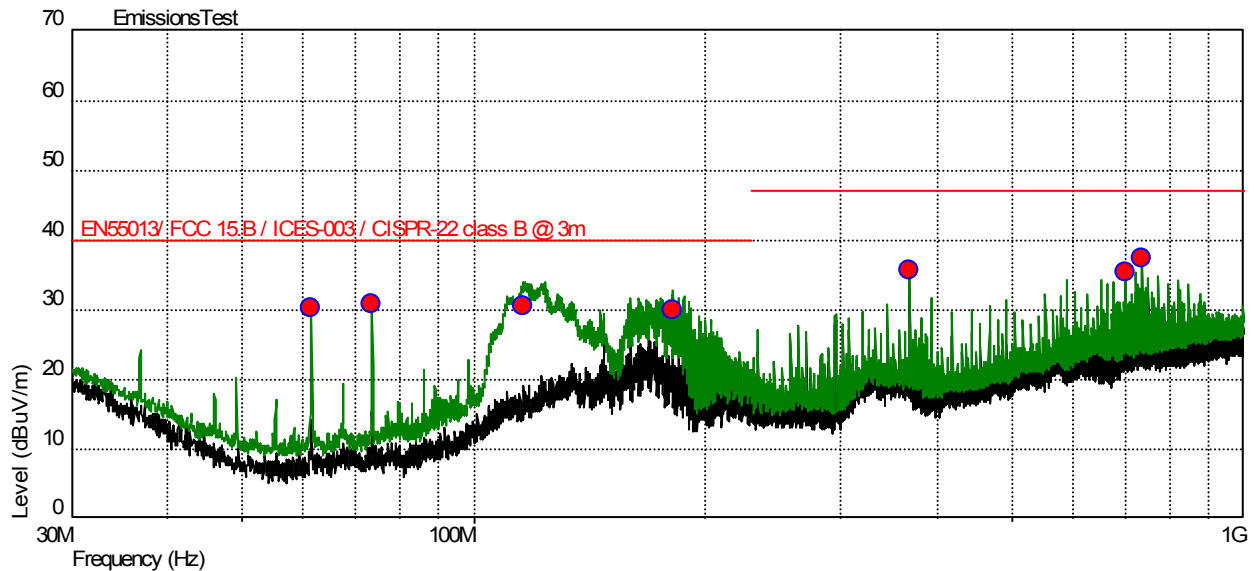
FCC rules part 15.109 (g), CAN-CSA-CISPR22 class B

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

6.2.2. Test setup details

The SL2 TX and RX units are tested as pair on the table, in a typical configuration, with the test setup according to ANSI C63.4. The units communicate with each other and pink noise is transmitted from the TX unit to the RX unit. The RX unit is connected to two speakers, producing approximately the maximum volume.

6.2.3. Test data



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Manual QP measurements are made for the 6 highest emissions relative to the limit line with the following results:

Frequency (MHz)	Level (dB μ V/m)	Height (m)	Polar	Angle (Deg)	Limit (dB μ V/m)	Margin (dB)	Comment
61.4	30.20	1.00		0	40.00	-9.8	manual QP
73.7	30.75	1.00		30	40.00	-9.25	manual QP
115.85	30.70	1.00		330	40.00	-9.3	manual QP
181.65	29.90	1.00		300	40.00	-10.1	manual QP
368.6	35.80	1.00	--	290	47.00	-11.2	manual QP
700.4	35.50	1.00		330	47.00	-11.5	manual QP
737.25	37.50	1.00		330	47.00	-9.5	manual QP

6.2.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service due date
Antenna	Sunol Sciences	JB5	TN1395	2/7/2007
Receiver	Rohde & Schwarz	ESIB40	TN1233	8/15/2007

6.2.5. Test information

Date of test:	Nov 3, 2006	Test location :	DCE - Maxwell House
EUT serial:	2270	Test routine:	C3 emissions
Tested by:	Peter Boers	Test result:	Pass with > 9 dB margin

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6.3. Peak output power

6.3.1. Requirements.

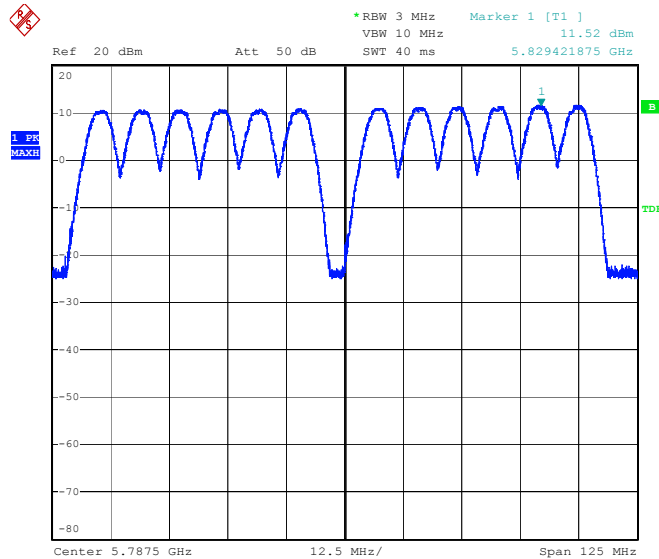
FCC 15.247(b)(1), RSS-210 section A8.4 (4).
The output power shall be less than 1 W (30 dBm)

6.3.2. Test setup details.

The transceiver is connected with a 36" low loss cable and a UFL-SMA adapter to the input of a spectrum analyzer. The transceiver is operated in an artificial test mode and programmed to hop through all channels with the carrier modulated. Data is identical for the RX and TX module.

The SA resolution bandwidth is set to 3 MHz (higher than the OBW), peak detector and max hold. The maximum output power is recorded.

6.3.3. Test data.



Date: 10.NOV.2006 12:18:27

Maximum output power is 11.52 dBm (0.0142 Watt)

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6.3.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service due date
Spectrum analyzer	Rohde & Schwarz	ESPI7	TN1420	5/2/2007
40 GHz cable			TN1277	NA

6.3.5. Test information

Date of test:	Nov 10, 2006		
EUT serial:	2270		
Tested by:	Peter Boers	Test result:	Pass

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6.4. Occupied Bandwidth

6.4.1. Requirements

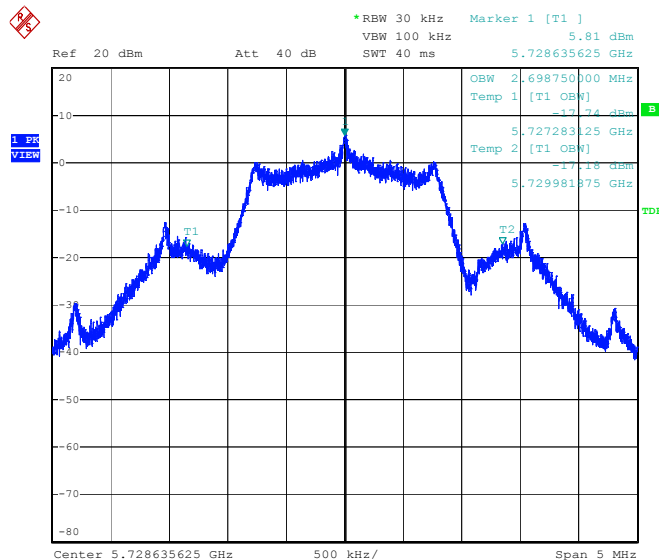
The 99% Bandwidth to be measured in the low, mid and high channels.

6.4.2. Test setup details

The transceiver is connected with a 36" low loss cable and a UFL-SMA adapter to the input of a spectrum analyzer. The transceiver is operated in an artificial test mode and programmed to hop through all channels with the carrier modulated. Data is identical for the RX and TX module.

The SA resolution bandwidth is set to 3 MHz (higher than the OBW), peak detector and max hold. The maximum output power is recorded.

6.4.3. Test data



Date: 10.NOV.2006 12:42:19

Occupied BW low channel 2.698 MHz

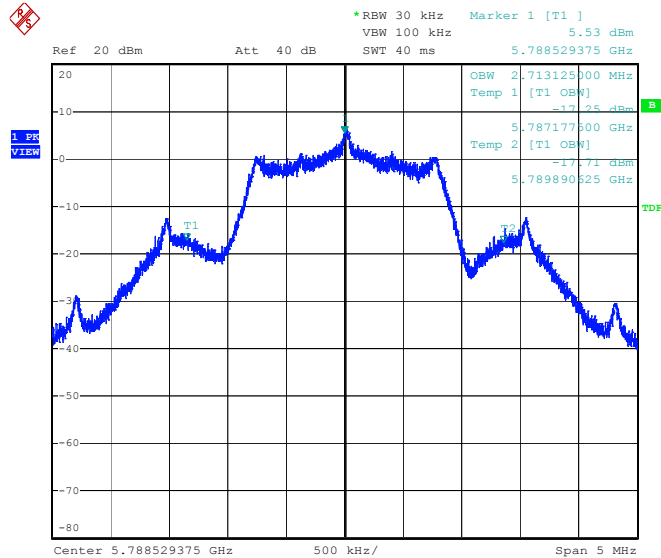
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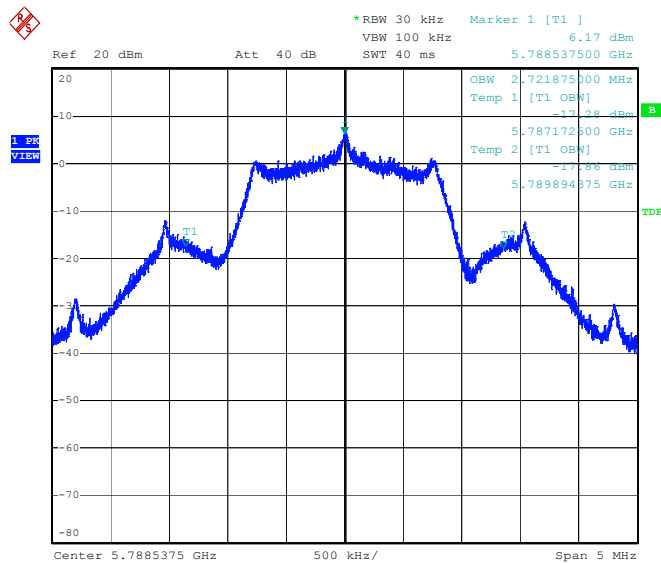


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Date: 10.NOV.2006 12:45:54

Occupied BW mid channel 2,713 MHz



Date: 10.NOV.2006 12:47:56

Occupied BW high channel 2.721 MHz

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6.4.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service due date
Receiver	Rohde & Schwarz	ESPI7	TN1420	5/2/2007
40 GHz cable			TN1277	

6.4.5. Test information

Date of test:	Nov 10, 2006		
EUT serial:	2270		
Tested by:	Peter Boers	Test result:	OBW is 2.721 MHz

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6.5. Power spectral Density

6.5.1. Requirements

FCC 15.247 (e) and RSS-210 section A8.2 (2)

The output power shall be less than 8 dBm in any 3 kHz band

6.5.2. Test setup details

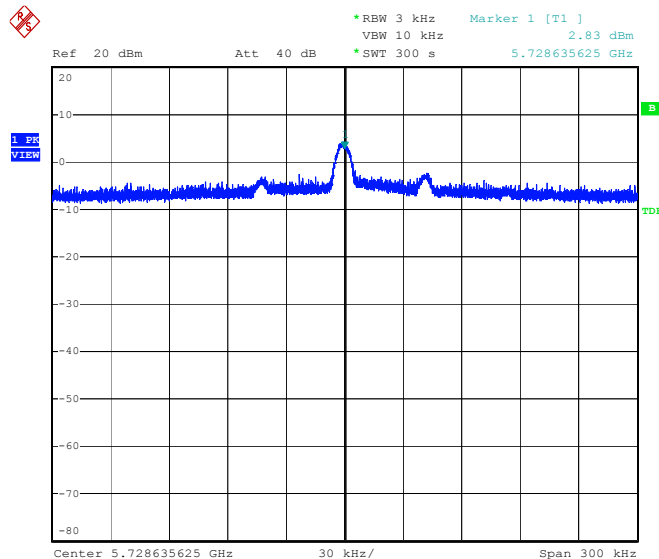
The transceiver is connected with a 36" low loss cable and a UFL-SMA adapter to the input of a spectrum analyzer. The transceiver is operated in an artificial test mode and programmed to stop the hopping sequence.

Low, mid and high channels are measured. Data is identical for the RX and TX module.

The SA RBW is set to 3 kHz, peak detector and the sweep rate is adjusted to (span/RBW) seconds.

6.5.3. Test data

Low channel, max PSD = 2.83 dBm



Date: 10.NOV.2006 13:56:54

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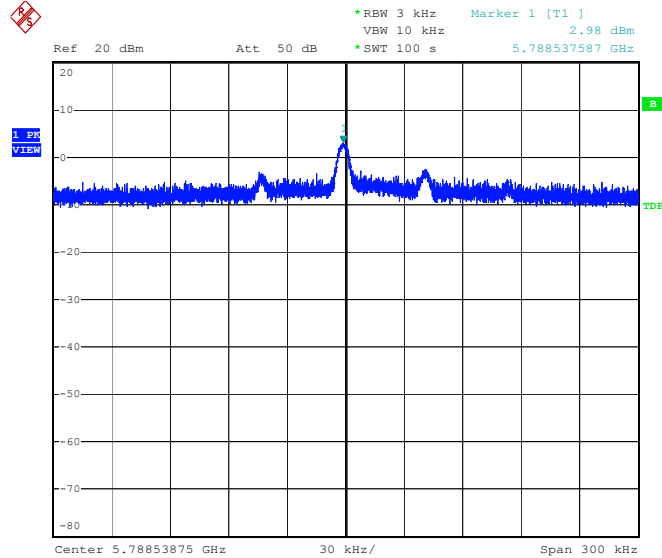


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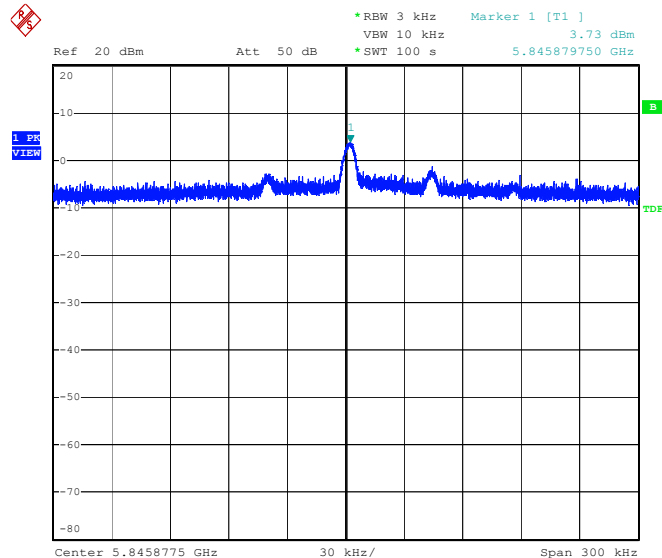
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Mid channel: PSD = 2.93 dBm



Date: 10.NOV.2006 14:04:14

High Channel: PSD = 2.73 dBm



Date: 10.NOV.2006 14:18:00

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6.5.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service due date
Receiver	Rohde & Schwarz	ESPI7	TN1420	5/2/2007
40 GHz cable			TN1277	

6.5.5. Test information

Date of test:	Nov 10, 2006		
EUT serial:	2270		
Tested by:	Peter Boers	Test result:	Pass, max PSD = 2.93 dBm

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6.6. Time of occupancy

6.6.1. Requirements

FCC 15.247 (f) and RSS-210 section A8.3 (1).

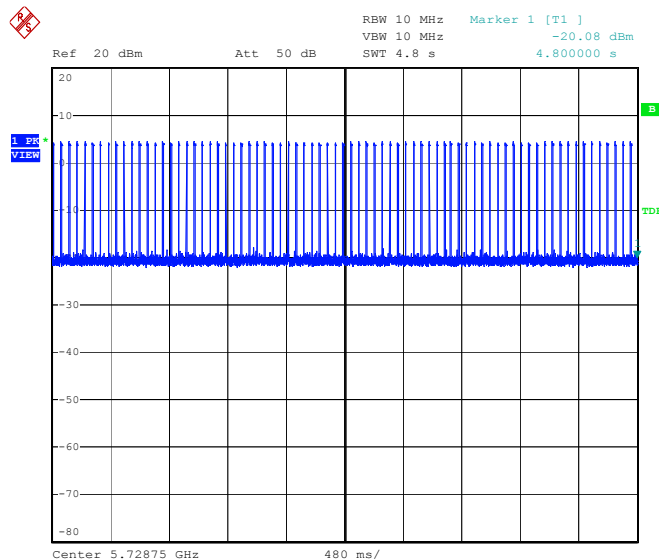
The frequency hopping operation shall have an average time occupancy on any frequency not to exceed 0.4 seconds within a duration in seconds equal to the number of hopping frequencies employed multiplied by 0.4

6.6.2. Test setup details

The SA is connected to the EUT via a low loss cable. The EUT is operating on its normal hop set. The SA sweep time is set to the number of hopping channels (12) times 0.4 seconds or 4.8 seconds.

6.6.3. Test data

Hopping time; number of hopping frequencies (12) multiplied by 0.4 seconds = 4.8 seconds



Date: 10.NOV.2006 14:26:05

There are 75 pulses in this plot

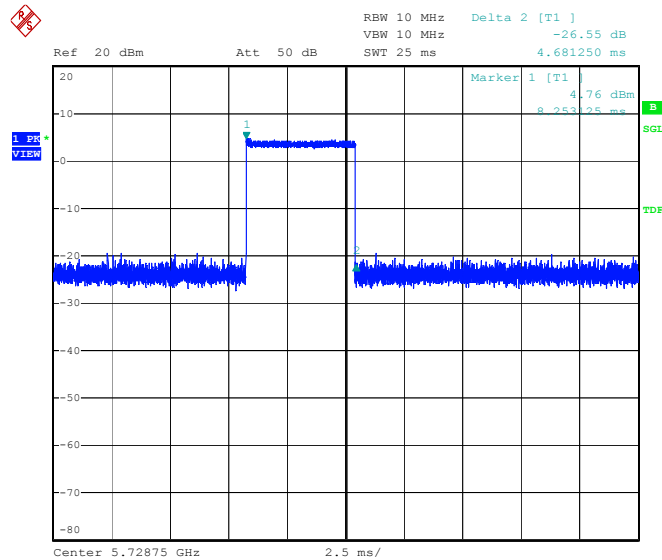
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Date: 10.NOV.2006 14:29:05

The pulse time is 4.681 ms. The average pulse time is $75 \times 4.681 \text{ ms} = 351.1 \text{ ms}$; the time of occupancy meets the limit of 0.4 s.

6.6.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service due date
Receiver	Rohde & Schwarz	ESPI7	TN1420	5/2/2007
40 GHz cable			TN1277	

6.6.5. Test information

Date of test:	Nov 10, 2006		
EUT serial:	2270		
Tested by:	Peter Boers	Test result:	Pass

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6.7. Receiver Conducted Spurious emissions

6.7.1. Requirements

RSS-GEN section 6(b) and 7.2.3.1

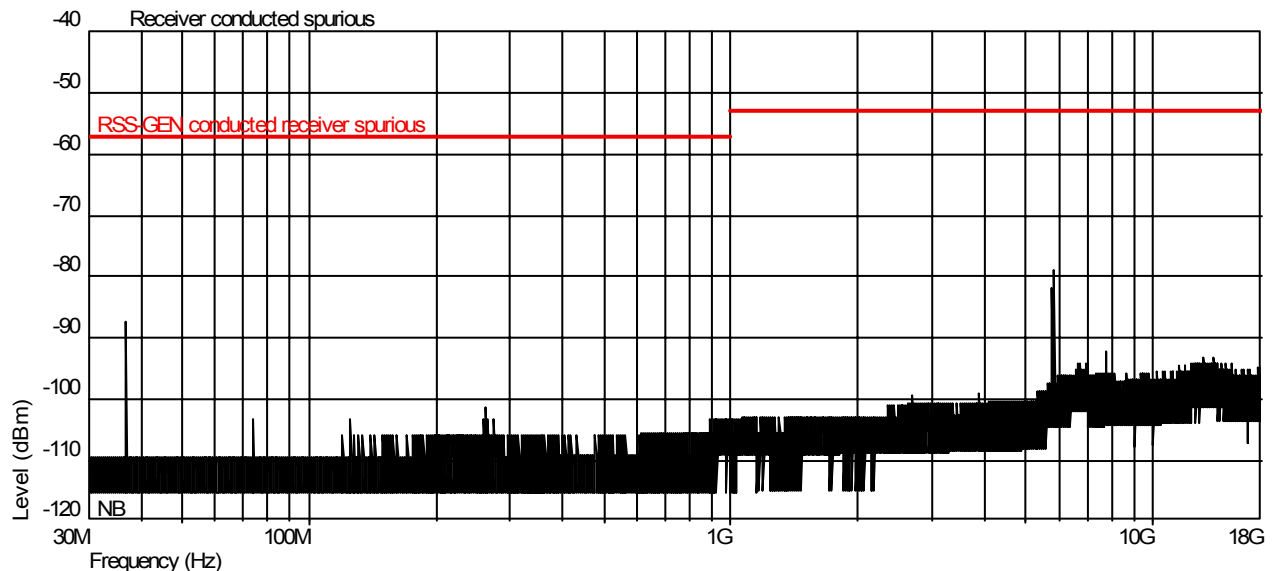
Spurious signals at the antenna terminals shall be limited to 2nW per 4 kHz BW in the frequency range of 30 – 1000 MHz and 5nW above 1 GHz.

6.7.2. Test setup details

The transceiver is connected with a 36" low loss cable and a UFL-SMA adapter to the input of a spectrum analyzer. The transceiver is operated in an artificial test mode and programmed to stop the hopping sequence and operate in receiver mode in the middle of the band.

The SA is set to a BW of 10 kHz and a peak detector. Compliance 3 software is used to collect data from 30 MHz to 18 GHz (3 times the highest tunable frequency).

6.7.3. Test data



Conclusion: The maximum receiver conducted spurious at the antenna port is -79 dBm, or 0.0125 nW.

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6.7.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service due date
Receiver	Rohde & Schwarz	ESPI7	TN1420	5/2/2007
40 GHz cable			TN1277	

6.7.5. Test information

Date of test:	Nov 10, 2006		
EUT serial:	2270		
Tested by:	Peter Boers	Test result:	Pass

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6.8. Radiated spurious emissions

6.8.1. Requirements

FCC part 15.209(a), part 15.247(d) , RSS-GEN section 7.2.3 and RSS-210 section 2.2

- (1) In any 100kHz BW, the spurious emissions shall be attenuated at least 20dB below the level of the wanted signal.
- (2) In any of the restricted bands defined in FCC part 15.209(a) or RSS-210 Table 1, the field strength at a distance of 3 meters (or EIPR) shall not exceed 54dB μ V/m (or 75nW)

6.8.2. Test setup details

- (1) The antenna (4 – 8 GHz horn) was placed at 1.5 meter from the EUT in order to increase the effective sensitivity. The SA BW was 100kHz, both peak and average detector values are traced on the screen. The SA amplitude reference was adjusted by 6dB to account for the 1/d scaling of the limit with the distance.
The TX unit was operated in normal mode, transmitting pink noise.
- (2) Antenna to EUT distance was reduced as necessary to allow the effective system noise floor to remain under the limit. The amplitude reference offset on the SA was adjusted to account for the distance scaling. Measurements of the radiated emissions were made from 1-40GHz in the following sections:
 - a. 1-5 GHz, JB5 antenna at 3 meters, ESIB40 with preamp enabled.
 - b. 5-7 GHz, 4-8 GHz horn antenna at 3 meters, with preamp enabled.
 - c. 7-8 GHz, 4-8 GHz, horn antenna at 1.5 meters. Preamp not available.
 - d. 8-18 GHz, 8-18 GHz horn antenna at 1 meter
 - e. 18-26.5 GHz, 18-26GHz horn antenna at 1 meter
 - f. 26-5. – 40 GHz, 26.5-40GHz horn antenna at 30cm.

6.8.3. Test data

- (1) 100 KHz BW measurement, Antenna at 1.5 meter, TN 727, TN1445

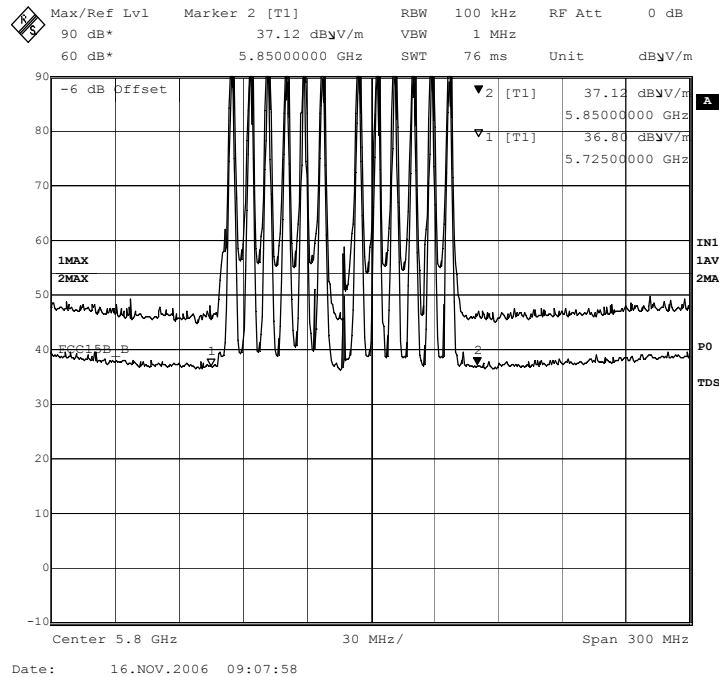
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Conclusion: Emissions in any 100kHz BW with in the 4 – 7 GHz range, measured radiated at 1.5 meters from the EUT are more than 20 dB below the corresponding values in the pass band of the transmitter.

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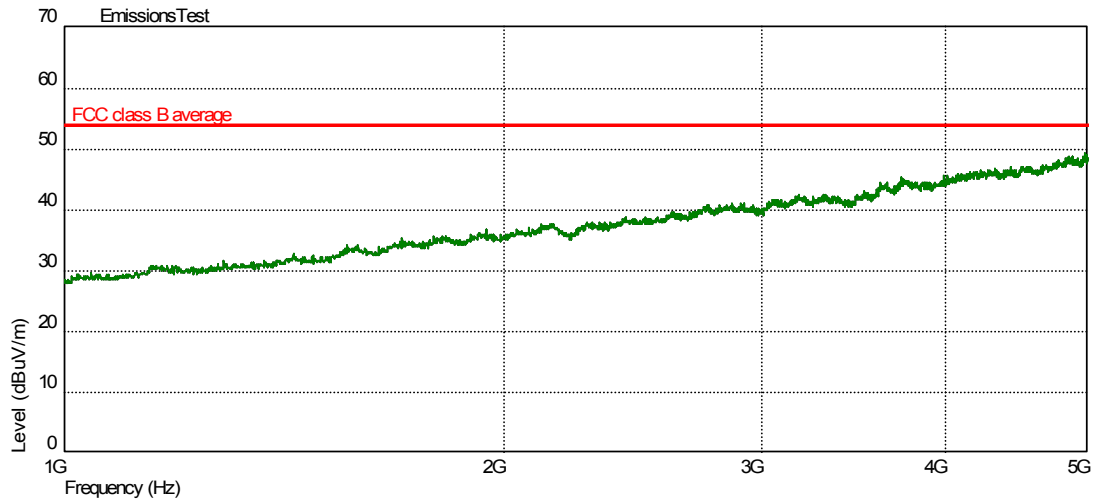
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(2) restricted bands:

a. 1-5 GHz, JB5 antenna at 3 meters, ESIB40 with preamp enabled. Average detector



b. 5-7 GHZ, 4-8 GHz horn antenna at 3 meters, with preamp enabled.

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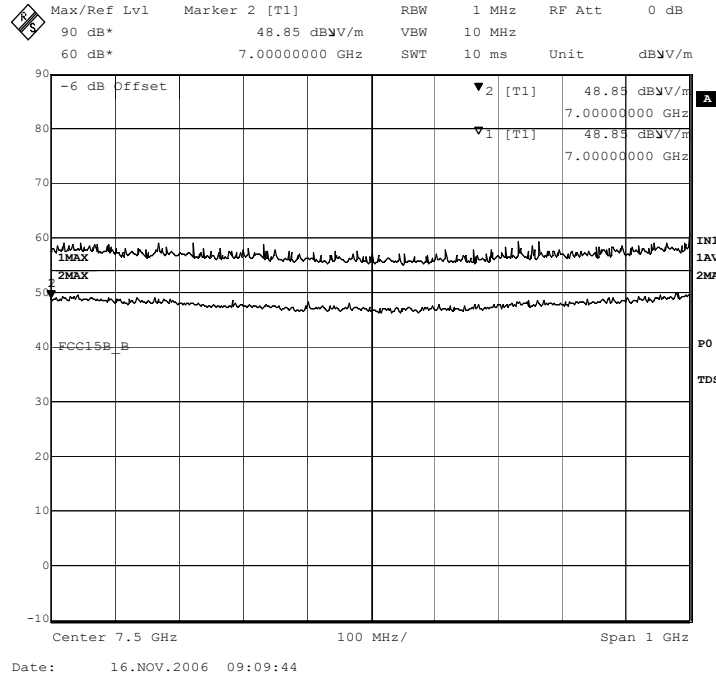


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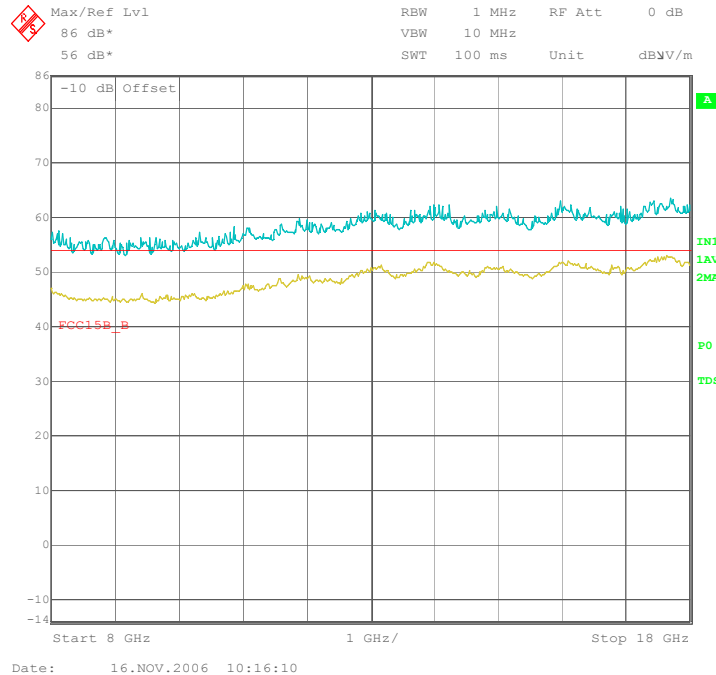


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c. 7-8 GHz, 4-8 GHz, horn antenna at 1.5 meters. Preamp not available.



d. 8-18 GHz, 8-18 GHz horn antenna at 1 meter. Peak and Average detector to the Av limit.



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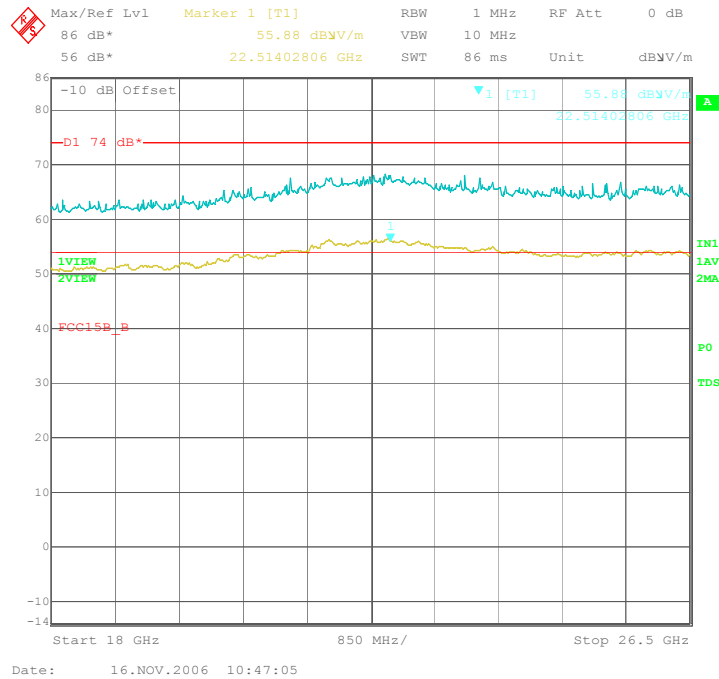


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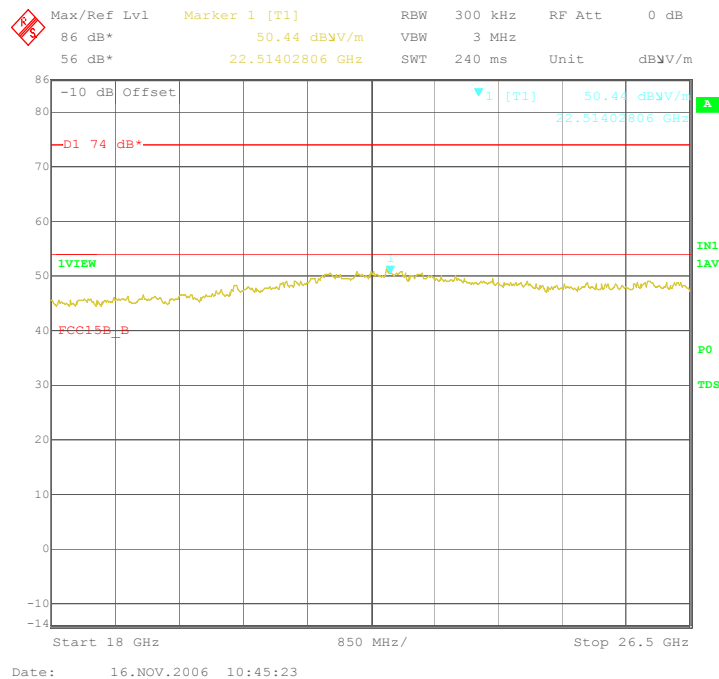


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e. 18-26.5 GHz, 18-26GHz horn antenna at 1 meter



RBW reduced to 300kHz to increase sensitivity with Av. detector



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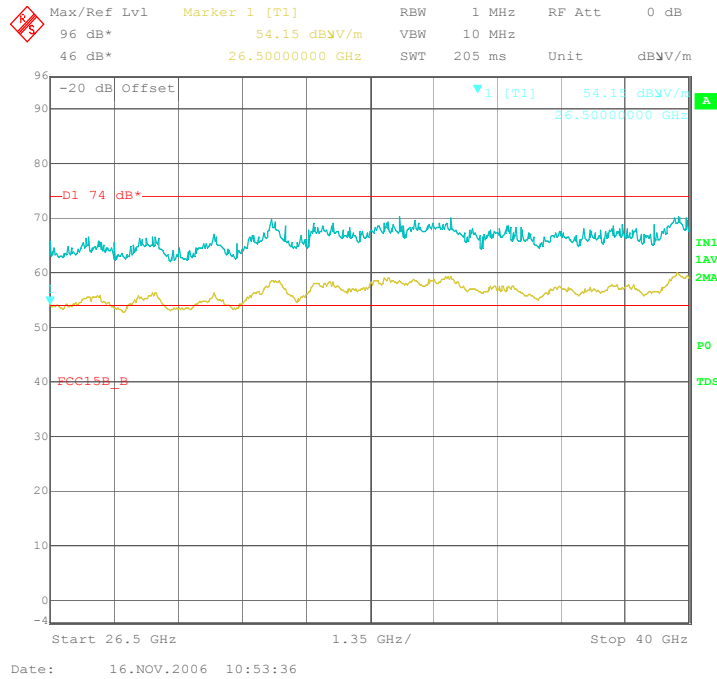


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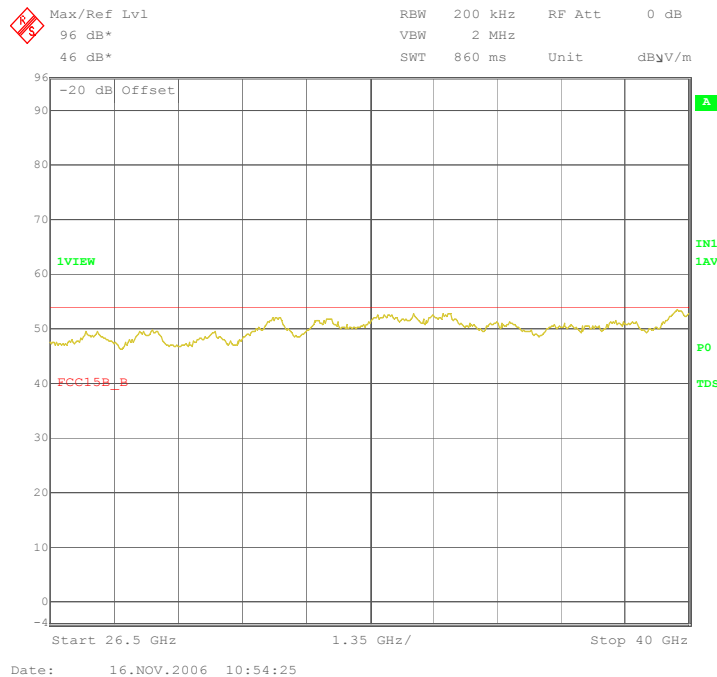


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f. 26-5. – 40 GHz, 26.5-40GHz horn antenna at 30cm.



RBW reduced to 200kHz to increase Av. Detector sensitivity



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6.8.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service due date
Receiver	Rohde & Schwarz	ESIB40	TN1233	8/15/2007
40 GHz cable			TN1277	NA
18GHz cable			TN1277-03	NA
Antenna, 0.03-5GHz	Sunol	JB5	TN1397	2/7/2007
Antenna 4-8 GHz	AR	AT4003	TN727	10/31/2007
Antenna 8-18 GHz	AR	AT4004	TN728	10/31/2007
Antenna 18-26.5 GHz	ETS	3160-09	TN1307	2/21/2008
Antenna 26.5-40GHz	ETS	3160-10	TN1426	2/22/2008

6.8.5. Test information

Date of test:	Nov 16, 2006		
EUT serial:	2270		
Tested by:	Peter Boers	Test result:	Pass

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7 Test Equipment Setup Photos.

Conducted emissions, RX unit



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TX unit



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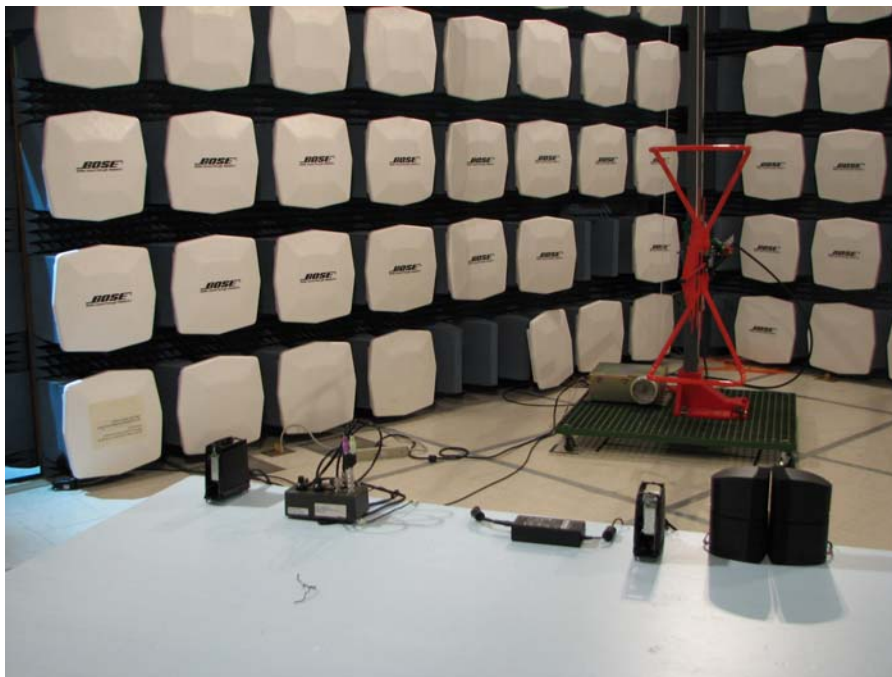
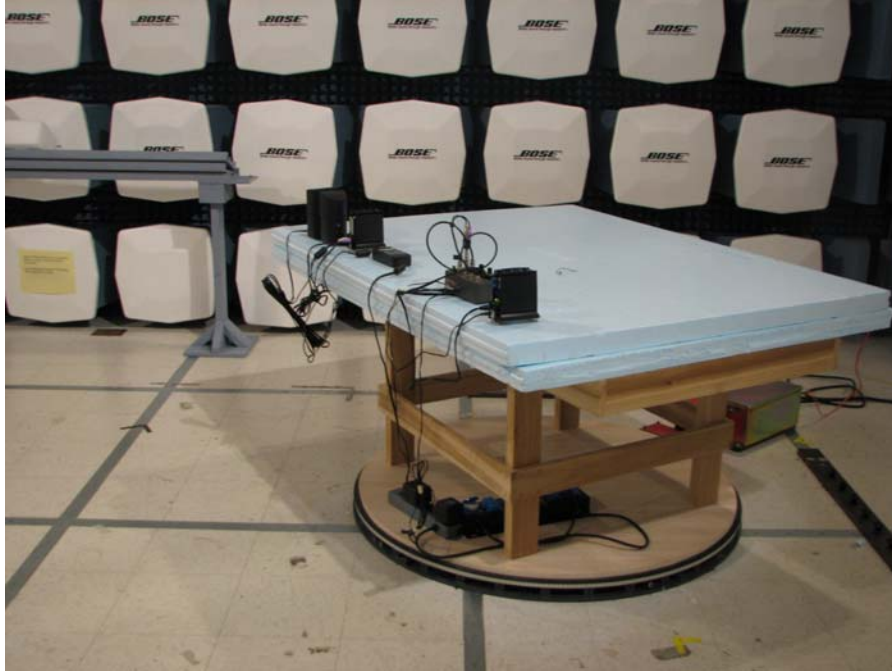


Wireless Transceiver Test Report



Certificate # 1514.1

RX and TX unit - radiated emissions



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Wireless Transceiver Test Report



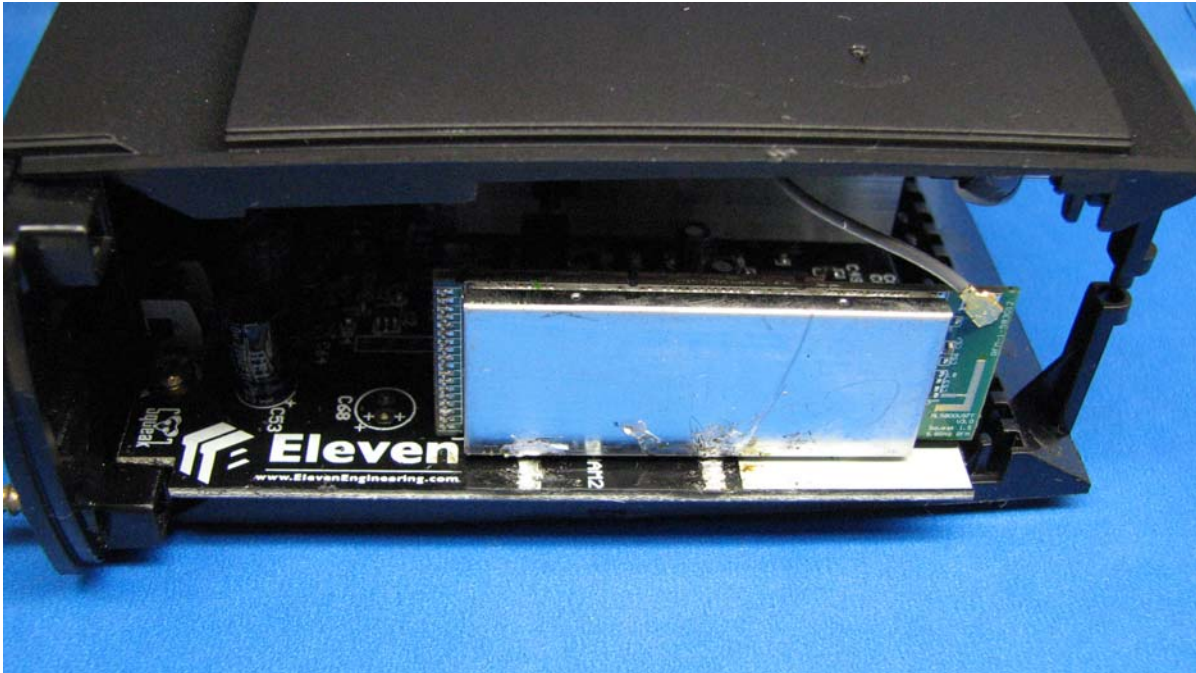
Certificate # 1514.1

8 EUT detail photos.

Short antenna:



Change in Radio module can grounding:



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