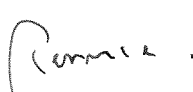
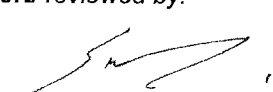


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Products

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Auftraggeber: <i>Client:</i>	MINEBEA CO., LTD. 1-1-1 Katase, Fujisawa City, Kanagawa 251-8531				
Gegenstand der Prüfung: <i>Test item:</i>	Wireless Keyboard				
Bezeichnung: <i>Identification:</i>	VGP-BKB1	Serien-Nr.: <i>Serial No.:</i>	2000135, 2000168		
Wareneingangs-Nr.: <i>Receipt No.:</i>	213091343	Eingangsdatum: <i>Date of receipt:</i>	2009-06-08		
Prüfart: <i>Testing location:</i>	4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan				
Prüfgrundlage: <i>Test specification:</i>	47 CFR Part 15, Subpart C, Section 15.247 (October 1, 2008) ANSI C63.4-2003 Public Notice DA 00-705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems (March 30, 2000) RSS-210 (Issue 7): 2007 RSS-Gen (Issue 2): 2007				
Prüfresultat: <i>Test Result:</i>	Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n). The test item passed the test specification(s).				
Prüflaboratorium: <i>Testing Laboratory:</i>	TÜV Rheinland Japan Ltd. - Global Technology Assessment Center 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan				
geprüft/ tested by:		kontrolliert/ reviewed by:			
					
2009-07-13	T. Cheung / Inspector	2009-07-13	R. Sehb / Reviewer		
Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>	Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>
Sonstiges / Other Aspects:					
This test report deals only with the intentional radiator portion of the tested product. Unintentional radiator aspects are covered by test reports 12605670 003.					
Abkürzungen:		Abbreviations:			
P(ass) = entspricht Prüfgrundlage		P(ass) = passed			
F(ail) = entspricht nicht Prüfgrundlage		F(ail) = failed			
N/A = nicht anwendbar		N/A = not applicable			
N/T = nicht getestet		N/T = not tested			
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products.</i>					

TEST SUMMARY

3.2.1 ANTENNA REQUIREMENTS, FCC 15.203, FCC 15.204 AND RSS-GEN 7.1.4

RESULT: PASS

5.1.1 CONDUCTED OUTPUT POWER, FCC 15.247(B)(1) AND RSS-210 A8.4(2)

RESULT: PASS

5.1.2 CARRIER FREQUENCY SEPARATION, FCC 15.247(A)(1) AND RSS-210 A8.1(B)

RESULT: PASS

5.1.3 20dB BANDWIDTH, FCC 15.247(A)(1) AND RSS-210 A8.1(A)

5.1.4 99% BANDWIDTH, RSS-GEN 4.6.1

5.1.5 NUMBER OF HOPPING FREQUENCIES, FCC 15.247(A)(1)(III) AND RSS-210 A8.1(D)

RESULT: PASS

5.1.6 AVERAGE TIME OF OCCUPANCY, FCC 15.247(A)(1)(III) AND RSS-210 A8.1(D)

RESULT: PASS

5.1.7 CONDUCTED SPURIOUS EMISSION, FCC 15.247(D) AND RSS-210 A8.5

RESULT: PASS

6.1.1 AC POWER LINE CONDUCTED EMISSION OF TRANSMITTER, FCC 15.207 AND RSS-GEN 7.2.2

RESULT: N/A

6.2.1 AC POWER LINE CONDUCTED EMISSION OF RECEIVER, FCC 15.107 AND RSS-GEN 7.2.2

RESULT: N/A

7.1.1 BAND EDGE RADIATED EMISSION, FCC 15.247(D) AND RSS-210 2.2

RESULT: Pass

7.1.2 OUT-OF-BAND AND SPURIOUS EMISSION OF TRANSMITTER, FCC 15.247(D), FCC 15.205, FCC 15.209, RSS-210 2.2, RSS-210 A8.5 AND RSS-GEN 7.2.1

RESULT: PASS

7.2.1 RADIATED SPURIOUS EMISSION OF RECEIVER, FCC 15.109, RSS-210 2.2, RSS-210 2.6, RSS-210 A8.5, RSS-GEN 7.2.3.2

RESULT: PASS

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1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report.

2. Test Sites

2.1 Test Facilities

TÜV Rheinland Japan Ltd. - Global Technology Assessment Center
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The Federal Communications Commission has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance with the requirements of section 2.948 of the FCC rules. The description of the test facility is listed under FCC registration number 299054.

The Industry Canada has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance. The description of the test facility is listed under OATS filing number 3466B.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2005. TÜV Rheinland Japan Ltd. is accredited by the Federal Communications Commission as a Conformity Assessment Body under Designation Number JP0017 and Test Firm Registration Number 386498.

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equipment ID	Calibrated until
For Antenna Port Conducted Emission					
Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	2010-01
RF Power Meter	Agilent	N1911A	MY451017 37	BT-8226	2009-10
RF Peak Power Sensor	Agilent	N1921A	MY452422 28	BT-8227	2009-10
For Radiated Emission					
Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	2010-02
Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	2010-01
RF Selector (10m)	Toyo Corporation	NS4900	0703-182	RF-0029	2010-05
3dB Attenuator 50Ohm	Tamagawa Electronics Co., Ltd.	CFA-01	-	RF-0265	2010-05
Low Noise Pre-Amplifier	TSJ	MLA-10K01-B01-35	1370750	RF-0253	2010-05
Microwave Pre-Amplifier, 1-8GHz	Toyo Corporation	TPA0108-40	0634	RF-0052	2009-12
Band Reject Filter	Nitsuki	NF-49BT	027	RF-0131	2009-12
Trilog Antenna, 30-1000MHz	Schwarzbeck	VULB9168	0245	RF-0019	2010-05
Horn Antenna, 1-10GHz	Schwarzbeck	BBHA9120B	419	RF-0050	2010-05
Horn Antenna with Pre-Amplifier, 2-18GHz	Toyo Corporation	HAP06-18W	00000025	RF-0065	2010-05
Horn Antenna with Pre-Amplifier, 18-26.5GHz	Toyo Corporation	HAP18-26N	00000010	RF-0070	2010-05

2.3 Measurement Uncertainty

Table 2: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Antenna Port Conducted Emission	< 1GHz	±0.39dB
	> 1GHz	±0.68dB
Radiated Emission	30MHz - 1GHz	±3.9dB
	> 1GHz	±5.2dB

3. General Product Information

3.1 Product Function and Intended Use

The EUT (Equipment Under Test) is a Bluetooth wireless keyboard intended to be produced for the general market.

3.2 System Details

Radio standard:	Bluetooth 2.0 (without EDR) Class 2
Specified output power:	-5dBm
Antenna gain:	0.77dBi
Antenna type:	Printed trace wiggle antenna
Antenna mounting type:	Internal
Frequency range:	2402 – 2480MHz
Number of channels:	79
Channel spacing:	1MHz
Modulation type:	GFSK
FCC classification:	DSS
Emission designator:	F1D
Rated voltage:	DC 3.0V (via two AA alkaline batteries)
Rated current:	Max. 150mA
Protection class:	III
Test voltage:	DC 3.0V (via two AA alkaline batteries)

3.2.1 Antenna Requirements, FCC 15.203, FCC 15.204 and RSS-Gen 7.1.4

RESULT: **PASS**

The EUT has an internal antenna which is not user accessible. Hence it complies with the requirements.

3.3 Clock Frequencies

The highest clock frequency generated by the EUT is 24MHz.

3.4 Independent Operation Modes

The test system was configured in a typical fashion (as a customer would normally use it).

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.4:2003. Testing was performed at the lowest operating frequency (2402MHz), at the operating frequency in the middle of the specified frequency band (2441MHz) and at the highest operating frequency (2480MHz).

The basic operation modes are:

- A. EUT transmits (TX mode), with full power, at lowest channel (2402MHz), a continuous modulated signal streaming with 100% duty cycle.
- B. EUT transmits (TX mode), with full power, at middle channel (2441MHz), a continuous modulated signal streaming with 100% duty cycle.
- C. EUT transmits (TX mode), with full power, at highest channel (2480MHz), a continuous modulated signal streaming with 100% duty cycle.
- D. EUT receives (RX mode), at middle channel (2441MHz), continuously.
- E. EUT transmits on pseudo-random sequence on all channels (hopping mode).

Note:

The EUT is intended to operate with DM1 packets only. Therefore tests to be done in operation mode E were performed using DM1 packets.

3.5 Noise Suppressing Parts

Refer to schematics.

4. Test Set-up and Operation Modes

4.1 Test Methodology

The test methodology used is based on the requirements of 47 CFR Part 15, Sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209 and Public Notice DA 00-705.

The test methods, which have been used, are based on ANSI C63.4-2003 and RSS-Gen (Issue 2).

For details, see under each test item.

4.2 Physical Configuration for Testing

Figure 1: Test Setup for Radiated Measurements

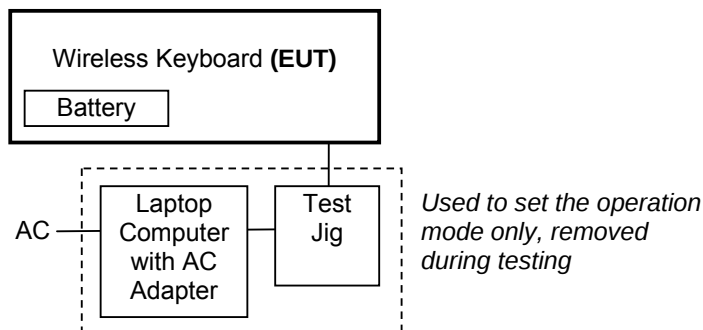
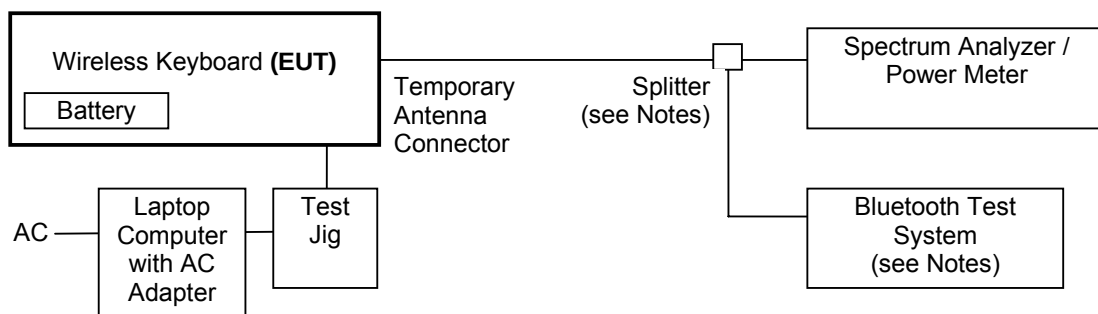


Figure 2: Test Setup for Antenna Conducted Measurements



Notes:

Two test samples were available. Sample No. 2000168 was used for antenna conducted measurements and sample No. 2000135 was used for radiated measurements.

The Bluetooth test system and the splitter were only used for the operation mode E (hopping)

For antenna conducted measurements, the antenna was replaced by a 50Ω antenna connector.

For more details, refer to section: Photographs of the Test Set-Up.

4.3 Test Operation and Test Software

Software used for testing: Broadcom Bluetooth version 1.1.1.7 by Broadcom Corporation.

This software was running on the laptop computer connected to the EUT. It was used to enable the test operation modes listed in section 3.4 as appropriate.

4.4 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

1. Product: Laptop Computer
Manufacturer: IBM
Model: 2525-5AE (X41)
Rated Voltage: DC 16V
Input Current: 3.5A
Serial Number: LV-D6940 05/10
2. Product: Docking Station for Laptop Computer
Manufacturer: IBM
Model: ThinkPad X4 UltraBase
Rated Voltage: DC 16V
Input Current: 3.5A
Serial Number: 11S91P9283Z1Z9VB5970FG
3. Product: AC Adapter for Laptop Computer
Manufacturer: IBM
Model: 02K6810
Rated Voltage: AC 100-240V
Input Current: 1.5A
Frequency: 50/60Hz
Serial Number: 11S02K6810Z1Z3BJ59G1JH

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4. Product: Bluetooth Test System
Manufacturer: Rohde & Schwarz
Model: TS8960
Rated Voltage: AC 200V
Serial Number: 338951/102

5. Product: Test Jig
Manufacturer: Minebea

Note:

The test jig was connected to the EUT via a UART port which is only accessible for testing purpose. For more details regarding the test jig, refer to the picture here below.

Photograph 1: Test Jig



4.5 Countermeasures to achieve EMC Compliance

No additional measures were employed to achieve compliance.

5. Test Results of Conducted Measurements at Antenna Port

For conducted tests, the antenna was replaced by a temporary SMA-type connector, directly attached to the transmitter.

The tests were performed using a new battery.

5.1.1 Conducted Output Power, FCC 15.247(b)(1) and RSS-210 A8.4(2)

RESULT:

PASS

Date of testing: 2009-06-11

Ambient temperature: 25°C

Relative humidity: 67%

Atmospheric pressure: 989hPa

Requirements:

For frequency hopping systems operating in the 2400-2483.5MHz band employing at least 75 non-overlapping hopping channels, the maximum peak output power shall be 1W (30dBm).

Test procedure:

ANSI C63.4-2003, RSS-Gen 4.8 and Public Notice DA 00-705.

The maximum peak output power (conducted) was measured at the antenna connector with a power meter. The final measurement takes into account the loss generated by all the involved cables.

Table 3: Conducted Output Power

Operating Frequency [MHz]	Reading [dBm]	Correction Factor [dB]	Output Power [dBm]	Output Power [mW]	Limit [dBm]	Limit [mW]	Margin [dB]
2402	-6.42	0.53	-5.89	0.26	30.00	1000	35.89
2441	-5.65	0.52	-5.13	0.31	30.00	1000	35.13
2480	-5.48	0.51	-4.97	0.32	30.00	1000	34.97

Notes: Output power = Reading + Correction factor
Correction factor = Total cable loss
 $\text{mW} = 10^{(\text{dBm}/10)}$
 $\text{dBm} = 10 \times \log(\text{mW})$

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5.1.2 Carrier Frequency Separation, FCC 15.247(a)(1) and RSS-210 A8.1(b)

RESULT:

PASS

Date of testing: 2009-07-03

Ambient temperature: 25°C

Relative humidity: 49%

Atmospheric pressure: 998hPa

Requirements:

Frequency hopping systems operating in the 2400-2483.5MHz band shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. In case of an output power less than 125mW, the frequency hopping system may have channels separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

Test procedure:

ANSI C63.4-2003 and Public Notice DA 00-705.

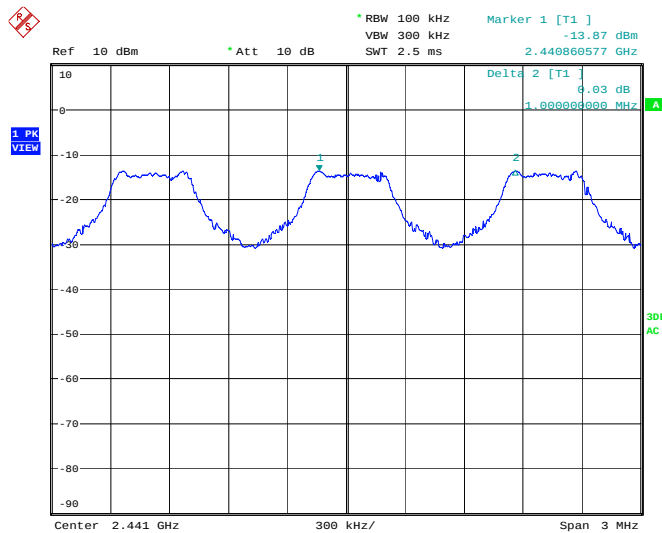
A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 100kHz and the video bandwidth to 300kHz. The Delta Marker function was used to determine the separation between the peaks of two adjacent channels.

Table 4: Carrier Frequency Separation

Channel Separation [kHz]	20dB Bandwidth [kHz]	Limit [kHz]
1000	961.54	641.03

Notes: Limit = 20dB bandwidth * 2/3 since it is greater than 125kHz and the output power is less than 125mW.

Figure 3: Carrier Frequency Separation



Channel carrier frequency separation, mode E
Date: 3.JUL.2009 22:48:47

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5.1.3 20dB Bandwidth, FCC 15.247(a)(1) and RSS-210 A8.1(a)

Date of testing: 2009-06-22

Ambient temperature: 25°C

Relative humidity: 64%

Atmospheric pressure: 1010hPa

Requirements:

For frequency hopping systems operating in the 2400-2483.5MHz band, no bandwidth limit is specified. Test data is provided for reference.

Test procedure:

ANSI C63.4-2003, RSS-Gen 4.6.2 and Public Notice DA 00-705.

A spectrum analyzer was connected to the antenna port of the EUT. The spectrum analyzer resolution bandwidth was set to 30kHz, the video bandwidth to 100kHz and the span to 3MHz.

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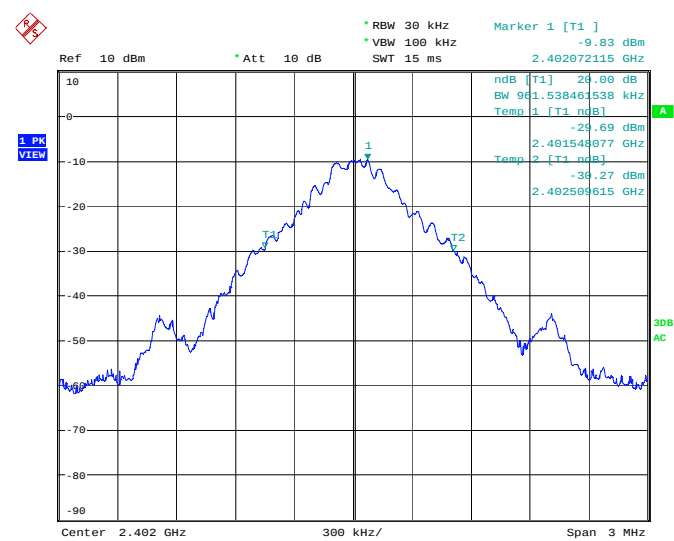
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Table 5: 20dB Bandwidth

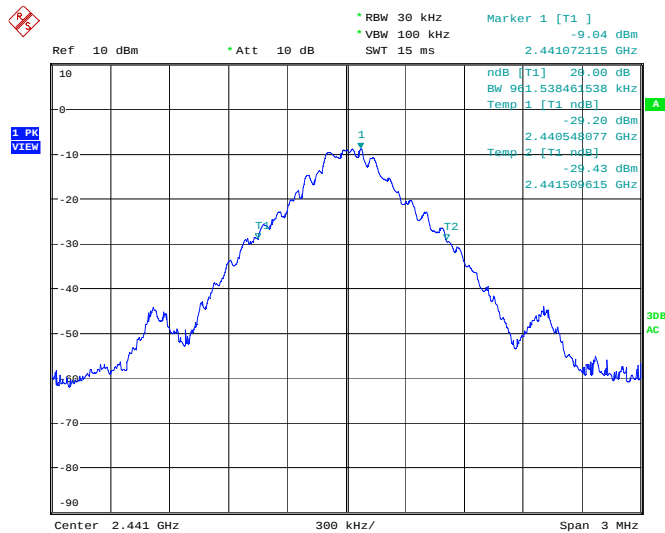
Operating Frequency [MHz]	20dB Bandwidth [kHz]
2402	961.54
2441	961.54
2480	961.54

Figure 4: 20dB Bandwidth, Mode A (2402MHz)



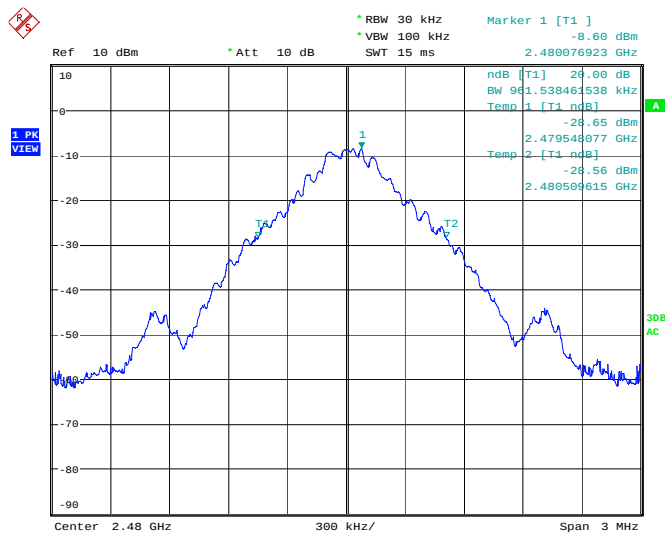
20dB bandwidth, mode A
Date: 22.JUN.2009 10:28:55

Figure 5: 20dB Bandwidth, Mode B (2441MHz)



20dB bandwidth, mode B
Date: 22.JUN.2009 10:31:58

Figure 6: 20dB Bandwidth, Mode C (2480MHz)



20dB bandwidth, mode C
Date: 22.JUN.2009 10:31:19

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5.1.4 99% Bandwidth, RSS-Gen 4.6.1

Date of testing: 2009-06-22

Ambient temperature: 25°C

Relative humidity: 64%

Atmospheric pressure: 1010hPa

Requirements:

The 99% bandwidth shall be reported according to RSS-Gen 4.6.1.

Test procedure:

RSS-Gen 4.6.1

A spectrum analyzer was connected to the antenna port of the EUT. The spectrum analyzer resolution bandwidth was set to 1% of the span (10MHz). The 99% bandwidth was measured by using the OBW function of the analyzer with a 99% coverage setting.

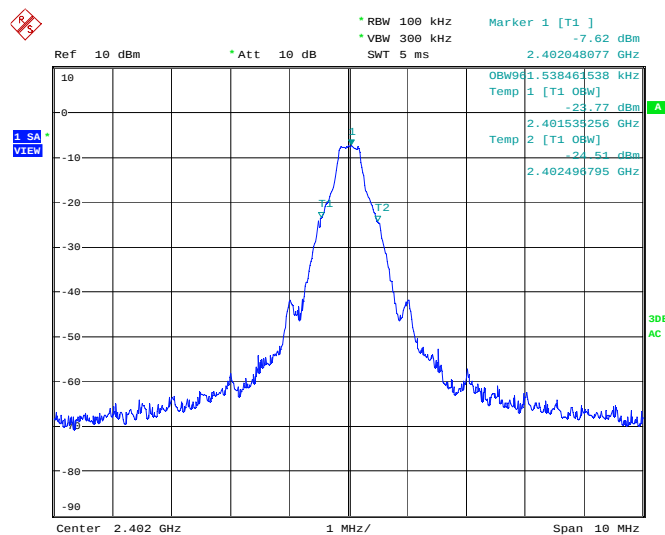
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Table 6: 99% Bandwidth

Operating Frequency [MHz]	99% Bandwidth [kHz]
2402	961.54
2441	977.56
2480	961.54

Figure 7: 99% Bandwidth, Mode A (2402MHz)

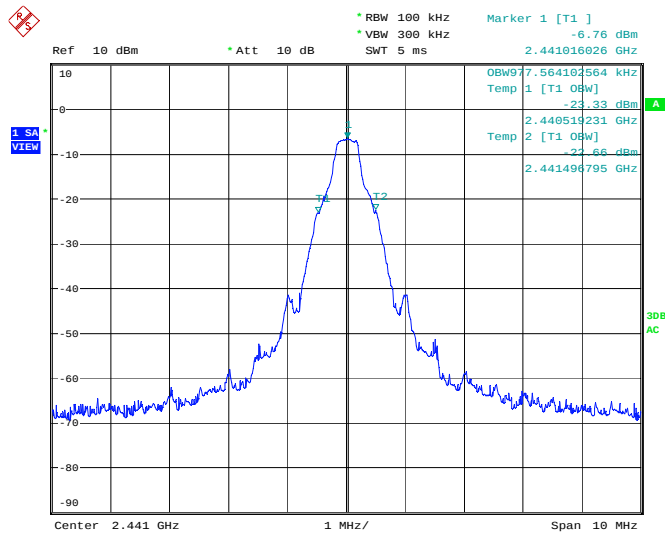


99% bandwidth, mode A
Date: 22.JUN.2009 10:37:27

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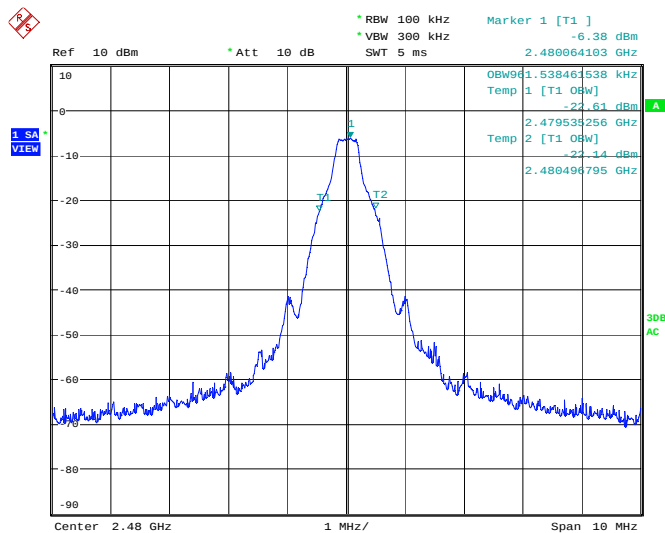
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Figure 8: 99% Bandwidth, Mode B (2441MHz)



99% bandwidth, mode B
Date: 22.JUN.2009 10:39:20

Figure 9: 99% Bandwidth, Mode C (2480MHz)



99% bandwidth, mode C
Date: 22.JUN.2009 10:38:15

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5.1.5 Number of Hopping Frequencies, FCC 15.247(a)(1)(iii) and RSS-210 A8.1(d)

RESULT:

PASS

Date of testing: 2009-07-03

Ambient temperature: 25°C

Relative humidity: 49%

Atmospheric pressure: 998hPa

Requirements:

Frequency hopping systems operating in the 2400-2483.5MHz band shall use at least 15 channels.

Test procedure:

ANSI C63.4-2003 and Public Notice DA 00-705.

A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth and video bandwidth were set to 1MHz. The spectrum was broken in two plots having each a 50MHz span to show all the hopping frequencies.

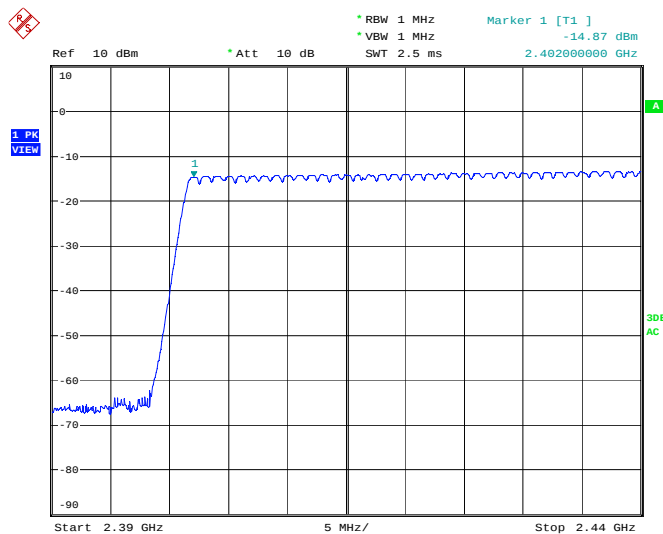
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Table 7: Number of Hopping Frequencies

Number of Hopping Frequencies	Limit
79	15

Figure 10: Hopping Frequencies up to 2441MHz, Mode E (Hopping)

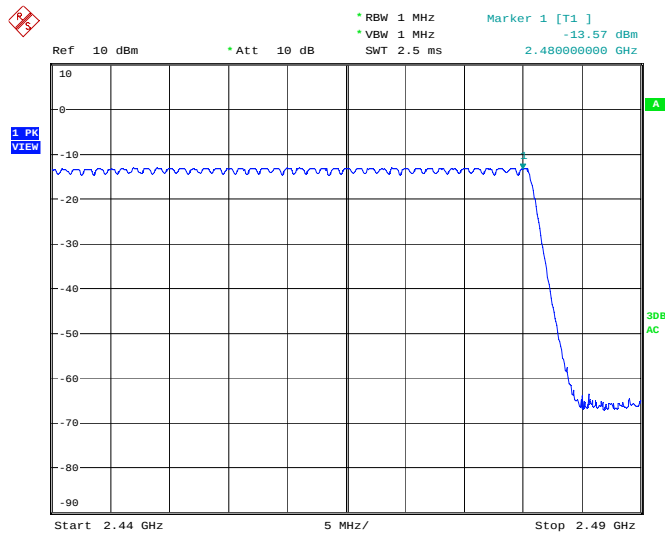


Number of hopping frequencies, mode E
Date: 3.JUL.2009 22:30:38

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Figure 11: Hopping Frequencies above 2441MHz, Mode E (Hopping)



Number of hopping frequencies, mode E
Date: 3.JUL.2009 22:33:14

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5.1.6 Average time of Occupancy, FCC 15.247(a)(1)(iii) and RSS-210 A8.1(d)

RESULT:

PASS

Date of testing: 2009-07-03

Ambient temperature: 25°C

Relative humidity: 49%

Atmospheric pressure: 998hPa

Requirements:

For frequency hopping systems operating in the 2400-2483.5MHz band, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test procedure:

ANSI C63.4-2003 and Public Notice DA 00-705.

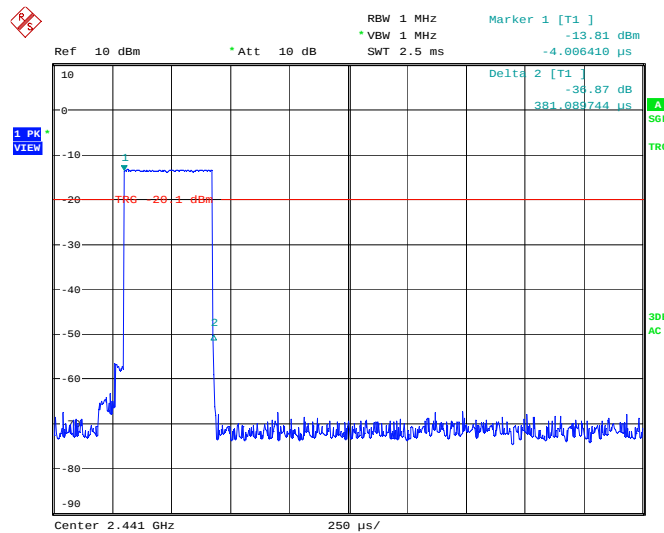
A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth and video bandwidth were set to 1MHz. The average time of occupancy was obtained by measuring first the dwell time of a single packet with the Delta Marker function using a zero span centered on a hopping channel and by counting then the number of hops per channel in a 31.6s period (0.4s times the number of hopping channels).

Table 8: Average Time of Occupancy

Packet Type	Packet Duration [ms]	Number of Hops per Channel in a 31.6s Period	Average Time of Occupancy [ms]	Limit [ms]
DM1	0.381	309	117.73	400

Notes: Average time of occupancy = Packet duration * Number of hops per channel in a 31.6s period

Figure 12: Dwell Time, Mode E (Hopping), DM1



Dwell time, mode E
Date: 3.JUL.2009 21:49:37

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5.1.7 Conducted Spurious Emission, FCC 15.247(d) and RSS-210 A8.5

RESULT:

PASS

Date of testing: 2009-06-22

Ambient temperature: 25°C

Relative humidity: 64%

Atmospheric pressure: 1010hPa

Requirements:

In any 100kHz bandwidth outside the frequency band, the RF power shall be at least 20dB below that of the maximum in-band 100kHz emission.

Test procedure:

ANSI C63.4-2003, RSS-Gen 4.9 and Public Notice DA 00-705.

A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 100kHz. For each channel investigated, the in-band and out-of-band emission measurements were performed. The out-of-band emissions were measured from 30MHz to 25GHz (10th harmonics).

The final measurement takes into account the loss generated by all the involved cables.

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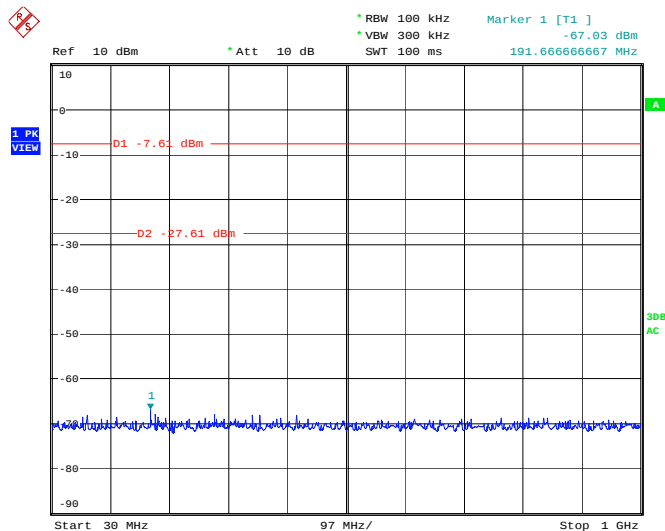
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Table 9: Conducted Spurious Emission, Mode A (2402MHz)

Frequency [MHz]	Reading [dBm]	Correction Factor [dB]	Emission Level [dBm]	Limit [dBm]	Margin [dB]
Fundamental	-7.61	0.53	-7.08	N/A	N/A
191.67	-67.03	0.14	-66.89	-27.08	39.81
1602.56	-61.74	0.42	-61.32	-27.08	34.24
4006.41	-55.57	0.53	-55.04	-27.08	27.96
4807.69	-43.65	0.77	-42.88	-27.08	15.80
7203.53	-59.95	0.81	-59.14	-27.08	32.05
9615.38	-51.05	1.09	-49.96	-27.08	22.88
12003.21	-66.51	1.20	-65.31	-27.08	38.23
22876.60	-68.37	1.60	-66.77	-27.08	39.69

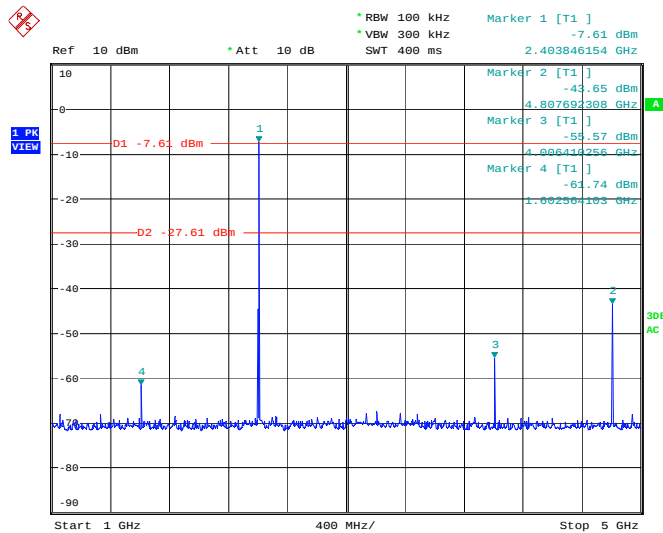
Notes: Limit = Reading of fundamental + Correction factor – 20dB
Emission level = Reading + Correction factor
Correction factor = Total cable loss

Figure 13: Spurious Emission from 30MHz to 1GHz, Mode A (2402MHz)



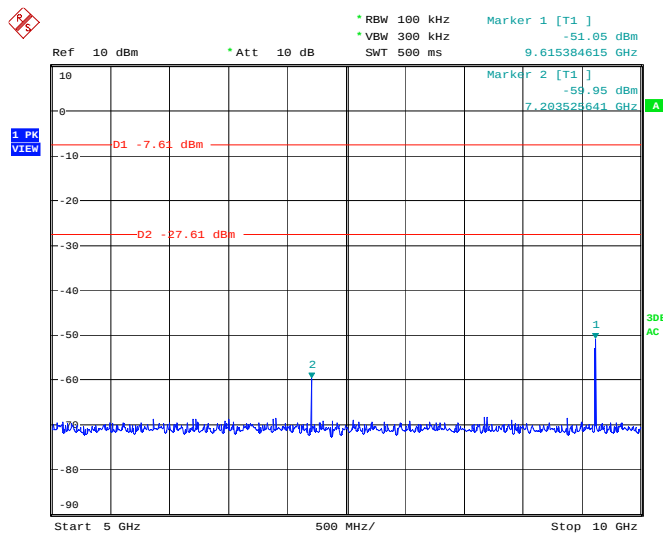
Conducted spurious emissions, mode A
Date: 22.JUN.2009 10:47:52

Figure 14: Spurious Emission from 1 to 5GHz, Mode A (2402MHz)



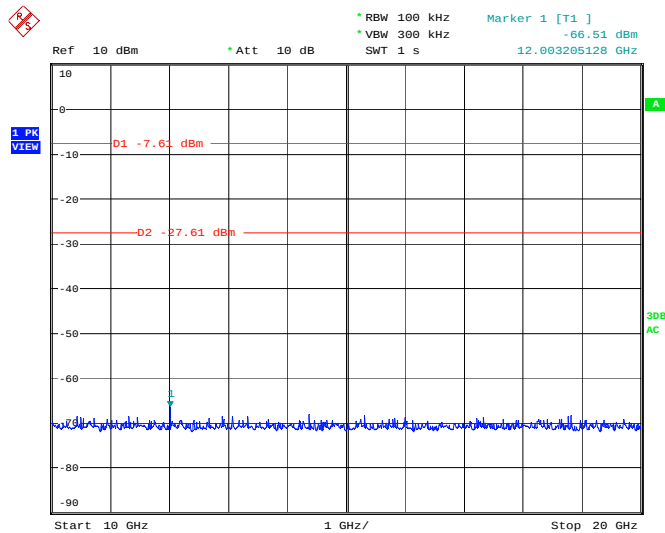
Conducted spurious emissions, mode A
Date: 22.JUN.2009 10:46:56

Figure 15: Spurious Emission from 5 to 10GHz, Mode A (2402MHz)



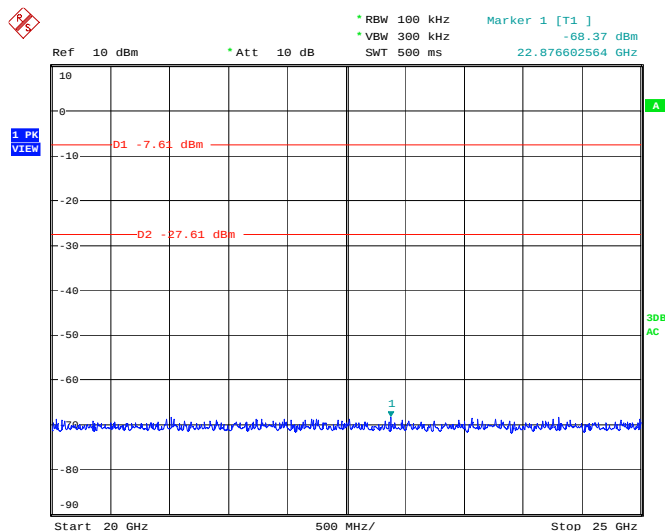
Conducted spurious emissions, mode A
Date: 22.JUN.2009 10:48:41

Figure 16: Spurious Emission from 10 to 20GHz, Mode A (2402MHz)



Conducted spurious emissions, mode A
Date: 22.JUN.2009 10:49:27

Figure 17: Spurious Emission from 20 to 25GHz, Mode A (2402MHz)



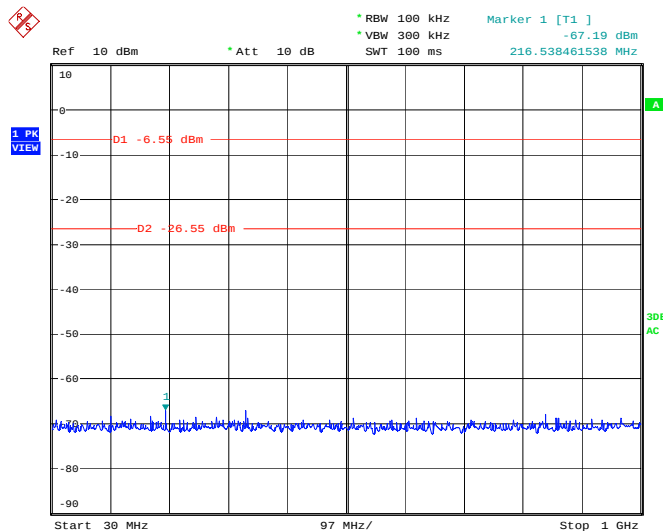
Conducted spurious emissions, mode A
Date: 22.JUN.2009 10:50:04

Table 10: Conducted Spurious Emission, Mode B (2441MHz)

Frequency [MHz]	Reading [dBm]	Correction Factor [dB]	Emission Level [dBm]	Limit [dBm]	Margin [dB]
Fundamental	-6.55	0.52	-6.03	N/A	N/A
216.54	-67.19	0.15	-67.04	-26.03	41.02
1628.21	-60.38	0.37	-60.01	-26.03	33.98
4070.51	-56.40	0.64	-55.76	-26.03	29.73
4884.62	-50.15	0.70	-49.45	-26.03	23.42
7323.72	-45.19	0.86	-44.33	-26.03	18.31
9767.63	-46.85	1.13	-45.72	-26.03	19.69
12195.51	-63.84	1.12	-62.72	-26.03	36.69
23261.22	-68.26	1.57	-66.69	-26.03	40.67

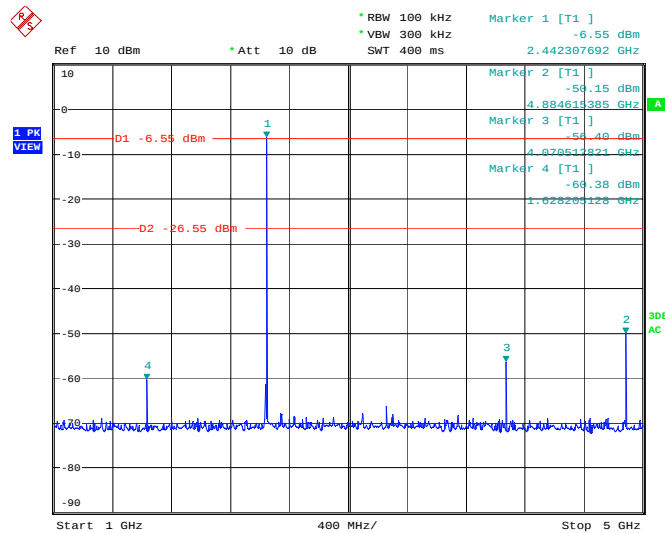
Notes: Limit = Reading of fundamental + Correction factor – 20dB
Emission level = Reading + Correction factor
Correction factor = Total cable loss

Figure 18: Spurious Emission from 30MHz to 1GHz, Mode B (2441MHz)



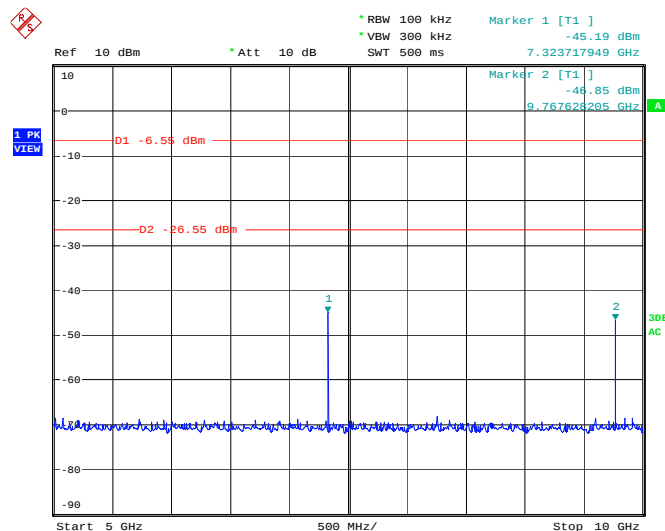
Conducted spurious emissions, mode B
Date: 22.JUN.2009 10:53:49

Figure 19: Spurious Emission from 1 to 5GHz, Mode B (2441MHz)



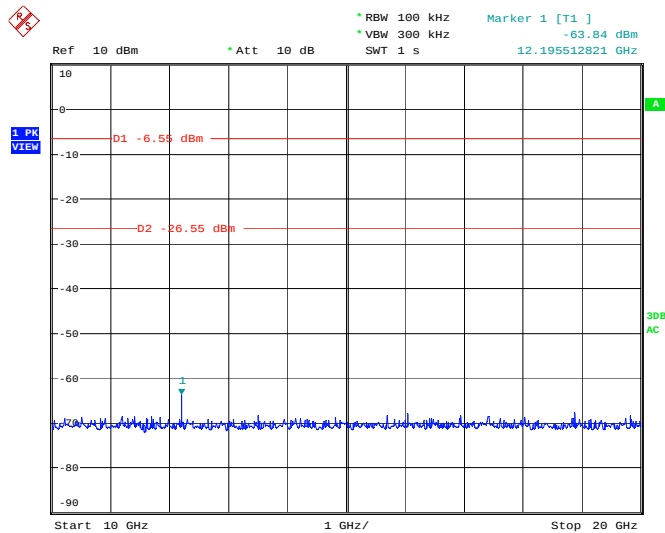
Conducted spurious emissions, mode B
Date: 22.JUN.2009 10:52:56

Figure 20: Spurious Emission from 5 to 10GHz, Mode B (2441MHz)



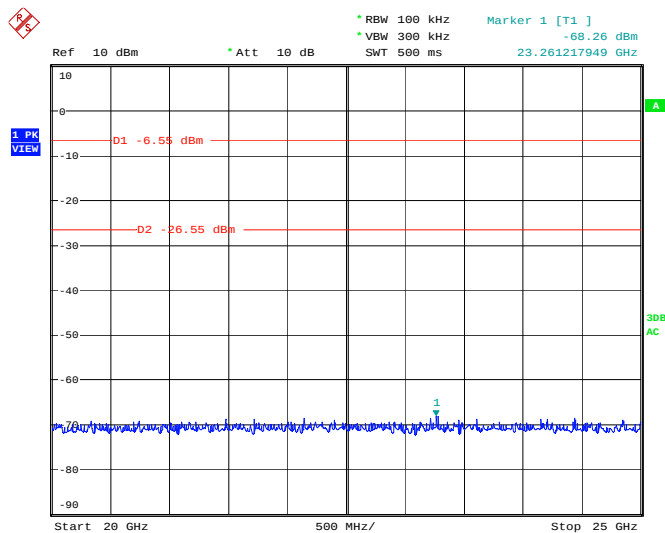
Conducted spurious emissions, mode B
Date: 22.JUN.2009 11:06:47

Figure 21: Spurious Emission from 10 to 20GHz, Mode B (2441MHz)



Conducted spurious emissions, mode B
Date: 22.JUN.2009 10:58:00

Figure 22: Spurious Emission from 20 to 25GHz, Mode B (2441MHz)



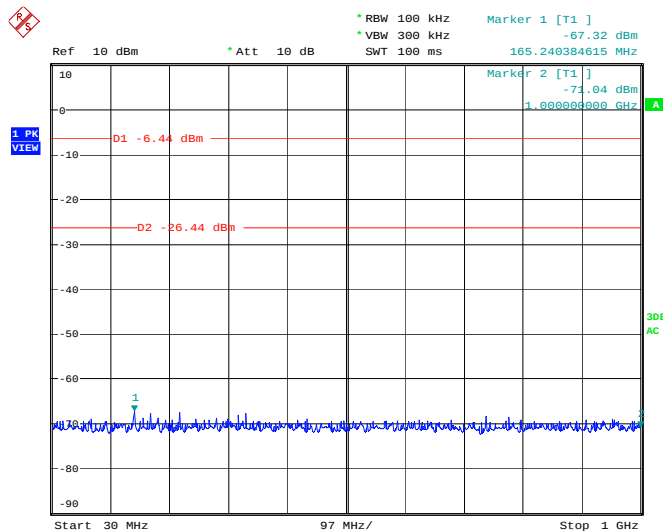
Conducted spurious emissions, mode B
Date: 22.JUN.2009 10:58:33

Table 11: Conducted Spurious Emission, Mode C (2480MHz)

Frequency [MHz]	Reading [dBm]	Correction Factor [dB]	Emission Level [dBm]	Limit [dBm]	Margin [dB]
Fundamental	-6.44	0.51	-5.93	N/A	N/A
165.24	-67.32	0.10	-67.22	-25.93	41.28
1653.85	-59.41	0.47	-58.94	-25.93	33.00
4134.62	-54.74	0.65	-54.09	-25.93	28.16
4961.54	-56.31	0.79	-55.52	-25.93	29.58
7443.91	-42.28	0.95	-41.33	-25.93	15.39
9927.88	-44.61	1.15	-43.46	-25.93	17.52
12403.85	-59.27	1.29	-57.98	-25.93	32.04
24022.44	-67.84	1.72	-66.12	-25.93	40.19

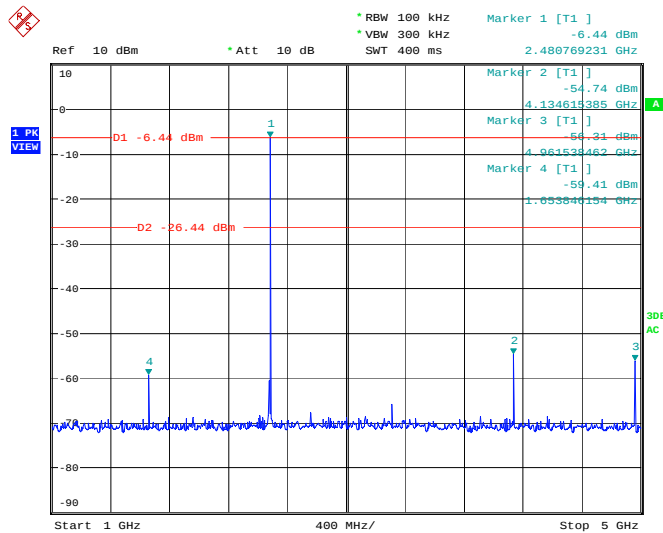
Notes: Limit = Reading of fundamental + Correction factor – 20dB
Emission level = Reading + Correction factor
Correction factor = Total cable loss

Figure 23: Spurious Emission from 30MHz to 1GHz, Mode C (2480MHz)



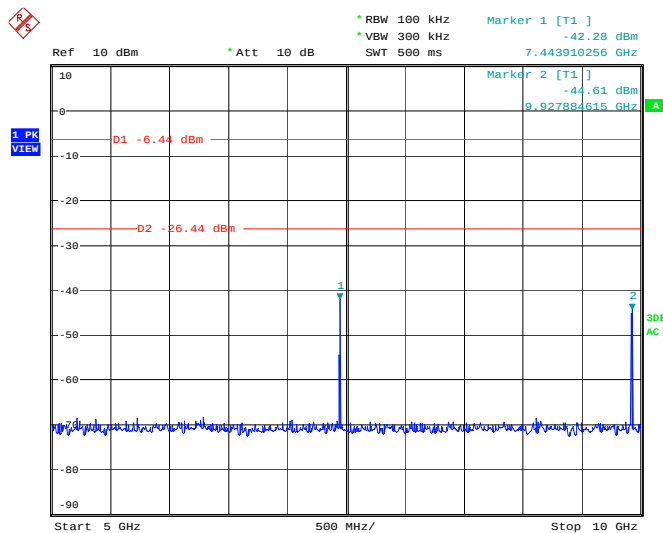
Conducted spurious emissions, mode C
Date: 22.JUN.2009 11:10:08

Figure 24: Spurious Emission from 1 to 5GHz, Mode C (2480MHz)



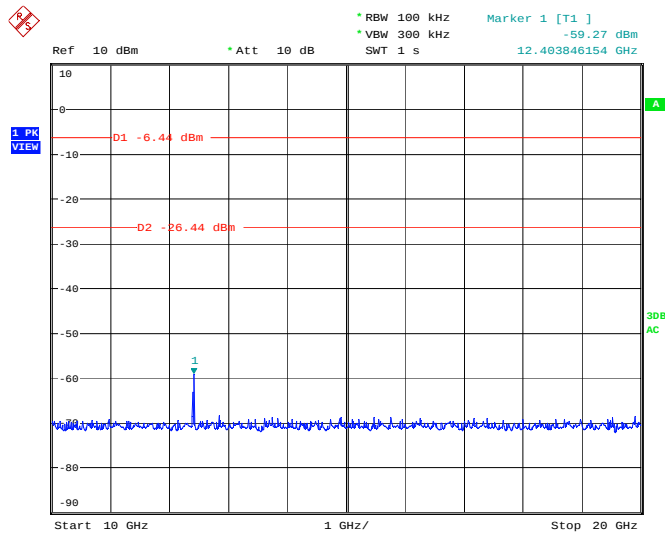
Conducted spurious emissions, mode C
Date: 22.JUN.2009 11:00:11

Figure 25: Spurious Emission from 5 to 10GHz, Mode C (2480MHz)



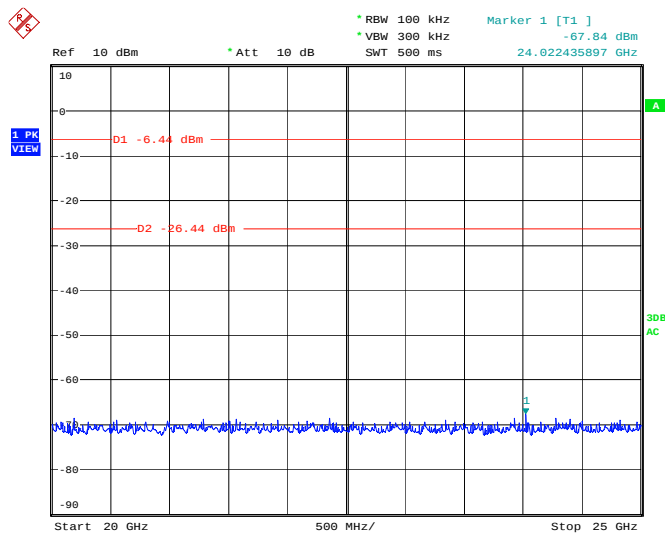
Conducted spurious emissions, mode C
Date: 22.JUN.2009 11:02:44

Figure 26: Spurious Emission from 10 to 20GHz, Mode C (2480MHz)



Conducted spurious emissions, mode C
Date: 22.JUN.2009 11:03:54

Figure 27: Spurious Emission from 20 to 25GHz, Mode C (2480MHz)



Conducted spurious emissions, mode C
Date: 22.JUN.2009 11:04:25

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6. Test Results of AC Power Line Conducted Measurements

6.1 AC Power Line Conducted Emission of Transmitter

6.1.1 AC Power Line Conducted Emission of Transmitter, FCC 15.207 and RSS-Gen 7.2.2

RESULT: N/A

The EUT is battery powered only and cannot be connected to the AC mains. Therefore this test is not applicable.

6.2 AC Power Line Conducted Emission of Receiver

6.2.1 AC Power Line Conducted Emission of Receiver, FCC 15.107 and RSS-Gen 7.2.2

RESULT: N/A

The EUT is battery powered only and cannot be connected to the AC mains. Therefore this test is not applicable.

7. Test Results of Radiated Measurements

7.1 Radiated Emission of Transmitter

7.1.1 Band Edge Radiated Emission, FCC 15.247(d) and RSS-210 2.2

RESULT: **Pass**

Date of testing: 2009-06-24

Ambient temperature: 20°C

Relative humidity: 61%

Atmospheric pressure: 996hPa

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Requirements:

Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) and RSS-210 2.7 (Table 1), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-210 2.7 (Table 2 and 3).

Test procedure:

ANSI C63.4-2003, RSS-Gen 4.9, 4.10 and Public Notice DA 00-705.

The EUT was placed horizontally on a nonconductive turntable 0.8m above the ground plane. Measurements were made at 3m distance. The EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level.

Measurements were taken using both horizontal and vertical antenna polarizations.

Measurements were performed using a spectrum analyzer with a suitable span to encompass the peak of the fundamental and using the following settings: Peak: RBW & VBW = 1MHz, Average: RBW = 1MHz, VBW = 10Hz.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

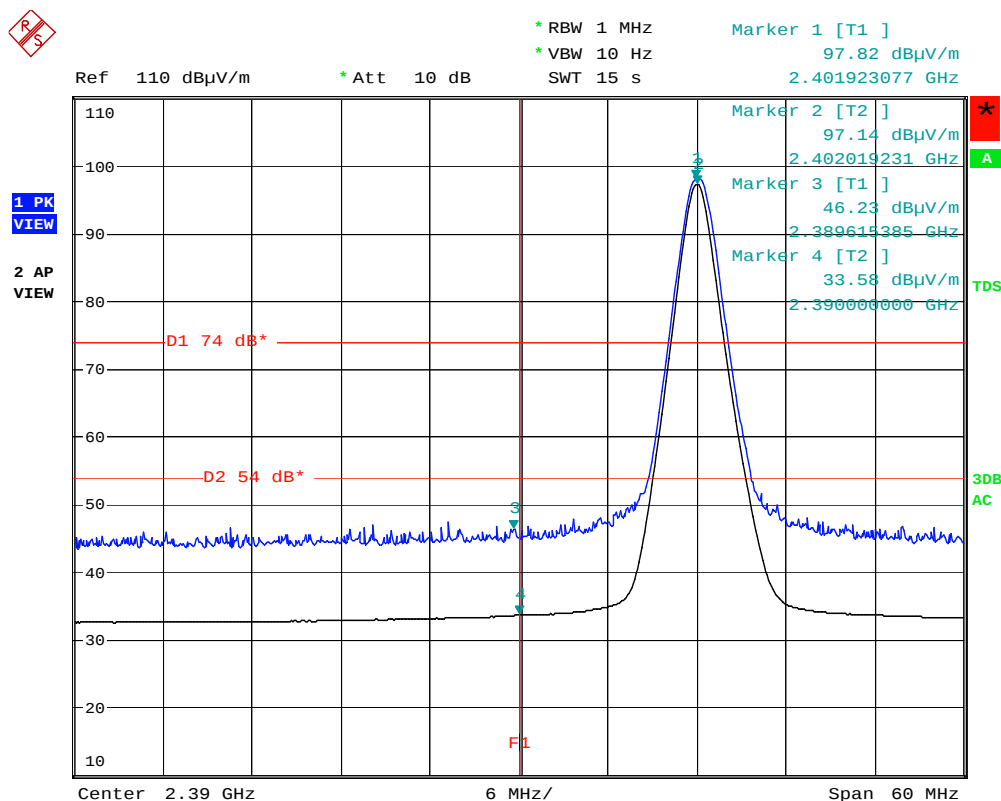
The tests were performed using a new battery.

Table 12: Band Edge Radiated Emission

Operating Frequency [MHz]	Antenna Orient.	Average Value [dBμV/m]	Peak Value [dBμV/m]	Average Limit [dBμV/m]	Peak Limit [dBμV/m]	Average Margin [dB]	Peak Margin [dB]
2402	V	33.58	46.23	54.00	74.00	20.42	27.77
2480	V	52.08	56.04	54.00	74.00	1.92 (*)	17.96

Notes: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.
Average limit in dBμV/m is calculated as follows: Average limit = 20 x log(500uV/m).
Peak limit in dBμV/m is calculated as follows: Peak limit = Average limit + 20dB.
(*) The measured result is below the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a high probability that the tested product complies with the specification limit.

Figure 28: Band Edge Radiated Emission, Mode A (2402MHz), Peak and Average

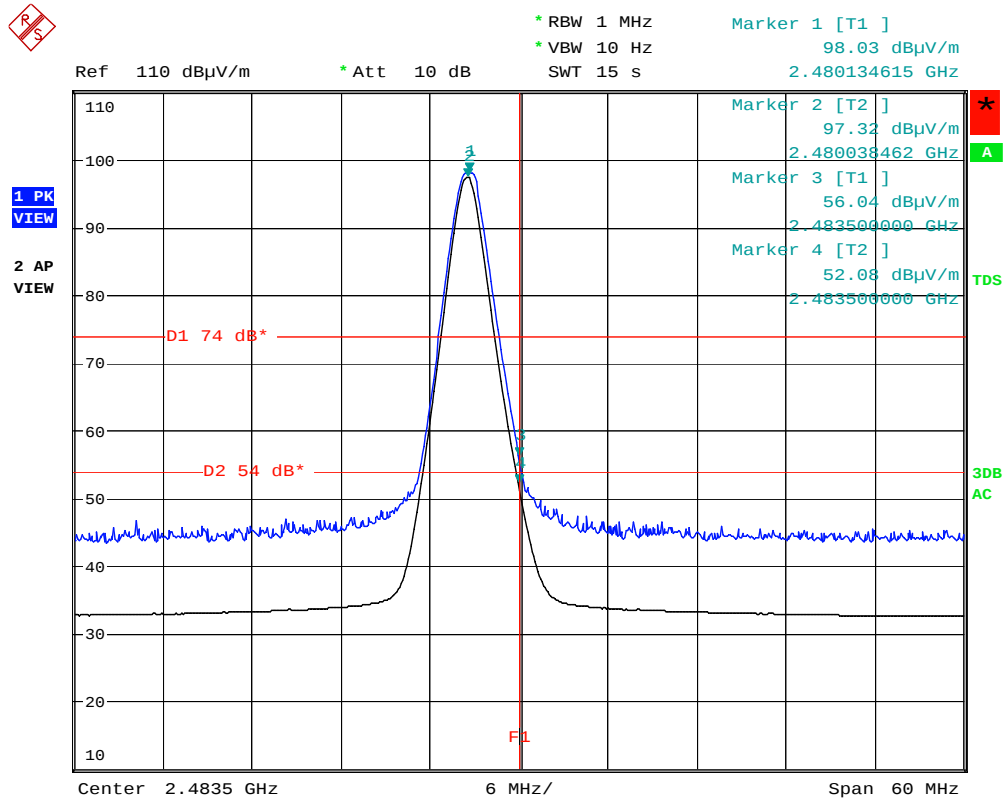


Band edge, antenna vert., mode A

Date: 24.JUN.2009 16:40:30

Note: The upper trace shows the peak value and the lower trace shows the average value.

Figure 29: Band Edge Radiated Emission, Mode C (2480MHz), Peak and Average



Band edge, antenna vert., mode C

Date: 24.JUN.2009 16:53:07

Note: The upper trace shows the peak value and the lower trace shows the average value.

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**7.1.2 Out-of-Band and Spurious Emission of Transmitter, FCC
15.247(d), FCC 15.205, FCC 15.209, RSS-210 2.2, RSS-210 A8.5
and RSS-Gen 7.2.1**

RESULT:

PASS

Date of testing: 2009-06-23, 2009-06-24

Ambient temperature: 21, 20°C

Relative humidity: 67, 61%

Atmospheric pressure: 992, 996hPa

Frequency range: 30MHz – 25GHz

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Requirements:

The emissions from the intentional radiator shall not exceed the field strength specified in FCC 15.209(a) and RSS-210 2.7.

Test procedure:

ANSI C63.4-2003, RSS-Gen 4.9, 4.10 and Public Notice DA 00-705.

The EUT was placed horizontally on a nonconductive turntable 0.8m above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system and the associated cabling were varied in order to ensure that maximum emission amplitudes were attained.

Final radiated emission measurements were made at 3m distance. The spectrum was examined from 30MHz to the 10th harmonic of the highest fundamental transmitter frequency (25GHz).

At each frequency, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

For frequencies between 30MHz and 1GHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1GHz, measurements were performed using the following settings: Peak: RBW & VBW = 1MHz, Average: RBW = 1MHz, VBW = 10Hz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

The tests were performed using a new battery.

Note:

Measurements were performed while the EUT was operating on a single channel (low middle or high) with full power and 100% duty cycle. These operation modes are only used for testing purpose and do not correspond to real use conditions since the EUT is to be operated in practice in hopping mode with DM1 packets. Therefore, the average level of harmonics needs to be corrected by a duty cycle correction factor in order to obtain a value which corresponds to normal use conditions.

The following principle has been applied regarding the duty cycle correction factor:

- (1) Harmonics which did not meet the average limit in 100% duty cycle with a margin greater than the uncertainty margin had their level adjusted to their normal operation level using the duty cycle correction factor described below, as permitted by Public Notice DA 00-705 and RSS-Gen 4.5. In this case, both values with and without duty cycle correction factor would be displayed in the tables here below.
- (2) Harmonics which met the average limit in 100% duty cycle with a margin greater than the measurement uncertainty were deemed to meet the limit in normal operation and no further calculation was performed, and only the value for 100% duty cycle would be displayed in the tables here below.

The duty cycle correction factor is calculated using the following formula:

Duty cycle correction factor (in dB)

$$= 20 * \log (\text{pulse duration} / \min [\text{pulse train duration}, 100\text{ms}])$$

Using the test results given for the test item "average time of occupancy", we obtain:

Pulse duration = 0.381ms

Pulse train duration

$$= 31.6\text{s} / (\text{number of pulses during } 31.6\text{s}) = 31.6\text{s} / 309 = 0.102\text{s} = 102\text{ms}$$

Therefore:

$$\text{Duty cycle correction factor} = 20 * \log (0.381\text{ms} / 100\text{ms}) = -48.4\text{dB}$$

To calculate the corrected average level of a harmonic, the duty cycle correction factor was applied to the corresponding peak measured level:

Average level with correction factor = peak level + duty cycle correction factor.

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Table 13: Radiated Emission 30MHz – 1GHz, Horizontal & Vertical Antenna Orientations, Quasi Peak Data, Mode A (2402MHz)

Freq. [MHz]	Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
30.603	H	48.8	-24.4	24.4	40	15.6	107	4
51.25	H	38.6	-23.2	15.4	40	24.6	331	4
66.758	V	41.1	-24.4	16.7	40	23.3	352	128
251.987	H	56.2	-23.2	33.0	46	13.0	109	177
311.992	H	53.4	-20.8	32.6	46	13.4	100	163
395.998	H	48.6	-18.5	30.1	46	15.9	101	130
895.505	H	31.0	-10.5	20.5	46	25.5	149	35

Note: Level QP = Reading QP + Factor

Table 14: Radiated Emission 1GHz – 25GHz, Horizontal and Vertical Antenna Orientations, Average and Peak Data, Mode A (2402MHz)

Freq. [MHz]	Antenna Orientation	Level AV [dBµV/m]	Level PK [dBµV/m]	Limit AV [dBµV/m]	Limit PK [dBµV/m]	Margin AV [dB]	Margin PK [dB]
1601.348	H	36.4	42.1	54	74	17.6	31.9
4804.014	H	58.8 / 12.2 *	60.6	54	74	-4.8 / 41.8 *	13.4
4804.014	V	52.6 / 6.8 *	55.2	54	74	1.4 / 47.2 *	18.8
7206.032	H	50.9 / 7.8 *	56.2	54	74	3.1 / 46.2 *	17.8
7206.023	V	52.9 / 9.5 *	57.9	54	74	1.1 / 44.5 *	16.1
14733.431	V	30.5	44.4	54	74	23.5	29.6
21705.420	V	26.4	40.6	54	74	27.6	33.4

Note: * Value without / with duty cycle correction factor.

All other correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

Table 15: Radiated Emission 30MHz – 1GHz, Horizontal & Vertical Antenna Orientations, Quasi Peak Data, Mode B (2441MHz)

Freq. [MHz]	Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
30.582	H	49	-24.4	24.6	40	15.4	104	335
51.324	H	41	-23.2	17.8	40	22.2	312	115
66.563	V	41.9	-24.4	17.5	40	22.5	284	20
264.006	H	57	-22.7	34.3	46	11.7	128	175
311.983	H	53	-20.8	32.2	46	13.8	101	169
396.006	H	48.4	-18.5	29.9	46	16.1	101	135
815.995	H	45.1	-11.5	33.6	46	12.4	101	231

Note: Level QP = Reading QP + Factor

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Table 16: Radiated Emission 1GHz – 25GHz, Horizontal and Vertical Antenna Orientations, Average and Peak Data, Mode B (2441MHz)

Freq. [MHz]	Antenna Orientation	Level AV [dBμV/m]	Level PK [dBμV/m]	Limit AV [dBμV/m]	Limit PK [dBμV/m]	Margin AV [dB]	Margin PK [dB]
1627.304	H	41.7	45.3	54	74	12.3	28.7
4068.355	H	40.0	46.2	54	74	14.0	27.8
4882.004	H	59.0 / 12.4 *	60.8	54	74	-5.0 / 41.6 *	13.2
4882.010	V	57.6 / 11.2 *	59.6	54	74	-3.6 / 42.8 *	14.4
7323.018	V	50.0 / 7.2 *	55.6	54	74	4.0 / 46.8 *	18.4
9764.070	V	30.9	42.1	54	74	23.1	31.9
22862.232	H	26.1	41.0	54	74	27.9	33.0

Note: * Value without / with duty cycle correction factor.

All other correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

Table 17: Radiated Emission 30MHz – 1GHz, Horizontal & Vertical Antenna Orientations, Quasi Peak Data, Mode C (2480MHz)

Freq. [MHz]	Antenna Orientation	Reading QP [dBμV]	Factor [dB(1/m)]	Level QP [dBμV/m]	Limit [dBμV/m]	Margin QP [dB]	Height [cm]	Angle [°]
30.621	H	47.8	-24.4	23.4	40	16.6	101	314
51.363	V	40.8	-23.6	17.2	40	22.8	173	166
66.711	V	40.3	-24.4	15.9	40	24.1	147	320
264.001	H	56.9	-22.7	34.2	46	11.8	130	353
395.998	H	48.3	-18.5	29.8	46	16.2	102	307
600.002	H	43.9	-13.8	30.1	46	15.9	138	47
816.018	H	44.8	-11.5	33.3	46	12.7	102	52

Note: Level QP = Reading QP + Factor

Table 18: Radiated Emission 1GHz – 25GHz, Horizontal and Vertical Antenna Orientations, Average and Peak Data, Mode C (2480MHz)

Freq. [MHz]	Antenna Orientation	Level AV [dBμV/m]	Level PK [dBμV/m]	Limit AV [dBμV/m]	Limit PK [dBμV/m]	Margin AV [dB]	Margin PK [dB]
1653.333	H	44.2	47.1	54	74	9.8	26.9
4133.351	H	43.5	48.2	54	74	10.5	25.8
4960.026	H	57.1 / 10.7 *	59.1	54	74	-3.1 / 43.3 *	14.9
4960.017	V	56.4 / 10.1 *	58.5	54	74	-2.4 / 43.9 *	15.5
7440.027	V	44.4	52.4	54	74	9.6	21.6
9920.059	V	36.8	45.8	54	74	17.2	28.2
23615.422	V	26.2	40.8	54	74	27.8	33.2

Note: * Value without / with duty cycle correction factor.

All other correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

7.2 Radiated Emission of Receiver

7.2.1 Radiated Spurious Emission of Receiver, FCC 15.109, RSS-210 2.2, RSS-210 2.6, RSS-210 A8.5, RSS-Gen 7.2.3.2

RESULT: **PASS**

Date of testing: 2009-06-23, 2009-06-24

Ambient temperature: 21, 20°C
Relative humidity: 67, 61%
Atmospheric pressure: 992, 996hPa

Frequency range: 30MHz – 12.5GHz
Measurement distance: 3m
Kind of test site: Semi Anechoic Chamber

Requirements:

The emissions from the unintentional radiator shall not exceed the field strength specified in 15.109(a) and RSS-210 Table 2 (and RSS-Gen Table 1).

Test procedure:

ANSI C63.4-2003, RSS-Gen 4.9, 4.10

The EUT was placed horizontally on a nonconductive turntable 0.8m above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system and the associated cabling were varied in order to ensure that maximum emission amplitudes were attained.

Final radiated emission measurements were made at 3m distance. The spectrum was examined from 30MHz to the 5th harmonic of the highest fundamental transmitter frequency (12.5GHz).

At each frequency, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

For frequencies between 30MHz and 1GHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1GHz, measurements were performed using the following settings: Peak: RBW & VBW = 1MHz, Average: RBW = 1MHz, VBW = 10Hz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

The tests were performed using a new battery.

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Table 19: Radiated Emission 30MHz – 1GHz, Horizontal & Vertical Antenna Orientations, Quasi Peak Data, Mode D (Receive at 2441MHz)

Freq. [MHz]	Antenna Orientation	Reading QP [dBμV]	Factor [dB(1/m)]	Level QP [dBμV/m]	Limit [dBμV/m]	Margin QP [dB]	Height [cm]	Angle [°]
30.596	H	51.9	-24.4	27.5	40	12.5	144	163
51.336	V	44.1	-23.6	20.5	40	19.5	111	320
66.706	V	40.9	-24.4	16.5	40	23.5	168	192
118.264	V	30.5	-25.1	5.4	43.5	38.1	387	25
263.994	H	55.1	-22.7	32.4	46	13.6	119	180
288.008	H	52.6	-21.5	31.1	46	14.9	116	166
395.995	H	49.7	-18.5	31.2	46	14.8	101	142
863.988	H	41.6	-10.7	30.9	46	15.1	112	253

Note: Level QP = Reading QP + Factor

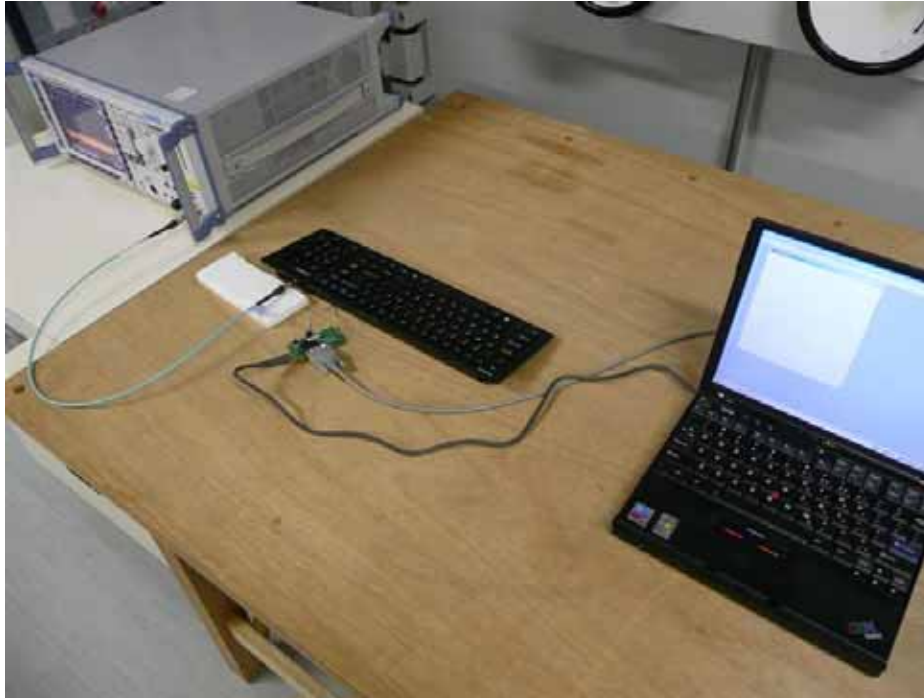
Table 20: Radiated Emission 1GHz – 12.5GHz, Horizontal & Vertical Antenna Orientations, Average and Peak Data, Mode D (Receive at 2441MHz)

Freq. [MHz]	Antenna Orientation	Level AV [dBμV/m]	Level PK [dBμV/m]	Limit AV [dBμV/m]	Limit PK [dBμV/m]	Margin AV [dB]	Margin PK [dB]
1628.643	H	38.1	42.9	54	74	15.9	31.1
2442.989	V	39.0	43.8	54	74	15.0	30.2
10984.752	V	28.4	42.7	54	74	25.6	31.3

Note: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

8. Photographs of the Test Setup

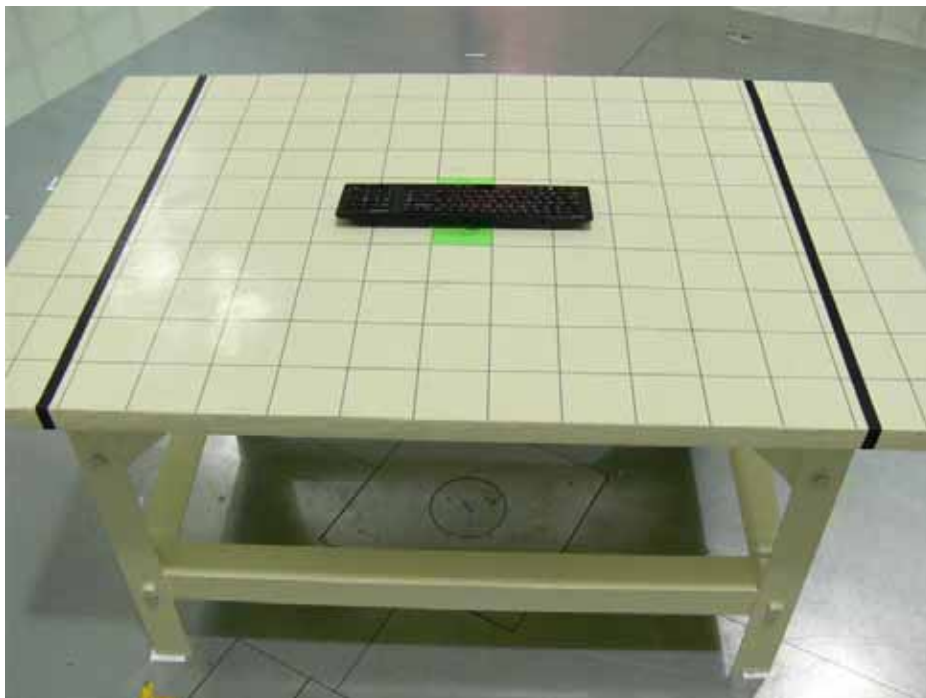
Photograph 2: Set-up for Conducted Emissions at Antenna Port



Photograph 3: Set-up for Radiated Emission of Transmitter, Front View



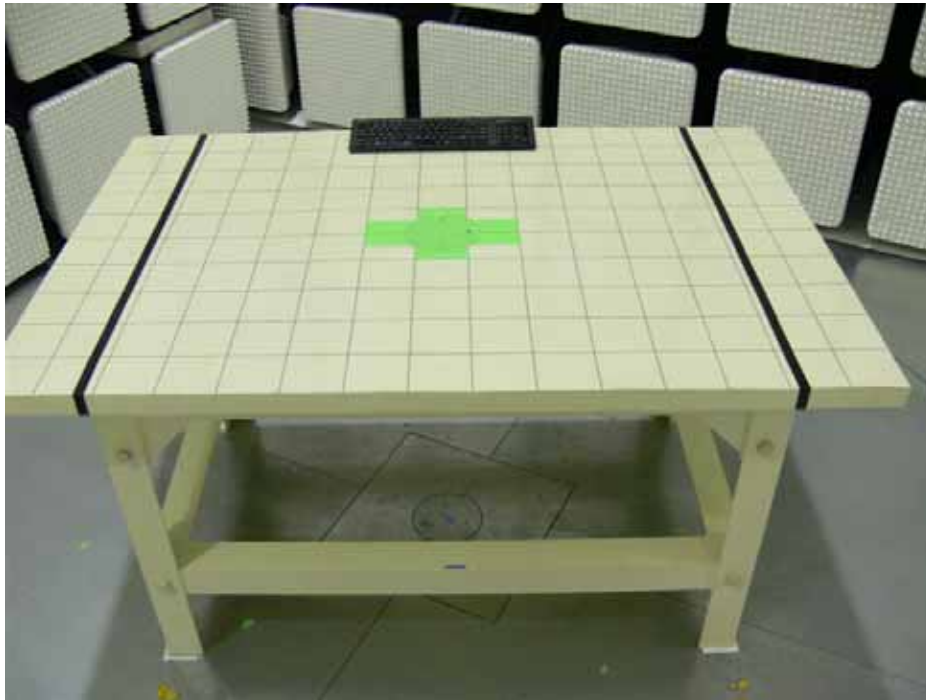
Photograph 4: Set-up for Radiated Emission of Transmitter, Rear View



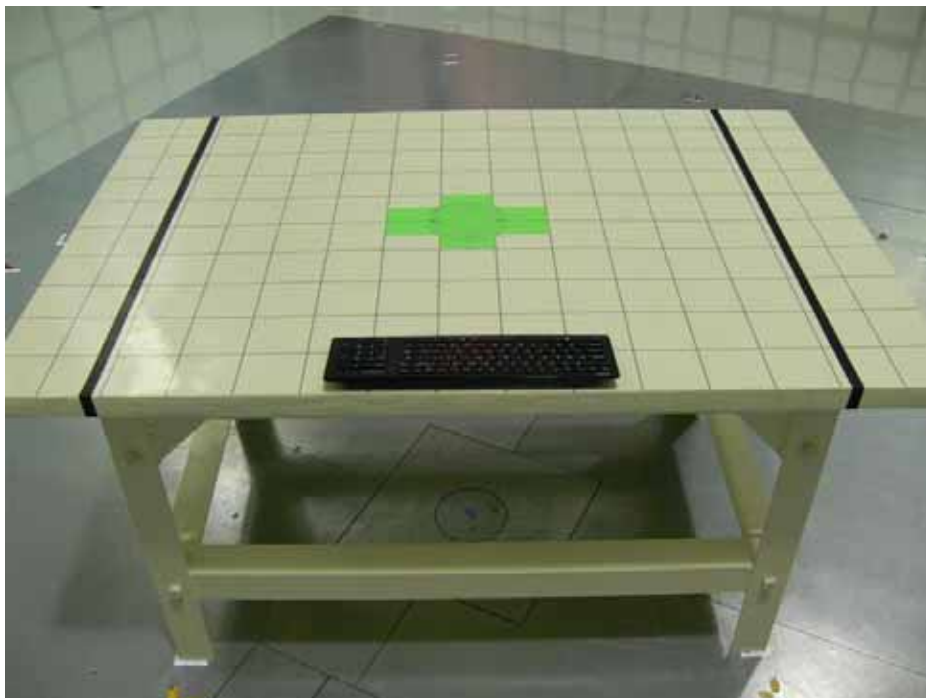
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Photograph 5: Set-up for Radiated Emission of Receiver, Front View



Photograph 6: Set-up for Radiated Emission of Receiver, Rear View



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