EMI Test Report

Tested in accordance with
Federal Communications Commission (FCC)
Personal Communications Services
CFR 47, Part 15 Subpart C
and
Industry Canada, RSS-210

Research In Motion Limited

REPORT NO.: RIM-0110-0411-02_revised

PRODUCT MODEL NO: RAR20CN
TYPE NAME: BlackBerry Wireless Handheld
FCC ID: L6ARAR20CN
IC: 2503A-RAR20CN

Date: _____13 December 2004_____

Declaration

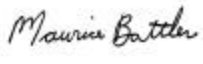
Statement of Performance:

The BlackBerry Wireless Handheld, model RAR20CN ASY-07338-001 Rev. B and accessories when configured and operated per RIM's operation instructions, performs within the requirements of the test standards.

Declaration:

We hereby certify that:
The test data reported herein is an accurate record of the performance of the sample(s) tested.
The test equipment used was suitable for the tests performed and within the manufacturers published specifications and operating parameters.
The test methods were consistent with the methods described in the relevant standards.

Tested by



Maurice Battler
Compliance Specialist

Date: 13 December 2004

Reviewed by:

Paul Lock
Senior Compliance Specialist

Date: 13 December 2004

Tested and Reviewed by:

Masud S. Attayi, P.Eng.
Senior Compliance Engineer

Date: 13 December 2004

Approved by:

Paul G. Cardinal, Ph.D.
Manager, Compliance and Certification

Date: 13 December 2004

Table of Contents

A) Scope

This report details the results of compliance tests which were performed in accordance to the requirements of:

- FCC CFR 15 Subpart C, Dec. 8, 2003
- Industry Canada, RSS-210, Issue 5, Nov./2001, Low Power Licence-Exempt Radiocommunication Devices

B) Product Identification

The equipment under test (EUT) was tested at the Research In Motion (RIM) EMI test facility, located at:

305 Phillip Street
Waterloo, Ontario
Canada, N2L 3W8
Phone: 519 888 7465
Fax: 519 888 6906
Web Site: www.rim.com

The testing began on October 20, 2004 and completed on December 13, 2004. The sample equipment under test (EUT) included:

1a) BlackBerry Wireless Handheld, model number RAR20CN, ASY-07338-001 Rev. B, PIN number 3004B2FF, FCC ID L6ARAR20CN, IC: 2503A-RAR20CN.
1b) BlackBerry Wireless Handheld, model number RAR20CN, ASY-07338-001 Rev. B, PIN number 3004B300, FCC ID L6ARAR20CN, IC: 2503A-RAR20CN.
2a) Travel Charger, model number PSM05R-050CH, part number ASY-03746-003 with an output voltage of 5.0 volts dc and attached USB data cable with a lead length of 0.71 metres.
2b) External Battery Charger model, number BCM6710A, part number ASY-06630-001.
2c) North American Travel Charger, model number PSM04A-050RIM, part number ASY-07040-001 with an output voltage of 5.0 volts dc and attached USB data cable with a lead length of 0.73 metres.
2d) Travel Charger, model number PSM05R-050Q, part number ASY-04078-001 with an output of 5.0 volts dc.
2e) Rapid Battery Travel Charger, model number PSM08R-050RIM, part number ASY-07041-001 with an output voltage of 5.0 volts dc and attached USB data cable with a lead length of 0.85 metres.
3) USB data cable, model number HDW-04162-001, 1.45 metres long.
4) Headset, model number HDW-03458-001. The lead length was 1.25 metres long.

The transmit frequency bands for the Handheld are: Cellular 824 to 849 MHz, PCS 1850 to 1910 MHz and Bluetooth 2402 to 2480 MHz.

C) Support Equipment Used for the Testing of the EUT

1) Communication Tester, Rohde & Schwarz, model CMU 200, serial number 100251
2) Communication Tester, Rohde & Schwarz, model CMU 200, serial number 837493/073
3) DC Power Supply, H/P, model 6632B, serial number US37472178

D) Test Voltage

The ac input voltage was 120 volts, 60 Hz where applicable. This configuration was per RIM's specifications.

E) Test Results Chart

SPECIFICATION	Test Type	MEETS REQUIREMENTS	Performed By
FCC CFR 47 Part 15.207 IC RSS-210	AC Conducted Emissions	Yes	Masud Attayi
FCC CFR 47 Part 15.209 IC RSS-210	Radiated Emissions	Yes	Masud Attayi
FCC CFR 47 Part 15.247(a) IC RSS-210	20 dB Bandwidth, Carrier Freq. Separation Number of Hopping freq. Dwell Time	Yes	Maurice Battler
FCC CFR 47 Part 15.247(b) IC RSS-210	Max. Peak Output Power	Yes	Maurice Battler
FCC CFR 47 Part 15.247(c) IC RSS-210	Band Edge Compliance Spurious RF Conducted Emissions	Yes	Maurice Battler

F) Modifications to EUT

No modifications were required to the EUT.

G) Summary of Results

1) AC CONDUCTED EMISSIONS

The conducted emissions were measured using the test procedure outlined in CISPR Recommendation 22 through a 50 Ohm Line Impedance Stabilization Network (LISN), which was inserted in the power line to the equipment to provide the specified impedance for measurements. The EUT was placed on a nonconductive wooden table, 80 cm high that was positioned 40 cm from a vertical ground plane. The RF output of the network was connected to an EMI receiver system with characteristics that duplicate those of the receiver specified in CISPR Publication 16.
The following test configurations were measured:

1. The Handheld in battery charging mode with Bluetooth transmitting was connected to the Travel Charger, model number PSM05R-050CH, part number ASY-03746-003. The ac input to the Travel Charger was 120 volts, 60 Hz
2. The Handheld in battery charging mode with Bluetooth transmitting was connected to the External Battery Charger, part number ASY-06630-001. The ac input to the External Battery Charger was 120 volts, 60 Hz.
3. The Handheld in battery charging mode with Bluetooth transmitting was connected to the North American Travel Charger, part number ASY-07040-001. The ac input to the North American Travel Charger was 120 volts, 60 Hz.
4. The Handheld in battery charging mode with Bluetooth transmitting was connected to the Travel Charger, part number ASY-04078-001 via the USB data cable. The ac input to the Travel Charger was 120 volts, 60 Hz.
5. The Handheld in battery charging mode with Bluetooth transmitting was connected to the Rapid Battery Travel Charger, part number ASY-07041-001. The ac input to the Rapid Battery Travel Charger was 120 volts, 60 Hz.

The sample EUT's conducted emissions were compared with respect to the FCC CFR 47 Part 15, Subpart C (CISPR 22) and RSS-210, Class B limit. The sample EUT had a worse case test margin of 2.66 dB at 0.170 MHz in the Rapid Battery Travel Charger test configuration.

Measurement Uncertainty ±2.0 dB

To view the test data/plots, see APPENDIX 1.

2) RADIATED EMISSIONS

The radiated emissions from the EUT were measured as per FCC Part 15.247 and IC RSS-210. The EUT was placed on a nonconductive wooden table, 100 cm high that was positioned on a remotely rotatable turntable. The test distance used between the EUT and the receiving antenna was three metres. Due to the noise floor at three metres, the emissions were repeated at a test distance of one metre. The turntable was rotated to determine the azimuth of the peak emissions. At this point the emissions were maximized by elevating the antenna in the range of 1 to 4 metres. The maximum emission level was recorded. The frequency range measured was from 30 MHz to 25.0 GHz. Both the horizontal and vertical polarisations of the emissions were measured.
The measurements were done in a semi-anechoic chamber. The semi-anechoic chamber FCC registration number is **778487** and the Industry Canada file number is **IC4240**.
The EUT was configured and operated to produce the maximum radiated emissions while still keeping within RIM's specifications.
The Handheld was measured in standalone configuration with Bluetooth transmitting at low channel (0), middle channel (39) and high channel (78).
The system's radiated emission levels were compared with respect to the FCC CFR 47 Part 15, Subpart C, 15.247 and RSS-210.
The Bluetooth harmonics were investigated up to the 10th harmonic. Emissions were in the noise floor (NF).

Sample Calculation:

Field Strength (dBµV/M) is calculated as follows:
FS = Measured Level (dBµV) + A.F. (dB/m) + Cable Loss (dB) - Preamp (dB) + Filter Loss (dB)

Measurement Uncertainty ±4.0 dB
To view the test data see APPENDIX 2.

3) BLUETOOTH RF CONDUCTED EMISSIONS

a) 20 dB Bandwidth
The EUT passed the 20 dB bandwidth requirement as per 47 CFR 15.247(a) and RSS-210. Low channel (0), middle channel (39) and high channel (78) were measured.
See APPENDIX 3 for the test data.

b) Carrier Frequency Separation
The EUT passed the carrier frequency separation as per 47 CFR 15.247(a) and RSS-210. Channel 38 to 39 was measured.
See APPENDIX 3 for the test data.

c) Number of Hopping frequencies
The EUT passed the number of hopping frequencies as per 47 CFR 15.247(a) and RSS-210. The number of hopping channels measured was 79.
See APPENDIX 3 for the test data.

d) Time of Occupancy (Dwell Time)
The EUT passed the dwell time as per 47 CFR 15.247(a) and RSS-210. Low channel (0), middle channel (39) and high channel (78) were measured in DH1, DH3 and DH5 modes. Bluetooth was operating in frequency hopping (Euro/US) mode during the measurements.
See APPENDIX 3 for the test data.

e) Maximum Peak Conducted Output Power
The EUT passed the maximum peak conducted output power as per 47 CFR 15.247(b) and RSS-210. Low channel (0), middle channel (39) and high channel (78) were measured.
See APPENDIX 3 for the test data.

f) Band-Edge Compliance of RF Conducted Emissions
The EUT passed the band-edge compliance of RF conducted emissions as per 47 CFR 15.247(c) and RSS-210. Channels 0 and 78 were measured in frequency hopping (Euro/US) mode and single frequency mode.
See APPENDIX 3 for the test data.

g) Spurious RF Conducted Emissions
The EUT passed the spurious RF conducted emissions as per 47 CFR 15.247(c) and RSS-210. The frequency range measured was 10 MHz to 26 GHz. Low channel (0), middle channel (39) and high channel (78) were measured in single frequency mode and frequency hopping (Euro/US) mode.
See APPENDIX 3 for the test data.

H) **Compliance Test Equipment Used**

UNIT	MANUFACTURER	MODEL	SERIAL NUMBER	CAL DUE DATE (YY MM DD)	USE
Preamplifier	Sonoma	310N/11909A	185831	04-11-06	Radiated Emissions
Preamplifier system	TDK RF Solutions	PA-02	080010	04-11-06	Radiated Emissions
EMC Analyzer	Agilent	E7405A	US40240226	05-07-29	Radiated Emissions
Hybrid Log Antenna	TDK	HLP-3003C	017301	04-12-16	Radiated Emissions
Horn Antenna	TDK	HRN-0118	30201	05-01-08	Radiated Emissions
Horn Antenna	TDK	HRN-0118	30101	05-07-21	Radiated Emissions
Horn Antenna	Emco	3116	2538	05-09-27	Radiated Emissions
Preamplifier	TDK	18-26	3002	04-11-27	Radiated Emissions
Dipole Antenna	Schwarzbeck	UHAP	1018	05-01-09	Radiated Emissions
Dipole Antenna	Schwarzbeck	UHAP	973	04-12-01	Radiated Emissions
Universal Radio Communication Tester	Rohde & Schwarz	CMU 200	837493/073	05-05-29	Radiated Emissions
Universal Radio Communication Tester	Rohde & Schwarz	CMU 200	100251	05-04-21	Conducted Emissions
L.I.S.N.	Emco	3816/2	1120	05-08-18	Conducted Emissions
Spectrum Analyzer	HP	8563E	3745A08112	05-07-20	Radiated/Conducted Emissions
DC Power Supply	HP	6632B	US37472178	05-08-01	Conducted Emissions
Environment Monitor	Control Company	1870	230355190	06-01-11	Radiated/Conducted Emissions
Environment Monitor	Control Company	1870	230355189	06-01-11	RF Conducted Emissions

APPENDIX 1

AC CONDUCTED EMISSIONS TEST DATA/PLOTS

AC Conducted Emissions Test Results

November 09, 2004

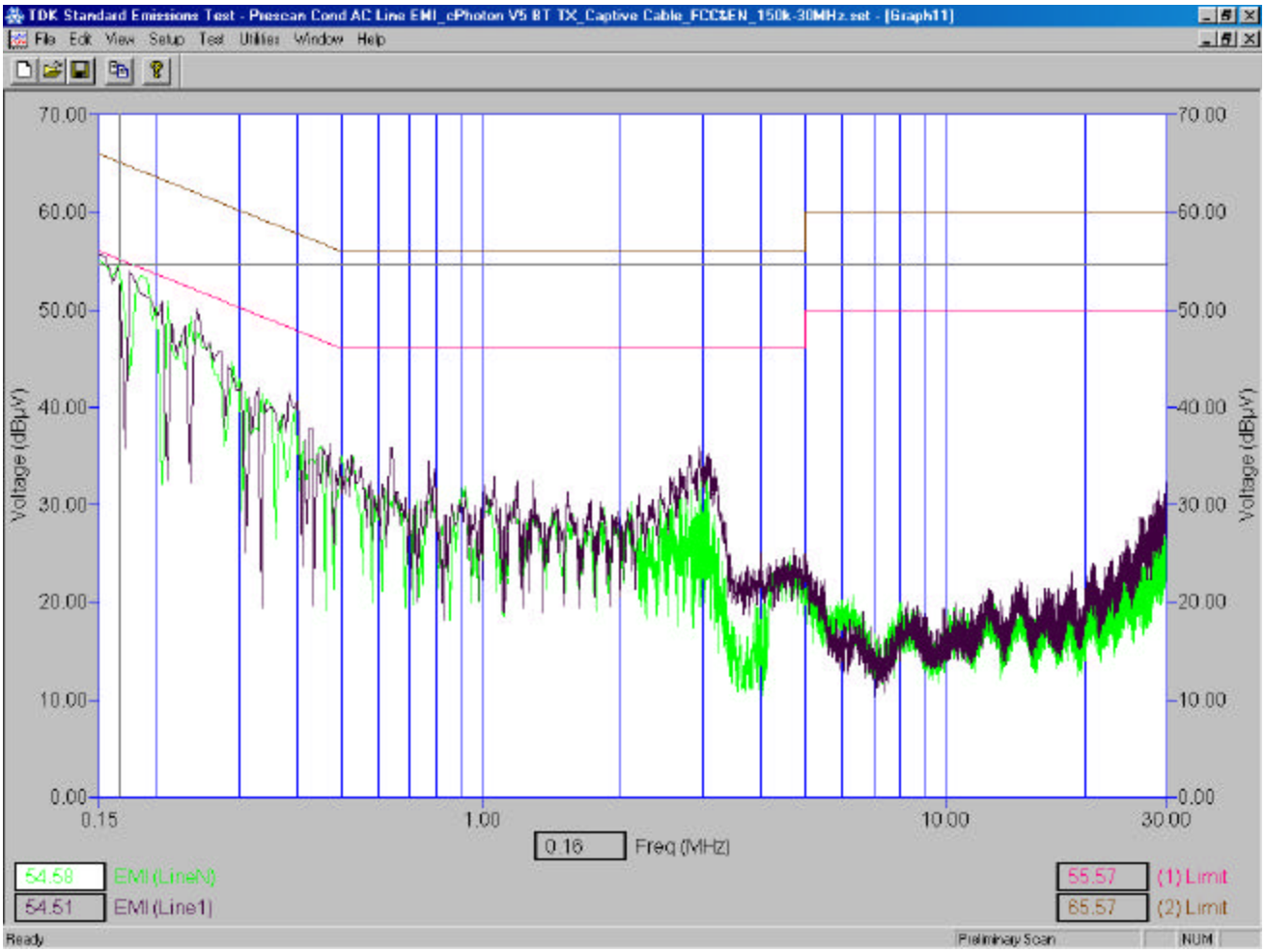
FCC CFR 47 Part 15, Subpart C (CISPR 22), Industry Canada, RSS-210, Class B

Operating Mode: The Handheld in battery charging mode with Bluetooth transmitting was connected to the Travel Charger part number ASY-03746-003. The ac input to the Travel Charger was 120 volts, 60 Hz

Frequency (MHz)	Line	Reading QP (dBµV)	Correction Factors for Impulse Limiter, LISN, Cable (dB)	QP Level (reading + Corr.Factor) (dB)	(QP) Limit (dBµV)	(AVG) Limit (dBµV)	Margin QP Limits (dB)	Margin Ave. Limits (dB)
0.151	N	9.82	41.00	50.82	66.00	56.00	-15.18	-5.18
0.153	L1	9.82	41.31	51.13	66.00	56.00	-14.87	-4.87
0.171	N	9.83	37.54	47.37	64.26	54.26	-16.89	-6.89
0.176	L1	9.83	38.32	48.15	64.72	54.72	-16.57	-6.57
0.201	L1	9.83	35.36	45.19	63.01	53.01	-17.82	-7.82
0.205	N	9.83	35.15	44.98	63.21	53.21	-18.22	-8.22
0.220	N	9.84	33.52	43.36	62.27	52.27	-18.91	-8.91
0.254	L1	9.84	31.79	41.63	61.92	51.92	-20.29	-10.29
0.282	L1	9.85	28.85	38.70	60.67	50.67	-21.97	-11.97
0.290	N	9.85	16.49	26.34	60.52	50.52	-34.19	-24.19
0.380	N	9.83	25.33	35.16	57.96	47.96	-22.80	-12.80
0.395	L1	9.83	24.26	34.09	58.17	48.17	-24.08	-14.08
2.946	L1	9.84	5.86	15.70	56.00	46.00	-40.30	-30.30

All other emission levels had a test margin of greater than 25 dB.
See graph 1 for the measurement plot.

AC Conducted Emissions Test Graph 1



The Handheld in battery charging mode with Bluetooth transmitting was connected to the Travel Charger part number ASY-03746-003. The ac input to the Travel Charger was 120 volts, 60 Hz.

AC Conducted Emissions Test Results cont'd

November 09, 2004

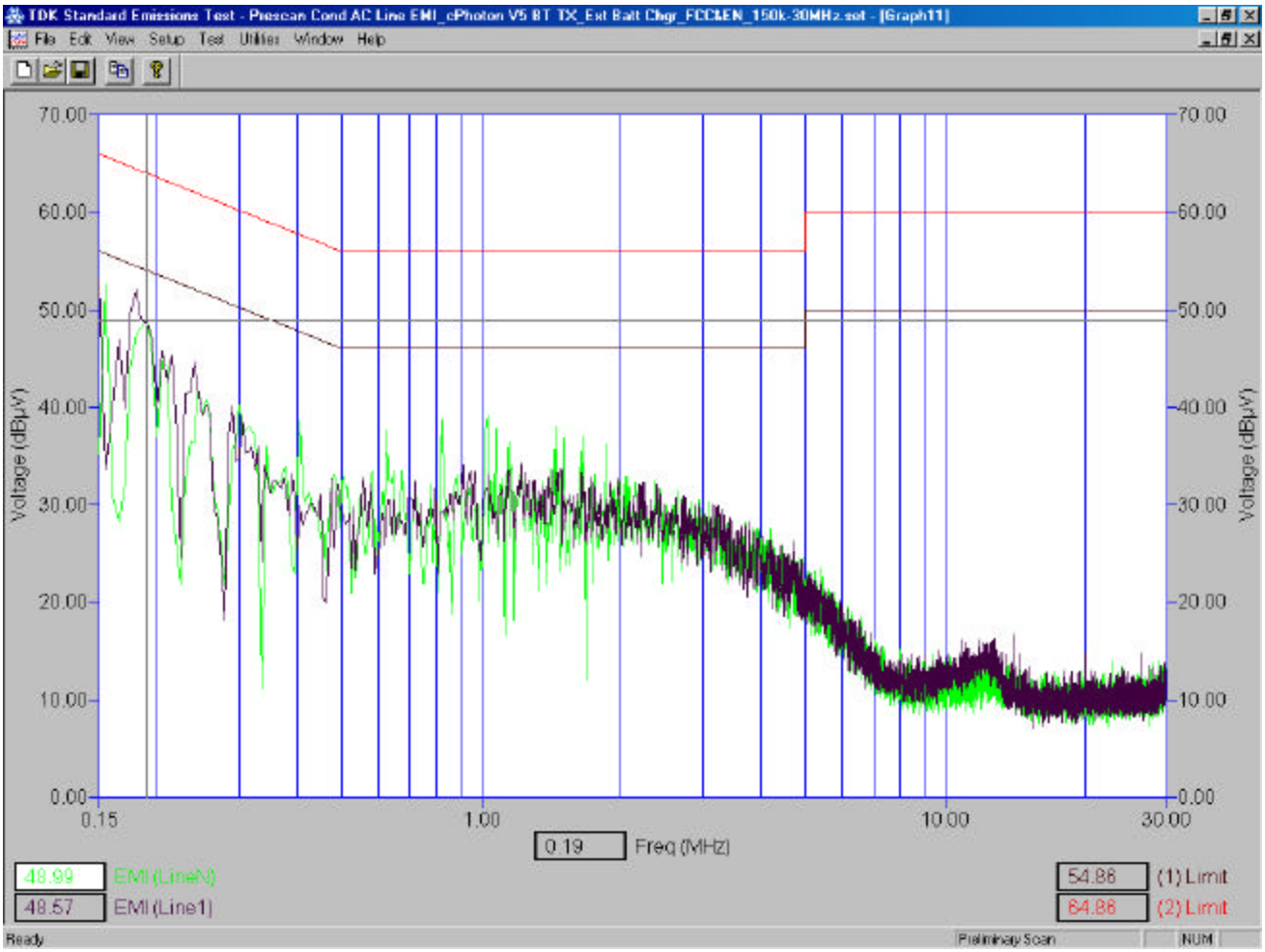
FCC CFR 47 Part 15, Subpart C (CISPR 22), Industry Canada, RSS-210, Class B

Operating Mode: The Handheld in battery charging mode with Bluetooth transmitting was connected to the External Battery Charger part number ASY-06630-001. The ac input to the External Battery Charger was 120 volts, 60 Hz

Frequency (MHz)	Line	Reading QP (dBµV)	Correction Factors for Impulse Limiter, LISN, Cable (dB)	QP Level (reading + Corr.Factor) (dB)	(QP) Limit (dBµV)	(AVG) Limit (dBµV)	Margin QP Limits (dB)	Margin Ave. Limits (dB)
0.155	N	33.09	9.82	42.91	65.73	55.73	-12.82	-22.82
0.157	L1	33.85	9.82	43.67	66.00	56.00	-12.33	-22.33
0.164	L1	32.85	9.82	42.67	65.21	55.21	-12.53	-22.53
0.179	L1	37.09	9.83	46.92	64.49	54.49	-7.57	-17.57
0.183	N	35.96	9.83	45.79	64.04	54.04	-8.25	-18.25
0.191	L1	35.51	9.83	45.34	63.41	53.41	-8.06	-18.06
0.243	L1	28.71	9.84	38.55	62.10	52.10	-13.55	-23.55

All other emission levels had a test margin of greater than 25 dB.
See graph 2 for the measurement plot.

AC Conducted Emissions Test Graph 2



The Handheld in battery charging mode with Bluetooth transmitting was connected to the External Battery Charger part number ASY-06630-001. The ac input to the External Battery Charger was 120 volts, 60 Hz.

AC Conducted Emissions Test Results cont'd

December 11, 2004

FCC CFR 47 Part 15, Subpart C (CISPR 22), Industry Canada, RSS-210, Class B

Operating Mode: The Handheld in battery charging mode with Bluetooth transmitting was connected to the North American Travel Charger part number ASY-07040-001. The ac input to the North American Travel Charger was 120 volts, 60 Hz

Frequency (MHz)	Line	Reading (QP) (dBµV)	Correction Factors for Impulse Limiter, LISN, Cable (dB)	Level (QP) (reading + Corr.Factor) (dB)	Limit (QP) (dBµV)	Margin (QP) Limits (dB)
0.153	N	47.58	9.98	57.56	66.00	-8.44
0.155	L1	47.84	9.98	57.82	65.21	-7.39
0.184	L1	36.98	9.98	46.96	63.61	-16.65
0.203	L1	36.33	9.98	46.31	63.21	-16.90
0.209	N	35.65	9.98	45.63	62.63	-17.00
1.919	N	23.99	10.06	34.05	56.00	-21.95
2.085	N	22.85	10.06	32.91	56.00	-23.09
2.417	L1	24.33	10.07	34.40	56.00	-21.60
2.699	N	25.35	10.07	35.42	56.00	-20.58
2.756	N	24.94	10.08	35.02	56.00	-20.98
3.226	L1	22.51	9.99	32.50	56.00	-23.50
3.388	L1	22.01	10.00	32.01	56.00	-23.99

Measurements were done with the quasi-peak detector.
See graph 3 for the measurement plot.

AC Conducted Emissions Test Results cont'd

December 11, 2004

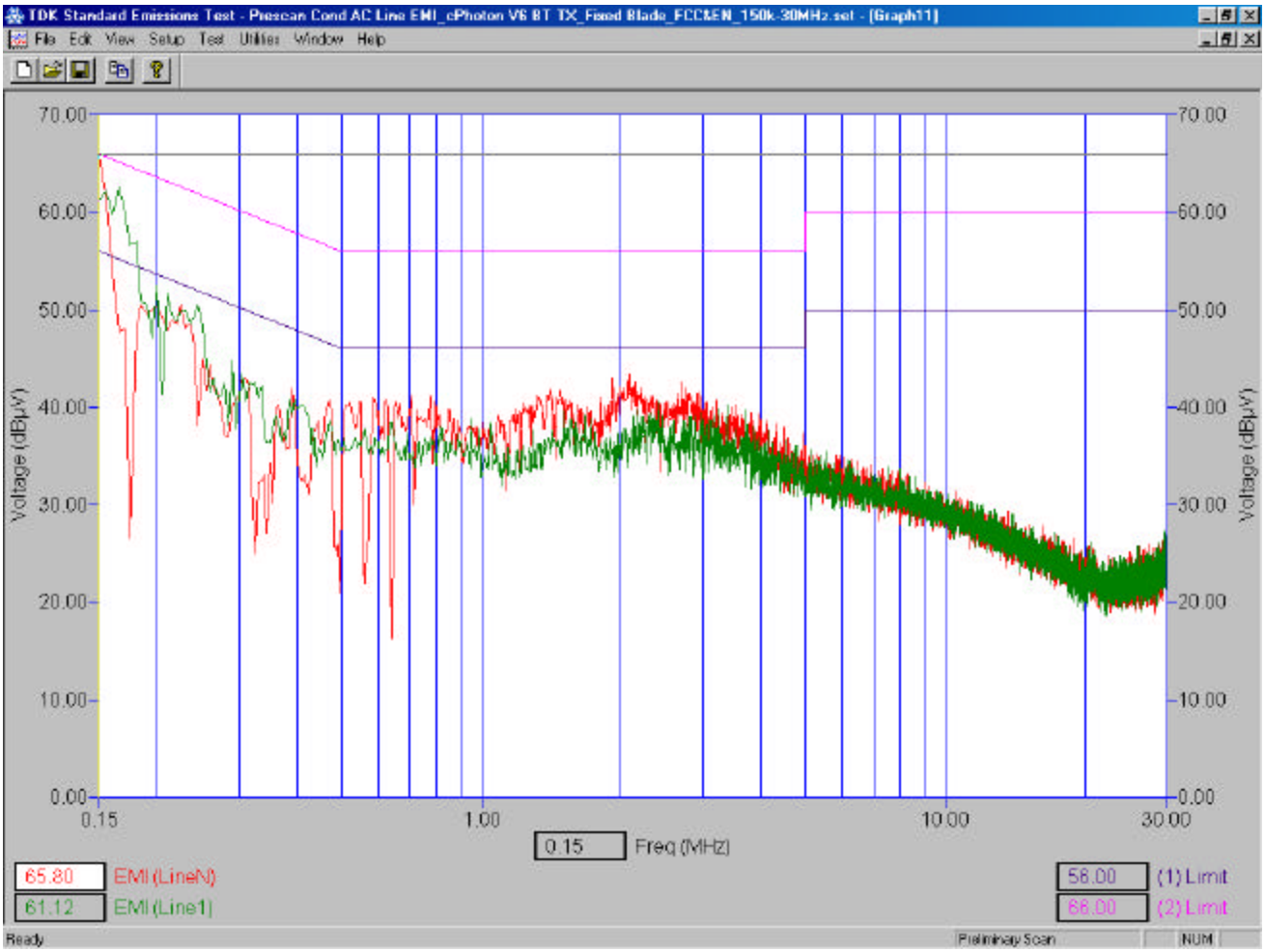
FCC CFR 47 Part 15, Subpart C (CISPR 22), Industry Canada, RSS-210, Class B

Operating Mode: The Handheld in battery charging mode with Bluetooth transmitting was connected to the North American Travel Charger part number ASY-07040-001. The ac input to the North American Travel Charger was 120 volts, 60 Hz

Frequency (MHz)	Line	Reading (Ave.) (dBµV)	Correction Factors for Impulse Limiter, LISN, Cable (dB)	Level (Ave.) (reading + Corr.Factor) (dB)	Limit (Ave.) (dBµV)	Margin (Ave.) Limits (dB)
0.158	N	16.58	9.98	26.56	56.00	-29.44
0.165	L1	28.22	9.98	38.20	55.21	-17.01
0.188	L1	16.35	9.98	26.33	53.61	-27.28
0.195	L1	12.96	9.98	22.94	53.21	-30.27
0.228	N	6.73	9.98	16.71	52.63	-35.92
1.902	N	15.50	10.06	25.56	46.00	-20.44
2.091	N	14.76	10.06	24.82	46.00	-21.18
2.409	L1	14.76	10.07	24.83	46.00	-21.17
2.708	N	15.79	10.07	25.86	46.00	-20.14
2.742	N	12.44	10.08	22.52	46.00	-23.48
3.226	L1	14.14	9.99	24.13	46.00	-21.87
3.385	L1	14.19	10.00	24.19	46.00	-21.81

Measurements were done with the average detector.
See graph 3 for the measurement plot.

AC Conducted Emissions Test Graph 3



The Handheld in battery charging mode with Bluetooth transmitting was connected to the North American Travel Charger part number ASY-07040-001. The ac input to the North American Travel Charger was 120 volts, 60 Hz.

AC Conducted Emissions Test Results cont'd

November 09, 2004

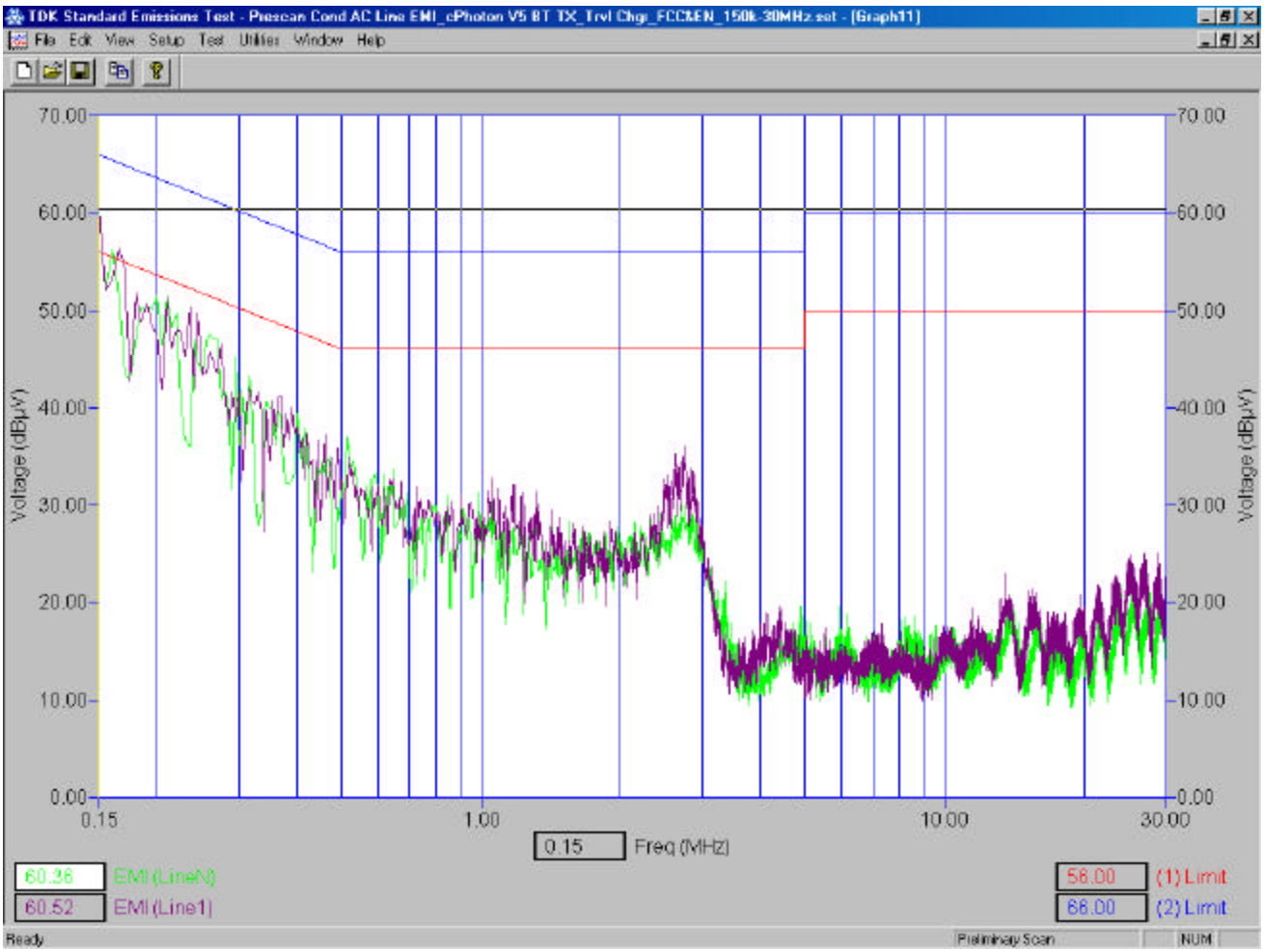
FCC CFR 47 Part 15, Subpart C (CISPR 22), Industry Canada, RSS-210, Class B

Operating Mode: The Handheld in battery charging mode with Bluetooth transmitting was connected to the Travel Charger part number ASY-04078-001 via the USB data cable, model number HDW-04162-001. The ac input to the Travel Charger was 120 volts, 60 Hz

Frequency (MHz)	Line	Reading QP (dBµV)	Correction Factors for Impulse Limiter, LISN, Cable (dB)	QP Level (reading + Corr.Factor) (dB)	(QP) Limit (dBµV)	(AVG) Limit (dBµV)	Margin QP Limits (dB)	Margin Ave. Limits (dB)
0.150	N	41.66	9.82	51.48	66.00	56.00	-14.52	-4.52
0.151	N	40.77	9.82	50.59	65.46	55.46	-14.87	-4.87
0.152	L1	41.51	9.82	51.33	66.00	56.00	-14.67	-4.67
0.154	L1	40.60	9.82	50.42	65.21	55.21	-14.78	-4.78
0.177	L1	37.51	9.83	47.34	64.49	54.49	-17.15	-7.15
0.189	N	35.91	9.83	45.74	63.61	53.61	-17.87	-7.87
0.197	N	34.95	9.83	44.78	63.21	53.21	-18.42	-8.42
0.203	L1	34.44	9.83	44.27	63.21	53.21	-18.93	-8.93
0.220	L1	33.04	9.84	42.88	62.27	52.27	-19.39	-9.39
0.247	L1	31.22	9.84	41.06	61.92	51.92	-20.86	-10.86
0.254	N	31.33	9.84	41.17	61.43	51.43	-20.26	-10.26
0.284	N	27.51	9.85	37.36	60.38	50.38	-23.02	-13.02
2.742	L1	18.45	9.91	28.36	56.00	46.00	-27.64	-17.64

See graph 4 for the measurement plot.

AC Conducted Emissions Test Graph 4



The Handheld in battery charging mode with Bluetooth transmitting was connected to the Travel Charger part number ASY-04078-001 via the USB data cable, model number HDW-04162-001. The ac input to the Travel Charger was 120 volts, 60 Hz.

AC Conducted Emissions Test Results cont'd

November 12, 2004

FCC CFR 47 Part 15, Subpart C (CISPR 22), Industry Canada, RSS-210, Class B

Operating Mode: The Handheld in battery charging mode with Bluetooth transmitting was connected to the Rapid Battery Travel Charger part number ASY-07041-001. The ac input to the Rapid Battery Travel Charger was 120 volts, 60 Hz

Frequency (MHz)	Line	Reading (QP) (dBµV)	Correction Factors for Impulse Limiter, LISN, Cable (dB)	Level (QP) (reading + Corr.Factor) (dB)	Limit (QP) (dBµV)	Margin (QP) Limits (dB)
0.159	N	18.42	9.82	28.24	65.73	-37.49
0.167	N	49.46	9.83	59.29	64.96	-5.68
0.170	L1	52.23	9.83	62.06	64.72	-2.66
0.175	N	51.26	9.83	61.09	64.04	-2.95
0.202	L1	49.79	9.83	59.62	63.61	-3.99
0.214	N	49.01	9.84	58.85	62.45	-3.60
0.218	L1	17.49	9.84	27.33	62.45	-35.12
0.289	N	45.08	9.85	54.93	60.11	-5.18
0.292	L1	43.14	9.85	52.99	60.82	-7.83
0.321	L1	43.19	9.84	53.03	59.45	-6.42
0.344	N	42.49	9.84	52.33	59.08	-6.75
0.436	L1	38.69	9.83	48.52	57.25	-8.73
0.510	L1	35.86	9.84	45.70	56.00	-10.30
0.655	N	31.66	9.85	41.51	56.00	-14.49

Measurements were done with the quasi-peak detector.
See graph 5 for the measurement plot.

AC Conducted Emissions Test Results cont'd

November 09, 2004

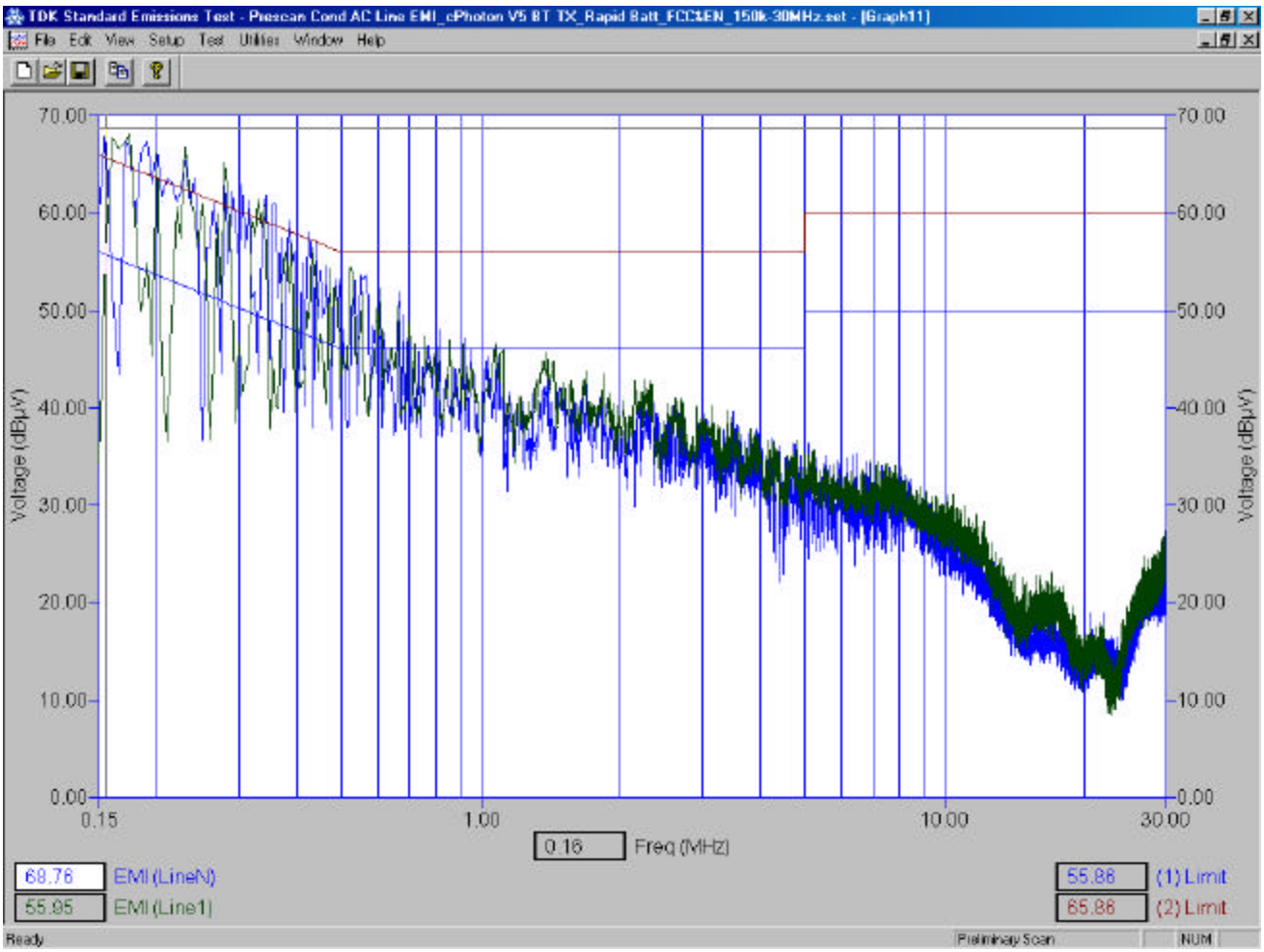
FCC CFR 47 Part 15, Subpart C (CISPR 22), Industry Canada, RSS-210, Class B

Operating Mode: The Handheld in battery charging mode with Bluetooth transmitting was connected to the Rapid Battery Travel Charger part number ASY-07041-001. The ac input to the Rapid Battery Travel Charger was 120 volts, 60 Hz

Frequency (MHz)	Line	Reading (Ave.) (dBµV)	Correction Factors for Impulse Limiter, LISN, Cable (dB)	Level (Ave.) (reading + Corr.Factor) (dB)	Limit (Ave.) (dBµV)	Margin (Ave.) Limits (dB)
0.156	N	23.56	9.82	33.38	55.73	-22.35
0.164	L1	23.65	9.83	33.48	54.72	-21.24
0.165	N	5.23	9.83	15.06	54.96	-39.91
0.173	N	23.68	9.83	33.51	54.04	-20.53
0.189	L1	22.51	9.83	32.34	53.61	-21.27
0.215	N	18.94	9.84	28.78	52.45	-23.67
0.221	L1	17.88	9.84	27.72	52.45	-24.73
0.295	N	15.20	9.85	25.05	50.11	-25.06
0.295	L1	21.23	9.85	31.08	50.82	-19.74
0.331	N	18.94	9.84	28.78	49.08	-20.30
0.338	L1	18.78	9.84	28.62	49.45	-20.83
0.422	L1	14.19	9.83	24.02	47.25	-23.23
0.526	L1	23.47	9.84	33.31	46.00	-12.69
0.657	N	15.00	9.85	24.85	46.00	-21.15

Measurements were done with the average detector.
See graph 5 for the measurement plot.

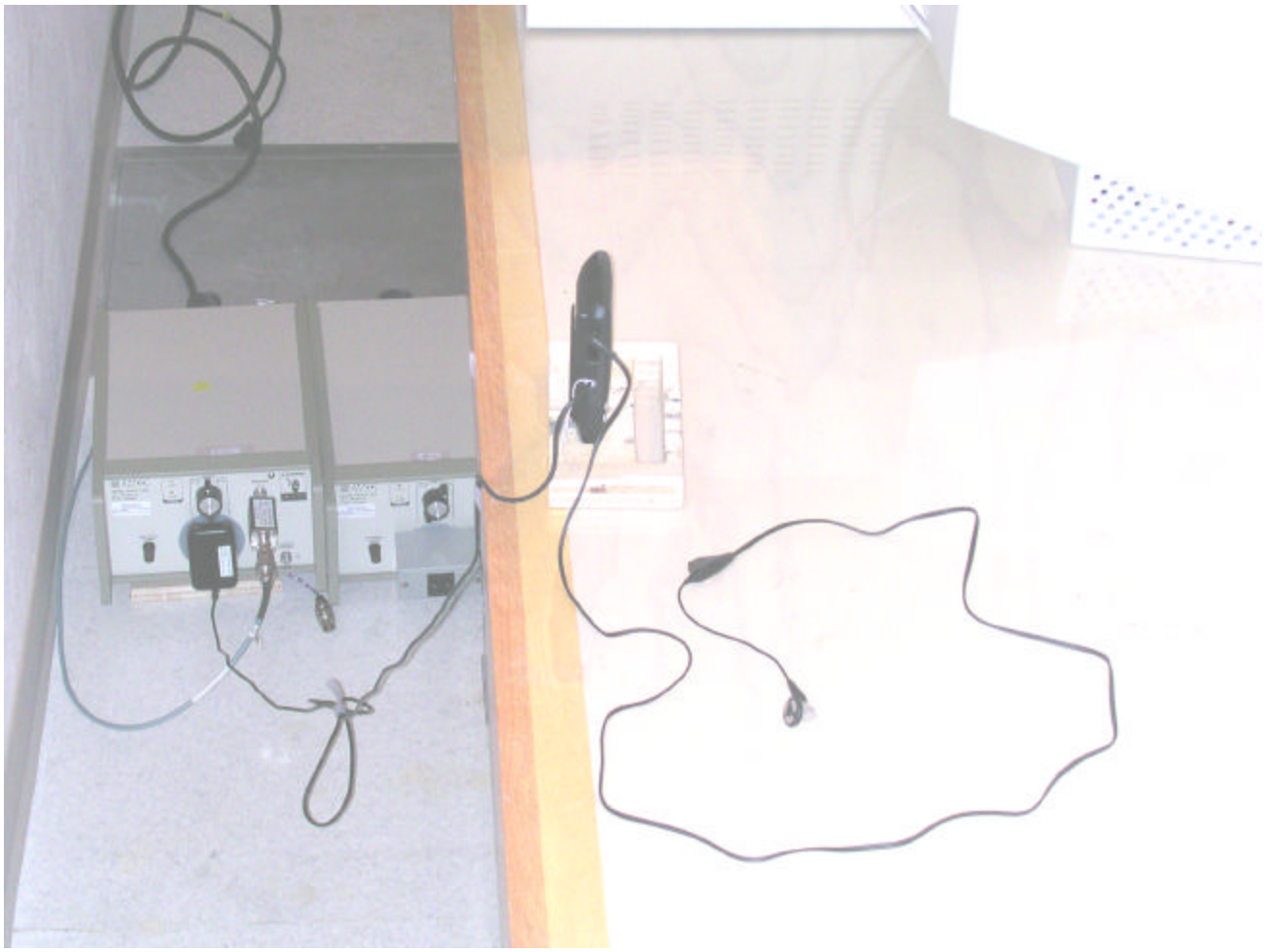
AC Conducted Emissions Test Graph 5



The Handheld in battery charging mode with Bluetooth transmitting was connected to the Rapid Battery Travel Charger part number ASY-07041-001. The ac input to the Rapid Battery Travel Charger was 120 volts, 60 Hz.

AC Conducted Emission Test-Setup Photo

FCC CFR 47 Part 15, Subpart C (CISPR 22), Industry Canada, RSS-210, Class B



APPENDIX 2

RADIATED EMISSIONS TEST DATA

Radiated Emissions Test Results

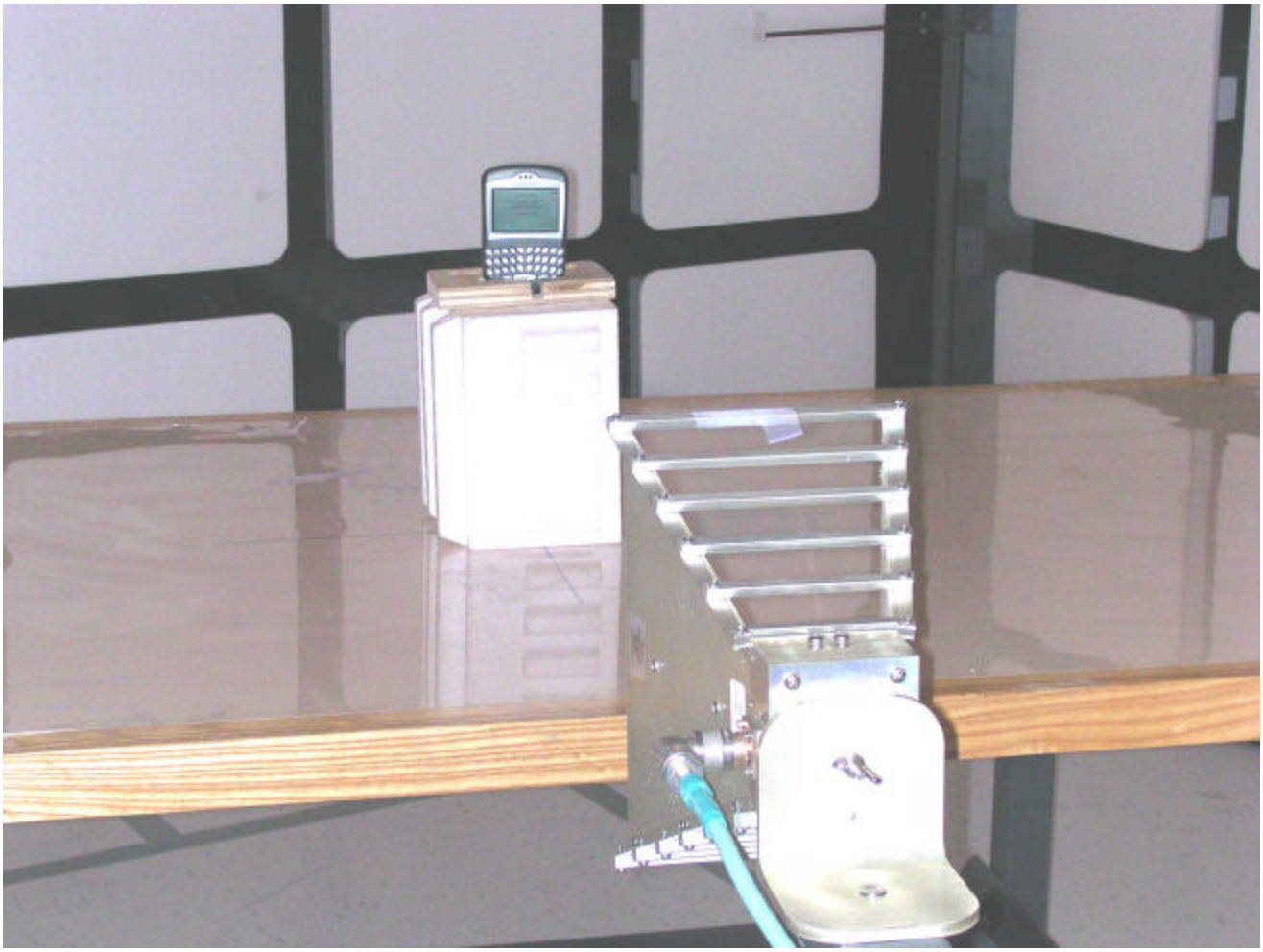
Test Distance was 1.0 metres. Bluetooth Band October 20, 2004

The measurements were performed in frequency hopping mode (channels 0 to 78) at maximum output power.

Type	Channel	Frequency	Antenna		Reading	Corrected Reading	Average Limit (at 1 metre)	Peak Limit (at 1 metre)	Diff. To Limit
		(MHz)	Type	Pol	(dBuV)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)
Handheld Standalone,Vertical position									
2nd	0 - 78	4804-4960	Horn	V	NF	NF	63.5	83.5	
2nd	0 - 78	4804-4960	Horn	H	NF	NF			
The harmonics were investigated up to the 10th harmonic. The NF was below the average limit. No emissions could be found.									
Handheld Standalone, horizontal position									
2nd	0 - 78	4804-4960	Horn	V	NF	NF	63.5	83.5	
2nd	0 - 78	4804-4960	Horn	H	NF	NF			
The harmonics were investigated up to the 10th harmonic. The NF was below the average limit. No emissions could be found.									
Handheld Standalone, on it's side									
2nd	0 - 78	4804-4960	Horn	V	NF	NF	63.5	83.5	
2nd	0 - 78	4804-4960	Horn	H	NF	NF			
The harmonics were investigated up to the 10th harmonic. The NF was below the average limit. No emissions could be found.									

Due to the noise floor level at three metres, the emissions were tested at a test distance of one metre. The emissions passed the 63.5 dBuV/m average one metre limit.

Radiated Emissions Test Photo



APPENDIX 3

BLUETOOTH RF CONDUCTED EMISSIONS TEST DATA/PLOTS

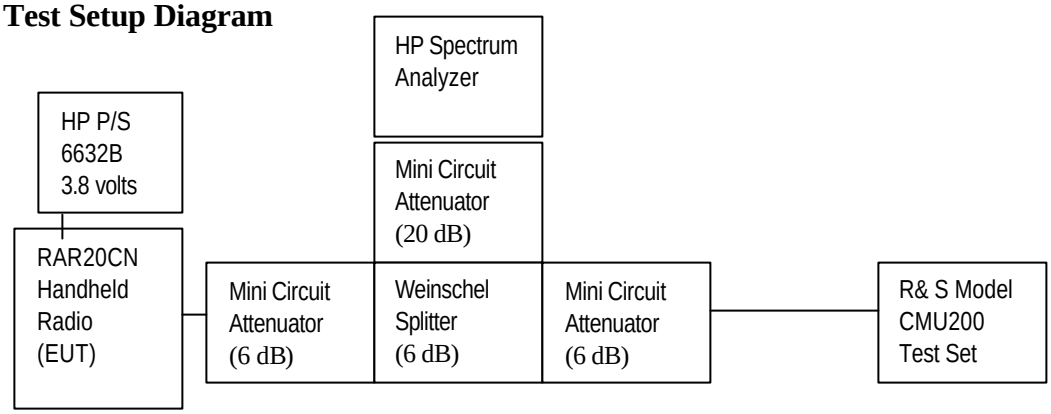
Bluetooth RF Conducted Emission Test Results

Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	HP	8563E	374A08112	30 Hz – 26.5 GHz
Splitter	Weinschel	1515	ME092	DC – 18 GHz
Attenuator	Mini Circuit	MCL BW-S20W2	-	DC – 18 GHz
Attenuator	Mini Circuit	MCL BW-S6W2	-	DC – 18 GHz
Attenuator	Mini Circuit	MCL BW-S6W2	-	DC – 18 GHz
Universal Radio Communication Tester	Rohde & Schwarz	CMU200	100251	-
DC Power Supply	HP	6632B	US37472178	-

Bluetooth power output was at maximum for all the recorded measurements shown below.

Test Setup Diagram



A reference offset of 32.3 dB was applied to the spectrum analyzer reference level for the attenuators and coaxial cable loss in the test circuit.

RF Conducted Emission Test Results cont'd

20 dB Bandwidth

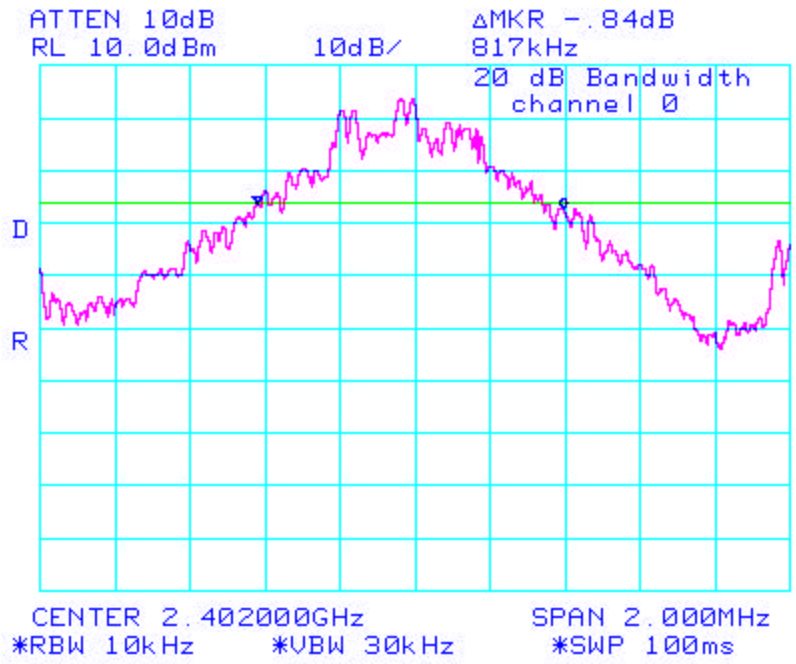
The EUT passed the 20 dB bandwidth requirement as per 47 CFR 15.247(a) and RSS-210. Low channel (0), middle channel (39) and high channel (78) were measured. Bluetooth was operating in single frequency mode using pattern type Static PRBS and packet type DH5 during the measurements.

Bluetooth Channel	Limit (MHz)	Measured Value (MHz)
0	<=1.0	0.817
39	<=1.0	0.817
78	<=1.0	0.817

See figures 1 to 3 for the plots of the 20 dB bandwidth measurements.

The environmental test conditions were: Temperature 27º C
Pressure 956 mb
Relative Humidity 25 %

Figure 1: 20 dB Bandwidth, channel 0



RF Conducted Emission Test Results cont'd

Figure 2: 20 dB Bandwidth, channel 39

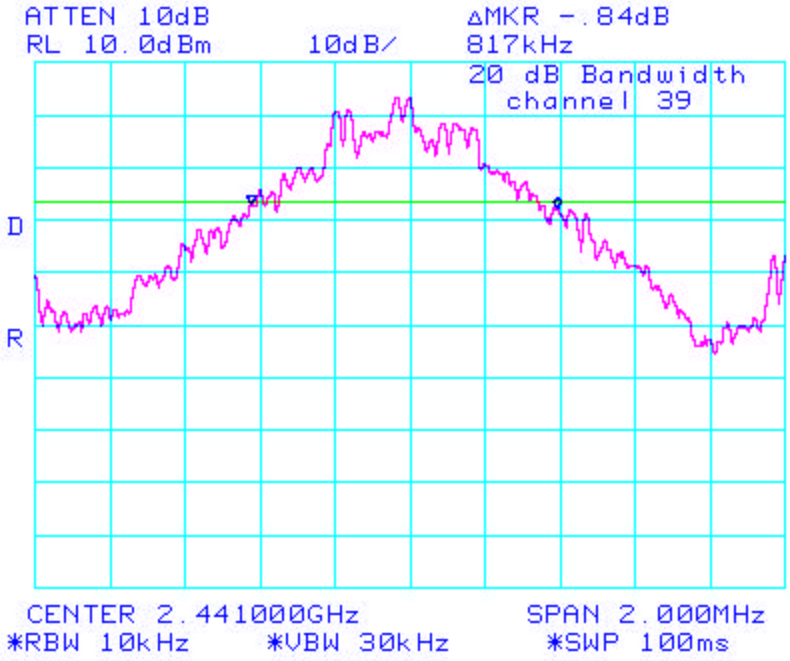
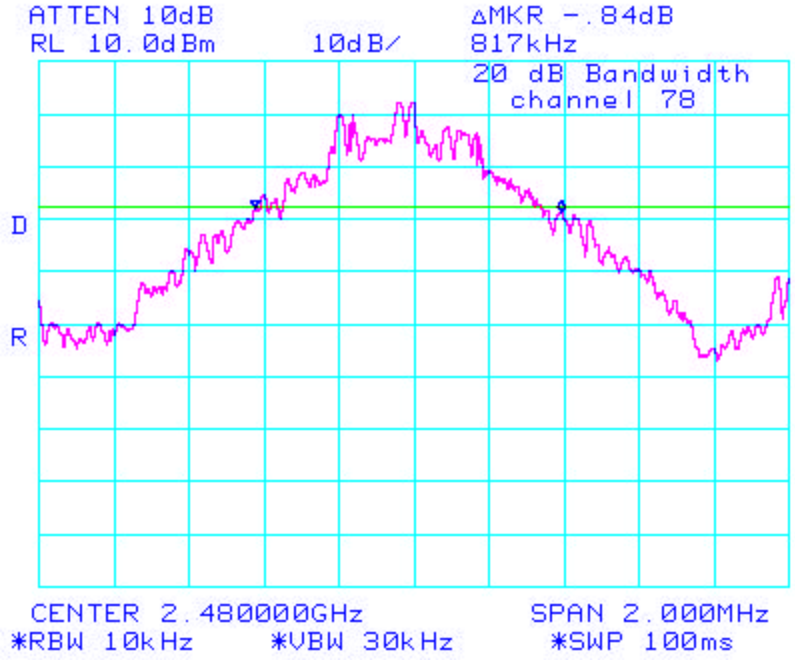


Figure 3: 20 dB Bandwidth, channel 78



RF Conducted Emission Test Results cont'd

Carrier Frequency Separation

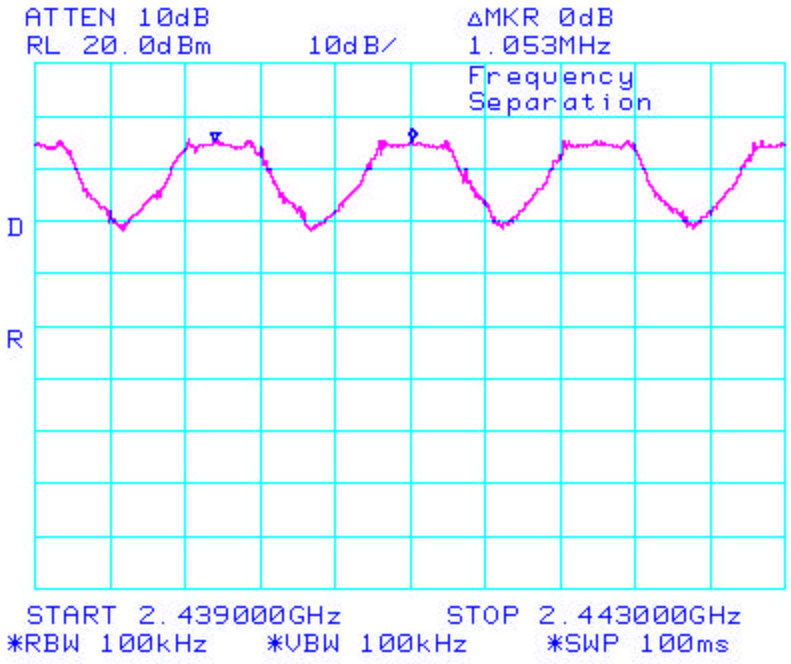
The EUT passed the Carrier Frequency Separation requirement as per 47 CFR 15.247(a) and RSS-210. Channel 38 to 39 was measured. Bluetooth was operating in frequency hopping (Euro/US) mode using pattern type Static PRBS and packet type DH5 during the measurements.

Bluetooth Channels	Limit (MHz)	Measured Value (MHz)
38 to 39	>= 0.025 or 20 dB bandwidth	1.053

The environmental test conditions were: Temperature 27° C
Pressure 956 mb
Relative Humidity 25 %

See figure 4 for the plot of the Carrier Frequency Separation measurement.

Figure 4: Carrier Frequency Separation, channel 38 to 39



RF Conducted Emission Test Results cont'd

Number of Hopping Frequencies

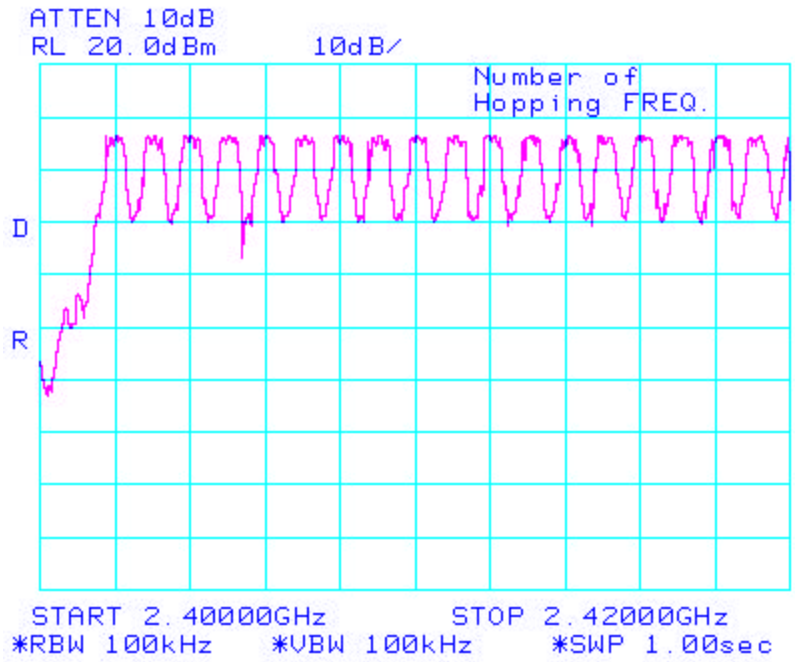
The EUT passed the number of hopping frequencies requirement as per 47 CFR 15.247(a) and RSS-210. Bluetooth was operating in frequency hopping (Euro/US) mode using pattern type Static PRBS and packet type DH5 during the measurements.

Limit (MHz)	Number of Hopping Frequencies
>= 75	79

The environmental test conditions were: Temperature 27° C
Pressure 956 mb
Relative Humidity 25 %

See figures 5 to 8 for the plots of the number of hopping frequencies.

Figure 5: Number of Hopping Frequencies



RF Conducted Emission Test Results cont'd

Figure 6: Number of Hopping Frequencies

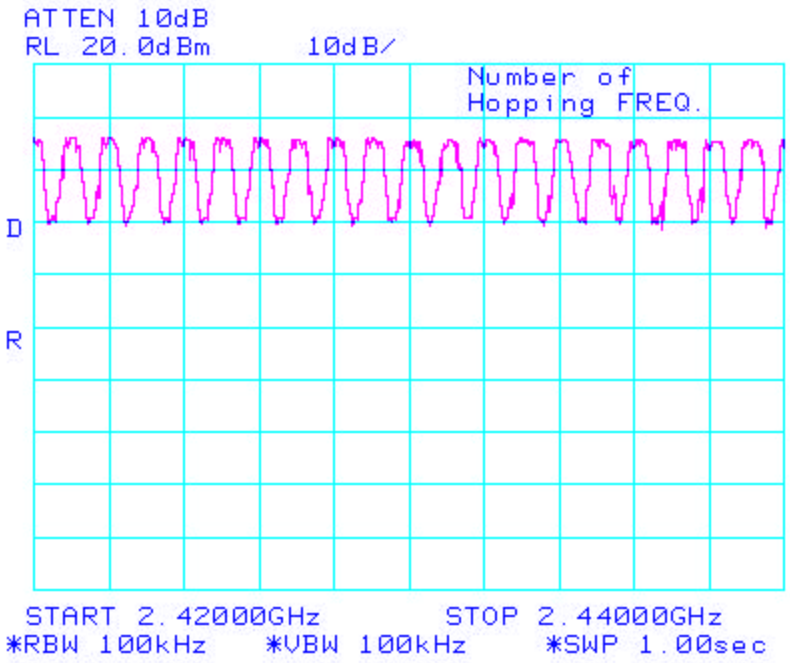
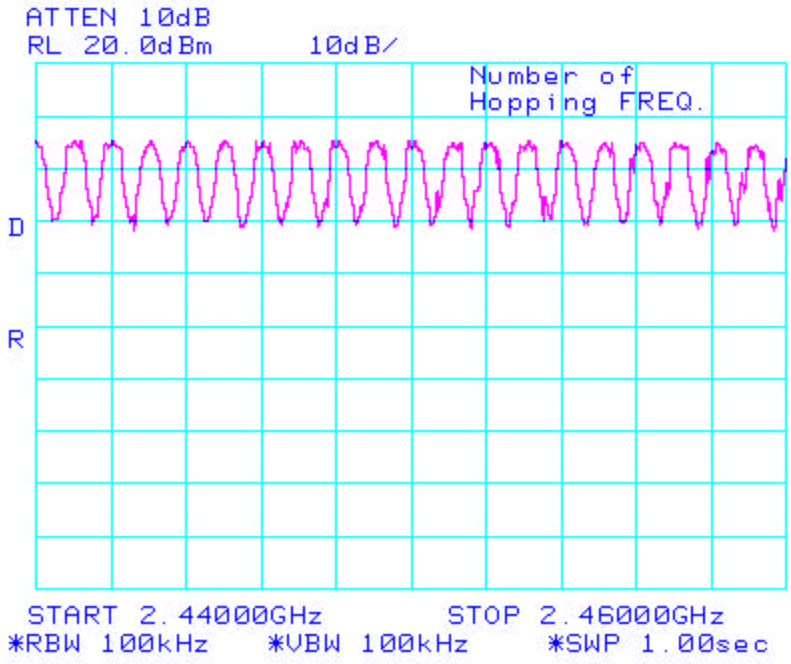
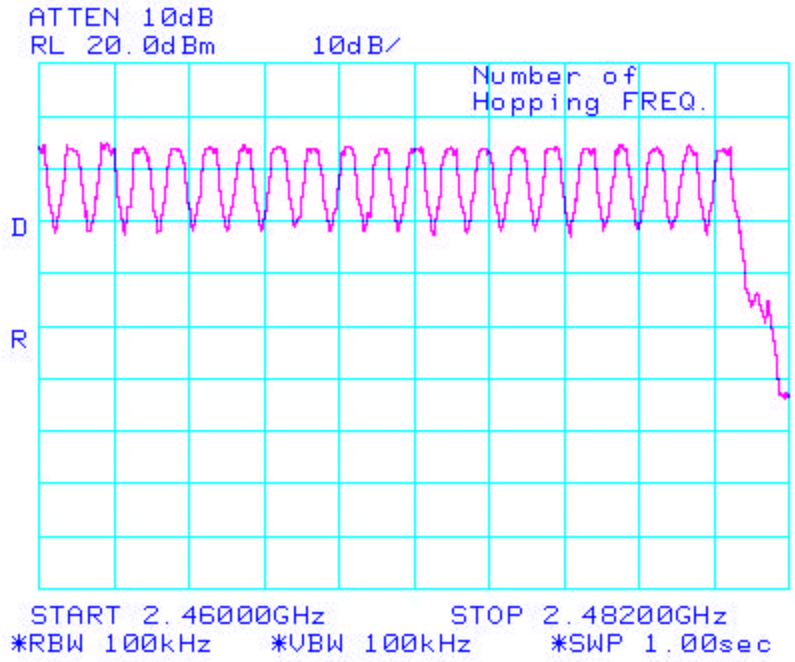


Figure 7: Number of Hopping Frequencies



RF Conducted Emission Test Results cont'd

Figure 8: Number of Hopping Frequencies



RF Conducted Emission Test Results cont'd

Time of Occupancy (Dwell Time)

The EUT passed the time of occupancy (dwell time) requirement as per 47 CFR 15.247(a) and RSS-210. Low channel (0), middle channel (39) and high channel (78) were measured in packet types DH1, DH3 and DH5. Bluetooth was operating in frequency hopping (Euro/US) mode during the measurements. The frequency hopping is 1600 hops per second for a dwell time of 625 µsec. for 79 channels.
A DH1 packet needs one time slot for transmitting and one time slot for receiving. The frequency hopping is 800 hops per second with 79 channels which is 10.127 times per second. As per 15.247(a) (iii) "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". Therefore for 31.6 seconds (79x0.4) there are 320.0 times of appearance.

A DH3 packet needs one time slot for transmitting and one time slot for receiving. The frequency hopping is 400 hops per second with 79 channels which is 5.06 times per second. Therefore for 31.6 seconds there are 159.9 times of appearance.

A DH5 packet needs one time slot for transmitting and one time slot for receiving. The frequency hopping is 266.7 hops per second with 79 channels which is 3.38 times per second. Therefore for 31.6 seconds there are 106.8 times of appearance.

Bluetooth Channel	Mode	Tx Time (ms)	Dwell Time/31.6 sec. (msec.)	Limit (msec.)	Margin (msec.)
0	DH1	0.4073	.4073 x 320.0 = 130.3	400	269.7
39	DH1	0.4160	.416 x 320.0 = 133.1	400	266.9
78	DH1	0.4073	.4073 x 320.0 = 130.3	400	269.7
0	DH3	1.6900	1.69 x 159.9 = 270.2	400	129.8
39	DH3	1.6987	1.6987 x 159.9 = 271.6	400	128.4
78	DH3	1.6987	1.6987 x 159.9 = 271.6	400	128.4
0	DH5	2.9400	2.94 x 106.8 = 314.0	400	86.0
39	DH5	2.9400	2.94 x 106.8 = 314.0	400	86.0
78	DH5	2.9400	2.94 x 106.8 = 314.0	400	86.0

The environmental test conditions were: Temperature 24° C
Pressure 967 mb
Relative Humidity 24 %

See figures 9 to 17 for the plots of the dwell time.

RF Conducted Emission Test Results cont'd

Figure 9: Dwell Time, Low Channel, Packet Type DH1

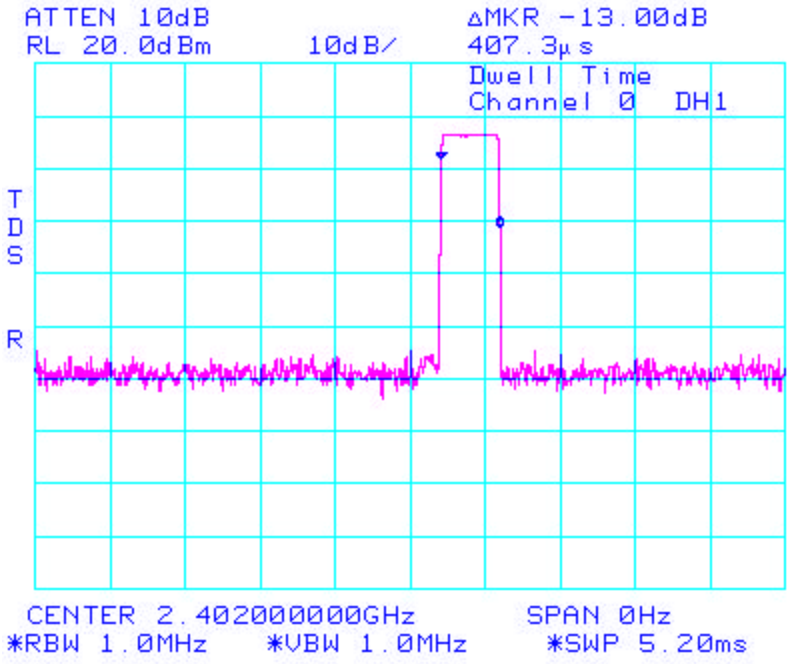
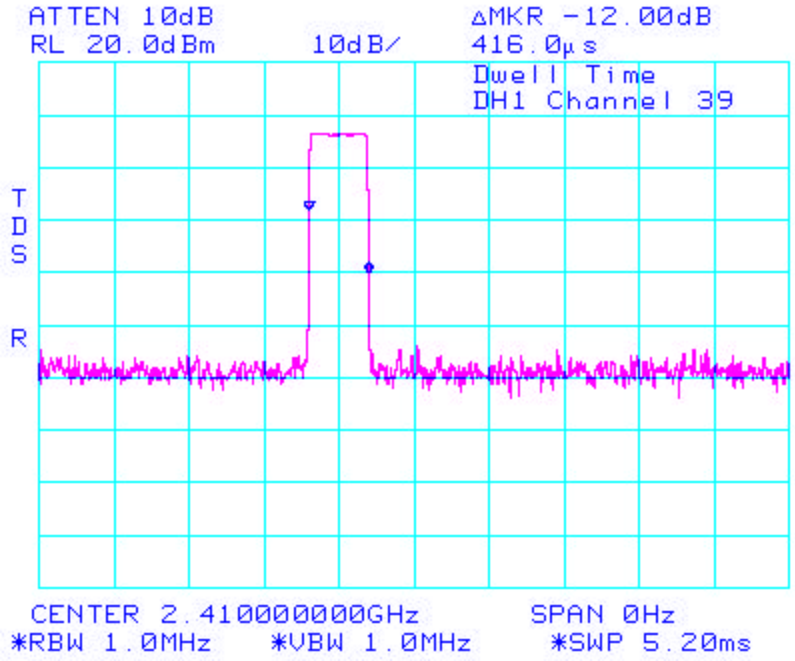


Figure 10: Dwell Time, Middle Channel, Packet Type DH1



RF Conducted Emission Test Results cont'd

Figure 11: Dwell Time, High Channel, Packet Type DH1

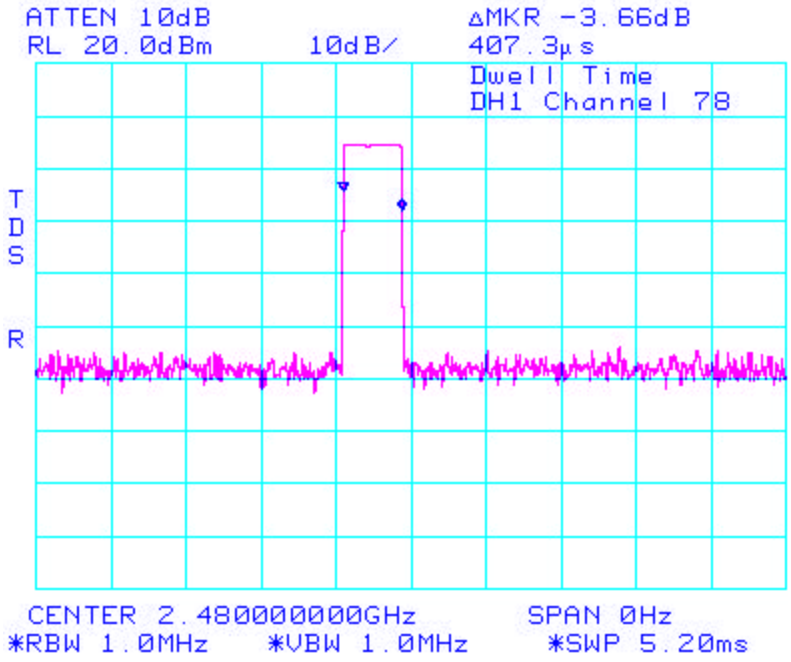
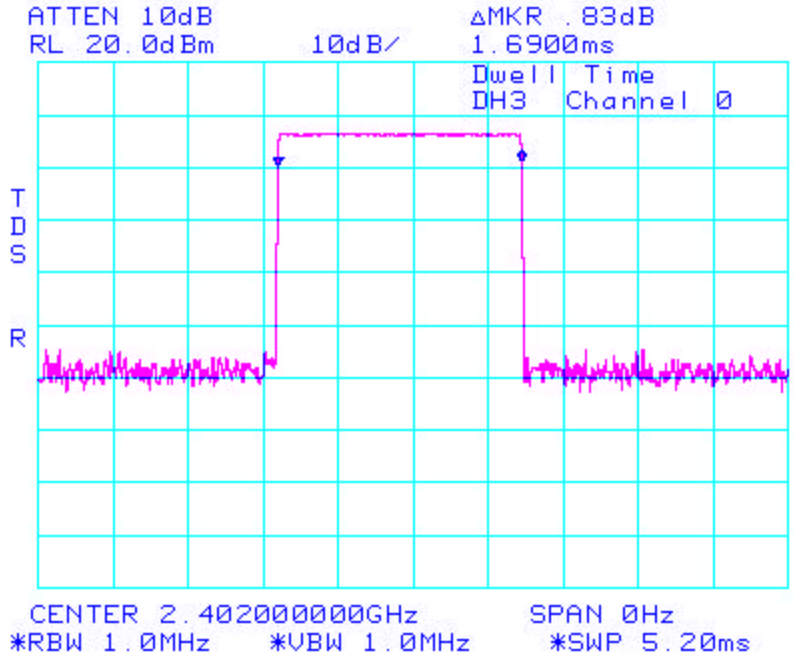


Figure 12: Dwell Time, Low Channel, Packet Type DH3



RF Conducted Emission Test Results cont'd

Figure 13: Dwell Time, Middle Channel, Packet Type DH3

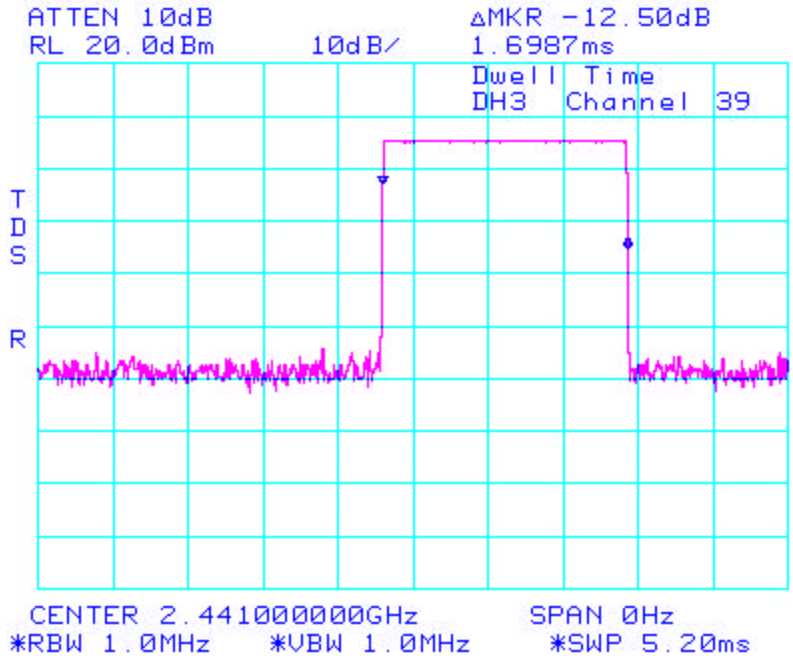
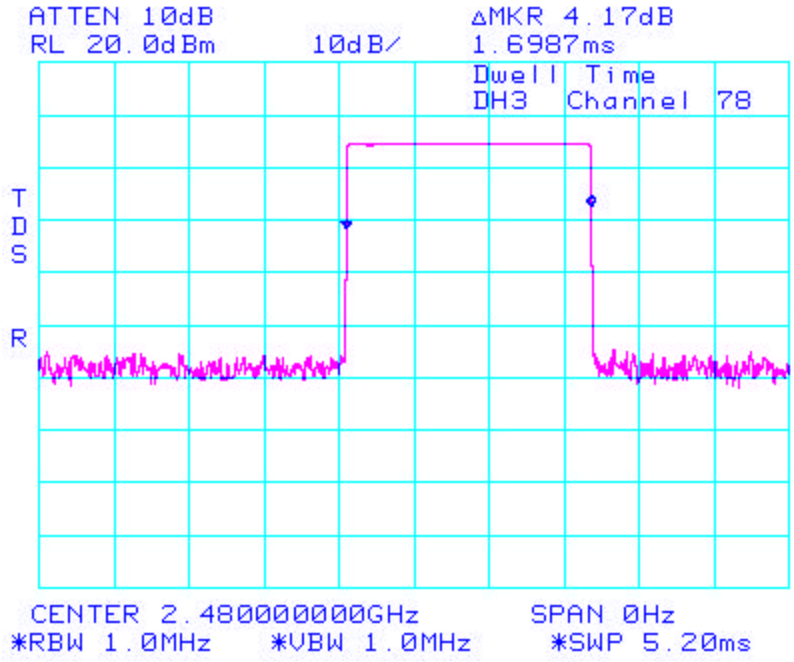


Figure 14: Dwell Time, High Channel, Packet Type DH3



RF Conducted Emission Test Results cont'd

Figure 15: Dwell Time, Low Channel, Packet Type DH5

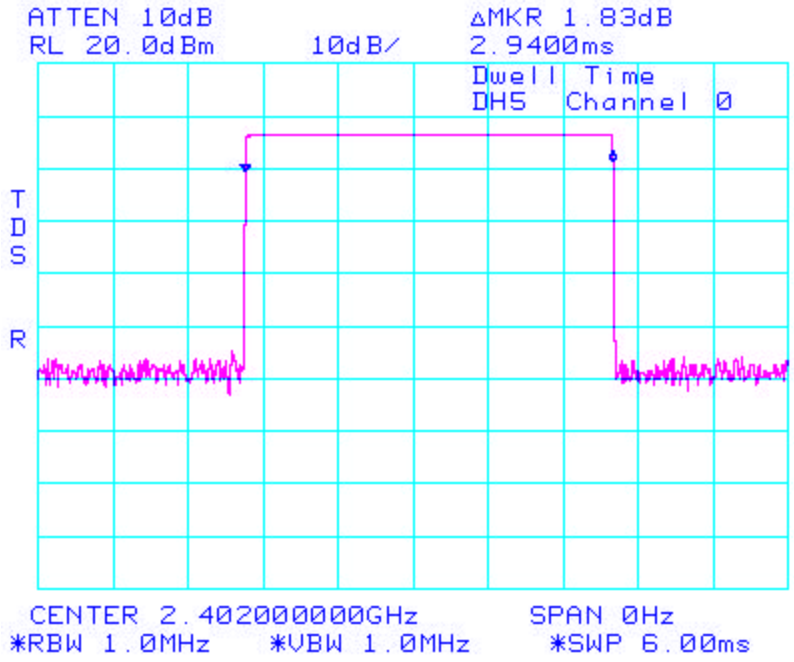
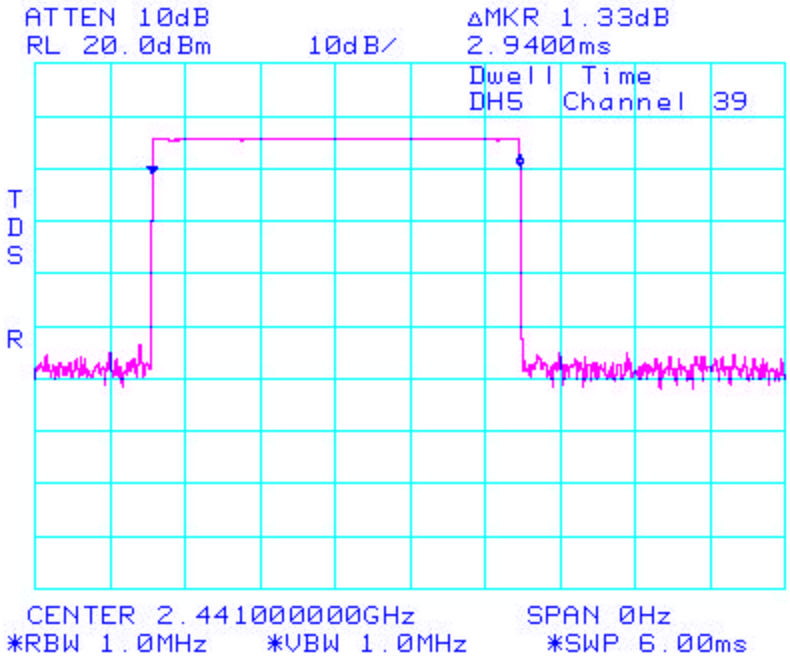
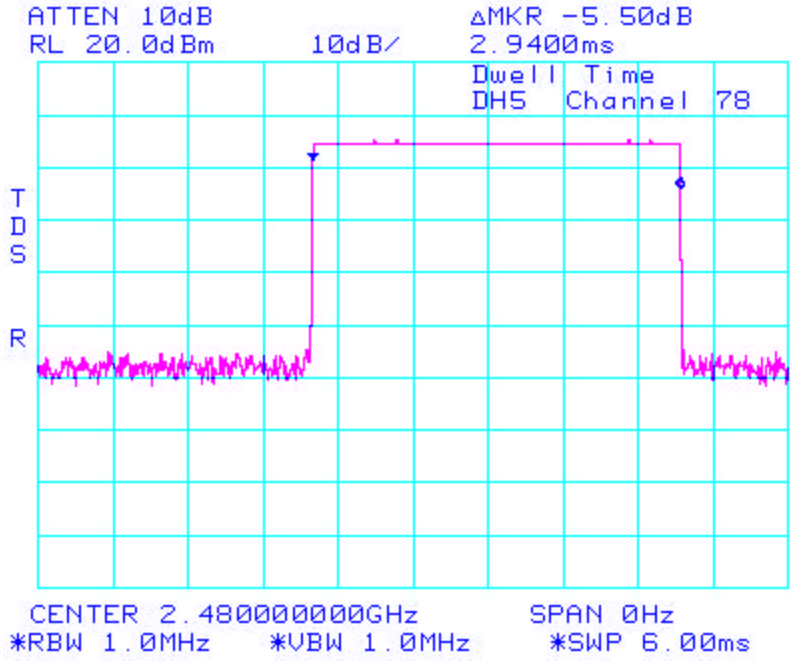


Figure 16: Dwell Time, Middle Channel, Packet Type DH5



RF Conducted Emission Test Results cont'd

Figure 17: Dwell Time, High Channel, Packet Type DH5



RF Conducted Emission Test Results cont'd

Maximum Peak Conducted Output Power

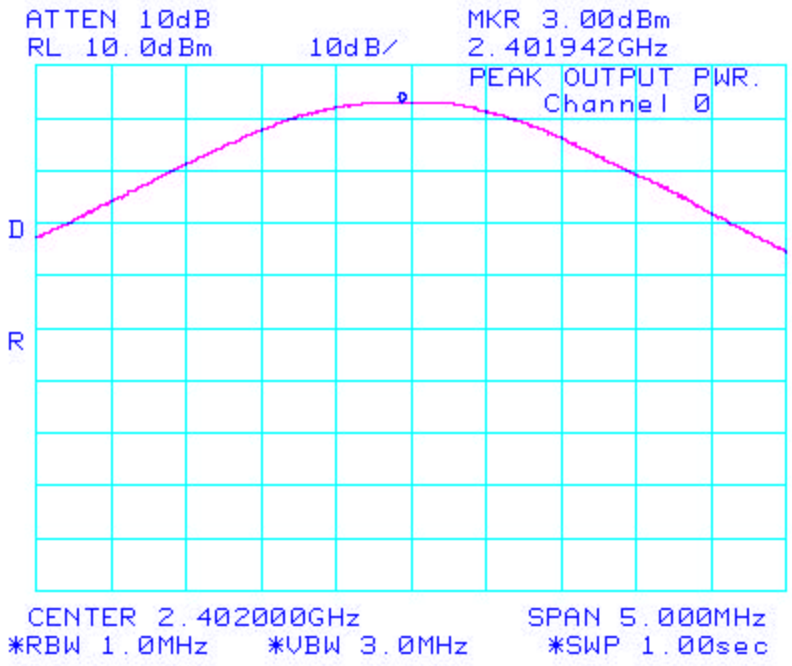
The EUT passed the maximum peak conducted output power requirement as per 47 CFR 15.247(b) and RSS-210. Low channel (0), middle channel (39) and high channel (78) were measured. Bluetooth was operating in single frequency mode during the measurements. A reference offset of 0.3 dB was applied to the spectrum analyzer reference level for the coaxial cable loss in the test circuit.

Bluetooth Channel	Measured Value (dBm)	Limit (dBm)
0	3.00	-6.0 to 4.0
39	2.33	-6.0 to 4.0
78	1.50	-6.0 to 4.0

The environmental test conditions were: Temperature 24° C
Pressure 967 mb
Relative Humidity 24 %

See figures 18 to 20 for the plots of the maximum peak conducted output power.

Figure 18: Maximum Peak Conducted Output Power



RF Conducted Emission Test Results cont'd

Figure 19: Maximum Peak Conducted Output Power

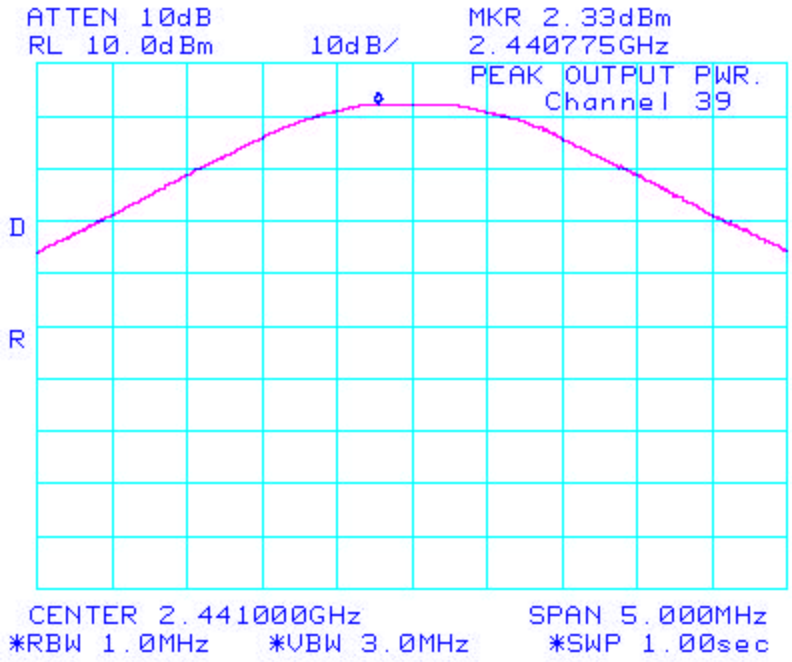
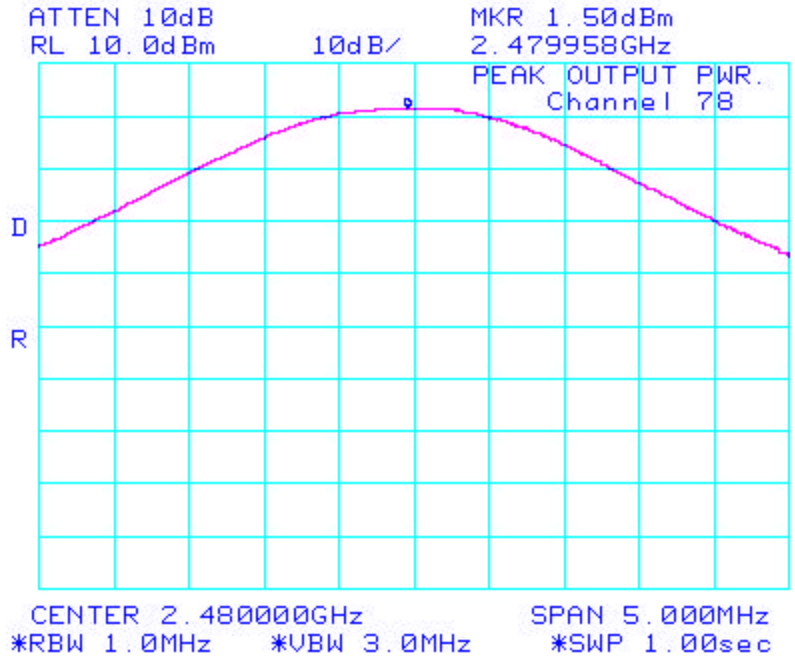


Figure 20: Maximum Peak Conducted Output Power



RF Conducted Emission Test Results cont'd

Band Edge Compliance

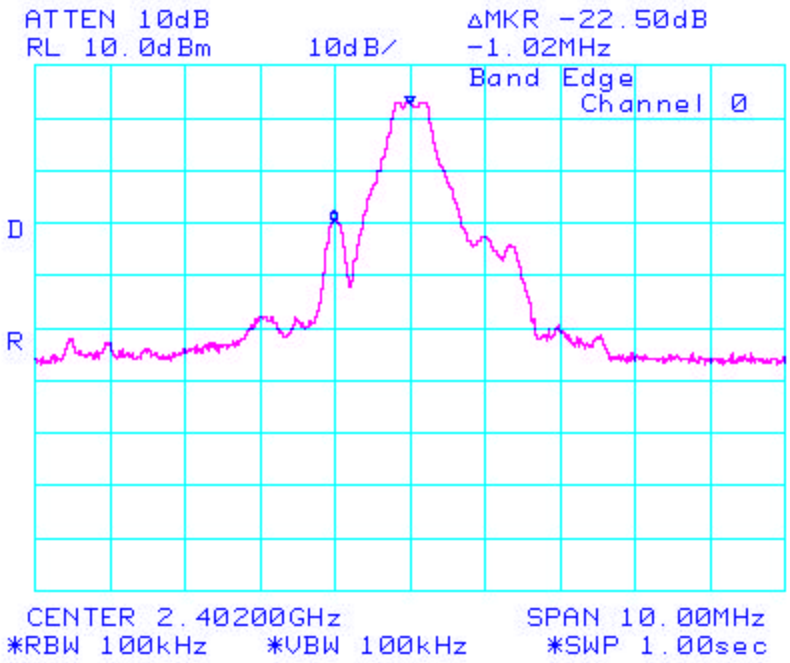
The EUT passed the band edge compliance requirement as per 47 CFR 15.247(c) and RSS-210. Low channel (0) and high channel (78) were measured. Bluetooth was operating in single frequency and hopping mode using pattern type Static PRBS and packet type DH5 during the measurements.

Bluetooth Channel	Operating Mode	Measured Value (dBc)	Limit (dBc)	Margin (dB)
0	Single Frequency	-22.50	20	2.50
0	Hopping	-23.17	20	3.17
78	Single Frequency	-27.84	20	7.84
78	Hopping	-27.17	20	7.17

The environmental test conditions were: Temperature 25° C
Pressure 969 mb
Relative Humidity 23 %

See figures 21 to 24 for the plots of the band edge compliance measurements.

Figure 21: Band Edge Compliance, Single Frequency Mode, Channel 0



RF Conducted Emission Test Results cont'd

Figure 22: Band Edge Compliance, Hopping Frequency Mode, Channel 0

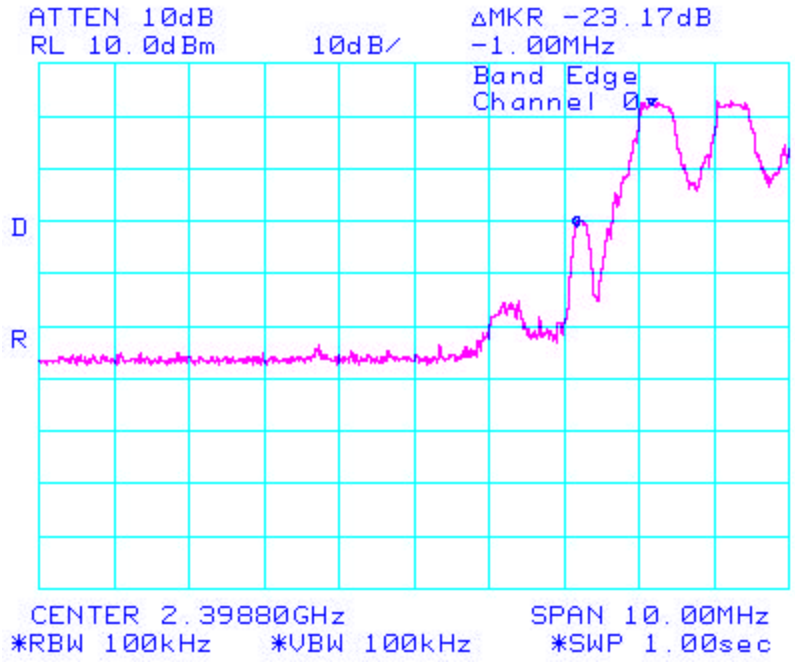
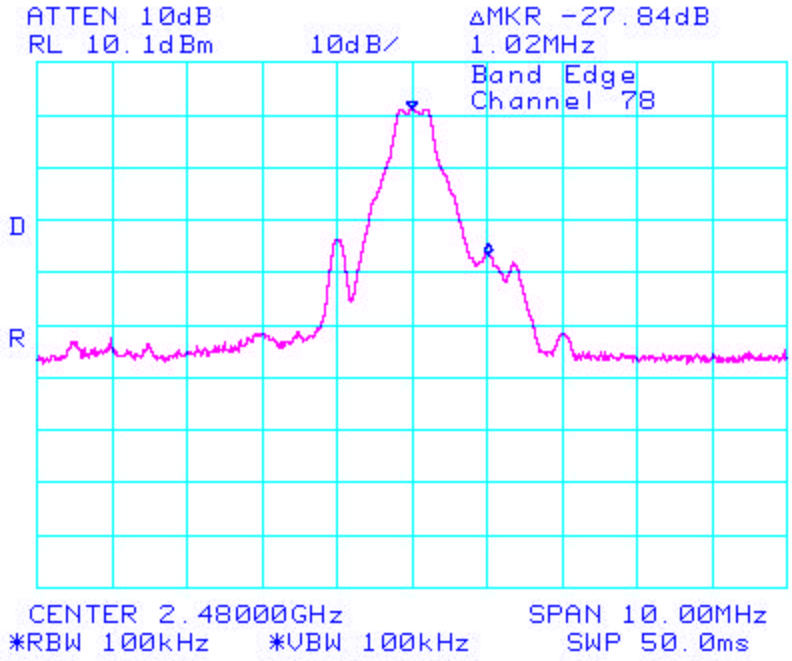
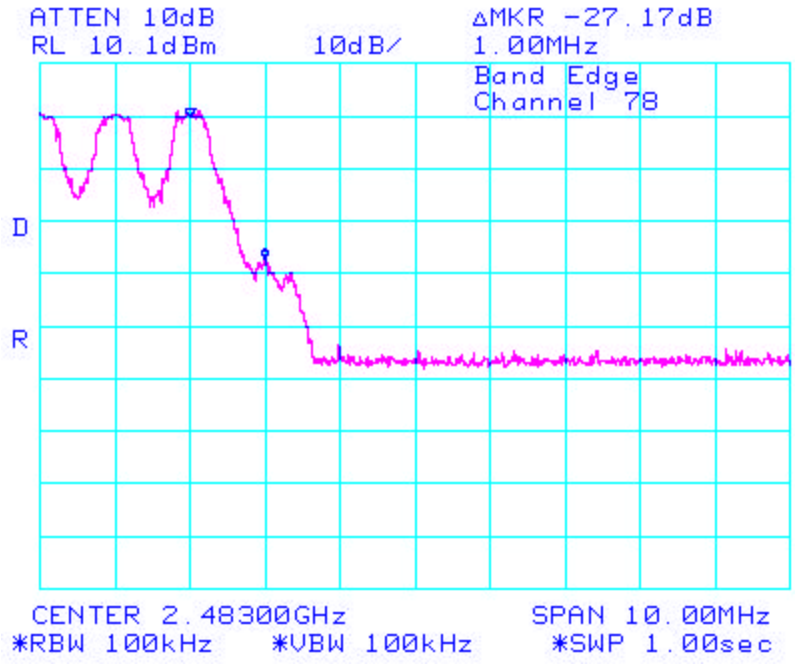


Figure 23: Band Edge Compliance, Single Frequency Mode, Channel 78



RF Conducted Emission Test Results cont'd

Figure 24: Band Edge Compliance, Hopping Frequency Mode, Channel 78



RF Conducted Emission Test Results cont'd

Spurious RF Conducted Emissions

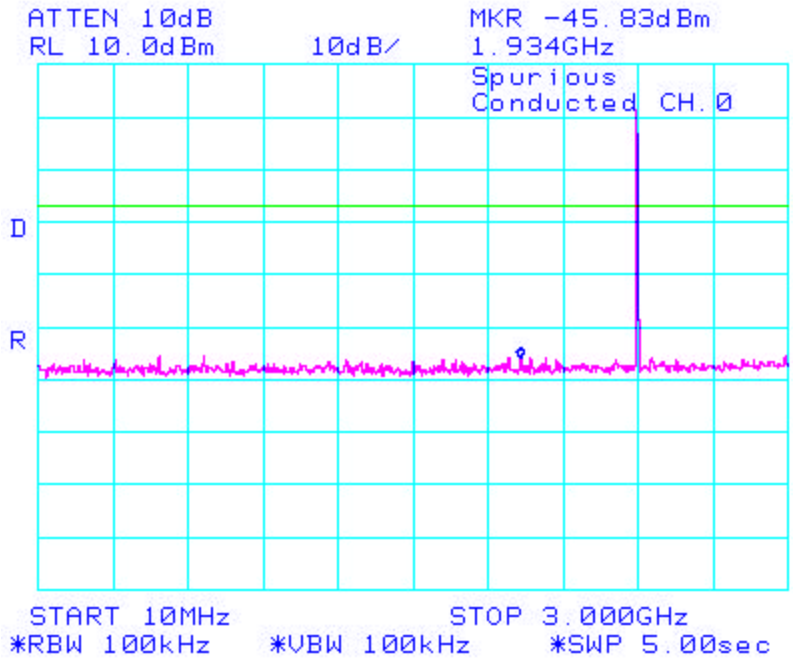
The EUT passed the spurious RF conducted emissions requirement as per 47 CFR 15.247(c) and RSS-210. Low channel (0) and high channel (78) were measured. Bluetooth was operating in single frequency mode using pattern type Static PRBS and packet type DH5 during the measurements. A reference offset of 32.9 dB was applied to the spectrum analyzer reference level for the attenuators and coaxial cable loss in the test circuit. No emissions could be seen above the noise floor (NF) of the spectrum analyzer.

Bluetooth Channel	Channel Power (dBm)	Max. Measured Value from dBc	Limit (dBc)
0	3.00	-41.67 (NF)	-20
39	2.33	-41.80 (NF)	-20
78	1.50	-40.33 (NF)	-20
Hopping mode	3.00	-41.83 (NF)	-20

The environmental test conditions were: Temperature 25º C
Pressure 969 mb
Relative Humidity 23 %

See figures 25 to 33 for the plots of the Spurious RF Conducted Emissions.

Figure 25: Spurious RF Conducted Emissions, Channel 0



RF Conducted Emission Test Results cont'd

Figure 26: Spurious RF Conducted Emissions, Channel 0

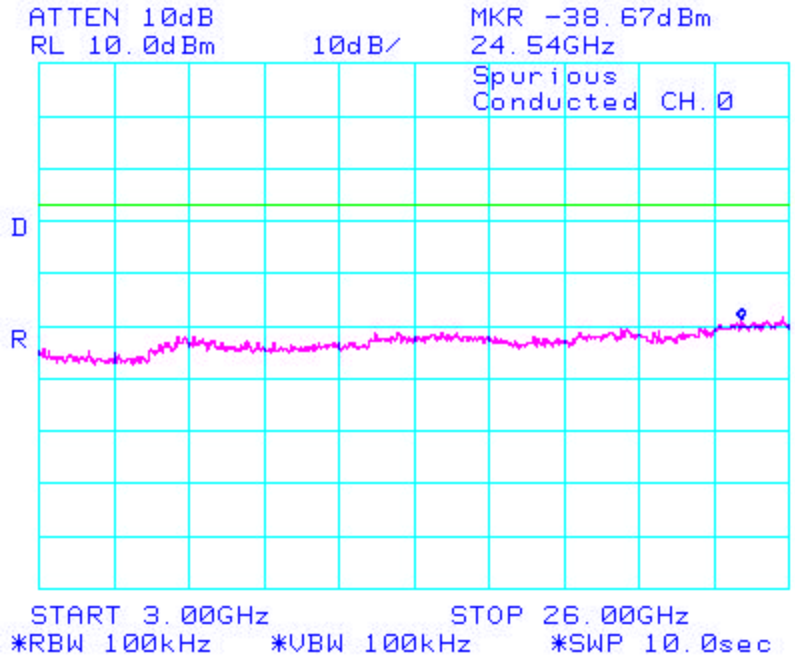
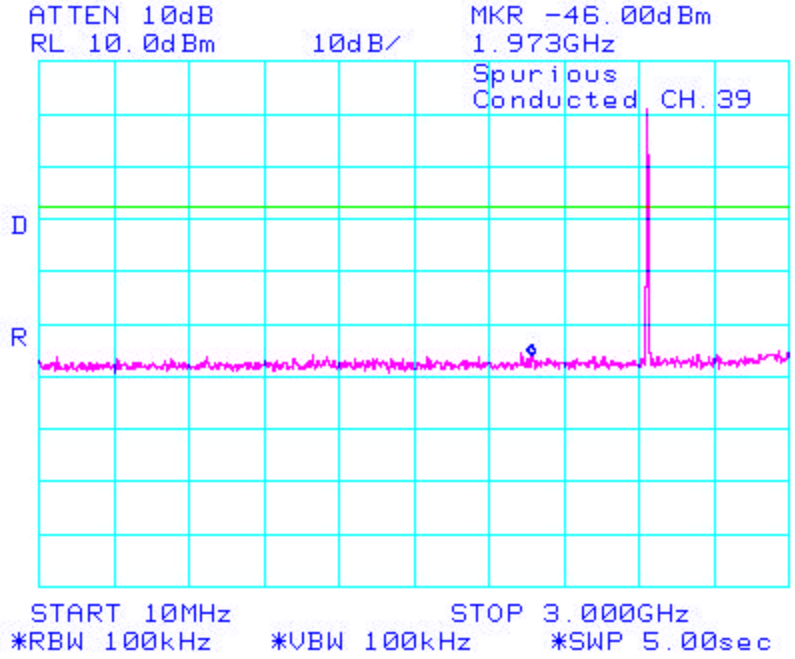


Figure 27: Spurious RF Conducted Emissions, Channel 39



RF Conducted Emission Test Results cont'd

Figure 28: - Spurious RF Conducted Emissions, Channel 39

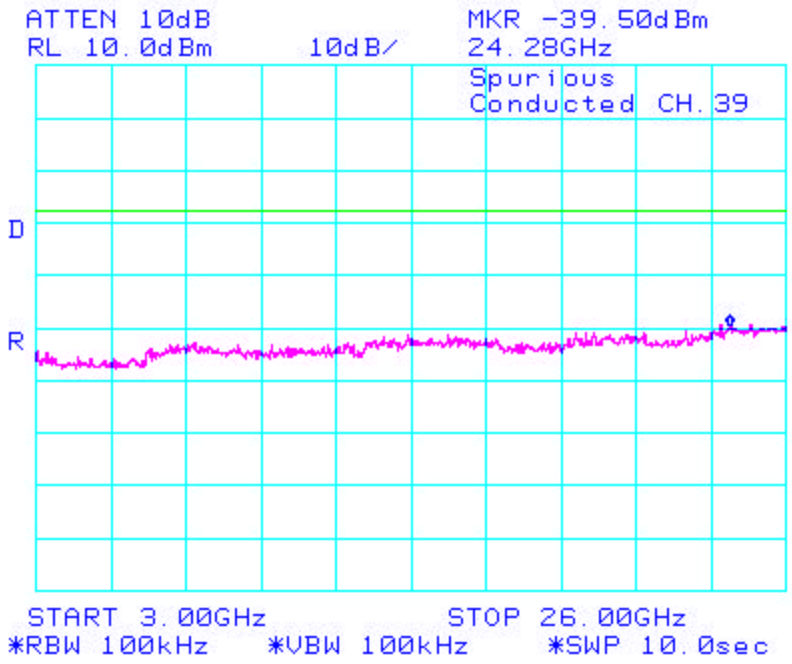
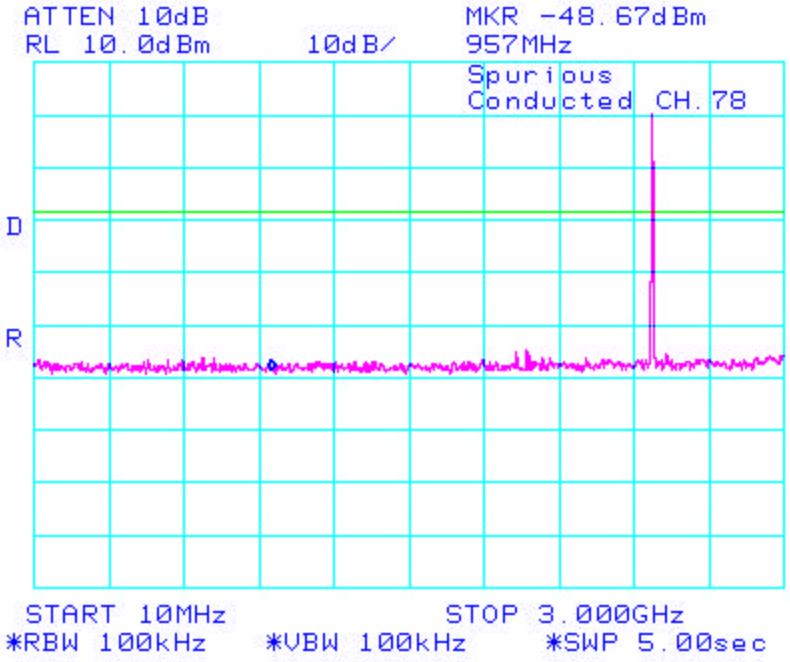


Figure 29: Spurious RF Conducted Emissions, Channel 78



RF Conducted Emission Test Results cont'd

Figure 30: Spurious RF Conducted Emissions, Channel 78

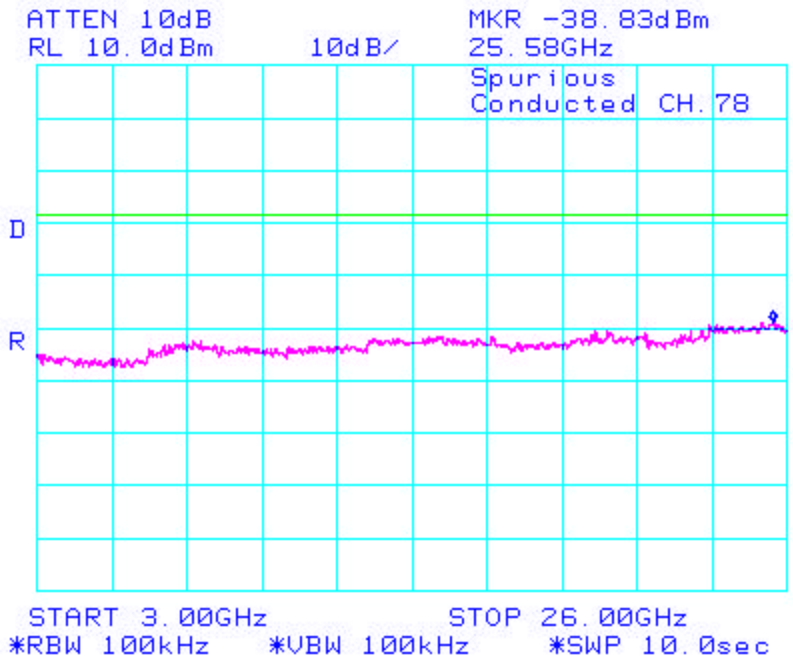
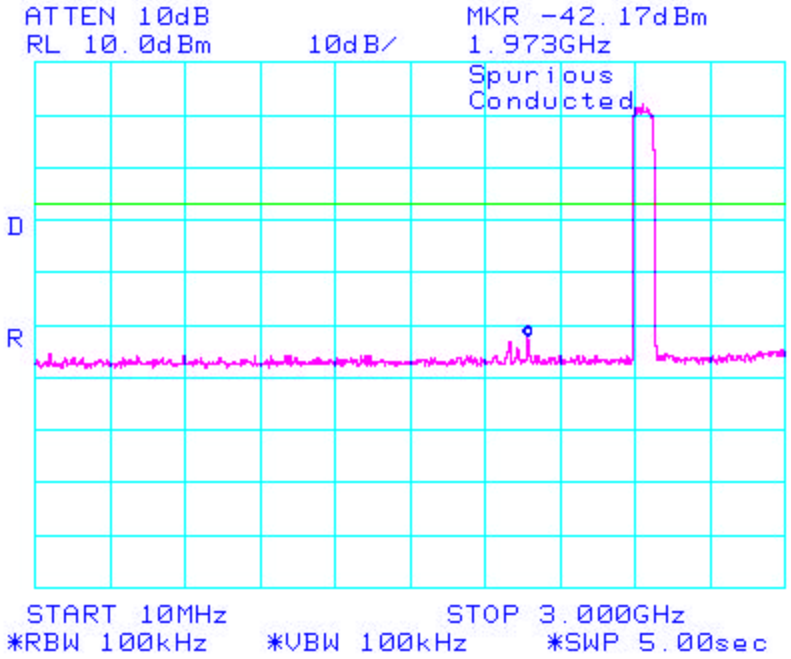
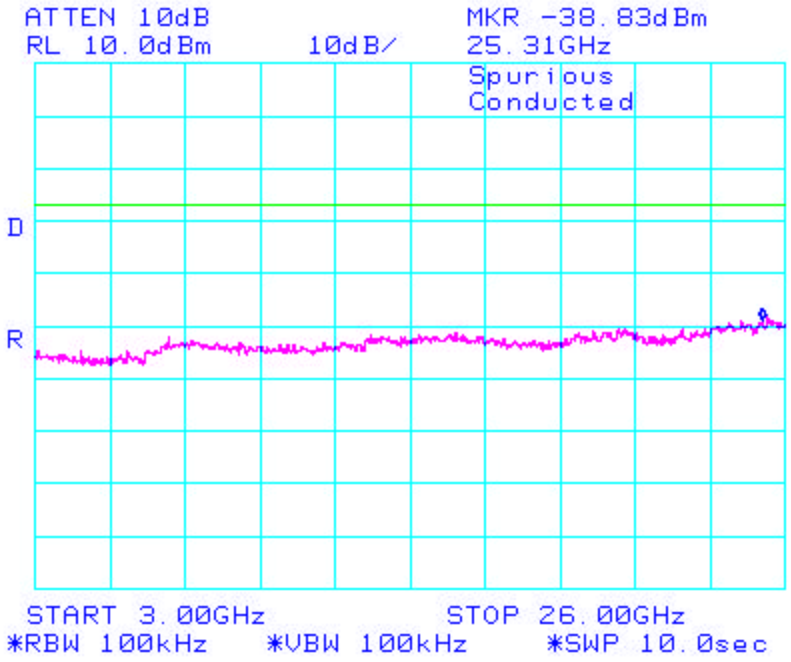


Figure 31: Spurious RF Conducted Emissions, Frequency Hopping Mode



RF Conducted Emission Test Results cont'd

Figure 32: Spurious RF Conducted Emissions, Frequency Hopping Mode



RF Conducted Emission Test-Setup Photo