EMI Test Report

For RAW20IN

Tested in accordance with
Federal Communications Commission (FCC)
Personal Communications Services
CFR 47, Part 15 Subpart C

RIM Testing Services (RTS)

REPORT NO RTS-0184-0508-01 Rev. 1

PRODUCT MODEL NO.: RAW20IN
TYPE NAME: BlackBerry Wireless Handheld
FCC ID: L6ARAW20IN
IC: 2503A-RAW20IN

Date: _____19 August 2005_____

Declaration

Statement of Performance:

The BlackBerry Wireless Handheld, model RAW20IN ASY-08961-001 and accessories when configured and operated per RIM's operating 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 results are valid for the tested unit (s) only.
The test equipment used was suitable for the tests performed and within manufacturer's 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: 02 August 2005

Tested and Reviewed by:

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

Date: 04 August 2005

Reviewed and Approved by:

Paul G. Cardinal, Ph.D.
Manager

Date: 05 August 2005

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, Amendment 4 August 2004, Low Power Licence-Exempt Radiocommunication Devices

B) Product Identification

The equipment under test (EUT) was tested at the RIM Testing Services (RTS) EMI test facility, at:

305 Phillip Street
Waterloo, Ontario
Canada, N2L 3W8
Phone: 519 888 7465
Fax: 519 888 6906

The testing began on July 14, 2005 and completed on August 19, 2005. The sample equipment under test (EUT) included:

1a) BlackBerry Wireless Handheld model number RAW20IN, ASY-08961-001, POP-00823-003, PIN 400B1FFB, FCC ID L6ARAW20IN, IC: 2503A-RAW20IN.
1b) BlackBerry Wireless Handheld model number RAW20IN, ASY-08961-001, POP-00823-003, PIN 400B20002, FCC ID L6ARAW20IN, IC: 2503A-RAW20IN.

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) Associated Document

1. Test report number RTS-0184-0507-03

D) 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

E) Test Voltage

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

F) Test Results Chart

SPECIFICATION	Test Type	MEETS REQUIREMENTS	Performed By
FCC CFR 47 Part 15.207 IC RSS-210	AC Conducted Emissions	See test report RTS-184-0507-03	-
FCC CFR 47 Part 15.209 IC RSS-210	Radiated Emissions Harmonics	Yes	Masud Attayi
FCC CFR 47 Part 15.247(a), (b), and (c) IC RSS-210	20 dB Bandwidth Carrier Freq. Separation Number of Hopping freq. Dwell Time Max. Peak Output Power Band Edge Compliance Spurious RF Conducted Emissions	Yes	Maurice Battler

G) Modifications to EUT

No modifications were required to the EUT.

H) Summary of Results

1) AC CONDUCTED EMISSIONS

The conducted emissions from the EUT were measured using the methods outlined in CISPR Recommendation 22.
To view the test results, see test report number RTS-0184-0507-03.

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 styrofoam table, 100 cm high that was positioned on a remotely controlled turntable. The test distance used between the EUT and the receiving antenna was three metres. 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's 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) and frequency hopping mode.
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. The worst test margin measured was 21.35 dB below the limit at 4882.0 MHz.

The Band-Edge Compliance of RF Radiated Emissions met the requirements as per 15.209.
See APPENDIX 1 for the test data.

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)

To view the test data see APPENDIX 1.

Measurement Uncertainty ±4.0 dB

3) BLUETOOTH RF CONDUCTED EMISSIONS

a) 20 dB Bandwidth
The EUT met the requirements of the 20 dB bandwidth as per 47 CFR 15.247(a) and RSS-210. Low channel (0), middle channel (39) and high channel (78) were measured.
See APPENDIX 2 for the test data.

b) Carrier Frequency Separation
The EUT met the requirements of the carrier frequency separation as per 47 CFR 15.247(a) and RSS-210. Channel 38 to 39 was measured.
See APPENDIX 2 for the test data.

c) Number of Hopping Frequencies
The EUT met the requirements of 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 2 for the test data.

d) Time of Occupancy (Dwell Time)
The EUT met the requirements of 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 2 for the test data.

e) Maximum Peak Conducted Output Power
The EUT met the requirements of 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 2 for the test data.

f) Band-Edge Compliance of RF Conducted Emissions
The EUT met the requirements of 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 2 for the test data.

g) Spurious RF Conducted Emissions
The EUT met the requirements of 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 2 for the test data.

l) Compliance Test Equipment Used

UNIT	MANUFACTURER	MODEL	SERIAL NUMBER	CAL DUE DATE (YY MM DD)	USE
Preamplifier	Sonoma	310N/11909A	185831	05-11-26	Radiated Emissions
Preamplifier system	TDK RF Solutions	PA-02	080010	06-01-13	Radiated Emissions
EMC Analyzer	Agilent	E7405A	US40240226	05-07-29	Radiated Emissions
Hybrid Log Antenna	TDK	HLP-3003C	017401	05-07-21	Radiated Emissions
Horn Antenna	TDK	HRN-0118	130092	05-09-24	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	06-06-13	Radiated Emissions
Dipole Antenna	Schwarzbeck	UHAP	974	05-09-21	Radiated Emissions
Dipole Antenna	Schwarzbeck	UHAP	973	05-12-13	Radiated Emissions
Universal Radio Communication Tester	Rohde & Schwarz	CMU 200	837493/073	06-02-06	Radiated Emissions
EMI Receiver	Rohde & Schwarz	ESIB-40	100255	06-06-20	Radiated Emissions
Universal Radio Communication Tester	Rohde & Schwarz	CMU 200	102205	06-06-07	Conducted Emissions
Spectrum Analyzer	HP	8563E	3745A08112	05-07-20	RF Conducted Emissions
DC Power Supply	HP	6632B	US37472178	05-08-01	RF Conducted Emissions
Environment Monitor	Control Company	1870	230355190	06-01-11	Radiated Emissions
Environment Monitor	Control Company	1870	230355189	06-01-11	RF Conducted Emissions

APPENDIX 1

RADIATED EMISSIONS AND HARMONICS TEST DATA

Radiated Emissions Test Results

Test Distance was 3.0 metres. Bluetooth Band July 19, 2005

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

Type	Channel	Frequency	Antenna		Reading (Peak)	Corrected Reading	Peak Limit	Diff. To Limit
		(MHz)	Type	Pol	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)
Handheld Standalone,Vertical position, single frequency mode								
2nd	39	4882.0	Horn	V	48.2	48.2	74.0	-23.0
2nd	39	4882.0	Horn	H	51.0	51.0		
The harmonics were investigated up to the 10th harmonic. Emissions above the 2nd harmonic were in the noise floor (NF)								
Handheld Standalone, on edge, single frequency mode								
2nd	39	4882.0	Horn	V	53.7	52.65	74.0	-21.35
2nd	39	4882.0	Horn	H	48.7	47.65		
The harmonics were investigated up to the 10th harmonic. Emissions above the 2nd harmonic were in the noise floor (NF)								
Handheld Standalone, on edge, frequency hopping mode								
2nd	0	4804.0	Horn	V	49.2	48.15	74.0	-25.85
2nd	0	4804.0	Horn	H	N.F.			
The harmonics were investigated up to the 10th harmonic. Emissions above the 2nd harmonic were in the noise floor (NF)								
Handheld Standalone, on edge, frequency hopping mode								
2nd	39	4882.0	Horn	V	53.9	52.85	74.0	-29.45
2nd	39	4882.0	Horn	H	N.F.			
The harmonics were investigated up to the 10th harmonic. Emissions above the 2nd harmonic were in the noise floor (NF)								

Radiated Emissions Test Results cont'd

Type	Channel	Frequency	Antenna		Reading (Peak)	Corrected Reading	Peak Limit	Diff. To Limit
		(MHz)	Type	Pol	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)
Handheld Standalone, on edge, frequency hopping mode								
2nd	78	4960.0	Horn	V	52.3	51.25	74.0	-22.75
2nd	78	4960.0	Horn	H	N.F.			
The harmonics were investigated up to the 10th harmonic. Emissions above the 2nd harmonic were in the noise floor (NF)								

Bluetooth Band-Edge Compliance of RF Radiated Emissions

Test Distance was 3.0 metres. August 19, 2005
Bluetooth only transmitting in single frequency mode.
Antenna extended, Handheld standalone, vertical position.

Channel	Freq.	Rx Antenna		Detector	Corrected Carrier Freq. Reading	Delta Marker	Corrected Band-edge	Limit	Diff. To Limit
	(MHz)	Type	POL.	(PK, AVE.)	(dBuV/m)	(dB)	(dBuV/m)	(dBuV/m)	(dB)
78	2480.00	Horn	V	PK	94.02	32.50	61.52	74.00	-12.48
78	2480.00	Horn	H	PK	97.97	32.50	65.47	74.00	-8.53
78	2480.00	Horn	V	AVE.	73.00	32.50	40.50	54.00	-13.50
78	2480.00	Horn	H	AVE.	76.31	32.50	43.81	54.00	-10.19

Radiated Emissions Test Photo

APPENDIX 2

BLUETOOTH RF CONDUCTED EMISSIONS TEST DATA/PLOTS

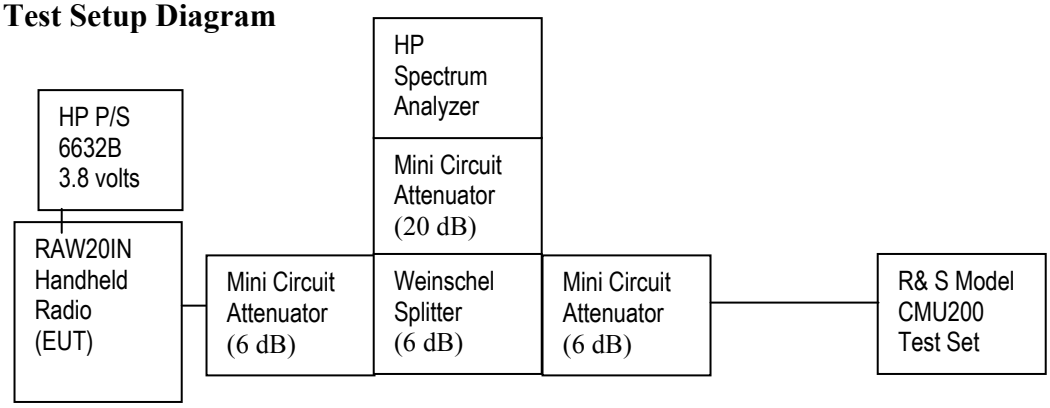
Bluetooth RF Conducted Emission Test Results

Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	HP	8563E	3745A08112	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	102205	-
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

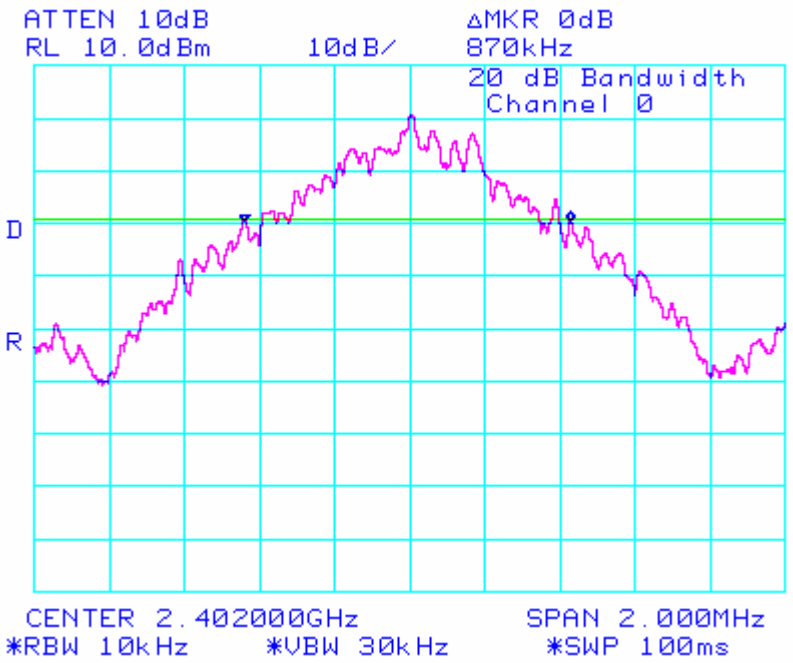
The EUT met the requirements of the 20 dB bandwidth as per 47 CFR 15.247(a) and RSS-210. Low channel (0), middle channel (39) and high channel (78) were measured. Bluetooth was operating in single frequency mode using pattern type Static PRBS and packet type DH5 during the measurements.

Bluetooth Channel	Limit (MHz)	Measured Value (MHz)
0	<=1.0	0.870
39	<=1.0	0.867
78	<=1.0	0.823

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

The environmental test conditions were: Temperature 26ºC
Pressure 1010 mb
Relative Humidity 32%

Figure 1: 20 dB Bandwidth, channel 0



RF Conducted Emission Test Results cont'd

Figure 2: 20 dB Bandwidth, channel 39

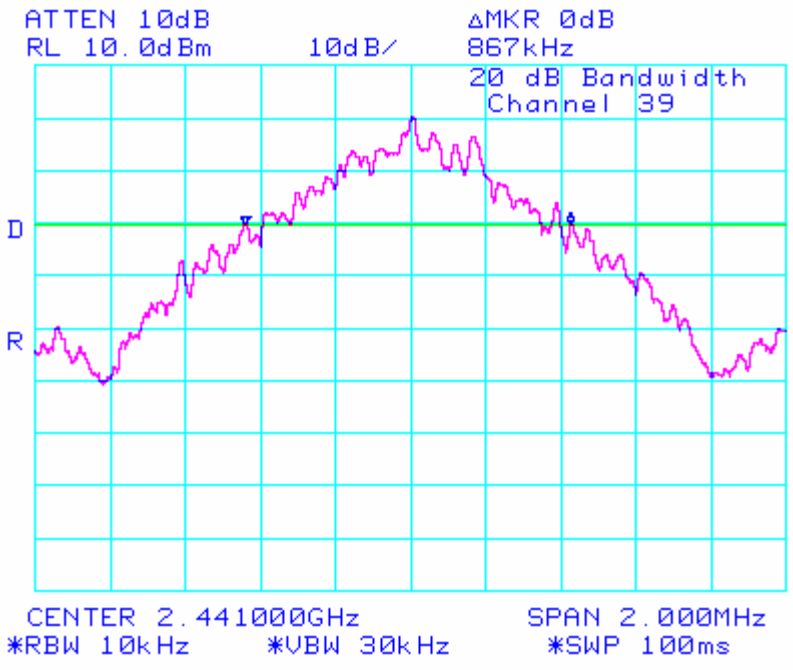
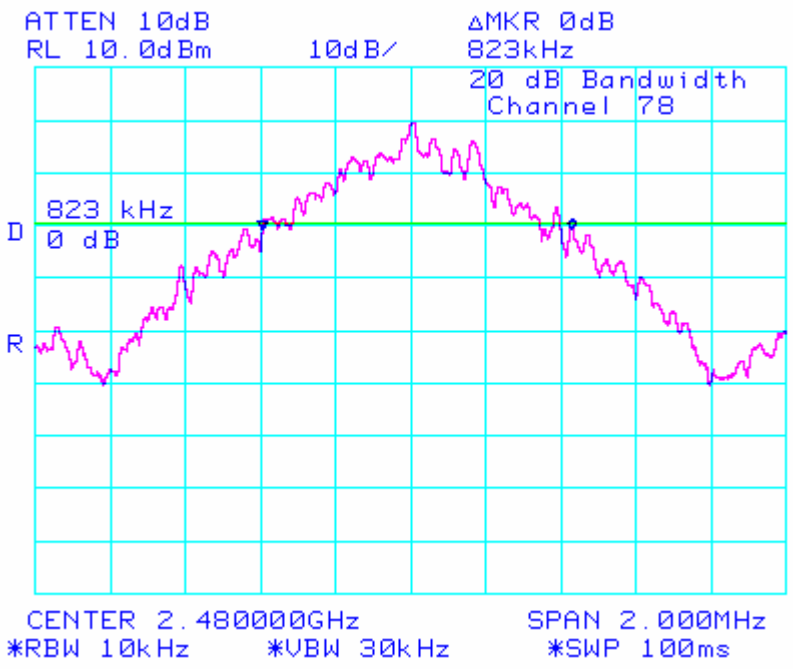


Figure 3: 20 dB Bandwidth, channel 78



RF Conducted Emission Test Results cont'd

Carrier Frequency Separation

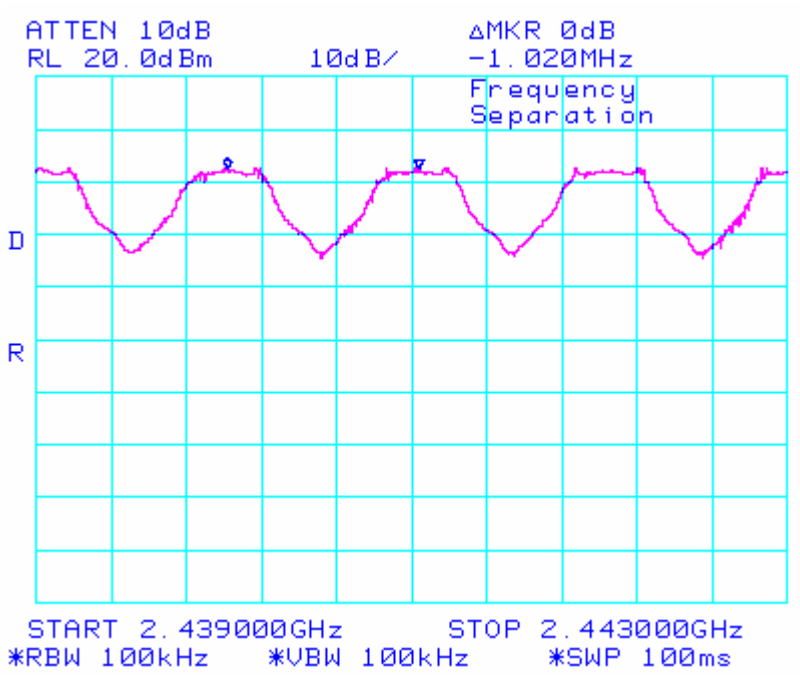
The EUT met the requirements of the Carrier Frequency Separation as per 47 CFR 15.247(a) and RSS-210. Carrier Frequency Separation was measured between Channels 38 to 39. Bluetooth was operating in frequency hopping (Euro/US) mode using pattern type Static PRBS and packet type DH5 during the measurements.

Bluetooth Channels	Limit (MHz)	Measured Value (MHz)
38 to 39	>= 0.025 or 20 dB bandwidth	1.020

The environmental test conditions were: Temperature 26ºC
Pressure 1010 mb
Relative Humidity 39%

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 met the requirements of the number of hopping frequencies as per 47 CFR 15.247(a) and RSS-210.

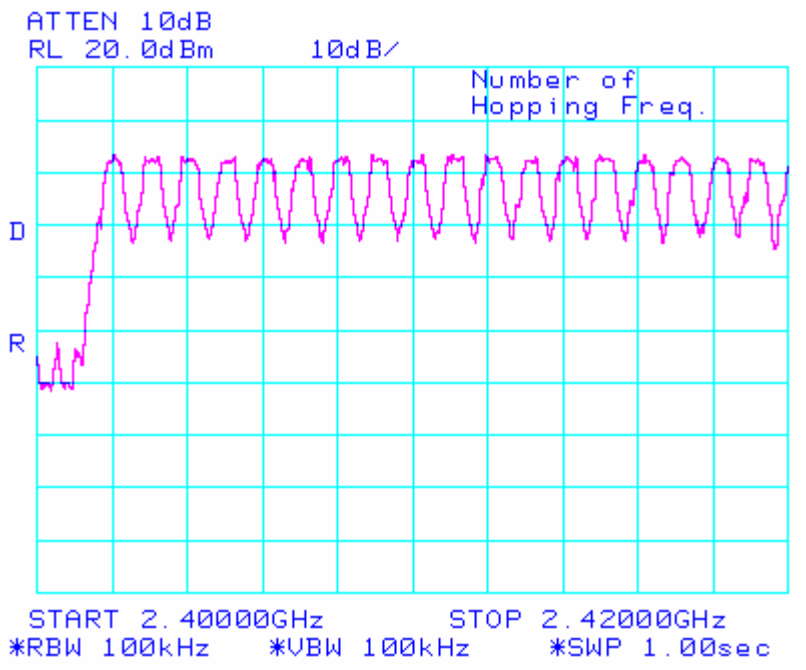
Bluetooth was operating in frequency hopping (Euro/US) mode using pattern type Static PRBS and packet type DH5 during the measurements.

Limit	Number of Hopping Frequencies
>= 75	79

The environmental test conditions were: Temperature 26ºC
Pressure 1010 mb
Relative Humidity 33%

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

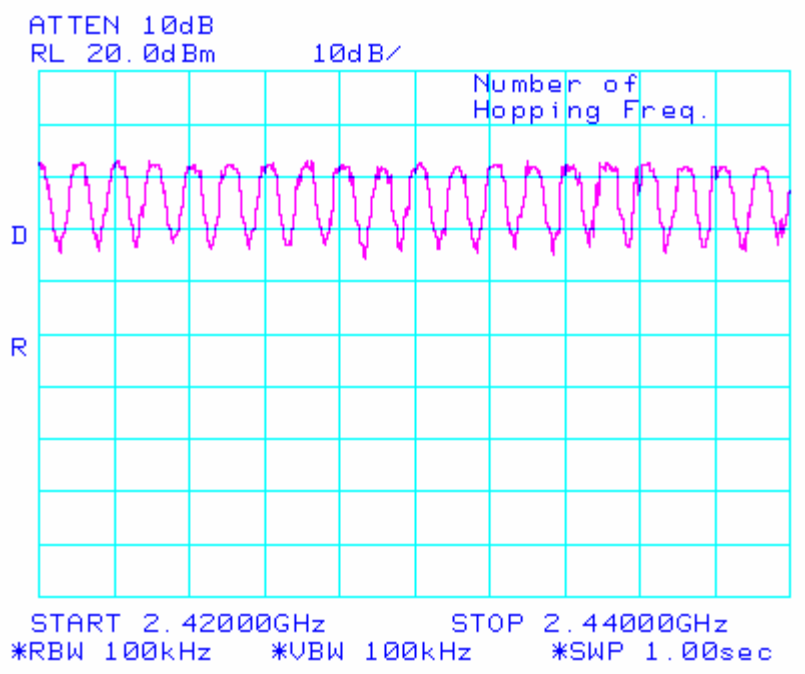
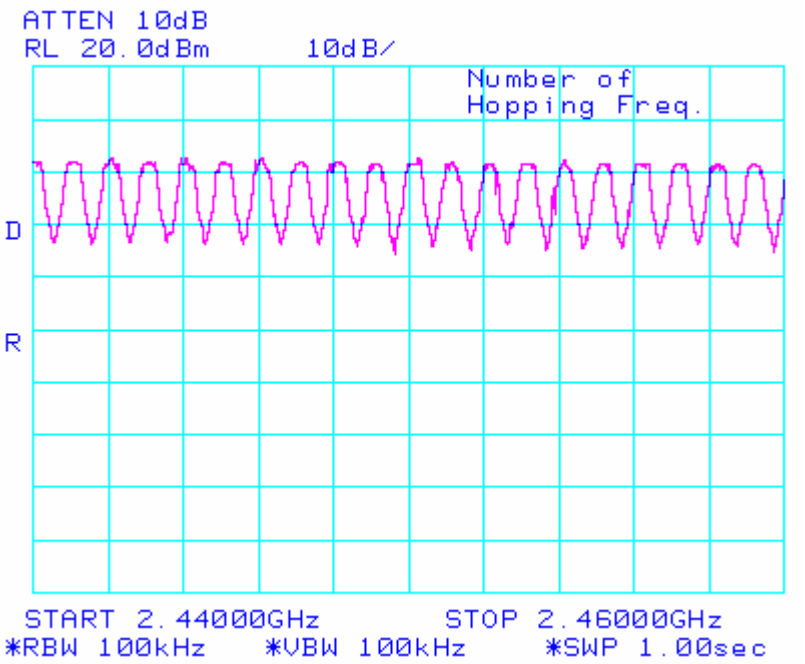
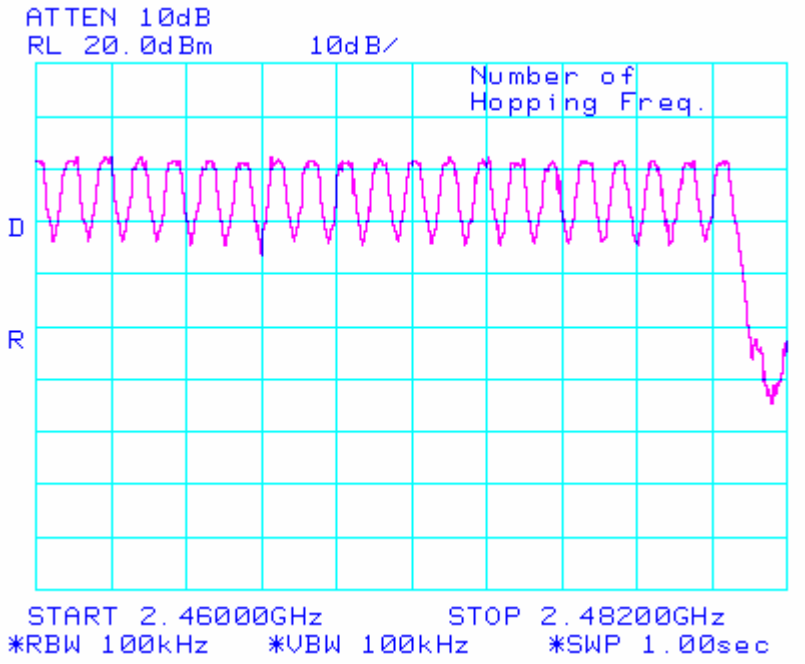


Figure 7: Number of Hopping Frequencies



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 met the requirements of the time of occupancy (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 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	0.4333	.4333 x 320.0 = 138.7	400	261.3
39	DH1	0.4333	.4333 x 320.0 = 138.7	400	261.3
78	DH1	0.4333	.4333 x 320.0 = 138.7	400	261.3
0	DH3	1.6987	1.6987 x 159.9 = 271.6	400	128.4
39	DH3	1.6900	1.6900 x 159.9 = 270.2	400	129.8
78	DH3	1.6900	1.6900 x 159.9 = 270.2	400	129.8
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	2.9500	2.95 x 106.8 = 315.1	400	84.9

The environmental test conditions were: Temperature 26ºC
Pressure 1010 mb
Relative Humidity 33%

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

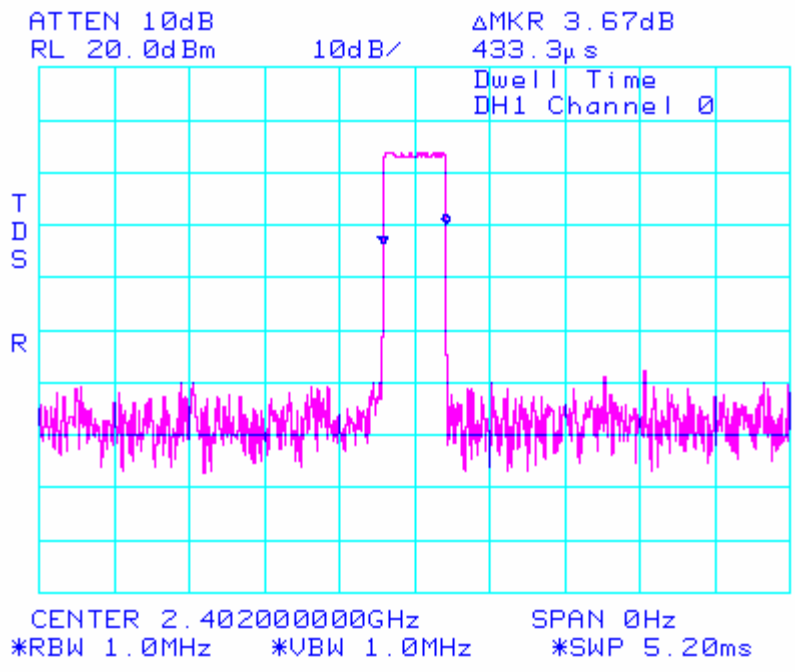
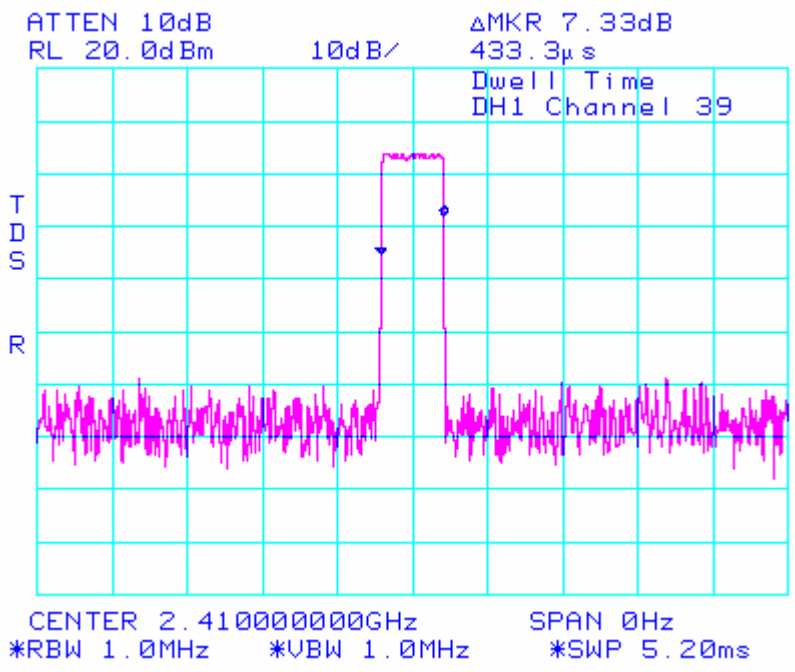


Figure 10: Dwell Time, Middle Channel, Packet Type DH1



RF Conducted Emission Test Results cont'd

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

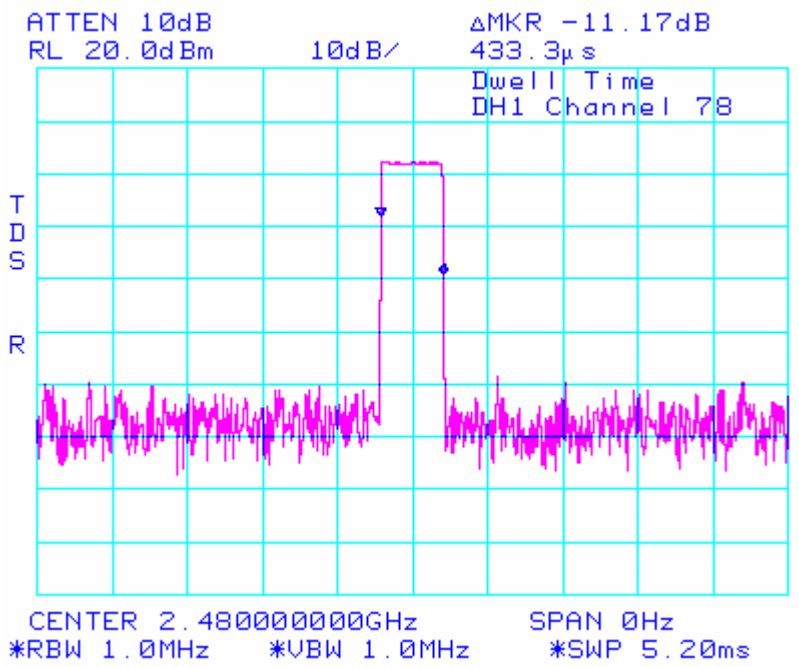
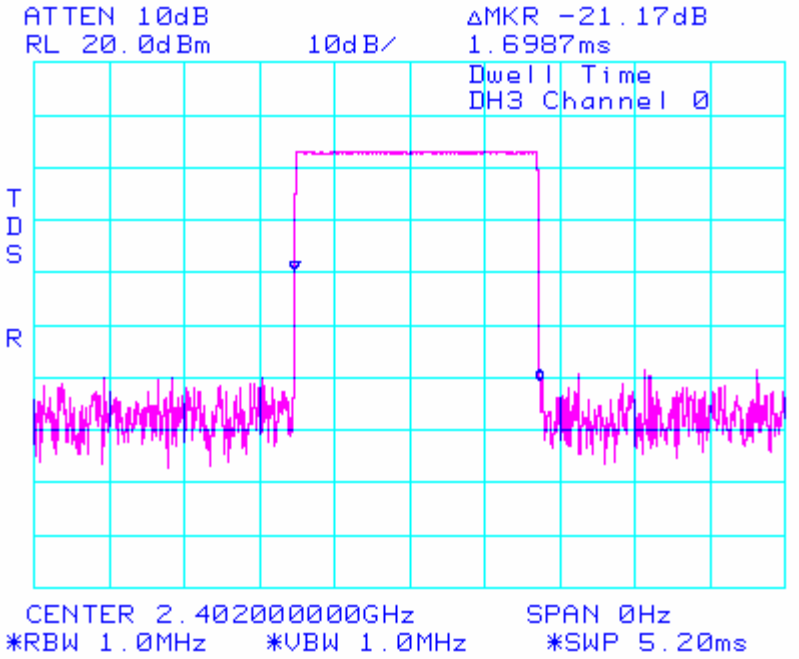


Figure 12: Dwell Time, Low Channel, Packet Type DH3



RF Conducted Emission Test Results cont'd

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

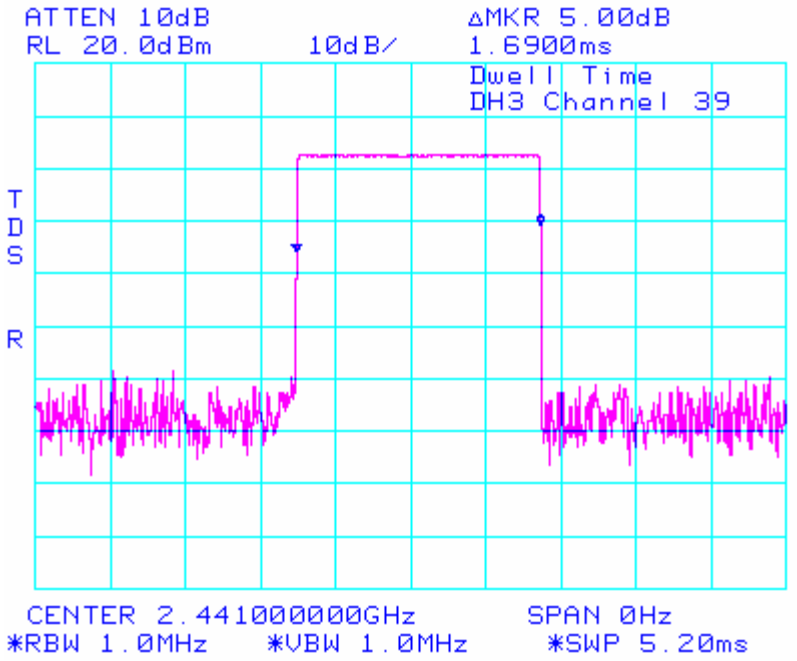
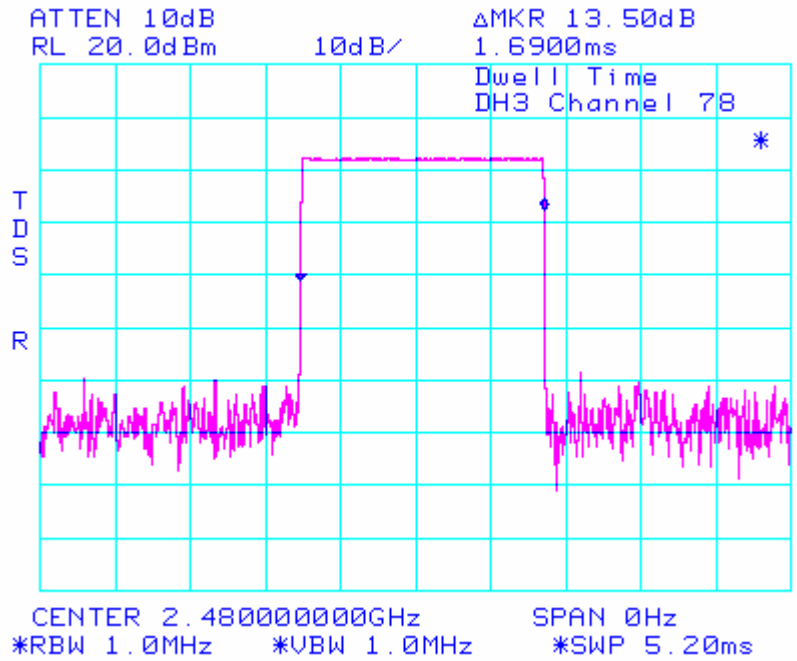


Figure 14: Dwell Time, High Channel, Packet Type DH3



RF Conducted Emission Test Results cont'd

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

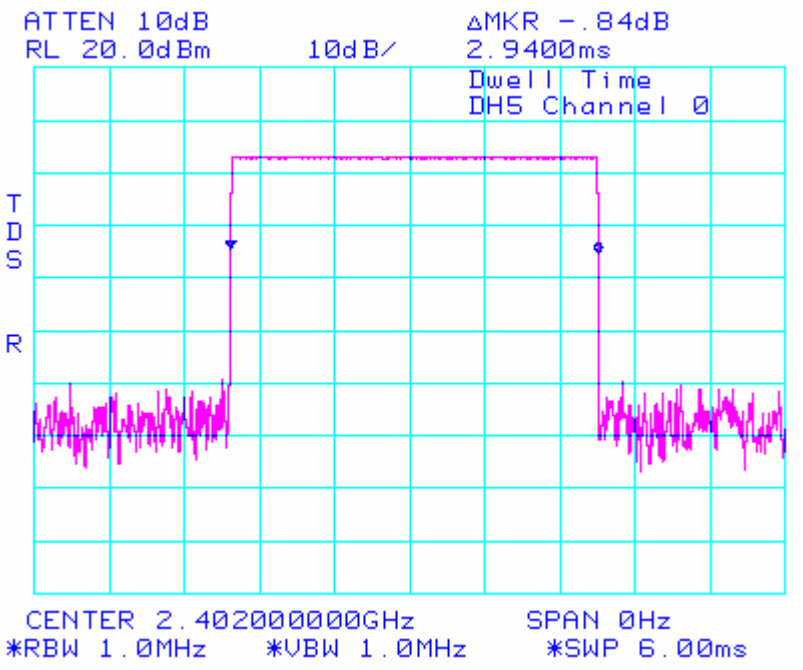
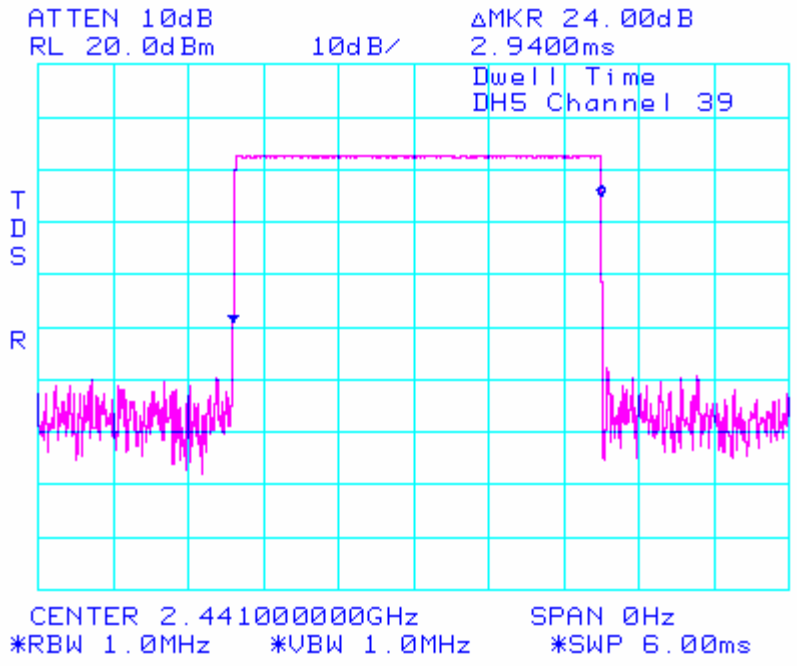
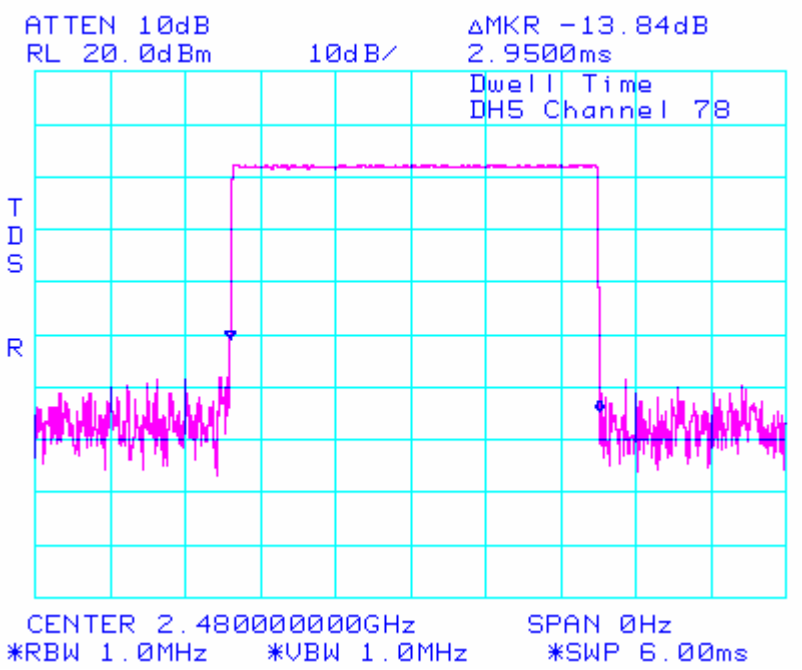


Figure 16: Dwell Time, Middle Channel, Packet Type DH5



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

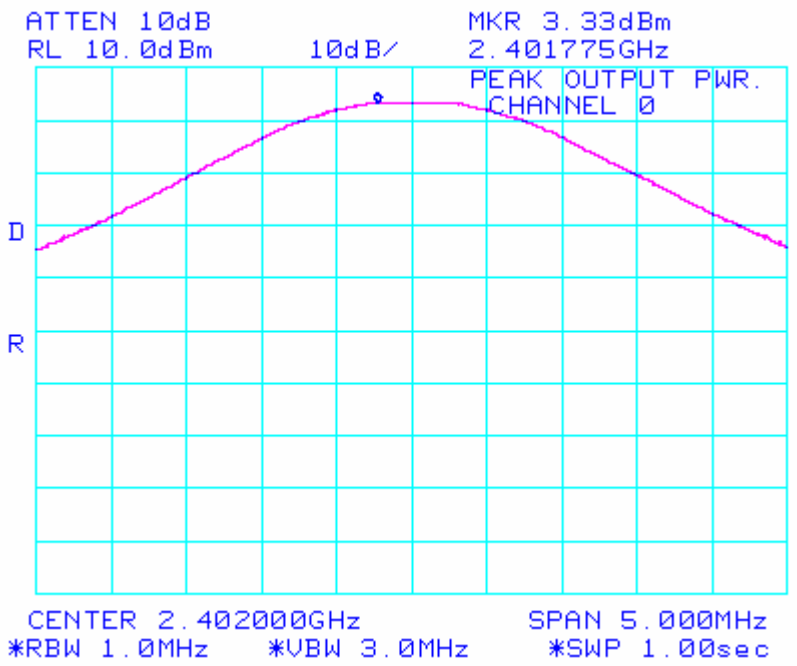
The EUT met the requirements of the maximum peak conducted output power as per 47 CFR 15.247(b) and RSS-210. Low channel (0), middle channel (39) and high channel (78) were measured. Bluetooth was operating in single frequency mode during the measurements. A reference offset of 0.3 dB was applied to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

Bluetooth Channel	Measured Value (dBm)	Limit (dBm)
0	3.33	-6.0 to 4.0
39	2.17	-6.0 to 4.0
78	2.50	-6.0 to 4.0

The environmental test conditions were: Temperature 24ºC
Pressure 1010 mb
Relative Humidity 42%

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

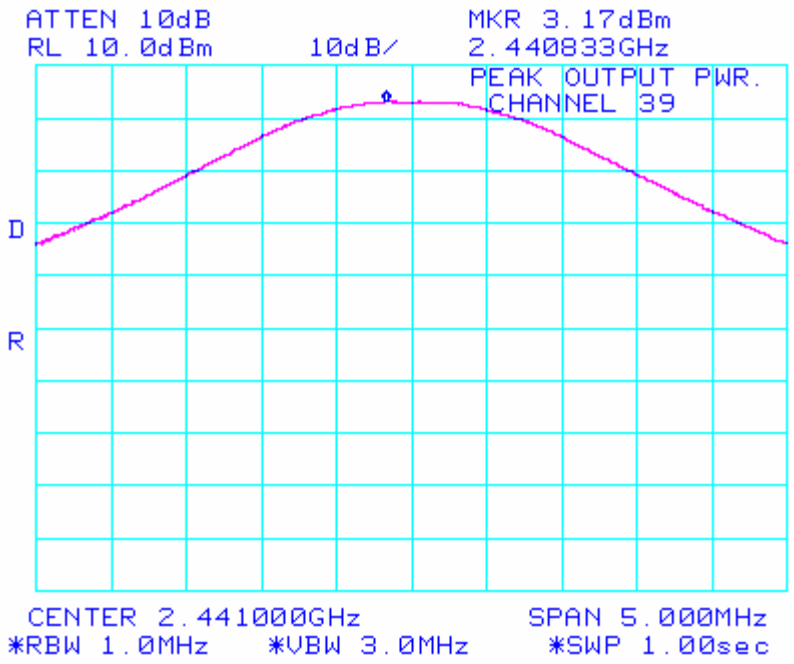
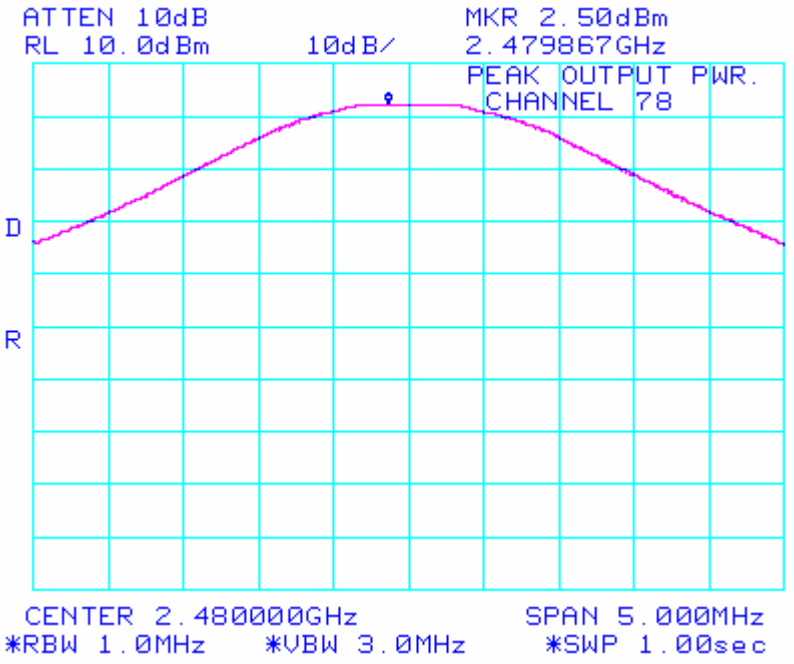


Figure 20: Maximum Peak Conducted Output Power



RF Conducted Emission Test Results cont'd

Band Edge Compliance

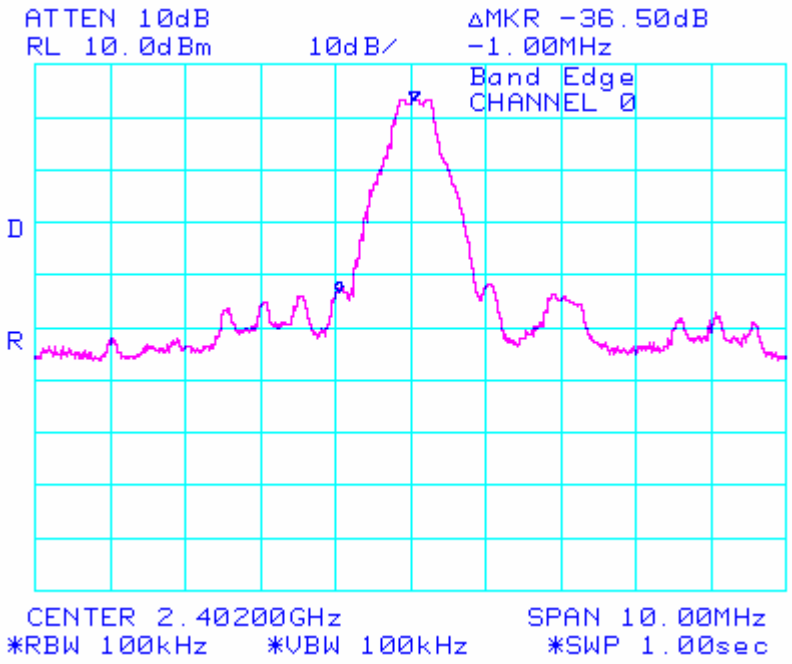
The EUT met the requirements of the band edge compliance as per 47 CFR 15.247(c) and RSS-210. Low channel (0) and high channel (78) were measured. Bluetooth was operating in single frequency and hopping mode using pattern type Static PRBS and packet type DH5 during the measurements.

Bluetooth Channel	Operating Mode	Measured Value (dBc)	Limit (dBc)	Margin (dB)
0	Single Frequency	-36.50	-20	16.50
0	Hopping	-36.66	-20	16.66
78	Single Frequency	-32.50	-20	12.50
78	Hopping	-33.83	-20	13.83

The environmental test conditions were: Temperature 25ºC
Pressure 1010 mb
Relative Humidity 39%

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

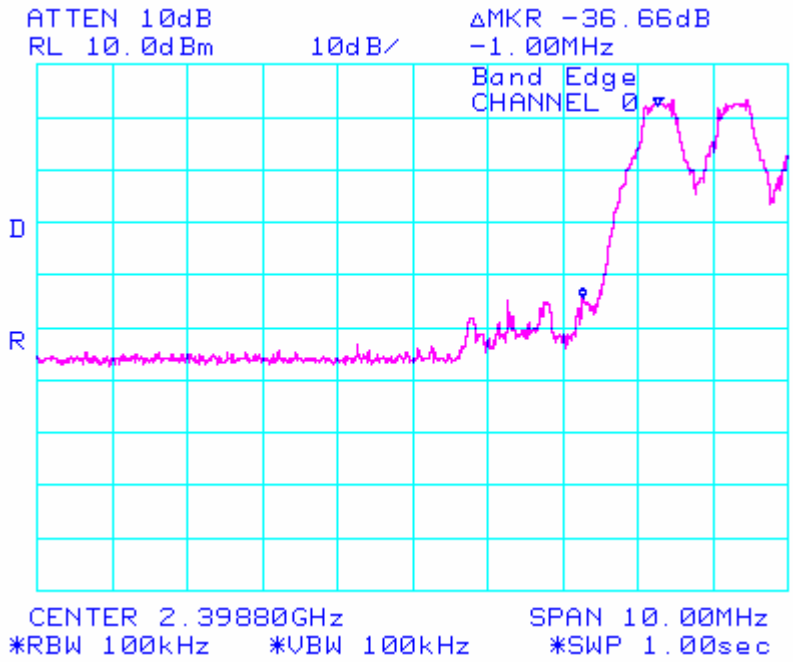
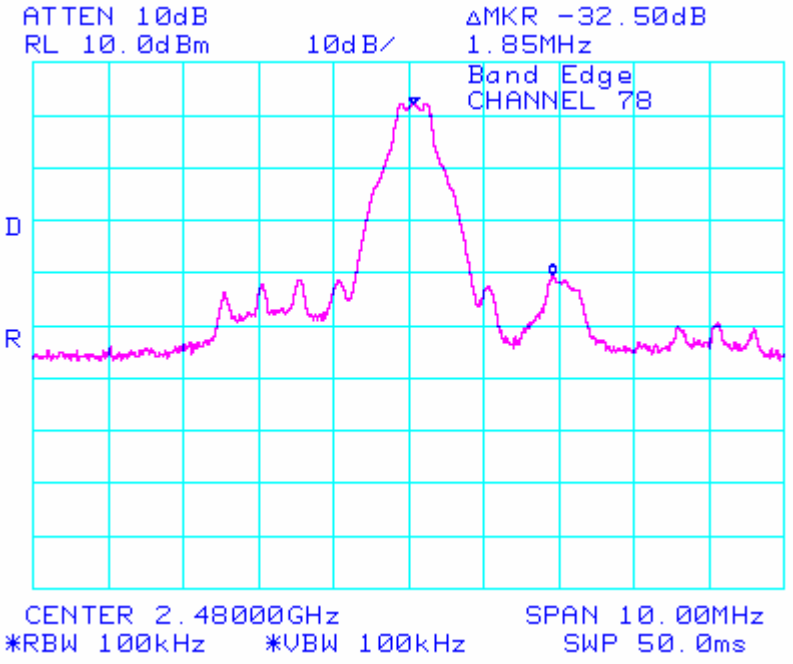
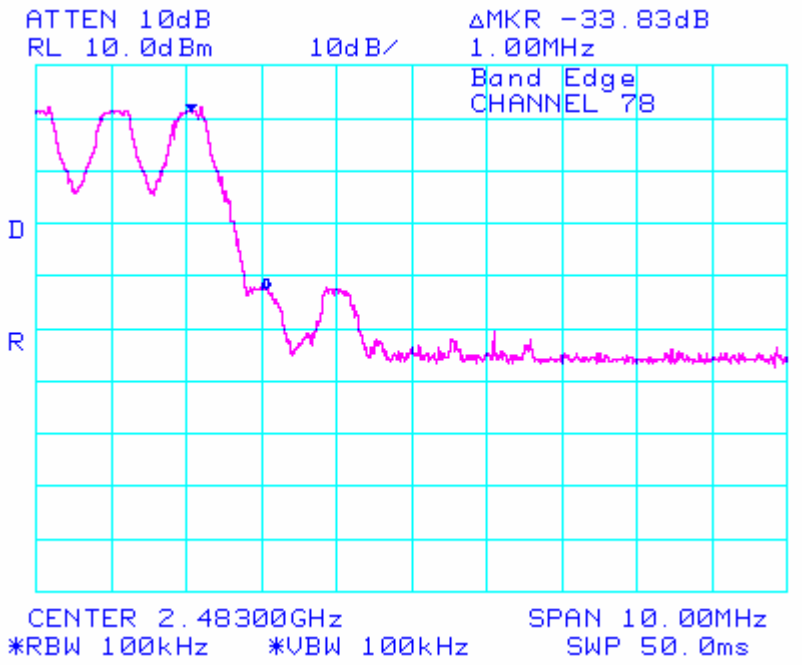


Figure 23: Band Edge Compliance, Single Frequency Mode, Channel 78



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

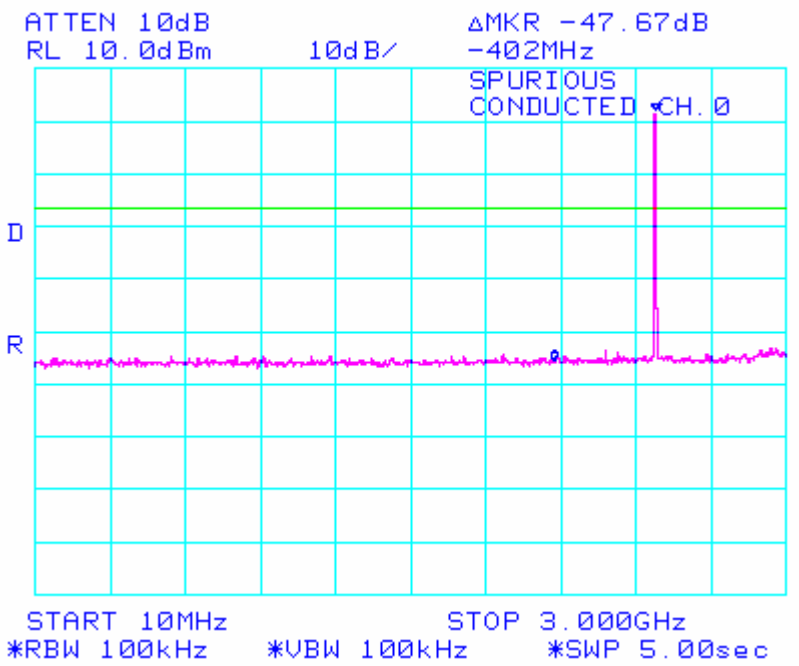
The EUT met the requirements of the spurious RF conducted emissions as per 47 CFR 15.247(c) and RSS-210. Low channel (0) and high channel (78) were measured. Bluetooth was operating in single frequency mode using pattern type Static PRBS and packet type DH5 during the measurements. A reference offset 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	3.33	-41.50 (NF)	-20
39	3.17	-41.50 (NF)	-20
78	2.50	-40.67 (NF)	-20
Hopping mode	3.33	-41.33 (NF)	-20

The environmental test conditions were: Temperature 24ºC
Pressure 1010 mb
Relative Humidity 42%

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

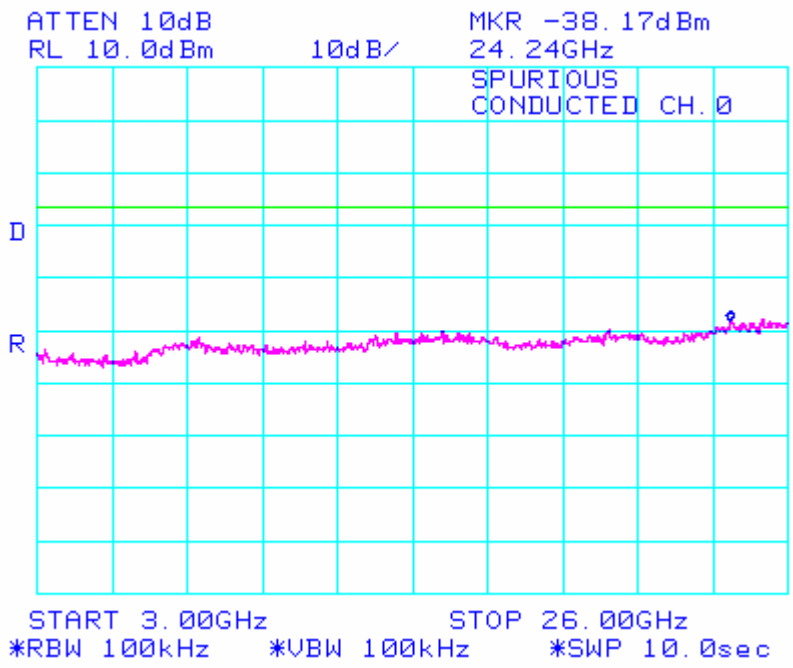
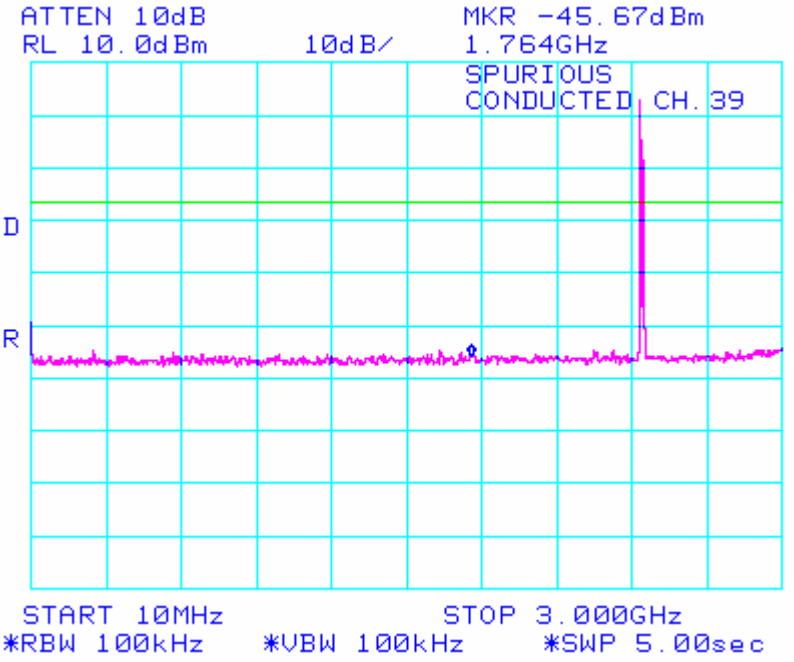


Figure 27: Spurious RF Conducted Emissions, Channel 39



RF Conducted Emission Test Results cont'd

Figure 28: - **Spurious RF Conducted Emissions, Channel 39**

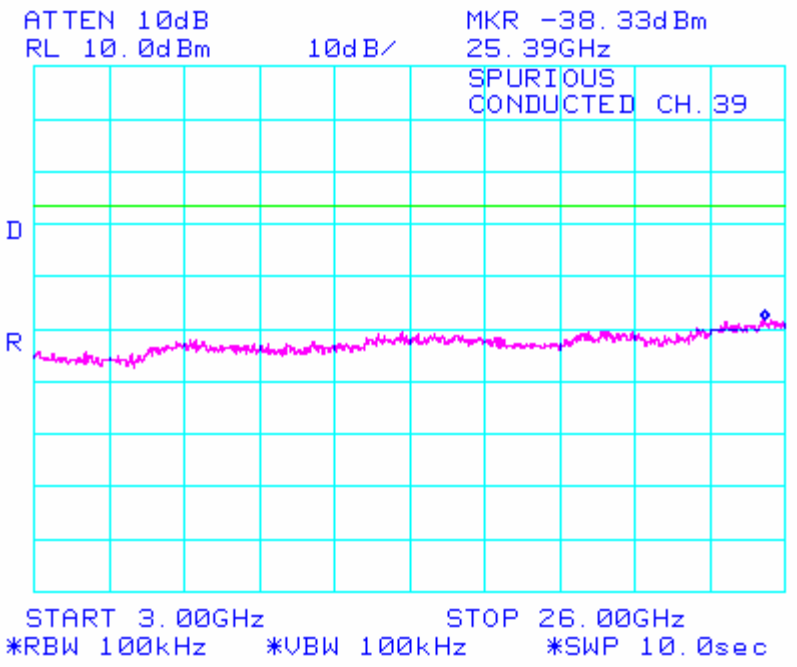
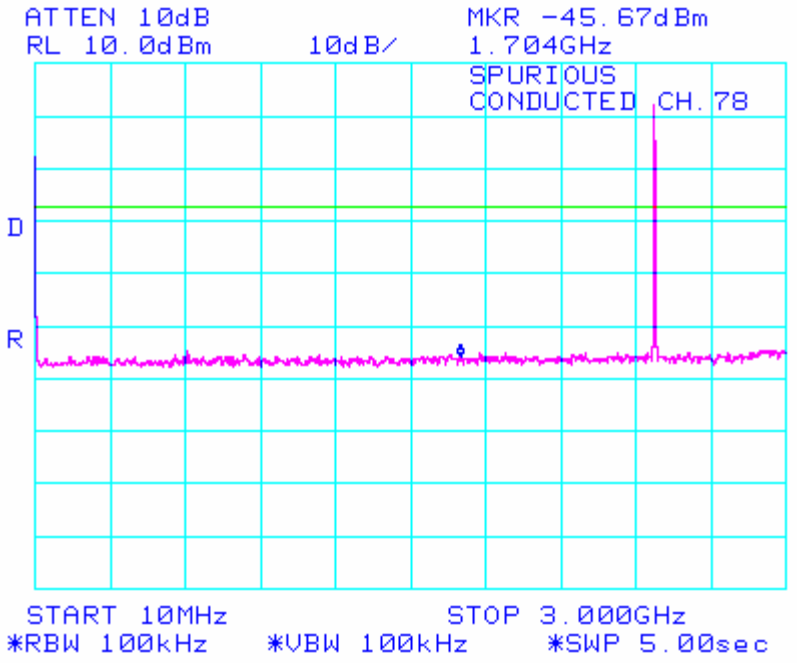


Figure 29: Spurious RF Conducted Emissions, Channel 78



RF Conducted Emission Test Results cont'd

Figure 30: **Spurious RF Conducted Emissions, Channel 78**

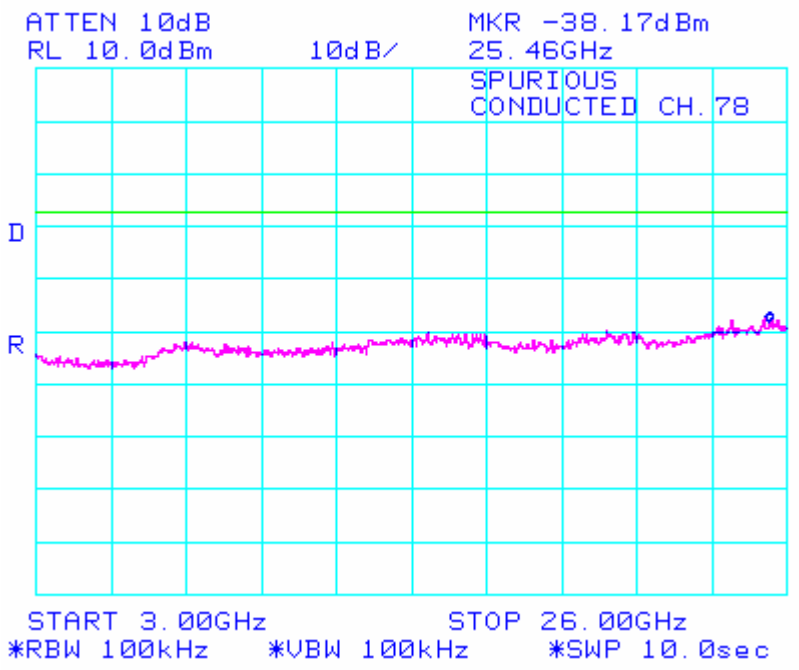
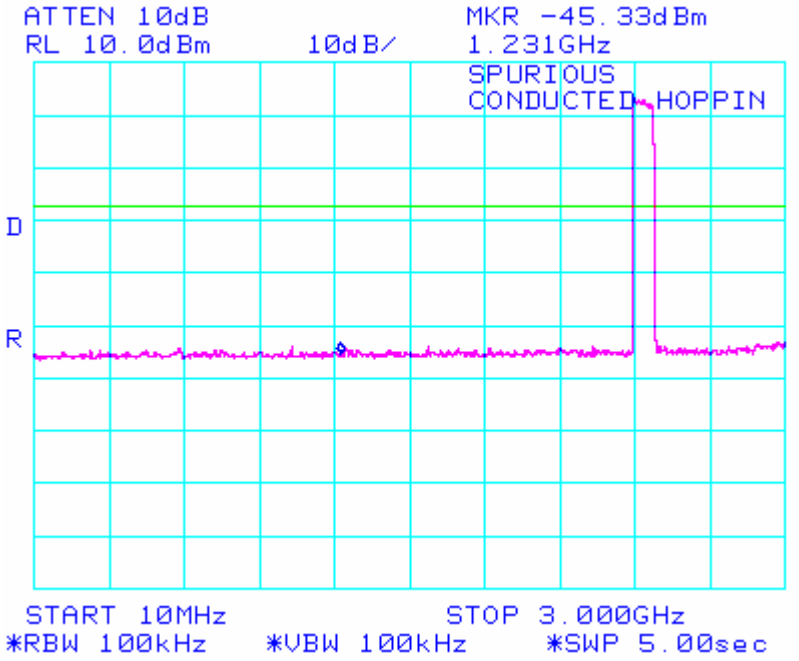
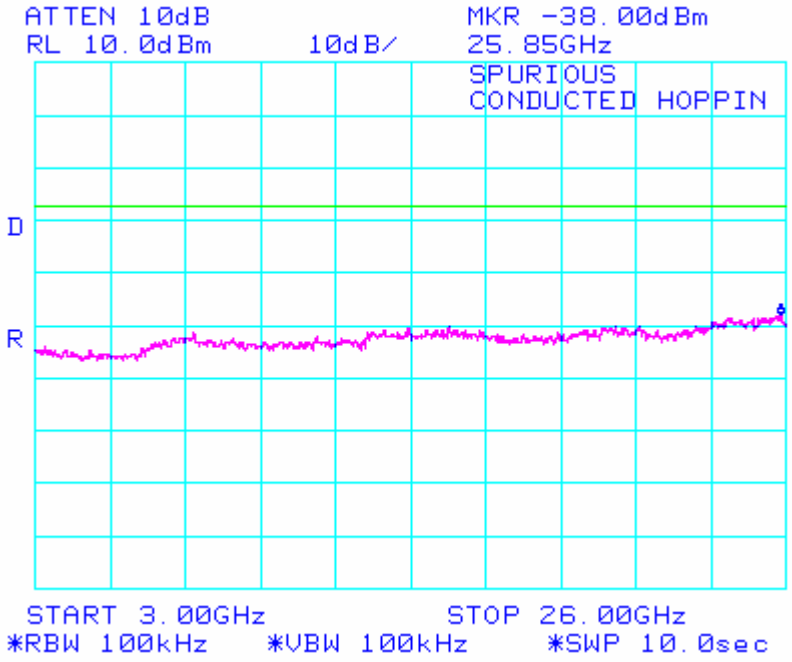


Figure 31: Spurious RF Conducted Emissions, Frequency Hopping Mode



RF Conducted Emission Test Results cont'd

Figure 32: Spurious RF Conducted Emissions, Frequency Hopping Mode



RF Conducted Emission Test-Setup Photo