



FCC CFR47 PART 15 SUBPART C  
INDUSTRY CANADA RSS-210 ISSUE 7  
CLASS II PERMISSIVE CHANGE

CERTIFICATION TEST REPORT

FOR

**BLUETOOTH TRANSCEIVER MODULE**  
*(Adding an option of an external antenna)*

**MODEL NUMBER: BCM92070MD\_REF**

**FCC ID: QDS-BRCM1043**  
**IC: 4324A-BRCM1043**

**REPORT NUMBER: 10U13202-1**

**ISSUE DATE: MAY 13, 2010**

*Prepared for*  
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**190 MATHILDA PLACE**  
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	05/13/10	Initial Issue	T. Chan

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** BROADCOM CORPORATION  
190 MATHILDA PLACE  
SUNNYVALE, CA 94086, U.S.A.

**EUT DESCRIPTION:** BLUETOOTH TRANSCEIVER MODULE

**MODEL:** BCM92070MD\_REF

**SERIAL NUMBER:** 62

**DATE TESTED:** MAY 11 – 12, 2010

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 7 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 2	Pass

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For CCS By:



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THU CHAN  
EMC MANAGER  
COMPLIANCE CERTIFICATION SERVICES

Tested By:



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VIEN TRAN  
EMC ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 2, and RSS-210 Issue 7.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a Bluetooth transceiver module 2.1 + EDR

The radio module is manufactured by Universal Scientific Industrial Co (Shanghai, China).

### 5.2. MAXIMUM OUTPUT POWER

The test measurement passed within  $\pm 0.5\text{dBm}$  of the original output power.

### 5.3. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

The major change filed under this application is adding an optional of an external antenna.

### 5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an external antenna, with a maximum gain of 2.56 dBi.

### 5.5. SOFTWARE AND FIRMWARE

The EUT driver software installed in the host support equipment during testing was Broadcom, 2070 Bluetooth rev.5.5.0.7600.

The test utility software used during testing was Blue Tool, rev. 1.1.2.7.

### 5.6. WORST-CASE CONFIGURATION AND MODE

Based on previous report 08U12247-11 grant date on 01/23/2009, there were not significant differences by compared the band edges of GFSK and 8PSK. The 8PSK mode is chosen as worst mode to conduct the testing since its data rate is higher than GFSK mode.

The worst-case channel is determined as the channel with the highest output power.

## 5.7. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Dell	Inspiron 630m	N/A	DoC
AC Adapter	Dell	LA90PS0-00	CN-0DF266-71615-67J-05BB	N/A
Adapter Board	Broadcom	BCM9USB3P3V	1238346	N/A

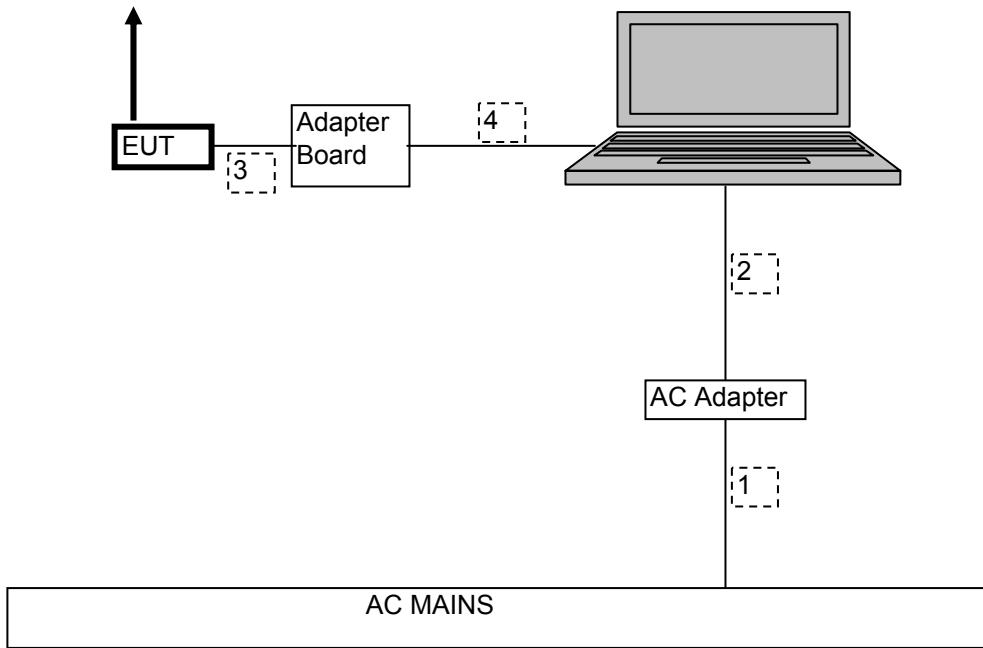
### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US115V	Unshielded	1m	N/A
2	DC	1	DC	Unshielded	1.5m	a ferrite at laptop end
3	Ribbon	1	Ribbon Cable	Unshielded	.3m	EUT / Adapter Board
4	USB	1	USB	UnShielded	.8m	N/A

### TEST SETUP

The EUT is connected to a host laptop computer via a 5 VDC adapter board during the tests. Test software exercised the radio card.

**SETUP DIAGRAM FOR TESTS**



## 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset	Cal Due
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	01/05/11
Antenna, Biolog, 2 GHz	Sunol Sciences	JB1	C01011	01/14/11
Antenna, Horn, 18 GHz	EMCO	3115	C00945	04/22/11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	03/31/11
Preamplifier, 1-26GHz	Agilent / HP	8449B	C01052	07/05/10
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	11/28/10

## 7. RADIATED TEST RESULTS

### 7.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

#### TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

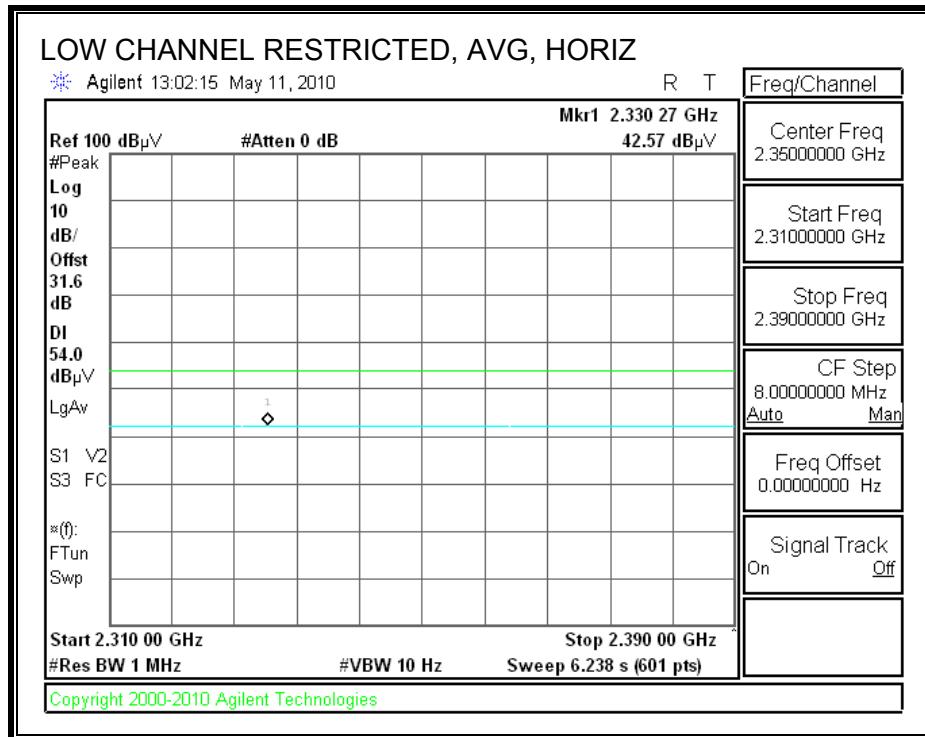
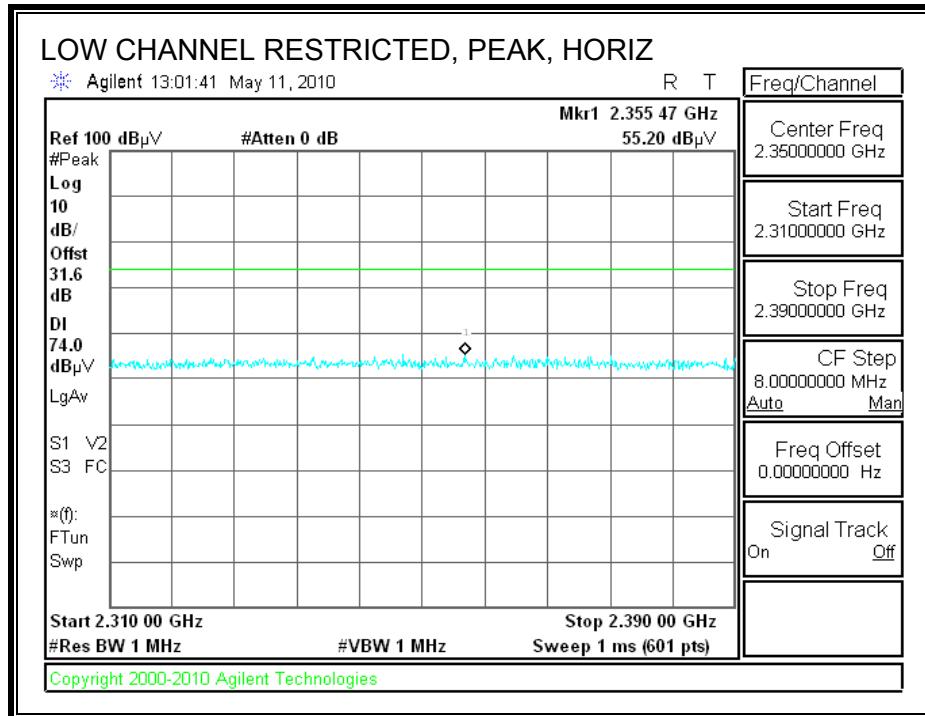
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

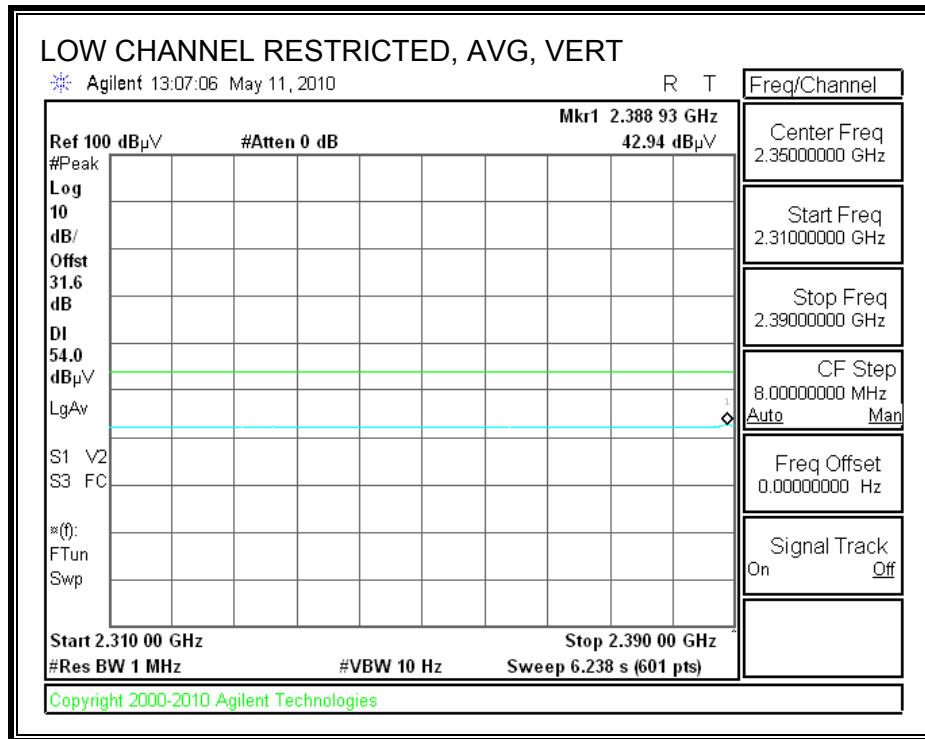
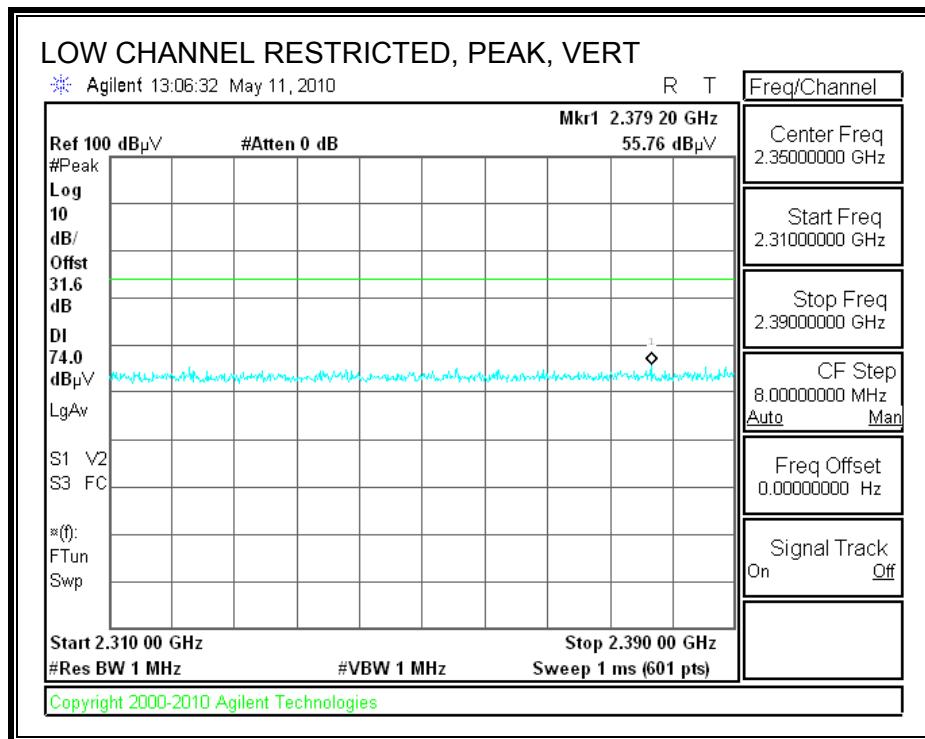
## 7.2. TRANSMITTER ABOVE 1 GHz

### 7.2.1. ENHANCED DATA RATE 8PSK MODULATION

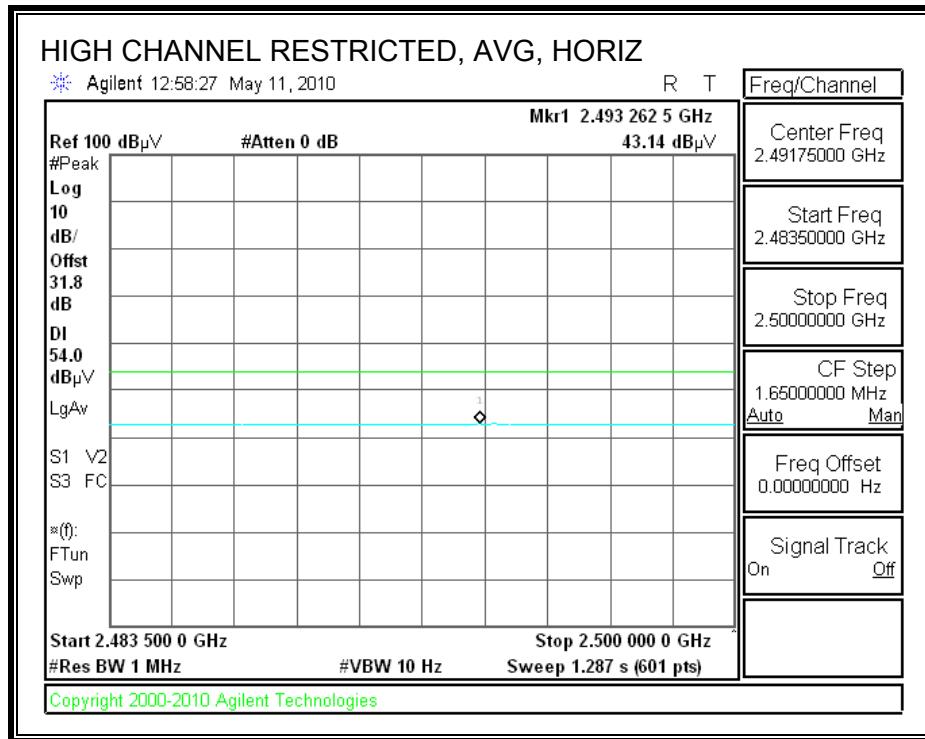
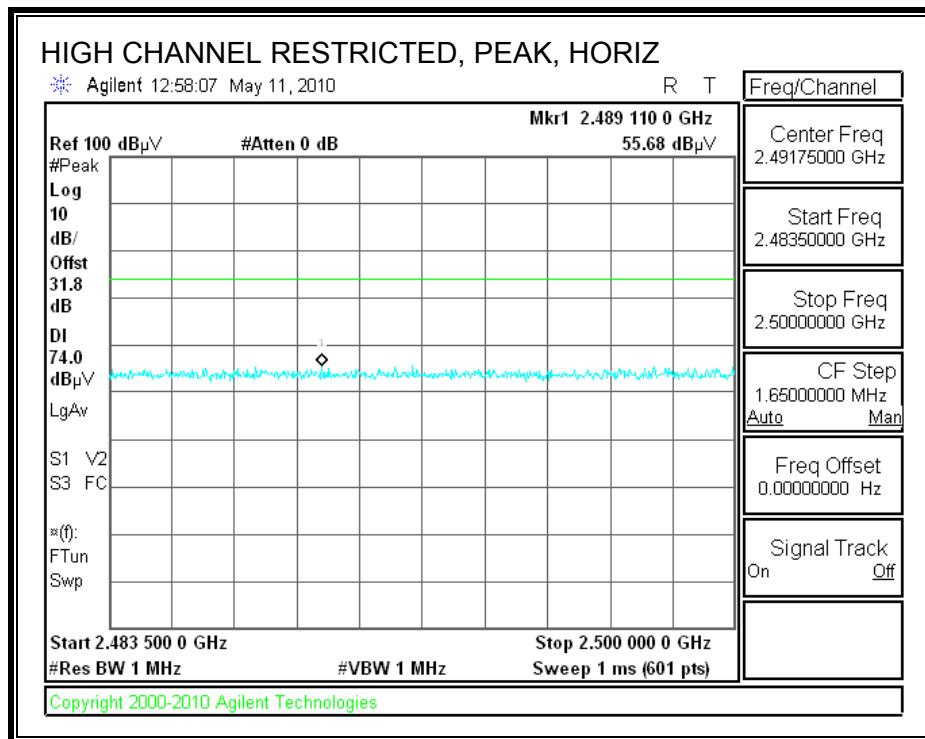
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



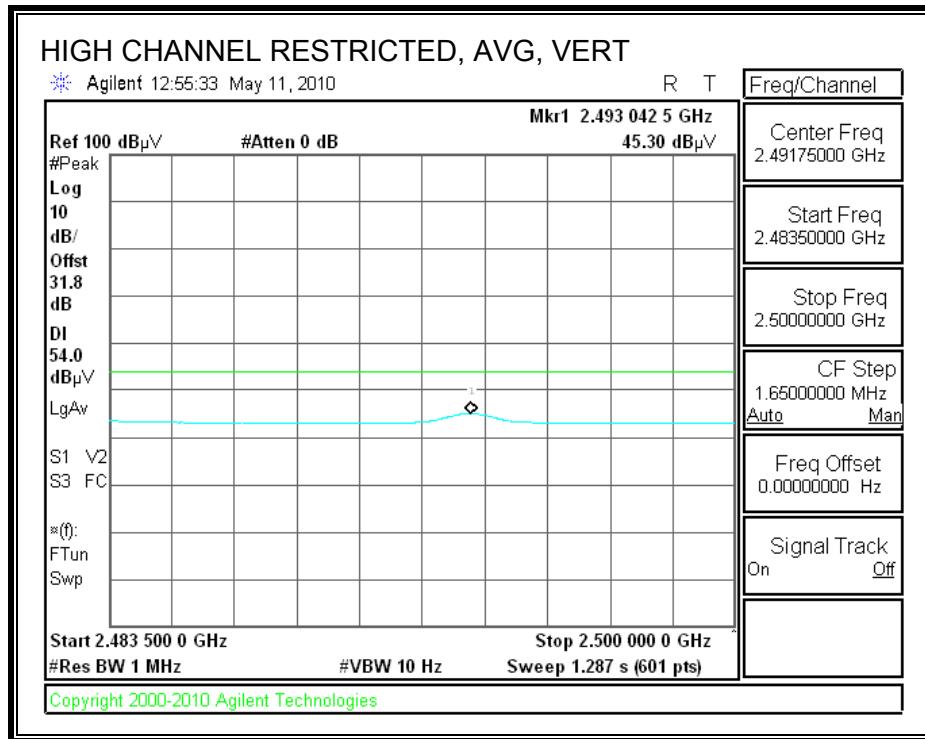
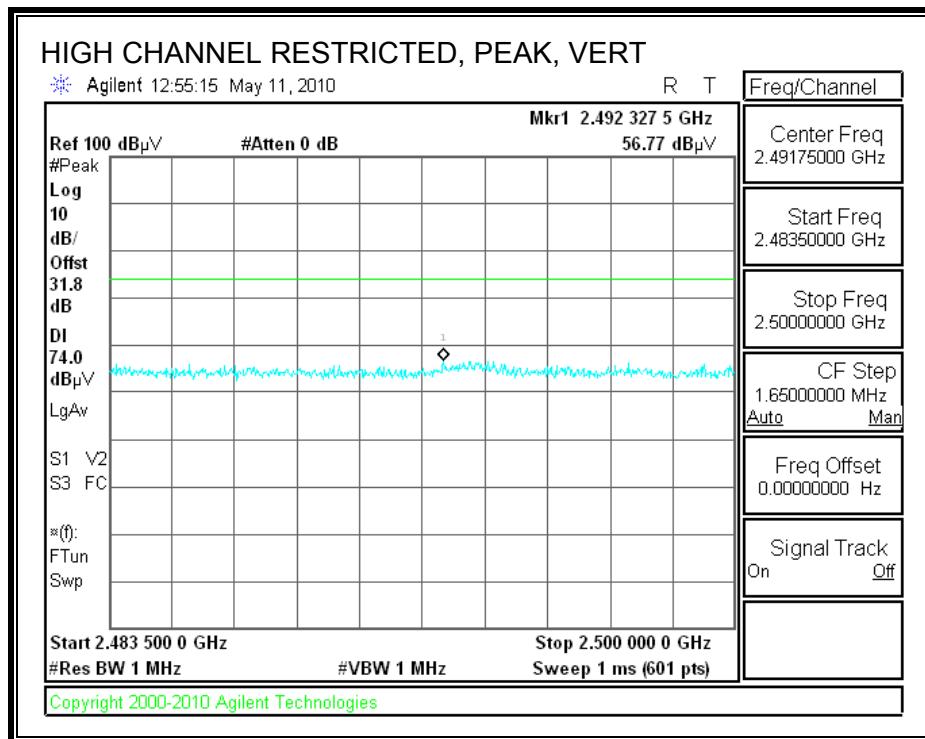
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



## HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**  
Compliance Certification Services, Fremont 3m Chamber

Test Engr: Vien Tran  
Date: 05/11/10  
Project #: 10U13202  
Company: Broadcom  
EUT Description: Bluetooth Transceiver Module 2.0 + EDR  
EUT M/N: BCM92070MD\_REF (Add higher gain of an external antenna, 2.56dBi)  
Test Target: FCC B  
Mode Oper: Tx 8PSK\_Harmonic & Spur

f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit	
Dist	Distance to Antenna	D	Corr	Distance Connect to 3 meters	Peak Field Strength Limit
Read	Analyzer Reading	Avg		Average Field Strength @ 3 m	Margin vs. Average Limit
AF	Antenna Factor	Peak		Calculated Peak Field Strength	Margin vs. Peak Limit
CL	Cable Loss	HPF		High Pass Filter	

f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
<b>8PSK Low Channel 2402MHz</b>															
4.804	3.0	42.2	32.7	5.8	-34.8	0.0	0.0	45.8	74.0	-28.2	H	P	124.0	103.0	
4.804	3.0	34.9	32.7	5.8	-34.8	0.0	0.0	38.5	54.0	-15.5	H	A	124.0	103.0	
4.804	3.0	40.5	32.7	5.8	-34.8	0.0	0.0	44.1	74.0	-29.9	V	P	99.0	219.0	
4.804	3.0	31.8	32.7	5.8	-34.8	0.0	0.0	35.4	54.0	-18.6	V	A	99.0	219.0	
<b>8PSK Mid Channel 2441MHz</b>															
4.882	3.0	38.7	32.7	5.8	-34.8	0.0	0.0	42.4	74.0	-31.6	H	P	106.0	21.0	
4.882	3.0	28.7	32.7	5.8	-34.8	0.0	0.0	32.4	54.0	-21.6	H	A	106.0	21.0	
7.323	3.0	35.3	35.5	7.3	-34.1	0.0	0.0	44.0	74.0	-30.0	H	P	98.0	207.0	
7.323	3.0	23.3	35.5	7.3	-34.1	0.0	0.0	32.0	54.0	-22.0	H	A	98.0	207.0	
4.882	3.0	38.2	32.7	5.8	-34.8	0.0	0.0	41.9	74.0	-32.1	V	P	99.0	251.0	
4.882	3.0	28.6	32.7	5.8	-34.8	0.0	0.0	32.4	54.0	-21.6	V	A	99.0	251.0	
7.323	3.0	36.0	35.5	7.3	-34.1	0.0	0.0	44.7	74.0	-29.3	V	P	145.0	296.0	
7.323	3.0	24.8	35.5	7.3	-34.1	0.0	0.0	33.5	54.0	-20.5	V	A	145.0	296.0	
<b>8PSK High Channel 2480MHz</b>															
4.960	3.0	45.5	32.8	5.9	-34.8	0.0	0.0	49.4	74.0	-24.6	H	P	103.0	304.0	
4.960	3.0	39.4	32.8	5.9	-34.8	0.0	0.0	43.3	54.0	-10.7	H	A	103.0	304.0	
7.440	3.0	35.6	35.6	7.3	-34.1	0.0	0.0	44.5	74.0	-29.5	H	P	139.0	331.0	
7.440	3.0	22.9	35.6	7.3	-34.1	0.0	0.0	31.8	54.0	-22.2	H	A	139.0	331.0	
4.960	3.0	42.6	32.8	5.9	-34.8	0.0	0.0	46.4	74.0	-27.6	V	P	99.0	326.0	
4.960	3.0	35.7	32.8	5.9	-34.8	0.0	0.0	39.6	54.0	-14.4	V	A	99.0	326.0	
7.440	3.0	35.7	35.6	7.3	-34.1	0.0	0.0	44.6	74.0	-29.4	V	P	106.0	299.0	
7.440	3.0	23.5	35.6	7.3	-34.1	0.0	0.0	32.4	54.0	-21.6	V	A	106.0	299.0	

Rev. 4.1.2.7

Note: No other emissions were detected above the system noise floor.

## 7.2.2. RECEIVER ABOVE 1 GHz

High Frequency Measurement Compliance Certification Services, Fremont 3m Chamber																																																																																																																																																																																																															
<p>Company: Broadcom Project #: 10U13202 Date: 05/12/10 Test Engineer: Vien Tran Configuration: EUT / Test JIG / Laptop Mode: Rx Mode</p> <p><u>Test Equipment:</u></p> <table border="1"> <tr> <td>Horn 1-18GHz T60; S/N: 2238 @3m</td> <td>Pre-amplifier 1-26GHz T34 HP 8449B</td> <td>Pre-amplifier 26-40GHz</td> <td colspan="3">Horn &gt; 18GHz</td> <td>Limit RX RSS 210</td> </tr> <tr> <td colspan="6">Hi Frequency Cables</td> <td rowspan="2">Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz; VBW=10Hz</td> </tr> <tr> <td>3' cable 22807700 3' cable 22807700</td> <td>12' cable 22807600 12' cable 22807600</td> <td>20' cable 22807500 20' cable 22807500</td> <td>HPF</td> <td>Reject Filter</td> </tr> </table> <p><u>Measurement Data:</u></p> <table border="1"> <thead> <tr> <th>f GHz</th> <th>Dist (m)</th> <th>Read Pk dBuV</th> <th>Read Avg dBuV</th> <th>AF dB/m</th> <th>CL dB</th> <th>Amp dB</th> <th>D Corr dB</th> <th>Fltr dB</th> <th>Peak dBuV/m</th> <th>Avg dBuV/m</th> <th>Pk Lim dBuV/m</th> <th>Avg Lim dBuV/m</th> <th>Pk Mar dB</th> <th>Avg Mar dB</th> <th>Notes (V/H)</th> </tr> </thead> <tbody> <tr><td>1.063</td><td>3.0</td><td>61.5</td><td>38.5</td><td>24.7</td><td>2.4</td><td>-38.2</td><td>0.0</td><td>0.0</td><td>50.4</td><td>27.4</td><td>74</td><td>54</td><td>-23.6</td><td>-26.6</td><td>V</td></tr> <tr><td>1.440</td><td>3.0</td><td>54.6</td><td>39.8</td><td>25.9</td><td>2.9</td><td>-37.7</td><td>0.0</td><td>0.0</td><td>45.8</td><td>31.0</td><td>74</td><td>54</td><td>-28.2</td><td>-23.0</td><td>V</td></tr> <tr><td>1.595</td><td>3.0</td><td>55.6</td><td>35.2</td><td>26.5</td><td>3.0</td><td>-37.4</td><td>0.0</td><td>0.0</td><td>47.7</td><td>27.3</td><td>74</td><td>54</td><td>-26.3</td><td>-26.7</td><td>V</td></tr> <tr><td>2.128</td><td>3.0</td><td>52.9</td><td>33.8</td><td>27.9</td><td>3.6</td><td>-36.7</td><td>0.0</td><td>0.0</td><td>47.7</td><td>28.6</td><td>74</td><td>54</td><td>-26.3</td><td>-25.4</td><td>V</td></tr> <tr><td>1.063</td><td>3.0</td><td>59.5</td><td>37.7</td><td>24.7</td><td>2.4</td><td>-36.2</td><td>0.0</td><td>0.0</td><td>48.4</td><td>26.6</td><td>74</td><td>54</td><td>-25.6</td><td>-27.4</td><td>H</td></tr> <tr><td>1.440</td><td>3.0</td><td>53.1</td><td>38.2</td><td>25.9</td><td>2.9</td><td>-37.7</td><td>0.0</td><td>0.0</td><td>44.3</td><td>29.4</td><td>74</td><td>54</td><td>-29.7</td><td>-24.6</td><td>H</td></tr> <tr><td>1.595</td><td>3.0</td><td>52.2</td><td>34.6</td><td>26.5</td><td>3.0</td><td>-37.4</td><td>0.0</td><td>0.0</td><td>44.3</td><td>26.7</td><td>74</td><td>54</td><td>-29.7</td><td>-27.3</td><td>H</td></tr> <tr><td>2.128</td><td>3.0</td><td>48.8</td><td>31.8</td><td>27.9</td><td>3.6</td><td>-36.7</td><td>0.0</td><td>0.0</td><td>43.6</td><td>26.6</td><td>74</td><td>54</td><td>-30.4</td><td>-27.4</td><td>H</td></tr> </tbody> </table> <p><u>Notes:</u> No other emissions were detected above system noise floor</p> <p><u>Definitions:</u></p> <table> <tr> <td>f</td> <td>Measurement Frequency</td> <td>Amp</td> <td>Preamp Gain</td> <td>Avg Lim</td> <td>Average Field Strength Limit</td> </tr> <tr> <td>Dist</td> <td>Distance to Antenna</td> <td>D Corr</td> <td>Distance Correct to 3 meters</td> <td>Pk Lim</td> <td>Peak Field Strength Limit</td> </tr> <tr> <td>Read</td> <td>Analyzer Reading</td> <td>Avg</td> <td>Average Field Strength @ 3 m</td> <td>Avg Mar</td> <td>Margin vs. Average Limit</td> </tr> <tr> <td>AF</td> <td>Antenna Factor</td> <td>Peak</td> <td>Calculated Peak Field Strength</td> <td>Pk Mar</td> <td>Margin vs. Peak Limit</td> </tr> <tr> <td>CL</td> <td>Cable Loss</td> <td>HPF</td> <td>High Pass Filter</td> <td></td> <td></td> </tr> </table>															Horn 1-18GHz T60; 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### 7.3. WORST-CASE BELOW 1 GHz

#### SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

30-1000MHz Frequency Measurement Compliance Certification Services, Fremont 3m Chamber																															
Test Engr:		Vien Tran																													
Date:		05/11/10																													
Project #:		10U13202																													
Company:		Broadcom																													
EUT Description:		Bluetooth Transceiver Module 2.0 + EDR																													
EUT M/N:		BCM92070MD_REF (Add higher gain of an external antenna, 2.56dBi)																													
Test Target:		FCC B																													
Mode Oper:		Tx Below 1GHz_8PSK																													
Read		Analyzer Reading		Filter		Filter Insert Loss		Corr.		Calculated Field Strength		Limit		Field Strength Limit																	
Read		dBuV		dB/m		dB		dB		dBi		dBuV/m		dBi																	
AF		Antenna Factor		Corr.		Calculated Field Strength		Limit		Field Strength Limit		Margin		Ant. Pol.																	
CL		Cable Loss		Limit		Field Strength Limit		Margin		Ant. Pol.		Det.		P/A/QP																	
f		Dist		Read		AF		CL		Amp		D Corr		Filter		Corr.		Limit		Margin		Ant. Pol.		Notes							
MHz		(m)		dBuV		dB/m		dB		dB		dB		dB		dBuV/m		dBuV/m		dB		V/H		P/A/QP		Notes					
Horizontal																															
50.401		3.0		54.8		9.3		0.6		28.3		0.0		0.0		36.4		40.0		-3.6		H		P							
50.401		3.0		52.6		9.3		0.6		28.3		0.0		0.0		34.2		40.0		-5.8		H		QP							
114.723		3.0		52.0		12.4		0.9		28.1		0.0		0.0		37.2		43.5		-6.3		H		P							
300.011		3.0		45.3		13.5		1.5		27.4		0.0		0.0		32.9		46.0		-13.1		H		P							
432.017		3.0		45.8		15.6		1.8		28.2		0.0		0.0		35.0		46.0		-11.0		H		P							
528.021		3.0		43.2		17.3		2.0		28.6		0.0		0.0		33.9		46.0		-12.1		H		P							
Vertical																															
50.401		3.0		53.1		9.3		0.6		28.3		0.0		0.0		34.6		40.0		-5.4		V		P							
114.603		3.0		44.5		12.4		0.9		28.1		0.0		0.0		29.7		43.5		-13.8		V		P							
202.927		3.0		44.1		11.9		1.2		27.4		0.0		0.0		29.8		43.5		-13.7		V		P							
432.017		3.0		44.4		15.6		1.8		28.2		0.0		0.0		33.6		46.0		-12.4		V		P							
544.101		3.0		42.4		17.6		2.1		28.6		0.0		0.0		33.4		46.0		-12.6		V		P							
744.149		3.0		41.8		19.8		2.5		28.4		0.0		0.0		35.6		46.0		-10.4		V		P							
Rev. 1.27.09															Note: No other emissions were detected above the system noise floor.																

## 8. MAXIMUM PERMISSIBLE EXPOSURE

### FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0 .....	614	1.63	*(100)	6
3.0–30 .....	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300 .....	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34 .....	614	1.63	*(100)	30
1.34–30 .....	824/f	2.19/f	*(180/f <sup>2</sup> )	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
30–300 .....	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

## IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

**Table 5**  
**Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)**

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m <sup>2</sup> )	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	280/f	2.19/f		6
10–30	28	2.19/f		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

\* Power density limit is applicable at frequencies greater than 100 MHz.

**Notes:**

1. Frequency,  $f$ , is in MHz.
2. A power density of 10 W/m<sup>2</sup> is equivalent to 1 mW/cm<sup>2</sup>.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla ( $\mu$ T) or 12.57 milligauss (mG).

## EQUATIONS

Power density is given by:

$$S = \text{EIRP} / (4 * \pi * D^2)$$

where

S = Power density in W/m<sup>2</sup>

EIRP = Equivalent Isotropic Radiated Power in W

D = Separation distance in m

Power density in units of W/m<sup>2</sup> is converted to units of mWc/m<sup>2</sup> by dividing by 10.

Distance is given by:

$$D = \text{SQRT} (\text{EIRP} / (4 * \pi * S))$$

where

D = Separation distance in m

EIRP = Equivalent Isotropic Radiated Power in W

S = Power density in W/m<sup>2</sup>

For multiple colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the Power \* Gain product (in linear units) of each transmitter.

$$\text{Total EIRP} = (P1 * G1) + (P2 * G2) + \dots + (Pn * Gn)$$

where

Px = Power of transmitter x

Gx = Numeric gain of antenna x

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

## LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm<sup>2</sup>

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m<sup>2</sup>

## RESULTS

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m <sup>2</sup> )	FCC Power Density (mW/cm <sup>2</sup> )
2.4 GHz	Bluetooth	0.20	4.27	2.56	0.010	0.001