



EMC Test Data

Client:	Broadcom	Job Number:	J50065
Model:	BCM94309MP in PP02X Laptop	T-Log Number:	T50131
Contact:	Dave Boldy	Proj Eng:	Juan Martinez
Emissions Spec:	FCC 15.247, 15.401	Class:	DSSS / UNII
Immunity Spec:	-	Environment:	-

EMC Test Data

For The

Broadcom

Model

BCM94309MP in PP02X Laptop



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EUT INFORMATION

General Description

The EUT is a 802.11a/g/b mini PC card which is designed for wireless internet access for the laptop. Normally, the EUT would be table-top during operation. The EUT was treated as table-top equipment during testing to simulate the end user environment.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	PP02X	Laptop	22500	DoC
Broadcom	BCM94309MP	Mini PCI Transceiver	-	TBD

Antenna

The EUT uses the antenna an antenna integral to the laptop with a gain of 4.9 dBi in the 5150 - 5350 MHz band and 2.39 dBi in the 2400 - 2483.5 MHz band.

The antenna connector used is non-standard antenna (Hirose U.FL series) to meet the requirements of FCC Part 15.203 and RSS-210

EUT Enclosure

The EUT does not have an enclosure as it is designed to be installed within the enclosure of a host computer.

Modification History

Mod. #	Test	Date	Modification
1			
2			
3			

Modifications applied are assumed to be used on subsequent tests unless otherwise stated as a further modification.



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Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
Dell	PP02X	Laptop	22500	
US Robotics	Pilot 1000	PDA	6.0482E+11	MQ90001
HP	Thinkjet 2225C	Printer	2714540166	DS16XU2225

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Cabling and Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Laptop serial	Palm	Multiconductor	Shieleded	1.5
Laptop Parallel	Printer	Multiconductor	Shieleded	1.5
Laptop Power in	AC adapter	2 wire	Unshielded	1
AC Adapter	AC Mains	2 wire	Unshielded	1

EUT Operation During Emissions

The radio was transmitting at full power on the specified channels with a 100 % duty cycle and at a data rates from 1 to 54 Mb/s. The channels were selected since they are at the top, near the center and at the bottom of the allocated bands. The radio uses 8-chip complementary code keying (CCK), 11-chip differential quadrature phase shift keying (DQPSK) modulation for 802.11b operation and Orthogonal Frequency Division Multiplexing (OFDM) for 802.11a and 802.11g operation.

Note: During digital device tests, scrolling H characters were displayed in a window on the laptop display and the radio was set to the channel and data rate that produced the highest output power.

The Card Bus was transmitting on either the low, middle or high channel



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Radiated Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 2/11/2003
 Test Engineer: jmartinez
 Test Location: SVOATS #4

Config. Used: 1
 Config Change: None
 EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing.

On the OATS, the measurement antenna was located 3 meters from the EUT for the measurement range 30 - 1000 MHz.

Note, **preliminary** testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. **Maximized** testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions: Temperature: 19°C
 Rel. Humidity: 36%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	RE, 30 - 1000MHz - Maximized Emissions	FCC B	Pass	-3.7dB @ 153.300MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.



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Contact: Dave Boldy	Proj Eng: Juan Martinez
Spec: FCC 15.247, 15.401	Class: DSSS / UNII

Run #1: Preliminary Radiated Emissions, 30-1000 MHz

Frequency MHz	Level dB μ V/m	Pol v/h	FCC B		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
153.300	39.8	h	43.5	-3.7	QP	360	401.0	
63.984	24.7	v	40.0	-15.3	QP	106	102.0	
167.980	21.4	v	43.5	-22.1	QP	191	90.0	
239.996	22	h	46.0	-24.0	QP	120	131.0	
138.100	19.3	v	43.5	-24.2	QP	152	89.0	
138.100	18.6	h	43.5	-24.9	QP	291	248.0	
239.996	20.2	v	46.0	-25.8	QP	227	90.0	
63.984	11.2	h	40.0	-28.8	QP	351	222.0	
167.980	21	h	43.5	-23.3	QP	166	201	

Note 1:	Add note here
Note 2:	

Run #2: Maximized Readings From Run #1

Frequency MHz	Level dB μ V/m	Pol v/h	FCC B		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
153.300	39.8	h	43.5	-3.7	QP	360	4.0	
63.984	24.7	v	40.0	-15.3	QP	106	1.0	
167.980	21.4	v	43.5	-22.1	QP	191	1.0	
167.980	21	h	43.5	-18.8	QP	166	2.0	
239.996	22	h	46.0	-24.0	QP	120	1.3	
138.100	19.3	v	43.5	-24.2	QP	152	1.0	



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Contact: Dave Boldy	
Spec: FCC 15.247, 15.401	Class: DSSS / UNII

Conducted Emissions - Power Ports

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 2/11/2003
Test Engineer: jgonzalez
Test Location: CCA #1

Config. Used: 1
Config Change: None
EUT Voltage: Refer to individual run

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table, 40 cm from a vertical coupling plane and 80cm from the LISN. A second LISN was used for all local support equipment.

Ambient Conditions: Temperature: 19°C
Rel. Humidity: 36%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power 120V/60Hz	EN55022 B	Pass	-2.7dB @ 0.623MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.



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Spec: FCC 15.247, 15.401	Class: DSSS / UNII

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz

Frequency MHz	Level dB μ V	AC Line	EN55022 B		Detector QP/Ave	Comments
			Limit	Margin		
0.6234	43.3	Neutra	46	-2.7	AV	
0.6235	41.6	Line 1	46	-4.4	AV	
12.7831	43.8	Line 1	50	-6.2	AV	
0.2077	47	Neutra	53.4	-6.4	AV	
0.2077	46.9	Line 1	53.4	-6.5	AV	
14.2376	43.2	Neutra	50	-6.8	AV	
0.2077	52.3	Line 1	63.4	-11.1	QP	
0.2077	51.5	Neutra	63.4	-11.9	QP	
0.6234	42.5	Neutra	56	-13.5	QP	
12.7831	45.6	Line 1	60	-14.4	QP	
0.6235	41	Line 1	56	-15	QP	
14.2376	44.5	Neutra	60	-15.5	QP	



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Contact: Dave Boldy	Proj Eng: Juan Martinez
Spec: FCC 15.247, 15.401	Class: N/A

Radiated Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 2/10/2003	Config. Used: 1
Test Engineer: Chris Byleckie	Config Change:
Test Location: SVOATS #4	EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators used.

Ambient Conditions: Temperature: 16°C
 Rel. Humidity: 44%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Output Power	15.401(a)	Pass	21.8 dBm
2a - 2c	RE, 30 - 40,000 MHz - Spurious Emissions In Restricted Bands	15.401(b)	Pass	-8.2dB @ 15543.60 MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.



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	Proj Eng: Juan Martinez
Contact: Dave Boldy	
Spec: FCC 15.247, 15.401	Class: N/A

Run #1: Output Power Data Rate 54Mb/s

The minimum VBW required for power measurements using a spectrum analyzer is 1/T, where T is the pulse transmission rate.

Pulse Transmission Rate: 4.0 uS
Minimum VBW: 250 kHz
VBW Used: 300 kHz

Antenna Gain: 4.9 dBi

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm) (note 3)	Comments
36	5180	15.0	17.0	
52	5260	21.5	24.0	
64	5320	21.8	24.0	



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Spec: FCC 15.247, 15.401	Class: N/A

Laptop S/N 231905
 Data rate 54 M/bs
 Antenna -Hitachi

Run #2a Radiated Spurious Emissions, 1-40 GHz. Low Channel @ 5180 MHz

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
15543.80	58.1	V	74.0	-15.9	Pk	0	1.0	
15543.60	45.8	V	54.0	-8.2	Avg	0	1.0	
15544.23	58.5	H	74.0	-15.5	Pk	0	1.0	
15544.04	45.8	H	54.0	-8.2	Avg	0	1.0	

Note 1: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Note 2: No emissions visible above the noise floor beyond 16 GHz

Run #2b: Radiated Spurious Emissions, 1-40 GHz. Center Channel @ 5260 MHz

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
15779.47	57.3	H	74.0	-16.7	Pk	0	1.0	
15779.33	44.6	H	54.0	-9.4	Avg	0	1.0	
15783.76	56.9	V	74.0	-17.1	Pk	0	1.0	
15783.51	44.7	V	54.0	-9.3	Avg	0	1.0	

Note 1: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Note 2: No emissions visible above the noise floor beyond 16 GHz



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Spec: FCC 15.247, 15.401	Class: N/A

Run #2c: Radiated Spurious Emissions, 1-40 GHz. High Channel @ 5320 MHz

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247 Limit	Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
10640.05	56.7	H	74.0	-17.3	Pk	0	1.0	
10639.80	43.7	H	54.0	-10.3	Avg	0	1.0	
15960.47	58.1	H	74.0	-15.9	Pk	0	1.0	
15960.28	45.7	H	54.0	-8.3	Avg	0	1.0	
10640.01	61.0	H	74.0	-13.0	Pk	0	1.0	
10639.61	46.1	H	54.0	-7.9	Avg	0	1.0	
15960.58	58.1	H	74.0	-15.9	Pk	0	1.0	
15960.36	45.7	H	54.0	-8.3	Avg	0	1.0	

Note 1: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Note 2: No emissions visible above the noise floor beyond 16 GHz



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Spec: FCC 15.247, 15.401	Class: N/A

Radiated Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 2/10/2003
 Test Engineer: Chris Byleckie
 Test Location: SVOATS #4

Config. Used: 1
 Config Change: None
 EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators used.

Ambient Conditions: Temperature: 16°C
 Rel. Humidity: 44%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Output Power	15.247(b)	Pass	19.8 dBm
2a-2c	RE, 30 - 26,000 MHz - Spurious Emissions In	FCC Part 15.209 / 15.247(c)	Pass	-1.6dB @ 14471.41 MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.



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	Proj Eng: Juan Martinez
Contact: Dave Boldy	
Spec: FCC 15.247, 15.401	Class: N/A

Run #1: Output Power

Antenna Gain: 2.39 dBi

Channel	Frequency (MHz)	Output Power	Graph reference #
Low	2412	19.4	none
Mid	2437	19.8	none
High	2462	19.5	none



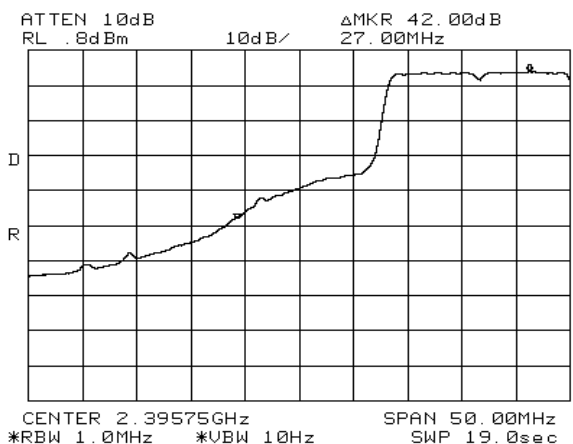
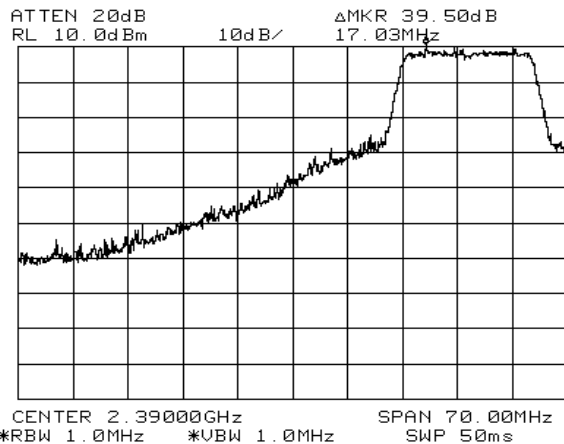
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Contact: Dave Boldy	Proj Eng: Juan Martinez
Spec: FCC 15.247, 15.401	Class: N/A

Laptop S/N 22500
 Data rate 54 M/bs
 Antenna -Wistron NeWeb
Run #2a: Radiated Spurious Emissions, 1-26.5GHz. Low Channel @ 2412 MHz

Fundamental Field Strength Measurements used for bandedge field strength calculations

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2416.900	106.8	H	-	-	Pk	-	-	
2416.427	91.0	H	-	-	Avg	-	-	
2416.598	104.1	V	-	-	Pk	-	-	
2415.259	88.3	V	-	-	Avg	-	-	



Band Edge Field Strength Calculations (54 Mb/s)

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2390.0	67.3	v	74.0	-6.7	Pk	-	-	Note 1
2390.0	49.0	v	54.0	-5.0	Avg	-	-	Note 1
2390.0	64.6	h	74.0	-9.4	Pk	-	-	Note 1
2390.0	46.3	h	54.0	-7.7	Avg	-	-	Note 1

Note 1: EUT operating on the lowest channel available in the 2.39 - 2.412 GHz band. Signal level calculated using the relative measurements in plots (39.5dBc for peak and 42dBc for average) applied to the highest peak and average field strength measurements of the fundamental signal level.



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Spec: FCC 15.247, 15.401	Class: N/A

Run #2a continued

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
4823.708	46.8	H	74.0	-27.2	Pk	0	1.0	
4823.634	33.9	H	54.0	-20.1	Avg	0	1.0	
12060.50	56.1	H	74.0	-17.9	Pk	0	1.0	
12059.66	43.1	H	54.0	-10.9	Avg	0	1.0	
14471.75	64.9	H	74.0	-9.1	Pk	0	1.0	
14471.34	52.4	H	54.0	-1.6	Avg	0	1.0	
4824.612	47.1	V	74.0	-26.9	Pk	0	1.0	
4823.042	33.7	V	54.0	-20.3	Avg	0	1.0	
12059.97	56.6	V	74.0	-17.4	Pk	0	1.0	
12059.89	43.1	V	54.0	-10.9	Avg	0	1.0	
14471.70	64.7	V	74.0	-9.3	Pk	0	1.0	
14471.44	52.4	V	54.0	-1.6	Avg	0	1.0	

Note 1:	For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.
Note 2:	No emissions visible above the noise floor beyond 15 GHz



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Contact: Dave Boldy	Proj Eng: Juan Martinez
Spec: FCC 15.247, 15.401	Class: N/A

Run #2b: Radiated Spurious Emissions, 1-26.5 GHz. Center Channel @ 2432 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4865.575	46.8	H	74.0	-27.2	Pk	0	1.0	
4864.058	33.7	H	54.0	-20.3	Avg	0	1.0	
7297.790	54.2	H	74.0	-19.8	Pk	0	1.0	
7297.544	41.3	H	54.0	-12.7	Avg	0	1.0	
12162.96	56.3	H	74.0	-17.7	Pk	0	1.0	
12162.71	42.9	H	54.0	-11.1	Avg	0	1.0	
4865.288	47.0	V	74.0	-27.0	Pk	0	1.0	
4864.780	33.6	V	54.0	-20.4	Avg	0	1.0	
7297.180	53.8	V	74.0	-20.2	Pk	0	1.0	
7296.948	41.3	V	54.0	-12.7	Avg	0	1.0	
12161.93	56.4	V	74.0	-17.6	Pk	0	1.0	
12161.69	42.8	V	54.0	-11.2	Avg	0	1.0	

Note 1: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Note 2: No emissions visible above the noise floor beyond 13 GHz



EMC Test Data

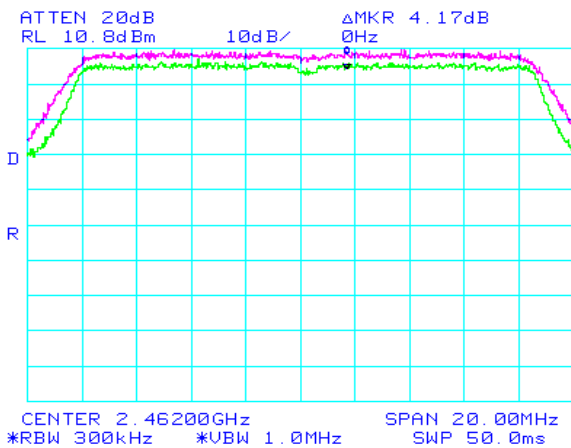
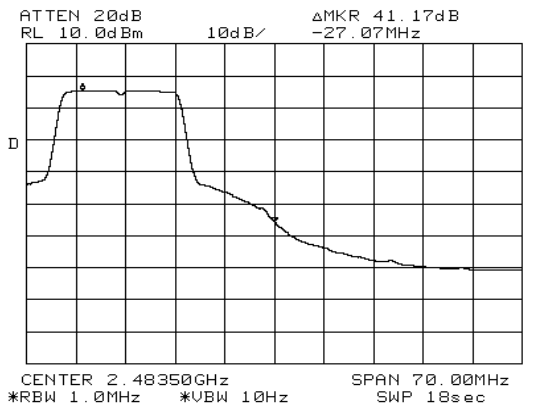
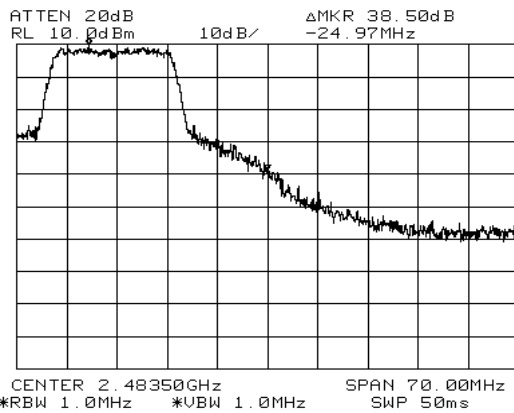
Client: Broadcom	Job Number: J50065
Model: BCM94309MP in PP02X Laptop	T-Log Number: T50131
Contact: Dave Boldy	Proj Eng: Juan Martinez
Spec: FCC 15.247, 15.401	Class: N/A

Run #2c: Radiated Spurious Emissions, 1-26.5 GHz. High Channel @ 2462 MHz

Fundamental Field Strength Measurements used for bandedge field strength calculations

54m/bs

Frequency MHz	Level dBμV/m	Pol v/h	15.209 / 15.407		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2466.841	105.1	H	-	-	Pk	-	-	
2466.888	90.2	H	-	-	Avg	-	-	
2466.700	104.4	V	-	-	Pk	-	-	
2466.549	89.7	V	-	-	Avg	-	-	





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Spec: FCC 15.247, 15.401	Class: N/A

Band Edge Field Strength Calculations (54 Mb/s)

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.407		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2483.5	66.6	v	74.0	-7.4	Pk	-	-	Note 1
2483.5	49.0	v	54.0	-5.0	Avg	-	-	Note 1
2483.5	65.9	h	74.0	-8.1	Pk	-	-	Note 1
2483.5	48.5	h	54.0	-5.5	Avg	-	-	Note 1

Note 1: EUT operating on highest channel available in the 2.462 - 2.4835 GHz band. Signal level calculated using the relative measurements in plots (38.5 dBc for peak and 41.17 dBc for average) applied to the highest peak and average field strength measurements of the fundamental signal level.

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
4924.027	46.5	H	74.0	-27.5	Pk	0	1.0	
4923.132	34.0	H	54.0	-20.0	Avg	0	1.0	
7386.010	54.1	H	74.0	-19.9	Pk	0	1.0	
7385.919	41.4	H	54.0	-12.6	Avg	0	1.0	
12310.66	56.7	H	74.0	-17.3	Pk	0	1.0	
12310.43	43.5	H	54.0	-10.5	Avg	0	1.0	
4924.040	46.3	V	74.0	-27.7	Pk	0	1.0	
4923.797	33.8	V	54.0	-20.2	Avg	0	1.0	
7386.223	54.6	V	74.0	-19.4	Pk	0	1.0	
7386.034	41.4	V	54.0	-12.6	Avg	0	1.0	
12310.30	56.3	V	74.0	-17.7	Pk	0	1.0	
12310.07	43.5	V	54.0	-10.5	Avg	0	1.0	

Note 1: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

Note 2: No emissions visible above the noise floor beyond 13 GHz

Radiated Emissions, 1 - 40GHz, 10-Feb-03

Engineer: Chris

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Assett #</u>	<u>Cal interval</u>	<u>Last Calibrated</u>	<u>Cal Due</u>
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	868	12	3/11/2002	3/11/2003
Hewlett Packard	Spectrum Analyzer 30Hz - 40 GHz	8564E (84125C)	1148	12	4/2/2002	4/2/2003
Hewlett Packard	Spectrum Analyzer 9KHz - 26.5GHz, non programable	8563E	284	12	3/21/2002	3/21/2003
Miteq	Preamplifier, 1-18GHz	AFS44	1346	12	1/6/2003	1/6/2004
Narda West	High Pass Filter 4.0 GHz,	60583 HXF370	247	12	3/14/2002	3/14/2003
Hewlett Packard	High Pass filter, 8.2GHz	P/N 84300-80039	1156	12	3/25/2002	2/25/2003