



Appendix B: Emission Test Results

Testing Laboratory: Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134, USA

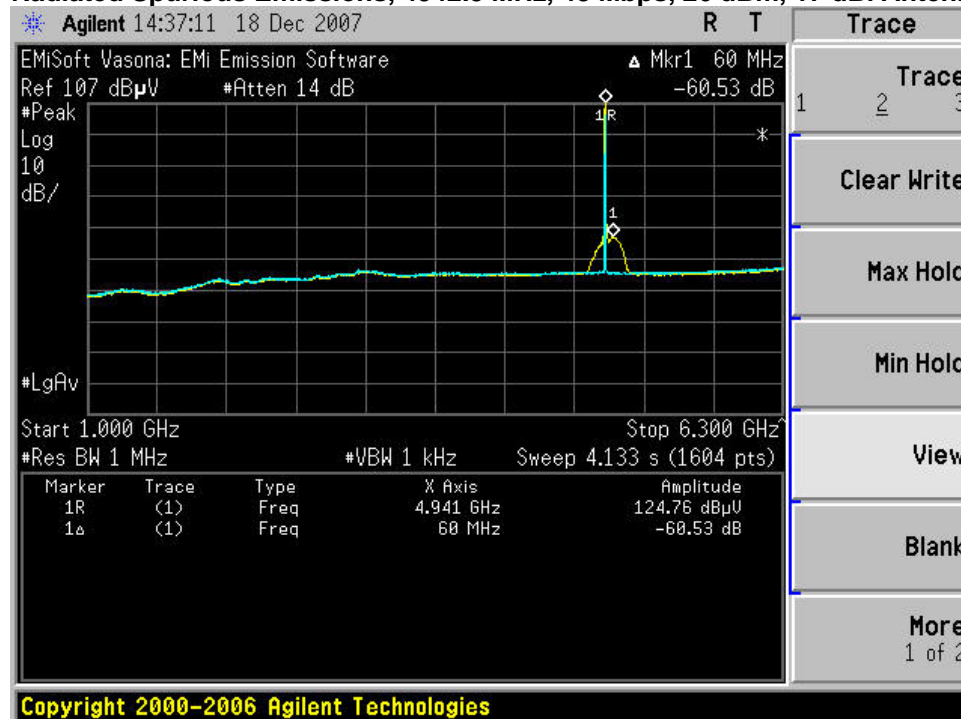
Radiated Transmitter Spurious Emissions

There were no measurable emissions above 18GHz for any of the channel/antenna combinations. The data is a worst case representation of all configurations. The limit for any out of band spurs is 50dB below the peak of the carrier.

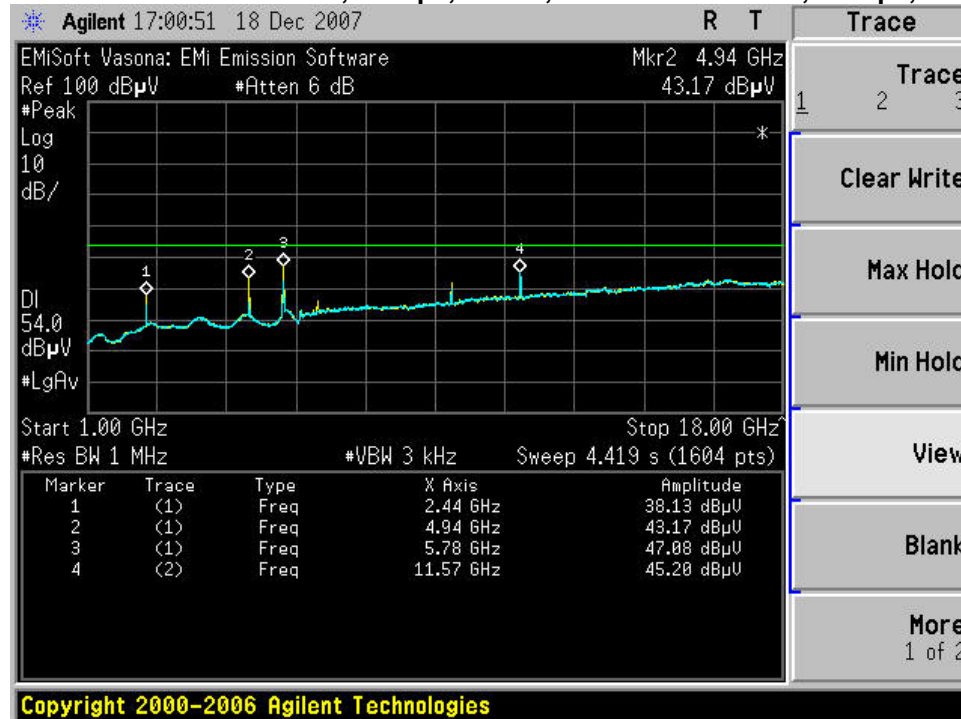
Frequency (MHz)	Channel Bandwidth (MHz)	Peak (dBuV/m)	Delta (dBc)	Limit (dBc)	Margin (dB)
4942.5	5	124.76			
5002.5		64.23	-60.53	-50	10.53
4967.5	5	120.79			
4997.5		61.36	-59.43	-50	9.43
4987.5	5	125.48			
5004.5		65.14	-60.34	-50	10.34
4945	10	121.59			
4988		63.59	-58.00	-50	8.00
4965	10	121.59			
5018		63.89	-57.70	-50	7.70
4985	10	121.65			
5021		63.22	-58.43	-50	8.43
4950	20	118.09			
5006		64.03	-54.06	-50	4.06
4965	20	117.84			
5015		62.96	-54.88	-50	4.88
4980	20	117.74			
5020		64.20	-53.54	-50	3.54



Radiated Spurious Emissions, 4942.5 MHz, 48 Mbps, 26 dBm, 17 dBi Antenna



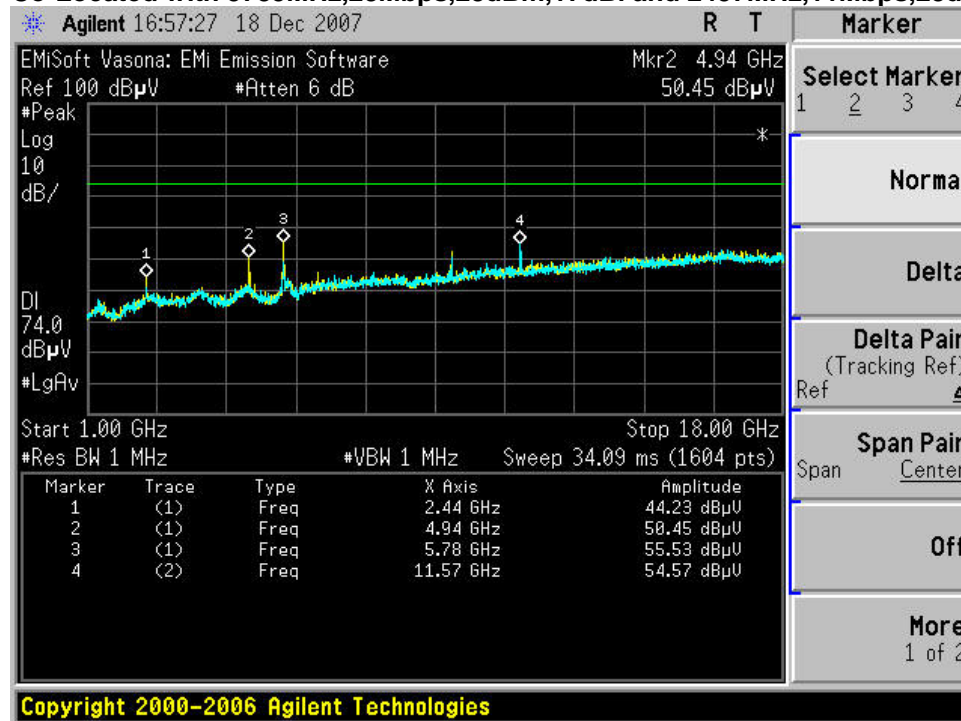
**Radiated Spurious Emissions, 4942.5 MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, Avg**



Radiated Spurious Emissions, 4942.5 MHz, 48 Mbps, 26 dBm, 17 dBi Antenna

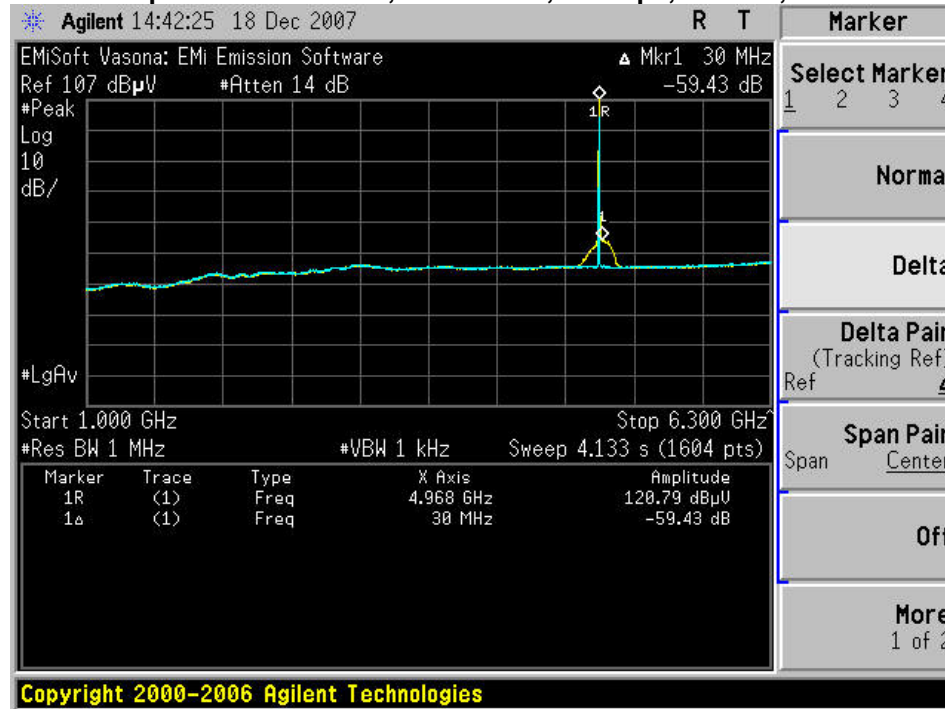


Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, PK

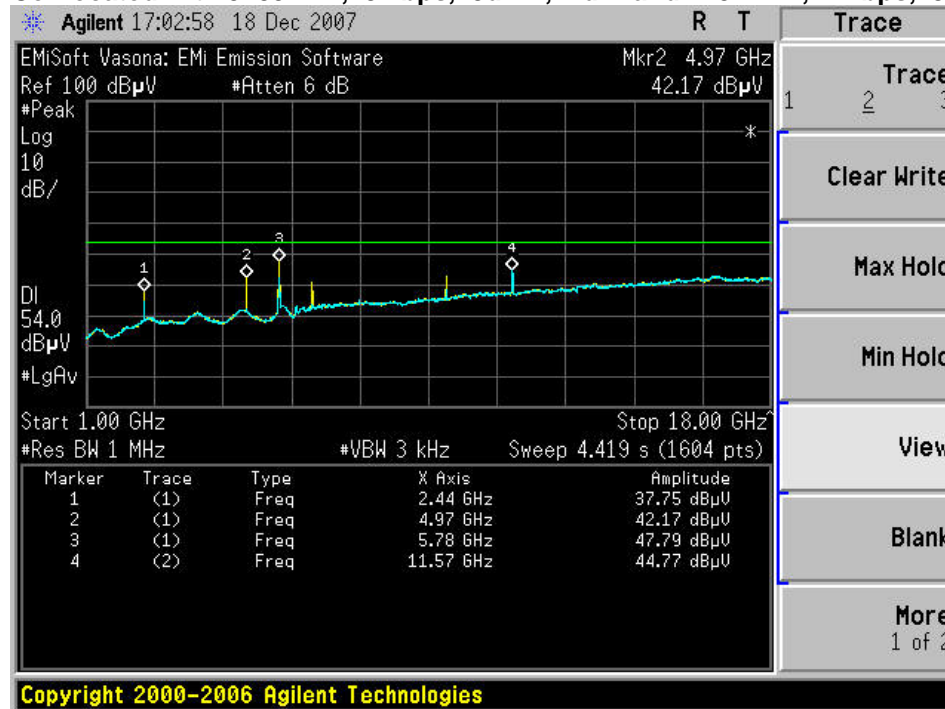




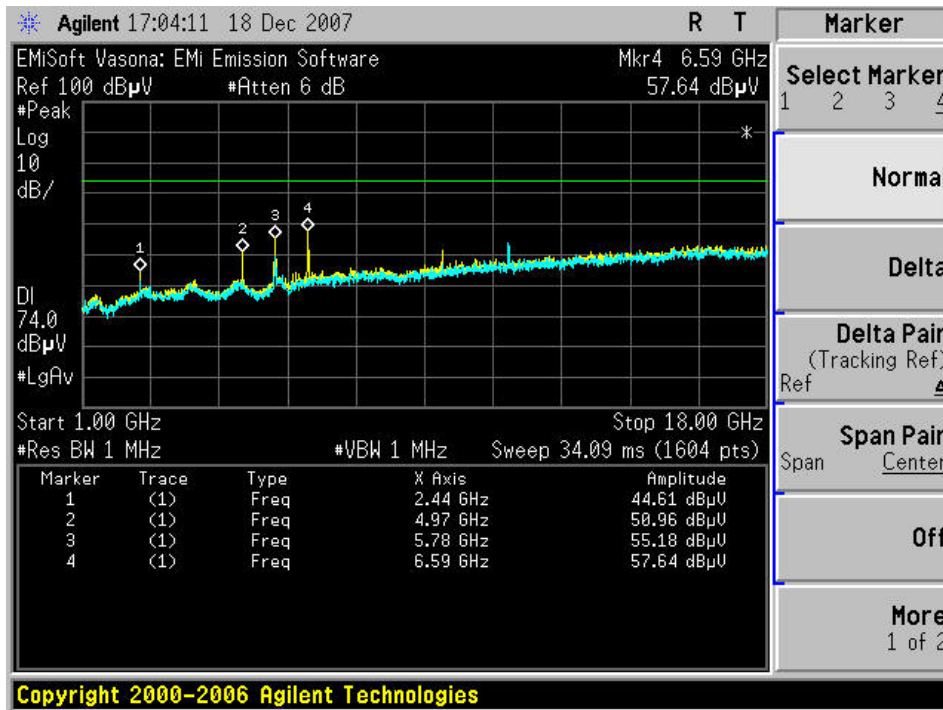
Radiated Spurious Emissions, 4967.5 MHz, 48 Mbps, 26 dBm, 17 dBi



**Radiated Spurious Emissions, 4967.5 MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
 Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, Avg**

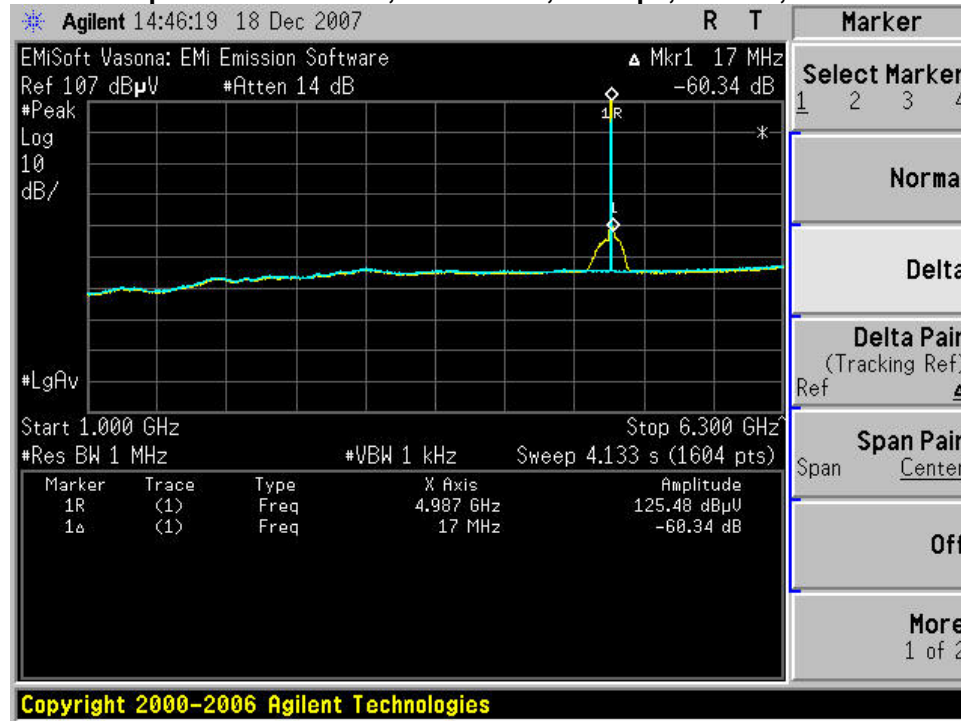


**Radiated Spurious Emissions, 4967.5 MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
 Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi,PK**

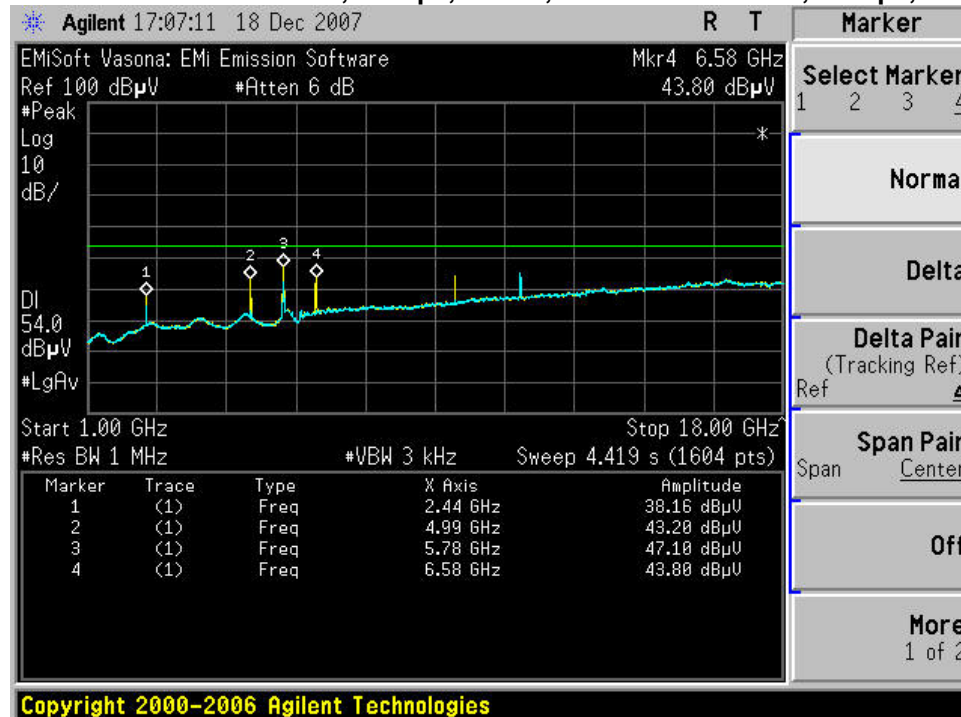




Radiated Spurious Emissions, 4987.5 MHz, 48 Mbps, 26 dBm, 17 dBi

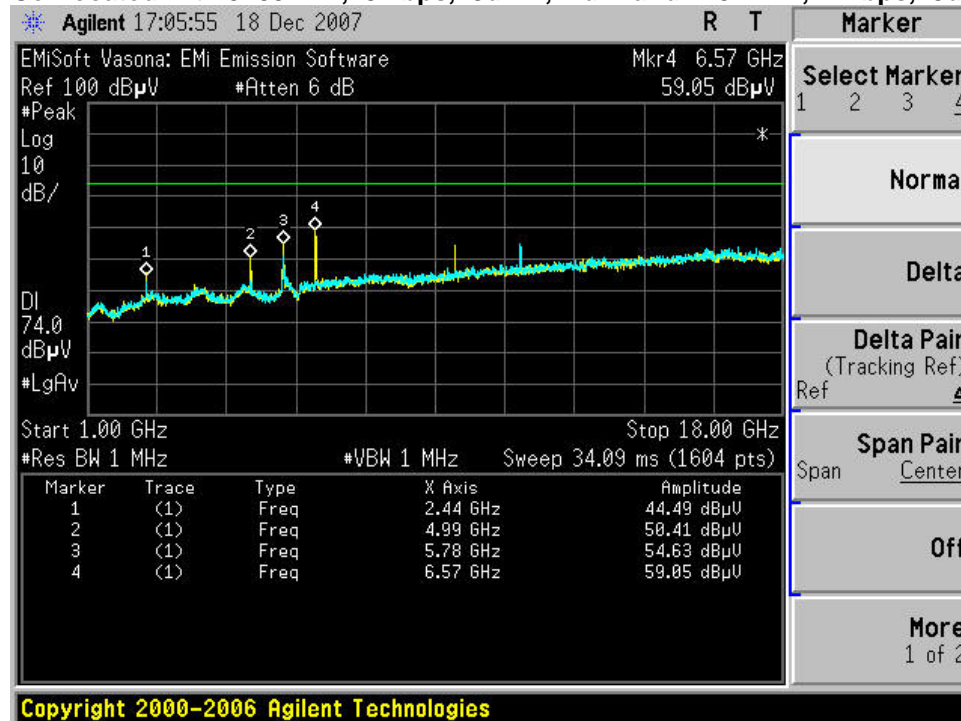


Radiated Spurious Emissions, 4987.5 MHz, 48 Mbps, 26 dBm, 17 dBi Antenna Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, Avg



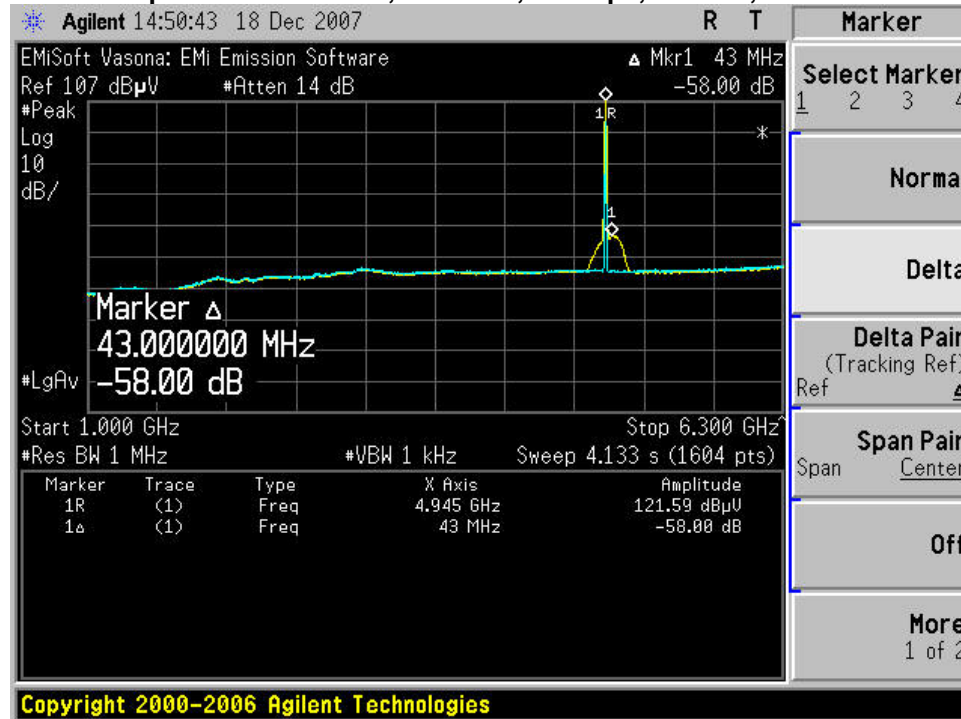


**Radiated Spurious Emissions, 4987.5 MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, PK**

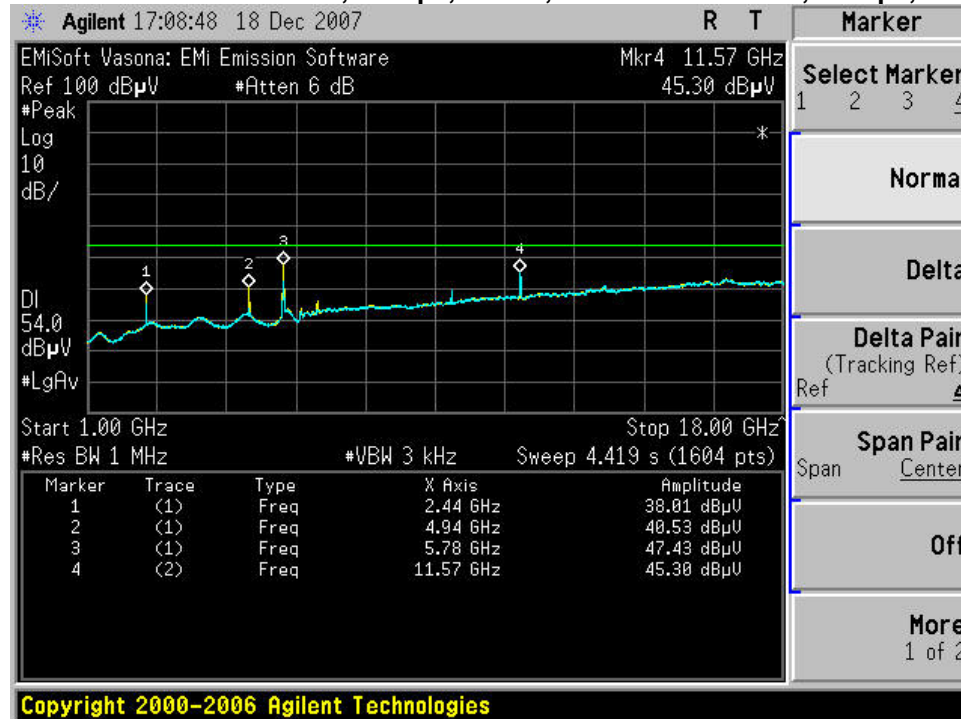




Radiated Spurious Emissions, 4945MHz, 48 Mbps, 26 dBm, 17 dBi Antenna

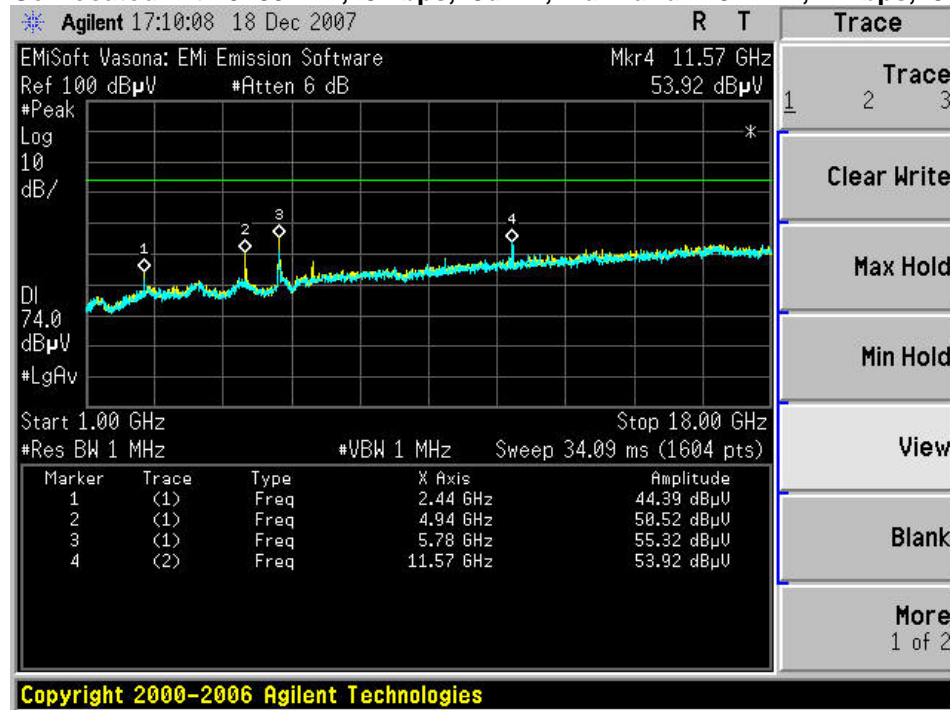


**Radiated Spurious Emissions, 4945MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, Avg**



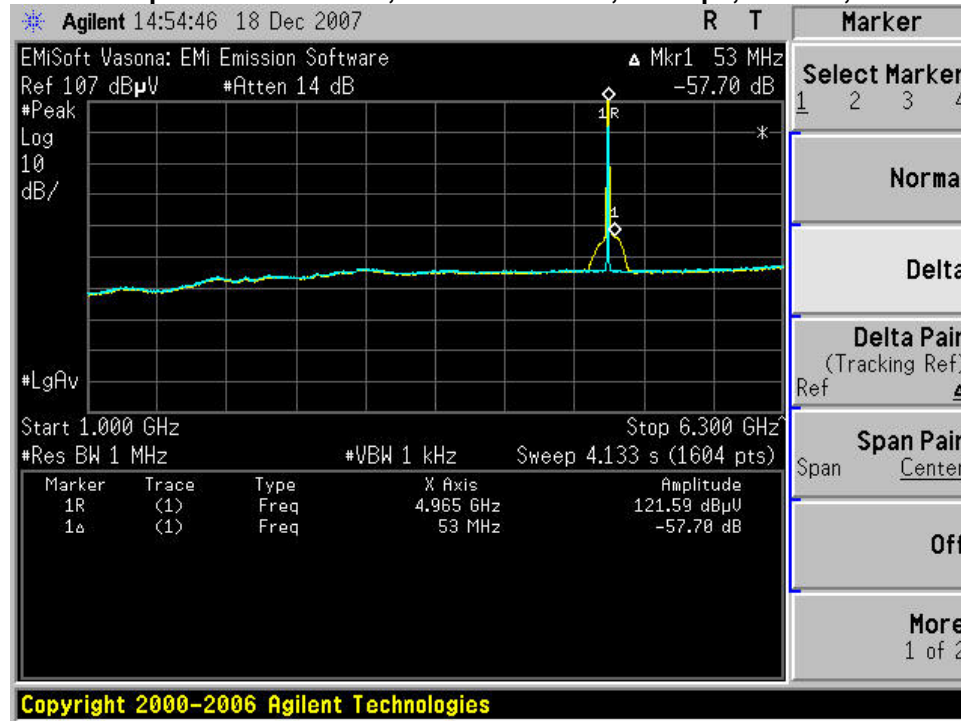


**Radiated Spurious Emissions, 4945MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, Pk**

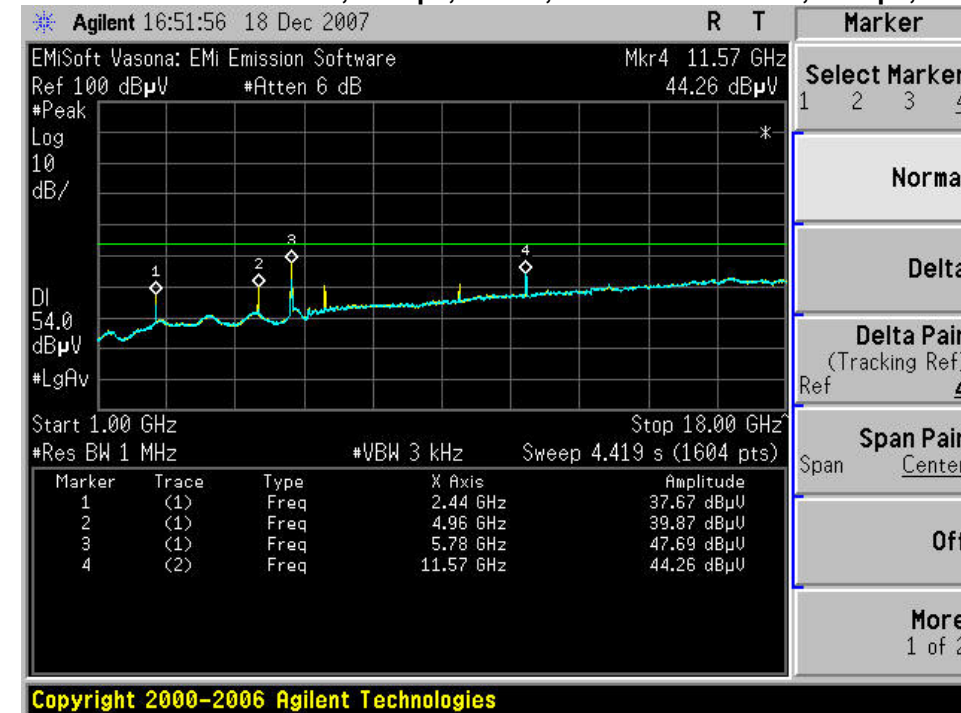




Radiated Spurious Emissions, 4965MHz-10MHz, 48 Mbps, 26 dBm, 17 dBi Antenna

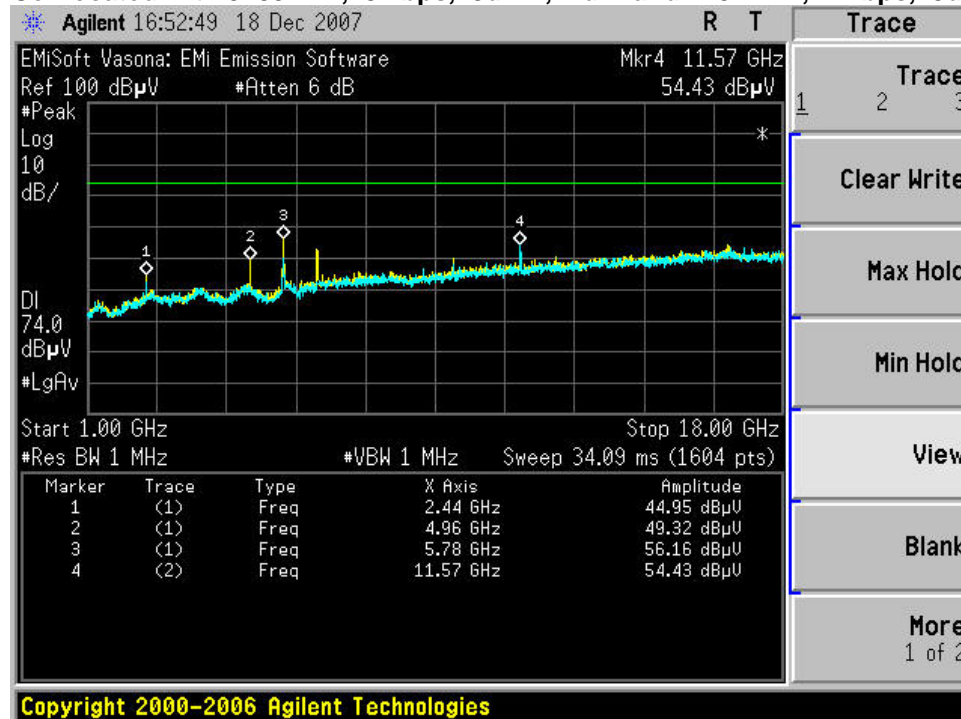


**Radiated Spurious Emissions, 4965MHz-10MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi,AvG**



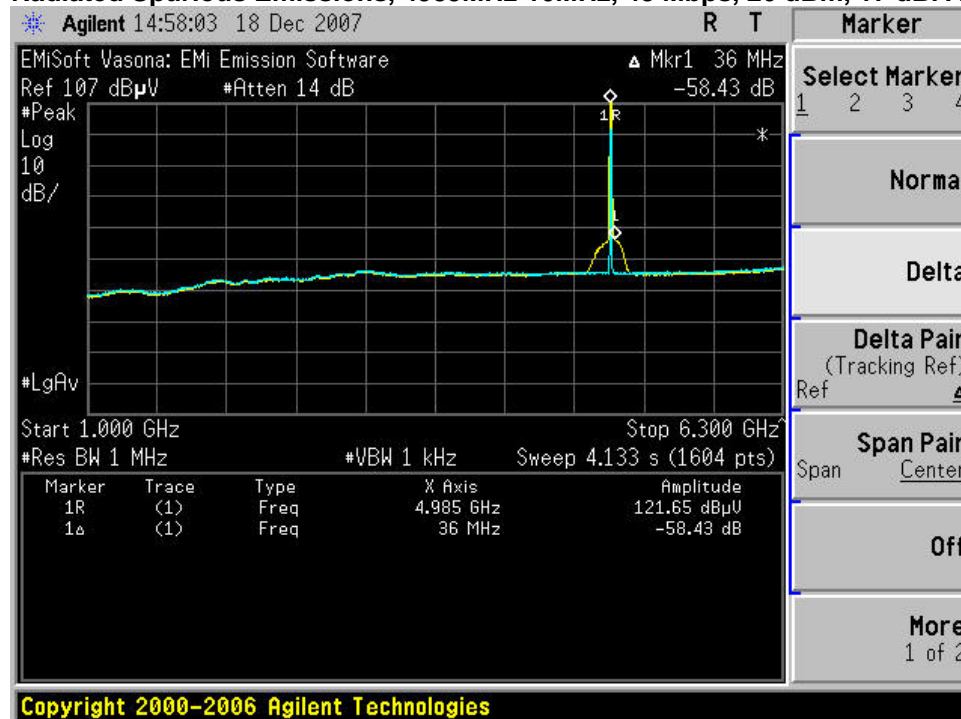


**Radiated Spurious Emissions, 4965MHz-10MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, PK**

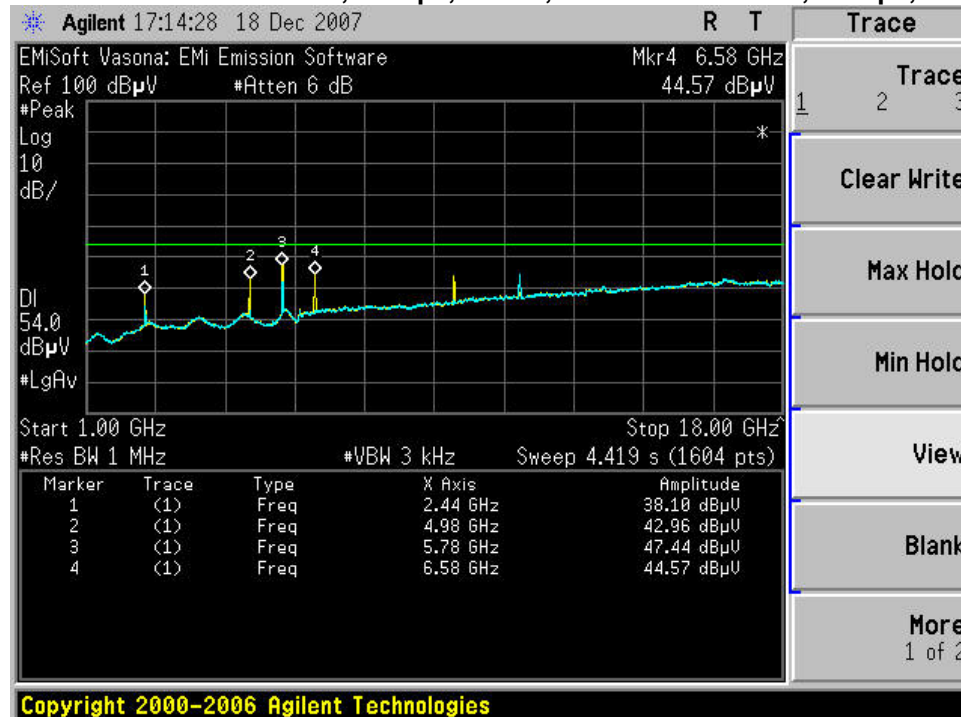




Radiated Spurious Emissions, 4985MHz-10MHz, 48 Mbps, 26 dBm, 17 dBi Antenna

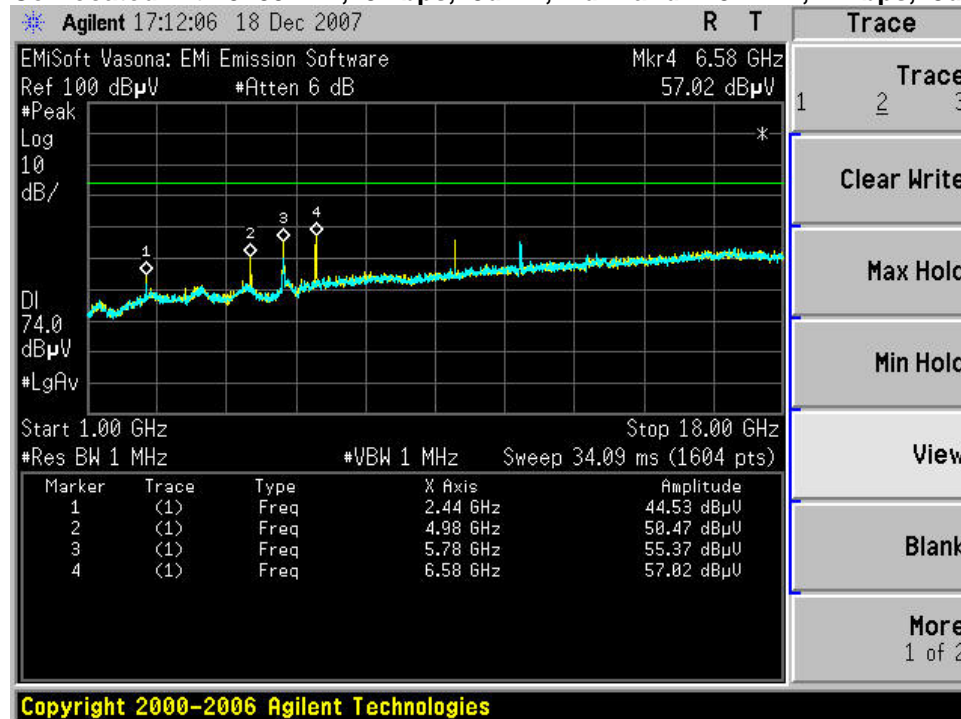


**Radiated Spurious Emissions, 4985MHz-10MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi,AvG**



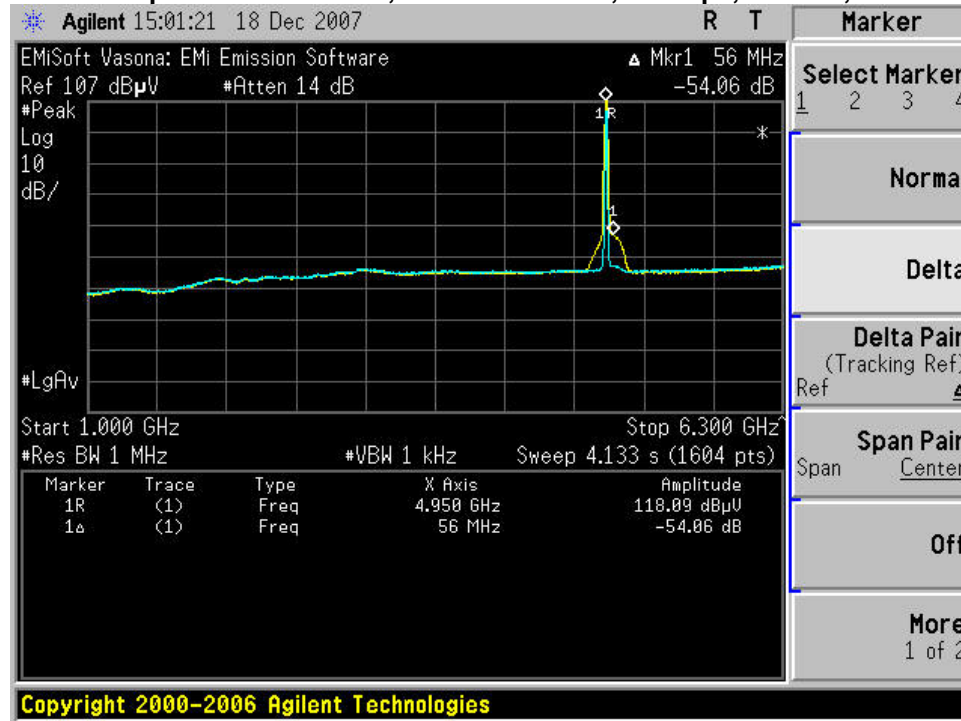


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Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, PK**

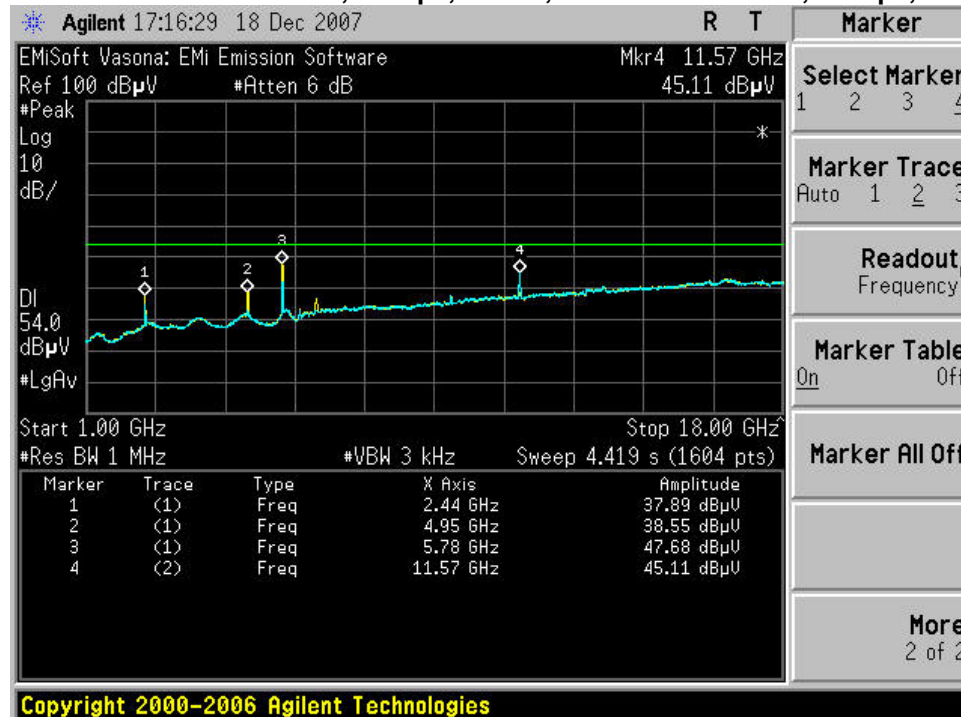




Radiated Spurious Emissions, 4950MHz-20MHz, 48 Mbps, 26 dBm, 17 dBi Antenna

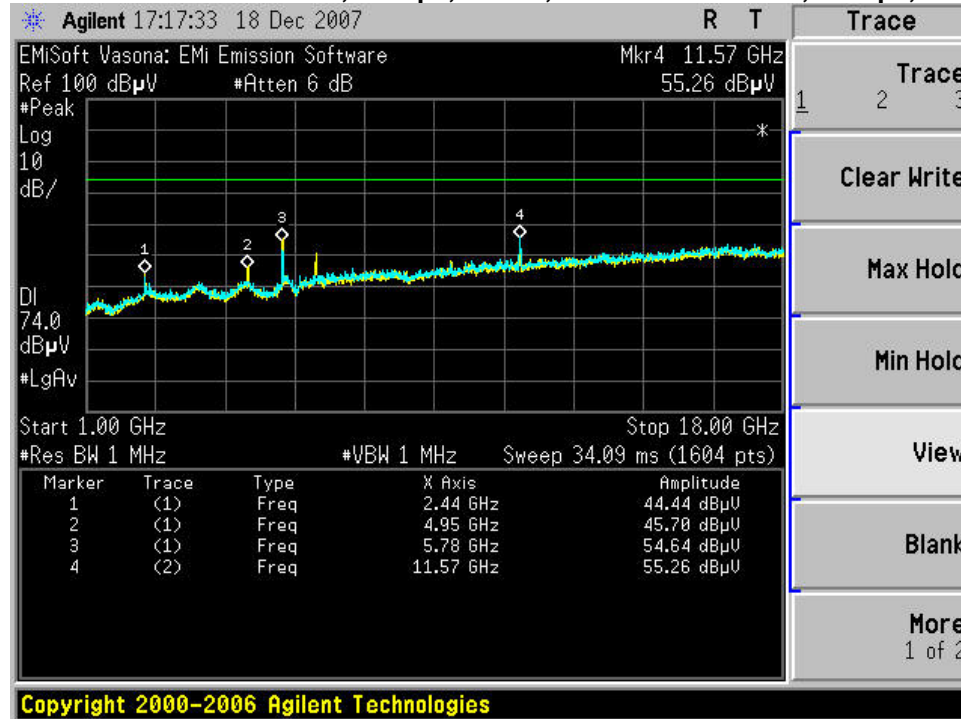


**Radiated Spurious Emissions, 4950MHz-20MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, Avg**



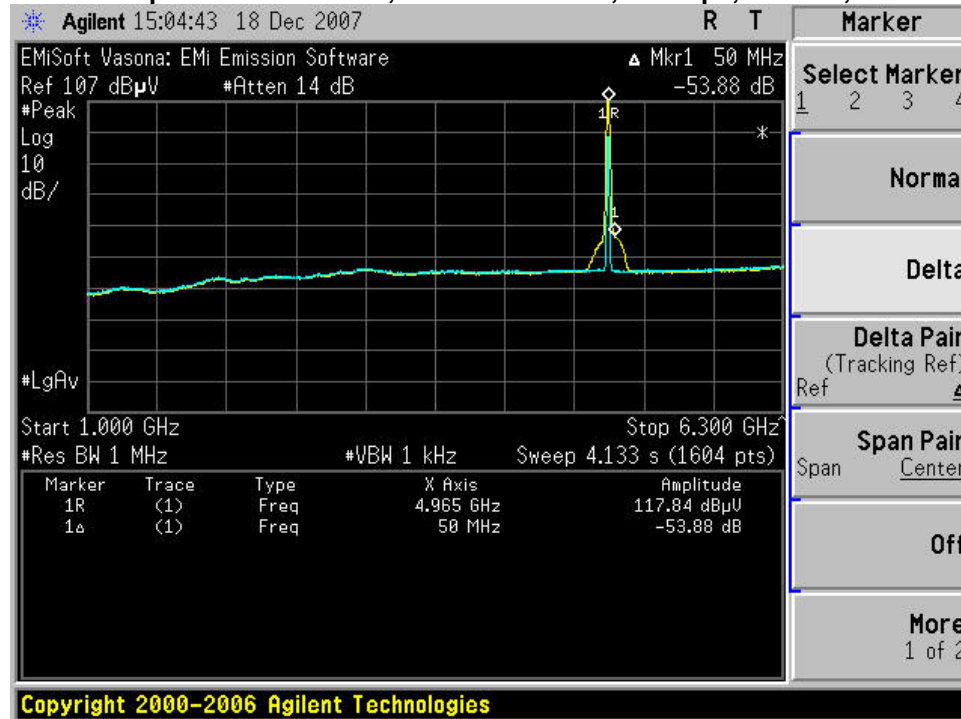


**Radiated Spurious Emissions, 4950MHz-20MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, PK**

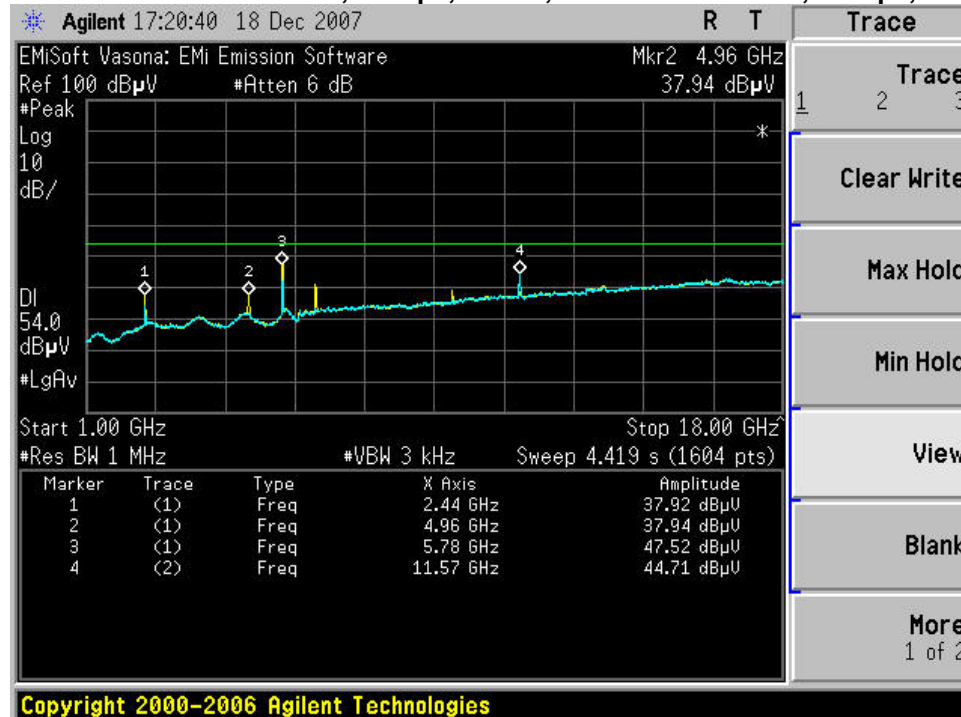




Radiated Spurious Emissions, 4965MHz-20MHz, 48 Mbps, 26 dBm, 17 dBi Antenna

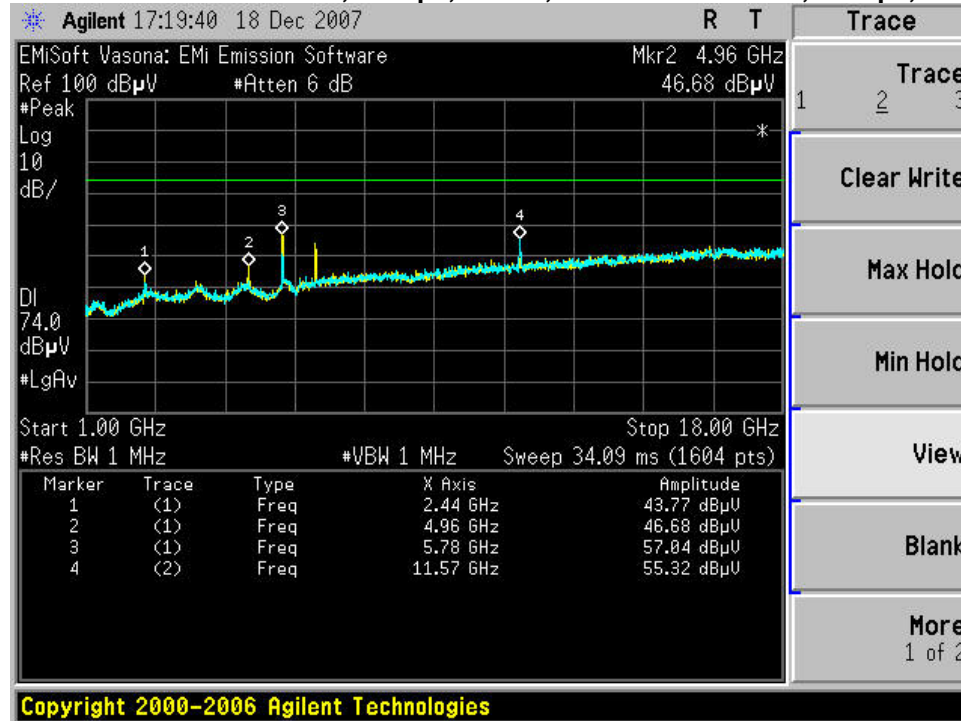


**Radiated Spurious Emissions, 4965MHz-20MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
 Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, Avg**



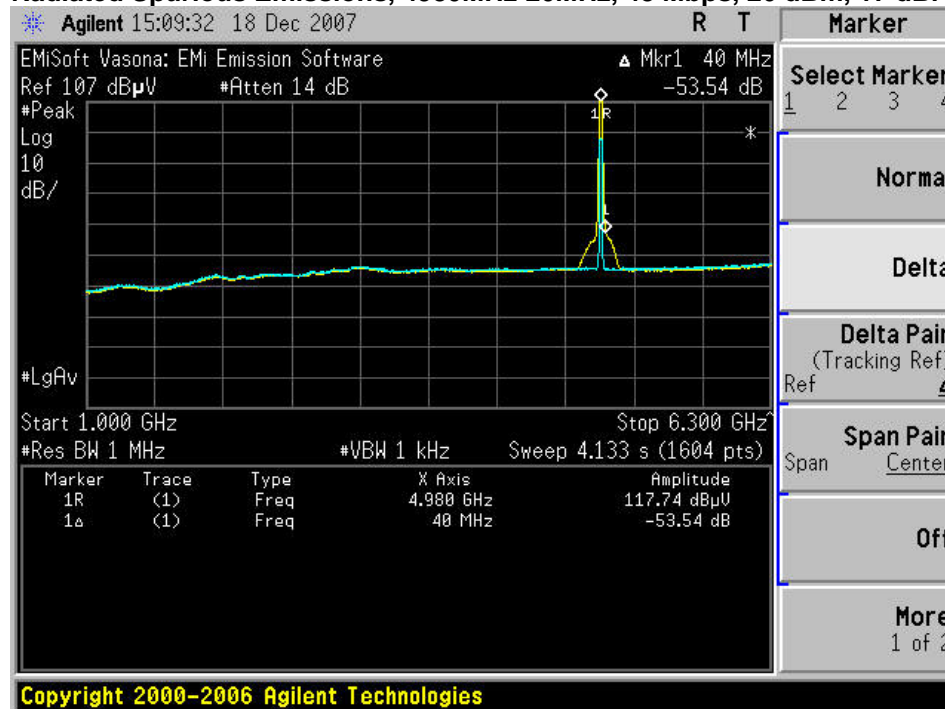


**Radiated Spurious Emissions, 4965MHz-20MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, PK**





Radiated Spurious Emissions, 4980MHz-20MHz, 48 Mbps, 26 dBm, 17 dBi Antenna

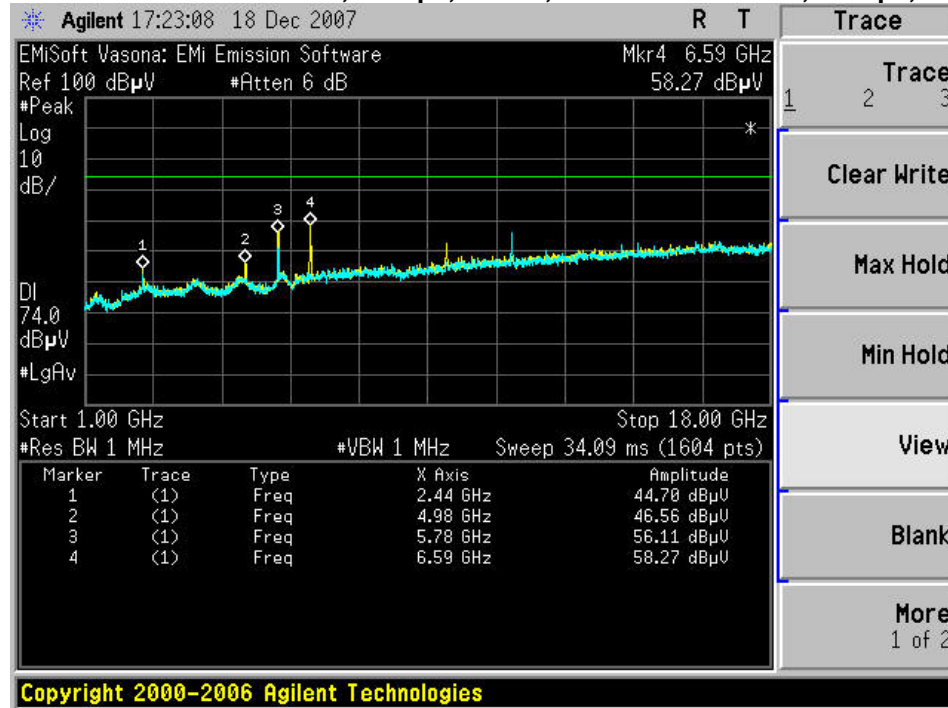


**Radiated Spurious Emissions, 4980MHz-20MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
 Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi,Avg**



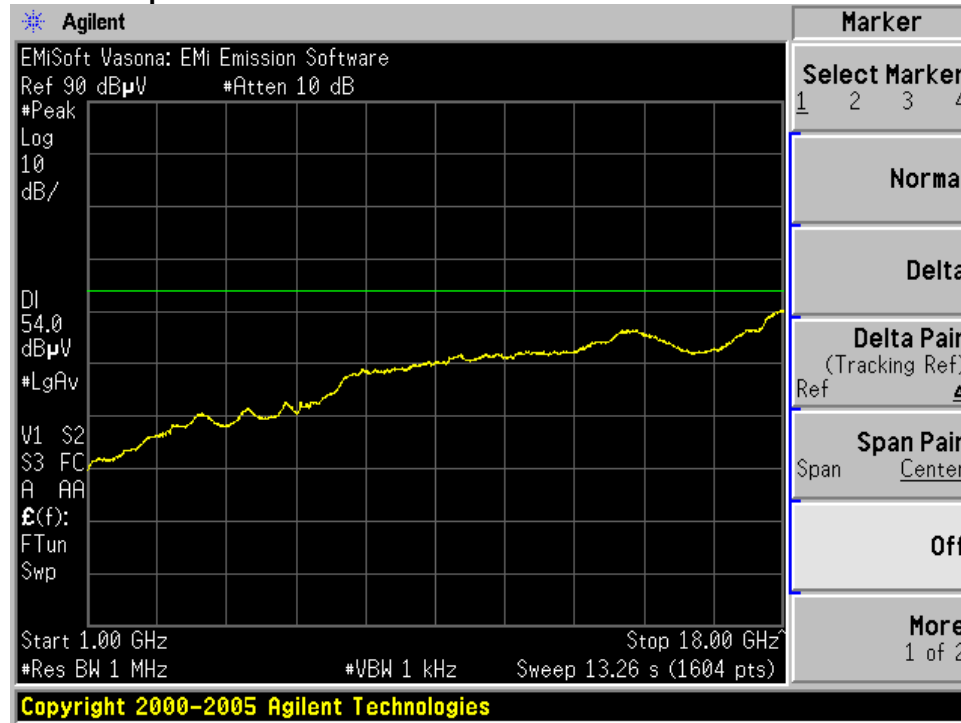


**Radiated Spurious Emissions, 4980MHz-20MHz, 48 Mbps, 26 dBm, 17 dBi Antenna
Co-Located with 5785MHz,28Mbps,28dBm,17dBi and 2437MHz,11Mbps,28dBm,8dBi, PK**





Radiated Spurious Rx Emissions

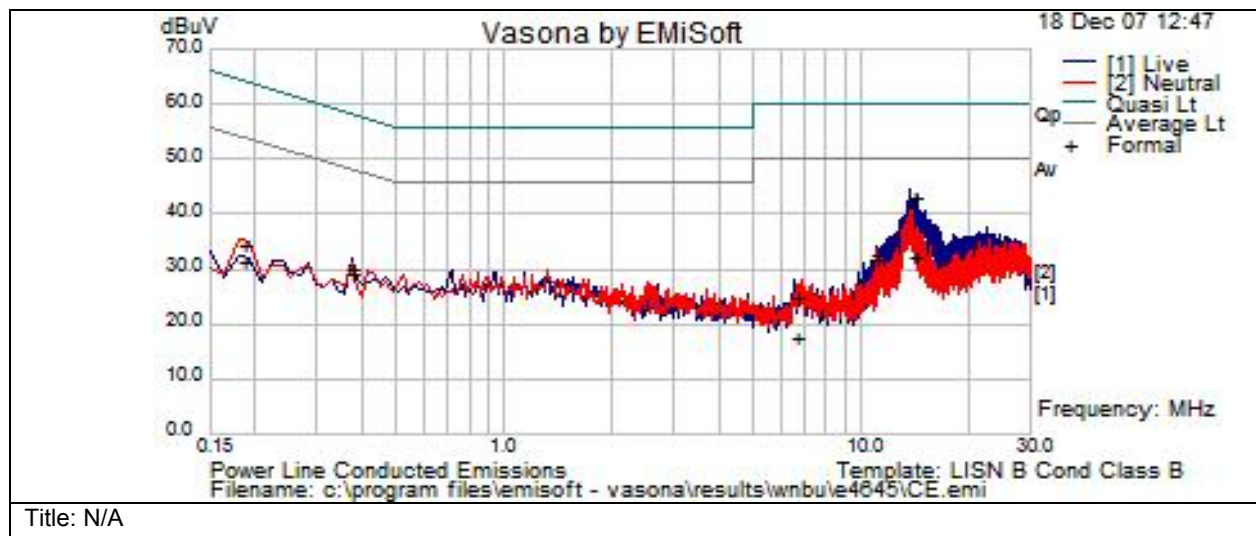




Powerline Conducted emissions

Basic Standard	Applied to	Class	Freq Range	Test Details / Comments
CFR47 Part 15.207 (LP0002 2.2.3, RSS210)	AC Power Line	B	0.150MHz - 30MHz	
Operating Mode	Mode : 1, Continuous			
Power Input	110, 60Hz (+/-20%)			
Overall Result	Pass			
Comments	No further comments			
Deviation	There were no deviations from the specification			

Subtest Number:		Subtest Date: 18-Dec-2007
Engineer	James Nicholson	
Lab Information	Building P, 10m Anechoic	
Subtest Results		
Line Under Test	Power Input	
Transducer	LISN	
Subtest Result	Pass	
Highest Frequency	30.0	
Lowest Frequency	0.15	
Comments on the above Test Results	No further comments	



Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.190706	8.55	20.39	0.25	29.19	Av	N	54.0	-24.8	Pass	
0.190706	11.56	20.39	0.25	32.19	Qp	N	64.0	-31.8	Pass	
0.382342	7.02	20.07	0.16	27.25	Av	L	48.2	-21.0	Pass	
0.382342	7.87	20.07	0.16	28.1	Qp	L	58.2	-30.1	Pass	
6.731672	2.54	20.1	0.18	22.82	Qp	N	60.0	-37.2	Pass	
6.731672	-4.76	20.1	0.18	15.52	Av	N	50.0	-34.5	Pass	
11.139486	9.27	20.16	0.19	29.62	Av	N	50.0	-20.4	Pass	
11.139486	10.35	20.16	0.19	30.7	Qp	N	60.0	-29.3	Pass	
14.327114	9.9	20.23	0.2	30.33	Av	L	50.0	-19.7	Pass	
14.327114	20.5	20.23	0.2	40.93	Qp	L	60.0	-19.1	Pass	
14.327434	20.39	20.23	0.2	40.82	Qp	L	60.0	-19.2	Pass	
14.327434	9.67	20.23	0.2	30.11	Av	L	50.0	-19.9	Pass	

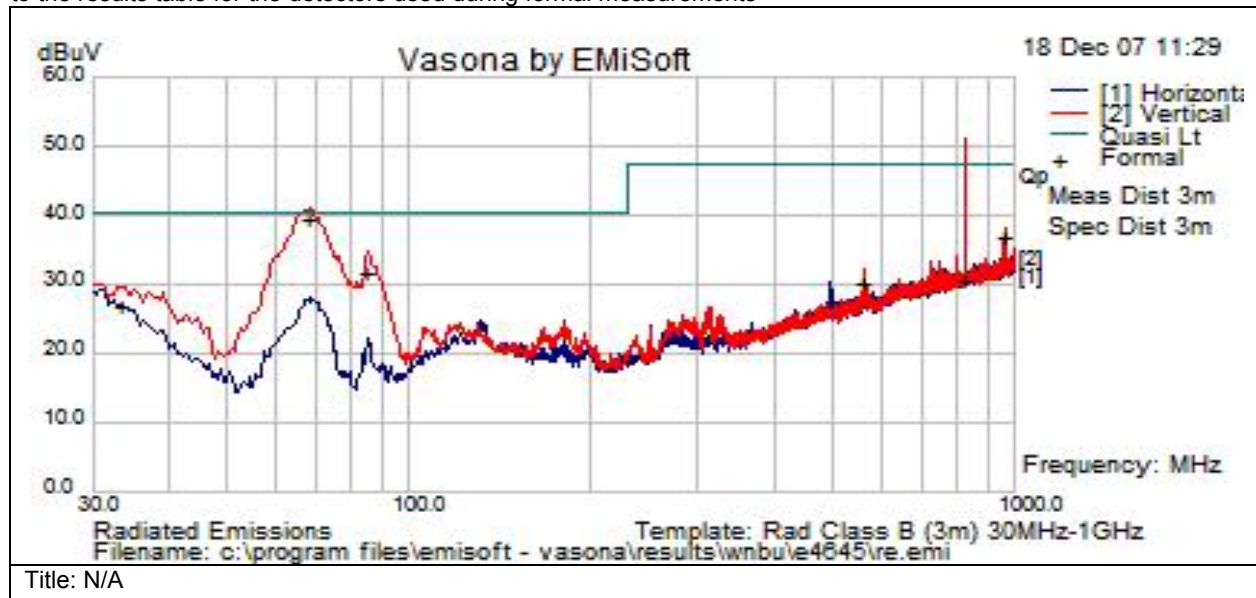


Unintentional Radiated emissions

Subtest Date: 18-Dec-2007	
Engineer	James Nicholson
Lab Information	Building P, 10m Anechoic
Subtest Results	
Subtest Title	RE
Subtest Result	Pass
Highest Frequency	1000.0
Lowest Frequency	30.0
Comments on the above Test Results	No further comments

Graphical Test Results

Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
33.487	6.4	0.45	18.21	25.05	Qp	V	100	106	40.5	-15.45	0	
68.271	29.35	0.64	7.83	37.81	Qp	V	120	88	40.5	-2.69	0	
85.413	21.97	0.72	7.23	29.93	Qp	V	162	126	40.5	-10.57	0	
563.993	8.13	1.87	18.58	28.58	Qp	V	136	350	47.5	-18.92	0	
830.246	4.66	2.29	21.7	28.66	Qp	V	114	187	47.5	-18.84	0	
962.683	9.51	2.46	23	34.98	Qp	V	218	360	47.5	-12.52	0	



Maximum Permissible Exposure (MPE) Calculations

4.9GHz devices are subject to the radio frequency radiation exposure requirements specified in Sec. 1.1307(b), Sec. 2.1091 and Sec. 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

Given

$$E = \sqrt{(30 * P * G) / d} \quad \text{and} \quad S = E^2 / 3770$$

where

E=Field Strength in Volts/meter
 P=Power in Watts
 G=Numeric Antenna Gain
 d=Distance in meters
 S=Power Density in mW/cm²

Combine equations and rearrange the terms to express the distance as a function of the remaining variables:

$$d = \sqrt{((30 * P * G) / (3770 * S))}$$

Changing to units of power in mW and distance in cm, using:

$$P(\text{mW}) = P(\text{W}) / 1000 \quad d(\text{cm}) = 100 * d(\text{m})$$

yields

$$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$$

$$d = 0.282 * \sqrt{(P * G / S)}$$

where

d=Distance in cm
 P=Power in mW
 G=Numerica Antenna Gain
 S=Power Density in mW/cm²

Substituting the logarithmic form of power and gain using:

$$P(\text{mW}) = 10^{(P(\text{dBm}) / 10)} \quad G(\text{numeric}) = 10^{(G(\text{dBi}) / 10)}$$

yields

$$d = 0.282 * 10^{((P + G) / 20)} / \sqrt{S} \quad \text{Equation (1)}$$

and

$$s = ((0.282 * 10^{((P + G) / 20)}) / d)^2 \quad \text{Equation (2)}$$

where

d=MPE distance in cm
 P=Power in dBm
 G=Antenna Gain in dBi
 S=Power Density in mW/cm²



Equation (1) and the measured peak power are used to calculate the MPE distance. Note that for mobile or fixed location transmitters such as an access point, the minimum separation distance is 20 cm even if the calculations indicate that the MPE distance may be less.

$S=1\text{mW/cm}^2$ maximum. Using the peak power levels and antenna gains recorded in the test report along with Equation 1 above, the MPE distances are calculated as follows.

Frequency (MHz)	Bit Rate (Mbps)	Power Density (mW/cm ²)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	Limit (cm)	Margin (cm)
4942.5	48	1	24.7	17	34.30	20	-14.30
4967.5	48	1	24.8	17	34.69	20	-14.69
4987.5	48	1	24.7	17	34.30	20	-14.30
4945	48	1	24.8	17	34.69	20	-14.69
4965	48	1	24.9	17	35.10	20	-15.10
4985	48	1	25.0	17	35.50	20	-15.50
4950	48	1	24.8	17	34.69	20	-14.69
4965	48	1	24.9	17	35.10	20	-15.10
4980	48	1	25.0	17	35.50	20	-15.50

MPE Calculations

To maintain compliance, installations will assure a separation distance of at least 50cm.

Using Equation 2, the MPE levels (s) at 20 cm are calculated as follows:

Frequency (MHz)	Bit Rate (Mbps)	MPE Distance (cm)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm ²)	Limit (mW/cm ²)	Margin (mW/cm ²)
4942.5	54	20	24.7	17	2.94	1	-1.94
4967.5	54	20	24.8	17	3.01	1	-2.01
4987.5	54	20	24.7	17	2.94	1	-1.94
4945	54	20	24.8	17	3.01	1	-2.01
4965	54	20	24.9	17	3.08	1	-2.08
4985	54	20	25.0	17	3.15	1	-2.15
4950	54	20	24.8	17	3.01	1	-2.01
4965	54	20	24.9	17	3.08	1	-2.08
4980	54	20	25.0	17	3.15	1	-2.15



Appendix C: Abbreviation Key and Definitions

The following table defines abbreviations used within this test report.

Abbreviation	Description	Abbreviation	Description
EMC	Electro Magnetic Compatibility	°F	Degrees Fahrenheit
EMI	Electro Magnetic Interference	°C	Degrees Celsius
EUT	Equipment Under Test	Temp	Temperature
ITE	Information Technology Equipment	S/N	Serial Number
TAP	Test Assessment Schedule	Qty	Quantity
ESD	Electro Static Discharge	emf	Electromotive force
EFT	Electric Fast Transient	RMS	Root mean square
EDCS	Engineering Document Control System	Qp	Quasi Peak
Config	Configuration	Av	Average
CIS#	Cisco Number (unique identification number for Cisco test equipment)	Pk	Peak
Cal	Calibration	kHz	Kilohertz (1×10^3)
EN	European Norm	MHz	Megahertz (1×10^6)
IEC	International Electro technical Commission	GHz	Gigahertz (1×10^9)
CISPR	International Special Committee on Radio Interference	H	Horizontal
CDN	Coupling/Decoupling Network	V	Vertical
LISN	Line Impedance Stabilization Network	dB	decibel
PE	Protective Earth	V	Volt
GND	Ground	kV	Kilovolt (1×10^3)
L1	Line 1	μ V	Microvolt (1×10^{-6})
L2	Line2	A	Amp
L3	Line 3	μ A	Micro Amp (1×10^{-6})
DC	Direct Current	mS	Milli Second (1×10^{-3})
RAW	Uncorrected measurement value, as indicated by the measuring device	μ S	Micro Second (1×10^{-6})
RF	Radio Frequency	μ S	Micro Second (1×10^{-6})
SLCE	Signal Line Conducted Emissions	m	Meter
Meas dist	Measurement distance	Spec dist	Specification distance
N/A or NA	Not Applicable	SL	Signal Line (or Telecom Line)
P	Power Line	L	Live Line
N	Neutral Line	R	Return
S	Supply	AC	Alternating Current

**Appendix E: Test Equipment/Software Used to perform the test**

Equipment #	Manufacturer/Model	Description	Last Cal	Next due
CIS005691	Miteq/NSP1800-25-S1	Broadband Preamplifier (1-18GHz)	9-Oct-07	9-Oct-08
CIS008195	TTE/H613-150K-50-21378	Hi Pass Filter - 150KHz cutoff	31-Dec-07	31-Dec-08
CIS008370	Andrew/F4A-PNMNM	49 ft Heliac Cable	16-Mar-07	16-Mar-08
CIS008588	Fischer/FCC-RFM2F-520R	LISN AC Adaptor - Std 120V outlet	16-Mar-07	16-Mar-08
CIS020975	Micro-Coax/UFB311A-0-1344-520520	RF Coaxial Cable, to 18GHz, 134.4 in	16-Mar-07	16-Mar-08
CIS030559	Micro-Coax/UFB311A-1-0950-504504	RF Coaxial Cable, to 18GHz, 95 in	16-Mar-07	16-Mar-08
CIS030652	Sunol Sciences/JB1	Combination Antenna, 30MHz-2GHz	16-Jul-07	16-Jul-08
CIS034304	Micro-Tronics/BRM50702-02	Notch Filter, SB:2.4-2.5GHz, to 18GHz	16-Jul-07	16-Jul-08
CIS034974	Midwest Microwave/ATT-0640-20-29M-02	Attenuator, 20dB, DC-40GHz	14-May-07	14-May-08
CIS035040	Micro-Tronics/HPM50112-02	High pass Filter, 6.4-18GHz	16-Jul-07	16-Jul-08
CIS035098	Micro-Coax/UFA147A-0-0180-110200	RF Coaxial Cable, to 40 GHz, 18 in	7-Mar-07	7-Mar-08
CIS037228	Micro-Tronics/BRC50705	Notch Filter, SB:5.725-5.875GHz, to 12 GHz	7-Mar-07	7-Mar-08
CIS040503	Agilent/E4440A	Precision Spectrum Analyzer	18-Mar-07	18-Mar-08
CIS040523	Rohde & Schwarz/ESCI	EMI Test Receiver	1-Jun-07	1-Jun-08
CIS040548	Megaphase/F230-NKNK-320	RF N Type cable 9KHz to 18GHz	13-Jul-07	13-Jul-08
CIS041202	ETS-Lindgren/3117	Double Ridged Horn Antenna	3-Jul-07	3-Jul-08
COM000590	Agilent	Spectrum Analyzer	7-Feb-07	2-Feb-08
COM000579	Megaphase	RF Coaxial Cable, to 26GHz, 36in	27-Dec-07	27-Dec-08
COM000601	Agilent	EPM-P Series Power Meter	23-Feb-07	23-Feb-08
COM000602	Agilent	Peak and Average Power Sensor	23-Feb-07	23-Feb-08
COM000599	Weinschel Corp.	20dB Attenuator	26-Dec-07	26-Dec-08