FCC CFR47 PART 15 SUBPART C

Test Report

2.4 GHz RFID Reader

Model Number: HSS-MUR-300

FCC ID: ES8-HSS-MUR-300

Report Number: 06PR037FCC

Issue Date: May 2, 2006

Prepared for

HITACHI AMERICA LTD.
Information Division
2000 Sierra Point Parkway
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Prepared by

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REPORT REVISION HISTORY

Date	Revision	Description	Revised by
2 May 06	1.0	Original Issue	T.N. Cokenias
22 May06	1.1	Editorial corrections per TCB review feedback	T.N. Cokenias

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Hitachi America Ltd.
Information Division
2000 Sierra Point Parkway, M/S 570
Brisbane, CA 94005-1845

EUT DESCRIPTION: RFID READER CARD

MODEL: HSS-MUR-300

DATE TESTED: 22-29 March 2006

Testing was performed following accepted test methodologies and practices, using equipment with calibrations traceable to NIST, and by properly trained personnel. All tests were performed at

Compliance Certification Services
561 F Monterey Road
Morgan Hill, CA 95037

Date: 2 May 2006

Thomas N. Cokenias
T.N. Cokenias Consulting
P.O. Box 1086
El Granada CA 94018

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.

3. EQUIPMENT UNDER TEST

3.1. DESCRIPTION OF EUT

The EUT is a frequency hopping spread spectrum RFID Reader.

3.2. MAXIMUM OUTPUT POWER

Channel	Frequency (MHz)	Power (dBm)	Power (mW)
Low	2420	27.14	517.6
Middle	2440	27.57	571.5
High	2460	28.03	635.3

3.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio was tested with two antennas:

MaxRad MP2400XFPT Linear polarized Antenna, gain = 8.5dBi
Hyperlink HG2409PCL/R Circularly polarized Antenna gain = 8.0 dBi

The 3foot coaxial cable (RG58/U) supplied with antennas has more than 0.6dB loss at 2.4GHz

3.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was MPR version 2.0

3.5. WORST-CASE CONFIGURATION AND MODE

Worst-case test mode for antenna port conducted measurements was using maximum output power for each of the test channels for each of the tests required.

Worst-case test mode for radiated emissions tests was with RFID tag placed on the test table, while reader operated at maximum output power for each of the tested channels.

3.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
LAPTOP	IBM	390E	AF - 1B8BD	N/A
AC/DC ADAPTER	IBM	N/A	02K6555	N/A
DC POWER SUPPLY	CUI	DTS060250UDC-P5P	N/A	N/A

I/O CABLES

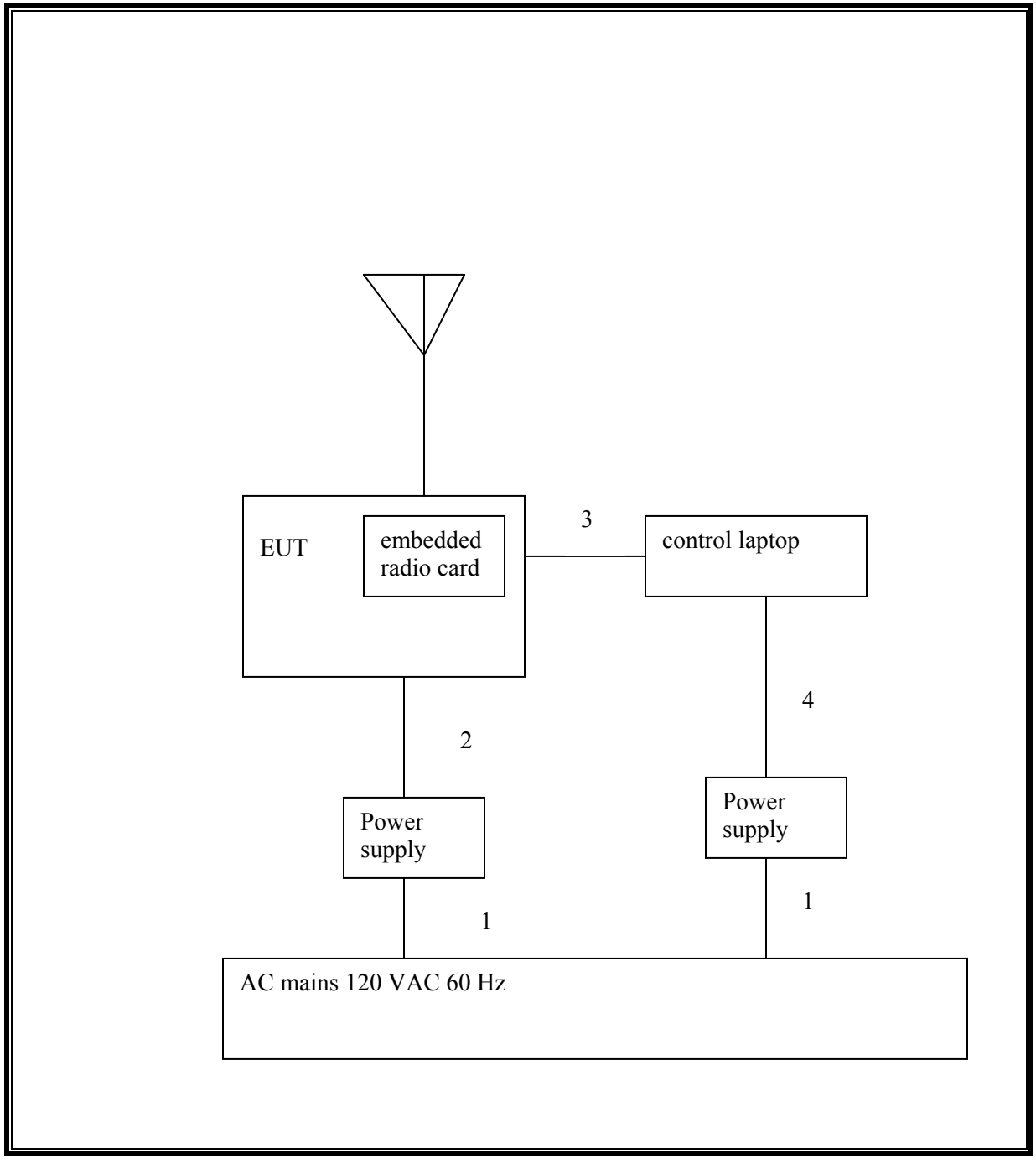
I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	2	AC	Un-shielded	0.5 m	N/A
2	DC	1	DC	Un-shielded	1m	N/A
3	SERIAL	1	RS-232	Un-shielded	1m	N/A
4	DC	1	DC	Un-shielded	0.5m	N/A

TEST SETUP

The EUT is an RFID tag reader. The EUT was set to continuously read RFID tags. An RFID tag was placed on the test table during radiated tests. Antenna port was connected via coaxial cable and suitable attenuation directly to the input of a spectrum analyzer for antenna conducted tests.

The software on the Laptop exercises the EUT in different channels and also into hopping mode when needed. The software is a Labview utility program by the manufacturer.

SETUP DIAGRAM FOR TESTS



4. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Name of Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Due Date**
Antenna, Horn 1 ~ 18 GHz	**ETS**	**3117**	**29310**	**4/22/2007**
Preamplifier, 1 ~ 26.5 GHz	**Agilent / HP**	**8449B**	**3008A00369**	**8/17/2006**
EMI Test Receiver	**R & S**	**ESHS 20**	**827129/006**	**6/3/2006**
Antenna, Loop 9 kHz ~ 30 MHz	**EMCO**	**6502**	**9202-2722**	**9/7/2006**
Spectrum Analyzer 3 Hz ~ 44 GHz	**Agilent / HP**	**E4446A**	**US42070220**	**7/29/2006**
RF Filter Section	**Agilent / HP**	**85420E**	**3705A00256**	**2/4/2007**

5. LIMITS AND RESULTS

5.1. ANTENNA PORT CONDUCTED TESTS

5.1.1. 20 dB BANDWIDTH

LIMIT

None, for reporting purposes only.

TEST PROCEDURE

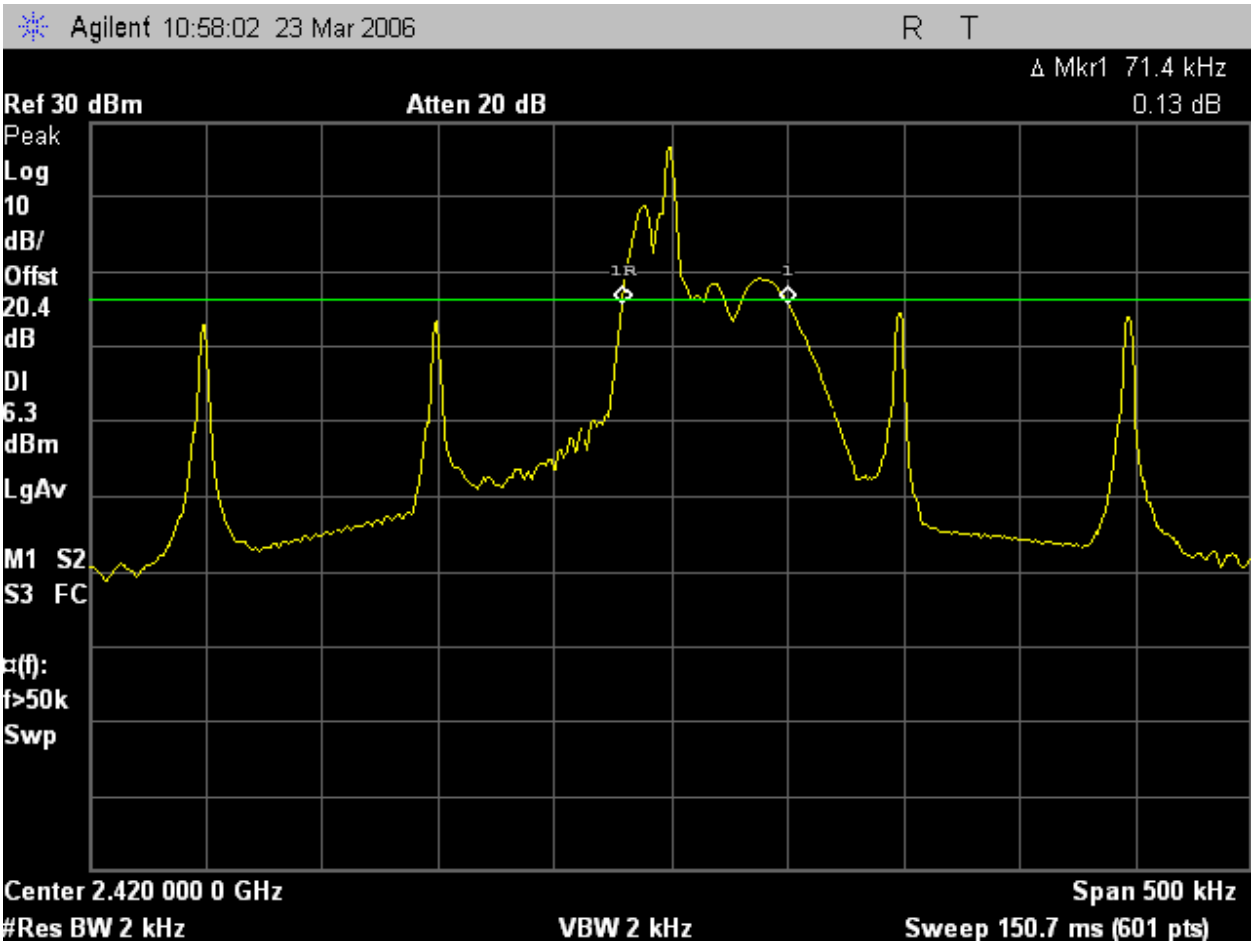
The transmitter output is connected to a spectrum analyzer. The RBW is set to 1% to 3% of the 20 dB bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled.

RESULTS

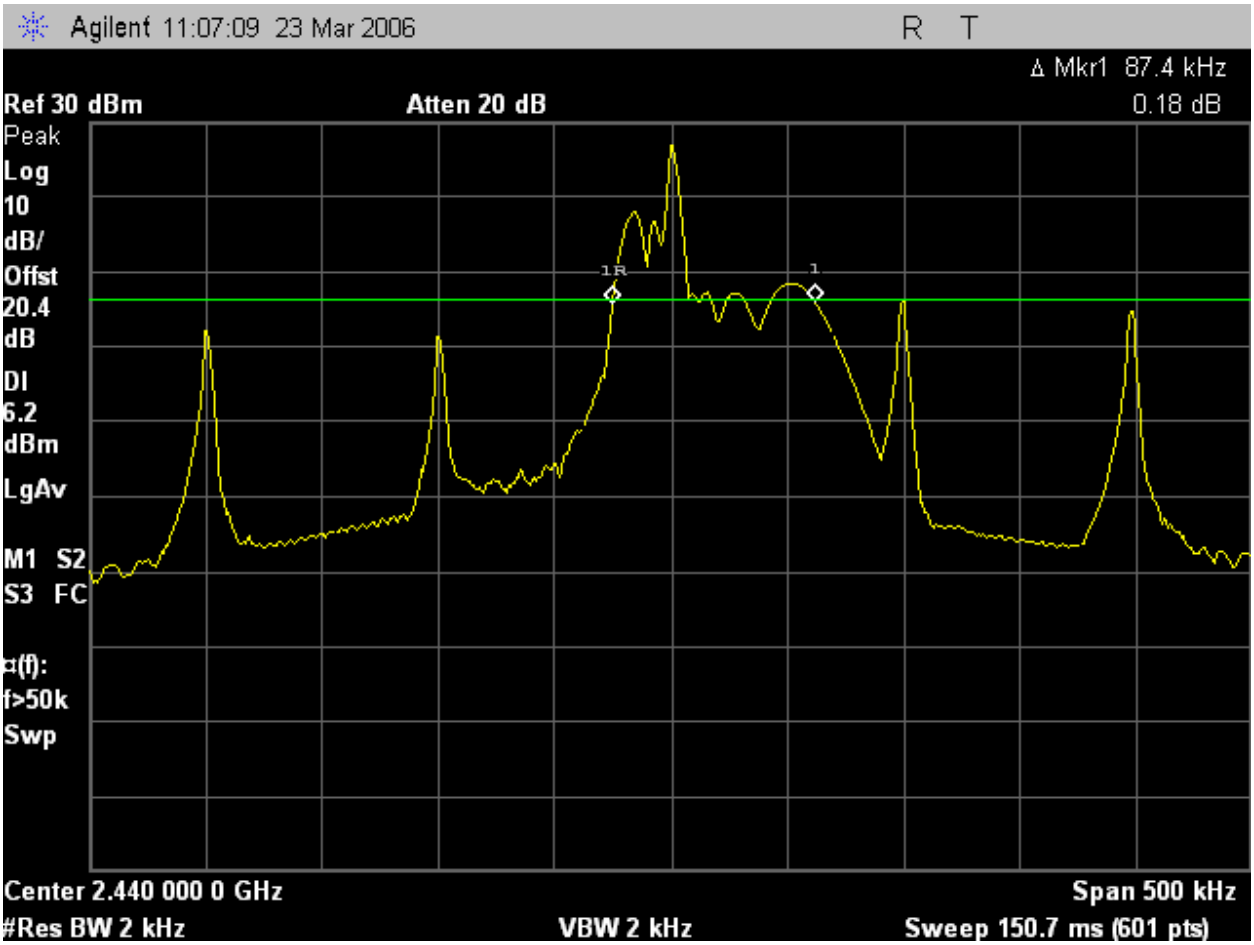
No non-compliance noted:

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	2420	71.4
Middle	2440	87.4
High	2480	85.7

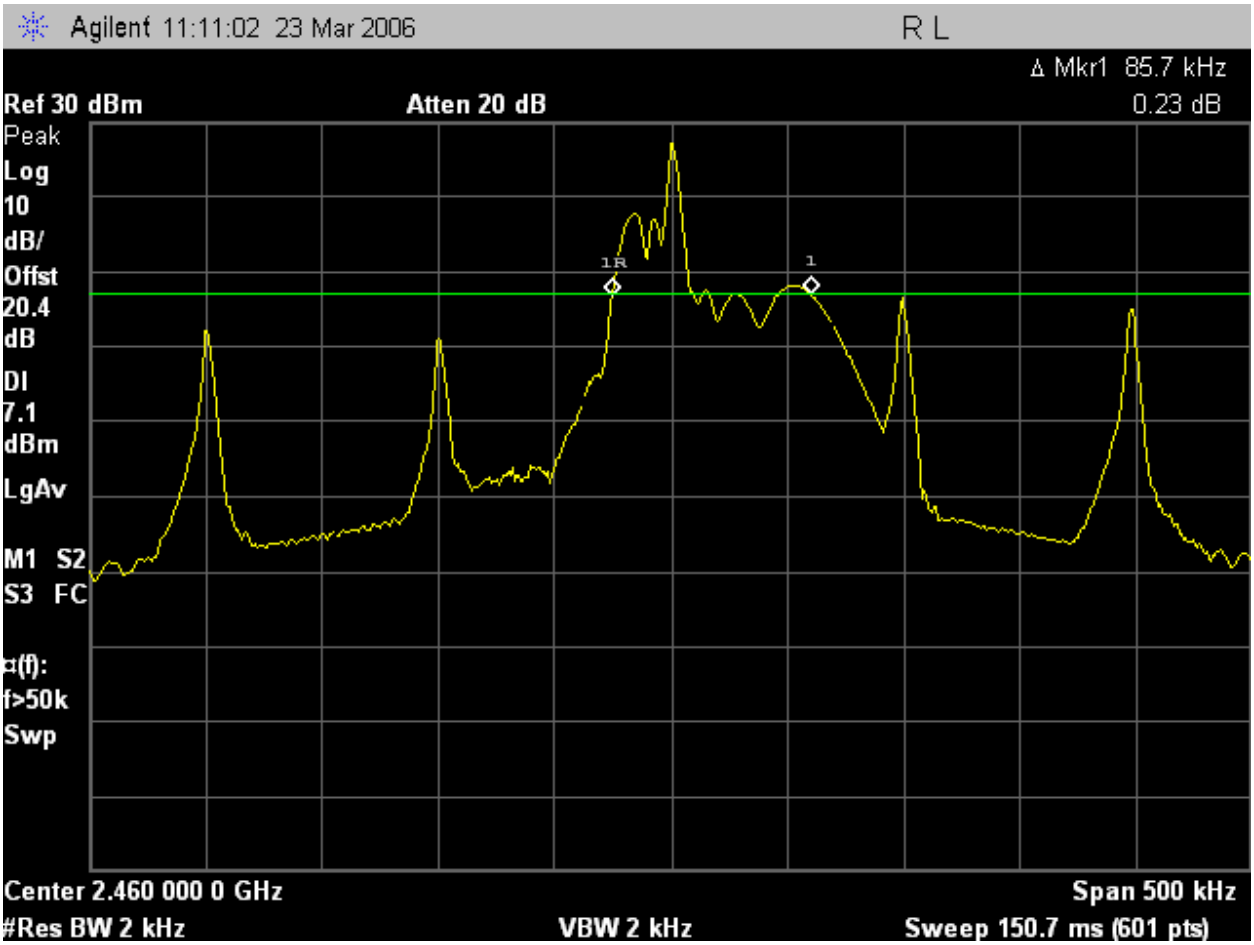
20 dB BANDWIDTH LOW CHANNEL



20 dB BANDWIDTH MID CHANNEL



20 dB BANDWIDTH HIGH CHANNEL



5.1.2 HOPPING FREQUENCY SEPARATION

LIMIT

§15.247 (a) (1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

TEST PROCEDURE

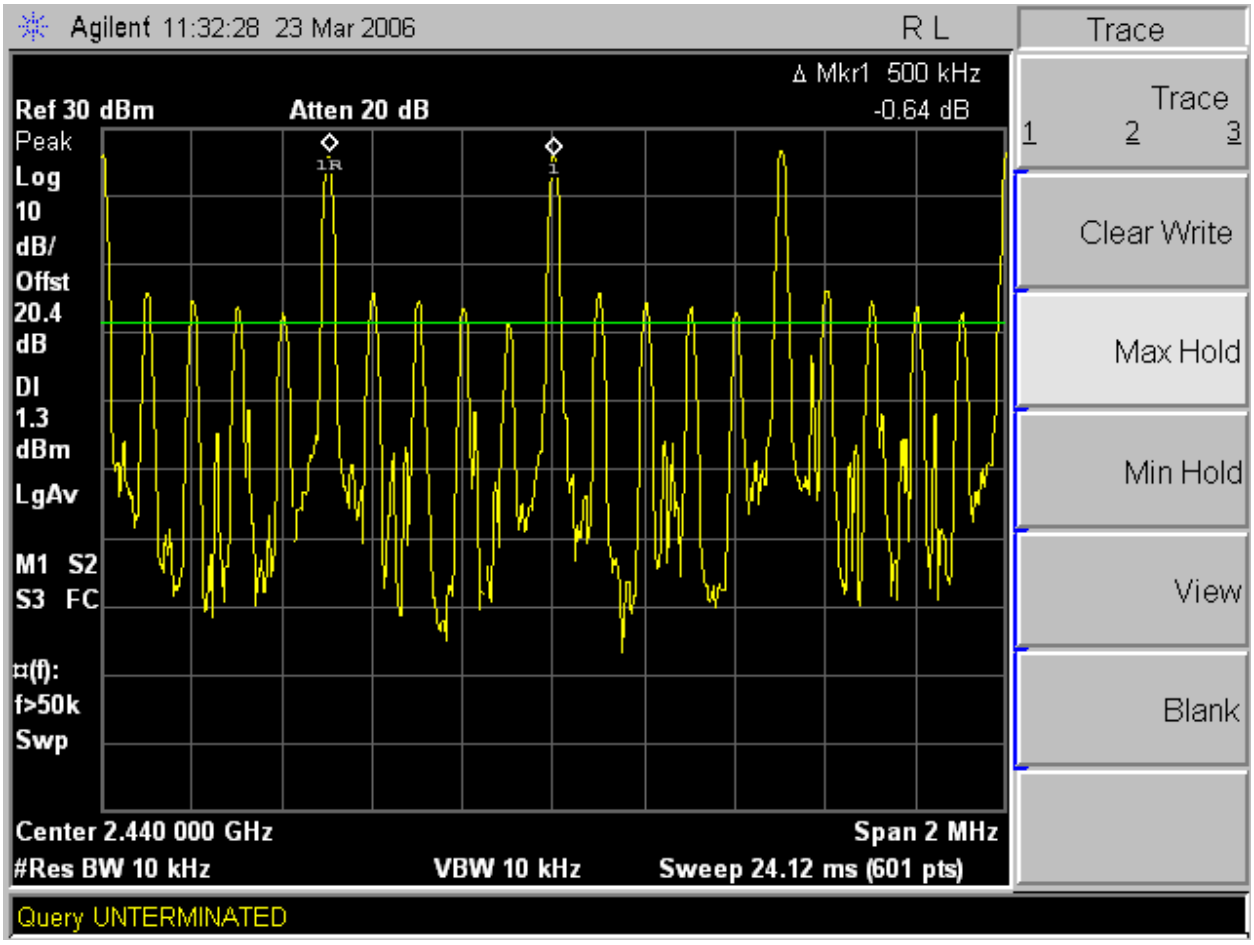
The transmitter output is connected to a spectrum analyzer. The RBW is set to 10 kHz and the VBW is set to 30 kHz. The sweep time is coupled.

RESULTS

No non-compliance noted:

The separation is 500KHz.

HOPPING FREQUENCY SEPARATION



5.1.3. NUMBER OF HOPPING CHANNELS

LIMIT

§15.247 (a) (1) (iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimumof 15 channels are used.

TEST PROCEDURE

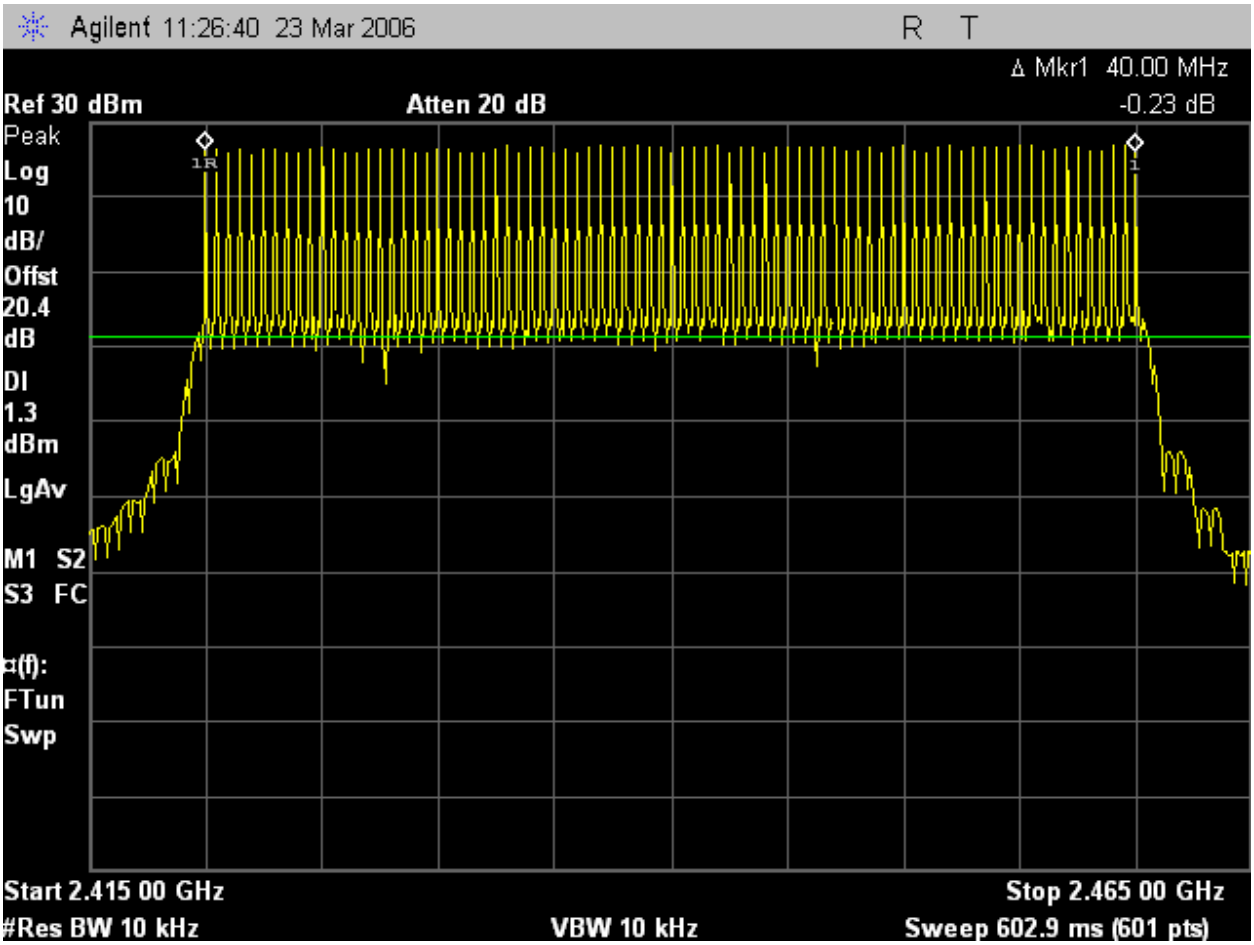
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to 3 % of the span. The analyzer is set to Max Hold.

RESULTS

No non-compliance noted:

81 channels observed.

NUMBER OF HOPPING CHANNELS



5.1.4. AVERAGE TIME OF OCCUPANCY

LIMIT

§15.247 (a) (1) (iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds withina period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The analyzer is set to Video Trigger to capture the desired signal and distinguish them from other emissions on nearby channels. The number of pulses is measured in a 30 second scan.

The width of a single pulse is measured in a fast scan.

RESULTS

No non-compliance noted:

The system has 81 hopping frequencies. There are 13 pulses within a 30 measurement period. The on time for each pulse is 14.12 ms.

Therefore, the average time of occupancy in the specified 30-second period is:

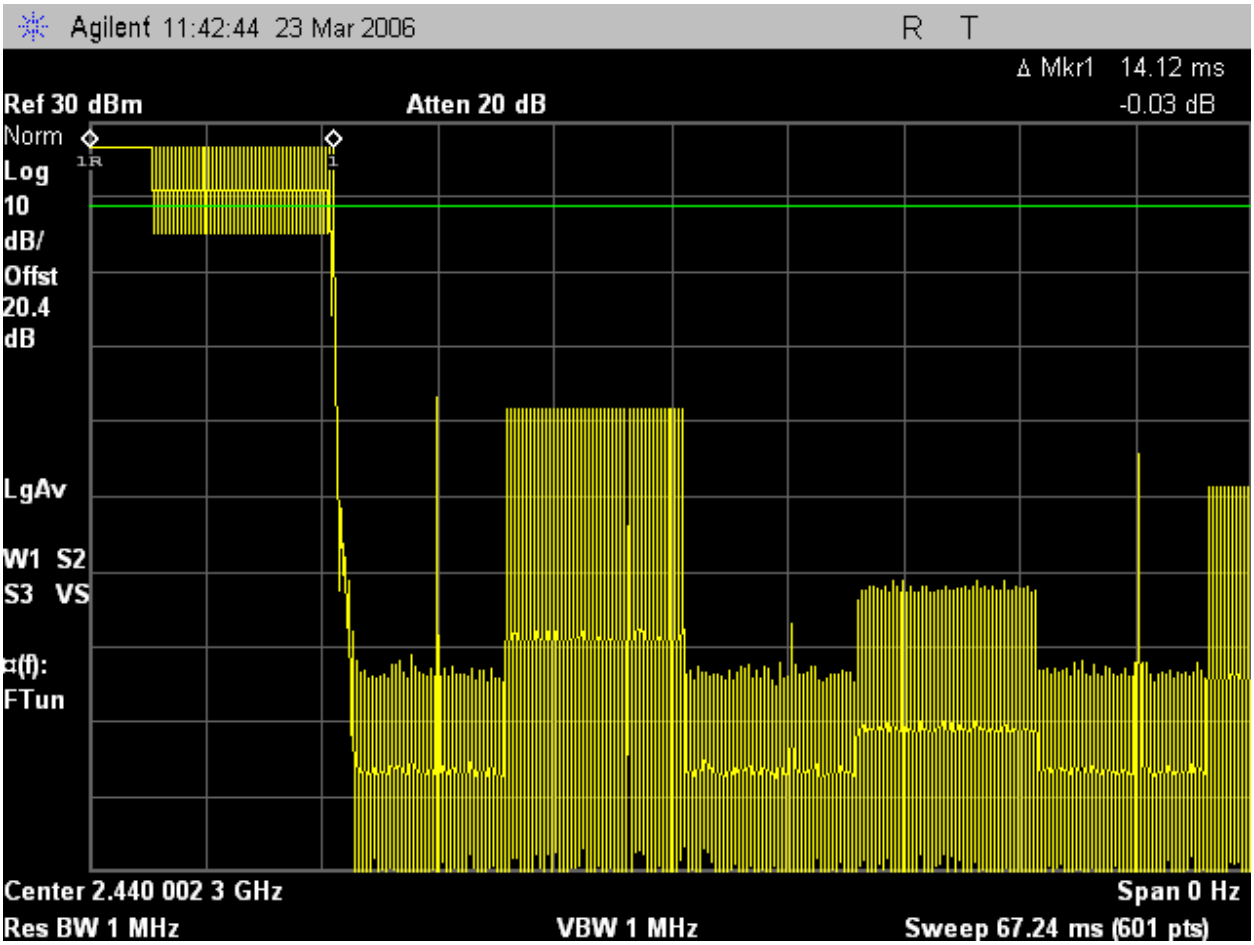
13 x 14.12 ms = 183.6 ms = 0.184 s

For 81 channels, any given channel may be occupied for less than 0.4 sec in 0.4 x 81 = 32.4sec.

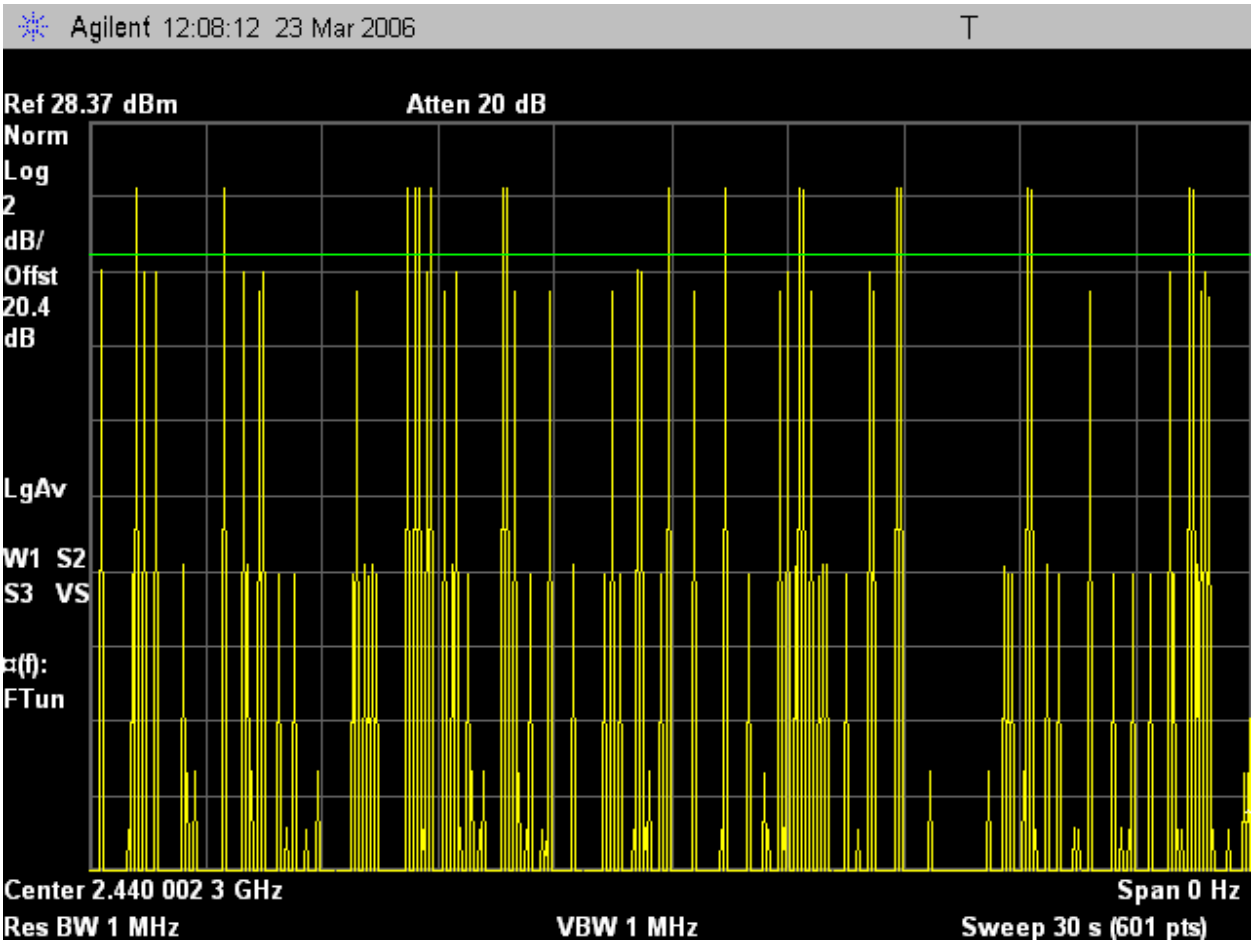
Calculated total channel occupancy in 32.4 sec = (32.4/30) x 0.184 sec = 0.199 sec

Maximum allowed occupancy: 0.4 sec.

PULSE WIDTH


Agilent 11:42:44 23 Mar 2006
R T
Δ Mkr1 14.12 ms
-0.03 dB
Ref 30 dBm
Atten 20 dB
Norm
Log
10
dB/
Offst
20.4
dB
LgAv
W1 S2
S3 VS
¤(f):
FTun
Center 2.440 002 3 GHz
Res BW 1 MHz
VBW 1 MHz
Span 0 Hz
Sweep 67.24 ms (601 pts)

NUMBER OF PULSES IN 30 SECOND OBSERVATION PERIOD



5.1.5. PEAK OUTPUT POWER

PEAK POWER LIMIT

15.247(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

15.247 (b) (4) Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer and the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

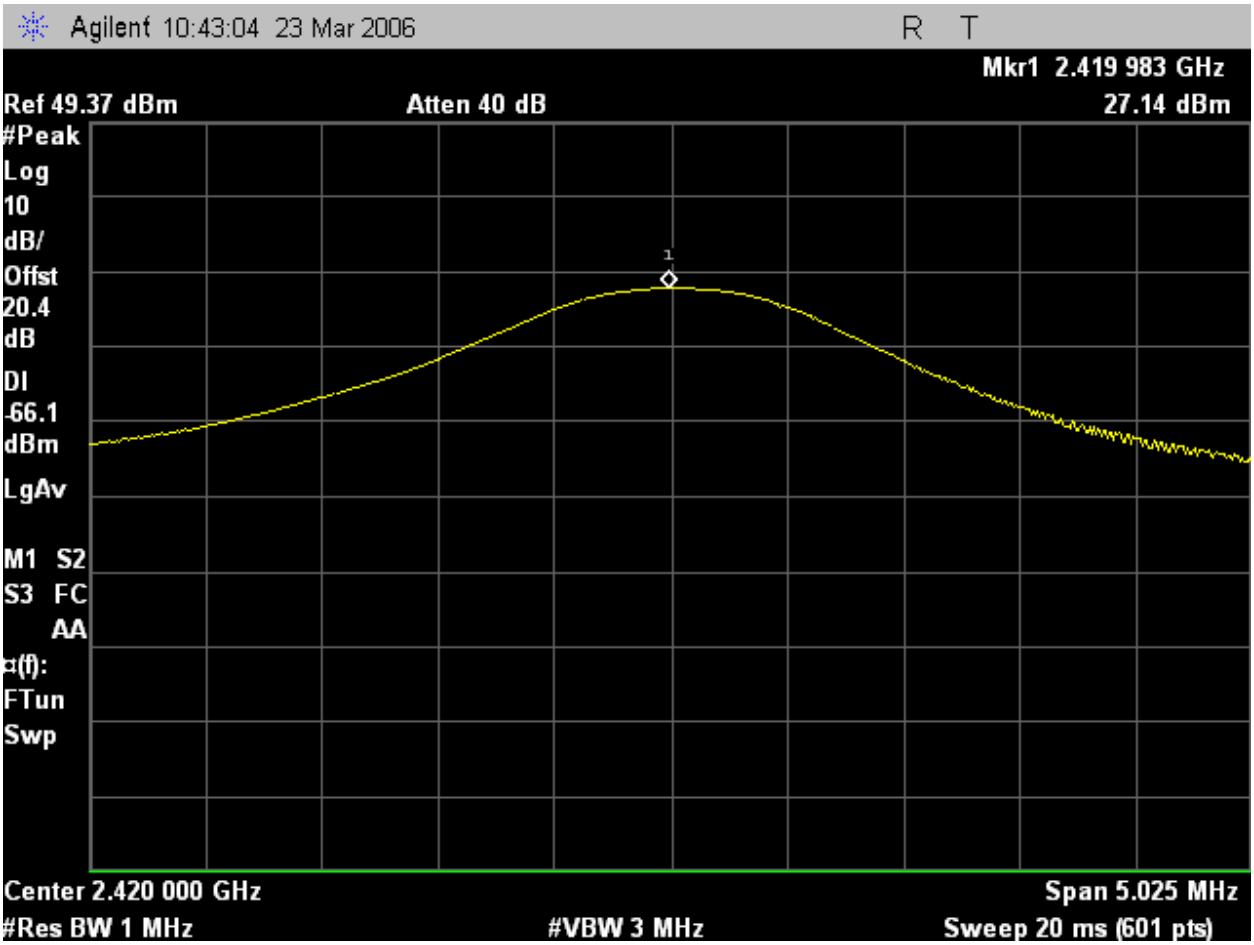
No non-compliance noted.

Maximum allowed power = 36 dBm eirp – (8.5 dBi + 0.6 dB cable loss) = 28.1 dBm

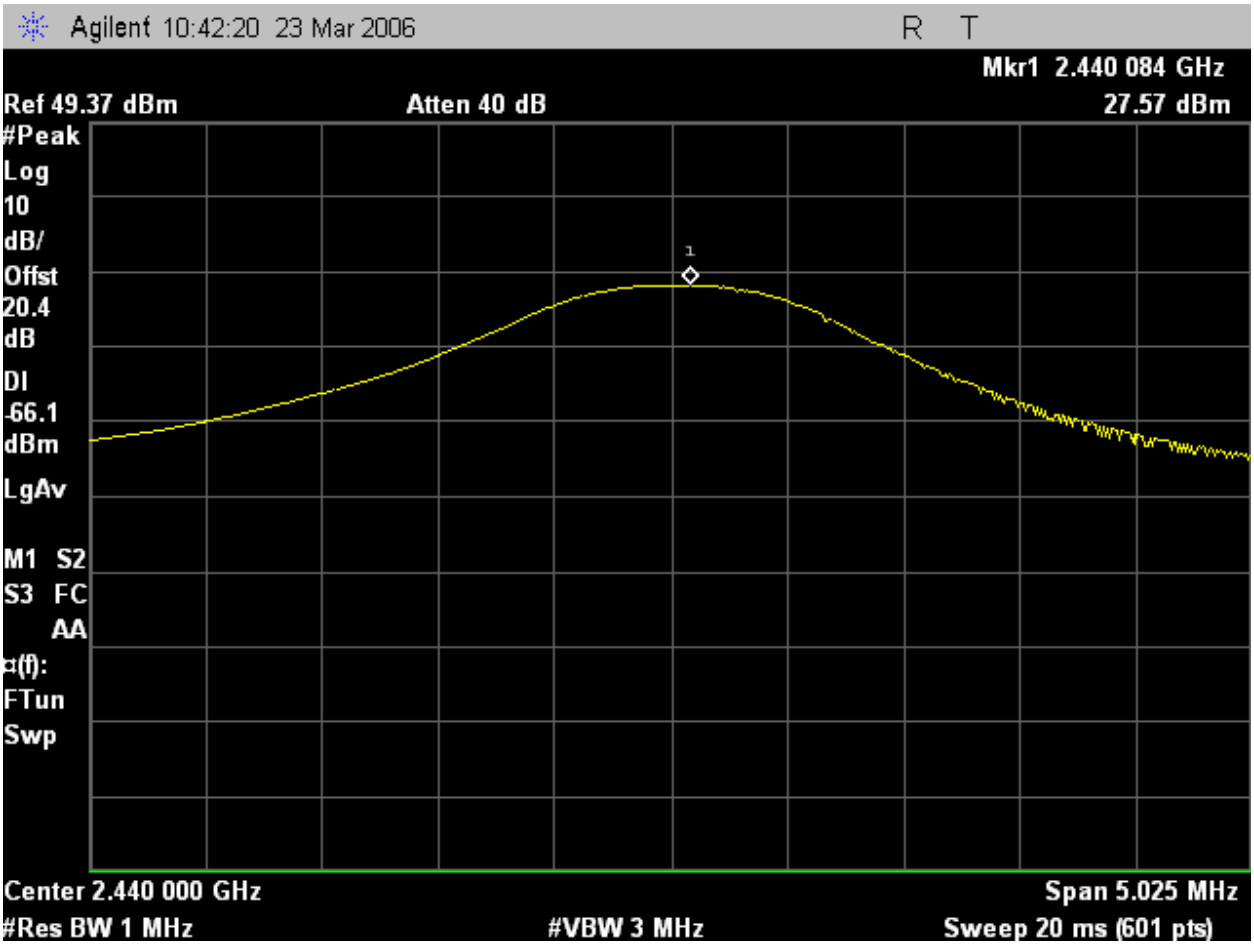
Refer to tabulated data and spectrum analyzer plots.

Channel	Frequency (MHz)	Power (dBm)	Power (mW)
Low	2420	27.14	517.6
Middle	2440	27.57	571.5
High	2460	28.03	635.3

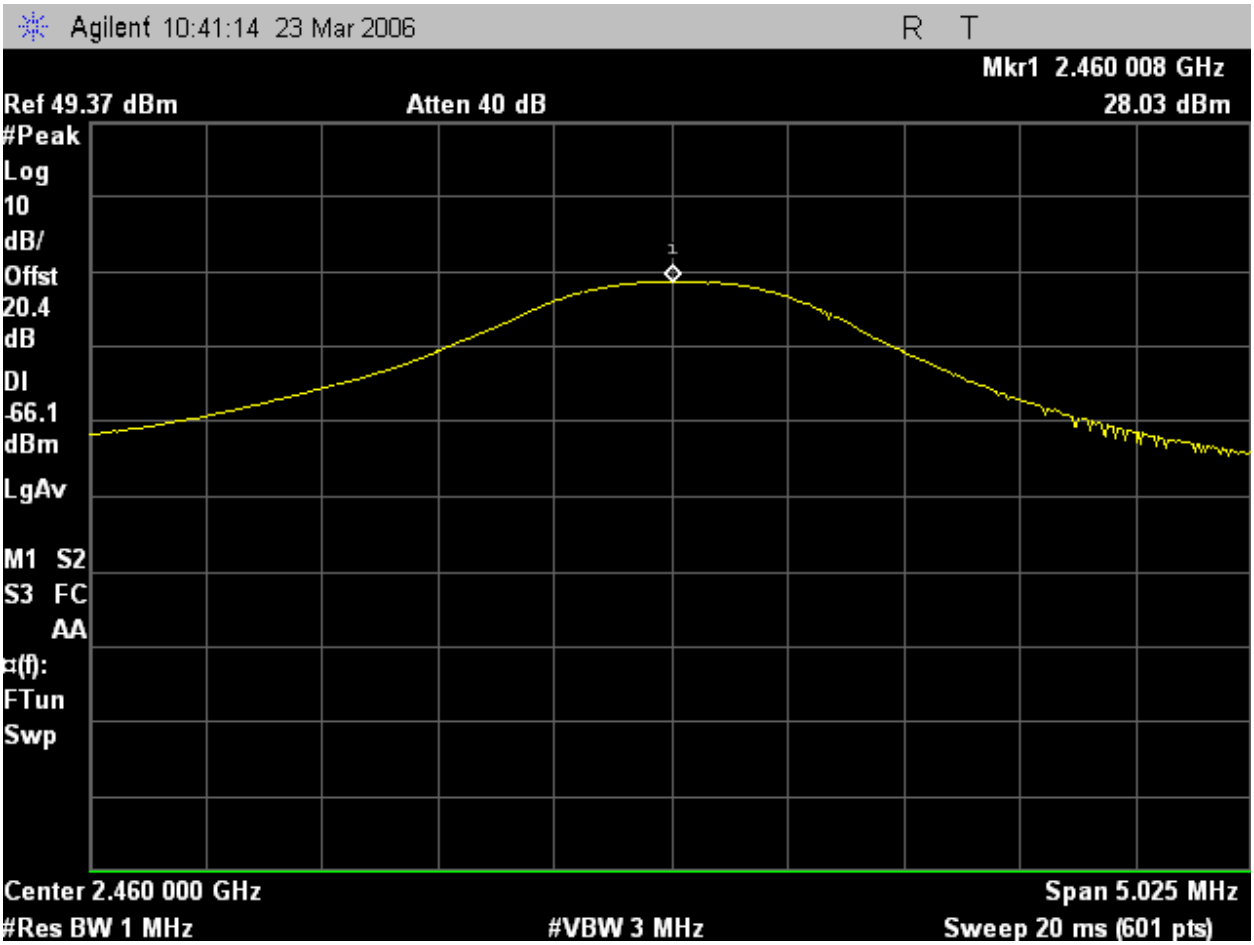
OUTPUT POWER LOW CHANNEL



OUTPUT POWER MID CHANNEL



OUTPUT POWER HIGH CHANNEL



5.1.6. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

§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^2)	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	*($900/f^2$)	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	*($180/f^2$)	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^2)	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.

CALCULATIONS

Given

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

and

$S = E ^ 2 / 3770$

where

E = Field Strength in Volts/meter
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power Density in milliwatts/square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

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

Changing to units of Power to mW and Distance to cm, using:

P (mW) = P (W) / 1000 and
d (cm) =100 * d (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 = Numeric antenna gain
S = Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P (mW) = 10 ^ (P (dBm) / 10) and
G (numeric) = 10 ^ (G (dBi) / 10)

yields

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

where

d = MPE distance in cm
P = Power in dBm
G = Effective Antenna Gain in dBi (=gain, dBi – cable loss, dB)
S = Power Density Limit in mW/cm^2

Equation (1) and the measured peak power is used to calculate the MPE distance.

LIMITS

From §1.1310 Table 1 (B), S = 1.0 mW/cm^2

RESULTS

No non-compliance noted:

Power Density Limit (mW/cm^2)	Output Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)
1.0	28.03	7.90	17.65

NOTE: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

5.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

§15.247 (c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in§15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST PROCEDURE

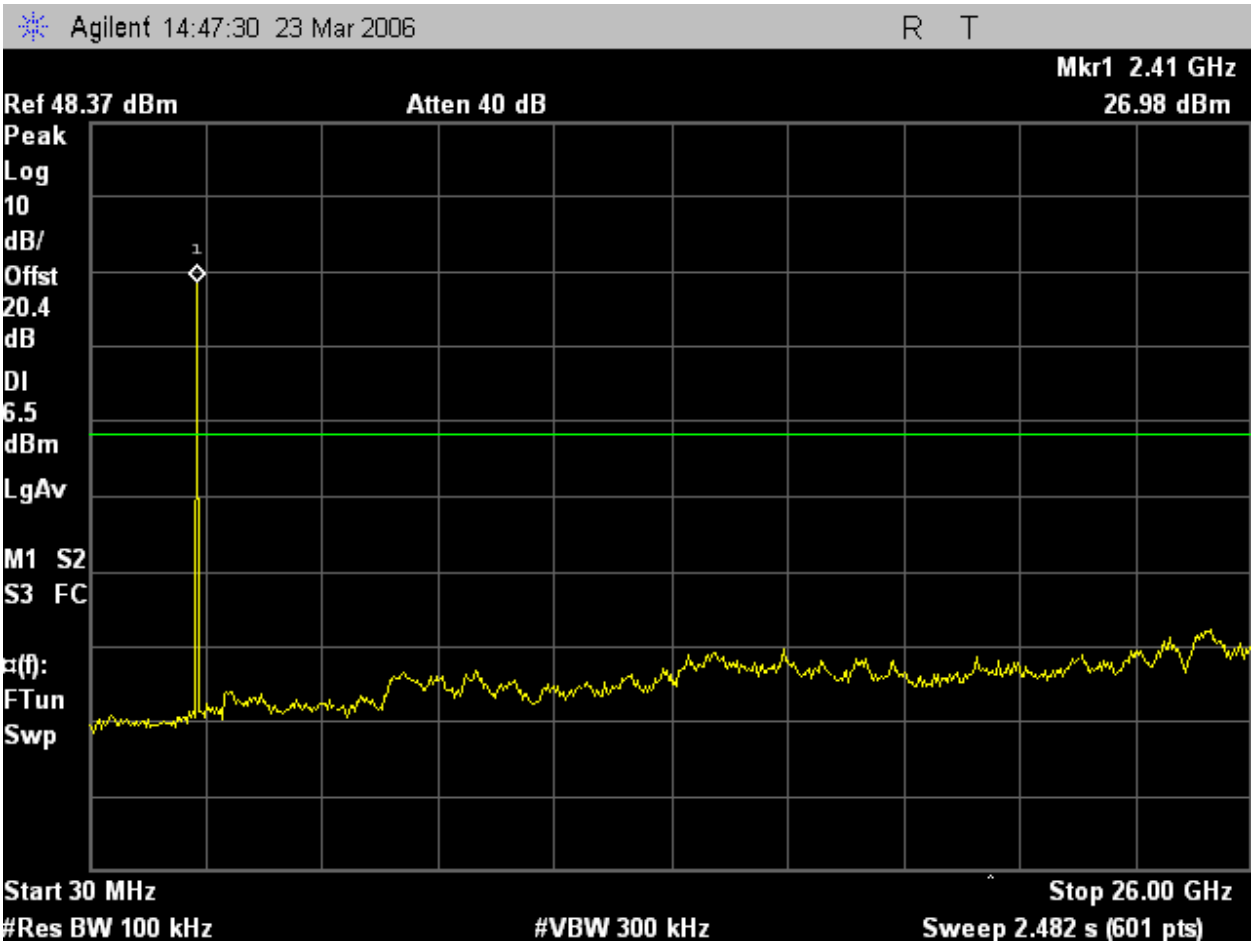
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

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

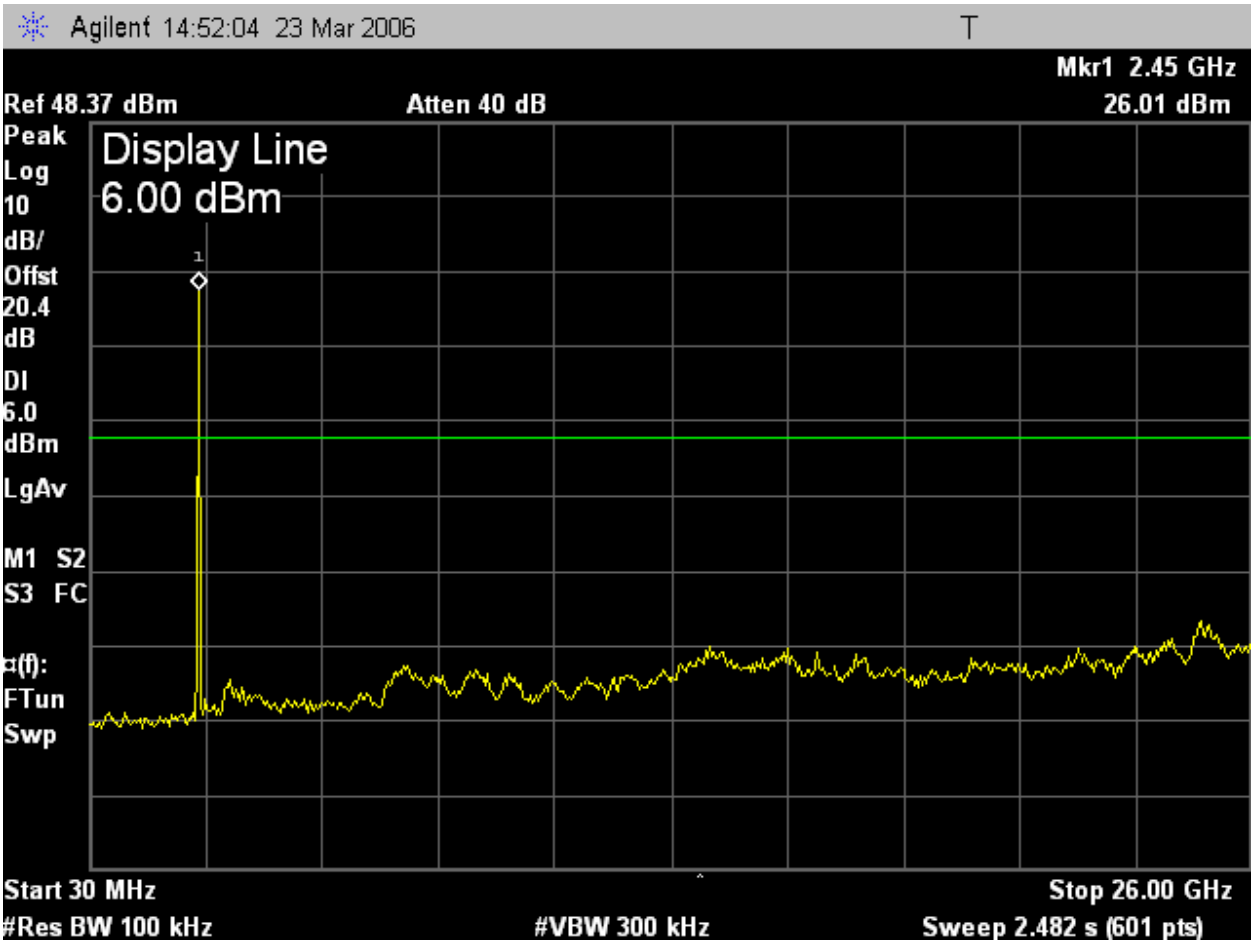
RESULTS

No non-compliance noted:

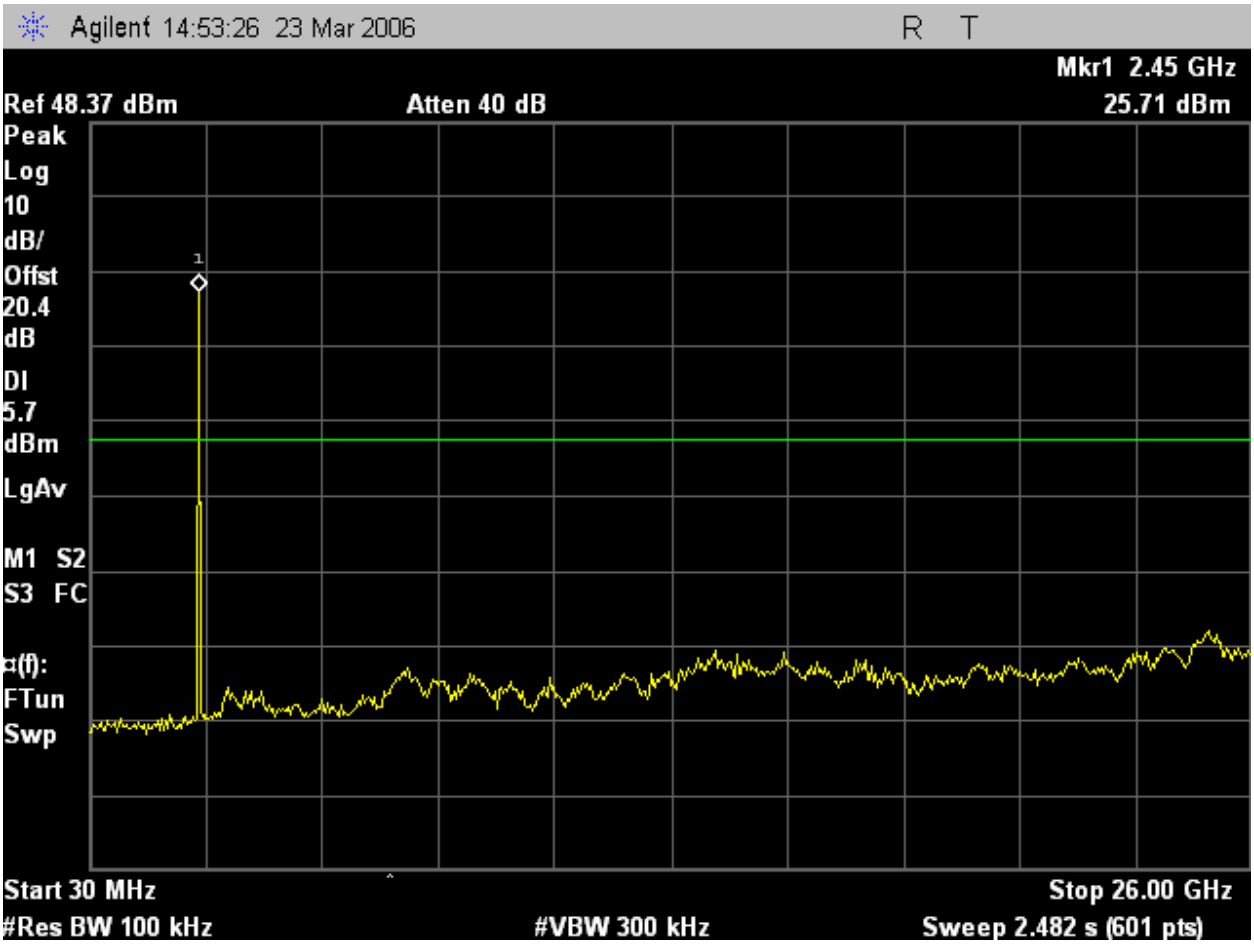
SPURIOUS EMISSIONS, LOW CHANNEL



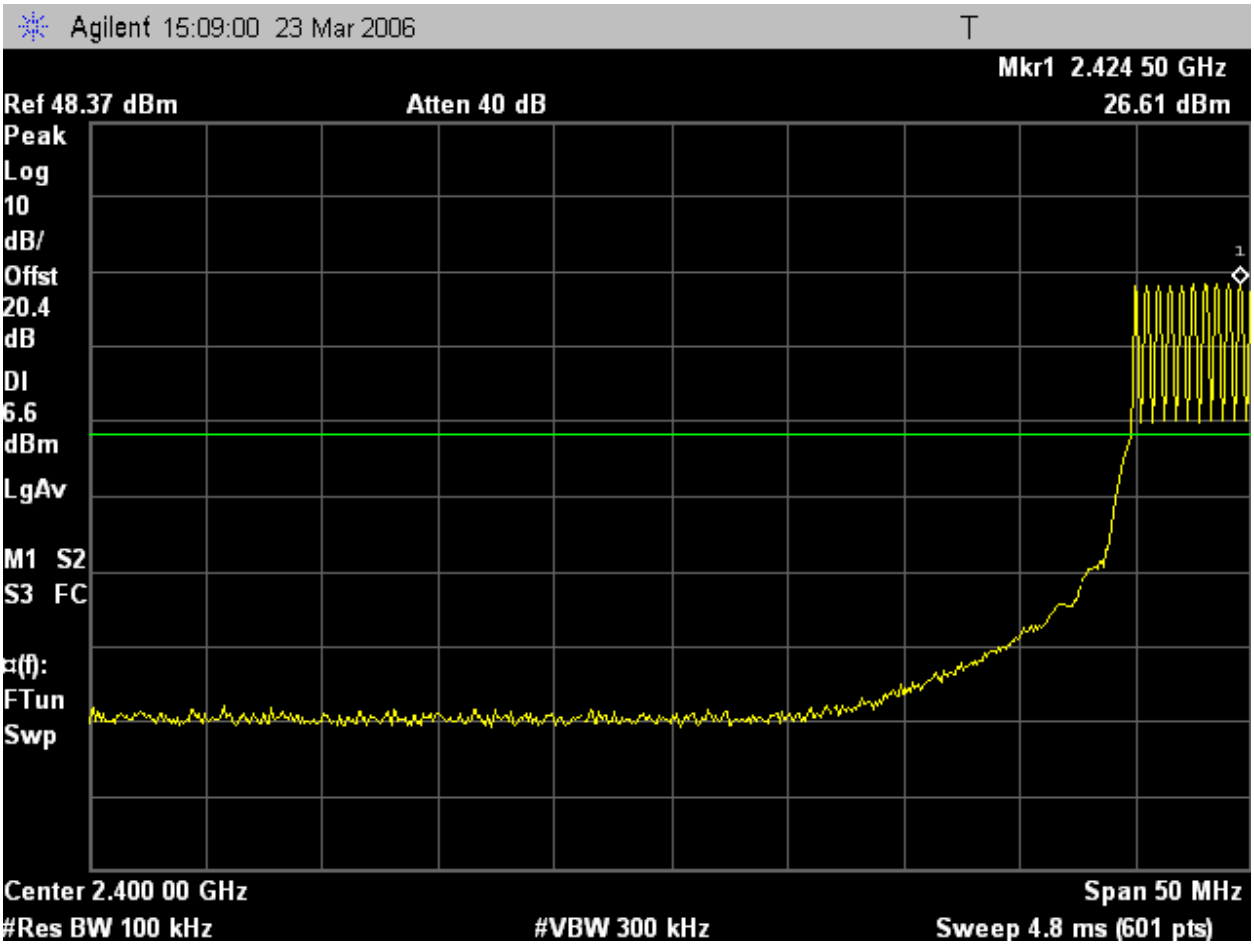
SPURIOUS EMISSIONS, MID CHANNEL



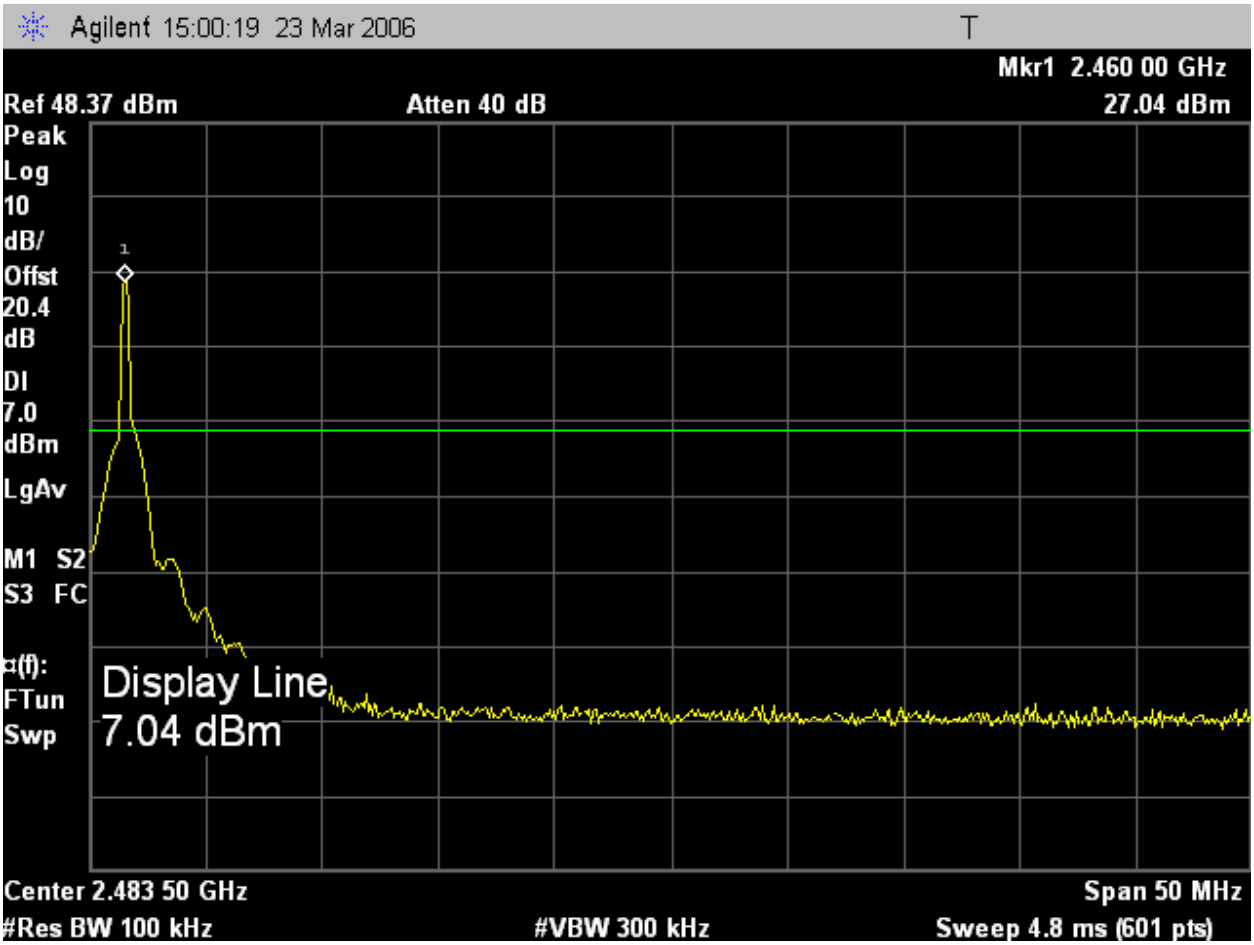
SPURIOUS EMISSIONS, HIGH CHANNEL



HOPPING FUNCTION ON, LOW CHANNEL



HOPPING FUNCTION ON, HIGH CHANNEL



5.2. RADIATED EMISSIONS

5.2.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

LIMITS

§15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2] Above 38.6

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. An RFID tag is also placed on the test table. 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, 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.

5.2.2. TRANSMITTER RADIATED EMISSIONS ABOVE 1 GHZ HARMONICS AND SPURIOUS EMISSIONS

Linearly Polarized Antenna (Grey cells indicate no emission found above system noise floor)

03/22/06 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engineer: Alvin Ilarina
Project #: 06U10168
Company:
EUT Description: SR 2500 Reader w/ 8dBi linear antenna
EUT M/N:
EUT S/N: Radio Board 21
Test Target:
Mode Of Operation: FCC 15.209
Average Power Meter: Low = xx dBm, Mid = xx dBm, High = xx dBm

Test Equipment:

Horn 1-18GHz: T60; S/N: 2238 @3m
Pre-amplifer 1-26GHz: T34 HP 8449B
Pre-amplifer 26-40GHz:
Horn > 18GHz:

Hi Frequency Cables

2 foot cable: Gordon 187207002
3 foot cable:
12 foot cable: Can 187209002
HPF: HPF_4.0GHz
Reject Filter:

Peak Measurements RBW=VBW=1MHz
Average Measurements RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
4.920	3.0	51.8	48.3	33.7	3.5	-34.8	0.0	0.6	54.9	51.4	74	54	-19.1	-5.7	V - hi
7.380	3.0	42.6	29.4	36.2	4.2	-34.1	0.0	0.6	49.6	36.4	74	54	-24.4	-24.6	V - hi
9.840	3.0			38.2	4.4	-33.1	0.0	0.8	10.4	10.4	74	54	-63.6	-54.0	V - hi
12.300	3.0			38.4	4.5	-32.5	0.0	0.9	11.3	11.3	74	54	-62.7	-54.0	V noise floor
4.920	3.0	50.8	47.3	33.7	3.5	-34.8	0.0	0.6	53.9	50.4	74	54	-20.1	-6.7	H - hi
7.380	3.0			36.2	4.2	-34.1	0.0	0.6	7.0	7.0	74	54	-67.0	-54.0	H - hi - noise floor
9.840	3.0			38.2	4.4	-33.1	0.0	0.8	10.4	10.4	74	54	-63.6	-54.0	H -hi -noise floor
4.880	3.0	46.5	41.4	33.7	3.5	-34.8	0.0	0.6	49.5	44.4	74	54	-24.5	-12.6	H - mid
7.320	3.0	41.9	31.8	36.2	4.2	-34.1	0.0	0.6	48.7	38.6	74	54	-25.3	-22.2	H -mid
9.760	3.0			38.2	4.4	-33.3	0.0	0.8	10.1	10.1	74	54	-63.9	-54.0	H - mid - noise floor
4.880	3.0	45.0	39.5	33.7	3.5	-34.8	0.0	0.6	48.0	42.5	74	54	-26.0	-14.5	V-mid
7.320	3.0	40.9	28.3	36.2	4.2	-34.1	0.0	0.6	47.8	35.2	74	54	-26.2	-25.7	V-mid
9.760	3.0			38.2	4.4	-33.3	0.0	0.8	10.1	10.1	74	54	-63.9	-54.0	V-mid
12.300	3.0			38.4	4.5	-32.5	0.0	0.9	11.3	11.3	74	54	-62.7	-54.0	V-mid - noise floor
4.840	3.0	43.5	35.3	33.6	3.5	-34.8	0.0	0.6	46.4	38.2	74	54	-27.6	-18.8	V- lo
4.840	3.0	48.6	44.6	33.6	3.5	-34.8	0.0	0.6	51.6	47.5	74	54	-22.4	-9.4	H-lo
7.260	3.0	42.7	33.1	36.1	4.2	-34.1	0.0	0.6	49.5	39.9	74	54	-24.5	-20.9	H-lo
9.680	3.0			38.1	4.4	-33.5	0.0	0.8	9.8	9.8	74	54	-64.2	-44.2	H-lo - noise floor
7.260	3.0	42.1	32.8	36.1	4.2	-34.1	0.0	0.6	48.9	39.6	74	54	-25.1	-14.4	V-lo
9.680	3.0			38.1	4.4	-33.5	0.0	0.8	9.8	9.8	74	54	-64.2	-44.2	V-lo
12.100	3.0			38.4	4.4	-32.5	0.0	0.9	11.2	11.2	74	54	-62.8	-42.8	V-lo
14.520	3.0			39.3	5.6	-32.3	0.0	0.9	13.5	13.5	74	54	-60.5	-40.5	V-lo-noise floor

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

Circularly Polarized Antenna (Grey cells indicate no emission found above system noise floor)

03/29/06 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engineer: Alvin Ilarina
Project #: 06U10168
Company: WJ Communications
EUT Description: SR 2500 Reader w/ right circular polarized antenna, cable added to compensate for 3 foot cable used in final installation
EUT M/N:
EUT S/N: Radio Board 21
Test Target: FCC 15.209
Mode Of Operation:
Average Power Meter: Low = xx dBm, Mid = xx dBm, High = xx dBm

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz
T120; S/N: 29310 @3m	T34 HP 8449B		

Hi Frequency Cables

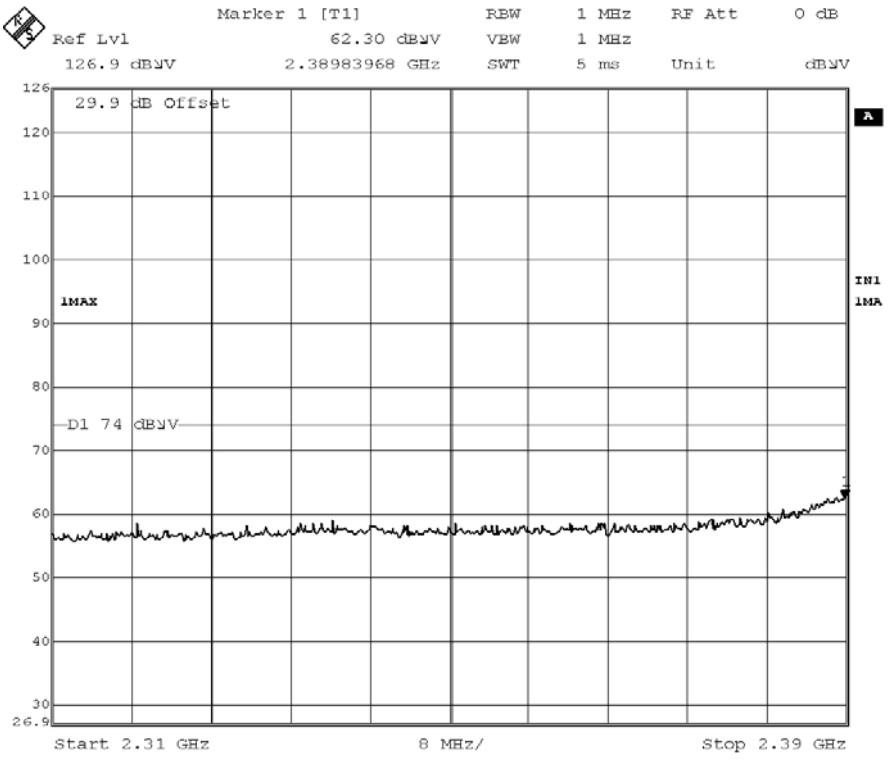
2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
Gordon 187207002		Gordon 203134001	HPF_4.0GHz	

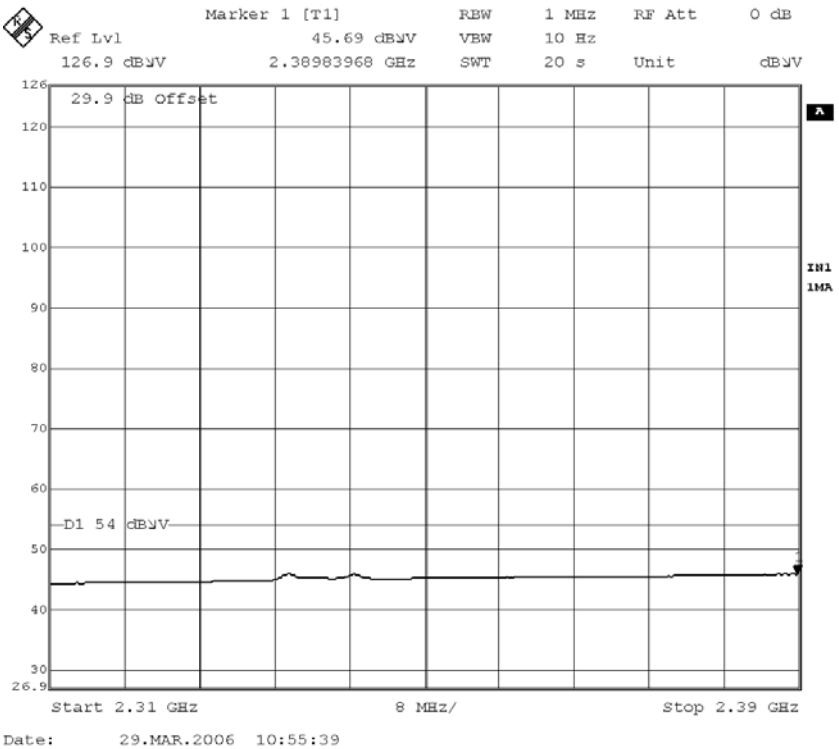
Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
4.920	3.0	57.2	43.4	34.0	3.1	-34.8	0.0	0.6	60.1	46.3	74	54	-13.9	-10.6	V - hi
7.380	3.0	52.7	41.5	35.9	3.5	-34.1	0.0	0.6	58.6	47.4	74	54	-15.4	-12.5	V - hi
9.840	3.0			37.8	3.8	-33.1	0.0	0.8	9.4	9.4	74	54	-64.6	-54.0	V - hi
12.300	3.0			38.7	3.9	-32.5	0.0	0.9	11.0	11.0	74	54	-63.0	-54.0	V noise floor
4.920	3.0	58.8	48.9	34.0	3.1	-34.8	0.0	0.6	61.7	51.8	74	54	-12.3	-5.1	H - hi
7.380	3.0	56.3	45.1	35.9	3.5	-34.1	0.0	0.6	62.2	51.0	74	54	-11.8	-8.9	H - hi
9.840	3.0	52.3	42.4	37.8	3.8	-33.1	0.0	0.8	61.7	51.8	74	54	-12.3	-11.6	H -hi -noise floor
4.880	3.0	60.7	49.3	34.0	3.1	-34.8	0.0	0.6	63.6	52.2	74	54	-10.4	-4.7	H - mid
7.320	3.0	53.5	42.5	35.9	3.5	-34.1	0.0	0.6	59.4	48.4	74	54	-14.6	-11.5	H -mid
9.760	3.0	54.9	44.1	37.7	3.8	-33.3	0.0	0.8	64.0	53.2	74	54	-10.0	-9.9	H - mid
4.880	3.0	57.8	47.6	34.0	3.1	-34.8	0.0	0.6	60.6	50.5	74	54	-13.4	-6.4	V-mid
7.320	3.0	52.5	41.5	35.9	3.5	-34.1	0.0	0.6	58.4	47.4	74	54	-15.6	-12.5	V-mid
9.760	3.0	53.5	43.1	37.7	3.8	-33.3	0.0	0.8	62.6	52.2	74	54	-11.4	-10.9	V-mid
12.300	3.0			38.7	3.9	-32.5	0.0	0.9	11.0	11.0	74	54	-63.0	-54.0	V-mid - noise floor
4.840	3.0	52.9	43.4	33.9	3.1	-34.8	0.0	0.6	55.7	46.2	74	54	-18.3	-10.6	V- lo
4.840	3.0	54.9	44.2	33.9	3.1	-34.8	0.0	0.6	57.7	47.0	74	54	-16.3	-9.8	H-lo
7.260	3.0	55.5	44.1	35.9	3.5	-34.1	0.0	0.6	61.3	49.9	74	54	-12.7	-9.9	H-lo
9.680	3.0			37.6	3.8	-33.5	0.0	0.8	8.8	8.8	74	54	-65.2	-45.2	H-lo - noise floor
7.260	3.0	55.1	43.8	35.9	3.5	-34.1	0.0	0.6	60.9	49.6	74	54	-13.1	-4.4	V-lo
9.680	3.0	52.0	41.8	37.6	3.8	-33.5	0.0	0.8	60.8	50.6	74	54	-13.2	-3.4	V-lo
12.100	3.0	48.0	38.9	38.6	3.8	-32.5	0.0	0.9	58.8	49.7	74	54	-15.2	-4.3	V-lo
14.520	3.0			39.8	5.1	-32.3	0.0	0.9	13.5	13.5	74	54	-60.5	-40.5	V-lo-noise floor

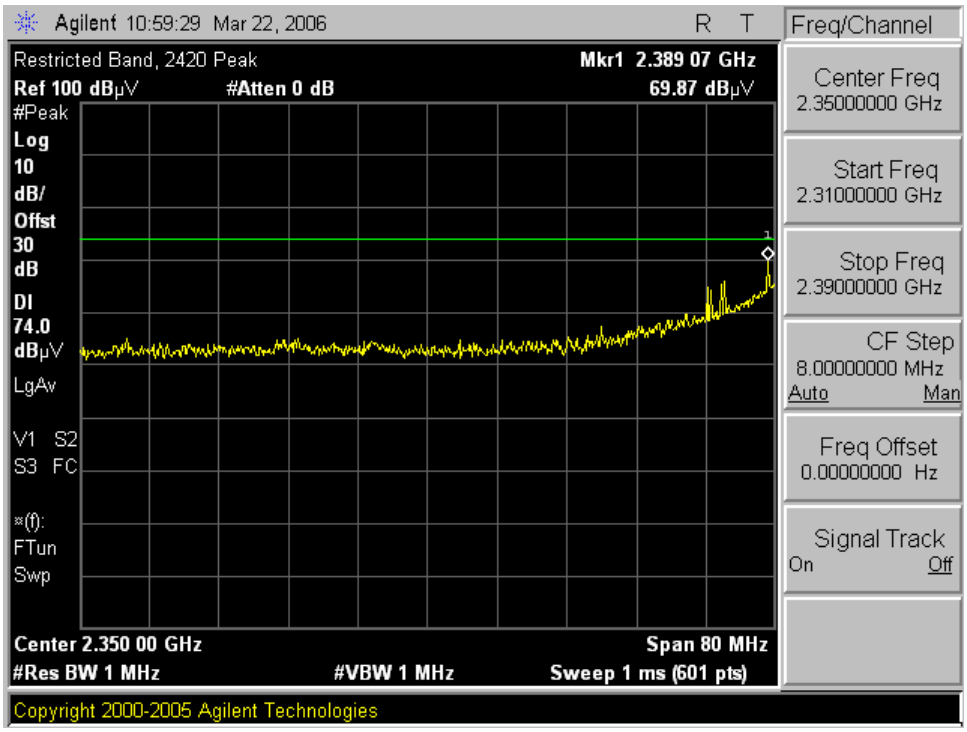
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field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

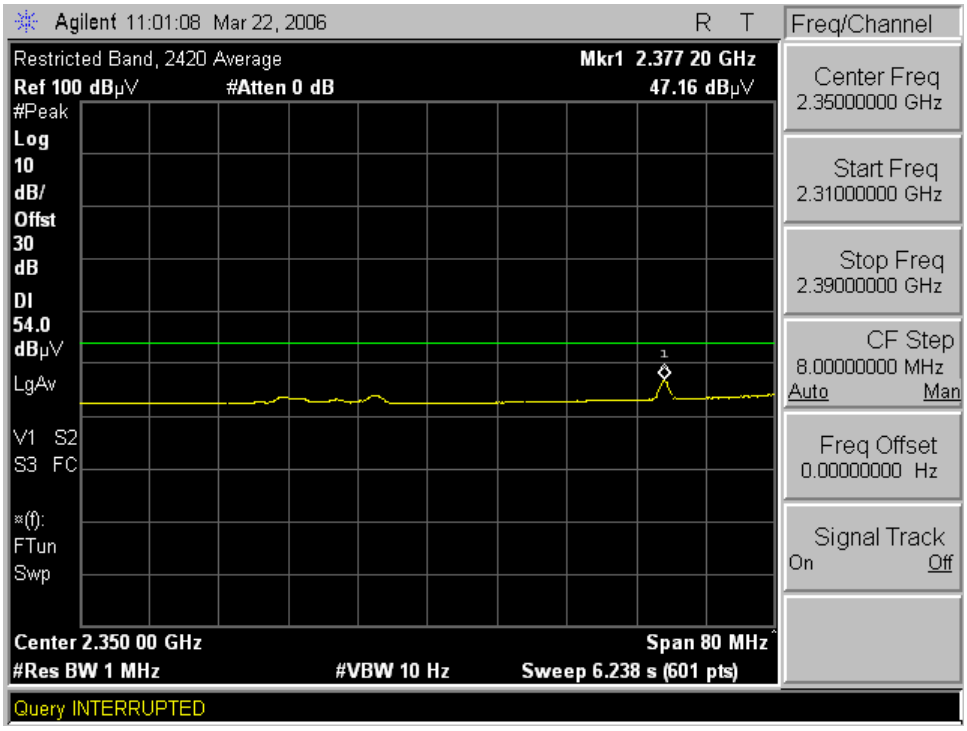
Worst Case Bandedge Radiated Emissions, 2310 – 2390 MHz – Circularly Polarized Antenna



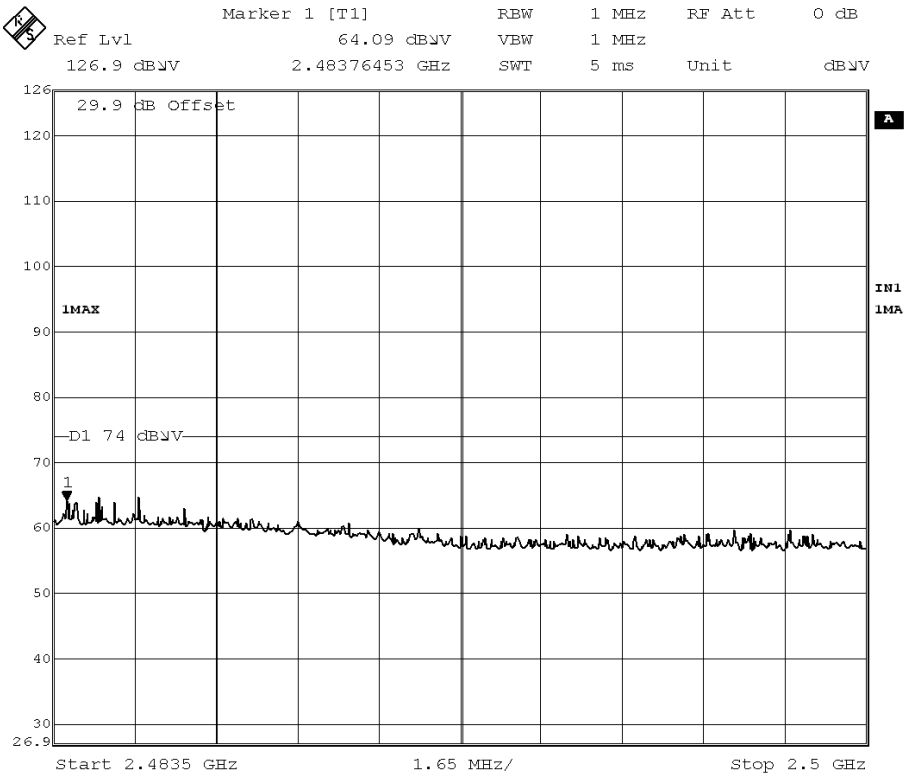


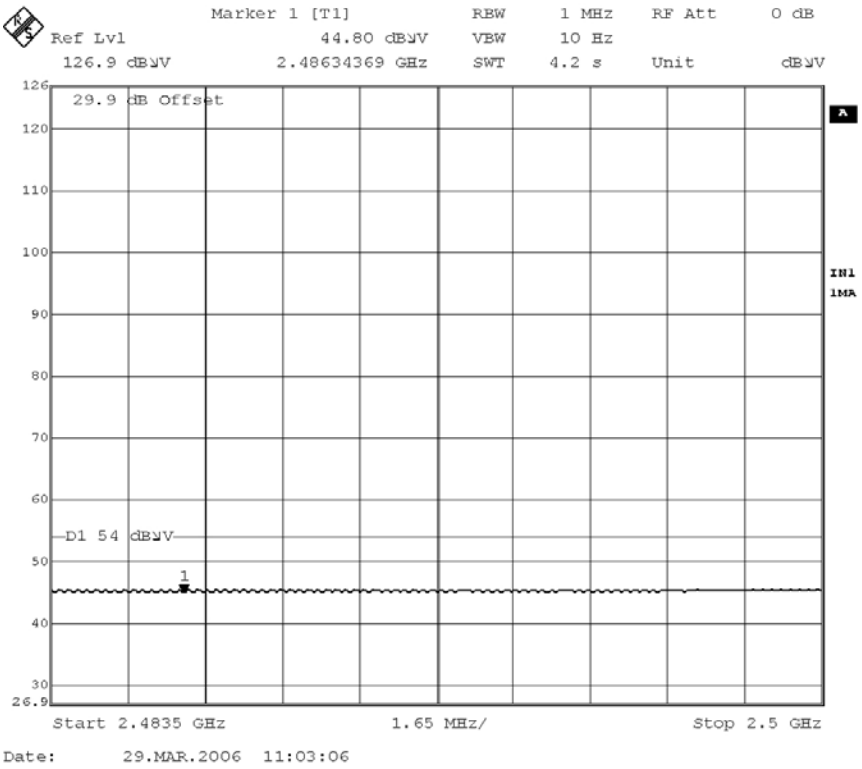
Worst Case Bandedge Radiated Emissions, 2310 – 2390 MHz – Linearly Polarized Antenna



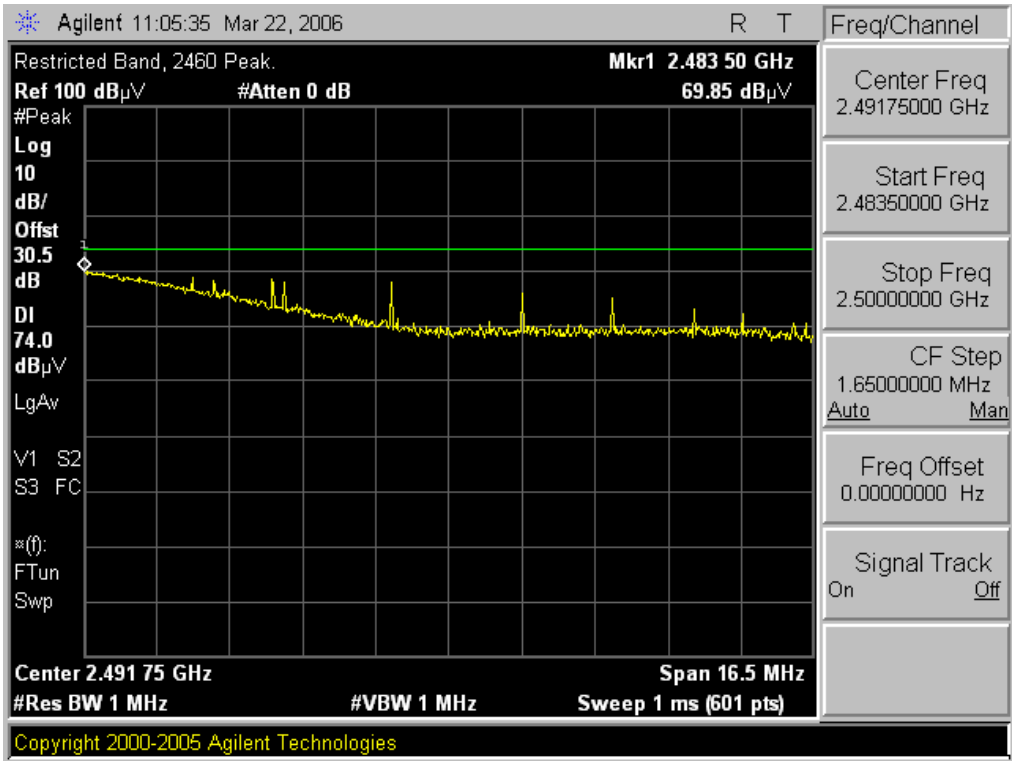


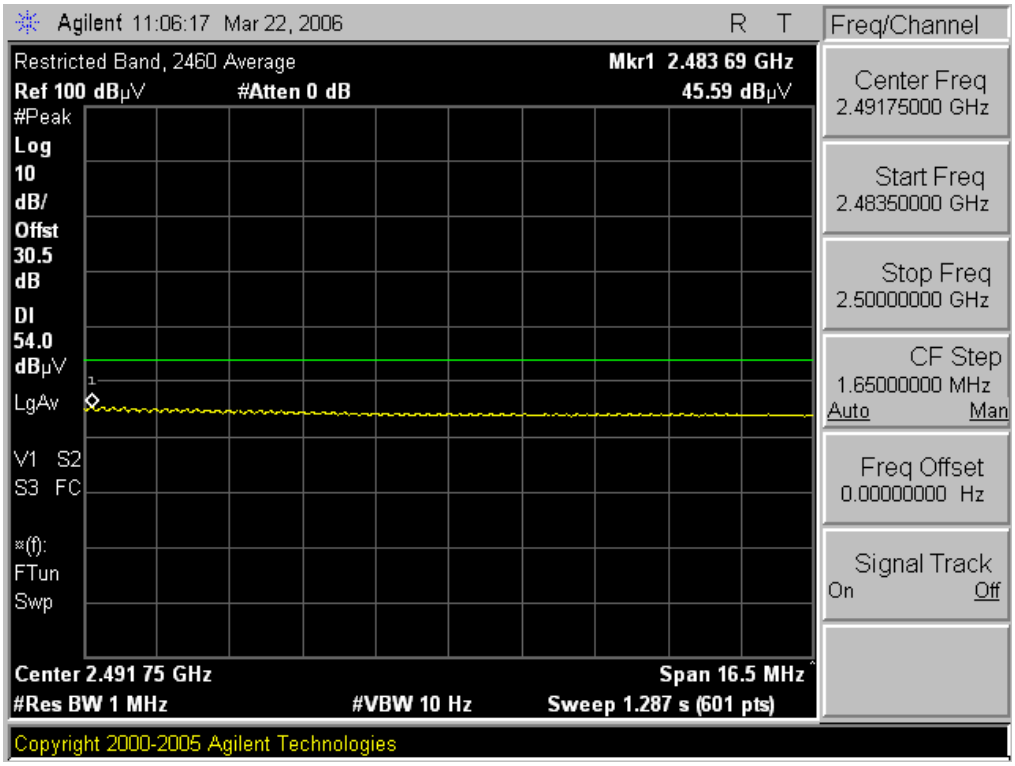
Worst Case Bandedge Radiated Emissions, 2483.5 – 2500 MHz – Circularly Polarized Antenna





Worst Case Bandedge Radiated Emissions, 2483.5 – 2500 MHz – Linearly Polarized Antenna



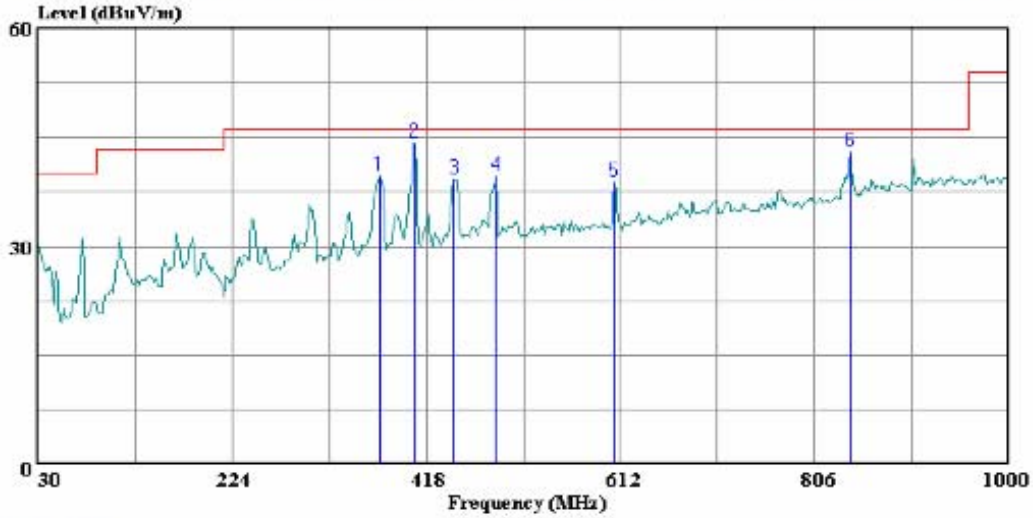


WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

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

COMPLIANCE Engineering Services, Inc.
561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 2 File#: 30MHz-1000MHz.EMI Date: 03-23-2006 Time: 16:53:13



(Audix ATC)

Trace: 1 Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator : Alvin Ilarina
Project # : 06U10168
Company : WJ Communications
EUT : SR 2500 Reader
Model No : SR 2500 Reader
Configuration : EUT/ 8dBi Antenna
Mode of operation: Tx Low
Target of Test : FCC 15.209

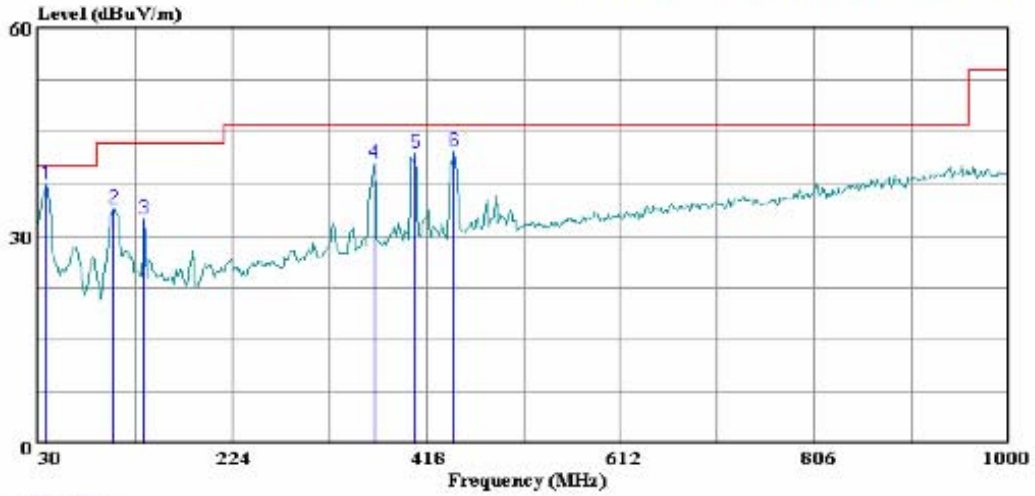
Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	371.440	22.29	17.44	39.73	46.00	-6.27	Peak
2	406.360	26.06	18.20	44.26	46.00	-1.74	Peak
3	446.130	20.05	19.09	39.14	46.00	-6.86	Peak
4	487.840	19.56	20.00	39.56	46.00	-6.44	Peak
5	606.180	17.24	21.63	38.87	46.00	-7.13	Peak
6	841.890	17.82	25.11	42.93	46.00	-3.07	Peak

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

561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 6 File#: 30MHz-1000MHz_no_laptop2.EMI
Date: 03-23-2006 Time: 17:49:16



(Audix ATC)
Trace: 5 Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator : Alvin Ilarina
Project # : 06U10168
Company : WJ Communications
EUT : SR 2500 Reader
Model No : SR 2500 Reader
Configuration : EUT/ 8dBi Antenna
Mode of operation: Tx Hi
Target of Test : FCC 15.209

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	38.730	21.25	16.12	37.37	40.00	-2.63	Peak
2	105.660	21.26	12.63	33.89	43.50	-9.61	Peak
3	135.730	17.35	14.96	32.31	43.50	-11.19	Peak
4	366.590	23.20	17.31	40.51	46.00	-5.49	Peak
5	407.330	23.81	18.21	42.02	46.00	-3.98	Peak
6	446.130	22.97	19.09	42.06	46.00	-3.94	Peak

5.3. POWERLINE CONDUCTED EMISSIONS

LIMIT

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The resolution bandwidth is set to 9 kHz for both peak detection and quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

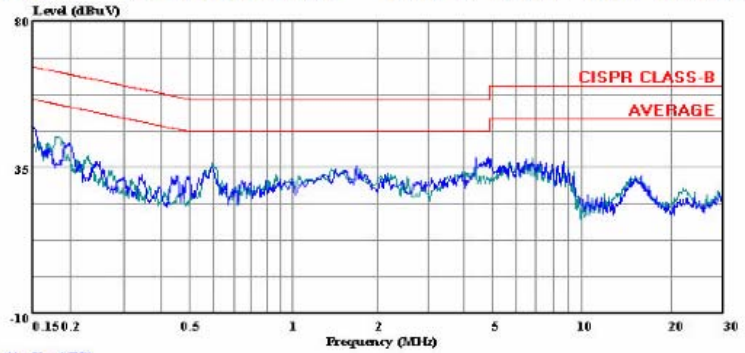
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

No non-compliance noted:

Compliance Certification Services
561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0885
Fax: (408) 463-0888

Data#: 7 File#: 06U10168.EMI Date: 03-22-2006 Time: 14:51:38

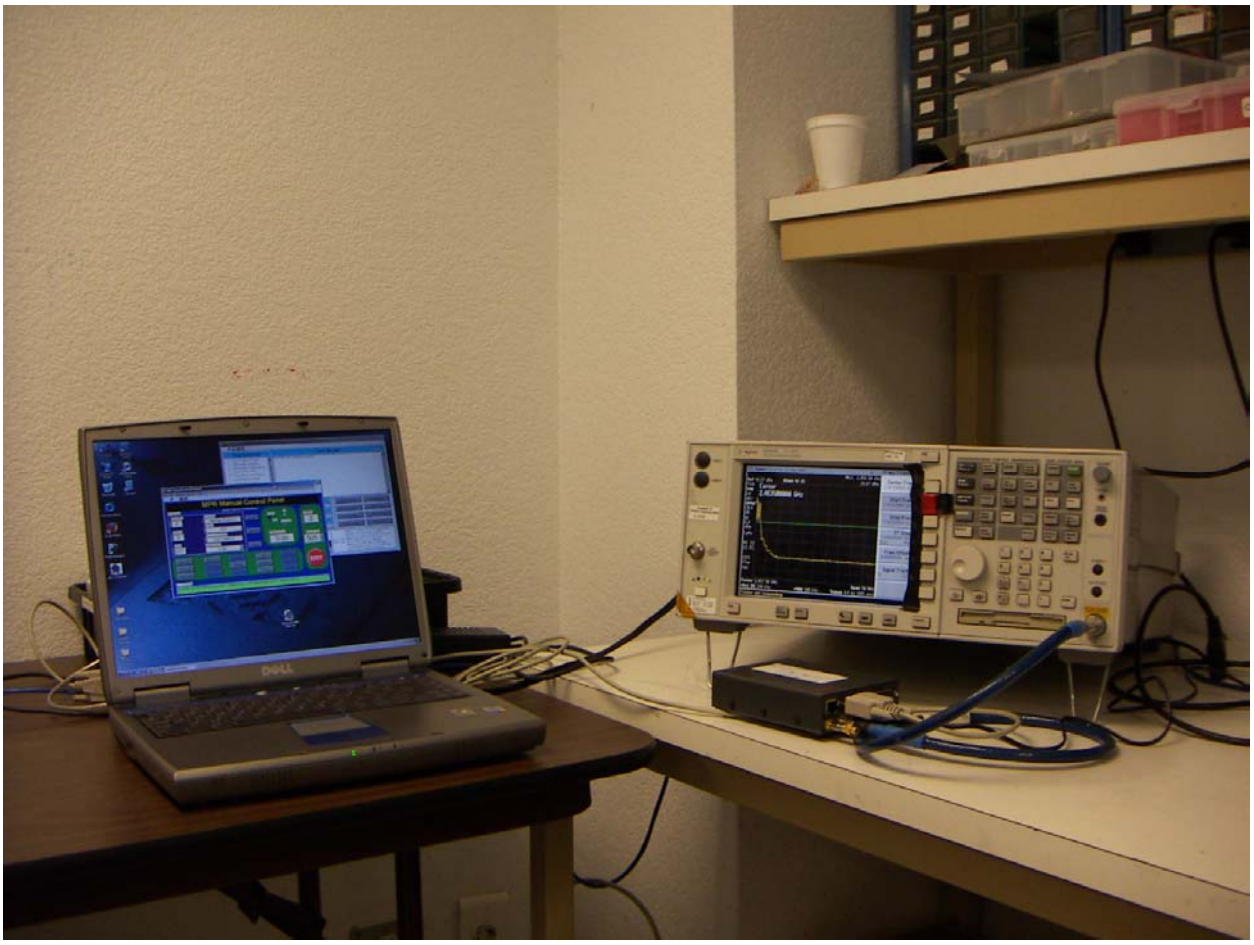


Trace: 3 Ref Trace:

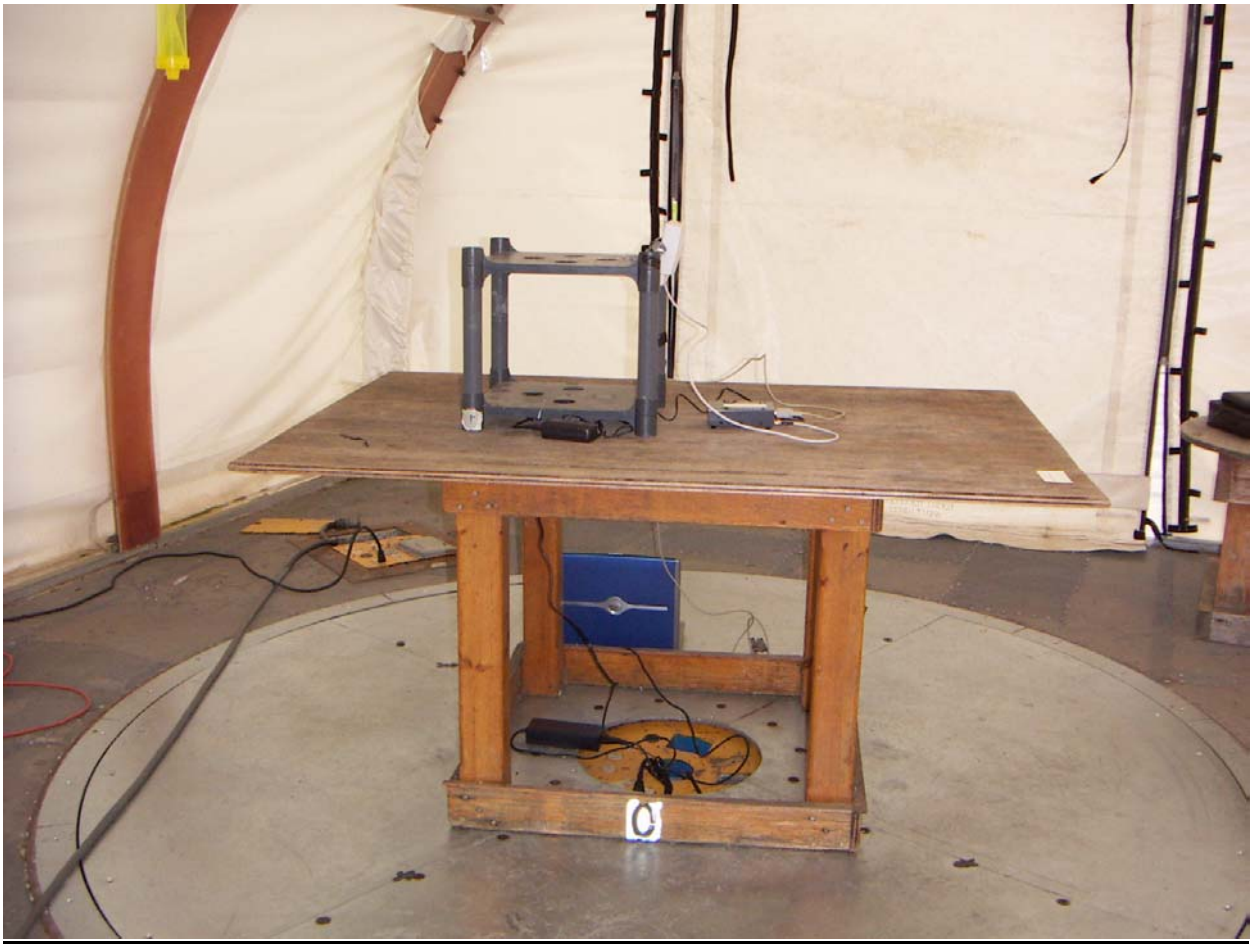
Condition: CISPR CLASS-B
Test Operator : Alvin Ilarina
Project # : 06U10168
Company : WJ Communications
EUT Description : RFID Reader
Model : SR 2500 Reader with S/N 28
EUT Config : EUT w/ antenna and support laptop
Mode Of Operation: TX
Target : FCC Class B
: L1: Peak (Black), Avg (Green)
Power Source : 115 VAC, 60 Hz

6. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



RADIATED RF MEASUREMENT SETUP



POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP

END OF REPORT