FCC CFR47 PART 15 SUBPART C

Test Report

902-928 MHZ RFID READER

Model Number: WJM3000

FCC ID: NTTWJM3000

Report Number: 06PR050FCC Rev 1.1

Issue Date: 7 January 2007

Prepared for

WJ Communications Inc.
401 River Oaks Parkway
San Jose 95134

Prepared by

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

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Report Revision History

REV	Description	Revised By	Date
1.0	Initial Issue	T. Cokenias	12/22/2006
1.1	Update TX timing calculations Add spectrum analyzer plots: band edge and number of hopping channels	T. Cokenias	01/08/2007

ATTESTATION OF TEST RESULTS

COMPANY NAME: WJ COMMUNICATIONS
401 RIVER OAKS PARKWAY
SAN JOSE, CA 95134

EUT DESCRIPTION: RFID READER CARD

MODEL: WJM3000

DATA ALSO APPLIES TO: WJM1000

DATE TESTED: 4 – 19 December 2006 and 3 January 2007

1. 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.

2. EQUIPMENT UNDER TEST

2.1. DESCRIPTION OF EUT

Model WJM3000 is a 1 watt RFID Reader card for use with a 6dBi circularly polarized antenna or a 6 dBi linearly polarized antenna. Model WJM1000 has identical circuitry and layout, but is limited in output power to 24 dBm. The RF power amplifiers of the two models are of the same design and have the same footprint, but different maximum power dissipation.

The EUT is capable of producing 10 types of modulation that are standards in the RFID tag industry:

SRE0, SRE1, SRE2
MRE0, MRE1, MRE2
DRE0, DRE1, DRE2
ISO6B

The 0,1, and 2 suffixes for SRE, DRE and MRE modulations are for different tari times.

Tests were performed at worst-case modulation, as determined in section 2.5 below.

2.2. MAXIMUM OUTPUT POWER

SRE0 Modulation (Worst Case)

Channel	Frequency (MHz)	Power (dBm)	Power (mW)
Low	902.75	28.95	785.2
Middle	914.75	29.83	961.6
High	927.25	28.41	693.4

2.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a circularly polarized flat panel antenna, with a maximum gain of 6 dBiL, and a linearly polarized flat panel antenna with a gain of 6 dBi.

2.4. SOFTWARE AND FIRMWARE

The software use during testing was LDR 3_6.exe

2.5. WORST-CASE TEST CONFIGURATIONS

There are a total of 10 types of modulation capable for this product. There are 30 possible combinations for antenna port tests (3 channels x 10 modulations) and 180 possible combinations for radiated spurious emissions (3 channels x 10 modulations x 3 module orientations x 2 antennas). Preliminary tests and the engineering rationale that follows were used to determine the worst-case modes for each test and to thereby reduce the number of required test combinations.

a. **20 dB bandwidth.** The mode producing the largest 20 dB emission bandwidth was chosen as worst case.
Test result: Modulation SRE0

b. **Peak output power.** Preliminary testing showed each modulation is capable of producing a maximum of 30 dBm, no differences determined among various modes.
Mode chosen: Modulation SRE0

c. **Antenna port spurious.** Preliminary testing showed no discernable differences in conducted spurious emissions with the different modulations.
Mode chosen: Modulation SRE0.

d. **Band edge (-20 dBc) emissions.** The mode producing the largest emission bandwidth was chosen as worst case.
Test result: Modulation SRE0

e. **Radiated spurious and harmonic emissions – modulation.** Worst case modulation for radiated emissions was determined in the following way:

1. Emissions were measured from 1GHz – 9280 MHz for SRE2 modulation, mid channel. Search antenna was raised and lowered, the EUT was rotated through 360 degrees in order to obtain the maximum field strength from each EUT emission.
2. The worst-case emission was identified (7318 MHz, 8th harmonic).
3. Testing was performed at 7318 MHz for all 10 modulations. The modulation yielding the highest amplitude was chosen for testing at LOW, MID and HIGH channels.

Test Result: Modulation SRE2

f. **Radiated spurious and harmonic emissions – orientation.** Using the SRE2 modulation determined in step (e), harmonic and spurious emissions were measured up to the 10th harmonic of the Mid channel frequency (914.75 MHz) for X-plane, Y-plane, and Z-plane orientations.

The orientation that yielded the worst-case emission was chosen for tests on the Low and High channels as well.
Test Result: Y-plane orientation

g. **Hopping channel separation and number of hopping channels.** For each modulation, there 50 channels separated by approximately 500 kHz. The frequency generator is the same for each modulation, only the modulation is different
Mode chosen: Modulation SRE0.

h. **Channel occupancy time.** All modulations were investigated for channel occupancy time. The main differences in the time of occupancy depended on channel bandwidth – occupancy times for channel bandwidths less than 250 kHz were taken over a 20 second period, for modulation channel band widths greater than 250 kHz occupancy times were measured over a 10 second period.

Test Result. Modulation SRE0 for bandwidth >250 kHz
Modulation ISO6B for bandwidth < 250 kHz

2.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Description	Manufacturer	Model
Laptop computer	Compaq	Presario V2000CA
EUT DC power supply	CUI	DPS060200UPS-P5-SZ
RFID Tag	Texas Instruments	C1G2 tag
RFID Tag	Intermec	ISO6B tag

I/O CABLES

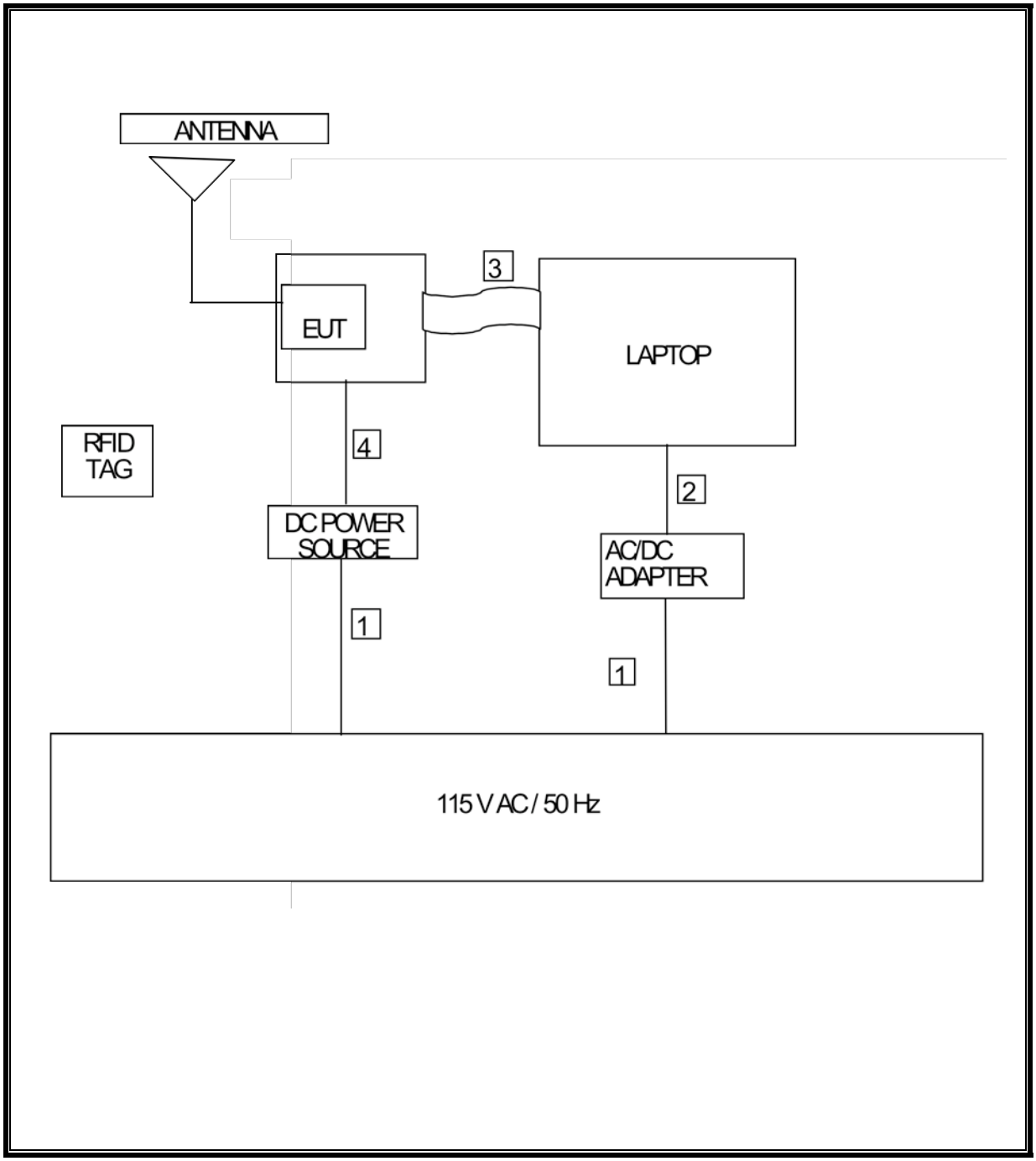
I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	2	AC	Un-shielded	0.5 m	N/A
2	DC	1	DC	Un-shielded	1m	N/A
3	USB/SERIAL	1	RS-232	Un-shielded	1m	N/A
4	DC	1	DC	Un-shielded	0.5m	N/A

TEST SETUP

The EUT is a self-contained RF module. For test purposes, the module was mounted on a metal heat sink on which a power and data interface circuit is also mounted. The interface card is used to connect the RF module to a laptop computer and to an external DC power supply.

The laptop sets channel, modulation, and power output, as well as enabling the hopping function when required.

SETUP DIAGRAM FOR TESTS



3. 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**	**Serial Number**	**Cal Due**
LISN, 10 kHz ~ 30 MHz	FCC	50/250-25-2	4/23/00	10/13/07
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	10/13/07
EMI Test Receiver	R & S	ESHS 20	827129/006	7/17/07
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	11/21/07
RF Filter Section	HP	85420E	3705A00256	11/21/07
30MHz---- 2Ghz	Sunol Sciences	JB1 Antenna	A121003	12/22/06
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	2/4/07
Amplifier 1-26GHz	MITEQ	NSP2600-SP	924342	4/25/07
Spectrum Analyzer 20 Hz ~ 44 GHz	Agilent	E4446A	US42070220	4/1/07
1.5 GHz High Pass Filter	Micro-Tronics	HPM13193	2	N/A

4. LIMITS AND RESULTS

4.1. ANTENNA PORT

4.1.1. 20 dB BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

Modulation was set to SRE0, determined previously as worst-case for this test. 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.

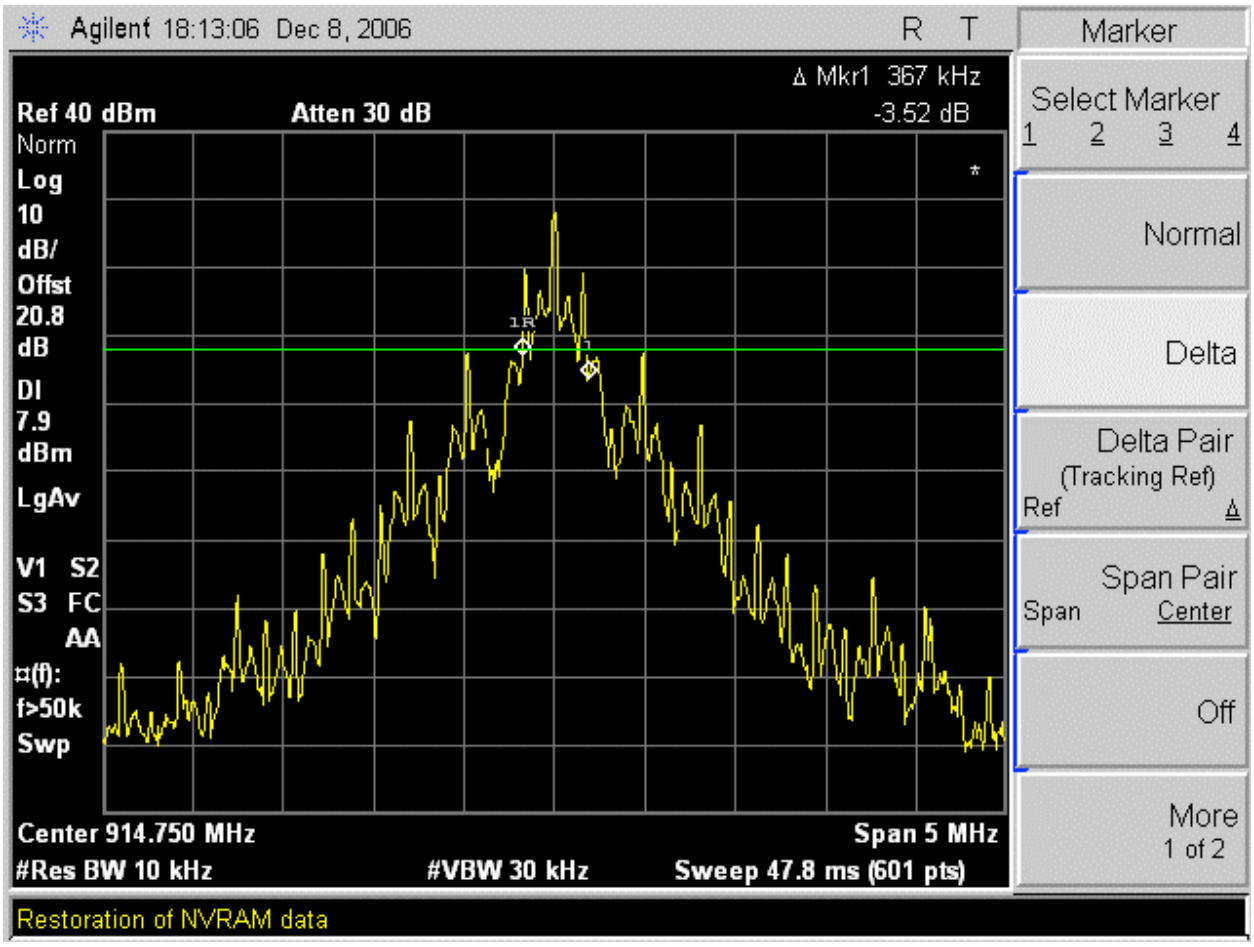
RESULTS

No non-compliance noted:

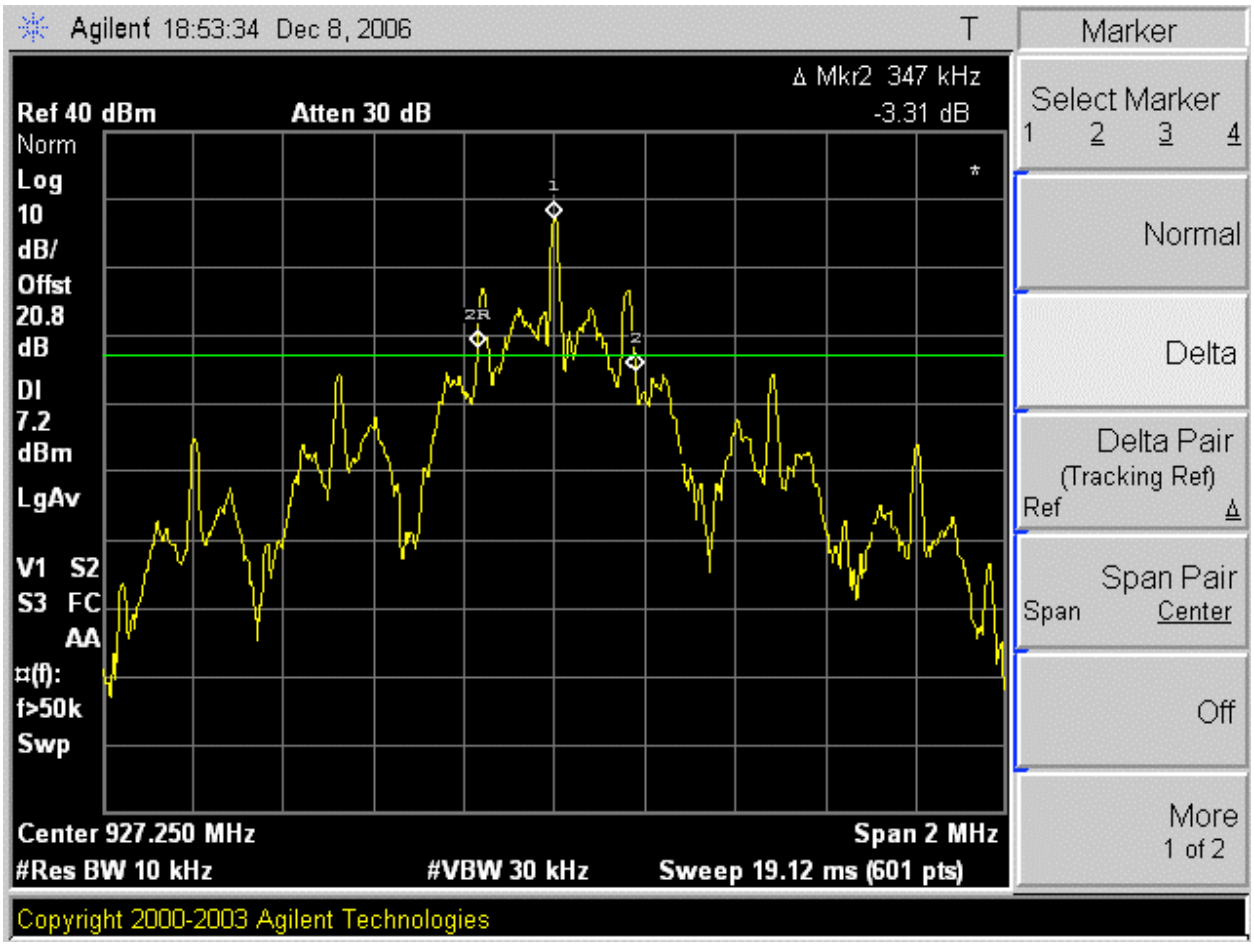
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	902.75	350
Middle	914.75	367
High	927.25	347

20 dB BANDWIDTH LOW CHANNEL (Worst Case Modulation: SRE0)

20 dB BANDWIDTH MID CHANNEL (Worst Case Modulation: SRE0)



20 dB BANDWIDTH HIGH CHANNEL (Worst Case Modulation: SRE0)



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

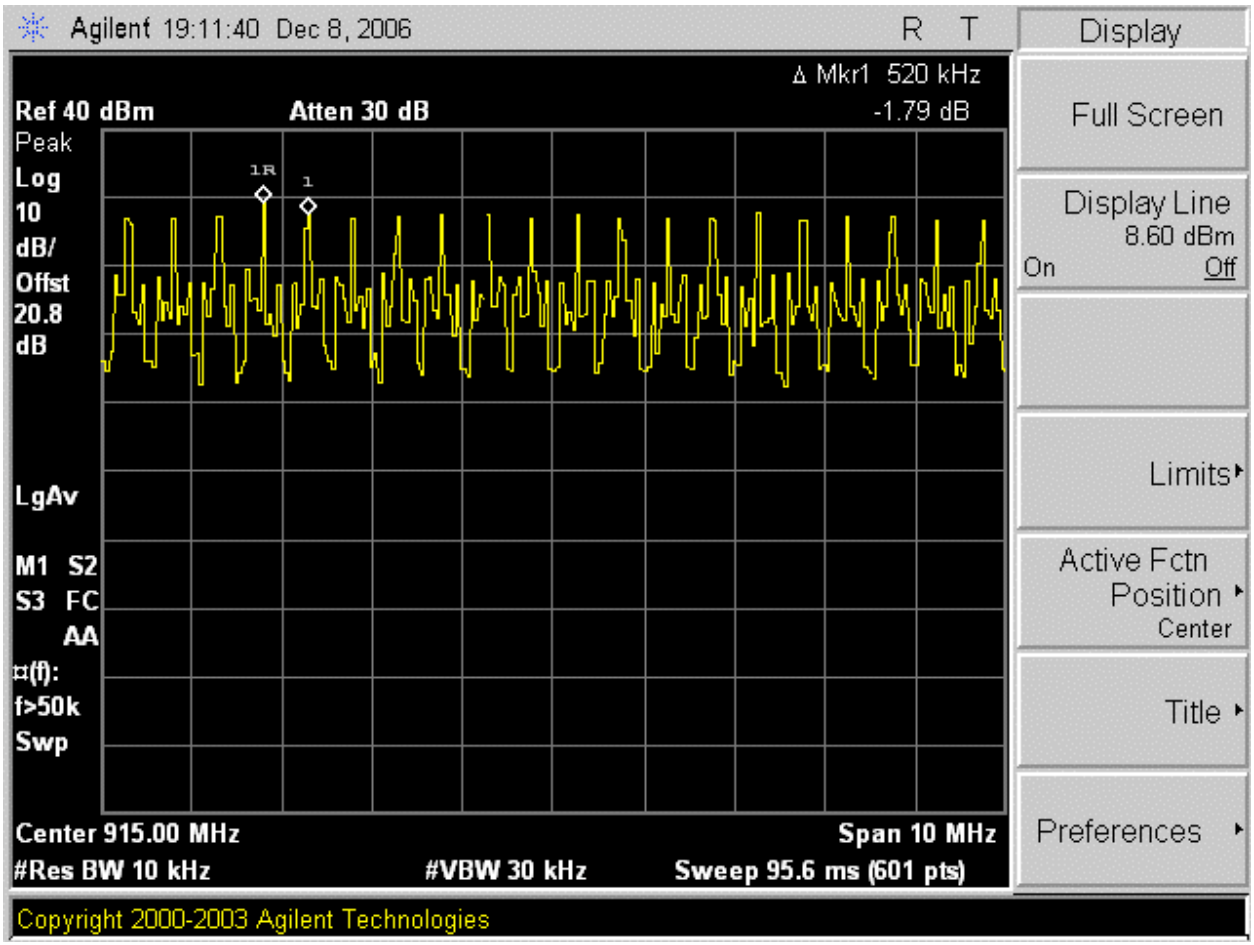
The transmitter output is connected to a spectrum analyzer. The RBW is set to 10 kHz and the VBW is set to 30 kHz. The sweep time is coupled.

RESULTS

No non-compliance noted:

The separation is 520KHz, greater than the 367 kHz 20dB bandwidth.

HOPPING FREQUENCY SEPARATION



4.1.2. NUMBER OF HOPPING CHANNELS

LIMIT

§15.247 (a) (1) (i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

TEST PROCEDURE

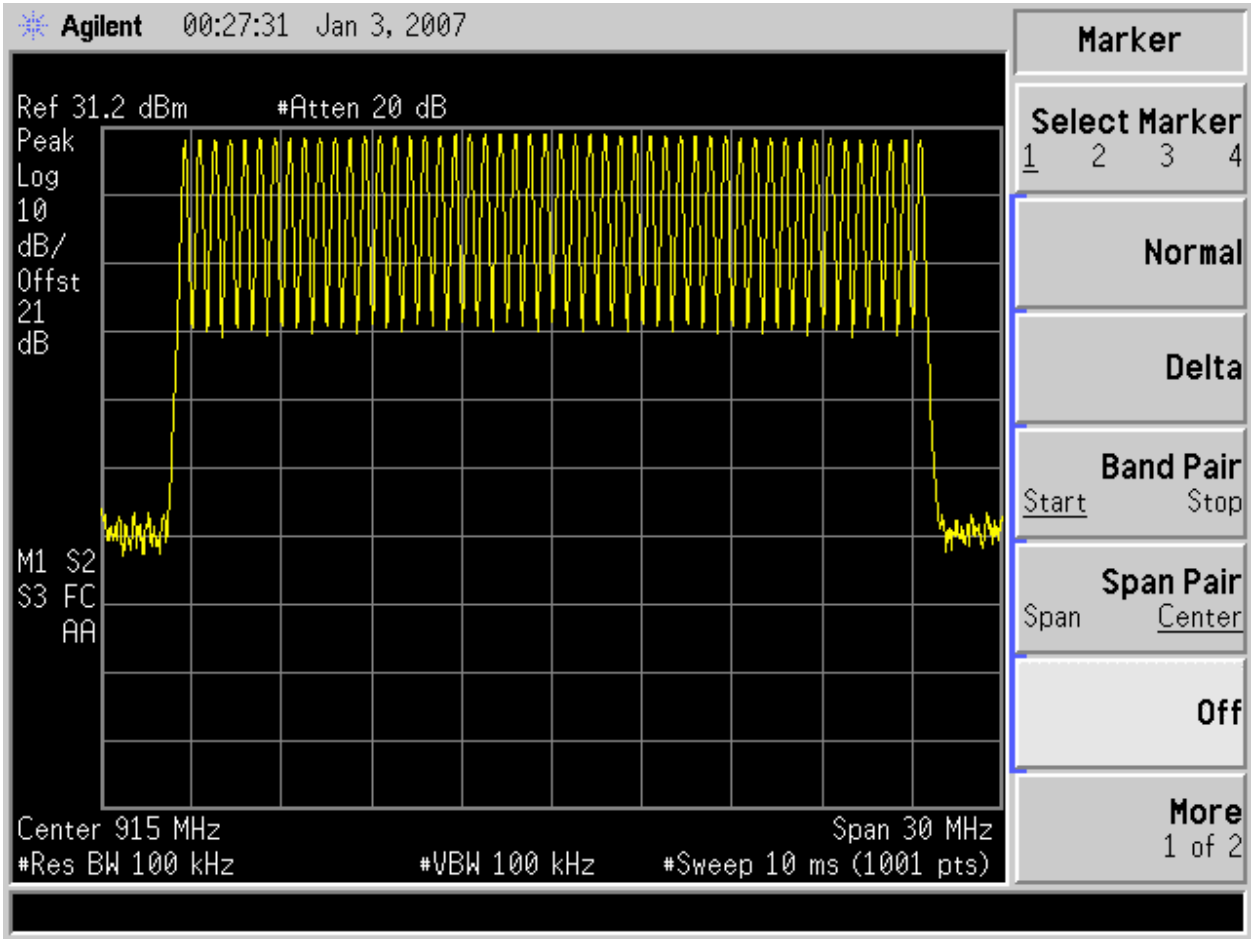
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to 3 % of the span. The analyzer is set to Max Hold.

RESULTS

No non-compliance noted:

50 Channels observed.

NUMBER OF HOPPING CHANNELS



4.1.3. AVERAGE TIME OF OCCUPANCY

LIMIT

§15.247 (a) (1) (i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

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 width of a single pulse is measured in a fast scan. The number of pulses is measured in a 10 or 20 second scan, depending on 20dB channel bandwidth, to enable resolution of each occurrence.

RESULTS

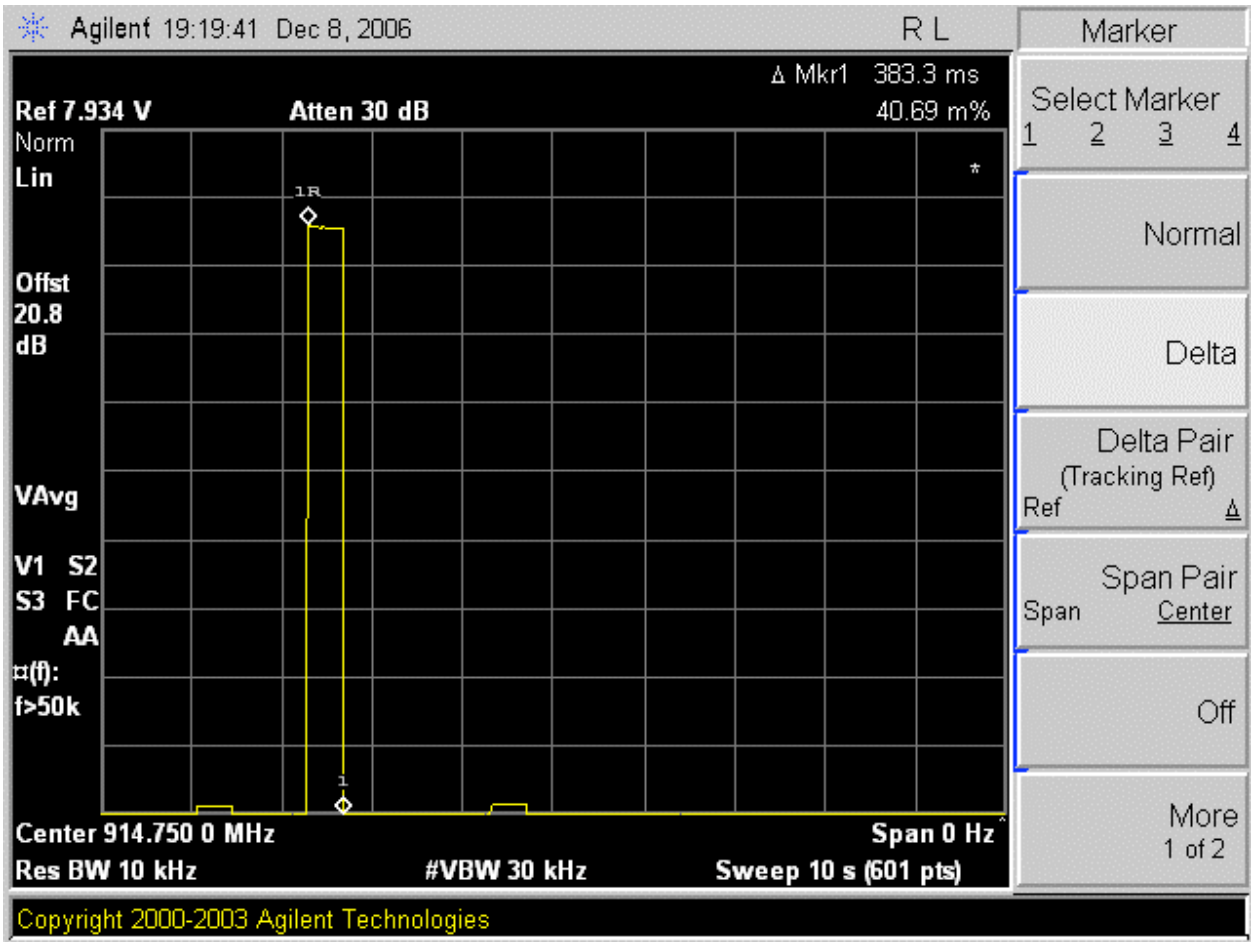
No non-compliance noted:

The system has 50 hopping frequencies.

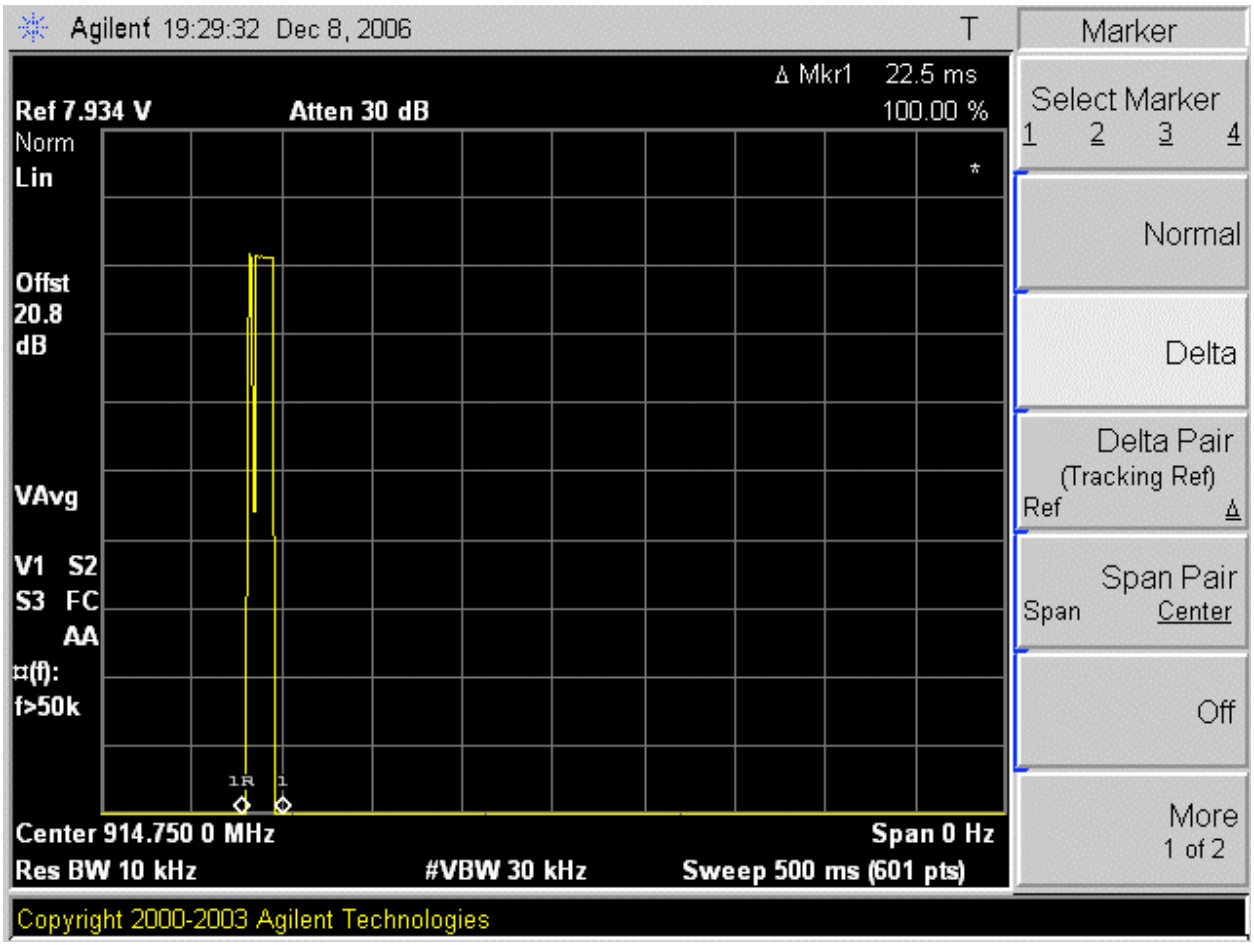
SRE0 Modulation:
Each transmission is 383 mS long. Each transmission takes place on one of 50 different channels in a pseudo-random sequence. All 50 channels are used equally on the average. The algorithm that determines the pseudo-random hop sequence does not allow the device to transmit on the same channel more than once in a 10 second period.

ISO6B
Modulation: Each transmission is 22.5mS long. Each transmission takes place on one of 50 different channels in a pseudo-random sequence. All 50 channels are used equally on the average. The algorithm that determines the pseudo-random hop sequence does not allow the device to transmit on the same channel more than twice in a 20 second period, for a total ON time of 43 msec.

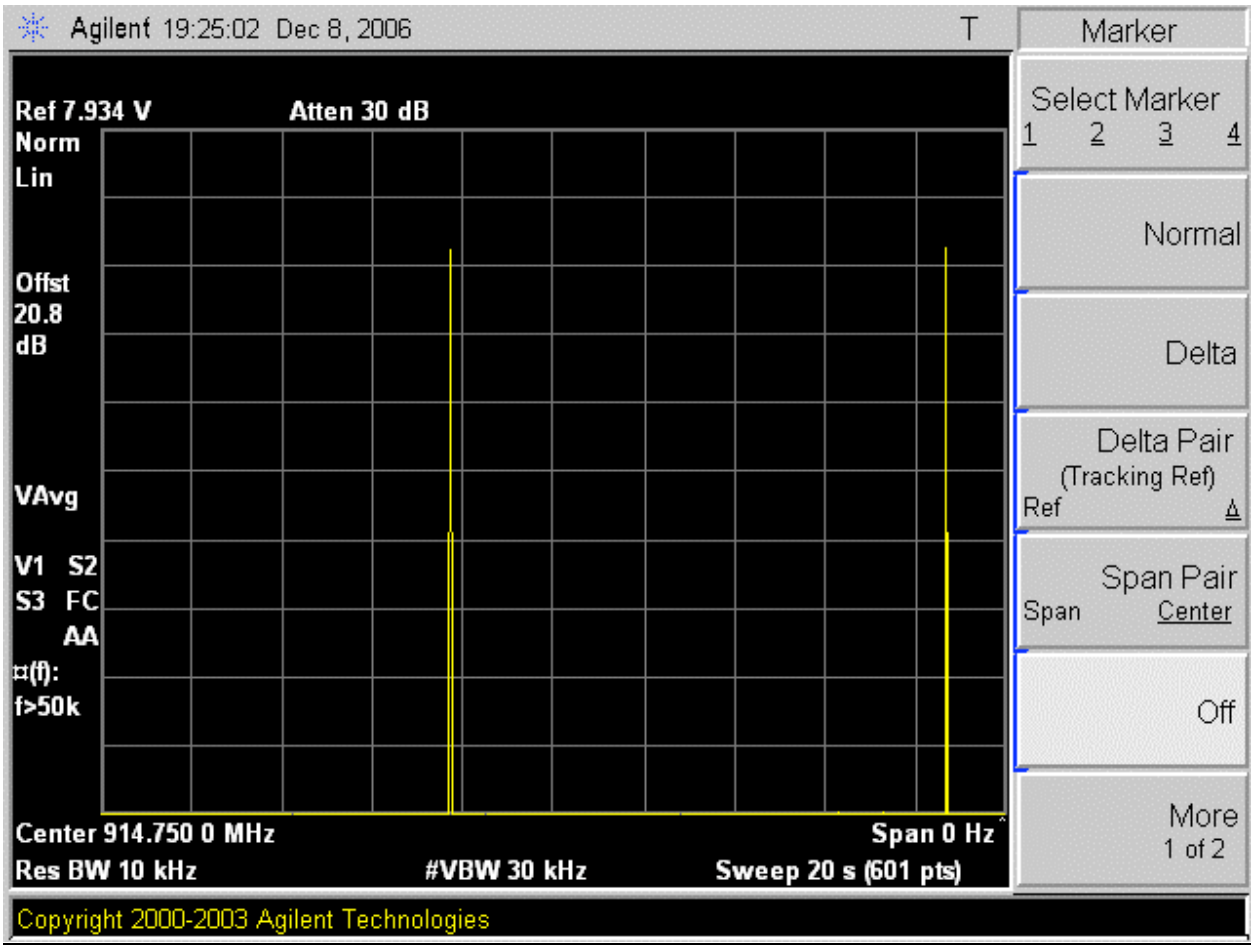
PULSE WIDTH AND OCCUPANCY SRE0 MODULATION



PULSE WIDTH ISO6B MODULATION



NUMBER OF PULSES IN 20 SEC ISO6B MODULATION



PEAK OUTPUT POWER

PEAK POWER LIMIT

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

§15.247 (b) (2) For frequency hopping systems operating in the 902-928 MHz band, employing at least 50 hopping channels: 1 watt; and employing less than 50 hopping channels, but at least 25 hopping channels: 0.25 watt.

§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.

The maximum antenna gain is 6 dBi, therefore the limit is 30 dBm.

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.

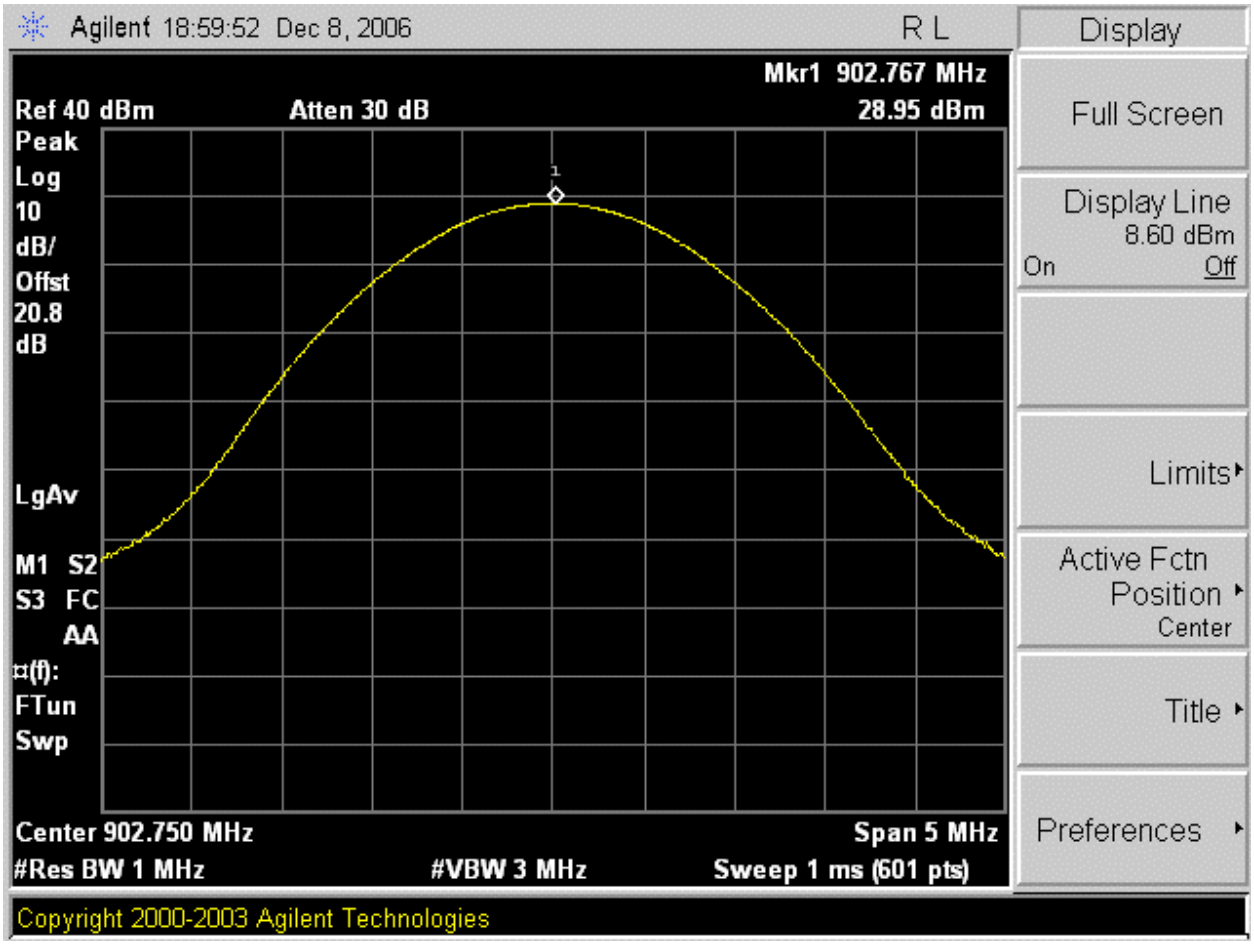
RESULTS

No non-compliance noted:

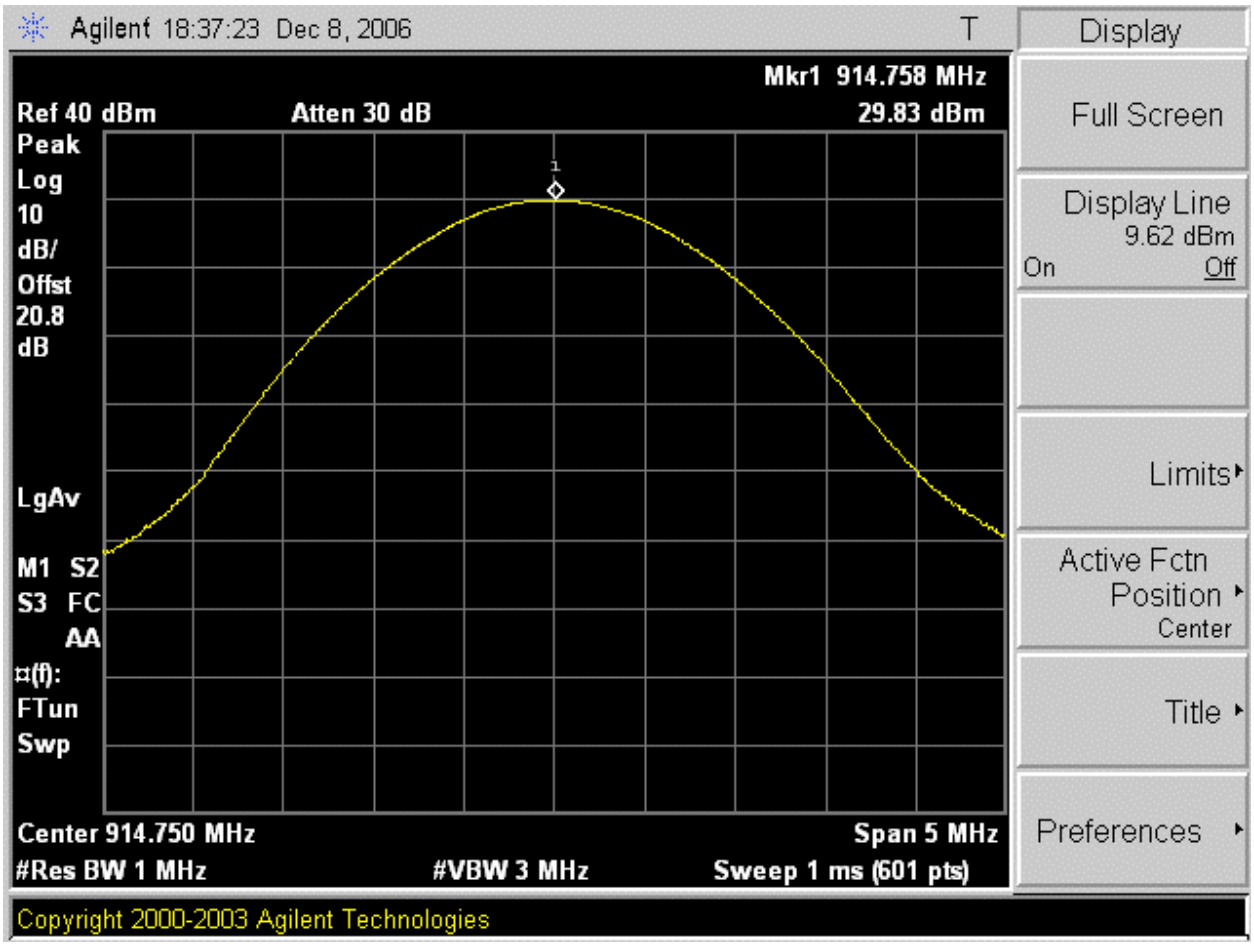
SRE0 Modulation (Worst Case)

Channel	Frequency (MHz)	Power (dBm)	Power (mW)
Low	902.75	28.95	785.2
Middle	914.75	29.83	961.6
High	927.25	28.41	693.4

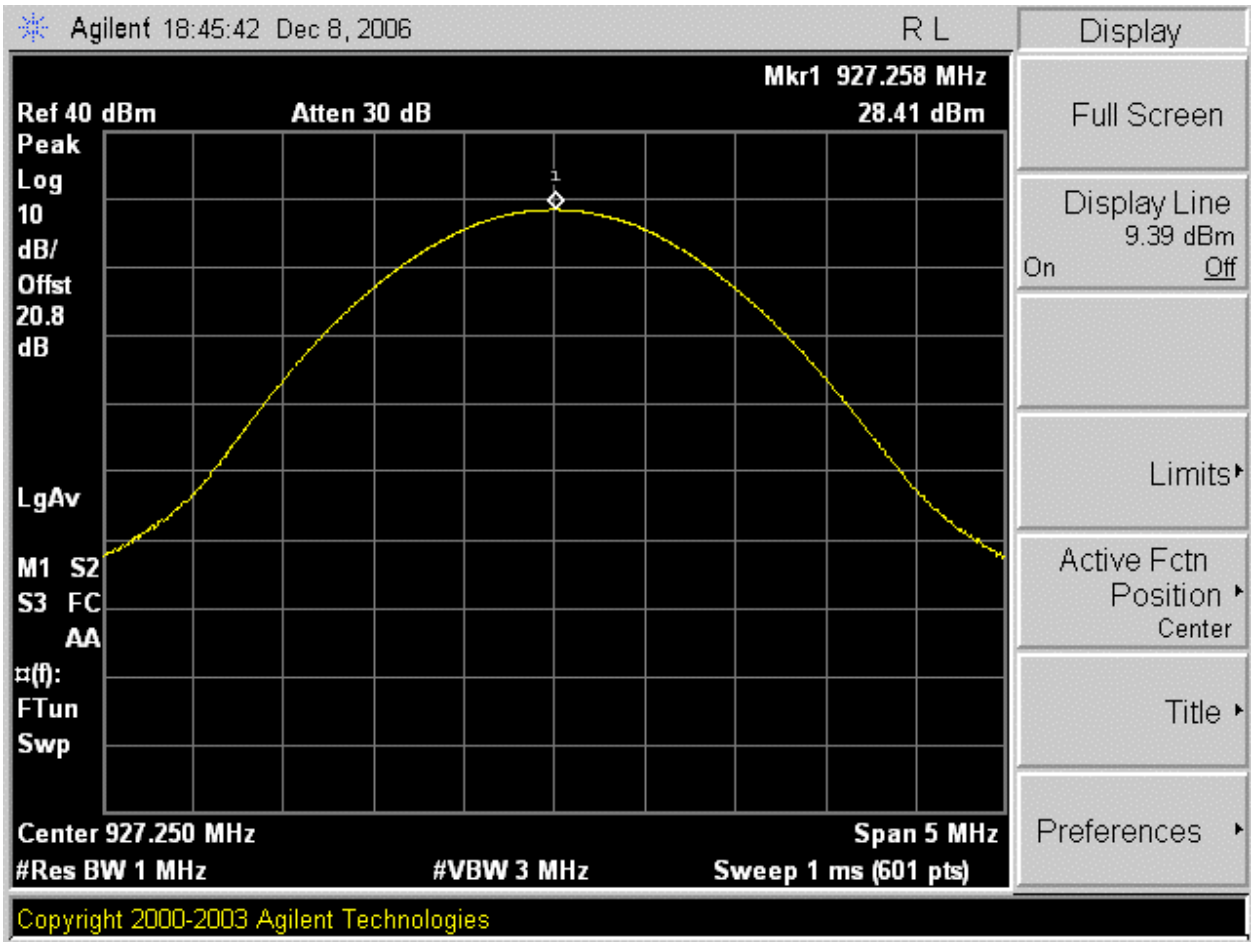
OUTPUT POWER LOW CHANNEL (Worst Case Modulation SRE02)



OUTPUT POWER MID CHANNEL (Worst Case Modulation SRE02)



OUTPUT POWER HIGH CHANNEL (Worst Case Modulation SRE02)



4.1.4. 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 = Antenna Gain in dBi
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	29.83	6.00	17.45

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.

4.1.5. 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

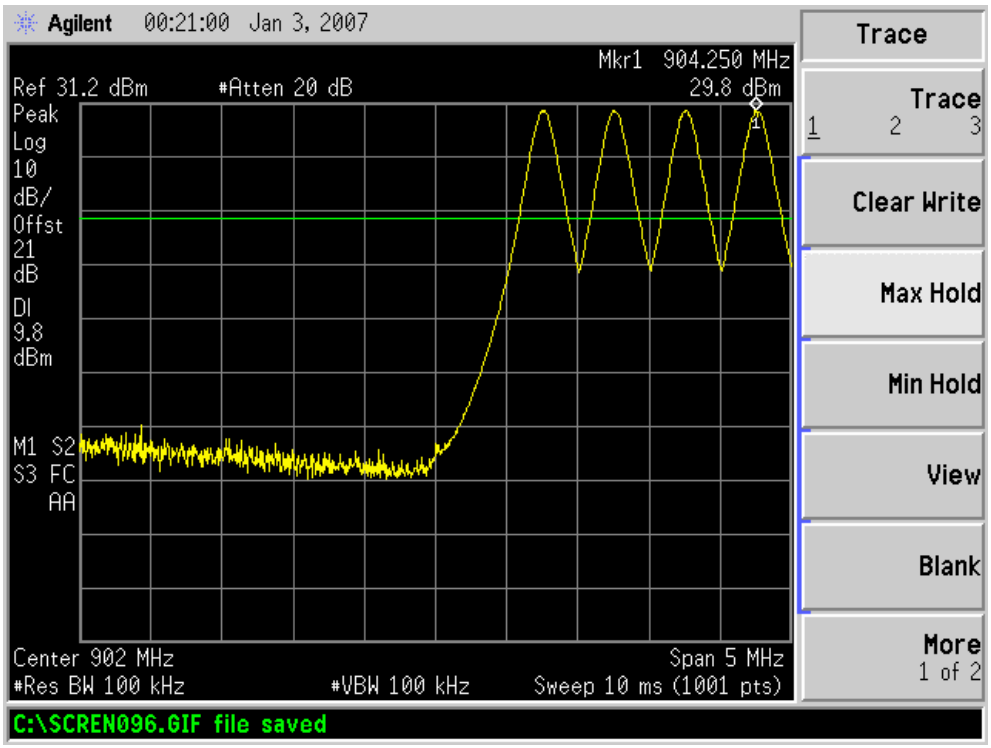
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

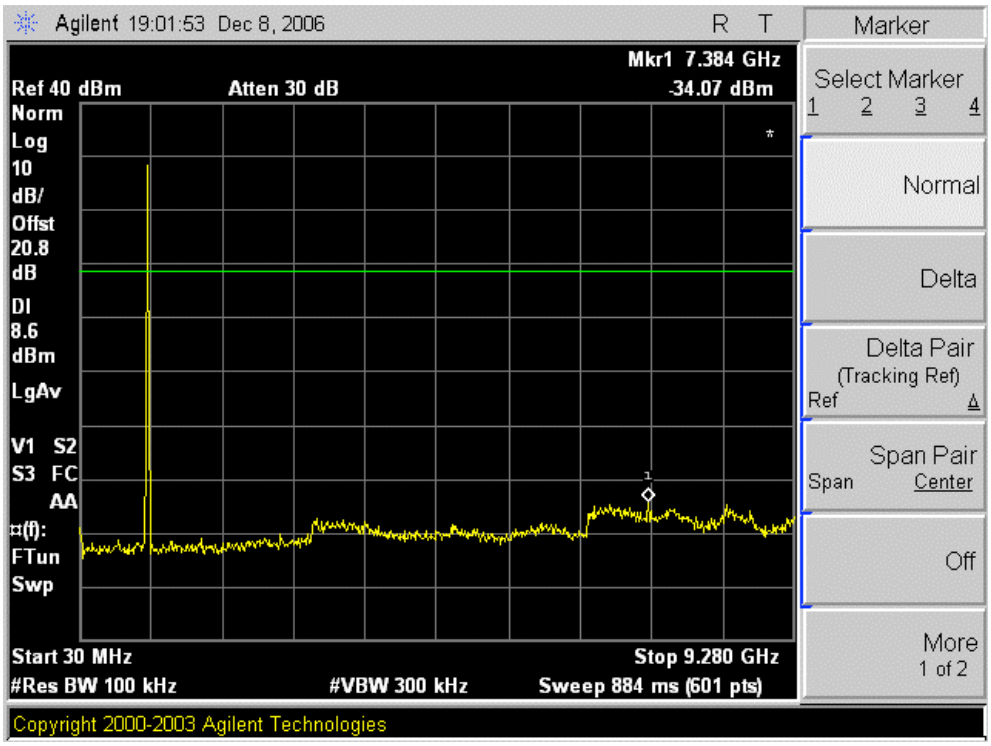
The spectrum from 30 MHz to 9.28 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

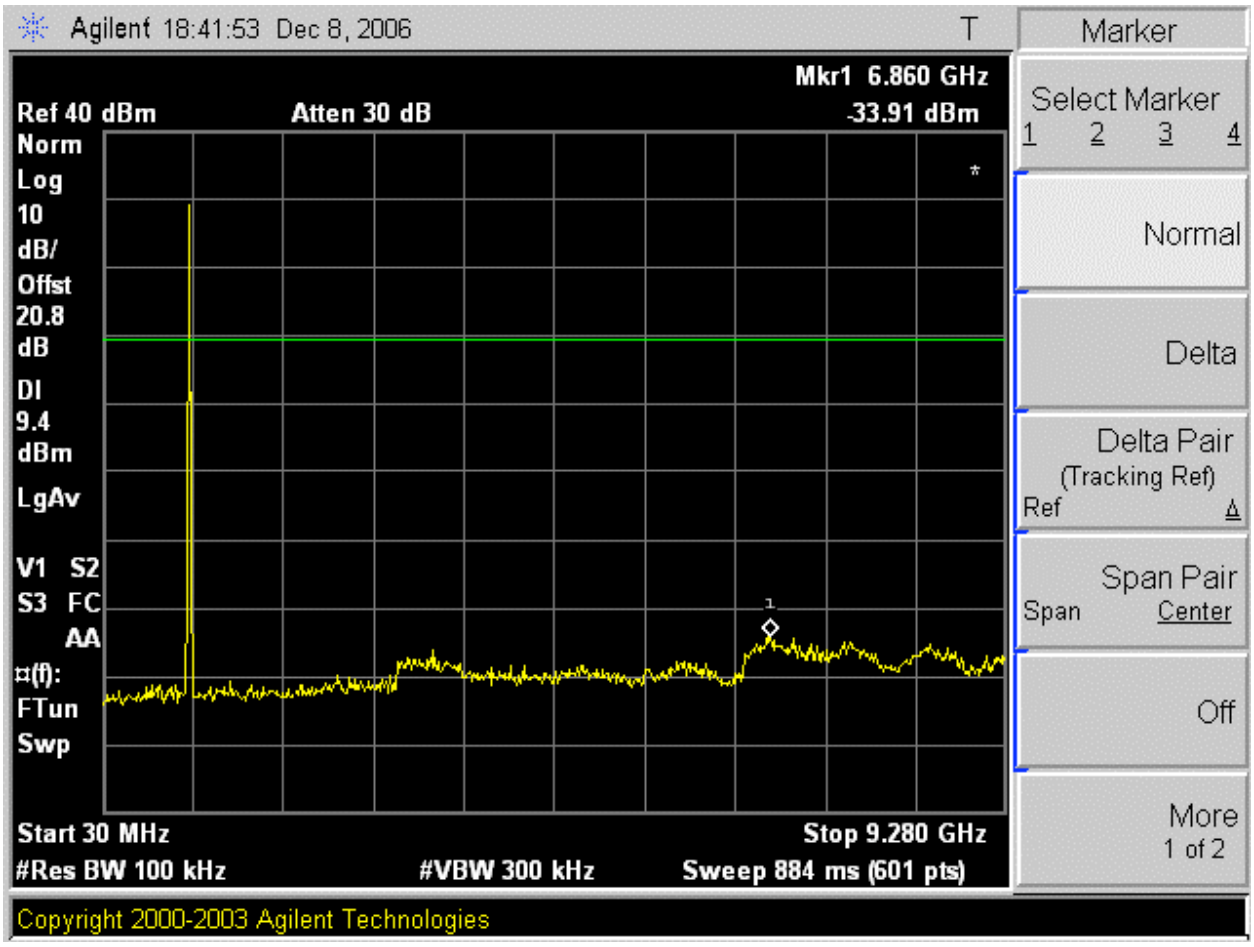
No non-compliance noted:

SPURIOUS EMISSIONS, LOW CHANNEL (Worst Case Modulation SRE02)

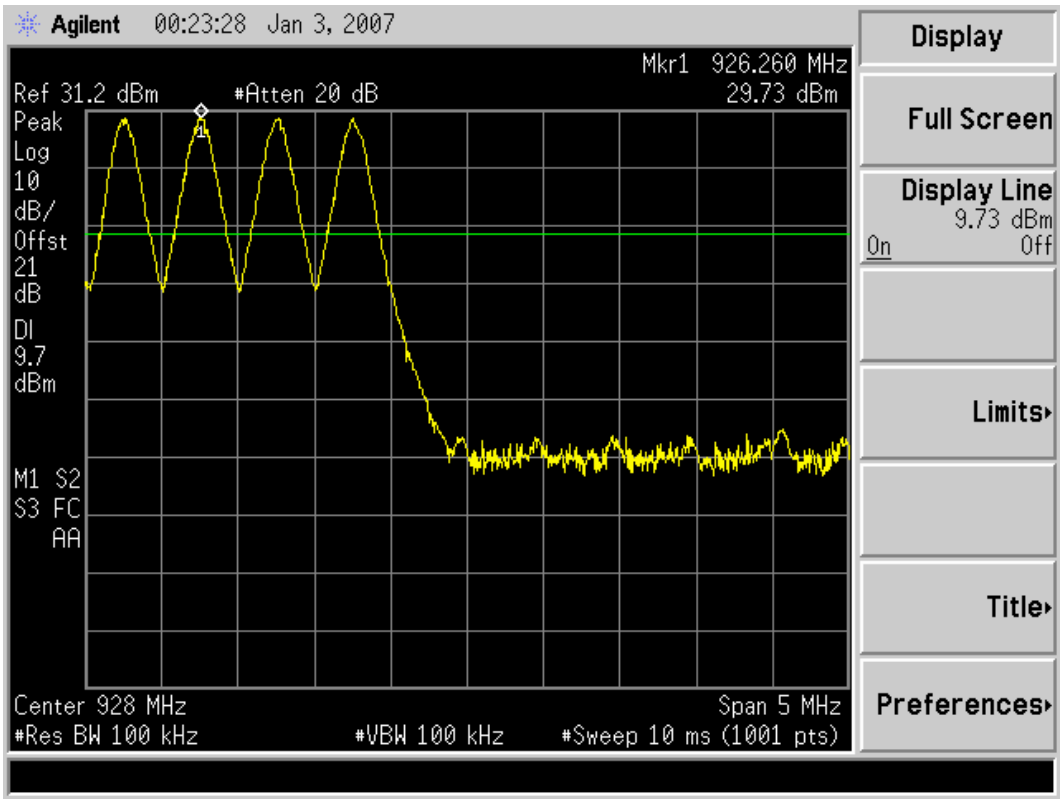


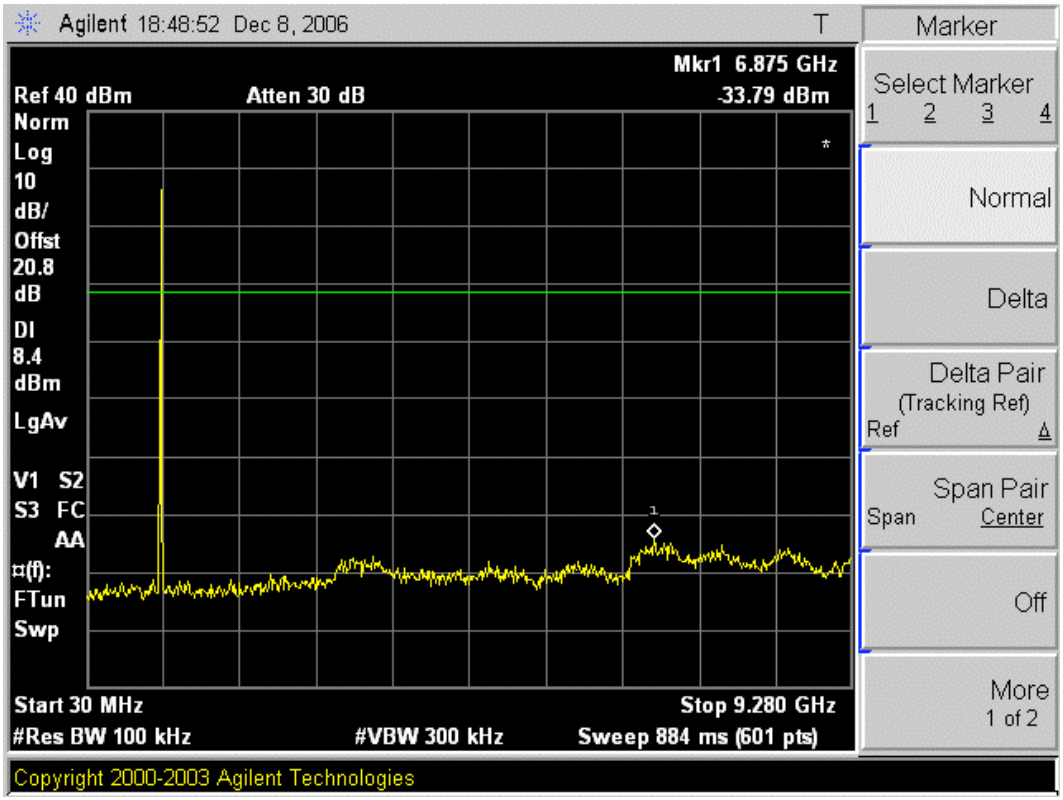


SPURIOUS EMISSIONS, MID CHANNEL (Worst Case Modulation SRE02)



SPURIOUS EMISSIONS, HIGH CHANNEL (Worst Case Modulation SRE02)





4.1.6. 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

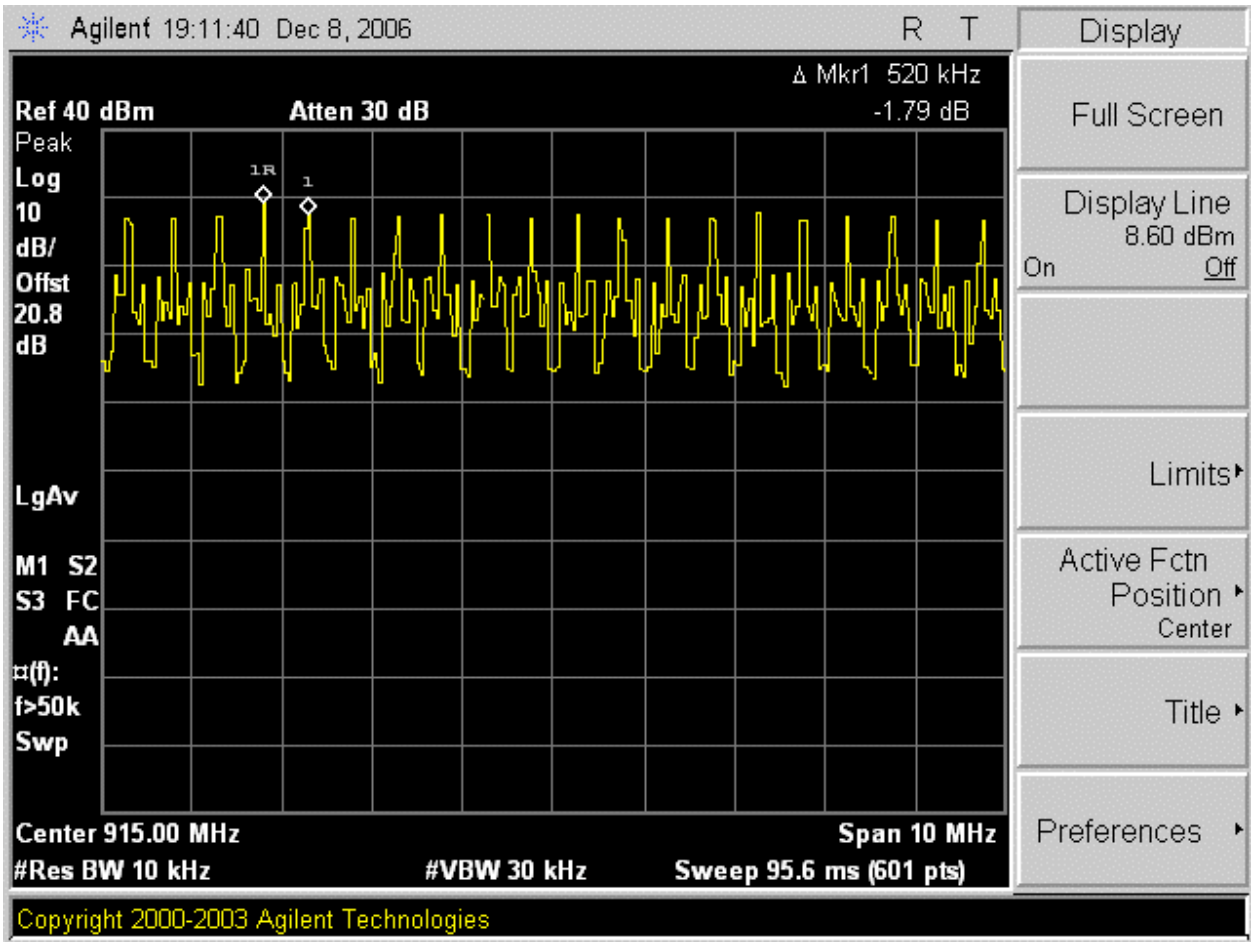
The transmitter output is connected to a spectrum analyzer. The RBW is set to 10 kHz and the VBW is set to 30 kHz. The sweep time is coupled.

RESULTS

No non-compliance noted:

The channel separation is 520KHz.

HOPPING FREQUENCY SEPARATION



4.2. RADIATED EMISSIONS

4.2.1. 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. 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 9.28 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 902-928 MHz 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.

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

LOW Channel: SRE02 Modulation, Y plane orientation

12/19/06 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Douglas Anderson
Project #:06U10737
Company:WJ Communication / T.N. Cokenias
EUT Descrip.:902-908 RFID
EUT M/N:WJM 3000
Test Target:FCC 15.247

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz
T120; S/N: 29310 @3m	T144 Miteq 3008A00931		

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
Can 187207004		Can 187209002	HPF_1.5GHz	

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)
1.805	3.0	54.8	46.0	30.9	2.6	-38.3	0.0	0.3	50.2	41.4	74.0	54.0	-23.8	-12.6	V
2.713	3.0	59.6	49.2	32.2	2.9	-37.4	0.0	0.6	57.9	47.5	74	54	-16.1	-6.5	V
3.611	3.0	47.6	36.7	32.9	3.3	-36.9	0.0	0.6	47.4	36.5	74	54	-26.6	-17.5	V
4.516	3.0	48.7	36.1	33.4	3.6	-36.5	0.0	0.6	49.7	37.2	74	54	-24.3	-16.8	V
5.416	3.0	45.2	36.0	34.0	4.2	-36.3	0.0	0.5	47.5	38.4	74	54	-26.5	-15.6	V
6.322	3.0	48.7	36.4	34.8	4.4	-36.3	0.0	0.5	52.1	39.8	74.0	54.0	-21.9	-14.2	V
7.225	3.0	52.5	42.6	35.2	4.6	-36.2	0.0	0.6	56.7	46.8	74.0	54.0	-17.3	-7.2	V
8.119	3.0	50.2	36.9	35.3	5.1	-36.2	0.0	0.7	55.0	41.7	74	54	-19.0	-12.3	V
9.032	3.0	50.3	37.0	35.9	5.6	-36.7	0.0	0.7	55.8	42.4	74	54	-18.2	-11.6	V
1.805	3.0	63.5	53.2	30.9	2.6	-38.3	0.0	0.3	58.9	48.6	74.0	54.0	-15.1	-5.4	H
2.713	3.0	58.4	48.7	32.2	2.9	-37.4	0.0	0.6	56.7	47.0	74	54	-17.3	-7.0	H
3.611	3.0	49.6	36.6	32.9	3.3	-36.9	0.0	0.6	49.4	36.4	74	54	-24.6	-17.6	H
4.516	3.0	47.0	36.2	33.4	3.6	-36.5	0.0	0.6	48.1	37.3	74	54	-25.9	-16.7	H
5.412	3.0	49.0	36.0	34.0	4.2	-36.3	0.0	0.5	51.3	38.4	74	54	-22.7	-15.6	H
6.323	3.0	49.9	36.3	34.8	4.4	-36.3	0.0	0.5	53.3	39.7	74.0	54.0	-20.7	-14.3	H
7.225	3.0	51.2	38.4	35.2	4.6	-36.2	0.0	0.6	55.4	42.6	74.0	54.0	-18.6	-11.4	H
8.119	3.0	48.8	36.7	35.3	5.1	-36.2	0.0	0.7	53.6	41.5	74	54	-20.4	-12.5	H
9.026	3.0	48.8	37.0	35.9	5.6	-36.7	0.0	0.7	54.3	42.5	74	54	-19.7	-11.5	H

Rev. 5.1.6

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		

MID Channel: SRE02 Modulation, Y plane orientation

12/14/06 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr:Mengistu Mekuria
Project #:06U10737
Company:WJ Communication / T.N. Cokenias
EUT Descrip.:902-908 RFID
EUT M/N:WJM 3000
Test Target:FCC 15.247
Mode Oper:Tx, SRE2, Mid Ch. 914.75MHz, Outputb Power: 29.8dBm-YY Position

Test Equipment:

Horn 1-18GHz: T119; S/N: 29301 @1m
Pre-amplifer 1-26GHz: T144 Miteq 3008A00931
Pre-amplifer 26-40GHz:
Horn > 18GHz:
Hi Frequency Cables
2 foot cable: Thanh 177079008
3 foot cable:
12 foot cable: Thanh 208946003
HPF: HPF_1.5GHz
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)
1.829	3.0	52.7	45.6	30.8	1.7	-38.3	0.0	0.3	47.3	40.2	74	54	-26.7	-13.8	V
2.744	3.0	52.0	44.8	32.4	2.1	-37.4	0.0	0.6	49.7	42.5	74	54	-24.3	-11.5	V
3.659	3.0	52.5	45.0	33.2	2.4	-36.9	0.0	0.6	51.8	44.4	74	54	-22.2	-9.6	V
4.574	3.0	59.0	49.1	33.8	2.7	-36.5	0.0	0.6	59.6	49.7	74	54	-14.4	-4.3	V
5.488	3.0	48.6	39.1	34.3	3.0	-36.4	0.0	0.5	50.1	40.5	74	54	-23.9	-13.5	V
6.403	3.0	55.5	46.4	35.3	3.2	-36.3	0.0	0.5	58.2	49.1	74	54	-15.8	-4.9	V
7.318	3.0	53.4	45.4	35.6	3.3	-36.2	0.0	0.6	56.8	48.7	74	54	-17.2	-5.3	V
8.233	3.0	52.9	40.0	35.9	3.4	-36.3	0.0	0.7	56.7	43.8	74	54	-17.3	-10.2	V
9.147	3.0	52.5	40.3	36.4	3.6	-36.7	0.0	0.7	56.4	44.2	74	54	-17.6	-9.8	V
1.829	3.0	52.8	45.0	30.8	1.7	-38.3	0.0	0.3	47.3	39.6	74	54	-26.7	-14.4	H
2.744	3.0	50.4	43.2	32.4	2.1	-37.4	0.0	0.6	48.0	40.9	74	54	-26.0	-13.1	H
3.659	3.0	48.6	39.1	33.2	2.4	-36.9	0.0	0.6	47.9	38.4	74	54	-26.1	-15.6	H
4.574	3.0	56.6	48.9	33.8	2.7	-36.5	0.0	0.6	57.2	49.5	74	54	-16.8	-4.5	H
5.488	3.0	49.2	38.7	34.3	3.0	-36.4	0.0	0.5	50.6	40.2	74	54	-23.4	-13.8	H
6.403	3.0	55.0	46.7	35.3	3.2	-36.3	0.0	0.5	57.7	49.4	74	54	-16.3	-4.6	H
7.318	3.0	53.1	44.7	35.6	3.3	-36.2	0.0	0.6	56.5	48.1	74	54	-17.5	-5.9	H
8.233	3.0	53.3	43.8	35.9	3.4	-36.3	0.0	0.7	57.1	47.6	74	54	-16.9	-6.4	H
9.147	3.0	52.3	43.2	36.4	3.6	-36.7	0.0	0.7	56.2	47.1	74	54	-17.8	-6.9	H

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		

HIGH Channel: SRE02 Modulation, Y plane orientation

12/19/06 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Douglas Anderson
Project #:06U10737
Company:WJ Communication / T.N. Cokenias
EUT Descrip.:902-908 RFID
EUT M/N:WJM 3000
Test Target:FCC 15.247

Test Equipment:

Horn 1-18GHz: T120; S/N: 29310 @3m
Pre-amplifer 1-26GHz: T144 Miteq 3008A00931
Pre-amplifer 26-40GHz:
Horn > 18GHz:
Hi Frequency Cables
2 foot cable: Can 187207004
3 foot cable:
12 foot cable: Can 187209002
HPF: HPF_1.5GHz
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)
1.854	3.0	64.2	52.5	31.0	2.6	-38.3	0.0	0.3	59.9	48.2	74.0	54.0	-14.1	-5.8	V
2.781	3.0	52.7	42.7	32.4	2.9	-37.4	0.0	0.6	51.2	41.2	74	54	-22.8	-12.8	V
3.708	3.0	49.6	37.0	32.9	3.3	-36.8	0.0	0.6	49.5	36.9	74	54	-24.5	-17.1	V
4.636	3.0	48.4	36.0	33.5	3.6	-36.5	0.0	0.6	49.6	37.2	74	54	-24.4	-16.8	V
5.564	3.0	49.7	36.1	34.1	4.3	-36.4	0.0	0.5	52.2	38.5	74.0	54.0	-21.8	-15.5	V
6.488	3.0	48.3	35.7	34.8	4.4	-36.3	0.0	0.5	51.9	39.3	74.0	54.0	-22.1	-14.7	V
7.417	3.0	51.3	39.7	35.2	4.7	-36.2	0.0	0.6	55.6	44.0	74.0	54.0	-18.4	-10.0	V
8.340	3.0	48.9	37.2	35.4	5.2	-36.3	0.0	0.7	53.9	42.2	74	54	-20.1	-11.8	V
9.272	3.0	49.3	37.5	36.3	5.6	-36.8	0.0	0.7	55.1	43.3	74.0	54.0	-18.9	-10.7	V
1.854	3.0	66.8	55.4	31.0	2.6	-38.3	0.0	0.3	62.5	51.1	74.0	54.0	-11.5	-2.9	H
2.781	3.0	53.9	44.7	32.4	2.9	-37.4	0.0	0.6	52.4	43.2	74	54	-21.6	-10.8	H
3.708	3.0	46.0	37.1	32.9	3.3	-36.8	0.0	0.6	45.9	37.0	74	54	-28.1	-17.0	H
4.636	3.0	49.4	36.1	33.5	3.6	-36.5	0.0	0.6	50.6	37.3	74	54	-23.4	-16.7	H
5.564	3.0	48.9	35.9	34.1	4.3	-36.4	0.0	0.5	51.3	38.3	74.0	54.0	-22.7	-15.7	H
6.488	3.0	48.3	35.8	34.8	4.4	-36.3	0.0	0.5	51.9	39.3	74.0	54.0	-22.1	-14.7	H
7.417	3.0	50.8	37.7	35.2	4.7	-36.2	0.0	0.6	55.1	42.0	74.0	54.0	-18.9	-12.0	H
8.340	3.0	49.5	37.1	35.4	5.2	-36.3	0.0	0.7	54.5	42.1	74	54	-19.5	-11.9	H
9.269	3.0	49.2	37.6	36.3	5.6	-36.8	0.0	0.7	55.0	43.3	74.0	54.0	-19.0	-10.7	H

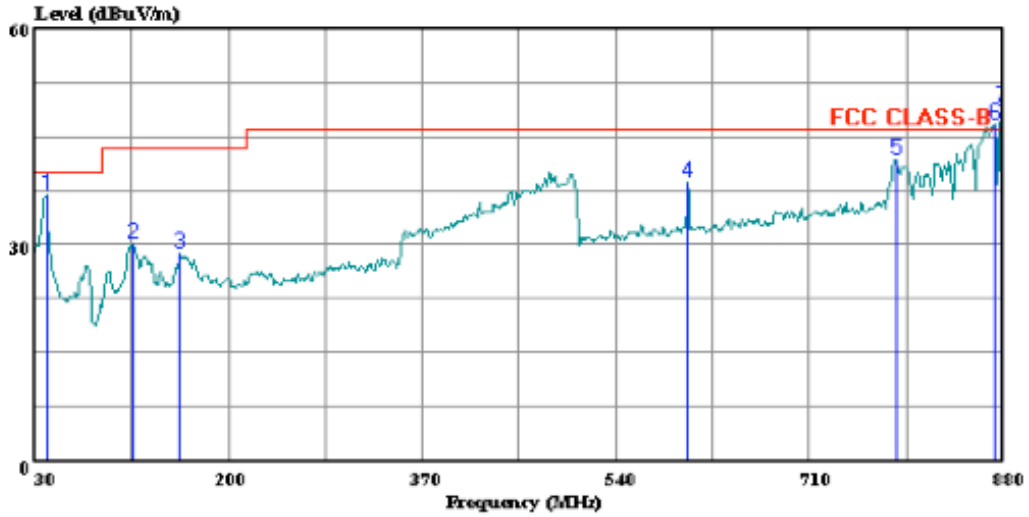
Rev. 5.1.6

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 RADIATED EMISSIONS BELOW 1 GHz

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

Data#: 28 File#: 06u10737.emi Date: 12-14-2006 Time: 10:29:15



(Audix ATC)

Trace: 27 Ref Trace:

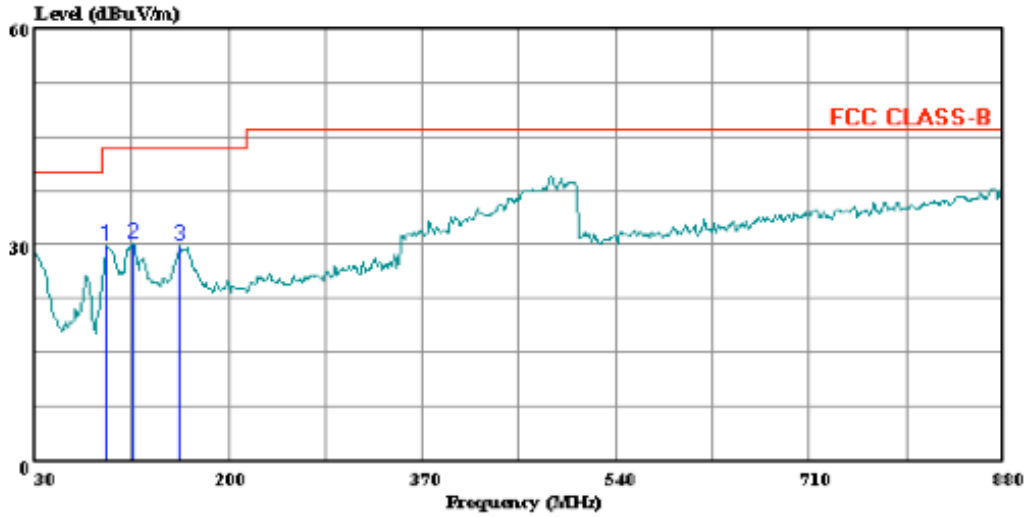
Condition: FCC CLASS-B VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Thomas N Cokenias/WJ Communication
Project #: : 06U10737
Configuration:: EUT only
Mode of Oper.:: TX, SRE Mid Ch. Output Power 29.6dBm
Target: : FCC Class B
: Model Name: WJM 3000
: FCC ID: NTTWJM3000
: 6 dBi linear Antenna

Page: 1

		Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1		40.200	21.81	15.17	36.98	40.00	-3.02	Peak
2		116.700	15.36	14.75	30.11	43.50	-13.39	Peak
3		156.650	14.86	13.94	28.80	43.50	-14.70	Peak
4		602.900	17.16	21.55	38.71	46.00	-7.29	Peak
5		785.650	17.43	24.35	41.78	46.00	-4.22	Peak
6	*	873.200	21.11	25.61	46.72	110.0	-63.28	Peak
7	*	877.450	23.41	25.63	49.04	110.0	-60.96	Peak

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

Data#: 26 File#: 06u10737.emi Date: 12-14-2006 Time: 10:21:36



(Audix ATC)

Trace: 25 Ref Trace:

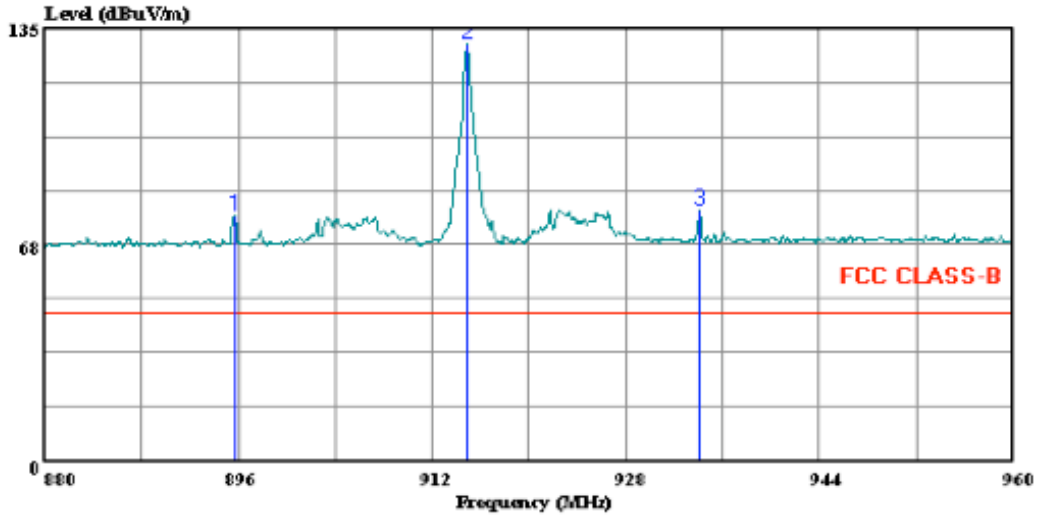
Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Mengistu Mekuria
Company: : Thomas N Cokenias/WJ Communication
Project #: : 06U10737
Configuration:: EUT only
Mode of Oper.:: TX, SRE Mid Ch. Output Power 29.6dBm
Target: : FCC Class B
: Model Name: WJM 3000
: FCC ID: NTTWJM3000
: 6 dBi linear Antenna

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	92.900	20.33	9.50	29.83	43.50	-13.67	Peak
2	116.700	15.33	14.75	30.08	43.50	-13.42	Peak
3	156.650	15.83	13.94	29.77	43.50	-13.73	Peak

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

Data#: 30 File#: 06u10737.emi Date: 12-14-2006 Time: 10:35:49



Trace: 29 Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Thomas N Cokenias/WJ Communication
Project #: : 06U10737
Configuration:: EUT only
Mode of Oper.:: TX, SRE Mid Ch. Output Power 29.6dBm
Target: : FCC Class B
: Model Name: WJM 3000
: FCC ID: NTTWJM3000
: 6 dBi linear Antenna

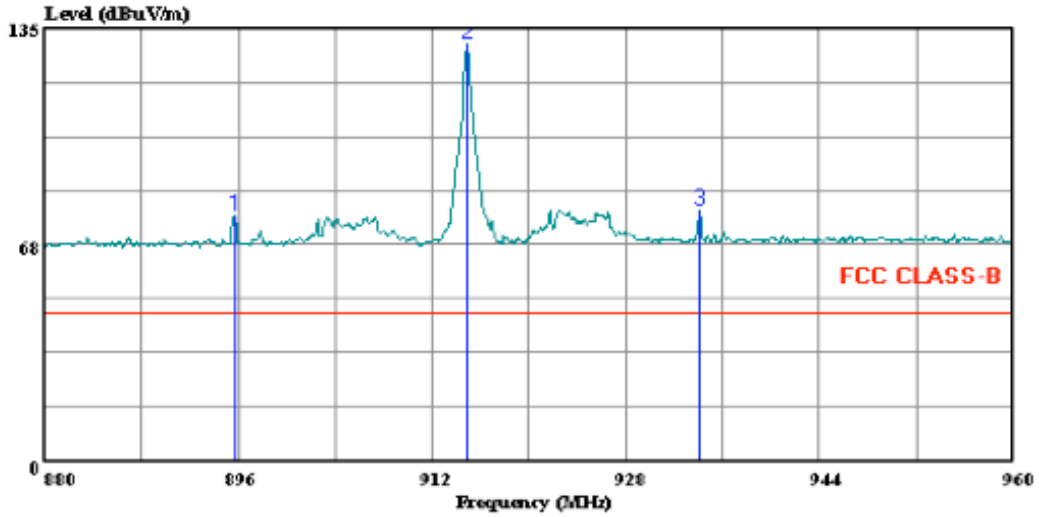
Page: 1

		Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	*	895.760	50.81	25.86	76.67	46.00	30.67	Peak
2	*	914.960	104.57	26.03	130.60	46.00	84.60	Peak
3	*	934.160	51.78	26.32	78.10	46.00	32.10	Peak

COMPLIANCE Engineering Services, Inc.

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

Data#: 30 File#: 06u10737.emi Date: 12-14-2006 Time: 10:35:49



(Audix ATC)

Trace: 29 Ref Trace:

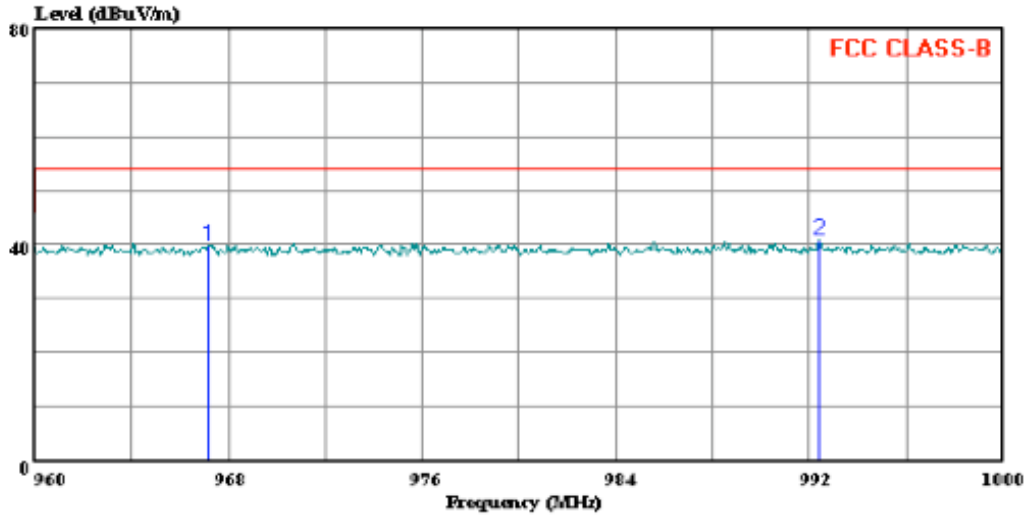
Condition: FCC CLASS-B VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Thomas N Cokenias/WJ Communication
Project #: : 06U10737
Configuration:: EUT only
Mode of Oper.:: TX, SRE Mid Ch. Output Power 29.6dBm
Target: : FCC Class B
: Model Name: WJM 3000
: FCC ID: NTTWJM3000
: 6 dBi linear Antenna

Page: 1

		Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	*	895.760	50.81	25.86	76.67	46.00	30.67	Peak
2	*	914.960	104.57	26.03	130.60	46.00	84.60	Peak
3	*	934.160	51.78	26.32	78.10	46.00	32.10	Peak

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

Data#: 22 File#: 06u10737.emi Date: 12-14-2006 Time: 10:03:29



(Audix ATC)

Trace: 21 Ref Trace:

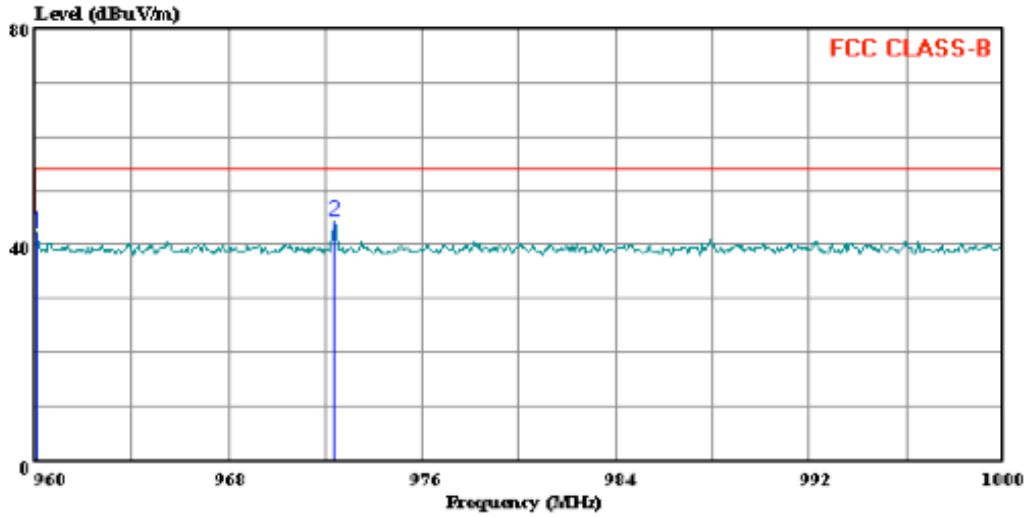
Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Mengistu Mekuria
Company: : Thomas N Cokenias/WJ Communication
Project #: : 06U10737
Configuration:: EUT only
Mode of Oper.:: TX, SRE Mid Ch. Output Power 29.6dBm
Target: : FCC Class B
: Model Name: WJM 3000
: FCC ID: NTTWJM3000
: 6 dBi linear Antenna

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	967.160	13.16	26.65	39.81	54.00	-14.19	Peak
2	992.360	13.94	26.93	40.87	54.00	-13.13	Peak

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

Data#: 20 File#: 06u10737.emi Date: 12-14-2006 Time: 09:57:16



(Audix ATC)

Trace: 19 Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Mengistu Mekuria
Company: : Thomas N Cokenias/WJ Communication
Project #: : 06U10737
Configuration:: EUT only
Mode of Oper.:: TX, SRE Mid Ch. Output Power 29.6dBm
Target: : FCC Class B
: Model Name: WJM 3000
: FCC ID: NTTWJM3000
: 6 dBi linear Antenna

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	960.080	15.78	26.54	42.32	54.00	-11.68	Peak
2	972.360	17.51	26.68	44.20	54.00	-9.81	Peak

4.3. 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.

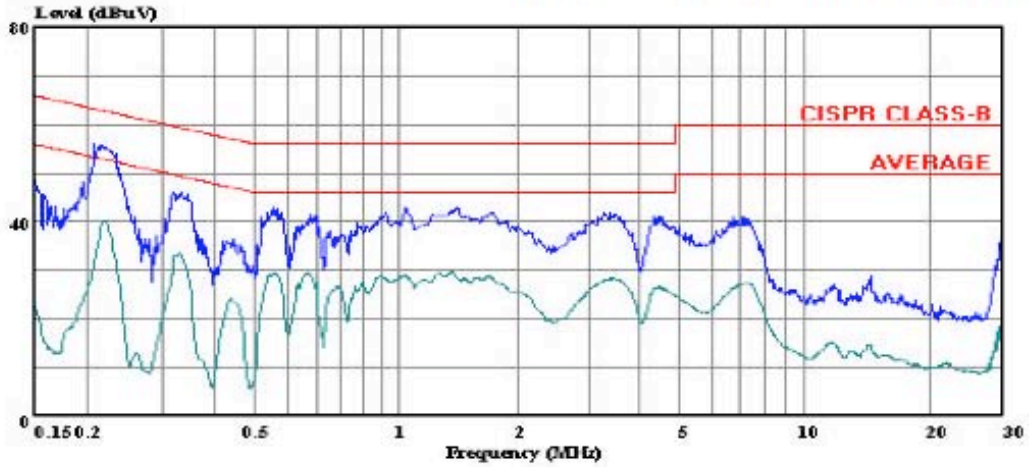
RESULTS

No non-compliance noted:

LINE 1 RESULTS

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

Data#: 7 File#: 06U10737_120VAC.EMI
Date: 12-19-2006 Time: 12:36:18



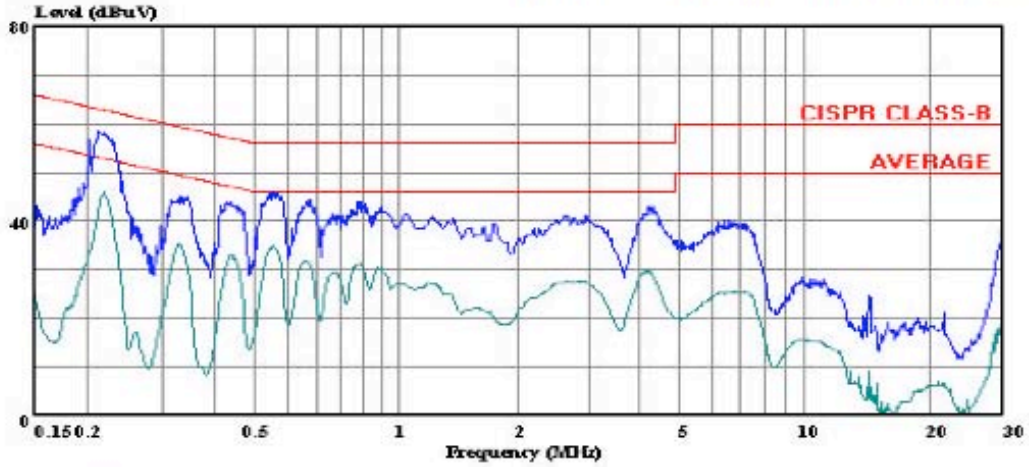
Trace: 5 Ref Trace:

Condition: CISPR CLASS-B
Test Operator : Doug Anderson
Project # : 06U10737
Company : WJ Wireless
EUT configuration: WJM3000 SRE2 Middle Channel
Mode of operation: Transmit Mode
Power Source : 115VAC, 60Hz
: L1: Peak (Blue), Averge (Green)

LINE 2 RESULTS

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

Data#: 14 File#: 06U10737_120VAC.EMI
Date: 12-19-2006 Time: 12:56:46



Trace: 12 Ref Trace:

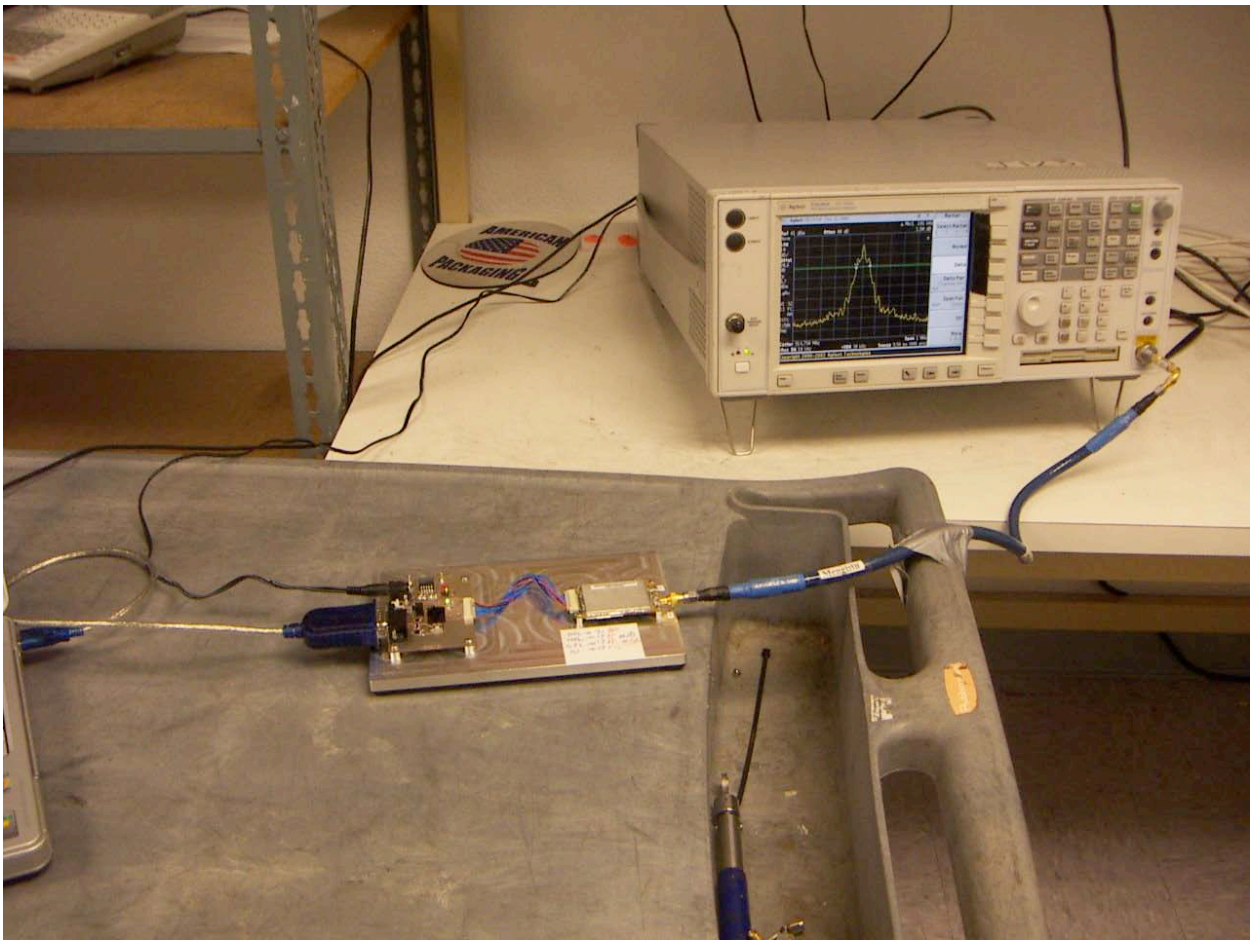
Condition: CISPR CLASS-B
Test Operator : Doug Anderson
Project # : 06U10737
Company : WJ Wireless
EUT configuration: WJM3000 SRE2 Middle Channel
Mode of operation: Transmit Mode
Power Source : 115VAC, 60Hz
: L2: Peak (Blue), Averge (Green)

WORST CASE EMISSIONS

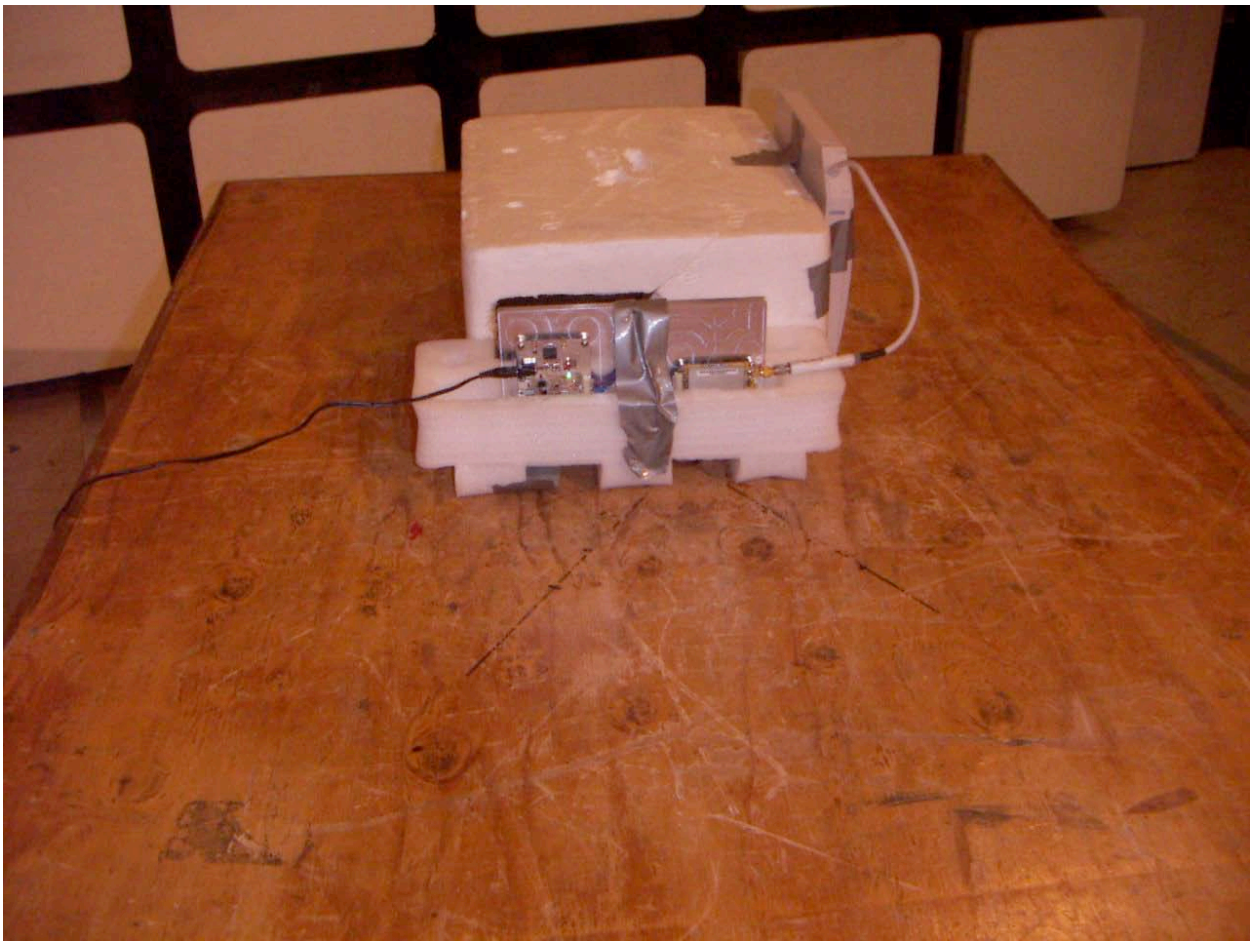
Freq (MHz)	Peak	AVG	Line
0.216	55.62	40.16	L1
0.32	45.94	32.77	L1
0.552	42.82	29.05	L1
0.219	58.01	45.93	L2
0.555	45.98	34.89	L2
0.668	44.47	31.82	L2

5. SETUP PHOTOS

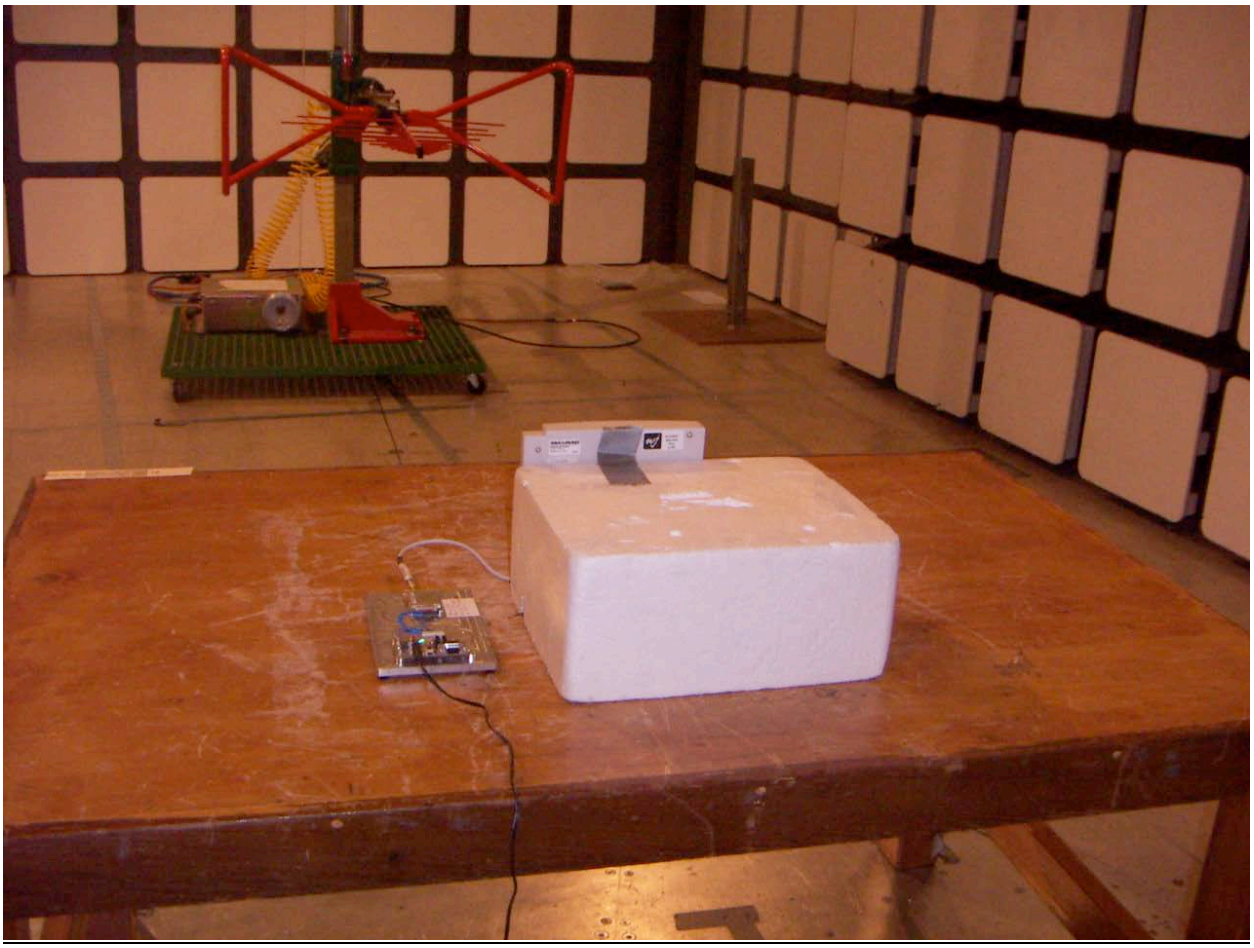
ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



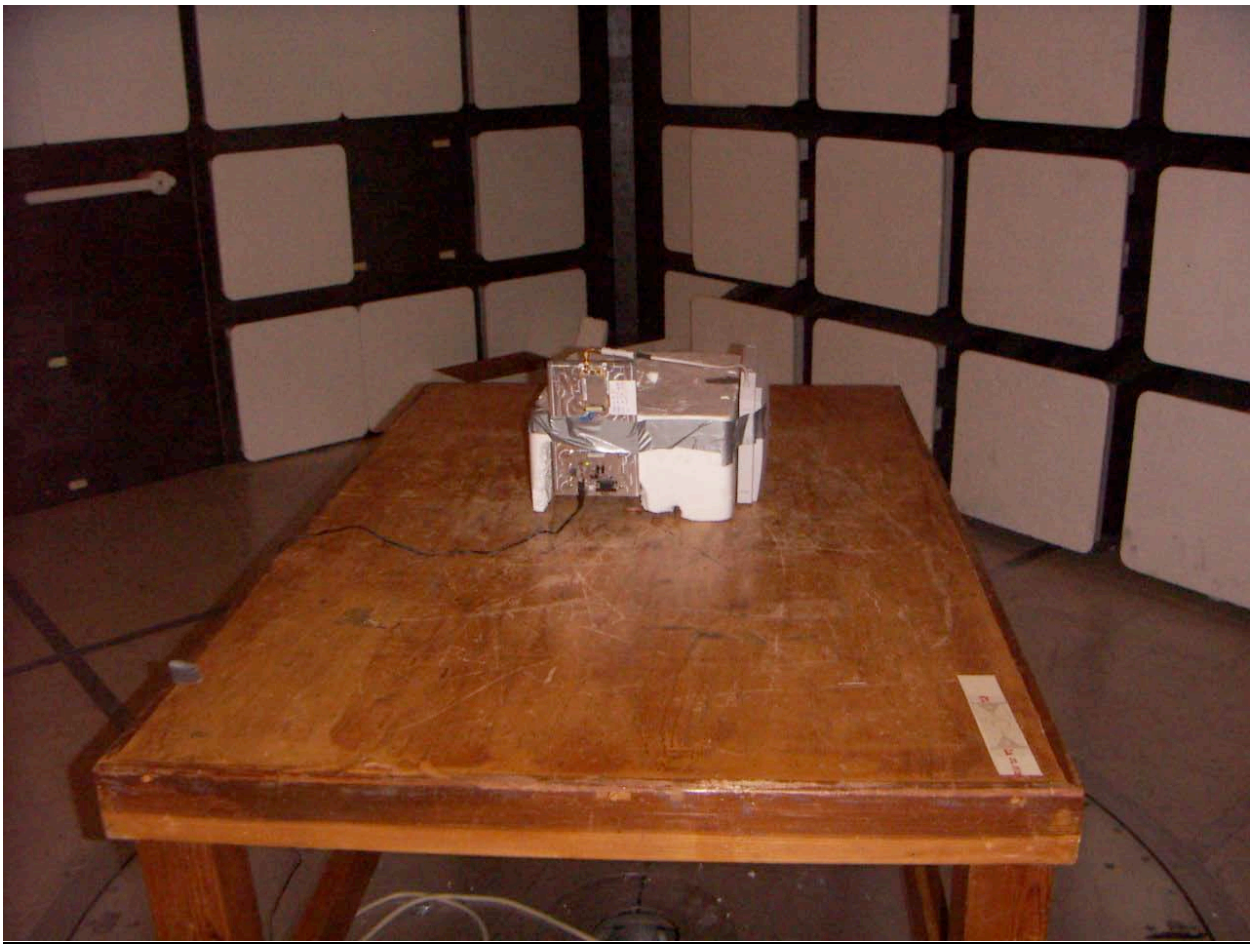
RADIATED RF MEASUREMENT SETUP (Y ORIENTATION, WORST CASE)



RADIATED RF MEASUREMENT SETUP (X ORIENTATION)

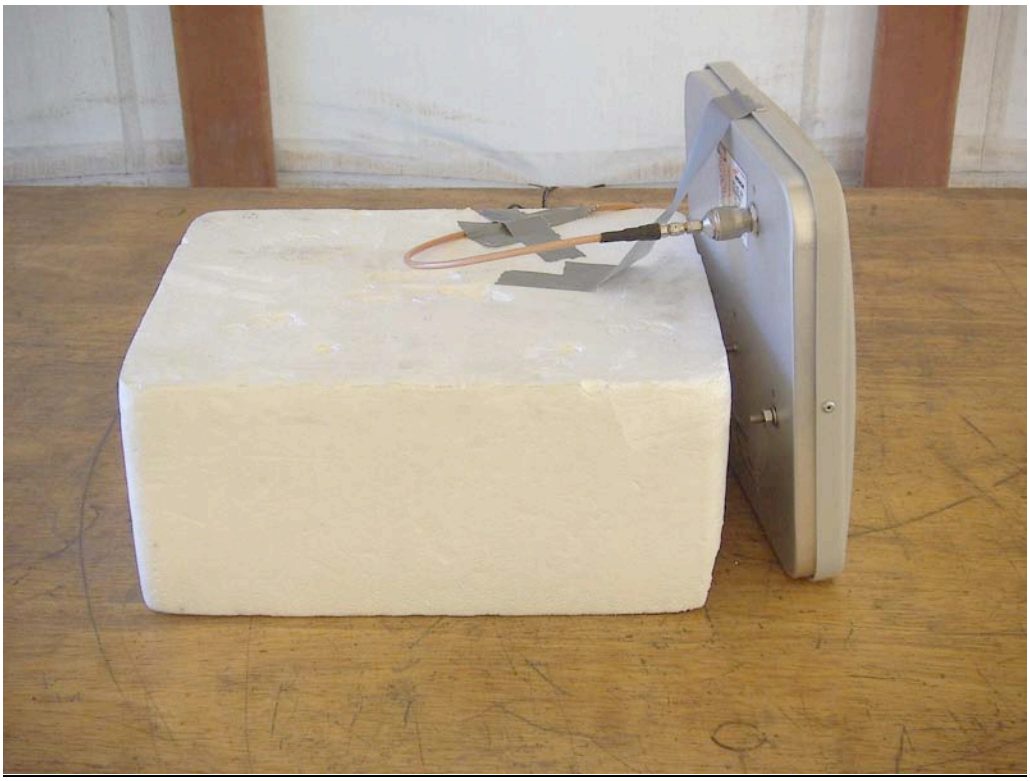


RADIATED RF MEASUREMENT SETUP (Z ORIENTATION)

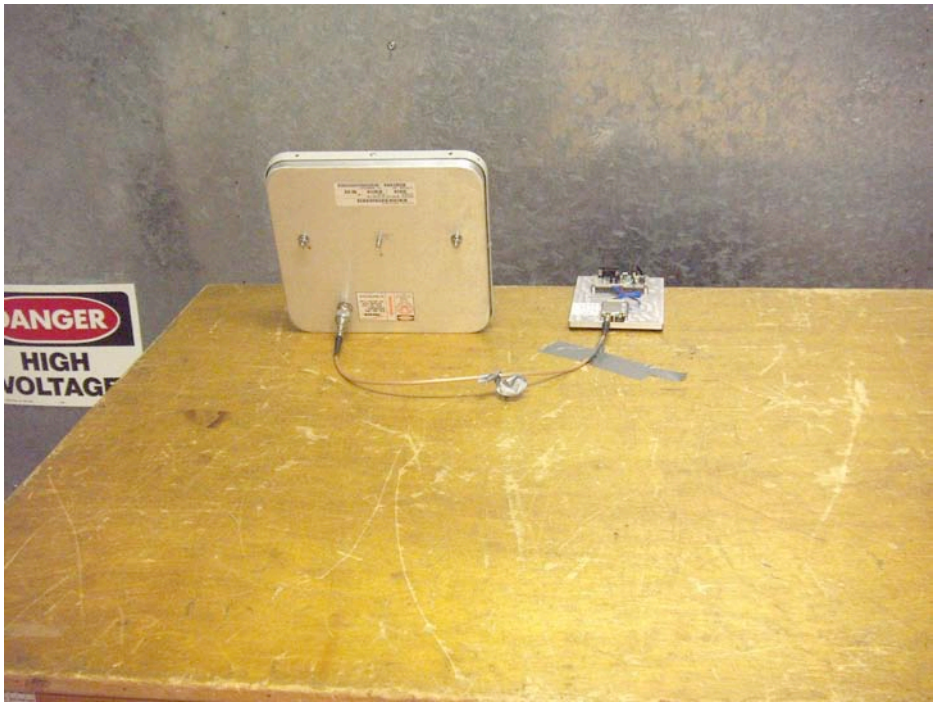


RADIATED RF MEASUREMENT SETUP ON OATS

LOW AND HIGH CHANNELS, WJM3000
LOW, MID, AND HIGH CHANNELS, WJM1000



POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP



END OF REPORT