



FCC 47 CFR PART 15 SUBPART E

TEST REPORT

For

Shuttle XPC (Wireless 802.11a+b+g)

Trade Name: Shuttle

Model: Xyy0yy (y=0~9)

Issued to

**UNIWILL COMPUTER CORP.
3F, No.43, Wu Chiuan Rd, Wu Cu Ind., Park,
Taipei, Taiwan, R.O.C.**

Issued by

**Compliance Certification Services Inc.
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1. TEST RESULT CERTIFICATION

Applicant: UNIWILL COMPUTER CORP.
3F, No.43, Wu Chiuian Rd., Wu Cu Ind, Park,
Taipei, Taiwan, R.O.C.

Equipment Under Test: Shuttle XPC (Wireless 802.11a+b+g)

Trade Name: Shuttle

Model: Xyy0yy (y=0~9)

Date of Test: March 20 ~ April 25, 2006

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 15 Subpart E	No non-compliance noted

We hereby certify that:

Compliance Certification Services Inc. tested the above equipment. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4: 2003 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.407.

The test results of this report relate only to the tested sample identified in this report.

Approved by:

Reviewed by:

Gavin Lim
Section Manager
Compliance Certification Services Inc.

Amanda Wu
Section Manager
Compliance Certification Services Inc.



2. EUT DESCRIPTION

Product	Shuttle XPC (Wireless 802.11a+b+g)
Trade Name	Shuttle
Model	Xyy0yy (y=0~9)
Model Discrepancy	1. All the specification and layout are identical except they come with different model numbers. 2. "y" could be 0-9 to denote different color of enclosure.
Power Supply	LI SHIN INTERNATIONAL ENTERPRISE CORP. / 0227A20120 I/P: AC 100-240V, 2.0A, 50-60Hz O/P: DC 20V, 6.0A
Frequency Range	5.15 ~ 5.35 GHz
Transmit Power	18.68 dBm
Modulation Technique	OFDM (QPSK, BPSK, 16-QAM, 64-QAM)
Transmit Data Rate	54, 48, 36, 24, 18, 12, 9, 6 Mbps
Number of Channels	8 Channels
Antenna Specification	PCB Antenna / Gain: 2.09 dBi



Operation Frequency:

UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII)	
CHANNEL	MHz
36	5180
40	5200
44	5220
48	5240
52	5260
56	5280
60	5300
64	5320

Remark:

1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: **SAZ-3945ABGXPCIA** filing to comply with Section 15.407 of the FCC Part 15, Subpart E Rules.



3. TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4. Radiated testing was performed at an antenna to EUT distance 3 meters.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed for RF field strength measurement to meet the Commissions requirement, and is operated in a manner intended to generate the maximum emission in a continuous normal application.

3.2 EUT EXERCISE

The EUT is operated in the engineering mode to fix the Tx frequency for the purposes of measurement.

According to its specifications, the EUT must comply with the requirements of Section 15.407 under the FCC Rules Part 15 Subpart E.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is positioned at 0.8 m above the ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4, the conducted emission from the EUT is measured in the frequency range between 0.15 MHz and 30MHz, using the CISPR Quasi-Peak detector mode.

Radiated Emissions

The EUT is placed on the turntable, which is 0.8 m above the ground plane. The turntable is then rotated for 360 degrees to determine the proper orientation for the maximum emission level. The EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission level. And, each emission is to be maximized by changing the horizontal and vertical polarization of the receiving antenna. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.4.



3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

- (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 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	(²)
13.36 - 13.41	322 - 335.4		

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

- (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.

3.5 DESCRIPTION OF TEST MODES

The EUT (model: Xyy0yy (y=0~9)) had been tested under operating condition.

Software used to control the EUT for staying in continuous transmitting mode was programmed.

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz, which worst case was in normal link mode only.

Channel Low (5180MHz), Channel Mid (5260MHz) and Channel High (5320MHz) with 6Mbps data rate were chosen for full testing.



4. INSTRUMENT CALIBRATION

4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

4.2 MEASUREMENT EQUIPMENT USED

Equipment Used for Emissions Measurement

Remark: Each piece of equipment is scheduled for calibration once a year.

Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY43360131	01/18/2007

Open Area Test Site # 3				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI Test Receiver	R&S	ESVS20	838804/004	01/18/2007
Spectrum Analyzer	R&S	FSP30	100112	09/12/2006
Spectrum Analyzer	Agilent	E4446A	MY43360131	01/18/2007
Pre-Amplifier	MITEC	AFS42-00102650	924206	N.C.R.
Pre-Amplifier	MITEC	AMF-6F-260400	945377	N.C.R.
Bilog Antenna	SCHWAZBECK	VULB9163	145	07/05/2006
Horn Antenna	EMCO	3115	00022250	04/16/2007
Horn-Antenna	TRC	HA-1201A	02	07/04/2006
Horn-Antenna	TRC	HA-1301A	02	07/04/2006
Turn Table	EMCO	2081-1.21	9709-1885	N.C.R.
Antenna Tower	EMCO	2075-2	9707-2060	N.C.R.
Controller	EMCO	2090	9709-1256	N.C.R.
RF Switch	ANRITSU	MP59B	M53867	N.C.R.
Site NSA	CCS	N/A	N/A	09/06/2006
Test S/W	LABVIEW (V 6.1)			

Remark: The measurement uncertainty is less than +/- 2.16dB, which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.

Powerline Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI TEST RECEIVER 9kHz-30MHz	ROHDE & SCHWARZ	ESHS30	828144/003	09/27/2006
TWO-LINE V-NETWORK 9kHz-30MHz	SCHAFFNER	NNB41	03/10013	06/12/2006
LISN 10kHz-100MHz	EMCO	3825/2	9106-1809	03/20/2007
Test S/W	LABVIEW (V 6.1)			

Remark: The measurement uncertainty is less than +/- 2.81dB, which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.



5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

☐ No. 199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.

Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029

☒ No. 11, Wugong 6th Rd., Wugu Industrial Park, Taipei Hsien 248, Taiwan

Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045

☒ No.81-1, Lane 210, Bade 2nd Rd., Luchu Hsiang, Taoyuan Hsien 338, Taiwan

Tel: 886-3-324-0332 / Fax: 886-3-324-5235

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

5.3 TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	A2LA	EN 55011, EN 55014-1/2, CISPR 11, CISPR 14-1/2, EN 55022, EN 55015, CISPR 22, CISPR 15, AS/NZS 3548, VCCI V3 (2001), CFR 47, FCC Part 15/18, CNS 13783-1, CNS 13439, CNS 13438, CNS 13803, CNS 14115, EN 55024, IEC 801-2, IEC 801-3, IEC 801-4, IEC/EN 61000-3-2, EIC/EN 61000-3-3, IEC/EN 61000-4-2/3/4/5/6/8/11, EN 50081-1/ EN 61000-6-3, EN 50081-2/EN 61000-6-4, EN 50081-2/EN 61000-6-1: 2001	 0824-01
USA	FCC	3/10 meter Open Area Test Sites (93105, 90471) / 3M Semi Anechoic Chamber (965860) to perform FCC Part 15/18 measurements	 93105, 90471 965860
Japan	VCCI	3/10 meter Open Area Test Sites to perform conducted/radiated measurements	 R-393/1066/725/879 C-402/747/912
Norway	NEMKO	EN 50081-1/2, EN 50082-1/2, IEC 61000-6-1/2, EN 50091-2, EN 50130-4, EN 55011, EN 55013, EN 55014-1/2, EN 55015, EN 55022, EN 55024, EN 61000-3-2/3, EN 61326-1, IEC 61000-4-2/3/4/5/6/8/11, EN 60601-1-2, EN 300 328, EN 300 422-2, EN 301 419-1, EN 301 489-01/03/07/08/09/17, EN 301 419-2/3, EN 300 454-2, EN 301 357-2	 ELA 124a ELA 124b ELA 124c
Taiwan	TAF	EN 300 328, EN 300 220-1, EN 300 220-2, EN 300 220-3, 47 CFR FCC Part 15 Subpart C, EN 61000-3-2, EN 61000-3-3, CNS 13439, CNS 13783-1, CNS 14115, CNS 13438, AS/NZS CISPR 22, CNS 13022-1, IEC 61000-4-2/3/4/5/6/8/11, CNS 13022-2/3	 Testing Laboratory 0363
Taiwan	BSMI	CNS 13438, CNS 13783-1, CNS 13439, CNS 14115	 SL2-IS-E-0014 SL2-IN-E-0014 SL2-A1-E-0014 SL2-R1-E-0014 SL2-R2-E-0014 SL2-L1-E-0014
Canada	Industry Canada	3/10 meter Open Area Test Sites (IC 3991-3, IC 3991-4) / 3M Semi Anechoic Chamber (IC 6106) to perform RSS 212 Issue 1	 IC 3991-3 IC 3991-4 IC 6106

* No part of this report may be used to claim or imply product endorsement by A2LA or any agency of the US Government.



6. SETUP OF EQUIPMENT UNDER TEST

6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

6.2 SUPPORT EQUIPMENT

No.	Device Type	Brand	Model	Series No.	FCC ID	Data Cable	Power Cord
1.	LCD Monitor	LG	L1740PQ	503KGXA2K858	BEJL17NU	Unshielded, 1.8m With 2 cores	Unshielded, 1.8m
2.	USB Keyboard	Compaq	KU-9978	B463AOAGALT097	FCC DoC	Shielded, 1.8m	N/A
3.	USB Mouse	HP	MO19UCA	20440964	FCC DoC	Shielded, 1.8m	N/A
4.	USB 2.0 External HDD	TeraSyS	F12-U	A0100214-31d0014	FCC DoC	Shielded, 1.8m	Shielded, 1.8m
5.	USB 2.0 External HDD	TeraSyS	F12-U	A0100214-31d0028	FCC DoC	Shielded, 1.8m	Shielded, 1.8m
6.	USB 2.0 External HDD	TeraSyS	F12-U	A0100214-2Bq0039	FCC DoC	Shielded, 1.8m	Shielded, 1.8m
7.	USB 2.0 & 1394 External HDD	TeraSyS	F12-UF(COMBO)	A0100215-420014	FCC DoC	Shielded, 1.8m	Shielded, 1.8m
8.	Walkman	Panasonic	RQ-L10	HB004471	FCC DoC	Unshielded, 1.8m	N/A
9.	Headset	LABTEC	980180-0121	N/A	FCC DoC	Unshielded, 1.8m	N/A
10.	Super a/g 108Mbps Wireless Lan Router (Remote)	PLANEX	BLW-04SAG	40DDA0421	SJ9-BLW54SAG	N/A	Unshielded, 1.8m

Remark:

- All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*
- Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*



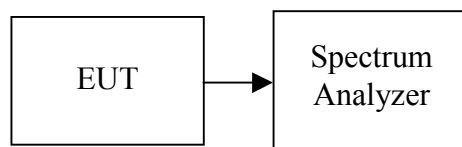
7. FCC PART 15 REQUIREMENTS

7.126 DB EMISSION BANDWIDTH

LIMIT

According to §15.303(c), for purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Compliance with the emissions limits is based on the use of measurement instrumentation employing a peak detector function with an instrument resolutions bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low-loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW > 1%EBW, VBW > RBW, Span >26dB bandwidth, and Sweep = auto.
4. Mark the peak frequency and -26dB (upper and lower) frequency.
5. Repeat until all the rest channels were investigated.

TEST RESULTS

No non-compliance noted

Test Data

Channel	Frequency (MHz)	Bandwidth (B) (MHz)
Low	5180	22.902
Mid	5260	26.829
High	5320	34.023



Test Plot

CH Low

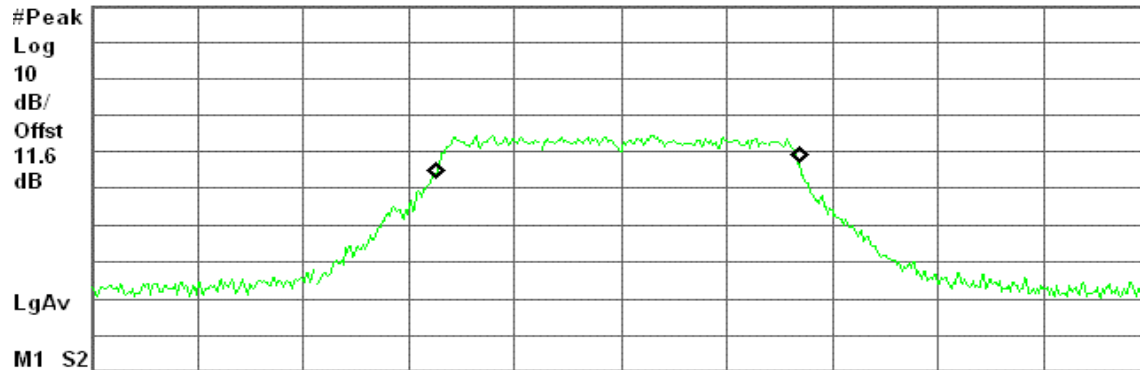
Agilent 15:37:17 Apr 25, 2006

R L

26 dB BW, a Mode Low Ch.

Ref 30 dBm

Atten 30 dB



Center 5.180 00 GHz

Span 50 MHz

#Res BW 270 kHz

#VBW 750 kHz

Sweep 1 ms (601 pts)

Occupied Bandwidth

17.1060 MHz

Occ BW % Pwr 99.00 %

x dB -26.00 dB

Transmit Freq Error

-126.658 kHz

x dB Bandwidth

22.902 MHz

CH Mid

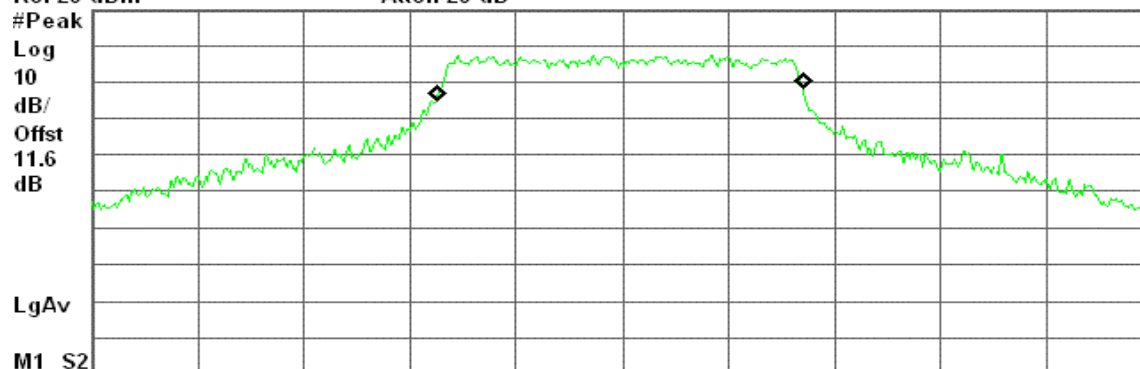
Agilent 11:06:31 Apr 25, 2006

R L

26 dB BW, a Mode Mid Ch.

Ref 20 dBm

Atten 20 dB



Center 5.260 00 GHz

Span 50 MHz

#Res BW 240 kHz

#VBW 750 kHz

Sweep 1 ms (601 pts)

Occupied Bandwidth

17.1552 MHz

Occ BW % Pwr 99.00 %

x dB -26.00 dB

Transmit Freq Error

-92.092 kHz

x dB Bandwidth

26.829 MHz



CH High

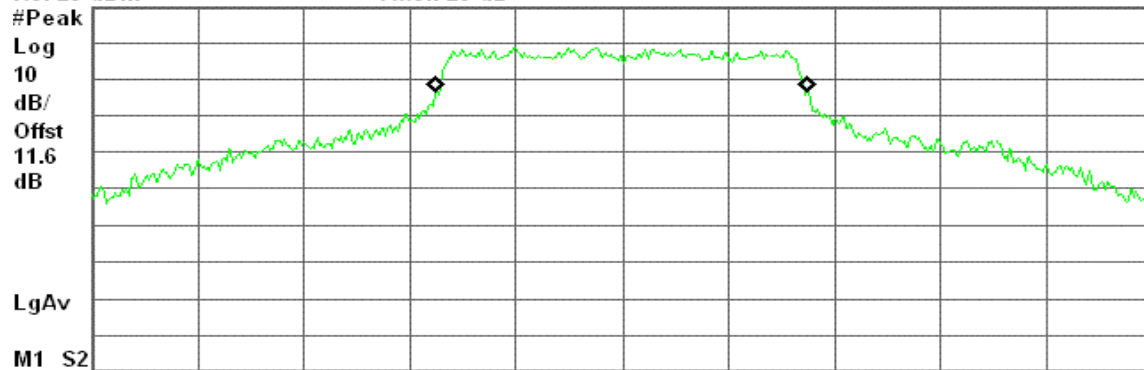
Agilent 11:10:24 Apr 25, 2006

R L

26 dB BW, a Mode High Ch.

Ref 20 dBm

Atten 20 dB



Center 5.320 00 GHz

Span 50 MHz

#Res BW 220 kHz

#VBW 680 kHz

Sweep 1 ms (601 pts)

Occupied Bandwidth

17.4296 MHz

Occ BW % Pwr 99.00 %
x dB -26.00 dB

Transmit Freq Error -19.171 kHz
x dB Bandwidth 34.023 MHz



7.2 PEAK POWER

LIMIT

According to §15.407(a),

- (1) For the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or $4 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in MHz.
- (2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in MHz.

If transmitting antennas of directional gain greater than 6dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

The peak power shall not exceed the limit as follow:

Specified Limit of the Peak Power

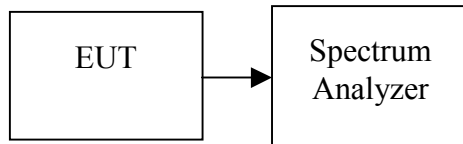
Channel	Frequency (MHz)	26 dB Bandwidth (B) (MHz)	10 Log B (dB)	4 + 10 Log B or 11 + 10 Log B (dBm)	Power Limit (dBm)
Low	5180	22.902	13.60	17.60	16.98
Mid	5260	26.829	14.29	25.29	23.98
High	5320	34.023	15.32	26.32	23.98

(Remark: Maximum antenna gain = 2.09dBi, therefore there is no reduction due to antenna gain.)



Test Configuration

The EUT was connected to a spectrum analyzer through a 50 Ω RF cable.



TEST PROCEDURE

Set span to encompass the entire emission bandwidth (EBW) of the signal.

Set RBW = 1 MHz / Set VBW = 3 MHz.

Use sample detector mode if bin width (i.e., span/number of points in spectrum display) < 0.5 RBW. Otherwise use peak detector mode. Use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at full control power for entire sweep of every sweep. If the device transmits continuously, with no off intervals or reduced power intervals, the trigger may be set to “free run”. Trace average 100 traces in power averaging mode. Compute power by integrating the spectrum across the 26 dB EBW of the signal. The integration can be performed using the spectrum analyzer’s band power measurement function with band limits set equal to the EBW band edges or by summing power levels in each 1 MHz band in linear power terms. The 1 MHz band power levels to be summed can be obtained by averaging, in linear power terms, power levels in each frequency bin across the 1 MHz.

TEST RESULTS

No non-compliance noted

Test Data

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)
Low	5180	16.25	16.98
Mid	5260	17.56	23.98
High	5320	18.68	23.98

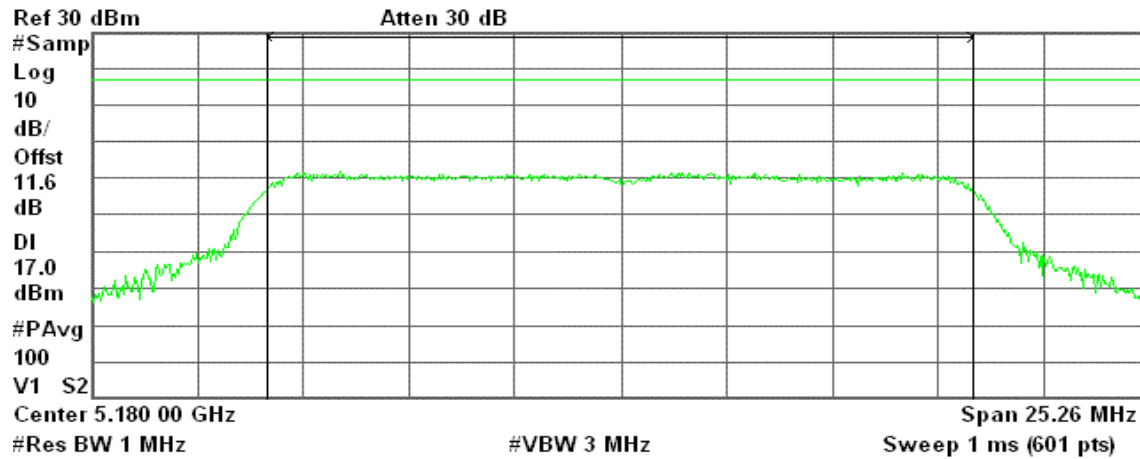


Test Plot

CH Low

Agilent 15:39:04 Apr 25, 2006
Peak Transmit Power, a Mode Low Ch.

R L



Channel Power

16.25 dBm / 16.8371 MHz

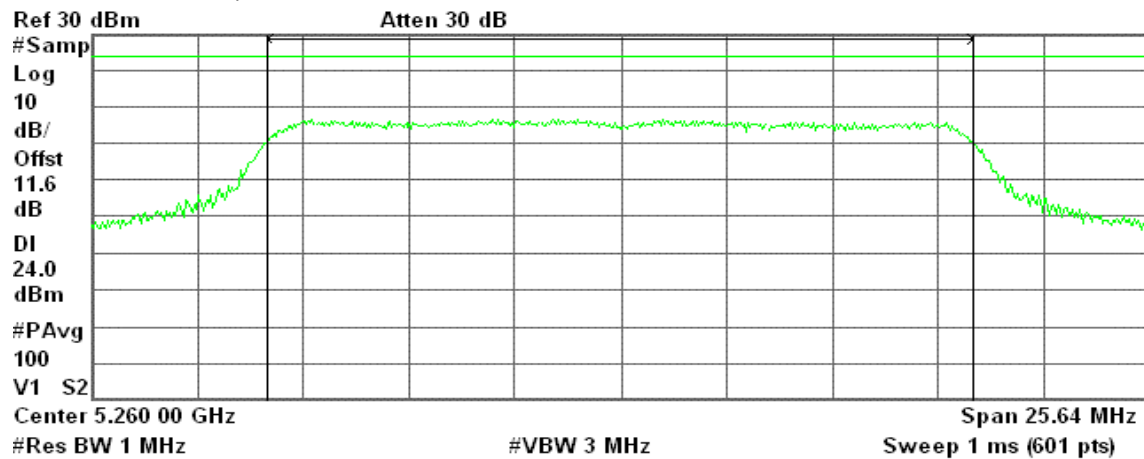
Power Spectral Density

-56.02 dBm/Hz

CH Mid

Agilent 11:07:18 Apr 25, 2006
Peak Transmit Power, a Mode Mid Ch.

R L



Channel Power

17.56 dBm / 17.0960 MHz

Power Spectral Density

-54.77 dBm/Hz



CH High

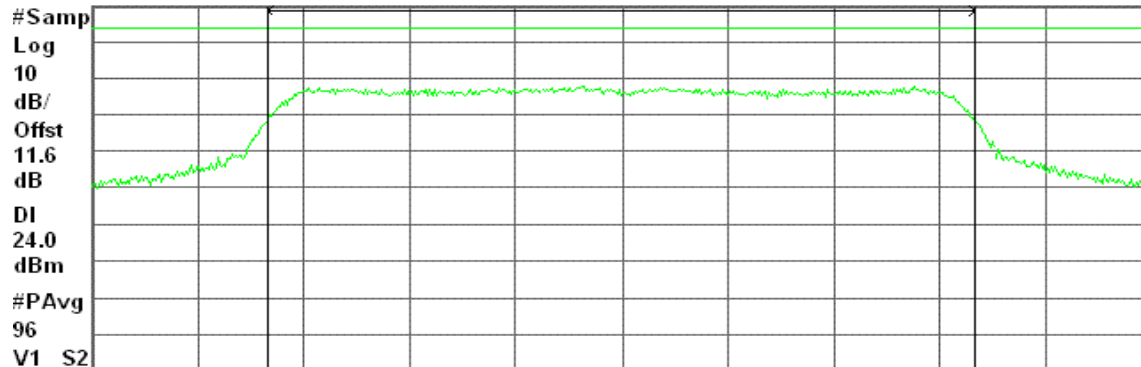
Agilent 11:10:54 Apr 25, 2006

R L

Peak Transmit Power, a Mode High Ch.

Ref 30 dBm

Atten 30 dB



Center 5.320 00 GHz

Span 26.3 MHz

#Res BW 1 MHz

#VBW 3 MHz

Sweep 1 ms (601 pts)

Channel Power

Power Spectral Density

18.68 dBm / 17.5330 MHz

-53.76 dBm/Hz

7.3BAND EDGES MEASUREMENT

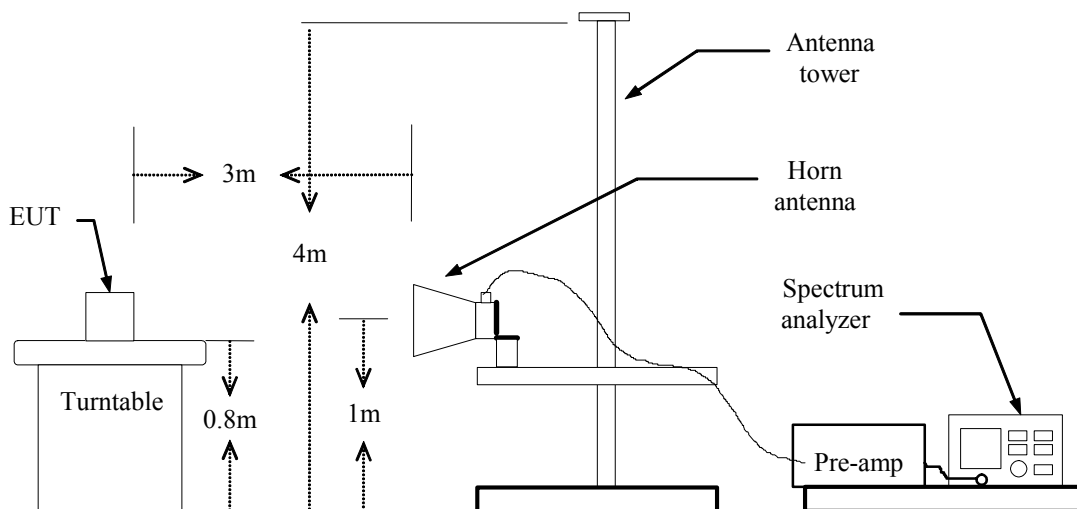
LIMIT

According to §15.407(b),

(7) The provisions of Section 15.205 of this part apply to intentional radiators operating under this section.

(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency block edges as the design of the equipment permits.

Test Configuration



TEST PROCEDURE

1. The EUT is placed on a turntable, which is 0.8m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
 - (a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
 - (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

TEST RESULTS

Refer to attach spectrum analyzer data chart.



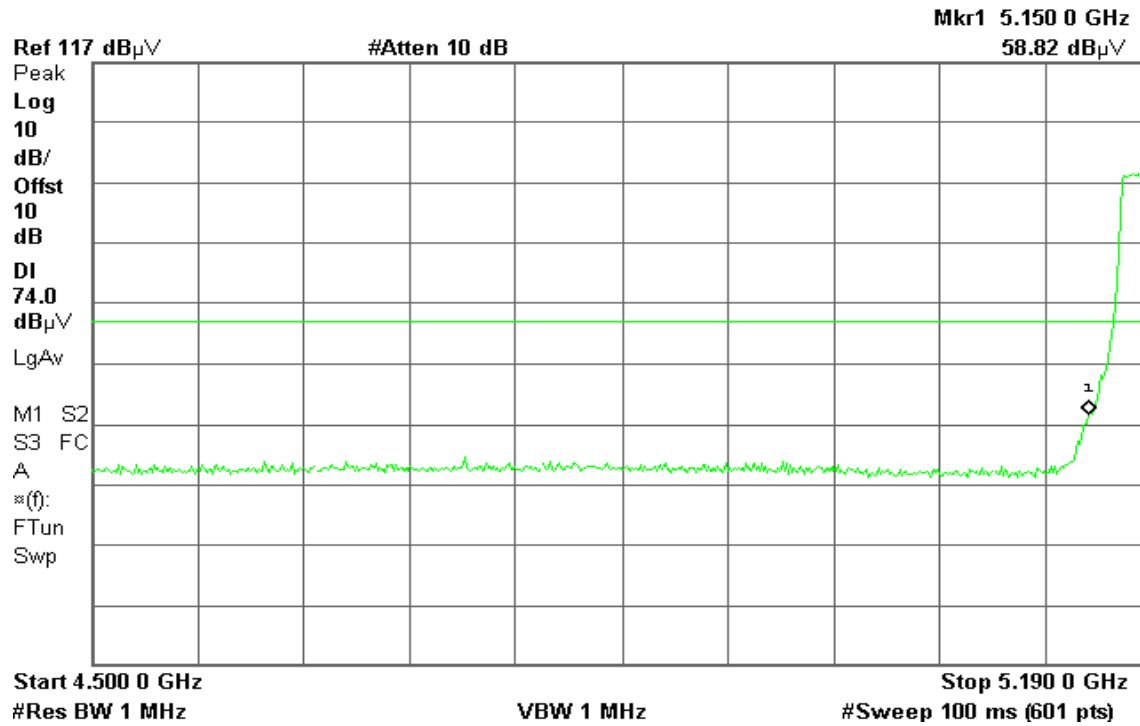
Band Edges (CH Low)

Detector mode: Peak

Polarity: Vertical

Agilent 13:29:03 Mar 20, 2006

T

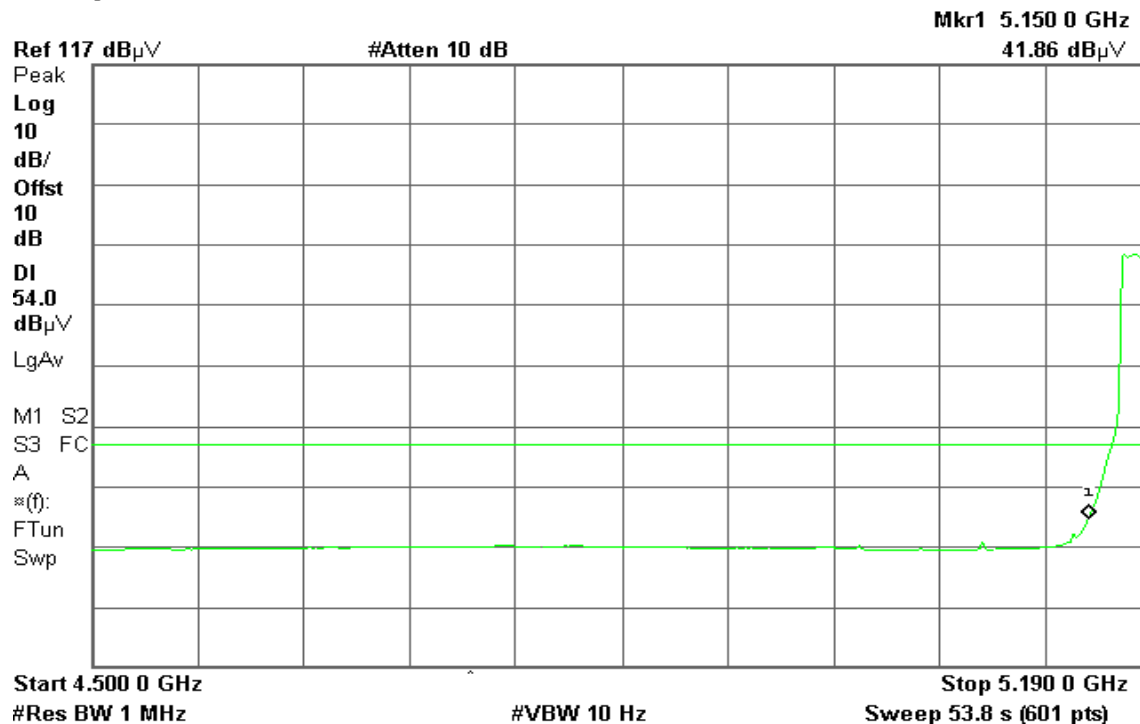


Detector mode: Average

Polarity: Vertical

Agilent 13:30:43 Mar 20, 2006

T



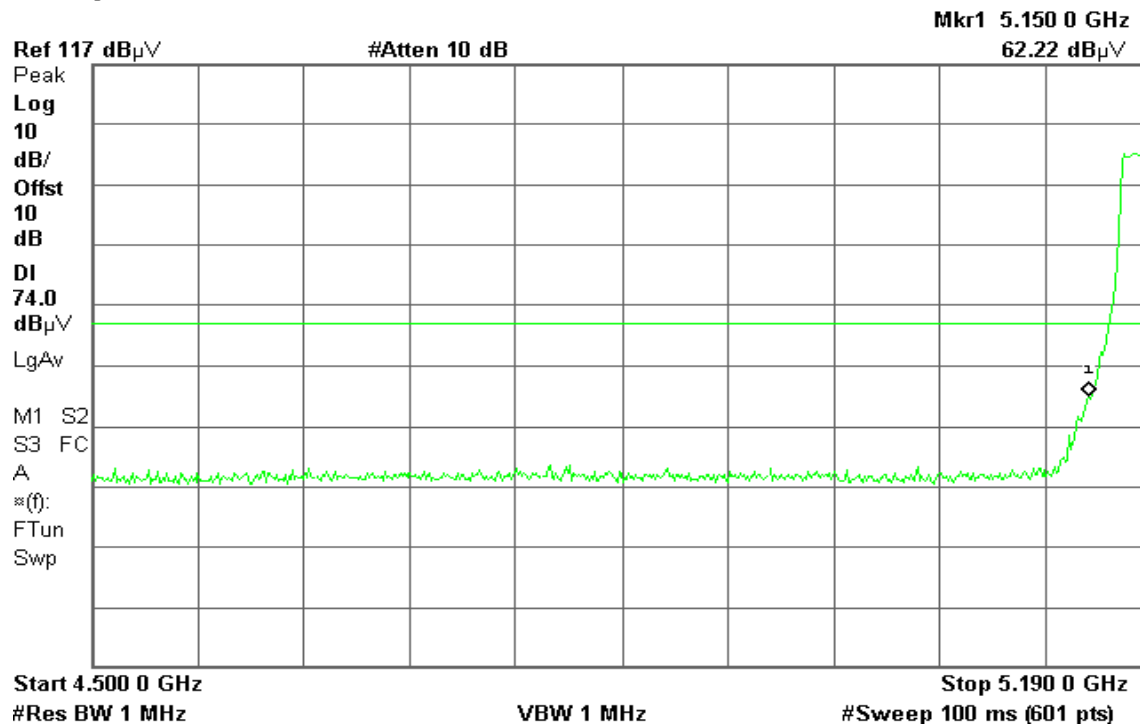


Detector mode: Peak

Polarity: Horizontal

Agilent 13:24:23 Mar 20, 2006

T

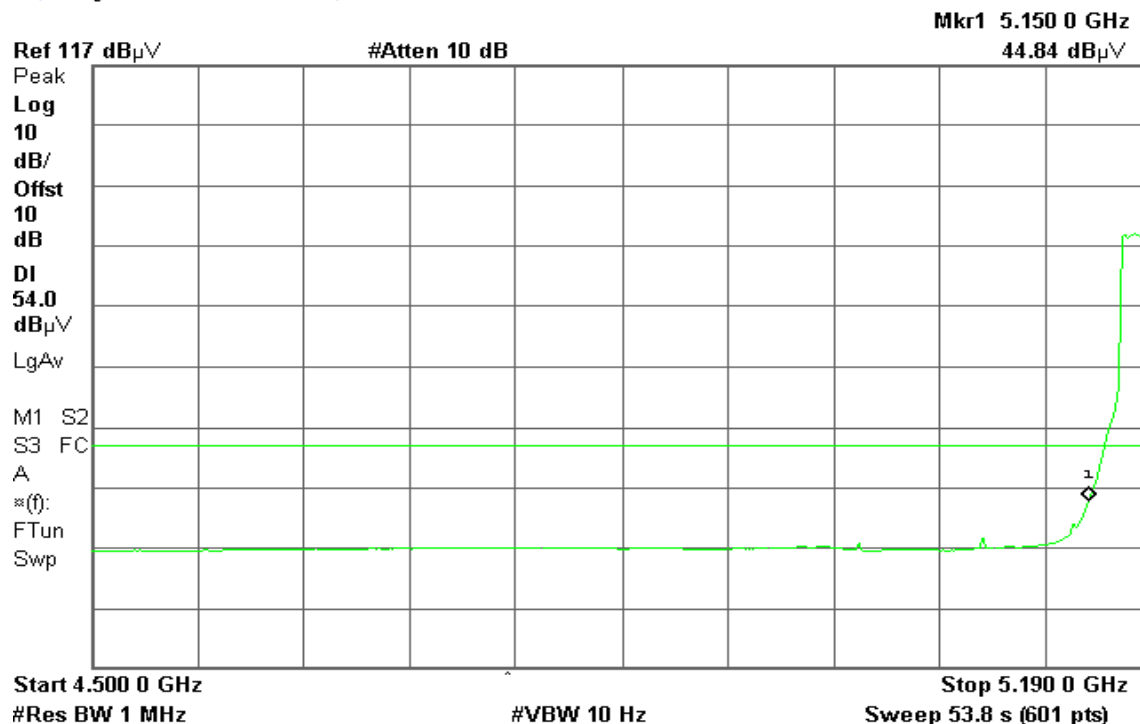


Detector mode: Average

Polarity: Horizontal

Agilent 13:26:01 Mar 20, 2006

T





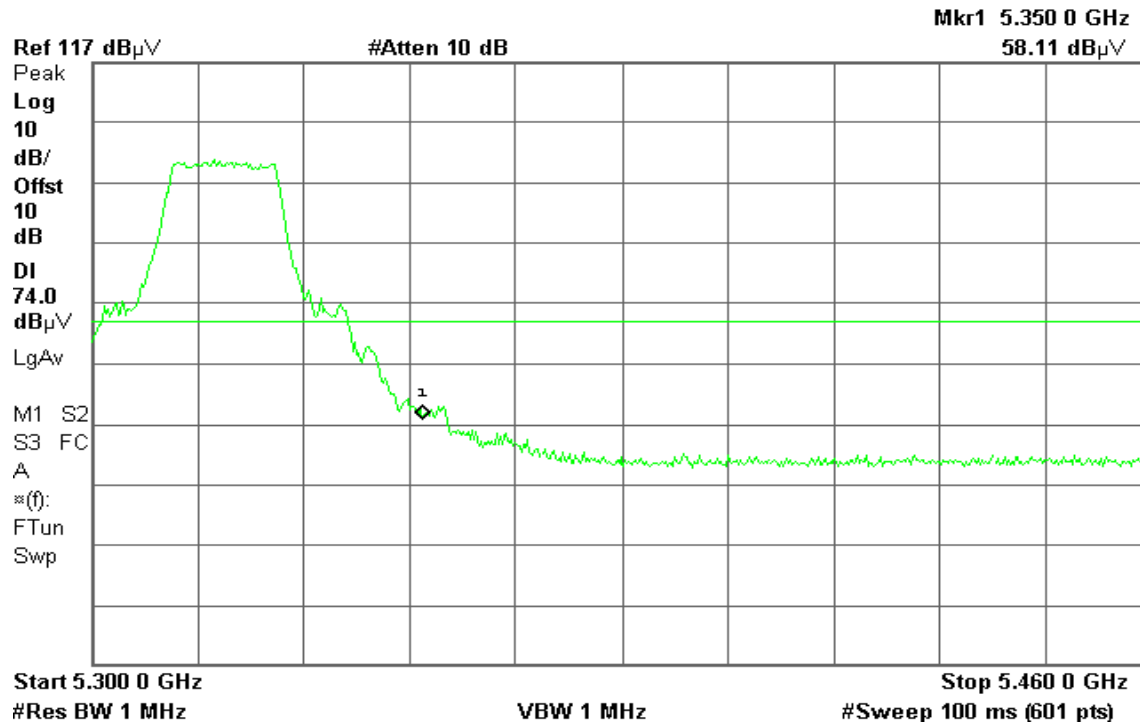
Band Edges (CH High)

Detector mode: Peak

Polarity: Vertical

Agilent 13:50:54 Mar 20, 2006

T

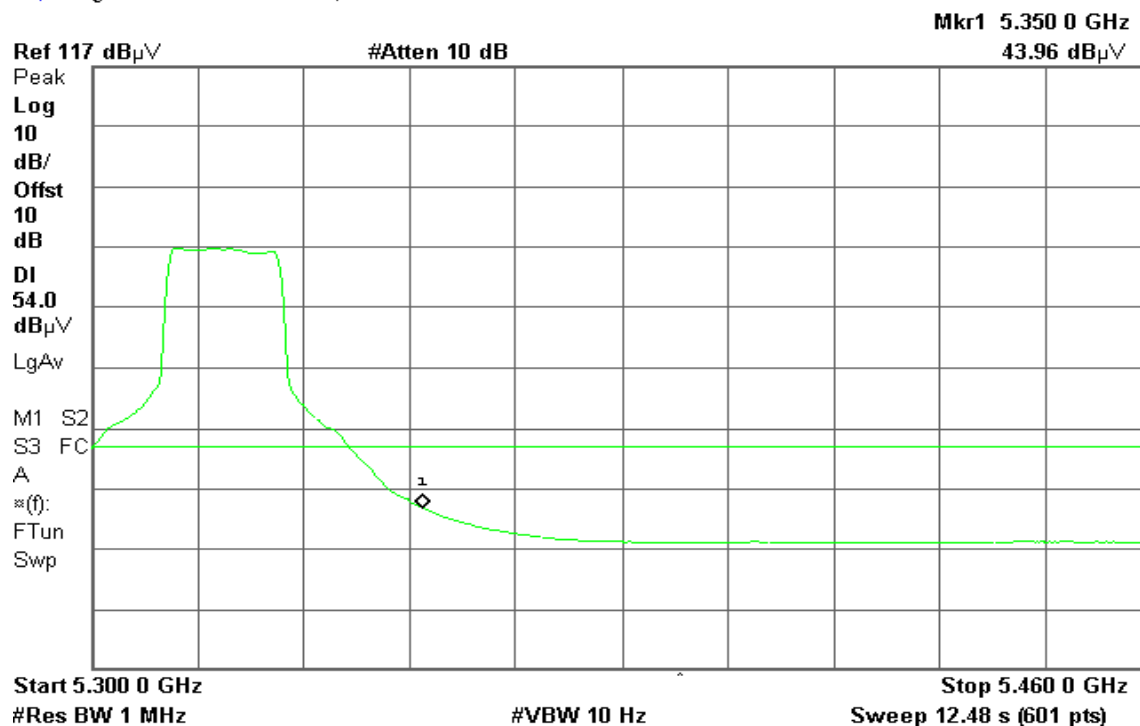


Detector mode: Average

Polarity: Vertical

Agilent 13:51:29 Mar 20, 2006

T



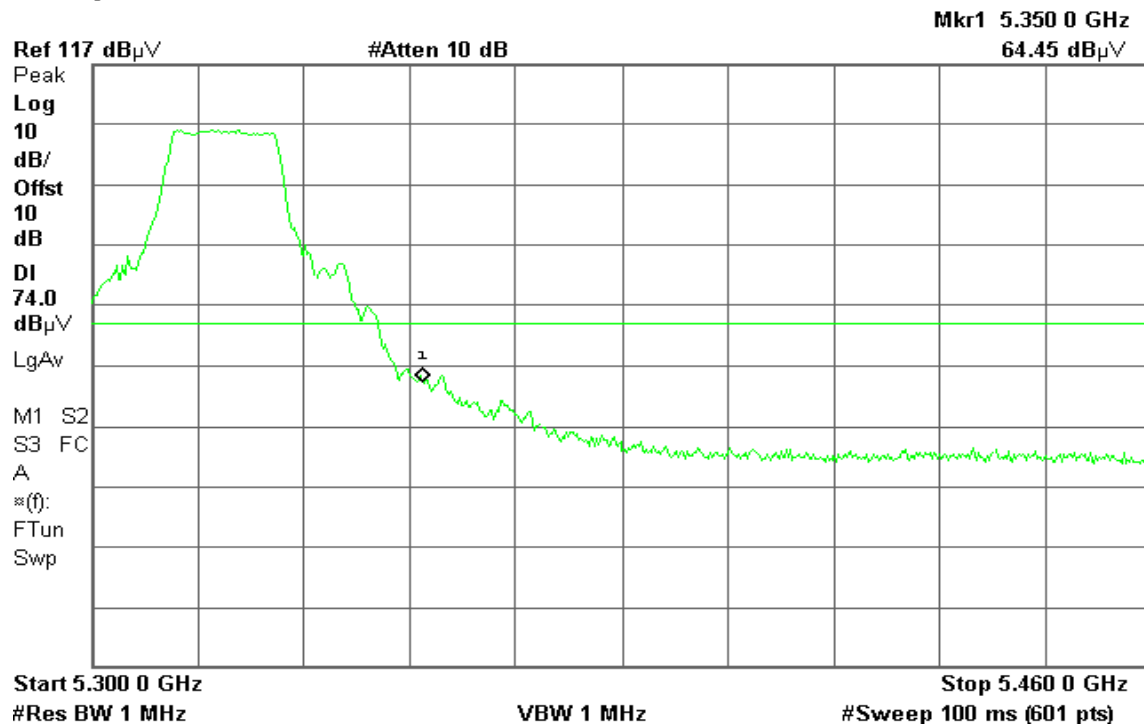


Detector mode: Peak

Polarity: Horizontal

Agilent 13:48:16 Mar 20, 2006

T



Detector mode: Average

Polarity: Horizontal

Agilent 13:47:39 Mar 20, 2006

T





7.4 PEAK POWER SPECTRAL DENSITY

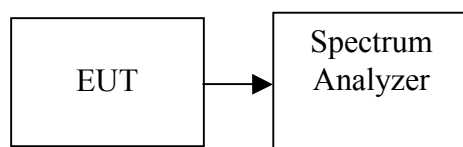
LIMIT

According to §15.407(a),

- (1) For the band 5.15-5.25 GHz, the peak power spectral density shall not exceed 4dBm in any 1MHz band.
- (2) For the band 5.25-5.35 GHz, the peak power spectral density shall not exceed 11dBm in any 1MHz band.

If transmitting antennas of directional gain greater than 6dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer as RBW = 1MHz, VBW = 3MHz, Span = 25MHz, Sweep=1ms
3. Record the max. reading.
4. Repeat the above procedure until the measurements for all frequencies are completed

TEST RESULTS

No non-compliance noted

Test Data

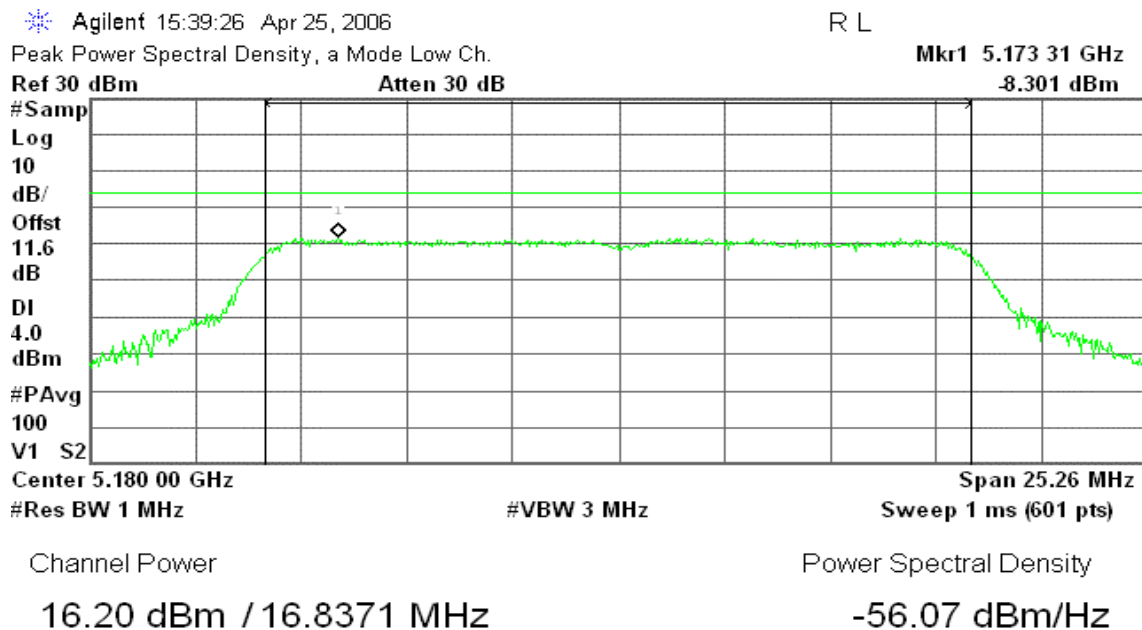
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)	Result
Low	5180	-8.30	4.00	-12.30	PASS
Mid	5260	6.71	11.00	-4.29	PASS
High	5320	7.89	11.00	-3.11	PASS

(Remark: Maximum antenna gain = 2.09dBi, therefore there is no reduction due to antenna gain.)

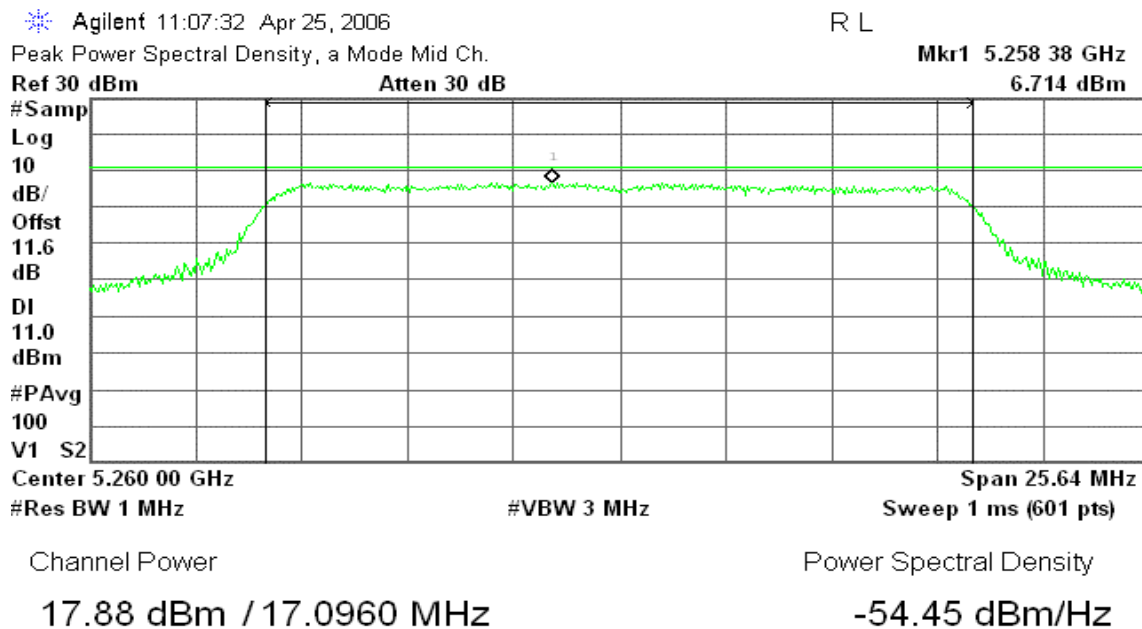


Test Plot

CH Low



CH Mid





CH High

Agilent 11:11:07 Apr 25, 2006

R L

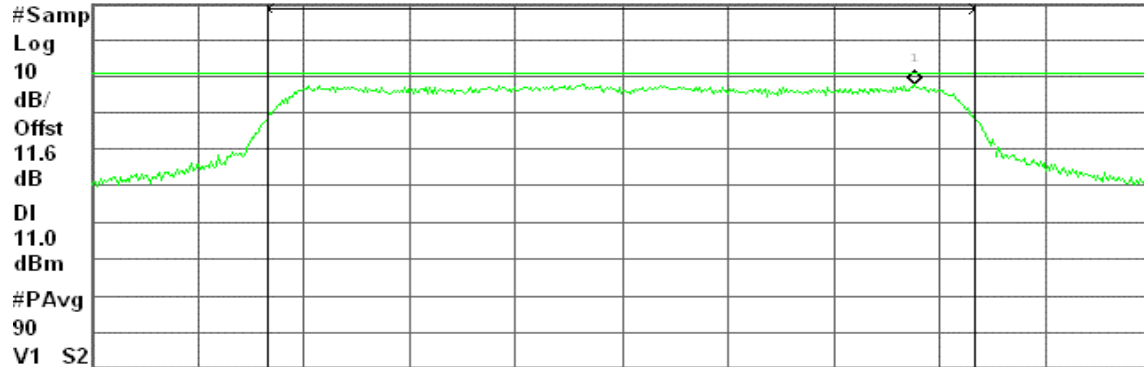
Peak Power Spectral Density, a Mode High Ch.

Mkr1 5.327 28 GHz

Ref 30 dBm

Atten 30 dB

7.890 dBm



Center 5.320 00 GHz

#VBW 3 MHz

Sweep 1 ms (601 pts)

Channel Power

Power Spectral Density

19.20 dBm / 17.5330 MHz

-53.23 dBm/Hz

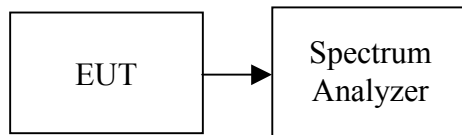


7.5 PEAK EXCURSION

LIMIT

According to §15.407(a)(6), the ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

Test Configuration



TEST PROCEDURE

The test is performed in accordance with <FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices> – Part 15, Subpart E, August 2002.

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to spectrum.
3. Trace A, Set RBW = 1MHz, VBW = 3MHz, Span >26dB bandwidth, Max. hold.
4. Delta Mark trace A Maximum frequency and trace B same frequency.
5. Repeat the above procedure until measurements for all frequencies were complete.

TEST RESULTS

No non-compliance noted

Test Data

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)	Result
Low	5180	7.56	13.00	-5.44	PASS
Mid	5260	9.16	13.00	-3.84	PASS
High	5320	8.55	13.00	-4.45	PASS



Test Plot

CH Low

Agilent 18:07:59 Apr 25, 2006

R T

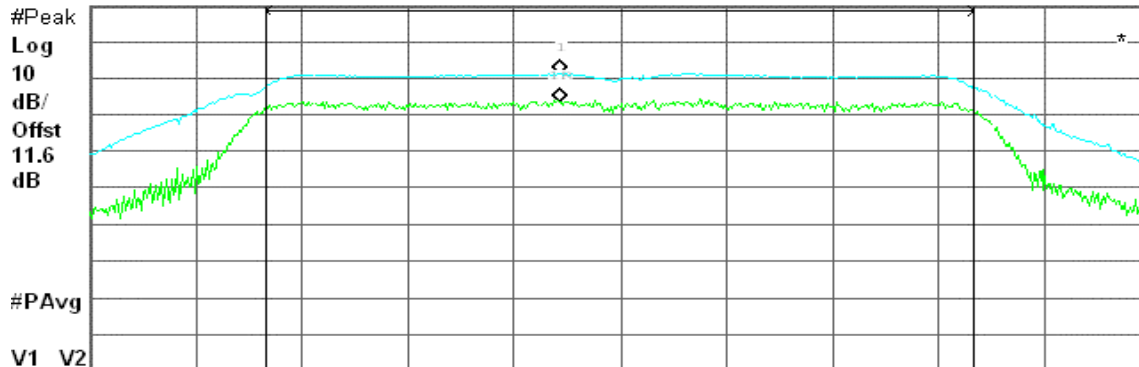
Peak Excursion, a Mode Low Ch.

Δ Mkr1 0 Hz

Ref 30 dBm

Atten 30 dB

7.56 dB



Center 5.180 00 GHz

Span 24.38 MHz

#Res BW 1 MHz

#VBW 3 MHz

Sweep 20 ms (601 pts)

Channel Power

Power Spectral Density

19.85 dBm / 16.2500 MHz

-52.25 dBm/Hz

CH Mid

Agilent 11:07:59 Apr 25, 2006

R L

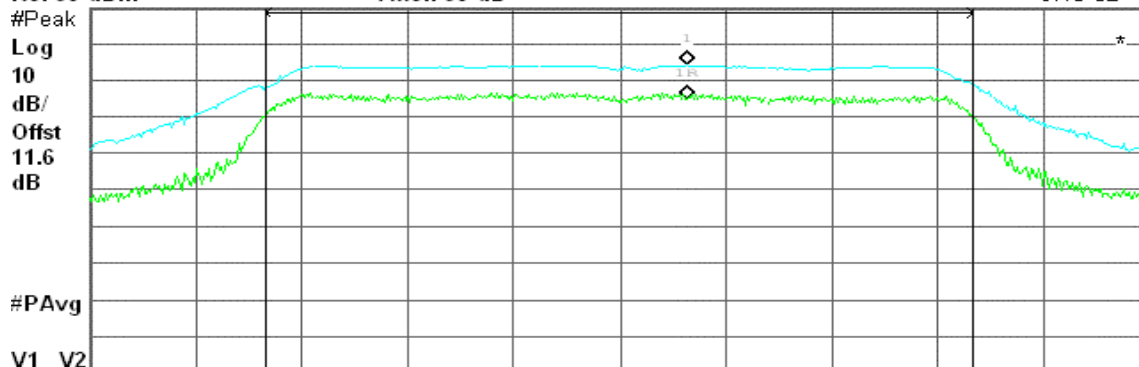
Peak Excursion, a Mode Mid Ch.

Δ Mkr1 0 Hz

Ref 30 dBm

Atten 30 dB

9.16 dB



Center 5.260 00 GHz

Span 25.64 MHz

#Res BW 1 MHz

#VBW 3 MHz

Sweep 20 ms (601 pts)

Channel Power

Power Spectral Density

23.71 dBm / 17.0960 MHz

-48.62 dBm/Hz



CH High

Agilent 11:11:32 Apr 25, 2006

R L

Peak Excursion, a Mode High Ch.

Δ Mkr1 0 Hz

Ref 30 dBm

Atten 30 dB

8.55 dB

#Peak

Log

10

dB/

Offst

11.6

dB

#PAvg

V1 V2

Center 5.320 00 GHz

#Res BW 1 MHz

#VBW 3 MHz

Span 26.3 MHz

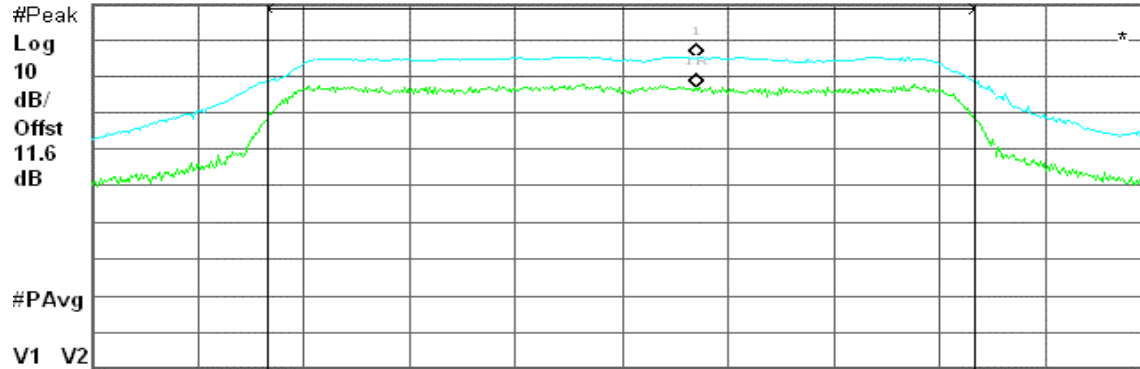
Sweep 20 ms (601 pts)

Channel Power

24.82 dBm / 17.5330 MHz

Power Spectral Density

-47.62 dBm/Hz



7.6 RADIATED UNDESIRABLE EMISSION

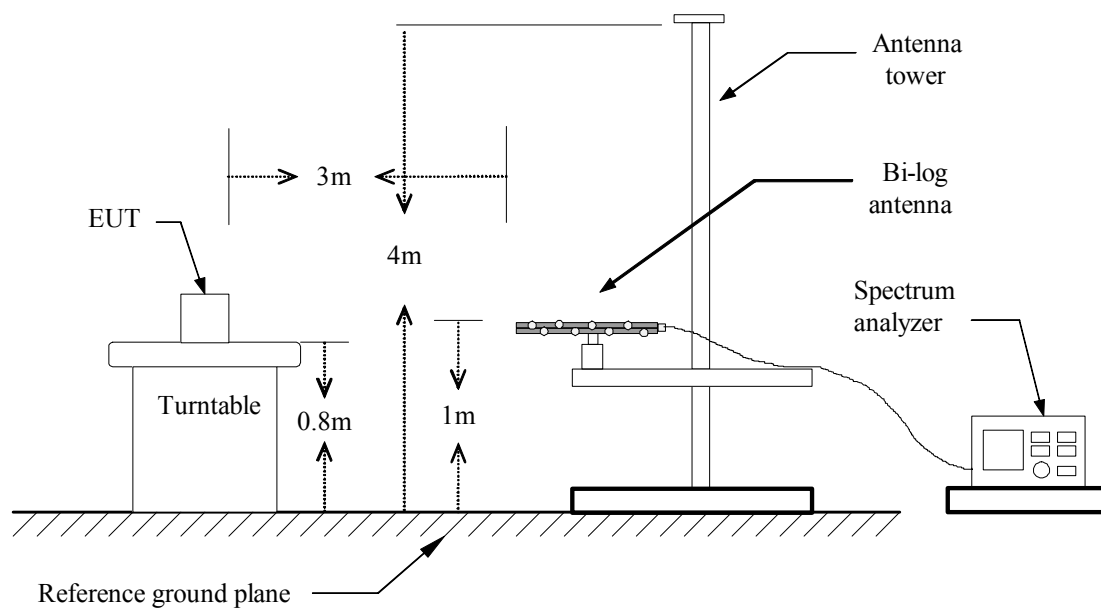
LIMIT

According to 15.407(b),

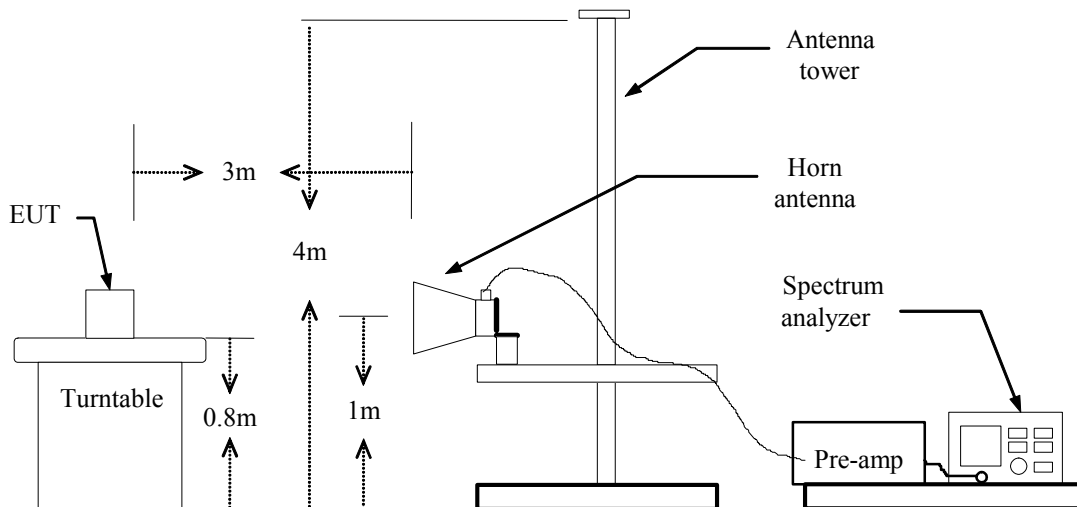
- (1) For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.
- (2) For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.

Test Configuration

Below 1 GHz



Above 1 GHz



TEST PROCEDURE

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:

Below 1GHz:

RBW=100kHz / VBW=300kHz / Sweep=AUTO

Above 1GHz:

(a) PEAK: RBW=VBW=1MHz / Sweep=AUTO

(b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO

7. Repeat above procedures until the measurements for all frequencies are complete.

**TEST RESULTS****Below 1 GHz****Operation Mode:** Normal Link**Test Date:** April 26, 2006**Temperature:** 26°C**Tested by:** Ryan Chen**Humidity:** 55% RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (QP) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (QP) (dBuV/m)	Limit (QP) (dBuV/m)	Margin (dB)	Remark
344.08	V	9.61	---	17.66	27.27	---	46.00	-18.73	Peak
539.68	V	1.76	---	21.69	23.45	---	46.00	-22.55	Peak
639.00	V	1.19	---	21.62	22.81	---	46.00	-23.19	Peak
680.85	V	8.02	---	22.93	30.95	---	46.00	-15.05	Peak
739.60	V	2.39	---	23.80	26.20	---	46.00	-19.80	Peak
838.43	V	3.60	---	24.15	27.75	---	46.00	-18.25	Peak
345.63	H	7.66	---	17.70	25.36	---	46.00	-20.64	Peak
397.85	H	10.28	---	18.38	28.66	---	46.00	-17.34	Peak
539.69	H	3.68	---	21.69	25.37	---	46.00	-20.63	Peak
589.49	H	4.51	---	22.65	27.16	---	46.00	-18.84	Peak
637.14	H	3.97	---	21.68	25.65	---	46.00	-20.35	Peak
738.97	H	5.53	---	23.80	29.33	---	46.00	-16.67	Peak

Remark:

1. Measuring frequencies from 30 MHz to the 1GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.
3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).

**Above 1 GHz****Operation Mode:** Tx / IEEE 802.11a / CH Low**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1303.33	V	55.77	---	-14.31	41.46	---	74.00	54.00	-12.54	Peak
10350.00	V	39.63	---	0.73	40.35	---	74.00	54.00	-13.65	Peak
15533.33	V	44.25	---	-0.88	43.38	---	74.00	54.00	-10.62	Peak
N/A										
1560.00	H	56.61	---	-13.56	43.05	---	74.00	54.00	-10.95	Peak
15533.33	H	43.31	---	-0.88	42.43	---	74.00	54.00	-11.57	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** Tx / IEEE 802.11a / CH Mid**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
2505.00	V	54.21	---	-10.26	43.94	---	74.00	54.00	-10.06	Peak
N/A										
1431.67	H	56.19	---	-14.06	42.14	---	74.00	54.00	-11.86	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** Tx / IEEE 802.11a / CH High**Test Date:** March 20, 2006**Temperature:** 24°C**Tested by:** Rex Lai**Humidity:** 55% RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant.Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
2995.00	V	55.00	---	-9.65	45.36	---	74.00	54.00	-8.64	Peak
10633.33	V	42.92	---	1.17	44.10	---	74.00	54.00	-9.90	Peak
15950.00	V	42.78	---	-0.57	42.22	---	74.00	54.00	-11.78	Peak
N/A										
1945.00	H	55.76	---	-11.24	44.52	---	74.00	54.00	-9.48	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).



7.7 CONDUCTED UNDESIRABLE EMISSION

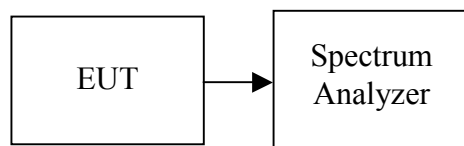
LIMIT

According to 15.407(b),

- (1) For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.
- (2) For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.

The provisions of §15.205 apply to intentional radiators operating under this section.

Test Configuration



TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements are made.

Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

TEST RESULTS

No non-compliance noted



Test Plot

CH Low

30MHz ~ 40GHz

Agilent 10:35:26 Apr 25, 2006

L

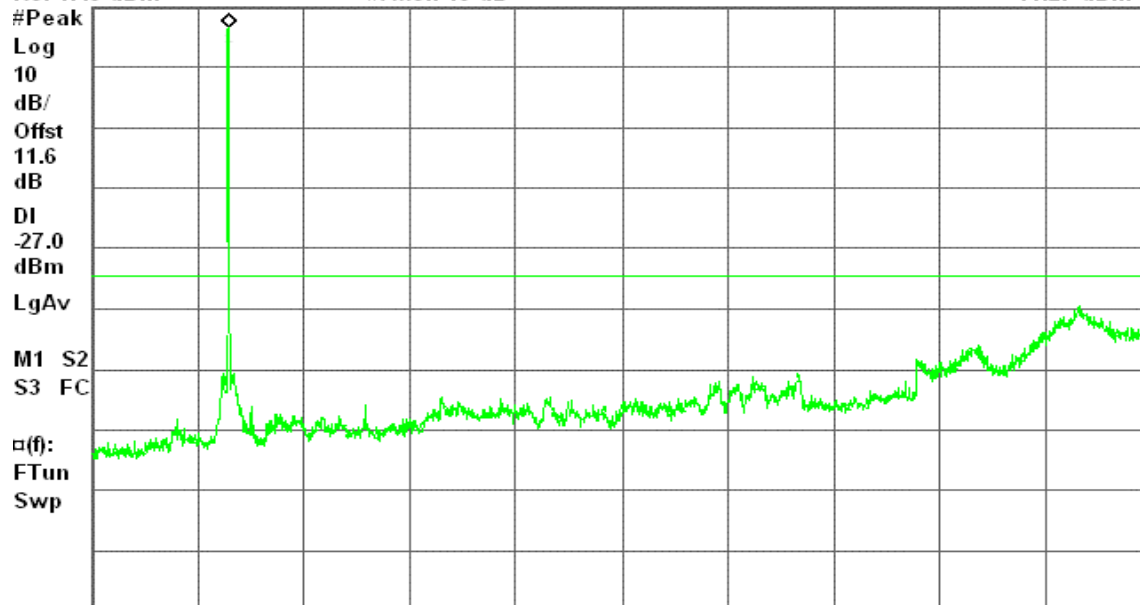
Conducted Spur., a Mode Low Ch.

Mkr1 5.19 GHz

Ref 17.6 dBm

#Atten 16 dB

14.27 dBm



Center 20.02 GHz

Span 39.97 GHz

#Res BW 1 MHz

#VBW 1 MHz

Sweep 100 ms (2001 pts)

CH Mid

30MHz ~ 40GHz

Agilent 11:08:48 Apr 25, 2006

L

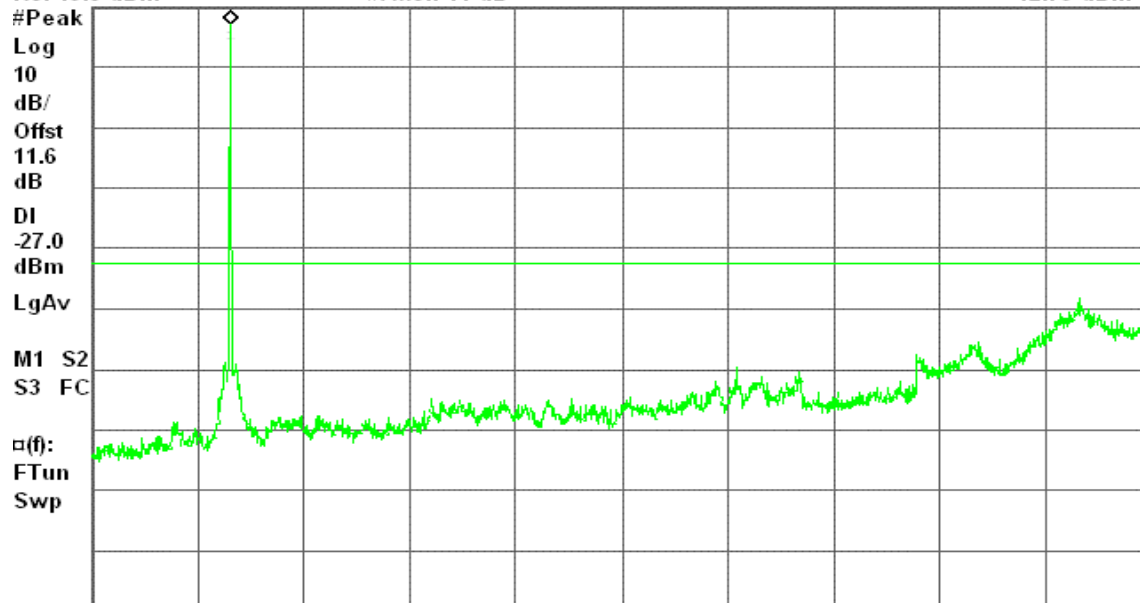
Conducted Spur., a Mode Mid Ch.

Mkr1 5.27 GHz

Ref 15.6 dBm

#Atten 14 dB

12.75 dBm



Center 20.02 GHz

Span 39.97 GHz

#Res BW 1 MHz

#VBW 1 MHz

Sweep 100 ms (2001 pts)



CH High 30MHz ~ 40GHz

Agilent 11:12:09 Apr 25, 2006

L

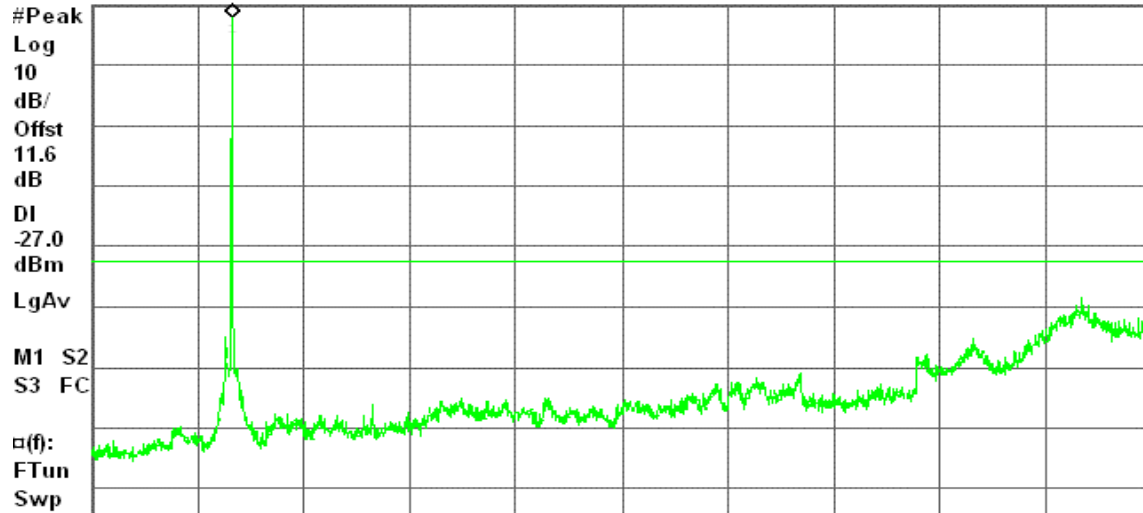
Conducted Spur., a Mode High Ch.

Mkr1 5.33 GHz

Ref 15.6 dBm

#Atten 14 dB

13.52 dBm



Center 20.02 GHz

Span 39.97 GHz

#Res BW 1 MHz

#VBW 1 MHz

Sweep 100 ms (2001 pts)



7.8 POWERLINE CONDUCTED EMISSIONS

LIMIT

According to §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 μ H/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 Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

* Decreases with the logarithm of the frequency.

TEST CONFIGURATION

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.



TEST RESULTS

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

Test Data

Operation Mode: Normal Link **Test Date:** March 28, 2006
Temperature: 25°C **Tested by:** Ivan Tsai
Humidity: 55% RH

Freq. (MHz)	QP Reading (dBuV)	AV Reading (dBuV)	Corr. factor (dB)	QP Result (dBuV)	AV Result (dBuV)	QP Limit (dBuV)	AV Limit (dBuV)	QP Margin (dB)	AV Margin (dB)	Note
0.240	38.830	37.250	0.100	38.930	37.350	62.103	52.103	-23.173	-14.753	L1
0.478	36.760	35.180	0.100	36.860	35.280	56.371	46.371	-19.511	-11.091	L1
0.721	35.950	32.840	0.100	36.050	32.940	56.000	46.000	-19.950	-13.060	L1
0.953	35.370	31.530	0.100	35.470	31.630	56.000	46.000	-20.530	-14.370	L1
1.082	35.200	30.490	0.100	35.300	30.590	56.000	46.000	-20.700	-15.410	L1
1.561	34.710	30.360	0.100	34.810	30.460	56.000	46.000	-21.190	-15.540	L1
0.238	38.910	37.820	0.100	39.010	37.920	62.166	52.166	-23.156	-14.246	L2
0.476	36.840	35.340	0.100	36.940	35.440	56.409	46.409	-19.469	-10.969	L2
0.595	34.520	32.440	0.100	34.620	32.540	56.000	46.000	-21.380	-13.460	L2
0.715	36.660	34.300	0.100	36.760	34.400	56.000	46.000	-19.240	-11.600	L2
0.945	33.370	28.140	0.100	33.470	28.240	56.000	46.000	-22.530	-17.760	L2
1.082	35.140	30.490	0.100	35.240	30.590	56.000	46.000	-20.760	-15.410	L2

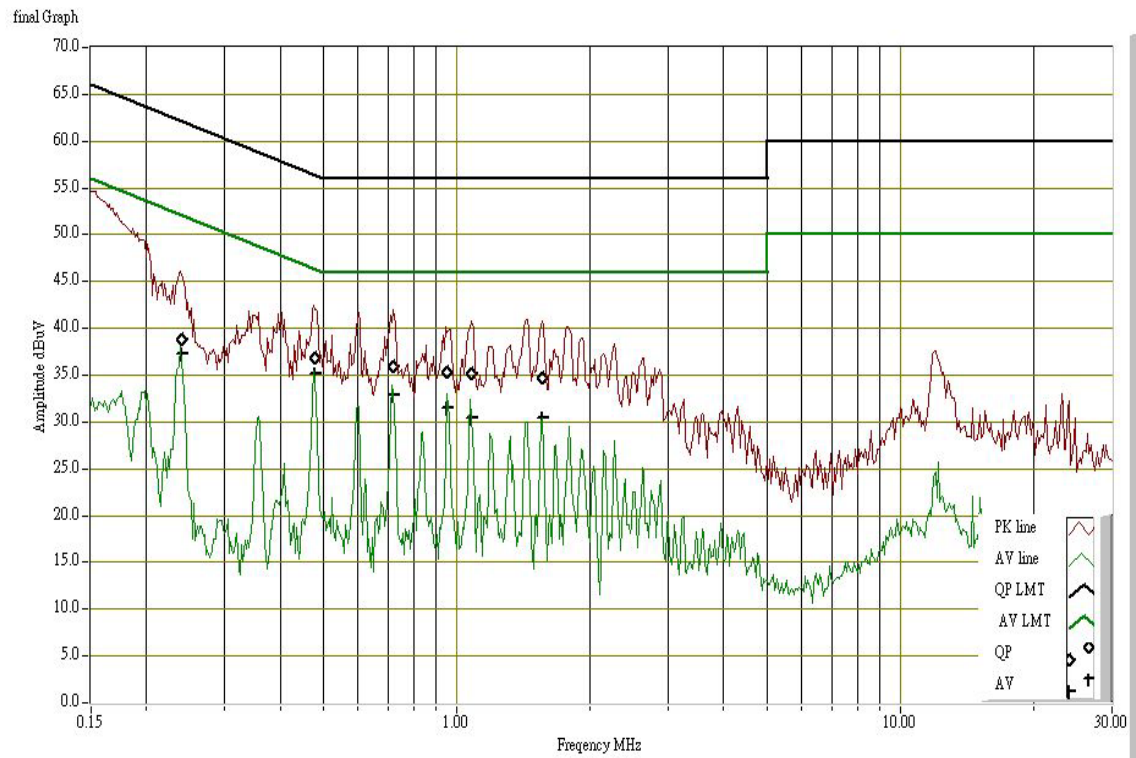
Remark:

1. Measuring frequencies from 0.15 MHz to 30MHz.
2. The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Quasi-peak detector and average detector.
3. The IF bandwidth of SPA between 0.15MHz to 30MHz was 10kHz; the IF bandwidth of Test Receiver between 0.15MHz to 30MHz was 9kHz;
4. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)

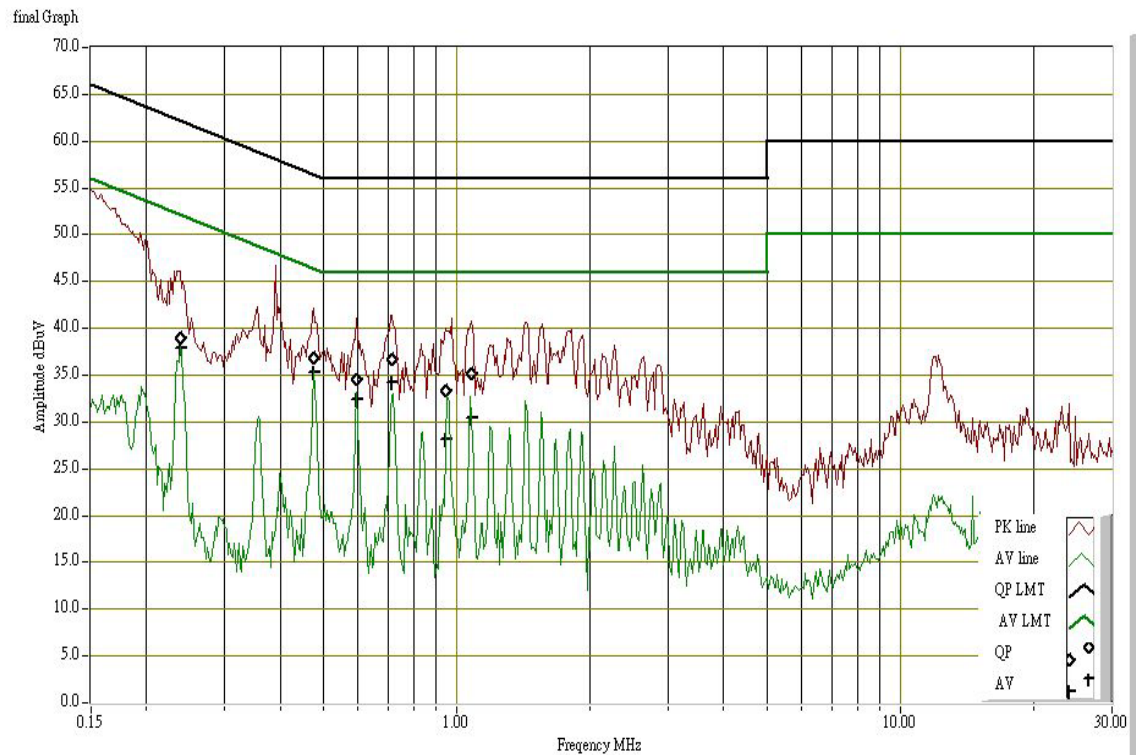


Test Plots

Conducted emissions (Line 1)



Conducted emissions (Line 2)





7.9 TRANSMISSION IN ABSENCE OF DATA

LIMIT

According to §15.319(f), the device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude transmission of control and signaling information or use of repetitive codes used by certain digital technologies to complete frame or burst intervals.

Applicants shall include in their application for equipment authorization a description of how this requirement is met.

TEST RESULTS

Please refer to the operational description for details.

Remark: For the details, please refer to the theory of the operation.

7.10 FREQUENCY STABILITY

LIMIT

According to §15.407(g), manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

TEST RESULTS

Please refer to the user's manual for further details.

Remark: An examination of the band-edge plots shows that the emission will stay within the authorized band over the entire temperature range.



APPENDIX I

RADIO FREQUENCY EXPOSURE

LIMIT

According to §15.407(f), U-NII devices are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 2.1091 and 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.

EUT Specification

EUT	Shuttle XPC (Wireless 802.11a+b+g)
Frequency band (Operating)	☐ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.725GHz ~ 5.850GHz ☒ WLAN: 5.15GHz ~ 5.35GHz ☐ Others: _____
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation) ☐ Others: _____
Exposure classification	☐ Occupational/Controlled exposure (S = 5mW/cm ²) ☒ General Population/Uncontrolled exposure (S=1mW/cm ²)
Antenna diversity	☐ Single antenna ☒ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☒ Tx/Rx diversity
Max. output power	18.68 dBm (73.79mW)
Antenna gain (Max)	2.09 dBi (Numeric gain: 1.62)
Evaluation applied	☒ MPE Evaluation* ☐ SAR Evaluation ☐ N/A
Remark: 1. The maximum output power is <u>18.68dBm (73.79mW)</u> at <u>5320MHz</u> (with <u>1.62 numeric antenna gain.</u>) 2. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 1.0 mW/cm ² even if the calculation indicates that the power density would be larger.	

TEST RESULTS

No non-compliance noted.

**Calculation**

$$\text{Given } E = \frac{\sqrt{30 \times P \times G}}{d} \quad \& \quad S = \frac{E^2}{3770}$$

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 re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = d \text{ (m)} / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \text{Equation 1}$$

Where d = Distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

Maximum Permissible Exposure

EUT output power = 73.79mW

Numeric Antenna gain = 1.62

Substituting the MPE safe distance using $d = 20$ cm into Equation 1:

Yields

$$S = 0.000199 \times P \times G$$

Where P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

$$\rightarrow \text{Power density} = 0.0238 \text{ mW} / \text{cm}^2$$

(For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm² even if the calculation indicates that the power density would be larger.)