FCC CFR47 PART 90 SUBPART Y
INDUSTRY CANADA RSS-111, ISSUE 2 AND RSS-GEN
CLASS II PERMISSIVE CHANGE
CERTIFICATION TEST REPORT

FOR

SINGLE BAND WIRELESS ACCESS POINT WITH BUILT-IN AMPLIFIER

MODEL NUMBER: 4954-R

FCC ID: HZB-4954R
IC: 1856A-4954R

REPORT NUMBER: 07U11295-1, REVISION B

ISSUE DATE: SEPTEMBER 19, 2007

Prepared for
PROXIM WIRELESS CORPORATION
2115 O'NEL DRIVE
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Revision History

Rev.	Issue Date	Revisions	Revised By
--	09/18/07	Initial Issue	T. Chan
B	09/19/07	Updated Output Power	T. Chan

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	PROXIM WIRELESS CORPORATION 2115 O'NEL DRIVE SAN JOSE, CA 95131, USA
EUT DESCRIPTION:	SINGLE BAND WIRELESS ACCESS POINT WITH BUILT-IN AMPLIFIER
MODEL:	4954-R
SERIAL NUMBER:	07UT05560386
DATE TESTED:	SEPTEMBER 6-10, 2007

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 90 SUBPART Y RSS 111, Issue 2 and RSS-GEN	NO NON-COMPLIANCE NOTED

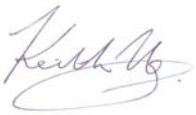
Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

THU CHAN
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:



KEITH NG
EMC EMNGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with TIA/EIA 603C (2004), ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 90, RSS-GEN and RSS 111.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radiated Emission, 30 to 200 MHz	+/- 3.3 dB
Radiated Emission, 200 to 1000 MHz	+4.5 / -2.9 dB
Radiated Emission, 1000 to 2000 MHz	+4.5 / -2.9 dB
Power Line Conducted Emission	+/- 2.9 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Single band wireless access point with built-in amplifier.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
4945 - 4985	5 MHz Bandwidth	13.19	20.84
4945 - 4985	10 MHz Bandwidth	15.46	35.16
4950 - 4980	20 MHz Bandwidth	15.68	36.98

5.3. DESCRIPTION OF CLASS II CHANGE

Re-measure the peak output power with sample detection and RMS power averaging instead.

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio may be used with a variety of antennas providing that for antenna gain over 9 dBi the conducted output power is adjusted as required to meet EIRP and MPE limits.

5.5. SOFTWARE AND FIRMWARE

The test utility software used during testing was ART, Revision 4.8 build #5.

5.6. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power. The highest measured output power was at 4965 MHz for 20 MHz channel bandwidth operation.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	HP	Pavilion N5420	TW12308893	DoC
AC Adapter	HP	f1781a	1203920	DoC
48 VDC POE	Made in China	PW143RD4800F02	5471	N/A

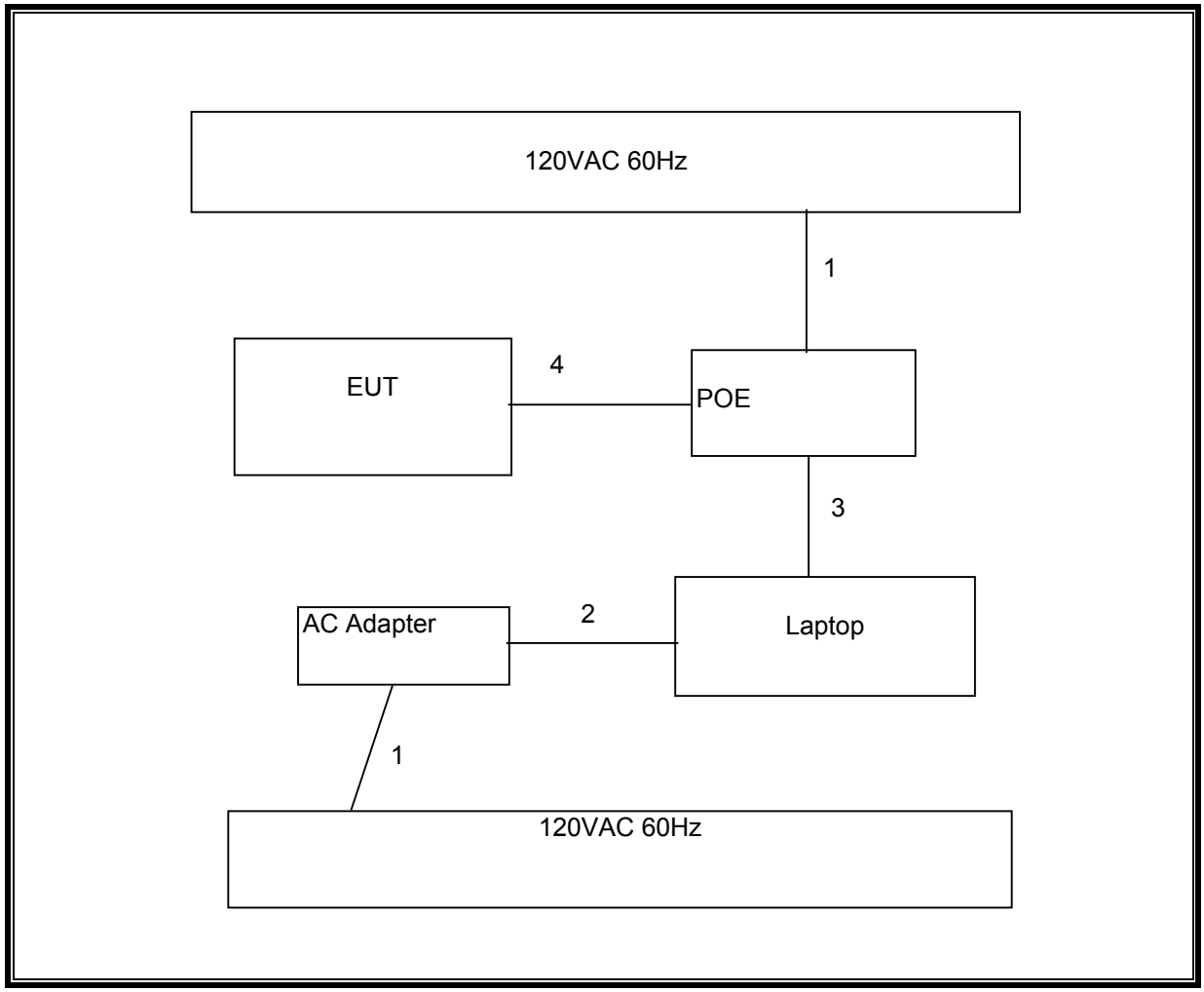
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	2	US 115V	Un-shielded	2m	N/A
2	DC	1	DC	Un-shielded	2m	N/A
3	Ethernet	1	RJ45	Un-shielded	2m	Connected to Laptop
4	POE	1	RJ45	Un-shielded	30m	N/A

TEST SETUP

The EUT is connected to a host laptop computer via an unshielded crossover LAN cable during the tests. Test software exercised the radio card.

SETUP DIAGRAM FOR TESTS



6. 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**
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	MY43360112	05/03/08
Peak Power Meter	Agilent / HP	E4416A	GB41291160	12/02/07
Peak / Average Power Sensor	Agilent	E9327A	US40440755	12/02/07
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	6717	04/22/08
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00561	10/03/07
7.6 GHz HPF	Micro-Tronics	HPM13195	002	C.N.R.

7. LIMITS AND RESULTS

7.1. CHANNEL TESTS FOR 5 MHz CHANNEL BANDWIDTH MODE

7.1.1. EMISSION BANDWIDTH

LIMIT

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 26 dB bandwidth and/or the 99% bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled.

RESULTS

No non-compliance noted:

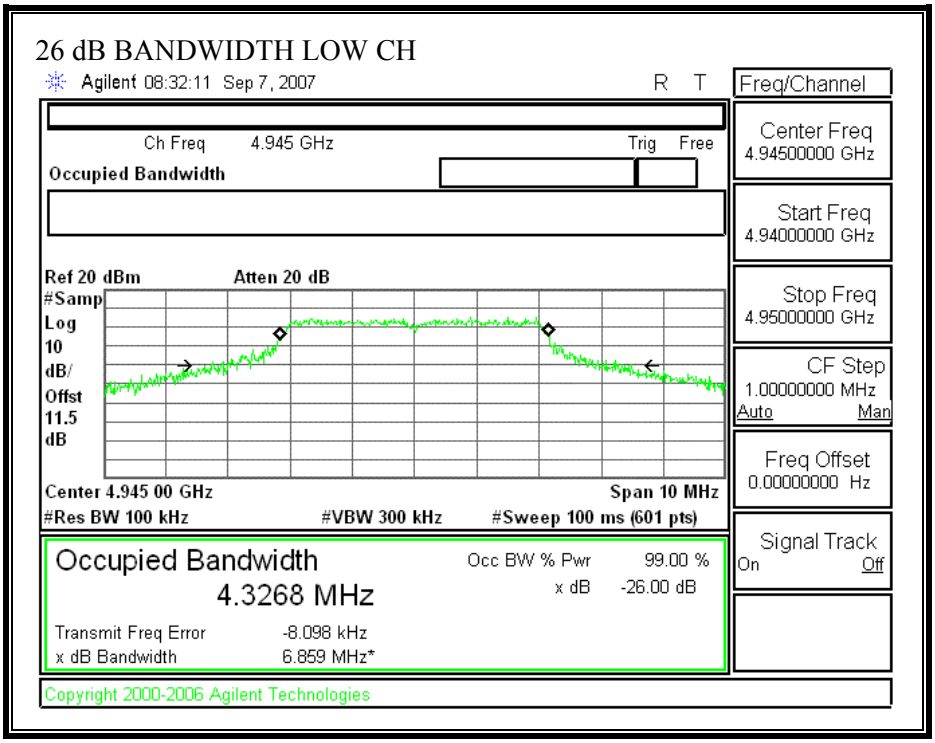
26 dB Bandwidth

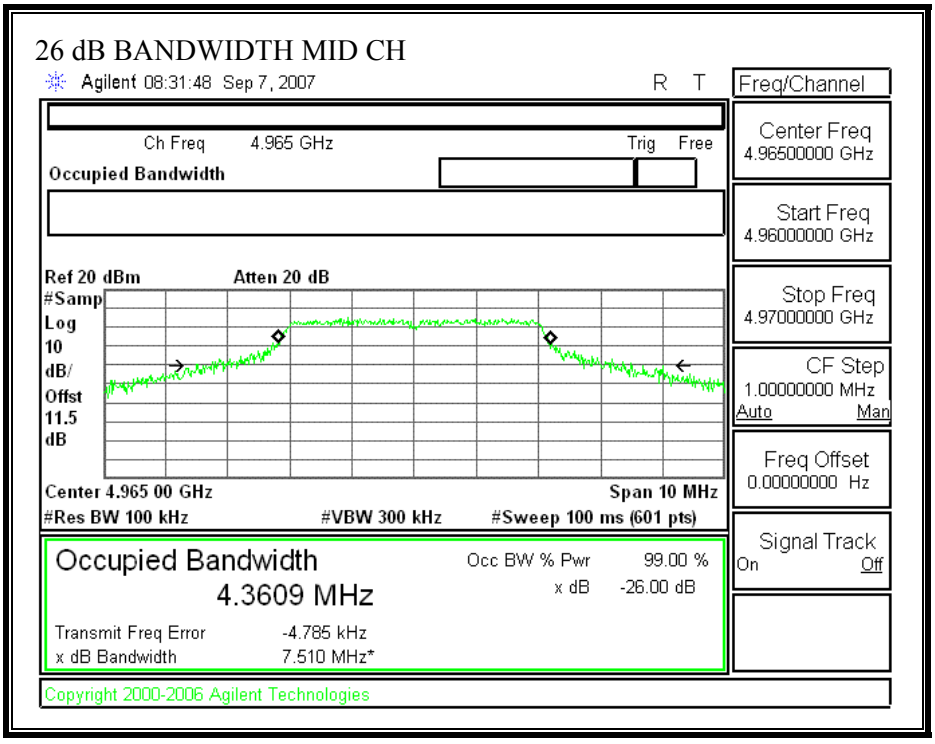
Channel	Frequency (MHz)	26 dB BW (MHz)	10 Log B (dB)
Low	4945	6.859	8.36
Middle	4965	7.510	8.76
High	4985	8.231	9.15

99% Bandwidth

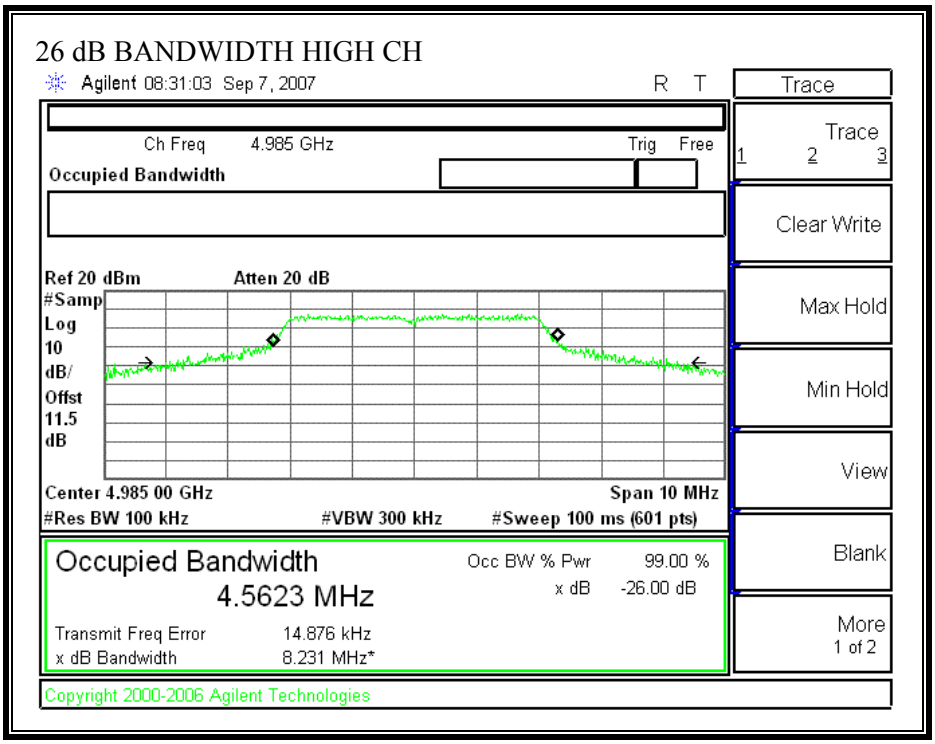
Channel	Frequency (MHz)	99% BW (MHz)
Low	4945	4.3268
Middle	4965	4.3609
High	4985	4.5623

26 dB EMISSION BANDWIDTH





26 dB BANDWIDTH HIGH CH



7.1.2. PEAK OUTPUT POWER

PEAK POWER LIMIT

§ 90.1215 The transmitting power of stations operating in the 4940–4990 MHz band must not exceed the maximum limits in this section.

(a) The peak transmit power should not exceed:

Channel bandwidth (MHz)	Low power Device Peak transmitter Power (dBm)	High power Device Peak transmitter Power (dBm)
1	7	20
5	14	27
10	17	30
15	18.8	31.8
20	20	33

High power devices are also limited to a peak power spectral density of 21 dBm per one MHz. High power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 21 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi. However, high power point-to-point or point-to-multipoint operation (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the transmitter power or spectral density. Corresponding reduction in the peak transmit power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi

RSS 111 Clause 4.3 Table 1 The peak power of low-power and high-power devices shall not exceed the limits corresponding to the equipment's channel bandwidth given in Table 1 below.

Table 1 - Channel Bandwidth and Power Limits

Channel Bandwidth (MHz)	Peak Transmitter Power (dBm)	
	Low-power Transmitter	High-power Transmitter
1	7	20
5	14	27
10	17	30
15	18.8	31.8
20	20	33

TEST PROCEDURE

The test is performed using peak power spectral integration.

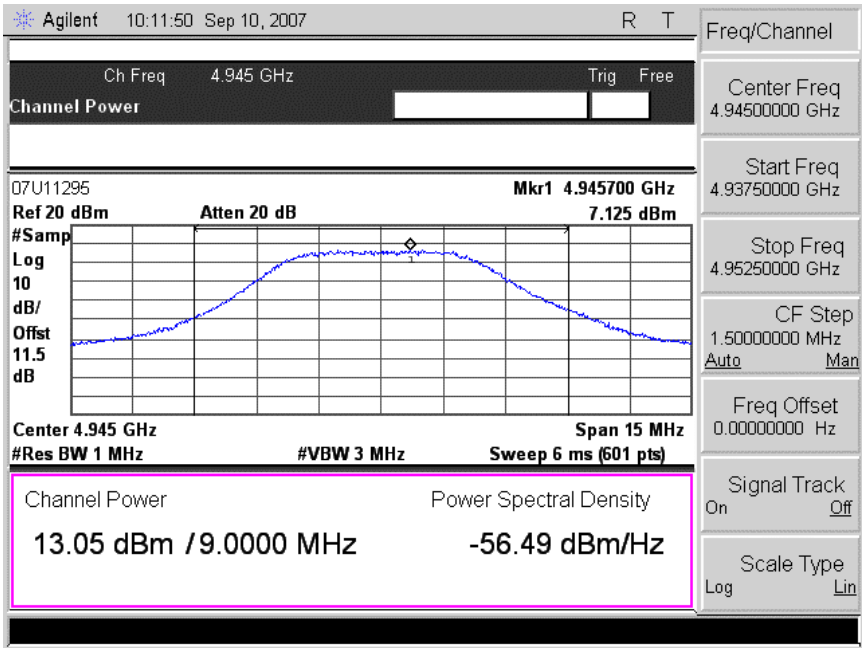
RESULTS

No non-compliance noted:

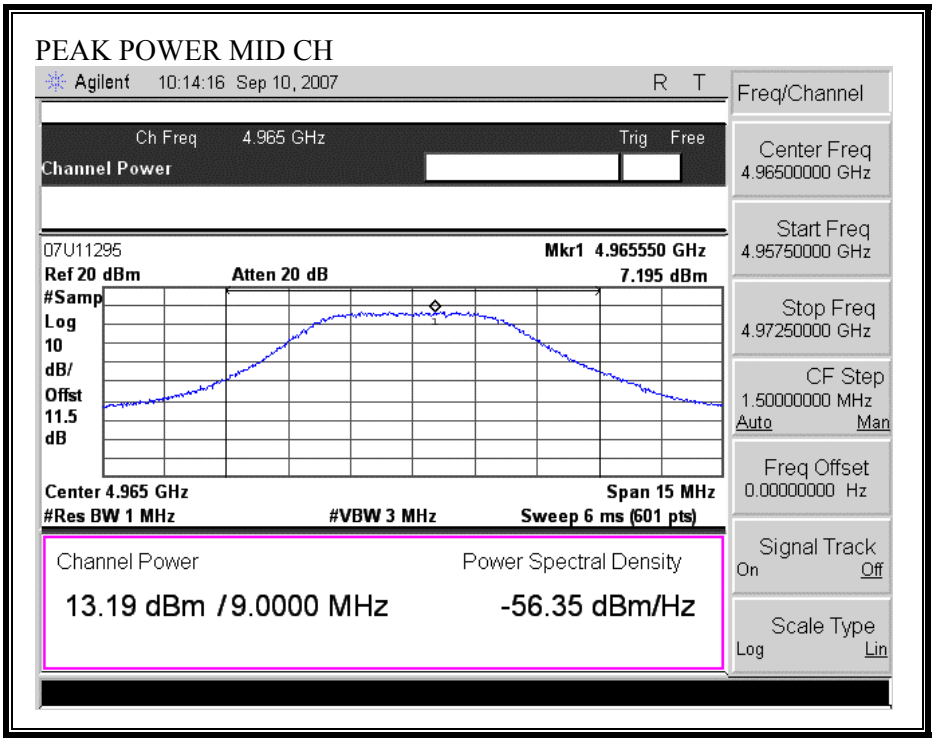
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	4945	13.05	14	-0.95
Middle	4965	13.19	14	-0.81
High	4985	13.13	14	-0.87

OUTPUT POWER (802.11a MODE)

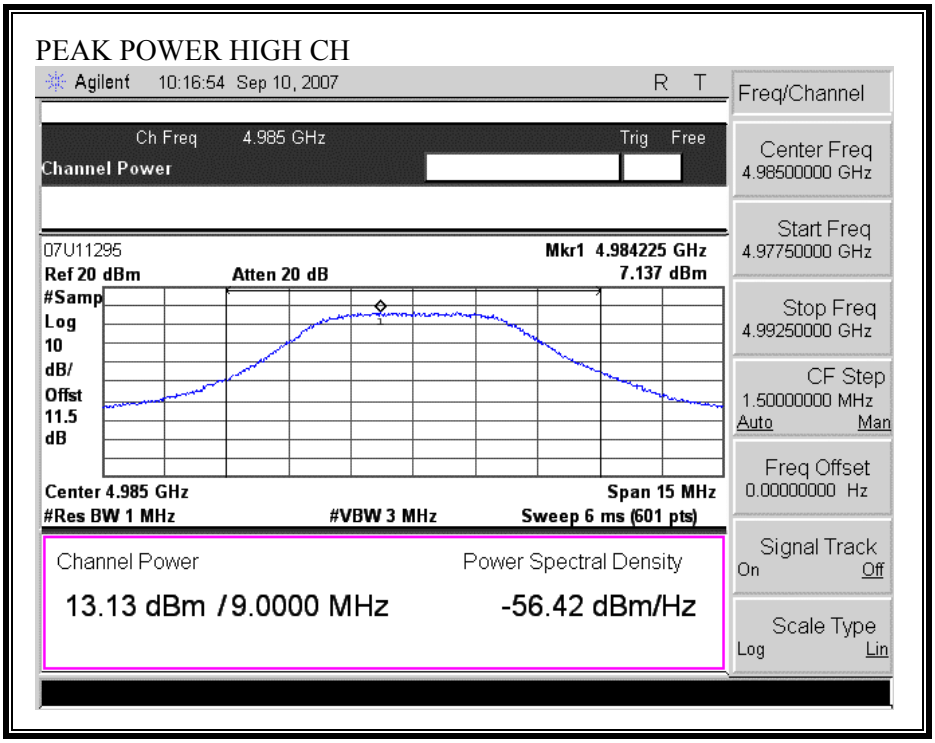
PEAK POWER LOW CH



PEAK POWER MID CH



PEAK POWER HIGH CH



7.1.3. 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.

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f, is in MHz.
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

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

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

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

Rearranging terms to calculate the power density at a specific distance yields

$S = 0.0795 * 10 ^ ((P + G) / 10) / (d^2)$

LIMITS

From §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2
From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

RESULTS

No non-compliance noted:

Mode	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
5 MHz Channel BW	20.0	13.19	9.00	0.0329

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.

7.1.4. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	4945	12.94
Middle	4965	13.20
High	4985	13.28

7.1.5. PEAK POWER SPECTRAL DENSITY

LIMIT

§ 90.1215 (b) Low power devices are also limited to a peak power spectral density of 8 dBm per one MHz. Low power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 8 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi..

(c) The peak power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

RSS 111 Clause 4.3 High and low-power devices are also limited to a peak power spectral density of 21 dBm/MHz and 8 dBm/MHz, respectively. Devices using channel bandwidths other than those listed in Table 1 are permitted. However they shall comply with the peak power spectral density limits of 21 dBm/MHz for high-power transmitters and 8 dBm/MHz for low-power transmitters.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer, the maximum level in a 1 MHz bandwidth is measured with the spectrum analyzer using RBW = 1 MHz and VBW 1 MHz. The PPSD is the highest level found across the emission in any 1 MHz band.

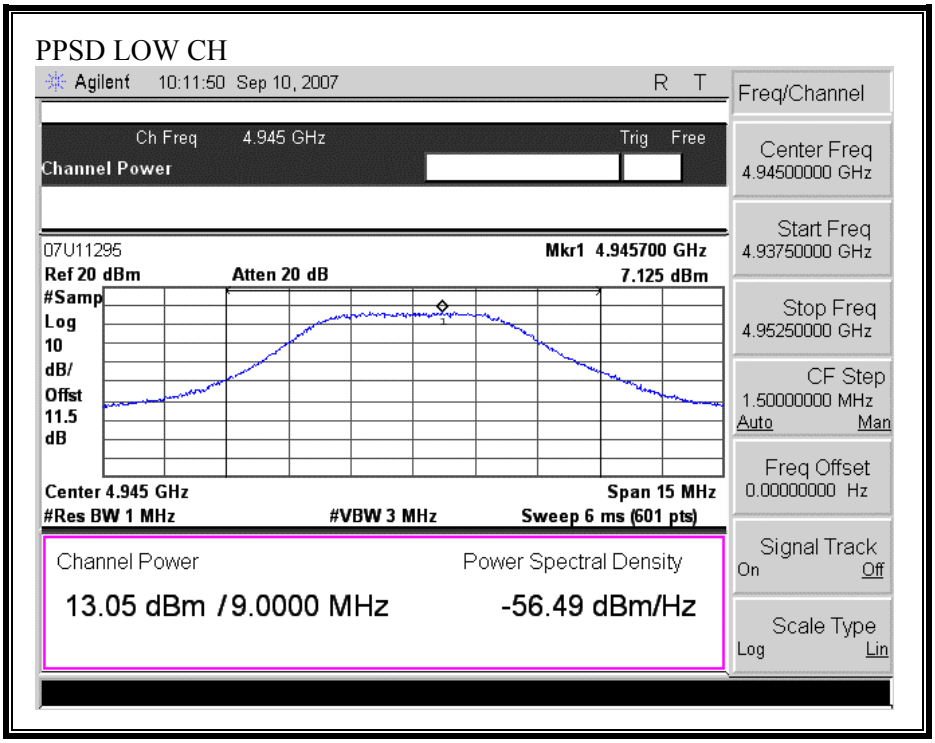
RESULTS

No non-compliance noted:

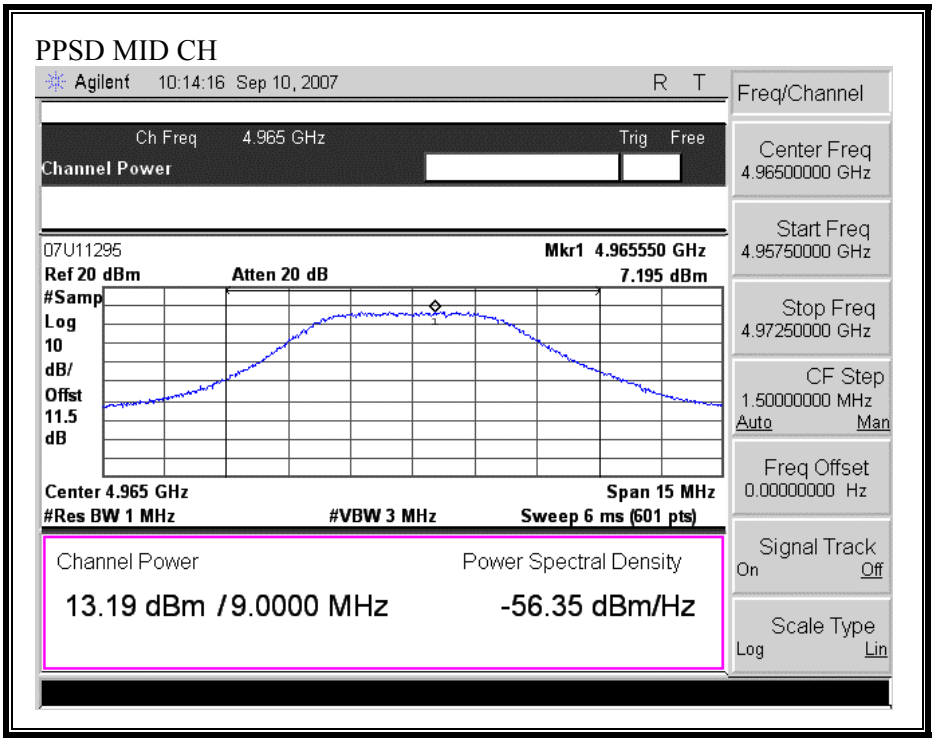
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	4945	7.125	8	-0.875
Middle	4965	7.195	8	-0.805
High	4985	7.137	8	-0.863

PEAK POWER SPECTRAL DENSITY

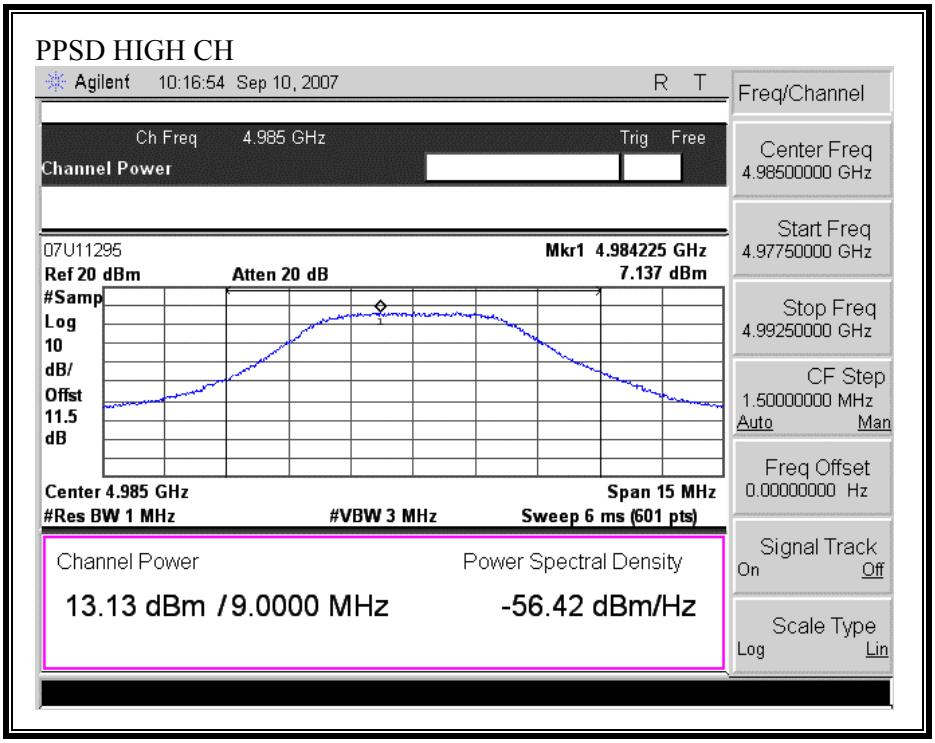
PPSD LOW CH



PPSD MID CH



PPSD HIGH CH



7.1.6. EMISSION MASK AND CONDUCTED SPURIOUS

§ 90.210 (l) Emission Mask L. For low power transmitters (20 dBm or less) operating in the 4940–4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0–45% of the authorized bandwidth (BW): 0 dB.
(2) On any frequency removed from the assigned frequency between 45–50% of the authorized bandwidth: 219 log (% of (BW)/45) dB.
(3) On any frequency removed from the assigned frequency between 50–55% of the authorized bandwidth: 10 + 242 log (% of (BW)/50) dB.
(4) On any frequency removed from the assigned frequency between 55–100% of the authorized bandwidth: 20 + 31 log (% of (BW)/55) dB attenuation.
(5) On any frequency removed from the assigned frequency between 100–150% of the authorized bandwidth: 28 + 68 log (% of (BW)/100) dB attenuation.
(6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 40 dB.
(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

RSS 111 Clause 4.4 The power spectral density of the emissions for low and high-power transmitters shall be attenuated below the transmitted output power as specified in Table 2.

The displacement frequency, fd, is the magnitude of the difference between the channel frequency and the emission component frequency expressed as a percentage of the authorized bandwidth.

Table 2 - Emission Mask for Low and High-power Transmitters

Displacement Frequency, f_d (% of the Authorized Bandwidth)	Minimum Attenuation (dB)	
	Low-power Transmitter (≤ 20 dBm)	High-power Transmitter (> 20 dBm)
$45 < f_d \leq 50$	$219 \log (f_d/45)$	$568 \log (f_d/45)$
$50 < f_d \leq 55$	$10 + 219 \log (f_d/50)$	$26 + 145 \log (f_d/50)$
$55 < f_d \leq 100$	$20 + 31 \log (f_d/55)$	$32 + 31 \log (f_d/55)$
$100 < fd \leq 150$	$28 + 68 \log (f_d/100)$	$40 + 57 \log (f_d/100)$
$f_d > 150$	40	whichever is less stringent 50 or $55 + 10 \log (P)$

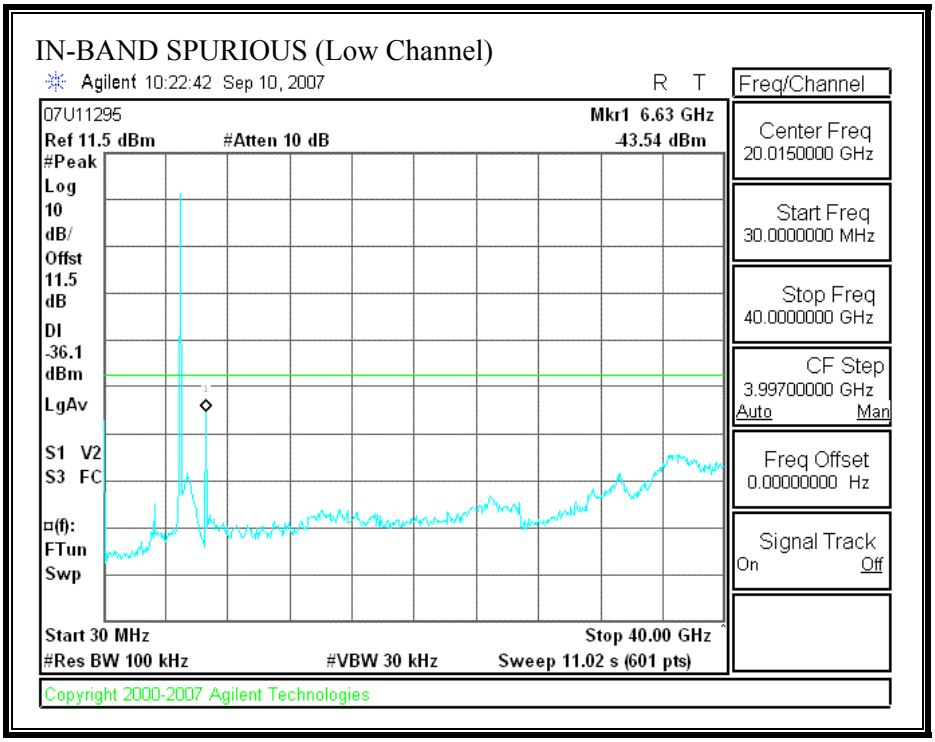
TEST PROCEDURE

The EUT is connected to the spectrum analyzer, the peak amplitude is used as the 0 dB reference value for the mask, and the trace is compared to the mask.

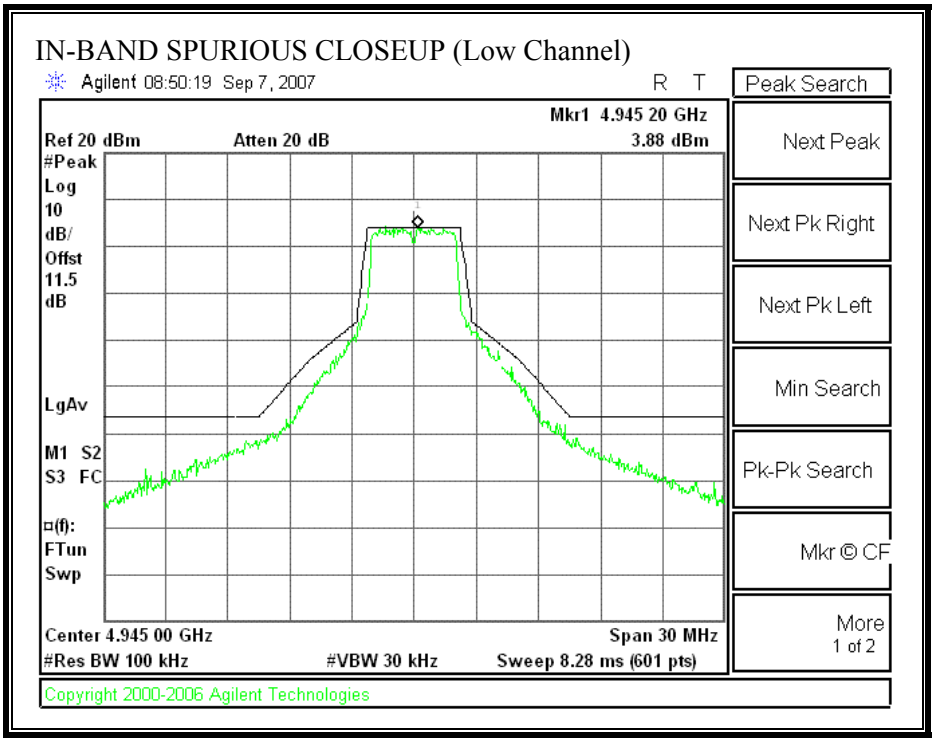
RESULTS

No non-compliance noted:

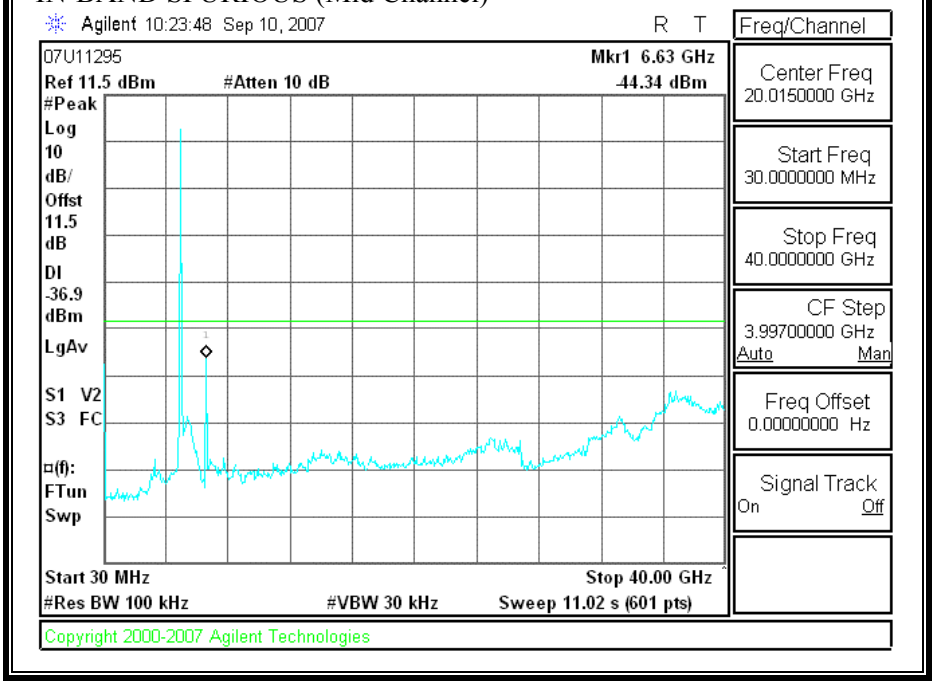
IN-BAND SPURIOUS EMISSIONS



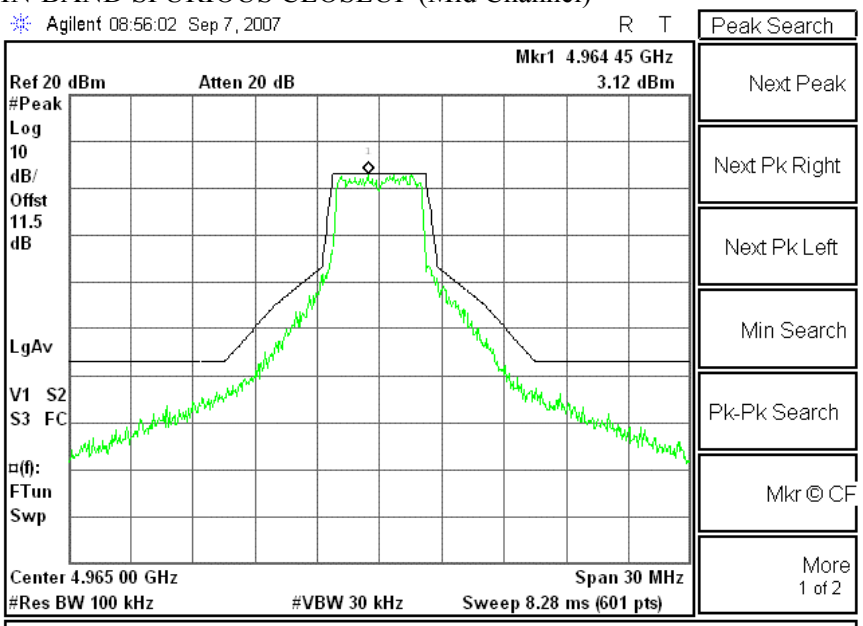
IN-BAND SPURIOUS CLOSEUP (Low Channel)



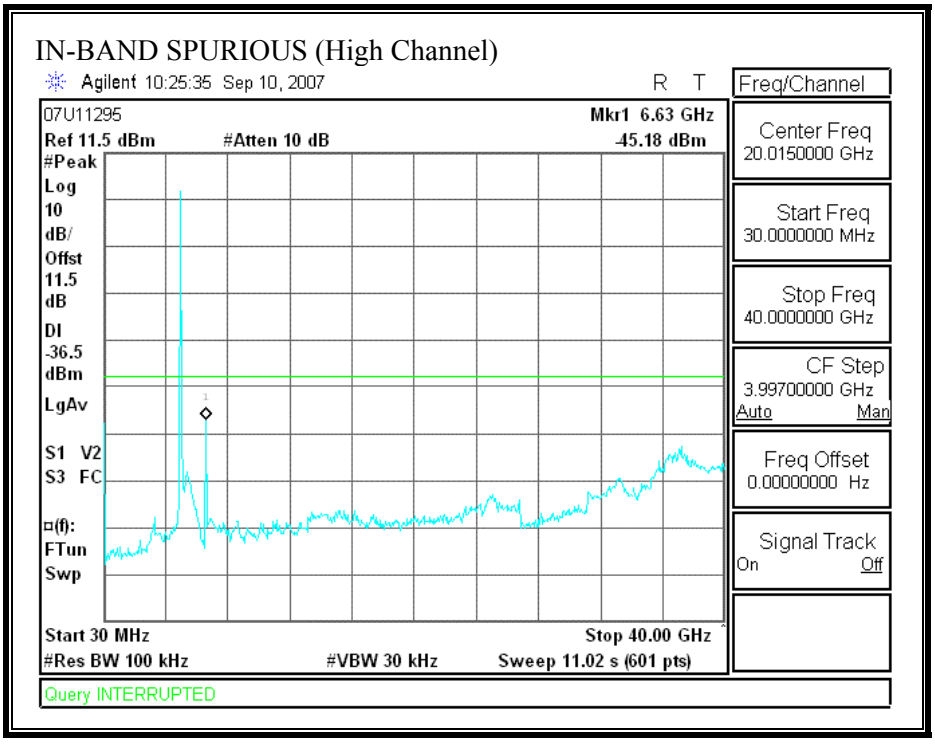
IN-BAND SPURIOUS (Mid Channel)

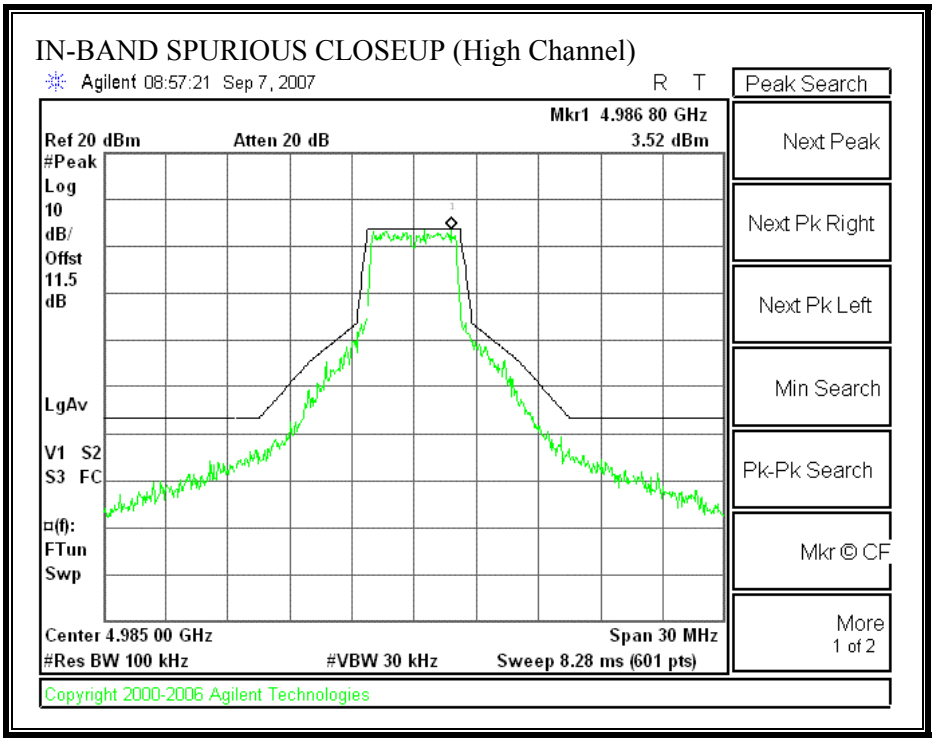


IN-BAND SPURIOUS CLOSEUP (Mid Channel)



IN-BAND SPURIOUS (High Channel)





7.2. CHANNEL TESTS FOR 10 MHz CHANNEL BANDWIDTH MODE

7.2.1. EMISSION BANDWIDTH

LIMIT

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 26 dB bandwidth and /or the 99% bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled.

RESULTS

No non-compliance noted:

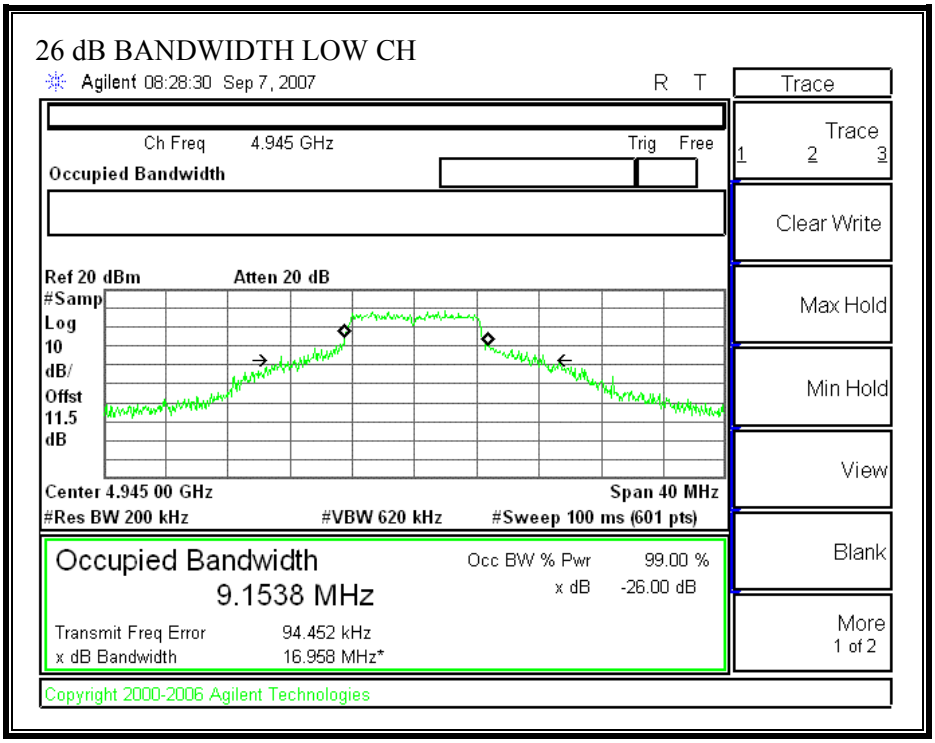
26 dB Bandwidth

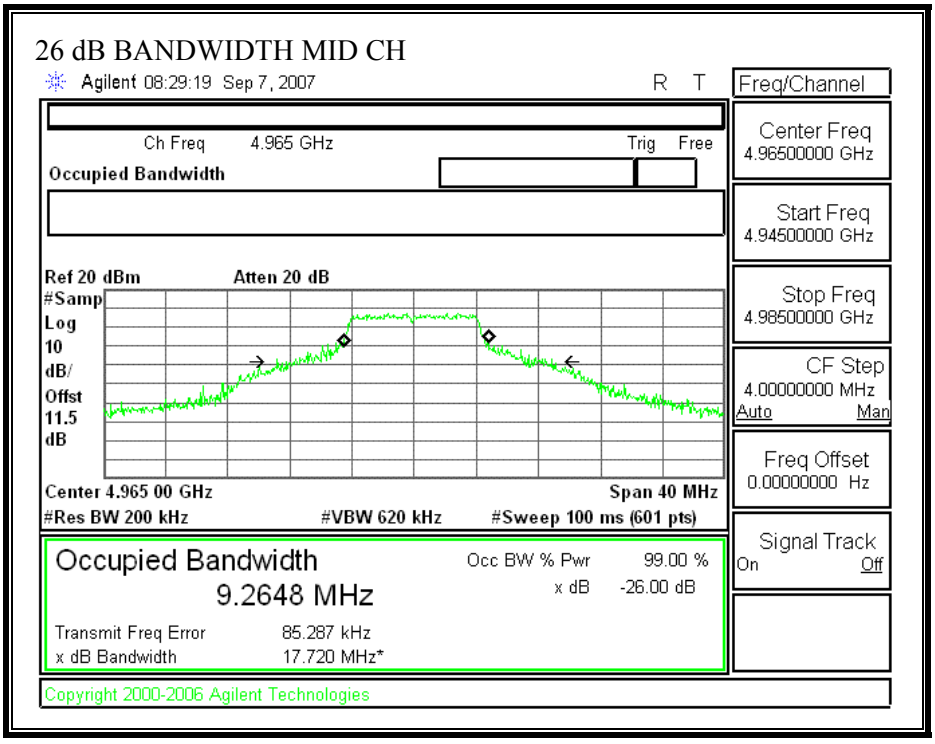
Channel	Frequency (MHz)	26 dB BW (MHz)	10 Log B (dB)
Low	4945	16.958	12.29
Middle	4965	17.720	12.48
High	4985	16.815	12.26

99% Bandwidth

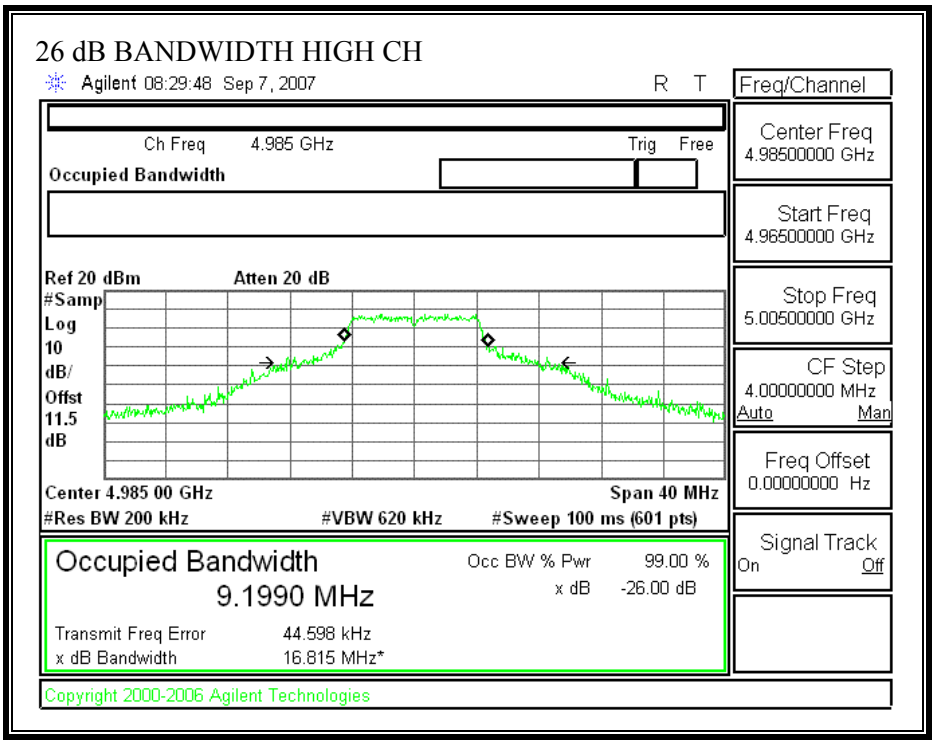
Channel	Frequency (MHz)	99% BW (MHz)
Low	4945	9.1538
Middle	4965	9.2648
High	4985	9.1990

26 dB EMISSION BANDWIDTH





26 dB BANDWIDTH HIGH CH



7.2.2. PEAK OUTPUT POWER

PEAK POWER LIMIT

§ 90.1215 The transmitting power of stations operating in the 4940–4990 MHz band must not exceed the maximum limits in this section.

(a) The peak transmit power should not exceed:

Channel bandwidth (MHz)	Low power Device Peak transmitter Power (dBm)	High power Device Peak transmitter Power (dBm)
1.....	7	20
5.....	14	27
10.....	17	30
15.....	18.8	31.8
20.....	20	33

High power devices are also limited to a peak power spectral density of 21 dBm per one MHz. High power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 21 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi. However, high power point-to-point or point-to-multipoint operation (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the transmitter power or spectral density. Corresponding reduction in the peak transmit power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.

RSS 111 Clause 4.3 Table 1 The peak power of low-power and high-power devices shall not exceed the limits corresponding to the equipment's channel bandwidth given in Table 1 below.

Table 1 - Channel Bandwidth and Power Limits

Channel Bandwidth (MHz)	Peak Transmitter Power (dBm)	
	Low-power Transmitter	High-power Transmitter
1	7	20
5	14	27
10	17	30
15	18.8	31.8
20	20	33

TEST PROCEDURE

The test is performed using peak power spectral integration.

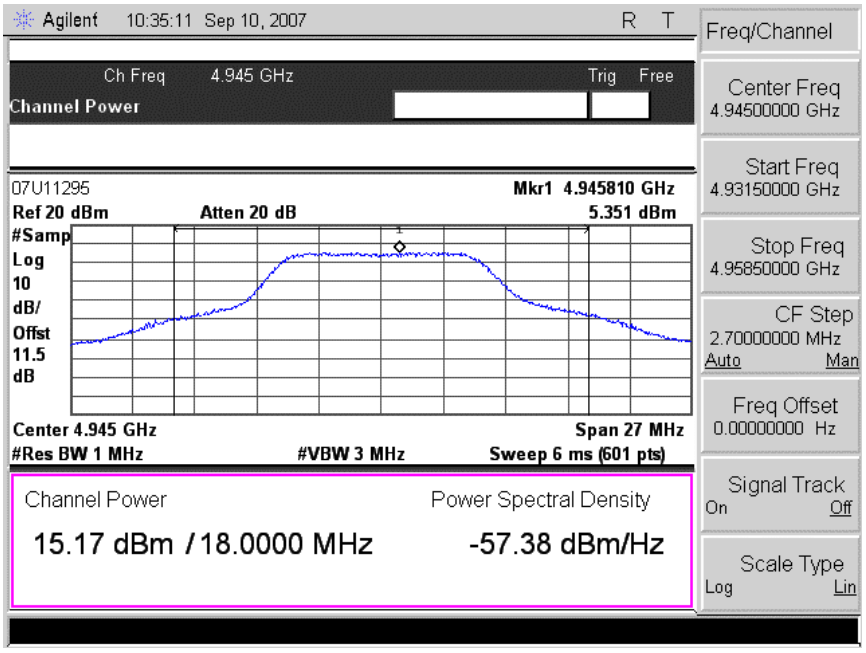
RESULTS

No non-compliance noted:

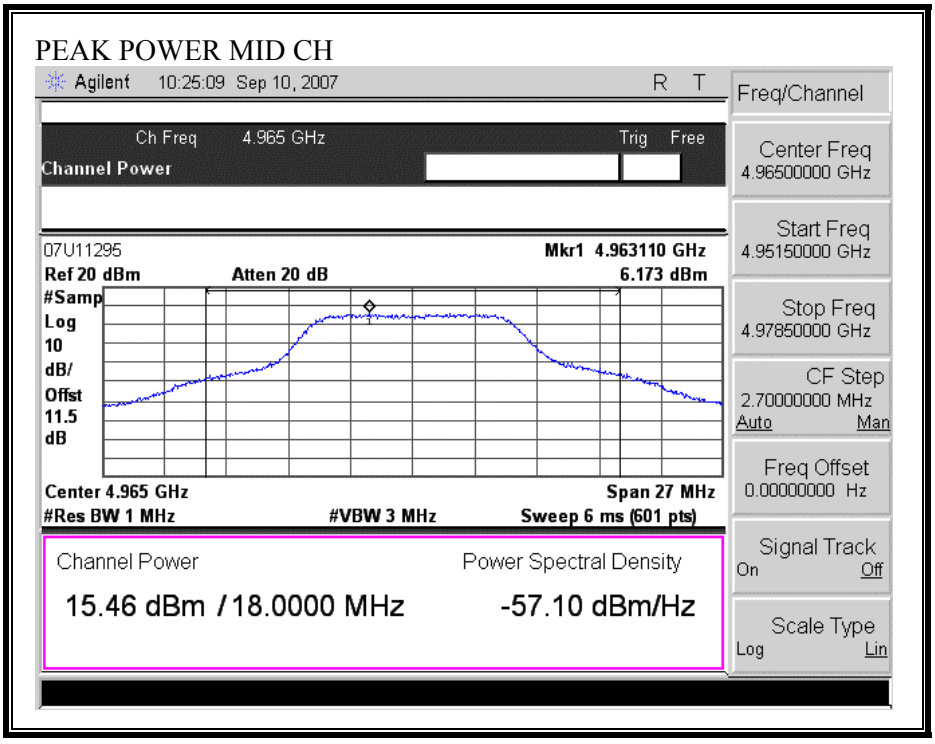
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	4945	15.17	17	-1.83
Middle	4965	15.46	17	-1.54
High	4985	15.30	17	-1.70

OUTPUT POWER (802.11a MODE)

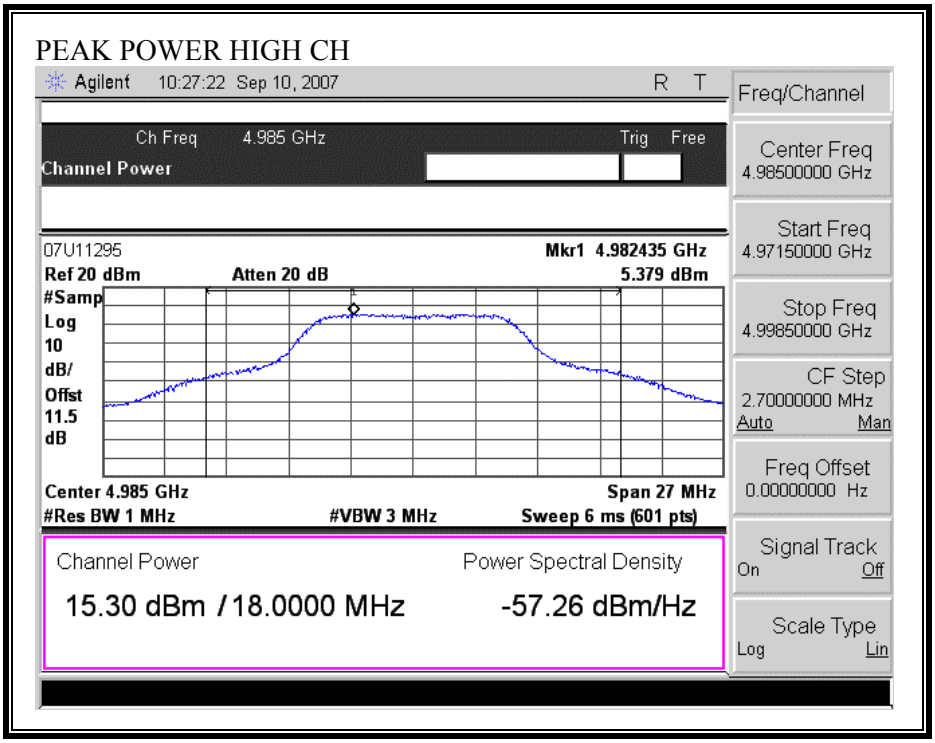
PEAK POWER LOW CH



PEAK POWER MID CH



PEAK POWER HIGH CH



7.2.3. 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.

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f, is in MHz.
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

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

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

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

Rearranging terms to calculate the power density at a specific distance yields

$S = 0.0795 * 10 ^ ((P + G) / 10) / (d^2)$

LIMITS

From §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2
From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

RESULTS

No non-compliance noted:

Mode	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
10 MHz Channel BW	20.0	15.46	9.00	0.0555

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.

7.2.4. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	4945	14.94
Middle	4965	14.87
High	4985	14.97

7.2.5. PEAK POWER SPECTRAL DENSITY

LIMIT

§ 90.1215 (b) Low power devices are also limited to a peak power spectral density of 8 dBm per one MHz. Low power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 8 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi..

(c) The peak power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

RSS 111 Clause 4.3 High and low-power devices are also limited to a peak power spectral density of 21 dBm/MHz and 8 dBm/MHz, respectively. Devices using channel bandwidths other than those listed in Table 1 are permitted. However they shall comply with the peak power spectral density limits of 21 dBm/MHz for high-power transmitters and 8 dBm/MHz for low-power transmitters.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer, the maximum level in a 1 MHz bandwidth is measured with the spectrum analyzer using RBW = 1 MHz and VBW 1 MHz. The PPSD is the highest level found across the emission in any 1 MHz band.

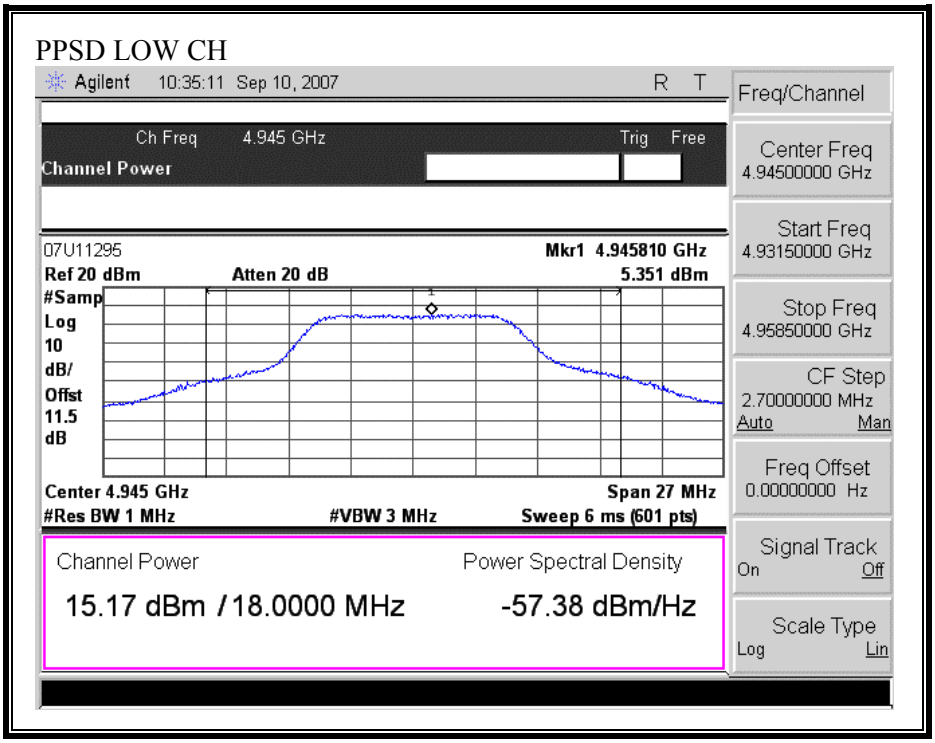
RESULTS

No non-compliance noted:

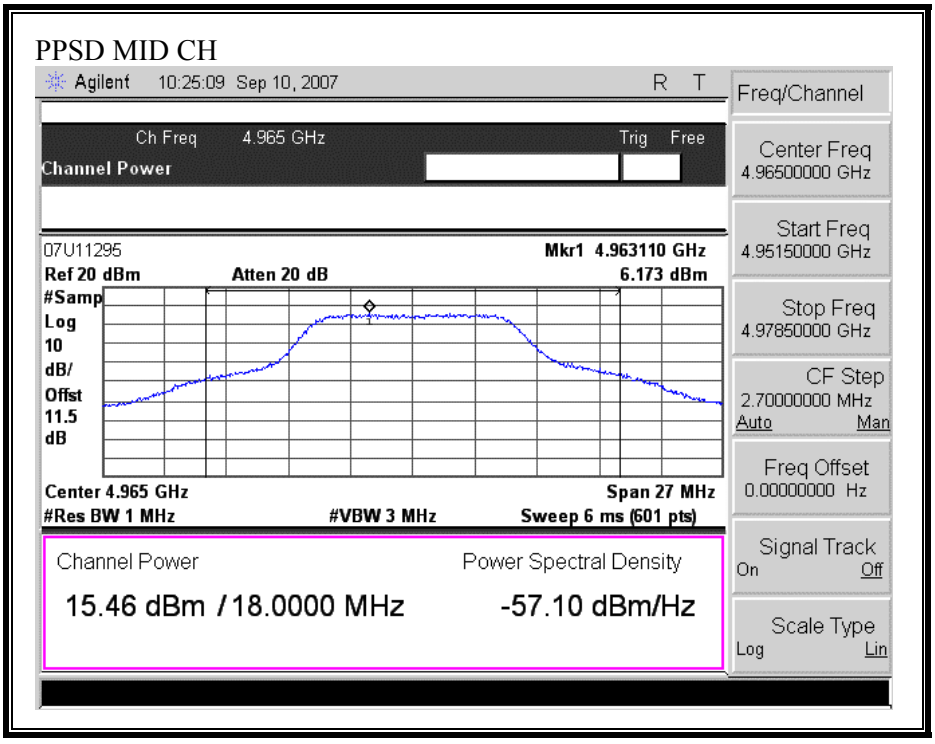
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	4945	5.351	8	-2.65
Middle	4965	6.173	8	-1.83
High	4985	5.379	8	-2.62

PEAK POWER SPECTRAL DENSITY

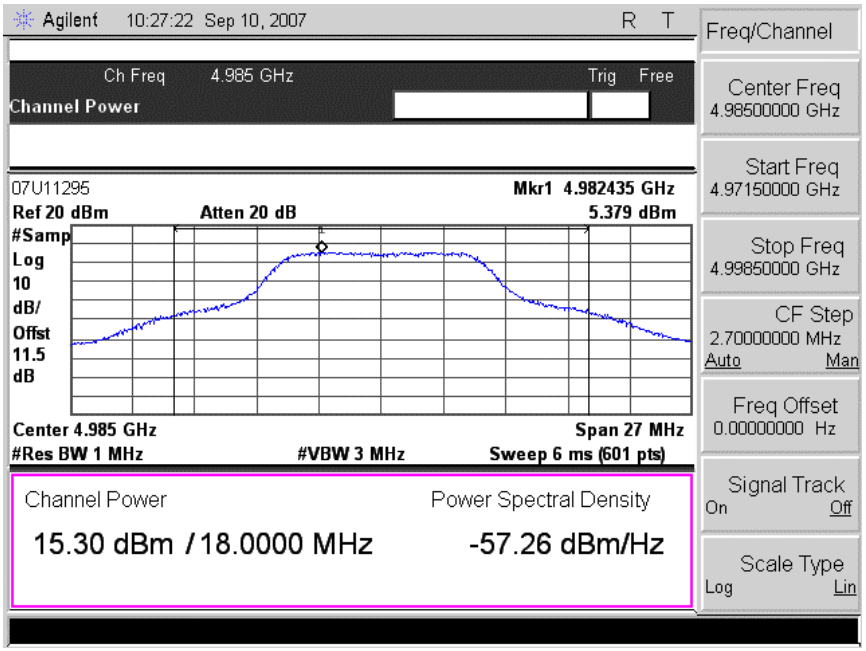
PPSD LOW CH



PPSD MID CH



PPSD HIGH CH



7.2.6. EMISSION MASK AND CONDUCTED SPURIOUS

§ 90.210 (l) Emission Mask L. For low power transmitters (20 dBm or less) operating in the 4940–4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0–45% of the authorized bandwidth (BW): 0 dB.
(2) On any frequency removed from the assigned frequency between 45–50% of the authorized bandwidth: 219 log (% of (BW)/45) dB.
(3) On any frequency removed from the assigned frequency between 50–55% of the authorized bandwidth: 10 + 242 log (% of (BW)/50) dB.
(4) On any frequency removed from the assigned frequency between 55–100% of the authorized bandwidth: 20 + 31 log (% of (BW)/55) dB attenuation.
(5) On any frequency removed from the assigned frequency between 100–150% of the authorized bandwidth: 28 + 68 log (% of (BW)/100) dB attenuation.
(6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 40 dB.
(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

RSS 111 Clause 4.4 The power spectral density of the emissions for low and high-power transmitters shall be attenuated below the transmitted output power as specified in Table 2.

The displacement frequency, fd, is the magnitude of the difference between the channel frequency and the emission component frequency expressed as a percentage of the authorized bandwidth.

Table 2 - Emission Mask for Low and High-power Transmitters

Displacement Frequency, f_d (% of the Authorized Bandwidth)	Minimum Attenuation (dB)	
	Low-power Transmitter (≤ 20 dBm)	High-power Transmitter (> 20 dBm)
$45 < f_d \leq 50$	$219 \log (f_d/45)$	$568 \log (f_d/45)$
$50 < f_d \leq 55$	$10 + 219 \log (f_d/50)$	$26 + 145 \log (f_d/50)$
$55 < f_d \leq 100$	$20 + 31 \log (f_d/55)$	$32 + 31 \log (f_d/55)$
$100 < fd \leq 150$	$28 + 68 \log (f_d/100)$	$40 + 57 \log (f_d/100)$
$f_d > 150$	40	whichever is less stringent 50 or $55 + 10 \log (P)$

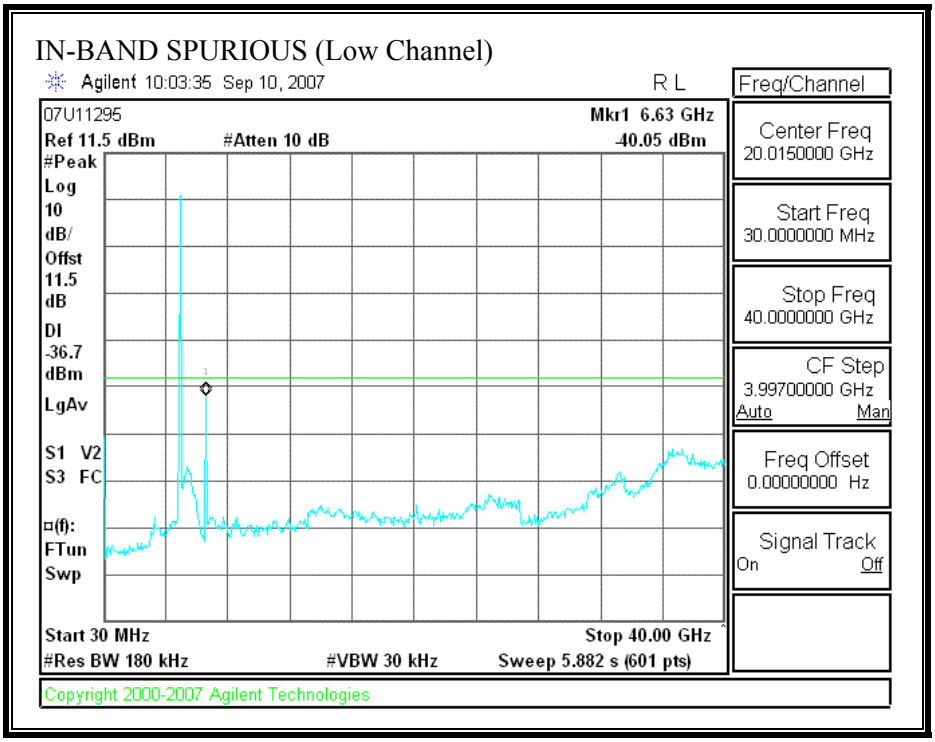
TEST PROCEDURE

The EUT is connected to the spectrum analyzer, the peak amplitude is used as the 0 dB reference value for the mask, and the trace is compared to the mask.

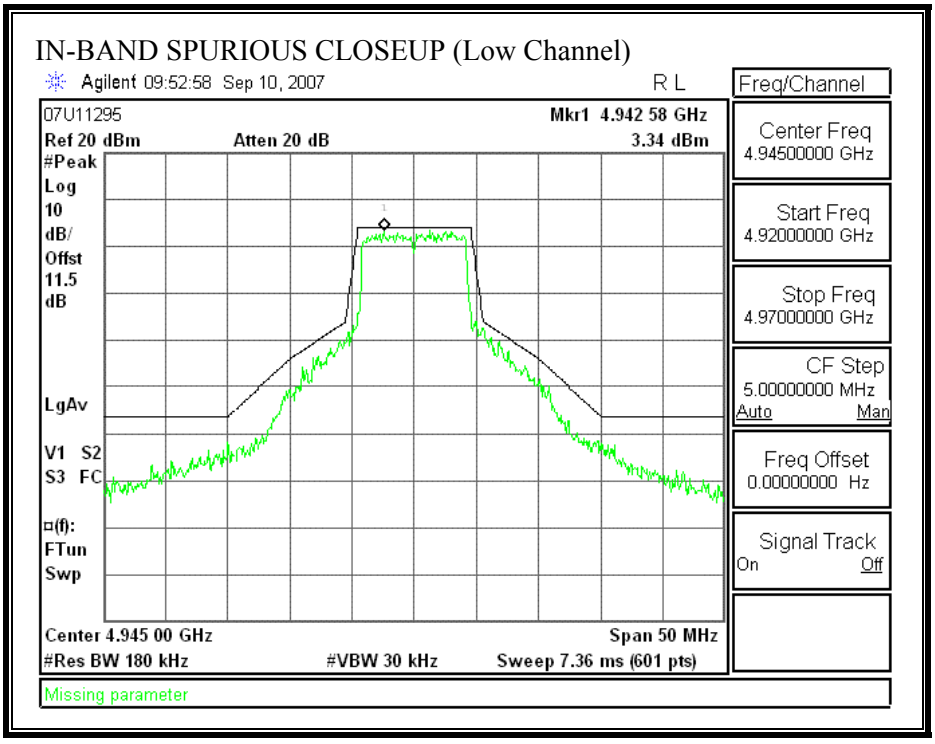
RESULTS

No non-compliance noted:

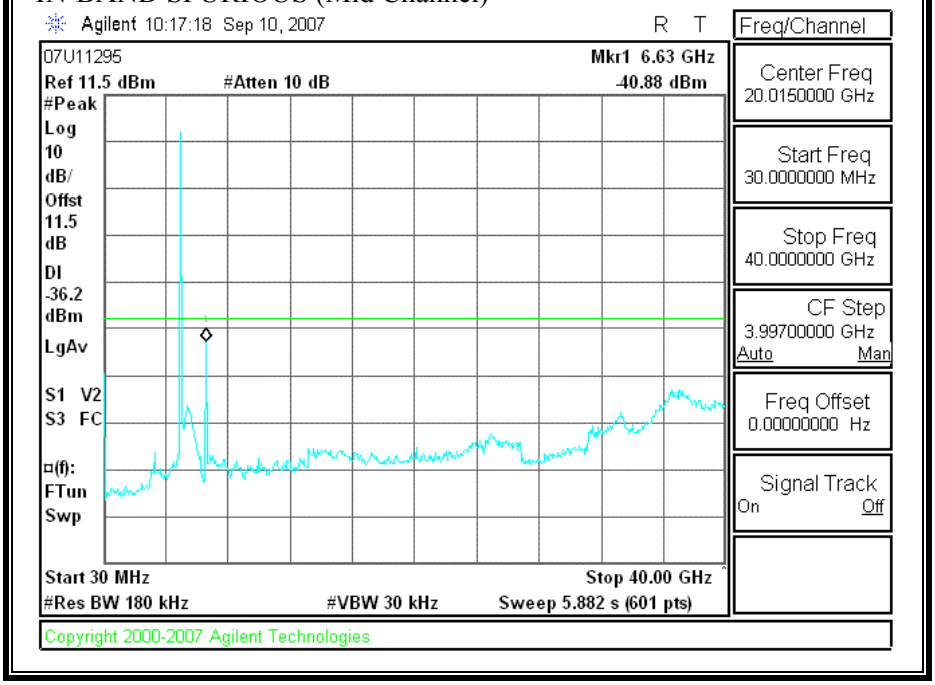
IN-BAND SPURIOUS EMISSIONS



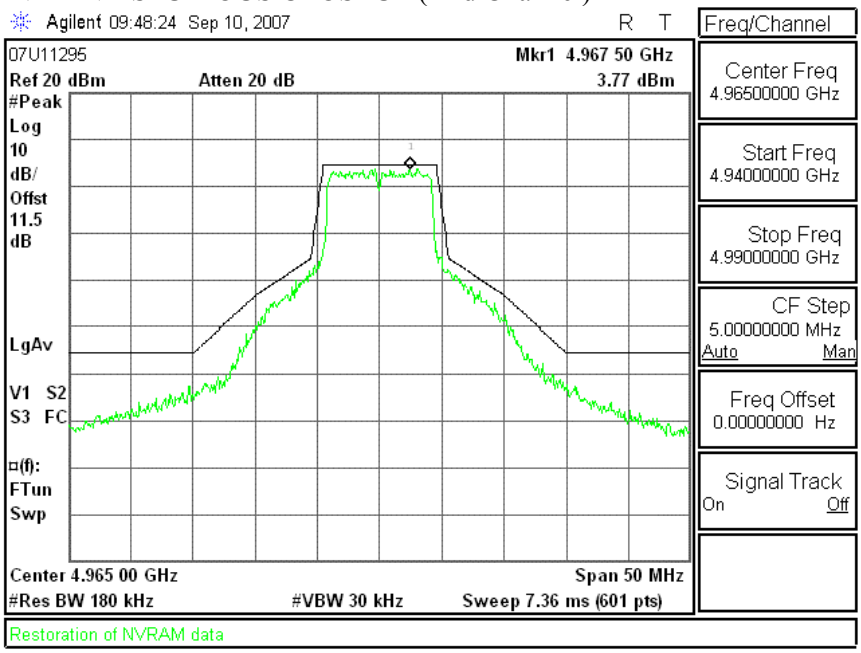
IN-BAND SPURIOUS CLOSEUP (Low Channel)



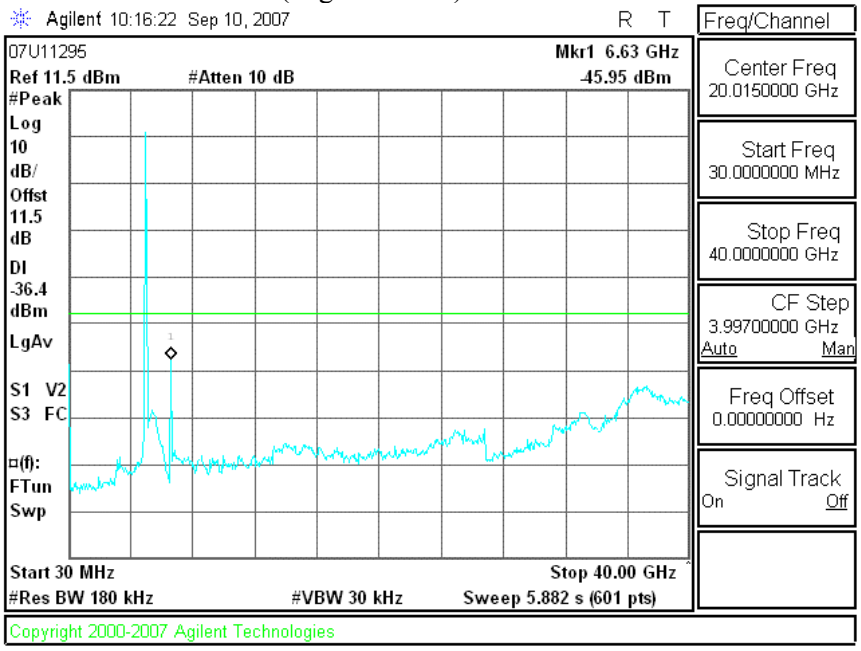
IN-BAND SPURIOUS (Mid Channel)



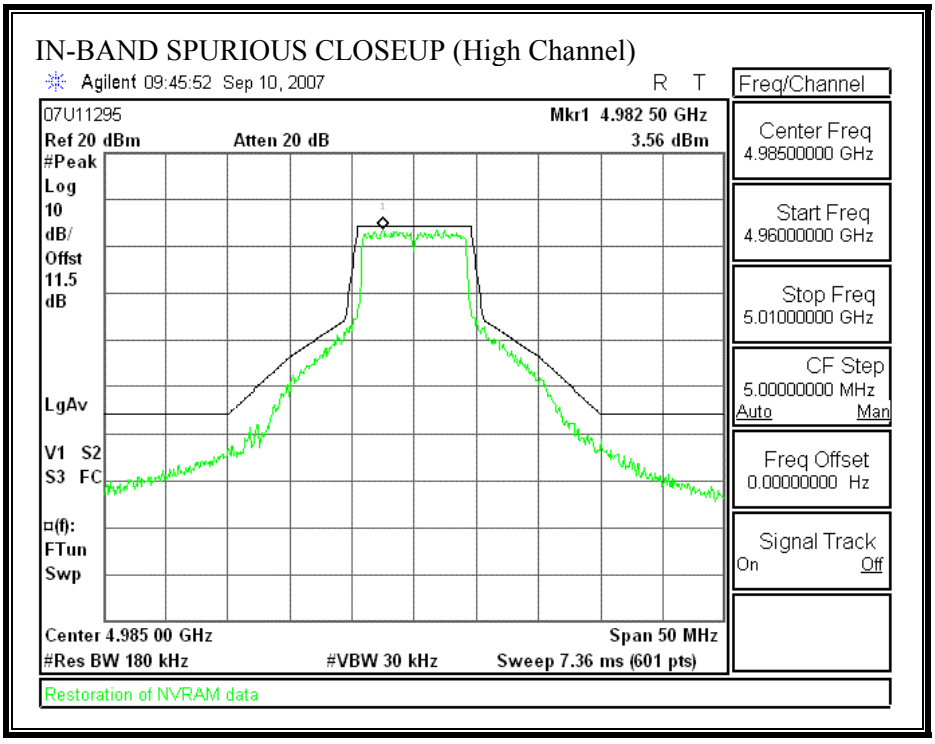
IN-BAND SPURIOUS CLOSEUP (Mid Channel)



IN-BAND SPURIOUS (High Channel)



IN-BAND SPURIOUS CLOSEUP (High Channel)



7.3. CHANNEL TESTS FOR 20 MHz CHANNEL BANDWIDTH MODE

7.3.1. EMISSION BANDWIDTH

LIMIT

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 26 dB bandwidth and /or the 99% bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled.

RESULTS

No non-compliance noted:

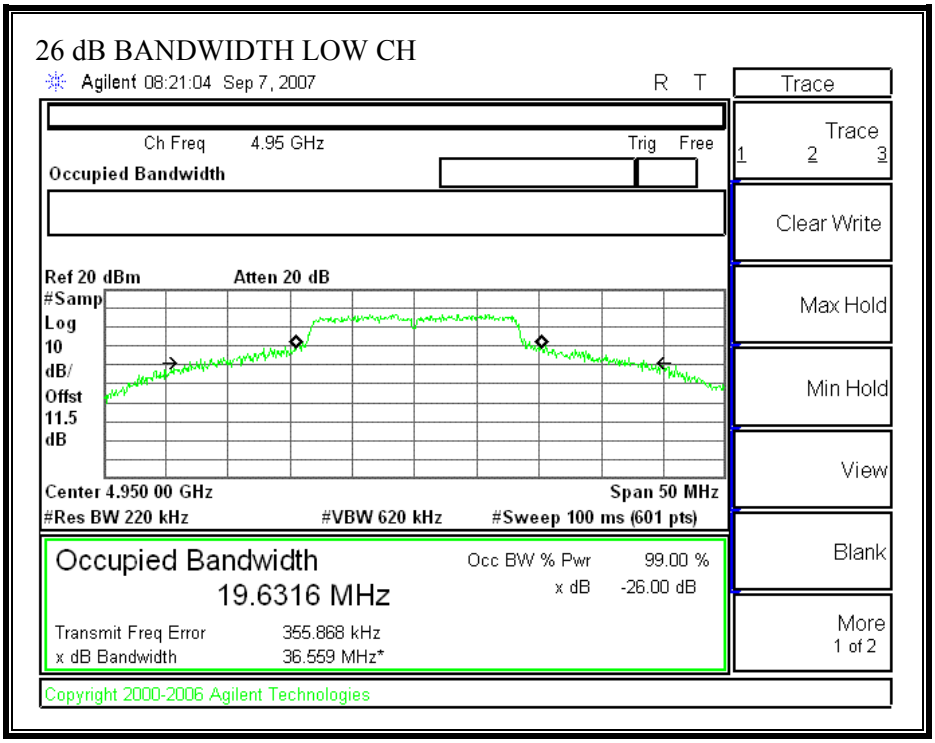
26 dB Bandwidth

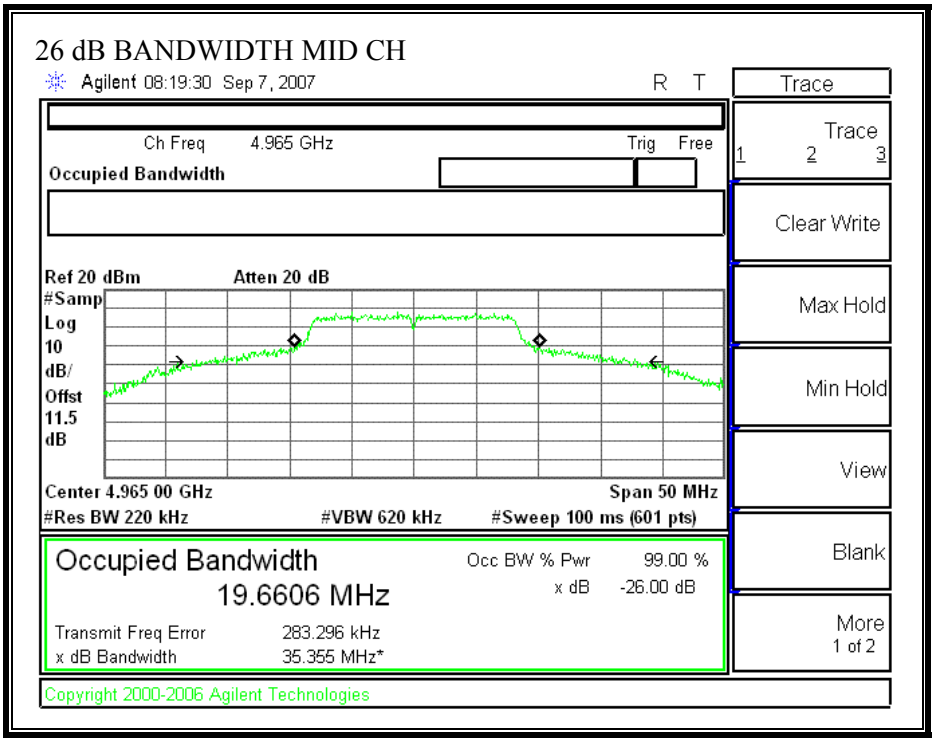
Channel	Frequency (MHz)	26 dB BW (MHz)	10 Log B (dB)
Low	4950	36.559	15.63
Middle	4965	35.355	15.48
High	4980	35.146	15.46

99% Bandwidth

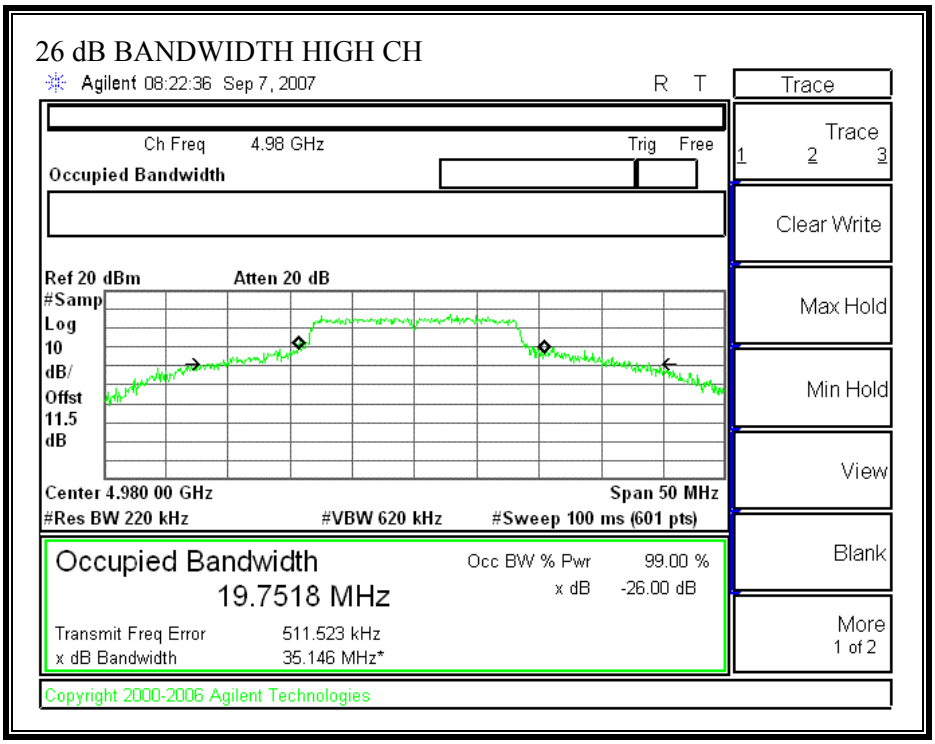
Channel	Frequency (MHz)	99% BW (MHz)
Low	4950	19.6316
Middle	4965	19.6606
High	4980	19.7518

26 dB EMISSION BANDWIDTH





26 dB BANDWIDTH HIGH CH



7.3.2. PEAK OUTPUT POWER

PEAK POWER LIMIT

§ 90.1215 The transmitting power of stations operating in the 4940–4990 MHz band must not exceed the maximum limits in this section.

(a) The peak transmit power should not exceed:

Channel bandwidth (MHz)	Low power Device Peak transmitter Power (dBm)	High power Device Peak transmitter Power (dBm)
1.....	7	20
5.....	14	27
10.....	17	30
15.....	18.8	31.8
20.....	20	33

High power devices are also limited to a peak power spectral density of 21 dBm per one MHz. High power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 21 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi. However, high power point-to-point or point-to-multipoint operation (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the transmitter power or spectral density. Corresponding reduction in the peak transmit power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi

RSS 111 Clause 4.3 Table 1 The peak power of low-power and high-power devices shall not exceed the limits corresponding to the equipment's channel bandwidth given in Table 1 below.

Table 1 - Channel Bandwidth and Power Limits

Channel Bandwidth (MHz)	Peak Transmitter Power (dBm)	
	Low-power Transmitter	High-power Transmitter
1	7	20
5	14	27
10	17	30
15	18.8	31.8
20	20	33

TEST PROCEDURE

The test is performed using peak power spectral integration.

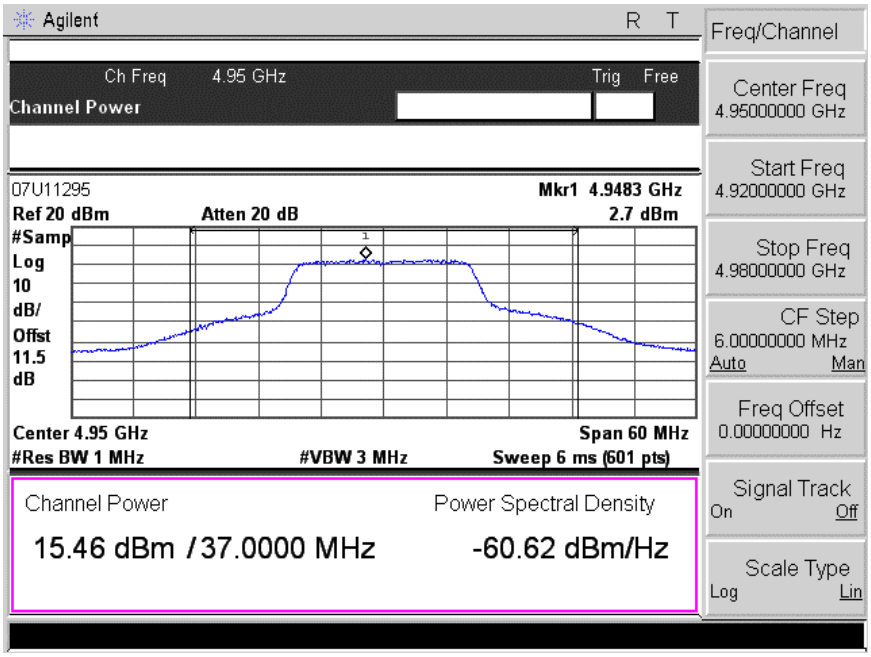
RESULTS

No non-compliance noted:

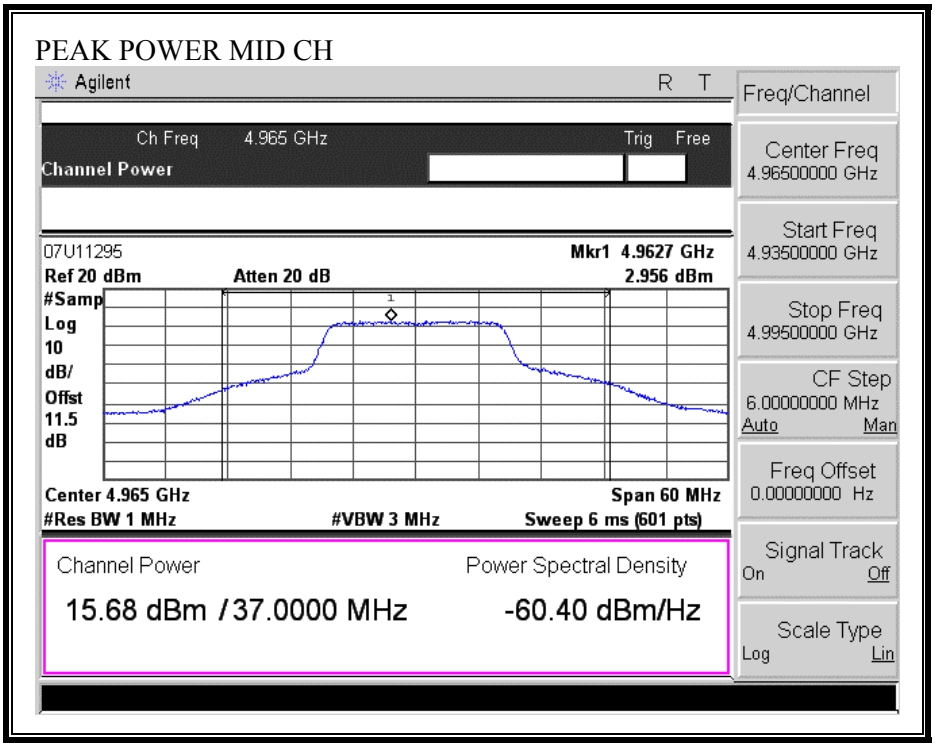
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	4950	15.46	20	-4.54
Middle	4965	15.68	20	-4.32
High	4980	15.46	20	-4.54

OUTPUT POWER (802.11a MODE)

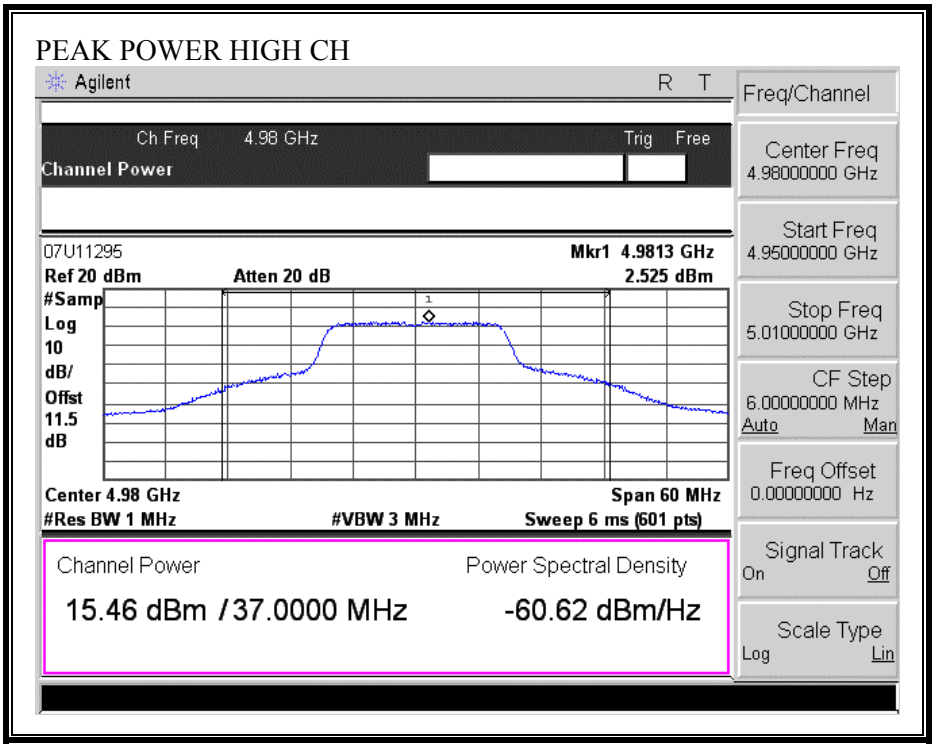
PEAK POWER LOW CH



PEAK POWER MID CH



PEAK POWER HIGH CH



7.3.3. 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.

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f, is in MHz.
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

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

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

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

Rearranging terms to calculate the power density at a specific distance yields

$S = 0.0795 * 10 ^ ((P + G) / 10) / (d^2)$

LIMITS

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

RESULTS

No non-compliance noted:

Mode	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
20 MHz Channel BW	20.0	15.68	9.00	0.0584

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.

7.3.4. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	4950	14.93
Middle	4965	14.95
High	4980	14.94

7.3.5. PEAK POWER SPECTRAL DENSITY

LIMIT

§ 90.1215 (b) Low power devices are also limited to a peak power spectral density of 8 dBm per one MHz. Low power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 8 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi..

(c) The peak power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

RSS 111 Clause 4.3 High and low-power devices are also limited to a peak power spectral density of 21 dBm/MHz and 8 dBm/MHz, respectively. Devices using channel bandwidths other than those listed in Table 1 are permitted. However they shall comply with the peak power spectral density limits of 21 dBm/MHz for high-power transmitters and 8 dBm/MHz for low-power transmitters.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer, the maximum level in a 1 MHz bandwidth is measured with the spectrum analyzer using RBW = 1 MHz and VBW 1 MHz. The PPSD is the highest level found across the emission in any 1 MHz band.

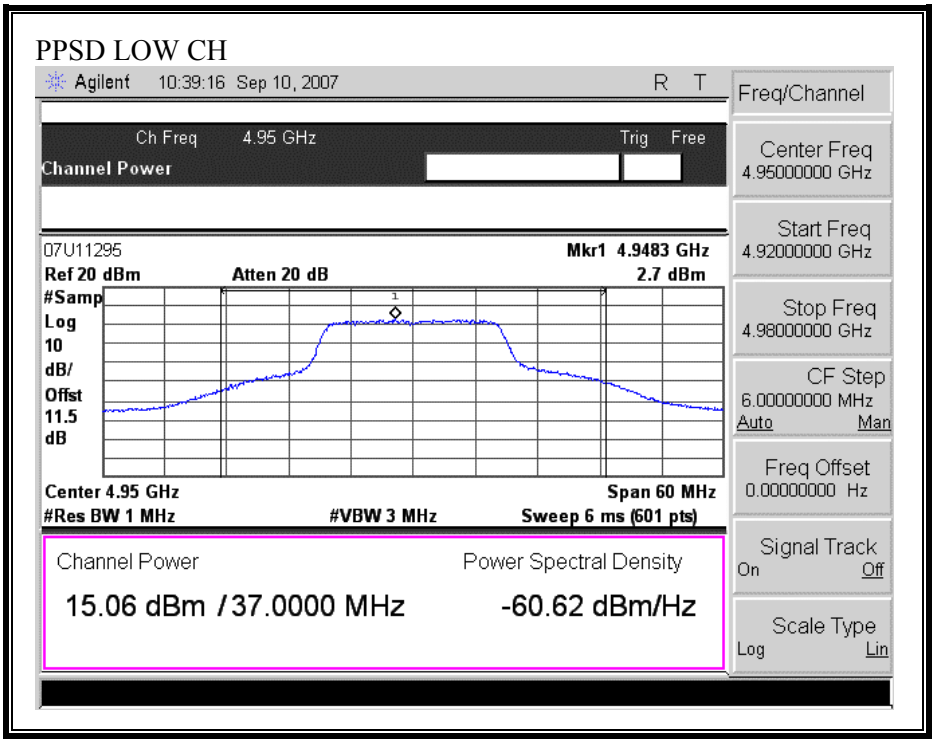
RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	4950	2.700	8	-5.30
Middle	4965	2.956	8	-5.04
High	4980	2.525	8	-5.48

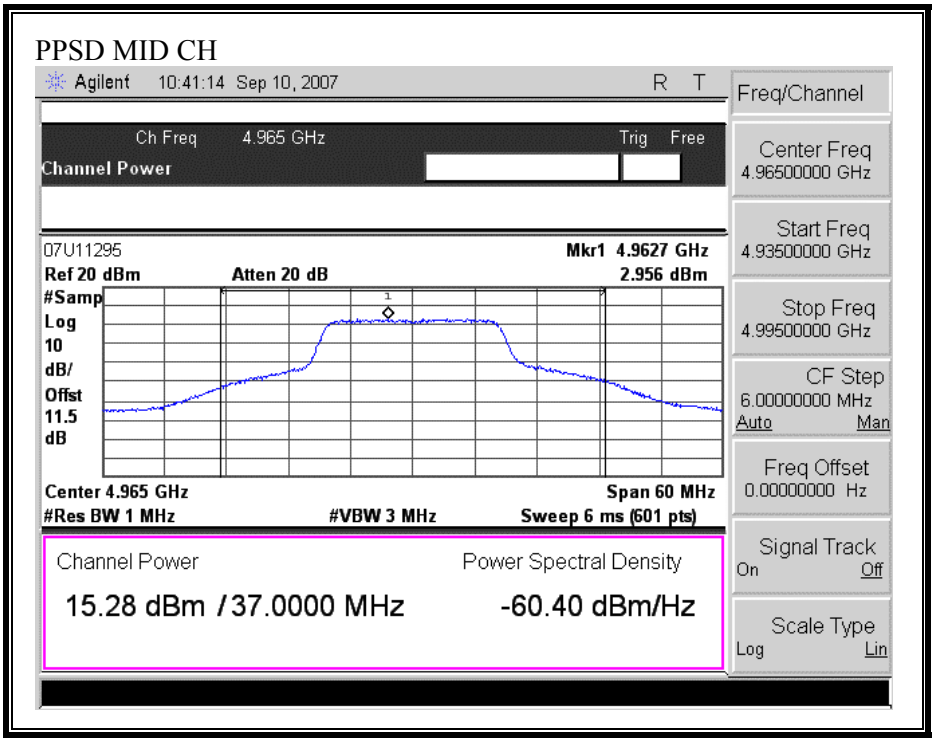
No non-compliance noted:

PEAK POWER SPECTRAL DENSITY

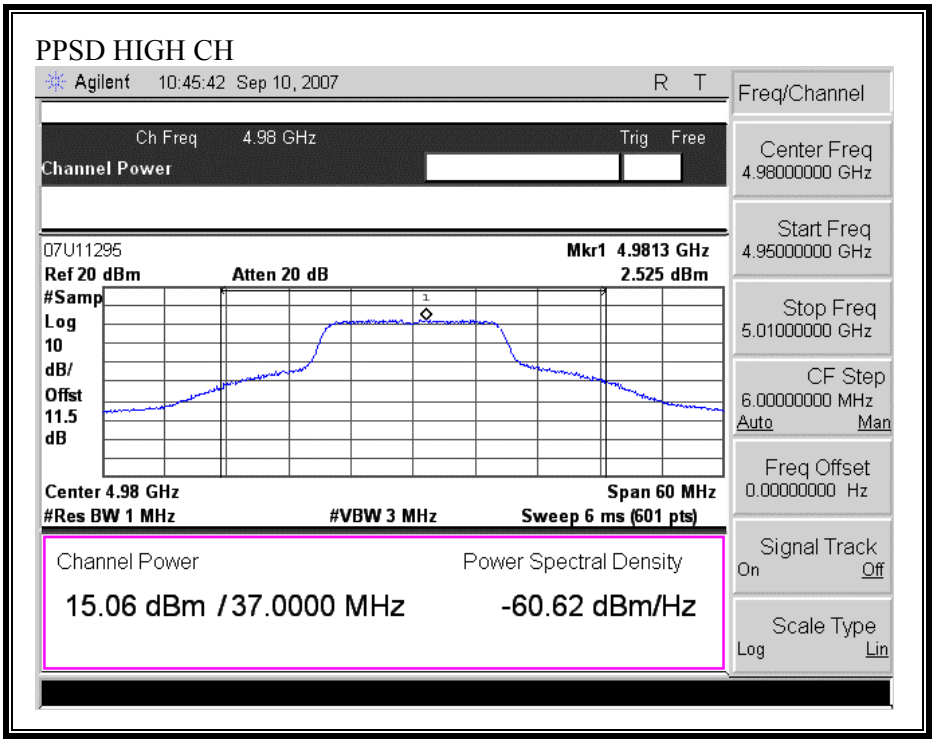
PPSD LOW CH



PPSD MID CH



PPSD HIGH CH



7.3.6. EMISSION MASK AND CONDUCTED SPURIOUS

§ 90.210 (l) Emission Mask L. For low power transmitters (20 dBm or less) operating in the 4940–4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0–45% of the authorized bandwidth (BW): 0 dB.
(2) On any frequency removed from the assigned frequency between 45–50% of the authorized bandwidth: 219 log (% of (BW)/45) dB.
(3) On any frequency removed from the assigned frequency between 50–55% of the authorized bandwidth: 10 + 242 log (% of (BW)/50) dB.
(4) On any frequency removed from the assigned frequency between 55–100% of the authorized bandwidth: 20 + 31 log (% of (BW)/55) dB attenuation.
(5) On any frequency removed from the assigned frequency between 100–150% of the authorized bandwidth: 28 + 68 log (% of (BW)/100) dB attenuation.
(6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 40 dB.
(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

RSS 111 Clause 4.4 The power spectral density of the emissions for low and high-power transmitters shall be attenuated below the transmitted output power as specified in Table 2.

The displacement frequency, fd, is the magnitude of the difference between the channel frequency and the emission component frequency expressed as a percentage of the authorized bandwidth.

Table 2 - Emission Mask for Low and High-power Transmitters

Displacement Frequency, f_d (% of the Authorized Bandwidth)	Minimum Attenuation (dB)	
	Low-power Transmitter (≤ 20 dBm)	High-power Transmitter (> 20 dBm)
$45 < f_d \leq 50$	219 log (f_d/45)	568 log (f_d/45)
$50 < f_d \leq 55$	10 + 219 log (f_d/50)	26 + 145 log (f_d/50)
$55 < f_d \leq 100$	20 + 31 log (f_d/55)	32 + 31 log (f_d/55)
$100 < fd \leq 150$	28 + 68 log (f_d/100)	40 + 57 log (f_d/100)
$f_d > 150$	40	whichever is less stringent 50 or 55 + 10 log (P)

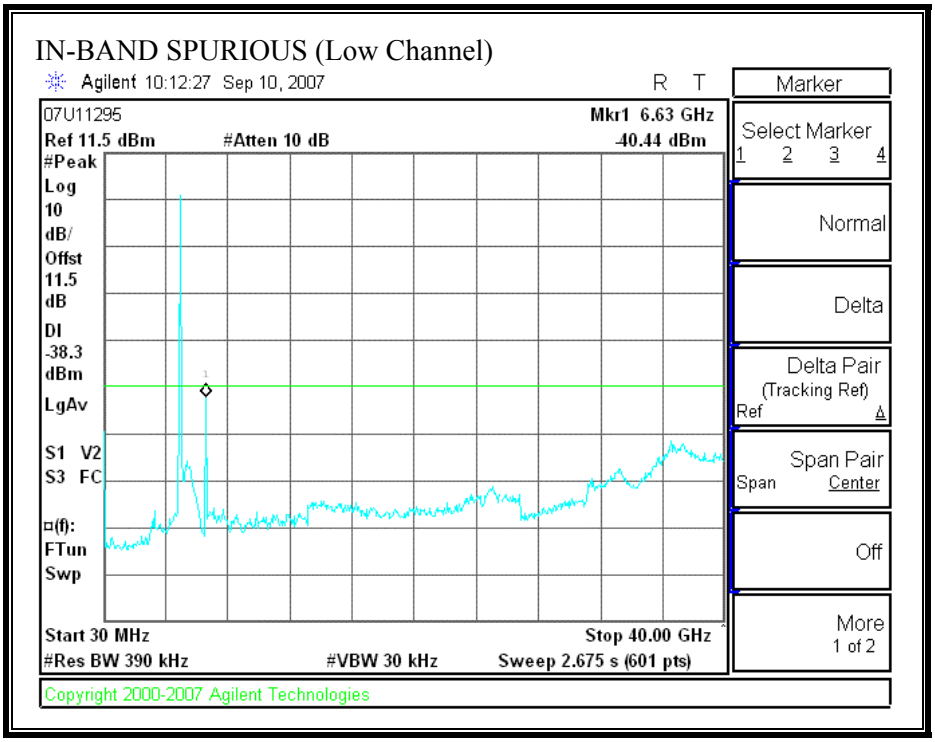
TEST PROCEDURE

The EUT is connected to the spectrum analyzer, the peak amplitude is used as the 0 dB reference value for the mask, and the trace is compared to the mask.

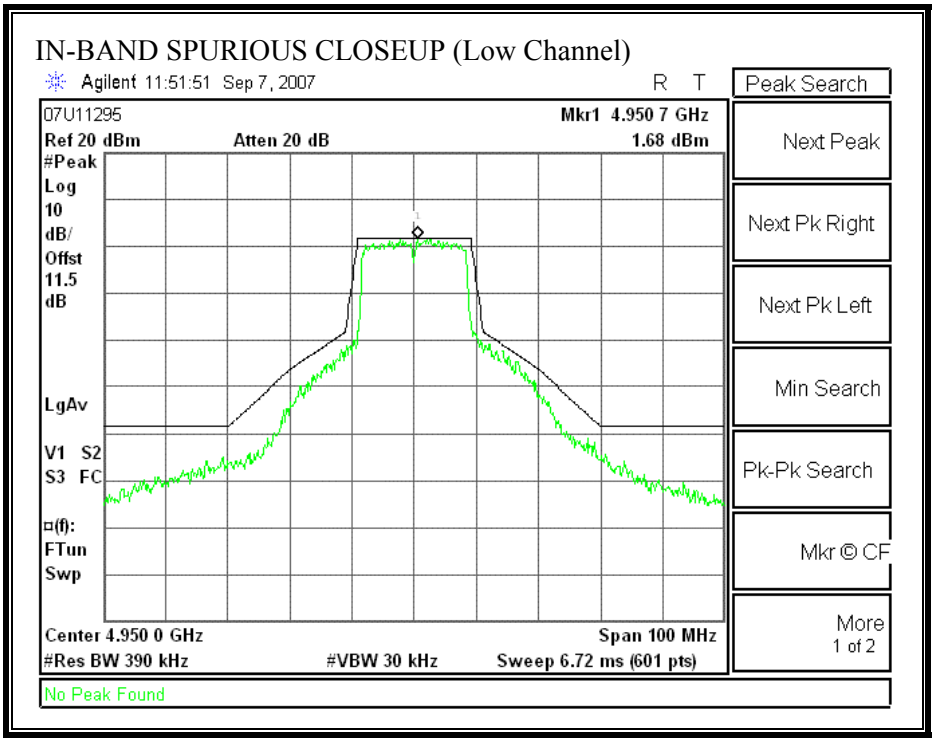
RESULTS

No non-compliance noted:

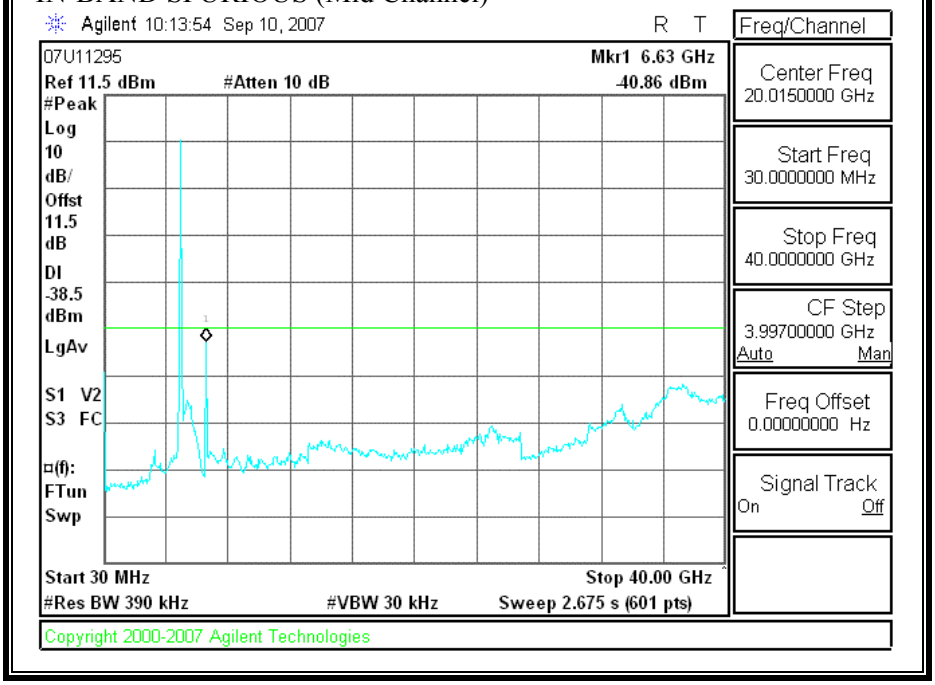
IN-BAND SPURIOUS EMISSIONS



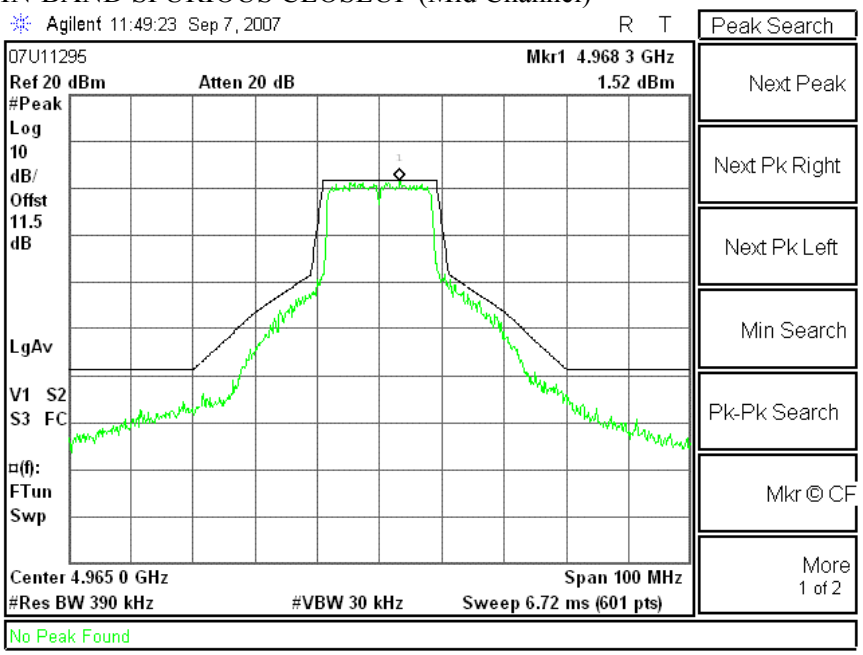
IN-BAND SPURIOUS CLOSEUP (Low Channel)



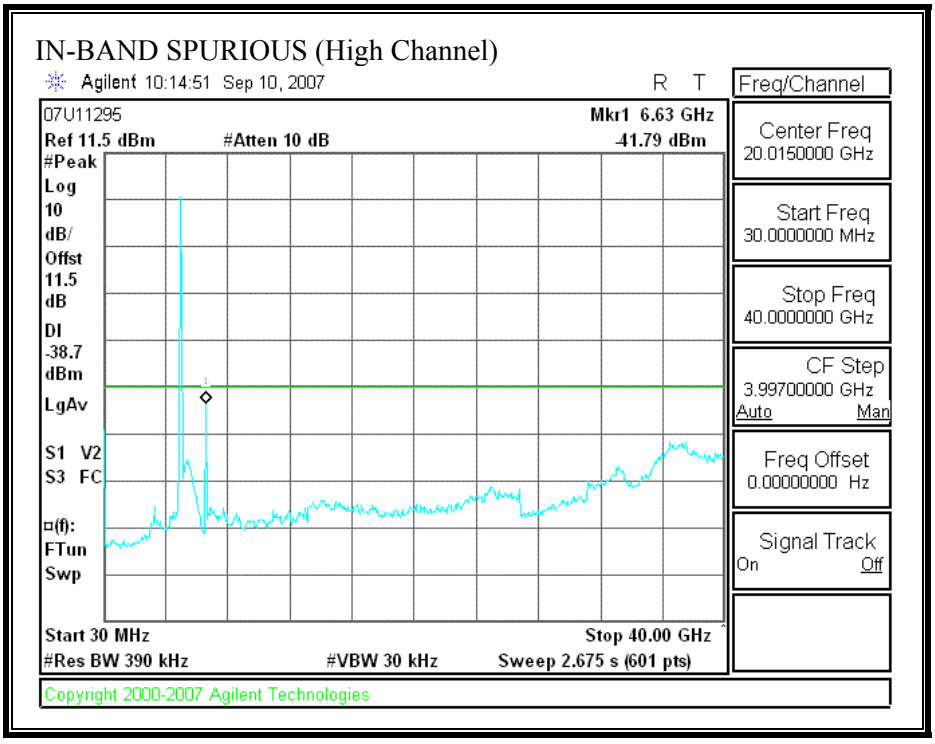
IN-BAND SPURIOUS (Mid Channel)

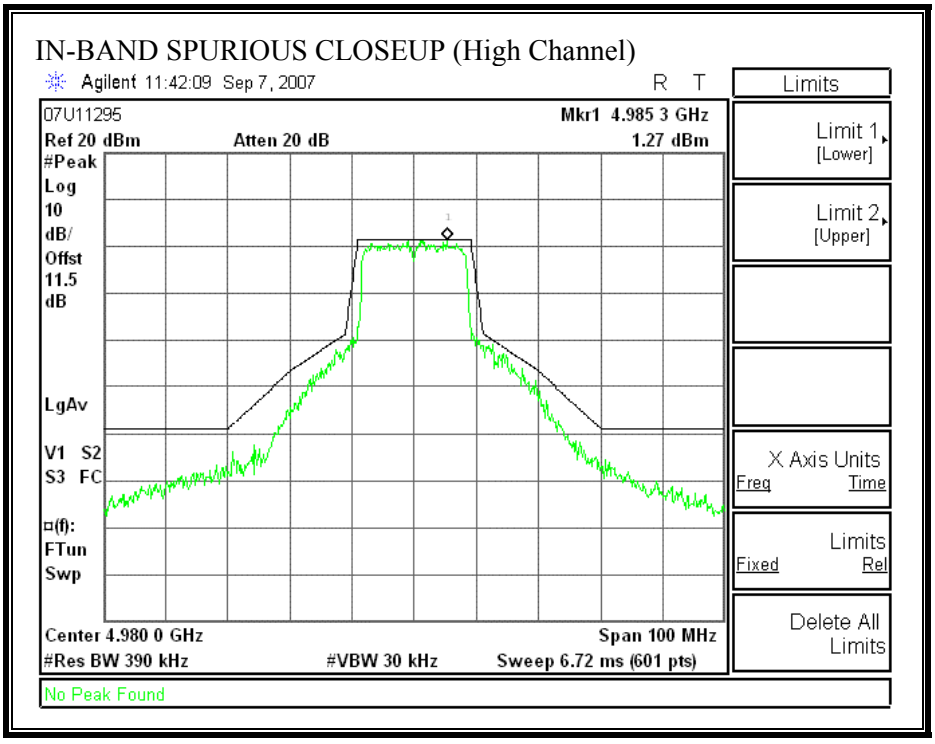


IN-BAND SPURIOUS CLOSEUP (Mid Channel)



IN-BAND SPURIOUS (High Channel)





7.4. RADIATED EMISSIONS

7.4.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

LIMITS

§ 90.210 (l) Emission Mask L. For low power transmitters (20 dBm or less) operating in the 4940–4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 40 dB.

The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

§15.109 (a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

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

RSS 111 Clause 4.4 The power spectral density of the emissions for low and high-power transmitters shall be attenuated below the transmitted output power as specified in Table 2.

The displacement frequency, f_d, is the magnitude of the difference between the channel frequency and the emissions component frequency expressed as a percentage of the authorized bandwidth.

Table 2 - Emission Mask for Low and High-power Transmitters

Displacement Frequency, f_d (% of the Authorized Bandwidth)	Minimum Attenuation (dB)	
	Low-power Transmitter (≤ 20 dBm)	High-power Transmitter (> 20 dBm)
$45 < f_d \leq 50$	$219 \log (f_d/45)$	$568 \log (f_d/45)$
$50 < f_d \leq 55$	$10 + 219 \log (f_d/50)$	$26 + 145 \log (f_d/50)$
$55 < f_d \leq 100$	$20 + 31 \log (f_d/55)$	$32 + 31 \log (f_d/55)$
$100 < f_d \leq 150$	$28 + 68 \log (f_d/100)$	$40 + 57 \log (f_d/100)$
$f_d > 150$	40	whichever is less stringent 50 or $55 + 10 \log (P)$

RSS-GEN Clause 4.7 The measurement method shall be described in the test report. The same parameter, peak power or average power, used for the transmitter output power measurement shall be used for unwanted emission measurements.

The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency), or from 30 MHz, whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

Unless otherwise specified, compliance with the emission limits shall be demonstrated using a CISPR quasi-peak detector measurement for emissions between 490 kHz and 1000 MHz and, an average detector with a minimum resolution bandwidth of 1 MHz for emissions above 1 GHz. Below 490 kHz, either a CISPR quasi-peak or an averaging detector may be used.

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.

The field strength of the fundamental is measured to provide a reference value for the –40 dBc limit. All measurements are peak.

The resolution bandwidth is set to 1 MHz, and the video bandwidth is set to 1 MHz for peak measurements.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels. Conducted measurements are made of spurious signals removed by less than 150% of the authorized bandwidth. Conducted and radiated measurements are made of spurious signals removed by more than 150% of the authorized bandwidth.

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.

7.4.2. TRANSMITTER ABOVE 1 GHz FOR 5 MHZ CHANNEL BANDWIDTH

HARMONICS AND SPURIOUS EMISSIONS (WITH 50 OHM LOADS)

High Frequency Substitution Measurement
Compliance Certification Services, Fremont 5m A-Chamber

Company:Proxim
Project #:07U11295
Date:9/7/2007
Test Engineer:Chin Pang
Configuration:EUT with 50 Ohms Load
Mode:TX

Test Equipment:

EMCO Horn 1-18GHz: T73; S/N: 6717 @3m
Horn > 18GHz:
Limit: EIRP
High Pass Filter: ☐
Hi Frequency Cables: ☐ (2 ft) ☐ (2 ~ 3 ft) ☑ (4 ~ 6 ft) ☑ (12 ft)
Pre-amplifer 1-26GHz: T34 HP 8449B
Pre-amplifer 26-40GHz:

f GHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Ch, 4945MHz										
1.096	53.6	H	-55.9	3.9	6.6	4.5	-53.1	-36.1	-17.0	
1.295	56.0	H	-52.3	4.1	7.1	5.0	-49.4	-36.1	-13.2	
1.394	55.8	H	-52.0	4.3	7.4	5.2	-48.9	-36.1	-12.8	
1.493	56.2	H	-51.0	4.4	7.6	5.5	-47.9	-36.1	-11.8	
1.593	52.4	H	-54.3	4.6	7.8	5.7	-51.1	-36.1	-15.0	
1.095	59.0	V	-51.2	3.9	6.6	4.5	-48.4	-36.1	-12.3	
1.195	58.4	V	-51.3	4.0	6.9	4.7	-48.4	-36.1	-12.3	
1.294	59.1	V	-50.0	4.1	7.1	5.0	-47.0	-36.1	-10.9	
1.394	52.6	V	-56.0	4.3	7.4	5.2	-52.9	-36.1	-16.8	
1.493	50.7	V	-57.3	4.4	7.6	5.5	-54.1	-36.1	-18.0	
1.593	60.1	V	-47.3	4.6	7.8	5.7	-44.0	-36.1	-7.9	
Mid Ch, 4965MHz										
1.393	55.3	H	-52.5	4.3	7.4	5.2	-49.4	-36.9	-12.6	
1.493	56.2	H	-51.0	4.4	7.6	5.5	-47.9	-36.9	-11.0	
1.593	57.8	H	-48.9	4.6	7.8	5.7	-45.6	-36.9	-8.8	
6.248	43.9	H	-44.9	9.5	12.2	10.1	-42.2	-36.9	-5.3	
1.391	59.3	V	-49.2	4.3	7.4	5.2	-46.2	-36.9	-9.3	
1.496	60.5	V	-47.4	4.4	7.6	5.5	-44.3	-36.9	-7.4	
1.589	60.9	V	-46.5	4.6	7.8	5.7	-43.3	-36.9	-6.4	
High Ch, 4985MHz										
1.394	55.0	H	-52.8	4.3	7.4	5.2	-49.7	-36.5	-13.2	
1.493	56.1	H	-51.1	4.4	7.6	5.5	-47.9	-36.5	-11.5	
1.595	58.0	H	-48.7	4.6	7.8	5.7	-45.4	-36.5	-9.0	
1.390	58.7	V	-49.8	4.3	7.4	5.2	-46.8	-36.5	-10.3	
1.493	60.5	V	-47.4	4.4	7.6	5.5	-44.3	-36.5	-7.8	
1.595	60.7	V	-46.7	4.6	7.8	5.7	-43.4	-36.5	-6.9	
3.189	44.9	V	-54.0	6.6	9.8	7.6	-50.9	-36.5	-14.4	

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7.4.3. TRANSMITTER ABOVE 1 GHz FOR 10 MHZ CHANNEL BANDWIDTH

HARMONICS AND SPURIOUS EMISSIONS (WITH 50 OHM LOADS)

High Frequency Substitution Measurement
Compliance Certification Services, Fremont 5m A-Chamber

Company:
Project #:07U11295
Date:9/7/2007
Test Engineer: Chin Pang
Configuration: EUT only
Mode: TX with 50 Ohms Load, 10MHz

Test Equipment:

EMCO Horn 1-18 GHz: T73; S/N: 6717 @3m
Horn > 18GHz:
Limit: EIRP
High Pass Filter: ☐
Hi Frequency Cables: ☐ (2 ft) ☐ (2 ~ 3 ft) ☑ (4 ~ 6 ft) ☑ (12 ft)
Pre-amplifer 1-26GHz: T34 HP 8449B
Pre-amplifer 26-40GHz:

f GHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Ch, 4945MHz										
1.393	55.2	H	-52.6	4.3	7.4	5.2	-49.5	-35.8	-13.8	
1.494	55.9	H	-51.3	4.4	7.6	5.5	-48.2	-35.8	-12.4	
1.593	58.7	H	-48.0	4.6	7.8	5.7	-44.7	-35.8	-9.0	
1.393	59.0	V	-49.5	4.3	7.4	5.2	-46.4	-35.8	-10.7	
1.493	59.1	V	-48.9	4.4	7.6	5.5	-45.7	-35.8	-9.9	
1.594	61.3	V	-46.1	4.6	7.8	5.7	-42.8	-35.8	-7.1	
3.186	44.7	V	-54.2	6.6	9.8	7.6	-51.1	-35.8	-15.3	
Mid Ch, 4965MHz										
1.394	55.6	H	-52.2	4.3	7.4	5.2	-49.1	-36.3	-12.9	
1.493	55.8	H	-51.4	4.4	7.6	5.5	-48.3	-36.3	-12.0	
1.595	58.1	H	-48.6	4.6	7.8	5.7	-45.3	-36.3	-9.0	
3.186	42.9	H	-55.9	6.6	9.8	7.6	-52.8	-36.3	-16.5	
1.391	59.2	V	-49.3	4.3	7.4	5.2	-46.3	-36.3	-10.0	
1.494	59.3	V	-48.6	4.4	7.6	5.5	-45.4	-36.3	-9.2	
1.591	60.8	V	-46.6	4.6	7.8	5.7	-43.4	-36.3	-7.1	
3.189	44.2	V	-54.7	6.6	9.8	7.6	-51.6	-36.3	-15.3	
High Ch, 4985MHz										
1.392	55.9	H	-51.9	4.3	7.4	5.2	-48.8	-37.1	-11.7	
1.495	56.1	H	-51.1	4.4	7.6	5.5	-48.0	-37.1	-10.9	
1.593	58.4	H	-48.3	4.6	7.8	5.7	-45.0	-37.1	-7.9	
1.391	60.0	V	-48.5	4.3	7.4	5.2	-45.5	-37.1	-8.3	
1.493	60.4	V	-47.5	4.4	7.6	5.5	-44.4	-37.1	-7.3	
1.593	60.3	V	-47.1	4.6	7.8	5.7	-43.8	-37.1	-6.7	
3.186	44.3	V	-54.6	6.6	9.8	7.6	-51.5	-37.1	-14.4	

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7.4.4. TRANSMITTER ABOVE 1 GHz FOR 20 MHZ CHANNEL BANDWIDTH

HARMONICS AND SPURIOUS EMISSIONS (WITH 50 OHM LOADS)

High Frequency Substitution Measurement
Compliance Certification Services, Fremont 5m A-Chamber

Company:
Project #:07U11295
Date:9/7/2007
Test Engineer: Chin Pang
Configuration: EUT only
Mode: TX with 50 Ohms Load, 20MHz BW

Test Equipment:

EMCO Horn 1-18 GHz: T73; S/N: 6717 @3m
Horn > 18GHz:
Limit: EIRP
☐ High Pass Filter
Hi Frequency Cables: ☐ (2 ft) ☐ (2 ~ 3 ft) ☑ (4 ~ 6 ft) ☑ (12 ft)
Pre-amplifer 1-26GHz: T34 HP 8449B
Pre-amplifer 26-40GHz:

f GHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Ch, 4945MHz										
1.393	55.6	H	-52.2	4.3	7.4	5.2	-49.1	-38.3	-10.8	
1.494	56.5	H	-50.7	4.4	7.6	5.5	-47.6	-38.3	-9.3	
1.595	57.8	H	-48.9	4.6	7.8	5.7	-45.6	-38.3	-7.3	
3.178	43.5	H	-55.4	6.6	9.8	7.6	-52.2	-38.3	-13.9	
1.393	59.2	V	-49.3	4.3	7.4	5.2	-46.2	-38.3	-7.9	
1.493	59.8	V	-48.2	4.4	7.6	5.5	-45.0	-38.3	-6.7	
1.594	60.4	V	-47.0	4.6	7.8	5.7	-43.7	-38.3	-5.4	
Mid Ch, 4965MHz										
1.394	55.8	H	-52.0	4.3	7.4	5.2	-48.9	-38.5	-10.4	
1.493	56.0	H	-51.2	4.4	7.6	5.5	-48.1	-38.5	-9.6	
1.595	58.6	H	-48.1	4.6	7.8	5.7	-44.8	-38.5	-6.3	
1.390	59.5	V	-49.0	4.3	7.4	5.2	-46.0	-38.5	-7.5	
1.494	58.6	V	-49.3	4.4	7.6	5.5	-46.2	-38.5	-7.7	
1.591	60.5	V	-46.9	4.6	7.8	5.7	-43.7	-38.5	-5.2	
3.189	44.1	V	-54.8	6.6	9.8	7.6	-51.7	-38.5	-13.2	
High Ch, 4985MHz										
1.394	55.0	H	-52.8	4.3	7.4	5.2	-49.7	-38.7	-11.0	
1.492	57.0	H	-50.2	4.4	7.6	5.4	-47.1	-38.7	-8.4	
1.593	57.4	H	-49.3	4.6	7.8	5.7	-46.0	-38.7	-7.3	
3.189	43.0	H	-55.8	6.6	9.8	7.6	-52.7	-38.7	-13.9	
1.390	58.8	V	-49.7	4.3	7.4	5.2	-46.7	-38.7	-7.9	
1.493	61.2	V	-46.8	4.4	7.6	5.5	-43.6	-38.7	-4.9	
1.593	59.7	V	-47.7	4.6	7.8	5.7	-44.4	-38.7	-5.7	
3.186	43.6	V	-55.3	6.6	9.8	7.6	-52.2	-38.7	-13.4	

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7.4.5. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

30 - 1000MHz Substitution Measurement
Compliance Certification Services, Morgan Hill 5m Chamber Site

CompanyProxim
Project #:06U10652
Date:11/22/06
Test Engineer:Chin Pang
Configuration:EUT with 50 Ohm Load
Mode:TX (Worst Case)

Test Equipment:

Bilog Antenna	Cable	Pre-amplifer 8447D	Limit
5m Chamber Sunol Bilog	5m Chamber Cable	T5 8447D	ERP

f MHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
100.00	53.0	H	-57.3	1.3	-0.9	-3.1	-61.7	-39.0	-22.7	
211.90	56.2	H	-54.2	1.9	5.8	3.6	-52.5	-39.0	-13.5	
323.40	56.0	H	-49.8	2.2	6.0	3.9	-48.1	-39.0	-9.1	
97.90	53.7	V	-57.2	1.3	-0.8	-2.9	-61.4	-39.0	-22.4	
100.40	63.5	V	-46.7	1.3	-1.0	-3.1	-51.1	-39.0	-12.1	
321.00	58.6	V	-48.2	2.2	6.0	3.9	-46.5	-39.0	-7.5	

Rev. 5.1.6

7.4.6. WORST-CASE RECEIVER RADIATED EMISSIONS ABOVE 1 GHz

LIMITS

RSS-GEN Clause 4.8 The receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate.

Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions.

Radiated emission measurements are to be performed using a calibrated open-area test site. As an alternative, the conducted measurement method may be used when the antenna is detachable. In such a case, the receiver spurious signal may be measured at the antenna port.

If the receiver is super-regenerative, stabilize it by coupling to it an unmodulated carrier on the receiver frequency (antenna conducted measurement) or by transmitting an unmodulated carrier on the receiver frequency from an antenna in the proximity of the receiver (radiated measurement). Taking care not to overload the receiver, vary the amplitude and frequency of the stabilizing signal to obtain the highest level of the spurious emissions from the receiver.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

For emissions below 1 GHz, measurements employing a CISPR quasi-peak detector shall be used. Above 1 GHz, measurements employing an average detector shall be used.

High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Company:Proxim
Project #:06U10562
Date:11/22/2006
Test Engineer:Chin Pang
Configuration:EUT with 50 Ohm Load
Mode:20M BW, RX, Mid Ch

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T144 Miteq 3008A00931			RX RSS 210

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
	Chin 197538001	Chin 200354001		

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)
Mid Ch, 4965MHz															
1.593	3.0	65.0	48.0	26.9	1.8	-38.6	0.0	0.0	55.1	38.1	74	54	-18.9	-15.9	V
2.090	3.0	54.0	40.5	28.1	2.0	-37.9	0.0	0.0	46.2	32.7	74	54	-27.8	-21.3	V
2.193	3.0	52.8	38.4	28.2	2.1	-37.8	0.0	0.0	45.3	30.9	74	54	-28.7	-23.1	V
1.390	3.0	58.0	45.0	26.4	1.7	-38.9	0.0	0.0	47.1	34.1	74	54	-26.9	-19.9	H
2.090	3.0	54.0	40.0	28.1	2.0	-37.9	0.0	0.0	46.2	32.2	74	54	-27.8	-21.8	H
2.193	3.0	50.6	37.8	28.2	2.1	-37.8	0.0	0.0	43.1	30.3	74	54	-30.9	-23.7	H

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Note: No other emissions were detected above the system 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		

7.5. FREQUENCY STABILITY

LIMIT

RSS-Gen Clause 4.5 When the carrier frequency stability is not specified, it need not be tested, provided that the carrier frequency is chosen such that the fundamental modulation products (meaning the nominal bandwidth) lie totally within the bands listed in Tables 2, 3, 4 and 5 and do not fall into any restricted band listed in Table 1. Due account shall be taken of carrier frequency drift as a result of aging, temperature, humidity, and supply voltage variations when using frequencies near the band edges. (RSS-210 2.1)

TEST PROCEDURE

Reference measurements of the carrier frequency are made at nominal conditions of +20°C and the rated supply voltage.

Additional measurements are made at temperatures of – 30°C to +50°C at the manufacturer's rated power supply voltage. Additional measurements are made at +/- 15 percent of the manufacturer's rated supply voltage temperature of +20°C.

The additional measurements are compared with the reference measurements to calculate the frequency stability.

RESULTS

No non-compliance noted:

NORMAL VOLTAGE EXTREME TEMPERATURE RESULTS

Temp. Celsius	Channel Frequency (MHz)	Measured Frequency (MHz)	Delta Frequency (kHz)	ppm
-30	4964.985743	4964.961895	-23.85	4.80
-20	4964.985743	4964.962777	-22.97	4.63
-10	4964.985743	4964.968422	-17.32	3.49
0	4964.985743	4964.991531	5.79	-1.17
10	4964.985743	4964.993496	7.75	-1.56
20	4964.985743	4964.985743	0.00	0.00
30	4964.985743	4964.966571	-19.17	3.86
40	4964.985743	4964.967886	-17.86	3.60
50	4964.985743	4964.966851	-18.89	3.81

LOW VOLTAGE NORMAL TEMPERATURE RESULTS

Temp. Celsius	Channel Frequency (MHz)	Measured Frequency (MHz)	Delta Frequency (kHz)	ppm
20	4965	4964.980625	-19.37	3.90

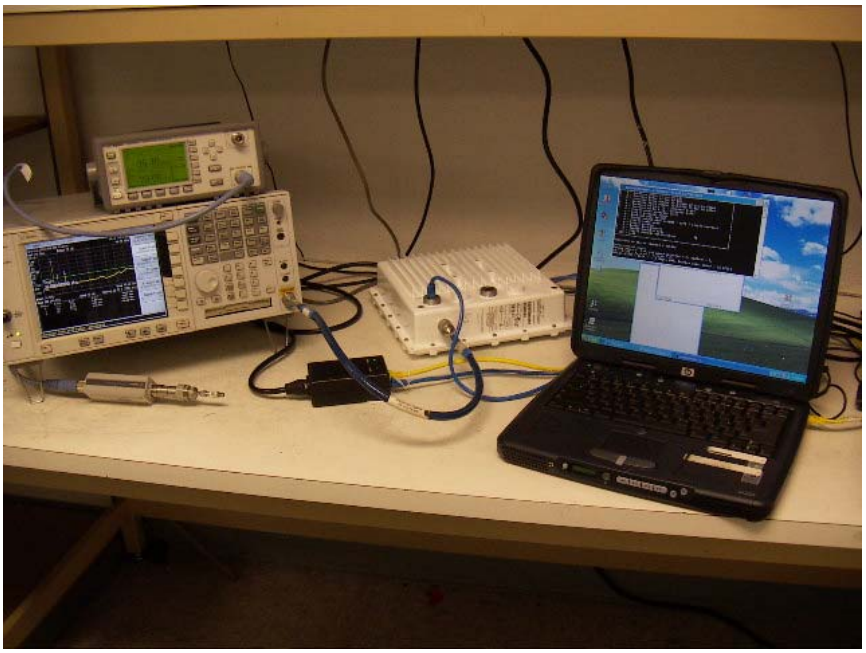
HIGH VOLTAGE NORMAL TEMPERATURE RESULTS

Temp. Celsius	Channel Frequency (MHz)	Measured Frequency (MHz)	Delta Frequency (kHz)	ppm
20	4965	4964.986757	-13.24	2.67

8. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP

ANTENNA PORT CONDUCTED PHOTO



TEMPERATURE CHAMBER MEASUREMENT SETUP

TEMPERATURE CHAMBER PHOTO

RADIATED RF MEASUREMENT SETUP WITH 50 OHM LOADS

RADIATED FRONT PHOTO

RADIATED BACK PHOTO

END OF REPORT