Engineering and Testing for EMC and Safety Compliance

Certification Report

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Model: VIDA Broadband High Power Client
4940–4990 MHz

FCC ID: BV8VIDA-BB-CL
IC: 3670A-VIDABBCL

March 14, 2007

Standards Referenced for this Report	
Part 2: 2006	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 90: 2006	Private Land Mobile Radio Services
ANSI/TIA-603-C-2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
ANSI/TIA/EIA – 102.CAAA; 2002	Digital C4FM/CQPSK Transceiver Measurement Methods
RSS-111 Issue 1 2006	Broadband Public Safety Equipment Operating in the Band 4940-4990 MHz

Frequency Range	Rated Peak Transmit Power (W)	Measured Frequency Tolerance (ppm)	Emission Designator
4940-4990 MHz	0.5	12.2	5M0X7D

Report Prepared by Test Engineer: Daniel Baltzell

Document Number: 2007133

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1 General Information

The following Certification Report is prepared on behalf of **M/A-COM, Inc**. in accordance with the Federal Communications Commission. The Equipment Under Test (EUT) was the **VIDA Broadband Client; FCC ID: BV8VIDA-BB-CL and IC: 3670A-VIDABBCL**. The test results reported in this document relate only to the item that was tested.

All measurements contained in this application were conducted in accordance with the applicable FCC Rules and Regulations in CFR 47. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

1.1 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc., 360 Herndon Parkway, Suite 1400, Herndon, Virginia, 20170. This site has been fully described in a report submitted to and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing.

1.2 Related Submittal(s)/Grant(s)

This is an original application report.

2 Tested System Details

The test sample was received on March 5, 2007. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable. The VIDA Broadband High Power Client implements the 802.16-2004 protocol in a 5 MHz channel, delivering an over-the-air throughput of 2–19 Mbps. The system was tested at a data rate of 6 Mb/s at a 5 MHz channel bandwidth.

The client used for testing was DC powered; there is also a version that is powered by AC voltage, to be included in this certification. The RF portions of both versions are identical. The DC powered client with the Ethernet interface was used for testing to Part 90 requirements. The DC version was tested for Part 15 unintentional emissions; this data is contained in a separate DoC report and is available upon request.

The client models MAVM-VMXCH and MAVM-VMCHH share transceiver, power supply, front-end, and communication circuitry inside the chassis. The model MAVM-VMCHH adds a media converter inside the chassis to provide fast Ethernet over multimode optical fiber as well as additional surge protection on the RF and power connections. The mobile version is the same as the MAVM-VMXCH except it has different mounting hardware and was not tested.

Model Tested	VIDA Broadband Client
Frequency Band	4940–4990 MHz
Modulation Type	OFDM signal with QPSK, BPSK, 16 QAM, 64 QAM
Channel Step Size	2.5 MHz
Channel Bandwidth	5 MHz
Primary Power	11 to 30 VDC/VAC
Rated Transmitter Output Power	5uW to 0.5W (-23 dBm to +27 dBm programmable with 1 dB step)
Duty Cycle	36%

Table 2-1: Equipment Under Test (EUT)

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
AC powered Client	M/A-Com, Inc.	MAVM-VMXCH	BS-010700-002	BV8VIDA-BB-CL	17794
DC powered Client	M/A-Com, Inc.	MAVM-VMCHH	BS-010700-003	BV8VIDA-BB-CL	17835
Mobile Client	M/A-Com, Inc.	MAVM-VMCHN	N/A	BV8VIDA-BB-CL	N/A

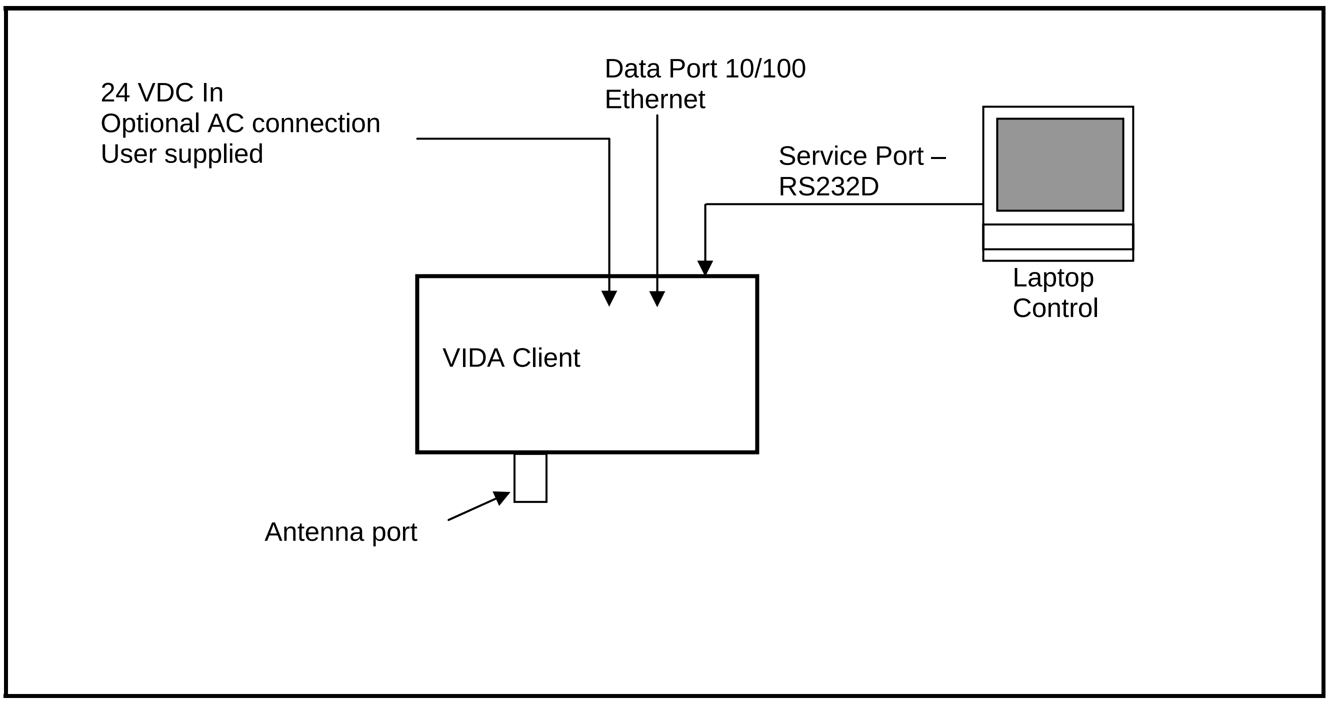
Table 2-2: Ports and Cabling (EUT)

Port	Cable Type	Quantity	Length (m)	Shield
AC/DC Power Port	3-pin industrial Conxall	1	1.5	No
RJ-45 Ethernet Port	RJ-45	1	1.4	No
Remote Antenna Mount Port	N type female	1	N/A	Yes
Service Port	RJ-45	1	N/A	No

Table 2-3: Support Equipment

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Notebook Computer	IBM	Thinkpad	N/A	N/A	17798
RJ-45 Cable	N/A	N/A	N/A	N/A	N/A

Figure 2-1: Configuration of Tested System



3 FCC Rules and Regulations Part 2 §2.1033(c)(8) Voltages and Currents Through The Final Amplifying Stage

Nominal DC Voltage: 24 VDC
Current: 0.3 AMPS

4 FCC Rules and Regulations Part 90 §90.1215(a) and Part 2 §2.1046(a): Peak Output Power; RSS-111 Section 4.3: Transmitter Output Power and Channel Bandwidth

§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…………………………….	7.0	20.0
5…………………………….	14.0	27.0
10………………………….	17.0	30.0
15………………………….	18.8	31.8
20………………………….	20.0	33.0

High power devices are also limited to a peak power spectral density of 21 dBm per 1 MHz. High power devices using channel bandwidths other than those listed above permitted; however, they are limited to a peak power spectral density of 21 dBm MHz. If the transmitting antennas of directional gain greater than 9dBi 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 a directional gain up to 26 dBi without any corresponding reduction in the transmitter power or the 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.

4.1 Test Procedure

TIA-603-C Section 2.2.1

The EUT transmitter output was connected through an appropriate 50 ohm attenuator to a spectrum analyzer. The resolution bandwidth and video bandwidth were set to auto. The peak transmit power was measured as a conducted emission over the interval of continuous transmission in terms of an RMS equivalent voltage RF burst gated with the width of 3.637ms with a sweep slow enough to fill the 5 MHz bandwidth channel spacing for the analyzer to properly integrate the power.

A 20 dB attenuator was used between the EUT and the spectrum analyzer for all power measurements. No cable was used between EUT and analyzer.

The system loss was measured by using a signal generator and reference cable. The attenuation was first measured with a reference cable, then measured in combination with the attenuators.

Loss (reference cable/attenuators) – Loss (reference cable) = Attenuator loss

20.8 dB – 0.8 dB = 20.0 dB total system loss (relative offset entered into analyzer)

4.2 Test Data

The EUT complies with 47CFR2.1046 and 90.1215(a). EUT does not exceed 27 dBm at carrier frequency.

Table 4-1: RF Power Output: Carrier Output Power

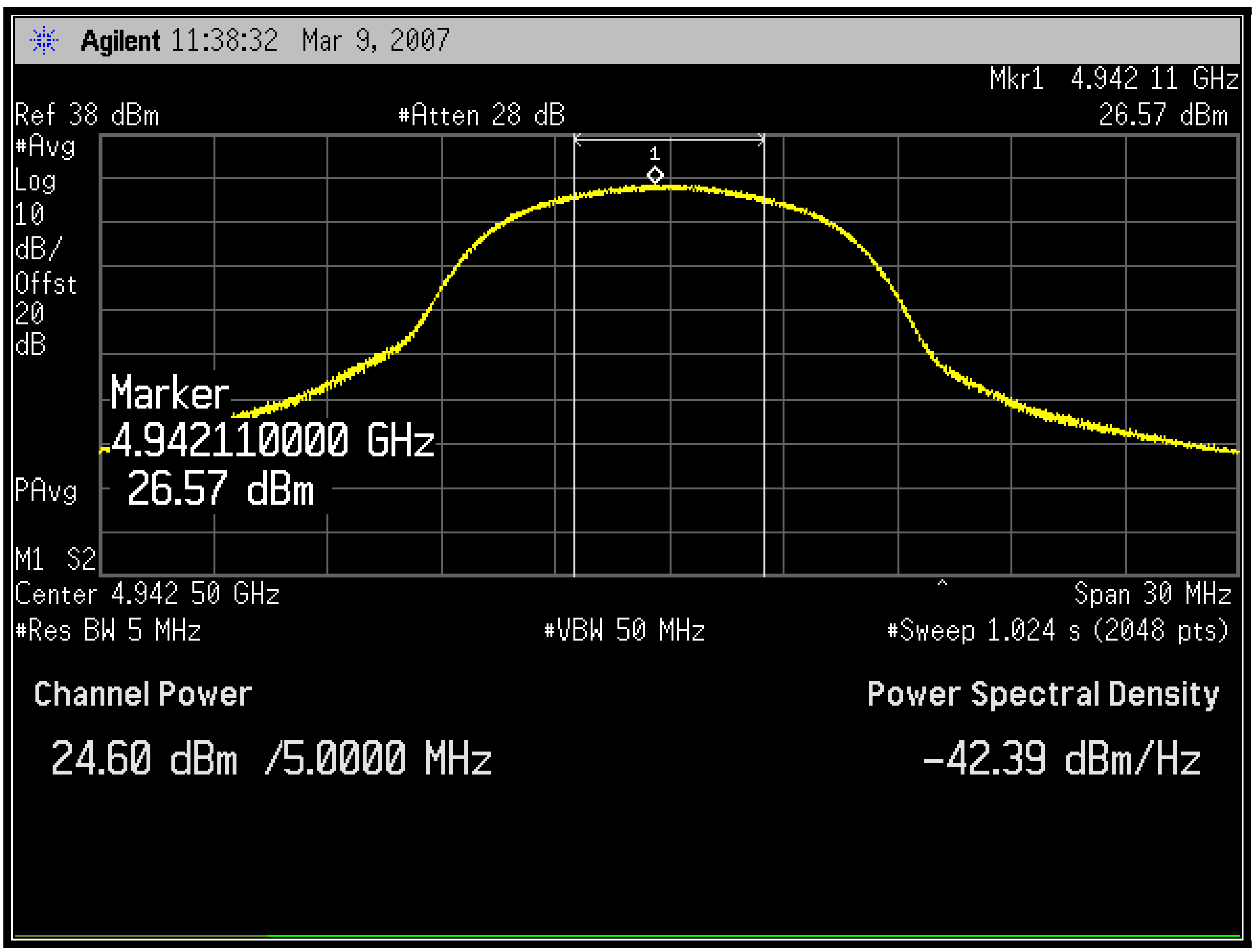
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)
3	4942.5	26.57	27
9	4962.5	26.78	27
16	4987.5	26.76	27

*Measurement accuracy: +/-.3 dB

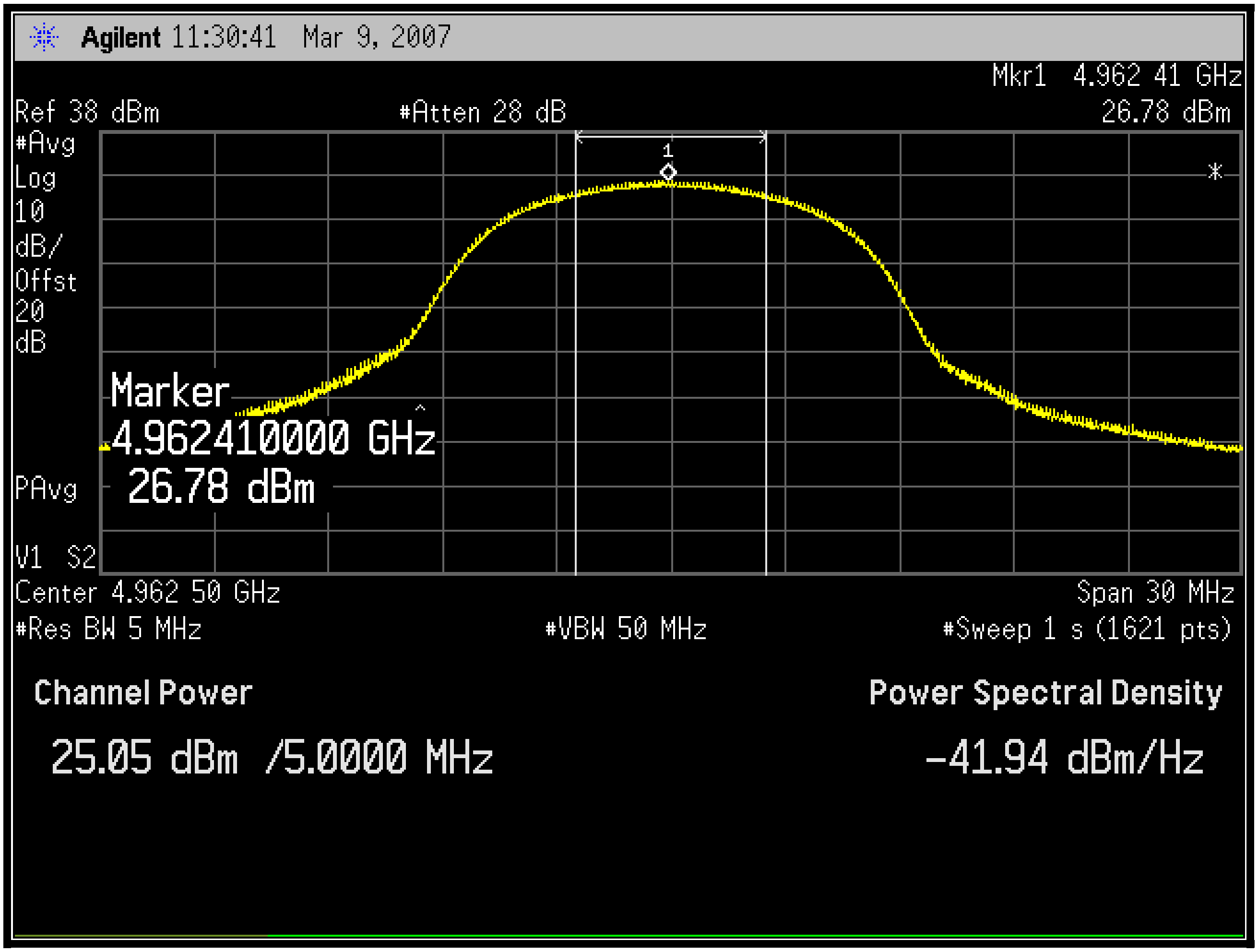
Table 4-2: RF Power Output (Rated Power)

Rated Power
0.5 W

Plot 4-1: Channel Power Output; Channel 3 - 4942.5 MHz



Plot 4-2: Channel Power Output; Channel 9 - 4962.5 MHz



Plot 4-3: Channel Power Output; Channel 16 - 4987.5 MHz

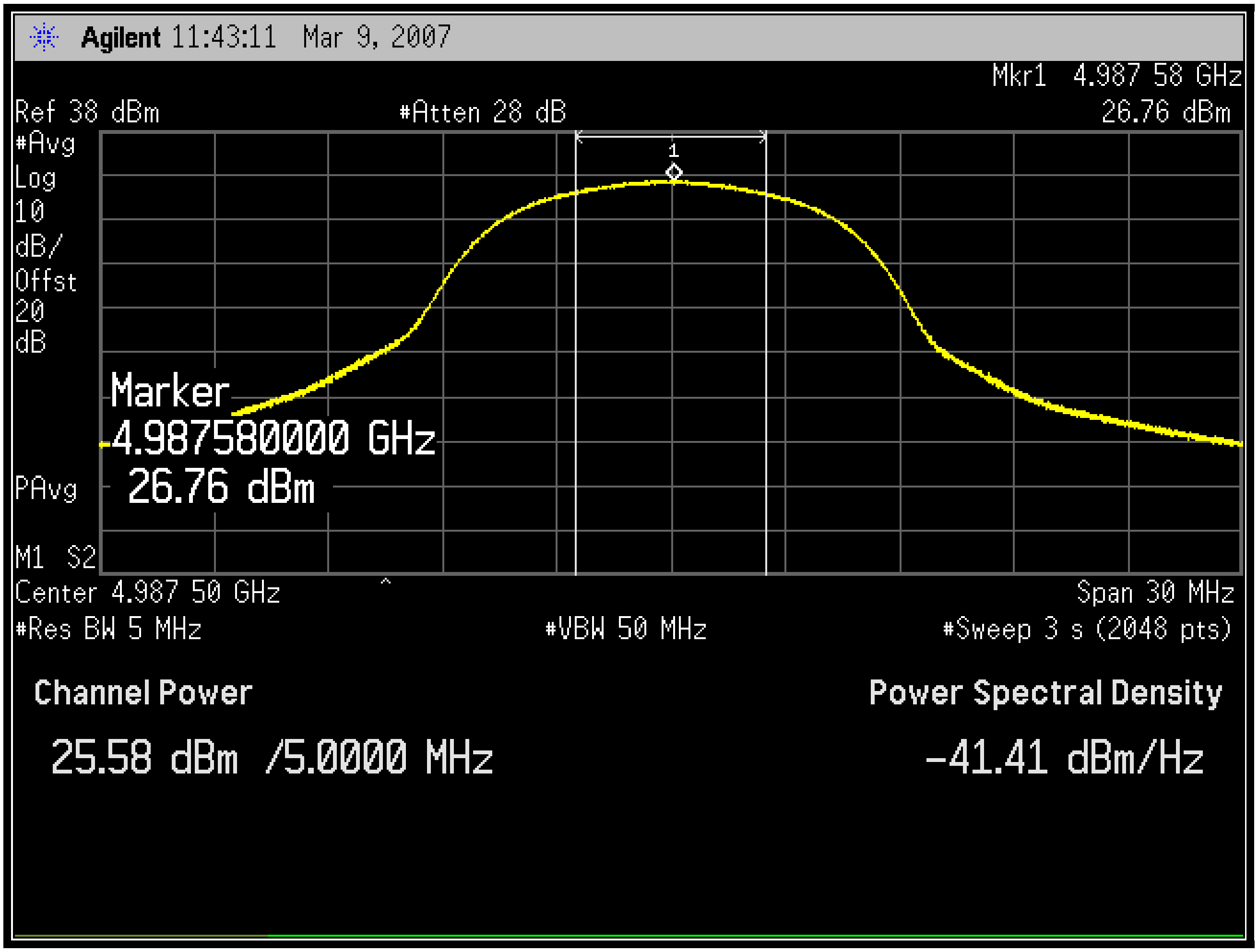


Table 4-3: Test Equipment for Testing RF Power Output – Conducted

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901413	Agilent Technologies	E4448	Spectrum Analyzer	US44020346	12/14/07
016793	MCL Weinschel	MCL BW-S20W5	Attenuator, 20 dB, DC-18 GHz, 5 W	N/A	12/9/08

Test Personnel:

Daniel Baltzell	[signature]	March 9, 2007
Test Engineer	Signature	Date Of Tests

5 FCC Rules and Regulations Part 90 §90.1215(a): Peak Power Spectral Density; RSS-111 Section 4.3: Transmitter Output Power and Channel Bandwidth

(a) High power devices are also limited to a peak power spectral density of 21 dBm per 1 MHz. High power devices using channel bandwidths other than those listed above permitted; however, they are limited to a peak power spectral density of 21 dBm MHz. If the 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 a directional gain up to 26 dBi without any corresponding reduction in the transmitter power or the 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.

(b) 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 for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

Limit determined by antenna gain:

Antenna Gain (dBi)	Limit (dBm)
Up to 26 dBi	21

5.1 Test Procedure

The EUT transmitter output was connected through the appropriate 50 ohm attenuator to a spectrum analyzer. Resolution bandwidth was set to 1% of occupied bandwidth and video bandwidth was set to a value greater than the resolution bandwidth. Peak search was used to find peak spectral density within 5 MHz signal bandwidth and centered within the 1 MHz span of measurement, the spectrum analyzer integrated measurement plot was taken.

20 dB attenuation was used between the EUT and the spectrum analyzer for all PSD measurements. No cable was used between EUT and analyzer.

Path loss was calculated as follows (checked across the frequency band of interest).

The system loss was measured by using a signal generator and reference cable.. The attenuation was first measured with a reference cable, then measured in combination with the attenuators.

Loss (reference cable/attenuators) – Loss (reference cable) = Attenuator loss

20.9 dB – 0.9 dB = 20.0 dB total system loss (relative offset entered into analyzer)

5.2 Test Data

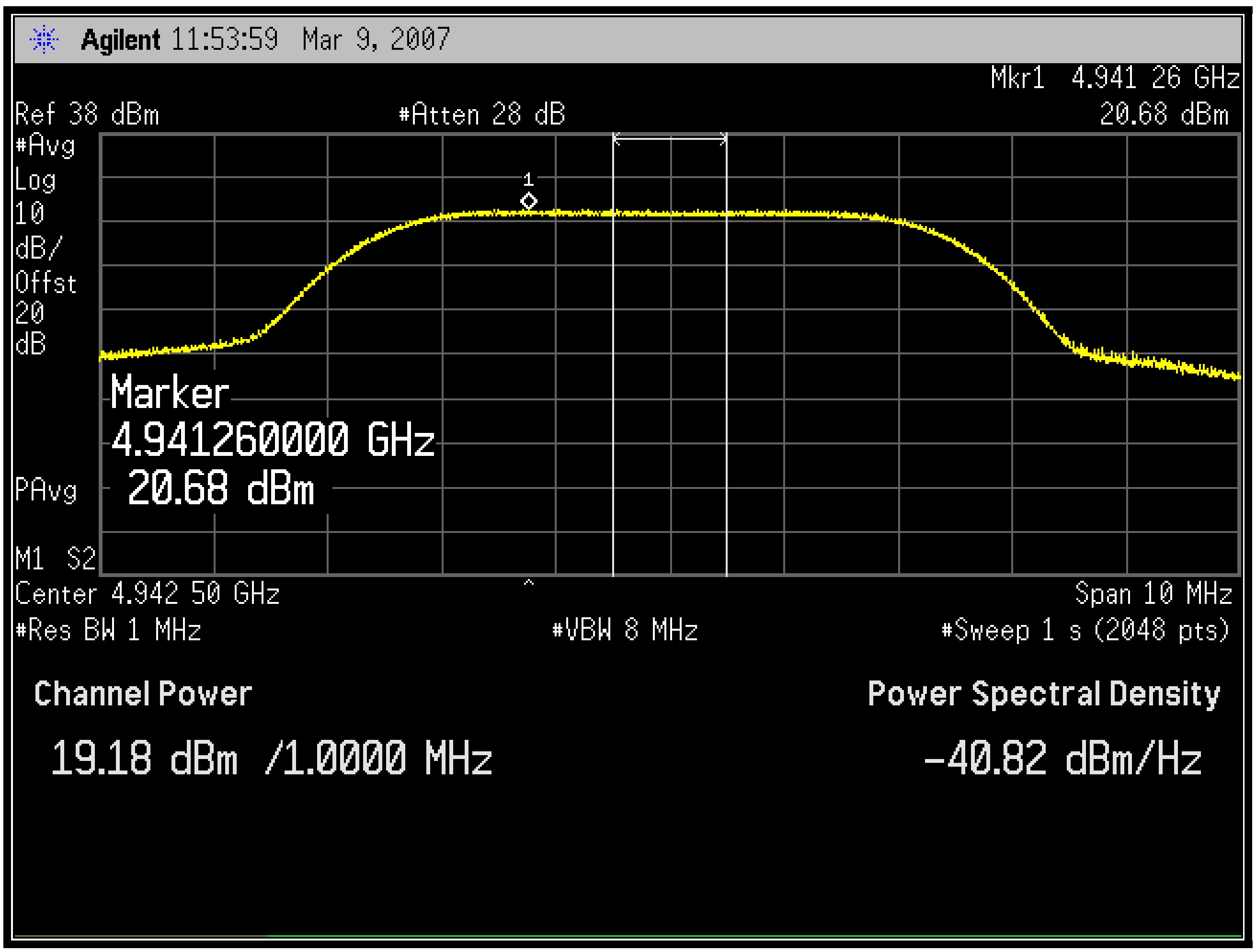
EUT complies with 47CFR2.1046 and 90.1215(a). EUT does not exceed 21 dBm at carrier frequency.

Table 5-1: RF Power Output: Peak Power Spectral Density

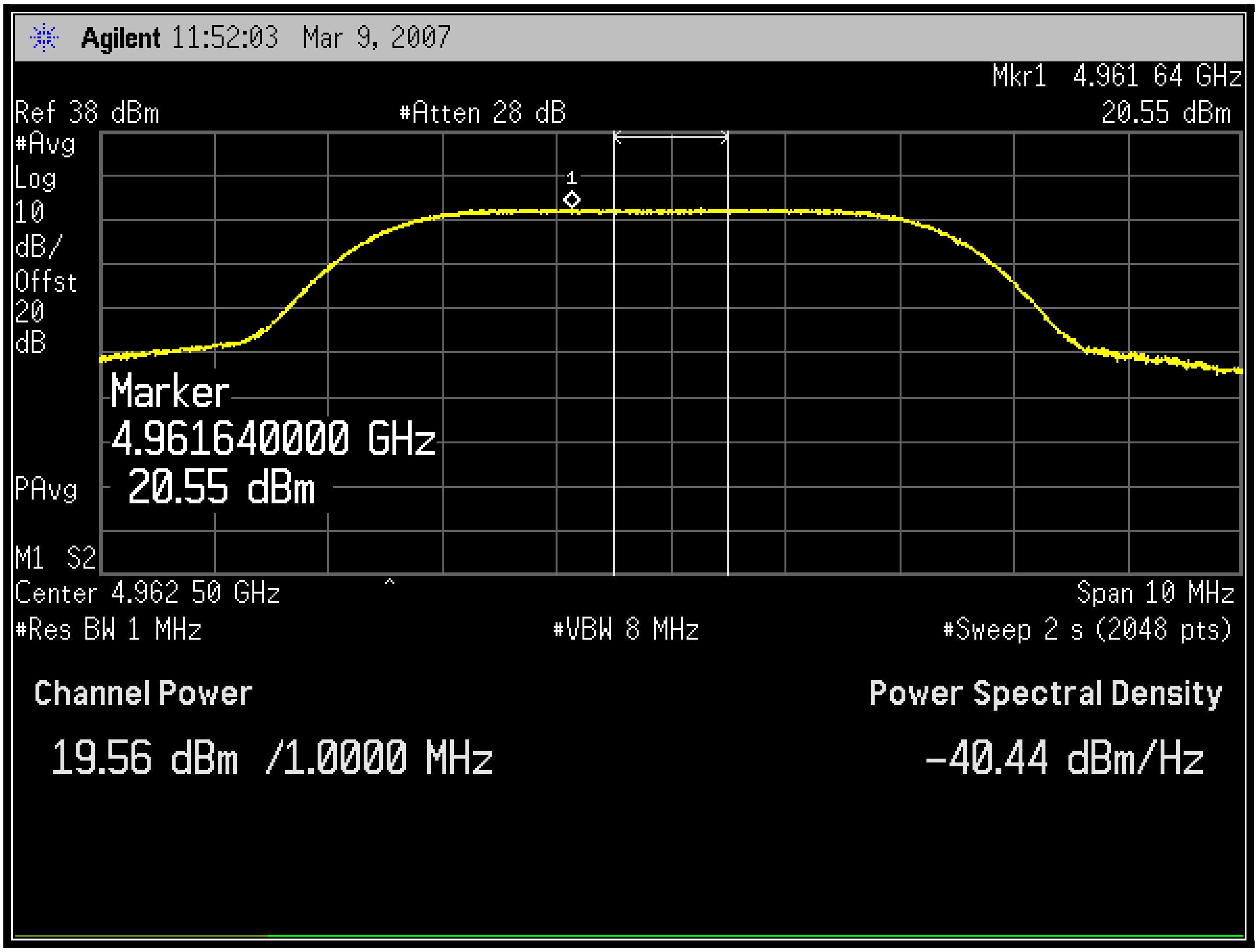
Channel	Frequency (MHz)	Channel BW (MHz)	Measured Peak Power Spectral Density (dBm per one MHz)	Limit (dBm per one MHz)
3	4942.5	5	20.68	21
9	4962.5	5	20.55	21
16	4987.5	5	20.68	21

* Measurement accuracy: +/-.3 dB

Plot 5-1: Peak Power Spectral Density; Channel 3 - 4942.5 MHz



Plot 5-2: Peak Power Spectral Density; Channel 9 - 4962.5 MHz



Plot 5-3: Peak Power Spectral Density; Channel 16 - 4987.5 MHz

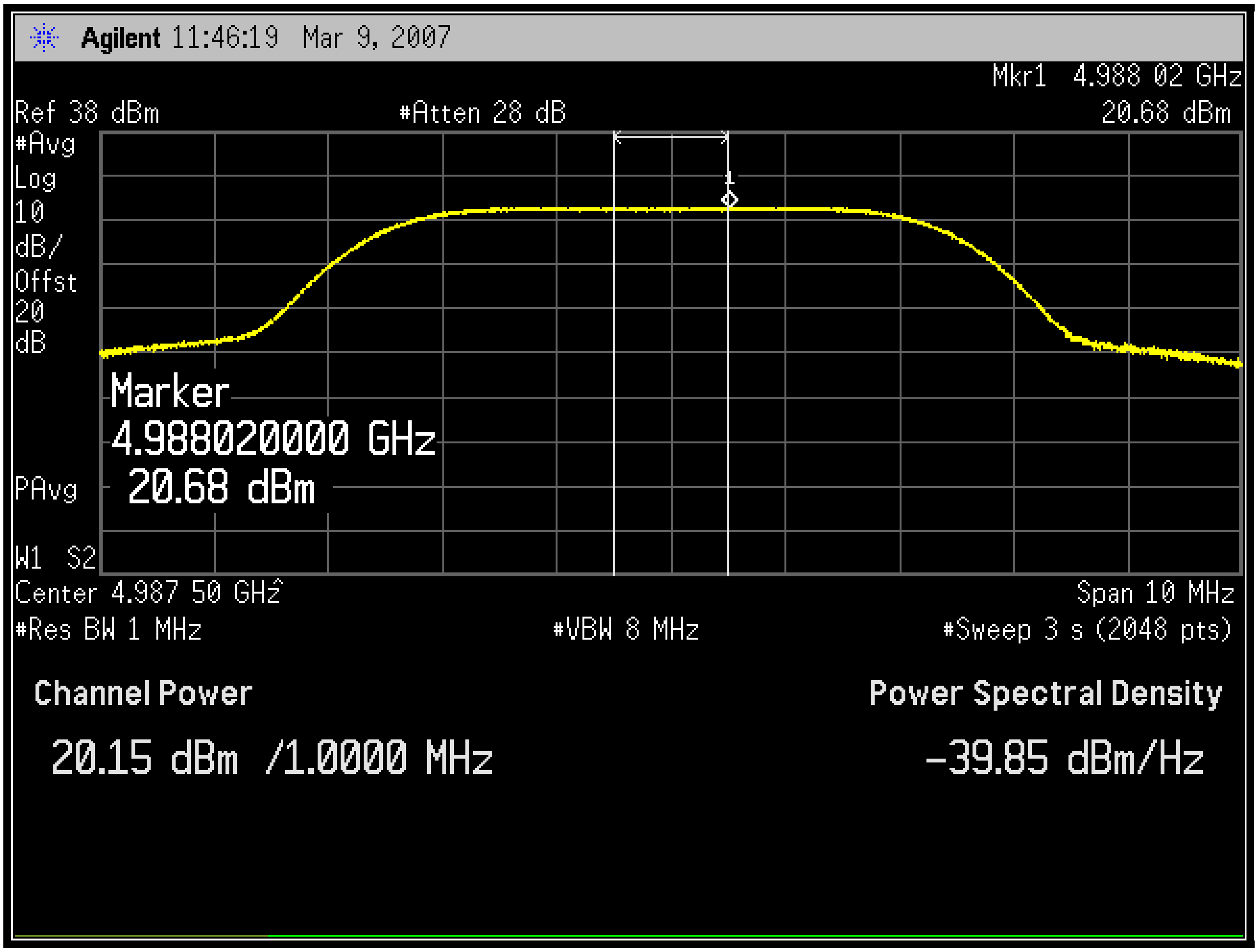
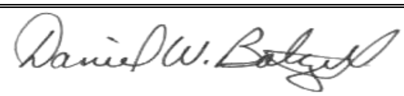


Table 5-2: Test Equipment for Testing Peak Power Spectral Density – Conducted

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901413	Agilent Technologies	E4448	Spectrum Analyzer	US44020346	12/14/07
016793	MCL Weinschel	MCL BW-S20W5	Attenuator, 20 dB, DC-18 GHz, 5 W	N/A	12/9/08

Test Personnel:

Daniel Baltzell		March 9, 2007
Test Engineer	Signature	Date Of Tests

6 FCC Rules and Regulations Part 90 §90.210(m) and Part 2 §2.1049: Occupied Bandwidth (Emissions Masks) and Conducted Spurious Emissions; RSS-111 Section 4.4: Transmitter Unwanted Emissions

§90.210(m) Emission Mask M: For high power transmitters (greater than 20 dBm) 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: 568 log (% of (BW)/45) dB.
(3) On any frequency removed from the assigned frequency between 50–55% of the authorized bandwidth: 26 + 145 log (% of (BW)/50) dB.
(4) On any frequency removed from the assigned frequency between 55–100% of the authorized bandwidth: 32 + 31 log (% of (BW)/55) dB attenuation.
(5) On any frequency removed from the assigned frequency between 100–150% of the authorized bandwidth: 40 + 57 log (% of (BW)/100) dB attenuation.
(6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 50 or 55+ 10 log (P) dB, whichever is the lesser attenuation.

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 1% 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.

Additionally, testing to the latest FCC interpretation was followed: With regard to the L and M masks in Part 90.210, the rule indicates using a minimum RBW of 1% of the bandwidth to determine the reference level, and a minimum RBW of 1% of the bandwidth to determine the mask skirts. The mask should be developed using the same resolution bandwidth throughout, for the reference level and the mask skirts.

6.1 Test Procedure

TIA-603-C Section 2.2.11, 2.2.13 (with FCC deviations)

The EUT transmitter was connected to a spectrum analyzer through an appropriate 50 ohm attenuator. The reference level for the mask was set using the highest average power of the fundamental emission measured across the channel bandwidth using a RBW of at least 1% of the occupied bandwidth of the fundamental emission (47 kHz for this test) and a VBW of 30 kHz.

A 20 dB attenuator was used between the EUT and the spectrum analyzer for measurements. No cable was used between EUT and analyzer.

Path loss was calculated as follows (checked across the frequency band of interest).

The system loss was measured by using a signal generator and reference cable.. The attenuation was first measured with a reference cable, then measured in combination with the attenuators.

Loss (reference cable/attenuators) – Loss (reference cable) = Attenuator loss

20.9 dB – 0.9 dB = 20.0 dB total system loss (relative offset entered into analyzer)

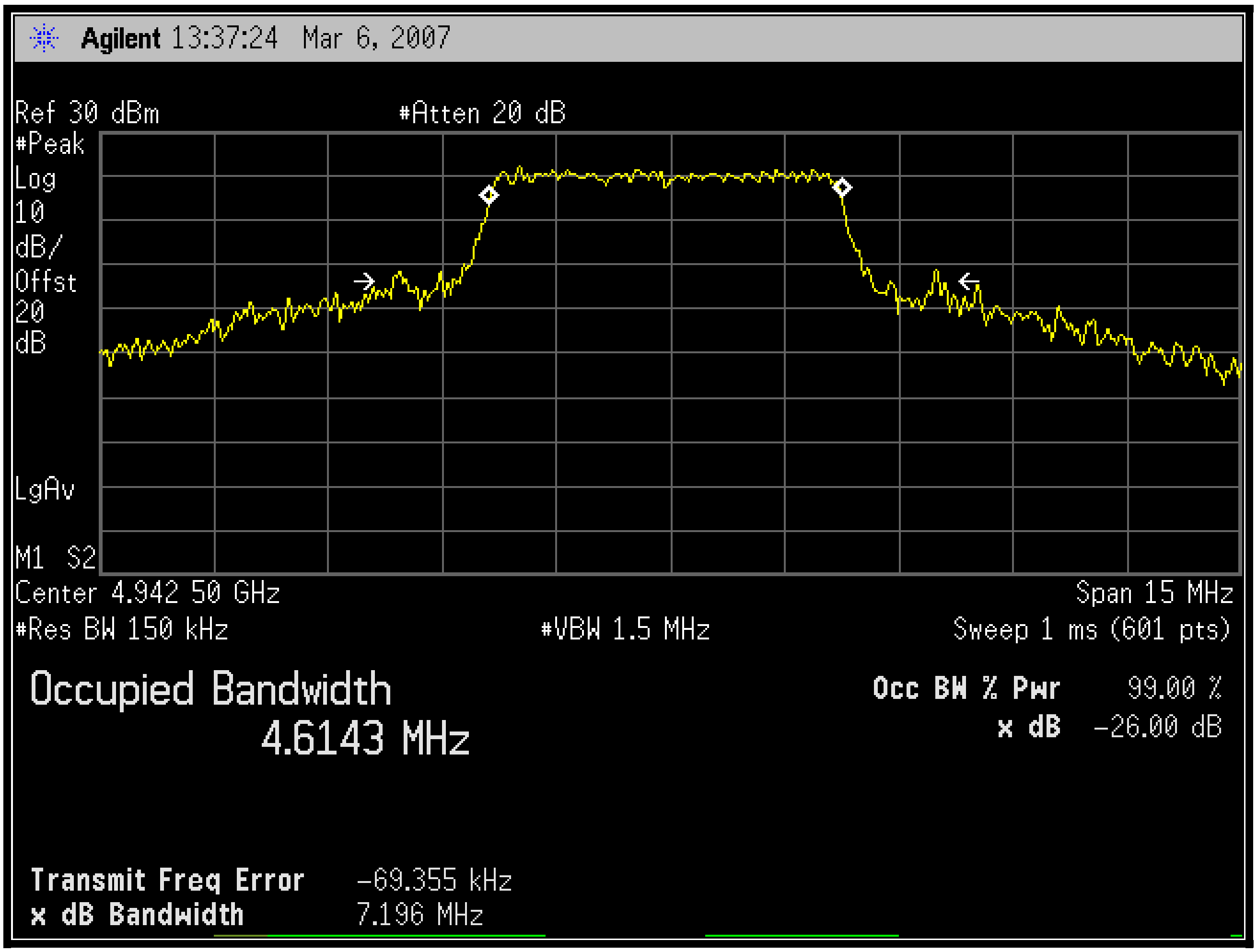
6.2 Reference Level Measurements

The following measurements were taken in order to determine the reference level for the mask measurements.

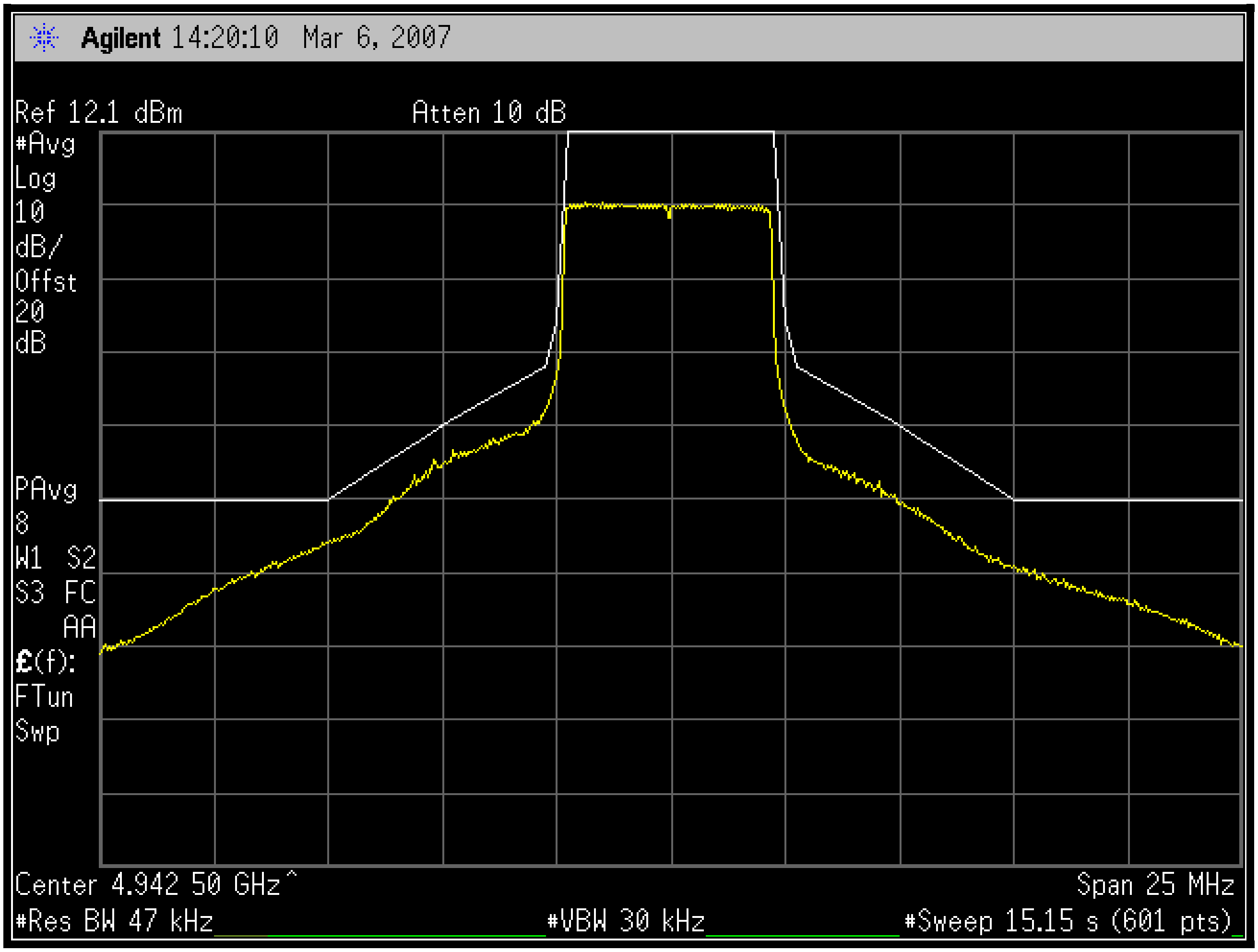
Channel	RBW (kHz)	VBW (kHz)	Level (dBm)
3	47	30	12.1
16	47	30	13.2

6.3 In Band Spurious Test Data

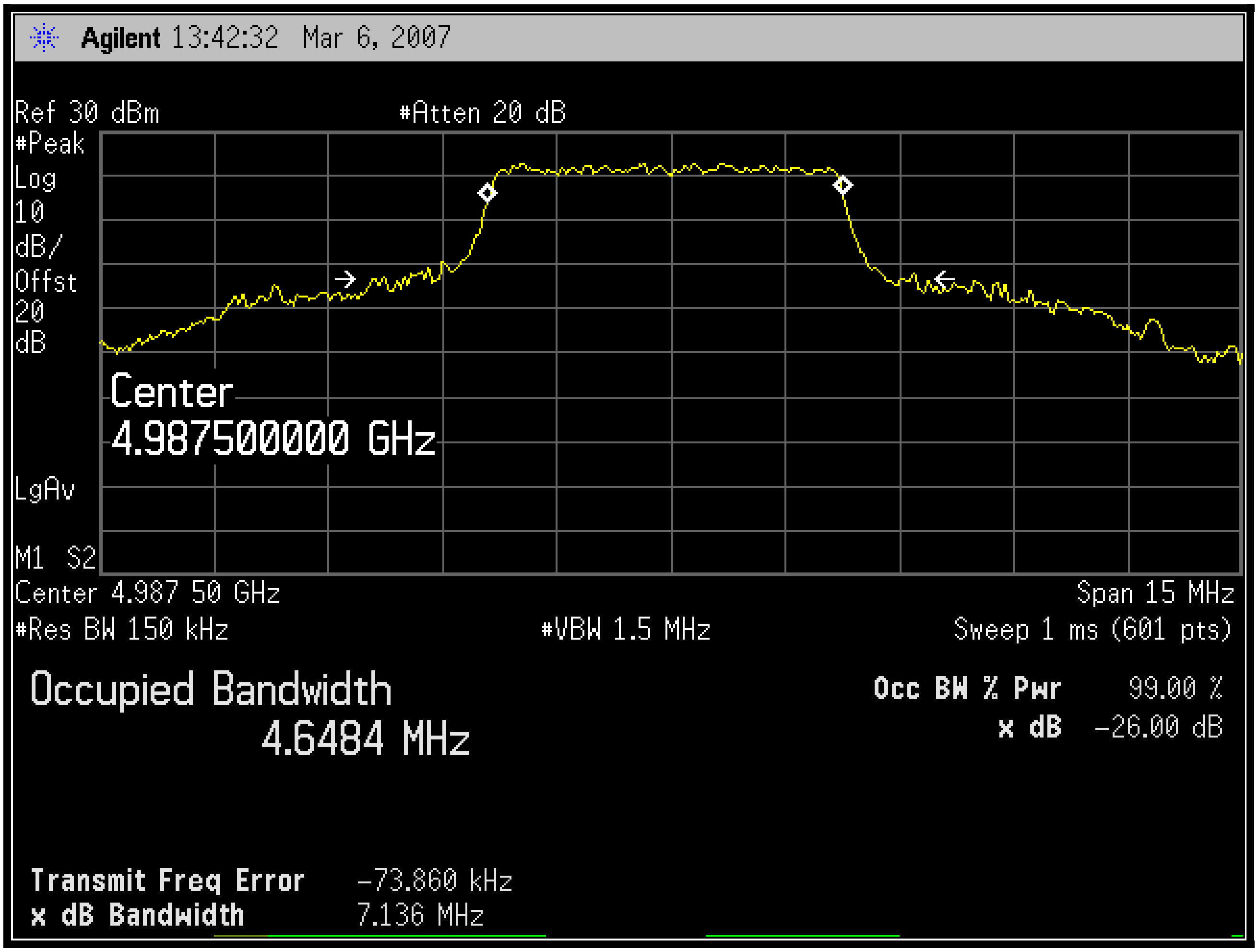
Plot 6-1: Occupied Bandwidth; Channel 3 - 4942.5 MHz



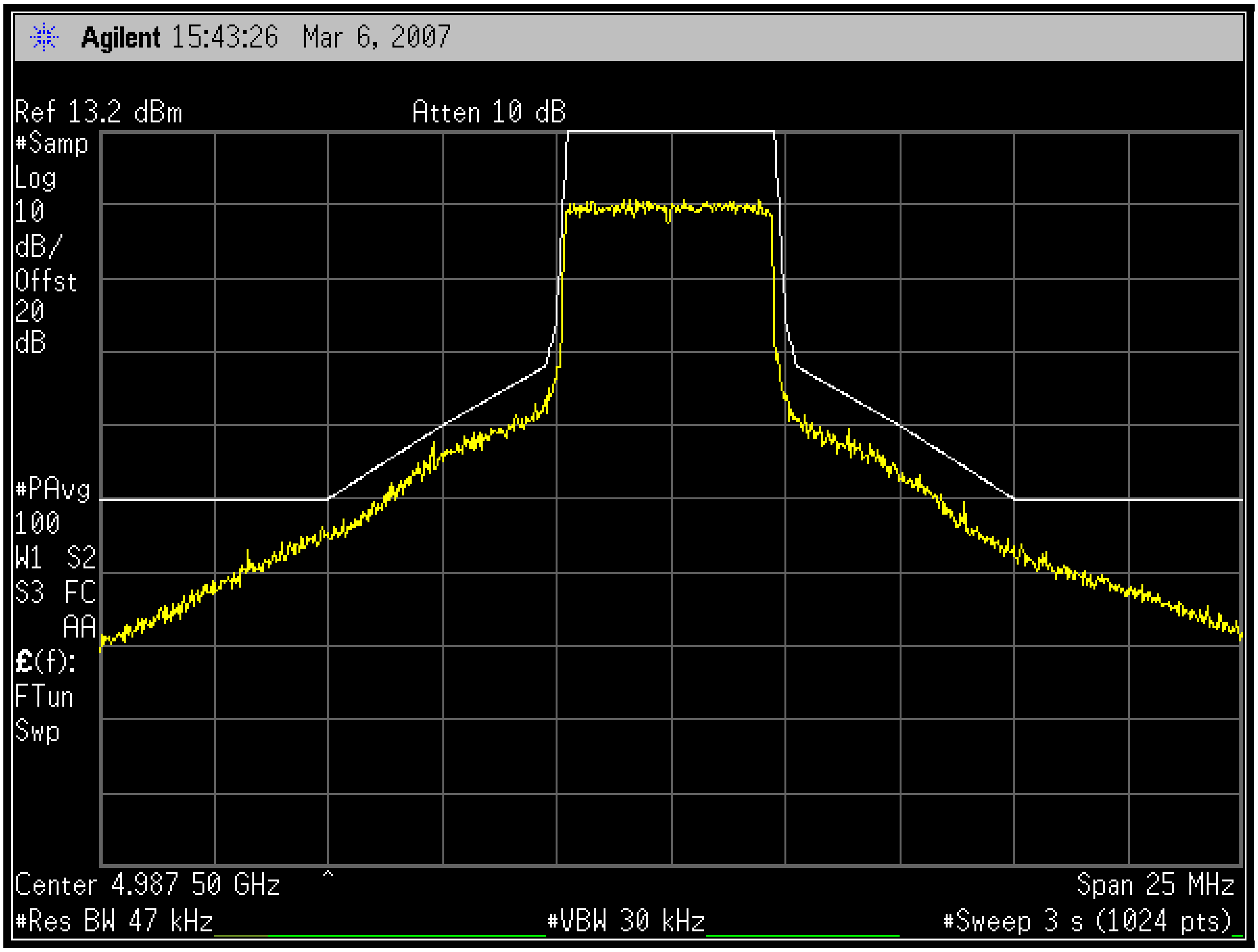
Plot 6-2: Emissions Mask M; Channel 3 - 4942.5 MHz



Plot 6-3: Occupied Bandwidth; Channel 16 - 4987.5 MHz



Plot 6-4: Emissions Mask M; Channel 16 - 4987.5 MHz



6.4 Out of Band Spurious Test Data

Plot 6-5: Conducted Spurious Emissions; Channel 9 – 4962.5 MHz; 9 kHz – 50 GHz

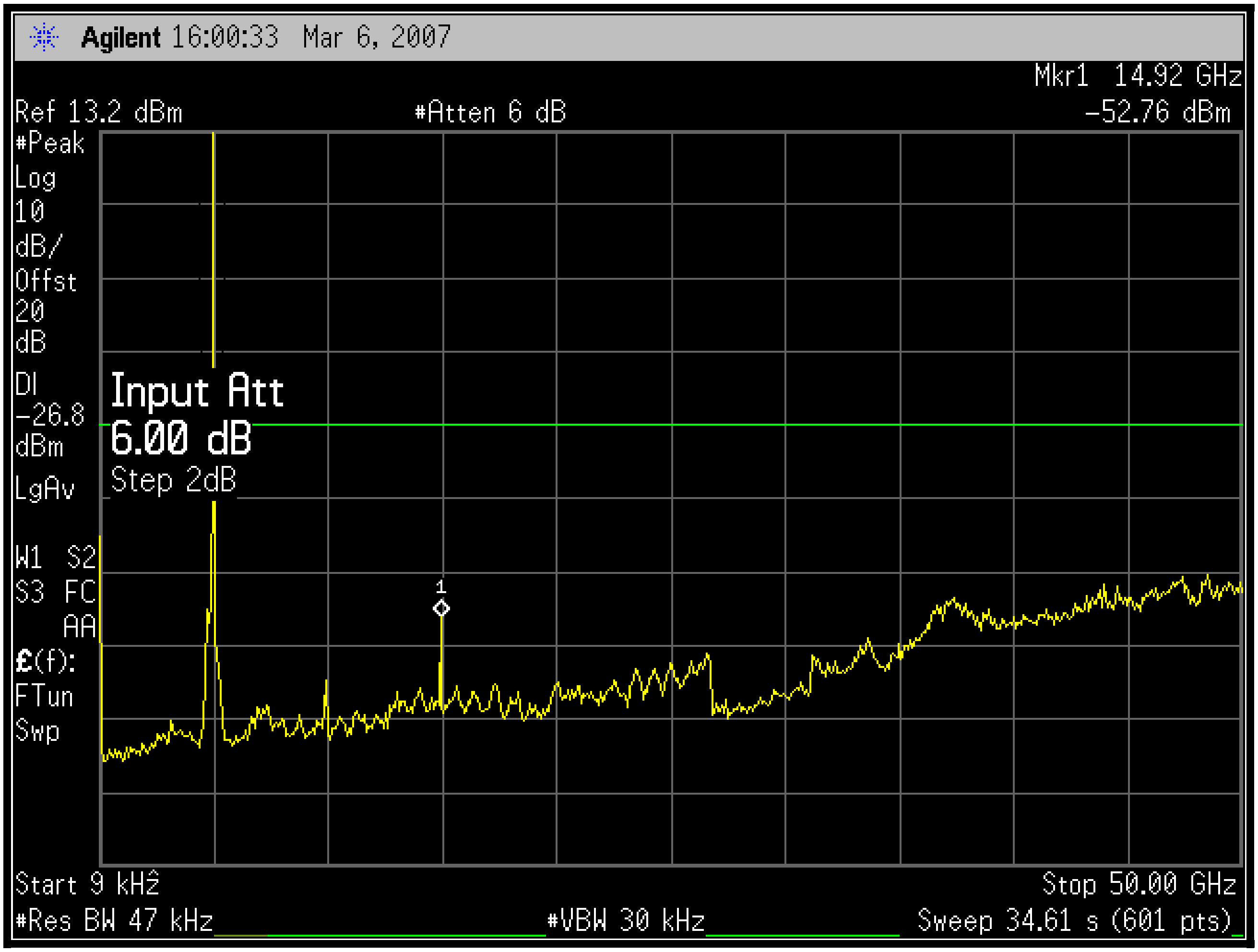


Table 6-1: Test Equipment for Testing Occupied Bandwidth/Conducted Spurious Emissions

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901413	Agilent Technologies	E4448	Spectrum Analyzer	US44020346	12/14/07
016793	MCL Weinschel	MCL BW-S20W5	Attenuator, 20 dB, DC-18 GHz, 5 W	N/A	12/9/08

Test Personnel:

Daniel Baltzell	[signature]	March 6, 2007
Test Engineer	Signature	Date Of Tests

7 FCC Rules and Regulations Part 90 §90.210(l) and Part 2 §2.1053(a): Field Strength of Spurious Radiation; RSS-111 Section 3.3: Transmitter Unwanted Emissions

§90.210(l): Emission Mask M: For high power transmitters (20 dBm or greater) 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

7.1 Test Procedure

TIA-603-C-2004, section 2.2.12.

The EUT was set to center channel and output power was set to maximum.

The EUT was placed on a non conducting table 80 cm above the ground plane. The antenna-to-EUT distance is 3 m. The EUT is rotated through 360 degrees to maximize emissions. The antenna is scanned in both vertical and horizontal polarizations. The spurious emissions levels were measured and the device under test was replaced by a substitution antenna connected to a signal generator. This signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator, and the gain of the antenna was further corrected to a half-wave dipole.

The EUT was scanned from 30 MHz to the 10^{th} harmonic of the fundamental. The spectrum analyzer resolution bandwidth was set to 1 MHz, and the video bandwidth was set to 1 MHz.

The spurious radiated emission limit is calculated as follows:

Average output power: 22.9 dBm

Spurious limit = 22.9 dBm – 50 db = -27.1 dBm

7.2 Test Data

7.2.1 CFR 47 Part 90.210 Requirements

The worst-case emissions test data are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

Table 7-1: Field Strength of Spurious Radiation: Channel 9 – 4962.5 MHz (High Power)

Limit = 50 dBc or -27.1 dBm
Conducted Power (Avg) = 22.9 dBm = 0.195 W

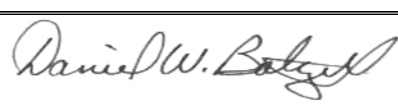
Frequency (MHz)	Polarization (H/V)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss* (dB)	Antenna Gain (dBd)	EIRP (dBm)	Limit	Margin (dB)
9925.0	H	36.4	-45.1	13.9	12.0	-47.0	-27.1	-19.9

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna.

Table 7-2: Test Equipment for Testing Field Strength of Spurious Radiation

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
901053	Schaffner-Chase	CBL6112	Antenna (25 MHz – 2 GHz)	2648	11/1/07
901413	Agilent Technologies	E4448	Spectrum Analyzer	US44020346	12/14/07
016793	MCL Weinschel	MCL BW-S20W5	Attenuator, 20 dB, DC-18 GHz, 5 W	N/A	12/9/08
900928	Hewlett Packard	HP 83752A	Synthesized Sweeper (.01 – 20 GHz)	3610A00866	11/30/07
900321	EMCO	3161-03	Horn Antennas (4 – 8 GHz)	9508-1020	5/20/07
900323	EMCO	3160-07	Horn Antennas (8.2 – 12 GHz)	9605-1054	7/31/09
900356	EMCO	3160-08	Horn Antennas (12.4 – 18 GHz)	9607-1044	5/20/07
900392	Hewlett Packard	1197OK	Harmonic mixer (18 – 26.5 GHz)	3525A00159	11/27/07
900126	Hewlett Packard	11970A	Horn Antennas (26.5 – 40 GHz)	2332A01199	10/29/09
901262	ETS	3115	Double ridge horn (1 – 26 GHz)	6748	4/19/08
901426	Insulated Wire Inc.	KPS-1503-3600-KPS	RF cable, 30'	NA	12/5/07
901425	Insulated Wire, Inc.	KPS-1503-2400-KPS	RF cable, 20'	NA	12/5/07
901424	Insulated Wire Inc.	KPS-1503-360-KPS	RF cable 36"	NA	12/5/07

Test Personnel:

Daniel Baltzell		March 8, 2007
Test Engineer	Signature	Date Of Tests

8 FCC Rules and Regulation Part 90 §90.213(a) and Part 2 §2.1055: Frequency Stability; RSS-111 Section 4.2: Transmitter Frequency Stability

§90.213(a): Unless noted elsewhere, transmitters used in the services governed by this part must have minimum frequency stability as specified in table (see 90.213 for table).

Above 2450 MHz, the frequency stability is to be specified in the station authorization.

For equipment authorization purposes, this is a reporting requirement only.

8.1 Test Procedure

TIA-603-C-2004, section 2.3.1 and 2.3.2.

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +60°C.

The temperature was initially set to -30°C and a 2-hour period was observed for stabilization of the EUT. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10°C through the range. A ½ hour period was observed to stabilize the EUT at each measurement step, and the frequency stability was measured within one minute after application of primary power to the transmitter. Additionally, the power supply voltage of the EUT was varied +/-15% nominal and range of input voltages.

The worst-case test data are shown below in Table 8-1 and Table 8-2.

8.2 Frequency Stability Test Data

8.2.1 Frequency Stability/Temperature Variation

Table 8-1: Frequency Stability/Temperature Variation – Channel 9 - 4962.5 MHz

Temperature (°C)	Channel Frequency (MHz)	Measured Frequency (MHz)	Delta Freq (MHz)	ppm
-30	4962.5	4962.439549	-0.0605	12.18
-20	4962.5	4962.454364	-0.0456	9.20
-10	4962.5	4962.448132	-0.0519	10.45
0	4962.5	4962.507249	0.0072	-1.46
10	4962.5	4962.498369	-0.0016	0.33
20	4962.5	4962.500000	0.0000	0.00
30	4962.5	4962.488050	-0.0120	2.41
40	4962.5	4962.482346	-0.0177	3.56
50	4962.5	4962.478135	-0.0219	4.41
60	4962.5	4962.470469	-0.0295	5.95

8.2.2 Frequency Stability/Voltage Variation

Table 8-2: Frequency Stability/Voltage Variation – Channel 9 - 4962.5 MHz

Voltage (VAC)	Channel Frequency (MHz)	Measured Frequency (MHz)	Delta Freq (MHz)	ppm
9.35	4962.5	4962.496964	-0.0030	0.61
20.40	4962.5	4962.497597	-0.0024	0.48
24.00	4962.5	4962.499953	0.0000	0.01
27.60	4962.5	4962.495438	-0.0046	0.92
34.50	4962.5	4962.495637	-0.0044	0.88

Table 8-3: Test Equipment for Testing Frequency Stability

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due
900946	Tenney Engineering, Inc.	TH65	Temperature Chamber with Humidity	11380	12/14/07
901413	Agilent Technologies	E4448	Spectrum Analyzer	US44020346	12/14/07
016793	MCL Weinschel	MCL BW-S20W5	Attenuator, 20 dB, DC-18 GHz, 5 W	N/A	12/9/08
901354	Meterman	37XR	Digital Multimeter	N/A	10/19/07
901425	Insulated Wire, Inc.	KPS-1503-2400-KPS	RF cable, 20'	NA	12/5/07

Test Personnel:

Daniel Baltzell	Daniel W. Baltzell	March 7, 2007
Test Engineer	Signature	Date Of Tests

9 Conclusion

The data in this measurement report shows that the **M/A-COM, Inc**. Models **VIDA Broadband High Power Client, FCC ID: BV8VIDA-BB-CL**, **IC: 3670A-VIDABBCL,** complies with all the applicable requirements of FCC Parts 90, 15 and 2 and Industry Canada RSS-111.