



FCC CFR47 PART 27 SUBPART M

CERTIFICATION TEST REPORT

FOR

WiMAX + WiFi Router

MODEL NUMBER: W801

FCC ID: N7N-MHS801

REPORT NUMBER: 09U12839-3, Revision B

ISSUE DATE: NOVEMBER 24, 2009

Prepared for
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NVLAP[®]

NVLAP LAB CODE 200065-0

Revision History

| Rev. | Issue Date | Revisions | Revised By |
|------|------------|--|------------|
| --- | 10/19/09 | Initial Issue | T. Chan |
| A | 11/24/09 | Addressed TCB Issue On Frequency Stability | T. Chan |
| B | 11/24/09 | Revised model number | A. Zaffar |

TABLE OF CONTENTS

| | |
|---|-----------|
| 1. ATTESTATION OF TEST RESULTS..... | 5 |
| 2. TEST METHODOLOGY | 6 |
| 3. FACILITIES AND ACCREDITATION..... | 6 |
| 4. CALIBRATION AND UNCERTAINTY | 6 |
| 4.1. <i>MEASURING INSTRUMENT CALIBRATION</i> | 6 |
| 4.2. <i>SAMPLE CALCULATION.....</i> | 6 |
| 4.3. <i>MEASUREMENT UNCERTAINTY.....</i> | 6 |
| 5. EQUIPMENT UNDER TEST | 7 |
| 5.1. <i>DESCRIPTION OF EUT.....</i> | 7 |
| 5.2. <i>MAXIMUM OUTPUT POWER.....</i> | 7 |
| 5.3. <i>DESCRIPTION OF AVAILABLE ANTENNAS.....</i> | 7 |
| 5.4. <i>SOFTWARE AND FIRMWARE.....</i> | 7 |
| 5.5. <i>WORST-CASE CONFIGURATION AND MODE</i> | 7 |
| 5.6. <i>DESCRIPTION OF TEST SETUP.....</i> | 8 |
| 6. TEST AND MEASUREMENT EQUIPMENT | 10 |
| 7. LIMITS AND RESULTS | 11 |
| 7.1. <i>ANTENNA PORT TEST RESULTS</i> | 11 |
| 7.1.1. <i>26 dB and 99% BANDWIDTH</i> | 11 |
| 7.1.2. <i>RF POWER OUTPUT AT THE ANTENNA TERMINALS.....</i> | 20 |
| 7.1.3. <i>LIMITS OF CHANNEL EDGE.....</i> | 29 |
| 7.1.4. <i>CONDUCTED SPURIOUS EMISSIONS.....</i> | 38 |
| 7.1.5. <i>FREQUENCY STABILITY MEASUREMENT</i> | 47 |
| 8. RADIATED TEST RESULTS | 48 |
| 8.1.1. <i>RADIATED OUTPUT POWER (EIRP)</i> | 48 |
| 8.1.2. <i>FIELD STRENGTH OF SPURIOUS RADIATION</i> | 53 |
| 9. AC POWER LINE CONDUCTED EMISSIONS | 56 |
| 10. MAXIMUM PERMISSIBLE EXPOSURE | 59 |
| 10.1. <i>Limits.....</i> | 59 |
| 10.1.1. <i>FCC RULES</i> | 59 |
| 10.1.2. <i>IC RULES</i> | 60 |
| 10.1.3. <i>LIMITS APPLICABLE TO THE EUT.....</i> | 60 |
| 10.2. <i>EQUATIONS</i> | 61 |
| 10.3. <i>RESULTS.....</i> | 62 |
| 10.3.1. <i>SINGLE TRANSMITTER (WiMAX OR WLAN).....</i> | 62 |
| 10.3.2. <i>WiMAX AND CDMA 800/1900 TRANSMITTERS</i> | 62 |

| | |
|---|-----------|
| 10.3.3. CO-LOCATED TRANSMITTERS (WiMAX AND WLAN)..... | 63 |
| 10.3.4. CO-LOCATED TRANSMITTERS (WLAN and CDMA 800)..... | 63 |
| 10.3.5. CO-LOCATED TRANSMITTERS (WLAN and CDMA 1900)..... | 63 |
| 11. SETUP PHOTOS | 64 |

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SIERRA WIRELESS INC.
2290 COSMOS COURT, CARLSBAD
CALIFORNIA 92011, USA

EUT DESCRIPTION: WiMAX + WiFi Router

MODEL: W801

SERIAL NUMBER: H9H239901472014 AND H9H239901122014

DATE TESTED: OCTOBER 8 – 16, 2009

| APPLICABLE STANDARDS | |
|-----------------------|--------------|
| STANDARD | TEST RESULTS |
| FCC PART 27 SUBPART M | PASS |

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

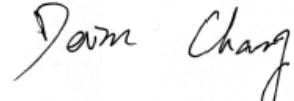
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For CCS By:



THU CHAN
EMC MANAGER
COMPLIANCE CERTIFICATION SERVICES

Tested By:



DEVIN CHANG
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with TIA/EIA 603C (2004), FCC CFR 47 Part 2, FCC CFR 47 Part 27M.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

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. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

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

| PARAMETER | UNCERTAINTY |
|---------------------------------------|-------------|
| Conducted Disturbance, 0.15 to 30 MHz | 3.52 dB |
| Radiated Disturbance, 30 to 1000 MHz | 4.94 dB |

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a WiMAX + WiFi Router.

The WiMAX radio module is manufactured by Sierra Wireless with the option to install a WAN radio module, FCC ID: N7N-MC5728, inside the EUT.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum EIRP as follows:

| Mode | Channel | Frequency (MHz) | EIRP (dBm) | EIRP (mW) |
|-------------|---------|-----------------|------------|-----------|
| 5MHz QPSK | Low | 2498.5 | 23.40 | 218.78 |
| 5MHz 16QAM | Low | 2498.5 | 22.80 | 190.55 |
| 10MHz QPSK | Low | 2501 | 22.70 | 186.21 |
| 10MHz 16QAM | Low | 2501 | 22.70 | 186.21 |

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain of -0.5 dBi.

5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was Beceem Diagnostic Control Panel version 3.3.0.

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

| PERIPHERAL SUPPORT EQUIPMENT LIST | | | | |
|-----------------------------------|--------------|------------|--------------------|--------|
| Description | Manufacturer | Model | Serial Number | FCC ID |
| Laptop PC | DELL | PP18L | 30216847141 | DOC |
| AC Adapter | DELL | HS65NS1-00 | 662-47890-86B-C06B | DOC |

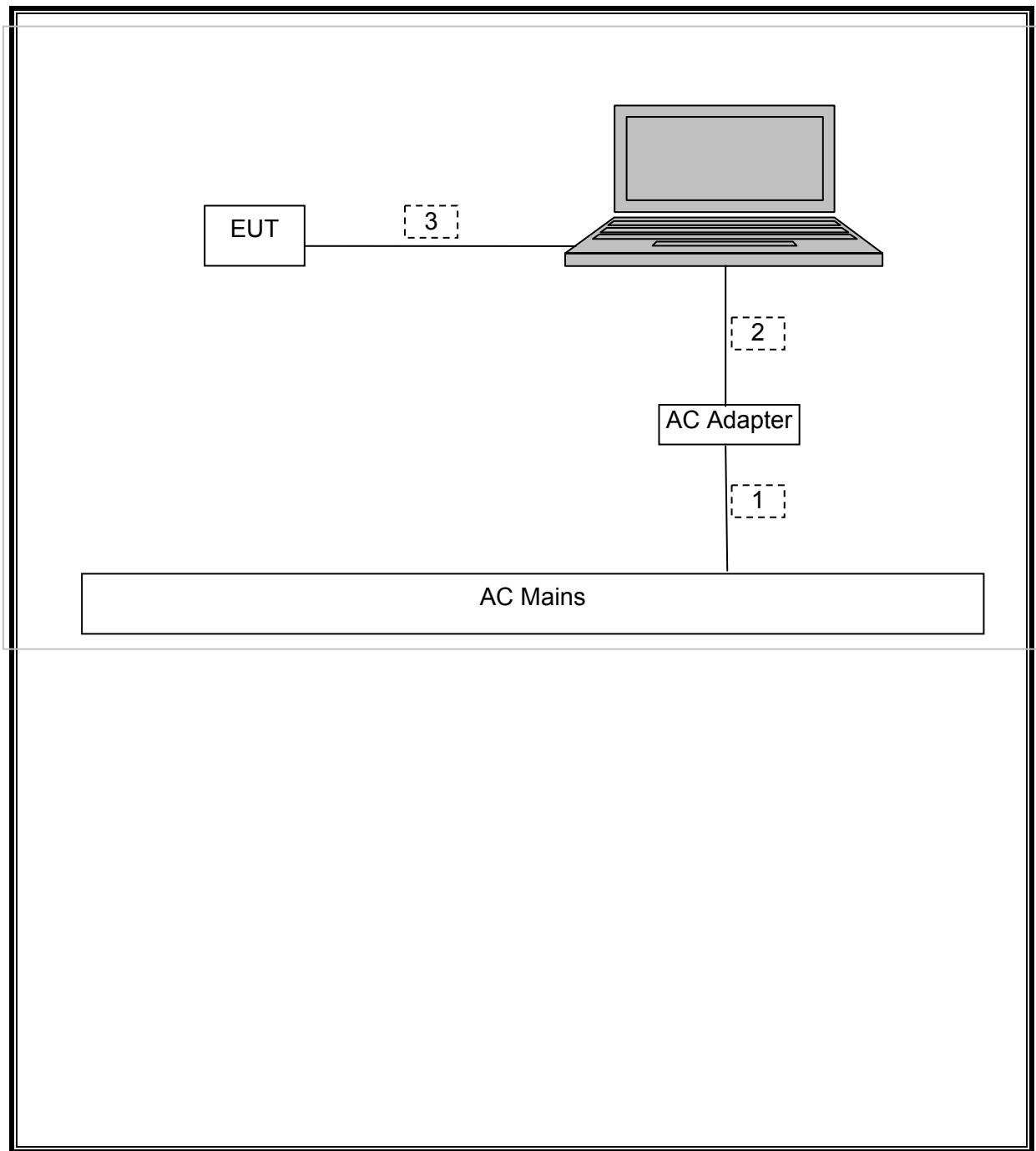
I/O CABLES

| I/O CABLE LIST | | | | | | |
|----------------|------|----------------------|----------------|------------|--------------|---------|
| Cable No. | Port | # of Identical Ports | Connector Type | Cable Type | Cable Length | Remarks |
| 1 | AC | 1 | AC | Unshielded | 1.8 m | N/A |
| 2 | DC | 1 | DC | Unshielded | 1.8 m | N/A |
| 3 | USB | 1 | USB | Unshielded | 1.2 m | N/A |

TEST SETUP

The EUT is connected to the host laptop computer via USB 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 | Asset | Cal Due |
| Preamplifier, 26.5 GHz | Agilent / HP | 8449B | C00749 | 02/04/10 |
| Antenna, Bilog, 2 GHz | Sunol Sciences | JB1 | C01171 | 01/14/10 |
| Preamplifier, 1300 MHz | Agilent / HP | 8447D | C00580 | 12/16/09 |
| Spectrum Analyzer, 44 GHz | Agilent / HP | E4446A | C01012 | 04/20/10 |
| Antenna, Horn, 18 GHz | EMCO | 3115 | C00872 | 04/22/10 |
| EMI Test Receiver, 30 MHz | R & S | ESHS 20 | N02396 | 05/06/11 |
| LISN, 30 MHz | FCC | LISN-50/250-25-2 | N02625 | 11/06/10 |
| LISN, 10 kHz ~ 30 MHz | Solar | 8012-50-R-24-BNC | N02481 | 11/06/10 |
| Power Meter | Agilent / HP | 437B | N02778 | 08/04/10 |
| Power Sensor, 18 GHz | Agilent / HP | 8481A | N02782 | 10/22/09 |
| Highpass Filter, 4.0 GHz | Micro-Tronics | HPM13351 | N02708 | N/A |
| ESG Vector Generator | Agilent | E4438C | MY42080130 | 04/17/10 |

7. LIMITS AND RESULTS

7.1. ANTENNA PORT TEST RESULTS

7.1.1. 26 dB and 99% BANDWIDTH

LIMITS

§2.1049 & §27.53 (m)(6)

TEST PROCEDURE

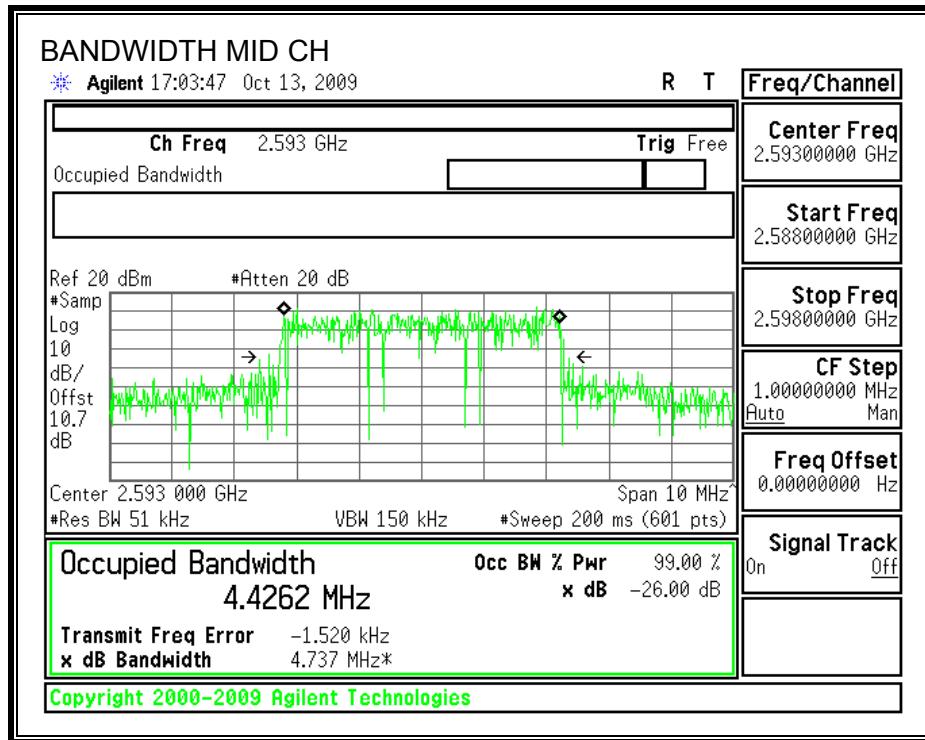
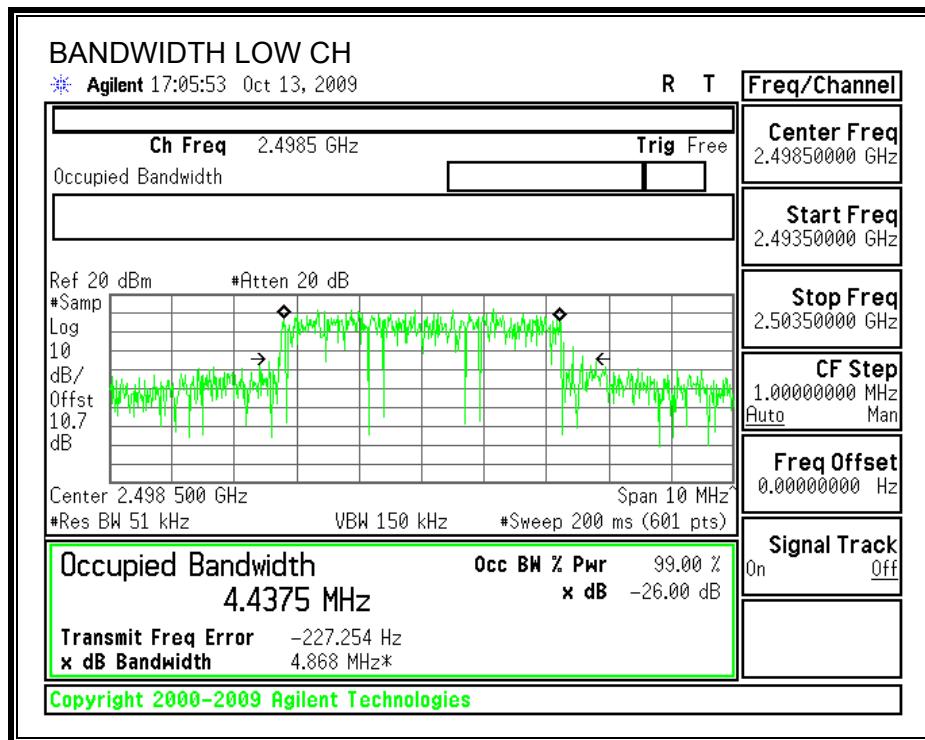
The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

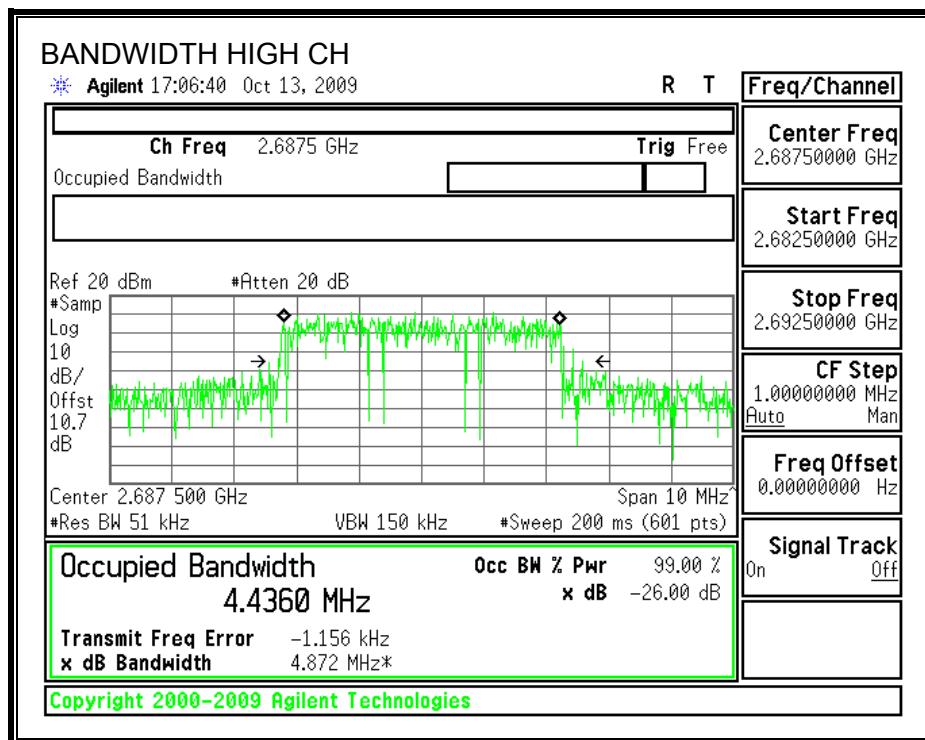
RESULTS

| Mode | Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|-------------|---------|-----------------|-----------------------|---------------------|
| 5MHz QPSK | Low | 2498.5 | 4.868 | 4.4375 |
| | Middle | 2593 | 4.737 | 4.4260 |
| | High | 2687.5 | 4.872 | 4.4360 |
| 5MHz 16QAM | Low | 2498.5 | 4.868 | 4.4375 |
| | Middle | 2593 | 4.737 | 4.4262 |
| | High | 2687.5 | 4.872 | 4.4360 |
| 10MHz QPSK | Low | 2501 | 9.387 | 9.0801 |
| | Middle | 2593 | 9.386 | 9.0751 |
| | High | 2685 | 9.386 | 9.0788 |
| 10MHz 16QAM | Low | 2501 | 9.329 | 9.0250 |
| | Middle | 2593 | 9.392 | 9.0135 |
| | High | 2685 | 9.361 | 9.0406 |

5MHz_QPSK

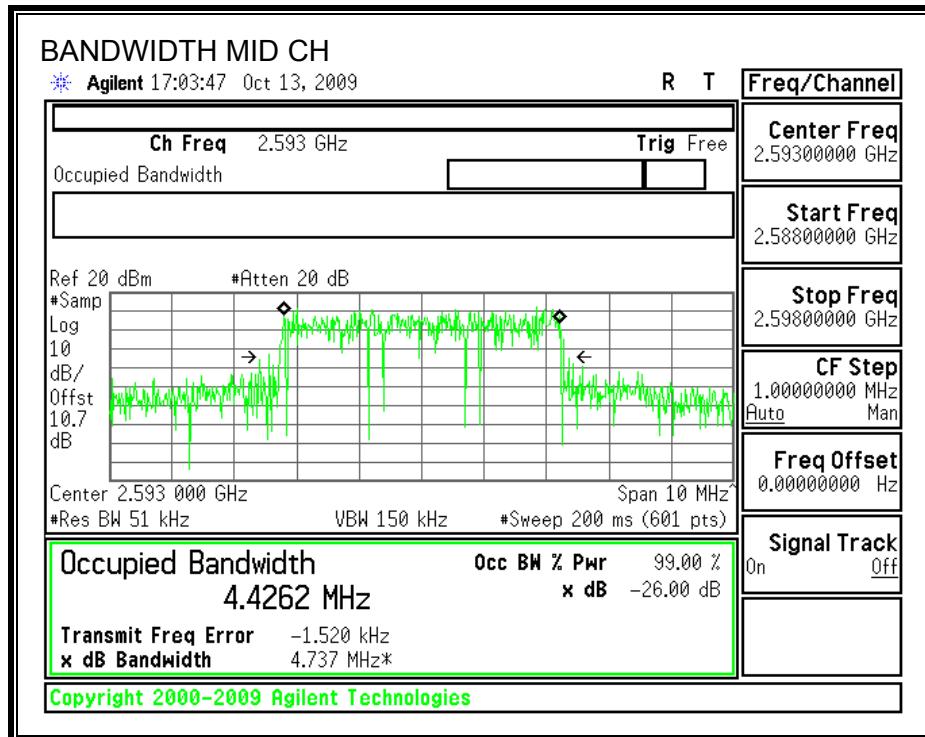
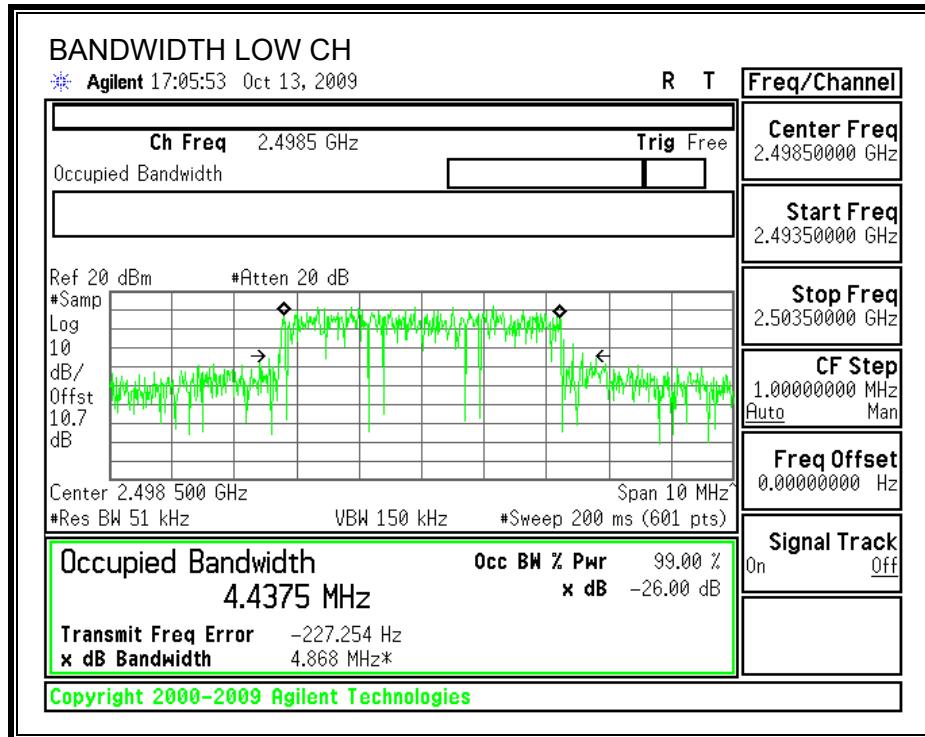
26 dB and 99% BANDWIDTH

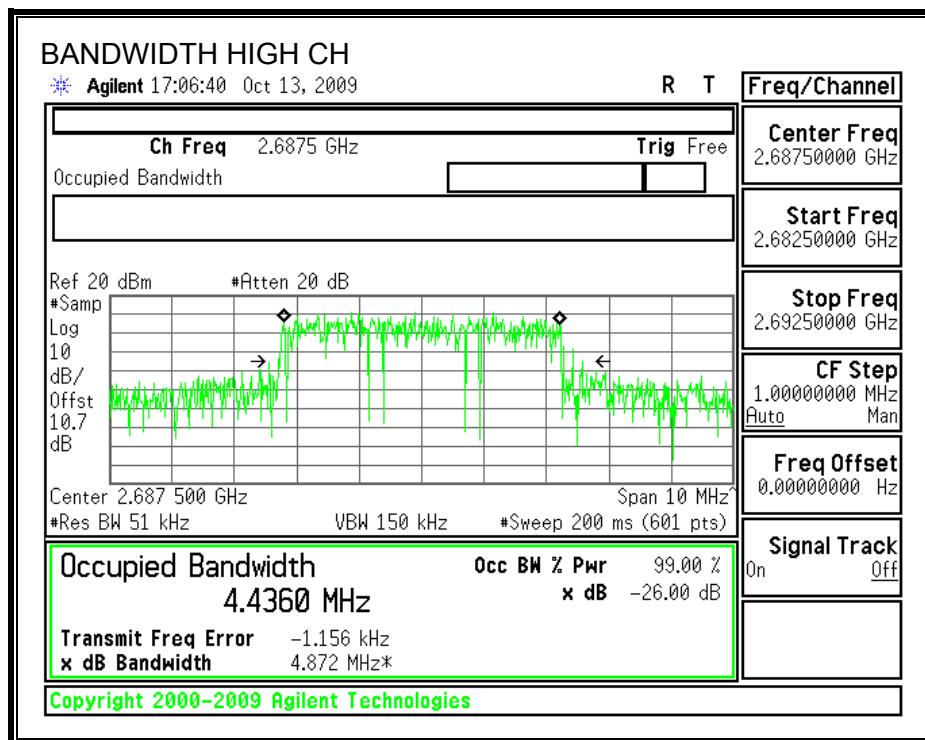




5MHz_16QAM

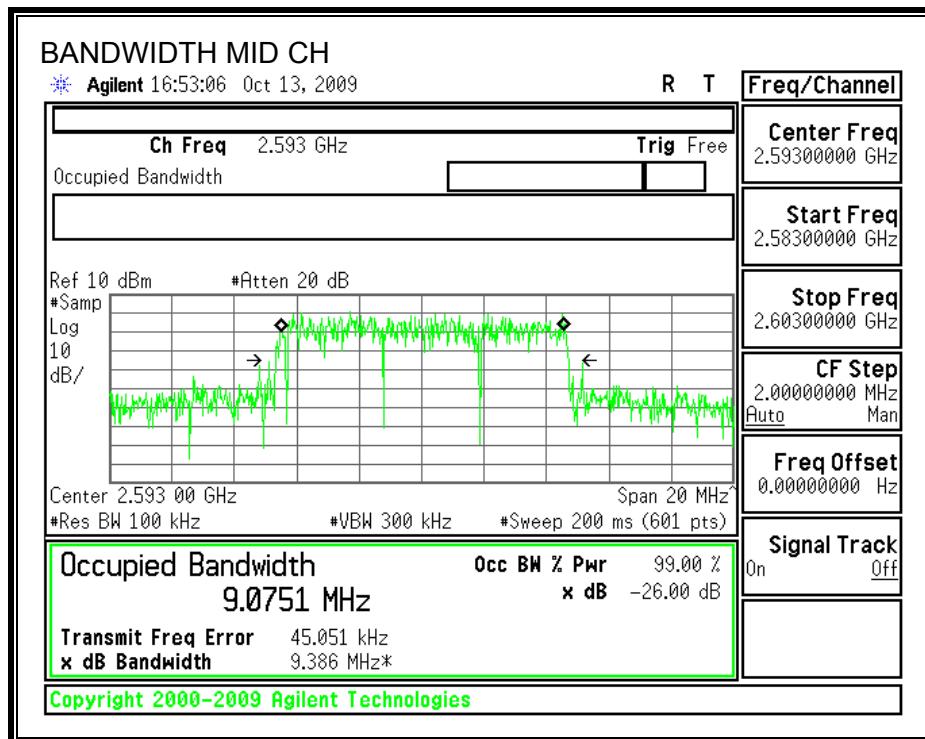
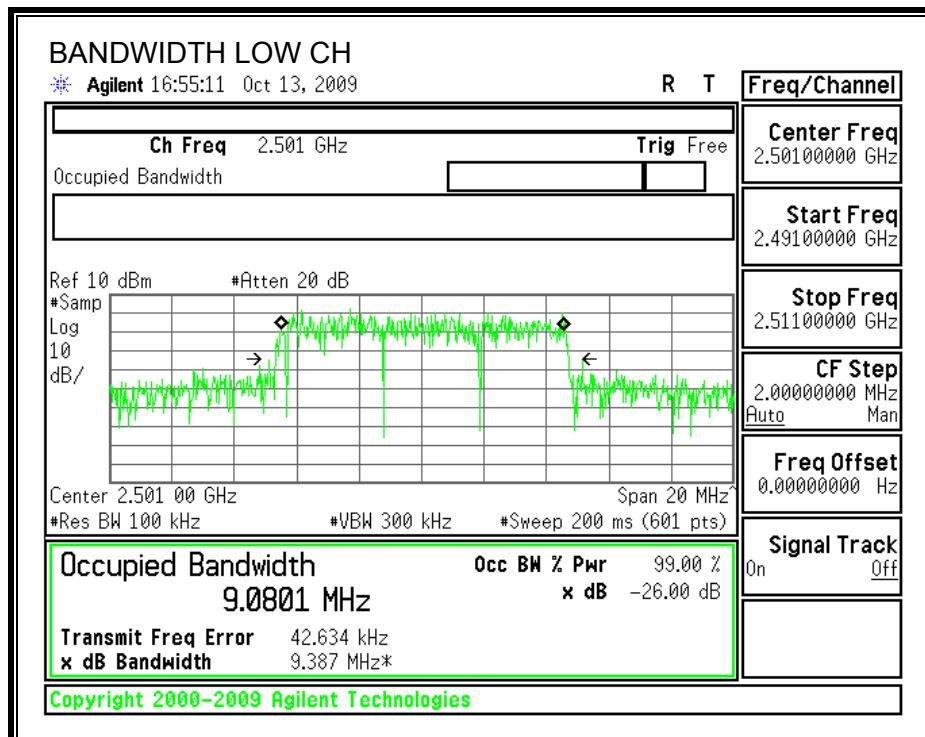
26 dB and 99% BANDWIDTH

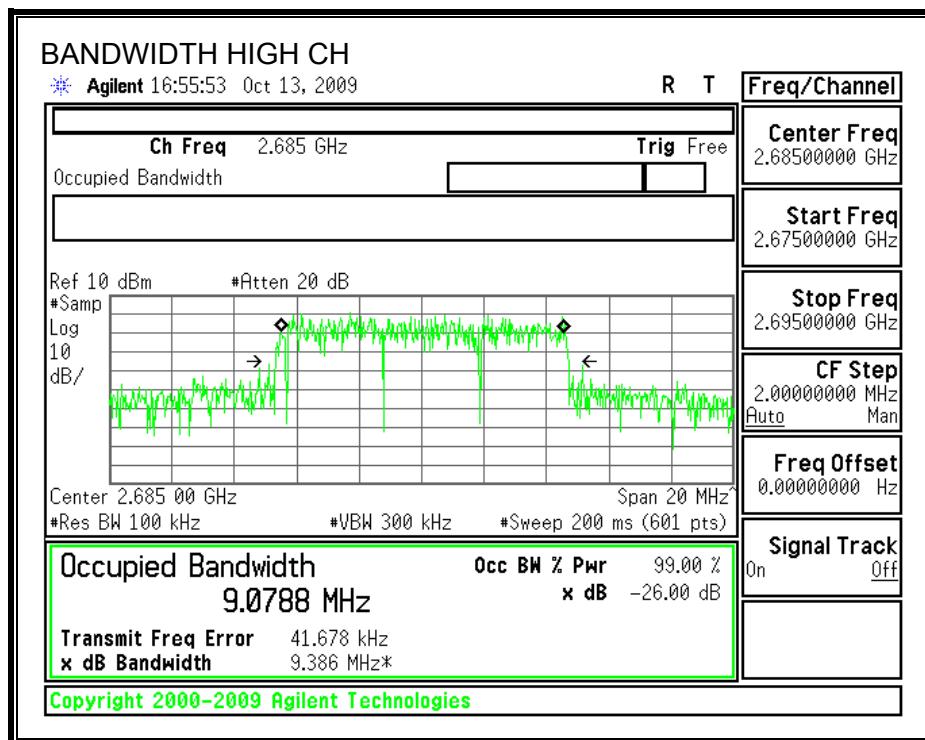




10MHz_QPSK

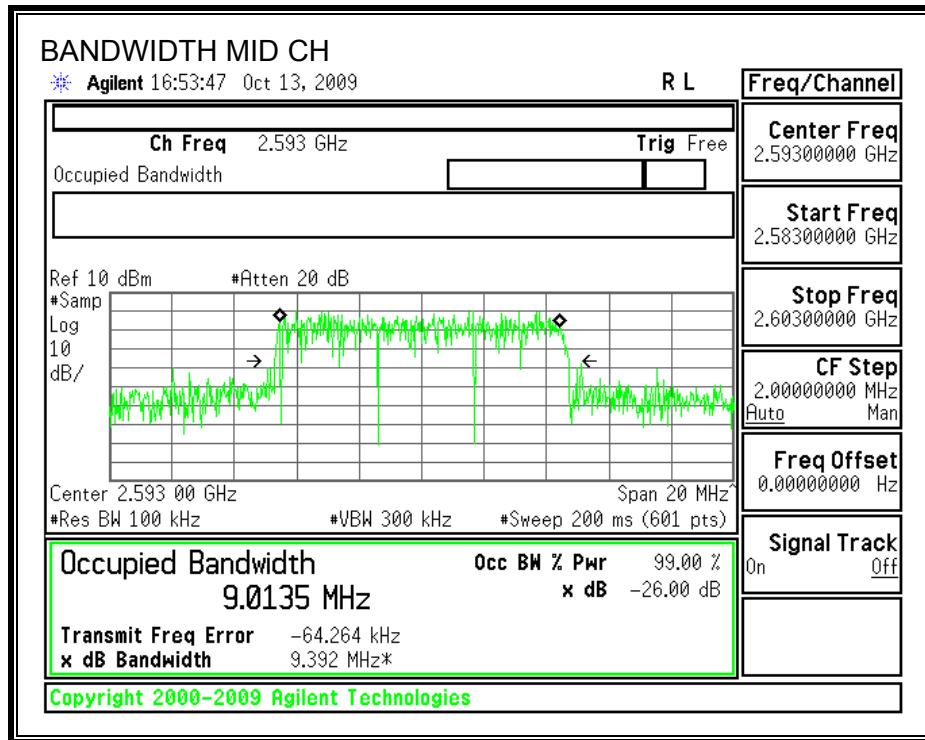
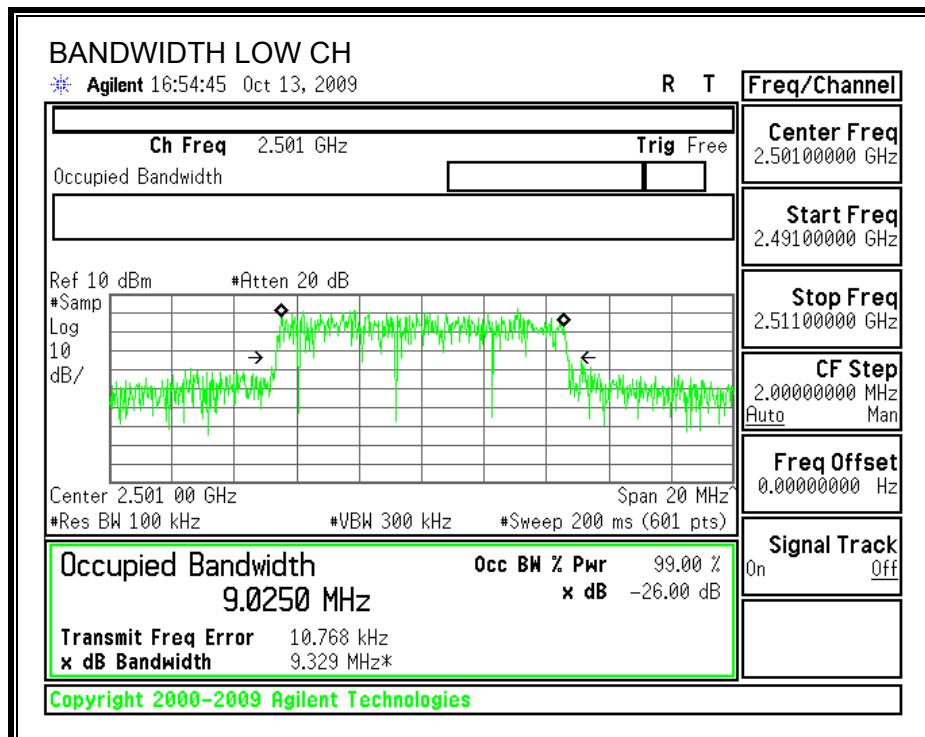
26 dB and 99% BANDWIDTH

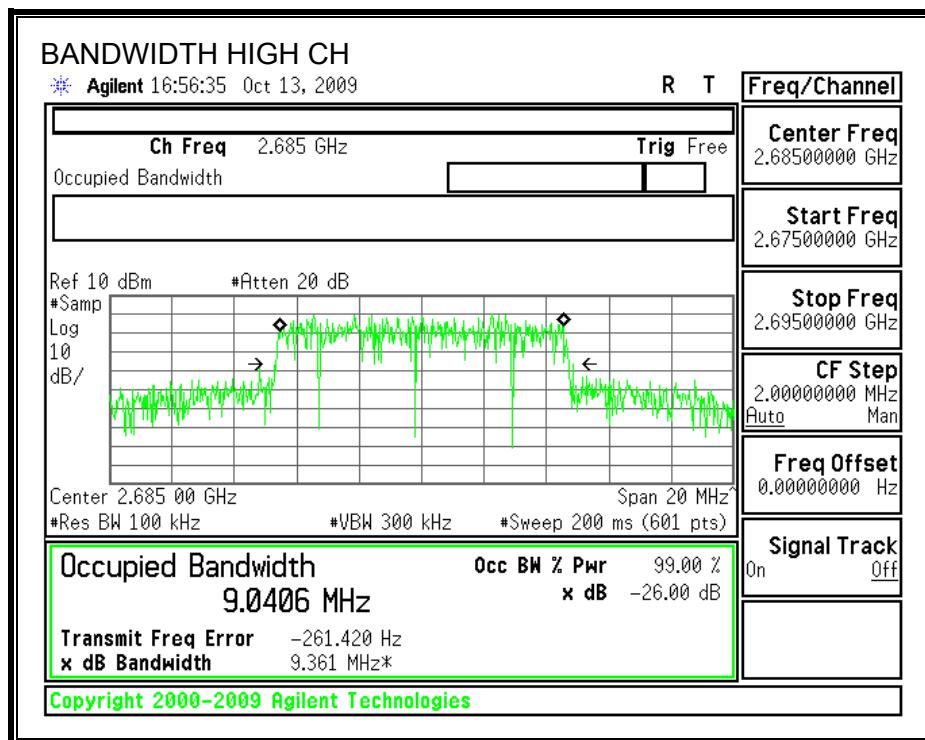




10MHz_16QAM

26 dB and 99% BANDWIDTH





7.1.2. RF POWER OUTPUT AT THE ANTENNA TERMINALS

LIMITS

§2.1046 & §27.50 (h)(2) Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

TEST PROCEDURE

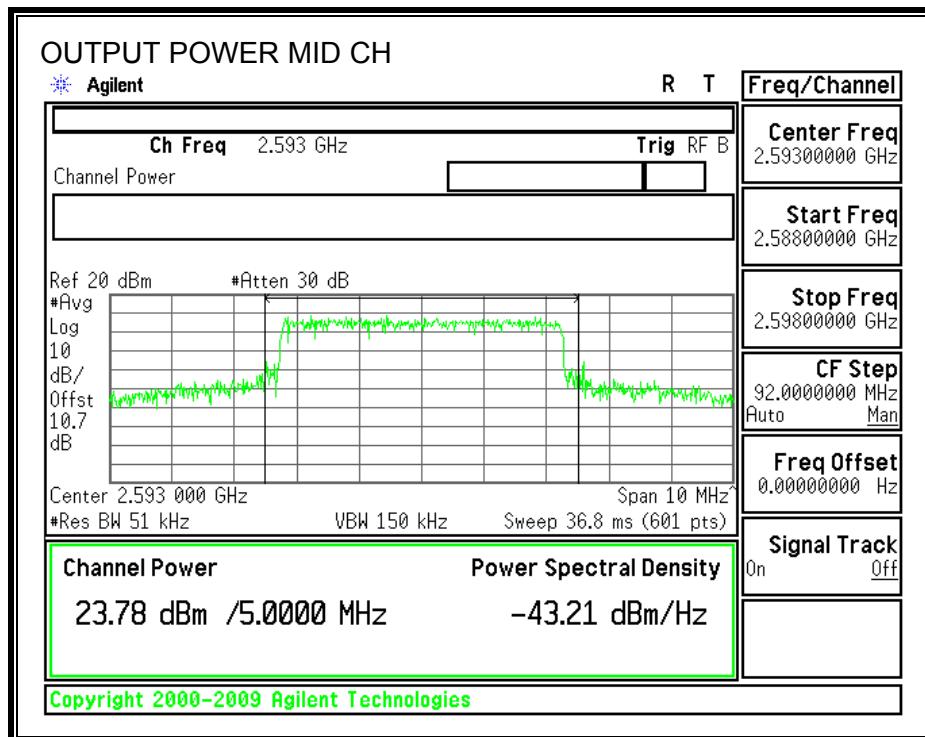
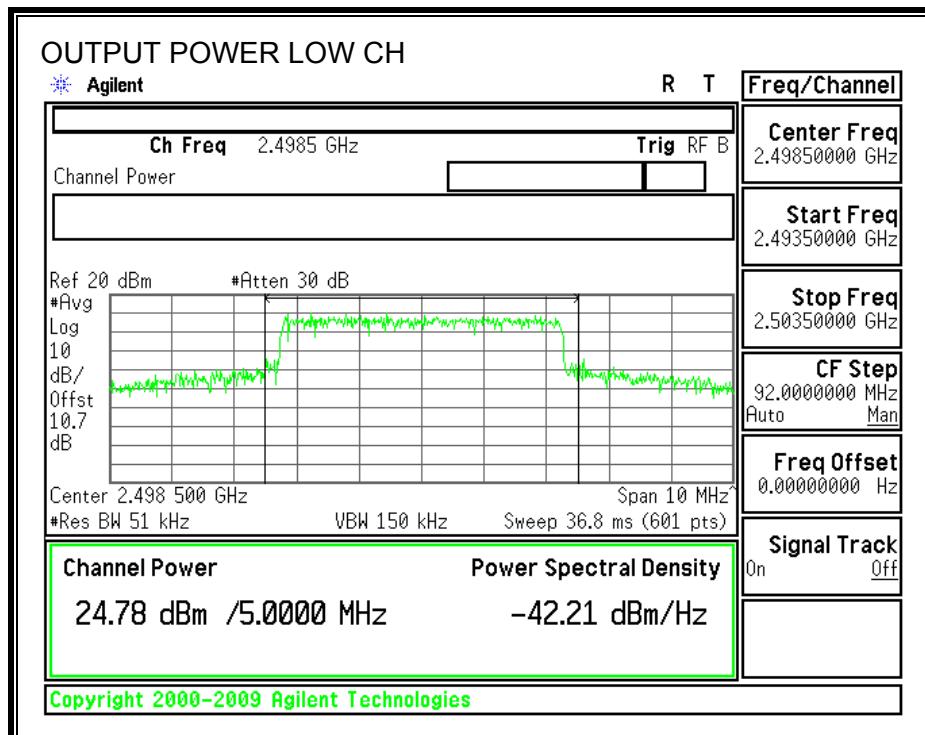
ANSI / TIA / EIA 603 Clause 2.2.17 and §27.50 (i)

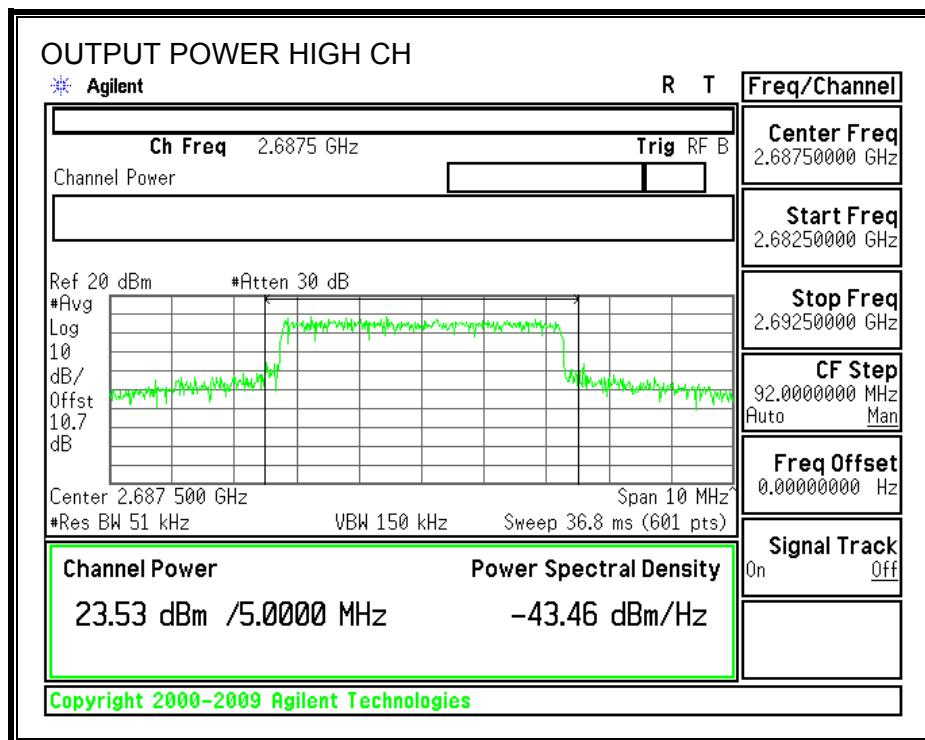
RESULTS

| Mode | Test Vector file name | Channel | Frequency (MHz) | Output power (dBm) | Output power (mW) |
|-------------|-----------------------|---------|-----------------|--------------------|-------------------|
| 5MHz QPSK | T5D29U184Q12S85 | Low | 2498.5 | 24.78 | 300.61 |
| | | Middle | 2593 | 23.78 | 238.78 |
| | | High | 2687.5 | 23.53 | 225.42 |
| 5MHz 16QAM | T5D29U1816Q34S85 | Low | 2498.5 | 24.66 | 292.42 |
| | | Middle | 2593 | 23.61 | 229.61 |
| | | High | 2687.5 | 23.39 | 218.27 |
| 10MHz QPSK | T10D29U184Q12S175 | Low | 2501 | 24.61 | 289.07 |
| | | Middle | 2593 | 23.65 | 231.74 |
| | | High | 2685 | 23.31 | 214.29 |
| 10MHz 16QAM | T10D29U1816Q12S175 | Low | 2501 | 24.62 | 289.73 |
| | | Middle | 2593 | 23.55 | 226.46 |
| | | High | 2685 | 23.32 | 214.78 |

5MHz_QPSK

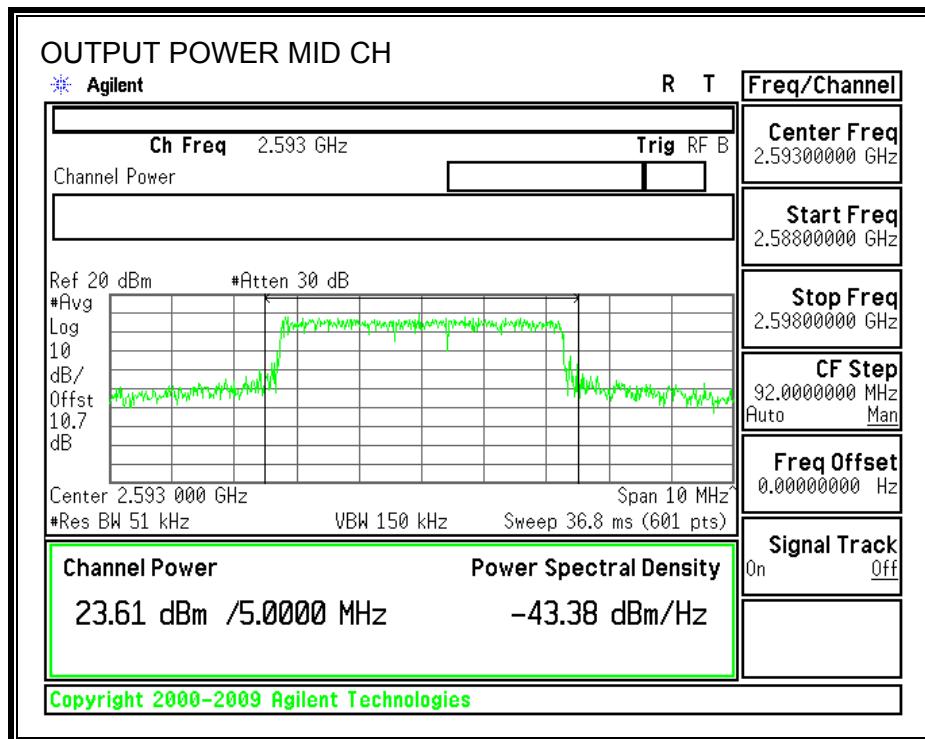
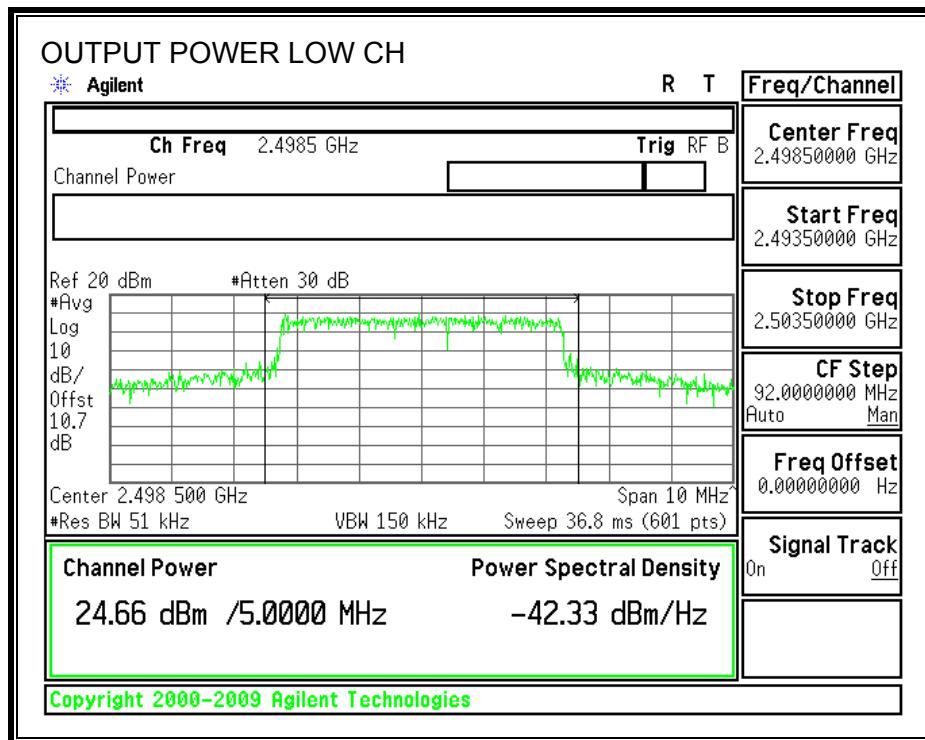
OUTPUT POWER

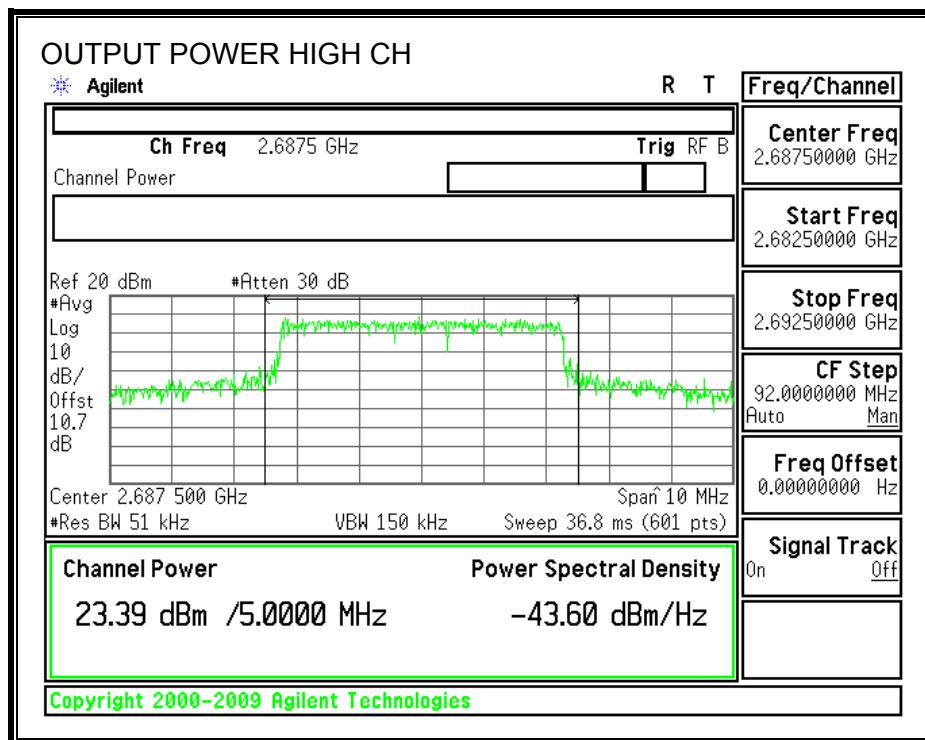




5MHz_16QAM

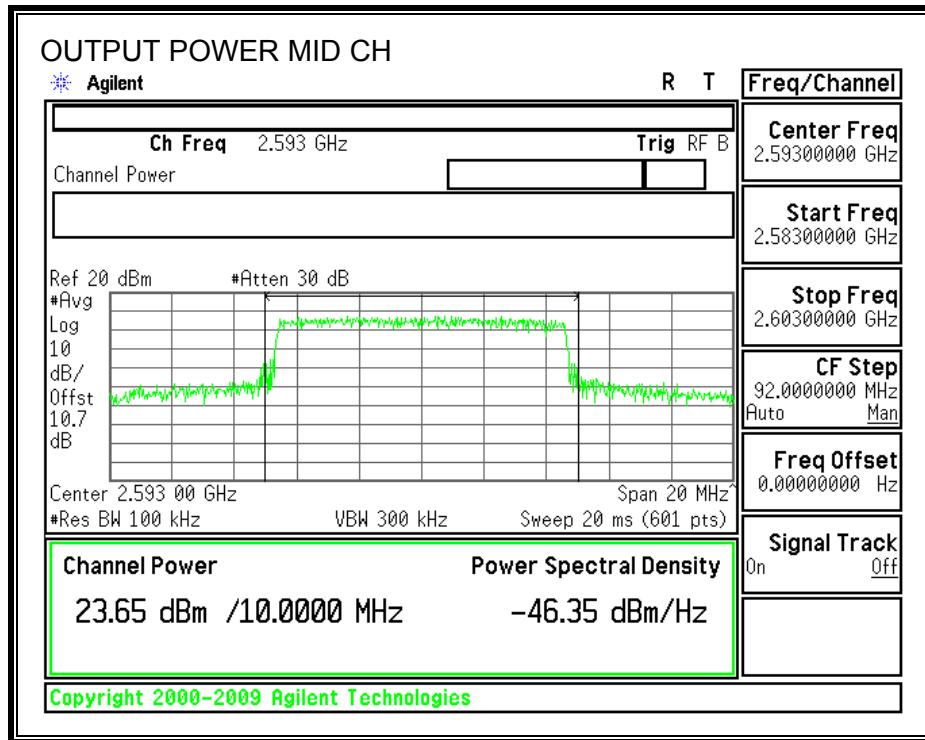
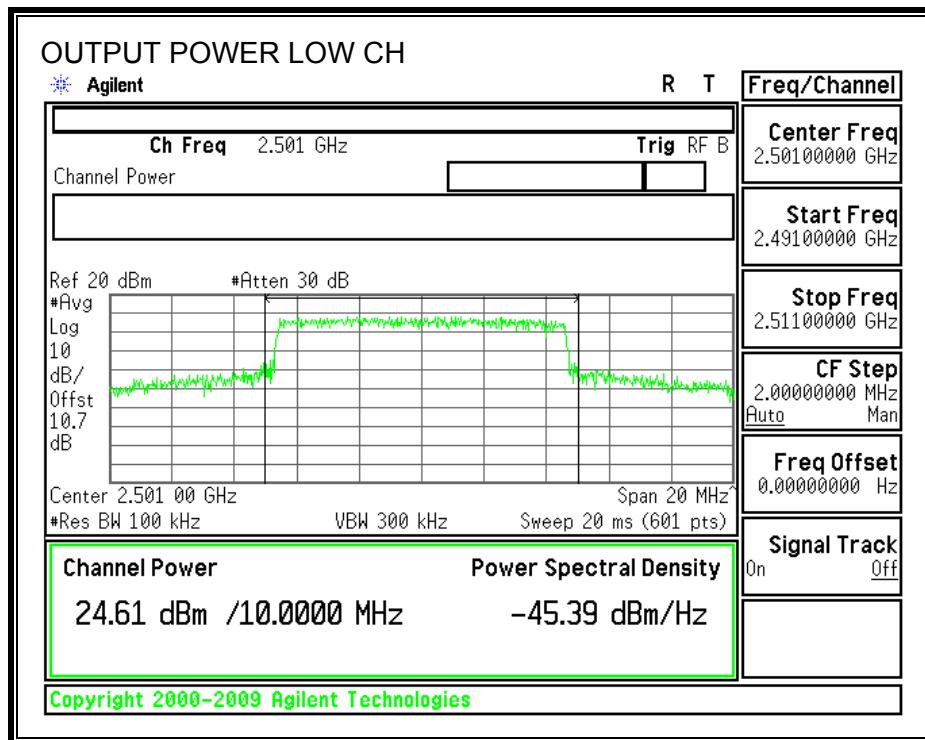
OUTPUT POWER

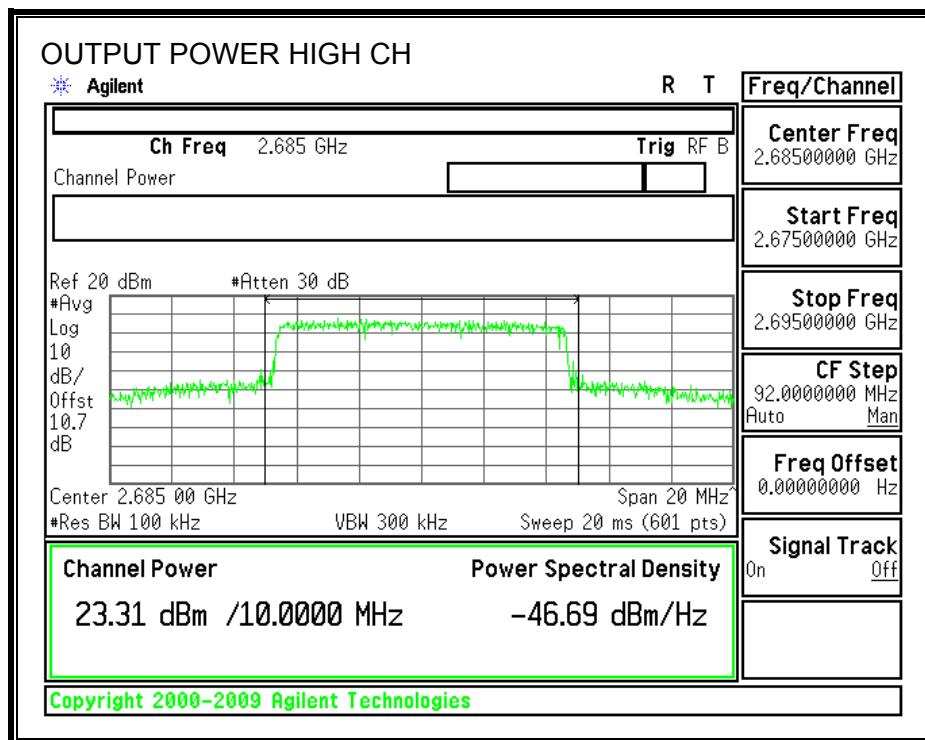




10MHz_QPSK

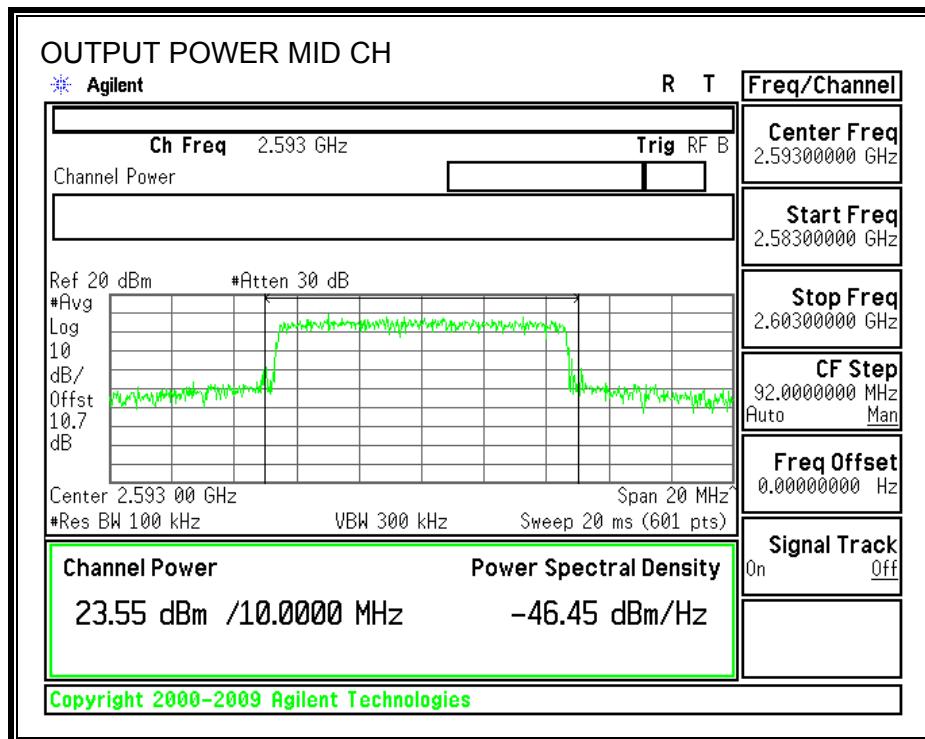
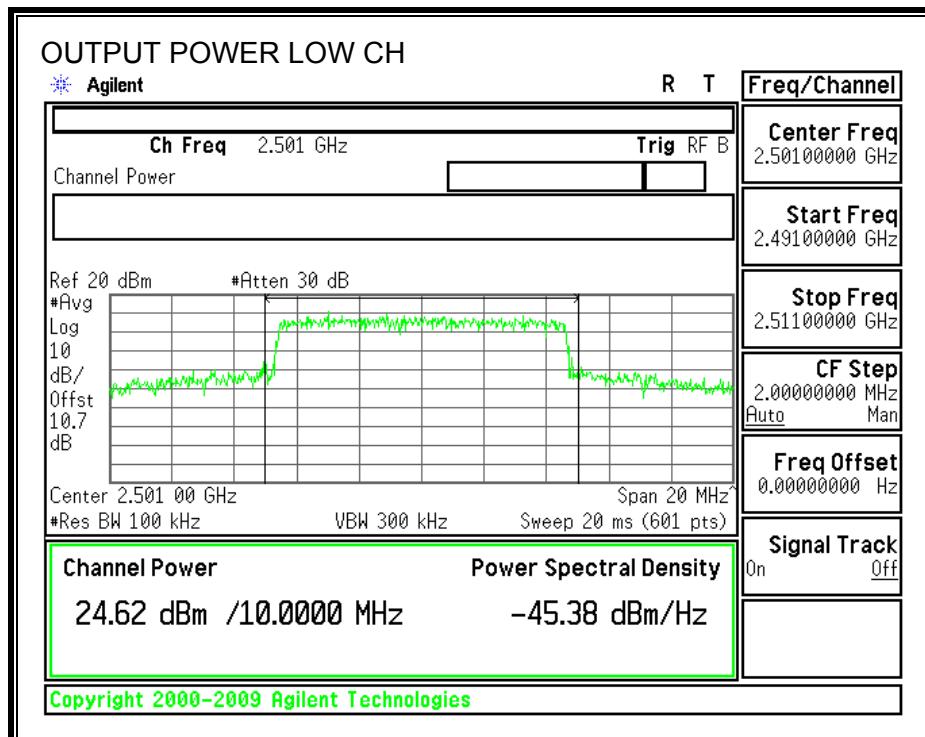
OUTPUT POWER

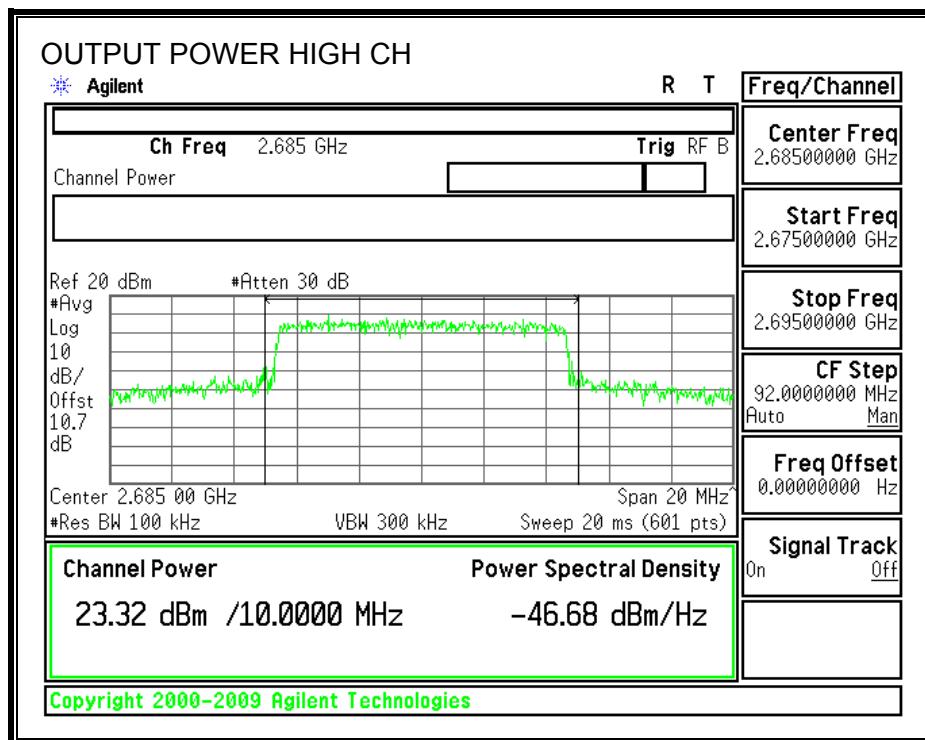




10MHz_16QAM

OUTPUT POWER





7.1.3. LIMITS OF CHANNEL EDGE

LIMITs

§2.1051

§27.53 (m)(4)(6) For mobile digital stations, the attenuation factor shall be not less than $43 + 10 \log (P)$ dB at the channel edge, the limit of emission equal to -13dBm, and $55 + 10 \log (P)$ dB at 5.5 megahertz from the channel edges, the limit of emission equal to -25dBm.

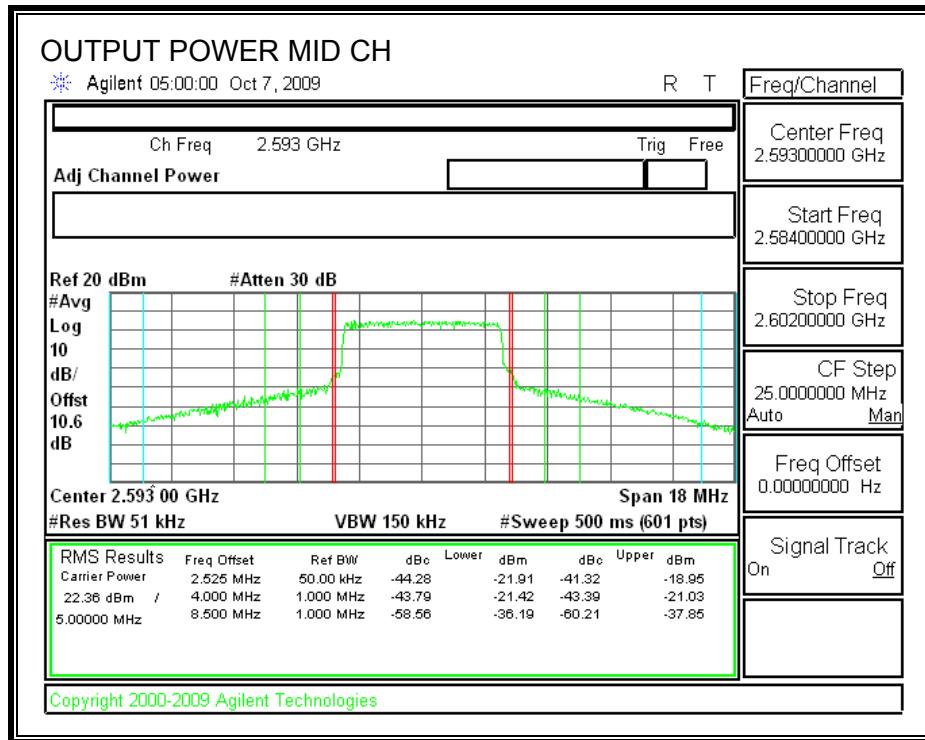
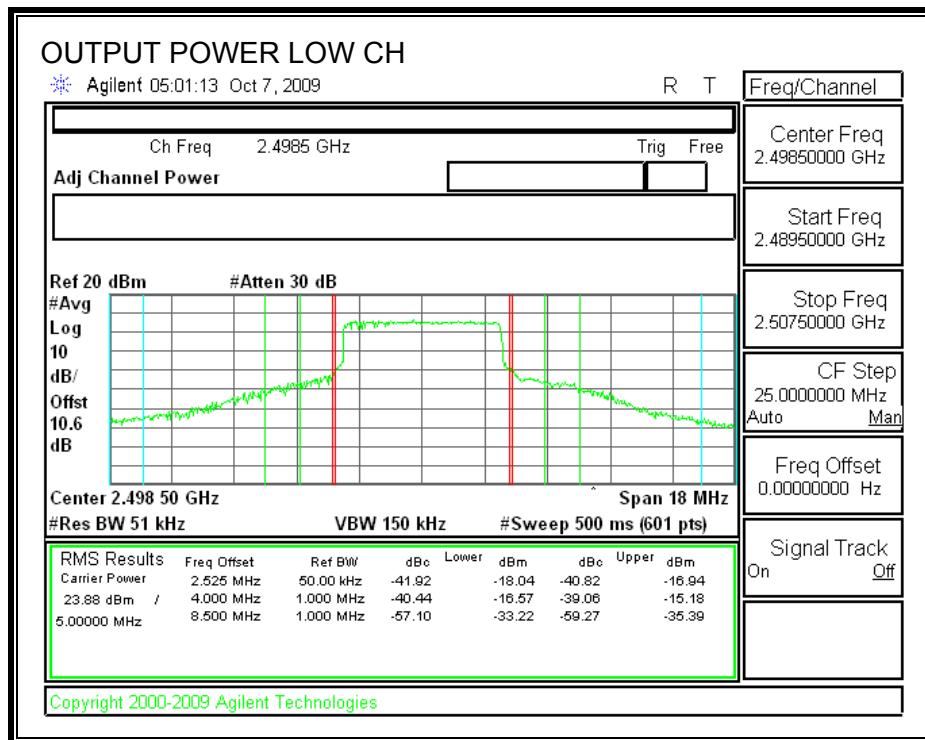
TEST PROCEDURE

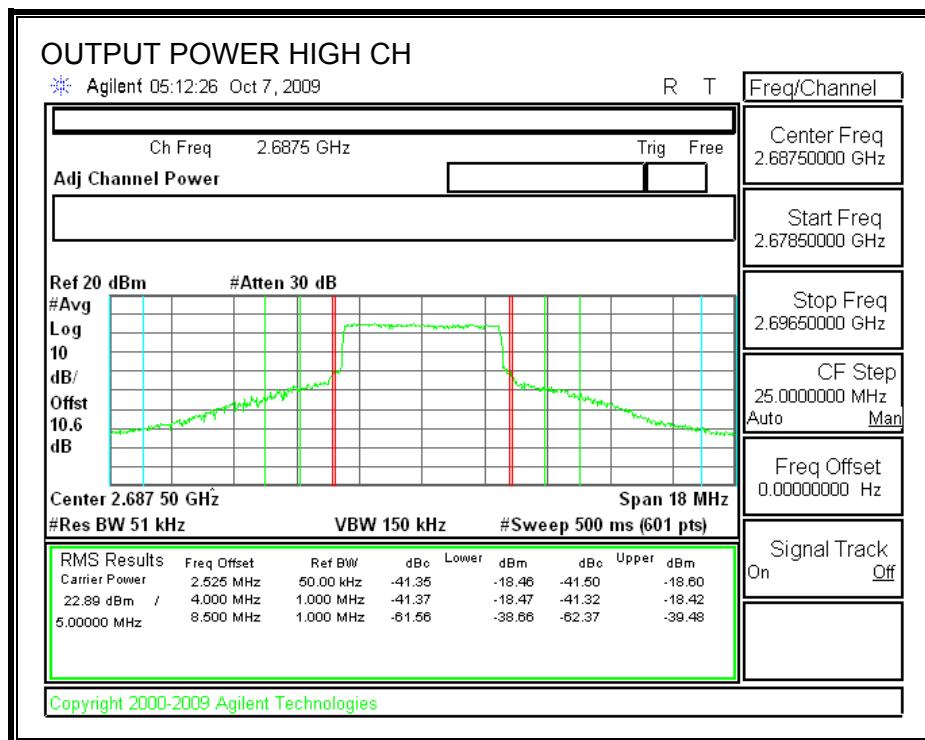
ANSI / TIA / EIA 603 Clause 3.2.12

RESULTS

5MHz_QPSK

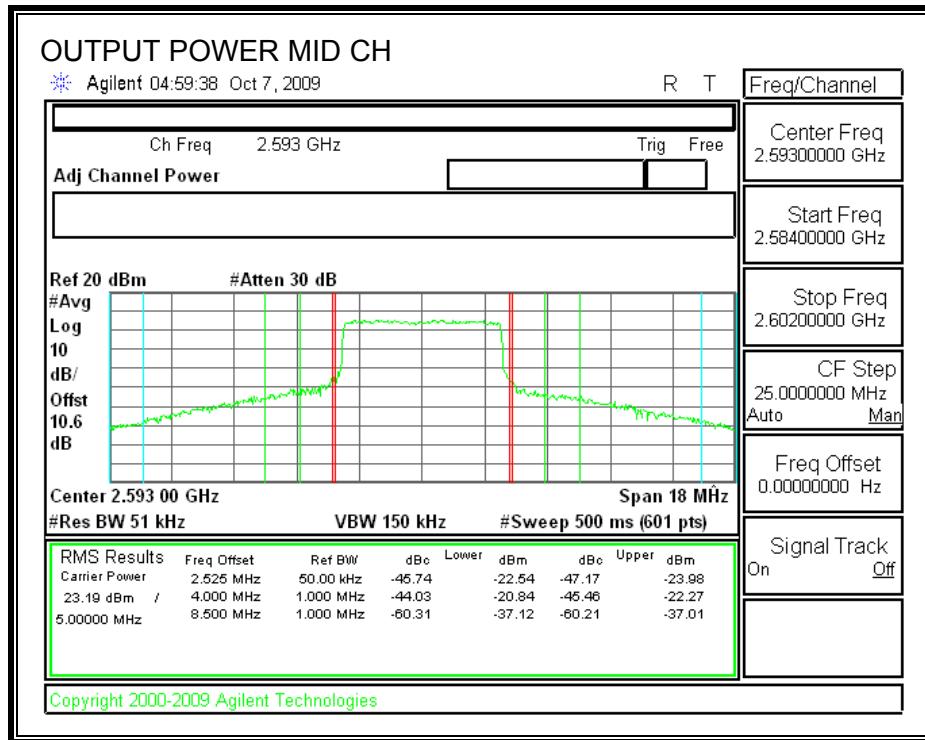
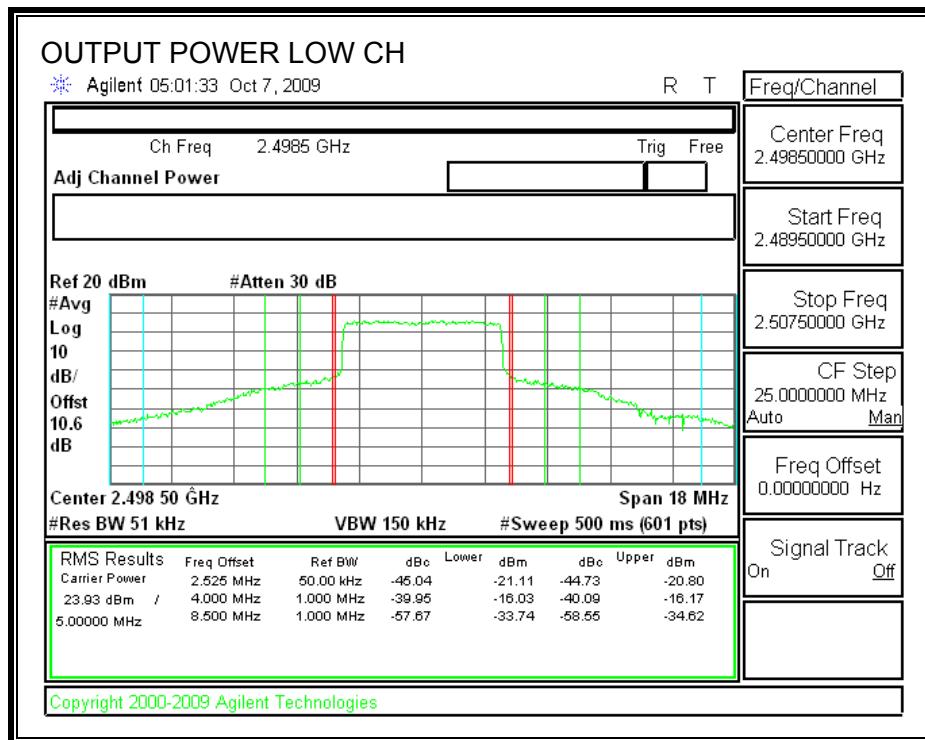
OUTPUT POWER

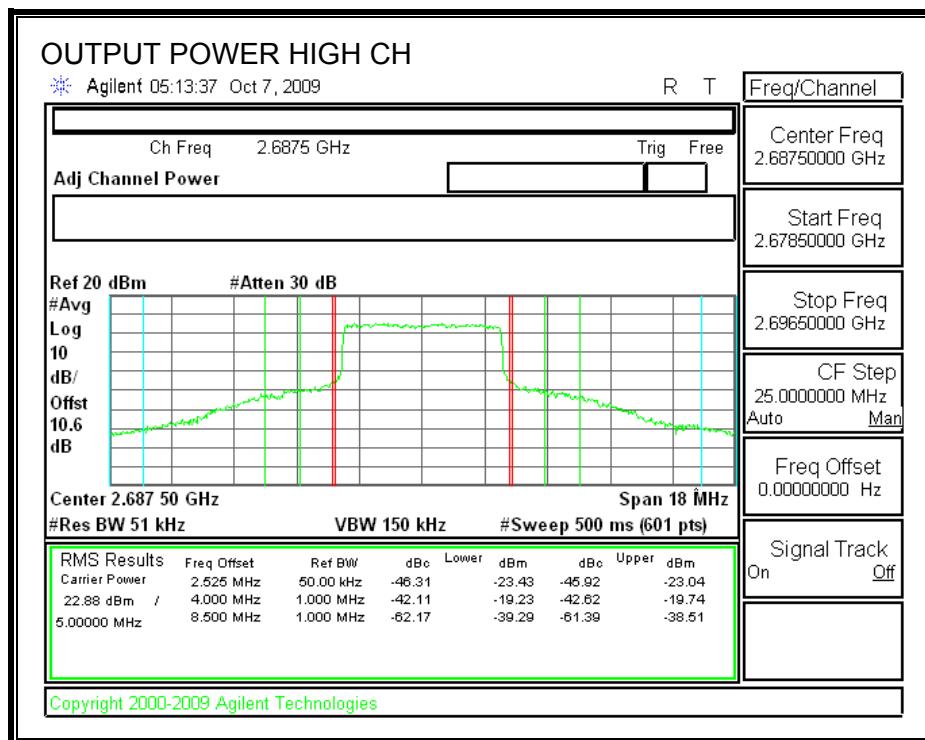




5MHz_16QAM

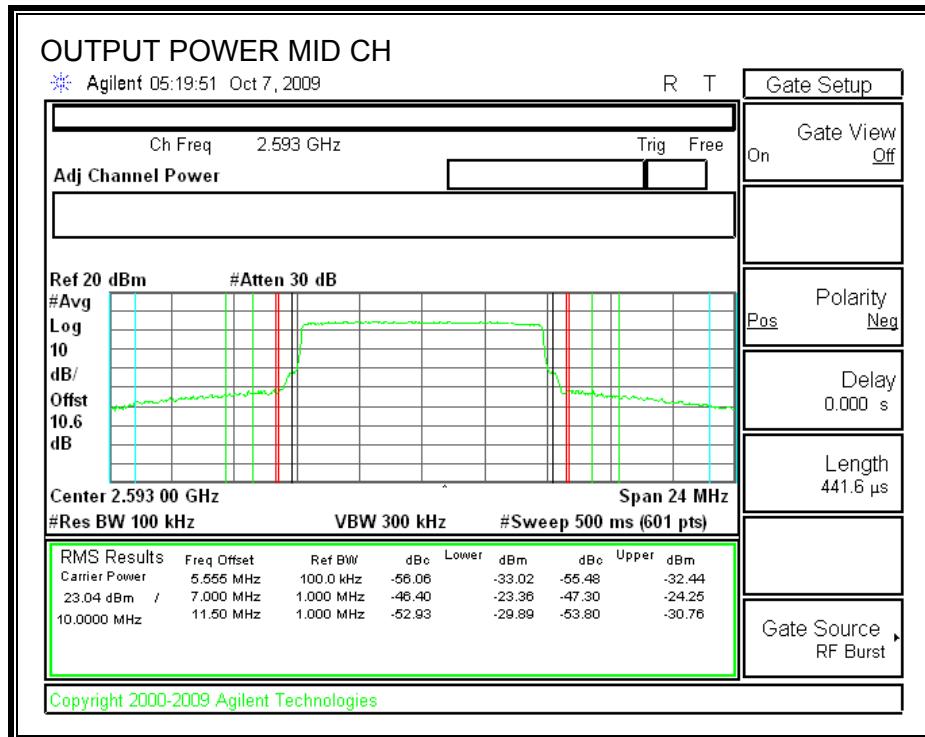
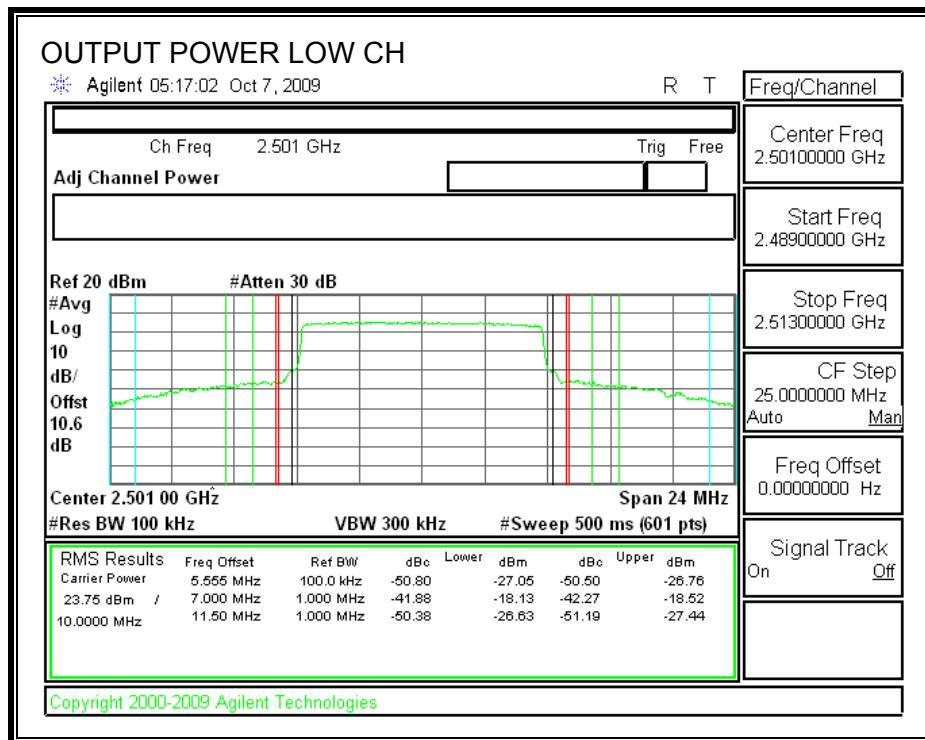
OUTPUT POWER

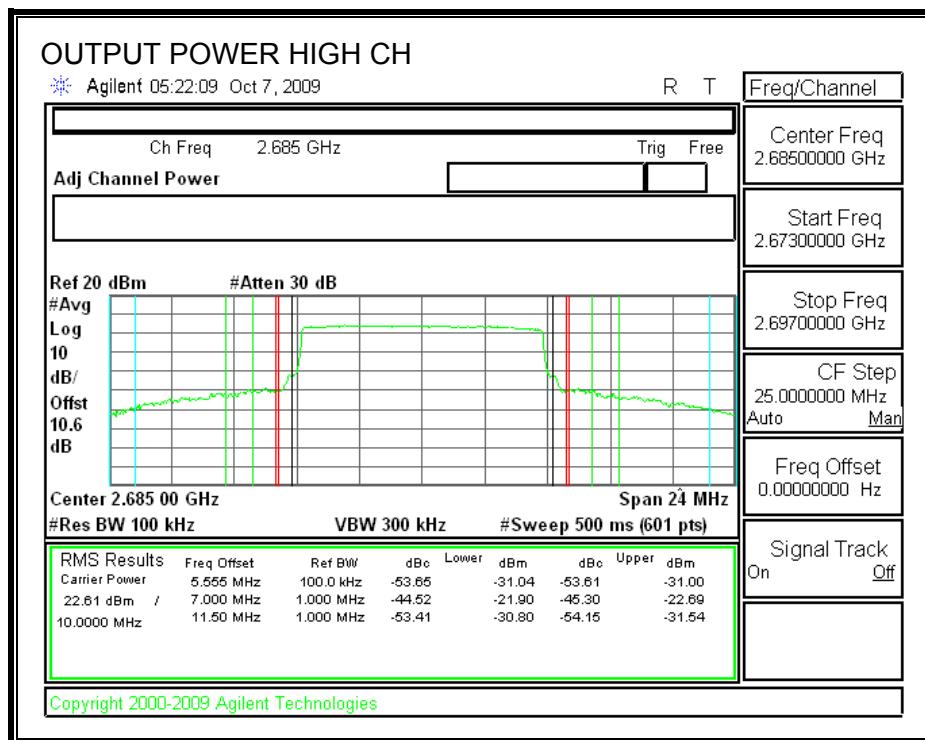




10MHz_QPSK

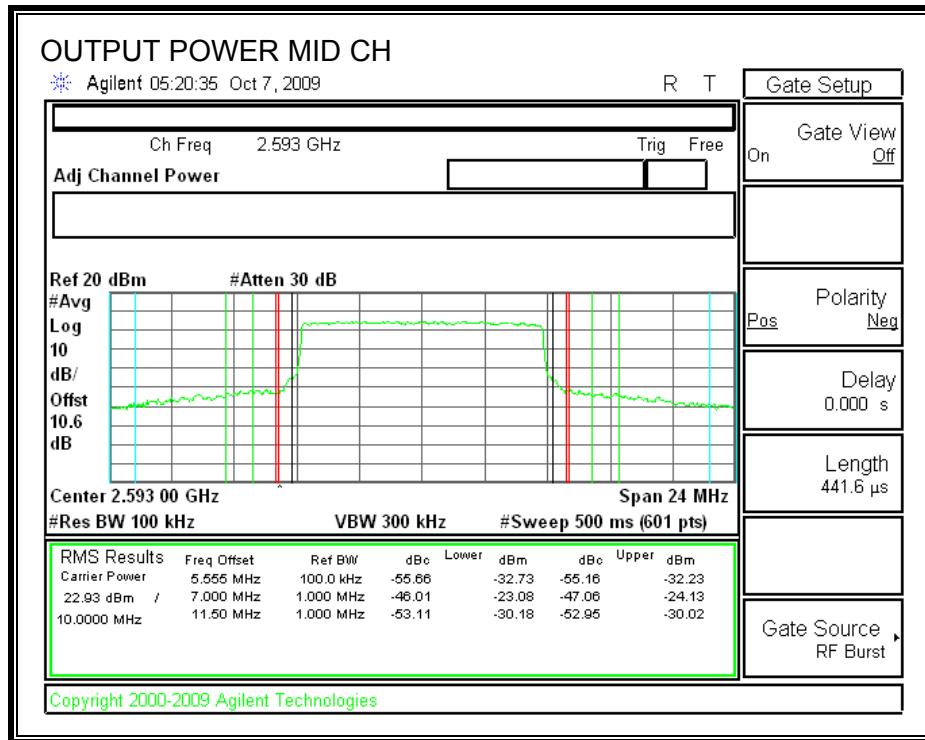
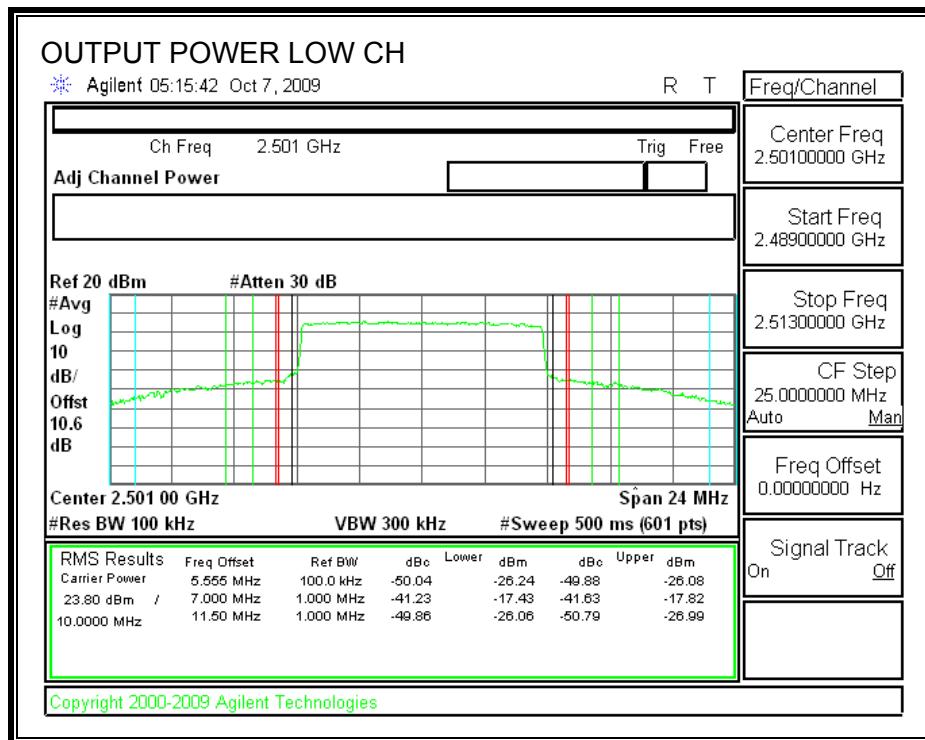
OUTPUT POWER

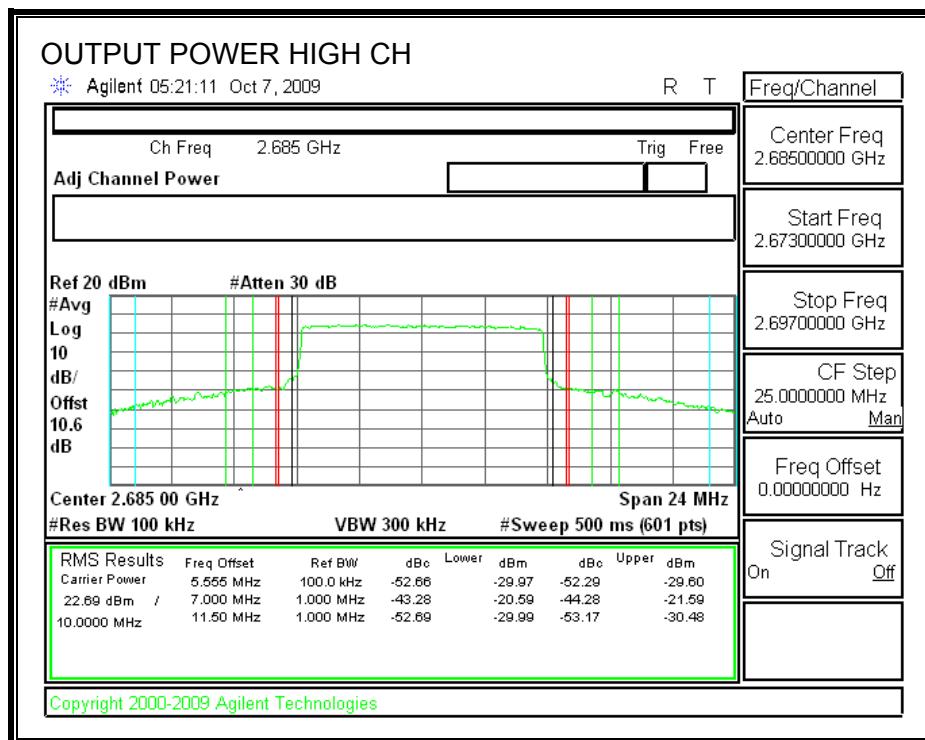




10MHz_16QAM

OUTPUT POWER





7.1.4. CONDUCTED SPURIOUS EMISSIONS

LIMIT

§2.1051

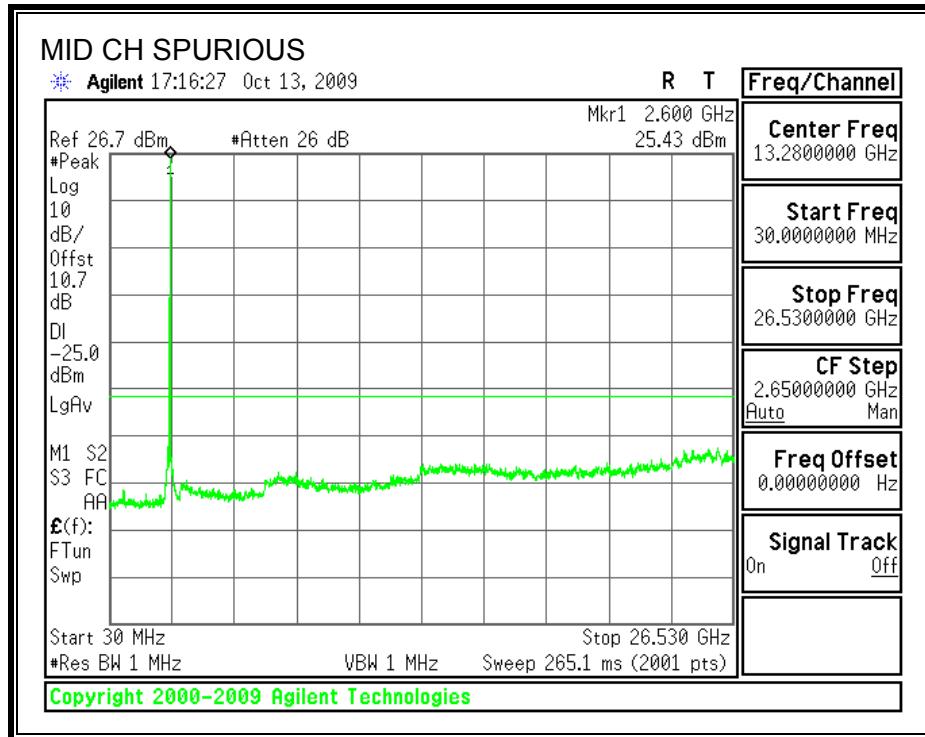
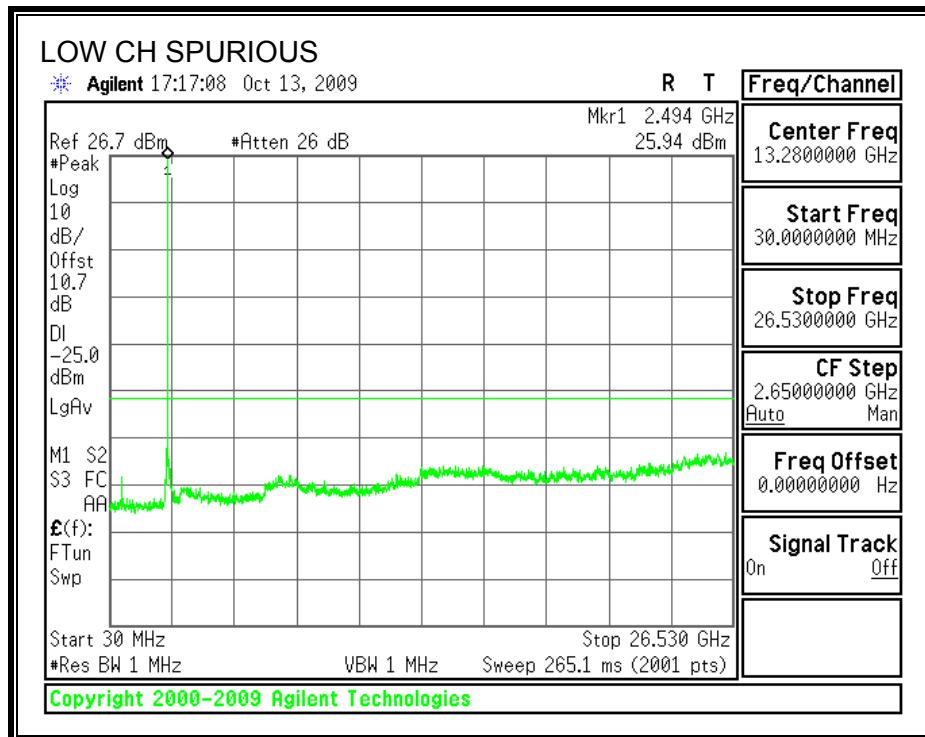
§27.53 (m)(4)(6) For mobile digital stations, the attenuation factor shall be not less than $43 + 10 \log (P)$ dB at the channel edge and $55 + 10 \log (P)$ dB at 5.5 megahertz from the channel edges.

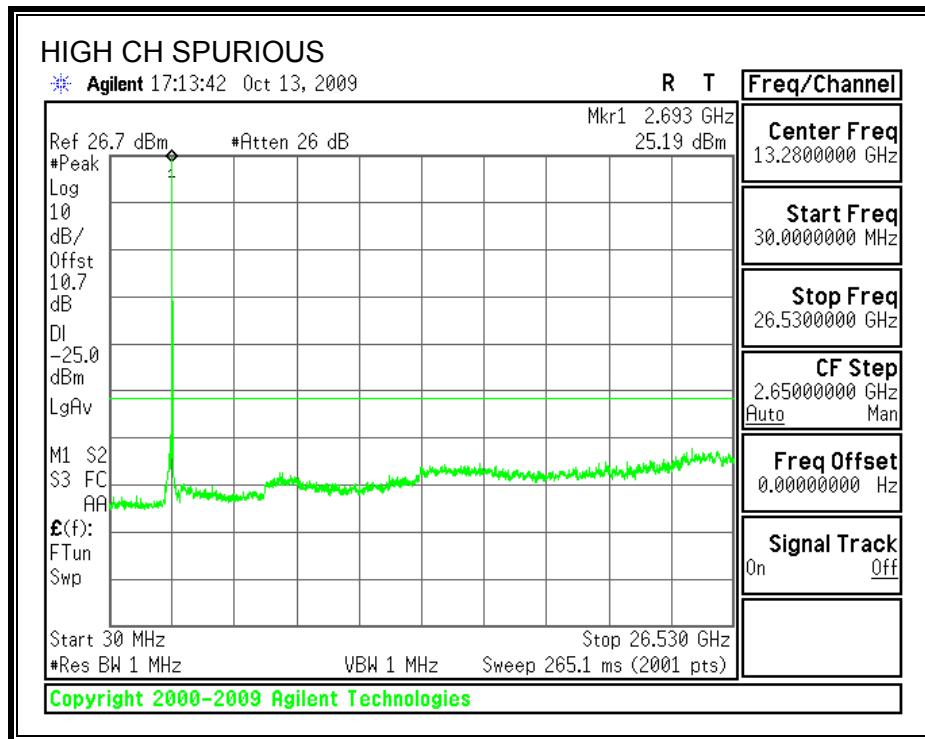
TEST PROCEDURE

ANSI / TIA / EIA 603 Clause 3.2.12 & FCC 27

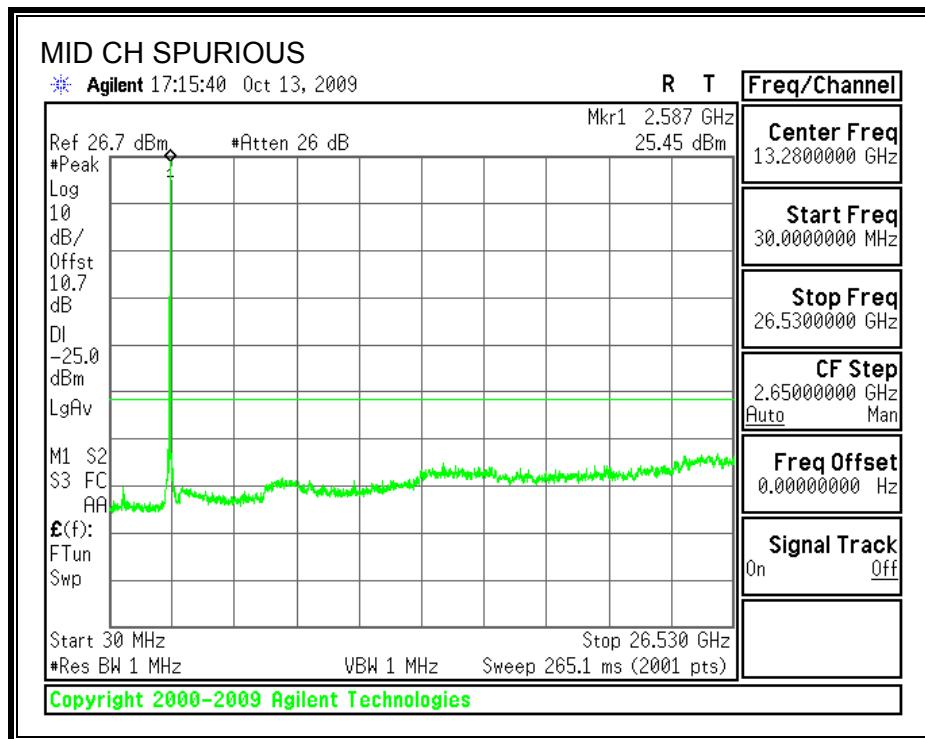
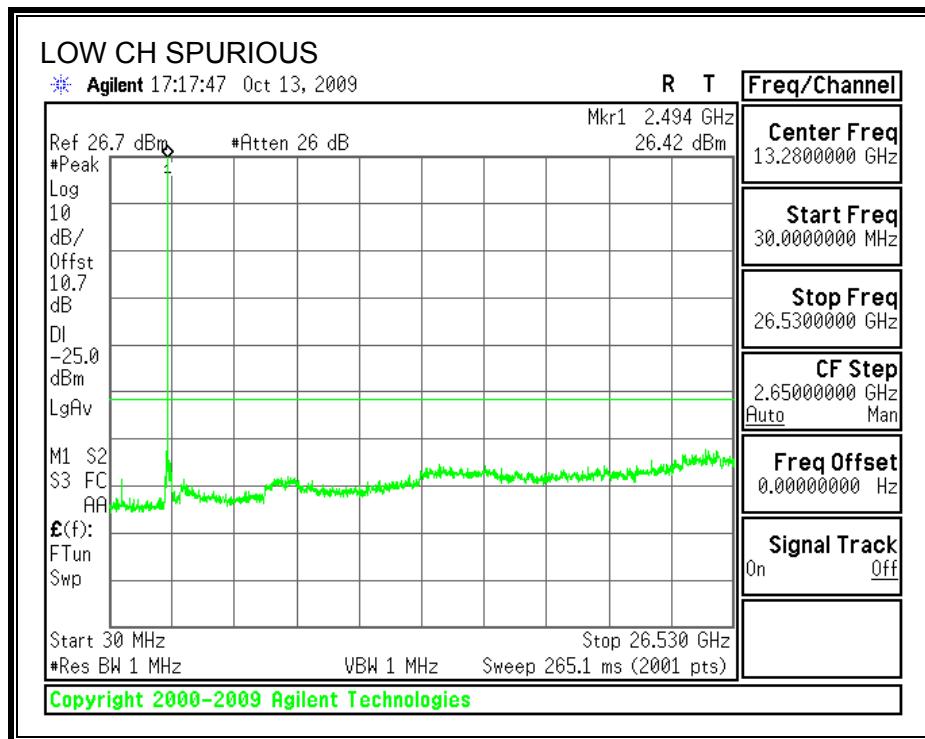
RESULTS

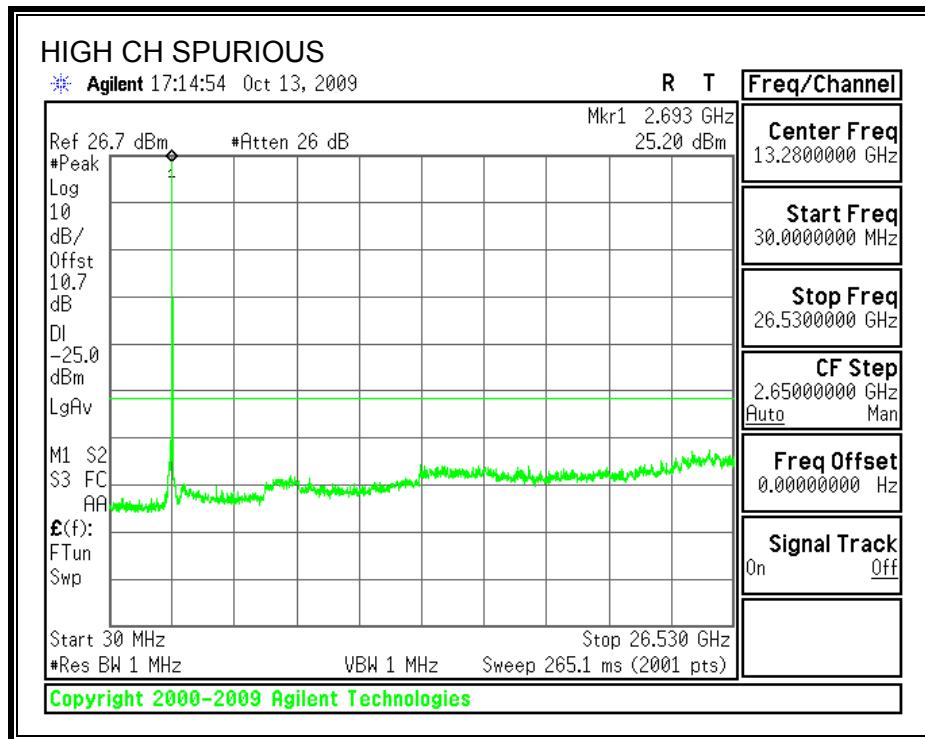
5MHz_QPSK



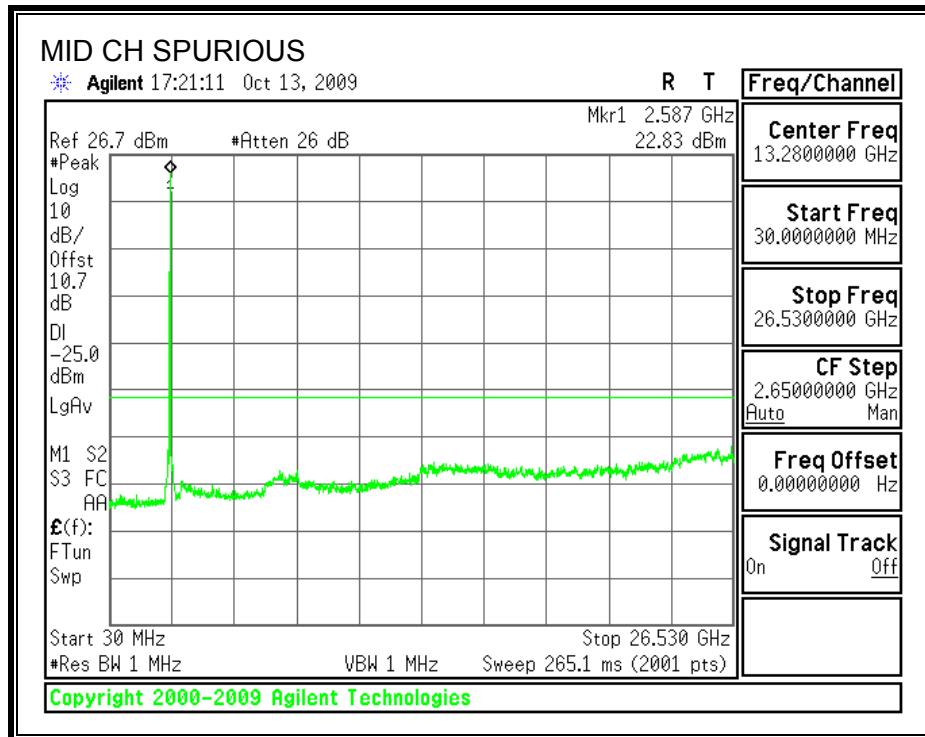
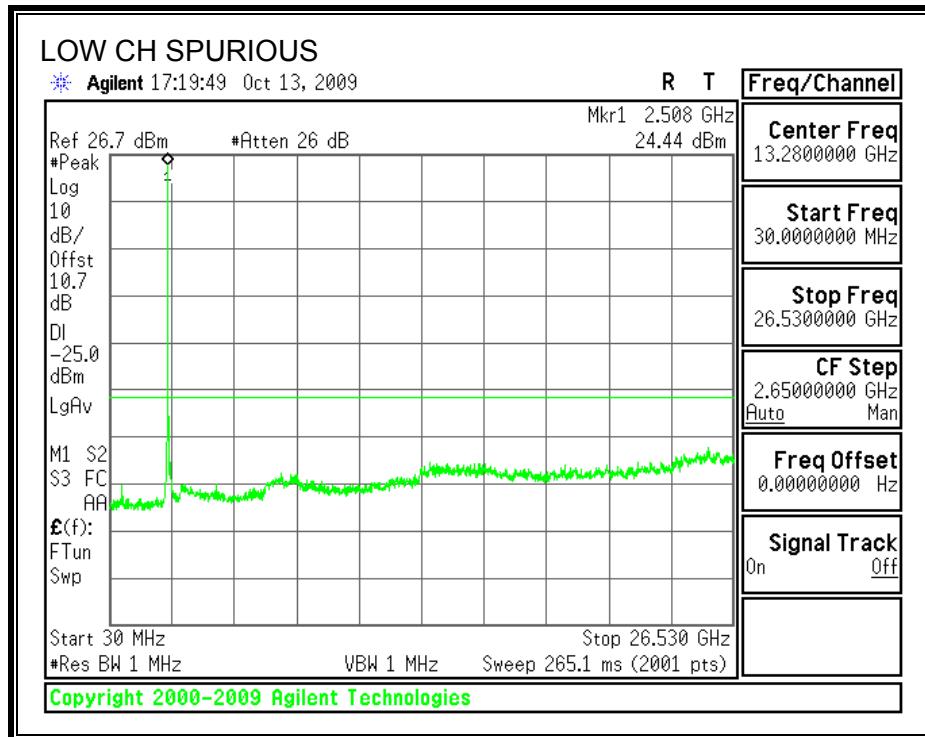


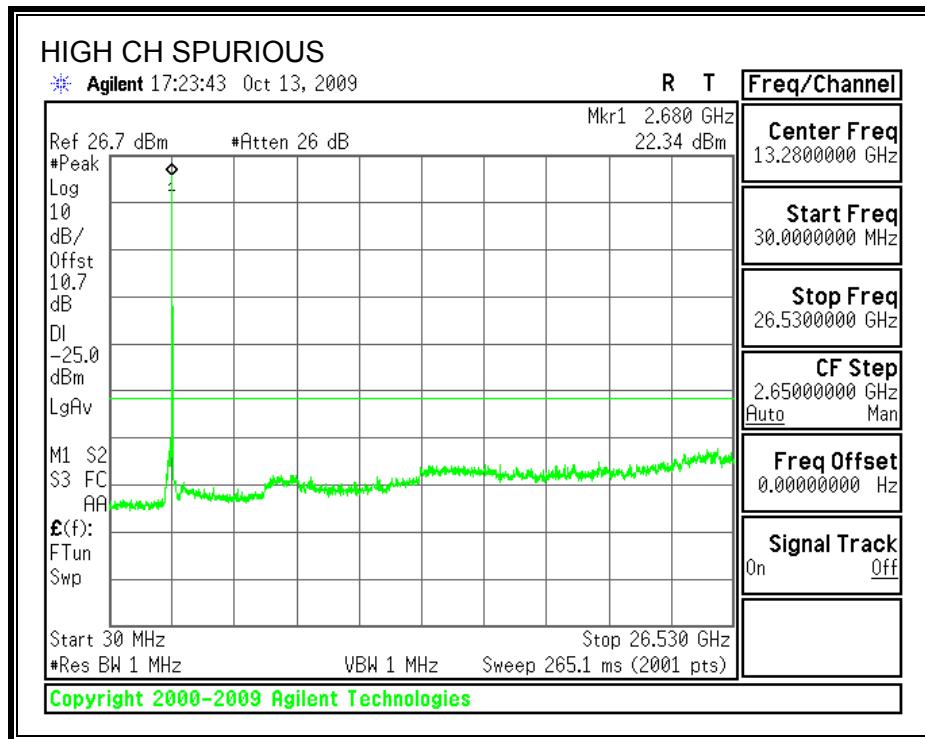
5MHz_16QAM



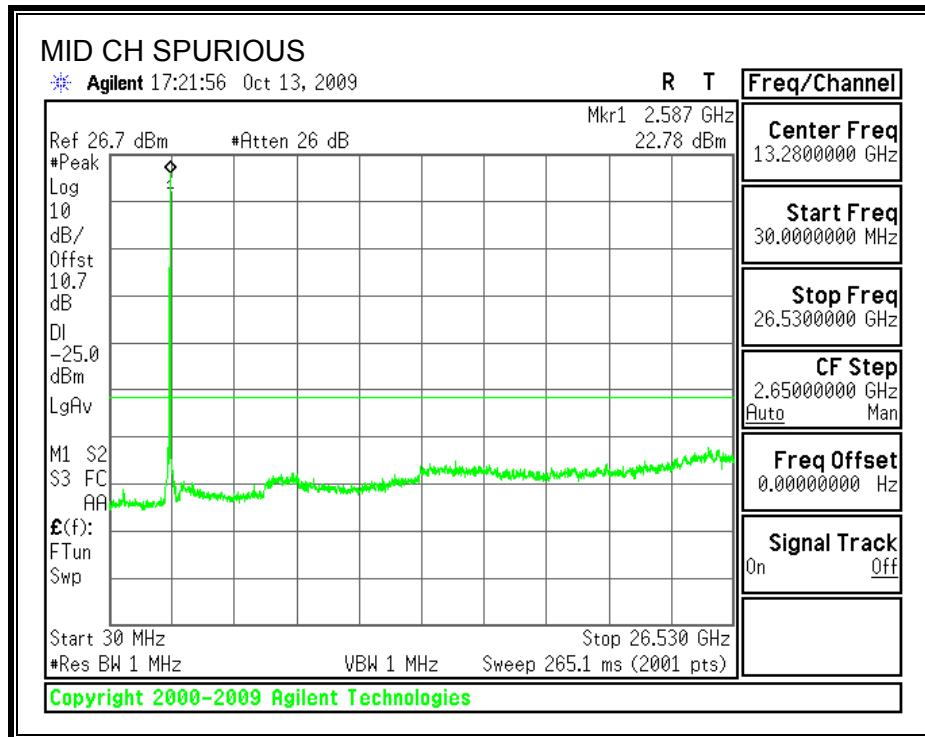
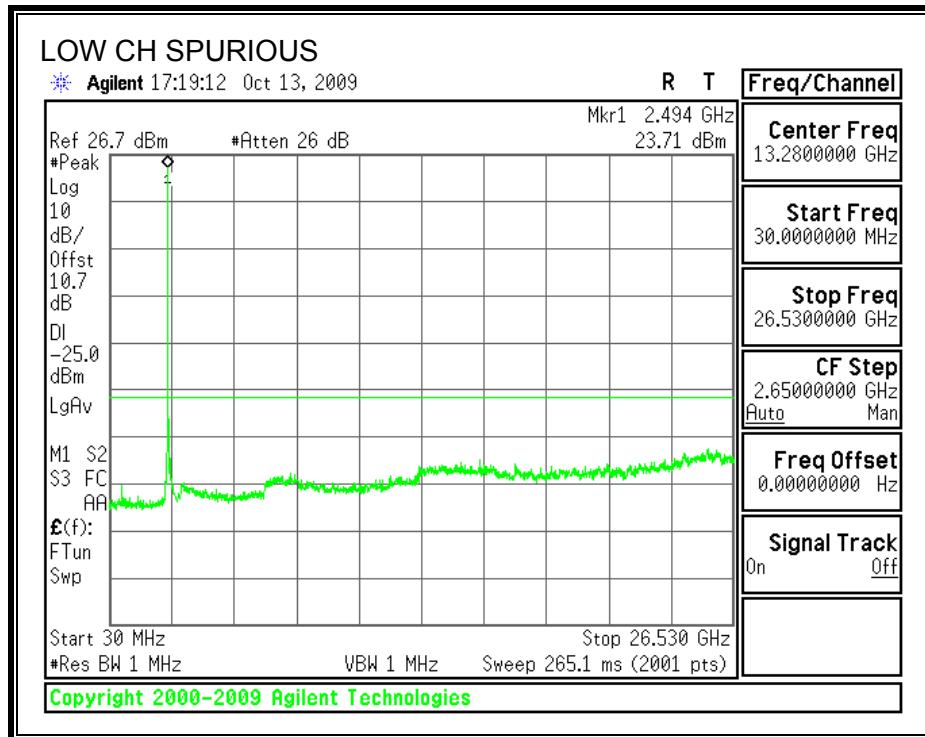


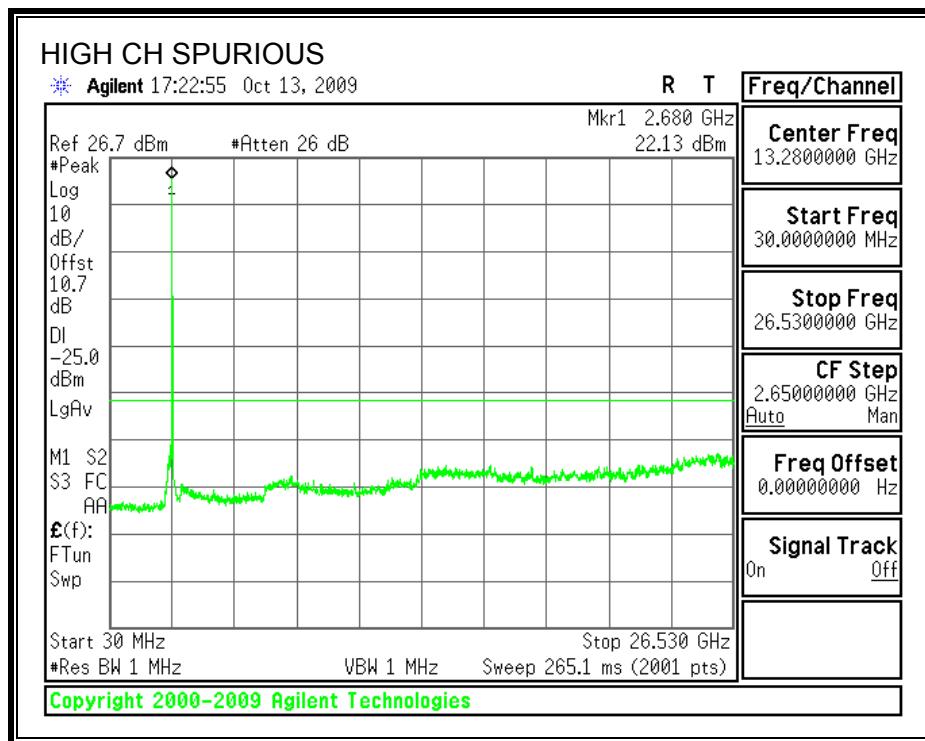
10MHz_QPSK





10MHz_16QAM





7.1.5. FREQUENCY STABILITY MEASUREMENT

LIMIT

§27.54 & 2.1055 Frequency stability.

Manufacturers of wireless medical telemetry devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all of the manufacturer's specified conditions.

TEST PROCEDURE

ANSI / TIA / EIA 603C Clause 2.3.1 and 2.3.2

TEST RESULTS

| | | Reference Frequency: | 2593.0164 | MHz @ 20°C |
|-----------------------|---------------------------------|---|-------------|--------------------------------------|
| | | Limit: ± 20 ppm = | 51860 | Hz |
| Power Supply (VAC) | Environment Temperature (°C) | Frequency Deviation Measured with Time Elapse | | |
| | | (MHz) | Delta (ppm) | Limit (ppm) |
| 115.00 | 50 | 2593.01235 | 1.571 | Within the authorized frequency band |
| 115.00 | 40 | 2593.01453 | 0.729 | |
| 115.00 | 30 | 2593.01582 | 0.231 | |
| 115.00 | 20 | 2593.01642 | 0.000 | |
| 115.00 | 10 | 2593.01778 | -0.524 | |
| 115.00 | 0 | 2593.01911 | -1.037 | |
| 115.00 | -10 | 2593.02210 | -2.190 | |
| 115.00 | -20 | 2593.02421 | -3.004 | |
| 115.00 | -30 | 2593.02688 | -4.034 | |
| 97.75 | 20 | 2593.01656 | -0.054 | Within the authorized frequency band |
| 132.25 | 20 | 2593.01637 | 0.019 | Within the authorized frequency band |
| Power Supply (VDC) | Environment Temperature (°C) | Frequency Deviation Measured with Time Elapse | | |
| | | (MHz) | Delta (ppm) | Limit (ppm) |
| 4.1Vdc (100%) | 20 | 2593.00771 | 3.361 | Within the authorized frequency band |
| 3.6Vdc (End Point) | 20 | 2593.00798 | 3.256 | Within the authorized frequency band |

8. RADIATED TEST RESULTS

8.1.1. RADIATED OUTPUT POWER (EIRP)

LIMITS

§2.1046 & §27.50 (h)(2) Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

TEST PROCEDURE

ANSI / TIA / EIA 603 Clause 2.2.17& FCC 27

RESULTS

| Mode | Channel | Frequency (MHz) | EIRP (dBm) | EIRP (mW) |
|-------------|---------|-----------------|------------|-----------|
| 5MHz QPSK | Low | 2498.5 | 23.40 | 218.78 |
| | Middle | 2593 | 20.90 | 123.03 |
| | High | 2687.5 | 23.20 | 208.93 |
| 5MHz 16QAM | Low | 2498.5 | 22.80 | 190.55 |
| | Middle | 2593 | 20.80 | 120.23 |
| | High | 2687.5 | 22.10 | 162.18 |
| 10MHz QPSK | Low | 2501 | 22.70 | 186.21 |
| | Middle | 2593 | 20.30 | 107.15 |
| | High | 2685 | 22.30 | 169.82 |
| 10MHz 16QAM | Low | 2501 | 22.70 | 186.21 |
| | Middle | 2593 | 20.20 | 104.71 |
| | High | 2685 | 22.10 | 162.18 |

OUTPUT POWER (EIRP)

5MHz_QPSK

Compliance Certification Services
Above 1GHz High Frequency Substitution Measurement

Company: Sierra Wireless
Project #: 09U12839
Date: 10/7/2009
Test Engineer: Devin Chang
Configuration: EUT With Laptop PC
Mode: QPSK_5MHz

| Chamber | | Pre-amplifier | | Filter | | Limit | | | | |
|--------------|---------------------|--------------------|-----------------|-------------------|----------------|----------------|---------------|----------------|---------------|-------|
| 5m Chamber A | | | | | | Part 27 | | | | |
| f GHz | SA reading (dBm) | Ant. Pol. (H/V) | Distance (m) | Path Loss (dB) | Preamp (dB) | Filter (dB) | EIRP (dBm) | Limit (dBm) | Delta (dB) | Notes |
| Low Ch | | | | | | | | | | |
| 2.4985 | -18.5 | V | 3.0 | 41.8 | | | 23.4 | 33.0 | -9.6 | |
| 2.4985 | -18.9 | H | 3.0 | 40.1 | | | 21.2 | 33.0 | -11.8 | |
| Mid Ch | | | | | | | | | | |
| 2.5930 | -21.2 | V | 3.0 | 42.1 | | | 20.9 | 33.0 | -12.1 | |
| 2.5930 | -22.4 | H | 3.0 | 40.6 | | | 18.2 | 33.0 | -14.8 | |
| High Ch | | | | | | | | | | |
| 2.6875 | -19.2 | V | 3.0 | 42.4 | | | 23.2 | 33.0 | -9.8 | |
| 2.6875 | -21.8 | H | 3.0 | 41.2 | | | 19.4 | 33.0 | -13.6 | |

Rev. 03.03.09

5MHz_16QAM

Compliance Certification Services
Above 1GHz High Frequency Substitution Measurement

Company: Sierra Wireless
Project #: 09U12839
Date: 10/7/2009
Test Engineer: Devin Chang
Configuration: EUT With Laptop PC
Mode: 16QAM_5MHz

| Chamber | | Pre-amplifier | | Filter | | Limit | | | | |
|----------|---------------------|--------------------|-----------------|-------------------|----------------|----------------|---------------|----------------|---------------|-------|
| | 5m Chamber A | | | | | | Part 27 | | | |
| f GHz | SA reading (dBm) | Ant. Pol. (H/V) | Distance (m) | Path Loss (dB) | Preamp (dB) | Filter (dB) | EIRP (dBm) | Limit (dBm) | Delta (dB) | Notes |
| Low Ch | | | | | | | | | | |
| 2.4985 | -19.0 | V | 3.0 | 41.8 | | | 22.8 | 33.0 | -10.2 | |
| 2.4985 | -19.7 | H | 3.0 | 40.1 | | | 20.4 | 33.0 | -12.6 | |
| Mid Ch | | | | | | | | | | |
| 2.5930 | -21.3 | V | 3.0 | 42.1 | | | 20.8 | 33.0 | -12.2 | |
| 2.5930 | -23.2 | H | 3.0 | 40.6 | | | 17.4 | 33.0 | -15.6 | |
| High Ch | | | | | | | | | | |
| 2.6875 | -20.3 | V | 3.0 | 42.4 | | | 22.1 | 33.0 | -10.9 | |
| 2.6875 | -23.5 | H | 3.0 | 41.2 | | | 17.6 | 33.0 | -15.4 | |

Rev. 03.03.09

10MHz_QPSK

Compliance Certification Services
Above 1GHz High Frequency Substitution Measurement

Company: Sierra Wireless
Project #: 09U12839
Date: 10/7/2009
Test Engineer: Devin Chang
Configuration: EUT With Laptop PC
Mode: QPSK_10MHz

| Chamber | Pre-amplifier | Filter | Limit |
|--------------|---------------|--------|---------|
| 5m Chamber B | | | Part 27 |

| f GHz | SA reading (dBm) | Ant. Pol. (H/V) | Distance (m) | Path Loss (dB) | Preamp (dB) | Filter (dB) | EIRP (dBm) | Limit (dBm) | Delta (dB) | Notes |
|----------|---------------------|--------------------|-----------------|-------------------|----------------|----------------|---------------|----------------|---------------|-------|
| Low Ch | | | | | | | | | | |
| 2.501 | -19.2 | V | 3.0 | 41.8 | | | 22.7 | 33.0 | -10.3 | |
| 2.501 | -19.8 | H | 3.0 | 39.8 | | | 20.0 | 33.0 | -13.0 | |
| Mid Ch | | | | | | | | | | |
| 2.593 | -21.8 | V | 3.0 | 42.1 | | | 20.3 | 33.0 | -12.7 | |
| 2.593 | -23.6 | H | 3.0 | 40.4 | | | 16.8 | 33.0 | -16.2 | |
| High Ch | | | | | | | | | | |
| 2.685 | -20.1 | V | 3.0 | 42.4 | | | 22.3 | 33.0 | -10.7 | |
| 2.685 | -23.0 | H | 3.0 | 41.0 | | | 18.0 | 33.0 | -15.0 | |

Rev. 03.03.09

10MHz _16QAM

Compliance Certification Services
Above 1GHz High Frequency Substitution Measurement

Company: Sierra Wireless
Project #: 09U12839
Date: 10/7/2009
Test Engineer: Devin Chang
Configuration: EUT With Laptop PC
Mode: 16QAM_10MHz

| Chamber | | Pre-amplifier | | Filter | | Limit | | | | |
|--------------|---------------------|--------------------|-----------------|-------------------|----------------|----------------|---------------|----------------|---------------|-------|
| 5m Chamber B | | | | | | Part 27 | | | | |
| f GHz | SA reading (dBm) | Ant. Pol. (H/V) | Distance (m) | Path Loss (dB) | Preamp (dB) | Filter (dB) | EIRP (dBm) | Limit (dBm) | Delta (dB) | Notes |
| Low Ch | | | | | | | | | | |
| 2.501 | -19.1 | V | 3.0 | 41.8 | | | 22.7 | 33.0 | -10.3 | |
| 2.501 | -19.4 | H | 3.0 | 39.8 | | | 20.4 | 33.0 | -12.6 | |
| Mid Ch | | | | | | | | | | |
| 2.593 | -21.9 | V | 3.0 | 42.1 | | | 20.2 | 33.0 | -12.8 | |
| 2.593 | -23.5 | H | 3.0 | 40.4 | | | 16.9 | 33.0 | -16.1 | |
| High Ch | | | | | | | | | | |
| 2.685 | -20.3 | V | 3.0 | 42.4 | | | 22.1 | 33.0 | -10.9 | |
| 2.685 | -23.1 | H | 3.0 | 41.0 | | | 17.9 | 33.0 | -15.1 | |

Rev. 03.03.09

8.1.2. FIELD STRENGTH OF SPURIOUS RADIATION

LIMIT

§2.1053

§27.53 (m)(4) For mobile digital stations, the attenuation factor shall be not less than $43 + 10 \log (P)$ dB at the channel edge and $55 + 10 \log (P)$ dB at 5.5 megahertz from the channel edges.

TEST PROCEDURE

ANSI / TIA / EIA 603 Clause 3.2.12 & FCC 27

RESULTS

SPURIOUS & HARMONIC

Below 1GHz (Worst Case)

| Compliance Certification Services 30 - 1000MHz Substitution Measurement | | | | | | | | | | | |
|--|---------------------|--------------------|-----------------|-------------------|----------------|----------------|---------------|----------------|---------------|-------|--|
| Chamber | | | Pre-amplifier | | | Filter | | | Limit | | |
| 5m Chamber B | T10 8447D | | | | | | | | Part 27 | | |
| f MHz | SA reading (dBm) | Ant. Pol. (H/V) | Distance (m) | Path Loss (dB) | Preamp (dB) | Filter (dB) | EIRP (dBm) | Limit (dBm) | Delta (dB) | Notes | |
| 58.08 | -53.6 | V | 3.0 | 31.3 | 29.6 | | -49.7 | -25.0 | 24.7 | | |
| 128.52 | -61.9 | V | 3.0 | 24.9 | 29.4 | | -64.3 | -25.0 | 39.3 | | |
| 481.70 | -64.4 | V | 3.0 | 27.1 | 29.6 | | -64.9 | -25.0 | 39.9 | | |
| 599.42 | -66.6 | V | 3.0 | 29.6 | 29.6 | | -64.5 | -25.0 | 39.5 | | |
| 663.75 | -66.9 | V | 3.0 | 31.0 | 29.6 | | -63.4 | -25.0 | 38.4 | | |
| 720.03 | -67.6 | V | 3.0 | 32.2 | 29.5 | | -62.7 | -25.0 | 37.7 | | |
| 999.40 | -61.8 | V | 3.0 | 35.2 | 28.4 | | -52.9 | -25.0 | 27.9 | | |
| 41.52 | -58.6 | H | 3.0 | 49.9 | 29.6 | | -36.3 | -25.0 | -11.3 | | |
| 136.32 | 56.9 | H | 3.0 | 20.0 | 29.4 | | -64.2 | -25.0 | 39.2 | | |
| 227.05 | -59.4 | H | 3.0 | 18.2 | 29.1 | | -68.1 | -25.0 | 43.1 | | |
| 480.02 | -67.3 | H | 3.0 | 24.4 | 29.6 | | -70.4 | -25.0 | 45.4 | | |
| 600.02 | -69.7 | H | 3.0 | 27.7 | 29.6 | | -69.5 | -25.0 | 44.5 | | |
| 720.51 | -71.8 | H | 3.0 | 29.5 | 29.5 | | -69.7 | -25.0 | 44.7 | | |
| 998.08 | -64.3 | H | 3.0 | 33.7 | 28.4 | | -56.9 | -25.0 | -31.9 | | |

Rev. 03.03.09

Above 1GHz

| 5MHz_16QAM | | | | | | | | | | | |
|---|---------------------|--------------------|-----------------|-------------------|----------------|----------------|---------------|----------------|---------------|-------|--|
| Compliance Certification Services Above 1GHz High Frequency Substitution Measurement | | | | | | | | | | | |
| Company: Sierra Wireless Project #: 09U12839 Date: 10/9/2009 Test Engineer: Devin Chang Configuration: EUT Mode: 16QAM_5MHz (T5D29U1816Q34S85) | | | | | | | | | | | |
| Chamber | | | Pre-amplifier | | | Filter | | Limit | | | |
| 5m Chamber B | | | T145 8449B | | | Filter 1 | | Part 27 | | | |
| f GHz | SA reading (dBm) | Ant. Pol. (H/V) | Distance (m) | Path Loss (dB) | Preamp (dB) | Filter (dB) | EIRP (dBm) | Limit (dBm) | Delta (dB) | Notes | |
| 2498.5MHz | | | | | | | | | | | |
| 4.997 | -69.4 | H | 3.0 | 48.9 | 35.3 | 1.0 | -54.9 | -25.0 | -29.9 | | |
| 7.495 | -69.6 | H | 3.0 | 53.1 | 35.7 | 1.0 | -51.3 | -25.0 | -26.3 | | |
| 4.997 | -69.5 | V | 3.0 | 48.3 | 35.3 | 1.0 | -55.6 | -25.0 | -30.6 | | |
| 7.495 | -68.8 | V | 3.0 | 51.4 | 35.7 | 1.0 | -52.1 | -25.0 | -27.1 | | |
| 2593MHz | | | | | | | | | | | |
| 5.186 | -68.9 | H | 3.0 | 49.4 | 35.3 | 1.0 | -53.8 | -25.0 | -28.8 | | |
| 7.779 | -70.2 | H | 3.0 | 53.4 | 35.7 | 1.0 | -51.5 | -25.0 | -26.5 | | |
| 5.186 | -69.0 | V | 3.0 | 48.8 | 35.3 | 1.0 | -54.6 | -25.0 | -29.6 | | |
| 7.779 | -70.2 | V | 3.0 | 51.8 | 35.7 | 1.0 | -53.1 | -25.0 | -28.1 | | |
| 2687.5MHz | | | | | | | | | | | |
| 5.375 | -69.6 | H | 3.0 | 49.7 | 35.4 | 1.0 | -54.3 | -25.0 | -29.3 | | |
| 8.062 | -69.9 | H | 3.0 | 53.7 | 35.7 | 1.0 | -50.9 | -25.0 | -25.9 | | |
| 5.375 | -69.3 | V | 3.0 | 49.0 | 35.4 | 1.0 | -54.7 | -25.0 | -29.7 | | |
| 8.062 | -70.0 | V | 3.0 | 52.1 | 35.7 | 1.0 | -52.6 | -25.0 | -27.6 | | |

Rev. 03.03.09

10MHz_16QAM

Compliance Certification Services
Above 1GHz High Frequency Substitution Measurement

Company: Sierra Wireless
Project #: 09U12839
Date: 10/9/2009
Test Engineer: Devin Chang
Configuration: EUT
Mode: 16QAM_10MHz (T10D29U1816Q12S175)

| Chamber | | Pre-amplifier | | Filter | | Limit | | | | |
|--------------|---------------------|--------------------|-----------------|-------------------|----------------|----------------|---------------|----------------|---------------|-------|
| 5m Chamber B | | T145 8449B | | Filter 1 | | Part 27 | | | | |
| f GHz | SA reading (dBm) | Ant. Pol. (H/V) | Distance (m) | Path Loss (dB) | Preamp (dB) | Filter (dB) | EIRP (dBm) | Limit (dBm) | Delta (dB) | Notes |
| 2501MHz | | | | | | | | | | |
| 5.002 | -69.2 | H | 3.0 | 48.9 | 35.3 | 1.0 | -54.7 | -25.0 | -29.7 | |
| 7.503 | -69.4 | H | 3.0 | 53.1 | 35.7 | 1.0 | -51.0 | -25.0 | -26.0 | |
| 5.002 | -68.2 | V | 3.0 | 48.3 | 35.3 | 1.0 | -54.2 | -25.0 | -29.2 | |
| 7.503 | -70.3 | V | 3.0 | 51.4 | 35.7 | 1.0 | -53.5 | -25.0 | -28.5 | |
| 2593MHz | | | | | | | | | | |
| 5.186 | -69.0 | H | 3.0 | 49.4 | 35.3 | 1.0 | -53.9 | -25.0 | -28.9 | |
| 7.779 | -70.2 | H | 3.0 | 53.4 | 35.7 | 1.0 | -51.4 | -25.0 | -26.4 | |
| 5.186 | -68.9 | V | 3.0 | 48.8 | 35.3 | 1.0 | -54.5 | -25.0 | -29.5 | |
| 7.779 | -70.5 | V | 3.0 | 51.8 | 35.7 | 1.0 | -53.4 | -25.0 | -28.4 | |
| 2685MHz | | | | | | | | | | |
| 5.370 | -69.3 | H | 3.0 | 49.7 | 35.4 | 1.0 | -53.9 | -25.0 | -28.9 | |
| 8.055 | -70.2 | H | 3.0 | 53.7 | 35.7 | 1.0 | -51.1 | -25.0 | -26.1 | |
| 5.370 | -69.3 | V | 3.0 | 49.0 | 35.4 | 1.0 | -54.7 | -25.0 | -29.7 | |
| 8.055 | -68.7 | V | 3.0 | 52.1 | 35.7 | 1.0 | -51.3 | -25.0 | -26.3 | |

Rev. 03.03.09

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

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

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

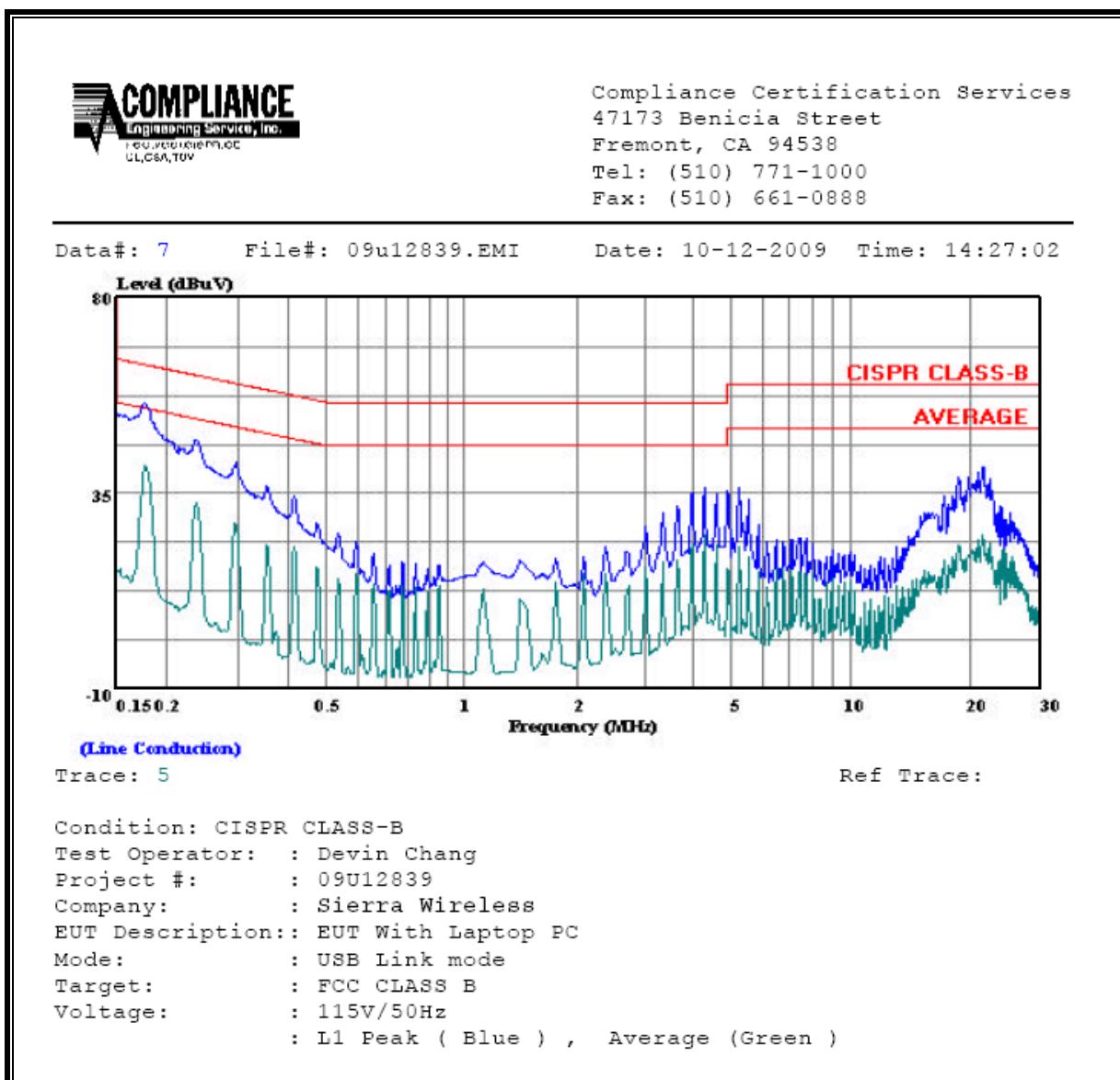
ANSI C63.4

RESULTS

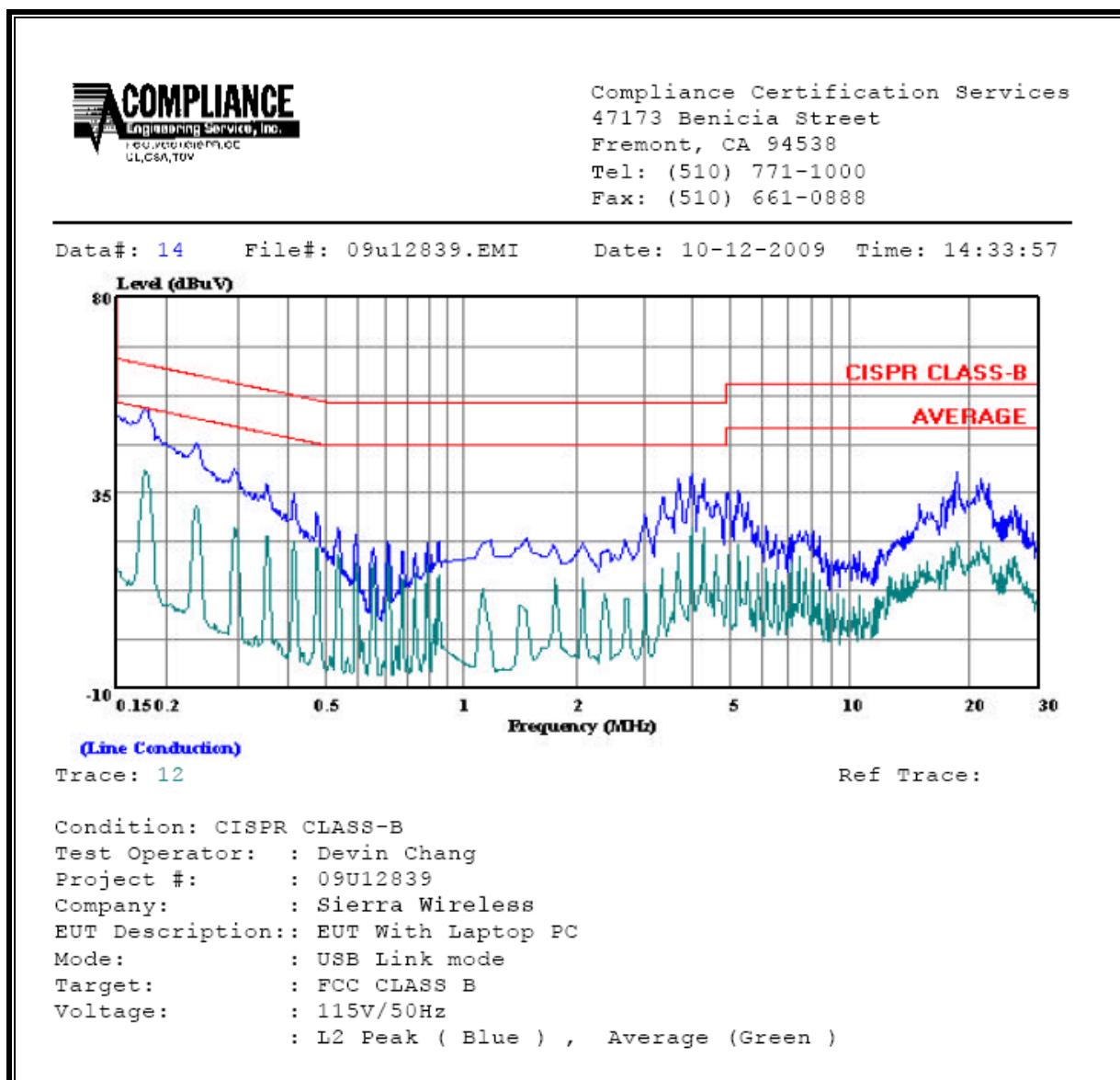
6 WORST EMISSIONS

| CONDUCTED EMISSIONS DATA (115VAC 60Hz) | | | | | | | | | |
|--|-----------|-----------|-----------|---------------|-------|-------|---------|---------|--------|
| Freq. (MHz) | Reading | | | Closs (dB) | Limit | FCC B | Margin | | Remark |
| | PK (dBuV) | QP (dBuV) | AV (dBuV) | | | | QP (dB) | AV (dB) | |
| 0.18 | 55.75 | -- | 41.05 | 0.00 | 64.63 | 54.63 | -8.88 | -13.58 | L1 |
| 4.38 | 36.25 | -- | 25.54 | 0.00 | 56.00 | 46.00 | -19.75 | -20.46 | L1 |
| 21.49 | 41.04 | -- | 25.40 | 0.00 | 60.00 | 50.00 | -18.96 | -24.60 | L1 |
| 0.18 | 54.23 | -- | 40.35 | 0.00 | 64.63 | 54.63 | -10.40 | -14.28 | L2 |
| 0.24 | 45.94 | -- | 32.15 | 0.00 | 62.17 | 52.17 | -16.23 | -20.02 | L2 |
| 4.38 | 39.49 | -- | 27.20 | 0.00 | 56.00 | 46.00 | -16.51 | -18.80 | L2 |
| 6 Worst Data | | | | | | | | | |

LINE 1 RESULTS



LINE 2 RESULTS



10. MAXIMUM PERMISSIBLE EXPOSURE

10.1. Limits

10.1.1. FCC RULES

§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.

10.1.2. IC RULES

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/m² is equivalent to 1 mW/cm².
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μ T) or 12.57 milligauss (mG).

10.1.3. LIMITS APPLICABLE TO THE EUT

For mobile radio equipment operating in the cellular phone band, the lowest power density limit is calculated using the lowest frequency, as $824\text{ MHz} / 1500 = 0.55\text{ mW/cm}^2$ (FCC) and $824\text{ MHz} / 150 = 5.5\text{ W/m}^2$ (IC).

For operation in the PCS band, the 2.4 GHz band and the 5 GHz bands, from FCC §1.1310 Table 1 (B), the maximum value of $S = 1.0\text{ mW/cm}^2$ and from IC Safety Code 6, Section 2.2 Table 5 Column 4, $S = 10\text{ W/m}^2$.

10.2. EQUATIONS

Power density is given by:

$$S = \text{EIRP} / (4 * \pi * D^2)$$

where

S = Power density in W/m²

EIRP = Equivalent Isotropic Radiated Power in W

D = Separation distance in m

For multiple colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the Power * Gain product (in linear units) of each transmitter.

$$\text{Total EIRP} = (P1 * G1) + (P2 * G2) + \dots + (Pn * Gn)$$

where

P_x = Power of transmitter x

G_x = Numeric gain of antenna x

For multiple colocated transmitters operating simultaneously in frequency bands where different limits apply, either the lowest limit applicable to the operating frequency ranges of the co-located transmitters can be applied or a fraction of the exposure limit is established for each band, such that the sum of the fractions is less than or equal to one.

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

10.3. RESULTS

10.3.1. SINGLE TRANSMITTER (WiMAX OR WLAN)

| Bandwidth Modulation | Mode | Separation Distance (m) | Output Power (dBm) | Antenna Gain (dBi) | IC Power Density (W/m^2) | FCC Power Density (mW/cm^2) |
|----------------------|-------|-------------------------|--------------------|--------------------|--------------------------|-----------------------------|
| 20 MHz 802.11b/g | WLAN | 0.20 | 22.16 | 1.00 | 0.41 | 0.041 |
| 5MHz QPSK | WiMAX | 0.20 | 24.78 | -0.50 | 0.53 | 0.053 |
| 5MHz 16QAM | WiMAX | 0.20 | 24.66 | -0.50 | 0.52 | 0.052 |
| 10MHz QPSK | WiMAX | 0.20 | 24.61 | -0.50 | 0.51 | 0.051 |
| 10MHz 16QAM | WiMAX | 0.20 | 24.62 | -0.50 | 0.51 | 0.051 |

Each Power Density is less than 10 W/m^2 or 1 mW/cm^2, which is the limit for these operating frequency ranges.

10.3.2. WiMAX AND CDMA 800/1900 TRANSMITTERS

These transmitters do not operate simultaneously, therefore they are not co-located.

10.3.3. CO-LOCATED TRANSMITTERS (WiMAX AND WLAN)

| Band | Mode | Separation Distance (m) | Output Power (dBm) | Antenna Gain (dBi) | IC Power Density (W/m^2) | FCC Power Density (mW/cm^2) |
|---------------|-------|-------------------------|--------------------|--------------------|--------------------------|-----------------------------|
| 2.4GHz g mode | WLAN | | 22.16 | 1.00 | | |
| 5MHz 16QAM | WiMAX | | 24.78 | -0.50 | | |
| Combined | | 0.20 | | | 0.95 | 0.095 |

The co-located Power Density is less than 10 W/m^2 or 1 mW/cm^2, which is the limit for these operating frequency ranges.

10.3.4. CO-LOCATED TRANSMITTERS (WLAN and CDMA 800)

| Band | Mode | Separation Distance (m) | Output Power (dBm) | Antenna Gain (dBi) | IC Power Density (W/m^2) | FCC Power Density (mW/cm^2) |
|---------------|------|-------------------------|--------------------|--------------------|--------------------------|-----------------------------|
| 2.4GHz g mode | WLAN | | 22.16 | 1.00 | | |
| 800 MHz | CDMA | | 29.82 | 0.00 | | |
| Combined | | 0.20 | | | 2.32 | 0.232 |

The co-located Power Density is less than 5.5 W/m^2 or 0.55 mW/cm^2, which is the most stringent of the limits for the above operating frequency ranges.

10.3.5. CO-LOCATED TRANSMITTERS (WLAN and CDMA 1900)

| Band | Mode | Separation Distance (m) | Output Power (dBm) | Antenna Gain (dBi) | IC Power Density (W/m^2) | FCC Power Density (mW/cm^2) |
|---------------|------|-------------------------|--------------------|--------------------|--------------------------|-----------------------------|
| 2.4GHz g mode | WLAN | | 22.16 | 1.00 | | |
| 1900 MHz | CDMA | | 29.11 | 0.00 | | |
| Combined | | 0.20 | | | 2.03 | 0.203 |

The co-located Power Density is less than 10 W/m^2 or 1 mW/cm^2, which is the limit for these operating frequency ranges.