Elliott Laboratories
www.elliottlabs.com
684 West Maude Avenue
Sunnyvale, CA 94085-3518
408-245-7800 Phone
408-245-3499 Fax

# *Radio Test Report*

## *FCC Part 95*
## *MedRadio Transmitter*

## *Model: SD2*

| | |
|---|---|
| COMPANY: | GE MDS LLC<br>175 Science Parkway<br>Rochester, NY 14620 |
| TEST SITE(S): | Elliott Laboratories<br>684 W. Maude Avenue<br>Sunnyvale, CA 94085 |
| REPORT DATE: | January 13, 2010 |
| FINAL TEST DATES: | October 29, November 5, 9, 12, and January 5 and 7, 2010 |

AUTHORIZED SIGNATORY:

David W Bare

David W. Bare
Chief Engineer
Elliott Laboratories

ACCREDITED

Testing Cert #2016.01

## *REVISION HISTORY*

| Rev# | Date | Comments | Modified By |
|---|---|---|---|
| - | January 13, 2010 | First release | |

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## *SCOPE*

Tests have been performed on the GE MDS LLC model SD2, pursuant to the relevant requirements of the following standard(s) in order to obtain device certification against the regulatory requirements of the Federal Communications Commission and Industry Canada.

- Code of Federal Regulations (CFR) Title 47 Part 2
- CFR 47 Part 95 (Medical Device Radiocommunication Service) Subpart I

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in Elliott Laboratories test procedures:

ANSI C63.4:2003
ANSI TIA-603-C August 17, 2004

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the GE MDS LLC model SD2 and therefore apply only to the tested sample. The sample was selected and prepared by Dennis McCarthy of GE MDS LLC.

## *OBJECTIVE*

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, the device requires certification. Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

## *STATEMENT OF COMPLIANCE*

The tested sample of GE MDS LLC model SD2 complied with the requirements of the standards and frequency bands declared in the scope of this test report.

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

## *DEVIATIONS FROM THE STANDARDS*

No deviations were made from the published requirements listed in the scope of this report.

## *TEST RESULTS*

*FCC Part 95 – IVDS*

| FCC | Description | Measured | Limit | Result |
|---|---|---|---|---|
| **Transmitter Modulation, output power and other characteristics** | | | | |
| §2.1033 (c) (5)<br>§ 95.853 | Frequency ranges (Listed for each channel spacing) | 25 kHz 218-219 MHz<br>12.5 kHz 218-219 MHz<br>6.25 kHz 218-219 MHz | 218-219 MHz | Complies |
| §2.1033 (c) (6)<br>§2.1033 (c) (7)<br>§2.1046<br>§ 95.855 | Total power (218-219 MHz) (Maximum for each channel spacing) | 50 kHz – 5.0 W<br>25 kHz 5.0 W<br>12.5 kHz 5.0 W<br>6.25 kHz 5.0 W | 20 Watts erp Fixed, 4 Watts erp Mobile[1] | Complies |
| §2.1033 (c) (4)<br>§2.1047<br>§ 95.857 | Emission types | F1D, F2D, F3D | Information only | - |
| | Emission mask | Device complies with spectral masks – refer to test data | 95.857 | Complies |
| §2.1049 | Occupied (99%) Bandwidth | 48.9 kHz – 218-219 MHz<br>16.8 kHz 216-220 MHz<br>9.32 kHz – 216-220 MHz<br>3.24 kHz – 216-220 MHz | Information only | - |
| **Transmitter spurious emissions** | | | | |
| §2.1051<br>§2.1057<br>§95.857 | At antenna terminal | -29.7 dBm | -13 dBm | Complies |
| | Radiated (erp) | -48.5 dBm[2] | | Complies |
| **Receiver spurious emissions** | | | | |
| 15.111 | At antenna terminal | -69.0 dBm | -57 dBm | Complies |
| 15.109 | Field strength | 33.4 dBuV/m | Refer to RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS | Complies |
| **Other details** | | | | |
| §2.1055 | Frequency stability | 0.2 ppm | None specified for IVDS in Part 95, so must be maintained in the frequency segment | Complies |
| §1.1307(b)<br>§2.1093 | RF Exposure | Although RF exposure compliance is addressed at the time of licensing an MPE calculation has been provided to demonstrate compliance with limits at distances of 1.5m or more from the antennas. | | |
| §2.1033 (c) (8) | Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range | 13.8V, 2.2A | Information only | - |
| - | Antenna Gain | This application is for antennas of 7.0 dBd (9.15 dBi) gain[1]. | | |

**Notes**
1) Licensee ensures Fixed and Mobile units limited to 20W and 4W ERP respectively.
2) Calculated from measured field strength using free space propagation equation

*EXTREME CONDITIONS*

Frequency stability is determined over extremes of temperature and voltage. The extremes of voltage were 85 to 115 percent of the nominal value.

The extremes of temperature were -30°C to +50°C as specified in FCC §2.1055(a)(1).

*MEASUREMENT UNCERTAINTIES*

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2) and were calculated in accordance with NAMAS document NIS 81 and M3003.

| Measurement Type | Measurement Unit | Frequency Range | Expanded Uncertainty |
|---|---|---|---|
| RF frequency | Hz | 25 to 7,000 MHz | $1.7 \times 10^{-7}$ |
| RF power, conducted | dBm | 25 to 7,000 MHz | ± 0.52 dB |
| Conducted emission of transmitter | dBm | 25 to 40,000 MHz | ± 0.7 dB |
| Conducted emission of receiver | dBm | 25 to 40,000 MHz | ± 0.7 dB |
| Radiated emission (substitution method) | dBm | 25 to 40,000 MHz | ± 2.5 dB |
| Radiated emission (field strength) | dBμV/m | 25 to 1,000 MHz<br>1 to 40 GHz | ± 3.6 dB<br>± 6.0 dB |

## *EQUIPMENT UNDER TEST (EUT) DETAILS*

### *GENERAL*

The GE MDS LLC model SD2 is a industrial radio operating in the 216-222 MHz band for FCC Parts 80, 90 and 95. Since the EUT could be placed anywhere in use, it was placed on a table top during testing to simulate the end-user environment. The electrical rating of the EUT is 10 - 30 Volts DC, 2.2 Amps.

The sample was received on October 29, 2009 and tested on October 29, November 5, 9, 12, and January 5 and 7, 2010. The EUT consisted of the following component(s):

| Company | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| GE MDS LLC | SD2 Transceiver | Industrial Radio | 999999 | E5MDS-SD2-1 |

### *OTHER EUT DETAILS*

The radio can operate on 5, 6.25, 12.5, 15, 25 and 50 KHz spaced channels using F1D, F2D and F3D modulations.

### *ENCLOSURE*

The EUT enclosure is primarily constructed of aluminum. It measures approximately 16cm wide by 12cm deep by 4cm high.

### *MODIFICATIONS*

No modifications were made to the EUT during the time the product was at Elliott.

### *SUPPORT EQUIPMENT*

The following equipment was used as support equipment for testing:

| Company | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| Winbook | Winbook XL | Computer | H1106677 | - |
| Agilent | E3610A | Power Source | MY40011740 | - |

The following equipment was used as remote support equipment for emissions testing:

| Company | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| Netgear | GS108 | Ethernet Switch | GS16152CB035447 | - |

No support equipment was used during testing.

*EUT INTERFACE PORTS*

The I/O cabling configuration during testing was as follows:

| Port | Connected To | Cable(s) | | |
|---|---|---|---|---|
| | | Description | Shielded or Unshielded | Length(m) |
| Ethernet | Switch | Cat 5 | Shielded | 10.0 |
| COM1 | Computer | Serial | Shielded | 2.0 |
| DC Power | Power Source | two wire | Unshielded | 2.0 |

Note: The COM2 port was not connected during testing except as needed for configuration of the radio. This port is for diagnostic purposes and therefore would not normally be connected.

*EUT OPERATION*

During radio performance emissions testing the EUT was set to transmit at 37dBm with modulation on or off as needed for testing. During receiver and unintentional emissions testing, the radio was set for receive mode.

## *TESTING*

### *GENERAL INFORMATION*

Radiated spurious emissions measurements were taken at the Elliott Laboratories Anechoic Chambers and/or Open Area Test Site(s) listed below. The sites conform to the requirements of ANSI C63.4: 2003 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* and CISPR 16-1-4:2007 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. They are on file with the FCC and industry Canada.

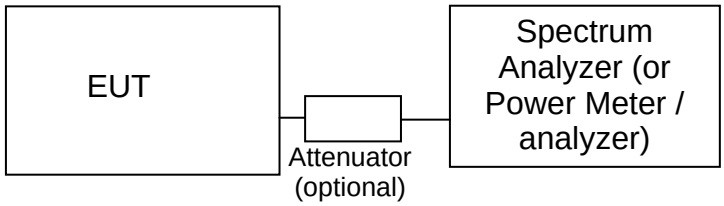
| Site | Registration Numbers | | Location |
|---|---|---|---|
| | FCC | Canada | |
| SVOATS #2 | 90593 | 2845A-2 | 684 West Maude Ave,<br>Sunnyvale<br>CA 94085-3518 |

In the case of Open Area Test Sites, ambient levels are at least 6 dB below the specification limits with the exception of predictable local TV, radio, and mobile communications traffic.

Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements.

## *RF PORT MEASUREMENT PROCEDURES*

Conducted measurements are performed with the EUT's rf input/output connected to the input of a spectrum analyzer, power meter or modulation analyzer. When required an attenuator, filter and/or dc block is placed between the EUT and the spectrum analyzer to avoid overloading the front end of the measurement device. Measurements are corrected for the insertion loss of the attenuators and cables inserted between the rf port of the EUT and the measurement equipment.




Test Configuration for Antenna Port Measurements

### *OUTPUT POWER*

Output power is measured using a power meter and an average sensor head, a spectrum analyzer or a power meter and peak power sensor head as required by the relevant rule part(s). Where necessary measurements are gated to ensure power is only measured over periods that the device is transmitting.

Power measurements made directly on the rf power port are, when appropriate, converted to an EIRP by adding the gain of the highest gain antenna that can be used with the device under test, as specified by the manufacturer.

For devices with an integral antenna the output power is measured as a field strength at a test distance of (typically) 3m and then converted to an eirp using far field equations as shown in SAMPLE CALCULATIONS –RADIATED POWER.

### *BANDWIDTH MEASUREMENTS*

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN. The measurement bandwidth is set to be at least 1% of the instrument's frequency span.

*FREQUENCY STABILITY*

The EUT is placed inside a temperature chamber with all support and test equipment located outside of the chamber. The temperature is varied across the specified frequency range in 10 degree increments with frequency measurements made at each temperature step. The EUT is allowed enough time to stabilize at each temperature variation.

The spectrum analyzer is configured to give a 5- or 6-digit display for the marker-frequency function. The spectrum analyzer's built-in frequency counter is used to measure the maximum deviation of the fundamental frequency at each temperature. Where possible the device is set to transmit an unmodulated signal. Where this is not possible the frequency drift is determined by finding a stable point on the signal (e.g. the null at the centre of an OFDM signal) or by calculating a centre frequency based on the upper and lower XdB points (where X is typically 6dB or 10dB) on the signal's skirts.

## *RADIATED EMISSIONS MEASUREMENTS*

Receiver radiated spurious emissions measurements are made in accordance with ANSI ANSI C63.4:2003 by measuring the field strength of the emissions from the device at a specific test distance and comparing them to a field strength limit. Where the field strength limit is specified at a longer distance than the measurement distance the measurement is extrapolated to the limit distance.

Transmitter radiated spurious emissions are initially measured as a field strength. The eirp or erp limit as specified in the relevant rule part(s) is converted to a field strength at the test distance and the emissions from the EUT are then compared to that limit. Emissions within 20dB of this limit are the subjected to a substitution measurement.

All radiated emissions measurements are performed in two phases. A preliminary scan of emissions is conducted in either an anechoic chamber or on an OATS during which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed across the complete frequency range of interest and at each operating frequency identified in the reference standard. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode).

During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit. For transmitter spurious emissions, where the limit is expressed as an effective radiated power, the eirp or erp is converted to a field strength limit.

Final measurements are made on an OATS or in a semi-anechoic chamber at the significant frequencies observed during the preliminary scan(s) using the same process of rotating the EUT and raising/lowering the measurement antenna to find the highest level of the emission. The field strength is recorded and, for receiver spurious emissions, compared to the field strength limit. For the final measurement the appropriate detectors (average, peak, normal, sample, quasi-peak) are used. For receiver measurements below 1GHz the detector is a Quasi-Peak detector, above 1GHz a peak detector is used and the peak value (RB=VB=1MHz) and average value (RB=1MHz, VB=10Hz) are recorded.

For transmitter spurious emissions, the radiated power of all emissions within 20dB of the calculated field strength limit are determined using a substitution measurement. The substitution measurement is made by replacing the EUT with an antenna of known gain (typically a dipole antenna or a double-ridged horn antenna), connected to a signal source. The output power of the signal generator is adjusted until the maximum field strength from the substitution antenna is similar to the field strength recorded from the EUT. The erp of the EUT is then calculated.

*INSTRUMENTATION*

An EMI receiver as specified in CISPR 16-1-1 is used for radiated emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary.

For measurements above the frequency range of the receivers and for all conducted measurements a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis.

Measurement bandwidths for the test instruments are set in accordance with the requirements of the standards referenced in this document.

Software control is used to correct the measurements for transducer factors (e.g. antenna) and the insertion loss of cables, attenuators and other series elements to obtain the final measurement value. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are exported in a graphic and/or tabular format, as appropriate.

*FILTERS/ATTENUATORS*

External filters and precision attenuators are often connected between the EUT antenna port or receiving antenna and the test receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

*ANTENNAS*

A combination of biconical, log periodic or bi-log antennas are used to cover the range from 30 MHz to 1000 MHz. Broadband antennas or tuned dipole antennas are used over the entire 25 to 1000 MHz frequency range as the reference antenna for substitution measurements.

Above 1000 MHz, a dual-ridge guide horn antenna or octave horn antenna are used as reference and measurement antennas.

The antenna calibration factors are included in site factors that are programmed into the test receivers and instrument control software when measuring the radiated field strength.

*ANTENNA MAST AND EQUIPMENT TURNTABLE*

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

Table mounted devices are placed on a non-conductive table at a height of 80 centimeters above the floor. Floor mounted equipment is placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. The EUT is positioned on a motorized turntable to allow it to be rotated during testing to determine the angel with the highest level of emissions.

## *SAMPLE CALCULATIONS*

*SAMPLE CALCULATIONS - CONDUCTED SPURIOUS EMISSIONS*

Measurements are compared directly to the conducted emissions specification limit (decibel form). The calculation is as follows:

$$R_r - S = M$$

where:

$R_r$ = Measured value in dBm
S = Specification Limit in dBm
M = Margin to Specification in +/- dB

*SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH*

Measurements of radiated field strength are compared directly to the specification limit (decibel form). The receiver and/or control software corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor is sued when measurements are made at a test distance that is different to the specified limit distance by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

$F_d$ = Distance Factor in dB

$D_m$ = Measurement Distance in meters

$D_s$ = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

$R_r$ = Receiver Reading in dBuV/m

$F_d$ = Distance Factor in dB

$R_C$ = Corrected Reading in dBuV/m

$L_S$ = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

*SAMPLE CALCULATIONS –RADIATED POWER*

The erp/eirp limits for transmitter spurious measurements are converted to a field strength in free space using the following formula:

$$E = \frac{\sqrt{30\ P\ G}}{d}$$

where:

E = Field Strength in V/m
P = Power in Watts
G = Gain of isotropic antenna (numeric gain) = 1
D = measurement distance in meters

The field strength limit is then converted to decibel form (dBuV/m) and the margin of a given emission peak relative to the limit is calculated (refer to *SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH*).

When substitution measurements are required (all signals with less than 20dB of margin relative to the calculated field strength limit) the eirp of the spurious emission is calculated using:

$$P_{EUT} = P_S - (E_S - E_{EUT})$$

and

$$P_S = G + P_{in}$$

where:

$P_S$ = effective isotropic radiated power of the substitution antenna (dBm)
$P_{in}$ = power input to the substitution antenna (dBm)
G = gain of the substitution antenna (dBi)
$E_S$ = field strength the substitution antenna (dBm) at eirp $P_S$
$E_{EUT}$ = field strength measured from the EUT

Where necessary the effective isotropic radiated power is converted to effective radiated power by subtracting the gain of a dipole (2.2dBi) from the eirp value.

## *RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS*

The table below shows the limits for the spurious emissions from receivers as detailed in FCC Part 15.109. Note that receivers operating outside of the frequency range 30 MHz – 960 MHz are exempt from the requirements of 15.109.

| Frequency Range (MHz) | Limit (uV/m @ 3m) | Limit (dBuV/m @ 3m) |
|---|---|---|
| 30 to 88 | 100 | 40 |
| 88 to 216 | 150 | 43.5 |
| 216 to 960 | 200 | 46.0 |
| Above 960 | 500 | 54.0 |

For MedRadio, the above limits also apply to the transmitter per §95.635(d).

# *Appendix A Test Equipment Calibration Data*

| **Conducted Emissions - AC Power Ports, 28-Oct-09** | | | | |
|---|---|---|---|---|
| **Engineer: Mehran Birgani** | | | | |
| **Manufacturer** | **Description** | **Model #** | **Asset #** | **Cal Due** |
| Elliott Laboratories | LISN, FCC / CISPR | LISN-3, OATS | 304 | 15-Jul-10 |
| Hewlett Packard | EMC Spectrum Analyzer, 9 kHz - 6.5 GHz | 8595EM | 780 | 30-Dec-09 |
| Rohde & Schwarz | Pulse Limiter | ESH3 Z2 | 812 | 23-Feb-10 |
| Rohde & Schwarz | Test Receiver, 0.009-30 MHz | ESH3 | 1316 | 06-Nov-09 |
| | | | | |

| **Radio Antenna Port (Power and Spurious Emissions), 29-Oct-09** | | | | |
|---|---|---|---|---|
| **Engineer: John Caizzi** | | | | |
| **Manufacturer** | **Description** | **Model #** | **Asset #** | **Cal Due** |
| Rohde & Schwarz | Power Meter, Single Channel | NRVS | 1290 | 22-Oct-10 |
| Rohde & Schwarz | Power Sensor 100 uW - 2 Watts (w/ 20 dB pad, SN BJ5155) | NRV-Z32 | 1536 | 02-Sep-10 |
| Agilent | PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX, | E4446A | 2139 | 30-Dec-09 |
| | | | | |

| **Radiated Emissions, 30 - 2,500 MHz Chamber Prescan, 02-Nov-09** | | | | |
|---|---|---|---|---|
| **Engineer: John Caizzi** | | | | |
| **Manufacturer** | **Description** | **Model #** | **Asset #** | **Cal Due** |
| Hewlett Packard | Microwave Preamplifier, 1-26.5GHz | 8449B | 870 | 19-Aug-10 |
| Hewlett Packard | EMC Spectrum Analyzer, 9 KHz-26.5 GHz | 8593EM | 1141 | 29-Dec-09 |
| EMCO | Log Periodic Antenna, 0.2-2 GHz | 3148 | 1404 | 24-Feb-10 |
| EMCO | Biconical Antenna, 30-300 MHz | 3110B | 1497 | 15-Sep-10 |
| EMCO | Antenna, Horn, 1-18 GHz | 3117 | 1662 | 11-Apr-10 |
| Hewlett Packard | Preamplifier, 100 kHz - 1.3 GHz | 8447D OPT 010 | 1826 | 26-May-10 |
| | | | | |

| **Radiated Emissions, 30 - 2,500 MHz, Final Data, 02-Nov-09** | | | | |
|---|---|---|---|---|
| **Engineer: John Caizzi** | | | | |
| **Manufacturer** | **Description** | **Model #** | **Asset #** | **Cal Due** |
| Rohde & Schwarz | Test Receiver, 20-1300 MHz | ESVP | 213 | 02-Apr-10 |
| EMCO | Log Periodic Antenna, 0.3-1 GHz | 3146A | 364 | 23-Dec-09 |
| | | | | |

| **Radiated Emissions, 30 - 2,300 MHz, 05-Nov-09** | | | | |
|---|---|---|---|---|
| **Engineer: Mehran Birgani** | | | | |
| **Manufacturer** | **Description** | **Model #** | **Asset #** | **Cal Due** |
| Elliott Laboratories | Biconical Antenna, 30-300 MHz | EL30.300 | 54 | 03-Apr-11 |
| Rohde & Schwarz | Test Receiver, 20-1300 MHz | ESVP | 213 | 02-Apr-10 |
| EMCO | Log Periodic Antenna, 0.3-1 GHz | 3146A | 364 | 23-Dec-09 |
| EMCO | Biconical Antenna, 30-300 MHz | 3110B | 801 | 08-Sep-11 |
| Hewlett Packard | Microwave Preamplifier, 1-26.5GHz | 8449B | 870 | 19-Aug-10 |
| Hewlett Packard | SpecAn 30 Hz -40 GHz, SV (SA40) Red | 8564E (84125C) | 1148 | 12-Mar-10 |
| EMCO | Log Periodic Antenna, 0.2-2 GHz | 3148 | 1404 | 24-Feb-10 |
| Hewlett Packard | Preamplifier, 100 kHz - 1.3 GHz | 8447D OPT 010 | 1826 | 26-May-10 |
| | | | | |

| **Radiated Emissions, 30 - 2,300 MHz, 06-Nov-09** | | | | |
|---|---|---|---|---|
| **Engineer: Mehran Birgani** | | | | |
| **Manufacturer** | **Description** | **Model #** | **Asset #** | **Cal Due** |
| Elliott Laboratories | Biconical Antenna, 30-300 MHz | EL30.300 | 54 | 03-Apr-11 |
| Rohde & Schwarz | Test Receiver, 20-1300 MHz | ESVP | 213 | 02-Apr-10 |
| EMCO | Log Periodic Antenna, 0.3-1 GHz | 3146A | 364 | 23-Dec-09 |
| EMCO | Antenna, Horn, 1-18 GHz | 3115 | 487 | 15-Jul-10 |
| Hewlett Packard | Microwave Preamplifier, 1-26.5GHz | 8449B | 870 | 19-Aug-10 |
| Hewlett Packard | SpecAn 30 Hz -40 GHz, SV (SA40) Red | 8564E (84125C) | 1148 | 12-Mar-10 |
| | | | | |
| **Frequency Stability, 09-Nov-09** | | | | |
| **Engineer: Mehran Birgani** | | | | |
| **Manufacturer** | **Description** | **Model #** | **Asset #** | **Cal Due** |
| Agilent | PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX, | E4446A | 2139 | 30-Dec-09 |
| Thermotron | Temp Chamber (w/ F4 Watlow Controller) | S1.2 | 2170 | 29-Jun-10 |
| | | | | |
| **Radiated Emissions, 30 - 2,300 MHz, 05-Jan-10** | | | | |
| **Engineer: Mehran Birgani** | | | | |
| **Manufacturer** | **Description** | **Model #** | **Asset #** | **Cal Due** |
| Hewlett Packard | Microwave Preamplifier, 1-26.5GHz | 8449B | 870 | 19-Aug-10 |
| Hewlett Packard | EMC Spectrum Analyzer, 9 KHz-26.5 GHz | 8593EM | 1141 | 21-Dec-10 |
| EMCO | Log Periodic Antenna, 0.2-2 GHz | 3148 | 1404 | 24-Feb-10 |
| EMCO | Biconical Antenna, 30-300 MHz | 3110B | 1497 | 15-Sep-10 |
| EMCO | Antenna, Horn, 1-18 GHz | 3117 | 1662 | 11-Apr-10 |
| Hewlett Packard | Preamplifier, 100 kHz - 1.3 GHz | 8447D OPT 010 | 1826 | 26-May-10 |
| | | | | |
| **Radiated Emissions, 30 - 2,300 MHz, Jan 05&07 of 2010** | | | | |
| **Engineer: Mehran Birgani** | | | | |
| **Manufacturer** | **Description** | **Model #** | **Asset #** | **Cal Due** |
| Elliott Laboratories | Biconical Antenna, 30-300 MHz | EL30.300 | 54 | 03-Apr-11 |
| Elliott Laboratories | Log Periodic Antenna 300-1000 MHz | EL300.1000 | 55 | 03-Apr-10 |
| Rohde & Schwarz | Test Receiver, 20-1300 MHz | ESVP | 213 | 02-Apr-10 |

# *Appendix B Test Data*

T77846 29 Pages

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | Project Engineer: | David Bare |
| Emissions Standard(s): | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | A |
| Immunity Standard(s): | - | Environment: | Radio |

# EMC Test Data

For The

# GE MDS LLC

Model

SD2 Transceiver

Date of Last Test: 1/12/2010

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

# Radiated Spurious Emissions
# RSS GEN, FCC Part 15

## Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

## General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing. All remote support equipment was located approximately 30 meters from the EUT with all I/O connections running on top of the groundplane or routed in overhead in the GR-1089 test configuration.

The measurement antenna was located 3 meters from the EUT.

## Ambient Conditions:

Temperature: 15-18 °C
Rel. Humidity: 40-45 %

## Summary of Results

| Run # | Test Performed | Limit | Pass / Fail | Result / Margin |
|---|---|---|---|---|
| 2 | Spurious Emissions<br>Receive/Stand-By Mode<br>30 - 2500 MHz | FCC 15<br>RSS GEN | Pass | 33.4dBµV/m (46.8µV/m)<br>@ 875.04MHz (-12.6dB) |

## Modifications Made During Testing

No modifications were made to the EUT during testing

## Deviations From The Standard

No deviations were made from the requirements of the standard.

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Run #1: Radiated Spurious Emissions, Receive Mode, 30 - 2500 MHz

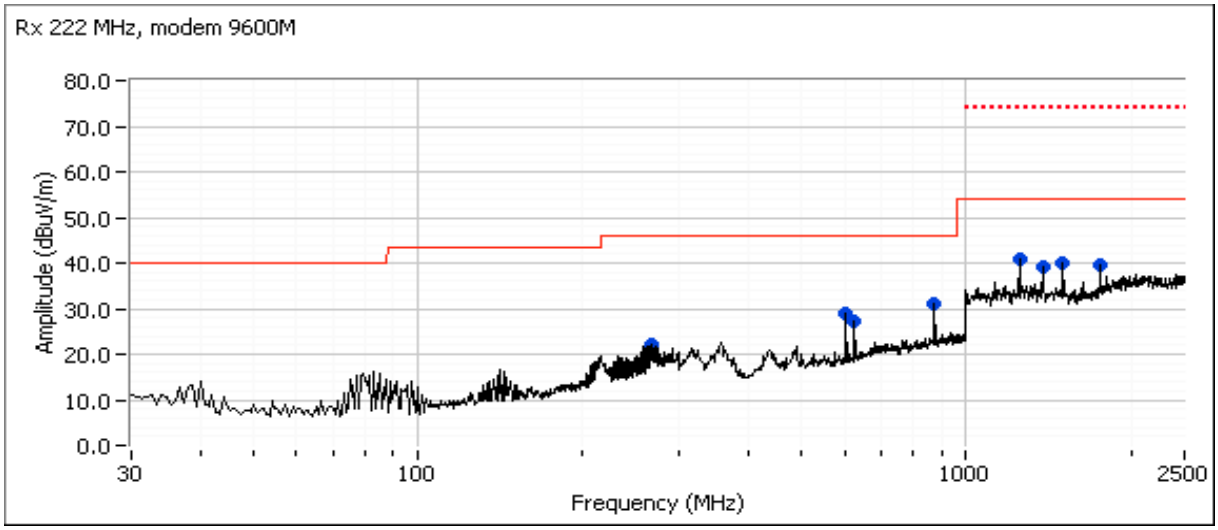
Run #1a - Preliminary measurements - chamber scans

Date: 11/1/2009 Engineer: John Caizzi Location: Chamber #2

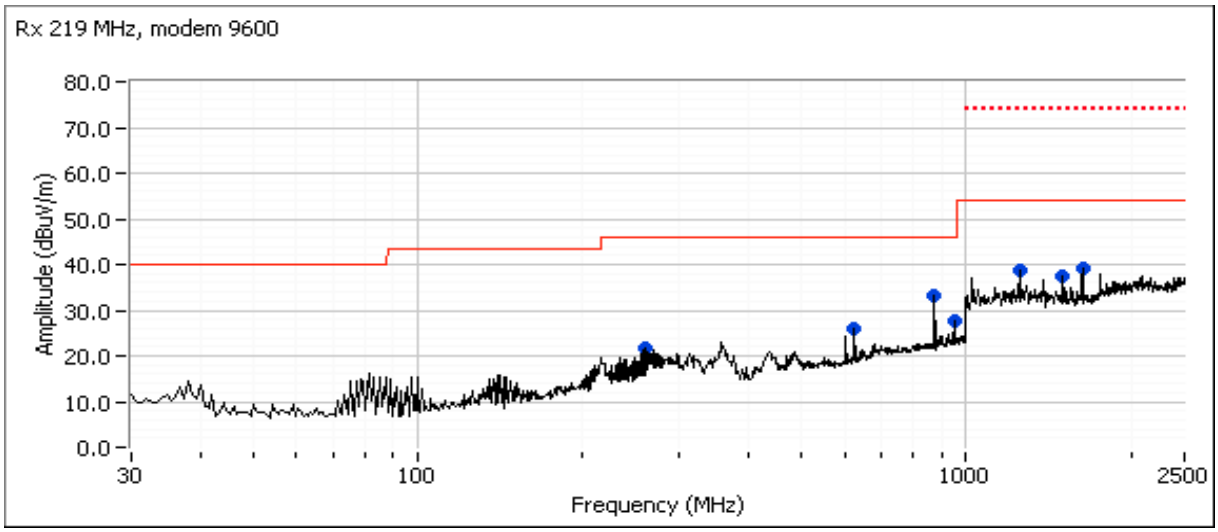
| Frequency MHz | Level dBµV/m | Pol V/H | FCC Limit | FCC Margin | Detector Pk/QP/Avg | Azimuth degrees | Height meters | Comments | Channel and mode |
|---|---|---|---|---|---|---|---|---|---|
| *259.500* | 21.6 | H | 46.0 | -24.4 | Peak | 148 | 1.7 | Modem 9600M, PWR 37 | 220 |
| *259.500* | 22.0 | H | 46.0 | -24.0 | Peak | 148 | 1.7 | Modem 19200, PWR 33 | 216 |
| *265.575* | 22.0 | H | 46.0 | -24.0 | Peak | 328 | 1.7 | Modem 9600M, PWR 37 | 222 |
| 600.031 | 29.0 | H | 46.0 | -17.0 | Peak | 349 | 1.7 | Modem 9600M, PWR 37 | 222 |
| 600.057 | 25.9 | H | 46.0 | -20.1 | Peak | 355 | 1.7 | Modem 19200, PWR 33 | 216 |
| 625.003 | 26.9 | H | 46.0 | -19.1 | Peak | 352 | 1.7 | Modem 19200, PWR 33 | 216 |
| 625.029 | 27.2 | H | 46.0 | -18.8 | Peak | 354 | 1.7 | Modem 9600M, PWR 37 | 222 |
| 625.029 | 25.9 | H | 46.0 | -20.1 | Peak | 344 | 1.7 | Modem 9600M, PWR 37 | 220 |
| 875.043 | 30.9 | H | 46.0 | -15.1 | Peak | 329 | 1.7 | Modem 9600M, PWR 37 | 222 |
| 875.043 | 33.4 | H | 46.0 | -12.6 | Peak | 327 | 1.7 | Modem 9600M, PWR 37 | 220 |
| 875.069 | 32.9 | H | 46.0 | -13.1 | Peak | 332 | 1.7 | Modem 19200, PWR 33 | 216 |
| 950.009 | 27.5 | V | 46.0 | -18.5 | Peak | 168 | 1.7 | Modem 9600M, PWR 37 | 220 |
| *1000.000* | 27.5 | H | 54.0 | -26.5 | Peak | 122 | 1.7 | Modem 9600M, PWR 37 | 220 |
| 1249.960 | 36.3 | V | 54.0 | -17.7 | Peak | 55 | 1.7 | Modem 19200, PWR 33 | 216 |
| 1250.070 | 40.9 | V | 54.0 | -13.1 | Peak | 256 | 1.7 | Modem 9600M, PWR 37 | 222 |
| 1250.180 | 39.7 | V | 54.0 | -14.3 | Peak | 263 | 1.7 | Modem 9600M, PWR 37 | 220 |
| 1374.990 | 38.5 | V | 54.0 | -15.5 | Peak | 312 | 1.7 | Modem 19200, PWR 33 | 216 |
| 1375.050 | 39.2 | V | 54.0 | -14.8 | Peak | 307 | 1.7 | Modem 9600M, PWR 37 | 222 |
| 1499.980 | 39.8 | V | 54.0 | -14.2 | Peak | 353 | 1.7 | Modem 9600M, PWR 37 | 222 |
| 1499.980 | 38.1 | V | 54.0 | -15.9 | Peak | 353 | 1.7 | Modem 19200, PWR 33 | 216 |
| 1500.090 | 38.2 | V | 54.0 | -15.8 | Peak | 338 | 1.7 | Modem 9600M, PWR 37 | 220 |
| 1625.010 | 39.3 | V | 54.0 | -14.7 | Peak | 190 | 1.7 | Modem 9600M, PWR 37 | 220 |
| 1749.990 | 36.7 | V | 54.0 | -17.3 | Peak | 296 | 1.7 | Modem 19200, PWR 33 | 216 |
| 1750.160 | 39.6 | V | 54.0 | -14.4 | Peak | 6 | 1.7 | Modem 9600M, PWR 37 | 222 |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Graph - Channel: 216.00625 MHz, Mode: Modem 9600M

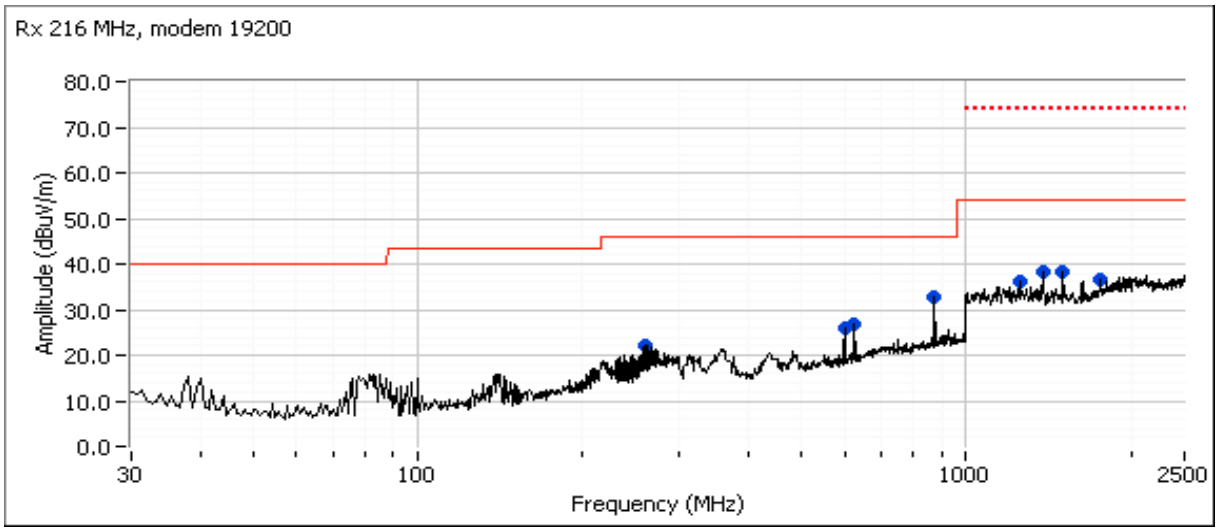



Graph - Channel: 219.00625 MHz, Mode: Modem 9600



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Graph - Channel: 216.0125 MHz, Mode: Modem 19200




Run #2: Radiated Spurious Emissions, Receive Mode: Final Field Strength

Date: 11/6/2009 Engineer: Mehran Birgani Location: OATS #2

| Frequency MHz | Level dBµV/m | Pol V/H | FCC Part 15 Limit | FCC Part 15 Margin | Detector Pk/QP/Avg | Azimuth degrees | Height meters | Comments | Channel and mode |
|---|---|---|---|---|---|---|---|---|---|
| 1250.090 | 38.2 | V | 54.0 | -15.8 | AVG | 178 | 1.0 | Modem 9600M | 222 |
| 1375.050 | 37.0 | V | 54.0 | -17.0 | AVG | 165 | 1.0 | Modem 9600M | 222 |
| 1500.070 | 35.8 | V | 54.0 | -18.2 | AVG | 168 | 1.0 | Modem 9600M | 222 |
| 1625.750 | 31.9 | V | 54.0 | -22.1 | AVG | 181 | 1.8 | Modem 9600M | 220 |
| 1750.060 | 34.3 | V | 54.0 | -19.7 | AVG | 170 | 1.1 | Modem 9600M | 222 |
| 1249.990 | 51.5 | V | 74.0 | -22.5 | PK | 178 | 1.0 | Modem 9600M | 222 |
| 1375.160 | 44.5 | V | 74.0 | -29.5 | PK | 165 | 1.0 | Modem 9600M | 222 |
| 1499.950 | 46.6 | V | 74.0 | -27.4 | PK | 168 | 1.0 | Modem 9600M | 222 |
| 1625.140 | 43.0 | V | 74.0 | -31.0 | PK | 181 | 1.8 | Modem 9600M | 220 |
| 1750.140 | 48.8 | V | 74.0 | -25.2 | PK | 170 | 1.1 | Modem 9600M | 222 |
| 259.500 | 19.8 | H | 46.0 | -26.2 | QP | 20 | 1.0 | Modem 19200 | 216 |
| 600.031 | 29.0 | H | 46.0 | -17.0 | QP | 349 | 2.0 | Modem 9600M | 222 |
| 625.029 | 27.2 | H | 46.0 | -18.8 | QP | 354 | 2.0 | Modem 9600M | 222 |
| 875.043 | 33.4 | H | 46.0 | -12.6 | QP | 327 | 2.0 | Modem 9600M | 220 |
| 950.009 | 27.5 | V | 46.0 | -18.5 | QP | 168 | 2.0 | Modem 9600M | 220 |
| 999.950 | 23.4 | H | 46.0 | -22.6 | QP | 150 | 1.0 | Modem 9600M | 220 |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

# RSS GEN and FCC Part 15
## Receiver Spurious Emissions

### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 11/9/2009
Test Engineer: J. Caizzu, M. Birgani
Test Location: Radio Lab

Config. Used: 1
Config Change: None
EUT Voltage: 13.8VDC

### General Test Configuration

With the exception of the radiated spurious emissions tests, all measurements are made with the EUT's rf port connected to the measurement instrument via an attenuator or dc-block if necessary. All amplitude measurements are adjusted to account for the attenuation between EUT and measuring instrument. For frequency stability measurements the EUT was place inside an environmental chamber.

Radiated measurements are made with the EUT located on a non-conductive table, 3m from the measurement antenna.

### Ambient Conditions:

Temperature: 17-22 °C
Rel. Humidity: 30-40 %

### Summary of Results

| Run # | Modem | CH Spacing | Test Performed | Limit | Pass / Fail | Result / Margin |
|---|---|---|---|---|---|---|
| 1 | - | - | Spurious Emissions (conducted) | -57dBm | Pass | -69.0dBm (0.1nW) @ 302.10MHz (-12.0dB) |

### Modifications Made During Testing

No modifications were made to the EUT during testing

### Deviations From The Standard

No deviations were made from the requirements of the standard.

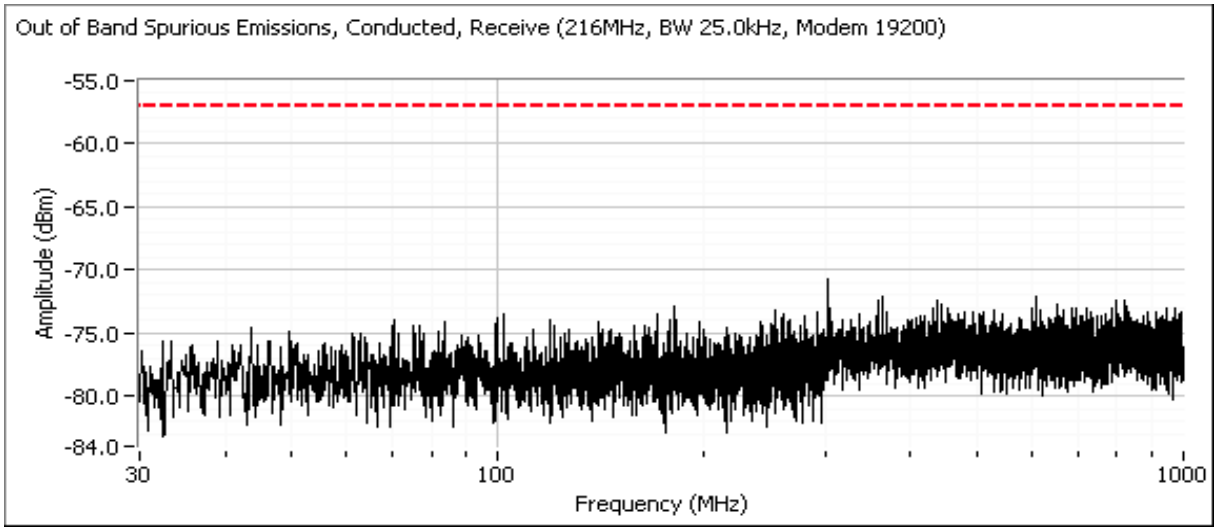
| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Run #1: Out of Band Spurious Emissions, Conducted

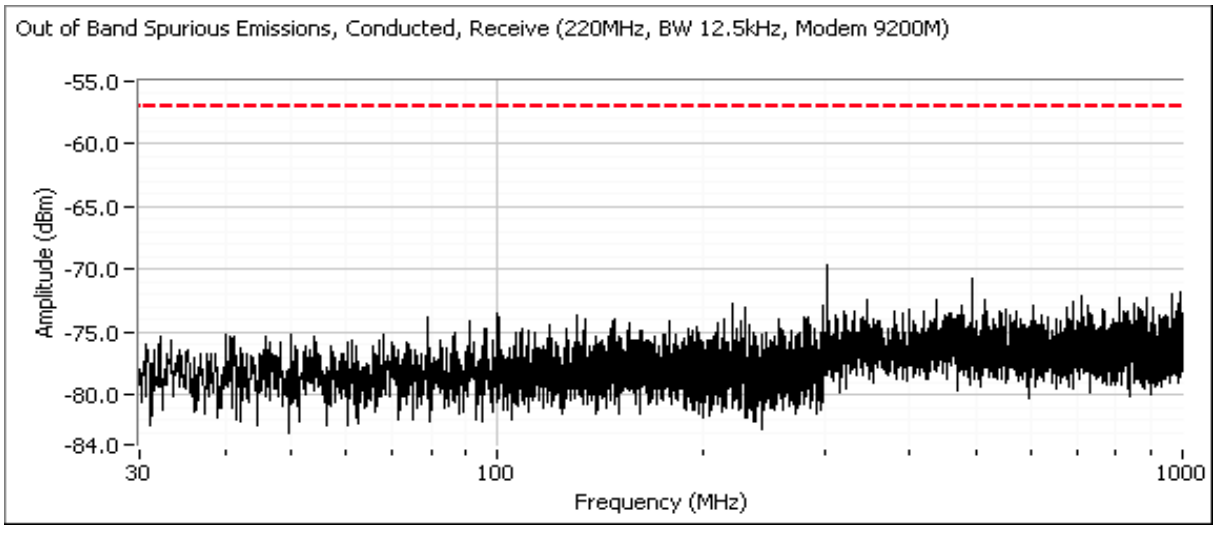
| Frequency (MHz) | Limit | Result |
|---|---|---|
| 216 | -57dBm | Pass |
| 220 | -57dBm | Pass |
| 222 | -57dBm | Pass |

The limit is taken from FCC Part 15.111 and RSS-GEN

Plots for low channel

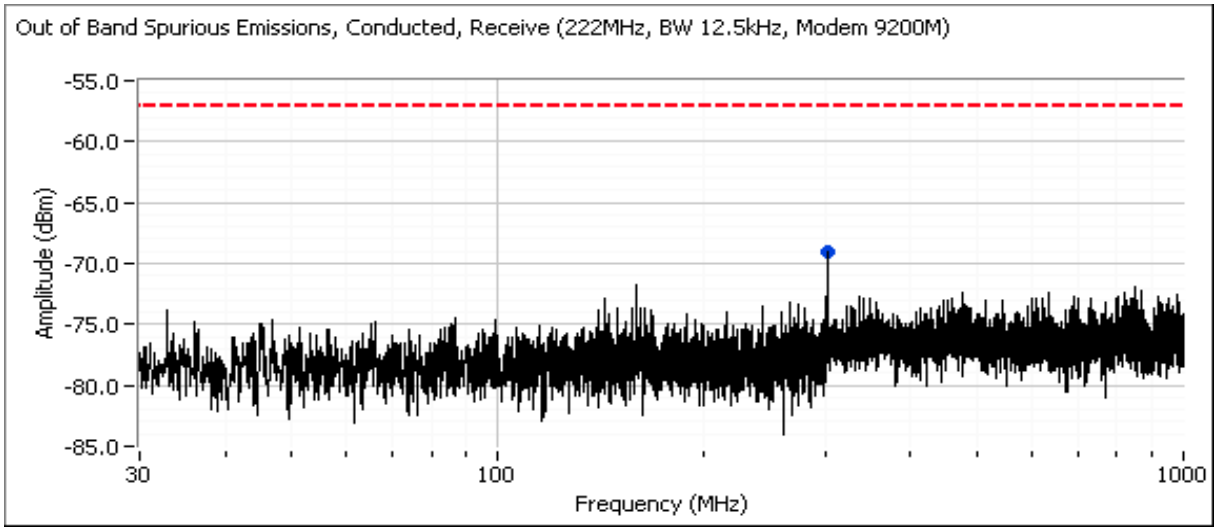



Plots for center channel



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Plots for high channel




| Frequency | Level | Pol | FCC Part 15 | | Detector | Rx | Mode | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBm | - | Limit | Margin | Pk/QP/Avg | Frequency | | |
| 302.101 | -69.0 | RF Port | -57.0 | -12.0 | Peak | 222 | 9600M | |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

# RSS 119 and FCC Part 80 & 90
## Radiated Spurious Emissions

### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: See below
Test Engineer: Mehran Birgani
Test Location: Refer to each run

Config. Used: 1
Config Change: no laptop
EUT Voltage: 13.8VDC

### General Test Configuration

All measurements are made with the EUT's rf port connected to the measurement instrument via an attenuator or dc-block if necessary. All amplitude measurements are adjusted to account for the attenuation between EUT and measuring instrument. For frequency stability measurements the EUT was place inside an environmental chamber.

Radiated measurements are made with the EUT located on a non-conductive table, 3m from the measurement antenna.

### Ambient Conditions:

Temperature: 13-18 °C
Rel. Humidity: 30-40 %

### Summary of Results

| Run # | Spacing | Data Rate | Test Performed | Limit | Pass / Fail | Result / Margin |
|---|---|---|---|---|---|---|
| 1 | - | - | Spurious emissions (radiated) | FCC 90.210 | Pass | 46.7dBµV/m @ 1000.1MHz (-23.5dB) |

### Modifications Made During Testing

No modifications were made to the EUT during testing

### Deviations From The Standard

No deviations were made from the requirements of the standard.

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Run #1: Out of Band Spurious Emissions, Radiated

Date: 11/5/09 & 1/5/10 Engineer: Mehran Birgani Location: Chamber #2

Conducted limit (dBm): -25

Approximate field strength limit @ 3m: 70.2

The limit is taken from FCC Part 90 Mask B for 216-220 MHz operation and Mask F for 220-222 MHz operation

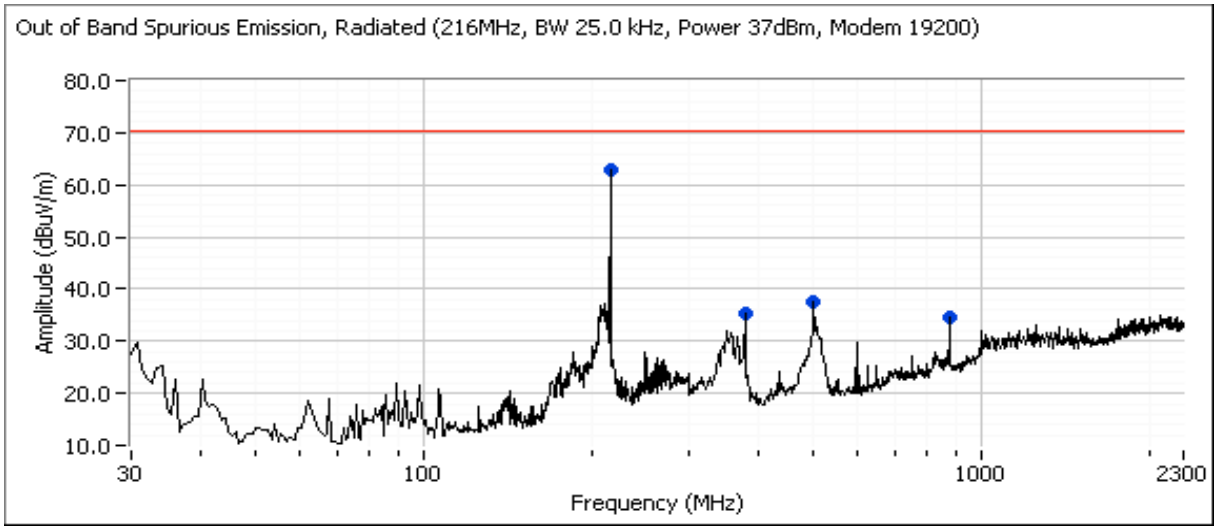
Run #1a - Preliminary measurements - chamber scans

| Frequency | Level | Pol | FCC 90.210 | | Detector | Azimuth | Height | Comments | Tx Freq |
|---|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | V/H | Limit | Margin | Pk/QP/Avg | degrees | meters | | MHz |
| *42.983* | 36.1 | V | 70.2 | -34.1 | Peak | 121 | 1.7 | Modem 9600M, PWR 37 | 222 |
| 42.983 | 35.7 | V | 70.2 | -34.5 | Peak | 239 | 1.7 | Modem 9600M, PWR 37 | 220 |
| 375.023 | 35.4 | H | 70.2 | -34.8 | Peak | 165 | 1.7 | Modem 19200, PWR 37 | 216 |
| 440.022 | 38.4 | H | 70.2 | -31.8 | Peak | 320 | 1.7 | Modem 9600M, PWR 37 | 220 |
| 444.006 | 39.2 | H | 70.2 | -31.0 | Peak | 315 | 1.7 | Modem 9600M, PWR 37 | 222 |
| 499.993 | 37.4 | V | 70.2 | -32.8 | Peak | 136 | 1.7 | Modem 19200, PWR 37 | 216 |
| 500.006 | 38.5 | V | 70.2 | -31.7 | Peak | 155 | 1.7 | Modem 19200, PWR 37 | 218.5 |
| 875.004 | 42.8 | H | 70.2 | -27.4 | Peak | 116 | 1.7 | Modem 9600M, PWR 37 | 222 |
| 875.017 | 38.6 | H | 70.2 | -31.6 | Peak | 112 | 1.7 | Modem 9600M, PWR 37 | 220 |
| 875.017 | 34.7 | H | 70.2 | -35.5 | Peak | 145 | 1.7 | Modem 19200, PWR 37 | 216 |
| 875.017 | 34.0 | V | 70.2 | -36.2 | Peak | 184 | 1.7 | Modem 19200, PWR 37 | 218.5 |
| 1000.060 | 43.3 | H | 70.2 | -26.9 | Peak | 163 | 1.7 | Modem 9600M, PWR 37 | 220 |
| 1000.060 | 40.5 | V | 70.2 | -29.7 | Peak | 38 | 1.7 | Modem 9600M, PWR 37 | 222 |
| 216.002 | 62.8 | H | - | - | Peak | 0 | 1.7 | Modem 19200, PWR 37 | 216 |
| 218.505 | 60.9 | H | - | - | Peak | 0 | 1.7 | Modem 19200, PWR 37 | 218.5 |
| 220.003 | 56.9 | V | - | - | Peak | 269 | 1.7 | Modem 9600M, PWR 37 | 220 |
| 222.003 | 57.1 | H | - | - | Peak | 119 | 1.7 | Modem 9600M, PWR 37 | 222 |

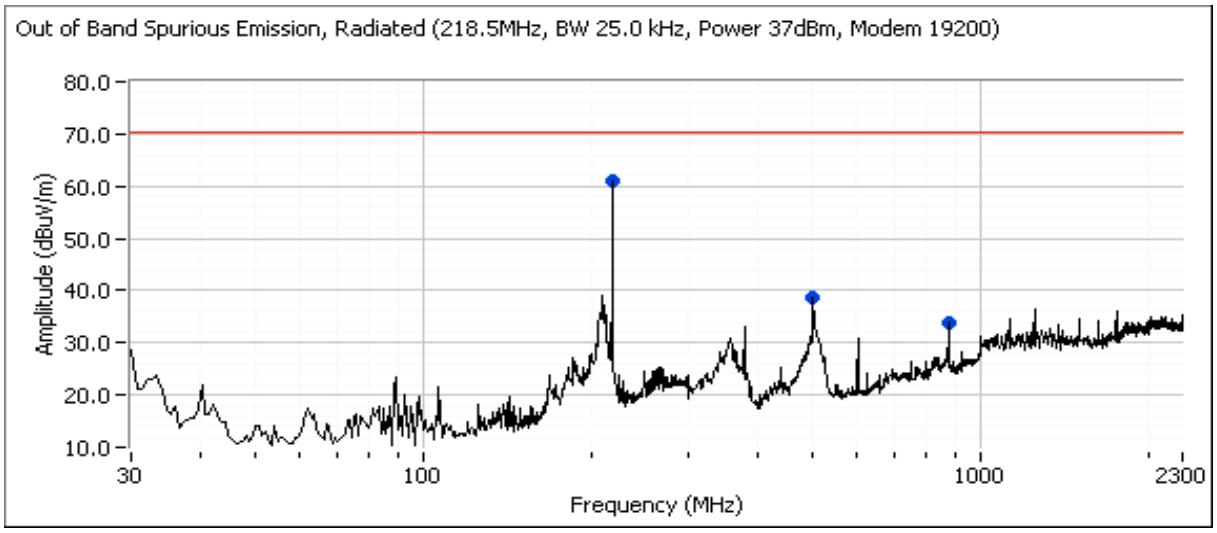
| | |
|---|---|
| Note 1: | The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: $E=\sqrt{(30PG)}/d$. This limit is conservative - it does not consider the presence of the ground plane and, for erp limits, the dipole gain (2.2dBi) has not been included. The erp or eirp for all signals with less than 20dB of margin relative to this field strength limit is determined using substitution measurements. |
| Note 2: | Measurements are made with the antenna port terminated. |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Plots for 216 MHz channel, power setting(s) = 37

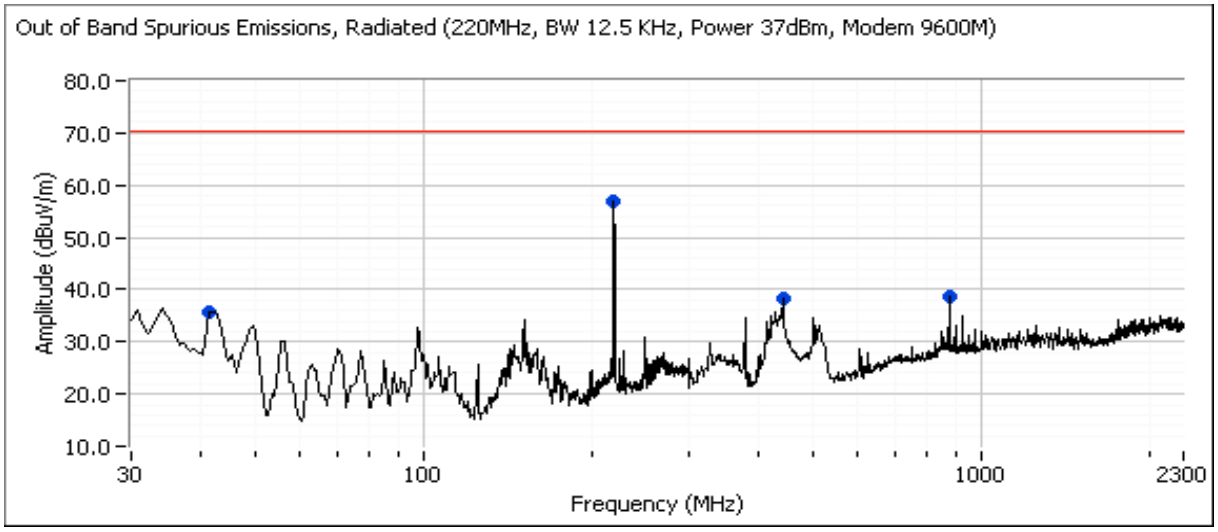



Plots for 218.5 MHz channel, power setting(s) = 37

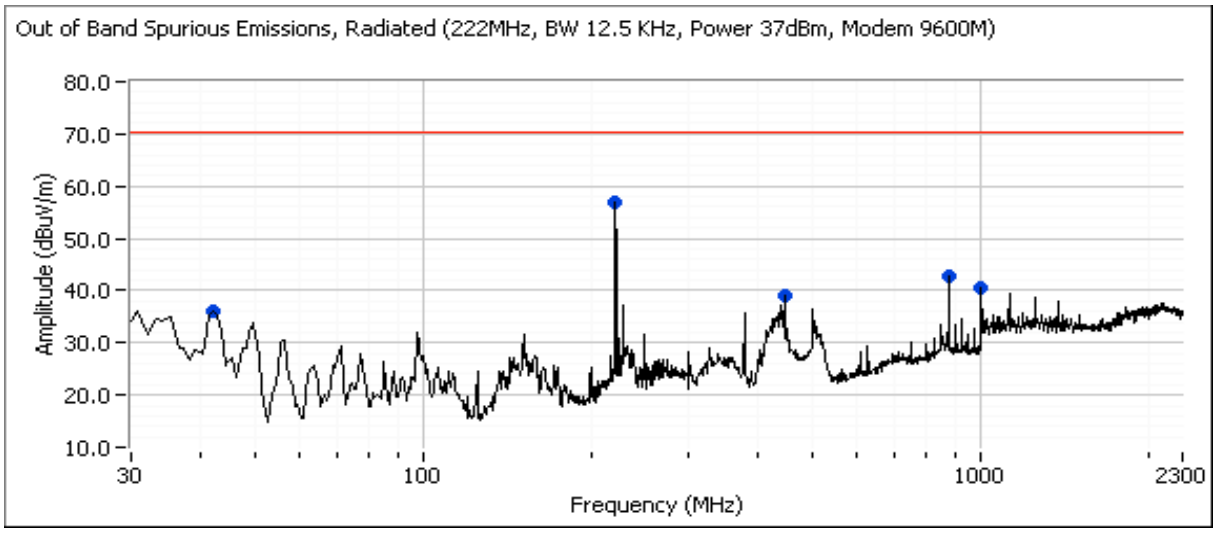


| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Plots for 220MHz channel, power setting(s) = 37




Plots for 222 MHz channel, power setting(s) = 37



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Run #1b: - OATS EUT Field Strength Measurements and Substitution Measurements

Date: 11/5/09 & 1/5/10 Engineer: Mehran Birgani Location: SVOATS #2

.

EUT Field Strength

| Frequency | Level | Pol | FCC 90.210 | | Detector | Azimuth | Height | Comments | Channel |
|---|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | V/H | Limit | Margin | Pk/QP/Avg | degrees | meters | | |
| 42.983 | 29.5 | V | 70.2 | -40.7 | PK | 5 | 1.0 | Modem 9600M, PWR 37 | 222 |
| 375.023 | 31.4 | H | 70.2 | -38.8 | PK | 165 | 1.0 | Modem 19200, PWR 37 | 216 |
| 440.022 | 35.2 | H | 70.2 | -35.0 | PK | 200 | 1.0 | Modem 9600M, PWR 37 | 220 |
| 443.998 | 34.5 | H | 70.2 | -35.7 | PK | 298 | 1.0 | Modem 9600M, PWR 37 | 222 |
| 500.006 | 41.2 | V | 70.2 | -29.0 | PK | 155 | 1.7 | Modem 19200, PWR 37 | 218.5 |
| 875.004 | 41.7 | H | 70.2 | -28.5 | PK | 309 | 1.0 | Modem 9600M, PWR 37 | 222 |
| 875.017 | 40.4 | H | 70.2 | -29.8 | PK | 350 | 1.0 | Modem 9600M, PWR 37 | 220 |
| 1000.060 | 46.7 | H | 70.2 | -23.5 | PK | 15 | 1.1 | Modem 9600M, PWR 37 | 220 |

| | |
|---|---|
| Note 1: | The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: E=√(30PG)/d. This limit is conservative - it does not consider the presence of the ground plane and, for erp limits, the dipole gain (2.2dBi) has not been included. The erp or eirp for all signals with less than 20dB of margin relative to this field strength limit is determined using substitution measurements. |
| Note 2: | Measurements are made with the antenna port terminated. |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

# RSS 119 and FCC Part 80 & 90

## Power, Occupied Bandwidth, Frequency Stability and Spurious Emissions

### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

### General Test Configuration

All measurements are made with the EUT's rf port connected to the measurement instrument via an attenuator or dc-block if necessary. All amplitude measurements are adjusted to account for the attenuation between EUT and measuring instrument. For frequency stability measurements the EUT was place inside an environmental chamber.

Radiated measurements are made with the EUT located on a non-conductive table, 3m from the measurement antenna.

### Ambient Conditions:

Temperature: 10-20 °C
Rel. Humidity: 40-60 %

### Summary of Results, serial #9999999

| Run # | Spacing | Test Performed | Limit | Pass / Fail | Result / Margin |
|---|---|---|---|---|---|
| 1 | 50, 25, 15, 12.5, 6.25 and 5 kHz | Output Power | Determined at time of Licensing | - | 37.0dBm (5Watts) |
| 2 | 50, 25, 15, 12.5, 6.25 and 5 kHz | Spectral Mask | Within Mask 90.210(b)/80.211(f) or 90.210(f) | Pass | See Plots |
| 3 | 50, 25, 15, 12.5, 6.25 and 5 kHz | 99% or Occupied Bandwidth | 50, 20, 11.25, 6 or 4 kHz | Pass | See Plots |
| 4 | 50, 25, 15, 12.5, 6.25 and 5 kHz | Spurious Emissions (conducted) | -13dBm or -25dBm | Pass | -29.7dBm @ 216.90MHz (-4.7dB) |

### Modifications Made During Testing

No modifications were made to the EUT during testing

### Deviations From The Standard

No deviations were made from the requirements of the standard.

Date of Test: 10/29/2009 & 1/7/2010
Test Engineer: John Caizzi & M. Birgani
Test Location: Environmental Lab

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Run #1: Output Power

Power settings from 20 to 37 are available corresponding to 0.1 to 5 Watts for 216 - 222 MHz.

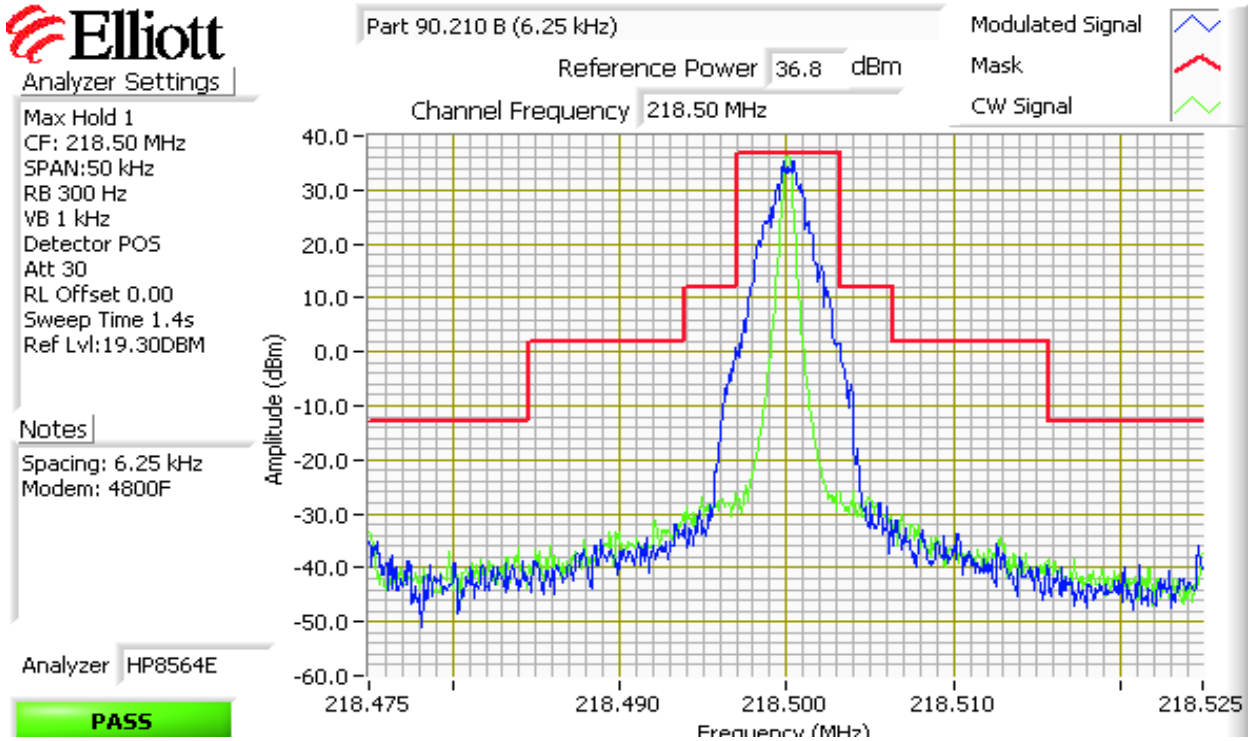
| Power Setting[2] | Frequency (MHz) | Output Power (dBm)[1] | Output Power W | Antenna Gain(dBd) | Result | ERP dBm | ERP W | Modem |
|---|---|---|---|---|---|---|---|---|
| 36 | 216.0 | 37.0 | 5.0 | 7.0 | Pass | 44.0 | 25.119 | 19200 |
| 36 | 218.5 | 37.0 | 5.0 | 7.0 | Pass | 44.0 | 25.119 | 64000 |
| 36 | 220.0 | 36.7 | 4.7 | 7.0 | Pass | 43.7 | 23.442 | 19200 |
| 36 | 216.0 | 36.9 | 4.9 | 7.0 | Pass | 43.9 | 24.547 | 9600 |
| 36 | 218.5 | 36.5 | 4.5 | 7.0 | Pass | 43.5 | 22.387 | 64000 |
| 36 | 220.0 | 36.3 | 4.3 | 7.0 | Pass | 43.3 | 21.380 | 9600 |
| 36 | 216.0 | 36.7 | 4.7 | 7.0 | Pass | 43.7 | 23.442 | 19200N |
| 36 | 218.5 | 36.6 | 4.6 | 7.0 | Pass | 43.6 | 22.909 | 64000 |
| 36 | 220.0 | 36.5 | 4.5 | 7.0 | Pass | 43.5 | 22.387 | 19200N |
| 36 | 216.0 | 36.7 | 4.7 | 7.0 | Pass | 43.7 | 23.442 | 4800F |
| 36 | 218.5 | 36.2 | 4.2 | 7.0 | Pass | 43.2 | 20.893 | 64000 |
| 36 | 220.0 | 36.5 | 4.5 | 7.0 | Pass | 43.5 | 22.387 | 4800F |
| 37 | 220.0 | 37.0 | 5.0 | 7.0 | Pass | 44.0 | 25.119 | 19200E |
| 37 | 222.0 | 36.6 | 4.6 | 7.0 | Pass | 43.6 | 22.909 | 19200E |
| 37 | 220.0 | 36.5 | 4.5 | 7.0 | Pass | 43.5 | 22.387 | 9600M |
| 37 | 222.0 | 37.0 | 5.0 | 7.0 | Pass | 44.0 | 25.119 | 9600M |
| 37 | 220.0 | 36.6 | 4.6 | 7.0 | Pass | 43.6 | 22.909 | 3200 |
| 37 | 222.0 | 36.6 | 4.6 | 7.0 | Pass | 43.6 | 22.909 | 3200 |

| | |
|---|---|
| Note 1: | Output power measured using a peak power meter |
| Note 2: | Power setting - the software power setting used during testing, included for reference only. |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Run #2: Spectral Mask, FCC Part 90, (6.25, 12.5, 25.0 and 50.0) kHz channel spacing

| | |
|---|---|
| Note 1: | Mask reference level based on CW level. |



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Elliott

Analyzer Settings

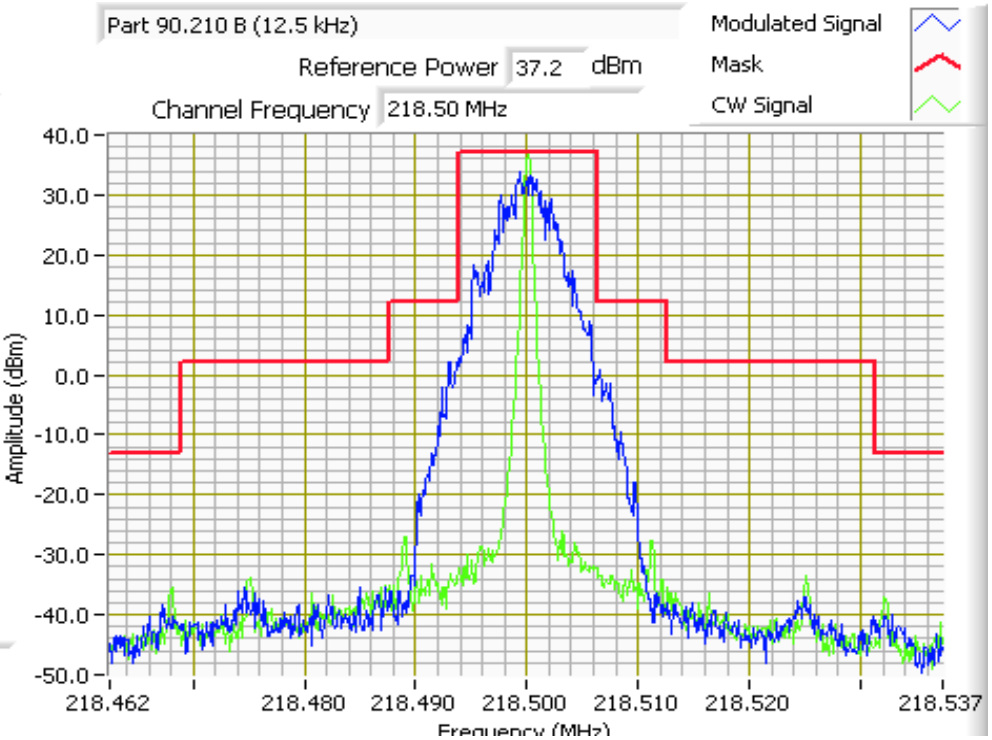
Max Hold 1
CF: 218.50 MHz
SPAN:75 kHz
RB 300 Hz
VB 1 kHz
Detector POS
Att 30
RL Offset 0.00
Sweep Time 2.1s
Ref Lvl:19.30DBM

Notes

Spacing: 12.5 kHz
Modem: 19200N

Analyzer HP8564E

PASS




Elliott

Analyzer Settings

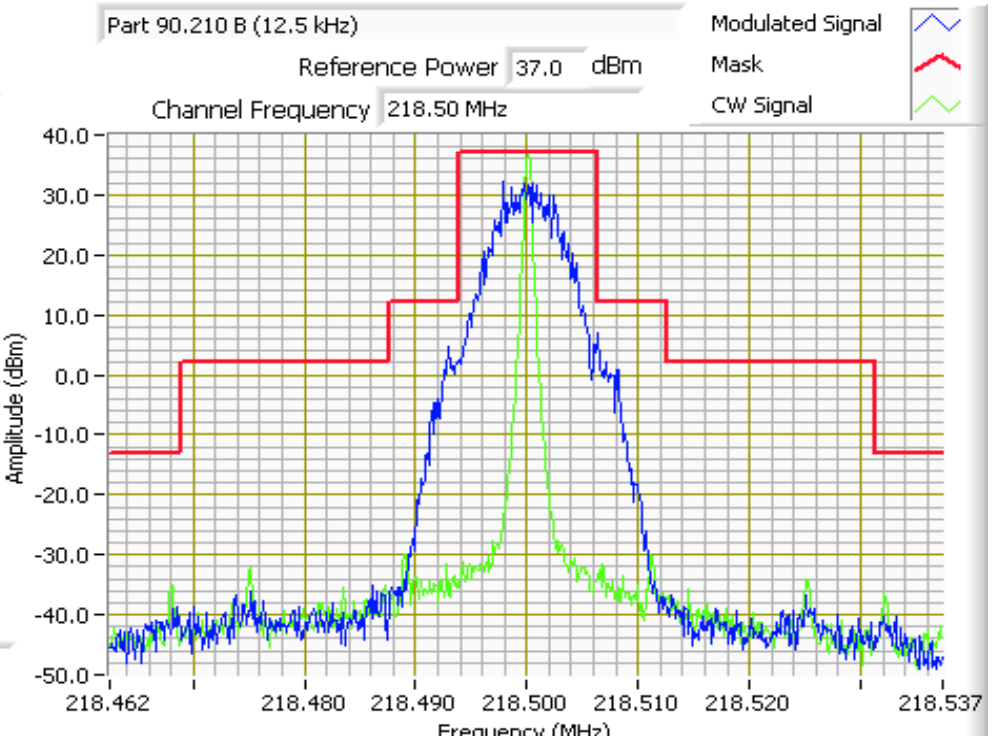
Max Hold 1
CF: 218.50 MHz
SPAN:75 kHz
RB 300 Hz
VB 1 kHz
Detector POS
Att 30
RL Offset 0.00
Sweep Time 2.1s
Ref Lvl:19.30DBM

Notes

Spacing: 12.5 kHz
Modem: 9600

Analyzer HP8564E

PASS



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Elliott

Analyzer Settings

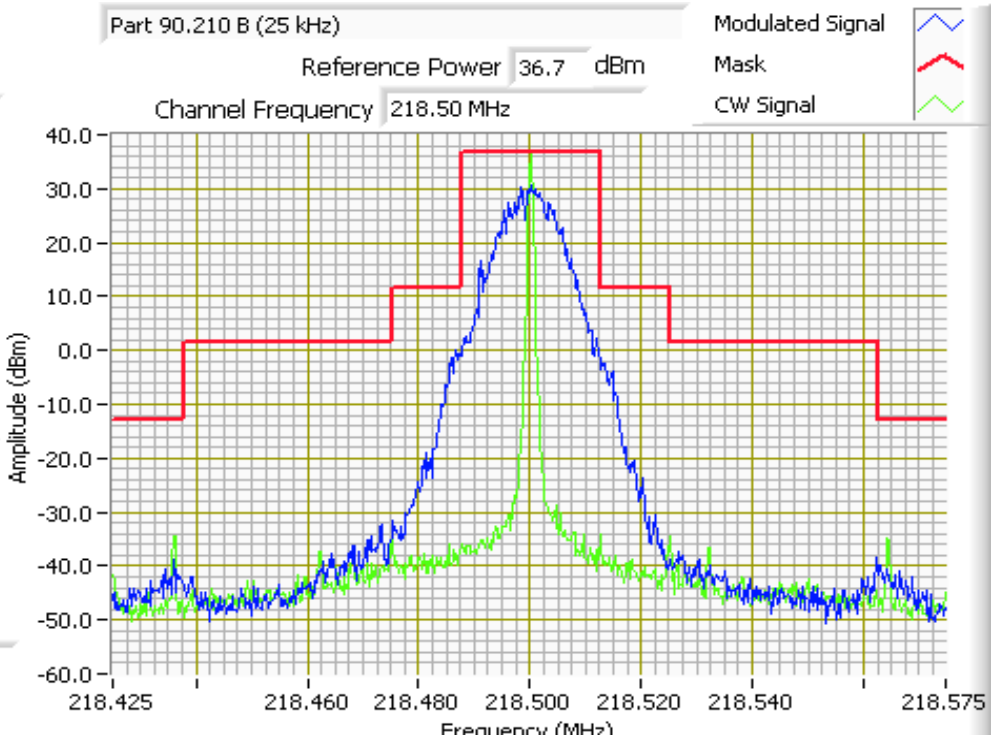
Max Hold 1
CF: 218.50 MHz
SPAN:150 kHz
RB 300 Hz
VB 1 kHz
Detector POS
Att 30
RL Offset 0.00
Sweep Time 4.2s
Ref Lvl:19.30DBM

Notes

Spacing: 25.0 kHz
Modem: 19200

Analyzer HP8564E

PASS




Elliott

Analyzer Settings

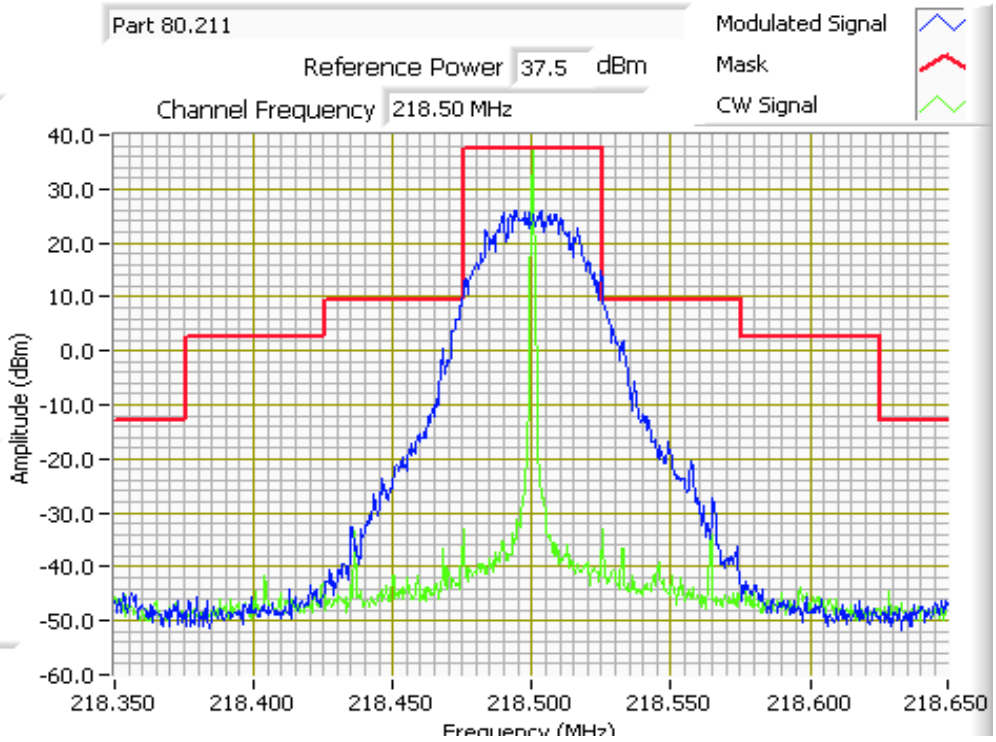
Max Hold 1
CF: 218.50 MHz
SPAN:300 kHz
RB 300 Hz
VB 1 kHz
Detector POS
Att 30
RL Offset 0.00
Sweep Time 8.4s
Ref Lvl:19.30DBM

Notes

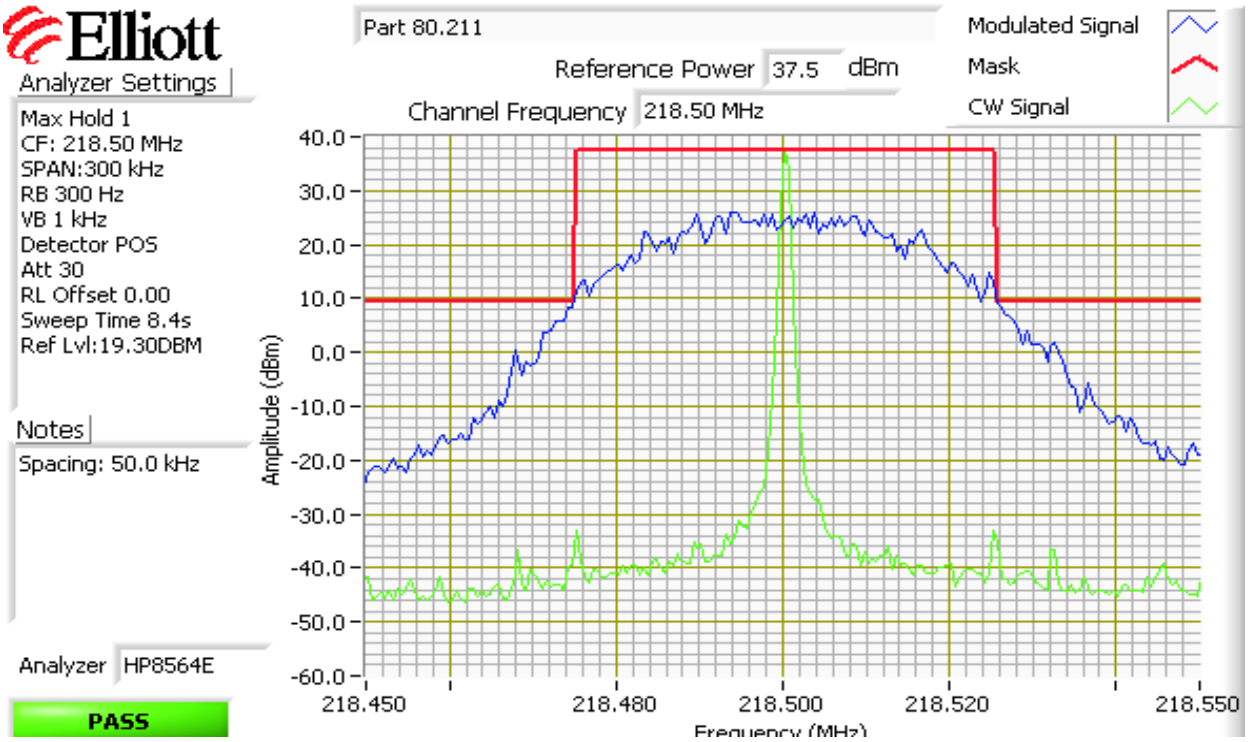
Spacing: 50.0 kHz

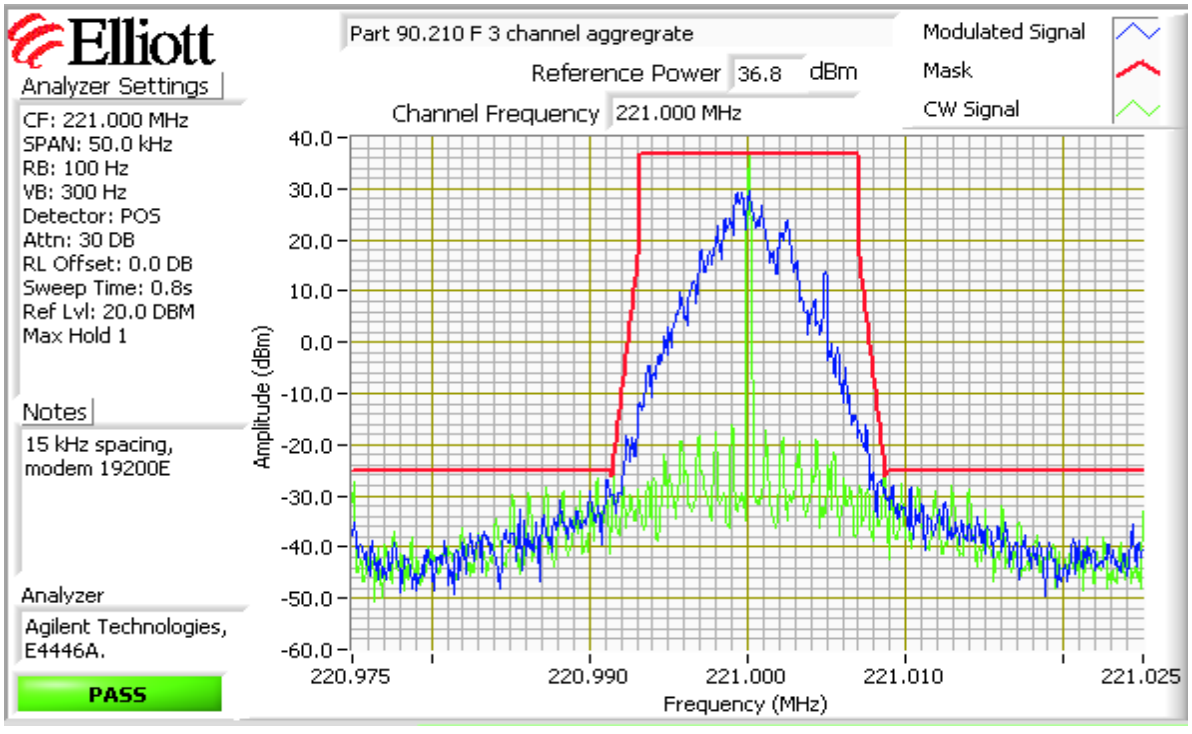
Analyzer HP8564E

PASS

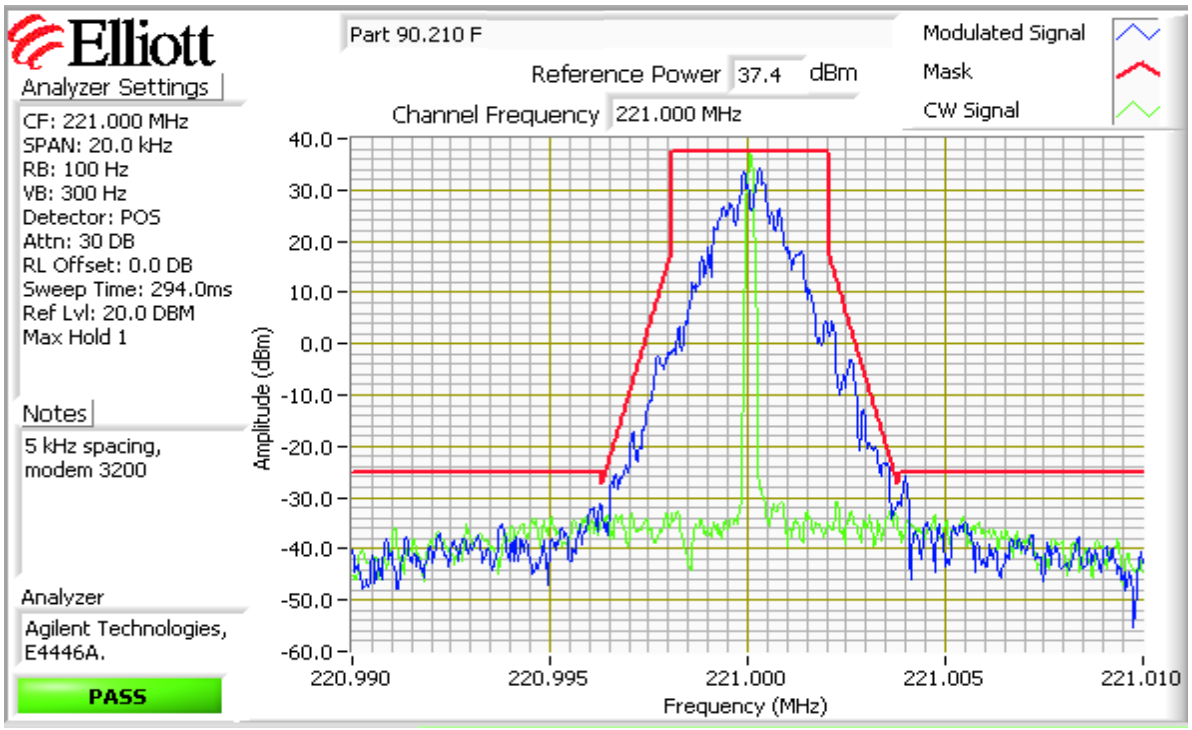


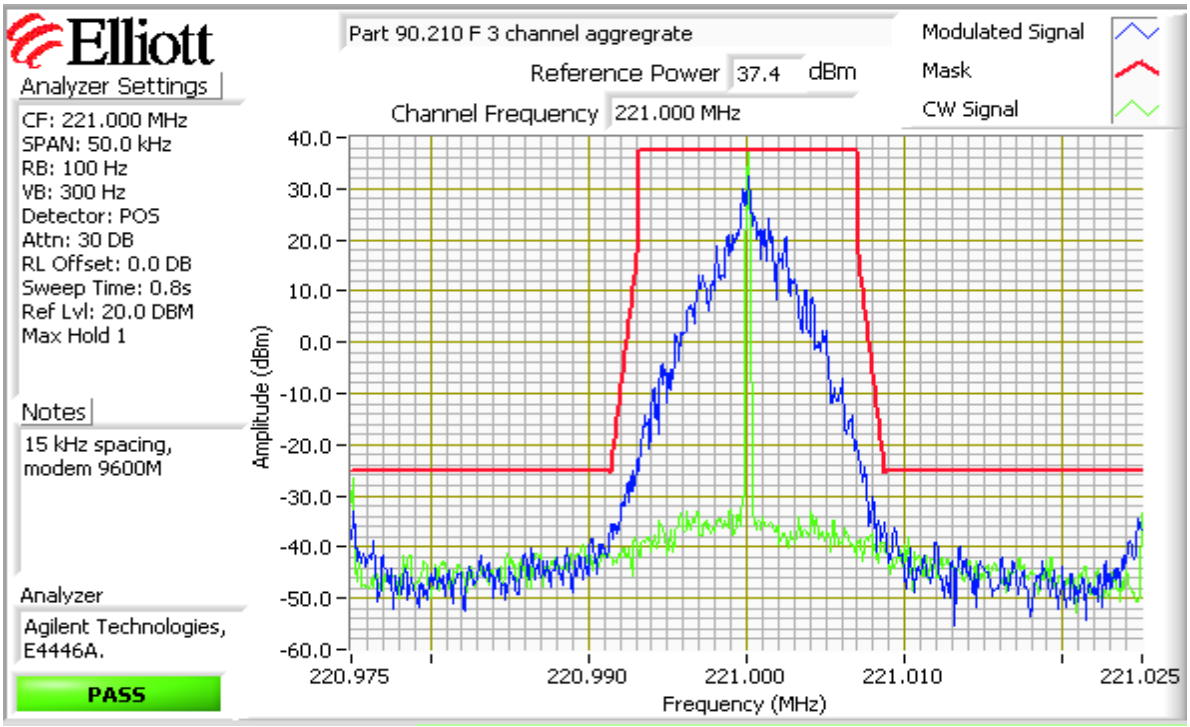
| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |



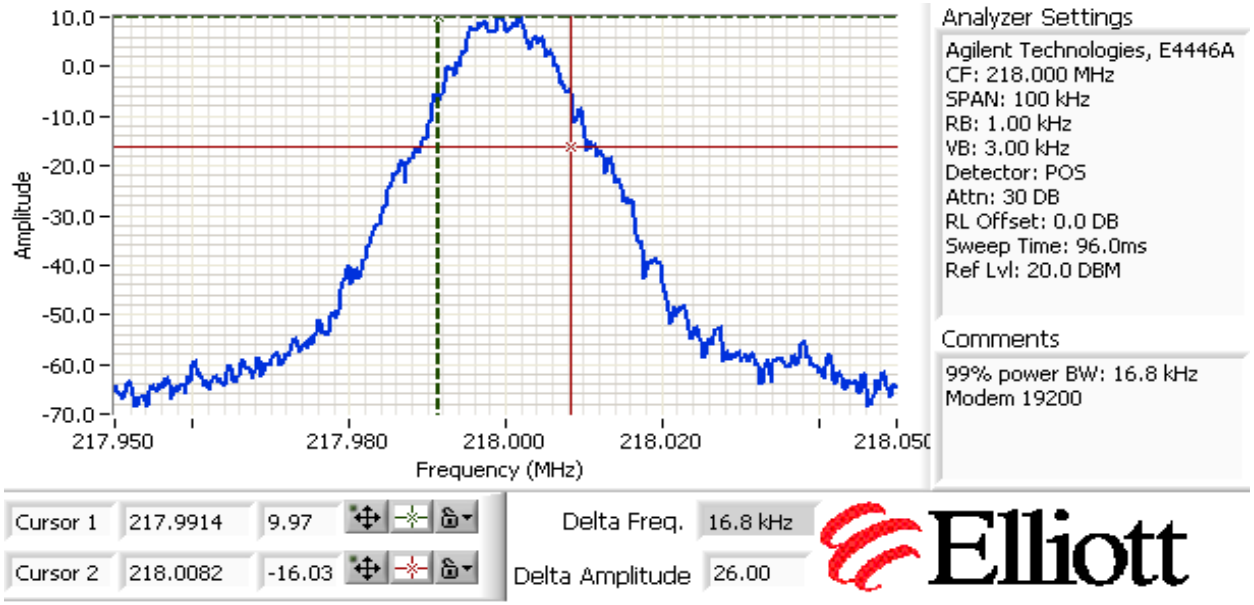



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

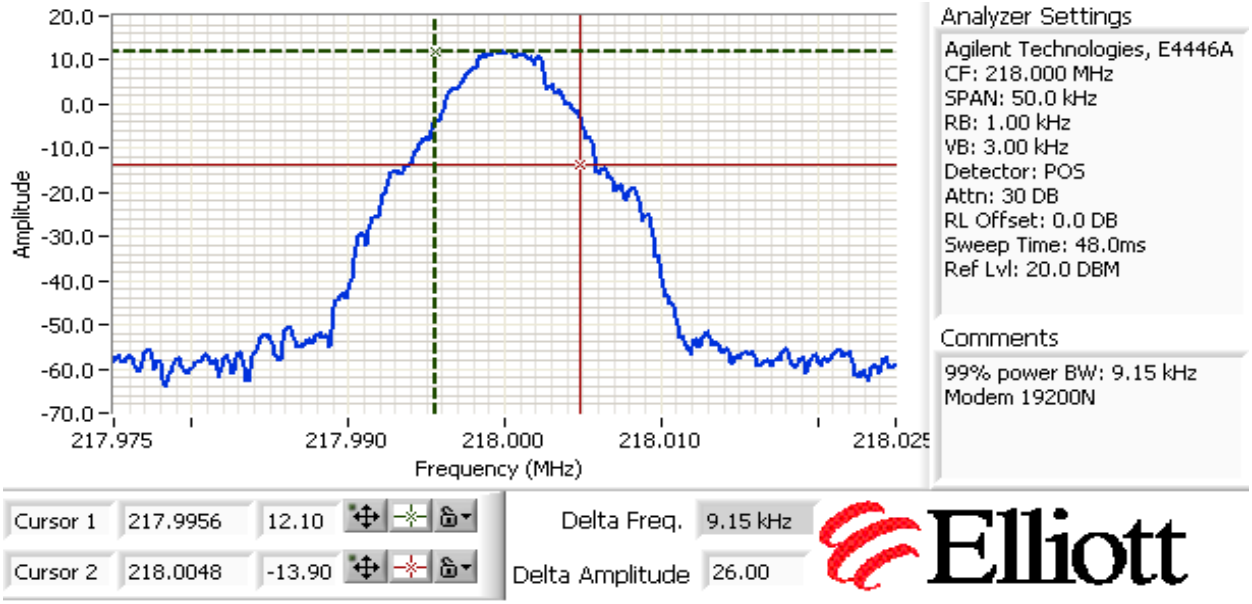
Run #3: Signal Bandwidth

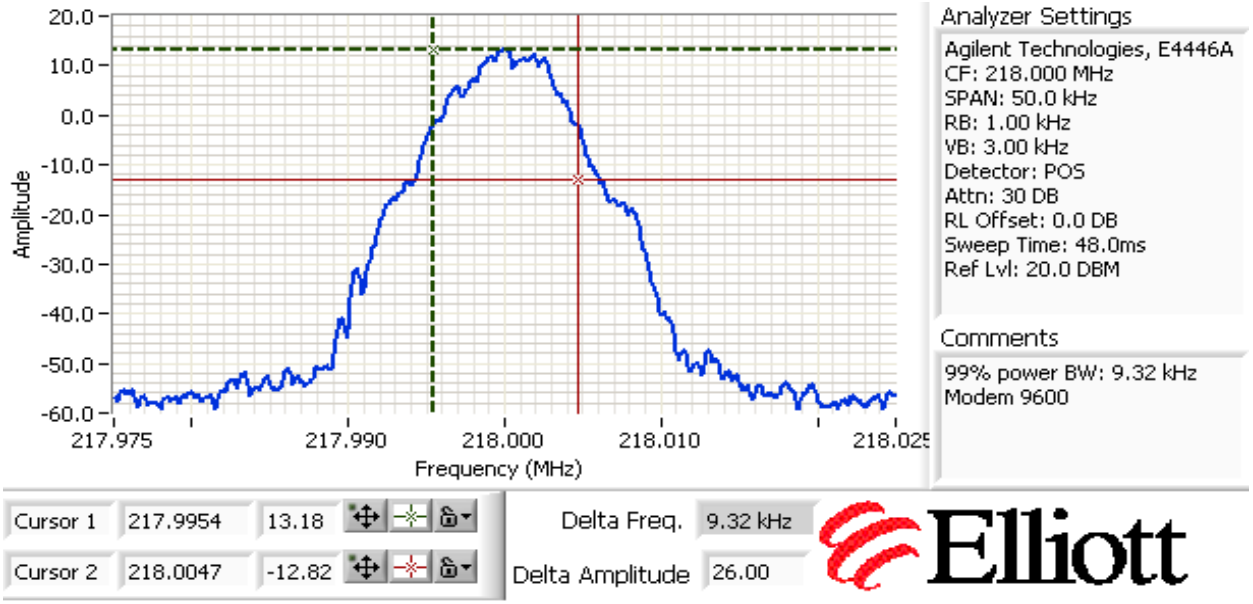
| Power Setting | Frequency (MHz) | Span (kHz) | Resolution Bandwidth | Bandwidth (kHz) 26dB | Bandwidth (kHz) 99% | Modem | Channel Spacing |
|---|---|---|---|---|---|---|---|
| 37 dBm | 218.0 | 100 | 1 kHz | | 16.80 | 19200 | 25 kHz |
| 37 dBm | 218.0 | 50 | 1 kHz | | 9.15 | 9600 | 12.5 kHz |
| 37 dBm | 218.0 | 50 | 1 kHz | | 9.32 | 19200N | 12.5 kHz |
| 37 dBm | 218.0 | 30 | 300 Hz | | 3.24 | 4800F | 6.25 kHz |
| 37 dBm | 218.5 | 200 | 3 kHz | | 48.90 | 64000 | 50 kHz |
| 37 dBm | 221.0 | 50 | 1 kHz | | 8.15 | 19200E | 15 kHz |
| 37 dBm | 221.0 | 50 | 1 kHz | | 6.91 | 9600M | 15 kHz |
| 37 dBm | 221.0 | 30 | 300 Hz | | 2.80 | 3200 | 5 kHz |

| | |
|---|---|
| Note 1: | 99% bandwidth measured in accordance with RSS GEN, with RB > 1% of the span and VB > 3xRB |

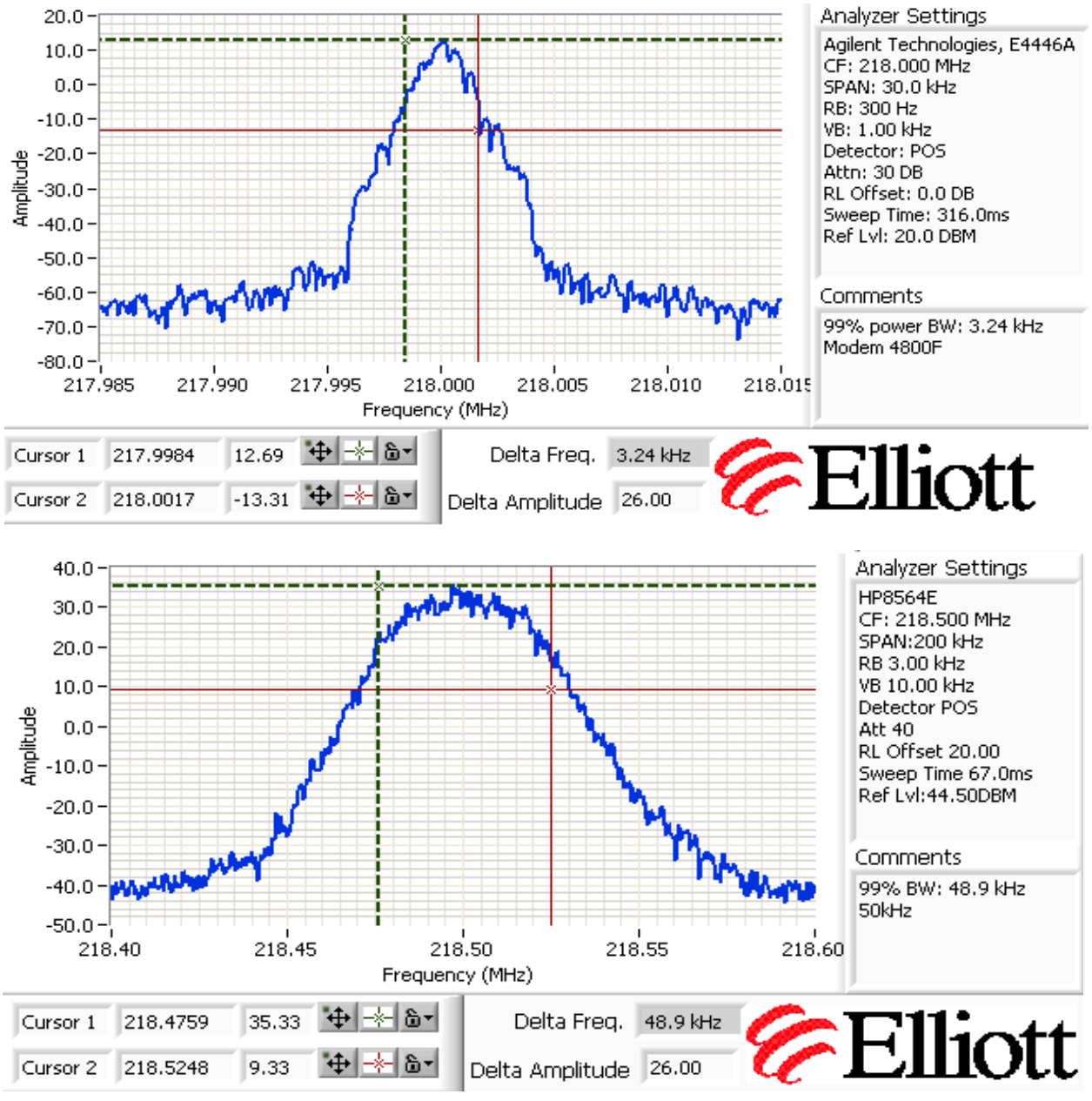


| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

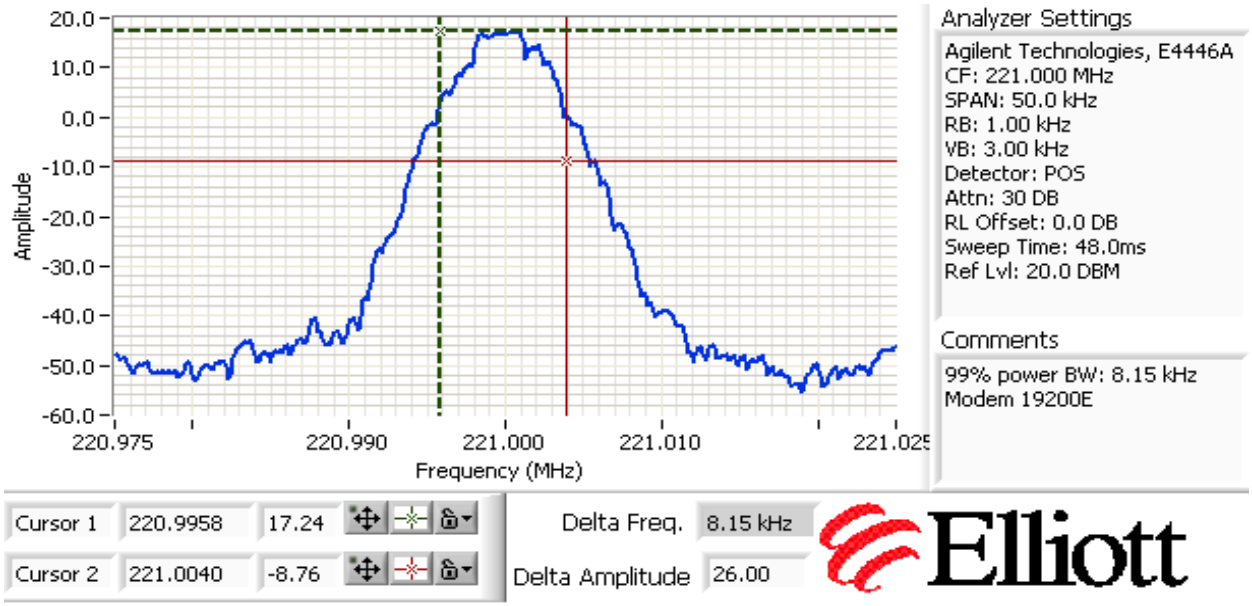


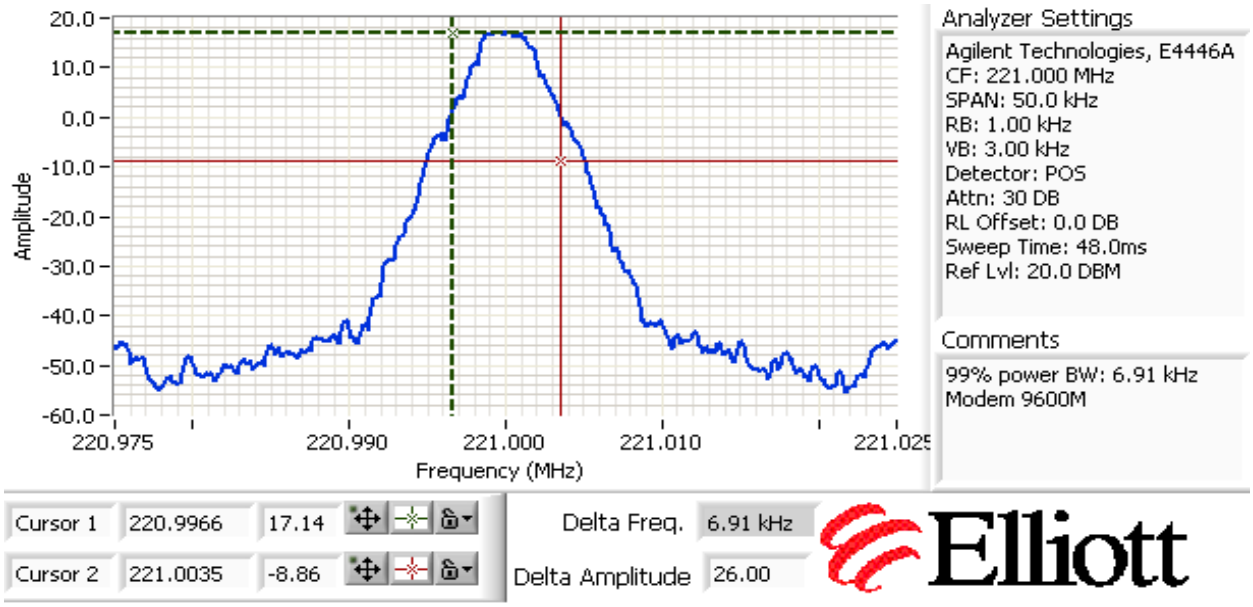



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

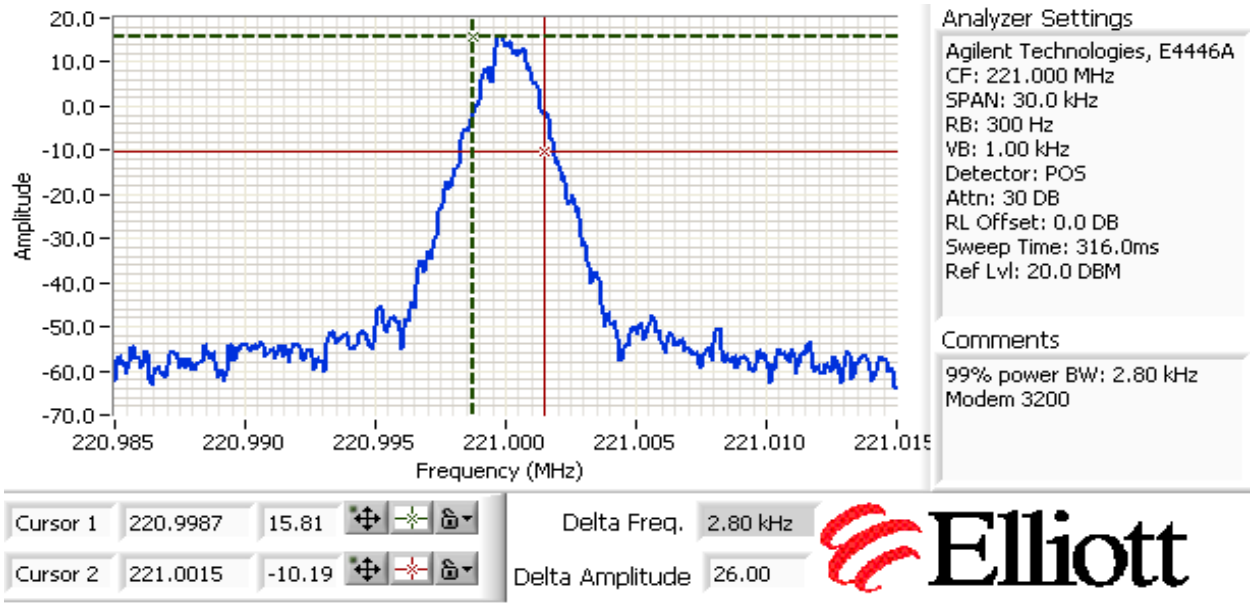


| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |




Run #4: Out of Band Spurious Emissions, Conducted

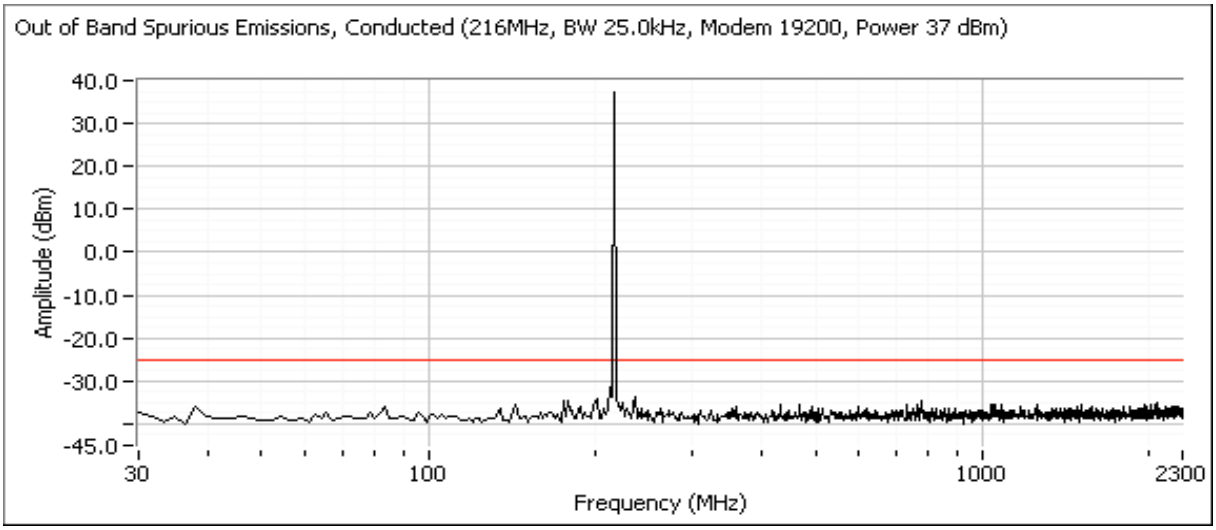
The limit is taken from FCC Part 90 Mask B for 216-220 MHz operation and Mask F for 220-222 MHz operation

| Frequency MHz | Level dBm | Port - | FCC Part 90 (Mask F) Limit | Margin | Detector | Tx Freq. | Mode | Comments |
|---|---|---|---|---|---|---|---|---|
| 181.967 | -33.5 | RF Port | -25.0 | -8.5 | Peak | 218.5 | 19200 | Power= 37dBm |
| 182.511 | -34.6 | RF Port | -25.0 | -9.6 | Peak | 220 | 9600M | Power= 37dBm |
| 184.492 | -34.6 | RF Port | -25.0 | -9.6 | Peak | 222 | 9600M | Power= 37dBm |
| 216.902 | -29.7 | RF Port | -25.0 | -4.7 | Peak | 220 | 9600M | Power= 37dBm |
| 218.883 | -29.9 | RF Port | -25.0 | -4.9 | Peak | 222 | 9600M | Power= 37dBm |

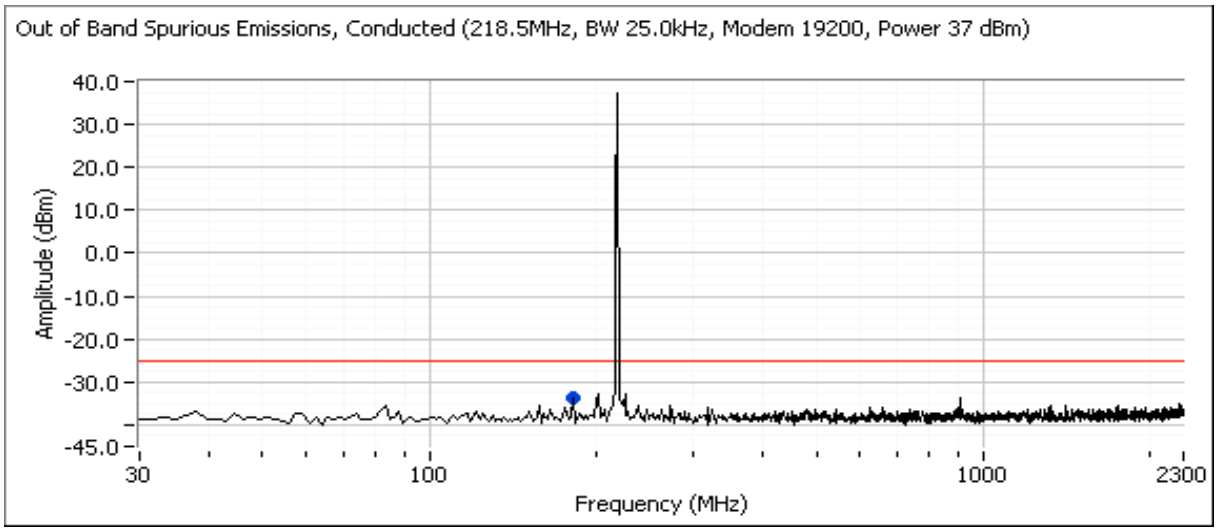
| | |
|---|---|
| Note 1: | The limit for this band was -13dBm but more restrictive limit (-25dBm) was used |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Plot for 216 MHz channel, power setting(s) = 37

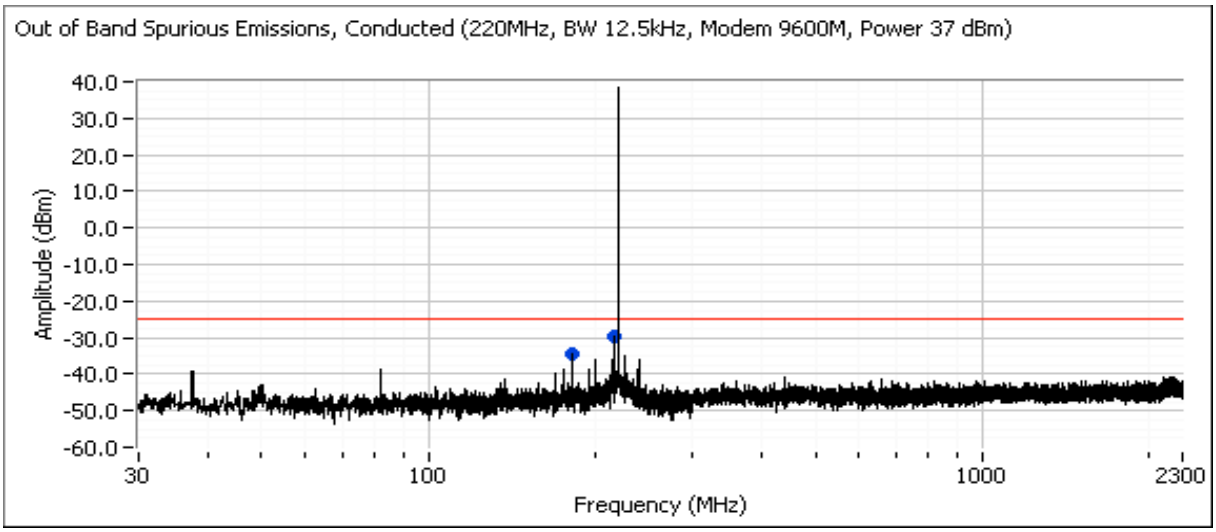



Plot for 218.5 MHz channel, power setting(s) = 37

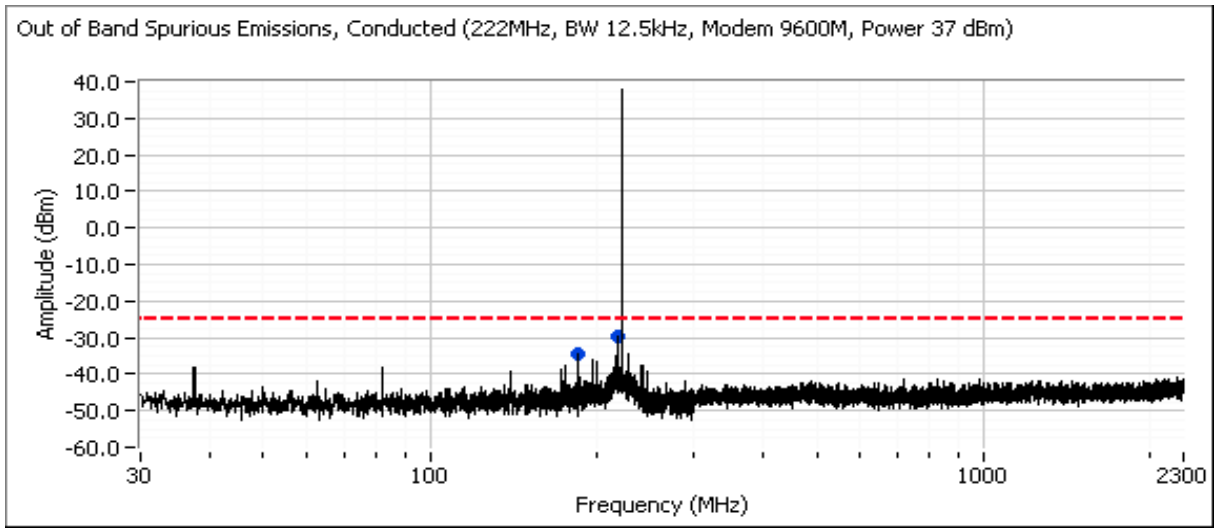


| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Plot for 220 MHz channel, power setting(s) = 37




Plot for 222 MHz channel, power setting(s) = 37



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

# RSS 119 and FCC Part 80 & 90
# Frequency Stability

## Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 11/9/2009
Test Engineer: J. Caizzu, M. Birgani
Test Location: Radio Lab
Config. Used: 1
Config Change: None
EUT Voltage: 13.8VDC

## General Test Configuration

All measurements are made with the EUT's rf port connected to the measurement instrument via an attenuator or dc-block if necessary. All amplitude measurements are adjusted to account for the attenuation between EUT and measuring instrument. For frequency stability measurements the EUT was placed inside an environmental chamber.

Radiated measurements are made with the EUT located on a non-conductive table, 3m from the measurement antenna.

## Ambient Conditions:

Temperature: 17-22 °C
Rel. Humidity: 30-40 %

## Summary of Results

| Run # | Spacing | Data Rate | Test Performed | Limit | Pass / Fail | Result / Margin |
|---|---|---|---|---|---|---|
| 1 | 12.5 | 9600M | Frequency Stability | Part 90 - 1.5ppm | Pass | 0.17 ppm |

## Modifications Made During Testing

No modifications were made to the EUT during testing

## Deviations From The Standard

No deviations were made from the requirements of the standard.

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J77843 |
| Model: | SD2 Transceiver | T-Log Number: | T77846 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | FCC Parts 80, 90 & 95, RSS-119, FCC Part 15 | Class: | N/A |

Run #8: Frequency Stability

Nominal Frequency: 220 MHz

Frequency Stability Over Temperature

The EUT was soaked at each temperature for a minimum of 30 minutes prior to making the measurements to ensure the EUT and chamber had stabilized at that temperature.

| Temperature | requency Measure | Drift | |
|---|---|---|---|
| (Celsius) | (MHz) | (Hz) | (ppm) |
| -30 | 219.999971 | -29 | 0.13 |
| -20 | 219.999968 | -32 | 0.15 |
| -10 | 219.999981 | -19 | 0.09 |
| 0 | 219.999963 | -37 | 0.17 |
| 10 | 219.999981 | -19 | 0.09 |
| 20 | 219.999988 | -12 | 0.05 |
| 30 | 219.999990 | -10 | 0.05 |
| 40 | 220.000003 | 3 | 0.01 |
| 50 | 220.000035 | 35 | 0.16 |
| | Worst case: | -37 | 0.17 |

Frequency Stability Over Input Voltage

Nominal Voltage: 13.8 Vdc

| Voltage | requency Measure | Drift | |
|---|---|---|---|
| (DC) | (MHz) | (Hz) | (ppm) |
| 11.7 | 219.999984 | -16 | 0.07 |
| 15.9 | 219.999985 | -15 | 0.07 |
| | Worst case: | -16 | 0.07 |

| | |
|---|---|
| Note 1: | Maximum drift of fundamental frequency before it shut down at 9.6 Vdc was 2.0 Hz. |

# *Appendix C Photographs*

Uploaded as a separate exhibit

# *Appendix D Proposed FCC ID Label & Label Location*

Uploaded as a separate exhibit

# *Appendix E Detailed Photographs*

Uploaded as a separate exhibit

# *Appendix F Operator's Manual*

Uploaded as a separate exhibit

# *Appendix G Block Diagram*

Uploaded as a separate exhibit

# *Appendix H Schematic Diagrams*

Uploaded as a separate exhibit

# *Appendix I Theory of Operation*

Uploaded as a separate exhibit

# *Appendix J Tune-up Procedure*

Uploaded as a separate exhibit

# *Appendix K Parts List*

Uploaded as a separate exhibit