

Radio Test Report

*FCC Part 90 and RSS 119
216 - 220 MHz and 220 - 222 MHz*

Model: SD2

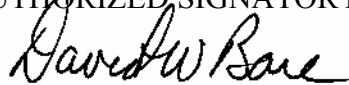
COMPANY: GE MDS LLC
175 Science Parkway
Rochester, NY 14620

TEST SITE(S): Elliott Laboratories
684 W. Maude Avenue
Sunnyvale, CA 94085

REPORT DATE: January 15, 2010

FINAL TEST DATES: October 29, November 5, 9, 12, and January 5
and 7, 2010

AUTHORIZED SIGNATORY:



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Testing Cert #2016.01

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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	January 13, 2010	First release	
2	January 15, 2010	Added RSS-119 to results summary	dwb

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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
- Industry Canada RSS-Gen Issue 2
- CFR 47 Part 90 (Private Land Mobile Radio Service) Subpart I
- RSS-119, Issue 9 (Land Mobile and Fixed Radio Transmitters and Receivers, 27.41 to 960 MHz)

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 90 – 216 – 222 MHz**

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
Transmitter Modulation, output power and other characteristics					
§2.1033 (c) (5) § 90.35	RSS-119	Frequency ranges (Listed for each channel spacing)	25 kHz, 216-220 MHz 12.5 kHz, 216-220 MHz 6.25 kHz, 216-220 MHz 15 kHz, 220-222 MHz ¹ 5 kHz, 220-222 MHz	216-222 MHz ⁴	Complies
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 § 90.205	RSS-119 5.4.3	Total power (216-220 MHz) (Maximum for each channel spacing)	25 kHz 5.0 W 12.5 kHz 5.0 W 6.25 kHz 5.0 W	15 Watts	Complies
§2.1033 (c) (4) §2.1047 § 90.210	RSS-119 5.5, Table 3	Emission types	F1D, F2D, F3D ³	Information only	-
		Emission mask	Device complies with spectral masks – refer to test data	Masks B and F (FCC) Masks F and I (IC)	Complies
§2.1049	RSS-119 5.5, Table 3	Occupied (99%) Bandwidth	16.8 kHz 216-220 MHz 9.32 kHz – 216-220 MHz 3.24 kHz – 216-220 MHz 8.15 kHz – 220-222 MHz ¹ 2.8 kHz 220-222 MHz	20 kHz 15 kHz 11.25 kHz ⁵ 6.25 kHz 5 kHz	Complies
Transmitter spurious emissions					
§2.1051 §2.1057 §80.211(f)	RSS-119 5.8	At antenna terminal	-29.7 dBm	-25 dBm	Complies
		Radiated (erp)	-48.5 dBm ²		Complies
Receiver spurious emissions					
15.111	RSS-GEN	At antenna terminal	-69.0 dBm	-57 dBm	Complies
15.109	RSS-GEN	Field strength	33.4 dBuV/m	Refer to RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS	Complies
Other details					
§2.1055 §90.213(a)	RSS-119 5.3 Table 1	Frequency stability	0.2 ppm 0.2 ppm	216-220 MHz 1.0 ppm 220-222 MHz 0.1 ppm	Complies
§1.1307(b) §2.1093 §80.227	RSS-102	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	13.8V, 2.2A	Information only	-

		currents for normal operation over the power range			
-	-	Antenna Gain	This application is for antennas of 7.0 dBd (9.15 dBi) gain.		
Notes					
1) Aggregate 3 channels.					
2) Calculated from measured field strength using free space propagation equation					
3) Refer to letters provided with this filing by GE MDS allowing exemption for the frequency stability. The measured bandwidth plus the measured stability is such that the emission remains within the 4 kHz or 15kHz authorized bandwidths.					
4) RSS-119 limits operation to 217-218 and 219-222 MHz.					
5) RSS-119 limits operation to 12.5 kHz channels only.					

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	1.7×10^{-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)	dB μ V/m	25 to 1,000 MHz 1 to 40 GHz	± 3.6 dB ± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS**GENERAL**

The GE MDS LLC model SD2 is an 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

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	-

EUT INTERFACE PORTS

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

Port		Description	Cable(s)	
From	To		Shielded/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.

EMISSIONS TESTING**GENERAL INFORMATION**

Antenna port measurements were taken at the Elliott Laboratories test site located at 684 West Maude Ave, Sunnyvale, CA 94085-3518 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.

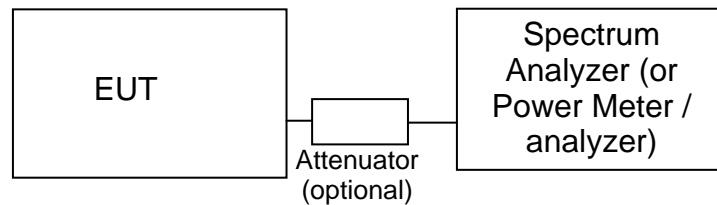
Site	Registration Numbers		Location
	FCC	Canada	
SVOATS #2	90593	2845A-2	684 West Maude Ave, Sunnyvale CA 94085-3518

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

For devices with an integral antenna the output power and spurious emissions are measured as a field strength at a test distance of (typically) 3m and then converted to an eirp using a substitution measurement (refer to RADIATED EMISSIONS MEASUREMENTS). All other measurements are made as detailed below but with the test equipment connected to a measurement antenna directed at the EUT.

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.

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.

CONDUCTED SPURIOUS EMISSIONS

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 measurements). Where the limits are expressed as an average power the spectrum analyzer is tuned to that frequency with a narrow span (wide enough to capture the emission and its sidebands) and the resolution and video bandwidths are adjusted as required by the reference measurement standards. For transmitter measurements the appropriate detector (average, peak, normal, sample, quasi-peak) is used when making measurements for licensed devices. For receiver conducted spurious measurements the detector is set to peak.

TRANSMITTER MASK MEASUREMENTS

The transmitter mask measurements are made using resolution bandwidths as specified in the pertinent rule part(s). Where narrower bandwidths are used the measurement is corrected to account for the reduced bandwidth by either using the adjacent channel power function of the spectrum analyzer to sum the power across the required measurement bandwidth. The frequency span of the analyzer is set to ensure the fundamental signal and all significant sidebands are displayed.

The top of the mask may be set by the total output power of the signal, the power of the unmodulated signal or the peak value of the signal in the reference bandwidth being used for the mask measurement.

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 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 angle 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:

$$\begin{aligned} R_r &= \text{Measured value in dBm} \\ S &= \text{Specification Limit in dBm} \\ M &= \text{Margin to Specification in +/- dB} \end{aligned}$$

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

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

where:

$$\begin{aligned} F_d &= \text{Distance Factor in dB} \\ D_m &= \text{Measurement Distance in meters} \\ D_s &= \text{Specification Distance in meters} \end{aligned}$$

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:

$$F_d = 40 * \text{LOG}_{10} (D_m/D_s)$$

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:

$$R_r = \text{Receiver Reading in dBuV/m}$$

- 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, RSS 210 Table 2, RSS GEN Table 1 and RSS 310 Table 3. 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

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				
<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
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				
<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
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				
<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
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				
<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
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



EMC Test Data

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 Receive/Stand-By Mode 30 - 2500 MHz	FCC 15 RSS GEN	Pass	33.4dB μ V/m (46.8 μ V/m) @ 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

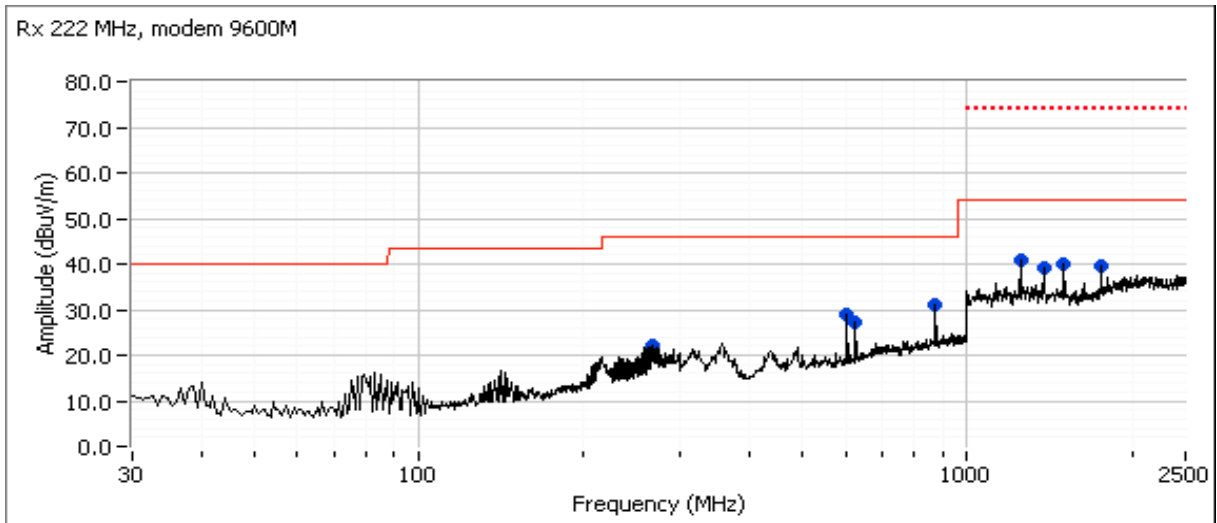
Engineer: John Caizzi

Location: Chamber #2

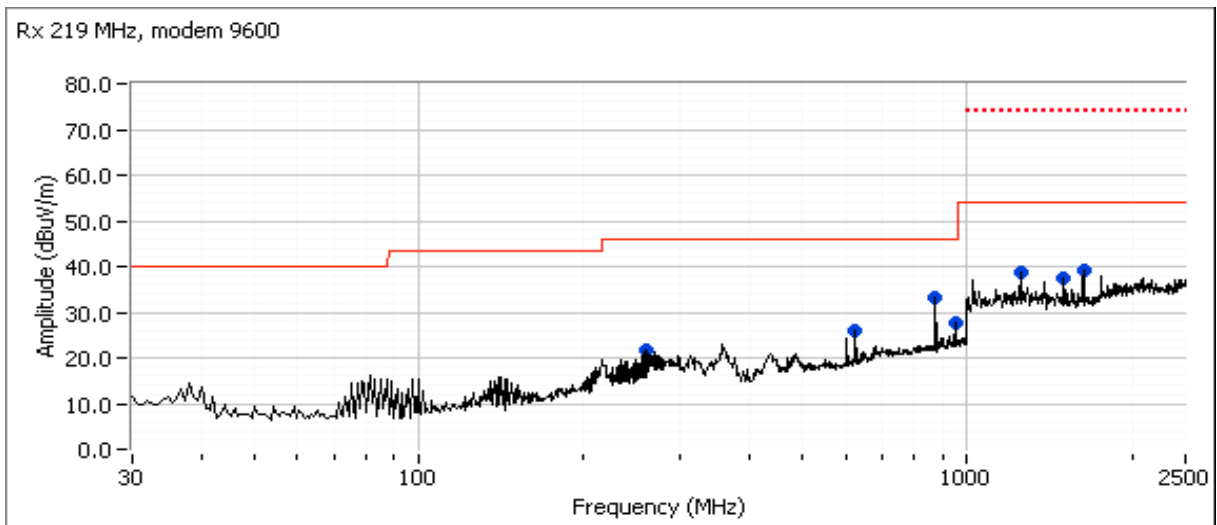
Frequency MHz	Level dB μ V/m	Pol V/H	FCC		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments	Channel and mode
			Limit	Margin					
259.500	21.6	H	46.0	-24.4	Peak	148	1.7	Modem 9600M, PWR 37	220
259.500	22.0	H	46.0	-24.0	Peak	148	1.7	Modem 19200, PWR 33	216
265.575	22.0	H	46.0	-24.0	Peak	328	1.7	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
Contact: Dennis McCarthy	Account Manager: Susan Pelzl
Standard: FCC Parts 80, 90 & 95, RSS-119, FCC Part 15	Class: N/A

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

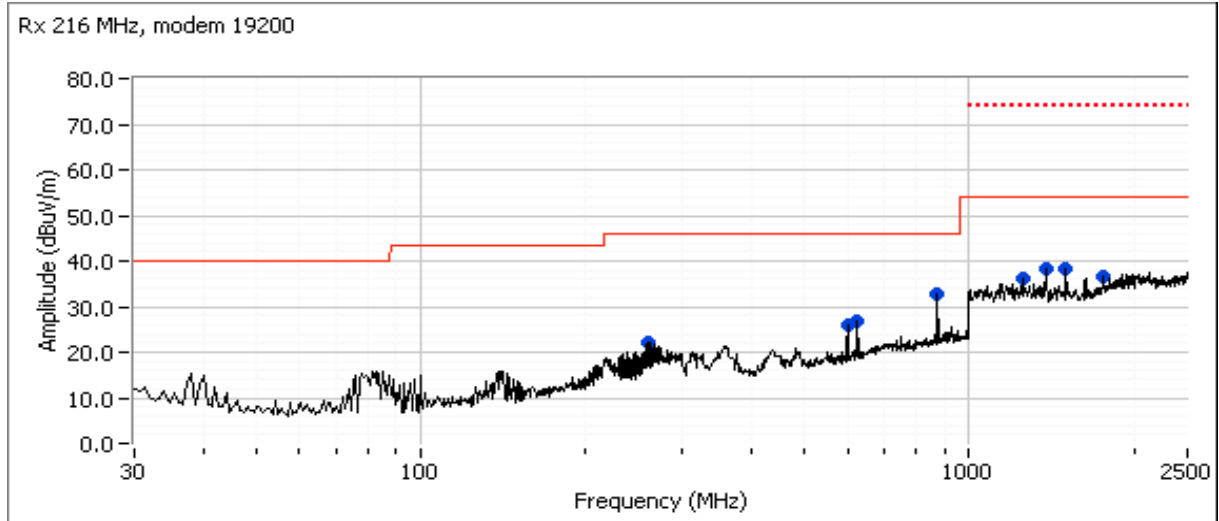


Graph - Channel: 219.00625 MHz, Mode: Modem 9600



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 dBuV/m	Pol V/H	FCC Part 15		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments	Channel and mode
			Limit	Margin					
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 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 #	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.

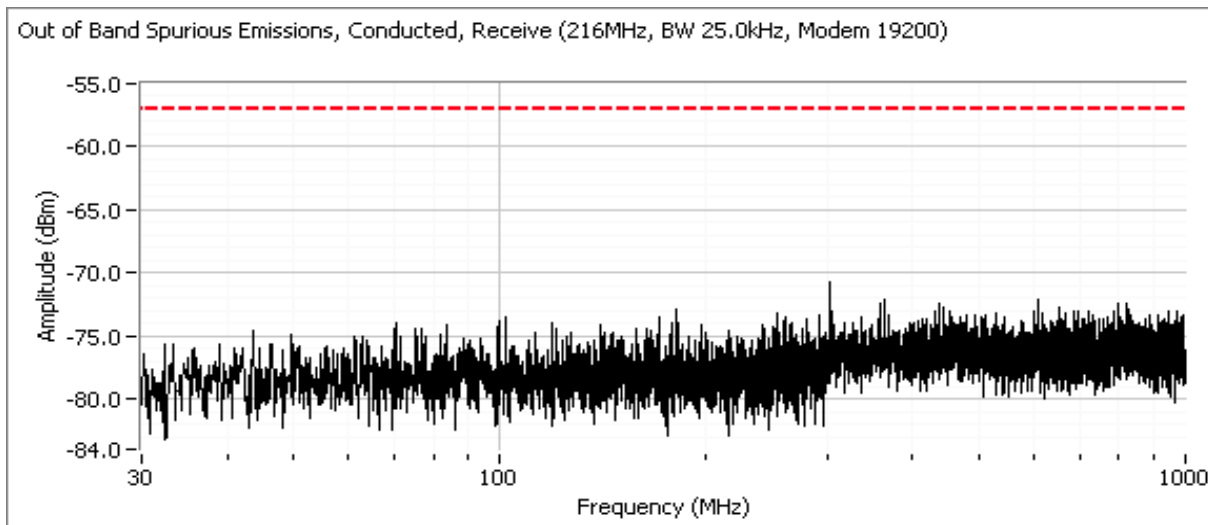
Client: GE MDS LLC	Job Number: J77843
Model: SD2 Transceiver	T-Log Number: T77846
	Account Manager: Susan Pelzl
Contact: Dennis McCarthy	
Standard: FCC Parts 80, 90 & 95, RSS-119, FCC Part 15	Class: N/A

Run #1: Out of Band Spurious Emissions, Conducted

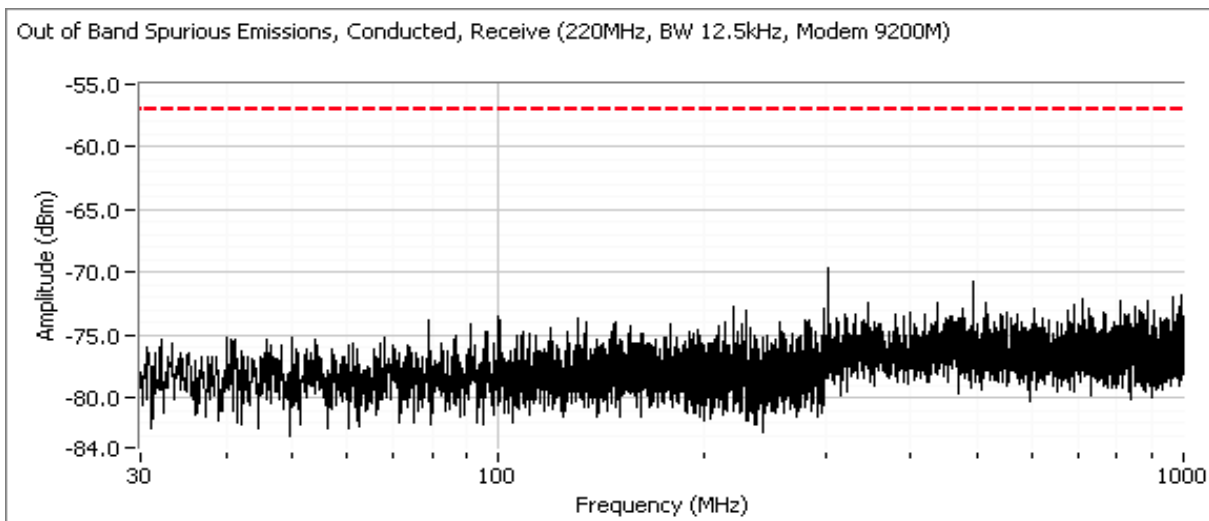
Frequency (MHz)	Limit	Result
216	-57dBm	Pass
220	-57dBm	Pass
222	-57dBm	Pass

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

Plots for low channel

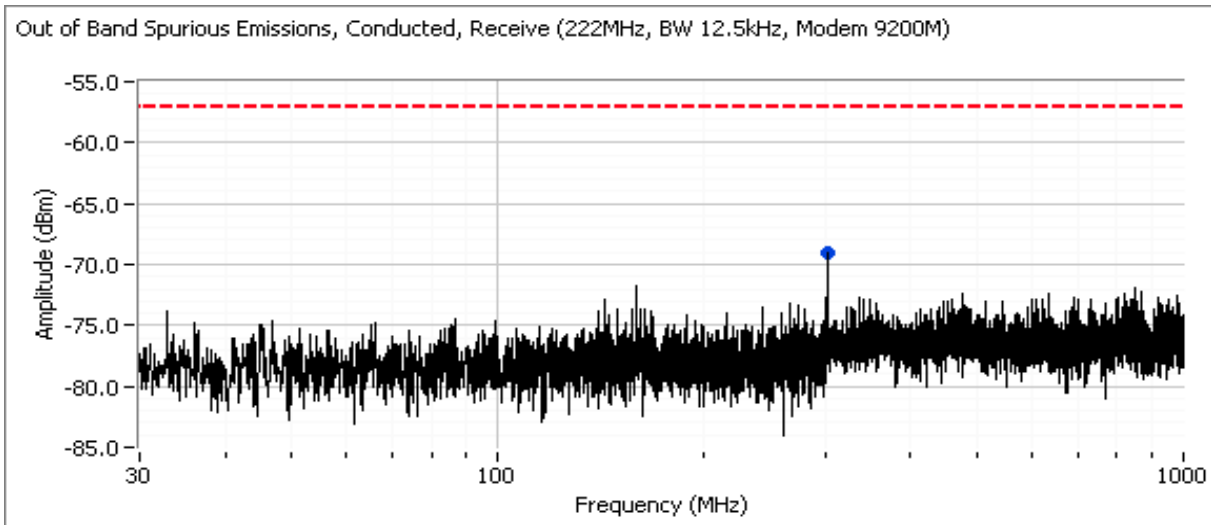


Plots for center channel



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
Contact:	Dennis McCarthy	Account Manager:	Susan Pelzl
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 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: 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.



Radio Test Data

Client:	GE MDS LLC	Job Number:	J77843
Model:	SD2 Transceiver	T-Log Number:	T77846
Contact:	Dennis McCarthy	Account Manager:	Susan Pelzl
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

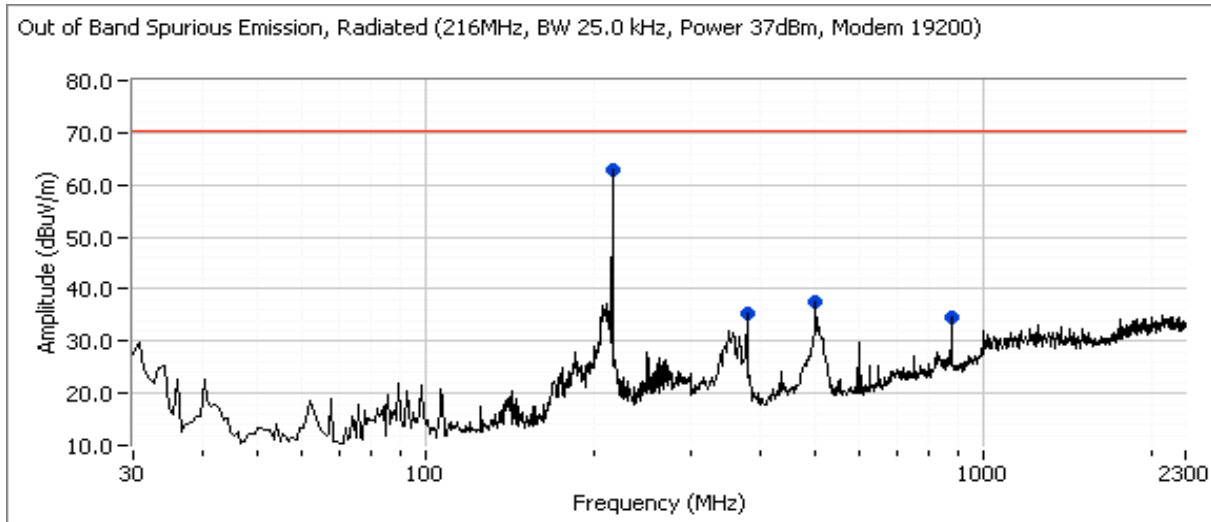
Frequency	Level	Pol	FCC 90.210		Detector	Azimuth	Height	Comments	Tx Freq
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters		MHz
42.983	36.1	V	70.2	-34.1	Peak	121	1.7	Modem 9600M, PWR 37	222
42.983	35.7	V	70.2	-34.5	Peak	239	1.7	Modem 9600M, PWR 37	220
375.023	35.4	H	70.2	-34.8	Peak	165	1.7	Modem 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.

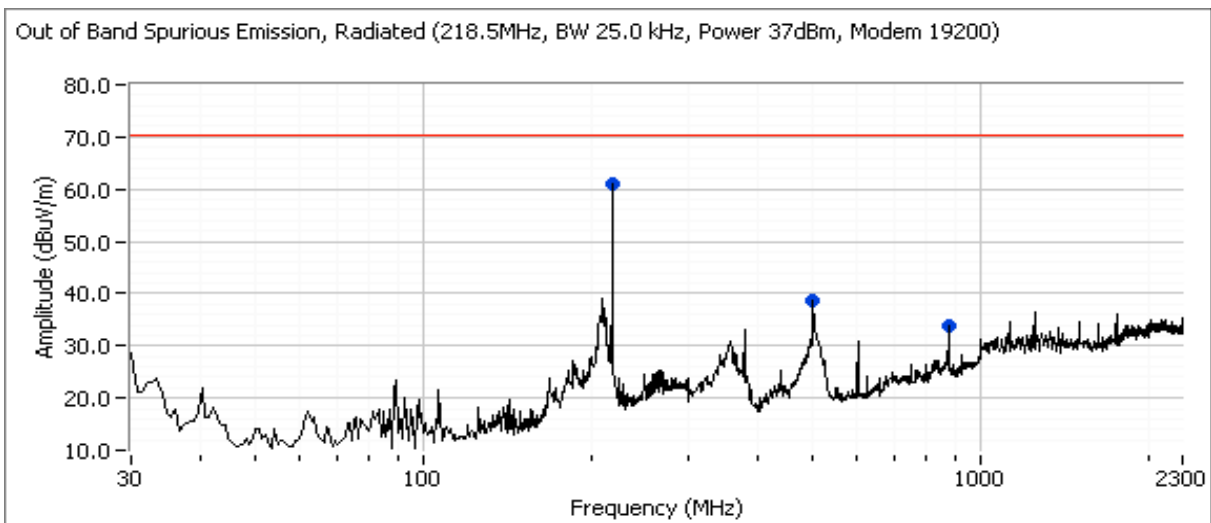
Note 2: Measurements are made with the antenna port terminated.

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

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

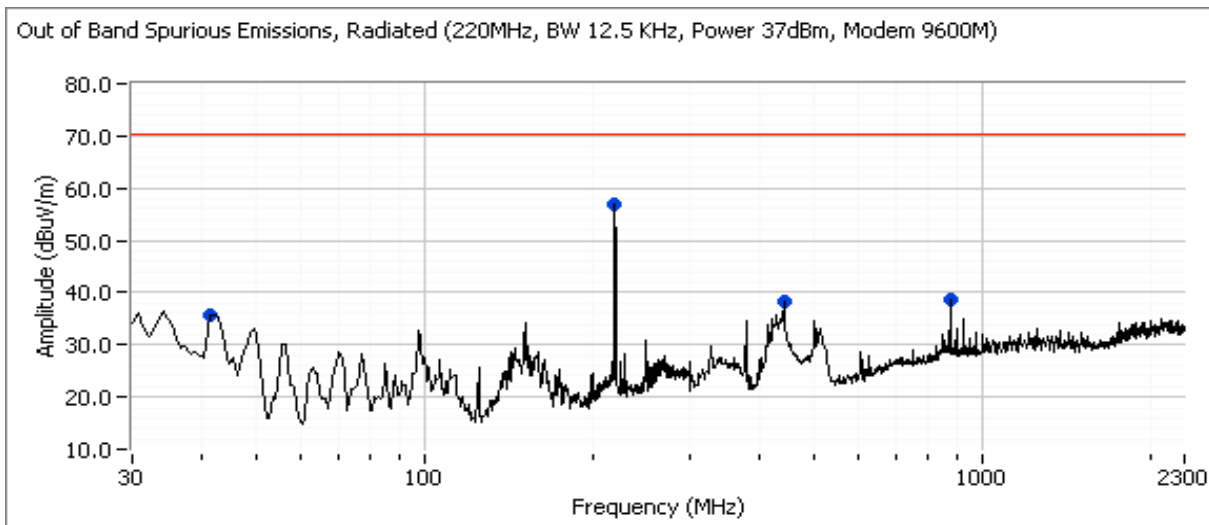


Plots for 218.5 MHz channel, power setting(s) = 37

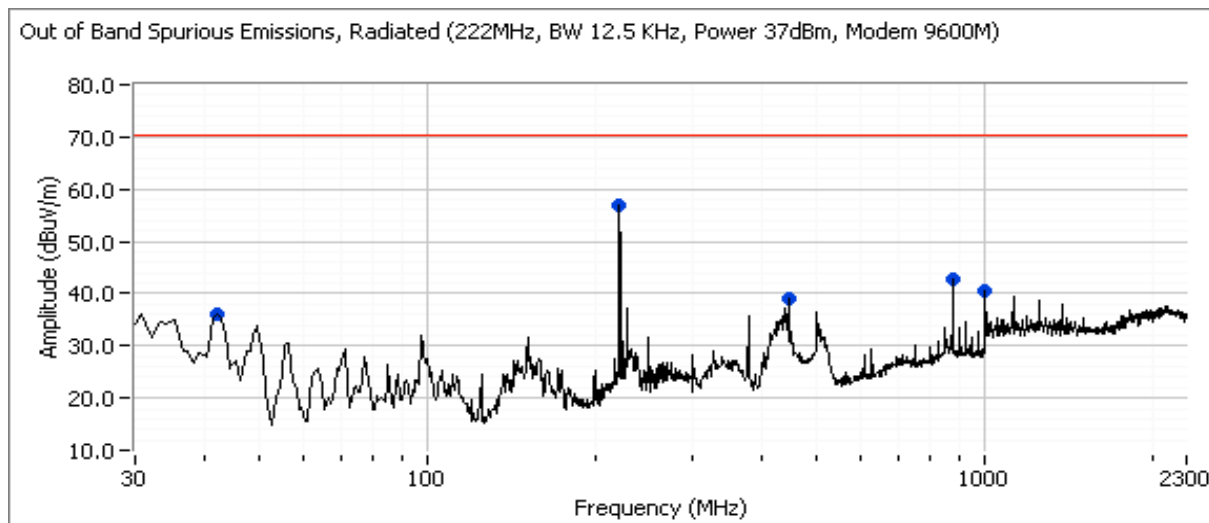


Client: GE MDS LLC	Job Number: J77843
Model: SD2 Transceiver	T-Log Number: T77846
Contact: Dennis McCarthy	Account Manager: Susan Pelzl
Standard: FCC Parts 80, 90 & 95, RSS-119, FCC Part 15	Class: N/A

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



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





Radio Test Data

Client:	GE MDS LLC	Job Number:	J77843
Model:	SD2 Transceiver	T-Log Number:	T77846
Contact:	Dennis McCarthy	Account Manager:	Susan Pelzl
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 MHz	Level dB μ V/m	Pol V/H	FCC 90.210		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments	Channel
			Limit	Margin					
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: $E = \sqrt{(30PG)/d}$. 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

**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 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: 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		Antenna Gain(dBd)	Result	ERP		Modem
		(dBm) ¹	W			dBm	W	
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
Contact: Dennis McCarthy	Account Manager: Susan Pelzl
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.



Analyzer Settings

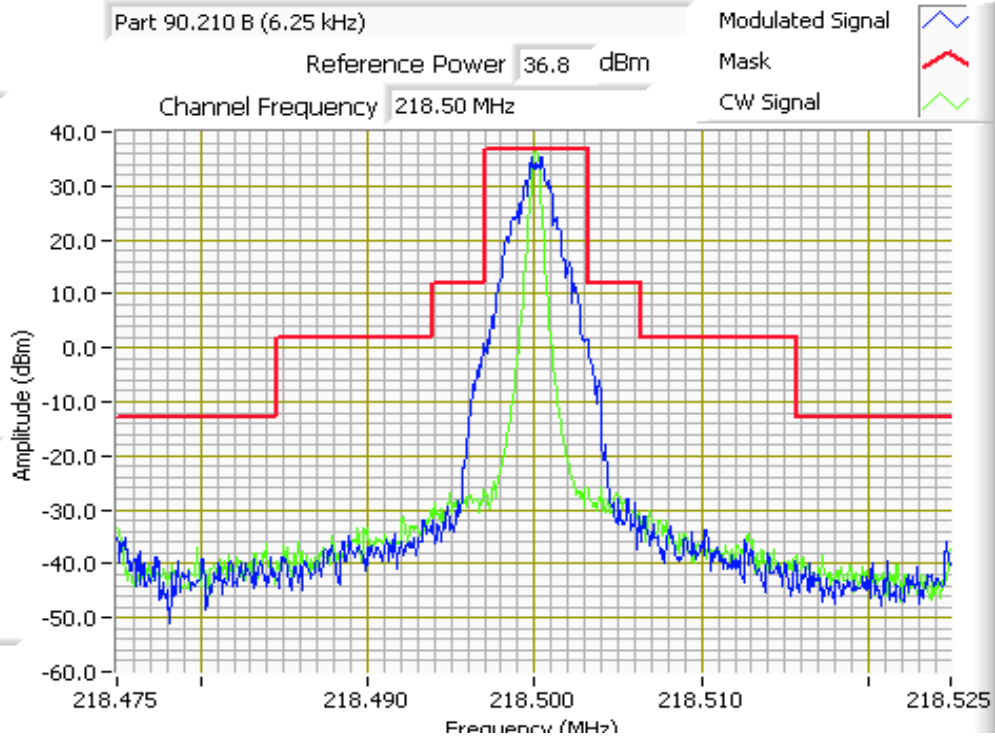
Max Hold 1
 CF: 218.50 MHz
 SPAN: 50 kHz
 RB 300 Hz
 VB 1 kHz
 Detector POS
 Att 30
 RL Offset 0.00
 Sweep Time 1.4s
 Ref Lvl: 19.30DBM

Notes

Spacing: 6.25 kHz
 Modem: 4800F

Analyzer HP8564E

PASS



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



Analyzer Settings

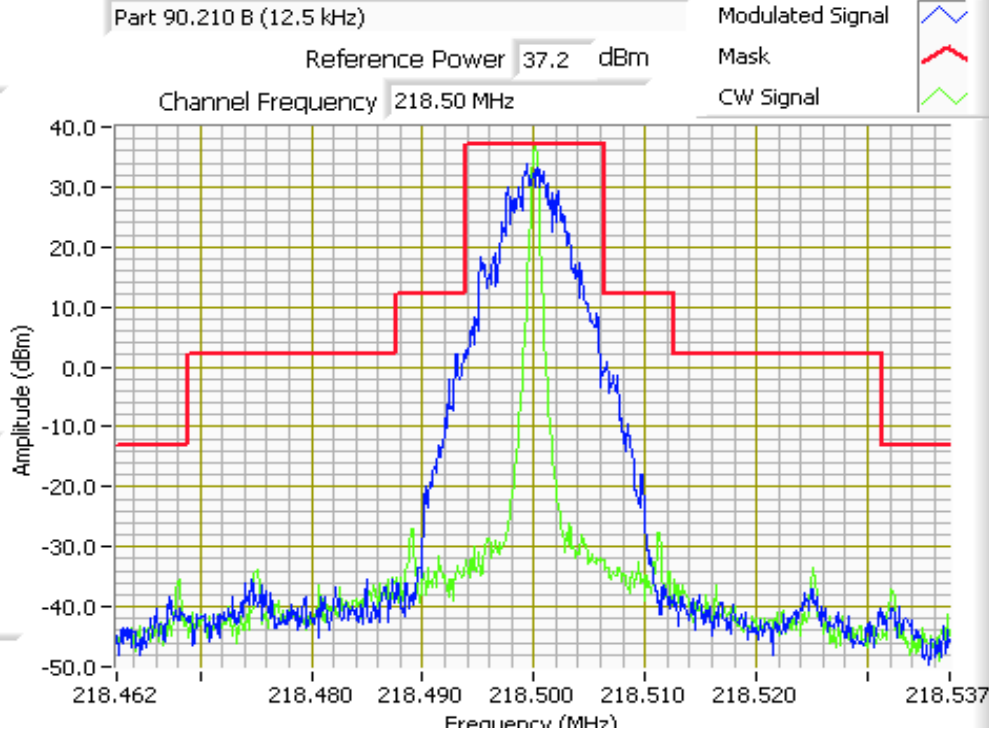
Max Hold 1
 CF: 218.50 MHz
 SPAN: 75 kHz
 RB 300 Hz
 VB 1 kHz
 Detector POS
 Att 30
 RL Offset 0.00
 Sweep Time 2.1s
 Ref Lvl: 19.30DBM

Notes

Spacing: 12.5 kHz
 Modem: 19200N

Analyzer HP8564E

PASS



Analyzer Settings

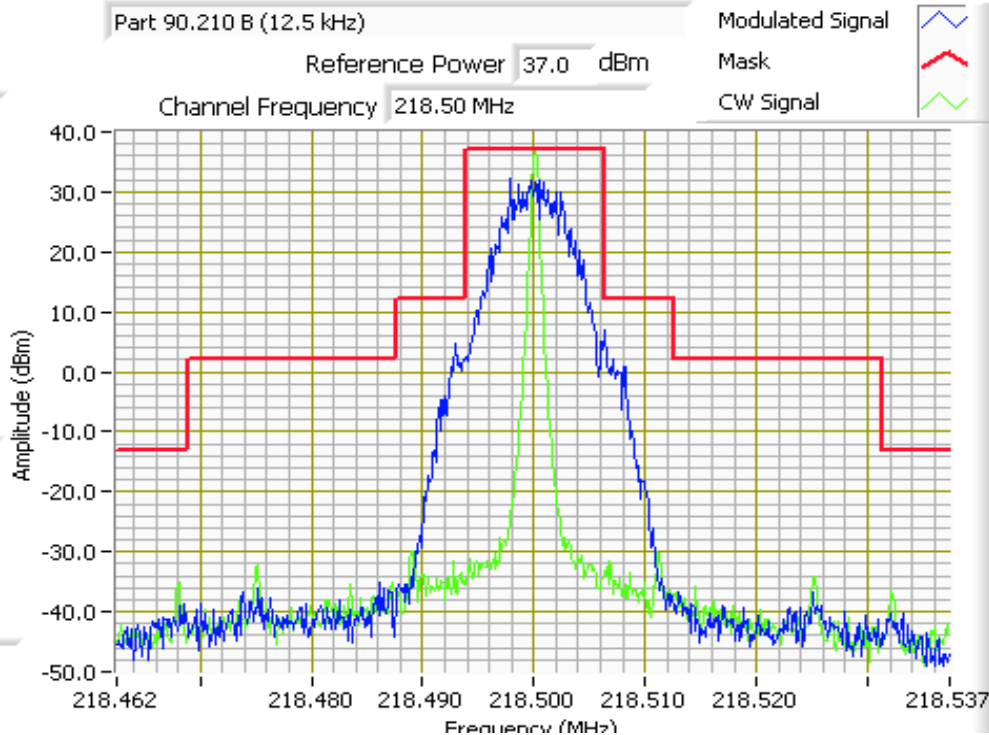
Max Hold 1
 CF: 218.50 MHz
 SPAN: 75 kHz
 RB 300 Hz
 VB 1 kHz
 Detector POS
 Att 30
 RL Offset 0.00
 Sweep Time 2.1s
 Ref Lvl: 19.30DBM

Notes

Spacing: 12.5 kHz
 Modem: 9600

Analyzer HP8564E

PASS



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



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

Part 90.210 B (25 kHz)

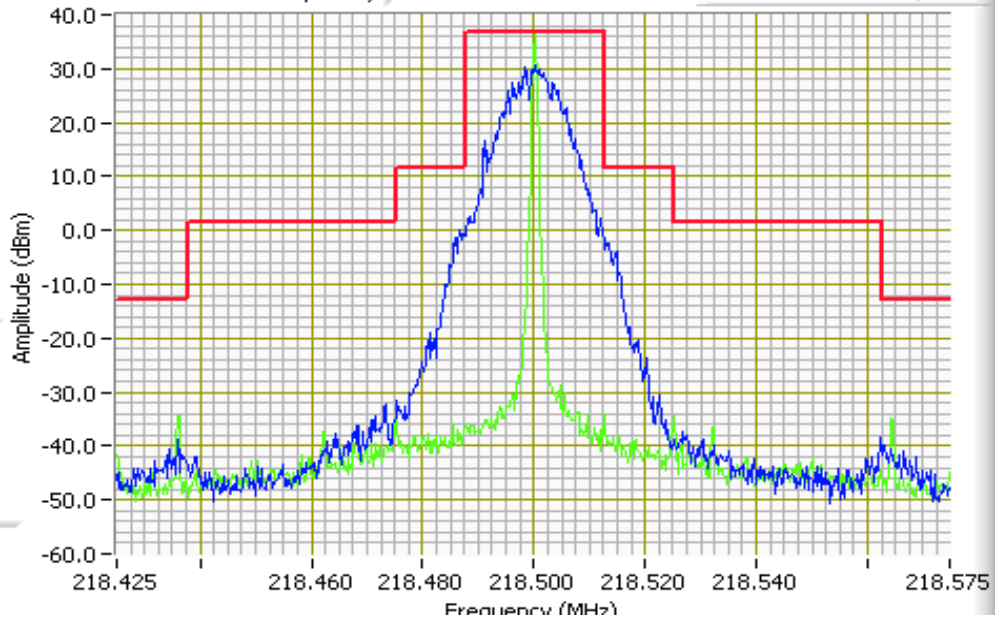
Reference Power 36.7 dBm

Channel Frequency 218.50 MHz

Modulated Signal

Mask

CW Signal



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

Part 80.211

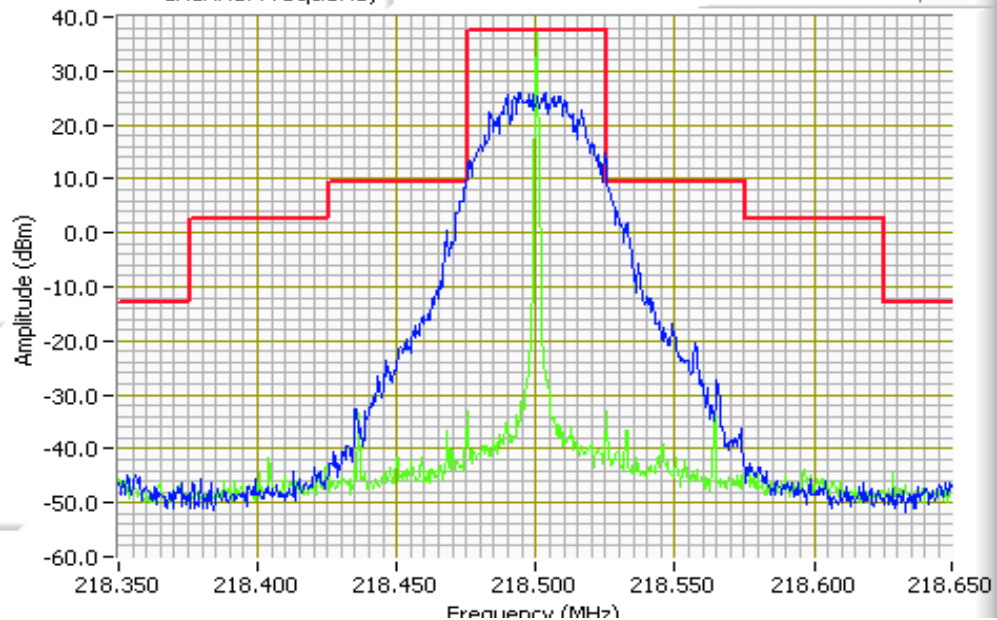
Reference Power 37.5 dBm

Channel Frequency 218.50 MHz

Modulated Signal

Mask

CW Signal



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



Analyzer Settings

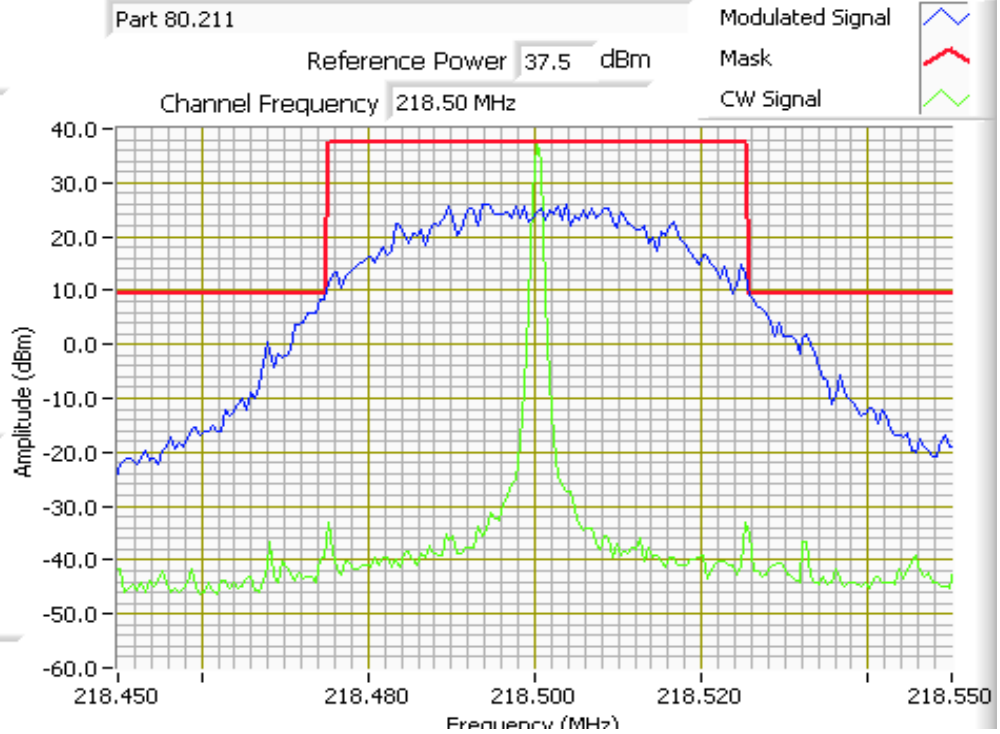
Max Hold 1
 CF: 218.50 MHz
 SPAN: 300 kHz
 RB 300 Hz
 VB 1 kHz
 Detector POS
 Att 30
 RL Offset 0.00
 Sweep Time 8.4s
 Ref Lvl: 19.30DBM

Notes

Spacing: 50.0 kHz

Analyzer HP8564E

PASS



Analyzer Settings

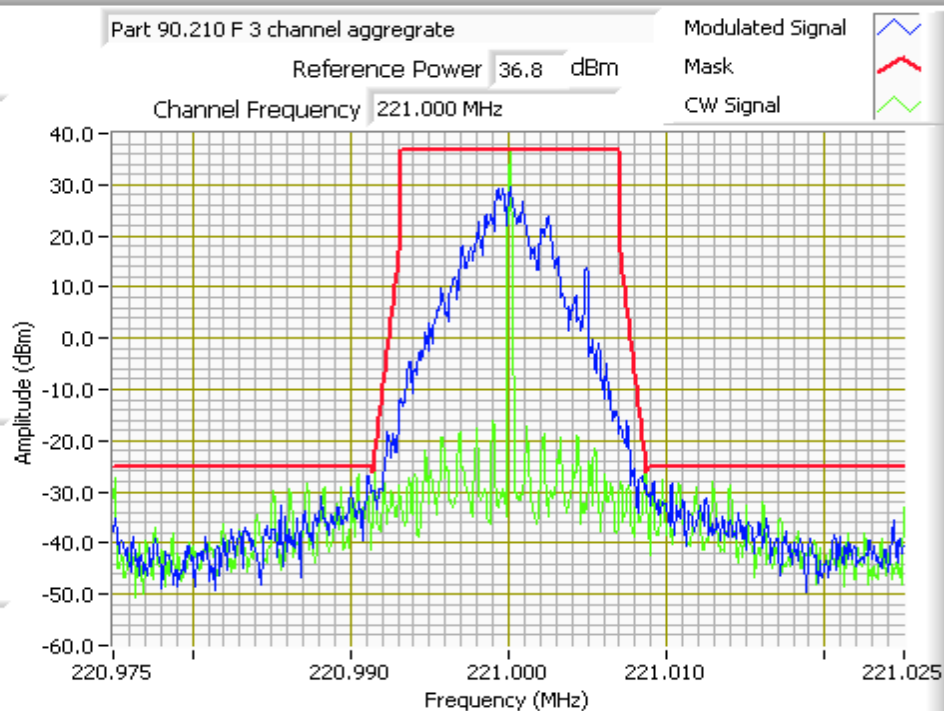
CF: 221.000 MHz
 SPAN: 50.0 kHz
 RB: 100 Hz
 VB: 300 Hz
 Detector: POS
 Attn: 30 DB
 RL Offset: 0.0 DB
 Sweep Time: 0.8s
 Ref Lvl: 20.0 DBM
 Max Hold 1

Notes

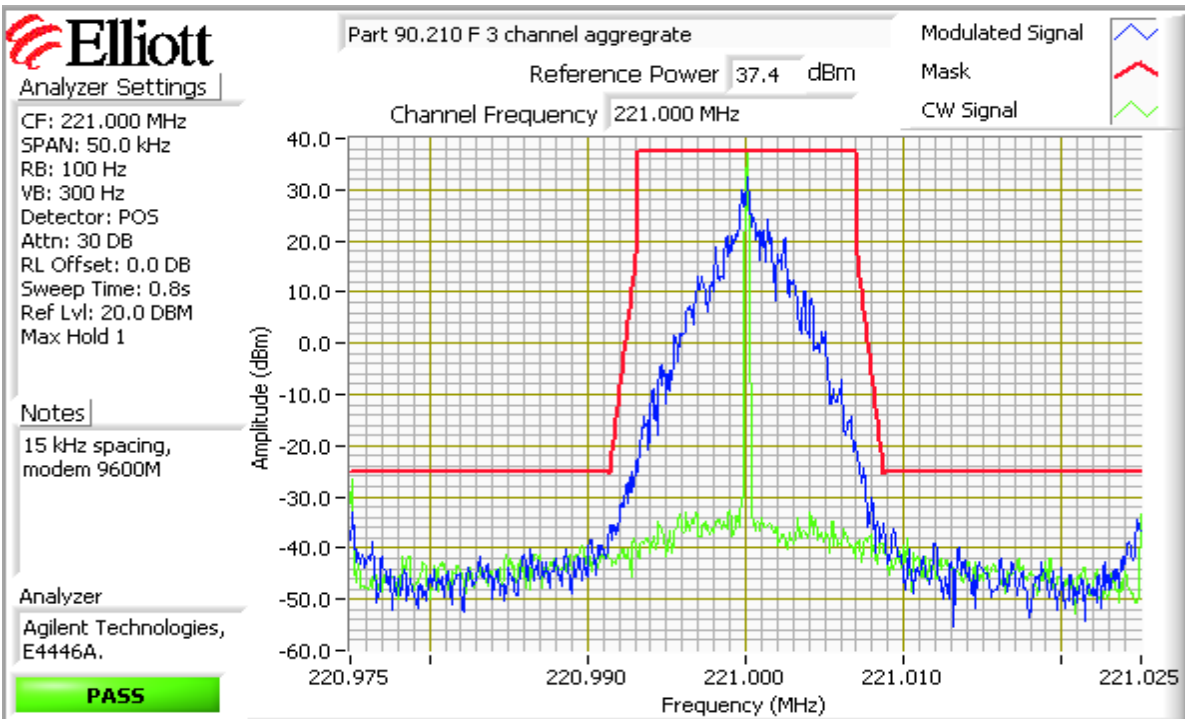
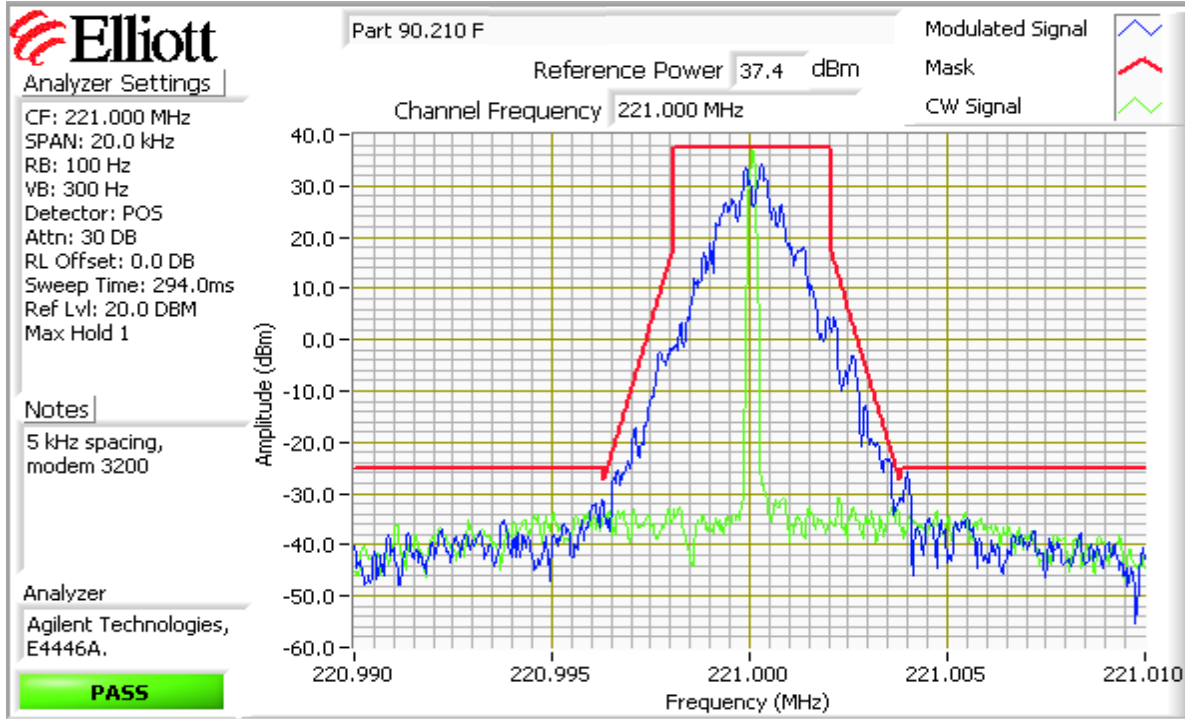
15 kHz spacing,
 modem 19200E

Analyzer
 Agilent Technologies,
 E4446A.

PASS



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

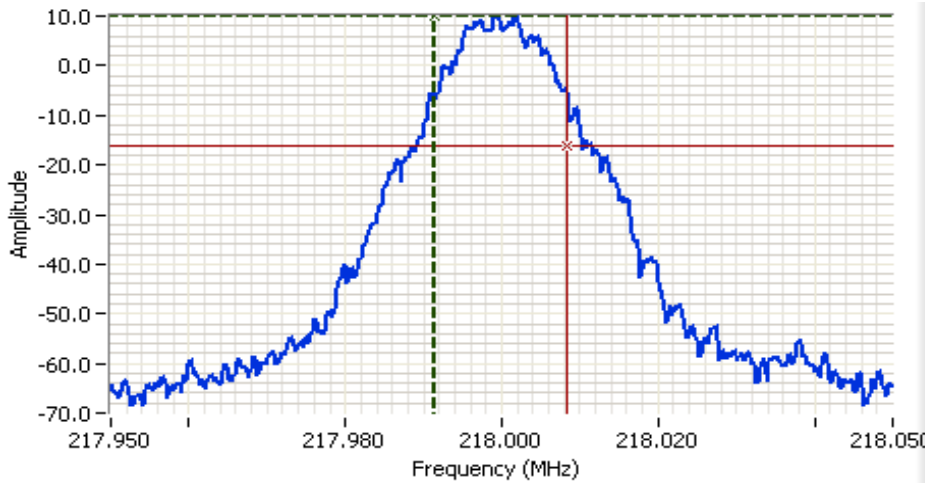


Client: GE MDS LLC	Job Number: J77843
Model: SD2 Transceiver	T-Log Number: T77846
	Account Manager: Susan Pelzl
Contact: Dennis McCarthy	
Standard: FCC Parts 80, 90 & 95, RSS-119, FCC Part 15	Class: N/A

Run #3: Signal Bandwidth

Power Setting	Frequency (MHz)	Span (kHz)	Resolution Bandwidth	Bandwidth (kHz)		Modem	Channel Spacing
				26dB	99%		
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



Analyzer Settings
 Agilent Technologies, E4446A
 CF: 218.000 MHz
 SPAN: 100 kHz
 RB: 1.00 kHz
 VB: 3.00 kHz
 Detector: POS
 Attn: 30 DB
 RL Offset: 0.0 DB
 Sweep Time: 96.0ms
 Ref Lvl: 20.0 DBM

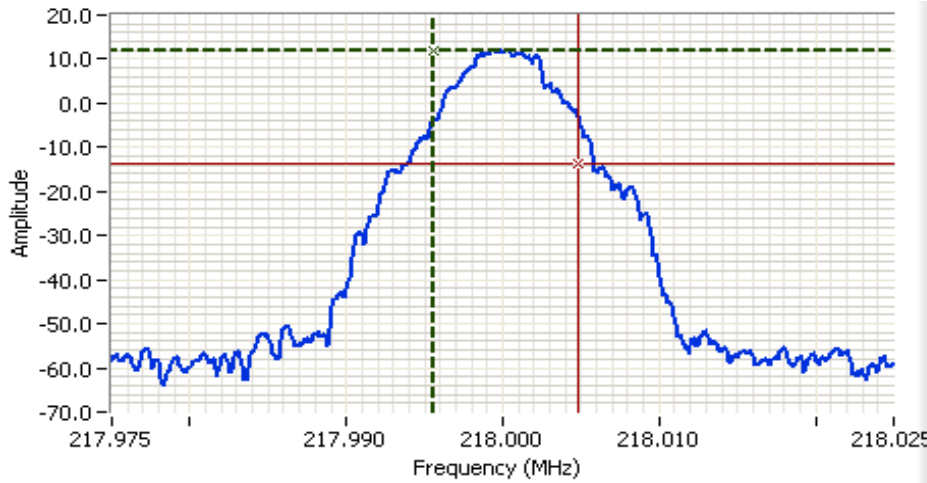
Comments
 99% power BW: 16.8 kHz
 Modem 19200

Cursor 1	217.9914	9.97	
Cursor 2	218.0082	-16.03	

Delta Freq. 16.8 kHz
 Delta Amplitude 26.00



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

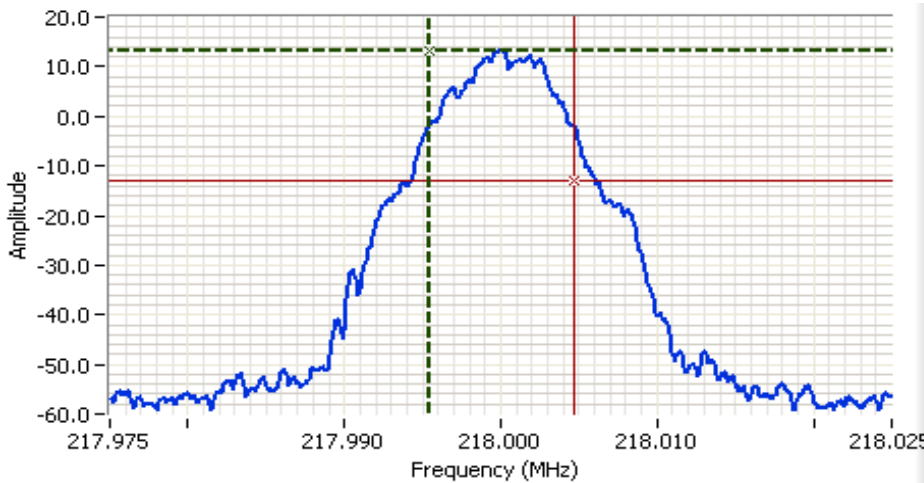


Analyzer Settings
 Agilent Technologies, E4446A
 CF: 218.000 MHz
 SPAN: 50.0 kHz
 RB: 1.00 kHz
 VB: 3.00 kHz
 Detector: POS
 Attn: 30 DB
 RL Offset: 0.0 DB
 Sweep Time: 48.0ms
 Ref Lvl: 20.0 DBM

Comments
 99% power BW: 9.15 kHz
 Modem 19200N

Cursor 1 217.9956 12.10
 Cursor 2 218.0048 -13.90

Delta Freq. 9.15 kHz
 Delta Amplitude 26.00



Analyzer Settings
 Agilent Technologies, E4446A
 CF: 218.000 MHz
 SPAN: 50.0 kHz
 RB: 1.00 kHz
 VB: 3.00 kHz
 Detector: POS
 Attn: 30 DB
 RL Offset: 0.0 DB
 Sweep Time: 48.0ms
 Ref Lvl: 20.0 DBM

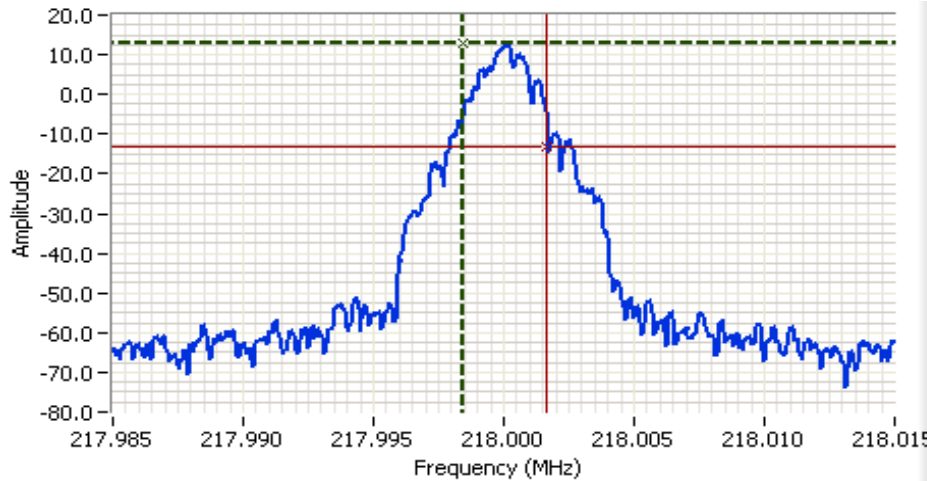
Comments
 99% power BW: 9.32 kHz
 Modem 9600

Cursor 1 217.9954 13.18
 Cursor 2 218.0047 -12.82

Delta Freq. 9.32 kHz
 Delta Amplitude 26.00



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



Analyzer Settings
 Agilent Technologies, E4446A
 CF: 218.000 MHz
 SPAN: 30.0 kHz
 RB: 300 Hz
 VB: 1.00 kHz
 Detector: POS
 Attn: 30 DB
 RL Offset: 0.0 DB
 Sweep Time: 316.0ms
 Ref Lvl: 20.0 DBM

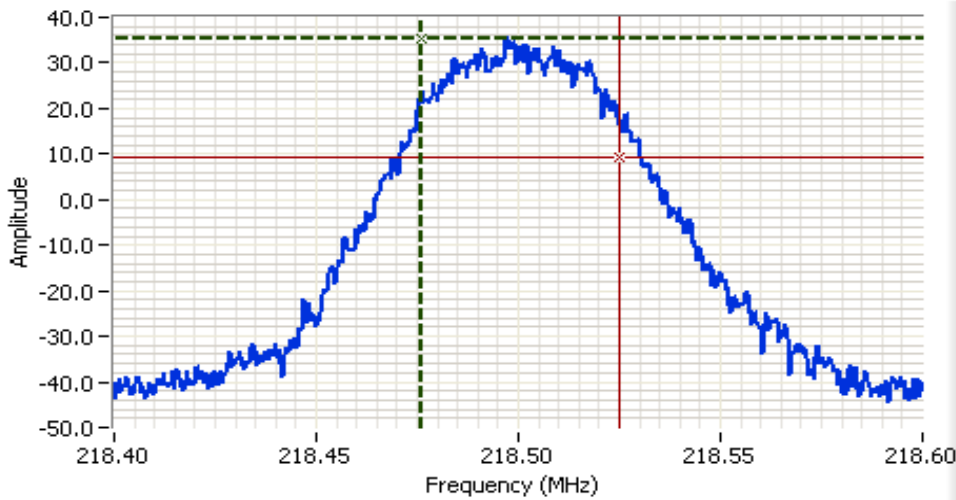
Comments
 99% power BW: 3.24 kHz
 Modem 4800F

Cursor 1 217.9984 12.69

Cursor 2 218.0017 -13.31

Delta Freq. 3.24 kHz

Delta Amplitude 26.00



Analyzer Settings
 HP8564E
 CF: 218.500 MHz
 SPAN: 200 kHz
 RB 3.00 kHz
 VB 10.00 kHz
 Detector POS
 Att 40
 RL Offset 20.00
 Sweep Time 67.0ms
 Ref Lvl: 44.50 DBM

Comments
 99% BW: 48.9 kHz
 50kHz

Cursor 1 218.4759 35.33

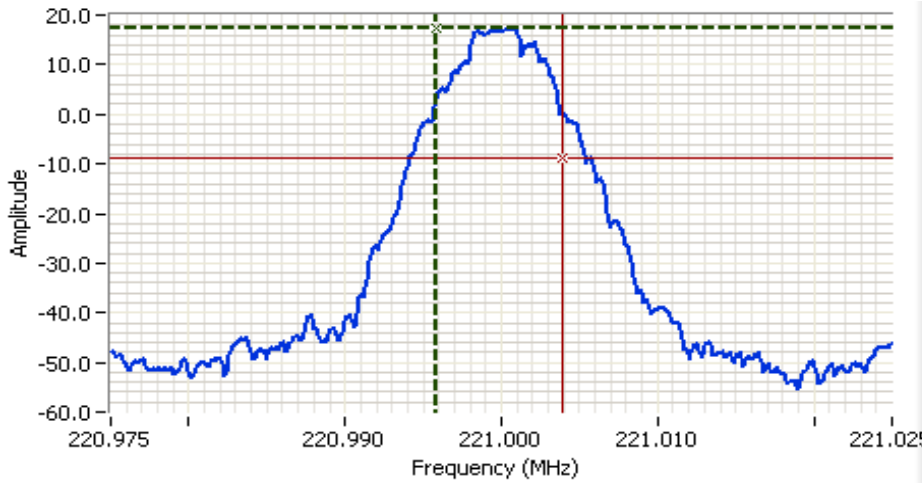
Cursor 2 218.5248 9.33

Delta Freq. 48.9 kHz

Delta Amplitude 26.00



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

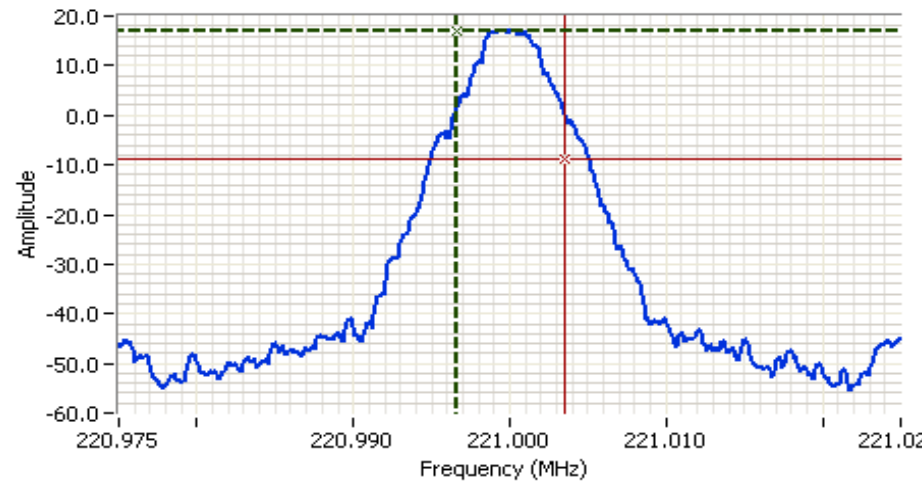


Analyzer Settings
 Agilent Technologies, E4446A
 CF: 221.000 MHz
 SPAN: 50.0 kHz
 RB: 1.00 kHz
 VB: 3.00 kHz
 Detector: POS
 Attn: 30 DB
 RL Offset: 0.0 DB
 Sweep Time: 48.0ms
 Ref Lvl: 20.0 DBM

Comments
 99% power BW: 8.15 kHz
 Modem 19200E

Cursor 1 220.9958 17.24
 Cursor 2 221.0040 -8.76

Delta Freq. 8.15 kHz
 Delta Amplitude 26.00



Analyzer Settings
 Agilent Technologies, E4446A
 CF: 221.000 MHz
 SPAN: 50.0 kHz
 RB: 1.00 kHz
 VB: 3.00 kHz
 Detector: POS
 Attn: 30 DB
 RL Offset: 0.0 DB
 Sweep Time: 48.0ms
 Ref Lvl: 20.0 DBM

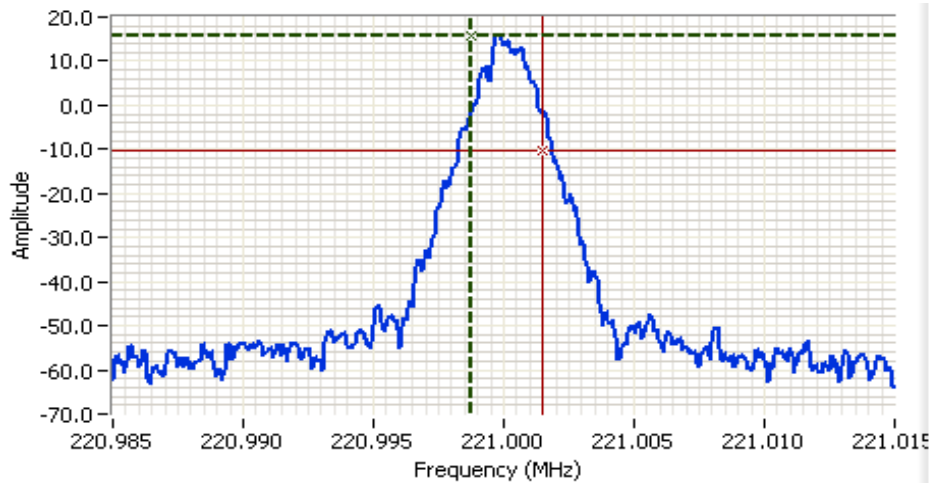
Comments
 99% power BW: 6.91 kHz
 Modem 9600M

Cursor 1 220.9966 17.14
 Cursor 2 221.0035 -8.86

Delta Freq. 6.91 kHz
 Delta Amplitude 26.00



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



Analyzer Settings
 Agilent Technologies, E4446A
 CF: 221.000 MHz
 SPAN: 30.0 kHz
 RB: 300 Hz
 VB: 1.00 kHz
 Detector: POS
 Attn: 30 DB
 RL Offset: 0.0 DB
 Sweep Time: 316.0ms
 Ref Lvl: 20.0 DBM

Comments
 99% power BW: 2.80 kHz
 Modem 3200

Cursor 1	220.9987	15.81	Delta Freq.	2.80 kHz
Cursor 2	221.0015	-10.19	Delta Amplitude	26.00



Run #4: Out of Band Spurious Emissions, Conducted

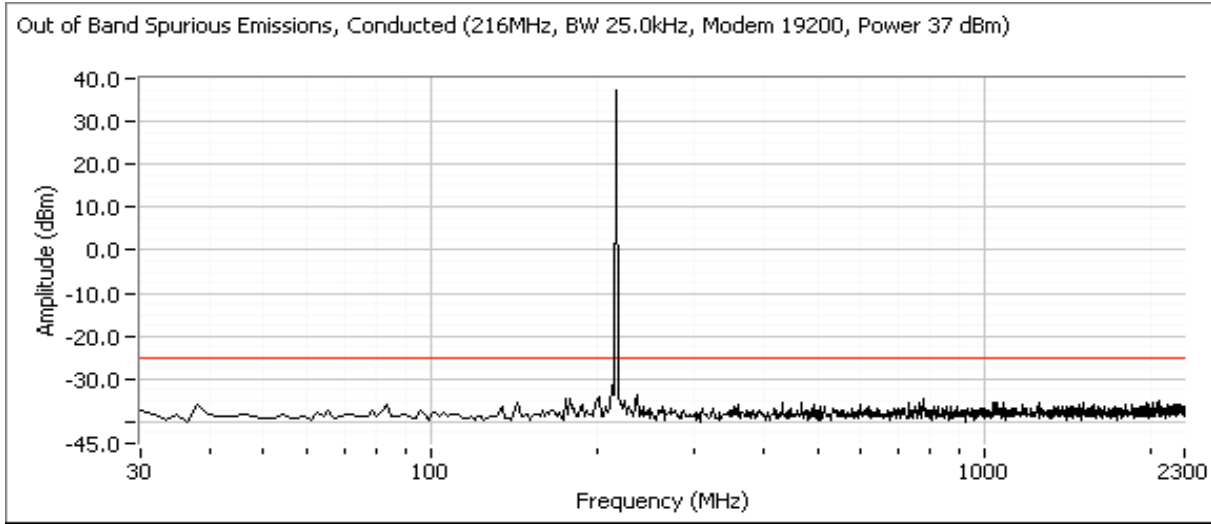
The limit is taken from FCC Part 90 Mask B for 216-220 MHz operation and Mask F for 220-222 MHz operation

Frequency MHz	Level dBm	Port	FCC Part 90 (Mask F)		Detector	Tx Freq.	Mode	Comments
			Limit	Margin				
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

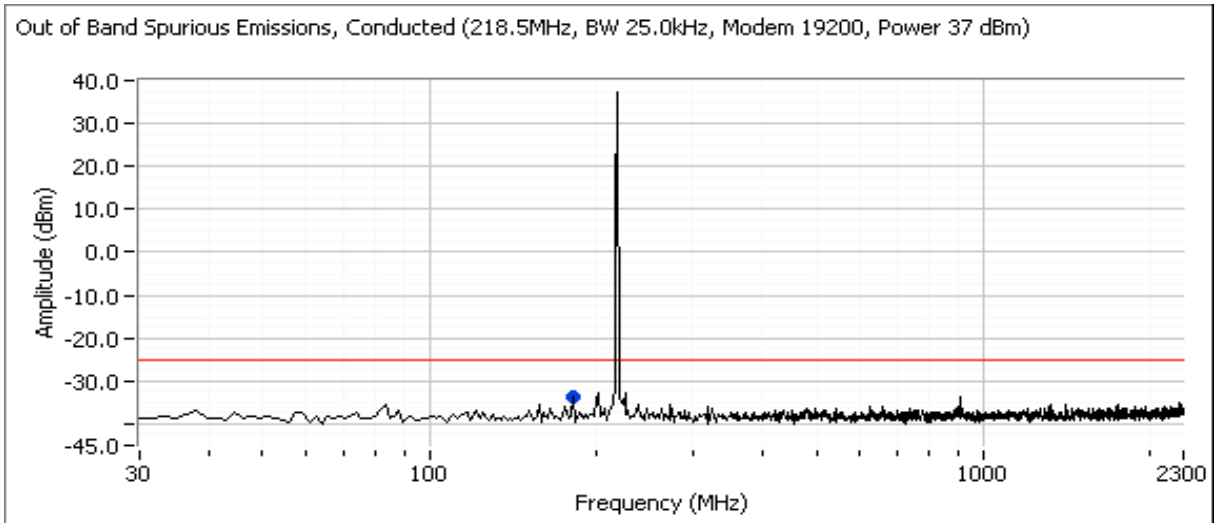
Note 1: The limit for this band was -13dBm but more restrictive limit (-25dBm) was used

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

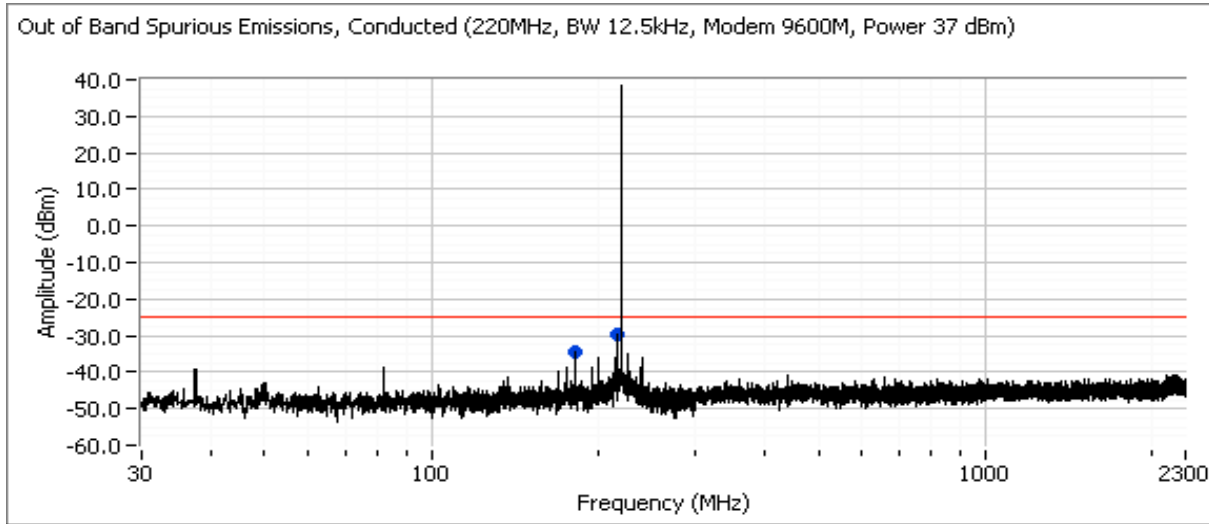


Plot for 218.5 MHz channel, power setting(s) = 37

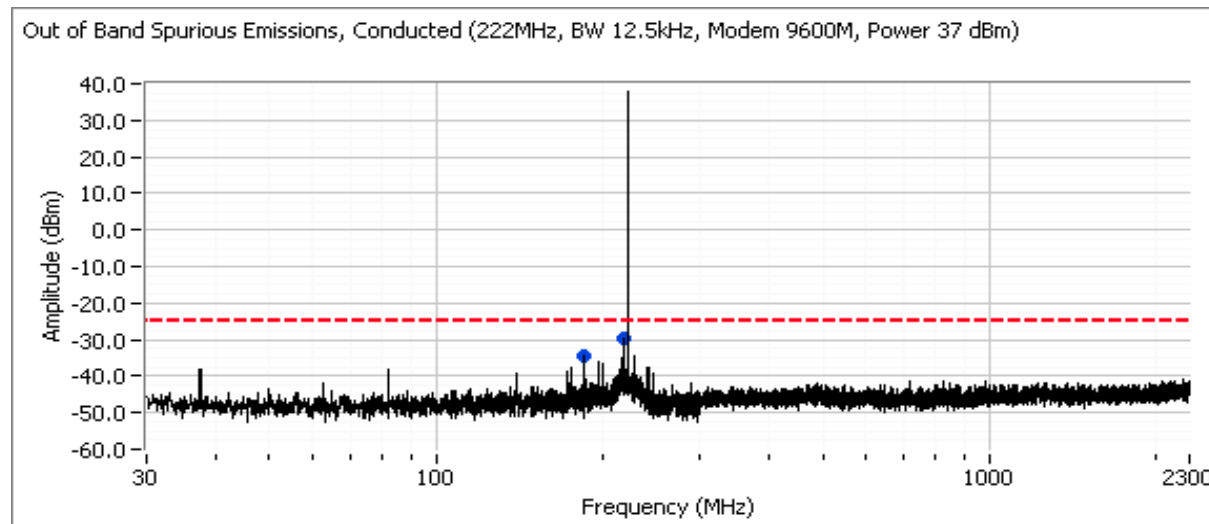


Client: GE MDS LLC	Job Number: J77843
Model: SD2 Transceiver	T-Log Number: T77846
	Account Manager: Susan Pelzl
Contact: Dennis McCarthy	
Standard: FCC Parts 80, 90 & 95, RSS-119, FCC Part 15	Class: N/A

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 (Celsius)	Frequency Measure (MHz)	Drift	
		(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 (DC)	Frequency Measure (MHz)	Drift	
		(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