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Radio Test Report

FCC Part 90 Subpart Z
3650 MHz to 3675 MHz

Model: Mercury 3650

FCC ID:	E5MDS-MERCURY3651
COMPANY:	GE MDS LLC 175 Science Parkway Rochester, NY 14620
TEST SITE(S):	NTS Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
REPORT DATE:	November 27, 2012
FINAL TEST DATES:	October 16, 19 and 30, 2012
TOTAL NUMBER OF PAGES:	43

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ACCREDITED
Testing Cert #0214.26

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	11-27-2012	First release	

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SCOPE

Tests have been performed on the GE MDS LLC model Mercury 3650, 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 3
- CFR 47 Part 90 (Private Land Mobile Radio Service) Subpart Z
- RSS 197 Issue 1 "Wireless Broadband Access Equipment Operating in the Band 3650-3700 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 NTS Silicon Valley 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 Mercury 3650 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 Mercury 3650 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. Testing was restricted to the 1.75 and 3.5 MHz bandwidth modes to demonstrate compliance over a broader frequency range than originally certified for these two modes.

TEST RESULTS

FCC Part 90Z – Base and Fixed Stations, 3650 – 3700 MHz

FCC	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics				
§2.1033 (c) (5) § 90.1321(b)	Frequency ranges (Listed for each channel spacing)	1.75 MHz BW 3650.875-3674.125 MHz 3.5 MHz BW 3651.75-3673.25 MHz	3650-3675 MHz Note 1	Complies
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 § 90.1321	EIRP – Total power (Maximum for each channel spacing)	3650.875 MHz 31.8 dBm (1.5 W) 3651.75 MHz 34.5 dBm (2.8 W)	25 Watts	Complies
	EIRP – PSD (Maximum)	29.7dBm	30 dBm/MHz	Complies
§2.1033 (c) (4) §2.1047 § 90.210	Emission types	No change from original submittal		-
	Emission mask	No change from original submittal		Complies
§2.1049	Occupied (99%) Bandwidth	No change from original submittal		-
Transmitter spurious emissions				
§2.1051 §2.1057 §90.1323	At the antenna terminals	-19.0 dBm	-13 dBm/MHz	Complies
	Radiated (eirp)	-34.5 dBm		Complies
Receiver spurious emissions				
15.109	Field strength	Not applicable, note 2		
Other details				
§90.1319	Policies of use	No change from original submittal		-
§2.1055 §90.213(a)	Frequency stability	No change from original submittal		-
§1.1307(b) §2.1093 §90.1335	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 22cm 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	No change from original submittal		-
-	Antenna Gain	This application is submitted for antennas of 13 and 18dBi gain using a feedline loss of 3 dB for effective antenna gain of 10 and 15 dBi..		

Notes

1) The upper part of the allocated band from 3675 – 3700 MHz requires the device to use an unrestricted contention-based protocol. This system does not have such a protocol and so cannot use the upper portion of the band.
2) Receiver spurious emissions requirements only apply to devices that operate (tune) below 960MHz.

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)	dBµV/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 Mercury 3650 is a broadband wireless transceiver which is designed to transmit and receive data in the 3.65 - 3.675 GHz band. Normally, the EUT would be placed on a tabletop or in a rack during operation. The EUT was, therefore, placed on a table during emissions testing to simulate the end user environment. The electrical rating of the EUT is 10-30Vdc, 2.5 Amps.

The sample was received on October 16, 2012 and tested on October 16, 19 and 30, 2012. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
GE MDS LLC	Mercury 3650	Digital UHF Radio	2228309	E5MDS-MERCURY3651

OTHER EUT DETAILS

The following EUT details should be noted: Permissive Change to extend the frequency range of operation using 1.75 and 3.5 MHz bandwidth modes.

The EUT can be used with antennas of 13 or 18 dBi and a cable with 3dB of loss.

ENCLOSURE

The EUT enclosure is primarily constructed of die cast metal. It measures approximately 20cm wide by 11cm deep by 5cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Silicon Valley.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Dell	Latitude D620	Laptop	6G1HLC1	DoC
Agilent	E3610A	DC Power Source	MY40011740	-

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Antenna	50 ohm Termination	-	-	-
Data Interface	Laptop	DB25	Shielded	2
GPS	Terminator	-	-	-
DC Power	13.8V DC Source	2 wire	Unshielded	2

EUT OPERATION

During emissions testing the EUT was set to continuous modulated transmit mode at the frequency and power as required for testing.

TESTING

GENERAL INFORMATION

Antenna port measurements were taken at the NTS Silicon Valley test site located at 41039 Boyce Road, Fremont, CA 94538-2435.

Radiated spurious emissions measurements were taken at the NTS Silicon Valley 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.

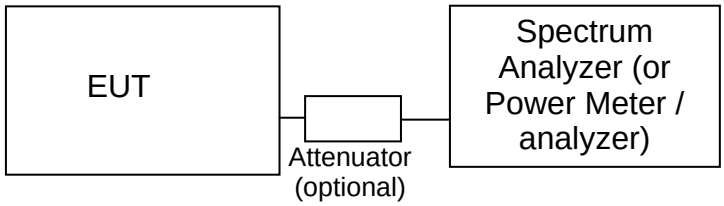
Site	Registration Numbers		Location
	FCC	Canada	
Chamber 4	211948	IC 2845B-4	41039 Boyce Road Fremont, CA 94538-2435
Chamber 5	211948	IC 2845B-5	

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 tunes 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.

TRANSIENT FREQUENCY BEHAVIOR:

The TIA/EIA 603 procedure is used to determine compliance with transient frequency timing requirements as the radio is keyed on and off.

The EUTs rf output is connected via a combiner/splitter to the test receiver/spectrum analyzer and to a diode detector. The test receiver or spectrum analyzer video output is connected to an oscilloscope, which is triggered by the output from the diode detector.

Plots showing Ton, T1, and T2 are made when turning on the transmitter and showing T3 when turning off the transmitter.

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, 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

Radio Antenna Port (Power and Spurious Emissions), 16-Oct-12

Manufacturer	Description	Model	Asset #	Cal Due
Agilent	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	2/23/2013

Radiated Emissions, 1000 - 37,000 MHz, 16-Oct-12

Manufacturer	Description	Model	Asset #	Cal Due
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	8/23/2014
Hewlett Packard	Head (Inc flex cable, 1143, 2198) Red	84125C	1145	7/5/2013
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/14/2013
A.H. Systems	Red System Horn, 18-40GHz	SAS-574, p/n: 2581	2161	3/20/2013

Radio Antenna Port (Power and Spurious Emissions), 19-Oct-12

Manufacturer	Description	Model	Asset #	Cal Due
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	12/9/2012

Radio Antenna Port (Power and Spurious Emissions), 30-Oct-12

Manufacturer	Description	Model	Asset #	Cal Due
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	12/9/2012

Appendix B Test Data

T89514 Pages 21 - 42

Client:	GE MDS LLC	Job Number:	J89493
Product	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Emissions Standard(s):	FCC Part 90, RSS-197	Class:	A
Immunity Standard(s):	-	Environment:	Radio

EMC Test Data

For The

GE MDS LLC

Product

Mercury 3650

Date of Last Test: 11/8/2012

Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

RSS 197 and FCC Part 90Z

Spurious Emissions (Band edge) and Transmitter 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.

General Test Configuration

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected

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

Ambient Conditions:

Temperature: 23 °C
Rel. Humidity: 40 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	Spurious Emissions (conducted)	-13 dBm	Pass	-13.8 dBm (-.8 dB)
2	Transmitter Frequency Stability	Part 90.213 / RSS-197 5.3	Pass	3650.016 MHz (16 kHz)

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:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

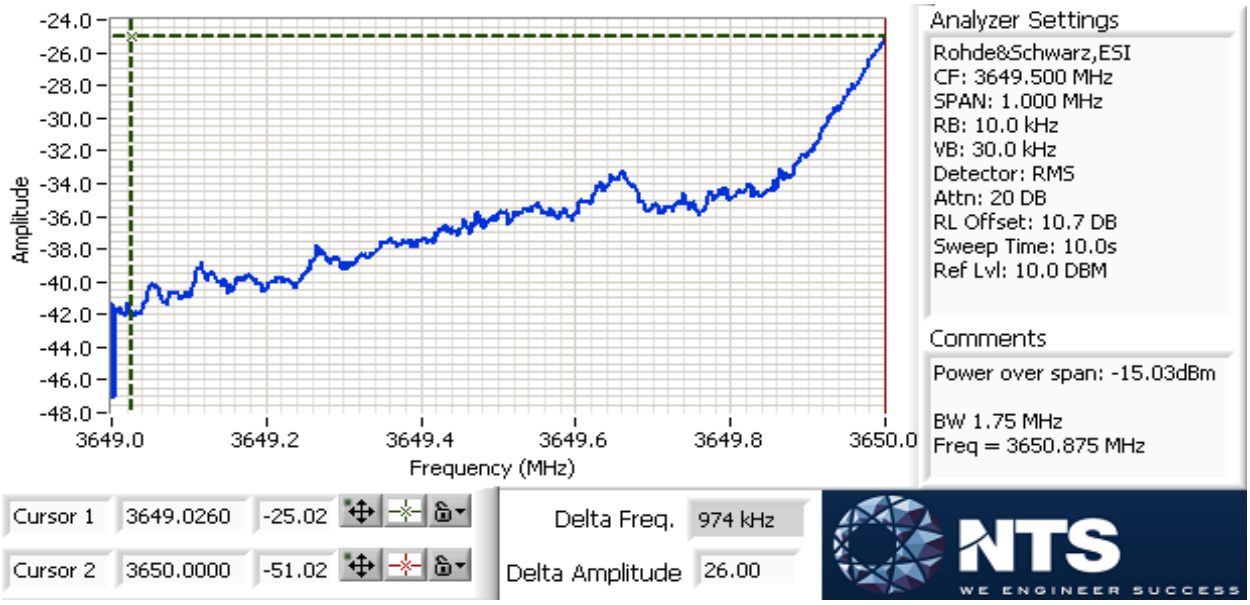
Run #1: Spurious Emissions (conducted)

Date 10/30/2012 Engineer: John Caizzi Location: FT Ch# 5

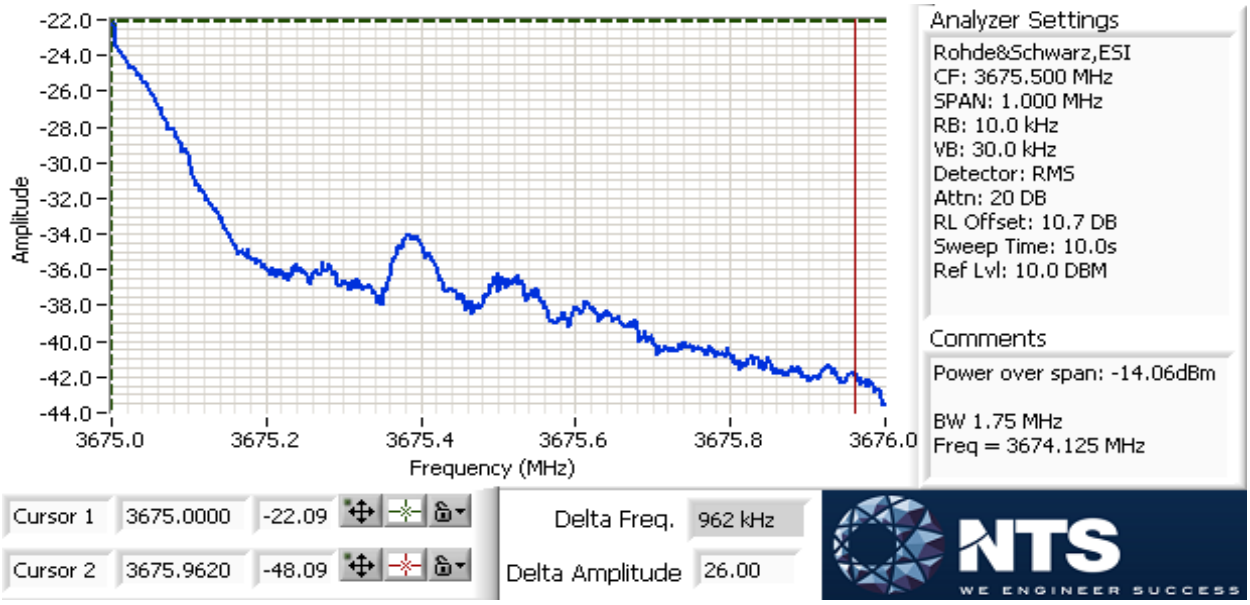
Cable Loss: 0.7 dB Attenuator: 10.0 dB Total Loss: 10.7 dB
Cable ID(s): EL 538 Attenuator IDs: 2100

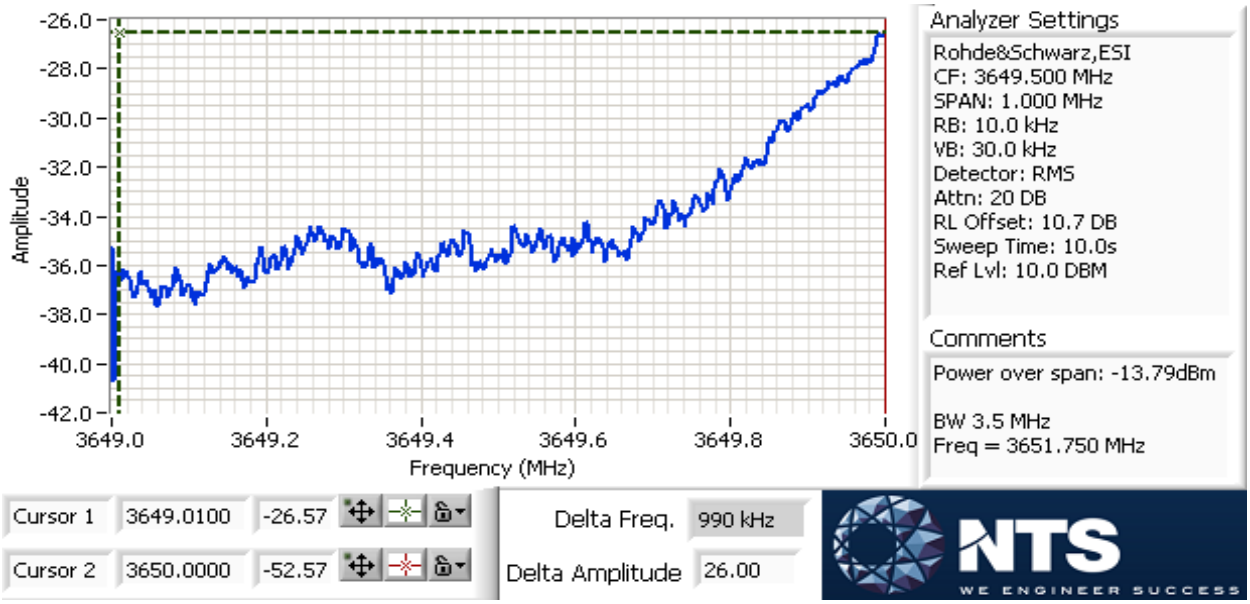
BW	Channel	Chain 1		Total	RSS-197	Margin	Detector	Frequency	Mode	Power
MHz	MHz	dBm		dBm	Limit	dB		MHz		setting
1.75	3650.875	-15.0		-15.0	-13.0	-2.0	RMS	3650.000	QAM64	21
1.75	3674.125	-14.1		-14.1	-13.0	-1.1	RMS	3675.000	QAM64	21
3.5	3651.750	-13.8		-13.8	-13.0	-0.8	RMS	3650.000	BPSK	22
3.5	3673.250	-14.3		-14.3	-13.0	-1.3	RMS	3675.000	BPSK	22

Note: QPSK and QAM16 modulations have also been measured and found to have no significant effect on band edge measurements

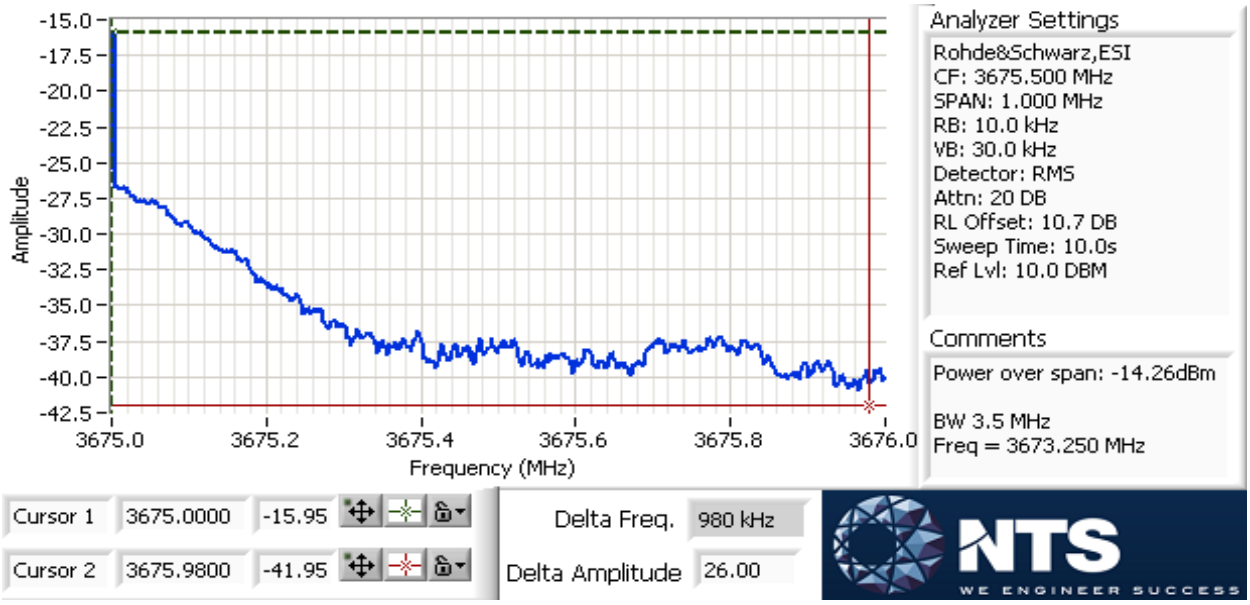


Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A





Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A



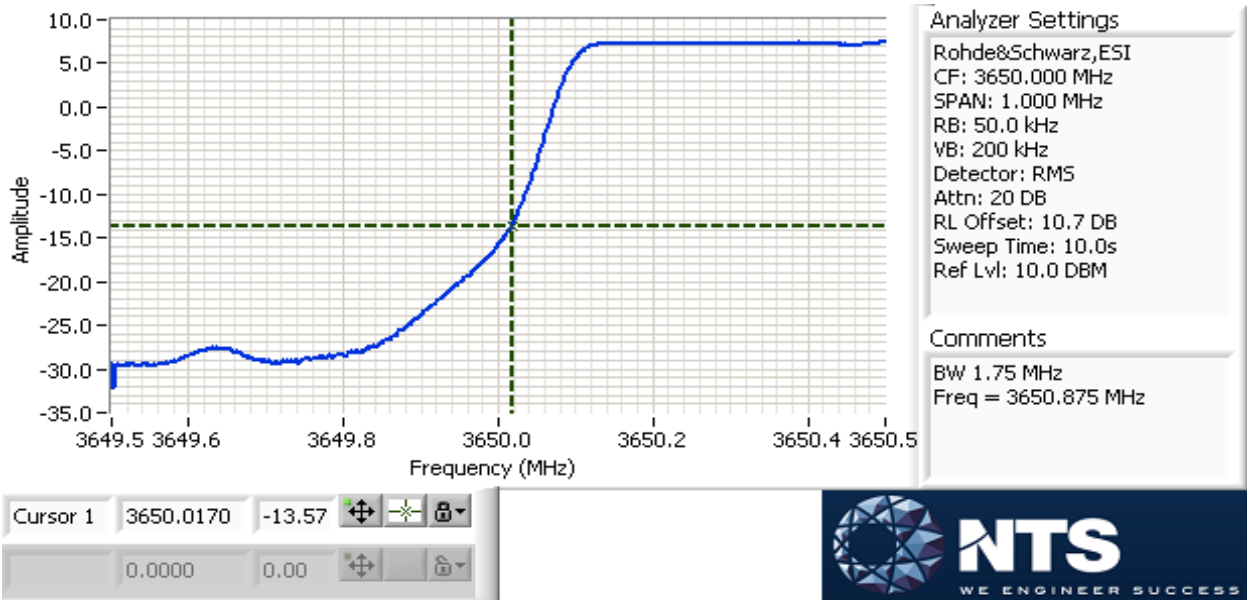
Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

Run #2: Transmitter Frequency Stability

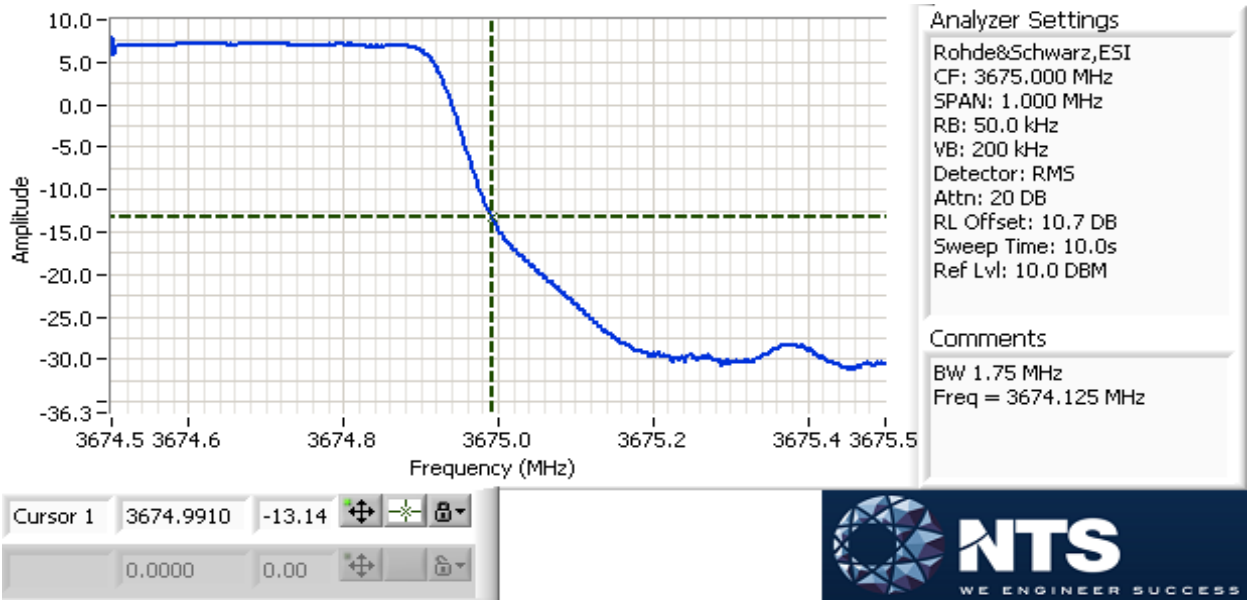
Date 10/30/2012 Engineer: John Caizzi Location: FT Ch# 5

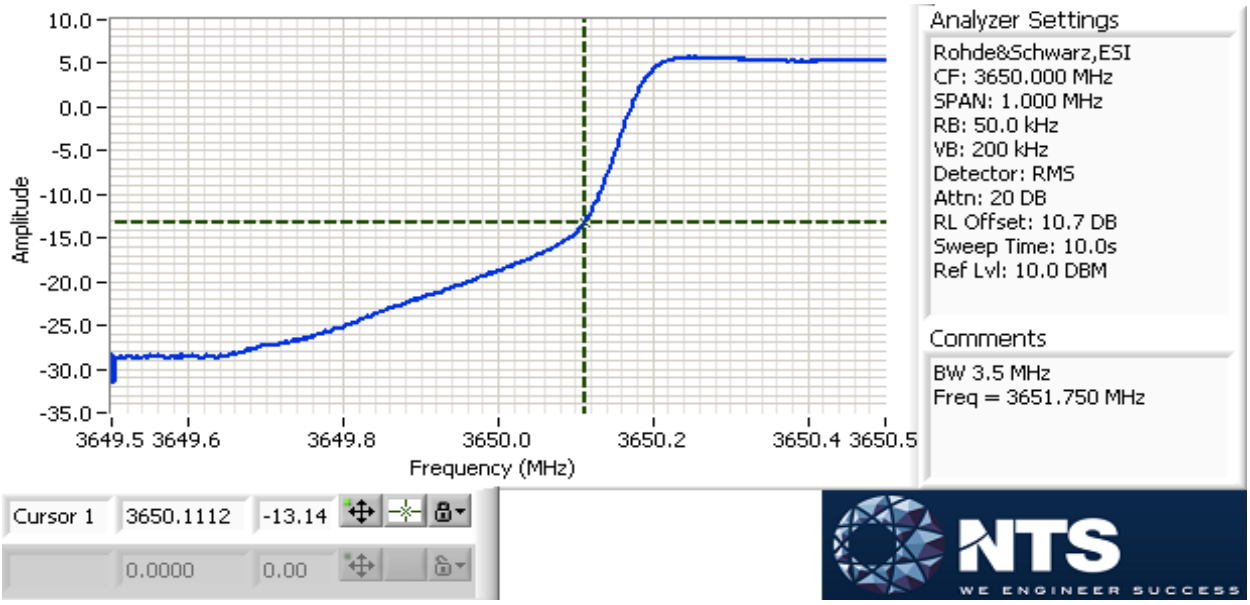
Cable Loss: 0.7 dB Attenuator: 10.0 dB Total Loss: 10.7 dB
Cable ID(s): EL 538 Attenuator IDs: 2100

BW MHz	Channel Frequency MHz	Mode	Power setting	Unwanted emissiom reference point	Worst case drift MHz	F_H or F_L
1.75	3650.875	QAM64	21	3650.017000	0.000760	3650.016240
1.75	3674.125	QAM64	21	3674.991000	0.000760	3674.991760
3.5	3651.750	BPSK	22	3650.111200	0.000760	3650.110440
3.5	3673.250	BPSK	22	3674.898800	0.000760	3674.899560

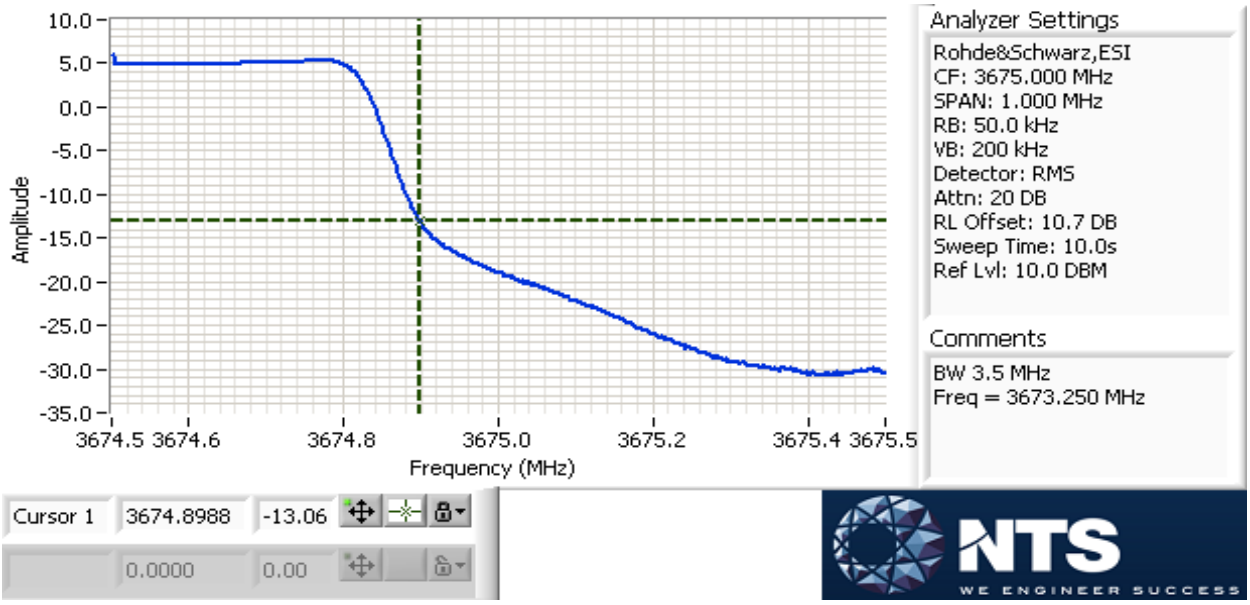


Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A





Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A



Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

RSS 197 and FCC Part 90Z

Power 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

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: 23 °C

Rel. Humidity: 40 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	Output Power	FCC Part 90Z	Pass	34.5 dBm
2	Spurious Emissions (conducted)	-13 dBm	Pass	All < -13dBm
3	Spurious emissions (radiated)	-13 dBm	Pass	-34.5dBm @ 10958.33MHz (-21.5dB)

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.

NTS WE ENGINEER SUCCESS

Radio Test Data

Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

Run #1: Output Power

Date: 10/16/2012 Engineer: J. Caizzi Location: FT Lab 4

Cable Loss: 0.7 dB Attenuator: 10.0 dB Total Loss: 10.7 dB

Cable ID(s): EL 539 Attenuator IDs: 2100

Freq. (MHz)	Modulation[7]	Channel bandiwdth	Software setting[1]	Power[2] (dBm)	PSD[3] dBm/MHz	Gain[4] (dBi)	EIRP PSD[5] dBm/MHz	EIRP[6] dBm
3650.875	QAM64	1.75 MHz	21	21.8	19.8	10.0	29.8	31.8
3674.125	QAM64	1.75 MHz	21	21.4	19.3	10.0	29.3	31.4
3650.875	QAM64	1.75 MHz	16	16.6	14.6	15.0	29.6	31.6
3674.125	QAM64	1.75 MHz	16	16.2	14.1	15.0	29.1	31.2
3651.750	BPSK	3.5 MHz	22	22.5	17.7	10.0	27.7	32.5
3673.250	BPSK	3.5 MHz	22	21.9	17.1	10.0	27.1	31.9
3651.750	BPSK	3.5 MHz	19	19.5	14.7	15.0	29.7	34.5
3673.250	BPSK	3.5 MHz	19	19.0	14.2	15.0	29.2	34.0

Note 1:	Software setting used to set the output power. Power set to match output powers at original lowest and highest channels.
Note 2:	Output power measured using RBW=100kHz VBW=300kHz and detector set to RMS, max hold enabled. The total power was integrated over the span (span > 2x channel bandwidth). Plot for channel with the highest power provided below.
Note 3:	The psd was measured using the following analyzer settings: RB=1MHz, VB=3MHz, detector = rms, sweep time 5 seconds, max hold. Multiple sweeps were made until the display had no new "peaks". Plot for channel with the highest power provided below.
Note 4:	This column contains the effective antenna gain (actual antenna gain minus feed cable loss). Two values are being evaluated - an effective gain of 10dBi and an effective gain of 15dBi. These two values include a cable loss of 3dB so the actual gain of the antennas are 13dBi and 18dBi.
Note 5,6:	These are the eirp power spectral density (measured power density plus effective antenna gain) and power (measured power plus effective antenna gain). The maximum permitted psd is 30dBm/MHz.

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Model:	Mercury 3650	T-Log Number:	T89514
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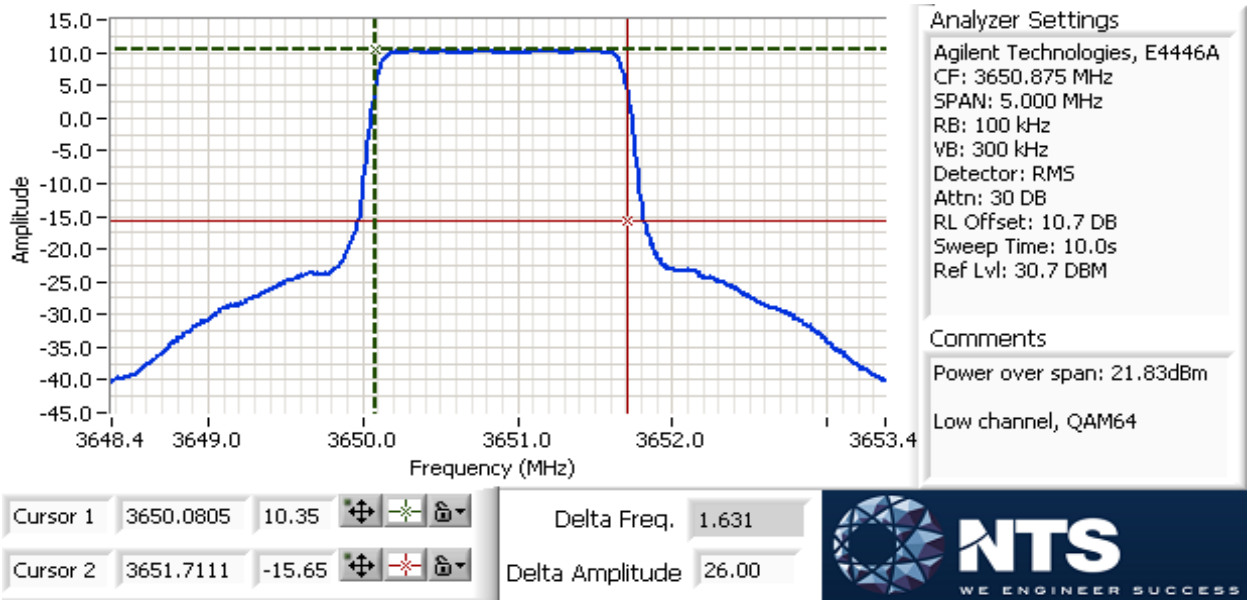
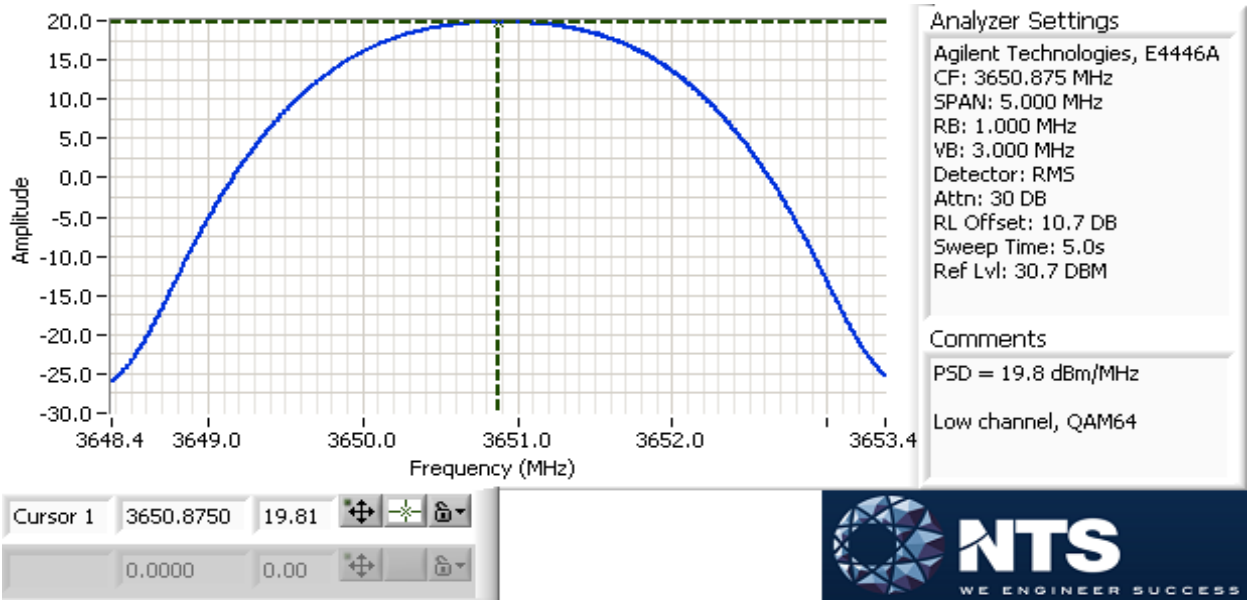
Standard:	FCC Part 90, RSS-197	Class:	N/A





Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

Run #4: Out of Band Spurious Emissions, Conducted

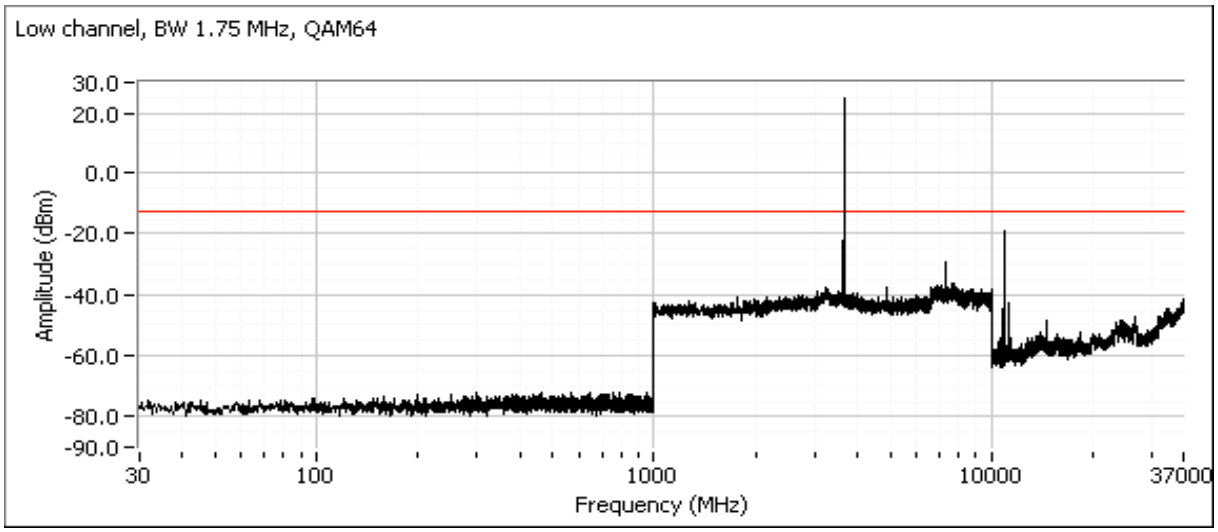
Date: 10/16/2012 Engineer: John Caizzi Location: Lab 4

Frequency (MHz)	Limit	Result
Low BW 1.75MHz	-13 dBm	Pass
High BW 1.75MHz		
Low BW 3.5MHz		
High BW 3.5MHz		

The limit is taken from FCC Part 90 Mask B (-13dBm)

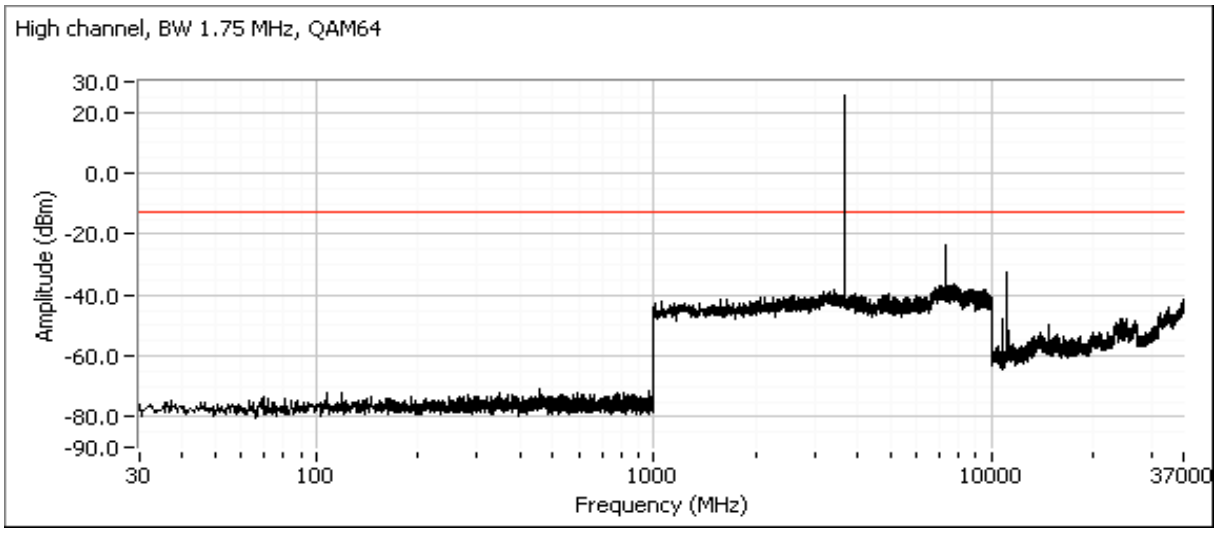
Run #4a: Spurious emissions, BW=1.75MHz, power setting of 21

Plot for low channel



Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

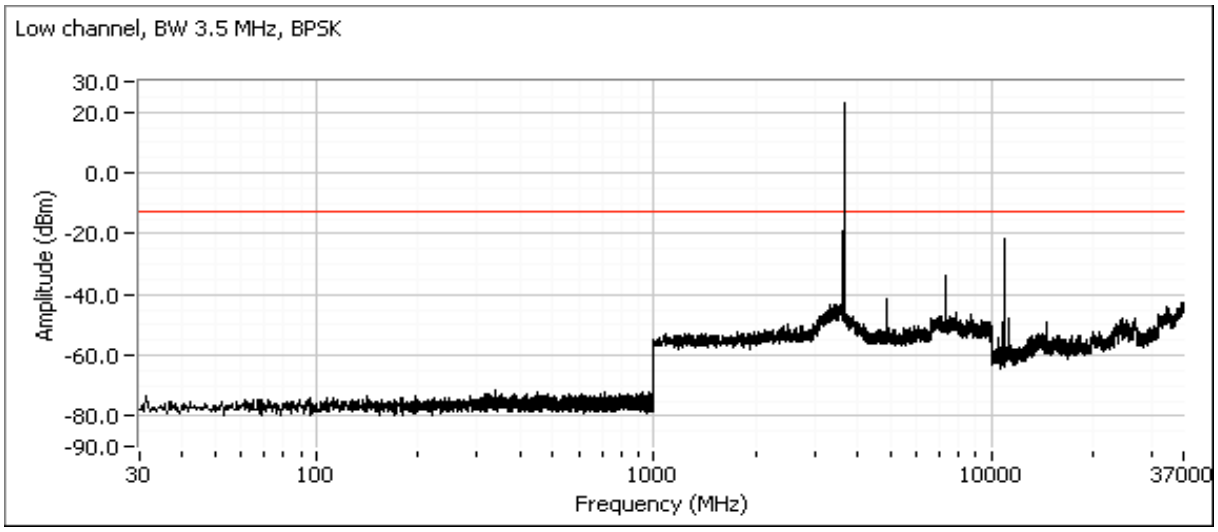
Plot for high channel



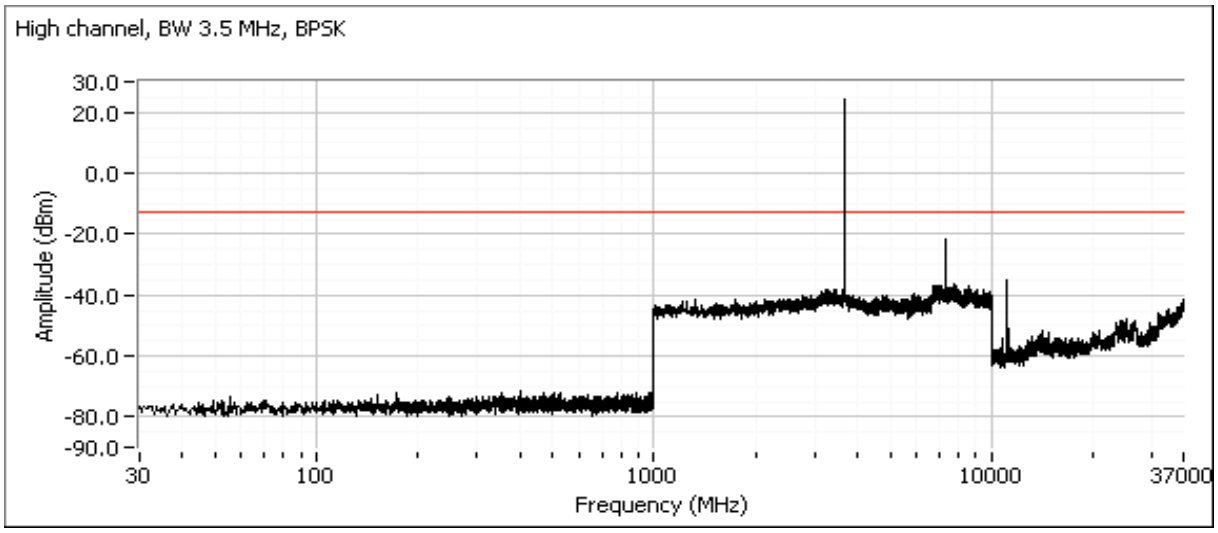
Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

Run #4b: Spurious emissions, BW=3.5MHz, power setting of 22

Plot for low channel



Plot for high channel



Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

Run #3: Out of Band Spurious Emissions, Radiated

Conducted limit (dBm): -13

Approximate field strength limit @ 3m: 82.2

The limit is taken from FCC Part 90 Mask B

Run #5a - Preliminary scans, 1.75 MHz BW mode

Date: 10/16/2012 Engineer: Joseph Cadigal Location: FT Chamber#5

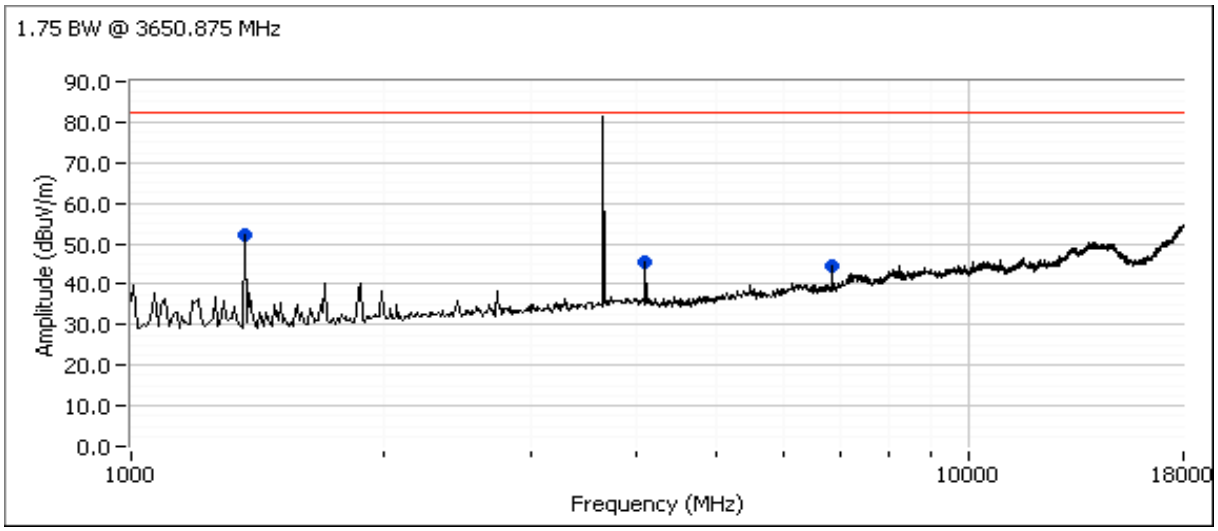
power setting = 23

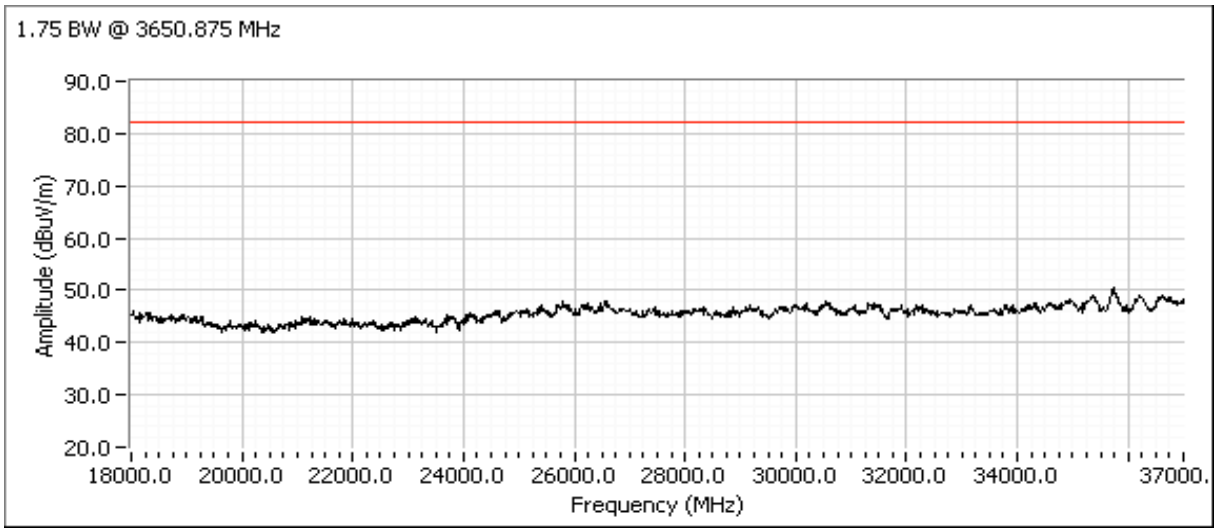
Frequency	Level	Pol	FCC 90.210		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
1366.670	*52.3*	*H*	*82.2*	*-29.9*	*Peak*	*256*	*1.0*	*Low channel*	*3650.875*
4108.330	*45.7*	*V*	*82.2*	*-36.5*	*Peak*	*155*	*1.0*	*Low channel*	*3650.875*
6858.330	*44.7*	*H*	*82.2*	*-37.5*	*Peak*	*181*	*1.0*	*Low channel*	*3650.875*
1366.670	*53.3*	*H*	*82.2*	*-28.9*	*Peak*	*254*	*1.0*	*high channel*	*3674.125*
3674.125	*83.6*	*V*	-	-	*Peak*	*17*	*1.5*	*Fundamental*	*3674.125*
4108.330	*47.7*	*H*	*82.2*	*-34.5*	*Peak*	*189*	*1.5*	*high channel*	*3674.125*
6858.330	*45.4*	*H*	*82.2*	*-36.8*	*Peak*	*192*	*1.0*	*high channel*	*3674.125*
3662.000	*83.3*	*V*	-	-	*Peak*	*140*	*1.0*	*Fundamental*	*3662*
1366.670	*54.7*	*H*	*82.2*	*-27.5*	*Peak*	*256*	*1.0*	*center channel*	*3662*
4116.670	*45.8*	*H*	*82.2*	*-36.4*	*Peak*	*195*	*2.0*	*center channel*	*3662*
6858.330	*46.5*	*H*	*82.2*	*-35.7*	*Peak*	*187*	*1.0*	*center channel*	*3662*

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:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

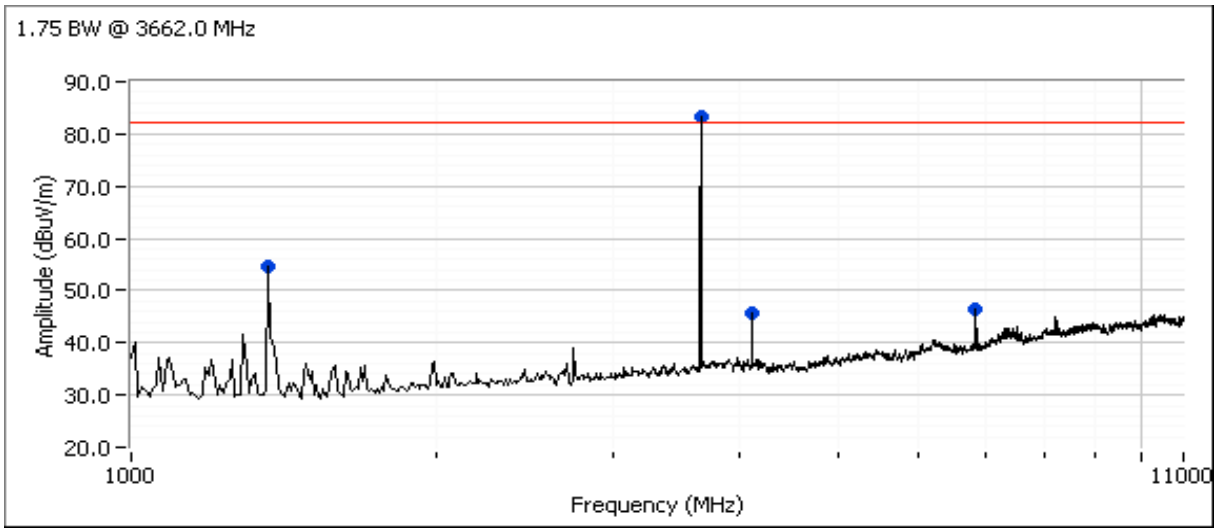
Plots for low channel, power setting(s) = 23

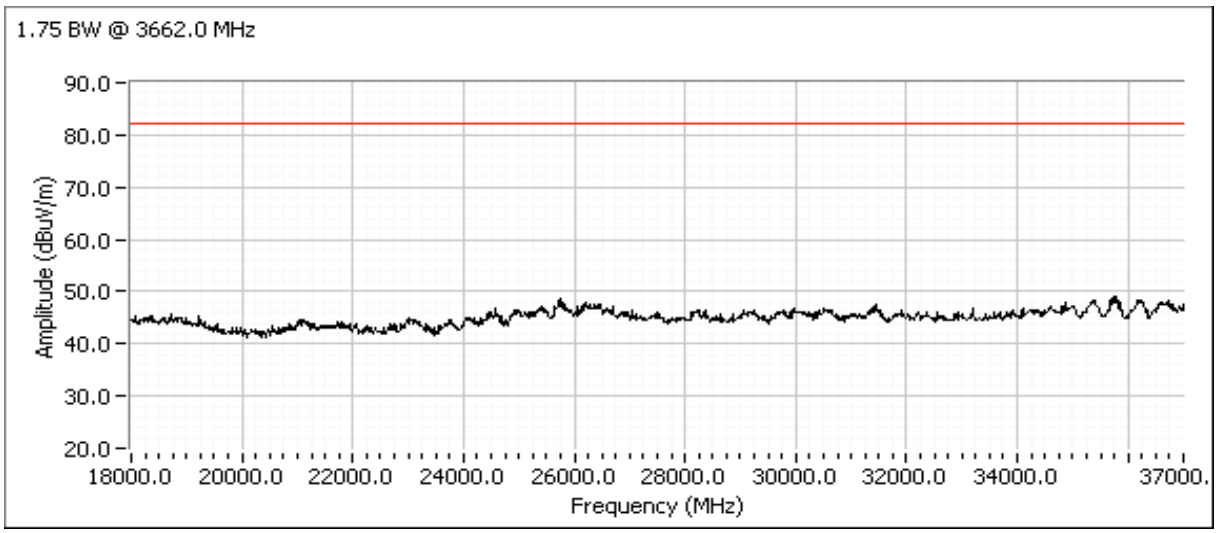




Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

Plots for center channel, power setting(s) = 23

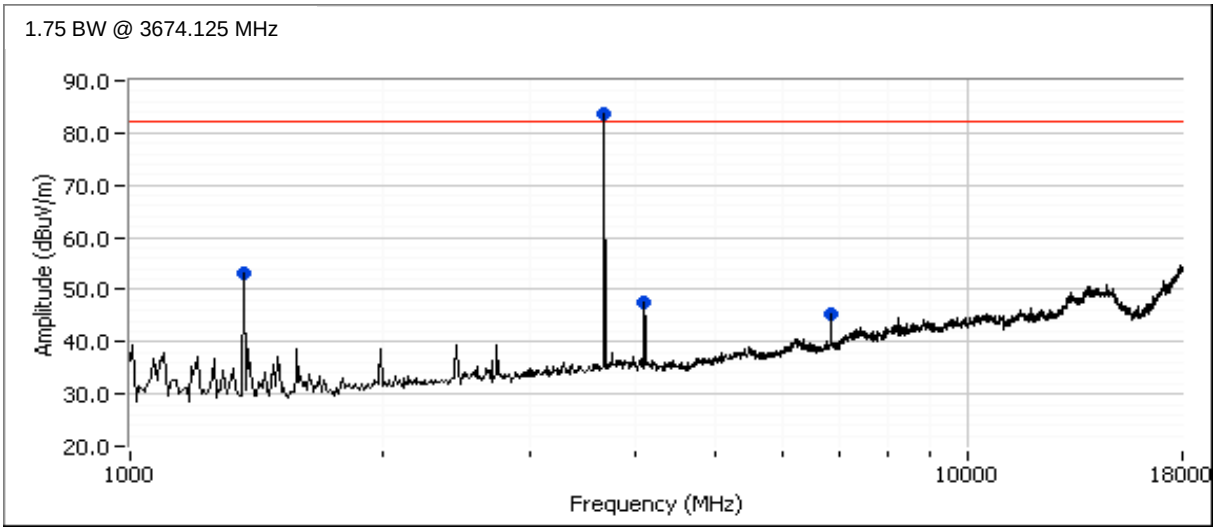




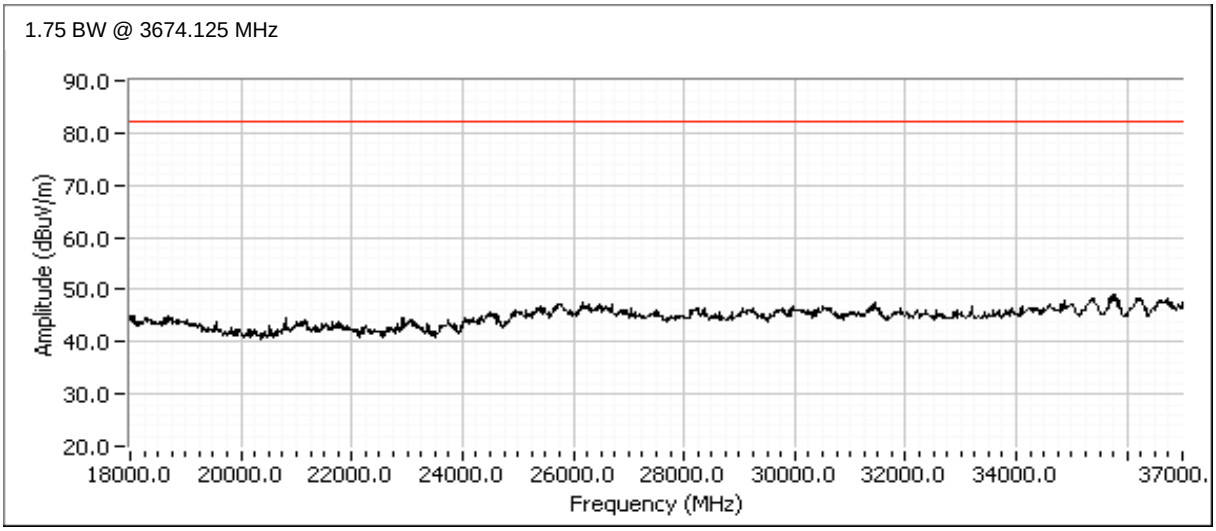
Client:	GE MDS LLC	Job Number:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

Plots for high channel, power setting(s) = 23

1.75 BW @ 3674.125 MHz



1.75 BW @ 3674.125 MHz



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Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

Run #5b - Preliminary scans, 3.5 MHz BW mode

Date: 10/16/2012 Engineer: Joseph Cadigal Location: FT Chamber#5

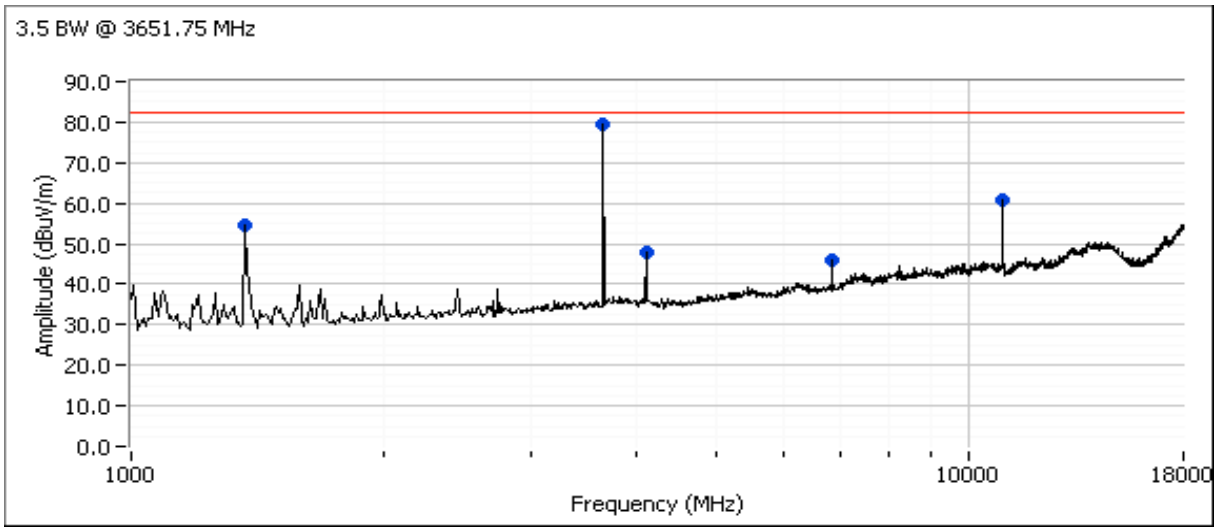
power setting = 23

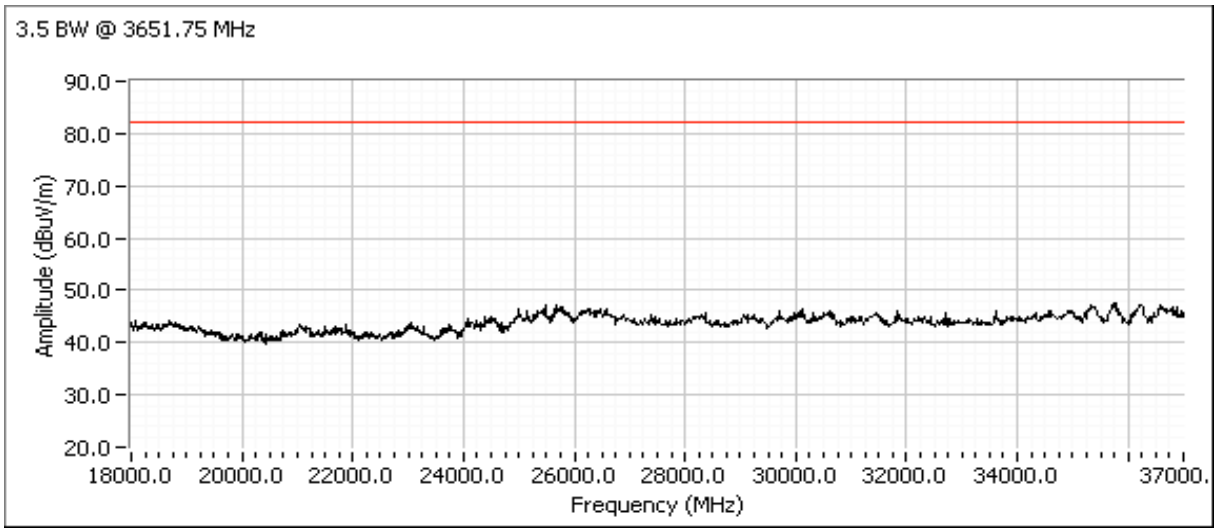
Frequency	Level	Pol	FCC 90.210		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
3651.750	*79.5*	*V*	-	-	*Peak*	*18*	*1.0*	*Fundamental*	*3651.75*
1366.670	*54.5*	*H*	*82.2*	*-27.7*	*Peak*	*254*	*1.0*	*low channel*	*3651.75*
4116.670	*48.0*	*H*	*82.2*	*-34.2*	*Peak*	*187*	*1.5*	*low channel*	*3651.75*
10958.330	*60.7*	*V*	*82.2*	*-21.5*	*Peak*	*4*	*1.0*	*low channel*	*3651.75*
6858.330	*46.0*	*H*	*82.2*	*-36.2*	*Peak*	*182*	*1.0*	*low channel*	*3651.75*
3662.000	*79.1*	*V*	-	-	*Peak*	*18*	*1.5*	*Fundamental*	*3662*
1858.330	*32.3*	*H*	*82.2*	*-49.9*	*Peak*	*322*	*1.0*	*center channel*	*3662*
1366.670	*54.7*	*H*	*82.2*	*-27.5*	*Peak*	*258*	*1.0*	*center channel*	*3662*
4116.670	*48.3*	*H*	*82.2*	*-33.9*	*Peak*	*190*	*1.5*	*center channel*	*3662*
10991.670	*53.6*	*V*	*82.2*	*-28.6*	*Peak*	*1*	*1.0*	*center channel*	*3662*
1366.670	*54.3*	*H*	*82.2*	*-27.9*	*Peak*	*257*	*1.0*	*high channel*	*3673.25*
3673.250	*78.6*	*V*	*82.2*	-	-	*28*	*1.5*	*Fundamental*	*3673.25*
4116.670	*47.3*	*H*	*82.2*	*-34.9*	*Peak*	*192*	*2.0*	*high channel*	*3673.25*

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:	J89493
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

Plots for low channel, power setting(s) = 23





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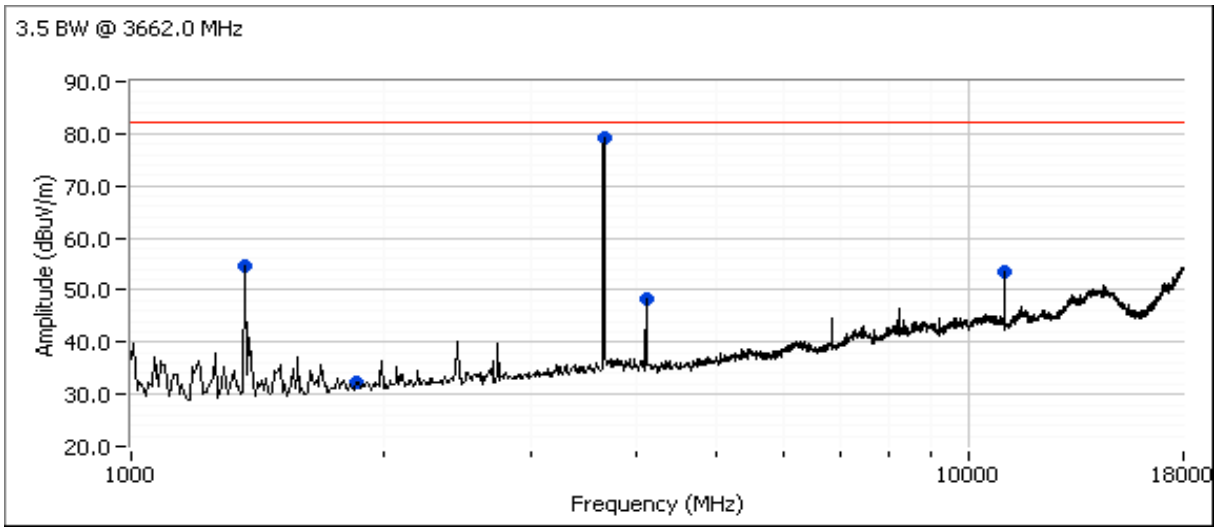
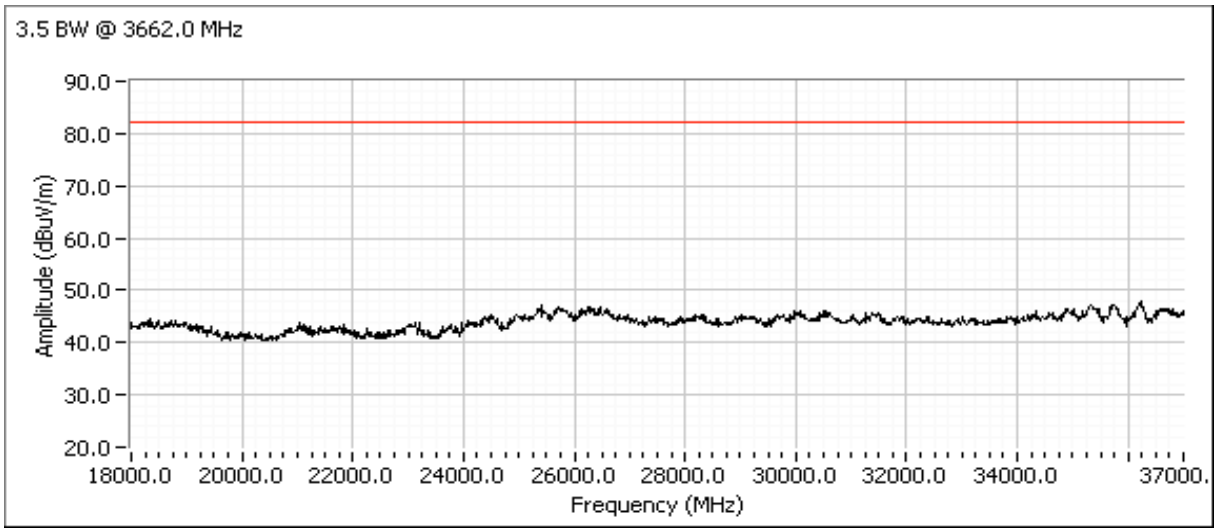
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

Plots for center channel, power setting(s) = 23





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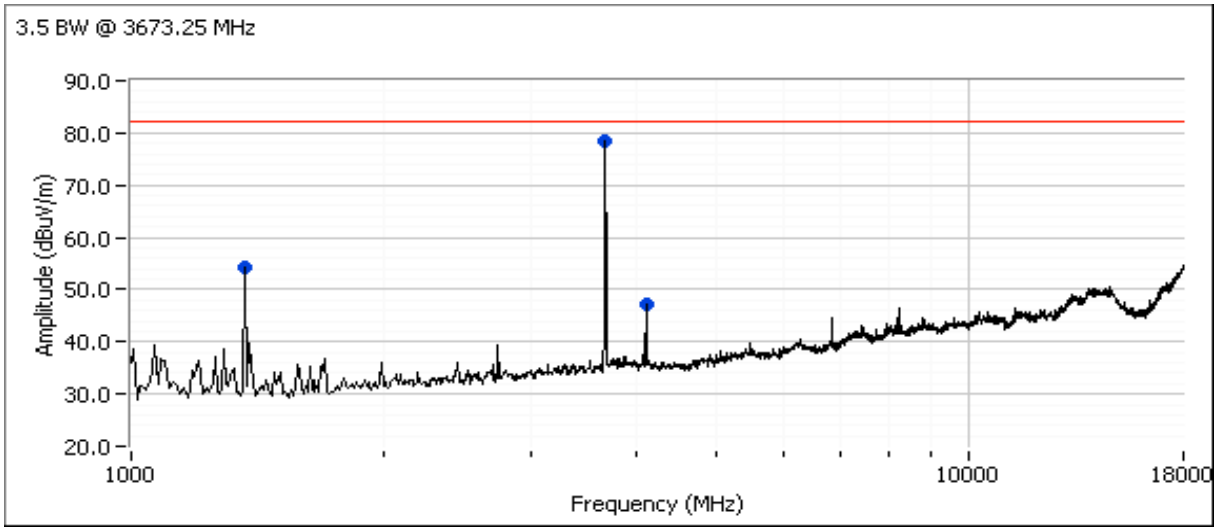
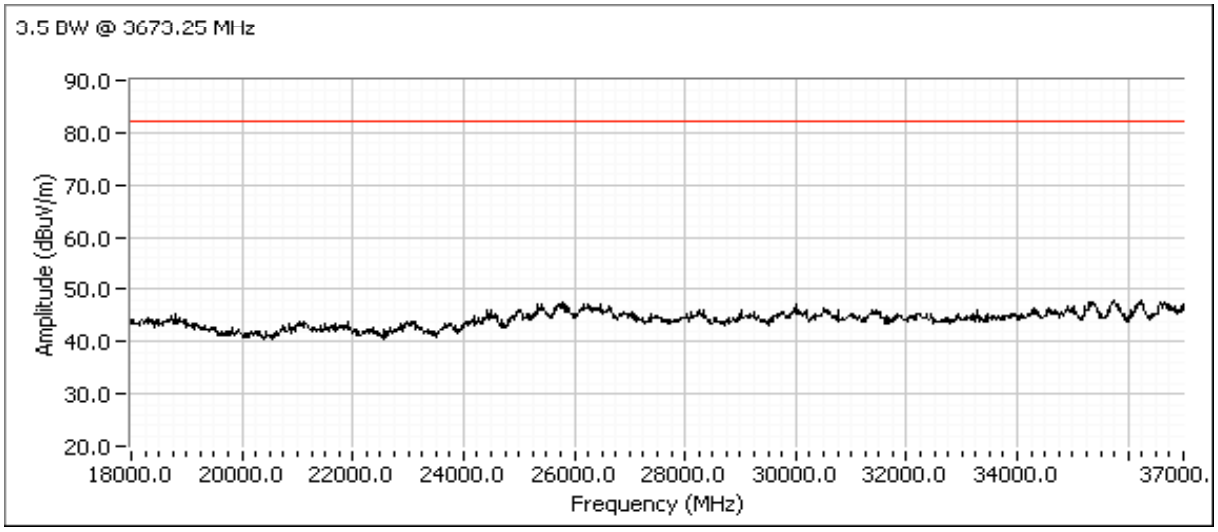
Model:	Mercury 3650	T-Log Number:	T89514
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	N/A

Plots for high channel, power setting(s) = 23





Since all of the emissions were more than 20dB below the limit, no substitution measurements were required.

End of Report

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