Radio Test Report

FCC Part 90 and RSS 197
3650 MHz to 3700 MHz

Models: Mercury 3650 Base Station and Mercury 3650 Subscriber

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 24, 25, 26 and 31, 2012

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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 Subscriber, 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 Subscriber and therefore apply only to the tested sample. The sample was selected and prepared by Jonathan Vilagy 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.).

Testing was performed only on model Mercury 3650 Subscriber. This model was considered representative of the Mercury 3650 Base Station.

STATEMENT OF COMPLIANCE

The tested sample of GE MDS LLC model Mercury 3650 Subscriber 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 for the test performed.

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)	3.5MHz 3651.75-3698.25 MHz 5.0MHz 3652.50-3697.50 MHz 7.0MHz 3653.50-3696.50 MHz 8.75MHz 3655.00-3695.00 MHz 10.0MHz 3655.00-3695.00 MHz	3650-3700 MHz Note 1	Complies
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 § 90.1321	EIRP – Total power (Maximum for each channel spacing)	3.5 MHz: 34.8dBm 5.0 MHz: 36.1dBm 7.0 MHz: 37.6dBm 8.75 MHz: 38.4dBm 10.0 MHz: 38.9dBm	25 Watts	Complies
	EIRP – PSD (Maximum)	3.5 MHz: 29.9dBm/MHz 5.0 MHz: 30.0dBm/MHz 7.0 MHz: 29.9dBm/MHz 8.75 MHz: 29.9dBm/MHz 10.0 MHz: 29.9dBm/MHz	30 dBm/MHz	Complies
§2.1033 (c) (4) §2.1047 § 90.210	Emission types	G1D	Information only	-
	Emission mask	No change from original	Mask B	Complies
§2.1049	Occupied (99%) Bandwidth	No change from original	Information only	-
Transmitter spurious emissions				
§2.1051 §2.1057 §90.1323	At the antenna terminals	-15.1 dBm	-13 dBm/MHz	Complies
	Radiated (erp)	-30.2 dBm		Complies
Receiver spurious emissions				
15.109	Field strength	Not applicable, note 2		
Other details				
§90.1319	Policies of use	Refer to operational description for details of the implementation.	Device must employ a contention-based protocol.	Complies
§2.1055 §90.213(a)	Frequency stability	No change from original	To be specified in the station authorization	-
§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	6Vdc, 1.2A for each chain	Information only	-
-	Antenna Gain	This application is submitted for antennas of 13 and 18 dBi gain with effective gains of 7 and 12 dBi based on 6dB feedline loss.		

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 has an unrestricted contention based protocol.
2) Receiver spurious emissions requirements only apply to devices that operate (tune) below 960MHz.

RSS-197 Base and Fixed Stations, 3650 – 3700 MHz

RSS-197	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics				
1	Frequency ranges (Listed for each channel spacing)	3.5MHz 3651.75-3698.25 MHz 5.0MHz 3652.50-3697.50 MHz 7.0MHz 3653.50-3696.50 MHz 8.75MHz 3655.00-3695.00 MHz 10.0MHz 3655.00-3695.00 MHz	3650-3700 MHz Note 1	Complies
5.6	EIRP – Total power (Maximum for each channel spacing)	3.5 MHz: 34.3dBm 5.0 MHz: 35.8dBm 7.0 MHz: 37.5dBm 8.75 MHz: 38.5dBm 10.0 MHz: 30.0dBm	No limit, Radio must comply with PSD EIRP limit	Complies
	EIRP – PSD (Maximum)	3.5 MHz: 30.0dBm/MHz 5.0 MHz: 29.8dBm/MHz 7.0 MHz: 29.9dBm/MHz 8.75 MHz: 29.8dBm/MHz 10.0 MHz: 30.0dBm/MHz	1 Watt/MHz	Complies
5.1, 5.7	Emission types	G1D	Must be Digital	Complies
	Emission mask	No change from original	Mask B	Complies
5.2	Occupied (99%) Bandwidth	No change from original	> 1 MHz	Complies
Transmitter spurious emissions				
5.7	At the antenna terminals	-15.1 dBm	-13 dBm/MHz	Complies
	Radiated (erp)	-30.2 dBm		Complies
Receiver spurious emissions				
5.8	Field strength	Not applicable, note 2		
Other details				
4.2	Policies of use	Refer to operational description for details of the implementation.	Device must employ a contention-based protocol.	Complies
5.5	Restriction for Mobile/Portable	Fixed Use	Station operates only when receiving enabling signal	NA
5.3	Frequency stability	F_l – Frequency offset = 3650.0381 MHz F_h + Frequency offset = 3699.9699 MHz	F_l – Frequency offset and F_h + Frequency offset remain in band	Complies
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 25cm or more from the antennas.		
-	Antenna Gain	This application is submitted for antennas of 13 and 18 dBi gain with effective gains of 7 and 12 dBi based on 6dB feedline loss.		

Notes

1) The upper part of the allocated band from 3675 – 3700 MHz requires the device to use an unrestricted contention-based protocol except in low population areas per SRSP 303.65. This system has an unrestricted contention based protocol.
2) Receiver spurious emissions requirements only apply to devices that operate (tune) below 960MHz.

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)	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 models Mercury 3650 Base Station and Mercury 3650 Subscriber are broadband wireless transceivers which are designed to transmit and receive data in the 3.65 - 3.7 GHz band using 2x2 spatial multiplexing MIMO at various bandwidths. Normally, the EUT would be permanently mounted in place 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 24, 2012 and tested on October 24, 25, 26 and 31, 2012. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
GE MDS LLC	Mercury 3650	Digital UHF Radio	2228180	E5MDS-MERCIDU3A

OTHER EUT DETAILS

Permissive Change/Re-assessment to extend the frequency range of operation using 3.5, 5, 7 and 10 MHz bandwidth modes.

The IDU can be used with antennas of 13 or 18 dBi and a feedline with 6dB of loss.

ENCLOSURE

The IDU 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
Agilent	E3610A	DC Power Source	MY40011740	-
Dell	Latitude D620	Laptop	6G1HLC1	-

EUT INTERFACE PORTS

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

IDU

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Ant 1	Terminated	-	-	-
Ant 2	Terminated	-	-	-
GPS	50 Ohm termination	-	-	-
Serial	Laptop	Serial cable	Shielded	3
Power	AC/DC power supply	Power cable	Unshielded	1.5
USB	Not connected	-	-	-
LAN	Not connected	-	-	-

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.

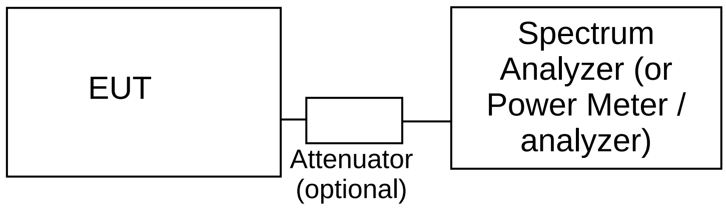
Site	Registration Numbers		Location
	FCC	Canada	
Chamber 3	769238	IC 2845B-3	41039 Boyce Road Fremont, CA 94538-2435
Chamber 4	211948	IC 2845B-4	
Chamber 5	211948	IC 2845B-5	
Chamber 7	A2LA Accredited	IC 2845B-7	

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.



<u>Test Configuration for Antenna Port Measurements</u>

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 (Spurious Emissions), 24-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), 26-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

Radiated Emissions, 30 MHz - 27 GHz, 31-Oct-12

Manufacturer	Description	Model	Asset #	Cal Due
EMCO	Antenna, Horn, 1-18GHz	3115	868	6/19/2014
Hewlett Packard	HF Amplifier, 45 MHz -50 GHz (with 1145)	83051A (84125C)	1143	7/5/2013
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
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	11/22/2012
A.H. Systems	Red System Horn, 18-40GHz	SAS-574, p/n: 2581	2161	3/20/2013
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	2197	2/7/2014
Hewlett Packard	HF Amplifier, 45 MHz -50 GHz (with 1145)	83051A (84125C)	2198	7/5/2013
Hewlett Packard	9KHz-1300MHz pre-amp	8447F	2328	5/2/2013
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	12/9/2012

Appendix B Test Data

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Client:	GE MDS LLC	Job Number:	J89699
Product	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Emissions Standard(s):	FCC Part 90, RSS-197	Class:	-
Immunity Standard(s):	-	Environment:	Radio

EMC Test Data

For The

GE MDS LLC

Product

Mercury 3650 IDU

Date of Last Test: 10/31/2012

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Radiated Emissions

(Elliott Laboratories Fremont Facility, Semi-Anechoic Chamber)

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: 10/31/2012
Test Engineer: Deniz Demirci
Test Location: Fremont Chamber #5

Config. Used: 2
Config Change: None
EUT Voltage: 16 Vdc

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. Any remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment where routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed without floor absorbers in place in accordance with the test methods of ANSI C63.4:2003.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Ambient Conditions:

Temperature: 22 °C
Rel. Humidity: 37 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Radiated Emissions 30 MHz - 37 GHz	Part 90Z	Pass	68.3 dBuV/m @ 1426.650 MHz (-17.8 dB)
2	Radiated Emissions 30 MHz - 37 GHz	Part 90Z	Pass	68.9 dBuV/m @ 1426.310 MHz (-17.2 dB)

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.

EMC Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Run #1: Radiated Emissions, 30 MHz - 37 GHz
Channel freq: 3651.75 MHz, Power setting 27 (Max), 3.5 MHz BW, Ant 1 (terminated with 50 ohms)

Test Parameters for Preliminary Scan(s)			
Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
30 - 1000 MHz	3	3	0.0
1000 - 18000 MHz	3	3	0.0
18000 - 37000 MHz	1	3	-9.5

Maximized readings

Frequency	Level	Pol	FCC Part 90Z/Part 15 B		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
44.163	30.6	V	84.4	-53.8	Peak	21	1.0	FCC Part 90Z
533.323	33.3	V	84.4	-51.1	Peak	8	1.0	FCC Part 90Z
599.991	34.3	V	84.4	-50.1	Peak	3	1.0	FCC Part 90Z
933.321	33.8	V	84.4	-50.6	Peak	325	1.0	FCC Part 90Z
999.992	35.5	V	84.4	-48.9	Peak	360	1.5	FCC Part 90Z
799.993	28.0	H	84.4	-56.4	Peak	66	2.0	FCC Part 90Z
44.163	24.3	V	40.0	-15.7	QP	19	1.0	FCC Part 15 B Class B
533.323	34.5	V	46.0	-11.5	QP	7	1.0	FCC Part 15 B Class B
599.991	35.1	V	46.0	-10.9	QP	1	1.0	FCC Part 15 B Class B
933.321	33.5	V	46.0	-12.5	QP	327	1.0	FCC Part 15 B Class B
999.992	38.8	V	54.0	-15.2	QP	360	1.5	FCC Part 15 B Class B
799.993	27.8	H	46.0	-18.2	QP	66	2.0	FCC Part 15 B Class B
1426.650	68.3	V	84.4	-16.1	PK	178	1.2	FCC Part 90Z
4868.960	55.6	V	84.4	-28.8	PK	145	1.0	FCC Part 90Z
7303.930	59.3	V	84.4	-25.1	PK	188	1.7	FCC Part 90Z
10959.620	66.9	V	84.4	-17.5	PK	143	1.0	FCC Part 90Z
21912.750	63.3	V	84.4	-21.1	PK	255	1.0	FCC Part 90Z
25564.670	66.5	V	84.4	-17.9	PK	241	1.0	FCC Part 90Z
29214.150	66.3	V	84.4	-18.1	PK	198	1.0	FCC Part 90Z
32863.330	62.8	V	84.4	-21.6	PK	164	1.0	FCC Part 90Z

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.
Note 3:	The worst case conducted RF spurious emission bandwidth mode was selected in order to show compliance with radiated spurious emissions.

EMC Test Data

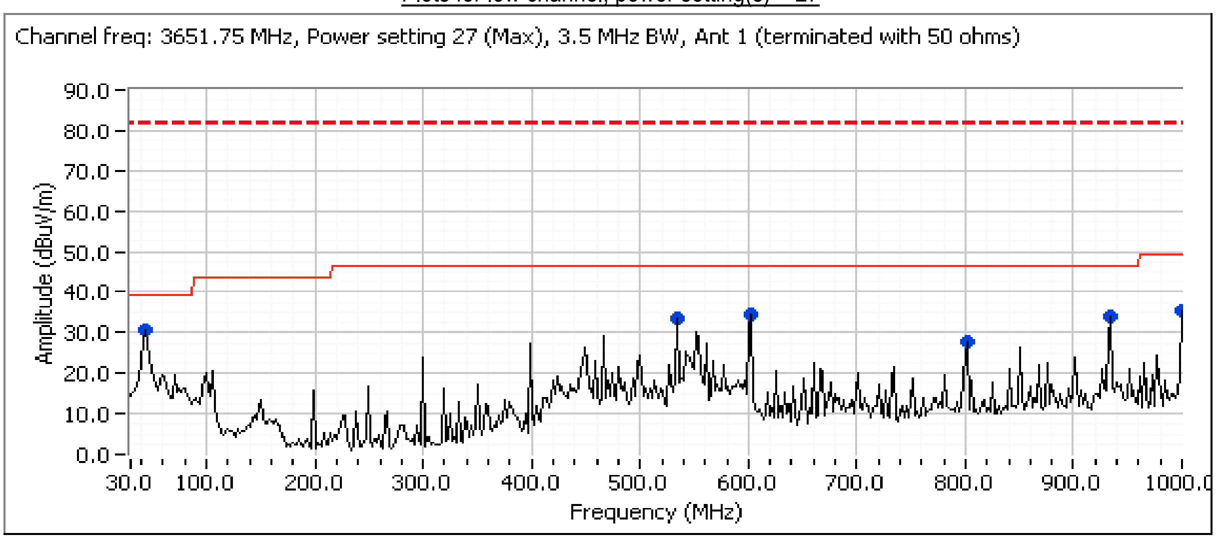
Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Cont. Run#1
Substitution measurements
Vertical

Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
1426.650	-32.0	7.9	72.8	96.9	68.3	-28.6	-30.8		-13.0	-17.8
10959.620	-35.0	12.7	74.8	97.1	66.9	-30.2	-32.4		-13.0	-19.4
25564.670	-38.5	18.1	78.4	98.8	66.5	-32.3	-34.5		-13.0	-21.5
29214.150	-39.7	18.9	79.7	100.5	66.3	-34.2	-36.4		-13.0	-23.4

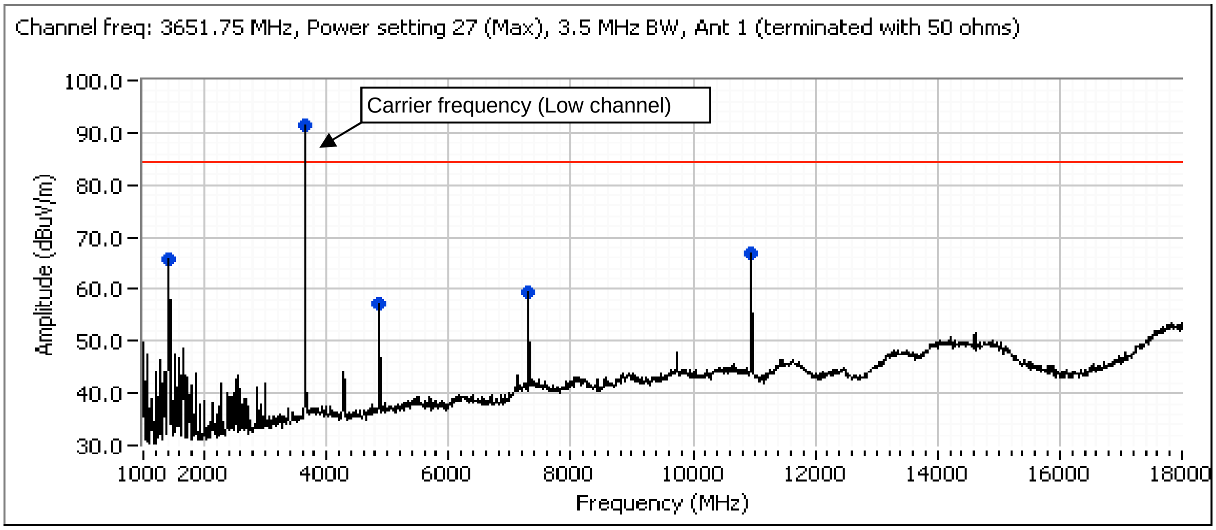
Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an eirp in dBm.
Note 5:	EUT field strength as measured during initial run.

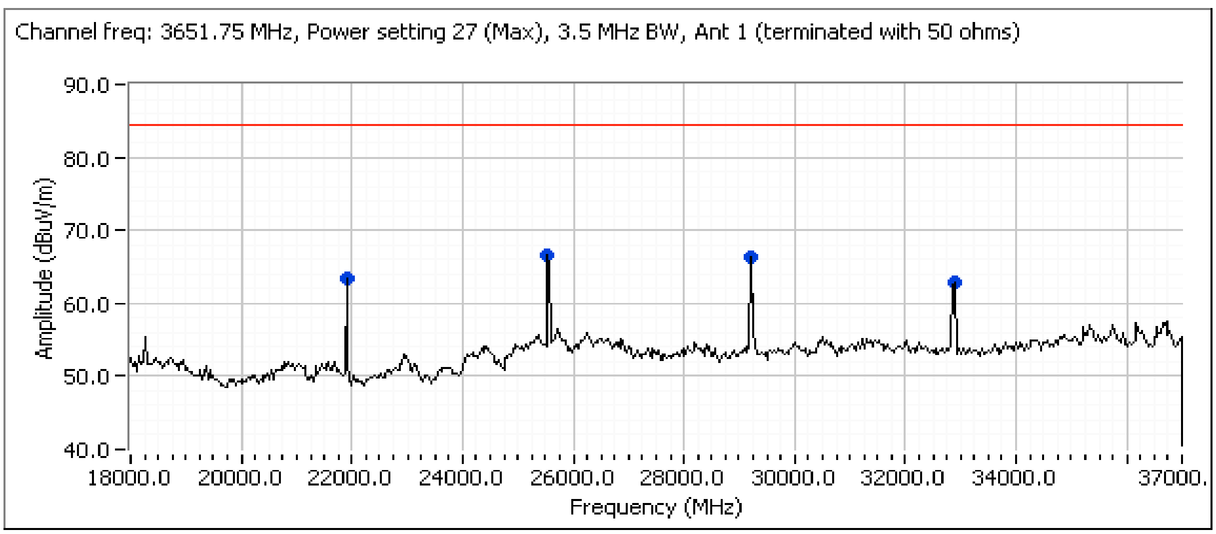
Plots for low channel, power setting(s) = 27



Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Cont. Run#1





NTS WE ENGINEER SUCCESS

EMC Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Run #2: Radiated Emissions, 30 MHz - 37 GHz
Channel freq: 3698.25 MHz, Power setting 27 (Max), 3.5 MHz BW, Ant 1 (terminated with 50 ohms)

Test Parameters for Preliminary Scan(s)			
Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
30 - 1000 MHz	3	3	0.0
1000 - 18000 MHz	3	3	0.0
18000 - 37000 MHz	1	3	-9.5

Maximized readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	FCC Part 90Z/Part 15 B		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
43.607	28.1	V	84.4	-56.3	Peak	158	1.0	FCC Part 90Z
533.467	33.2	V	84.4	-51.2	Peak	0	1.0	FCC Part 90Z
601.503	34.4	V	84.4	-50.0	Peak	324	1.0	FCC Part 90Z
801.723	29.8	H	84.4	-54.6	Peak	93	1.0	FCC Part 90Z
933.908	33.3	V	84.4	-51.1	Peak	316	1.0	FCC Part 90Z
1000.000	35.4	V	84.4	-49.0	Peak	10	1.5	FCC Part 90Z
44.746	22.8	V	40.0	-17.2	QP	158	1.0	FCC Part 15 B Class B
533.323	34.5	V	46.0	-11.5	QP	0	1.0	FCC Part 15 B Class B
599.991	34.0	V	46.0	-12.0	QP	326	1.0	FCC Part 15 B Class B
799.985	30.8	H	46.0	-15.2	QP	90	1.0	FCC Part 15 B Class B
933.329	33.4	V	46.0	-12.6	QP	317	1.0	FCC Part 15 B Class B
999.992	38.5	V	54.0	-15.5	QP	7	1.5	FCC Part 15 B Class B
1426.310	68.9	V	84.4	-15.5	PK	163	1.3	FCC Part 90Z
4931.150	49.8	V	84.4	-34.6	PK	140	1.0	FCC Part 90Z
7397.490	61.0	V	84.4	-23.4	PK	206	1.3	FCC Part 90Z
11096.040	62.6	V	84.4	-21.8	PK	138	1.0	FCC Part 90Z
22189.247	53.7	V	84.4	-30.7	PK	273	1.3	FCC Part 90Z
29586.780	60.2	V	84.4	-24.2	PK	223	1.3	FCC Part 90Z
33284.790	59.2	V	84.4	-25.2	PK	316	1.5	FCC Part 90Z

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 15dB of margin relative to this field strength limit is determined using substitution measurements.
Note 2:	Measurements are made with the antenna port terminated.
Note 3:	The worst case conducted RF spurious emission channel frequency and mode is selected in order to show compliance with radiated spurious emissions

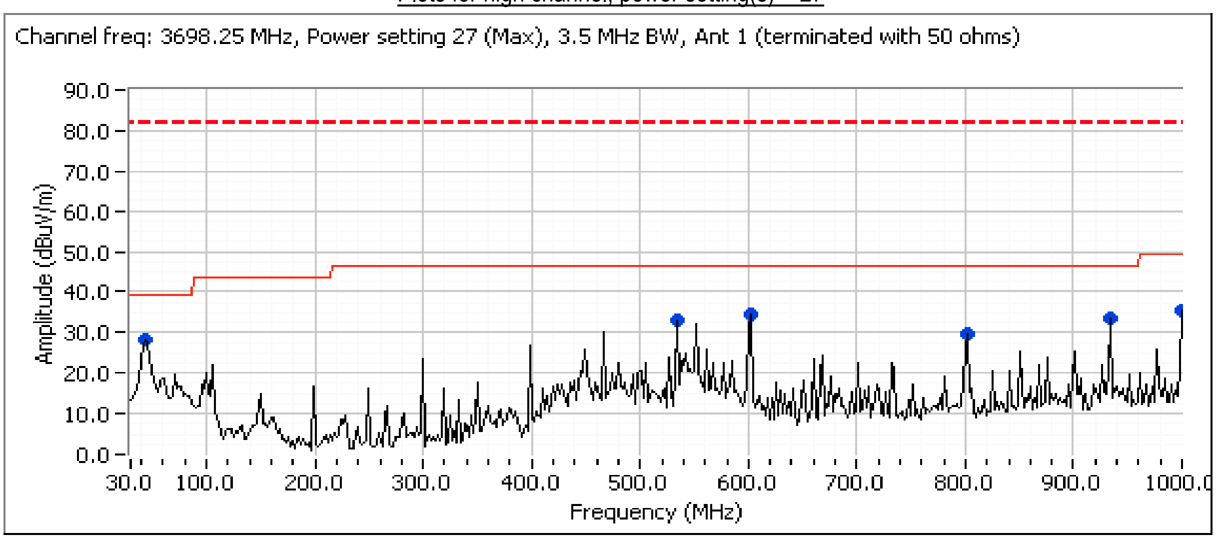
Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Cont. Run#2
Substitution measurements
Vertical

Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
1426.310	-32.0	7.9	72.8	96.9	68.9	-28.0	-30.2		-13.0	-17.2

Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an eirp in dBm.
Note 5:	EUT field strength as measured during initial run.

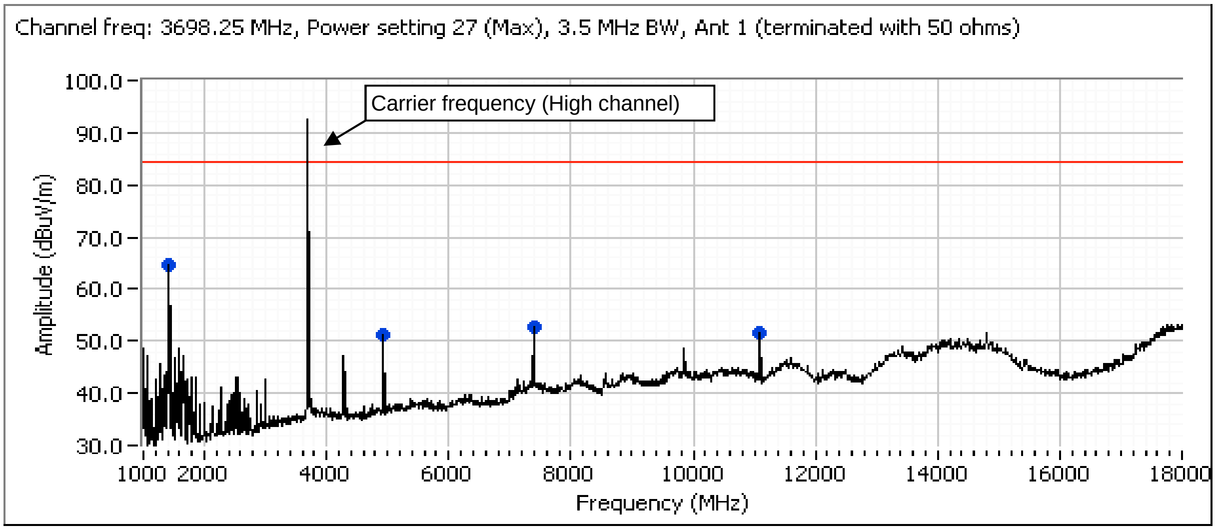
Plots for high channel, power setting(s) = 27

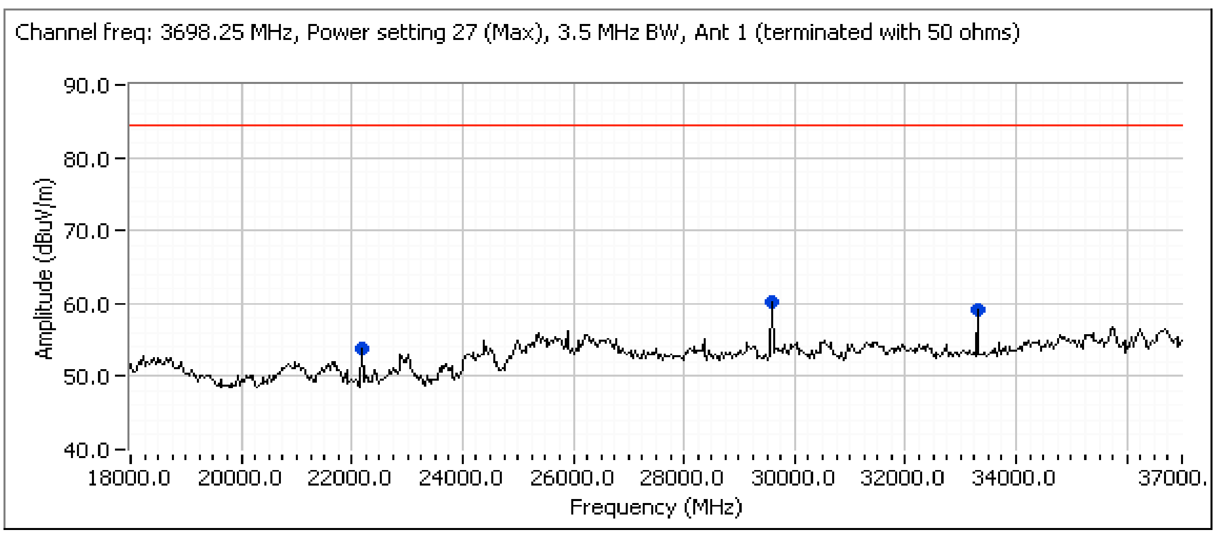


NTS	EMC Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Cont. Run#2





EMC Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

RSS-197 - Antenna Port Measurements
Power, PSD 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.

Date of Test: 10/25/2012 and 10/26/2012
Test Engineer: Deniz Demirci
Test Location: FT Chamber# 5

Config. Used: 1
Config Change: none
EUT Voltage: 16 Vdc

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	Power (13 dBi antenna)	25 Watts/25 MHz EIRP 90.1321(a)	Pass	35.8 dBm / -8.2 dB margin
2	PSD (13 dBi antenna)	1 Watt/MHz 90.1321(c)	Pass	28 dBm/MHz / -2 dB margin
3	Power (18 dBi antenna)	25 Watts/25 MHz EIRP 90.1321(a)	Pass	38.6 dBm/ -5.4 dB margin
4	PSD (18 dBi antenna)	1 Watt/MHz 90.1321(c)	Pass	29.4 dBm/MHz / -0.6 dB margin
5	Antenna Conducted Out of Band Spurious	RSS-197 90.1323 (a)	Pass	-33.1 dBm/MHz @ 7303.56 MHz -17.1 dB margin

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 to allow for the external attenuators and cables used.

Ambient Conditions:

Temperature: 23 °C
Rel. Humidity: 35 %

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.

Test Notes

Power measured only on new low and high channels and does not affect granted powers.

	EMC Test Data		
Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Run #1: Output Power - MIMO Systems

Note - the effective gain of 10dBi includes the minimum cable loss (6 dB) between antenna ports and each antenna.

Limits from 90.321(a): Base and fixed stations are limited to 25 watts/25 MHz equivalent isotropically radiated power (EIRP).

	Chain 1	Chain 2	Chain 3	Coherent	Effective[3]	EIRP (mW)	EIRP (dBm)
Antenna Gain (dBi):	7	7		Yes	10.0	3785.2	35.8

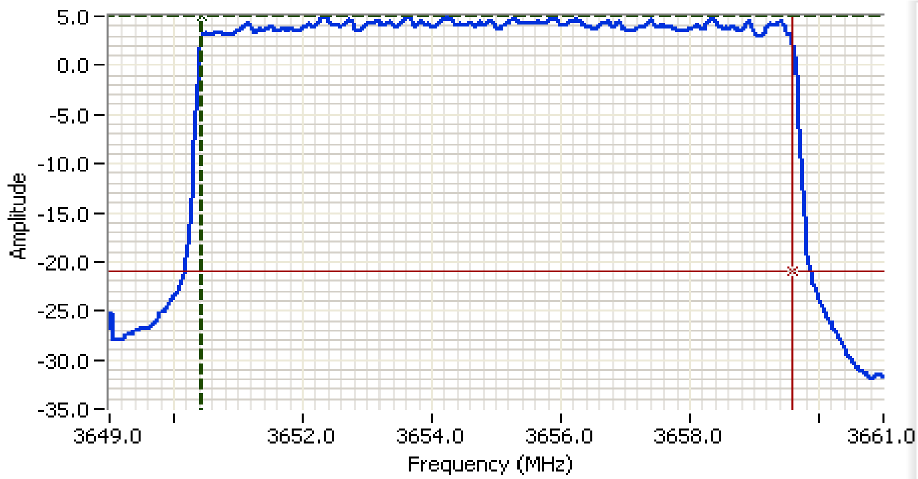
Power - Limit accounts for maximum antenna gain at this power setting.

Frequency (MHz)	Software Setting[1]	Modulation	Measured Output Power[2] dBm Chain 1	Chain 2	Chain 3	Total mW	Total dBm	EIRP dBm	Limit (eirp) dBm	Pass or Fail
3.5 MHz BW, Low Channel										
3651.750	20	64-QAM	19.2	18.1		147.9	21.7	31.7	44.0	PASS
5.0 MHz BW, Low channel										
3652.500	22	64-QAM	19.9	19.0		177.0	22.5	32.5	44.0	PASS
7.0 MHz BW, Low channel										
3653.500	24	64-QAM	22.5	21.5		317.7	25.0	35.0	44.0	PASS
10.0 MHz BW, Low channel										
3655.000	26	64-QAM	23.2	22.3		377.6	25.8	35.8	44.0	PASS
3.5 MHz BW, High channel										
3698.250	22	64-QAM	19.9	18.9		175.2	22.4	32.4	44.0	PASS
5.0 MHz BW, High channel										
3697.500	24	64-QAM	20.7	19.7		209.2	23.2	33.2	44.0	PASS
7.0 MHz BW, High channel										
3696.500	24	64-QAM	21.0	20.1		227.6	23.6	33.6	44.0	PASS
10.0 MHz BW, High channel										
3695.000	26	64-QAM	22.0	20.9		281.1	24.5	34.5	44.0	PASS

Note 1:	Power setting is the software setting used to set the output power.
Note 2:	Output power measured using RBW=100kHz VBW=300kHz , detector = rms, sweep time 10 seconds, max hold. The total power was integrated over the span. The sweep time was such that the dwell itme per any one display piont was less than the "on-time" for the transmitter (4ms). The plot for the channel with the highest power is provided below.
Note 3:	For MIMO systems the total output power and total PSD are calculated form the sum of the powers of the individual chains (in linear terms). The antenna gain used to determine the EIRP and limits for PSD/Output power depends on the operating mode of the MIMO device. If the signals on the non-coherent between the transmit chains then the gain used to determine the limits is the highest gain of the individual chains and the EIRP is the sum of the products of gain and power on each chain. If the signals are coherent then the effective antenna gain is the sum (in linear terms) of the gains for each chain and the EIRP is the product of the effective gain and total power.
Note 4:	BPSK, QPSK and QAM16 modulations have also been measured and found no significant effect on power measurements

EMC Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-



Analyzer Settings

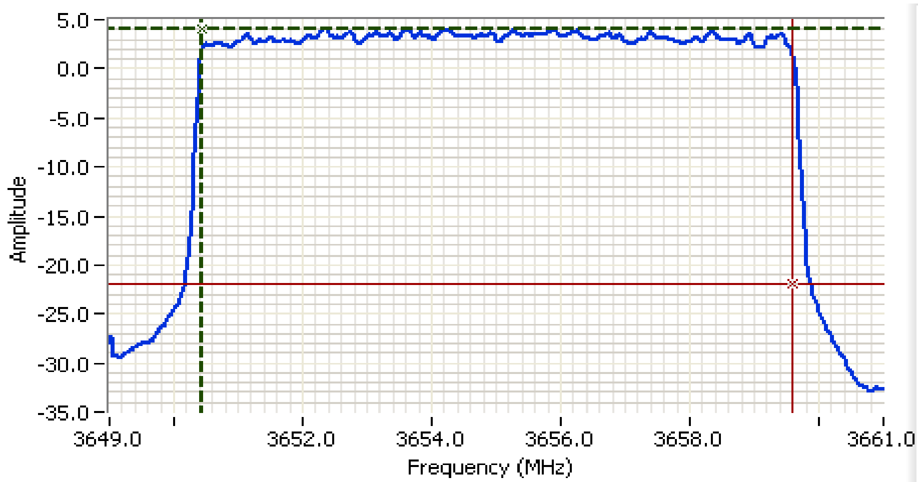
Rohde&Schwarz,ESI
CF: 3655.000 MHz
SPAN: 12.000 MHz
RB: 100 kHz
VB: 300 kHz
Detector: RMS
Attn: 40 DB
RL Offset: 10.8 DB
Sweep Time: 10.0s
Ref Lvl: 30.0 DBM

Comments

Power over span: 23.16dBm
Channel freq: 3655.0 MHz
BW: 10 MHz QAM64
Power setting: 26
Chain 1

Cursor 1	3650.4400	4.98
Cursor 2	3659.5840	-21.02

Delta Freq. 9.144
Delta Amplitude 26.00



Analyzer Settings

Rohde&Schwarz,ESI
CF: 3655.000 MHz
SPAN: 12.000 MHz
RB: 100 kHz
VB: 300 kHz
Detector: RMS
Attn: 40 DB
RL Offset: 10.8 DB
Sweep Time: 10.0s
Ref Lvl: 30.0 DBM

Comments

Power over span: 22.32dBm
Channel freq: 3655.0 MHz
BW: 10 MHz QAM64
Power setting: 26
Chain 2

Cursor 1	3650.4400	4.14
Cursor 2	3659.5840	-21.86

Delta Freq. 9.144
Delta Amplitude 26.00

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Run#2: Power Spectral Density - MIMO Systems

Note - the effective gain of 10dBi includes the minimum cable loss (6 dB) between antenna ports and each antenna.

Limits from 90.321(a): Base and fixed stations, In any event, the peak EIRP power density shall not exceed 1 Watt in any one-megahertz slice of spectrum (30dBm/MHz).

	Chain 1	Chain 2	Chain 3	Coherent	Effective[3]	EIRP (mW)	EIRP (dBm)
Antenna Gain (dBi):	7	7		Yes	10.0	626.0	28.0

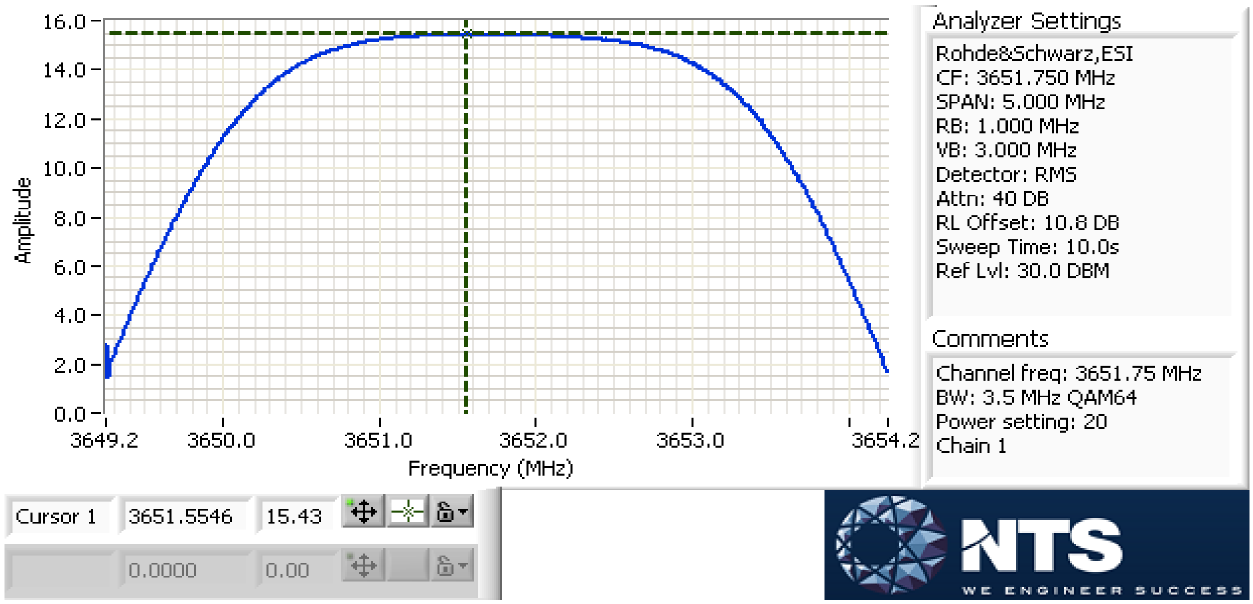
Run#1b: Power Spectral Density - MIMO Systems

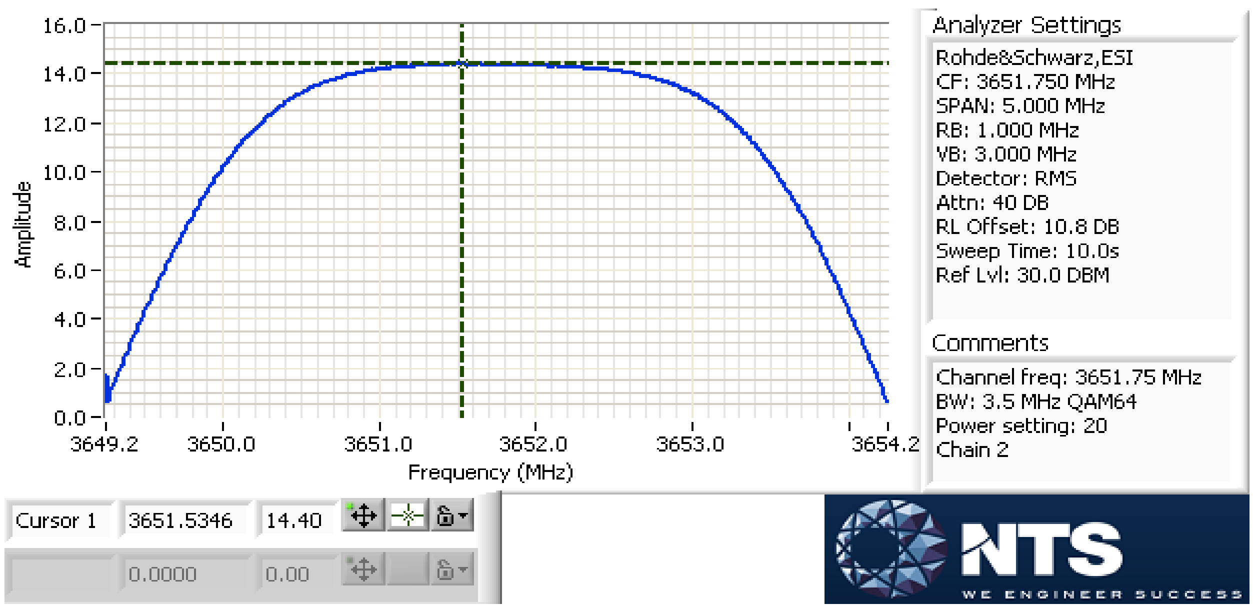
Frequency (MHz)	Software Setting[1]	Modulation	PSD[2] dBm/MHz Chain 1	Chain 2	Chain 3	Total PSD mW/MHz	Total PSD dBm/MHz	PSD EIRP dBm/MHz	Limit (eirp) dBm/MHz	Pass or Fail
3.5 MHz BW, Low Channel										
3651.750	20	64-QAM	15.4	14.4		62.5	18.0	28.0	30.0	PASS
5.0 MHz BW, Low channel										
3652.500	22	64-QAM	14.7	13.7		53.1	17.2	27.3	30.0	PASS
7.0 MHz BW, Low channel										
3653.500	24	64-QAM	15.1	13.6		55.6	17.5	27.5	30.0	PASS
10.0 MHz BW, Low channel										
3655.000	26	64-QAM	14.3	13.3		48.5	16.9	26.9	30.0	PASS
3.5 MHz BW, High channel										
3698.250	22	64-QAM	15.3	14.2		60.7	17.8	27.8	30.0	PASS
5.0 MHz BW, High channel										
3697.500	24	64-QAM	14.7	13.8		53.5	17.3	27.3	30.0	PASS
7.0 MHz BW, High channel										
3696.500	24	64-QAM	13.5	12.5		40.2	16.0	26.1	30.0	PASS
10.0 MHz BW, High channel										
3695.000	26	64-QAM	13.0	12.1		36.3	15.6	25.6	30.0	PASS

Note 1:	Power setting is the software setting used to set the output power.
Note 2:	The PSD was measured using the following analyzer settings: RB=1MHz, VB=3MHz, detector = rms, sweep time 10 seconds, max hold. Multiple sweeps were made until the display had no new "peaks". The plot for the channel with the highest power is provided below. The sweep time was such that the dwell itme per any one display point was less than the "on-time" for the transmitter (4ms).
Note 3:	For MIMO systems the total output power and total PSD are calculated form the sum of the powers of the individual chains (in linear terms). The antenna gain used to determine the EIRP and limits for PSD/Output power depends on the operating mode of the MIMO device. If the signals on the non-coherent between the transmit chains then the gain used to determine the limits is the highest gain of the individual chains and the EIRP is the sum of the products of gain and power on each chain. If the signals are coherent then the effective antenna gain is the sum (in linear terms) of the gains for each chain and the EIRP is the product of the effective gain and total power.
Note 4:	BPSK, QPSK and QAM16 modulations have also been measured and found no significant effect on PSD measurements

EMC Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-





EMC Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Run #3: Output Power - MIMO Systems

Note - the effective gain of 15dBi includes the minimum cable loss (6 dB) between antenna ports and each antenna.

Limits from 90.321(a): Base and fixed stations are limited to 25 watts/25 MHz equivalent isotropically radiated power (EIRP).

	Chain 1	Chain 2	Chain 3	Coherent	Effective[3]	EIRP (mW)	EIRP (dBm)
Antenna Gain (dBi):	12	12		Yes	15.0	7299.0	38.6

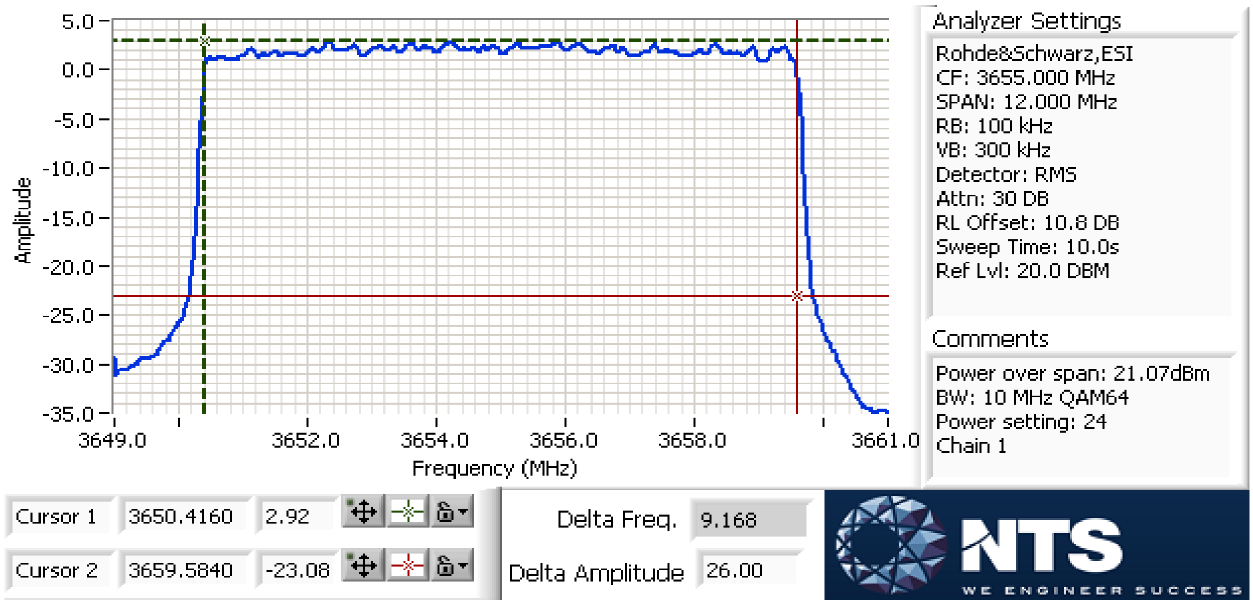
Power - Limit accounts for maximum antenna gain at this power setting.

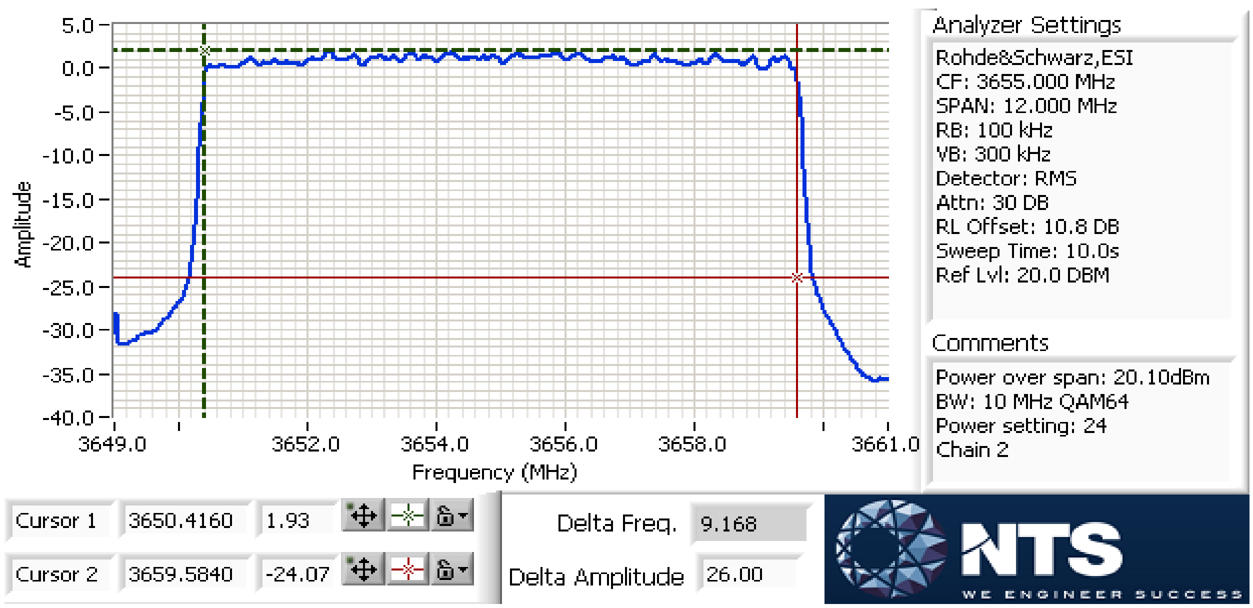
Frequency (MHz)	Software Setting[1]	Modulation	Measured Output Power[2] dBm Chain 1	Chain 2	Chain 3	Total mW	Total dBm	EIRP dBm	Limit (eirp) dBm	Pass or Fail
3.5 MHz BW, Low Channel										
3651.750	16	64-QAM	16.2	15.3		75.6	18.8	33.8	44.0	PASS
5.0 MHz BW, Low channel										
3652.500	19	64-QAM	17.5	16.5		100.4	20.0	35.0	44.0	PASS
7.0 MHz BW, Low channel										
3653.500	21	64-QAM	19.4	18.5		157.5	22.0	37.0	44.0	PASS
10.0 MHz BW, Low channel										
3655.000	24	64-QAM	21.1	20.1		230.3	23.6	38.6	44.0	PASS
3.5 MHz BW, High channel										
3698.250	18	64-QAM	16.3	15.3		76.8	18.9	33.9	44.0	PASS
5.0 MHz BW, High channel										
3697.500	21	64-QAM	18.0	16.9		111.9	20.5	35.5	44.0	PASS
7.0 MHz BW, High channel										
3696.500	22	64-QAM	19.2	18.3		151.7	21.8	36.8	44.0	PASS
10.0 MHz BW, High channel										
3695.000	24	64-QAM	20.2	19.2		187.6	22.7	37.7	44.0	PASS

Note 1:	Power setting is the software setting used to set the output power.
Note 2:	Output power measured using RBW=100kHz VBW=300kHz , detector = rms, sweep time 10 seconds, max hold. The total power was integrated over the span. The sweep time was such that the dwell itme per any one display piont was less than the "on-time" for the transmitter (4ms). The plot for the channel with the highest power is provided below.
Note 3:	For MIMO systems the total output power and total PSD are calculated form the sum of the powers of the individual chains (in linear terms). The antenna gain used to determine the EIRP and limits for PSD/Output power depends on the operating mode of the MIMO device. If the signals on the non-coherent between the transmit chains then the gain used to determine the limits is the highest gain of the individual chains and the EIRP is the sum of the products of gain and power on each chain. If the signals are coherent then the effective antenna gain is the sum (in linear terms) of the gains for each chain and the EIRP is the product of the effective gain and total power.
Note 4:	BPSK, QPSK and QAM16 modulations have also been measured and found no significant effect on power measurements

EMC Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-





Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Run#4: Power Spectral Density - MIMO Systems

Note - the effective gain of 15dBi includes the minimum cable loss (6 dB) between antenna ports and each antenna.

Limits from 90.321(a): Base and fixed stations, In any event, the peak EIRP power density shall not exceed 1 Watt in any one-megahertz slice of spectrum (30dBm/MHz).

	Chain 1	Chain 2	Chain 3	Coherent	Effective[3]	EIRP (mW)	EIRP (dBm)
Antenna Gain (dBi):	12	12		Yes	15.0	865.9	29.4

Run#1b: Power Spectral Density - MIMO Systems

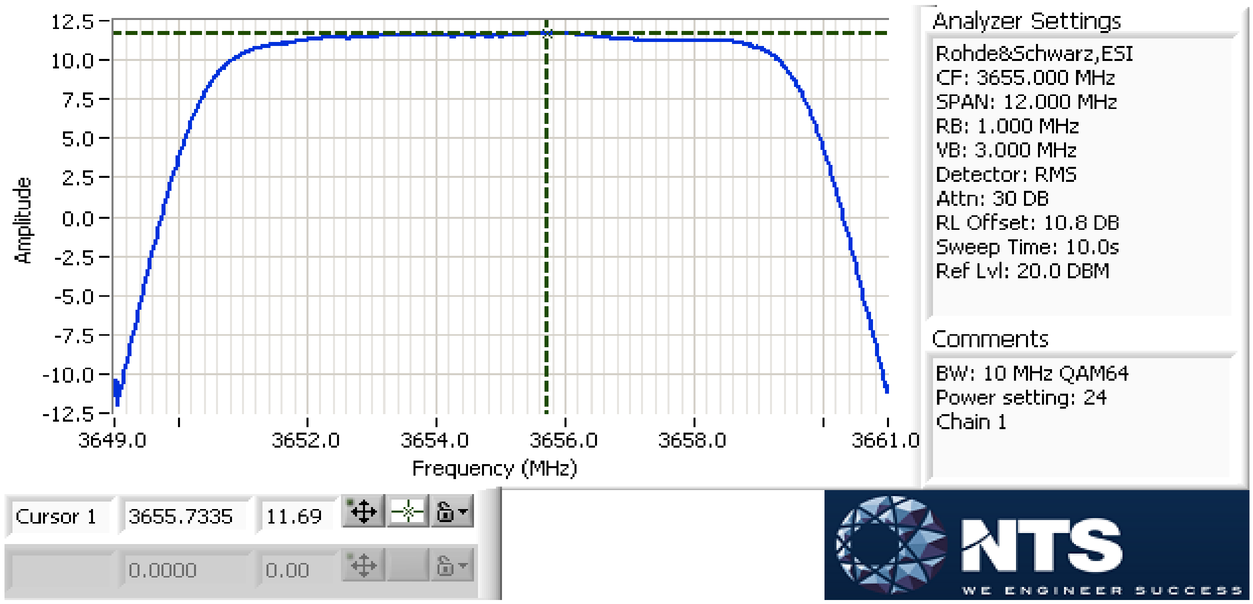
Frequency (MHz)	Software Setting[1]	Modulation	PSD[2] dBm/MHz Chain 1	Chain 2	Chain 3	Total PSD mW/MHz	Total PSD dBm/MHz	PSD EIRP dBm/MHz	Limit (eirp) dBm/MHz	Pass or Fail
3.5 MHz BW, Low Channel										
3651.750	16	64-QAM	11.5	10.2		24.7	13.9	28.9	30.0	PASS
5.0 MHz BW, Low channel										
3652.500	19	64-QAM	11.1	10.3		23.6	13.7	28.7	30.0	PASS
7.0 MHz BW, Low channel										
3653.500	21	64-QAM	11.6	10.5		25.8	14.1	29.1	30.0	PASS
10.0 MHz BW, Low channel										
3655.000	24	64-QAM	11.7	11.0		27.3	14.4	29.4	30.0	PASS
3.5 MHz BW, High channel										
3698.250	18	64-QAM	11.4	10.3		24.6	13.9	28.9	30.0	PASS
5.0 MHz BW, High channel										
3697.500	21	64-QAM	11.6	10.7		26.2	14.2	29.2	30.0	PASS
7.0 MHz BW, High channel										
3696.500	22	64-QAM	11.5	10.4		24.8	13.9	29.0	30.0	PASS
10.0 MHz BW, High channel										
3695.000	24	64-QAM	10.9	10.2		22.7	13.6	28.6	30.0	PASS

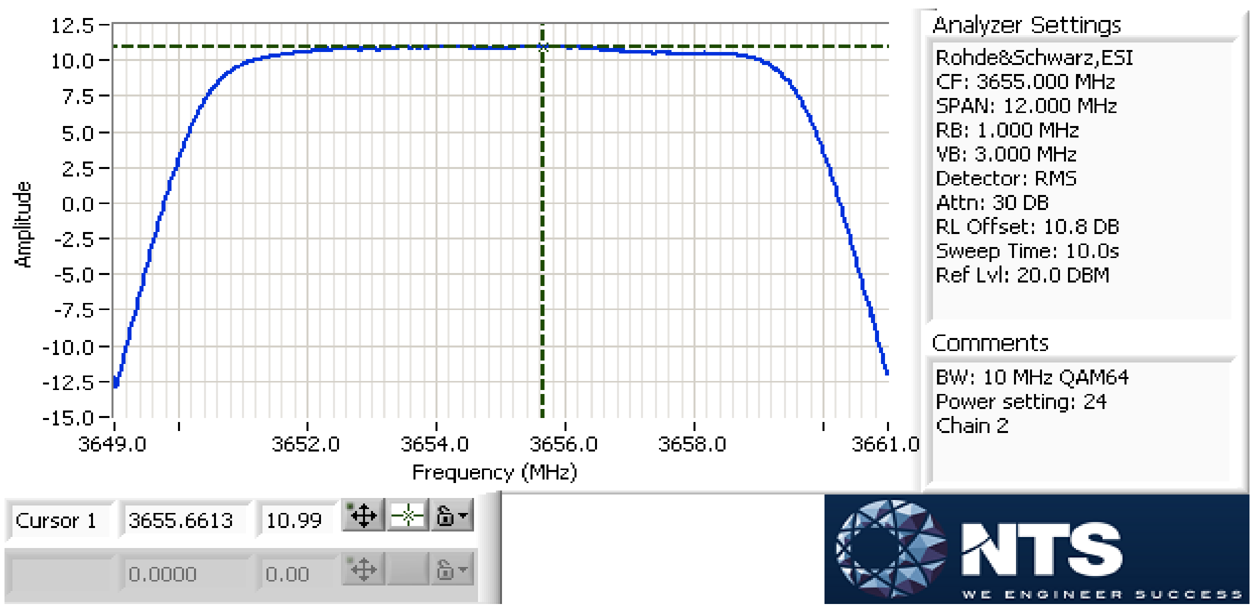
Note 1:	Power setting is the software setting used to set the output power.
Note 2:	The PSD was measured using the following analyzer settings: RB=1MHz, VB=3MHz, detector = rms, sweep time 10 seconds, max hold. Multiple sweeps were made until the display had no new "peaks". The plot for the channel with the highest power is provided below. The sweep time was such that the dwell itme per any one display point was less than the "on-time" for the transmitter (4ms).
Note 3:	For MIMO systems the total output power and total PSD are calculated form the sum of the powers of the individual chains (in linear terms). The antenna gain used to determine the EIRP and limits for PSD/Output power depends on the operating mode of the MIMO device. If the signals on the non-coherent between the transmit chains then the gain used to determine the limits is the highest gain of the individual chains and the EIRP is the sum of the products of gain and power on each chain. If the signals are coherent then the effective antenna gain is the sum (in linear terms) of the gains for each chain and the EIRP is the product of the effective gain and total power.
Note 4:	BPSK, QPSK and QAM16 modulations have also been measured and found no significant effect on PSD measurements

NTS
WE ENGINEER SUCCESS

EMC Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-





NTS WE ENGINEER SUCCESS

EMC Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Run #5: Unwanted emissions, at max. power settings

Number of transmit chains:	2	
Spurious Limit:	-13.0	dBm/MHz eirp
Adjustment for 2 chains:	-3.0	dB adjustment for multiple chains.
Limit Used On Plots	-16.0	dBm/MHz

MIMO Devices: The plots were obtained for each chain individually and the limit was adjusted to account for all chains transmitting simultaneously

Conducted spurious emissions

Frequency	Level	Port	Conducted Spurious		Detector	Channel	Comments
MHz	dBm		Limit	Margin		MHz	
7303.560	-33.1	Chain 1	-16.0	-17.1	RMS	3651.75	BW: 3.5 MHz, max power
10955.140	-40.7	Chain 1	-16.0	-24.7	RMS	3651.75	BW: 3.5 MHz, max power
7305.060	-35.5	Chain 1	-16.0	-19.5	RMS	3652.50	BW: 5 MHz, max power
7306.685	-37.4	Chain 1	-16.0	-21.4	RMS	3653.50	BW: 7 MHz, max power
7309.619	-39.9	Chain 1	-16.0	-23.9	RMS	3655.00	BW: 10 MHz, max power

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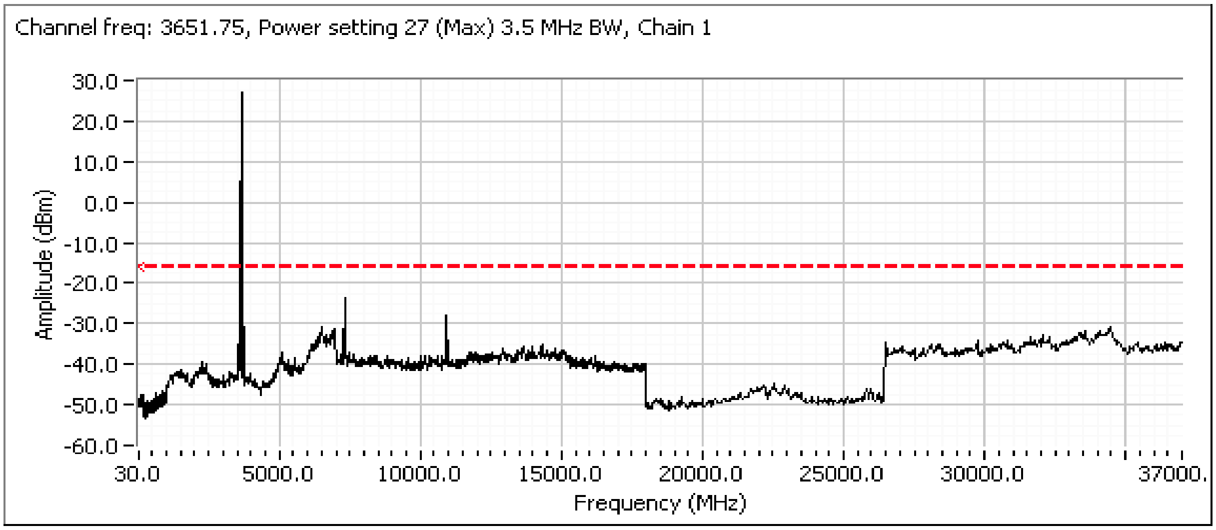
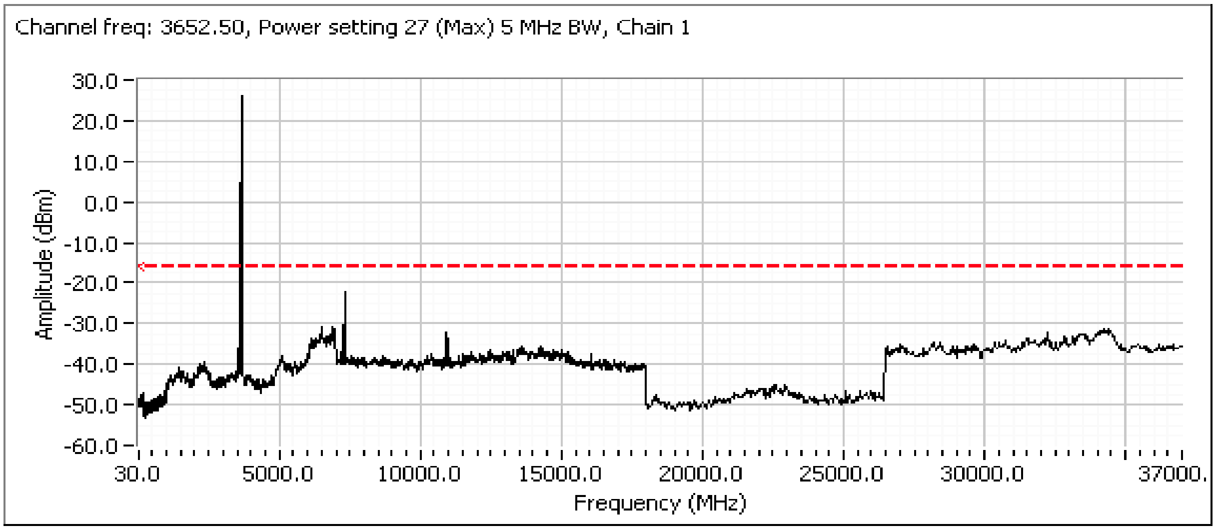
EMC Test Data

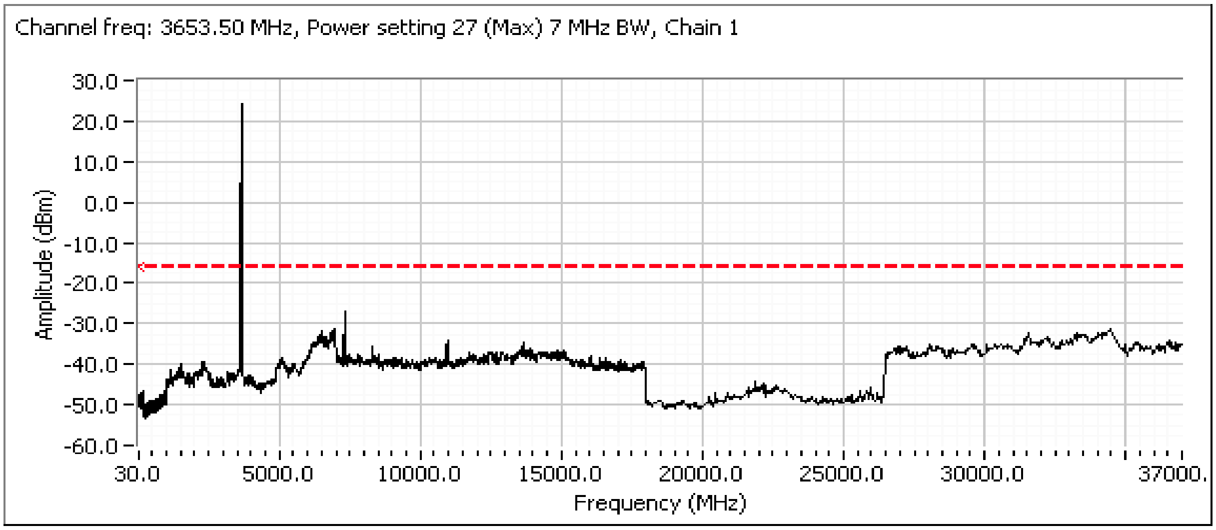
Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

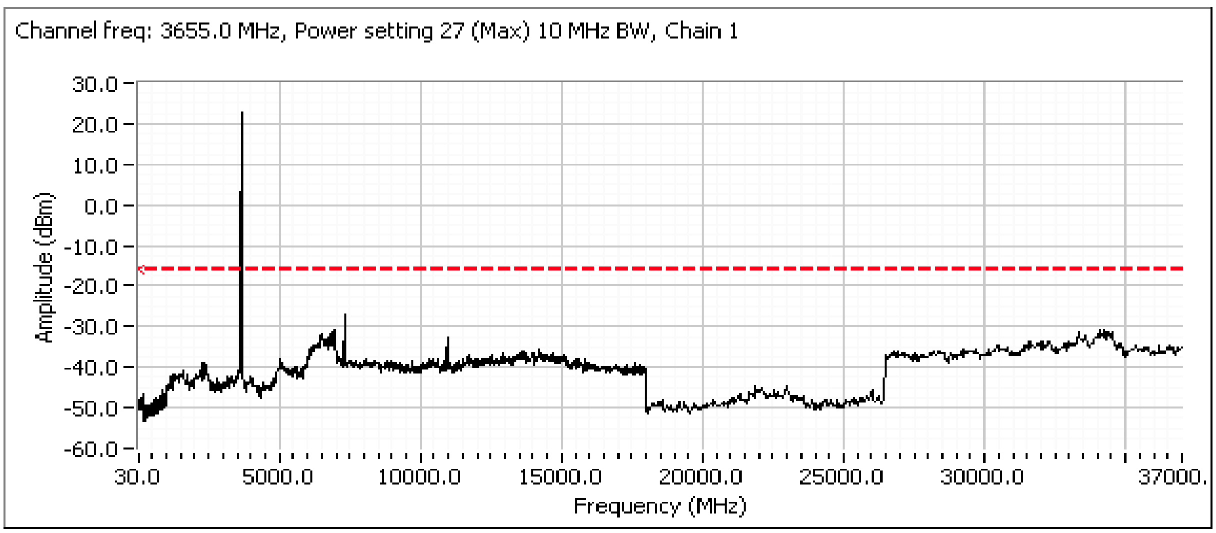
Plots Showing Out-Of-Band Emissions (RBW=VBW=1MHz)



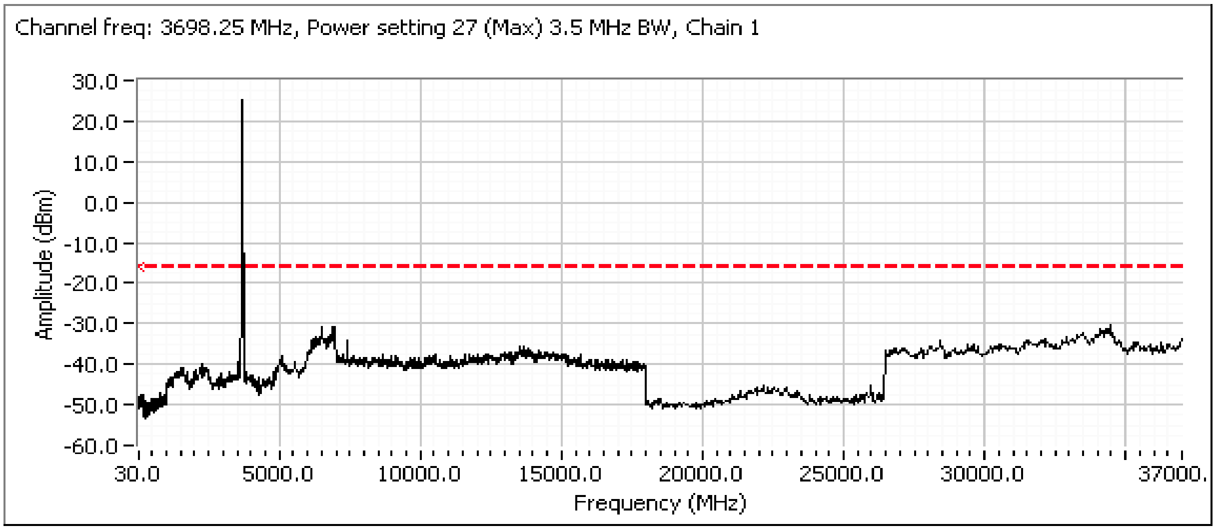


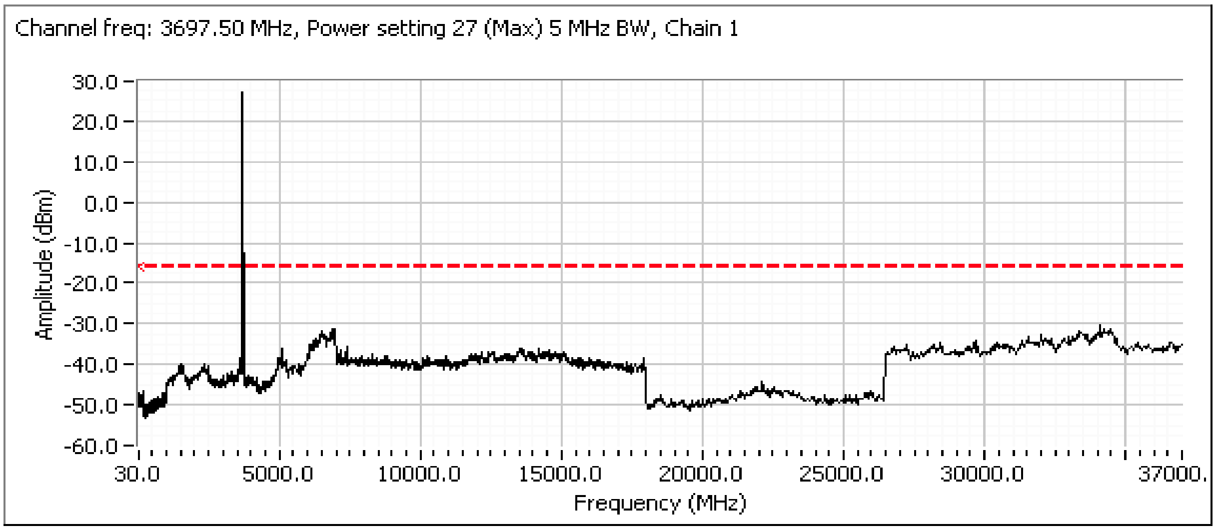
Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-





Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-





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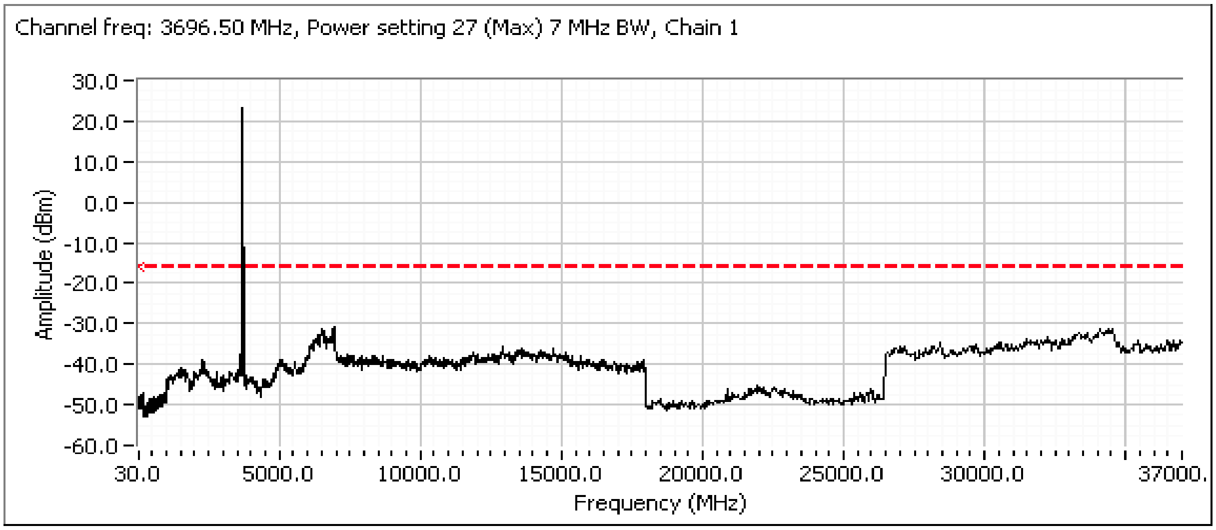
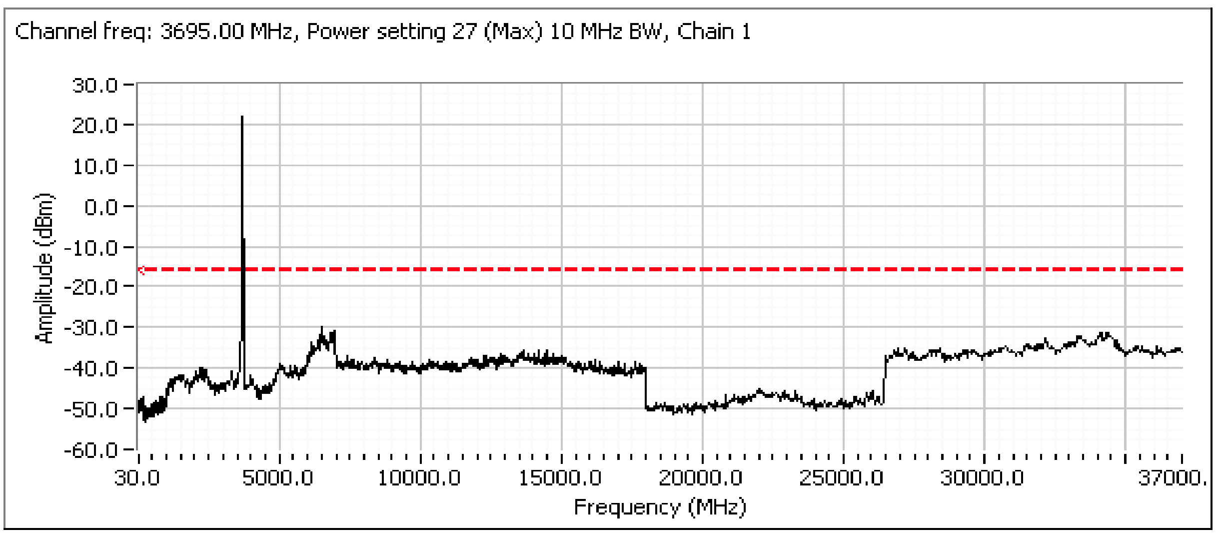
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-





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Radio Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

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 to allow for the external attenuators and cables used.

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	-2.1 dB @ 3650 MHz (BW: 3.5 MHz, P: 20)
2	Transmitter Frequency Stability	Part 90.213 / RSS-197 5.3	Pass	760 Hz / .21 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.

Radio Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Run #1: Spurious Emissions (conducted)

Date 10/24/2012 Engineer: Deniz Demirci Location: FT Ch# 5

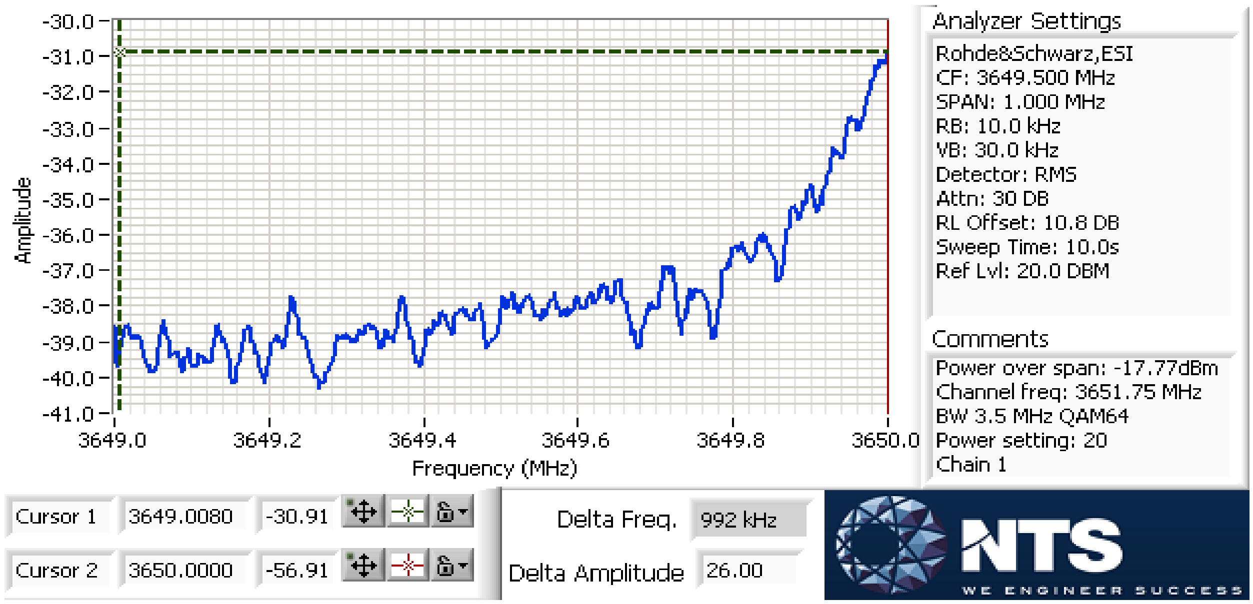
Cable Loss: 0.8 dB Attenuator: 10.0 dB Total Loss: 10.8 dB
Cable ID(s): EL 539 Attenuator IDs: 2100

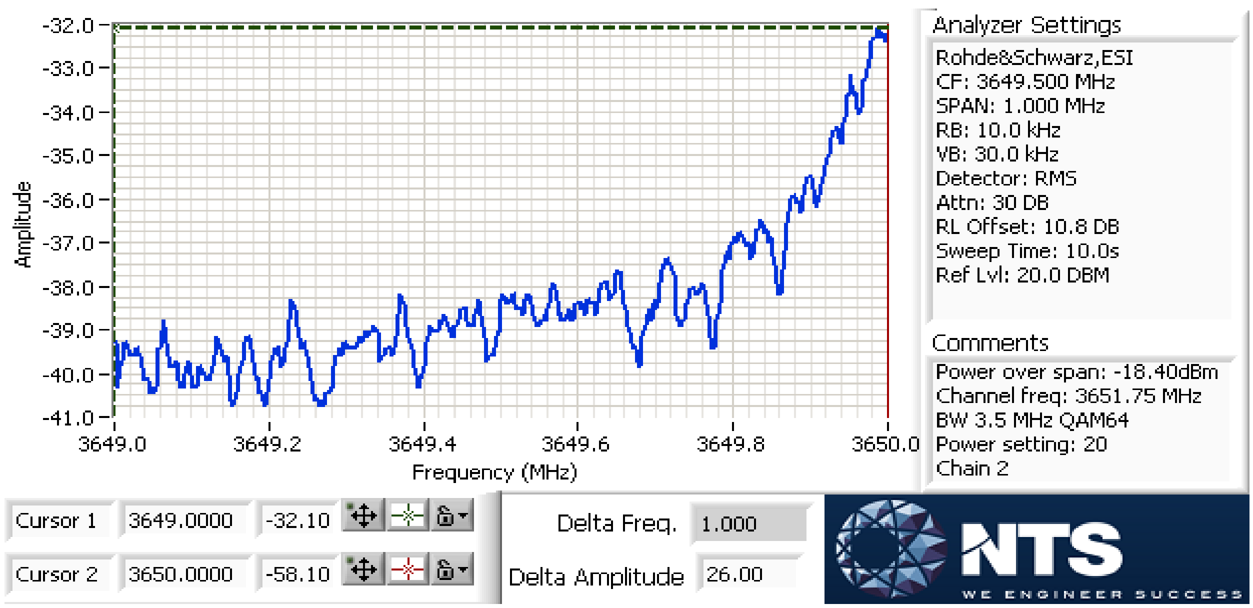
BW MHz	Channel MHz	Chain 1 dBm	Chain 2 dBm	Total dBm	RSS-197 Limit	Margin dB	Detector	Frequency MHz	Mode	Power setting
3.5	3651.750	-17.8	-18.4	-15.1	-13.0	-2.1	RMS	3650.000	QAM64	20
5	3652.500	-18.3	-19.2	-15.7	-13.0	-2.7	RMS	3650.000	QAM64	22
7	3653.500	-18.3	-18.9	-15.6	-13.0	-2.6	RMS	3650.000	QAM64	24
10	3655.000	-17.9	-19.3	-15.5	-13.0	-2.5	RMS	3650.000	QAM64	26
3.5	3698.250	-18.0	-18.7	-15.3	-13.0	-2.3	RMS	3700.000	QAM64	22
5	3697.500	-19.5	-20.5	-16.9	-13.0	-3.9	RMS	3700.000	QAM64	24
7	3696.500	-19.6	-20.3	-16.9	-13.0	-3.9	RMS	3700.000	QAM64	24
10	3695.000	-21.4	-22.3	-18.8	-13.0	-5.8	RMS	3700.000	QAM64	26

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

Radio Test Data

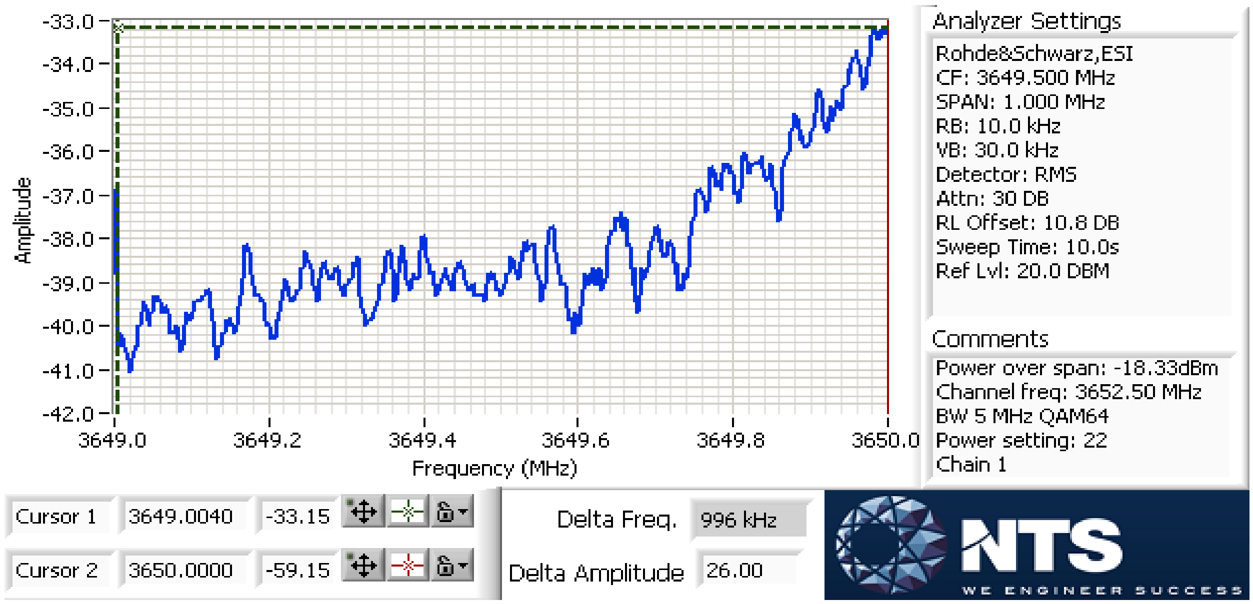
Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

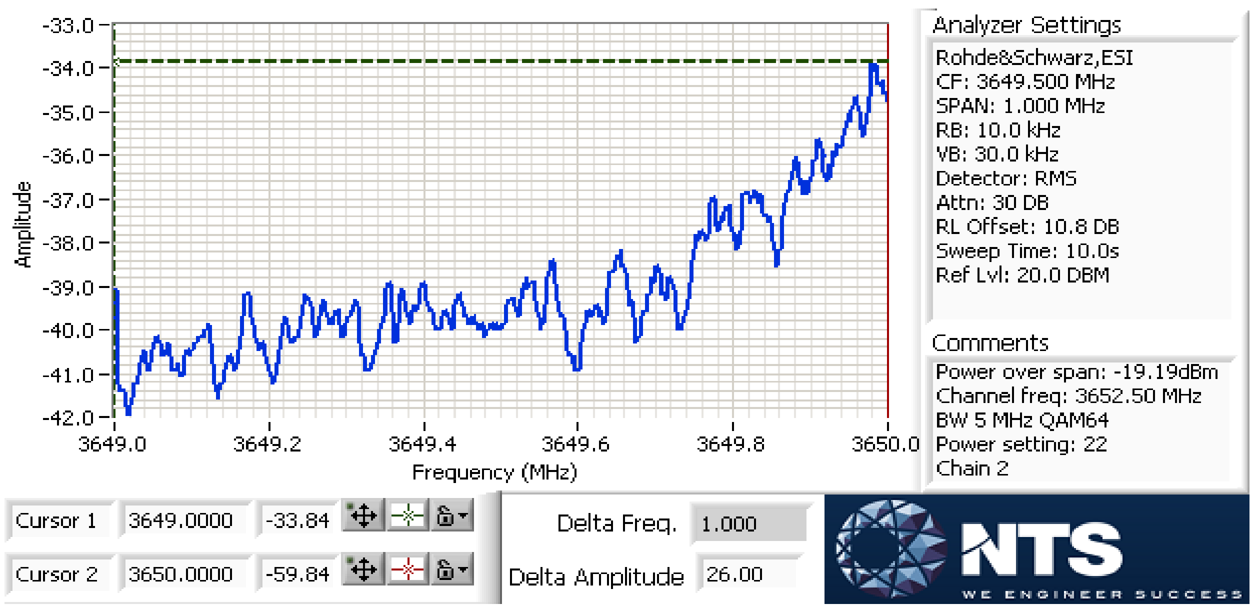




Radio Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-





Radio Test Data

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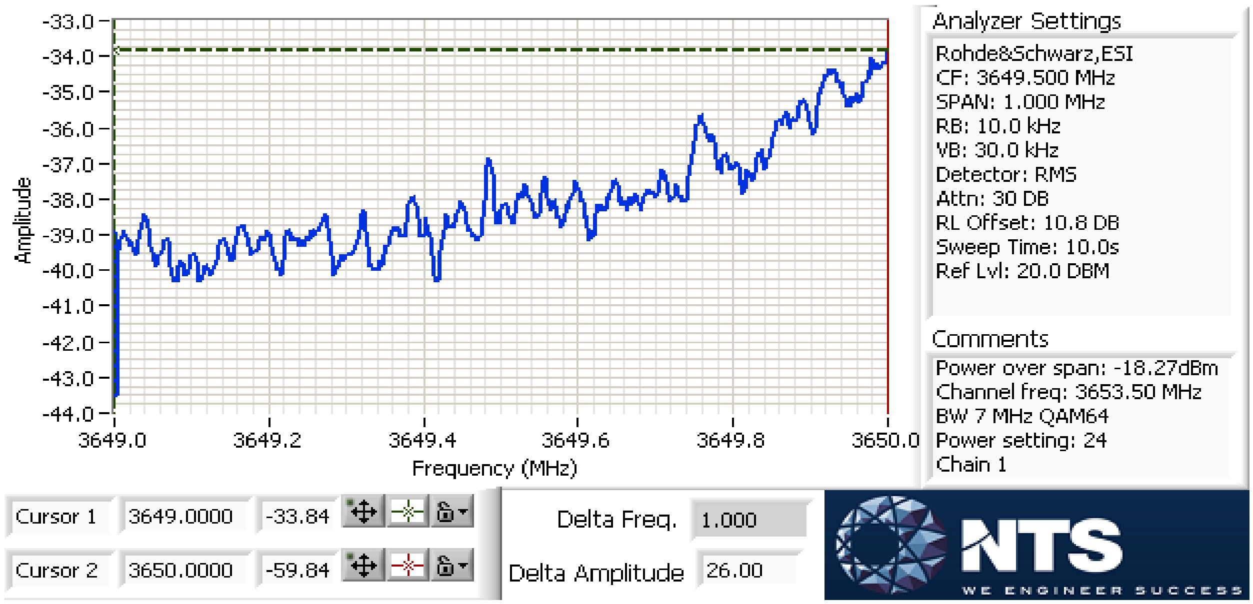
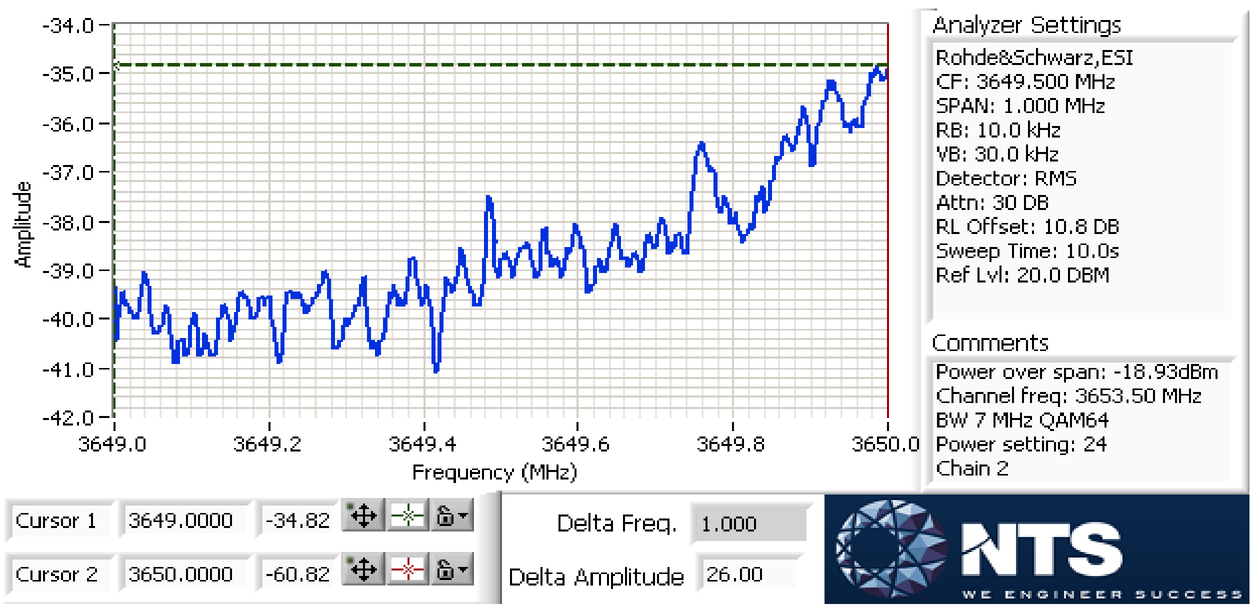
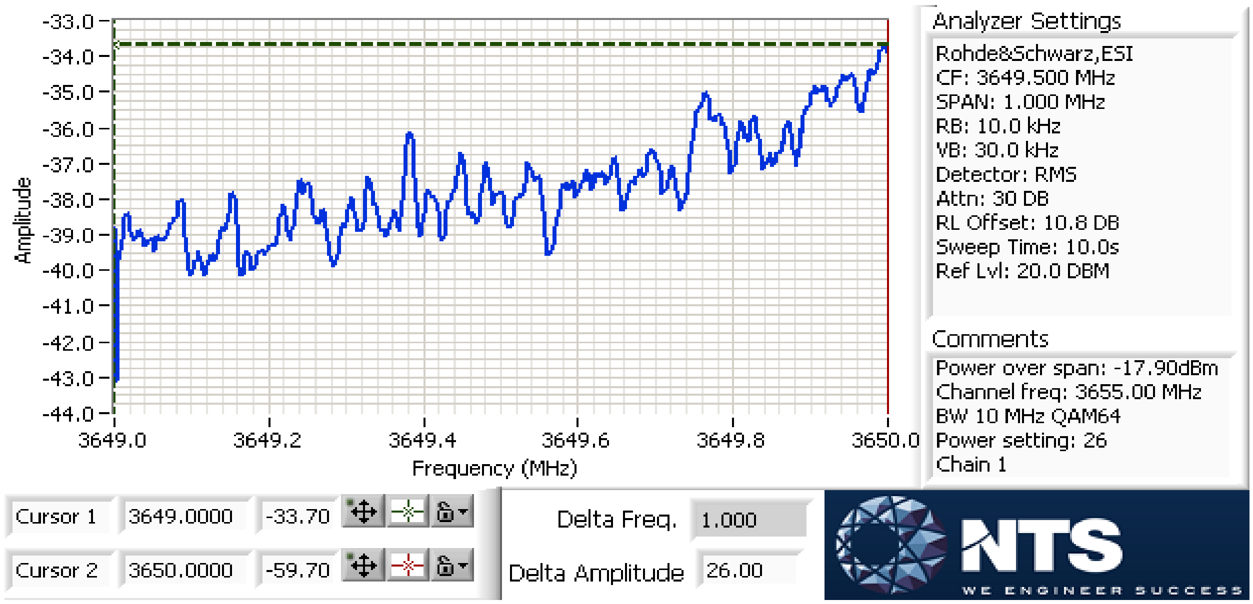


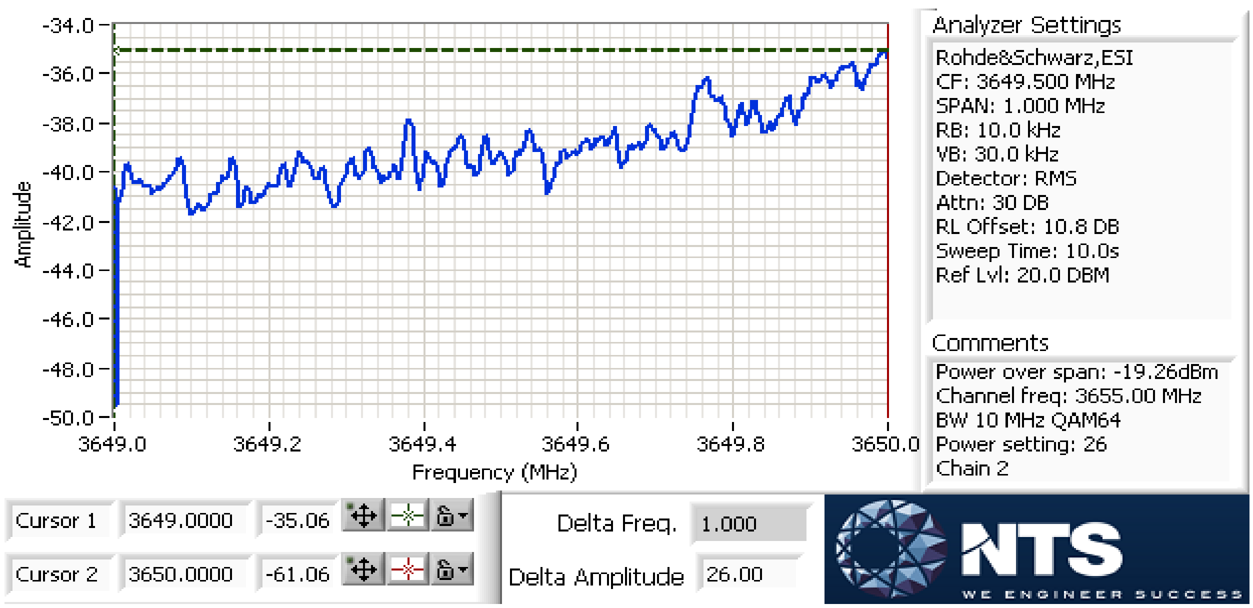


NTS WE ENGINEER SUCCESS

Radio Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-





Radio Test Data

Client:	GE MDS LLC	Job Number:	J89699
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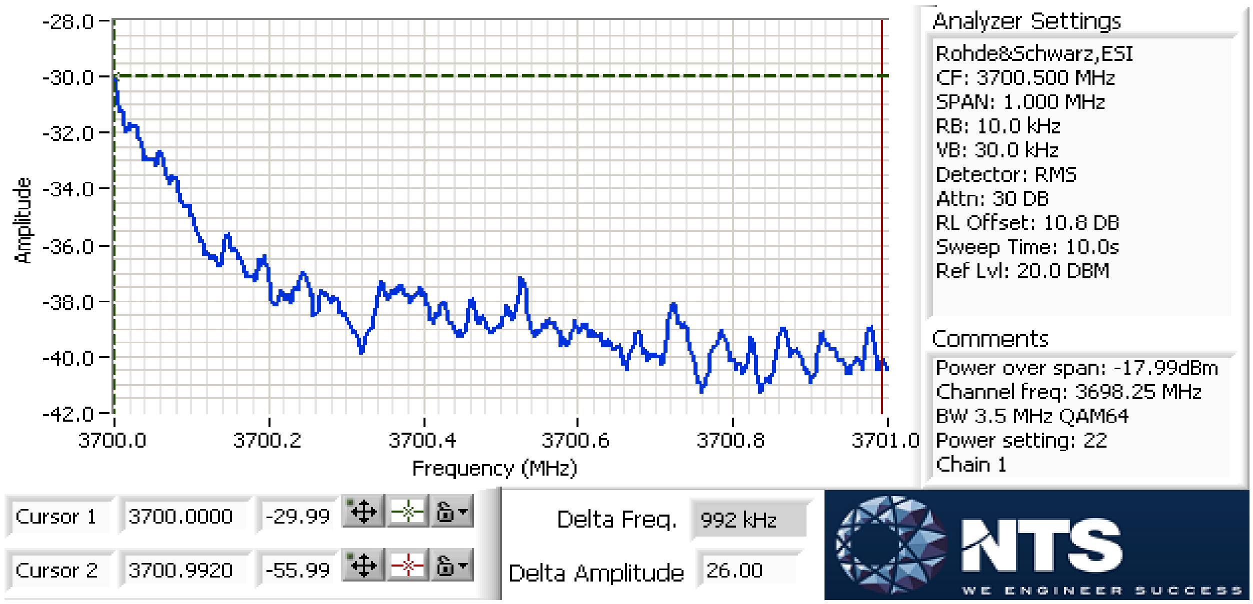
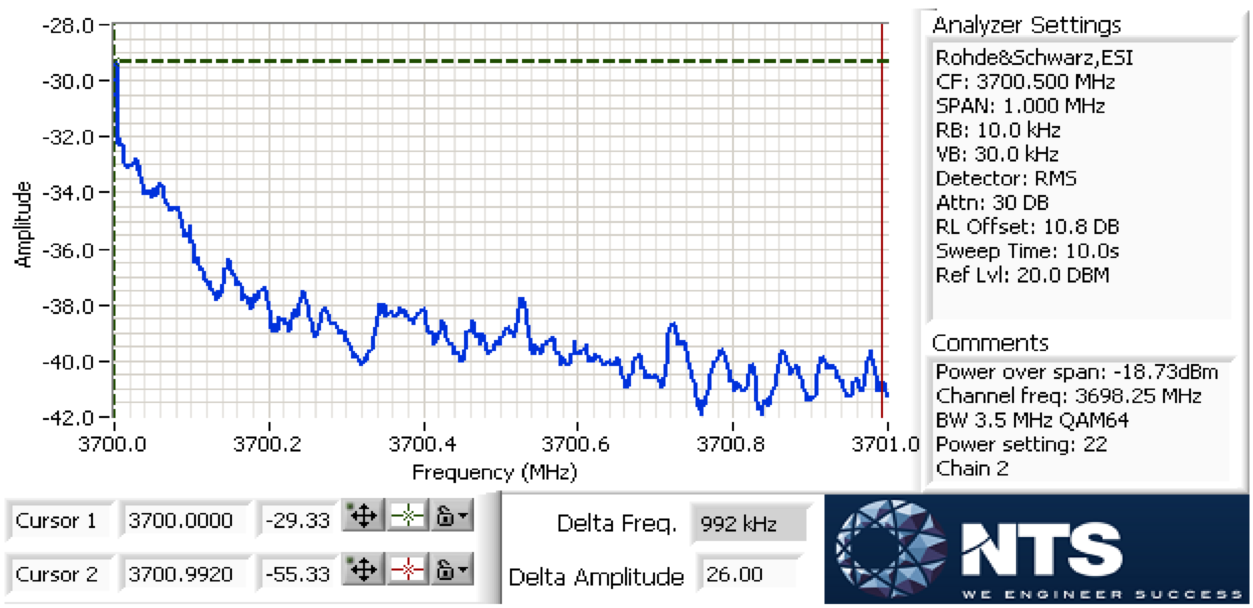
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

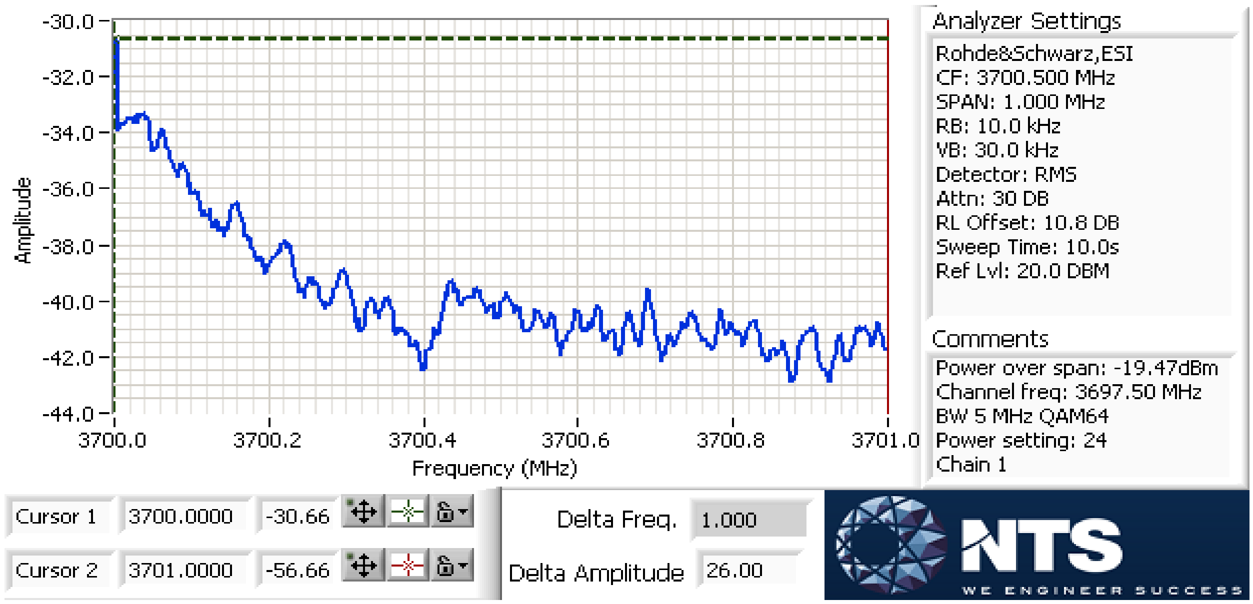


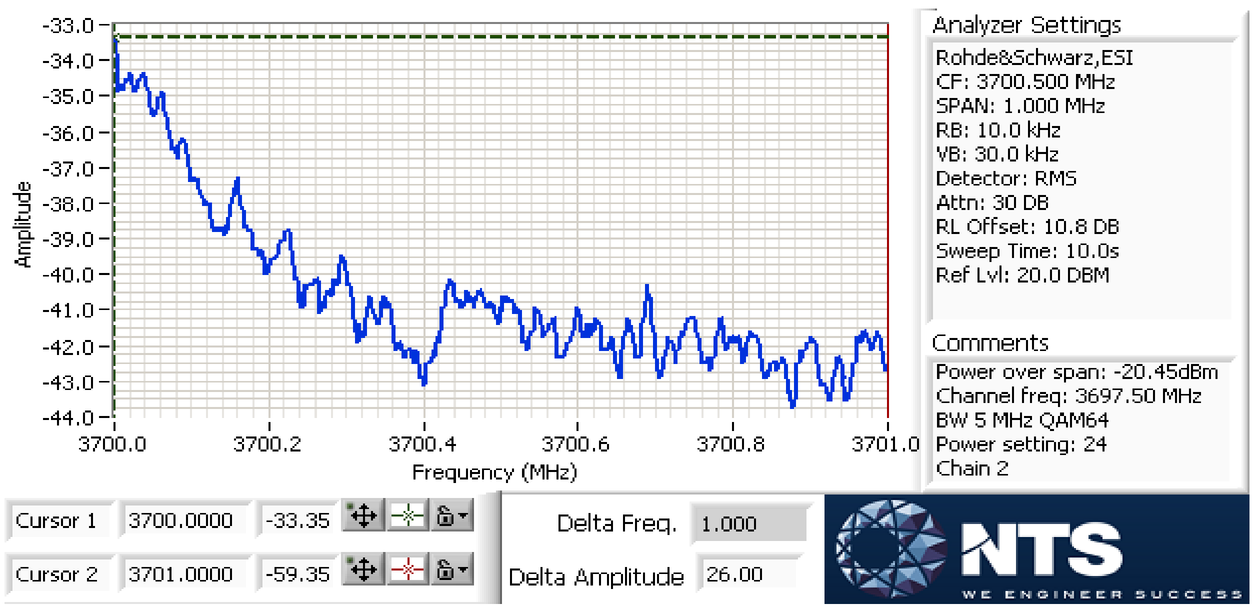


NTS WE ENGINEER SUCCESS

Radio Test Data

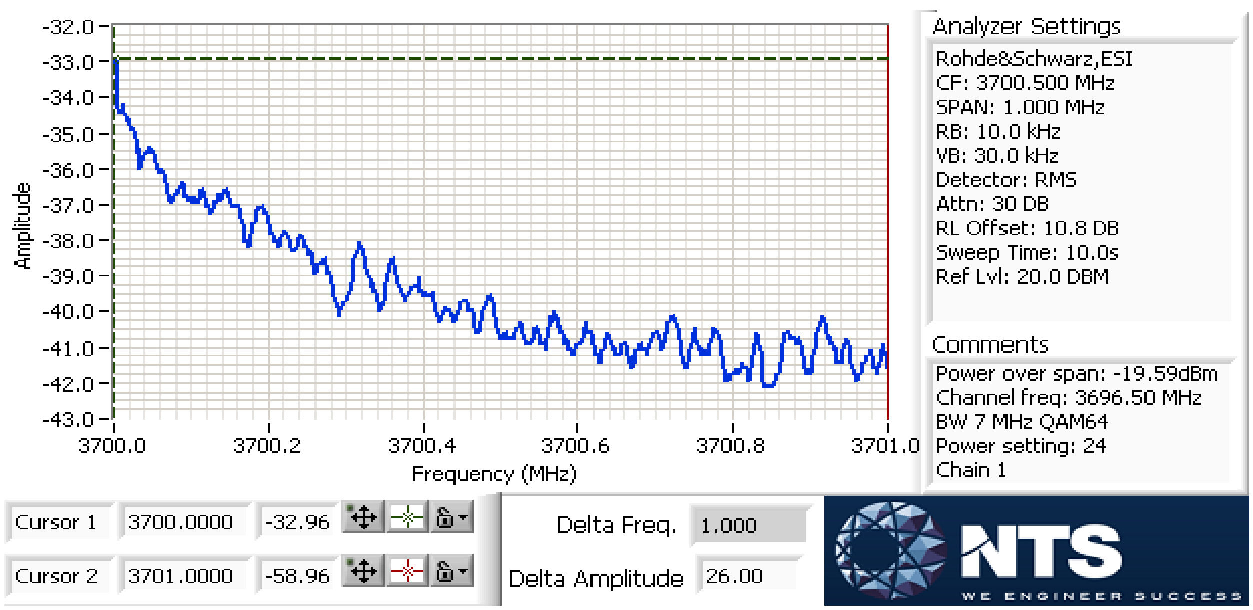
Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

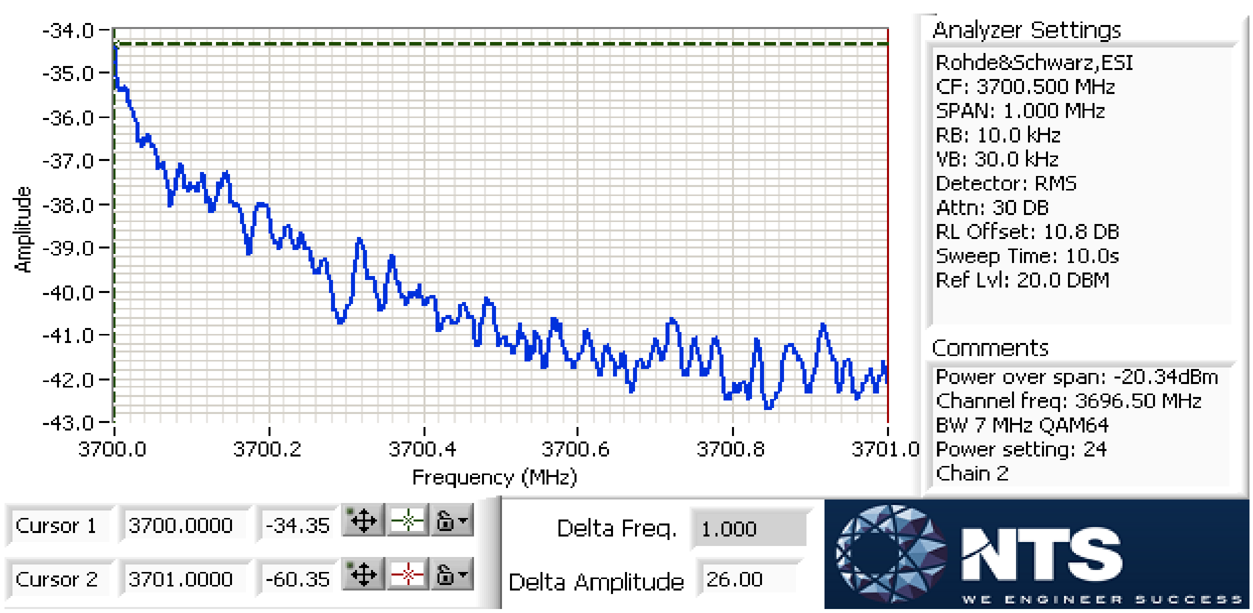




Radio Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

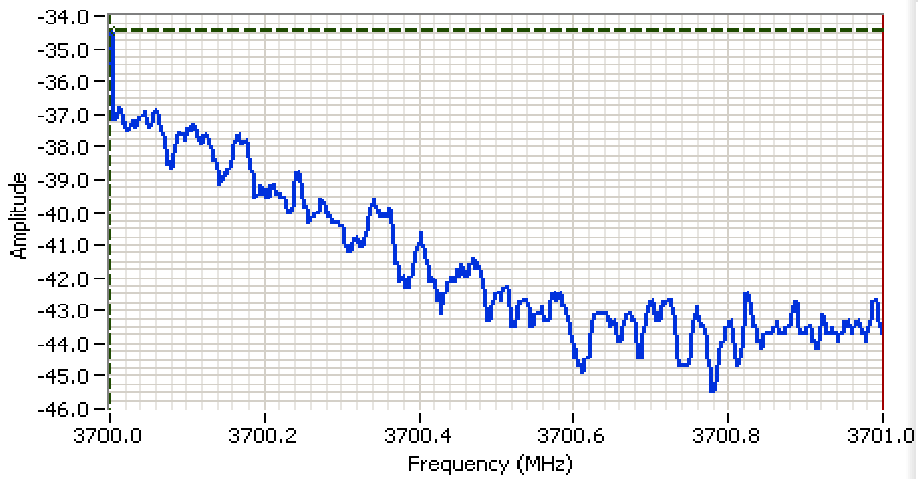




NTS
WE ENGINEER SUCCESS

Radio Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-



Analyzer Settings

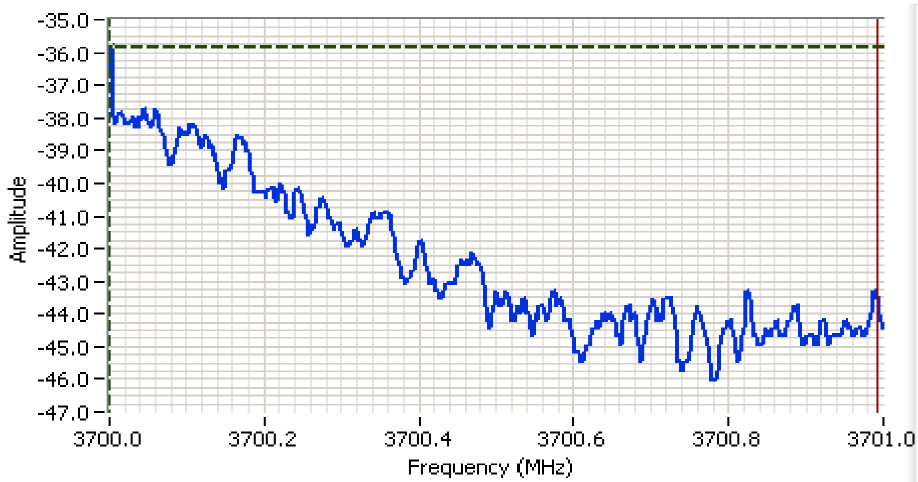
Rohde&Schwarz,ESI
CF: 3700.500 MHz
SPAN: 1.000 MHz
RB: 10.0 kHz
VB: 30.0 kHz
Detector: RMS
Attn: 30 DB
RL Offset: 10.8 DB
Sweep Time: 10.0s
Ref Lvl: 20.0 DBM

Comments

Power over span: -21.40dBm
Channel freq: 3695.00 MHz
BW 10 MHz QAM64
Power setting: 26
Chain 1

Cursor 1	3700.0000	-34.43	Delta Freq.	1.000
Cursor 2	3701.0000	-60.43	Delta Amplitude	26.00

NTS
WE ENGINEER SUCCESS



Analyzer Settings

Rohde&Schwarz,ESI
CF: 3700.500 MHz
SPAN: 1.000 MHz
RB: 10.0 kHz
VB: 30.0 kHz
Detector: RMS
Attn: 30 DB
RL Offset: 10.8 DB
Sweep Time: 10.0s
Ref Lvl: 20.0 DBM

Comments

Power over span: -22.30dBm
Channel freq: 3695.00 MHz
BW 10 MHz QAM64
Power setting: 26
Chain 2

Cursor 1	3700.0000	-35.83	Delta Freq.	992 kHz
Cursor 2	3700.9920	-61.83	Delta Amplitude	26.00

NTS
WE ENGINEER SUCCESS

Radio Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

Run #2: Transmitter Frequency Stability

Date 10/25/2012 Engineer: Deniz Demirci Location: FT Ch# 7

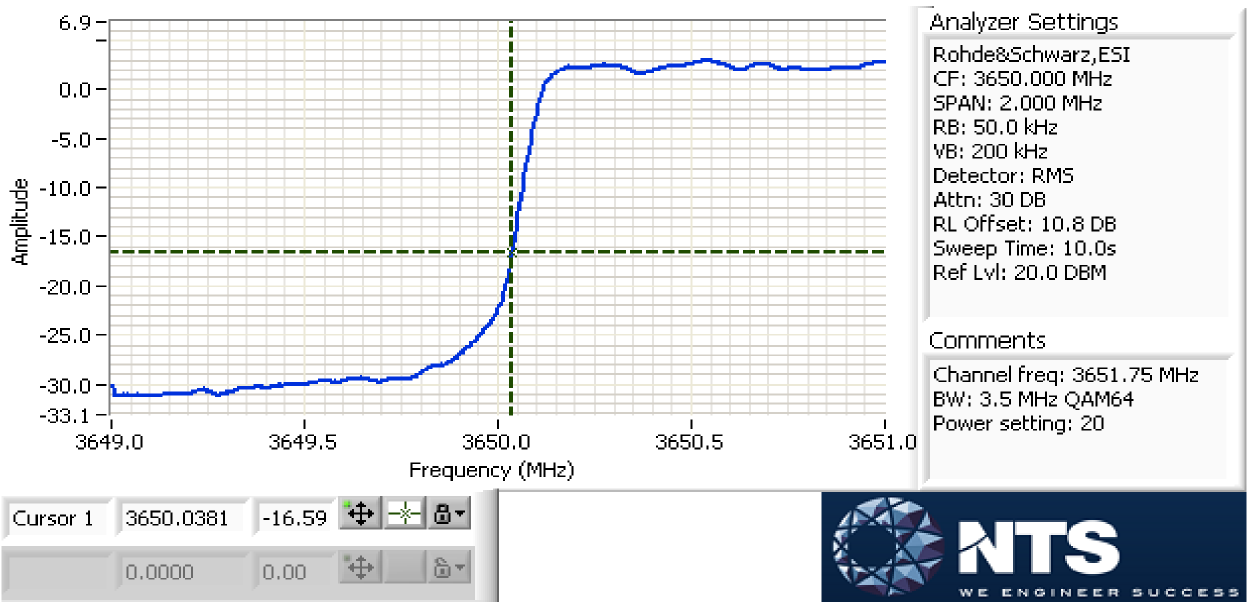
Cable Loss: 0.8 dB Attenuator: 10.0 dB Total Loss: 10.8 dB
Cable ID(s): EL 539 Attenuator IDs: 2100

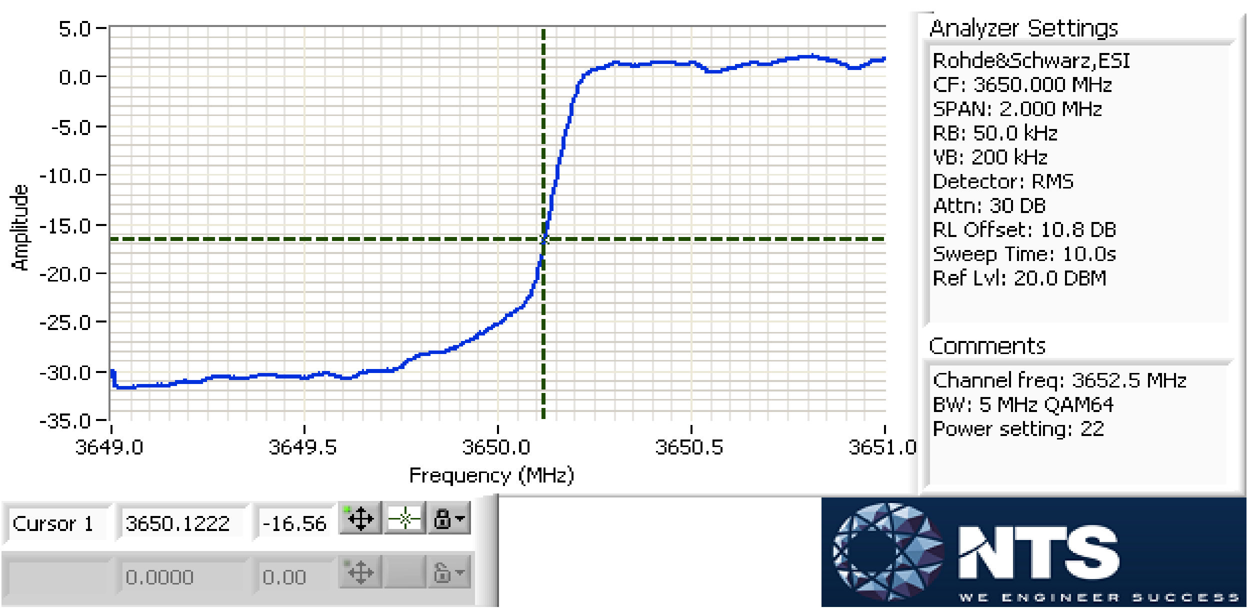
BW MHz	Channel Frequency MHz	Mode	Power setting	Unwanted emissiom reference point	Worst case drift MHz	F_H or F_L
3.5	3651.750	QAM64	20	3650.038100	0.000760	3650.037340
5	3652.500	QAM64	22	3650.122200	0.000760	3650.121440
7	3653.500	QAM64	24	3650.066100	0.000760	3650.065340
10	3655.000	QAM64	26	3650.238500	0.000760	3650.237740
3.5	3698.250	QAM64	22	3699.969900	0.000760	3699.969140
5	3697.500	QAM64	24	3699.885800	0.000760	3699.885040
7	3696.500	QAM64	24	3699.929900	0.000760	3699.929140
10	3695.000	QAM64	26	3699.749500	0.000760	3699.748740

Note 3: Chain 1 is measured (worst case power) and the limit is adjusted -3 dB in order to combine two chains

Radio Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-





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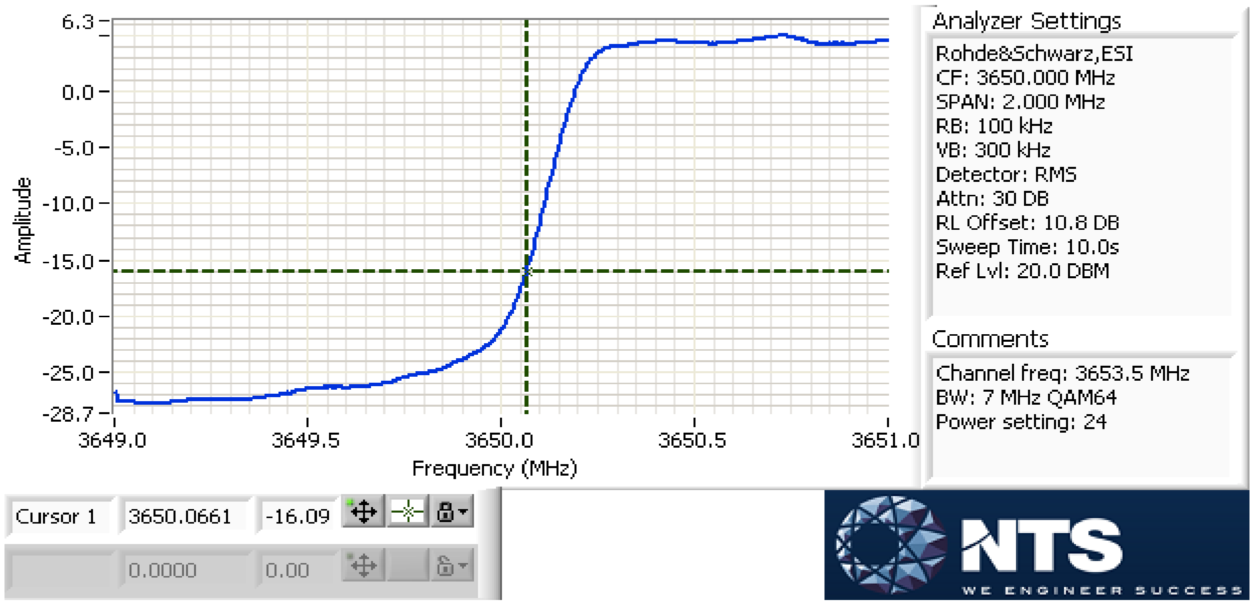
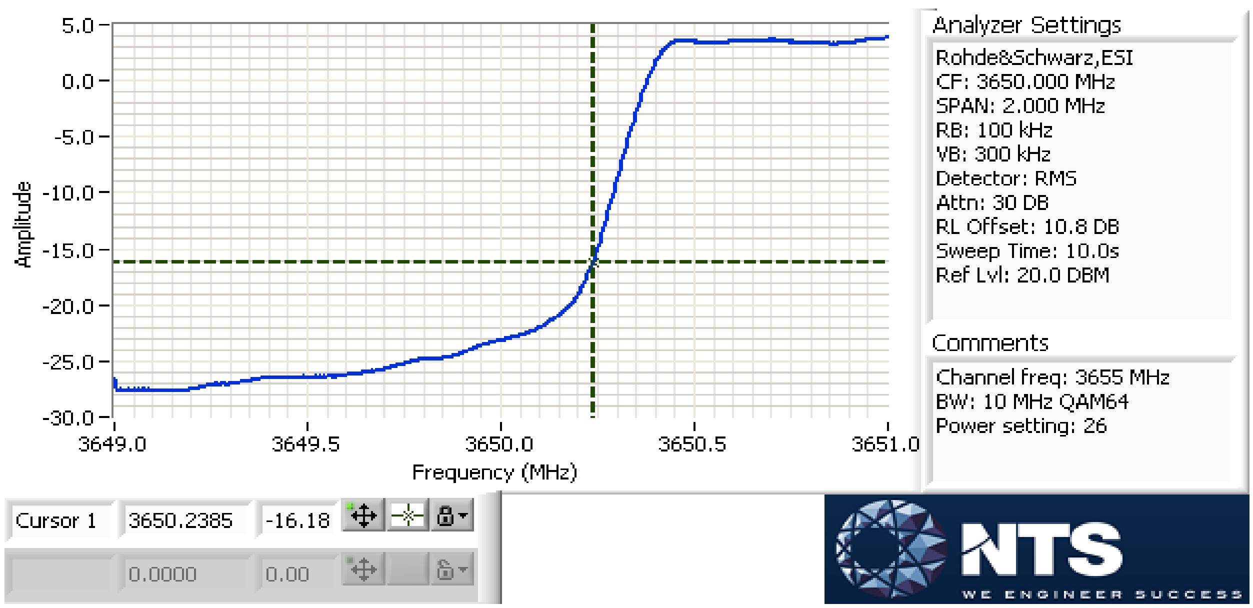
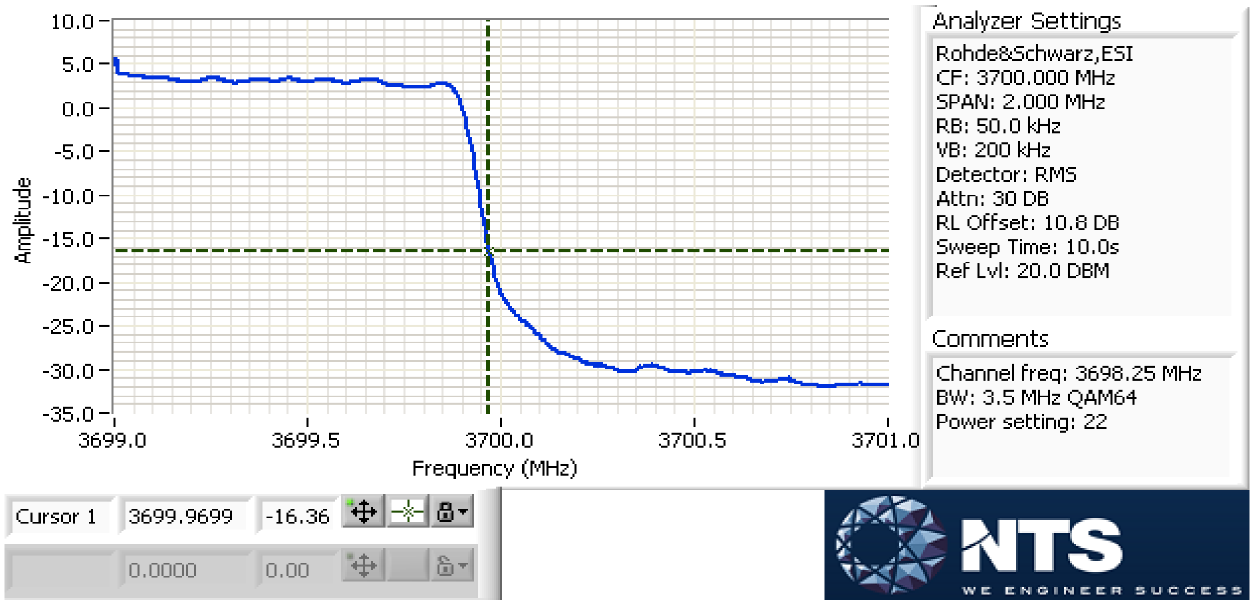
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

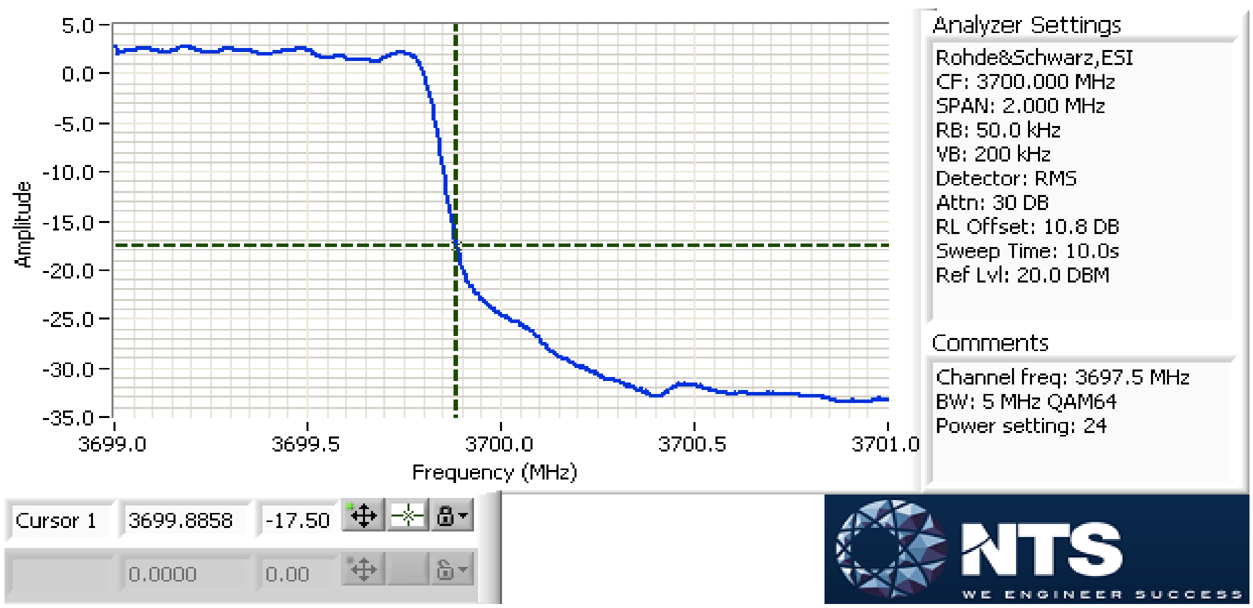




Radio Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-

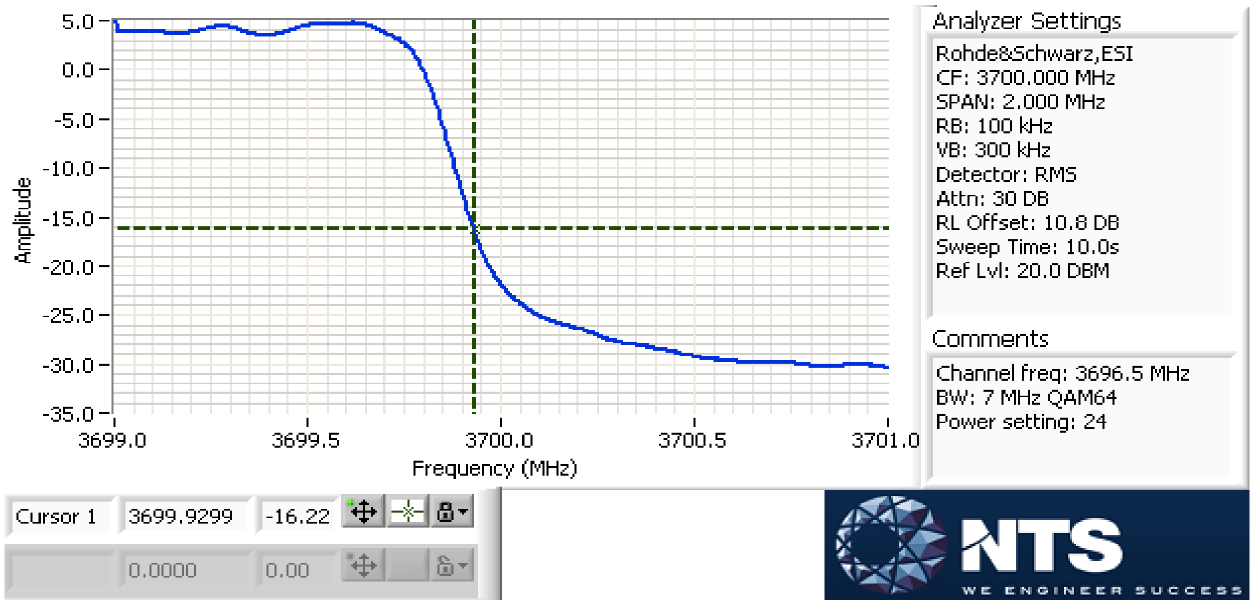


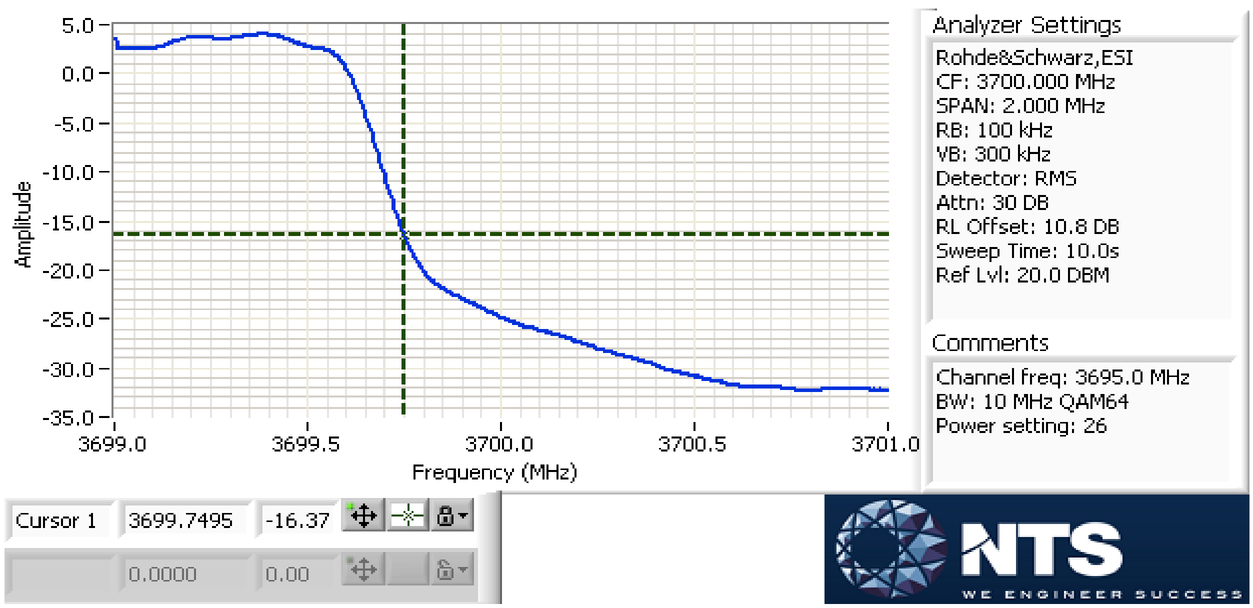


NTS WE ENGINEER SUCCESS

Radio Test Data

Client:	GE MDS LLC	Job Number:	J89699
Model:	Mercury 3650 IDU	T-Log Number:	T89731
		Account Manager:	Michelle Kim
Contact:	Dennis McCarthy		
Standard:	FCC Part 90, RSS-197	Class:	-





End of Report

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