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Radio Test Report

FCC Part 90
(150 MHz to 174 MHz)

Model: GPA-1

COMPANY:	GE MDS LLC 175 Science Parkway Rochester, NY 14620
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
REPORT DATE:	April 22, 2016
RE-ISSUED:	May 13, 206
FINAL TEST DATES:	February 23 and 25 and March 11, 2016
TOTAL NUMBER OF PAGES:	37

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ACCREDITED
Testing Cert #0214.26

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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	April 22, 2016	First release	
1	May 2, 2016	Revised to correct limits on page 6	Dwb
2	May 13, 2016	Corrected typo on page 24 for the bandwidth	DWB

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SCOPE

Tests have been performed on the GE MDS LLC model GPA-1, pursuant to the relevant requirements of the following standard(s) in order to obtain device certification against the regulatory requirements of the Federal Communications Commission and Industry Canada.

- Code of Federal Regulations (CFR) Title 47 Part 2
- CFR 47 Part 90 (Private Land Mobile Radio Service) Subpart I

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in National Technical Systems - Silicon Valley test procedures:

ANSI C63.4:2014
ANSI TIA-603-D 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 GPA-1 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 GPA-1 complied with the requirements of the standards and frequency bands declared in the scope of this test report.

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

DEVIATIONS FROM THE STANDARDS

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

TEST RESULTS

FCC Part 90 and RSS-131

FCC		Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics					
§2.1033 (c) (5) § 90.35		Frequency range(s)	150 – 174 MHz	150 – 174 MHz	Complied
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 § 90.205		RF power output at the antenna terminals	10 - 42.7 W (46.3 dBm)	57 dBm ERP	Complied
		Amplifier Passband and Gain	23.3 dBm 131.33 MHz	< 1.0 dB above nominal	Complied
§2.1033 (c) (4) §2.1047 § 90.210		Emission types	F1D, F2D and F3D	-	-
		Emission mask	complied with Masks	Below mask	Complied
§2.1049 § 90.209		Occupied Bandwidth	14.1 kHz in, 14.2 kHz out	Same input and output	Complied
Transmitter spurious emissions					
§2.1051 §2.1057		At the antenna terminals	-26.9 dBm @ 324.00 MHz (-1.9 dB)	-25 dBm	Complied
§2.1053 §2.1057		Field strength	-25.8 dBm @ 348.00 MHz (-0.8 dB)	-25 dBm	Complied
Other details					
§2.1093		RF Exposure	To be considered at time of licensing	-	-
§2.1033 (c) (8)		Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range	10-16 V, 8 A	Information only	-
-		Antenna Gain	Maximum 10.7 dBd	Any allowed subject to licensing	Complied
Notes					

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 GPA-1 is a single channel signal amplifier that is designed to increase the transmit power of the GE MDS SD1 radio operating in the 150-174 MHz band. Since the EUT could be placed in any position during operation, the EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 10-16 VDC, 8 Amps.

The sample was received on February 23, 2016 and tested on February 23 and 25 and March 11, 2016. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
GE MDS LLC	GPA-1	Amplifier	None	E5MDS-GPA-1

OTHER EUT DETAILS

The EUT is considered an ERFPA or signal amplifier as defined in FCC Rules Part 90.7. "A device that amplifies radio frequency signals and is connected to a mobile radio transceiver, portable or handset, typically to the antenna connector. Note that a signal amplifier is not the same thing as a signal booster."

ENCLOSURE

The EUT enclosure is primarily constructed of aluminum. It measures approximately 10.5 cm wide by 10.5 cm deep by 4 cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at National Technical Systems - Silicon Valley.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
GE MDS LLC	SD1	Industrial Radio	02186930	E5MDS-SD1

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

Company	Model	Description	Serial Number	FCC ID
Mastech	HY6020EX	Power Supply	-	-
IBM	ThnikPad 2647	Laptop	78-NPKZH 09/01	-

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Input	SD1 radio	Coax	Shielded	1
Output	Test Receiver	Coax	Shielded	3.5
Power	Power Supply	Two wire	Unshielded	2.3

Additional on Support Equipment

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
SD1 Serial	Laptop	Serial	Shielded	2

EUT OPERATION

During testing, the EUT presented with a normal modulated transmission signal at various levels from the GE MDS SD1 radio with which the amplifier is intended to be used.

TESTING

GENERAL INFORMATION

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

Radiated spurious emissions measurements were taken at the National Technical Systems - Silicon Valley Anechoic Chambers and/or Open Area Test Site(s) listed below. The sites conform to the requirements of ANSI C63.4: 2014 *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.

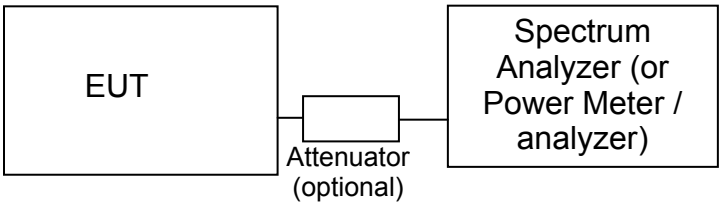
Site	Designation / Registration Numbers		Location
	FCC	Canada	
Chamber 4	US0027	IC 2845B-4	41039 Boyce Road Fremont, CA 94538-2435

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.

RADIATED EMISSIONS MEASUREMENTS

Receiver radiated spurious emissions measurements are made in accordance with ANSI ANSI C63.4:2014 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.

Appendix A Test Equipment Calibration Data

Radio Antenna Port (Power and Spurious Emissions), 23-Feb-16

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	1/22/2016	1/22/2017
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	3/31/2015	3/31/2016
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts use with 20dB attenuator sn:1031.6959.00 only	NRV-Z32	3225	9/24/2015	9/24/2016

Radiated Emissions, 30 - 2,000 MHz, 25-Feb-16

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1548	9/17/2014	9/17/2016
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	6/27/2014	6/27/2016
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	7/6/2015	7/6/2016
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	10/9/2015	10/9/2016
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/7/2015	3/7/2016
Com-Power	Preamplifier, 1-1000 MHz	PAM-103	2885	10/13/2015	10/13/2016

Substitution, 11-Mar-16

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Rohde & Schwarz	Signal Generator, 9 kHz-1.04 GHz	SMY01	1450	10/8/2015	10/8/2016
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	7/6/2015	7/6/2016
Compliance Design	Tuned Dipole Antenna	Roberts (180-400MHz)	1894	1/19/2016	1/19/2018
Compliance Design	Tuned Dipole Antenna	Roberts (400-1000MHz)	1896	1/19/2016	1/19/2018
Compliance Design	Tuned Dipole Antenna	Roberts (30-65MHz)	1897	1/19/2016	1/19/2018
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	2197	9/9/2015	9/9/2018

Appendix B Test Data

T99463 Pages 20 – 36

Client:	GE MDS LLC	Job Number:	JD99150
Product	GPA-1	T-Log Number:	T99463
System Configuration:		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	
Emissions Standard(s):	FCC part 90	Class:	
Immunity Standard(s):		Environment:	Radio

EMC Test Data

For The

GE MDS LLC

Product

GPA-1

Date of Last Test: 3/11/2016

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

FCC Part 90.219

Power, Occupied Bandwidth, Masks 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: 21 °C

Rel. Humidity: 36 %

Summary of Results

Run #			Test Performed	Limit	Pass / Fail	Result / Margin
1			Output Power, Gain and AGC	Depends on usage	Pass	42.7 W (46.3 dBm)
2			Masks (In vs Out)	No change between input and output	Pass	complied with Masks
3			99% or Occupied Bandwidth (In vs Out)	No change between input and output	Pass	14.1 kHz in, 14.2 kHz out
4			Spurious Emissions (conducted)	-25 dBm	Pass	-26.9 dBm @ 324.00 MHz (-1.9 dB)
5			Spurious emissions (radiated)	-25 dBm ERP	Pass	-25.8 dBm @ 348.00 MHz (-0.8 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.

The following deviations were made from the standard:

Describe deviation here

NTS WE ENGINEER SUCCESS

EMC Test Data

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

Run #1: Output Power

Date of Test: 2/23/2016
Test Engineer: David Bare
Test Location: Fremont EMC Lab #4A

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

Cable Loss: 0.2 dB
Cable ID(s): EL603

Attenuator: 20.0 dB
Attenuator IDs: 1878.0

Total Loss: 20.2 dB

Power Setting[2]	Frequency (MHz)	Output Power (dBm) [1]	Output Power mW	Antenna Gain (dBd)	Result	ERP dBm	ERP W
40W	150	46.0	39810.7	10.7	Pass	56.7	467.735
40W	162	46.3	42658.0	10.7	Pass	57.0	501.187
40W	174	45.9	38904.5	10.7	Pass	56.6	457.088

Note 1:	Output power measured using a peak power meter
Note 2:	Power setting - the software power setting used during testing, included for reference only.
Note 3:	Input signal level set at 23 dBm (design minimum)

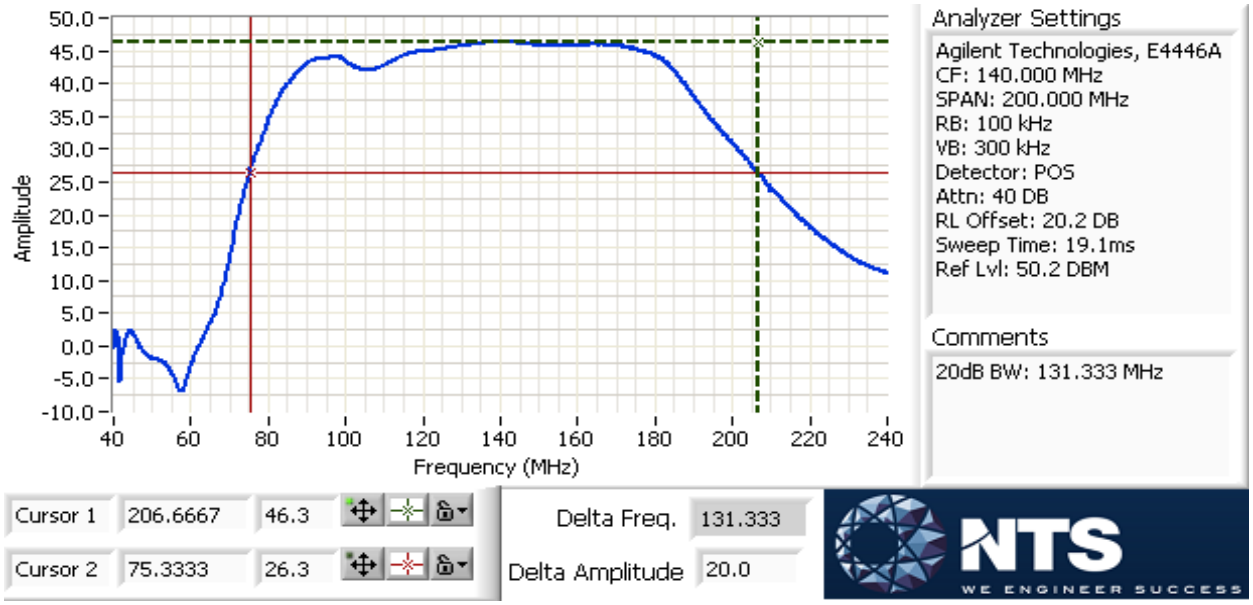
AGC threshold:

input	output	Gain	
15 dBm	41.5 dBm	26.5	
16 dBm	42.2 dBm	26.2	
17 dBm	42.9 dBm	25.9	
23 dBm	46.3 dBm	23.3	Minimum designed input amplitude
27 dBm	46.3 dBm	19.3	Maximum designed input amplitude

Below 15 dBm input, no output is produced so there is no AGC threshold as any 1 dB increase above 15 dBm results in less than 1 dB increase in output power. Tests were therefore performed with the input at 23 dBm to obtain maximum output power.

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

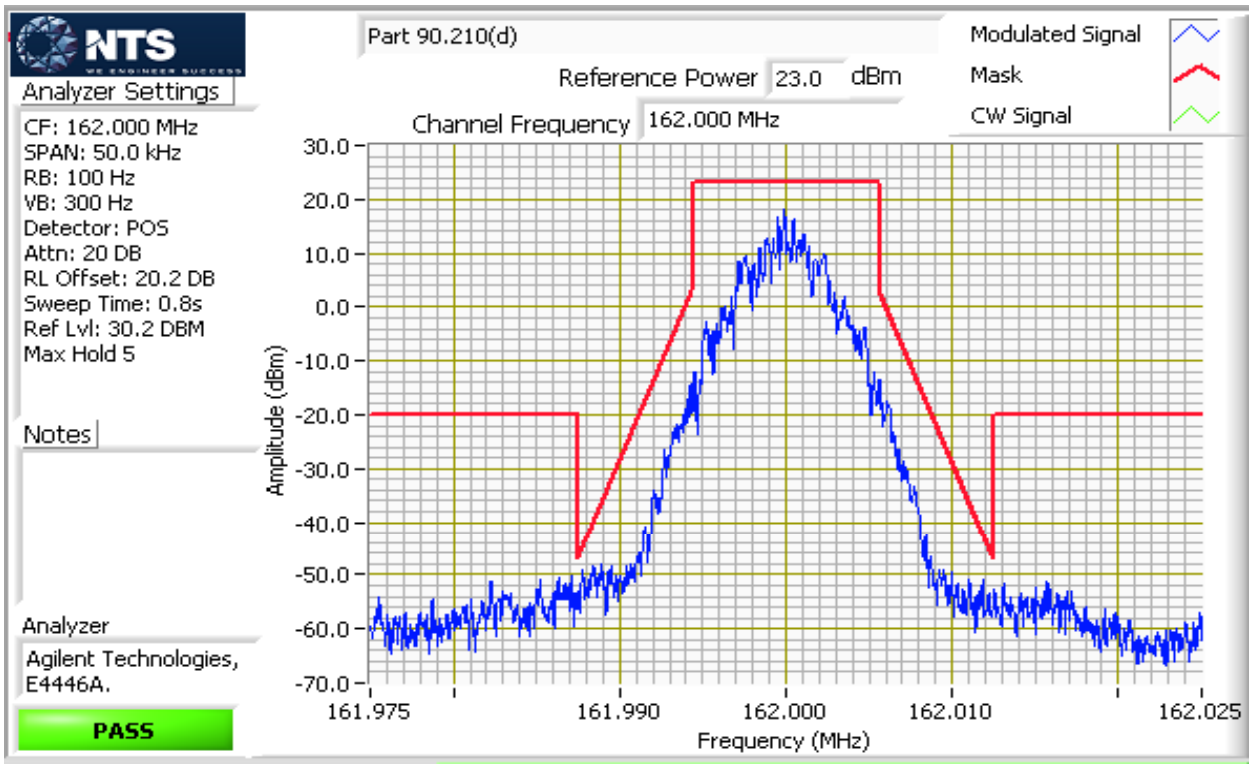
Output power vs. frequency plot. Performed at nominal input (23 dBm) instead of 3 dB below AGC threshold as the radio will not operated 3 dB below AGC threshold.



Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

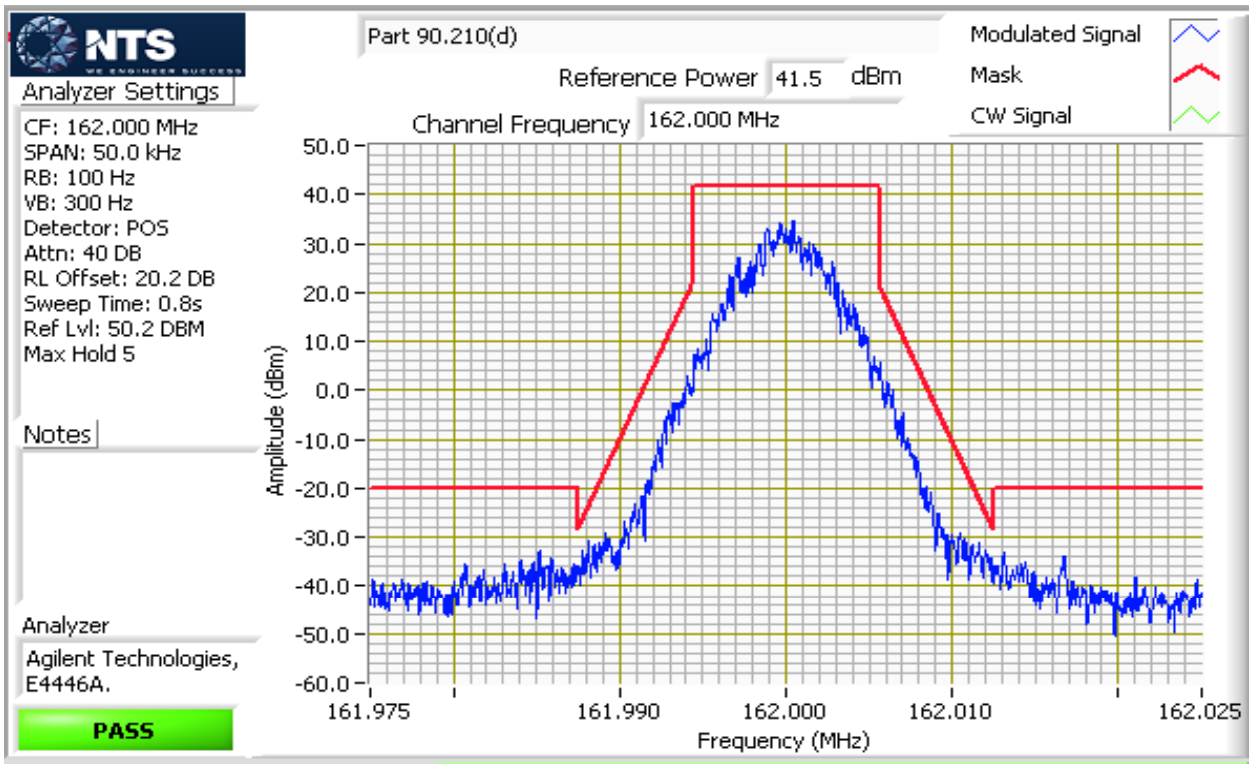
Run #2: Masks

Input



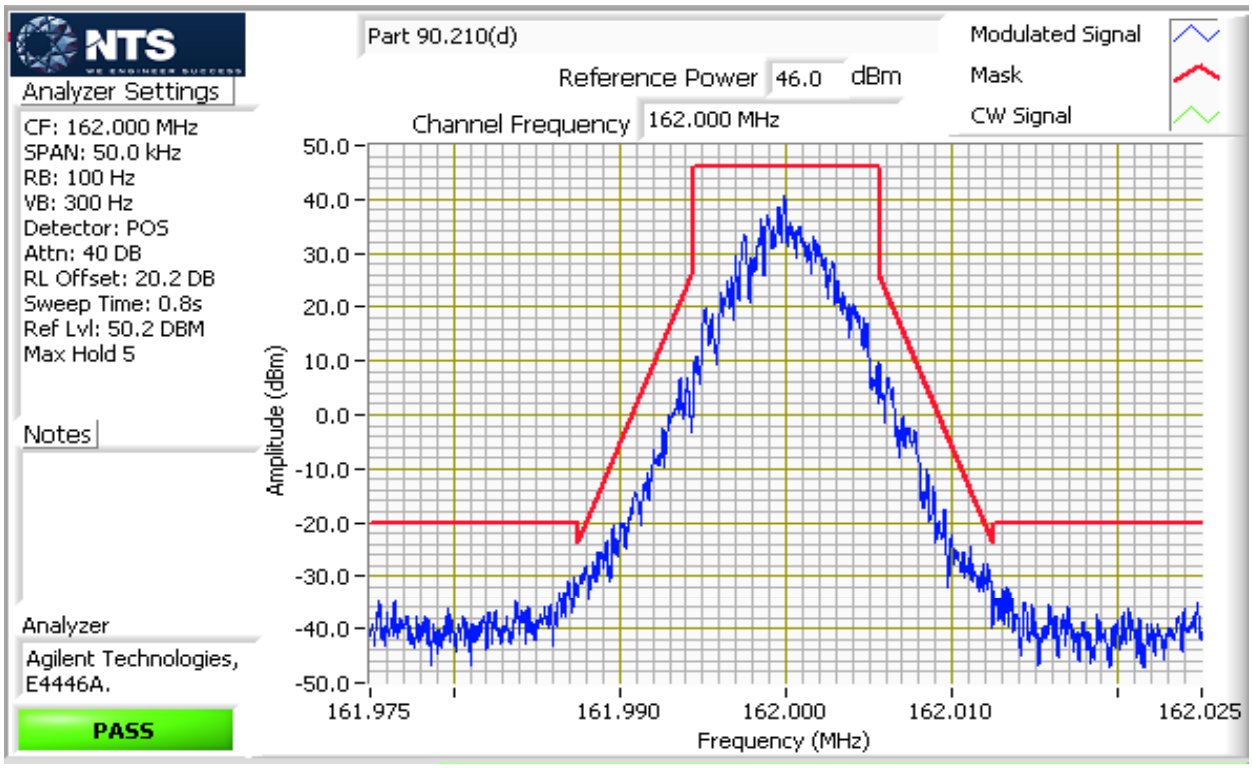
Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

Output at lowest power



Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

Output at maximum power



Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

Run #3: Signal Bandwidth

Date of Test: 2/23/2016
Test Engineer: David Bare
Test Location: Fremont EMC Lab #4A

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

Input

	Frequency (MHz)	Resolution Bandwidth	Bandwidth (kHz)	99%
	162	300 Hz		14.20

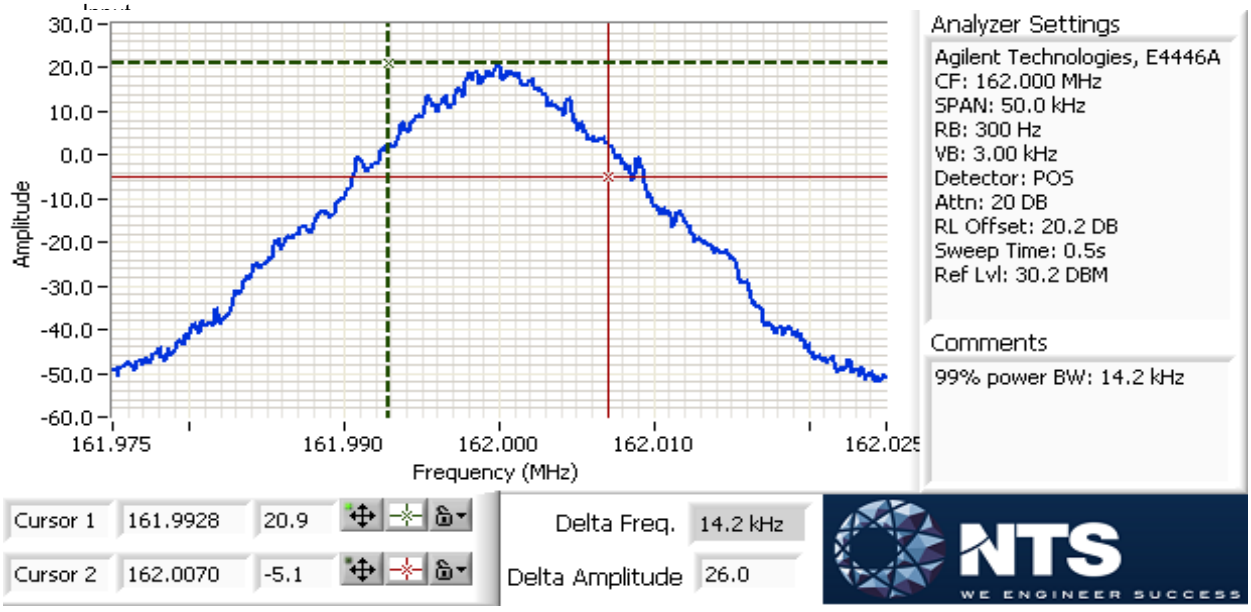
Modem 19200

Output

Power Setting	Frequency (MHz)	Resolution Bandwidth	Bandwidth (kHz)	99%
40W	162	300 Hz		14.10

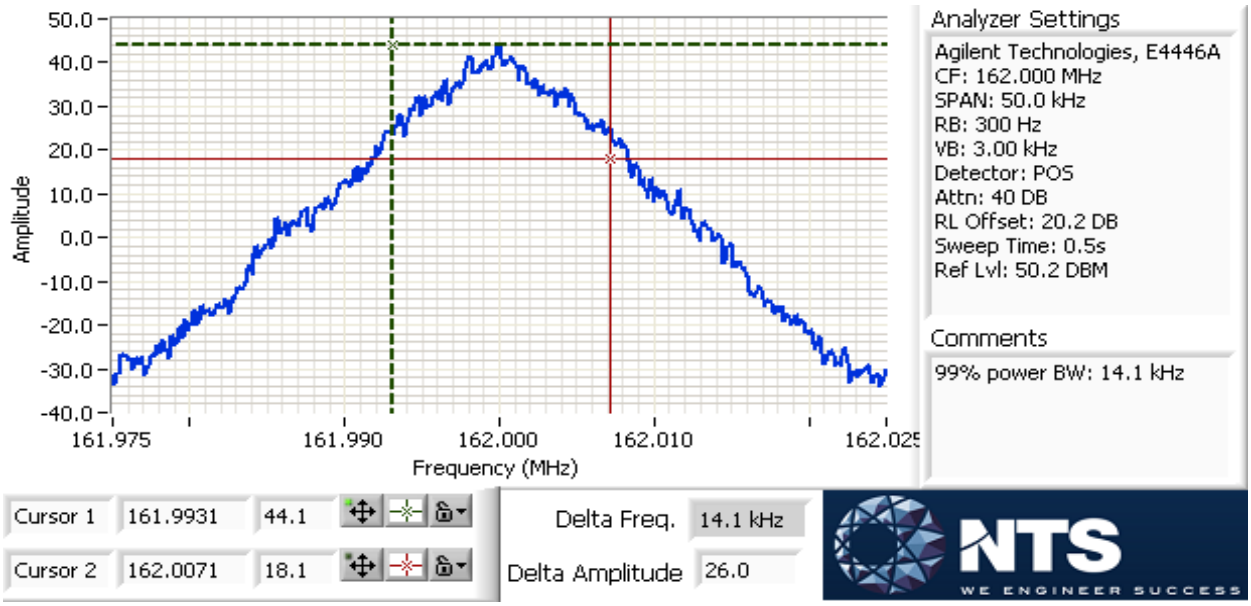
Note 1:	99% bandwidth measured in accordance with RSS GEN, with RB > 1% and < 5% of the OBW and VB > 3xRB

Input BW



Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

Output BW



Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

Run #4: Out of Band Spurious Emissions, Conducted

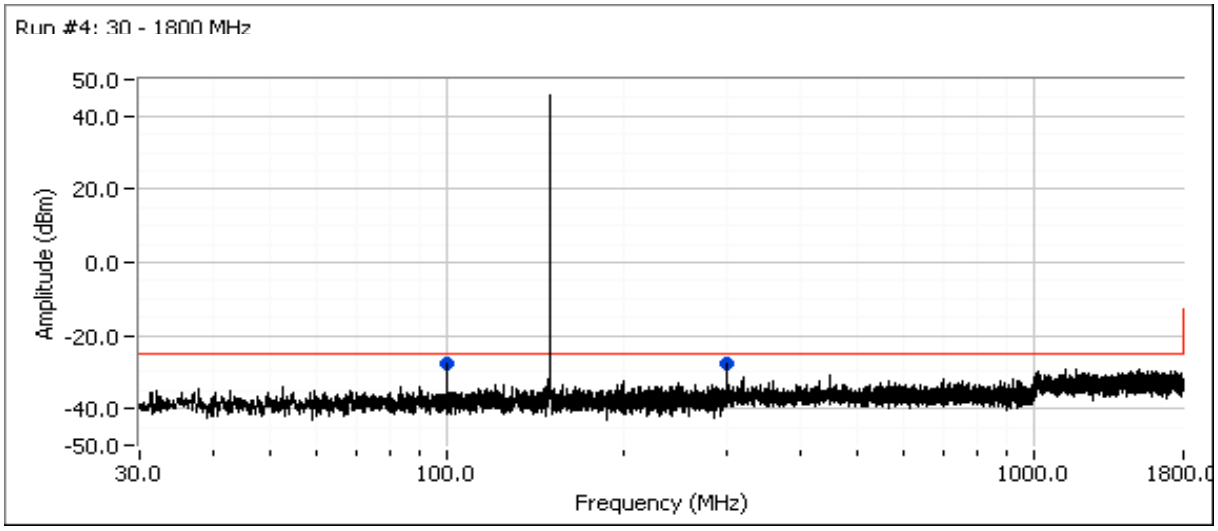
Date of Test: 2/23/2016
Test Engineer: David Bare
Test Location: Fremont EMC Lab #4A

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

Frequency	Level		FCC 90.210		Detector	Comments	Channel
MHz	dBm	Port	Limit	Margin			
324.000	-26.9	RF Port	-25.0	-1.9	Peak		162
134.000	-27.9	RF Port	-25.0	-2.9	Peak		162
100.000	-27.9	RF Port	-25.0	-2.9	Peak		150
300.000	-27.7	RF Port	-25.0	-2.7	Peak		150
130.000	-33.8	RF Port	-25.0	-8.8	Peak		174
348.000	-29.7	RF Port	-25.0	-4.7	Peak		174

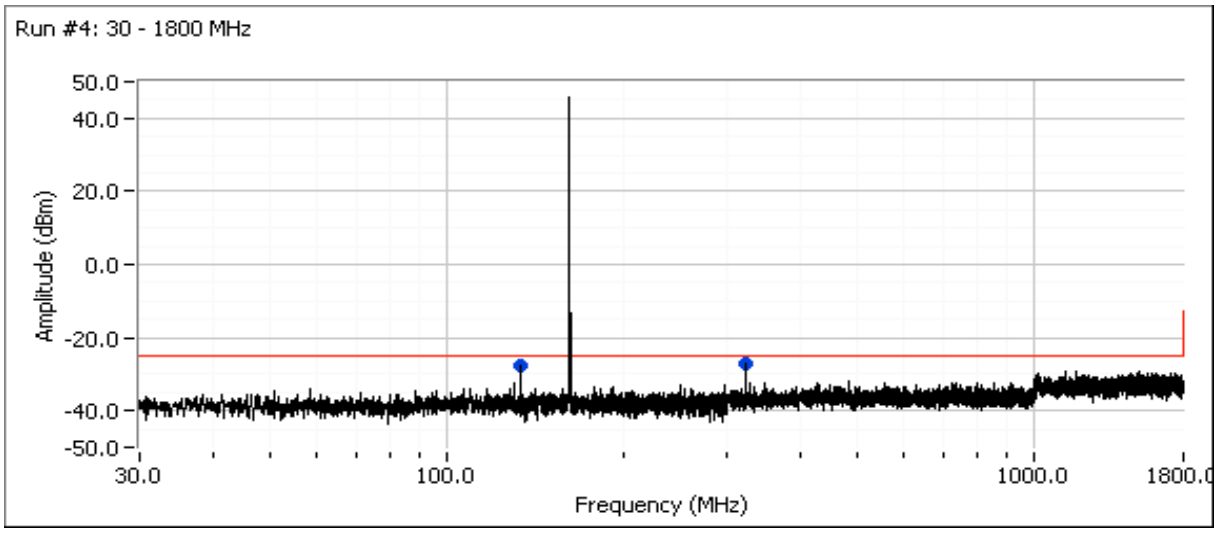
The limit is taken from FCC Part 90 Mask E
Below 1 GHz, RBW = 100 kHz, VBW = 300 kHz, Aboce 1 GHz, RBW = 1 MHz and VBW = 3 MHz

Plots for low channel, power setting(s) = 40W

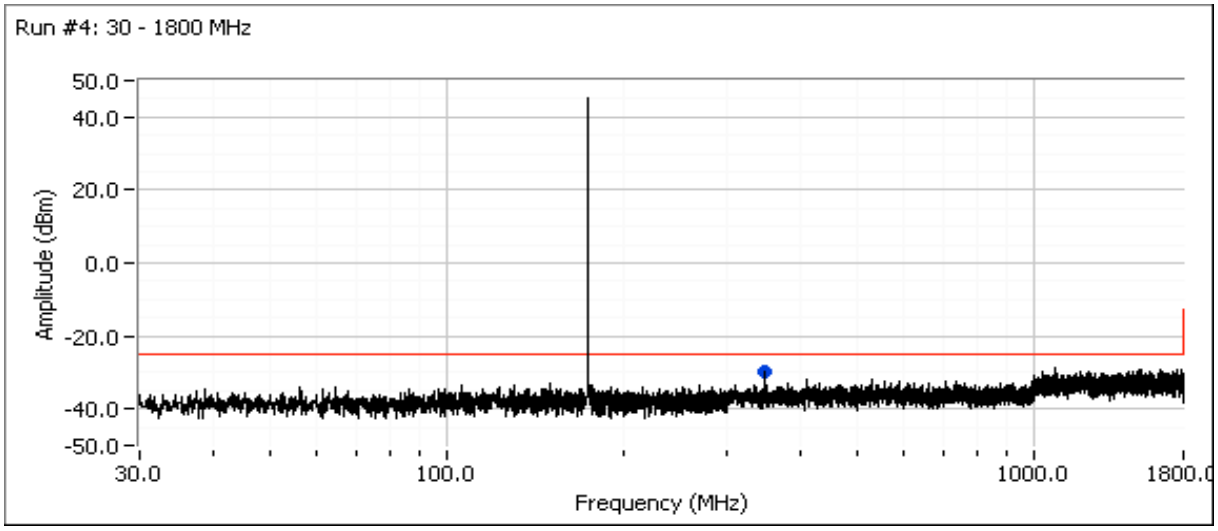


Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

Plots for center channel, power setting(s) = 40W



Plots for high channel, power setting(s) = 40W



Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

Run #5: Out of Band Spurious Emissions, Radiated

Conducted limit (dBm): -25

Approximate field strength limit @ 3m: 70.3

The limit is taken from FCC Part 90.210 Mask d

Run #5a - Preliminary measurements

Date of Test: 02/25/16 Config. Used: 1

Test Engineer: M. Birgani Config Change: -

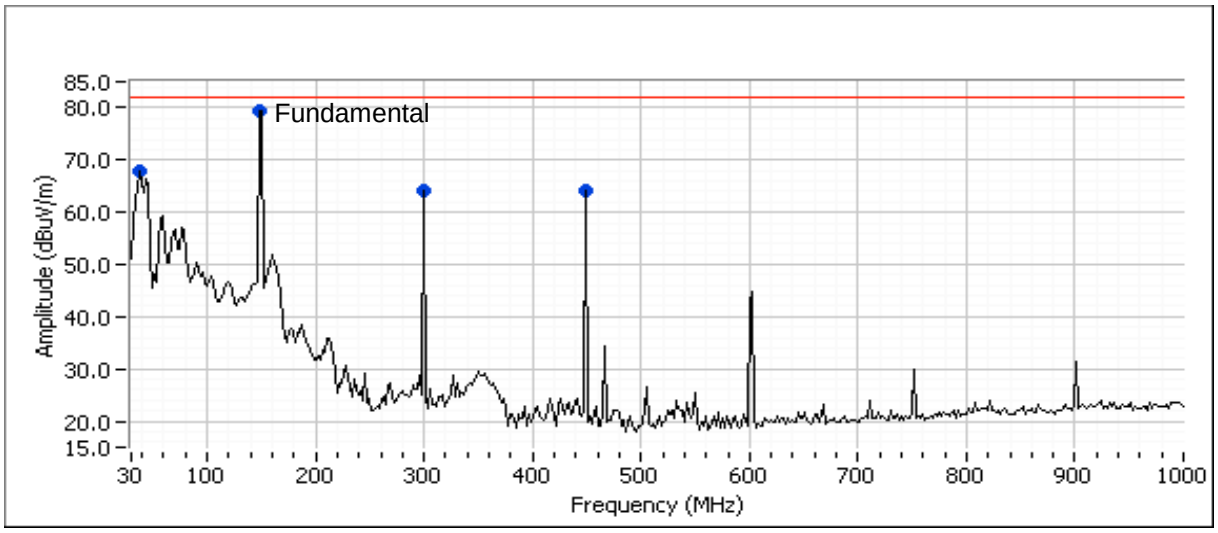
Test Location: Chamber #4 EUT Voltage: 13.8VDC

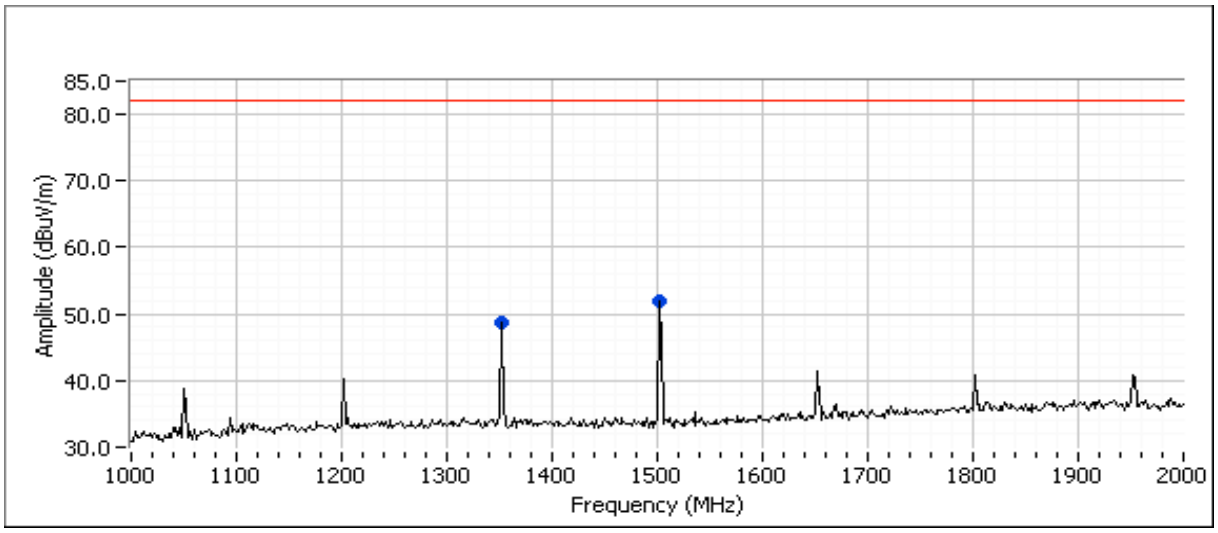
Frequency	Level	Pol	FCC 90.219		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
38.754	67.9	V	70.3	-2.4	Peak	236	1.0		150MHz
150.005	79.6	H	-	-	Peak	81	2.5	Fundamental	150MHz
299.997	64.0	H	70.3	-6.3	Peak	241	1.0		150MHz
450.003	64.0	V	70.3	-6.3	Peak	271	1.0		150MHz
1350.010	48.6	V	70.3	-21.7	Peak	185	1.3		150MHz
1500.030	52.0	V	70.3	-18.3	Peak	188	1.9		150MHz
38.954	67.6	V	70.3	-2.7	Peak	226	1.0		162MHz
162.005	79.4	V	-	-	Peak	291	1.0	Fundamental	162MHz
324.007	67.1	H	70.3	-3.2	Peak	256	1.0		162MHz
485.998	57.7	V	70.3	-12.6	Peak	267	1.0		162MHz
1134.030	42.9	H	70.3	-27.4	Peak	246	1.3		162MHz
1458.020	46.8	V	70.3	-23.5	Peak	181	2.2		162MHz
38.548	67.1	V	70.3	-3.2	Peak	250	1.5		174MHz
174.008	78.8	V	-	-	Peak	336	1.0	Fundamental	174MHz
348.012	62.7	H	70.3	-7.6	Peak	256	1.0		174MHz
522.011	54.0	V	70.3	-16.3	Peak	261	1.0		174MHz
1218.000	42.6	V	70.3	-27.7	Peak	173	1.6		174MHz

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:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

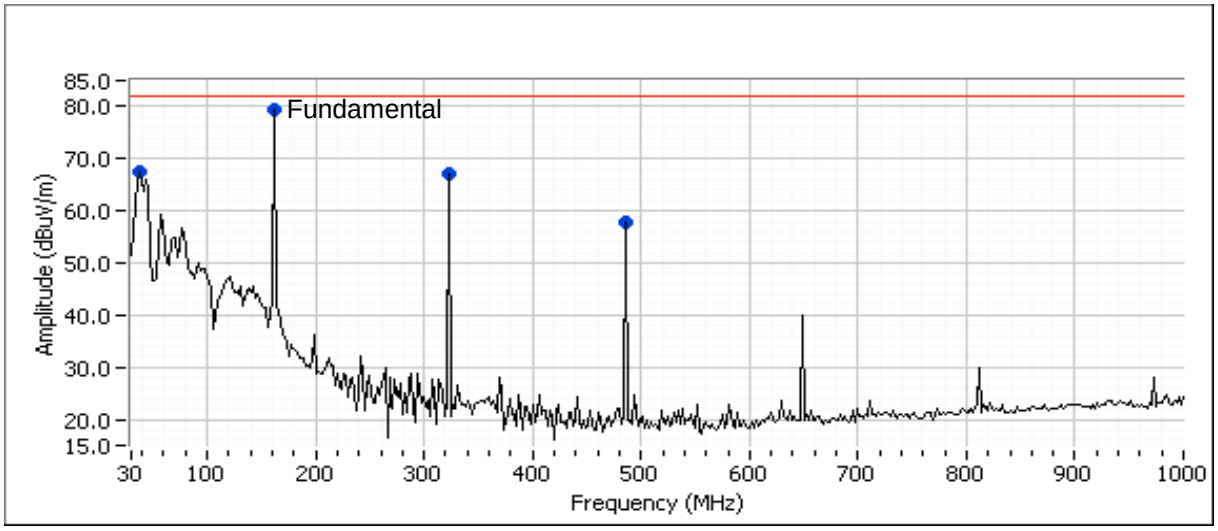
Plots for low channel at 150MHz, power setting(s) = 23dBm

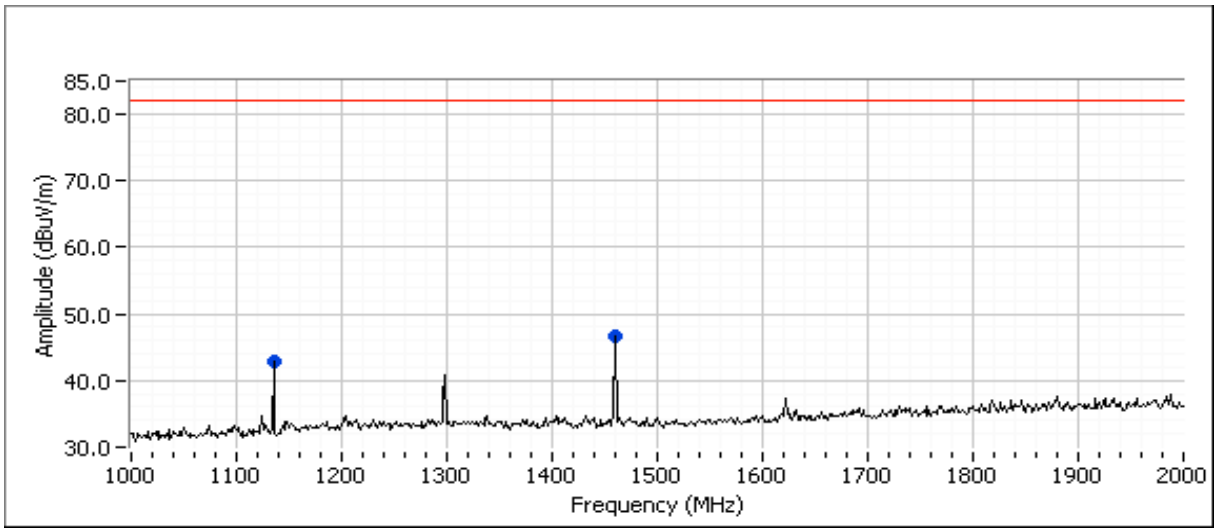




Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

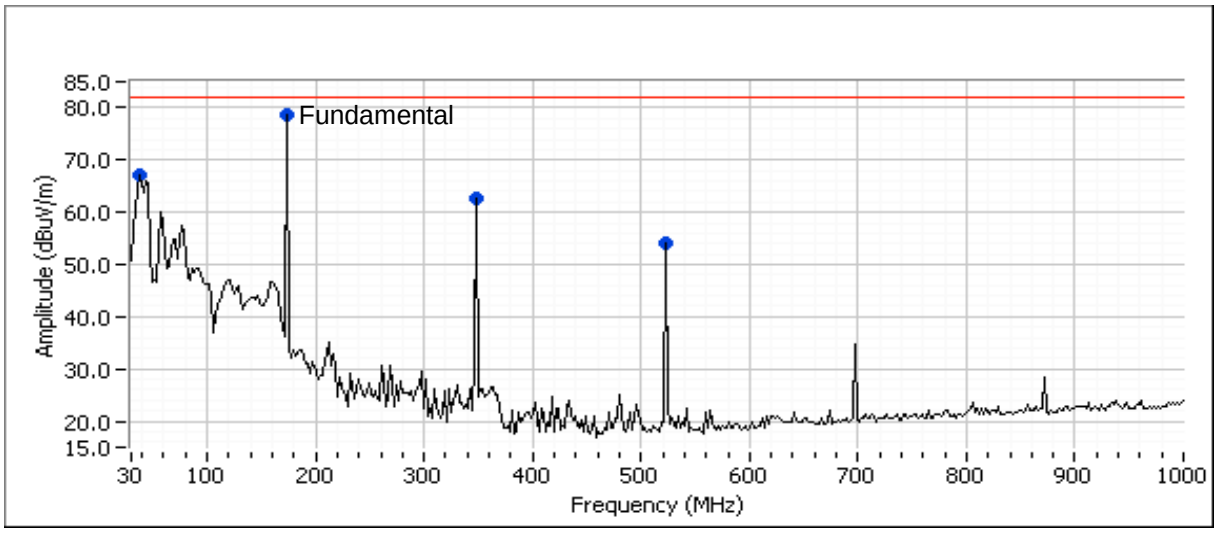
Plots for center channel at 162MHz, power setting(s) = 23dBm

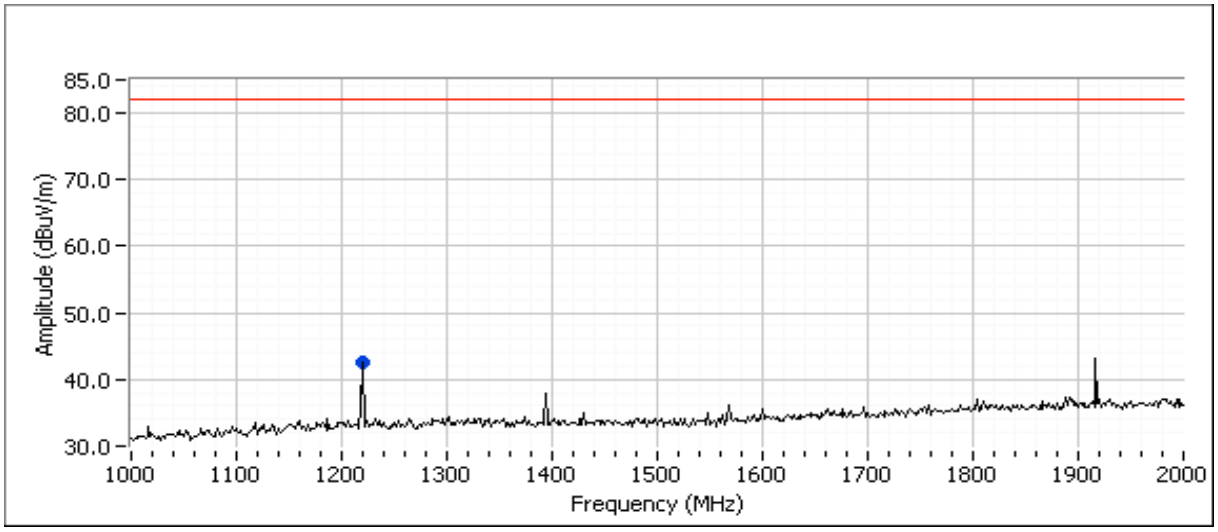




Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

Plots for high channel at 174MHz, power setting(s) = 23dBm





Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

Run #5b: - EUT Field Strength Measurements and Substitution Measurements

Date of Test: 2/25/2016 & 3/11/16 Config. Used: 1

Test Engineer: M. Birgani & David Bare Config Change: -

Test Location: Chamber #4 EUT Voltage: 13.8VDC

EUT Field Strength

Frequency	Level	Pol	FCC 90.219		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
38.754	70.9	V	70.3	0.6	PK	236	1.0	PK	150MHz
150.005	84.1	H	-	-	PK	81	2.5	PK - Fundmental	150MHz
299.997	63.8	H	70.3	-6.5	PK	240	1.0	PK	150MHz
450.003	63.4	V	70.3	-6.9	PK	270	1.0	PK	150MHz
1350.000	48.4	V	70.3	-21.9	PK	185	1.3	RB 1MHz;VB 3MHz;Pk	150MHz
1500.070	52.7	V	70.3	-17.6	PK	188	1.9	RB 1MHz;VB 3MHz;Pk	150MHz
38.954	70.0	V	70.3	-0.3	PK	226	1.0	PK	162MHz
162.005	82.2	V	-	-	PK	289	1.0	PK - Fundmental	162MHz
324.007	66.6	H	70.3	-3.7	PK	256	1.0	PK	162MHz
485.998	59.5	V	70.3	-10.8	PK	268	1.0	PK	162MHz
1133.940	44.6	H	70.3	-25.7	PK	245	1.3	RB 1MHz;VB 3MHz;Pk	162MHz
1458.060	49.7	V	70.3	-20.6	PK	181	2.2	RB 1MHz;VB 3MHz;Pk	162MHz
348.012	72.1	H	70.3	1.8	PK	255	1.0	PK	174MHz
1218.140	44.3	V	70.3	-26.0	PK	172	1.6	RB 1MHz;VB 3MHz;Pk	174MHz

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.

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-1	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90	Class:	N/A

Substitution measurements

Horizontal

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
300.000	-30.0	2.2	68.0	95.8	63.8	-32.0	-34.2		-25.0	-9.2
324.000	-30.0	2.2	67.8	95.6	66.6	-29.0	-31.2		-25.0	-6.2
348.000	-30.0	2.2	67.9	95.7	72.1	-23.6	-25.8		-25.0	-0.8

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
38.754	-30.0	2.2	67.0	94.8	70.9	-23.9	-26.1		-25.0	-1.1
450.000	-30.0	2.2	66.5	94.3	63.4	-30.9	-33.1		-25.0	-8.1

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.

End of Report

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