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Radio Test Report

FCC Part 90
(896-901, 929-930 and 935-940 MHz)

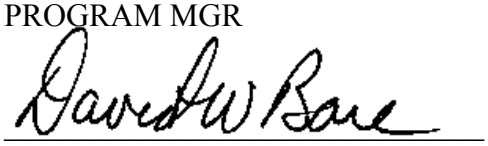
Model: GPA-9

FCC ID:	E5MDS-GPA-9
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:	May 8, 2017
REISSUE DATE:	May 16, 2017
FINAL TEST DATES:	November 29 and 30, 2016 and April 17 and 19, 2017
TOTAL NUMBER OF PAGES:	41

Testing Cert #0214.26

VALIDATING SIGNATORIES

PROGRAM MGR



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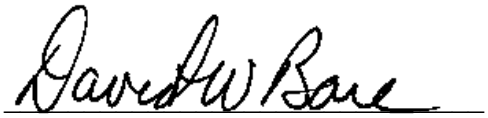

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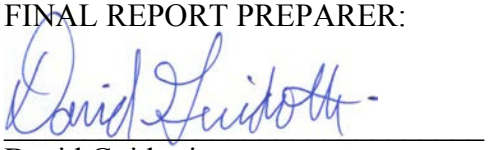

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REVISION HISTORY

Rev#	Date	Comments	Modified By
0	May 8, 2017	First release	
1	May 16, 2017	Revised to replace FCC part 24 data with part 90 data	David Bare

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SCOPE

Tests have been performed on the GE MDS LLC model GPA-9, 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 Innovation Science and Economic Development 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 June 2010
FCC KDB 971168 Licensed Digital Transmitters
FCC KDB 935210 Signal Boosters

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Innovation Science and Economic Development 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-9 and therefore apply only to the tested samples. The samples were 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 samples of GE MDS LLC model GPA-9 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

FCC	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics				
§2.1033 (c) (5) §90.35	Frequency range(s)	896-901, 929-930 and 935-940 MHz	896-901, 929-930 and 935-940 MHz	Complied
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 §90.205	RF power output at the antenna terminals	42.7 W (46.3 dBm)	-	-
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 §90.205 §90.635 §90.494	ERP	53.4 dBm	60dBm	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	6.94 kHz in, 6.94 kHz out	Same input and output	Complied
§90.219(e)(2)	Noise Figure	-0.6 dB	<= 9 dB	Complied
Transmitter spurious emissions				
§2.1051 §2.1057	At the antenna terminals	all signals were below the limit	-25 dBm	Complied
§2.1053 §2.1057	Field strength	-40.9 dBm @ 2820.0 MHz (-15.9 dB)	-25 dBm	Complied
Other details				
-	Amplifier Gain and Passband	23.3 dBm 490.4 MHz	< 1.0 dB above nominal	Complied
§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	13.8 V,8 A	Information only	-
-	Antenna Gain	Maximum 8.5 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-9 is a single channel amplifier that is designed to increase the range of radio equipment operating in the 896-940 MHz bands operating under FCC Part 90 Rules. 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 13.8 VDC, 8 Amps.

The samples were received on September 29, 2016 and April 14, 2017 and tested on November 29 and 30, 2016 and April 17 and 19, 2017. The following samples were used for testing:

Company	Model	Description	Serial Number	FCC ID
GE MDS LLC	GPA-9	Amplifier	None	E5MDS-GPA-9
GE MDS LLC	GPA-9	Amplifier	9898989	E5MDS-GPA-9

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 10.1 cm wide by 11.3 cm deep by 4 cm high.

MODIFICATIONS

The EUT required the following modifications in order to comply with the emission specifications.

Mod. #	Test	Date	Modification
1	RE	4/19/2017	Changed to PC mounted N connector to eliminate cable loss Changed to use filtered terminal block for DC power entry Changed metalwork to improve cover shielding and mounting PCB size and layout altered slightly for above changes

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
GE MDS LLC	SD9	Industrial Radio	2764450	E5MDS-SD9-1
GE MDS LLC	SD9	Industrial Radio	2764906	E5MDS-SD9-1
HP	6024A	Power Supply	2430A-03013	-
Agilent	E3610A	Power Supply	MY40011740	-
Dell	Latitude D620	Laptop	6G1HLC1	-

No support equipment was used during testing.

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Input	SD9 radio	Coax	Shielded	1
Output	Test Receiver or Load	Coax	Shielded	1
Power	Power Supply	Two wire	Unshielded	2

Additional on Support Equipment

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
SD9 Serial	Laptop	Multiwire	Shielded	2
SD9 Power	Power Supply	Two wire	Unshielded	2

EUT OPERATION

During testing, the EUT presented with a normal modulated transmission signal at various levels from the GE MDS SD9 radio with which the amplifier is intended to be used. The output was terminated into a test receiver or a load as needed for testing.

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 Innovation Science and Economic Development Canada.

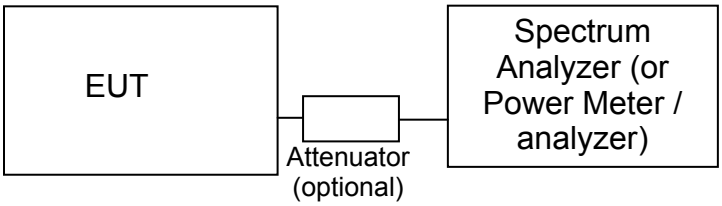
Site	Designation / Registration Numbers		Location
	FCC	Canada	
Chamber 7	US0027	IC 2845B-7	41039 Boyce Road Fremont, CA 94538-2435

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 and TIA-603D 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 for emissions below 1 GHz and 150 cm above the floor for emissions above 1 GHz. 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

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Radio Antenna Port (Power and Spurious Emissions), 29 and 30-Nov-16					
Rohde & Schwarz	Signal Analyzer 20 Hz - 26.5 GHz	FSQ26	2327	6/17/2016	6/17/2017
Radio Antenna Port (Power and Spurious Emissions), 30-Nov-16					
Rohde & Schwarz	Signal Analyzer 20 Hz - 26.5 GHz	FSQ26	2327	6/17/2016	6/17/2017
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/6/2016	5/6/2017
Radiated Emissions, 30 - 1,000 MHz, 30-Nov-16					
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1549	6/2/2015	6/2/2017
Com-Power	Preamplifier, 30-1000 MHz	PA-103	1632	6/6/2016	6/6/2017
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	2/20/2016	2/20/2017
Radiated Emissions, 1,000 - 10,000 MHz, 17-Apr-17					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	1/17/2017	1/17/2018
Hewlett Packard	High Pass filter, 1.5 GHz (Purple System)	P/N 84300-80037	1769	9/9/2016	9/9/2017
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/1/2017	3/1/2018
Radiated Emissions, 1,000 - 10,000 MHz, 19-Apr-17					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	1/17/2017	1/17/2018
Hewlett Packard	High Pass filter, 1.5 GHz (Blu System)	P/N 84300-80037 (84125C)	1389	9/9/2016	9/9/2017
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/1/2017	3/1/2018
Substitution Measurements, 19-Apr-17					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
EMCO	Antenna, Horn, 1-18GHz	3115	868	6/30/2016	6/30/2018
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	1/17/2017	1/17/2018
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1290	12/12/2016	12/12/2017
Anritsu	Anritsu 68347C Signal Generator, 10MHz-20GHz	68347C	1785	3/10/2017	3/10/2018
Rohde & Schwarz	Power Sensor, 1 nW-20 mW, 10 MHz-18 GHz, 50ohms	NRV-Z1	2114	10/27/2016	10/27/2017
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/1/2017	3/1/2018

Appendix B Test Data

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Client:	GE MDS LLC	Job Number:	JD99150
Product	GPA-9	T-Log Number:	T99463
System Configuration:		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	
Emissions Standard(s):	FCC part 90 & RSS-131	Class:	
Immunity Standard(s):		Environment:	Radio

EMC Test Data

For The

GE MDS LLC

Product

GPA-9

Date of Last Test: 4/19/2017

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

FCC Part 90.219

Power, Occupied Bandwidth 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: 18-20 °C

Rel. Humidity: 35-40 %

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	6.94 kHz in, 6.94 kHz out
4			Spurious Emissions (conducted)	-25 dBm	Pass	All emissions more than 5 dB below the limit
5			Spurious emissions (radiated)	-25 dBm ERP	Pass	-40.3 dBm @ 2879.9 MHz (-15.3 dB)
6			Noise Figure	Less than 9 dB	Pass	-0.6 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.

Use FCC KDB 935210 D05 for measurement procedures

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Run #1: Output Power

Date of Test: 11/29/2016 & 11/30/2016
Test Engineer: Mehran Birgani & David Bare
Test Location: Fremont EMC Lab #4b

Config. Used: Conducted
Config Change: -
EUT Voltage: 13.8VDC

Cable Loss: 0.1 dB
Cable ID(s): EL566

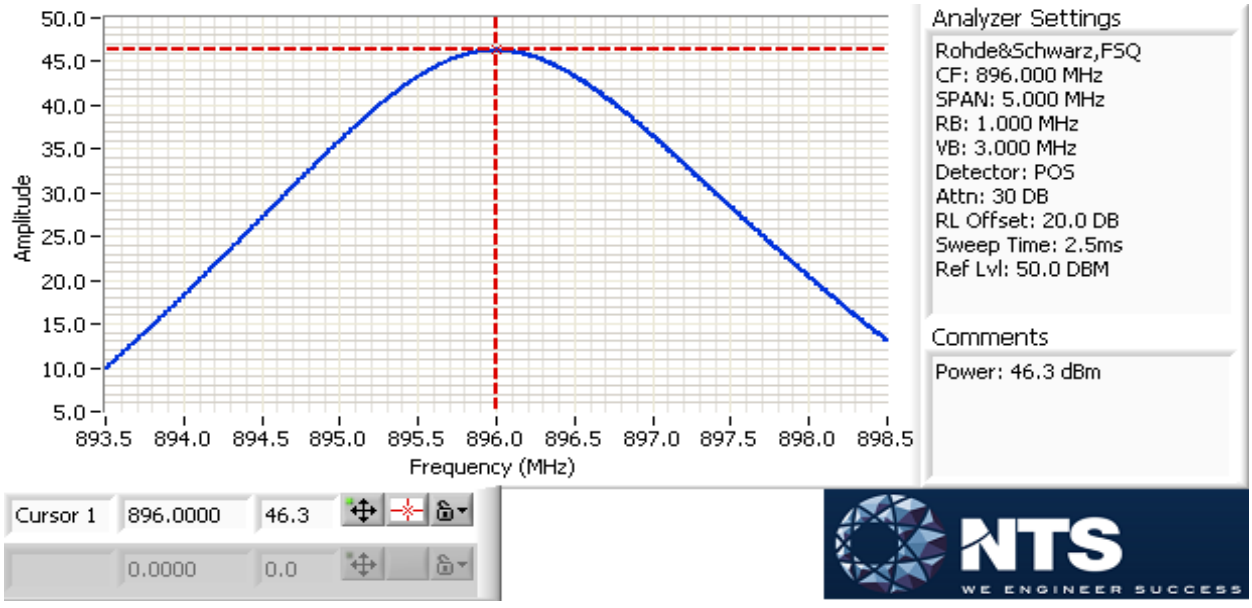
Attenuator: 19.9 dB
Attenuator IDs: 1878

Total Loss: 20.0 dB

FCC part 2 bands for Part 90 operation (896-901, 902-928, 928-929, 929-930, 935-940)
Modem 9600M

Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power W	Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power W
26	896.000	46.3	42.7	26	929.000	46.1	40.7
26	901.000	46.2	41.7	26	940.000	46.1	40.7

Note 1:	Output power measured Analyzer set to RB 1MHz; VB 3 MHz and Peak detector and Max hold.
Note 2:	Power setting - the software power setting used on the SD9 driver radio during testing, included for reference only.



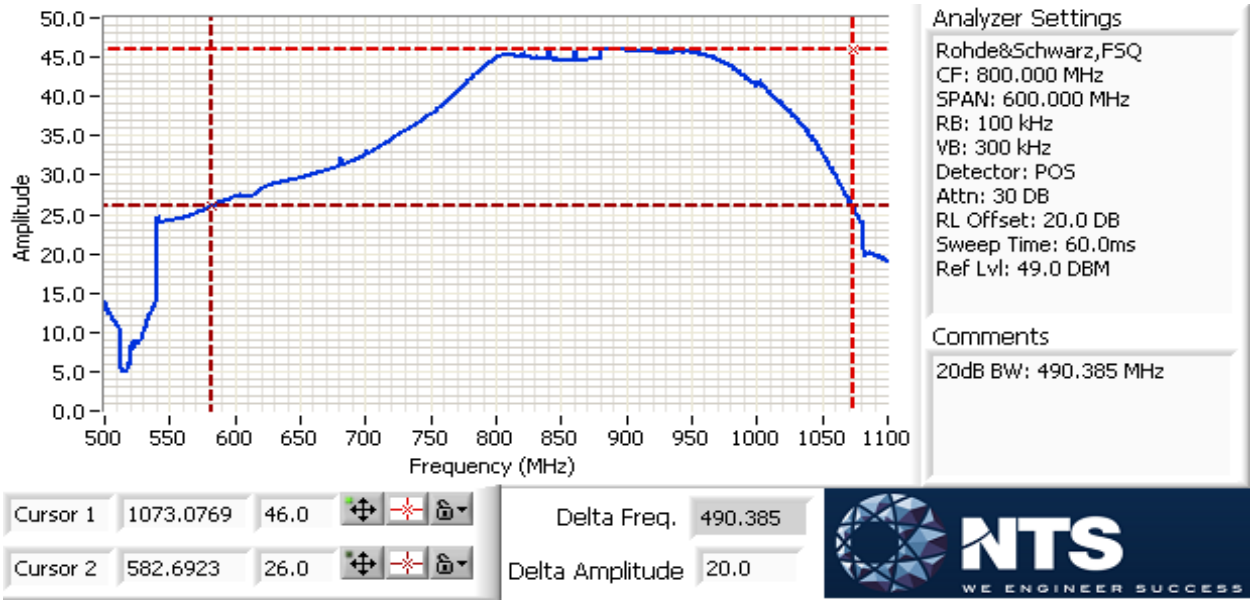
Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

AGC threshold:

input	output	Gain	
22.0 dBm	42.5 dBm	20.5 dB	
23.0 dBm	46.3 dBm	23.3 dB	Minimum designed input amplitude
24.0 dBm	46.3 dBm	22.3 dB	
27.0 dBm	46.3 dBm	19.3 dB	Maximum designed input amplitude

Below 22 dBm input, no output is produced. The AGC threshold is 23 dBm as further increases in input level resulted in no change in output power. Tests were therefore performed with the input at 26 dBm to obtain maximum output power.

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.



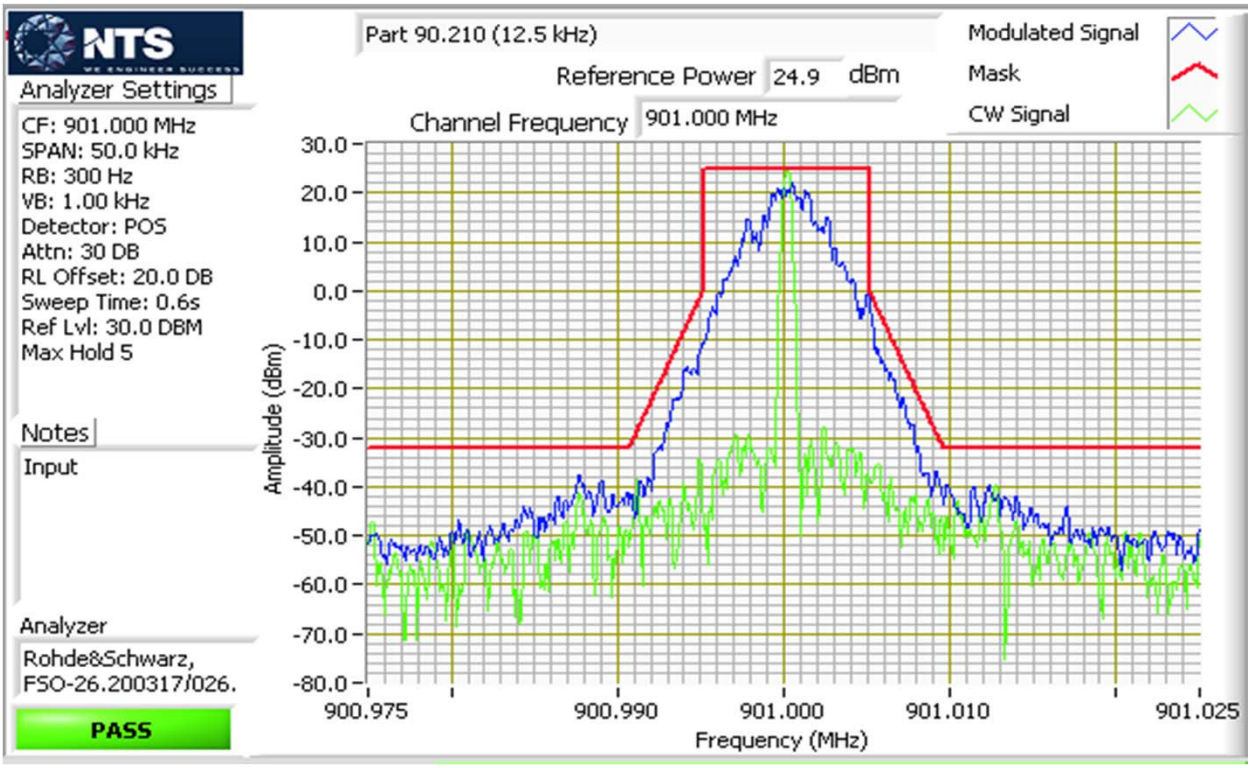
Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Run #2: Spectral Mask, FCC Part 90 Mask (Modem 9600M for 12.5kHz)

Date of Test: 09/29/16
Test Engineer: Mehran Birgani
Test Location: Fremont EMC Lab #4b

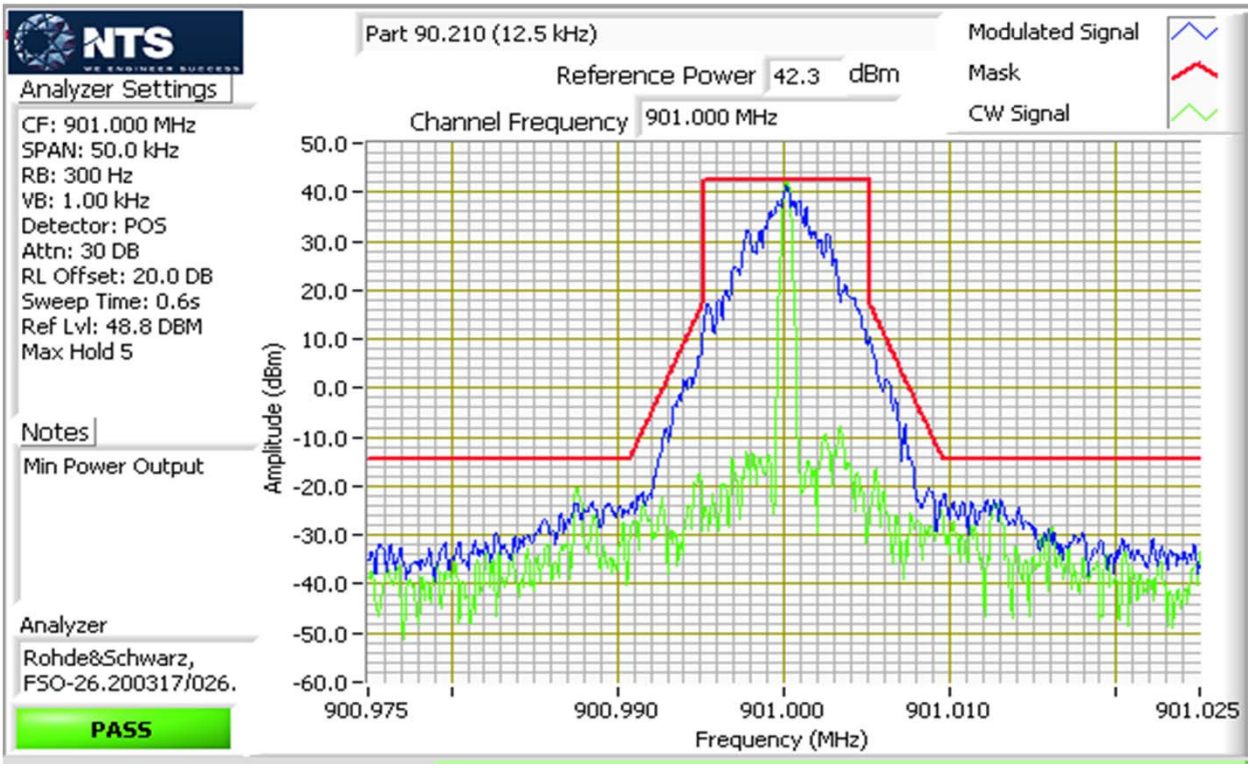
Config. Used: Conducted
Config Change: -
EUT Voltage: 13.8VDC

Input



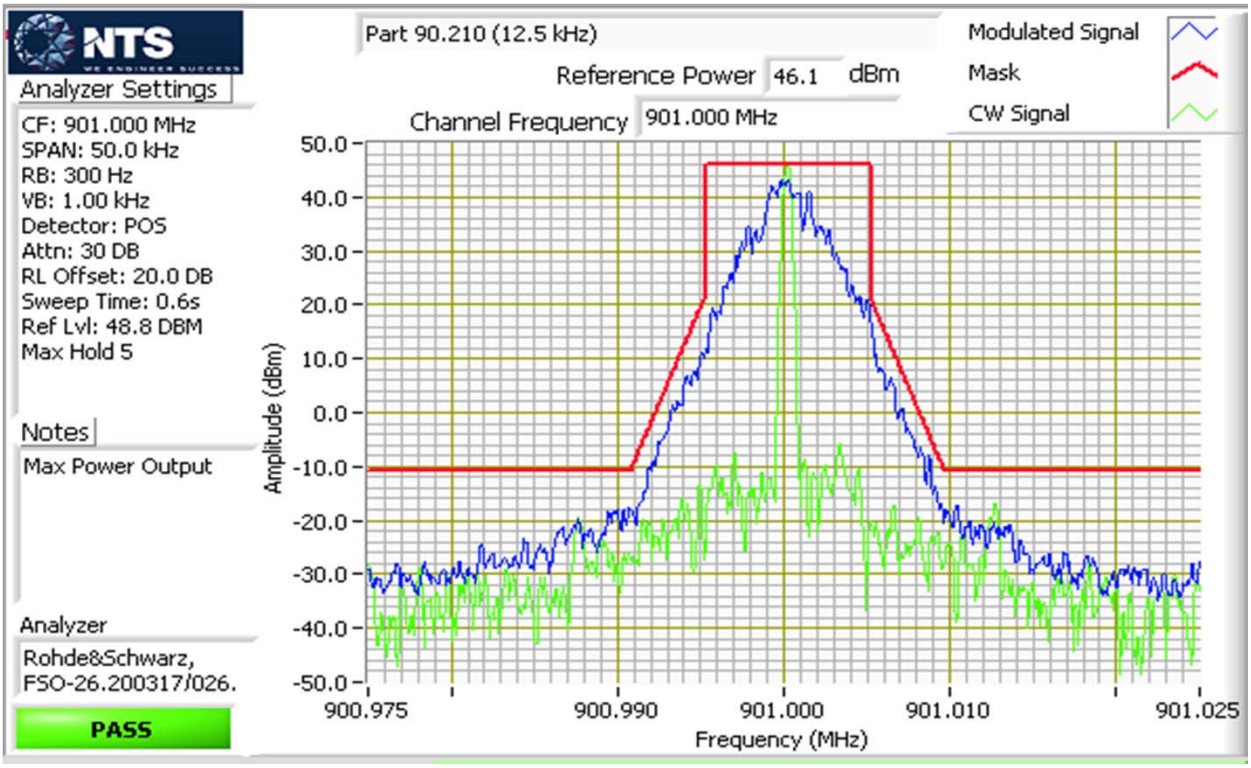
Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Output at lowest power (42.5 dBm)



Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Output at maximum power



Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Run #3: Signal Bandwidth

Date of Test: 09/29/16 — Config. Used: Conducted
Test Engineer: Mehran Birgani — Config Change: None
Test Location: Fremont EMC Lab #4a — EUT Voltage: 13.8VDC

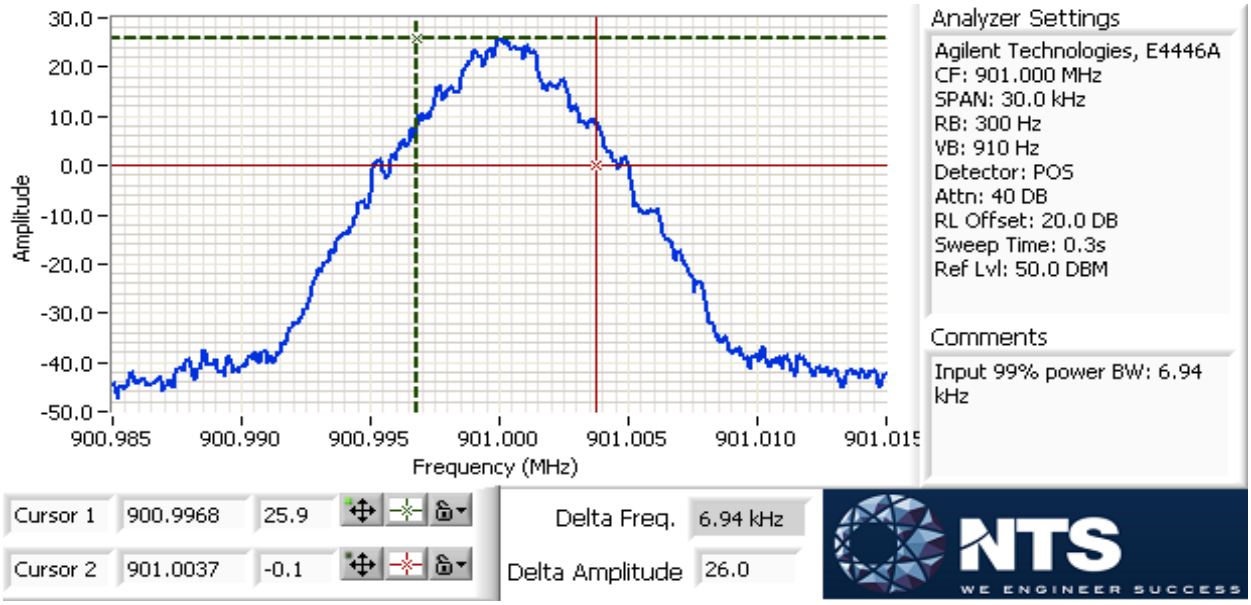
Input

Power Setting	Frequency (MHz)	Resolution Bandwidth	Bandwidth (kHz)	99%
27	901	300Hz		6.94

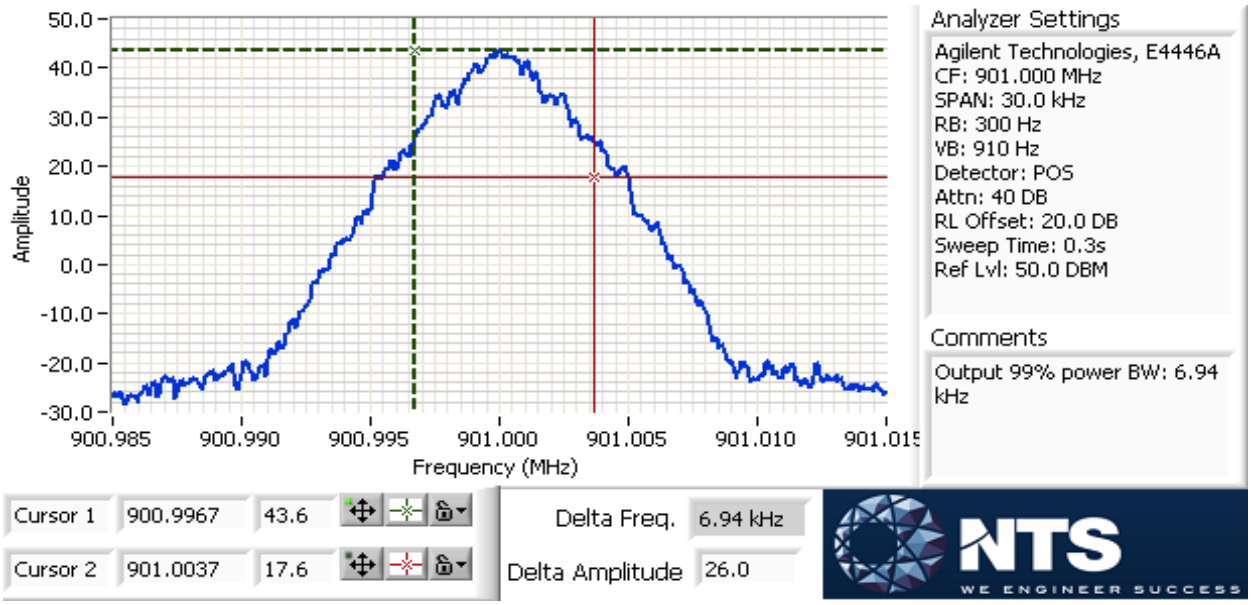
Output

Power Setting	Frequency (MHz)	Resolution Bandwidth	Bandwidth (kHz)	99%
Full	940	300Hz		6.94

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



Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A



Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

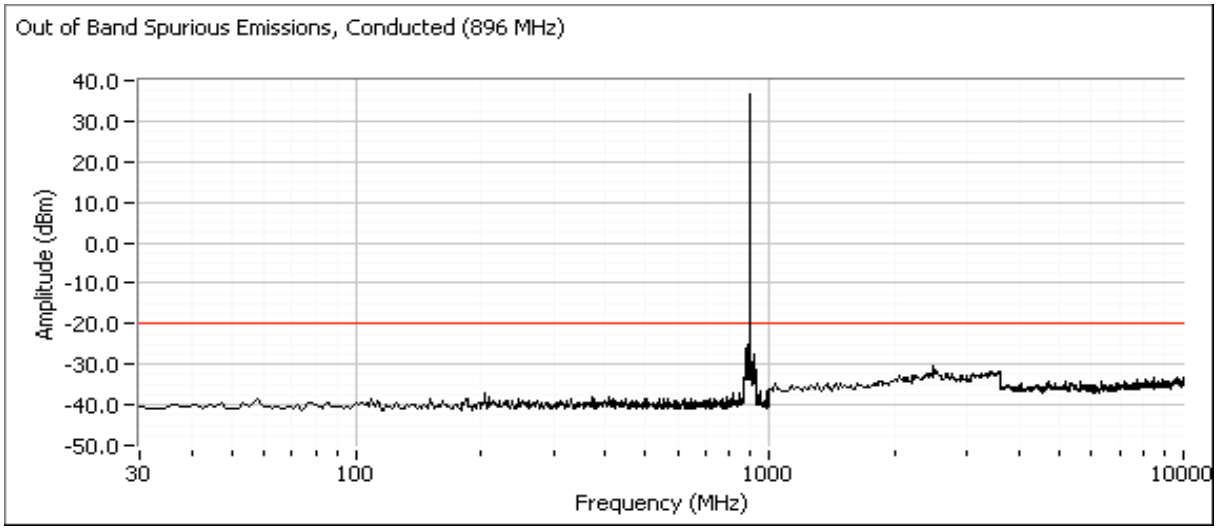
Run #4: Out of Band Spurious Emissions, Conducted

Date of Test: 11/30/16 Config. Used: Conducted
Test Engineer: Mehran Birgani Config Change: None
Test Location: Fremont EMC Lab #4a EUT Voltage: 13.8 VDC

Frequency (MHz)	Limit	Result
896	-25	Pass
901	-25	Pass
929	-25	Pass
940	-25	Pass

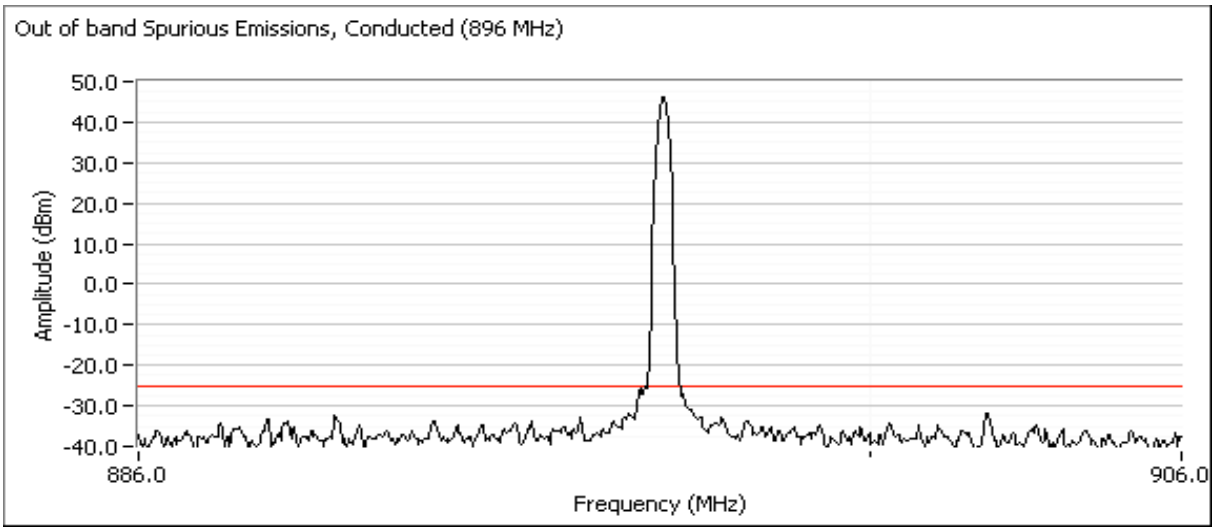
The limit is taken from FCC Part 90 (The limit is -25dBm based on the worse case of Part 90 mask K that may be used). SA set to RBW=100 kHz, VBW =300kHz for emissions < 1 GHz and RBW=1 MHz, VBW=3MHz for emissions > 1 GHz.

Plots for 896 MHz, power setting = Max



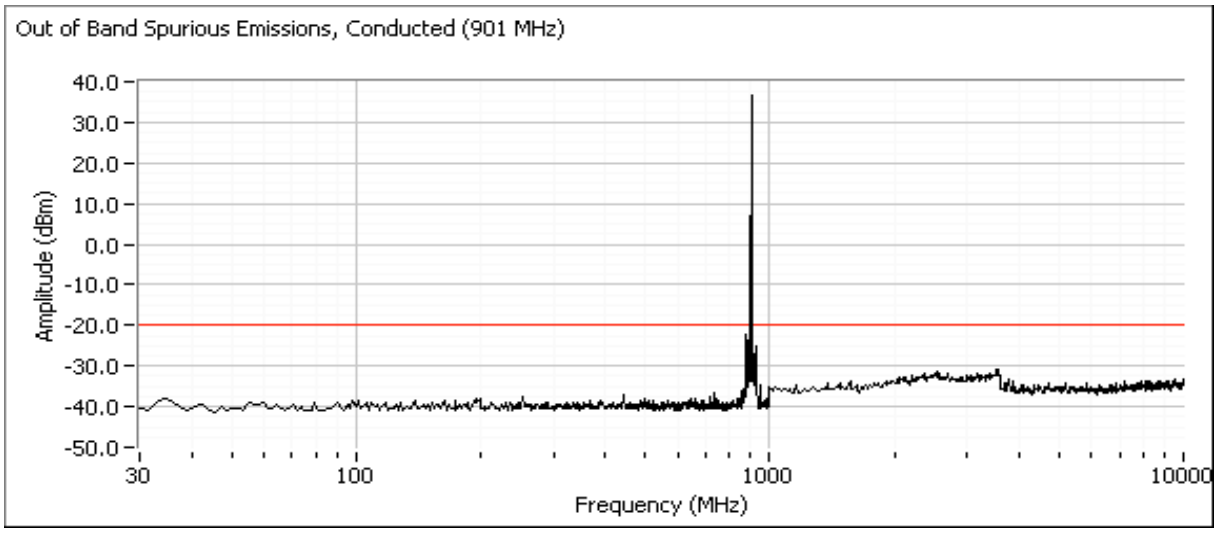
Note: Limit on graph is -20 dBm

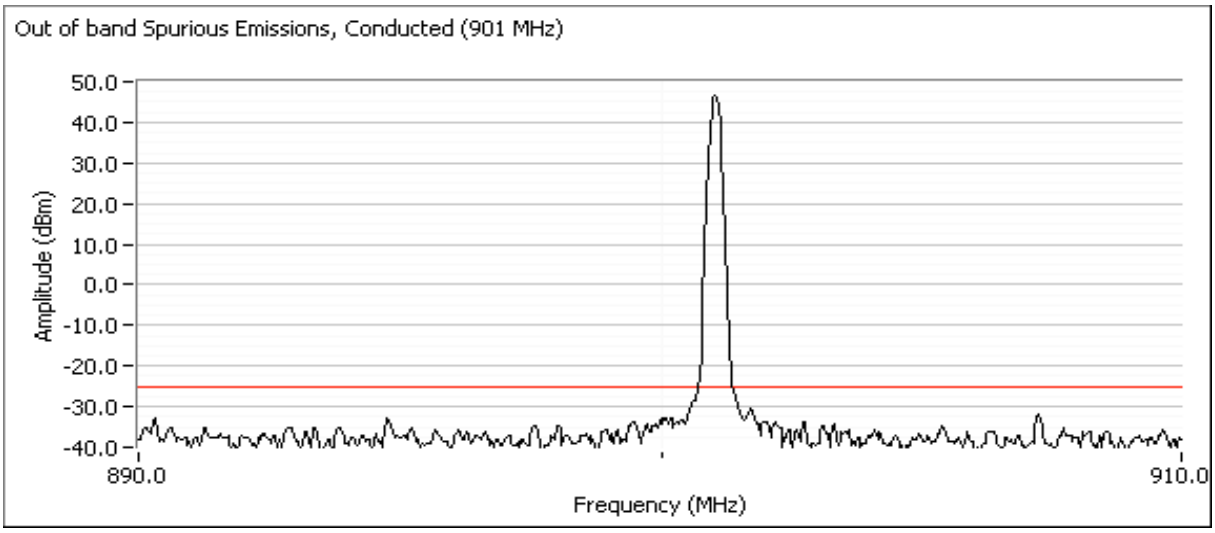
Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A



Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

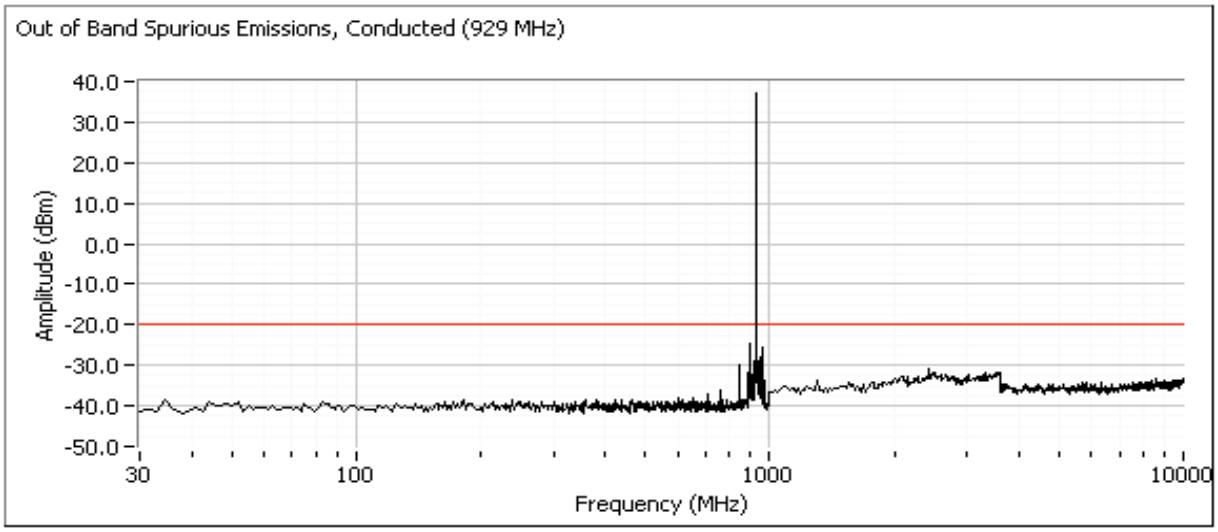
Plots for 901 MHz, power setting = Max

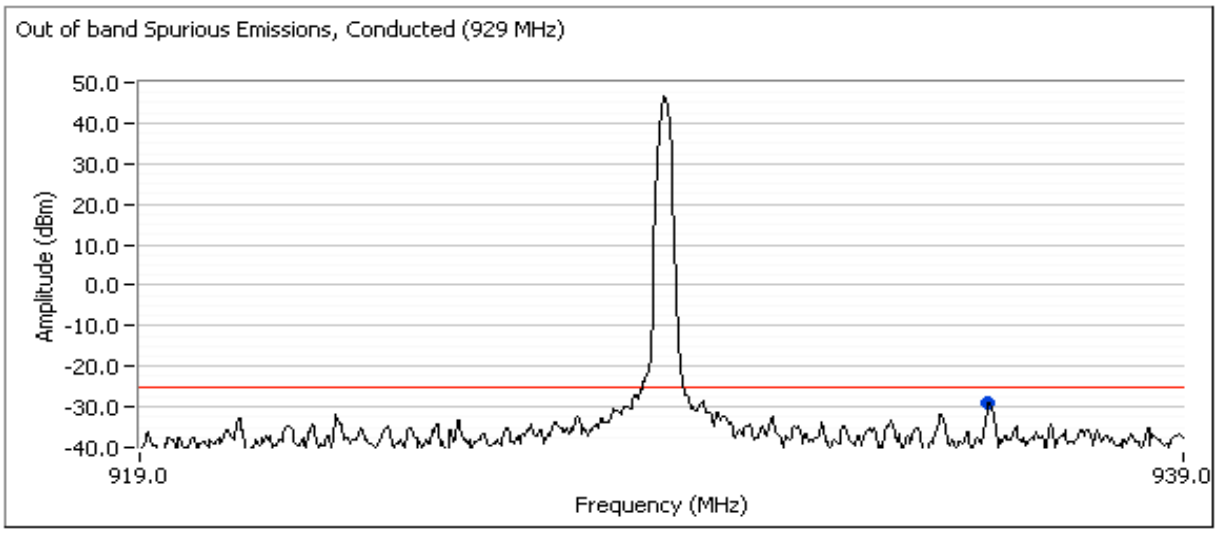




Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Plots for 929 MHz, power setting = Max

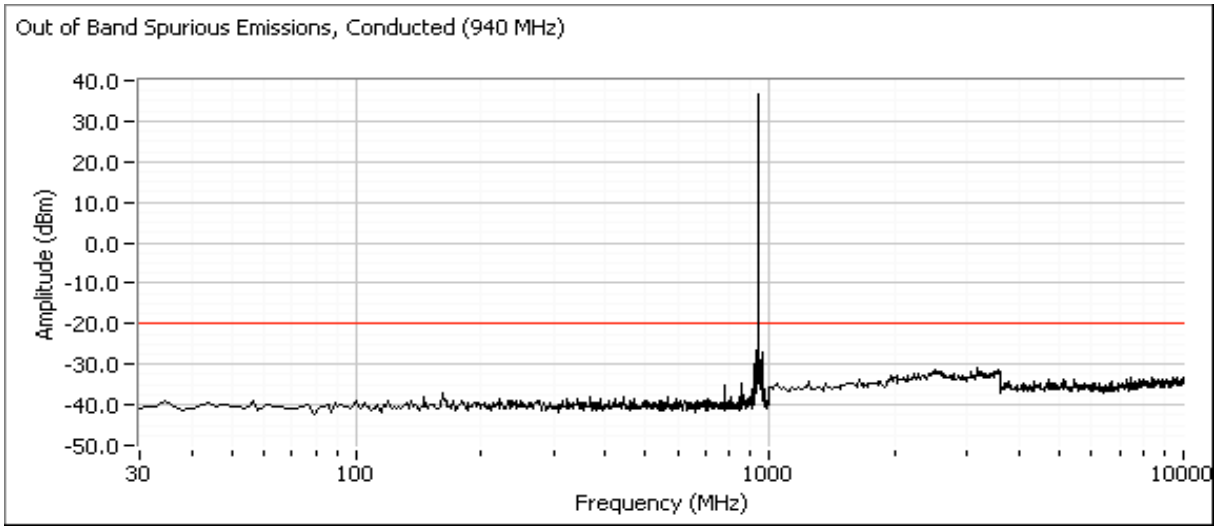


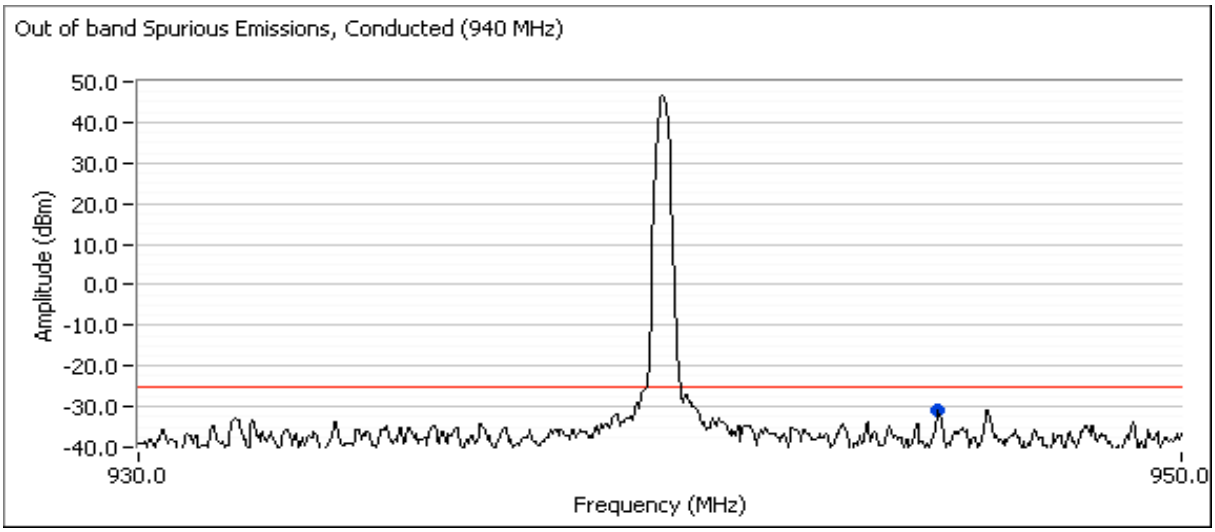


Frequency MHz	Level dBm	Port RF	FCC part 90 Limit	FCC part 90 Margin	Detector	Comments
935.237	-28.9	RF Port	-25.0	-3.9	Peak	

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Plots for 940 MHz, power setting = Max





Frequency MHz	Level dBm	Port RF	FCC part 90 Limit	FCC part 90 Margin	Detector	Comments
945.300	-30.7	RF Port	-25.0	-5.7	Peak	

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Run #5: Out of Band Spurious Emissions, Radiated

Date of Test: 11/30/2016 & 4/19/2017
Test Engineer: M. Birgani and D. Bare
Test Location: Fremont EMC Chamber 7

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

Conducted limit (dBm): -25
Approximate field strength limit @ 3m: 70.3

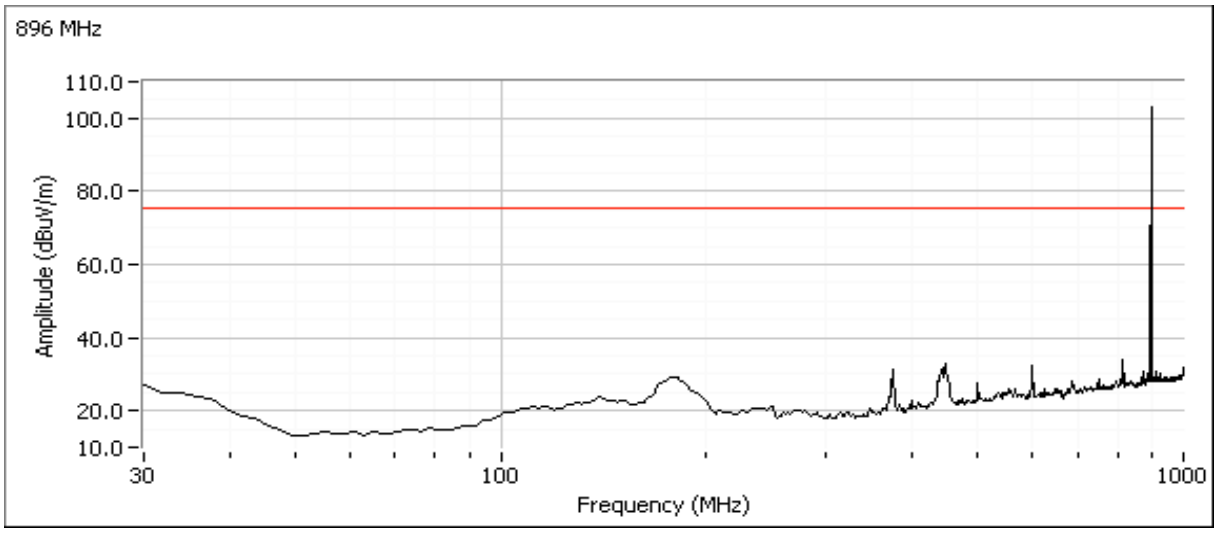
The limit is taken from FCC Parts 90, 24 or 101 (The limit is -25dBm based on the worse case of Part 90 mask K that may be used)

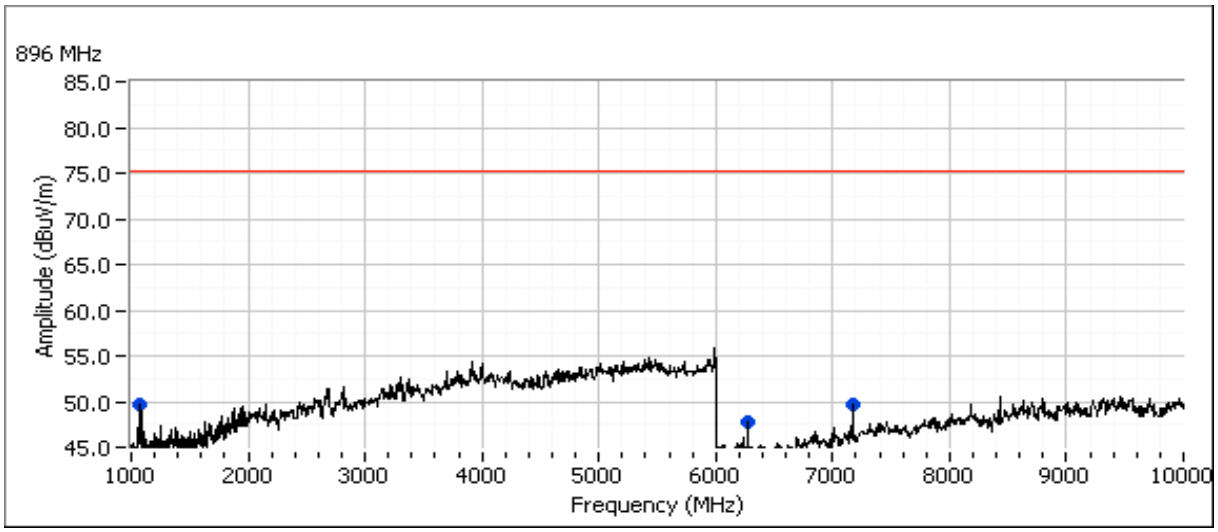
Frequency	Level	Pol	FCC Part 90		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		MHz
1078.330	49.6	V	70.3	-20.7	PK	74	1.0	RB 1 MHz;VB 3 MHz;Pe	896
6272.030	47.8	V	70.3	-22.5	PK	127	1.0	RB 1 MHz;VB 3 MHz;Pe	896
7168.330	49.7	H	70.3	-20.6	PK	215	1.0	RB 1 MHz;VB 3 MHz;Pe	896
1061.670	56.2	V	70.3	-14.1	PK	214	1.0	RB 1 MHz;VB 3 MHz;Pe	901
6306.970	48.9	V	70.3	-21.4	PK	128	1.0	RB 1 MHz;VB 3 MHz;Pe	901
7207.970	49.3	V	70.3	-21.0	PK	294	2.0	RB 1 MHz;VB 3 MHz;Pe	901
9009.950	51.3	V	70.3	-19.0	PK	170	1.5	RB 1 MHz;VB 3 MHz;Pe	901
1060.900	54.3	H	70.3	-16.0	PK	294	1.00	RB 1 MHz, VB 3 MHz	928
7424.100	54.2	V	70.3	-16.1	PK	242	1.00	RB 1 MHz, VB 3 MHz	928
1063.330	55.7	H	70.3	-14.6	PK	152	1.00	RB 1 MHz, VB 3 MHz	940
2820.000	57.0	V	70.3	-13.3	PK	173	1.50	RB 1 MHz, VB 3 MHz	940
6580.000	49.4	V	70.3	-20.9	PK	235	1.00	RB 1 MHz, VB 3 MHz	940
7520.070	55.5	V	70.3	-14.8	PK	219	1.00	RB 1 MHz, VB 3 MHz	940
9406.670	53.5	V	70.3	-16.8	PK	104	1.00	RB 1 MHz, VB 3 MHz	940

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

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Plots for 896 MHz, power setting = 26

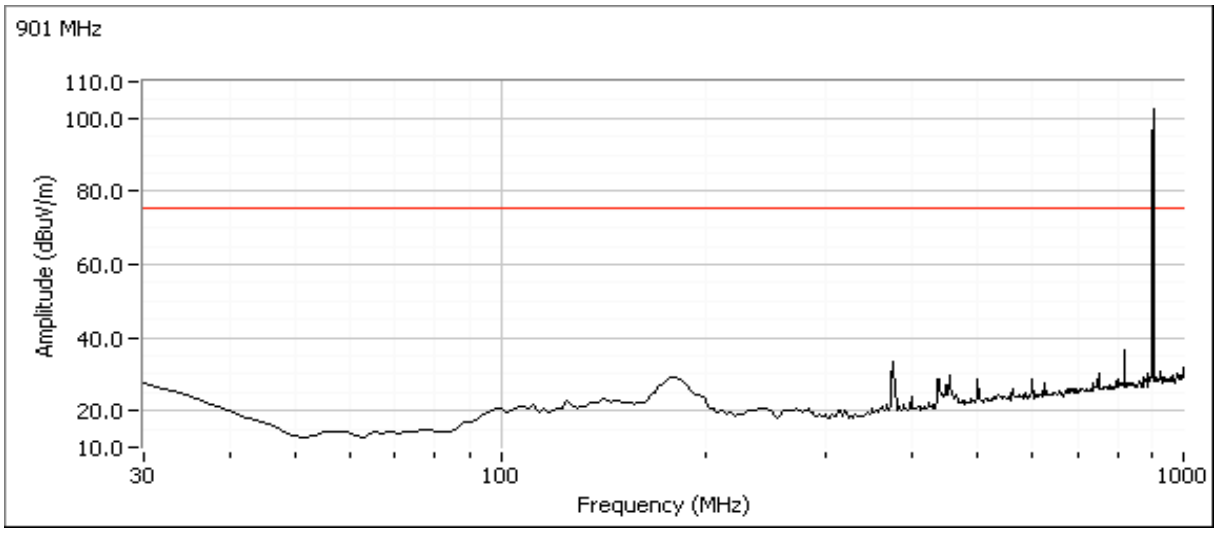


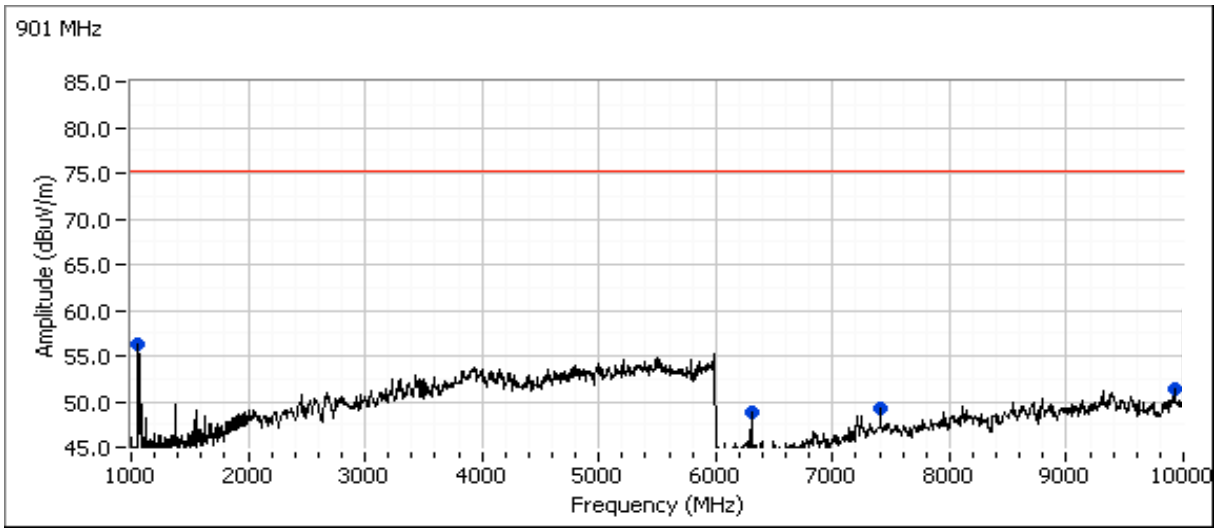


Eng. note:	30 -1000 MHz scans, 10 dB attenuator, RBW = 100 kHz, VBW = 300 kHz 1 - 2 GHz scans, 10 dB attenuator, RBW = 1 MHz, VBW = 3 MHz 2 - 6 GHz scans, 10 dB attenuator and 1.5 GHz HPF, RBW = 1 MHz, VBW = 3 MHz 6 - 10 GHz scans, 1.5 GHz HPF, RBW = 1 MHz, VBW = 3 MHz

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Plots for 901 MHz, power setting = 26

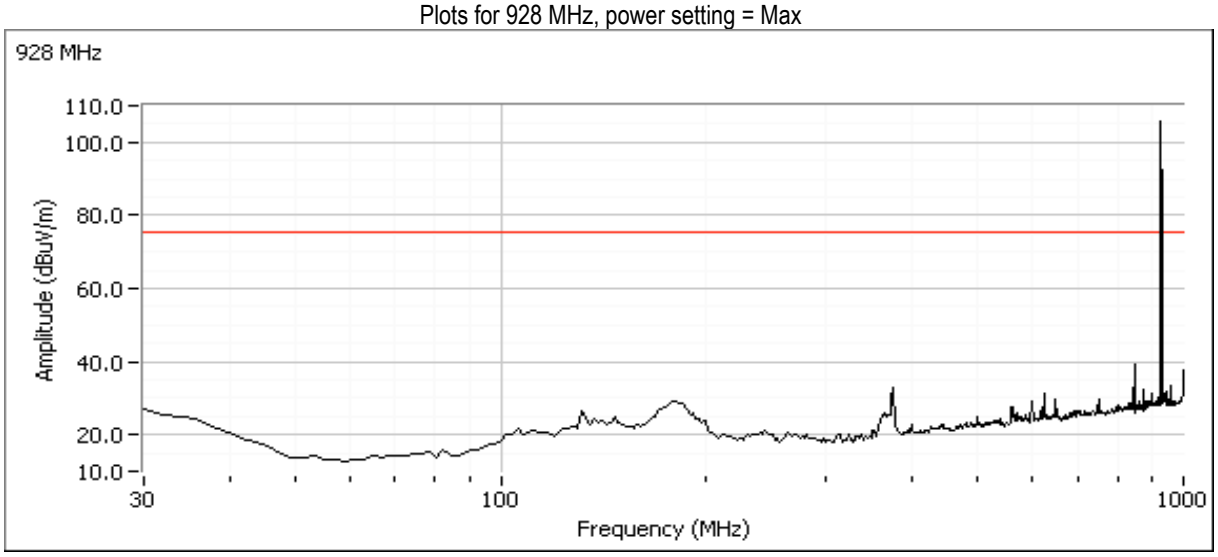


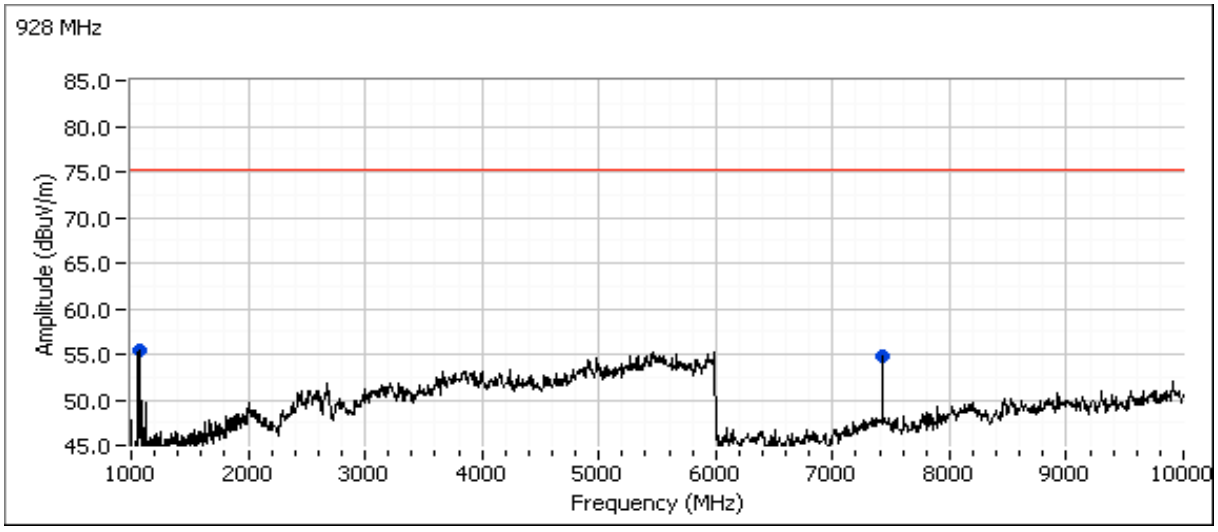


Eng. note:	30 -1000 MHz scans, 10 dB attenuator, RBW = 100 kHz, VBW = 300 kHz 1 - 2 GHz scans, 10 dB attenuator, RBW = 1 MHz, VBW = 3 MHz 2 - 6 GHz scans, 10 dB attenuator and 1.5 GHz HPF, RBW = 1 MHz, VBW = 3 MHz 6 - 10 GHz scans, 1.5 GHz HPF, RBW = 1 MHz, VBW = 3 MHz

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Plots for 928 MHz, power setting = Max

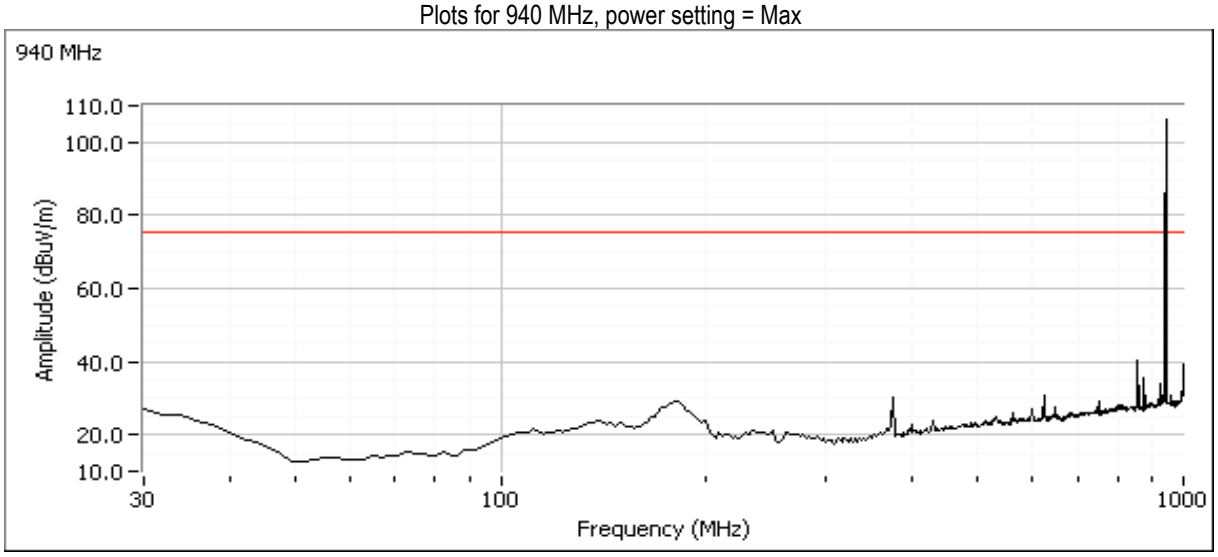


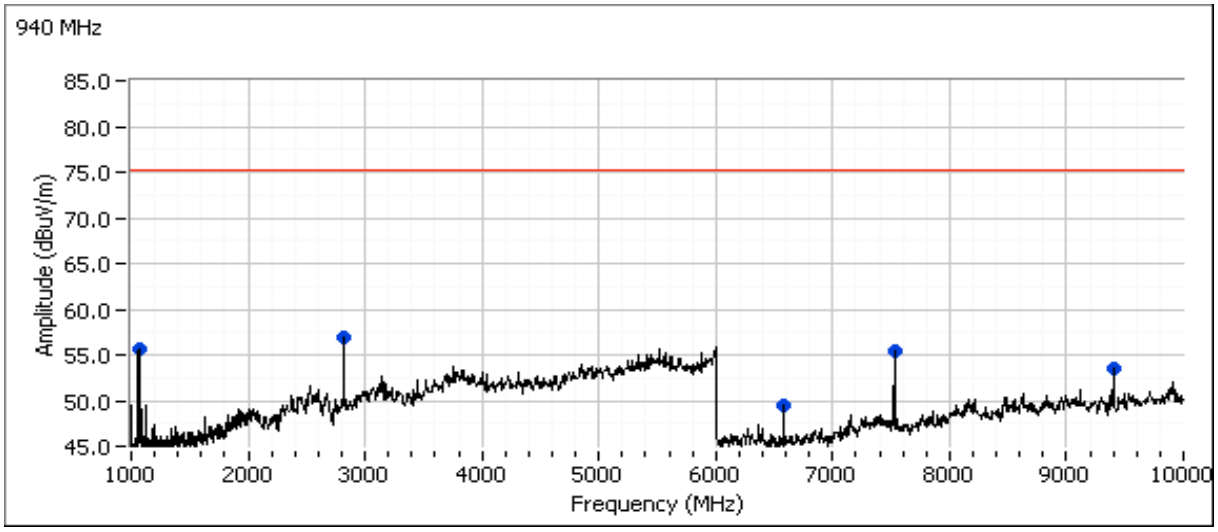


Eng. note:	30 -1000 MHz scans, 10 dB attenuator, RBW = 100 kHz, VBW = 300 kHz 1 - 2 GHz scans, 10 dB attenuator, RBW = 1 MHz, VBW = 3 MHz 2 - 6 GHz scans, 10 dB attenuator and 1.5 GHz HPF, RBW = 1 MHz, VBW = 3 MHz 6 - 10 GHz scans, 1.5 GHz HPF, RBW = 1 MHz, VBW = 3 MHz

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Plots for 940 MHz, power setting = Max





Eng. note:	30 -1000 MHz scans, 10 dB attenuator, RBW = 100 kHz, VBW = 300 kHz 1 - 2 GHz scans, 10 dB attenuator, RBW = 1 MHz, VBW = 3 MHz 2 - 6 GHz scans, 10 dB attenuator and 1.5 GHz HPF, RBW = 1 MHz, VBW = 3 MHz 6 - 10 GHz scans, 1.5 GHz HPF, RBW = 1 MHz, VBW = 3 MHz

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Run #5b: - Substitution Measurements

Date of Test: 11/30/2016 & 4/19/2017 Config. Used: 1
Test Engineer: Mehran Birgani & Deniz Demirci Config Change: None
Test Location: Fremont Chamber #7 EUT Voltage: 13.8 VDC

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
1060.900	-40.0	5.8	61.4	95.6	54.3	-41.3	-43.5		-25.0	-18.5
1063.330	-40.0	5.8	61.5	95.7	55.7	-40.0	-42.2		-25.0	-17.2

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
1061.670	-40.0	5.8	61.4	95.6	56.2	-39.4	-41.6		-25.0	-16.6
2820.000	-40.0	9.9	65.6	95.7	57.0	-38.7	-40.9		-25.0	-15.9
7424.100	-40.0	11.2	67.4	96.2	54.2	-42.0	-44.2		-25.0	-19.2
7520.070	-40.0	11.2	67.2	96.0	55.5	-40.5	-42.7		-25.0	-17.7
9009.950	-40.0	11.8	67.3	95.5	51.3	-44.2	-46.4		-25.0	-21.4
9406.670	-40.0	11.8	67.4	95.6	53.5	-42.1	-44.3		-25.0	-19.3

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.

Client:	GE MDS LLC	Job Number:	JD99150
Model:	GPA-9	T-Log Number:	T99463
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC part 90 & RSS-131	Class:	N/A

Run #6: Noise Figure

Date of Test: 11/30/2016 Config. Used: 1
Test Engineer: David Bare Config Change: None
Test Location: Fremont EMC Lab #4b EUT Voltage: 13.8Vdc

Noise Figure measured using a spectrum analyzer to measure the noise level with the amplifier powered and the input terminated in a 50 Ohm load
Noise Figure calculated from the equation NF = N - Gain - 10Log B+174+1.7 in DB where:
N = measured noise level with input terminated
G= Gain of the amplifier
B = Bandwidth of the Analyzer (100 kHz was used)
174 dB is calculated from Boltmann's constant and Temperature in K and 1.7 dB is correction for the spectruam analyzer filter shape and the averaging effect of the video filter.

Measured value of N was -103.3 dBm/100 kHz
Therefore NF = -0.6 dB for the designed gain of the amplifier

End of Report

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marks the last page of this test report.