41039 Boyce Road
Fremont, CA. 94538

510-578-3500 Phone
510-440-9525 Fax

Radio Test Report

FCC Parts 22 and 90 and RSS-119
(406.1 MHz to 512 MHz)

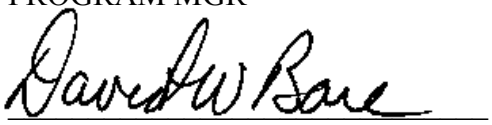
Model: SD4

ISEDC CERTIFICATION #:	101D-SD4
FCC ID:	E5MDS-SD4
COMPANY:	GE Digital Energy - MDS 175 Science Pkwy Rochester, NY 14620
TEST SITE(S):	National Technical Systems 41039 Boyce Road. Fremont, CA. 94538-2435
PROJECT NUMBER:	PR094108
REPORT DATE:	April 1, 2019
FINAL TEST DATES:	March 11, 12, 13 and 14, 2019
TOTAL NUMBER OF PAGES:	50

A2LA ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

PROGRAM MGR

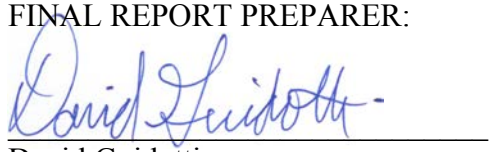


David W. Bare
Chief Engineer

TECHNICAL REVIEWER:

David W. Bare
Chief Engineer

FINAL REPORT PREPARER:



David Guidotti
Senior Technical Writer

QUALITY ASSURANCE DELEGATE

Gary Izard
Quality Assurance Representative

REVISION HISTORY

Rev#	Date	Comments	Modified By
0	April 1, 2019	First release	

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SCOPE

Tests have been performed on the GE Digital Energy - MDS model SD4, 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
- RSS-Gen Issue 5, April 2018
- CFR 47 Part 90 (Private Land Mobile Radio Service) Subpart I
- RSS-119, Issue 12, May 2015 (Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41-960 MHz)

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

ANSI C63.26:2015
ANSI TIA-603-D June 2010
FCC KDB 971168 Licensed Digital Transmitters

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.

National Technical Systems is accredited by the A2LA, certificate number 0214.26, to perform the test(s) listed in this report, except where noted otherwise.

The test results recorded herein are based on a single type test of the GE Digital Energy - MDS model SD4 and therefore apply only to the tested samples. The samples were selected and prepared by Dennis McCarthy of GE Digital Energy - MDS.

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 Digital Energy - MDS model SD4 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 tests performed.

TEST RESULTS

FCC Parts 22 & 90 and RSS-119

FCC	Canada	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics					
§2.1033 (c) (5) §90.35	RSS-119	Frequency range(s)	No change from original filing		N/A
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 §90.205	RSS-119	RF power output at the antenna terminals	37.3 dBm	Up to 500 W ERP allowed Determined at the time of licensing	Pass
§2.1033 (c) (4) §2.1047 §22.357 §22.359 §90.210	RSS-119	Emission types	No change from original filing		N/A
		Emission mask			
	RSS-GEN 6.7 RSS-119	Occupied Bandwidth			
§2.1049 §90.209		Occupied Bandwidth			
§90.214	RSS-119	Transient Frequency Behavior			
Transmitter spurious emissions					
§2.1051 §2.1057 §22.359 §90.210	RSS-119	At the antenna terminals	-28.0 dBm @ 429.8.4 MHz (-3.0 dB)	-25 dBm	Pass
§2.1053 §2.1057 §22.359 §90.210	RSS-119	Field strength	-45.6 dBm @ 1218.4 MHz (-20.5 dB)	-25 dBm	Pass
Other details					
§2.1055 §22.355 §90.213	RSS-119	Frequency stability	0.2 ppm	5 ppm	Pass
§2.1093	RSS-102	RF Exposure	No change from original filing		N/A
§2.1033 (c) (8)		Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range			
-	-	Antenna Gain			
Notes					

EXTREME CONDITIONS

Frequency stability is determined over extremes of temperature and voltage. The extremes of voltage were 10 to 30 VDC which is the operating voltage range of the device.

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 Digital Energy - MDS model SD4 is an industrial radio that is designed to operate from 406.1-512 MHz. Since the EUT could be placed anywhere in use, it was placed on a table top during testing to simulate the end-user environment. The electrical rating of the EUT is 10 - 30 Volts DC, 2.2 Amps.

The samples were received on March 11, 2019 and tested on March 11, 12, 13 and 14, 2019. The following samples of the EUT were used during testing:

Company	Model	Description	Serial Number	FCC ID
GE MDS LLC	SD4	Industrial Radio	03024203	E5MDS-SD4
GE MDS LLC	SD4	Industrial Radio	03024201	E5MDS-SD4

OTHER EUT DETAILS

The following EUT details should be noted: Sample serial # 03024203 operates from 406.1-450 MHz; sample serial # 03024201 operates from 450-512 MHz.

The EUT antenna is a determined at the time of licensing.

ENCLOSURE

The EUT enclosure is primarily constructed of aluminum. It measures approximately 16 cm wide by 12 cm deep by 4 cm high.

MODIFICATIONS

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

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
HP	6024A	AC/DC power supply	2430A-03013	-

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

Company	Model	Description	Serial Number	FCC ID
Dell	Latitude E5500	Laptop	9XZ6WN1	-
Cisco	SD2005	Ethernet switch	DNI145303V1	-

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
DC power	AC/DC power supply	DC cable	Unshielded	1.2
RF	50 Ohm termination	Direct connection	Shielded	-
Ethernet	Ethernet switch	CAT5-e	Shielded	20
Serial	Laptop (removed during emission testing)	Serial cable	Unshielded	1.5

EUT OPERATION

During emissions testing the EUT was continuously transmitting in specified frequencies and modes for each test case.

TESTING

GENERAL INFORMATION

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

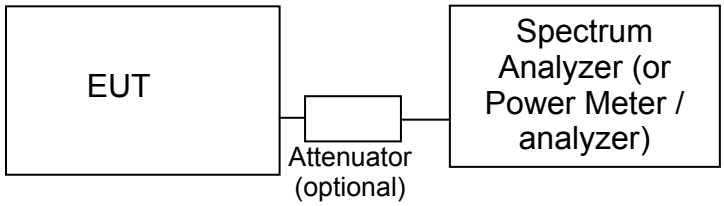
Radiated spurious emissions measurements were taken at the National Technical Systems Anechoic Chambers and/or Open Area Test Site(s) listed below. The sites conform to the requirements of ANSI C63.4 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* and CISPR 16-1-4:2019 - *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 4	US1031	US0027	41039 Boyce Road Fremont, CA 94538-2435
Chamber 7			

ANSI C63.4 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Results from testing performed in this chamber have been correlated with results from an open area test site. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4.

RF PORT MEASUREMENT PROCEDURES

Conducted measurements are performed with the EUT's rf input/output connected to the input of a spectrum analyzer, power meter or modulation analyzer. When required an attenuator, filter and/or dc block is placed between the EUT and the spectrum analyzer to avoid overloading the front end of the measurement device. Measurements are corrected for the insertion loss of the attenuators and cables inserted between the rf port of the EUT and the measurement equipment.



Test Configuration for Antenna Port Measurements

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

OUTPUT POWER

Output power is measured using a power meter and an average sensor head, a spectrum analyzer or a power meter and peak power sensor head as required by the relevant rule part(s). Where necessary measurements are gated to ensure power is only measured over periods that the device is transmitting.

Power measurements made directly on the rf power port are, when appropriate, converted to an EIRP by adding the gain of the highest gain antenna that can be used with the device under test, as specified by the manufacturer.

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS-GEN. The measurement bandwidth is set to be at least 1% of the instrument's frequency span.

CONDUCTED SPURIOUS EMISSIONS

Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode measurements). Where the limits are expressed as an average power the spectrum analyzer is tunes to that frequency with a narrow span (wide enough to capture the emission and its sidebands) and the resolution and video bandwidths are adjusted as required by the reference measurement standards. For transmitter measurements the appropriate detector (average, peak, normal ,sample, quasi-peak) is used when making measurements for licensed devices. For receiver conducted spurious measurements the detector is set to peak.

TRANSMITTER MASK MEASUREMENTS

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

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

FREQUENCY STABILITY

The EUT is placed inside a temperature chamber with all support and test equipment located outside of the chamber. The temperature is varied across the specified frequency range in 10 degree increments with frequency measurements made at each temperature step. The EUT is allowed enough time to stabilize at each temperature variation.

The spectrum analyzer is configured to give a 5- or 6-digit display for the marker-frequency function. The spectrum analyzer's built-in frequency counter is used to measure the maximum deviation of the fundamental frequency at each temperature. Where possible the device is set to transmit an unmodulated signal. Where this is not possible the frequency drift is determined by finding a stable point on the signal (e.g. the null at the centre of an OFDM signal) or by calculating a centre frequency based on the upper and lower XdB points (where X is typically 6dB or 10dB) on the signal’s skirts.

TRANSIENT FREQUENCY BEHAVIOR:

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

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

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

RADIATED EMISSIONS MEASUREMENTS

Receiver radiated spurious emissions measurements are made in accordance with ANSI ANSI C63.4:2003 by measuring the field strength of the emissions from the device at a specific test distance and comparing them to a field strength limit. Where the field strength limit is specified at a longer distance than the measurement distance the measurement is extrapolated to the limit distance.

Transmitter radiated spurious emissions are initially measured as a field strength. The eirp or erp limit as specified in the relevant rule part(s) is converted to a field strength at the test distance and the emissions from the EUT are then compared to that limit. Emissions within 20dB of this limit are the subjected to a substitution measurement.

All radiated emissions measurements are performed in two phases. A preliminary scan of emissions is conducted in either an anechoic chamber or on an OATS during which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed across the complete frequency range of interest and at each operating frequency identified in the reference standard. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode).

During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit. For transmitter spurious emissions, where the limit is expressed as an effective radiated power, the eirp or erp is converted to a field strength limit.

Final measurements are made on an OATS or in a semi-anechoic chamber at the significant frequencies observed during the preliminary scan(s) using the same process of rotating the EUT and raising/lowering the measurement antenna to find the highest level of the emission. The field strength is recorded and, for receiver spurious emissions, compared to the field strength limit. For the final measurement the appropriate detectors (average, peak, normal, sample, quasi-peak) are used. For receiver measurements below 1GHz the detector is a Quasi-Peak detector, above 1GHz a peak detector is used and the peak value (RB=VB=1MHz) and average value (RB=1MHz, VB=10Hz) are recorded.

For transmitter spurious emissions, the radiated power of all emissions within 20dB of the calculated field strength limit are determined using a substitution measurement. The substitution measurement is made by replacing the EUT with an antenna of known gain (typically a dipole antenna or a double-ridged horn antenna), connected to a signal source. The output power of the signal generator is adjusted until the maximum field strength from the substitution antenna is similar to the field strength recorded from the EUT. The erp of the EUT is then calculated.

INSTRUMENTATION

An EMI receiver as specified in CISPR 16-1-1 is used for radiated emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary.

For measurements above the frequency range of the receivers and for all conducted measurements a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis.

Measurement bandwidths for the test instruments are set in accordance with the requirements of the standards referenced in this document.

Software control is used to correct the measurements for transducer factors (e.g. antenna) and the insertion loss of cables, attenuators and other series elements to obtain the final measurement value. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are exported in a graphic and/or tabular format, as appropriate.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the EUT antenna port or receiving antenna and the test receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A combination of biconical, log periodic or bi-log antennas are used to cover the range from 30 MHz to 1000 MHz. Broadband antennas or tuned dipole antennas are used over the entire 25 to 1000 MHz frequency range as the reference antenna for substitution measurements.

Above 1000 MHz, a dual-ridge guide horn antenna or octave horn antenna are used as reference and measurement antennas.

The antenna calibration factors are included in site factors that are programmed into the test receivers and instrument control software when measuring the radiated field strength.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

Table mounted devices are placed on a non-conductive table at a height of 80 or 150 centimeters above the 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
Frequency stability, 11-Mar-19					
Fluke	Multimeter, True RMS	111	1480	4/4/2018	4/4/2019
Rohde & Schwarz	Signal Analyzer 20 Hz - 26.5 GHz	FSQ26	2327	6/25/2018	6/25/2019
Agilent Technologies	20 channel MUX card	34901A	WC065063	5/25/2018	5/25/2019
Keysight Technologies	LXI Data Aquisition / Switch Unit	34972A	WC065127	6/20/2018	6/20/2019
RF Power and spurious, 12-Mar-19					
Rohde & Schwarz	Power Meter, Dual Channel	NRVD	1071	4/4/2018	4/4/2019
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts (w/ 20 dB pad, SN BJ5155)	NRV-Z32	1536	6/21/2018	6/21/2019
Agilent Technologies	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	7/27/2018	7/27/2019
Radiated Emissions, 30 - 6,000 MHz, 12-Mar-19					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz	3115	1242	4/11/2017	4/19/2019
Hewlett Packard	Spectrum Analyzer (SA40) Blue 9 kHz - 40 GHz	8564E (84125C)	1393	12/8/2018	12/8/2019
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1548	10/24/2018	1/9/2021
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	8/30/2018	8/30/2019
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	9482	10/13/2018	10/13/2019
Radiated Emissions, 30 - 2,000 MHz, 13-Mar-19					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	9/5/2018	9/5/2019
EMCO	Antenna, Horn, 1-18GHz	3115	868	7/9/2018	7/9/2020
Hewlett Packard	Spectrum Analyzer (SA40) Red 30 Hz -40 GHz	8564E (84125C)	1148	9/27/2018	9/27/2019
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	2237	7/3/2018	7/3/2020
Com-Power	Preamplifier, 30-1000 MHz	PA-103	2465	5/24/2018	5/24/2019
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESI 40	2493	3/22/2018	3/22/2019
Radiated Emissions, 9 kHz - 30 MHz, 13-Mar-19					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESI 40	2493	3/22/2018	3/22/2019
Rhode & Schwarz	Magnetic Loop Antenna, 9 kHz-30 MHz	HFH2-Z2	WC062457	1/5/2018	1/5/2020

Appendix B Test Data

TL094108-RA Pages 21 – 49

Client:	GE MDS LLC	PR Number:	PR094108
Product	SD4	T-Log Number:	TL094108-RA
System Configuration:	-	Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Emissions Standard(s):	FCC parts 22 & 90, RSS-119	Class:	
Immunity Standard(s):		Environment:	Radio

EMC Test Data

For The

GE MDS LLC

Product

SD4

Date of Last Test: 3/14/2019

Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

RSS 119 and FCC Parts 22 & 90

Power, Frequency Stability and Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

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, 3 m from the measurement antenna.

Ambient Conditions:

Temperature: 21 °C

Rel. Humidity: 39 %

Summary of Results

Run #			Test Performed	Limit	Pass / Fail	Result / Margin
1			Output Power	Determined at time of Licensing	Pass	37.3 dBm
2			Spurious Emissions (conducted)	-25 dBm	Pass	-28 dBm @ 429.7 MHz (-3.0 dB)
3			Spurious emissions (radiated)	-25 dBm	Pass	51.9 dBµV/m @ 1218.4 MHz (-20.5 dB)
4			Frequency Stability	0.5 ppm	Pass	106 Hz / 0.2 ppm

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #1: Output Power

Date of Test: 3/12/2019 Config. Used: 1
Test Engineer: Deniz Demirci Config Change: None
Test Location: FT Lab #4a EUT Voltage: 13.8 VDC

Cable Loss: 0.0 dB Attenuator: 20.0 dB Total Loss: 20.0 dB
Cable ID(s): None Attenuator IDs: WC068107

Power Setting[2]	Frequency (MHz)	Output Power (dBm) [1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W
37	406.1	37.2	5248.1	16.5	Pass	53.7	234.423
37	430.0	37.2	5248.1	16.5	Pass	53.7	234.423
37	450.0	37.3	5370.3	16.5	Pass	53.8	239.883
37	470.0	37.2	5248.1	16.5	Pass	53.7	234.423
37	512.0	37.3	5370.3	16.5	Pass	53.8	239.883

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:	Power and antenna selection are set by licensee and power is reduced as necessary to meet the limits for the rule part for which the device is used. 16.5 dBi is the highest gain mentioned in the install manual.

Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #2: Out of Band Spurious Emissions, Conducted

Date of Test: 3/12/2019
Test Engineer: Deniz Demirci
Test Location: FT Lab #4a

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

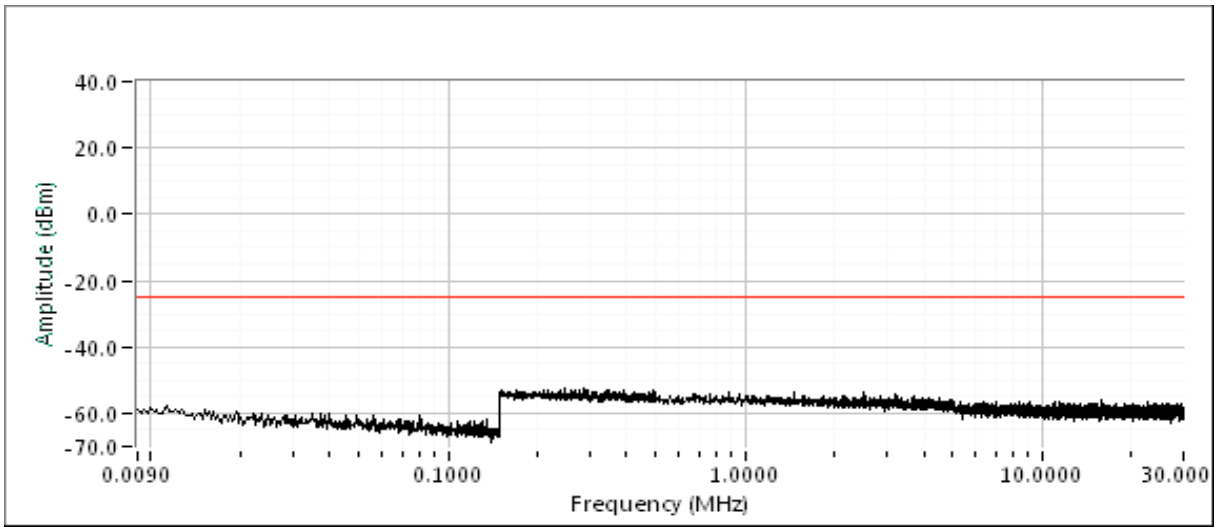
Frequency (MHz)	Limit (dBm)	Result
406.1125	-25	Pass
430.0000	-25	Pass
450.0000	-25	Pass
470.0000	-25	Pass
512.0000	-25	Pass

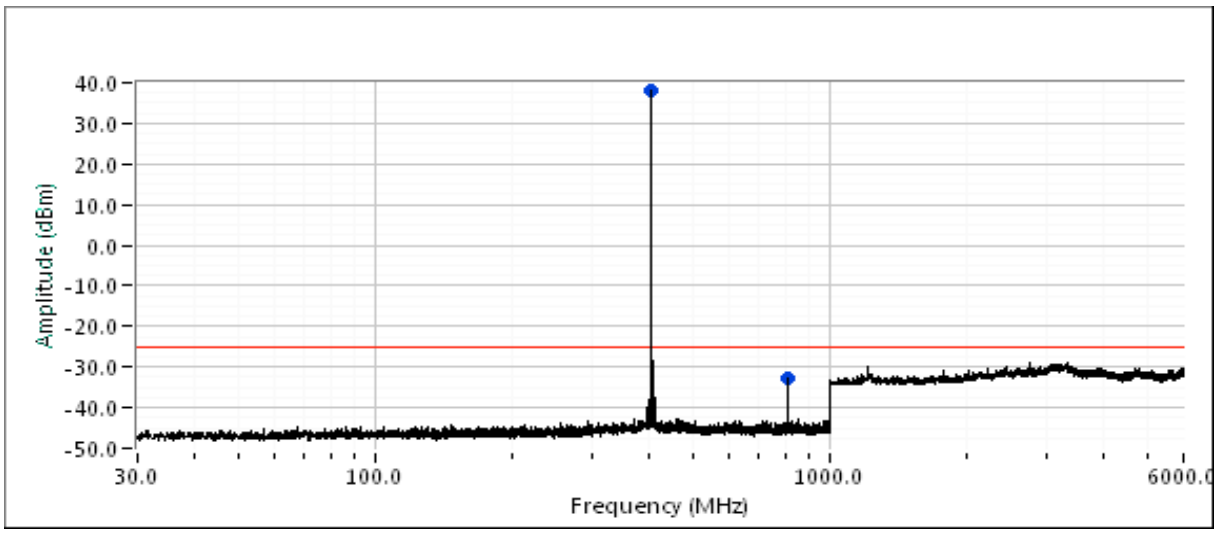
The limit is taken from FCC Part 90 Mask E (55+10*log(P) = -25 dBm)
SA settings: Peak detector, RBW = 1 kHz below 150 kHz, 9 kHz below 30 MHz and 100 kHz above 30 MHz with video bandwidth 3x the resolution BW. Any emissions observed above 1 GHz were measured using a 1 MHz RBW.

Frequency	Level	Pol	FCC Part 90		Detector	Azimuth	Height	Comments	Channel
MHz	dBm	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		MHz
406.113	37.8	RF Port	-	-	PK	-	-	Carrier	406.1125
812.237	-32.9	RF Port	-25.0	-7.9	PK	-	-		406.1125
430.010	37.9	RF Port	-	-	PK	-	-	Carrier	430.0000
859.993	-30.7	RF Port	-25.0	-5.7	PK	-	-		430.0000
450.003	37.3	RF Port	-	-	PK	-	-	Carrier	450.0000
532.244	-38.2	RF Port	-25.0	-13.2	PK	-	-		450.0000
900.020	-38.7	RF Port	-25.0	-13.7	PK	-	-		450.0000
469.993	37.6	RF Port	-	-	PK	-	-	Carrier	470.0000
940.013	-34.7	RF Port	-25.0	-9.7	PK	-	-		470.0000
512.000	38.1	RF Port	-	-	PK	-	-	Carrier	512.0000
429.777	-28.0	RF Port	-25.0	-3.0	PK	-	-		512.0000

Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

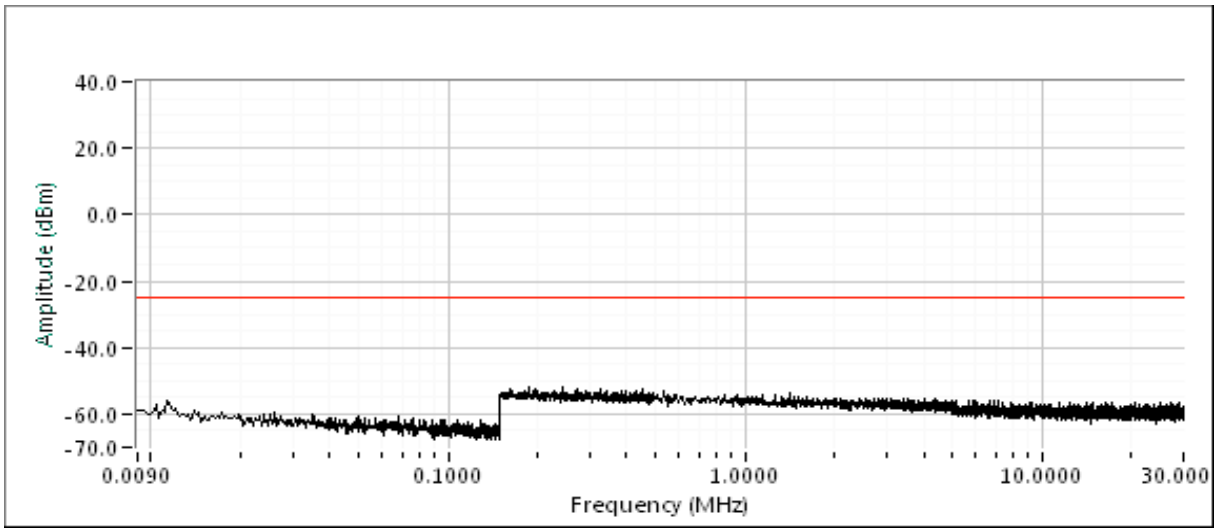
Plots for 406.1 MHz, power setting(s) = 37

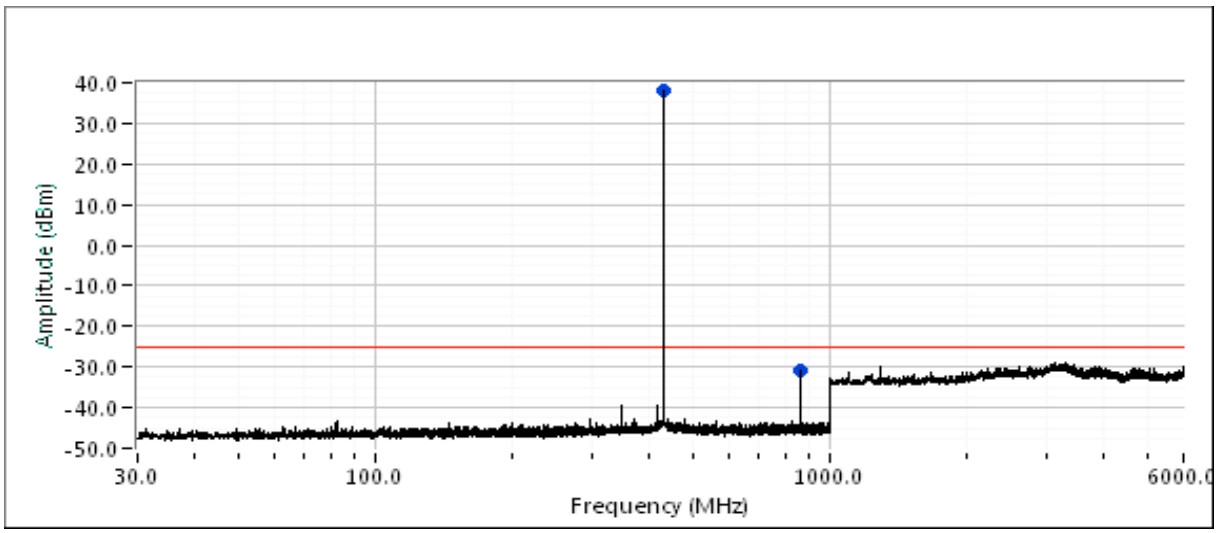




Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

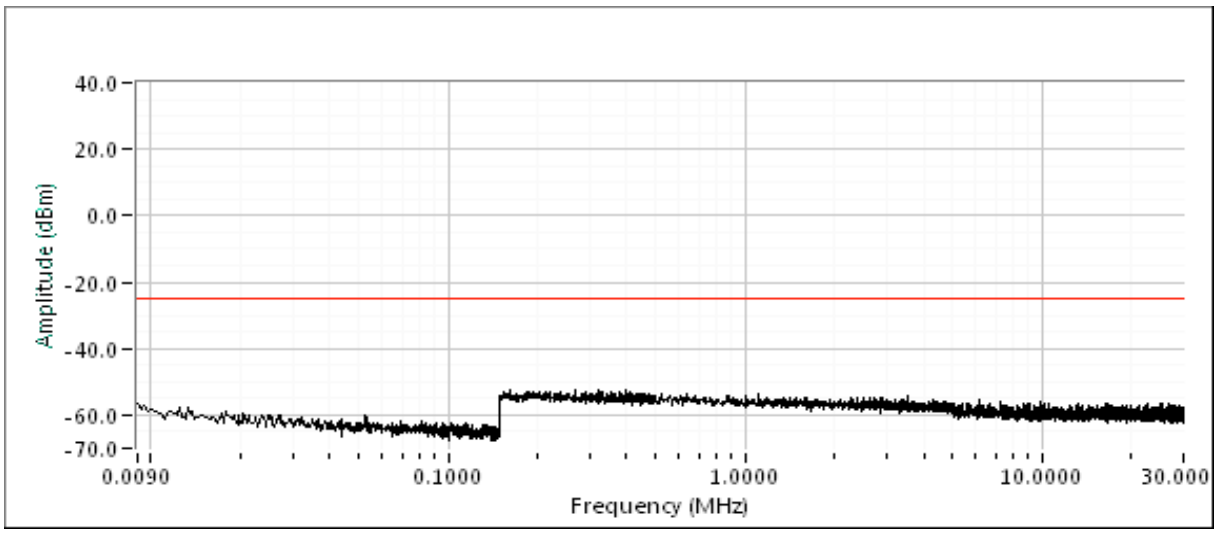
Plots for 430 MHz, power setting(s) = 37

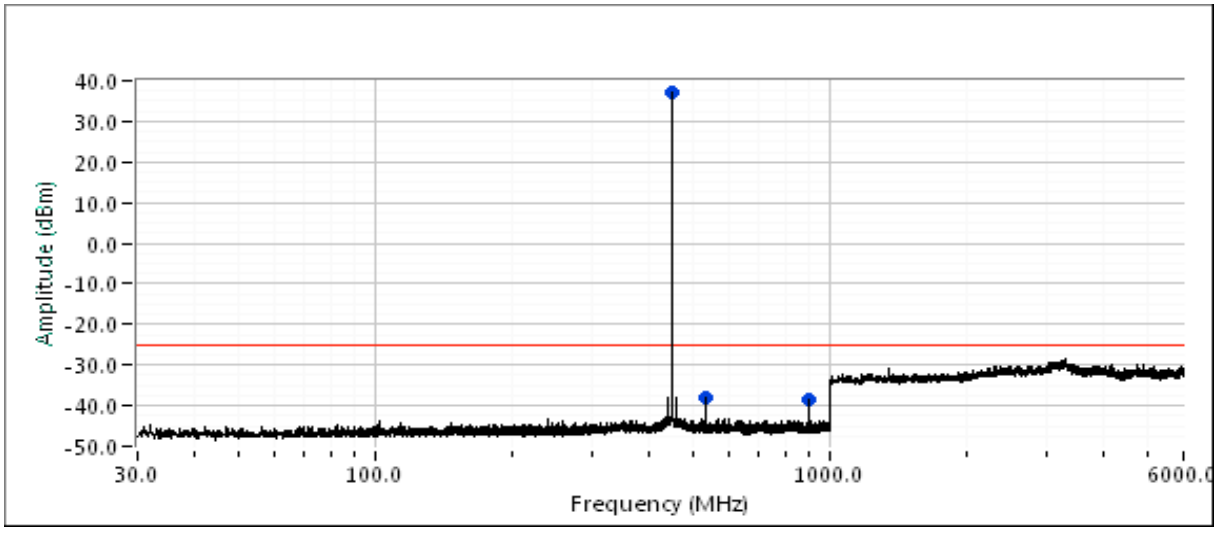




Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

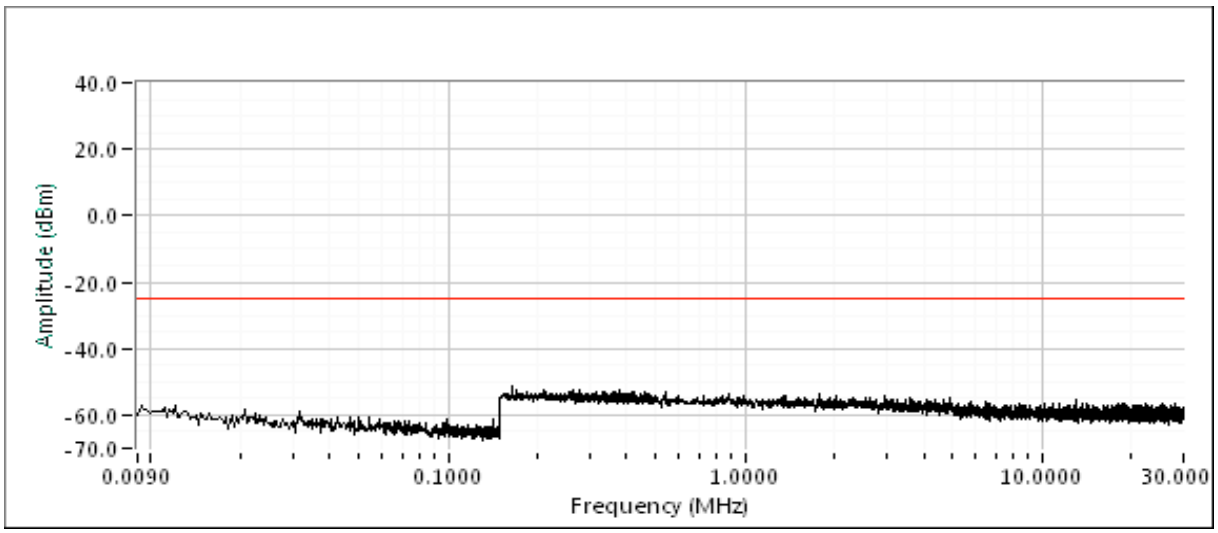
Plots for 450 MHz, power setting(s) = 37

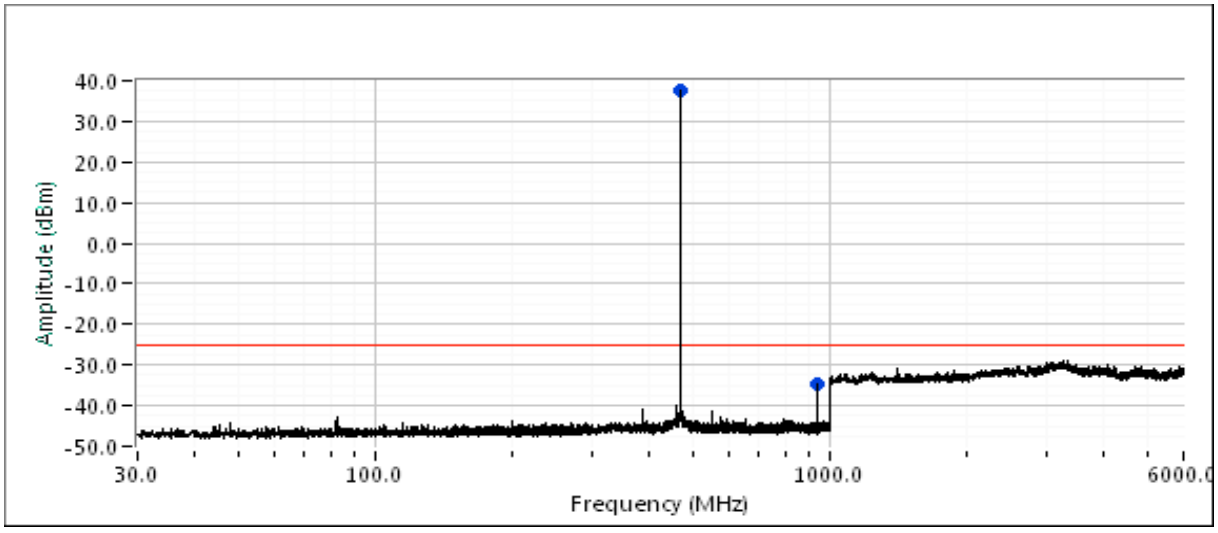




Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

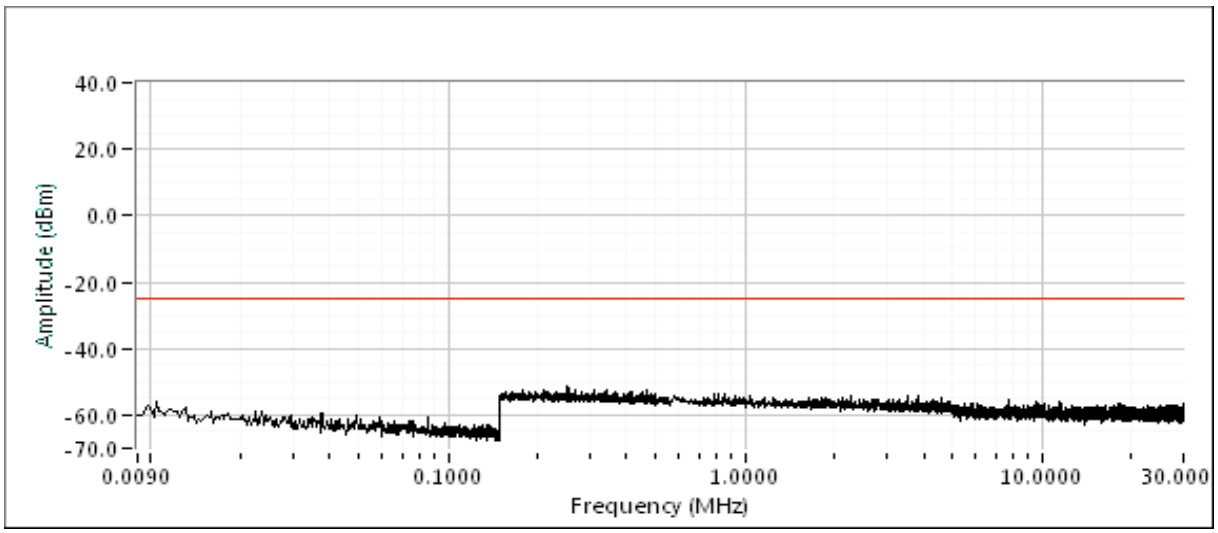
Plots for 470 MHz, power setting(s) = 37

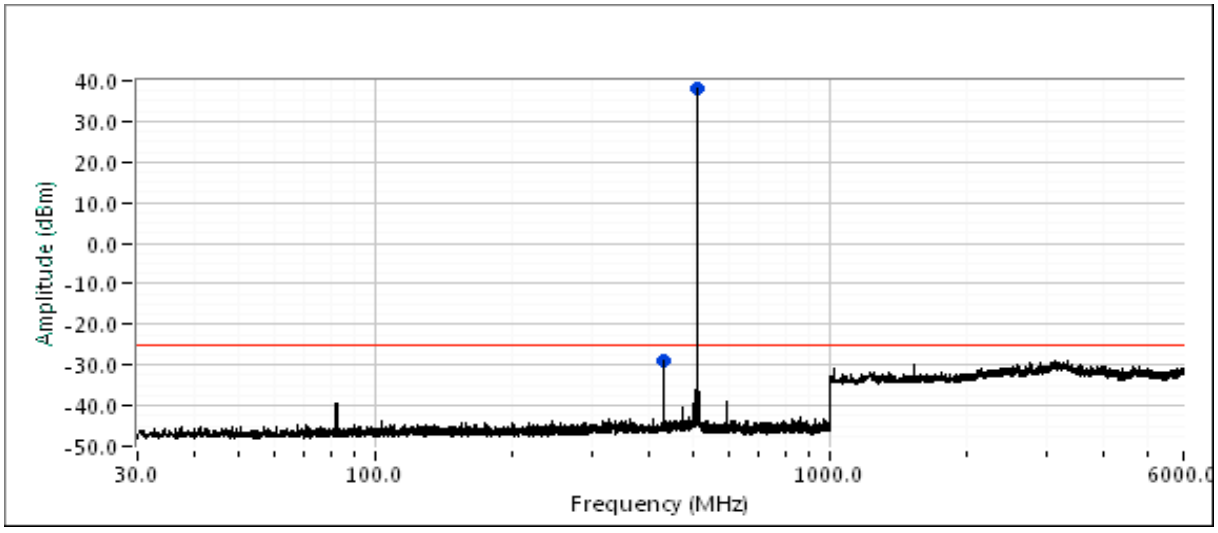




Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Plots for 512 MHz, power setting(s) = 37





Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #3: Out of Band Spurious Emissions, Radiated

Conducted limit (dBm): -25
Approximate field strength limit @ 3m: 72.4
The limit is taken from FCC Part 90 Mask E (55+10*log(P) = -25 dBm)

Run #3a - Preliminary measurements

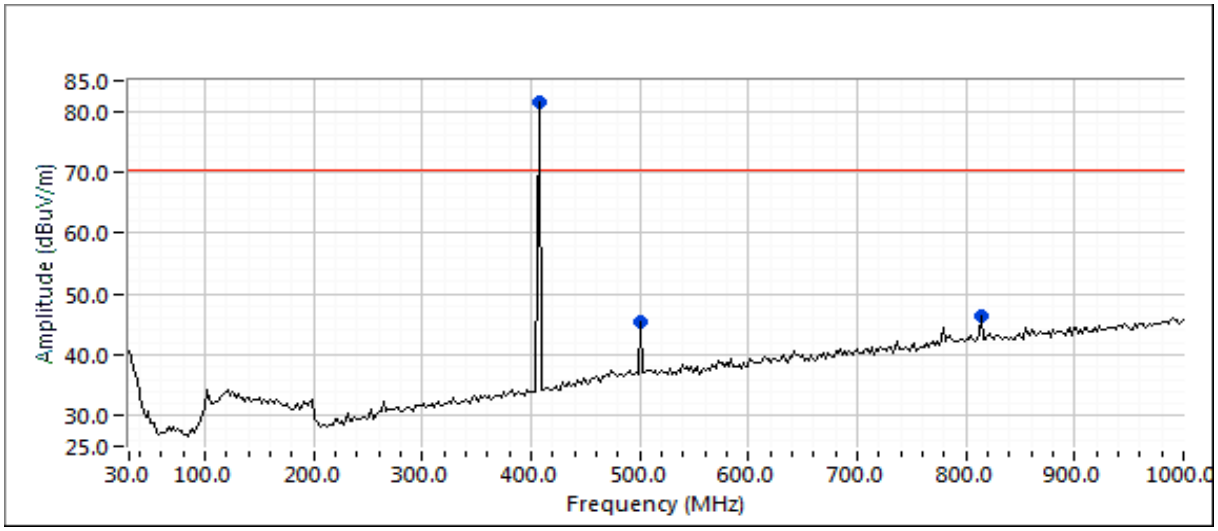
Date of Test: 3/12/2019 Config. Used: 1
Test Engineer: Deniz Demirci Config Change: None
Test Location: FTChamber #5 EUT Voltage: 13.8 VDC

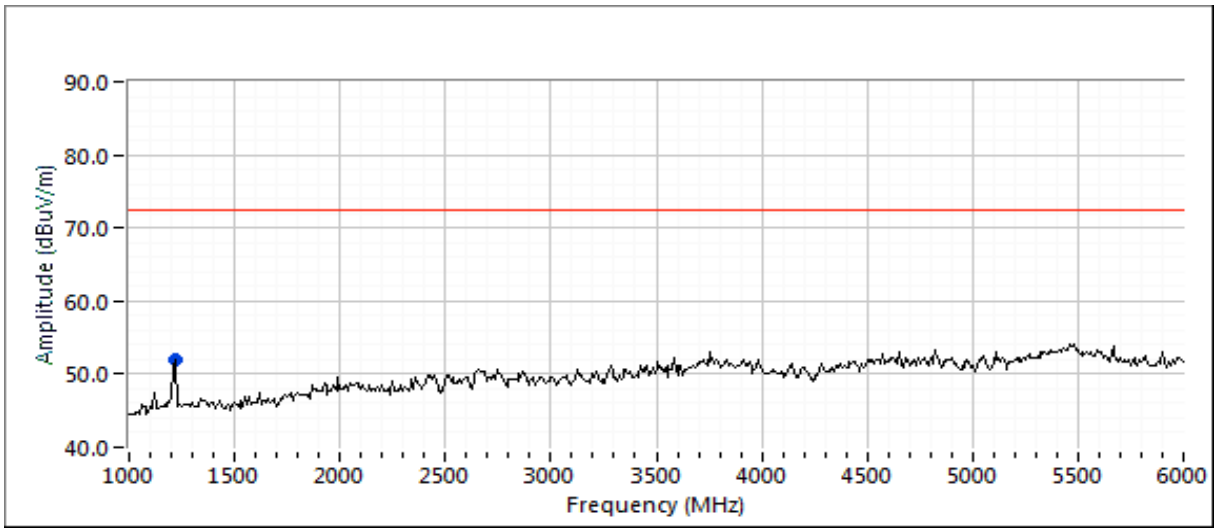
Frequency	Level	Pol	FCC Part 90		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
406.114	*81.4*	*H*	-	-	PK	*290*	*2.5*	Carrier	406.1125
500.421	*45.3*	*V*	*72.4*	*-27.1*	PK	*352*	*1.0*		406.1125
813.387	*46.3*	*H*	*72.4*	*-26.1*	PK	*5*	*2.5*		406.1125
1218.360	51.9	H	72.4	-20.5	PK	125	1.5	RB 1 MHz;VB 3 MHz;Pe	406.1125
430.041	*84.0*	*H*	-	-	PK	*287*	*2.5*	Carrier	430.0000
500.421	*41.0*	*V*	*72.4*	*-31.4*	PK	*8*	*1.0*		430.0000
601.503	*40.8*	*H*	*72.4*	*-31.6*	PK	*324*	*1.5*		430.0000
449.990	*85.2*	*H*	-	-	PK	*296*	*2.5*	Carrier	450.0000
500.421	*48.0*	*V*	*72.4*	*-24.4*	PK	*312*	*1.0*		450.0000
601.503	*41.9*	*H*	*72.4*	*-30.5*	PK	*293*	*1.5*		450.0000
470.063	*86.3*	*H*	-	-	PK	*308*	*2.0*	Carrier	470.0000
624.830	*42.3*	*H*	*72.4*	*-30.1*	PK	*261*	*2.0*		470.0000
512.084	*88.7*	*H*	-	-	PK	*295*	*2.0*	Carrier	512.0000
624.830	*42.5*	*H*	*72.4*	*-29.9*	PK	*113*	*2.5*		*512.0000*

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 (2.2 dBi) has not been included. The erp or eirp for all signals with less than 20 dB 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:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

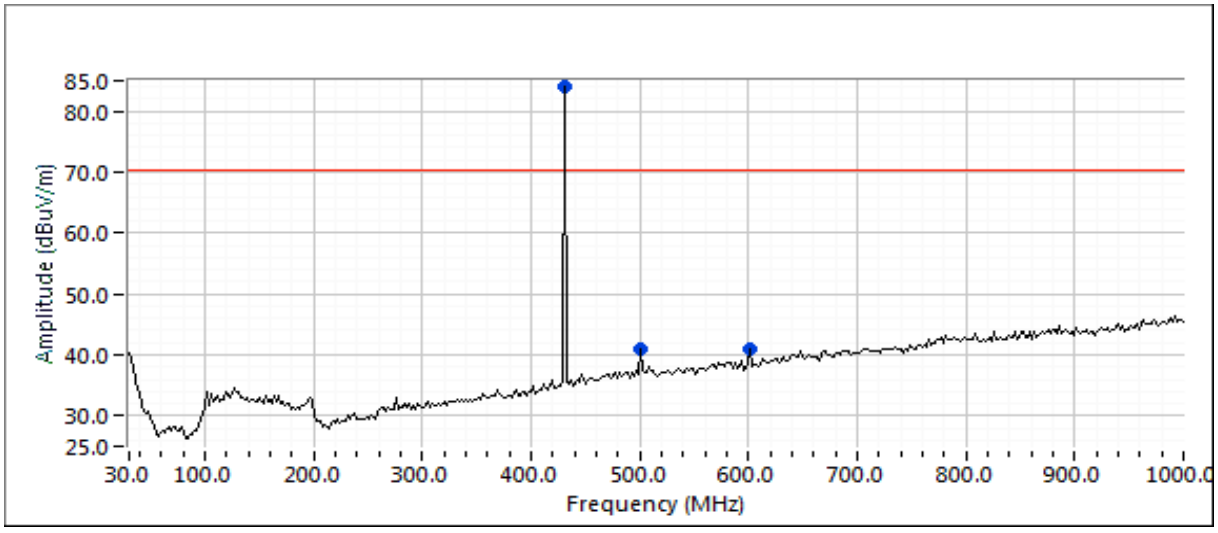
Plots for 406.1 MHz, power setting(s) = 37

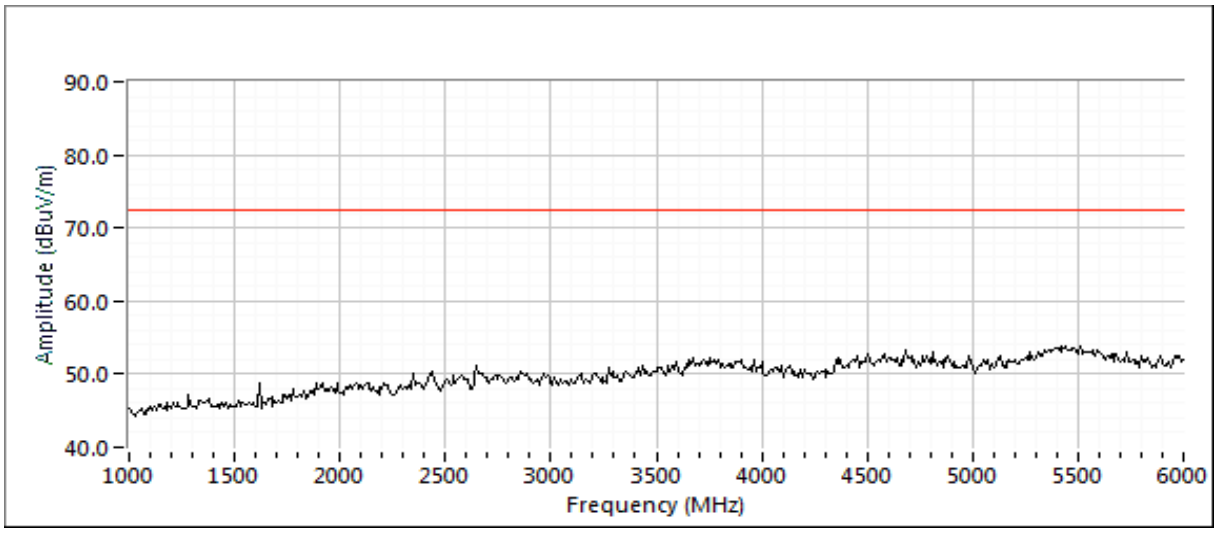




Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

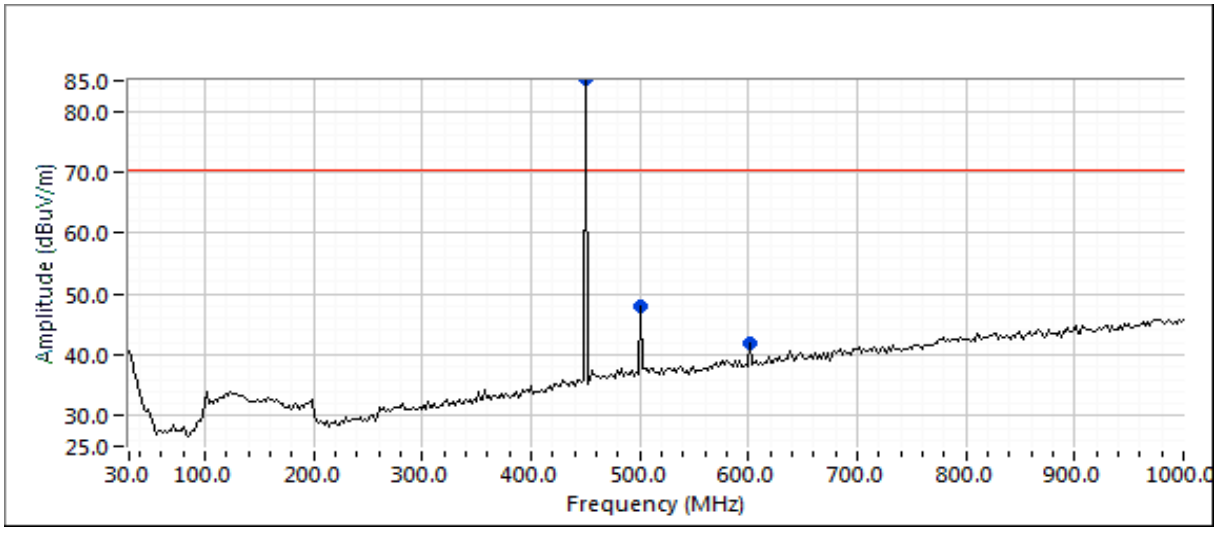
Plots for 430 MHz, power setting(s) = 37

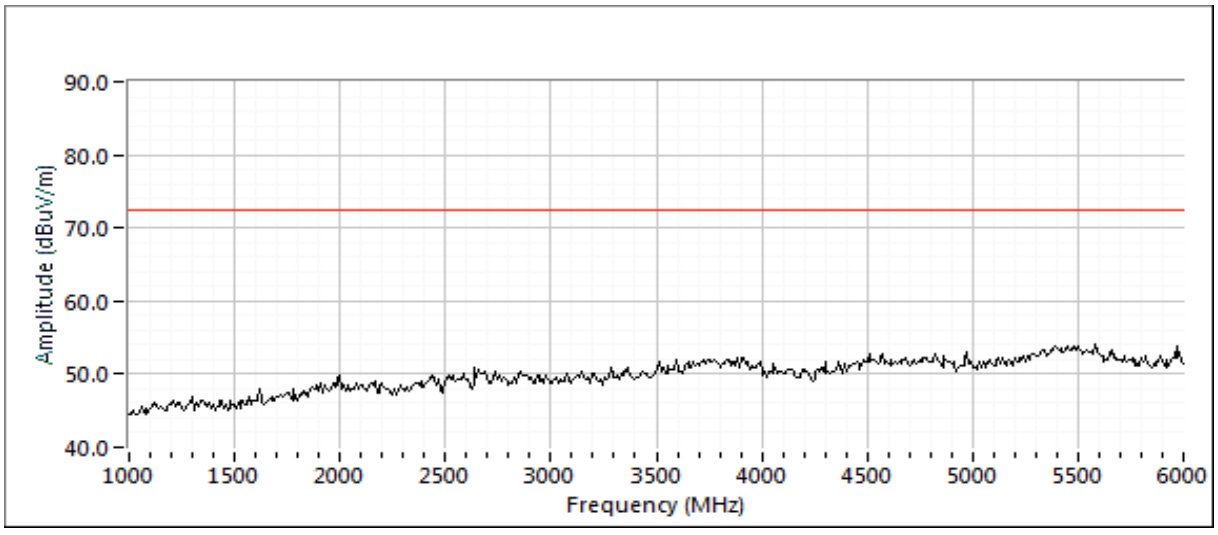




Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

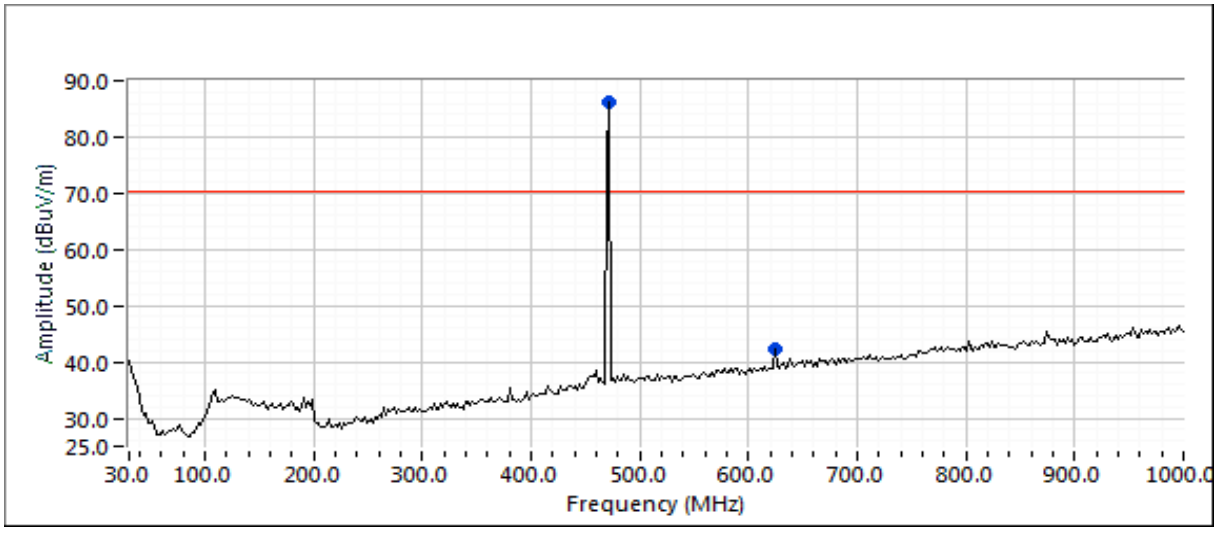
Plots for 450 MHz, power setting(s) = 37

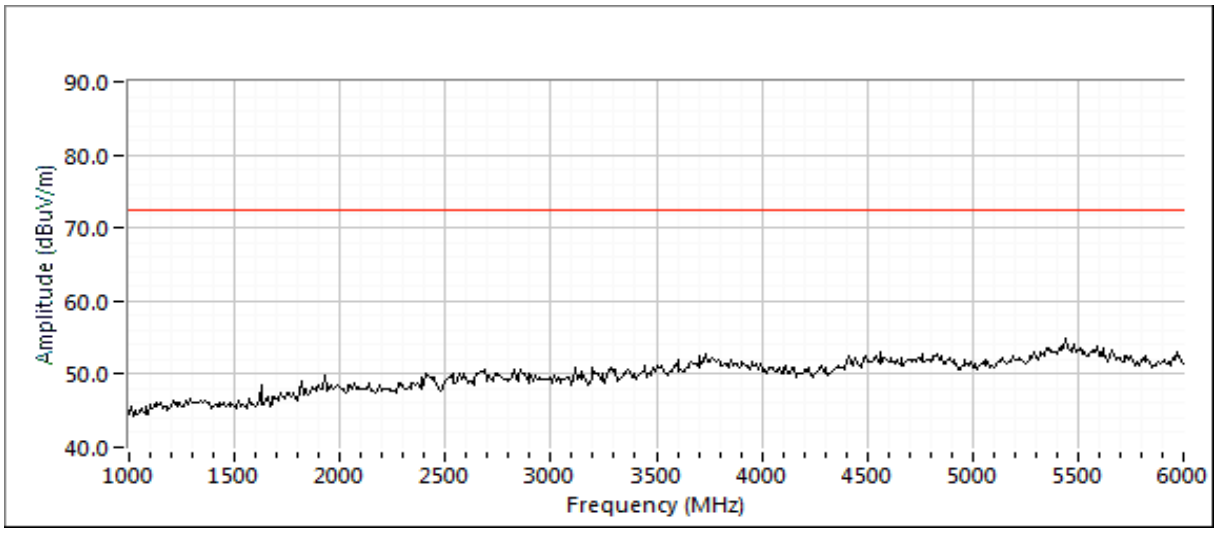




Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

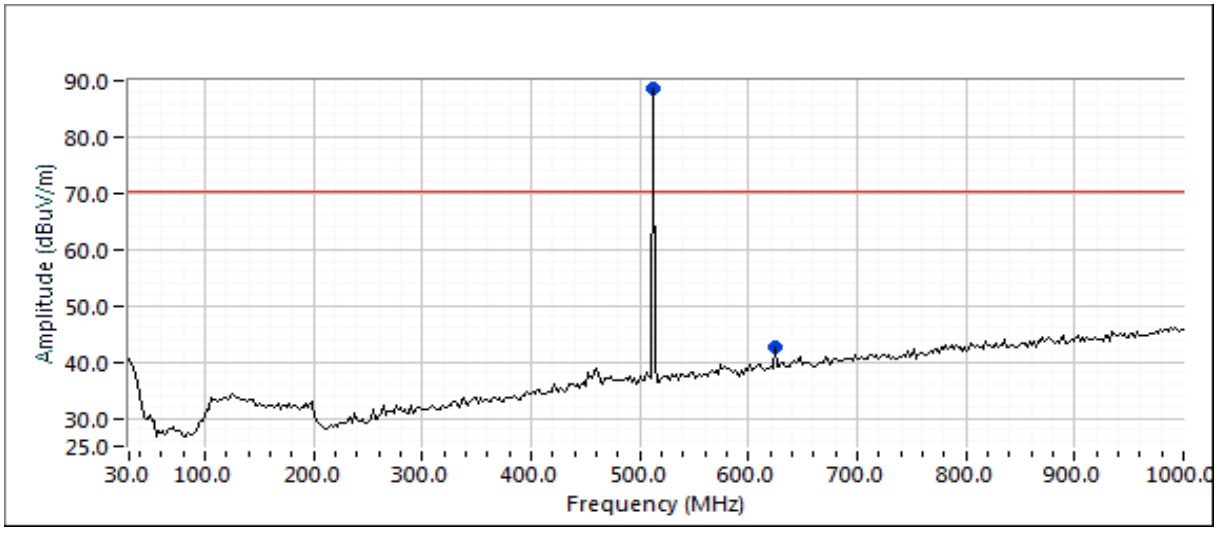
Plots for 470 MHz, power setting(s) = 37

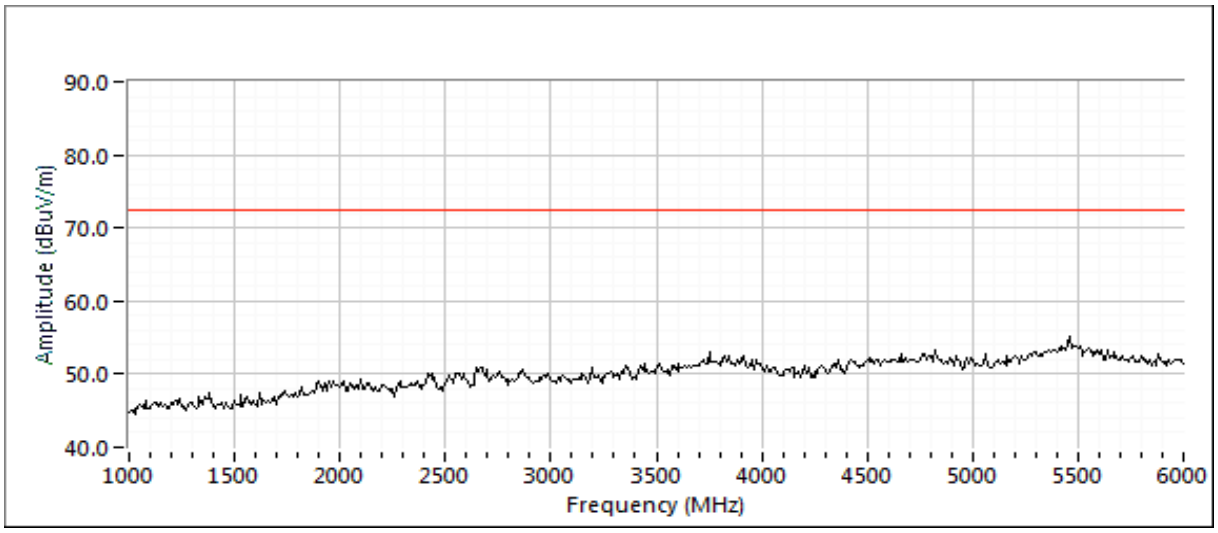




Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Plots for 512 MHz, power setting(s) = 37





Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #3b: - Final Field Strength and Substitution Measurements

Date of Test: 3/12/2019 Config. Used: 1
Test Engineer: Deniz Demirci Config Change: None
Test Location: FTChamber #5 EUT Voltage: 13.8 VDC

EUT Field Strength

Frequency	Level	Pol	FCC Part 90		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
1218.360	51.9	H	72.4	-20.5	PK	125	1.5	RB 1 MHz;VB 3 MHz;Pe	406.1125
500.421	49.6	V	*72.4*	*-22.8*	PK	327	1.3	PK (0.10s)	450.0000

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 (2.2 dBi) has not been included. The erp or eirp for all signals with less than 20 dB of margin relative to this field strength limit is determined using substitution measurements.
Note 2:	Measurements are made with the antenna port terminated.

Substitution measurements

As all emisisosn were more than 20 dB below the calculated field stength lmimt, no substitutions were performed.

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
-										

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
-										

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:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #3c: - Out of Band Spurious Emissions, Radiated (< 30 MHz)

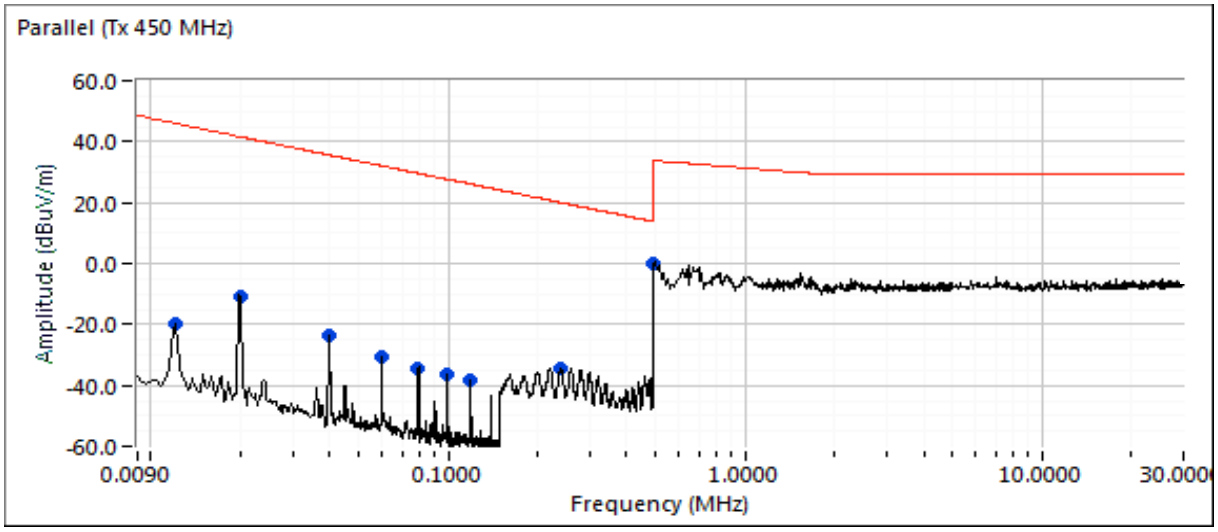
Date of Test: 3/13/2019
Test Engineer: Deniz Demirci
Test Location: FTChamber #7

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

EUT Field Strength

Frequency	Level	Pol	FCC Part 15.209		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m		Limit	Margin	Pk/QP/Avg	degrees	meters		
0.0121	*-19.9*	*Parallel*	*45.9*	*-65.8*	*Peak*	*240*	*1.0*	*Power supply noise.*	
0.0200	*-10.8*	*Parallel*	*41.6*	*-52.4*	*Peak*	*240*	*1.0*		
0.0399	*-23.4*	*Parallel*	*35.6*	*-59.0*	*Peak*	*240*	*1.0*		
0.0596	*-30.9*	*Parallel*	*32.1*	*-63.0*	*Peak*	*360*	*1.0*		
0.0799	*-34.2*	*Parallel*	*29.6*	*-63.8*	*Peak*	*240*	*1.0*		
0.1000	*-36.1*	*Parallel*	*27.6*	*-63.7*	*Peak*	*240*	*1.0*		
0.1192	*-38.6*	*Parallel*	*26.1*	*-64.7*	*Peak*	*240*	*1.0*		
0.2399	*-34.5*	*Parallel*	*20.0*	*-54.5*	*Peak*	*112*	*1.0*		
0.4900	*0.2*	*Parallel*	*33.8*	*-33.6*	*Peak*	*128*	*1.0*	*Noise floor reading*	

Plot for 450 MHz, power setting(s) = 37



Client:	GE MDS LLC	Job Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #4: Frequency Stability

Date of Test: 3/11/2019
Test Engineer: Deniz Demirci
Test Location: FT Lab #3

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

Nominal Frequency: 450.01250 MHz

Frequency Stability Over Temperature

The EUT was soaked at each temperature for a minimum of 30 minutes prior to making the measurements to ensure the EUT and chamber had stabilized at that temperature.

Temperature	Frequency Measured	Drift	
(Celsius)	(MHz)	(Hz)	(ppm)
-30	450.0126058	106	0.2
-20	450.0126058	106	0.2
-10	450.0126058	106	0.2
0	450.0125750	75	0.2
10	450.0125750	75	0.2
20	450.0125256	26	0.1
30	450.0125256	26	0.1
40	450.0125256	26	0.1
50	450.0125256	26	0.1
	Worst case:	106	0.2

Frequency Stability Over Input Voltage

Nominal Voltage is 13.8Vdc.

Voltage	Frequency Measured	Drift	
(DC)	(MHz)	(Hz)	(ppm)
10	450.0125256	26	0.1
30	450.0125256	26	0.1
	Worst case:	106	0.2

Client:	GE MDS LLC	PR Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	Enter on cover sheet

Radiated Emissions

(NTS Silicon Valley, 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: 3/13/2019
Test Engineer: Deniz Demirci
Test Location: FT Chamber #7

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

General Test Configuration

The EUTs were located on the turntable for radiated emissions testing. No remote support equipment was used.
The test distance and extrapolation factor (if applicable) are detailed under each run description.
Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 20 °C
Rel. Humidity: 39 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	Radiated Emissions 30 - 2000 MHz, Maximized	FCC §15.109(a) Receiver		45.7 dBµV/m @ 875.00 MHz (-0.3 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.

Client:	GE MDS LLC	PR Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	Enter on cover sheet

Run #1: Preliminary Radiated Emissions, 30 - 2000 MHz

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	3	3	0.0
1000 - 2000	3	3	0.0

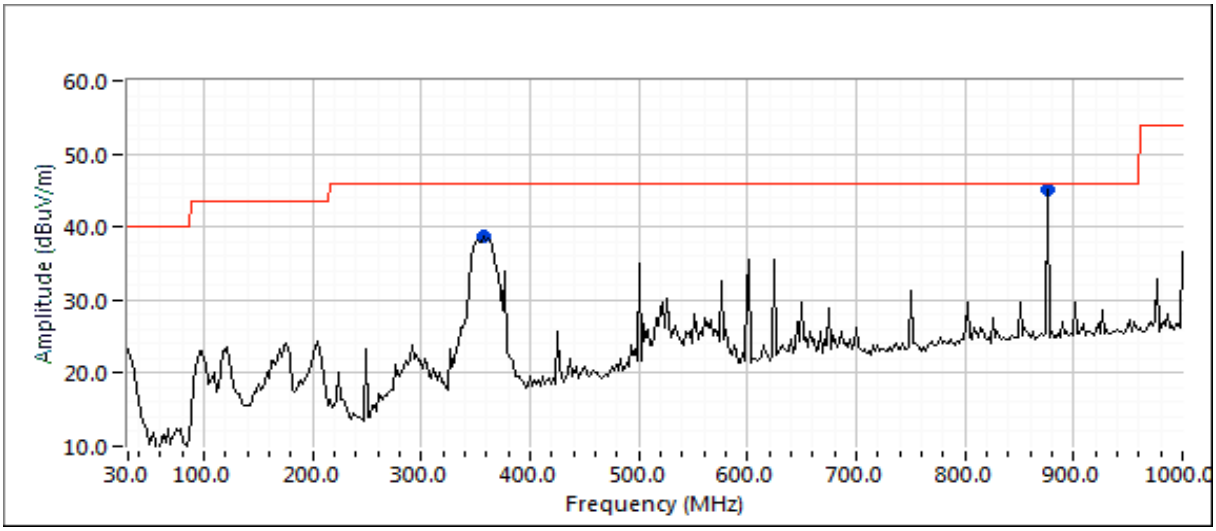
Run #1a:

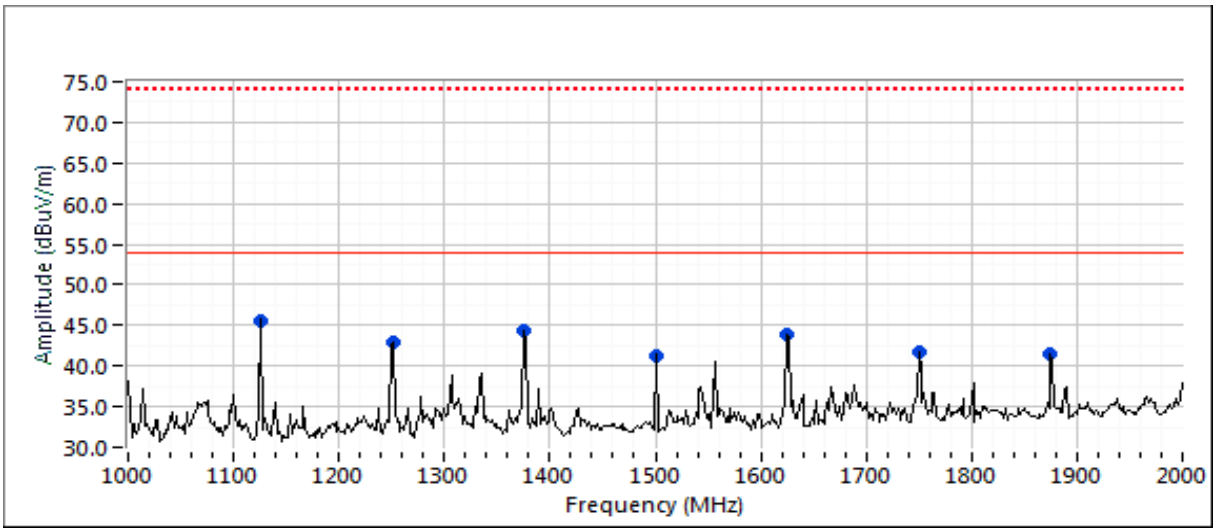
Receivers set to 406.1 and 512 MHz

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	FCC 15.109(a)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
356.573	*38.7*	*H*	*46.0*	*-7.3*	*Peak*	*260*	*1.0*	
875.591	*45.2*	*H*	*46.0*	*-0.8*	*Peak*	*162*	*1.0*	*Ethernet*
1126.670	*45.6*	*V*	*54.0*	*-8.4*	*Peak*	*89*	*2.5*	
1251.670	*43.0*	*V*	*54.0*	*-11.0*	*Peak*	*206*	*1.5*	
1375.000	*44.4*	*H*	*54.0*	*-9.6*	*Peak*	*69*	*1.3*	
1625.000	*43.8*	*H*	*54.0*	*-10.2*	*Peak*	*232*	*2.0*	
1875.000	*41.5*	*H*	*54.0*	*-12.5*	*Peak*	*78*	*1.5*	
1750.000	*41.7*	*H*	*54.0*	*-12.3*	*Peak*	*137*	*1.3*	
1501.670	*41.3*	*H*	*54.0*	*-12.7*	*Peak*	*229*	*1.5*	

Client:	GE MDS LLC	PR Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	Enter on cover sheet





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Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	Enter on cover sheet

Run #1b:

Receivers set to 450 and 470 MHz

Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	FCC 15.109(a)		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
352.685	*38.8*	*V*	*46.0*	*-7.2*	*Peak*	*250*	*1.0*	
500.421	*36.5*	*H*	*46.0*	*-9.5*	*Peak*	*309*	*3.5*	
601.503	*35.2*	*V*	*46.0*	*-10.8*	*Peak*	*125*	*1.5*	
624.830	*34.9*	*H*	*46.0*	*-11.1*	*Peak*	*270*	*1.5*	
875.591	*45.8*	*V*	*46.0*	*-0.2*	*Peak*	*162*	*1.0*	*Ethernet*
1125.000	*44.9*	*V*	*54.0*	*-9.1*	*Peak*	*58*	*1.0*	
1250.000	*43.1*	*V*	*54.0*	*-10.9*	*Peak*	*153*	*1.8*	
1376.670	*42.4*	*V*	*54.0*	*-11.6*	*Peak*	*276*	*1.5*	
1500.000	*41.6*	*H*	*54.0*	*-12.4*	*Peak*	*141*	*1.0*	
1876.670	*47.2*	*V*	*54.0*	*-6.8*	*Peak*	*143*	*1.3*	

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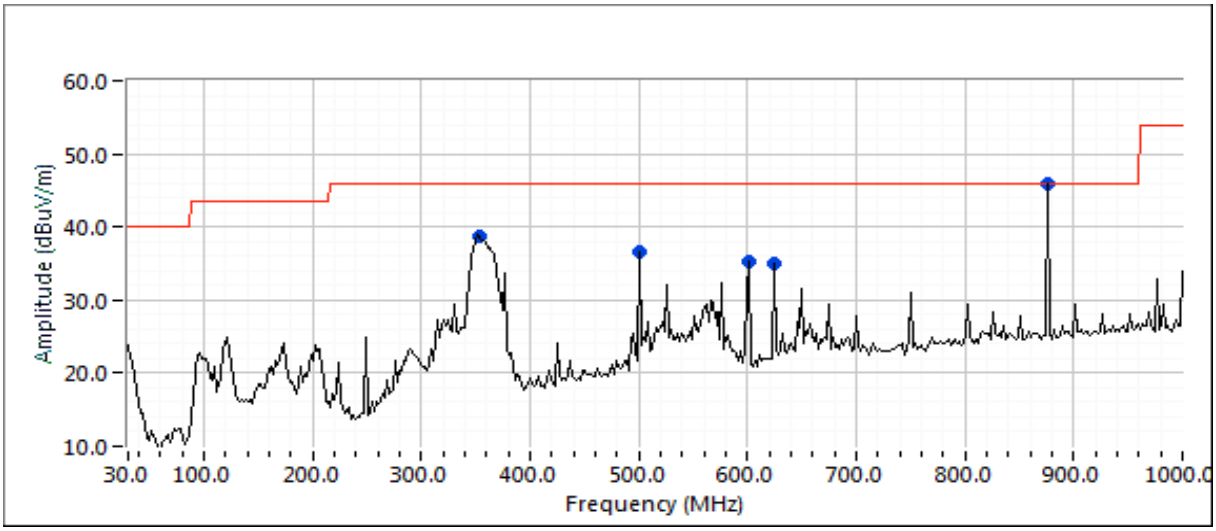
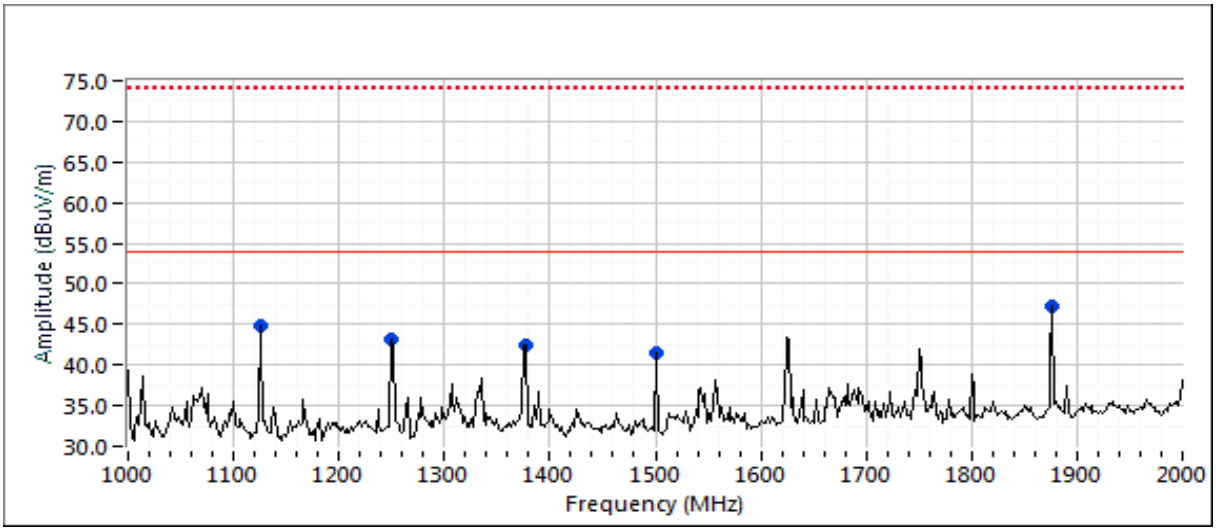
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	Enter on cover sheet





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Model:	SD4	T-Log Number:	TL094108-RA
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Standard:	FCC parts 22 & 90, RSS-119	Class:	Enter on cover sheet

Run #2: Maximized Readings From Run #1

Test Parameters for Maximized Reading(s)			
Frequency Range (MHz)	Test Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	3	3	0.0
1000 - 2000	3	3	0.0

Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	FCC 15.109(a)		Detector	Azimuth	Height	Comments	
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
874.996	45.7	H	46.0	-0.3	QP	162	1.0	QP (1.00s)	
357.868	38.9	H	46.0	-7.1	QP	262	1.0	QP (1.00s)	
1125.060	43.7	V	54.0	-10.3	AVG	68	2.5	RB 1 MHz;VB 10 Hz;Pea	run 1a
1125.270	49.3	V	74.0	-24.7	PK	68	2.5	RB 1 MHz;VB 3 MHz;Pe	run 1a
1249.750	39.1	V	54.0	-14.9	AVG	186	1.4	RB 1 MHz;VB 10 Hz;Pea	run 1a
1250.110	46.5	V	74.0	-27.5	PK	186	1.4	RB 1 MHz;VB 3 MHz;Pe	run 1a
1374.990	40.8	H	54.0	-13.2	AVG	72	1.2	RB 1 MHz;VB 10 Hz;Pea	run 1a
1374.870	47.1	H	74.0	-26.9	PK	72	1.2	RB 1 MHz;VB 3 MHz;Pe	run 1a
1500.010	38.9	H	54.0	-15.1	AVG	222	1.6	RB 1 MHz;VB 10 Hz;Pea	run 1a
1500.060	44.8	H	74.0	-29.2	PK	222	1.6	RB 1 MHz;VB 3 MHz;Pe	run 1a
1624.550	38.5	H	54.0	-15.5	AVG	247	1.0	RB 1 MHz;VB 10 Hz;Pea	run 1a
1625.050	48.4	H	74.0	-25.6	PK	247	1.0	RB 1 MHz;VB 3 MHz;Pe	run 1a
1874.920	35.3	H	54.0	-18.7	AVG	108	1.0	RB 1 MHz;VB 10 Hz;Pea	run 1a
1874.740	46.7	H	74.0	-27.3	PK	108	1.0	RB 1 MHz;VB 3 MHz;Pe	run 1a
1750.020	37.1	H	54.0	-16.9	AVG	86	1.2	RB 1 MHz;VB 10 Hz;Pea	run 1a
1750.340	49.2	H	74.0	-24.8	PK	86	1.2	RB 1 MHz;VB 3 MHz;Pe	run 1a
352.323	38.2	V	46.0	-7.8	QP	234	1.4	QP (1.00s)	run 1b
499.989	33.5	H	46.0	-12.5	QP	309	2.9	QP (1.00s)	run 1b
599.998	35.5	V	46.0	-10.5	QP	42	1.0	QP (1.00s)	run 1b
625.005	35.9	H	46.0	-10.1	QP	270	1.5	QP (1.00s)	run 1b
874.996	45.5	V	46.0	-0.5	QP	216	1.2	QP (1.00s)	run 1b
1125.100	43.3	V	54.0	-10.7	AVG	72	1.0	RB 1 MHz;VB 10 Hz;Pea	run 1b
1124.930	48.9	V	74.0	-25.1	PK	72	1.0	RB 1 MHz;VB 3 MHz;Pe	run 1b
1249.960	38.8	V	54.0	-15.2	AVG	166	1.9	RB 1 MHz;VB 10 Hz;Pea	run 1b
1249.790	45.9	V	74.0	-28.1	PK	166	1.9	RB 1 MHz;VB 3 MHz;Pe	run 1b
1375.080	41.0	V	54.0	-13.0	AVG	267	1.5	RB 1 MHz;VB 10 Hz;Pea	run 1b
1375.070	47.5	V	74.0	-26.5	PK	267	1.5	RB 1 MHz;VB 3 MHz;Pe	run 1b
1500.040	40.6	H	54.0	-13.4	AVG	136	1.0	RB 1 MHz;VB 10 Hz;Pea	run 1b
1499.910	45.3	H	74.0	-28.7	PK	136	1.0	RB 1 MHz;VB 3 MHz;Pe	run 1b
1875.140	38.5	V	54.0	-15.5	AVG	143	1.3	RB 1 MHz;VB 10 Hz;Pea	run 1b
1874.670	48.3	V	74.0	-25.7	PK	143	1.3	RB 1 MHz;VB 3 MHz;Pe	run 1b

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Standard:	FCC parts 22 & 90, RSS-119	Class:	Enter on cover sheet

Conducted Emissions

(NTS Silicon Valley, 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: 3/14/2019
Test Engineer: Deniz Demirci
Test Location: Fremont EMC Lab #4A

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

General Test Configuration

All measurements are made with the EUT's rf port connected to the measurement instrument via an attenuator or dc-block if necessary. All amplitude measurements are adjusted to account for the attenuation between EUT and measuring instrument.

Ambient Conditions:

Temperature: 21 °C
Rel. Humidity: 42 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Conducted Emissions 30 - 2,000 MHz	FCC §15.111 (2 nW)	Pass	-69.1 dBm @ 1215 MHz (-12.1 dB Noise floor reading)

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

If no emissions related to the receiver are observed with the receiver set to a channel near the middle of the possible frequencies then there is no need to test with the lowest and highest receiver frequency settings.

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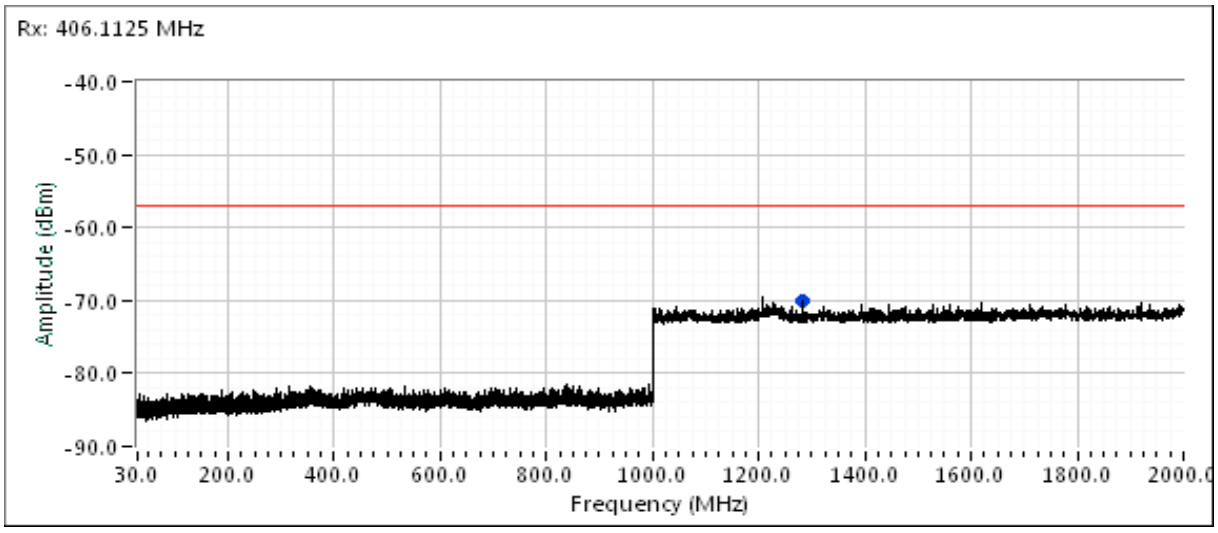
Standard:	FCC parts 22 & 90, RSS-119	Class:	Enter on cover sheet

Run #1a: Conducted Spurious Emissions, 30 - 2,000 MHz
Receiver set to 406.1 MHz

Frequency MHz	Level dBµV	AC Line	Part 15 Receiver Limit	Part 15 Receiver Margin	Detector QP/Ave	Comments
1281.140	*-70.0*	*RF Port*	*-57.0*	*-13.0*	*Peak*	*Noise floor reading*



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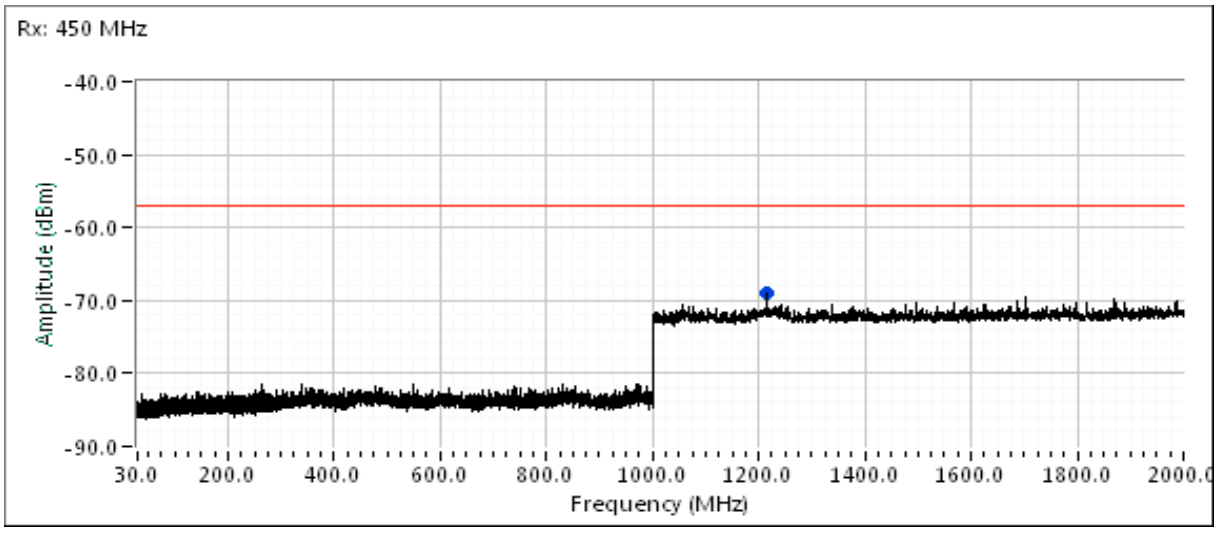
Run #1b: Conducted Spurious Emissions, 30 - 2,000 MHz
Receiver set to 450 MHz

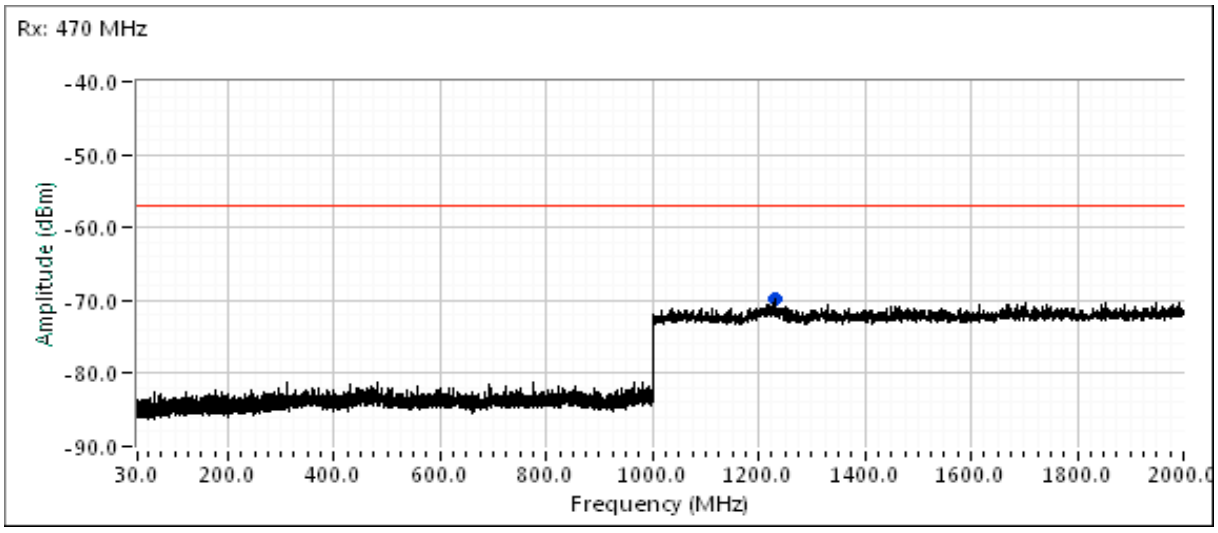
Frequency MHz	Level dBµV	AC Line	Part 15 Receiver Limit	Part 15 Receiver Margin	Detector QP/Ave	Comments
1215.610	*-69.1*	*RF Port*	*-57.0*	*-12.1*	*Peak*	*Noise floor reading*



Client:	GE MDS LLC	PR Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	Enter on cover sheet

Run #1c: Conducted Spurious Emissions, 30 - 2,000 MHz
Receiver set to 470 MHz

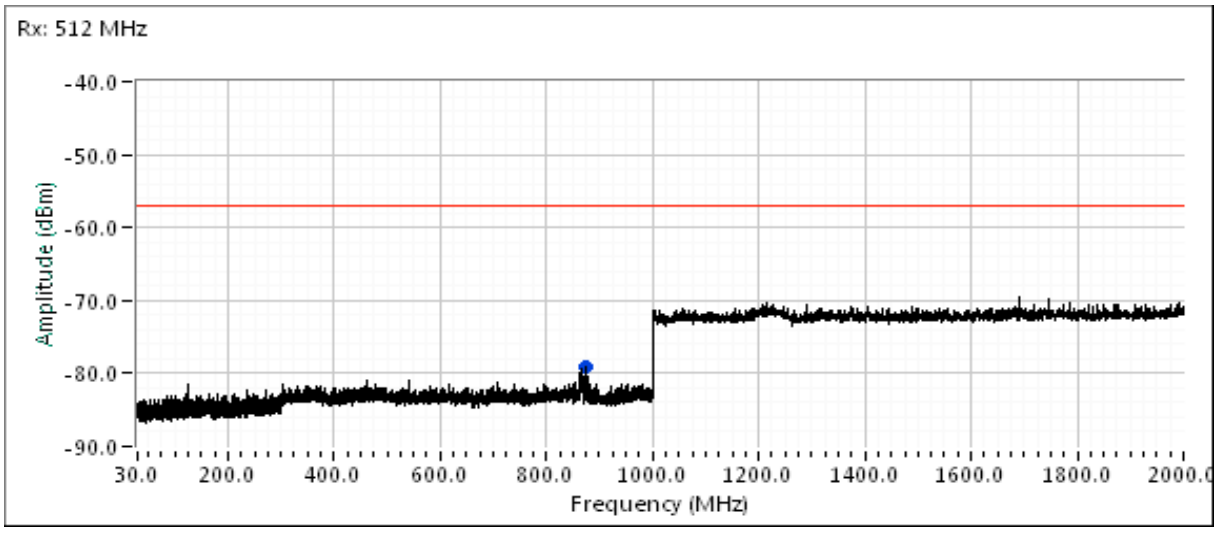
Frequency MHz	Level dBµV	AC Line	Part 15 Receiver Limit	Part 15 Receiver Margin	Detector QP/Ave	Comments
1232.620	*-69.9*	*RF Port*	*-57.0*	*-12.9*	*Peak*	*Noise floor reading*



Client:	GE MDS LLC	PR Number:	PR094108
Model:	SD4	T-Log Number:	TL094108-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	Enter on cover sheet

Run #1d: Conducted Spurious Emissions, 30 - 2,000 MHz
Receiver set to 512 MHz

Frequency MHz	Level dBµV	AC Line	Part 15 Receiver Limit	Part 15 Receiver Margin	Detector QP/Ave	Comments
874.892	*-79.0*	*RF Port*	*-57.0*	*-22.0*	*Peak*	



End of Report

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