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Radio Test Report

FCC Part 90
(406.1 MHz to 512 MHz)
FCC Part 22
(454 MHz to 512 MHz)
RSS-119
(406.1-430 MHz and 450-470 MHz)

Model: SDM4-1

IC CERTIFICATION #:	101D-SDM41
FCC ID:	E5MDS-SDM4-1
COMPANY:	GE MDS LLC 175 Science Pkwy Rochester, NY 14620
TEST SITE(S):	National Technical Systems 41039 Boyce Road. Fremont, CA. 94538-2435
PROJECT NUMBER:	PR099808
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ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

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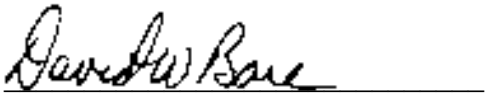

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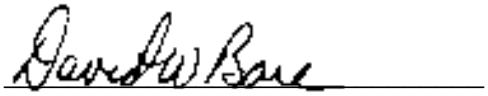

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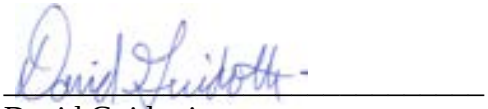

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REVISION HISTORY

Rev#	Date	Comments	Modified By
0	August 2, 2019	First release	
1	August 15, 2019	Revised report to correct model number	David Guidotti

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SCOPE

Tests have been performed on the GE MDS LLC model SDM4-1, pursuant to the relevant requirements of the following standard(s) in order to obtain device certification against the regulatory requirements of the Federal Communications Commission and Innovation Science and Economic Development Canada.

- Code of Federal Regulations (CFR) Title 47 Part 2
- RSS-Gen Issue 5, April 2018
- CFR 47 Part 22 Subpart H (Cellular Radiotelephone Service)
- CFR 47 Part 90 (Private Land Mobile Radio Service) Subpart I, K and L
- 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 MDS LLC model SDM4-1 and therefore apply only to the tested sample. The sample was selected and prepared by Dennis McCarthy of GE MDS LLC.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, the device requires certification. Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of GE MDS LLC model SDM4-1 complied with the requirements of the standards and frequency bands declared in the scope of this test report.

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

DEVIATIONS FROM THE STANDARDS

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

TEST RESULTS

FCC Part 90 and RSS-119

FCC	Canada	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics					
§2.1033 (c) (5) § 90.35		Frequency range(s)	406.1-512 MHz	406.1-512 MHz	Pass
	RSS-119	Frequency range(s)	406.1-430 MHz 450-470 MHz	406.1-430 MHz 450-470 MHz	Pass
§2.1033 (c) (6) §2.1033 (c) (7) § 2.1046 § 90.205	RSS-119	RF power output at the antenna terminals	30 to 40.2 dBm	Determined based on License	Pass
§2.1033 (c) (4) § 2.1047 § 90.210	RSS-119	Emission types	F1D, F2D, F3D		
		Emission mask	Masks C, D, E	Within Mask	Pass
§ 2.1049 § 90.209	RSS-GEN 6.7 RSS-119	Occupied Bandwidth	3.51 kHz 9.13 kHz 16.6 kHz	6 kHz 11.25 kHz 20.0 kHz	Pass
§ 90.214	RSS-119	Transient Frequency Behavior	Within allowed deviation	Within allowed deviation	Pass
Transmitter spurious emissions					
§ 2.1051 § 2.1057	RSS-119	At the antenna terminals	-25.2 dBm @ 312 kHz (-0.2 dB)	-25 dBm	Pass
§ 2.1053 § 2.1057	RSS-119	Field strength	-27.8 dBm erp @ 900.0 MHz (-2.8 dB)	-25 dBm	Pass
Other details					
§ 2.1055 § 90.213	RSS-119	Frequency stability	0.3 ppm	0.5 ppm	Pass
§ 2.1093	RSS-102	RF Exposure	Complies, see separate exhibit		
§2.1033 (c) (8)		Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range	24V DC and 2.5 A		
-	-	Antenna Gain	Maximum 16 dBi declared		
Notes					

FCC		Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics					
§2.1033 (c) (5) §22.561 §22.651 §22.725		Frequency range(s)	454-455 MHz 456-460 MHz 470-512 MHz	454-455 MHz 456-460 MHz 470-512 MHz	Pass
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 §22.565 §22.659		ERP	46.0 dBm to 56.2 dBm	50.0 dBm to 65.4 dBm ERP depending on frequency	Pass
§2.1033 (c) (4) §2.1047 §22.357 §22.359(a)		Emission types	F1D, F2D, F3D		
		Emission limits	Below limit	43 + 10*log(P)	Pass
§2.1049 §22.561 §22.651 §22.725		Occupied Bandwidth	3.51 kHz 9.13 kHz 16.6 kHz	20 kHz	Pass
Transmitter spurious emissions					
§2.1051 §2.1057 §22.917		At the antenna terminals	-25.2 dBm @ 312 kHz (-12.2 dB)	-13 dBm	Pass
§2.1053 §2.1057 §22.917		Field strength	-27.8 dBm erp @ 900.0 MHz (-14.8 dB)	-13 dBm	Pass
Other details					
§2.1055 §22.355	RSS-132 4.3	Frequency stability	0.3 ppm	2.5 ppm	Pass
§2.1093	RSS-102	RF Exposure	Complies, see separate exhibit		
§2.1033 (c) (8)		Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range	24V DC and 2.5 A		
-	-	Antenna Gain	Maximum 16 dBi declared		
Notes					

EXTREME CONDITIONS

Frequency stability is determined over extremes of temperature and voltage. The extremes of voltage were 23 to 25 volts DC.

The extremes of temperature were -30°C to +70°C as specified in FCC §2.1055(a)(1) and per product specifications.

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 SDM4-1 is an industrial radio module operating in the 406.1-512 MHz bands and uses CPFSK modulation. Since the EUT could be placed in any position during operation, the EUT was treated as table-top equipment during testing to simulate the end-user environment. The electrical rating of the EUT module is +24 Volts DC, 2.5 Amps max.

The sample was received on July 15, 2019 and tested on July 15, 16, 17 and 18, 2019. The following samples of the EUT were used for testing:

Company	Model	Description	Serial Number	FCC ID
GE MDS	SDM4-1	Radio module	3441793 (406.1 - 430 MHz)	E5MDS-SDM4-1
GE MDS	SDM4-1	Radio module	3441787 (450 - 512 MHz)	E5MDS-SDM4-1

OTHER EUT DETAILS

The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes. In some cases, the highest internal source determines the frequency range of test for radiated emissions. The highest internal source of the EUT was declared as: 621 MHz.

ENCLOSURE

The EUT does not have an enclosure as it is intended to be installed in a complete product. The PCB measures approximately 40 cm wide by 60 cm deep by 15 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	DC power supply	2430A-03013	-
GE MDS	-	Test Fixture	None	-

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

Company	Model	Description	Serial Number	FCC ID
HP	Probook	Laptop	5CB2480TRQ	-

INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Fixture DC	DC power supply	2 wire	Unshielded	1.0
Fixture Serial	Laptop	Multiwire	Shielded	2.0

EUT OPERATION

During emissions testing the EUT was set for continuous transmission at the specified channel frequencies and power.

TESTING

GENERAL INFORMATION

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

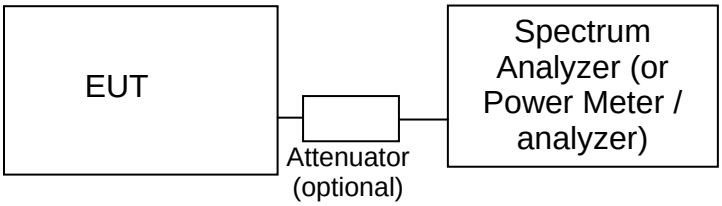
Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 6.2 of RSS-GEN, NTS has been recognized as an accredited test laboratory by the Commission and Innovation, Science and Economic Development Canada. A description of the facilities employed for testing is maintained by NTS.

Site	Company / Registration Numbers		Location
	FCC	Canada	
Chamber 4	US1031	2845B (Wireless test lab #US0027)	41039 Boyce Road Fremont, CA 94538-2435

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

Radiated spurious emissions measurements are made in accordance with ANSI C63.26 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. 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), 15-Jul-19					
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	2/8/2019	2/8/2020
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts (w/ 20 dB attenuator)	NRV-Z32	1536	6/28/2019	6/28/2020
Radio Antenna Port (Transient Frequency Behaviour), 15-Jul-19					
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESI 40	2493	3/15/2019	3/15/2020
Rohde & Schwarz	signal generator 100KHz-12.75GHz	SMB 100A	3002		N/A
Tektronix	350 MHz Digital Oscilloscope	TDS5034B	3255	2/21/2019	2/21/2020
Radio Antenna Port (Spurious Emissions), 16-Jul-19					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
National Technical Systems	NTS Capture Analyzer Software (rev 3.8)	N/A	0		N/A
Filtek	Filter, 1 GHz High Pass	HP12/1000-5BA	957	4/25/2019	4/25/2020
Agilent Technologies	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	7/27/2018	7/27/2019
Radio Antenna Port (Mask and Bandwidth), 15-Jul-19					
National Technical Systems	NTS Mask Software (rev 3.8)	N/A	0		N/A
National Technical Systems	NTS Capture Analyzer Software (rev 3.8)	N/A	0		N/A
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/21/2019	5/21/2020
Radio Antenna Port (Stability), 16-Jul-19					
Fluke	Multimeter, True RMS	111	1480	4/23/2019	4/23/2020
Rohde & Schwarz	Signal Analyzer 20 Hz - 26.5 GHz	FSQ26	2327	7/4/2019	7/4/2020
Watlow	F4 Controller	F4DH-CCCC-21RG	3166	5/8/2019	5/8/2020
Radiated Emissions, 30 - 1,000 MHz, 17-Jul-19					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1548	10/24/2018	1/9/2021
Rohde & Schwarz	EMI Test Receiver 20 Hz - 26.5 GHz	ESIB26	WC071498	4/9/2019	4/9/2020
Hewlett Packard	Spectrum Analyzer (SA40) Blue 9 kHz - 40 GHz	8564E (84125C)	1393	12/8/2018	12/8/2019
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	8/30/2018	8/30/2019

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Substitution measurements, 17-Jul-19					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz (SA40-Blu)	3115	1386	10/8/2018	10/8/2020
Hewlett Packard	Spectrum Analyzer (SA40) Blue 9 kHz - 40 GHz	8564E (84125C)	1393	12/8/2018	12/8/2019
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1534	6/18/2019	6/18/2020
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
Compliance Design	Tuned Dipole Antenna	Roberts (180-400MHz)	1894	4/17/2018	4/17/2020
Rohde & Schwarz	Power Sensor, 1 nW-20 mW, 10 MHz-18 GHz, 50ohms	NRV-Z1	2114	11/7/2018	11/7/2019
Agilent Technologies	MXG Analog Signal Generator 6 GHz	N5181A	2146	1/10/2019	1/10/2020
EMCO	Antenna, Horn, 1-18 GHz	3115	2870	8/24/2017	8/24/2019
Rohde & Schwarz	EMI Test Receiver 20 Hz - 26.5 GHz	ESIB26	WC071498	4/9/2019	4/9/2020
Radiated Emissions, 20 - 30 MHz, 18-Jul-19					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
Rhode & Schwarz	Magnetic Loop Antenna, 9 kHz-30 MHz	HFH2-Z2	WC062457	1/5/2018	1/5/2020
Rohde & Schwarz	EMI Test Receiver 20 Hz - 26.5 GHz	ESIB26	WC071498	4/9/2019	4/9/2020

Appendix B Test Data

TL099808-RA Pages 23 - 61

Client:	GE MDS LLC	PR Number:	PR099808
Product	SDM4-1	T-Log Number:	TL099808-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

SDM4-1

Date of Last Test: 7/18/2019

Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

RSS-119 and FCC Parts 22 and 90

Power, Occupied Bandwidth, 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, 3m from the measurement antenna.

Ambient Conditions:

Temperature: 23 °C

Rel. Humidity: 39 %

Summary of Results

Run #	Spacing	Data Rate	Test Performed	Limit	Pass / Fail	Result / Margin
1			Output Power	Determined at time of Licensing	Pass	40.2 dBm
2			Spectral Mask	Masks C, D, E	Pass	Within mask
2			Band Edge	-13 dBm	Pass	-15.0 dBm (-2.0 dB)
3	6.25 kHz 12.5 kHz 25.0 kHz		99% or Occupied Bandwidth	FCC Part 90	-	3.51 kHz 9.13 kHz 16.6 kHz
4			Spurious Emissions (conducted)	FCC Part 90	Pass	-25.2 dBm @ 312 MHz (-0.2 dB)
5			Spurious emissions (radiated)	FCC Part 90		-27.8 dBm erp @ 900.0 MHz (-2.8 dB)
6			Transient Frequency Behavior	FCC Part 90	Pass	Whitin allowed deviation
7			Frequency Stability	0.5 ppm	Pass	0.3 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	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #1: Output Power

Date of Test: 7/15/2019 Config. Used: 1

Test Engineer: David Bare Config Change: None

Test Location: Fremont EMC Lab #4B EUT Voltage: 24 VDC

Cable Loss: Attenuator: Total Loss: 0.0 dB

Cable ID(s): Attenuator IDs:

Power Setting[2]	Frequency (MHz)	Output Power (dBm) [1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W
40	406.1	40.1	10232.9	16.0	Pass	56.1	407.380
40	421	40.2	10471.3	16.0	Pass	56.2	416.869
40	430	40.2	10471.3	16.0	Pass	56.2	416.869
40	450	40.2	10471.3	16.0	Pass	56.2	416.869
40	454	40.2	10471.3	16.0	Pass	56.2	416.869
40	470	40.2	10471.3	16.0	Pass	56.2	416.869
40	512[3]	40.1	10232.9	16.0	Pass	56.1	407.380

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:	RSS-119 does not allow frequencies above 470 MHz

Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

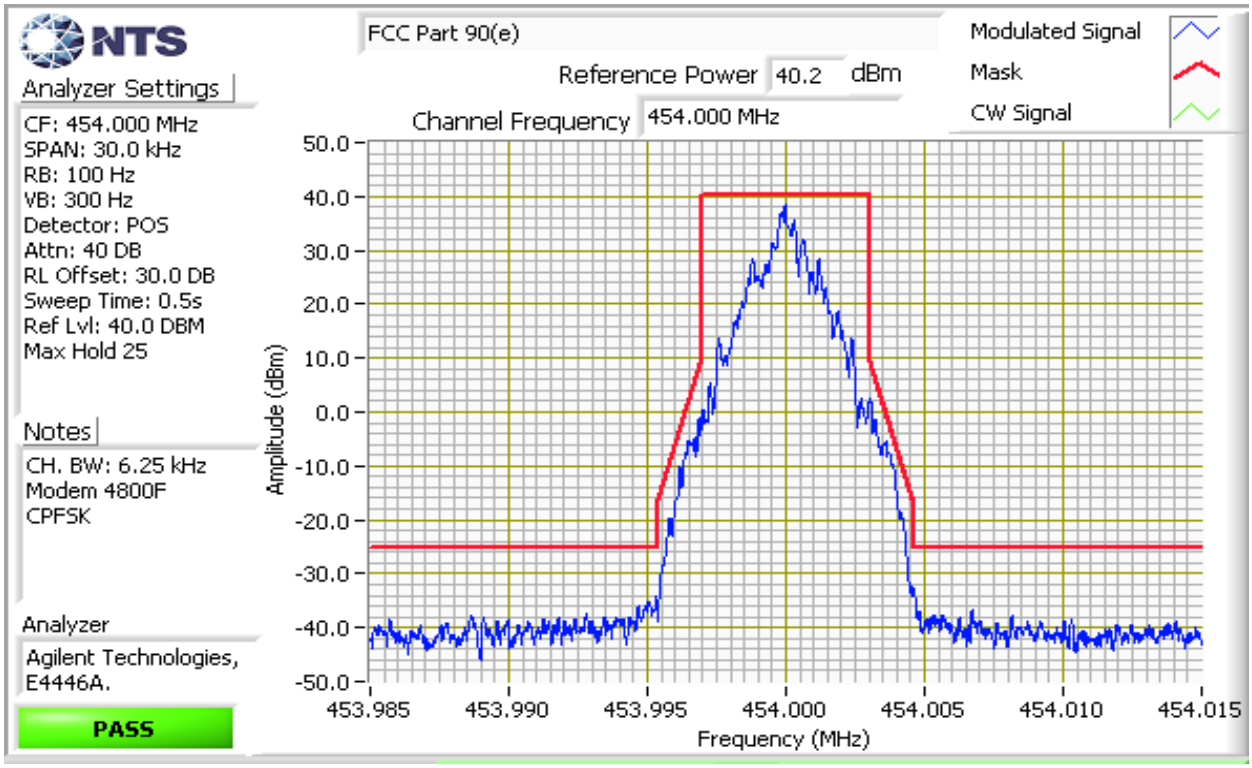
Run #2: Spectral Mask, FCC Part 90 Masks C, D or E

Date of Test: 7/15/2019 Config. Used: 1

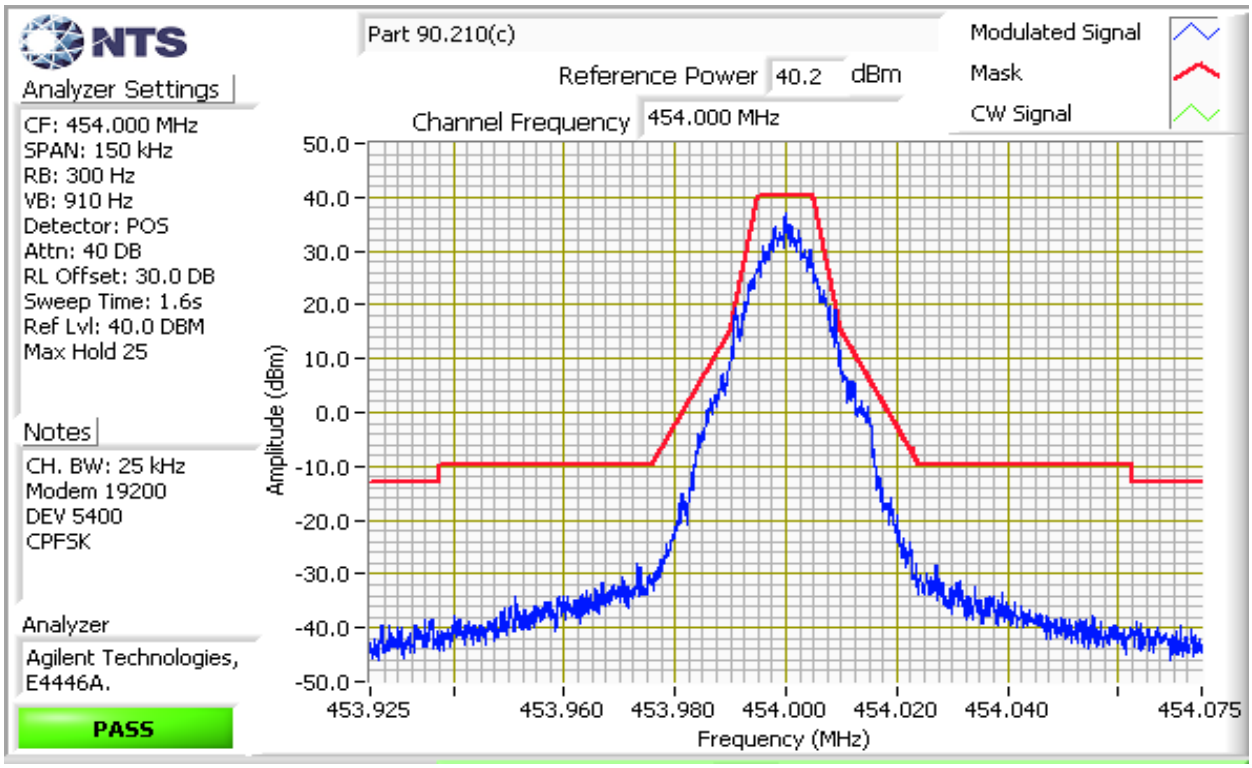
Test Engineer: David Bare Config Change: None

Test Location: Fremont EMC Lab #4B EUT Voltage: 24 VDC

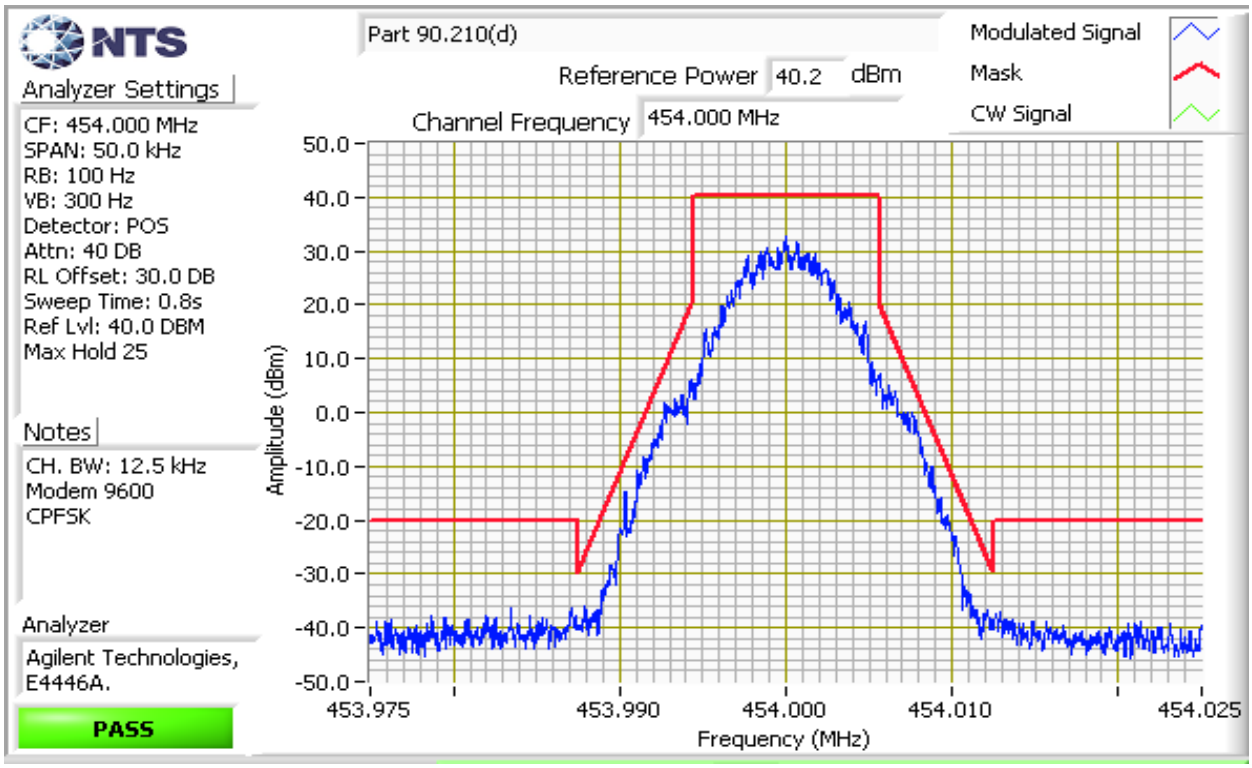
Note 1:	The reference for the top of the mask was determined with peak power meter measurements.



Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A



Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A



Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #2: Band edge FCC §22.359

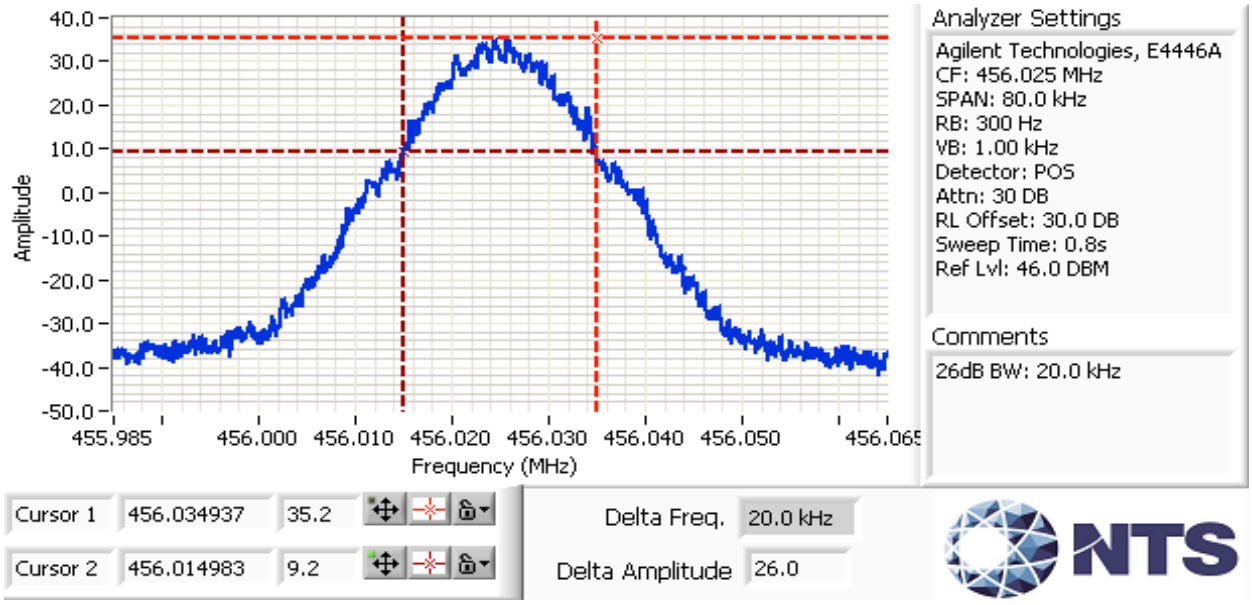
On any frequency outside the 454-512 MHz bands, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB (-13 dBm)

Compliance with this section is based on the use of measurement instrumentation employing a resolution bandwidth of 30 kHz or greater. However, in the 60 kHz bands immediately outside and adjacent to the frequency bands a resolution bandwidth of at least 1% of the emissions bandwidth may be employed. Refer to the rule part to determine appropriate settings and if need for 26 dB bandwidth to determine minimum BW used for tests.

Bands : 454 MHz to 455 MHz, 456 MHz to 460 MHz and 470 MHz to 512 MHz

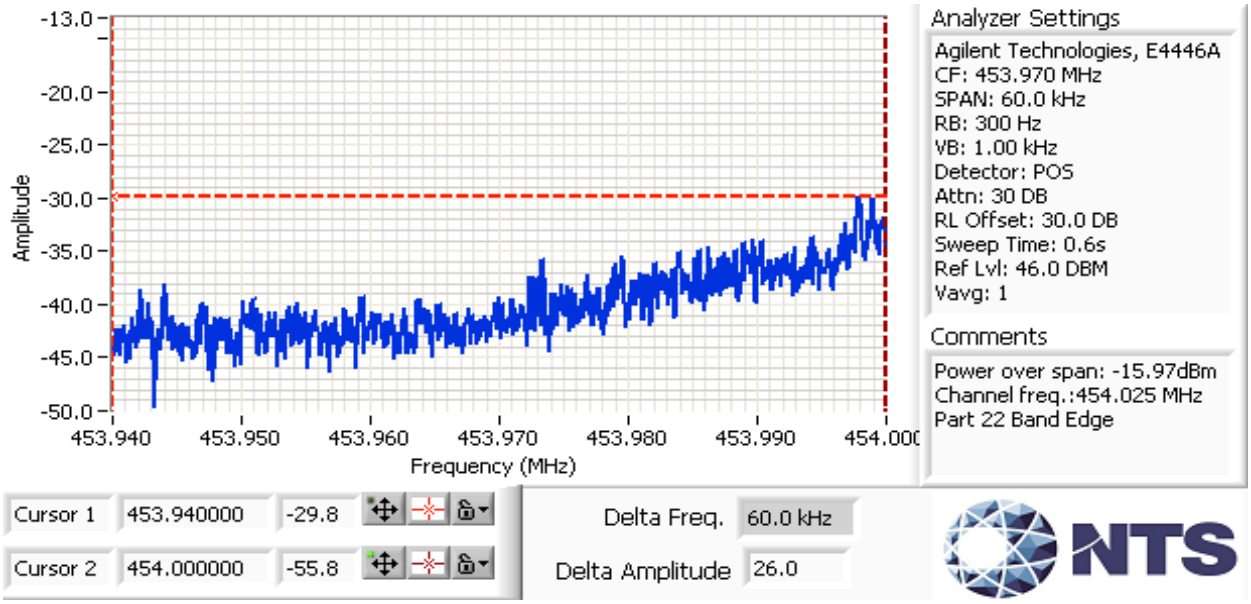
Channel frequency MHz		Ch. BW kHz	Band edge frequency (MHz)		Worst case spurious dBm	Limit (dBm)	Margin (dB)
Low	454.02500	25	Low	454.0000	-16.0	-13.0	-3.0
High	454.97500	25	High	455.0000	-17.0	-13.0	-4.0
Low	456.02500	25	Low	456.0000	-15.0	-13.0	-2.0
High	459.96250	25	High	460.0000	-17.5	-13.0	-4.5
Low	470.02500	25	Low	470.0000	-15.2	-13.0	-2.2
High	511.96250	25	High	512.0000	-15.9	-13.0	-2.9

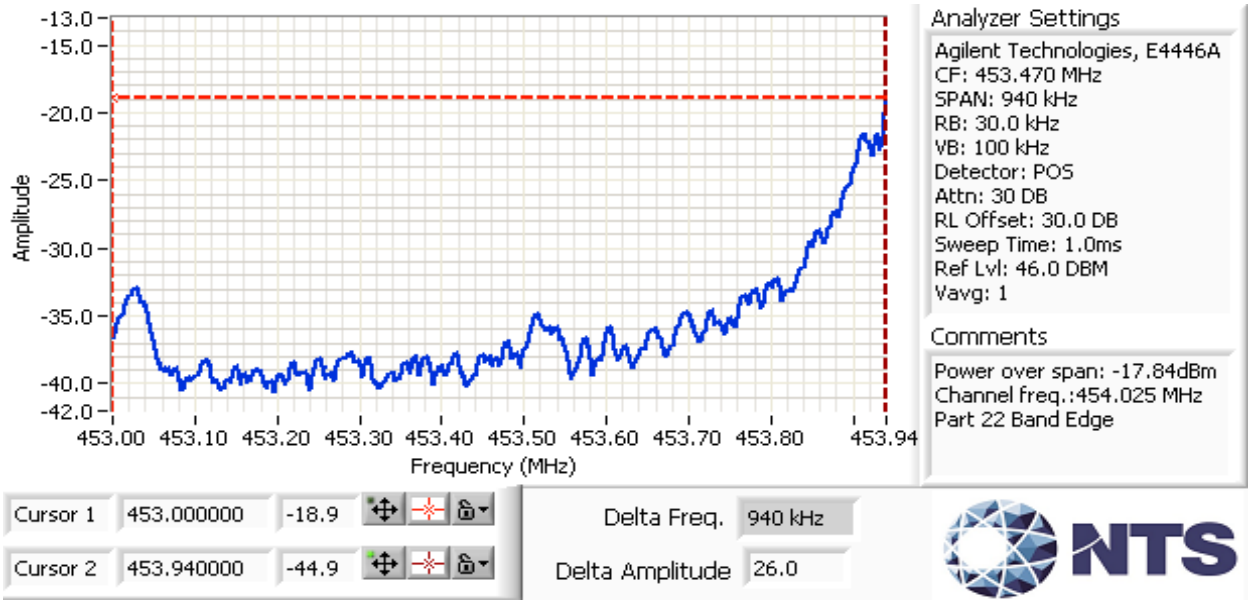
26 dB BW



Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

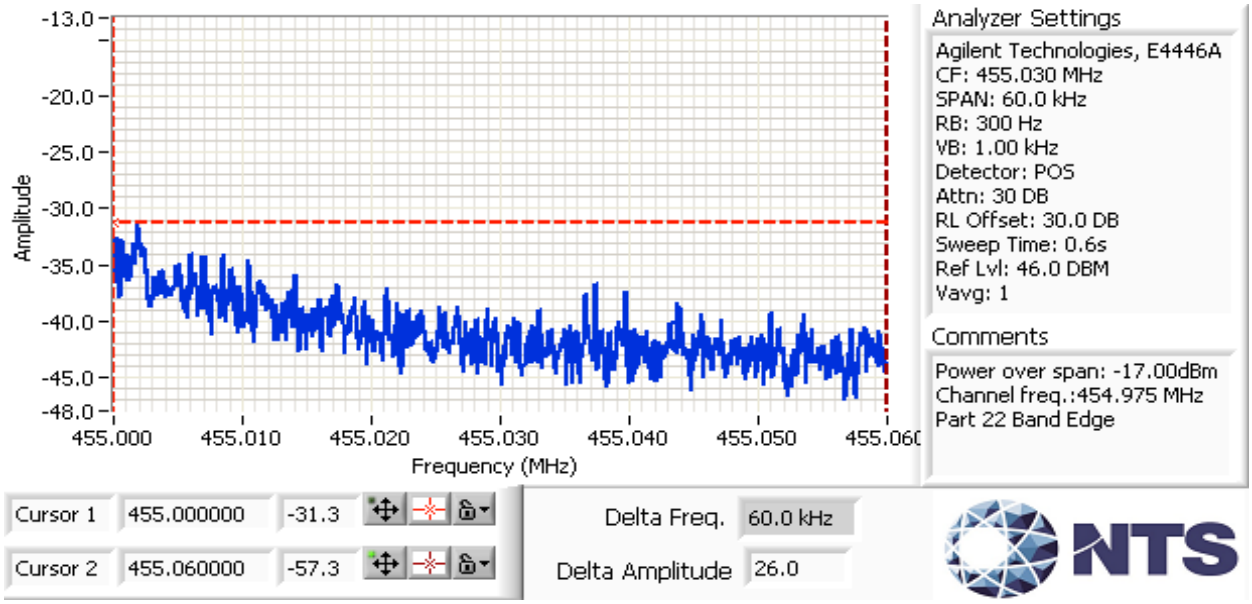
Channel frequency: 454.025 MHz (25 kHz BW) Band edge at 454.0 MHz

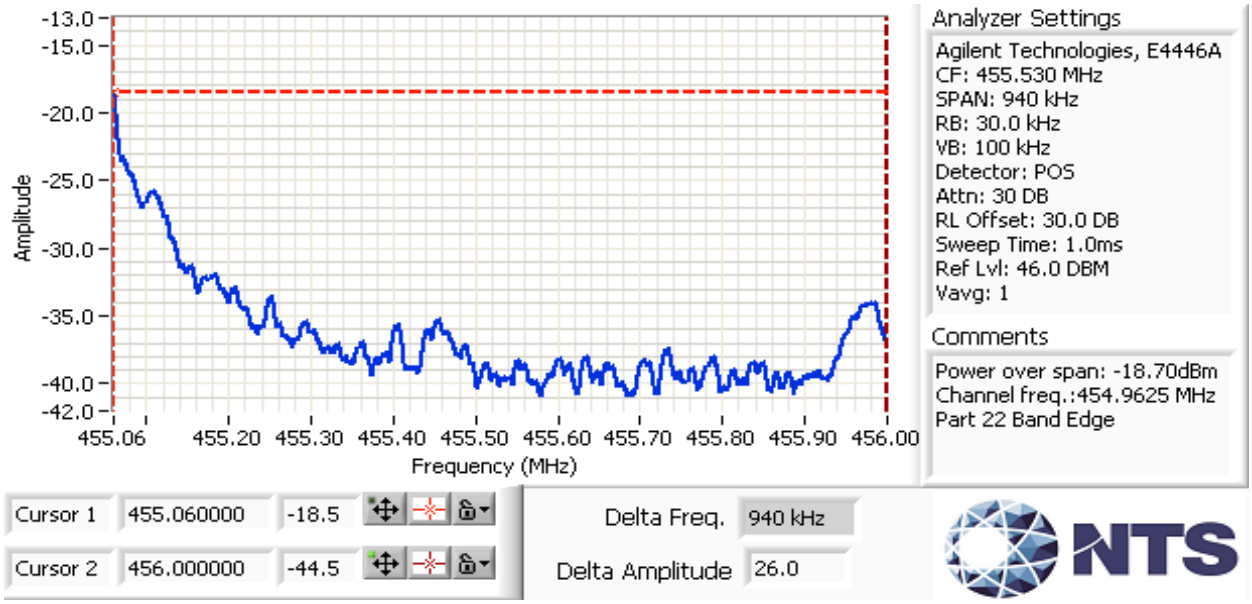




Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

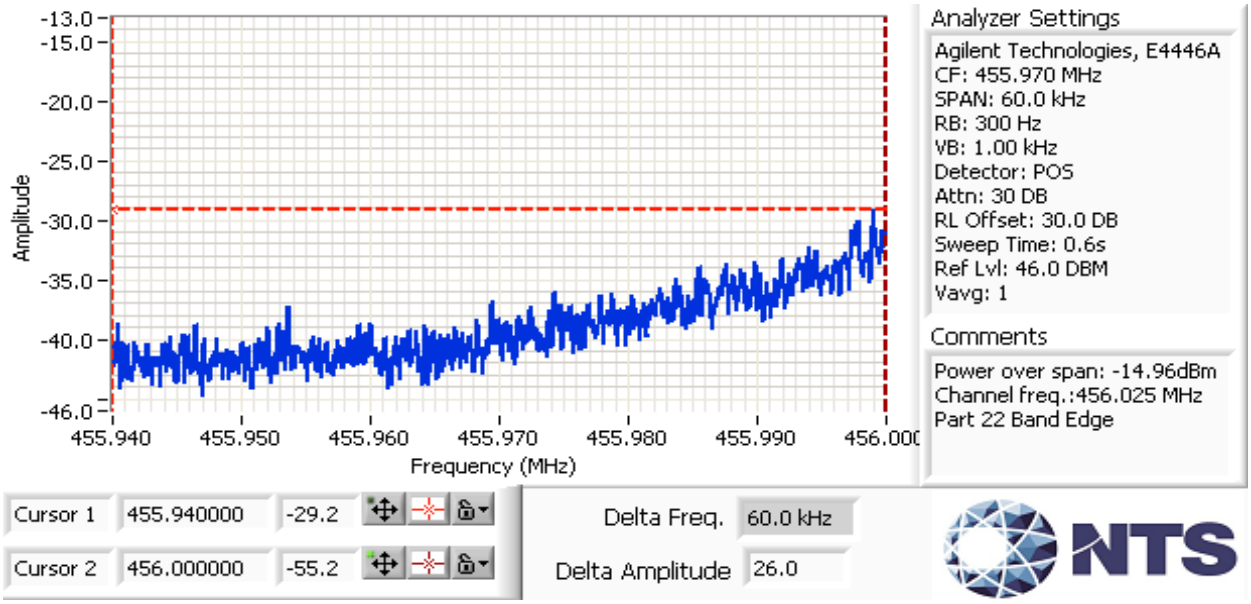
Channel frequency: 454.9625 MHz (25 kHz BW) Band edge at 455.0 MHz

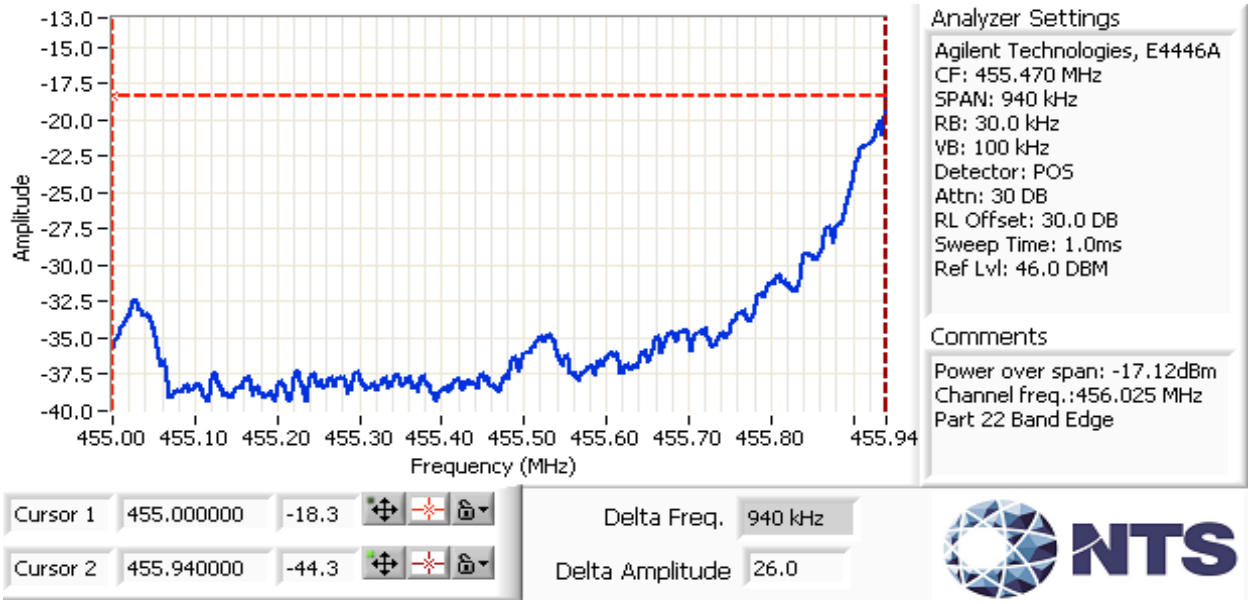




Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

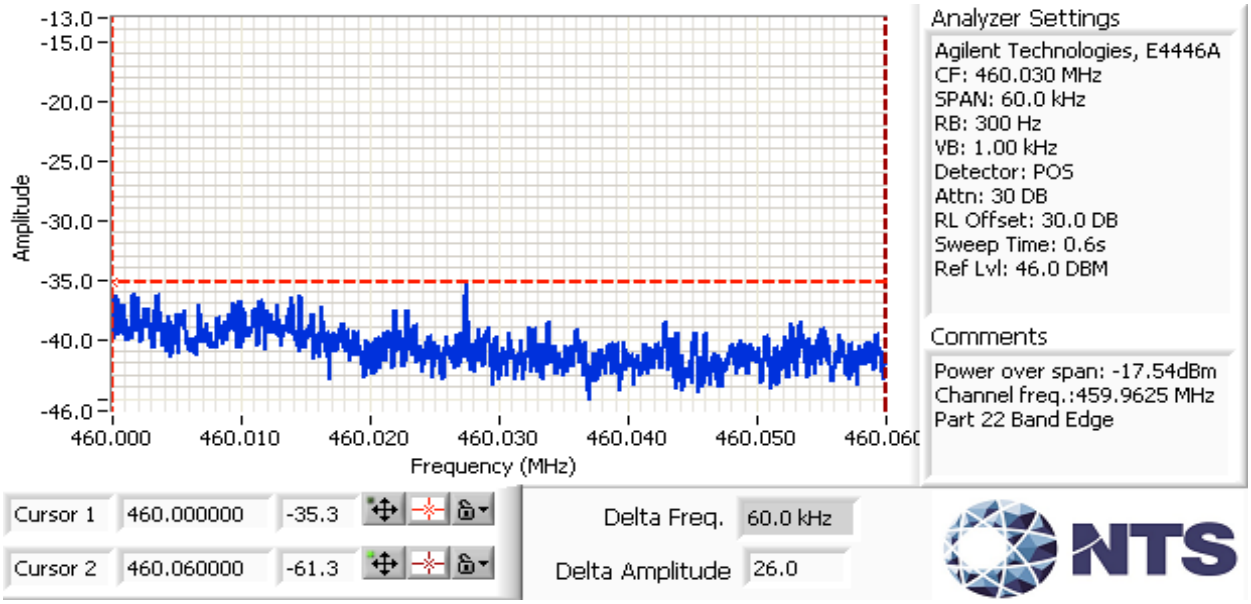
Channel frequency: 456.025 MHz (25 kHz BW) Band edge at 456.0 MHz

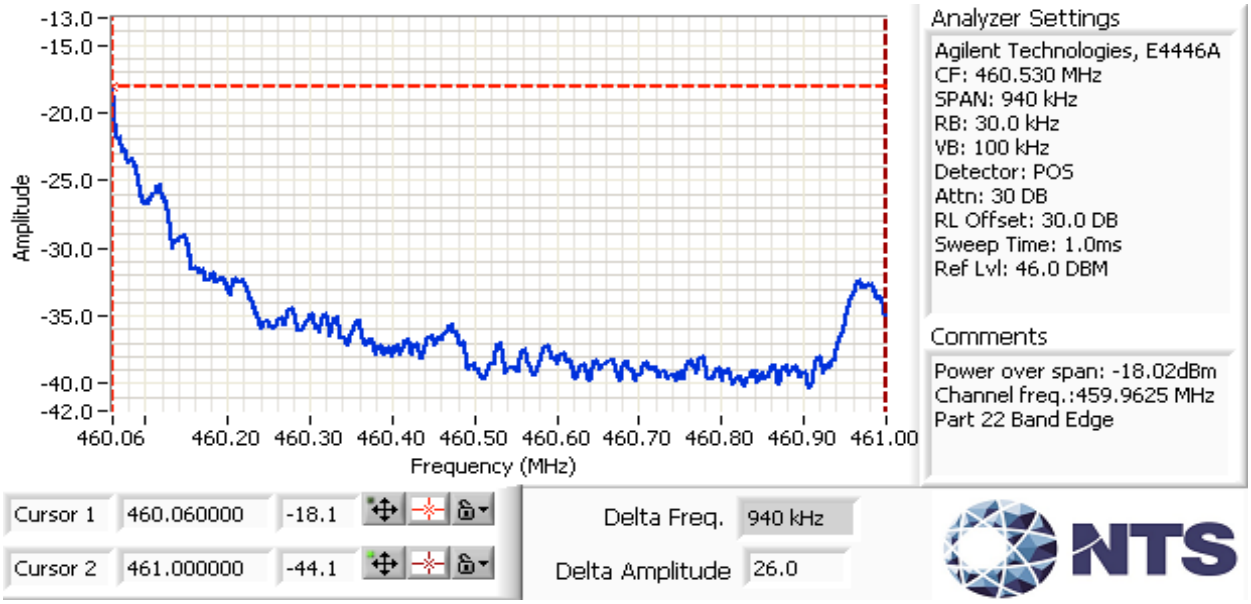




Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

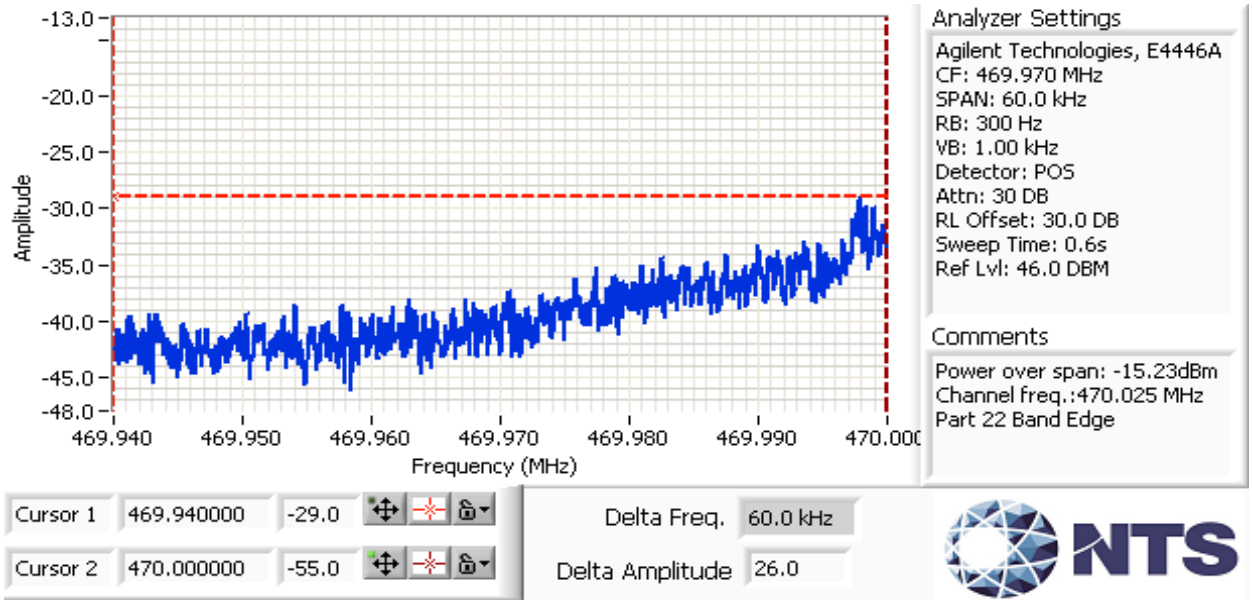
Channel frequency: 459.9625 MHz (25 kHz BW) Band edge at 460.0 MHz

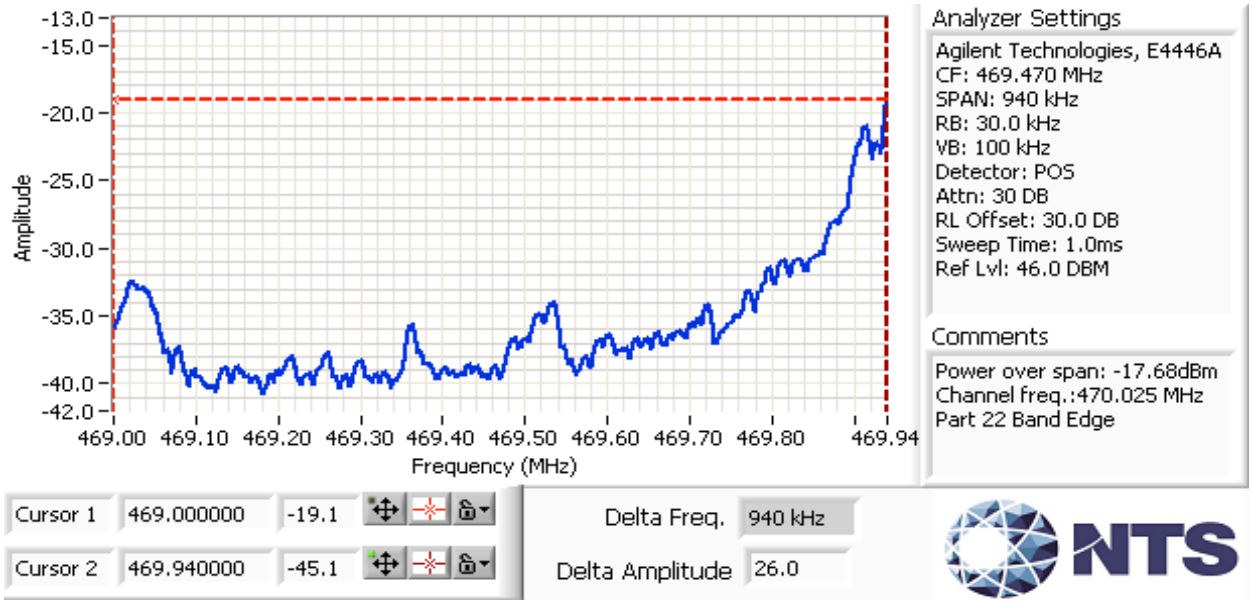




Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

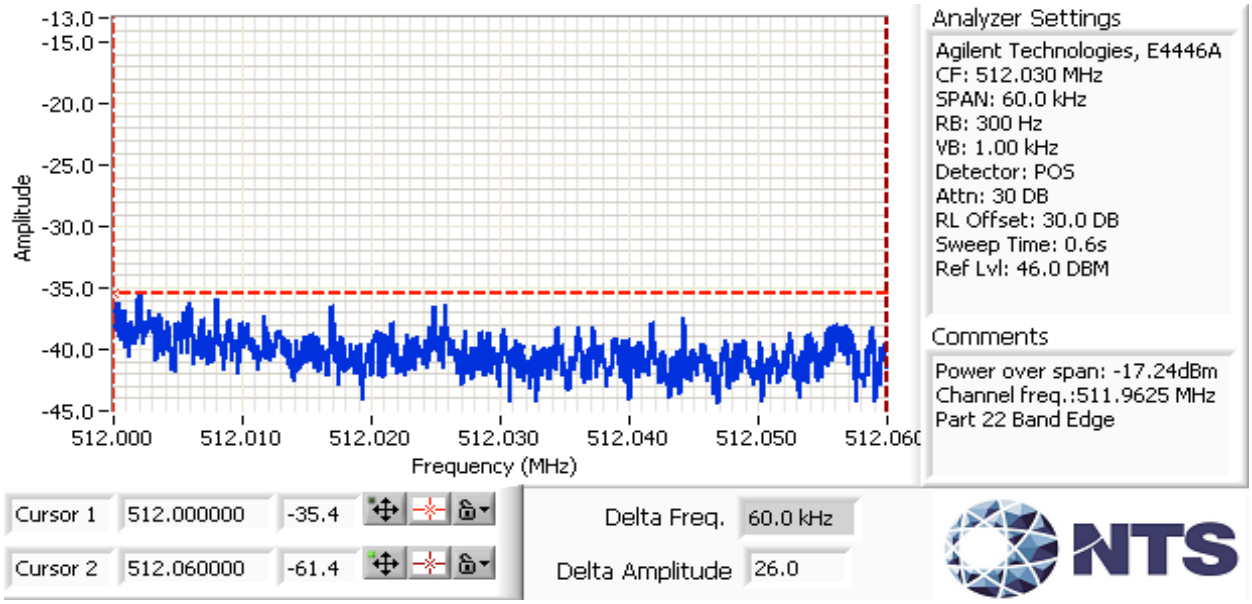
Channel frequency: 470.025 MHz (25 kHz BW) Band edge at 470.0 MHz

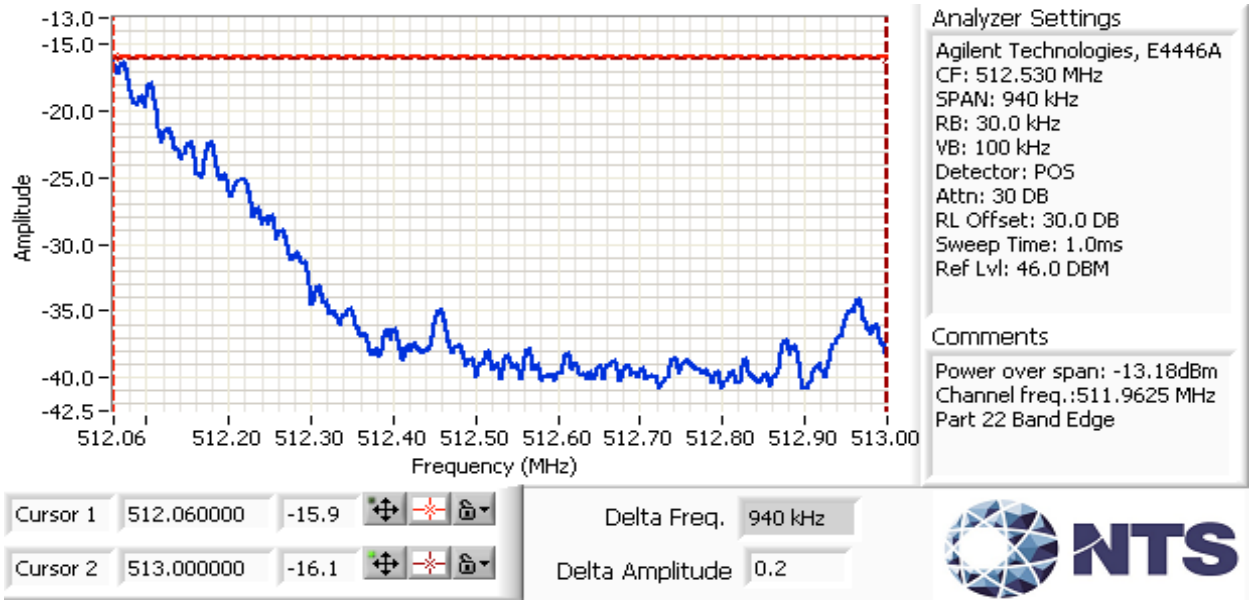




Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Channel frequency: 511.9625 MHz (25 kHz BW) Band edge at 512.0 MHz





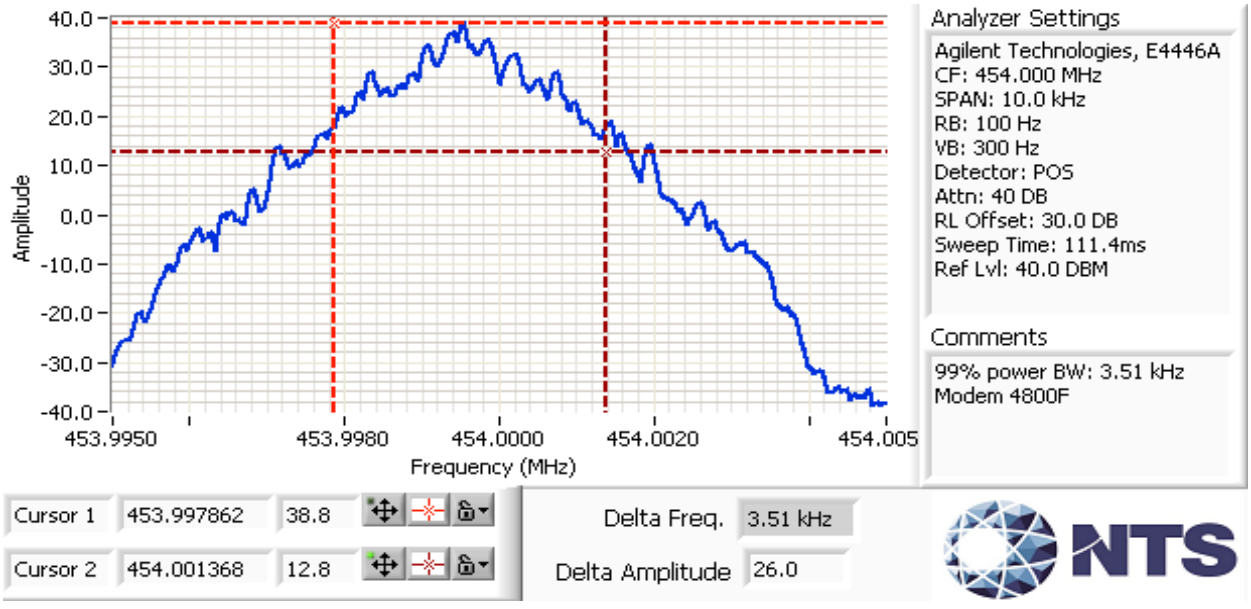
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #3: Signal Bandwidth

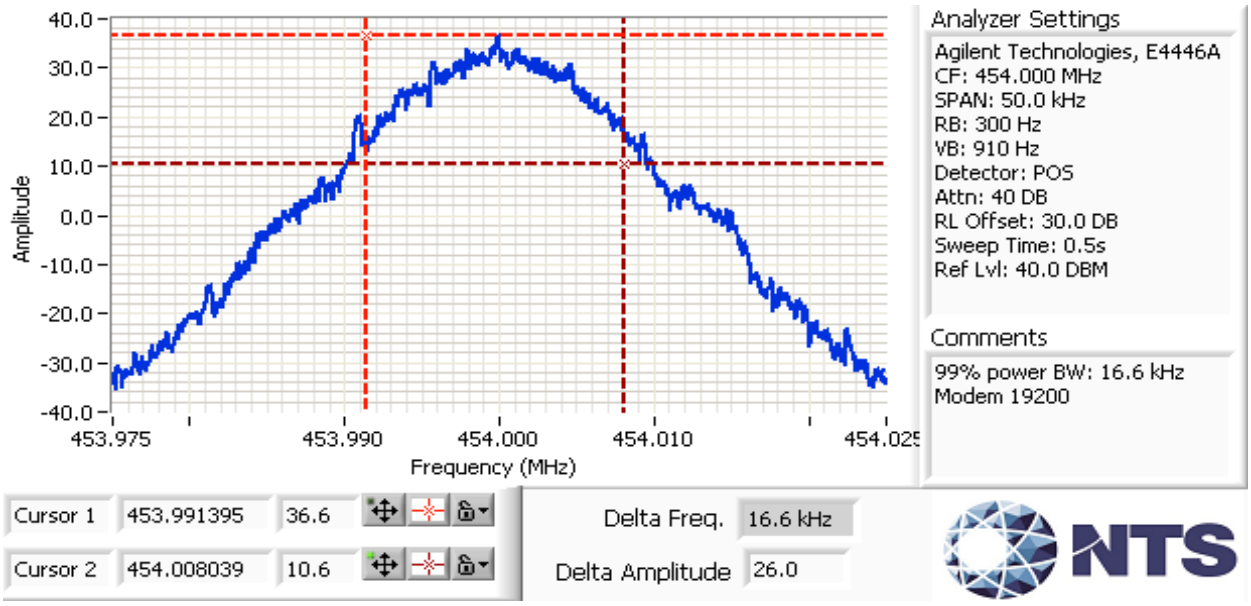
Date of Test: 7/15/2019 Config. Used: 1
Test Engineer: David Bare Config Change: None
Test Location: Fremont EMC Lab #4B EUT Voltage: 24 VDC

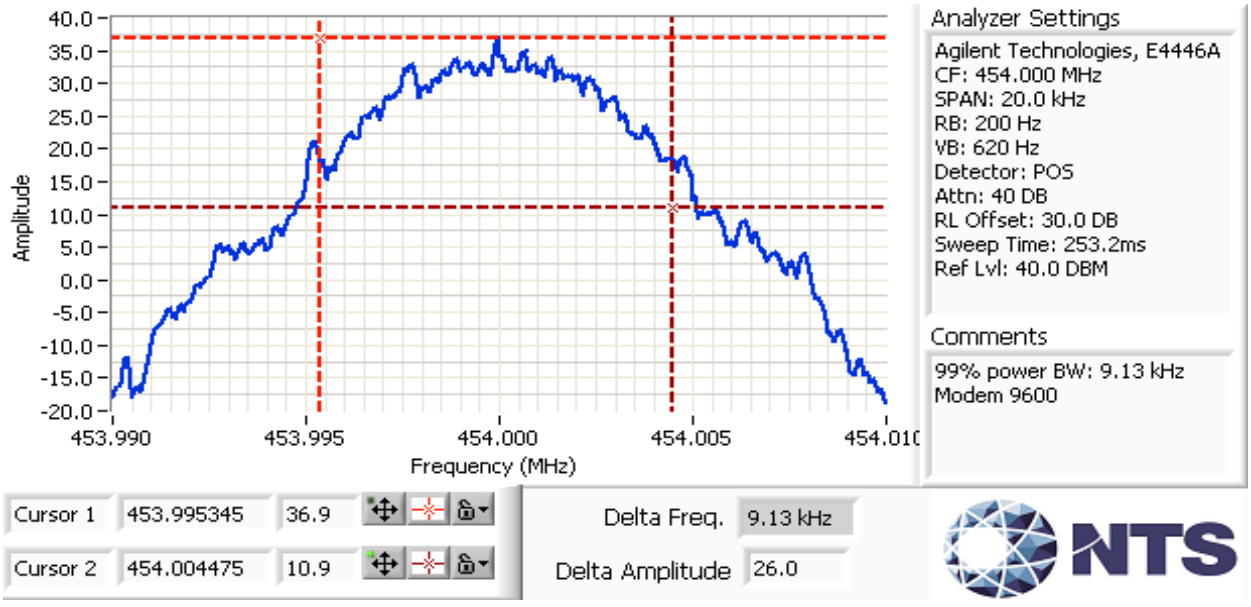
Power Setting	Frequency (MHz)	Modulation	Resolution Bandwidth	Bandwidth (kHz)	99%	
40	454	4800	100 Hz		3.51	Modem 4800F
40	454	9600	200 Hz		9.13	Modem 9600
40	454	19200	300 Hz		16.60	Modem 19200

Note 1:	99% bandwidth measured in accordance with ANSI C63.10, with RB between 1% and 5% of the measured bandwidth and VB ≥ 3*RB and Span ≥ 1.5% and ≤ 5% of measured bandwidth.



Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A





Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #4: Out of Band Spurious Emissions, Conducted

Date of Test: 7/15/2019 Config. Used: 1

Test Engineer: Deniz Demirci Config Change: None

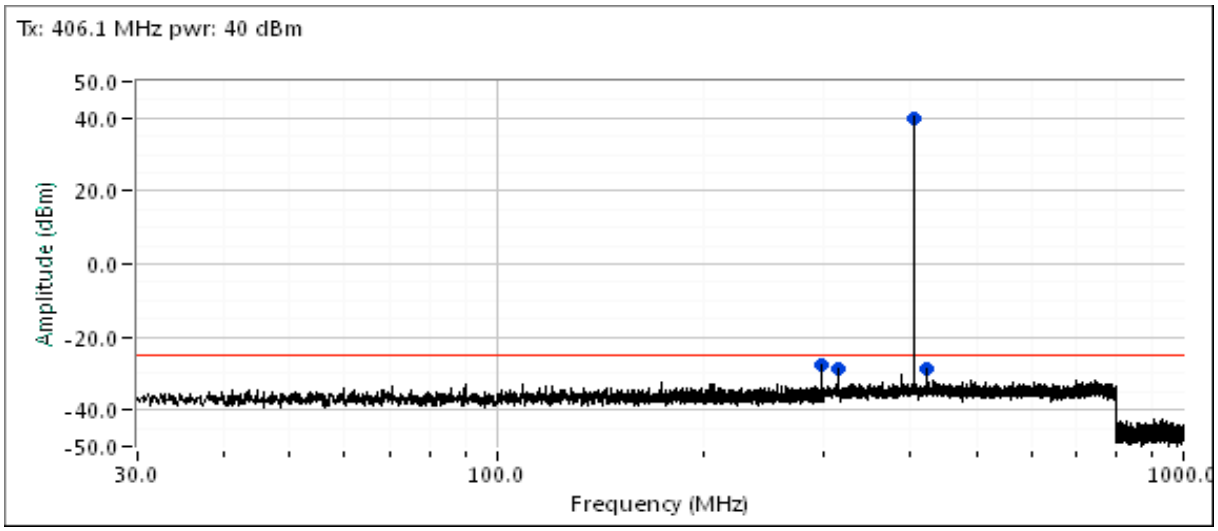
Test Location: FT Lab #4b EUT Voltage: 24 Vdc

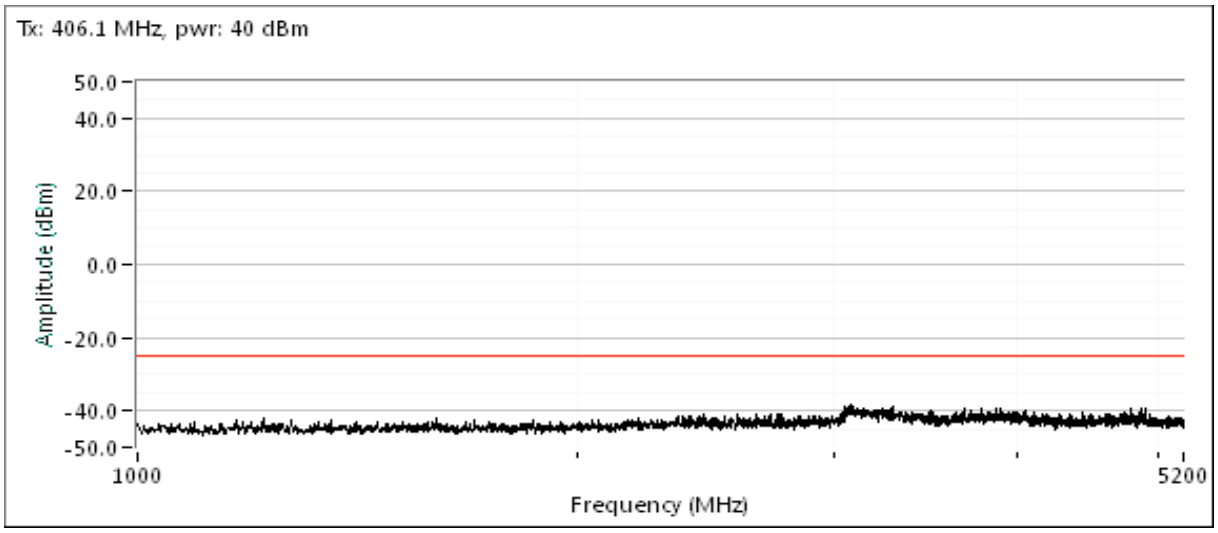
Frequency (MHz)	Limit	Result
406.1	-25	Pass
421	-25	Pass
430	-25	Pass
450	-25	Pass
454	-25	Pass
470	-25	Pass
512	-25	Pass

The limit is taken from FCC Part 90 Mask E.

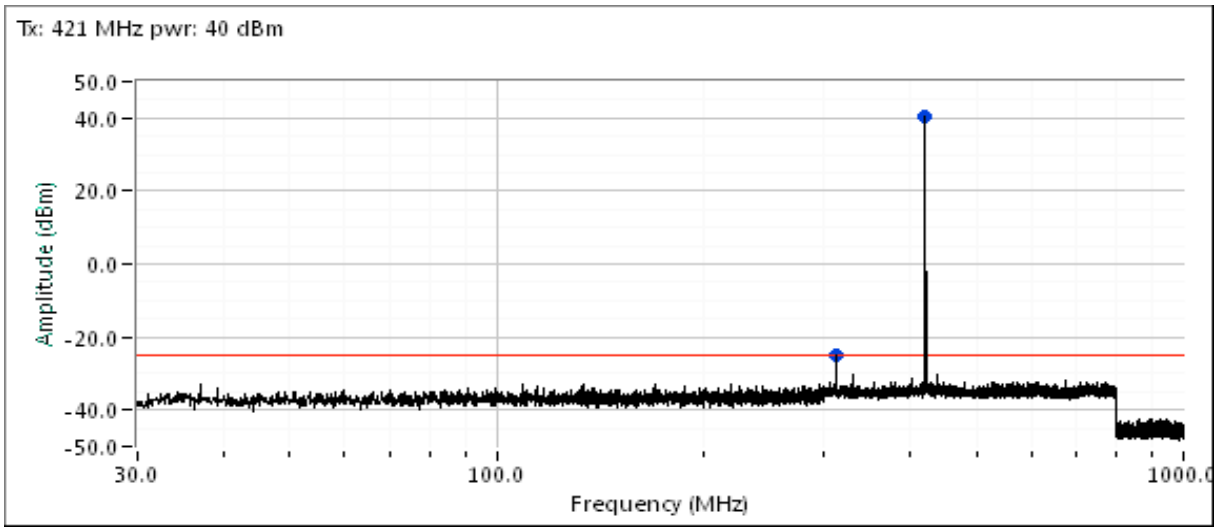
Frequency	Level	Port	FCC Part 90		Detector	Azimuth	Height	Comments	Channel
MHz	dBm		Limit	Margin	Pk/QP/Avg	degrees	meters		frequency
297.119	-27.8	RF Port	-25.0	-2.8	PK				406.10
315.172	-28.5	RF Port	-25.0	-3.5	PK				406.10
406.102	40.0	RF Port	-	-	PK			Carrier	406.10
424.041	-28.6	RF Port	-25.0	-3.6	PK				406.10
312.004	-25.2	RF Port	-25.0	-0.2	PK				421.00
421.000	40.2	RF Port	-	-	PK			Carrier	421.00
321.007	-25.4	RF Port	-25.0	-0.4	PK				430.00
430.043	40.1	RF Port	-	-	PK			Carrier	430.00
359.020	-26.5	RF Port	-25.0	-1.5	PK				450.00
449.999	40.2	RF Port	-	-	PK			Carrier	450.00
467.889	-28.6	RF Port	-25.0	-3.6	PK				450.00
540.914	-28.1	RF Port	-25.0	-3.1	PK				450.00
363.021	-26.2	RF Port	-25.0	-1.2	PK				454.00
454.001	40.1	RF Port	-	-	PK			Carrier	454.00
472.057	-27.2	RF Port	-25.0	-2.2	PK				454.00
544.915	-29.3	RF Port	-25.0	-4.3	PK				454.00
361.020	-27.1	RF Port	-25.0	-2.1	PK				470.00
379.026	-28.6	RF Port	-25.0	-3.6	PK				470.00
470.007	40.2	RF Port	-	-	PK			Carrier	470.00
488.063	-25.5	RF Port	-25.0	-0.5	PK				470.00
511.999	40.1	RF Port	-	-	PK			Carrier	512.00
530.077	-30.4	RF Port	-25.0	-5.4	PK				512.00

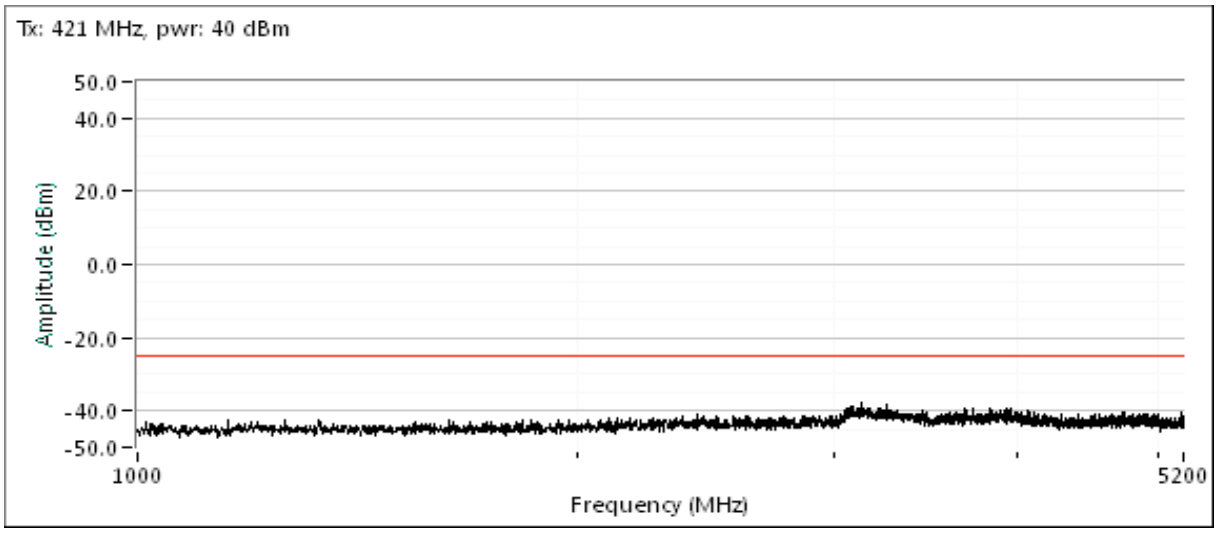
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A



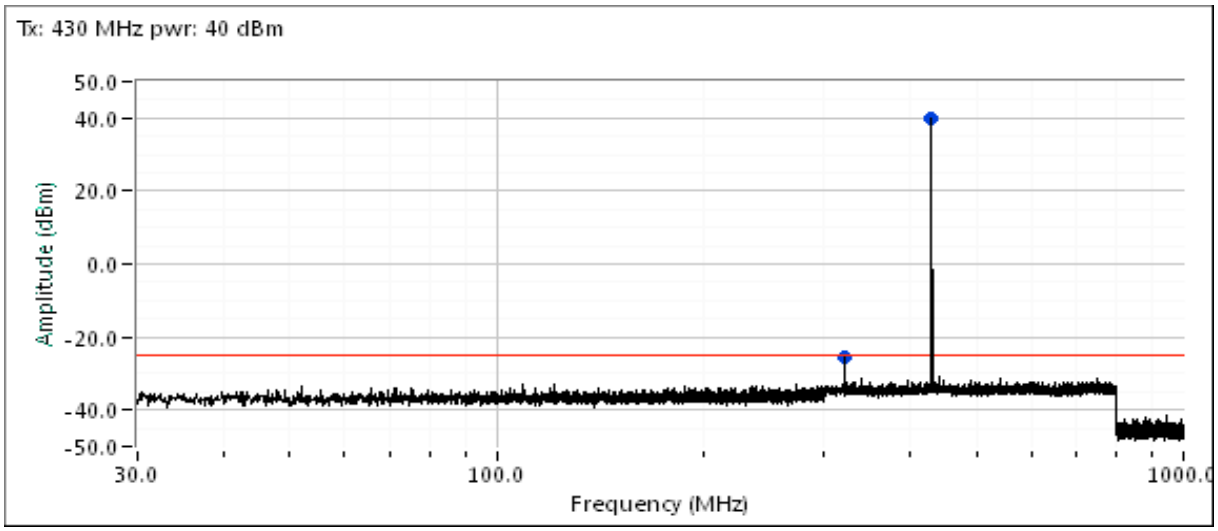


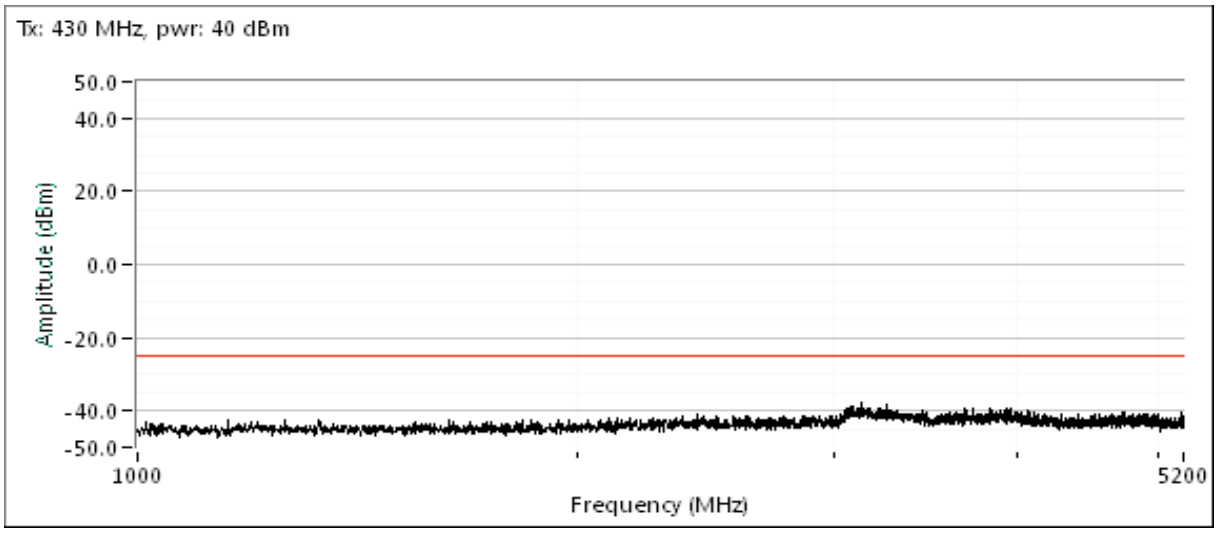
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A



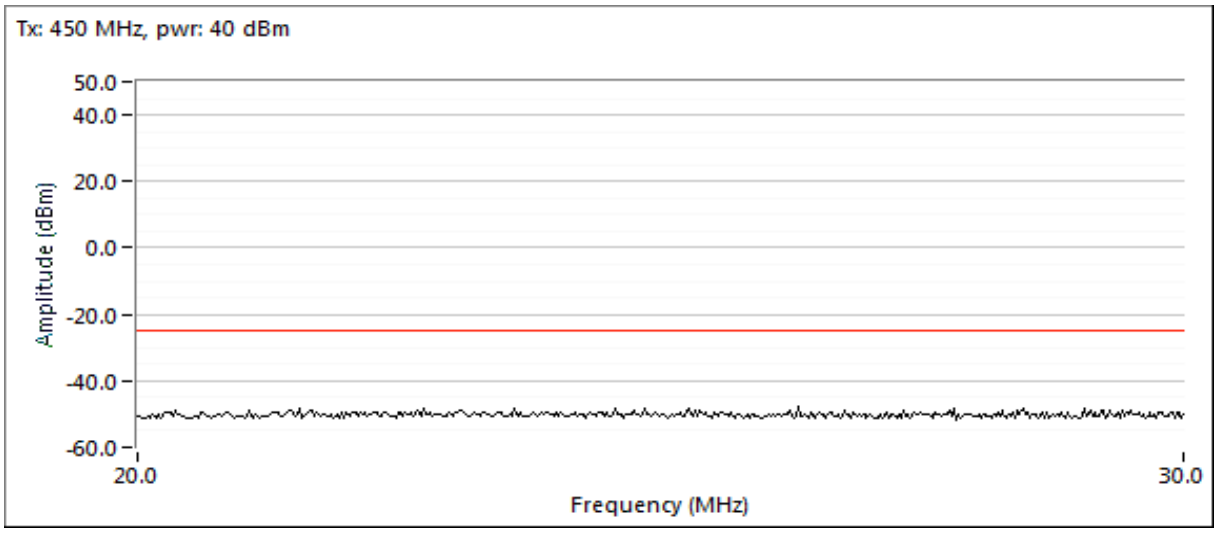


Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

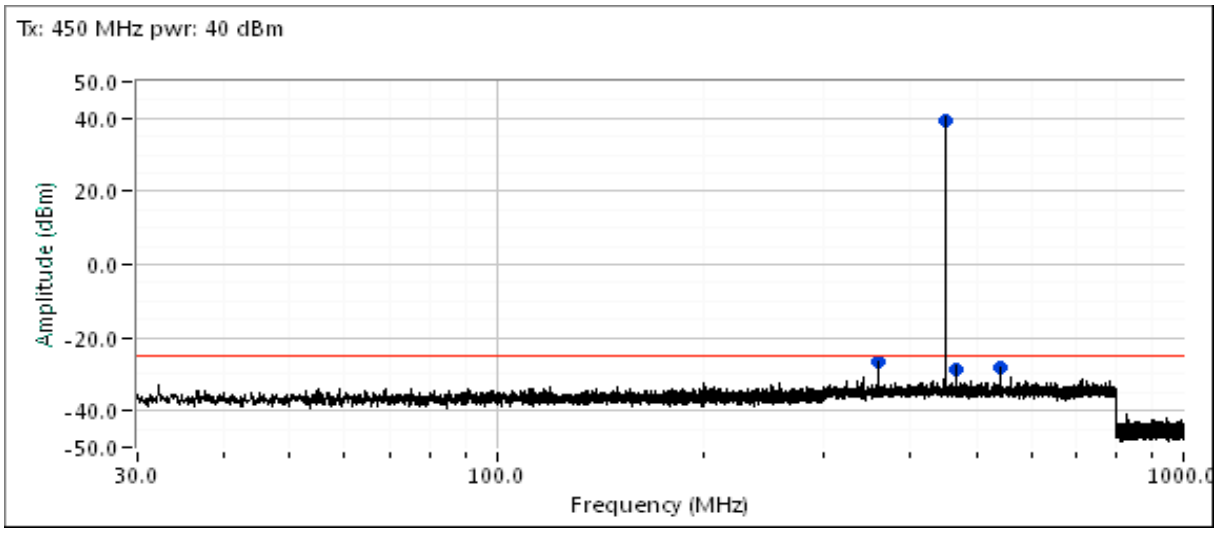


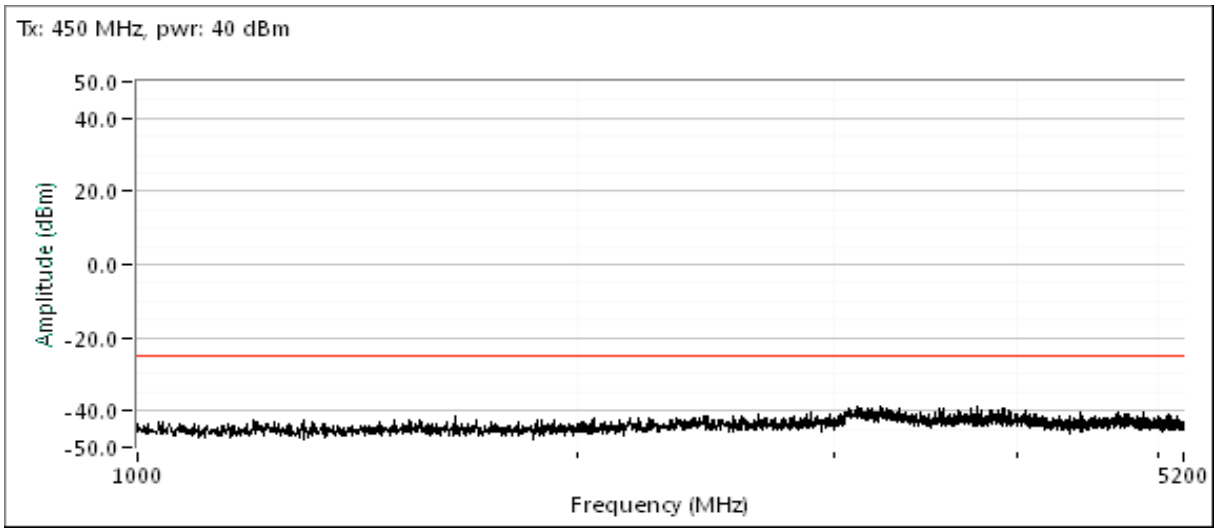


Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

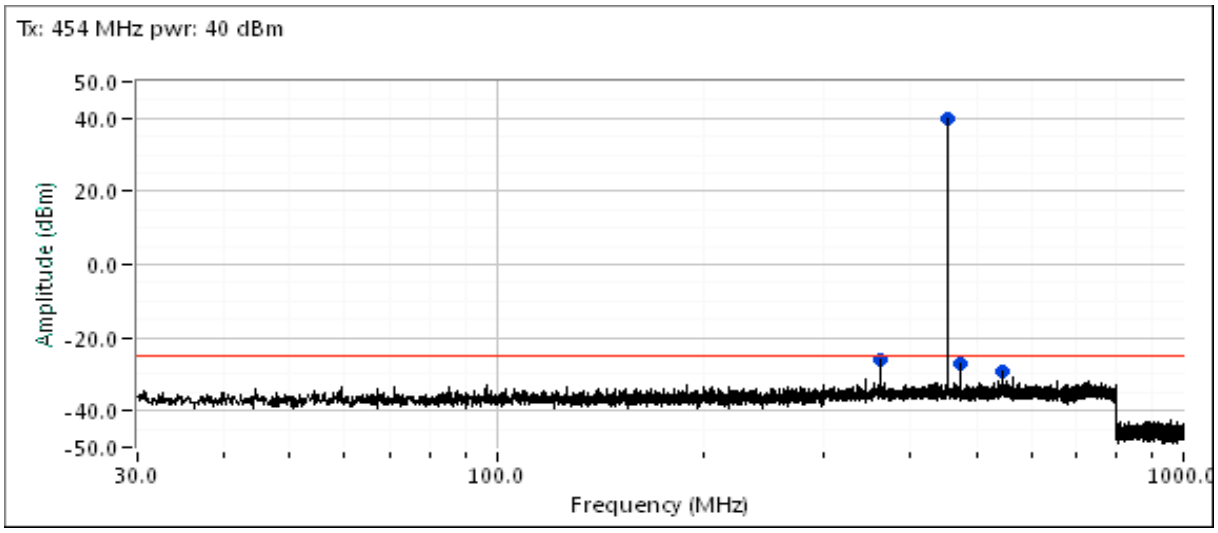


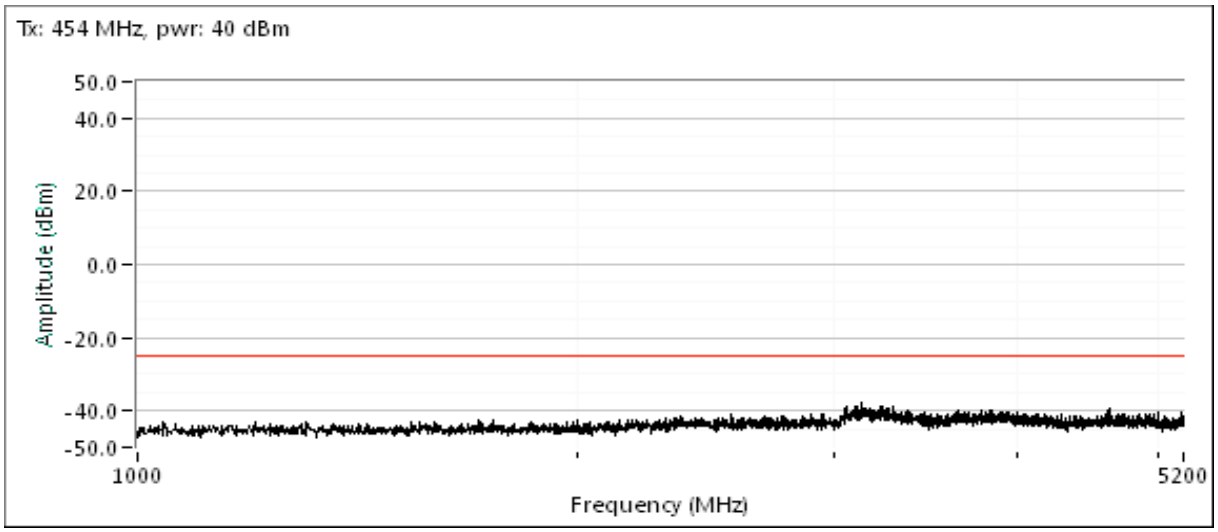
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A



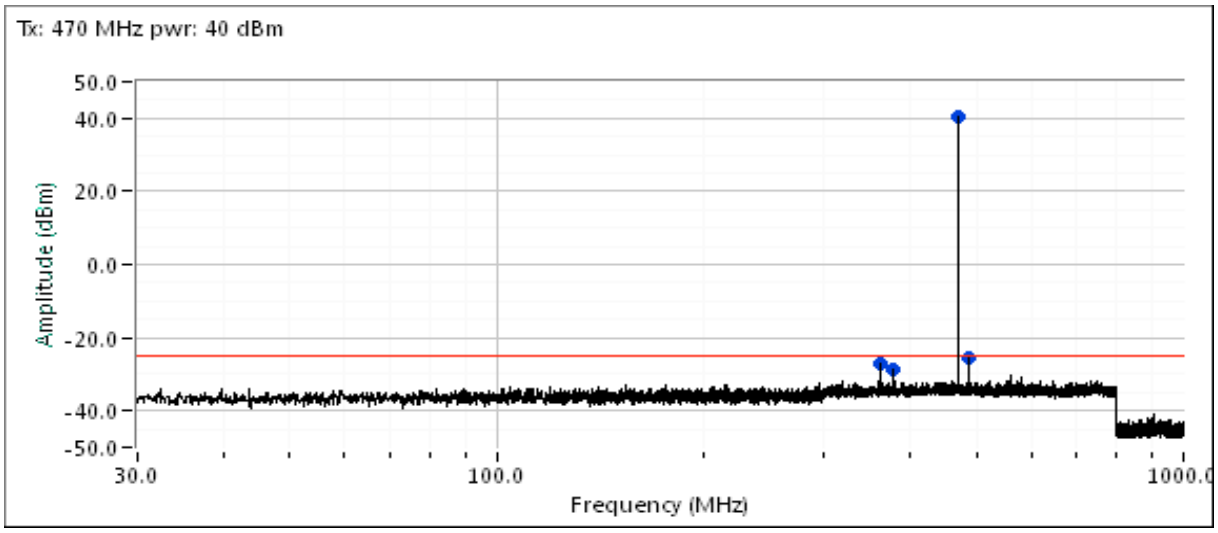


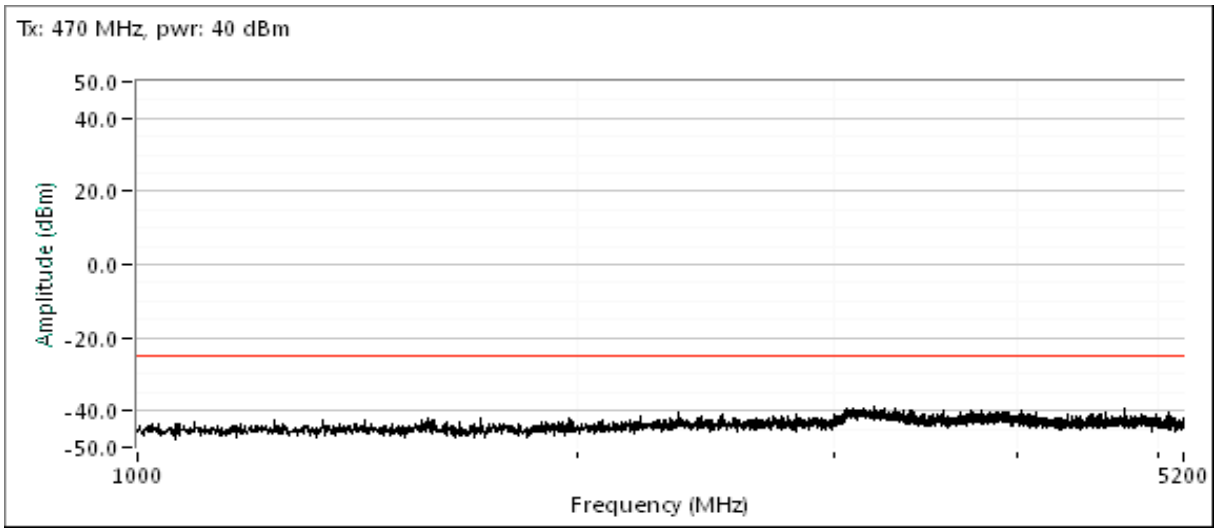
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A



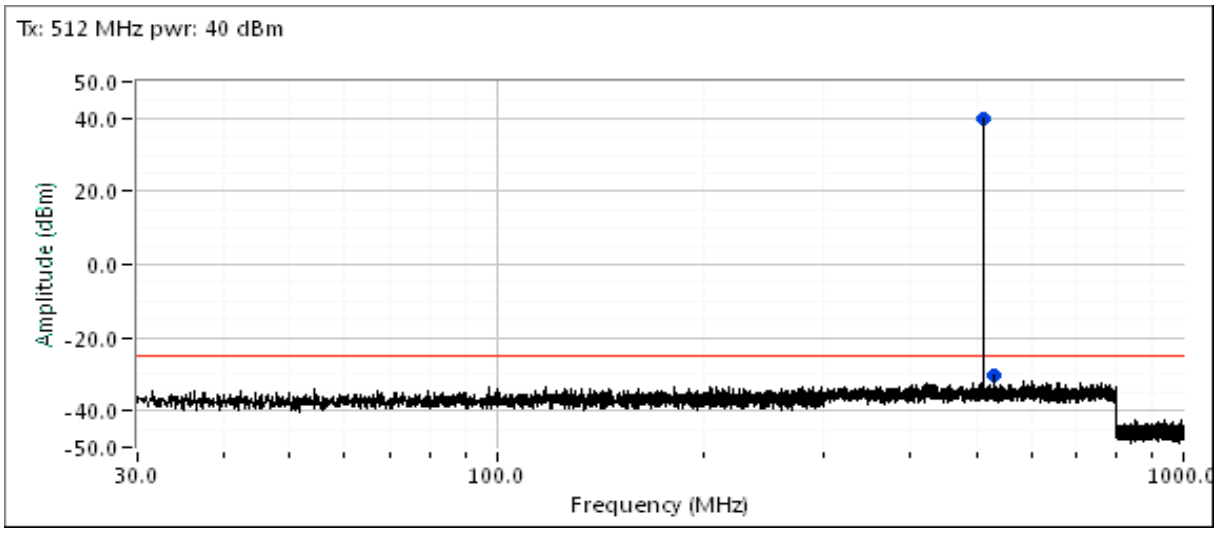


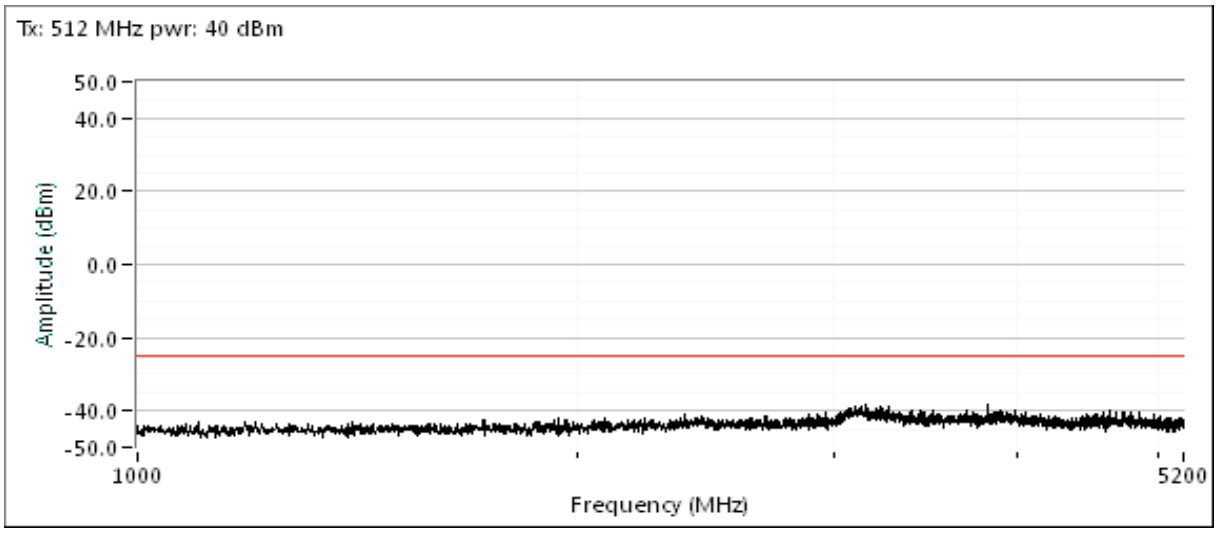
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A





Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A





Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #5: Out of Band Spurious Emissions, Radiated

Conducted limit (dBm): -25
Approximate field strength limit @ 3m: 72.3 based on ERP

The limit is taken from FCC Part 90 Mask E

Run #5a - Preliminary radiated measurements

Date of Test: 7/16/2019, 7/17/2019 Config. Used: 1
Test Engineer: Deniz Demirci Config Change: None
Test Location: FT Ch #4 EUT Voltage: 24 Vdc

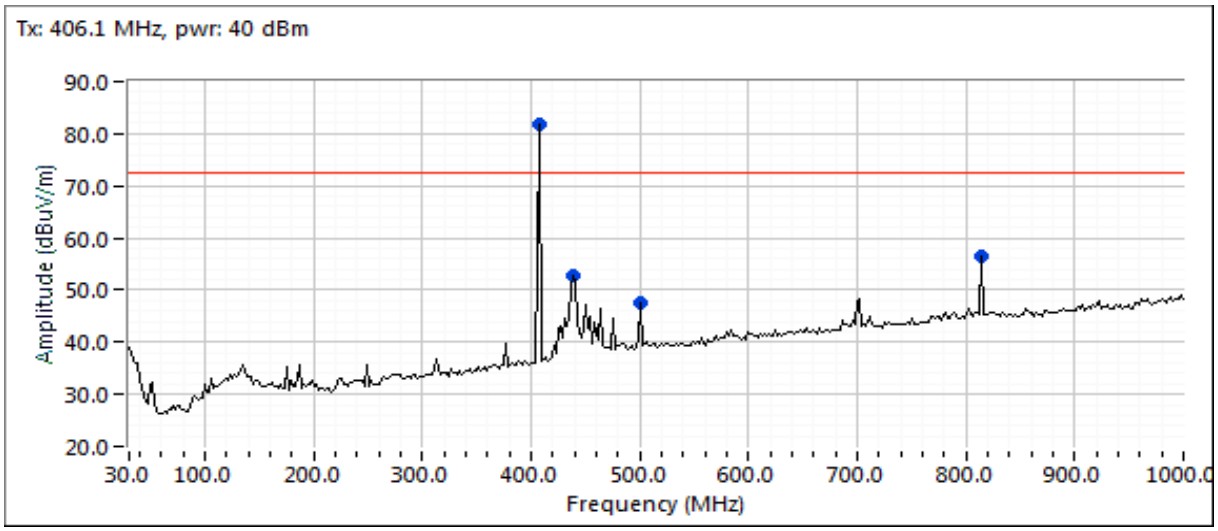
Frequency	Level	Pol	FCC Part 90		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		frequency
406.100	81.8	V	-	-	PK	161	1.0	Fundamental	406.1
438.216	52.3	H	72.4	-20.1	PK	252	2.0	POS; RB 100 kHz; VB: 3	406.1
500.421	47.4	H	72.4	-25.0	PK	331	1.5	POS; RB 100 kHz; VB: 3	406.1
812.191	56.7	H	72.4	-15.7	PK	285	1.0	POS; RB 100 kHz; VB: 3	406.1
2436.600	54.7	H	72.4	-17.7	PK	315	1.5	RB 1 MHz;VB 3 MHz;Pe	406.1
4122.000	53.0	V	72.4	-19.4	PK	271	2.2	RB 1 MHz;VB 3 MHz;Pe	406.1
420.998	89.3	H	-	-	PK	244	2.0	Fundamental	421.0
842.005	54.7	H	72.4	-17.7	PK	105	1.8	POS; RB 100 kHz; VB: 3	421.0
2526.000	55.3	V	72.4	-17.1	PK	328	1.3	RB 1 MHz;VB 3 MHz;Pe	421.0
3368.000	60.0	V	72.4	-12.4	PK	34	1.3	RB 1 MHz;VB 3 MHz;Pe	421.0
430.001	92.4	H	-	-	PK	244	2.0	Fundamental	430.0
500.421	47.6	V	72.4	-24.8	PK	291	1.0	POS; RB 100 kHz; VB: 3	430.0
860.040	54.0	H	72.4	-18.4	PK	162	1.0	POS; RB 100 kHz; VB: 3	430.0
1434.000	52.3	V	72.4	-20.1	PK	290	1.8	RB 1 MHz;VB 3 MHz;Pe	430.0
374.997	42.7	H	72.4	-29.7	PK	264	1.0	POS; RB 100 kHz; VB: 3	450.0
440.160	50.9	H	72.4	-21.5	PK	239	2.0	POS; RB 100 kHz; VB: 3	450.0
450.000	88.4	H	-	-	PK	231	2.0	Fundamental	450.0
900.000	72.1	H	72.4	-0.3	PK	45	1.0	POS; RB 100 kHz; VB: 3	450.0
1349.970	67.5	V	72.4	-4.9	PK	0	0.9	RB 1 MHz;VB 3 MHz;Pe	450.0
454.007	85.2	H	-	-	PK	322	2.0	Fundamental	454.0
907.998	71.6	H	72.4	-0.8	PK	39	1.0	POS; RB 100 kHz; VB: 3	454.0
1245.000	52.9	H	72.4	-19.5	PK	29	2.0	RB 1 MHz;VB 3 MHz;Pe	454.0
1362.030	65.1	V	72.4	-7.3	PK	0	1.2	RB 1 MHz;VB 3 MHz;Pe	454.0
1623.000	51.4	V	72.4	-21.0	PK	92	2.0	RB 1 MHz;VB 3 MHz;Pe	454.0

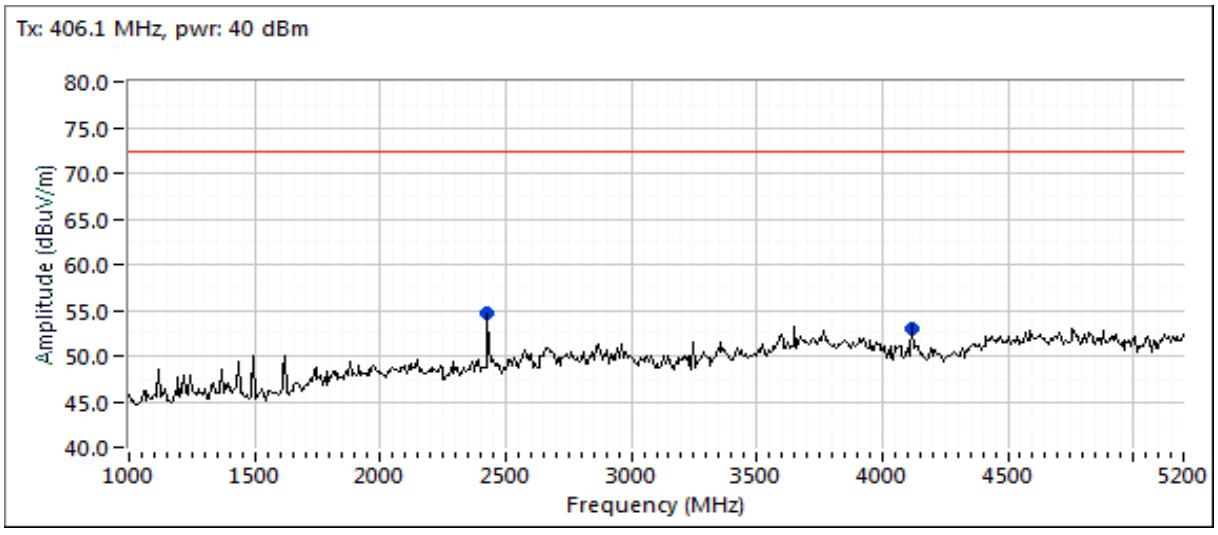
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Frequency	Level	Pol	FCC Part 90		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		frequency
470.025	86.6	H	-	-	PK	56	2.0	Fundamental	470.0
940.001	68.3	H	72.4	-4.1	PK	46	1.0	POS; RB 100 kHz; VB: 3	470.0
1409.930	59.6	V	72.4	-12.8	PK	59	1.8	RB 1 MHz;VB 3 MHz;Pe	470.0
1497.000	53.4	V	72.4	-19.0	PK	286	1.5	RB 1 MHz;VB 3 MHz;Pe	470.0
512.004	88.0	H	-	-	PK	296	1.5	Fundamental	512.0
1021.000	56.6	V	72.4	-15.8	PK	295	1.5	RB 1 MHz;VB 3 MHz;Pe	512.0
1536.000	56.6	V	72.4	-15.8	PK	301	1.7	RB 1 MHz;VB 3 MHz;Pe	512.0
3072.000	53.3	V	72.4	-19.1	PK	339	1.5	RB 1 MHz;VB 3 MHz;Pe	512.0

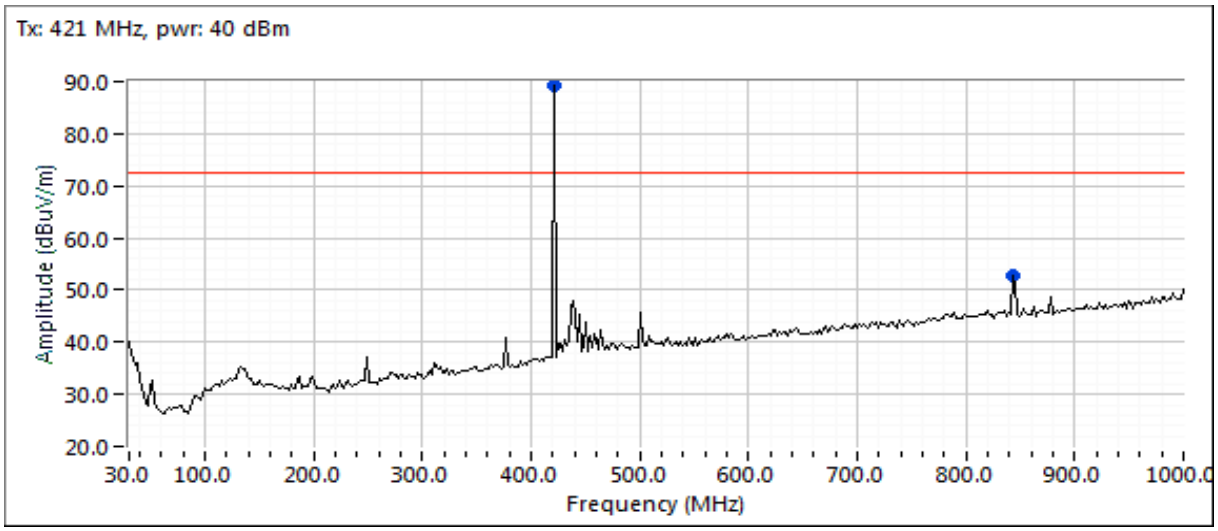
Note 1:	The field strength limit in the tables above was calculated from the erp/eirp limit detailed in the standard using the free space propagation equation: $E=\sqrt{(30PG)}/d$. This limit is conservative - it does not consider the presence of the ground plane and, for erp limits, the dipole gain (2.2 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.

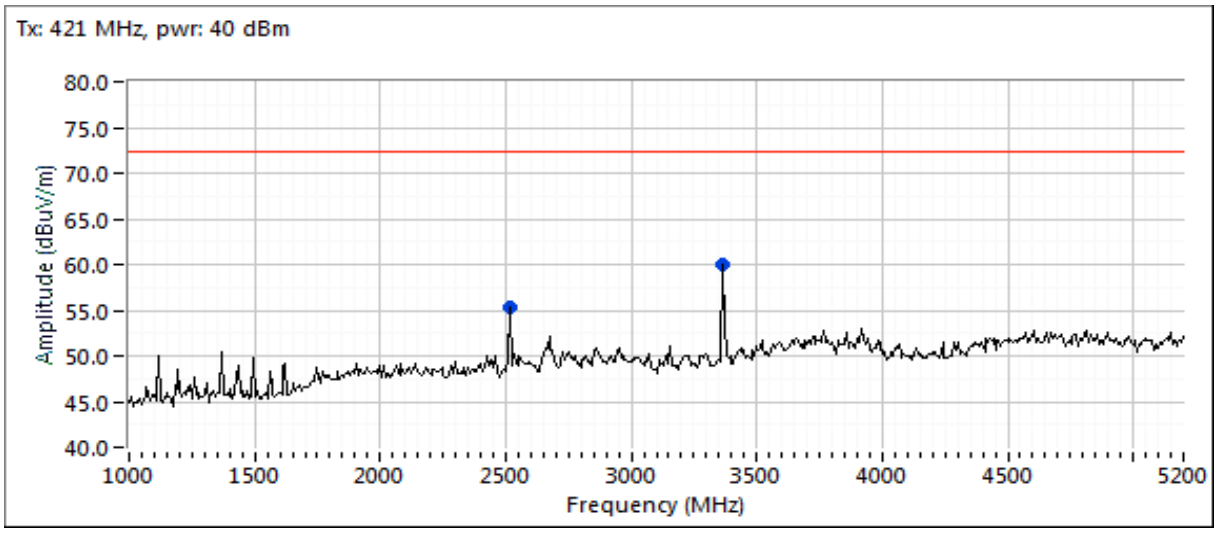
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A



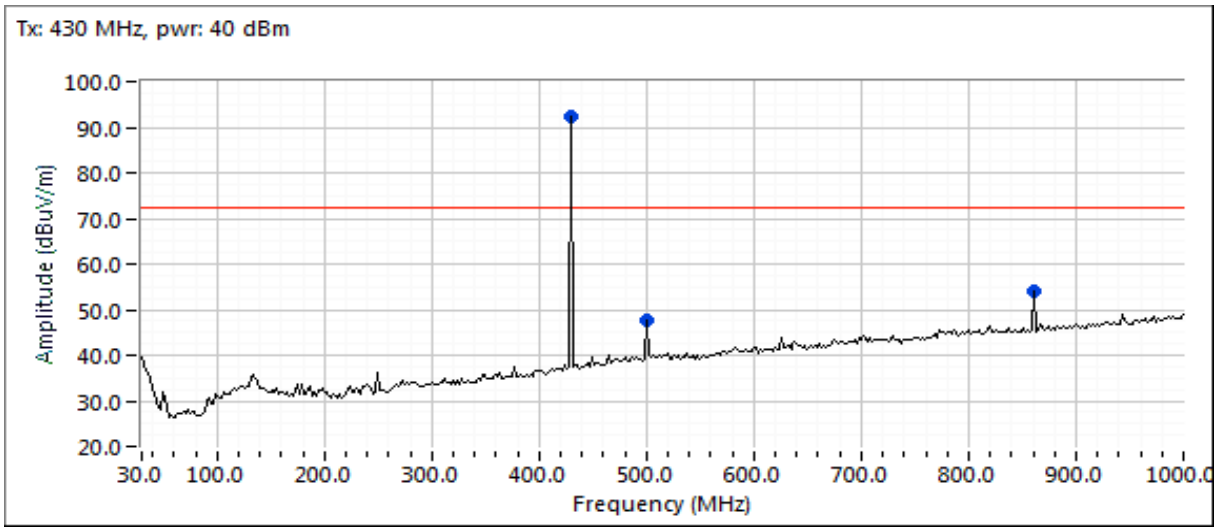


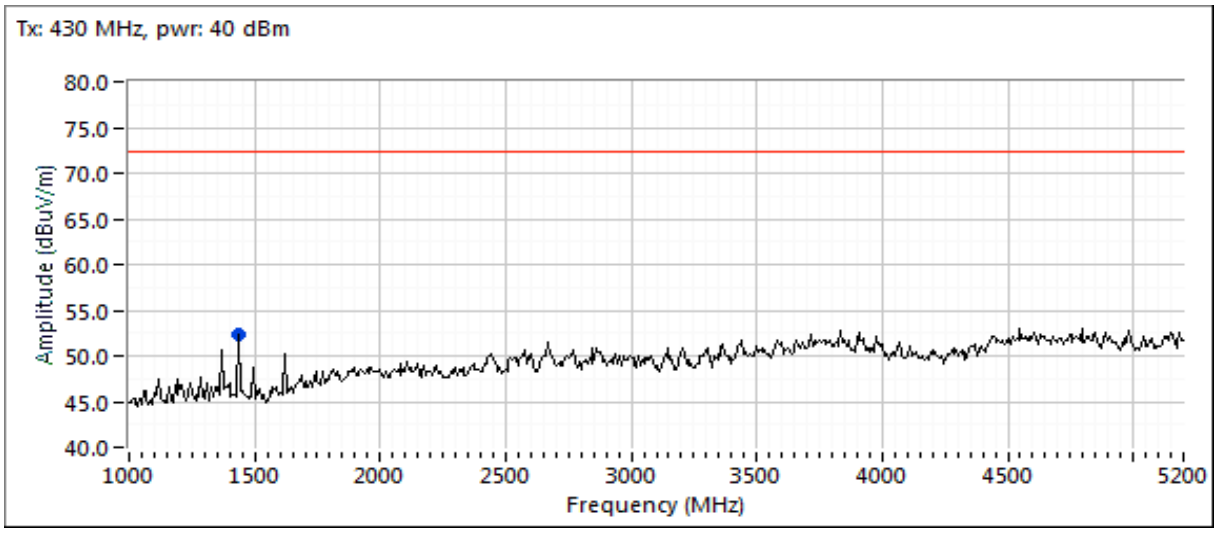
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A



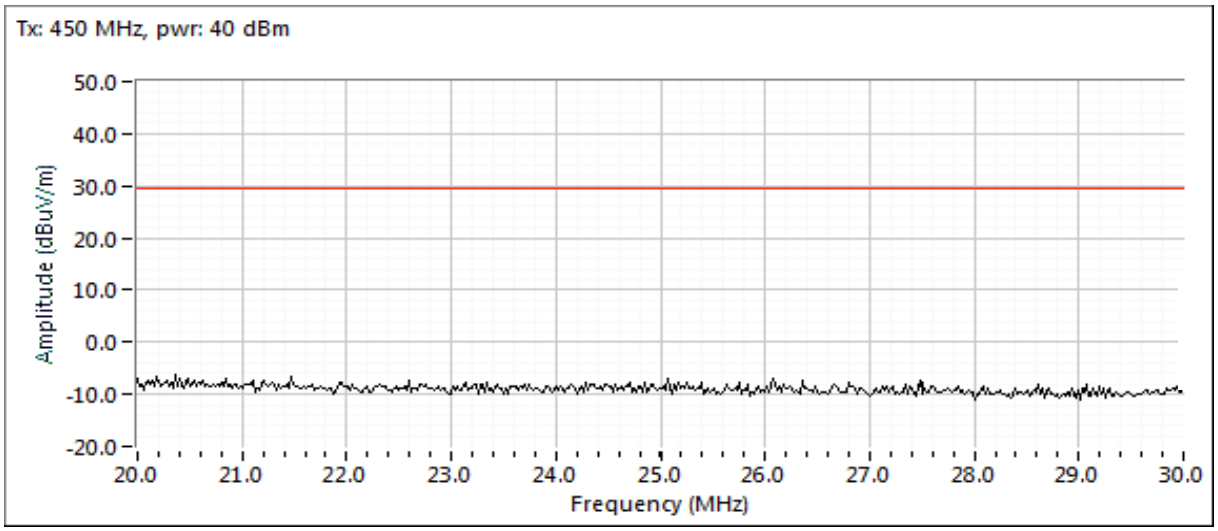


Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

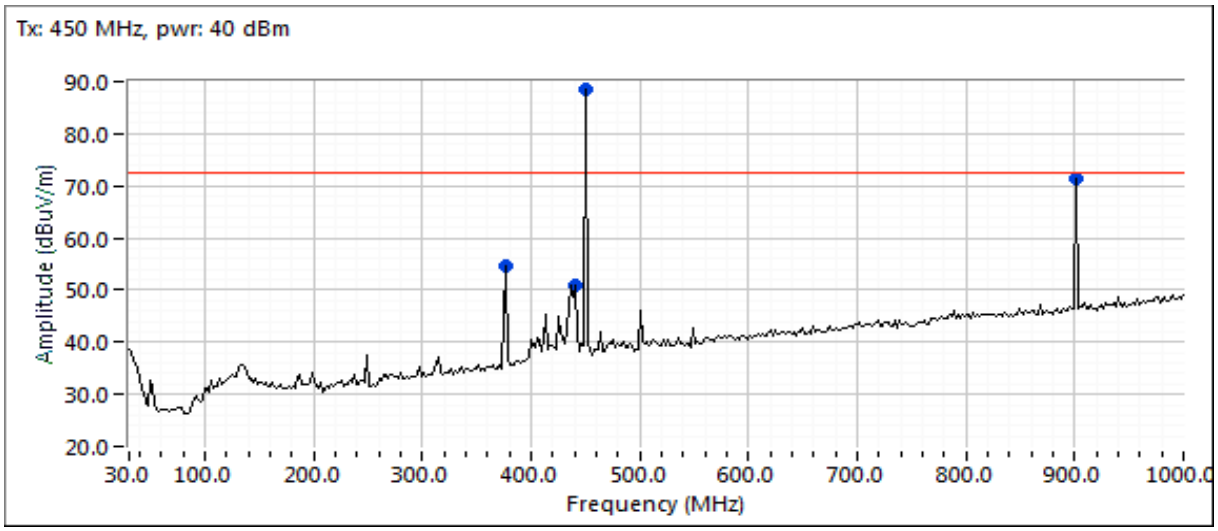


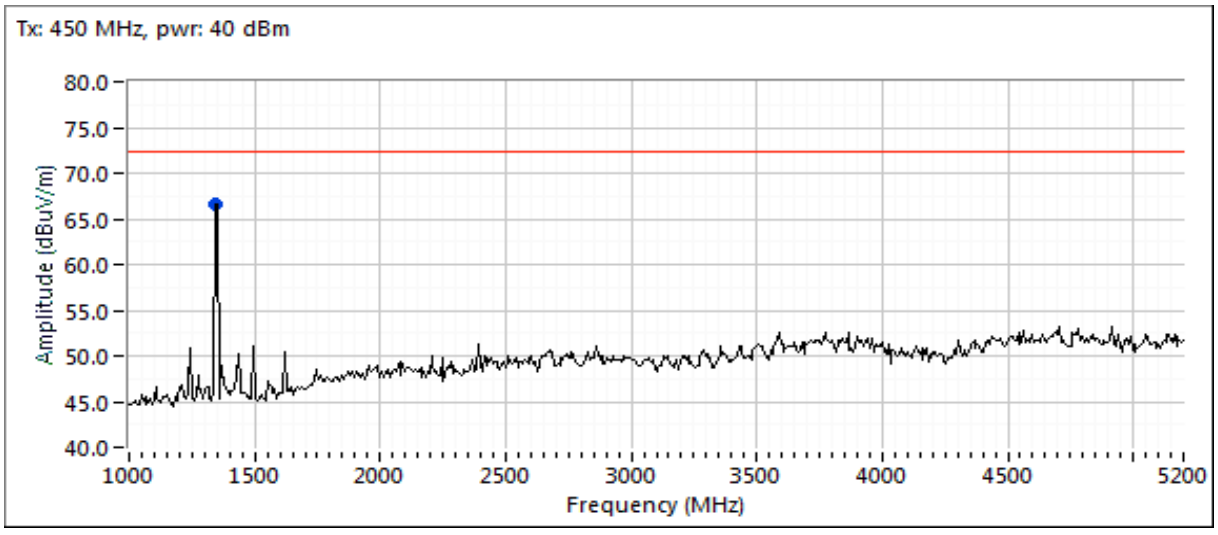


Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

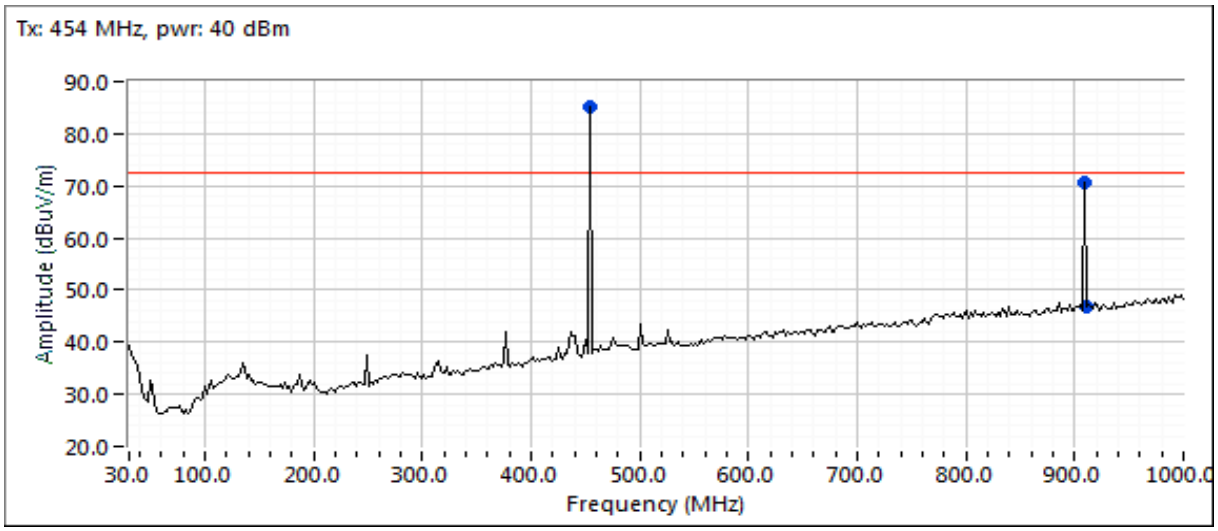


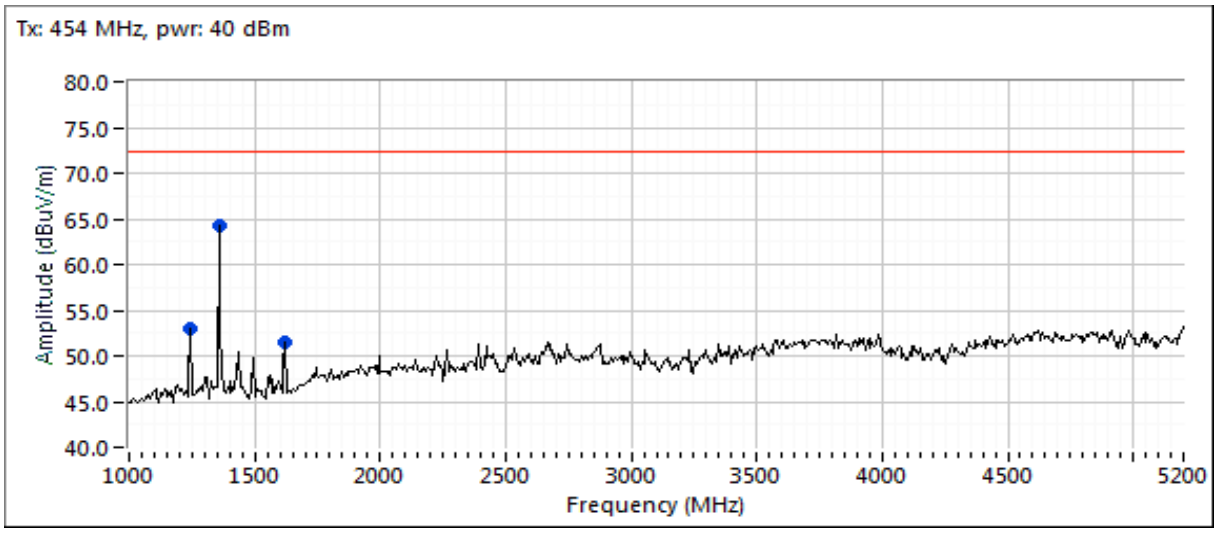
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A



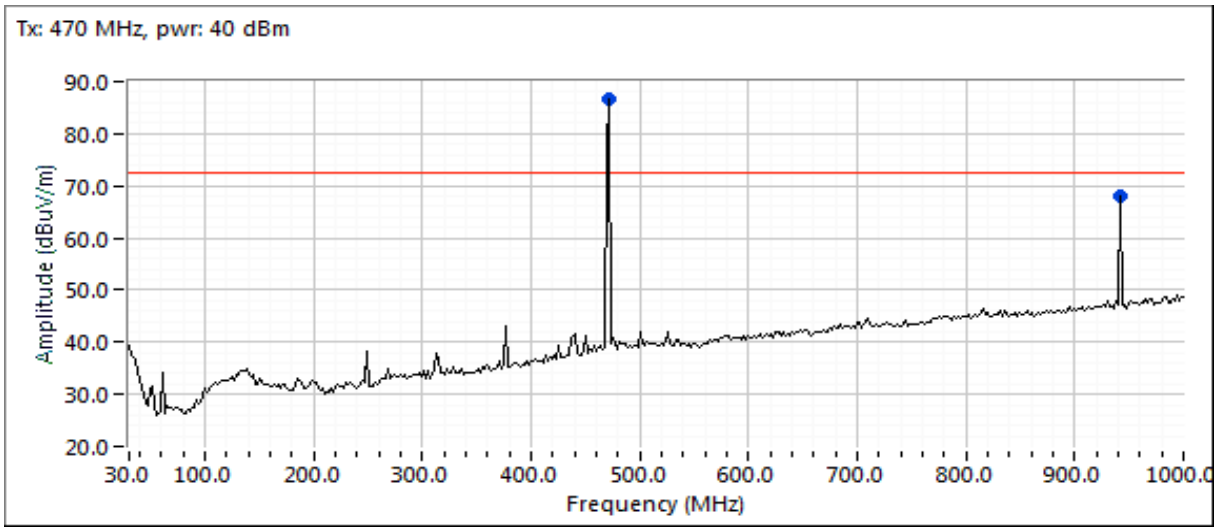


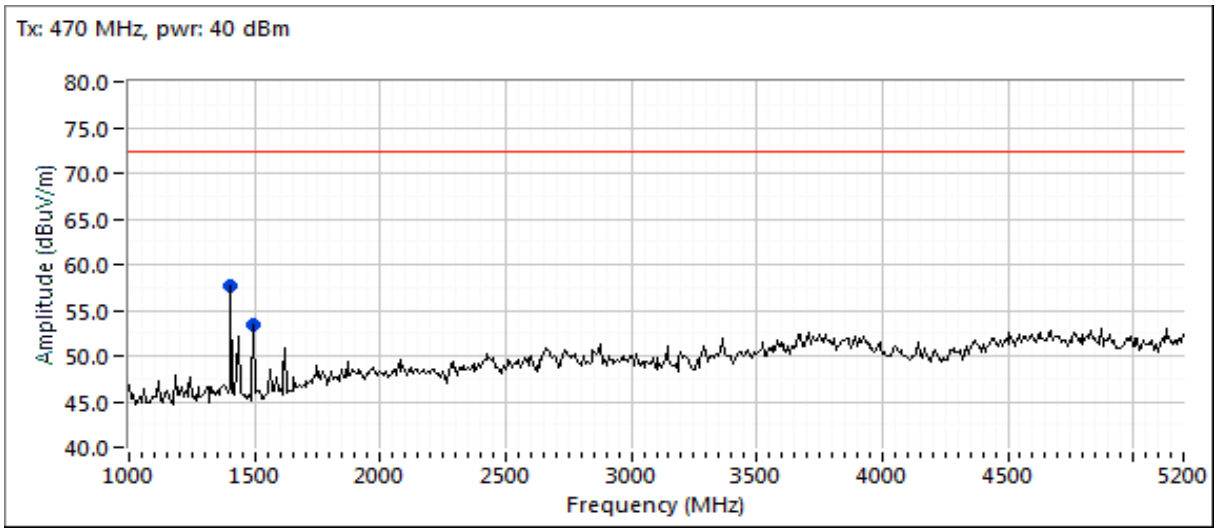
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A



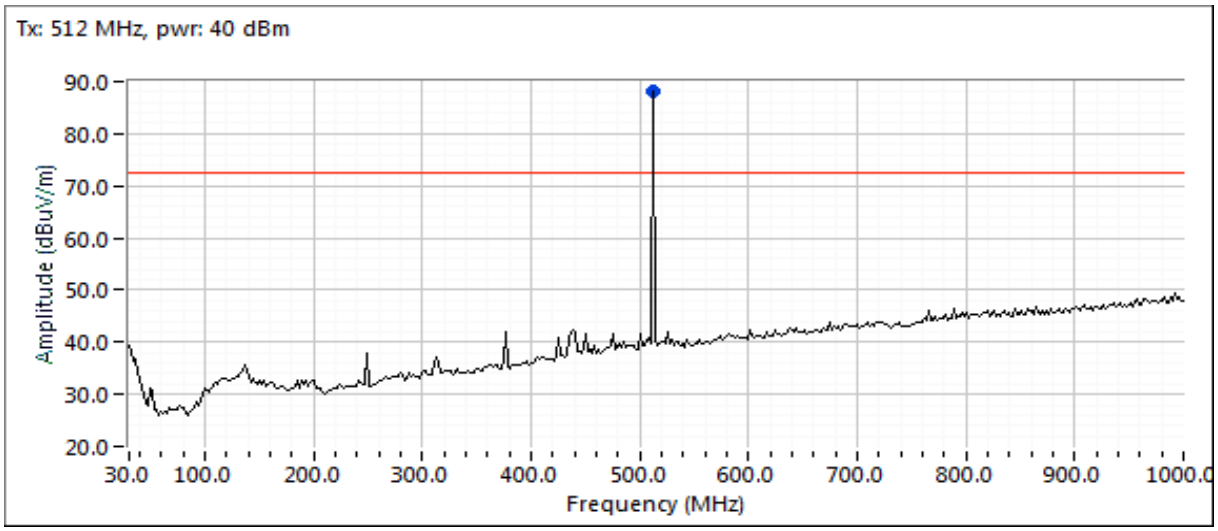


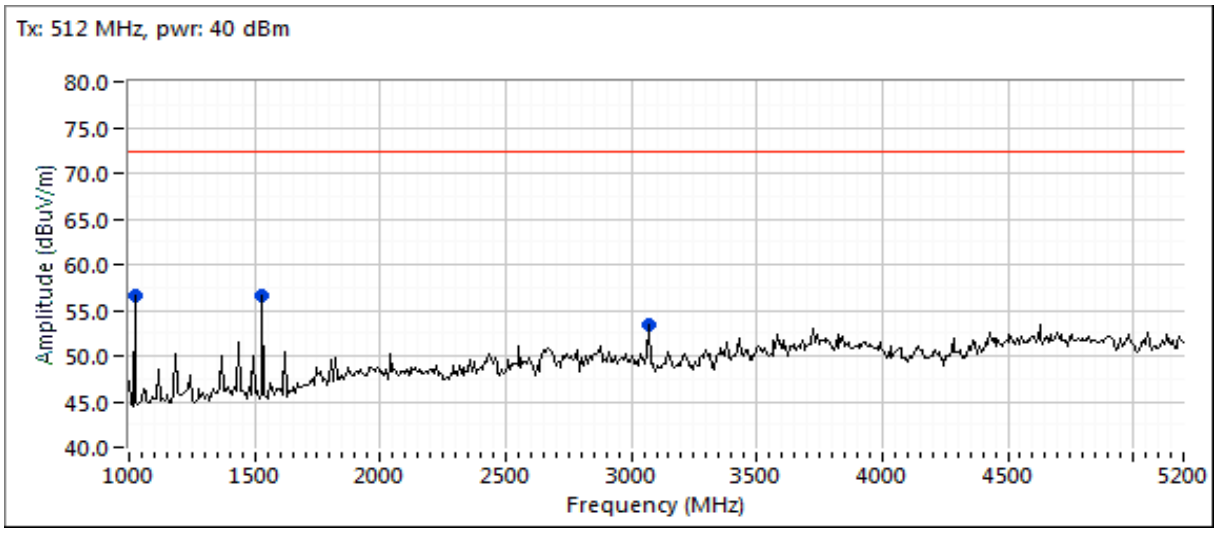
Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A





Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A





Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

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

Date of Test: 7/17/2019 Config. Used: 1

Test Engineer: Deniz Demirci Config Change: None

Test Location: FT Ch #4 EUT Voltage: 24 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		
812.191	56.7	H	72.4	-15.7	PK	285	1.0	POS; RB 100 kHz; VB: 3	406.1
842.005	54.7	H	72.4	-17.7	PK	105	1.8	POS; RB 100 kHz; VB: 3	421.0
860.040	54.0	H	72.4	-18.4	PK	162	1.0	POS; RB 100 kHz; VB: 3	430.0
900.000	72.1	H	72.4	-0.3	PK	45	1.0	POS; RB 100 kHz; VB: 3	450.0
907.998	71.6	H	72.4	-0.8	PK	39	1.0	POS; RB 100 kHz; VB: 3	454.0
940.001	68.3	H	72.4	-4.1	PK	46	1.0	POS; RB 100 kHz; VB: 3	470.0
2436.600	54.7	H	72.4	-17.7	PK	315	1.5	RB 1 MHz;VB 3 MHz;Pe	406.1
4122.000	53.0	V	72.4	-19.4	PK	271	2.2	RB 1 MHz;VB 3 MHz;Pe	406.1
2526.000	55.3	V	72.4	-17.1	PK	328	1.3	RB 1 MHz;VB 3 MHz;Pe	421.0
3368.000	60.0	V	72.4	-12.4	PK	34	1.3	RB 1 MHz;VB 3 MHz;Pe	421.0
1349.970	67.5	V	72.4	-4.9	PK	0	0.9	RB 1 MHz;VB 3 MHz;Pe	450.0
1245.000	52.9	H	72.4	-19.5	PK	29	2.0	RB 1 MHz;VB 3 MHz;Pe	454.0
1362.030	65.1	V	72.4	-7.3	PK	0	1.2	RB 1 MHz;VB 3 MHz;Pe	454.0
1409.930	59.6	V	72.4	-12.8	PK	59	1.8	RB 1 MHz;VB 3 MHz;Pe	470.0
1497.000	53.4	V	72.4	-19.0	PK	286	1.5	RB 1 MHz;VB 3 MHz;Pe	470.0
1021.000	56.6	V	72.4	-15.8	PK	295	1.5	RB 1 MHz;VB 3 MHz;Pe	512.0
1536.000	56.6	V	72.4	-15.8	PK	301	1.7	RB 1 MHz;VB 3 MHz;Pe	512.0
3072.000	53.3	V	72.4	-19.1	PK	339	1.5	RB 1 MHz;VB 3 MHz;Pe	512.0

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	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Substitution measurements

Horizontal

Frequency	Substitution measurements			Site	EUT measurements			eirp Limit	erp Limit	Margin
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	dBm	dBm	dB
812.191	-35.0	1.6	63.8	97.2	56.7	-40.5	-42.7		-25.0	-17.7
842.005	-35.0	1.6	63.7	97.1	54.7	-42.4	-44.6		-25.0	-19.6
860.040	-35.0	1.7	63.9	97.2	54.0	-43.2	-45.4		-25.0	-20.4
900.000	-35.0	1.7	64.4	97.7	72.1	-25.6	-27.8		-25.0	-2.8
907.998	-35.0	1.7	64.4	97.7	71.6	-26.1	-28.3		-25.0	-3.3
940.001	-35.0	1.8	64.8	98.0	68.3	-29.7	-31.9		-25.0	-6.9
1245.000	-35.0	6.5	67.0	95.5	52.9	-42.6	-44.8		-25.0	-19.8
2436.600	-35.0	9.5	69.7	95.2	54.7	-40.5	-42.7		-25.0	-17.7

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
1021.000	-35.0	5.6	66.4	95.8	56.6	-39.2	-41.4		-25.0	-16.4
1349.970	-35.0	7.3	68.2	95.9	67.5	-28.4	-30.6		-25.0	-5.6
1362.030	-35.0	7.3	68.2	95.9	65.1	-30.8	-33.0		-25.0	-8.0
1409.930	-35.0	7.2	68.5	96.3	59.6	-36.7	-38.9		-25.0	-13.9
1497.000	-35.0	8.4	69.2	95.8	53.4	-42.4	-44.6		-25.0	-19.6
1536.000	-35.0	8.4	69.1	95.7	56.6	-39.1	-41.3		-25.0	-16.3
2526.000	-35.0	9.6	69.8	95.2	55.3	-39.9	-42.1		-25.0	-17.1
3072.000	-35.0	9.5	70.2	95.7	53.3	-42.4	-44.6		-25.0	-19.6
3368.000	-35.0	9.6	70.1	95.5	60.0	-35.5	-37.7		-25.0	-12.7
4122.000	-35.0	10.2	70.6	95.4	53.0	-42.4	-44.6		-25.0	-19.6

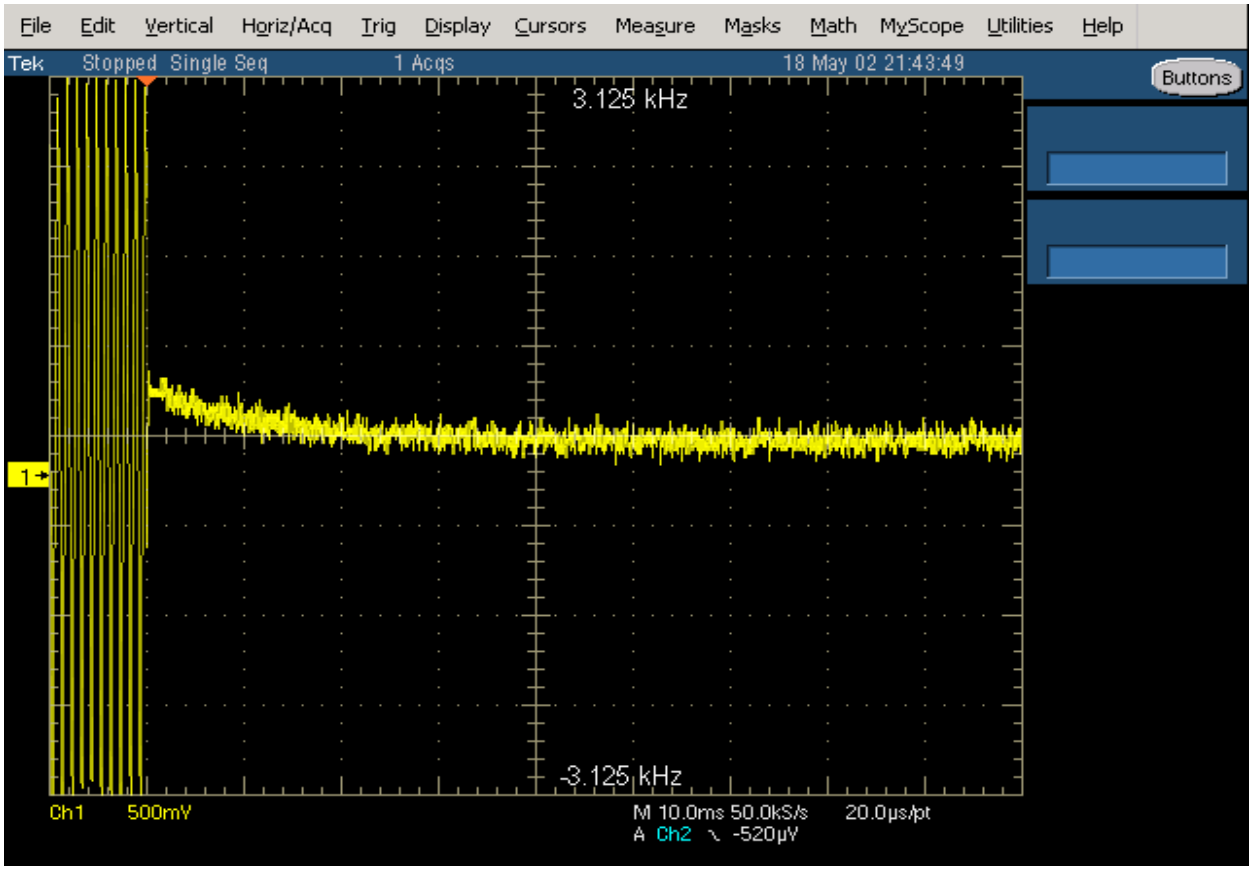
Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an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

Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #6: Transient Frequency Behavior

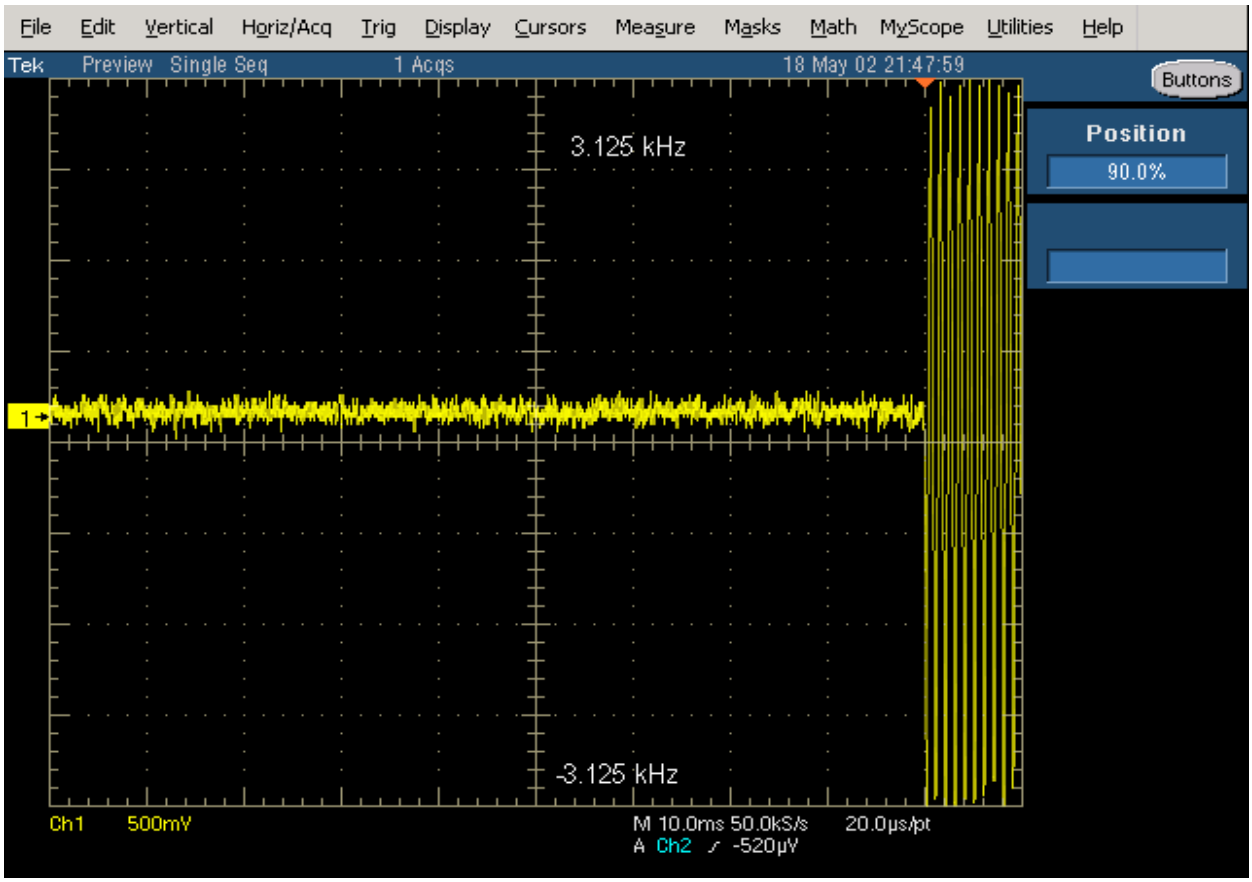
Date of Test: 7/15/2019 Config. Used: 1
Test Engineer: David Bare Config Change: None
Test Location: Fremont EMC Lab #4B EUT Voltage: 24 VDC

Run #6a
Carrier Frequency: 470 MHz
Channel Spacing: 6.25 kHz
Modulation: CPFSK
Description: Switch on condition ton, t1, and t2



Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #6b
Carrier Frequency: 470 MHz
Channel Spacing: 6.25 kHz
Modulation: CPFSK
Description: Switch off condition t3 and toff



Client:	GE MDS LLC	PR Number:	PR099808
Model:	SDM4-1	T-Log Number:	TL099808-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Standard:	FCC parts 22 & 90, RSS-119	Class:	N/A

Run #7: Frequency Stability

Date of Test: 7/16/2019 Config. Used: 1

Test Engineer: Deniz Demirci Config Change: None

Test Location: FT Lab #3 EUT Voltage: 24 Vdc

Nominal Frequency: 454.00000 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	454.0000433	43	0.1
-20	454.0000321	32	0.1
-10	453.9999631	-37	-0.1
0	453.9999485	-51	-0.1
10	454.0000144	14	0.0
20	453.9999159	-84	-0.2
30	453.9998640	-136	-0.3
40	453.9998570	-143	-0.3
50	453.9998700	-130	-0.3
60	453.9999360	-64	-0.1
70	454.0000380	38	0.1
	Worst case:	-143	-0.3

Frequency Stability Over Input Voltage

Nominal Voltage is 24Vdc.

Voltage	Frequency Measured	Drift	
(DC)	(MHz)	(Hz)	(ppm)
23	454.0000480	48	0.1
25	454.0000770	77	0.2
	Worst case:	77	-0.3

Note 1:	Maximum drift of fundamental frequency before it shut down at 20.3 Vdc was 143 Hz (0.3 ppm).
Note 2:	Extreme voltages are ±4% of nominal voltage (Grant notes)

End of Report

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