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Radio Test Report

FCC Part 90
406.1 MHz to 512MHz
Permissive Change

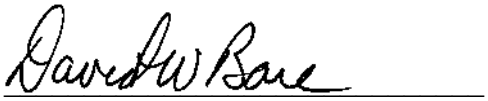
Model: LN400

FCC ID:	E5MDS-LN400
COMPANY:	GE MDS LLC 175 Science Parkway Rochester, NY 14620
TEST SITE(S):	National Technical Systems 41039 Boyce Road. Fremont, CA. 94538-2435
PROJECT NUMBER:	PR089859
REPORT DATE:	December 7, 2018
FINAL TEST DATES:	November 20, 28 and 30, 2018
TOTAL NUMBER OF PAGES:	27

A2LA ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

PROGRAM MGR



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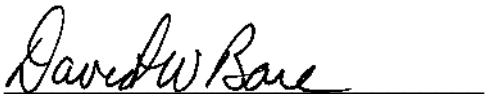

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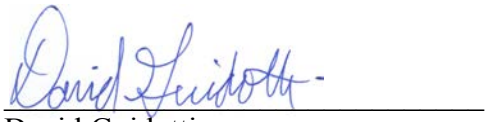

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REVISION HISTORY

Rev#	Date	Comments	Modified By
1	December 7, 2018	First release	

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SCOPE

Tests have been performed on the GE MDS LLC model LN400, pursuant to the relevant requirements of the following standard(s) in order to obtain a permissive change for the certification against the regulatory requirements of the Federal Communications Commission and Innovation Science and Economic Development Canada.

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

The scope of the permissive change is to extend the frequency range to 512 from 470 MHz and to reduce power for the 3-Level FSK modulations.

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

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 LN400 and therefore apply only to the tested samples. The samples were selected and prepared by Dennis McCarthy of GE MDS LLC.

OBJECTIVE

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

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

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

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

STATEMENT OF COMPLIANCE

The tested samples of GE MDS LLC model LN400 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 Part 90

FCC		Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics					
§2.1033 (c) (5) § 90.35		Frequency range(s)	406.1-430 MHz 450–512 MHz	406.1-430 MHz 450-512 MHz	Pass
§2.1033 (c) (6) §2.1033 (c) (7) § 2.1046 § 90.205		RF power output at the antenna terminals	19.6 – 41.2 dBm (QAM) FSK (406.1-470MHz) 19.6 – 38.0 dBm (FSK) (470-512MHz)	Determined at time of Licensing	Pass
§2.1033 (c) (4) § 2.1047 § 90.210		Emission types	F1D, F2D, F3D and D1D		
		Emission mask C, D, E	Complies, No change from original filing		
§ 90.221	-	Adjacent Channel Power	Complies, No change from original filing		
§ 2.1049 § 90.209		Occupied Bandwidth	5.16 kHz 8.49 kHz 10.3 kHz 10.8 kHz 17.2 kHz 21.4 kHz	No change from original filings	
§ 90.214		Transient Frequency Behavior	Complies, No change from original filing		
Transmitter spurious emissions					
§ 2.1051 § 2.1057		At the antenna terminals	-26.4 dBm @ 1024.1 MHz (-1.4 dB)	-25 dBm	Pass
§ 2.1053 § 2.1057		Field strength	-26.7 dBm @ 1024.00 MHz (-1.7dB)	-25 dBm	Pass
Other details					
§ 2.1055 § 90.213		Frequency stability	Complies, No change from original filing		
§ 2.1093		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	No change from original filing 34.5 VDC, 755 mA		
-	-	Antenna Gain	Maximum 16 dBi		
Notes					

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2) and were calculated in accordance with NAMAS document NIS 81 and M3003.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF frequency	Hz	25 to 7,000 MHz	1.7×10^{-7}
RF power, conducted	dBm	25 to 7,000 MHz	± 0.52 dB
Conducted emission of transmitter	dBm	25 to 40,000 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 40,000 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 40,000 MHz	± 2.5 dB
Radiated emission (field strength)	dBµV/m	25 to 1,000 MHz 1 to 40 GHz	± 3.6 dB ± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The GE MDS LLC model LN400 is an industrial radio module operating in the 406.1-512 MHz bands and uses QAM and 3-level FSK modulations. 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 is 10.0-60.0 Volts DC, 1.5 Amps max.

The samples were received on November 19, 2018 and tested on November 20, 28 and 30, 2018. The following samples were used for testing:

Company	Model	Description	Serial Number	FCC ID
GE MDS LLC	LN400	Industrial Radio Module	2947986	E5MDS-LN400
GE MDS LLC	LN400	Industrial Radio Module	2947987	E5MDS-LN400

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: 1880 MHz

The following EUT details should be noted: The supported modulations are 4800 Baud (6.25kHz Channels) QAM, 9600 Baud (12.5kHz Channels) QAM, 10000 Baud (12.5kHz Channels) QAM, 16000 Baud (25kHz channels) QAM, 20000 Baud (25kHz Channels) QAM, 9600 Baud (12.5kHz Channels) 3-Level FSK, and 19200 Baud (25 kHz channels) 3-Level FSK. The host product in which this product will be used "Orbit MCR" is rated from -40°C to +70°C, 10-60 VDC input

ENCLOSURE

The EUT does not have an enclosure as it is intended to be installed in a complete product. The PCB measures approximately 11 cm wide by 3.8 cm deep 0.6 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	Power Supply		-
Agilent	E3610A	Power Supply	MY40011740	-
Agilent	E3610A	Power Supply	MY40001912	-
GE MDS LLC	-	Test board	2629719	-
GE MDS LLC	-	Test board	2629715	-

hp supply and test board s/n 2629719 used for conducted RF port tests. Agilent supplies and test board s/n 2629715 used for radiated tests.

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

Company	Model	Description	Serial Number	FCC ID
hp	Probook 6570b	Laptop	5CB2480TRQ	

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
RF out	Load	-	-	-

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Test Board COM1	Laptop	Cat 6	Unshielded	1.0
Test Board Power	Power Supply	Two wire	Unshielded	1.2

EUT OPERATION

During emissions testing the EUT was set to transmit continuously on the selected frequency at the power setting indicated.

TESTING

GENERAL INFORMATION

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

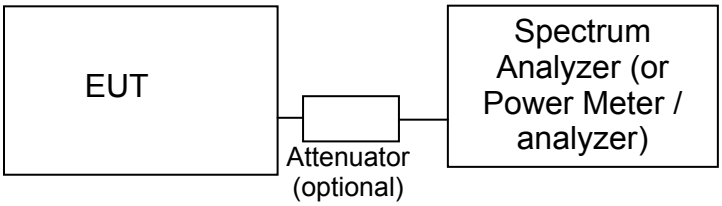
Radiated spurious emissions measurements were taken at the National Technical Systems Anechoic Chambers and/or Open Area Test Site(s) listed below. The sites conform to the requirements of ANSI C63.4 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* and CISPR 16-1-4 - *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 3	US0027	IC 2845B-3	41039 Boyce Road Fremont, CA 94538-2435
Chamber 4	US0027	IC 2845B-4	
Chamber 5	US0027	IC 2845B-5	
Chamber 7	US0027	IC 2845B-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.

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.

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 either 80 or 150 centimeters above the floor depending on the frequency measured. The EUT is positioned on a motorized turntable to allow it to be rotated during testing to determine the angel with the highest level of emissions.

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS - CONDUCTED SPURIOUS EMISSIONS

Measurements are compared directly to the conducted emissions specification limit (decibel form). The calculation is as follows:

$$R_r - S = M$$

where:

R_r = Measured value in dBm
S = Specification Limit in dBm
M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH

Measurements of radiated field strength are compared directly to the specification limit (decibel form). The receiver and/or control software corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor is sued when measurements are made at a test distance that is different to the specified limit distance by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB
D_m = Measurement Distance in meters
D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS –RADIATED POWER

The erp/eirp limits for transmitter spurious measurements are converted to a field strength in free space using the following formula:

$$E = \frac{\sqrt{30\ P\ G}}{d}$$

where:

E = Field Strength in V/m
P = Power in Watts
G = Gain of isotropic antenna (numeric gain) = 1
D = measurement distance in meters

The field strength limit is then converted to decibel form (dBuV/m) and the margin of a given emission peak relative to the limit is calculated (refer to *SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH*).

When substitution measurements are required (all signals with less than 20dB of margin relative to the calculated field strength limit) the eirp of the spurious emission is calculated using:

$$P_{EUT} = P_S - (E_S - E_{EUT})$$

and

$$P_S = G + P_{in}$$

where:

P_S = effective isotropic radiated power of the substitution antenna (dBm)
P_{in} = power input to the substitution antenna (dBm)
G = gain of the substitution antenna (dBi)
E_S = field strength the substitution antenna (dBm) at eirp P_S
E_{EUT} = field strength measured from the EUT

Where necessary the effective isotropic radiated power is converted to effective radiated power by subtracting the gain of a dipole (2.2dBi) from the eirp value.

Appendix A Test Equipment Calibration Data

Radio Antenna Port (Power and Spurious Emissions), 20-Nov-18

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
Rohde & Schwarz	Power Meter, Dual Channel	NRVD	1071	4/4/2018	4/4/2019
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/31/2018	5/31/2019
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts	NRV-Z32	3225	11/5/2017	12/5/2018

Radiated Emissions, 30 - 5,500 MHz, 20-Nov-18

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1549	5/30/2017	5/30/2019
Com-Power	Preamplifier, 1-1000 MHz	PAM-103	2885	8/21/2018	8/21/2019
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	9482	10/13/2018	10/13/2019

Radiated Emissions, 28-Nov-18

Manufacturer	Description	Model #	Asset #	Last Cal	Cal Due
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	9/18/2018	9/18/2020
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	9482	10/13/2018	10/13/2019

Radio Antenna Port (Power), 30-Nov-18

Manufacturer	Description	Model #	Asset #	Last Cal	Cal Due
Rohde & Schwarz	Power Meter, Dual Channel	NRVD	1071	4/4/2018	4/4/2019
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/31/2018	5/31/2019
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts	NRV-Z32	3225	11/5/2017	12/5/2018

Appendix B Test Data

TL089859-RA Pages 20 – 26

Client:	GE MDS LLC	PR Number:	PR089859
Product	LN400	T-Log Number:	TL089859-RA
System Configuration:	-	Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Engineer:	David Bare
Emissions Standard(s):	FCC part 90	Class:	-
Immunity Standard(s):		Environment:	Radio

EMC Test Data

For The

GE MDS LLC

Product

LN400

Date of Last Test: 11/30/2018

Client:	GE MDS LLC	Job Number:	PR089859
Model:	LN400	T-Log Number:	TL089859-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC part 90	Class:	N/A

FCC Part 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: 20-21 °C
Rel. Humidity: 38-40 %

Summary of Results

Run #			Test Performed	Limit	Pass / Fail	Result / Margin
1			Output Power	Determined at time of Licensing	Pass	40.8 dBm 38.0 dBm
3			Spurious Emissions (conducted)	-25 dBm	Pass	-26.4 dBm @ 1024.1 MHz (-1.4 dB)
4			Spurious emissions (radiated)	-25 dBm	Pass	-26.7 dBm @ 1024.00 MHz (-1.7dB)

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.

Sample

S/N: 2947986 (Antenna port tests), 2947987 (radiated emissions tests)

Client:	GE MDS LLC	Job Number:	PR089859
Model:	LN400	T-Log Number:	TL089859-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC part 90	Class:	N/A

Run #1: Output Power

Date of Test: 11/20 and 11/30/2018 Config. Used: 1

Test Engineer: David Bare Config Change: None

Test Location: Fremont EMC Lab #3 EUT Voltage: 13.8Vdc

Cable Loss: Attenuator: 20.0 dB Total Loss: 20.0 dB

Cable ID(s): - Attenuator IDs: WC068107

Power Setting[2]	Frequency (MHz)	Output Power (dBm) [1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W		
40	512	40.8	12022.6	16.5	Pass	57.3	537.032	QAM	FB27
38	512	38.0	6309.6	16.5	Pass	54.5	281.838	FSK	

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.

Client:	GE MDS LLC	Job Number:	PR089859
Model:	LN400	T-Log Number:	TL089859-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC part 90	Class:	N/A

Run #3: Out of Band Spurious Emissions, Conducted

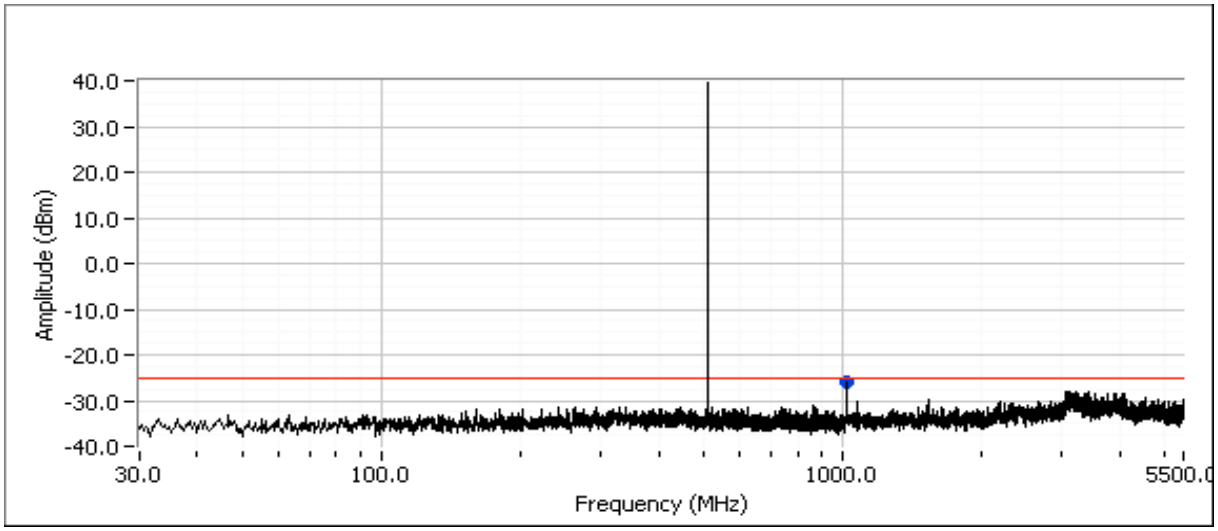
Date of Test: 11/20/2018 Config. Used: 1
Test Engineer: David Bare Config Change: None
Test Location: Fremont EMC Lab #3 EUT Voltage: 13.8Vdc

Frequency (MHz)	Limit	Result
512	-25	Pass

The limit is taken from FCC Part 90 Mask E.

Frequency MHz	Level dBm	Port	FCC Part 90 Limit	FCC Part 90 Margin	Detector QP/Ave	Comments
1024.090	-26.4	RF Port	-25.0	-1.4	Peak	RB 1 MHz; VB: 3 MHz

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



Client:	GE MDS LLC	Job Number:	PR089859
Model:	LN400	T-Log Number:	TL089859-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC part 90	Class:	N/A

Run #4: Out of Band Spurious Emissions, Radiated

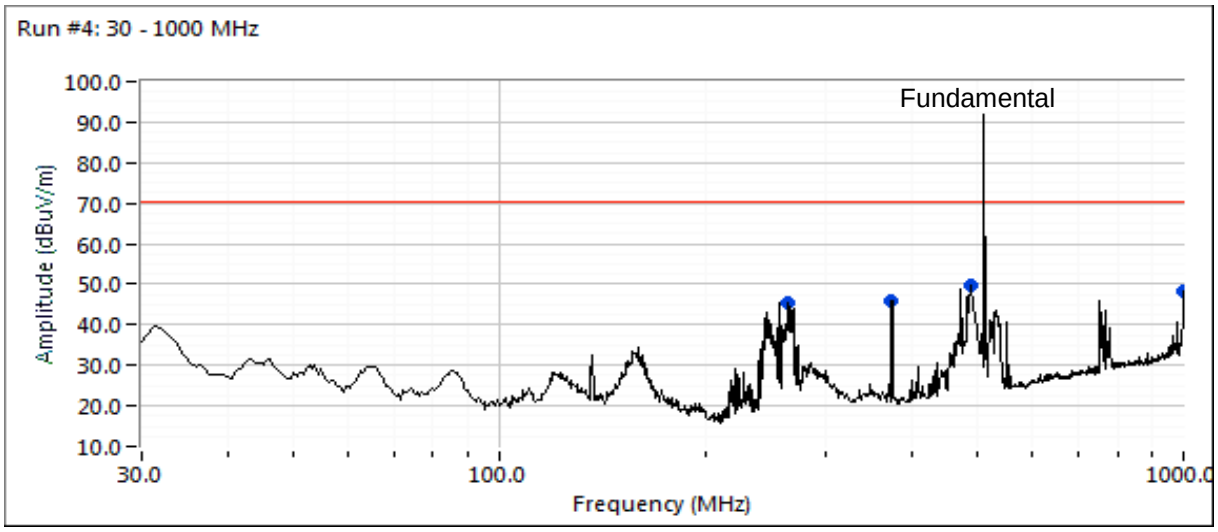
Conducted limit (dBm): -25
Approximate field strength limit @ 3m: 70.3

The limit is taken from FCC Part 90 Mask E.

Run #4a - Preliminary measurements

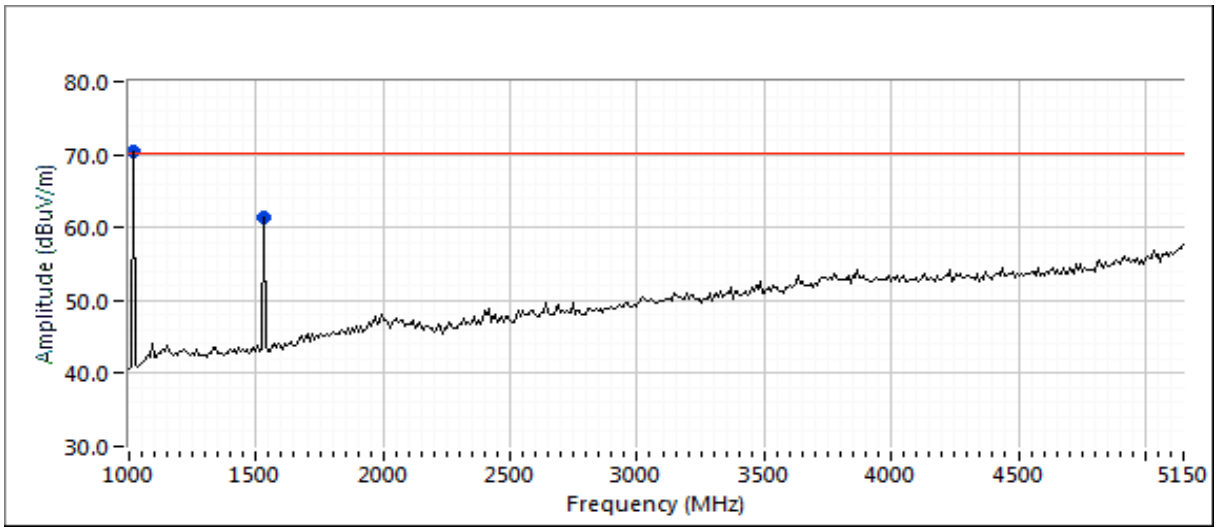
Date of Test: 11/20 and 11/28/2018
Test Engineer: David Bare
Test Location: Fremont Chamber #5
Config. Used: 1
Config Change: None
EUT Voltage: 13.8 & 5.25Vdc

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

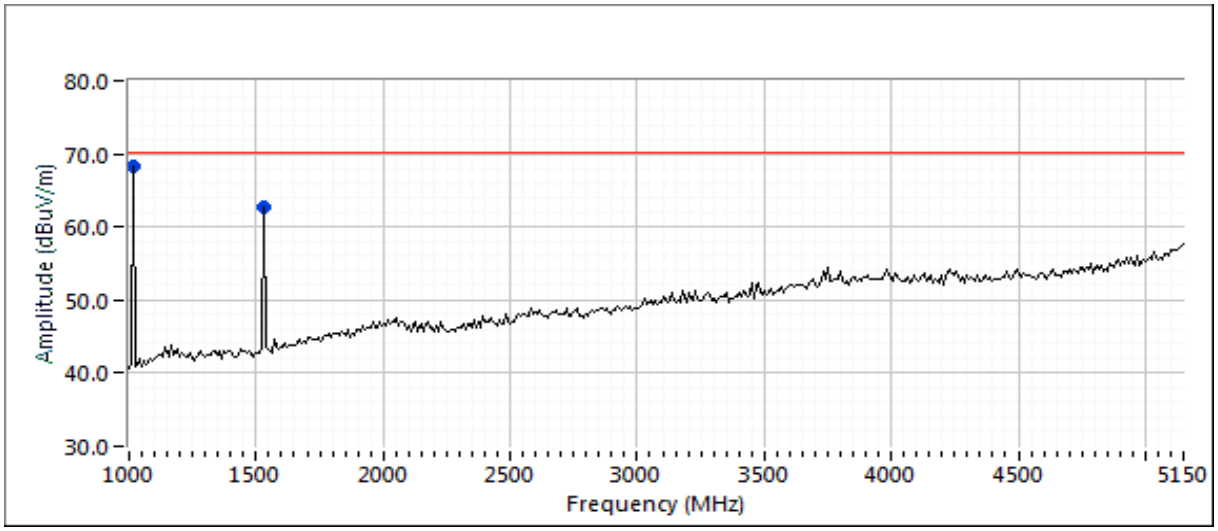


Client:	GE MDS LLC	Job Number:	PR089859
Model:	LN400	T-Log Number:	TL089859-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC part 90	Class:	N/A

Plots for high channel (3-FSK), power setting(s) = 38



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



Client:	GE MDS LLC	Job Number:	PR089859
Model:	LN400	T-Log Number:	TL089859-RA
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	David Bare
Standard:	FCC part 90	Class:	N/A

Run #4b: - Final Field Strength Measurements and Substitution Measurements

Date of Test: 11/20 & 11/28/2018 Config. Used: 1

Test Engineer: Mehran Birgani Config Change: None

Test Location: Fremont Chamber #5 EUT Voltage: 13.8 & 5.25Vdc

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			
264.392	45.6	V	70.2	-24.6	Peak	191	2.0	QAM	PWR 40	512
375.008	45.9	V	70.2	-24.3	Peak	180	1.5	QAM	PWR 40	512
489.553	49.9	H	70.2	-20.3	Peak	236	1.0	QAM	PWR 40	512
998.315	48.5	H	70.2	-21.7	Peak	90	1.0	QAM	PWR 40	512
1024.000	70.4	V	70.2	0.2	PK	126	1.0	3-FSK	PWR 38	512
1536.000	63.5	V	70.2	-6.7	PK	124	1.0	3-FSK	PWR 38	512
1024.000	71.6	V	70.2	1.4	PK	219	1.0	QAM	PWR 40	512
1536.000	64.7	V	70.2	-5.5	PK	129	1.0	QAM	PWR 40	512

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

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
1024.00	-28.5	6.2	73.8	96.1	71.6	-24.5	-26.7		-25.0	-1.7
1536.00	-28.6	8.5	75.2	95.3	64.7	-30.6	-32.8		-25.0	-7.8

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

End of Report

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