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Radio Test Report

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

Model: LN400

COMPANY:	GE MDS LLC 175 Science Parkway Rochester, NY 14620
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
REPORT DATE:	June 7, 2016
FINAL TEST DATES:	May 23, 2016
TOTAL NUMBER OF PAGES:	21

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ACCREDITED
Testing Cert #0214.26

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	June 7, 2016	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 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 4, November 2014
- CFR 47 Part 90 (Private Land Mobile Radio Service) Subpart I
- RSS-119, Issue 12, May 2015 (Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41-960 MHz)

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

ANSI C63.4:2014
ANSI TIA-603-D June 2010

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Innovation Science and Economic Development Canada performance and procedural standards.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the GE MDS LLC model LN400 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 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.

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	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	19.6 - 41.2 dBm conducted	Determined based on License	Pass
§2.1033 (c) (4) § 2.1047 § 90.210	RSS-119	Emission types	F1D, F2D, F3D, 3-Level FSK		
		Emission mask, C and D	Within mask	Shall be within mask	Pass
§ 2.1049 § 90.209	RSS-GEN 6.6 RSS-119	Occupied Bandwidth	8.49 kHz 17.2 kHz	11.25 kHz 20.0 kHz	Pass
§ 90.214	RSS-119	Transient Frequency Behaviour	Complies, No change from original filing		
Transmitter spurious emissions					
§ 2.1051 § 2.1057	RSS-119	At the antenna terminals	Complies, no change from original filing		
§ 2.1053 § 2.1057	RSS-119	Field strength	Complies, no change from original filing		
Other details					
§ 2.1055 § 90.213	RSS-119	Frequency stability	Complies, No change from original filing		
§ 2.1093	RSS-102	RF Exposure	Complies, no change from original filing, see separate RSS-102 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

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The GE MDS LLC model LN400 is an industrial radio module operating in the 406.1-470 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 sample was received on May 23, 2016 and tested on May 23, 2016. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
GE MDS LLC	LN400	Industrial Radio Module	2728563	E5MDS-LN400

OTHER EUT DETAILS

The following EUT details should be noted: New modulations to add are 9600 (12.5kHz BW) and 19200 (25.0kHz BW) BAUD 3-level FSK modems. Original certification was for 4800 (6.25 kHz BW), 9600 (12.5 kHz BW) and 19200 (25 kHz BW) BAUD QAM modems. 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 - Silicon Valley.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
HP	Pavilion dv6000	Laptop	CNF73411TQ	-
HP	6024A	Power Supply	2430A-03013	-

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
COM1	Laptop	Cat 5	Unshielded	1.0
Power	Power Supply	Single leads	Unshielded	1.2

EUT OPERATION

During testing, the EUT was configured to transmit continuously at the selected frequency, power and modulation.

TESTING

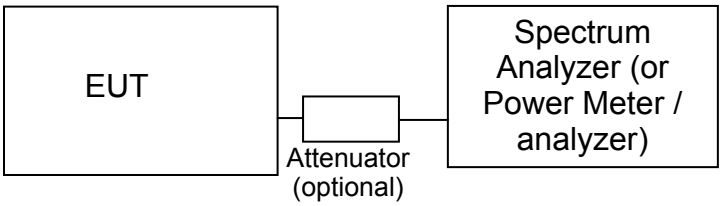
GENERAL INFORMATION

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

Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements.

RF PORT MEASUREMENT PROCEDURES

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



Test Configuration for Antenna Port Measurements

For devices with an integral antenna the output power and spurious emissions are measured as a field strength at a test distance of (typically) 3m and then converted to an eirp using a substitution measurement (refer to **Error! Reference source not found.**). 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.

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

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

Appendix A Test Equipment Calibration Data

Antenna port measurements, 23-May-16

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Fluke	Fluke Mulitmeter, True RMS	175	1447	7/25/2015	7/25/2016
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/6/2016	5/6/2017

Appendix B Test Data

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Client:	GE MDS LLC	Job Number:	JD101659
Product	LN400	T-Log Number:	T101705
System Configuration:	Module	Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Emissions Standard(s):	FCC Part 90, RSS-119	Class:	-
Immunity Standard(s):	-	Environment:	Radio

EMC Test Data

For The

GE MDS LLC

Product

LN400

Date of Last Test: 5/23/2016

Client:	GE MDS LLC	Job Number:	JD101659
Model:	LN400	T-Log Number:	T101705
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC Part 90, RSS-119	Class:	N/A

RSS 119 and FCC Part 90

Power and Occupied Bandwidth

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

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

Ambient Conditions:

Temperature: 20-22 °C

Rel. Humidity: 30-35 %

Summary of Results

Run #	Spacing	Data Rate	Test Performed	Limit	Pass / Fail	Result / Margin
1	-	-	Output Power	Determined at time of Licensing	Pass	High: 41.0 dBm Low: 20.2 dBm
2	12.5 kHz, 25.0 kHz	9.6 ksps 19.2 ksps	Spectral Mask	Mask D Mask C	Pass	Within mask
3	12.5 kHz, 25.0 kHz	9.6 ksps 19.2 ksps	99% or Occupied Bandwidth	11.25 kHz 20.0 kHz	Pass	8.49 kHz 17.2 kHz

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	GE MDS LLC	Job Number:	JD101659
Model:	LN400	T-Log Number:	T101705
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC Part 90, RSS-119	Class:	N/A

Run #1: Output Power

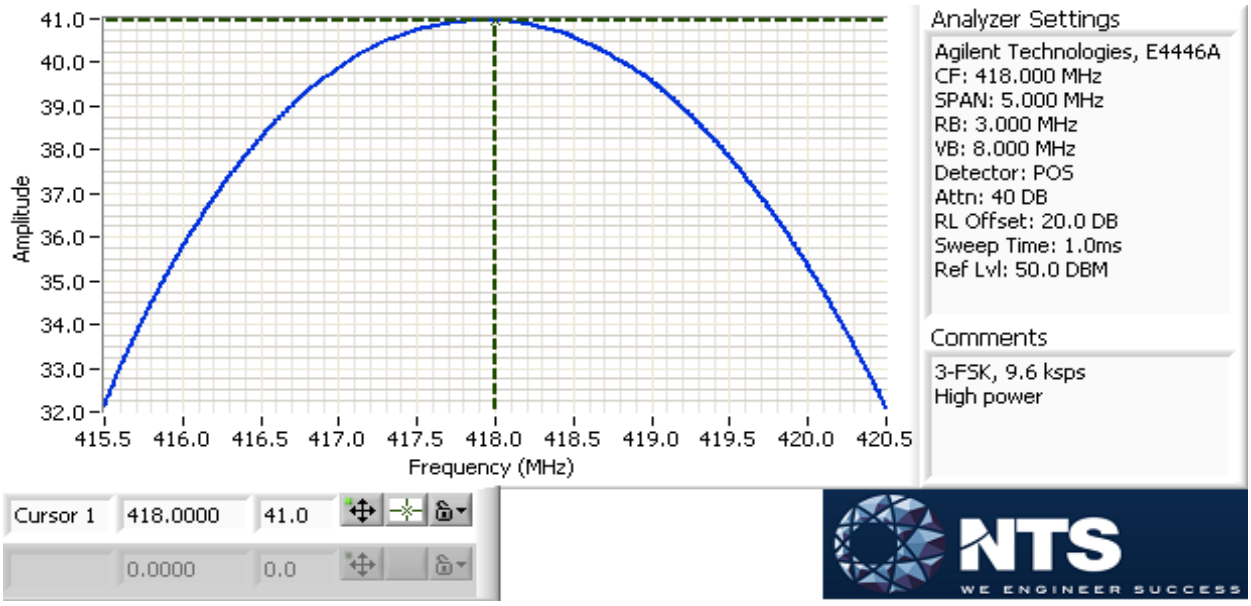
Date of Test: 23-May-16 Config. Used: 1
Test Engineer: Deniz Demirci Config Change: none
Test Location: FT Lab #4 EUT Voltage: 13.8 VDC

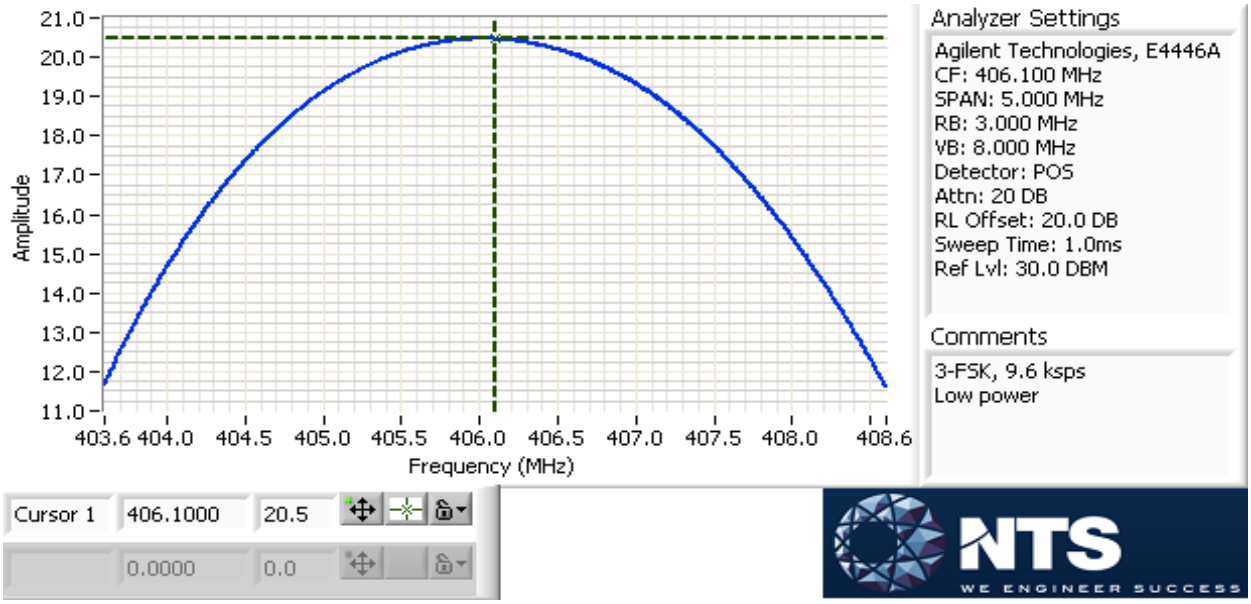
Cable Loss: 0.0 dB Attenuator: 20.0 dB Total Loss: 20.0 dB
Cable ID(s): - Attenuator IDs: 1878.0

Power Setting[2]	Frequency (MHz)	Output Power (dBm) [1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W
High power							
40	406.1000	41.0	12589.3	16.0	Pass	57.0	501.187
40	418.0000	41.0	12589.3	16.0	Pass	57.0	501.187
40	430.0000	41.0	12589.3	16.0	Pass	57.0	501.187
40	451.0000	40.9	12302.7	16.0	Pass	56.9	489.779
40	460.0000	40.9	12302.7	16.0	Pass	56.9	489.779
40	470.0000	40.8	12022.6	16.0	Pass	56.8	478.630
Low power							
20	406.1000	20.5	112.2	16.0	Pass	36.5	4.467
20	418.0000	20.4	109.6	16.0	Pass	36.4	4.365
20	430.0000	20.3	107.2	16.0	Pass	36.3	4.266
20	451.0000	20.2	104.7	16.0	Pass	36.2	4.169
20	460.0000	20.2	104.7	16.0	Pass	36.2	4.169
20	470.0000	20.2	104.7	16.0	Pass	36.2	4.169

Note 1:	Output power measured using a spectrum analyzer (see plots below) with RBW=3 MHz, VB=8 MHz, peak detector
Note 2:	Power setting - the software power setting used during testing, included for reference only.
Note 3:	Baud rate and modulation type do not have significant effect to the measured power level.

Client:	GE MDS LLC	Job Number:	JD101659
Model:	LN400	T-Log Number:	T101705
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC Part 90, RSS-119	Class:	N/A





Client:	GE MDS LLC	Job Number:	JD101659
Model:	LN400	T-Log Number:	T101705
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC Part 90, RSS-119	Class:	N/A

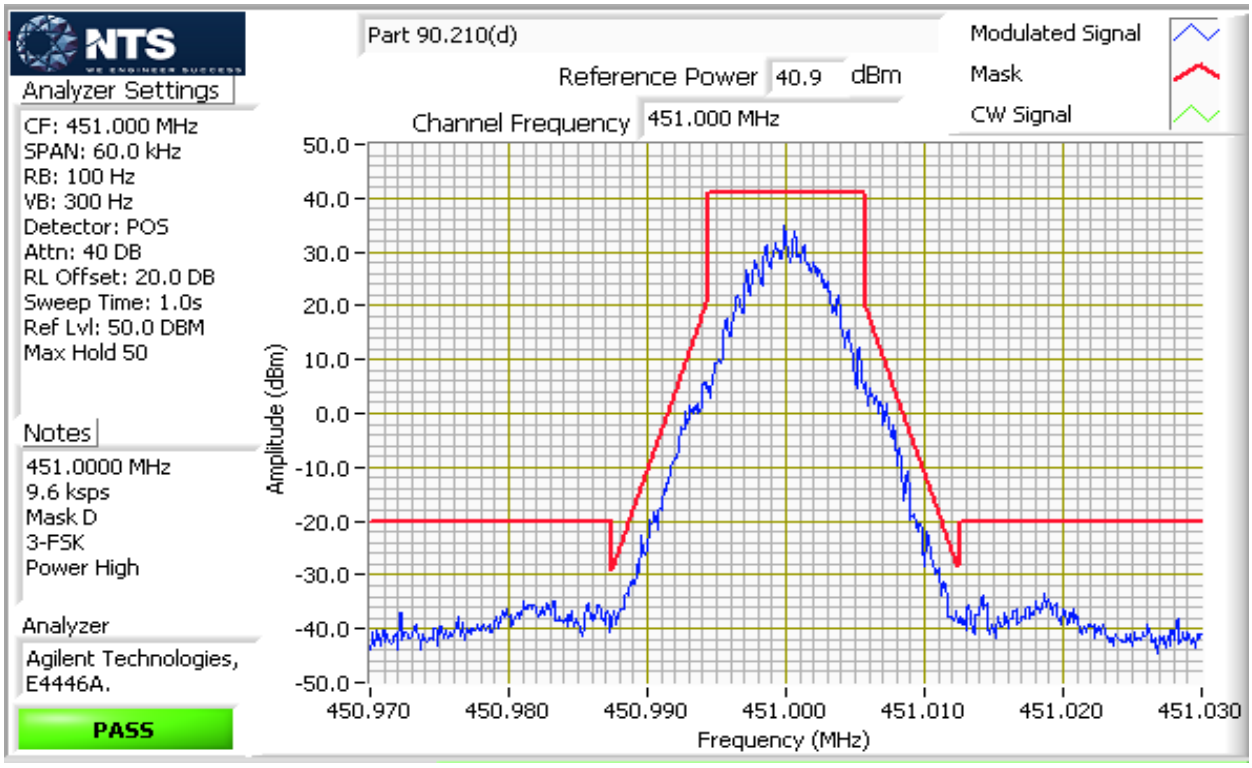
Run #2: Spectral Mask, FCC Part 90 and RSS-119 Masks C, Mask D

Date of Test: 23-May-16
Test Engineer: Deniz Demirci
Test Location: FT Lab #4

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

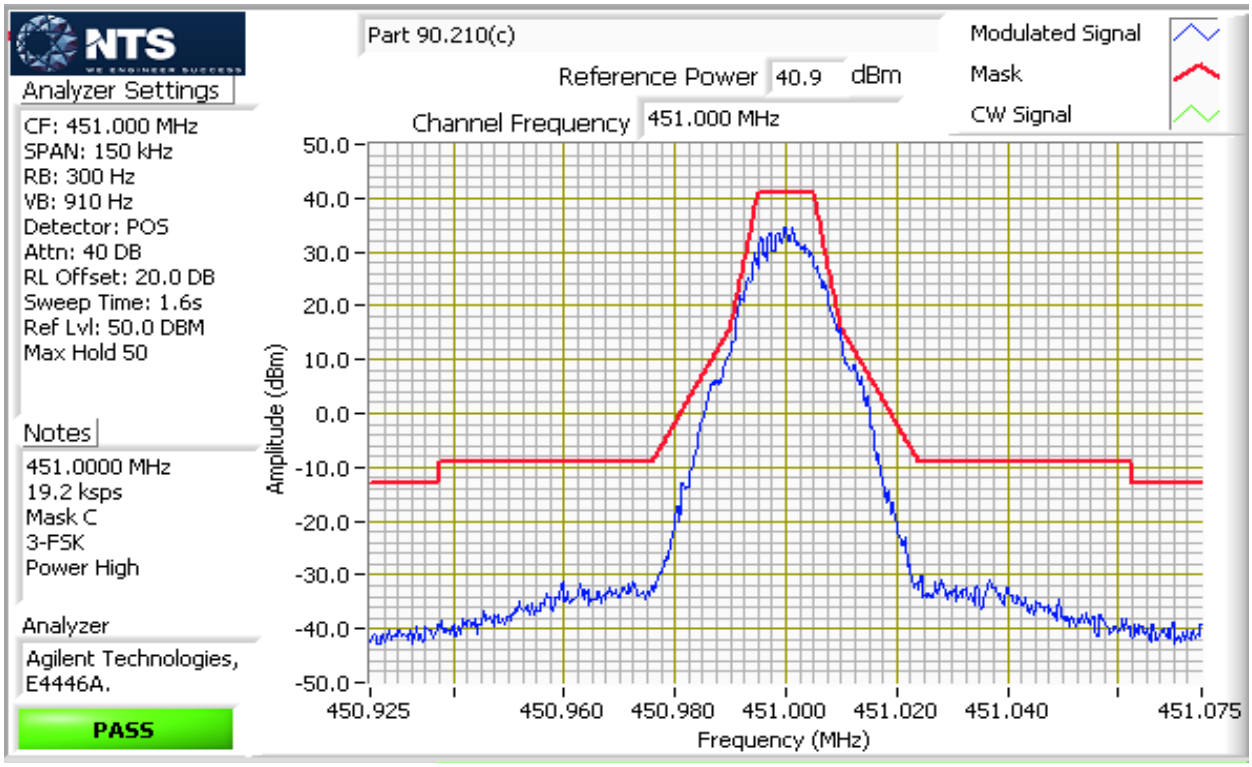
Note 1:	451 MHz peak power measurements were used as a spectral mask power reference.

9.6 ksps: 12.5 kHz BW (Mask D)



Client:	GE MDS LLC	Job Number:	JD101659
Model:	LN400	T-Log Number:	T101705
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC Part 90, RSS-119	Class:	N/A

19.2 ksps: 25 kHz BW (Mask C)



Client:	GE MDS LLC	Job Number:	JD101659
Model:	LN400	T-Log Number:	T101705
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC Part 90, RSS-119	Class:	N/A

Run #3: Signal Bandwidth

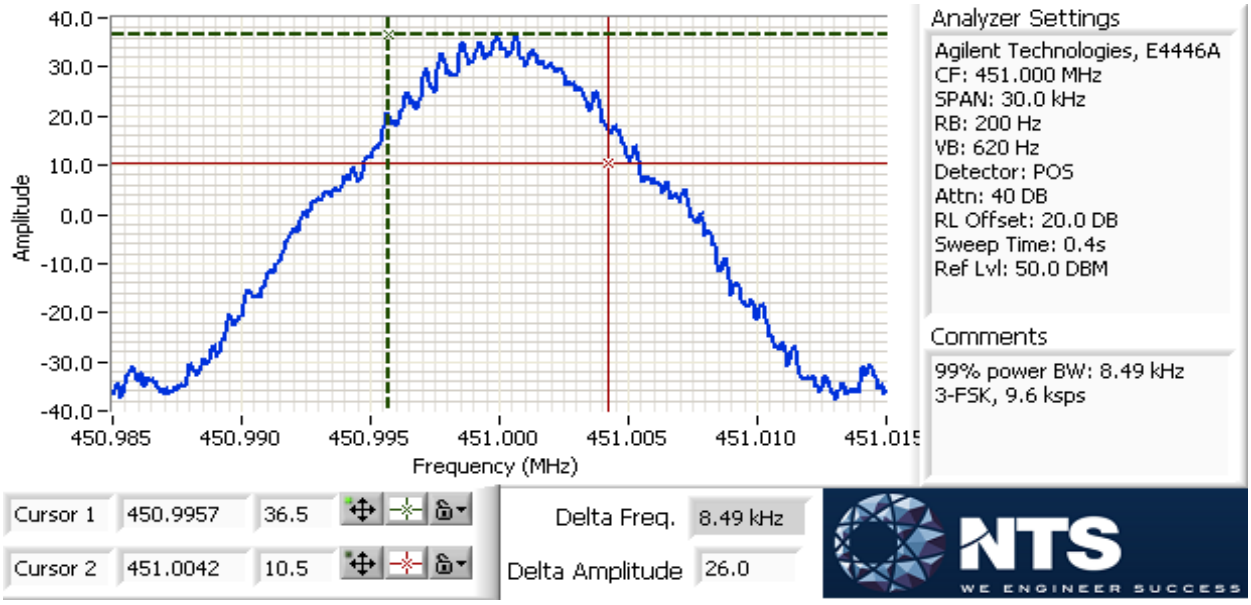
Date of Test: 23-May-16
Test Engineer: Deniz Demirci
Test Location: FT Lab #4

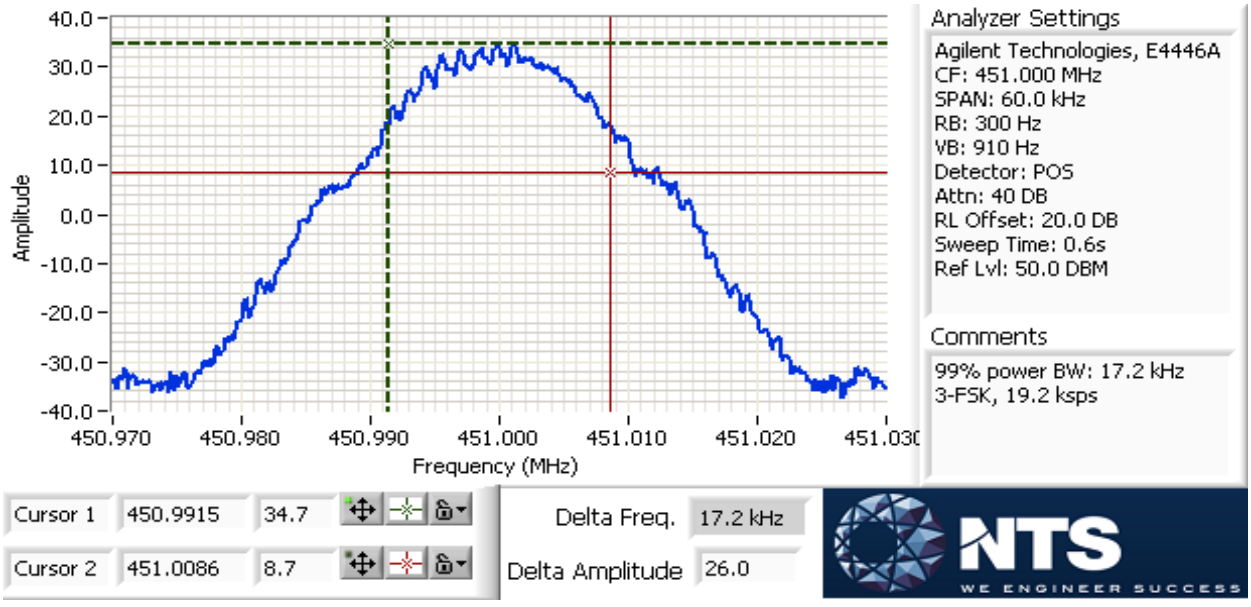
Config. Used: 1
Config Change: none
EUT Voltage: 13.8 VDC

Power Setting	Baud rate (ksps)	Frequency (MHz)	RBW (kHz)	OBW (kHz)	
				26dB	99%
40	9.6	451.0000	0.2		8.49
40	19.2	451.0000	0.3		17.2

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

Client:	GE MDS LLC	Job Number:	JD101659
Model:	LN400	T-Log Number:	T101705
		Project Manager:	Christine Krebill
Contact:	Dennis McCarthy	Project Coordinator:	-
Standard:	FCC Part 90, RSS-119	Class:	N/A





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