



Nemko USA, Inc.

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CERTIFICATION TEST REPORT

Report Number: 2012 10221060 EMC

Project Number: 10231106

Nex Number: 221060

Applicant: LINEAR LLC
1950 CAMINO VIDA ROBLE
Carlsbad, CA 92008

Equipment Under Test (EUT): REPEATER


Model: SW-ATT-RPTR9

FCC ID: QNP915RPT

IC: 4676A-915RPT

In Accordance With: FCC Part 15 Subpart C, 15.249
IC RSS-210 Issue 8 December 2010
IC RSS-Gen Issue 3 December 2010

Tested By: Nemko USA Inc.
2210 Faraday Avenue, Suite 150
Carlsbad, CA 92008

Authorized By: 
Alan Laudani, EMC/RF Test Engineer

Date: OCTOBER 5, 2012

Total Number of Pages: 26

1 Applicant Affirmation

John Kuivinen representing Linear LLC hereby affirms:

- a) That he/she has reviewed and concurs that the test shown in this report are reflective of the operational characteristics of the device for which certification is sought;
- b) That the device in this test report will be representative of production units;
- c) That all changes (in hardware and software/firmware) to the subject device will be reviewed.
- d) That any changes impacting the attributes, functionality or operational characteristics documented in this report will be communicated to the body responsible for approving (certifying) the subject equipment.

John Kuivinen

Printed name of official

Signature of official

1950 Camino Vida Roble

Address

October 5, 2012

Date

760-438-7138

Telephone number

johnk@linearcorp.com

Email address of official

NOTE—This affirmation must be signed by the responsible party before it is submitted to a regulatory body for approval.

Section1: Summary of Test Results

General

All measurements are traceable to national standards

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15; Subpart C and IC RSS-210. Radiated tests were conducted in accordance with ANSI C63.4-2003. Radiated emissions are made in a 10m semi-anechoic chamber. A description of the test facility is on file with the FCC and IC.

The assessment summary is as follows:

Apparatus Assessed:	Repeater
Model:	SW-ATT-RPTR9
Specification:	FCC Part 15 Subpart C, 15.249 IC RSS-210 Issue 8 December 2010
Date Received in Laboratory:	September 24, 2011
Compliance Status:	Complies
Exclusions:	None
Non-compliances:	None

1.1 Report Release History

REVISION	DATE	COMMENTS
-	October 5, 2012	Prepared By: Mark Phillips
-	October 5, 2012	Initial Release: Alan Laudani

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025.

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TESTED BY:  Date: October 5, 2012
Mark Phillips, EMC Test Engineer

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Section 2: Equipment Under Test

2.1 Product Identification

The Equipment Under Test was identified as follows:

Linear LLC SW-ATT-RPTR9 Repeater

2.2 Samples Submitted for Assessment

The following sample of the apparatus has been submitted for type assessment:

Sample No.	Description	Serial No.
221060-1	SW-ATT-RPTR9 REPEATER	040001F0



2.3 Theory of Operation

The SW-ATT-RPTR9 is a Repeater. Its function is to act as a wireless repeater. The SW-ATT-RPTR9 has no software.

The EUT's performance during test was evaluated against the performance criterion specified by applicable test standards. Performance results are detailed in the test results section of this report.

2.4 Technical Specifications of the EUT

Manufacturer:	Linear LLC
Operating Frequency:	911.78 MHz, 913.28MHz,,918.78 MHz 919.78MHz in the 902 – 928 MHz Band
Number of Operating Frequencies:	4
Rated Field Strength:	72.9 dBµV/m @ 3 meters Or 4.4 mV/m
Modulation:	GFSK
Antenna Type:	Integral Dipole
Antenna Connector:	None
Power Source:	120VAC 60Hz (2ea. CR123A Lithium Battery Backup)

Section 3: Test Conditions

3.1 Specifications

The apparatus was assessed against the following specifications:

FCC Part 15 Subpart C, 15.249

Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz and 24.0-24.25 GHz bands.

IC RSS-210 Issue 8 December 2010

Low-power Licence-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment. Annex 8 - Frequency Hopping and Digital Modulation Systems Operating in the Bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

IC RSS-Gen Issue 3 December 2010

General Requirements and Information for the Certification of Radio-communication Equipment

3.2 Deviations From Laboratory Test Procedures

No deviations from Laboratory Test Procedure

3.3 Test Environment

All tests were performed under the following environmental conditions:

Temperature range	21-26 °C
Humidity range	50-60%



3.4 Test Equipment

Nemko ID	Device	Manufacturer	Model	Serial Number	Cal Date	Cal Due Date
E1018	9kHz to 7GHz Spectrum Analyzer	Rohde & Schwarz	FSP7	835363/0003	2-23-12	2-23-13
752	Antenna, DRWG	EMCO	3115	4943	6-11-12	6-11-13
133	Antenna, Loop	Electrometrics	ALR-25M	678	7/18/11	7/18/13
317	Preamplifier	HP	8449A	2749A00167	12-2-11	12-2-12
128	Antenna, Bicon	EMCO	3104	2882	3-21-12	3-21-13
110	Antenna, LPA	Electrometrics	LPA-25	1217	4-1-12	4-1-13
911	Spectrum Analyzer	Agilent	E4440A	US41421266	10-27-11	10-27-12
E1018	9kHz to 7GHz Spectrum Analyzer	Rohde & Schwarz	FSP7	835363/0003	2-23-12	2-23-13
E1020	Two Line V-Network	Rohde & Schwarz	ENV216	101044	4-6-12	4-6-13

Registration of the 10m Semi-anechoic chamber is on file with the Federal Communications Commission and with Industry Canada under Site Number 2040B-3.



Section 4: Observations

4.1 Modifications Performed During Assessment

No modifications were performed during assessment.

4.2 Record Of Technical Judgements

No technical judgements were made during the assessment.

4.3 EUT Parameters Affecting Compliance

The user of the apparatus could not alter parameters that would affect compliance.

4.4 Test Deleted

No Tests were deleted from this assessment.

4.5 Additional Observations

There were no additional observations made during this assessment.



Section 5: Results Summary

This section contains the following:

FCC Part 15 Subpart C: §15.249
IC RSS-210 Issue 8 December 2010 Annex A2.9
IC RSS-Gen Issue 3 December 2010

The column headed "Required" indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

N No: not applicable / not relevant

Y Yes: Mandatory i.e. the apparatus shall conform to these tests.

N/T Not Tested, mandatory but not assessed. (See section 4.4 Test deleted)

The results contained in this section are representative of the operation of the apparatus as originally submitted.

5.1 Test Results

Part 15C	Industry Canada	Test Description	Required	Result
15.207 (a)	RSS-Gen 7.2.4	Conducted Emission Limit	Y	Pass
15.215(c)	RSS-Gen 4.6.3	20 dB Bandwidth	Y	Pass
15.249(a)	A2.9	Field Strength of Emissions	Y	Pass
15.249(a)	A2.9	Spurious Emissions Outside of the band	Y	Pass
15.109 (a)	RSS-Gen 4.10 & RSS-Gen 6.1	Receiver Spurious Emissions	Y	Pass



Appendix A: Test Results

Section 15.215(c) – Occupied Bandwidth

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

RSS-Gen Section 4.6.1 – Occupied Bandwidth

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded.

The span between the two recorded frequencies is the occupied bandwidth.

Test Conditions:

Sample Number:	SW-ATT-RPTR9	Temperature:	25°C
Date:	9-27-12	Humidity:	57%
Modification State:	Low and High Channel	Tester:	Mark Phillips
		Laboratory:	Nemko

Test Results:

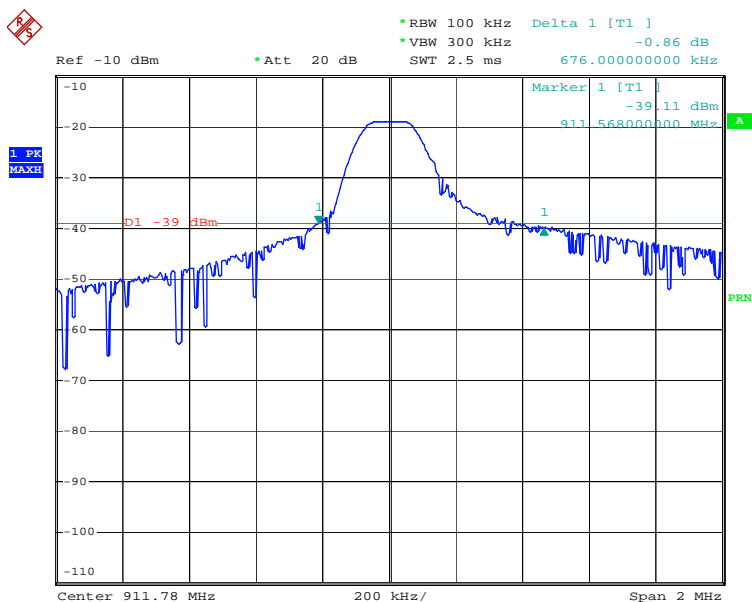
See attached plots

Additional Observations:

- Span is wide enough to capture the channel transmission
- RBW is 1% of the span or worst case

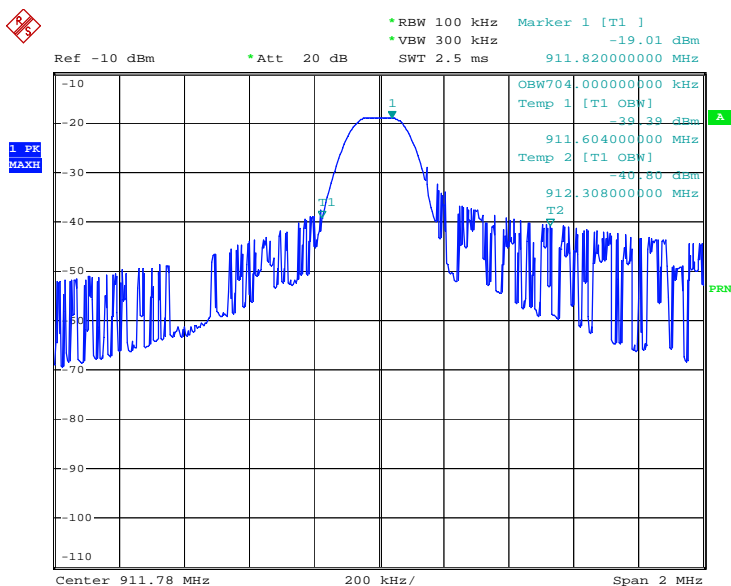
- VBW is 3X RBW
- Sweep is auto
- Detector is Peak
- Trace is Max Hold
- A peak output max hold reading was taken; a display line was drawn 20 dB lower than peak level. The 20 dB bandwidth was determined from where the channel output spectrum intersected the display line.
- Per Industry Canada requirement, another measurement was made using the built-in OBW measuring feature of the spectrum analyzer with power BW of 99%.
- $911.78 \text{ MHz} - 0.676/2 \text{ MHz} = 910.442 \text{ MHz}$ (within the frequency band)
- $919.78 \text{ MHz} + 512/2 \text{ MHz} = 920.036 \text{ MHz}$ (within the frequency band)
-

Frequency	20dB band width	99% band width
911.78 MHz	676 kHz	704 kHz
919.78 MHz	512 kHz	518 kHz



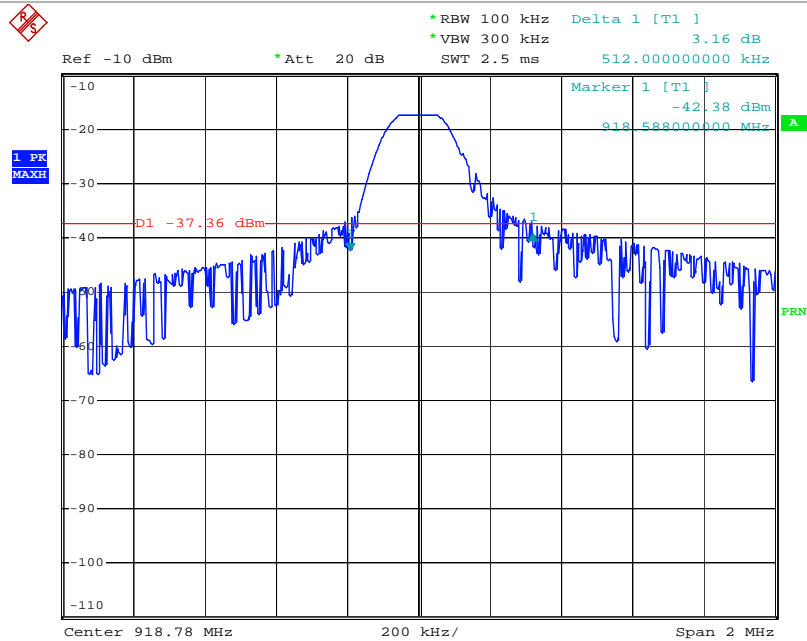
Date: 27.SEP.2012 19:46:48

Low Channel (911.78 kHz) 20dB Occupied Bandwidth is 676 kHz

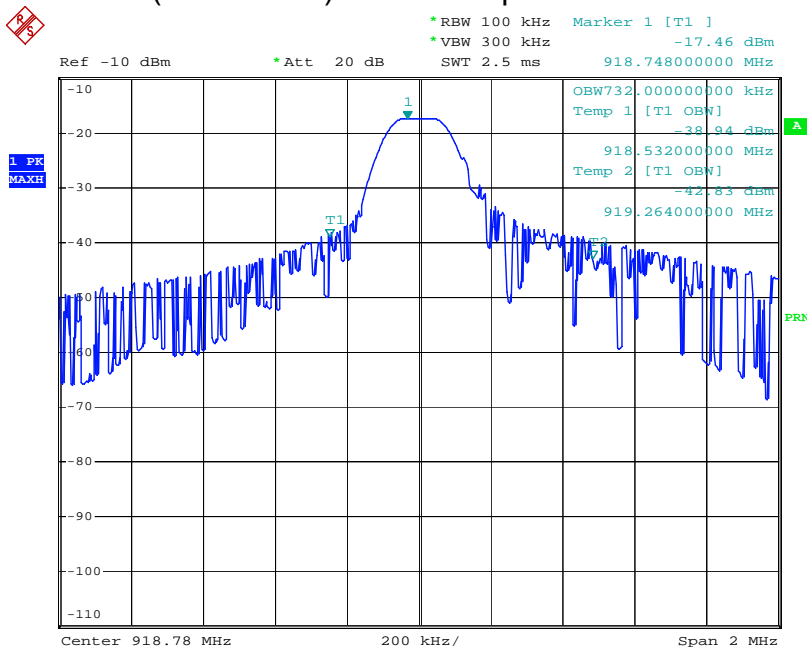


Date: 27.SEP.2012 19:50:25

Low Channel (911.78 kHz) 99% Occupied Bandwidth is 704 kHz



Date: 27.SEP.2012 20:25:47
High Channel (918.78 kHz) 20dB Occupied Bandwidth is 512kHz



Date: 27.SEP.2012 20:30:12
High Channel (918.78 kHz) 99% Occupied Bandwidth is 732 kHz

Section 15.249(a) – Field Strength of Emissions

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

RSS-210 A2.9 – Field Strength of Emissions

This section provides standards for low-power devices that can be used for any application provided the following conditions are met:

(a) The field strengths measured at 3 metres shall not exceed the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (millivolts/meter)
902–928 MHz	50 ^(Note 1)	0.5
2400–2483.5 MHz	50 ^(Note 1)	0.5
5725–5875 MHz	50 ^(Note 1)	0.5

Note 1: Equivalent to 0.75 mW e.i.r.p.

(b) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to Table 2 limits, whichever is the less stringent.

Section 4.4 of RSS-Gen (Pulsed Operation) does not apply to CISPR measurement for the band 902-928 MHz.

Test Conditions:

Sample Number:	SW-ATT-RPTR9	Temperature:	25°C
Date:	9/26/2012	Humidity:	57%
Modification State:	Low and High Channel	Tester:	Mark Phillips
		Laboratory:	Nemko

Additional Observations:

- All measurements were performed using a peak detector.
- RBW is 1MHz while VBW is 3MHz.
- Spectrum was investigated up to 10.0GHz
- There are no emissions found other than the fundamental.
- Average data are calculated from Peak measurements plus Duty Cycle Correction Factor (DCCF).

Sample Computation (Radiated Emissions Data Sheet):

Correction factor	
@ 911.78 MHz	= 61.6 dB μ V/m
	= Antenna factor + Cable loss – Preamp gain
	= 23.5 + 6.1 – 0
Corrected reading	= Max. reading + Correction factor
	= 61.6 + 29.6
	= 91.2 dB μ V/m

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Specification: FCC Part 15 Subpart C, 15.249

Test Results:

Radiated Emissions Data

Job # : 10231106 Date : 9/26/12
NEX #: 221060 Time : 1900
Staff : MP

Page 1 of 1

Client Name :	Linear LLC
EUT Name :	Repeater
EUT Model # :	SW-ATT-RPTR9
EUT Serial # :	050001FC
EUT Config. :	Transmitting

EUT Voltage :	120VAC
EUT Frequency :	60Hz
Phase:	1

Specification :	CFR47 Part 15.249	
Loop Ant. #:	NA	
Bicon Ant.#:	NA	Temp. (°C) : 25
Log Ant. #:	110_3m	Humidity (%) : 57
DRG Ant. #	877	Spec Analyzer #: 911
Cable LF#:	SAC_10m	Analyzer Display #: 911
Cable HF#:	WCC	Quasi-Peak Detector #: 911
Preamp LF#:	902	Duty Cycle (%): 9.50
Preamp HF#	317	Measurement

Distance < 1000 MHz:	3 m
Distance > 1000 MHz:	3 m

Quasi-Peak	RBW: 120 kHz
	Video Bandwidth: 300 kHz
Peak	RBW: 1 MHz
	Video Bandwidth: 3 MHz

Average = Peak + Duty Cycle Factor

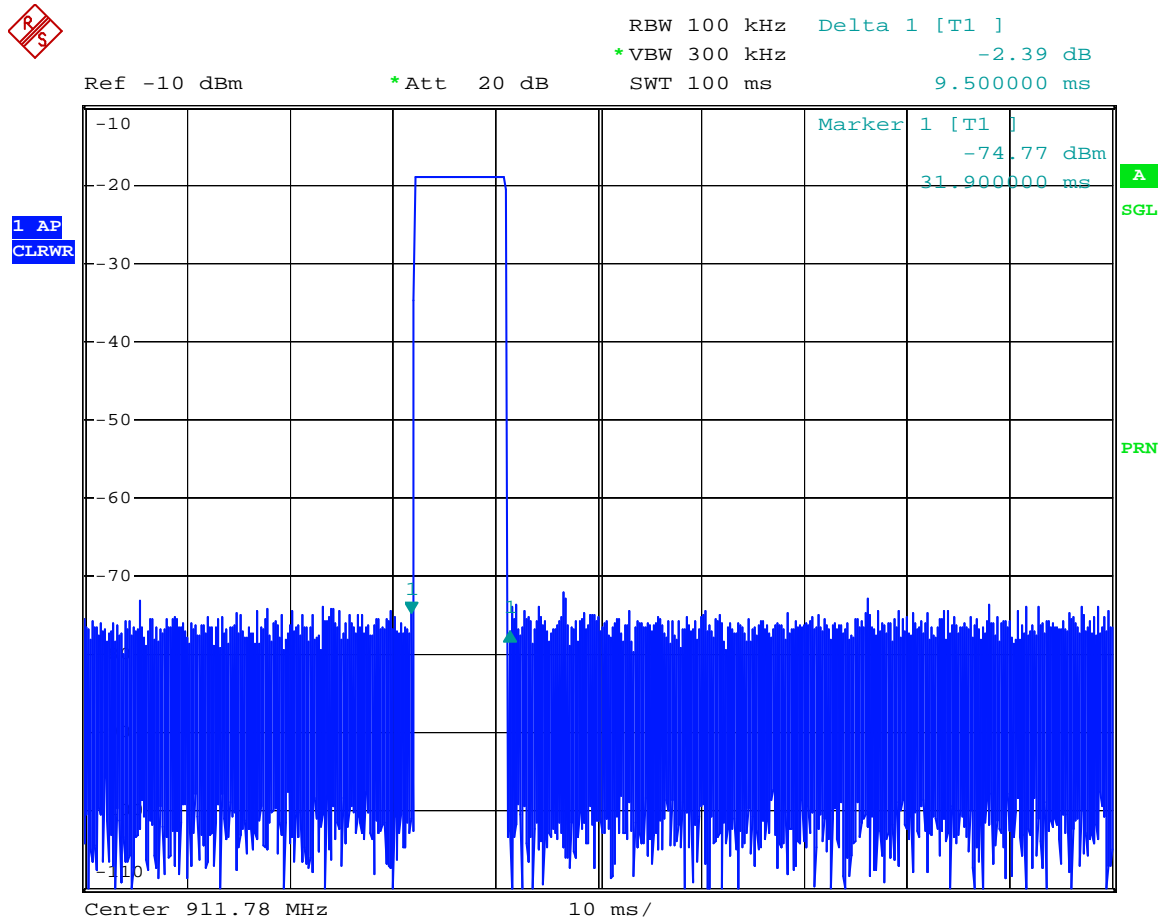
DCF = 20 x log(duty cycle)

Measurements below 1 GHz are Quasi-Peak values, unless otherwise stated.

Measurements above 1 GHz are Average values, unless otherwise stated.

[illegible]

Duty Cycle Correction Factor Calculations



Date: 27.SEP.2012 19:35:36

One (1) set of data packets in 100ms sweep

Each data packet is 9.5 mS long

$$\begin{aligned} \text{Duty Cycle} &= 0.95 \text{ ms} \times 1 \\ &= 9.5 \text{ ms}/100 \text{ ms} \\ &= 0.095 \end{aligned}$$

$$\begin{aligned} \text{DCCF} &= 20 \log (0.095) \\ &= -20.44 \end{aligned}$$

Section 15.249 (d) – Spurious Emissions Outside of the band

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

RSS-210 A2.9 – Spurious Emissions Outside of the band

(b) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to Table 2 limits, whichever is the less stringent.

Section 4.4 of RSS-Gen (Pulsed Operation) does not apply to CISPR measurement for the band 902-928 MHz.

Test Conditions:

Sample Number:	SW-ATT-RPTR9	Temperature:	25°C
Date:	9-27-12	Humidity:	56%
Modification State:	Low and High Channel	Tester:	Mark Phillips
		Laboratory:	Nemko

Test Results:

No emissions found.

Additional Observations:

- Emissions were investigated in Transmit and Receive modes.
- All measurements below 1 GHz were performed at 3m employing a CISPR quasi-peak detector.
- Peak measurements above 1 GHz utilize a RBW of 1 MHz and a VBW of 3 MHz
- The Spectrum was searched from 9 kHz to 10.0 GHz.
- There were no emissions found other than the fundamental (Section 15.249(a)).



RSS-Gen 4.10 – Receiver Spurious Emissions

6.1 Radiated Limits

Radiated spurious emission measurements shall be performed with the receiver antenna connected to the receiver antenna terminals.

Table 2: Radiated Limits of Receiver Spurious Emissions

Frequency (MHz)	Field Strength (microvolts/m at 3 meters)*
30-88	100
88-216	150
216-960	200
Above 960	500

*Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 7.2.7.

Test Conditions:

Sample Number:	SW-ATT-RPTR9	Temperature:	25°C
Date:	9-26-12	Humidity:	55%
Modification State:	Mid Channel	Tester:	Mark Phillips
		Laboratory:	Nemko

Additional Observations:

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is higher, without exceeding 40 GHz.

For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.

Above 1000 MHz, measurements shall be performed using an average detector with a minimum resolution bandwidth of 1 MHz.

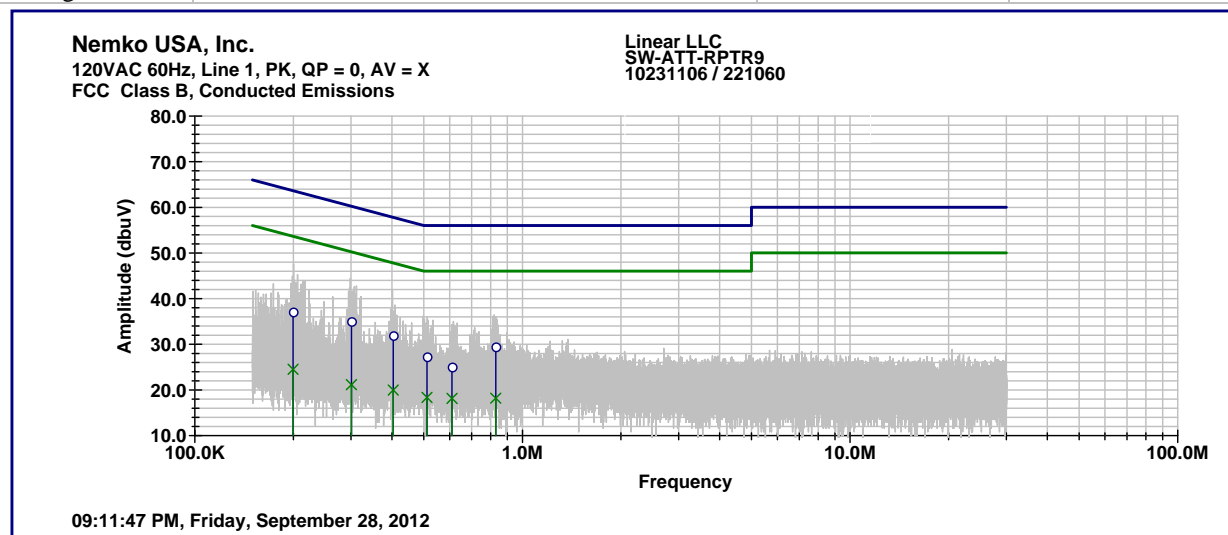
- All measurements below 1 GHz were performed at 3m employing a CISPR quasi-peak detector.
- Peak measurements above 1 GHz utilize a RBW of 1 MHz and a VBW of 3 MHz
- The Spectrum was searched from 9 kHz to 5.0 GHz.

Test Results:

No emissions found.

Conducted Emissions

Client	Linear LLC	Temperature	24	°C
NEx #:	221065	Relative Humidity	54	%
EUT Name	Repeater	Barometric Pressure	100.4	kPa
EUT Model	SW-ATT-RPTR9	Test Location	Ground Plane	
Governing Doc	CFR 47, Part 15B, Sec. 15.107	Test Engineer	Mark Phillips	
Basic Standard	ANSI C63.4	Date	9-28-12	
Voltage:	120 Vac Line 1	Transmit Mode		

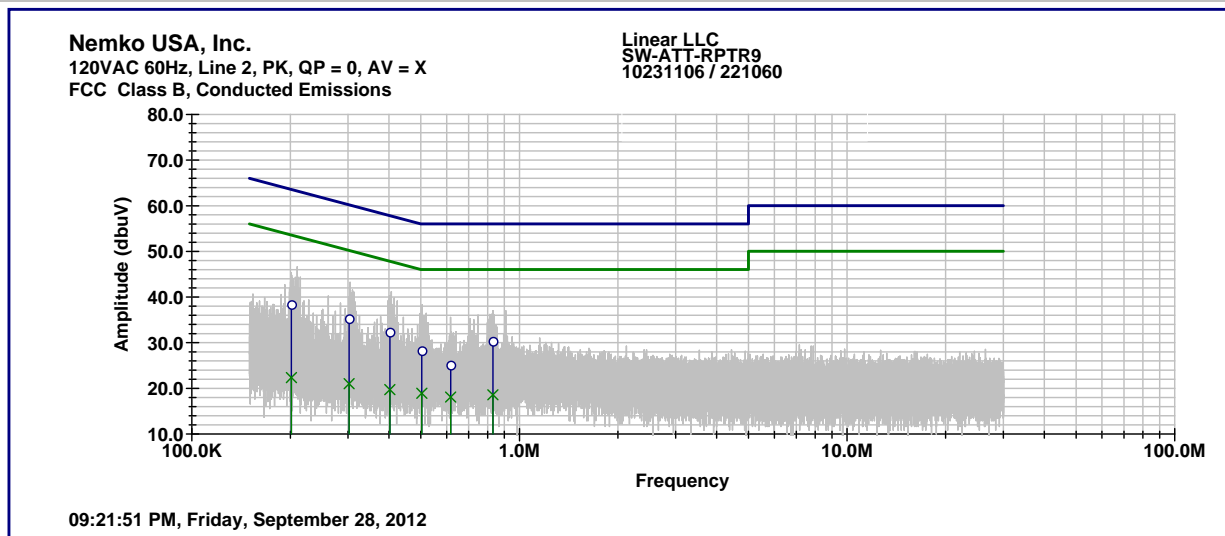


Frequency (kHz)	Measured		Limit		Margin	
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
199.5	37.1	24.5	63.6	53.6	-26.5	-29.1
300.7	35.0	21.1	60.2	50.2	-25.2	-29.1
403.3	31.9	20.0	57.8	47.8	-25.9	-27.8
511.3	27.3	18.4	56.0	46.0	-28.7	-27.6
609.6	25.0	18.1	56.0	46.0	-31.0	-27.9
828.8	29.5	18.2	56.0	46.0	-26.5	-27.8

FCC ID: QNP915RPT
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Report Number: 2012 10221060 EMC
Specification: FCC Part 15 Subpart C, 15.249

Client	Linear LLC	Temperature	24	°C
NEx #:	221065	Relative Humidity	54	%
EUT Name	Repeater	Barometric Pressure	100.4	kPa
EUT Model	SW-ATT-RPTR9	Test Location	Ground Plane	
Governing Doc	CFR 47, Part 15B, Sec. 15.107	Test Engineer	Mark Phillips	
Basic Standard	ANSI C63.4	Date	9-28-12	
Voltage:	120 Vac Line 2 Transmit Mode			

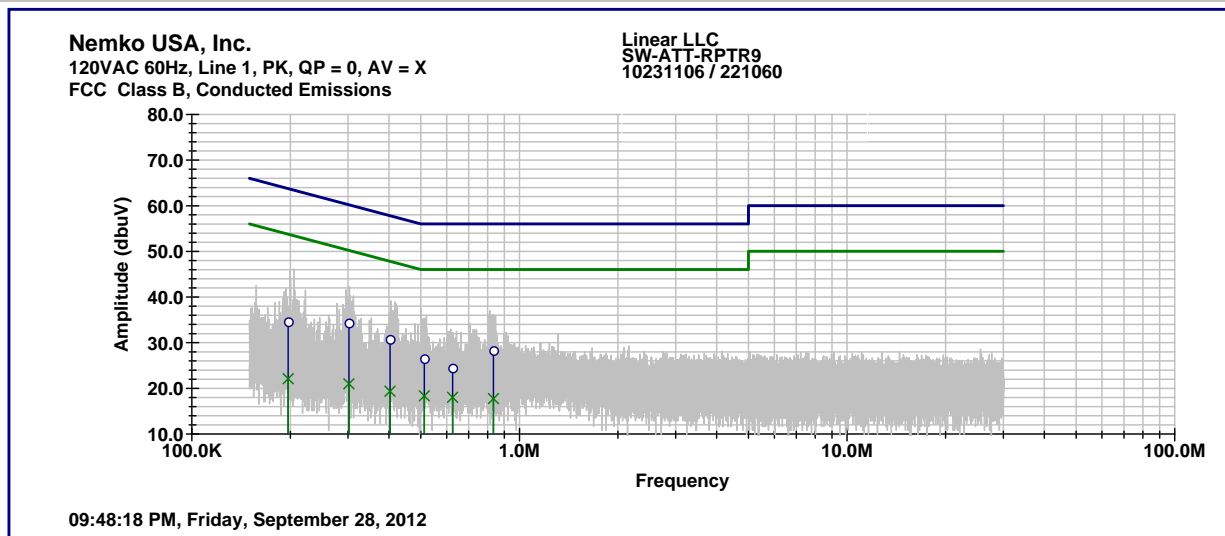


Frequency (kHz)	Measured		Limit		Margin	
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
201.4	38.4	22.4	63.6	53.6	-25.2	-31.2
302.2	35.3	21.0	60.2	50.2	-24.9	-29.2
402.2	32.3	19.7	57.8	47.8	-25.5	-28.1
503.6	28.3	18.9	56.0	46.0	-27.7	-27.1
616.8	25.1	18.1	56.0	46.0	-30.9	-27.9
830.0	30.3	18.6	56.0	46.0	-25.7	-27.4

FCC ID: QNP915RPT
IC: 4676A-915RPT

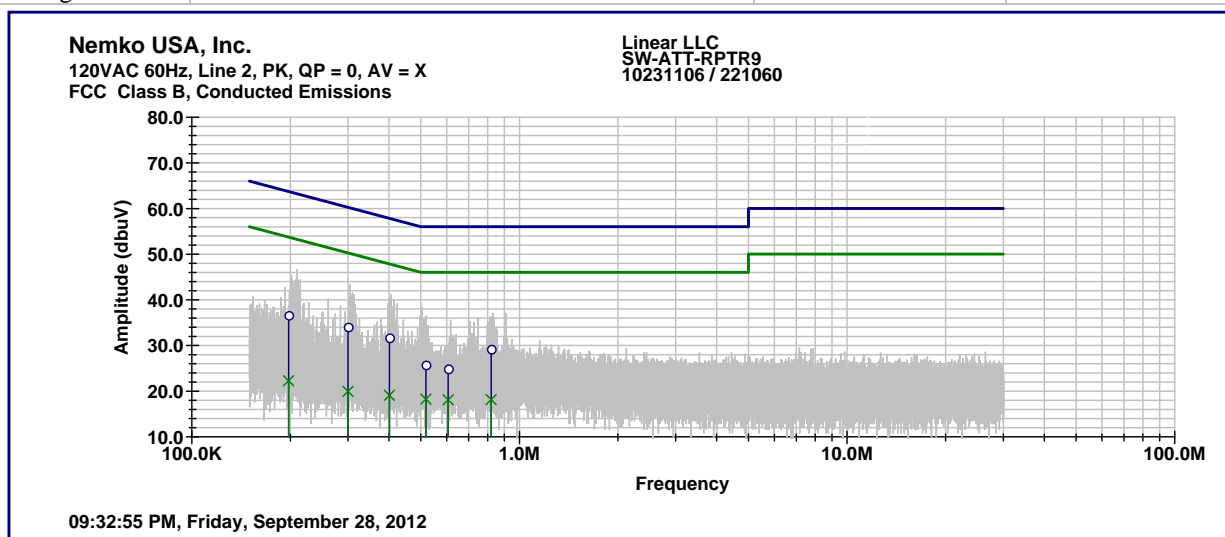
Report Number: 2012 10221060 EMC
Specification: FCC Part 15 Subpart C, 15.249

Client	Linear LLC	Temperature	24	°C
NEx #:	221065	Relative Humidity	54	%
EUT Name	Repeater	Barometric Pressure	100.4	kPa
EUT Model	SW-ATT-RPTR9	Test Location	Ground Plane	
Governing Doc	CFR 47, Part 15B, Sec. 15.107	Test Engineer	Mark Phillips	
Basic Standard	ANSI C63.4	Date	9-28-12	
Voltage:	120 Vac Line 1 Receive Mode			



Frequency (kHz)	Measured		Limit		Margin	
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
196.9	34.6	22.1	63.7	53.7	-29.1	-31.6
301.7	34.3	21.0	60.2	50.2	-25.9	-29.2
402.8	30.7	19.3	57.8	47.8	-27.1	-28.5
512.6	26.5	18.3	56.0	46.0	-29.5	-27.7
625.0	24.5	18.0	56.0	46.0	-31.5	-28.0
833.3	28.3	17.7	56.0	46.0	-27.7	-28.3

Client	Linear LLC	Temperature	24	°C
NEx #:	221065	Relative Humidity	54	%
EUT Name	Repeater	Barometric Pressure	100.4	kPa
EUT Model	SW-ATT-RPTR9	Test Location	Ground Plane	
Governing Doc	CFR 47, Part 15B, Sec. 15.107	Test Engineer	Mark Phillips	
Basic Standard	ANSI C63.4	Date	9-28-12	
Voltage:	120 Vac Line 2 Receive Mode			



Frequency (kHz)	Measured		Limit		Margin	
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
197.5	36.6	22.3	63.7	53.7	-27.1	-31.4
299.8	34.1	20.0	60.2	50.2	-26.1	-30.2
401.3	31.7	19.1	57.8	47.8	-26.1	-28.7
517.9	25.7	18.3	56.0	46.0	-30.3	-27.7
606.5	24.9	18.1	56.0	46.0	-31.1	-27.9
820.2	29.2	18.1	56.0	46.0	-26.8	-27.9