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ENGINEERING TEST REPORT # TR314035 A
LSR Job #: C-1898

Compliance Testing of:
VRS (TWIG)

Test Date(s):
10/3/2016 to 10/6/2016

Prepared For:
Nelson Irrigation Corp
Attn: Mark Bauman, P.E.
848 Airport Road
Wala Walla, WA 99362

This Test Report issued:
Khairul Aidi Zainal, Engineering Manager – Test Services

Signature: Date: 10/7/16

Quality Assurance by:	**Report by:**
Tom Smith, Director of EMC Compliance	Khairul Aidi Zainal, Engineering Manager – Test Services
Signature: Date: 10/7/2016	Signature: Date: 10/7/16

Table of Contents

LS Research, LLC in Review

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

TESTING CERT #1255.01

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: 1255.01

Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948
FCC Registration Number: 90756

Industrie Canada Industry Canada

Canada

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1
File Number: IC 3088-A
On file, 3 and 10 Meter OATS based on RSS-212 – Issue 1
File Number: IC 3088

CE

U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Competent Body operating under the U. S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility –Council Directive 2004/108/EC (formerly 89/336/EEC, Article 10.2).
Date of Validation: January 16, 2001

Validated by the European Commission as a U.S. Notified Body operating under the U.S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.
Date of Validation: November 20, 2002
Notified Body Identification Number: 1243

1.0 Summary of Test Report

In October 2016 the EUT, VRS(TWIG), as provided by Nelson Corporation was tested and MEETS the following requirements:

FCC Requirement	IC Requirement	Test Requirements	Measurement Procedure	Compliance (Yes/No)
15.247 (a)(2)	RSS-247 Section 5.2 (1)	6 dB Bandwidth of a Digital Modulation System	ANSI C63.10-2013 Section 11.8	Yes
15.247(b) & 1.1310	RSS-247 Section 5.4 (4)	Maximum Output Power	ANSI C63.10-2013 Section 11.9	Yes
15.247 (e)	RSS-247 Section 5.2 (2)	Power Spectral Density of a Digital Modulation System	ANSI C63.10-2013 Section 11.10	Yes
15.247(d)	RSS-247 Section 5.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	ANSI C63.10-2013 Section 11.11, 11.12.2	Yes
15.247(c), 15.209 & 15.205	RSS-GEN Section 8.9, 8.10	Transmitter Radiated Emissions in Restricted Bands	ANSI C63.10-2013 Section 11.12 (6.3,6.5,6.6)	Yes
2.1055 (d)	RSS-GEN Section 6.11	Frequency Stability	ANSI C63.10-2013 Section 6.8	Yes
15.207	RSS-GEN Section 8.8	Power Line Conducted Emissions Measurements	ANSI C63.10-2013 Section 6.2	Yes

2.0 Test Facilities

All testing was performed at:

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, Wisconsin, 53012 USA

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to the requirements of ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.
LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted.

3.0 Client Information

Manufacturer Name:	Nelson Irrigation
Address:	848 Airport Road, Wala Walla, WA 99362
Contact Person:	Mark Bauman, P.E.

3.1 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	VRS(TWIG)
Model Number:	NIC-11543-01
MAC ID:	00:25:CA:08:00:00:05:15

3.2 Product Information (As provided by customer)

The VRS (TWIG) module is a high performance 900MHz IEEE 802.15.4 radio (AT86RF212 & RF amplifier and low noise amplifier circuit) and microcontroller (ATXMEGA256A3).

Microcontroller

The Atmel XMEGA A3 is a family of low power, high performance and peripheral rich CMOS 8/16-bit microcontrollers based on the AVR® enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the XMEGA A3 achieves throughputs approaching 1 Million Instructions Per Second (MIPS), thus allowing the system designer to optimize power consumption versus processing speed.

Radio

The Atmel AT86RF212 is a low-power, low-voltage 800/900 MHz transceiver specially designed for low-cost IEEE 802.15.4, ZigBee™, and high data rate ISM applications. Furthermore hardware accelerators improve overall system power efficiency and timing.

RF Front End Module

The module contains a high performance RF Front End Module for 900MHz wireless applications. It also has a built in low noise amplifier for the receiver to increase sensitivity and all antenna switching.

Associated antennas:

+6 dBi Dipole Antenna

The HyperGain® HGV-906 is a high performance omni-directional antenna designed for the 900 MHz band. It is ideally suited for multipoint, Non Line of Sight (NLOS) and mobile applications where high gain and wide coverage is desired.

Per the manufacturer, the antenna operates in 824-960 MHz range. The maximum gain is +6 dBi.

Articulating Dipole Antenna

A dipole with a gain of +2.0 dBi was connected to both ports of the radio board. The antenna can articulate 90 degrees.

Bowtie Antenna
A custom bowtie-PCB antenna with a gain of +3.7 dBi.

Custom Antenna
A custom PCB antenna with a gain of -9.9 dBi.

3.3 Modifications Incorporated In the EUT for Compliance Purposes

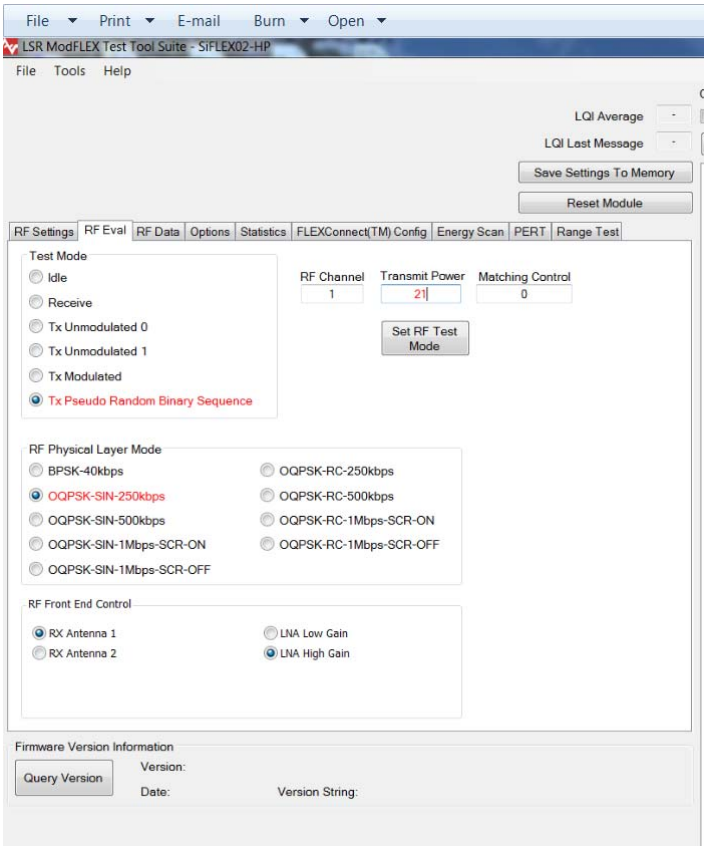
None noted at time of test

3.4 Deviations & Exclusions from Test Specifications

None noted at time of test

3.5 Additional Information

EUT programmed for necessary test modes via USB cable connected to laptop computer running LSR Modflex Test tool suite version 2.6.2.0. Test channels; Low Channel (906 MHz), Mid Channel (914 MHz), and High Channel (924 MHz). Settings used during testing (Except for Transmit power):



Transmit power setting in the LSR Modflex test tool was **'8'**.

3.6 EUT Technical Specifications

EUT Frequency Range (in MHz)	906-924 MHz
Minimum Conducted Output power in Watts	0.091
Maximum Conducted Output power in Watts	0.102
Minimum Conducted Output Power (in dBm)	19.6
Maximum Conducted Output Power (in dBm)	20.1
Occupied Bandwidth (99% BW) (MHz)	1.196
DTS Bandwidth (MHz)	0.789
Type of Modulation	O-QPSK
Emission Designator	1M20D1X
Transmitter Spurious (worst case) at 3 meters	26.3dBuV/m @ 3m (320MHz)
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Antenna Information	
Detachable/non-detachable	Detachable
Type	Dipole, Bowtie, Articulating Dipole, Custom
Gain (in dBi)	6.0 dBi, 3.7 dBi, 2.0 dBi, -9.9 dBi
EUT will be operated under FCC Rule Part(s)	15.247
EUT will be operated under RSS Rule Part(s)	RSS 247
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	Mobile

4.0 Conditions of Test

Environmental:

Temperature: 20-25º C
Relative Humidity: 30-60%
Atmospheric Pressure: 86-106 kPa

Mains Voltage: 120VAC 60Hz

5.0 Test Equipment

All test equipment is calibrated by a calibration laboratory accredited by A2LA to the requirements of ISO 17025. For a complete list of test equipment and calibration dates, see Appendix A. Unless otherwise noted, resolution bandwidth of measuring instrument used during testing for given frequency range, see below.

Frequency Range	Resolution Bandwidth
9 kHz – 150 kHz	200 Hz
150 kHz – 30 MHz	9 kHz
30 MHz – 1000 MHz	120 kHz
Above 1000 MHz	1 MHz

6.0 Conformance Summary

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, 15.207, Industry Canada RSS-247, Issue 1 (2015), Annex 8, RSS-GEN Issue 4 (2014).

If some emissions are seen to be within 3 dB of their respective limits:
As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

Appendix A – Test Equipment

LSR
a Laird Business

Date : 4-Oct-2016 Type Test : Radiated Emissions Job # : C-1898

Prepared By: John Johnston Customer : Nelson Irrigation Corporation Quote #: 314035

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration
2	AA 960158	Double Ridge Horn Antenna	ETS Lindgren	3117	109300	2/4/2016	2/4/2017	Active Calibration
3	AA 960156	900MHz High Pass Filter	KWM	HPF-L-14185	unknown	7/25/2016	7/25/2017	Active Calibration
4	EE 960159	0.8 - 21GHz LNA	Mini-Circuits	ZVA-213X-S+	40201429	2/4/2016	2/4/2017	Active Calibration
5	AA 960171	Cable - low loss 6m	A.H. Systems, Inc.	SAC-26G-6	386	3/31/2016	3/31/2017	Active Calibration
6	AA 960150	Biconical Antenna	ETS	3110B	0003-3346	2/1/2016	2/1/2017	Active Calibration
7	AA 960163	Log Periodic Antenna	A.H. Systems, Inc.	SAS-512-2	500	3/18/2016	3/18/2017	Active Calibration

LSR
a Laird Business

Date : 26-Aug-2014 Type Test : Conducted measurement Job # : C-1898

Prepared By: Mike Customer : Nelson Irrigation Corporation Quote #: 314035

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	44GHz EXA Spectrum Analyzer	Agilent	N9010A	MY53400296	12/18/2015	12/18/2016	Active Calibration
2	AA 960156	900MHz High Pass Filter	KWM	HPF-L-14185	unknown	7/25/2016	7/25/2017	Active Calibration
3	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/26/2015	6/26/2017	Active Calibration

LSR
a Laird Business

Date : 26-Aug-2014 Type Test : AC Mains Conducted emissions Job # : C-1898

Prepared By: John Johnston Customer : Nelson Irrigation Corporation Quote #: 314035

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/12/2016	5/12/2017	Active Calibration
2	EE 960089	LISN - 15A	COM-POWER	LI-215A	191943	3/8/2016	3/8/2017	Active Calibration
3	EE 960162	LISN - 15A	COM-POWER	LI-215A	191969	8/15/2016	8/15/2017	Active Calibration

Appendix B – Test Data
B.1 – RF Conducted Emissions

Manufacturer	Nelson Corp.
Test Location	LS Research, LLC
Rule Part	FCC 15.247 IC RSS-247
General Measurement Procedure	ANSI C63.10 Section 6.7 and 11
General Description of Measurement	A direct measurement of the transmitted signal was performed at the antenna port of the EUT via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source.

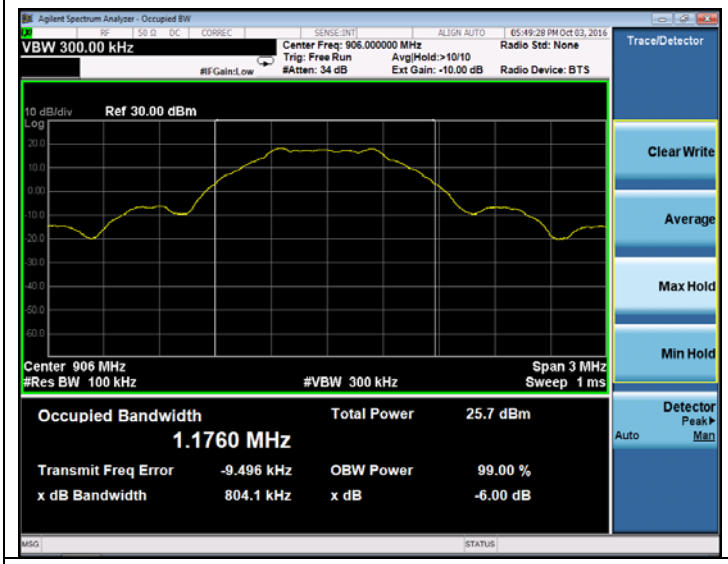
B.1.1 – RF Conducted – Fundamental Bandwidth

Manufacturer	Nelson Corp
Date	10-3-2016
Operator	Mike Hintzke
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (a)(2) IC RSS-247 Section 5.2(1)
Specific Measurement Procedure	ANSI C63.10-2013 Section 11.8
Additional Description of Measurement	Peak detector used
Additional Notes	1. Continuous transmit modulated used for this test.

Table

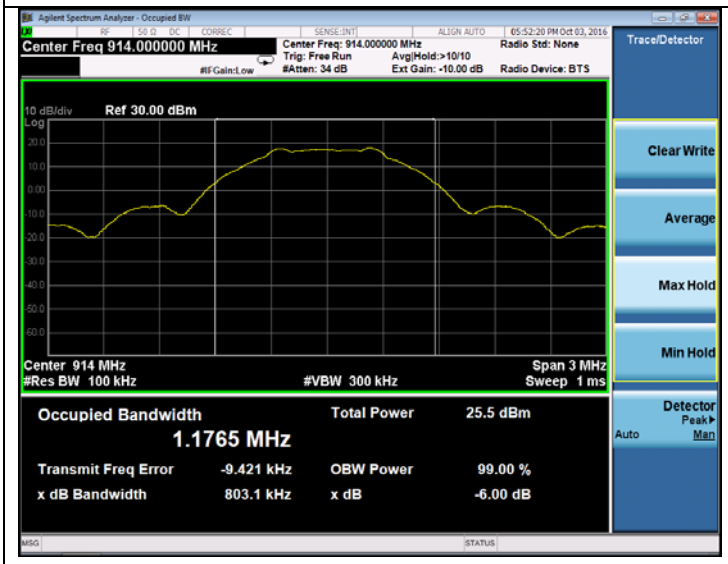
Channel Frequency (MHz)	6dB Bandwidth (MHz)	6dB Bandwidth minimum limit (MHz)	99% OBW (MHz)
906	0.804	0.500	1.193
914	0.803	0.500	1.189
924	0.789	0.500	1.196

Plots –

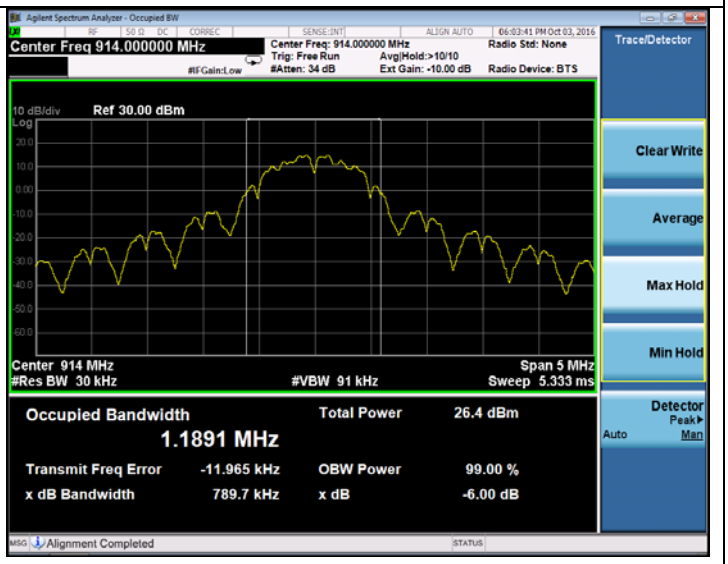


DTS BW – Low Channel

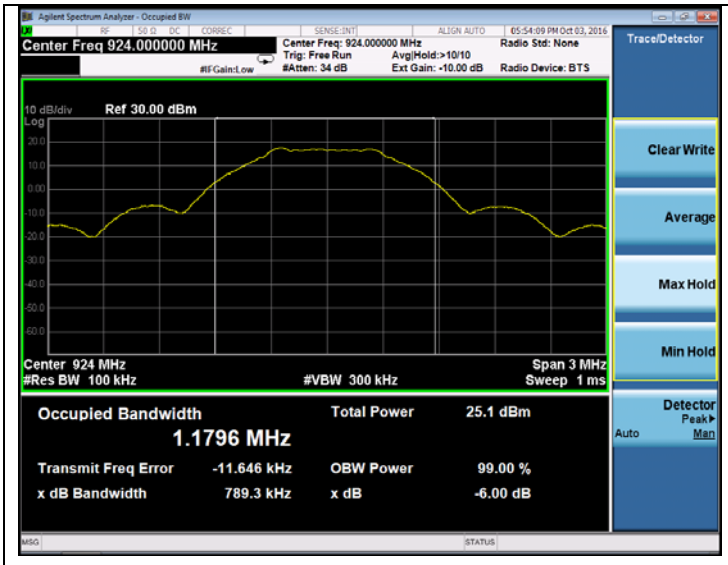
OBW + 99% BW – Low Channel



DTS BW – Mid Channel



OBW + 99% BW – Mid Channel



DTS BW – High Channel

OBW + 99% BW – High Channel

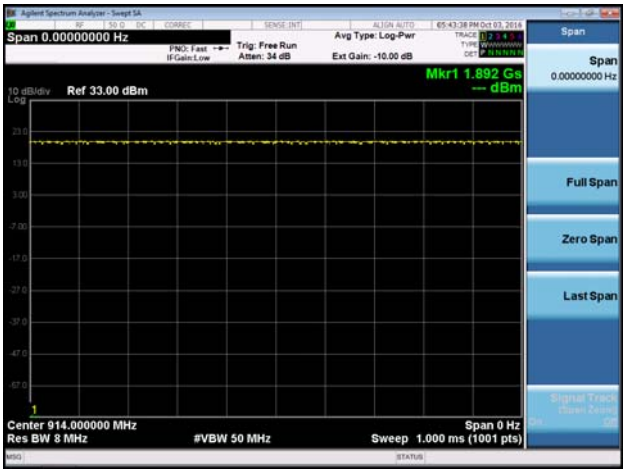
B.1.2 – RF Conducted – Fundamental Power and Spectral Density

Manufacturer	Nelson Corp.
Date	10/3/16
Operator	Mike Hinztke
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (b) & (e) IC RSS-247 Section 5.4 (4) & 5.2 (2)
Specific Measurement Procedure	ANSI C63.10-2013 Section 11.9 and 11.10
Additional Description of Measurement	Peak Output Power and Peak PSD methods utilized for measurement 3 kHz resolution bandwidth used for Peak Power Spectral Density measurement
Additional Notes	1. Continuous transmit modulated used for this test. Sample Calculation: Margin (dB) = Limit – Measured Level

Table

Channel Frequency (MHz)	Max Peak Conducted Power (dBm)	Power Limit (dBm)	Power margin (dB)	Peak PSD in 3kHz Minimum BW (dBm)	PSD in 3kHz limit(dBm)	PSD margin (dBm)
906	20.1	30.0	9.9	7.7	8.0	0.3
914	19.9	30.0	10.1	7.6	8.0	0.4
924	19.6	30.0	10.4	7.2	8.0	0.8

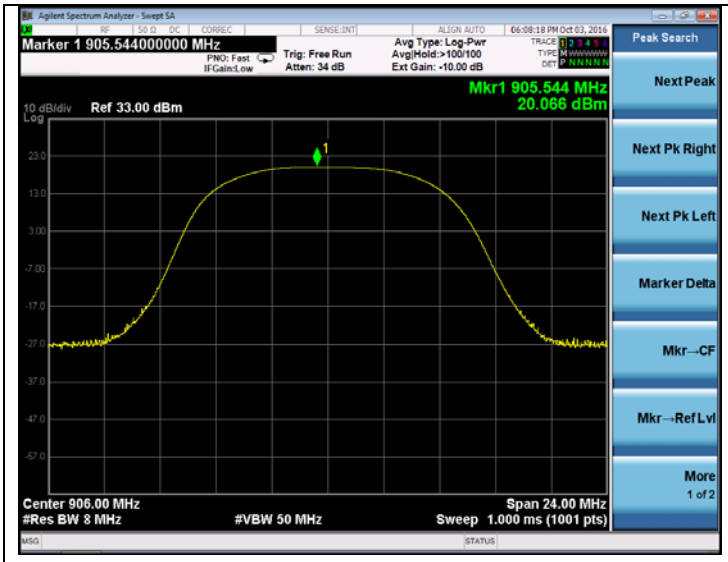
Duty Cycle = 100%



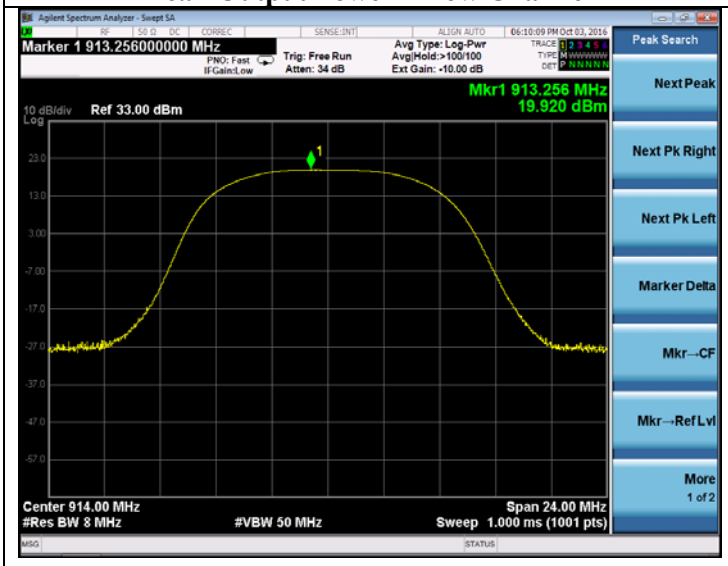
Middle channel

Note: Low and high channel was checked and duty cycle measured to be 100%

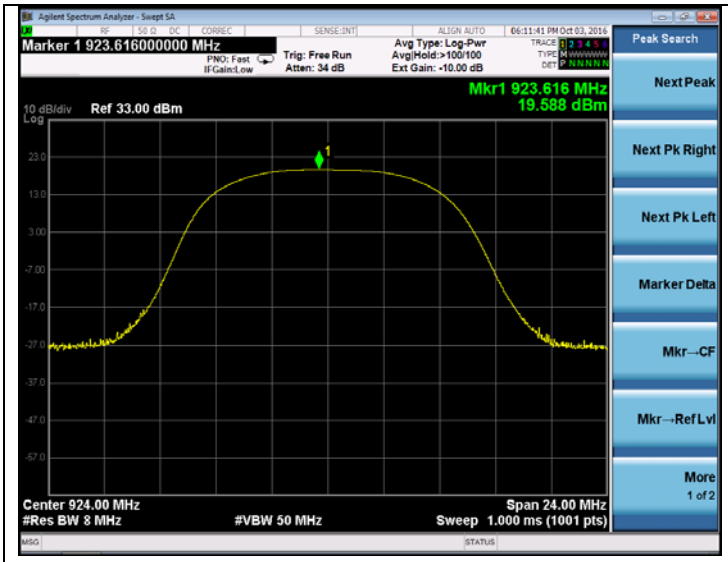
Plots – Max Power



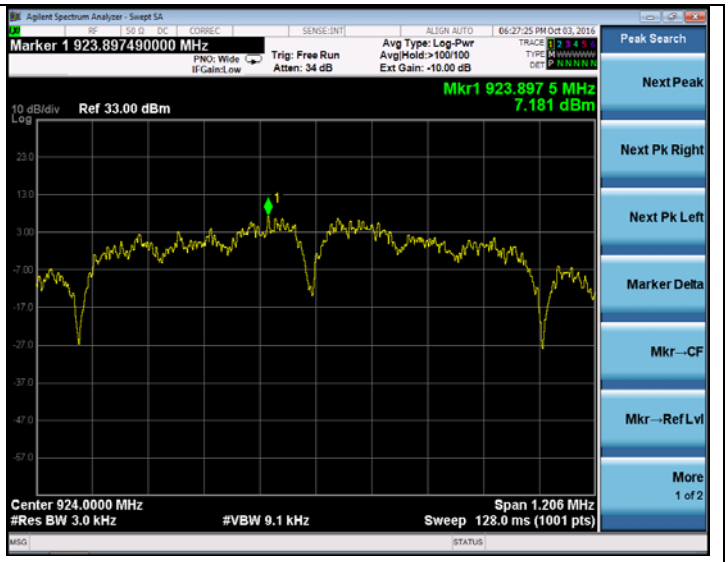
Peak Output Power – Low Channel	PPSD – Low Channel



Peak Output Power – Mid Channel	PPSD – Md Channel



Peak Output Power – High Channel

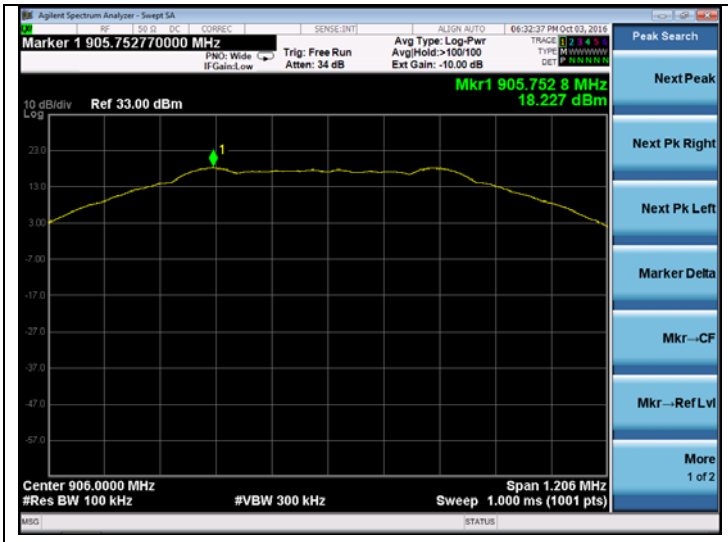


PPSD – High Channel

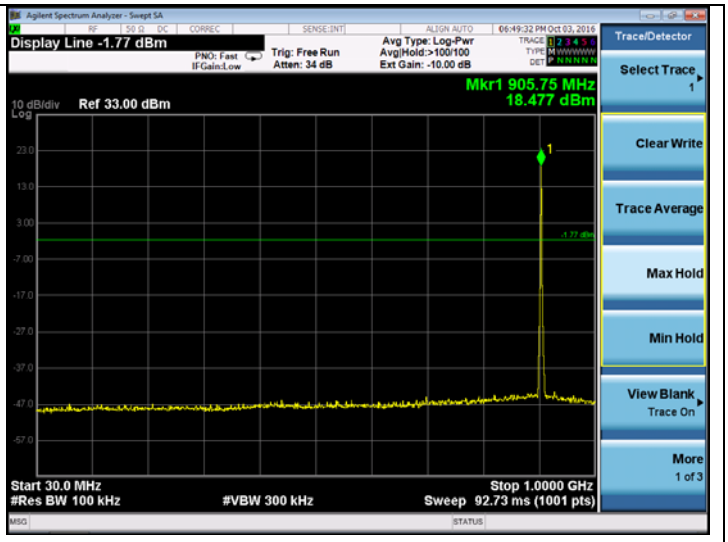
B.1.3 – RF Conducted – Spurious Emissions

Manufacturer	Nelson Corp
Date	10/3/16,10/4/16
Operator	Mike Hintzke
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (d) IC RSS-247 Section 5.5
Specific Measurement Procedure	ANSI C63.10-2013 Section 11.11 and 11.12
Additional Description of Measurement	Peak output power measurements therefore spurious emissions attenuated 20 dBc. Includes antenna port measurement for restricted band emissions
Additional Notes	1. Continuous transmit modulated used for this test. 2. Peak emissions compared to non-peak limits for measurements per section 11.12 of C63.10 (Restricted band emissions) 3. In Restricted band emissions measurement, antenna gain value of 6dBi was included as an external gain on the spectrum analyzer. 4. In Restricted band emissions measurements below 1 GHz, ground reflection factor of 4.7dB and antenna gain of 6dBi was included as an external gain on the spectrum analyzer.

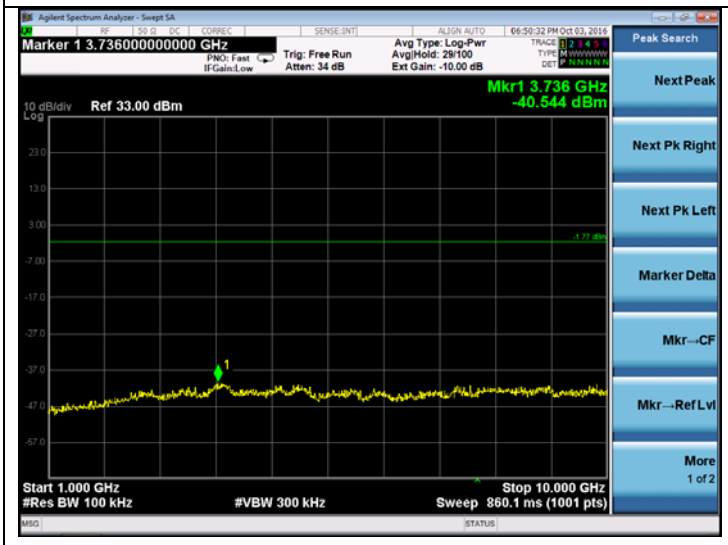
Emissions in non-restricted frequency bands:
Low Channel:



Reference level



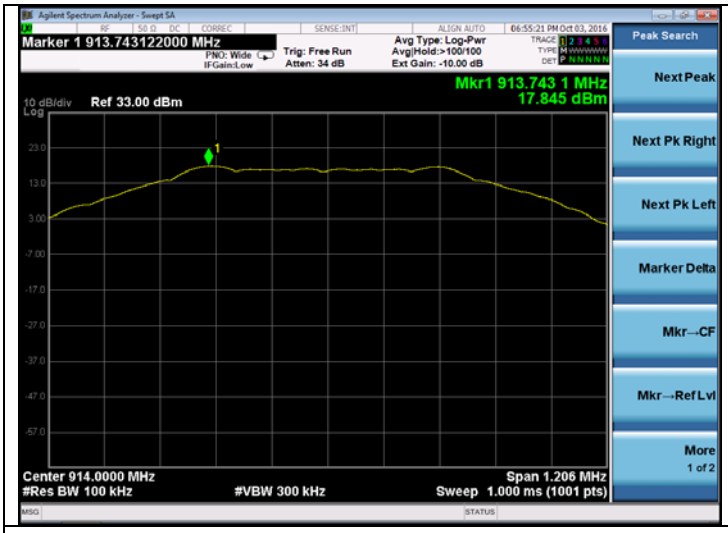
30 to 1000 MHz



1000 to 10000 MHz

10000 to 250000MHz

Middle Channel:



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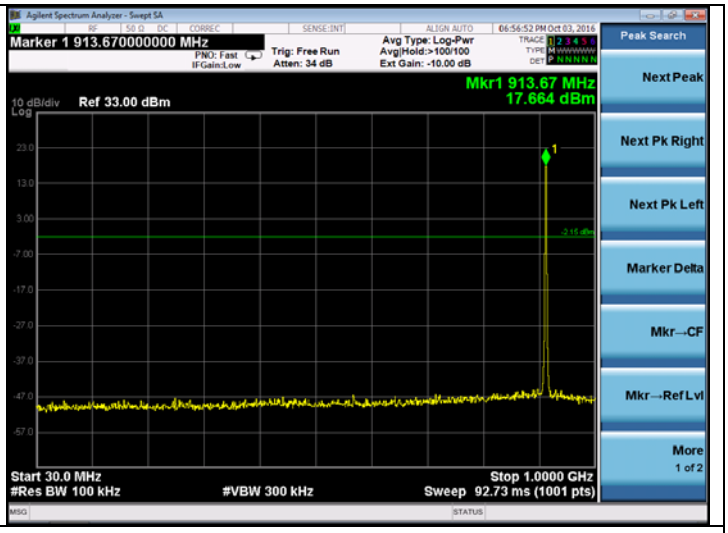
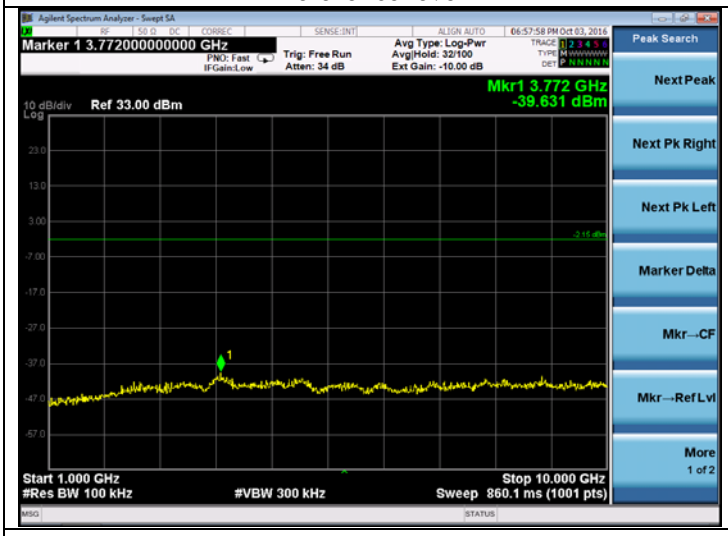


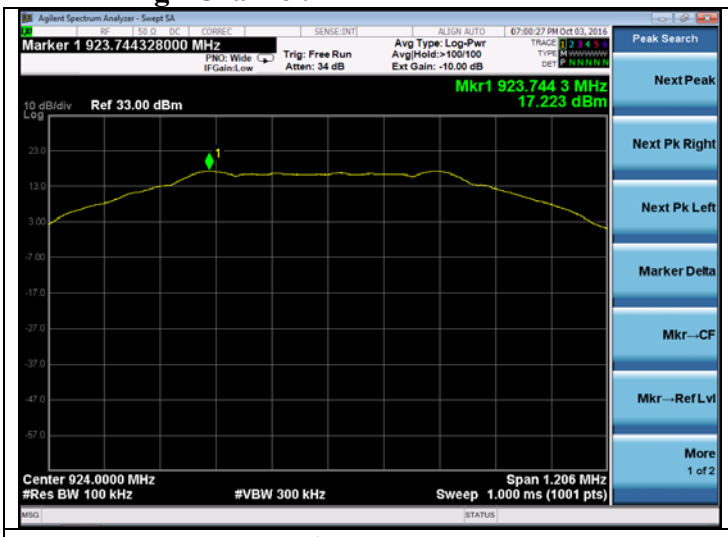
30 to 1000 MHz



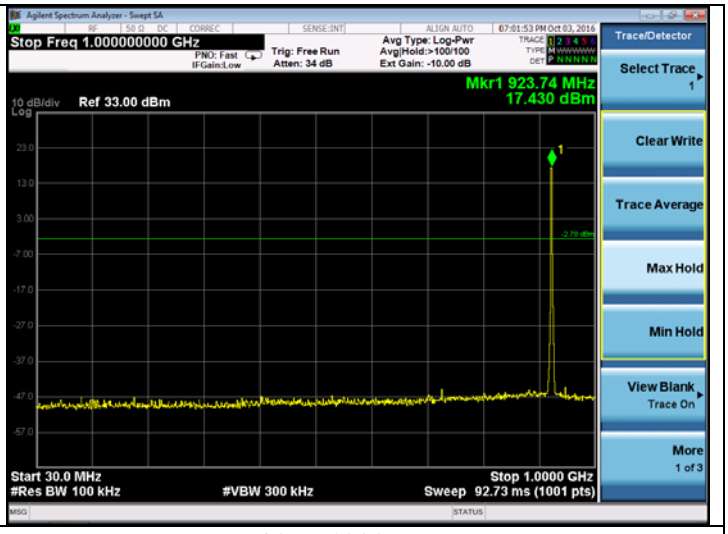
1000 to 10000 MHz

10000 to 250000MHz

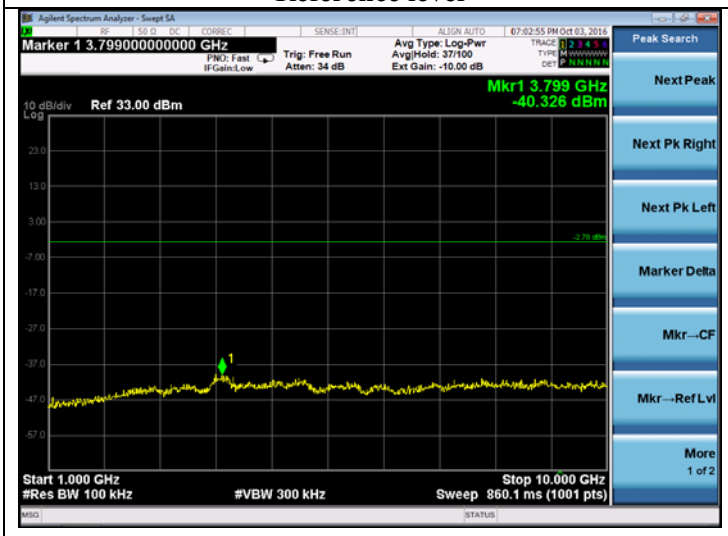
High Channel:



Reference level



30 to 1000 MHz



1000 to 10000 MHz

10000 to 250000MHz

Emissions in Restricted Frequency bands:

Frequency (MHz)	EIRP (dBm) Peak detector	Limit (dBm)	Margin (dB)
258.4	-60.1	-49.2	10.9
268.7	-59.6	-49.2	10.4
614.0	-64.2	-49.2	15.0
969.9	-42.5	-41.2	1.3
987.8	-43.4	-41.2	2.2
978.0	-42.9	-41.2	1.7
1002.0	-44.7	-41.2	3.5
1010.3	-44.9	-41.2	3.6
1003.8	-44.5	-41.2	3.3

Note:

1. **Measurements are Peak and compared to quasi peak limit for below 1GHz and Average for above 1 GHz.**

Calculation of restricted band limits:
From ANSI C63.10 section 11.12.2.2;

$$E = \text{EIRP} - 20 \log d + 104.8$$

where

E is the electric field strength in dBµV/m
EIRP is the equivalent isotropically radiated power in dBm
d is the specified measurement distance in m

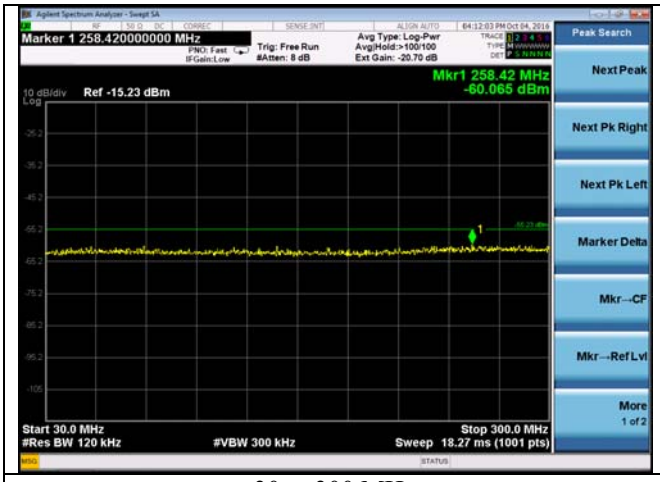
Restricted band Limit in dBm (EIRP) = Restricted band Limit in dBµV/m (E) + 20log$d$ – 104.8

Example:

Restricted band limit (E) = 46dBµV/m at d = 3m

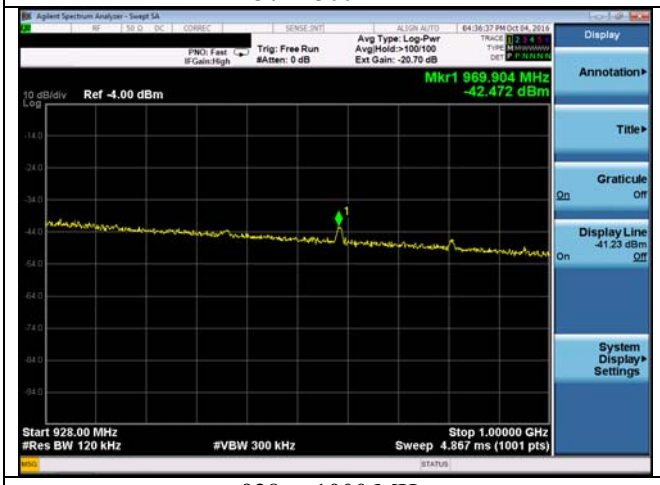
Limit (dBm) = 54 dBµV/m + 20log (3m) -104.8 = **-41.2 dBm**

Low channel emissions



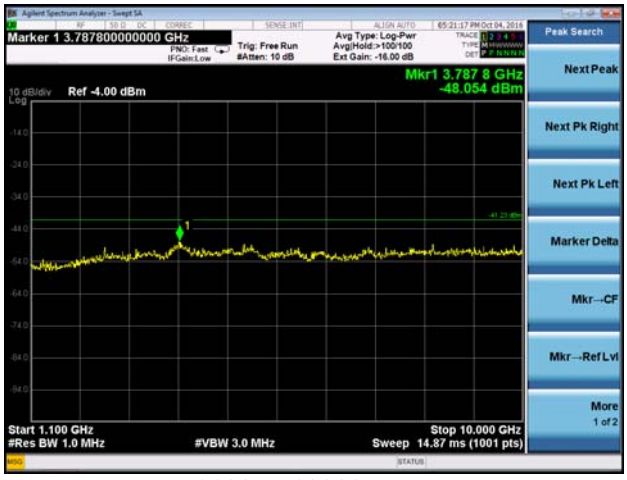
30 to 300 MHz

300 to 900MHz



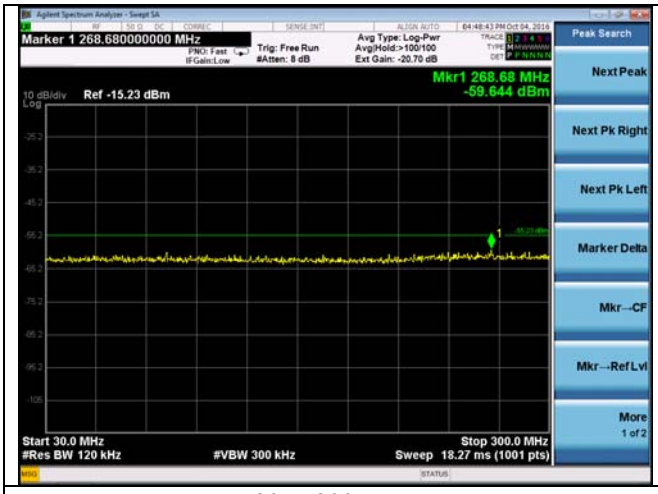
928 to 1000 MHz

1000 to 1100 MHz



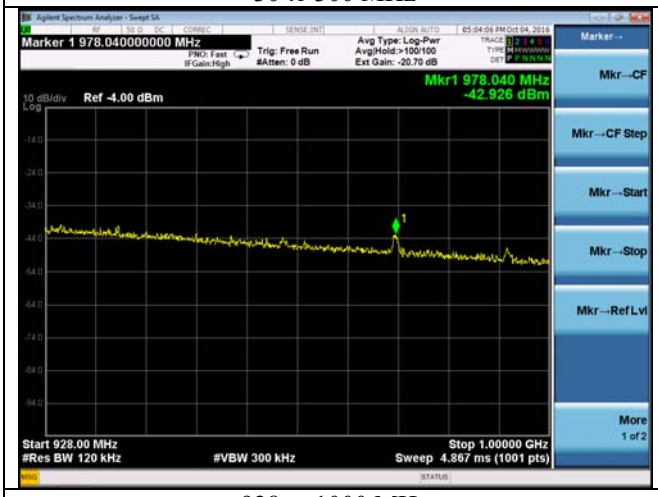
1100 to 10000 MHz

Middle channel emissions



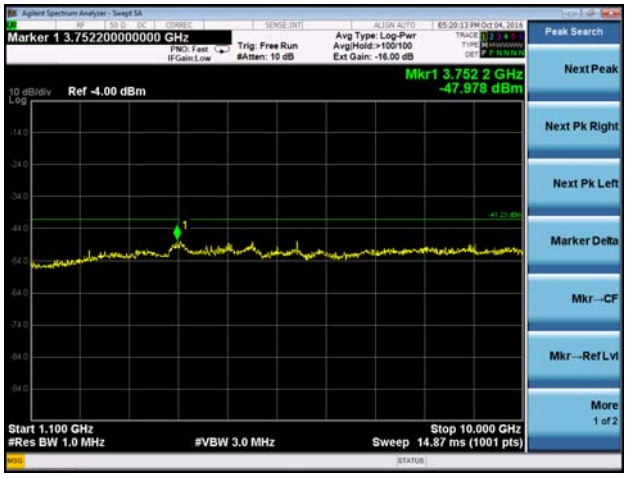
30 to 300 MHz

300 to 900MHz



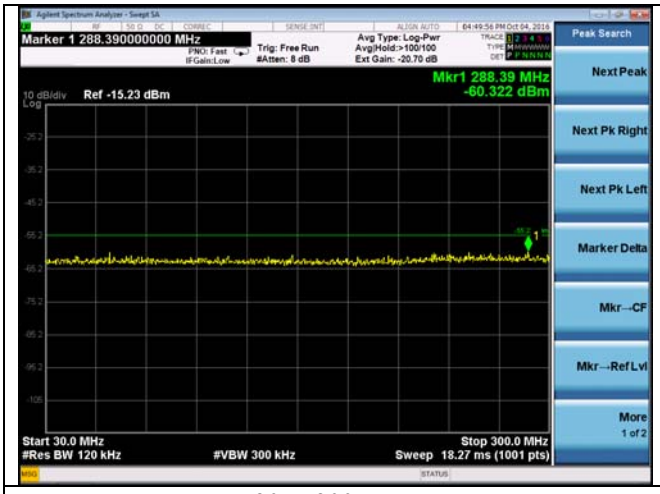
928 to 1000 MHz

1000 to 1100 MHz



1100 to 10000 MHz

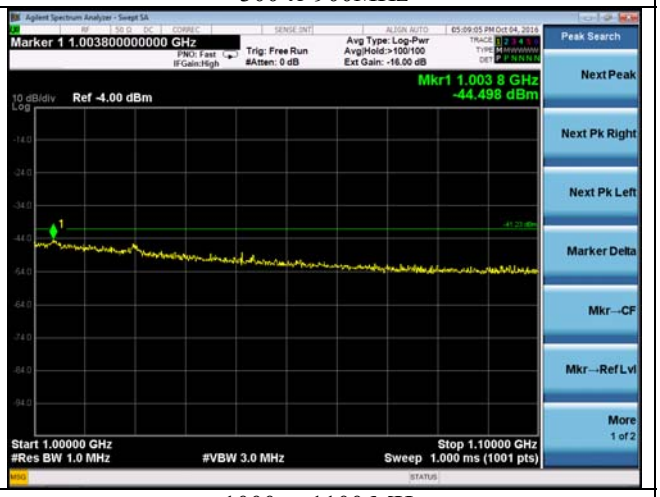
High channel emissions



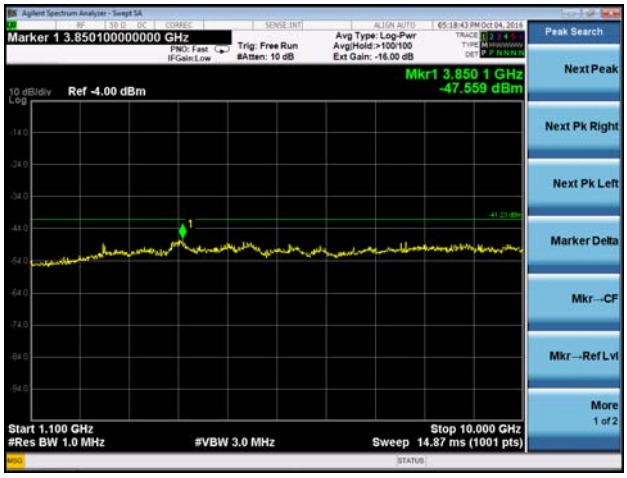
30 to 300 MHz

300 to 900MHz

928 to 1000 MHz



1000 to 1100 MHz



1100 to 10000 MHz

B.1.4 – RF Conducted – Frequency Stability

Manufacturer	Nelson Corp
Date	10/4/16
Operator	Mike Hintzke
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 2.1055 RSS-GEN Section 6.11
Specific Measurement Procedure	ANSI C63.10-2013 Section 6.8
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	The power and frequency stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the RF output power and frequency at the appropriate frequency markers. Power was supplied by an external bench-type DC power supply and was varied from the nominal. The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were well behaved, and the system returned to the same state of operation as before the power cycle. Below is data showing stability of the fundamental frequency. Continuous transmit un-modulated used for this test. EUT operates at 3.3 VDC (transceiver) and 4.0VDC (amplifier) nominal

Table

Frequency Stability f = 906 MHz					
Supply Voltage (VDC)		Frequency (Hz)	Deviation		
V_{CC}	V_{PA}		Hz	Limit (Hz)	Margin (Hz)
2.8	3.4	906000000	906091448	90600	182048
3.3	4.0	906000000	906091093	90600	181693
3.8	4.6	906000000	906090733	90600	181333

Frequency Stability f = 914 MHz					
Supply		Frequency (Hz)	Deviation		
V_{CC}	V_{PA}		Hz	Limit (Hz)	Margin (Hz)
2.8	3.4	914000000	914091477	91400	182877
3.3	4.0	914000000	914090904	91400	182304
3.8	4.6	914000000	914091304	91400	182704

Frequency Stability f = 924 MHz					
Supply		Frequency (Hz)	Deviation		
V_{CC}	V_{PA}		Hz	Limit (Hz)	Margin (Hz)
2.8	3.4	924000000	924091474	92400	183874
3.3	4.0	924000000	924090308	92400	182708
3.8	4.6	924000000	924091758	92400	184158

B.2 – Transmitter Radiated Emissions in Restricted Bands

Rule Part(s)	FCC: 15.247 / 15.205 / 15.209 IC: RSS-GEN Section 8.9,8.10			
Measurement Procedure	ANSI C63.10 – 2013 Section 11.12 (6.3,6.5,6.6)			
Test Location	LS Research, LLC - FCC Listed 3 meter Semi-Anechoic Chamber			
Test Distance	See data section			
EUT Placement	Above 1 GHz: 150 cm height non-conductive table above reference ground plane covered with absorbers Below 1 GHz: 80 cm height non-conductive table above reference ground plane			
Frequency Range of Measurement	Biconical: 30-300 MHz	Log Periodic Dipole Array: 300-1000 MHz	Double-Ridged Waveguide Horn: 1-18 GHz	Standard Gain Horn: 18-26GHz
Measurement Detectors	30-1000MHz RBW: 120 kHz VBW: At least 300 kHz		1 - 40 GHz: RBW : 1MHz VBW: At least 3 (MHz) Peak 10 Hz Average	
Description of Measurement	1) The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal made of expanded polyethylene foam centered on a turn-table in the test location with the antenna at the test distance from the EUT 3) Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height.			
Example Calculations	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)			

Limits:

Frequency (MHz)	3 m Limit (µV/m)	3 m Limit (dBµV/m)	Type
30-88	100	40.0	Quasi-Peak
88-216	150	43.5	Quasi-Peak
216-960	200	46.0	Quasi-Peak
Above 960	500	54.0	Average (>1 GHz)

B.2.1 – Transmitter Radiated Spurious Emissions in Restricted Bands

Manufacturer	Nelson Corp
Date	10/4/16 to 10/5/16
Operator	John Johnston
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 11.12
Test Distance	3 meter
EUT Placement	Above 1 GHz: 150 cm height non-conductive table centered on turn-table with absorbers covering ground plane Below 1 GHz: 80 cm height non-conductive table centered on turn-table
Detectors	Final Measurements: Peak / Max Hold, RBW 1 MHz, Average VBW 30Hz, Peak VBW 3 MHz
Additional Notes	1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported. 2) Antenna port terminated with 50 ohms. 3) Screen captures presented are representative of all channels investigated.

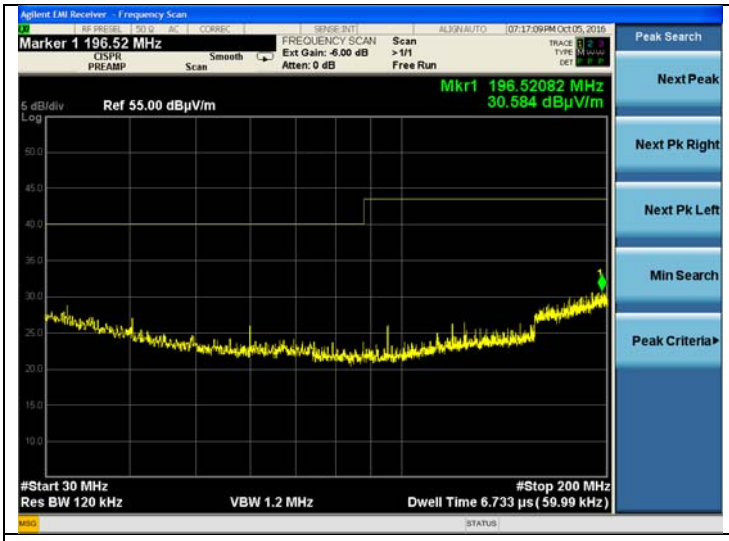
Example Calculation:
Limit (dBµV/m) – Reading (dBµV/m) = Margin (dB)

Table
30-1000 MHz

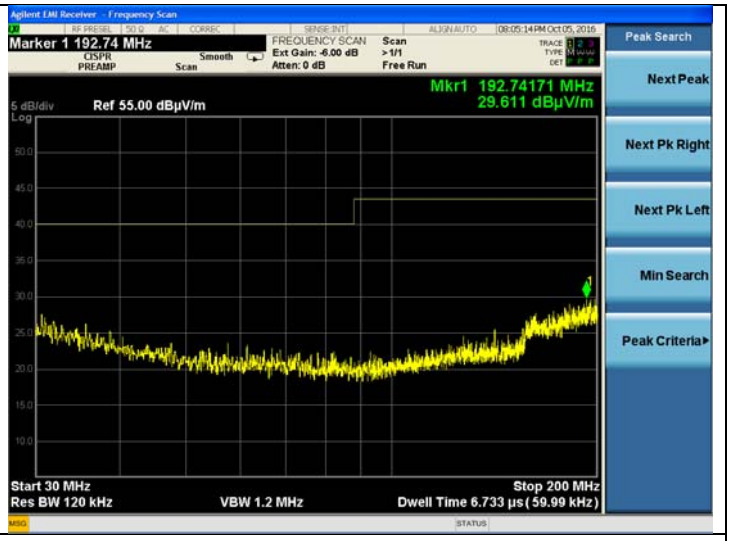
Frequency (MHz)	Channel	Height (m)	Azimuth (degree)	Orientation	Quasi-Peak Reading (dBuV/m)	Quasi-Peak Limit (dBuV/m)	Margin (dB)
37.5	Low	1.00	235	F	20.5	40.0	19.5
256.0	Low	1.00	179	V	22.1	46.0	23.9
256.1	Low	1.00	162	H	24.2	46.0	21.8
256.0	Mid	1.00	189	H	24.3	46.0	21.7
256.0	High	1.00	172	H	24.3	46.0	21.7
320.0	High	1.00	276	H	26.3	46.0	19.7

1-10 GHz

Frequency (MHz)	Height (m)	Azimuth (degree)	Orientation	Peak Reading (dBuV/m)	Average Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Antenna Polarity	Notes
9987.0	1.00	0	V	33.7	21.2	54.0	32.8	H	Noise Floor
9937.0	1.00	0	v	34.3	21.1	54.0	32.9	v	Noise Floor

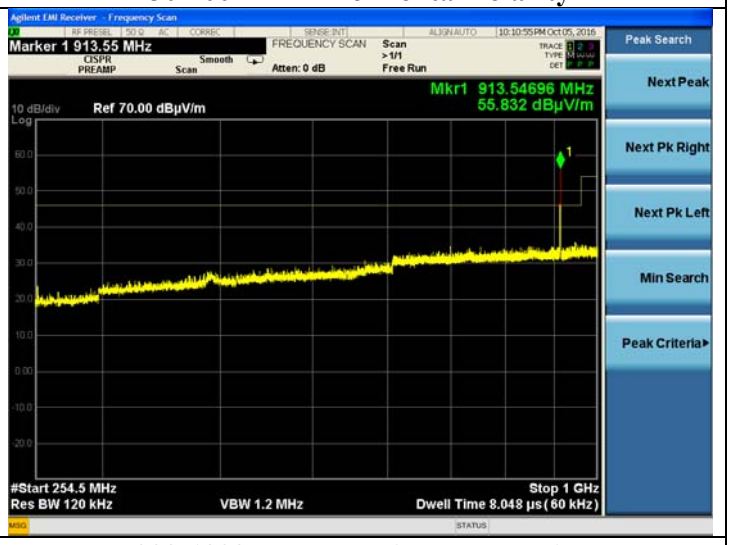


30-200 MHz - Vertical Polarity

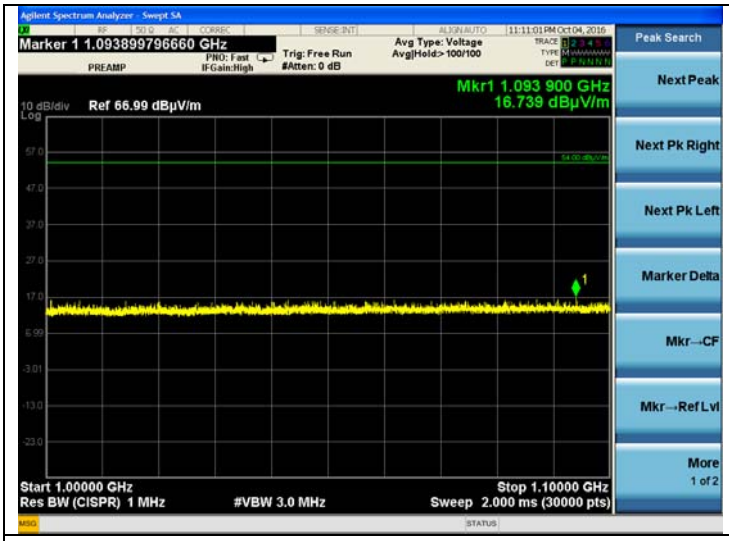


30-200 MHz - Horizontal Polarity

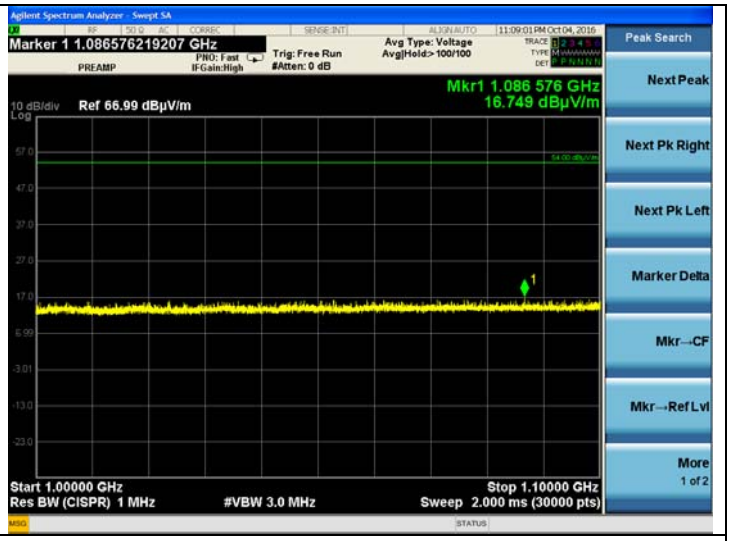
200-1000 MHz - Vertical Polarity



200-1000 MHz - Horizontal Polarity



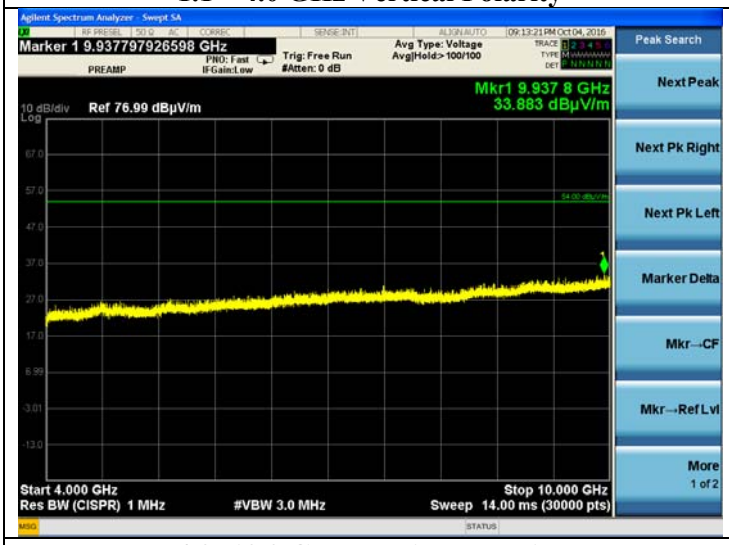
1.0-1.1 GHz Vertical Polarity



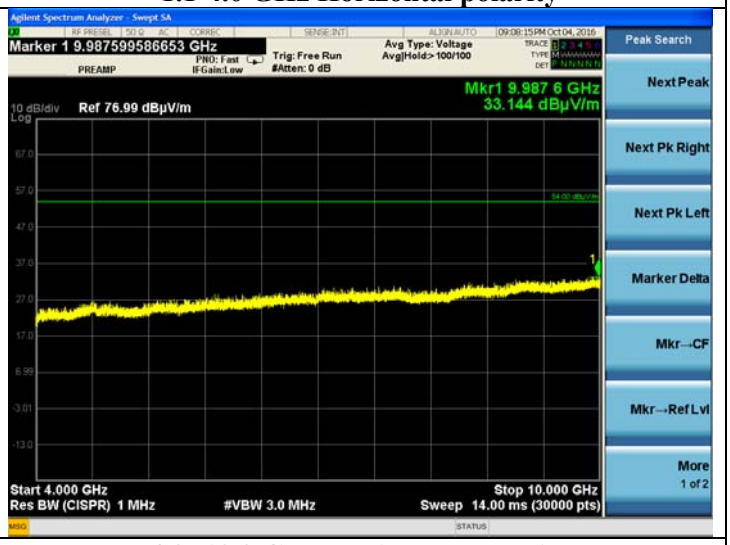
1-1.1 GHz Horizontal polarity

1.1 – 4.0 GHz Vertical Polarity

1.1-4.0 GHz Horizontal polarity



4.0 -10.0 GHz Vertical Polarity



4.0 -10.0 GHz Horizontal Polarity

B.3 – AC Mains Conducted Emissions

Rule Part(s)	FCC: 15.207 IC: RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.4 - 2014 ANSI C63.10 – 2013
Test Location	LS Research, LLC – Conducted Emissions Area
Test Voltage	120 VAC 60 Hz
EUT Placement	80 cm height non-conductive table above reference ground plane
Frequency Range of Measurement	150 kHz – 30 MHz
Measurement Detectors	Peak, Quasi-Peak, Average RBW: 9 kHz VBW: At least 27 kHz
Description of Measurement	1) The LISN, cable, limiter, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal at appropriate distance from ground planes and plugged into LISN. The LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral). 3) Maximum emissions are determined with peak detector and measurements at select points are made with quasi-peak and average detectors. Results are recorded and compared to limit.
Example Calculations	Reported Measurement data = Raw receiver measurement + LISN Factor + Cable factor (dB) + Additional factor (when applicable)

Limits of Conducted Emissions at the AC Mains Ports:

Frequency Range (MHz)	Class B Limits (dBµV)	
	Quasi-Peak	Average
0.150 -0.50 *	66-56	56-46
0.5 – 5.0	56	46
5.0 – 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

B.4.1 – AC Mains Conducted Emissions

Manufacturer	Nelson Corp
Date	10/6/16
Operator	John Johnston
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	15.207 / RSS-GEN
Measurement Procedure	ANSI C63.4 - 2014 ANSI C63.10 - 2013 Section 6.2
Test Voltage	120 VAC 60 Hz
EUT Placement	80 cm height non-conductive table, 40 cm from vertical ground plane
Detectors	Peak; RBW 9 kHz Quasi-Peak and Average
Additional Notes	1) Tested in continuous transmit with no significant difference between operating channels. 2) DC voltage supplied using generic AC/DC wall adapter.

Example Calculation:
Margin (dB) = Limit (dBµV) – Reading (dBµV)

Table – Max Power

Line	Frequency (MHz)	Quasi-Peak Measurement (dBuV)	Quasi-Peak Limit (dBuV)	Margin (dB)	Average Measurement (dBuV)	Average Limit (dBuV)	Margin (dB)
1	0.150	42.5	66.0	23.5	33.6	56.0	22.4
1	0.185	41.3	64.3	23.0	32.0	54.3	22.3
1	0.617	34.5	56.0	21.5	26.7	46.0	19.3
2	0.150	37.5	66.0	28.5	27.3	56.0	28.7
2	0.167	37.8	65.1	27.3	28.1	55.1	27.0
2	0.622	34.8	56.0	21.2	28.0	46.0	18.0

Plots

	
Line 1	Line 2

Appendix C - Uncertainty Summary

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.82 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.88 dB
Radiated Emissions	3-Meter Chamber, Horn Antenna	4.85 dB
Absolute Conducted Emissions	Agilent PSA/ESA Series	1.38 dB
AC Line Conducted Emissions	Shielded Room/EMCO LISN	3.20 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	2.05 Volts/Meter
Conducted Immunity	3 Volts level	2.33 V
EFT Burst, Surge, VDI	230 VAC	54.4 V
ESD Immunity	Discharge at 15kV	3200 V
Temperature/Humidity	Thermo-hygrometer	0.64° / 2.88 %RH

Appendix D - References

Publication	Year	Title
FCC CFR Parts 0-15	2016	Code of Federal Regulations – Telecommunications
RSS-247 Issue 1	2015	Digital Transmissions Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN Issue 4	2014	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing Unlicensed Wireless Devices

END OF REPORT

Date	Version	Comments	Person
	V0	Initial Draft Release	Aidi Zainal
		Final Version	