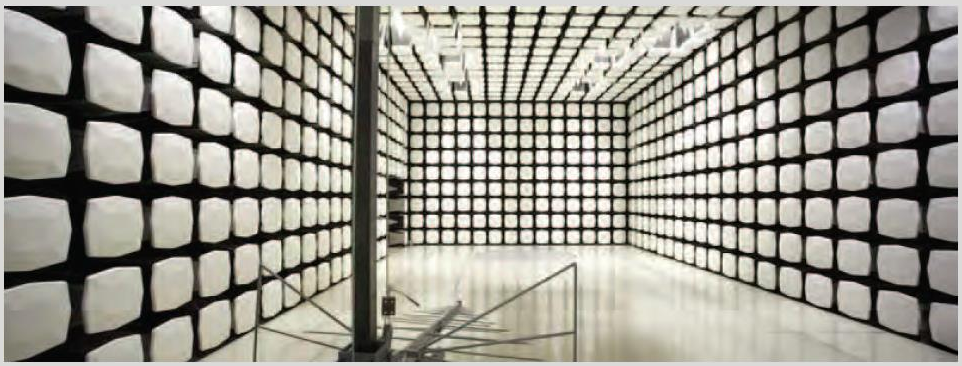
Nelson Irrigation Corporation

TWIG V UNO

FCC 15.247:2024
RSS-247 Issue 3:2023
RSS-Gen Issue 5:2018+A1:2019+A2:2021

902 - 928 MHz Other Wideband (DTS) transceiver

Report: NELS0019.0 Rev. 1, Issue Date: March 1, 2024



CERT #3310.02

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Section	Page Number

CERTIFICATE OF TEST

Last Date of Test: February 28, 2024
Nelson Irrigation Corporation
EUT: TWIG V UNO

Radio Equipment Testing

Standards

Specification	Method
*FCC 15.247:2024	ANSI C63.10:2013
RSS-247 Issue 3:2023	
RSS-Gen Issue 5:2018+A1:2019+A2:2021	

*A gap analysis was performed, and the results continue to show compliance to FCC 15.247:2024

Guidance

FCC KDB 558074 v05r02:2019

Results

Test Description	Result	FCC Section(s)	RSS Section(s)	ANSI C63.10 Section(s)	Comments
Powerline Conducted Emissions (Transmitter)	Pass	15.207	RSS-Gen 8.8	6.2	
Spurious Radiated Emissions	Pass	15.247(d), KDB 558074 -8.6, 8.7	RSS-247 5.5	6.5, 6.6, 11.12.1, 11.13.2	
Duty Cycle	Evaluated	15.247, KDB 558074 -6.0	RSS-Gen 3.2	11.6	
Carrier Frequency Separation	N/A	15.247(a)(1)	RSS-247 5.1(b)	7.8.2	Not required for DTS devices.
Number of Hopping Frequencies	N/A	15.247(a)(1)	RSS-247 5.1(d)	7.8.3	Not required for DTS devices.
Dwell Time	N/A	15.247(a)(1)	RSS-247 5.1(d)	7.8.4	Not required for DTS devices.
Output Power	Pass	15.247(b), KDB 558074 -8.3	RSS-247 5.4(d)	11.9.1.1	
Equivalent Isotropic Radiated Power (EIRP)	Pass	15.247(b), KDB 558074 -8.3	RSS-247 5.4(d)	11.9.1.1	
Band Edge Compliance	Pass	15.247(d), KDB 558074 -8.5	RSS-247 5.5	11.11	
Band Edge Compliance - Hopping Mode	N/A	15.247(d)	RSS-247 5.5	7.8.6	Not required for DTS devices.
DTS Bandwidth (6 dB)	Pass	15.247(a), KDB 558074 -8.2	RSS-247 5.2(a)	11.8.2	
Occupied Bandwidth (99%)	Pass	KDB 558074 - 2.1	RSS-Gen 6.7	6.9.3	
Spurious Conducted Emissions	Pass	15.247(d), KDB 558074 -8.5	RSS-247 5.5	11.11	
Power Spectral Density	Pass	15.247(e), KDB 558074 -8.4	RSS-247 5.2(b)	11.10.2	

CERTIFICATE OF TEST

Powerline Conducted Emissions (Receiver)	N/A	15.101, 15.107	RSS-Gen 5.2	ANSI C63.4 - 12.2.4	Not included per FCC 15.101 as this will be covered under SDoC rules for the FCC. RSS-Gen section 7 stated receiver requirements only apply to standalone receivers operating in the 30-960 MHz band and this is not a standalone receiver.
Radiated Emissions for Receiver	N/A	15.101, 15.109	RSS-Gen 5.2	ANSI C63.4 - 12.2.5	Not included per FCC 15.101 as this will be covered under SDoC rules for the FCC. RSS-Gen section 7 stated receiver requirements only apply to standalone receivers operating in the 30-960 MHz band and this is not a standalone receiver.

Deviations From Test Standards

None

Approved By:

Cole Ghizzone, Operations Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		
01	Updated Spurious Radiated Emission data	2024-02-28	35-48
	Updated Powerline Conducted Emission data		22-34
	Updated EUT name to TWIG V UNO		1, 3, 12, 14-20, 23, 25, 27, 29, 31, 33, 37, 40, 43, 46, 54, 57, 61, 63, 66, 70, 74, 79
	Added new configurations		14-20
	Updated Modifications log		21
	Updated internal trace antenna gain value		13, 61

ACCREDITATIONS AND AUTHORIZATIONS

United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Each laboratory is accredited by A2LA to ISO / IEC 17025, and as a product certifier to ISO / IEC 17065 which allows Element to certify transmitters to FCC and IC specifications.

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Recognized as an EU Notified Body validated for the EMCD and RED Directives.

United Kingdom

BEIS – Recognized by the UK as an Approved Body under the UK Radio Equipment and UK EMC Regulations.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

MIC – Recognized by MIC as a CAB for the acceptance of test data.

SCOPE

For details on the Scopes of our Accreditations, please visit:

California Minnesota Oregon Texas Washington

FACILITIES

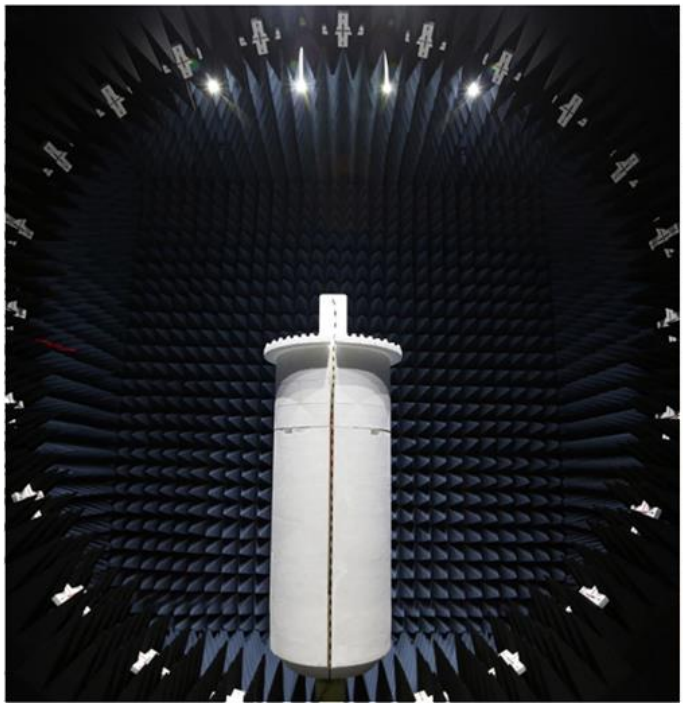
element
2023.09.21

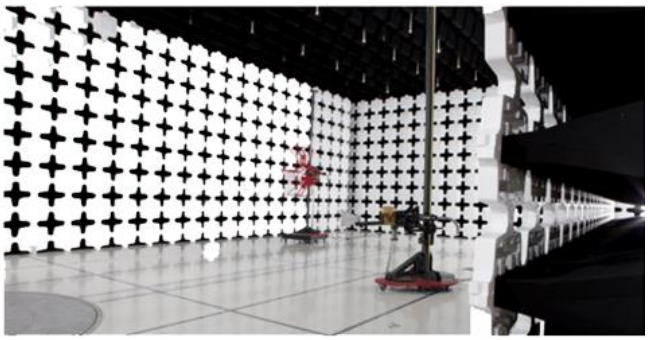
Testing was performed at the following location(s)

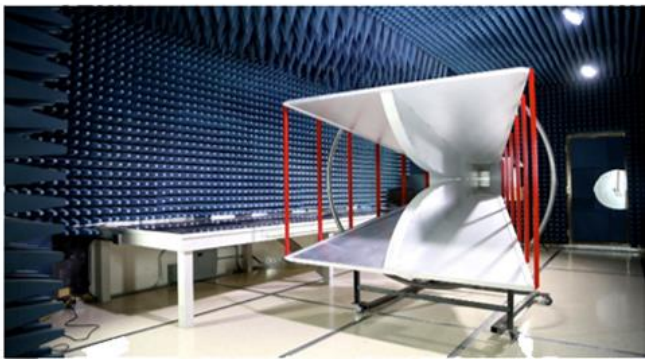
	Location	Labs (1)	Address	A2LA (2)	ISED (3)	BSMI (4)	VCCI (5)	CAB (6)	FDA (7)
☐	California	OC01-17	41 Tesla Irvine, CA 92618 (949) 861-8918	3310.04	2834B	SL2-IN-E-1154R	A-0029	US0158	TL-55
☐	Minnesota	MN01-11	9349 W Broadway Ave. Brooklyn Park, MN 55445 (612) 638-5136	3310.05	2834E	SL2-IN-E-1152R	A-0109	US0175	TL-57
☒	Oregon	EV01-12	6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	3310.02	2834D	SL2-IN-E-1017	A-0108	US0017	TL-56
☐	Texas	TX01-09	3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	3310.03	2834G	SL2-IN-E-1158R	A-0201	US0191	TL-54
☐	Washington	NC01-05	19201 120th Ave NE Bothell, WA 98011 (425) 984-6600	3310.06	2834F	SL2-IN-E-1153R	A-0110	US0157	TL-67
☐	Offsite	N/A	See Product Description	N/A	N/A	N/A	N/A	N/A	N/A

See data sheets for specific labs

(1) The lab designations denote individual rooms within each location. (OC01, OC02, OC03, etc.)
(2) A2LA Certificate No.
(3) ISED Company No.
(4) BSMI No.
(5) VCCI Site Filing No.
(6) CAB Identifier. Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA
(7) FDA ASCA No.







MEASUREMENT UNCERTAINTY

element
TMU.2015.07.10

Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found in the table below. A lab specific value may also be found in the applicable test description section. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	3.2 dB	-3.2 dB

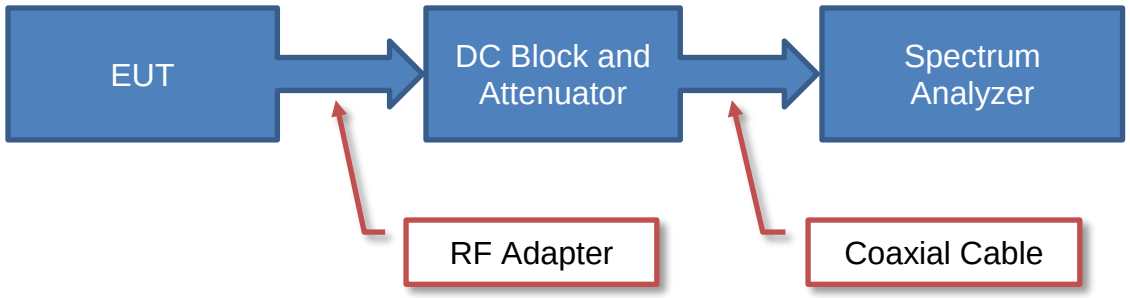
TEST SETUP BLOCK DIAGRAMS

Measurement Bandwidths

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

Unless otherwise stated, measurements were made using the bandwidths and detectors specified. No video filter was used.

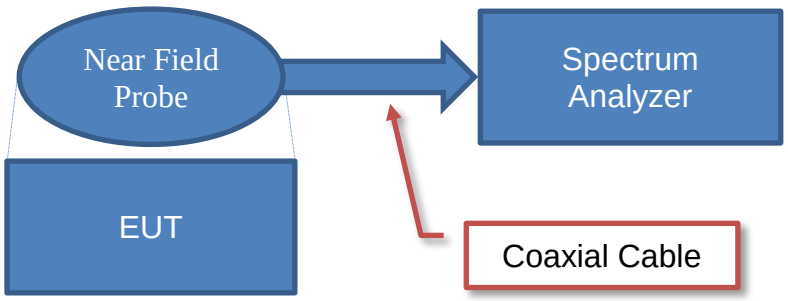
Antenna Port Conducted Measurements



Sample Calculation (logarithmic units)

Measured Value		Measured Level		Reference Level Offset
71.2	=	42.6	+	28.6

Near Field Test Fixture Measurements

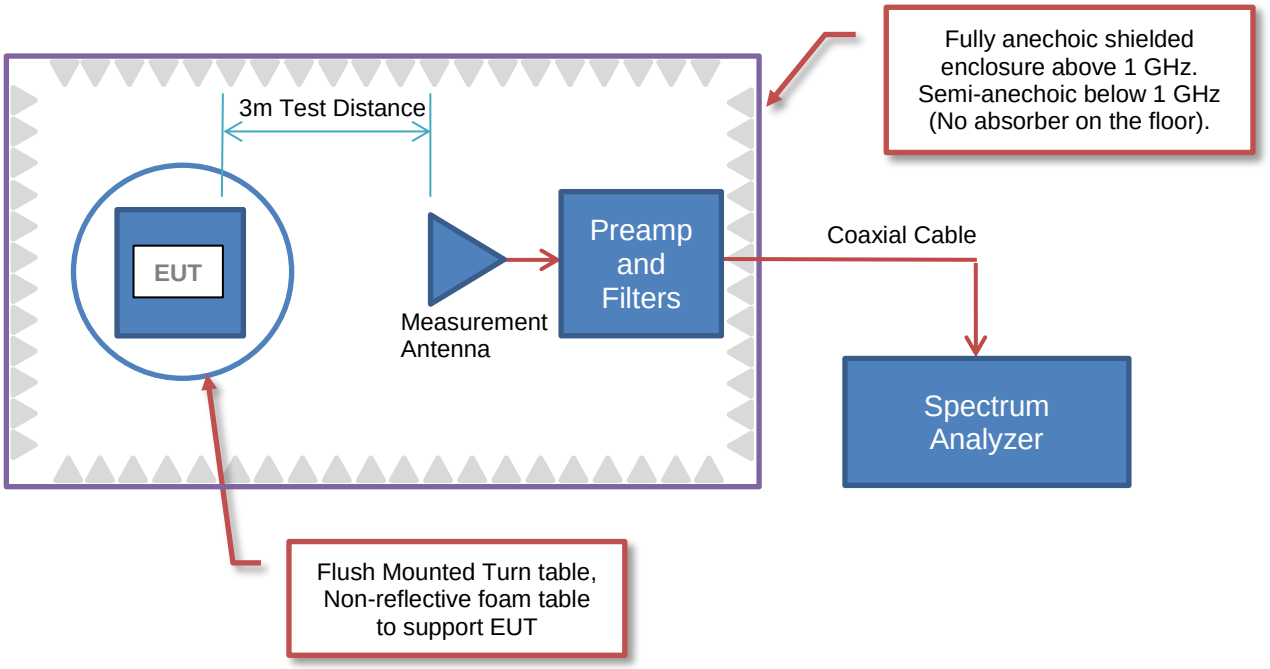


Sample Calculation (logarithmic units)

Measured Value		Measured Level		Reference Level Offset
71.2	=	42.6	+	28.6

TEST SETUP BLOCK DIAGRAMS

Emissions Measurements



Sample Calculation (logarithmic units)

Radiated Emissions:

Measured Level (Amplitude)		Factor: Antenna Factor		Factor: Cable Factor		Factor: Amplifier Gain		Distance Adjustment Factor		External Attenuation		Field Strength
42.6	+	28.6	+	3.1	-	40.8	+	0.0	+	0.0	=	**33.5**

Conducted Emissions:

Measured Level (Amplitude)		Factor: Transducer Factor		Factor: Cable Factor		External Attenuation		Adjusted Level
26.7	+	0.3	+	0.1	+	20.0	=	**47.1**

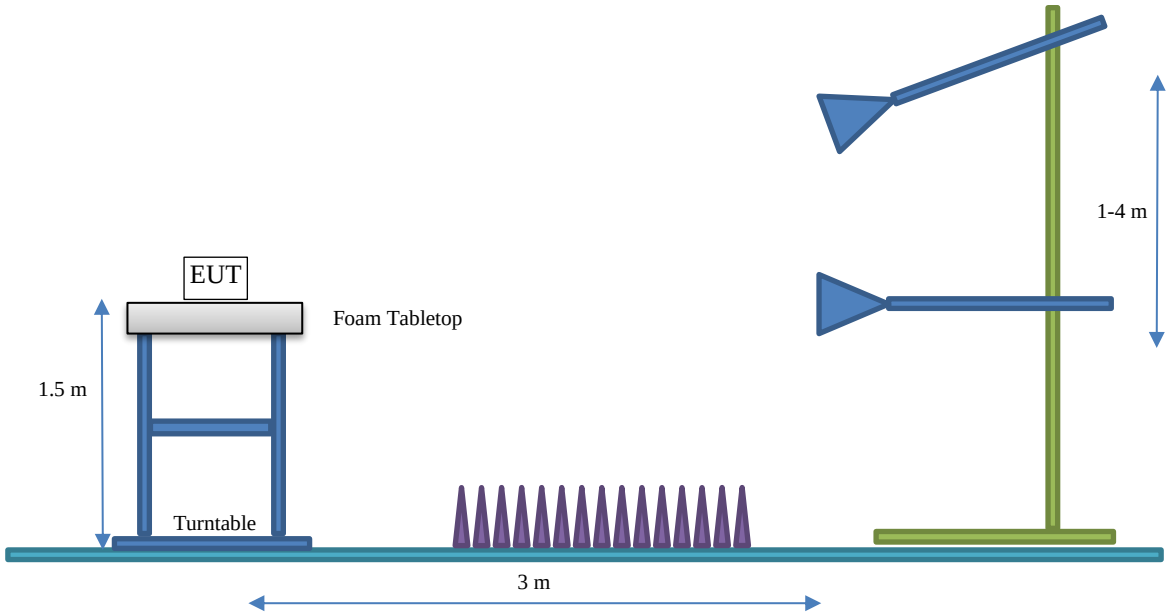
Radiated Power (ERP/EIRP) – Substitution Method:

Measured Level into Substitution Antenna (Amplitude dBm)		Substitution Antenna Factor (dBi)		EIRP to ERP (if applicable)		Measured power (dBm ERP/EIRP)
10.0	+	6.0	-	2.15	=	**13.9/16.0**

TEST SETUP BLOCK DIAGRAMS

Bore Sighting (>1GHz)

The diameter of the illumination area is the dimension of the line tangent to the EUT formed by 3 dB beamwidth of the measurement antenna at the measurement distance. At a 3 meter test distance, the diameter of the illumination area was 3.8 meters at 1 GHz and greater than 2.1 meters up to 6 GHz. Above 1 GHz, when required by the measurement standard, the antenna is pointed for both azimuth and elevation to maintain the receive antenna within the cone of radiation from the EUT. The specified measurement detectors were used for comparison of the emissions to the peak and average specification limits.



PRODUCT DESCRIPTION

Client and Equipment under Test (EUT) Information

Company Name:	Nelson Irrigation Corporation
Address:	848 Airport Road
City, State, Zip:	Walla Walla, WA 99362-2271
Test Requested By:	Mark Bauman
EUT:	TWIG V UNO
First Date of Test:	December 15, 2023
Last Date of Test:	February 28, 2024
Receipt Date of Samples:	December 15, 2023
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
The TWIG V UNO radio module is configured to transmit and receive LoRa® chirp-based modulation. The radio module can be configured to transmit on either an internal trace antenna or an external antenna.

Testing Objective:
Seeking to demonstrate compliance in the 902 - 928 MHz band for operation under FCC 15.247:2024 and RSS-247 Issue 3:2023, RSS-Gen Issue 5:2018+A1:2019+A2:2021 specifications under technology category Other.

POWER SETTINGS AND ANTENNAS

The power settings, antenna gain value(s) and cable loss (if applicable) used for the testing contained in this report were provided by the customer and will affect the validity of the results. Element assumes no responsibility for the accuracy of this information. The power settings below reflect the maximum power that the EUT is allowed to transmit at during normal operation.

ANTENNA GAIN (dBi)

Type	Part Number	Manufacturer	Frequency Range (MHz)	Gain (dBi)
Yagi	HG912YE-NF	L-Com	824 – 960	12
Omni	HGV-906U	L-Com	824 – 960	6
Trace Antenna – meandering monopole	N/A	N-A	900 – 930	-3.4

The EUT was tested using the power settings provided by the manufacturer which were based upon:

☐ Test software settings Test software/firmware installed on EUT: 0x54aa04d
☒ Rated power settings

SETTINGS FOR ALL TESTS IN THIS REPORT

Modulation Types	Bandwidth (kHz)	Spreading Factor	Coding Rate	Data Rate (kBps)	Position (if multiple channels)	Power Setting (dBm)
CSS	500	8	4/8	12.5	Low Channel - 903 MHz	24
					Mid Channel - 915 MHz	
					High Channel - 927 MHz	

CONFIGURATIONS

Configuration NELS0019-1

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
LoRa Transceiver	Nelson Irrigation Corporation	TWIG V UNO	Sample 1

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
DC Power Supply	KORAD	KD3005D	202006016603
Laptop	Lenovo	T470	USSALTS312
TTL to RS-422 PCB x2	Nelson Irrigation Corporation	13288 REV. D	None

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
DC Power	No	0.5	No	TTL to RS-422 PCB	DC Power Supply
Serial Cable	No	15.25	No	TTL to RS-422 PCB	TTL to RS-422 PCB
Serial to USB	No	1.0	No	TTL to RS-422 PCB	Laptop
TTL programing cable	No	0.1	No	LoRa Transceiver	TTL to RS-422 PCB

Software	
Description	**Version**
Firmware	0x54aa04d

CONFIGURATIONS

Configuration NELS0019-5

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
LoRa Transceiver	Nelson Irrigation Corporation	TWIG V UNO	Sample 3

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None

Remote Equipment			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	Pansonic	CF-30	8FKSB60399
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None
DC Power Supply	KORAD	KD3005D	202006016603

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Serial Cable	No	15.25	No	TTL to RS-422 PCB	TTL to RS-422 PCB
TTL programing cable	No	0.1	No	LoRa Transceiver	TTL to RS-422 PCB

Software	
Description	**Version**
Firmware	0x54aa04d

CONFIGURATIONS

Configuration NELS0019-6

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
LoRa Transceiver	Nelson Irrigation Corporation	TWIG V UNO	Sample 3
Yagi Antenna	L-Com	HG912YE	Unknown

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None

Remote Equipment			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	Pansonic	CF-30	8FKSB60399
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None
DC Power Supply	KORAD	KD3005D	202006016603

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Serial Cable	No	15.25	No	TTL to RS-422 PCB	TTL to RS-422 PCB
TTL programing cable	No	0.1	No	LoRa Transceiver	TTL to RS-422 PCB
Coax cable	No	0.6	No	LoRa Transceiver	External Antenna

Software	
Description	**Version**
Firmware	0x54aa04d

CONFIGURATIONS

Configuration NELS0019-7

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
LoRa Transceiver	Nelson Irrigation Corporation	TWIG V UNO	Sample 3
Omnidirectional Antenna	L-Com	HGV-906U	Unknown

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None

Remote Equipment			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	Pansonic	CF-30	8FKSB60399
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None
DC Power Supply	KORAD	KD3005D	202006016603

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Serial Cable	No	15.25	No	TTL to RS-422 PCB	TTL to RS-422 PCB
TTL programing cable	No	0.1	No	LoRa Transceiver	TTL to RS-422 PCB
Coax cable	No	0.6	No	LoRa Transceiver	External Antenna

Software	
Description	**Version**
Firmware	0x54aa04d

CONFIGURATIONS

Configuration NELS0019-8

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
LoRa Transceiver	Nelson Irrigation Corporation	TWIG V UNO	Sample 3

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None
Laptop	Pansonic	CF-30	8FKSB60399
AC Adapter	Pansonic	CF-AA1653A	1653ASA07Y09303B

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Serial Cable	No	15.25	No	TTL to RS-422 PCB	TTL to RS-422 PCB
TTL programing cable	No	0.1	No	LoRa Transceiver	TTL to RS-422 PCB
DC Power	No	0.5	No	TTL to RS-422 PCB	DC Power
Serial to USB	No	1.0	No	TTL to RS-422 PCB	Laptop
DC Power (Laptop)	No	1.0	Yes	AC Adapter	Laptop
AC Power	No	1.8	No	AC Power	AC Adapter

Software	
Description	**Version**
Firmware	0x54aa04d

CONFIGURATIONS

Configuration NELS0019-9

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
LoRa Transceiver	Nelson Irrigation Corporation	TWIG V UNO	Sample 3
Yagi Antenna	L-Com	HG912YE	Unknown

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None
Laptop	Pansonic	CF-30	8FKSB60399
AC Adapter	Pansonic	CF-AA1653A	1653ASA07Y09303B

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Serial Cable	No	15.25	No	TTL to RS-422 PCB	TTL to RS-422 PCB
TTL programing cable	No	0.1	No	LoRa Transceiver	TTL to RS-422 PCB
DC Power	No	0.5	No	TTL to RS-422 PCB	DC Power
Serial to USB	No	1.0	No	TTL to RS-422 PCB	Laptop
DC Power (Laptop)	No	1.0	Yes	AC Adapter	Laptop
AC Power	No	1.8	No	AC Power	AC Adapter
Coax cable	No	0.6	No	LoRa Transceiver	External Antenna

Software	
Description	**Version**
Firmware	0x54aa04d

CONFIGURATIONS

Configuration NELS0019-10

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
LoRa Transceiver	Nelson Irrigation Corporation	TWIG V UNO	Sample 3
Omnidirectional Antenna	L-Com	HGV-906U	Unknown

Peripherals in Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None
TTL to RS-422 PCB	Nelson Irrigation Corporation	13288 REV. D	None
Laptop	Pansonic	CF-30	8FKSB60399
AC Adapter	Pansonic	CF-AA1653A	1653ASA07Y09303B

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Serial Cable	No	15.25	No	TTL to RS-422 PCB	TTL to RS-422 PCB
TTL programing cable	No	0.1	No	LoRa Transceiver	TTL to RS-422 PCB
DC Power	No	0.5	No	TTL to RS-422 PCB	DC Power
Serial to USB	No	1.0	No	TTL to RS-422 PCB	Laptop
DC Power (Laptop)	No	1.0	Yes	AC Adapter	Laptop
AC Power	No	1.8	No	AC Power	AC Adapter
Coax cable	No	0.6	No	LoRa Transceiver	External Antenna

Software	
Description	**Version**
Firmware	0x54aa04d

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2023-12-15	Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2023-12-15	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2023-12-15	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	2023-12-15	Equivalent Isotropic Radiated Power (eirp)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2023-12-15	Occupied Bandwidth (99%)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
6	2023-12-15	DTS Bandwidth (6 Db)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
7	2023-12-15	Duty Cycle	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
8	2023-12-19	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
9	2024-02-26	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT was taken home by the client before the next scheduled test.
10	2024-02-28	Powerline Conducted Emissions (Transmitter)	Tested as delivered to test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, conducted emissions tests were performed. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Per the standard, an insulating material was also added to ground plane between the EUT's power and remote I/O cables. Equipment is tested with power cords that are normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network), the 50ohm measuring port is terminated by a 50ohm EMI meter or a 50ohm resistive load. All 50ohm measuring ports of the LISN are terminated by 50ohm. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Receiver	Gauss Instruments	TDEMI 30M	ARN	2023-05-08	2024-05-08
Cable - Conducted Cable Assembly	Northwest EMC	EVG, HHD, RKT, VAB	EVGA	2023-05-16	2024-05-16
LISN	Solar Electronics	9252-50-R-24-BNC	LIR	2023-09-11	2024-09-11
Power Supply - DC	Topward	TPS-2000	TPD	NCR	NCR

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	3.2 dB	-3.2 dB

CONFIGURATIONS INVESTIGATED

NELS0019-7
NELS0019-8
NELS0019-9

MODES INVESTIGATED

LoRa, 500kHz BW, SF8, Mid Ch. = 915 MHz, Internal Antenna
LoRa, 500kHz BW, SF8, Mid Ch. = 915 MHz, Omni Antenna
LoRa, 500kHz BW, SF8, Mid Ch. = 915 MHz, Yagi Antenna

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

EUT:	Twig V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2024-02-28
Customer:	Nelson Irrigation Corporation	Temperature:	22.3°C
Attendees:	None	Relative Humidity:	37.6%
Customer Project:	None	Bar. Pressure (PMSL):	1009 mb
Tested By:	Jeff Alcoke	Job Site:	EV07
Power:	5 VDC via 110VAC/60 Hz	Configuration:	NELS0019-7

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2024	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	11	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

Measuring AC power of linear DC power supply.

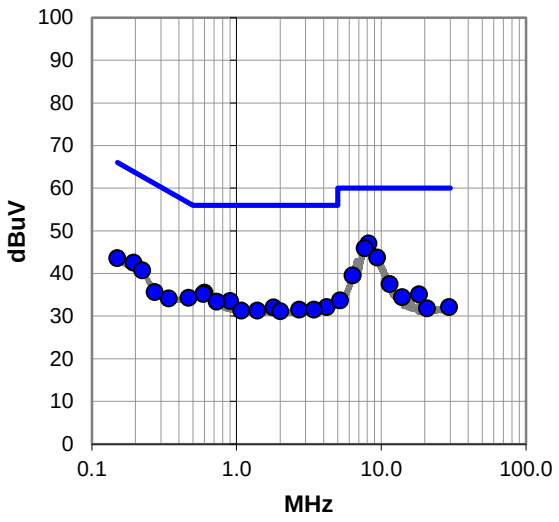
EUT OPERATING MODES

LoRa, 500kHz BW, SF8, Mid Ch. = 915 MHz, Omni Antenna

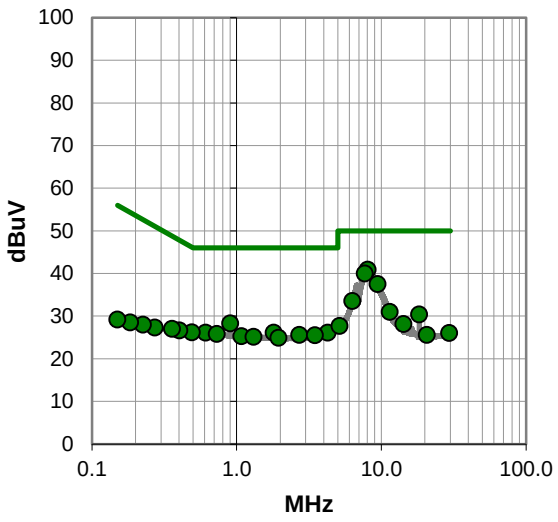
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #11

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
8.167	26.5	20.5	47.0	60.0	-13.0
7.704	25.5	20.4	45.9	60.0	-14.1
9.402	23.2	20.5	43.7	60.0	-16.3
0.600	15.5	20.0	35.5	56.0	-20.5
6.331	19.1	20.4	39.5	60.0	-20.5
0.589	15.2	20.0	35.2	56.0	-20.8
0.194	22.5	20.0	42.5	63.9	-21.4
0.223	20.7	20.0	40.7	62.7	-22.0
0.466	14.4	19.9	34.3	56.6	-22.3
0.150	23.5	20.1	43.6	66.0	-22.4
0.902	13.5	20.0	33.5	56.0	-22.5
11.458	16.8	20.7	37.5	60.0	-22.5
0.728	13.4	20.0	33.4	56.0	-22.6
4.196	11.9	20.2	32.1	56.0	-23.9
1.804	11.9	20.1	32.0	56.0	-24.0
2.706	11.4	20.1	31.5	56.0	-24.5
3.421	11.3	20.2	31.5	56.0	-24.5
1.081	11.3	20.0	31.3	56.0	-24.7
1.395	11.2	20.1	31.3	56.0	-24.7
2.011	11.0	20.1	31.1	56.0	-24.9
18.293	14.0	21.1	35.1	60.0	-24.9
0.339	14.2	19.9	34.1	59.2	-25.1
0.272	15.6	20.0	35.6	61.1	-25.5
13.943	13.6	20.8	34.4	60.0	-25.6
5.200	13.5	20.2	33.7	60.0	-26.3

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
8.048	20.4	20.5	40.9	50.0	-9.1
7.709	19.6	20.4	40.0	50.0	-10.0
9.412	17.0	20.5	37.5	50.0	-12.5
6.322	13.1	20.4	33.5	50.0	-16.5
0.902	8.3	20.0	28.3	46.0	-17.7
11.439	10.3	20.7	31.0	50.0	-19.0
18.292	9.3	21.1	30.4	50.0	-19.6
0.611	6.1	20.0	26.1	46.0	-19.9
1.804	6.0	20.1	26.1	46.0	-19.9
4.267	5.9	20.2	26.1	46.0	-19.9
0.490	6.3	19.9	26.2	46.2	-20.0
0.730	5.8	20.0	25.8	46.0	-20.2
2.706	5.5	20.1	25.6	46.0	-20.4
3.473	5.3	20.2	25.5	46.0	-20.5
1.081	5.3	20.0	25.3	46.0	-20.7
1.311	5.0	20.1	25.1	46.0	-20.9
1.943	4.8	20.1	24.9	46.0	-21.1
0.402	6.7	19.9	26.6	47.8	-21.2
0.358	7.1	19.9	27.0	48.8	-21.8
14.227	7.3	20.8	28.1	50.0	-21.9
5.158	7.5	20.2	27.7	50.0	-22.3
0.272	7.3	20.0	27.3	51.1	-23.8
29.470	4.0	22.0	26.0	50.0	-24.0
20.657	4.3	21.3	25.6	50.0	-24.4
0.225	8.0	20.0	28.0	52.6	-24.6

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

EUT:	Twig V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2024-02-28
Customer:	Nelson Irrigation Corporation	Temperature:	22.3°C
Attendees:	None	Relative Humidity:	37.6%
Customer Project:	None	Bar. Pressure (PMSL):	1009 mb
Tested By:	Jeff Alcoke	Job Site:	EV07
Power:	5 VDC via 110VAC/60 Hz	Configuration:	NELS0019-7

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2024	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	12	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

Measuring AC power of linear DC power supply.

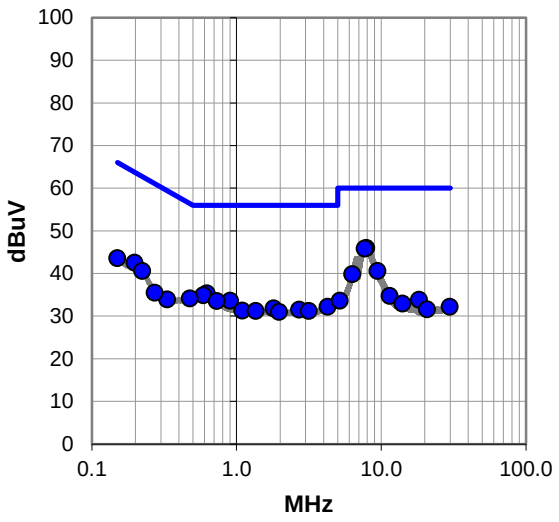
EUT OPERATING MODES

LoRa, 500kHz BW, SF8, Mid Ch. = 915 MHz, Omni Antenna

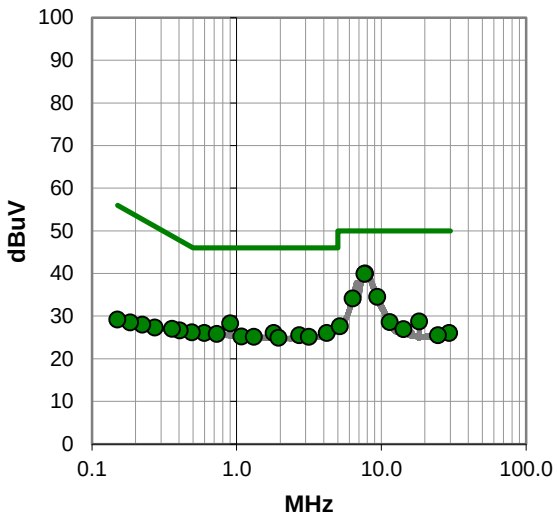
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #12

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
7.878	25.6	20.4	46.0	60.0	-14.0
7.695	25.4	20.4	45.8	60.0	-14.2
9.407	20.1	20.5	40.6	60.0	-19.4
6.317	19.4	20.4	39.8	60.0	-20.2
0.623	15.3	20.0	35.3	56.0	-20.7
0.589	14.9	20.0	34.9	56.0	-21.1
0.197	22.5	20.0	42.5	63.7	-21.2
0.223	20.6	20.0	40.6	62.7	-22.1
0.475	14.2	19.9	34.1	56.4	-22.3
0.150	23.5	20.1	43.6	66.0	-22.4
0.902	13.6	20.0	33.6	56.0	-22.4
0.728	13.5	20.0	33.5	56.0	-22.5
4.265	12.0	20.2	32.2	56.0	-23.8
1.802	11.7	20.1	31.8	56.0	-24.2
2.704	11.4	20.1	31.5	56.0	-24.5
1.094	11.3	20.0	31.3	56.0	-24.7
1.358	11.1	20.1	31.2	56.0	-24.8
3.160	11.0	20.2	31.2	56.0	-24.8
1.969	10.9	20.1	31.0	56.0	-25.0
11.444	14.0	20.7	34.7	60.0	-25.3
0.332	14.0	19.9	33.9	59.4	-25.5
0.272	15.5	20.0	35.5	61.1	-25.6
18.295	12.7	21.1	33.8	60.0	-26.2
5.165	13.4	20.2	33.6	60.0	-26.4
13.994	12.1	20.8	32.9	60.0	-27.1

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
7.738	19.6	20.4	40.0	50.0	-10.0
7.672	19.5	20.4	39.9	50.0	-10.1
9.393	14.0	20.5	34.5	50.0	-15.5
6.333	13.7	20.4	34.1	50.0	-15.9
0.902	8.3	20.0	28.3	46.0	-17.7
0.597	6.0	20.0	26.0	46.0	-20.0
1.802	5.9	20.1	26.0	46.0	-20.0
4.207	5.8	20.2	26.0	46.0	-20.0
0.490	6.3	19.9	26.2	46.2	-20.0
0.728	5.8	20.0	25.8	46.0	-20.2
2.704	5.4	20.1	25.5	46.0	-20.5
1.078	5.2	20.0	25.2	46.0	-20.8
1.317	5.0	20.1	25.1	46.0	-20.9
3.160	4.9	20.2	25.1	46.0	-20.9
1.950	4.8	20.1	24.9	46.0	-21.1
0.405	6.7	19.9	26.6	47.8	-21.2
18.295	7.6	21.1	28.7	50.0	-21.3
11.444	7.9	20.7	28.6	50.0	-21.4
0.358	7.1	19.9	27.0	48.8	-21.8
5.184	7.4	20.2	27.6	50.0	-22.4
14.227	6.1	20.8	26.9	50.0	-23.1
0.272	7.3	20.0	27.3	51.1	-23.8
29.488	4.0	22.0	26.0	50.0	-24.0
24.616	4.0	21.5	25.5	50.0	-24.5
0.223	8.0	20.0	28.0	52.7	-24.7

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

EUT:	Twig V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2024-02-28
Customer:	Nelson Irrigation Corporation	Temperature:	22.3°C
Attendees:	None	Relative Humidity:	37.6%
Customer Project:	None	Bar. Pressure (PMSL):	1009 mb
Tested By:	Jeff Alcoke	Job Site:	EV07
Power:	5 VDC via 110VAC/60 Hz	Configuration:	NELS0019-9

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2024	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	13	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

Measuring AC power of linear DC power supply.

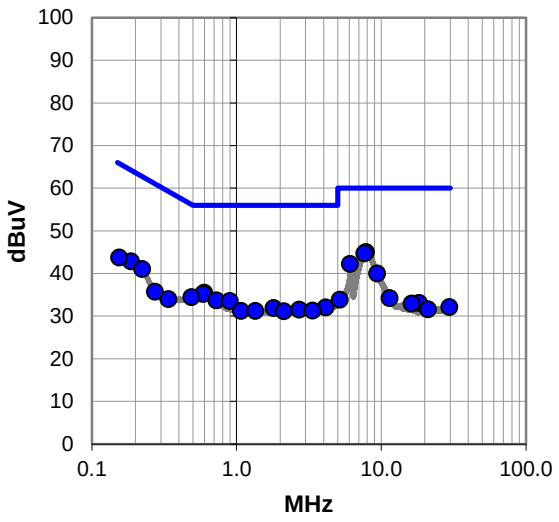
EUT OPERATING MODES

LoRa, 500kHz BW, SF8, Mid Ch. = 915 MHz, Yagi Antenna

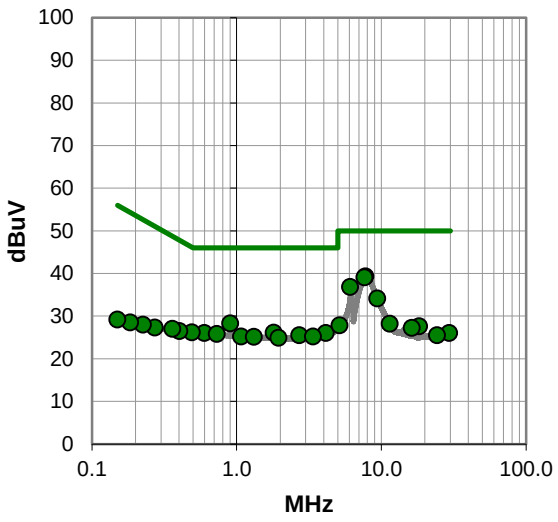
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #13

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
7.846	24.6	20.4	45.0	60.0	-15.0
7.646	24.3	20.4	44.7	60.0	-15.3
6.096	21.8	20.4	42.2	60.0	-17.8
9.393	19.5	20.5	40.0	60.0	-20.0
0.599	15.5	20.0	35.5	56.0	-20.5
0.585	15.2	20.0	35.2	56.0	-20.8
0.187	22.8	20.0	42.8	64.2	-21.4
0.223	21.0	20.0	41.0	62.7	-21.7
0.489	14.5	19.9	34.4	56.2	-21.8
0.155	23.6	20.1	43.7	65.8	-22.1
0.727	13.7	20.0	33.7	56.0	-22.3
0.901	13.5	20.0	33.5	56.0	-22.5
4.126	11.8	20.2	32.0	56.0	-24.0
1.802	11.8	20.1	31.9	56.0	-24.1
2.706	11.4	20.1	31.5	56.0	-24.5
3.350	11.1	20.2	31.3	56.0	-24.7
1.076	11.2	20.0	31.2	56.0	-24.8
1.352	11.1	20.1	31.2	56.0	-24.8
2.126	11.0	20.1	31.1	56.0	-24.9
0.274	15.7	20.0	35.7	61.0	-25.3
0.338	14.1	19.9	34.0	59.3	-25.3
11.441	13.5	20.7	34.2	60.0	-25.8
5.161	13.6	20.2	33.8	60.0	-26.2
18.287	12.0	21.1	33.1	60.0	-26.9
16.256	11.9	21.0	32.9	60.0	-27.1

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
7.782	18.9	20.4	39.3	50.0	-10.7
7.672	18.7	20.4	39.1	50.0	-10.9
6.096	16.4	20.4	36.8	50.0	-13.2
9.393	13.6	20.5	34.1	50.0	-15.9
0.902	8.3	20.0	28.3	46.0	-17.7
1.804	6.0	20.1	26.1	46.0	-19.9
0.597	6.0	20.0	26.0	46.0	-20.0
4.129	5.8	20.2	26.0	46.0	-20.0
0.490	6.3	19.9	26.2	46.2	-20.0
0.730	5.8	20.0	25.8	46.0	-20.2
2.704	5.4	20.1	25.5	46.0	-20.5
1.076	5.2	20.0	25.2	46.0	-20.8
3.366	5.0	20.2	25.2	46.0	-20.8
1.317	5.0	20.1	25.1	46.0	-20.9
1.946	4.8	20.1	24.9	46.0	-21.1
0.402	6.6	19.9	26.5	47.8	-21.3
0.359	7.1	19.9	27.0	48.8	-21.8
11.446	7.5	20.7	28.2	50.0	-21.8
5.159	7.6	20.2	27.8	50.0	-22.2
18.287	6.5	21.1	27.6	50.0	-22.4
16.256	6.2	21.0	27.2	50.0	-22.8
0.272	7.3	20.0	27.3	51.1	-23.8
29.471	4.0	22.0	26.0	50.0	-24.0
24.264	4.0	21.5	25.5	50.0	-24.5
0.225	8.0	20.0	28.0	52.6	-24.6

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

EUT:	Twig V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2024-02-28
Customer:	Nelson Irrigation Corporation	Temperature:	22.3°C
Attendees:	None	Relative Humidity:	37.6%
Customer Project:	None	Bar. Pressure (PMSL):	1009 mb
Tested By:	Jeff Alcoke	Job Site:	EV07
Power:	5 VDC via 110VAC/60 Hz	Configuration:	NELS0019-9

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2024	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	14	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

Measuring AC power of linear DC power supply.

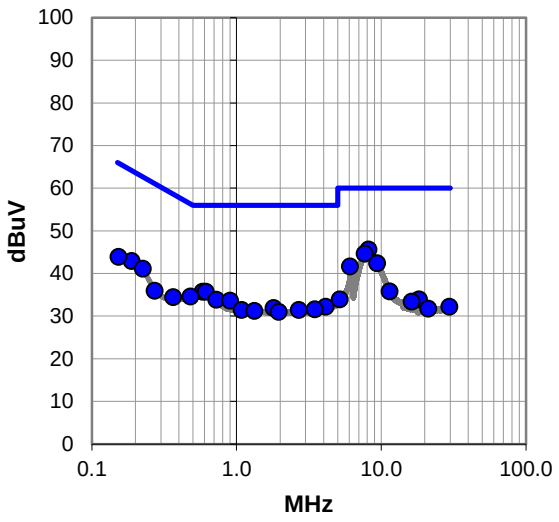
EUT OPERATING MODES

LoRa, 500kHz BW, SF8, Mid Ch. = 915 MHz, Yagi Antenna

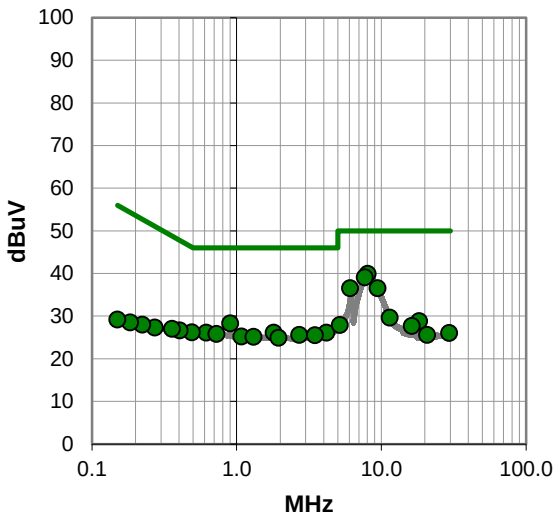
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #14

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
8.168	25.1	20.5	45.6	60.0	-14.4
7.687	24.2	20.4	44.6	60.0	-15.4
9.393	21.9	20.5	42.4	60.0	-17.6
6.096	21.2	20.4	41.6	60.0	-18.4
0.582	15.7	20.0	35.7	56.0	-20.3
0.612	15.7	20.0	35.7	56.0	-20.3
0.188	22.9	20.0	42.9	64.1	-21.2
0.225	21.1	20.0	41.1	62.6	-21.5
0.481	14.7	19.9	34.6	56.3	-21.7
0.153	23.8	20.1	43.9	65.8	-21.9
0.727	13.8	20.0	33.8	56.0	-22.2
0.902	13.6	20.0	33.6	56.0	-22.4
4.129	12.0	20.2	32.2	56.0	-23.8
1.802	11.8	20.1	31.9	56.0	-24.1
0.365	14.5	19.9	34.4	58.6	-24.2
11.446	15.1	20.7	35.8	60.0	-24.2
3.475	11.4	20.2	31.6	56.0	-24.4
1.084	11.4	20.0	31.4	56.0	-24.6
2.703	11.3	20.1	31.4	56.0	-24.6
1.326	11.1	20.1	31.2	56.0	-24.8
1.958	10.9	20.1	31.0	56.0	-25.0
0.272	15.9	20.0	35.9	61.1	-25.2
5.161	13.7	20.2	33.9	60.0	-26.1
18.289	12.8	21.1	33.9	60.0	-26.1
16.256	12.4	21.0	33.4	60.0	-26.6

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
8.049	19.4	20.5	39.9	50.0	-10.1
7.707	18.7	20.4	39.1	50.0	-10.9
6.096	16.1	20.4	36.5	50.0	-13.5
9.409	16.0	20.5	36.5	50.0	-13.5
0.902	8.3	20.0	28.3	46.0	-17.7
0.617	6.1	20.0	26.1	46.0	-19.9
1.804	6.0	20.1	26.1	46.0	-19.9
4.184	5.9	20.2	26.1	46.0	-19.9
0.490	6.3	19.9	26.2	46.2	-20.0
0.727	5.8	20.0	25.8	46.0	-20.2
2.706	5.5	20.1	25.6	46.0	-20.4
11.439	8.9	20.7	29.6	50.0	-20.4
3.470	5.3	20.2	25.5	46.0	-20.5
1.079	5.2	20.0	25.2	46.0	-20.8
1.311	5.0	20.1	25.1	46.0	-20.9
1.944	4.8	20.1	24.9	46.0	-21.1
0.403	6.7	19.9	26.6	47.8	-21.2
18.289	7.7	21.1	28.8	50.0	-21.2
0.358	7.1	19.9	27.0	48.8	-21.8
5.162	7.7	20.2	27.9	50.0	-22.1
16.256	6.7	21.0	27.7	50.0	-22.3
0.272	7.3	20.0	27.3	51.1	-23.8
29.468	4.0	22.0	26.0	50.0	-24.0
20.770	4.3	21.3	25.6	50.0	-24.4
0.223	8.0	20.0	28.0	52.7	-24.7

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

EUT:	Twig V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2024-02-28
Customer:	Nelson Irrigation Corporation	Temperature:	22.3°C
Attendees:	None	Relative Humidity:	37.6%
Customer Project:	None	Bar. Pressure (PMSL):	1009 mb
Tested By:	Jeff Alcoke	Job Site:	EV07
Power:	5 VDC via 110VAC/60 Hz	Configuration:	NELS0019-8

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2024	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	15	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

Measuring AC power of linear DC power supply.

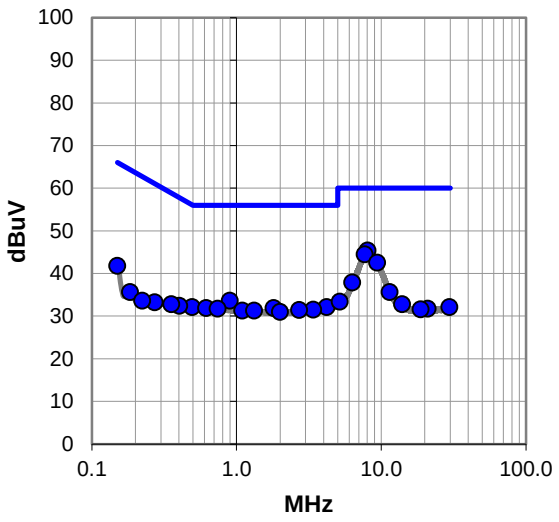
EUT OPERATING MODES

LoRa, 500kHz BW, SF8, Mid Ch. = 915 MHz, Internal Antenna

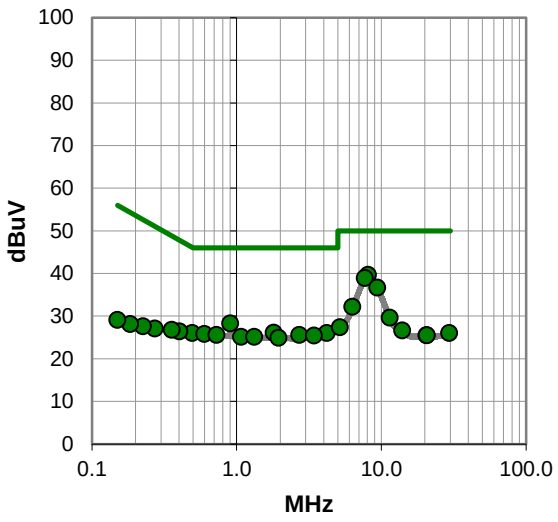
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #15

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
8.057	24.9	20.5	45.4	60.0	-14.6
7.683	24.1	20.4	44.5	60.0	-15.5
9.396	22.0	20.5	42.5	60.0	-17.5
6.319	17.5	20.4	37.9	60.0	-22.1
0.901	13.6	20.0	33.6	56.0	-22.4
4.195	11.9	20.2	32.1	56.0	-23.9
0.492	12.2	19.9	32.1	56.1	-24.0
0.617	11.9	20.0	31.9	56.0	-24.1
1.804	11.8	20.1	31.9	56.0	-24.1
0.150	21.7	20.1	41.8	66.0	-24.2
0.739	11.7	20.0	31.7	56.0	-24.3
11.439	14.9	20.7	35.6	60.0	-24.4
3.392	11.3	20.2	31.5	56.0	-24.5
2.704	11.3	20.1	31.4	56.0	-24.6
1.094	11.3	20.0	31.3	56.0	-24.7
1.322	11.2	20.1	31.3	56.0	-24.7
1.999	10.9	20.1	31.0	56.0	-25.0
0.402	12.5	19.9	32.4	57.8	-25.4
0.354	12.9	19.9	32.8	58.9	-26.1
5.161	13.2	20.2	33.4	60.0	-26.6
13.931	12.0	20.8	32.8	60.0	-27.2
0.272	13.2	20.0	33.2	61.1	-27.9
29.561	10.1	22.0	32.1	60.0	-27.9
21.006	10.4	21.3	31.7	60.0	-28.3
18.740	10.5	21.1	31.6	60.0	-28.4

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
8.113	19.2	20.5	39.7	50.0	-10.3
7.709	18.5	20.4	38.9	50.0	-11.1
9.395	16.2	20.5	36.7	50.0	-13.3
0.902	8.3	20.0	28.3	46.0	-17.7
6.322	11.8	20.4	32.2	50.0	-17.8
1.804	6.0	20.1	26.1	46.0	-19.9
4.198	5.8	20.2	26.0	46.0	-20.0
0.493	6.1	19.9	26.0	46.1	-20.1
0.597	5.8	20.0	25.8	46.0	-20.2
0.727	5.6	20.0	25.6	46.0	-20.4
2.706	5.5	20.1	25.6	46.0	-20.4
11.439	8.9	20.7	29.6	50.0	-20.4
3.421	5.2	20.2	25.4	46.0	-20.6
1.076	5.1	20.0	25.1	46.0	-20.9
1.323	5.0	20.1	25.1	46.0	-20.9
1.952	4.8	20.1	24.9	46.0	-21.1
0.402	6.5	19.9	26.4	47.8	-21.4
0.356	6.9	19.9	26.8	48.8	-22.0
5.161	7.2	20.2	27.4	50.0	-22.6
13.930	5.8	20.8	26.6	50.0	-23.4
0.272	7.1	20.0	27.1	51.1	-24.0
29.470	4.0	22.0	26.0	50.0	-24.0
20.556	4.2	21.3	25.5	50.0	-24.5
20.655	4.2	21.3	25.5	50.0	-24.5
0.225	7.6	20.0	27.6	52.6	-25.0

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

EUT:	Twig V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2024-02-28
Customer:	Nelson Irrigation Corporation	Temperature:	22.3°C
Attendees:	None	Relative Humidity:	37.6%
Customer Project:	None	Bar. Pressure (PMSL):	1009 mb
Tested By:	Jeff Alcoke	Job Site:	EV07
Power:	5 VDC via 110VAC/60 Hz	Configuration:	NELS0019-8

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2024	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

TEST PARAMETERS

Run #:	16	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

Measuring AC power of linear DC power supply.

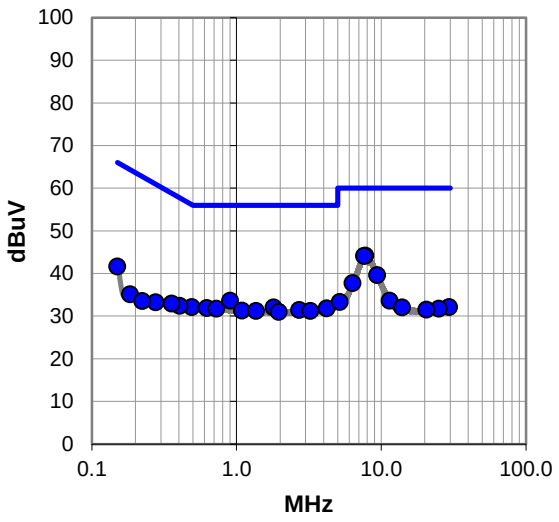
EUT OPERATING MODES

LoRa, 500kHz BW, SF8, Mid Ch. = 915 MHz, Internal Antenna

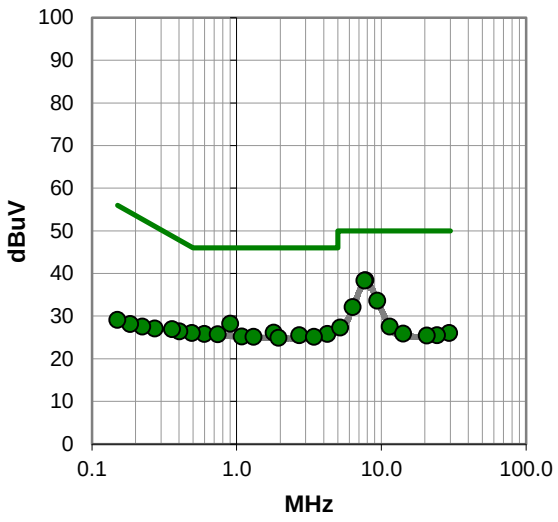
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #16

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
7.758	23.8	20.4	44.2	60.0	-15.8
7.623	23.7	20.4	44.1	60.0	-15.9
9.401	19.1	20.5	39.6	60.0	-20.4
6.334	17.3	20.4	37.7	60.0	-22.3
0.902	13.6	20.0	33.6	56.0	-22.4
1.804	11.9	20.1	32.0	56.0	-24.0
0.490	12.2	19.9	32.1	56.2	-24.1
0.621	11.9	20.0	31.9	56.0	-24.1
4.196	11.6	20.2	31.8	56.0	-24.2
0.727	11.7	20.0	31.7	56.0	-24.3
0.150	21.5	20.1	41.6	66.0	-24.4
2.706	11.3	20.1	31.4	56.0	-24.6
1.088	11.3	20.0	31.3	56.0	-24.7
1.366	11.1	20.1	31.2	56.0	-24.8
3.241	11.0	20.2	31.2	56.0	-24.8
1.954	10.9	20.1	31.0	56.0	-25.0
0.403	12.5	19.9	32.4	57.8	-25.4
0.356	13.0	19.9	32.9	58.8	-25.9
11.450	12.9	20.7	33.6	60.0	-26.4
5.162	13.1	20.2	33.3	60.0	-26.7
0.277	13.2	20.0	33.2	60.9	-27.7
29.476	10.1	22.0	32.1	60.0	-27.9
13.955	11.2	20.8	32.0	60.0	-28.0
25.001	10.2	21.5	31.7	60.0	-28.3
20.553	10.2	21.3	31.5	60.0	-28.5

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
7.758	18.0	20.4	38.4	50.0	-11.6
7.642	17.9	20.4	38.3	50.0	-11.7
9.395	13.1	20.5	33.6	50.0	-16.4
0.902	8.2	20.0	28.2	46.0	-17.8
6.334	11.7	20.4	32.1	50.0	-17.9
1.804	6.0	20.1	26.1	46.0	-19.9
0.597	5.8	20.0	25.8	46.0	-20.2
4.232	5.6	20.2	25.8	46.0	-20.2
0.490	6.1	19.9	26.0	46.2	-20.2
0.740	5.7	20.0	25.7	46.0	-20.3
2.704	5.4	20.1	25.5	46.0	-20.5
1.085	5.2	20.0	25.2	46.0	-20.8
1.311	5.0	20.1	25.1	46.0	-20.9
3.427	4.9	20.2	25.1	46.0	-20.9
1.946	4.8	20.1	24.9	46.0	-21.1
0.402	6.5	19.9	26.4	47.8	-21.4
0.358	7.0	19.9	26.9	48.8	-21.9
11.441	6.8	20.7	27.5	50.0	-22.5
5.200	7.1	20.2	27.3	50.0	-22.7
0.272	7.1	20.0	27.1	51.1	-24.0
29.502	4.0	22.0	26.0	50.0	-24.0
14.174	5.1	20.8	25.9	50.0	-24.1
24.351	4.0	21.5	25.5	50.0	-24.5
20.602	4.1	21.3	25.4	50.0	-24.6
0.223	7.5	20.0	27.5	52.7	-25.2

CONCLUSION

Pass

Tested By

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

TEST DESCRIPTION

The highest gain antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequencies and the modes as showed in the data sheets.

For each configuration, the spectrum was scanned throughout the specified range as part of the exploratory investigation of the emissions. These “pre-scans” are not included in the report. Final measurements on individual emissions were then made and included in this test report.

The individual emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis if required, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass filter (and notch filter) were used for this test to provide sufficient measurement sensitivity.

Measurements were made with the required detectors and annotated on the data for each individual point using the following annotation:

QP = Quasi-Peak Detector
PK = Peak Detector
AV = RMS Detector

Measurements were made to satisfy the specific requirements of the test specification for out of band emissions as well as the restricted band requirements.

If there are no detectable emissions above the noise floor, the data included may show noise floor measurements for reference only.

Where the radio test software does not provide for a duty cycle at continuous transmit conditions (> 98%) and the RMS (power average) measurements were made across the on and off times of the EUT transmissions, a duty cycle correction is added to the measurements using the formula of 10*log(1/dc).

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFO	2023-10-04	2024-10-04
Antenna - Biconilog	EMCO	3142B	AXJ	2023-04-17	2025-04-17
Antenna - Standard Gain	ETS Lindgren	3160-07	AHU	NCR	NCR
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AOL	2023-11-05	2024-11-05
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAG	2023-03-26	2024-03-26
Amplifier - Pre-Amplifier	L-3 Narda-MITEQ	AMF-6F-08001200-30-10P	PAO	2023-10-31	2024-10-31
Cable	N/A	Bilog Cables	EVA	2023-11-05	2024-11-05
Cable	N/A	Double Ridge Horn Cables	EVB	2023-03-26	2024-03-26
Cable	None	Standard Gain Horn Cables	EVF	2023-10-31	2024-10-31
Attenuator	Coaxicom	3910-10	AWX	2024-02-12	2025-02-12
Filter - Low Pass	Micro-Tronics	LPM50003	LFB	2024-02-12	2025-02-12
Filter - High Pass	Micro-Tronics	HPM50108	HFV	2023-11-06	2024-11-06

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	5.2 dB	-5.2 dB

FREQUENCY RANGE INVESTIGATED

30 MHz TO 12400 MHz

POWER INVESTIGATED

5 VDC

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

CONFIGURATIONS INVESTIGATED

NELS0019-5
NELS0019-6
NELS0019-7

MODES INVESTIGATED

LoRa, 500kHz BW, SF8, Low Ch.= 903 MHz, Mid Ch.=915 MHz, High Ch.=927 MHz

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

EUT:	Twig V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2024-02-23
Customer:	Nelson Irrigation Corporation	Temperature:	21.7°C
Attendees:	None	Relative Humidity:	37.4%
Customer Project:	None	Bar. Pressure (PMSL):	1027 mb
Tested By:	Jeff Alcoke	Job Site:	EV01
Power:	5 VDC	Configuration:	NELS0019-5

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2024	ANSI C63.10:2013
RSS-247 Issue 3:2023	ANSI C63.10:2013

TEST PARAMETERS

Run #:	118	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

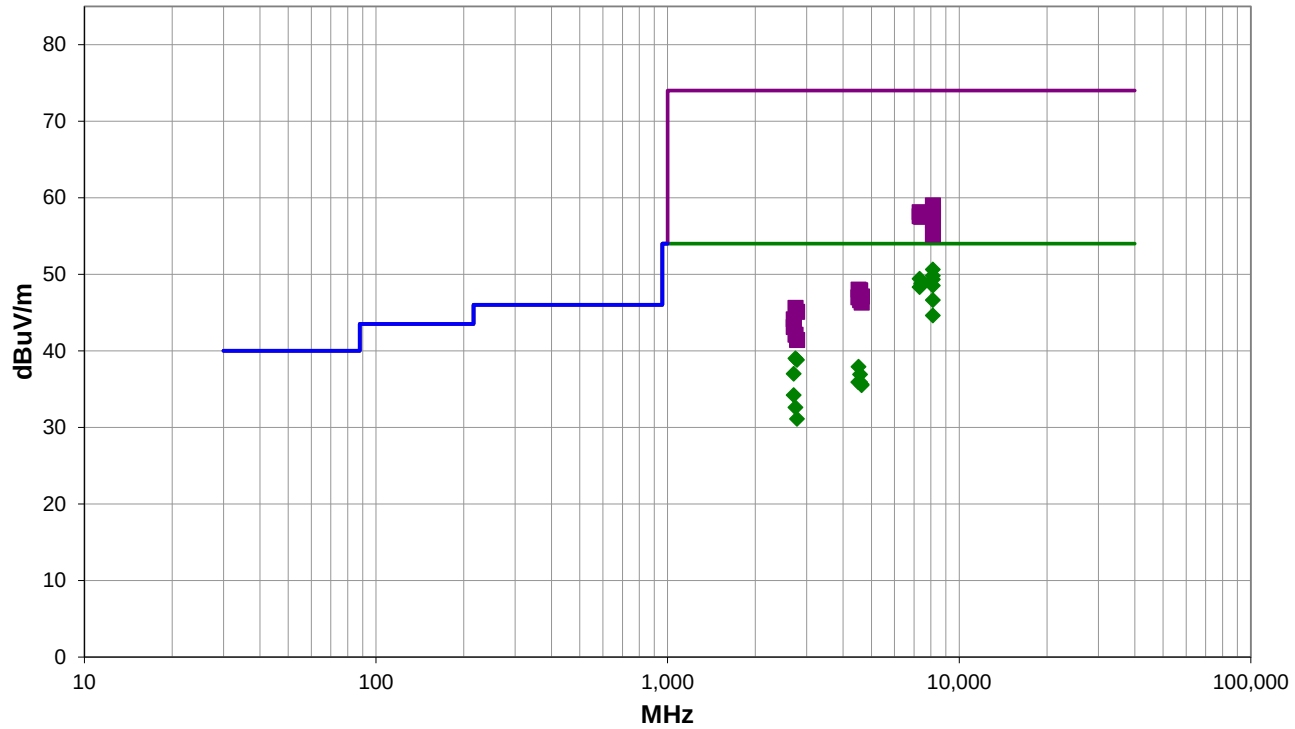
Test mode operates at 90.5% duty cycle. An upward DCCF was applied to the RMS Avg measurements based on 10*log(1/DC) = 10*log(1/0.905) = 0.4 dB. Please reference data comments below for Channel and EUT orientation.

EUT OPERATING MODES

LoRa, 500kHz BW, SF8, Low Ch. = 903 MHz, Mid Ch. = 915 MHz, High Ch. = 927 MHz, Internal antenna

DEVIATIONS FROM TEST STANDARD

None



Run #: 118 PK AV QP

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #118

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
8126.092	35.8	14.4	1.5	186.0	0.4	0.0	Vert	AV	0.0	50.6	54.0	-3.4	Low Ch, EUT Vert
8127.158	35.0	14.4	2.0	19.0	0.4	0.0	Horz	AV	0.0	49.8	54.0	-4.2	Low Ch, EUT on Side
7320.725	33.6	15.4	1.4	190.0	0.4	0.0	Vert	AV	0.0	49.4	54.0	-4.6	Mid Ch, EUT Vert
8125.942	34.5	14.4	2.2	215.0	0.4	0.0	Vert	AV	0.0	49.3	54.0	-4.7	Low Ch, EUT Horz
7416.700	32.9	15.5	1.6	40.0	0.4	0.0	Horz	AV	0.0	48.8	54.0	-5.2	High Ch, EUT on Side
7416.500	32.8	15.5	1.5	154.0	0.4	0.0	Vert	AV	0.0	48.7	54.0	-5.3	High Ch, EUT Vert
8126.117	33.7	14.4	1.4	241.0	0.4	0.0	Horz	AV	0.0	48.5	54.0	-5.5	Low Ch, EUT Vert
7319.367	32.5	15.4	1.5	38.0	0.4	0.0	Horz	AV	0.0	48.3	54.0	-5.7	Mid Ch, EUT on Side
8125.833	31.8	14.4	2.0	131.0	0.4	0.0	Horz	AV	0.0	46.6	54.0	-7.4	Low Ch, EUT Horz
8125.908	29.8	14.4	1.5	151.0	0.4	0.0	Vert	AV	0.0	44.6	54.0	-9.4	Low Ch, EUT on Side
2744.950	39.4	-0.8	1.5	92.0	0.4	0.0	Horz	AV	0.0	39.0	54.0	-15.0	Mid Ch., EUT On Side
8125.667	44.6	14.4	1.5	186.0	0.0	0.0	Vert	PK	0.0	59.0	74.0	-15.0	Low Ch, EUT Vert
2780.942	39.2	-0.8	1.5	153.0	0.4	0.0	Horz	AV	0.0	38.8	54.0	-15.2	High Ch., EUT On Side
8125.483	43.8	14.4	2.0	19.0	0.0	0.0	Horz	PK	0.0	58.2	74.0	-15.8	Low Ch, EUT on Side
8126.942	43.7	14.4	2.2	215.0	0.0	0.0	Vert	PK	0.0	58.1	74.0	-15.9	Low Ch, EUT Horz
7320.067	42.7	15.4	1.4	190.0	0.0	0.0	Vert	PK	0.0	58.1	74.0	-15.9	Mid Ch, EUT Vert
8126.792	43.6	14.4	1.4	241.0	0.0	0.0	Horz	PK	0.0	58.0	74.0	-16.0	Low Ch, EUT Vert
4515.033	30.5	7.0	1.5	234.0	0.4	0.0	Horz	AV	0.0	37.9	54.0	-16.1	Low Ch, EUT on Side
7415.083	42.2	15.5	1.6	40.0	0.0	0.0	Horz	PK	0.0	57.7	74.0	-16.3	High Ch, EUT on Side
7320.783	42.2	15.4	1.5	38.0	0.0	0.0	Horz	PK	0.0	57.6	74.0	-16.4	Mid Ch, EUT on Side
7416.133	42.0	15.5	1.5	154.0	0.0	0.0	Vert	PK	0.0	57.5	74.0	-16.5	High Ch, EUT Vert
8128.683	42.7	14.4	2.0	131.0	0.0	0.0	Horz	PK	0.0	57.1	74.0	-16.9	Low Ch, EUT Horz
2708.875	37.5	-0.9	1.5	43.0	0.4	0.0	Horz	AV	0.0	37.0	54.0	-17.0	Low Ch., EUT On Side
4574.450	29.4	7.1	1.7	113.0	0.4	0.0	Horz	AV	0.0	36.9	54.0	-17.1	Mid Ch, EUT on Side
4514.733	28.5	7.0	2.2	141.0	0.4	0.0	Vert	AV	0.0	35.9	54.0	-18.1	Low Ch, EUT Vert
4576.517	28.4	7.1	1.5	19.0	0.4	0.0	Vert	AV	0.0	35.9	54.0	-18.1	Mid Ch, EUT Vert
4633.300	27.9	7.3	1.5	88.0	0.4	0.0	Horz	AV	0.0	35.6	54.0	-18.4	High Ch, EUT on Side
4633.117	27.8	7.3	1.5	311.0	0.4	0.0	Vert	AV	0.0	35.5	54.0	-18.5	High Ch, EUT Vert
8128.075	40.8	14.4	1.5	151.0	0.0	0.0	Vert	PK	0.0	55.2	74.0	-18.8	Low Ch, EUT on Side
2708.667	34.7	-0.9	1.5	216.0	0.4	0.0	Vert	AV	0.0	34.2	54.0	-19.8	Low Ch, EUT Vert
2744.983	33.0	-0.8	1.5	250.0	0.4	0.0	Vert	AV	0.0	32.6	54.0	-21.4	Mid Ch, EUT Vert
2780.967	31.5	-0.8	1.5	360.0	0.4	0.0	Vert	AV	0.0	31.1	54.0	-22.9	High Ch, EUT Vert
4515.283	41.0	7.0	1.5	234.0	0.0	0.0	Horz	PK	0.0	48.0	74.0	-26.0	Low Ch, EUT on Side
4576.642	40.8	7.1	1.7	113.0	0.0	0.0	Horz	PK	0.0	47.9	74.0	-26.1	Mid Ch, EUT on Side
4634.867	39.8	7.3	1.5	88.0	0.0	0.0	Horz	PK	0.0	47.1	74.0	-26.9	High Ch, EUT on Side
4513.075	40.0	7.0	2.2	141.0	0.0	0.0	Vert	PK	0.0	47.0	74.0	-27.0	Low Ch, EUT Vert
4574.142	39.5	7.1	1.5	19.0	0.0	0.0	Vert	PK	0.0	46.6	74.0	-27.4	Mid Ch, EUT Vert
4632.900	39.0	7.3	1.5	311.0	0.0	0.0	Vert	PK	0.0	46.3	74.0	-27.7	High Ch, EUT Vert
2745.025	46.4	-0.8	1.5	92.0	0.0	0.0	Horz	PK	0.0	45.6	74.0	-28.4	Mid Ch., EUT On Side
2781.083	45.9	-0.8	1.5	153.0	0.0	0.0	Horz	PK	0.0	45.1	74.0	-28.9	High Ch., EUT On Side

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2709.592	45.0	-0.9	1.5	43.0	0.0	0.0	Horz	PK	0.0	44.1	74.0	-29.9	Low Ch., EUT On Side
2708.683	44.0	-0.9	1.5	216.0	0.0	0.0	Vert	PK	0.0	43.1	74.0	-30.9	Low Ch, EUT Vert
2744.250	42.9	-0.8	1.5	250.0	0.0	0.0	Vert	PK	0.0	42.1	74.0	-31.9	Mid Ch, EUT Vert
2780.525	42.2	-0.8	1.5	360.0	0.0	0.0	Vert	PK	0.0	41.4	74.0	-32.6	High Ch, EUT Vert

CONCLUSION

Pass

Tested By

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

EUT:	Twig V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2024-02-23
Customer:	Nelson Irrigation Corporation	Temperature:	21.8°C
Attendees:	None	Relative Humidity:	36.7%
Customer Project:	None	Bar. Pressure (PMSL):	1026 mb
Tested By:	Jeff Alcoke	Job Site:	EV01
Power:	5 VDC	Configuration:	NELS0019-6

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2024	ANSI C63.10:2013
RSS-247 Issue 3:2023	ANSI C63.10:2013

TEST PARAMETERS

Run #:	131	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

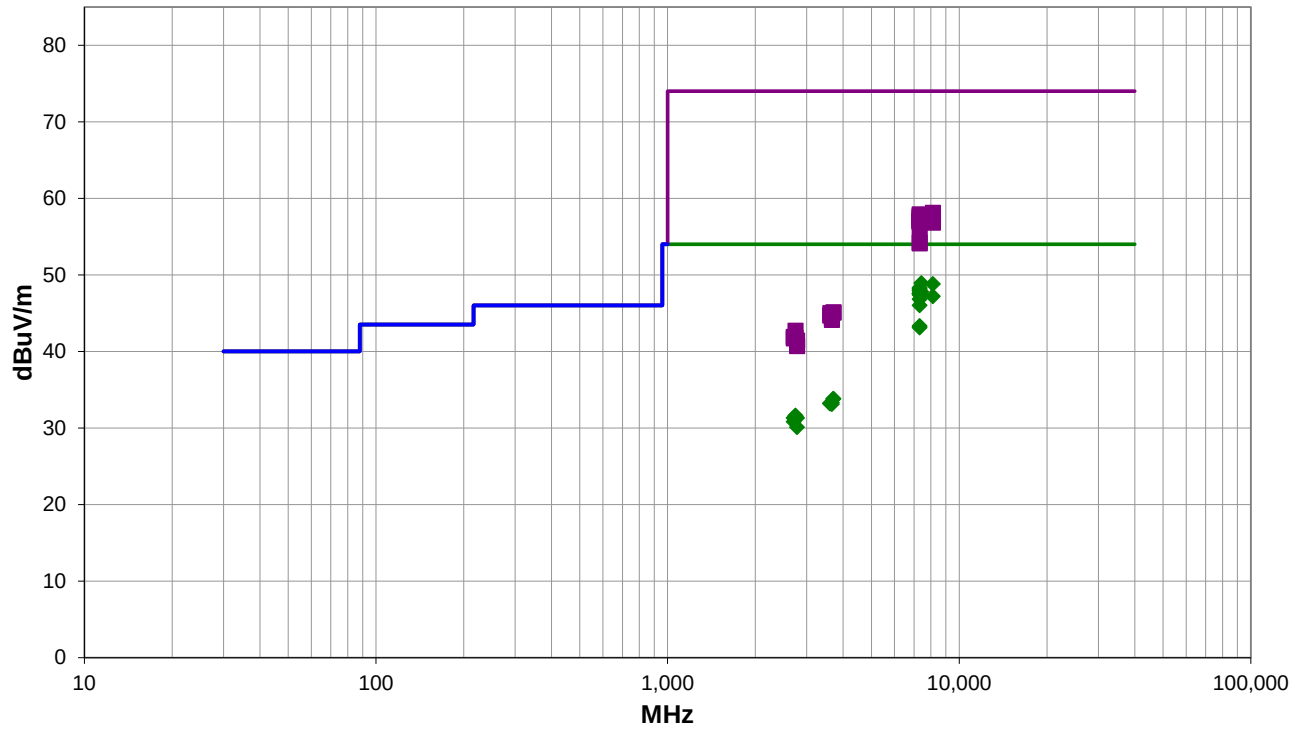
Test mode operates at 90.5% duty cycle. An upward DCCF was applied to the RMS Avg measurements based on 10*log(1/DC) = 10*log(1/0.905) = 0.4 dB. Please reference data comments below for Channel, EUT orientation, and Antenna polarity.

EUT OPERATING MODES

LoRa, 500kHz BW, SF8, Low Ch. = 903 MHz, Mid Ch. = 915 MHz, High Ch. = 927 MHz, Yagi Antenna

DEVIATIONS FROM TEST STANDARD

None



Run #: 131

PK AV QP

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #131

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
7416.925	33.0	15.5	1.6	64.0	0.4	0.0	Vert	AV	0.0	48.9	54.0	-5.1	High Ch, EUT Vert, Ant Horz
8126.375	34.0	14.4	2.0	355.0	0.4	0.0	Horz	AV	0.0	48.8	54.0	-5.2	Low Ch, EUT on Side, Ant Horz
7319.467	32.5	15.4	2.2	45.0	0.4	0.0	Horz	AV	0.0	48.3	54.0	-5.7	Mid Ch, EUT on Side, Ant Horz
7319.042	32.4	15.4	1.9	144.0	0.4	0.0	Vert	AV	0.0	48.2	54.0	-5.8	Mid Ch, EUT Vert, Ant Horz
7321.017	32.2	15.4	1.7	44.0	0.4	0.0	Horz	AV	0.0	48.0	54.0	-6.0	Mid Ch, EUT Horz, Ant Vert
7319.783	32.1	15.4	1.9	209.0	0.4	0.0	Vert	AV	0.0	47.9	54.0	-6.1	Mid Ch, EUT on Side, Ant Horz
7415.242	31.9	15.5	1.5	19.0	0.4	0.0	Horz	AV	0.0	47.8	54.0	-6.2	High Ch, EUT on Side, Ant Horz
7318.867	31.8	15.4	1.8	14.0	0.4	0.0	Horz	AV	0.0	47.6	54.0	-6.4	Mid Ch, EUT Vert, Ant Horz
7321.108	31.8	15.4	1.5	131.0	0.4	0.0	Vert	AV	0.0	47.6	54.0	-6.4	Mid Ch, EUT Vert, Ant Vert
7319.425	31.7	15.4	1.5	183.0	0.4	0.0	Horz	AV	0.0	47.5	54.0	-6.5	Mid Ch, EUT Horz, Ant Horz
7318.700	31.6	15.4	1.5	321.0	0.4	0.0	Horz	AV	0.0	47.4	54.0	-6.6	Mid Ch, EUT Vert, Ant Vert
8125.975	32.4	14.4	1.9	121.0	0.4	0.0	Vert	AV	0.0	47.2	54.0	-6.8	Low Ch, EUT Vert, Ant Horz
7319.325	31.0	15.4	1.0	55.0	0.4	0.0	Vert	AV	0.0	46.8	54.0	-7.2	Mid Ch, EUT Horz, Ant Horz
7319.917	30.2	15.4	1.0	92.0	0.4	0.0	Vert	AV	0.0	46.0	54.0	-8.0	Mid Ch, EUT Horz, Ant Vert
7317.925	27.5	15.4	2.1	362.0	0.4	0.0	Horz	AV	0.0	43.3	54.0	-10.7	Mid Ch, EUT on Side, Ant Vert
7317.667	27.3	15.4	2.7	191.0	0.4	0.0	Vert	AV	0.0	43.1	54.0	-10.9	Mid Ch, EUT on Side, Ant Vert
8126.858	43.7	14.4	2.0	355.0	0.0	0.0	Horz	PK	0.0	58.1	74.0	-15.9	Low Ch, EUT on Side, Ant Horz
7321.883	42.5	15.4	2.2	45.0	0.0	0.0	Horz	PK	0.0	57.9	74.0	-16.1	Mid Ch, EUT on Side, Ant Horz
7416.625	42.3	15.5	1.6	64.0	0.0	0.0	Vert	PK	0.0	57.8	74.0	-16.2	High Ch, EUT Vert, Ant Horz
7320.150	42.3	15.4	1.9	144.0	0.0	0.0	Vert	PK	0.0	57.7	74.0	-16.3	Mid Ch, EUT Vert, Ant Horz
7320.725	42.1	15.4	1.0	55.0	0.0	0.0	Vert	PK	0.0	57.5	74.0	-16.5	Mid Ch, EUT Horz, Ant Horz
7321.008	42.1	15.4	1.7	44.0	0.0	0.0	Horz	PK	0.0	57.5	74.0	-16.5	Mid Ch, EUT Horz, Ant Vert
7415.375	41.8	15.5	1.5	19.0	0.0	0.0	Horz	PK	0.0	57.3	74.0	-16.7	High Ch, EUT on Side, Ant Horz
7320.750	41.7	15.4	1.9	209.0	0.0	0.0	Vert	PK	0.0	57.1	74.0	-16.9	Mid Ch, EUT on Side, Ant Horz
7320.708	41.7	15.4	1.8	14.0	0.0	0.0	Horz	PK	0.0	57.1	74.0	-16.9	Mid Ch, EUT Vert, Ant Horz
7319.933	41.6	15.4	1.5	321.0	0.0	0.0	Horz	PK	0.0	57.0	74.0	-17.0	Mid Ch, EUT Vert, Ant Vert
7318.225	41.6	15.4	1.5	131.0	0.0	0.0	Vert	PK	0.0	57.0	74.0	-17.0	Mid Ch, EUT Vert, Ant Vert
7320.367	41.5	15.4	1.5	183.0	0.0	0.0	Horz	PK	0.0	56.9	74.0	-17.1	Mid Ch, EUT Horz, Ant Horz
8126.683	42.4	14.4	1.9	121.0	0.0	0.0	Vert	PK	0.0	56.8	74.0	-17.2	Low Ch, EUT Vert, Ant Horz
7320.417	40.7	15.4	1.0	92.0	0.0	0.0	Vert	PK	0.0	56.1	74.0	-17.9	Mid Ch, EUT Horz, Ant Vert
7319.567	38.8	15.4	2.1	362.0	0.0	0.0	Horz	PK	0.0	54.2	74.0	-19.8	Mid Ch, EUT on Side, Ant Vert
7317.783	38.7	15.4	2.7	191.0	0.0	0.0	Vert	PK	0.0	54.1	74.0	-19.9	Mid Ch, EUT on Side, Ant Vert
3707.567	28.7	4.7	2.7	108.0	0.4	0.0	Vert	AV	0.0	33.8	54.0	-20.2	High Ch, EUT Vert, Ant Horz
3707.642	28.7	4.7	1.5	121.0	0.4	0.0	Horz	AV	0.0	33.8	54.0	-20.2	High Ch, EUT on Side, Ant Horz
3657.850	28.5	4.4	1.8	29.0	0.4	0.0	Vert	AV	0.0	33.3	54.0	-20.7	Mid Ch, EUT Vert, Ant Horz
3609.817	28.4	4.4	1.5	241.0	0.4	0.0	Vert	AV	0.0	33.2	54.0	-20.8	Low Ch, EUT Vert, Ant Horz
3609.875	28.4	4.4	1.5	19.0	0.4	0.0	Horz	AV	0.0	33.2	54.0	-20.8	Low Ch, EUT on Side, Ant Horz
3657.617	28.3	4.4	1.5	171.0	0.4	0.0	Horz	AV	0.0	33.1	54.0	-20.9	Mid Ch, EUT on Side, Ant Horz
2744.958	32.0	-0.8	1.5	287.0	0.4	0.0	Vert	AV	0.0	31.6	54.0	-22.4	Mid Ch, EUT Vert, Ant Horz
2745.117	31.9	-0.8	1.5	67.0	0.4	0.0	Horz	AV	0.0	31.5	54.0	-22.5	Mid Ch, EUT on Side, Ant Horz

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2709.000	31.8	-0.9	1.0	306.0	0.4	0.0	Vert	AV	0.0	31.3	54.0	-22.7	Low Ch, EUT Vert, Ant Horz
2781.017	31.7	-0.8	1.5	85.0	0.4	0.0	Horz	AV	0.0	31.3	54.0	-22.7	High Ch, EUT on Side, Ant Horz
2708.983	31.3	-0.9	1.5	54.0	0.4	0.0	Horz	AV	0.0	30.8	54.0	-23.2	Low Ch, EUT on Side, Ant Horz
2781.308	30.5	-0.8	1.5	185.0	0.4	0.0	Vert	AV	0.0	30.1	54.0	-23.9	High Ch, EUT Vert, Ant Horz
3707.975	40.4	4.7	2.7	108.0	0.0	0.0	Vert	PK	0.0	45.1	74.0	-28.9	High Ch, EUT Vert, Ant Horz
3708.283	40.4	4.7	1.5	121.0	0.0	0.0	Horz	PK	0.0	45.1	74.0	-28.9	High Ch, EUT on Side, Ant Horz
3614.425	40.6	4.4	1.5	241.0	0.0	0.0	Vert	PK	0.0	45.0	74.0	-29.0	Low Ch, EUT Vert, Ant Horz
3611.275	40.3	4.4	1.5	19.0	0.0	0.0	Horz	PK	0.0	44.7	74.0	-29.3	Low Ch, EUT on Side, Ant Horz
3658.642	39.9	4.4	1.8	29.0	0.0	0.0	Vert	PK	0.0	44.3	74.0	-29.7	Mid Ch, EUT Vert, Ant Horz
3658.500	39.7	4.4	1.5	171.0	0.0	0.0	Horz	PK	0.0	44.1	74.0	-29.9	Mid Ch, EUT on Side, Ant Horz
2744.200	43.5	-0.8	1.5	287.0	0.0	0.0	Vert	PK	0.0	42.7	74.0	-31.3	Mid Ch, EUT Vert, Ant Horz
2708.442	42.8	-0.9	1.0	306.0	0.0	0.0	Vert	PK	0.0	41.9	74.0	-32.1	Low Ch, EUT Vert, Ant Horz
2745.275	42.6	-0.8	1.5	67.0	0.0	0.0	Horz	PK	0.0	41.8	74.0	-32.2	Mid Ch, EUT on Side, Ant Horz
2709.750	42.6	-0.9	1.5	54.0	0.0	0.0	Horz	PK	0.0	41.7	74.0	-32.3	Low Ch, EUT on Side, Ant Horz
2781.300	42.2	-0.8	1.5	85.0	0.0	0.0	Horz	PK	0.0	41.4	74.0	-32.6	High Ch, EUT on Side, Ant Horz
2779.908	41.5	-0.8	1.5	185.0	0.0	0.0	Vert	PK	0.0	40.7	74.0	-33.3	High Ch, EUT Vert, Ant Horz

CONCLUSION

Pass

Tested By

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

EUT:	Twig V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2024-02-26
Customer:	Nelson Irrigation Corporation	Temperature:	29.9°C
Attendees:	None	Relative Humidity:	26%
Customer Project:	None	Bar. Pressure (PMSL):	1012 mb
Tested By:	Christopher Ladwig and Jeff Alcoke	Job Site:	EV01
Power:	5 VDC	Configuration:	NELS0019-7

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2024	ANSI C63.10:2013
RSS-247 Issue 3:2023	ANSI C63.10:2013

TEST PARAMETERS

Run #:	141	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

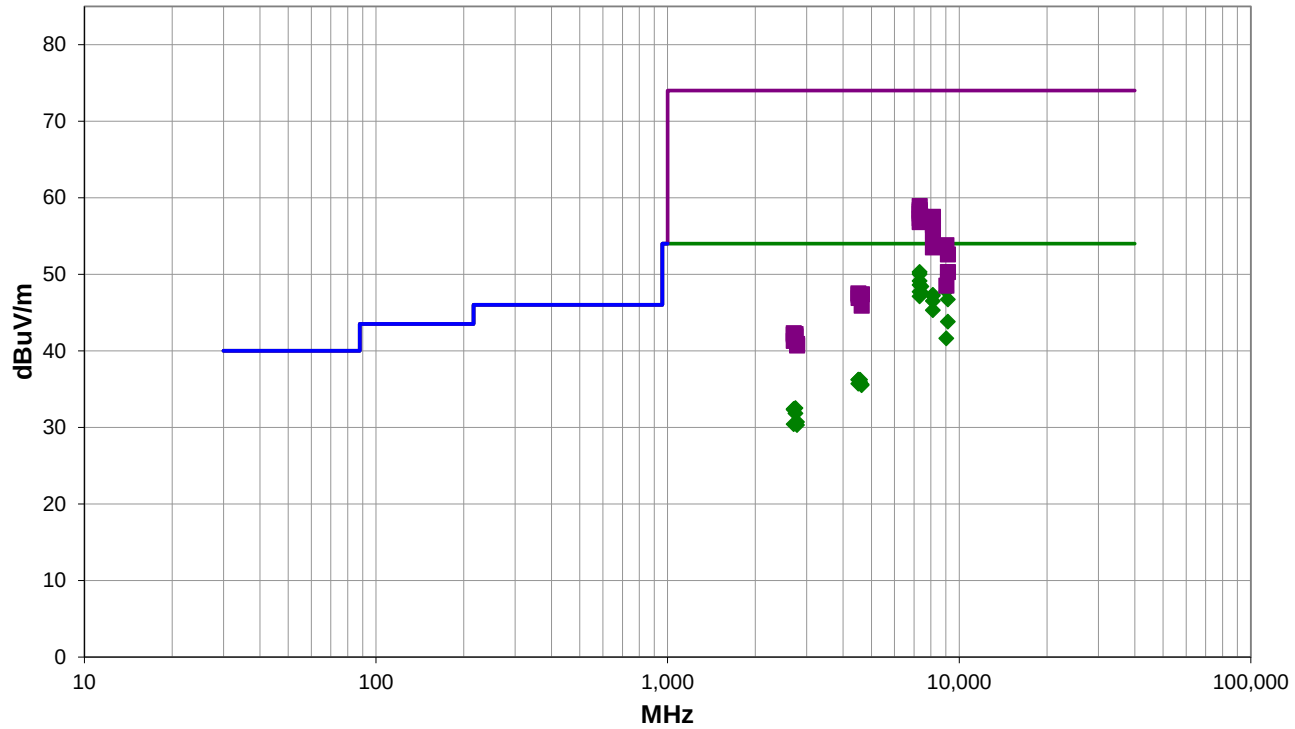
Test mode operates at 90.5% duty cycle. An upward DCCF was applied to the RMS Avg measurements based on 10*log(1/DC) = 10*log(1/0.905) = 0.4 dB. Please reference data comments below for Channel and EUT orientation.

EUT OPERATING MODES

LoRa, 500kHz BW, SF8, Low Ch. = 903 MHz, Mid Ch. = 915 MHz, High Ch. = 927 MHz, Omni Antenna

DEVIATIONS FROM TEST STANDARD

None



Run #: 141 PK AV QP

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #141

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
7321.183	34.5	15.4	1.7	88.0	0.4	0.0	Vert	AV	0.0	50.3	54.0	-3.7	Mid Ch, EUT Vertical
7318.967	34.2	15.4	2.1	41.0	0.4	0.0	Horz	AV	0.0	50.0	54.0	-4.0	Mid Ch, EUT On Side
7319.467	33.3	15.4	1.5	273.0	0.4	0.0	Horz	AV	0.0	49.1	54.0	-4.9	Mid Ch, EUT Vertical
7318.875	32.8	15.4	1.6	131.0	0.4	0.0	Horz	AV	0.0	48.6	54.0	-5.4	Mid Ch, EUT Horz
7416.683	32.5	15.5	1.5	86.0	0.4	0.0	Vert	AV	0.0	48.4	54.0	-5.6	High Ch, EUT Vert
9031.567	50.4	-3.0	1.9	328.0	0.4	0.0	Horz	AV	0.0	47.8	54.0	-6.2	Low Ch, EUT On Side
7319.083	31.9	15.4	1.5	134.0	0.4	0.0	Vert	AV	0.0	47.7	54.0	-6.3	Mid Ch, EUT On Side
7417.092	31.7	15.5	1.5	36.0	0.4	0.0	Horz	AV	0.0	47.6	54.0	-6.4	High Ch, EUT On Side
8126.917	32.5	14.4	1.5	139.0	0.4	0.0	Vert	AV	0.0	47.3	54.0	-6.7	Low Ch, EUT Horz
8125.892	32.4	14.4	1.9	117.0	0.4	0.0	Vert	AV	0.0	47.2	54.0	-6.8	Low Ch, EUT Vert
7320.908	31.3	15.4	1.4	74.0	0.4	0.0	Vert	AV	0.0	47.1	54.0	-6.9	Mid Ch, EUT Horz
9151.500	48.8	-2.5	1.9	338.0	0.4	0.0	Horz	AV	0.0	46.7	54.0	-7.3	Mid Ch, EUT Vert
8126.367	31.7	14.4	1.5	334.0	0.4	0.0	Horz	AV	0.0	46.5	54.0	-7.5	Low Ch, EUT On Side
8125.583	30.5	14.4	2.0	69.0	0.4	0.0	Horz	AV	0.0	45.3	54.0	-8.7	Low Ch, EUT Horz
9151.542	45.9	-2.5	1.5	149.0	0.4	0.0	Vert	AV	0.0	43.8	54.0	-10.2	Mid Ch, EUT Vert
9031.492	44.2	-3.0	1.6	151.0	0.4	0.0	Vert	AV	0.0	41.6	54.0	-12.4	Low Ch, EUT Vert
7321.858	43.5	15.4	1.7	88.0	0.0	0.0	Vert	PK	0.0	58.9	74.0	-15.1	Mid Ch, EUT Vertical
7320.850	43.0	15.4	2.1	41.0	0.0	0.0	Horz	PK	0.0	58.4	74.0	-15.6	Mid Ch, EUT On Side
7321.575	42.8	15.4	1.5	273.0	0.0	0.0	Horz	PK	0.0	58.2	74.0	-15.8	Mid Ch, EUT Vertical
7321.158	42.5	15.4	1.6	131.0	0.0	0.0	Horz	PK	0.0	57.9	74.0	-16.1	Mid Ch, EUT Horz
7415.050	42.0	15.5	1.5	86.0	0.0	0.0	Vert	PK	0.0	57.5	74.0	-16.5	High Ch, EUT Vert
8128.892	43.1	14.4	1.9	117.0	0.0	0.0	Vert	PK	0.0	57.5	74.0	-16.5	Low Ch, EUT Vert
7319.250	41.9	15.4	1.5	134.0	0.0	0.0	Vert	PK	0.0	57.3	74.0	-16.7	Mid Ch, EUT On Side
7416.325	41.7	15.5	1.5	36.0	0.0	0.0	Horz	PK	0.0	57.2	74.0	-16.8	High Ch, EUT On Side
7319.883	41.4	15.4	1.4	74.0	0.0	0.0	Vert	PK	0.0	56.8	74.0	-17.2	Mid Ch, EUT Horz
8126.475	42.0	14.4	1.5	334.0	0.0	0.0	Horz	PK	0.0	56.4	74.0	-17.6	Low Ch, EUT On Side
4575.750	28.7	7.1	1.5	153.0	0.4	0.0	Horz	AV	0.0	36.2	54.0	-17.8	Mid Ch, EUT On Side
4515.208	28.8	7.0	1.7	56.0	0.4	0.0	Vert	AV	0.0	36.2	54.0	-17.8	Low Ch, EUT Vert
4514.867	28.8	7.0	1.5	318.0	0.4	0.0	Horz	AV	0.0	36.2	54.0	-17.8	Low Ch, EUT On Side
4575.767	28.4	7.1	1.0	97.0	0.4	0.0	Vert	AV	0.0	35.9	54.0	-18.1	Mid Ch, EUT Vert
4514.525	28.3	7.0	1.5	13.0	0.4	0.0	Horz	AV	0.0	35.7	54.0	-18.3	Low Ch, EUT On Side
4633.817	27.9	7.3	1.5	168.0	0.4	0.0	Horz	AV	0.0	35.6	54.0	-18.4	High Ch, EUT On Side
8124.667	41.1	14.4	1.5	139.0	0.0	0.0	Vert	PK	0.0	55.5	74.0	-18.5	Low Ch, EUT Horz
4630.583	27.8	7.3	1.0	82.0	0.4	0.0	Vert	AV	0.0	35.5	54.0	-18.5	High Ch, EUT Vert
9032.267	56.8	-3.0	1.9	328.0	0.0	0.0	Horz	PK	0.0	53.8	74.0	-20.2	Low Ch, EUT On Side
8127.083	39.1	14.4	2.0	69.0	0.0	0.0	Horz	PK	0.0	53.5	74.0	-20.5	Low Ch, EUT Horz
9152.308	55.1	-2.5	1.9	338.0	0.0	0.0	Horz	PK	0.0	52.6	74.0	-21.4	Mid Ch, EUT Vert
2744.875	32.9	-0.8	1.0	119.0	0.4	0.0	Vert	AV	0.0	32.5	54.0	-21.5	Mid Ch, EUT Vert
2708.925	32.9	-0.9	2.6	5.0	0.4	0.0	Horz	AV	0.0	32.4	54.0	-21.6	Low Ch, EUT On Side
2708.708	32.8	-0.9	2.7	356.0	0.4	0.0	Horz	AV	0.0	32.3	54.0	-21.7	Low Ch, EUT On Side

SPURIOUS RADIATED EMISSIONS

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Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2744.908	32.2	-0.8	1.5	49.0	0.4	0.0	Horz	AV	0.0	31.8	54.0	-22.2	Mid Ch, EUT On Side
2780.842	31.1	-0.8	1.2	9.0	0.4	0.0	Horz	AV	0.0	30.7	54.0	-23.3	High Ch, EUT On Side
2708.633	30.9	-0.9	1.5	6.0	0.4	0.0	Vert	AV	0.0	30.4	54.0	-23.6	Low Ch, EUT Vert
9149.758	52.8	-2.5	1.5	149.0	0.0	0.0	Vert	PK	0.0	50.3	74.0	-23.7	Mid Ch, EUT Vert
2781.083	30.7	-0.8	1.5	108.0	0.4	0.0	Vert	AV	0.0	30.3	54.0	-23.7	High Ch, EUT Vert
9032.375	51.5	-3.0	1.6	151.0	0.0	0.0	Vert	PK	0.0	48.5	74.0	-25.5	Low Ch, EUT Vert
4512.617	40.5	7.0	1.5	318.0	0.0	0.0	Horz	PK	0.0	47.5	74.0	-26.5	Low Ch, EUT On Side
4636.558	40.1	7.3	1.5	168.0	0.0	0.0	Horz	PK	0.0	47.4	74.0	-26.6	High Ch, EUT On Side
4516.083	40.3	7.0	1.5	13.0	0.0	0.0	Horz	PK	0.0	47.3	74.0	-26.7	Low Ch, EUT On Side
4573.125	40.2	7.1	1.0	97.0	0.0	0.0	Vert	PK	0.0	47.3	74.0	-26.7	Mid Ch, EUT Vert
4574.892	40.0	7.1	1.5	153.0	0.0	0.0	Horz	PK	0.0	47.1	74.0	-26.9	Mid Ch, EUT On Side
4515.017	39.9	7.0	1.7	56.0	0.0	0.0	Vert	PK	0.0	46.9	74.0	-27.1	Low Ch, EUT Vert
4629.708	38.6	7.3	1.0	82.0	0.0	0.0	Vert	PK	0.0	45.9	74.0	-28.1	High Ch, EUT Vert
2709.692	43.2	-0.9	2.6	5.0	0.0	0.0	Horz	PK	0.0	42.3	74.0	-31.7	Low Ch, EUT On Side
2745.008	43.0	-0.8	1.0	119.0	0.0	0.0	Vert	PK	0.0	42.2	74.0	-31.8	Mid Ch, EUT Vert
2708.725	43.0	-0.9	2.7	356.0	0.0	0.0	Horz	PK	0.0	42.1	74.0	-31.9	Low Ch, EUT On Side
2744.800	42.7	-0.8	1.5	49.0	0.0	0.0	Horz	PK	0.0	41.9	74.0	-32.1	Mid Ch, EUT On Side
2707.842	42.2	-0.9	1.5	6.0	0.0	0.0	Vert	PK	0.0	41.3	74.0	-32.7	Low Ch, EUT Vert
2780.492	41.7	-0.8	1.2	9.0	0.0	0.0	Horz	PK	0.0	40.9	74.0	-33.1	High Ch, EUT On Side
2781.833	41.5	-0.8	1.5	108.0	0.0	0.0	Vert	PK	0.0	40.7	74.0	-33.3	High Ch, EUT Vert

CONCLUSION

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EUT:	Twig V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2024-02-26
Customer:	Nelson Irrigation Corporation	Temperature:	29.9°C
Attendees:	None	Relative Humidity:	26%
Customer Project:	None	Bar. Pressure (PMSL):	1012 mb
Tested By:	Christopher Ladwig and Jeff Alcoke	Job Site:	EV01
Power:	5 VDC	Configuration:	NELS0019-7

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2024	ANSI C63.10:2013

TEST PARAMETERS

Run #:	141	Test Distance (m):	3	Ant. Height(s) (m):	1 to 4(m)

COMMENTS

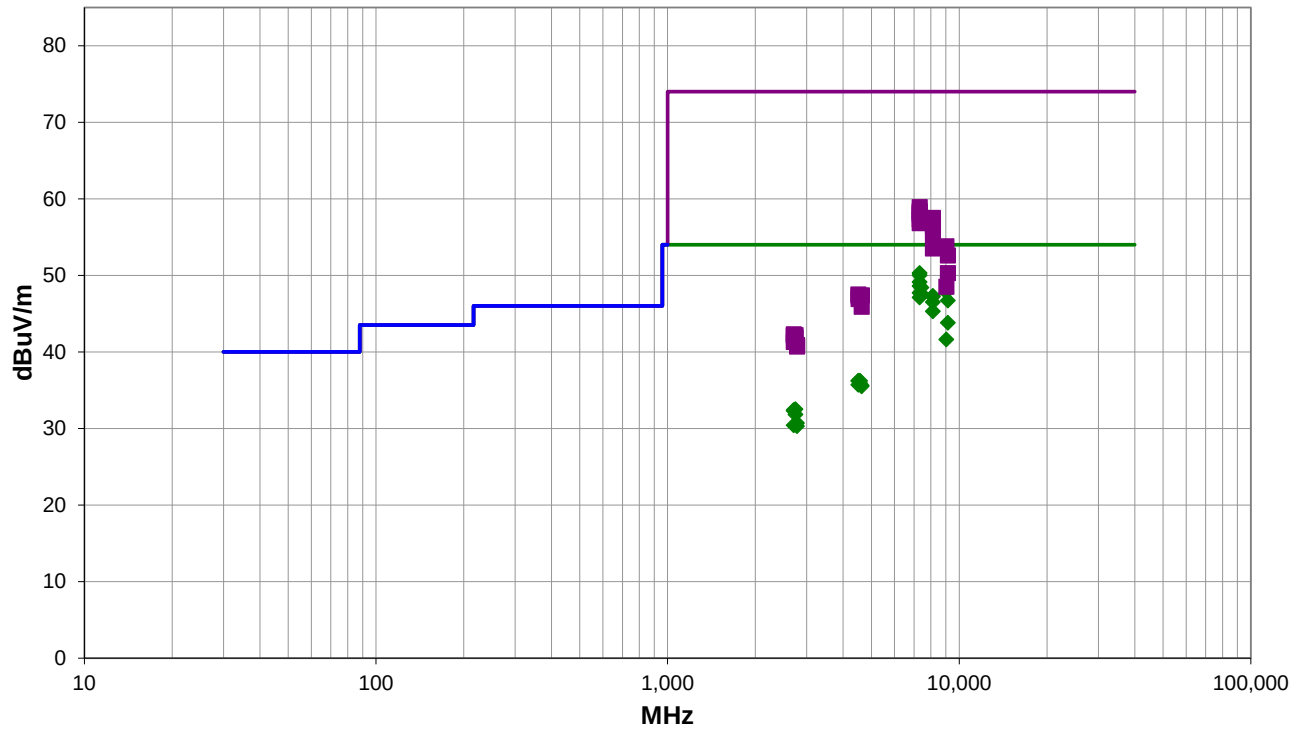
Test mode operates at 90.5% duty cycle. An upward DCCF was applied to the RMS Avg measurements based on 10*log(1/DC) = 10*log(1/0.905) = 0.4 dB. Please reference data comments below for Channel and EUT orientation.

EUT OPERATING MODES

LoRa, 500kHz BW, SF8, Low Ch. = 903 MHz, Mid Ch. = 915 MHz, High Ch. = 927 MHz, Omni Antenna

DEVIATIONS FROM TEST STANDARD

None



Run #: 141 PK AV QP

SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

RESULTS - Run #141

Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
7321.183	34.5	15.4	1.7	88.0	0.4	0.0	Vert	AV	0.0	50.3	54.0	-3.7	Mid Ch, EUT Vertical
7318.967	34.2	15.4	2.1	41.0	0.4	0.0	Horz	AV	0.0	50.0	54.0	-4.0	Mid Ch, EUT On Side
7319.467	33.3	15.4	1.5	273.0	0.4	0.0	Horz	AV	0.0	49.1	54.0	-4.9	Mid Ch, EUT Vertical
7318.875	32.8	15.4	1.6	131.0	0.4	0.0	Horz	AV	0.0	48.6	54.0	-5.4	Mid Ch, EUT Horz
7416.683	32.5	15.5	1.5	86.0	0.4	0.0	Vert	AV	0.0	48.4	54.0	-5.6	High Ch, EUT Vert
9031.567	50.4	-3.0	1.9	328.0	0.4	0.0	Horz	AV	0.0	47.8	54.0	-6.2	Low Ch, EUT On Side
7319.083	31.9	15.4	1.5	134.0	0.4	0.0	Vert	AV	0.0	47.7	54.0	-6.3	Mid Ch, EUT On Side
7417.092	31.7	15.5	1.5	36.0	0.4	0.0	Horz	AV	0.0	47.6	54.0	-6.4	High Ch, EUT On Side
8126.917	32.5	14.4	1.5	139.0	0.4	0.0	Vert	AV	0.0	47.3	54.0	-6.7	Low Ch, EUT Horz
8125.892	32.4	14.4	1.9	117.0	0.4	0.0	Vert	AV	0.0	47.2	54.0	-6.8	Low Ch, EUT Vert
7320.908	31.3	15.4	1.4	74.0	0.4	0.0	Vert	AV	0.0	47.1	54.0	-6.9	Mid Ch, EUT Horz
9151.500	48.8	-2.5	1.9	338.0	0.4	0.0	Horz	AV	0.0	46.7	54.0	-7.3	Mid Ch, EUT Vert
8126.367	31.7	14.4	1.5	334.0	0.4	0.0	Horz	AV	0.0	46.5	54.0	-7.5	Low Ch, EUT On Side
8125.583	30.5	14.4	2.0	69.0	0.4	0.0	Horz	AV	0.0	45.3	54.0	-8.7	Low Ch, EUT Horz
9151.542	45.9	-2.5	1.5	149.0	0.4	0.0	Vert	AV	0.0	43.8	54.0	-10.2	Mid Ch, EUT Vert
9031.492	44.2	-3.0	1.6	151.0	0.4	0.0	Vert	AV	0.0	41.6	54.0	-12.4	Low Ch, EUT Vert
7321.858	43.5	15.4	1.7	88.0	0.0	0.0	Vert	PK	0.0	58.9	74.0	-15.1	Mid Ch, EUT Vertical
7320.850	43.0	15.4	2.1	41.0	0.0	0.0	Horz	PK	0.0	58.4	74.0	-15.6	Mid Ch, EUT On Side
7321.575	42.8	15.4	1.5	273.0	0.0	0.0	Horz	PK	0.0	58.2	74.0	-15.8	Mid Ch, EUT Vertical
7321.158	42.5	15.4	1.6	131.0	0.0	0.0	Horz	PK	0.0	57.9	74.0	-16.1	Mid Ch, EUT Horz
7415.050	42.0	15.5	1.5	86.0	0.0	0.0	Vert	PK	0.0	57.5	74.0	-16.5	High Ch, EUT Vert
8128.892	43.1	14.4	1.9	117.0	0.0	0.0	Vert	PK	0.0	57.5	74.0	-16.5	Low Ch, EUT Vert
7319.250	41.9	15.4	1.5	134.0	0.0	0.0	Vert	PK	0.0	57.3	74.0	-16.7	Mid Ch, EUT On Side
7416.325	41.7	15.5	1.5	36.0	0.0	0.0	Horz	PK	0.0	57.2	74.0	-16.8	High Ch, EUT On Side
7319.883	41.4	15.4	1.4	74.0	0.0	0.0	Vert	PK	0.0	56.8	74.0	-17.2	Mid Ch, EUT Horz
8126.475	42.0	14.4	1.5	334.0	0.0	0.0	Horz	PK	0.0	56.4	74.0	-17.6	Low Ch, EUT On Side
4575.750	28.7	7.1	1.5	153.0	0.4	0.0	Horz	AV	0.0	36.2	54.0	-17.8	Mid Ch, EUT On Side
4515.208	28.8	7.0	1.7	56.0	0.4	0.0	Vert	AV	0.0	36.2	54.0	-17.8	Low Ch, EUT Vert
4514.867	28.8	7.0	1.5	318.0	0.4	0.0	Horz	AV	0.0	36.2	54.0	-17.8	Low Ch, EUT On Side
4575.767	28.4	7.1	1.0	97.0	0.4	0.0	Vert	AV	0.0	35.9	54.0	-18.1	Mid Ch, EUT Vert
4514.525	28.3	7.0	1.5	13.0	0.4	0.0	Horz	AV	0.0	35.7	54.0	-18.3	Low Ch, EUT On Side
4633.817	27.9	7.3	1.5	168.0	0.4	0.0	Horz	AV	0.0	35.6	54.0	-18.4	High Ch, EUT On Side
8124.667	41.1	14.4	1.5	139.0	0.0	0.0	Vert	PK	0.0	55.5	74.0	-18.5	Low Ch, EUT Horz
4630.583	27.8	7.3	1.0	82.0	0.4	0.0	Vert	AV	0.0	35.5	54.0	-18.5	High Ch, EUT Vert
9032.267	56.8	-3.0	1.9	328.0	0.0	0.0	Horz	PK	0.0	53.8	74.0	-20.2	Low Ch, EUT On Side
8127.083	39.1	14.4	2.0	69.0	0.0	0.0	Horz	PK	0.0	53.5	74.0	-20.5	Low Ch, EUT Horz
9152.308	55.1	-2.5	1.9	338.0	0.0	0.0	Horz	PK	0.0	52.6	74.0	-21.4	Mid Ch, EUT Vert
2744.875	32.9	-0.8	1.0	119.0	0.4	0.0	Vert	AV	0.0	32.5	54.0	-21.5	Mid Ch, EUT Vert
2708.925	32.9	-0.9	2.6	5.0	0.4	0.0	Horz	AV	0.0	32.4	54.0	-21.6	Low Ch, EUT On Side
2708.708	32.8	-0.9	2.7	356.0	0.4	0.0	Horz	AV	0.0	32.3	54.0	-21.7	Low Ch, EUT On Side

SPURIOUS RADIATED EMISSIONS

element
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EmiR5 2023.08.29.0
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Freq (MHz)	Amplitude (dBuV)	Factor (dB/m)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2744.908	32.2	-0.8	1.5	49.0	0.4	0.0	Horz	AV	0.0	31.8	54.0	-22.2	Mid Ch, EUT On Side
2780.842	31.1	-0.8	1.2	9.0	0.4	0.0	Horz	AV	0.0	30.7	54.0	-23.3	High Ch, EUT On Side
2708.633	30.9	-0.9	1.5	6.0	0.4	0.0	Vert	AV	0.0	30.4	54.0	-23.6	Low Ch, EUT Vert
9149.758	52.8	-2.5	1.5	149.0	0.0	0.0	Vert	PK	0.0	50.3	74.0	-23.7	Mid Ch, EUT Vert
2781.083	30.7	-0.8	1.5	108.0	0.4	0.0	Vert	AV	0.0	30.3	54.0	-23.7	High Ch, EUT Vert
9032.375	51.5	-3.0	1.6	151.0	0.0	0.0	Vert	PK	0.0	48.5	74.0	-25.5	Low Ch, EUT Vert
4512.617	40.5	7.0	1.5	318.0	0.0	0.0	Horz	PK	0.0	47.5	74.0	-26.5	Low Ch, EUT On Side
4636.558	40.1	7.3	1.5	168.0	0.0	0.0	Horz	PK	0.0	47.4	74.0	-26.6	High Ch, EUT On Side
4516.083	40.3	7.0	1.5	13.0	0.0	0.0	Horz	PK	0.0	47.3	74.0	-26.7	Low Ch, EUT On Side
4573.125	40.2	7.1	1.0	97.0	0.0	0.0	Vert	PK	0.0	47.3	74.0	-26.7	Mid Ch, EUT Vert
4574.892	40.0	7.1	1.5	153.0	0.0	0.0	Horz	PK	0.0	47.1	74.0	-26.9	Mid Ch, EUT On Side
4515.017	39.9	7.0	1.7	56.0	0.0	0.0	Vert	PK	0.0	46.9	74.0	-27.1	Low Ch, EUT Vert
4629.708	38.6	7.3	1.0	82.0	0.0	0.0	Vert	PK	0.0	45.9	74.0	-28.1	High Ch, EUT Vert
2709.692	43.2	-0.9	2.6	5.0	0.0	0.0	Horz	PK	0.0	42.3	74.0	-31.7	Low Ch, EUT On Side
2745.008	43.0	-0.8	1.0	119.0	0.0	0.0	Vert	PK	0.0	42.2	74.0	-31.8	Mid Ch, EUT Vert
2708.725	43.0	-0.9	2.7	356.0	0.0	0.0	Horz	PK	0.0	42.1	74.0	-31.9	Low Ch, EUT On Side
2744.800	42.7	-0.8	1.5	49.0	0.0	0.0	Horz	PK	0.0	41.9	74.0	-32.1	Mid Ch, EUT On Side
2707.842	42.2	-0.9	1.5	6.0	0.0	0.0	Vert	PK	0.0	41.3	74.0	-32.7	Low Ch, EUT Vert
2780.492	41.7	-0.8	1.2	9.0	0.0	0.0	Horz	PK	0.0	40.9	74.0	-33.1	High Ch, EUT On Side
2781.833	41.5	-0.8	1.5	108.0	0.0	0.0	Vert	PK	0.0	40.7	74.0	-33.3	High Ch, EUT Vert

CONCLUSION

Pass

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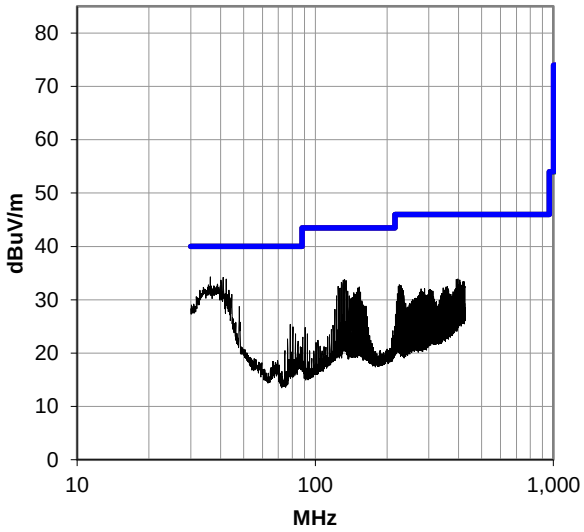
PSA-ESCI 2023.04.25.0

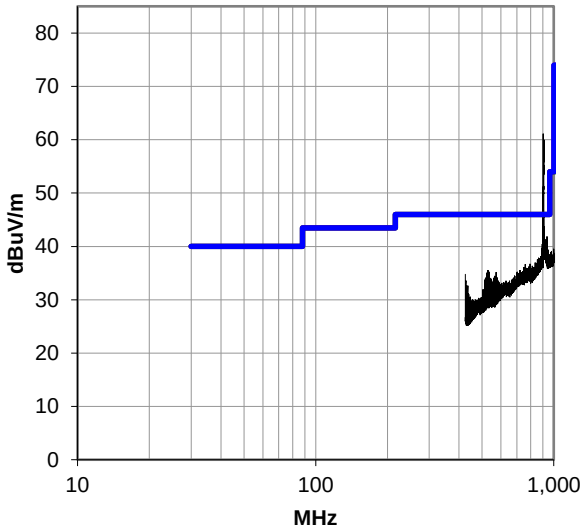
PRESCAN DATA

Radiated spurious emissions from the EUT are initially reviewed with Pre-scans (Preview scans). Pre-scans are performed, with the EUT transmitting on the lowest applicable data rate, for both vertical and horizontal polarizations. The Pre-scan plots below are shown with a peak detector and RBW for the following frequency ranges: 9 kHz RBW (< 30 MHz); 120 kHz RBW (30 - 1000 MHz); 1 MHz RBW (> 1 GHz). In the case where unintentional emissions are observed, an ambient or idle pre-scan with the radio off, will be shown for comparison.

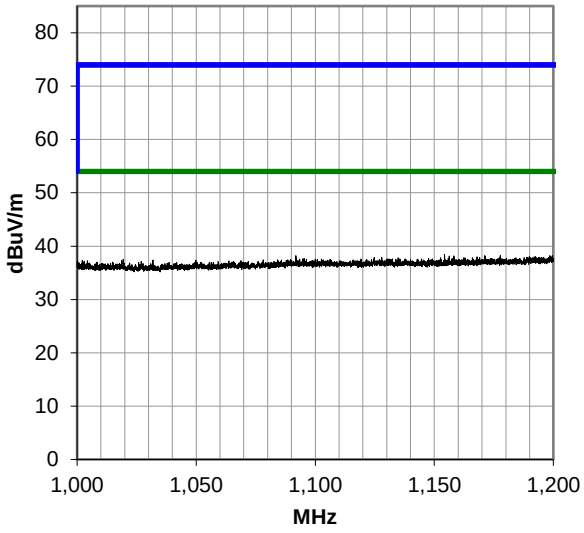
Internal Antenna, Low Ch: 30-425 MHz, Run 149



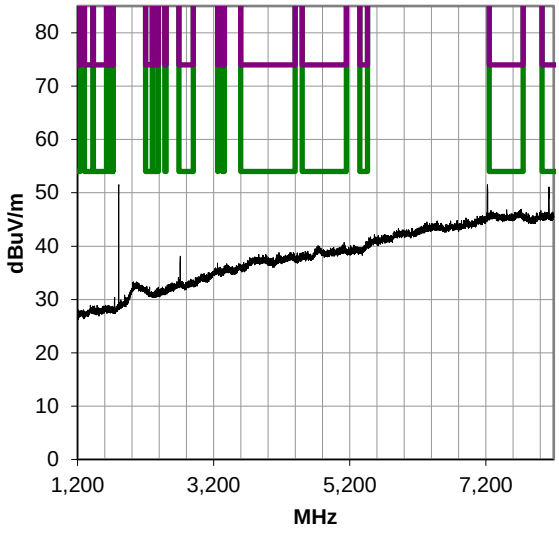
Internal Antenna, Low Ch: 425-1000 MHz, Run 154



Internal Antenna, Low Ch: 1000-1200 MHz, Run 120



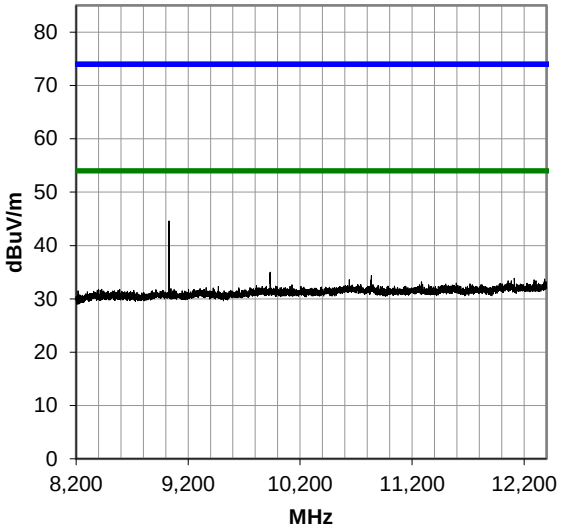
Internal Antenna, Low Ch: 1200-8200 MHz, Run 113



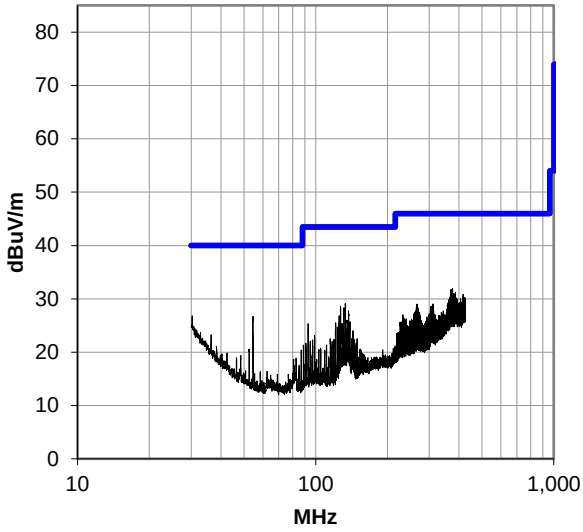
SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

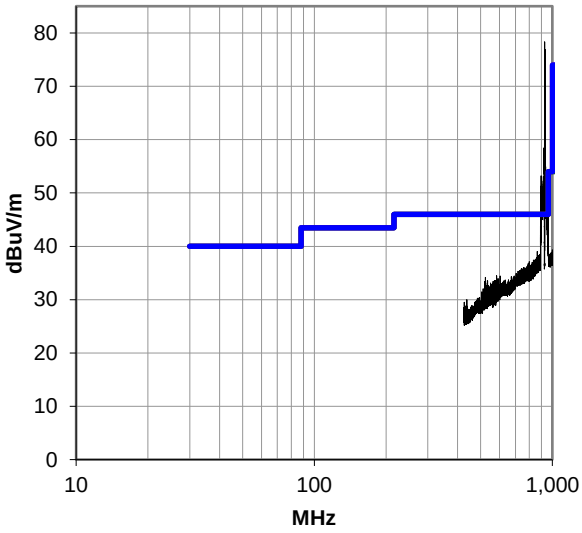
Internal Antenna, Low Ch: 8200-12400 MHz, Run 114



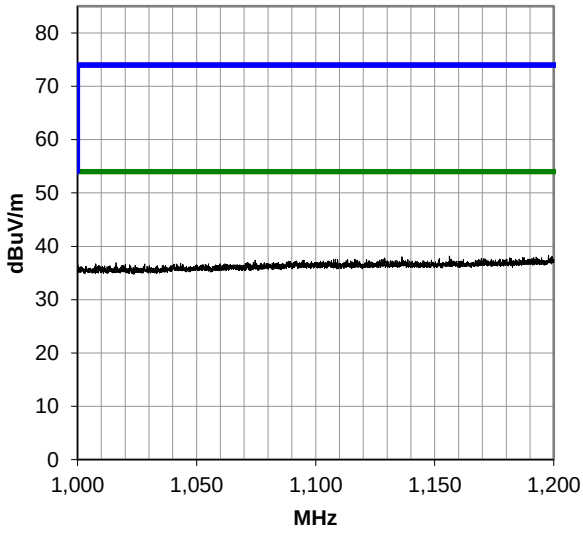
Yagi, High Ch: 30-425 MHz, Run 158



Yagi, High Ch: 425-1000 MHz, Run 157



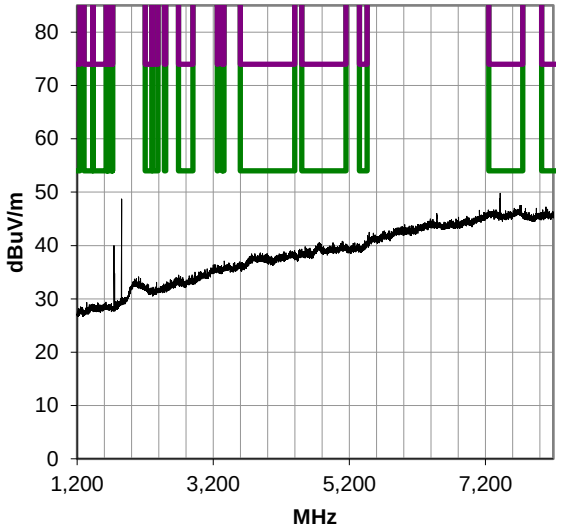
Yagi, High Ch: 1000-1200 MHz, Run 123



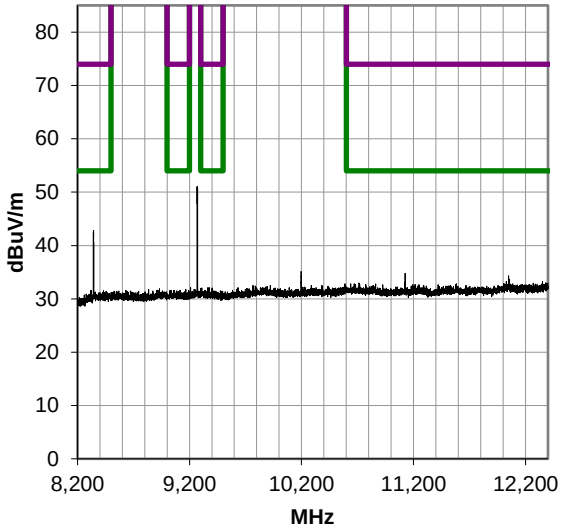
SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

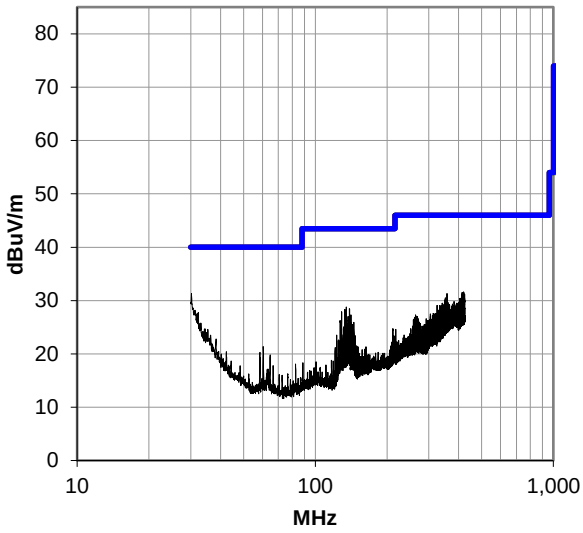
Yagi, High Ch: 1200-8200 MHz, Run 130



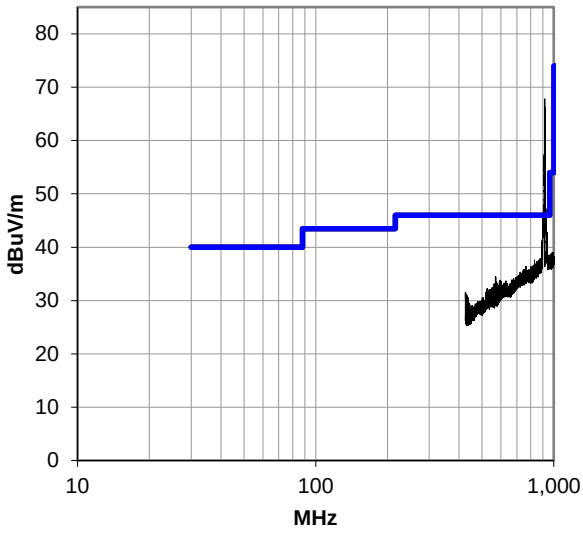
Yagi, High Ch: 8200-12400 MHz, Run 131



Omni, Mid Ch: 30-425 MHz, Run 162



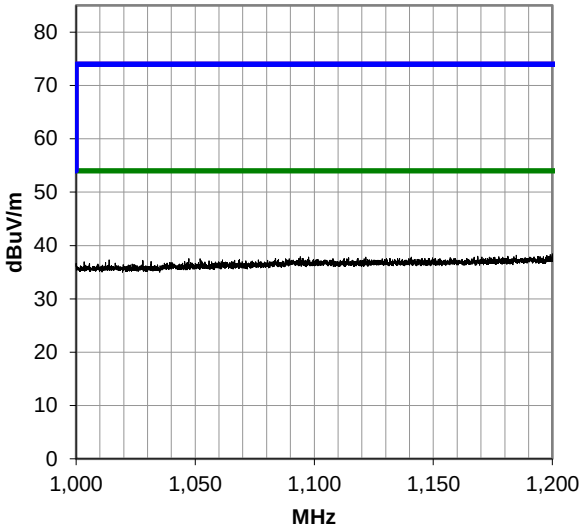
Omni, Mid Ch: 425-1000 MHz, Run 165



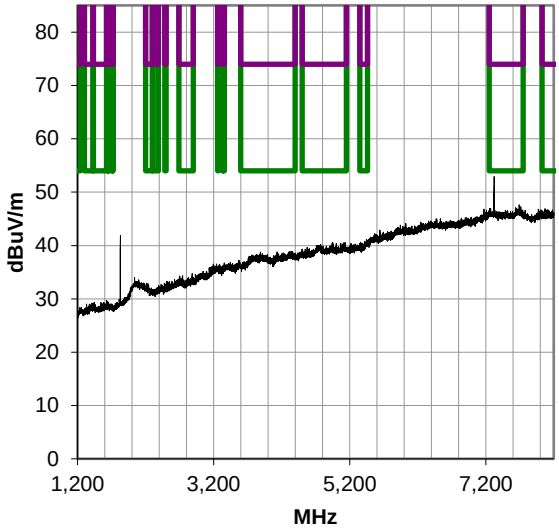
SPURIOUS RADIATED EMISSIONS

element
WTD.2023.11.13.0
EmiR5 2023.08.29.0
PSA-ESCI 2023.04.25.0

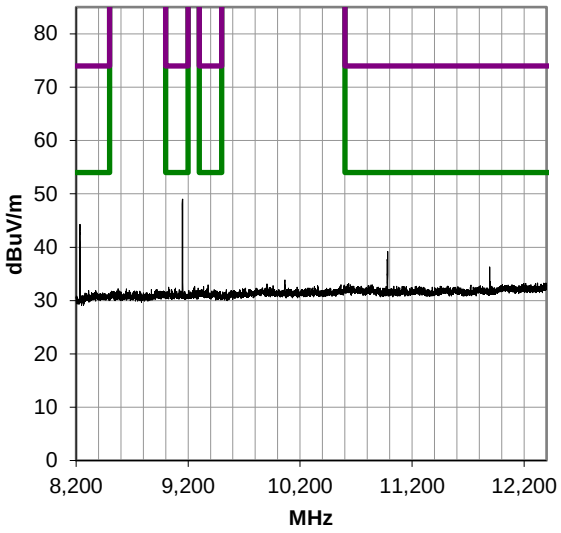
Omni, Mid Ch: 1000-1200 MHz, Run 134



Omni, Mid Ch: 1200-8200 MHz, Run 138



Omni, Mid Ch: 8200-12400 MHz, Run 139



DUTY CYCLE

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

TEST DESCRIPTION

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer.

The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

There is no compliance requirement to be met by this test, so therefore no Pass / Fail criteria.

The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum.

The duty cycle was calculated by dividing the transmission pulse duration (T) by the total period of a single on and total off time.

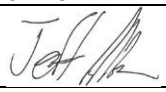
If the transmit duty cycle < 98 percent, burst gating may have been used during some of the other tests in this report to only take the measurement during the burst duration.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2023-11-29	2024-11-29
Block - DC	Fairview Microwave	SD3379	AMW	2023-03-13	2024-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2023-03-13	2024-03-13
Attenuator	Fairview Microwave	SA26B-10	TWG	2023-03-13	2024-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2023-11-22	2024-11-22
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

DUTY CYCLE

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

EUT:	TWIG V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2023-12-15
Customer:	Nelson Irrigation Corporation	Temperature:	23°C
Attendees:	None	Relative Humidity:	33%
Customer Project:	None	Bar. Pressure (PMSL):	1001 mbar
Tested By:	Jeff Alcoke	Job Site:	EV06
Power:	5VDC	Configuration:	NELS0019-1
Signature:			

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

COMMENTS

Internal Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable and RF patch cable.
External Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable

DEVIATIONS FROM TEST STANDARD

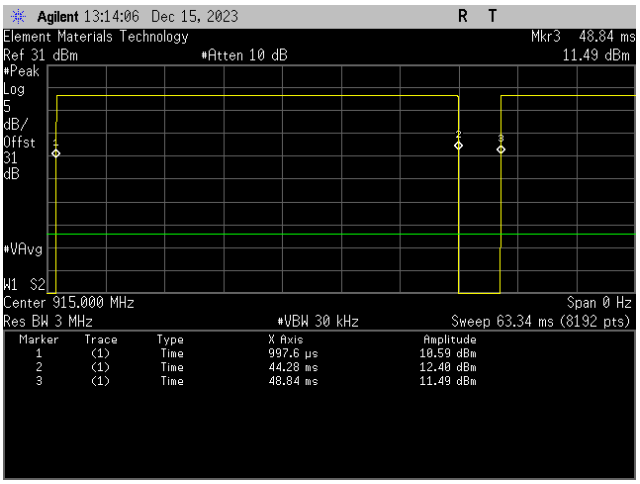
None

TEST RESULTS

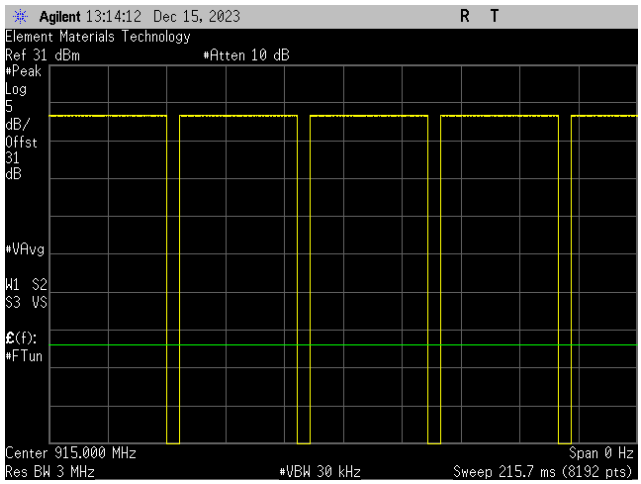
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8						
Internal Antenna Port						
Low Ch. = 903 MHz	43.291 ms	47.862 ms	1	90.5	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
Mid Ch. = 915 MHz	43.284 ms	47.838 ms	1	90.5	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
High Ch = 927 MHz	43.284 ms	47.838 ms	1	90.5	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
External Antenna Port						
Low Ch. = 903 MHz	43.284 ms	47.862 ms	1	90.4	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
Mid Ch. = 915 MHz	43.291 ms	47.854 ms	1	90.5	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A
High Ch = 927 MHz	43.291 ms	47.846 ms	1	90.5	N/A	N/A
	N/A	N/A	5	N/A	N/A	N/A

DUTY CYCLE

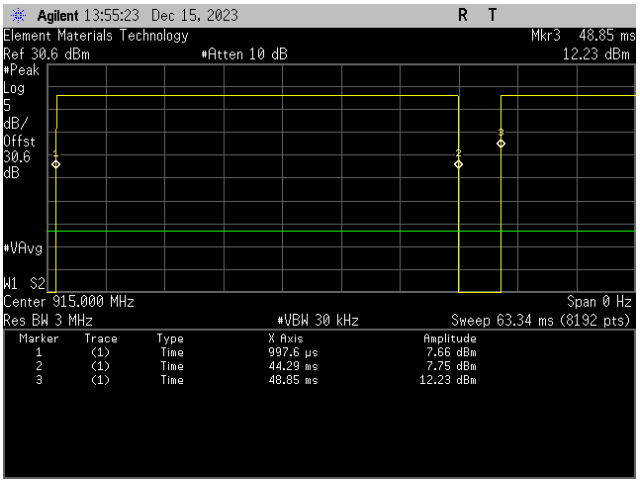
element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



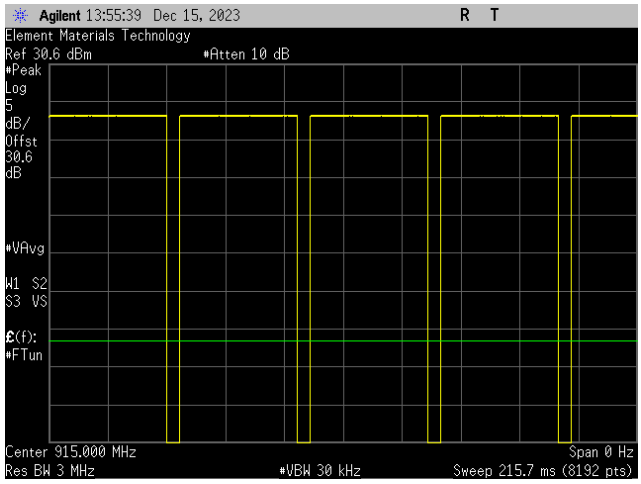
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Mid Ch. = 915 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Mid Ch. = 915 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Mid Ch. = 915 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Mid Ch. = 915 MHz

OUTPUT POWER

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

TEST DESCRIPTION

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer.

The fundamental emission output power (maximum average conducted output power) was measured using the channels and modes as called out on the following data sheets. The transmit power was set to its default maximum.

Prior to measuring output power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. Both are required to determine the method of measuring Maximum Conducted Output Power. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The method AVGSA-2 in section 11.9.2.2.4 of ANSI C63.10:2013 was used to make the measurement. This method uses trace averaging across ON and OFF times of the EUT transmissions in the spectrum analyzer channel power function using an RMS detector. Following the measurement a duty cycle correction was applied by adding [10 log (1 / D)], where D is the duty cycle, to the measured power to compute the average power during the actual transmission times.

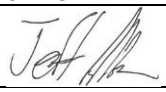
The AVGSA-2 method was modified as the available resolution bandwidth (RBw) on the spectrum analyzer could be set wider than the measured emissions bandwidth (B). RBw was set wider than B. This follows the guidance of section 11.9.1.1 and is equivalent to a measurement with a power meter AVGPM per section 11.9.2.3.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2023-11-29	2024-11-29
Block - DC	Fairview Microwave	SD3379	AMW	2023-03-13	2024-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2023-03-13	2024-03-13
Attenuator	Fairview Microwave	SA26B-10	TWG	2023-03-13	2024-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2023-11-22	2024-11-22
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

OUTPUT POWER

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

EUT:	TWIG V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2023-12-15
Customer:	Nelson Irrigation Corporation	Temperature:	23°C
Attendees:	None	Relative Humidity:	33%
Customer Project:	None	Bar. Pressure (PMSL):	1001 mbar
Tested By:	Jeff Alcoke	Job Site:	EV06
Power:	5VDC	Configuration:	NELS0019-1
Signature:			

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 3:2023	ANSI C63.10:2013

COMMENTS

Internal Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable and RF patch cable.
External Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable

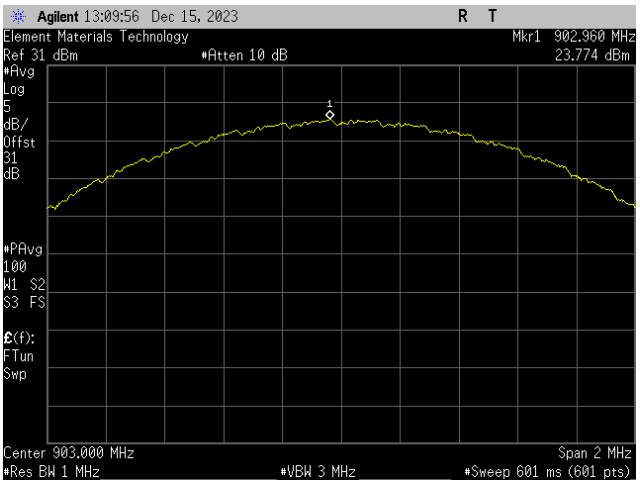
DEVIATIONS FROM TEST STANDARD

None

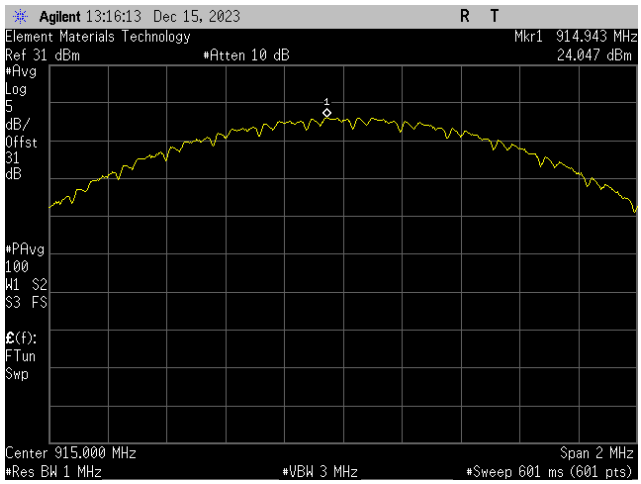
TEST RESULTS

	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Limit (dBm)	Result
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8					
Internal Antenna Port					
Low Ch. = 903 MHz	23.774	0.4	24.2	30	Pass
Mid Ch. = 915 MHz	24.047	0.4	24.4	30	Pass
High Ch = 927 MHz	24.06	0.4	24.5	30	Pass
External Antenna Port					
Low Ch. = 903 MHz	23.211	0.4	23.6	30	Pass
Mid Ch. = 915 MHz	23.521	0.4	23.9	30	Pass
High Ch = 927 MHz	23.582	0.4	24	30	Pass

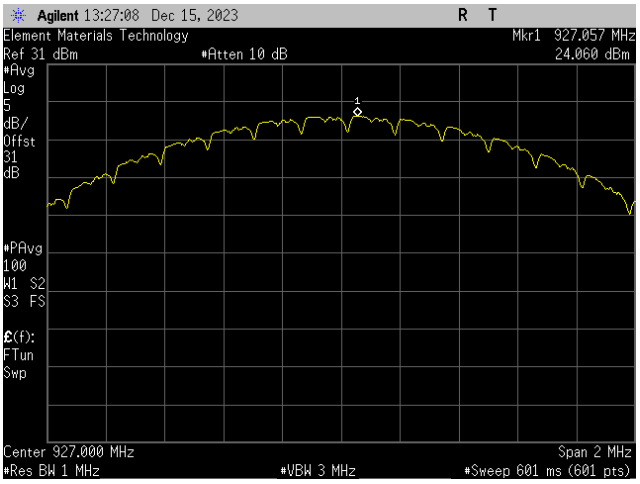
OUTPUT POWER



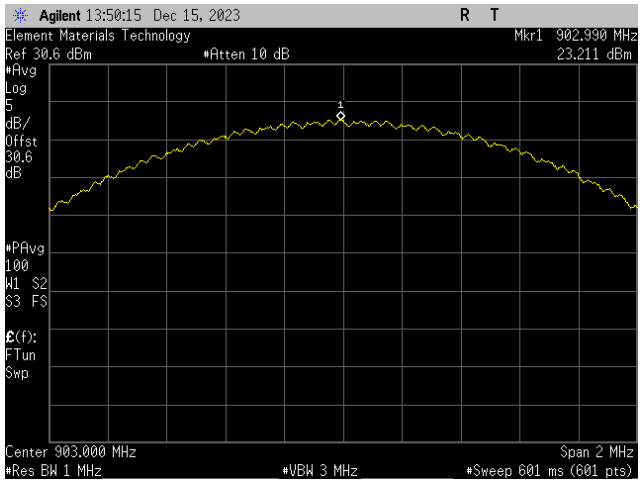
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Low Ch. = 903 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Mid Ch. = 915 MHz



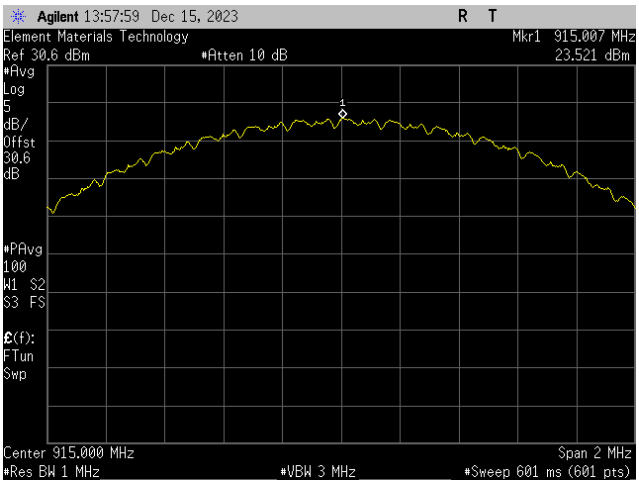
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
High Ch = 927 MHz



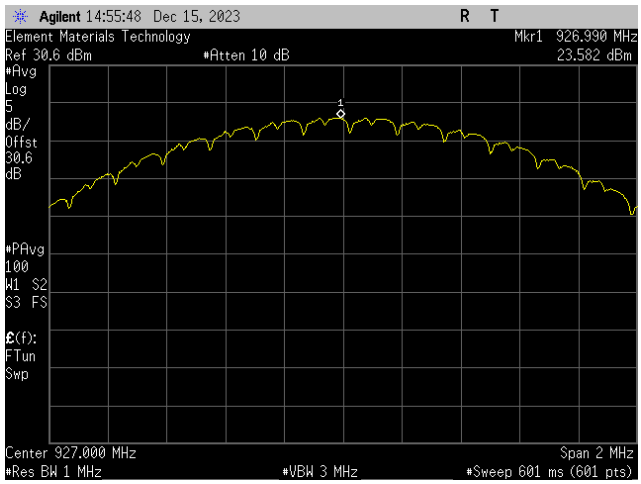
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Low Ch. = 903 MHz

OUTPUT POWER

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Mid Ch. = 915 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
High Ch = 927 MHz

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

TEST DESCRIPTION

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer.

The fundamental emission output power (maximum average conducted output power) was measured using the channels and modes as called out on the following data sheets. The transmit power was set to its default maximum.

Prior to measuring output power; the emission bandwidth (B) and the transmission pulse duration (T) were measured. Both are required to determine the method of measuring Maximum Conducted Output Power. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The method AVGSA-2 in section 11.9.2.2.4 of ANSI C63.10:2013 was used to make the measurement. This method uses trace averaging across ON and OFF times of the EUT transmissions in the spectrum analyzer channel power function using an RMS detector. Following the measurement a duty cycle correction was applied by adding [10 log (1 / D)], where D is the duty cycle, to the measured power to compute the average power during the actual transmission times.

The AVGSA-2 method was modified as the available resolution bandwidth (RBw) on the spectrum analyzer could be set wider than the measured emissions bandwidth (B). RBw was set wider than B. This follows the guidance of section 11.9.1.1 and is equivalent to a measurement with a power meter AVGPM per section 11.9.2.3.

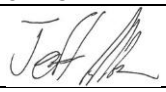
Equivalent Isotropic Radiated Power (EIRP) = Max Measured Power + Antenna gain (dBi)

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2023-11-29	2024-11-29
Block - DC	Fairview Microwave	SD3379	AMW	2023-03-13	2024-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2023-03-13	2024-03-13
Attenuator	Fairview Microwave	SA26B-10	TWG	2023-03-13	2024-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2023-11-22	2024-11-22
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

EUT:	TWIG V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2023-12-15
Customer:	Nelson Irrigation Corporation	Temperature:	23°C
Attendees:	None	Relative Humidity:	33%
Customer Project:	None	Bar. Pressure (PMSL):	1001 mbar
Tested By:	Jeff Alcoke	Job Site:	EV06
Power:	5VDC	Configuration:	NELS0019-1
Signature:			

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 3:2023	ANSI C63.10:2013

COMMENTS

Internal Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable and RF patch cable.
External Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable.

The external antenna port has an additional 4 ft. of coax cable between the measurement location in this report and connection to the external antenna. An additional 0.4 dB is subtracted from the final value to derive the EIRP.

Avg Cond Pwr + Duty Cycle Factor – Cable Loss to external antenna + Ant. Gain = EIRP

DEVIATIONS FROM TEST STANDARD

None

TEST RESULTS

	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Out Pwr (dBm)	Cable loss to Ext. Ant (dB)	Ant. Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8								
Internal Antenna Port								
Low Ch. = 903 MHz	23.774	0.4	24.2	N/A	-3.4	20.8	36	Pass
Mid Ch. = 915 MHz	24.047	0.4	24.4	N/A	-3.4	21	36	Pass
High Ch = 927 MHz	24.06	0.4	24.5	N/A	-3.4	21.1	36	Pass
External Antenna Port								
Low Ch. = 903 MHz	23.211	0.4	23.6	0.4	12	35.2	36	Pass
Mid Ch. = 915 MHz	23.521	0.4	23.9	0.4	12	35.5	36	Pass
High Ch = 927 MHz	23.582	0.4	24	0.4	12	35.6	36	Pass

BAND EDGE COMPLIANCE

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

TEST DESCRIPTION

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer.

The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in each available band. The channels closest to the band edges were selected. The EUT was transmitting at the data rate(s) listed in the datasheet.

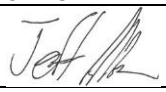
The spectrum was scanned below the lower band edge and above the higher band edge. The analyzer screen captures for this test show an example of the emission mask for the test mode also used during the radiated spurious emissions at the restricted band edges test.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2023-11-29	2024-11-29
Block - DC	Fairview Microwave	SD3379	AMW	2023-03-13	2024-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2023-03-13	2024-03-13
Attenuator	Fairview Microwave	SA26B-10	TWG	2023-03-13	2024-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2023-11-22	2024-11-22
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

BAND EDGE COMPLIANCE

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

EUT:	TWIG V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2023-12-15
Customer:	Nelson Irrigation Corporation	Temperature:	23°C
Attendees:	None	Relative Humidity:	33%
Customer Project:	None	Bar. Pressure (PMSL):	1001 mbar
Tested By:	Jeff Alcoke	Job Site:	EV06
Power:	5VDC	Configuration:	NELS0019-1
Signature:			

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 3:2023	ANSI C63.10:2013

COMMENTS

Internal Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable and RF patch cable.
External Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable

DEVIATIONS FROM TEST STANDARD

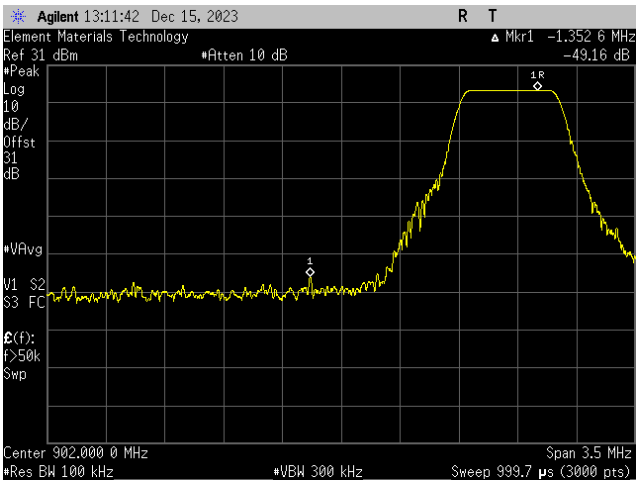
None

TEST RESULTS

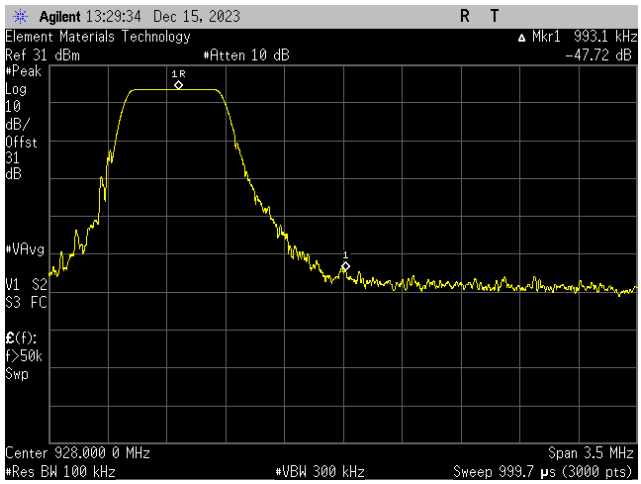
	Value (dBc)	Limit ≤ (dBc)	Result
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8			
Internal Antenna Port			
Low Ch. = 903 MHz	-49.16	-30	Pass
High Ch = 927 MHz	-47.72	-30	Pass
External Antenna Port			
Low Ch. = 903 MHz	-50.25	-30	Pass
High Ch = 927 MHz	-48.18	-30	Pass

BAND EDGE COMPLIANCE

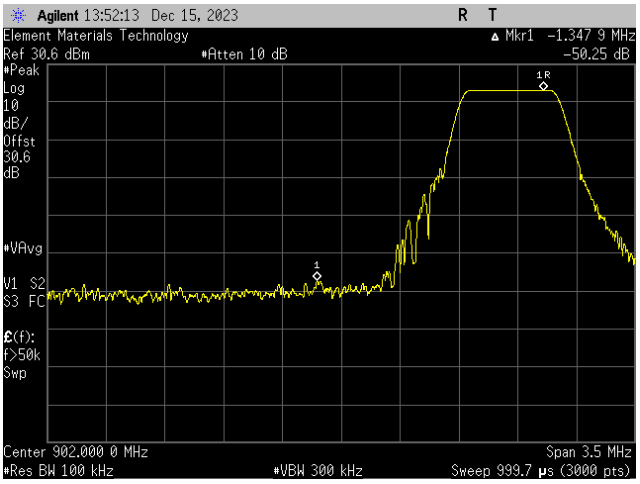
element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



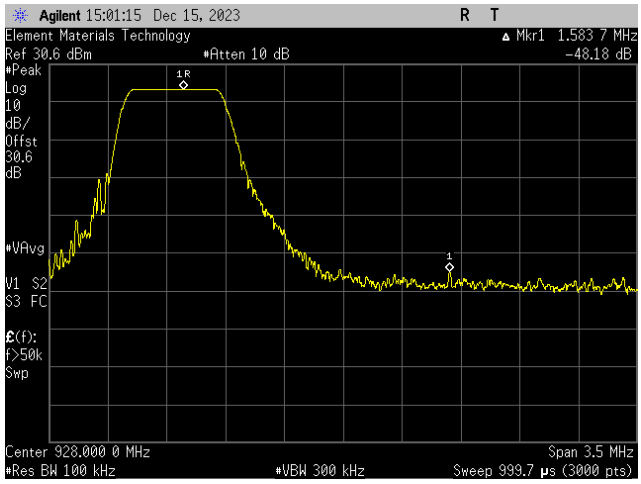
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Low Ch. = 903 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
High Ch = 927 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Low Ch. = 903 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
High Ch = 927 MHz

DTS BANDWIDTH (6 dB)

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

TEST DESCRIPTION

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer.

The EUT was set to the channels and modes listed in the datasheet.

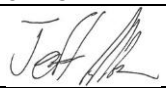
The 6dB DTS bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2023-11-29	2024-11-29
Block - DC	Fairview Microwave	SD3379	AMW	2023-03-13	2024-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2023-03-13	2024-03-13
Attenuator	Fairview Microwave	SA26B-10	TWG	2023-03-13	2024-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2023-11-22	2024-11-22
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

DTS BANDWIDTH (6 dB)

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

EUT:	TWIG V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2023-12-15
Customer:	Nelson Irrigation Corporation	Temperature:	23°C
Attendees:	None	Relative Humidity:	33%
Customer Project:	None	Bar. Pressure (PMSL):	1001 mbar
Tested By:	Jeff Alcoke	Job Site:	EV06
Power:	5VDC	Configuration:	NELS0019-1
Signature:			

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 3:2023	ANSI C63.10:2013

COMMENTS

Internal Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable and RF patch cable.
External Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable

DEVIATIONS FROM TEST STANDARD

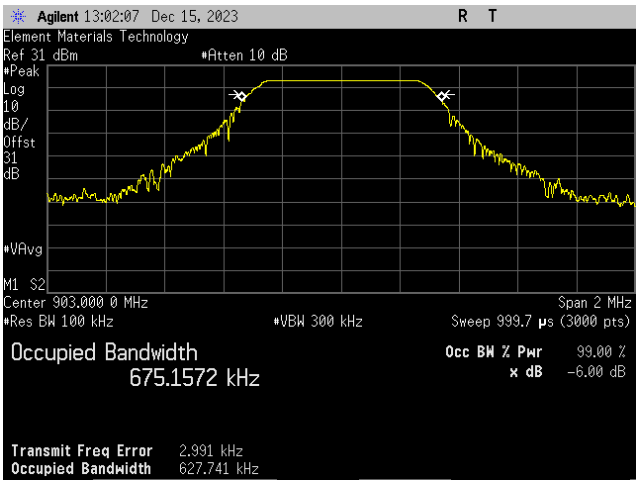
None

TEST RESULTS

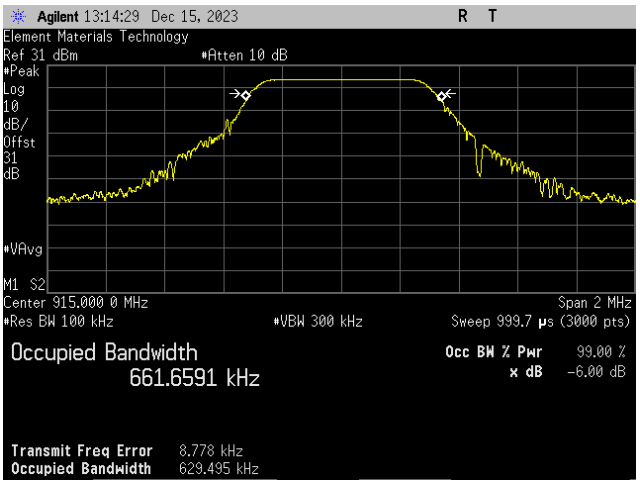
	Value	Limit (>)	Result
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8			
Internal Antenna Port			
Low Ch. = 903 MHz	627.741 kHz	500 kHz	Pass
Mid Ch. = 915 MHz	629.495 kHz	500 kHz	Pass
High Ch = 927 MHz	627.691 kHz	500 kHz	Pass
External Antenna Port			
Low Ch. = 903 MHz	630.272 kHz	500 kHz	Pass
Mid Ch. = 915 MHz	629.766 kHz	500 kHz	Pass
High Ch = 927 MHz	624.893 kHz	500 kHz	Pass

DTS BANDWIDTH (6 dB)

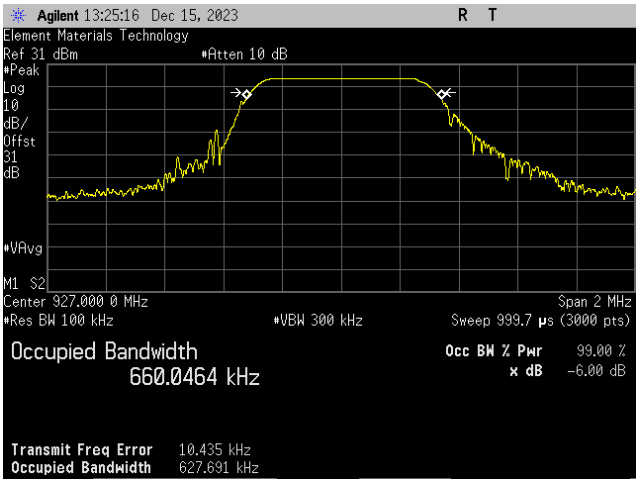
element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



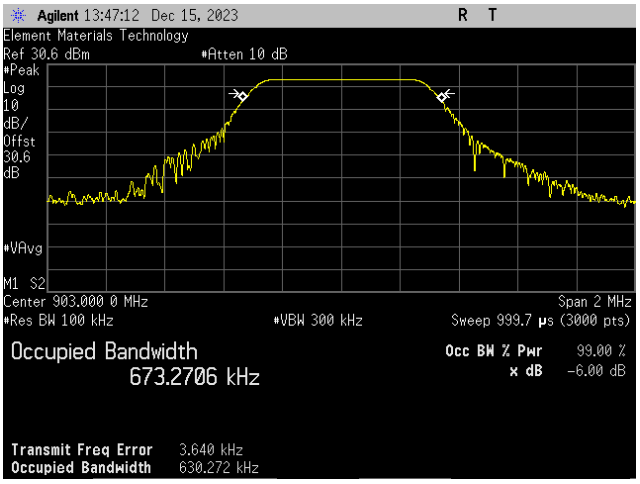
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Low Ch. = 903 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Mid Ch. = 915 MHz



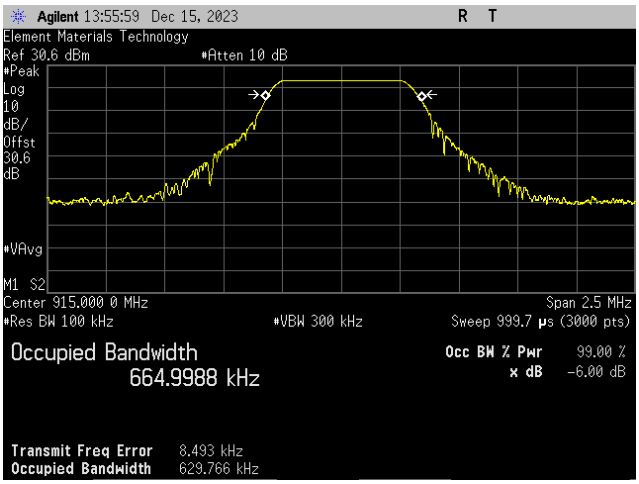
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
High Ch = 927 MHz



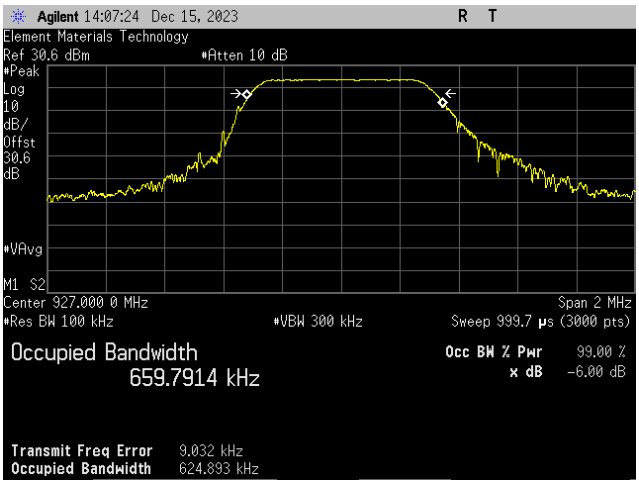
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Low Ch. = 903 MHz

DTS BANDWIDTH (6 dB)

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Mid Ch. = 915 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
High Ch = 927 MHz

OCCUPIED BANDWIDTH (99%)

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

TEST DESCRIPTION

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer.

The 99% occupied bandwidth was measured with the EUT configured for continuous modulated operation.

Per ANSI C63.10:2013, 6.9.3, the spectrum analyzer was configured as follows:

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) of the spectrum analyzer was set to the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) bandwidth was set to at least 3 times the resolution bandwidth. The analyzer sweep time was set to auto to prevent video filtering or averaging. A sample detector was used unless the device was not able to be operated in a continuous transmit mode, in which case a peak detector was used.

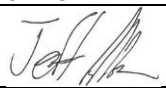
The spectrum analyzer occupied bandwidth measurement function was used to sum the power of the transmission in linear terms to obtain the 99% bandwidth.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2023-11-29	2024-11-29
Block - DC	Fairview Microwave	SD3379	AMW	2023-03-13	2024-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2023-03-13	2024-03-13
Attenuator	Fairview Microwave	SA26B-10	TWG	2023-03-13	2024-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2023-11-22	2024-11-22
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

OCCUPIED BANDWIDTH (99%)

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

EUT:	TWIG V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2023-12-15
Customer:	Nelson Irrigation Corporation	Temperature:	23°C
Attendees:	None	Relative Humidity:	22%
Customer Project:	None	Bar. Pressure (PMSL):	1001 mbar
Tested By:	Jeff Alcoke	Job Site:	EV06
Power:	5VDC	Configuration:	NELS0019-1
Signature:			

TEST SPECIFICATIONS

Specification:	Method:
RSS-Gen Issue 5:2018+A1:2019+A2:2021	ANSI C63.10:2013

COMMENTS

Internal Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable and RF patch cable.
External Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable

DEVIATIONS FROM TEST STANDARD

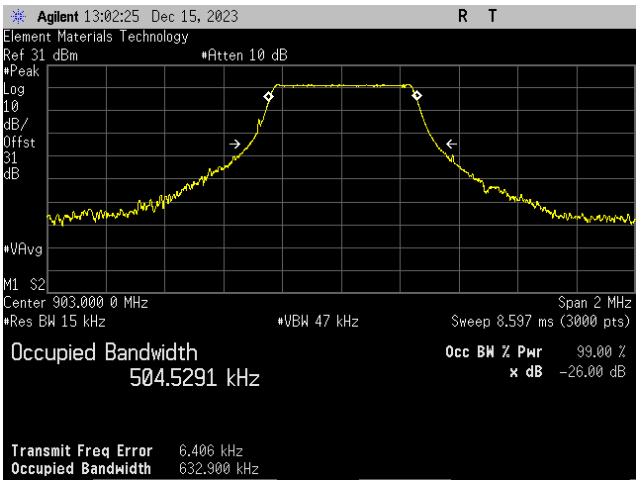
None

TEST RESULTS

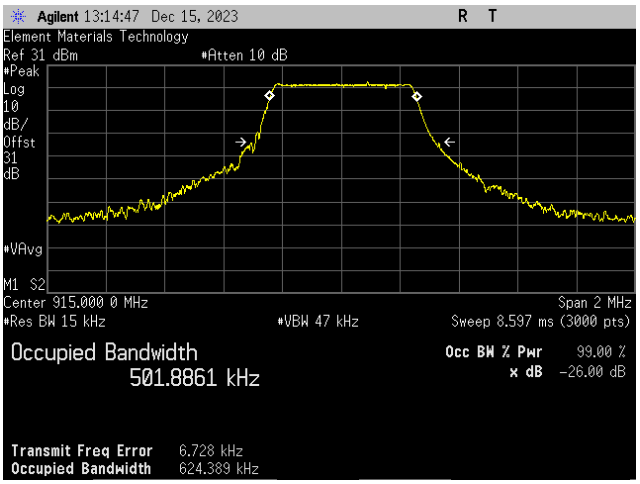
	Value	Limit	Result
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8			
Internal Antenna Port			
Low Ch. = 903 MHz	504.529 kHz	N/A	N/A
Mid Ch. = 915 MHz	501.886 kHz	N/A	N/A
High Ch = 927 MHz	498.098 kHz	N/A	N/A
External Antenna Port			
Low Ch. = 903 MHz	504.686 kHz	N/A	N/A
Mid Ch. = 915 MHz	501.201 kHz	N/A	N/A
High Ch = 927 MHz	500.31 kHz	N/A	N/A

OCCUPIED BANDWIDTH (99%)

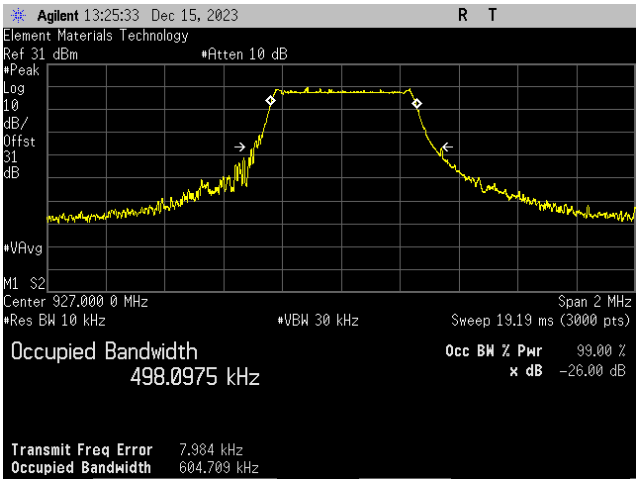
element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



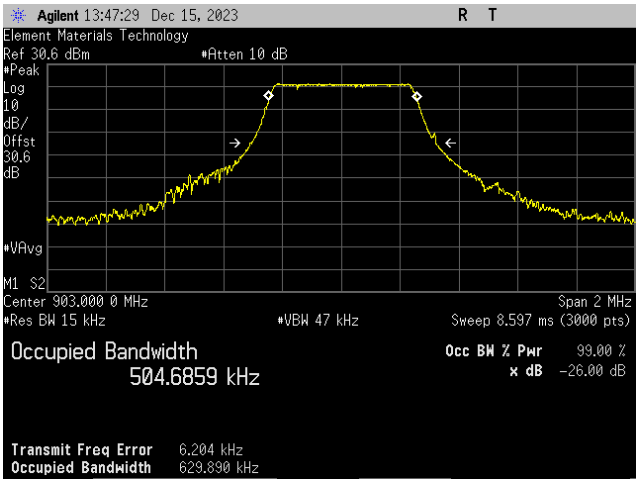
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Low Ch. = 903 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Mid Ch. = 915 MHz



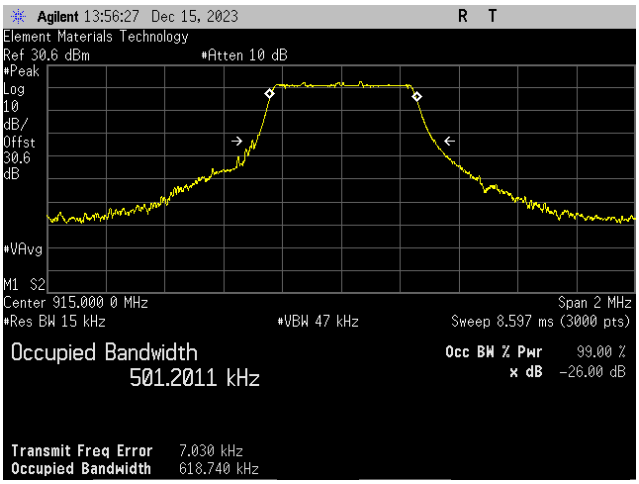
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
High Ch = 927 MHz



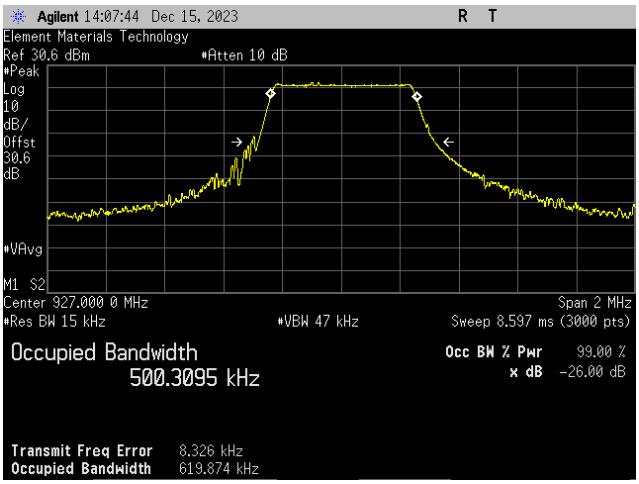
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Low Ch. = 903 MHz

OCCUPIED BANDWIDTH (99%)

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Mid Ch. = 915 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
High Ch = 927 MHz

SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

TEST DESCRIPTION

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer.

The spurious RF conducted emissions were measured with the EUT set to low, medium and high transmit frequencies. The EUT was transmitting at the data rate(s) listed in the datasheet. For each transmit frequency, the fundamental was measured with a 100 kHz resolution bandwidth and the highest value was recorded. The rest of the spectrum was then measured with a 100 kHz resolution bandwidth and the highest value was found. The difference between the value found on the fundamental and the rest of the spectrum was compared against the limit to determine compliance.

The reference level offset for the fundamental screen capture was based on a measured value of the loss between the spectrum analyzer and the EUT which was verified at the time of test. The remaining screen capture(s) use an internal transducer factor on the analyzer to correct the displayed trace based on the cable loss over frequency. The reference level offset for the additional screen capture(s) is then based on the expected attenuator value and any other losses.

Fundamental Offset = Ref Lvl Offset showing measured composite factor of all losses

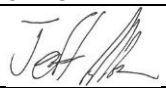
Remaining Screen capture(s) Offset = “Internal” cable loss factor not shown on screen capture + Ref Lvl Offset showing expected attenuator value and any other losses

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2023-11-29	2024-11-29
Block - DC	Fairview Microwave	SD3379	AMW	2023-03-13	2024-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2023-03-13	2024-03-13
Attenuator	Fairview Microwave	SA26B-10	TWG	2023-03-13	2024-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2023-11-22	2024-11-22
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

SPURIOUS CONDUCTED EMISSIONS

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

EUT:	TWIG V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2023-12-15
Customer:	Nelson Irrigation Corporation	Temperature:	23°C
Attendees:	None	Relative Humidity:	32%
Customer Project:	None	Bar. Pressure (PMSL):	1001 mbar
Tested By:	Jeff Alcoke	Job Site:	EV06
Power:	5VDC	Configuration:	NELS0019-1
Signature:			

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 3:2023	ANSI C63.10:2013

COMMENTS

Internal Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable and RF patch cable.
External Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable

DEVIATIONS FROM TEST STANDARD

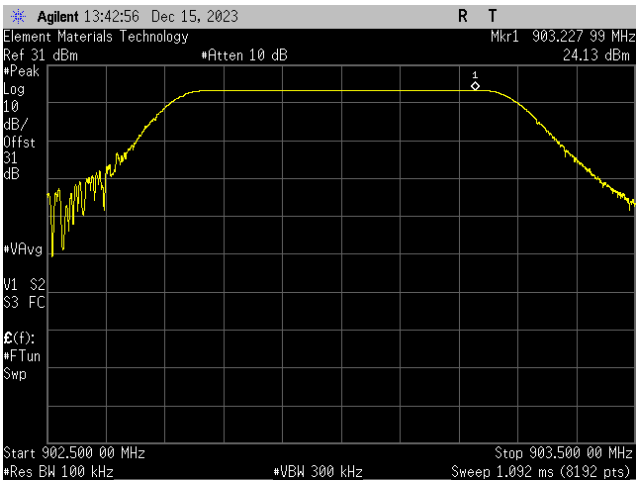
None

TEST RESULTS

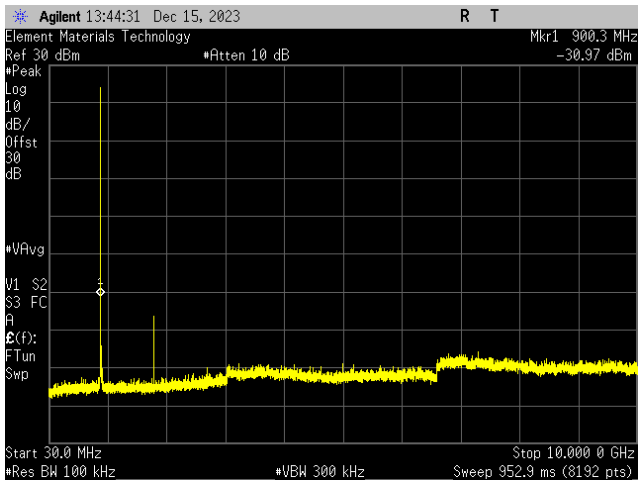
	Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8					
Internal Antenna Port					
Low Ch. = 903 MHz	Fundamental	903.23	N/A	N/A	N/A
	30 MHz - 10 GHz	900.3	-55.1	-30	Pass
Mid Ch. = 915 MHz	Fundamental	915.16	N/A	N/A	N/A
	30 MHz - 10 GHz	1830.2	-62.1	-30	Pass
High Ch = 927 MHz	Fundamental	927.23	N/A	N/A	N/A
	30 MHz - 10 GHz	929.5	-50.29	-30	Pass
External Antenna Port					
Low Ch. = 903 MHz	Fundamental	903.24	N/A	N/A	N/A
	30 MHz - 10 GHz	900.3	-54.78	-30	Pass
Mid Ch. = 915 MHz	Fundamental	915.21	N/A	N/A	N/A
	30 MHz - 10 GHz	1830.2	-64.35	-30	Pass
High Ch = 927 MHz	Fundamental	927.16	N/A	N/A	N/A
	30 MHz - 10 GHz	929.5	-51.13	-30	Pass

SPURIOUS CONDUCTED EMISSIONS

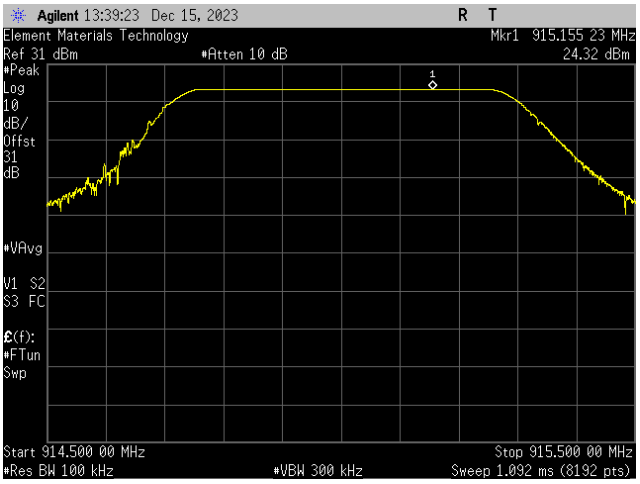
element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



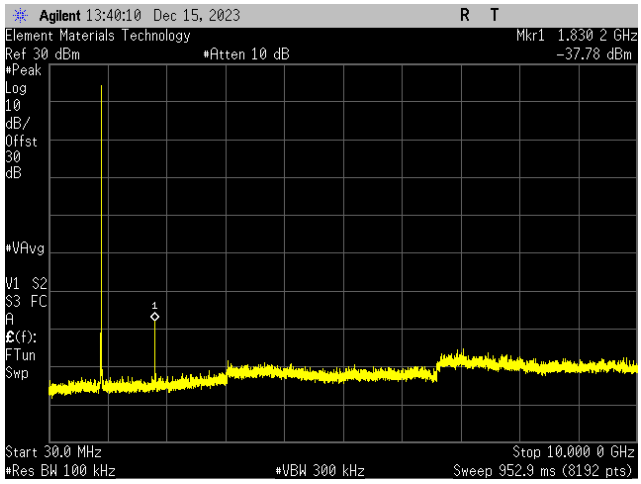
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Low Ch. = 903 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Low Ch. = 903 MHz



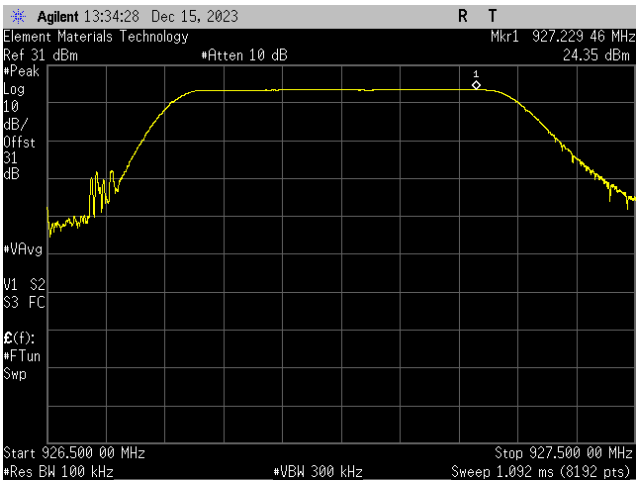
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Mid Ch. = 915 MHz



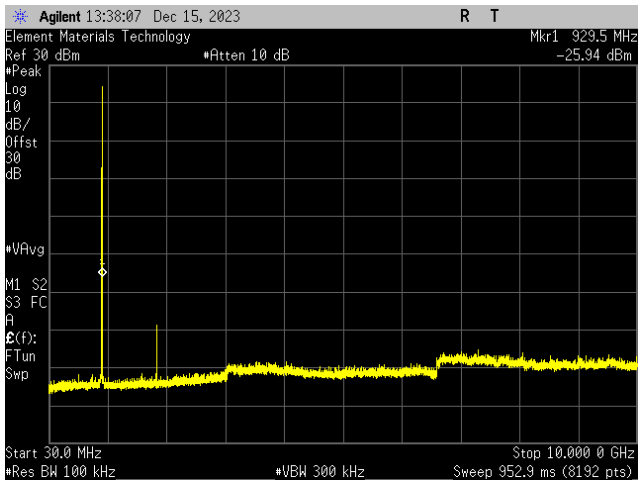
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Mid Ch. = 915 MHz

SPURIOUS CONDUCTED EMISSIONS

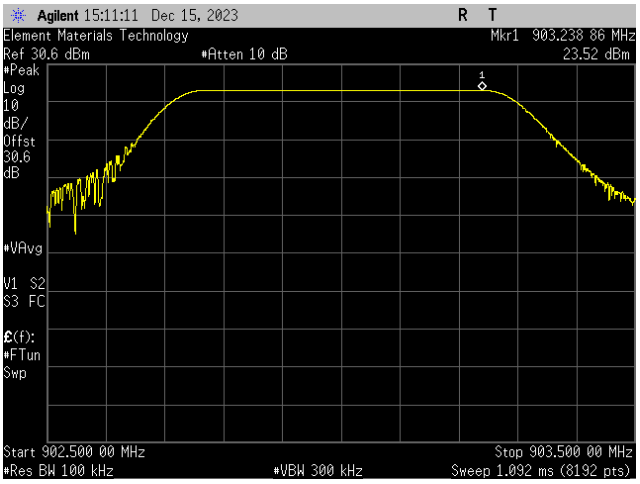
element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



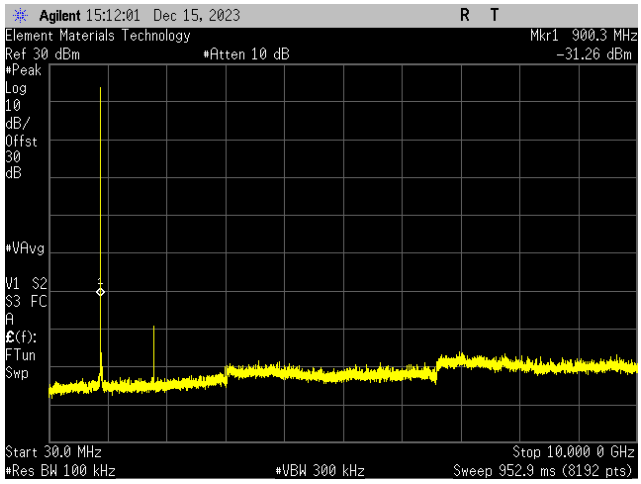
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
High Ch = 927 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
High Ch = 927 MHz



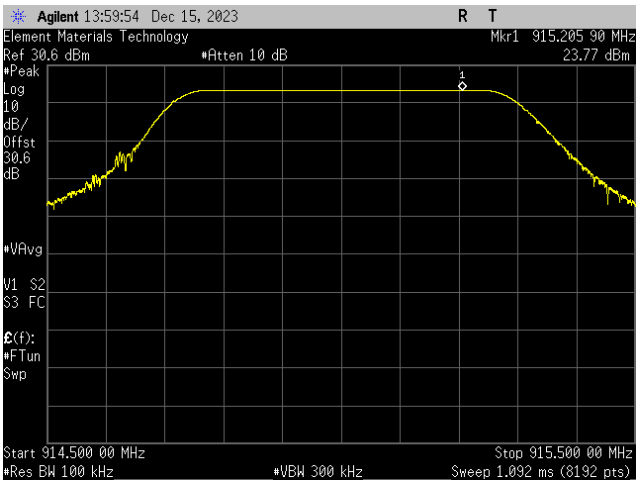
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Low Ch. = 903 MHz



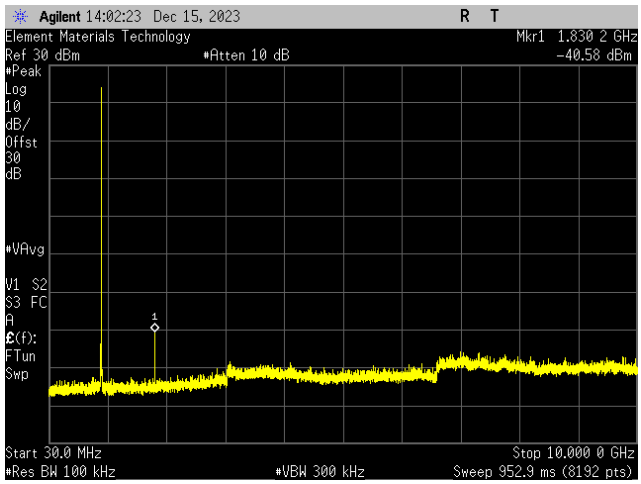
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Low Ch. = 903 MHz

SPURIOUS CONDUCTED EMISSIONS

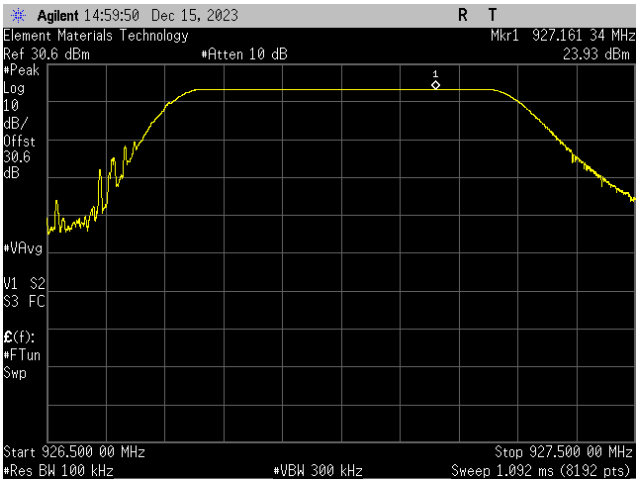
element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



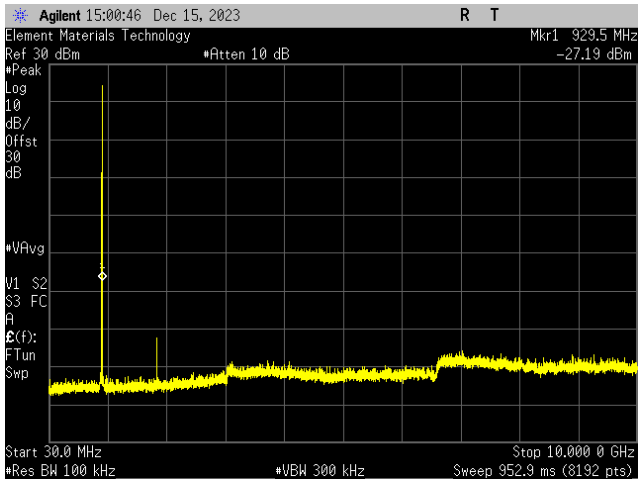
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Mid Ch. = 915 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Mid Ch. = 915 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
High Ch = 927 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
High Ch = 927 MHz

POWER SPECTRAL DENSITY

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

TEST DESCRIPTION

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer.

The power spectral density was measured using the channels and modes as called out in the following data sheets.

The method AVGPSD-2 in clause 11.10.5 of ANSI C63.10:2013 was used to make the measurement. This method uses trace averaging and RMS detection across the ON and OFF times of the transmission. The analyzer was configured to the following settings:

Span = at least 1.5 * OBW
RBW = 3 kHz
VBW = at least 3 * RBW
Detector = RMS
Sweep = 601 mS
Points = 601

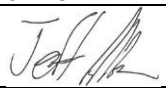
The peak marker function was used to determine the maximum amplitude level. An additional [10*log(1 / D)], where D is the duty cycle was added to the marker value to compute the average PSD during the actual transmission time.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	2023-11-29	2024-11-29
Block - DC	Fairview Microwave	SD3379	AMW	2023-03-13	2024-03-13
Attenuator	S.M. Electronics	SA26B-20	AUY	2023-03-13	2024-03-13
Attenuator	Fairview Microwave	SA26B-10	TWG	2023-03-13	2024-03-13
Cable	Micro-Coax	UFD150A-1-0720-200200	EVI	2023-11-22	2024-11-22
Generator - Signal	Keysight	N5182B	TFU	2022-12-02	2024-12-02

POWER SPECTRAL DENSITY

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0

EUT:	TWIG V UNO	Work Order:	NELS0019
Serial Number:	Sample 1	Date:	2023-12-15
Customer:	Nelson Irrigation Corporation	Temperature:	22°C
Attendees:	None	Relative Humidity:	35%
Customer Project:	None	Bar. Pressure (PMSL):	1001 mbar
Tested By:	Jeff Alcoke	Job Site:	EV06
Power:	5VDC	Configuration:	NELS0019-1
Signature:			

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2023	ANSI C63.10:2013
RSS-247 Issue 3:2023	ANSI C63.10:2013

COMMENTS

Internal Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable and RF patch cable
Externa Antenna Port: Reference level offset includes DC block, 30 dB attenuator, measurement cable

DEVIATIONS FROM TEST STANDARD

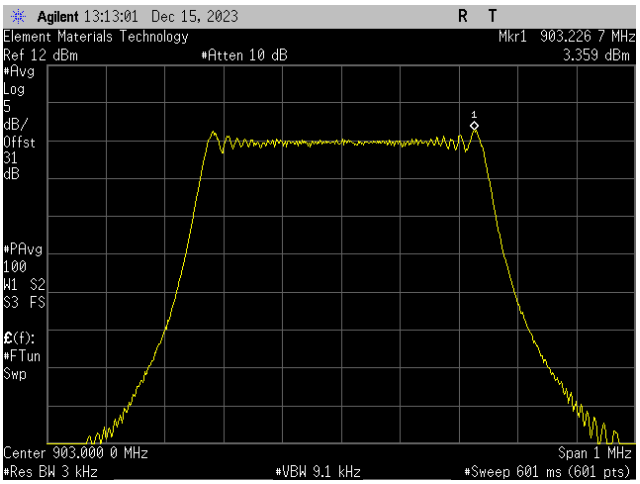
None

TEST RESULTS

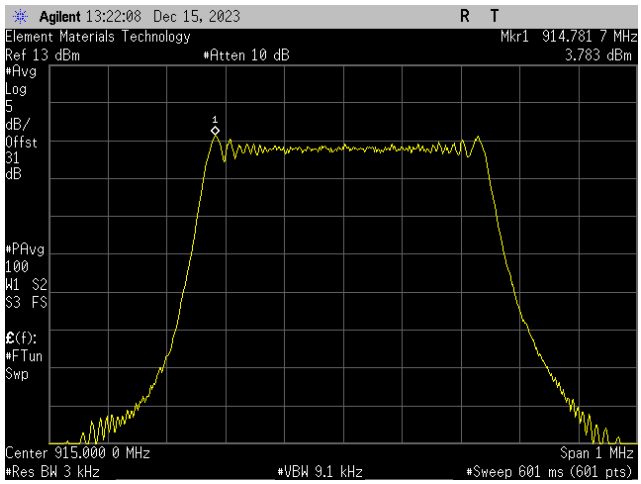
	Value dBm/3 kHz	Duty Cycle Factor (dB)	Value dBm/3 kHz	Limit ≤ (dBm / 3 kHz)	Results
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8					
Internal Antenna Port					
Low Ch. = 903 MHz	3.359	0.4	3.8	8	Pass
Mid Ch. = 915 MHz	3.783	0.4	4.2	8	Pass
High Ch = 927 MHz	3.82	0.4	4.2	8	Pass
External Antenna Port					
Low Ch. = 903 MHz	2.857	0.4	3.3	8	Pass
Mid Ch. = 915 MHz	3.438	0.4	3.8	8	Pass
High Ch = 927 MHz	3.442	0.4	3.8	8	Pass

POWER SPECTRAL DENSITY

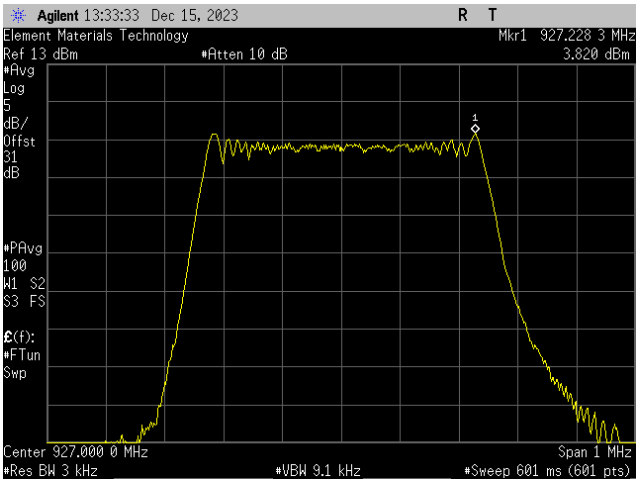
element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



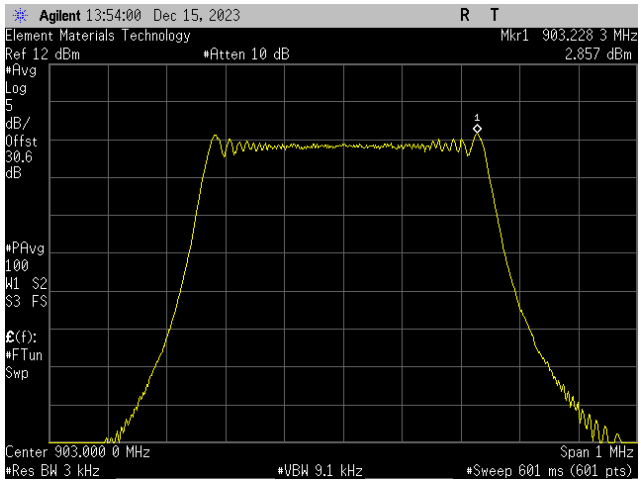
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Low Ch. = 903 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
Mid Ch. = 915 MHz



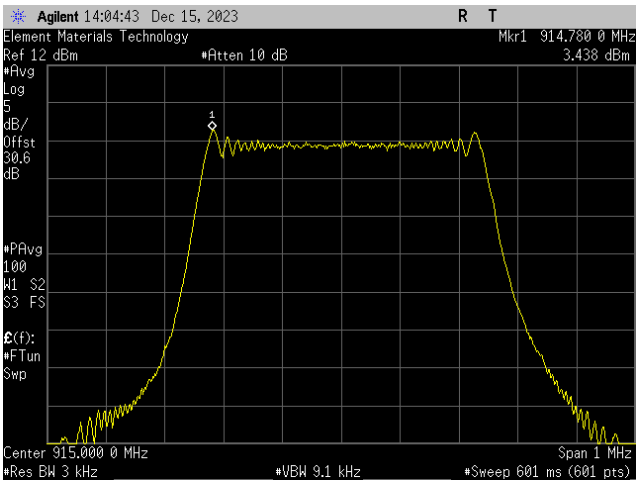
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
Internal Antenna Port
High Ch = 927 MHz



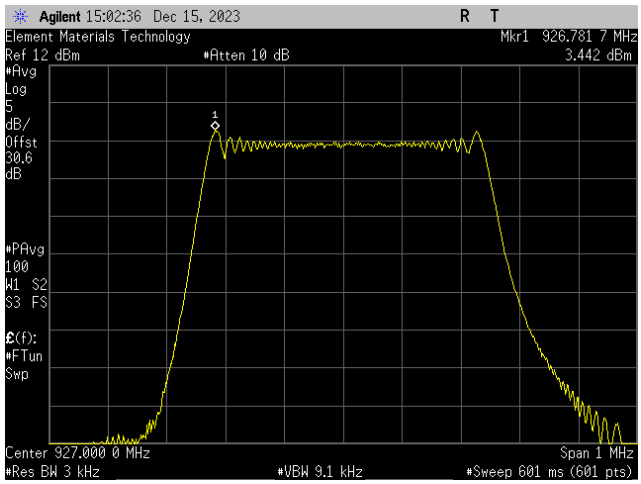
LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Low Ch. = 903 MHz

POWER SPECTRAL DENSITY

element
TbtTx 2023.08.15.2
WTD.2023.10.23.0



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
Mid Ch. = 915 MHz



LoRa, Spreading Factor = 8, 500 kHz BW, Coding Rate =4/8
External Antenna Port
High Ch = 927 MHz

End of Test Report