

Nelson Irrigation Corporation

TWIG V – Radio Module

FCC 15.247:2019

902 – 928 MHz Other Wideband DTS Transceiver

Report # NELS0008.1





NVLAP LAB CODE: 200630-0



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CERTIFICATE OF TEST



Last Date of Test: September 19, 2019 Nelson Irrigation Corporation EUT: TWIG V - Radio Module

Radio Equipment Testing

Standards

Specification	Method
FCC 15.207:2019	ANSI C63.10:2013, KDB 558074
FCC 15.247:2019	ANSI C03.10.2013, KDB 556074

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions (Transmitter)	Yes	Pass	
6.5, 6.6, 11.12.1, 11.13.2	Spurious Radiated Emissions	Yes	Pass	
11.6	Duty Cycle	Yes	Pass	
7.8.2	Carrier Frequency Separation	No	N/A	Not required for DTS devices.
7.8.3	Number of Hopping Frequencies	No	N/A	Not required for DTS devices.
7.8.4	Dwell Time	No	N/A	Not required for DTS devices.
11.9.1.1	Output Power	Yes	Pass	
11.9.1.1	Equivalent Isotropic Radiated Power	Yes	Pass	
11.11	Band Edge Compliance	Yes	Pass	
7.8.6	Band Edge Compliance - Hopping Mode	No	N/A	Not required for DTS devices.
11.8.2	Occupied Bandwidth	Yes	Pass	
11.11	Spurious Conducted Emissions	Yes	Pass	
11.10.2	Power Spectral Density	Yes	Pass	

Deviations From Test Standards

None

Approved By:

Kyle Holgate, 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



Revisior Number		Description	Date (yyyy-mm-dd)	Page Number
00	None			

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 - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

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 – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

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

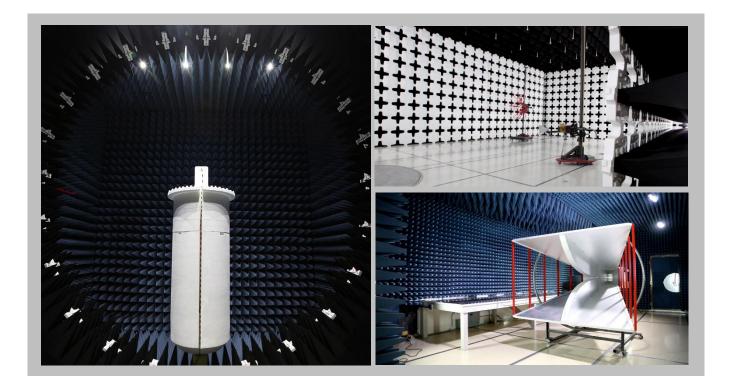
For details on the Scopes of our Accreditations, please visit: https://www.nwemc.com/emc-testing-accreditations

FACILITIES





California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Oregon Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Texas Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Washington Labs NC01-05 19201 120 th Ave NE Bothell, WA 98011 (425)984-6600	
		NVLAP			
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0	
Innovation, Science and Economic Development Canada					
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1	
		BSMI			
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R	
		VCCI			
A-0029	A-0109	A-0108	A-0201	A-0110	
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA					
US0158	US0175	US0017	US0191	US0157	



MEASUREMENT UNCERTAINTY



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.

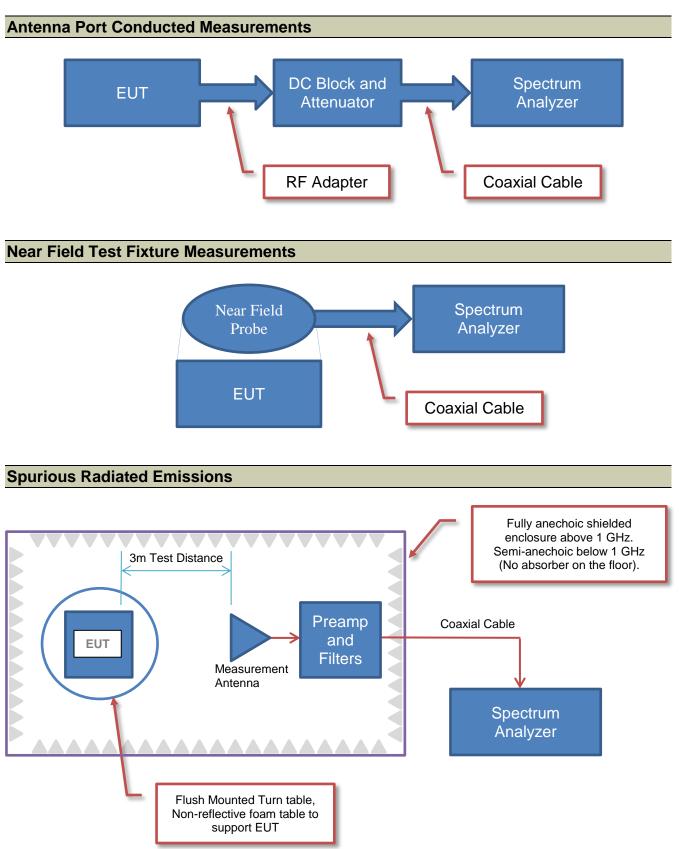
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable test description page. 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)	2.4 dB	-2.4 dB

Test Setup Block Diagrams





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 – Radio Module
First Date of Test:	August 29, 2019
Last Date of Test:	September 19, 2019
Receipt Date of Samples:	August 28, 2019
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:

Irrigation Control Network: The End Node product is designed to drive latching solenoids or latching relays in response to LoRa radio packets and provides status information to the network using LoRa radio packets. It is a limited energy device and spends most of its life in a state of sleep. The Command Node product provides network timing information that is encoded into the LoRa packets that coordinates operation. It responds to LoRa packets by providing control data that is utilized by the End Nodes. It is continuously powered and spends most of its time waiting to respond to LoRa packets. The Echo Node product retransmits directed LoRa packets to extend the coverage of the network. It is continuously powered and spends most of its life waiting to receive LoRa packets.

Testing Objective:

Seeking to demonstrate compliance under FCC 15.247:2019 for operation in the 902 - 928 MHz Band.



Software/Firmware Running during test	
Description	Version
EMC Test Software	0xAE256A4

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
LoRa Radio Module	Nelson Irrigation Corporation	TWIG V	256395-0059

Peripherals in test setup boundary						
Description Manufacturer Model/Part Number Serial Number						
Omni Antenna	L-com	HG908UP-NF	HG908UP-NFPOLC10063101918			
DC Power Supply	TOPWARD	TPS2000	None			

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
CA-195R	Yes	3.1 m	No	u.fl to SMA Patch Cable	Antenna
DC Power	No	0.1 m	No	LoRa Radio Module	DC Power
DC Power	No	2.0 m	No	DC Power	DC Power Supply
AC Power	No	1.8 m	No	AC Mains	DC Power Supply
u.fl to SMA Patch Cable	Yes	0.2 m	No	LoRa Radio Module	CA-195R



Software/Firmware Running during test	
Description	Version
EMC Test Software	0xAE256A4

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
LoRa Radio Module	Nelson Irrigation Corporation	TWIG V	256395-0059

Peripherals in test setup boundary							
Description Manufacturer Model/Part Number Serial Number							
Yagi Antenna	L-com	HG912YE-NF	HG912YE-NFPO2022821839				
DC Power Supply	TOPWARD	TPS2000	None				

Cables								
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2			
CA-195R	Yes	3.1 m	No	u.fl to SMA Patch Cable	Antenna			
DC Power	No	0.1 m	No	LoRa Radio Module	DC Power			
DC Power	No	2.0 m	No	DC Power	DC Power Supply			
AC Power	No	1.8 m	No	AC Mains	DC Power Supply			
u.fl to SMA Patch Cable	Yes	0.2 m	No	LoRa Radio Module	CA-195R			



Software/Firmware Running during test				
Description	Version			
EMC Test Software	0xAE256A4			

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
LoRa Radio Module	Nelson Irrigation Corporation	TWIG V	256395-0059

Peripherals in test setup boundary						
Description Manufacturer Model/Part Number Serial Number						
DC Power Supply	TOPWARD	TPS2000	None			

Cables								
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2			
DC Power	No	0.1 m	No	LoRa Radio Module	DC Power			
DC Power	No	2.0 m	No	DC Power	DC Power Supply			
AC Power	No	1.8 m	No	AC Mains	DC Power Supply			



Software/Firmware Running during test				
Description	Version			
EMC Test Software	0xAE256A4			

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
LoRa Radio Module	Nelson Irrigation Corporation	TWIG V	256395-0059

Peripherals in test setup boundary						
Description Manufacturer Model/Part Number Serial Number						
Remote Laptop	Panasonic	Toughbook CF30	000634			
DC Power Supply	TOPWARD	TPS2000	None			

Cables								
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2			
DC Power	No	0.1 m	No	LoRa Radio Module	DC Power			
DC Power	No	2.0 m	No	DC Power	DC Power Supply			
AC Power	No	1.8 m	No	AC Mains	DC Power Supply			
Serial to USB	Yes	1.5 m	No	Remote Laptop	LoRa Radio Module			

MODIFICATIONS



Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2019-08-29	Spurious Radiated 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.
2	2019-09-05	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.
3	2019-09-05	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.
4	2019-09-05	Equivalent Isotropic Radiated 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.
5	2019-09-05	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.
6	2019-09-05	Occupied Bandwidth	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	2019-09-05	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.
8	2019-09-05	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.
9	2019-09-06	Powerline Conducted Emissions (Transmitter)	Modified from delivered configuration.	Installed Fair-Rite brand ferrite (PN# 0431173951) on the u.fl to SMA adapter/patch cable near the u.fl connection for the external antenna. Modification authorized by Mark Bauman.	EUT remained at Element following the test.
10	2019-09-19	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.



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 500hm measuring port is terminated by a 500hm EMI meter or a 500hm resistive load. All 500hm measuring ports of the LISN are terminated by 500hm. 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	Rohde & Schwarz	ESCI	ARH	2019-05-02	2020-05-02
Cable - Conducted Cable Assembly	Northwest EMC	EVG, HHD, RKT	EVGA	2019-01-07	2020-01-07
LISN	Solar Electronics	9252-50-R-24-BNC	LIN	2018-12-27	2019-12-27

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	2.4 dB	-2.4 dB

CONFIGURATIONS INVESTIGATED

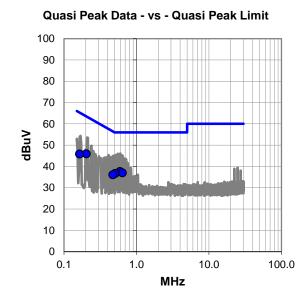
NELS0008-10 NELS0008-8 NELS0008-9

MODES INVESTIGATED

Transmitting LoRa, SF8, 500 kHz BW, Software power setting = 10. Mid Ch. = 915 MHz



EUT:	TWIG V - Ra	dio Module	9		Work Order:	NELS0008		
Serial Number:	256395-0059				Date:	2019-09-05		
Customer:	Nelson Irriga	tion Corpo	ration		Temperature:	23.7°C		
Attendees:	None				Relative Humidity:	48.7%		
Customer Project:	None				Bar. Pressure:	1015 mb		
Tested By:	Jeff Alcoke				Job Site:	EV07		
Power:	5.0 VDC via	110VAC/6	OHz		Configuration:	NELS0008-10		
TEST SPECIFIC	TEST SPECIFICATIONS							
Specification:				Method:	Method:			
FCC 15.207:2019	FCC 15.207:2019 ANSI				NSI C63.10:2013			
TEST PARAME	TERS							
Run #: 12		Line:	Neutral	A	dd. Ext. Attenuation (dB	s): 0		
COMMENTS								
Measuring AC mair	is of Linear Lat	DC Powe	er Supply.					
EUT OPERATING MODES								
Transmitting LoRa,	SF8, 500 kHz	BW, Softw	are power setting = 10.	Mid Ch. = 915	MHz			
DEVIATIONS FROM TEST STANDARD								
None	None							



100 90 80 70 60 dBuV 50 40 30 20 10 0 0.1 1.0 10.0 100.0 MHz

Average Data - vs - Average Limit



RESULTS - Run #12

Quasi Peak Data - vs - Quasi Peak Limit							
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)		
0.203	25.9	20.0	45.9	63.5	-17.6		
0.594	17.7	19.9	37.6	56.0	-18.4		
0.640	17.1	19.9	37.0	56.0	-19.0		
0.507	16.9	19.8	36.7	56.0	-19.3		
0.164	25.8	20.0	45.8	65.3	-19.5		
0.473	16.3	19.8	36.1	56.5	-20.4		

Average Data - vs - Average Limit							
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)		
0.594	-2.6	19.9	17.3	46.0	-28.7		
0.640	-2.7	19.9	17.2	46.0	-28.8		
0.507	-2.7	19.8	17.1	46.0	-28.9		
0.473	-2.9	19.8	16.9	46.5	-29.6		
0.203	0.7	20.0	20.7	53.5	-32.8		
0.164	0.6	20.0	20.6	55.3	-34.7		

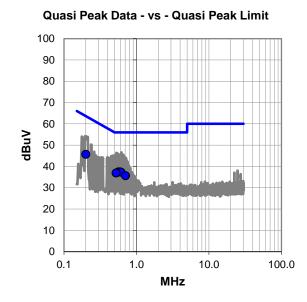
CONCLUSION

Pass

Tested By



EUT:		TWIG V - Radio Module			Work Order:	NELS0008			
Serial Numbe	er:	256395-0059			Date:	2019-09-05			
Customer:		Nelson Irriga	tion Corpor	ation		Temperature:	23.7°C		
Attendees:		None				Relative Humidity:	48.7%		
Customer Pro	oject:	None				Bar. Pressure:	1015 mb		
Tested By:		Jeff Alcoke				Job Site:	EV07		
Power:		5.0 VDC via	110VAC/60)Hz		Configuration:	NELS0008-10		
TEST SPECIFICATIONS									
Specification:					Method:				
FCC 15.207:2	2019				ANSI C63.10:2013				
TEST PAR	AME	TERS							
Run #:	13		Line:	High Line		Add. Ext. Attenuation (dE	3): 0		
	COMMENTS								
Measuring AC	main	s of Linear La	b DC Powe	r Supply.					
EUT OPERATING MODES									
Transmitting LoRa, SF8, 500 kHz BW, Software power setting = 10. Mid Ch. = 915 MHz									
		DOM TEST	CTAND/						
	NJ F	ROM TEST	STANDA	ARD					
None	None								



100 90 80 70 60 dBuV 50 40 30 20 10 0 0.1 1.0 10.0 100.0 MHz

Average Data - vs - Average Limit



RESULTS - Run #13

Quasi Peak Data - vs - Quasi Peak Limit							
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)		
0.201	25.7	20.0	45.7	63.6	-17.9		
0.565	17.5	19.9	37.4	56.0	-18.6		
0.595	17.5	19.9	37.4	56.0	-18.6		
0.613	17.4	19.9	37.3	56.0	-18.7		
0.525	17.0	19.9	36.9	56.0	-19.1		
0.708	15.7	19.9	35.6	56.0	-20.4		

Average Data - vs - Average Limit							
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)		
0.613	-2.5	19.9	17.4	46.0	-28.6		
0.525	-2.5	19.9	17.4	46.0	-28.6		
0.565	-2.6	19.9	17.3	46.0	-28.7		
0.595	-2.6	19.9	17.3	46.0	-28.7		
0.708	-2.8	19.9	17.1	46.0	-28.9		
0.201	0.3	20.0	20.3	53.6	-33.3		

CONCLUSION

Pass

Tested By



EUT:	TWIG V - Radio Module	Work Order:	NELS0008
Serial Number:	256395-0059	Date:	2019-09-06
Customer:	Nelson Irrigation Corporation	Temperature:	23.2°C
Attendees:	None	Relative Humidity:	48.6%
Customer Project:	None	Bar. Pressure:	1021 mb
Tested By:	Jeff Alcoke	Job Site:	EV07
Power:	5.0 VDC via 110VAC/60Hz	Configuration:	NELS0008-9

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	18	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

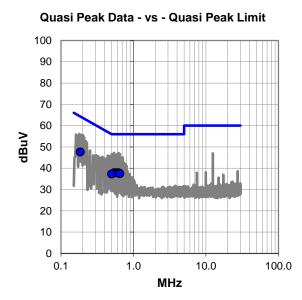
Measuring AC mains of Linear Lab DC Power Supply. Fair-Rite brand ferrite (PN#0431173951) installed on the u.fl to SMA patch cable at the u.fl end of the cable.

EUT OPERATING MODES

Transmitting LoRa, SF8, 500 kHz BW, Software power setting = 10. Mid Ch. = 915 MHz

DEVIATIONS FROM TEST STANDARD

None



100 90 80 70 60 dBuV 50 40 30 U III 20 10 0 0.1 1.0 10.0 100.0 MHz

Average Data - vs - Average Limit



RESULTS - Run #18

Quasi Peak Data - vs - Quasi Peak Limit							
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)		
0.185	27.6	20.0	47.6	64.3	-16.7		
0.547	18.0	19.9	37.9	56.0	-18.1		
0.598	18.0	19.9	37.9	56.0	-18.1		
0.629	17.9	19.9	37.8	56.0	-18.2		
0.650	17.5	19.9	37.4	56.0	-18.6		
0.501	17.5	19.8	37.3	56.0	-18.7		

Average Data - vs - Average Limit							
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)		
0.598	-2.5	19.9	17.4	46.0	-28.6		
0.501	-2.5	19.8	17.3	46.0	-28.7		
0.547	-2.6	19.9	17.3	46.0	-28.7		
0.629	-2.6	19.9	17.3	46.0	-28.7		
0.650	-2.7	19.9	17.2	46.0	-28.8		
0.185	2.1	20.0	22.1	54.3	-32.2		

CONCLUSION

Pass

Tested By



EUT:	TWIG V - Radio Module	Work Order:	NELS0008		
Serial Number:	256395-0059	Date:	2019-09-06		
Customer:	Nelson Irrigation Corporation	Temperature:	23.2°C		
Attendees:	None	Relative Humidity:	48.6%		
Customer Project:	None	Bar. Pressure:	1021 mb		
Tested By:	Jeff Alcoke	Job Site:	EV07		
Power: 5.0 VDC via 110VAC/60Hz Configuration: NELS0008-9					
TEST SPECIFICATIONS					

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	19	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

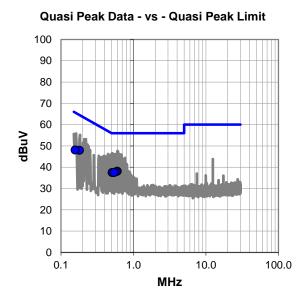
Measuring AC mains of Linear Lab DC Power Supply. Fair-Rite brand ferrite (PN#0431173951) installed on the u.fl to SMA patch cable at the u.fl end of the cable.

EUT OPERATING MODES

Transmitting LoRa, SF8, 500 kHz BW, Software power setting = 10. Mid Ch. = 915 MHz

DEVIATIONS FROM TEST STANDARD

None



100 90 80 70 60 dBuV 50 40 30 20 10 0 0.1 1.0 10.0 100.0

MHz

Average Data - vs - Average Limit

Report No. NELS0008.1



RESULTS - Run #19

Q	Quasi Peak Data - vs - Quasi Peak Limit				
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.180	27.9	20.0	47.9	64.5	-16.6
0.157	28.0	20.1	48.1	65.6	-17.5
0.597	18.2	19.9	38.1	56.0	-17.9
0.577	18.0	19.9	37.9	56.0	-18.1
0.509	17.7	19.8	37.5	56.0	-18.5
0.540	17.6	19.9	37.5	56.0	-18.5

Average Data - vs - Average Limit					
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.540	-2.4	19.9	17.5	46.0	-28.5
0.597	-2.5	19.9	17.4	46.0	-28.6
0.577	-2.6	19.9	17.3	46.0	-28.7
0.509	-2.6	19.8	17.2	46.0	-28.8
0.157	3.7	20.1	23.8	55.6	-31.8
0.180	2.5	20.0	22.5	54.5	-32.0

CONCLUSION

Pass

Tested By



EUT:	TWIG V - Radio Module	Work Order:	NELS0008	
Serial Number:	256395-0059	Date:	2019-09-06	
Customer:	Nelson Irrigation Corporation	Temperature:	23.2°C	
Attendees:	None	Relative Humidity:	48.6%	
Customer Project:	None	Bar. Pressure:	1021 mb	
Tested By:	Jeff Alcoke	Job Site:	EV07	
Power:	5.0 VDC via 110VAC/60Hz	Configuration:	NELS0008-8	
TEST SPECIFICATIONS				

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	20	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

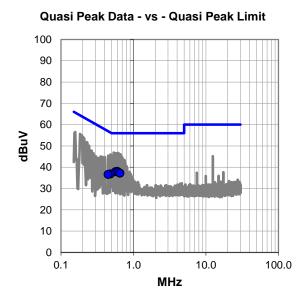
Measuring AC mains of Linear Lab DC Power Supply. Fair-Rite brand ferrite (PN#0431173951) installed on the u.fl to SMA patch cable at the u.fl end of the cable.

EUT OPERATING MODES

Transmitting LoRa, SF8, 500 kHz BW, Software power setting = 10. Mid Ch. = 915 MHz

DEVIATIONS FROM TEST STANDARD

None



100 90 80 70 60 dBuV 50 40 30 20 10 0 0.1 1.0 10.0 100.0

MHz

Average Data - vs - Average Limit



RESULTS - Run #20

Quasi Peak Data - vs - Quasi Peak Limit					
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.594	18.1	19.9	38.0	56.0	-18.0
0.565	18.0	19.9	37.9	56.0	-18.1
0.611	17.9	19.9	37.8	56.0	-18.2
0.651	17.3	19.9	37.2	56.0	-18.8
0.481	17.0	19.8	36.8	56.3	-19.5
0.448	16.8	19.8	36.6	56.9	-20.3

Average Data - vs - Average Limit					
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.594	-2.4	19.9	17.5	46.0	-28.5
0.611	-2.5	19.9	17.4	46.0	-28.6
0.565	-2.5	19.9	17.4	46.0	-28.6
0.651	-2.7	19.9	17.2	46.0	-28.8
0.481	-2.6	19.8	17.2	46.3	-29.1
0.448	-2.6	19.8	17.2	46.9	-29.7

CONCLUSION

Pass

Tested By



EUT:	TWIG V - Radio Module	Work Order:	NELS0008
Serial Number:	256395-0059	Date:	2019-09-06
Customer:	Nelson Irrigation Corporation	Temperature:	23.2°C
Attendees:	None	Relative Humidity:	48.6%
Customer Project:	None	Bar. Pressure:	1021 mb
Tested By:	Jeff Alcoke	Job Site:	EV07
Power:	5.0 VDC via 110VAC/60Hz	Configuration:	NELS0008-8

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	21	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

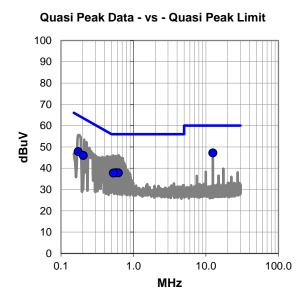
Measuring AC mains of Linear Lab DC Power Supply. Fair-Rite brand ferrite (PN#0431173951) installed on the u.fl to SMA patch cable at the u.fl end of the cable.

EUT OPERATING MODES

Transmitting LoRa, SF8, 500 kHz BW, Software power setting = 10. Mid Ch. = 915 MHz

DEVIATIONS FROM TEST STANDARD

None



100 90 80 70 60 dBuV 50 40 30 20 10 0 0.1 1.0 10.0 100.0

MHz

Average Data - vs - Average Limit



RESULTS - Run #21

Quasi Peak Data - vs - Quasi Peak Limit												
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)							
12.452	26.8	20.4	47.2	60.0	-12.8							
0.173	27.8	20.0	47.8	64.8	-17.0							
0.204	26.0	20.0	46.0	63.5	-17.5							
0.577	18.0	19.9	37.9	56.0	-18.1							
0.620	17.9	19.9	37.8	56.0	-18.2							
0.529	17.8	19.9	37.7	56.0	-18.3							

	Average	Data - vs	- Average	Limit	
Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
12.452	26.5	20.4	46.9	50.0	-3.1
0.620	-2.3	19.9	17.6	46.0	-28.4
0.529	-2.5	19.9	17.4	46.0	-28.6
0.577	-2.5	19.9	17.4	46.0	-28.6
0.173	2.3	20.0	22.3	54.8	-32.5
0.204	0.9	20.0	20.9	53.5	-32.6

CONCLUSION

Pass

Tested By



PSA-ESCI 2019.05.10

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 test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Transmitting LoRa, SF8, 500 kHz BW, Software power setting = 10.	Low Ch. = 902.5 MHz, Mid Ch. = 915 MHz, High Ch. = 927 MHz
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POWER SETTINGS INVESTIGATED

5.0 VDC

CONFIGURATIONS INVESTIGATED

NELS0008 - 10 NELS0008 - 9 NELS0008 - 8

FREQUENCY RANGE INVESTIGATED

Start Frequency 30 MHz

Stop Frequency 12750 MHz

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Filter - Band Pass/Notch	K&L Microwave	3TNF-500/1000-N/N	HFT	5-Dec-2018	12 mo
Filter - Low Pass	Micro-Tronics	LPM50003	LFB	15-Feb-2019	12 mo
Attenuator	Coaxicom	3910-10	AWX	15-Feb-2019	12 mo
Attenuator	Coaxicom	3910-20	AXZ	15-Feb-2019	12 mo
Cable	None	Standard Gain Horns Cable	EVF	24-Nov-2018	12 mo
Cable	N/A	Double Ridge Horn Cables	EVB	24-Nov-2018	12 mo
Cable	N/A	Bilog Cables	EVA	24-Nov-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-12001800-30-10P	AVD	24-Nov-2018	12 mo
Amplifier - Pre-Amplifier	L-3 Narda-MITEQ	AMF-6F-08001200-30-10P	PAO	24-Nov-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAG	24-Nov-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AOL	24-Nov-2018	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-08	AHV	NCR	0 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AHU	NCR	0 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIZ	7-Feb-2018	24 mo
Antenna - Biconilog	Teseq	CBL 6141B	AXR	2-Oct-2018	24 mo
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAQ	24-Mar-2019	12 mo

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 in order 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.

Measurements at the edges of the allowable band may be presented in an alternative method as provided for in the ANSI C63.10 Marker-Delta method. This method involves performing an in-band fundamental measurement followed by a screen capture of the fundamental and out-of-band emission using reduced measurement instrumentation bandwidths. The amplitude delta measured on this screen capture is applied to the fundamental emission value to show the out-of-band emission level as applied to the limit.

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(dc).

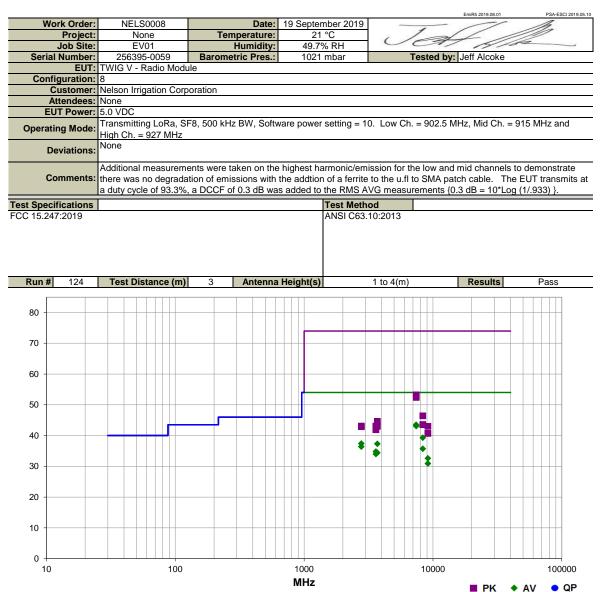


	Order:	NE	ELS00	008					Dat	e:	2	9 Au	gust 2	2019			_	_				2019.08.	/		1	7	CI 2019
	Project:		None				Tem						3.2 °C					1	1	-	1	/	1	1	Ŋ	1	
Jo	b Site:		EV01					Hum					5% R			C	/	0	-	1	-	5	1	12	-		_
Serial Nu			6395-0			Bar	ome						3 mb					Те	ste	d by:	Jeff	Alco	ke				
	EUT:																										
Configu	ration:	8																									
		Nelson	Irrigat	ion (Corpor	ation																					
	ndees:																										
EUT F	Power:	5.0 VD0	5																								
Operating	Mode:	Transm	itting	LoRa	a, SF8	, 500) kHz	BW	, So	ftwa	are	pow	er sett	ing =	10.	Lo	wC	h. =	= 90	2.5 M	Hz aı	nd M	lid C	h. =	915	MH:	z
Devia	ations:	None																									
Com	ments:		annel, EUT orientation, Antenna Orientation, and Antenr F of 0.3 dB was added to the RMS AVG measurements {															ta									
t Specifica	ations												To	st Me	thor	1											
C 15.247:20		I												SI C6			13										
Run #	56	Test	Dista	nce	(m)	3		An	iten	na I	lei	ght(5)		1	to	4(m)			Re	sult	S		Pa	SS	
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Freq (MHz)	Amplitude (dBuV)	Factor (dB)	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
9148.450	42.8	-1.8	2.9	131.0	0.3	0.0	Horz	AV	0.0	41.3	54.0	-12.7	Mid Ch, EUT Vert, Ant Vert, Omni
9148.467	40.3	-1.8	2.3	277.0	0.3	0.0	Vert	AV	0.0	38.8	54.0	-15.2	Mid Ch, EUT on Side, Ant Vert, Omni
2745.017	41.0	-3.4	3.8	64.0	0.3	0.0	Horz	AV	0.0	37.9	54.0	-16.1	Mid Ch, EUT Vert, Ant Vert, Omni
2707.633	40.6	-3.4	4.0	129.0	0.3	0.0	Vert	AV	0.0	37.5	54.0	-16.5	Low Ch, EUT Horz, Ant Vert, Omni
3660.300	34.7	2.1	1.0	216.0	0.3	0.0	Horz	AV	0.0	37.1	54.0	-16.9	Mid Ch, EUT Vert, Ant Vert, Omni
9148.367	38.3	-1.8	2.5	144.0	0.3	0.0	Horz	AV	0.0	36.8	54.0	-17.2	Mid Ch, EUT on Side, Ant Horz, Omni
5414.283	29.7	6.0	2.6	119.0	0.3	0.0	Vert	AV	0.0	36.0	54.0	-18.0	Low Ch, EUT Horz, Ant Vert, Omni
9148.600	37.1	-1.8	2.3	314.0	0.3	0.0	Horz	AV	0.0	35.6	54.0	-18.4	Mid Ch, EUT on Side, Ant Vert, Omni
3660.217	33.2	2.1	2.2	136.0	0.3	0.0	Vert	AV	0.0	35.6	54.0	-18.4	Mid Ch, EUT Horz, Ant Vert, Omni
5414.467	29.3	6.0	1.5	169.0	0.3	0.0	Horz	AV	0.0	35.6	54.0	-18.4	Low Ch, EUT Vert, Ant Vert, Omni
9148.433	36.8	-1.8	2.2	79.0	0.3	0.0	Vert	AV	0.0	35.3	54.0	-18.7	Mid Ch, EUT on Side, Ant Horz, Omni
9148.650	36.6	-1.8	3.8	3.0	0.3	0.0	Horz	AV	0.0	35.1	54.0	-18.9	Mid Ch, EUT Horz, Ant Vert, Omni
9148.350	36.6	-1.8	2.1	286.0	0.3	0.0	Vert	AV	0.0	35.1	54.0	-18.9	Mid Ch, EUT Horz, Ant Horz, Omni
2707.683	37.9	-3.4	1.5	250.0	0.3	0.0	Horz	AV	0.0	34.8	54.0	-19.2	Low Ch, EUT Vert, Ant Vert, Omni
2745.167	37.6	-3.4	1.3	59.0	0.3	0.0	Vert	AV	0.0	34.5	54.0	-19.5	Mid Ch, EUT Horz, Ant Vert, Omni
4575.000	30.0	4.0	1.5	289.0	0.3	0.0	Horz	AV	0.0	34.3	54.0	-19.7	Mid Ch, EUT Vert, Ant Vert, Omni
4575.617	30.0	3.9	2.6	35.0	0.3	0.0	Vert	AV	0.0	34.2	54.0	-19.8	Mid Ch, EUT Horz, Ant Vert, Omni
9148.250	35.2	-1.8	1.5	71.0	0.3	0.0	Vert	AV	0.0	33.7	54.0	-20.3	Mid Ch, EUT Vert, Ant Vert, Omni
9024.183	35.4	-2.1	1.8	204.0	0.3	0.0	Horz	AV	0.0	33.6	54.0	-20.4	Low Ch, EUT Vert, Ant Vert, Omni
9148.500	35.0	-1.8	1.6	85.0	0.3	0.0	Vert	AV	0.0	33.5	54.0	-20.5	Mid Ch, EUT Vert, Ant Horz, Omni
9024.500	33.5	-2.1	2.8	121.0	0.3	0.0	Vert	AV	0.0	31.7	54.0	-22.3	Low Ch, EUT Horz, Ant Vert, Omni
9149.000	31.5	-1.8	2.6	196.0	0.3	0.0	Horz	AV	0.0	30.0	54.0	-24.0	Mid Ch, EUT Horz, Ant Horz, Omni
9147.567	50.2	-1.8	2.9	131.0	0.0	0.0	Horz	PK	0.0	48.4	74.0	-25.6	Mid Ch, EUT Vert, Ant Vert, Omni
5413.917	40.9	6.0	2.6	119.0	0.0	0.0	Vert	PK	0.0	46.9	74.0	-27.1	Low Ch, EUT Horz, Ant Vert, Omni
9148.433	48.4	-1.8	2.3	277.0	0.0	0.0	Vert	PK	0.0	46.6	74.0	-27.4	Mid Ch, EUT on Side, Ant Vert, Omni

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	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
5415.033	40.1	6.0	1.5	169.0	0.0	0.0	Horz	PK	0.0	46.1	74.0	-27.9	Low Ch, EUT Vert, Ant Vert, Omni
9148.050	46.7	-1.8	2.5	144.0	0.0	0.0	Horz	PK	0.0	44.9	74.0	-29.1	Mid Ch, EUT on Side, Ant Horz, Omni
3659.850	42.7	2.1	1.0	216.0	0.0	0.0	Horz	PK	0.0	44.8	74.0	-29.2	Mid Ch, EUT Vert, Ant Vert, Omni
9148.217	46.1	-1.8	2.3	314.0	0.0	0.0	Horz	PK	0.0	44.3	74.0	-29.7	Mid Ch, EUT on Side, Ant Vert, Omni
4574.983	40.0	3.9	2.6	35.0	0.0	0.0	Vert	PK	0.0	43.9	74.0	-30.1	Mid Ch, EUT Horz, Ant Vert, Omni
4574.367	39.9	3.9	1.5	289.0	0.0	0.0	Horz	PK	0.0	43.8	74.0	-30.2	Mid Ch, EUT Vert, Ant Vert, Omni
3659.233	41.7	2.1	2.2	136.0	0.0	0.0	Vert	PK	0.0	43.8	74.0	-30.2	Mid Ch, EUT Horz, Ant Vert, Omni
9149.400	45.6	-1.8	2.1	286.0	0.0	0.0	Vert	PK	0.0	43.8	74.0	-30.2	Mid Ch, EUT Horz, Ant Horz, Omni
9147.933	45.5	-1.8	2.2	79.0	0.0	0.0	Vert	PK	0.0	43.7	74.0	-30.3	Mid Ch, EUT on Side, Ant Horz, Omni
9148.717	45.5	-1.8	3.8	3.0	0.0	0.0	Horz	PK	0.0	43.7	74.0	-30.3	Mid Ch, EUT Horz, Ant Vert, Omni
2745.283	46.9	-3.4	3.8	64.0	0.0	0.0	Horz	PK	0.0	43.5	74.0	-30.5	Mid Ch, EUT Vert, Ant Vert, Omni
2707.967	46.9	-3.4	4.0	129.0	0.0	0.0	Vert	PK	0.0	43.5	74.0	-30.5	Low Ch, EUT Horz, Ant Vert, Omni
9027.183	45.2	-1.9	1.8	204.0	0.0	0.0	Horz	PK	0.0	43.3	74.0	-30.7	Low Ch, EUT Vert, Ant Vert, Omni
9148.433	44.5	-1.8	1.6	85.0	0.0	0.0	Vert	PK	0.0	42.7	74.0	-31.3	Mid Ch, EUT Vert, Ant Horz, Omni
9147.767	44.4	-1.8	1.5	71.0	0.0	0.0	Vert	PK	0.0	42.6	74.0	-31.4	Mid Ch, EUT Vert, Ant Vert, Omni
2707.583	45.5	-3.4	1.5	250.0	0.0	0.0	Horz	PK	0.0	42.1	74.0	-31.9	Low Ch, EUT Vert, Ant Vert, Omni
9023.850	43.8	-2.1	2.8	121.0	0.0	0.0	Vert	PK	0.0	41.7	74.0	-32.3	Low Ch, EUT Horz, Ant Vert, Omni
2744.383	45.0	-3.5	1.3	59.0	0.0	0.0	Vert	PK	0.0	41.5	74.0	-32.5	Mid Ch, EUT Horz, Ant Vert, Omni
9153.200	41.9	-1.9	2.6	196.0	0.0	0.0	Horz	PK	0.0	40.0	74.0	-34.0	Mid Ch, EUT Horz, Ant Horz, Omni





Freq (MHz)	Amplitude (dBuV)	Factor (dB)	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
7415.283	28.9	14.3	1.0	191.0	0.3	0.0	Vert	AV	0.0	43.5	54.0	-10.5	High Ch, EUT Horz, Ant Vert, Omni
7416.925	28.5	14.3	1.0	151.0	0.3	0.0	Horz	AV	0.0	43.1	54.0	-10.9	High Ch, EUT Vert, Ant Vert, Omni
8341.733	43.2	-4.2	2.0	309.0	0.3	0.0	Horz	AV	0.0	39.3	54.0	-14.7	High Ch, EUT Vert, Ant Vert, Omni
2780.900	40.3	-3.2	1.0	218.0	0.3	0.0	Horz	AV	0.0	37.4	54.0	-16.6	High Ch, EUT Vert, Ant Vert, Omni
3708.108	34.8	2.2	1.0	255.0	0.3	0.0	Horz	AV	0.0	37.3	54.0	-16.7	High Ch, EUT Vert, Ant Vert, Omni
2780.775	39.3	-3.2	1.0	1.0	0.3	0.0	Vert	AV	0.0	36.4	54.0	-17.6	High Ch, EUT Horz, Ant Vert, Omni
8341.667	39.6	-4.2	1.0	354.0	0.3	0.0	Vert	AV	0.0	35.7	54.0	-18.3	High Ch, EUT Horz, Ant Vert, Omni
3610.033	32.8	1.7	3.9	243.0	0.3	0.0	Vert	AV	0.0	34.8	54.0	-19.2	Low Ch, EUT Horz, Ant Vert, Omni
3707.717	31.9	2.2	1.0	59.0	0.3	0.0	Vert	AV	0.0	34.4	54.0	-19.6	High Ch, EUT Horz, Ant Vert, Omni
3609.750	32.0	1.7	1.9	246.0	0.3	0.0	Horz	AV	0.0	34.0	54.0	-20.0	Low Ch, EUT Vert, Ant Vert, Omni
7416.883	38.9	14.3	1.0	191.0	0.0	0.0	Vert	PK	0.0	53.2	74.0	-20.8	High Ch, EUT Horz, Ant Vert, Omni
7417.167	38.1	14.3	1.0	151.0	0.0	0.0	Horz	PK	0.0	52.4	74.0	-21.6	High Ch, EUT Vert, Ant Vert, Omni
9150.650	34.2	-1.9	1.8	241.0	0.3	0.0	Horz	AV	0.0	32.6	54.0	-21.4	Mid Ch, EUT Vert, Ant Vert, Omni
9148.450	32.4	-1.8	3.5	326.0	0.3	0.0	Vert	AV	0.0	30.9	54.0	-23.1	Mid Ch, EUT Horz, Ant Vert, Omni
8341.150	50.6	-4.2	2.0	309.0	0.0	0.0	Horz	PK	0.0	46.4	74.0	-27.6	High Ch, EUT Vert, Ant Vert, Omni
3707.967	42.4	2.2	1.0	255.0	0.0	0.0	Horz	PK	0.0	44.6	74.0	-29.4	High Ch, EUT Vert, Ant Vert, Omni
8341.283	47.8	-4.2	1.0	354.0	0.0	0.0	Vert	PK	0.0	43.6	74.0	-30.4	High Ch, EUT Horz, Ant Vert, Omni
2781.717	46.2	-3.1	1.0	218.0	0.0	0.0	Horz	PK	0.0	43.1	74.0	-30.9	High Ch, EUT Vert, Ant Vert, Omni
3610.933	41.4	1.7	3.9	243.0	0.0	0.0	Vert	PK	0.0	43.1	74.0	-30.9	Low Ch, EUT Horz, Ant Vert, Omni
9149.317	44.8	-1.8	1.8	241.0	0.0	0.0	Horz	PK	0.0	43.0	74.0	-31.0	Mid Ch, EUT Vert, Ant Vert, Omni
3708.208	40.8	2.2	1.0	59.0	0.0	0.0	Vert	PK	0.0	43.0	74.0	-31.0	High Ch, EUT Horz, Ant Vert, Omni
2781,400	46.0	-3.1	1.0	1.0	0.0	0.0	Vert	PK	0.0	42.9	74.0	-31.1	High Ch, EUT Horz, Ant Vert, Omni
3609.850	40.2	1.7	1.9	246.0	0.0	0.0	Horz	PK	0.0	41.9	74.0	-32.1	Low Ch, EUT Vert, Ant Vert, Omni

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	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
9150.900	42.6	-1.9	3.5	326.0	0.0	0.0	Vert	PK	0.0	40.7	74.0	-33.3	Mid Ch, EUT Horz, Ant Vert, Omni

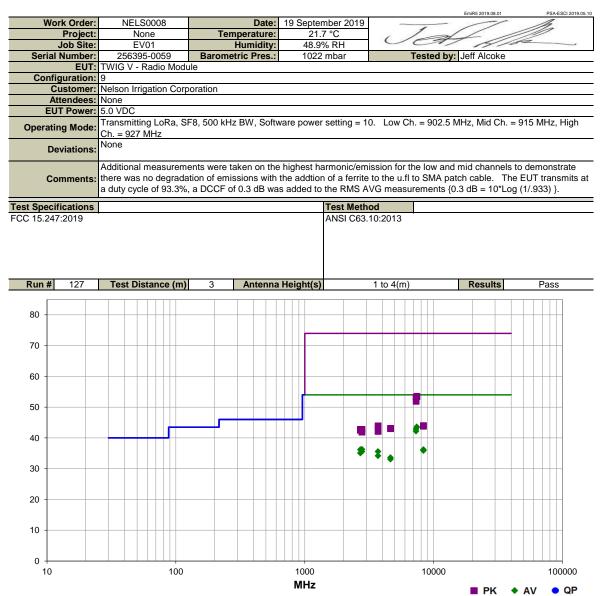


Wor	k Order:	NF	LS00	08			Date:	29) Augu	st 2019					-	~		12	
	Project:		None			Ter	nperature:	20	23.2				1	/	/		1	1	
	lob Site:		EV01			101	Humidity:		46.5%		C	/	-	2	15	1/2	6		
	Number:		395-0			Barom	etric Pres.:		1013			7	este	d hv:	Jeff Alc	oke			
oonan	EUT:					Baronna			1010	mbai			0010	a 89. [c	2011 7 110	0110			
Config	uration:				.cuulo														
		Nelson	rrigat	ion C	orpora	ation													
	endees:		mgaa		orpore														
		5.0 VDC	:																
Operatin				LoRa	, SF8,	500 kH	z BW, Softw	/are p	ower	setting = 1	0. Lov	v Ch.	= 90	2.5 M⊦	Iz, Mid	Ch. =	915 N	1Hz	
Dev	viations:	None																	
Cor	nments:						el, EUT orier).3 dB was a												at a
st Specifi	cations	1								Test Met	hod								
C 15.247:										ANSI C63		3							
Run #	66	Test	Dista	nce ((m)	3	Antenna	Heig	jht(s)		1 to 4	(m)			Resu	lts		Pass	
Run #	66	Test	Dista	nce ((m)	3	Antenna	Heig	jht(s)		1 to 4	(m)			Resu	lts		Pass	
	66	Test	Dista	nce ((m)	3	Antenna	Heig	jht(s)		1 to 4	(m)			Resu	lts		Pass	
Run #	66	Test	Dista	nce ((m)	3	Antenna	Heig	iht(s)		1 to 4	(m)			Resu	lts		Pass	
	66	Test	Dista	nce ((m)	3	Antenna	Heig	ıht(s)		1 to 4	(m)			Resu	lts		Pass	
	66	Test	Dista	nce ((m)	3	Antenna	Heig	pht(s)		1 to 4	(m)			Resu	Its		Pass	
80	66	Test	Dista	nce (m)	3	Antenna	Heig	pht(s)		1 to 4	(m)			Resu			Pass	
80	66	Test		nce ('m)	3	Antenna	Heig	Jht(s)		1 to 4	(m)			Resu			Pass	
80	66	Test		nce ('m)	3	Antenna	Heig	liht(s)		1 to 4	(m)			Resu			Pass	
80	66	Test			m)	3	Antenna	Heig	Jht(s)		1 to 4	(m)			Resu			Pass	
80	66	Test		nce (m)	3	Antenna	Heig	Jht(s)		1 to 4	(m)			Resu			Pass	
80	66	Test	Dista		m)	3	Antenna	Heig	Jht(s)		1 to 4	(m)			Resu			Pass	
80	66	Test			(m)	3	Antenna	Heig	Jht(s)		1 to 4	(m)			Resu			Pass	
80	66	Test			m)	3	Antenna	Heig	Jht(s)		1 to 4	(m)			Resu			Pass	
80	66	Test			m)	3	Antenna	Heig	Jht(s)		1 to 4	(m)			Resu			Pass	
80	66	Test			m)	3	Antenna	Heig			1 to 4	(m)			Resu			Pass	
80	66				m)	3	Antenna	Heig				(m)			Resu			Pass	
80 70 60 50 40	66				m)	3	Antenna	Heig	Jht(S)		1 to 4	(m)			Resu			Pass	
80 70 60 50 40 30					m)	3	Antenna		uht(s)		1 to 4	(m)			Resu			Pass	
80 70 60 50 40					m)	3	Antenna		yht(s)		1 to 4	(m)			Resu			Pass	
80 70 60 50 40 30					m)	3	Antenna		yht(s)		1 to 4	(m)			Resu				
80 70 60 50 40 30					m)	3	Antenna	Heig			1 to 4	(m)							
80 70 60 50 40 30 20					m)	3	Antenna		<pre> </pre>		1 to 4	(m)							
80 70 60 50 40 30 20					m)	3	Antenna				1 to 4	(m)							
80 70 60 50 40 30 20 10 0						3	Antenna				1 to 4	(m)			Resu				
80 70 60 50 40 30 20 10					m)	3	Antenna		ht(s)		1 to 4							Pass	0000

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Freq (MHz)	Amplitude (dBuV)	Factor (dB)	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
7320.867	29.2	13.1	1.5	103.0	0.3	0.0	Horz	AV	0.0	42.6	54.0	-11.4	Mid Ch, EUT Vert, Ant Vert, Yagi
7321.883	28.6	13.1	3.2	133.0	0.3	0.0	Vert	AV	0.0	42.0	54.0	-12.0	Mid Ch, EUT Horz, Ant Horz, Yagi
2745.050	41.1	-3.4	3.6	18.0	0.3	0.0	Vert	AV	0.0	38.0	54.0	-16.0	Mid Ch, EUT Horz, Ant Horz, Yagi
2707.650	40.3	-3.4	4.0	23.0	0.3	0.0	Vert	AV	0.0	37.2	54.0	-16.8	Low Ch, EUT Horz, Ant Horz, Yagi
2745.167	40.1	-3.4	1.7	11.0	0.3	0.0	Horz	AV	0.0	37.0	54.0	-17.0	Mid Ch, EUT Vert, Ant Vert, Yagi
3609.767	33.9	1.7	1.0	207.0	0.3	0.0	Horz	AV	0.0	35.9	54.0	-18.1	Low Ch, EUT Vert, Ant Vert, Yagi
3659.717	32.5	2.1	3.4	144.0	0.3	0.0	Horz	AV	0.0	34.9	54.0	-19.1	Mid Ch, EUT Vert, Ant Vert, Yagi
2707.617	37.7	-3.4	2.8	217.0	0.3	0.0	Horz	AV	0.0	34.6	54.0	-19.4	Low Ch, EUT Vert, Ant Vert, Yagi
9148.283	36.0	-1.8	2.3	192.0	0.3	0.0	Vert	AV	0.0	34.5	54.0	-19.5	Mid Ch, EUT Horz, Ant Horz, Yagi
3660.133	32.1	2.1	1.6	89.0	0.3	0.0	Vert	AV	0.0	34.5	54.0	-19.5	Mid Ch, EUT Horz, Ant Horz, Yagi
9148.583	35.1	-1.8	3.3	130.0	0.3	0.0	Horz	AV	0.0	33.6	54.0	-20.4	Mid Ch, EUT Vert, Ant Vert, Yagi
9148.700	35.1	-1.8	1.5	305.0	0.3	0.0	Vert	AV	0.0	33.6	54.0	-20.4	Mid Ch, EUT Horz, Ant Vert, Yagi
9148.417	35.0	-1.8	1.4	207.0	0.3	0.0	Vert	AV	0.0	33.5	54.0	-20.5	Mid Ch, EUT on Side, Ant Vert, Yagi
9148.750	34.9	-1.8	2.5	195.0	0.3	0.0	Vert	AV	0.0	33.4	54.0	-20.6	Mid Ch, EUT on Side, Ant Horz, Yagi
3609.617	31.4	1.7	2.1	71.0	0.3	0.0	Vert	AV	0.0	33.4	54.0	-20.6	Low Ch, EUT Horz, Ant Horz, Yagi
7320.150	39.9	13.1	1.5	103.0	0.0	0.0	Horz	PK	0.0	53.0	74.0	-21.0	Mid Ch, EUT Vert, Ant Vert, Yagi
4512.967	28.6	4.0	1.5	241.0	0.3	0.0	Horz	AV	0.0	32.9	54.0	-21.1	Low Ch, EUT Vert, Ant Vert, Yagi
4516.350	28.5	3.9	1.5	356.0	0.3	0.0	Vert	AV	0.0	32.7	54.0	-21.3	Low Ch, EUT Horz, Ant Horz, Yagi
9148.217	34.0	-1.8	1.4	80.0	0.3	0.0	Horz	AV	0.0	32.5	54.0	-21.5	Mid Ch, EUT Vert, Ant Horz, Yagi
9150.583	33.7	-1.9	3.0	191.0	0.3	0.0	Horz	AV	0.0	32.1	54.0	-21.9	Mid Ch, EUT on Side, Ant Vert, Yagi
7322.650	39.0	13.1	3.2	133.0	0.0	0.0	Vert	PK	0.0	52.1	74.0	-21.9	Mid Ch, EUT Horz, Ant Horz, Yagi
9148.433	33.5	-1.8	1.5	64.0	0.3	0.0	Vert	AV	0.0	32.0	54.0	-22.0	Mid Ch, EUT Vert, Ant Vert, Yagi
9025.033	33.6	-1.9	3.6	178.0	0.3	0.0	Vert	AV	0.0	32.0	54.0	-22.0	Low Ch, EUT Horz, Ant Horz, Yagi
9149.217	33.3	-1.8	1.5	68.0	0.3	0.0	Vert	AV	0.0	31.8	54.0	-22.2	Mid Ch, EUT Vert, Ant Horz, Yagi
9023.483	33.5	-2.1	1.5	14.0	0.3	0.0	Horz	AV	0.0	31.7	54.0	-22.3	Low Ch, EUT Vert, Ant Vert, Yagi

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	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
9148.900	33.1	-1.8	1.5	142.0	0.3	0.0	Horz	AV	0.0	31.6	54.0	-22.4	Mid Ch, EUT on Side, Ant Horz, Yaqi
9148.367	32.9	-1.8	3.3	44.0	0.3	0.0	Horz	AV	0.0	31.4	54.0	-22.6	Mid Ch, EUT Horz, Ant Horz, Yagi
9148.567	32.1	-1.8	2.6	46.0	0.3	0.0	Horz	AV	0.0	30.6	54.0	-23.4	Mid Ch, EUT Horz, Ant Vert, Yaqi
2744.200	47.1	-3.5	3.6	18.0	0.0	0.0	Vert	PK	0.0	43.6	74.0	-30.4	Mid Ch, EUT Horz, Ant Horz, Yagi
3661.167	41.4	2.1	1.6	89.0	0.0	0.0	Vert	PK	0.0	43.5	74.0	-30.5	Mid Ch, EUT Horz, Ant Horz, Yagi
3609.483	41.8	1.7	1.0	207.0	0.0	0.0	Horz	PK	0.0	43.5	74.0	-30.5	Low Ch, EUT Vert, Ant Vert, Yagi
9149.000	45.2	-1.8	2.3	192.0	0.0	0.0	Vert	PK	0.0	43.4	74.0	-30.6	Mid Ch, EUT Horz, Ant Horz, Yagi
2707.267	46.8	-3.4	4.0	23.0	0.0	0.0	Vert	PK	0.0	43.4	74.0	-30.6	Low Ch, EUT Horz, Ant Horz, Yagi
4510.033	39.2	4.0	1.5	241.0	0.0	0.0	Horz	PK	0.0	43.2	74.0	-30.8	Low Ch, EUT Vert, Ant Vert, Yagi
9152.317	45.0	-1.9	3.3	130.0	0.0	0.0	Horz	PK	0.0	43.1	74.0	-30.9	Mid Ch, EUT Vert, Ant Vert, Yagi
4512.767	39.1	4.0	1.5	356.0	0.0	0.0	Vert	PK	0.0	43.1	74.0	-30.9	Low Ch, EUT Horz, Ant Horz, Yagi
3659.767	40.9	2.1	3.4	144.0	0.0	0.0	Horz	PK	0.0	43.0	74.0	-31.0	Mid Ch, EUT Vert, Ant Vert, Yagi
9148.100	44.7	-1.8	3.0	191.0	0.0	0.0	Horz	PK	0.0	42.9	74.0	-31.1	Mid Ch, EUT on Side, Ant Vert, Yagi
9151.550	44.8	-1.9	1.5	305.0	0.0	0.0	Vert	PK	0.0	42.9	74.0	-31.1	Mid Ch, EUT Horz, Ant Vert, Yagi
3609.167	41.2	1.7	2.1	71.0	0.0	0.0	Vert	PK	0.0	42.9	74.0	-31.1	Low Ch, EUT Horz, Ant Horz, Yagi
2745.267	46.2	-3.4	1.7	11.0	0.0	0.0	Horz	PK	0.0	42.8	74.0	-31.2	Mid Ch, EUT Vert, Ant Vert, Yagi
9147.867	44.6	-1.8	1.4	207.0	0.0	0.0	Vert	PK	0.0	42.8	74.0	-31.2	Mid Ch, EUT on Side, Ant Vert, Yagi
9148.333	44.5	-1.8	2.5	195.0	0.0	0.0	Vert	PK	0.0	42.7	74.0	-31.3	Mid Ch, EUT on Side, Ant Horz, Yagi
9147.750	43.6	-1.8	1.5	64.0	0.0	0.0	Vert	PK	0.0	41.8	74.0	-32.2	Mid Ch, EUT Vert, Ant Vert, Yagi
9149.000	43.6	-1.8	1.4	80.0	0.0	0.0	Horz	PK	0.0	41.8	74.0	-32.2	Mid Ch, EUT Vert, Ant Horz, Yagi
9148.300	43.6	-1.8	1.5	142.0	0.0	0.0	Horz	PK	0.0	41.8	74.0	-32.2	Mid Ch, EUT on Side, Ant Horz, Yagi
2706.917	45.2	-3.4	2.8	217.0	0.0	0.0	Horz	PK	0.0	41.8	74.0	-32.2	Low Ch, EUT Vert, Ant Vert, Yagi
9025.283	43.7	-1.9	1.5	14.0	0.0	0.0	Horz	PK	0.0	41.8	74.0	-32.2	Low Ch, EUT Vert, Ant Vert, Yagi
9147.517	43.5	-1.8	2.6	46.0	0.0	0.0	Horz	PK	0.0	41.7	74.0	-32.3	Mid Ch, EUT Horz, Ant Vert, Yagi
9149.950	43.4	-1.8	3.3	44.0	0.0	0.0	Horz	PK	0.0	41.6	74.0	-32.4	Mid Ch, EUT Horz, Ant Horz, Yagi
9148.017	43.1	-1.8	1.5	68.0	0.0	0.0	Vert	PK	0.0	41.3	74.0	-32.7	Mid Ch, EUT Vert, Ant Horz, Yagi
9023.533	43.4	-2.1	3.6	178.0	0.0	0.0	Vert	PK	0.0	41.3	74.0	-32.7	Low Ch, EUT Horz, Ant Horz, Yagi





Freq (MHz)	Amplitude (dBuV)	Factor (dB)	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)	Community
7444.000	20.0	44.0	1.0	404.0	0.0	0.0	Mart	AV	0.0	42.0	54.0	-10.4	Comments High Ch, EUT Horz, Ant Horz, Yagi
7414.600 7414.817	29.0 28.9	14.3 14.3	1.0	181.0 15.0	0.3 0.3	0.0 0.0	Vert Horz	AV	0.0	43.6 43.5	54.0 54.0	-10.4	High Ch, EUT Vert, Ant Vert, Yagi
7319.167	20.9	14.5	3.3	289.0	0.3	0.0	Horz	AV	0.0	43.5		-10.5	Mid Ch, EUT Vert, Ant Vert, Tagi
								AV			54.0		Mid Ch, EUT Horz, Ant Horz, Yagi
7319.117	28.8	13.1	2.6	257.0	0.3	0.0	Vert		0.0	42.2	54.0	-11.8	
2780.967	39.2	-3.2	1.0	352.0	0.3	0.0	Horz	AV	0.0	36.3	54.0	-17.7	High Ch, EUT Vert, Ant Vert, Yagi
2707.550	39.3	-3.4	2.5	87.0	0.3	0.0	Horz	AV	0.0	36.2	54.0	-17.8	Low Ch, EUT Vert, Ant Vert, Yagi
8341.567	40.1	-4.2	1.0	338.0	0.3	0.0	Vert	AV	0.0	36.2	54.0	-17.8	High Ch, EUT Horz, Ant Horz, Yagi
8341.767	39.8	-4.2	2.2	219.0	0.3	0.0	Horz	AV	0.0	35.9	54.0	-18.1	High Ch, EUT Vert, Ant Vert, Yagi
3707.967	33.1	2.2	1.0	257.0	0.3	0.0	Horz	AV	0.0	35.6	54.0	-18.4	High Ch, EUT Vert, Ant Vert, Yagi
2780.950	38.5	-3.2	1.1	16.0	0.3	0.0	Vert	AV	0.0	35.6	54.0	-18.4	High Ch, EUT Horz, Ant Horz, Yagi
2707.567	38.2	-3.4	3.9	353.0	0.3	0.0	Vert	AV	0.0	35.1	54.0	-18.9	Low Ch, EUT Horz, Ant Horz, Yagi
3707.967	31.7	2.2	3.2	65.0	0.3	0.0	Vert	AV	0.0	34.2	54.0	-19.8	High Ch, EUT Horz, Ant Horz, Yagi
4635.117	29.3	4.0	1.0	218.0	0.3	0.0	Horz	AV	0.0	33.6	54.0	-20.4	High Ch, EUT Vert, Ant Vert, Yagi
7415.367	39.2	14.3	1.0	181.0	0.0	0.0	Vert	PK	0.0	53.5	74.0	-20.5	High Ch, EUT Horz, Ant Horz, Yagi
7420.500	39.2	14.2	1.0	15.0	0.0	0.0	Horz	PK	0.0	53.4	74.0	-20.6	High Ch, EUT Vert, Ant Vert, Yagi
7316.833	40.0	13.2	3.3	289.0	0.0	0.0	Horz	PK	0.0	53.2	74.0	-20.8	Mid Ch, EUT Vert, Ant Vert, Yagi
4634.233	28.8	4.0	1.0	301.0	0.3	0.0	Vert	AV	0.0	33.1	54.0	-20.9	High Ch, EUT Horz, Ant Horz, Yagi
7322.050	38.8	13.1	2.6	257.0	0.0	0.0	Vert	PK	0.0	51.9	74.0	-22.1	Mid Ch, EUT Horz, Ant Horz, Yagi
8342.817	48.2	-4.2	1.0	338.0	0.0	0.0	Vert	PK	0.0	44.0	74.0	-30.0	High Ch, EUT Horz, Ant Horz, Yagi
3707.900	41.7	2.2	1.0	257.0	0.0	0.0	Horz	PK	0.0	43.9	74.0	-30.1	High Ch, EUT Vert, Ant Vert, Yagi
8343.367	48.0	-4.2	2.2	219.0	0.0	0.0	Horz	PK	0.0	43.8	74.0	-30.2	High Ch, EUT Vert, Ant Vert, Yagi
4638.200	39.0	4.1	1.0	301.0	0.0	0.0	Vert	PK	0.0	43.1	74.0	-30.9	High Ch, EUT Horz, Ant Horz, Yagi
4636.083	39.0	4.0	1.0	218.0	0.0	0.0	Horz	PK	0.0	43.0	74.0	-31.0	High Ch, EUT Vert, Ant Vert, Yagi

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	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
2780.517	46.0	-3.2	1.0	352.0	0.0	0.0	Horz	PK	0.0	42.8	74.0	-31.2	High Ch, EUT Vert, Ant Vert, Yagi
2707.733	46.2	-3.4	2.5	87.0	0.0	0.0	Horz	PK	0.0	42.8	74.0	-31.2	Low Ch, EUT Vert, Ant Vert, Yagi
2707.867	45.9	-3.4	3.9	353.0	0.0	0.0	Vert	PK	0.0	42.5	74.0	-31.5	Low Ch, EUT Horz, Ant Horz, Yagi
3709.483	39.9	2.2	3.2	65.0	0.0	0.0	Vert	PK	0.0	42.1	74.0	-31.9	High Ch, EUT Horz, Ant Horz, Yagi
2780.183	45.1	-3.2	1.1	16.0	0.0	0.0	Vert	PK	0.0	41.9	74.0	-32.1	High Ch, EUT Horz, Ant Horz, Yagi

SPURIOUS RADIATED EMISSIONS



Wor	k Order:	NELS0	008		Date:	29 Augus	+ 2010				1
	Project:	NELSO		Tomp	perature:	29 Augus 23.2			1	// ,	11
	Job Site:	EV0			lumidity:	46.5%		0	07	4 //	4
				Barometr					Tested		
Serial	Number:	256395-0			ic Pres.:	1013 n	Ibar		rested by	y: Jeff Alcoke	
		TWIG V - Ra	dio Modu	le							
Config	guration:	10									
		Nelson Irriga	tion Corpo	oration							
	tendees:										
EUT	T Power:	5.0 VDC									
Onorotin	g Mode:	Transmitting	LoRa, SF	⁻ 8, 500 kHz E	3W, Softwa	are power s	etting = 10). Low Ch	n. = 902.5	MHz, Mid Ch. = 9	15 MHz, Hig
operatin	ig mode.	Ch. = 927 MI	Ηz								
_		None									
Dev	viations:										
		See commer	ts helow	for Channel	ELIT orien	tation and	Antenna T	vne The	ELIT tran	smits at a duty cy	cle of 93 3%
Cor	mments:	DCCF of 0.3									
001	innento.	DCCI 010.3	ub was a		KING AVG	measureme	ms (0.5 u		y (17.933)	<i>j</i> .	
t Specifi	ications						est Metho				
C 15.247	:2019					A	NSI C63.	10:2013			
-											
Run #	72	Test Dista	ince (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
Run #	72	Test Dista	ince (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
	72	Test Dista	ince (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
80 -	72	Test Dista	ince (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
	72	Test Dista	nnce (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
80	72	Test Dista	ance (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
	72	Test Dista	ance (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
80	72	Test Dista	ance (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
80	72	Test Dista	ance (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
80	72	Test Dista	ance (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
80	72	Test Dista	ance (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
80	72	Test Dista	ance (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
80	72	Test Dista	ance (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
80	72	Test Dista	Ince (m)	3	Antenna	Height(s)		1 to 4(m)		Results	Pass
80	72	Test Dista	ance (m)	3		Height(s)		1 to 4(m)		Results	Pass
80	72	Test Dista	ance (m)	3		Height(s)		1 to 4(m)		Results	Pass
80		Test Dista	ince (m)	3		Height(s)		1 to 4(m)		Results	Pass
80 70 60 50 40	72	Test Dista		3	Antenna	Height(s)		1 to 4(m)		Results	Pass
80	72	Test Dista	ance (m)	3		Height(s)		1 to 4(m)			Pass
80 70 60 50 40	72	Test Dista	ance (m)	3		Height(s)		1 to 4(m)			Pass
80 70 60 50 40 30		Test Dista		3		Height(s)		1 to 4(m)			Pass
80 70 60 50 40		Test Dista		3		Height(s)		1 to 4(m)			Pass
80 70 60 50 40 30		Test Dista		3		Height(s)		1 to 4(m)			Pass
80 70 60 50 40 30 20		Test Dista		3		Height(s)		1 to 4(m)			Pass
80 70 60 50 40 30		Test Dista		3		Height(s)		1 to 4(m)			Pass
80 70 60 50 40 30 20		Test Dista		3		Height(s)		1 to 4(m)			Pass
80 70 60 50 40 30 20 10		Test Dista		3		Height(s)		1 to 4(m)			Pass
80 70 60 50 40 30 20		Test Dista	ance (m)	3		Height(s)		1 to 4(m)	10000		Pass

PK AV OP

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	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
9026.517	50.5	-1.9	1.0	58.0	0.3	0.0	Horz	AV	0.0	48.9	54.0	-5.1	Low ch, EUT Vert, Dipole
9026.483	47.2	-1.9	3.4	59.0	0.3	0.0	Vert	AV	0.0	45.6	54.0	-8.4	Low ch, EUT Horz, Dipole
7318.733	30.2	13.2	1.6	126.0	0.3	0.0	Vert	AV	0.0	43.7	54.0	-10.3	Mid ch, EUT Vert, Dipole
7416.433	28.9	14.3	1.1	107.0	0.3	0.0	Vert	AV	0.0	43.5	54.0	-10.5	High Ch, EUT Vert, Dipole
7414.500	28.5	14.3	3.1	166.0	0.3	0.0	Horz	AV	0.0	43.1	54.0	-10.9	High Ch, EUT Horz, Dipole
3609.800	41.0	1.7	2.7	33.0	0.3	0.0	Horz	AV	0.0	43.0	54.0	-11.0	Low ch, EUT Horz, Dipole
7319.383	29.4	13.1	1.5	360.0	0.3	0.0	Horz	AV	0.0	42.8	54.0	-11.2	Mid ch, EUT Horz, Dipole
3609.983	40.5	1.7	2.5	118.0	0.3	0.0	Horz	AV	0.0	42.5	54.0	-11.5	Low ch, EUT On Side, Dipole
2707.483	45.2	-3.4	2.6	135.0	0.3	0.0	Horz	AV	0.0	42.1	54.0	-11.9	Low ch, EUT Horz, Dipole
3609.817	39.1	1.7	1.7	207.0	0.3	0.0	Horz	AV	0.0	41.1	54.0	-12.9	Low ch, EUT Vert, Dipole
9151.633	42.5	-1.9	2.2	39.0	0.3	0.0	Vert	AV	0.0	40.9	54.0	-13.1	Mid ch, EUT Horz, Dipole
9026.600	42.4	-1.9	3.6	123.0	0.3	0.0	Horz	AV	0.0	40.8	54.0	-13.2	Low ch, EUT Horz, Dipole
2707.417	43.4	-3.4	1.0	270.0	0.3	0.0	Vert	AV	0.0	40.3	54.0	-13.7	Low ch, EUT Vert, Dipole
3610.283	38.1	1.7	3.5	269.0	0.3	0.0	Vert	AV	0.0	40.1	54.0	-13.9	Low ch, EUT Vert, Dipole
9026.567	40.8	-1.9	1.5	166.0	0.3	0.0	Vert	AV	0.0	39.2	54.0	-14.8	Low ch, EUT Vert, Dipole
3610.117	37.2	1.7	1.5	355.0	0.3	0.0	Vert	AV	0.0	39.2	54.0	-14.8	Low ch, EUT On Side, Dipole
2745.000	42.2	-3.4	2.6	137.0	0.3	0.0	Horz	AV	0.0	39.1	54.0	-14.9	Mid ch, EUT Horz, Dipole
2745.083	42.0	-3.4	3.0	217.0	0.3	0.0	Vert	AV	0.0	38.9	54.0	-15.1	Mid ch, EUT Vert, Dipole
3609.800	36.3	1.7	3.9	148.0	0.3	0.0	Vert	AV	0.0	38.3	54.0	-15.7	Low ch, EUT Horz, Dipole
3660.117	35.8	2.1	1.9	260.0	0.3	0.0	Horz	AV	0.0	38.2	54.0	-15.8	Mid ch, EUT Horz, Dipole

					Duty Cycle		Polarity/						
					Correction	External	Transducer		Distance			Compared to	
Freq	Amplitude	Factor	Antenna Height	Azimuth	Factor	Attenuation	Туре	Detector	Adjustment	Adjusted	Spec. Limit	Spec.	
(MHz)	(dBuV)	(dB)	(meters)	(degrees)	(dB)	(dB)			(dB)	(dBuV/m)	(dBuV/m)	(dB)	
													Comments
3660.217	35.2	2.1	3.8	292.0	0.3	0.0	Vert	AV	0.0	37.6	54.0	-16.4	Mid ch, EUT Vert, Dipole
2781.150	40.0	-3.2	1.0	338.0	0.3	0.0	Vert	AV	0.0	37.1	54.0	-16.9	High Ch, EUT Vert, Dipole
2780.900	39.5	-3.2	1.0	328.0	0.3	0.0	Horz	AV	0.0	36.6	54.0	-17.4	High Ch, EUT Horz, Dipole
3708.067	32.2	2.2	3.7	326.0	0.3	0.0	Horz	AV	0.0	34.7	54.0	-19.3	High Ch, EUT Horz, Dipole
9027.100	56.5	-1.9	1.0	58.0	0.0	0.0	Horz	PK	0.0	54.6	74.0	-19.4	Low ch, EUT Vert, Dipole
7414.567	39.3	14.3	3.1	166.0	0.0	0.0	Horz	PK	0.0	53.6	74.0	-20.4	High Ch, EUT Horz, Dipole
4635.367	29.1	4.0	2.6	20.0	0.3	0.0	Horz	AV	0.0	33.4	54.0	-20.6	High Ch, EUT Horz, Dipole
4635.667	29.1	4.0	1.0	338.0	0.3	0.0	Vert	AV	0.0	33.4	54.0	-20.6	High Ch, EUT Vert, Dipole
7321.517	40.0	13.1	1.6	126.0	0.0	0.0	Vert	PK	0.0	53.1	74.0	-20.9	Mid ch, EUT Vert, Dipole
7418.183	38.8	14.3	1.1	107.0	0.0	0.0	Vert	PK	0.0	53.1	74.0	-20.9	High Ch, EUT Vert, Dipole
4513.167	28.6	4.0	1.5	261.0	0.3	0.0	Vert	AV	0.0	32.9	54.0	-21.1	Low ch, EUT Vert, Dipole
3707.633	30.4	2.2	1.0	110.0	0.3	0.0	Vert	AV	0.0	32.9	54.0	-21.1	High Ch, EUT Vert, Dipole
4512.133	28.5	4.0	1.7	153.0	0.3	0.0	Horz	AV	0.0	32.8	54.0	-21.2	Low ch, EUT Horz, Dipole
7323.267	39.6	13.1	1.5	360.0	0.0	0.0	Horz	PK	0.0	52.7	74.0	-21.3	Mid ch, EUT Horz, Dipole
9027.433	53.7	-1.9	3.4	59.0	0.0	0.0	Vert	PK	0.0	51.8	74.0	-22.2	Low ch, EUT Horz, Dipole
9151.883	50.3	-1.9	2.2	39.0	0.0	0.0	Vert	PK	0.0	48.4	74.0	-25.6	Mid ch, EUT Horz, Dipole
3610.650	46.4	1.7	2.7	33.0	0.0	0.0	Horz	PK	0.0	48.1	74.0	-25.9	Low ch, EUT Horz, Dipole
9027.450	49.7	-1.9	3.6	123.0	0.0	0.0	Horz	PK	0.0	47.8	74.0	-26.2	Low ch, EUT Horz, Dipole
3609.883	45.9	1.7	2.5	118.0	0.0	0.0	Horz	PK	0.0	47.6	74.0	-26.4	Low ch, EUT On Side, Dipole
3610.300	45.1	1.7	1.7	207.0	0.0	0.0	Horz	PK	0.0	46.8	74.0	-27.2	Low ch, EUT Vert, Dipole
9026.883	48.7	-1.9	1.5	166.0	0.0	0.0	Vert	PK	0.0	46.8	74.0	-27.2	Low ch, EUT Vert, Dipole
3609.933	44.5	1.7	3.5	269.0	0.0	0.0	Vert	PK	0.0	46.2	74.0	-27.8	Low ch, EUT Vert, Dipole
2708.067	49.6	-3.4	2.6	135.0	0.0	0.0	Horz	PK	0.0	46.2	74.0	-27.8	Low ch, EUT Horz, Dipole
3609.833	43.7	1.7	1.5	355.0	0.0	0.0	Vert	PK	0.0	45.4	74.0	-28.6	Low ch, EUT On Side, Dipole
2707.717	48.6	-3.4	1.0	270.0	0.0	0.0	Vert	PK	0.0	45.2	74.0	-28.8	Low ch, EUT Vert, Dipole
3660.133	42.8	2.1	1.9	260.0	0.0	0.0	Horz	PK	0.0	44.9	74.0	-29.1	Mid ch, EUT Horz, Dipole
3610.283	43.2	1.7	3.9	148.0	0.0	0.0	Vert	PK	0.0	44.9	74.0	-29.1	Low ch, EUT Horz, Dipole
3659.583	42.7	2.1	3.8	292.0	0.0	0.0	Vert	PK	0.0	44.8	74.0	-29.2	Mid ch, EUT Vert, Dipole
2744.783	47.6	-3.4	3.0	217.0	0.0	0.0	Vert	PK	0.0	44.2	74.0	-29.8	Mid ch, EUT Vert, Dipole
2744.283	47.4	-3.5	2.6	137.0	0.0	0.0	Horz	PK	0.0	43.9	74.0	-30.1	Mid ch, EUT Horz, Dipole
2781.300	46.9	-3.1	1.0	328.0	0.0	0.0	Horz	PK	0.0	43.8	74.0	-30.2	High Ch, EUT Horz, Dipole
3708.133	41.2	2.2	3.7	326.0	0.0	0.0	Horz	PK	0.0	43.4	74.0	-30.6	High Ch, EUT Horz, Dipole
4513.683	39.1	4.0	1.5	261.0	0.0	0.0	Vert	PK	0.0	43.1	74.0	-30.9	Low ch, EUT Vert, Dipole
4508.350	39.0	4.0	1.7	153.0	0.0	0.0	Horz	PK	0.0	43.0	74.0	-31.0	Low ch, EUT Horz, Dipole
4633.100	38.9	4.0	2.6	20.0	0.0	0.0	Horz	PK	0.0	42.9	74.0	-31.1	High Ch, EUT Horz, Dipole
4634.517	38.9	4.0	1.0	338.0	0.0	0.0	Vert	PK	0.0	42.9	74.0	-31.1	High Ch, EUT Vert, Dipole
2780.633	45.9	-3.2	1.0	338.0	0.0	0.0	Vert	PK	0.0	42.7	74.0	-31.3	High Ch, EUT Vert, Dipole
3708.350	40.5	2.2	1.0	110.0	0.0	0.0	Vert	PK	0.0	42.7	74.0	-31.3	High Ch, EUT Vert, Dipole
			-								-		



XMit 2019.06.11

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.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Attenuator	Fairview Microwave	18B5W-26	RFZ	23-Jul-19	23-Jul-20
Block - DC	Fairview Microwave	SD3379	AMX	29-Mar-19	29-Mar-20
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	7-Jun-19	7-Jun-20

TEST DESCRIPTION

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.



								TbtTx 2019.08.02	XMit 2019.
EUT:	TWIG V - Radio Module						Work Order:	NELS0008	
Serial Number:	256395-0059						Date:	5-Sep-19	
Customer:	Nelson Irrigation Corporatio	on					Temperature:	23.1 °C	
Attendees:	None						Humidity:	48.6% RH	
Project:	None					E	Barometric Pres.:	1018 mbar	
Tested by:	Jeff Alcoke		Power	r: 5.0 VDC			Job Site:	EV06	
FEST SPECIFICATION	ONS			Test Method					
FCC 15.247:2019				ANSI C63.10:2013					
COMMENTS									
oforonco loval offe	set of 28.1 dB includes: DC B	Block 26 dB attenuator m	escurement cable, and ma	anufacturores natch c	able (0.2 dB state	d lose) Software no	war satting = 10		
DEVIATIONS FROM	I TEST STANDARD								
Ione									
Configuration #	11	Signature	JA.		·				
Configuration #	11	Signature	JA.		1	Number of	Value	Limit	
Configuration #	11	Signature	JA.	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
Configuration #		Signature	JA.	Pulse Width	Period				Results
.oRa, Spreading Fac		Signature	JAI,	Pulse Width 39.147 ms	Period 41.981 ms				Results N/A
oRa, Spreading Fac	ctor = 8	Signature	JA.				(%)	(%)	
oRa, Spreading Fac	ctor = 8 Low Channel, 902.5 MHz	Signature	JA.	39.147 ms	41.981 ms		(%) 93.3	(%) N/A	N/A
oRa, Spreading Fac	ctor = 8 Low Channel, 902.5 MHz Low Channel, 902.5 MHz	Signature	JAI.	39.147 ms N/A	41.981 ms N/A		(%) 93.3 N/A	(%) N/A N/A	N/A N/A
.oRa, Spreading Fac	ctor = 8 Low Channel, 902.5 MHz Low Channel, 902.5 MHz Mid Channel, 915 MHz	Signature	JA	39.147 ms N/A 39.174 ms	41.981 ms N/A 41.981 ms		(%) 93.3 N/A 93.3	(%) N/A N/A N/A	N/A N/A N/A



	Lorta, opreading	Factor = 8, Low Ch Number of	Value	Limit	
Pulse	Nidth Period	Pulses	(%)	(%)	Results
39.14		1 1	93.3	N/A	N/A
59.14	41.301113		33.3	IN/A	IN/A
Agilent Spectrum Analyzer - Element Ma					
LX RL RF 50Ω DC	SI	ENSE:INT Trig Delay-1.000 ms	ALIGN OFF #Avg Type		09:39:56 AM Sep 05, 2019
	PNO: Fast 🔸	Trig: Video	wavg type	. Log-r wi	TRACE 1 2 3 4 5 6 TYPE WWWWWW
	IFGain:Low	#Atten: 10 dB			DETPPPP
Ref Offset 28.1 dB					Mkr3 42.97 ms
5 dB/div Ref 28.10 dBm					20.66 dBm
Log		. 2	3		
23.1				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~
18.1					
13.1					
8.10					
3.10					
-1.90					
-6.90					
-11.9					TRIG LVL
-16.9					TRIG LVL
Center 902.500000 MHz					Span 0 Hz
Res BW 1.0 MHz	#VBV	V 30 kHz		Sween 7	5.36 ms (8192 pts)
				-	
MKR MODE TRC SCL X	Y	FUNCTION	FUNCTION WIDTH	FUNCI	ION VALUE
2 1					
5					=
6					
8					
9					
11					~
<		ш.			>

L	oRa, Spreading F	actor = 8, Low C	hannel, 902.5 MF	lz		
		Number of	Value	Limit		
 Pulse Width	Period	Pulses	(%)	(%)	Results	
N/A	N/A	5	N/A	N/A	N/A	

RL RF 50 Ω DC	SENSE:INT	ALIGN OFF	09:40:12 AM Sep 05, 2019
	Trig Delay-2.000 ms PNO: Fast Trig: Video IFGain:Low #Atten: 10 dB	#Avg Type: Log-Pwr	TRACE 12345 TYPE WWWWWW DET PPPP
Ref Offset 28.1 dB dB/div Ref 28.10 dBm			
	100 M 110 B 111 M 100 M 100 M 110		
2.1			
8.1			
3.1			
.10			
.10			
90			
90			
1.9			TRIG LV
5.9 			IRGE
enter 902.500000 MHz es BW 1.0 MHz	#VBW 30 kHz	Swee	Span 0 H 210.2 ms (8192 pt
		STATUS	



		oRa, Spreading F	Number of	Value	Limit	
	Pulse Width	Period	Pulses	(%)	(%)	Results
	39.174 ms	41.981 ms	1	93.3	N/A	N/A
gilent Spectrum Analyze R L RF	<mark>r - Element Materials Tecl</mark> 50 Ω DC	SENS	E:INT rig Delay-1.000 ms	ALIGN OFF	e: Log-Pwr	02:17:04 PM Sep 04, 20: TRACE 1 2 3 4 5
			'rig: Video Atten: 10 dB			TRACE 1 2 3 4 5 TYPE WWWWWW DET P P P P
Ref Offs 5 dB/div Ref 28	set 28.1 dB .10 dBm					Mkr3 42.96 m 17.84 dBr
Log						
23.1 1			2	3		
13.1			I Y			
8.10						
3.10						
-1.90						
-6.90						
-11.9						
-16.9						TRIG L
Center 915.00000	0 MHz					Span 0 H
Res BW 1.0 MHz		#VBW 3	0 kHz		Sweep 7	5.36 ms (8192 pt
MKR MODE TRC SCL	× 979.6 µ	y 15.55 dBr	FUNCTION	FUNCTION WIDTH	FUNCTI	ON VALUE
2 N 1 t	40.15 m	s 15.78 dBr	n			
3 N 1 t	42.96 m	s 17.84 dBr	n			
5 6 						
7 8 11 11 11 11 11 11 11 11 11 11 11 11 11						
9						
11						>
MSG				STATUS		
MSG						

		LoRa, Spreading	Factor = 8, Mid C	Channel, 915 MHz	2		
			Number of	Value	Limit		
	Pulse Width	Period	Pulses	(%)	(%)	Results	
	N/A	N/A	5	N/A	N/A	N/A	

gilent Spectrum Analyzer - Element Materia RL RF 50 Ω DC		ALIGN OFF	02:17:25 PM Sep 04, 2019
	Trig Delay-2.000 ms PNO: Fast Trig: Video IFGain:Low #Atten: 10 dB	#Avg Type: Log-Pwr	TRACE 12345 TYPE WWWWWWW DET PPPP
Ref Offset 28.1 dB dB/div Ref 28.10 dBm			
23.1 - Разлика на на силанија и се 			
8.1			
3.1			
3.10			
3.10			
.90			
.90			
1.9			
6.9			TRIG LV
enter 915.000000 MHz es BW 1.0 MHz	#VBW 30 kHz	Sweep	Span 0 H: 210.2 ms (8192 pts
G		STATUS	



		Number of	Value	Limit	
Pulse Width	Period	Pulses	(%)	(%)	Results
39.157 ms	41.982 ms	1	93.3	Ň/Á	N/A
· · · · · · · · · · · · · · · · · · ·				·	
Agilent Spectrum Analyzer - Element Materials	Technology				
LX/ RL RF 50Ω DC		NSE:INT	ALIGN OFF		09:11:46 AM Sep 05, 2019
		Trig Delay-1.000 m		oe: Log-Pwr	TRACE 123456 TYPE WWWWWW DET PPPPP
	PNO: Fast	Trig: Video #Atten: 10 dB			DET PPPPP
	II GUILLOW				Mkr3 42.97 ms
Ref Offset 28.1 dB 5 dB/div Ref 28.10 dBm					20.13 dBm
Log		_			
23.1 Annon 23.1	*****	<u>~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~</u>	• ³ ••••••••	****	~~~~~
18.1		Ť_			
13.1					
8.10					
3.10					
-1.90					
-6.90					
-11.9					TRIG LVL
-16.9					
Center 927.000000 MHz					Span 0 Hz
Res BW 1.0 MHz	#VBW	30 kHz		Sweep 7	'5.36 ms (8192 pts)
MKR MODE TRC SCL X	Y	FUNCTION	FUNCTION WIDTH	FUNCT	ION VALUE
1 1					
4					
6					
8					
9					
10					~
<		ш.) >

LoRa, Spreading Factor = 8, High Channel, 927 MHz							
Number of Value Limit							
	Pulse Width	Period	Pulses	(%)	(%)	Results	_
	N/A	N/A	5	N/A	N/A	N/A	

RL RF 50Ω DC	SENSE:INT	ALIGN OFF	09:12:09 AM Sep 05, 2019
	Trig Delay-2.000 ms PNO: Fast Trig: Video IFGain:Low #Atten: 10 dB	s #Avg Type: Log-Pwr	TRACE 12345 TYPE WWWWWW DET PPPP
Ref Offset 28.1 dB dB/div Ref 28.10 dBm			
			Nampinanon, et al composito di altera desta data data data da
18.1			
13.1			
3.10			
3.10			
.90			
.90			
1.9			
6.9			TRIG LV
0.2			
enter 927.000000 MHz es BW 1.0 MHz	#VBW 30 kHz	Sweep	Span 0 H: 210.2 ms (8192 pts
G		STATUS	



XMit 2019.06.11

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.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Attenuator	Fairview Microwave	18B5W-26	RFZ	23-Jul-19	23-Jul-20
Block - DC	Fairview Microwave	SD3379	AMX	29-Mar-19	29-Mar-20
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	7-Jun-19	7-Jun-20

TEST DESCRIPTION

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 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.



	VIG V - Radio Module				Work Order:		
Serial Number: 256	6395-0059				Date:	5-Sep-19	
Customer: Ne	Ison Irrigation Corporation				Temperature:	23.1 °C	
Attendees: No	ne				Humidity:	48.6% RH	
Project: No	ne				Barometric Pres.:	1018 mbar	
Tested by: Jef	ff Alcoke		Power: 5.0 VDC		Job Site:	EV06	
TEST SPECIFICATION	S		Test Method				
FCC 15.247:2019			ANSI C63.10:2013				
	of 28.1 dB includes: DC Block, 26 dB attenu loss) = 11 dBi. Conducted output power lin			cable (0.2 dB stated loss). So	ftware power setting = 10.	Maximum antenna	assembly gain
Reference level offset (Antenna Gain + Cable DEVIATIONS FROM TE	e loss) = 11 dBi. Conducted output power lin			cable (0.2 dB stated loss). So	ftware power setting = 10.	Maximum antenna	assembly gain
Reference level offset (Antenna Gain + Cable	e loss) = 11 dBi. Conducted output power lin			cable (0.2 dB stated loss). Sol	ftware power setting = 10. I	Maximum antenna	assembly gain
Reference level offset (Antenna Gain + Cable DEVIATIONS FROM TE	e loss) = 11 dBi. Conducted output power lin	nit adjusted accordingly		cable (0.2 dB stated loss). So	ftware power setting = 10. I	Maximum antenna	assembly gain
Reference level offset (Antenna Gain + Cable DEVIATIONS FROM TE None	e loss) = 11 dBi. Conducted output power lin	nit adjusted accordingly		Cable (0.2 dB stated loss). So	ftware power setting = 10. I	Maximum antenna	assembly gain
Reference level offset Antenna Gain + Cable DEVIATIONS FROM TE None	e loss) = 11 dBi. Conducted output power lin	nit adjusted accordingly	as per 15.247(b)(4)	· · ·			assembly gain
Reference level offset Antenna Gain + Cable DEVIATIONS FROM TE None Configuration #	e loss) = 11 dBi. Conducted output power lin EST STANDARD 11 Signatu	nit adjusted accordingly	as per 15.247(b)(4)	Duty Cycle	Value	Limit	
Reference level offset Antenna Gain + Cable DEVIATIONS FROM TE Ione Configuration #	e loss) = 11 dBi. Conducted output power lin EST STANDARD 11 Signatu	nit adjusted accordingly	as per 15.247(b)(4)	Duty Cycle	Value	Limit	
Reference level offset (Antenna Gain + Cable DEVIATIONS FROM TE None Configuration #	e loss) = 11 dBi. Conducted output power lin EST STANDARD 11 Signatu	nit adjusted accordingly	as per 15.247(b)(4) Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)	Value (dBm)	Limit (dBm)	Results

-



	Avg Cond	Duty Cycle	Value	Limit	
	Pwr (dBm)	Factor (dB)	(dBm)	(dBm)	Results
	23.882	0.3	24.2	≤ 25	Pass
Agilent Spectrum Analyz	zer - Element Materials To	echnology			
Agilent Spectrum Analyz	zer - Element Materials To 50 Ω DC	echnology	ALIGN OFF #Avg Typ		09:43:03 AM Sep 05, TRACE 1 28

5 dB/div Ref 28.10 dBm		↓ 1		
23.1				
18.1				
8.10				
3.10				
-1.90				
6.90				
-11.9				
-16.9				
Center 902.500 MHz #Res BW 1.5 MHz	#VBW 5	.0 MHz*	#Swe	Span 2.500 M eep 1.001 s (1001 p

LoRa, Spreading Factor = 8, Mid Channel, 915 MHz							
		Avg Cond	Duty Cycle		Value	Limit	
		Pwr (dBm)	Factor (dB)		(dBm)	(dBm)	Results
		23.779	0.3		24.1	≤ 25	Pass

RL RF 50Ω DC	SENSE:INT	ALIGN OFF	02:48:11 PM Sep 04, 201
	PNO: Fast ↔→ Trig: Free Run IFGain:Low #Atten: 10 dB	#Avg Type: RMS Avg Hold: 100/100	TRACE 12345 TYPE A WANNA DET A A A A A
Ref Offset 28.1 dB dB/div Ref 28.10 dBm		MI	r1 914.962 5 MH 23.779 dBr
3.1	1		
3.1			man and a state of the state of
3.1			
10			
10			
90			
30			
.99			
.9			
			6non 2 500 M
enter 915.000 MHz Res BW 1.5 MHz	#VBW 5.0 MHz*	#Swe	Span 2.500 MH ep 1.001 s (1001 pt
G		STATUS	



PN0: Fast IFGain.Low Trig: Free Run WAtten: 10 dB #Avg Type: RMS Avg Hold: 100/100 Trace IF as a set of the field of the fie		Avg Cond	Duty Cycle		Value	Limit		
Allow OFF RE S0 2 DC SENSE:INT Available of the sense of		Pwr (dBm)	Factor (dB)		(dBm)	(dBm)	Results	
RL RF SO Q DC SENSE INT ALIGN OFF O9:24:59 AM Sep05, 2019 #Aug Type: RMS Avg Hold: 100/100 #Aug Type: RMS Avg Hold: 100/100 Trest 23 4 450 Trest 23 4 450 CF Ref Offset 28.1 dB Ref 28.10 dBm Mkr1 927,007 5 MHz 23.740 dBm 31 0 0 31 0 0 31 0 0 31 0 0 30 0 0 31 0 0 30 0 0 31 0 0 30 0 0 31 0 0 32 0 0 33 0 0 34 0 0 35 0 0 36 0 0 37 0 0 38 0 0 39 0 0		23.740	0.3		24.0	≤ 25	Pass	
RL RF SO Q DC SENSE INT ALIGN OFF O9:24:59 AM Sep05, 2019 #Aug Type: RMS Avg Hold: 100/100 #Aug Type: RMS Avg Hold: 100/100 Trest 23 4 450 Trest 23 4 450 CF Ref Offset 28.1 dB Ref 28.10 dBm Mkr1 927,007 5 MHz 23.740 dBm 31 0 0 31 0 0 31 0 0 31 0 0 30 0 0 31 0 0 30 0 0 31 0 0 30 0 0 31 0 0 32 0 0 33 0 0 34 0 0 35 0 0 36 0 0 37 0 0 38 0 0 39 0 0								
RL RF SO Q DC SENSE INT ALIGN OFF O9:24:59 AM Sep05, 2019 #Aug Type: RMS Avg Hold: 100/100 #Aug Type: RMS Avg Hold: 100/100 Trest 23 4 450 Trest 23 4 450 CF Ref Offset 28.1 dB Ref 28.10 dBm Mkr1 927,007 5 MHz 23.740 dBm 31 0 0 31 0 0 31 0 0 31 0 0 30 0 0 31 0 0 30 0 0 31 0 0 30 0 0 31 0 0 32 0 0 33 0 0 34 0 0 35 0 0 36 0 0 37 0 0 38 0 0 39 0 0	Agilent Spectrum Analyzer	Floment Materials Ter	hology					100
PHO: Fast IFGain: Low Trig: Free Run #Atten: 10 dB #Avg Type: RMS Avg Hold: 100/100 Trace IP 34 set Ver Mkr1 927.007 5 MHz 23.740 dBm 99 10 11 11 11 12 131 14 14 15 15 16 16 17 18 18 19 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 11 12 13 14 15 16 17 18 19 19 19 10 10 10 10 11 12 13 14 15 16 16 17 1				ENSE:INT	ALIGN OFF		09:24:59 AM Sep 05, 2019	Ð
Ref Offset 28.10 dBm Mkr1 927.007 5 MHz 23.740 dBm 09 1 <td< td=""><td></td><td></td><td></td><td></td><td>#Avg Type</td><td>: RMS</td><td>TRACE 1 2 3 4 5</td><td>6</td></td<>					#Avg Type	: RMS	TRACE 1 2 3 4 5	6
Ref Offset 28.10 dBm Mkr1 927.007 5 MHz 23.740 dBm 09 1 <td< td=""><td></td><td></td><td>PNO: Fast</td><td></td><td>Avg Hold:</td><td>100/100</td><td>DET A A A A A</td><td>Å</td></td<>			PNO: Fast		Avg Hold:	100/100	DET A A A A A	Å
dg/div Ref 28.10 dBm 09 1 11 1 131 1 141 1 151 1 161 1 171 1 182 1 183 1 184 1 184 1 184 1 184 1 184 1 184 1 184 1 184 1			IFGalli.Low	FIREEN. IV WE		Miland		-
00 1 10 1 11 1 12 1 131 1 141 1 151 1 151 1 151 1 151 1 151 1 151 1 151 1 151 1 152 1 153 1 153 1 154 1 155 <	Ref Offse	t 28.1 dB				WIKIT	23 7/0 dBn	
	5 dB/div Ref 28.1	IU aBm					20.740 001	
				1				
	23.1				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
						mann.		
	18.1	and a start and a start					- man	
	TOUT MANAGE						- marine	
	42.4						~	
	13.1							
	0.40							
	8.10							
1.90	3.10							
1.90								
6.9	-1.90							1
6.9								
6.9	-6.90							1
6.9								
	-11.9							
enter 927.000 MHz Span 2.500 MHz Res BW 1.5 MHz #VBW 5.0 MHz* #Sweep 1.001 s (1001 bts)	-16.9							
enter 927.000 MHz Span 2.500 MHz Span 2.500 MHz Res BW 1.5 MHz #VBW 5.0 MHz* #Sweep 1.001 s (1001 bts)								
Res BW 1.5 MHz #VBW 5.0 MHz* #Sweep 1.001 s (1001 bts)	Cepter 927 000 MH	7					Span 2 500 MH	
	#Res BW 1.5 MHz	2	#VB	V 5.0 MHz*		#Sween	1.001 s (1001 nts	ŝ.



XMit 2019.06.11

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.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Attenuator	Fairview Microwave	18B5W-26	RFZ	23-Jul-19	23-Jul-20
Block - DC	Fairview Microwave	SD3379	AMX	29-Mar-19	29-Mar-20
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	7-Jun-19	7-Jun-20

TEST DESCRIPTION

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 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 antenna gain/s of the EUT was then added to the conducted output power to derive the EIRP Values



XMit 2019.06.1 EUT: TWIG V - Radio Module Serial Number: 256395-0059 Customer: Nelson Irrigation Corporation Work Order: NELS0008 Date: 5-Sep-19 Temperature: 23.1 °C Humidity: 48.6% RH Barometric Pres.: 1018 mbar Attendees: None Project: None Tested by: Jeff Alcoke TEST SPECIFICATIONS Power: 5.0 VDC Test Method Job Site: EV06 FCC 15.247:2019 ANSI C63.10:2013 COMMENTS Reference level offset of 28.1 dB includes: DC Block, 26 dB attenuator, measurement cable, and manufacturers patch cable (0.2 dB stated loss). Software power setting = 10. Cable loss value was determined from the data sheet for CA-195R cable. The cable loss @ 900 MHz = 0.365 dB/m. The specified cable length used is 3.1 m giving a calculated cable loss of 0.365 dB/m * 3.1 m = 1.1 DEVIATIONS FROM TEST STANDARD None 1 Configuration # 11 A 6 Signature Avg Cond Pwr (dBm) Duty Cycle Factor (dB) Value (dBm) Limit (dBm) Results LoRa, Spreading Factor = 8 Low Channel, 902.5 MHz 23.882 0.3 24.2 Mid Channel, 915 MHz 23.779 0.3 24.1 High Channel, 927 MHz 23.740 0.3 24.0 -Value Cable Antenna Corrected I imit (dBm) Loss (dB) Gain (dBi) Value (dBm) (dBm) Results LoRa, Spreading Factor = 8 Internal Dipole Low Channel, 902.5 MHz Mid Channel, 915 MHz 24.2 24.1 0.0 0.0 26.2 26.1 ≤ 36 ≤ 36 2 Pass 2 Pass High Channel, 927 MHz 24.0 0.0 26.0 < 36 Pass LoRa, Spreading Factor = 8 External Yagi Antenna Low Channel, 902.5 MHz 24.2 Pass 12 35.1 ≤ 36 1.1 Mid Channel, 915 MHz High Channel, 927 MHz 24.1 24.0 1.1 1.1 35.0 34.9 ≤ 36 ≤ 36 Pass Pass 12 12 LoRa, Spreading Factor = 8 External Omnidirectional Antenna 24.2 24.1 24.0 1.1 1.1 1.1 Low Channel, 902.5 MHz Mid Channel, 915 MHz 8 8 31.1 31.0 ≤ 36 ≤ 36 Pass Pass High Channel, 927 MHz 8 30.9 < 36 Pass



			Factor = 8, Low C	hannel, 902.5 Mi		
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)		Value (dBm)	Limit (dBm)	Results
	23.882	0.3		24.2	-	-
Ref Off	er - Element Materials Te 50 Ω DC set 28.1 dB 3.10 dBm		vse:INT Trig: Free Run #Atten: 10 dB	ALIGN OFF #Avg Type Avg Hold:	100/100	09:43:03 AM Sep 05, 2019 TRACE 12 3 4 5 6 TYPE A A A A A 902.502 5 MHz 23.882 dBm
23.1			1			mmmmmm
18.1						
8.10 3.10						
-1.90						
-11.9						
Center 902.500 M #Res BW 1.5 MH		#VBW	5.0 MHz*		#Sweep	Span 2.500 MHz 1.001 s (1001 pts)
MSG				STATUS		
		LoRa, Spreading	Factor = 8, Mid 0			
	Avg Cond Pwr (dBm)	Duty Cycle Factor (dB)		Value (dBm)	Limit (dBm)	Results
	23.779	0.3		24.1		-

LoRa, Spreading Factor = 8, Mid Channel, 915 MHz						
Avg Cond	Duty Cycle		Value	Limit		
 Pwr (dBm)	Factor (dB)		(dBm)	(dBm)	Results	_
23.779	0.3		24.1	-	-	

RL RF 50Ω DC	SENSE:INT	ALIGN	OFF	02:48:11 PM Sep 04, 201
	PNO: Fast Trig: F	#/	Avg Type: RMS vg Hold: 100/100	TRACE 1 2 3 4 5 TYPE A WWWW DET A A A A A
Ref Offset 28.1 dB B/div Ref 28.10 dBm			Mk	r1 914.962 5 MH 23.779 dBr
g		↓ 1		
				www.www.www.
10				
10				
20				
30				
9				
.9				
				S non 2 500 M
enter 915.000 MHz tes BW 1.5 MHz	#VBW 5.0 N	1Hz*	#Swe	Span 2.500 MH ep 1.001 s (1001 pt



	Avg Cond	Duty Cycle	, <u>,</u>	Channel, 927 MH: Value	Limit	
	Pwr (dBm)	Factor (dB)		(dBm)	(dBm)	Results
	23.740	0.3		24.0	-	-
	zer - Element Materials Te 50 Ω DC		SENSE:INT	ALIGN OFF		09:24:59 AM Sep 05, 2019
	30 x DC			#Avg Type:	RMS	TRACE 1 2 3 4 5 6
		PNO: Fast ++-	Trig: Free Run #Atten: 10 dB	Avg Hold: 1	100/100	TYPE A WAAAAAAA DET A A A A A A
		IFGain:Low	#Atten. 10 dB			
RefOf	fset 28.1 dB				WKr	1 927.007 5 MHz
5 dB/div Ref 2	8.10 dBm					23.740 dBm
			1			
23.1						
	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			min	
18.1	and a second and a second a se					man
1011						- months
10.1						
13.1						
8.10						
3.10						
-1.90						
-6.90						
-11.9						
-16.9						
Center 927.000	MH7	I				Span 2.500 MHz
#Res BW 1.5 MH		#VB	W 5.0 MHz*		#Sweet	5 1.001 s (1001 pts)

# **BAND EDGE COMPLIANCE**



XMit 2019.06.11

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.

#### **TEST EQUIPMENT**

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Attenuator	Fairview Microwave	18B5W-26	RFZ	23-Jul-19	23-Jul-20
Block - DC	Fairview Microwave	SD3379	AMX	29-Mar-19	29-Mar-20
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	7-Jun-19	7-Jun-20

#### TEST DESCRIPTION

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.

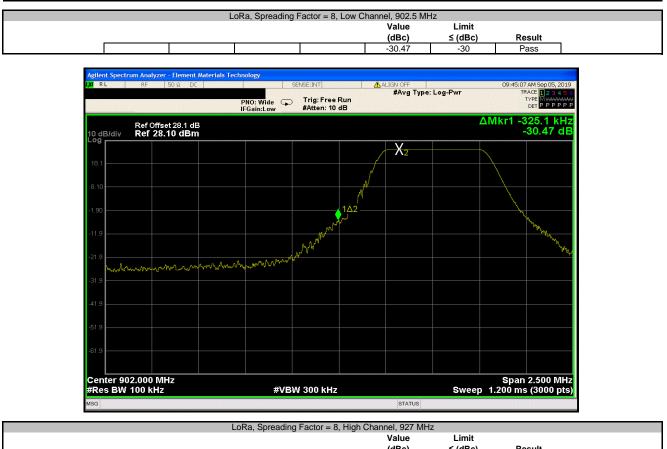
### **BAND EDGE COMPLIANCE**



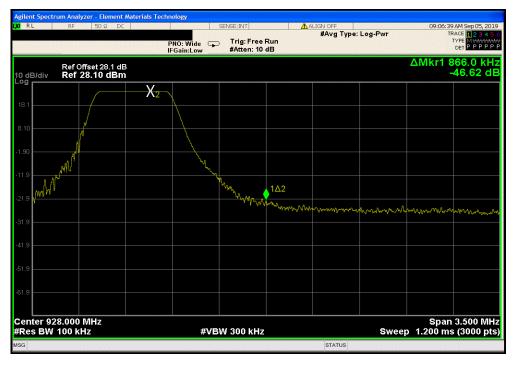
EUT:	TWIG V - Radio Module		Work Order:	NELS0008	
Serial Number:	256395-0059			5-Sep-19	
Customer:	Nelson Irrigation Corporation		Temperature:	23.1 °C	
Attendees:	None		Humidity:	48.5% RH	
Project:	None		Barometric Pres.:	1017 mbar	
Tested by:	Jeff Alcoke	Power: 5.0 VDC	Job Site:	EV06	
TEST SPECIFICATI	IONS	Test Method			
FCC 15.247:2019		ANSI C63.10:2013			
COMMENTS					
vererence lever on	set of 20.1 ub includes. Do block, 20 ub attenuator, measurer	ment cable, and manufactureres patch cable (0.2 dB state	a 1055).		
	N TEST STANDARD	ment cable, and manufactureres patch cable (0.2 db state	ia ioss).		
DEVIATIONS FROM	M TEST STANDARD		ra 1055).		
DEVIATIONS FROM	M TEST STANDARD		Value (dBc)	Limit ≤ (dBc)	Result
DEVIATIONS FROM None	11 Signature		Value		Result
DEVIATIONS FROM None Configuration #	11 Signature		Value		Result Pass

### **BAND EDGE COMPLIANCE**





	Loria, oproaanig i	 o,			
			Value	Limit	
			(dBc)	≤ (dBc)	Result
			-46.63	-30	Pass





XMit 2019.06.11

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.

#### TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Attenuator	Fairview Microwave	18B5W-26	RFZ	23-Jul-19	23-Jul-20
Block - DC	Fairview Microwave	SD3379	AMX	29-Mar-19	29-Mar-20
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	7-Jun-19	7-Jun-20

#### TEST DESCRIPTION

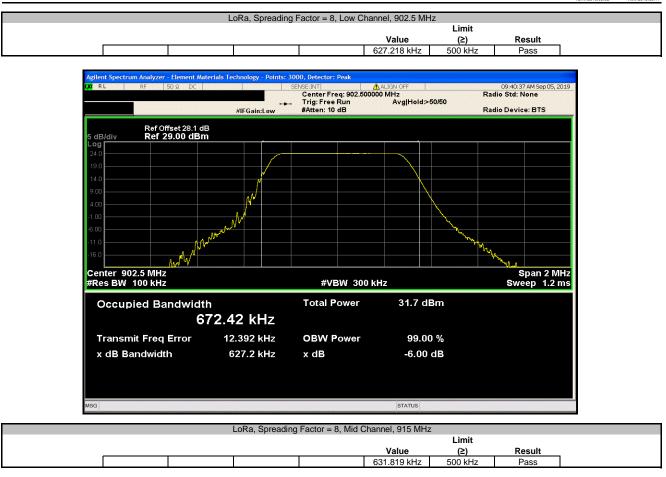
The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The EUT was set to the channels and modes listed in the datasheet.

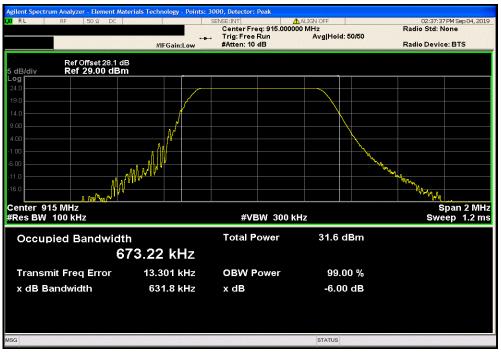
The 6dB occupied bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The 99.0% occupied bandwidth was also measured at the same time which can be needed during Output Power depending on the applicable method.



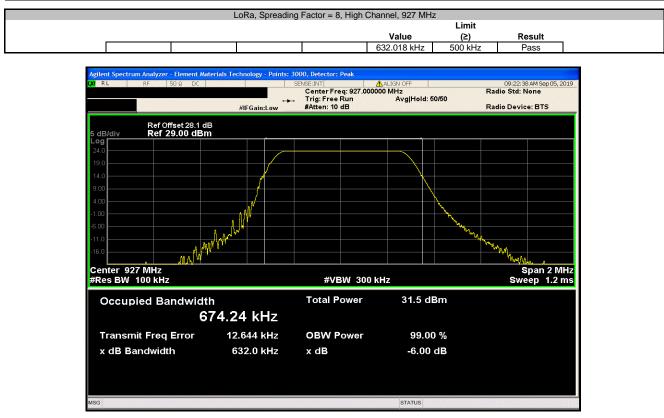
					TbtTx 2019.08.02	XMit 2019
EUT	TWIG V - Radio Module			Work Order:	NELS0008	
Serial Number	r: 256395-0059			Date:	5-Sep-19	
Customer	r: Nelson Irrigation Corporati	ion		Temperature:	23.1 °C	
Attendees	S: None			Humidity:	48.4% RH	
Project	t: None			Barometric Pres.:	1018 mbar	
Tested by	/: Jeff Alcoke		Power: 5.0 VDC	Job Site:	EV06	
TEST SPECIFICAT	TIONS		Test Method			
FCC 15.247:2019			ANSI C63.10:2013			
EVIATIONS FRO	OM TEST STANDARD					
Configuration #	11		T			
Ū		Signature	Ot Alan			
					Limit	
				Value	Limit (≥)	Result
.oRa, Spreading Fa	actor = 8			Value		Result
.oRa, Spreading Fa	actor = 8 Low Channel, 902.5 MHz			Value 627.218 kHz		Result Pass
LoRa, Spreading Fa	Low Channel, 902.5 MHz Mid Channel, 915 MHz			627.218 kHz 631.819 kHz	(≥) 500 kHz 500 kHz	Pass Pass
oRa, Spreading Fa	Low Channel, 902.5 MHz			627.218 kHz	(≥) 500 kHz	Pass













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.

#### **TEST EQUIPMENT**

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Attenuator	Fairview Microwave	18B5W-26	RFZ	23-Jul-19	23-Jul-20
Block - DC	Fairview Microwave	SD3379	AMX	29-Mar-19	29-Mar-20
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	7-Jun-19	7-Jun-20

#### TEST DESCRIPTION

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 spectrum was scanned throughout the specified frequency range.



EUT:	: TWIG V - Radio Module				Work Order:	NELS0008	
Serial Number:	256395-0059					5-Sep-19	
Customer:	Nelson Irrigation Corpora	tion			Temperature:	23.1 °C	
Attendees:					Humidity:		
Project:					<b>Barometric Pres.:</b>		
	: Jeff Alcoke		Power: 5.0 VDC		Job Site:	EV06	
TEST SPECIFICAT	IONS		Test Method				
FCC 15.247:2019			ANSI C63.10:2013				
COMMENTS							
		Dioon, 20 all alternation, measu	urement cable, and manufactureres patch cable (0.2 dB sta				
DEVIATIONS FROM None	M TEST STANDARD	Signature	JAI //		-		
	M TEST STANDARD		Tequency	Measured	Max Value	Limit < (dBc)	Posult
DEVIATIONS FROM None Configuration #	M TEST STANDARD		JA-M_		-	Limit ≤ (dBc)	Result
DEVIATIONS FROM None Configuration #	M TEST STANDARD		Tequency Range	Measured Freq (MHz)	Max Value (dBc)	≤ (dBc)	
DEVIATIONS FROM None	M TEST STANDARD 11 actor = 8 Low Channel, 902.5 MHz		Frequency Range Fundamental	Measured Freq (MHz) 902.28	Max Value (dBc) N/A	≤ (dBc) N/A	N/A
DEVIATIONS FROM None	M TEST STANDARD 11 actor = 8 Low Channel, 902.5 MHz Low Channel, 902.5 MHz		Tequency Range	Measured Freq (MHz) 902.28 900.97	Max Value (dBc)	≤ (dBc) N/A -30	N/A Pass
DEVIATIONS FROM None Configuration #	M TEST STANDARD 11 actor = 8 Low Channel, 902.5 MHz Low Channel, 905.5 MHz		Frequency Range Fundamental 30 MHz - 12 GHz Fundamental	Measured Freq (MHz) 902.28 900.97 914.77	Max Value (dBc) N/A -49.77 N/A	≤ (dBc) N/A -30 N/A	N/A Pass N/A
DEVIATIONS FROM	M TEST STANDARD 11 actor = 8 Low Channel, 902.5 MHz Low Channel, 902.5 MHz		Frequency Range Fundamental 30 MHz - 12 GHz	Measured Freq (MHz) 902.28 900.97	Max Value (dBc) N/A -49.77	≤ (dBc) N/A -30	N/A Pass



	LoRa, Spreadi	ng Factor = 8, Low C	hannel, 902.5 MH	lz	
	Frequency	Measured	Max Value	Limit	
	Range	Freq (MHz)	(dBc)	≤ (dBc)	Result
	Fundamental	902.28	N/A	N/A	N/A
Agilent Spectrum Analyzer CR RL RF 9 10 dB/div Ref Offse 18 1 8.10	Element Materials Technology	SENSE:INT	ALIGN OFF   #Avg Type:	Log-Pwr	09:43:44 AM Sep 05, 2019 TRACE 12 23 4 5 6 TYPE 12 3 4 5 6 TYPE 12 5 6 TYPE 12 4 5 6 TYPE 12 5 6 TYP
-1.90					
Center 902.5000 M #Res BW 100 kHz	#V	BW 300 kHz ng Factor = 8, Low C Measured	status hannel, 902.5 MH Max Value		Span 1.000 MHz .092 ms (8192 pts)
	Range	Freq (MHz)	(dBc)	≤ (dBc)	Result
	30 MHz - 12 GHz	900.97	-49.77	-30	Pass

RL	F	RF 5	50 Ω DC	Materials Techr		SENSE:INT		ALIGN				7 AM Sep 05, 201
					PNO: Fast 🖵 FGain:Low	Trig: Free #Atten: 10	Run dB	#/	∖vg Type:	Log-Pwr		TYPE MUMMUM DET P P P P P
0 dB/d	liv <b>R</b> e	ef Offsei ef 28.1	t 28.1 de IO dBm	3							Mkr1 9 -2	01.0 MH 5.63 dBr
8.1												
3.10 —												
.90												
1.9 —												
1.9		1										
1.9												
1.9												
			الله ال	and the second second	فالمقاد والمعينين والمجاهز	المرجع المرجع المالية			د مقانون و أن	فالمتحد والفقائد والفا	ماند رائلس بالأطار	and and the later of the second s
1.9 	البغمنيني	(ne on the last						and the state of t	B MA A A MARINA A A			A PARTING ON A LIGHT
51.9												
	30 MHz BW 100				#VE	SW 300 kHz				Sw	Stop eep 1.144	12.000 GH s (8192 pt
G									STATUS		~~~~	





Frequency	Measured	Max Value	Limit	
Range	Freq (MHz)	(dBc)	≤ (dBc)	Result
30 MHz - 12 GHz	1830.4	-60.06	-30	Pass

RL	RF	50 Ω D	C		SENSE:INT		ALIGN OFF		02:22:4	3 PM Sep 04, 201
				PNO: Fast 🕞 FGain:Low	Trig: Free #Atten: 10		#Avg Type:	Log-Pwr	T	RACE 12345 TYPE MWWWM DET PPPP
dB/div	Ref Off Ref 28	set 28.1 d 8.10 dBr	B n						Mkr1 1.8 -3	30 4 GH 6.00 dBr
3.1										
10										
90										
.9										
.9										
.9		•1								
.9										
.9	والمرايين المراي			A Contraction	Alaha ang sa	الموسين إنها فالعجورة	in the state of the			
.9	and a second second	and a second								
art 30 I les BW	MHz 100 kH	z		#VB	W 300 kHz			Swe	Stop ep 1.144	12.000 GH s (8192 pt
à							STATUS			





Frequency	Measured	Max Value	Limit	
Range	Freq (MHz)	(dBc)	≤ (dBc)	Result
30 MHz - 12 GHz	930.2	-52.84	-30	Pass

RL	RF	50 Ω D			SENSE	INT	🔥 AL	IGN OFF		09:26:2	3 AM Sep 05, 20:
				PNO: Fast C IFGain:Low		rig: Free Atten: 10		#Avg Type:	Log-Pwr	T	RACE 12345 TYPE MWWWWA DET PPPP
dB/div	Ref Off Ref 2	5set28.1 d 8 <b>.10 dB</b> n	B n							Mkr1 9 -2	30.2 MH 8.91 dBr
3.1											
10											
30											
.9											
.9											
.9	<b>♦</b> ¹										
9											
.9				with which	in the second			ing the last to all		والابيرية البريراتاني	a line of the second second
.9											
art 30 № tes BW		z		#V	BW 3	00 kHz			Swe	ep 1.144	12.000 GF s (8192 pt



XMit 2019.06.11

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.

#### **TEST EQUIPMENT**

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Micro-Coax	UFD150A-1-0720-200200	EVH	28-Mar-19	28-Mar-20
Attenuator	Fairview Microwave	18B5W-26	RFZ	23-Jul-19	23-Jul-20
Block - DC	Fairview Microwave	SD3379	AMX	29-Mar-19	29-Mar-20
Generator - Signal	Keysight	N5182B	TFU	5-Nov-18	5-Nov-21
Analyzer - Spectrum Analyzer	Agilent	N9010A	AFI	7-Jun-19	7-Jun-20

#### TEST DESCRIPTION

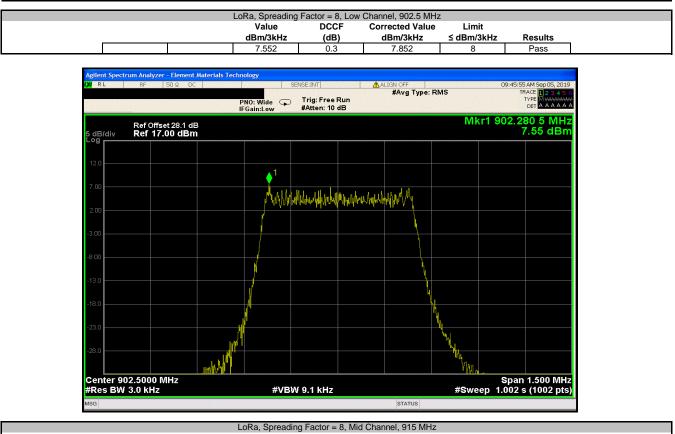
The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The power spectral density was measured using the channels and modes as called out on the following data sheets. The transmit power was set to its default maximum.

The method AVGPSD-2 in section 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, followed by a duty cycle correction. This method is allowed as the same method has been used to determine the conducted output power.



									TbtTx 2019.08.02	
EUT: T	WIG V - Radio Module							Work Order:	NELS0008	
Serial Number: 2	56395-0059							Date:	5-Sep-19	
Customer: N	lelson Irrigation Corpora	tion						Temperature: 2	23.1 °C	
Attendees: N	lone							Humidity:	48.6% RH	
Project: N	lone							Barometric Pres.:	1018 mbar	
Tested by: J	eff Alcoke			Power: 5.0	VDC			Job Site:	EV06	
EST SPECIFICATIO	NS			Te	st Method					
CC 15.247:2019				AN	SI C63.10:2013					
COMMENTS										
Reference level offse		Block, 26 dB attenuator, m	neasurement cab	ble, and manufa	ctureres patch ca	ble (0.2 dB stated	loss). Softwar	e power setting = 10.		
Reference level offse		Block, 26 dB attenuator, m	neasurement cab	ble, and manufa	ctureres patch ca	ble (0.2 dB stated	loss). Softwar	e power setting = 10.		
Reference level offse		Block, 26 dB attenuator, m	neasurement cab		ctureres patch ca	ble (0.2 dB stated	loss). Softwar	e power setting = 10.		
Reference level offse DEVIATIONS FROM 1 None	TEST STANDARD		neasurement cab		ctureres patch ca	ble (0.2 dB stated	DCCF (dB)	e power setting = 10. Corrected Value dBm/3kHz	Limit ≤ dBm/3kHz	Results
Reference level offse DEVIATIONS FROM 1 Jone Configuration #	TEST STANDARD		neasurement cab		ctureres patch ca	Value	DCCF	Corrected Value		Results
Reference level offse DEVIATIONS FROM 1 None Configuration #	TEST STANDARD		neasurement cab	ole, and manufa	ctureres patch ca	Value	DCCF	Corrected Value		Results Pass
Reference level offse DEVIATIONS FROM 1 Jone Configuration #	11 07 = 8		neasurement cab		ctureres patch ca	Value dBm/3kHz	DCCF (dB)	Corrected Value dBm/3kHz	≤ dBm/3kHz	





LoRa, Spreading Factor = 8, Mid Channel, 915 MHz									
		Value	DCCF	Corrected Value	Limit				
		dBm/3kHz	(dB)	dBm/3kHz	≤ dBm/3kHz	Results			
		7.008	0.3	7.308	8	Pass			
			0	)					

