

Carnegie Technologies

LoRa Sensor 3 Button (Model LV-PSH-173)

FCC 15.247:2019 902 - 928 MHz Transceiver

Report # CRNE0006.6





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Last Date of Test: February 27, 2019 Carnegie Technologies Model: LoRa Sensor 3 Button (Model LV-PSH-173)

Radio Equipment Testing

Standards

Specification	Method		
FCC 15.247:2019	ANSI C63.10:2013		

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	No	N/A	Not required for a battery powered EUT.
6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	
7.5	Duty Cycle	Yes	Pass	
7.8.2	Carrier Frequency Separation	Yes	Pass	
7.8.3	Number of Hopping Frequencies	Yes	Pass	
7.8.4	Dwell Time	Yes	Pass	
7.8.5	Output Power	Yes	Pass	
7.8.5	Equivalent Isotropic Radiated Power	Yes	Pass	
7.8.6	Band Edge Compliance	Yes	Pass	
7.8.6	Band Edge Compliance - Hopping Mode	Yes	Pass	
7.8.7	Occupied Bandwidth	Yes	Pass	
7.8.8	Spurious Conducted Emissions	Yes	Pass	
11.10.2	Power Spectral Density	Yes	Pass	

Deviations From Test Standards

None

Approved By:

Jeremiah Darden, Operations Manager

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

REVISION HISTORY



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

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). Certification chambers and Open Area Test Sites are filed with ISED.

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

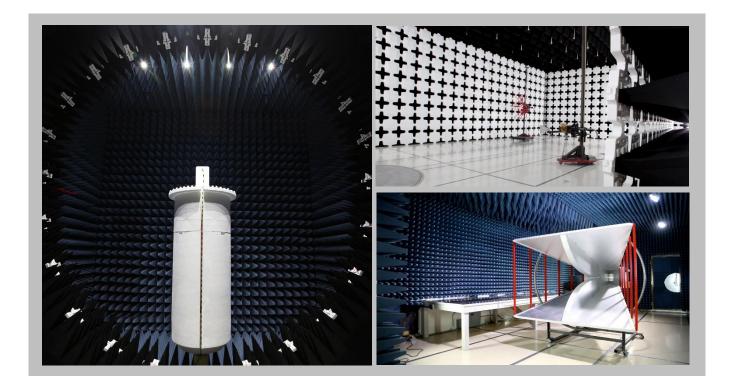
For details on the Scopes of our Accreditations, please visit: https://www.nwemc.com/emc-testing-accreditations

FACILITIES





California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	9349 W Broadway Ave. 4939 Jordan Rd. 6775 NE Evergreen Pkwy #400		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			
		NV	LAP				
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200761-0	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	N/A	2834D-1	2834G-1	2834F-1		
		BSI	MI				
SL2-IN-E-1154R	SL2-IN-E-1152R	N/A	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R		
		VC	CI				
A-0029	A-0109	N/A	A-0108	A-0201	A-0110		
	Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA						
US0158	US0175	N/A	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.

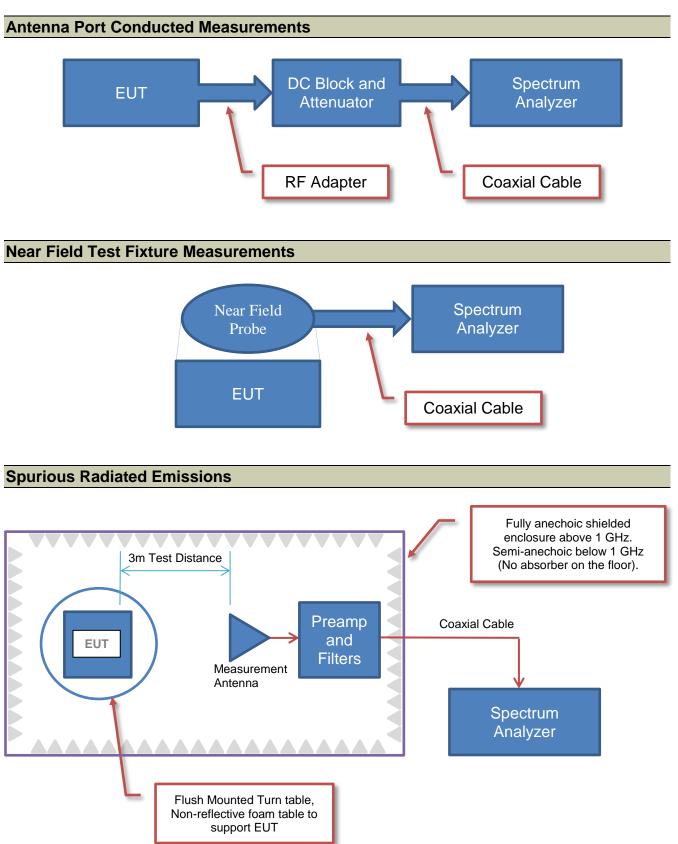
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable 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 (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	0.3 dB	-0.3 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)	5.1 dB	-5.1 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

Test Setup Block Diagrams





POWER SETTINGS



The EUT was tested using the power settings provided by the manufacturer:

SETTINGS FOR ALL TESTS IN THIS REPORT

Modulation Types / Data					
Rates	Туре	Channel	Frequency (MHz)	Power Setting	
		Low	903	10	
LoRa	DTS	Mid	909	10	
		High	915	10	
Modulation Types / Data					
Rates	Туре	Channel	Frequency (MHz)	Power Setting	
LoRa	FHSS	All	902.3-914.9	10	

PRODUCT DESCRIPTION



Client and Equipment Under Test (EUT) Information

Company Name:	Carnegie Technologies
Address:	9737 Great Hills Trail STE 260
City, State, Zip:	Austin, TX 78759
Test Requested By:	Mark Jones
Model:	LoRa Sensor 3 Button (Model LV-PSH-173)
First Date of Test:	February 26, 2019
Last Date of Test:	February 27, 2019
Receipt Date of Samples:	February 25, 2019
Equipment Design Stage:	Prototype
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:

The device has 3 buttons (Model LV-PSH-173) that send a LoRa status after being depressed.

Testing Objective:

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





Configuration CRNE0006-2

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
LoRa Sensor 3 Button	Carnegie Technologies	LV-PSH-173	1236

Configuration CRNE0006-4

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
LoRa Sensor 3 Button (Direct Connect)	Carnegie Technologies	LV-PSH-173	1237

MODIFICATIONS



Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
		Spurious	Tested as	No EMI suppression	EUT remained at
1	2019-02-26	Radiated	delivered to	devices were added or	Element following
		Emissions	Test Station.	modified during this test.	the test.
		Number of	Tested as	No EMI suppression	EUT remained at
2	2019-02-27	Hopping	delivered to	devices were added or	Element following
		Frequencies	Test Station.	modified during this test.	the test.
			Tested as	No EMI suppression	EUT remained at
3	2019-02-27	Dwell Time	delivered to	devices were added or	Element following
			Test Station.	modified during this test.	the test.
			Tested as	No EMI suppression	EUT remained at
4	2019-02-27	Output Power	delivered to	devices were added or	Element following
			Test Station.	modified during this test.	the test.
		Equivalent	Tested as	No EMI suppression	EUT remained at
5	2019-02-27	Isotropic	delivered to	devices were added or	Element following
		Radiated Power	Test Station.	modified during this test.	the test.
		Band Edge	Tested as	No EMI suppression	EUT remained at
6	2019-02-27	Compliance	delivered to	devices were added or	Element following
		•	Test Station.	modified during this test.	the test.
		Band Edge	Tested as	No EMI suppression	EUT remained at
7	2019-02-27	Compliance -	delivered to	devices were added or	Element following
		Hopping Mode	Test Station.	modified during this test.	the test.
		Occupied	Tested as	No EMI suppression	EUT remained at
8	2019-02-27	Bandwidth	delivered to	devices were added or	Element following
			Test Station.	modified during this test.	the test.
_		Spurious	Tested as	No EMI suppression	EUT remained at
9	2019-02-27	Conducted	delivered to	devices were added or	Element following
		Emissions	Test Station.	modified during this test.	the test.
		Power Spectral	Tested as	No EMI suppression	EUT remained at
10	2019-02-27	Density	delivered to	devices were added or	Element following
		-	Test Station.	modified during this test.	the test.
		Carrier	Tested as	No EMI suppression	Scheduled testing
11	2019-02-27	Frequency	delivered to	devices were added or	was completed.
		Separation	Test Station.	modified during this test.	was completed.

SPURIOUS RADIATED EMISSIONS



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

Continuously Transmitting at Low Channel 903 MHz, Mid Channel 909 MHz, High Channel 915 MHz

POWER SETTINGS INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

CRNE0006 - 2

FREQUENCY RANGE INVESTIGATED Start Frequency 30 MHz

Stop Frequency 10 GHz

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 - Low Pass	Micro-Tronics	LPM50003	ННТ	3-Aug-2018	12 mo
Filter - High Pass	Micro-Tronics	HPM50108	HGD	10-Oct-2018	12 mo
Attenuator	Weinschel Corp	4H-10	AWA	16-Mar-2018	12 mo
Attenuator	Weinschel Corp	4H-20	AWB	16-Mar-2018	12 mo
Filter - Low Pass	Micro-Tronics	LPM50004	HHV	3-Aug-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	PAK	9-Oct-2018	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-07	AJF	NCR	0 mo
Cable	Northwest EMC	8-18GHz	TXD	31-May-2018	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	PAJ	31-May-2018	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AJL	11-Oct-2018	24 mo
Cable	Northwest EMC	1-8.2 GHz	TXC	31-May-2018	12 mo
Pre-Amplifier	Fairview Microwave	FMAM63001	PAS	24-Jan-2019	12 mo
Cable	Northwest EMC	RE 9kHz - 1GHz	TXB	22-Aug-2018	12 mo
Antenna - Biconilog	ETS Lindgren	3143B	AYF	10-May-2018	24 mo
Analyzer - Spectrum Analyzer	Agilent	E4446A	AAT	21-May-2018	12 mo
Filter - Band Reject	Wainwright Instruments	WTRCTV5-750-1000-20-70-60EEK	CUL	25-Feb-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).

SPURIOUS RADIATED EMISSIONS



							EmiR5 2018.09.26	PSA-ESCI 2018.07.27		
Wor	k Order:	CRNE0006		Date:	26-Feb-2019					
	Project:	None	Ten	nperature:	21.9 °C	Jo	rathan Kief	pen		
	Job Site:	TX02		Humidity:	31.4% RH					
Serial I	Number:	1236		etric Pres.:	1025 mbar	Tes	sted by: Jonathan Kiefe	er		
	EUT:	LoRa Sensor 3 Buttor	n (Model LV	-PSH-173)						
	guration:									
Cı	ustomer:	Carnegie Technologie	es							
		Kevin Cotton								
EUT	Power:	Battery								
Operatin		Continuously Transm	ntinuously Transmitting at Low Channel 903 MHz, Mid Channel 909 MHz, High Channel 915 MHz							
Dev	viations:	None								
Coi	mments:	See the table comme	nts for EUT	channel and	prientation.					
Test Specifi	ications				Test M	ethod				
FCC 15.247:						63.10:2013				
Run #	25	Test Distance (m)	3	Antenna H	eight(s)	1 to 4(m)	Results	Pass		
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					MHz		■ PK ◆	AV OP		

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2726.900	55.0	-1.9	3.3	267.0	3.0	0.0	Horz	AV	0.0	53.1	54.0	-0.9	Mid Ch, EUT Horizontal
2709.117	53.9	-1.9	3.4	274.9	3.0	0.0	Horz	AV	0.0	52.0	54.0	-2.0	Low Ch, EUT Horizontal
3612.092	48.5	3.4	3.2	235.0	3.0	0.0	Horz	AV	0.0	51.9	54.0	-2.1	Low Ch, EUT Horizontal
3636.042	48.0	3.5	3.2	252.0	3.0	0.0	Horz	AV	0.0	51.5	54.0	-2.5	Mid Ch, EUT Horizontal
2744.975	53.4	-1.9	3.3	274.9	3.0	0.0	Horz	AV	0.0	51.5	54.0	-2.5	High Ch, EUT Horizontal
2727.067	53.1	-1.9	3.3	228.0	3.0	0.0	Horz	AV	0.0	51.2	54.0	-2.8	Mid Ch, EUT Vertical
3659.817	47.6	3.5	3.2	87.0	3.0	0.0	Horz	AV	0.0	51.1	54.0	-2.9	High Ch, EUT Horizontal
3635.850	47.1	3.5	2.8	183.0	3.0	0.0	Vert	AV	0.0	50.6	54.0	-3.4	Mid Ch, EUT Vertical
3611.892	47.0	3.4	3.1	194.0	3.0	0.0	Vert	AV	0.0	50.4	54.0	-3.6	Low Ch, EUT Vertical
2727.042	50.9	-1.9	3.2	9.0	3.0	0.0	Horz	AV	0.0	49.0	54.0	-5.0	Mid Ch, EUT On Side
3659.942	45.4	3.5	2.8	183.9	3.0	0.0	Vert	AV	0.0	48.9	54.0	-5.1	High Ch, EUT Vertical
2745.075	50.6	-1.9	3.2	273.0	3.0	0.0	Vert	AV	0.0	48.7	54.0	-5.3	High Ch, EUT Vertical
2709.100	50.2	-1.9	3.2	276.0	3.0	0.0	Vert	AV	0.0	48.3	54.0	-5.7	Low Ch, EUT Vertical
2726.900	50.0	-1.9	3.3	267.0	3.0	0.0	Vert	AV	0.0	48.1	54.0	-5.9	Mid Ch, EUT Vertical
2727.150	49.6	-1.9	1.0	343.0	3.0	0.0	Vert	AV	0.0	47.7	54.0	-6.3	Mid Ch, EUT Horizontal
2726.983	48.4	-1.9	1.1	357.0	3.0	0.0	Vert	AV	0.0	46.5	54.0	-7.5	Mid Ch, EUT On Side
4544.842	35.7	5.7	4.0	27.9	3.0	0.0	Horz	AV	0.0	41.4	54.0	-12.6	Mid Ch, EUT Horizontal
4545.033	34.4	5.7	4.0	183.9	3.0	0.0	Vert	AV	0.0	40.1	54.0	-13.9	Mid Ch, EUT Vertical

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
4514.808	34.3	5.6	3.3	218.0	3.0	0.0	Horz	AV	0.0	39.9	54.0	-14.1	Low Ch, EUT Horizontal
4514.925	33.8	5.6	3.1	184.9	3.0	0.0	Vert	AV	0.0	39.4	54.0	-14.6	Low Ch, EUT Vertical
4575.183	33.1	5.8	4.0	187.0	3.0	0.0	Vert	AV	0.0	38.9	54.0	-15.1	High Ch, EUT Vertical
2726.883	56.7	-1.9	3.3	267.0	3.0	0.0	Horz	PK	0.0	54.8	74.0	-19.2	Mid Ch, EUT Horizontal
4575.942	28.4	5.8	1.2	236.0	3.0	0.0	Horz	AV	0.0	34.2	54.0	-19.8	High Ch, EUT Horizontal
3612.042	50.4	3.4	3.2	235.0	3.0	0.0	Horz	PK	0.0	53.8	74.0	-20.2	Low Ch, EUT Horizontal
3636.142	50.2	3.5	3.2	252.0	3.0	0.0	Horz	PK	0.0	53.7	74.0	-20.3	Mid Ch, EUT Horizontal
2709.058	55.6	-1.9	3.4	274.9	3.0	0.0	Horz	PK	0.0	53.7	74.0	-20.3	Low Ch, EUT Horizontal
3636.117	49.9	3.5	2.8	183.0	3.0	0.0	Vert	PK	0.0	53.4	74.0	-20.6	Mid Ch, EUT Vertical
3659.967	49.9	3.5	3.2	87.0	3.0	0.0	Horz	PK	0.0	53.4	74.0	-20.6	High Ch, EUT Horizontal
2745.083	55.1	-1.9	3.3	274.9	3.0	0.0	Horz	PK	0.0	53.2	74.0	-20.8	High Ch, EUT Horizontal
2727.033	55.0	-1.9	3.3	228.0	3.0	0.0	Horz	PK	0.0	53.1	74.0	-20.9	Mid Ch, EUT Vertical
3611.800	49.3	3.4	3.1	194.0	3.0	0.0	Vert	PK	0.0	52.7	74.0	-21.3	Low Ch, EUT Vertical
3659.967	48.3	3.5	2.8	183.9	3.0	0.0	Vert	PK	0.0	51.8	74.0	-22.2	High Ch, EUT Vertical
2727.167	53.5	-1.9	3.2	9.0	3.0	0.0	Horz	PK	0.0	51.6	74.0	-22.4	Mid Ch, EUT On Side
2709.050	53.2	-1.9	3.2	276.0	3.0	0.0	Vert	PK	0.0	51.3	74.0	-22.7	Low Ch, EUT Vertical
2744.800	52.8	-1.9	3.2	273.0	3.0	0.0	Vert	PK	0.0	50.9	74.0	-23.1	High Ch, EUT Vertical
2726.850	52.5	-1.9	3.3	267.0	3.0	0.0	Vert	PK	0.0	50.6	74.0	-23.4	Mid Ch, EUT Vertical
2727.125	52.4	-1.9	1.0	343.0	3.0	0.0	Vert	PK	0.0	50.5	74.0	-23.5	Mid Ch, EUT Horizontal
2726.983	51.6	-1.9	1.1	357.0	3.0	0.0	Vert	PK	0.0	49.7	74.0	-24.3	Mid Ch, EUT On Side
4544.975	42.0	5.7	4.0	27.9	3.0	0.0	Horz	PK	0.0	47.7	74.0	-26.3	Mid Ch, EUT Horizontal
4545.358	41.3	5.7	4.0	183.9	3.0	0.0	Vert	PK	0.0	47.0	74.0	-27.0	Mid Ch, EUT Vertical
4515.058	41.3	5.6	3.1	184.9	3.0	0.0	Vert	PK	0.0	46.9	74.0	-27.1	Low Ch, EUT Vertical
4515.575	41.1	5.6	3.3	218.0	3.0	0.0	Horz	PK	0.0	46.7	74.0	-27.3	Low Ch, EUT Horizontal
4574.508	40.7	5.8	4.0	187.0	3.0	0.0	Vert	PK	0.0	46.5	74.0	-27.5	High Ch, EUT Vertical
4574.025	39.4	5.8	1.2	236.0	3.0	0.0	Horz	PK	0.0	45.2	74.0	-28.8	High Ch, EUT Horizontal

DUTY CYCLE



TEST DESCRIPTION

The Duty Cycle (x) were measured for each of the EUT operating modes. 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. A direct connection was made between the RF output of the EUT and a spectrum analyzer. Attenuation and a DC block were used

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

The EUT operates at 100% Duty Cycle.

CARRIER FREQUENCY SEPARATION



XMit 2017.12.13

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
Attenuator	Fairview Microwave	SA4018-20	TYW	29-Mar-18	29-Mar-19
Block - DC	Fairview Microwave	SD3379	AMM	29-Mar-18	29-Mar-19
Cable	Micro-Coax	UFD150A-1-0720-200200	TXG	10-Oct-18	10-Oct-19
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-18	19-Mar-19

TEST DESCRIPTION

The channel carrier frequencies in the 902-928 MHz band must be separated by 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater. The EUT was operated in pseudorandom hopping mode. The spectrum was scanned across two adjacent peaks. The separation between the peaks of these channels was measured.

CARRIER FREQUENCY SEPARATION



							TbtTx 2018.09.13	XMit 2017.12.1
EUT:	LoRa Sensor 3 Button (Mod	lel LV-PSH-173)				Work Order:	CRNE0006	
Serial Number:	1237					Date:	27-Feb-19	
Customer:	Carnegie Technologies					Temperature:	22.1 °C	
Attendees:	Kevin Cotton					Humidity:	46.5% RH	
Project:	None					Barometric Pres.:	1020 mbar	
	Jonathan Kiefer		Power:	Battery		Job Site:	TX09	
TEST SPECIFICATI	IONS			Test Method				
FCC 15.247:2019				ANSI C63.10:2013				
COMMENTS								
Ref Offset 20.44 dB	3 (20 dB Attenuator + DC Blo	ck + Cable).						
DEVIATIONS FROM	I TEST STANDARD							
None								
Configuration #	4	Signature	Jonathan	Kiefer				
							Limit	
						Value	(≥)	Results
Hopping Mode (All C	Channels)							
	Mid Channel, 908.9 MHz					200.27 kHz	160.197 kHz	Pass

Report No. CRNE0006.6

CARRIER FREQUENCY SEPARATION





NUMBER OF HOPPING FREQUENCIES



XMit 2017.12.13

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
Attenuator	Fairview Microwave	SA4018-20	TYW	29-Mar-18	29-Mar-19
Block - DC	Fairview Microwave	SD3379	AMM	29-Mar-18	29-Mar-19
Cable	Micro-Coax	UFD150A-1-0720-200200	TXG	10-Oct-18	10-Oct-19
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-18	19-Mar-19

TEST DESCRIPTION

The number of hopping frequencies was measured across the authorized band. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The hopping function of the EUT was enabled.

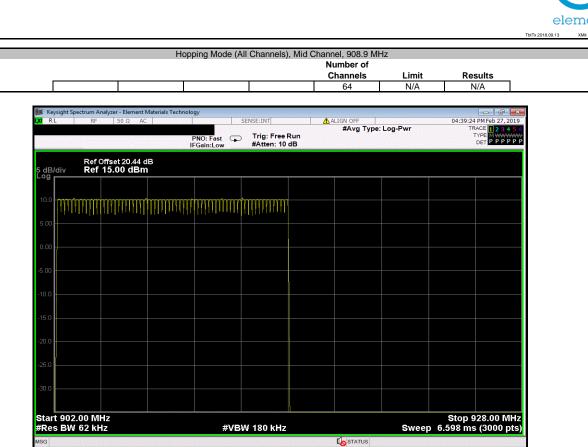
NUMBER OF HOPPING FREQUENCIES



					TbtTx 2018.09.13	XMit 2017.12.13
EUT:	LoRa Sensor 3 Button (M	odel LV-PSH-173)		Work Order:	CRNE0006	
Serial Number:	1237			Date:	27-Feb-19	
Customer:	Carnegie Technologies			Temperature:	22.2 °C	
Attendees:	Kevin Cotton			Humidity	46.3% RH	
Project:	None			Barometric Pres.:	1020 mbar	
Tested by:	Jonathan Kiefer		Power: Battery	Job Site:	TX09	
TEST SPECIFICAT	IONS		Test Method			
FCC 15.247:2019			ANSI C63.10:2013			
COMMENTS						
Ref Offset 20.44 dE	3 (20 dB Attenuator + DC E	Block + Cable).				
DEVIATIONS FROM	M TEST STANDARD					
None						
Configuration #	4	Signature	Jonathan Kiefer			
				Number of Channels	Limit	Results
Hopping Mode (All C	Channels)					
	Mid Channel, 908.9 MHz			64	N/A	N/A

Report No. CRNE0006.6

NUMBER OF HOPPING FREQUENCIES









XMit 2017.12.13

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
Attenuator	Fairview Microwave	SA4018-20	TYW	29-Mar-18	29-Mar-19
Block - DC	Fairview Microwave	SD3379	AMM	29-Mar-18	29-Mar-19
Cable	Micro-Coax	UFD150A-1-0720-200200	TXG	10-Oct-18	10-Oct-19
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-18	19-Mar-19

TEST DESCRIPTION

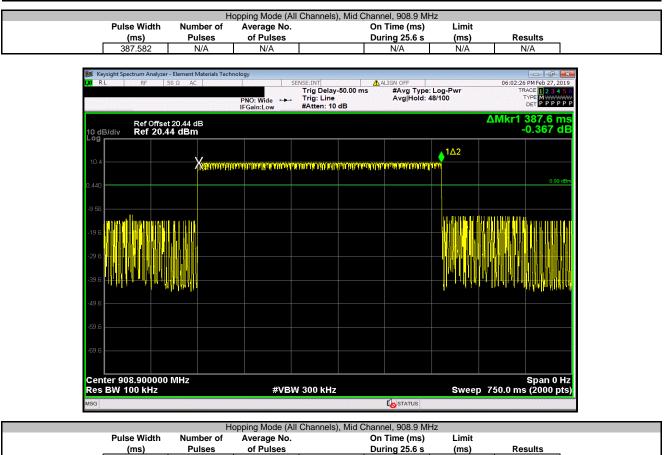
The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The average dwell time per hopping channel was measured at one hopping channel in the middle of the authorized band. The hopping function of the EUT was enabled.

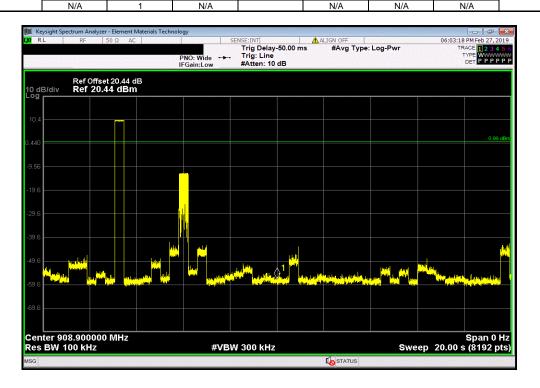
The dwell time limit is based on the Number of Hopping Channels * 400 mS. For this device it would be 64 Channels * 400mS = 25.6 Sec.



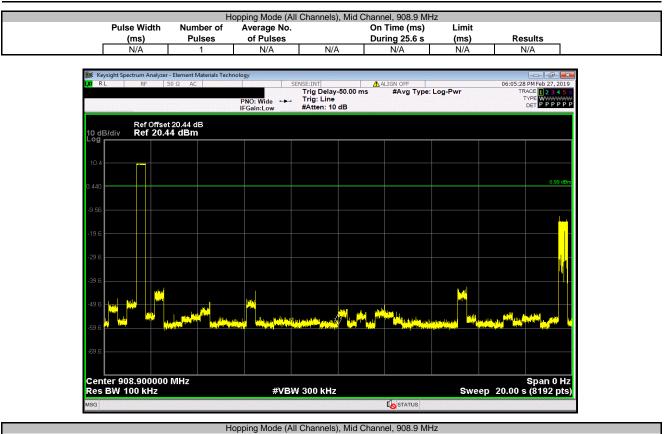
	LoRa Sensor 3 Button (Me	odel LV-PSH-173)				Work Order:		
Serial Number							27-Feb-19	
	: Carnegie Technologies					Temperature:		
	: Kevin Cotton					Humidity:		
Project						Barometric Pres.:		
	Jonathan Kiefer			Battery		Job Site:	TX09	
TEST SPECIFICAT	TIONS			Test Method				
FCC 15.247:2019				ANSI C63.10:2013				
COMMENTS								
DEVIATIONS FRO								
None Configuration #	4		Jonathan	Niefer				
None Configuration #	4	Signature	Jonathan Pulse Width (ms)	Niefer Number of Pulses	Average No. of Pulses	On Time (ms) During 25.6 s	Limit (ms)	Results
None	4 Channels)	Signature	Pulse Width (ms)	Number of Pulses	of Pulses	During 25.6 s	(ms)	
None Configuration #	4 Channels) Mid Channel, 908.9 MHz	Signature	Pulse Width (ms) 387.582	Number of	of Pulses	During 25.6 s	(ms) N/A	N/A
lone Configuration #	4 Channels) Mid Channel, 908.9 MHz Mid Channel, 908.9 MHz	Signature	Pulse Width (ms) 387.582 N/A	Number of Pulses	N/A N/A	During 25.6 s N/A N/A	(ms) N/A N/A	N/A N/A
None Configuration #	4 Channels) Mid Channel, 908.9 MHz Mid Channel, 908.9 MHz Mid Channel, 908.9 MHz	Signature	Pulse Width (ms) 387.582 N/A N/A	Number of Pulses	of Pulses N/A N/A N/A	During 25.6 s N/A N/A N/A	(ms) N/A N/A N/A	N/A N/A N/A
lone Configuration #	4 Channels) Mid Channel, 908.9 MHz Mid Channel, 908.9 MHz Mid Channel, 908.9 MHz	Signature	Pulse Width (ms) 387.582 N/A N/A N/A	Number of Pulses	of Pulses N/A N/A N/A N/A	During 25.6 s N/A N/A N/A N/A	(ms) N/A N/A N/A N/A	N/A N/A N/A N/A
lone Configuration #	4 Channels) Mid Channel, 908.9 MHz Mid Channel, 908.9 MHz Mid Channel, 908.9 MHz	Signature	Pulse Width (ms) 387.582 N/A N/A	Number of Pulses	of Pulses N/A N/A N/A	During 25.6 s N/A N/A N/A	(ms) N/A N/A N/A	N/A N/A N/A

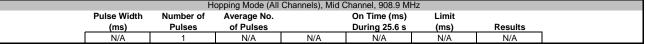


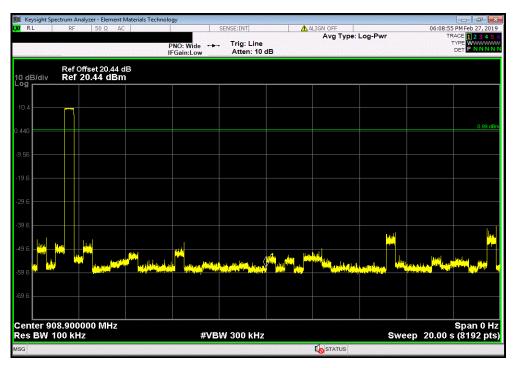














	н	opping Mode (All	Channels) M	lid Channel	908 9 MHz			
Pulse Width	Number of	Average No.	C		ne (ms)	Limit		
(ms)	Pulses	of Pulses			25.6 s	(ms)	Results	
N/A	1	N/A	N/A	N		N/A	N/A	
19/74	1	IN/A	19/73	14/		19/73	11/73	
📜 Keysight Spectrum A	nalyzer - Element Materi	als Technology	नस्मिननस्मितनस्मितनस्					
LXI RL RF	50 Ω AC		SENSE:INT	Δ	ALIGN OFF		06:13:24 PM Feb 2	7,2019
			🛶 Trig: Lir		Avg Type	e: Log-Pwr		3 4 5 6
		PNO: Wide IFGain:Low	Atten: 1	0 dB			TYPE WW DET P N	NNNN
Ref .	Offset 20.44 dB							
10 dB/div Ref	20.44 dBm	1		1		1		
10.4								
			<u>1997</u>					
								0.99 dBm
0.440								
-9.56		<u>/</u>						
-19.6								
-29.6								
-39.6								
-39.b								
				No.				
-49.6								tin and
and the state	Market Market	The second se		فأنقله فرواد	and Mahamatana	a day on busingede	a a statistica a st	
-59.6	Concepting and the pass		and a star		all of the second second second	hings himmin	ale still ^{the} grade ^{the} and ^{the} ye	
-69.6								
Center 908.900	00 MHz						Span 1.000	MHz
#Res BW 100 I	KHZ	#	VBW 300 kH	z		#Sv	veep 20.00 s (8192	2 pts)
MSG					STATUS			
					•			
	Н	opping Mode (All	Channels), N	lid Channel,	908.9 MHz			
Pulse Width	Number of	Average No.	,,		ne (ms)	Limit		
(ms)	Pulses	of Pulses			25.6 s	(ms)	Results	
387.582	N/A	1	1		.582	400	Pass	

Calculation Only

No Screen Capture Required



XMit 2017.12.13

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TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Attenuator	Fairview Microwave	SA4018-20	TYW	29-Mar-18	29-Mar-19
Block - DC	Fairview Microwave	SD3379	AMM	29-Mar-18	29-Mar-19
Cable	Micro-Coax	UFD150A-1-0720-200200	TXG	10-Oct-18	10-Oct-19
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-18	19-Mar-19

TEST DESCRIPTION

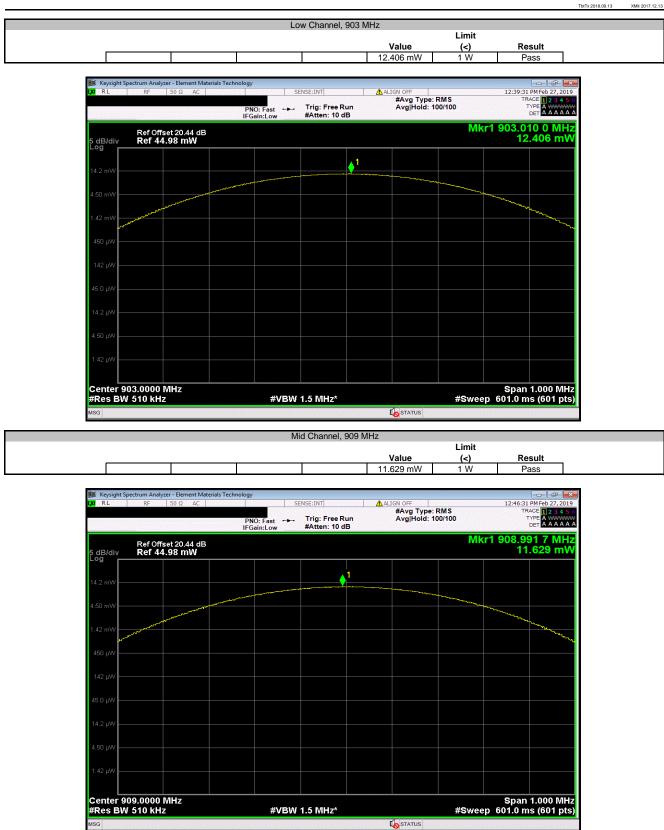
The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The fundamental emission output power (maximum average conducted output power) was measured using the channels and modes as called out on the following data sheets. The transmit power was set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

The method AVGSA-1 in section 11.9.2.2.2 of ANSI C63.10:2013 was used to make the measurement. This method uses trace averaging with the EUT transmitting at full power throughout each sweep using an RMS detector. Following the measurement a du ty cycle correction factor was applied by adding [10 log (1 / D)], where D is the duty cycle, to the measured power to compute t he average power during the actual transmission times.



EUT: Lo	Ra Sensor 3 Button (Model LV-PSH-173)		Work Order:		
Serial Number: 123	37		Date:	27-Feb-19	
Customer: Ca	arnegie Technologies		Temperature:	22.9 °C	
Attendees: Ke	evin Cotton		Humidity:	40.6% RH	
Project: No	one		Barometric Pres.:	1022 mbar	
Tested by: Jo	nathan Kiefer	Power: Battery	Job Site:	TX09	
TEST SPECIFICATION	IS	Test Method			
FCC 15.247:2019		ANSI C63.10:2013			
		1			
COMMENTS					
	0 dB Attenuator - DC Block - Cable) EUT has a BIEA anton	ana with a 2.0 dPi antonna gain			
	0 dB Attenuator + DC Block + Cable). EUT has a PIFA anten	nna with a 2.0 dBi antenna gain.			
		na with a 2.0 dBi antenna gain.			
Ref Offset 20.44 dB (20		ına with a 2.0 dBi antenna gain.			
Ref Offset 20.44 dB (20		ina with a 2.0 dBi antenna gain. Jourathan Kiefer			
Ref Offset 20.44 dB (20 DEVIATIONS FROM TE None	EST STANDARD			Limit	
Ref Offset 20.44 dB (20 DEVIATIONS FROM TE None	EST STANDARD		Value		Result
Ref Offset 20.44 dB (20 DEVIATIONS FROM TE None	EST STANDARD 4 Signature		Value 12.406 mW	Limit (<) 1 W	Result Pass
Ref Offset 20.44 dB (20 DEVIATIONS FROM TE None Configuration #	A Signature			(<)	











XMit 2017.12.13

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TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Attenuator	Fairview Microwave	SA4018-20	TYW	29-Mar-18	29-Mar-19
Block - DC	Fairview Microwave	SD3379	AMM	29-Mar-18	29-Mar-19
Cable	Micro-Coax	UFD150A-1-0720-200200	TXG	10-Oct-18	10-Oct-19
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-18	19-Mar-19

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.

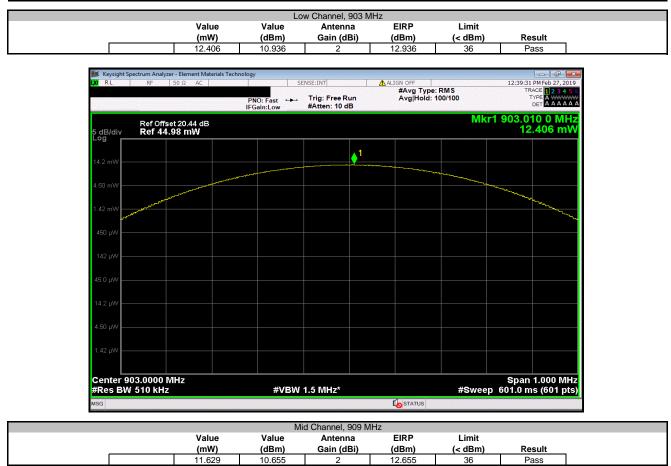
The method AVGSA-1 in section 11.9.2.2.2 of ANSI C63.10:2013 was used to make the measurement. This method uses trace averaging with the EUT transmitting at full power throughout each sweep using an RMS detector. Following the measurement a duty cycle correction factor was applied by adding [10 log (1 / D)], where D is the duty cycle, to the measured power to compute the average power during the actual transmission times.

The actual antenna gain of the EUT was added to the conducted output power to derive the EIRP values.



EUT: LoRa Sensor 3 Button (Model LV-PSH-173)					Work Order: CRNE0006				
Serial Number: 1237					Date: 27-Feb-19				
Customer: Carnegie Technologies					Temperature:	rature: 22.9 °C			
Attendees: Kevin Cotton					Humidity:				
Project: None					Barometric Pres.:				
Tested by: Jonathan Kiefer Power: Battery					Job Site:	Site: TX09			
TEST SPECIFICATION	S	Test Method							
FCC 15.247:2019 ANSI C63.10:2013									
COMMENTS									
	dP Attonuctor - DC Block - Cable) EUT has a BIEA anto	anna with a 2.0 dPi antonna gain							
Ref Offset 20.44 dB (20	0 dB Attenuator + DC Block + Cable). EUT has a PIFA ante	enna with a 2.0 dBi antenna gain.							
Ref Offset 20.44 dB (20		enna with a 2.0 dBi antenna gain.							
Ref Offset 20.44 dB (20		enna with a 2.0 dBi antenna gain.							
Ref Offset 20.44 dB (20		enna with a 2.0 dBi antenna gain. Jonathan Nie for							
Ref Offset 20.44 dB (20 DEVIATIONS FROM TI None	EST STANDARD	-	Value	Antenna	EIRP	Limit			
Ref Offset 20.44 dB (20 DEVIATIONS FROM TI None	EST STANDARD	Jonathan Kiefer	Value (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (< dBm)	Result		
Ref Offset 20.44 dB (20 DEVIATIONS FROM TI None Configuration #	4 Signature	Jonathan Niefer Value					Result Pass		
Ref Offset 20.44 dB (20 DEVIATIONS FROM TI None	4 Signature	Jonathan Niefer Value (mW)	(dBm)		(dBm)	(< dBm)			





RL	ectrum Analyzer - Element Materials RF 50 Ω AC	recimology	SENSE:INT	ALIGN OFF	12:46:31 PM Feb 27, 201			
		PNO: Fast ↔ IFGain:Low		#Avg Type: RMS Avg Hold: 100/100	TRACE 1 2 3 4 5 TYPE A WWW DET A A A A A			
dB/div og r	Ref Offset 20.44 dB Ref 44.98 mW				Mkr1 908.991 7 MH 11.629 m\			
			. 1					
.2 mW			·					
50 mW								
	- A Carlow And A Carlow A Carl				and a second and a second and a second			
42 mVV								
.50 μW								
42 µ₩								
5.0 μW								
4.2 µ₩								
50 μVV								
42 µW								
12.01								
	9.0000 MHz 510 kHz	#\/B)	N 1.5 MHz*	#9	Span 1.000 MH weep 601.0 ms (601 pt			
ig Dw		#951						



			gh Channel, 915 N			
	Value	Value	Antenna	EIRP	Limit	
	(mW)	(dBm)	Gain (dBi)	(dBm)	(< dBm)	Result
	11.106	10.456	2	12.456	36	Pass
🎉 Keysight Spectrum Analyzer - I		ology				
LXI RL RF 50	Ω AC	SI	ENSE:INT	ALIGN OFF #Avg Type	DME	12:53:10 PM Feb 27, 2019
		PNO: Fast ++-	Trig: Free Run	Avg Hold:		TRACE 1 2 3 4 5 6 TYPE A WWWW DET A A A A A A
		IFGain:Low	#Atten: 10 dB			DET A A A A A A
Ref Offset 2	20.44 dB				Mkr1	915.008 3 MHz
5 dB/div Ref 44.98	mW					11.106 mW
Log						
			▲1			
14.2 mW			V			
		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			- marine - marine	
4.50 mW	Server Warner Col					www.
and the second second	~-					. Warner and the second
1.42 mW						- alwyknowych
<del>ر</del>						
450 μW						
142 μW						
45.0 μVV						
45.0 µVV						
14.2 µVV						
14.2 µVV						
4.50 μVV						
4300 000						
1.42 µW						
1.42 JWV						
Center 915.0000 MH	Z					Span 1.000 MHz 601.0 ms (601 pts)
#Res BW 510 kHz		#VBW	1.5 MHz*		#Sweep	601.0 ms (601 pts)
MSG				<b>I</b> STATUS		

# **BAND EDGE COMPLIANCE**



XMit 2017.12.13

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	Description Manufacturer		ID	Last Cal.	Cal. Due
Attenuator	Fairview Microwave	SA4018-20	TYW	29-Mar-18	29-Mar-19
Block - DC	Fairview Microwave	SD3379	AMM	29-Mar-18	29-Mar-19
Cable	Micro-Coax	UFD150A-1-0720-200200	TXG	10-Oct-18	10-Oct-19
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-18	19-Mar-19

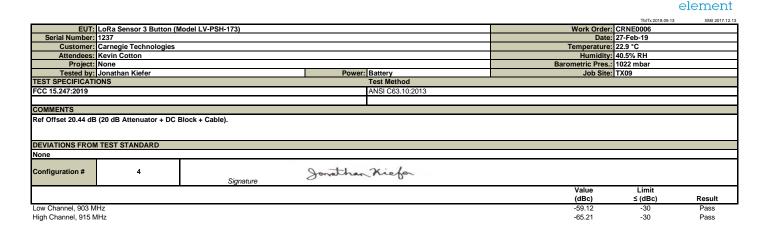
#### TEST DESCRIPTION

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.

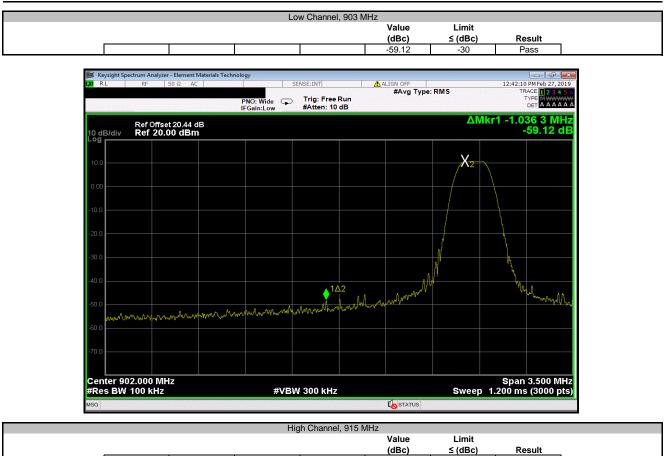
An RMS detector was used to match the method called out for Output Power. Because the reference level was taken with an RMS detector, the attenuation requirement is -30 dBc.

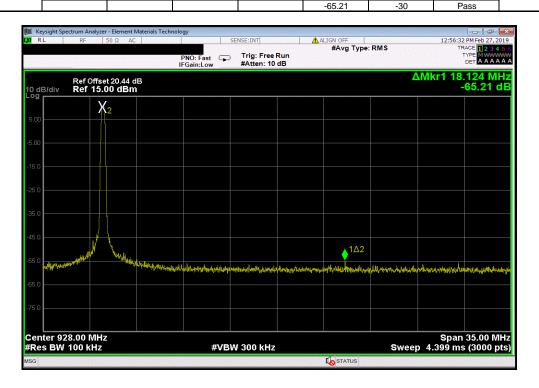
### **BAND EDGE COMPLIANCE**



### **BAND EDGE COMPLIANCE**







# **BAND EDGE COMPLIANCE - HOPPING MODE**



XMit 2017.12.13

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
Attenuator	Fairview Microwave	SA4018-20	TYW	29-Mar-18	29-Mar-19
Block - DC	Fairview Microwave	SD3379	AMM	29-Mar-18	29-Mar-19
Cable	Micro-Coax	UFD150A-1-0720-200200	TXG	10-Oct-18	10-Oct-19
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-18	19-Mar-19

#### 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 band were measured with the EUT set to its normal pseudo-random hopping sequence. 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.

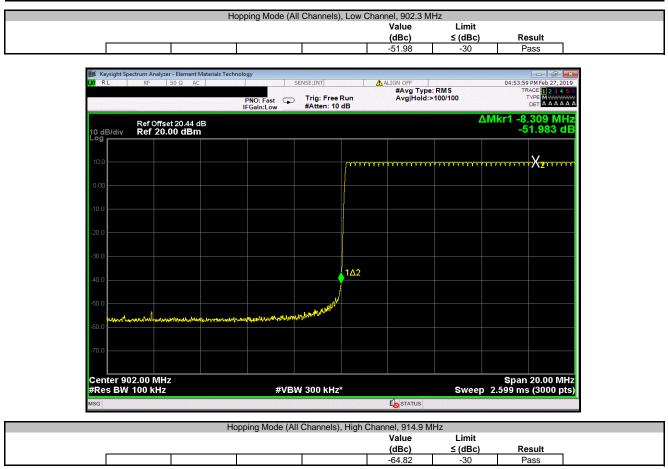
# **BAND EDGE COMPLIANCE -HOPPING MODE**

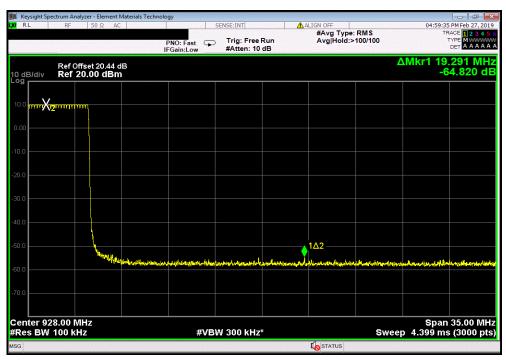


					TbtTx 2018.09.13	XMit 2017.12.13
EUT:	LoRa Sensor 3 Button (Me	odel LV-PSH-173)		Work Order:	CRNE0006	
Serial Number:	1237			Date:	27-Feb-19	
Customer:	Carnegie Technologies			Temperature:	22.1 °C	
	Kevin Cotton				46.4% RH	
Project:				Barometric Pres.:		
	Jonathan Kiefer		Power: Battery	Job Site:	TX09	
TEST SPECIFICATI	IONS		Test Method			
FCC 15.247:2019			ANSI C63.10:2013			
COMMENTS						
Ref Offset 20.44 dB	3 (20 dB Attenuator + DC B	lock + Cable).				
DEVIATIONS FROM	I TEST STANDARD					
None						
Configuration #	4	Signature	Jonathan Kiefer			
				Value (dBc)	Limit ≤ (dBc)	Result
Hopping Mode (All C	Channels)					
	Low Channel, 902.3 MHz			-51.98	-30	Pass
	High Channel, 914.9 MHz			-64.82	-30	Pass

### **BAND EDGE COMPLIANCE -HOPPING MODE**









XMit 2017.12.13

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#### TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Attenuator	Fairview Microwave	SA4018-20	TYW	29-Mar-18	29-Mar-19
Block - DC	Fairview Microwave	SD3379	AMM	29-Mar-18	29-Mar-19
Cable	Micro-Coax	UFD150A-1-0720-200200	TXG	10-Oct-18	10-Oct-19
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-18	19-Mar-19

#### 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 20dB occupied bandwidth was measured. Since there is no requirement for this type of hybrid system to comply with the 500 kHz minimum bandwidth, the measurements were taken for characterization only.



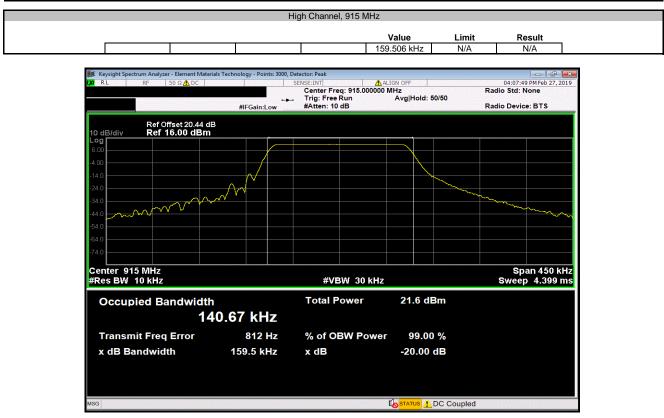
					TbtTx 2018.09.13	
	Ra Sensor 3 Button (Model	LV-PSH-173)		Work Order:		
Serial Number: 123	37				27-Feb-19	
Customer: Ca	rnegie Technologies			Temperature:	22.9 °C	
Attendees: Key				Humidity:	42.9% RH	
Project: No				Barometric Pres.:		
Tested by: Jor			Power: Battery	Job Site:	TX09	
TEST SPECIFICATIONS	S		Test Method			
FCC 15.247:2019			ANSI C63.10:2013			
COMMENTS						
None						
DEVIATIONS FROM TE	EST STANDARD					
DEVIATIONS FROM TE None	EST STANDARD					
DEVIATIONS FROM TE None	EST STANDARD					
None	EST STANDARD		Insthe Nieder			
	EST STANDARD	Signature	Jonethan Niefe			
None	EST STANDARD	Signature	Jonsthan Niefe			
None	EST STANDARD	Signature	Jonethan Niefer	Value	Limit	Result
None	4	Signature	Jonathan Kiefer	Value 159.815 kHz	Limit	Result N/A
None Configuration #	4	Signature	Jonethan Niefe			

Report No. CRNE0006.6











XMit 2017.12.13

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
Attenuator	Fairview Microwave	SA4018-20	TYW	29-Mar-18	29-Mar-19
Block - DC	Fairview Microwave	SD3379	AMM	29-Mar-18	29-Mar-19
Cable	Micro-Coax	UFD150A-1-0720-200200	TXG	10-Oct-18	10-Oct-19
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-18	19-Mar-19

#### 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.



	LoRa Sensor 3 Button (Mo	del LV-PSH-173)			Work Order:		
Serial Number:						27-Feb-19	
Customer:	: Carnegie Technologies				Temperature:	22.9 °C	
	: Kevin Cotton				Humidity:		
Project:					<b>Barometric Pres.:</b>	1022 mbar	
	: Jonathan Kiefer		Power: Battery		Job Site:	TX09	
EST SPECIFICATI	TIONS		Test Method				
CC 15.247:2019			ANSI C63.10:2013				
COMMENTS			·				
ef Offset 20.44 dB	B (20 dB Attenuator + DC Blo	ock + Cable).					
	M TEAT AT AND ADD						
	M TEST STANDARD						
DEVIATIONS FROM	M TEST STANDARD						
None	M TEST STANDARD						
	M TEST STANDARD	Sinnati ira	Jonethan Kiefer				
None	M TEST STANDARD	Signature		Measured	Max Value	Limit	
lone	M TEST STANDARD	Signature	Jonathan Kiefen Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
lone	4	Signature	Frequency	Measured Freq (MHz) 902.94			Result N/A
lone Configuration # .ow Channel, 903 M	4 MHz	Signature	Frequency Range	Freq (MHz)	(dBc)	≤ (dBc)	
None	4 WHz WHz	Signature	Frequency Range Fundamental	Freq (MHz) 902.94	(dBc) N/A	<b>≤ (dBc)</b> N/A	N/A
Configuration # Configuration # Low Channel, 903 M Low Channel, 903 M Low Channel, 903 M	4 WHz WHz WHz	Signature	Frequency Range Fundamental 30 MHz - 12.5 GHz	Freq (MHz) 902.94 2709.43	(dBc) N/A -54.56	≤ (dBc) N/A -30	N/A Pass
tone configuration # ow Channel, 903 M ow Channel, 903 M ow Channel, 903 M did Channel, 909 MI	4 MHz MHz WHz HHz	Signature	Frequency Range           Fundamental           30 MHz - 12.5 GHz           12.5 GHz - 25 GHz           12.5 GHz - 25 GHz	Freq (MHz) 902.94 2709.43 24989.32	(dBc) N/A -54.56 -51.28	≤ (dBc) N/A -30 -30	N/A Pass Pass
tone Configuration # ow Channel, 903 M ow Channel, 903 M ow Channel, 903 M did Channel, 909 M lid Channel, 909 M	4 MHz MHz MHz MHz MHz MHz	Signature	Frequency Range Fundamental 30 MHz - 12.5 GHz 12.5 GHz - 25 GHz Fundamental	Freq (MHz) 902.94 2709.43 24989.32 908.94	(dBc) N/A -54.56 -51.28 N/A	≤ (dBc) N/A -30 -30 N/A	N/A Pass Pass N/A
ow Channel, 903 M ow Channel, 903 M ow Channel, 903 M ow Channel, 903 M lid Channel, 909 M lid Channel, 909 M	4 WHz WHz WHz AHz AHz AHz Hz	Signature	Frequency Range           Fundamental           30 MHz - 12.5 GHz           12.5 GHz - 25 GHz           Fundamental           30 MHz - 12.5 GHz           12.5 GHz - 25 GHz           50 MHz - 12.5 GHz           12.5 GHz - 25 GHz           30 MHz - 12.5 GHz           12.5 GHz - 25 GHz	Freq (MHz) 902.94 2709.43 24989.32 908.94 2727.7 24475.03	(dBc) N/A -54.56 -51.28 N/A -54.4 -50.88	≤ (dBc) N/A -30 -30 N/A -30 -30	N/A Pass Pass N/A Pass Pass
Configuration # configuration # .ow Channel, 903 M .ow Channel, 903 M	4 MHz MHz MHz MHz MHz MHz MHz MHz	Signature	Frequency Range Fundamental 30 MHz - 12.5 GHz 12.5 GHz - 25 GHz Fundamental 30 MHz - 12.5 GHz	Freq (MHz) 902.94 2709.43 24989.32 908.94 2727.7	(dBc) N/A -54.56 -51.28 N/A -54.4	≤ (dBc) N/A -30 -30 N/A -30	N/A Pass Pass N/A Pass





Frequency	Measured	Max Value	Limit	
Range	Freq (MHz)	(dBc)	≤ (dBc)	Result
30 MHz - 12.5 GHz	2709.43	-54.56	-30	Pass

RL	RF 50 Ω A	C S S S S S S S S S S S S S S S S S S S		SENSE:INT	/\A	LIGN OFF		12:40:50	0 PM Feb 27, 201
		I	PNO: Fast 🕞 FGain:Low	Trig: Free #Atten: 10	Run	#Avg Type	: Log-Pwr		TYPE MWWWW DET P P P P P
) dB/div	Ref Offset 20.44 Ref 16.00 dBr	dB n						Mkr1 2.7 -4	09 4 GH 3.67 dBr
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4.0									
4.0									
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		<b>♦</b> ¹							
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tart 0.03	0 GHz							Ston	12.500 GH
	100 kHz		#VE	3W 300 kHz			Swe	Stop ² ep 1.192 s	s (8192 pt

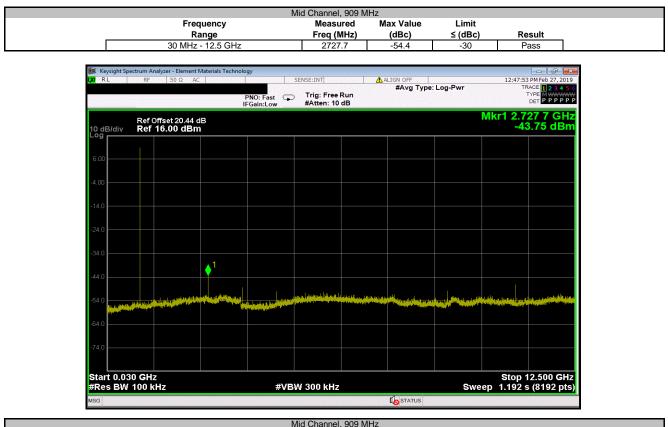




	Frequency	Measured	Max Value	Limit	
_	Range	Freq (MHz)	(dBc)	≤ (dBc)	Result
	Fundamental	908.94	N/A	N/A	N/A







Mid Channel, 909 MHz					
Frequency	Measured	Max Value	Limit		
Range	Freq (MHz)	(dBc)	≤ (dBc)	Result	
12.5 GHz - 25 GHz	24475.03	-50.88	-30	Pass	

				ent Materials Te	cnnology			1				
RL	-	RF	50 Ω	AC		5	ENSE:INT		ALIGN OFF	e: Log-Pwr	12:48	:54 PM Feb 27, 201
		1			PNO: Fast IFGain:Low	Ģ	Trig: Free R #Atten: 10 d		#Avg Typ	e: Log-Pwr		TRACE 1 2 3 4 5 TYPE MWWW DET PPPP
		Ref Off	set 20.4	4 dB								475 0 GH 40.23 dBr
0 dE og n	3/div	Ref 10	5.00 dE	sm							_	40.20 GDI
6.00												
4.00												
14.0												
24.0												
34.0												
												<b>♦</b> '
44.0												أوجاه في ومستقل سدار
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	a Martin States and	-										
64.0												
74.0												
	12.50										Stop	25.000 GH
Ret	s BW 1	UU KH	2		#	VBV	V 300 kHz			S	veep 1.19:	is (8192 pt
SG									STATUS			





Frequency	Measured	Max Value	Limit	
Range	Freq (MHz)	(dBc)	≤ (dBc)	Result
30 MHz - 12.5 GHz	2744.44	-54.4	-30	Pass

RL		RF	50 Ω	AC		S	ENSE:INT		ALIG	N OFF		12:55:0	5 PM Feb 27, 201
					PNO: Fast IFGain:Low		Trig: Free #Atten: 10			#Avg Type:	Log-Pwr	TI	RACE 1 2 3 4 5 TYPE M WWWWW DET P P P P P
0 dB og r	/div	Ref 0 Ref	ffset 20.44 15.00 dE	4 dB Sm								Mkr1 2.7 -4	44 4 GH 3.95 dBr
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5.0 -													
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5.0													
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			And an Hill			-				and the second		Station of Anissian and	
5.0													
5.0													
	0.030						N 200 KU-					Stop	12.500 GF
44	BW 1	00 K	12		#	VDV	N 300 kHz			STATUS	Swe	ep 1.192	5 (8 192 pt



	_	Π	ligh Channel, 915				
	Frequency		Measured	Max Value	Limit		
	Range		Freq (MHz)	(dBc)	≤ (dBc)	Result	-
	12.5 GHz - 25 GH	Ηz	24740.57	-50.33	-30	Pass	
Keysight Spectrum A	Analyzer - Element Materials Tech	nnology					X
LXI RL RF	50 Ω AC		SENSE:INT	ALIGN OFF		12:56:11 PM Feb 27, 2	2019
			Trig: Free Run	#Avg Type	:: Log-Pwr	TRACE 1 2 3 4	<b>5</b> 6
		PNO: Fast C	#Atten: 10 dB			TRACE 1 2 3 4 TYPE MWW DET P P P	PPP
		in Guineon			ML	r1 24.740 6 G	
Ref	Offset 20.44 dB				WIK	-39.88 dE	
10 dB/div Ref	15.00 dBm						
5.00							
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10010							
75.0							
-75.0							
Start 12.500 G	Hz					Stop 25.000 G	Hz
#Res BW 100		#VB	W 300 kHz		Sween	1.195 s (8192 p	ots)
				STATUS		بالكاهر وهدد	-



XMit 2017.12.13

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
Attenuator	Fairview Microwave	SA4018-20	TYW	29-Mar-18	29-Mar-19
Block - DC	Fairview Microwave	SD3379	AMM	29-Mar-18	29-Mar-19
Cable	Micro-Coax	UFD150A-1-0720-200200	TXG	10-Oct-18	10-Oct-19
Generator - Signal	Keysight	N5171B-506	TEW	2-May-18	2-May-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	19-Mar-18	19-Mar-19

#### 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-1 in section 11.10.3 of ANSI C63.10:2013 was used to make the measurement. This method uses trace averaging and RMS detection across the full power of the burst. This method is allowed as the same method has been used to determine the conducted output power.



				TbtTx 2018.09.13	
EUT: Lo	oRa Sensor 3 Button (Model LV-PSH-173)		Work Order:		
Serial Number: 12	237		Date:	27-Feb-19	
Customer: Ca	arnegie Technologies		Temperature:	22.9 °C	
Attendees: Ke	evin Cotton		Humidity:	40.6% RH	
Project: No	one		Barometric Pres.:	1022 mbar	
	onathan Kiefer	Power: Battery	Job Site:	TX09	
TEST SPECIFICATION	NS	Test Method			
FCC 15.247:2019		ANSI C63.10:2013			
COMMENTS					1
DEVIATIONS FROM TI	EST STANDARD				
DEVIATIONS FROM TI	EST STANDARD				
None	A Signature	Jonethan Hiefer			
lone	4	Jonethan Kiefer	Value dBm/3kHz	Limit < dBm/3kHz	Results
lone Configuration #	<b>4</b> Signature	Jonathan Kiefer			Results Pass
	4 Signature	Jonethan Hiefer	dBm/3kHz	< dBm/3kHz	



