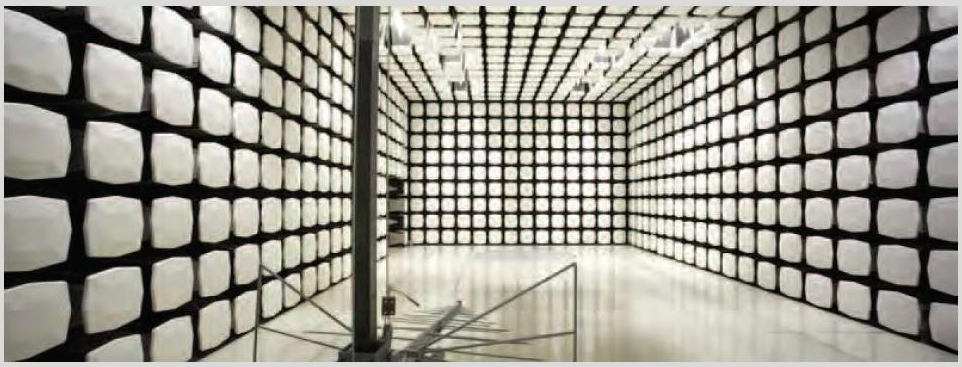
Carnegie Technologies

LoRa Sensor 1 Button (Model LV-PSH-171)

FCC 15.247:2019
902 - 928 MHz Transceiver

Report # CRNE0006.1



NVLAP LAB CODE: 201049-0

CERTIFICATE OF TEST

Last Date of Test: February 27, 2019
Carnegie Technologies
Model: LoRa Sensor 1 Button (Model LV-PSH-171)

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

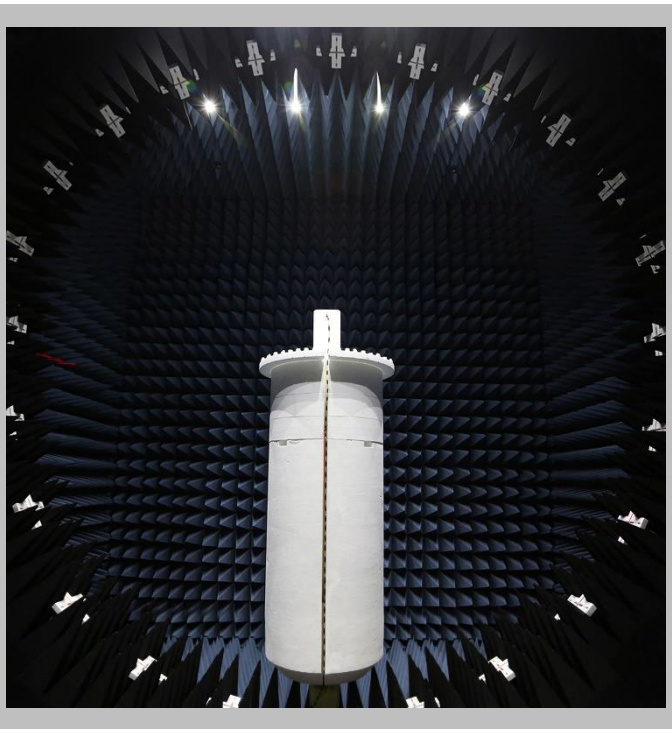
MIC – Recognized by MIC as a CAB for the acceptance of test data.

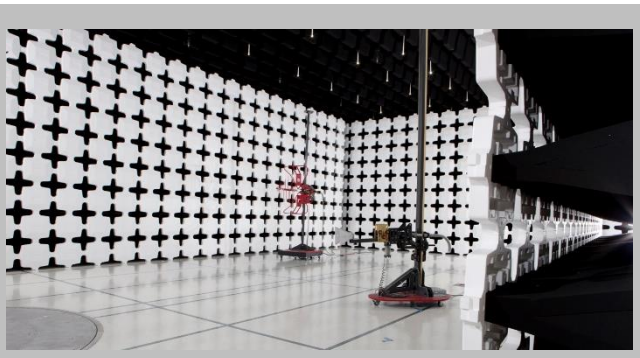
SCOPE

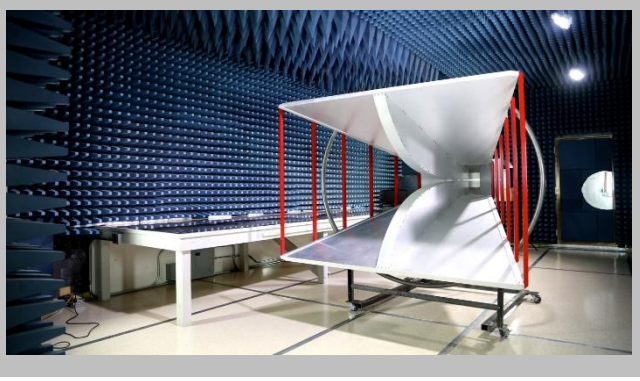
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

FACILITIES

California	Minnesota	New York	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs NY01-04 4939 Jordan Rd. Elbridge, NY 13060 (315) 554-8214	Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP					
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
BSMI					
SL2-IN-E-1154R	SL2-IN-E-1152R	N/A	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI					
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

element
TMU.2015.07.10

Measurement Uncertainty

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

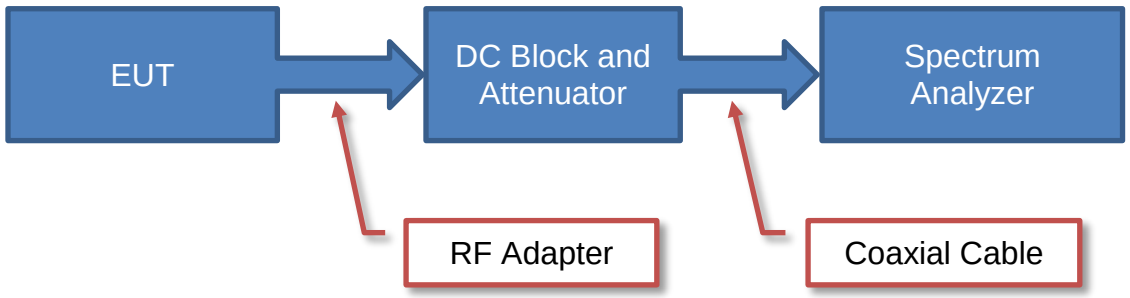
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable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

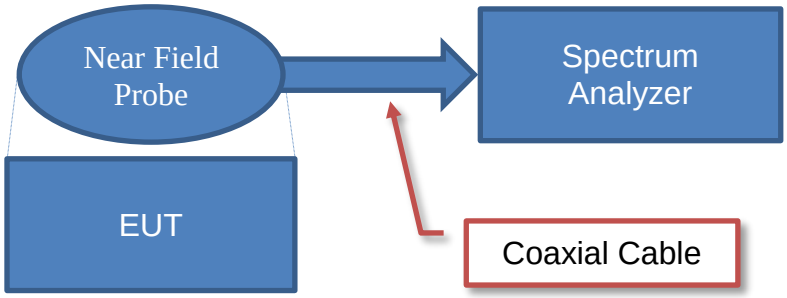
Test	+ MU	- MU
Frequency Accuracy (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	0.3 dB	-0.3 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.1 dB	-5.1 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

Test Setup Block Diagrams

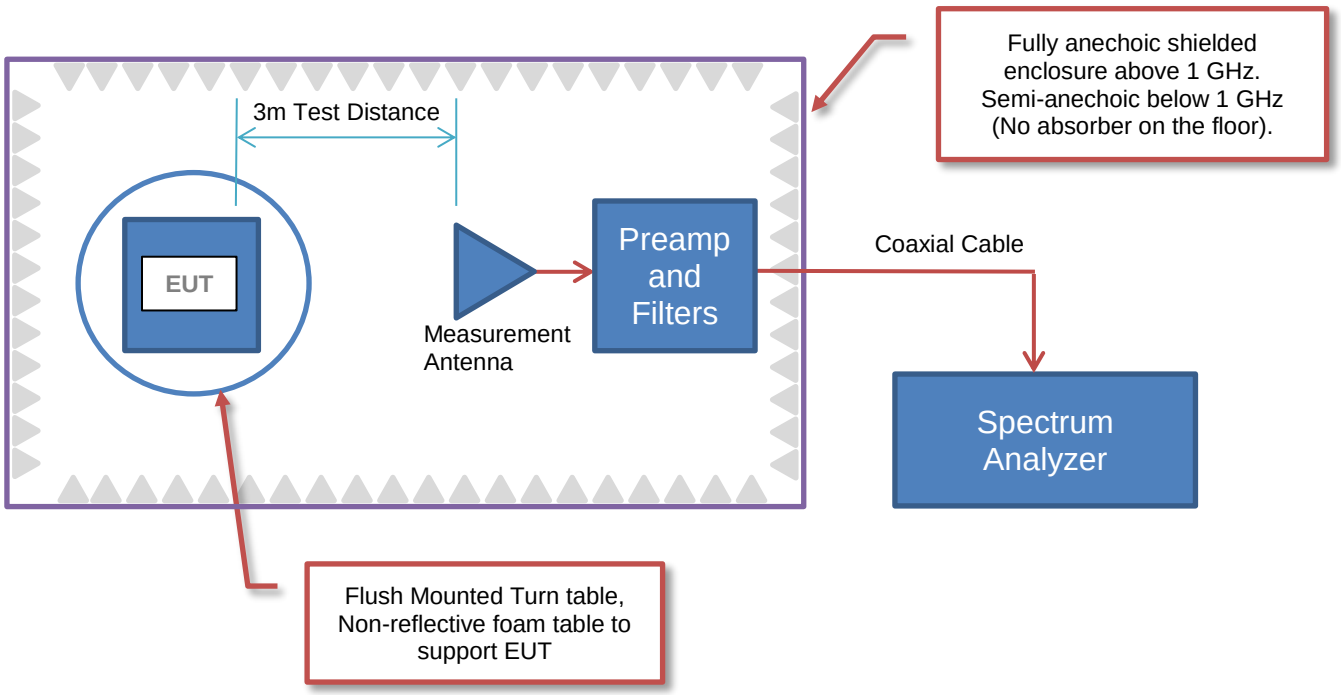
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



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	Type	Channel	Frequency (MHz)	Power Setting
LoRa	DTS	Low	903	10
		Mid	909	10
		High	915	10

Modulation Types / Data Rates	Type	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 1 Button (Model LV-PSH-171)
First Date of Test:	February 25, 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 a single button (Model LV-PSH-171) that sends 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.

CONFIGURATIONS

Configuration CRNE0006- 1

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
LoRa Sensor 1 Button	Carnegie Technologies	LV-PSH-171	898

Configuration CRNE0006- 3

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
LoRa Sensor 1 Button (Direct Connect)	Carnegie Technologies	LV-PSH-171	910

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2019-02-25	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	2019-02-27	Number of Hopping Frequencies	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	2019-02-27	Dwell Time	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	2019-02-27	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.
5	2019-02-27	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.
6	2019-02-27	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.
7	2019-02-27	Band Edge Compliance - Hopping Mode	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	2019-02-27	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.
9	2019-02-27	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.
10	2019-02-27	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.
11	2019-02-27	Carrier Frequency Separation	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2018.07.27

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 - 1

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	HHT	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).

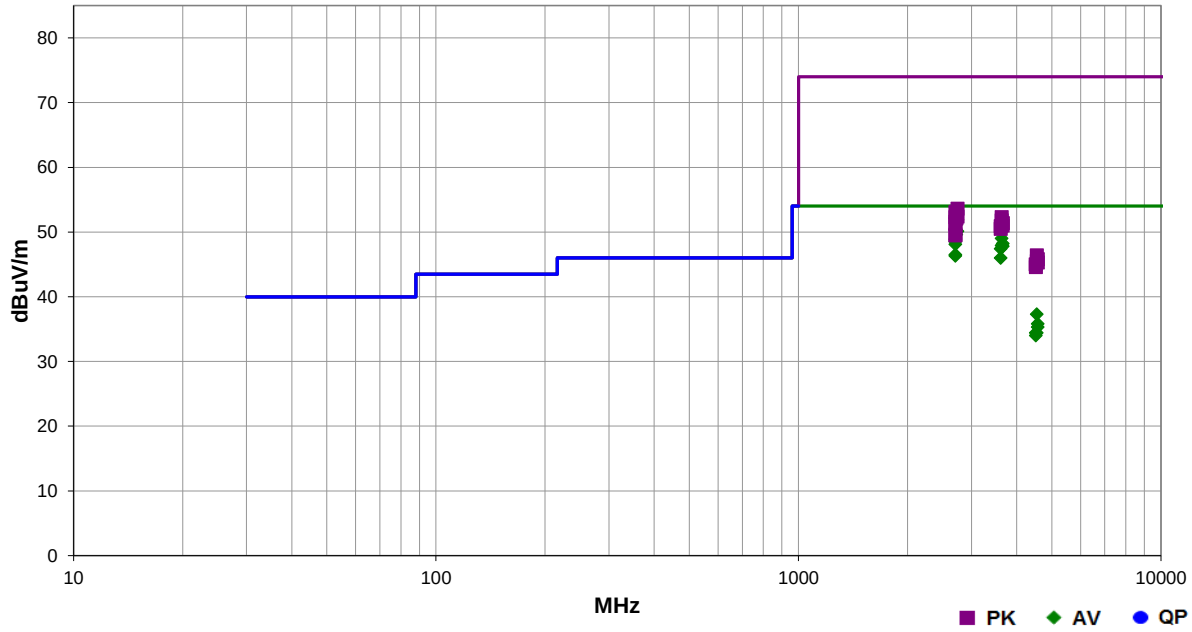
SPURIOUS RADIATED EMISSIONS

EmiR5 2018.09.26 PSA-ESCI 2018.07.27

Work Order:	CRNE0006	**Date:**	25-Feb-2019		
Project:	None	**Temperature:**	22 °C		
Job Site:	TX02	**Humidity:**	29.1% RH		
Serial Number:	898	**Barometric Pres.:**	1029 mbar	**Tested by:**	Jonathan Kiefer
EUT:	LoRa Sensor 1 Button (Model LV-PSH-171)				
Configuration:	1				
Customer:	Carnegie Technologies				
Attendees:	Kevin Cotton				
EUT Power:	Battery				
Operating Mode:	Continuously Transmitting at Low Channel 903 MHz, Mid Channel 909 MHz, High Channel 915 MHz				
Deviations:	None				
Comments:	See table comments for EUT channel and orientation.				

Test Specifications	**Test Method**
FCC 15.247:2019	ANSI C63.10:2013

Run #	6	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



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
2744.917	53.8	-1.9	3.2	284.0	3.0	0.0	Horz	AV	0.0	51.9	54.0	-2.1	High Ch, EUT On Side
2726.917	53.1	-1.9	3.2	279.9	3.0	0.0	Horz	AV	0.0	51.2	54.0	-2.8	Mid Ch, EUT On Side
2709.083	52.3	-1.9	3.2	286.9	3.0	0.0	Horz	AV	0.0	50.4	54.0	-3.6	Low Ch, EUT On Side
2745.133	52.0	-1.9	3.2	300.0	3.0	0.0	Vert	AV	0.0	50.1	54.0	-3.9	High Ch, EUT On Side
2727.083	51.5	-1.9	3.2	302.0	3.0	0.0	Vert	AV	0.0	49.6	54.0	-4.4	Mid Ch, EUT On Side
3635.883	45.5	3.5	3.9	303.9	3.0	0.0	Vert	AV	0.0	49.0	54.0	-5.0	Mid Ch, EUT On Side
2709.142	50.8	-1.9	3.2	338.0	3.0	0.0	Vert	AV	0.0	48.9	54.0	-5.1	Low Ch, EUT On Side
2709.092	50.4	-1.9	3.3	168.0	3.0	0.0	Horz	AV	0.0	48.5	54.0	-5.5	Low Ch, EUT Vertical
3660.075	44.7	3.5	2.3	295.0	3.0	0.0	Horz	AV	0.0	48.2	54.0	-5.8	High Ch, EUT On Side
2708.867	50.0	-1.9	1.2	123.9	3.0	0.0	Horz	AV	0.0	48.1	54.0	-5.9	Low Ch, EUT Horizontal
3636.033	44.4	3.5	1.7	21.9	3.0	0.0	Horz	AV	0.0	47.9	54.0	-6.1	Mid Ch, EUT On Side
3660.125	44.3	3.5	2.9	354.0	3.0	0.0	Vert	AV	0.0	47.8	54.0	-6.2	High Ch, EUT On Side
3612.058	44.0	3.4	2.7	328.9	3.0	0.0	Vert	AV	0.0	47.4	54.0	-6.6	Low Ch, EUT On Side
2708.917	48.4	-1.9	3.2	154.0	3.0	0.0	Vert	AV	0.0	46.5	54.0	-7.5	Low Ch, EUT Vertical
2709.100	48.2	-1.9	1.2	61.0	3.0	0.0	Vert	AV	0.0	46.3	54.0	-7.7	Low Ch, EUT Horizontal
3611.900	42.6	3.4	1.7	18.0	3.0	0.0	Horz	AV	0.0	46.0	54.0	-8.0	Low Ch, EUT On Side
4545.067	31.6	5.7	1.9	297.0	3.0	0.0	Horz	AV	0.0	37.3	54.0	-16.7	Mid Ch, EUT On Side
4574.850	30.0	5.8	3.1	198.0	3.0	0.0	Horz	AV	0.0	35.8	54.0	-18.2	High Ch, EUT On Side

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
4575.033	29.5	5.8	1.2	258.0	3.0	0.0	Vert	AV	0.0	35.3	54.0	-18.7	High Ch, EUT On Side
4515.175	28.8	5.6	1.2	195.0	3.0	0.0	Horz	AV	0.0	34.4	54.0	-19.6	Low Ch, EUT On Side
4545.033	28.7	5.7	1.2	328.9	3.0	0.0	Vert	AV	0.0	34.4	54.0	-19.6	Mid Ch, EUT On Side
4516.158	28.4	5.6	1.2	246.0	3.0	0.0	Vert	AV	0.0	34.0	54.0	-20.0	Low Ch, EUT On Side
2744.675	55.5	-1.9	3.2	284.0	3.0	0.0	Horz	PK	0.0	53.6	74.0	-20.4	High Ch, EUT On Side
2708.892	55.0	-1.9	3.2	286.9	3.0	0.0	Horz	PK	0.0	53.1	74.0	-20.9	Low Ch, EUT On Side
2726.883	55.0	-1.9	3.2	279.9	3.0	0.0	Horz	PK	0.0	53.1	74.0	-20.9	Mid Ch, EUT On Side
2745.150	54.3	-1.9	3.2	300.0	3.0	0.0	Vert	PK	0.0	52.4	74.0	-21.6	High Ch, EUT On Side
2709.025	54.2	-1.9	3.3	168.0	3.0	0.0	Horz	PK	0.0	52.3	74.0	-21.7	Low Ch, EUT Vertical
3636.275	48.8	3.5	1.7	21.9	3.0	0.0	Horz	PK	0.0	52.3	74.0	-21.7	Mid Ch, EUT On Side
2726.867	54.0	-1.9	3.2	302.0	3.0	0.0	Vert	PK	0.0	52.1	74.0	-21.9	Mid Ch, EUT On Side
3635.867	48.3	3.5	3.9	303.9	3.0	0.0	Vert	PK	0.0	51.8	74.0	-22.2	Mid Ch, EUT On Side
2709.092	53.5	-1.9	3.2	338.0	3.0	0.0	Vert	PK	0.0	51.6	74.0	-22.4	Low Ch, EUT On Side
3660.175	47.9	3.5	2.3	295.0	3.0	0.0	Horz	PK	0.0	51.4	74.0	-22.6	High Ch, EUT On Side
2709.117	53.1	-1.9	1.2	123.9	3.0	0.0	Horz	PK	0.0	51.2	74.0	-22.8	Low Ch, EUT Horizontal
3659.650	47.5	3.5	2.9	354.0	3.0	0.0	Vert	PK	0.0	51.0	74.0	-23.0	High Ch, EUT On Side
3612.200	47.5	3.4	2.7	328.9	3.0	0.0	Vert	PK	0.0	50.9	74.0	-23.1	Low Ch, EUT On Side
3612.183	47.1	3.4	1.7	18.0	3.0	0.0	Horz	PK	0.0	50.5	74.0	-23.5	Low Ch, EUT On Side
2709.100	51.5	-1.9	1.2	61.0	3.0	0.0	Vert	PK	0.0	49.6	74.0	-24.4	Low Ch, EUT Horizontal
2709.117	51.4	-1.9	3.2	153.9	3.0	0.0	Vert	PK	0.0	49.5	74.0	-24.5	Low Ch, EUT Vertical
4545.175	40.7	5.7	1.9	297.0	3.0	0.0	Horz	PK	0.0	46.4	74.0	-27.6	Mid Ch, EUT On Side
4574.775	40.0	5.8	1.2	258.0	3.0	0.0	Vert	PK	0.0	45.8	74.0	-28.2	High Ch, EUT On Side
4543.325	39.8	5.7	1.2	328.9	3.0	0.0	Vert	PK	0.0	45.5	74.0	-28.5	Mid Ch, EUT On Side
4574.125	39.5	5.8	3.1	198.0	3.0	0.0	Horz	PK	0.0	45.3	74.0	-28.7	High Ch, EUT On Side
4513.992	39.4	5.6	1.2	195.0	3.0	0.0	Horz	PK	0.0	45.0	74.0	-29.0	Low Ch, EUT On Side
4514.350	39.0	5.6	1.2	246.0	3.0	0.0	Vert	PK	0.0	44.6	74.0	-29.4	Low Ch, EUT On Side

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

element

TbtTx 2018.09.13 XMit 2017.12.13

EUT:	**LoRa Sensor 1 Button (Model LV-PSH-171)**			**Work Order:**	**CRNE0006**
Serial Number:	**910**			**Date:**	**27-Feb-19**
Customer:	**Carnegie Technologies**			**Temperature:**	**22.7 °C**
Attendees:	**Kevin Cotton**			**Humidity:**	**43.8% RH**
Project:	**None**			**Barometric Pres.:**	**1021 mbar**
Tested by:	**Jonathan Kiefer**	**Power:**	**Battery**	**Job Site:**	**TX09**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

Ref Offset 20.44 dB (20 dB Attenuator + DC Block + Cable).

DEVIATIONS FROM TEST STANDARD

None

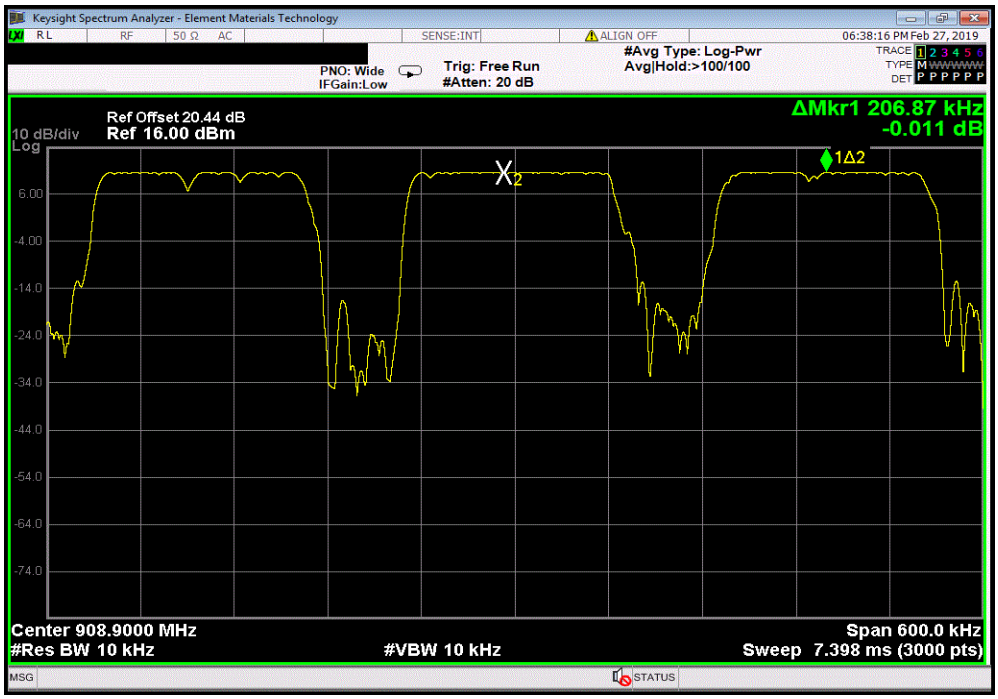
Configuration #	**3**	*Signature* Jonathan Kiefer

	Value	**Limit (≥)**	**Results**
Mid Channel, 908.9 MHz	206.87 kHz	163.641 kHz	Pass

CARRIER FREQUENCY SEPARATION

TbtTx 2018.09.13 XMit 2017.12.13

Mid Channel, 908.9 MHz						
				Value	Limit (≥)	Results
				206.87 kHz	163.641 kHz	Pass



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 number of hopping frequencies was measured across the authorized band. The hopping function of the EUT was enabled.

NUMBER OF HOPPING FREQUENCIES

element

TbtTx 2018.09.13 XMit 2017.12.13

EUT:	**LoRa Sensor 1 Button (Model LV-PSH-171)**			**Work Order:**	**CRNE0006**
Serial Number:	**910**			**Date:**	**27-Feb-19**
Customer:	**Carnegie Technologies**			**Temperature:**	**22.1 °C**
Attendees:	**Kevin Cotton**			**Humidity:**	**44.3% RH**
Project:	**None**			**Barometric Pres.:**	**1021 mbar**
Tested by:	**Jonathan Kiefer**	**Power:**	**Battery**	**Job Site:**	**TX09**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

Ref Offset 20.44 dB (20 dB Attenuator + DC Block + Cable).

DEVIATIONS FROM TEST STANDARD

None

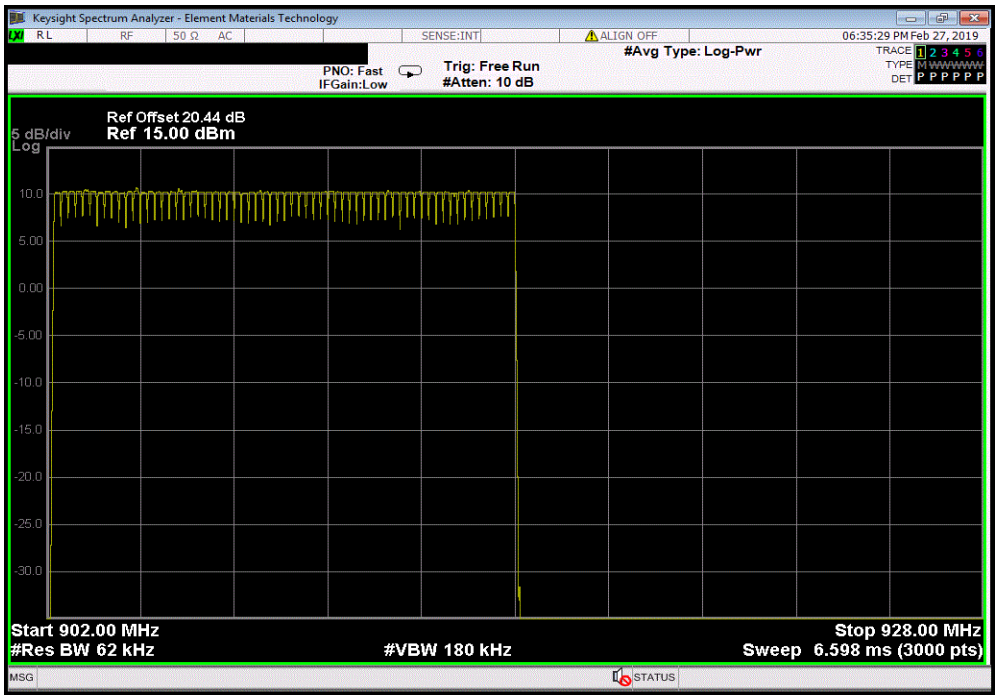
Configuration #	**3**	*Signature* Jonathan Kiefer

	Number of Channels	**Limit**	**Results**
Mid Channel, 908.9 MHz	64	N/A	N/A

NUMBER OF HOPPING FREQUENCIES

TbtTx 2018.09.13 XMit 2017.12.13

Mid Channel, 908.9 MHz						
				Number of Channels	Limit	Results
				64	N/A	N/A



DWELL TIME

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.

DWELL TIME

element

TbtTx 2018.09.13 XMit 2017.12.13

EUT:	LoRa Sensor 1 Button (Model LV-PSH-171)			**Work Order:**	CRNE0006
Serial Number:	910			**Date:**	27-Feb-19
Customer:	Carnegie Technologies			**Temperature:**	22.5 °C
Attendees:	Kevin Cotton			**Humidity:**	43.7% RH
Project:	None			**Barometric Pres.:**	1021 mbar
Tested by:	Jonathan Kiefer	**Power:**	Battery	**Job Site:**	TX09

TEST SPECIFICATIONS	Test Method
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

Ref Offset 20.44 dB (20 dB Attenuator + DC Block + Cable).

DEVIATIONS FROM TEST STANDARD

None

Configuration #	3	*Signature* Jonathan Kiefer

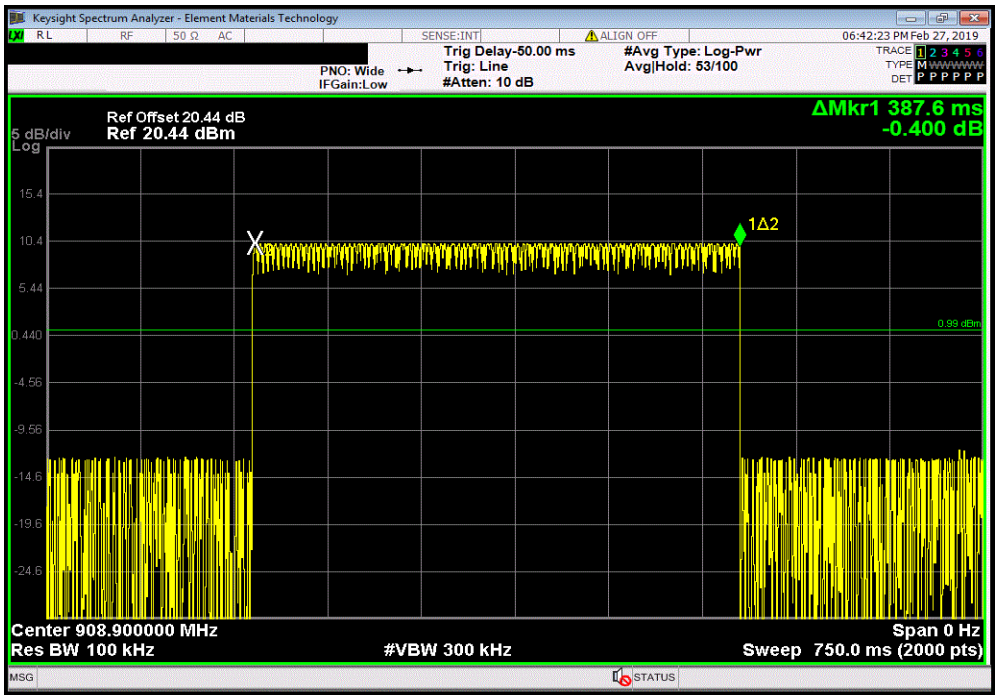
	Pulse Width (ms)	Number of Pulses	Average No. of Pulses	On Time (ms) During 25.6 s	Limit (ms)	Results
Mid Channel, 908.9 MHz	387.582	N/A	N/A	N/A	N/A	N/A
Mid Channel, 908.9 MHz	N/A	1	N/A	N/A	N/A	N/A
Mid Channel, 908.9 MHz	N/A	1	N/A	N/A	N/A	N/A
Mid Channel, 908.9 MHz	N/A	1	N/A	N/A	N/A	N/A
Mid Channel, 908.9 MHz	N/A	1	N/A	N/A	N/A	N/A
Mid Channel, 908.9 MHz	387.582	N/A	1	387.582	400	Pass

DWELL TIME

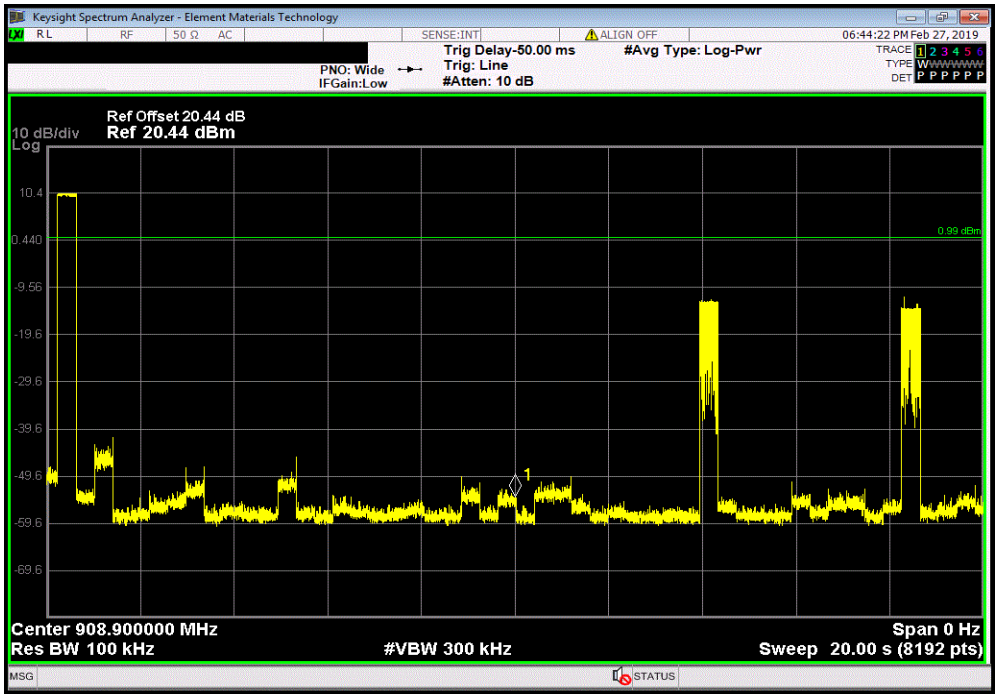
element

TbtTx 2018.09.13 XMit 2017.12.13

Mid Channel, 908.9 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses		On Time (ms) During 25.6 s	Limit (ms)	Results
387.582	N/A	N/A		N/A	N/A	N/A

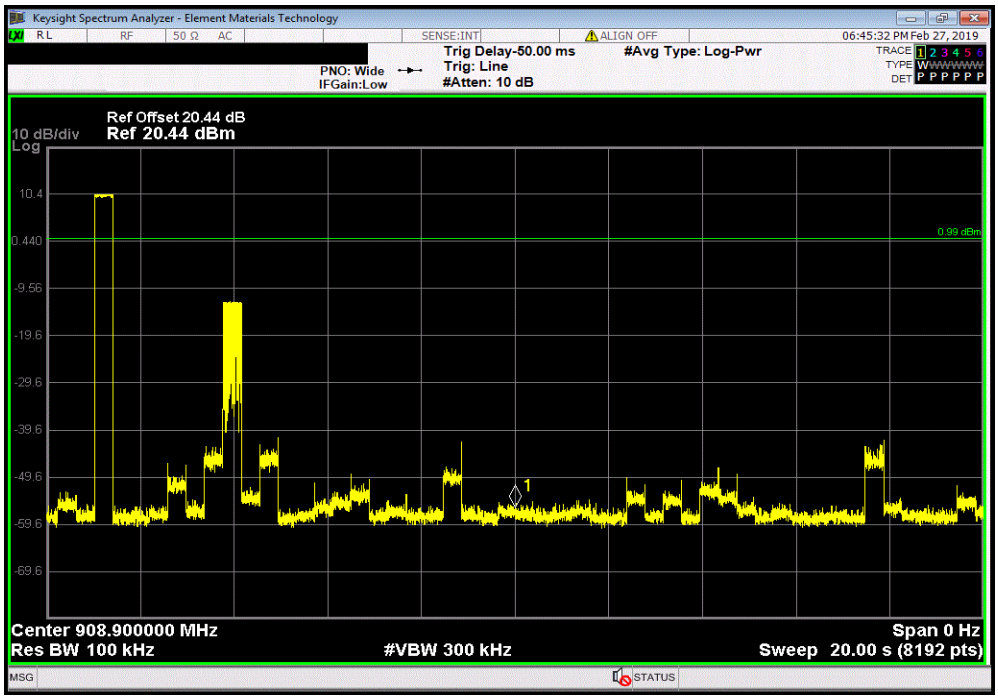


Mid Channel, 908.9 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses		On Time (ms) During 25.6 s	Limit (ms)	Results
N/A	1	N/A		N/A	N/A	N/A

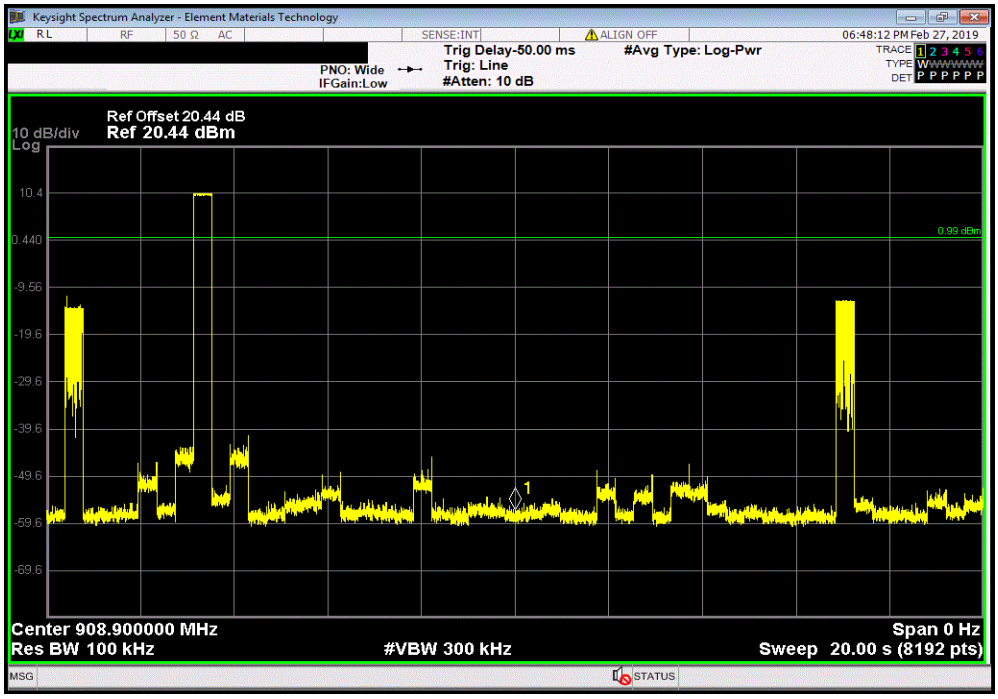


DWELL TIME

Mid Channel, 908.9 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses		On Time (ms) During 25.6 s	Limit (ms)	Results
N/A	1	N/A		N/A	N/A	N/A



Mid Channel, 908.9 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses		On Time (ms) During 25.6 s	Limit (ms)	Results
N/A	1	N/A		N/A	N/A	N/A

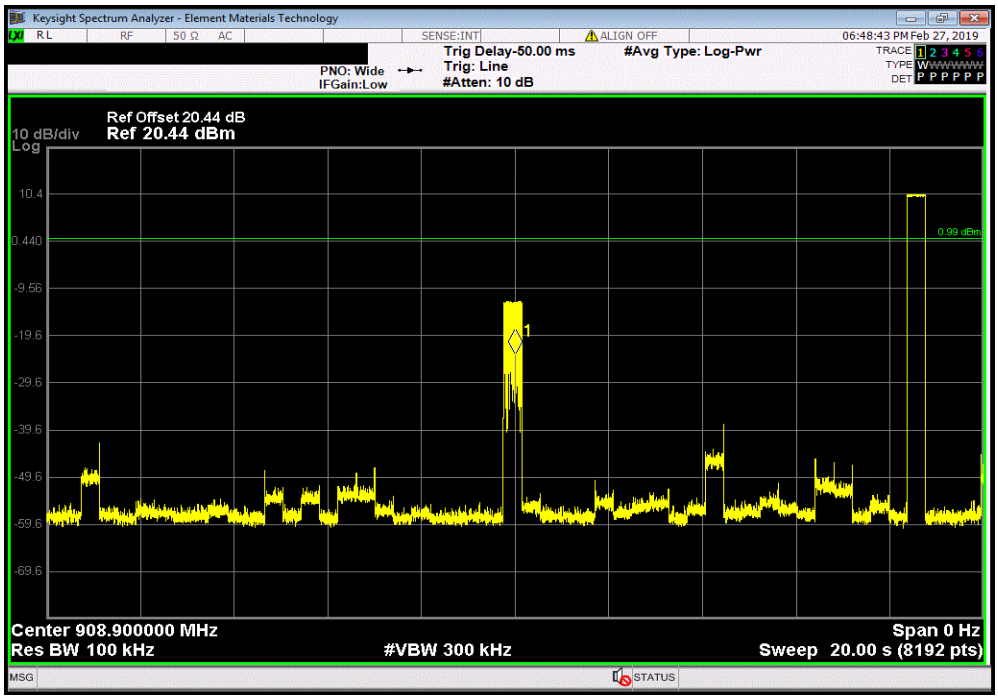


DWELL TIME

element

TbtTx 2018.09.13 XMit 2017.12.13

Mid Channel, 908.9 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses		On Time (ms) During 25.6 s	Limit (ms)	Results
N/A	1	N/A		N/A	N/A	N/A



Mid Channel, 908.9 MHz						
Pulse Width (ms)	Number of Pulses	Average No. of Pulses		On Time (ms) During 25.6 s	Limit (ms)	Results
387.582	N/A	1		387.582	400	Pass

Calculation Only

No Screen Capture Required

OUTPUT POWER

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 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.

OUTPUT POWER

element

TbtTx 2018.09.13 XMit 2017.12.13

EUT:	LoRa Sensor 1 Button (Model LV-PSH-171)			**Work Order:**	CRNE0006
Serial Number:	910			**Date:**	27-Feb-19
Customer:	Carnegie Technologies			**Temperature:**	22.8 °C
Attendees:	Kevin Cotton			**Humidity:**	40.3% RH
Project:	None			**Barometric Pres.:**	1022 mbar
Tested by:	Jonathan Kiefer	**Power:**	Battery	**Job Site:**	TX09

TEST SPECIFICATIONS	Test Method
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

Ref Offset 20.44 dB (20 dB Attenuator + DC Block + Cable). EUT has a PIFA antenna with a 2.0 dBi antenna gain.

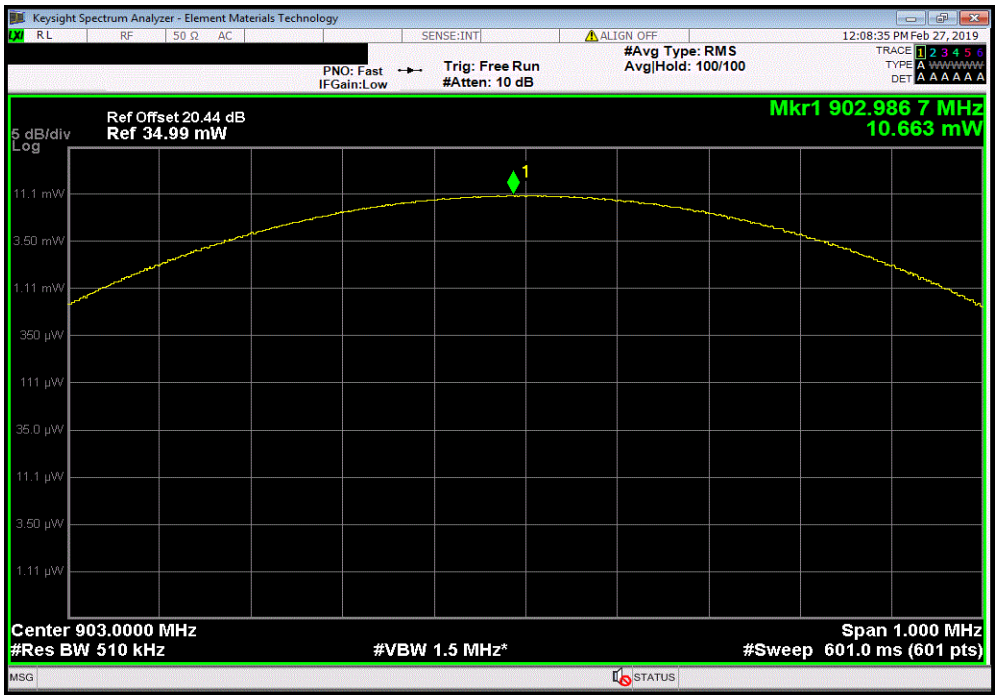
DEVIATIONS FROM TEST STANDARD

None

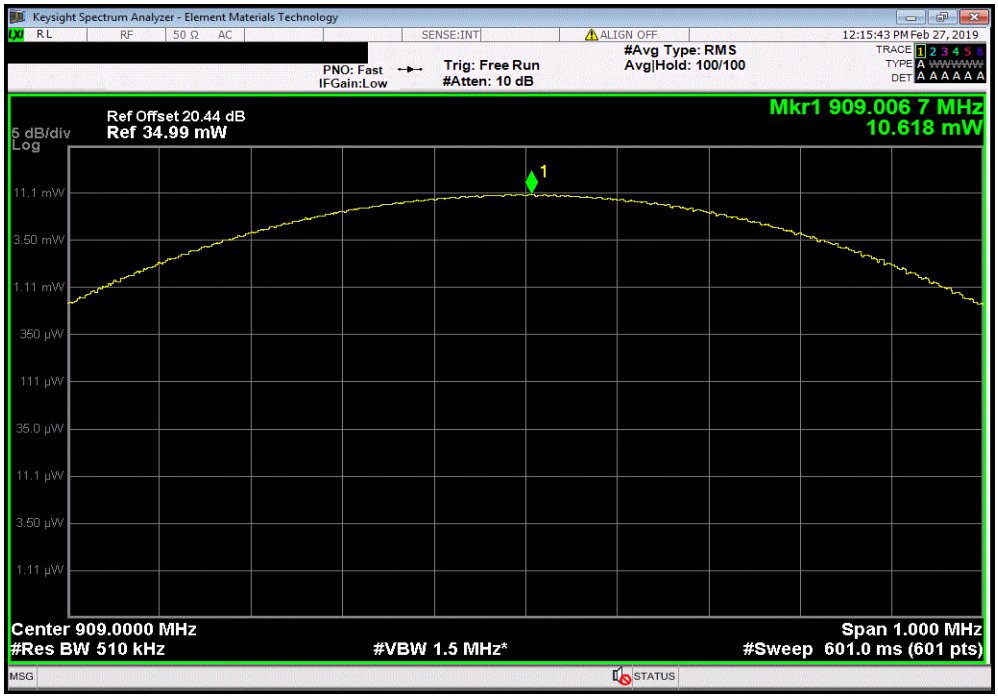
Configuration #	3	Signature Jonathan Kiefer

	Value	Limit (<)	Result
Low Channel, 903 MHz	10.663 mW	1 W	Pass
Mid Channel, 909 MHz	10.618 mW	1 W	Pass
High Channel, 915 MHz	10.508 mW	1 W	Pass

Low Channel, 903 MHz						
				Value	Limit (<)	Result
				10.663 mW	1 W	Pass

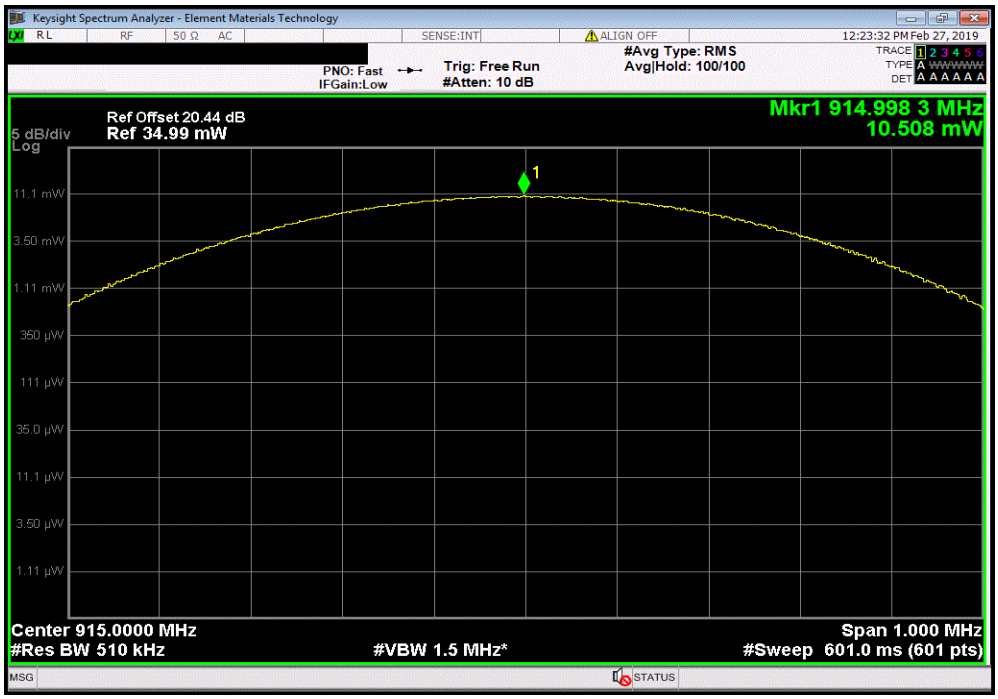


Mid Channel, 909 MHz						
				Value	Limit (<)	Result
				10.618 mW	1 W	Pass



OUTPUT POWER

High Channel, 915 MHz						
				Value	Limit (<)	Result
				10.508 mW	1 W	Pass



EQUIVALENT ISOTROPIC RADIATED POWER

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 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.

EQUIVALENT ISOTROPIC RADIATED POWER

element

TbtTx 2018.09.13 XMit 2017.12.13

EUT:	LoRa Sensor 1 Button (Model LV-PSH-171)			**Work Order:**	CRNE0006
Serial Number:	910			**Date:**	27-Feb-19
Customer:	Carnegie Technologies			**Temperature:**	22.8 °C
Attendees:	Kevin Cotton			**Humidity:**	40.3% RH
Project:	None			**Barometric Pres.:**	1022 mbar
Tested by:	Jonathan Kiefer	**Power:**	Battery	**Job Site:**	TX09

TEST SPECIFICATIONS	Test Method
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

Ref Offset 20.44 dB (20 dB Attenuator + DC Block + Cable). EUT has a PIFA antenna with a 2.0 dBi antenna gain.

DEVIATIONS FROM TEST STANDARD

None

Configuration #	3	*Signature* Jonathan Kiefer

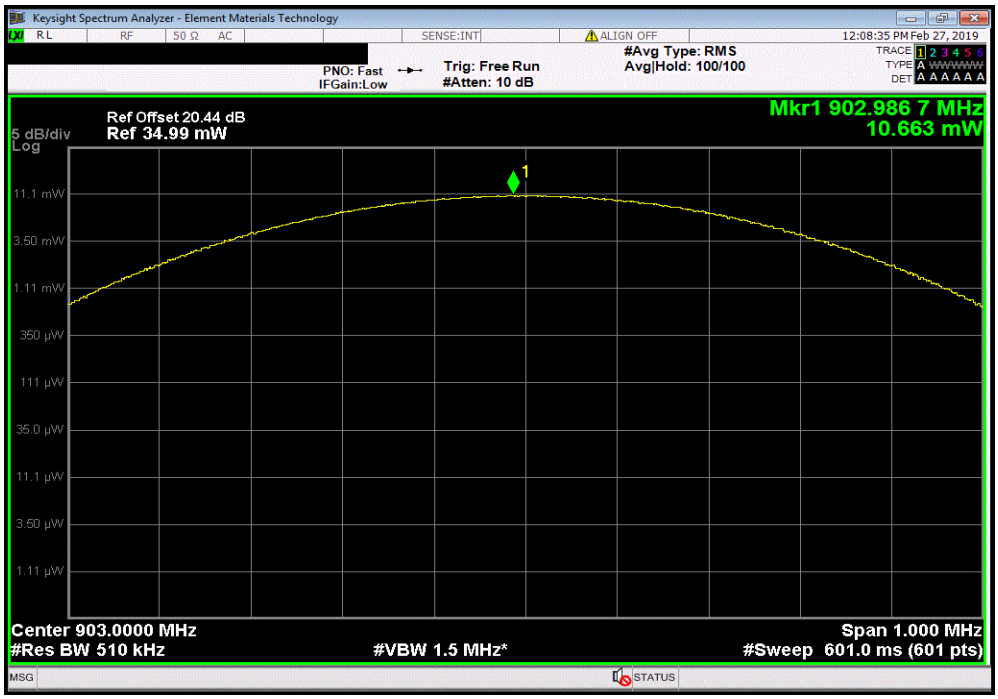
	Value (mW)	Value (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (< dBm)	Result
Low Channel, 903 MHz	10.663	10.279	2	12.279	36	Pass
Mid Channel, 909 MHz	10.618	10.260	2	12.260	36	Pass
High Channel, 915 MHz	10.508	10.215	2	12.215	36	Pass

EQUIVALENT ISOTROPIC RADIATED POWER

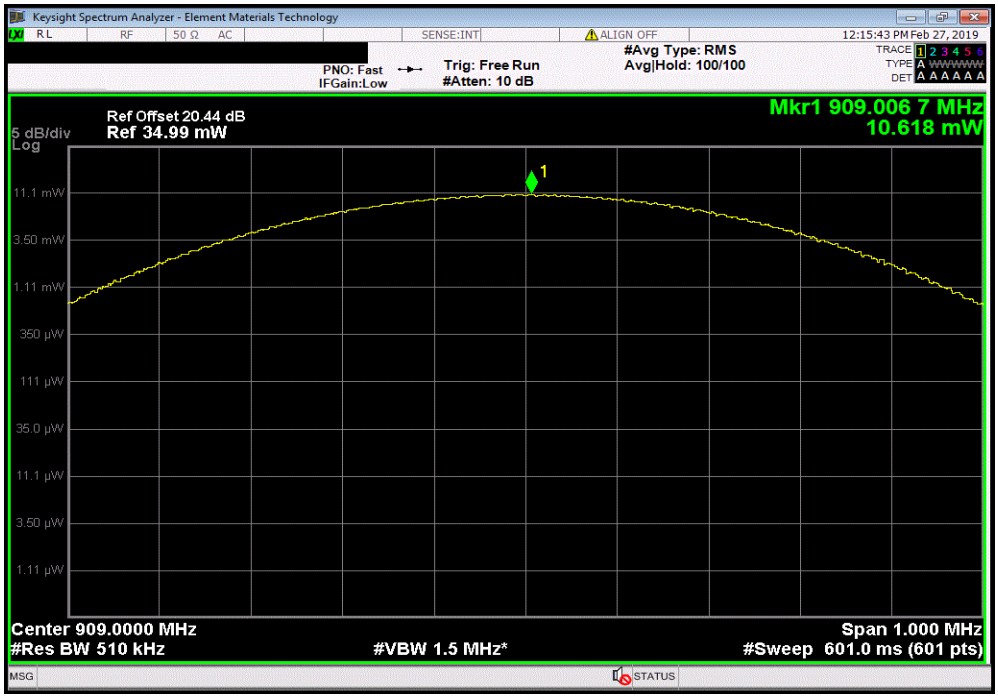
element

TbtTx 2018.09.13 XMit 2017.12.13

Low Channel, 903 MHz						
	Value (mW)	Value (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (< dBm)	Result
	10.663	10.279	2	12.279	36	Pass



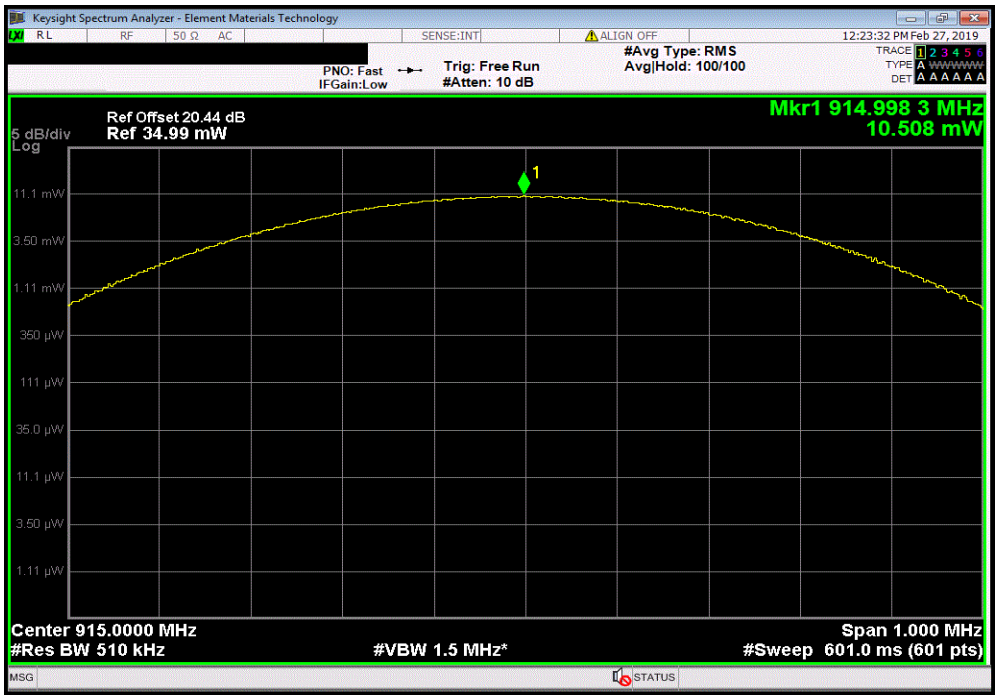
Mid Channel, 909 MHz						
	Value (mW)	Value (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (< dBm)	Result
	10.618	10.260	2	12.260	36	Pass



EQUIVALENT ISOTROPIC RADIATED POWER

TbtTx 2018.09.13 XMit 2017.12.13

High Channel, 915 MHz						
	Value (mW)	Value (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (< dBm)	Result
	10.508	10.215	2	12.215	36	Pass



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	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 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

TbtTx 2018.09.13 XMit 2017.12.13

EUT:	LoRa Sensor 1 Button (Model LV-PSH-171)			**Work Order:**	CRNE0006
Serial Number:	910			**Date:**	27-Feb-19
Customer:	Carnegie Technologies			**Temperature:**	22.8 °C
Attendees:	Kevin Cotton			**Humidity:**	40.4% RH
Project:	None			**Barometric Pres.:**	1022 mbar
Tested by:	Jonathan Kiefer	**Power:**	Battery	**Job Site:**	TX09

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

Ref Offset 20.44 dB (20 dB Attenuator + DC Block + Cable).

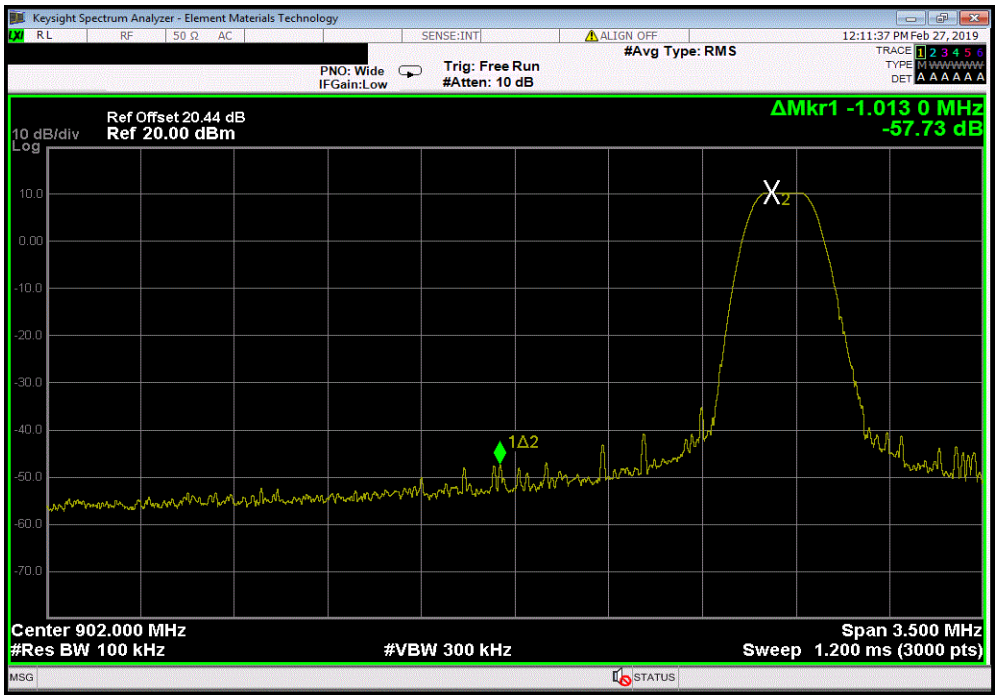
DEVIATIONS FROM TEST STANDARD

None

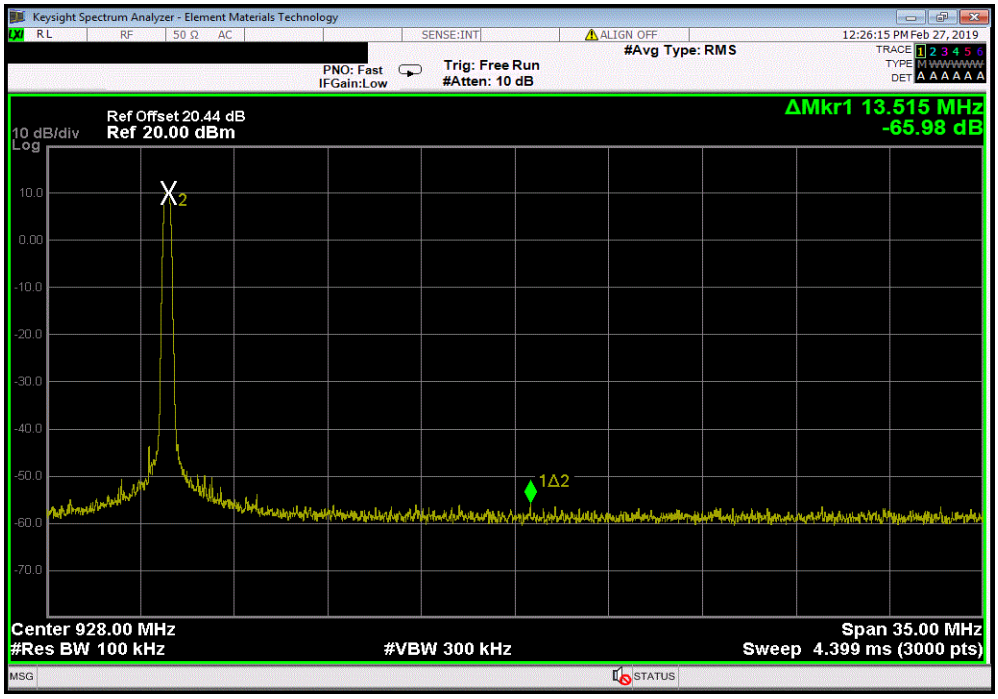
Configuration #	3	*Signature* Jonathan Kiefer

	Value (dBc)	**Limit ≤ (dBc)**	**Result**
Low Channel, 903 MHz	-57.73	-30	Pass
High Channel, 915 MHz	-65.98	-30	Pass

Low Channel, 903 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-57.73	-30	Pass



High Channel, 915 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-65.98	-30	Pass



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 1 Button (Model LV-PSH-171)**			**Work Order:**	**CRNE0006**
Serial Number:	**910**			**Date:**	**27-Feb-19**
Customer:	**Carnegie Technologies**			**Temperature:**	**22.7 °C**
Attendees:	**Kevin Cotton**			**Humidity:**	**43.8% RH**
Project:	**None**			**Barometric Pres.:**	**1021 mbar**
Tested by:	**Jonathan Kiefer**	**Power:**	**Battery**	**Job Site:**	**TX09**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

Ref Offset 20.44 dB (20 dB Attenuator + DC Block + Cable).

DEVIATIONS FROM TEST STANDARD

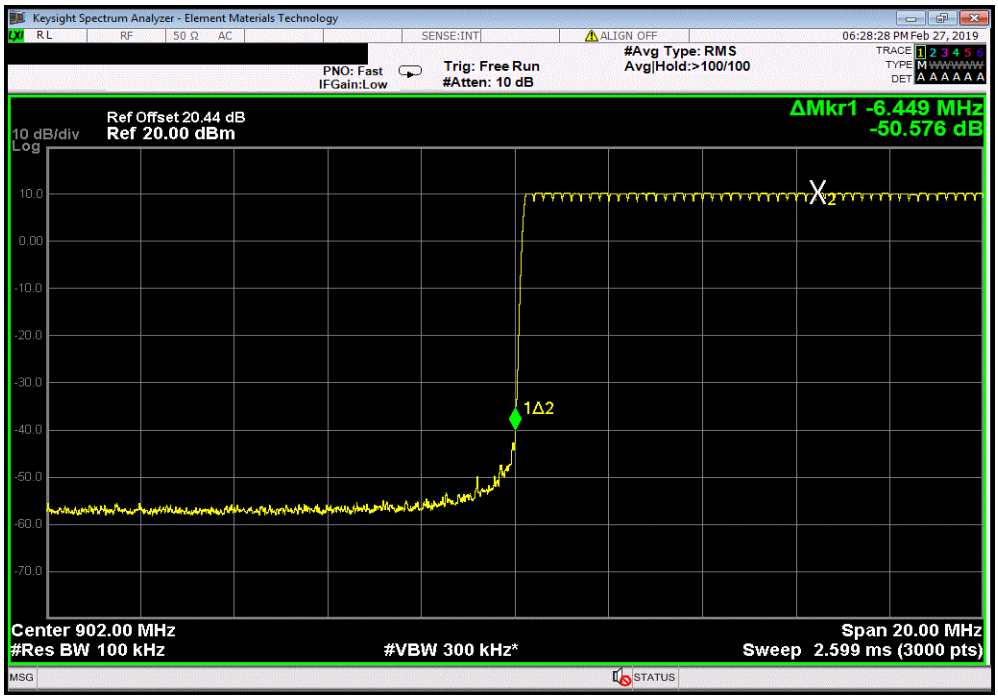
None

Configuration #	**3**	*Signature* Jonathan Kiefer

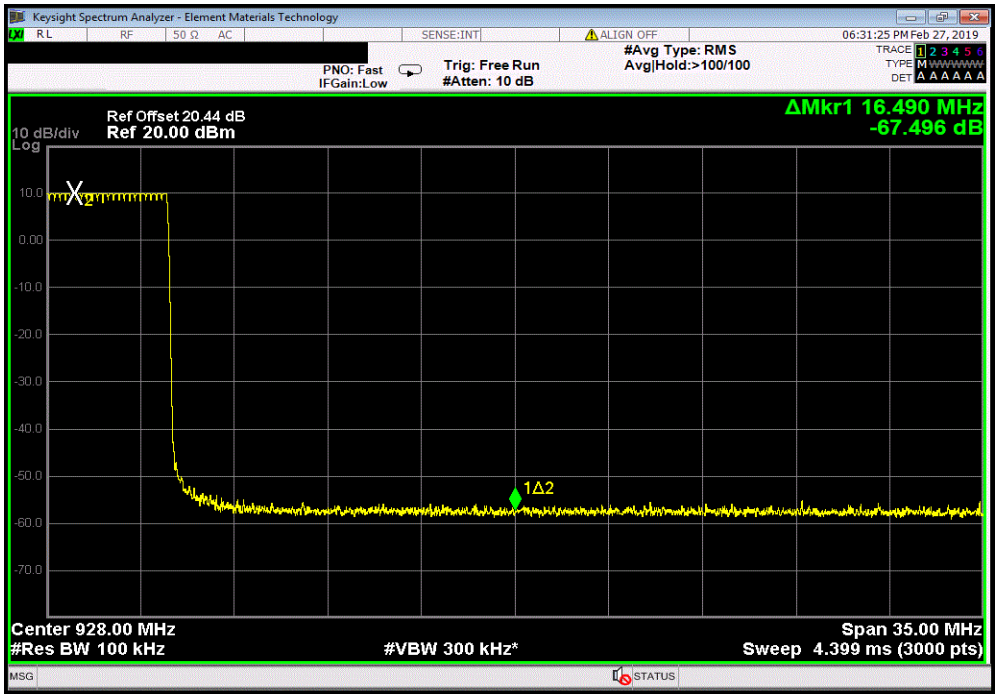
	Value (dBc)	**Limit ≤ (dBc)**	**Result**
Low Channel, 902.3 MHz	-50.58	-30	Pass
High Channel, 914.9 MHz	-67.5	-30	Pass

BAND EDGE COMPLIANCE -HOPPING MODE

Low Channel, 902.3 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-50.58	-30	Pass



High Channel, 914.9 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-67.5	-30	Pass



OCCUPIED BANDWIDTH

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

The 20dB occupied bandwidth. 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.

OCCUPIED BANDWIDTH

TbtTx 2018.09.13 XMit 2017.12.13

EUT:	**LoRa Sensor 1 Button (Model LV-PSH-171)**			**Work Order:**	**CRNE0006**
Serial Number:	**910**			**Date:**	**27-Feb-19**
Customer:	**Carnegie Technologies**			**Temperature:**	**22.9 °C**
Attendees:	**Kevin Cotton**			**Humidity:**	**42.6% RH**
Project:	**None**			**Barometric Pres.:**	**1021 mbar**
Tested by:	**Jonathan Kiefer**	**Power:**	**Battery**	**Job Site:**	**TX09**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

Ref Offset 20.44 dB (20 dB Attenuator + DC Block + Cable).

DEVIATIONS FROM TEST STANDARD

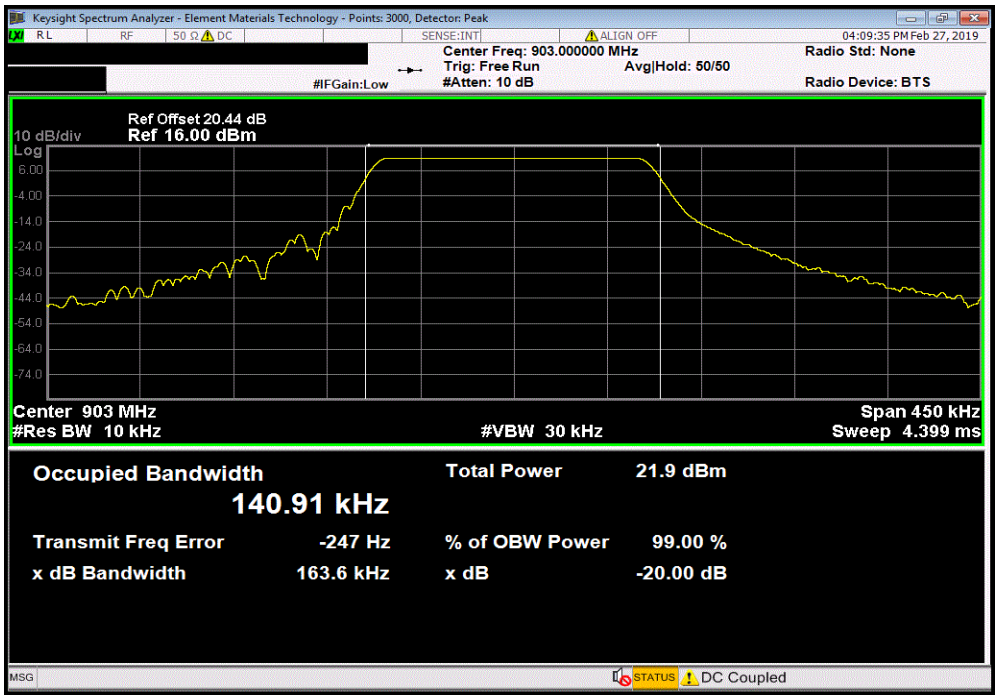
None

Configuration #	**3**	*Signature* Jonathan Kiefer

	Value	**Limit**	**Result**
Low Channel, 903 MHz	163.641 kHz	N/A	N/A
Mid Channel, 909 MHz	161.549 kHz	N/A	N/A
High Channel, 915 MHz	163.6 kHz	N/A	N/A

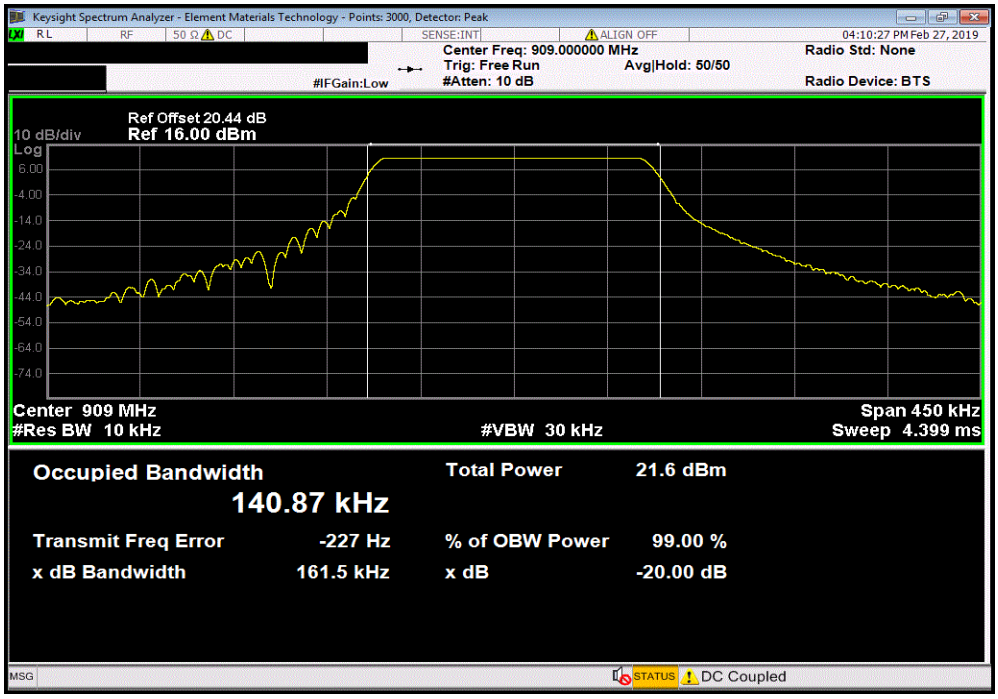
Low Channel, 903 MHz

				Value	Limit	Result
				163.641 kHz	N/A	N/A



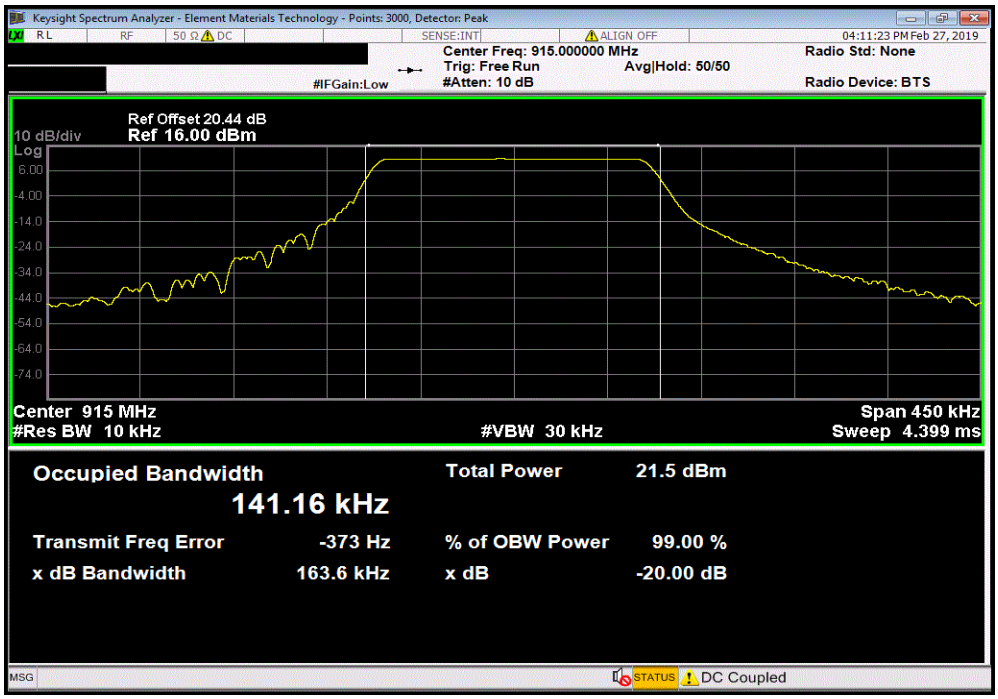
Mid Channel, 909 MHz

				Value	Limit	Result
				161.549 kHz	N/A	N/A



OCCUPIED BANDWIDTH

High Channel, 915 MHz						
				Value	Limit	Result
				163.6 kHz	N/A	N/A



SPURIOUS CONDUCTED EMISSIONS

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.

SPURIOUS CONDUCTED EMISSIONS

TbtTx 2018.09.13 XMit 2017.12.13

EUT:	LoRa Sensor 1 Button (Model LV-PSH-171)			**Work Order:**	CRNE0006
Serial Number:	910			**Date:**	27-Feb-19
Customer:	Carnegie Technologies			**Temperature:**	22.8 °C
Attendees:	Kevin Cotton			**Humidity:**	40.5% RH
Project:	None			**Barometric Pres.:**	1022 mbar
Tested by:	Jonathan Kiefer	**Power:**	Battery	**Job Site:**	TX09

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

Ref Offset 20.44 dB (20 dB Attenuator + DC Block + Cable).

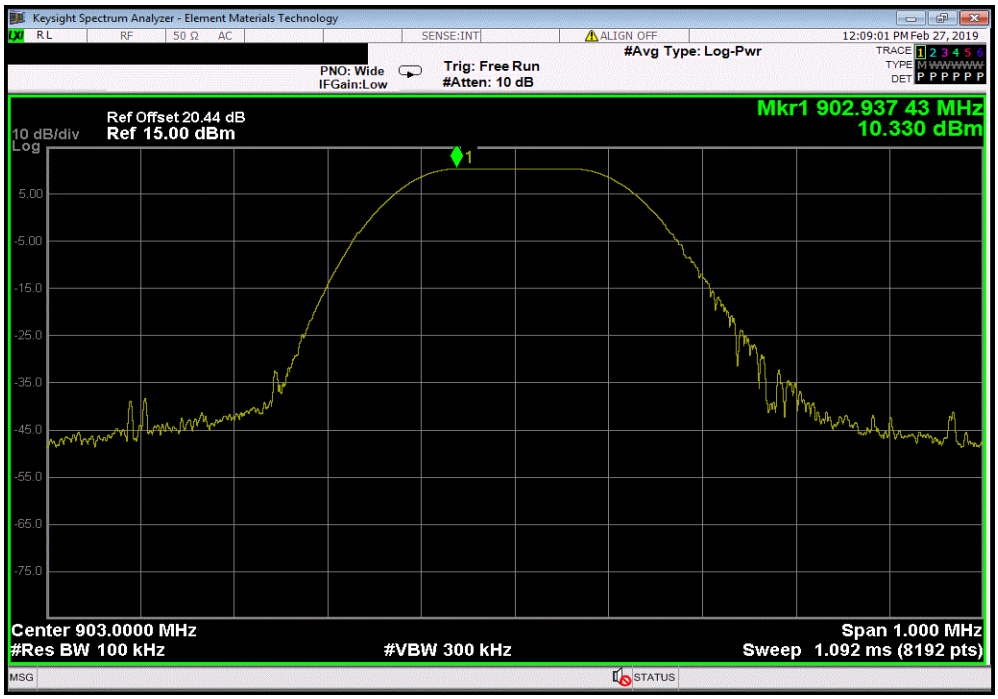
DEVIATIONS FROM TEST STANDARD

None

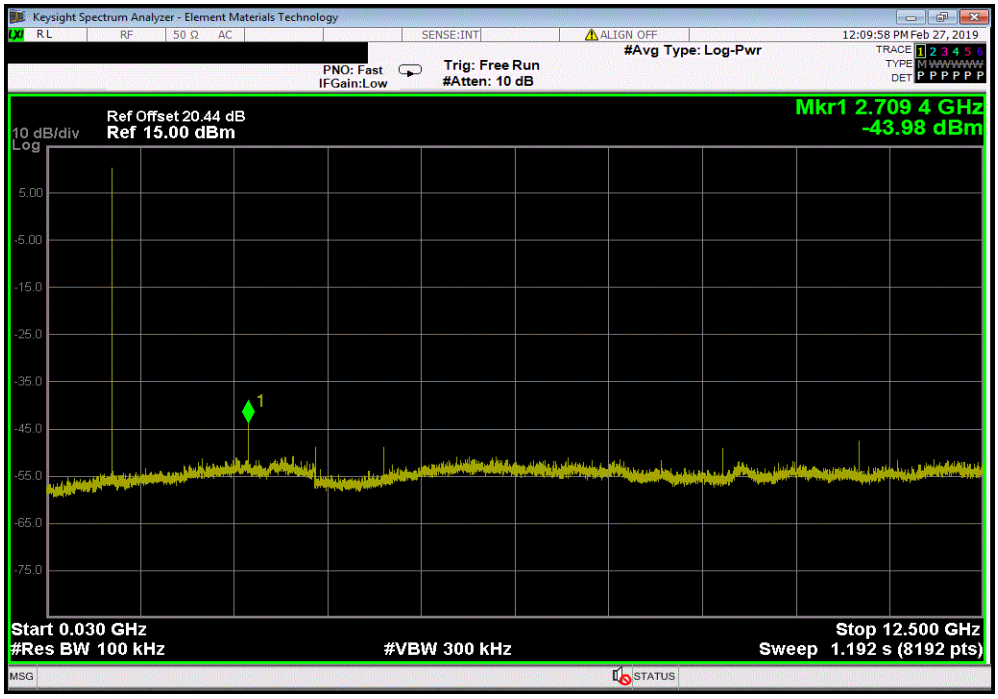
Configuration #	3	*Signature* Jonathan Kiefer

	Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
Low Channel, 903 MHz	Fundamental	902.94	N/A	N/A	N/A
Low Channel, 903 MHz	30 MHz - 12.5 GHz	2709.43	-54.31	-30	Pass
Low Channel, 903 MHz	12.5 GHz - 25 GHz	24587.96	-50.13	-30	Pass
Mid Channel, 909 MHz	Fundamental	908.99	N/A	N/A	N/A
Mid Channel, 909 MHz	30 MHz - 12.5 GHz	2726.18	-54.7	-30	Pass
Mid Channel, 909 MHz	12.5 GHz - 25 GHz	24830.61	-50.39	-30	Pass
High Channel, 915 MHz	Fundamental	914.94	N/A	N/A	N/A
High Channel, 915 MHz	30 MHz - 12.5 GHz	2744.44	-55.18	-30	Pass
High Channel, 915 MHz	12.5 GHz - 25 GHz	24598.64	-50.49	-30	Pass

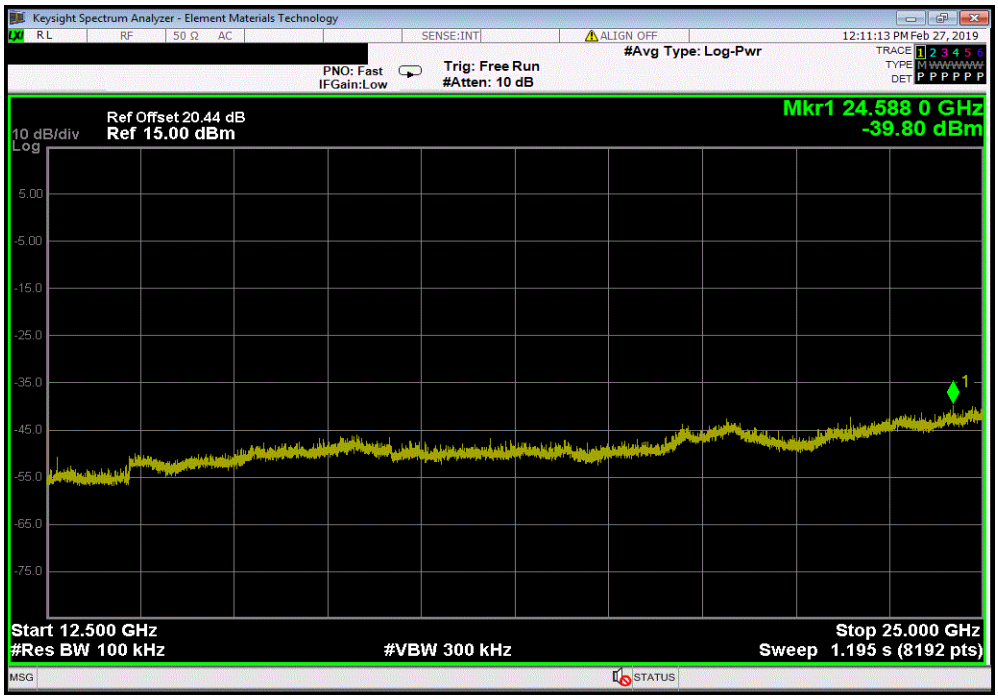
Low Channel, 903 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	902.94	N/A	N/A	N/A



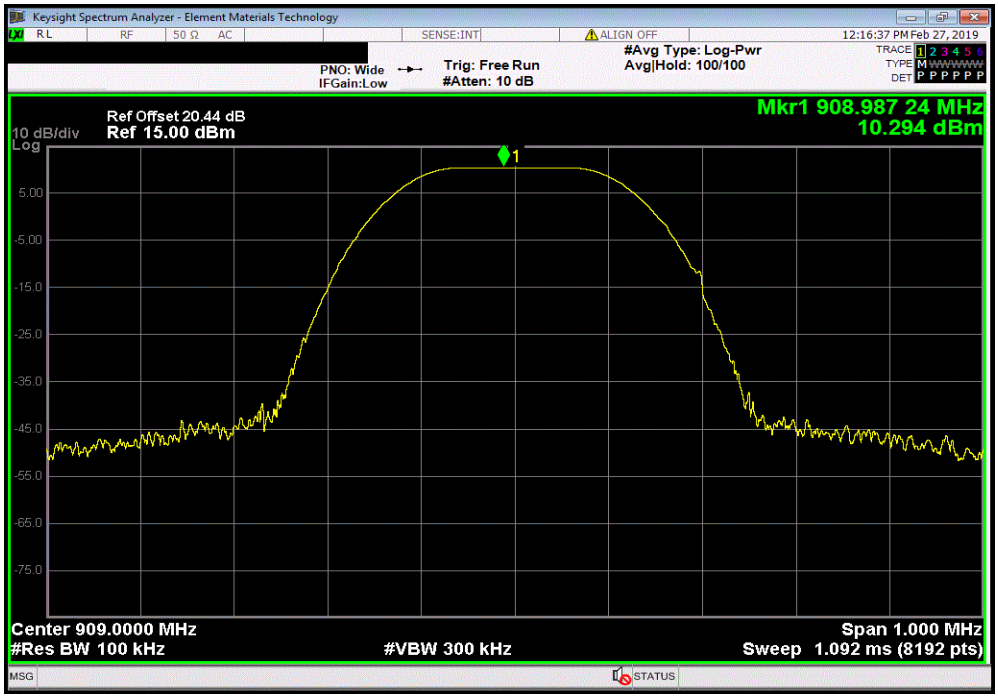
Low Channel, 903 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	2709.43	-54.31	-30	Pass



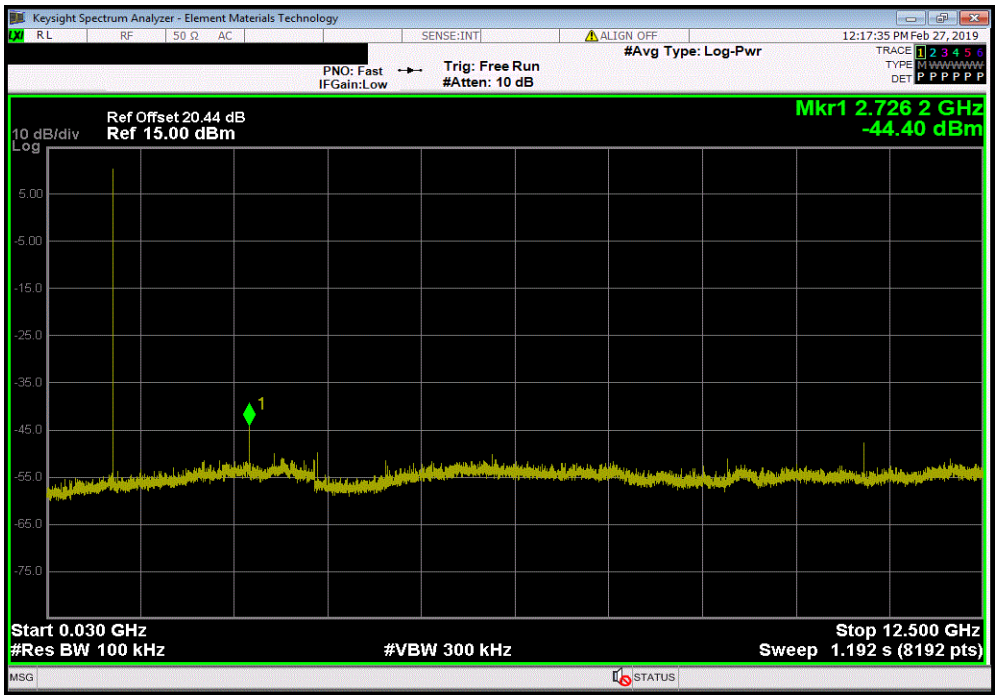
Low Channel, 903 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	24587.96	-50.13	-30	Pass



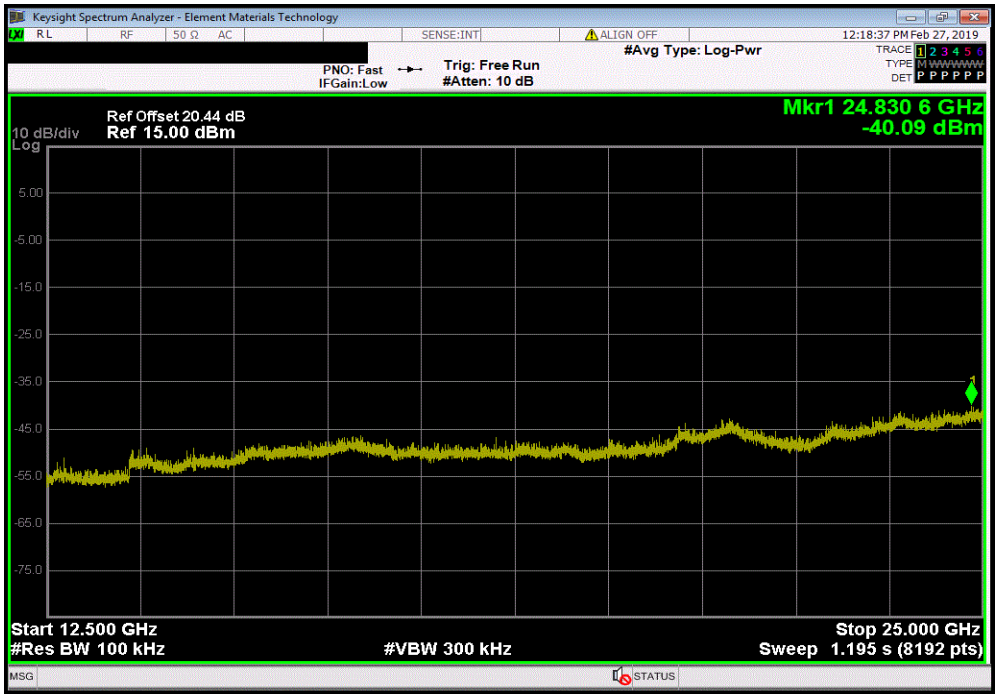
Mid Channel, 909 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
Fundamental	908.99	N/A	N/A	N/A



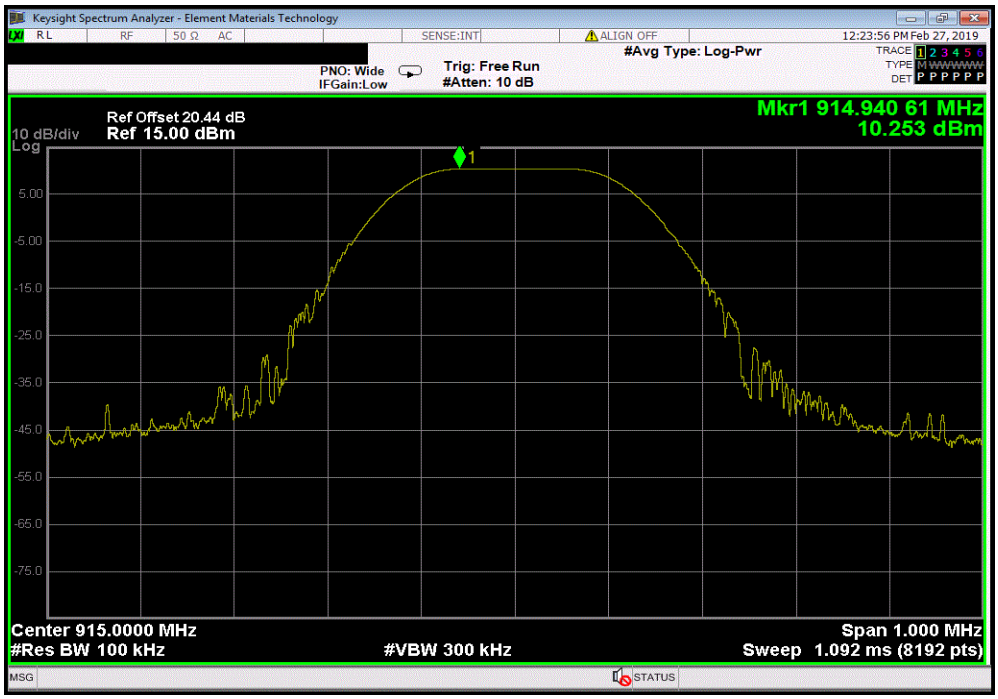
Mid Channel, 909 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	2726.18	-54.7	-30	Pass



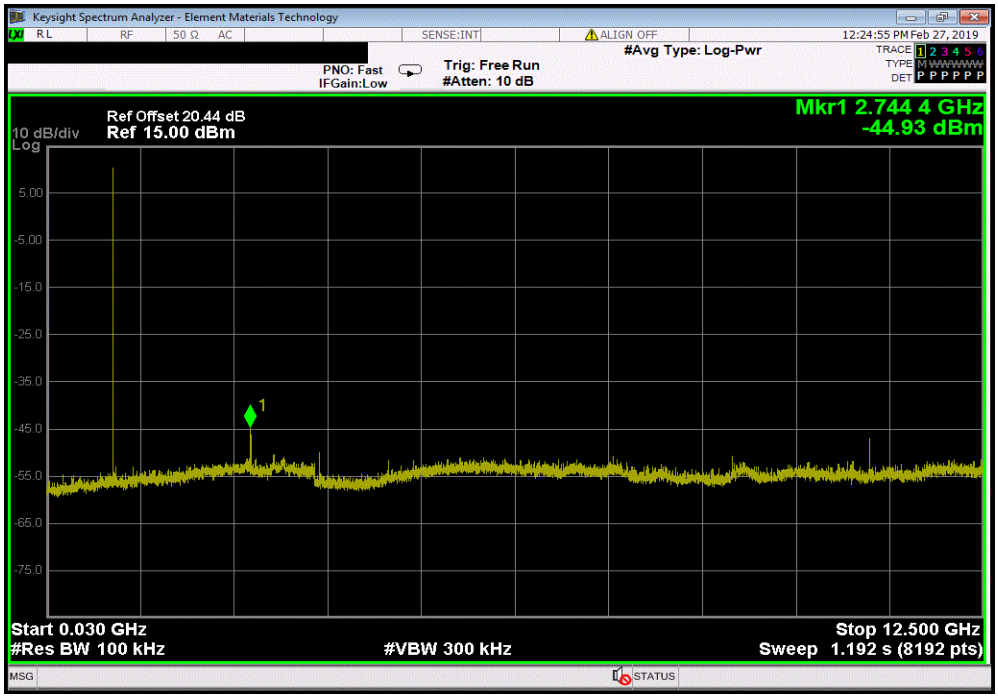
Mid Channel, 909 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	24830.61	-50.39	-30	Pass



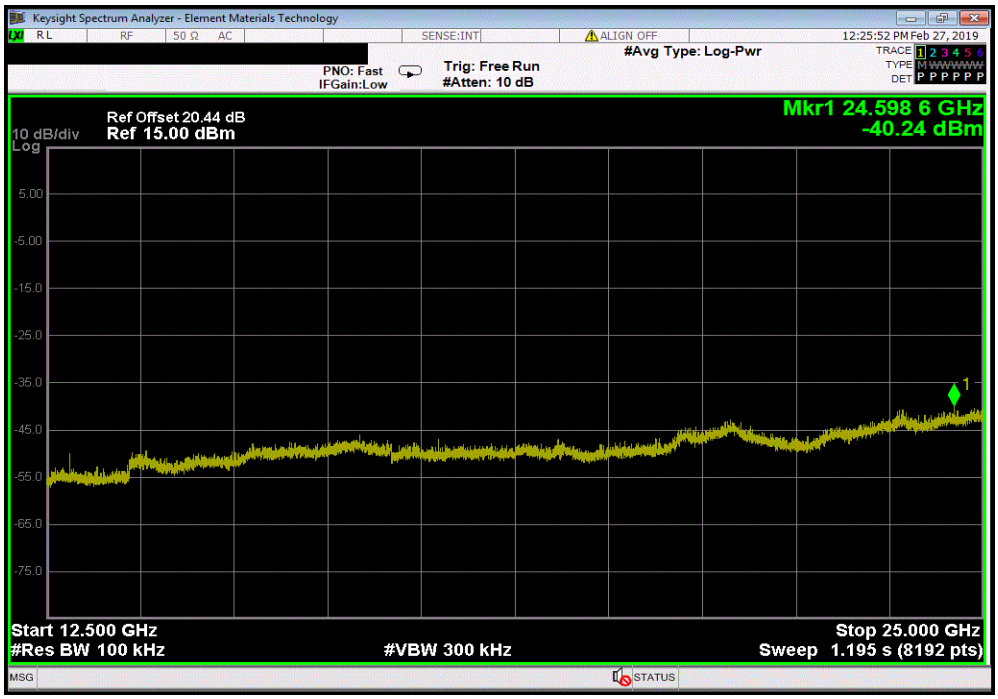
High Channel, 915 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	914.94	N/A	N/A	N/A



High Channel, 915 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	2744.44	-55.18	-30	Pass



High Channel, 915 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	24598.64	-50.49	-30	Pass



POWER SPECTRAL DENSITY

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.

POWER SPECTRAL DENSITY

element

TbtTx 2018.09.13 XMit 2017.12.13

EUT:	**LoRa Sensor 1 Button (Model LV-PSH-171)**			**Work Order:**	**CRNE0006**
Serial Number:	**910**			**Date:**	**27-Feb-19**
Customer:	**Carnegie Technologies**			**Temperature:**	**22.8 °C**
Attendees:	**Kevin Cotton**			**Humidity:**	**40.9% RH**
Project:	**None**			**Barometric Pres.:**	**1022 mbar**
Tested by:	**Jonathan Kiefer**	**Power:**	**Battery**	**Job Site:**	**TX09**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

Ref Offset 20.44 dB (20 dB Attenuator + DC Block + Cable).

DEVIATIONS FROM TEST STANDARD

None

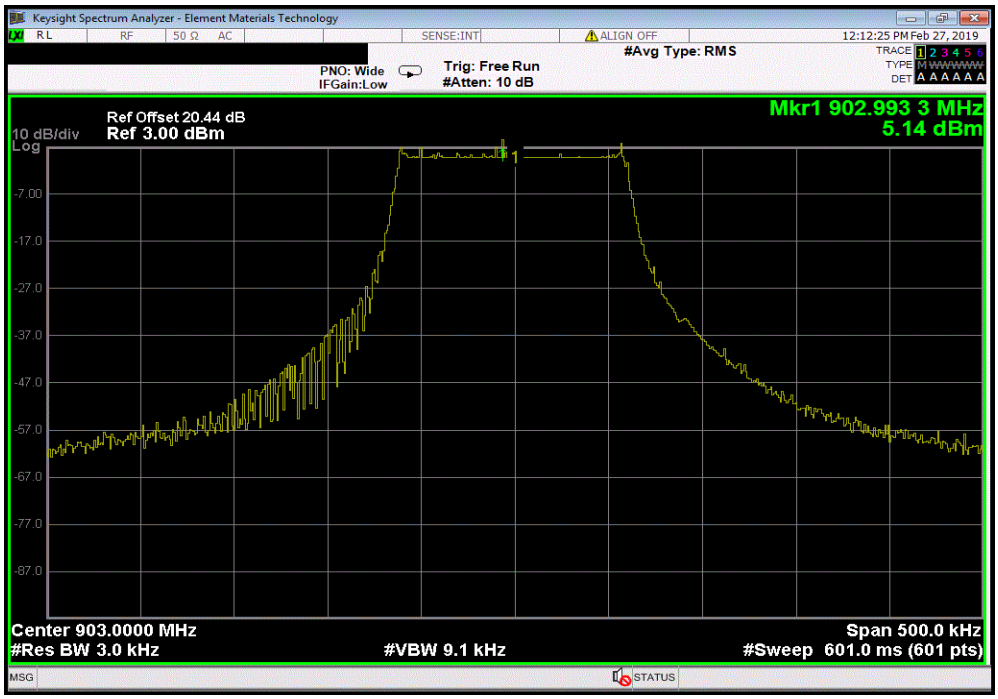
Configuration #	**3**	*Signature* Jonathan Kiefer

	Value dBm/3kHz	**Limit < dBm/3kHz**	**Results**
Low Channel, 903 MHz	5.144	8	Pass
Mid Channel, 909 MHz	5.083	8	Pass
High Channel, 915 MHz	3.363	8	Pass

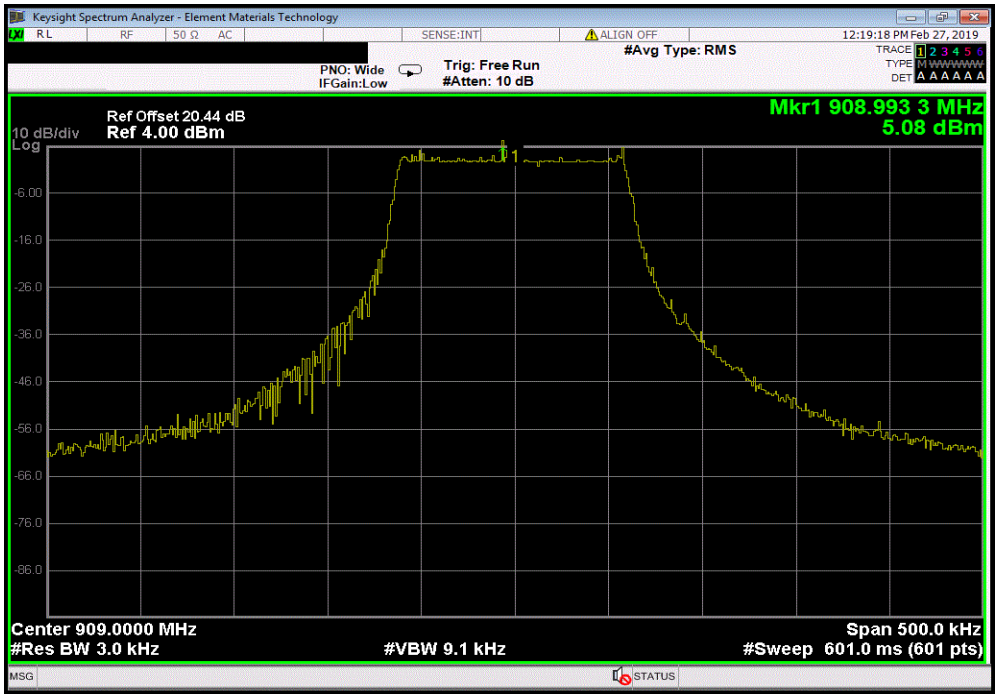
POWER SPECTRAL DENSITY

TbtTx 2018.09.13 XMit 2017.12.13

Low Channel, 903 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				5.144	8	Pass



Mid Channel, 909 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				5.083	8	Pass



High Channel, 915 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				3.363	8	Pass