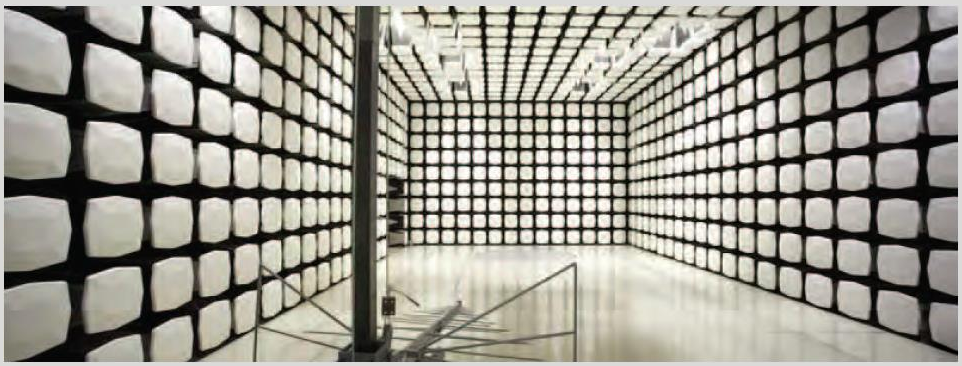
SMRTGrid Inc.

Beacon

FCC 15.247:2019

902 - 928 MHz Hybrid Transceiver

Report # SMNC0001.1



NVLAP LAB CODE: 200881-0

CERTIFICATE OF TEST

Last Date of Test: November 26, 2019
SMRTGrid Inc.
EUT: Beacon

Radio Equipment Testing

Standards

Specification	Method
FCC 15.247:2019	ANSI C63.10:2013, KDB 558074

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions (Transmitter)	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	N/A	No requirement
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:

Eric Brandon, Department 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) and as a CAB for the acceptance of test data.

European Union

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

Australia/New Zealand

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

Korea

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

Japan

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

Taiwan

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

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

Singapore

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

Israel

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

Hong Kong

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

Vietnam

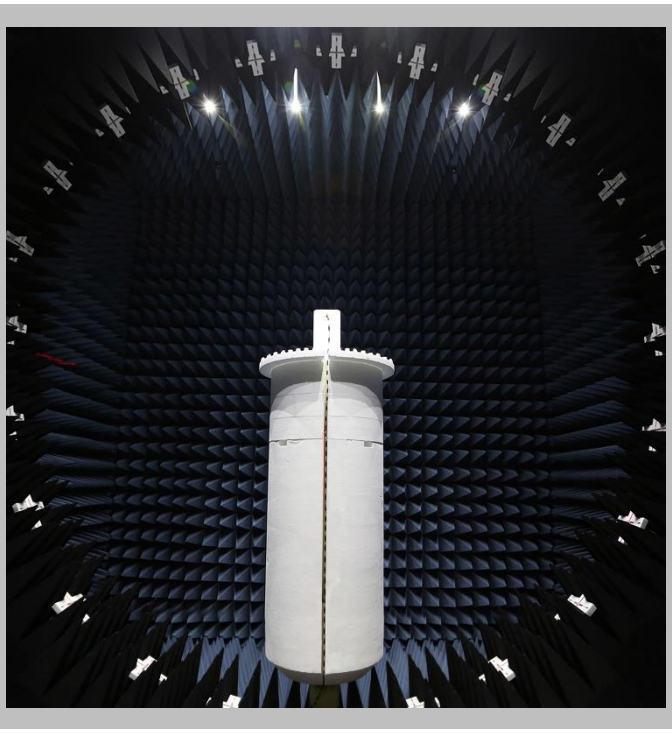
MIC – Recognized by MIC as a CAB for the acceptance of test data.

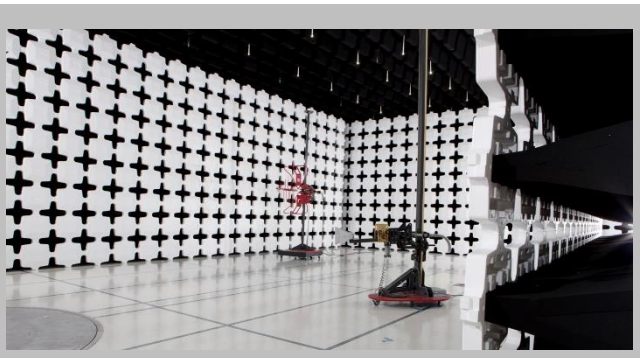
SCOPE

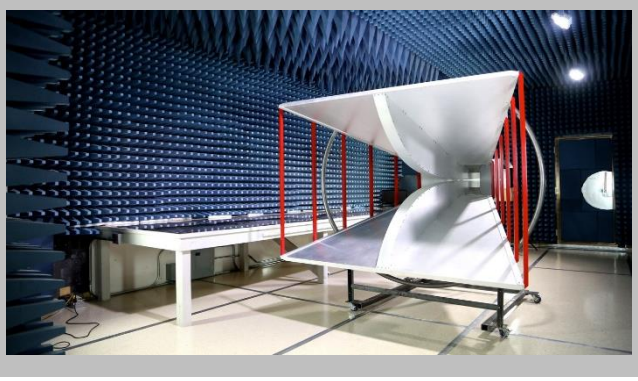
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

FACILITIES

California	Minnesota	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 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: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157







MEASUREMENT UNCERTAINTY

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.

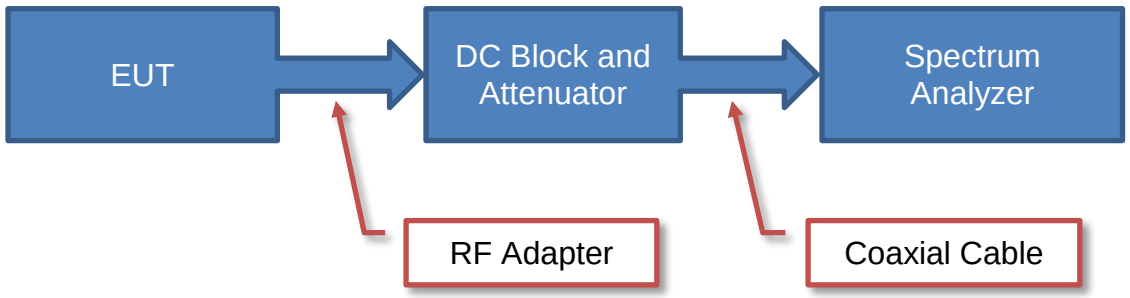
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable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

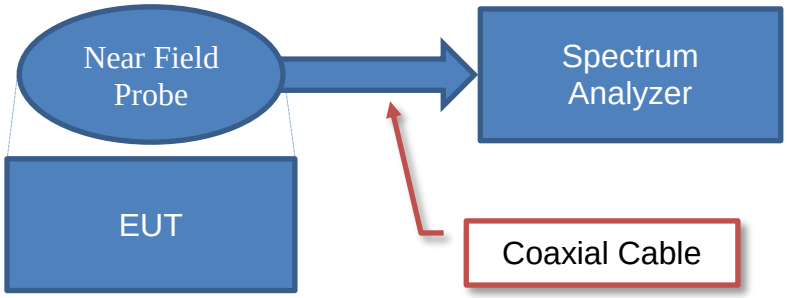
Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

Test Setup Block Diagrams

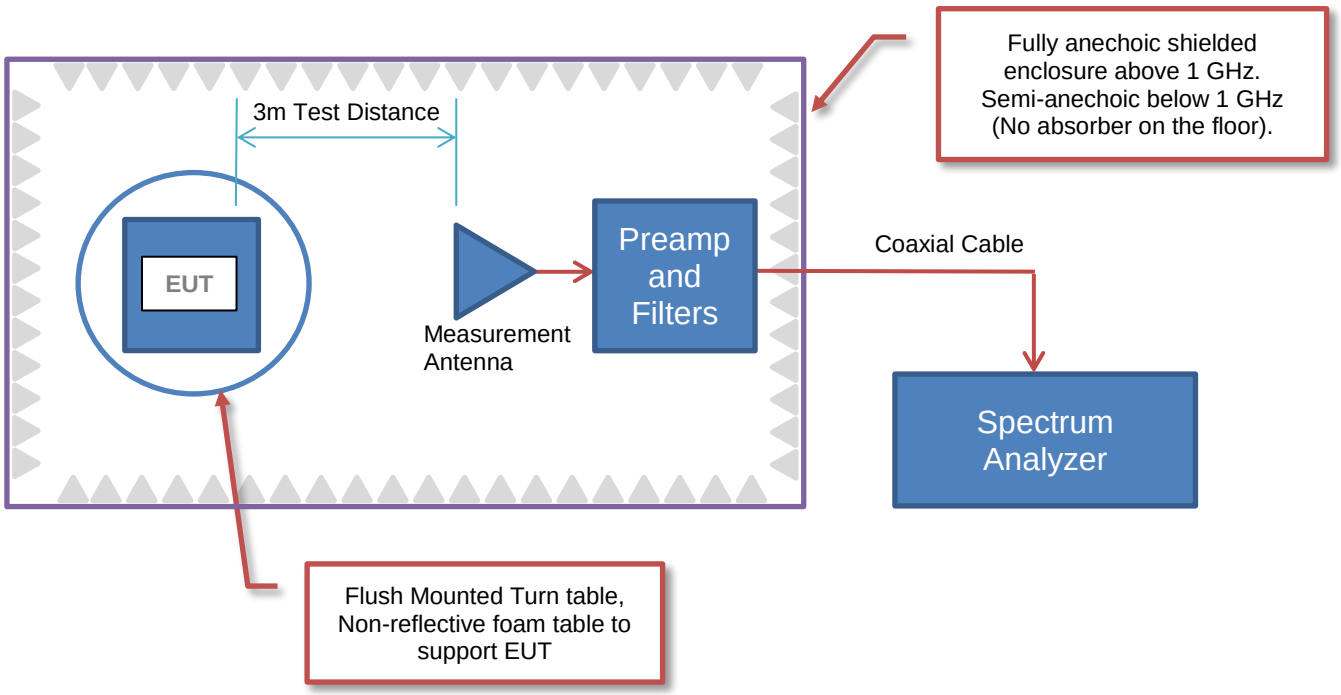
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	SMRTGrid Inc.
Address:	1675 Samco Road
City, State, Zip:	Rapid City, SD 57702
Test Requested By:	Bill Haag
EUT:	Beacon
First Date of Test:	November 25, 2019
Last Date of Test:	November 26, 2019
Receipt Date of Samples:	November 25, 2019
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
The device gathers data from the onboard sensors, and when appropriate, sends data through the CATm1 module (verizon) to a cloud repository. There will also be LoRa for medium range communication, and BLE for short range communication.

Testing Objective:
Seeking to demonstrate compliance of the LoRa radio under FCC 15.247:2019 for operation in the 902 - 928 MHz Band as a Hybrid device.

CONFIGURATIONS

Configuration SMNC0001- 1

Software/Firmware Running during test	
Description	**Version**
Firmware (Low Channel, 293 bps)	6.hex
Firmware (Low Channel, 3516 bps)	17.hex
Firmware (Low Channel, 37500 bps)	5.hex
Firmware (Mid Channel, 293 bps)	4.hex
Firmware (Mid Channel, 3516 bps)	16.hex
Firmware (Mid Channel, 37500 bps)	3.hex
Firmware (High Channel, 293 bps)	2.hex
Firmware (High Channel, 3516 bps)	15.hex
Firmware (High Channel, 37500 bps)	1.hex

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Beacon	SMRTGrid Inc.	N/A	Unit 1

Configuration SMNC0001- 4

Software/Firmware Running during test	
Description	**Version**
Firmware (Low Channel, 293 bps)	6.hex
Firmware (Low Channel, 3516 bps)	17.hex
Firmware (Low Channel, 37500 bps)	5.hex
Firmware (Mid Channel, 293 bps)	4.hex
Firmware (Mid Channel, 3516 bps)	16.hex
Firmware (Mid Channel, 37500 bps)	3.hex
Firmware (High Channel, 293 bps)	2.hex
Firmware (High Channel, 3516 bps)	15.hex
Firmware (High Channel, 37500 bps)	1.hex
Firmware (Hopping Mode, 293 bps)	47.hex
Firmware (Hopping Mode, 3516 bps)	46.hex
Firmware (Hopping Mode, 37500 bps)	48.hex

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Beacon	SMRTGrid Inc.	N/A	Unit 1

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2019-11-25	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	2019-11-26	Duty Cycle	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2019-11-26	Carrier Frequency Separation	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	2019-11-26	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.
5	2019-11-26	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.
6	2019-11-26	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.
7	2019-11-26	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.
8	2019-11-26	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.
9	2019-11-26	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.
10	2019-11-26	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.
11	2019-11-26	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.
12	2019-11-26	Power Spectral Density	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 2019.05.10

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

MODES OF OPERATION

Transmitting LoRa - low channel (903.08 MHz), mid channel (915 MHz), and high channel (926.84 MHz); 293 bps, 3516 bps, and 37500 bps data rates.

POWER SETTINGS INVESTIGATED

Battery

CONFIGURATIONS INVESTIGATED

SMNC0001 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	10000 MHz

SAMPLE CALCULATIONS

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Filter - Band Pass/Notch	K&L Microwave	3TNF-500/1000-N/N	HGS	13-Jul-2019	12 mo
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFD	28-Jul-2019	12 mo
Filter - High Pass	Micro-Tronics	HPM50108	HFW	18-Sep-2019	12 mo
Attenuator	Coaxicom	3910-20	AXY	17-Sep-2019	12 mo
Cable	Element	Biconilog Cable	MNX	23-Feb-2019	12 mo
Cable	Element	Standard Gain Cable	MNW	23-Feb-2019	12 mo
Cable	Element	Double Ridge Guide Horn Cables	MNV	23-Feb-2019	12 mo
Antenna - Biconilog	Ametek	CBL 6141B	AYS	19-Mar-2019	24 mo
Antenna - Standard Gain	ETS-Lindgren	3160-07	AJJ	NCR	0 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIB	27-Aug-2018	24 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVC	23-Feb-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVX	23-Feb-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1064-9079 and SA18E-10	AOO	23-Feb-2019	12 mo

MEASUREMENT BANDWIDTHS

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

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).

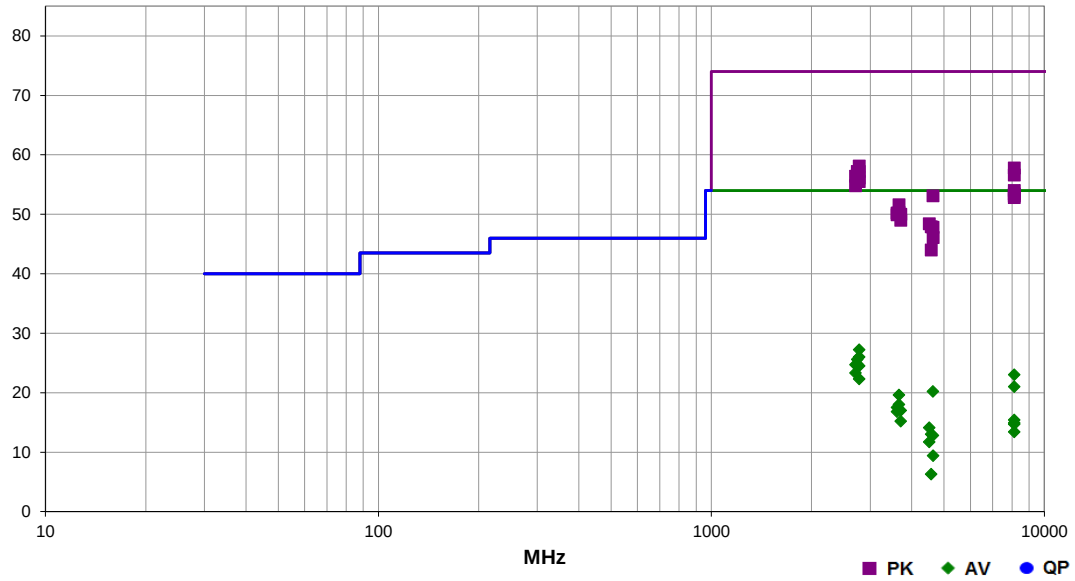
SPURIOUS RADIATED EMISSIONS

EmiR5 2019.08.15.1 PSA-ESCI 2019.05.10

Work Order:	SMNC0001	**Date:**	25-Nov-2019		
Project:	None	**Temperature:**	22 °C		
Job Site:	MN09	**Humidity:**	31.5% RH		
Serial Number:	Unit 1	**Barometric Pres.:**	1000 mbar	**Tested by:**	Dustin Sparks
EUT:	Beacon				
Configuration:	1				
Customer:	SMRTGrid Inc.				
Attendees:	Bill Haag				
EUT Power:	Battery				
Operating Mode:	Transmitting LoRa - low channel (903.08 MHz), mid channel (915 MHz), and high channel (926.84 MHz); 293 bps, 3516 bps, and 37500 bps data rates.				
Deviations:	None				
Comments:	Duty cycle correction factor (DCCF) of 0.5 dB added to RMS average points, based on the worst case operating duty cycle (89.7%) and the formula 10 * log(1/0.897). Another DCCF of 30.9 dB was subtracted from the RMS average points based on a calculated duty cycle of 2.853% while in frequency hopping mode. Formula: 20 * log(0.02853).				

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

Run #	17	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2780.412	61.7	-3.6	1.0	138.0	0.0	0.0	Horz	PK	0.0	58.1	74.0	-15.9	High ch, EUT on side, 125 kHz, 293 bps
8126.628	44.7	13.1	2.1	228.0	0.0	0.0	Vert	PK	0.0	57.8	74.0	-16.2	Low ch, EUT vert, 250 kHz, 3516 bps
2744.790	60.7	-3.5	1.0	142.0	0.0	0.0	Horz	PK	0.0	57.2	74.0	-16.8	Mid ch, EUT on side, 250 kHz, 3516 bps
2780.820	60.8	-3.6	2.8	50.0	0.0	0.0	Horz	PK	0.0	57.2	74.0	-16.8	High ch, EUT on side, 250 kHz, 3516 bps
8127.228	43.5	13.1	2.3	170.0	0.0	0.0	Horz	PK	0.0	56.6	74.0	-17.4	Low ch, EUT on side, 250 kHz, 3516 bps
2709.598	59.9	-3.5	2.3	165.0	0.0	0.0	Horz	PK	0.0	56.4	74.0	-17.6	Low ch, EUT on side, 250 kHz, 3516 bps
2744.725	59.7	-3.5	2.9	148.0	0.0	0.0	Vert	PK	0.0	56.2	74.0	-17.8	Mid ch, EUT vert, 250 kHz, 3516 bps
2780.787	59.7	-3.6	4.0	18.0	0.0	0.0	Vert	PK	0.0	56.1	74.0	-17.9	High ch, EUT vert, 250 kHz, 3516 bps
2780.803	59.1	-3.6	1.0	293.0	0.0	0.0	Horz	PK	0.0	55.5	74.0	-18.5	High ch, EUT on side, 500 kHz, 37500 bps
2709.407	58.3	-3.5	3.8	199.0	0.0	0.0	Vert	PK	0.0	54.8	74.0	-19.2	Low ch, EUT vert, 250 kHz, 3516 bps
8127.662	40.9	13.1	2.7	260.0	0.0	0.0	Vert	PK	0.0	54.0	74.0	-20.0	Low ch, EUT on side, 250 kHz, 3516 bps
8128.187	40.3	13.1	2.8	235.0	0.0	0.0	Horz	PK	0.0	53.4	74.0	-20.6	Low ch, EUT horz, 250 kHz, 3516 bps
8127.162	40.0	13.1	1.7	213.0	0.0	0.0	Horz	PK	0.0	53.1	74.0	-20.9	Low ch, EUT vert, 250 kHz, 3516 bps
4633.783	49.9	3.2	2.3	267.0	0.0	0.0	Horz	PK	0.0	53.1	74.0	-20.9	High ch, EUT on side, 125 kHz, 293 bps
8128.462	39.7	13.1	1.5	17.0	0.0	0.0	Vert	PK	0.0	52.8	74.0	-21.2	Low ch, EUT horz, 250 kHz, 3516 bps
3660.040	51.9	-0.3	2.5	235.0	0.0	0.0	Horz	PK	0.0	51.6	74.0	-22.4	Mid ch, EUT on side, 250 kHz, 3516 bps
3660.400	50.6	-0.3	3.8	176.0	0.0	0.0	Vert	PK	0.0	50.3	74.0	-23.7	Mid ch, EUT vert, 250 kHz, 3516 bps
3612.587	50.9	-0.7	1.5	134.0	0.0	0.0	Horz	PK	0.0	50.2	74.0	-23.8	Low ch, EUT on side, 250 kHz, 3516 bps
3707.518	50.3	-0.3	4.0	0.0	0.0	0.0	Vert	PK	0.0	50.0	74.0	-24.0	High ch, EUT vert, 250 kHz, 3516 bps
3611.912	50.6	-0.7	2.6	145.0	0.0	0.0	Vert	PK	0.0	49.9	74.0	-24.1	Low ch, EUT vert, 250 kHz, 3516 bps
3707.093	49.3	-0.3	1.5	349.0	0.0	0.0	Horz	PK	0.0	49.0	74.0	-25.0	High ch, EUT on side, 250 kHz, 3516 bps
4515.175	45.5	2.9	2.3	68.0	0.0	0.0	Horz	PK	0.0	48.4	74.0	-25.6	Low ch, EUT on side, 250 kHz, 3516 bps
4575.710	44.8	3.1	2.4	89.0	0.0	0.0	Horz	PK	0.0	47.9	74.0	-26.1	Mid ch, EUT on side, 250 kHz, 3516 bps
4633.908	44.6	3.2	2.7	140.0	0.0	0.0	Horz	PK	0.0	47.8	74.0	-26.2	High ch, EUT on side, 250 kHz, 3516 bps
2780.445	61.2	-3.6	1.0	138.0	-30.4	0.0	Horz	AV	0.0	27.2	54.0	-26.8	High ch, EUT on side, 125 kHz, 293 bps
4634.450	42.9	3.2	1.5	226.0	0.0	0.0	Vert	PK	0.0	46.1	74.0	-27.9	High ch, EUT vert, 250 kHz, 3516 bps

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2780.695	60.0	-3.6	2.8	50.0	-30.4	0.0	Horz	AV	0.0	26.0	54.0	-28.0	High ch, EUT on side, 250 kHz, 3516 bps
2745.080	59.5	-3.5	1.0	142.0	-30.4	0.0	Horz	AV	0.0	25.6	54.0	-28.4	Mid ch, EUT on side, 250 kHz, 3516 bps
2745.083	58.7	-3.5	2.9	148.0	-30.4	0.0	Vert	AV	0.0	24.8	54.0	-29.2	Mid ch, EUT vert, 250 kHz, 3516 bps
2709.423	58.6	-3.5	2.3	165.0	-30.4	0.0	Horz	AV	0.0	24.7	54.0	-29.3	Low ch, EUT on side, 250 kHz, 3516 bps
2780.687	58.5	-3.6	4.0	18.0	-30.4	0.0	Vert	AV	0.0	24.5	54.0	-29.5	High ch, EUT vert, 250 kHz, 3516 bps
4574.608	40.9	3.1	1.5	149.0	0.0	0.0	Vert	PK	0.0	44.0	74.0	-30.0	Mid ch, EUT vert, 250 kHz, 3516 bps
2709.382	57.2	-3.5	3.8	199.0	-30.4	0.0	Vert	AV	0.0	23.3	54.0	-30.7	Low ch, EUT vert, 250 kHz, 3516 bps
8127.562	40.3	13.1	2.1	228.0	-30.4	0.0	Vert	AV	0.0	23.0	54.0	-31.0	Low ch, EUT vert, 250 kHz, 3516 bps
2780.495	56.3	-3.6	1.0	293.0	-30.4	0.0	Horz	AV	0.0	22.3	54.0	-31.7	High ch, EUT on side, 500 kHz, 37500 bps
8128.087	38.3	13.1	2.3	170.0	-30.4	0.0	Horz	AV	0.0	21.0	54.0	-33.0	Low ch, EUT on side, 250 kHz, 3516 bps
4634.050	47.4	3.2	2.3	267.0	-30.4	0.0	Horz	AV	0.0	20.2	54.0	-33.8	High ch, EUT on side, 125 kHz, 293 bps
3660.210	50.3	-0.3	2.5	235.0	-30.4	0.0	Horz	AV	0.0	19.6	54.0	-34.4	Mid ch, EUT on side, 250 kHz, 3516 bps
3659.842	48.7	-0.3	3.8	176.0	-30.4	0.0	Vert	AV	0.0	18.0	54.0	-36.0	Mid ch, EUT vert, 250 kHz, 3516 bps
3612.337	48.6	-0.7	1.5	134.0	-30.4	0.0	Horz	AV	0.0	17.5	54.0	-36.5	Low ch, EUT on side, 250 kHz, 3516 bps
3707.393	47.7	-0.3	4.0	0.0	-30.4	0.0	Vert	AV	0.0	17.0	54.0	-37.0	High ch, EUT vert, 250 kHz, 3516 bps
3612.137	47.9	-0.7	2.6	145.0	-30.4	0.0	Vert	AV	0.0	16.8	54.0	-37.2	Low ch, EUT vert, 250 kHz, 3516 bps
8127.862	32.7	13.1	2.7	260.0	-30.4	0.0	Vert	AV	0.0	15.4	54.0	-38.6	Low ch, EUT on side, 250 kHz, 3516 bps
3707.402	45.9	-0.3	1.5	349.0	-30.4	0.0	Horz	AV	0.0	15.2	54.0	-38.8	High ch, EUT on side, 250 kHz, 3516 bps
8127.937	32.2	13.1	1.7	213.0	-30.4	0.0	Horz	AV	0.0	14.9	54.0	-39.1	Low ch, EUT vert, 250 kHz, 3516 bps
8128.312	32.0	13.1	2.8	235.0	-30.4	0.0	Horz	AV	0.0	14.7	54.0	-39.3	Low ch, EUT horz, 250 kHz, 3516 bps
4515.150	41.6	2.9	2.3	68.0	-30.4	0.0	Horz	AV	0.0	14.1	54.0	-39.9	Low ch, EUT on side, 250 kHz, 3516 bps
8127.620	30.7	13.1	1.5	17.0	-30.4	0.0	Vert	AV	0.0	13.4	54.0	-40.6	Low ch, EUT horz, 250 kHz, 3516 bps
4574.920	40.3	3.1	2.4	89.0	-30.4	0.0	Horz	AV	0.0	13.0	54.0	-41.0	Mid ch, EUT on side, 250 kHz, 3516 bps
4634.133	40.0	3.2	2.7	140.0	-30.4	0.0	Horz	AV	0.0	12.8	54.0	-41.2	High ch, EUT on side, 250 kHz, 3516 bps
4515.258	39.2	2.9	1.0	7.0	-30.4	0.0	Vert	AV	0.0	11.7	54.0	-42.3	Low ch, EUT vert, 250 kHz, 3516 bps
4634.400	36.6	3.2	1.5	226.0	-30.4	0.0	Vert	AV	0.0	9.4	54.0	-44.6	High ch, EUT vert, 250 kHz, 3516 bps
4575.283	33.6	3.1	1.5	149.0	-30.4	0.0	Vert	AV	0.0	6.3	54.0	-47.7	Mid ch, EUT vert, 250 kHz, 3516 bps

DUTY CYCLE

XMit 2019.09.05

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	5-Jul-17	5-Jul-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	1-May-19	1-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The Duty Cycle (x) of the single channel operation of the radio as controlled by the provided test software was measured for each of the EUT operating modes.

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

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

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

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

DUTY CYCLE

element

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	**Beacon**			**Work Order:**	**SMNC0001**
Serial Number:	**Unit 1**			**Date:**	**26-Nov-19**
Customer:	**SMRTGrid Inc.**			**Temperature:**	**23.2 °C**
Attendees:	**Bill Haag**			**Humidity:**	**29.2% RH**
Project:	**None**			**Barometric Pres.:**	**1013 mbar**
Tested by:	**Dustin Sparks**	**Power:**	**Battery**	**Job Site:**	**MN08**

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

COMMENTS

DC block, measurement cable, and customer U.FL to SMA cable included in reference level offset. No external attenuator required due to low output power.

DEVIATIONS FROM TEST STANDARD

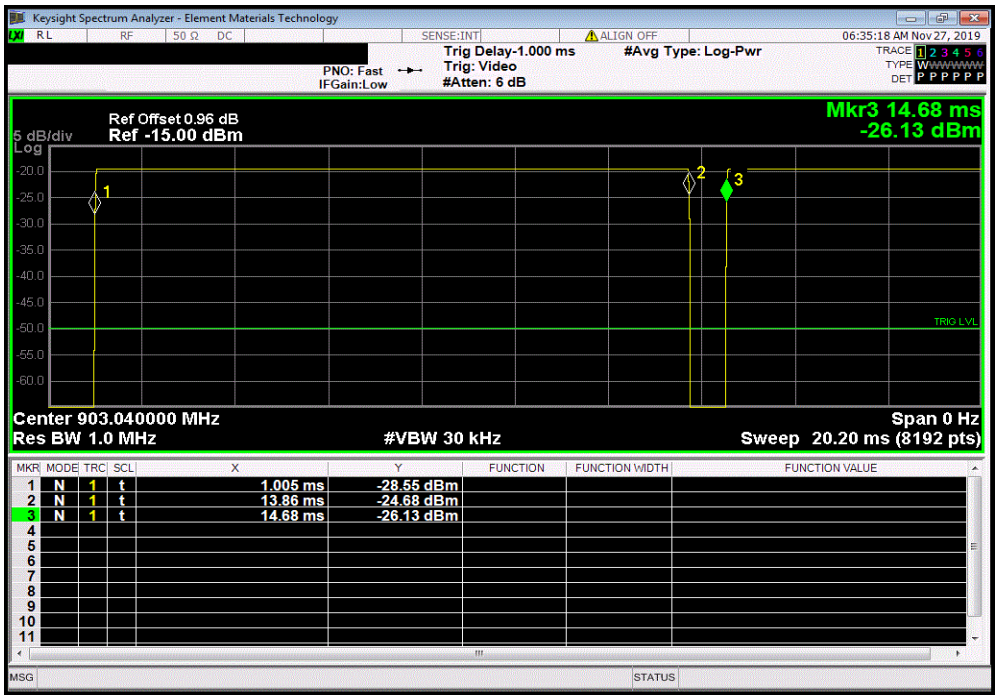
None

Configuration #	**4**	*Signature* Dustin Sparks

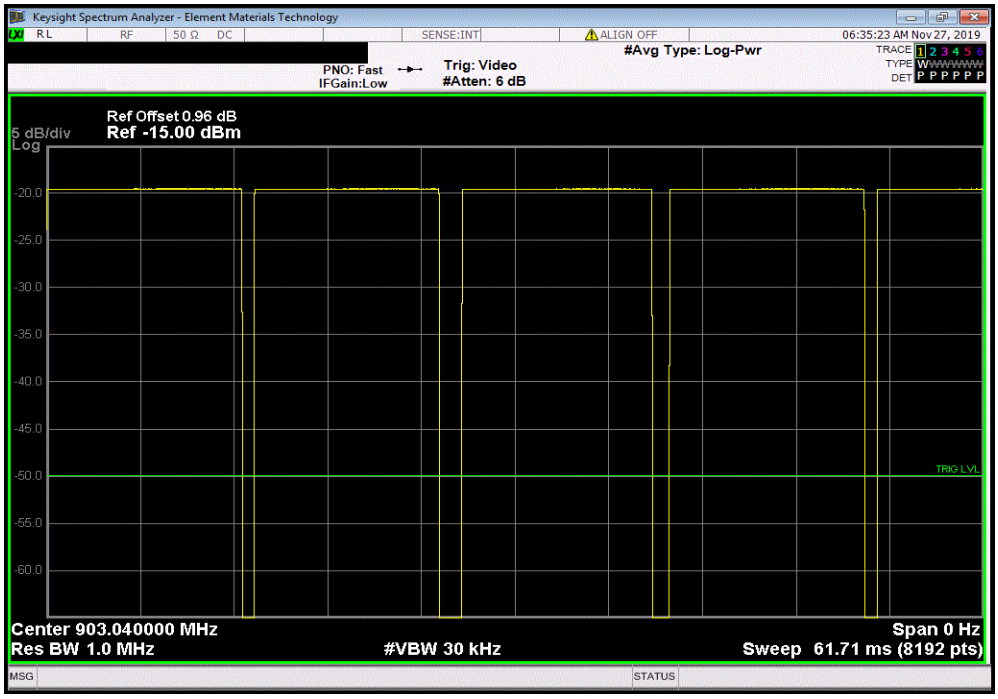
		Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
LoRa, 902-928 MHz							
	Low Channel, 903.04 MHz						
	293 bps	12.859 ms	13.676 ms	1	94	N/A	N/A
	293 bps	N/A	N/A	5	N/A	N/A	N/A
	3516 bps	12.831 ms	13.668 ms	1	93.9	N/A	N/A
	3516 bps	N/A	N/A	5	N/A	N/A	N/A
	37500 bps	12.847 ms	13.697 ms	1	93.8	N/A	N/A
	37500 bps	N/A	N/A	5	N/A	N/A	N/A
	Mid Channel, 915 MHz						
	293 bps	12.852 ms	13.689 ms	1	93.9	N/A	N/A
	293 bps	N/A	N/A	5	N/A	N/A	N/A
	3516 bps	12.862 ms	13.697 ms	1	93.9	N/A	N/A
	3516 bps	N/A	N/A	5	N/A	N/A	N/A
	37500 bps	13.165 ms	14.673 ms	1	89.7	N/A	N/A
	37500 bps	N/A	N/A	5	N/A	N/A	N/A
	High Channel, 926.84 MHz						
	293 bps	12.861 ms	13.699 ms	1	93.9	N/A	N/A
	293 bps	N/A	N/A	5	N/A	N/A	N/A
	3516 bps	12.501 ms	13.669 ms	1	91.5	N/A	N/A
	3516 bps	N/A	N/A	5	N/A	N/A	N/A
	37500 bps	12.834 ms	13.674 ms	1	93.9	N/A	N/A
	37500 bps	N/A	N/A	5	N/A	N/A	N/A

DUTY CYCLE

LoRa, 902-928 MHz, Low Channel, 903.04 MHz, 293 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	12.859 ms	13.676 ms	1	94	N/A	N/A

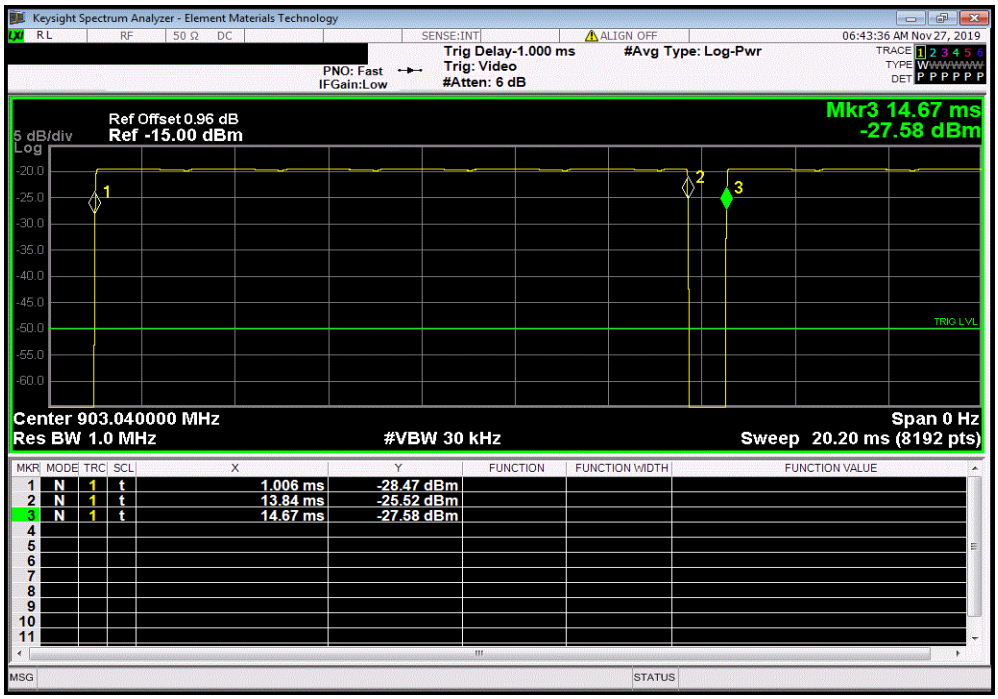


LoRa, 902-928 MHz, Low Channel, 903.04 MHz, 293 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

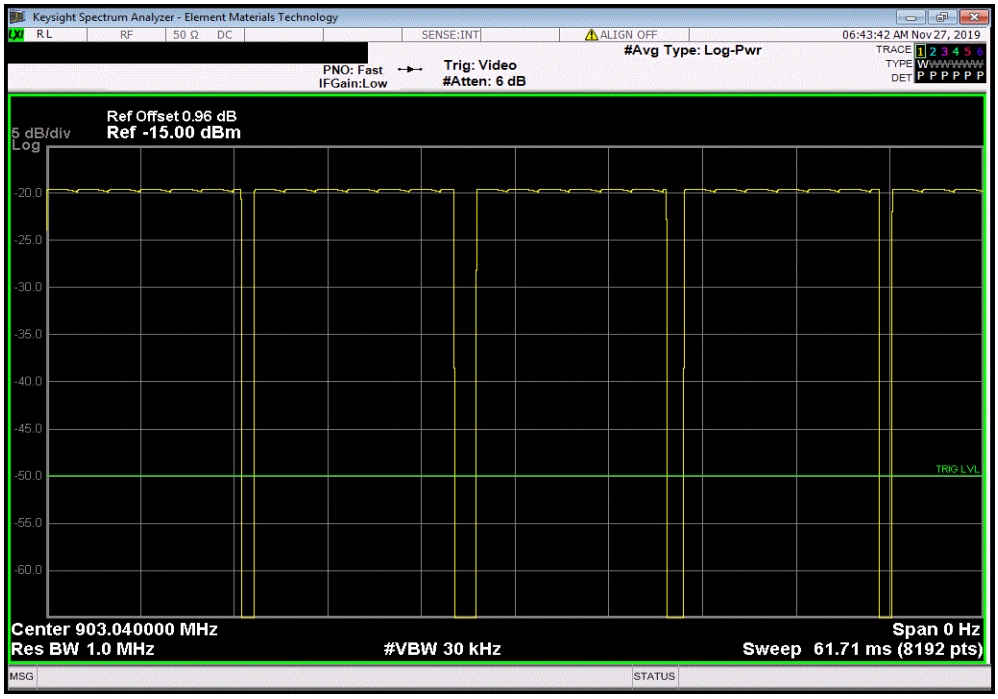


DUTY CYCLE

LoRa, 902-928 MHz, Low Channel, 903.04 MHz, 3516 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	12.831 ms	13.668 ms	1	93.9	N/A	N/A

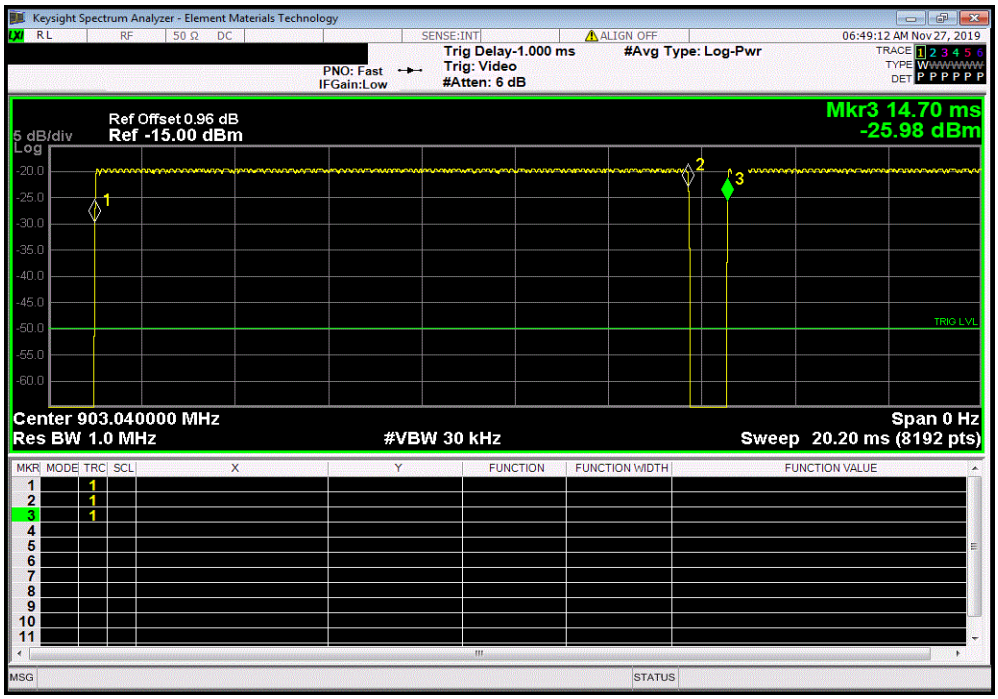


LoRa, 902-928 MHz, Low Channel, 903.04 MHz, 3516 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

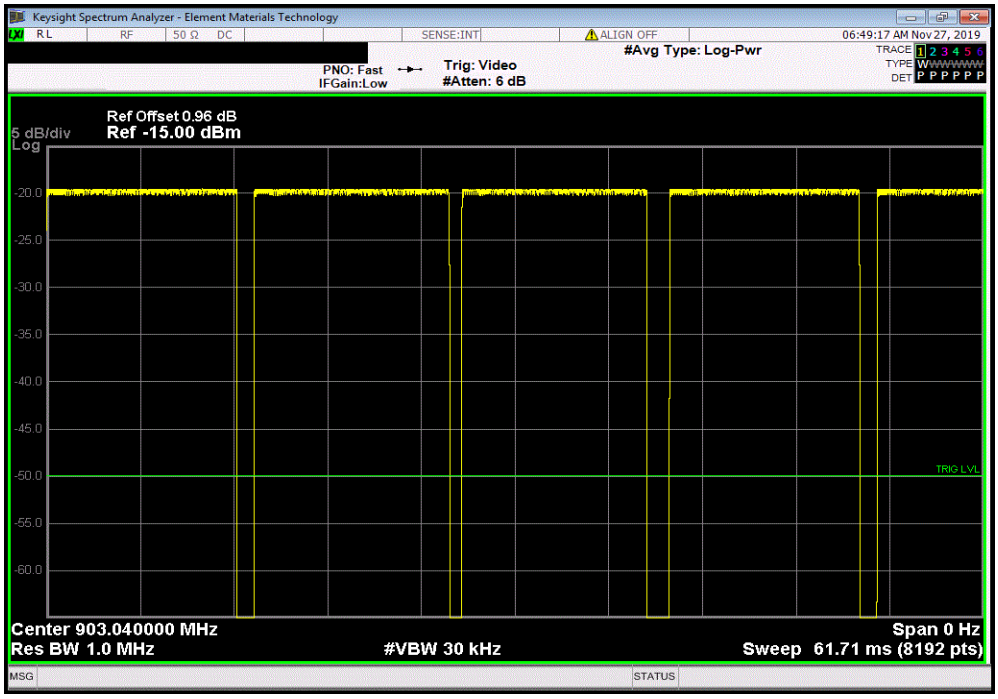


DUTY CYCLE

LoRa, 902-928 MHz, Low Channel, 903.04 MHz, 37500 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	12.847 ms	13.697 ms	1	93.8	N/A	N/A

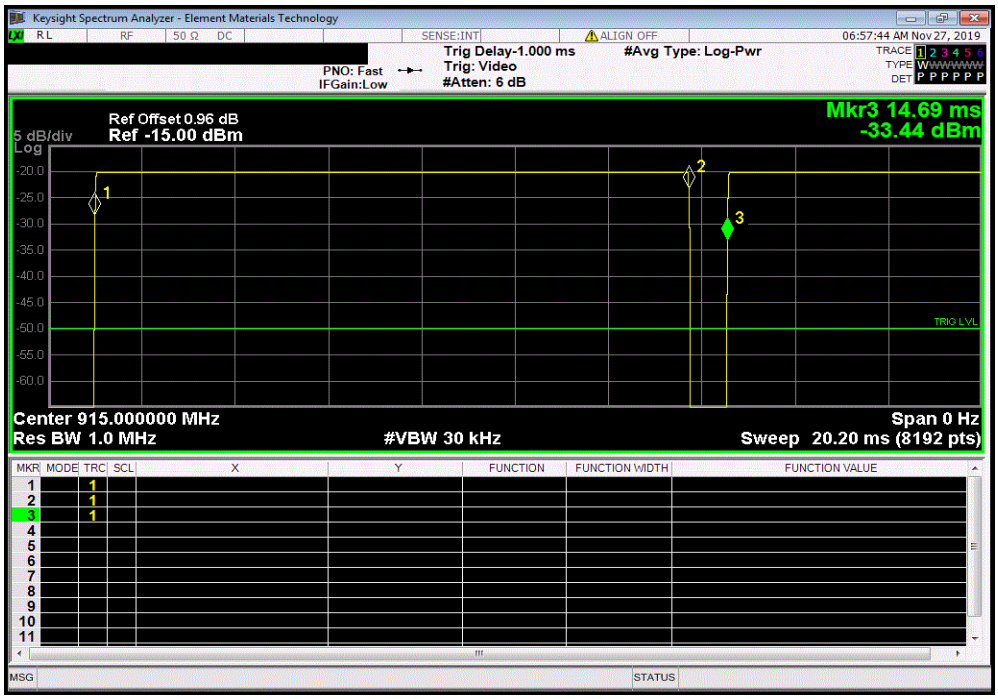


LoRa, 902-928 MHz, Low Channel, 903.04 MHz, 37500 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

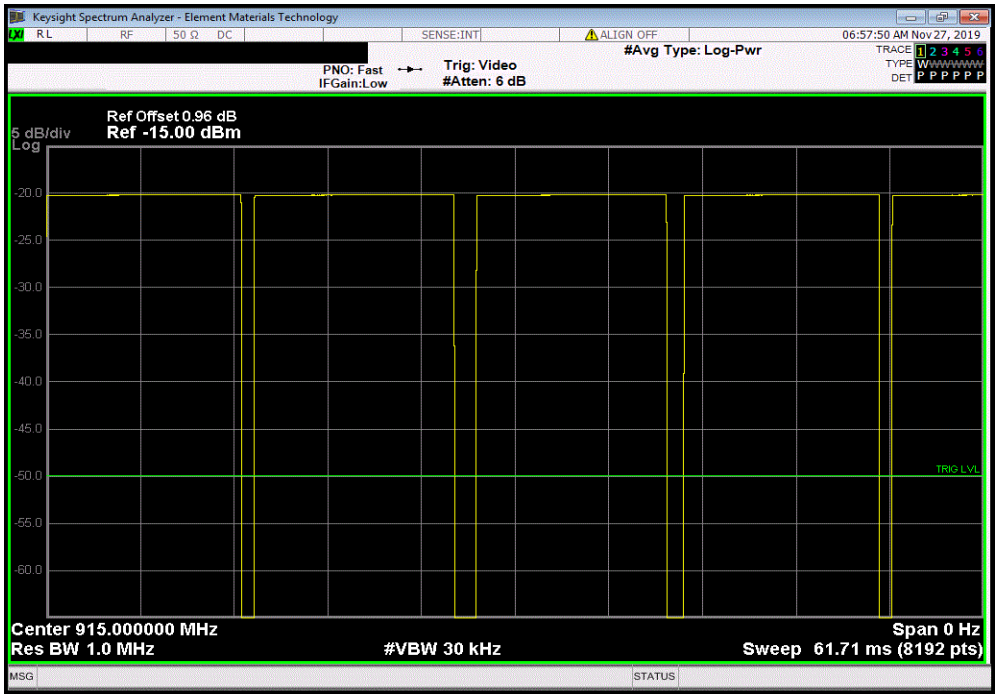


DUTY CYCLE

LoRa, 902-928 MHz, Mid Channel, 915 MHz, 293 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	12.852 ms	13.689 ms	1	93.9	N/A	N/A

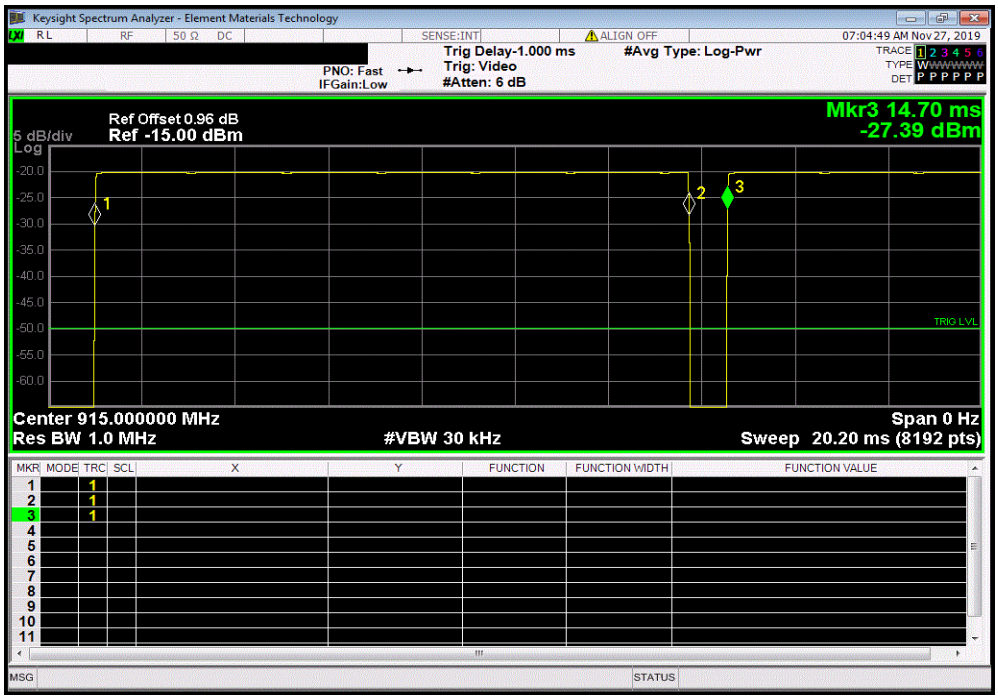


LoRa, 902-928 MHz, Mid Channel, 915 MHz, 293 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

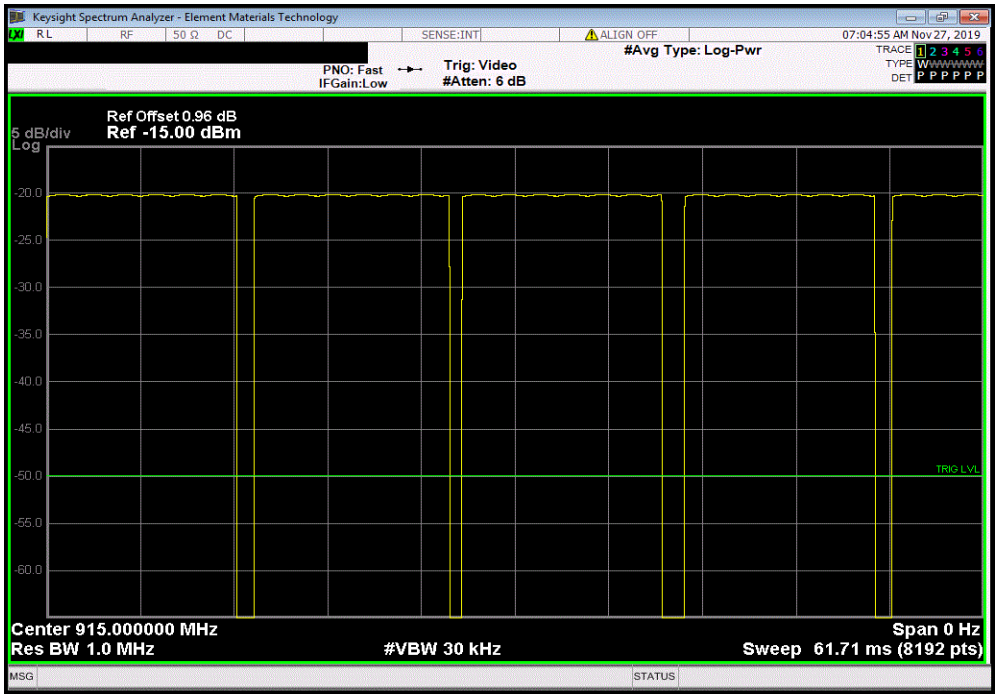


DUTY CYCLE

LoRa, 902-928 MHz, Mid Channel, 915 MHz, 3516 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	12.862 ms	13.697 ms	1	93.9	N/A	N/A

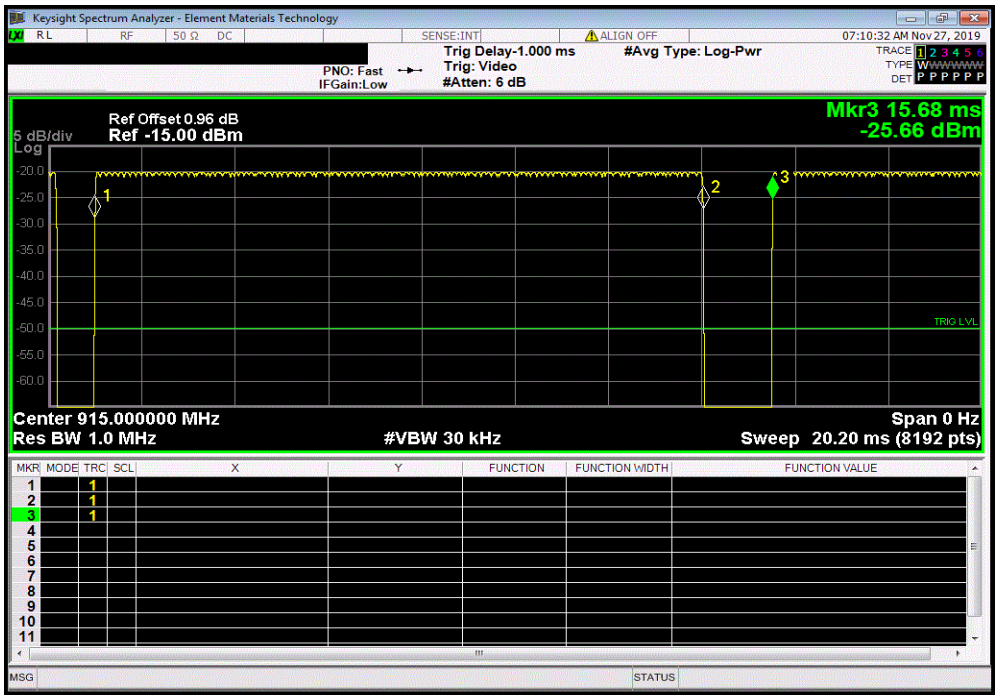


LoRa, 902-928 MHz, Mid Channel, 915 MHz, 3516 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

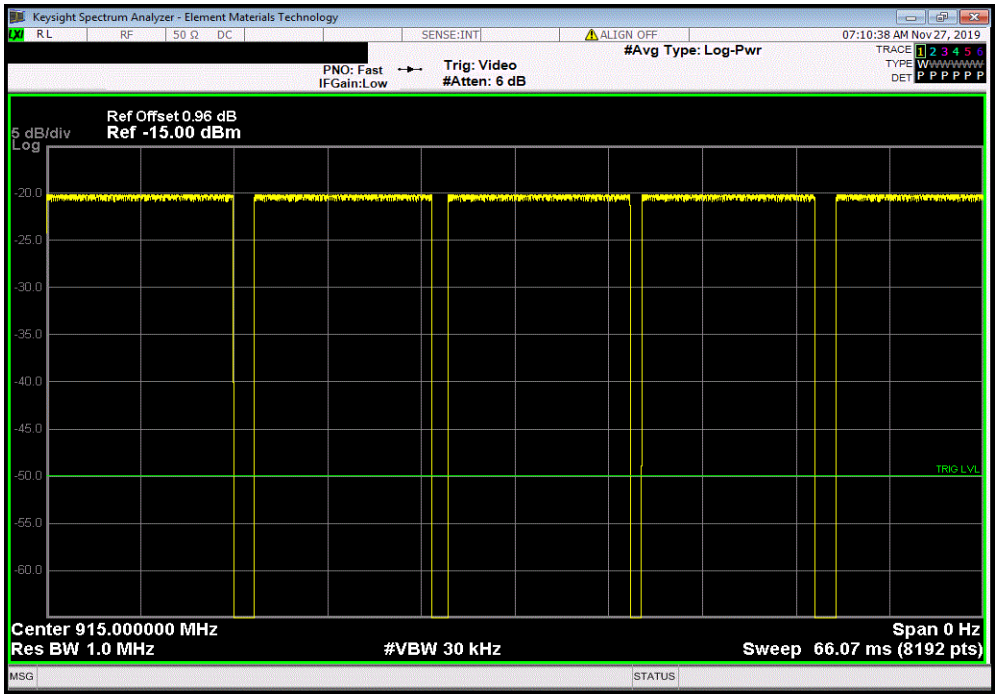


DUTY CYCLE

LoRa, 902-928 MHz, Mid Channel, 915 MHz, 37500 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	13.165 ms	14.673 ms	1	89.7	N/A	N/A

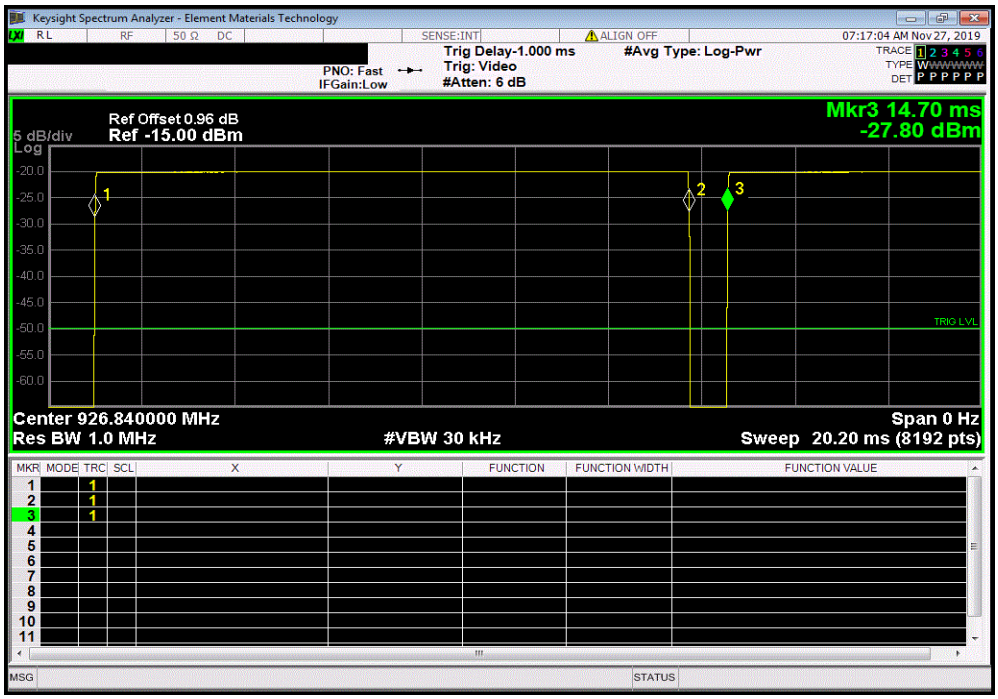


LoRa, 902-928 MHz, Mid Channel, 915 MHz, 37500 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

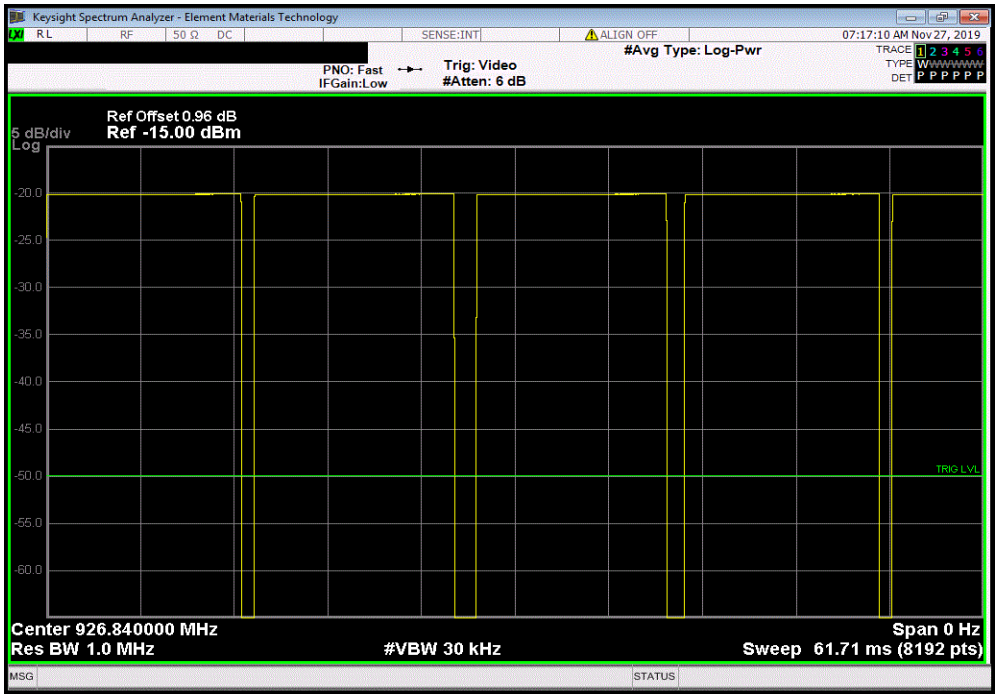


DUTY CYCLE

LoRa, 902-928 MHz, High Channel, 926.84 MHz, 293 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	12.861 ms	13.699 ms	1	93.9	N/A	N/A

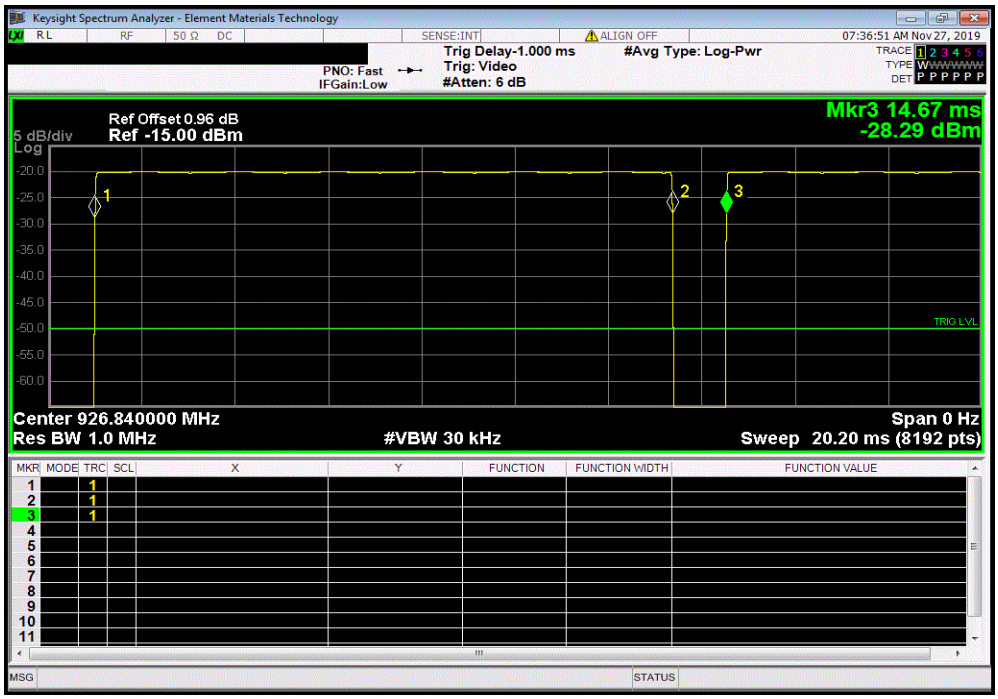


LoRa, 902-928 MHz, High Channel, 926.84 MHz, 293 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

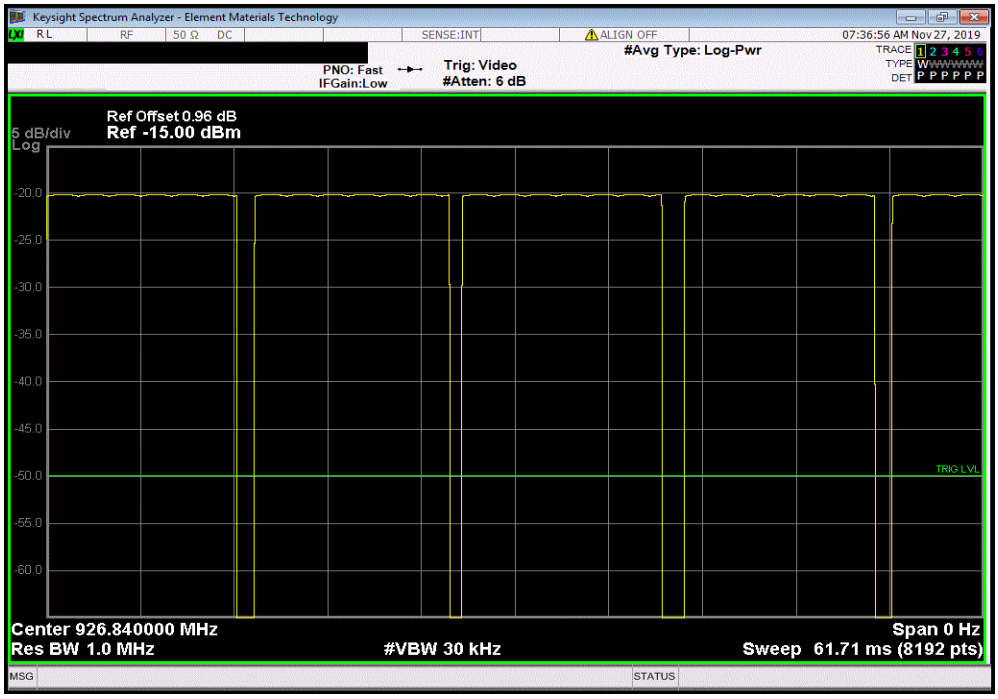


DUTY CYCLE

LoRa, 902-928 MHz, High Channel, 926.84 MHz, 3516 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	12.501 ms	13.669 ms	1	91.5	N/A	N/A

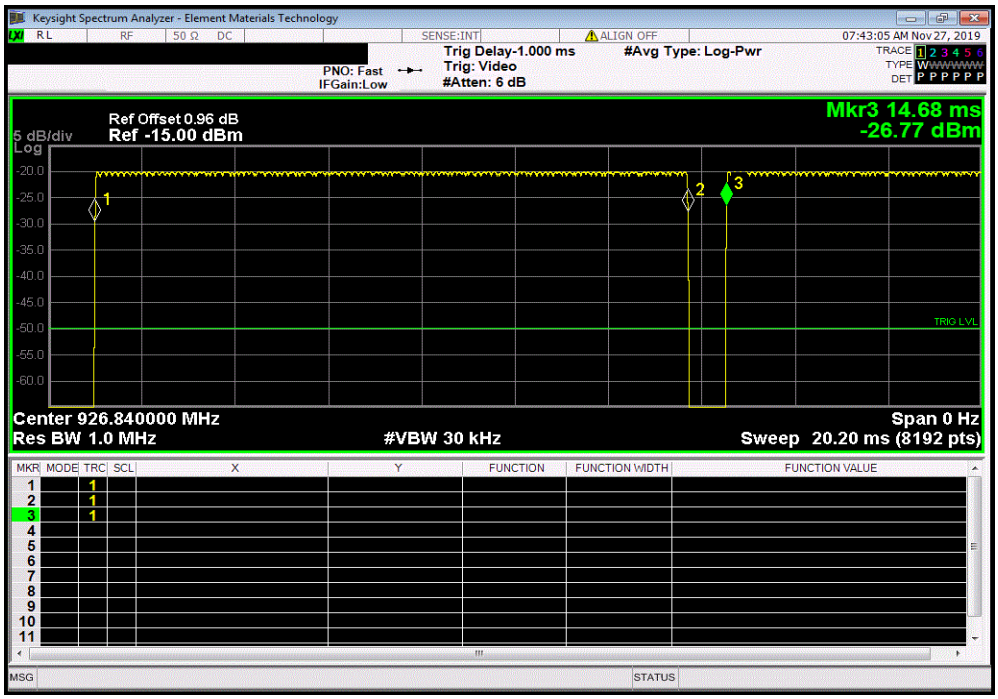


LoRa, 902-928 MHz, High Channel, 926.84 MHz, 3516 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A

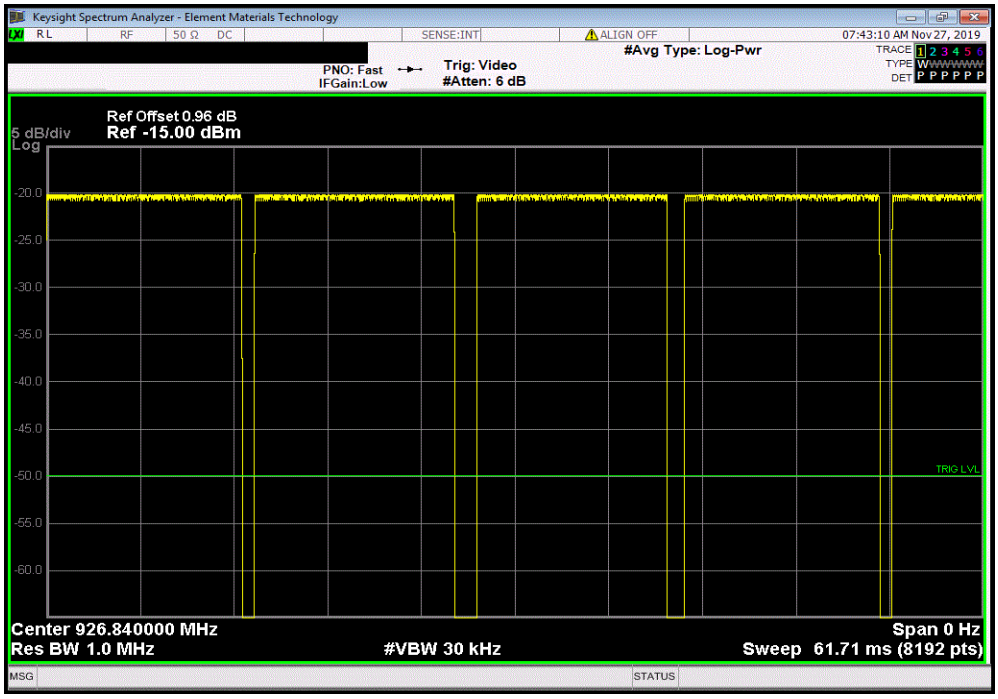


DUTY CYCLE

LoRa, 902-928 MHz, High Channel, 926.84 MHz, 37500 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	12.834 ms	13.674 ms	1	93.9	N/A	N/A



LoRa, 902-928 MHz, High Channel, 926.84 MHz, 37500 bps						
	Pulse Width	Period	Number of Pulses	Value (%)	Limit (%)	Results
	N/A	N/A	5	N/A	N/A	N/A



CARRIER FREQUENCY SEPARATION - HOPPING MODE

XMit 2019.09.05

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	5-Jul-17	5-Jul-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	1-May-19	1-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The channel carrier frequencies must be separated by 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Or, if the output power is less than 125 mW, the channel separation can be 25 kHz or 2/3 of the 20dB bandwidth. 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 -HOPPING MODE

element

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	**Beacon**			**Work Order:**	**SMNC0001**
Serial Number:	**Unit 1**			**Date:**	**26-Nov-19**
Customer:	**SMRTGrid Inc.**			**Temperature:**	**23.1 °C**
Attendees:	**Bill Haag**			**Humidity:**	**29.4% RH**
Project:	**None**			**Barometric Pres.:**	**1011 mbar**
Tested by:	**Dustin Sparks**	**Power:**	**Battery**	**Job Site:**	**MN08**

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

COMMENTS

DC block, measurement cable, and customer U.FL to SMA cable included in reference level offset. No external attenuator required due to low output power.

DEVIATIONS FROM TEST STANDARD

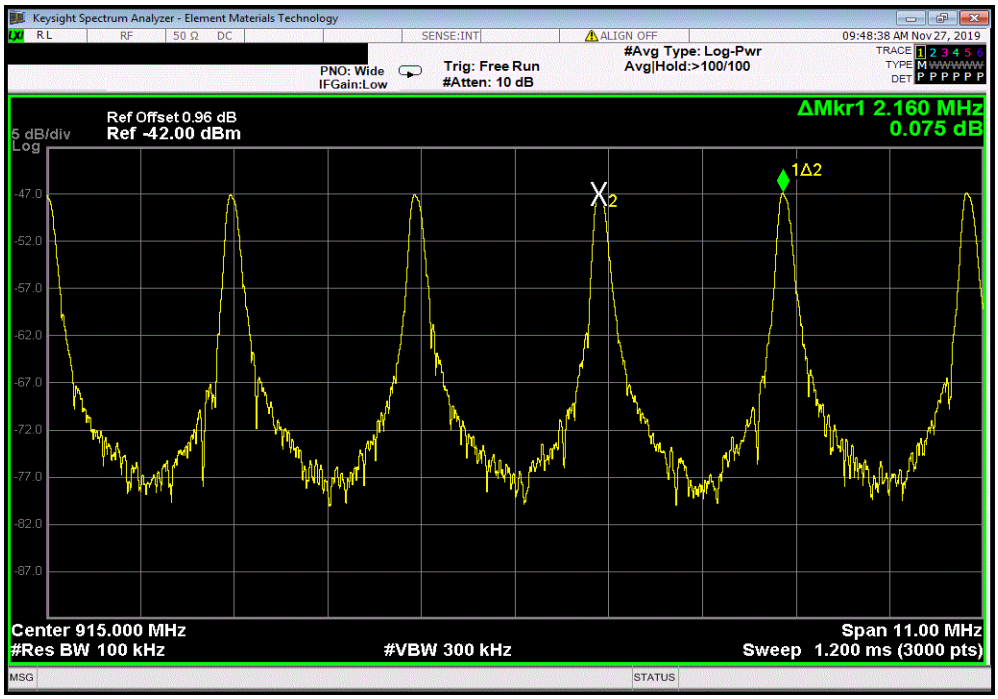
None

Configuration #	**4**	*Signature* Dustin Sparks

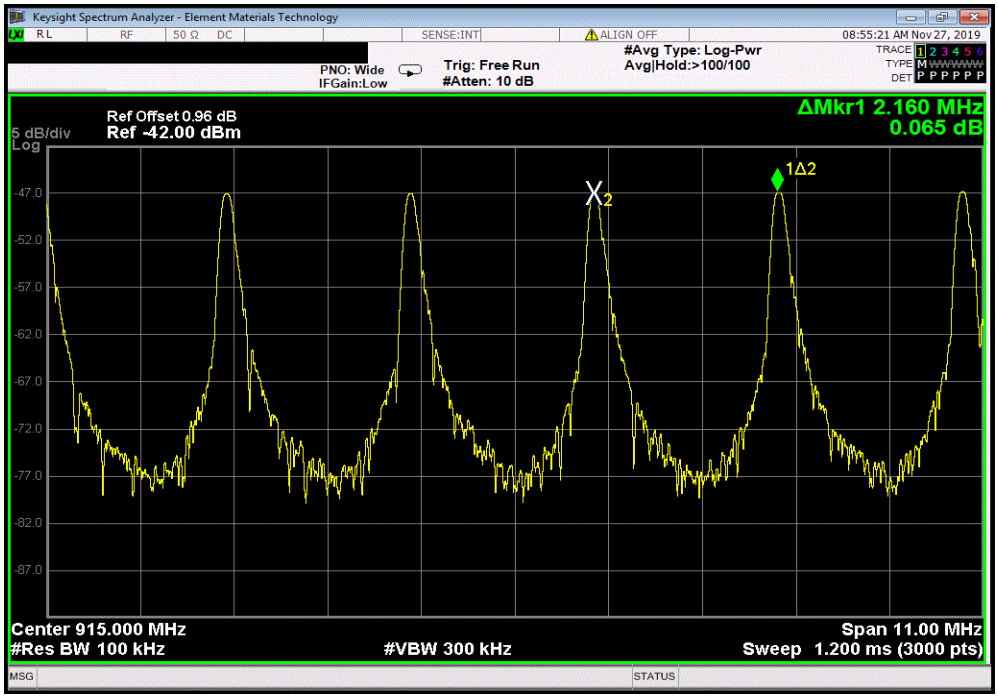
	Value	**Limit (>)**	**Results**
Hopping Mode (All Channels)			
LoRa, 293 bps			
Mid Channel, 915 MHz	2.2 MHz	54.274 kHz	Pass
LoRa, 3516 bps			
Mid Channel, 915 MHz	2.2 MHz	280.177 kHz	Pass
LoRa, 37500 bps			
Mid Channel, 915 MHz	2.2 MHz	700.362 kHz	Pass

CARRIER FREQUENCY SEPARATION -HOPPING MODE

Hopping Mode (All Channels), LoRa, 293 bps, Mid Channel, 915 MHz						
				Value	Limit (>)	Results
				2.2 MHz	54.274 kHz	Pass



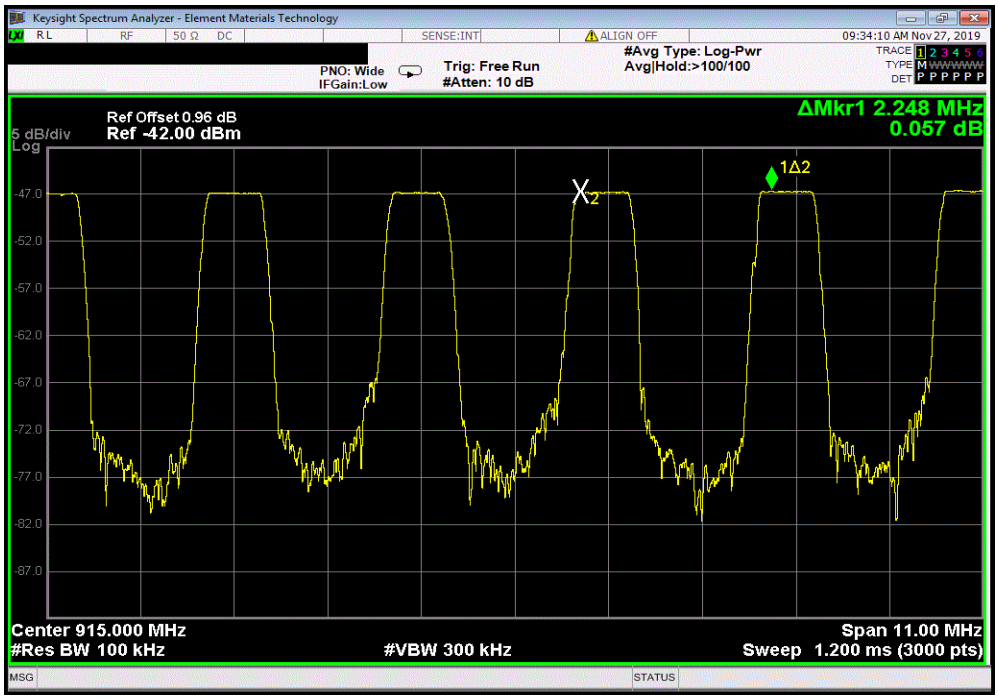
Hopping Mode (All Channels), LoRa, 3516 bps, Mid Channel, 915 MHz						
				Value	Limit (>)	Results
				2.2 MHz	280.177 kHz	Pass



CARRIER FREQUENCY SEPARATION -HOPPING MODE

TbtTx 2019.08.30.0 XMit 2019.09.05

Hopping Mode (All Channels), LoRa, 37500 bps, Mid Channel, 915 MHz						
				Value	Limit (>)	Results
				2.2 MHz	700.362 kHz	Pass



NUMBER OF HOPPING FREQUENCIES

XMit 2019.09.05

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

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	5-Jul-17	5-Jul-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	1-May-19	1-May-20

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 2019.08.30.0 XMit 2019.09.05

EUT:	**Beacon**			**Work Order:**	**SMNC0001**
Serial Number:	**Unit 1**			**Date:**	**26-Nov-19**
Customer:	**SMRTGrid Inc.**			**Temperature:**	**23.1 °C**
Attendees:	**Bill Haag**			**Humidity:**	**29.4% RH**
Project:	**None**			**Barometric Pres.:**	**1011 mbar**
Tested by:	**Dustin Sparks**	**Power:**	**Battery**	**Job Site:**	**MN08**

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

COMMENTS

DC block, measurement cable, and customer U.FL to SMA cable included in reference level offset. No external attenuator required due to low output power.

DEVIATIONS FROM TEST STANDARD

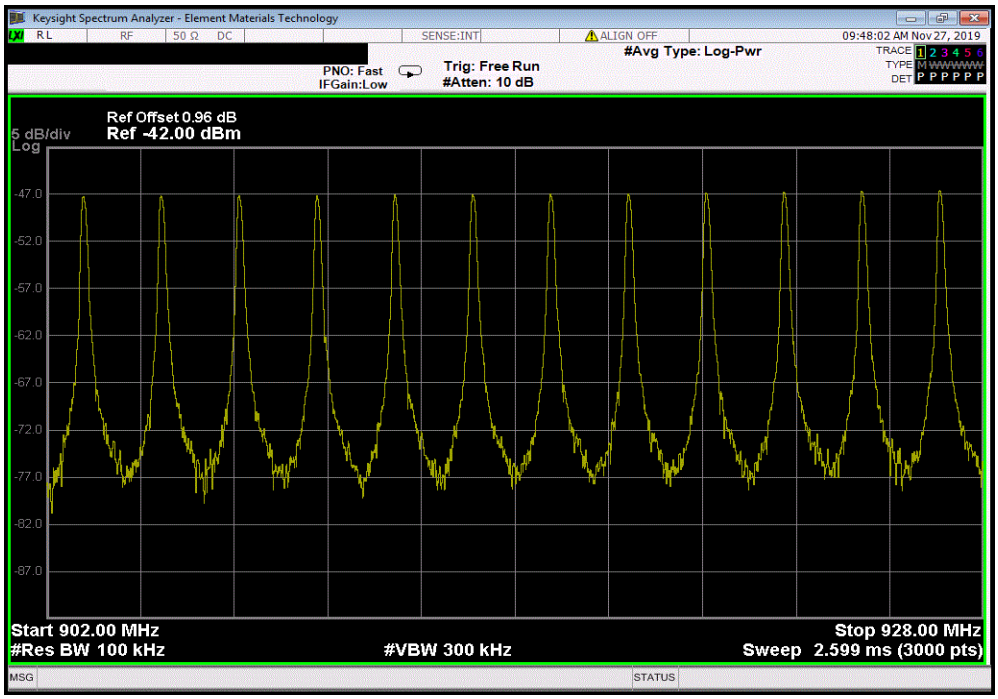
None

Configuration #	**4**	*Signature* Dustin Sparks

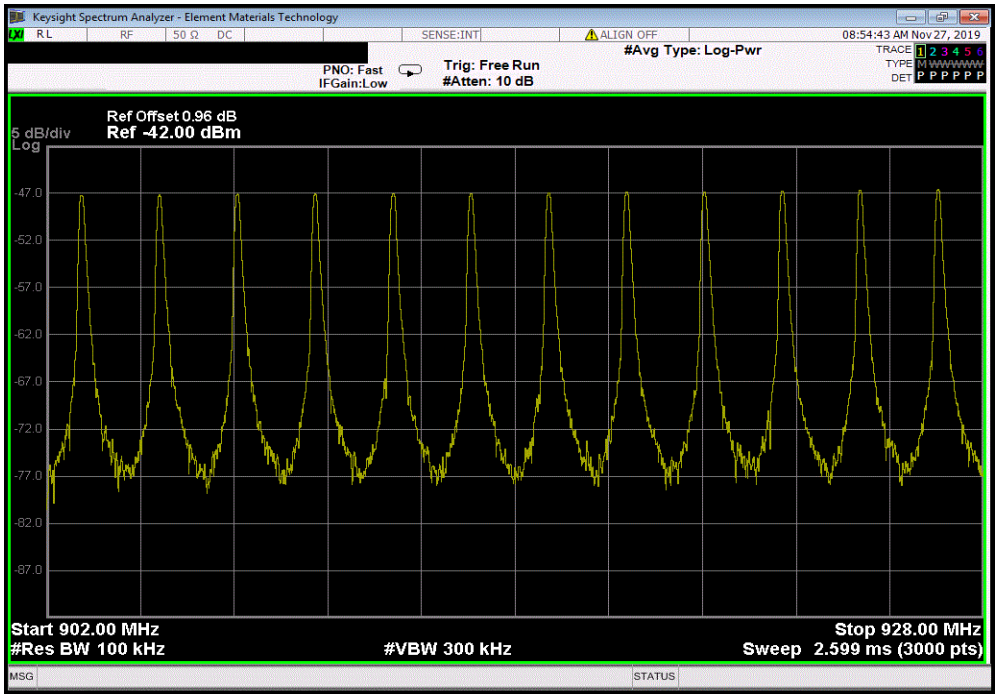
	Number of Channels	Limit (N/A)	Results
Hopping Mode (All Channels)			
LoRa, 293 bps			
Mid Channel, 915 MHz	12	N/A	N/A
LoRa, 3516 bps			
Mid Channel, 915 MHz	12	N/A	N/A
LoRa, 37500 bps			
Mid Channel, 915 MHz	12	N/A	N/A

NUMBER OF HOPPING FREQUENCIES

Hopping Mode (All Channels), LoRa, 293 bps, Mid Channel, 915 MHz						
				Number of Channels	Limit (N/A)	Results
				12	N/A	N/A

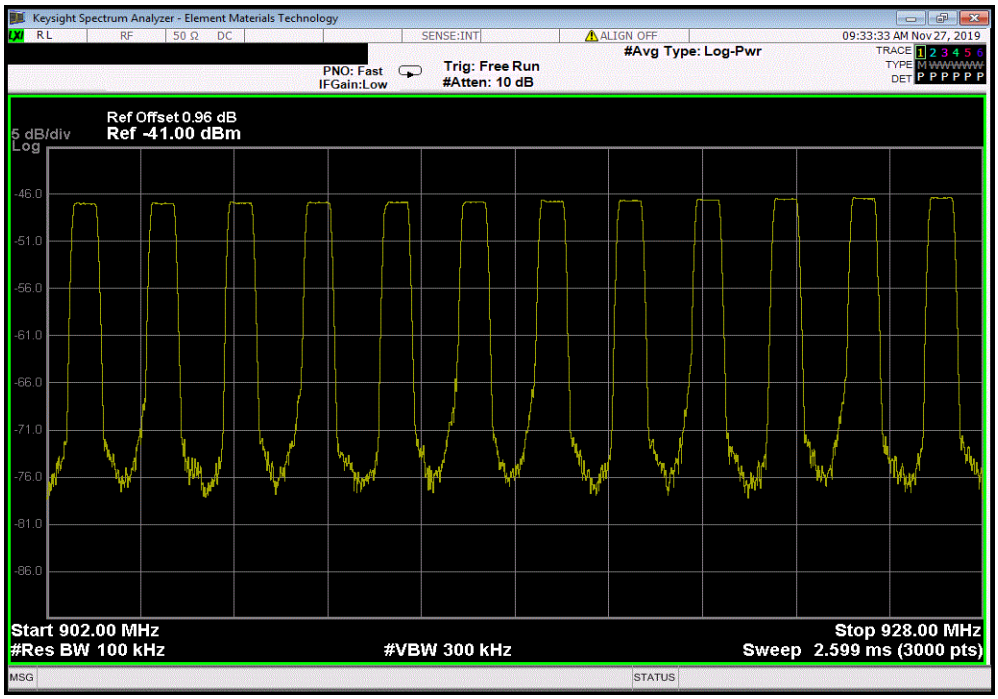


Hopping Mode (All Channels), LoRa, 3516 bps, Mid Channel, 915 MHz						
				Number of Channels	Limit (N/A)	Results
				12	N/A	N/A



NUMBER OF HOPPING FREQUENCIES

Hopping Mode (All Channels), LoRa, 37500 bps, Mid Channel, 915 MHz						
				Number of Channels	Limit (N/A)	Results
				12	N/A	N/A



DWELL TIME

XMit 2019.09.05

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TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	5-Jul-17	5-Jul-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	1-May-19	1-May-20

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 the low and high channels 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 LoRa this would be 12 Channels * 400mS = 4.8 Sec.

On Time During 4.8 Sec = Pulse Width * Number of Pulses * Scale Factor

➢Scale Factor = 4.8 Sec / Screen Capture Sweep Time = 4.8 Sec / 100 mSec = 48

DWELL TIME

element

XMit 2019.09.05

EUT:	**Beacon**			**Work Order:**	**SMNC0001**
Serial Number:	**Unit 1**			**Date:**	**26-Nov-19**
Customer:	**SMRTGrid Inc.**			**Temperature:**	**23.2 °C**
Attendees:	**Bill Haag**			**Humidity:**	**29% RH**
Project:	**None**			**Barometric Pres.:**	**1010 mbar**
Tested by:	**Dustin Sparks**	**Power:**	**Battery**	**Job Site:**	**MN08**

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

COMMENTS

DC block, measurement cable, and customer U.FL to SMA cable included in reference level offset. No external attenuator required due to low output power. One second sweep for low channel on 3516 bps hopping mode included with the photos for reference purposes.

DEVIATIONS FROM TEST STANDARD

None

Configuration #	**4**	*Signature* Dustin Sparks

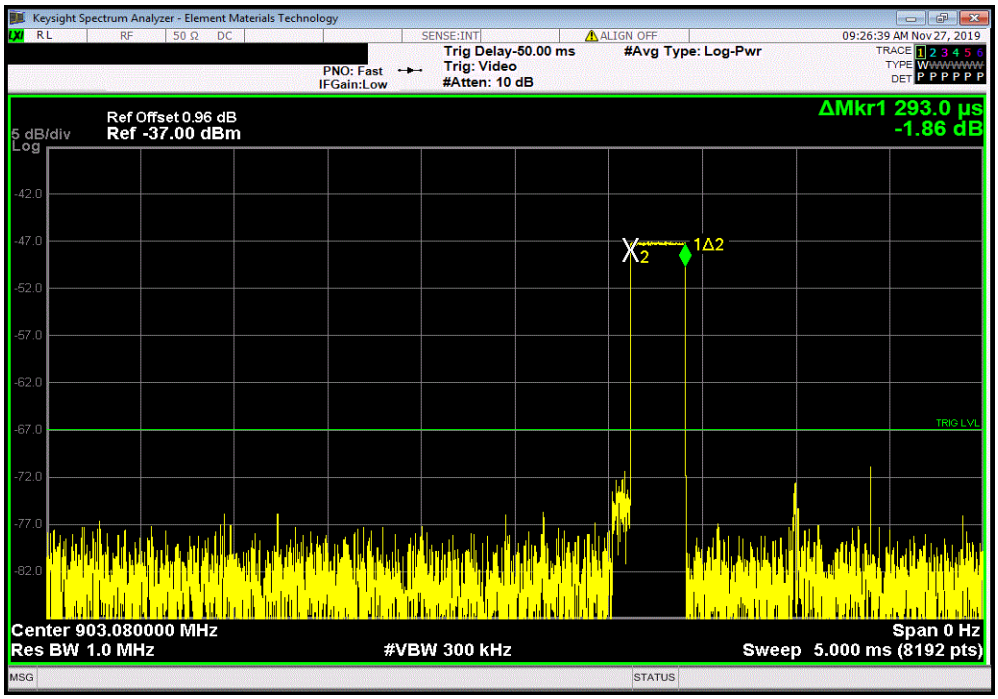
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
Hopping Mode (All Channels)						
LoRa, 293 bps						
Low Channel (903.08 MHz)						
Pulse Length	0.293	N/A	N/A	N/A	N/A	N/A
# of Pulses in 100 ms	0.293	9	48	126.576	< 400	Pass
High Channel (926.84 MHz)						
Pulse Length	0.313	N/A	N/A	N/A	N/A	N/A
# of Pulses in 100 ms	0.313	9	48	135.216	< 400	Pass
LoRa, 3516 bps						
Low Channel (903.08 MHz)						
Pulse Length	0.291	N/A	N/A	N/A	N/A	N/A
# of Pulses in 100 ms	0.291	9	48	125.712	< 400	Pass
High Channel (926.84 MHz)						
Pulse Length	0.311	N/A	N/A	N/A	N/A	N/A
# of Pulses in 100 ms	0.311	9	48	134.352	< 400	Pass
LoRa, 37500 bps						
Low Channel (903.08 MHz)						
Pulse Length	0.292	N/A	N/A	N/A	N/A	N/A
# of Pulses in 100 ms	0.292	9	48	126.144	< 400	Pass
High Channel (926.84 MHz)						
Pulse Length	0.315	N/A	N/A	N/A	N/A	N/A
# of Pulses in 100 ms	0.315	9	48	136.08	< 400	Pass

DWELL TIME

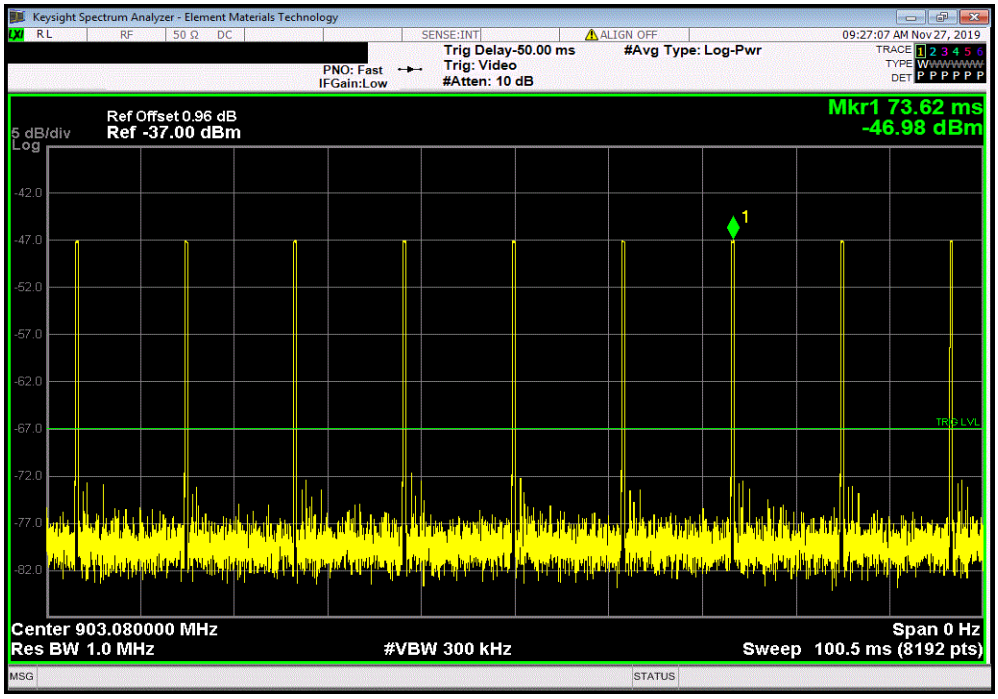
element

XMit 2019.09.05

Hopping Mode (All Channels), LoRa, 293 bps, Low Channel (903.08 MHz), Pulse Length						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.293	N/A	N/A	N/A	N/A	N/A



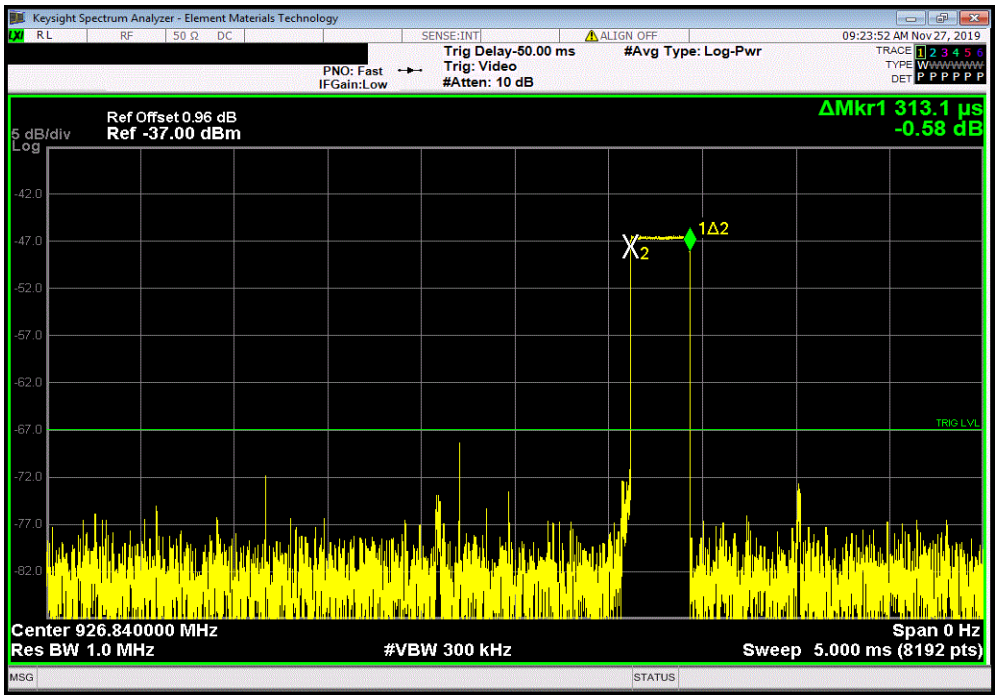
Hopping Mode (All Channels), LoRa, 293 bps, Low Channel (903.08 MHz), # of Pulses in 100 ms						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.293	9	48	126.576	< 400	Pass



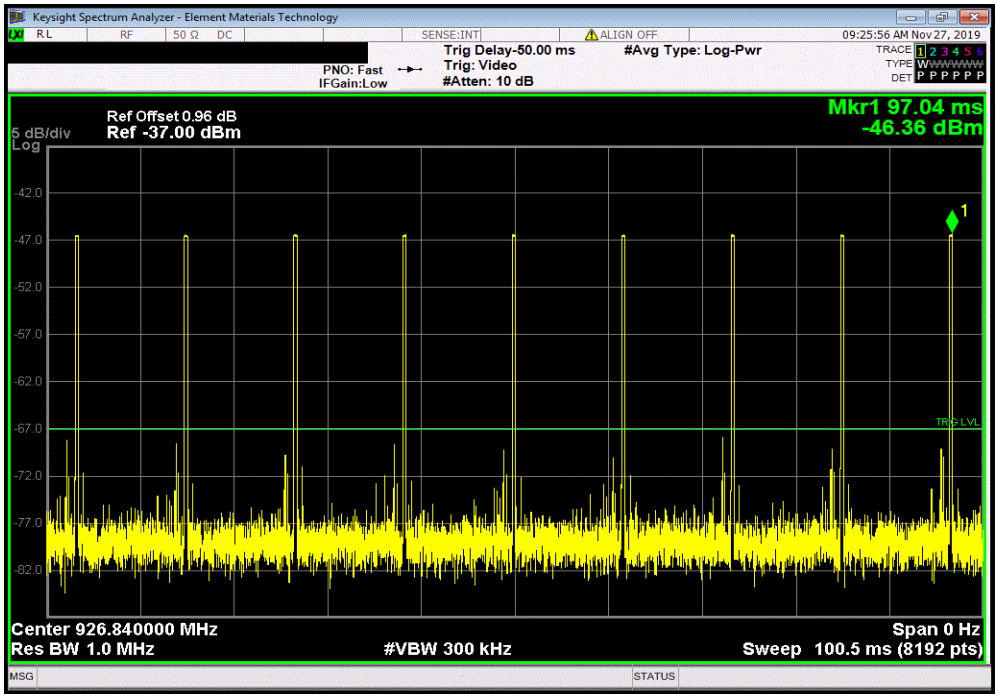
DWELL TIME

XMit 2019.09.05

Hopping Mode (All Channels), LoRa, 293 bps, High Channel (926.84 MHz), Pulse Length						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.313	N/A	N/A	N/A	N/A	N/A



Hopping Mode (All Channels), LoRa, 293 bps, High Channel (926.84 MHz), # of Pulses in 100 ms						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.313	9	48	135.216	< 400	Pass

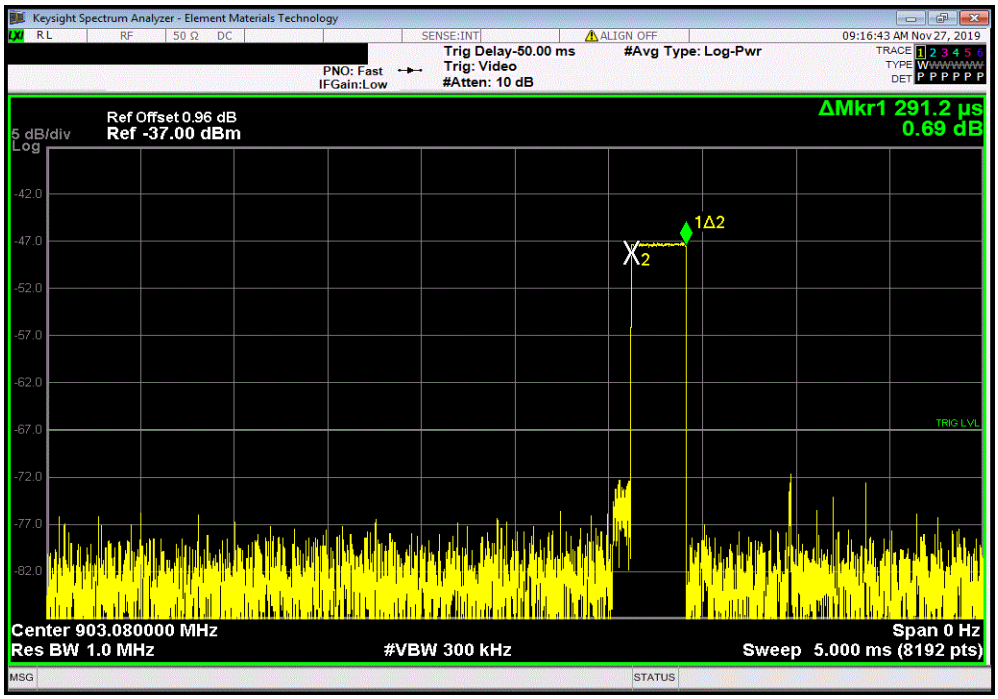


DWELL TIME

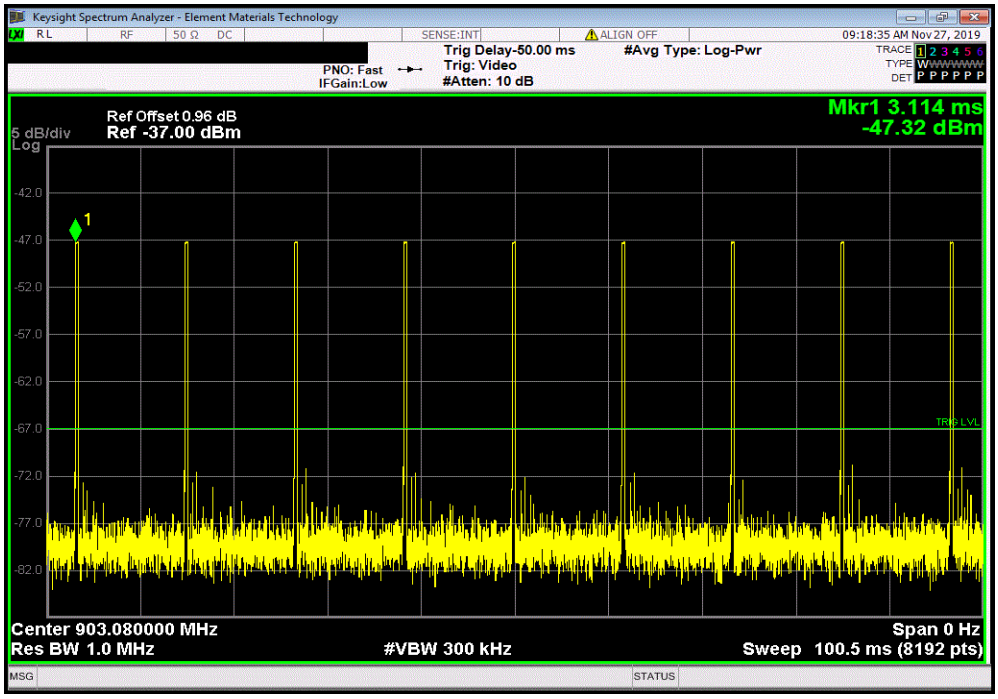
element

XMit 2019.09.05

Hopping Mode (All Channels), LoRa, 3516 bps, Low Channel (903.08 MHz), Pulse Length						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.291	N/A	N/A	N/A	N/A	N/A



Hopping Mode (All Channels), LoRa, 3516 bps, Low Channel (903.08 MHz), # of Pulses in 100 ms						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.291	9	48	125.712	< 400	Pass

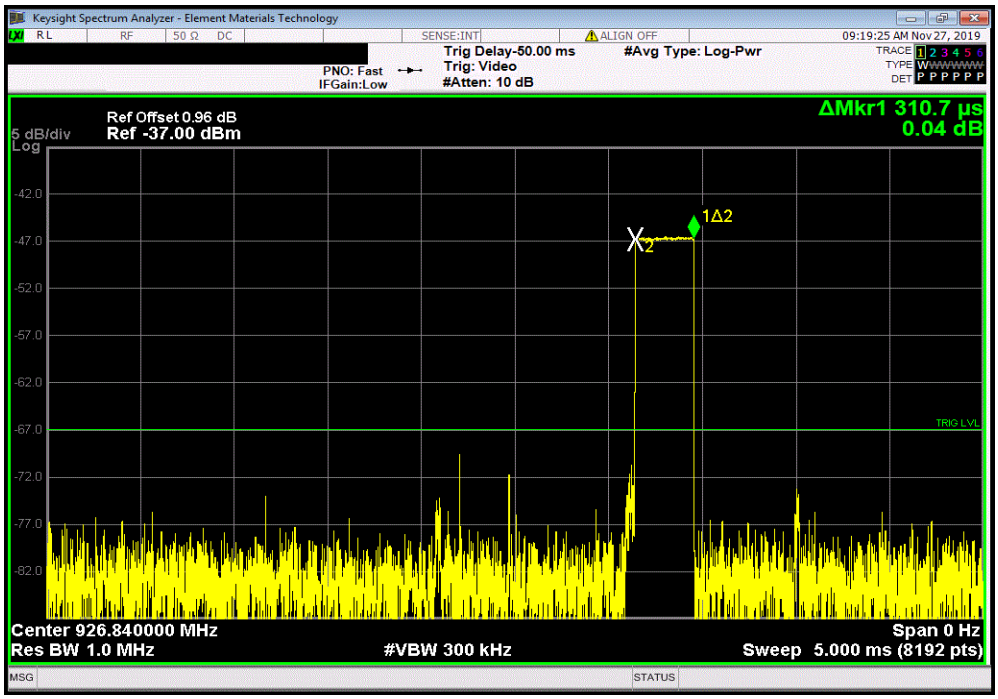


DWELL TIME

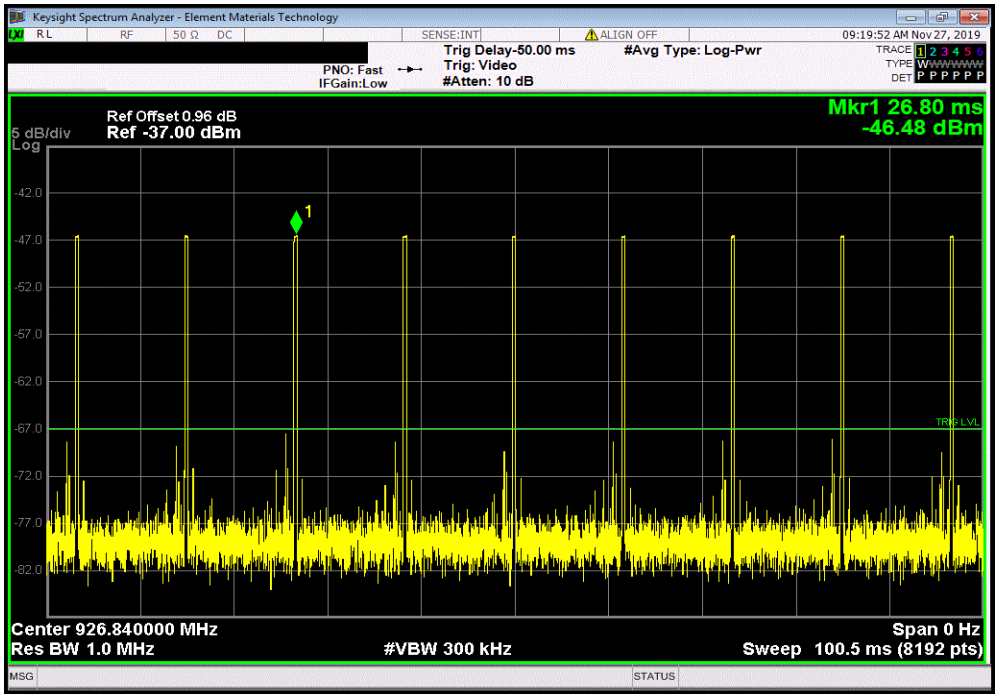
element

XMit 2019.09.05

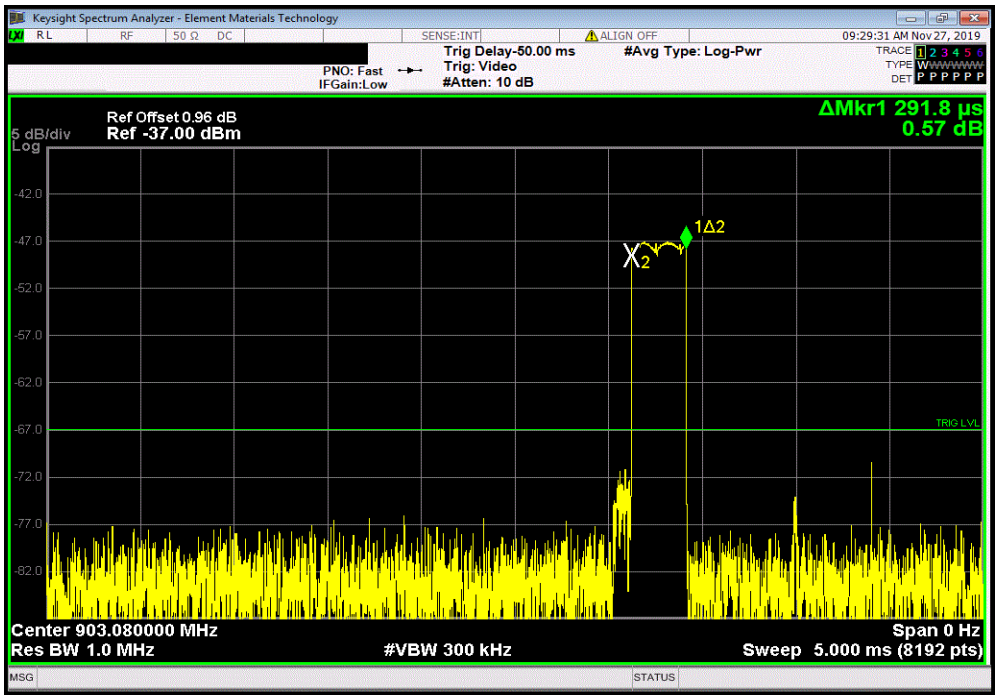
Hopping Mode (All Channels), LoRa, 3516 bps, High Channel (926.84 MHz), Pulse Length						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.311	N/A	N/A	N/A	N/A	N/A



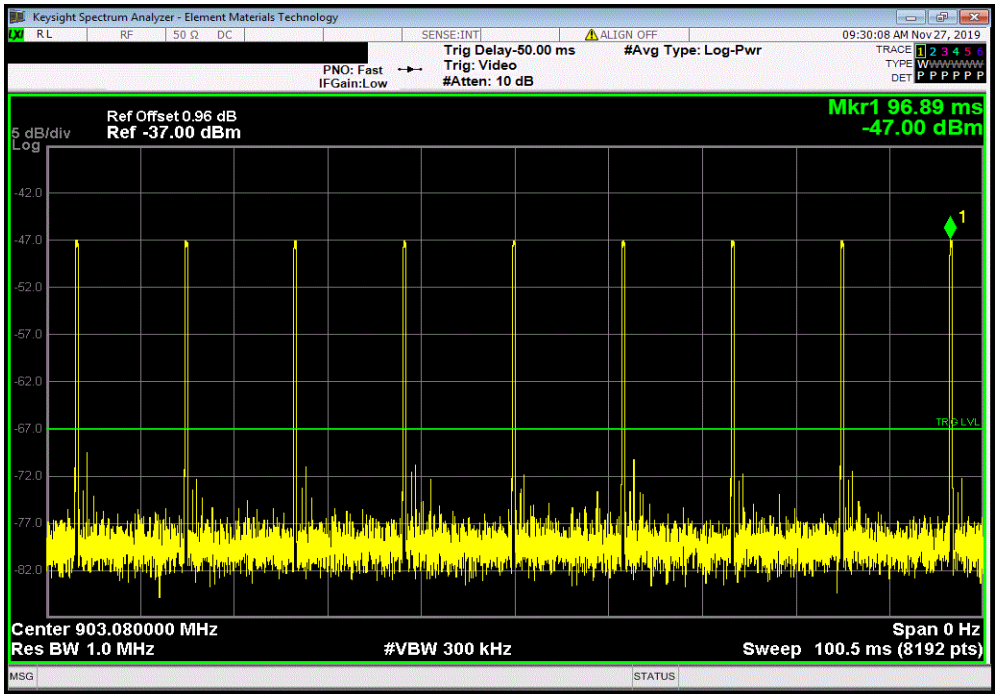
Hopping Mode (All Channels), LoRa, 3516 bps, High Channel (926.84 MHz), # of Pulses in 100 ms						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.311	9	48	134.352	< 400	Pass



Hopping Mode (All Channels), LoRa, 37500 bps, Low Channel (903.08 MHz), Pulse Length						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.292	N/A	N/A	N/A	N/A	N/A



Hopping Mode (All Channels), LoRa, 37500 bps, Low Channel (903.08 MHz), # of Pulses in 100 ms						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.292	9	48	126.144	< 400	Pass

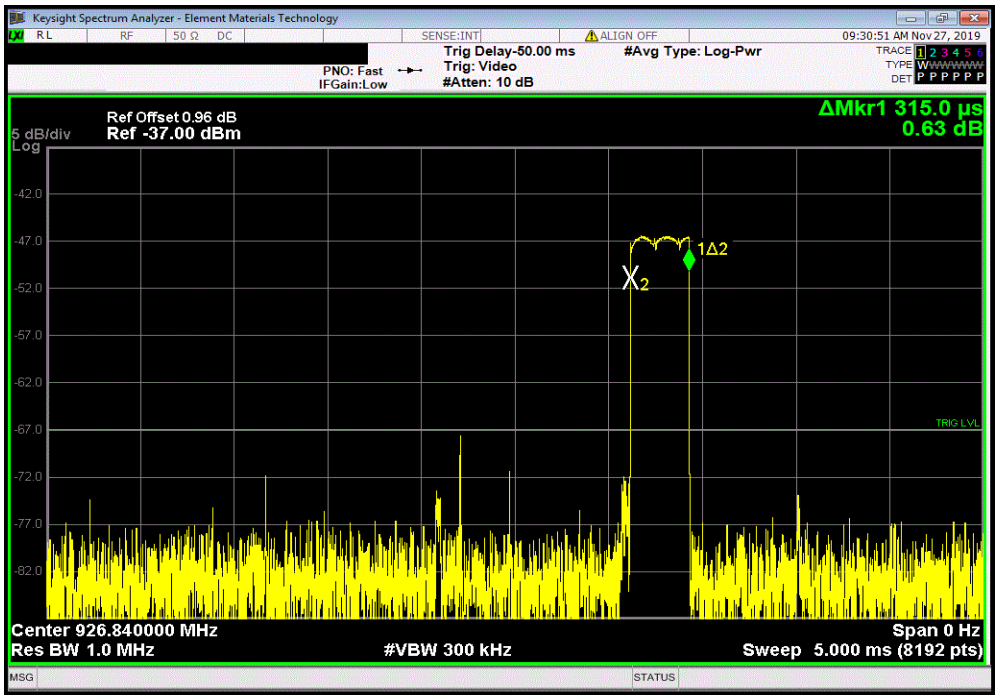


DWELL TIME

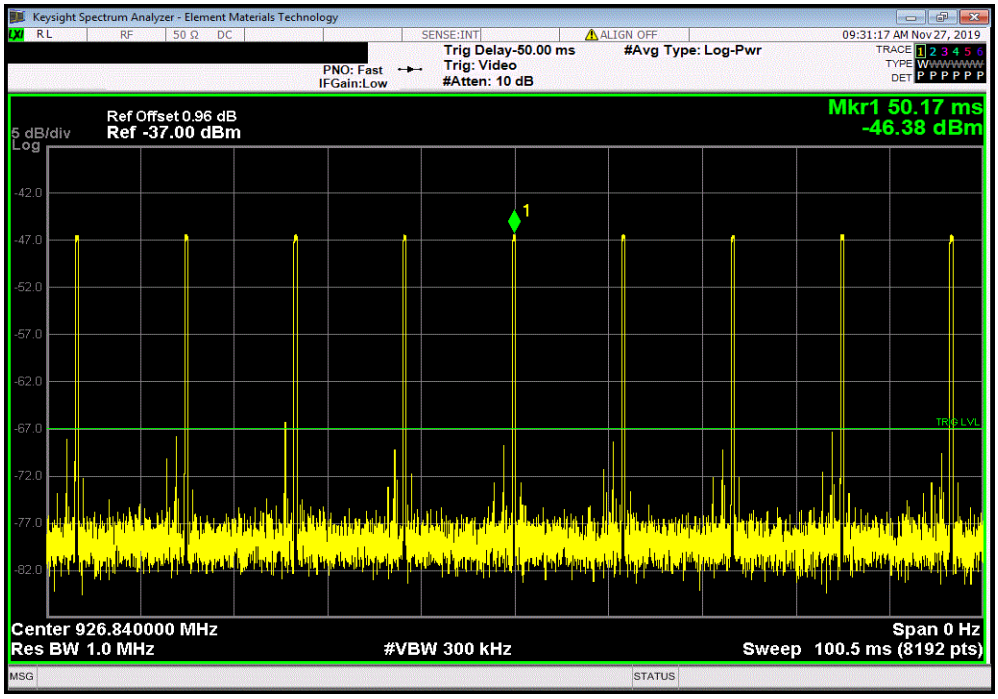
element

XMit 2019.09.05

Hopping Mode (All Channels), LoRa, 37500 bps, High Channel (926.84 MHz), Pulse Length						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.315	N/A	N/A	N/A	N/A	N/A

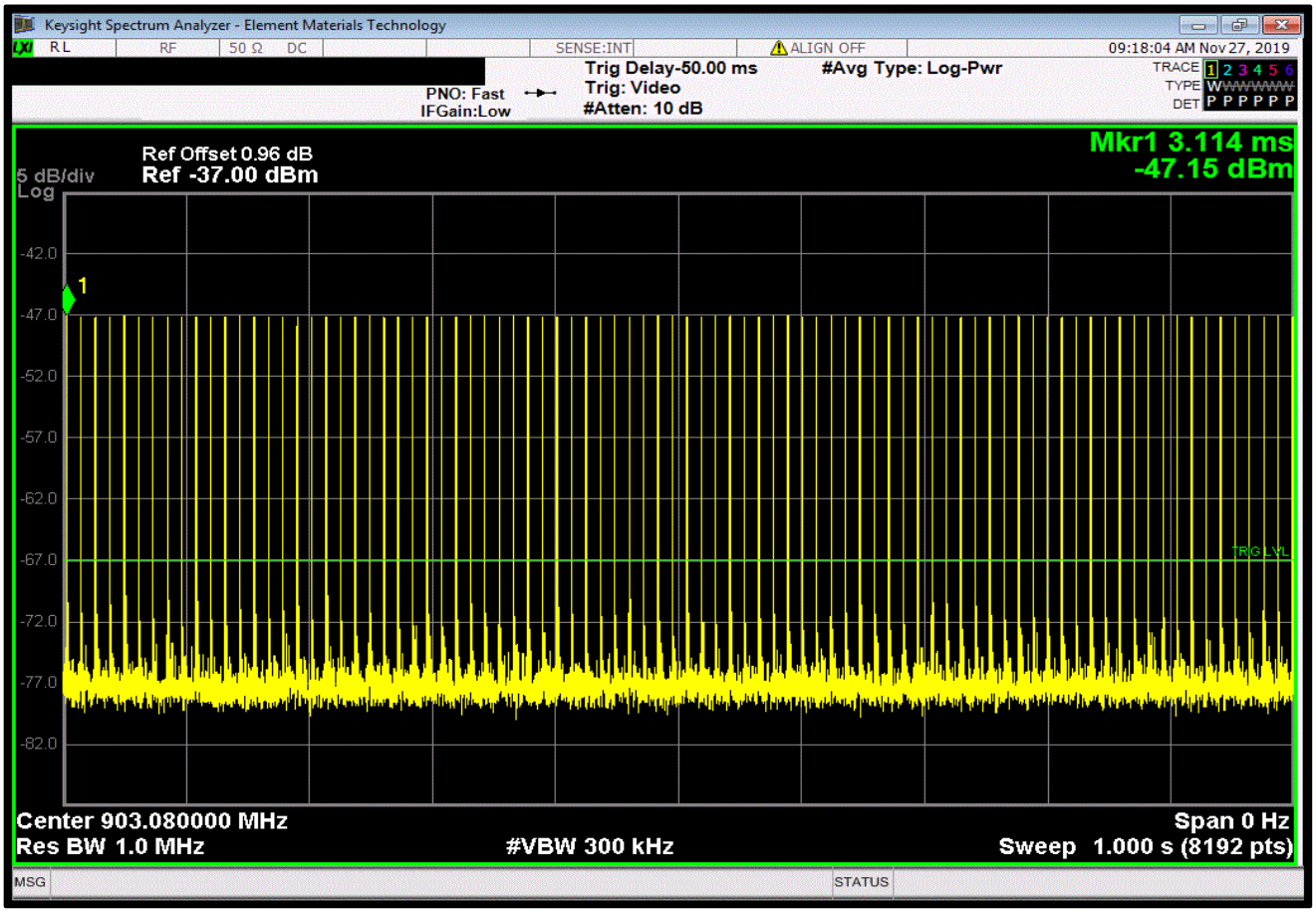


Hopping Mode (All Channels), LoRa, 37500 bps, High Channel (926.84 MHz), # of Pulses in 100 ms						
	Pulse Width (ms)	Number of Pulses	Scale Factor	On Time (ms) during 4.8 s	Limit (ms)	Result
	0.315	9	48	136.08	< 400	Pass



DWELL TIME

XMit 2019.09.05



OUTPUT POWER

XMit 2019.09.05

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TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	5-Jul-17	5-Jul-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	1-May-19	1-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum.

Prior to measuring peak transmit power the occupied bandwidth (B) was measured.

The method found in ANSI C63.10:2013 Section 11.9.1.1 was used because the RBW on the analyzer was greater than the occupied bandwidth of the radio.

OUTPUT POWER

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	**Beacon**			**Work Order:**	**SMNC0001**
Serial Number:	**Unit 1**			**Date:**	**26-Nov-19**
Customer:	**SMRTGrid Inc.**			**Temperature:**	**23.2 °C**
Attendees:	**Bill Haag**			**Humidity:**	**28.8% RH**
Project:	**None**			**Barometric Pres.:**	**1013 mbar**
Tested by:	**Dustin Sparks**	**Power:**	**Battery**	**Job Site:**	**MN08**

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

COMMENTS

DC block, measurement cable, and customer U.FL to SMA cable included in reference level offset. No external attenuator required due to low output power.

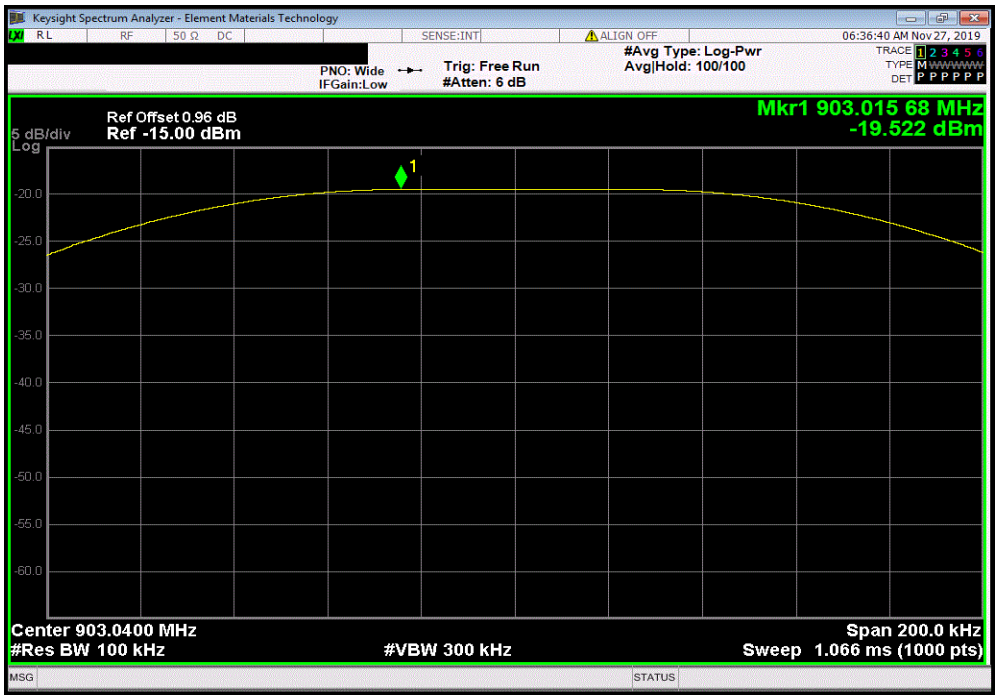
DEVIATIONS FROM TEST STANDARD

None

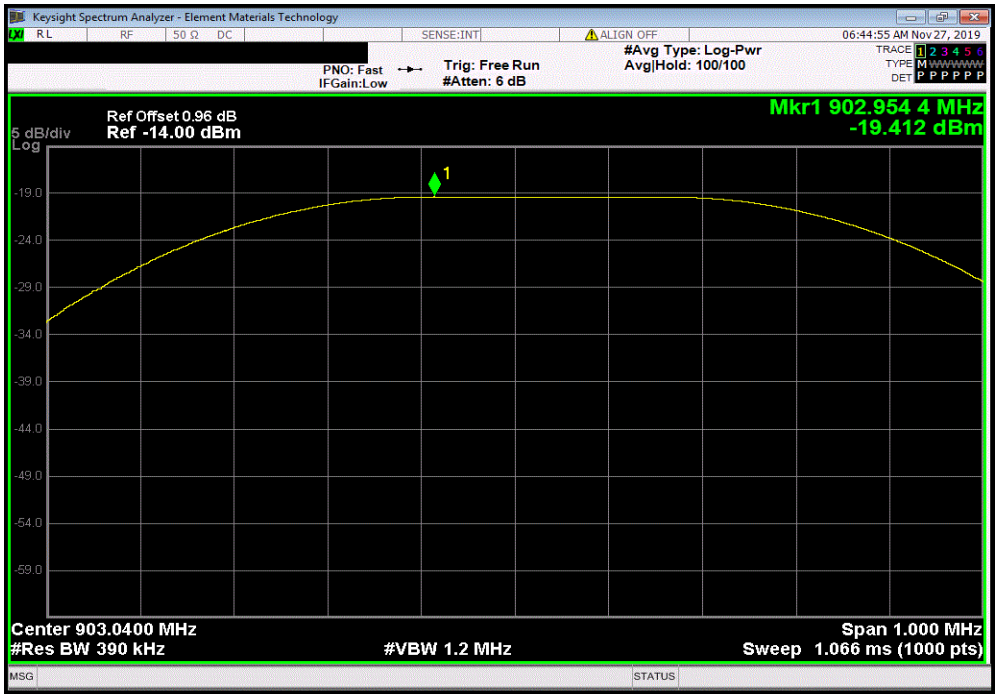
Configuration #	**4**	*Signature* Dustin Sparks

		Out Pwr (dBm)	**Limit (dBm)**	**Result**
LoRa, 902-928 MHz				
	Low Channel, 903.08 MHz			
	293 bps	-19.5	30	Pass
	3516 bps	-19.4	30	Pass
	37500 bps	-19.5	30	Pass
	Mid Channel, 915 MHz			
	293 bps	-20.1	30	Pass
	3516 bps	-20.0	30	Pass
	37500 bps	-20.2	30	Pass
	High Channel, 926.84 MHz			
	293 bps	-20.1	30	Pass
	3516 bps	-20.0	30	Pass
	37500 bps	-20.1	30	Pass

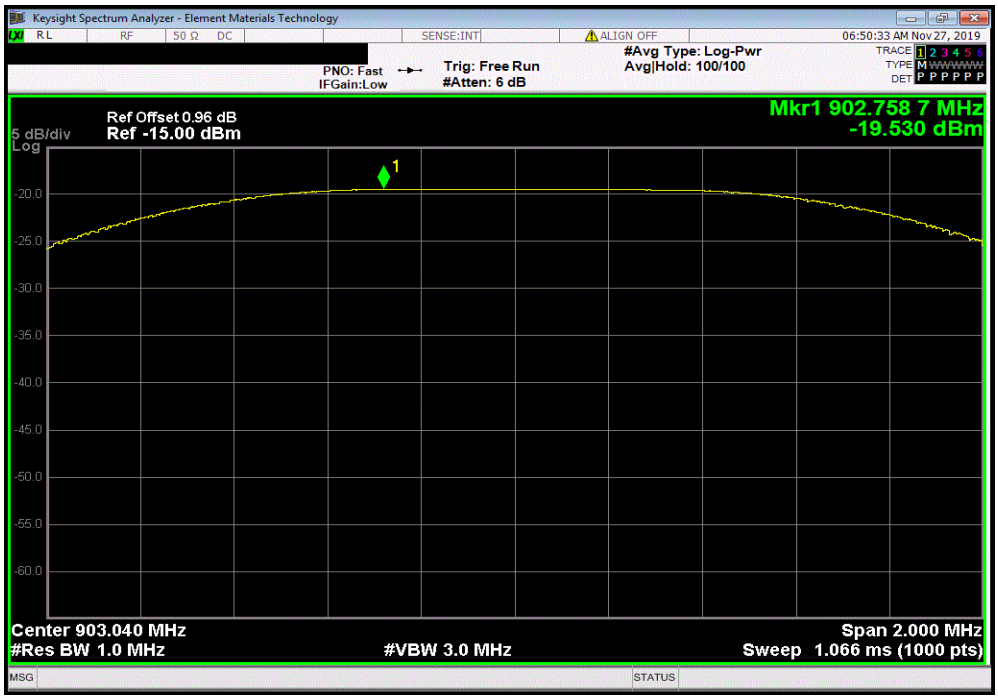
LoRa, 902-928 MHz, Low Channel, 903.08 MHz, 293 bps						
				Out Pwr (dBm)	Limit (dBm)	Result
				-19.522	30	Pass



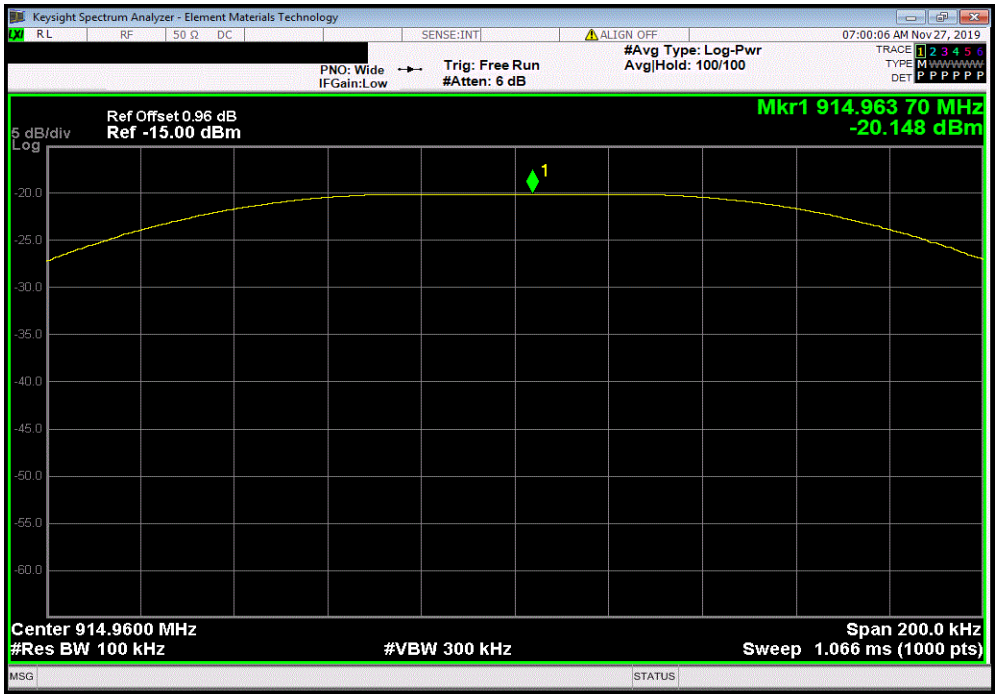
LoRa, 902-928 MHz, Low Channel, 903.08 MHz, 3516 bps						
				Out Pwr (dBm)	Limit (dBm)	Result
				-19.412	30	Pass



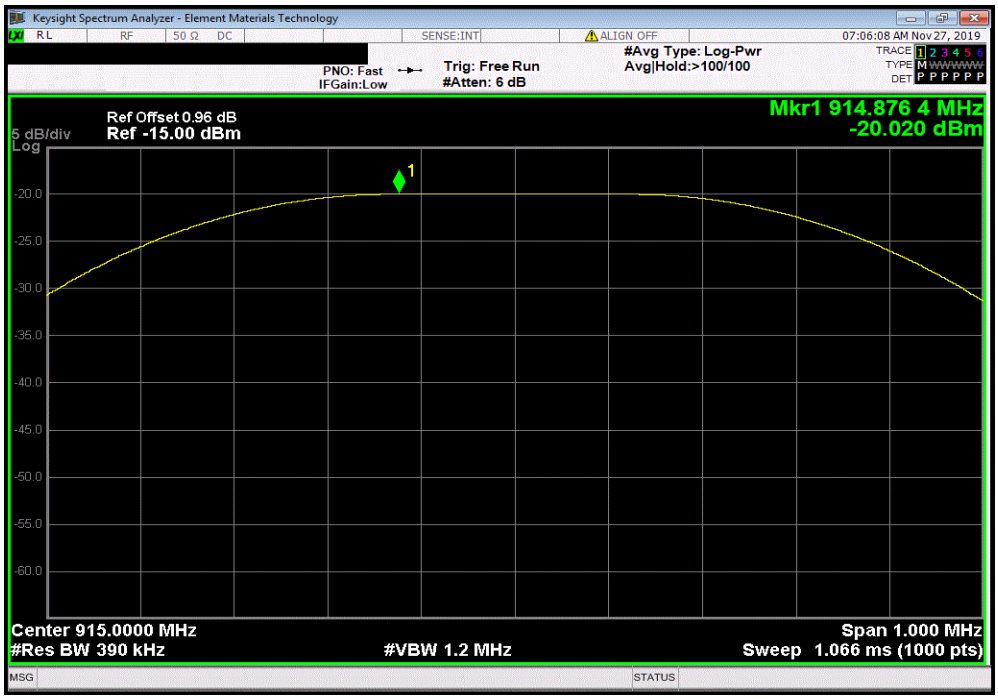
LoRa, 902-928 MHz, Low Channel, 903.08 MHz, 37500 bps						
				Out Pwr (dBm)	Limit (dBm)	Result
				-19.53	30	Pass



LoRa, 902-928 MHz, Mid Channel, 915 MHz, 293 bps						
				Out Pwr (dBm)	Limit (dBm)	Result
				-20.148	30	Pass

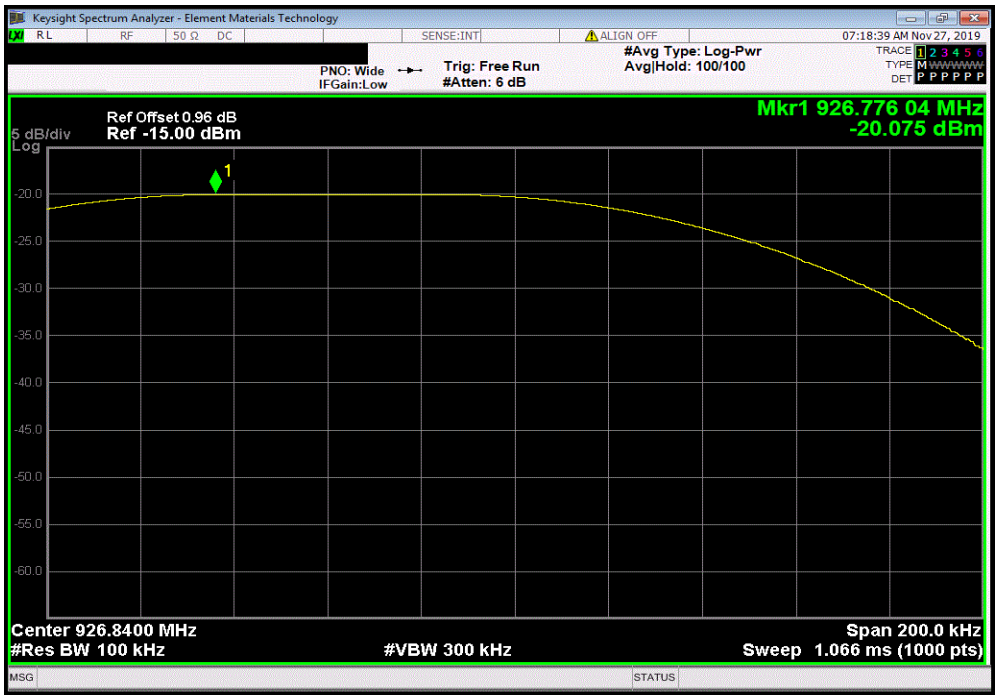


LoRa, 902-928 MHz, Mid Channel, 915 MHz, 3516 bps						
				Out Pwr (dBm)	Limit (dBm)	Result
				-20.02	30	Pass

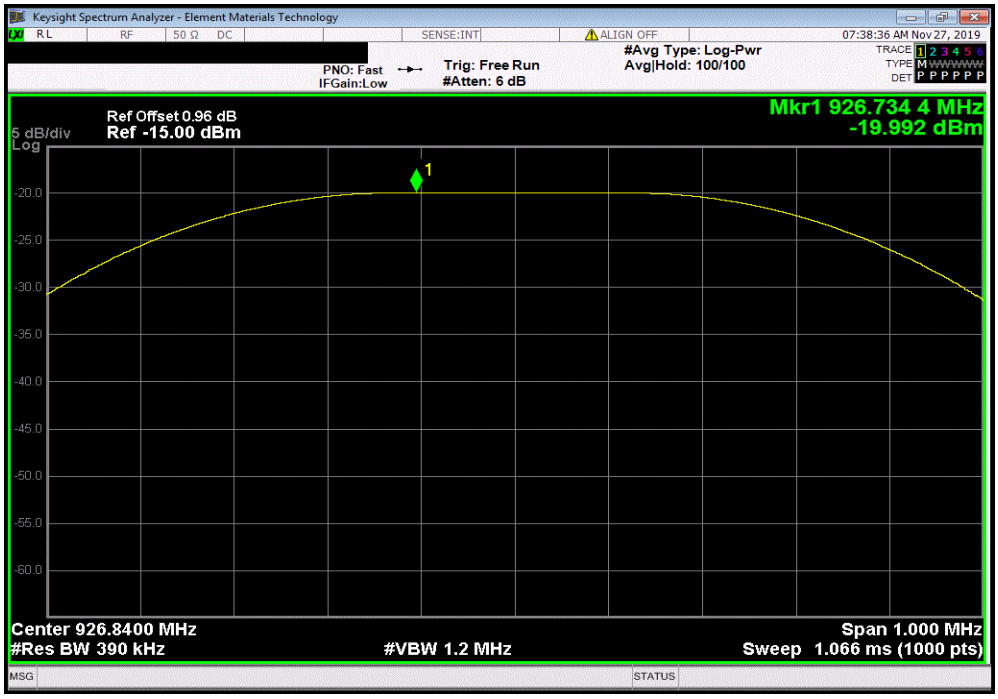


LoRa, 902-928 MHz, Mid Channel, 915 MHz, 37500 bps						
				Out Pwr (dBm)	Limit (dBm)	Result
				-20.166	30	Pass

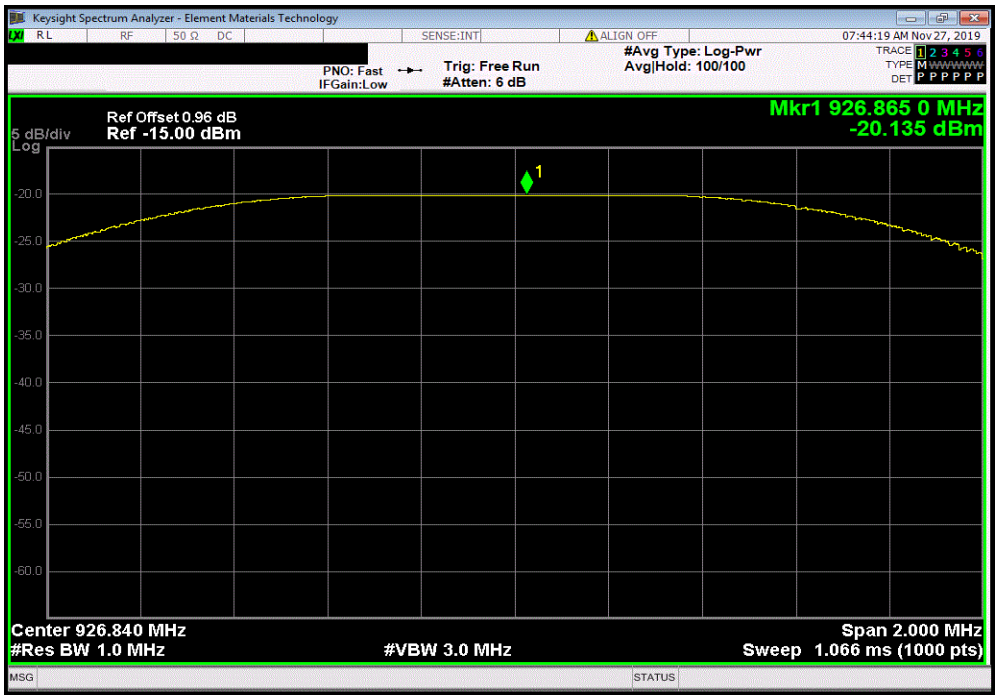
LoRa, 902-928 MHz, High Channel, 926.84 MHz, 293 bps						
				Out Pwr (dBm)	Limit (dBm)	Result
				-20.075	30	Pass



LoRa, 902-928 MHz, High Channel, 926.84 MHz, 3516 bps						
				Out Pwr (dBm)	Limit (dBm)	Result
				-19.992	30	Pass



LoRa, 902-928 MHz, High Channel, 926.84 MHz, 37500 bps						
				Out Pwr (dBm)	Limit (dBm)	Result
				-20.135	30	Pass



EQUIVALENT ISOTROPIC RADIATED POWER

XMit 2019.09.05

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TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	N5173B	TIW	5-Jul-17	5-Jul-20
Cable	Micro-Coax	UFD150A-1-0720-200200	MNL	15-Sep-19	15-Sep-20
Block - DC	Fairview Microwave	SD3379	AMI	6-Aug-19	6-Aug-20
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFN	1-May-19	1-May-20

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum.

Prior to measuring peak transmit power the DTS bandwidth (B) was measured.

The method found in ANSI C63.10:2013 Section 11.9.1.1 was used because the RBW on the analyzer was greater than the DTS Bandwidth of the radio.

The antenna gain was added to the output power in order to obtain the EIRP value.

EQUIVALENT ISOTROPIC RADIATED POWER

element

TbtTx 2019.08.30.0 XMit 2019.09.05

EUT:	**Beacon**			**Work Order:**	**SMNC0001**
Serial Number:	**Unit 1**			**Date:**	**26-Nov-19**
Customer:	**SMRTGrid Inc.**			**Temperature:**	**23.2 °C**
Attendees:	**Bill Haag**			**Humidity:**	**29% RH**
Project:	**None**			**Barometric Pres.:**	**1013 mbar**
Tested by:	**Dustin Sparks**	**Power:**	**Battery**	**Job Site:**	**MN08**

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

COMMENTS

DC block, measurement cable, and customer U.FL to SMA cable included in reference level offset. No external attenuator required due to low output power.

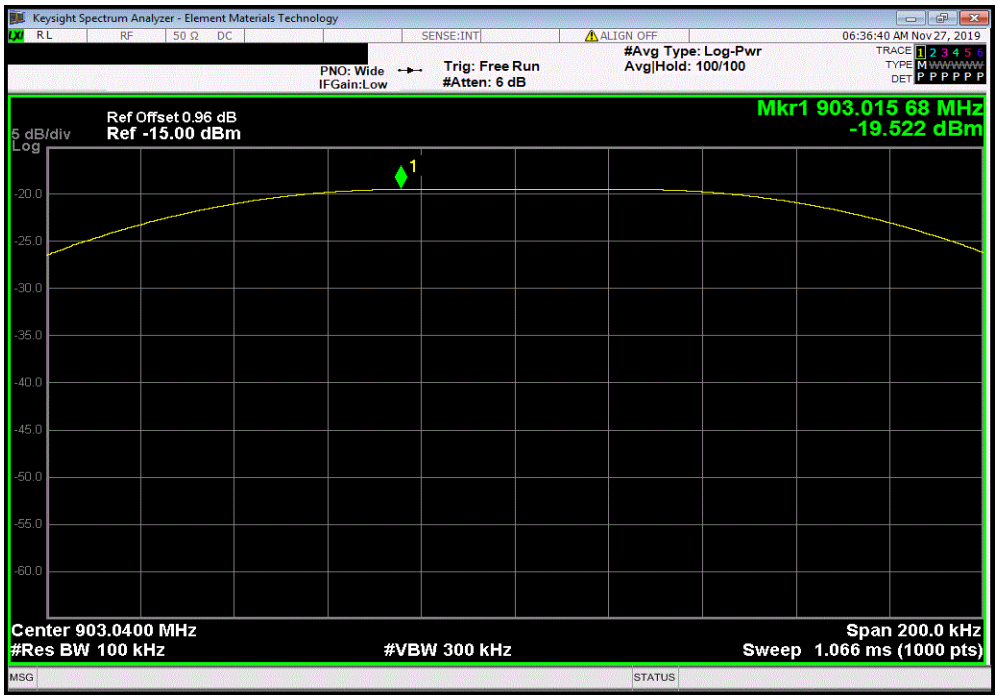
DEVIATIONS FROM TEST STANDARD

None

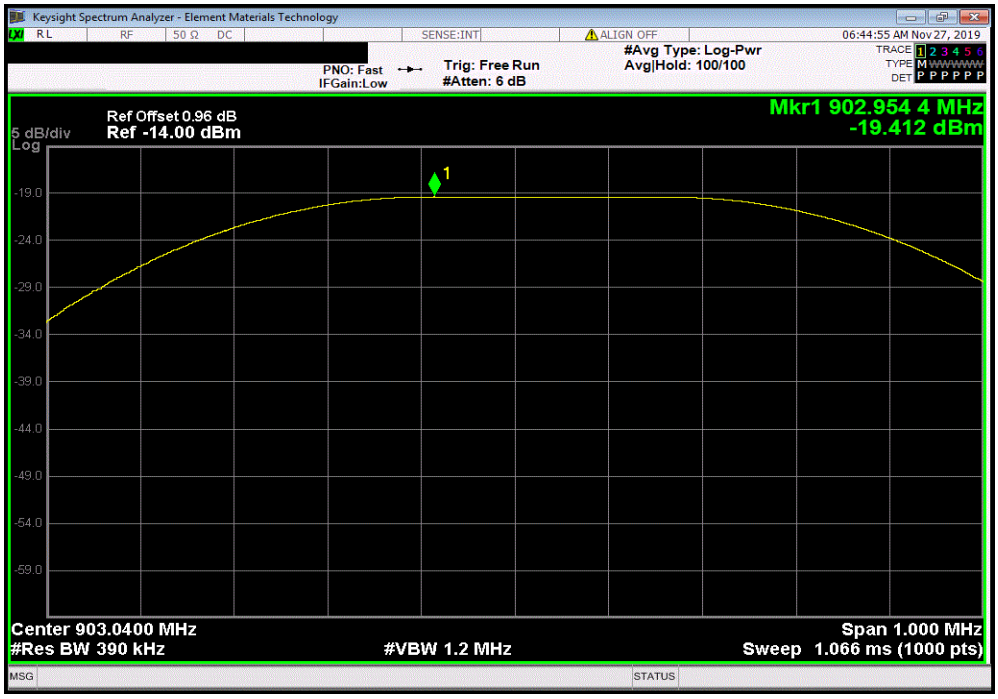
Configuration #	**4**	*Signature* Dustin Sparks

		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
LoRa, 902-928 MHz						
	Low Channel, 903.08 MHz					
	293 bps	-19.522	2.9	-16.622	36	Pass
	3516 bps	-19.412	2.9	-16.512	36	Pass
	37500 bps	-19.53	2.9	-16.63	36	Pass
	Mid Channel, 915 MHz					
	293 bps	-20.148	2.9	-17.248	36	Pass
	3516 bps	-20.02	2.9	-17.12	36	Pass
	37500 bps	-20.166	2.9	-17.266	36	Pass
	High Channel, 926.84 MHz					
	293 bps	-20.075	2.9	-17.175	36	Pass
	3516 bps	-19.992	2.9	-17.092	36	Pass
	37500 bps	-20.135	2.9	-17.235	36	Pass

LoRa, 902-928 MHz, Low Channel, 903.08 MHz, 293 bps						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-19.522	2.9	-16.622	36	Pass

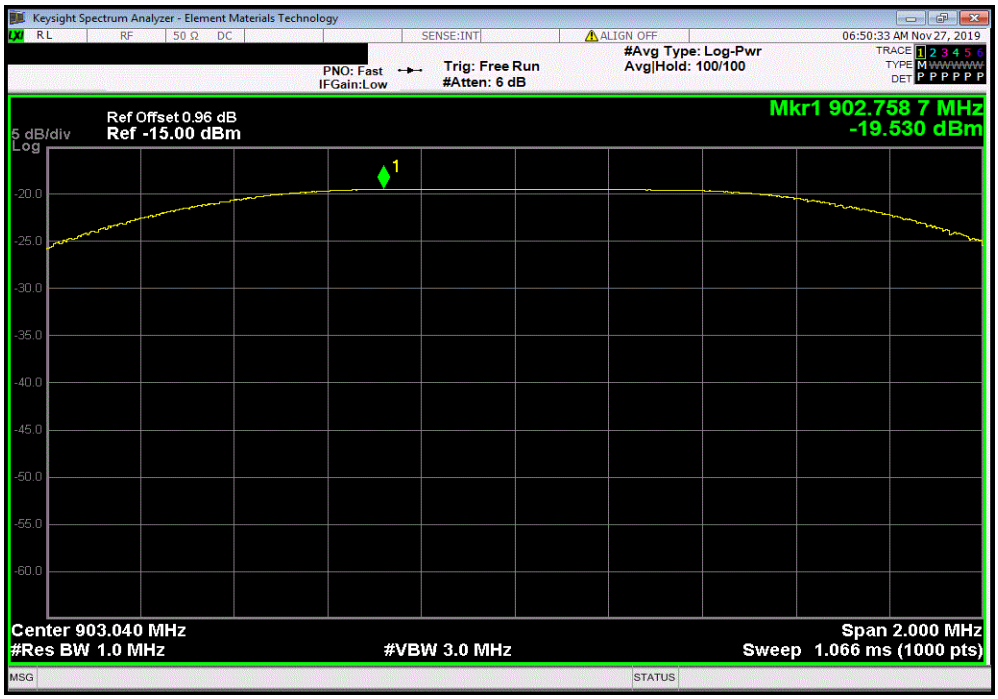


LoRa, 902-928 MHz, Low Channel, 903.08 MHz, 3516 bps						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-19.412	2.9	-16.512	36	Pass

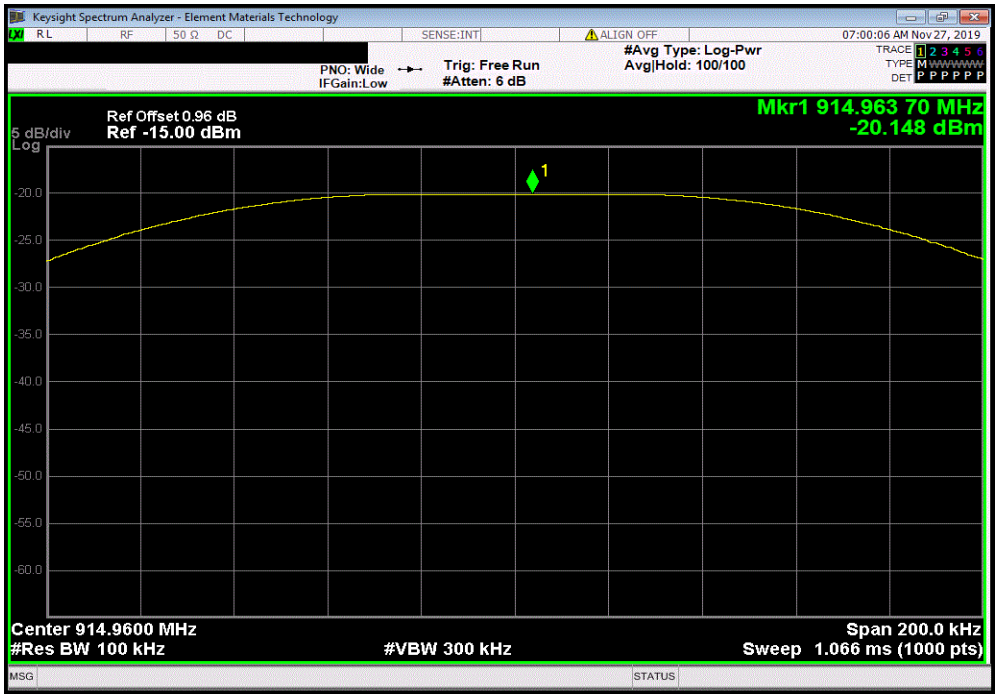


EQUIVALENT ISOTROPIC RADIATED POWER

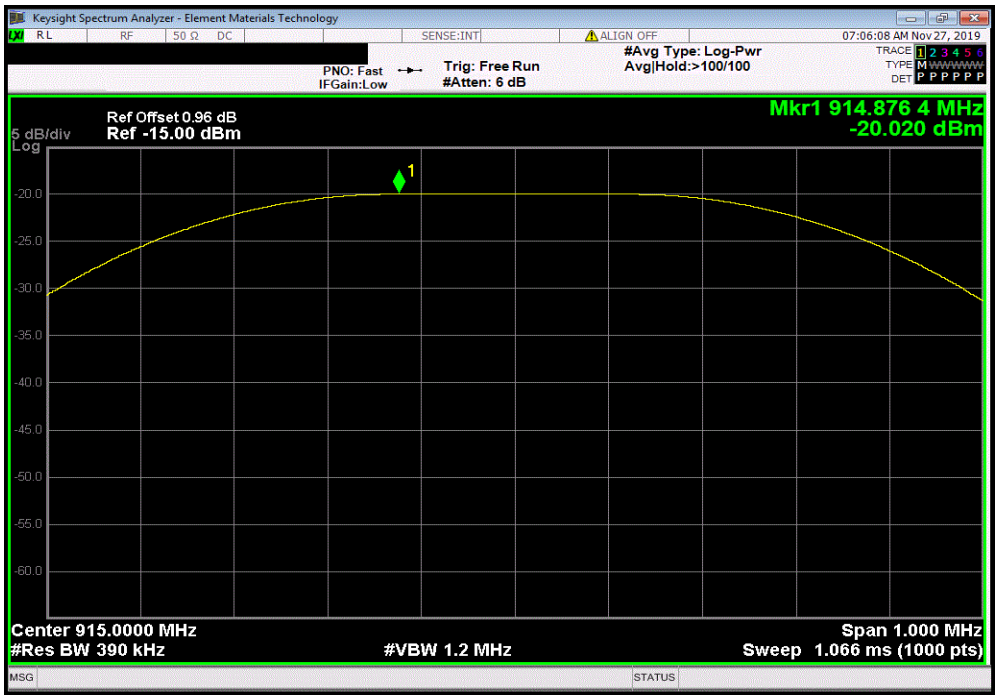
LoRa, 902-928 MHz, Low Channel, 903.08 MHz, 37500 bps						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-19.53	2.9	-16.63	36	Pass



LoRa, 902-928 MHz, Mid Channel, 915 MHz, 293 bps						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-20.148	2.9	-17.248	36	Pass



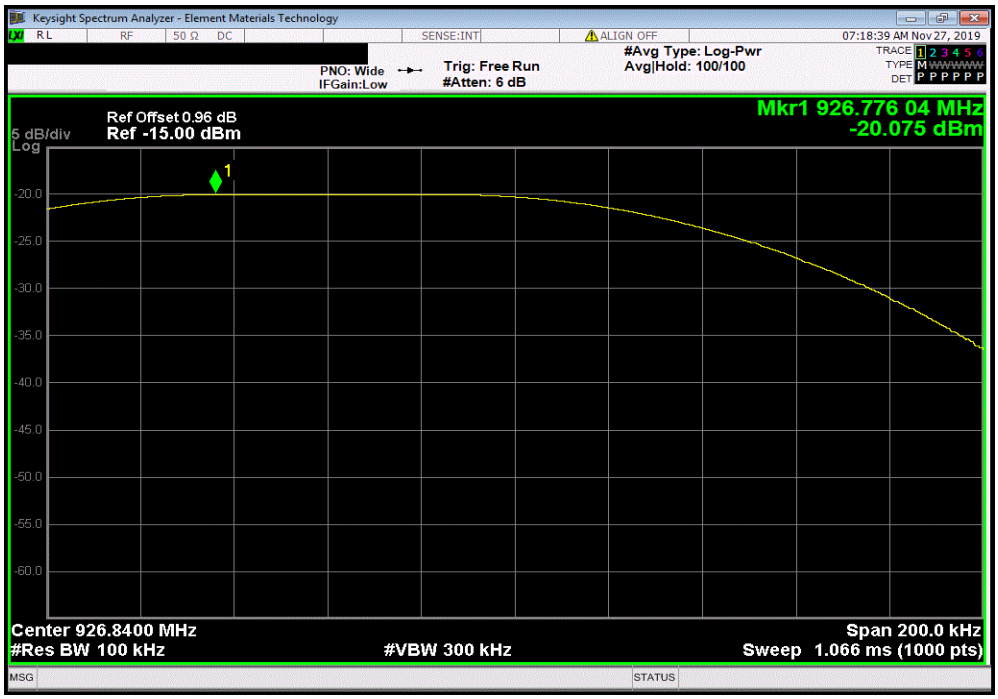
LoRa, 902-928 MHz, Mid Channel, 915 MHz, 3516 bps						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-20.02	2.9	-17.12	36	Pass



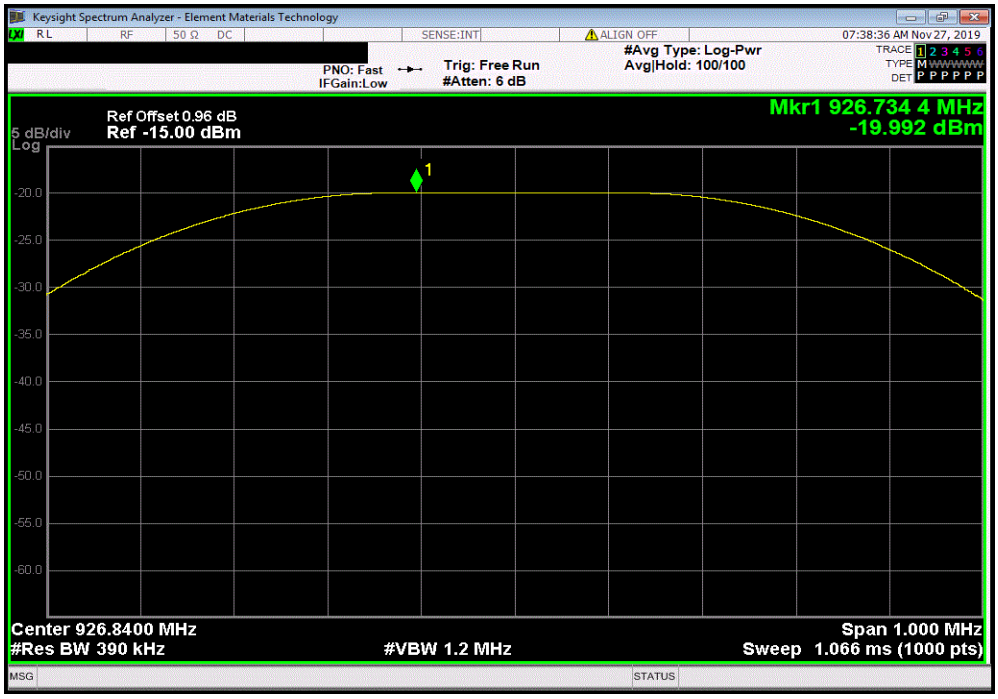
LoRa, 902-928 MHz, Mid Channel, 915 MHz, 37500 bps						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-20.166	2.9	-17.266	36	Pass

EQUIVALENT ISOTROPIC RADIATED POWER

LoRa, 902-928 MHz, High Channel, 926.84 MHz, 293 bps						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-20.075	2.9	-17.175	36	Pass



LoRa, 902-928 MHz, High Channel, 926.84 MHz, 3516 bps						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-19.992	2.9	-17.092	36	Pass



EQUIVALENT ISOTROPIC RADIATED POWER

LoRa, 902-928 MHz, High Channel, 926.84 MHz, 37500 bps						
		Out Pwr (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Result
		-20.135	2.9	-17.235	36	Pass