



# element

**SMRTGrid Inc.**

**Beacon**

**FCC 15.247:2019**

**902 - 928 MHz Hybrid Transceiver**

**Report # SMNC0001.1**



NVLAP LAB CODE: 200881-0



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# 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<br>(yyyy-mm-dd) | Page Number |
|-----------------|-------------|----------------------|-------------|
| 00              | None        |                      |             |

# ACCREDITATIONS AND AUTHORIZATIONS



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## 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

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## 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.

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## European Union

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

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## Australia/New Zealand

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

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## Korea

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

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## Japan

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

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## 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.

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## Singapore

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

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## Israel

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

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## Hong Kong

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

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## Vietnam

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

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## SCOPE

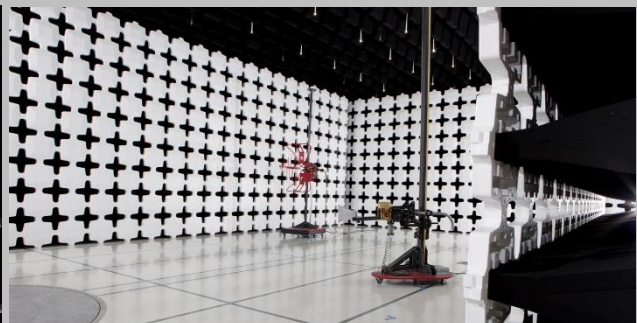
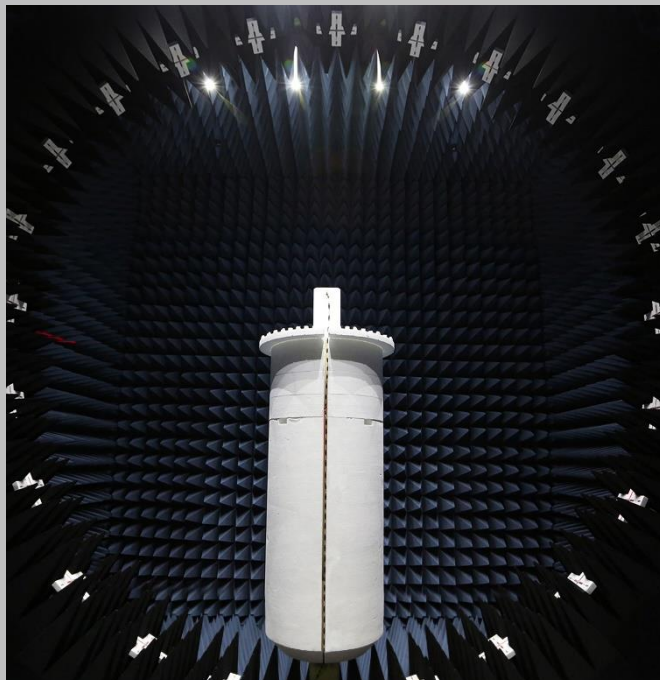
For details on the Scopes of our Accreditations, please visit:

<https://www.nwemc.com/emc-testing-accreditations>

# FACILITIES



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



# MEASUREMENT UNCERTAINTY

## Measurement Uncertainty

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

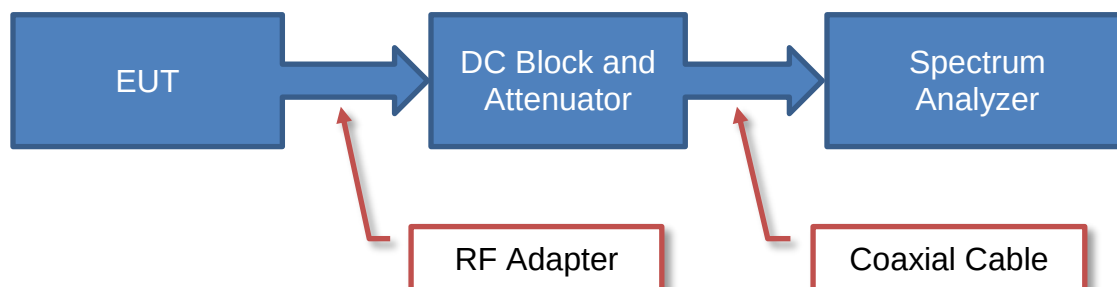
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable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

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

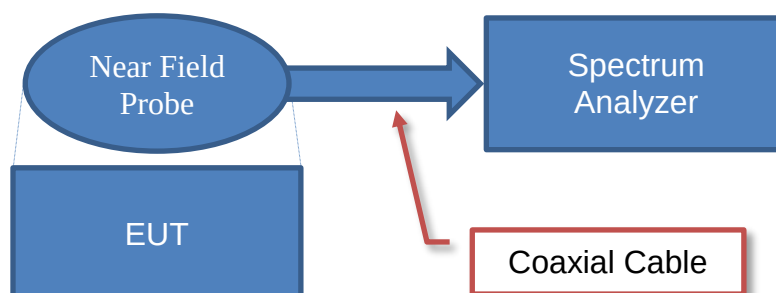
| Test                                  | + MU    | - MU     |
|---------------------------------------|---------|----------|
| Frequency Accuracy                    | 0.0007% | -0.0007% |
| Amplitude Accuracy (dB)               | 1.2 dB  | -1.2 dB  |
| Conducted Power (dB)                  | 1.2 dB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

# Test Setup Block Diagrams

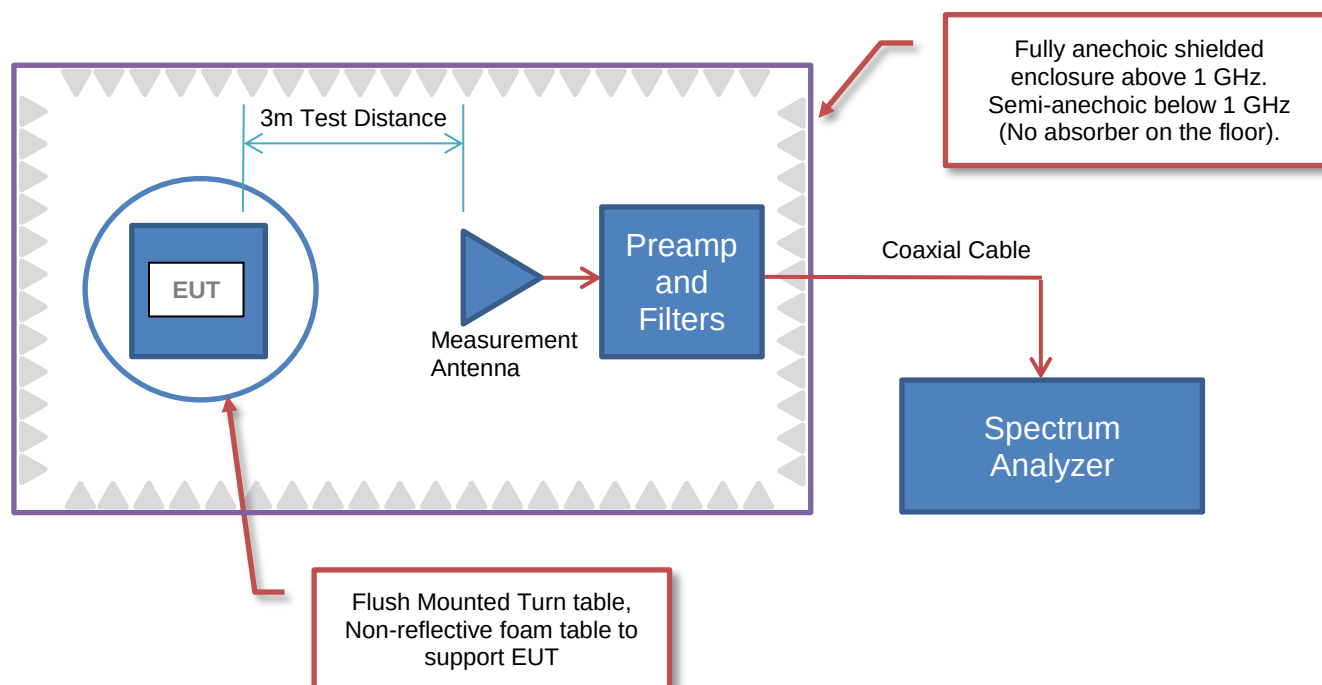
## Antenna Port Conducted Measurements



## 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.

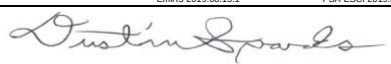
If there are no detectable emissions above the noise floor, the data included may show noise floor measurements for reference only.

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.

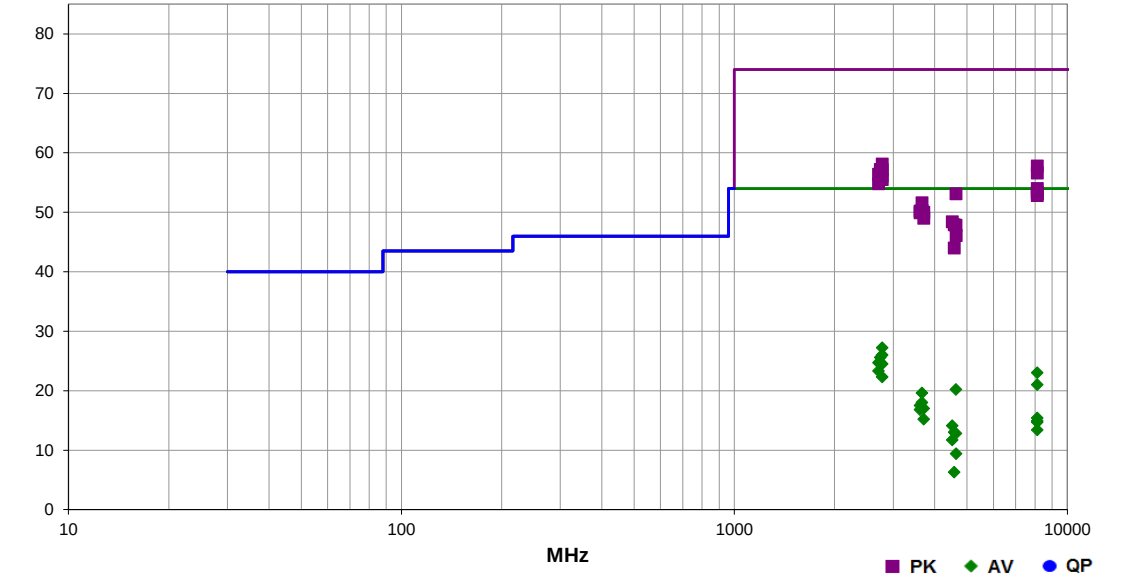
Where the radio test software does not provide for a duty cycle at continuous transmit conditions (> 98%) and the RMS (power average) measurements were made across the on and off times of the EUT transmissions, a duty cycle correction is added to the measurements using the formula of  $10 \cdot \text{LOG}(\text{dc})$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



# SPURIOUS RADIATED EMISSIONS

|                     |                                                                                                                                                                                                                                                                                                                                               |                   |             |                                                                                    |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------|------------------------------------------------------------------------------------|
| 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 | FCC 15.247:2019                                                                                                                                                                                                                                                                                                                               |                   | Test Method | 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<br>(MHz) | Amplitude<br>(dBuV) | Factor<br>(dB) | Antenna<br>Height<br>(meters) | Azimuth<br>(degrees) | Duty Cycle<br>Correction<br>Factor<br>(dB) | External<br>Attenuation<br>(dB) | Polarity/<br>Transducer<br>Type | Detector | Distance<br>Adjustment<br>(dB) | Adjusted<br>(dBuV/m) | Spec. Limit<br>(dBuV/m) | Compared to<br>Spec.<br>(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



TMTx 2019.08.30.0 XMI 2019.09.05

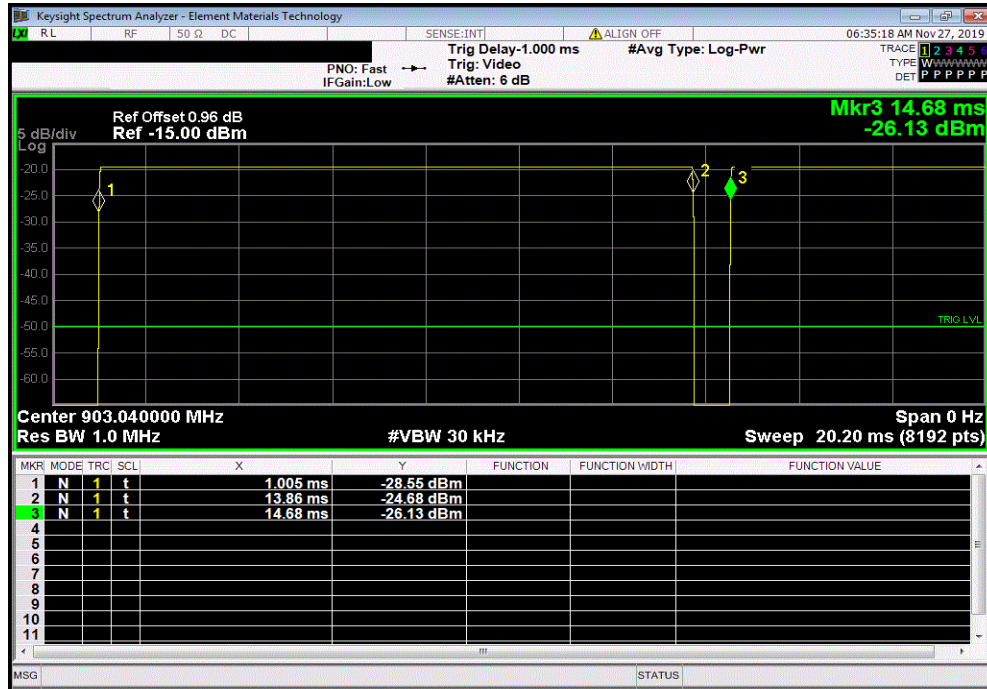
|                                                                                                                                                          |           |                                |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------------------------|-----------|
| 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 <i>Dustin Sparks</i> |           |
|                                                                                                                                                          |           | 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 |
|                                                                                                                                                          | 293 bps   | N/A                            | N/A       |
|                                                                                                                                                          | 3516 bps  | 12.831 ms                      | 13.668 ms |
|                                                                                                                                                          | 3516 bps  | N/A                            | N/A       |
|                                                                                                                                                          | 37500 bps | 12.847 ms                      | 13.697 ms |
|                                                                                                                                                          | 37500 bps | N/A                            | N/A       |
| Mid Channel, 915 MHz                                                                                                                                     |           |                                |           |
|                                                                                                                                                          | 293 bps   | 12.852 ms                      | 13.689 ms |
|                                                                                                                                                          | 293 bps   | N/A                            | N/A       |
|                                                                                                                                                          | 3516 bps  | 12.862 ms                      | 13.697 ms |
|                                                                                                                                                          | 3516 bps  | N/A                            | N/A       |
|                                                                                                                                                          | 37500 bps | 13.165 ms                      | 14.673 ms |
|                                                                                                                                                          | 37500 bps | N/A                            | N/A       |
| High Channel, 926.84 MHz                                                                                                                                 |           |                                |           |
|                                                                                                                                                          | 293 bps   | 12.861 ms                      | 13.699 ms |
|                                                                                                                                                          | 293 bps   | N/A                            | N/A       |
|                                                                                                                                                          | 3516 bps  | 12.501 ms                      | 13.669 ms |
|                                                                                                                                                          | 3516 bps  | N/A                            | N/A       |
|                                                                                                                                                          | 37500 bps | 12.834 ms                      | 13.674 ms |
|                                                                                                                                                          | 37500 bps | N/A                            | N/A       |

# DUTY CYCLE

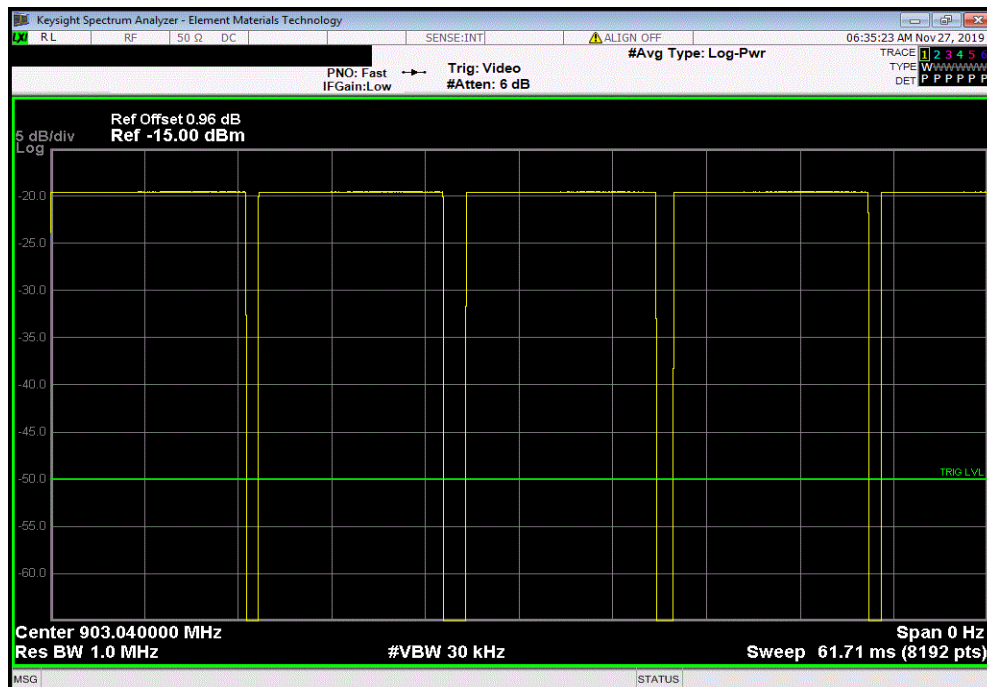


TbTtx 2019.08.30.0 XMI 2019.09.05

| 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     |  |

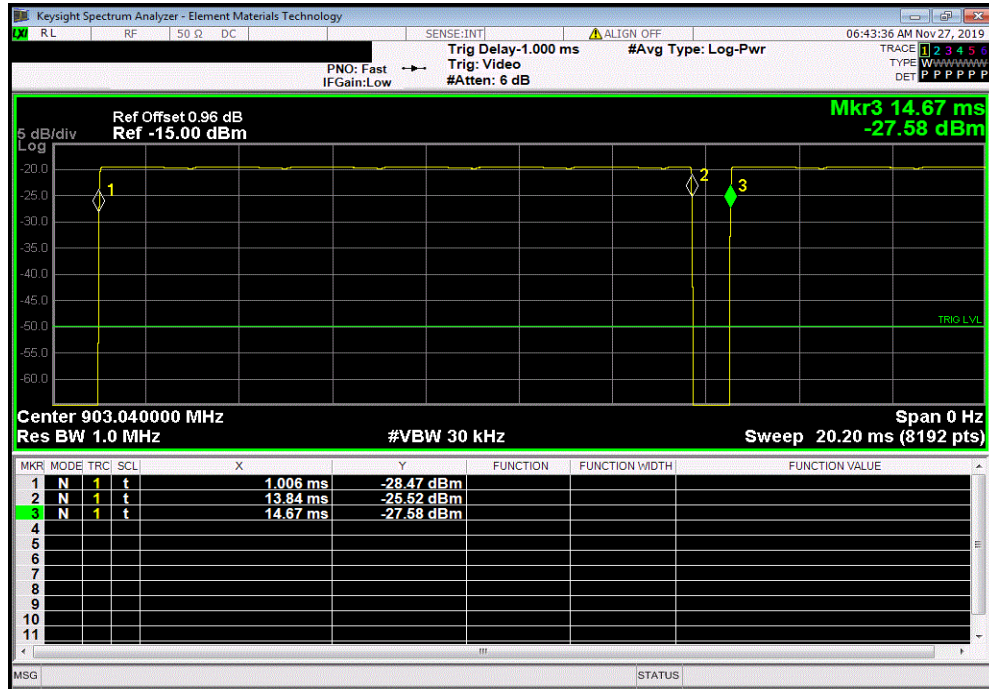


# DUTY CYCLE

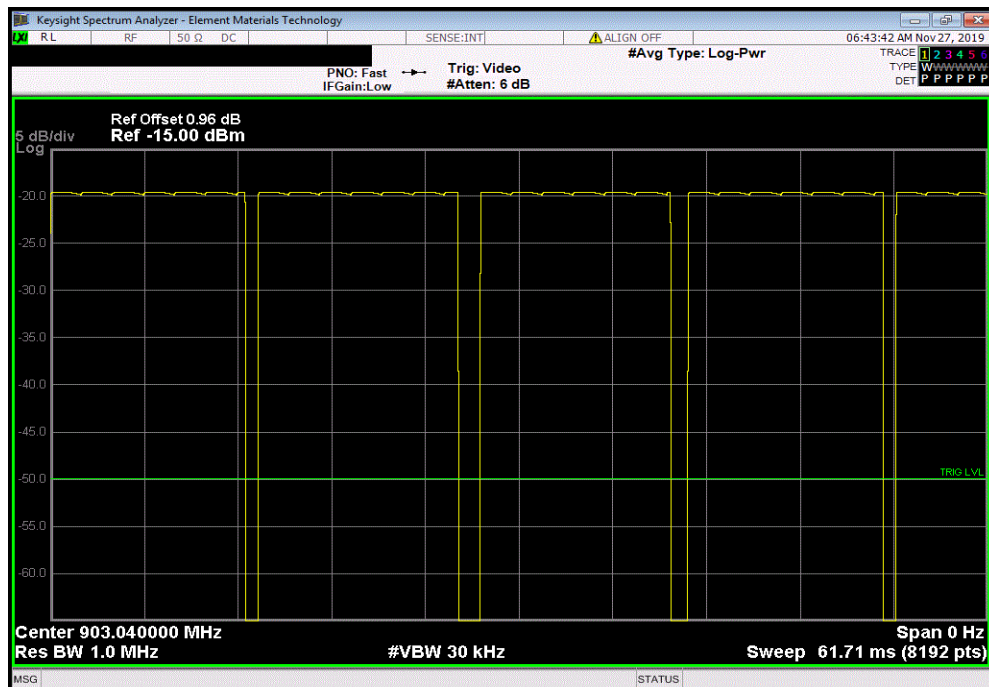


TbTx 2019.08.30.0 XMI 2019.09.05

| 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     |  |

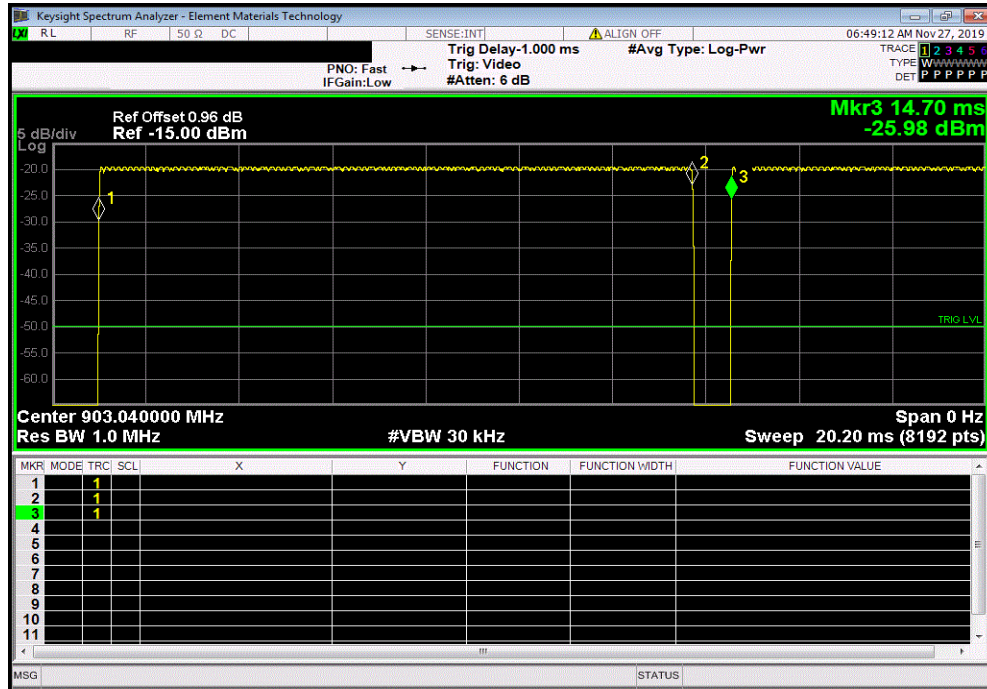


# DUTY CYCLE

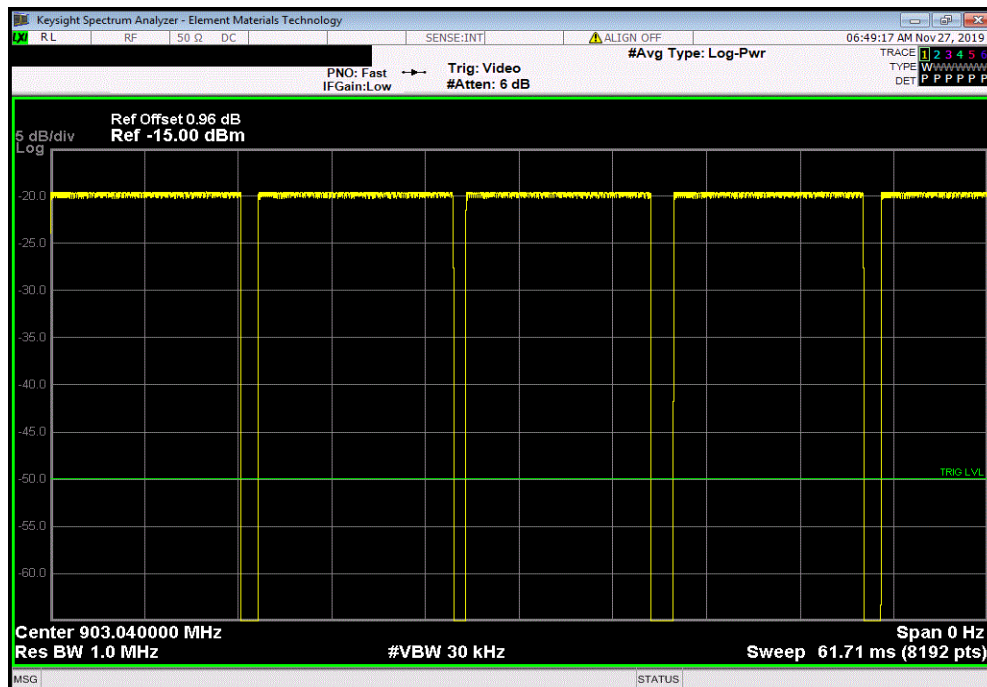


TbTtx 2019.08.30.0 XMI 2019.09.05

| 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     |  |

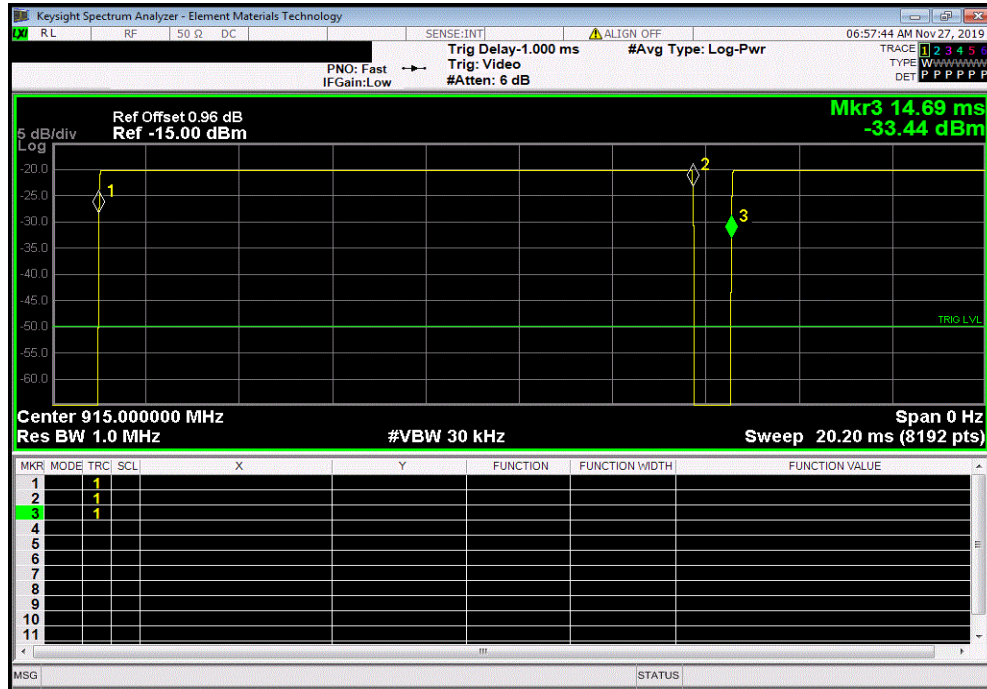


# DUTY CYCLE

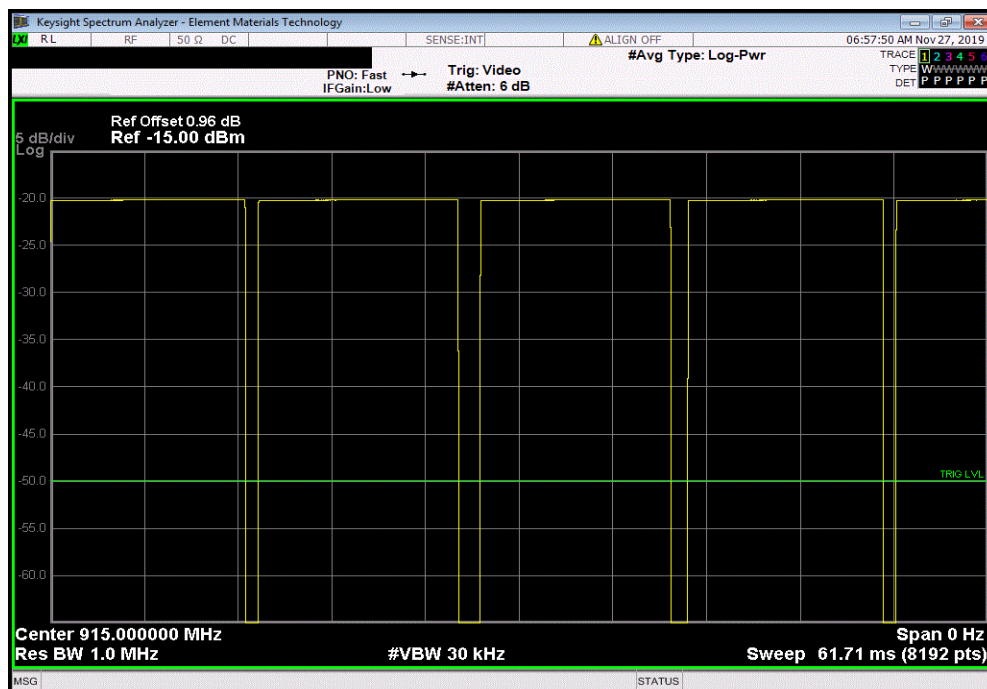


TbTtx 2019.08.30.0 XMI 2019.09.05

| 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     |  |

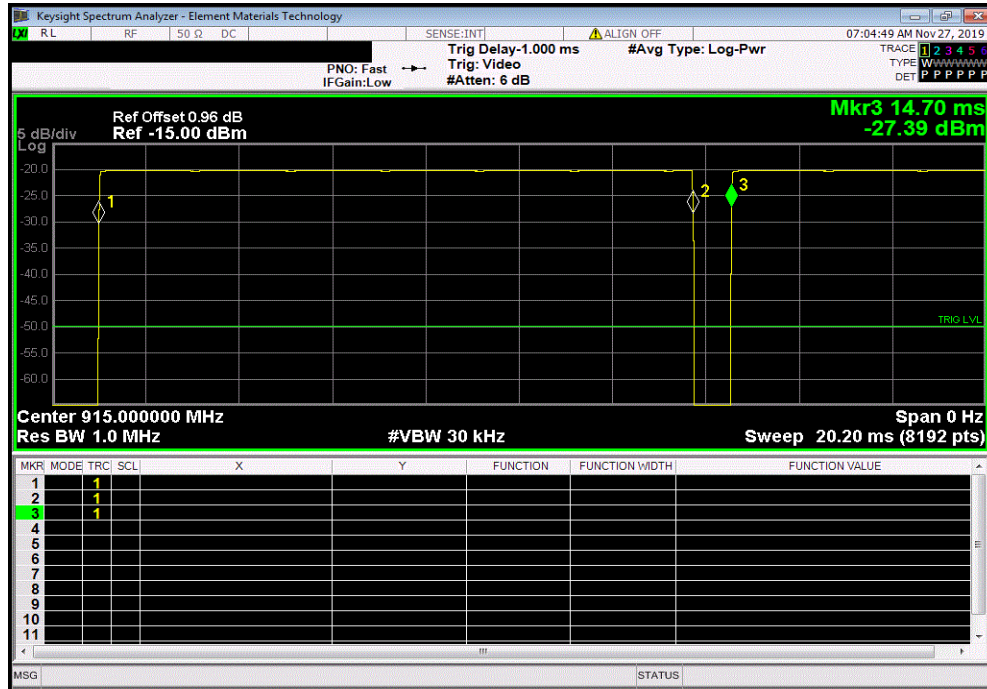


# DUTY CYCLE

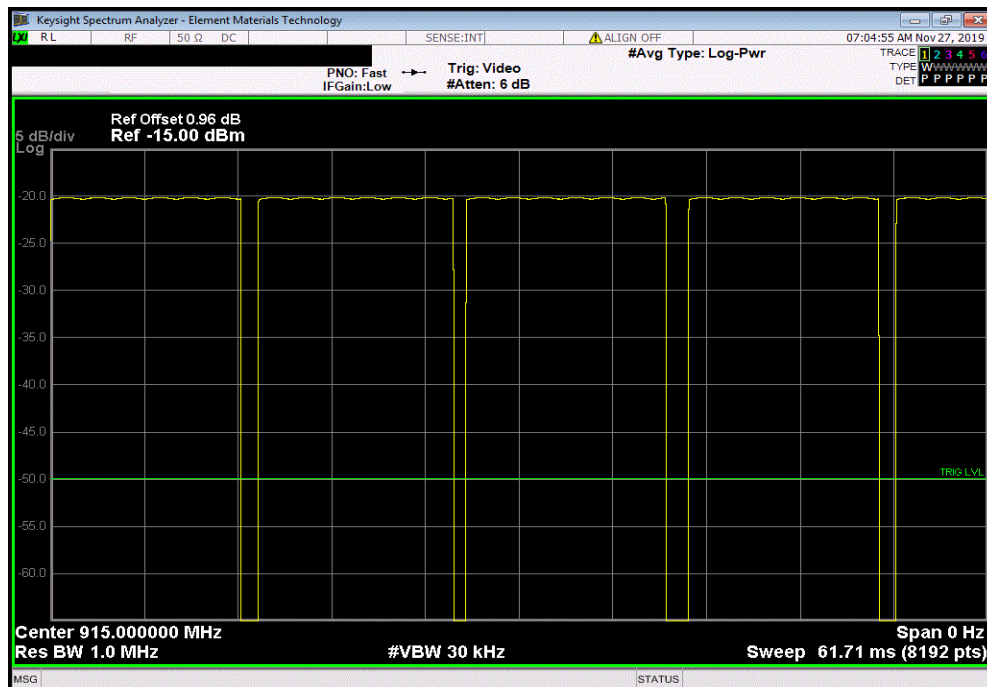


TbTtx 2019.08.30.0 XMI 2019.09.05

| 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     |  |

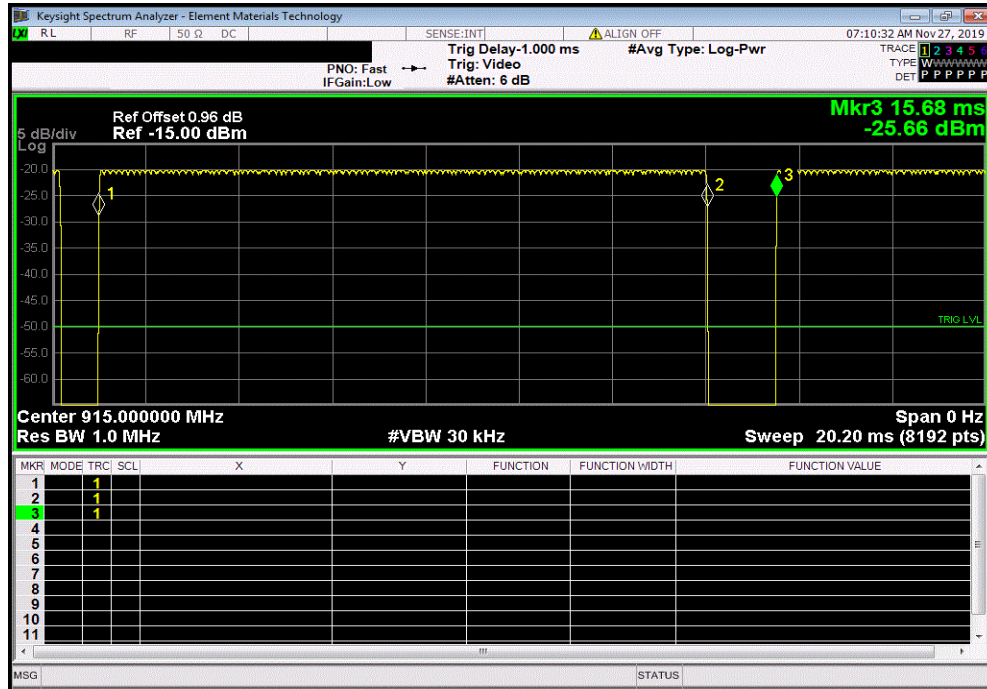


# DUTY CYCLE

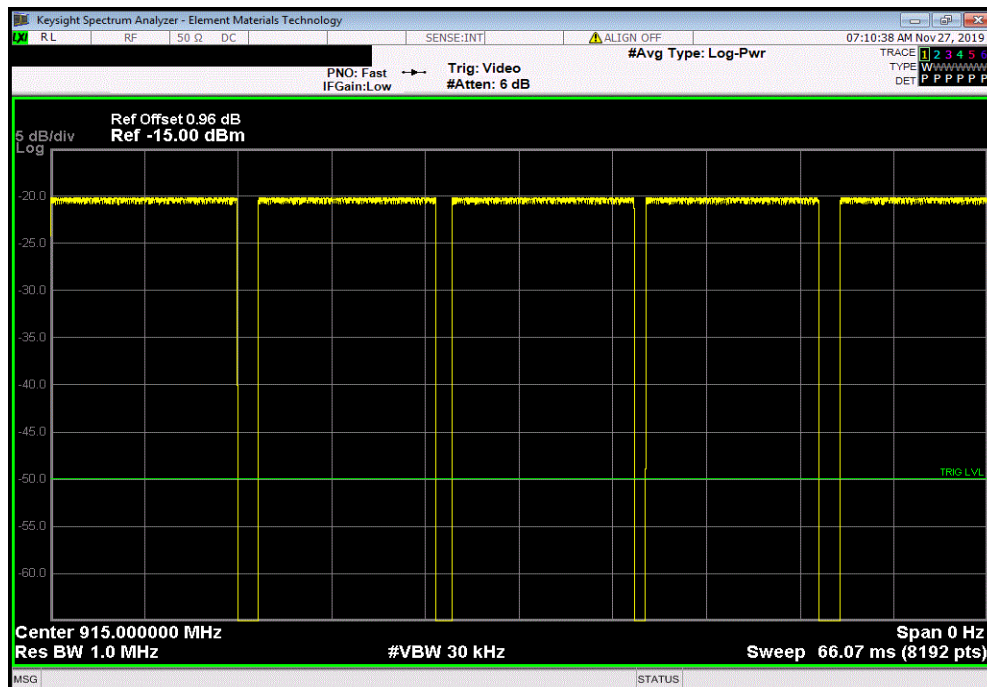


TbTx 2019.08.30.0 XMI 2019.09.05

| 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     |  |

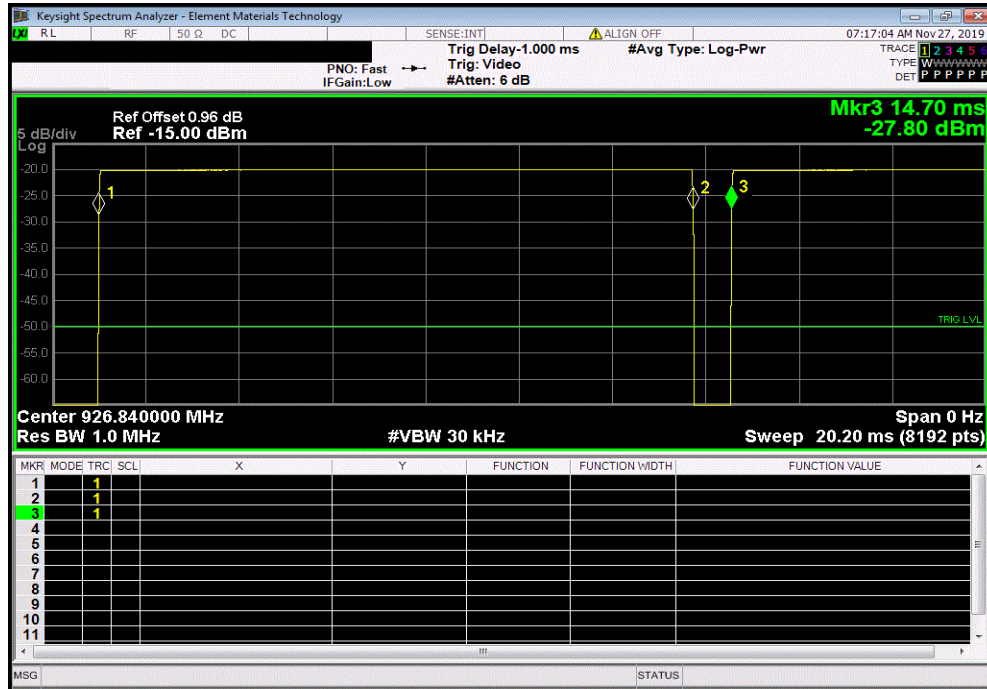


# DUTY CYCLE

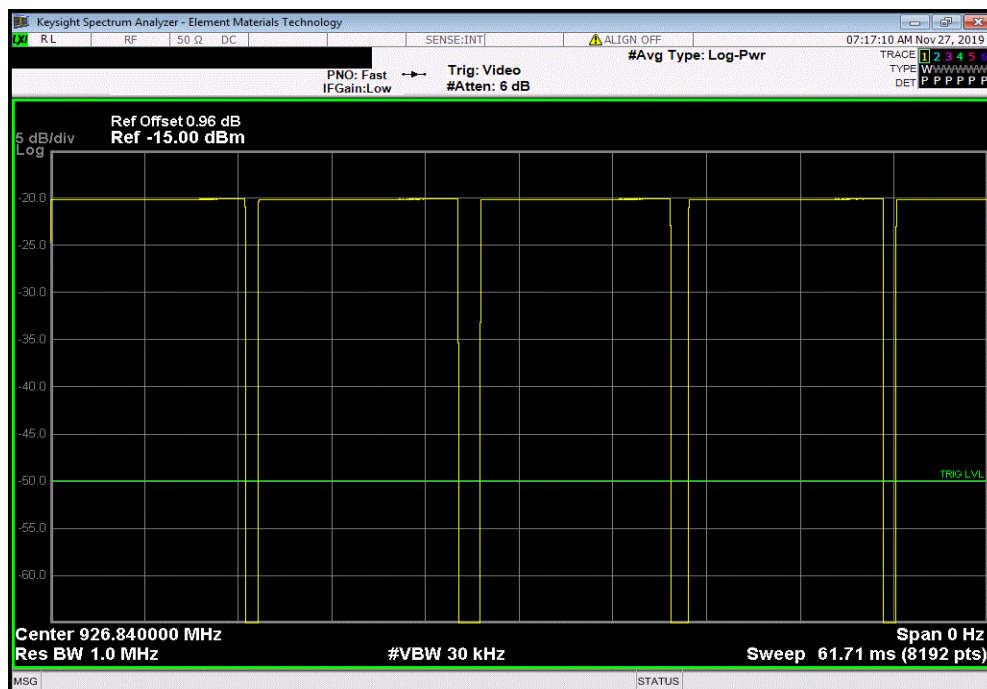


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| LoRa, 902-928 MHz, High Channel, 926.84 MHz, 293 bps |           |                  |           |           |         |  |
|------------------------------------------------------|-----------|------------------|-----------|-----------|---------|--|
| 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     |  |

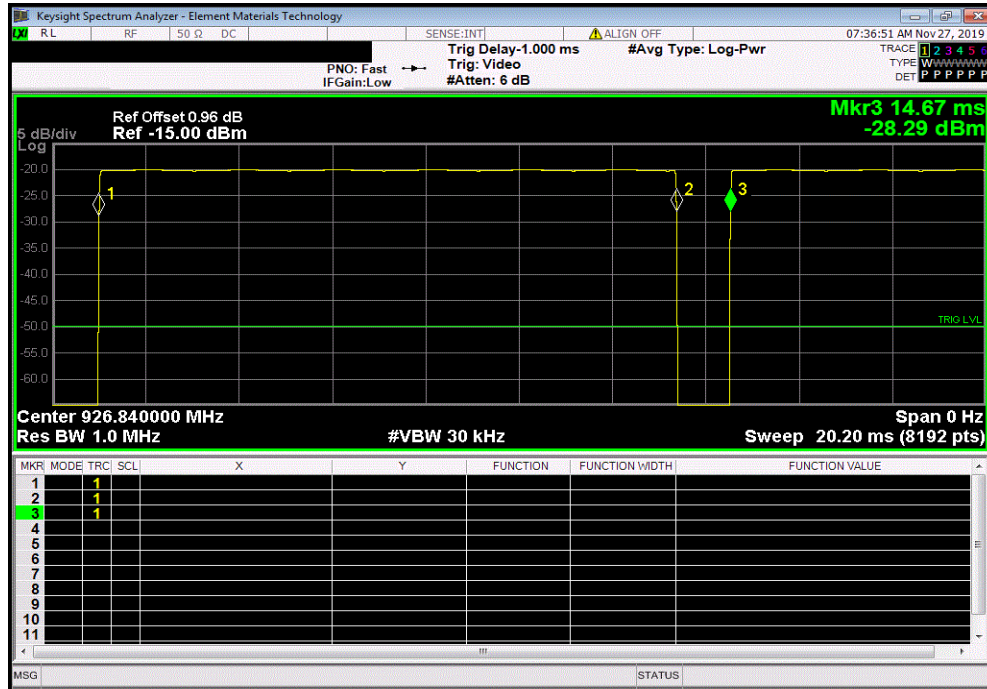


# DUTY CYCLE

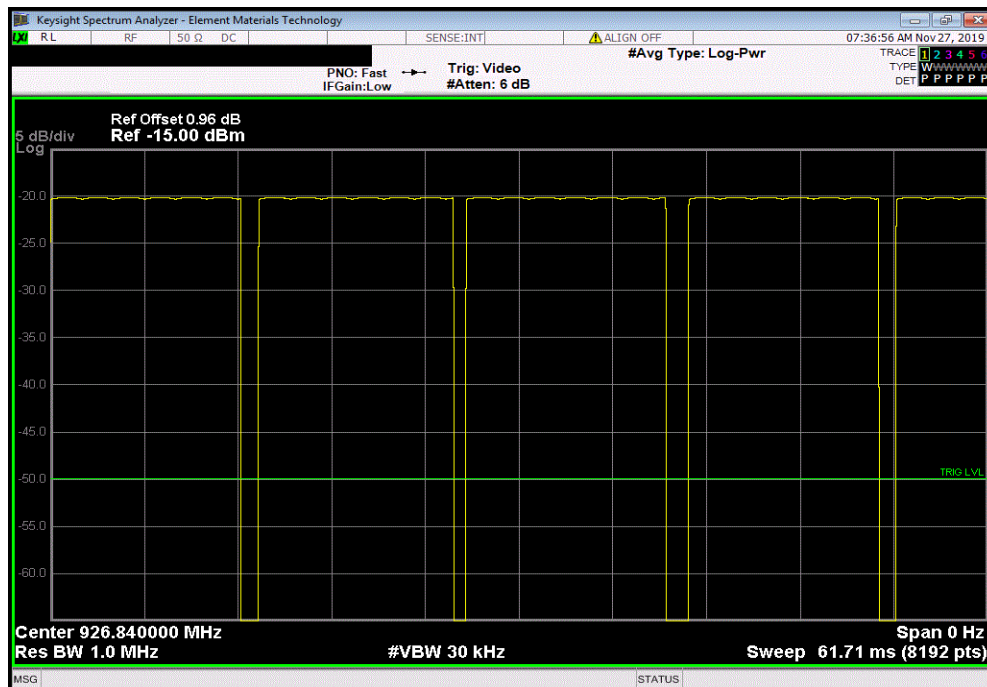


TbTx 2019.08.30.0 XMI 2019.09.05

| 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     |  |

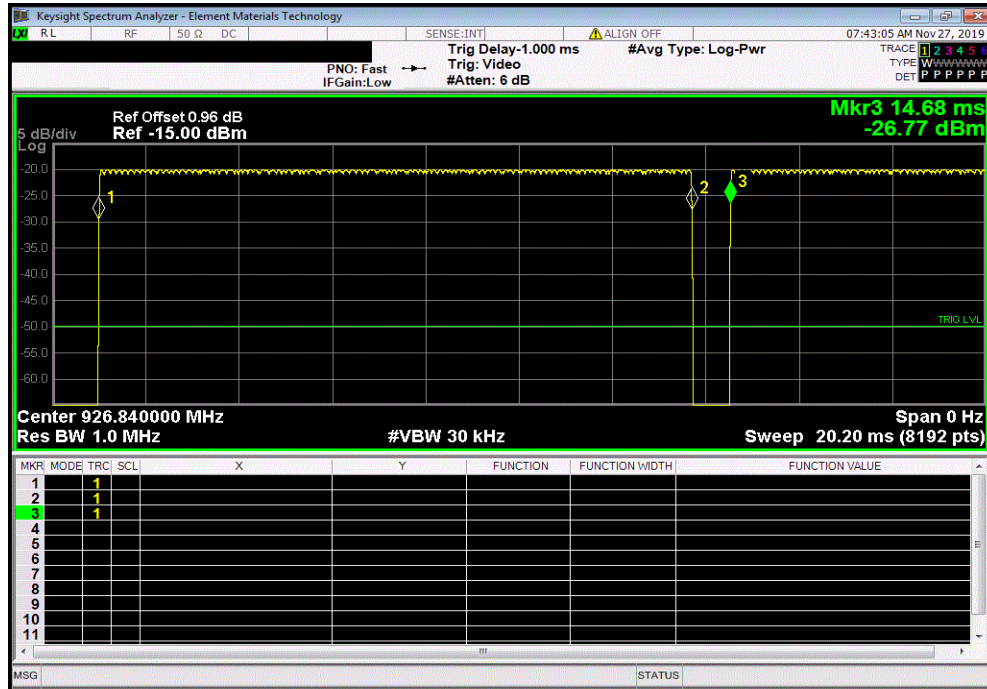


# DUTY CYCLE

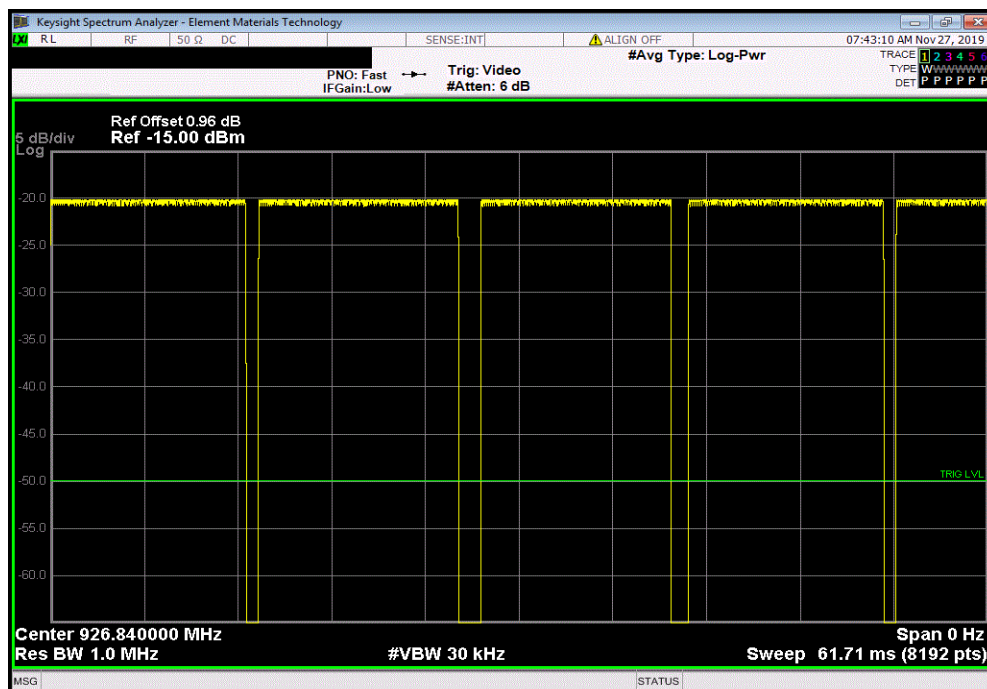


TbTx 2019.08.30.0 XMI 2019.09.05

| 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



TMTx 2019.08.30.0 XMI 2019.09.05

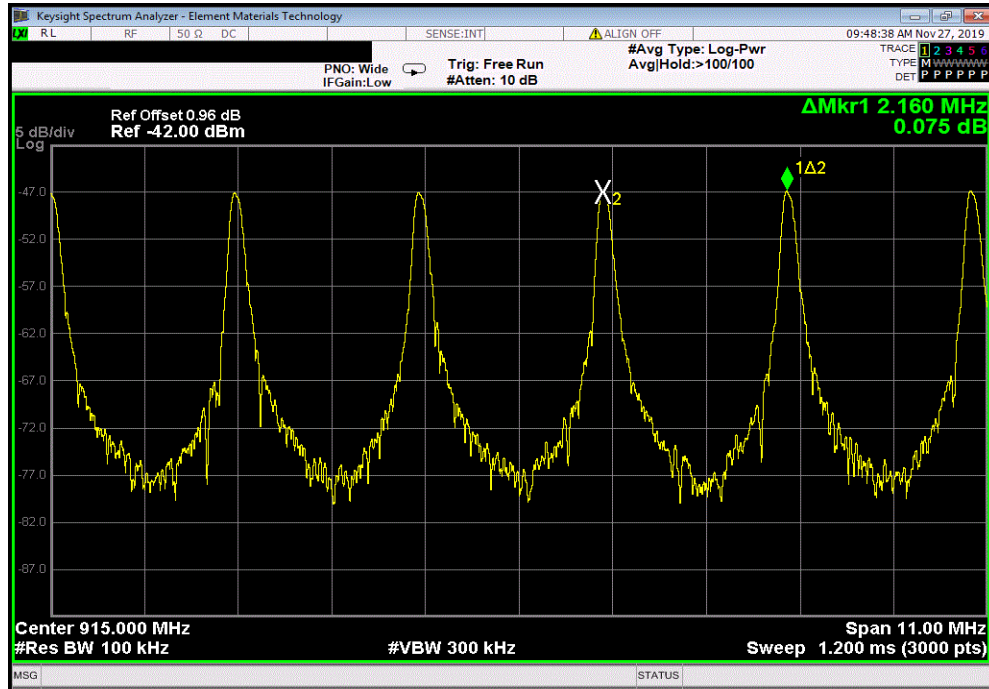
|                                                                                                                                                          |   |                                |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------|------------------|
| 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 <i>Dustin Sparks</i> |                  |
|                                                                                                                                                          |   | Value                          | Limit (>)        |
| 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

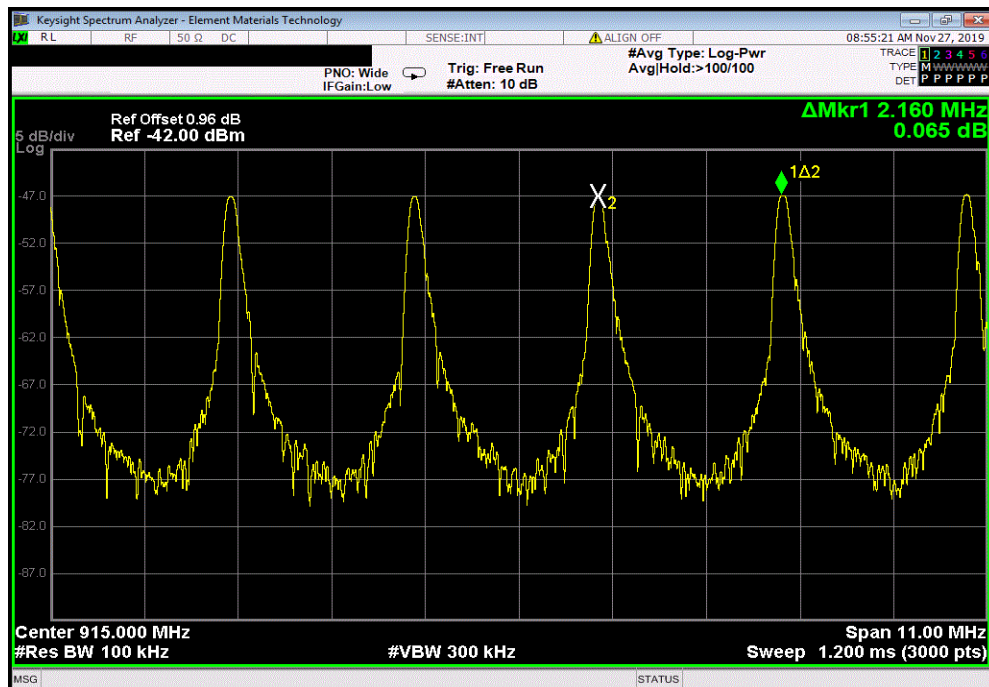


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| Hopping Mode (All Channels), LoRa, 293 bps, Mid Channel, 915 MHz |         |            |         |  |  |  |
|------------------------------------------------------------------|---------|------------|---------|--|--|--|
|                                                                  | 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    |  |  |  |

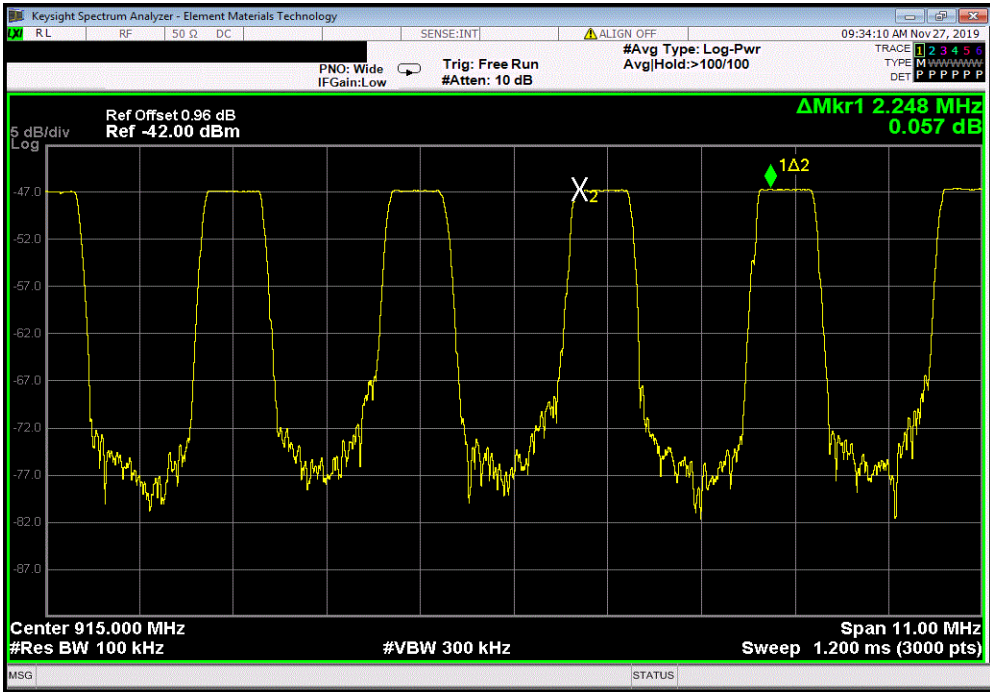


# CARRIER FREQUENCY SEPARATION -HOPPING MODE



TbTtx 2019.08.30.0 XMI 2019.09.05

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



# NUMBER OF HOPPING FREQUENCIES



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

# NUMBER OF HOPPING FREQUENCIES



TMTx 2019.08.30.0 XMI 2019.09.05

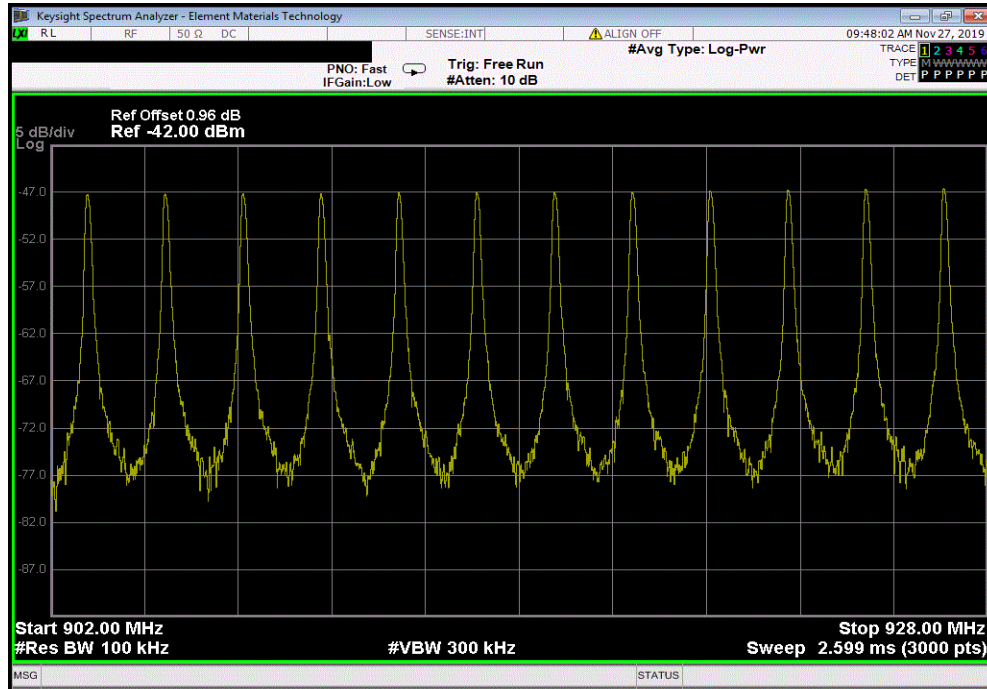
|                                                                                                                                                          |   |                                |             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------|-------------|
| 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 <i>Dustin Sparks</i> |             |
|                                                                                                                                                          |   | Number of Channels             | Limit (N/A) |
| Hopping Mode (All Channels)                                                                                                                              |   |                                |             |
| LoRa, 293 bps                                                                                                                                            |   |                                |             |
| Mid Channel, 915 MHz                                                                                                                                     |   | 12                             | N/A         |
| LoRa, 3516 bps                                                                                                                                           |   |                                |             |
| Mid Channel, 915 MHz                                                                                                                                     |   | 12                             | N/A         |
| LoRa, 37500 bps                                                                                                                                          |   |                                |             |
| Mid Channel, 915 MHz                                                                                                                                     |   | 12                             | N/A         |
|                                                                                                                                                          |   |                                | Results     |

# NUMBER OF HOPPING FREQUENCIES

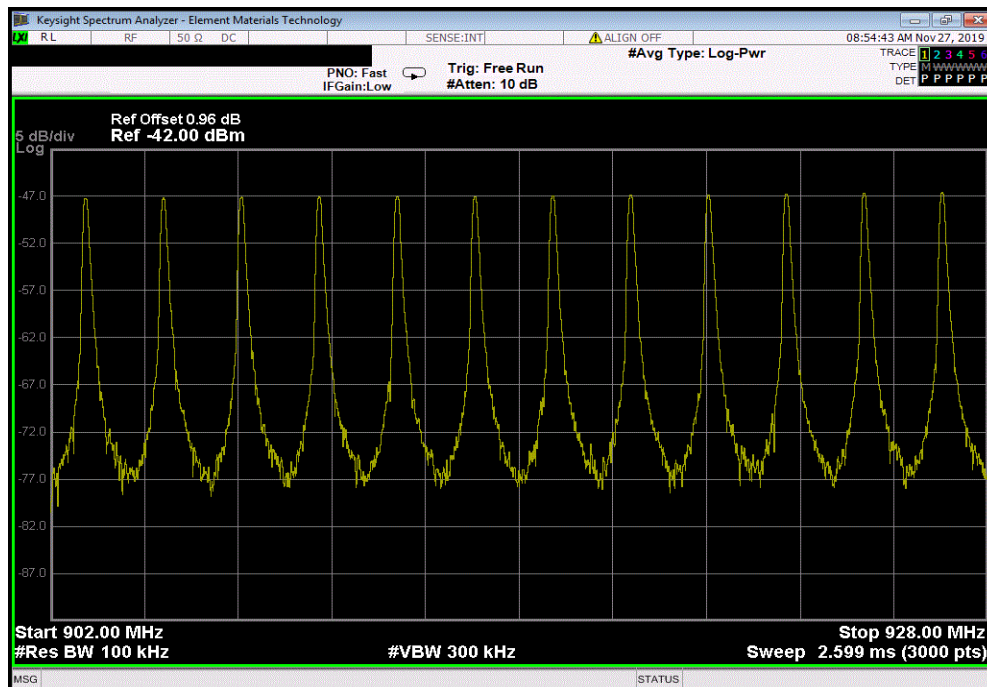


TbTx 2019.08.30.0 XMI 2019.09.05

| 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     |



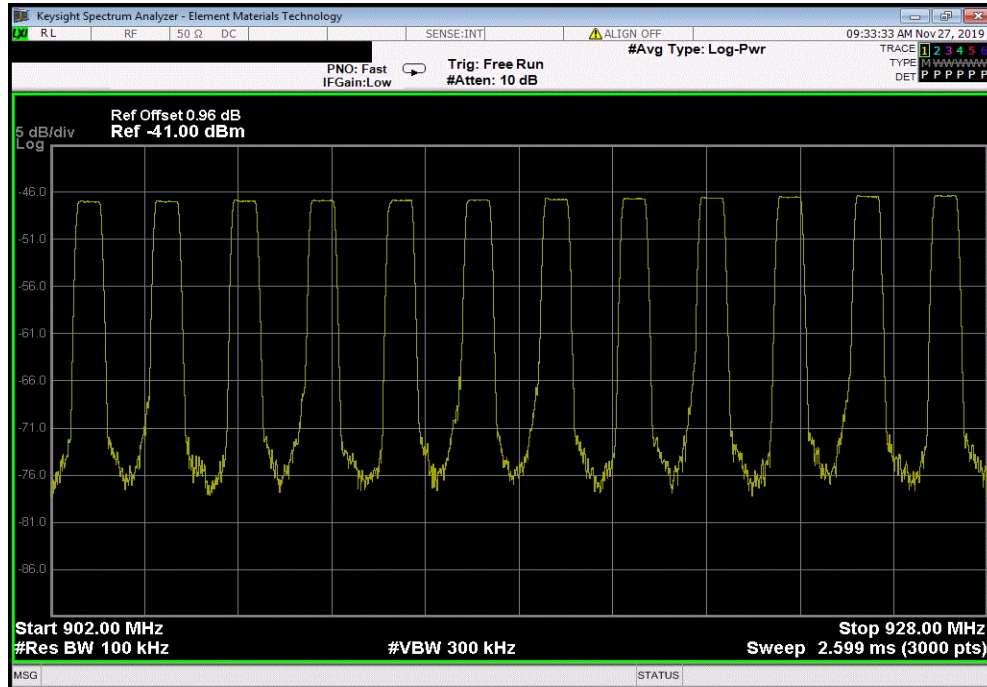


## Results

12

N/A

|     |
|-----|
| N/A |
|-----|



# DWELL TIME



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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 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



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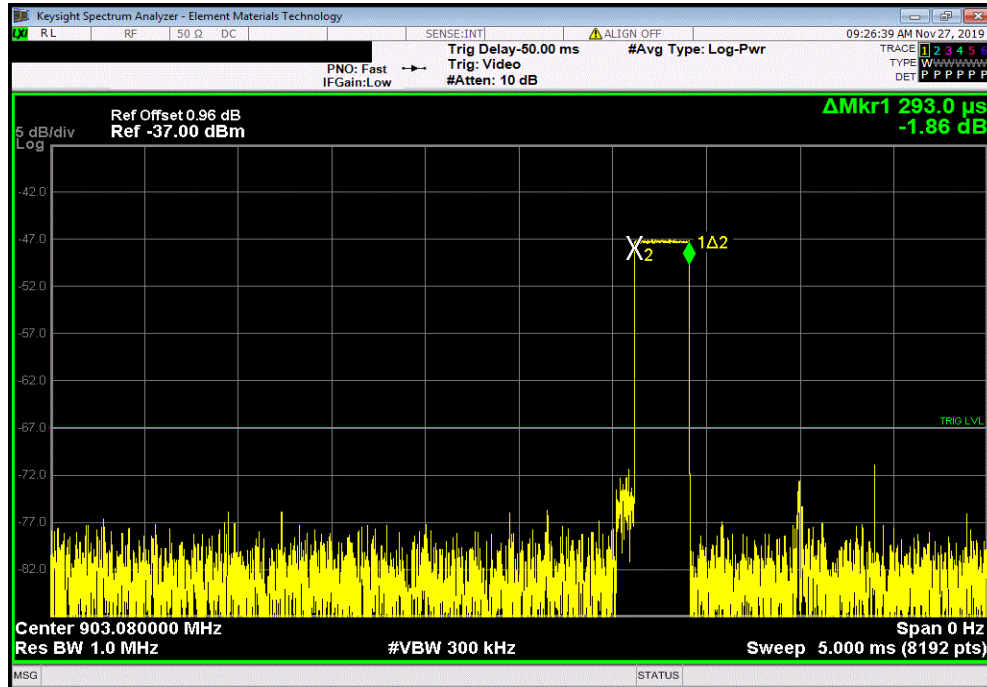
|                                                                                                                                                                                                                                                                     |                       |                                |                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------|---------------------------|
| 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 <i>Dustin Sparks</i> |                           |
|                                                                                                                                                                                                                                                                     |                       | 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                       |
|                                                                                                                                                                                                                                                                     | # of Pulses in 100 ms | 0.293                          | 9                         |
|                                                                                                                                                                                                                                                                     |                       | 48                             | 126.576                   |
|                                                                                                                                                                                                                                                                     |                       |                                | < 400                     |
|                                                                                                                                                                                                                                                                     |                       |                                | N/A                       |
| High Channel (926.84 MHz)                                                                                                                                                                                                                                           |                       |                                |                           |
|                                                                                                                                                                                                                                                                     | Pulse Length          | 0.313                          | N/A                       |
|                                                                                                                                                                                                                                                                     | # of Pulses in 100 ms | 0.313                          | 9                         |
|                                                                                                                                                                                                                                                                     |                       | 48                             | 135.216                   |
|                                                                                                                                                                                                                                                                     |                       |                                | < 400                     |
|                                                                                                                                                                                                                                                                     |                       |                                | N/A                       |
| LoRa, 3516 bps                                                                                                                                                                                                                                                      |                       |                                |                           |
| Low Channel (903.08 MHz)                                                                                                                                                                                                                                            |                       |                                |                           |
|                                                                                                                                                                                                                                                                     | Pulse Length          | 0.291                          | N/A                       |
|                                                                                                                                                                                                                                                                     | # of Pulses in 100 ms | 0.291                          | 9                         |
|                                                                                                                                                                                                                                                                     |                       | 48                             | 125.712                   |
|                                                                                                                                                                                                                                                                     |                       |                                | < 400                     |
|                                                                                                                                                                                                                                                                     |                       |                                | N/A                       |
| High Channel (926.84 MHz)                                                                                                                                                                                                                                           |                       |                                |                           |
|                                                                                                                                                                                                                                                                     | Pulse Length          | 0.311                          | N/A                       |
|                                                                                                                                                                                                                                                                     | # of Pulses in 100 ms | 0.311                          | 9                         |
|                                                                                                                                                                                                                                                                     |                       | 48                             | 134.352                   |
|                                                                                                                                                                                                                                                                     |                       |                                | < 400                     |
|                                                                                                                                                                                                                                                                     |                       |                                | N/A                       |
| LoRa, 37500 bps                                                                                                                                                                                                                                                     |                       |                                |                           |
| Low Channel (903.08 MHz)                                                                                                                                                                                                                                            |                       |                                |                           |
|                                                                                                                                                                                                                                                                     | Pulse Length          | 0.292                          | N/A                       |
|                                                                                                                                                                                                                                                                     | # of Pulses in 100 ms | 0.292                          | 9                         |
|                                                                                                                                                                                                                                                                     |                       | 48                             | 126.144                   |
|                                                                                                                                                                                                                                                                     |                       |                                | < 400                     |
|                                                                                                                                                                                                                                                                     |                       |                                | N/A                       |
| High Channel (926.84 MHz)                                                                                                                                                                                                                                           |                       |                                |                           |
|                                                                                                                                                                                                                                                                     | Pulse Length          | 0.315                          | N/A                       |
|                                                                                                                                                                                                                                                                     | # of Pulses in 100 ms | 0.315                          | 9                         |
|                                                                                                                                                                                                                                                                     |                       | 48                             | 136.08                    |
|                                                                                                                                                                                                                                                                     |                       |                                | < 400                     |
|                                                                                                                                                                                                                                                                     |                       |                                | N/A                       |

# DWELL TIME

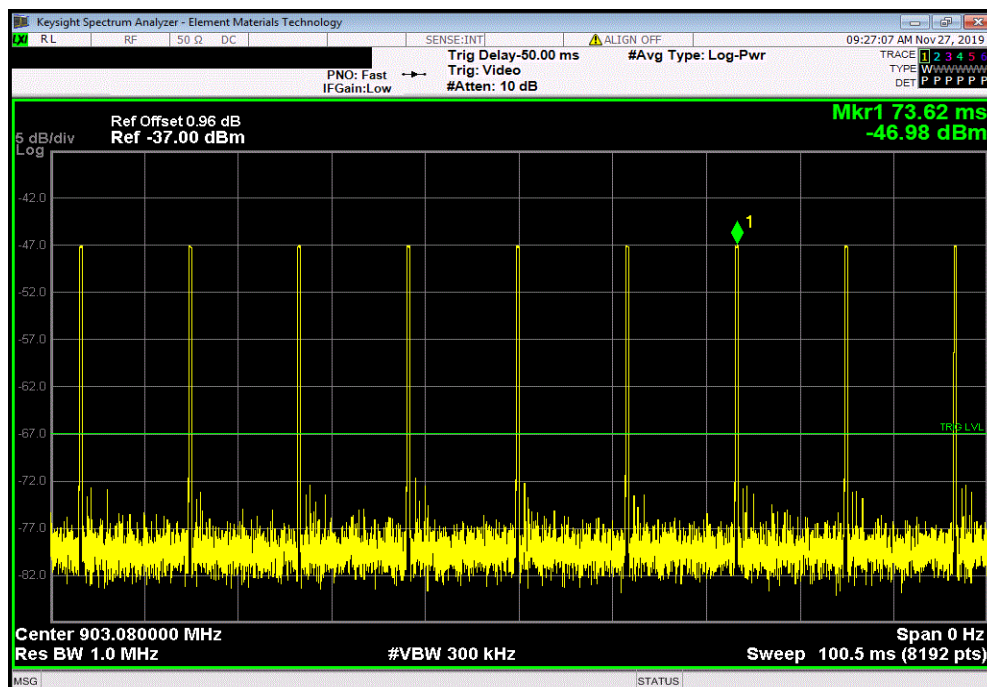


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| Hopping Mode (All Channels), LoRa, 293 bps, Low Channel (903.08 MHz), Pulse Length |                  |              |                           |            |        |  |
|------------------------------------------------------------------------------------|------------------|--------------|---------------------------|------------|--------|--|
| 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    |  |

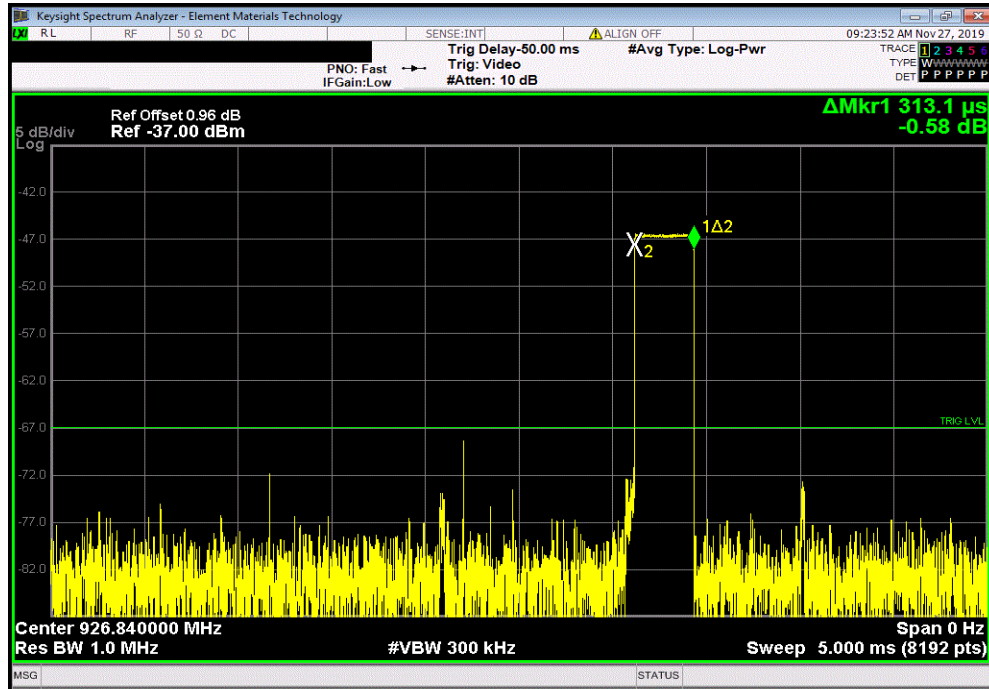


| Hopping Mode (All Channels), LoRa, 293 bps, Low Channel (903.08 MHz), # of Pulses in 100 ms |                  |              |                           |            |        |  |
|---------------------------------------------------------------------------------------------|------------------|--------------|---------------------------|------------|--------|--|
| 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   |  |

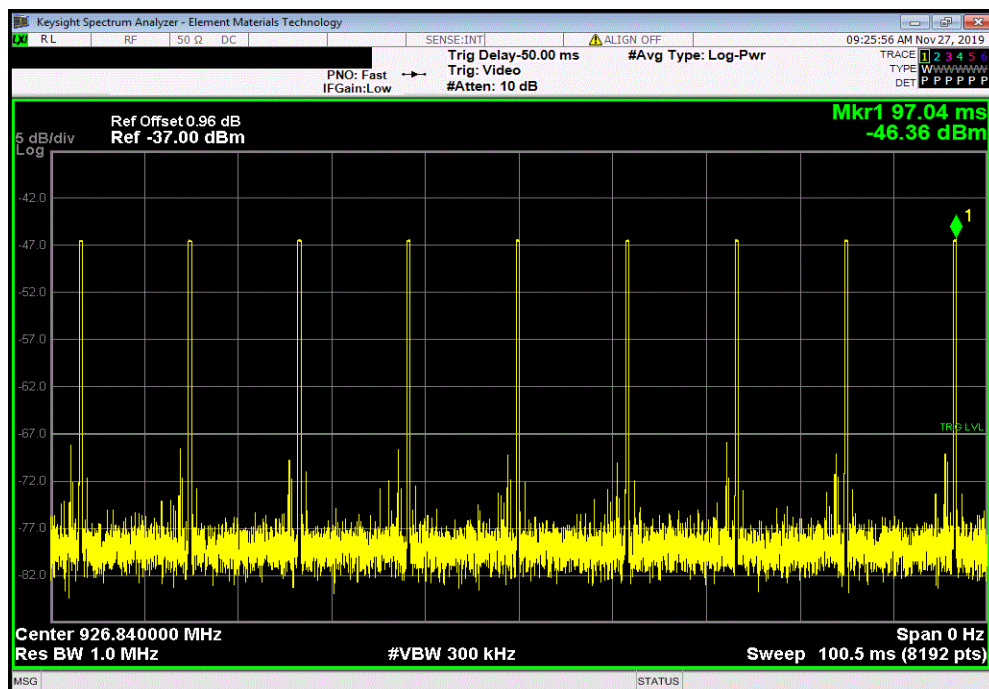


# DWELL TIME

| 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    |  |

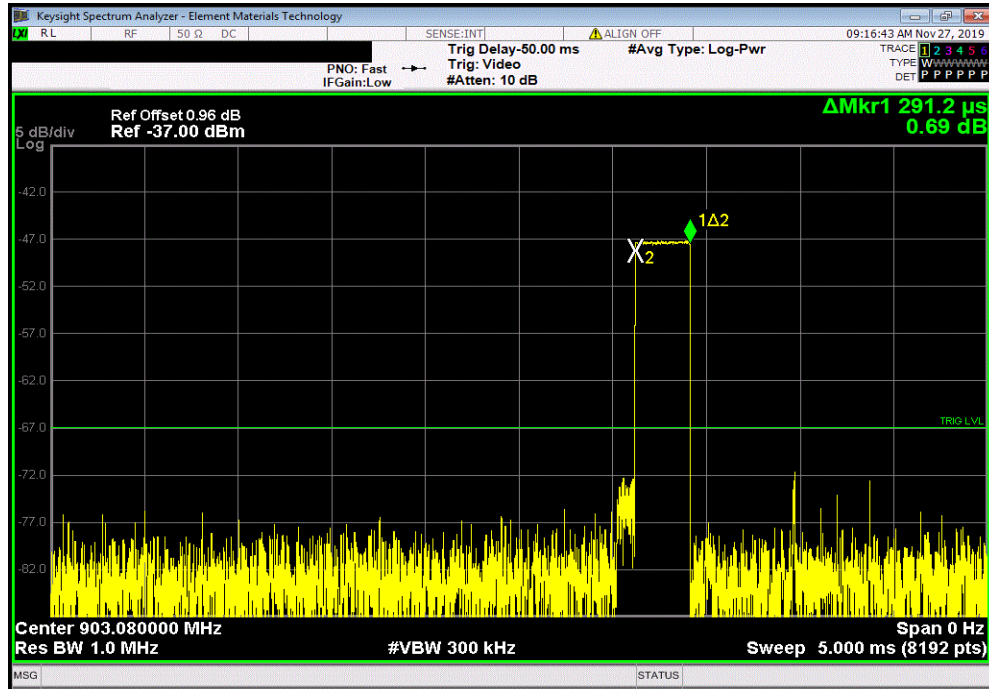


| Hopping Mode (All Channels), LoRa, 293 bps, High Channel (926.84 MHz), # of Pulses in 100 ms |                  |              |                           |            |        |  |
|----------------------------------------------------------------------------------------------|------------------|--------------|---------------------------|------------|--------|--|
| 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   |  |

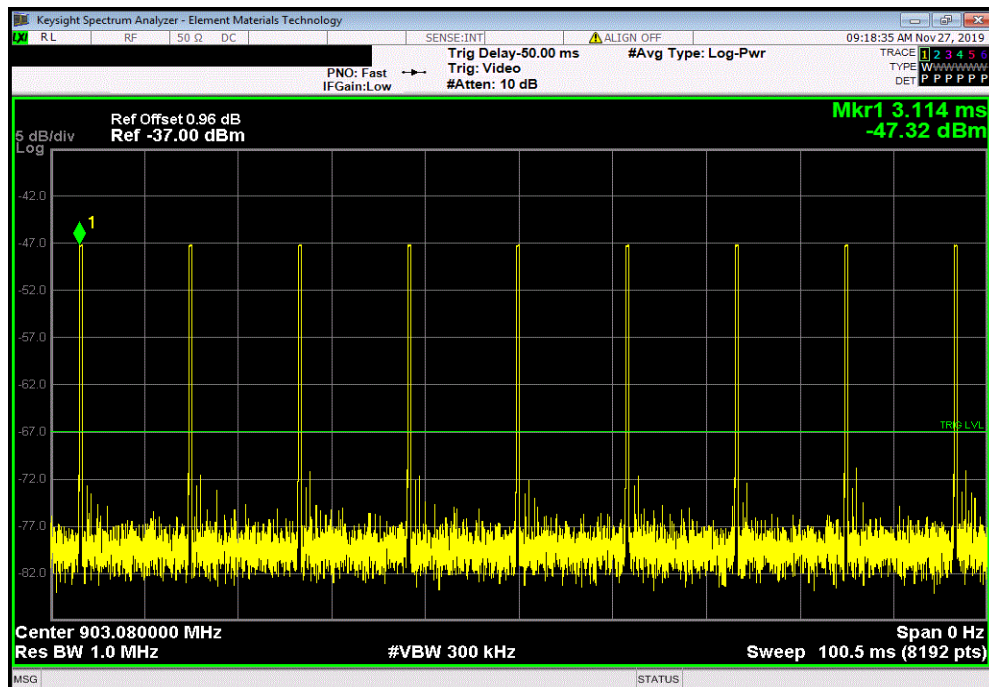


# DWELL TIME

| 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   |  |

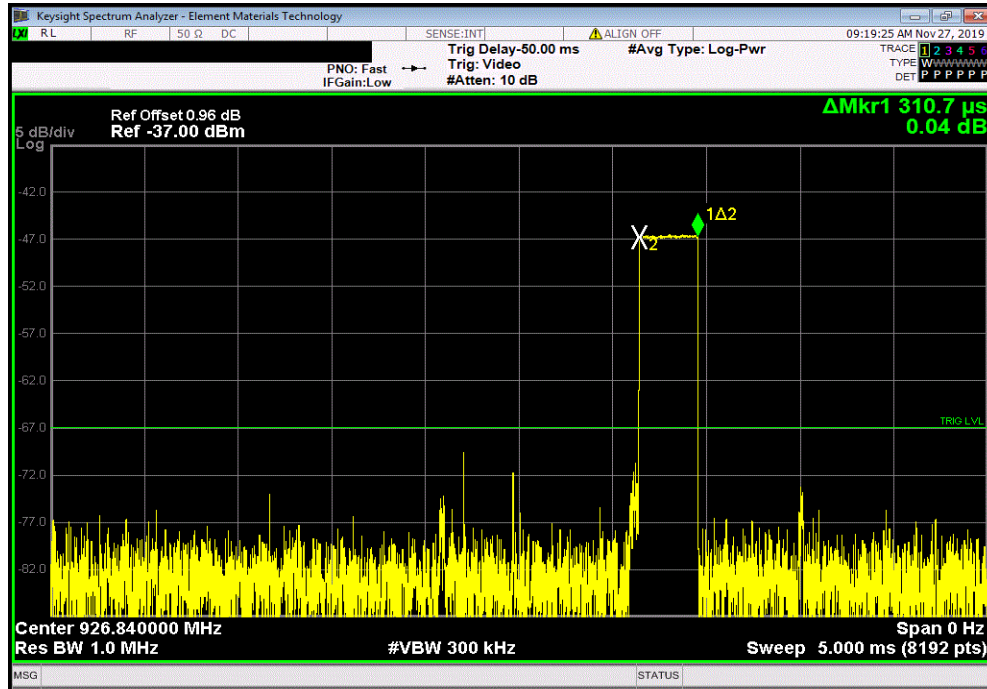


# DWELL TIME

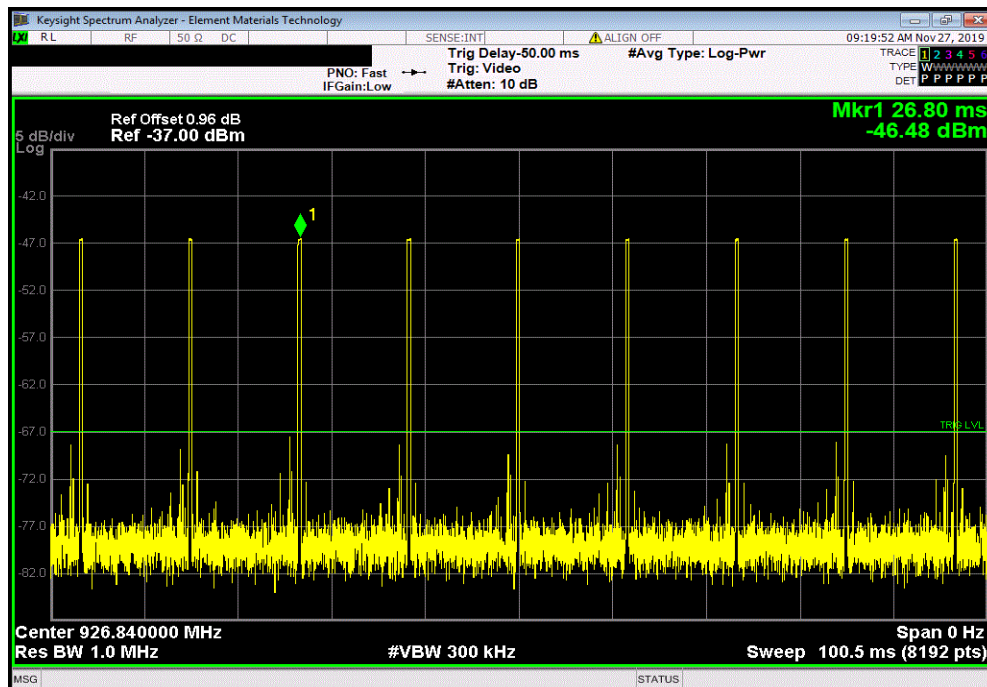


XMI 2019.09.05

| 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   |  |

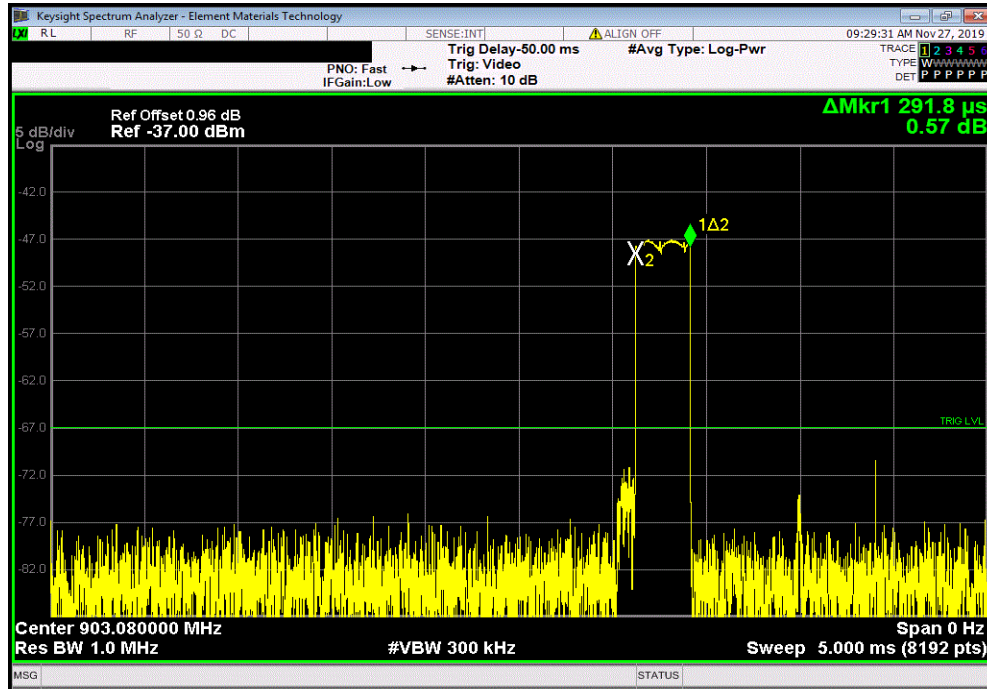


# DWELL TIME

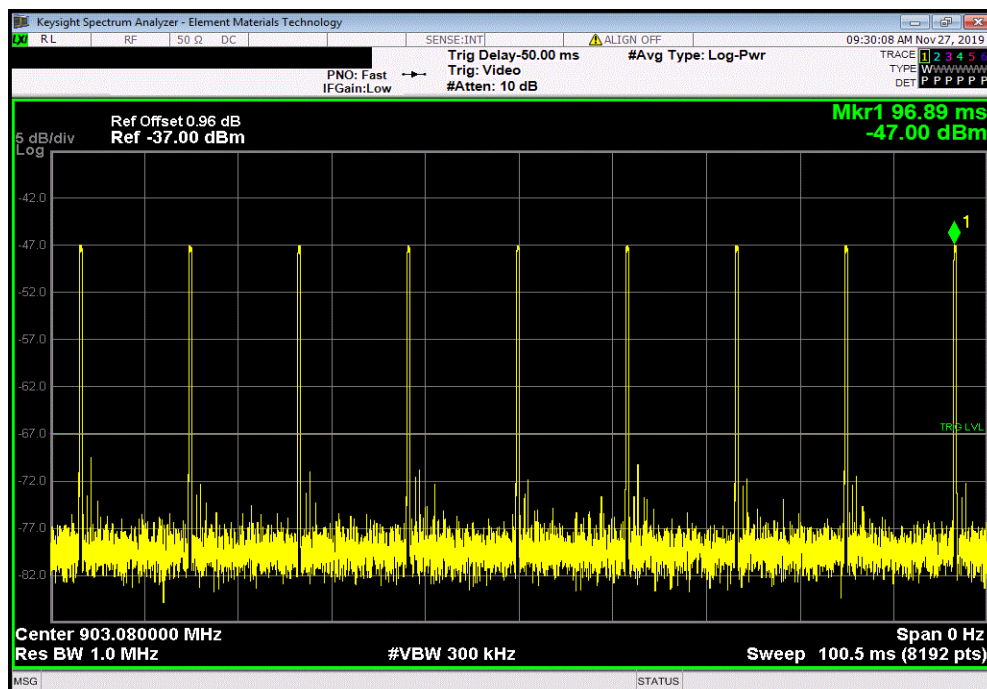


XMI 2019.09.05

| 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   |  |

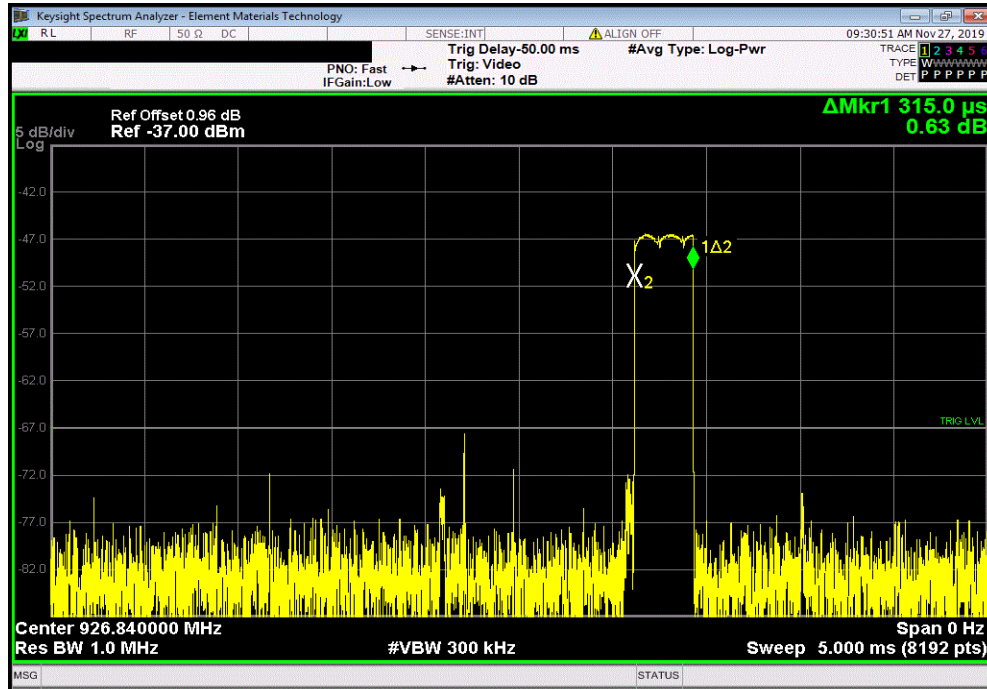


# DWELL TIME

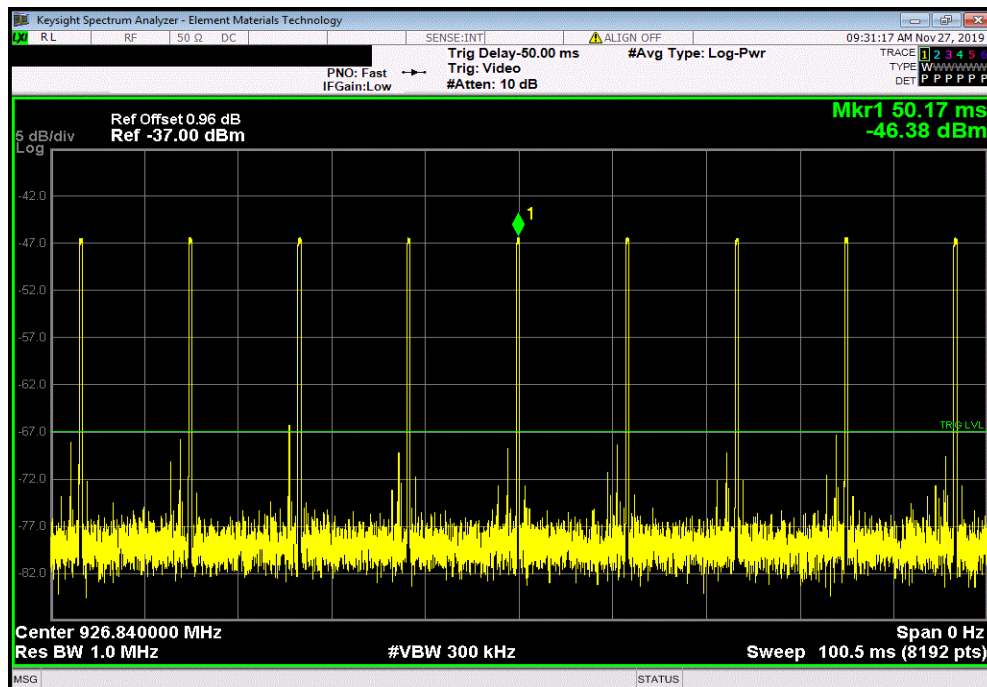


XMI 2019.09.05

| 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    |  |



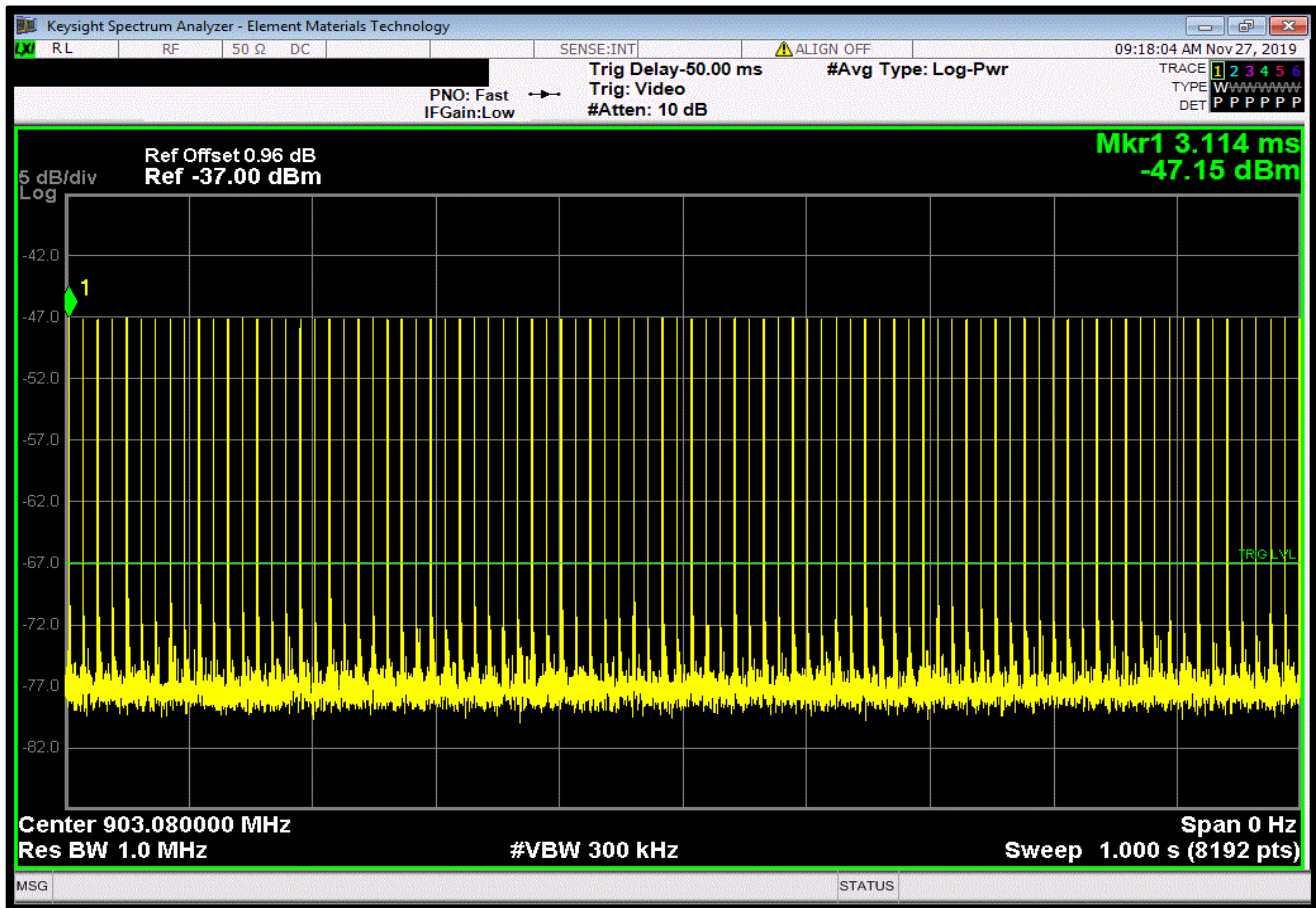
| Hopping Mode (All Channels), LoRa, 37500 bps, High Channel (926.84 MHz), # of Pulses in 100 ms |                  |              |                           |            |        |  |
|------------------------------------------------------------------------------------------------|------------------|--------------|---------------------------|------------|--------|--|
| 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

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 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



TMTx 2019.08.30.0 XMt 2019.09.05

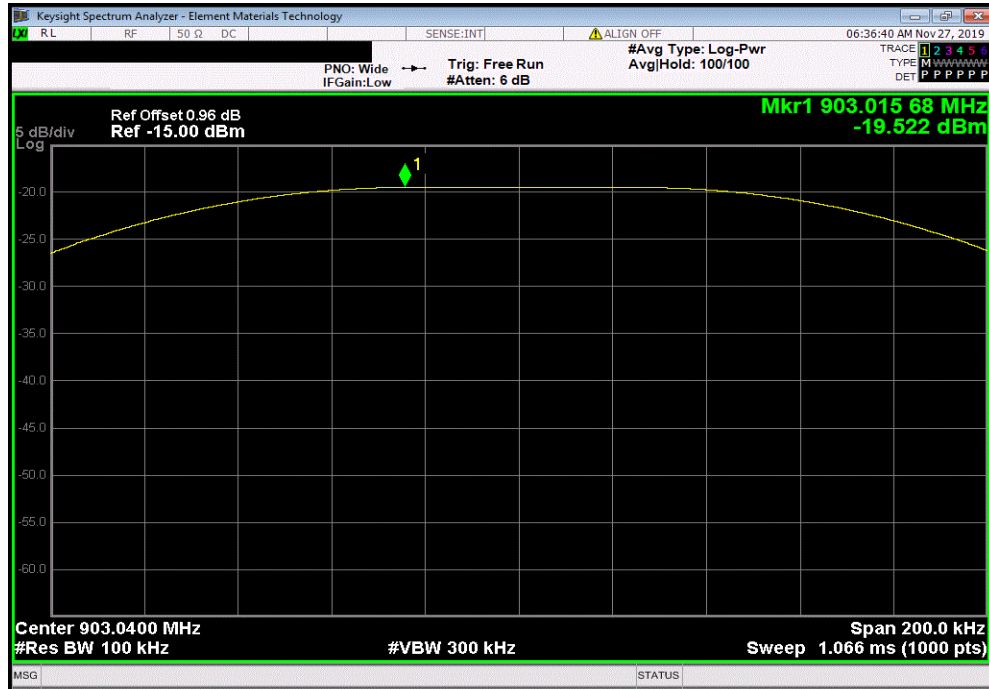
|                                                                                                                                                          |           |                                |             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------------------------|-------------|
| 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 <i>Dustin Sparks</i> |             |
|                                                                                                                                                          |           | Out Pwr (dBm)                  | Limit (dBm) |
| LoRa, 902-928 MHz                                                                                                                                        |           |                                |             |
| Low Channel, 903.08 MHz                                                                                                                                  |           |                                |             |
|                                                                                                                                                          | 293 bps   | -19.5                          | 30          |
|                                                                                                                                                          | 3516 bps  | -19.4                          | 30          |
|                                                                                                                                                          | 37500 bps | -19.5                          | 30          |
| Mid Channel, 915 MHz                                                                                                                                     |           |                                |             |
|                                                                                                                                                          | 293 bps   | -20.1                          | 30          |
|                                                                                                                                                          | 3516 bps  | -20.0                          | 30          |
|                                                                                                                                                          | 37500 bps | -20.2                          | 30          |
| High Channel, 926.84 MHz                                                                                                                                 |           |                                |             |
|                                                                                                                                                          | 293 bps   | -20.1                          | 30          |
|                                                                                                                                                          | 3516 bps  | -20.0                          | 30          |
|                                                                                                                                                          | 37500 bps | -20.1                          | 30          |

# OUTPUT POWER

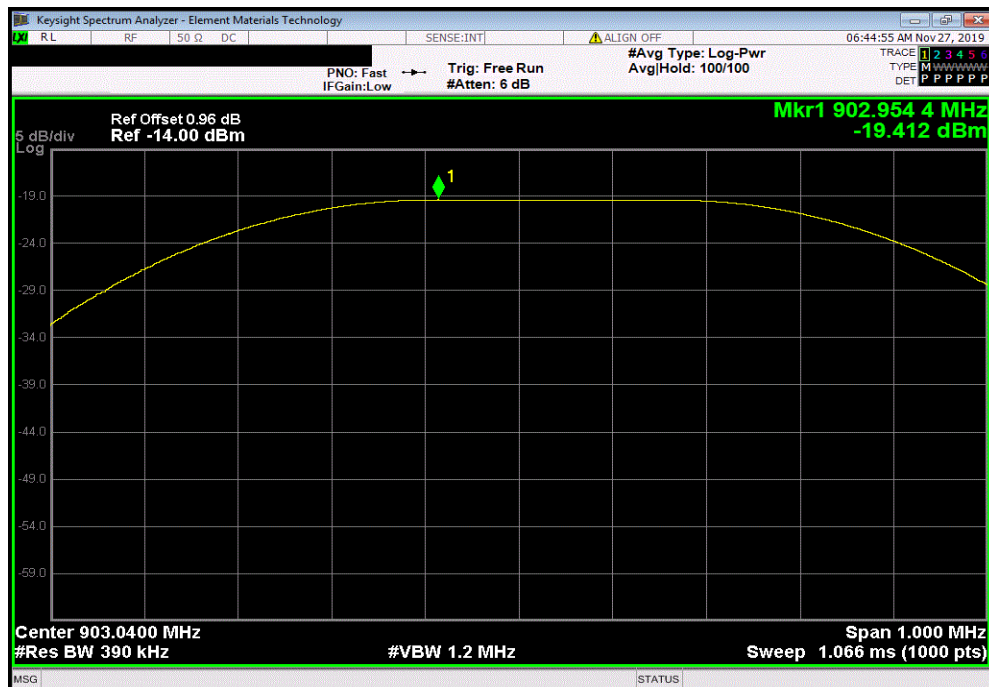


TbTx 2019.08.30.0 XMI 2019.09.05

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



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

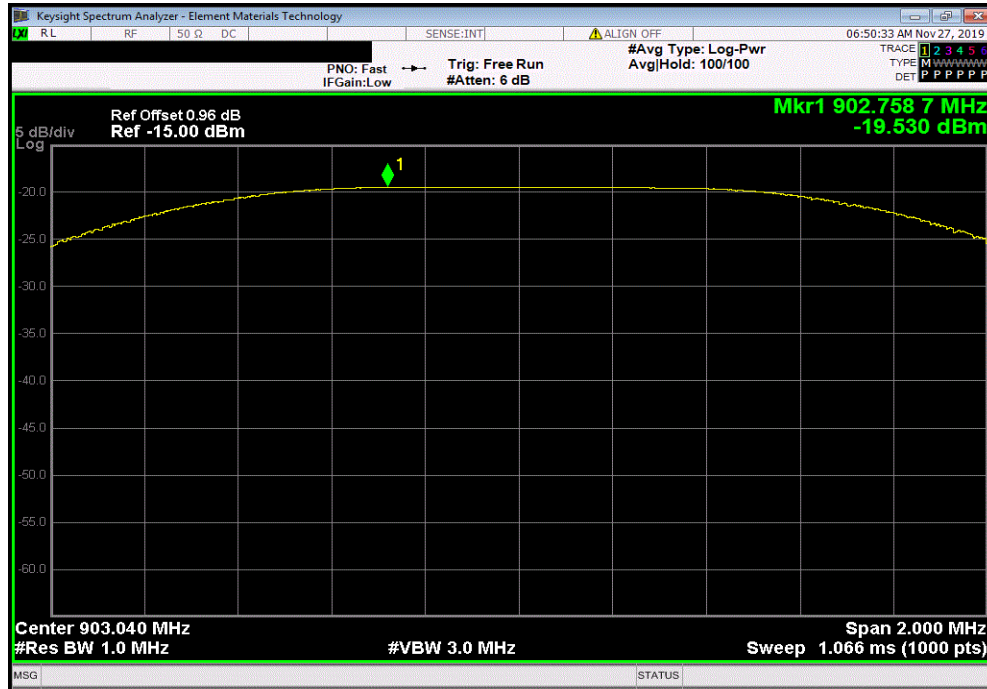


# OUTPUT POWER

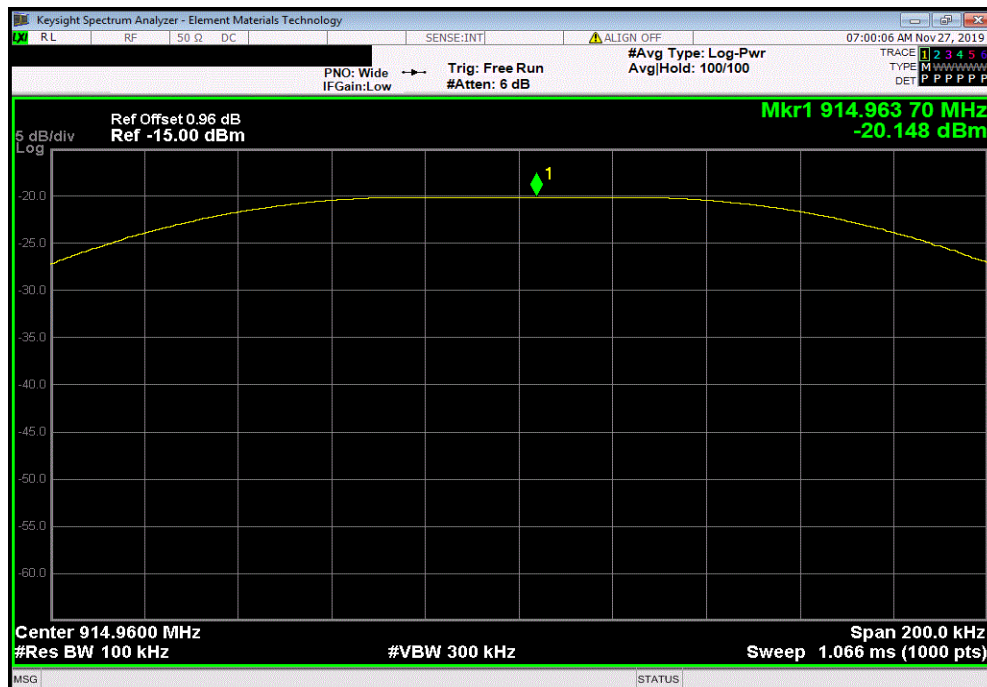


TbTtx 2019.08.30.0 XMI 2019.09.05

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



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

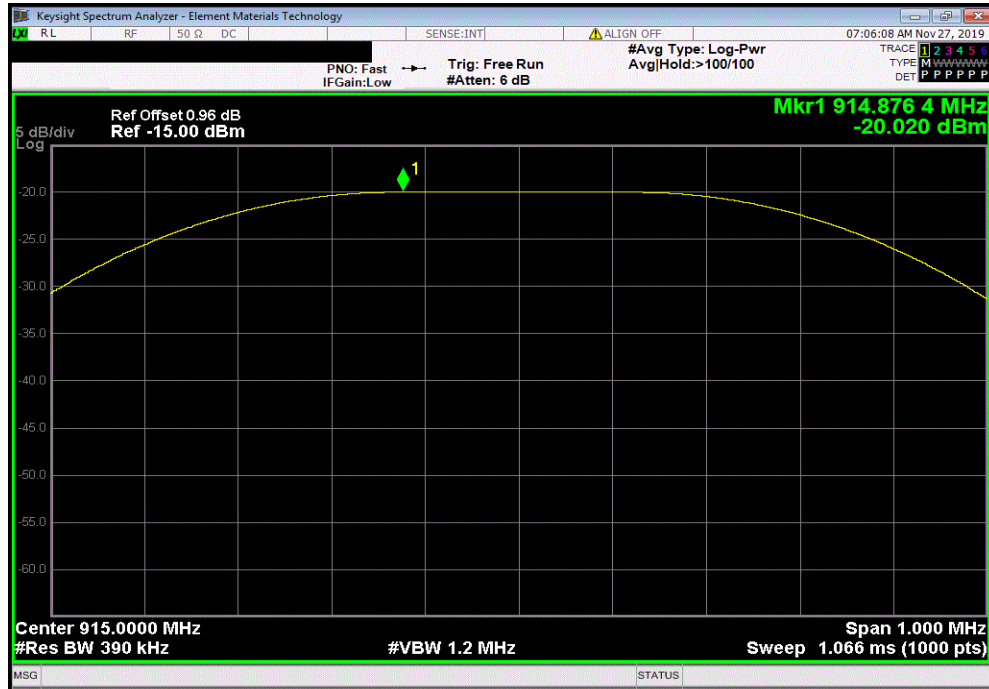


# OUTPUT POWER

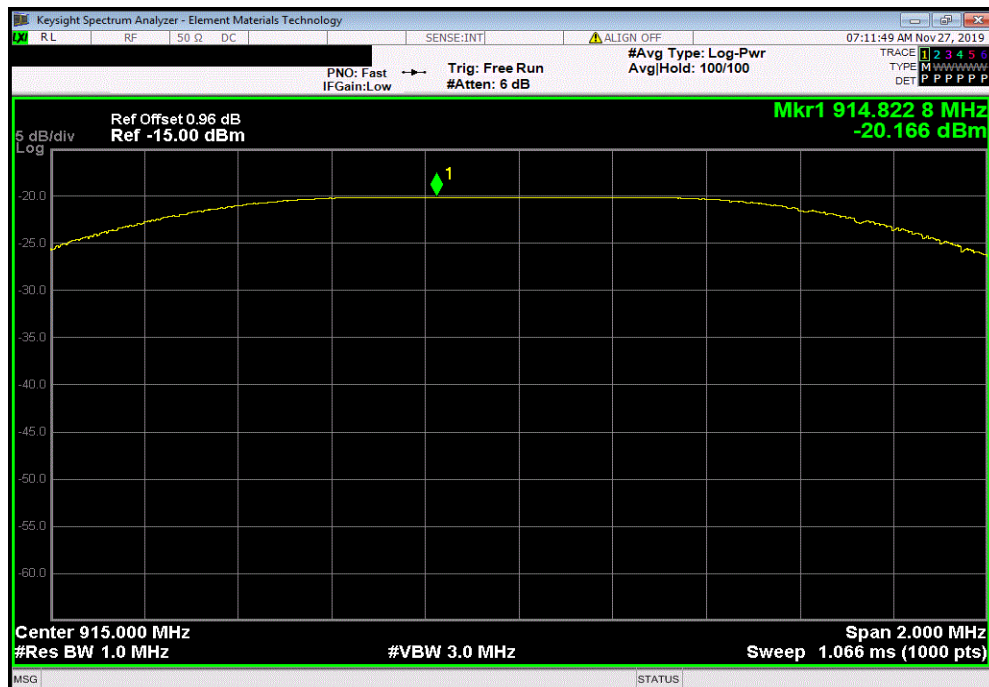


TbTtx 2019.08.30.0 XMI 2019.09.05

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



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

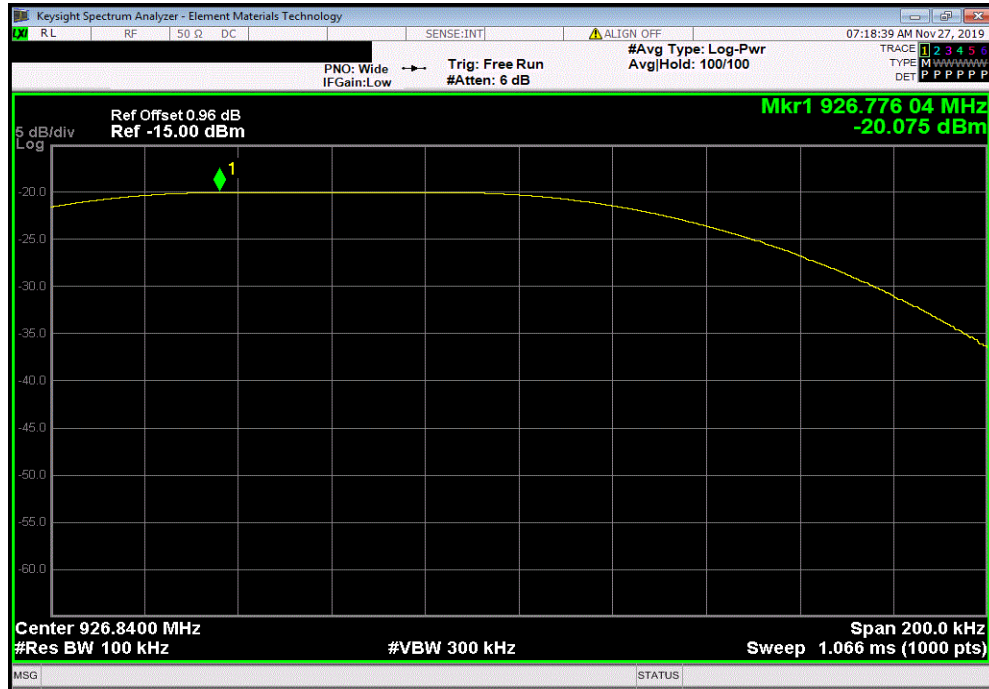


# OUTPUT POWER

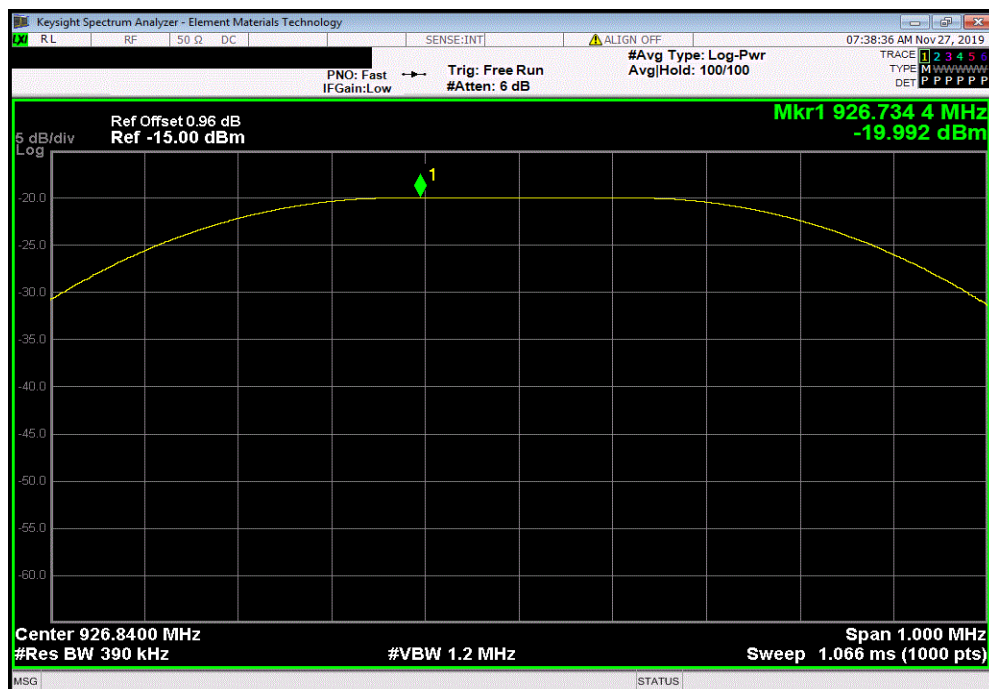


TbTx 2019.08.30.0 XMI 2019.09.05

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



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

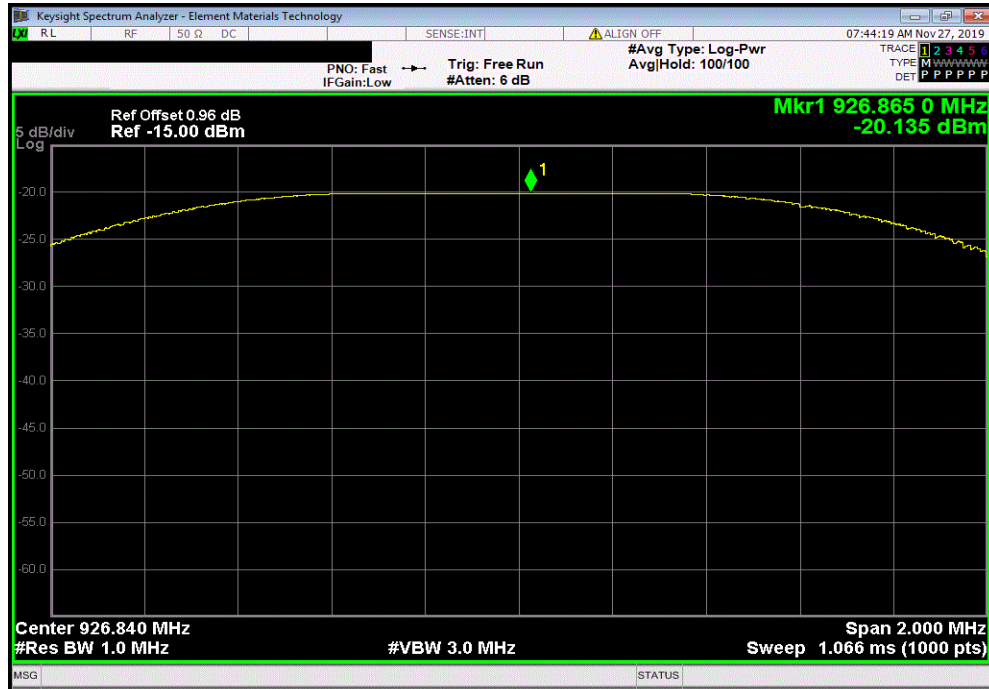


# OUTPUT POWER



TbTx 2019.08.30.0 XMI 2019.09.05

| 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



XMR 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 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



TMTx 2019.08.30.0 XMI 2019.09.05

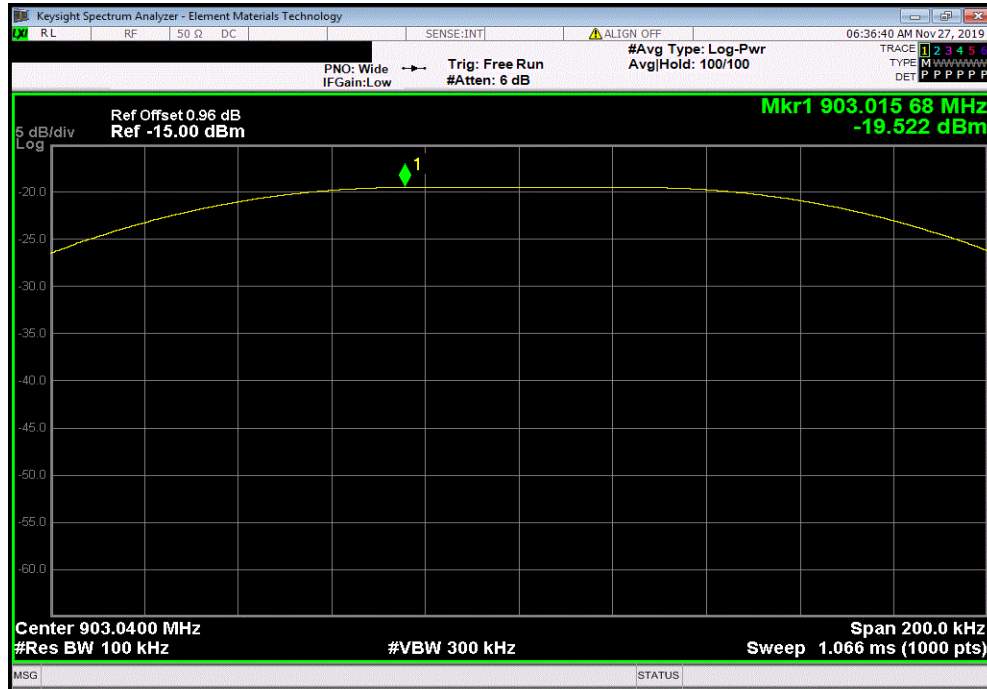
|                                                                                                                                                          |           |                                |                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------------------------|--------------------|
| 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 <i>Dustin Sparks</i> |                    |
|                                                                                                                                                          |           | 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                |
|                                                                                                                                                          | 3516 bps  | -19.412                        | 2.9                |
|                                                                                                                                                          | 37500 bps | -19.53                         | 2.9                |
| Mid Channel, 915 MHz                                                                                                                                     |           |                                |                    |
|                                                                                                                                                          | 293 bps   | -20.148                        | 2.9                |
|                                                                                                                                                          | 3516 bps  | -20.02                         | 2.9                |
|                                                                                                                                                          | 37500 bps | -20.166                        | 2.9                |
| High Channel, 926.84 MHz                                                                                                                                 |           |                                |                    |
|                                                                                                                                                          | 293 bps   | -20.075                        | 2.9                |
|                                                                                                                                                          | 3516 bps  | -19.992                        | 2.9                |
|                                                                                                                                                          | 37500 bps | -20.135                        | 2.9                |

# EQUIVALENT ISOTROPIC RADIATED POWER

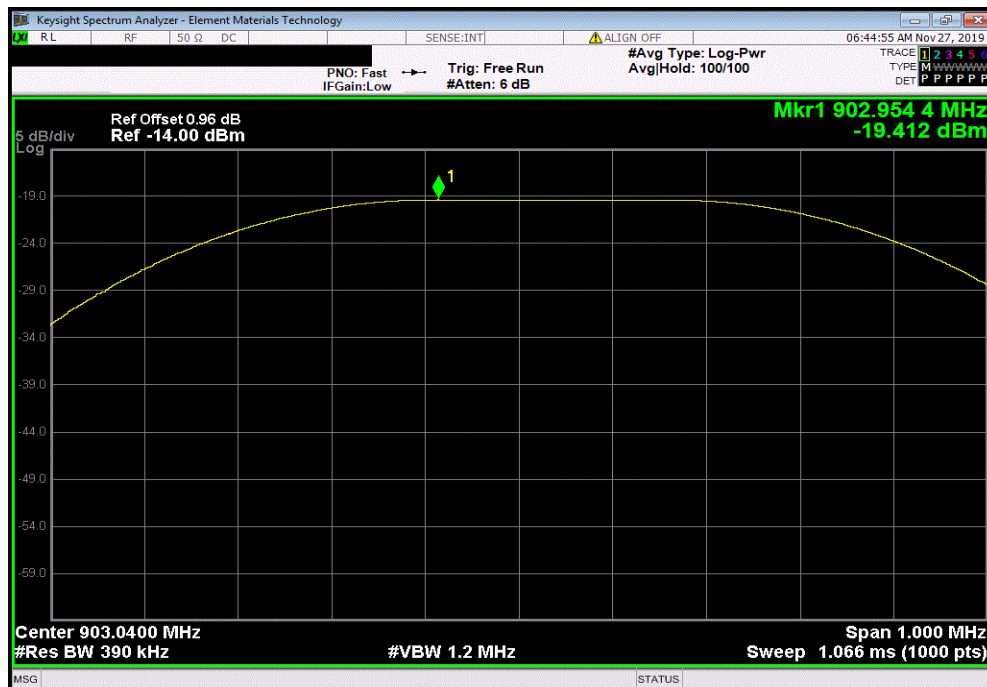


TbTx 2019.08.30.0 XMI 2019.09.05

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



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

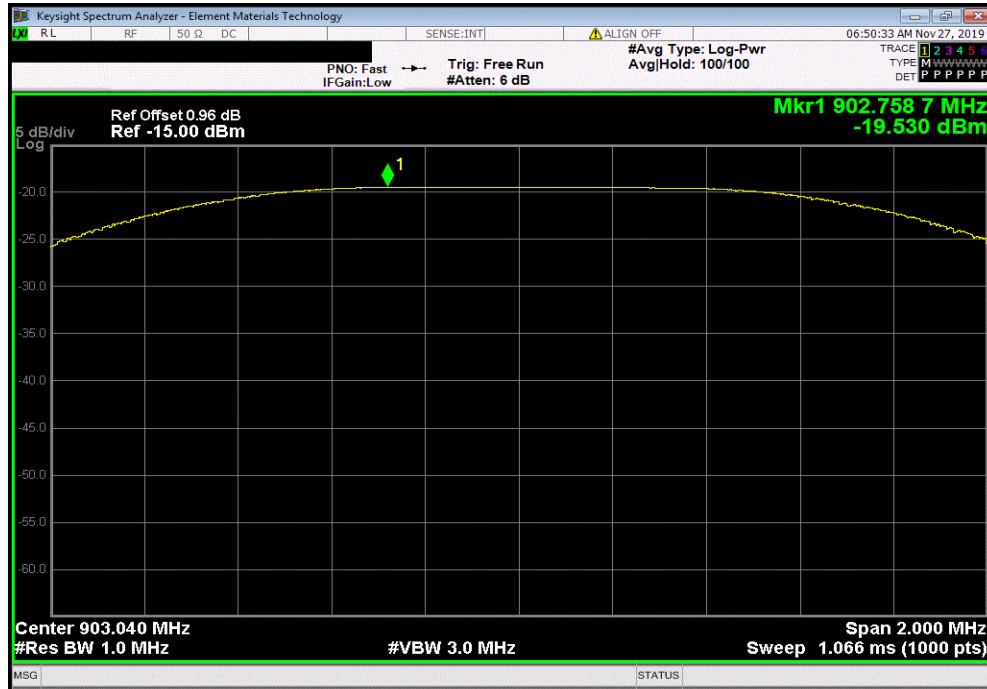


# EQUIVALENT ISOTROPIC RADIATED POWER

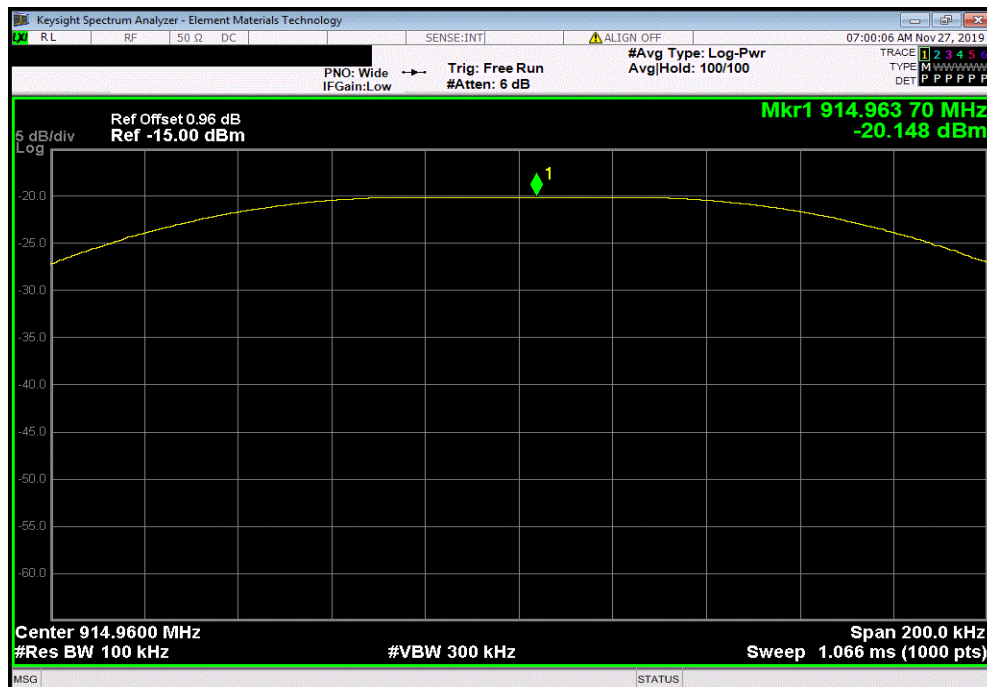


TbTx 2019.08.30.0 XMI 2019.09.05

| 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   |  |

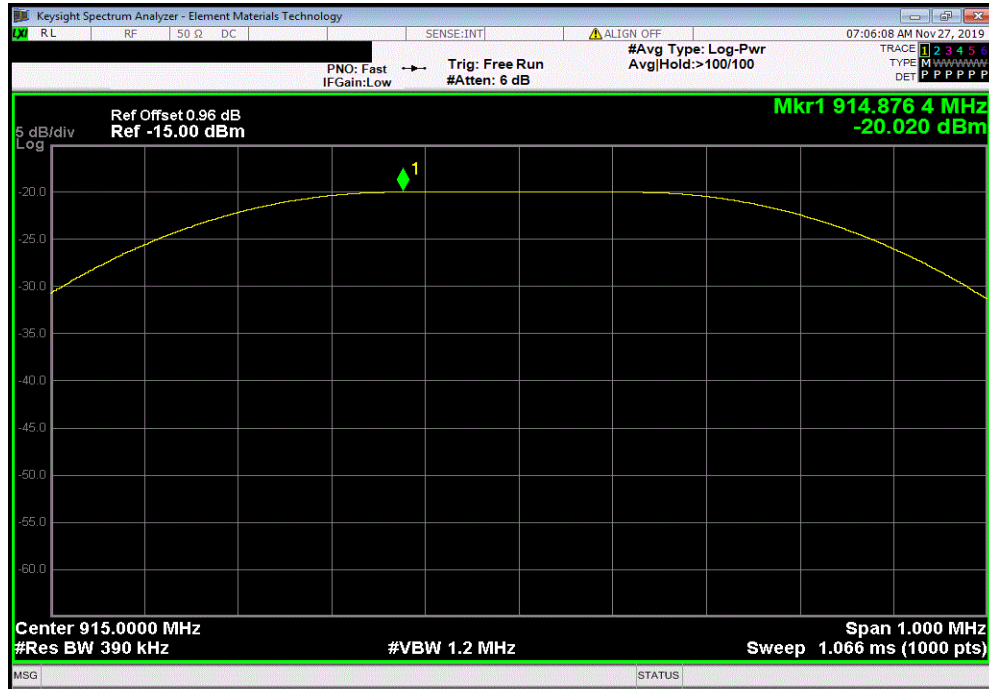


# EQUIVALENT ISOTROPIC RADIATED POWER

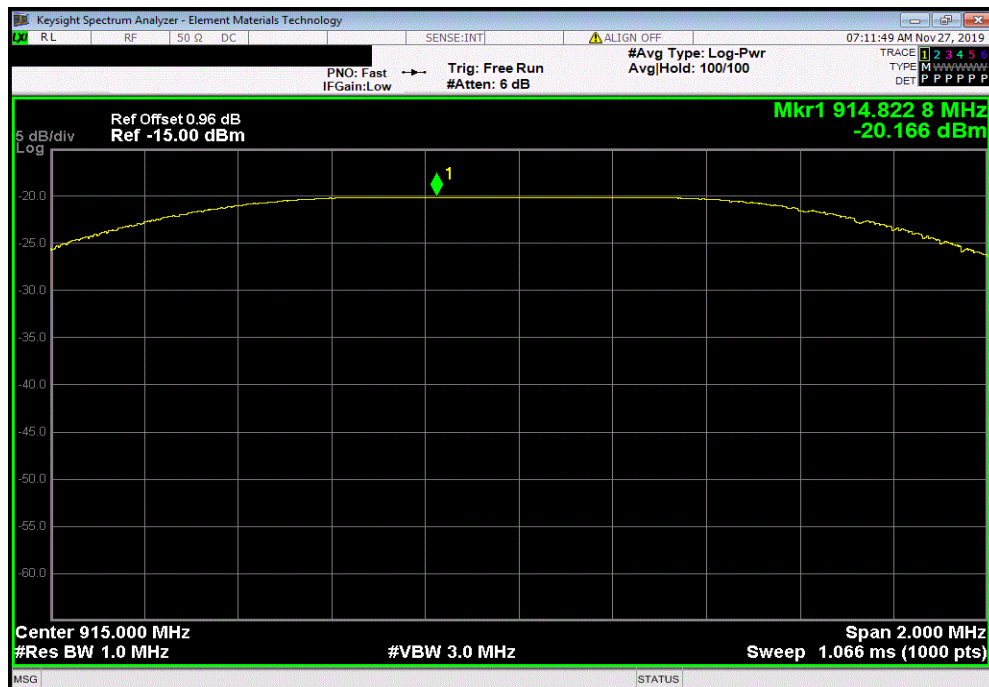


TbTx 2019.08.30.0 XMI 2019.09.05

| 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   |  |

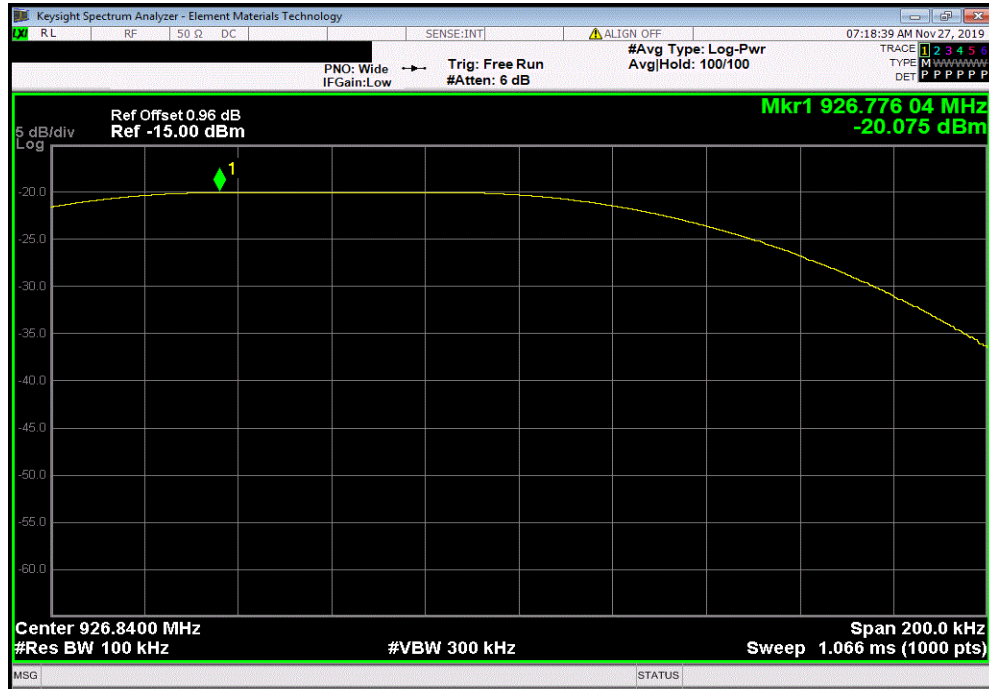


# EQUIVALENT ISOTROPIC RADIATED POWER

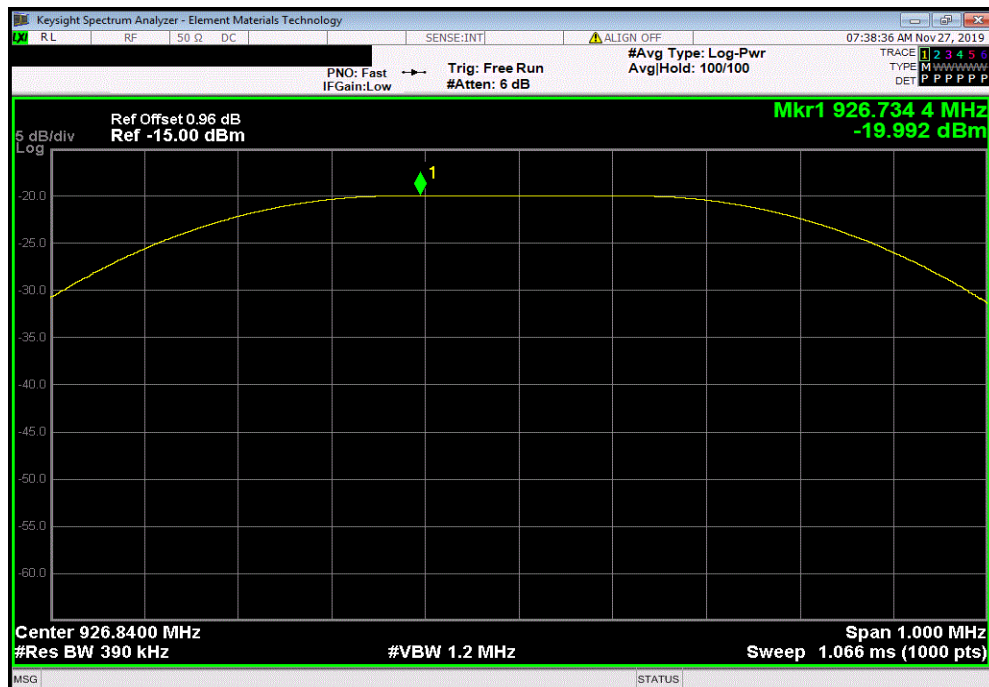


TbTx 2019.08.30.0 XMI 2019.09.05

| 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



TbTtx 2019.08.30.0 XMI 2019.09.05

| LoRa, 902-928 MHz, High Channel, 926.84 MHz, 37500 bps |                       |               |                     |        |  |
|--------------------------------------------------------|-----------------------|---------------|---------------------|--------|--|
| Out Pwr<br>(dBm)                                       | Antenna<br>Gain (dBi) | EIRP<br>(dBm) | EIRP Limit<br>(dBm) | Result |  |
| -20.135                                                | 2,9                   | -17.235       | 36                  | Pass   |  |

