

# NORTHWEST EMC

## Multi-Tech Systems

MTAC-Lora-915

FCC 15.247:2015

Report # MLTI0043



NVLAP Lab Code: 201049-0

*This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government of the United States of America. This Report may only be duplicated in its entirety*

# CERTIFICATE OF TEST

**Last Date of Test: May 18, 2015**  
**Multi-Tech Systems**  
**Model: MTAC-Lora-915**

## Radio Equipment Testing

### Standards

| Specification   | Method           |
|-----------------|------------------|
| FCC 15.247:2015 | ANSI C63.10:2009 |

### Results

| Method Clause | Test Description              | Applied | Results | Comments                                   |
|---------------|-------------------------------|---------|---------|--------------------------------------------|
| 7.5           | Duty Cycle                    | No      | N/A     | Not required for class 2 permissive change |
| 6.9.1         | Occupied Bandwidth            | No      | N/A     | Not required for class 2 permissive change |
| 6.10.2        | Output Power                  | Yes     | Pass    |                                            |
| 6.11.2        | Power Spectral Density        | Yes     | Pass    |                                            |
| 6.7           | Band Edge Compliance          | Yes     | Pass    |                                            |
| 6.7           | Spurious Conducted Emissions  | Yes     | Pass    |                                            |
| 6.5, 6.6      | Spurious Radiated Emissions   | Yes     | Pass    |                                            |
| 6.2           | Powerline Conducted Emissions | No      | N/A     | Not required for class 2 permissive change |

### Deviations From Test Standards

None

### Approved By:



Jeremiah Darden, Operations Manager

*Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test.*

# REVISION HISTORY

| Revision Number |  | Description | Date | 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 Northwest EMC to certify transmitters to FCC and IC specifications.

**NVLAP** - Each laboratory is accredited by NVLAP to ISO 17025

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## Canada

**IC** - Recognized by Industry Canada as a Certification Body (CB). Certification chambers and Open Area Test Sites are filed with IC.

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## European Union

**European Commission** – Validated by the European Commission as a Conformity Assessment Body (CAB) under the EMC directive and as a Notified Body under the R&TTE Directive.

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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

**MSIP / 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:

<http://www.nwemc.com/accreditations/>  
<http://gsi.nist.gov/global/docs/cabs/designations.html>

# 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 WP 342. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) for each test is on each data sheet. 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.

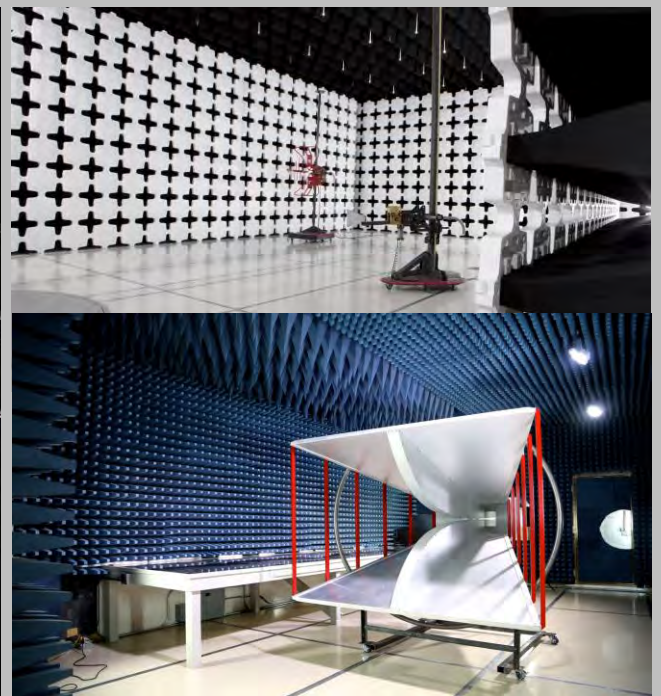
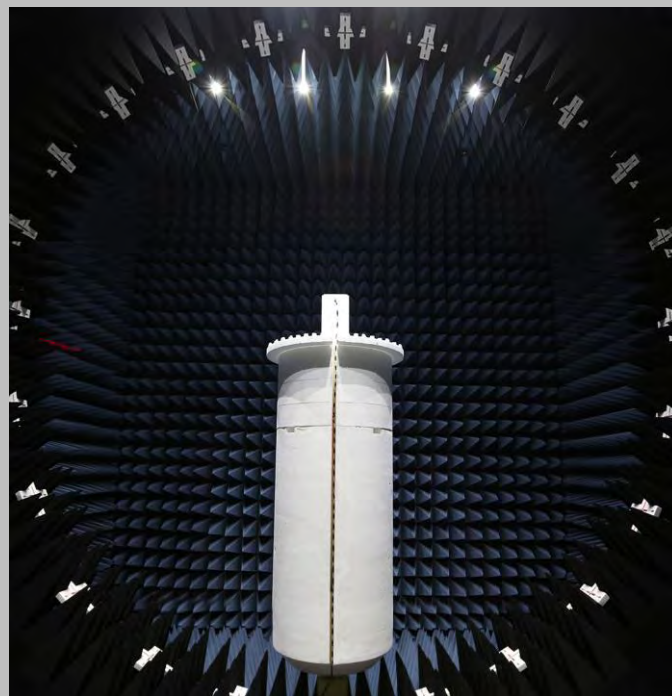
The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

| <b>Test</b>                           | <b>+ MU</b> | <b>- MU</b> |
|---------------------------------------|-------------|-------------|
| Frequency Accuracy (Hz)               | 0.0007%     | -0.0007%    |
| Amplitude Accuracy (dB)               | 1.2 dB      | -1.2 dB     |
| Conducted Power (dB)                  | 0.3 dB      | -0.3 dB     |
| Radiated Power via Substitution (dB)  | 0.7 dB      | -0.7 dB     |
| Temperature (degrees C)               | 0.7°C       | -0.7°C      |
| Humidity (% RH)                       | 2.5% RH     | -2.5% RH    |
| Voltage (AC)                          | 1.0%        | -1.0%       |
| Voltage (DC)                          | 0.7%        | -0.7%       |
| Field Strength (dB)                   | 4.7 dB      | -4.7 dB     |
| AC Powerline Conducted Emissions (dB) | 2.9 dB      | -2.9 dB     |

# FACILITIES



|                                                                                     |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                          |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <b>California</b><br>Labs OC01-13<br>41 Tesla<br>Irvine, CA 92618<br>(949) 861-8918 | <b>Minnesota</b><br>Labs MN01-08, MN10<br>9349 W Broadway Ave.<br>Brooklyn Park, MN 55445<br>(612)-638-5136 | <b>New York</b><br>Labs NY01-04<br>4939 Jordan Rd.<br>Elbridge, NY 13060<br>(315) 554-8214 | <b>Oregon</b><br>Labs EV01-12<br>22975 NW Evergreen Pkwy<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 9801<br>(425)984-6600 |
| <b>NVLAP</b>                                                                        |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                          |
| NVLAP Lab Code: 200676-0                                                            | NVLAP Lab Code: 200881-0                                                                                    | NVLAP Lab Code: 200761-0                                                                   | NVLAP Lab Code: 200630-0                                                                          | NVLAP Lab Code:201049-0                                                                | NVLAP Lab Code: 200629-0                                                                                 |
| <b>Industry Canada</b>                                                              |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                          |
| 2834B-1, 2834B-3                                                                    | 2834E-1                                                                                                     | N/A                                                                                        | 2834D-1, 2834D-2                                                                                  | 2834G-1                                                                                | 2834F-1                                                                                                  |
| <b>BSMI</b>                                                                         |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                          |
| SL2-IN-E-1154R                                                                      | SL2-IN-E-1152R                                                                                              | N/A                                                                                        | SL2-IN-E-1017                                                                                     | SL2-IN-E-1158R                                                                         | SL2-IN-E-1153R                                                                                           |
| <b>VCCI</b>                                                                         |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                          |
| A-0029                                                                              | A-0109                                                                                                      | N/A                                                                                        | A-0108                                                                                            | A-0201                                                                                 | A-0110                                                                                                   |
| <b>Recognized Phase I CAB for ACMA, BSMI, IDA, KCC/RRR, MIC, MOC, NCC, OFCA</b>     |                                                                                                             |                                                                                            |                                                                                                   |                                                                                        |                                                                                                          |
| US0158                                                                              | US0175                                                                                                      | N/A                                                                                        | US0017                                                                                            | US0191                                                                                 | US0157                                                                                                   |



# PRODUCT DESCRIPTION

## Client and Equipment Under Test (EUT) Information

|                                 |                       |
|---------------------------------|-----------------------|
| <b>Company Name:</b>            | Multi-Tech Systems    |
| <b>Address:</b>                 | 2205 Woodale Drive    |
| <b>City, State, Zip:</b>        | Mounds View, MN 55112 |
| <b>Test Requested By:</b>       | Bud Sundeen           |
| <b>Model:</b>                   | MTAC-Lora-915         |
| <b>First Date of Test:</b>      | May 18, 2015          |
| <b>Last Date of Test:</b>       | May 18, 2015          |
| <b>Receipt Date of Samples:</b> | May 18, 2015          |
| <b>Equipment Design Stage:</b>  | Prototype             |
| <b>Equipment Condition:</b>     | No Damage             |

## Information Provided by the Party Requesting the Test

|                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Functional Description of the EUT:</b>                                                                                                                              |
| Lora Gateway Accessory Card                                                                                                                                            |
| <b>Testing Objective:</b>                                                                                                                                              |
| To demonstrate compliance of the change of the high channel and show compliance to FCC 15.247 requirements for a Class II Permissive change on FCC ID: AU792U13A16856. |

# CONFIGURATIONS

## Configuration MLTI0043- 1

| EUT                                |         |                    |         |                               |                                   |
|------------------------------------|---------|--------------------|---------|-------------------------------|-----------------------------------|
| Description                        |         | Manufacturer       |         | Model/Part Number             | Serial Number                     |
| MTAC-Lora                          |         | Multi-Tech Systems |         | MTAC-LORA-915                 | None                              |
|                                    |         |                    |         |                               |                                   |
| Peripherals in test setup boundary |         |                    |         |                               |                                   |
| Description                        |         | Manufacturer       |         | Model/Part Number             | Serial Number                     |
| Laptop Computer                    |         | Hewlett Packard    |         | Bres2-29-02XT                 | CNU72602XT                        |
| AC Power Adapter (for laptop)      |         | Hewlett Packard    |         | PPP014S                       | 3892A300                          |
| AC Power Adapter (for controller)  |         | GobTek             |         | 01006610L                     | None                              |
| Controller                         |         | Multi-Tech Systems |         | MTCDT-H5                      | 18062244                          |
|                                    |         |                    |         |                               |                                   |
| Cables                             |         |                    |         |                               |                                   |
| Cable Type                         | Shield  | Length (m)         | Ferrite | Connection 1                  | Connection 2                      |
| AC Power                           | Unknown | 0.8 m              | No      | AC Power Adapter (for laptop) | AC Mains                          |
| DC Power                           | Unknown | 1.1 m              | Yes     | AC Power Adapter (for laptop) | Laptop Computer                   |
| USB Cable                          | Unknown | 1.8 m              | Yes     | Controller                    | MTAC-Lora                         |
| Ethernet Cable                     | Unknown | 1.95 m             | No      | Controller                    | Laptop Computer                   |
| DC Power                           | Unknown | 3 m                | Yes     | MTAC-Lora FCC                 | AC Power Adapter (for controller) |

## Configuration MLTI0043- 2

| EUT                                |                    |            |                   |                               |                                   |
|------------------------------------|--------------------|------------|-------------------|-------------------------------|-----------------------------------|
| Description                        | Manufacturer       |            | Model/Part Number | Serial Number                 |                                   |
| MTAC-Lora                          | Multi-Tech Systems |            | MTAC-LORA-915     | None                          |                                   |
|                                    |                    |            |                   |                               |                                   |
| Peripherals in test setup boundary |                    |            |                   |                               |                                   |
| Description                        | Manufacturer       |            | Model/Part Number | Serial Number                 |                                   |
| Laptop Computer                    | Hewlett Packard    |            | Bres2-29-02XT     | CNU72602XT                    |                                   |
| AC Power Adapter (for laptop)      | Hewlett Packard    |            | PPP014S           | 3892A300                      |                                   |
| AC Power Adapter (for controller)  | GobTek             |            | 01006610L         | None                          |                                   |
| Controller                         | Multi-Tech Systems |            | MTCDT-H5          | 18062244                      |                                   |
| Wireless External Antenna          | Pulse              |            | W1063             | None                          |                                   |
|                                    |                    |            |                   |                               |                                   |
| Cables                             |                    |            |                   |                               |                                   |
| Cable Type                         | Shield             | Length (m) | Ferrite           | Connection 1                  | Connection 2                      |
| AC Power                           | Unknown            | 0.8 m      | No                | AC Power Adapter (for laptop) | AC Mains                          |
| DC Power                           | Unknown            | 1.1 m      | Yes               | AC Power Adapter (for laptop) | Laptop Computer                   |
| USB Cable                          | Unknown            | 1.8 m      | Yes               | Controller                    | MTAC-Lora                         |
| Ethernet Cable                     | Unknown            | 1.95 m     | No                | Controller                    | Laptop Computer                   |
| DC Power                           | Unknown            | 3 m        | Yes               | MTAC-Lora FCC                 | AC Power Adapter (for controller) |

# MODIFICATIONS

## Equipment Modifications

| Item | Date      | Test                         | Modification                         | Note                                                                | Disposition of EUT                                |
|------|-----------|------------------------------|--------------------------------------|---------------------------------------------------------------------|---------------------------------------------------|
| 1    | 5/18/2015 | Power Spectral Density       | Tested as delivered to Test Station. | No EMI suppression devices were added or modified during this test. | EUT remained at Northwest EMC following the test. |
| 2    | 5/18/2015 | Band Edge Compliance         | Tested as delivered to Test Station. | No EMI suppression devices were added or modified during this test. | EUT remained at Northwest EMC following the test. |
| 3    | 5/18/2015 | Spurious Conducted Emissions | Tested as delivered to Test Station. | No EMI suppression devices were added or modified during this test. | EUT remained at Northwest EMC following the test. |
| 4    | 5/18/2015 | Spurious Radiated Emissions  | Tested as delivered to Test Station. | No EMI suppression devices were added or modified during this test. | EUT remained at Northwest EMC following the test. |
| 5    | 5/18/2015 | Output Power                 | Tested as delivered to Test Station. | No EMI suppression devices were added or modified during this test. | Scheduled testing was completed.                  |

# SPURIOUS RADIATED EMISSIONS

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

## MODES OF OPERATION

Transmitting Lora at High Channel @ 927.5 MHz.

## POWER SETTINGS INVESTIGATED

USB via 110VAC/60Hz

## CONFIGURATIONS INVESTIGATED

MLTI0043-2

## 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 |
|----------------------------------|--------------------|------------------------|-----|------------|----------|
| High Pass Filter, 2.8-18 GHz     | Micro-Tronics      | HPM50111               | HHX | 8/18/2014  | 12 mo    |
| Low Pass Filter, 0-1000 MHz      | Micro-Tronics      | LPM50004               | HHV | 8/18/2014  | 12 mo    |
| Pre-Amplifier                    | Miteq              | AMF-6F-08001200-30-10P | PAK | 10/27/2014 | 12 mo    |
| Pre-Amplifier                    | Miteq              | AMF-6F-12001800-30-10P | PAL | 10/27/2014 | 12 mo    |
| TX02 Cable                       | Northwest EMC      | 8-18GHz                | TXD | 10/27/2014 | 12 mo    |
| Pre-Amplifier                    | Miteq              | JSDQK42-18004000-60-5P | PAM | 11/21/2014 | 12 mo    |
| Cable                            | Northwest EMC      | 18-40GHz               | TXE | 11/21/2014 | 12 mo    |
| Antenna, Double Ridge Guide Horn | A.H. Systems, Inc. | SAS-574                | AXW | 4/23/2014  | 24 mo    |
| Antenna, Horn                    | ETS Lindgren       | 3160-08                | AJG | NCR        | 0 mo     |
| Antenna, Horn                    | ETS Lindgren       | 3160-07                | AJF | NCR        | 0 mo     |
| Pre-Amplifier                    | Miteq              | AMF-3D-00100800-32-13P | PAJ | 9/22/2014  | 12 mo    |
| TX02 Cable                       | Northwest EMC      | 1-8.2 GHz              | TXC | 9/22/2014  | 12 mo    |
| Antenna, Horn                    | ETS Lindgren       | 3115                   | AJL | 9/15/2014  | 24 mo    |
| Pre-Amplifier                    | Miteq              | AM-1551                | PAH | 9/13/2014  | 12 mo    |
| TX02 Cable                       | Northwest EMC      | RE 9kHz - 1GHz         | TXB | 9/22/2014  | 12 mo    |
| Attenuator                       | Fairview Microwave | SA4018-20              | TQY | 2/27/2015  | 12 mo    |
| Antenna, Biconilog               | ETS Lindgren       | 3143B                  | AYF | 4/7/2014   | 24 mo    |
| Spectrum Analyzer                | Agilent            | N9010A                 | AFL | 6/20/2014  | 12 mo    |

## TEST DESCRIPTION

The highest gain of each type of antenna to be used with the EUT was tested. The EUT was configured for the high transmit frequency. For each configuration, the spectrum was scanned throughout the specified range. In addition, measurements were made in the restricted bands to verify compliance.

While scanning, emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and the EUT antenna in three orthogonal axis, and adjusting measurement antenna height and polarization. A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.



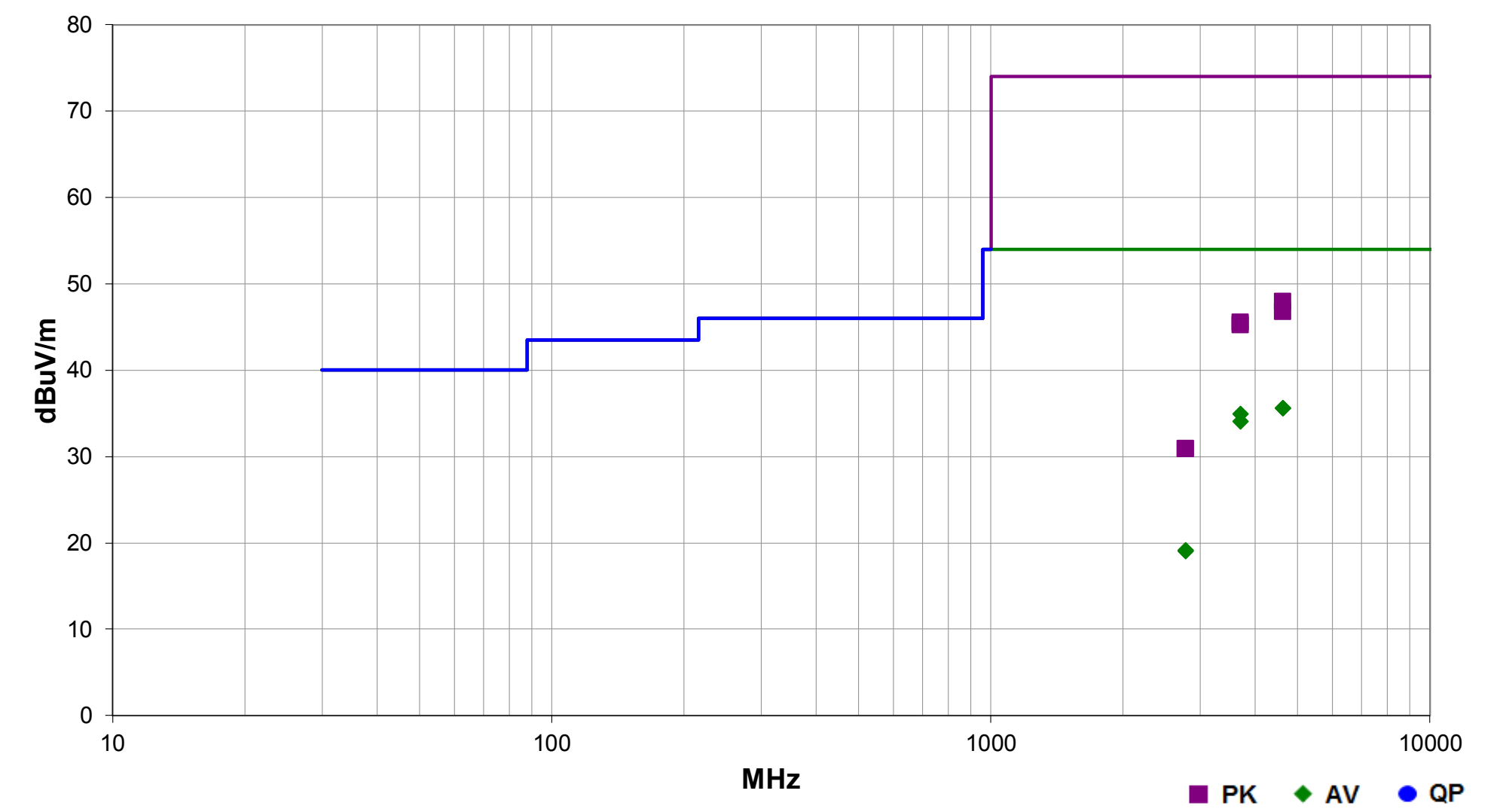
SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2015.03.03  
EmiR5 2015.03.19.1

|                 |          |                                                |           |                                                                                     |
|-----------------|----------|------------------------------------------------|-----------|-------------------------------------------------------------------------------------|
| Work Order:     | MLTI0043 | Date:                                          | 05/18/15  |  |
| Project:        | None     | Temperature:                                   | 24.6 °C   |                                                                                     |
| Job Site:       | TX02     | Humidity:                                      | 50.6% RH  |                                                                                     |
| Serial Number:  | None     | Barometric Pres.:                              | 1021 mbar |                                                                                     |
| EUT:            |          | MTAC-Lora                                      |           |                                                                                     |
| Configuration:  |          | 2                                              |           |                                                                                     |
| Customer:       |          | Multi-Tech Systems                             |           |                                                                                     |
| Attendees:      |          | None                                           |           |                                                                                     |
| EUT Power:      |          | USB via 110VAC/60Hz                            |           |                                                                                     |
| Operating Mode: |          | Transmitting Lora at High Channel @ 927.5 MHz. |           |                                                                                     |
| Deviations:     |          | None                                           |           |                                                                                     |
| Comments:       |          | None                                           |           |                                                                                     |

|                     |                  |
|---------------------|------------------|
| Test Specifications | Test Method      |
| FCC 15.247:2015     | ANSI C63.10:2009 |

|       |    |                   |   |                   |           |         |      |
|-------|----|-------------------|---|-------------------|-----------|---------|------|
| Run # | 10 | Test Distance (m) | 3 | Antenna Height(s) | 1 to 4(m) | Results | Pass |
|-------|----|-------------------|---|-------------------|-----------|---------|------|



| Freq (MHz) | Amplitude (dBuV) | Factor (dB) | Antenna Height (meters) | Azimuth (degrees) | Test Distance (meters) | External Attenuation (dB) | Polarity/ Transducer Type | Detector | Distance Adjustment (dB) | Adjusted (dBuV/m) | Spec. Limit (dBuV/m) | Compared to Spec. (dB) | Comments                |
|------------|------------------|-------------|-------------------------|-------------------|------------------------|---------------------------|---------------------------|----------|--------------------------|-------------------|----------------------|------------------------|-------------------------|
| 4640.467   | 28.3             | 7.3         | 1.4                     | 220.9             | 3.0                    | 0.0                       | Vert                      | AV       | 0.0                      | 35.6              | 54.0                 | -18.4                  | High Ch, EUT Horizontal |
| 4640.342   | 28.3             | 7.3         | 1.0                     | 211.0             | 3.0                    | 0.0                       | Horz                      | AV       | 0.0                      | 35.6              | 54.0                 | -18.4                  | High Ch, EUT Vertical   |
| 3709.967   | 30.7             | 4.2         | 2.1                     | 220.9             | 3.0                    | 0.0                       | Vert                      | AV       | 0.0                      | 34.9              | 54.0                 | -19.1                  | High Ch, EUT Horizontal |
| 3709.958   | 29.8             | 4.2         | 1.0                     | 338.0             | 3.0                    | 0.0                       | Horz                      | AV       | 0.0                      | 34.0              | 54.0                 | -20.0                  | High Ch, EUT Vertical   |
| 4635.600   | 40.6             | 7.3         | 1.0                     | 211.0             | 3.0                    | 0.0                       | Horz                      | PK       | 0.0                      | 47.9              | 74.0                 | -26.1                  | High Ch, EUT Vertical   |
| 4639.567   | 39.4             | 7.3         | 1.4                     | 220.9             | 3.0                    | 0.0                       | Vert                      | PK       | 0.0                      | 46.7              | 74.0                 | -27.3                  | High Ch, EUT Horizontal |
| 3709.717   | 41.3             | 4.2         | 1.0                     | 338.0             | 3.0                    | 0.0                       | Horz                      | PK       | 0.0                      | 45.5              | 74.0                 | -28.5                  | High Ch, EUT Vertical   |
| 3710.633   | 41.0             | 4.2         | 2.1                     | 220.9             | 3.0                    | 0.0                       | Vert                      | PK       | 0.0                      | 45.2              | 74.0                 | -28.8                  | High Ch, EUT Horizontal |
| 2782.442   | 22.1             | -3.0        | 1.0                     | 165.0             | 3.0                    | 0.0                       | Vert                      | AV       | 0.0                      | 19.1              | 54.0                 | -34.9                  | High Ch, EUT Horizontal |
| 2782.242   | 22.0             | -3.0        | 1.0                     | 118.9             | 3.0                    | 0.0                       | Horz                      | AV       | 0.0                      | 19.0              | 54.0                 | -35.0                  | High Ch, EUT Vertical   |
| 2781.533   | 33.9             | -3.0        | 1.0                     | 118.9             | 3.0                    | 0.0                       | Horz                      | PK       | 0.0                      | 30.9              | 74.0                 | -43.1                  | High Ch, EUT Vertical   |
| 2784.842   | 33.8             | -3.0        | 1.0                     | 165.0             | 3.0                    | 0.0                       | Vert                      | PK       | 0.0                      | 30.8              | 74.0                 | -43.2                  | High Ch, EUT Horizontal |

# SPURIOUS CONDUCTED EMISSIONS



XMit 2015.01.14

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. | Interval (mo) |
|--------------------------|--------------------|-----------|-----|-----------|---------------|
| Signal Generator, 40 GHz | Agilent            | N5173B    | TIW | 7/15/2014 | 36            |
| DC Block, 40 GHz         | Fairview Microwave | SD4018-20 | AMM | 2/27/2015 | 12            |
| Attenuator, 20dB, 40 GHz | Fairview Microwave | SA4018-20 | TQY | 2/27/2015 | 12            |
| Signal Analyzer          | Agilent            | N9010A    | AFL | 6/20/2014 | 12            |

## TEST DESCRIPTION

The spurious RF conducted emissions were measured with the EUT set the high transmit frequency. The measurements were made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at the data rate(s) listed in the datasheet. For each transmit frequency, the spectrum was scanned throughout the specified frequency range.

# SPURIOUS CONDUCTED EMISSIONS

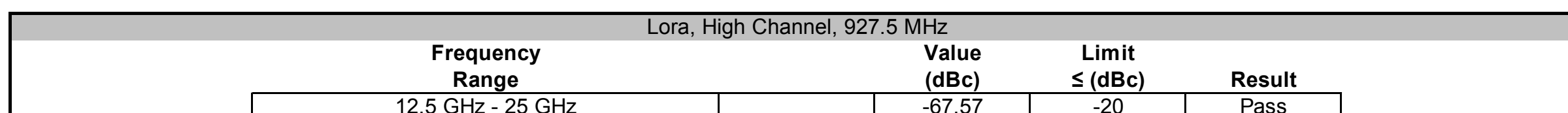


XMit 2015.01.14

|                                                |                         |                                                                                              |             |               |        |
|------------------------------------------------|-------------------------|----------------------------------------------------------------------------------------------|-------------|---------------|--------|
| EUT: MTAC-Lora                                 |                         | Work Order: MLTI0043                                                                         |             |               |        |
| Serial Number: None                            |                         | Date: 05/18/15                                                                               |             |               |        |
| Customer: Multi-Tech Systems                   |                         | Temperature: 24.0°C                                                                          |             |               |        |
| Attendees: None                                |                         | Humidity: 51%                                                                                |             |               |        |
| Project: None                                  |                         | Barometric Pres.: 1019 mbar                                                                  |             |               |        |
| Tested by: Jonathan Kiefer                     |                         | Power: USB via 110VAC/60Hz                                                                   |             |               |        |
| Job Site: TX09                                 |                         |                                                                                              |             |               |        |
| TEST SPECIFICATIONS                            |                         | Test Method                                                                                  |             |               |        |
| FCC 15.247:2015                                |                         | ANSI C63.10:2009                                                                             |             |               |        |
| COMMENTS                                       |                         |                                                                                              |             |               |        |
| Transmitting Lora at High Channel @ 927.5 MHz. |                         |                                                                                              |             |               |        |
| DEVIATIONS FROM TEST STANDARD                  |                         |                                                                                              |             |               |        |
| None                                           |                         |                                                                                              |             |               |        |
| Configuration #                                | 1                       | Signature  |             |               |        |
|                                                |                         | Frequency Range                                                                              | Value (dBc) | Limit ≤ (dBc) | Result |
| Lora                                           |                         |                                                                                              |             |               |        |
|                                                | High Channel, 927.5 MHz | 30 MHz - 12.5 GHz                                                                            | -66.48      | -20           | Pass   |
|                                                | High Channel, 927.5 MHz | 12.5 GHz - 25 GHz                                                                            | -67.57      | -20           | Pass   |

**NORTHWEST  
EMC**

| Lora, High Channel, 927.5 MHz |  |             |               |        |
|-------------------------------|--|-------------|---------------|--------|
| Frequency Range               |  | Value (dBc) | Limit ≤ (dBc) | Result |
| 30 MHz - 12.5 GHz             |  | -66.48      | -20           | Pass   |



# BAND EDGE COMPLIANCE



XMit 2015.01.14

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. | Interval (mo) |
|--------------------------|--------------------|-----------|-----|-----------|---------------|
| Signal Generator, 40 GHz | Agilent            | N5173B    | TIW | 7/15/2014 | 36            |
| DC Block, 40 GHz         | Fairview Microwave | SD4018-20 | AMM | 2/27/2015 | 12            |
| Attenuator, 20dB, 40 GHz | Fairview Microwave | SA4018-20 | TQY | 2/27/2015 | 12            |
| Signal Analyzer          | Agilent            | N9010A    | AFL | 6/20/2014 | 12            |

## TEST DESCRIPTION

The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to high transmit frequency. The channels closest to the band edges were selected. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at the data rate(s) listed in the datasheet.

The spectrum was scanned below the lower band edge and above the higher band edge.

# BAND EDGE COMPLIANCE

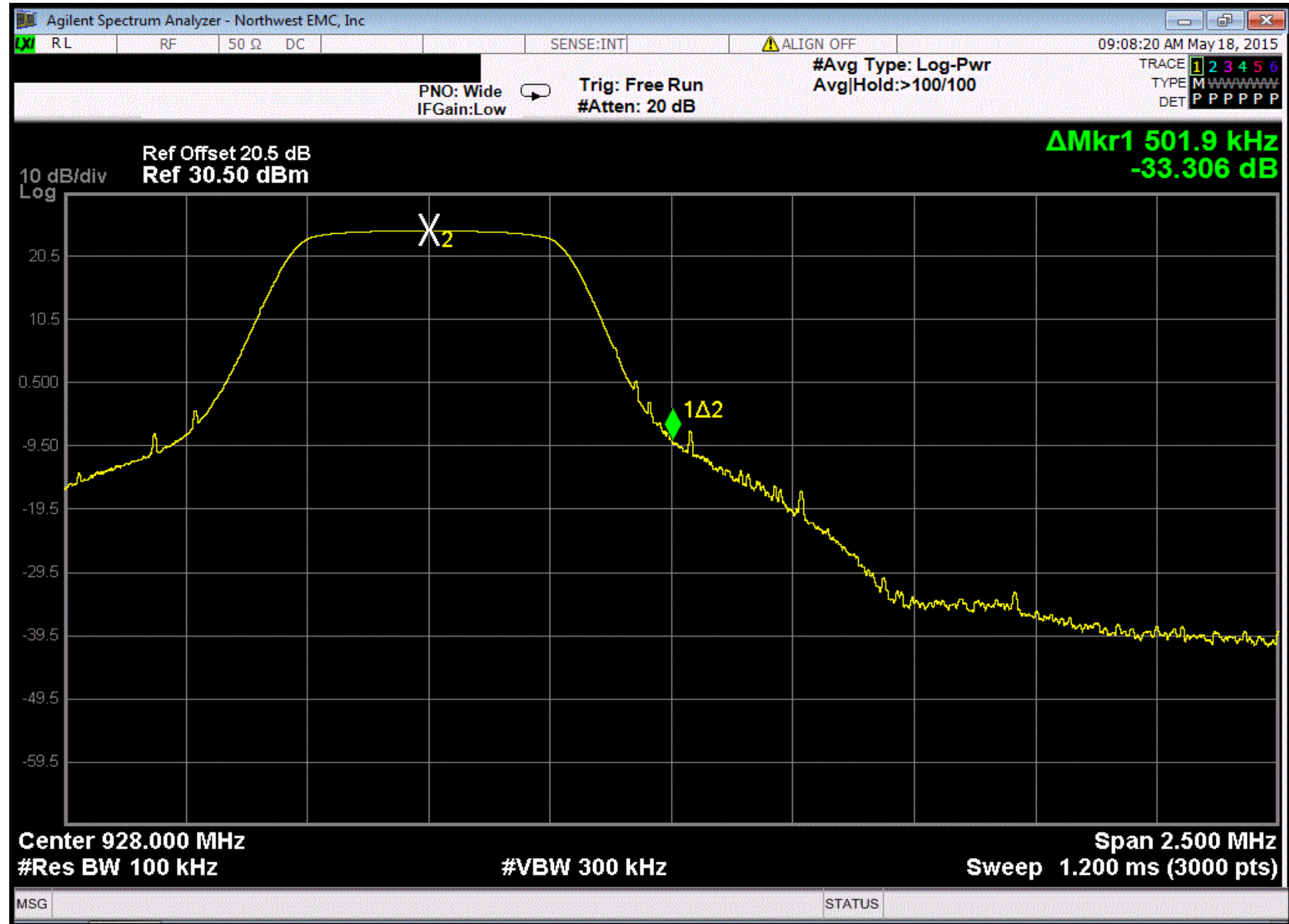


XMit 2015.01.14

|                                                |   |                                                                                              |               |
|------------------------------------------------|---|----------------------------------------------------------------------------------------------|---------------|
| EUT: MTAC-Lora                                 |   | Work Order: MLTI0043                                                                         |               |
| Serial Number: None                            |   | Date: 05/18/15                                                                               |               |
| Customer: Multi-Tech Systems                   |   | Temperature: 24.0°C                                                                          |               |
| Attendees: None                                |   | Humidity: 51%                                                                                |               |
| Project: None                                  |   | Barometric Pres.: 1019 mbar                                                                  |               |
| Tested by: Jonathan Kiefer                     |   | Power: USB via 110VAC/60Hz                                                                   |               |
|                                                |   | Job Site: TX09                                                                               |               |
| TEST SPECIFICATIONS                            |   | Test Method                                                                                  |               |
| FCC 15.247:2015                                |   | ANSI C63.10:2009                                                                             |               |
| COMMENTS                                       |   |                                                                                              |               |
| Transmitting Lora at High Channel @ 927.5 MHz. |   |                                                                                              |               |
| DEVIATIONS FROM TEST STANDARD                  |   |                                                                                              |               |
| None                                           |   |                                                                                              |               |
| Configuration #                                | 1 | Signature  |               |
|                                                |   | Value (dBc)                                                                                  | Limit ≤ (dBc) |
|                                                |   |                                                                                              | Result        |
| Lora                                           |   |                                                                                              |               |
| High Channel, 927.5 MHz                        |   | -33.31                                                                                       | -20           |
|                                                |   |                                                                                              | Pass          |

## BAND EDGE COMPLIANCE

| Lora, High Channel, 927.5 MHz |  |  |  |                |                  |        |
|-------------------------------|--|--|--|----------------|------------------|--------|
|                               |  |  |  | Value<br>(dBc) | Limit<br>≤ (dBc) | Result |
|                               |  |  |  | -33.31         | -20              | Pass   |



# OUTPUT POWER

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. | Interval (mo) |
|--------------------------|--------------------|-----------|-----|-----------|---------------|
| Signal Generator, 40 GHz | Agilent            | N5173B    | TIW | 7/15/2014 | 36            |
| DC Block, 40 GHz         | Fairview Microwave | SD4018-20 | AMM | 2/27/2015 | 12            |
| Attenuator, 20dB, 40 GHz | Fairview Microwave | SA4018-20 | TQY | 2/27/2015 | 12            |
| Signal Analyzer          | Agilent            | N9010A    | AFL | 6/20/2014 | 12            |

## TEST DESCRIPTION

The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum. A direct connection was made between the RF output of the EUT and a spectrum analyzer. Attenuation and a DC block were used. The reference level offset on the spectrum analyzer was adjusted to compensate for cable loss and the external attenuation used between the RF output and the spectrum analyzer input.

Prior to measuring peak transmit power the DTS bandwidth (B) and the transmission pulse duration (T) were measured. Both are required to determine the method of measuring Maximum Conducted Output Power. The transmission pulse duration (T) was measured using a zero span on the spectrum analyzer to see the pulses in the time domain.

The method found in KDB 558074 DTS D01 Measurement Section 9.1.1 was used because the RBW on the analyzer was greater than the DTS Bandwidth of the radio.

**De Facto EIRP Limit:** Per 47 CFR 15.247 (b)(1-3), the EUT meets the de facto EIRP limit of +36 dBm.

OUTPUT POWER

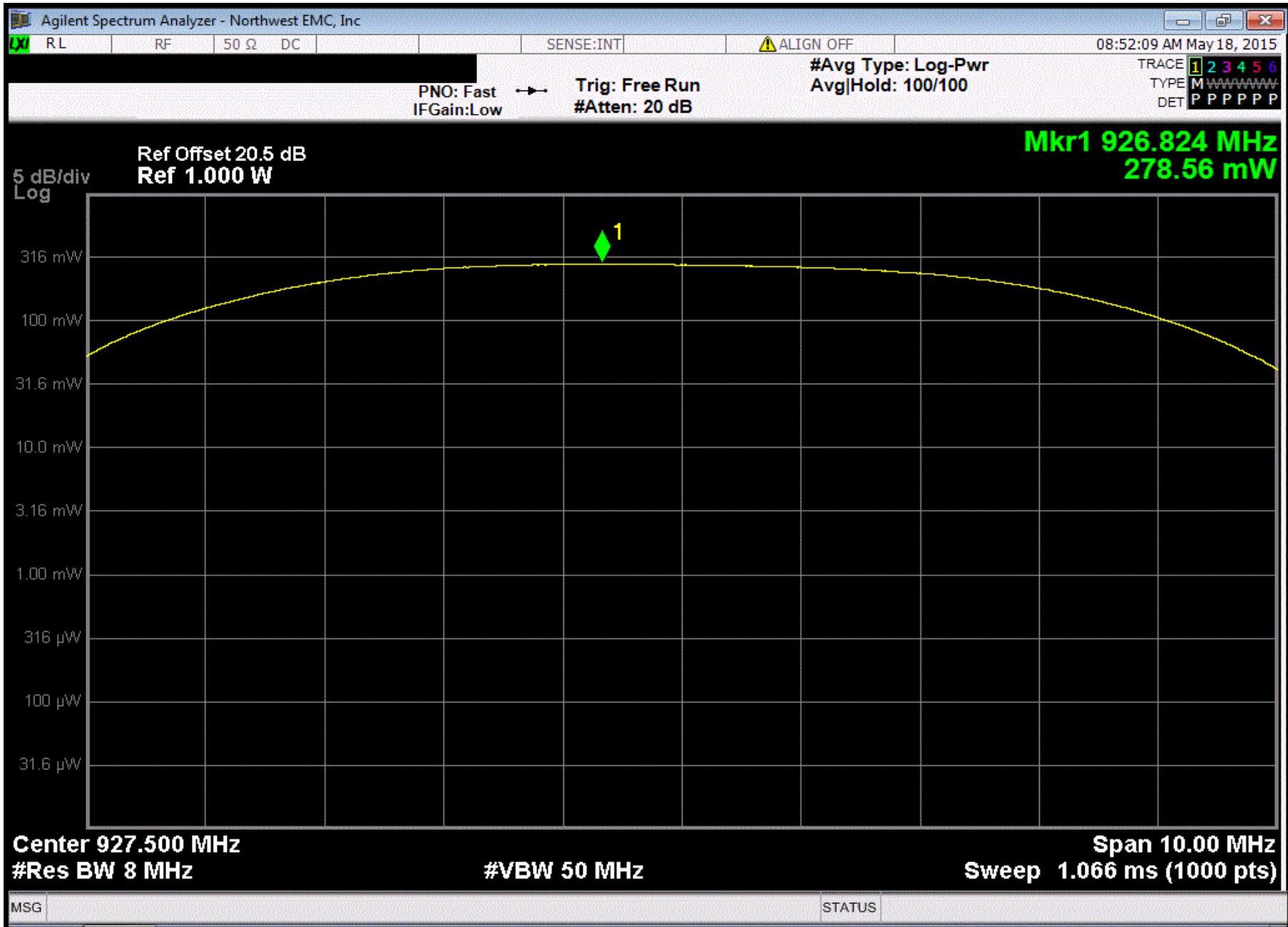


XMit 2015.01.14

|                                                |   |                                                                                              |                  |
|------------------------------------------------|---|----------------------------------------------------------------------------------------------|------------------|
| EUT: MTAC-Lora                                 |   | Work Order: MLTI0043                                                                         |                  |
| Serial Number: None                            |   | Date: 05/18/15                                                                               |                  |
| Customer: Multi-Tech Systems                   |   | Temperature: 24.0°C                                                                          |                  |
| Attendees: None                                |   | Humidity: 51%                                                                                |                  |
| Project: None                                  |   | Barometric Pres.: 1019 mbar                                                                  |                  |
| Tested by: Jonathan Kiefer                     |   | Power: USB via 110VAC/60Hz                                                                   | Job Site: TX09   |
| TEST SPECIFICATIONS                            |   | Test Method                                                                                  |                  |
| FCC 15.247:2015                                |   | ANSI C63.10:2009                                                                             |                  |
| COMMENTS                                       |   |                                                                                              |                  |
| Transmitting Lora at High Channel @ 927.5 MHz. |   |                                                                                              |                  |
| DEVIATIONS FROM TEST STANDARD                  |   |                                                                                              |                  |
| None                                           |   |                                                                                              |                  |
| Configuration #                                | 1 | Signature  |                  |
|                                                |   | Value                                                                                        | Limit (<) Result |
| Lora                                           |   |                                                                                              |                  |
| High Channel, 927.5 MHz                        |   | 278.56 mW                                                                                    | 1 W Pass         |

## OUTPUT POWER

| Lora, High Channel, 927.5 MHz |  |  |  |           |                     |        |
|-------------------------------|--|--|--|-----------|---------------------|--------|
|                               |  |  |  | Value     | Limit<br>( $\leq$ ) | Result |
|                               |  |  |  | 278.56 mW | 1 W                 | Pass   |



# POWER SPECTRAL DENSITY

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. | Interval (mo) |
|--------------------------|--------------------|-----------|-----|-----------|---------------|
| Signal Analyzer          | Agilent            | N9010A    | AFL | 6/20/2014 | 12            |
| Attenuator, 20dB, 40 GHz | Fairview Microwave | SA4018-20 | TQY | 2/27/2015 | 12            |
| DC Block, 40 GHz         | Fairview Microwave | SD4018-20 | AMM | 2/27/2015 | 12            |
| Signal Generator, 40 GHz | Agilent            | N5173B    | TIW | 7/15/2014 | 36            |

## TEST DESCRIPTION

The maximum power spectral density measurements were measured with the EUT set to the high frequency. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. The EUT was transmitting at the lowest, middle, and maximum data rate for each modulation type available. A duty cycle of >98% was used.

Per the procedure outlined in section 10.3 in the KDB 558074 D01 v03r02 document, a power spectral density measurement using the AVGPSD-1 method was used on each channel.

- b) Set span to at least 1.5 times the OBW.
- c) Set RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- d) Set VBW  $\geq 3 \times \text{RBW}$ .
- e) Detector = power averaging (RMS)
- f) Ensure that the number of measurement points in the sweep  $\geq 2 \times \text{span/RBW}$ .
- g) Sweep time = auto couple.
- h) Employ trace averaging (RMS) mode over a minimum of 100 traces.
- i) Use the peak marker function to determine the maximum amplitude level.

POWER SPECTRAL DENSITY



XMit 2015.01.14

|                                                |   |                                                                                              |                   |
|------------------------------------------------|---|----------------------------------------------------------------------------------------------|-------------------|
| EUT: MTAC-Lora                                 |   | Work Order: MLTI0043                                                                         |                   |
| Serial Number: None                            |   | Date: 05/18/15                                                                               |                   |
| Customer: Multi-Tech Systems                   |   | Temperature: 24.0°C                                                                          |                   |
| Attendees: None                                |   | Humidity: 51%                                                                                |                   |
| Project: None                                  |   | Barometric Pres.: 1019 mbar                                                                  |                   |
| Tested by: Jonathan Kiefer                     |   | Power: USB via 110VAC/60Hz                                                                   |                   |
|                                                |   | Job Site: TX09                                                                               |                   |
| TEST SPECIFICATIONS                            |   | Test Method                                                                                  |                   |
| FCC 15.247:2015                                |   | ANSI C63.10:2009                                                                             |                   |
| COMMENTS                                       |   |                                                                                              |                   |
| Transmitting Lora at High Channel @ 927.5 MHz. |   |                                                                                              |                   |
| DEVIATIONS FROM TEST STANDARD                  |   |                                                                                              |                   |
| None                                           |   |                                                                                              |                   |
| Configuration #                                | 1 | Signature  |                   |
|                                                |   | Value<br>dBm/3kHz                                                                            | Limit<br>dBm/3kHz |
|                                                |   |                                                                                              | Results           |
| Lora                                           |   |                                                                                              |                   |
| High Channel, 927.5 MHz                        |   | 2.879                                                                                        | 8                 |
|                                                |   |                                                                                              | Pass              |

## POWER SPECTRAL DENSITY

XMit 2015.01.14

| Lora, High Channel, 927.5 MHz |  |       |          |   |         |  |
|-------------------------------|--|-------|----------|---|---------|--|
| Value                         |  |       | Limit    |   | Results |  |
| dBm/3kHz                      |  |       | dBm/3kHz |   |         |  |
|                               |  | 2.879 |          | 8 | Pass    |  |

