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**EMC testing of the Tektelic Communication Inc. Kona Pico Gateway in accordance with FCC Part 15.247, ANSI C63.4: 2014 and ANSI C63.10: 2013 as referenced by FCC OET KDB 558074 D01 DTS Measurement Guidance v04. FCC ID: 2ALEPT0004280**

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Prepared for: Tektelic Communication Inc.

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## REVISION RECORD

| ISSUE | DATE | AUTHOR | REVISIONS |
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| DRAFT 1 | 2017-08-17 | I. Akram | Initial draft submitted for review. |
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# 1.0 INTRODUCTION

## 1.1 Scope

The purpose of this report is to present the results of compliance testing performed in accordance with FCC Part 15.247 ANSI C63.4-2014 and ANSI C63.10-2013. All test procedures, limits, criteria, and results described in this report apply only to the Tektelic Communication Inc. Kona Pico Gateway test sample, referred to herein as the EUT (Equipment Under Test).

This report does not imply product endorsement by the Electronics Test Centre, SCC, NAVLP, A2LA, nor any Canadian Government agency.

## 1.2 Applicant

This test report has been prepared for Tektelic Communication Inc., located in Calgary, Alberta, Canada.

## 1.3 Test Sample Description

As provided to ETC (Airdrie) by Tektelic Communication Inc.:

| | | |
|---|---|---|
| **Product Name:** | | Kona Pico Gateway |
| **Lora Radio** | **Frequency Range** | 923.3 – 927.5 MHz |
| | **Type of Modulation** | LoRa 500KHz DTS |
| | **Associated Antenna** | 2.7 dBi gain, type: dipole mfr: Airgain, model: ET830DBLTRPSMA |
| **Model# / Serial#** | | T0004313 / 1647D0015 (see note below) |
| **Power supply:** | | Mfr: CLICK Technology Co. p/n CPS012D050200U, 100-240VAC 0.4A<br>Mfr: TRIAD switching power supply, p/n WSU050-2000, 100-240VAC 0.4A |

This product is a wireless LoRa gateway device with external antennas. It may incorporate a 3G/4G WiLAN backhaul module, FCC ID O7P-362.
WiFi module and antenna gain analysis from vendor are provided in Appendix.

Note: Both model **T0004313** and **T0004471** were evaluated. T0004313 was chosen since it provided the worst emission results.
Both model use identical electrical host board. The only difference is the WiFi module, which is what makes the product variation.

## 1.4 General Test Conditions and Assumptions

The EUT was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. All inputs and outputs to and from other equipment associated with the EUT were adequately simulated.

Where relevant, the EUT was only tested using the monitoring methods and test criteria defined in this report.

The environmental conditions are recorded during each test, and are reported in the relevant sections of this document.

## 1.5 Scope of Testing

Tests were performed in accordance with FCC Part 15.247, ANSI C63.4-2014, and ANSI C63.10-2013 as referenced in FCC KDB 558074 D01 v04 for DTS.

### 1.5.1 Test Methodology

Test methods are specified in the Basic Standard as referenced and/or modified by the Product Standard in the part of Section 2 of this report associated with each particular test case.

### 1.5.2 Variations in Test Methodology

Any variance in methodology or deviation from the reference Standard is documented in the part of Section 2 of this report associated with each particular Test Case.

### 1.5.3 Test Sample Verification, Configuration & Modifications

EUT setup, configuration, protocols for operation and monitoring of EUT functions, and any modifications performed in order to meet the requirements, are detailed in each Test Case of Section 2 of this report.

## 2.0 TEST CONCLUSION

### STATEMENT OF COMPLIANCE

**The customer equipment referred to in this report was found to comply with the requirements, as summarized below.**

The EUT was subjected to the following tests. Compliance status is reported as **Compliant** or **Non-compliant**. **N/A** indicates the test was Not Applicable to the EUT.

**Note:** Maintenance of compliance is the responsibility of the Manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the EUT with respect to the standards detailed in this test report.

The following table summarizes the tests performed in terms of the specification, class or performance criterion applied, and the EUT modification state.

| Test Case | Test Type | Specification | Test Sample | Modifications | Config. | Result |
|---|---|---|---|---|---|---|
| 2.1 | AC Conducted Emissions (Tx) | 15.207 | Kona Pico Gateway | none | see § 2.1 | **Compliant** |
| 2.2 | Occupied Bandwidth | 15.247(a) | Kona Pico Gateway | none | see § 2.2 | **Compliant** |
| 2.3 | Max Output Power | 15.247(d) | Kona Pico Gateway | none | see § 2.3 | **Compliant** |
| 2.4 | Power Spectral Density | 15.247(e) | Kona Pico Gateway | none | see § 2.4 | **Compliant** |
| 2.5 | Band Edge | 15.247(d) | Kona Pico Gateway | none | see § 2.5 | **Compliant** |
| 2.6 | Conducted Spurious | 15.247(d) | Kona Pico Gateway | none | see § 2.6 | **Compliant** |
| 2.7 | EUT Position | ANSI C63.4 | Kona Pico Gateway | - | - | **n/a** |
| 2.8 | Radiated Spurious | 15.205, 15.209 15.247(d) | Kona Pico Gateway | none | see § 2.8 | **Compliant** |
| 2.9 | Radiated Spurious (Co-Location) | 15.209 15.247(d) | Kona Pico Gateway | none | see § 2.9 | **Compliant** |
| 2.10 | RF Exposure | 15.247(i) | Kona Pico Gateway | none | see § 2.10 | **Compliant** |

Refer to the test data for applicable test conditions.

## 2.1 AC Power Line Conducted Emissions: Transmit Mode

| | |
|---|---|
| **Test Lab: Electronics Test Centre, Airdrie** | **EUT: Kona Pico Gateway** |
| **Test Personnel: David Raynes** | **Standard: FCC Part 15.207** |
| **Date: August 3, 2017 (21.3°C,37.7% RH)** | **Basic Standard: ANSI C63.4: 2014** |

**EUT status: Compliant**

**Specification: Part15-207**

| Frequency (MHz) | Quasi-Peak Limit (dBµV) | Average Limit (dBµV) |
|---|---|---|
| 0.15 – 0.5 | 66 – 56 | 56 – 46 |
| 0.5 – 5 | 56 | 46 |
| 5 – 30 | 60 | 50 |
| **Criteria:** The conducted emissions produced by a device shall not exceed the limits as specified. | | |

### 2.1.1 Test Guidance: ANSI C63.4-2014, Clause 7.3.1

Before any testing is performed, the Ambient (measurement noise floor) is recorded, and a QC check is performed to show that the system is functioning correctly.

Testing starts with a scan, performed under software control. After this is complete, the list of frequencies of interest is generated. These frequencies are then investigated for quasi-peak and average amplitude, as applicable. Emissions measured with a QP detector that fall below the Average limit are deemed to meet both requirements.

### 2.1.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

### 2.1.3 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document “Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002.” As based on the “ISO Guide to the Expression of Uncertainty in Measurement, 1995.”

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of k = 2.

| Test Method | Frequency | Uncertainty |
|---|---|---|
| Conducted Emissions Level | 150 KHz – 30 MHz | ±2.7 dB |

### 2.1.4 Test Equipment

Testing was performed with the following equipment:

| Equipment | Manufacturer | Model # | Asset # | Calibration Date | Calibration Due |
|---|---|---|---|---|---|
| EMC Software | UL | Ver. 9.5 | ETC-SW-EMC 2.1 | N/A | N/A |
| EMI receiver | Agilent | N9038A | 6130 | 2017-06-20 | 2018-06-20 |
| LISN | Com-Power | LI-215A | 6180 | 2017-03-24 | 2018-03-24 |
| Temp/RH logger | Extech | 42270 | 5892 | 2017-04-06 | 2018-04-06 |

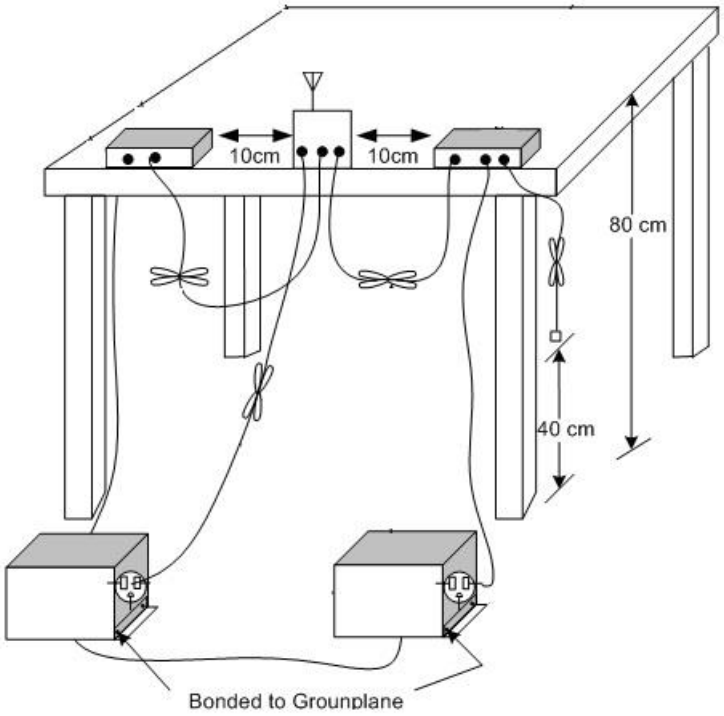
### 2.1.5 Test Sample Verification, Configuration & Modifications

The EUT was power through AC/DC Adaptors. EUT is in transmitting mode. Two AC/DC power adaptor of different manufacturer are tested for conducted emission with EUT.

Mfr: CLICK Technology Co. p/n CPS012D050200U, 100-240VAC 0.4A
Mfr: TRIAD switching power supply, p/n WSU050-2000, 100-240VAC 0.4A

The EUT met the requirements without modification.

**Test setup diagram:**



### 2.1.6 Conducted Emissions Data:

The EUT was evaluated in all transmit mode. No mode of transmission showed emission worst then another. The plots are from the DTS mode using mid-channel. There are two AC/DC adaptor variant are used to perform the conducted emission.

| Freq. Marker | Freq. (MHz) | Raw reading (dBµv) | Det. | LISN Factor (dB/m) | Cable Loss (dB) | Corrected Reading (dBµV) | FCC 15.207 Limit (dBµV) | Delta (dB) | L / N |
|---|---|---|---|---|---|---|---|---|---|
| 1 | .15309 | 27.57 | Av | .8 | 10 | 38.37 | 55.83 | -17.46 | L |
| 1 | .15533 | 26.2 | Av | .7 | 10 | 36.9 | 55.71 | -18.81 | N |

**Av = Average Detector**

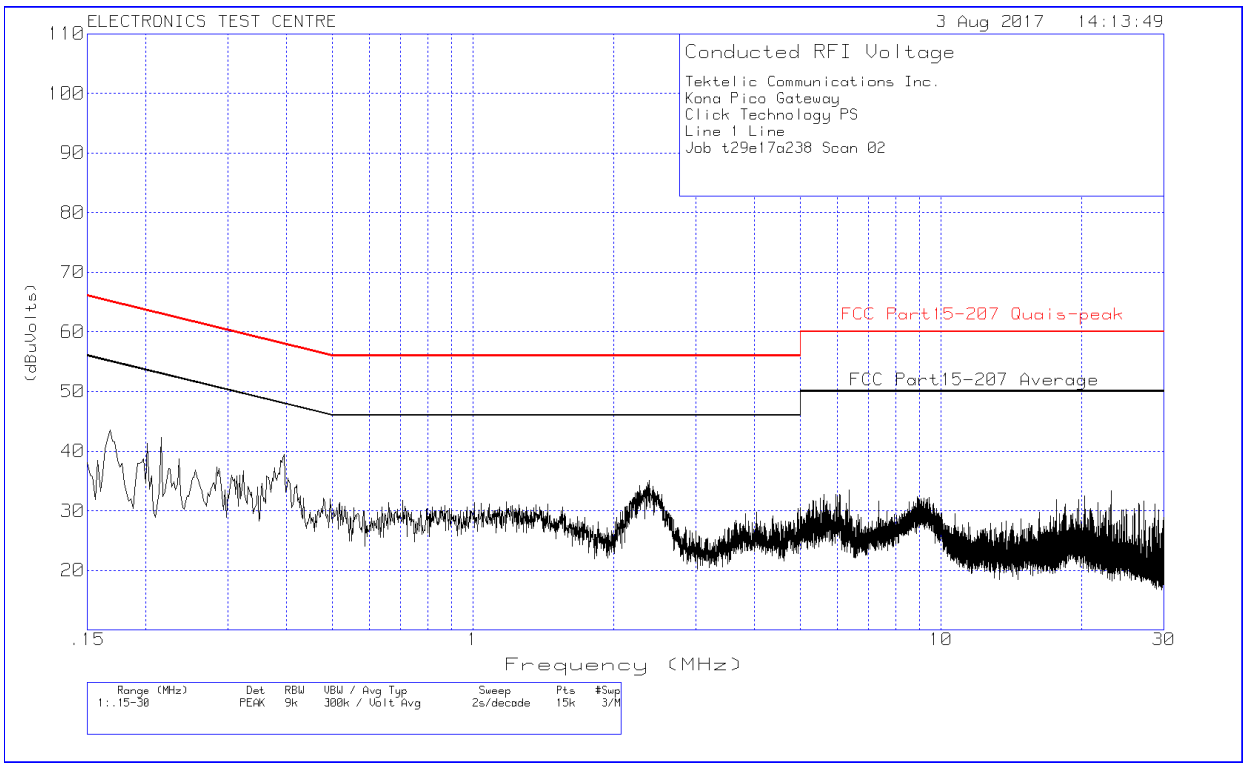
**Raw Reading in dBµV + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dbµV/m.**

Note: When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.

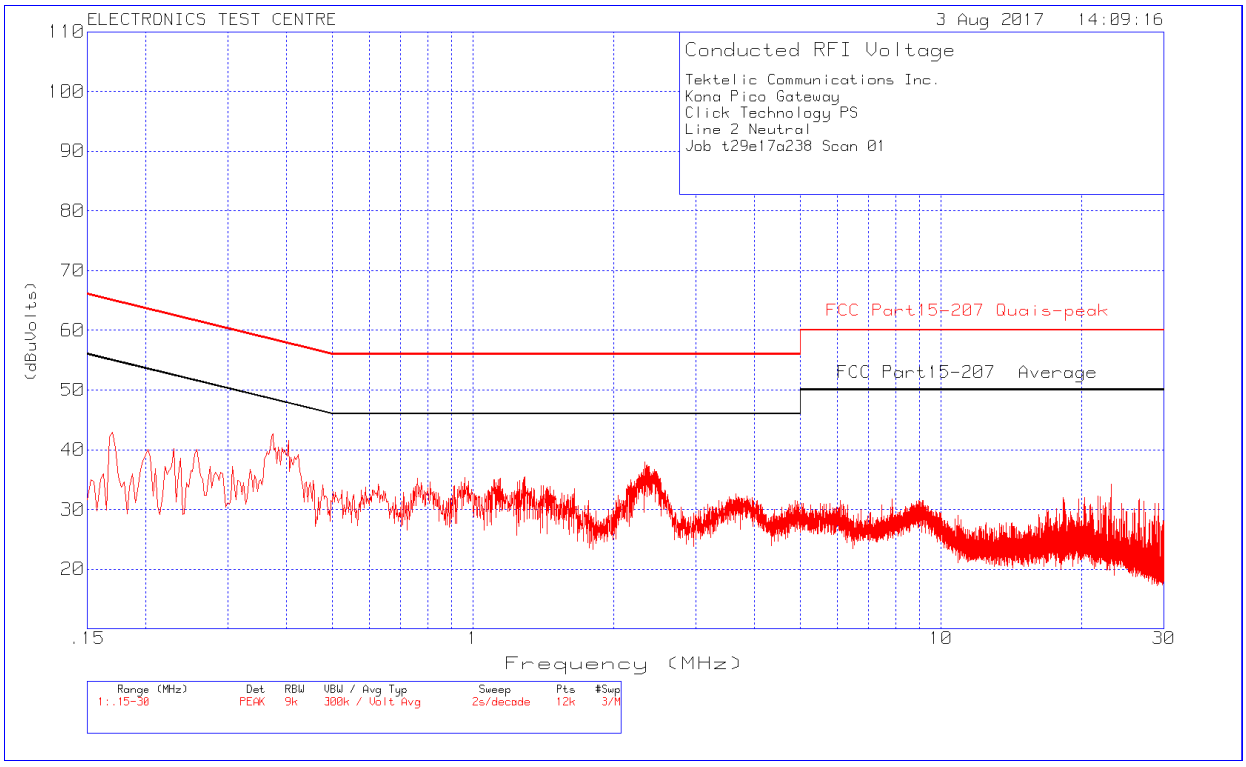
**Negative values for Delta indicate compliance.**

**The Ground Bond was measured and found to be 1.1 mΩ.**

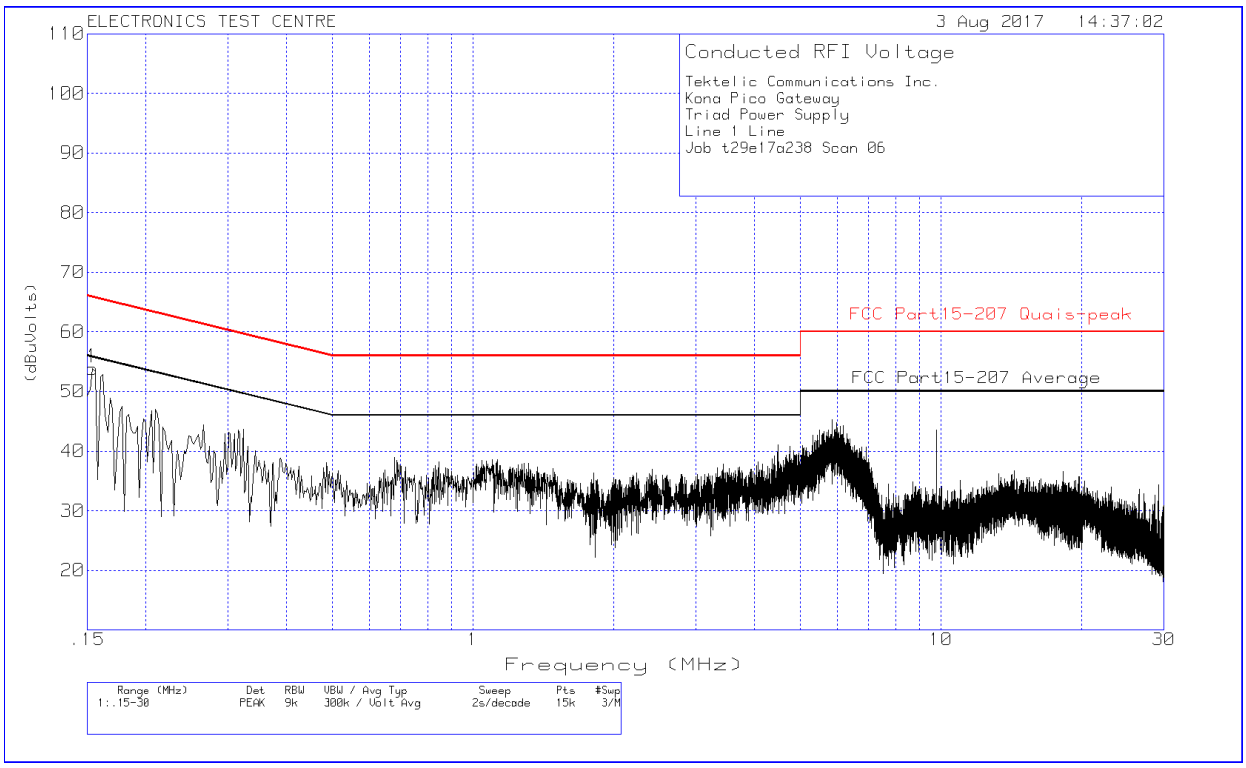
## Plot of Conducted Emissions: Line (Adaptor-1)



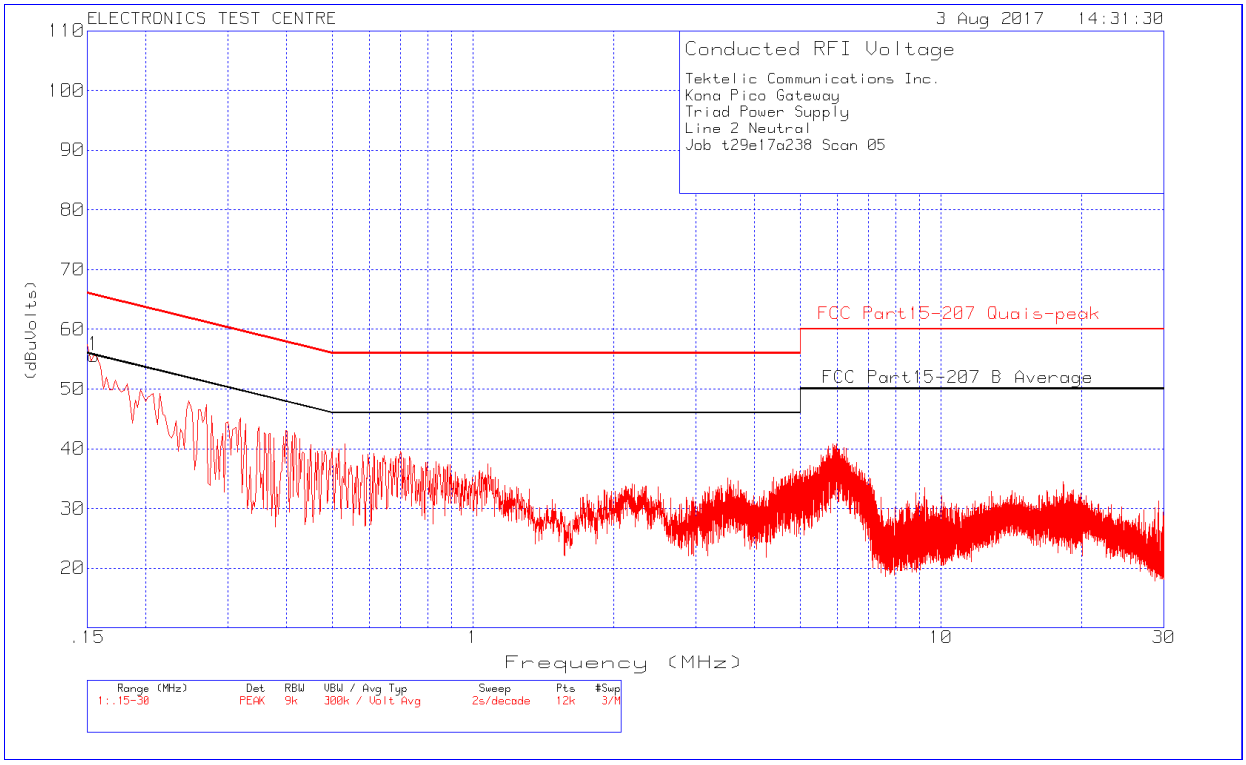

## Plot of Conducted Emissions: Neutral



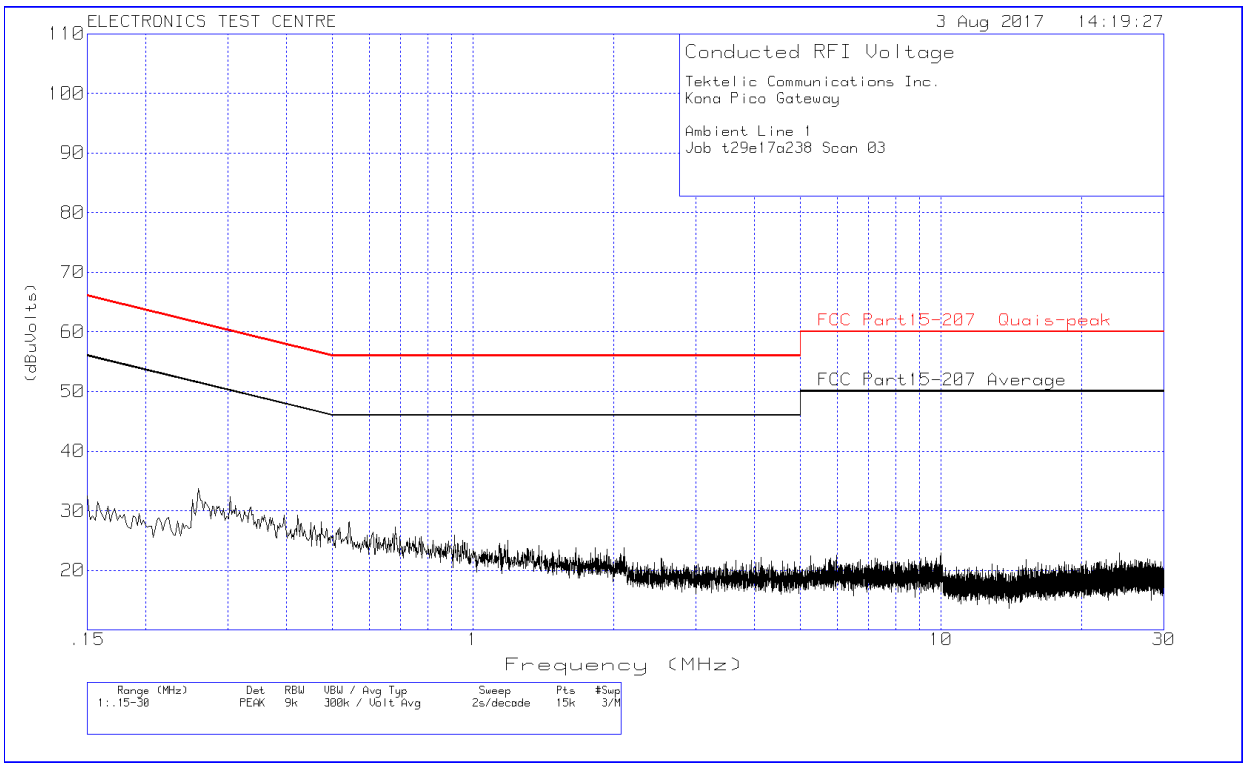
## Plot of Conducted Emissions: Line (Adaptor-2)



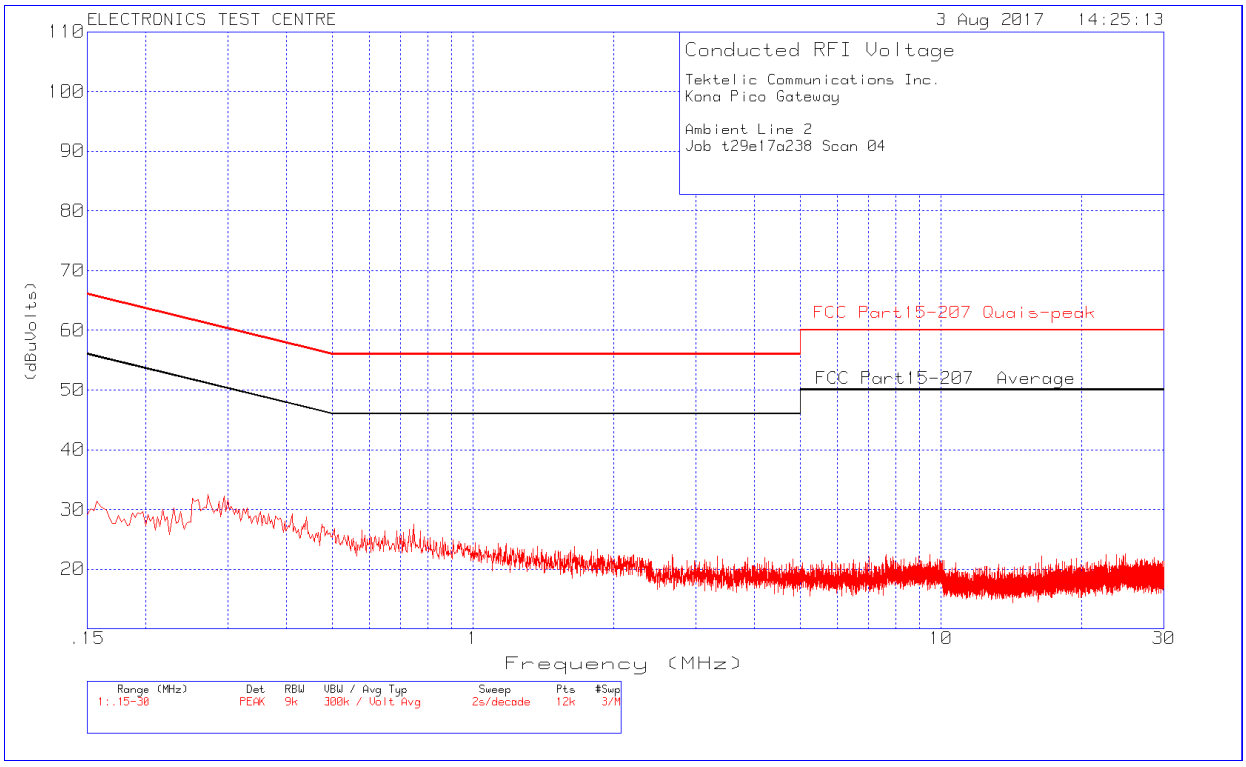

## Plot of Conducted Emissions: Neutral



## Plot of Test Chamber Ambient: (measurement noise floor): Line




## Plot of Test Chamber Ambient: (measurement noise floor): Neutral



## 2.2 Channel Occupied Bandwidth

| | |
|---|---|
| **Test Lab: Electronics Test Centre, Airdrie** | **EUT: Kona Pico Gateway** |
| **Test Personnel: Imran Akram** | **Standard: FCC PART 15.247** |
| **Date: August 17, 2017 (23.0°C,32.4% RH)** | **Basic Standard: ANSI C63.10-2013 FCC OET KDB 558074** |

**EUT status: Compliant**

**Specification: FCC Part 15.247 (a, 2), FCC 15.215 (c)**

**Criteria:** Systems using digital modulation techniques may operate in the 902-928 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 2.2.1 Test Guidance: ANSI C63.10-2013, Clause 6.9.2 & 6.9.3/ FCC OET KDB 558074 Section 8 Option 2

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, with out the need for any further corrections.

For DTS the spectrum analyzer is set for a frequency span ≥ (2 * OBW), ≤ (5 * OBW), selected to clearly display the channel. The RBW is set to 100 kHz. The VBW is set to ≥ (3 * RBW). The Peak detector is used, with the trace set to Max Hold.

The automated 99% BW function of the spectrum analyzer is engaged, and the 6 dB OBW and/or 20 dB OBW is measured with the x dB function.

### 2.2.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

### 2.2.3 Test Equipment

Testing was performed with the following equipment:

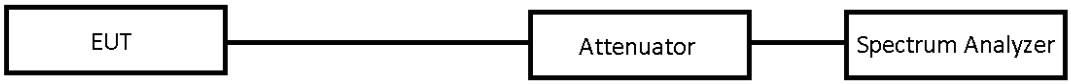
| Equipment | Manufacturer | Model # | Asset # | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| EMI receiver | Agilent | N9038A | 6130 | 2017-06-20 | 2018-06-20 |
| Temp/Humidity | Extech | 42270 | 5892 | 2017-04-06 | 2018-04-06 |
| Attenuator | JFW | 50FH-020-10 | - | Monitored | |
| DC Blocker | MCL | BLK-89-S+ | - | Monitored | |

### 2.2.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

**Test setup diagrams for Occupied Bandwidth testing:**

**Conducted:**

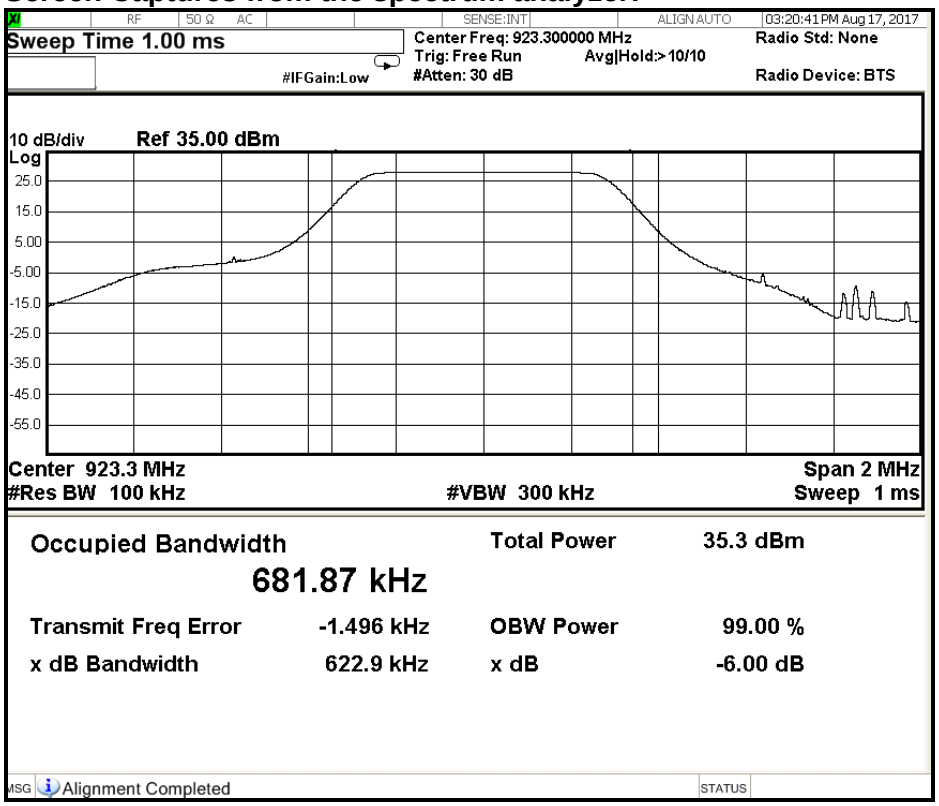



## 2.2.5 Channel Occupied Bandwidth Data:

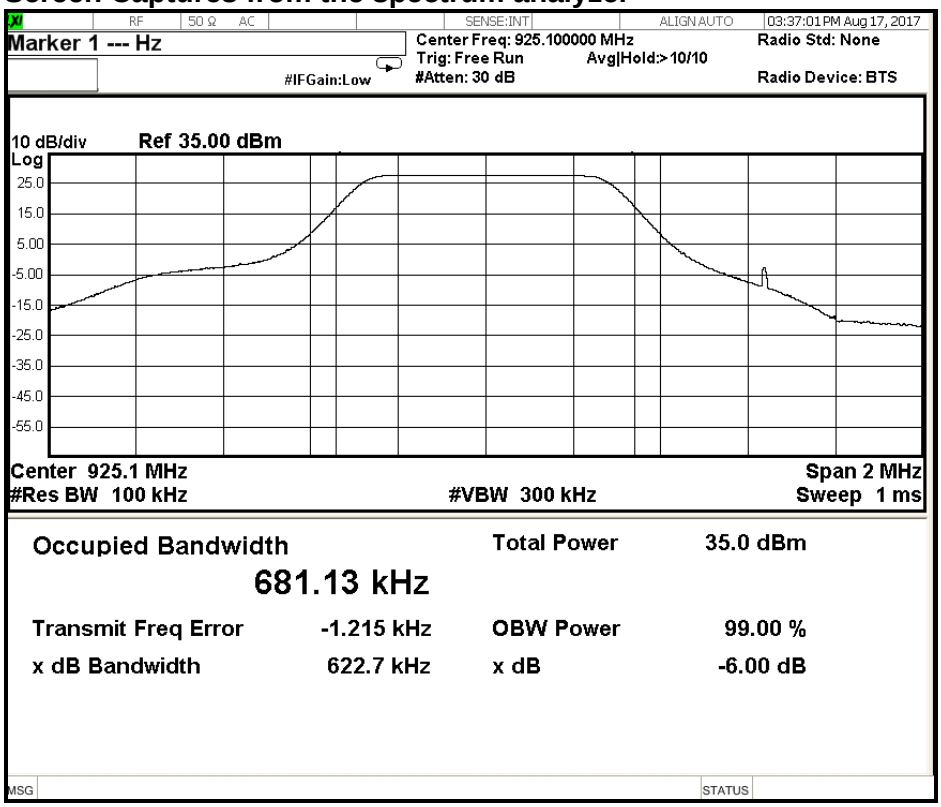
**Lora 500 KHz DTS**

| Channel | Freq. [MHz] | 6 dB OBW [kHz] | 99% OBW [KHz] | Limit 6 dB OBW |
|---|---|---|---|---|
| Low | 923.3 | 622.9 | 681.87 | ≥ 500 KHz |
| Mid | 925.1 | 622.7 | 681.22 | ≥ 500 KHz |
| High | 927.5 | 621.9 | 681.02 | ≥ 500 KHz |

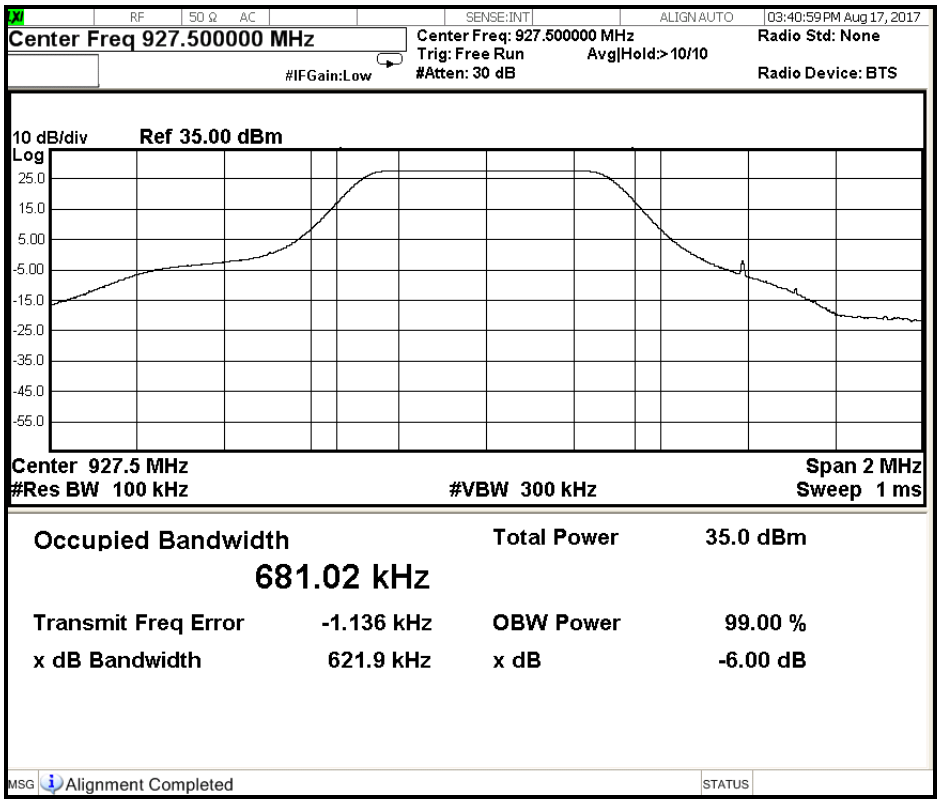
**Screen Captures from the spectrum analyzer:**



## Screen Captures from the spectrum analyzer




## Screen Captures from the spectrum analyzer



## 2.3 Max Output Power

| | |
|---|---|
| **Test Lab: Electronics Test Centre, Airdrie** | **EUT: Kona Pico Gateway** |
| **Test Personnel: David Raynes/Imran Akram** | **Standard: FCC PART 15.247** |
| **Date: August 03, 2017 (21.3°C,37.7% RH)** | **Basic Standard: ANSI C63.10: 2013 FCC OET KDB 558074** |

**EUT status: Compliant**

**Specification: FCC Part 15.247(b, 3)**

| | |
|---|---|
| **Criteria** | (3) For systems using digital modulation in the 902-928 MHz bands: 1 Watt. |

### 2.3.1 Test Guidance: ANSI C63.10-2013, Clause 11.9.1.1, Clause 7.8.5 / FCC OET KDB 558074 Section 9.2.2.2

This measurement is performed at low, mid and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, with out the need for any further corrections.

### 2.3.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

### 2.3.3 Test Equipment

Testing was performed with the following equipment:

| Equipment | Manufacturer | Model # | Asset # | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| EMI receiver | Agilent | N9038A | 6130 | 2017-06-20 | 2018-06-20 |
| Temp/Humidity | Extech | 42270 | 5892 | 2017-04-06 | 2018-04-06 |
| Attenuator | JFW | 50FH-020-10 | | Monitored | |
| DC Blocker | MCL | BLK-89-S+ | | Monitored | |

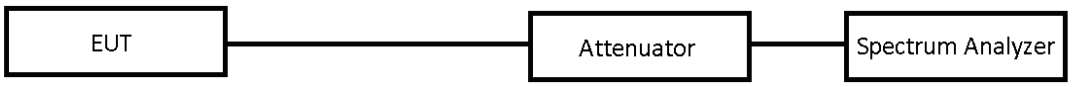
### 2.3.4 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT met the requirements without modification.

**Test setup diagrams for Peak Power testing:**

**Conducted:**



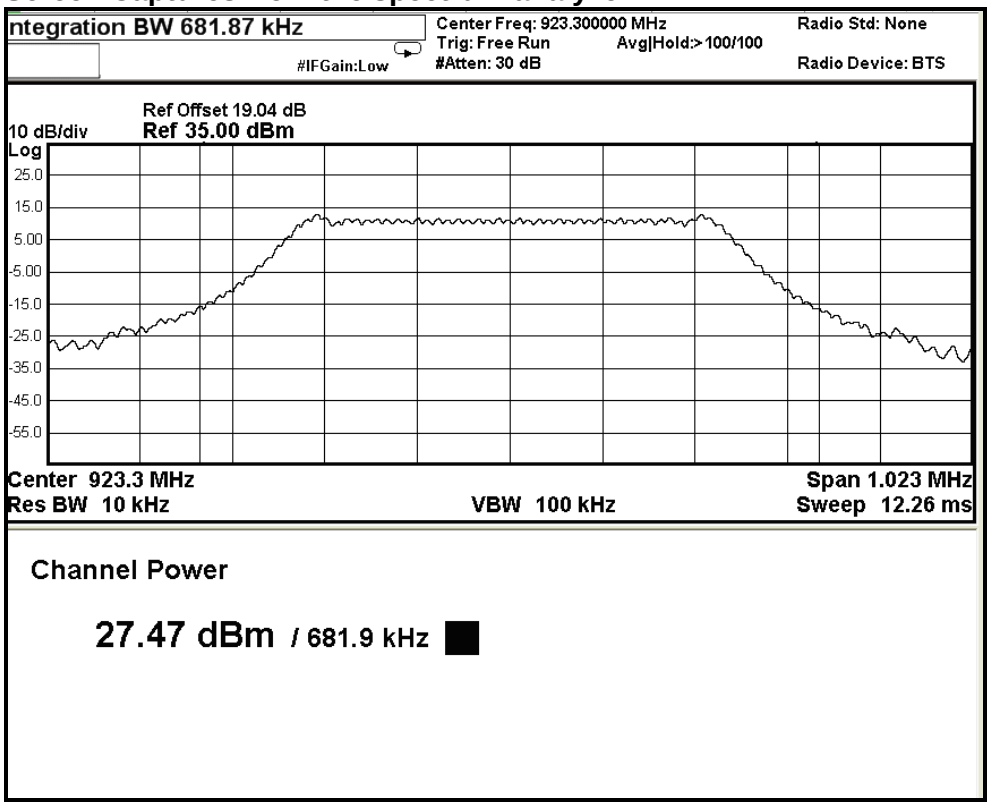

### 2.3.5 Peak Output Power Data

**Lora 500 KHz DTS**

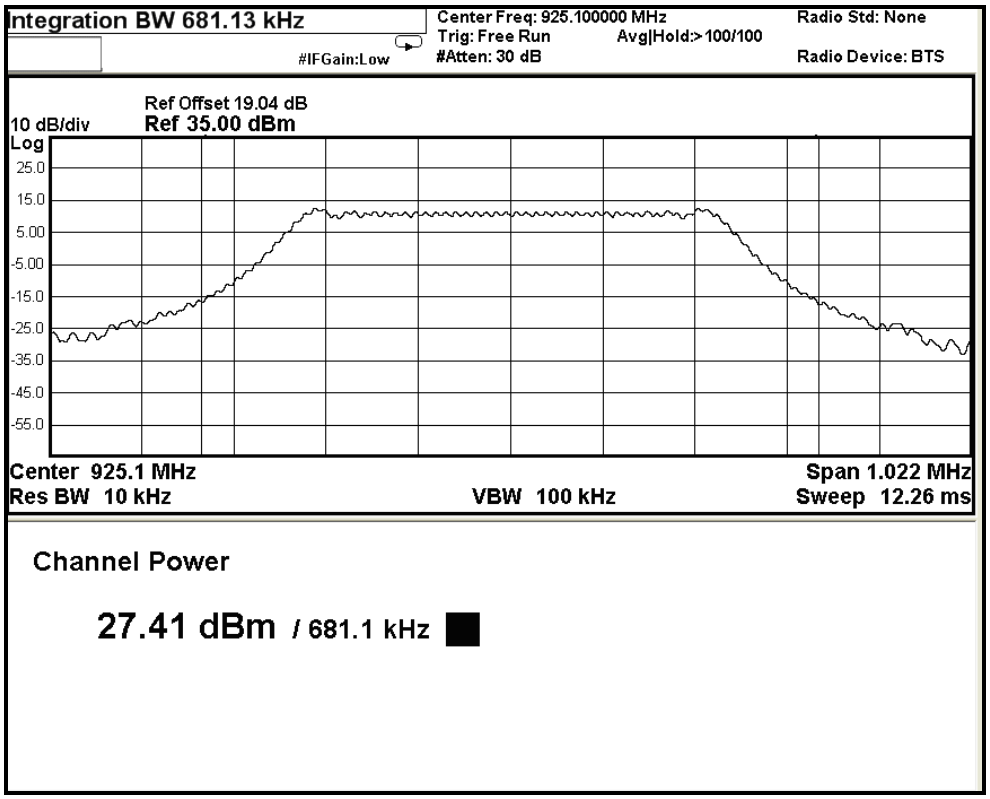
| Channel | Freq. [MHz] | Out Put Power (dBm) | Out Put Power Limit (dBm | Margin (dB) |
|---|---|---|---|---|
| Low | 923.3 | 27.47 | 30 | 2.53 |
| Mid | 925.1 | 27.41 | 30 | 2.59 |
| High | 927.5 | 27.56 | 30 | 2.44 |

| Output Power Method AVGSA-1 For DTS | |
|---|---|
| Span | ≥ 1.5 times the OBW |
| RBW | 1 – 5 % of the OBW, ≤ 1 MHz |
| VBW | ≥ 3 x RBW |
| Number of Points in sweep | ≥ 2 x Span / RBW |
| Sweep time | Auto |
| Detector | RMS (Power Averaging) |
| Sweep trigger | Free Run (Duty Cycle ≥98%) |
| Trace Average | 100 traces in power Averaging (RMS) |
| Power measured | Integrated the spectrum across the OBW of the signal using the S/A band power measurement function, with band limit set equal to the OBW band edge. |

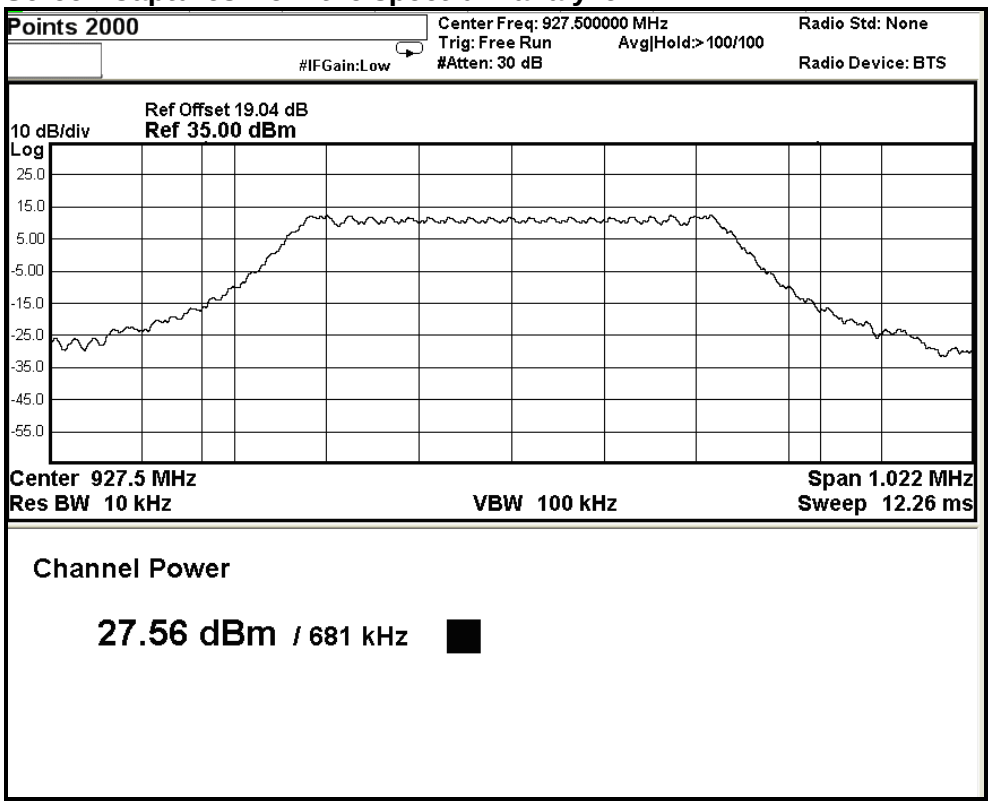
**Screen Captures from the spectrum analyzer**



## Screen Captures from the spectrum analyzer:




## Screen Captures from the spectrum analyzer:



## 2.4 Power Spectral Density

| | |
|---|---|
| **Test Lab: Electronics Test Centre, Airdrie** | **EUT: Kona Pico Gateway** |
| **Test Personnel: Imran Akram** | **Standard: FCC PART 15.247** |
| **Date: August 17, 2017 (23.0°C,32.4%RH)** | **Basic Standard: ANSI C63.10: 2013** |

**EUT status: Compliant**

**Specification: FCC Part 15.247(e)**

**Criteria** For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### 2.4.1 Test Guidance: ANSI C63.10-2013, Clause 11.10.2 / FCC OET KDB 558074 10.5

This measurement is performed at low, mid and high frequencies, in continuous transmission, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, with out the need for any further corrections.

The spectrum analyzer is set for a frequency span of (1.5*(6dB BW)) centered on a channel. The RBW is set to 3 kHz and VBW is set to 10 kHz. The RMS average detector is used, with the trace set to average Hold. The marker is placed on the highest peak of the resulting trace.

### 2.4.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

### 2.4.3 Test Equipment

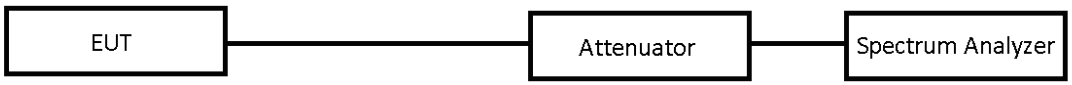
Testing was performed with this equipment:

| Equipment | Manufacturer | Model # | Asset # | Calibration Date | Calibration Due |
|---|---|---|---|---|---|
| EMI receiver | Agilent | N9010A | 6678 | 2017-05-11 | 2018-05-11 |
| Temp/Humidity | Extech | 42270 | 5892 | 2017-04-06 | 2018-04-06 |
| Attenuator | JFW | 50FH-020-10 | | Monitored | |
| DC Blocker | MCL | BLK-89-S+ | | Monitored | |

### 2.4.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

**Test setup diagrams for Peak Power Spectral Density testing:**
**Conducted:**

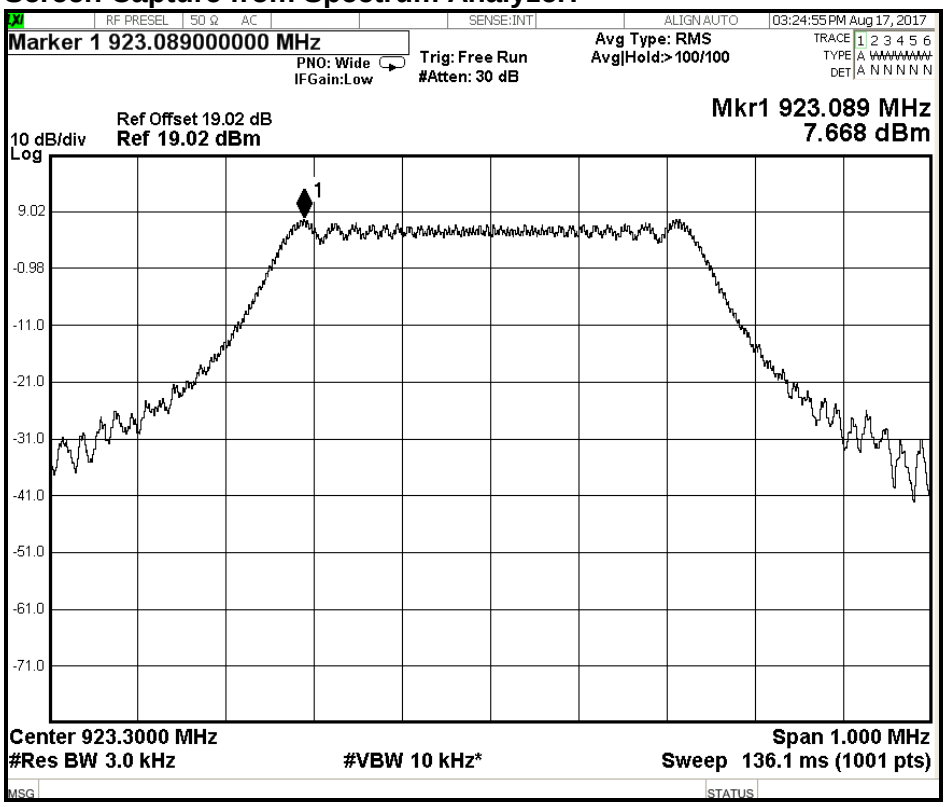



### 2.4.5 Peak PSD Data

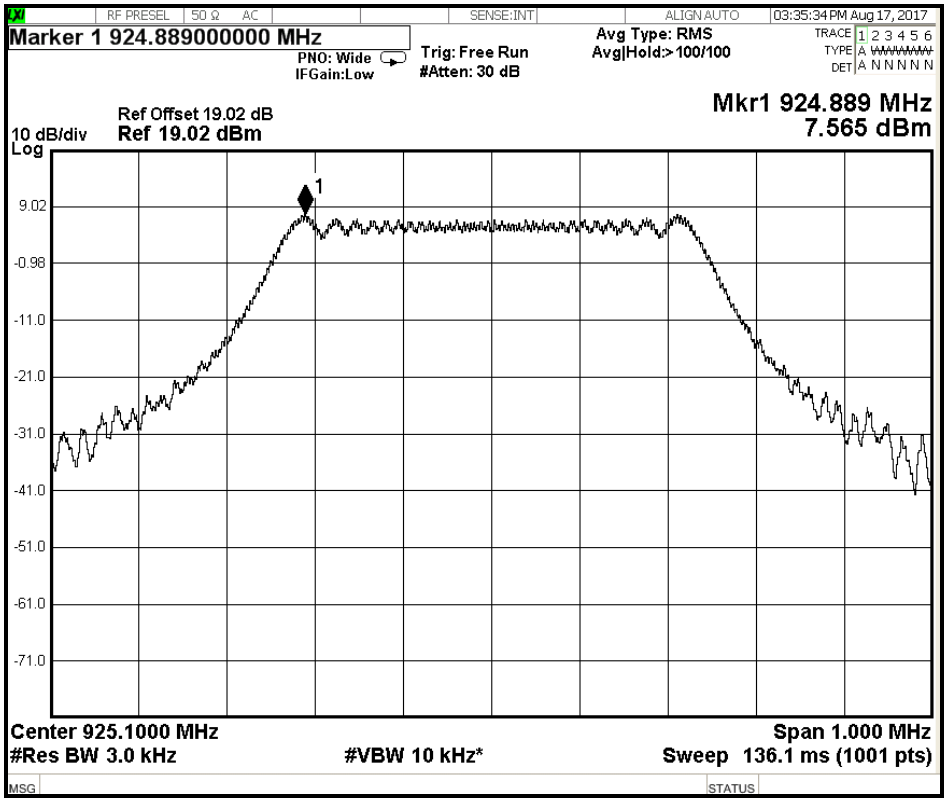
**500 KHZ DTS**

| Channel | Freq. [MHz] | PSD (dBm) | PSD Limit (dBm | Margin (dB) |
|---|---|---|---|---|
| Low | 923.3 | 7.668 | 8 | 0.332 |
| Mid | 925.1 | 7.565 | 8 | 0.435 |
| High | 927.5 | 7.416 | 8 | 0.584 |

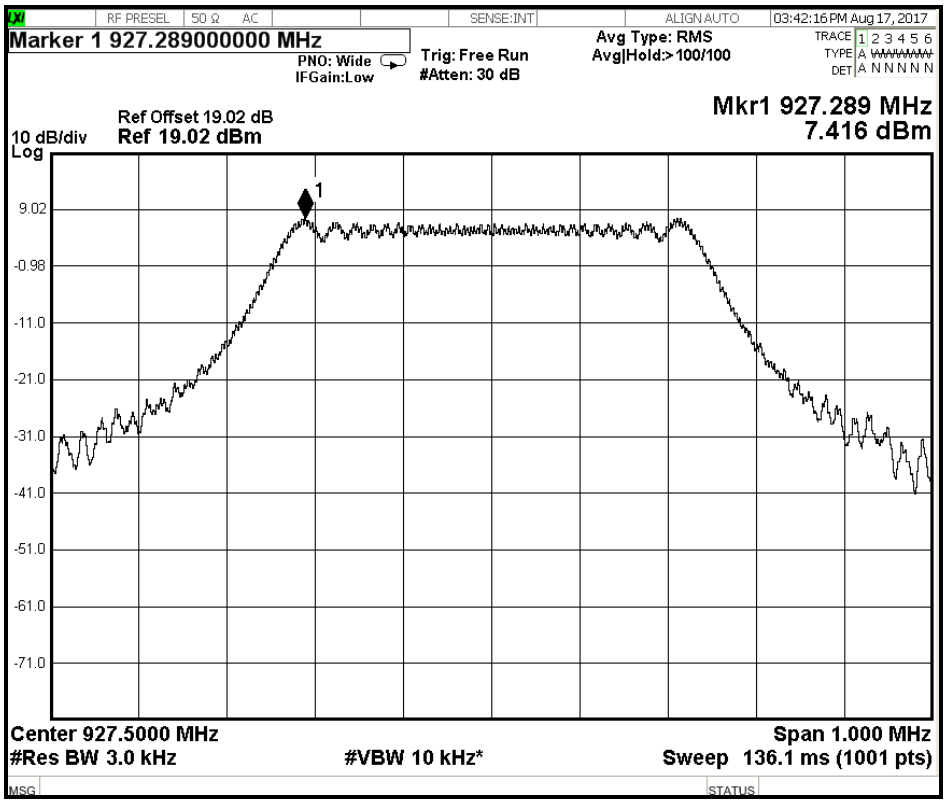
**Screen Capture from Spectrum Analyzer:**



## Screen Capture from Spectrum Analyzer:




## Screen Capture from Spectrum Analyzer:



## 2.5 Band Edge Attenuation

| | |
|---|---|
| **Test Lab: Electronics Test Centre, Airdrie** | **EUT: Kona Pico Gateway** |
| **Test Personnel: David Raynes** | **Standard: FCC PART 15.247** |
| **Date: August 3, 2017 (21.3°C,37.7% RH)** | **Basic Standard: ANSI C63.10: 2013** |

**EUT status: Compliant**

**Specification: FCC Part 15.247(d)**

**Criteria:** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### 2.5.1 Test Guidance: ANSI C63.10-2013 Clause 11.13.2 & 6.10.4, 6.10.6 / FCC OET KDB 558074

This measurement is performed at the low and high frequencies, with modulation.

The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, with out the need for any further corrections.

The spectrum analyzer is set for a frequency span to show the band edge and the nearest channel. The RBW is set to ≥ 100 kHz. The VBW is set to ≥ (RBW * 3). The Peak detector is used, with the trace set to Max Hold.

The attenuation is measured with the Marker Delta function.

### 2.5.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

### 2.5.3 Test Equipment

Testing was performed with the following equipment:

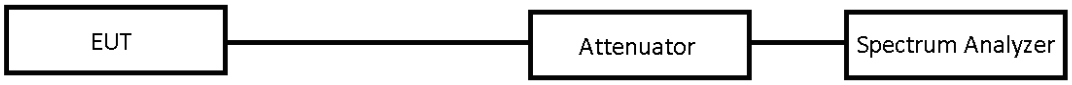
| Equipment | Manufacturer | Model # | Asset # | Calibration Date | Calibration Due |
|---|---|---|---|---|---|
| EMI receiver | Agilent | N9038A | 6130 | 2017-06-20 | 2018-06-20 |
| Temp/Humidity | Extech | 42270 | 5892 | 2017-04-06 | 2018-04-06 |
| Attenuator | JFW | 50FH-020-10 | | Monitored | |
| DC Blocker | MCL | BLK-89-S+ | | Monitored | |

### 2.5.4 Test Sample Verification, Configuration & Modifications

The EUT was set to transmit continuously on a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

**Test setup diagrams for Band Edge Attenuation testing:**

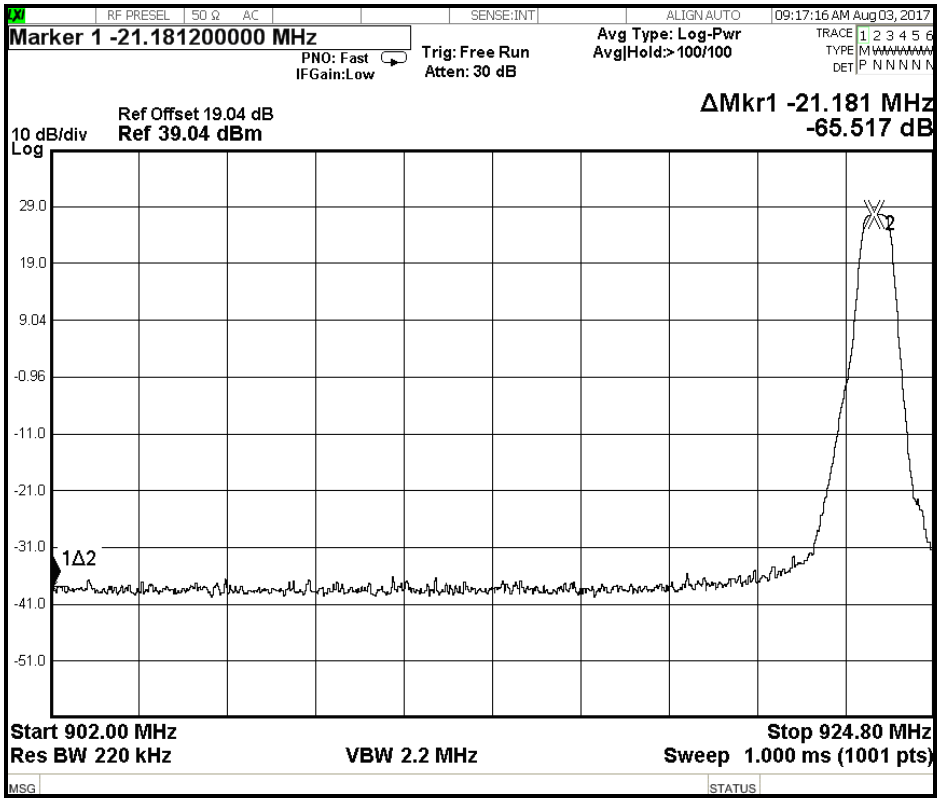
**Conducted:**



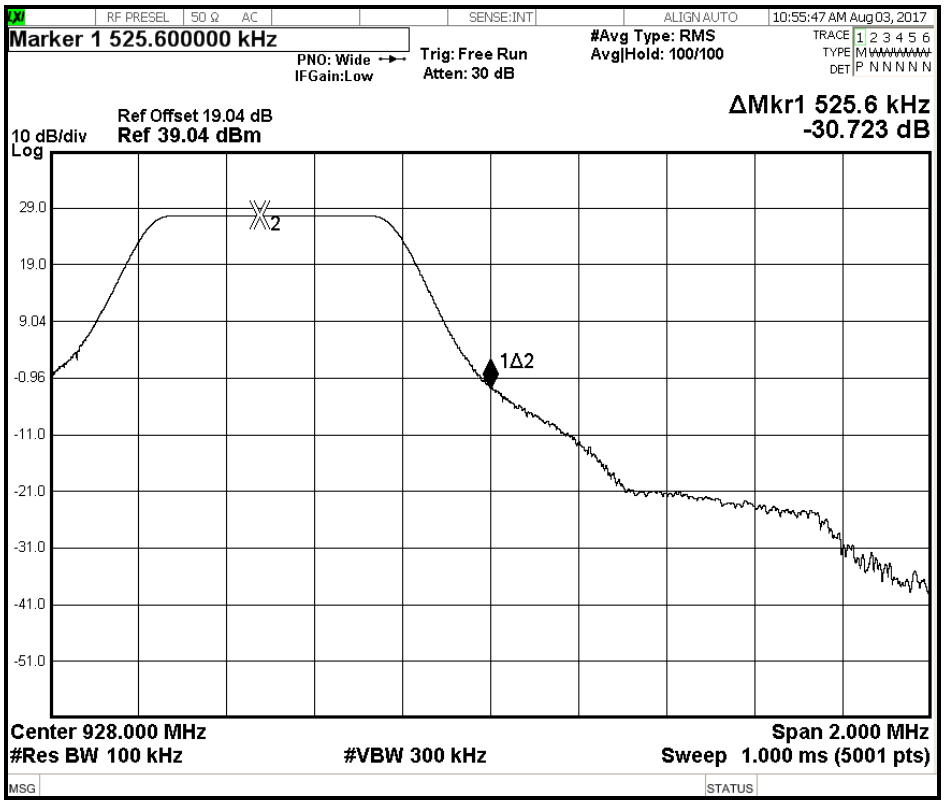

### 2.5.5 Band Edge Data

| Modulation | Channel | Attenuation at Band Edge | Attenuation Limit at Band Edge |
|---|---|---|---|
| Lora 500KHz DTS | 923.3 | 65.517 dBc | 20 dBc |
| | 927.5 | 30.723 dBc | 20 dBc |

## Screen Capture from the spectrum analyzer: Lower Band Edge (DTS)




## Screen Capture from the spectrum analyzer: Upper Band Edge (DTS)



## 2.6 Conducted Spurious Emissions

| | |
|---|---|
| **Test Lab: Electronics Test Centre, Airdrie** | **EUT: Kona Pico Gateway** |
| **Test Personnel: David Raynes** | **Standard: FCC PART 15.247** |
| **Date: August 3, 2017 (21.3°C,37.7% RH)** | **Basic Standard: ANSI C63.4-2014**<br>**FCC OET KDB 558470 v04 DTS** |

**EUT status: Compliant**

**Specification: FCC Part 15.247(d)**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

### 2.6.1 Test Guidance: ANSI C63.10-2013, Clause 6.7

This measurement is performed at the low, mid and high frequencies, with modulation.
The RF output of EUT with an antenna connector is fed to the input of the spectrum analyzer through appropriate attenuation. The loss from the cable and the attenuator were added on the analyzer as gain offset setting there by allowing direct measurements, with out the need for any further corrections.
The spectrum analyzer is stepped through the spectrum in frequency spans selected to ensure acceptable frequency resolution. The RBW is set to 100 kHz. The VBW is set to ≥ 300 kHz. The Peak detector is used, with the trace set to Max Hold.

### 2.6.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

### 2.6.3 Test Equipment

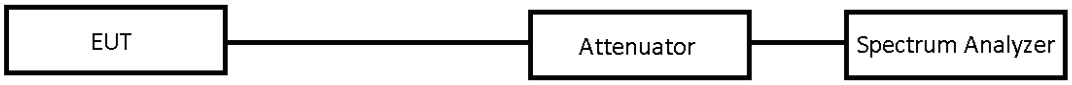
Testing was performed with the following equipment:

| Equipment | Manufacturer | Model # | Asset # | Calibration Date | Calibration Due |
|---|---|---|---|---|---|
| EMI receiver | Agilent | N9038A | 6130 | 2017-06-20 | 2018-06-20 |
| Temp/Humidity | Extech | 42270 | 5892 | 2017-04-06 | 2018-04-06 |
| Attenuator | JFW | 50FH-020-10 | | Monitored | |
| DC Blocker | MCL | BLK-89-S+ | | Monitored | |

### 2.6.4 Test Sample Verification, Configuration & Modifications

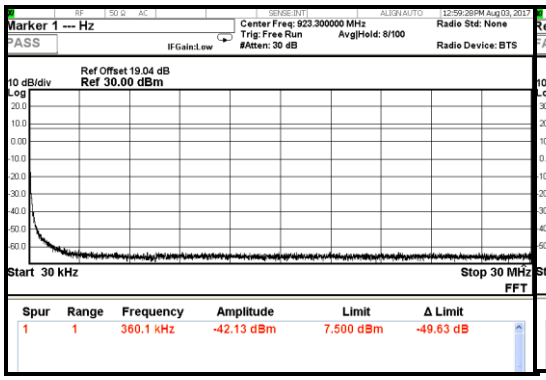
The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation. The EUT met the requirements without modification.

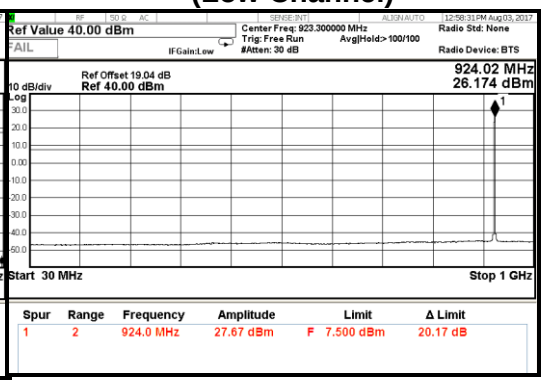
## Test setup diagram for Conducted Spurious Emissions testing:

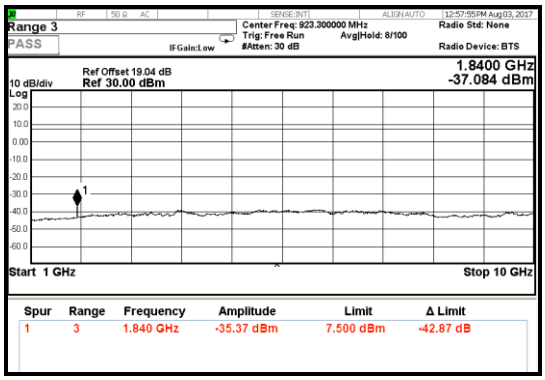



## 2.6.5 Conducted Emissions Data: 500 KHz DTS

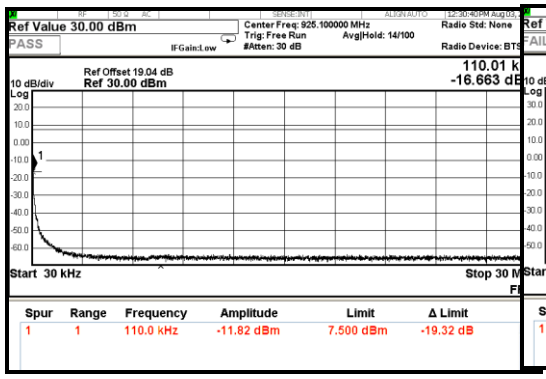
### (Low Channel)

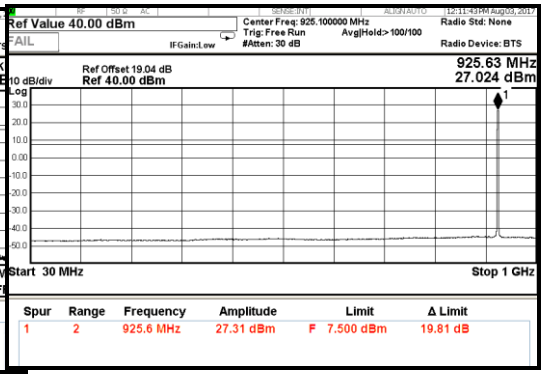


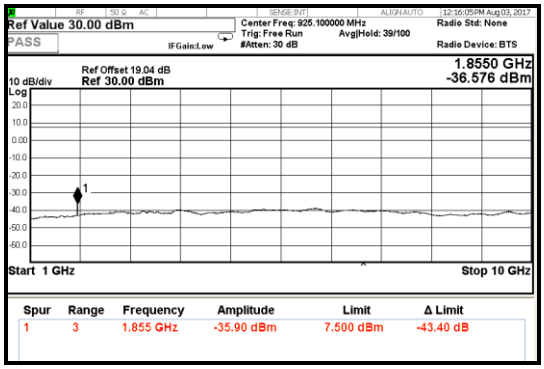



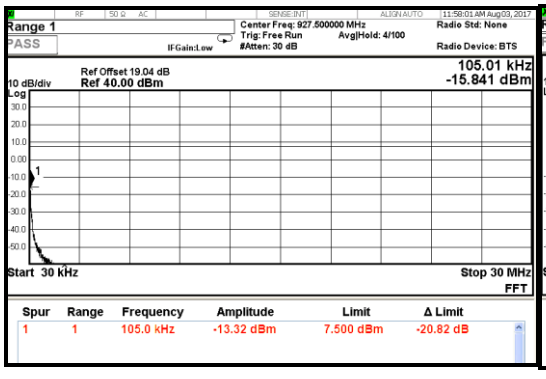

### (MID Channel)

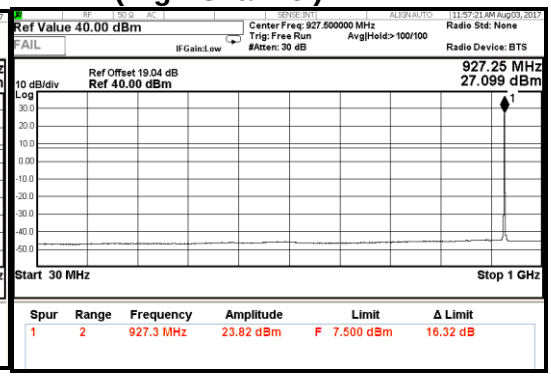


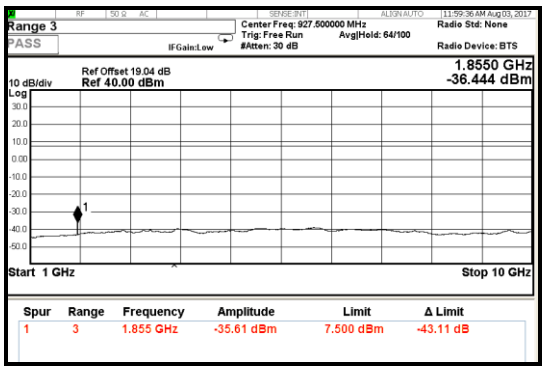




### (High Channel)

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## 2.7 EUT Positioning Assessment

| | |
|---|---|
| **Test Lab: Electronics Test Centre, Airdrie** | **EUT: Kona Pico Gateway** |
| **Test Personnel:** | **Standard: FCC PART 15.247** |
| **Date:** | **Basic Standard: ANSI C63.4-2014** |

**EUT status: N/A**

**Comments:** EUT is not a handheld or portable device. It installed in one orientation in its final installation.

**Specification: ANSI C63.4-2014, Clause 6.3.2.1**

Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a non-conducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m, but it may be larger or smaller to accommodate various sized EUTs (see Figure 6, Figure 7, and Figure 9). For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.

## 2.8 Radiated Spurious Emissions

| | |
|---|---|
| **Test Lab: Electronics Test Centre, Airdrie** | **EUT: Kona Pico Gateway** |
| **Test Personnel: Imran Akram** | **Standard: FCC PART 15.247** |
| **Date: 2017-08-14 (21.4° C,46.4 % RH)** | **Basic Standard: ANSI C63.10-2013** |

**EUT status: Compliant**

**Specification: FCC PART 15.247(d)**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

**Restricted Bands of Operation:**

| MHz | MHz | MHz | MHz | MHz | GHz | GHz |
|---|---|---|---|---|---|---|
| 0.0900000 – 0.1100000 | 8.2910000 - 8.2940000 | 16.804250 - 16.804750 | 162.01250 - 167.17000 * | 1660.0000 – 1710.0000 | 3.6000000 – 4.4000000 | 14.470000 – 14.500000 |
| 0.4950000 - 0.5050000 * | 8.3620000 - 8.3660000 | 25.500000 - 25.670000 | 167.72000 - 173.20000 * | 1718.8000 – 1722.2000 | 4.5000000 – 5.1500000 | 15.350000 – 16.200000 |
| 2.1735000 - 2.1905000 | 8.3762500 - 8.3867500 | 37.500000 - 38.250000 | 240.00000 – 285.00000 | 2200.0000 – 2300.0000 | 5.3500000 – 5.4600000 | 17.700000 – 21.400000 |
| 4.1250000 - 4.1280000 | 8.4142500 - 8.4147500 | 73.000000 - 74.600000 | 322.00000 - 335.40000 | 2310.0000 – 2390.0000 | 7.2500000 – 7.7500000 | 22.010000 – 23.120000 |
| 4.1772500 - 4.1777500 | 12.290000 - 12.293000 | 74.800000 - 75.200000 | 399.90000 – 410.00000 | 2483.5000 – 2500.0000 * | 8.0250000 – 8.5000000 | 23.600000 – 24.000000 |
| 4.2072500 - 4.2077500 | 12.519750 - 12.520250 | 108.00000 - 121.94000 ** | 608.00000 – 614.00000 | 2655.0000 – 2900.0000 | 9.0000000 – 9.2000000 | 31.200000 – 31.800000 |
| 5.6770000 - 5.6830000 | 12.576750 - 12.577250 | 123.00000 - 138.00000 ** | 960.00000 – 1240.0000 *** | 3260..0000 – 3267.0000 | 9.3000000 – 9.5000000 | 36.430000 – 36.500000 |
| 6.2150000 - 6.2180000 | 13.360000 - 13.410000 | 149.90000 - 150.05000 * | 1300.0000 – 1427.0000 *** | 3332.0000 – 3339.0000 | 10.600000 – 12.700000 | Above 38.600000 |
| 6.2677500 - 6.2682500 | 16.420000 - 16.423000 | 156.52475- 156.52525 | 1435.0000 – 1626.5000 | 3345.8000 – 3358.0000 | 13.250000 – 13.400000 | |
| 6.3117500 - 6.3122500 | 16.694750 - 16.695250 | 156.70000 - 156.90000 | 1645.5000 – 1646.5000 | 3500.0000 – 3600.0000 **** | | |

* US only  ** Canada 108 – 138 MHz  *** Canada 960 – 1427 MHz  **** Canada only

### 2.8.1 Test Guidance: ANSI C63.10-2013, Clause 13.4.2

From 9 kHz to 150 kHz (resolution bandwidth of 200 Hz) and from 150 kHz to 30 MHz (resolution bandwidth 9 kHz) measurements are performed with a loop antenna (as per KDB 460108).

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz. The EUT is raised to 150 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The scan is performed at discreet increments of turntable azimuth and antenna height, which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

Frequencies having peak emissions within 10dB of the limits are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

### 2.8.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

### 2.8.3 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document “Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002.” as based on the “ISO Guide to the Expression of Uncertainty in Measurement, 1995.”

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of k = 2.

| Test Method | Frequency | Uncertainty |
|---|---|---|
| Radiated Emissions Level | 30 MHz – 1 GHz | ±4.6 dB |
| Radiated Emissions Level | 1 GHz – 26.5 GHz | ±5.31 dB |

### 2.8.4 Test Equipment

Testing was performed with the following equipment:

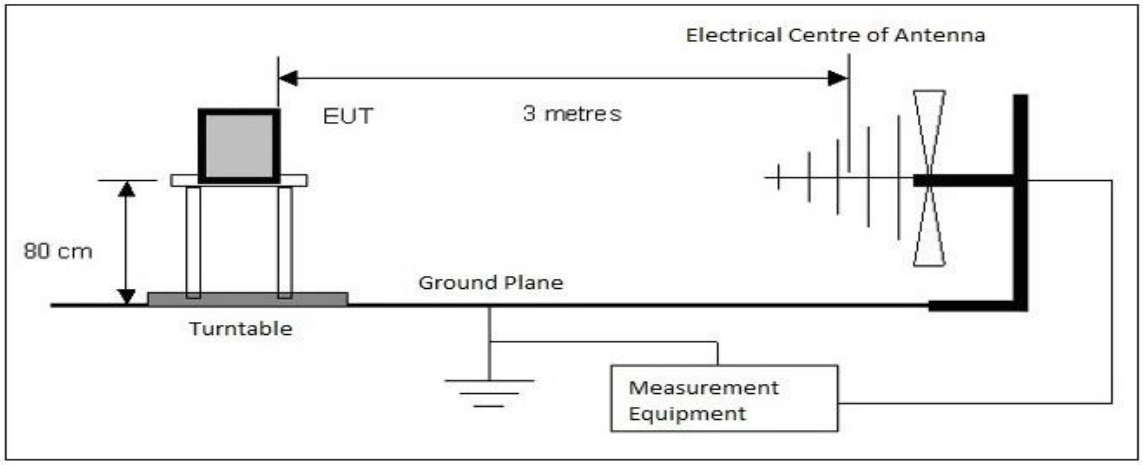
| Equipment | Manufacturer | Model # | Asset # | Calibration Date | Calibration Due |
|---|---|---|---|---|---|
| EMC Software | UL | Ver. 9.5 | ETC-SW-EMC 2.1 | N/A | |
| EMI receiver | Agilent | N9038A | 6130 | 2017-06-20 | 2018-06-20 |
| Loop Antenna | EMCO | 6502 | 10868 | 2017-03-29 | 2019-03-29 |
| Biconilog Antenna | ARA | LPB-2520/A | 4318 | 2016-05-18 | 2018-05-18 |
| DRG Horn | EMCO | 3115 | 19357 | 2016-08-24 | 2018-08-24 |
| Humidity/Temp Logger | Extech Ins. Corp. | 42270 | 5892 | 2017-04-06 | 2018-04-06 |
| Low Noise Amplifier (1 – 18 GHz) | MITEQ | JS43-01001800-21-5P | 4354 | Monitored | |
| Pre-Amplifier | hp | 8447D | 9291 | Monitored | |

### 2.8.5 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation.

The EUT met the requirements without modification.

**Test setup diagram for Radiated Spurious Emissions testing (below 1GHz):**




Above 1GHz, the EUT is raised using a low permittivity material (polystyrene) to a height of 1.5m.

### 2.8.6 Radiated Emissions Data:

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

**Meter Reading in dBμV + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dbμV/m.**

**Delta = Field Strength - Limit**

**Notes:**

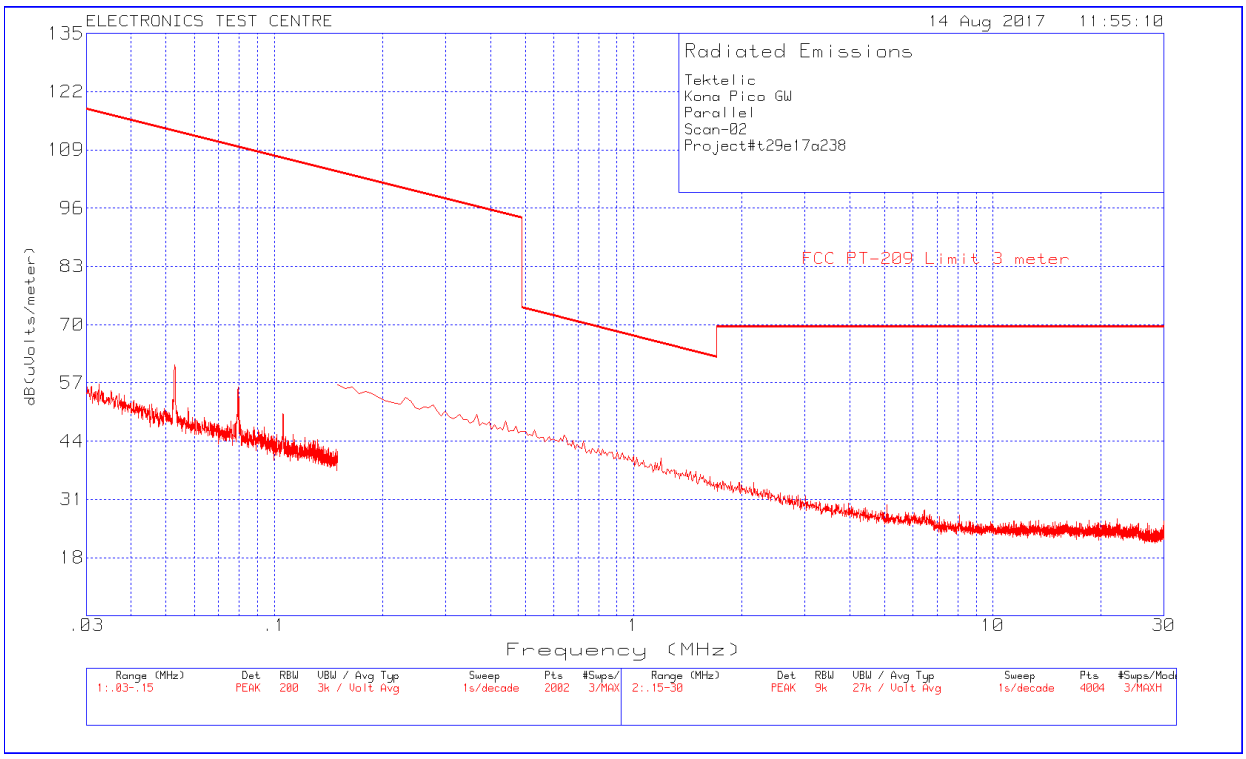
- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet increments of height and azimuth, while the reported measurement is obtained with the appropriate Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission.
- Preliminary scans were performed for all channels in Transmit modes. The Upper band channel 927.5 MHz was selected as the worst-case condition for detailed examination.
- In Transmit mode, the EUT was assessed up to 10.0 GHz.

**Negative values for Delta indicate compliance.**

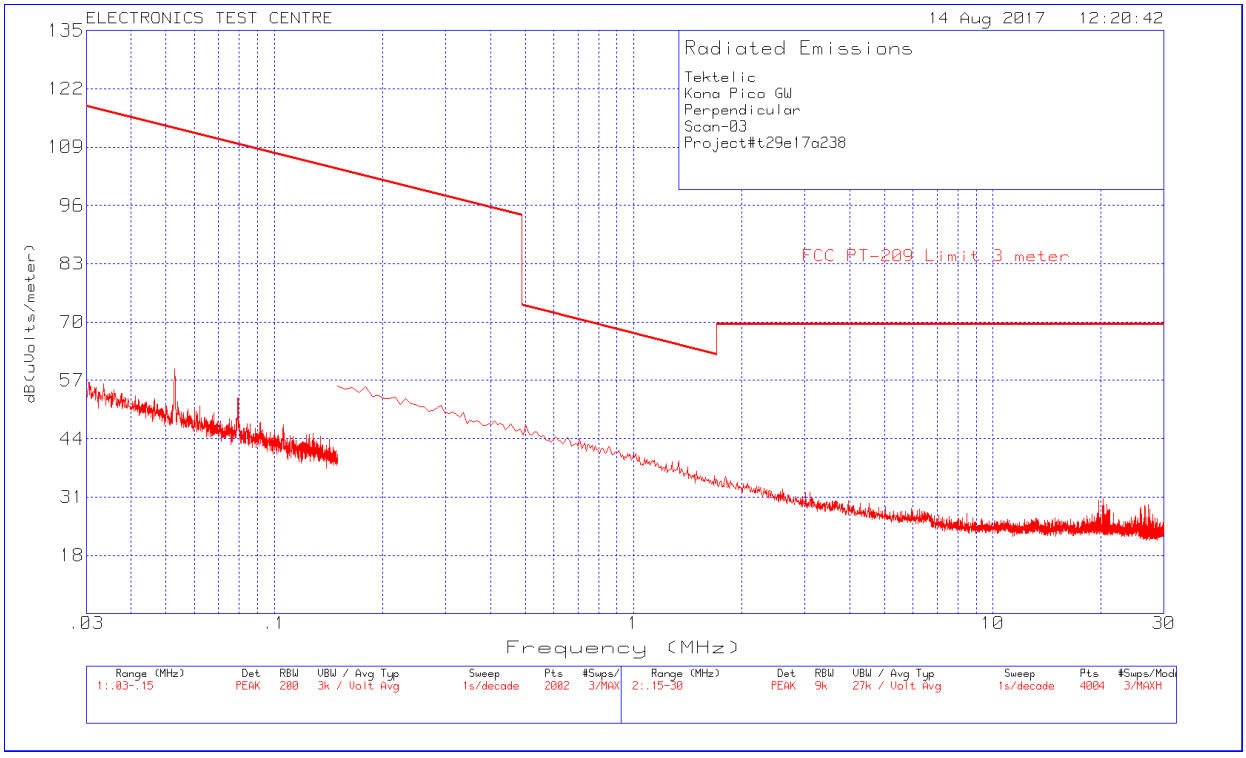
| Freq. Marker | Freq. [MHz] | Raw reading [dBμv] | Det | Antenna Factor [dB/m] | Pre amp Gain [dB] | Corrected Reading [dBμv/m] | FCC 15.209 Limit [dBμv/m] | Delta [dB] | Azimuth [Deg] | Height [cm] | Polarization |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 32.5942 | 34.17 | QP | 21.7 | -25.1 | 30.77 | 40 | -9.23 | 90 | 100 | Vertical |
| 2 | 104.7443 | 46.68 | QP | 13.5 | -24 | 36.18 | 43.5 | -7.32 | 113 | 116 | Vertical |
| 3 | *111.5634 | 44.44 | QP | 14.5 | -24 | 34.94 | 43.5 | -8.56 | 89 | 105 | Vertical |
| 4 | 145.2558 | 42.83 | QP | 12.5 | -23.7 | 31.63 | 43.5 | -11.87 | 359 | 100 | Vertical |
| 1 | 1855.1 | 62.31 | PK | 27.6 | -34.6 | 55.31 | 74 | -18.69 | 70 | 159 | Horizontal |
| 1 | 1855.2 | 58.02 | AV | 27.6 | -34.6 | 51.02 | 54 | -2.98 | 73 | 154 | Horizontal |
| 2 | *2783.3 | 48.5 | PK | 29.3 | -33.6 | 44.2 | 74 | -29.8 | 69 | 164 | Horizontal |
| 2 | *2783.3 | 38.12 | AV | 29.3 | -33.6 | 33.82 | 54 | -20.18 | 69 | 164 | Horizontal |
| 3 | 1854.6 | 52.95 | PK | 27.6 | -34.6 | 45.95 | 74 | -28.05 | 24 | 169 | Vertical |
| 3 | 1854.8 | 49.69 | AV | 27.6 | -34.6 | 42.69 | 54 | -11.31 | 24 | 169 | Vertical |
| 1 | *7420.0 | 31.45 | PK | 36.5 | -27.7 | 40.25 | 74 | -33.75 | 0 | 214 | Vertical |
| 1 | *7420.0 | 23.38 | AV | 36.5 | -27.7 | 32.18 | 54 | -21.82 | 0 | 214 | Vertical |

*** Restricted Band**

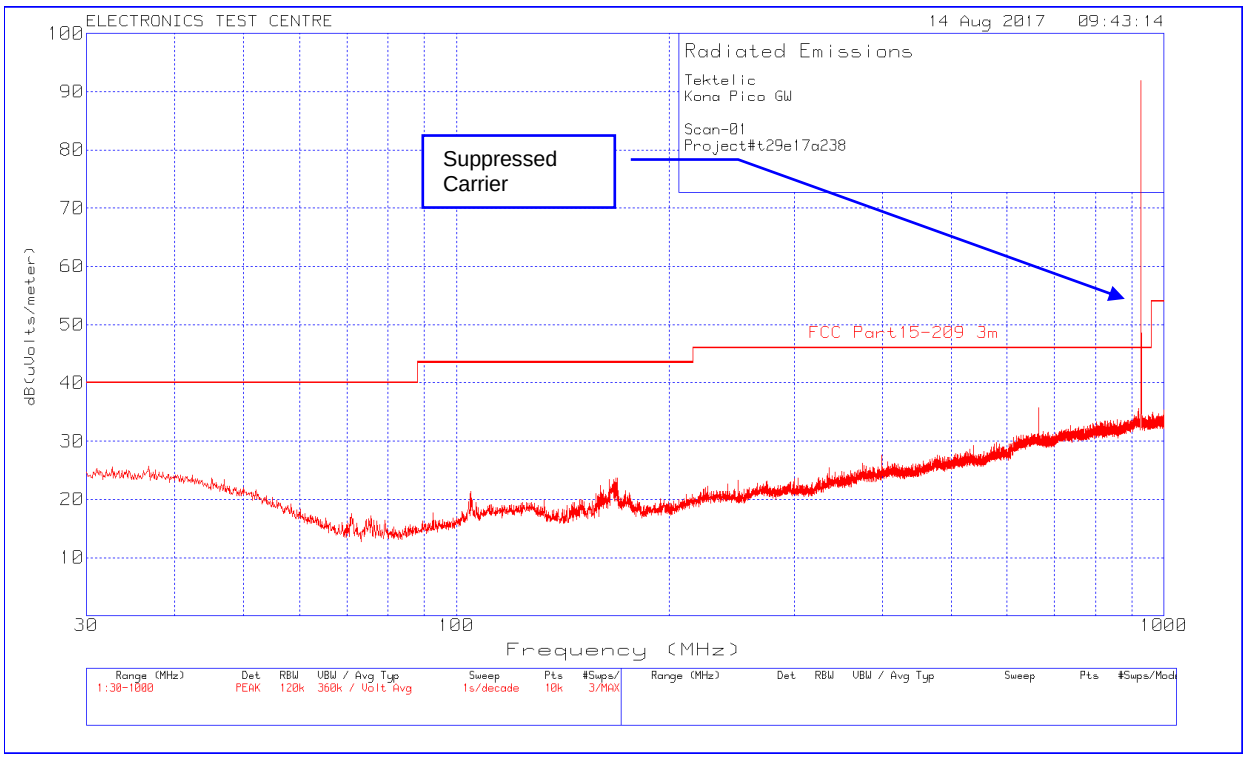
## Plot of Radiated Emissions: Measuring Antenna 1st Orientation



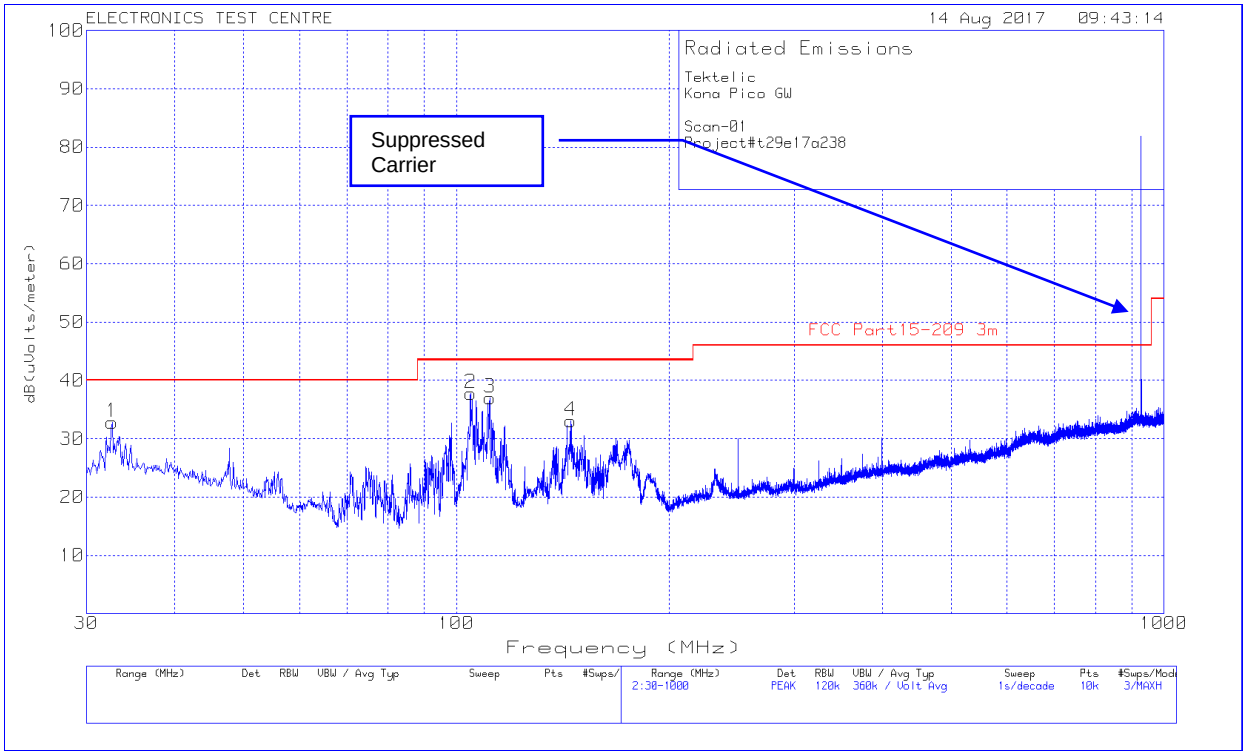

## Plot of Radiated Emissions: Measuring Antenna 2nd Orientation



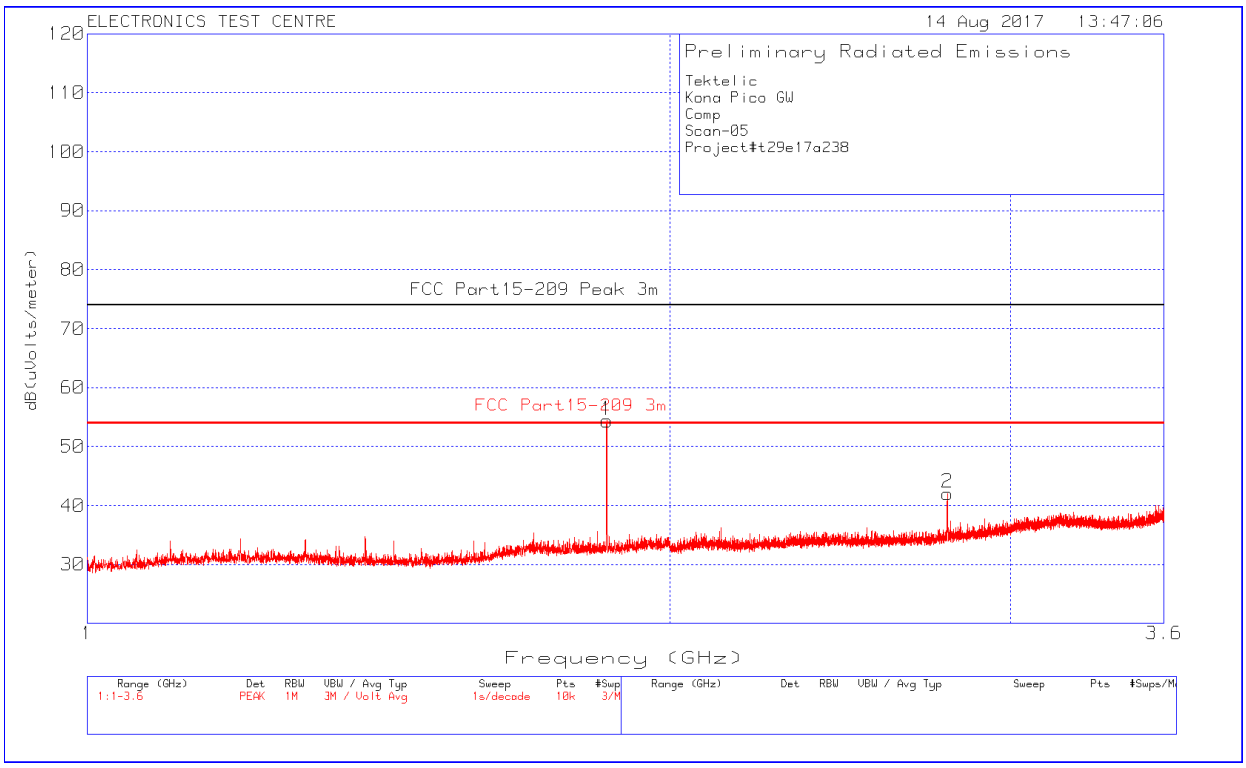
## Plot of Radiated Emissions: Horizontal polarization



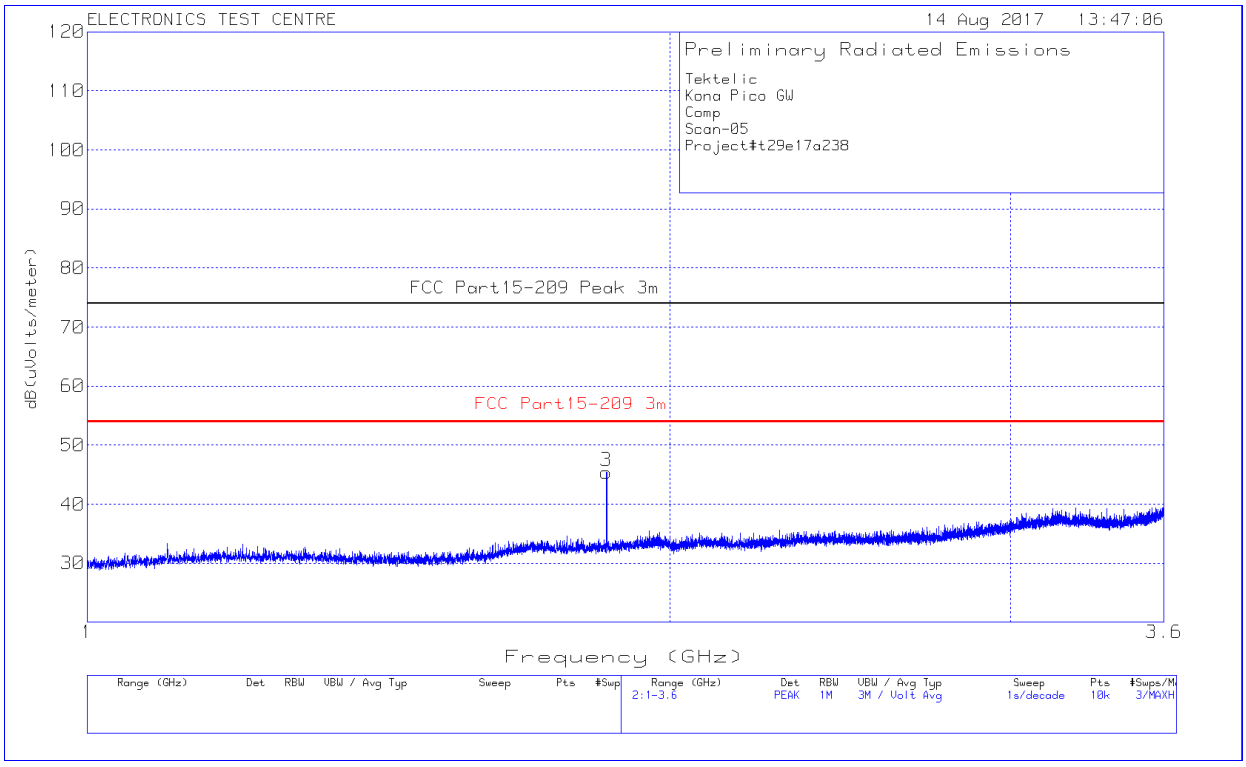

## Plot of Radiated Emissions: Vertical polarization



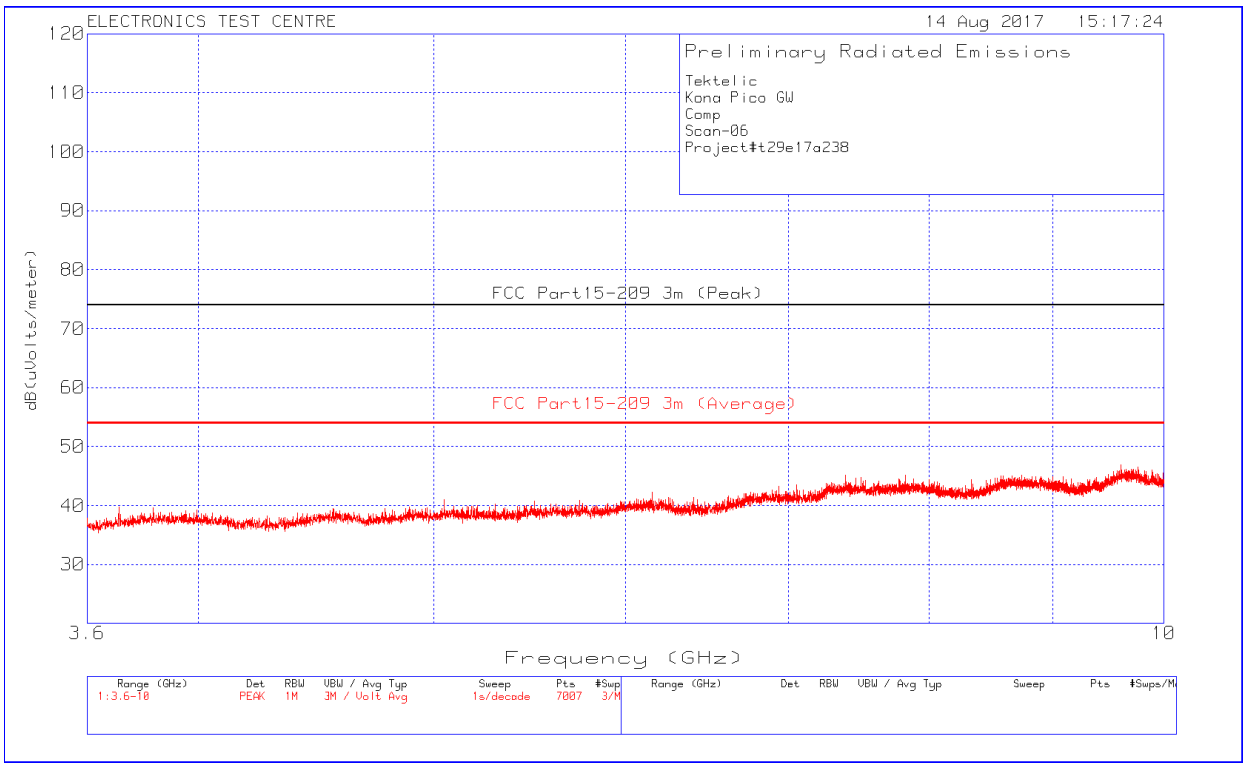
## Plot of Radiated Emissions: Horizontal polarization



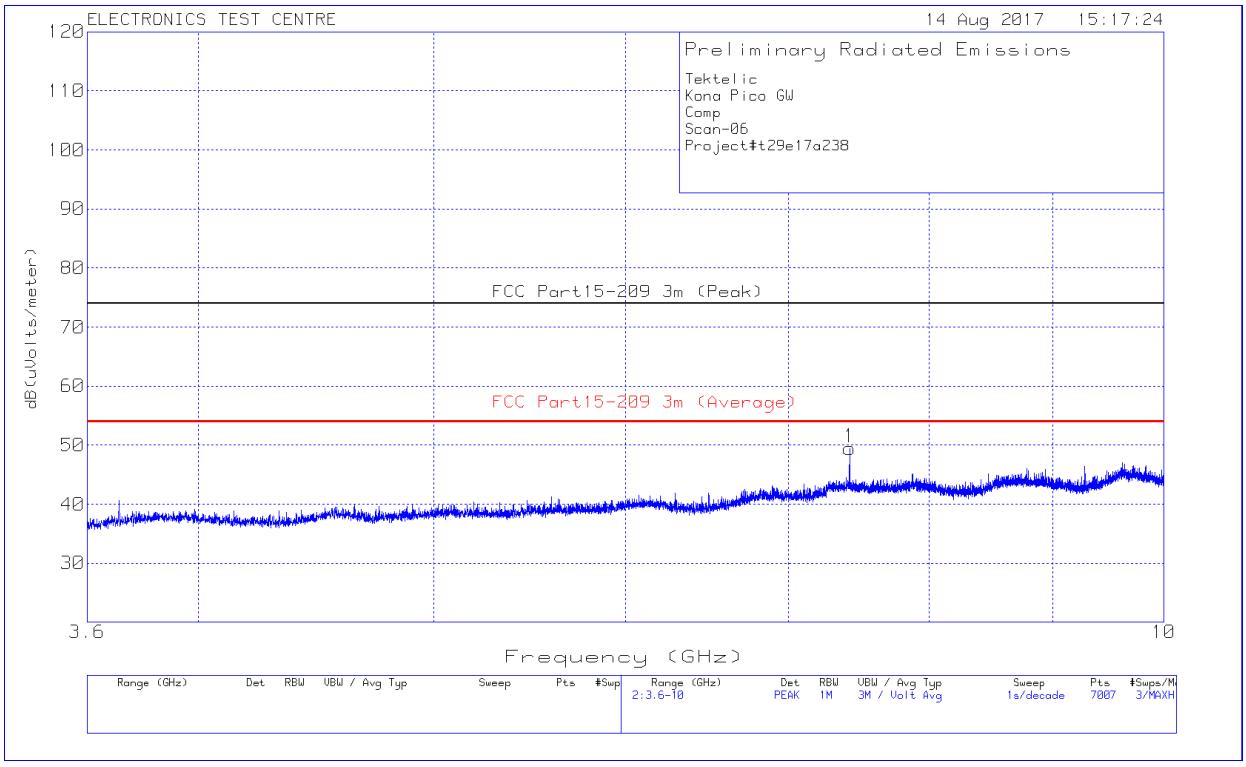

## Plot of Radiated Emissions: Vertical polarization



## Plot of Radiated Emissions: Horizontal polarization




## Plot of Radiated Emissions: Vertical polarization



## 2.9 Radiated Spurious Emissions (Co-Location)

| | |
|---|---|
| **Test Lab: Electronics Test Centre, Airdrie** | **EUT: Kona Pico Gateway** |
| **Test Personnel: Imran Akram/Henry Cookeygam** | **Standard: FCC PART 15.247/ FCC Part15.209** |
| | **Basic Standard: ANSI C63.10-2013** |
| **Date: 2017-08-14/15**<br>**(21.4° C,46.4% RH), (20.3° C,38.8% RH)** | |

**EUT status: Compliant**

**Specification: FCC PART 15.247(d)**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

**Restricted Bands of Operation:**

| MHz | MHz | MHz | MHz | MHz | GHz | GHz |
|---|---|---|---|---|---|---|
| 0.0900000 – 0.1100000 | 8.2910000 - 8.2940000 | 16.804250 - 16.804750 | 162.01250 - 167.17000 * | 1660.0000 – 1710.0000 | 3.6000000 – 4.4000000 | 14.470000 – 14.500000 |
| 0.4950000 - 0.5050000 * | 8.3620000 - 8.3660000 | 25.500000 - 25.670000 | 167.72000 - 173.20000 * | 1718.8000 – 1722.2000 | 4.5000000 – 5.1500000 | 15.350000 – 16.200000 |
| 2.1735000 - 2.1905000 | 8.3762500 - 8.3867500 | 37.500000 - 38.250000 | 240.00000 – 285.00000 | 2200.0000 – 2300.0000 | 5.3500000 – 5.4600000 | 17.700000 – 21.400000 |
| 4.1250000 - 4.1280000 | 8.4142500 - 8.4147500 | 73.000000 - 74.600000 | 322.00000 - 335.40000 | 2310.0000 – 2390.0000 | 7.2500000 – 7.7500000 | 22.010000 – 23.120000 |
| 4.1772500 - 4.1777500 | 12.290000 - 12.293000 | 74.800000 - 75.200000 | 399.90000 – 410.00000 | 2483.5000 – 2500.0000 * | 8.0250000 – 8.5000000 | 23.600000 – 24.000000 |
| 4.2072500 - 4.2077500 | 12.519750 - 12.520250 | 108.00000 - 121.94000 ** | 608.00000 – 614.00000 | 2655.0000 – 2900.0000 | 9.0000000 – 9.2000000 | 31.200000 – 31.800000 |
| 5.6770000 - 5.6830000 | 12.576750 - 12.577250 | 123.00000 - 138.00000 ** | 960.00000 – 1240.0000 *** | 3260..0000 – 3267.0000 | 9.3000000 – 9.5000000 | 36.430000 – 36.500000 |
| 6.2150000 - 6.2180000 | 13.360000 - 13.410000 | 149.90000 - 150.05000 * | 1300.0000 – 1427.0000 *** | 3332.0000 – 3339.0000 | 10.600000 – 12.700000 | Above 38.600000 |
| 6.2677500 - 6.2682500 | 16.420000 - 16.423000 | 156.52475-156.52525 | 1435.0000 – 1626.5000 | 3345.8000 – 3358.0000 | 13.250000 – 13.400000 | |
| 6.3117500 - 6.3122500 | 16.694750 - 16.695250 | 156.70000 - 156.90000 | 1645.5000 – 1646.5000 | 3500.0000 – 3600.0000 **** | | |

* US only  ** Canada 108 – 138 MHz  *** Canada 960 – 1427 MHz  **** Canada only

### 2.9.1 Test Guidance: ANSI C63.10-2013, Clause 13.4.2

From 9 kHz to 150 kHz (resolution bandwidth of 200 Hz) and from 150 kHz to 30 MHz (resolution bandwidth 9 kHz) measurements are performed with a loop antenna (as per KDB 460108).

From 30 MHz to 1000 MHz, measurements are performed with a broadband biconilog antenna and a resolution bandwidth of 120 kHz.

Above 1000 MHz, measurements are performed with a DRG Horn antenna or a Standard Gain horn, and a resolution bandwidth of 1 MHz. The EUT is raised to 150 cm above the ground plane, and the area between the EUT and the antenna mast is covered with RF absorbent material.

The scan is performed at discreet increments of turntable azimuth and antenna height, which are selected in accordance with the applicable standard in order to assure capture of frequencies of interest. Optimization is performed based on the scan data.

Frequencies having peak emissions within 10dB of the limits are optimized. The EUT is rotated in azimuth over 360 degrees and the direction of maximum emission is noted.

Antenna height is varied from 1 – 4 meters at this azimuth to obtain the maximum emission. Then the maximum level is measured with the appropriate detector and recorded. Up to 1 GHz, measurements are performed with a Quasi-Peak detector. Above 1 GHz, measurements are recorded with Peak and/or Average detectors, as applicable.

### 2.9.2 Deviations From The Standard:

There were no deviations from the EUT setup or methodology specified in the standard.

### 2.9.3 Uncertainty of Measurement:

The factors contributing to uncertainty of measurement are identified and calculated in accordance with UKAS (United Kingdom Accreditation Service) document “Lab 34, The Expression of Uncertainty in EMC Testing, Aug 2002.” as based on the “ISO Guide to the Expression of Uncertainty in Measurement, 1995.”

This uncertainty estimate represents an expended uncertainty expressed at approximately 95% confidence using a coverage factor of k = 2.

| Test Method | Frequency | Uncertainty |
|---|---|---|
| Radiated Emissions Level | 30 MHz – 1 GHz | ±4.6 dB |
| Radiated Emissions Level | 1 GHz – 26.5 GHz | ±5.31 dB |

### 2.9.4 Test Equipment

Testing was performed with the following equipment:

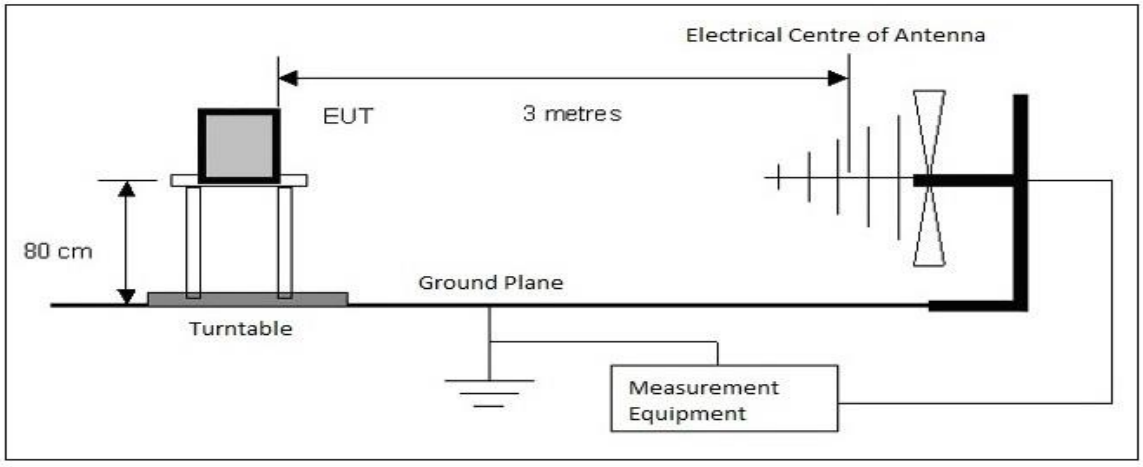
| Equipment | Manufacturer | Model # | Asset # | Calibration Date | Calibration Due |
|---|---|---|---|---|---|
| EMC Software | UL | Ver. 9.5 | ETC-SW-EMC 2.1 | N/A | |
| EMI receiver | Agilent | N9038A | 6130 | 2017-06-20 | 2018-06-20 |
| Loop Antenna | EMCO | 6502 | 10868 | 2017-03-29 | 2019-03-29 |
| Biconilog Antenna | ARA | LPB-2520/A | 4318 | 2016-05-18 | 2018-05-18 |
| DRG Horn | EMCO | 3115 | 19357 | 2016-08-24 | 2018-08-24 |
| Standard Gain Horn | QuinStar Tech. Inc. | QWH-KPRS00 | 6163 | 2016-08-22 | 2018-08-22 |
| Humidity/Temp Logger | Extech Ins. Corp. | 42270 | 5892 | 2017-04-06 | 2018-04-06 |
| Low Noise Amplifier (1 – 18 GHz) | MITEQ | JS43-01001800-21-5P | 4354 | Monitored | |
| Low Noise Amplifier (18 – 26 GHz) | MITEQ | JS44-01002650-33-3P | 6163 | Monitored | |
| Pre-Amplifier | hp | 8447D | 9291 | Monitored | |

### 2.9.5 Test Sample Verification, Configuration & Modifications

The EUT was set to a selected channel with test-specific software. The output was modulated as in normal operation. Both radios (WiFi and Lora) transmitting simultaneously at full power. WiFi is a pre approved module used in the EUT

The EUT met the requirements without modification.

**Test setup diagram for Radiated Spurious Emissions testing (below 1GHz):**




Above 1GHz, the EUT is raised using a low permittivity material (polystyrene) to a height of 1.5m.

### 2.9.6 Radiated Emissions Data:

The emissions data are presented in tabular form, showing turntable azimuth, antenna height and polarization, the uncorrected spectrum analyzer reading, the correction factors applied, the net result, the value of the limit at the frequency investigated, and the Delta between the result and the limit.

**Meter Reading in dBμV + Antenna Factor in dB/m + Gain/Loss Factor in dB = Corrected Field Strength in dbμV/m.**

**Delta = Field Strength - Limit**

**Notes:**

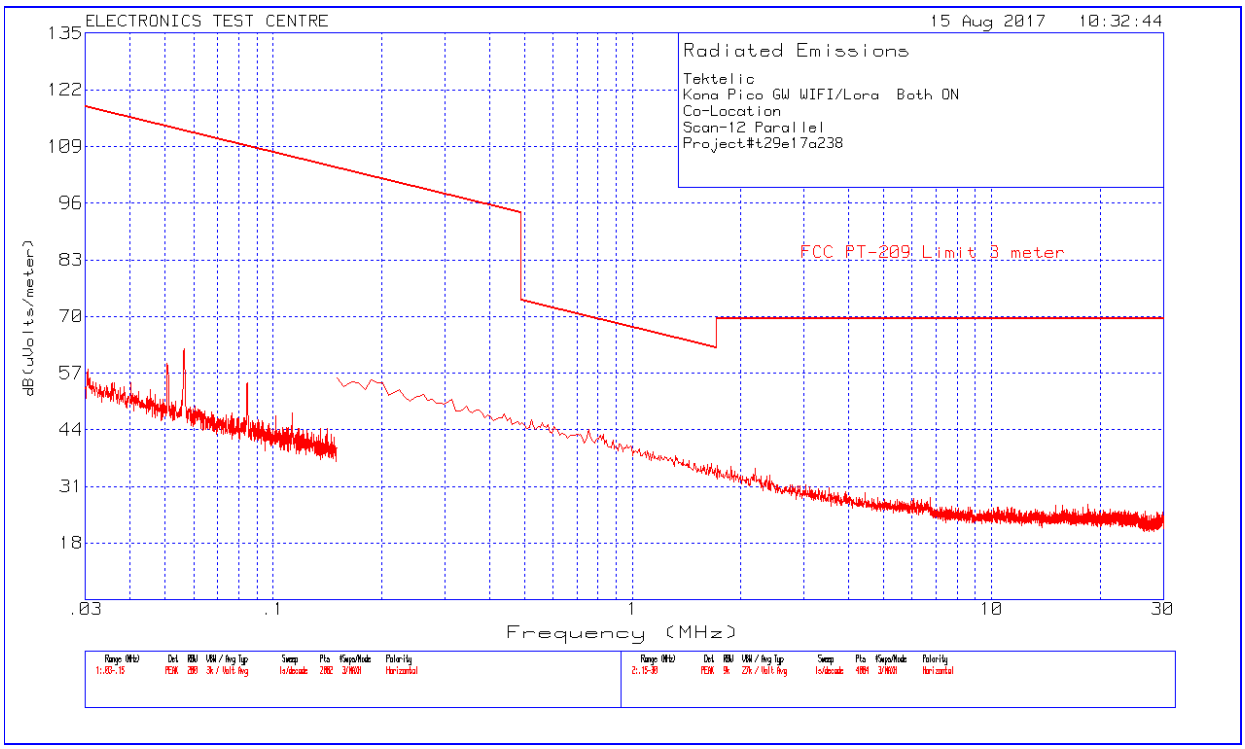
- When a preamp is used, the resulting gain is compensated, producing a negative value for the Cable Loss.
- Measurements reported are the result of adjusting the turntable azimuth and antenna height to obtain the maximum EUT emission. This may produce a different reading than the plot trace. The plot is a Peak Hold function obtained at discreet increments of height and azimuth, while the reported measurement is obtained with the appropriate Quasi Peak or Average detector after the height and azimuth have been adjusted for maximum emission.
- EUT transmitting at Upper band channel 927.5 MHz and WIFI is transmitting with full power at mid Channel.
- In Transmit mode, the EUT was assessed up to 25.0 GHz.

**Negative values for Delta indicate compliance.**

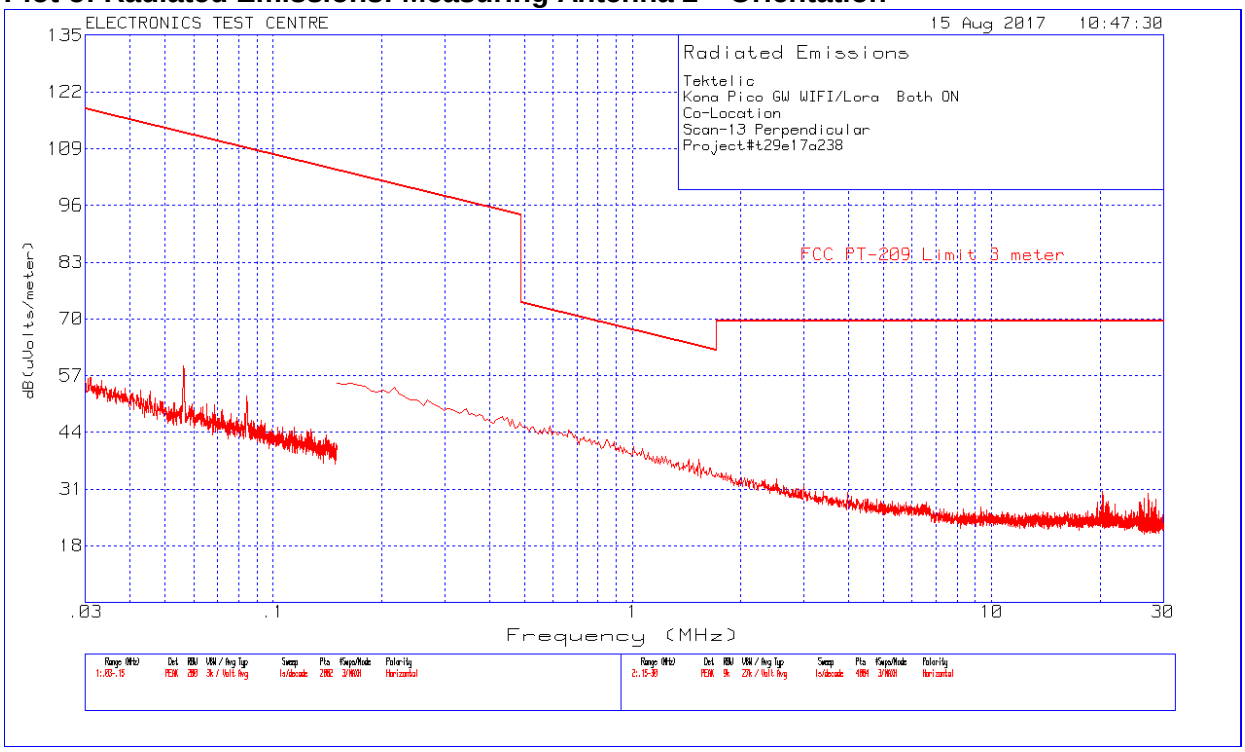
| Freq. Marker | Freq. [MHz] | Raw reading [dBμv] | Det | Antenna Factor [dB/m] | Pre amp Gain [dB] | Corrected Reading [dBμv/m] | FCC 15.209 Limit [dBμv/m] | Delta [dB] | Azimuth [Deg] | Height [cm] | Polarization |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 33.4456 | 30.46 | QP | 21.6 | -25 | 27.06 | 40 | -12.94 | 354 | 100 | Horizontal |
| 2 | 34.1036 | 41.75 | QP | 21.6 | -25 | 38.35 | 40 | -1.65 | 276 | 107 | Vertical |
| 3 | 77.2026 | 46.52 | QP | 10.5 | -24.4 | 32.62 | 40 | -7.38 | 51 | 124 | Vertical |
| 4 | 98.434 | 39.54 | QP | 12.8 | -24.2 | 28.14 | 43.5 | -15.36 | 21 | 100 | Vertical |
| 1 | *3653.1 | 45.67 | AV | 31.8 | -32.7 | 44.77 | 54 | -9.23 | 153 | 289 | Horizontal |
| 1 | *3650.6 | 48.4 | PK | 31.8 | -32.7 | 47.5 | 74 | -26.5 | 152 | 289 | Horizontal |
| 2 | *4872.8 | 40.32 | AV | 33 | -31.5 | 41.82 | 54 | -12.18 | 113 | 251 | Horizontal |
| 2 | *4864.3 | 47.9 | PK | 33 | -31.5 | 49.4 | 74 | -24.6 | 113 | 251 | Horizontal |
| 3 | *7308.9 | 33.74 | AV | 36.4 | -27.8 | 42.34 | 54 | -11.66 | 217 | 108 | Horizontal |
| 3 | *7307.5 | 41.39 | PK | 36.4 | -27.8 | 49.99 | 74 | -24.01 | 217 | 108 | Horizontal |
| 1 | *3652.3 | 28.3 | AV | 31.8 | -32.7 | 27.4 | 54 | -26.6 | 214 | 113 | Vertical |
| 1 | *3650.9 | 49.89 | PK | 31.8 | -32.7 | 48.99 | 74 | -25.01 | 214 | 113 | Vertical |
| 2 | *4873.7 | 41.16 | AV | 33 | -31.5 | 42.66 | 54 | -11.34 | 233 | 116 | Vertical |
| 2 | *4873.7 | 51.74 | PK | 33 | -31.5 | 53.23 | 74 | -20.77 | 233 | 118 | Vertical |
| 3 | *7307.5 | 31.31 | AV | 36.4 | -27.8 | 39.91 | 54 | -14.09 | 114 | 119 | Vertical |
| 3 | *7307.5 | 43.07 | PK | 36.4 | -27.8 | 51.67 | 74 | -22.33 | 114 | 118 | Vertical |

*** Restricted Band**

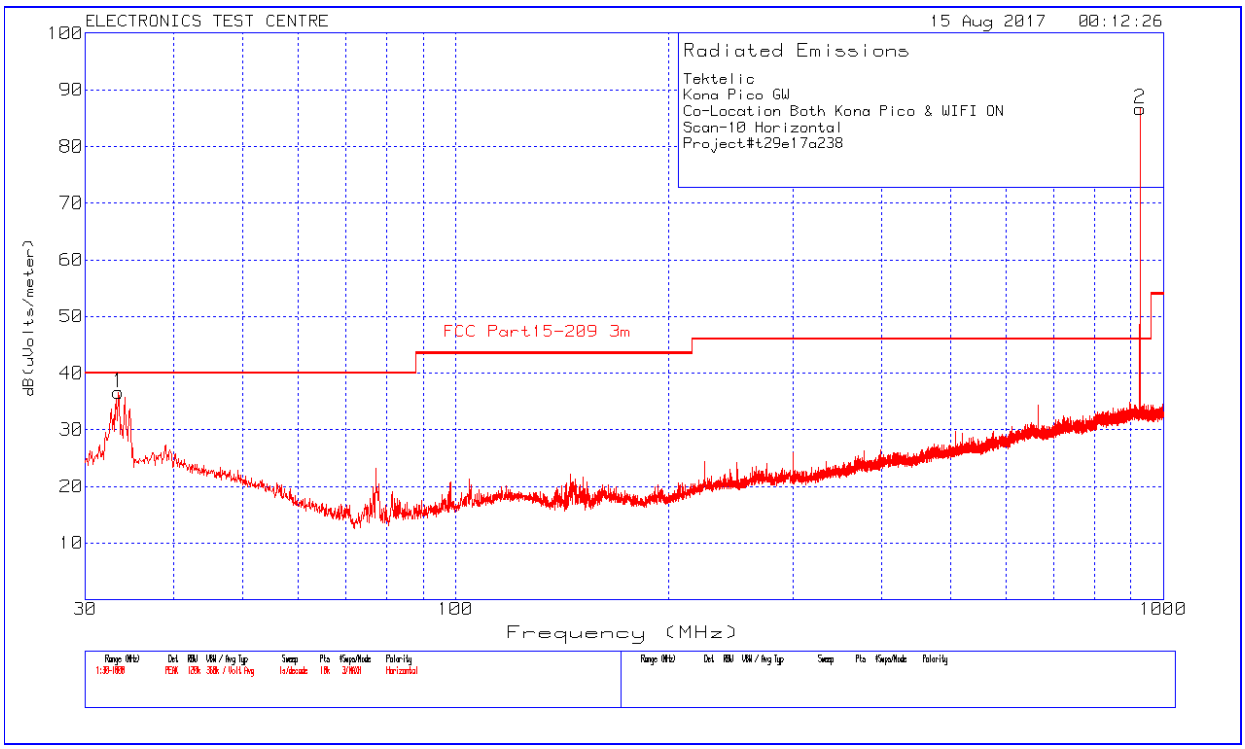
## Plot of Radiated Emissions: Measuring Antenna 1st Orientation



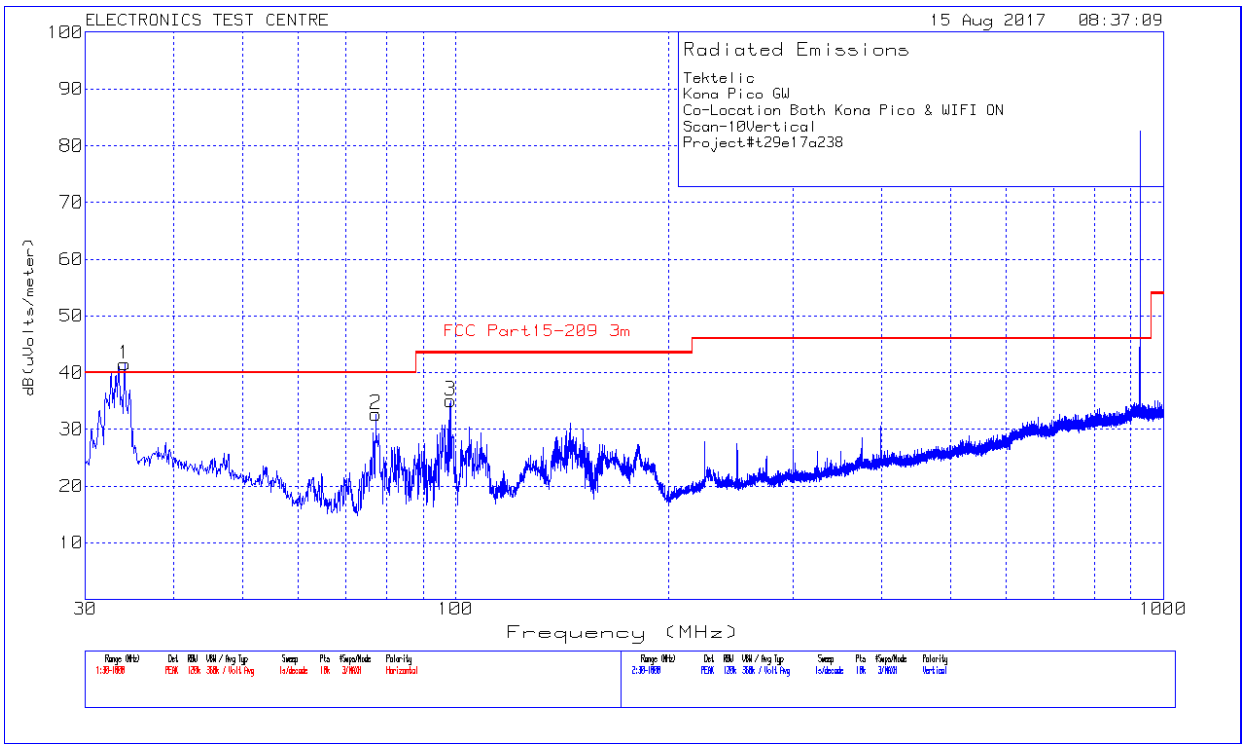

## Plot of Radiated Emissions: Measuring Antenna 2nd Orientation



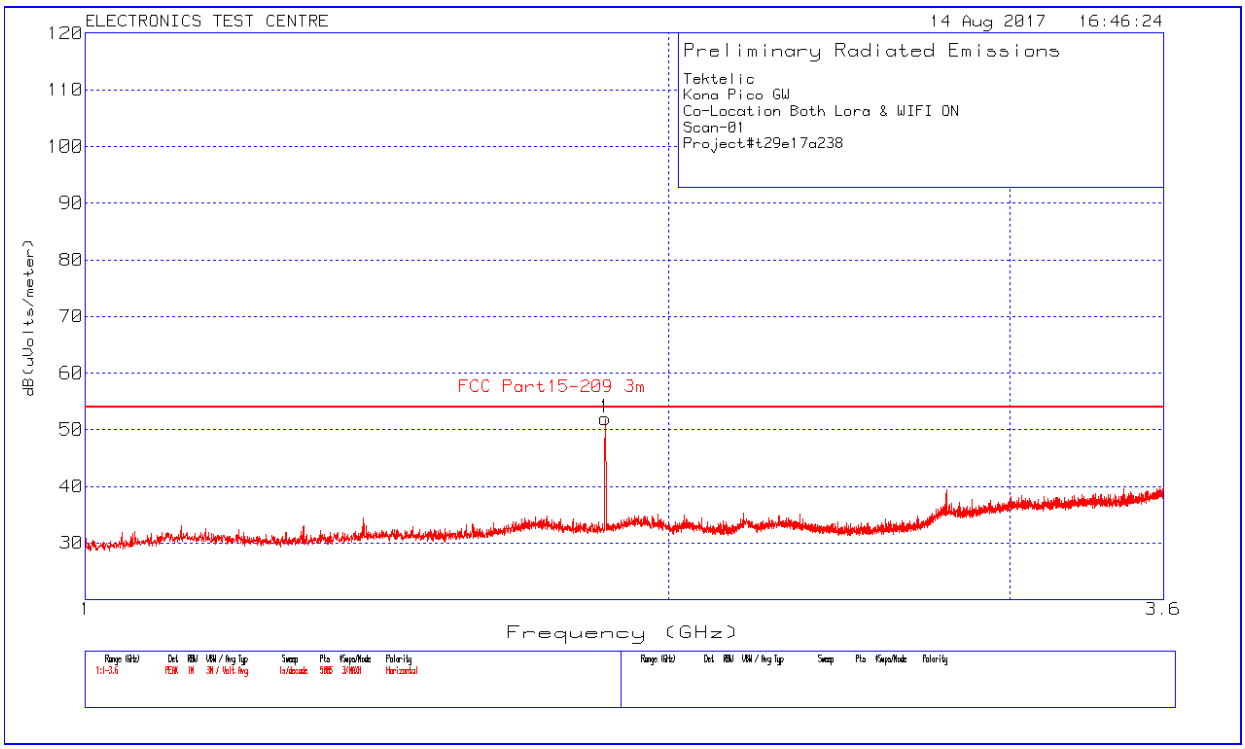
## Plot of Radiated Emissions: Horizontal polarization



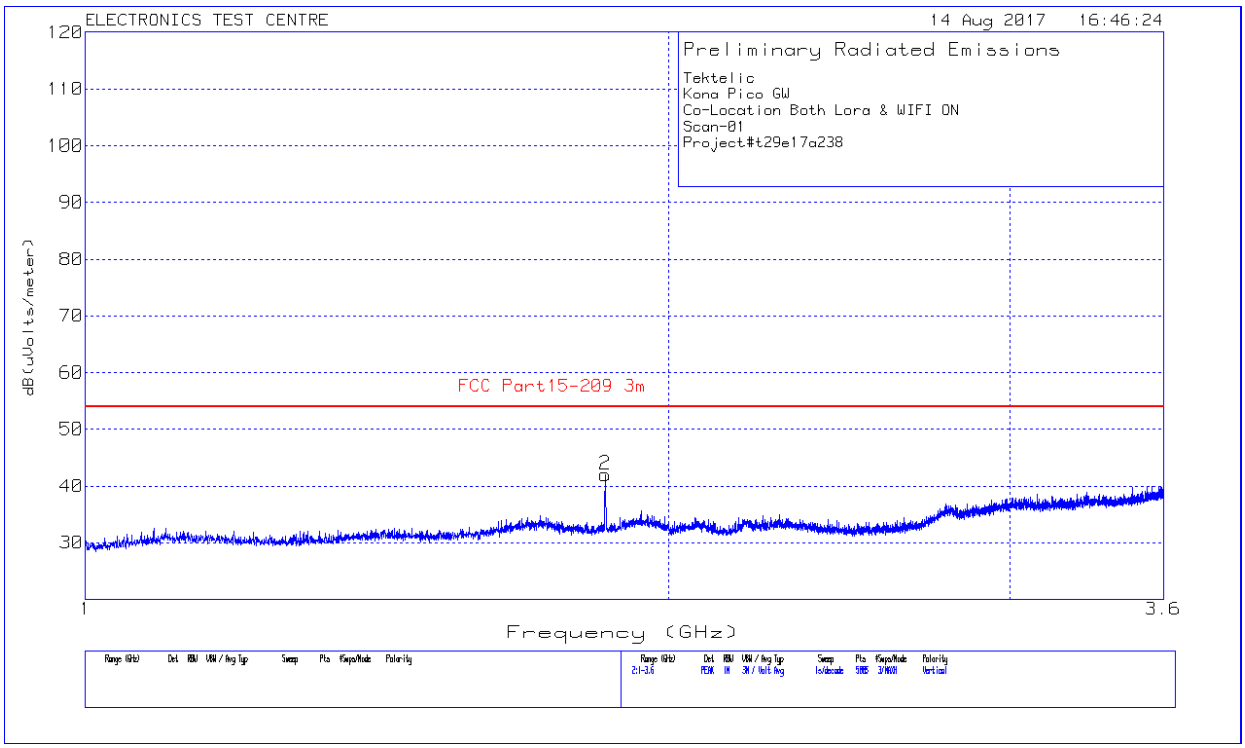

## Plot of Radiated Emissions: Vertical polarization



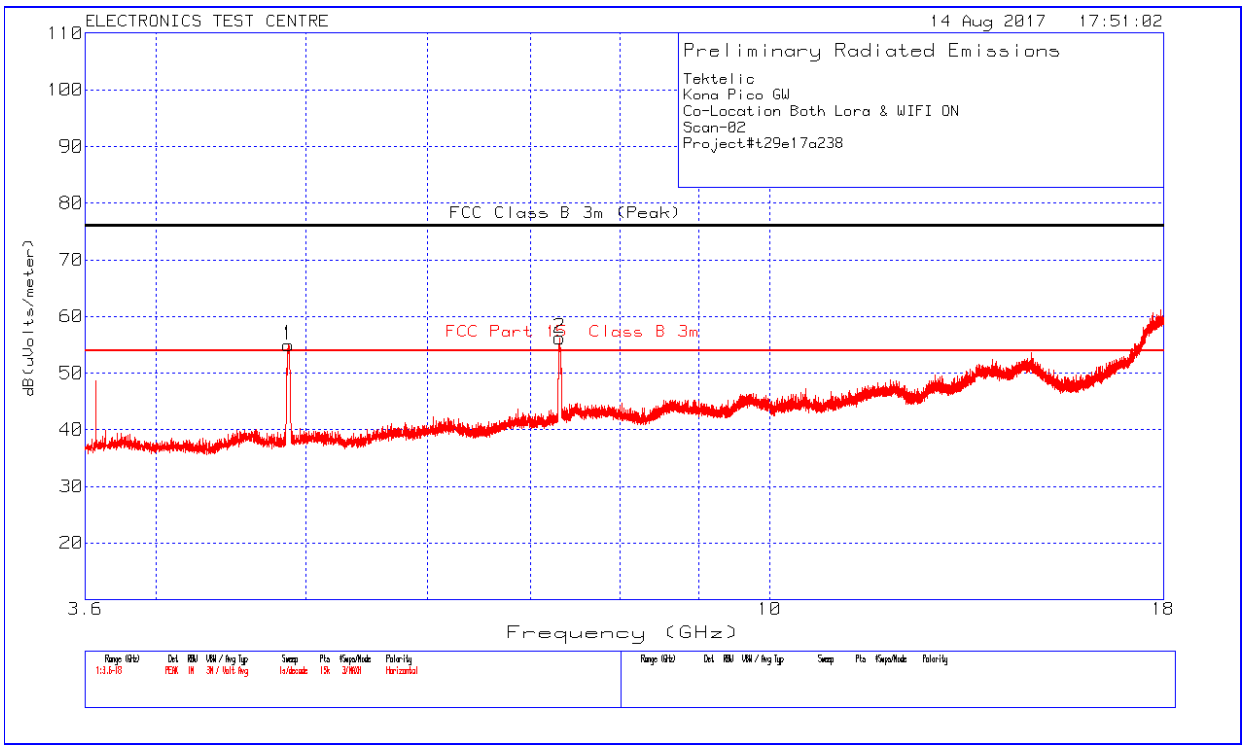
## Plot of Radiated Emissions: Horizontal polarization



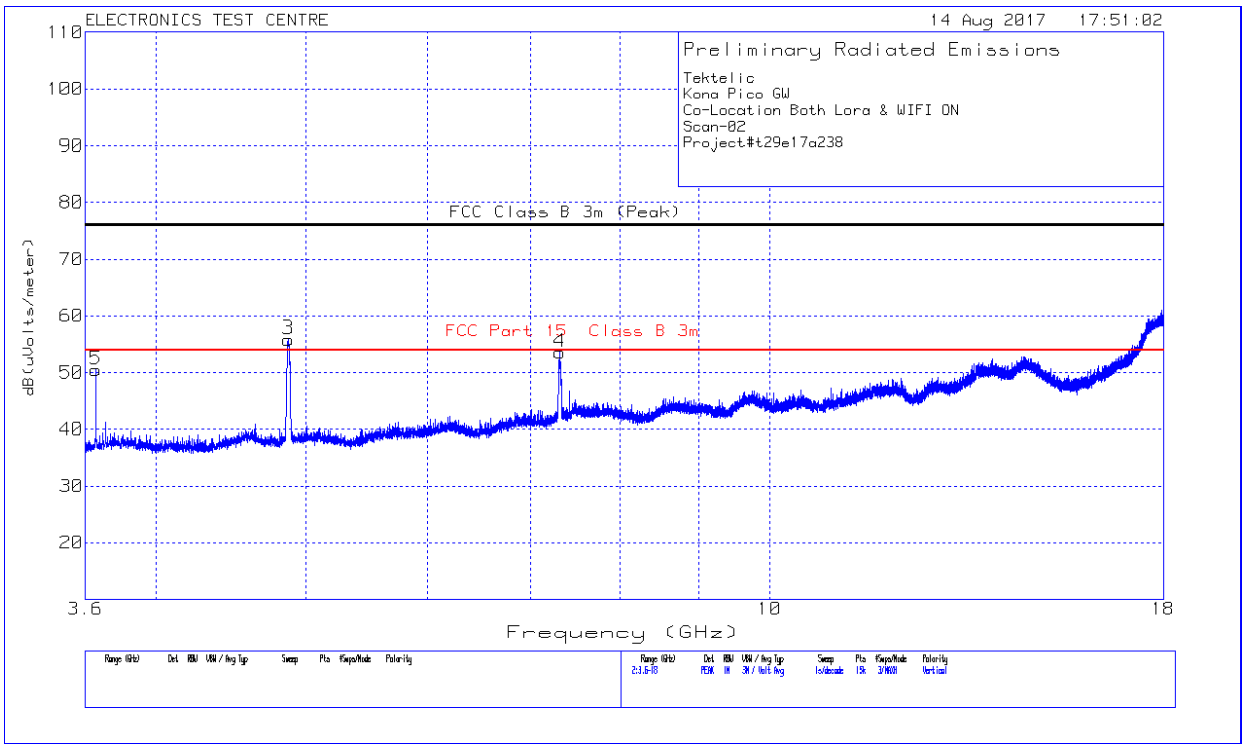

## Plot of Radiated Emissions: Vertical polarization



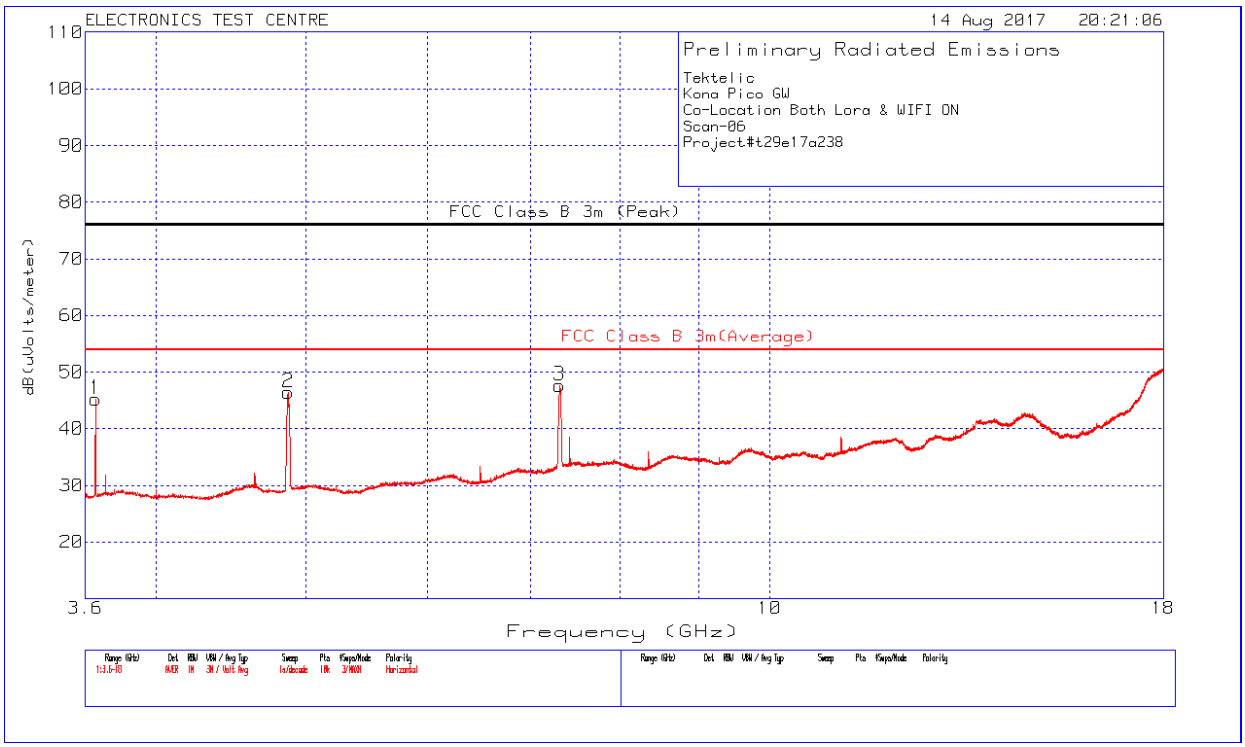
## Plot of Radiated Emissions: Horizontal polarization



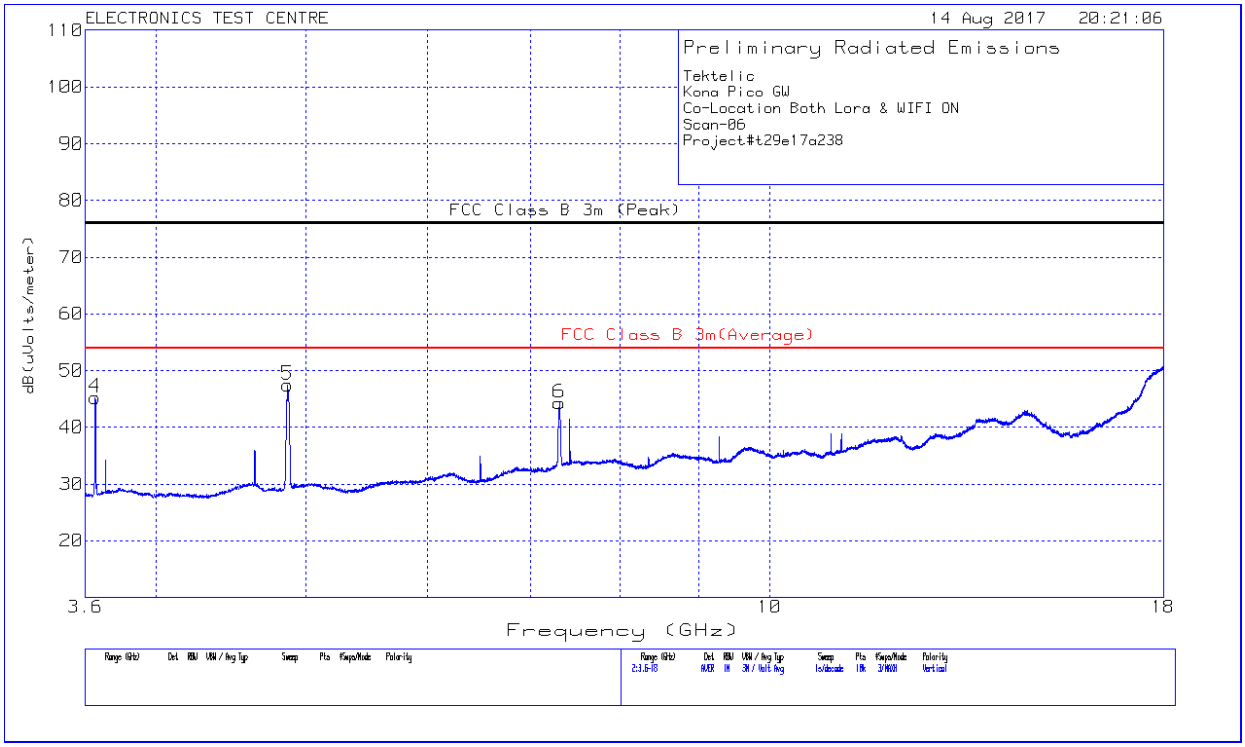

## Plot of Radiated Emissions: Vertical polarization



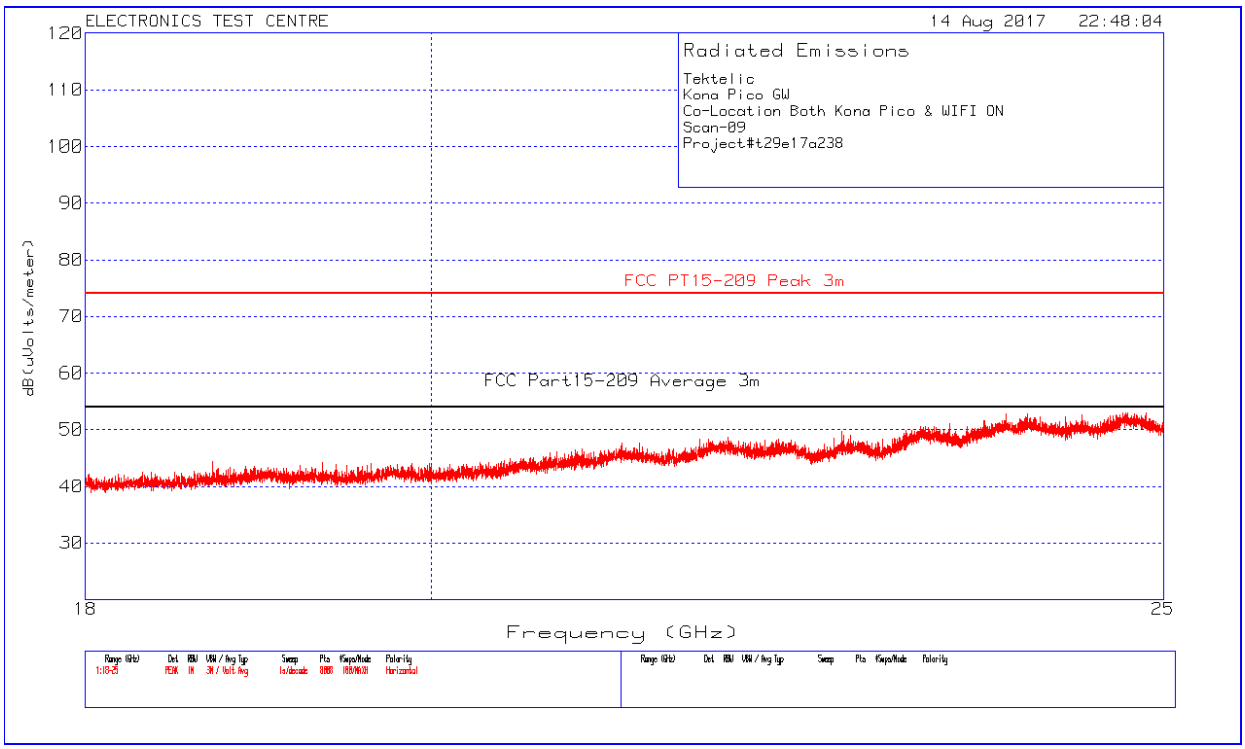
## Plot of Radiated Emissions: Horizontal polarization



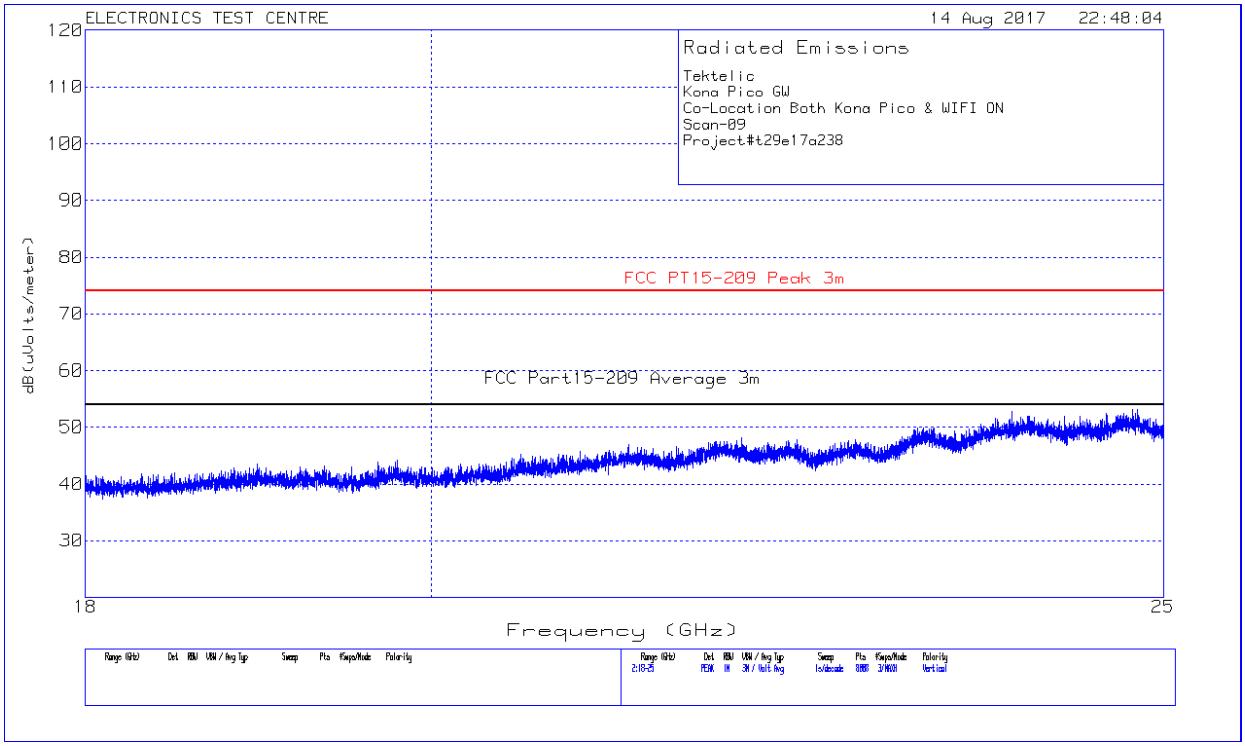

## Plot of Radiated Emissions: Vertical polarization



## Plot of Radiated Emissions: Horizontal polarization




## Plot of Radiated Emissions: Vertical polarization



## 2.10 RF Exposure

| | |
|---|---|
| **Test Lab: Electronics Test Centre, Airdrie** | **EUT: Kona Pico Gateway** |
| **Test Personnel:** | **Standard: FCC PART 15.247** |
| **Date:** | |

**EUT status: Compliant**

**Compliant:** RF exposure assessment to be provided in a separate Exhibit.

# 3.0 TEST FACILITY

## 3.1 Location

The Kona Pico Gateway was tested for emissions at the Electronics Test Centre laboratory located in Airdrie, Alberta, Canada. The Radio Frequency Anechoic Chamber (RFAC), identified as Chamber 1, has a usable working space measuring 10.6 m long x 7.3 m wide x 6.5 m high.

Measurements taken at this site are accepted by Industry Canada as evidence of conformity per registration file # 2046A. This site is also listed with the FCC under Registration Number CA2046.

The floor, walls and ceiling consist of annealed steel panels. The walls and ceiling are covered with ferrite tile, augmented by RF absorbant foam material on the end wall nearest the turntable, and on the adjacent walls and the ceiling. The chamber floor supports a 15 cm high internal floor, constructed of annealed steel panels, that forms the ground plane, and is bonded to the chamber walls.

The 3-m diameter turntable is flush-mounted with the floor. A sub-floor cable-way is provided to route cables between the turntable pit and EUT support equipment located in the Control Room. Cables reach the EUT through an opening in the centre of the turntable.

Test instrumentation and EUT support equipment is located in the Control Room, consisting of two shielded vestibules joined together at the side of the main room. Cables are routed through bulkhead panels between the rooms and the test chamber as required. Power feeds are routed into the main room and vestibules through line filters providing at least 100 dB of attenuation between 10 kHz and 10 GHz.

Either floor mounted or table-top equipment can be tested at this facility.

## 3.2 Grounding Plan

The Kona Pico Gateway was placed at the centre of the test chamber turntable on top of an 80-cm high polystyrene foam table. The EUT was grounded according to Tektelic Communication Inc. specifications.

## 3.3 Power Supply

All EUT power was supplied by an internal rechargeable battery. There is no EUT function while the battery is charging.

## Appendix A – WiFi Module

Product Brief
InventekeS-WiFi Family
Embedding Connectivity Everywhere

Inventek Systems
Embedding Connectivity Everywhere

# Wi-Fi 802.11b/g/n Wireless Networking Module

## ISM43362-M3G-L44-E or -U

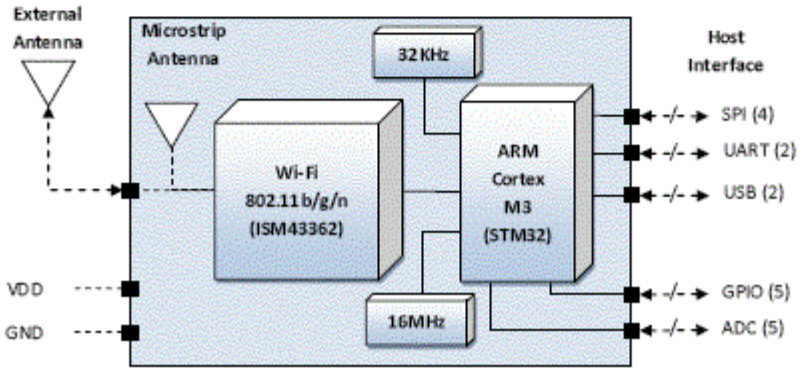
*Plug-and-Play… Small Foot Print… Integrated Antenna*

The ***ISM43362-M3G-L44*** is a member of Inventek's eS-WiFi family of embedded wireless internet connectivity devices that operate in the 2.4 GHz spectrum. The Wi-Fi module's hardware consists of a 120MHz STM 32bit Cortex M3 microcomputer, a Broadcom BCM43362 Wi-Fi device and two antenna options, a PCB trace antenna (-E) or a U.FL connector (-U) for external antenna.

The module provides USB, SPI and UART interfaces enabling easy connection to an embedded design. The Wi-Fi module requires no operating system and has a completely integrated TCP/IP Stack that only requires a simple AT command set to establish connectivity for your wireless product, minimizing development time and testing . The simple AT command set can be run on any 8/16/32 bit microcontroller. The low-cost, small footprint design (15mmx30mm), and ease of design-in make it ideal for a wide range of embedded wireless applications.

***Main Features:***

- 802.11 b/g/n compliant based on Broadcom MAC/Baseband/Radio device.
- Fully contained TCP/IP stack minimizing host CPU requirements.
- Configurable though simple AT commands.
- FCC and CE certification.
- Soft Access Point for up to 7 clients for configuration and ad-hoc networks.
- Host interfaces: USB (HID/VCP),UART, and SPI.
- Network features: ICMP ( Ping), ARP, DHCP,TCP, UDP
- Low power operation (3.3V supply) with built in low power modes.
- Secure Wi-Fi authentication WEP-128, WPA-PSK (TKIP), WPA2-PSK.




www.inventeksys.com
Embedding Connectivity Everywhere

Product Brief
Inventek eS-WiFi Family
Embedding Connectivity Everywhere

Inventek Systems
Embedding Connectivity Everywhere

### *Application Examples*

- PDA, Pocket PC, computing devices
- Building automation and smart energy control
- Industrial sensing and remote equipment monitoring
- Health and Fitness
- Warehousing, logistics and freight management
- PC and gaming peripherals
- Printers, scanners, alarm and video systems
- Medical applications including patient monitoring and remote diagnostics

| | |
|---|---|
| *Network Standard* | IEEE 802.11b/g/n |
| *RF Frequency* | 2.400 GHz ~ 2.497 GHz |
| *Data Rates* | 802.11n: 6.5, 13, 19.5, 26, 39, 52, 58.5, 65 Mbps |
| | 802.11g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps |
| | 802.11b: 1, 2, 5.5, 11 Mbps |
| *Modulation Techniques* | 802.11g/n: 64-QAM, 16-QAM, QPSK, BPSK |
| | 802.11b: CCK, DQPSK, DBPSK |
| *Wireless Security* | WEP (64/128-bit),WPA™ (PSK, TKIP) / WPA2™ (AES, CCMP, 802.1x Authentication) |
| *Host Interfaces* | SPI, UART, USB ( HID and VCP) |
| *Network Protocols* | TCP, UDP, IPv4, ARP, ICMP, DHCP Client |
| *WLAN Functions* | Power save modes, automatic roaming, auto-rate |
| | Ad-hoc and Infrastructure modes |
| *Configuration* | AT commands, SPI frames |
| *Supply Voltage* | 3.3V ± 5% |
| *Package* | 44-pin LGA, 14.5mm x 30 mm |
| *Operating Temperature* | -35°C to +80°C |
| *Certifications* | FCC and CE |

| Product Availability | Model Number | Description |
|---|---|---|
| eS-WiFi ISM43362 | ISM43362-M3G-L44-E | 802.11 b/g/n, 44 pin LGA package, etched antenna |
| eS-WiFi ISM43362 | ISM43362-M3G-L44-U | 802.11 b/g/n, 44 pin LGA package, u.fl for antenna |

| eS-WiFi Evaluation Board | Description |
|---|---|
| ISM43362-M3G-EVB-E/U | EVB for both ISM43362-M3G-L44-E and ISM43362M3G-L44-U |

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www.inventeksys.com

Embedding Connectivity Everywhere

Inventek Systems
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## Appendix B – Antenna

Airgain ET830DBLTRPSMA Engineering Data Sheet

### 1. Airgain ET830DBLTRPSMA Embedded Antenna

The Model ET830DBLTRPSMA dipole Antenna provides an Omni-directional high performance antenna solution for 900MHz (ISM Band) LoRa, and LTE applications. This antenna was designed to accommodate most access point applications, and small client station applications.

### 2. Features

The Model ET830DBLTRPSMA DipoleAntenna is defined by the following features:

- LTE standards
- 868-928MHz (ISM Band)
- External Dipole antenna

Figure 1: Model ET830DBLTRPSMA Embedded Antenna

# End of Document