**Compliance Testing, LLC**
Previously Flom Test Lab
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toll-free: (866) 311-3268
fax: (480) 926-3598
http://www.ComplianceTesting.com
info@ComplianceTesting.com

# Test Report

**Prepared for: Wilson Electronics, LLC**

**Model: 460042**

**Description: WilsonPro Pro 1000C**

**Serial Number: 03, 07**

**FCC ID: PWO460042**
**IC: 4726A-460042**

**To**

**FCC Part 20**

**And**

**IC RSS-131, Issue 3**

**Date of Issue: April 12, 2018**

| | |
|---|---|
| **On the behalf of the applicant:** | **Wilson Electronics, LLC**<br>**3301 E Deseret Drive**<br>**St. George, UT 84790** |
| **To the attention of:** | **Erin Elder, Senior IP and Compliance Engineer**<br>**Ph: (435)673-5021**<br>**Email: eelder@wilsonelectronics.com** |

**Prepared By**
**Compliance Testing, LLC**
**1724 S. Nevada Way**
**Mesa, AZ 85204**
**(480) 926-3100 phone / (480) 926-3598 fax**
**www.compliancetesting.com**
**Project No: p1810004**

**Alex Macon**
**Project Test Engineer**

**Test Report Revision History**

| Revision | Date | Revised By | Reason for Revision |
|---|---|---|---|
| 1.0 | January 16, 2018 | Alex Macon | Original Document |
| 2.0 | March 26, 2018 | Alex Macon | Updated Annex D with conducted spurious results for part 27<br>Updated detection time table on page 27<br>Updated number of restarts for the downlink table on page 28<br>Updated the test report to show the full KDB name for 935210<br>Updated Gain limits on page 10<br>Updated Intermodulation Test Data on pages 12 and 38 and Annex B and L.<br>Updated conducted spurious table on page 36.<br>Removed PAG KDB number |
| | | | |

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**ILAC / A2LA**

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The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

Testing Certificate Number: **2152.01**

ACCREDITED
TESTING CERT
#2152.01

**FCC Site Reg. #349717**

**IC Site Reg. #2044A-2**

**Non-accredited tests contained in this report:**

**N/A**

**Test and Measurement Data**
Sub-part
2.1033(c)(14):

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Part 2, Subpart J and the following individual Parts: 20.21 in conjunction with latest version of KDB 935210 D03 Signal Booster Measurements V04R01.

**Standard Test Conditions and Engineering Practices**
Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI/C63.4-2014, and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F), unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

| Environmental Conditions | | |
|---|---|---|
| **Temp (ºC)** | **Humidity (%)** | **Pressure (mbar)** |
| 18.7 – 24.8 | 29.7 – 41.4 | 961.4 – 979.7 |

Measurement results, unless otherwise noted, are worst-case measurements.

**EUT Description**
**Model:** 460042
**Description:** Quint Band Consumer Signal Booster w/ Modem
**Firmware:** A460042A
**Software:** A460042A
**Serial Number:** 03, 07
**Additional Information:**
The EUT is an In-Building bi-directional amplifier for the boosting of cellular phone signals and data communication devices. This device has an internal cellular modem that is used for remote diagnostics and can only transmit on the uplink path. It can transmit on any uplink band.
The following frequency bands and emission types are utilized.

| Frequency Band (MHz) | | | | | |
|---|---|---|---|---|---|
| **Uplink** | 698 - 716 | 776 – 787 (IC, 777 – 787) | 824 - 849 | 1850 - 1910 | 1710 – 1755 |
| **Downlink** | 728 - 746 | 746 – 757 (IC, 746 – 756) | 869 - 894 | 1930 - 1990 | 2110 - 2155 |
| **Modulation Type** | LTE | | GSM, CDMA, EDGE, HSPA. EVDO, LTE | | CDMA, HSPA, LTE, EDGE, EVDO |

| Emission Designators | | | | | |
|---|---|---|---|---|---|
| **CDMA** | **HSPA** | **LTE** | **EVDO** | **EDGE** | **GSM** |
| F9W | F9W | G7D | F9W | G7W | GXW |

The modulation types and emission designators listed in the tables represent the modulations that the cell phone providers use for each frequency band. GSM, CDMA, and WCDMA represent all the modulation types (phase and amplitude or a combination thereof) utilized within the industry. EDGE, HSPA, LTE etc. are all protocols or multiplexing techniques using the base modulations.

**EUT Operation during Tests**

The EUT was in a normal operating condition.
All of the standard tests were performed as required, during this part of the testing, the modem was powered on but not transmitting.
After a couple of KDB inquiries with the FCC, it was agreed upon with the FCC and the manufacturer that the following 3 additional tests were performed with the modem transmitting in the band being tested. Conducted Spurious, Radiated Spurious and a 3 tone intermodulation test were performed with the modem transmitting.
The modem was set to transmit at maximum power with a 1.4 MHz wide modulated signal produced internally by the modem.
EUT S/N 03 was used to perform all the traditional tests as required.
EUT S/N: 07, was used to perform the 3 additional tests described above.
The only difference in the 2 boosters is that the S/N: 07 was modified by adding 2 wires for debugging purposes only if required during the tests. These additional temporary wires have no impact on the tests performed.

**Test Result Summary**

| Specification | Test Name | Pass, Fail, N/A | Comments |
|---|---|---|---|
| 20.21(e)(3) | Authorized Frequency Band | Pass | |
| 20.21(e)(8)(i)(B)<br>20.21(e)(8)(i)(C)<br>20.21(e)(8)(i)(D) | Maximum Power and Gain | Pass | |
| 20.21(e)(8)(i)(F) | Intermodulation | Pass | |
| 20.21(e)(8)(i)(E) | Out-of-Band Emissions | Pass | |
| 2.1051<br>22.917(a)<br>24.238((a)<br>27.53(c)<br>27.53(f)<br>27.53(g)<br>27.53(h) | Conducted Spurious Emissions | Pass | |
| 20.21(e)(8)(i)(A) | Noise Limits | Pass | |
| 20.21(e)(8)(i)(I) | Uplink Inactivity | Pass | |
| 20.21(e)(8)(i)(C)(1)<br>20.21(e)(8)(i)(H)<br>20.21(e)(8)(i)(C)(2)(i) (Fixed) | Variable Gain | Pass | |
| 2.1049 | Occupied Bandwidth | Pass | |
| 20.21(e)(8)(ii)(A) | Anti - Oscillation | Pass | |
| 2.1053 | Radiated Spurious | Pass | |
| 20.21(e)(8)(i)(B) | Spectrum Block Filtering | N/A | This only applies to devices utilizing spectrum block filtering |
| KDB Inquiry | Conducted Spurious w/ modem transmitting | Pass | This test was performed with the internal modem transmitting. Refer to EUT Operation during Test: on page 6 for additional details |
| KDB Inquiry | 3 tone Intermodulation test w/ modem transmitting | Pass | This test was performed with the internal modem transmitting. Refer to EUT Operation during Test: on page 6 for additional details |
| KDB Inquiry | Radiated Spurious w/ modem transmitting | Pass | This test was performed with the internal modem transmitting. Refer to EUT Operation during Test: on page 6 for additional details |

**Authorized Frequency Band**

**Engineer:** Alex Macon

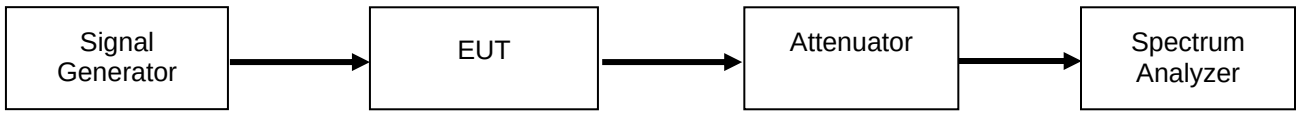
Test Date: 1/9/2018

**Test Procedure**

The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as needed to ensure accurate readings. A signal generator was utilized to produce a CW input signal tuned to the center channel of the operational band. The RF input level was increased to a point just prior to the AGC being in control of the power. The Signal generator was set to sweep across 2X the operational band of the EUT while the spectrum analyzer was set to MAX HOLD. Two markers were placed at the edges of the operational band and a third marker was placed at the highest point within the band no closer than 2.5 MHz from the band edge.

As per KDB 935210 D03 Section 7.1, The RBW was set to 100 kHZ

**Test Setup**




**Refer to Annex A for Authorized Frequency Band plots.**

**Maximum Power and Gain**

**Engineer:** Alex Macon

Test Date: 1/9/2018

**Test Procedure**

The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as needed to ensure accurate readings. The spectrum analyzer and signal generator were tuned to the frequency with the highest power level in the band, as determined by the Authorized Frequency Band test. The RF input level was increased to a point just prior to the AGC being in control of the power for both pulsed single time slot GSM modulation and 4.1 MHz AWGN modulation. The maximum power was measured and verified to meet the minimum and maximum levels allowed, with the maximum gain being computed from these values. The uplink and downlink gain under each condition were verified to be within 9 dB of each other.

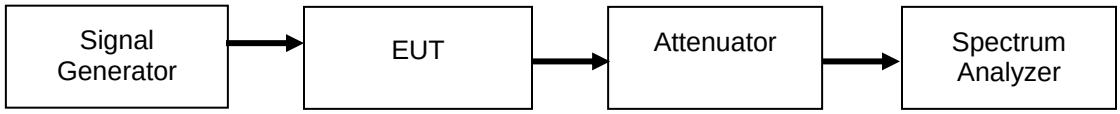
The input level was incremented in 2 dB steps up to the maximum input level for the EUT. The output power was recorded at the maximum input level. If the EUT shutdown before the maximum input level was reached, the input level was reduced to 1 dB before the EUT shutdown and the input and output levels were recorded.

For Fixed installations the following formula was used for calculating the gain limits.

Gain Limit (dB) = 6.5 dB + 20Log($F_{MHz}$)

$F_{MHz}$ is the uplink mid-band frequency with the downlink gain limit being equivalent to the paired Uplink band gain limit.

**Test Setup**




**Uplink Power Test Results**

| Frequency Band (MHz) | Input Level (dBm) | Output Power (dBm) | Lower Limit (dBm) | Upper Limit (dBm) | Antenna Gain (dBi) | EIRP (dBm) | Result |
|---|---|---|---|---|---|---|---|
| 698 - 716 MHz Pulsed GSM | -40.7 | 20.9 | 17 | 30 | 4.5 | 25.4 | Pass |
| 698 - 716 MHz AWGN | -39.8 | 20.8 | 17 | 30 | 4.5 | 25.3 | Pass |
| 776 - 787 MHz Pulsed GSM | -37.1 | 22.9 | 17 | 30 | 4.2 | 27.1 | Pass |
| 776 - 787 MHz AWGN | -38.8 | 20.2 | 17 | 30 | 4.2 | 24.4 | Pass |
| 824 - 849 MHz Pulsed GSM | -40.1 | 22.7 | 17 | 30 | 4.5 | 27.2 | Pass |
| 824 - 849 MHz AWGN | -42.3 | 19.7 | 17 | 30 | 4.5 | 24.2 | Pass |
| 1710 - 1755 MHz Pulsed GSM | -42.9 | 24.3 | 17 | 30 | 3.8 | 28.1 | Pass |
| 1710 - 1755 MHz AWGN | -48.0 | 18.8 | 17 | 30 | 3.8 | 22.6 | Pass |
| 1850 - 1910 MHz Pulsed GSM | -46.0 | 21.7 | 17 | 30 | 4.7 | 26.4 | Pass |
| 1850 - 1910 MHz AWGN | -47.7 | 20.3 | 17 | 30 | 4.7 | 25 | Pass |

**Downlink Power Test Results**

| Frequency Band (MHz) | Input Level (dBm) | Output Power (dBm) | Upper Limit (dBm) | Antenna Gain (dBi) | EIRP (dBm) | Result |
|---|---|---|---|---|---|---|
| 728 - 746 MHz Pulsed GSM | -45.4 | 16.7 | 17 | -1.17 | 15.53 | Pass |
| 728 - 746 MHz AWGN | -45.0 | 16.3 | 17 | -1.17 | 15.13 | Pass |
| 746 - 757 MHz Pulsed GSM | -45.4 | 15.0 | 17 | -1.10 | 13.9 | Pass |
| 746 - 757 MHz AWGN | -44.7 | 15.0 | 17 | -1.10 | 13.9 | Pass |
| 869 - 894 MHz Pulsed GSM | -46.3 | 16.0 | 17 | -2.36 | 13.64 | Pass |
| 869 - 894 MHz AWGN | -45.7 | 15.7 | 17 | -2.36 | 13.34 | Pass |
| 1930 - 1990 MHz Pulsed GSM | -53.4 | 14.8 | 17 | 1.09 | 15.89 | Pass |
| 1930 - 1990 MHz AWGN | -53.3 | 15.5 | 17 | 1.09 | 16.59 | Pass |
| 2110 - 2155 MHz Pulsed GSM | -52.1 | 15.9 | 17 | -0.01 | 15.89 | Pass |
| 2110 - 2155 MHz AWGN | -51.2 | 16.4 | 17 | -0.01 | 16.39 | Pass |

**Uplink and Downlink Gain Test Results**

| Modulation | Uplink Frequency (MHz) | Downlink Frequency (MHz) | Uplink Gain (dB) | Uplink Limit (dB) | Downlink Gain (dB) | Downlink Limit (dB) | Delta (dB) | Limit (dB) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| Pulsed GSM | 711 | 742.5 | 61.6 | 63.5 | 62.1 | 63.5 | 0.52 | 9 | -8.48 |
| AWGN | 711 | 742.5 | 60.6 | 63.5 | 61.3 | 63.5 | 0.69 | 9 | -8.31 |
| Pulsed GSM | 779.43 | 746.35 | 60.0 | 64.4 | 60.4 | 64.4 | 0.39 | 9 | -8.61 |
| AWGN | 779.43 | 746.35 | 59.0 | 64.4 | 59.7 | 64.4 | 0.69 | 9 | -8.31 |
| Pulsed GSM | 833.68 | 877.61 | 62.8 | 64.9 | 62.3 | 64.9 | 0.43 | 9 | -8.57 |
| AWGN | 833.68 | 877.61 | 62.0 | 64.9 | 61.5 | 64.9 | 0.5 | 9 | -8.5 |
| Pulsed GSM | 1753.96 | 2140.5 | 67.2 | 71.3 | 68.0 | 71.3 | 0.8 | 9 | -8.2 |
| AWGN | 1753.96 | 2140.5 | 66.8 | 71.3 | 67.6 | 71.3 | 0.81 | 9 | -8.19 |
| Pulsed GSM | 1870.3 | 1966 | 67.7 | 72.0 | 68.2 | 72.0 | 0.43 | 9 | -8.57 |
| AWGN | 1870.3 | 1966 | 68.0 | 72.0 | 68.8 | 72.0 | 0.82 | 9 | -8.18 |

**Maximum Input Power Test**

| Frequency Band (MHz) | Maximum Input Level (dBm) | Output Power at Maximum Input Power (dBm) | Lower Limit (dBm) | Upper Limit (dBm) | Result |
|---|---|---|---|---|---|
| 698 - 716 MHz Pulsed GSM | 0.0 | 21.1 | 17 | 30 | Pass |
| 698 - 716 MHz AWGN | 0.0 | 21.0 | 17 | 30 | Pass |
| 776 - 787 MHz Pulsed GSM | 0.0 | 22.7 | 17 | 30 | Pass |
| 776 - 787 MHz AWGN | 0.0 | 20.3 | 17 | 30 | Pass |
| 824 - 849 MHz Pulsed GSM | 0.0 | 22.9 | 17 | 30 | Pass |
| 824 - 849 MHz AWGN | 0.0 | 20.2 | 17 | 30 | Pass |
| 1710 - 1755 MHz Pulsed GSM | 0.0 | 24.0 | 17 | 30 | Pass |
| 1710 - 1755 MHz AWGN | 0.0 | 18.3 | 17 | 30 | Pass |
| 1850 - 1910 MHz Pulsed GSM | 0.0 | 21.7 | 17 | 30 | Pass |
| 1850 - 1910 MHz AWGN | 0.0 | 20.2 | 17 | 30 | Pass |

| Frequency Band (MHz) | Maximum Input Level (dBm) | Output Power at Maximum Input Power (dBm) | Upper Limit (dBm) | Result |
|---|---|---|---|---|
| 728 - 746 MHz Pulsed GSM | -20.0 | 16.2 | 17 | Pass |
| 728 - 746 MHz AWGN | -20.0 | 16.2 | 17 | Pass |
| 746 - 757 MHz Pulsed GSM | -20.0 | 14.4 | 17 | Pass |
| 746 - 757 MHz AWGN | -20.0 | 14.6 | 17 | Pass |
| 869 - 894 MHz Pulsed GSM | -20.0 | 15.5 | 17 | Pass |
| 869 - 894 MHz AWGN | -20.0 | 15.2 | 17 | Pass |
| 1930 - 1990 MHz Pulsed GSM | -20.0 | 14.3 | 17 | Pass |
| 1930 - 1990 MHz AWGN | -20.0 | 14.5 | 17 | Pass |
| 2110 - 2155 MHz Pulsed GSM | -20.0 | 15.5 | 17 | Pass |
| 2110 - 2155 MHz AWGN | -20.0 | 16.0 | 17 | Pass |

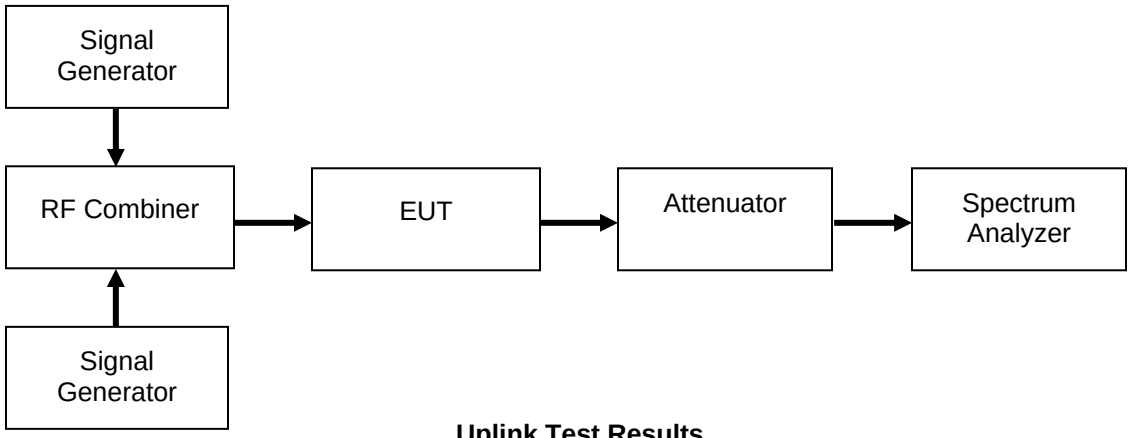
**Intermodulation**
**Engineer:** Alex Macon
**Test Date:** 1/10/2018

**Test Procedure**

The EUT was connected to a spectrum analyzer through an attenuator. Two signal generators were utilized to produce two CW signals 600 kHz apart and centered in the operational band. Attenuator and cable insertion loss correction factors were input to either the signal generator or the spectrum analyzer as required to ensure that accurate measurements were recorded. The input power was set at the maximum allowable power and the RMS intermodulation products were measured to ensure they were less than -19 dBm in a 3 kHz RBW. The uplink and downlink intermodulation products were plotted, with the levels being listed in the summary tables.

The input power was increased in 2 dB increments to 10 dB above the AGC threshold and to verify the intermod products remain below the limit. During this test, the input power was not increased past the maximum allowed.
The Intermodulation level was recorded

**Test Setup**




**Uplink Test Results**

| Frequency Band (MHz) | Intermodulation Level (dBm) | Limit (dBm) | Result | Intermod Level with Input Power @ AGC + 10 dB | Result (Pass / Fail) |
|---|---|---|---|---|---|
| 698 - 716 MHz | -26.7 | -19 | Pass | -27.5 | Pass |
| 776 - 787 MHz | -36 | -19 | Pass | -28.3 | Pass |
| 824 - 849 MHz | -24.6 | -19 | Pass | -23.6 | Pass |
| 1710 - 1755 MHz | -28.3 | -19 | Pass | -31.8 | Pass |
| 1850 - 1910 MHz | -29.4 | -19 | Pass | -24.25 | Pass |

**Downlink Test Results**

| Frequency Band (MHz) | Intermodulation Level (dBm) | Limit (dBm) | Result | Intermod Level with Input Power @ AGC + 10 dB | Result (Pass / Fail) |
|---|---|---|---|---|---|
| 728 - 746 MHz | -36.68 | -19 | Pass | -19.11 | Pass |
| 746 - 757 MHz | -33.62 | -19 | Pass | -23.71 | Pass |
| 869 - 894 MHz | -39.93 | -19 | Pass | -27.05 | Pass |
| 1930 - 1990 MHz | -32.47 | -19 | Pass | -31.68 | Pass |
| 2110 - 2155 MHz | -24.02 | -19 | Pass | -24.28 | Pass |

**Refer to Annex B for Intermodulation Test plots**

**Out-of-Band Emissions**
**Engineer:** Alex Macon
**Test Date:** 1/11/2018

## Test Procedure

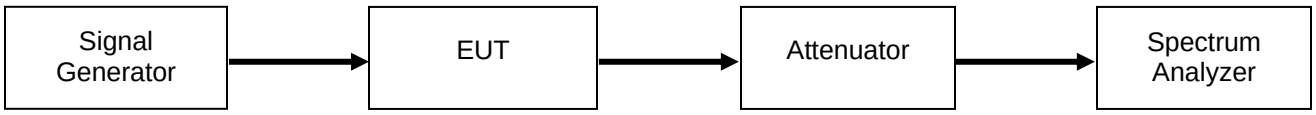
The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor in order to ensure accurate readings. A signal generator was utilized to produce the following signals: GSM, CDMA, and WCDMA. The signal generator was tuned to the lowest allowable upper and lower channel within the EUT operational band for each respective modulation type. The RF input level was increased to a point just prior to the AGC being in control of the power. For each modulation type the Out of Band Emissions were measured to ensure they met the limits.

The following formula was used for calculating the limits:

Limit = P1 - 6 - (43+ 10Log(P2)) = -19dBm
P1 = power in dBm
P2 = power in Watts

The input power was increased in 2 dB steps up to the maximum input power for the booster being tested. The OOBE was verified to stay below the OOBE Limit. This was recorded as Pass / Fail in the OOBE tables.

## Test Setup



**GSM Uplink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result | OOBE Below Limit at Max Input Power (Yes / No) |
|---|---|---|---|---|---|
| 698 - 716 | Lower | -41.5 | -19 | Pass | Yes |
| 698 - 716 | Upper | -36.8 | -19 | Pass | Yes |
| 776 - 787 | Lower | -38.2 | -19 | Pass | Yes |
| 776 - 787 | Upper | -42.4 | -19 | Pass | Yes |
| 824 - 849 | Lower | -35.3 | -19 | Pass | Yes |
| 824 - 849 | Upper | -44.5 | -19 | Pass | Yes |
| 1710 - 1755 | Lower | -41.2 | -19 | Pass | Yes |
| 1710 - 1755 | Upper | -36.6 | -19 | Pass | Yes |
| 1850 - 1910 | Lower | -41.0 | -19 | Pass | Yes |
| 1850 - 1910 | Upper | -38.7 | -19 | Pass | Yes |

**CDMA Uplink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result | OOBE Below Limit at Max Input Power (Yes / No) |
|---|---|---|---|---|---|
| 698 - 716 | Lower | -52.8 | -19 | Pass | Yes |
| 698 - 716 | Upper | -46.3 | -19 | Pass | Yes |
| 776 - 787 | Lower | -49.6 | -19 | Pass | Yes |
| 776 - 787 | Upper | -50.9 | -19 | Pass | Yes |
| 824 - 849 | Lower | -48.1 | -19 | Pass | Yes |
| 824 - 849 | Upper | -56.1 | -19 | Pass | Yes |
| 1710 - 1755 | Lower | -48.2 | -19 | Pass | Yes |
| 1710 - 1755 | Upper | -45.0 | -19 | Pass | Yes |
| 1850 - 1910 | Lower | -44.4 | -19 | Pass | Yes |
| 1850 - 1910 | Upper | -51.3 | -19 | Pass | Yes |

**WCDMA Uplink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result | OOBE Below Limit at Max Input Power (Yes / No) |
|---|---|---|---|---|---|
| 698 - 716 | Lower | -47.4 | -19 | Pass | Yes |
| 698 - 716 | Upper | -47.4 | -19 | Pass | Yes |
| 776 - 787 | Lower | -50.5 | -19 | Pass | Yes |
| 776 - 787 | Upper | -51.9 | -19 | Pass | Yes |
| 824 - 849 | Lower | -43.6 | -19 | Pass | Yes |
| 824 - 849 | Upper | -47.6 | -19 | Pass | Yes |
| 1710 - 1755 | Lower | -42.3 | -19 | Pass | Yes |
| 1710 - 1755 | Upper | -43.0 | -19 | Pass | Yes |
| 1850 - 1910 | Lower | -39.9 | -19 | Pass | Yes |
| 1850 - 1910 | Upper | -37.4 | -19 | Pass | Yes |

**GSM Downlink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result | OOBE Below Limit at Max Input Power (Yes / No) |
|---|---|---|---|---|---|
| 728 - 746 | Lower | -43.1 | -19 | Pass | Yes |
| 728 - 746 | Upper | -40.2 | -19 | Pass | Yes |
| 746 - 757 | Lower | -39.9 | -19 | Pass | Yes |
| 746 - 757 | Upper | -40.0 | -19 | Pass | Yes |
| 869 - 894 | Lower | -47.2 | -19 | Pass | Yes |
| 869 - 894 | Upper | -45.0 | -19 | Pass | Yes |
| 1930 - 1990 | Lower | -48.1 | -19 | Pass | Yes |
| 1930 - 1990 | Upper | -49.1 | -19 | Pass | Yes |
| 2110 - 2155 | Lower | -44.8 | -19 | Pass | Yes |
| 2110 - 2155 | Upper | -44.5 | -19 | Pass | Yes |

**CDMA Downlink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result | OOBE Below Limit at Max Input Power (Yes / No) |
|---|---|---|---|---|---|
| 728 - 746 | Lower | -50.7 | -19 | Pass | Yes |
| 728 - 746 | Upper | -43.4 | -19 | Pass | Yes |
| 746 - 757 | Lower | -44.8 | -19 | Pass | Yes |
| 746 - 757 | Upper | -46.1 | -19 | Pass | Yes |
| 869 - 894 | Lower | -46.9 | -19 | Pass | Yes |
| 869 - 894 | Upper | -44.2 | -19 | Pass | Yes |
| 1930 - 1990 | Lower | -56.1 | -19 | Pass | Yes |
| 1930 - 1990 | Upper | -41.8 | -19 | Pass | Yes |
| 2110 - 2155 | Lower | -46.3 | -19 | Pass | Yes |
| 2110 - 2155 | Upper | -46.4 | -19 | Pass | Yes |

**WCDMA Downlink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result | OOBE Below Limit at Max Input Power (Yes / No) |
|---|---|---|---|---|---|
| 728 - 746 | Lower | -51.0 | -19 | Pass | Yes |
| 728 - 746 | Upper | -52.4 | -19 | Pass | Yes |
| 746 - 757 | Lower | -47.2 | -19 | Pass | Yes |
| 746 - 757 | Upper | -52.7 | -19 | Pass | Yes |
| 869 - 894 | Lower | -43.1 | -19 | Pass | Yes |
| 869 - 894 | Upper | -40.7 | -19 | Pass | Yes |
| 1930 - 1990 | Lower | -52.7 | -19 | Pass | Yes |
| 1930 - 1990 | Upper | -50.1 | -19 | Pass | Yes |
| 2110 - 2155 | Lower | -42.0 | -19 | Pass | Yes |
| 2110 - 2155 | Upper | -49.9 | -19 | Pass | Yes |

**Refer to Annex C for Out of Band Emission plots**

**Conducted Spurious Emissions**

**Engineer:** Alex Macon

**Test Date:** 1/11/2018

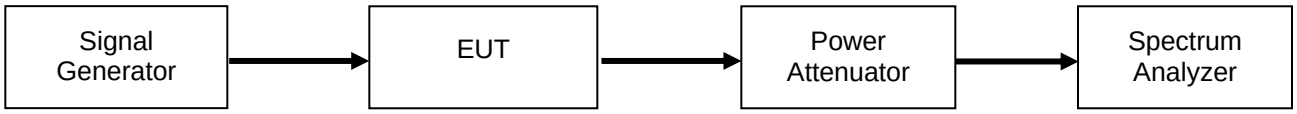
## Test Procedure

The EUT was connected to a spectrum analyzer through an attenuator, with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as needed to ensure accurate readings. A signal generator was utilized to produce a 4.1 MHz AWGN signal operating at the maximum allowable power. The conducted spurious emissions from 9 kHz to 10 times the highest tunable frequency for each operational band were measured (excluding the band defined by the Out of band emissions test). The emissions were plotted and the highest level was recorded in the summary table.

The following formulas are used for calculating the limits.

Conducted Spurious Emissions Limit = P1 – (43+ 10Log(P2)) = -13 dBm
P1 = power in dBm
P2 = power in Watts

## Test Setup




## Uplink Test Results

| Frequency Band (MHz) | Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 698 - 716 | 2845 | -43.9 | -13 | Pass |
| 776 - 787 | 2801 | -44.1 | -13 | Pass |
| 824 - 849 | 2838 | -43.7 | -13 | Pass |
| 1710 - 1755 | 7905 | -42.8 | -13 | Pass |
| 1850 - 1910 | 15268 | -43.7 | -13 | Pass |

## Downlink Test Results

| Frequency Band (MHz) | Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 728 - 746 | 1960 | -27.7 | -13 | Pass |
| 746 - 757 | 757.1 | -26.9 | -13 | Pass |
| 869 - 894 | 1968 | -27.2 | -13 | Pass |
| 1930 - 1990 | 2140 | -27.2 | -13 | Pass |
| 2110 - 2155 | 1973.4 | -27.8 | -13 | Pass |

**For the 746 – 758 downlink and 776 – 788 Uplink bands of operation, the following additional spurious emissions requirements apply.**

**FCC 27.53(c)**
*For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:*

*(3)On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;*

The test is performed using a 10 kHz RBW. Since the limit is referenced to a 6.25 kHz BW, the following correction factor is applied to the measured data.

BW correction Factor = 10Log B1/B2
BW correction Factor =10Log 6.25 / 10 = - 2.0 dB

Final Value (dBm) = conducted measurement +BW correction factor

**776 – 787 MHz Uplink Band**

| Spurious Frequency Range (MHz) | Measured Frequency (MHz) | Measured Value (dBm) | Bandwidth Correction Factor (dB) | Final Value (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| 763 – 775 | 772.705 | -67.3 | -2.0 | -69.3 | -46 | 23.3 |
| 793 – 805 | 793.043 | -69.6 | -2.0 | -71.6 | -46 | -25.6 |

**746 - 757 MHz Downlink Band**

| Spurious Frequency Range (MHz) | Measured Frequency (MHz) | Measured Value (dBm) | Bandwidth Correction Factor (dB) | Final Value (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| 763 – 775 | 764.023 | -69.8 | -2.0 | -71.8 | -46 | -25.8 |
| 793 – 805 | 803.92 | -72.4 | -2.0 | -74.2 | -46 | -28.2 |

**FCC 27.53(e)**
For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

Since the limit is referenced to EIRP, the final data is computed using the Conducted Spurious Emission data and adding the BW correction factor plus the final gain/loss data from the antenna kitting information supplied by the manufacturer.

For the Narrowband measurement, the test is performed using a 10 kHz RBW. Since the limit is referenced to a 700 Hz BW, the following correction factor is applied to the measured data.

BW correction Factor = 10Log B1/B2
BW correction Factor =10Log 700 / 10000 = -11.55 dB

Final Value (dBm) = conducted measurement +BW correction factor + final gain/loss from Antenna Kitting document

The Limit for discreet (narrowband) emissions is -80dBW (-50 dBm) in 700 MHz BW.
The Limit for (wideband Emissions) is -70 dBW (-40 dBm) in a 1 MHz BW.

**776 – 787 MHz Uplink Band**

| Spurious Frequency Range (MHz) | Measured Frequency (MHz) | Measured Value (dBm) | Bandwidth Correction Factor (dB) | Gain/Loss from Antenna Kitting Information (dB) | Final Value (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 1559 – 1610 (Wideband) | 1564.061 | -59.8 | 0 | 4.2 | -55.6 | -40 | -15.6 |
| 1559 – 1610 (Narrowband) | 1563.857 | -66.6 | -11.55 | 4.2 | -62.4 | -50 | -12.4 |

**746 - 757 MHz Downlink Band**

| Spurious Frequency Range (MHz) | Measured Frequency (MHz) | Measured Value (dBm) | Bandwidth Correction Factor (dB) | Gain/Loss from Antenna Kitting Information (dB) | Final Value (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 1559 – 1610 (Wideband) | 1571.102 | -51.6 | 0 | -1.10 | -52.7 | -40 | -12.7 |
| 1559 – 1610 (Narrowband) | 1575.020 | -71.1 | -11.55 | -1.10 | -72.2 | -50 | -22.2 |

**Refer to Annex D for Conducted Spurious Emission plots.**

**Noise Limits**

**Engineer:** Alex Macon

**Test Date:** 1/11/2018

**Test Procedure**

The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as necessary to ensure that accurate readings were obtained. A series of three tests were performed: the maximum uplink and downlink noise, the variable noise for the uplink and downlink in the presence of a downlink signal, and the variable uplink noise timing. The detailed procedures from the latest version of KDB 935210 D03 Signal Booster Measurements V04R01 were followed.

For all other installations the Noise Limit is calculated using the following formula.

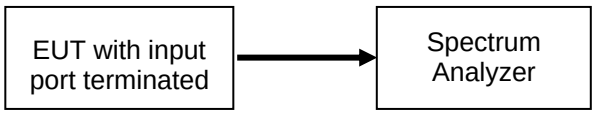
The following formulas are used for calculating the limits. Note – Downlink noise power limit is calculated with the center frequency of the associated uplink band.

Noise Power =-102.5+LOG10(Band Center Frequency)*20

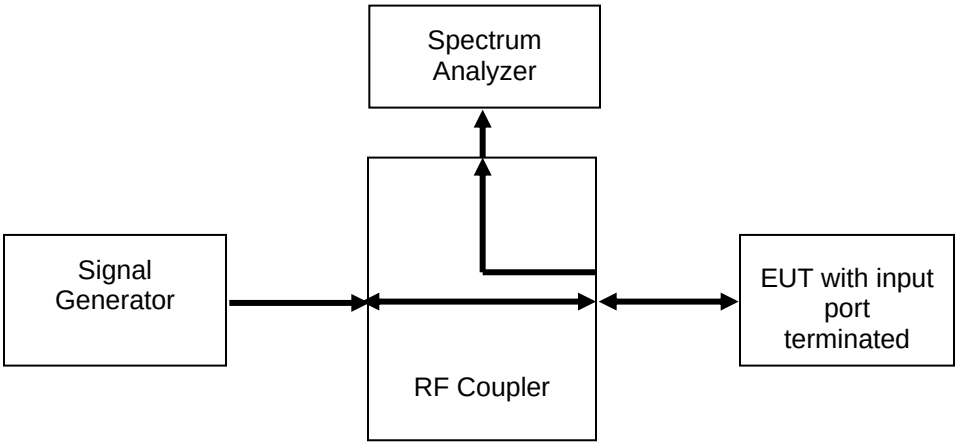
Variable Noise =-103 dBm/MHz-RSSI

**Test Setup**

**Maximum Noise Power**




**Variable Uplink Noise Power and Timing**



**Maximum Uplink Noise Test Results**

| Frequency Band (MHz) | Measured Noise (dBm) | Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|
| 698 - 716 | -45.99 | -45.5 | -0.5 | Pass |
| 776 - 787 | -45.77 | -44.6 | -1.1 | Pass |
| 824 - 849 | -45.66 | -44.1 | -1.6 | Pass |
| 1710 - 1755 | -39.34 | -37.7 | -1.6 | Pass |
| 1850 - 1910 | -37.82 | -37.0 | -0.8 | Pass |

**Maximum Downlink Noise Test Results**

| Frequency Band (MHz) | Measured Noise (dBm) | Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|
| 728 - 746 | -46.03 | -45.5 | -0.5 | Pass |
| 746 - 757 | -47.36 | -44.6 | -2.7 | Pass |
| 869 - 894 | -45.53 | -44.1 | -1.5 | Pass |
| 1930 - 1990 | -38.49 | -37.0 | -1.5 | Pass |
| 2110 - 2155 | -39.11 | -37.7 | -1.4 | Pass |

**Uplink Noise Timing Test Results**

| Frequency Band (MHz) | Measured Timing (Seconds) | Limit (Seconds) | Result |
|---|---|---|---|
| 698 - 716 | 0.300 | 3 | Pass |
| 776 - 787 | 0.975 | 3 | Pass |
| 824 - 849 | 0.715 | 3 | Pass |
| 1710 - 1755 | 1.47 | 3 | Pass |
| 1850 - 1910 | 0.615 | 3 | Pass |

**Refer to Annex E for Noise Limits and Uplink Noise Timing Plots**

## Variable Uplink Noise Limit Test Results

**698 - 716 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -39.0 | -64.0 | -73.4 | -9.4 |
| -38.0 | -65.0 | -72.68 | -7.7 |
| -37.0 | -66.0 | -73.45 | -7.5 |
| -36.0 | -67.0 | -74.48 | -7.5 |
| -35.0 | -68.0 | -75.04 | -7.0 |
| -34.0 | -69.0 | -76.03 | -7.0 |

**776 - 787 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -39.0 | -64.0 | -71.53 | -7.5 |
| -38.0 | -65.0 | -72.55 | -7.6 |
| -37.0 | -66.0 | -73.24 | -7.2 |
| -36.0 | -67.0 | -74.12 | -7.1 |
| -35.0 | -68.0 | -74.73 | -6.7 |
| -34.0 | -69.0 | -73.89 | -4.9 |

**824 - 849 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -53.0 | -50.0 | -59.1 | -9.1 |
| -38.0 | -65.0 | -74.25 | -9.3 |
| -37.0 | -66.0 | -74.72 | -8.7 |
| -36.0 | -67.0 | -75.68 | -8.7 |
| -35.0 | -68.0 | -75.79 | -7.8 |
| -34.0 | -69.0 | -76.43 | -7.4 |

**1710 - 1755 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -61.0 | -42.0 | -46.91 | -4.9 |
| -60.0 | -43.0 | -48.32 | -5.3 |
| -59.0 | -44.0 | -49.17 | -5.2 |
| -58.0 | -45.0 | -49.96 | -5.0 |
| -57.0 | -46.0 | -51.92 | -5.9 |
| -55.0 | -48.0 | -53.79 | -5.8 |

**1850 - 1910 MHz**

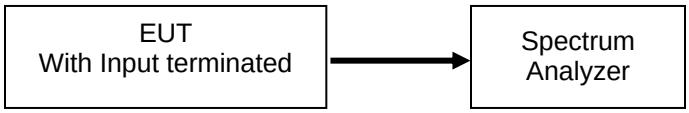
| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -63.0 | -40.0 | -43.95 | -4.0 |
| -62.0 | -41.0 | -45.21 | -4.2 |
| -61.0 | -42.0 | -46.69 | -4.7 |
| -60.0 | -43.0 | -47.76 | -4.8 |
| -35.0 | -68.0 | -72.98 | -5.0 |
| -34.0 | -69.0 | -73.8 | -4.8 |

**Uplink Inactivity**
**Engineer:** Alex Macon
**Test Date:** 1/10/2018

**Test Procedure**

The EUT was connected directly to a spectrum analyzer set to operate in the center of the EUT operational uplink and downlink bands. The span was set to 0 Hz with a sweep time of 330 seconds and MAX HOLD operation. The EUT was powered on and the time for the uplink to return to an inactive state was measured using the DELTA MARKER method to ensure that it was less than 300 seconds. The noise level after the return to an inactive state was less than -70 dBm/MHz.

**Test Setup**




**Uplink Test Results**

| Frequency Band (MHz) | Measured Time (Seconds) | Limit (Seconds) | Result |
|---|---|---|---|
| 698 - 716 | 286.2 | 300 | Pass |
| 776 - 787 | 286.2 | 300 | Pass |
| 824 - 849 | 285.6 | 300 | Pass |
| 1710 - 1755 | 286.7 | 300 | Pass |
| 1850 - 1910 | 286.2 | 300 | Pass |

**Refer to Annex F for Uplink Inactivity Plots**

**Variable Gain**
**Engineer:** Alex Macon
**Test Date:** 1/11/2018

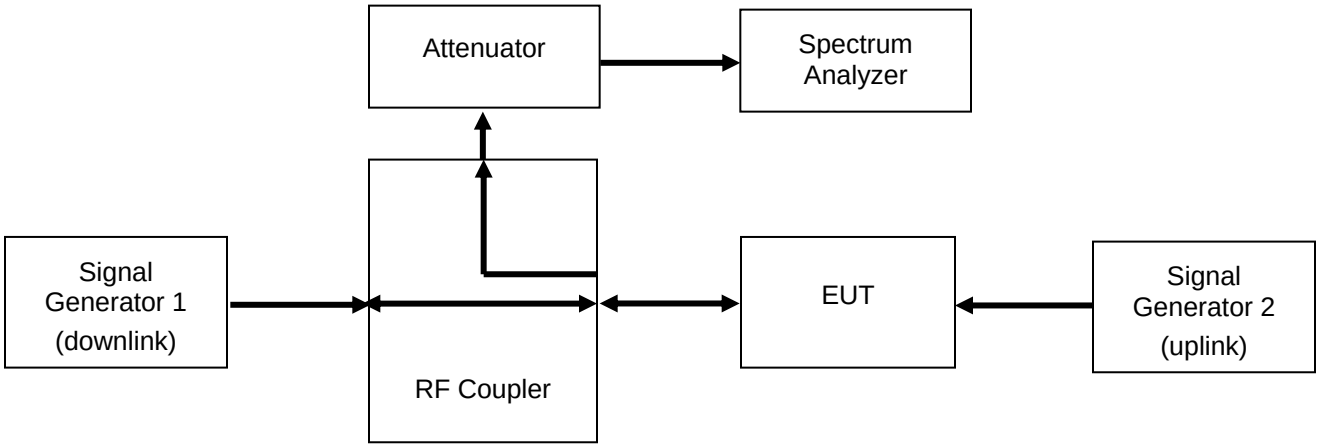
**Test Procedure**

The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor in order to ensure accurate readings were obtained. The uplink gain in the presence of a downlink signal was measured for each operational uplink band using the detailed procedures from the latest version of KDB 935210 D03 Signal Booster Measurements V04R01.

The following formula is used for calculating the limits:

Variable Gain = -34 dB - RSSI +MSCL

**Test Setup**




**Uplink Test Results**

**698 - 716 MHz**

| RSSI (dBm) | MSCL (dB) | Gain Limit (dBm) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|---|---|---|---|---|---|---|
| -53.0 | 38.9 | 57.9 | -44.8 | 8.3 | 53.1 | -4.8 |
| -52.0 | 38.9 | 56.9 | -44.8 | 7.3 | 52.1 | -4.8 |
| -50.0 | 38.9 | 54.9 | -44.8 | 5.4 | 50.2 | -4.7 |
| -49.0 | 38.9 | 53.9 | -44.8 | 4.1 | 48.9 | -5.0 |
| -45.0 | 38.9 | 49.9 | -44.8 | 0.7 | 45.5 | -4.4 |
| -34.0 | 38.9 | 38.9 | -44.8 | -8.0 | 36.8 | -2.1 |

**776 - 787 MHz**

| RSSI (dBm) | MSCL (dB) | Gain Limit (dBm) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|---|---|---|---|---|---|---|
| -52.0 | 39.9 | 57.9 | -43.8 | 7.7 | 51.5 | -6.4 |
| -51.0 | 39.9 | 56.9 | -43.8 | 6.8 | 50.6 | -6.4 |
| -50.0 | 39.9 | 55.9 | -43.8 | 5.9 | 49.7 | -6.3 |
| -49.0 | 39.9 | 54.9 | -43.8 | 4.9 | 48.7 | -6.3 |
| -36.0 | 39.9 | 41.9 | -43.8 | -8.2 | 35.6 | -6.4 |
| -34.0 | 39.9 | 39.9 | -43.8 | -10.2 | 33.6 | -6.3 |

**824 - 849 MHz**

| RSSI (dBm) | MSCL (dB) | Gain Limit (dBm) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|---|---|---|---|---|---|---|
| -57.0 | 41.5 | 64.5 | -47.3 | 10.9 | 58.2 | -6.4 |
| -56.0 | 41.5 | 63.5 | -47.3 | 9.9 | 57.2 | -6.3 |
| -55.0 | 41.5 | 62.5 | -47.3 | 9.2 | 56.5 | -6.0 |
| -54.0 | 41.5 | 61.5 | -47.3 | 7.4 | 54.7 | -6.8 |
| -53.0 | 41.5 | 60.5 | -47.3 | 6.4 | 53.7 | -6.8 |
| -52.0 | 41.5 | 59.5 | -47.3 | 5.4 | 52.7 | -6.8 |

**1710 - 1755 MHz**

| RSSI (dBm) | MSCL (dB) | Gain Limit (dBm) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|---|---|---|---|---|---|---|
| -59.0 | 45.5 | 70.5 | -53.0 | 8.2 | 61.2 | -9.3 |
| -58.0 | 45.5 | 69.5 | -53.0 | 7.3 | 60.3 | -9.2 |
| -57.0 | 45.5 | 68.5 | -53.0 | 5.8 | 58.8 | -9.7 |
| -56.0 | 45.5 | 67.5 | -53.0 | 4.8 | 57.8 | -9.7 |
| -55.0 | 45.5 | 66.5 | -53.0 | 3.4 | 56.4 | -10.1 |
| -54.0 | 45.5 | 65.5 | -53.0 | 2.5 | 55.5 | -10.0 |

**1850 - 1910 MHz**

| RSSI (dBm) | MSCL (dB) | Gain Limit (dBm) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|---|---|---|---|---|---|---|
| -60.0 | 45.1 | 71.1 | -52.7 | 8.7 | 61.4 | -9.8 |
| -59.0 | 45.1 | 70.1 | -52.7 | 7.1 | 59.8 | -10.3 |
| -58.0 | 45.1 | 69.1 | -52.7 | 6.0 | 58.7 | -10.5 |
| -57.0 | 45.1 | 68.1 | -52.7 | 5.1 | 57.8 | -10.4 |
| -52.0 | 45.1 | 63.1 | -52.7 | 0.6 | 53.3 | -9.8 |
| -44.0 | 45.1 | 55.1 | -52.7 | -7.8 | 44.9 | -10.3 |

**Uplink Gain Timing Test Results**

| Frequency Band (MHz) | Measured Timing (Seconds) | Limit (Seconds) | Result |
|---|---|---|---|
| 698 - 716 | 1.25 | 3.0 | Pass |
| 776 - 787 | 1.075 | 3.0 | Pass |
| 824 - 849 | 0.525 | 3.0 | Pass |
| 1710 - 1755 | 0.338 | 3.0 | Pass |
| 1850 - 1910 | 1.063 | 3.0 | Pass |

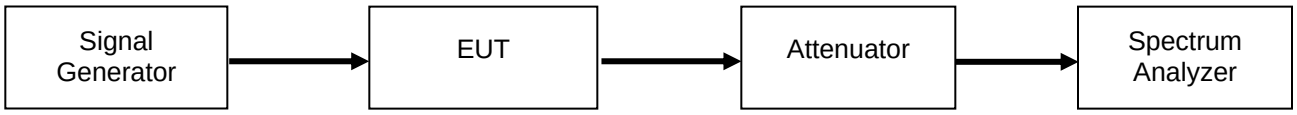
**Refer to Annex G for Uplink Gain Timing Plots**

**Occupied Bandwidth**
**Engineer:** Alex Macon
**Test Date:** 1/12/2018

## Test Procedure

The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as required to ensure that accurate readings were obtained. A signal generator was utilized to produce the following signals: GSM, CDMA, and WCDMA. The signal generator was tuned to the center channel of each of the EUT operational uplink and downlink bands with the RF level set at a point just prior to the AGC being in control of the power. For each modulation type, the input and output signal was measured and plotted to ensure that the signals were similar.

## Test Setup



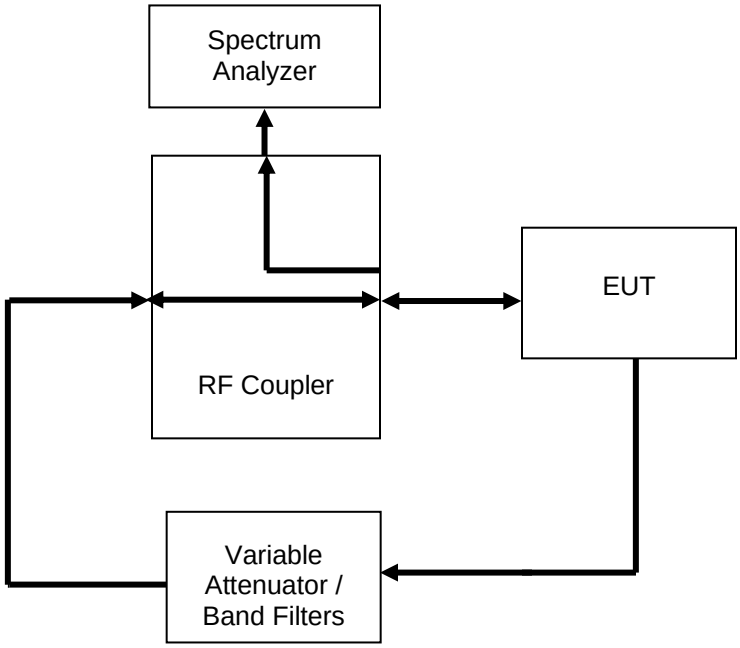

**Refer to Annex H for Occupied Bandwidth plots**

**Anti-Oscillation**
**Engineer:** Greg Corbin
**Test Date:** 3/8/2018

**Test Procedure**

The EUT was connected to a spectrum analyzer set for zero span mode. The EUT uplink and downlink were loop backed to each other through a selectable band pass filter and variable attenuator. The EUT uplink and downlink were tested to ensure that the presence of oscillation was detected and that the EUT output turned off within 300 mS for the Uplink and 1 second for the Downlink and remained off for 1 minute. The time was extended to capture how many times the unit attempted to restart.

**Test Setup**




**Uplink Detection Time Test Results**

| Frequency Band (MHz) | Measured Time (mS) | Limit (mS) | Result |
|---|---|---|---|
| 698 - 716 | 175 | 300 | Pass |
| 776 - 787 | 162.5 | 300 | Pass |
| 824 - 849 | 162.5 | 300 | Pass |
| 1710 - 1755 | 250 | 300 | Pass |
| 1850 - 1910 | 262.5 | 300 | Pass |

**Downlink Detection Time Test Results**

| **Frequency Band (MHz)** | **Measured Time (mS)** | **Limit (mS)** | **Result** |
|---|---|---|---|
| 728 - 746 | 275 | 1000 | Pass |
| 746 - 757 | 225 | 1000 | Pass |
| 869 - 894 | 275 | 1000 | Pass |
| 1930 - 1990 | 275 | 1000 | Pass |
| 2110 - 2155 | 275 | 1000 | Pass |

**Uplink Restart Time Test Results**

| Frequency Band (MHz) | Measured Time (S) | Limit (S) | Result |
|---|---|---|---|
| 698 - 716 | 70 | ≥60 | Pass |
| 776 - 787 | 70.125 | ≥60 | Pass |
| 824 - 849 | 70.125 | ≥60 | Pass |
| 1710 - 1755 | 70.25 | ≥60 | Pass |
| 1850 - 1910 | 70.25 | ≥60 | Pass |

**Downlink Restart Time Test Results**

| Frequency Band (MHz) | Measured Time (S) | Limit (S) | Result |
|---|---|---|---|
| 728 - 746 | 70.25 | ≥60 | Pass |
| 746 - 757 | 70.125 | ≥60 | Pass |
| 869 - 894 | 70.375 | ≥60 | Pass |
| 1930 - 1990 | 70.375 | ≥60 | Pass |
| 2110 - 2155 | 70.125 | ≥60 | Pass |

**Uplink Restart Count Test Results**

| Frequency Band (MHz) | Restarts | Limit | Result |
|---|---|---|---|
| 698 - 716 | 3 | ≤5 | Pass |
| 776 - 787 | 3 | ≤5 | Pass |
| 824 - 849 | 2 | ≤5 | Pass |
| 1710 - 1755 | 3 | ≤5 | Pass |
| 1850 - 1910 | 1 | ≤5 | Pass |

**Downlink Restart Count Test Results**

| Frequency Band (MHz) | Restarts | Limit | Result |
|---|---|---|---|
| 728 - 746 | 2 | ≤5 | Pass |
| 746 - 757 | 2 | ≤5 | Pass |
| 869 - 894 | 2 | ≤5 | Pass |
| 1930 - 1990 | 2 | ≤5 | Pass |
| 2110 - 2155 | 3 | ≤5 | Pass |

**Refer to Annex I for Anti-Oscillation Plots**

**Oscillation Mitigation**
**Engineer:** Greg Corbin
**Test Date:** 2/20/2018

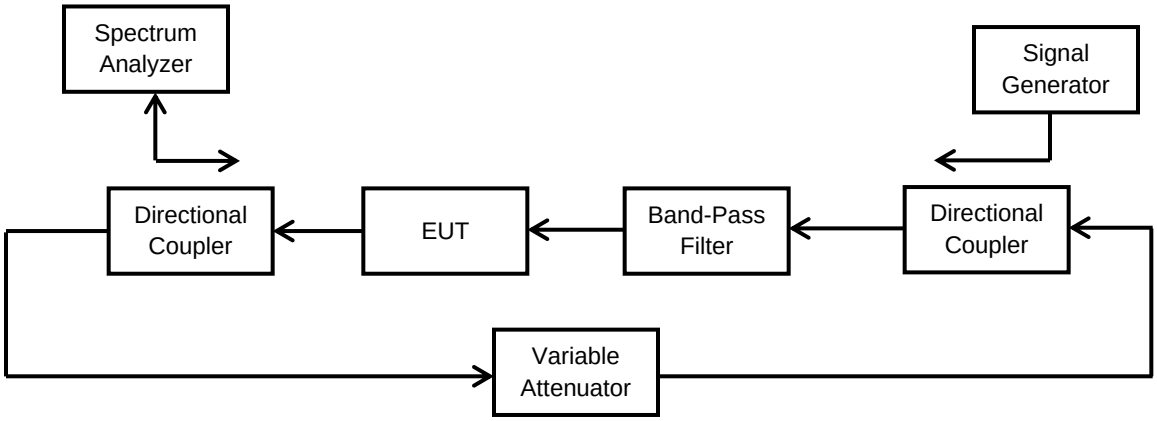
## Test Procedure

The EUT was connected as shown per KDB 935210 D03 Signal Booster Measurements V04R01. The EUT was verified to shut down in the presence of an oscillation.
The total attenuation from output to input was set +5 dB higher than the gain for the band being tested.
For EUT's that do not shutdown, the peak oscillation was measured and the variable attenuator was reduced in 1 dB increments until the booster shuts off.
The frequency and amplitude of the highest oscillation and the lowest level in the valley next to the oscillation was recorded for each 1 dB step as required per the KDB.
For oscillations that exceeded the 12 dB limit, the time required for the booster to mitigate the oscillation to less than 12 dB was recorded.

**Notes for Tables below**:
For all bands, after every mitigation the feedback attenuation was increased and the EUT was reset. After rebooting, the feedback attenuation was decreased 1 dB past the previous step, if the margin was greater than 12 dB, the timer was started.
After the 4th or 5th step, the EUT mitigated the oscillation immediately and the EUT continued to operate. Even when the EUT was reset, the EUT mitigated the oscillation for the next step immediately.
This process was repeated for the remaining steps unless the EUT actually shutdown. After each mitigation, the EUT was verified as still operating by verifying the signal at the edge of the passband was still present.
If the EUT shutdown it was noted in the table of test results.

In all cases the booster mitigated the oscillation to less than 12 dB before the 300 second limit.

## Test Setup



## Uplink Oscillation Mitigation Test Data

| Oscillation Mitigation - Uplink | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **698 – 716 MHz** | | | | | | | | |
| **Test Signal Type** | **CDMA** | | | | | | | | |
| **Variable Attenuator Setting** | **Oscillations** | | **Lowest Output Power Level** | | **Margin** | **Limit** | **Time to Mitigate Oscillation** | **Mitigation Time Limit** | **Pass / Fail** |
| | **Freq.** | **Level** | **Freq.** | **Level** | | | | | |
| **dB** | **MHz** | **dBm** | **MHz** | **dBm** | **dB** | **dB** | **sec** | **sec** | |
| **+5** | 712.17 | -60.1 | 713.8 | -73.4 | 13.3 | <12 | 125 | < 300 | Pass |
| **+4** | 712.17 | -57.5 | 713.8 | -74.1 | 16.6 | <12 | 154 | < 300 | Pass |
| **+3** | 712.17 | -53.5 | 713.8 | -74.2 | 20.7 | <12 | 165 | < 300 | Pass |
| **+2** | 712.17 | -47.2 | 713.8 | -74.1 | 26.9 | <12 | 167 | < 300 | Pass |
| **+1** | 712.17 | -74.2 | 713.8 | -80.2 | 6 | <12 | See Notes in Test Procedure above | < 300 | Pass |
| **+0** | 712.17 | -72.8 | 713.8 | -80.6 | 7.8 | <12 | | < 300 | Pass |
| **-1** | 712.17 | -75.2 | 713.8 | -81.7 | 6.5 | <12 | | < 300 | Pass |
| **-2** | 712.17 | -74.1 | 713.8 | -81.2 | 7.1 | <12 | | < 300 | Pass |
| **-3** | 712.17 | -76.2 | 713.8 | -83.4 | 7.2 | <12 | | < 300 | Pass |
| **-4** | 712.17 | -76.3 | 713.8 | -84.1 | 7.8 | <12 | | < 300 | Pass |
| **-5** | 712.17 | -75.8 | 713.8 | -84 | 8.2 | <12 | | < 300 | Pass |

| Oscillation Mitigation - Uplink | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **776 – 787 MHz** | | | | | | | | |
| **Test Signal Type** | **CDMA** | | | | | | | | |
| **Variable Attenuator Setting** | **Oscillations** | | **Lowest Output Power Level** | | **Margin** | **Limit** | **Time to Mitigate Oscillation** | **Mitigation Time Limit** | **Pass / Fail** |
| | **Freq.** | **Level** | **Freq.** | **Level** | | | | | |
| **dB** | **MHz** | **dBm** | **MHz** | **dBm** | **dB** | **dB** | **sec** | **sec** | |
| **+5** | 780.12 | -56.7 | 781.68 | -73.2 | 16.5 | <12 | 154 | < 300 | Pass |
| **+4** | 780.12 | -53.5 | 781.68 | -73.6 | 20.1 | <12 | 166 | < 300 | Pass |
| **+3** | 780.12 | -47.2 | 781.68 | -74.1 | 26.9 | <12 | 152 | < 300 | Pass |
| **+2** | 780.12 | -72.1 | 781.68 | -79.6 | 7.5 | <12 | See Notes in Test Procedure above | < 300 | Pass |
| **+1** | 780.12 | -71.8 | 781.68 | -79.4 | 7.6 | <12 | | < 300 | Pass |
| **+0** | 780.12 | -74.5 | 781.68 | -81.6 | 7.1 | <12 | | < 300 | Pass |
| **-1** | 780.12 | -73.5 | 781.68 | -81.2 | 7.7 | <12 | | < 300 | Pass |
| **-2** | 780.12 | -72.1 | 781.68 | -81.6 | 9.5 | <12 | | < 300 | Pass |
| **-3** | 780.12 | -75.5 | 781.68 | -83.2 | 7.7 | <12 | | < 300 | Pass |
| **-4** | 780.12 | -75.2 | 781.68 | -84.1 | 8.9 | <12 | | < 300 | Pass |
| **-5** | 780.12 | -74.2 | | -80.6 | 6.4 | <12 | | < 300 | Pass |

| Oscillation Mitigation - Uplink | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **824 - 849 MHz** | | | | | | | | |
| **Test Signal Type** | **CDMA** | | | | | | | | |
| **Variable Attenuator Setting** | **Oscillations** | | **Lowest Output Power Level** | | **Margin** | **Limit** | **Time to Mitigate Oscillation** | **Mitigation Time Limit** | **Pass / Fail** |
| | **Freq.** | **Level** | **Freq.** | **Level** | | | | | |
| **dB** | **MHz** | **dBm** | **MHz** | **dBm** | **dB** | **dB** | **sec** | **sec** | |
| **+5** | 837.97 | -46.2 | 835.35 | -56.7 | 10.5 | <12 | N/A | < 300 | Pass |
| **+4** | 837.97 | -44.7 | 835.35 | -57.1 | 12.4 | <12 | 120 | < 300 | Pass |
| **+3** | 837.97 | -43.2 | 835.35 | -57.4 | 14.2 | <12 | 165 | < 300 | Pass |
| **+2** | 837.97 | -40 | 835.35 | -57.8 | 17.8 | <12 | 162 | < 300 | Pass |
| **+1** | 837.97 | 10 | 835.35 | -54.1 | 64.1 | <12 | 168 | < 300 | Pass |
| **+0** | 837.97 | -57.3 | 835.35 | -62.1 | 4.8 | <12 | See Notes in Test Procedure above | < 300 | Pass |
| **-1** | 837.97 | -57.8 | 835.35 | -62.4 | 4.6 | <12 | | < 300 | Pass |
| **-2** | 837.97 | -57.1 | 835.35 | -62.7 | 5.6 | <12 | | < 300 | Pass |
| **-3** | 837.97 | -59.3 | 835.35 | -64.1 | 4.8 | <12 | | < 300 | Pass |
| **-4** | 837.97 | -60.1 | 835.35 | -64.2 | 4.1 | <12 | | < 300 | Pass |
| **-5** | 837.97 | -59.1 | 835.35 | -64.5 | 5.4 | <12 | | < 300 | Pass |

| Oscillation Mitigation - Uplink | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **1710 - 1755 MHz** | | | | | | | | |
| **Test Signal Type** | **CDMA** | | | | | | | | |
| **Variable Attenuator Setting** | **Oscillations** | | **Lowest Output Power Level** | | **Margin** | **Limit** | **Time to Mitigate Oscillation** | **Mitigation Time Limit** | **Pass / Fail** |
| | **Freq.** | **Level** | **Freq.** | **Level** | | | | | |
| **dB** | **MHz** | **dBm** | **MHz** | **dBm** | **dB** | **dB** | **sec** | **sec** | |
| **+5** | 1731.17 | -35.0 | 1735.25 | -51.4 | 16.4 | <12 | 168 | < 300 | Pass |
| **+4** | 1731.17 | -33.6 | 1735.25 | -51.5 | 17.9 | <12 | 161 | < 300 | Pass |
| **+3** | 1731.17 | -28.0 | 1735.25 | -51.6 | 23.6 | <12 | 165 | < 300 | Pass |
| **+2** | 1731.17 | -50.1 | 1735.25 | -55.2 | 5.1 | <12 | See Notes in Test Procedure above | < 300 | Pass |
| **+1** | 1731.17 | -49.8 | 1735.25 | -56.9 | 7.1 | <12 | | < 300 | Pass |
| **+0** | 1731.17 | -49.7 | 1735.25 | -54.2 | 4.5 | <12 | | < 300 | Pass |
| **-1** | 1731.17 | -49.1 | 1735.25 | -53.4 | 4.3 | <12 | | < 300 | Pass |
| **-2** | 1731.17 | -48.7 | 1735.25 | -53.6 | 4.9 | <12 | | < 300 | Pass |
| **-3** | 1731.17 | -51.2 | 1735.25 | -54.7 | 3.5 | <12 | | < 300 | Pass |
| **-4** | 1731.17 | -50.2 | 1735.25 | -55.1 | 4.9 | <12 | | < 300 | Pass |
| **-5** | 1731.17 | -35.0 | 1735.25 | -51.4 | 16.4 | <12 | | < 300 | Pass |

| Oscillation Mitigation - Uplink | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **1850 - 1910 MHz** | | | | | | | | |
| **Test Signal Type** | **CDMA** | | | | | | | | |
| **Variable Attenuator Setting** | **Oscillations** | | **Lowest Output Power Level** | | **Margin** | **Limit** | **Time to Mitigate Oscillation** | **Mitigation Time Limit** | **Pass / Fail** |
| | **Freq.** | **Level** | **Freq.** | **Level** | | | | | |
| **dB** | **MHz** | **dBm** | **MHz** | **dBm** | **dB** | **dB** | **sec** | **sec** | |
| **+5** | 1873.45 | -32.7 | 1878.82 | -49.5 | 16.8 | <12 | 134 | < 300 | Pass |
| **+4** | 1873.45 | -30.5 | 1878.82 | -49.4 | 18.9 | <12 | 163 | < 300 | Pass |
| **+3** | 1873.45 | -24.1 | 1878.82 | -49.9 | 25.8 | <12 | 161 | < 300 | Pass |
| **+2** | 1873.45 | -47.2 | 1878.82 | -55.1 | 7.9 | <12 | See Notes in Test Procedure above | < 300 | Pass |
| **+1** | 1873.45 | -47.6 | 1878.82 | -55.9 | 8.3 | <12 | | < 300 | Pass |
| **+0** | 1873.45 | -47.1 | 1878.82 | -53.8 | 6.7 | <12 | | < 300 | Pass |
| **-1** | 1873.45 | -47.8 | 1878.82 | -53.2 | 5.4 | <12 | | < 300 | Pass |
| **-2** | 1873.45 | -47.4 | 1878.82 | -55.3 | 7.9 | <12 | | < 300 | Pass |
| **-3** | 1873.45 | -47.1 | 1878.82 | -53.8 | 6.7 | <12 | | < 300 | Pass |
| **-4** | 1873.45 | -50.5 | 1878.82 | -57.6 | 7.1 | <12 | | < 300 | Pass |
| **-5** | 1873.45 | -49.4 | 1878.82 | -57.2 | 7.8 | <12 | | < 300 | Pass |

**Downlink Oscillation Mitigation Test Data**

| Oscillation Mitigation - Downlink | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **728 - 746 MHz** | | | | | | | | |
| **Test Signal Type** | **CDMA** | | | | | | | | |
| **Variable Attenuator Setting** | **Oscillations** | | **Lowest Output Power Level** | | **Margin** | **Limit** | **Time to Mitigate Oscillation** | **Mitigation Time Limit** | **Pass / Fail** |
| | **Freq.** | **Level** | **Freq.** | **Level** | | | | | |
| **dB** | **MHz** | **dBm** | **MHz** | **dBm** | **dB** | **dB** | **sec** | **sec** | |
| **+5** | 740.12 | -60.1 | 737.9 | -73.2 | 13.1 | <12 | 156 | < 300 | Pass |
| **+4** | 740.12 | -59.2 | 737.9 | -73.1 | 13.9 | <12 | 165 | < 300 | Pass |
| **+3** | 740.12 | -56.2 | 737.9 | -74.0 | 17.8 | <12 | 159 | < 300 | Pass |
| **+2** | 740.12 | -53.1 | 737.9 | -74.5 | 21.4 | <12 | 170 | < 300 | Pass |
| **+1** | 740.12 | -44.6 | 737.9 | -75.8 | 31.2 | <12 | 161 | < 300 | Pass |
| **+0** | 740.12 | -73.2 | 737.9 | -81.5 | 8.3 | <12 | See Notes in Test Procedure above | < 300 | Pass |
| **-1** | 740.12 | -72.1 | 737.9 | -81.2 | 9.1 | <12 | | < 300 | Pass |
| **-2** | 740.12 | -75.2 | 737.9 | -82.4 | 7.2 | <12 | | < 300 | Pass |
| **-3** | 740.12 | -74.5 | 737.9 | -82.4 | 7.9 | <12 | | < 300 | Pass |
| **-4** | 740.12 | -74 | 737.9 | -83.9 | 9.9 | <12 | | < 300 | Pass |
| **-5** | 740.12 | -77.5 | 737.9 | -83.2 | 5.7 | <12 | | < 300 | Pass |

| Oscillation Mitigation - Downlink | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **746 - 757 MHz** | | | | | | | | |
| **Test Signal Type** | **CDMA** | | | | | | | | |
| **Variable Attenuator Setting** | **Oscillations** | | **Lowest Output Power Level** | | **Margin** | **Limit** | **Time to Mitigate Oscillation** | **Mitigation Time Limit** | **Pass / Fail** |
| | **Freq.** | **Level** | **Freq.** | **Level** | | | | | |
| **dB** | **MHz** | **dBm** | **MHz** | **dBm** | **dB** | **dB** | **sec** | **sec** | |
| **+5** | 746.85 | -61.7 | 749.16 | -75.2 | 13.5 | <12 | 159 | < 300 | Pass |
| **+4** | 746.85 | -59.3 | 749.16 | -75.4 | 16.1 | <12 | 161 | < 300 | Pass |
| **+3** | 746.85 | -56.2 | 749.16 | -75.9 | 19.7 | <12 | 162 | < 300 | Pass |
| **+2** | 746.85 | -76.1 | 749.16 | -82.5 | 6.4 | <12 | See Notes in Test Procedure above | < 300 | Pass |
| **+1** | 746.85 | -75.1 | 749.16 | -82.4 | 7.3 | <12 | | < 300 | Pass |
| **+0** | 746.85 | -77.5 | 749.16 | -84.3 | 6.8 | <12 | | < 300 | Pass |
| **-1** | 746.85 | -77.8 | 749.16 | -83.3 | 5.5 | <12 | | < 300 | Pass |
| **-2** | 746.85 | -76.8 | 749.16 | -84.2 | 7.4 | <12 | | < 300 | Pass |
| **-3** | 746.85 | -81.5 | 749.16 | -83.2 | 1.7 | <12 | | < 300 | Pass |
| **-4** | 746.85 | -80.5 | 749.16 | -83.5 | 3 | <12 | | < 300 | Pass |
| **-5** | 746.85 | -80.4 | 749.16 | -84.3 | 3.9 | <12 | | < 300 | Pass |

| Oscillation Mitigation – Downlink | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **869 - 894 MHz** | | | | | | | | |
| **Test Signal Type** | **CDMA** | | | | | | | | |
| **Variable Attenuator Setting** | **Oscillations** | | **Lowest Output Power Level** | | **Margin** | **Limit** | **Time to Mitigate Oscillation** | **Mitigation Time Limit** | **Pass / Fail** |
| | **Freq.** | **Level** | **Freq.** | **Level** | | | | | |
| **dB** | **MHz** | **dBm** | **MHz** | **dBm** | **dB** | **dB** | **sec** | **sec** | |
| **+5** | 878.83 | -59.9 | 877 | -72.1 | 12.2 | <12 | 153 | < 300 | Pass |
| **+4** | 878.83 | -58.0 | 877 | -72.1 | 14.1 | <12 | 165 | < 300 | Pass |
| **+3** | 878.83 | -55.8 | 877 | -72.8 | 17.0 | <12 | 167 | < 300 | Pass |
| **+2** | 878.83 | -51.5 | 877 | -74.2 | 22.7 | <12 | 169 | < 300 | Pass |
| **+1** | 878.83 | -40.5 | 877 | -74.3 | 33.8 | <12 | 158 | < 300 | Pass |
| **+0** | 878.83 | -72.5 | 877 | -79.4 | 6.9 | <12 | See Notes in Test Procedure above | < 300 | Pass |
| **-1** | 878.83 | -74.1 | 877 | -81.5 | 7.4 | <12 | | < 300 | Pass |
| **-2** | 878.83 | -73.1 | 877 | -81.2 | 8.1 | <12 | | < 300 | Pass |
| **-3** | 878.83 | -72.9 | 877 | -81.4 | 8.5 | <12 | | < 300 | Pass |
| **-4** | 878.83 | -77 | 877 | -83.1 | 6.1 | <12 | | < 300 | Pass |
| **-5** | 878.83 | -76.2 | 877 | -84.1 | 7.9 | <12 | | < 300 | Pass |

| Oscillation Mitigation - Downlink | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **1930 - 1990 MHz** | | | | | | | | |
| **Test Signal Type** | **CDMA** | | | | | | | | |
| **Variable Attenuator Setting** | **Oscillations** | | **Lowest Output Power Level** | | **Margin** | **Limit** | **Time to Mitigate Oscillation** | **Mitigation Time Limit** | **Pass / Fail** |
| | **Freq.** | **Level** | **Freq.** | **Level** | | | | | |
| **dB** | **MHz** | **dBm** | **MHz** | **dBm** | **dB** | **dB** | **sec** | **sec** | |
| **+5** | 1968.28 | -51.2 | 1973.40 | -65.1 | 13.9 | <12 | 144 | < 300 | Pass |
| **+4** | 1968.28 | -48.2 | 1973.40 | -65.3 | 17.1 | <12 | 127 | < 300 | Pass |
| **+3** | 1968.28 | -45.8 | 1973.40 | -65.7 | 19.9 | <12 | 146 | < 300 | Pass |
| **+2** | 1968.28 | -38.5 | 1973.40 | -66.0 | 27.5 | <12 | 160 | < 300 | Pass |
| **+1** | 1968.28 | -62.5 | 1973.40 | -71.0 | 8.5 | <12 | See Notes in Test Procedure above | < 300 | Pass |
| **+0** | 1968.28 | -65.0 | 1973.40 | -72.1 | 7.1 | <12 | | < 300 | Pass |
| **-1** | 1968.28 | -64.2 | 1973.40 | -72.3 | 8.1 | <12 | | < 300 | Pass |
| **-2** | 1968.28 | -66.6 | 1973.40 | -71.9 | 5.3 | <12 | | < 300 | Pass |
| **-3** | 1968.28 | -65.0 | 1973.40 | -72.1 | 7.1 | <12 | | < 300 | Pass |
| **-4** | 1968.28 | -64.5 | 1973.40 | -71.9 | 7.4 | <12 | | < 300 | Pass |
| **-5** | 1968.28 | -65.5 | 1973.40 | -74.4 | 8.9 | <12 | | < 300 | Pass |

| Oscillation Mitigation - Downlink | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Band** | **2110 - 2155 MHz** | | | | | | | | |
| **Test Signal Type** | **CDMA** | | | | | | | | |
| **Variable Attenuator Setting** | **Oscillations** | | **Lowest Output Power Level** | | **Margin** | **Limit** | **Time to Mitigate Oscillation** | **Mitigation Time Limit** | **Pass / Fail** |
| | **Freq.** | **Level** | **Freq.** | **Level** | | | | | |
| **dB** | **MHz** | **dBm** | **MHz** | **dBm** | **dB** | **dB** | **sec** | **sec** | |
| **+5** | 2124.87 | -54.0 | 2118.75 | -65.5 | 11.5 | <12 | N/A | < 300 | Pass |
| **+4** | 2124.87 | -52.0 | 2118.75 | -66.1 | 14.1 | <12 | 122 | < 300 | Pass |
| **+3** | 2124.87 | -50.2 | 2118.75 | -66.1 | 15.9 | <12 | 163 | < 300 | Pass |
| **+2** | 2124.87 | -48.1 | 2118.75 | -66.9 | 18.8 | <12 | 145 | < 300 | Pass |
| **+1** | 2124.87 | -43.6 | 2118.75 | -67.5 | 23.9 | <12 | 163 | < 300 | Pass |
| **+0** | 2124.87 | -60.6 | 2118.75 | -69.1 | 8.5 | <12 | See Notes in Test Procedure above | < 300 | Pass |
| **-1** | 2124.87 | -59.2 | 2118.75 | -68.5 | 9.3 | <12 | | < 300 | Pass |
| **-2** | 2124.87 | -61.4 | 2118.75 | -70.2 | 8.8 | <12 | | < 300 | Pass |
| **-3** | 2124.87 | -59.8 | 2118.75 | -69.9 | 10.1 | <12 | | < 300 | Pass |
| **-4** | 2124.87 | -58.6 | 2118.75 | -69.8 | 11.2 | <12 | | < 300 | Pass |
| **-5** | 2124.87 | -64.8 | 2118.75 | -72.9 | 8.1 | <12 | | < 300 | Pass |

**Radiated Spurious**
**Engineer:** Alex Macon
**Test Date:** 1/16/2018

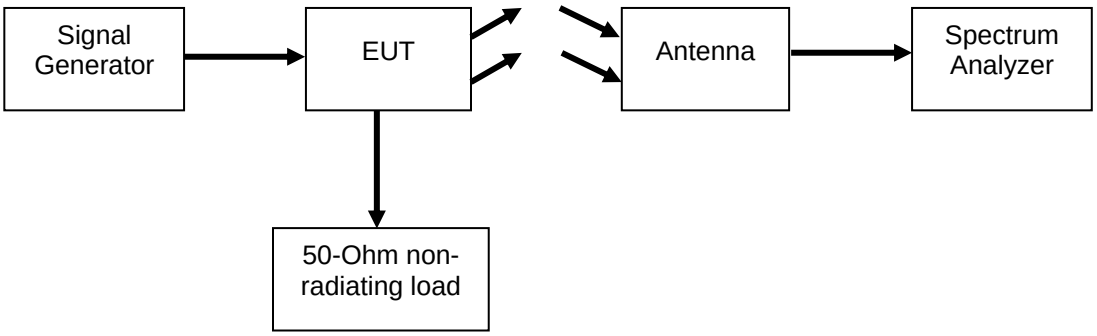
**Test Procedure**

The EUT was tested in a semi-anechoic chamber with the turntable set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360 degrees with the antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure that the signal levels were maximized. All cable and antenna correction factors were input into the spectrum analyzer ensuring an accurate measurement in ERP/EIRP with the resultant power in dBm. A signal generator was used to provide a CW signal centered in each operational uplink and downlink band. The EUT output was terminated into a 50 Ohm non-radiating load.

The following formula was used for calculating the limits:

Radiated Spurious Emissions Limit = P1 – (43+ 10Log(P2)) = -13dBm
P1 = power in dBm
P2 = power in Watts

**Test Setup**




**Refer to Annex J for Radiated Spurious Emission plots**

All emissions were lower than -13 dBm.

**Conducted Spurious Emissions with Modem Transmitting**

**Engineer:** Greg Corbin

**Test Date:** 2/6/2018

**Test Procedure**

The EUT was connected to a spectrum analyzer through an attenuator, with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as needed to ensure accurate readings. A signal generator was utilized to produce a 4.1 MHz AWGN signal operating at the maximum allowable power.

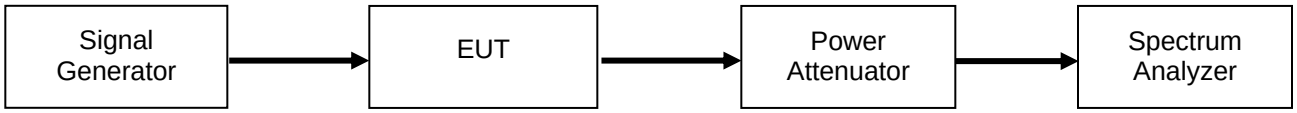
The internal cellular modem was powered on and transmitting at maximum power in the uplink direction at the frequency listed in the table.
Note: the cellular modem only transmits ion the uplink direction, so no downlink tests are impacted by the cellular modem transmitting.

The conducted spurious emissions from 9 kHz to 10 times the highest tunable frequency for each operational band were measured (excluding the band defined by the Out of band emissions test). The emissions were plotted and the highest level was recorded in the summary table.

The following formulas are used for calculating the limits.

Conducted Spurious Emissions Limit = P1 – (43+ 10Log(P2)) = -13 dBm
P1 = power in dBm
P2 = power in Watts

**Test Setup**




**Uplink Test Results**

| Frequency Band (MHz) | Cellular modem Frequency | Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|
| 698 - 716 | 704 | 1866.34 | 31.2 | -13 | Pass |
| 776 - 787 | 779 | 6889.01 | -21.6 | -13 | Pass |
| 824 - 849 | 831.5 | 8259.03 | -22.6 | -13 | Pass |
| 1710 - 1755 | 1720 | 15750.11 | -26.8 | -13 | Pass |
| 1850 - 1910 | 1860 | 16685.54 | -25.4 | -13 | Pass |

**Refer to Annex K for Conducted Spurious Emission plots with the cellular modem transmitting**

**Intermodulation with Modem Transmitting**

**Engineer:** Greg Corbin

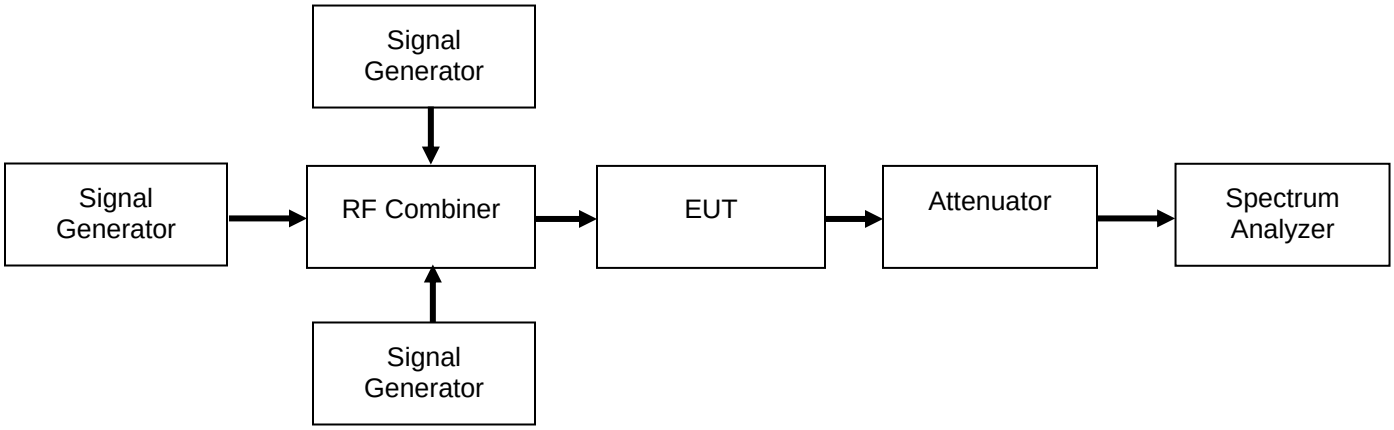
**Test Date:** 2/6/2018

**Test Procedure**

2 tests were performed for 3-tone intermodulation.
The first test was performed using 3 CW signals combined at the EUT input.
The internal modem was powered on but not transmitting.
The CW signals were spaced 600 kHz apart and centered at the peak of the operational band.
Attenuator, combiner, and cable insertion loss correction factors were input to either the signal generator or the spectrum analyzer as required to ensure that accurate measurements were recorded.
The input power was increased until the AGC level was reached. The input power was then set to 0.2 dB below the AGC level and intermodulation products were measured to ensure they were less than -19 dBm in a 3 kHz RBW.
The spectrum analyzer screenshot was captured and the highest-level intermodulation signal was recorded in the test summary table.
The input power was increased in 2 dB increments to 10 dB above the AGC threshold to verify the intermodulation products remain below the limit. During this test, the input power was not increased past the maximum allowed.
The intermodulation level with the input power 10 dB higher than the AGC threshold was recorded in the test summary table.

For the 2nd test, a two-tone test with the modem transmitting was performed. The 2 CW signals were centered at the peak of the passband.
The modem was tuned to a channel near the CW signals without masking the intermodulation signals.
Before setting the modem to transmit mode, a screen capture of the 2-tone intermodulation products was recorded with the input power set to 0.2 dB below the AGC threshold.
The modem was then set to transmit mode at the maximum power level and the intermodulation products were recorded along with the spectrum analyzer screen capture.
With the modem signal present, the output level of the 2 CW signals and associated intermodulation products was reduced.
The input power was increased in 2 dB increments to 10 dB above the AGC threshold to verify the intermodulation products remain below the limit. During this test, the input power was not increased past the maximum allowed.
The intermodulation level with the input power 10 dB higher than the AGC threshold was recorded in the test summary table.
At no time during the test, did the intermodulation products exceed the -19 dBm limit.
For all tests an Average detector was used and the RBW was set to 3 kHz.

### 3 Tone Intermodulation Test Setup




### Intermodulation Test Results with 3 CW signals

| Uplink Band (MHz) | 1st Tone (MHz) | 2nd Tone (MHz) | 3rd Tone (MHz) | Intermodulation Level (dBm) | Limit (dBm) | Result (Pass / Fail) | Intermod Level with Input Power @ AGC + 10 dB | Result (Pass / Fail) |
|---|---|---|---|---|---|---|---|---|
| 698 - 716 | 710.40 | 711.00 | 711.60 | -19.4 | -19 | Pass | -19.5 | Pass |
| 776 – 787 | 779.33 | 779.73 | 780.33 | -21.1 | -19 | Pass | -22.9 | Pass |
| 824 – 849 | 833.38 | 833.98 | 834.58 | -22.7 | -19 | Pass | -23.1 | Pass |
| 1710 – 1755 | 1753.66 | 1754.26 | 1754.86 | -22.1 | -19 | Pass | -22.4 | Pass |
| 1850 – 1910 | 1870.00 | 1870.60 | 1871.20 | -20.7 | -19 | Pass | -24.5 | Pass |

### Intermodulation Test Results with 2 CW signals and Modem Transmitting

| Uplink Band (MHz) | 1st Tone (MHz) | 2nd Tone (MHz) | Modem Frequency (MHz) | Intermodulation Level (dBm) | Limit (dBm) | Result (Pass / Fail) | Intermod Level with Input Power @ AGC + 10 dB | Result (Pass / Fail) |
|---|---|---|---|---|---|---|---|---|
| 698 - 716 | 710.70 | 711.30 | 704.00 | -46 | -19 | Pass | -28 | Pass |
| 776 – 787 | 779.13 | 779.73 | 784.00 | -33.1 | -19 | Pass | -28.5 | Pass |
| 824 – 849 | 833.38 | 833.98 | 829.50 | -36.5 | -19 | Pass | -24.1 | Pass |
| 1710 – 1755 | 1753.66 | 1754.26 | 1749.00 | -50.3 | -19 | Pass | -32.7 | Pass |
| 1850 – 1910 | 1870.00 | 1870.60 | 1865.00 | -24.2 | -19 | Pass | -22.1 | Pass |

**Refer to Annex L for Intermodulation Test plots with modem**

**Radiated Spurious with Modem Transmitting**
**Engineer:** Greg Corbin
**Test Date:** 2/7/2018

**Test Procedure**

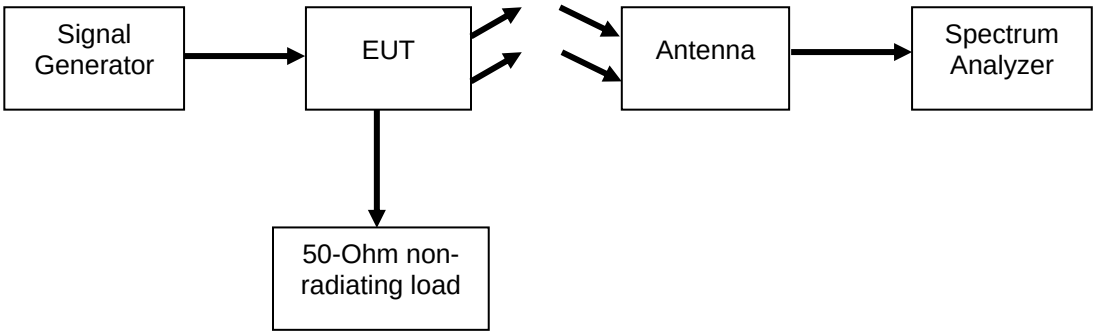
The EUT was tested in a semi-anechoic chamber with the turntable set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360 degrees with the antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure that the signal levels were maximized. All cable and antenna correction factors were input into the spectrum analyzer ensuring an accurate measurement in ERP/EIRP with the resultant power in dBm. A signal generator was used to provide a CW signal centered in each operational uplink band. The EUT output was terminated into a 50 Ohm non-radiating load.

The internal cellular modem was powered on and transmitting at maximum power in the uplink direction at the frequency listed in the table.
Note: the cellular modem only transmits ion the uplink direction, so no downlink tests are impacted by the cellular modem transmitting.

The following formula was used for calculating the limits:

Radiated Spurious Emissions Limit = P1 – (43+ 10Log(P2)) = -13dBm
P1 = power in dBm
P2 = power in Watts

**Test Setup**




**Refer to Annex M for Radiated Spurious Emission plots with Modem**

All emissions were lower than -13 dBm.

**Test Equipment Utilized**

| Description | Manufacturer | Model # | CT Asset # | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| Horn Antenna, Amplified | ARA | DRG-118/A | i00271 | 6/16/16 | 6/16/18 |
| Humidity / Temp Meter | Newport | IBTHX-W-5 | i00282 | 6/9/17 | 6/9/18 |
| Spectrum Analyzer | Agilent | E4407B | i00331 | 11/21/17 | 11/21/18 |
| Bi-Log Antenna | Schaffner | CBL 6111D | i00349 | 8/3/16 | 8/3/18 |
| EMI Analyzer | Agilent | E7405A | i00379 | 2/13/18 | 2/13/19 |
| Signal Generator | Rohde & Schwarz | SMU200A | i00405 | 5/5/17 | 5/5/18 |
| Spectrum Analyzer | Textronix | RSA5126A | i00424 | 5/3/17 | 5/3/18 |
| 3 Meter Semi-Anechoic Chamber | Panashield | 3 Meter Semi-Anechoic Chamber | i00428 | 8/15/16 | 8/15/19 |
| Preamplifier | Miteq | AFS44 00101 400 23-10P-44 | i00509 | N/A | N/A |

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT