Compliance Testing, LLC
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Test Report

Prepared for: Clear RF

Model: WRE5500

Description: Five-Band Bi-Directional Cellular Amplifier

FCC ID: XS7WRE5500
IC: 8918A-WRE5500

To

FCC Part 20
IC RSS-131

Date of Issue: March 1, 2017

On the behalf of the applicant:	**Clear RF** **12825 E. Mirabeau Parkway** **Suite 104** **Spokane Valley, WA 99216**
To the attention of:	**Shawn Taylor, Chief Operating Officer** **Ph: (509)321-9520** **Email: shawn.taylor@servatron.com**

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Greg Corbin
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	February 17, 2017	Greg Corbin	Original Document
2.0	March 1, 2017	Greg Corbin	Added MSCL statement to page 22

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ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

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**

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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.

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)**
19.5 – 25.6	25 – 48.2	962.1 – 975.4

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

EUT Description
Model: WRE5500-S
Description: Five-Band Bi-Directional Cellular Amplifier
Firmware: 1.04
Software: N/A
Serial Number: S2171700
Additional Information:
The EUT is a Direct Connect bi-directional amplifier for the boosting of cellular phone signals and data communication devices.
The following frequency bands and emission types are utilized.

Frequency Band (MHz)					
Uplink	698 - 716	776 – 787 (IC, 777 – 787)	824 - 849	1850 - 1915	1710 – 1755
Downlink	728 - 746	746 – 757 (IC, 746 – 756)	869 - 894	1930 - 1995	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 tested under normal operating conditions with all external attenuation set to 0 dB.

Test Result Summary

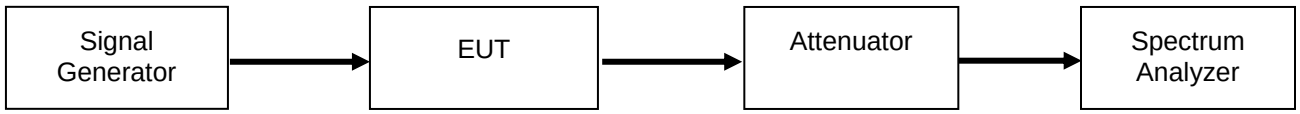
Specification	Test Name	Pass, Fail, N/A	Comments
20.21(e)(3)	Authorized Frequency Band	Pass	
20.21(e)(8)(i)(B) 20.21(e)(8)(i)(C) 20.21(e)(8)(i)(D)	Maximum Power and Gain	Pass	
20.21(e)(8)(i)(F)	Intermodulation	Pass	
20.21(e)(8)(i)(E)	Out-of-Band Emissions	Pass	
2.1051 22.917(a) 24.238((a) 27.53(c) 27.53(f) 27.53(g) 27.53(h)	Conducted Spurious Emissions	Pass	
20.21(e)(8)(i)(A)	Noise Limits	Pass	Per the test data on page 20, the noise is below -70dBm/MHz (“Transmit Power OFF Mode”), therefore is by default compliant to the Variable Uplink Noise Power Tests, and Uplink Noise timing tests. These tests are not applicable.
20.21(e)(8)(i)(I)	Uplink Inactivity	Pass	Per rule 20.21(e)(8)(i)(H)... if noise is less than -70dBm/MHz (“Transmit Power OFF Mode”) then EUT will not shut off, therefore this test will not be performed
20.21(e)(8)(i)(C)(1) 20.21(e)(8)(i)(H) Choose: 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	N/A	Anti-Oscillation and Oscillation Mitigation not required for Direct Connect boosters with less than 15 dB gain
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

Authorized Frequency Band
Engineer: Greg Corbin
Test Date: 11/18/2016

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.

Test Setup



Refer to Annex A for Authorized Frequency Band plots

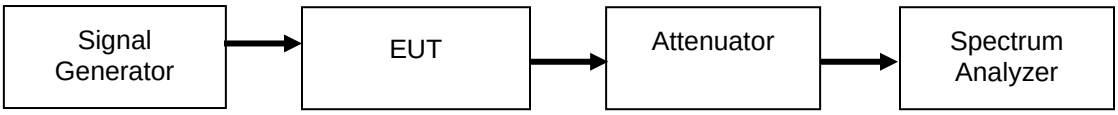
Maximum Power and Gain
Engineer: Greg Corbin
Test Date: 2/9/2017

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 Direct Connect installations the gain is fixed at 15 dB.

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	6.4	20.9	17	30	3	23.9	Pass
698 - 716 MHz AWGN	6.7	20.9	17	30	3	23.9	Pass
776 - 787 MHz Pulsed GSM	6.2	18.7	17	30	3	21.7	Pass
776 - 787 MHz AWGN	6.9	18.7	17	30	3	21.7	Pass
824 - 849 MHz Pulsed GSM	5.3	19.8	17	30	3	22.8	Pass
824 - 849 MHz AWGN	5.0	18.7	17	30	3	21.7	Pass
1710 - 1755 MHz Pulsed GSM	3.7	18.1	17	30	3	21.1	Pass
1710 - 1755 MHz AWGN	3.6	17.5	17	30	3	20.5	Pass
1850 - 1915 MHz Pulsed GSM	3.9	17.6	17	30	3	20.6	Pass
1850 - 1915 MHz AWGN	3.8	17.1	17	30	3	20.1	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	-20.0	-5.7	17	N/A, Direct Connect		Pass
728 - 746 MHz AWGN	-53.1	-40.2	17	N/A, Direct Connect		Pass
746 - 757 MHz Pulsed GSM	-20.0	-5.3	17	N/A, Direct Connect		Pass
746 - 757 MHz AWGN	-53.3	-40.0	17	N/A, Direct Connect		Pass
869 - 894 MHz Pulsed GSM	-20.0	-10.2	17	N/A, Direct Connect		Pass
869 - 894 MHz AWGN	-53.3	-39.5	17	N/A, Direct Connect		Pass
1930 - 1995 MHz Pulsed GSM	-20.0	-8.3	17	N/A, Direct Connect		Pass
1930 - 1995 MHz AWGN	-53.0	-41.4	17	N/A, Direct Connect		Pass
2110 - 2155 MHz Pulsed GSM	-20.0	-8.1	17	N/A, Direct Connect		Pass
2110 - 2155 MHz AWGN	-51.8	-38.7	17	N/A, Direct Connect		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	703.19	738.6875	14.5	63.5	14.3	63.5	0.2	9	-8.8
AWGN	703.19	738.6875	14.2	63.5	12.9	63.5	1.3	9	-7.7
Pulsed GSM	781.5	746.475	12.5	64.4	14.7	64.4	2.2	9	-6.8
AWGN	781.5	746.475	11.8	64.4	13.3	64.4	1.5	9	-7.5
Pulsed GSM	840.81	878.725	14.5	64.9	9.8	64.9	4.7	9	-4.3
AWGN	840.81	878.725	13.7	64.9	13.8	64.9	0.1	9	-8.9
Pulsed GSM	1732.5	2134.15	14.4	71	11.9	71	2.5	9	-6.5
AWGN	1732.5	2134.15	13.9	71	13.1	71	0.8	9	-8.2
Pulsed GSM	1879.05	1949.85	13.7	72	11.7	72	2	9	-7
AWGN	1879.05	1949.85	13.3	72	11.6	72	1.7	9	-7.3

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	27.0	25.7	17	30	Pass
698 - 716 MHz AWGN	27.0	25.6	17	30	Pass
776 - 787 MHz Pulsed GSM	27.0	25.6	17	30	Pass
776 - 787 MHz AWGN	27.0	25.4	17	30	Pass
824 - 849 MHz Pulsed GSM	27.0	25.4	17	30	Pass
824 - 849 MHz AWGN	27.0	25.0	17	30	Pass
1710 - 1755 MHz Pulsed GSM	27.0	24.0	17	30	Pass
1710 - 1755 MHz AWGN	27.0	22.8	17	30	Pass
1850 - 1915 MHz Pulsed GSM	27.0	23.1	17	30	Pass
1850 - 1915 MHz AWGN	27.0	21.6	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	-5.7	17	Pass
728 - 746 MHz AWGN	-20.0	-21.0	17	Pass
746 - 757 MHz Pulsed GSM	-20.0	-5.3	17	Pass
746 - 757 MHz AWGN	-20.0	-20.8	17	Pass
869 - 894 MHz Pulsed GSM	-20.0	-10.2	17	Pass
869 - 894 MHz AWGN	-20.0	-21.3	17	Pass
1930 - 1995 MHz Pulsed GSM	-20.0	-8.3	17	Pass
1930 - 1995 MHz AWGN	-20.0	-24.2	17	Pass
2110 - 2155 MHz Pulsed GSM	-20.0	-8.1	17	Pass
2110 - 2155 MHz AWGN	-20.0	-23.6	17	Pass

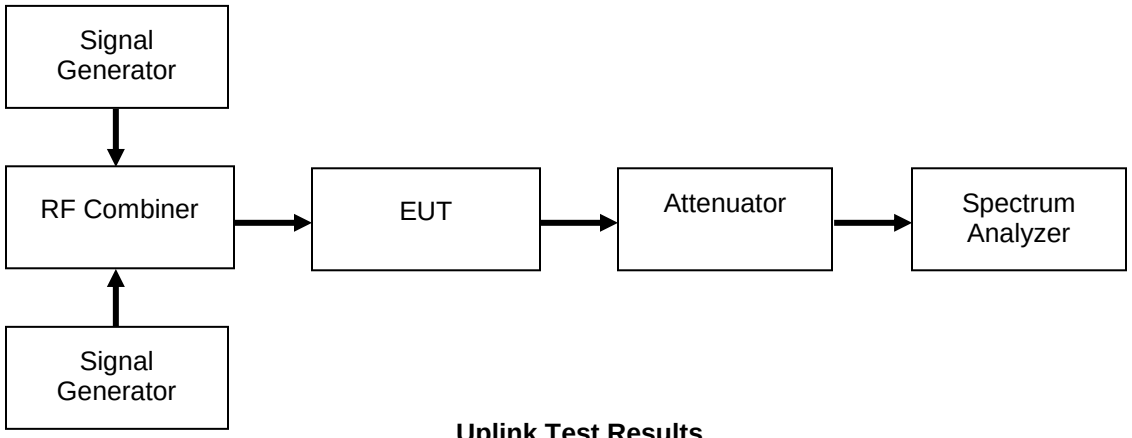
Intermodulation
Engineer: Greg Corbin
Test Date: 2/9/2017

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	-31.7	-19	Pass	-32.1	Pass
776 - 787 MHz	-33.7	-19	Pass	-34	Pass
824 - 849 MHz	-34.6	-19	Pass	-24.1	Pass
1710 - 1755 MHz	-23.7	-19	Pass	-21.7	Pass
1850 - 1915 MHz	-20.5	-19	Pass	-21.1	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	<-107	-19	Pass	<-107	Pass
746 - 757 MHz	<-107	-19	Pass	<-107	Pass
869 - 894 MHz	<-107	-19	Pass	<-107	Pass
1930 - 1995 MHz	<-107	-19	Pass	<-107	Pass
2110 - 2155 MHz	<-107	-19	Pass	<-107	Pass

Refer to Annex B for Intermodulation Test plots

Out-of-Band Emissions
Engineer: Greg Corbin
Test Date: 1/10/2017

Test Procedure

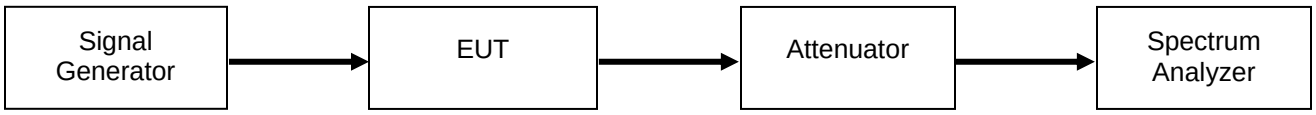
The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor in order to ensure accurate readings. A signal generator was utilized to produce the following signals: GSM, CDMA, 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	-22.8	-19	Pass	Yes
698 - 716	Upper	-23.9	-19	Pass	Yes
776 - 787	Lower	-29.1	-19	Pass	Yes
776 - 787	Upper	-26.9	-19	Pass	Yes
824 - 849	Lower	-32.9	-19	Pass	Yes
824 - 849	Upper	-33.6	-19	Pass	Yes
1710 - 1755	Lower	-34	-19	Pass	Yes
1710 - 1755	Upper	-34.8	-19	Pass	Yes
1850 - 1915	Lower	-49.7	-19	Pass	Yes
1850 - 1915	Upper	-44.1	-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	-44.1	-19	Pass	Yes
698 - 716	Upper	-48.4	-19	Pass	Yes
776 - 787	Lower	-54.4	-19	Pass	Yes
776 - 787	Upper	-51.2	-19	Pass	Yes
824 - 849	Lower	-41.1	-19	Pass	Yes
824 - 849	Upper	-41.4	-19	Pass	Yes
1710 - 1755	Lower	-37.6	-19	Pass	Yes
1710 - 1755	Upper	-36.7	-19	Pass	Yes
1850 - 1915	Lower	-37.2	-19	Pass	Yes
1850 - 1915	Upper	-42.2	-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	-43.3	-19	Pass	Yes
698 - 716	Upper	-52	-19	Pass	Yes
776 - 787	Lower	-52.9	-19	Pass	Yes
776 - 787	Upper	-54.9	-19	Pass	Yes
824 - 849	Lower	-38.5	-19	Pass	Yes
824 - 849	Upper	-40.4	-19	Pass	Yes
1710 - 1755	Lower	-33.3	-19	Pass	Yes
1710 - 1755	Upper	-31.6	-19	Pass	Yes
1850 - 1915	Lower	-33.8	-19	Pass	Yes
1850 - 1915	Upper	-40.1	-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 MHz	Lower	-71.6	-19	Pass	Yes
728 - 746 MHz	Upper	-77	-19	Pass	Yes
746 - 757 MHz	Lower	-77.1	-19	Pass	Yes
746 - 757 MHz	Upper	-77.3	-19	Pass	Yes
869 - 894 MHz	Lower	-86.8	-19	Pass	Yes
869 - 894 MHz	Upper	-86.5	-19	Pass	Yes
1930 - 1995 MHz	Lower	-87.3	-19	Pass	Yes
1930 - 1995 MHz	Upper	-86.9	-19	Pass	Yes
2110 - 2155 MHz	Lower	-88.4	-19	Pass	Yes
2110 - 2155 MHz	Upper	-87.5	-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 MHz	Lower	-77.1	-19	Pass	Yes
728 - 746 MHz	Upper	-77.3	-19	Pass	Yes
746 - 757 MHz	Lower	-77.4	-19	Pass	Yes
746 - 757 MHz	Upper	-77.8	-19	Pass	Yes
869 - 894 MHz	Lower	-76.9	-19	Pass	Yes
869 - 894 MHz	Upper	-77.3	-19	Pass	Yes
1930 - 1995 MHz	Lower	-77.8	-19	Pass	Yes
1930 - 1995 MHz	Upper	-77.6	-19	Pass	Yes
2110 - 2155 MHz	Lower	-78	-19	Pass	Yes
2110 - 2155 MHz	Upper	-78	-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 MHz	Lower	-77.2	-19	Pass	Yes
728 - 746 MHz	Upper	-76.9	-19	Pass	Yes
746 - 757 MHz	Lower	-77.4	-19	Pass	Yes
746 - 757 MHz	Upper	-76.7	-19	Pass	Yes
869 - 894 MHz	Lower	-70.9	-19	Pass	Yes
869 - 894 MHz	Upper	-72	-19	Pass	Yes
1930 - 1995 MHz	Lower	-71.7	-19	Pass	Yes
1930 - 1995 MHz	Upper	-72.1	-19	Pass	Yes
2110 - 2155 MHz	Lower	-72	-19	Pass	Yes
2110 - 2155 MHz	Upper	-71.9	-19	Pass	Yes

Refer to Annex C for Out of Band Emission plots

Conducted Spurious Emissions
Engineer: Greg Corbin
Test Date: 2/13/2017

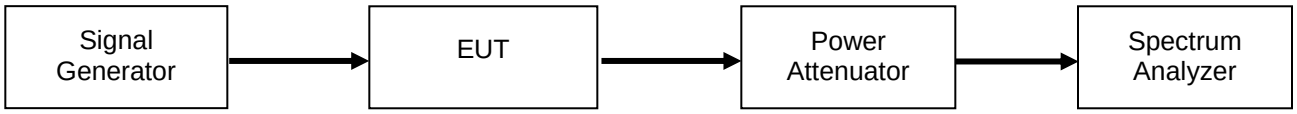
Test Procedure

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	7418.59	-31.6	-13	Pass
776 - 787	7311.16	-31.8	-13	Pass
824 - 849	8331.7	-31.3	-13	Pass
1710 - 1755	17033.5	-25.3	-13	Pass
1850 - 1915	18521.6	-26.3	-13	Pass

Downlink Test Results

Frequency Band (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
728 - 746	7256.85	-46.7	-13	Pass
746 - 757	7300.62	-46.7	-13	Pass
869 - 894	8268.52	-47.1	-13	Pass
1930 - 1995	18501.17	-41.3	-13	Pass
2110 - 2155	21434.42	-40.2	-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;

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

776 – 787 MHz Uplink Band

Spurious Frequency Range (MHz)	Measured Frequency (MHz)	Measured Value (dBm)	RBW (kHz)	Final Value (dBm)	Limit (dBm)	Margin (dB)
763 – 775	774.466	-53.3	6.25	-53.30	-46	-7.30
793 – 805	797.401	-56.9	6.25	-56.90	-46	-10.90

746 - 757 MHz Downlink Band

Spurious Frequency Range (MHz)	Measured Frequency (MHz)	Measured Value (dBm)	RBW (kHz)	Final Value (dBm)	Limit (dBm)	Margin (dB)
763 – 775	768.547	-66.7	6.25	-66.70	-46	-20.70
793 – 805	797.494	-66.8	6.25	-66.80	-46	-20.80

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.

Final Value (dBm) = conducted measurement + 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)	RBW	Gain/Loss from Antenna Kitting Information (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
1559 – 1610 (Wideband)	1595.91	-51.6	1 MHz	3.00	-48.60	-40	-8.60
1559 – 1610 (Narrowband)	1576.63	-82.2	700 Hz	3.00	-79.20	-50	-29.20

746 - 757 MHz Downlink Band

Spurious Frequency Range (MHz)	Measured Frequency (MHz)	Measured Value (dBm)	RBW	Gain/Loss from Antenna Kitting Information (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
1559 – 1610 (Wideband)	1574.77	-51.7	1 MHz	3.00	-48.70	-40	-8.70
1559 – 1610 (Narrowband)	1582.24	-82	700 Hz	3.00	-79.00	-50	-29.00

Refer to Annex D for Conducted Spurious Emission plots

Noise Limits

Engineer: Greg Corbin

Test Date: 2/10/2017

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 KDB 935210 D03 v04 were followed.

(The uplink variable noise and the variable uplink noise timing were tests that were not performed, because they are N/A, due to noise being less than -70dBm/MHz).

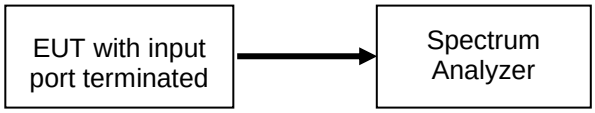
The following formulas are used for calculating the limits. Note – Downlink noise power limit is calculated with the center frequency of the associated uplink band.

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

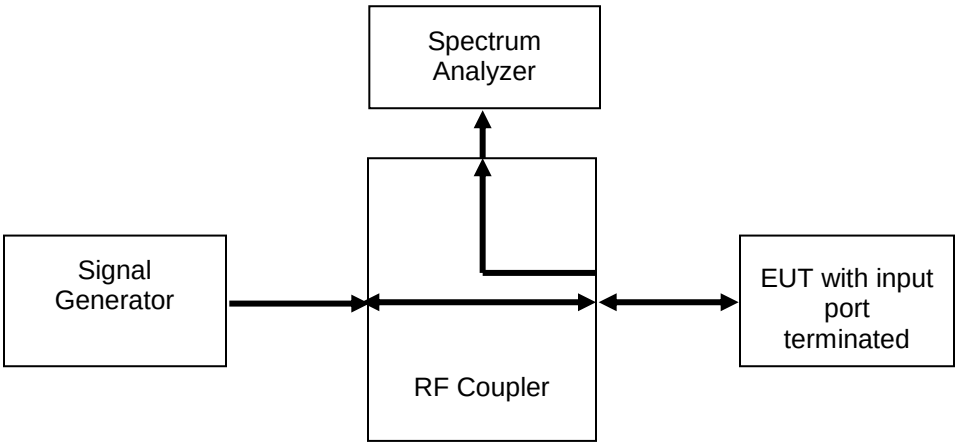
Variable Noise =-103 dBm/MHz-RSSI

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	-82.7	-45.5	-37.2	Pass
776 - 787	-82.5	-44.6	-37.9	Pass
824 - 849	-81.8	-44.1	-37.7	Pass
1710 - 1755	-81.3	-37.7	-43.6	Pass
1850 - 1915	-82.2	-37.0	-45.2	Pass

Maximum Downlink Noise Test Results

Frequency Band (MHz)	Measured Noise (dBm)	Limit (dBm)	Margin (dB)	Result
728 - 746	-82.9	-45.5	-37.4	Pass
746 - 757	-82.4	-44.6	-37.8	Pass
869 - 894	-81.7	-44.1	-37.6	Pass
1930 - 1995	-81.8	-37.0	-44.8	Pass
2110 - 2155	-82.2	-37.7	-44.5	Pass

Refer to Annex E for Noise Limits

Uplink Noise Timing Test Results

Variable Uplink Noise Limit Test Results

If the noise power is below -70 dBm/MHz Variable Noise and Variable Noise Timing tests does not need to be performed

Uplink Inactivity

Engineer: Greg Corbin

Test Date: 2/10/2017

Per rule 20.21(e)(8)(i)(H)... if noise is less than -70dBm/MHz (“Transmit Power OFF Mode”) then the EUT meets the Uplink Inactivity requirement
Noise Power < 70 dBm at all times, measured noise level = - 80 dBm, EUT does not need to shut down after 5 minutes due to low noise level

Variable Gain
Engineer: Greg Corbin
Test Date: 2/24/2017

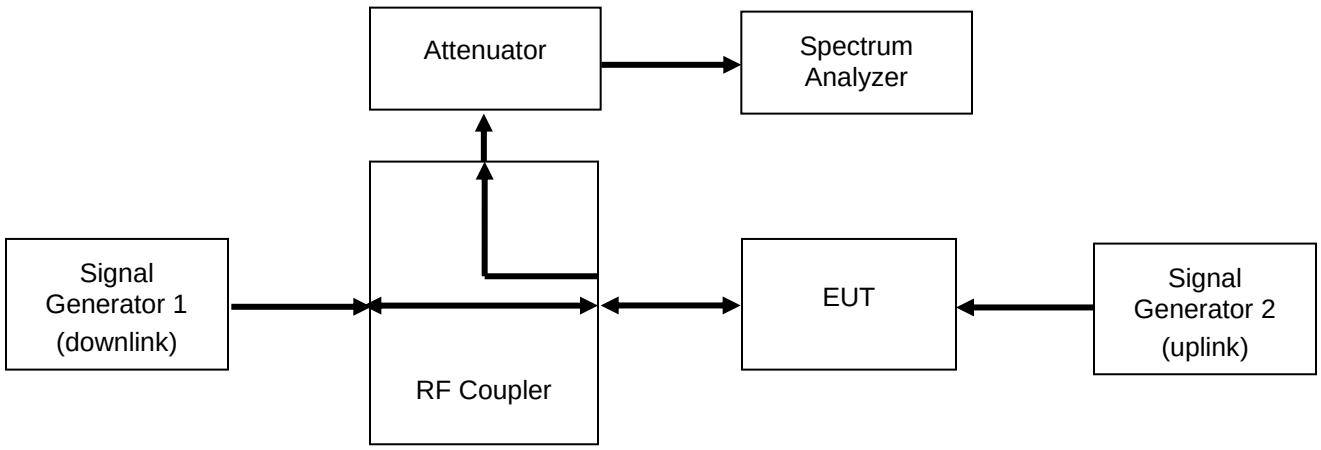
Test Procedure

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 KDB 935210 D03 v04.

The following formula is used for calculating the limits:
Variable Gain = -34 dB - RSSI +MSCL

Note: MSCL is defined as the Mobile Station Coupling Loss is the minimum coupling loss in dB between the wireless device and the input port to the consumer booster.
The booster in this filing is a direct connect booster (meaning the wireless device is connected directly to the booster input port) therefor there is no coupling loss, MSCL = 0 dB.

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)
-62.0	0.0	15.0	-3.4	9.8	13.2	-1.8
-61.0	0.0	15.0	-3.4	9.8	13.2	-1.8
-60.0	0.0	15.0	-3.4	9.8	13.2	-1.8
-59.0	0.0	15.0	-3.4	9.8	13.2	-1.8
-46.0	0.0	12.0	-3.4	3.6	7.0	-5.0
-43.0	0.0	9.0	-3.4	0.4	3.8	-5.2

776 - 787 MHz

RSSI (dBm)	MSCL (dB)	Gain Limit (dBm)	P(in) (dBm)	P(out) (dBm)	Gain (dB)	Margin (dB)
-53.0	0.0	15.0	-15.4	-3.3	12.1	-2.9
-52.0	0.0	15.0	-15.4	-3.3	12.1	-2.9
-51.0	0.0	15.0	-15.4	-3.3	12.1	-2.9
-50.0	0.0	15.0	-15.4	-3.3	12.1	-2.9
-46.0	0.0	12.0	-15.4	-8.4	7.0	-5.0
-40.0	0.0	6.0	-15.4	-13.5	1.9	-4.1

824 - 849 MHz

RSSI (dBm)	MSCL (dB)	Gain Limit (dBm)	P(in) (dBm)	P(out) (dBm)	Gain (dB)	Margin (dB)
-59.0	0.0	15.0	-18.0	-5.8	12.2	-2.8
-58.0	0.0	15.0	-18.0	-5.8	12.2	-2.8
-57.0	0.0	15.0	-18.0	-5.8	12.2	-2.8
-56.0	0.0	15.0	-18.0	-5.8	12.2	-2.8
-39.0	0.0	5.0	-18.0	-16.7	1.3	-3.7
-38.0	0.0	4.0	-18.0	-17.1	0.9	-3.1

1710 - 1755 MHz

RSSI (dBm)	MSCL (dB)	Gain Limit (dBm)	P(in) (dBm)	P(out) (dBm)	Gain (dB)	Margin (dB)
-57.0	0.0	15.0	-2.3	11.4	13.7	-1.3
-56.0	0.0	15.0	-2.3	11.4	13.7	-1.3
-55.0	0.0	15.0	-2.3	11.4	13.7	-1.3
-54.0	0.0	15.0	-2.3	11.4	13.7	-1.3
-37.0	0.0	3.0	-2.3	-1.2	1.1	-1.9
-36.0	0.0	2.0	-2.3	-1.8	0.5	-1.5

1850 - 1915 MHz

RSSI (dBm)	MSCL (dB)	Gain Limit (dBm)	P(in) (dBm)	P(out) (dBm)	Gain (dB)	Margin (dB)
-56.0	0.0	15.0	-2.3	11.5	13.8	-1.2
-55.0	0.0	15.0	-2.3	11.5	13.8	-1.2
-54.0	0.0	15.0	-2.3	11.5	13.8	-1.2
-53.0	0.0	15.0	-2.3	11.5	13.8	-1.2
-38.0	0.0	4.0	-2.3	0.0	2.3	-1.7
-37.0	0.0	3.0	-2.3	-0.3	2.0	-1.0

Uplink Gain Timing Test Results

Frequency Band (MHz)	Measured Timing (Seconds)	Limit (Seconds)	Result
704 - 716	0.61	3.0	Pass
776 - 787	0.53	3.0	Pass
824 - 849	1.01	3.0	Pass
1710 - 1755	1.38	3.0	Pass
1850 - 1915	0.70	3.0	Pass

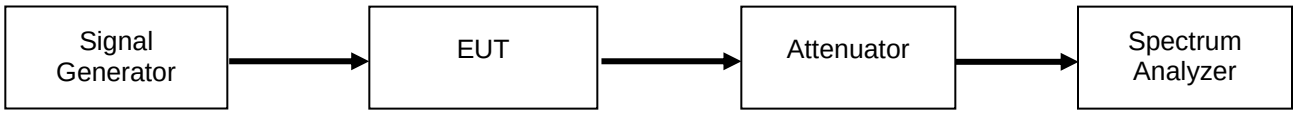
Refer to Annex F for Variable Gain Timing Plots

Occupied Bandwidth
Engineer: Greg Corbin
Test Date: 2/14/2017

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 G for Occupied Bandwidth plots

Anti-Oscillation
Engineer: Greg Corbin
Test Date: 2/17/2017

Anti-Oscillation not required for Direct Connect boosters with less than 15 dB gain.

Oscillation Mitigation
Engineer: Greg Corbin
Test Date: 2/17/2017

Oscillation Mitigation not required for Direct Connect boosters with less than 15 dB gain.

Radiated Spurious
Engineer: Greg Corbin
Test Date: 2/17/2017

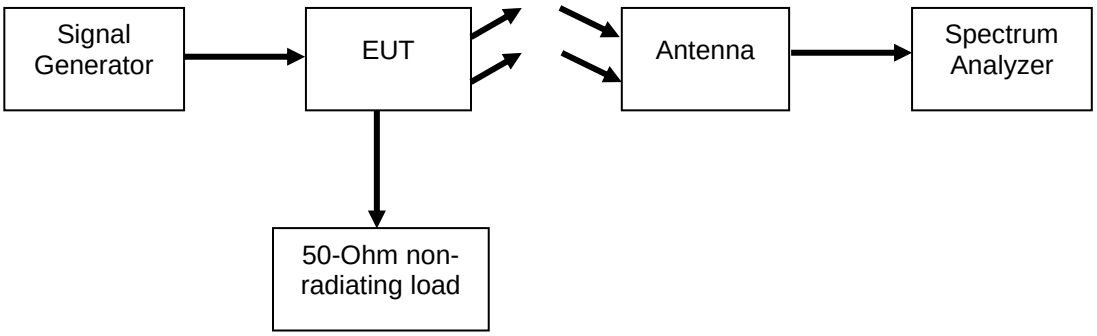
Test Procedure

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 H for Radiated Spurious Emission plots

All emissions were lower than -13 dBm.

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna	ARA	DRG-118/A	i00271	6/16/16	6/16/18
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	5/26/16	5/26/17
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	8/3/16	8/3/18
EMI Analyzer	Agilent	E7405A	i00379	2/11/16	2/11/17**
Signal Generator	Rohde & Schwarz	SMU200A	i00405	1/22/16	1/22/17**
Spectrum Analyzer	Textronix	RSA5126A	i00424	3/28/16	3/28/17
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

**30 day calibration extension approved by QA manager.

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