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Test Report

Prepared for: SolidRF

Model: SolidRF SOHO Tri Band Cell Phone Booster

Description: Tri Band Cell Phone booster

Serial Number: 01961701190001

FCC ID: A7V-SR13652001

To

FCC Part 20

Date of Issue: January 23, 2017

On the behalf of the applicant:	**SolidRF** **E3 Building, Fenghuang Third Industry** **Baoan District** **Schenzhen, Guangdong 518103**
To the attention of:	**Johnny Zhing, CMO** **Ph: (213)995-7300** **Email: ning0508@gmail.com**

Prepared By
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Project No: p16c0009

Greg Corbin

Greg Corbin
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	January 18, 2017	Greg Corbin	Original Document

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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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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)**
19.2 – 25.4	23.5 – 48.3	960.2 – 975 6

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

EUT Description
Model: SolidRF SOHO Tri Band Cell Phone Booster
Description: Tri Band Cell Phone Booster
Firmware: 192-LGW-65-A-1.0, 196-RF-KD-A-1.2
Software: 196-MainCPUFCC.V1, 196-SlaveCPU.V1
Serial Number: 01961701190001

Additional Information:
The EUT is an **In-Building,** 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	824 - 849	1850 - 1915
Downlink	728 - 746	869 - 894	1930 - 1995
Modulation Type	LTE	GSM, CDMA, EDGE, HSPA. EVDO, LTE	

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.

Test Result Summary

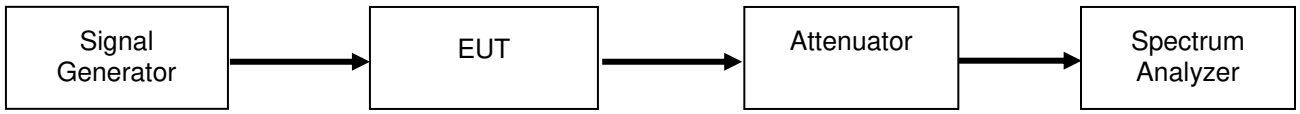
Specification	Test Name	Pass, Fail, N/A	Comments
20.21(e)(3)	Authorized Frequency Band	Pass	
20.21(e)(8)(i)(B) 20.21(e)(8)(i)(C) 20.21(e)(8)(i)(D)	Maximum Power and Gain	Pass	
20.21(e)(8)(i)(F)	Intermodulation	Pass	
20.21(e)(8)(i)(E)	Out-of-Band Emissions	Pass	
2.1051 22.917(a) 24.238((a) 27.53(g)	Conducted 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) 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	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

Authorized Frequency Band
Engineer: Greg Corbin
Test Date: 1/12/2017

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 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: 1/16/2017

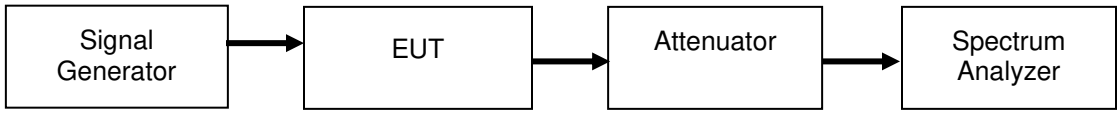
Test Procedure

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 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	-36.5	19.9	17	30	5.1	25	Pass
698 - 716 MHz AWGN	-38.6	17.1	17	30	5.1	22.2	Pass
824 - 849 MHz Pulsed GSM	-38.0	20.6	17	30	5.05	25.65	Pass
824 - 849 MHz AWGN	-42.0	17.5	17	30	5.05	22.55	Pass
1850 - 1915 MHz Pulsed GSM	-39.8	20.8	17	30	5.1	25.9	Pass
1850 - 1915 MHz AWGN	-44.5	18.1	17	30	5.1	23.2	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	-62.1	-4.6	17	5.7	1.1	Pass
728 - 746 MHz AWGN	-67.1	-10.0	17	5.7	-4.3	Pass
869 - 894 MHz Pulsed GSM	-61.6	-7.2	17	5.65	-1.55	Pass
869 - 894 MHz AWGN	-63.8	-9.8	17	5.65	-4.15	Pass
1930 - 1995 MHz Pulsed GSM	-68.3	-7.9	17	8.2	0.3	Pass
1930 - 1995 MHz AWGN	-70.6	-10.4	17	8.2	-2.2	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	705.37	732.19	56.4	63.5	57.5	63.5	1.1	9	-7.9
AWGN	705.37	732.19	55.7	63.5	57.1	63.5	1.4	9	-7.6
Pulsed GSM	838.81	881.69	58.6	64.9	54.4	64.9	4.2	9	-4.8
AWGN	838.81	881.69	59.5	64.9	54.0	64.9	5.5	9	-3.5
Pulsed GSM	1861	1956.29	60.6	72	60.4	72	0.2	9	-8.8
AWGN	1861	1956.29	62.6	72	60.2	72	2.4	9	-6.6

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	21.0	17	30	Pass
698 - 716 MHz AWGN	-25.0	17.2	17	30	Pass
824 - 849 MHz Pulsed GSM	-24.0	21.3	17	30	Pass
824 - 849 MHz AWGN	-29.0	17.7	17	30	Pass
1850 - 1915 MHz Pulsed GSM	-27.0	21.0	17	30	Pass
1850 - 1915 MHz AWGN	-31.0	18.5	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	-48.0	-4.9	17	Pass
728 - 746 MHz AWGN	-53.0	-9.0	17	Pass
869 - 894 MHz Pulsed GSM	-48.0	-7.2	17	Pass
869 - 894 MHz AWGN	-51.0	-9.7	17	Pass
1930 - 1995 MHz Pulsed GSM	-58.0	-7.0	17	Pass
1930 - 1995 MHz AWGN	-58.0	-10.4	17	Pass

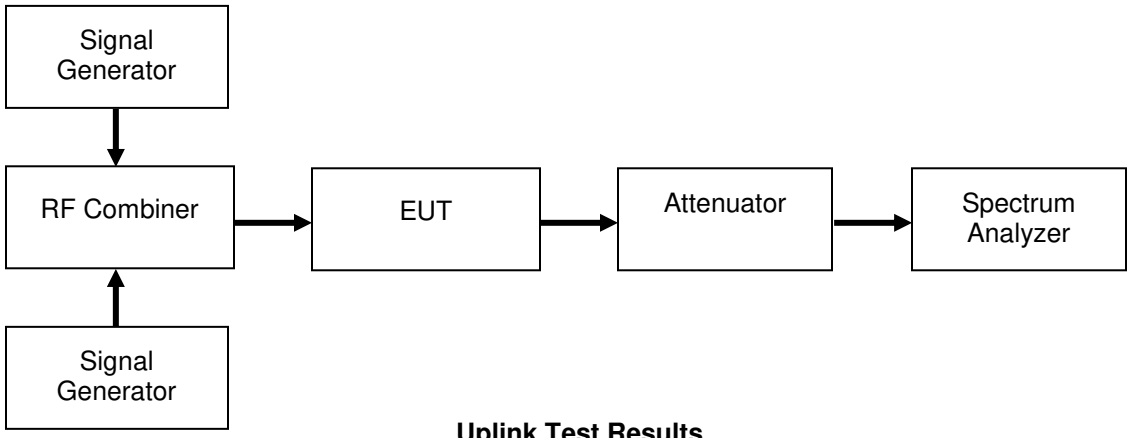
Intermodulation
Engineer: Greg Corbin
Test Date: 1/17/2017

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	-21.9	-19	Pass	-22.5	Pass
824 - 849 MHz	-21.3	-19	Pass	-21	Pass
1850 - 1915 MHz	-20.4	-19	Pass	-20.4	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	-68.6	-19	Pass	-69	Pass
869 - 894 MHz	-74	-19	Pass	-76	Pass
1930 - 1995 MHz	-63.9	-19	Pass	-63.5	Pass

Refer to Annex B for Intermodulation test plots

Out-of-Band Emissions
Engineer: Greg Corbin
Test Date: 1/17/2017

Test Procedure

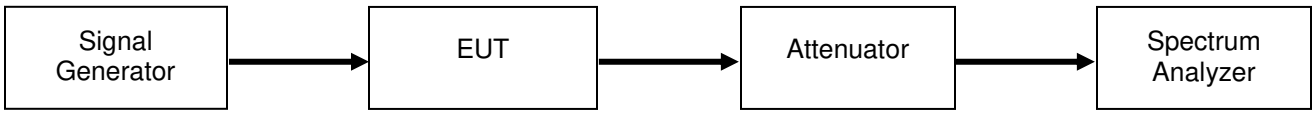
The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor in order to ensure accurate readings. A signal generator was utilized to produce the following signals: GSM, CDMA, 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	-31.8	-19	Pass	Yes
698 - 716	Upper	-29	-19	Pass	Yes
824 - 849	Lower	-36.9	-19	Pass	Yes
824 - 849	Upper	-41.6	-19	Pass	Yes
1850 - 1915	Lower	-37.1	-19	Pass	Yes
1850 - 1915	Upper	-50	-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	-51.2	-19	Pass	Yes
698 - 716	Upper	-43.8	-19	Pass	Yes
824 - 849	Lower	-32.9	-19	Pass	Yes
824 - 849	Upper	-39.8	-19	Pass	Yes
1850 - 1915	Lower	-41.2	-19	Pass	Yes
1850 - 1915	Upper	-50.6	-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	-53.8	-19	Pass	Yes
698 - 716	Upper	-43	-19	Pass	Yes
824 - 849	Lower	-32.2	-19	Pass	Yes
824 - 849	Upper	-37.3	-19	Pass	Yes
1850 - 1915	Lower	-37	-19	Pass	Yes
1850 - 1915	Upper	-44.5	-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	-32.9	-19	Pass	Yes
728 - 746 MHz	Upper	-34.4	-19	Pass	Yes
869 - 894 MHz	Lower	-46.3	-19	Pass	Yes
869 - 894 MHz	Upper	-46	-19	Pass	Yes
1930 - 1995 MHz	Lower	-53.3	-19	Pass	Yes
1930 - 1995 MHz	Upper	-55.5	-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	-46.3	-19	Pass	Yes
728 - 746 MHz	Upper	-45.9	-19	Pass	Yes
869 - 894 MHz	Lower	-48.4	-19	Pass	Yes
869 - 894 MHz	Upper	-49.9	-19	Pass	Yes
1930 - 1995 MHz	Lower	-51.1	-19	Pass	Yes
1930 - 1995 MHz	Upper	-53.8	-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	-46.7	-19	Pass	Yes
728 - 746 MHz	Upper	-46.1	-19	Pass	Yes
869 - 894 MHz	Lower	-43.4	-19	Pass	Yes
869 - 894 MHz	Upper	-44.4	-19	Pass	Yes
1930 - 1995 MHz	Lower	-45.9	-19	Pass	Yes
1930 - 1995 MHz	Upper	-48.7	-19	Pass	Yes

Refer to Annex C for Out of Band Emission plots

Conducted Spurious Emissions
Engineer: Greg Corbin
Test Date: 1/17/2017

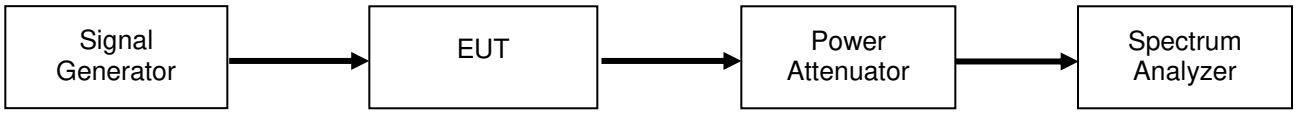
Test Procedure

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	697.02	-33.6	-13	Pass
824 - 849	1674.28	-37.3	-13	Pass
1850 - 1915	16.787	-50.3	-13	Pass

Downlink Test Results

Frequency Band (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
728 - 746	2478.47	-67.3	-13	Pass
869 - 894	8633.84	-69.1	-13	Pass
1930 - 1995	19712.9	-64.7	-13	Pass

Refer to Annex D for Conducted Spurious Emission plots

Noise Limits

Engineer: Greg Corbin

Test Date: 1/17/2017

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.

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

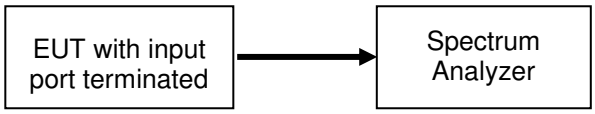
The following formulas are used for calculating the limits. Note – Downlink noise power limit is calculated with the center frequency of the associated uplink band.

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

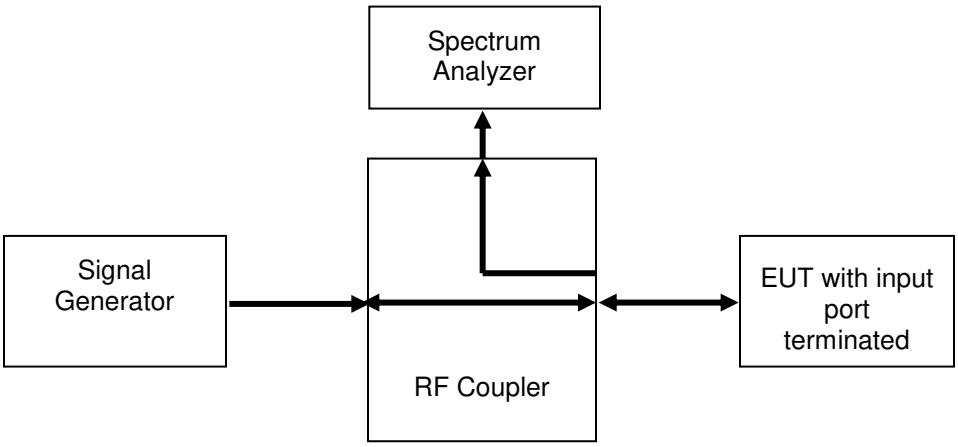
Variable Noise =-103 dBm/MHz-RSSI

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	-48.8	-45.5	-3.3	Pass
824 - 849	-45.9	-44.1	-1.8	Pass
1850 - 1915	-42.3	-37.0	-5.3	Pass

Maximum Downlink Noise Test Results

Frequency Band (MHz)	Measured Noise (dBm)	Limit (dBm)	Margin (dB)	Result
728 - 746	-50.6	-45.5	-5.1	Pass
869 - 894	-53.6	-44.1	-9.5	Pass
1930 - 1995	-47.1	-37.0	-10.1	Pass

Uplink Noise Timing Test Results

Frequency Band (MHz)	Measured Timing (Seconds)	Limit (Seconds)	Result
698 - 716	0.13	3.0	Pass
824 - 849	0.14	3.0	Pass
1850 - 1915	0.13	3.0	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)
-68.0	-45.5	-49.3	-3.8
-67.0	-45.5	-49.3	-3.8
-66.0	-45.5	-49.3	-3.8
-64.0	-45.5	-49.2	-3.7
-51.0	-52.0	-57.2	-5.2
-50.0	-53.0	-58.1	-5.1

824 - 849 MHz

RSSI (dBm)	Noise Limit (dBm)	Measured Noise (dBm)	Margin (dB)
-74.0	-44.0	-46.6	-2.6
-73.0	-44.0	-46.6	-2.6
-72.0	-44.0	-46.6	-2.6
-71.0	-44.0	-46.6	-2.6
-65.0	-44.0	-46.4	-2.4
-64.0	-44.0	-46.9	-2.9

1850 - 1915 MHz

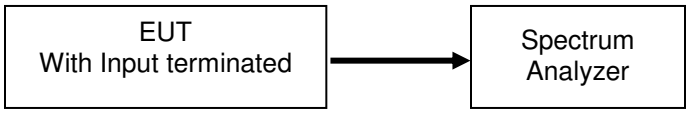
RSSI (dBm)	Noise Limit (dBm)	Measured Noise (dBm)	Margin (dB)
-60.0	-43.0	-48.6	-5.6
-59.0	-44.0	-49.2	-5.2
-57.0	-46.0	-50.2	-4.2
-56.0	-47.0	-51.6	-4.6
-55.0	-48.0	-52.1	-4.1
-54.0	-49.0	-51.7	-2.7

Uplink Inactivity
Engineer: Greg Corbin
Test Date: 1/18/2017

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	262.8	300	Pass
824 - 849	262.8	300	Pass
1850 - 1915	262.35	300	Pass

Refer to Annex F for Uplink Inactivity Plots

Variable Gain
Engineer: Greg Corbin
Test Date: 1/18/2017

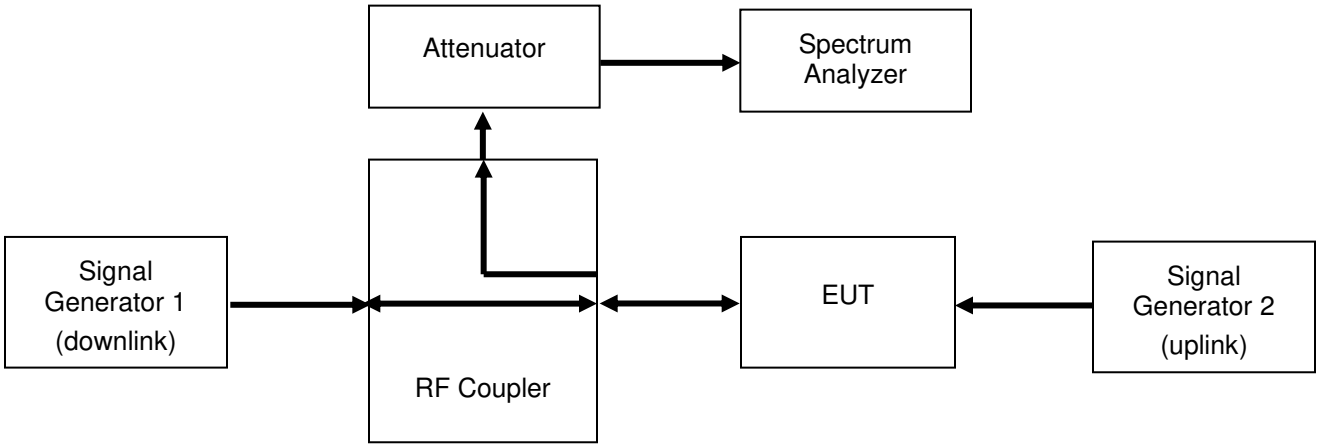
Test Procedure

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

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)
-63.0	29.6	58.6	-44.8	10.7	55.5	-3.1
-62.0	29.6	57.6	-44.8	10.0	54.8	-2.8
-61.0	29.6	56.6	-44.8	9.0	53.8	-2.8
-60.0	29.6	55.6	-44.8	7.6	52.4	-3.2
-59.0	29.6	54.6	-44.8	6.6	51.4	-3.2
-58.0	29.6	53.6	-44.8	5.6	50.4	-3.2

824 - 849 MHz

RSSI (dBm)	MSCL (dB)	Gain Limit (dBm)	P(in) (dBm)	P(out) (dBm)	Gain (dB)	Margin (dB)
-63.0	31.2	60.2	-47.6	12.2	59.8	-0.4
-62.0	31.2	59.2	-47.6	11.1	58.7	-0.4
-61.0	31.2	58.2	-47.6	10.3	57.9	-0.2
-60.0	31.2	57.2	-47.6	9.2	56.8	-0.4
-59.0	31.2	56.2	-47.6	8.1	55.7	-0.4
-57.0	31.2	54.2	-47.6	6.1	53.7	-0.4

1850 - 1915 MHz

RSSI (dBm)	MSCL (dB)	Gain Limit (dBm)	P(in) (dBm)	P(out) (dBm)	Gain (dB)	Margin (dB)
-69.0	35.6	70.6	-54.7	10.0	64.7	-5.9
-68.0	35.6	69.6	-54.7	9.0	63.7	-5.9
-67.0	35.6	68.6	-54.7	7.9	62.6	-6.0
-66.0	35.6	67.6	-54.7	6.9	61.6	-6.0
-65.0	35.6	66.6	-54.7	5.8	60.5	-6.1
-64.0	35.6	65.6	-54.7	4.8	59.5	-6.1

Uplink Gain Timing Test Results

Frequency Band (MHz)	Measured Timing (Seconds)	Limit (Seconds)	Result
704 - 716	0.11	3.0	Pass
824 - 849	0.11	3.0	Pass
1850 - 1915	0.11	3.0	Pass

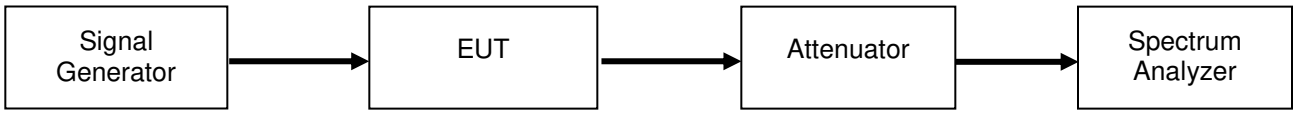
Refer to Annex G for Uplink Gain Timing Plots

Occupied Bandwidth
Engineer: Greg Corbin
Test Date: 1/18/2017

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



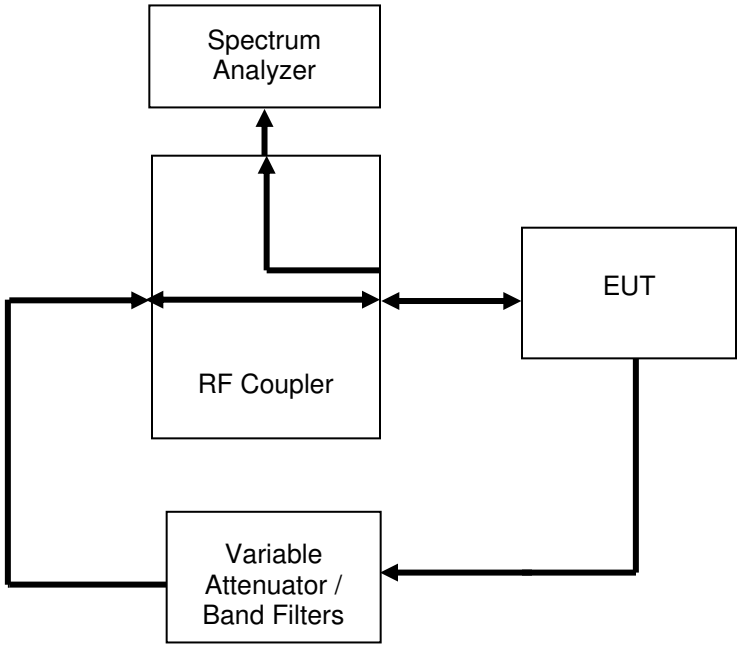
Refer to Annex H for Occupied Bandwidth plots

Anti-Oscillation
Engineer: Greg Corbin
Test Date: 1/16/2017

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	37.5	300	Pass
824 - 849	150	300	Pass
1850 - 1915	75	300	Pass

Downlink Detection Time Test Results

Frequency Band (MHz)	Measured Time (mS)	Limit (mS)	Result
728 - 746	37.5	1000	Pass
869 - 894	50	1000	Pass
1930 - 1995	50	1000	Pass

Note:
The EUT shuts down after detecting the first oscillation and does not re-try until power reset by the user, therefor there is no Restart Times or Restart Counts.
Refer to spectrum analyzer plots in Annex I for verification.

Uplink Restart Time Test Results

Frequency Band (MHz)	Measured Time (S)	Limit (S)	Result
698 - 716	No Restart	≥60	Pass
824 - 849	No Restart	≥60	Pass
1850 - 1915	No Restart	≥60	Pass

Downlink Restart Time Test Results

Frequency Band (MHz)	Measured Time (S)	Limit (S)	Result
728 - 746	No Restart	≥60	Pass
869 - 894	No Restart	≥60	Pass
1930 - 1995	No Restart	≥60	Pass

Uplink Restart Count Test Results

Frequency Band (MHz)	Restarts	Limit	Result
698 - 716	No Restart	≤5	Pass
824 - 849	No Restart	≤5	Pass
1850 - 1915	No Restart	≤5	Pass

Downlink Restart Count Test Results

Frequency Band (MHz)	Restarts	Limit	Result
728 - 746	No Restart	≤5	Pass
869 - 894	No Restart	≤5	Pass
1930 - 1995	No Restart	≤5	Pass

Refer to Annex I for Oscillation Detection Plots

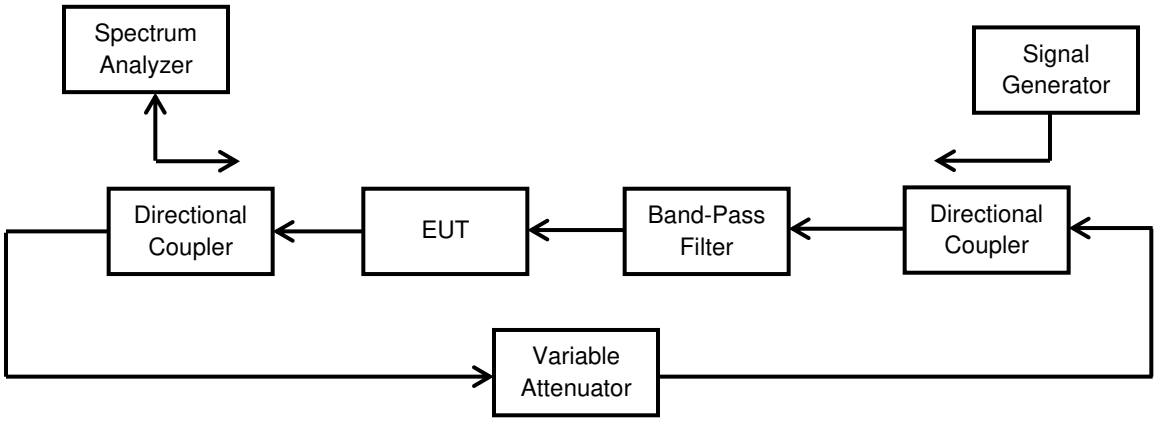
Oscillation Mitigation
Engineer: Greg Corbin
Test Date: 1/16/2017

Test Procedure

The EUT was connected as shown per KDB 935210 D03 v04. 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.
If the booster mitigated the oscillation within the 300 second time limit, the time required to mitigate the oscillation was recorded along with the final level of the oscillation after mitigation.

Note: 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	701.98	-56.2	703.99	-70.6	14.4	<12	20	< 300	Pass
+4	EUT Shutdown				N/A	<12	N/A	< 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	837.25	-50.5	839.79	-66.6	16.1	<12	45	< 300	Pass
+4	837.25	-47	839.79	-67	20	<12	80	< 300	Pass
+3	837.25	-42	839.79	-67	25	<12	40	< 300	Pass
+2	837.25	-27	839.79	-68	41	<12	55	< 300	Pass
+1	EUT Shutdown				N/A	<12	N/A	< 300	Pass

Oscillation Mitigation - Uplink									
Band	**1850 - 1915 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	1866.77	-52.4	1870.14	-63	10.6	<12	N/A	< 300	Pass
+4	1866.77	-50.5	1870.14	-63	12.5	<12	77	< 300	Pass
+3	1866.77	-48.5	1870.14	-63	14.5	<12	85	< 300	Pass
+2	1866.77	-46	1870.14	-63.5	17.5	<12	89	< 300	Pass
+1	1866.77	-40.7	1870.14	-64	23.3	<12	87	< 300	Pass
+0	EUT Shutdown					<12	N/A	< 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	735.04	-58.5	735.87	-72.6	14.1	<12	20	< 300	Pass
+4	735.04	-57.1	735.87	-72.7	15.6	<12	21	< 300	Pass
+3	735.04	-54	735.87	-73	19	<12	20	< 300	Pass
+2	735.04	-49	735.87	-73	24	<12	22	< 300	Pass
+1	735.04	-36	735.87	-74	38	<12	25	< 300	Pass
+0	EUT Shutdown				N/A	<12	N/A	< 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	882.49	-60	884.72	-72.6	12.6	<12	65	< 300	Pass
+4	882.49	-59	884.72	-73.2	14.2	<12	71	< 300	Pass
+3	882.49	-56	884.72	-73	17	<12	64	< 300	Pass
+2	882.49	-53.2	884.72	-73.5	20.3	<12	55	< 300	Pass
+1	882.49	-46.7	884.72	-74.2	27.5	<12	62	< 300	Pass
+0	EUT Shutdown				N/A	<12	N/A	< 300	Pass

Oscillation Mitigation - Downlink									
Band	**1930 - 1995 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	1956.4	-51.9	1959.4	-68.2	16.3	<12	43	< 300	Pass
+4	1956.4	-50.2	1959.4	-67.6	17.4	<12	110	< 300	Pass
+3	1956.4	-48.5	1959.4	-68.3	19.8	<12	125	< 300	Pass
+2	1956.4	-44	1959.4	-68.7	24.7	<12	128	< 300	Pass
+1	1956.4	-36.7	1959.4	-69	32.3	<12	127	< 300	Pass
+0	EUT Shutdown				N/A	<12	N/A	< 300	Pass

Radiated Spurious
Engineer: Greg Corbin
Test Date: 1/18/2017

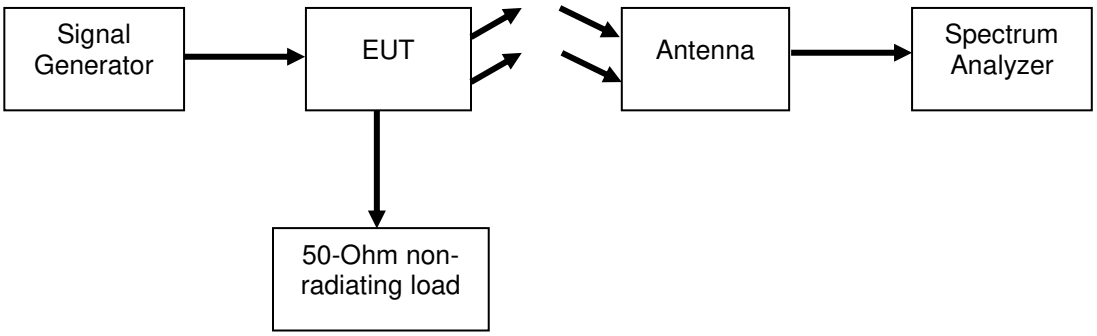
Test Procedure

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 J 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

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