

Test Report

Prepared for: **Wilson Electronics, LLC (weBoost)**

Model: **Home Studio Lite**

Description: **dual Band Signal Booster**

FCC ID: **PWO460065**

ISED ID: **4726A-460065**

To

FCC: **Part 20**

ISED: **RSS-131 (Issue 3)**

Date of Issue: **October 28, 2020**

On the behalf of the applicant:

Wilson Electronics, LLC (weBoost)
3301 E Deseret Drive
St. George, UT 84790

To the attention of:

Sam Judd, Compliance Engineer
Ph: (435)673-5021
E-Mail: sjudd@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: **p20400010**



Greg Corbin
Project Test Engineer

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All results contained herein relate only to the sample tested.

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	October 28, 2020	Greg Corbin	Original Document

Current revision of the test report replaces any prior versions. Only the current version of the test report is valid.

Table of Contents

<u>Description</u>	<u>Page</u>
Table of Contents	3
Table of Annexes	4
Standard Test Conditions and Engineering Practices	6
Test Result Summary Table	8
Statements of conformity	8
Authorized Frequency Band	9
Maximum Power and Gain	10
Intermodulation	12
Out-of-Band Emissions	13
Conducted Spurious Emissions	15
Noise Limits	18
Uplink Inactivity	20
Variable Gain	21
Occupied Bandwidth	23
Anti-Oscillation	24
Oscillation Mitigation	26
Radiated Spurious	29
Measurement Uncertainty	30
Test Equipment Utilized	31

Table of Annexes

<u>Description</u>	<u>Page</u>
Annex A Authorized Frequency Band	9
Annex B Intermodulation	12
Annex C Out of Band Emission	14
Annex D Conducted Spurious Emission	17
Annex E Noise Limits and Uplink Noise Timing	19
Annex F Uplink Inactivity	20
Annex G Uplink Gain Timing	22
Annex H Occupied Bandwidth	23
Annex I Anti-Oscillation	25
Annex J Radiated Spurious Emission	29

ANAB

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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.



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, ANSI C63-26-2015. For ISSED, RSS-131 and RSS-GEN were used.

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 (°C)	Humidity (%)	Pressure (mbar)
27.3 – 28.8	113.5– 24.2	960.5 – 967.2

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

EUT Description

Model: Home Studio Lite_460065
Description: Dual Band Signal Booster
Firmware: V4.04
Serial Number: 01
PMN: Home Studio Lite
FVIN: V4.04
HVIN: 460065
HMN: 460065

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	776 – 787 (IC, 777 – 787)
Downlink	728 - 746	746 – 757 (IC, 746 – 756)
Modulation Type	LTE	
Emission Designators	G7D, W7D	

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 with all external attenuation set to 0 dB.

The EUT input supply voltage is 4.2 vdc.

The EUT donor port impedance is 75 ohms.

The EUT Server port is 50 ohms.

A 75 ohm to 50 ohm adapter was installed on the Donor port to match the impedance of the test equipment.

The transformer was installed for all tests.

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	AC to DC power supply	Power Partners	SAW20-050-2500UD	N/A
1	75 ohm to 50 ohm Transformer	Mini-Circuits	SFMP-5075-3+	N/A

Cables: none

Modifications: none

Test Result Summary Table

Specification		Test Name	Pass, Fail, N/A	Comments
FCC	ISED			
20.21(e)(3)	RSS-131_3.5(a)	Authorized Frequency Band	Pass	
20.21(e)(8)(i)(B) 20.21(e)(8)(i)(C) 20.21(e)(8)(i)(D)	RSS-131_5.1.1.2 RSS-131_5.1.3.3	Maximum Power and Gain	Pass	
20.21(e)(8)(i)(F)	RSS-131_5.1.3.5	Intermodulation	Pass	
20.21(e)(8)(i)(E)	RSS-131_5.1.3.4	Out-of-Band Emissions	Pass	
2.1051 27.53(c) 27.53(f) 27.53(g)	RSS-130_4.7.1 RSS-130_4.7.2	Conducted Spurious Emissions	Pass	
20.21(e)(8)(i)(A)	RSS-131_5.1.3.1	Noise Limits	Pass	
20.21(e)(8)(i)(I)	RSS-131_5.1.3.7	Uplink Inactivity	Pass	
20.21(e)(8)(i)(C)(1) 20.21(e)(8)(i)(H) 20.21(e)(8)(i)(C)(2)(i) (Fixed)	RSS-131_5.1.3.2	Variable Gain	Pass	
2.1049	RSS-GEN_6.7	Occupied Bandwidth	Pass	
20.21(e)(8)(ii)(A)	RSS-131_5.1.1.1	Anti - Oscillation	Pass	
2.1053	RSS-GEN_6.13	Radiated Spurious	Pass	
20.21(e)(8)(i)(B)		Spectrum Block Filtering	N/A	This device does not use spectrum block filtering

Statements of conformity

Statements of conformity are reported as:

- Pass - the measured value is below the acceptance limit, *acceptance limit = test limit.*
- Fail - the measured value is above the acceptance limit, *acceptance limit = test limit.*

Authorized Frequency Band

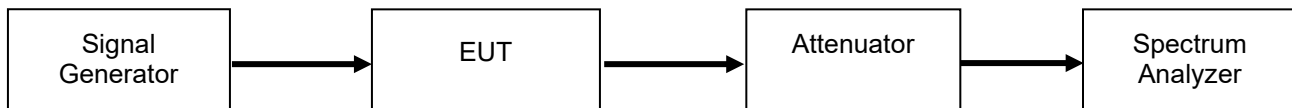
Engineer: Greg Corbin

Test Date: 10/26/2020

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, then reduced 3 dB. 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



Annex A Authorized Frequency Band

Refer to Annex A for Authorized Frequency Band plots.

Maximum Power and Gain

Engineer: Greg Corbin

Test Date: 10/26/2020

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.

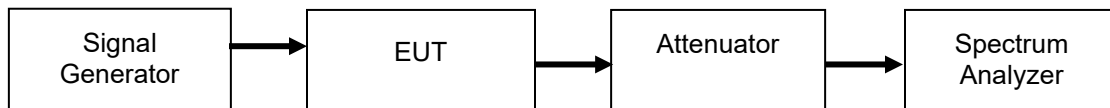
For Fixed installations, the following formula was used for calculating the gain limits.

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

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

$$\text{Antenna Gain (dBi)} = \text{maximum antenna gain} + \text{the minimum cable loss}$$

Test Setup



Uplink Power Test Results

Frequency Band (MHz)	Input Level (dBm)	Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Lower Limit (dBm)	Upper Limit (dBm)	Result
698 - 716 MHz Pulsed GSM	-34.4	24.3	4.9	29.2	17	30	Pass
698 - 716 MHz AWGN	-35.7	22.0	4.9	26.9	17	30	Pass
776 - 787 MHz Pulsed GSM	-33.7	23.0	4.9	27.9	17	30	Pass
776 - 787 MHz AWGN	-34.6	21.2	4.9	26.1	17	30	Pass

Downlink Power Test Results

Frequency Band (MHz)	Input Level (dBm)	Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Upper Limit (dBm)	Result
728 - 746 MHz Pulsed GSM	-48.4	11.4	2	13.4	17	Pass
728 - 746 MHz AWGN	-46.6	11.7	2	13.7	17	Pass
746 - 757 MHz Pulsed GSM	-48.9	12.9	2.2	15.1	17	Pass
746 - 757 MHz AWGN	-48.6	10.9	2.2	13.1	17	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	702.95	732.35	58.7	63.5	59.8	63.5	1.1	9	-7.9
AWGN	702.95	732.35	57.7	63.5	58.3	63.5	0.6	9	-8.4
Pulsed GSM	784.13	750.375	56.7	64.4	61.8	64.4	5.1	9	-3.9
AWGN	784.13	750.375	55.8	64.4	59.5	64.4	3.7	9	-5.3

Uplink Output Power at Maximum Input Power Test

Frequency Band (MHz)	Maximum Input Level (dBm)	Output Power at Maximum Input Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Lower Limit (dBm)	Upper Limit (dBm)	Result
698 - 716 MHz Pulsed GSM	0.0	24.2	4.9	29.1	17	30	Pass
698 - 716 MHz AWGN	0.0	22.0	4.9	26.9	17	30	Pass
776 - 787 MHz Pulsed GSM	0.0	22.8	4.9	27.7	17	30	Pass
776 - 787 MHz AWGN	0.0	21.1	4.9	26	17	30	Pass

Downlink Output Power at Maximum Input Power Test

Frequency Band (MHz)	Maximum Input Level (dBm)	Output Power at Maximum Input Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Upper Limit (dBm)	Result
728 - 746 MHz Pulsed GSM	-20	11.4	2	13.4	17	Pass
728 - 746 MHz AWGN	-20	-7.7	2	-5.7	17	Pass
746 - 757 MHz Pulsed GSM	-20	12.8	2.2	15	17	Pass
746 - 757 MHz AWGN	-20	-7.8	2.2	-5.6	17	Pass

Intermodulation

Engineer: Greg Corbin

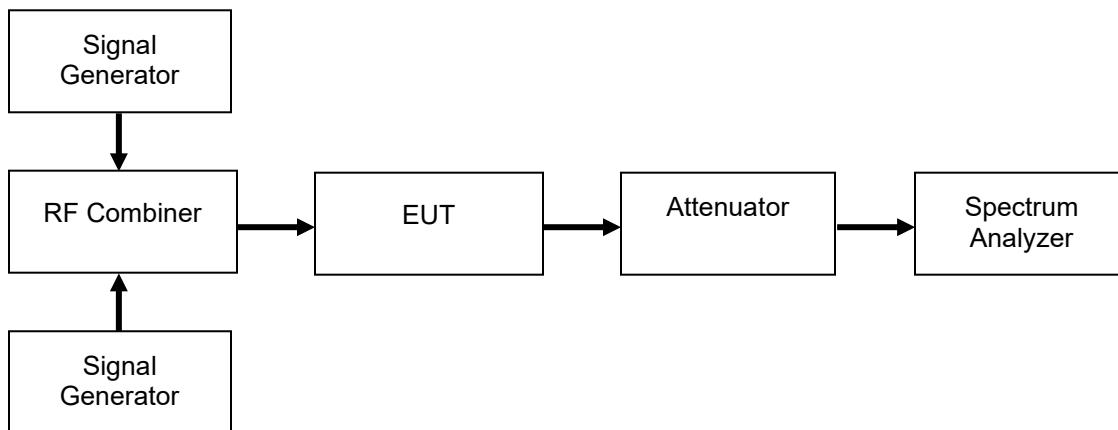
Test Date: 10/26/2020

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 at the peak of 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 intermodulation 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



Intermodulation Test Results 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	-20.2	-19	Pass	-20.1	Pass
776 - 787 MHz	-19.8	-19	Pass	-19	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	-20.1	-19	Pass	-27.6	Pass
746 - 757 MHz	-19.1	-19	Pass	-26.6	Pass

Annex B Intermodulation

Refer to Annex B for Intermodulation Test plots

Out-of-Band Emissions

Engineer: Greg Corbin

Test Date: 10/26/2020

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:

$$\text{Limit} = P1 - 6 - (43 + 10\text{Log}(P2)) = -19\text{dBm}$$

P1 = power in dBm

P2 = power in Watts

The Booster is compliant to the OOB Limits at 10 dB above the AGC Threshold.

Test Setup



GSM Uplink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result	OOBE Below Limit at Max Input Power (Pass/Fail)
698 - 716	Lower	-30.9	-19	Pass	Pass
776 - 787	Lower	-29.3	-19	Pass	Pass
698 - 716	Upper	-28.9	-19	Pass	Pass
776 - 787	Upper	-29.2	-19	Pass	Pass

CDMA Uplink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result	OOBE Below Limit at Max Input Power (Pass/Fail)
698 - 716	Lower	-47.9	-19	Pass	Pass
776 - 787	Lower	-40.9	-19	Pass	Pass
698 - 716	Upper	-41.8	-19	Pass	Pass
776 - 787	Upper	-39.3	-19	Pass	Pass

WCDMA Uplink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result	Oobe Below Limit at Max Input Power (Pass/Fail)
698 - 716	Lower	-47.1	-19	Pass	Pass
776 - 787	Upper	-43.2	-19	Pass	Pass
698 - 716	Upper	-44.3	-19	Pass	Pass
776 - 787	Lower	-43.8	-19	Pass	Pass

GSM Downlink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result	Oobe Below Limit at Max Input Power (Pass/Fail)
728 - 746 MHz	Lower	-38.4	-19	Pass	Pass
746 - 757 MHz	Lower	-34.6	-19	Pass	Pass
728 - 746 MHz	Upper	-35.1	-19	Pass	Pass
746 - 757 MHz	Upper	-41.5	-19	Pass	Pass

CDMA Downlink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result	Oobe Below Limit at Max Input Power (Pass/Fail)
728 - 746 MHz	Lower	-56.1	-19	Pass	Pass
746 - 757 MHz	Lower	-58.2	-19	Pass	Pass
728 - 746 MHz	Upper	-50.7	-19	Pass	Pass
746 - 757 MHz	Upper	-63.4	-19	Pass	Pass

WCDMA Downlink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result	Oobe Below Limit at Max Input Power (Pass/Fail)
728 - 746 MHz	Lower	-53.5	-19	Pass	Pass
746 - 757 MHz	Lower	-52.8	-19	Pass	Pass
728 - 746 MHz	Upper	-54.1	-19	Pass	Pass
746 - 757 MHz	Upper	-54.6	-19	Pass	Pass

Annex C Out of Band Emission

Refer to Annex C for Out of Band Emission plots

Conducted Spurious Emissions

Engineer: Greg Corbin

Test Date: 10/26/2020

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.

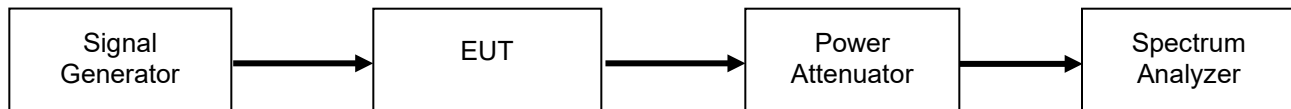
The following formulas are used for calculating the limits.

Conducted Spurious Emissions Limit = $P1 - (43 + 10\log(P2)) = -13 \text{ dBm}$

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	7378.7	-30.5	-13	Pass
776 - 787	7384.5	-30.7	-13	Pass

Downlink Test Results

Frequency Band (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
728 - 746	7472.1	-30.4	-13	Pass
746 - 757	7361.2	-29.2	-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;

776 – 787 MHz Uplink Band

Spurious Frequency Range (MHz)	Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
763 – 775	774.721	-52.1	-46	-6.10
793 – 805	793.129	-59.7	-46	-13.70

746 - 757 MHz Downlink Band

Spurious Frequency Range (MHz)	Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
763 – 775	770.548	-69.8	-46	-23.80
793 – 805	802.972	-68.7	-46	-22.70

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.

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)	Gain/Loss from Antenna Kitting Information (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
1559 – 1610 (Wideband)	1565.2	-51.1	4.90	-46.20	-40	-6.20
1559 – 1610 (Narrowband)	1572.6	-80.6	4.90	-75.70	-50	-25.70

746 - 757 MHz Downlink Band

Spurious Frequency Range (MHz)	Measured Frequency (MHz)	Measured Value (dBm)	Gain/Loss from Antenna Kitting Information (dB)	Final Value (dBm)	Limit (dBm)	Margin (dB)
1559 – 1610 (Wideband)	1566	-49.6	2.20	-47.40	-40	-7.40
1559 – 1610 (Narrowband)	1588.8	-78.9	2.20	-76.70	-50	-26.70

Annex D Conducted Spurious Emission

Refer to Annex D for Conducted Spurious Emission plots.

Noise Limits

Engineer: Greg Corbin

Test Date: 10/27/2020

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 were followed.

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

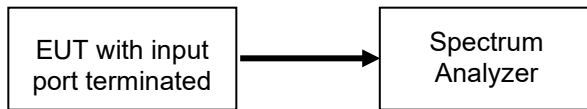
The following formulas are used for calculating the limits. Note – Downlink noise power limit is calculated with the center frequency of the associated uplink band.

Noise Power = $-102.5 + \text{LOG}_{10}(\text{Band Center Frequency}) * 20$

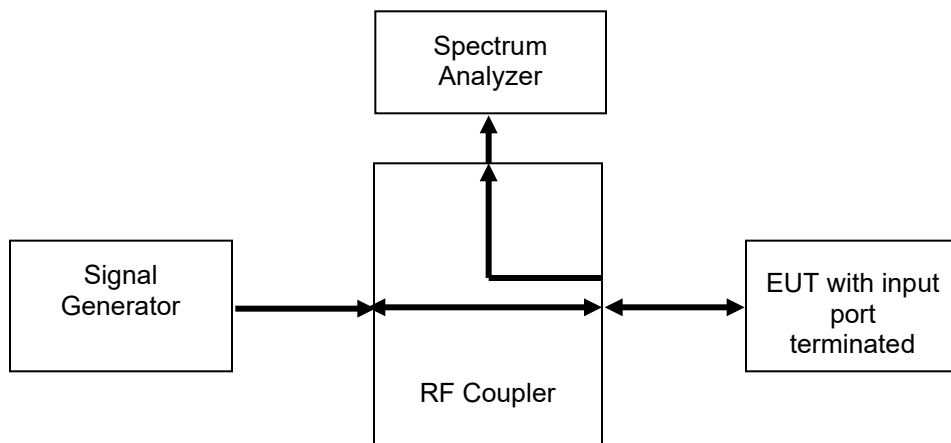
Variable Noise = $-103 \text{ dBm/MHz} - \text{RSSI}$

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	-49.7	-45.5	-4.2	Pass
776 - 787	-53	-44.6	-8.4	Pass

Maximum Downlink Noise Test Results

Frequency Band (MHz)	Measured Noise (dBm)	Limit (dBm)	Margin (dB)	Result
728 - 746	-49.8	-45.5	-4.3	Pass
746 - 757	-50.1	-44.6	-5.5	Pass

Uplink Noise Timing Test Results

Frequency Band (MHz)	Measured Timing (Seconds)	Limit (Seconds)	Result
698 - 716	0.50	3.0	Pass
776 - 787	0.34	3.0	Pass

**Variable Uplink Noise Limit Test Results
698 - 716 MHz**

RSSI (dBm)	Noise Limit (dBm)	Measured Noise (dBm)	Margin (dB)
-63.0	-45.5	-49.2	-3.7
-62.0	-45.5	-49.2	-3.7
-61.0	-45.5	-49.2	-3.7
-60.0	-45.5	-49.8	-4.3
-49.0	-54.0	-58.5	-4.5
-41.0	-62.0	-65.7	-3.7

776 - 787 MHz

RSSI (dBm)	Noise Limit (dBm)	Measured Noise (dBm)	Margin (dB)
-66.0	-44.6	-52.2	-7.6
-65.0	-44.6	-52.1	-7.5
-51.0	-52.0	-59.1	-7.1
-47.0	-56.0	-63	-7.0
-46.0	-57.0	-64	-7.0
-45.0	-58.0	-64.3	-6.3

Annex E Noise Limits and Uplink Noise Timing

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

Uplink Inactivity

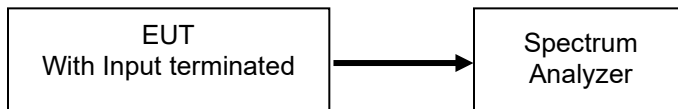
Engineer: Greg Corbin

Test Date: 10/27/2020

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	285.8	300	Pass
776 - 787	286.2	300	Pass

Annex F Uplink Inactivity

Refer to Annex F for Uplink Inactivity Plots

Variable Gain

Engineer: Greg Corbin

Test Date: 10/27/2020

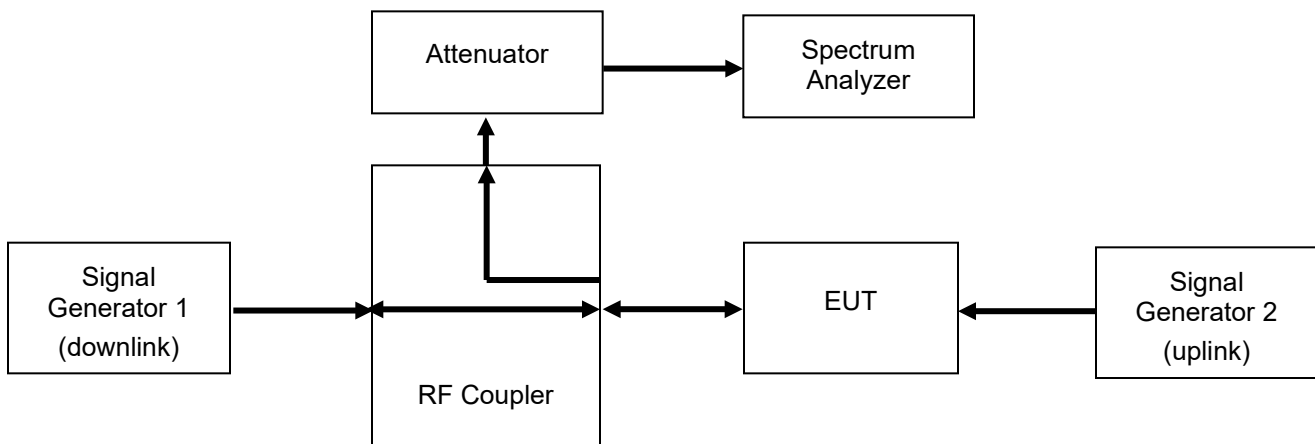
Test Procedure

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.

The following formula is used for calculating the limits:

$$\text{Variable Gain} = -34 \text{ dB} - \text{RSSI} + \text{MSCL}$$

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)
-60.0	36.4	62.4	-40.7	13.6	54.3	-8.1
-59.0	36.4	61.4	-40.7	13.1	53.8	-7.6
-58.0	36.4	60.4	-40.7	11.6	52.3	-8.1
-57.0	36.4	59.4	-40.7	10.6	51.3	-8.1
-56.0	36.4	58.4	-40.7	9.7	50.4	-8.0
-55.0	36.4	57.4	-40.7	8.2	48.9	-8.5

776 - 787 MHz

RSSI (dBm)	MSCL (dB)	Gain Limit (dBm)	P(in) (dBm)	P(out) (dBm)	Gain (dB)	Margin (dB)
-59.0	37.1	62.1	-39.6	15.3	54.9	-7.2
-58.0	37.1	61.1	-39.6	14.3	53.9	-7.2
-57.0	37.1	60.1	-39.6	12.9	52.5	-7.6
-56.0	37.1	59.1	-39.6	11.9	51.5	-7.6
-55.0	37.1	58.1	-39.6	10.4	50.0	-8.1
-54.0	37.1	57.1	-39.6	9.5	49.1	-8.0

Uplink Gain Timing Test Results

Frequency Band (MHz)	Measured Timing (Seconds)	Limit (Seconds)	Result
698 - 716 MHz	0.35	3.0	Pass
776 - 787 MHz	0.38	3.0	Pass

Annex G Uplink Gain Timing

Refer to Annex G for Uplink Gain Timing Plots

Occupied Bandwidth

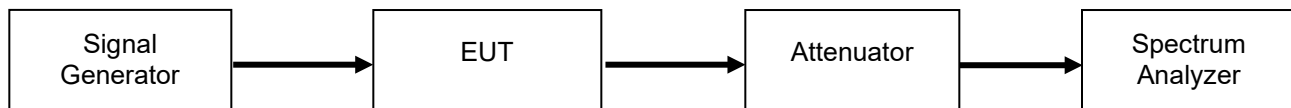
Engineer: Greg Corbin

Test Date: 10/27/2020

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



Annex H Occupied Bandwidth

Refer to Annex H for Occupied Bandwidth plots

Anti-Oscillation

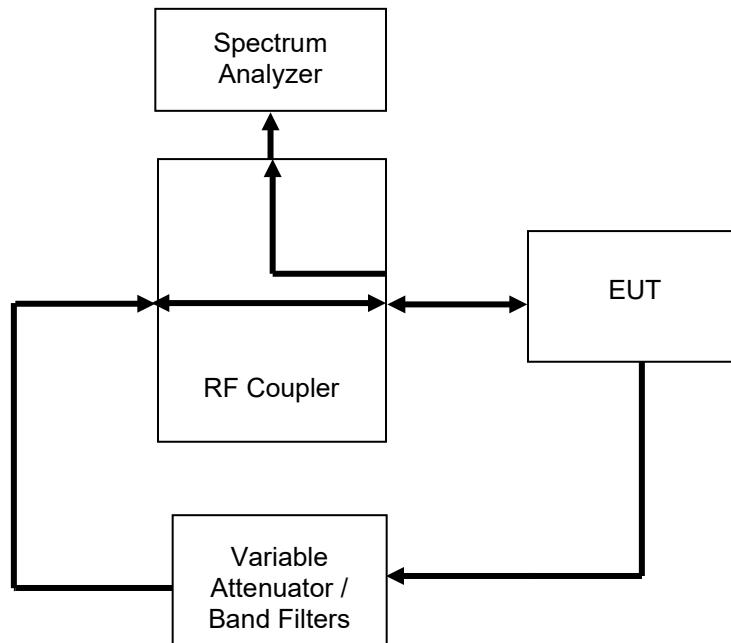
Engineer: Greg Corbin

Test Date: 10/27/2020

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	112.5	300	Pass
776 - 787	75	300	Pass

Downlink Detection Time Test Results

Frequency Band (MHz)	Measured Time (mS)	Limit (mS)	Result
728 - 746	137.5	1000	Pass
746 - 757	150	1000	Pass

Uplink Restart Time Test Results

Frequency Band (MHz)	Measured Time (S)	Limit (S)	Result
698 - 716	>90	≥60	Pass
776 - 787	>90	≥60	Pass

Downlink Restart Time Test Results

Frequency Band (MHz)	Measured Time (S)	Limit (S)	Result
728 - 746	>90	≥60	Pass
746 - 757	>90	≥60	Pass

Uplink Restart Count Test Results

Frequency Band (MHz)	Restarts	Limit	Result
698 - 716	0	≤5	Pass
776 - 787	0	≤5	Pass

Downlink Restart Count Test Results

Frequency Band (MHz)	Restarts	Limit	Result
728 - 746	0	≤5	Pass
746 - 757	0	≤5	Pass

Annex I Anti-Oscillation

Refer to Annex I for Anti-Oscillation Plots

Oscillation Mitigation

Engineer: Greg Corbin

Test Date: 10/27/2020

Test Procedure

The EUT was connected as shown per KDB 935210 D03. 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.

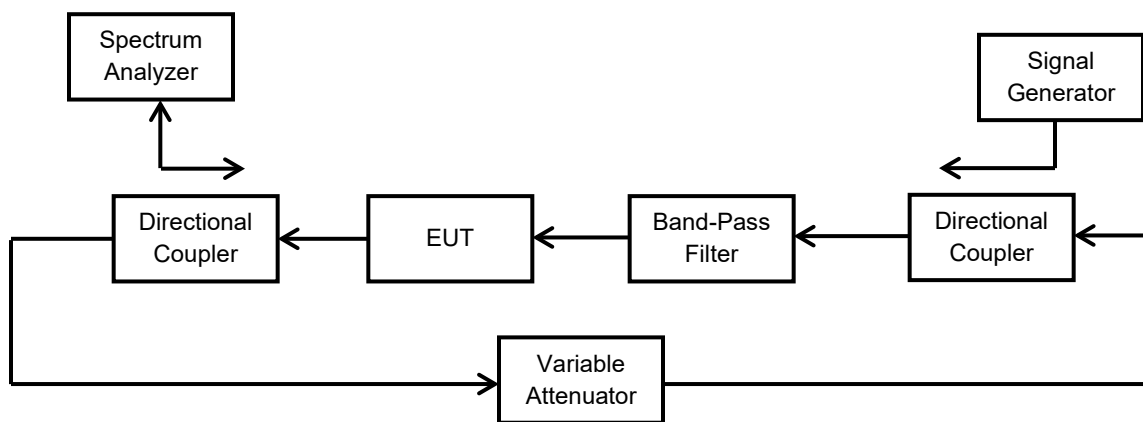
The frequency and amplitude of the highest oscillation and the lowest level in the valley next to the oscillation was recorded for each 1 dB step as required per the KDB.

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 and Power Levels				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	703.9	-62.1	706.4	-70.7	8.6	<12	N/A	< 300	Pass
+4	703.9	-61.3	706.4	-70.8	9.5	<12	N/A	< 300	Pass
+3	703.9	-61.1	706.4	-71.7	10.6	<12	N/A	< 300	Pass
+2	703.9	-59.1	706.4	-71.9	12.8	<12	51	< 300	Pass
+1	703.9	-57.9	706.4	-71.1	13.2	<12	52	< 300	Pass
+0	703.9	-56.2	706.4	-72.4	16.2	<12	45	< 300	Pass
-1	703.9	-54.9	706.4	-72.3	17.4	<12	48	< 300	Pass
-2	703.9	-45.4	706.4	-72.8	27.4	<12	57	< 300	Pass
-3	EUT shutdown								Pass

Oscillation Mitigation - Uplink									
Band	776 – 787 MHz								
Test Signal Type	CDMA								
Variable Attenuator Setting	Oscillations and Power Levels				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	783.5	-60.6	785.1	-72.3	11.7	<12	N/A	< 300	Pass
+4	783.5	-58.9	785.1	-72.6	13.7	<12	50	< 300	Pass
+3	783.5	-57	785.1	-73.3	16.3	<12	45	< 300	Pass
+2	783.5	-53.9	785.1	-73.1	19.2	<12	56	< 300	Pass
+1	783.5	-50.3	785.1	-73.3	23	<12	54	< 300	Pass
+0	783.5	-45.1	785.1	-73.3	28.2	<12	49	< 300	Pass
-1	EUT shutdown								Pass

Downlink Oscillation Mitigation Test Data

Oscillation Mitigation - Downlink									
Band	728 - 746 MHz								
Test Signal Type	CDMA								
Variable Attenuator Setting	Oscillations and Power Levels				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	738.3	-64.1	736.9	-72.6	8.5	<12	N/A	< 300	Pass
+4	738.3	-63.6	736.9	-72.4	8.8	<12	N/A	< 300	Pass
+3	738.3	-62.4	736.9	-73.1	10.7	<12	N/A	< 300	Pass
+2	738.3	-62	736.9	-74.3	12.3	<12	43	< 300	Pass
+1	EUT shutdown								Pass

Oscillation Mitigation - Downlink									
Band	746 - 757 MHz								
Test Signal Type	CDMA								
Variable Attenuator Setting	Oscillations and Power Levels				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	749.8	-57.5	748.2	-70.4	12.9	<12	55	< 300	Pass
+4	749.8	-55.4	748.2	-69.7	14.3	<12	47	< 300	Pass
+3	749.8	-53.8	748.2	-70.3	16.5	<12	56	< 300	Pass
+2	749.8	-52.3	748.2	-70.3	18	<12	54	< 300	Pass
+1	EUT shutdown								Pass

Radiated Spurious

Engineer: Greg Corbin

Test Date: 10/27/2020

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.

The radiated spurious emissions were measured from 30 MHz to the 10th harmonic of the highest frequency used by the EUT.

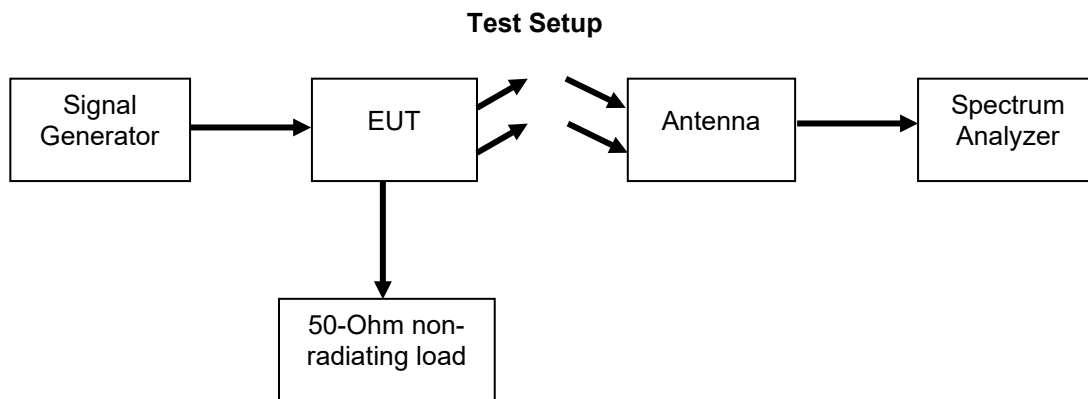
All cable and antenna correction factors were input into the spectrum analyzer ensuring an accurate measurement in ERP/EIRP with the resultant power in dBm. A signal generator was used to provide a CW signal centered in each operational uplink and downlink band. The EUT output was terminated into a 50 Ohm non-radiating load.

The following formula was used for calculating the limits:

$$\text{Radiated Spurious Emissions Limit} = P1 - (43 + 10\text{Log}(P2)) = -13\text{dBm}$$

P1 = power in dBm

P2 = power in Watts



All emissions were lower than -13 dBm.

Annex J Radiated Spurious Emission

Refer to Annex J for Radiated Spurious Emission plots

Measurement Uncertainty

Measurement Uncertainty for Compliance Testing is listed in the table below.

The reported expanded uncertainty has been estimated at a 95% confidence level (k=2)

Measurement Type	Expanded Uncertainty
Conducted Emissions, AC Powerline	± 3.28 dB
Radiated Emissions_30 – 1000 MHz	± 4.82 dB
Radiated Emissions_1 – 18 GHz	± 5.73 dB
Frequency Error	± 22 Hz
Conducted RF Power	± 0.98 dB
Conducted Spurious Emission	± 2.49 dB
AC Voltage	± 2.3 %
DC Voltage	± 0.12 %
Temperature	± 1.0 deg C
Humidity	± 4.32 %

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna	EMCO	3116	i00085	2/28/19	2/28/21
Horn Antenna	ARA	DRG-118/A	i00271	8/3/20	8/3/21
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	8/28/20	8/28/21
Bi-Log Antenna	Schaffner	CBL 6111D	i00267	8/28/20	8/28/22
EMI Analyzer	Agilent	E7405A	i00379	1/21/20	1/21/21
Signal Generator	Rohde & Schwarz	SMU200A	i00405	8/6/20	8/6/21
Filter Test Box	Compliance Testing	N/A	i00411	N/A	N/A
Spectrum Analyzer	Textronix	RSA5126A	i00424	8/3/20	8/3/21
Variable Attenuator	JFW	940-60-33-1	i00433	N/A	N/A
Signal Generator	Agilent	E4438C	i00457	1/3/2020	1/3/2021
Preamplifier	Miteq	AMF-6F-18004000-29-8P	i00461	N/A	N/A
Voltmeter	Fluke	179	i00488	5/18/20	5/18/21
Preamplifier	Miteq	AFS44 00101 400 23-10P-44	i00509	N/A	N/A
Step Attenuator	JFW Industries	50DR-061	S/N: 293459 0015	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