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Test Report

Prepared for: Fiplex Communications, Inc.

Model: DH1

Description: Signal Booster

Serial Numbers: (174) 16080972FU & (150) 16080970FU

FCC ID: P3TDH1
IC: 8986A-DH1

To

FCC Part 90

And

RSS-131

Date of Issue: June 6, 2017

On the behalf of the applicant:	**Fiplex Communications, Inc.** **7331 NW 54th St.** **Miami, FL 33166**
Attention of:	**Ricardo Matias de Goyoechea** **Ph: (305)884-8991** **E-Mail: matias@fiplex.com**

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Alex Macon
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	May 9, 2017	Alex Macon	Original Document
2.0	May 24, 2017	Alex Macon	Updated the test procedure on page 9 to include more details on 20dB bandwidth and additional information on page 6
3.0	June 6, 2017	Alex Macon	Added more detail into additional information on page 6
4.0	June 6, 2017	Alex Macon	Updated emission designator on page 6

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

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FCC Site Reg. #349717

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N/A

The Applicant has been cautioned as to the following:

15.21: **Information to the User**

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a): **Special Accessories**

Equipment marketed to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer, without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Test and Measurement Data

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations Part 90.219, KDB 935210 D05 Booster, and FCC Part 2, where appropriate.

Standard Test Conditions and Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing.

In accordance with ANSI/TIA 603C, 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 specify 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)**
25.3	30.2	968.7

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

EUT Description
Model: DH1
Description: Signal Booster
Serial Numbers: (174) 16080972FU & (150) 16080970FU
Firmware: N/A
Software: N/A
Additional Information: The EUT incorporates narrowband filtering. The device can be ordered tuned to be a custom channelized BDA with an operating band width of 2MHz. This 2 MHz can be located anywhere within the allocated frequency band of 150 – 174 MHz. The manufacturer has supplied two separate devices for this testing. One box has been tuned to the low end (150MHz) and another box tuned to the high end (174 MHz). Due to the channelized nature of the EUT, some of the described tests in KDB 935210 were slightly altered to accommodate the truncated frequency selection. Within the mentioned 2 MHz, the device is further controlled using digital filtering techniques to adjust individual 45kHz wide channel. Each narrowband 45kHz channel is separately tunable by the manufacturer to maximize the output power; therefore, the output power should be the same throughout the band. The channel with the highest amplitude measured was used to determine compliance throughout the testing. The out of band rejection test was performed with both units and the delta between their highest and lowest -20dBc points were taken as the bandwidth of the EUT. The term “center of the passband” is referring to the center of the 2 MHz band that is being tested and is deemed to be the worst case maximum rated output condition.

EUT Operation during Tests
The EUT is in normal operating mode with the maximum gain and power set.

	Frequency (MHz)	**Emission Designators**
Downlink	150 - 174	16K0F3E, 11K3F3E, 4K00F1E and 6K25F1D
Uplink	150 - 174	16K0F3E, 11K3F3E, 4K00F1E and 6K25F1D

Accessories: None

Cables: None

Modifications: None

Test Result Summary

Specification	Test Name	Pass, Fail, N/A	Comments
KDB 935210 D05	AGC Threshold	Pass	
KDB 935210-D05	Out of Band Rejection	Pass	
2.1046	Output Power (Conducted)	Pass	
90.210 2.1049	Occupied Bandwidth (Emission Masks)	Pass	
2.1051	Spurious Emissions (Transmitter Conducted)	Pass	
2.1053	Radiated Spurious Emissions	Pass	
KDB 935210-D05	Intermodulation	Pass	
90.219(e)(2)	Noise Figure	Pass	
90.213	Frequency Stability (Temperature Variation)	N/A	EUT does not implement Frequency Translation
90.213	Frequency Stability (Voltage Variation)	N/A	EUT does not implement Frequency Translation

AGC Threshold

Engineer: Kenneth Lee

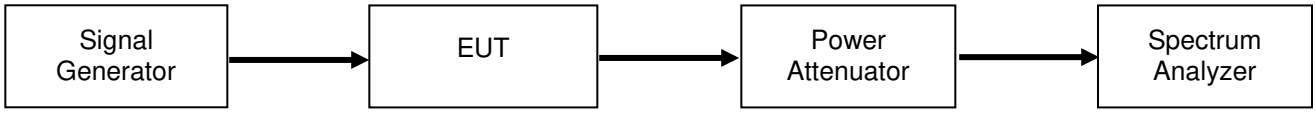
Test Date: 4/27/2017

Test Procedure

A signal generator producing a CW signal was connected to the input of the EUT. A spectrum analyzer was connected to the EUT in order to monitor the output power levels. The input power level was increase in 1 dB increments until the power no longer increased. The input levels were recorded in the table below.

Spectrum Analyzer settings
Power Channel integration
RBW = 100 kHz
Video BW = 3x RBW

Test Setup



Mobile to Base

Tuned Frequency (MHz)	AGC Threshold (dBm)
150	-57.62
174	-55.36

Base to Mobile

Tuned Frequency (MHz)	AGC Threshold (dBm)
150	-58.24
174	-56.38

Out of Band Rejection

Engineer: Kenneth Lee

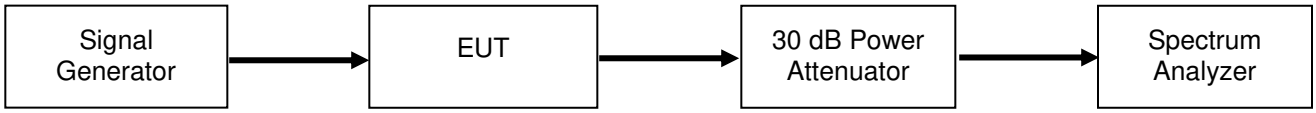
Test Date: 4/28/2017

Test Procedure

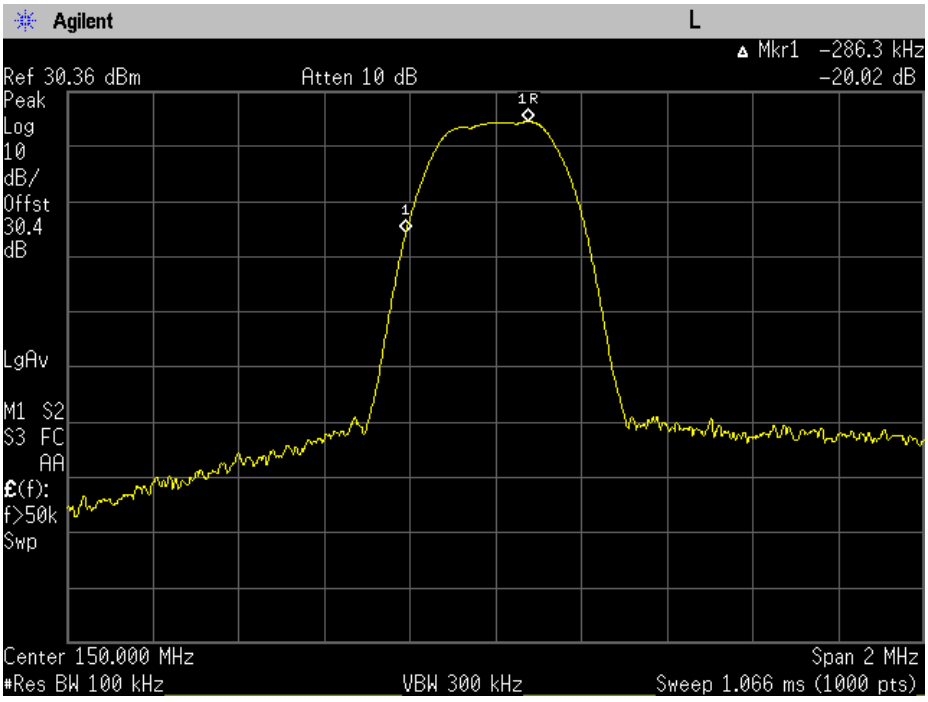
The EUT was connected to a spectrum analyzer through a 30 dB power attenuator. A signal generator was utilized to produce a swept CW signal with the RF input level set to 3 dB below the AGC Threshold level. The Uplink and Downlink filter response and the -20 dB bandwidth were measured. The marker delta function of the spectrum analyzer was used to show the -20 dB bandwidth of the pass band filter on the high end and low end. The measured frequency associated with the -20dB BW on the low end was than subtracted from the measured frequency to be the -20dB BW on the high end. The outcome is the -20dB bandwidth of the passband. In addition the high and low channels were swept to show the maximum bandwidth of the filter utilized.

RBW = 100 KHz
Video BW = 3x RBW

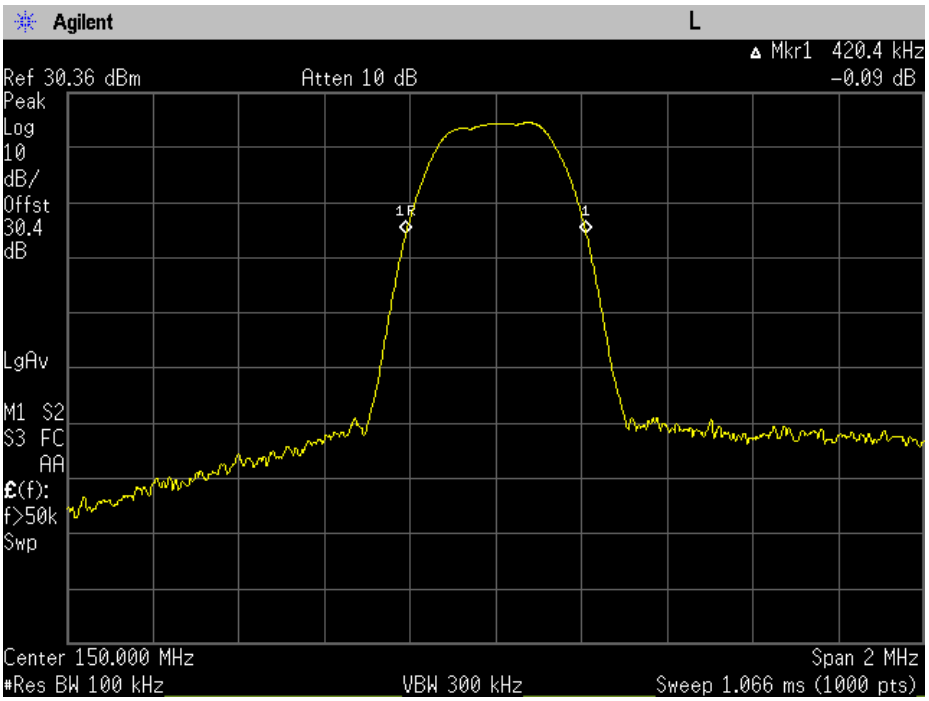
Test Setup



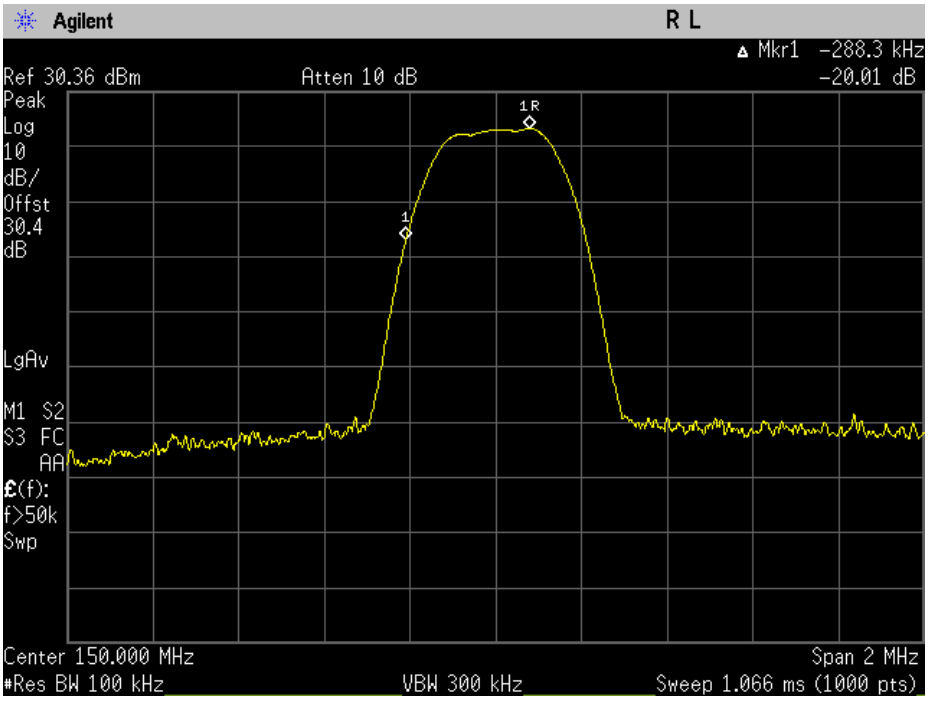
Downlink 150 – Low Side



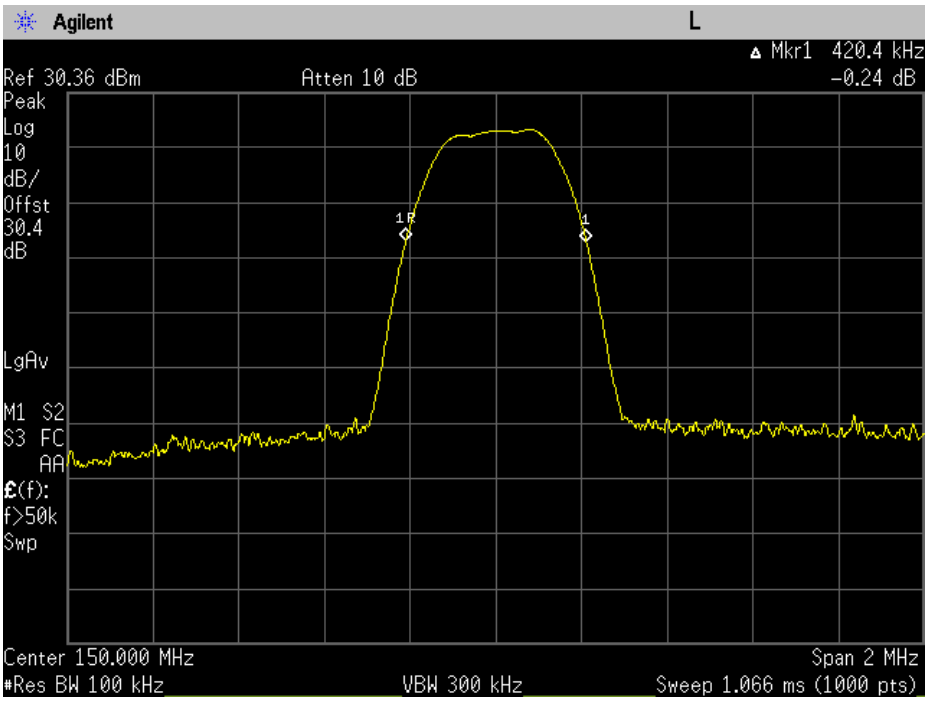
Downlink 150 – Single Channel BW



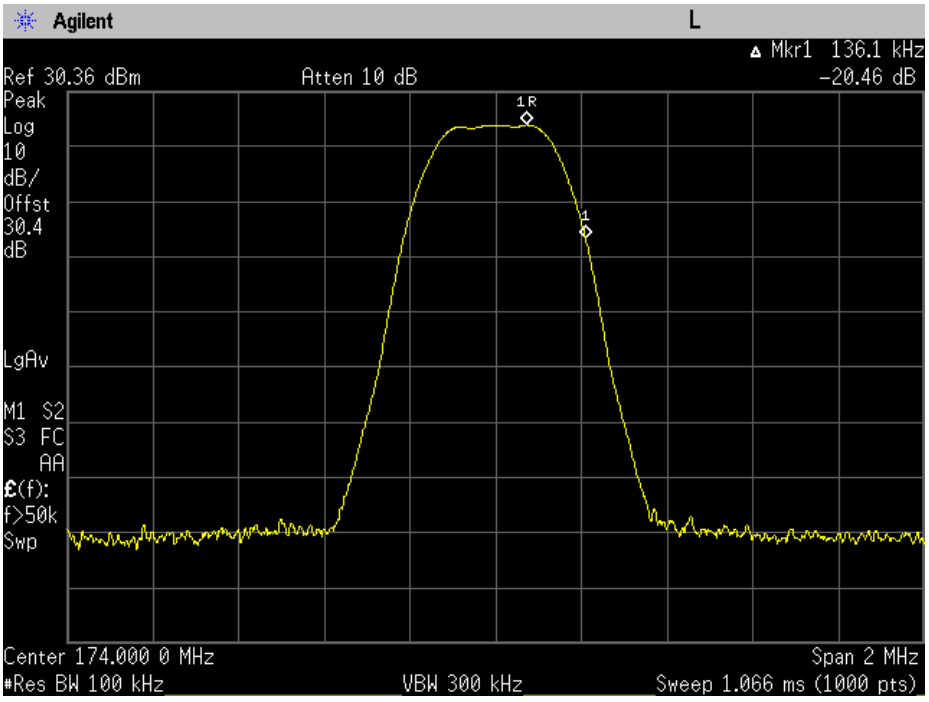
Uplink 150 – Low Side



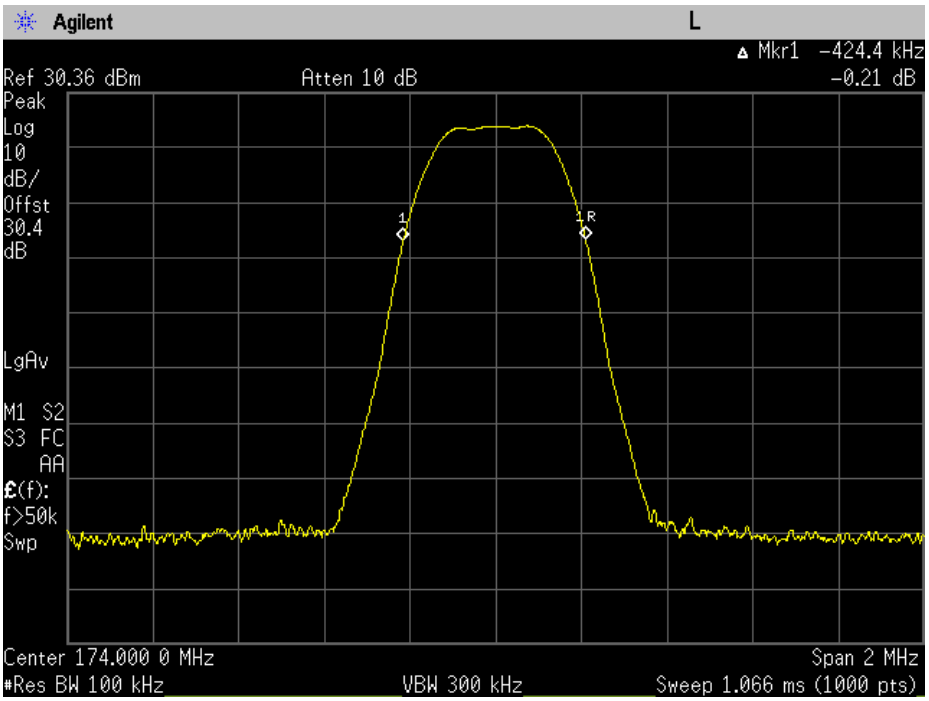
Uplink 150 – Single Channel BW



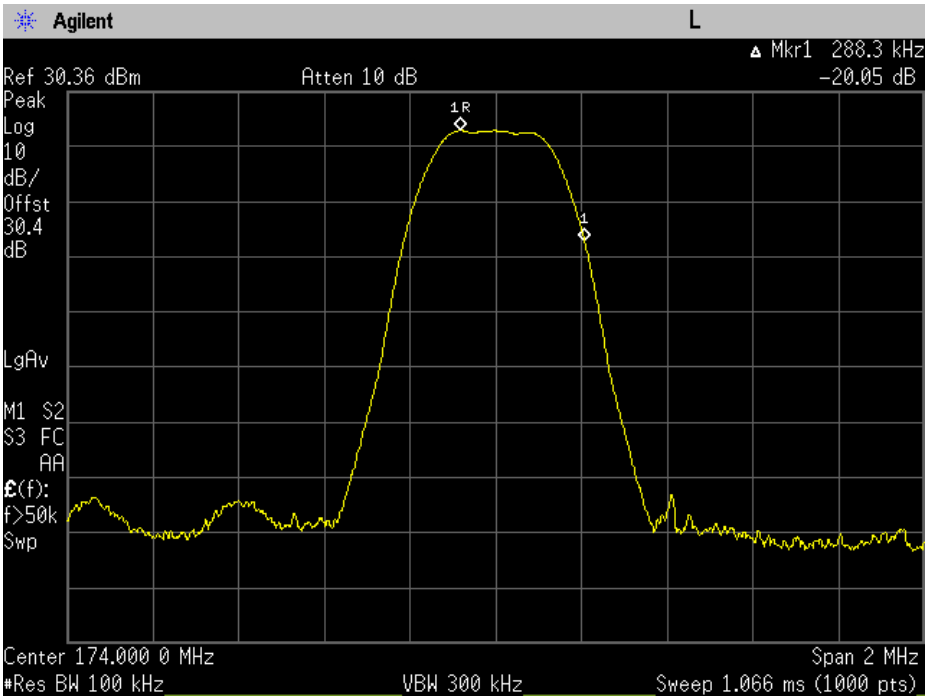
Downlink 174 – High Side



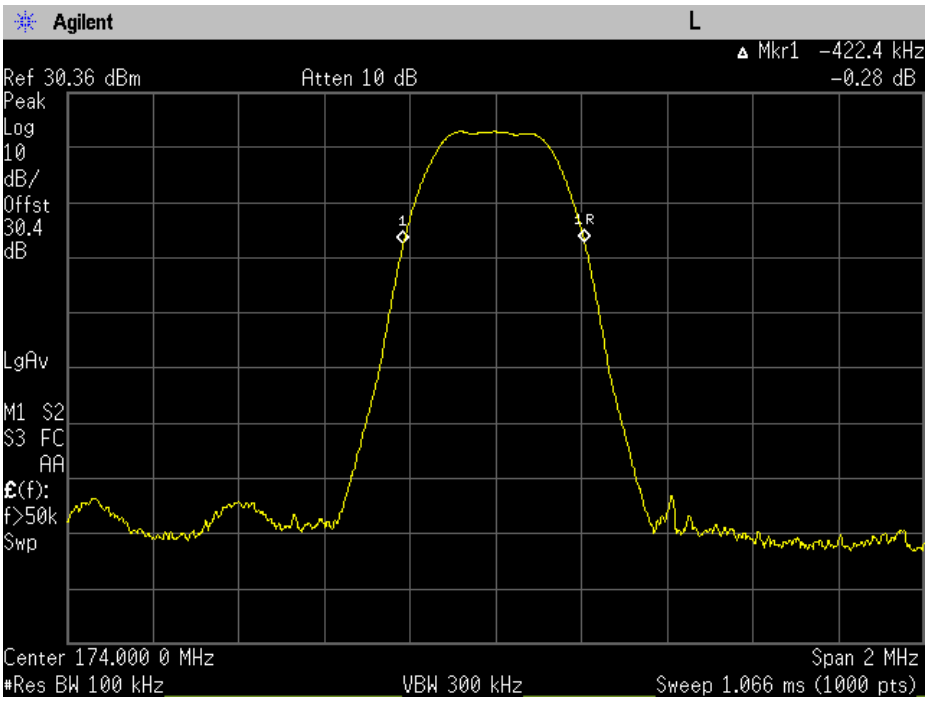
Downlink 174 – Single Channel BW



Uplink 174 – High Side



Uplink 174 – Single Channel BW



Uplink Outcome: 174.212 – 149.7898 = 24.4 MHz

Downlink Outcome: 174.2122 – 149.7798 = 24.4324 MHz

Conducted Output Power and Amplifier Gain

Engineer: Kenneth Lee

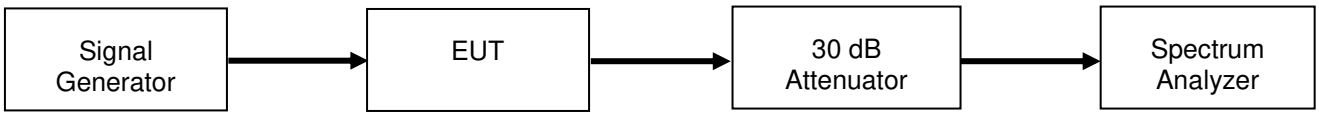
Test Date: 4/27/2017

Test Procedure

The Equipment Under Test (EUT) was connected to a spectrum analyzer through a 30 dB Power attenuator. All cable and attenuator losses were input into the spectrum analyzer as a reference level offset to ensure accurate readings were obtained.
A CW signal was utilized
The RF input signal level was set to 0.2 dB below the AGC Threshold.
RBW = 100 kHz
Video BW = 3x RBW
The Input and Output power levels were recorded and the gain was calculated using the following formula:

Gain (dB) = Output Power (dBm) – Input Power (dBm)

Test Setup



Output Power and Gain Test Results

Tuned Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
150 (Uplink)	-58.44	23.09	81.53
150 (Downlink)	-57.82	24.54	82.36
174 (Uplink)	-56.58	23.63	80.21
174 (Downlink)	-55.56	24.18	79.74

Radiated Output Power

Radiated Power (ERP) is dependent on the cable loss and antennas used when installed.
The user manual specification for Composite Output Power is 24 dBm.

Conducted Spurious Emissions

Engineer: Kenneth Lee

Test Date: 4/28/2017

Test Procedure

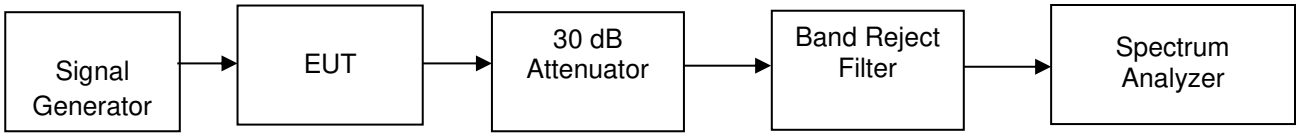
The Equipment Under Test (EUT) was connected to a spectrum analyzer through a 30 dB Power attenuator. All cable and attenuator losses were input into the spectrum analyzer as a combination of reference level offset and correction factor as needed to ensure accurate readings were obtained.
A CW signal was utilized, set to 150 MHz, and again at 174 MHz.
The RF input signal level was set to 0.2 dB below the AGC Threshold.
The RBW was set to 1 MHz for measurements for all measurements since this is worst case.
The VBW was set to 3 times the RBW.

The frequency range from 30 MHz to the 10th harmonic of the passband frequency was observed and plotted.

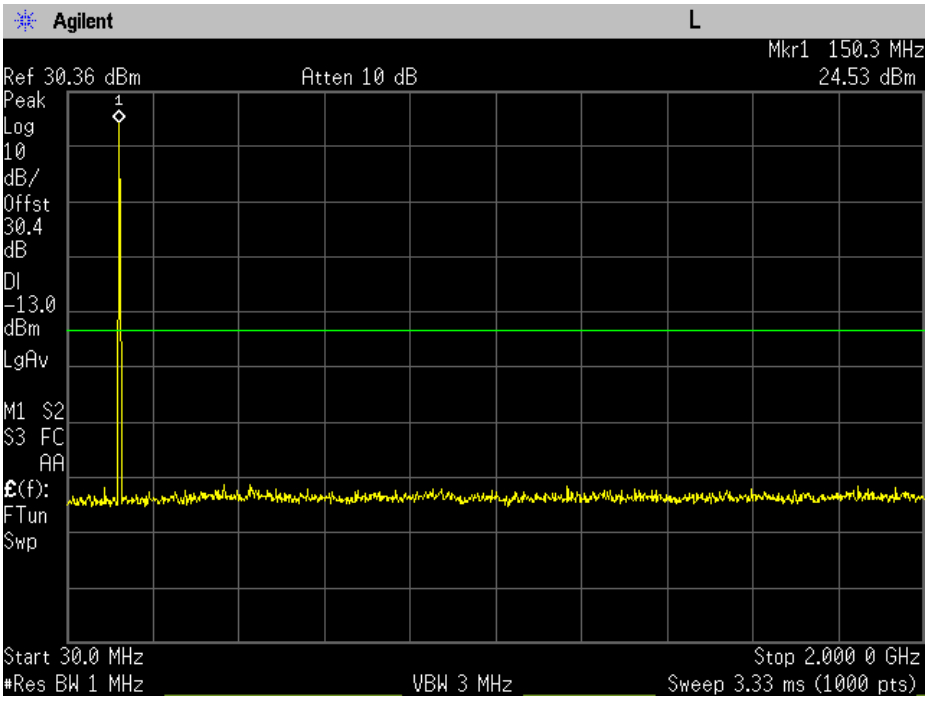
The following formula was used for calculating the limits.

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

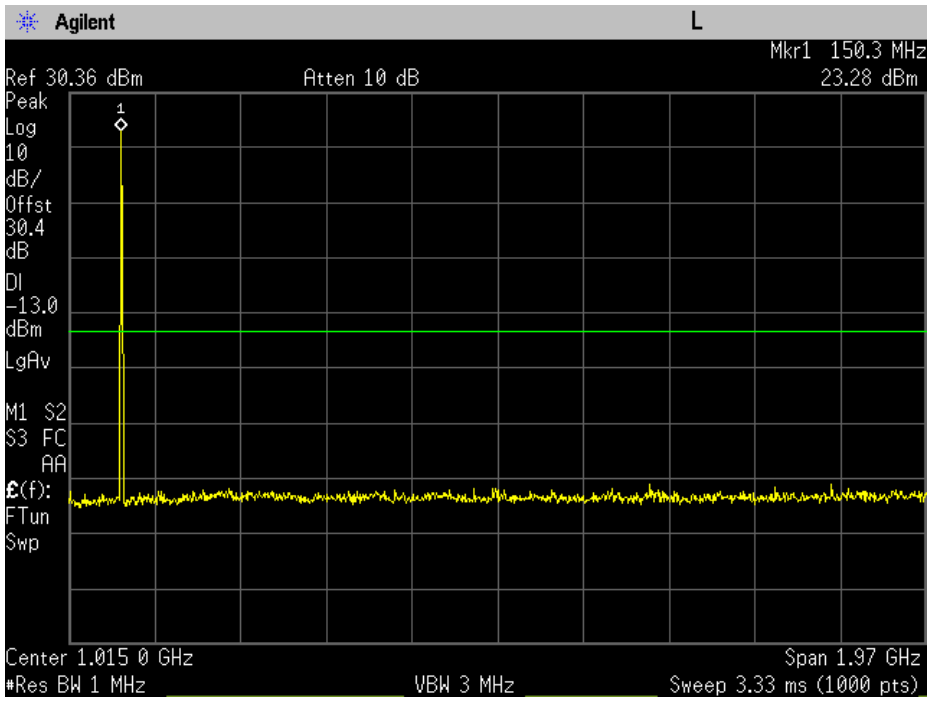
Test Setup



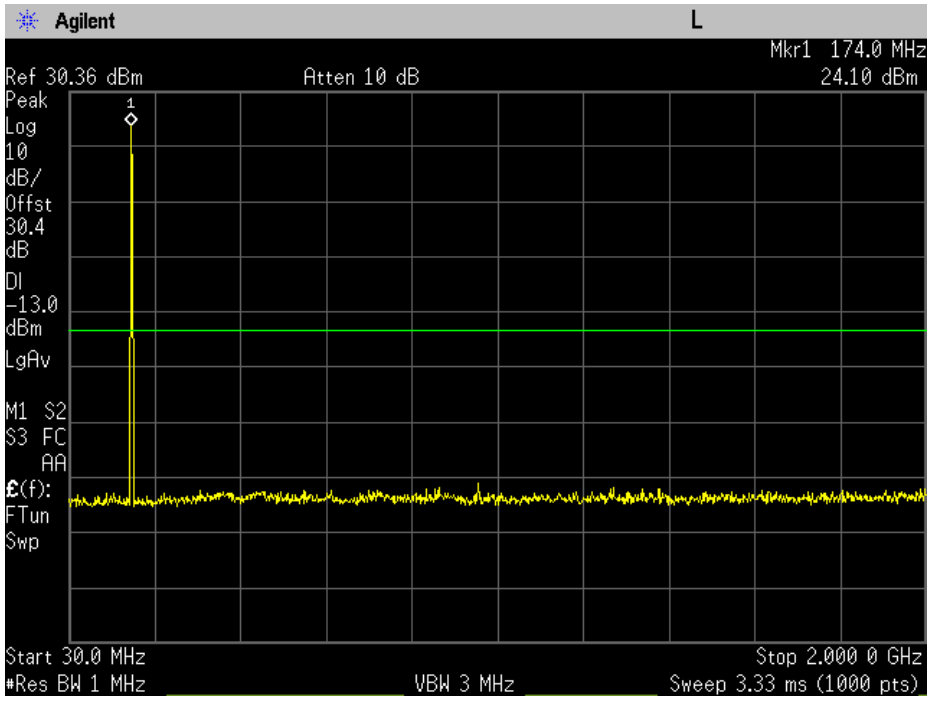
Downlink 150 – 30-2000 MHz



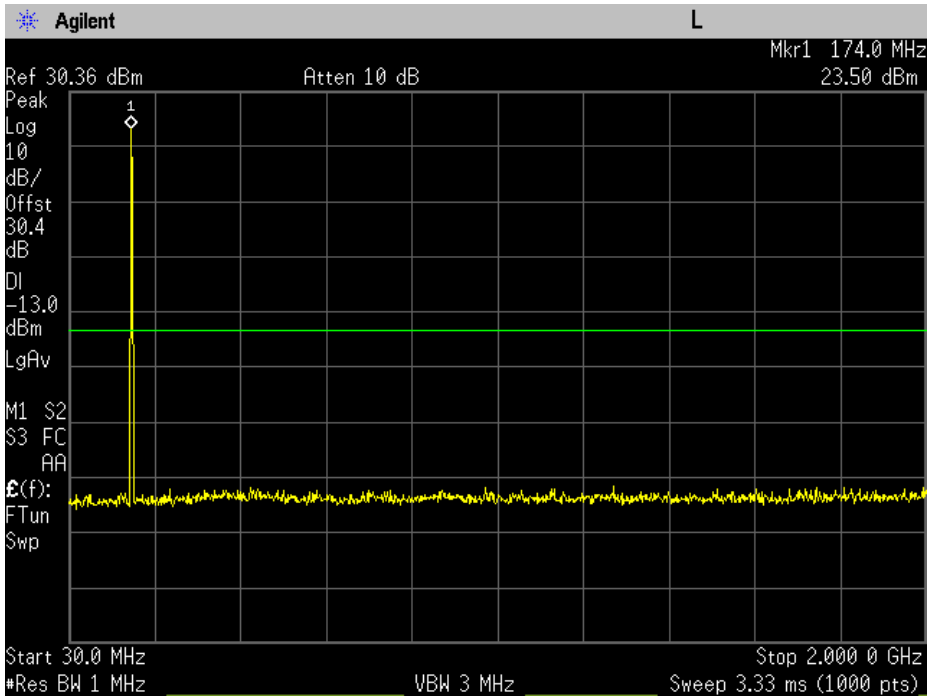
Uplink 150 – 30-2000 MHz



Downlink 174 – 30-2000 MHz



Uplink 174 – 30-2000 MHz



Radiated Spurious Emissions

Engineer: Kenneth Lee

Test Date: 4/30/2017

Test Procedure

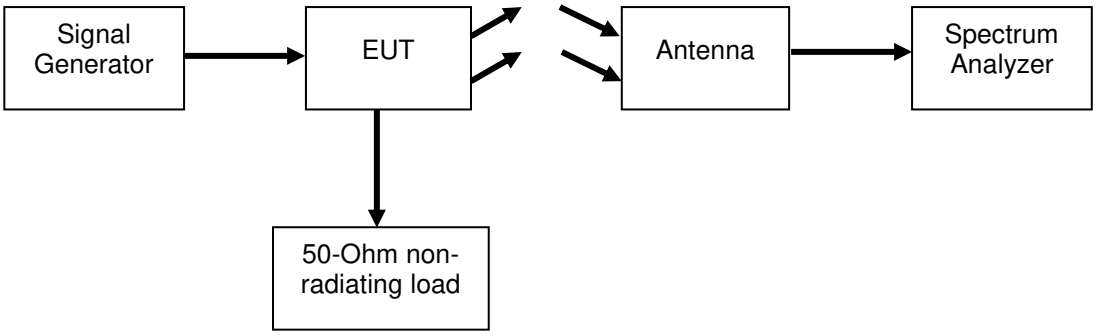
The EUT was tested in a semi-anechoic chamber with the turntable set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360 degrees with the antenna in both the vertical and horizontal orientation 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. The EUT output was terminated into a 50 Ohm non-radiating load.

The RBW was set to 100 kHz for measurements below 1 GHz and 1 MHz for measurements above 1 GHz.
The VBW was set to 3 times the RBW.

The following formula was used for calculating the limits:

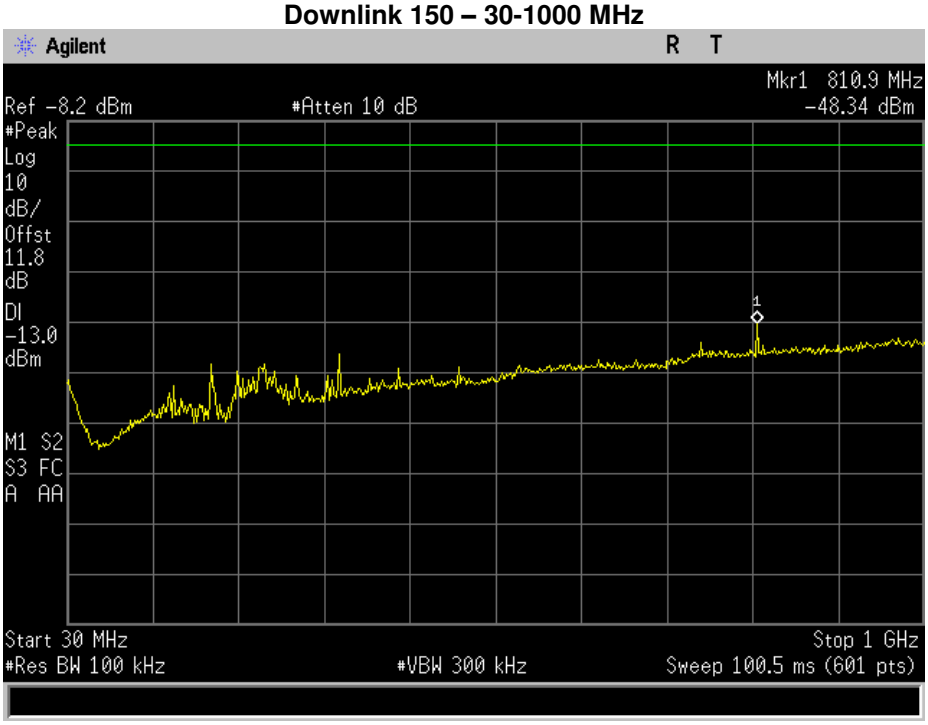
Radiated Spurious Emissions Limit = P1 – (43+ 10Log(P2)) = -13dBm
P1 = power in dBm
P2 = power in Watts

Test Setup

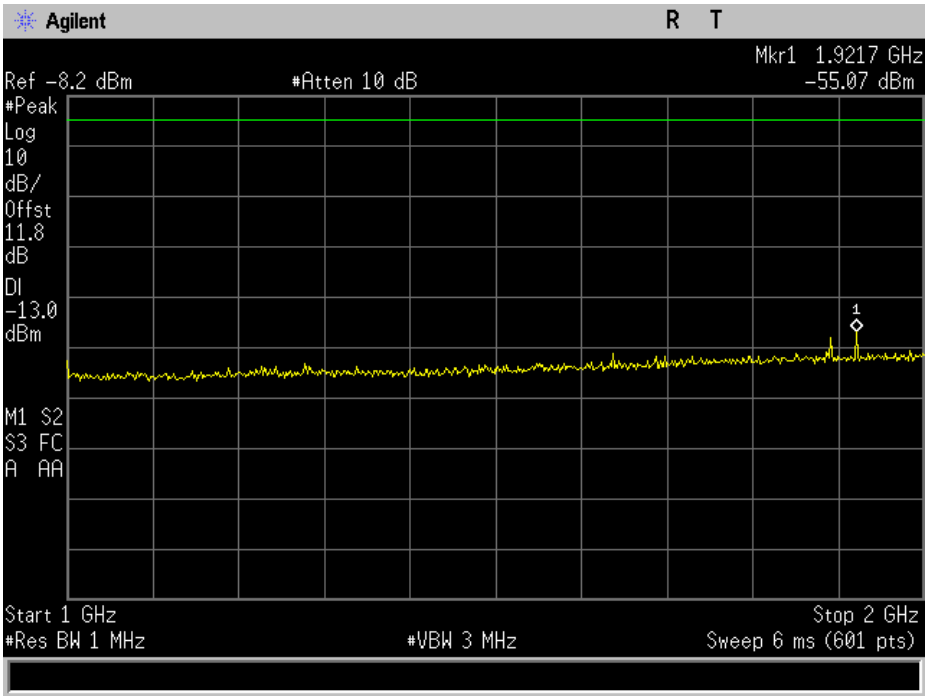


Test Results

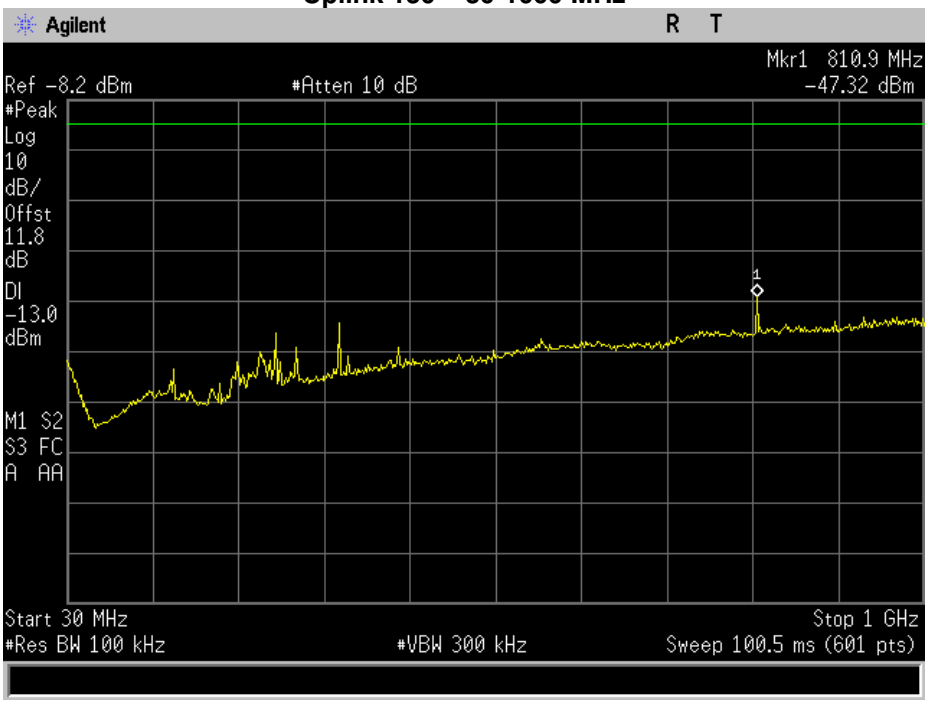
Downlink 150 – 30-1000 MHz



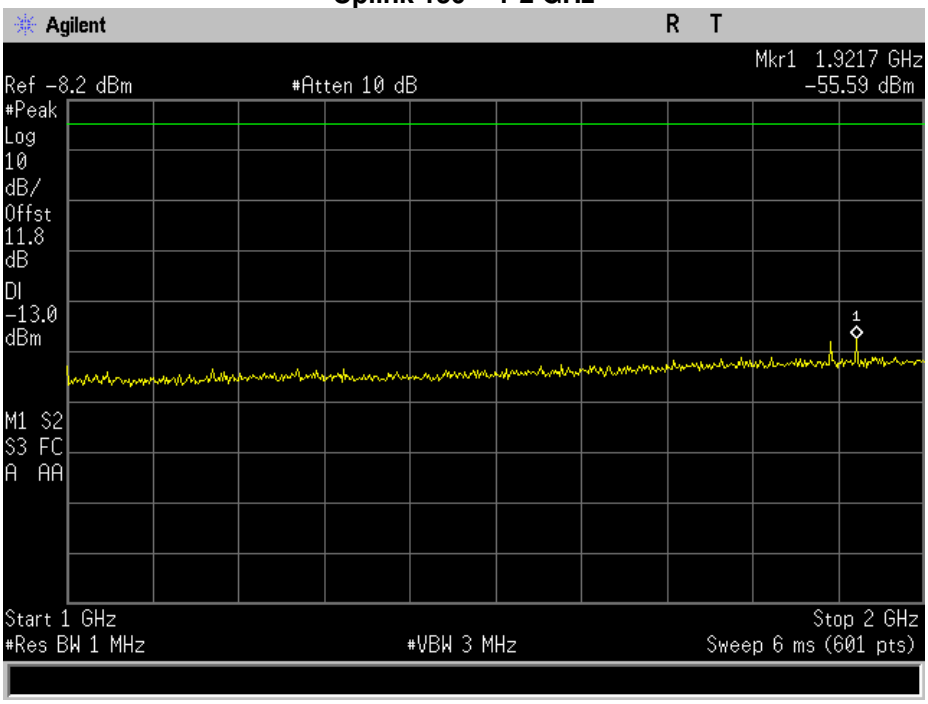
Downlink 150 – 1-2 GHz



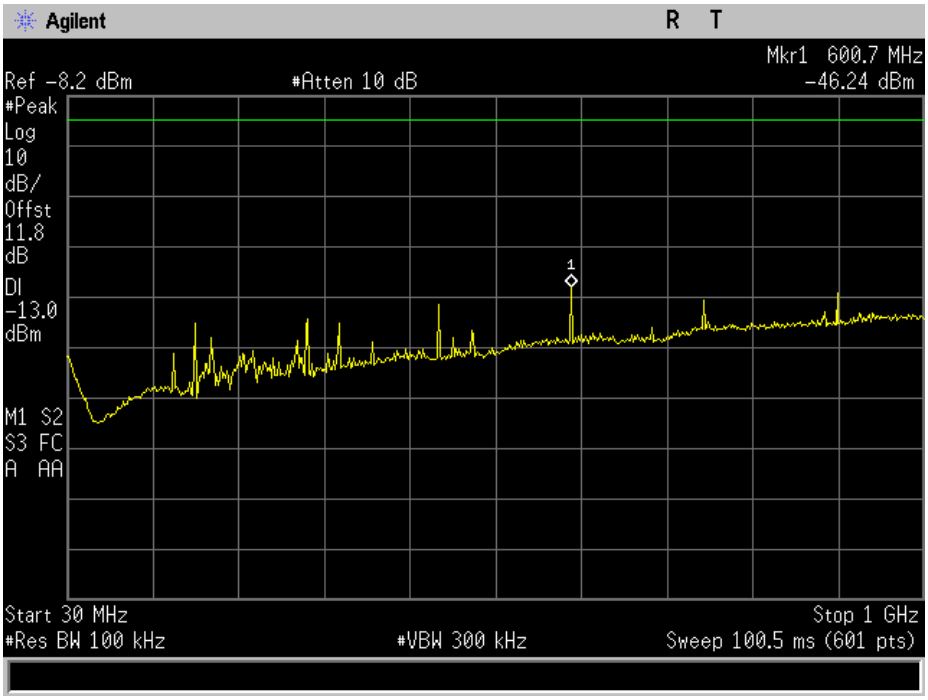
Uplink 150 – 30-1000 MHz



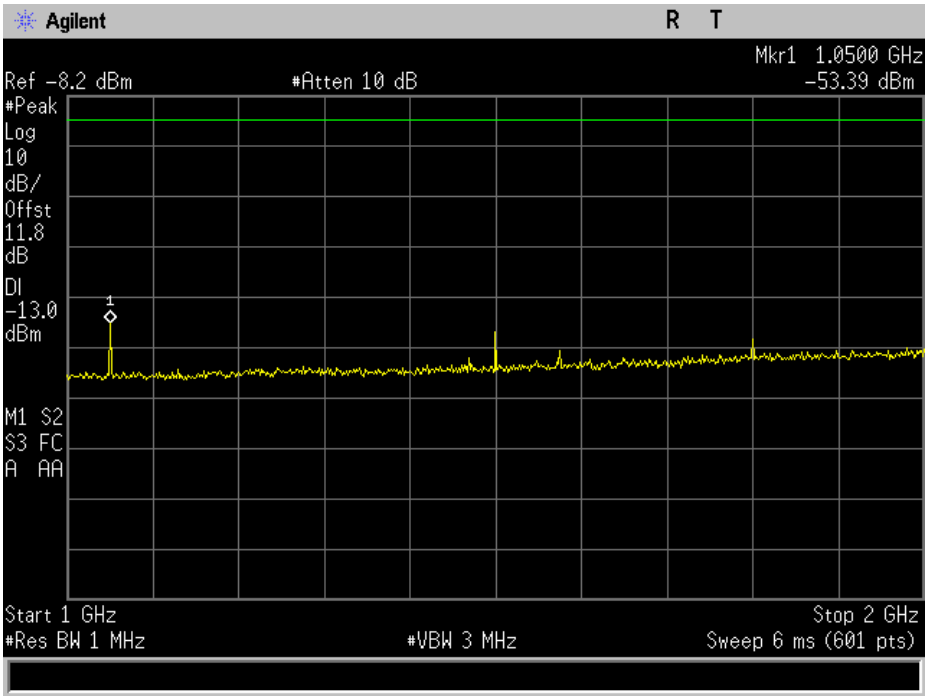
Uplink 150 – 1-2 GHz



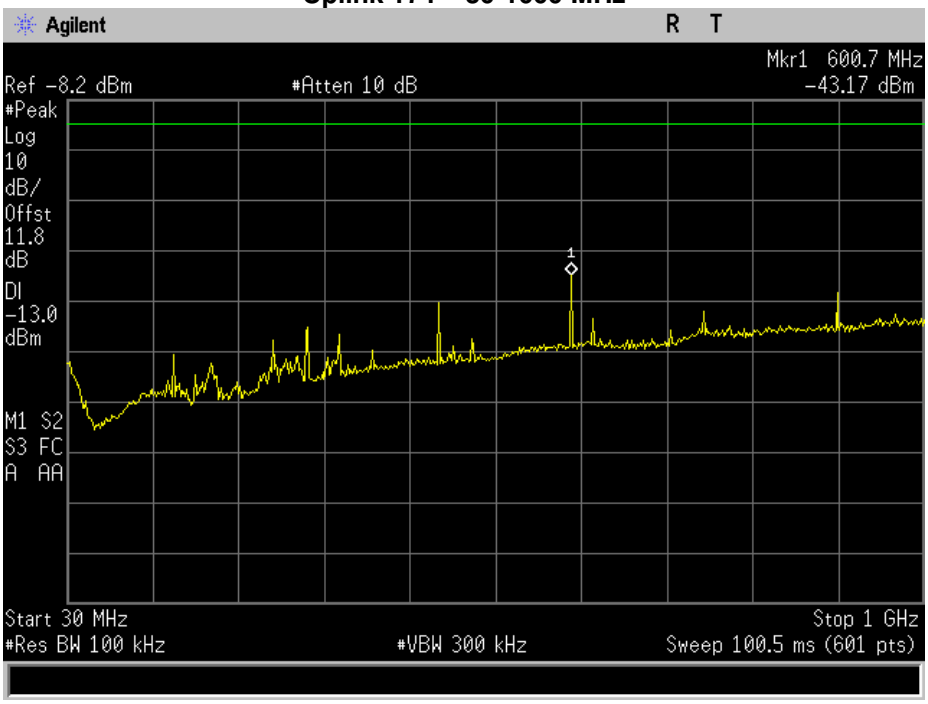
Downlink 174 – 30-1000 MHz



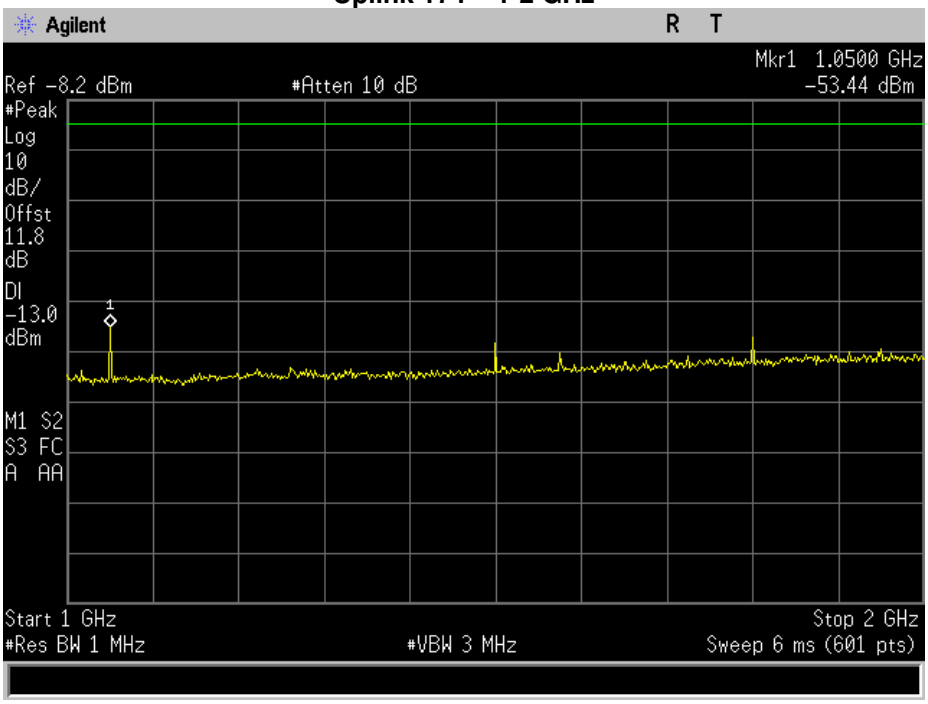
Downlink 174 – 1-2 GHz



Uplink 174 – 30-1000 MHz



Uplink 174 – 1-2 GHz



Emission Masks (Occupied Bandwidth)

Engineer: Kenneth Lee

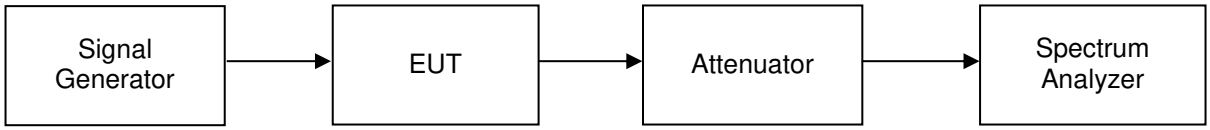
Test Date: 4/28/2017

Test Procedure

The EUT was connected directly to a spectrum analyzer to verify that the EUT meets the required emissions mask.
The EUT is a booster amplifier that does not contain a transmitter; representative emission designators used in the industry were used for the emission masks and are listed in Table 1.
The output signal was tested to the required mask.
The input signal was recorded and compared to the output signal.
The input and output was tested at 0.2 dB below the AGC Threshold and +3 dB above the AGC Threshold.

Emission Designator	Emission Mask	Type of Modulation	Occupied Bandwidth (kHz)	Channel Spacing (kHz)	Audio Frequency (kHz)	Deviation (kHz)	RBW (Hz)
16K0F3E	C	FM	16.0	25	1.0	5.0	300
11K3F3E	D	FM	11.3	12.5	1.0	2.5	100
4K00F1E	E	FM	4	6.25	1.0	1.0	100
F1D	D	C4FM	7.5	12.5	C4FM	N/A	100

Test Setup



Refer to Annex A for Emission Mask plots

Intermodulation

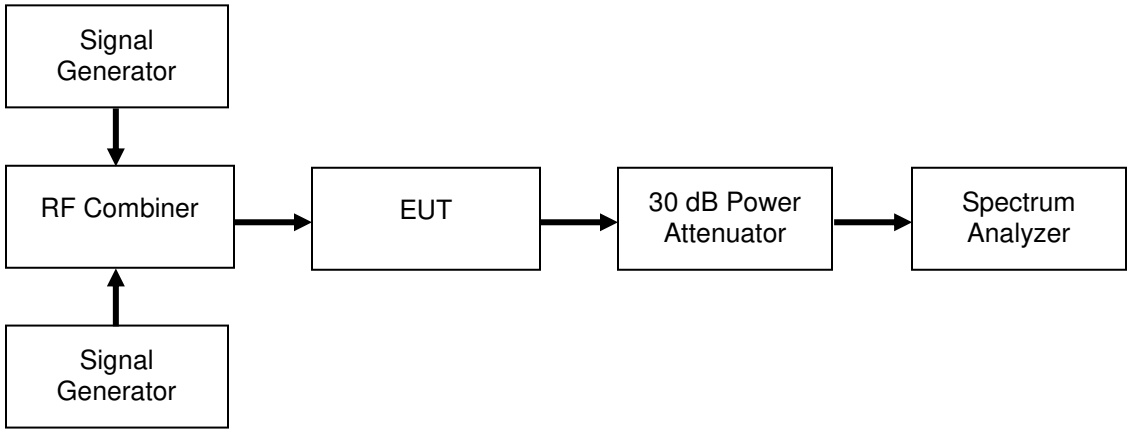
Engineer: Kenneth Lee

Test Date: 4/27/2017

Test Procedure

The EUT was connected to a spectrum analyzer through a 30 dB power attenuator. Two signal generators were utilized to produce a two tone signal with the 6.25, 12.5 and 25 KHz channel spacing set so the intermodulation products fell within the operational band. Frequencies centered at 150 MHz were utilized.
The Test was performed on both the uplink and downlink.
The RF input signal level was set to 0.2 dB below the AGC Threshold and again at +3dB above AGC.
RBW = 300 Hz
Video BW = 3x RBW

Test Setup



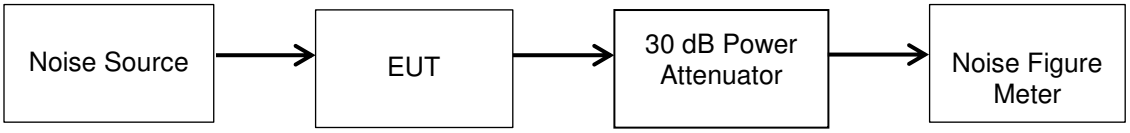
Refer to Annex B for Intermodulation plots

Noise Figure Test
Engineer: Kenneth Lee
Test Date: 4/28/2017

Test Procedure

The test equipment was connected as shown in the test setup.

The noise figure was measured at the passband center frequency.
Noise figure was measured using the high power output.



Frequency (MHz)	Noise Figure (dB)	Limit (dB)	Margin (dB)
150 (Uplink)	2.83	9	-6.17
150 (Downlink)	6.1	9	-2.9

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	2/22/17	2/22/18
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	8/15/16	8/15/19
PSA Spectrum Analyzer	Agilent	E4445A	i00471	8/30/16	8/30/17
Preamplifier for 1-18GHz horn antenna	Miteq	AFS44 00101 400 23-10P-44	i00509	N/A	N/A
Noise Figure Meter	HP	8970B	i00444	8/13/15	8/13/17
Signal Generator	Agilent	E4438C	i00457	10/19/16	10/19/18
Signal Generator	Agilent	E4438C	i00490	5/24/16	5/24/17

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