Compliance Testing, LLC
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Test Report

Prepared for: Solid Technologies

Model: EXPRESS Public Safety

Description: Class B Part 90 Booster System

SC-MRU700PS800PS – 700/800 MHz Amplifier

FCC ID: W6U700P800P

To

FCC Part 90

Date of Issue: July 28, 2014

On the behalf of the applicant:

Solid Technologies
4332 E Siesta Lane
Phoenix, AZ 85050

Attention of:

Gregory Glenn
(408) 649-4803
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Prepared By
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Project No: p13a0005

Mike Graffeo
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	April 29, 2014	Mike Graffeo	Original Document
2.0	May 7, 2014	Mike Graffeo	Updated Emission Designators
3.0	July 8, 2014	John Erhard	Add additional part 90 rule section information to test summary table
4.0	July 28, 2014	Mike Graffeo	Added noise figure tests to show compliance with 90.219(e)(2)

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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 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**

FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

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 D02, 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)**
21.6 - 29.0	40.2 - 57.9	964.7 - 969.4

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

EUT Description

Model: EXPRESS Public Safety

Description: Multiple-Enclosure Booster System

Firmware: N/A

Test Software: DAS Management Ver12

Accessories: None

Cables: Customer Supplied

Modifications: None

Additional Information:

The EUT is an industrial booster that amplifies the signal of cellular phone signals and data communication devices. The following frequency bands and emission types are utilized

Frequency Band (MHz)		
Downlink	758 to 775	851 to 869
Emission Designator	F3E F3D F1E	F3E F3D F1E

EUT Operation during Tests

The EUT was in a normal operating condition.

Accessories: None

Cables: None

Modifications: None

Test Result Summary

Specification	Test Name	Pass, Fail, N/A	Comments
KDB 935210-D03	Out of Band Rejection	Pass	
2.1046	Output Power (Conducted)	Pass	
90.210 2.1049	Occupied Bandwidth (Emission Masks)	Pass	
90.219(e)(2)	Noise Figure	Pass	
2.1051	Spurious Emissions (Transmitter Conducted)	Pass	
KDB 935210-D03	Intermodulation	Pass	
90.213	Frequency Stability (Temperature Variation)	N/A	The EUT does not perform frequency translation
90.213	Frequency Stability (Voltage Variation)	N/A	The EUT does not perform frequency translation
2.202	Necessary Bandwidth Calculation	N/A	The EUT does not perform frequency translation

The following Part 90 band specific rules apply

Frequency Band (MHz)	Test Name	Part 90 Specification	Comments
758-769	Operational band	90.531(f), 90.531(g)	It is noted that the guard band of 768-769 exists but is not used
758-769	Power Limits	90.542	
758-769		90.543(e), 90.543(f)	
769-775	Operational band	90.531(f), 90.531(g)	
769-775	Spectrum Efficiency	90.535	The EUT cannot generate a modulated signal therefore the host signal from an already certified device controls the spectrum efficiency.
769-775	Power Limits	90.541	
769-775		90.543(a)-(d), 90.543(f)	The ACPR requirements for 90.534(a)-(d) are for the licensed radios with which the EUT operates. Compliance to the emissions masks requirements proves linear operation thus compliance.
758 to 775 851 to 869	Noise Figure	90.219(e)(2)	

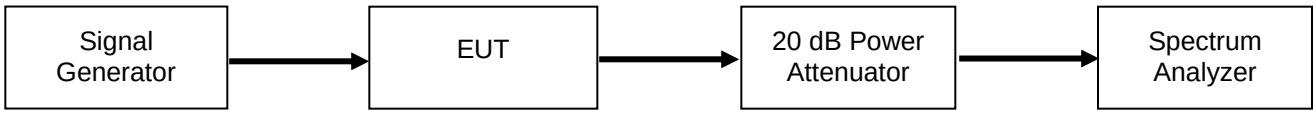
Out of Band Rejection

Name of Test:	Out of Band Rejection	**Engineer:** Mike Graffeo
Test Equipment Utilized:	i00405, i00331	**Test Date:** 4/9/2014

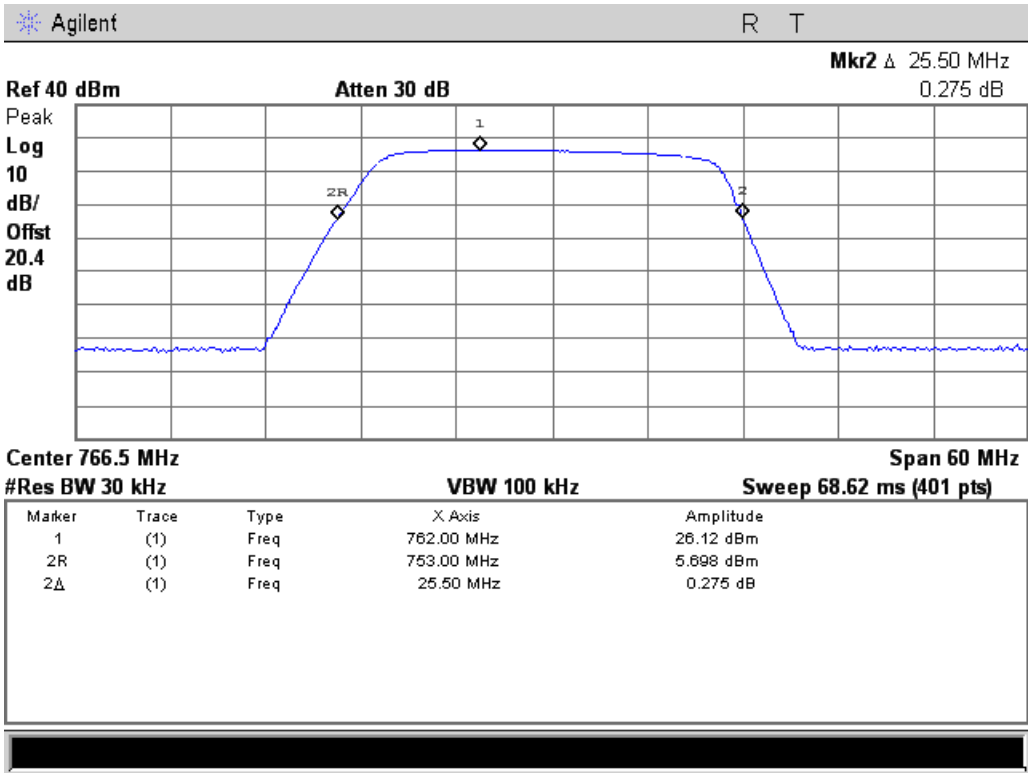
Test Procedure

The EUT was connected to a spectrum analyzer through a 20 dB power attenuator. A signal generator was utilized to produce a swept CW signal with the RF input level set to the level determined by the intermodulation testing requirements. The downlink filter response and bandwidth were measured. The marker table function of the spectrum analyzer was used to show the maximum power and the 20 dB bandwidth of the pass band filter.

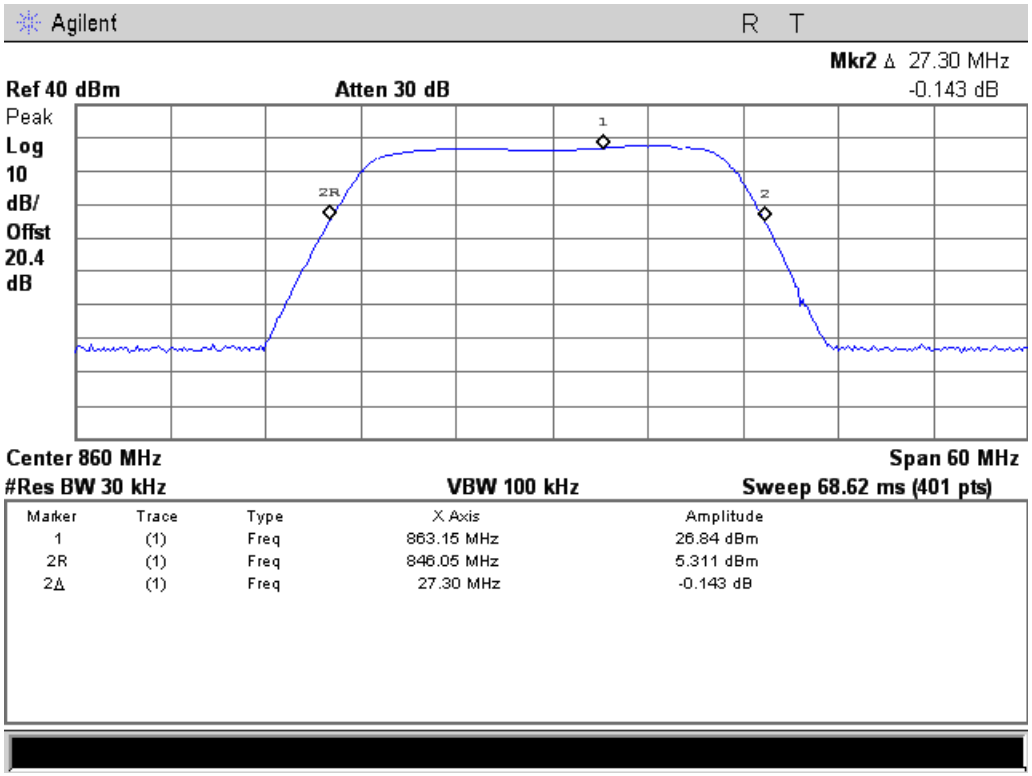
Test Setup



758 - 775 MHz Band



851 - 869 MHz Band



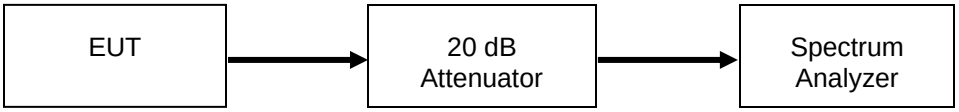
Carrier Output Power (Conducted)

Name of Test:	Carrier Output Power (Conducted)	**Engineer:** Mike Graffeo
Test Equipment Utilized:	i00405, i00331	**Test Date:** 4/12/14

Measurement Procedure

The EUT was connected to a spectrum analyzer through a 20 dB power attenuator. A signal generator was utilized to produce a CW input signal. The RF input level was increased while monitoring the output power. The input RF drive level was increased until the EUT output reached saturation (the output stopped increasing) whereby the maximum power level and gain was achieved. The output levels with the highest output power from Out of Band Rejection Test are recorded in the following tables to and then the gain was calculated.

Test Setup



Downlink Output Power and Gain

758 to 775 MHz Band

Tuned Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
762.00	-22.01	27	49.01

851 to 869 MHz Band

Tuned Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Gain (dB)
863.15	-21.51	27	48.51

Conducted Spurious Emissions

Name of Test:	Conducted Spurious Emissions	**Engineer:** Mike Graffeo
Test Equipment Utilized:	i00405, i00331	**Test Date:** 4/9/2014

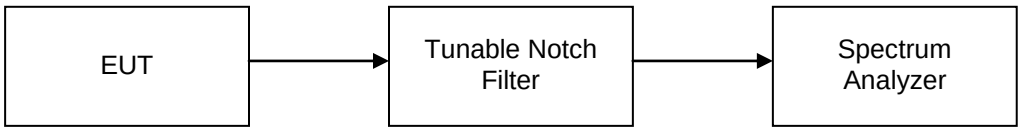
Test Procedure

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 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

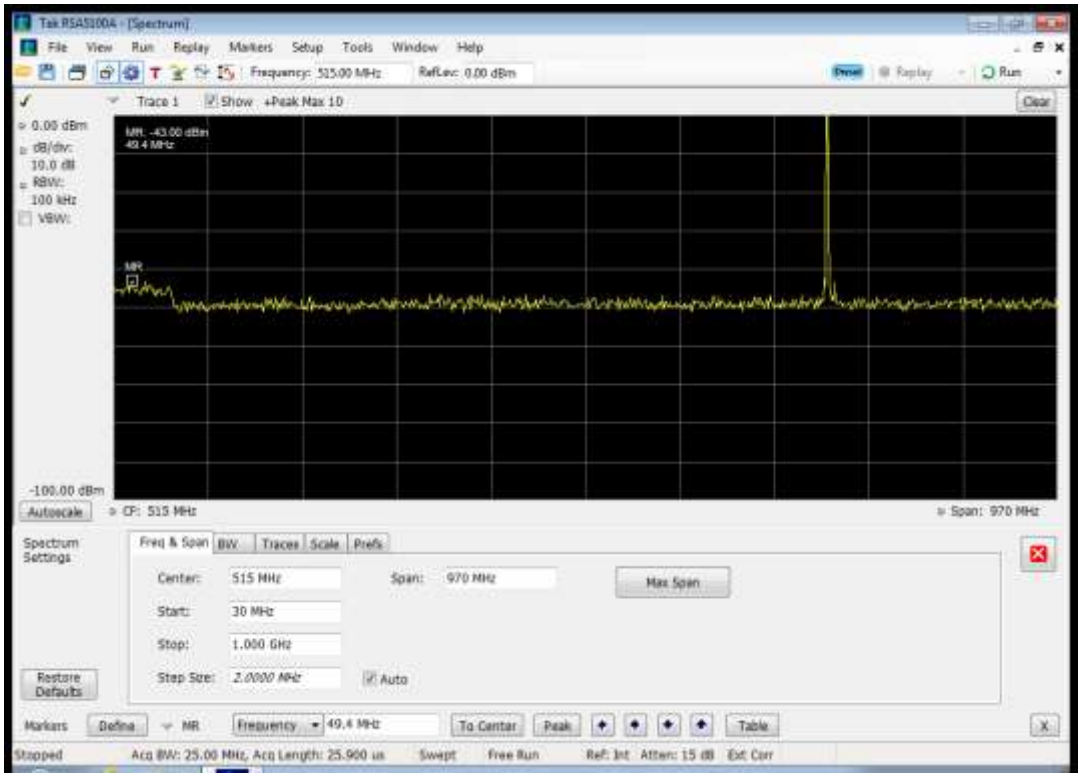
Test Setup



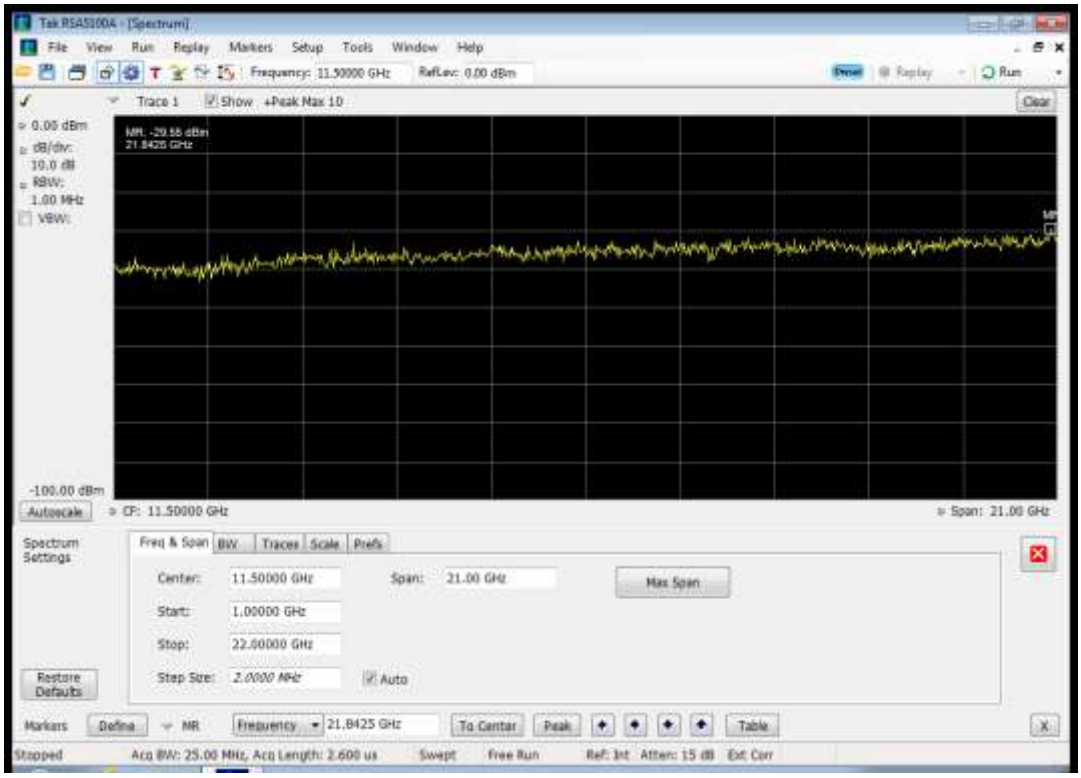
Conducted Spurious Emissions Summary Test Table

Tuned Frequency (MHz)	Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Specification Limit (dBm)	Result
758 to 775	21842.5	-29.55	-19	Pass
851 to 869	14966	-30.99	-19	Pass

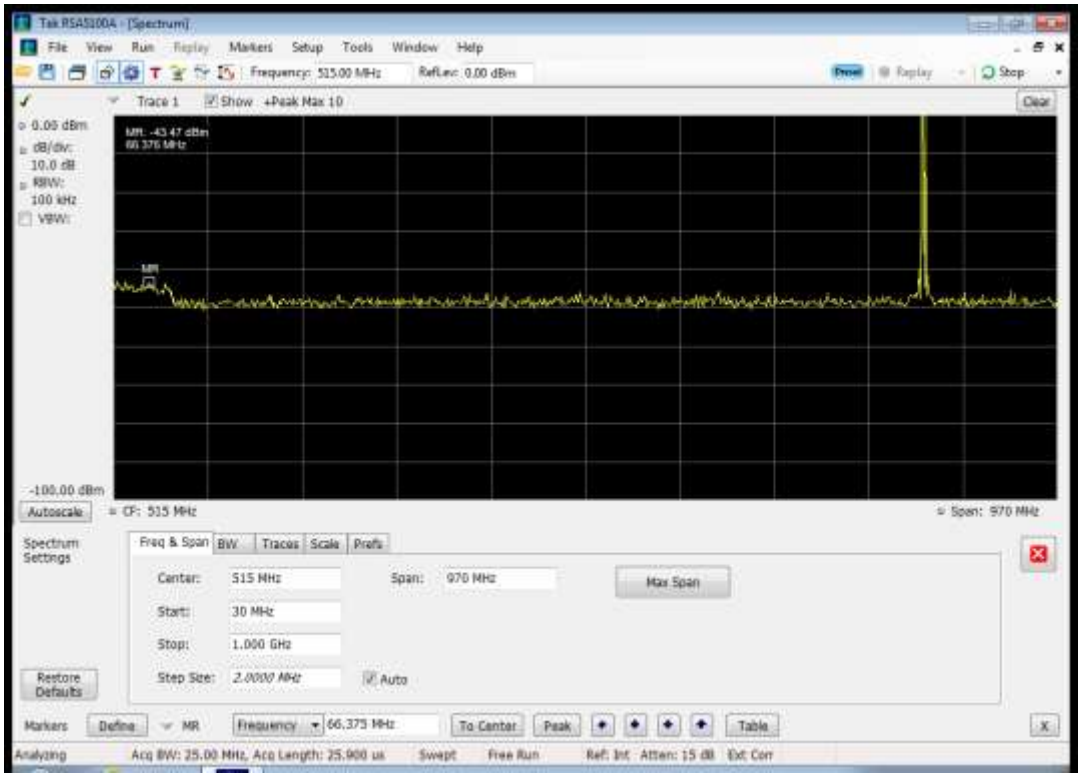
Test Plots
758 - 775 MHz Band
30 MHz to 1 GHz



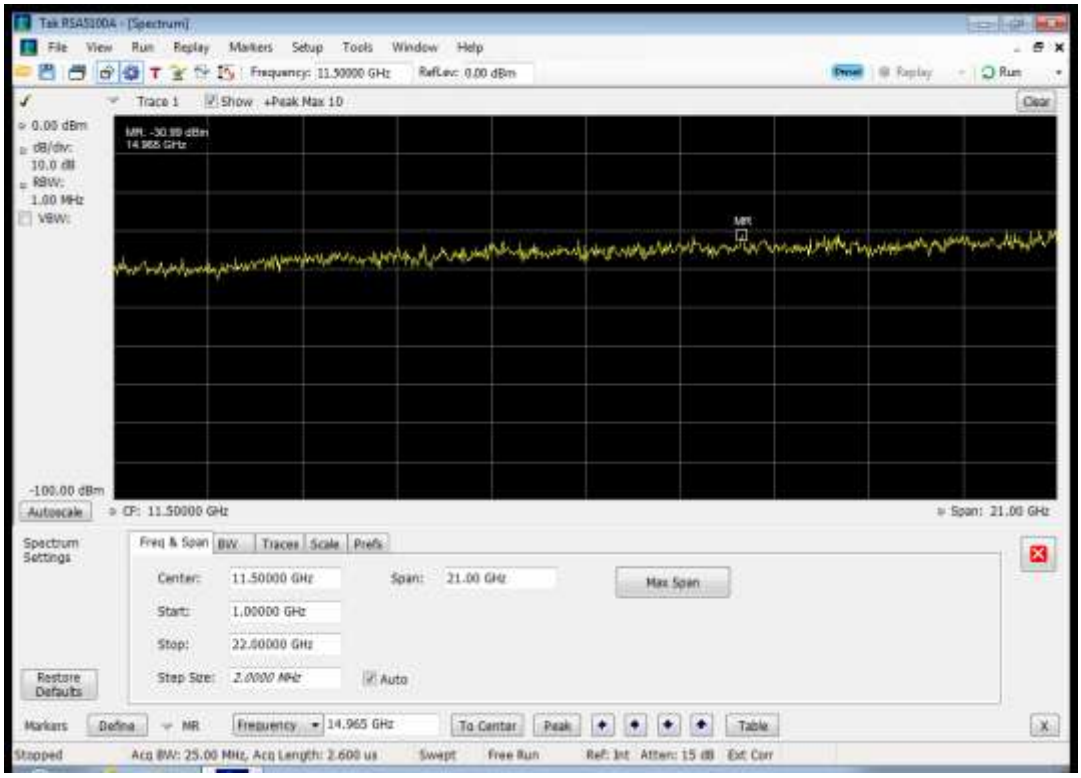
758 - 775 MHz Band
1 GHz to 22 GHz



851 - 869 Band
30 MHz to 1 GHz

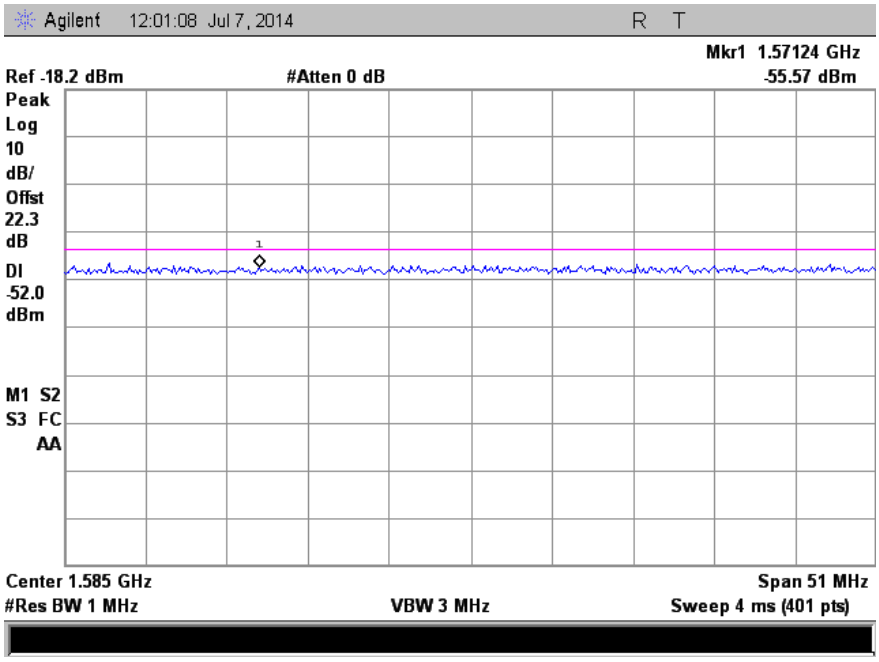


851 - 869 Band
1 GHz to 22 GHz



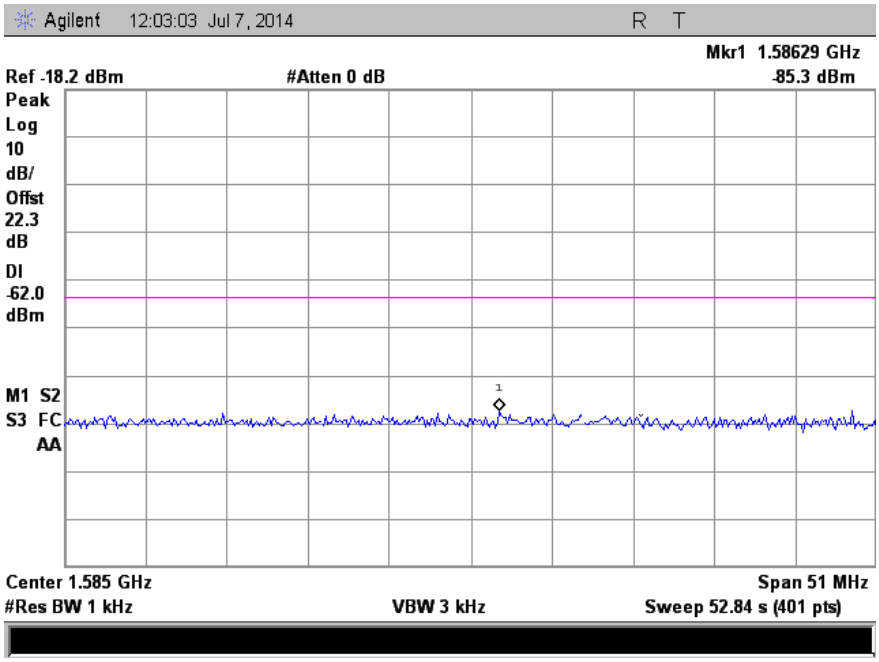
Part 90.543(f) Testing
851 - 869 Band

1559 MHz to 1610 MHz with 1MHz RBW



Note1: -70dBW/MHz = -40dBm
Note2: DL = -40 plus and additional -12bB for antenna gain to account for EIRP

1559 MHz to 1610 MHz with 700Hz RBW



Note1: -80dBW/MHz = -50dBm
Note2: DL = -50 plus and additional -12bB for antenna gain to account for EIRP
The test is performed using a 1.0 kHz RBW. Since the limit is referenced to a 700 Hz BW, the following correction factor is applied to the measured data.
BW correction Factor = 10Log B1/B2
BW correction Factor =10Log 700 / 1000 = -1.55 dB
Final Value (dBm) = conducted measurement + BW correction factor
Final Value (dBm) = -85.30 – 1.55 = -86.85dBm

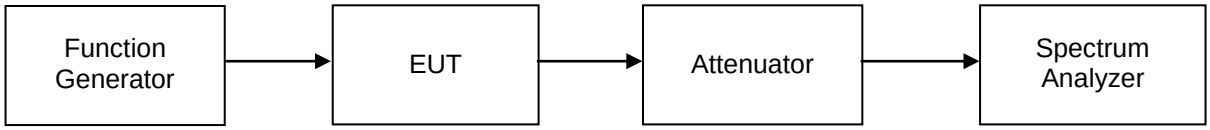
Emission Masks (Occupied Bandwidth)

Name of Test:	Emission Masks (Occupied Bandwidth)	**Engineer:** Mike Graffeo
Test Equipment Utilized	i00405, i00331	**Test Date:** 4/29/2014

Measurement Procedure

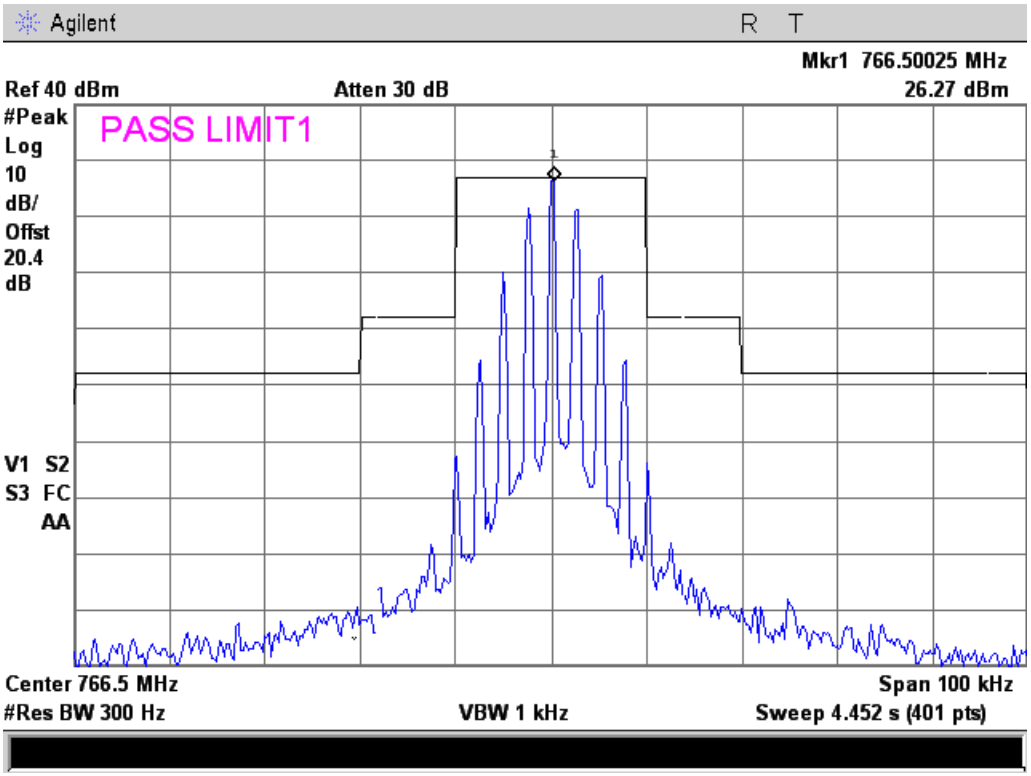
The EUT was connected directly to a spectrum analyzer to verify that the EUT meets the required emissions mask. Bandwidth calculations are located in the final section of this report.

Test Setup

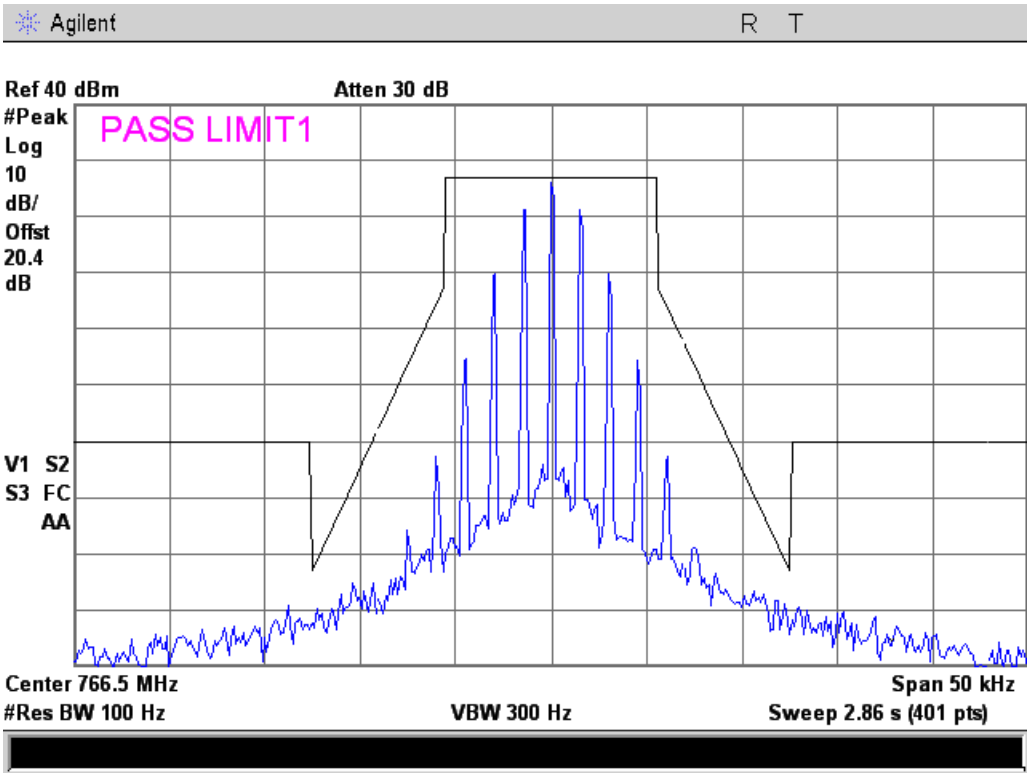


Emission Masks Plots

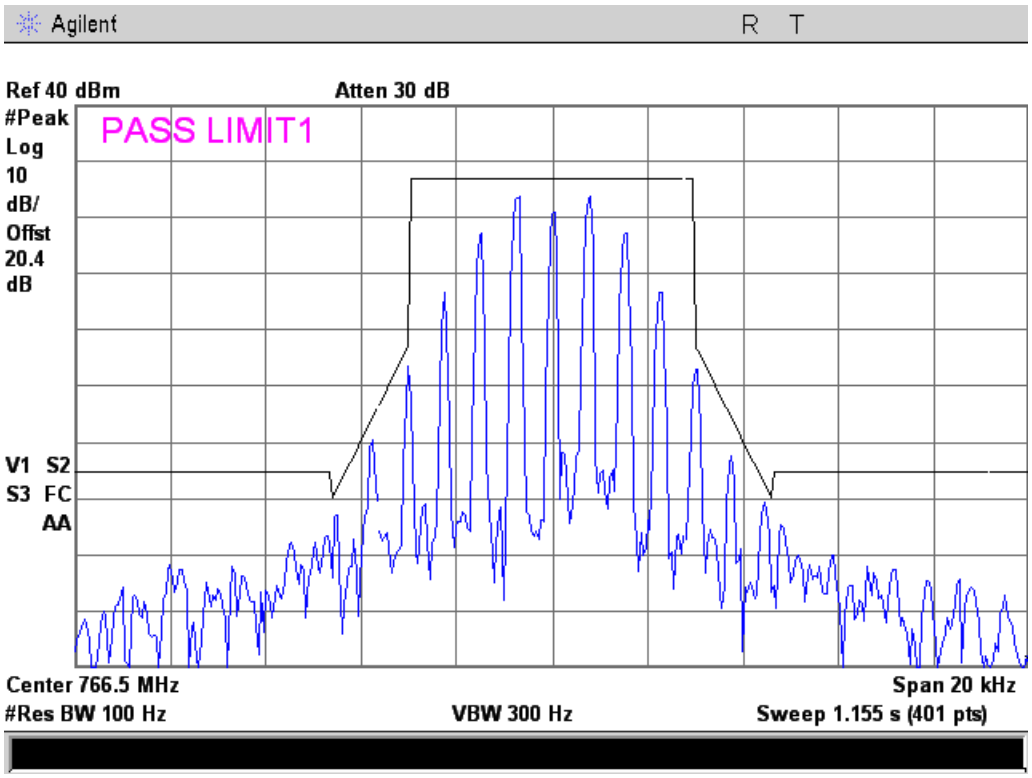
758 - 775 MHz Band
Mask B



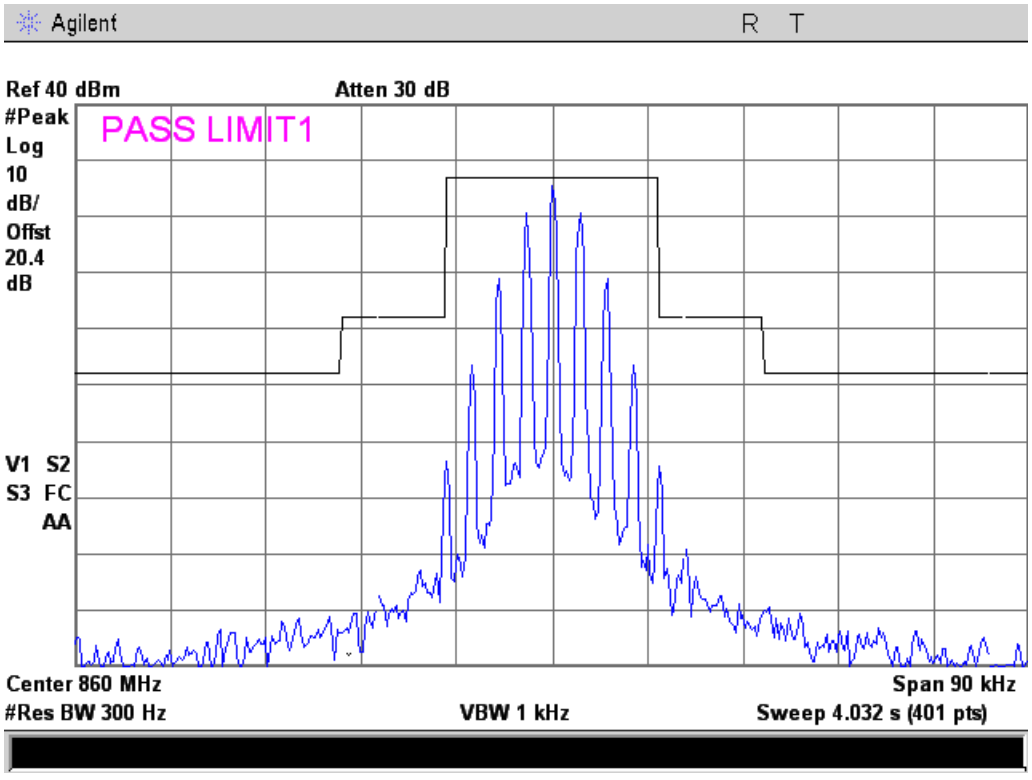
758 - 775 MHz Band
Mask D



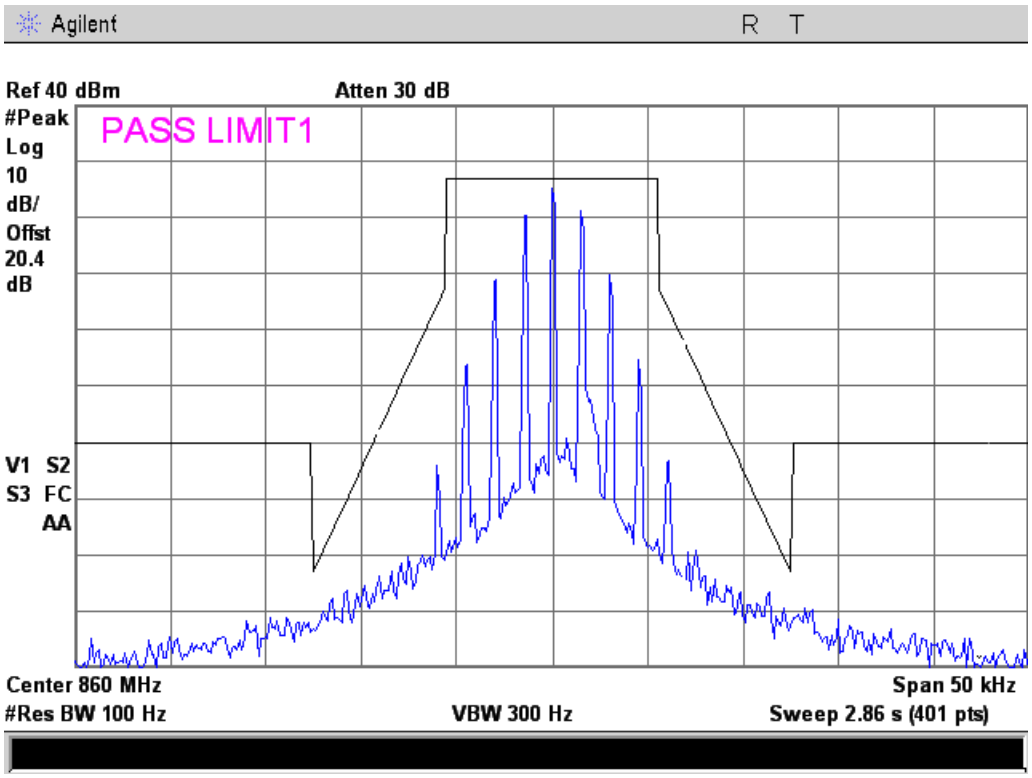
758 - 775 MHz Band
Mask E



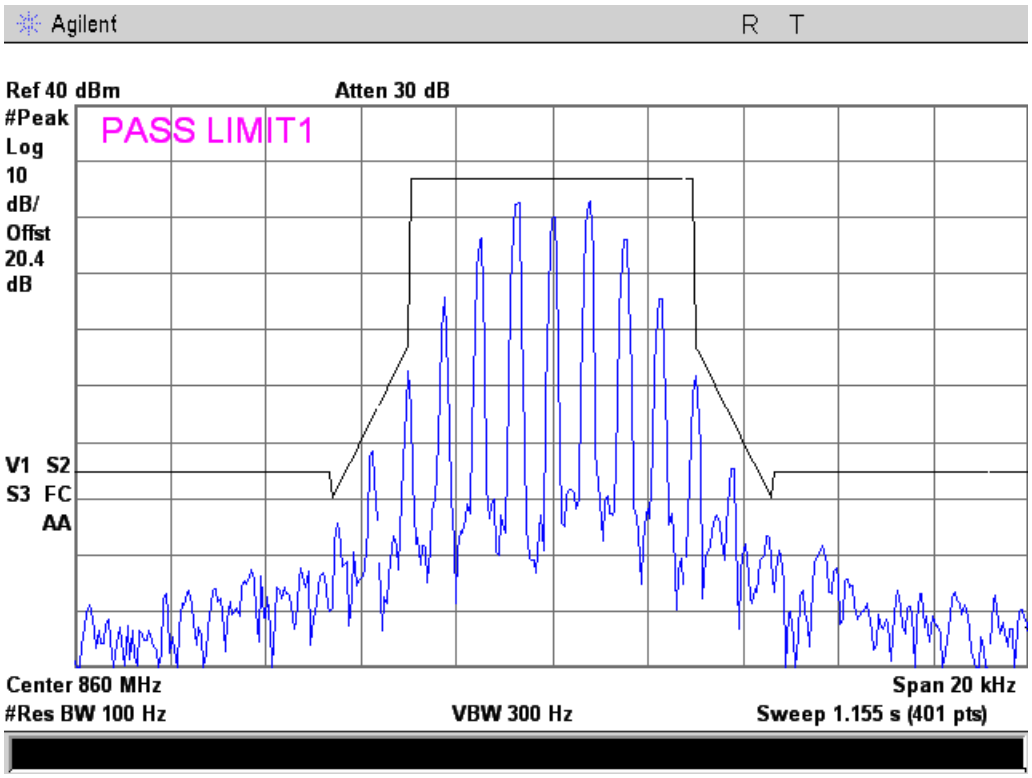
851 - 869 Band
Mask B



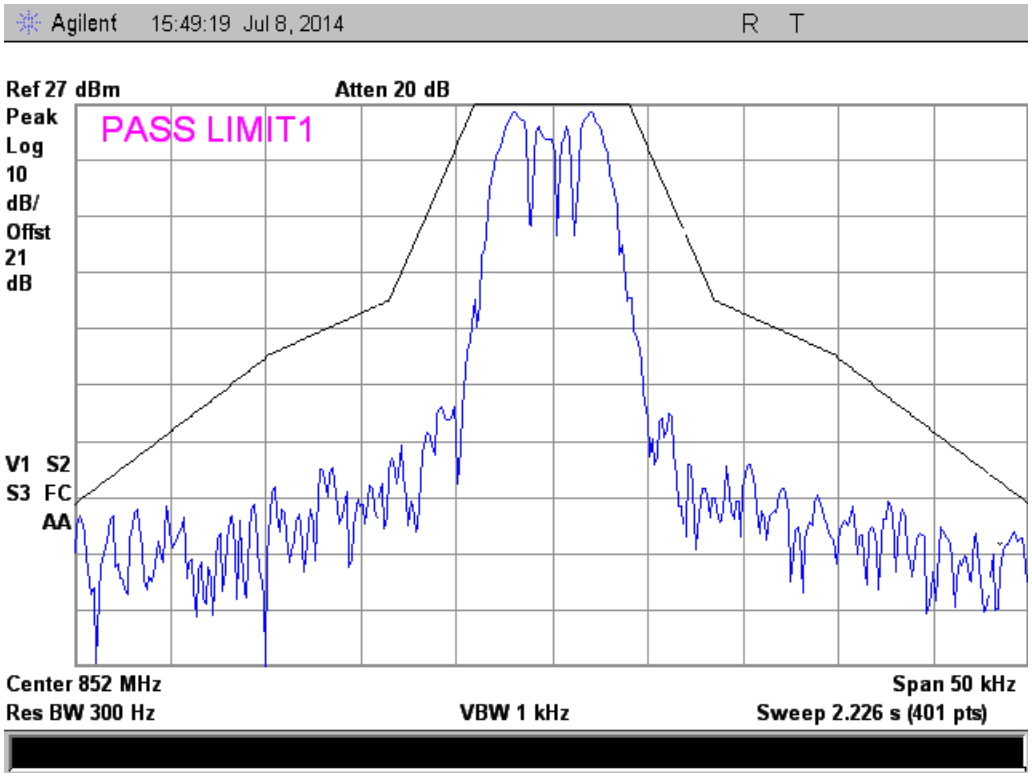
851 - 869 Band
Mask D



851 - 869 Band
Mask E



851 - 854 Band
Mask H



Intermodulation

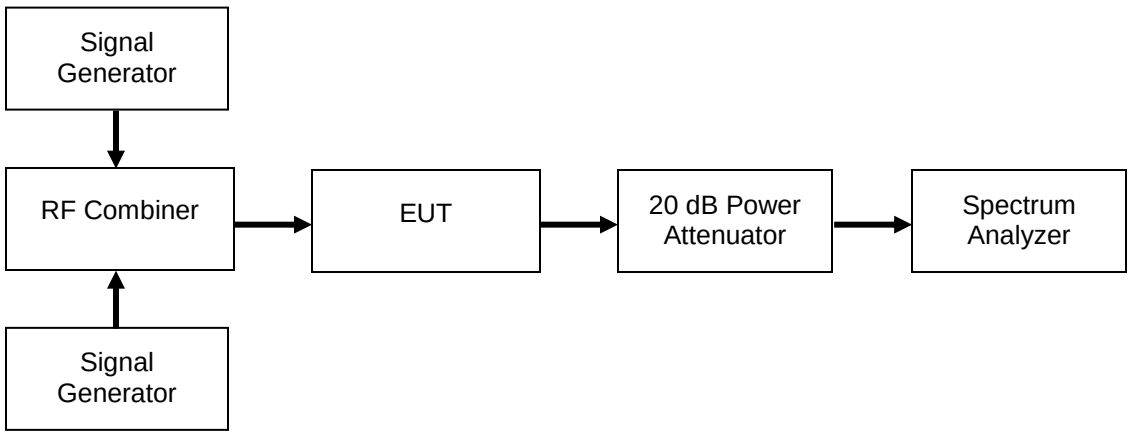
Name of Test:	Intermodulation	**Engineer:** Mike Graffeo
Test Equipment Utilized:	i00405, i00331	**Test Date:** 4/8/2014

Test Procedure

The EUT was connected to a spectrum analyzer through a 20 dB power attenuator. Two signal generators were utilized to produce a two tone signal with the 12.5KHz channel spacing set so the intermodulation products fell within the operational band. Frequency at the maximum power from out of band rejection was utilized.

The input signal level was increased until the intermodulation products were as close as possible to the maximum allowable level of -19 dBm without being greater than that limit. The downlink intermodulation products within the operational band were examined. The input signal level, output power, intermodulation level and gain are listed in the summary tables.

Test Setup



Downlink Test Results

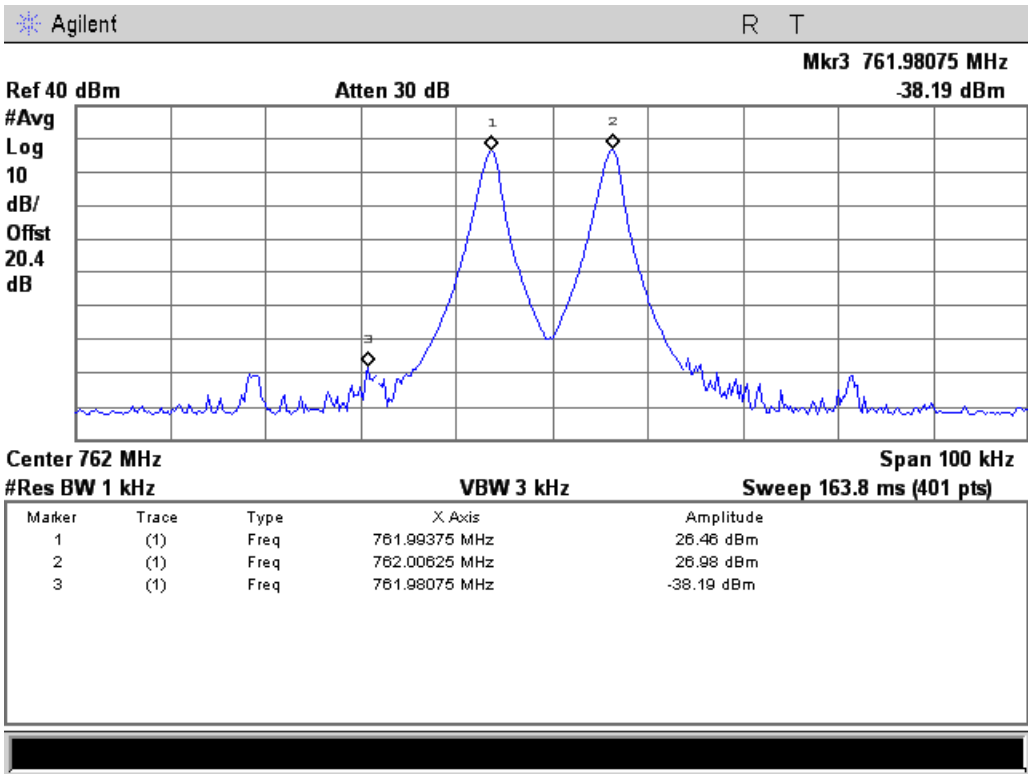
758 to 775 MHz Band
Tuned to 762.00 MHz

Frequency Pair (MHz)	Input Power (dBm)	Intermodulation Level (dBm)	Output Power (dBm)	Gain (dB)
761.9938 -762.0063	-22.01	-38.19	26.46	48.47

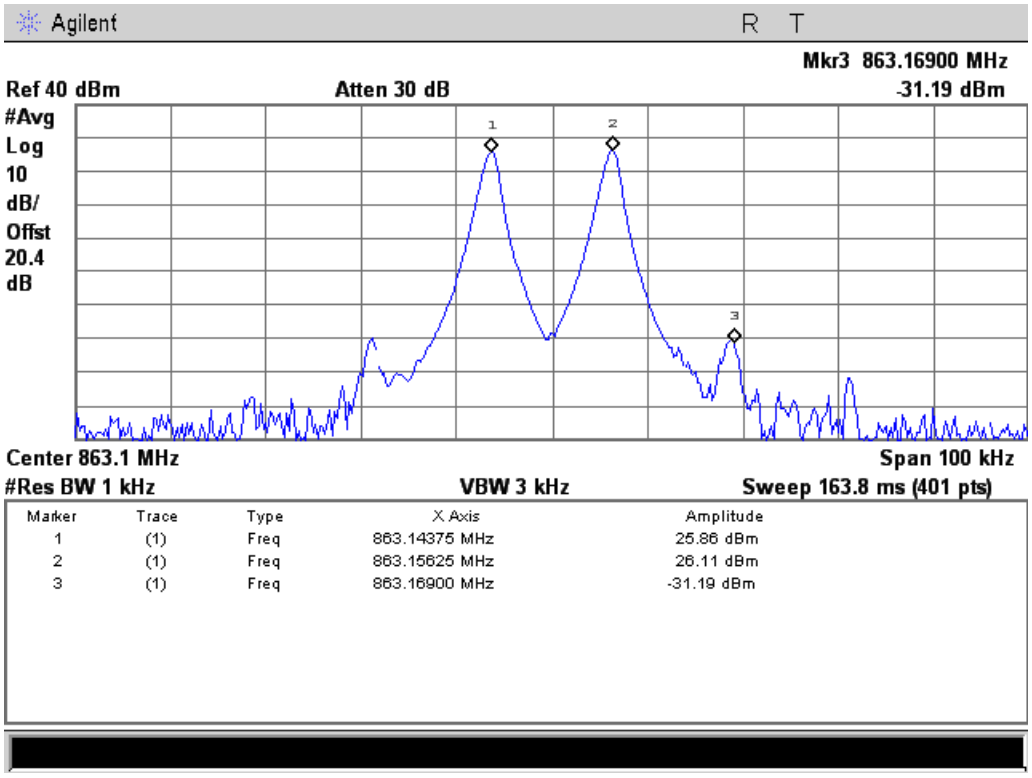
851 to 869 MHz Band
Tuned to 863.15 MHz

Frequency Pair (MHz)	Input Power (dBm)	Intermodulation Level (dBm)	Output Power (dBm)	Gain (dB)
863.1438 - 863.1563	-21.51	-31.19	26.11	47.62

758 - 775 MHz Band



851 - 869 Band



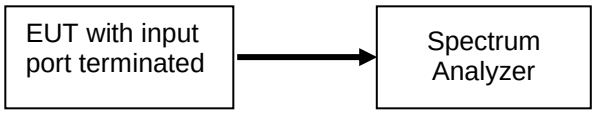
Noise Figure Test

Name of Test:	Noise Figure	**Engineer:** Mike Graffeo
Test Equipment Utilized:	i00331	**Test Date:** 7/23/2014

Test Procedure

The EUT was tested using Agilent Application Note 57-1, gain method.

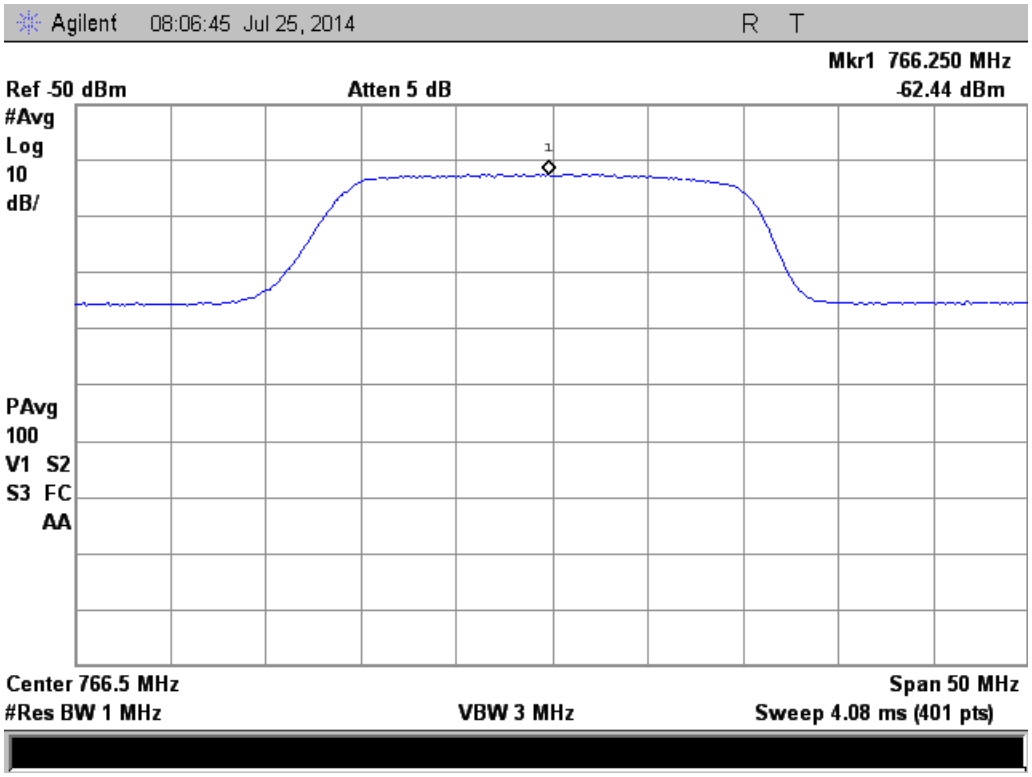
Test Setup



NF = NP – G – BCF + PNAD + ECF
NF = NP – G – 60 + 174 + 1.74
NF = NP – G +115.74

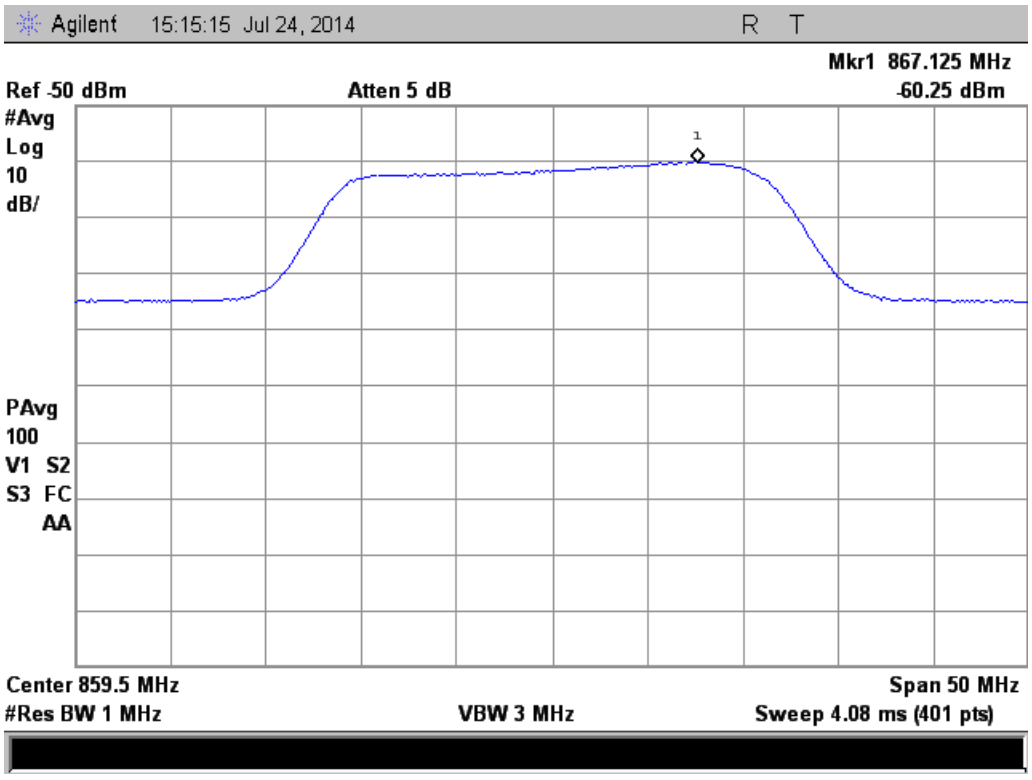
NF = Noise Figure (dB)
NP = Noise power measured (dBm/MHz)
G = Gain for the Frequency band (dB)
BCF = Bandwidth Correction Factor = 10Log B1/B2 = 10Log(1MHz/1Hz) = 60 (Where BW1 = 1MHz, BW2 = 1Hz)
PNAD = Noise Power Density = 174 dBm/Hz
ECF = band edge correction factor (1%) = 1.74 dBm/Hz

758 to 775 MHz Band



NF= -62.44 – 49.01 + 115.74 = 4.29 dB

851 to 869 MHz Band



NF= -60.25 – 48.51 + 115.74 = 6.98 dB

Radiated Spurious Emissions

Name of Test:	Radiated Spurious	**Engineer:** Mike Graffeo
Test Equipment Utilized:	i00405, i00331, i00103	**Test Date:** 4/10/2014

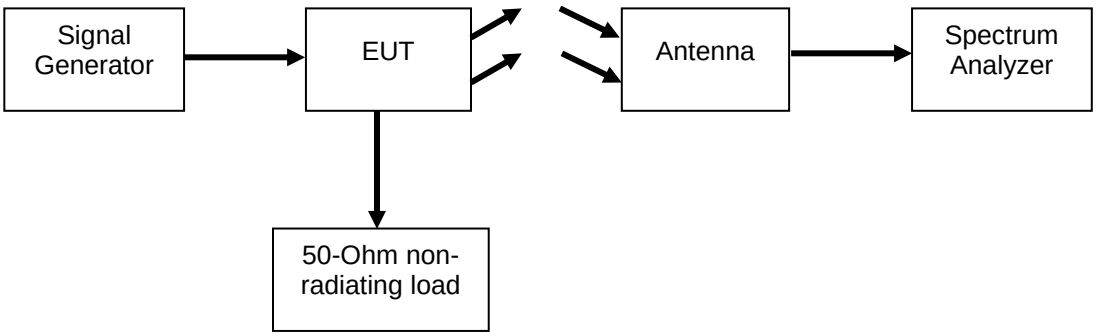
Test Procedure

The EUT was tested in an 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



Downlink Test Results

758 to 775 MHz Band 766.5 MHz Tuned Frequency

Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
1533.0	-74.39	-13	Pass
2299.5	-69.43	-13	Pass
3066.0	-52.82	-13	Pass

851 to 869 MHz Band 860 MHz Tuned Frequency

Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
1720	-73.15	-13	Pass
2580	-66.08	-13	Pass
3440	-50.88	-13	Pass

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Signal Generator	Rohde & Schwarz	SMU200A	i00405	12/11/13	12/11/14
Spectrum Analyzer	Tektronix	RSA5126A	i00424	9/22/13	9/22/14
Spectrum Analyzer	Agilent	E4407B	i00331	4/23/13	4/23/14*
Humidity / Temp Meter	Omega	RH81	i00408	4/15/13	4/15/15
Horn Antenna	EMCO	3115	i00103	12/11/12	12/11/14
Power Attenuator	Lucas Weinschel	24-40-12	S/N: AY3295	Verified on: 8/19/13	

* Note: Equipment is under a 60 day calibration extension per Lab 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

Test Setup Photos
FCC ID: W6U700P800P

RF Conducted

RF Radiated