Compliance Testing, LLC
Previously Flom Test Lab
EMI, EMC, RF Testing Experts Since 1963

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fax: (480) 926-3598
http://www.ComplianceTesting.com
info@ComplianceTesting.com

Test Report

Prepared for: Kenwood USA Corporation

Model: NX-411-K2

Description: 900MHz Digital Transceiver

To

FCC Part 24 and 90

Date of Issue: September 27, 2011

On the behalf of the applicant:

Kenwood USA Corporation
3970 Johns Creek Ct
Ste 100
Suwanee, GA 30024

Attention of:

Joel Berger, Research & Development
Ph: (678)474-4722
Fax: (602)489-5896
E-Mail: jberger@kenwoodusa.com

Prepared by
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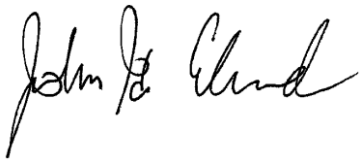
Project No: p1180017



John Erhard
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	September 27, 2011	John Erhard	Original Document

Table of Contents

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 in the table below.

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

Testing Certificate Number: **2152.01**

FCC OATS Reg, #933597

IC Reg. #2044A-1

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 cold 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.

Sub-part
2.1033(c)(14): **Test and Measurement Data**

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Volume II, Part 2, Sub-part J, Sections 2.947, 2.1033(c), 2.1041, 2.1046, 2.1047, 2.1079, 2.1051, 2.1053, 2.1055, 2.1057, and the following individual Parts: 24 and 90.

Standard Test Conditions and Engineering Practices

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

In accordance with ANSI/C63.4-2009, 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	
Temperature	**Humidity**
21.76	34.45

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

EUT Description:
Model:
S/N:
Firmware:
Software:

EUT during Test Conditions:

Accessories: None

Qty	Type	Make, Model	S/N	Description

Test Result Summary

Specification	Test Name	Pass, Fail, N/A	Comments
2.1046	Carrier Output Power (Conducted)	Pass	
2.1051	Unwanted Emissions (Transmitter Conducted)	Pass	
2.1053	Field Strength of Spurious Radiation	Pass	
90.210 / 24.133	Emission Masks (Occupied Bandwidth)	Pass	
2.1047	Audio Low Pass Filter (Voice Input)	Pass	
2.1047	Audio Frequency Response	Pass	
2.1047	Modulation Limiting	Pass	
90.213	Frequency Stability (Temperature Variation)	Pass	
90.213	Frequency Stability (Voltage Variation)	Pass	

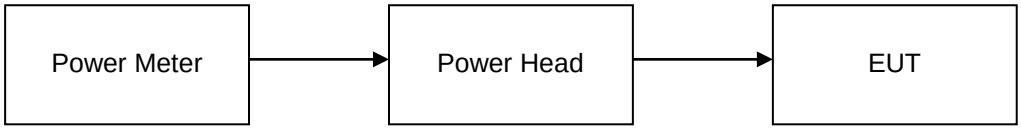
Carrier Output Power (Conducted)

Name of Test: Carrier Output Power (Conducted)
Specification: 2.1046 **Engineer:** John Erhard
Test Equipment Utilized: i00331, i00347 **Test Date:** 9/12/2011

Measurement Procedure

The Equipment under Test (EUT) was connected directly to a power meter input. The peak readings were taken and the result was then compared to the limit.

Test Setup



Conducted Output Power

Part 90

Tuned Frequency MHz	Recorded Measurement dBm	Result
896.05	33.98	Pass
900.95	33.98	Pass
935.05	33.98	Pass
939.95	33.98	Pass

Part 24

Tuned Frequency MHz	Recorded Measurement dBm	Result
901.55	33.98	Pass
940.55	33.98	Pass

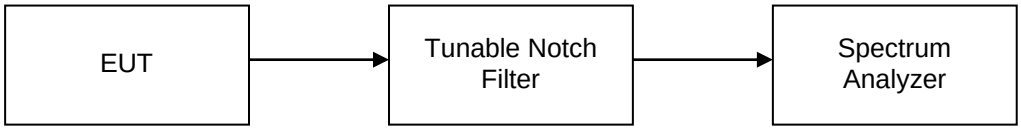
Conducted Spurious Emissions

Name of Test: Conducted Spurious Emissions
Specification: 2.1051 **Engineer:** John Erhard
Test Equipment Utilized: i00331, i00347 **Test Date:** 9/13/2011

Test Procedure

The EUT was connected directly to a spectrum analyzer to verify that the UUT met the requirements for spurious emissions. A tunable notch filter was utilized to ensure the fundamental did not put the spectrum analyzer into compression. The resolution bandwidth set for 1 MHz and the reference level was adjusted to ensure the system had sufficient dynamic range to measure spurious emissions. The frequency range from 30 MHz to the 10th harmonic of the fundamental transmitter was observed and plotted.

Test Setup



Conducted Spurious Emissions Summary Test Table

Part 90

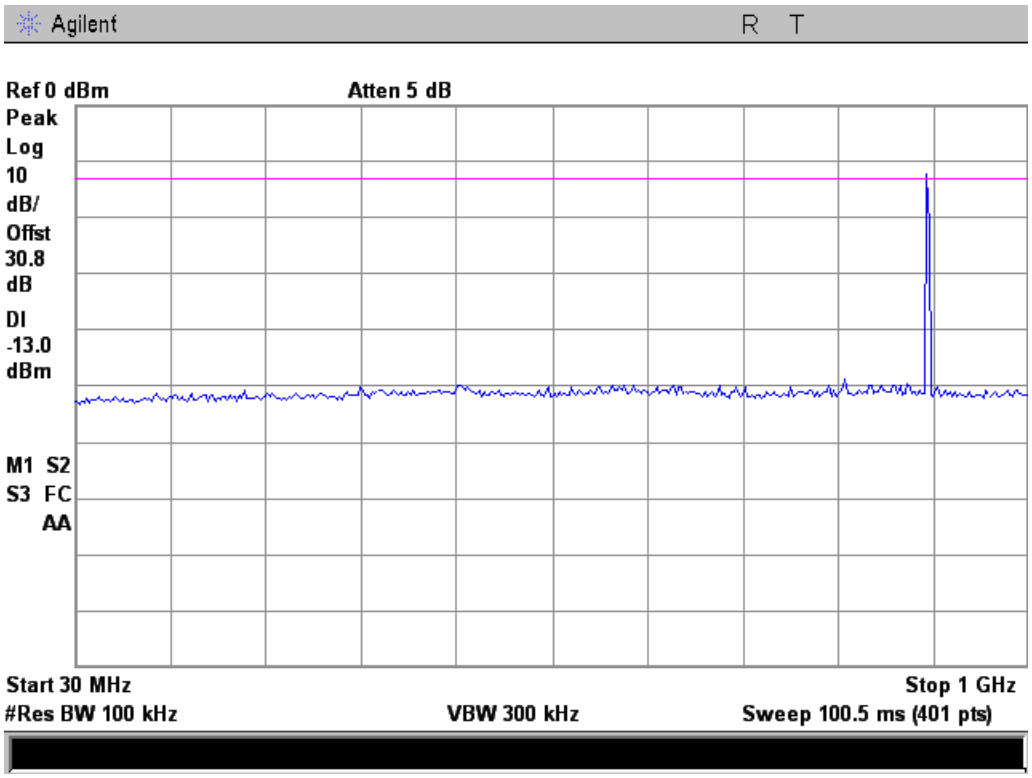
Tuned Frequency (MHz)	Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Specification Limit (dBm)	Result
896.05	7210.0	-37.33	-13	Pass
900.95	2980.0	-38.18	-13	Pass
935.05	2980.0	-38.12	-13	Pass
939.95	7277.5	-37.52	-13	Pass

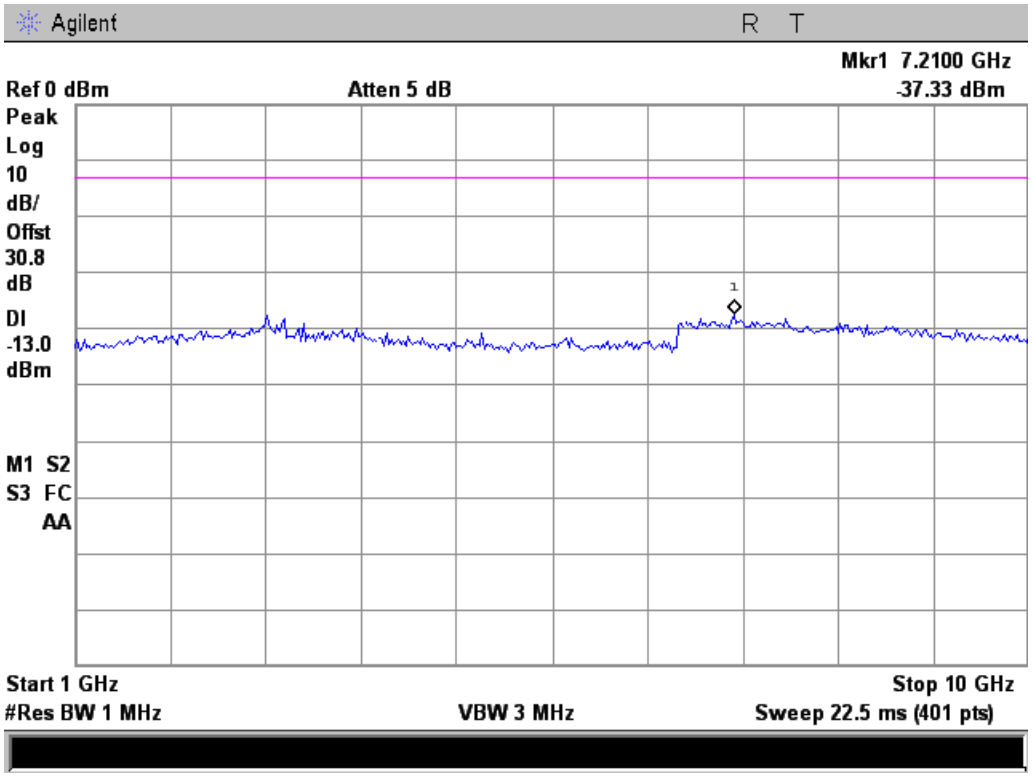
Part 24

Tuned Frequency (MHz)	Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Specification Limit (dBm)	Result
901.55	7300.0	-38.56	-13	Pass
940.55	2980.0	-37.2	-13	Pass

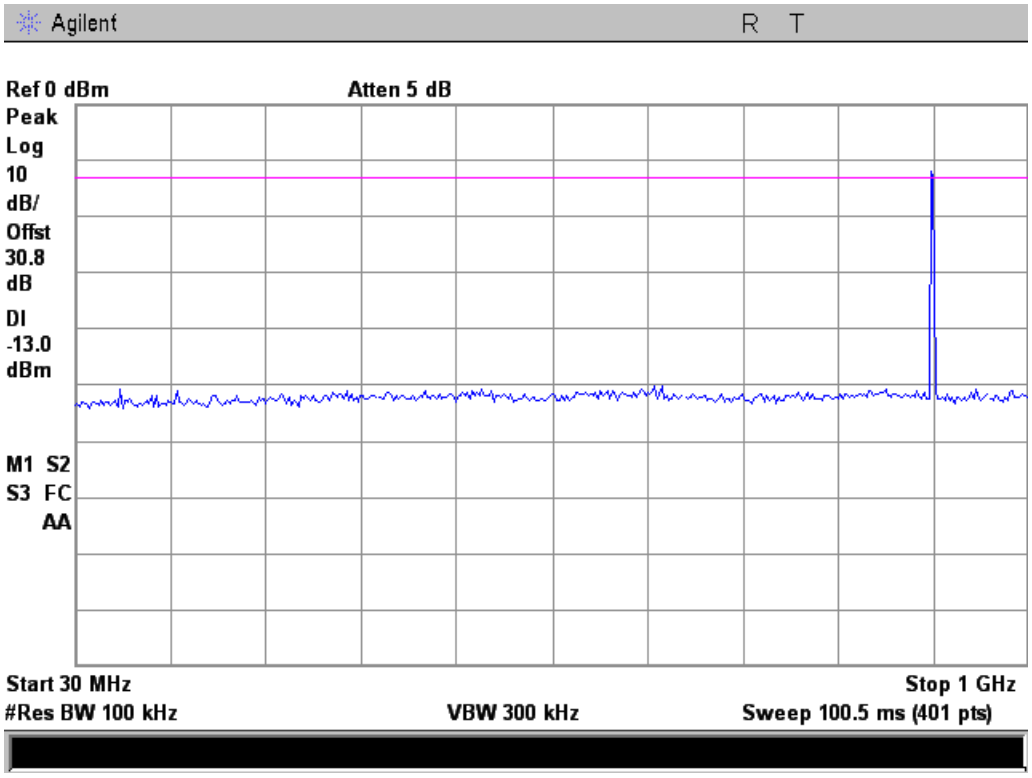
Part 90 Test Plots

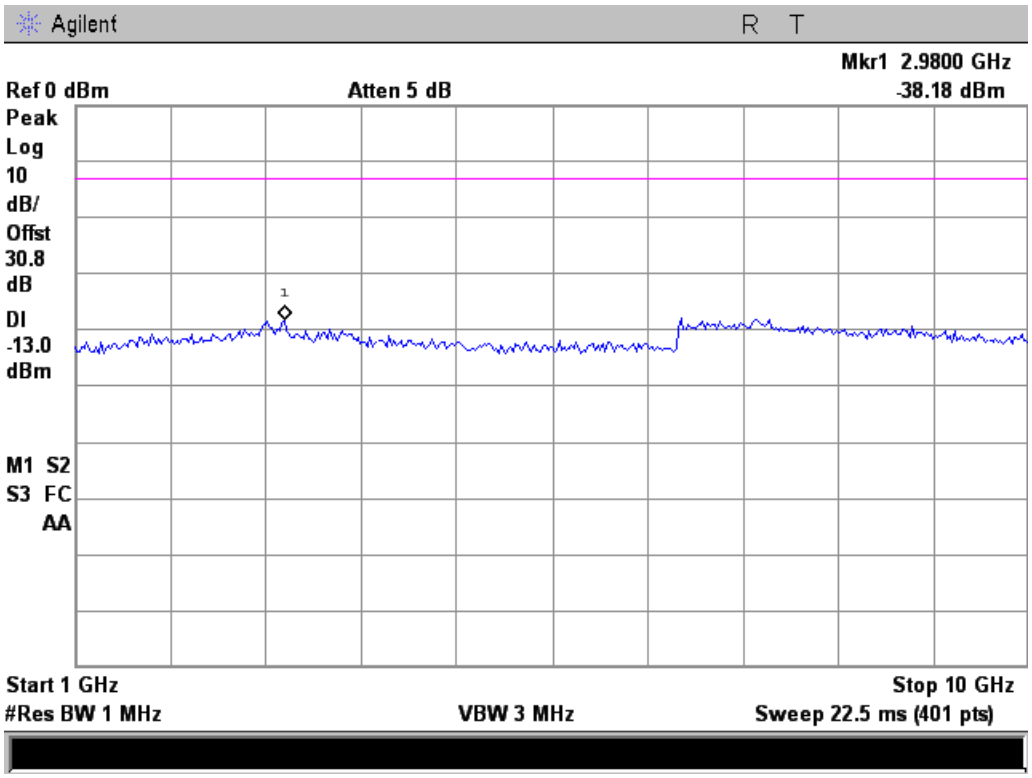
896.05 MHz



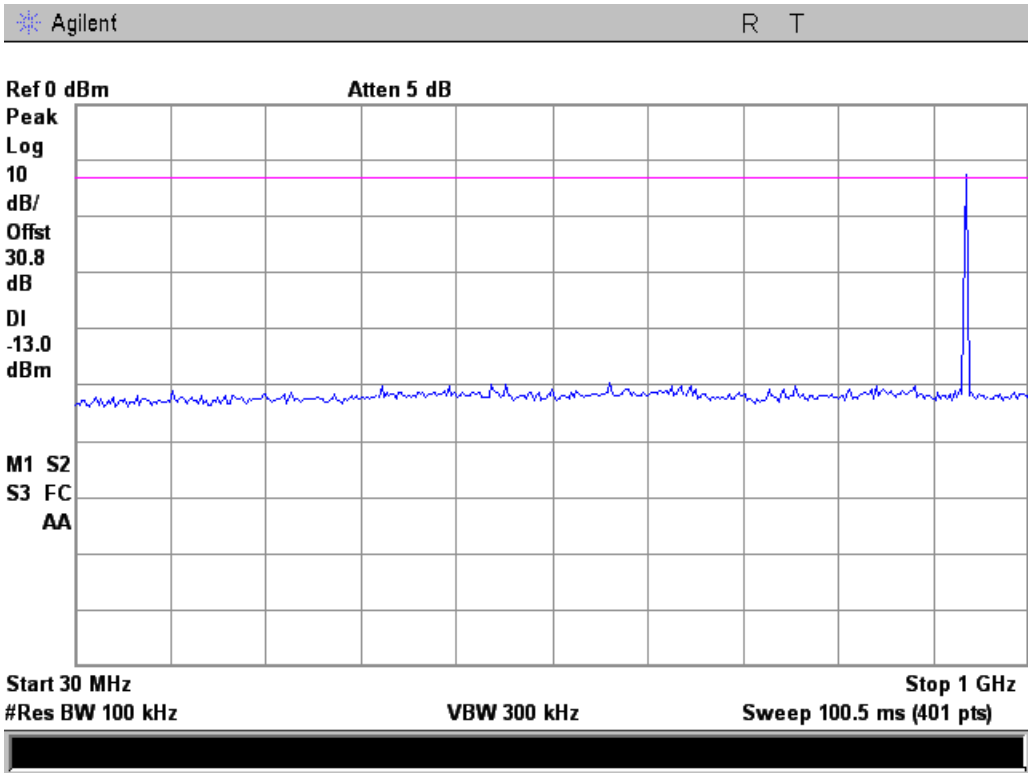


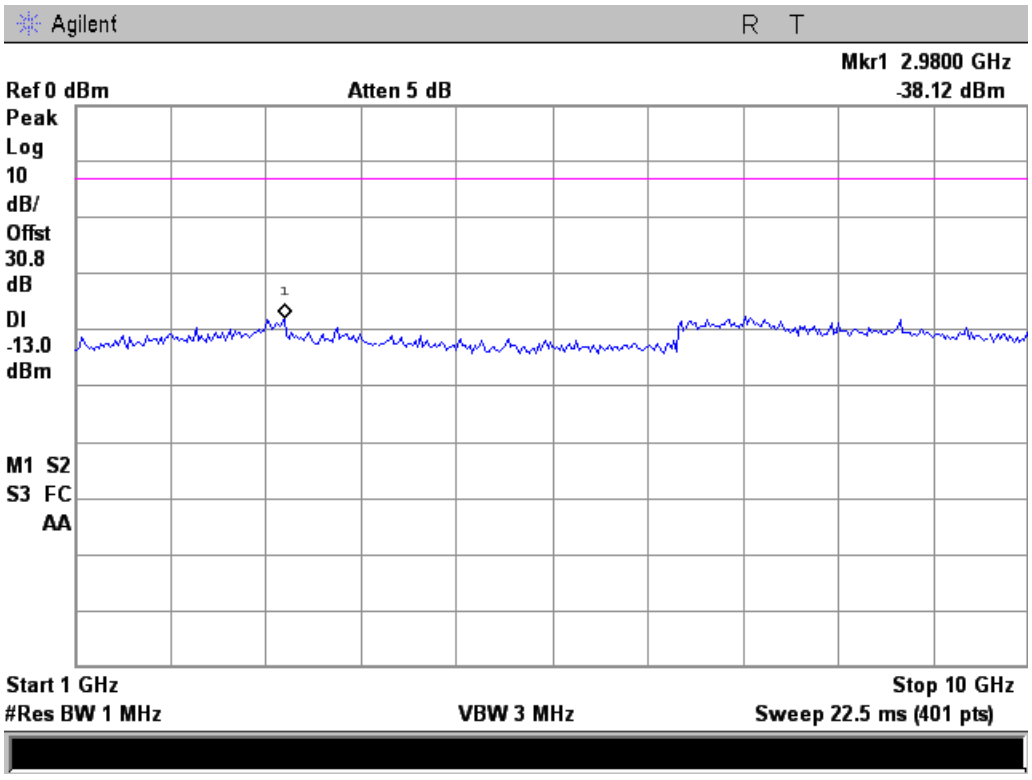
900.95 MHz


Agilent
R T
Ref 0 dBm
Atten 5 dB
Peak
Log
10
dB/
Offst
30.8
dB
Dl
-13.0
dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 100 kHz
VBW 300 kHz
Stop 1 GHz
Sweep 100.5 ms (401 pts)

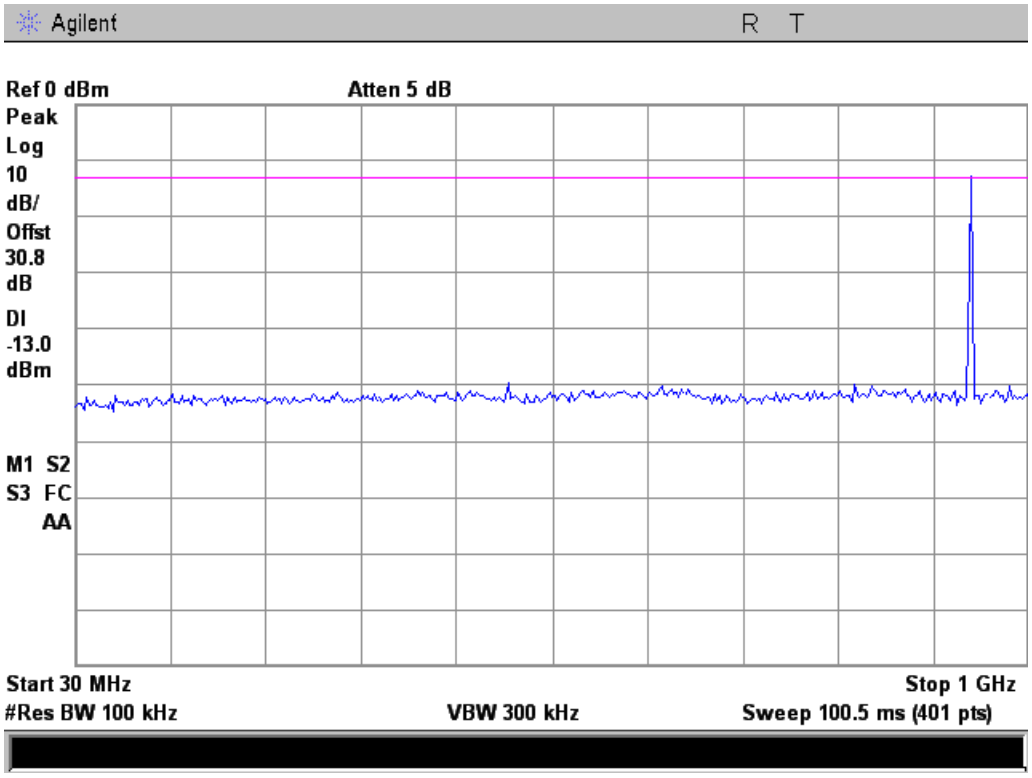

Agilent
R T
Mkr1 2.9800 GHz
-38.18 dBm
Ref 0 dBm
Atten 5 dB
Peak
Log
10
dB/
Offst
30.8
dB
Dl
-13.0
dBm
1
M1 S2
S3 FC
AA
Start 1 GHz
#Res BW 1 MHz
VBW 3 MHz
Stop 10 GHz
Sweep 22.5 ms (401 pts)

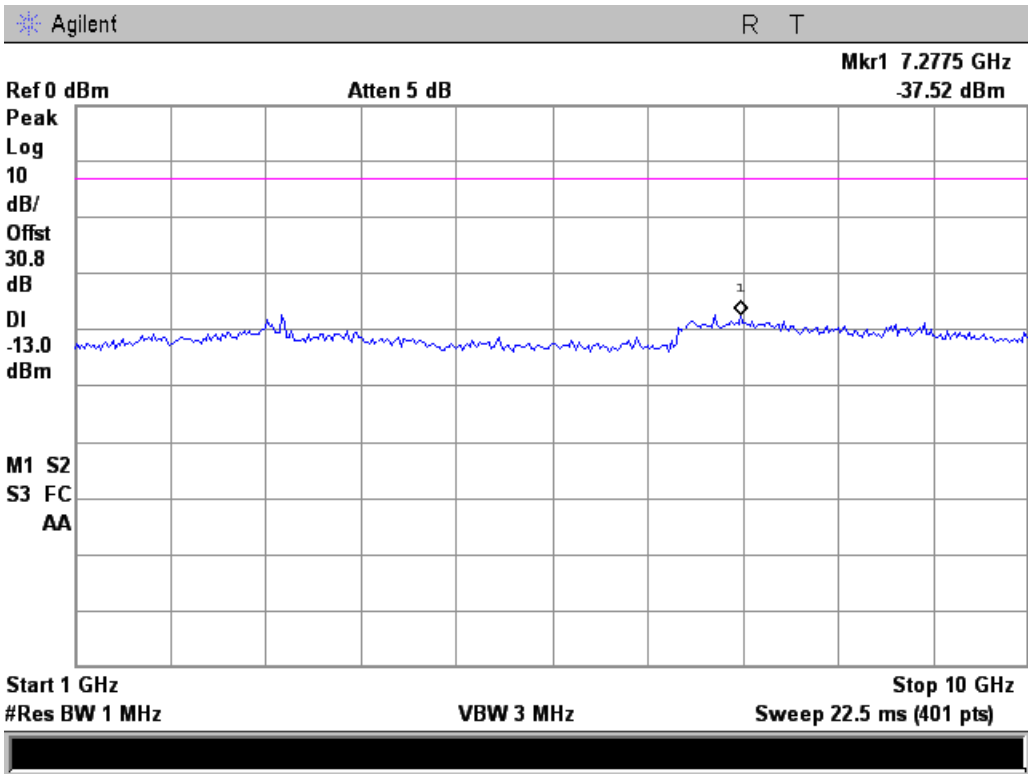
935.05 MHz


Agilent
R T
Ref 0 dBm
Atten 5 dB
Peak
Log
10
dB/
Offst
30.8
dB
Dl
-13.0
dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 100 kHz
VBW 300 kHz
Stop 1 GHz
Sweep 100.5 ms (401 pts)


Agilent
R T
Mkr1 2.9800 GHz
-38.12 dBm
Ref 0 dBm
Atten 5 dB
Peak
Log
10
dB/
Offst
30.8
dB
Dl
-13.0
dBm
1
M1 S2
S3 FC
AA
Start 1 GHz
#Res BW 1 MHz
VBW 3 MHz
Stop 10 GHz
Sweep 22.5 ms (401 pts)

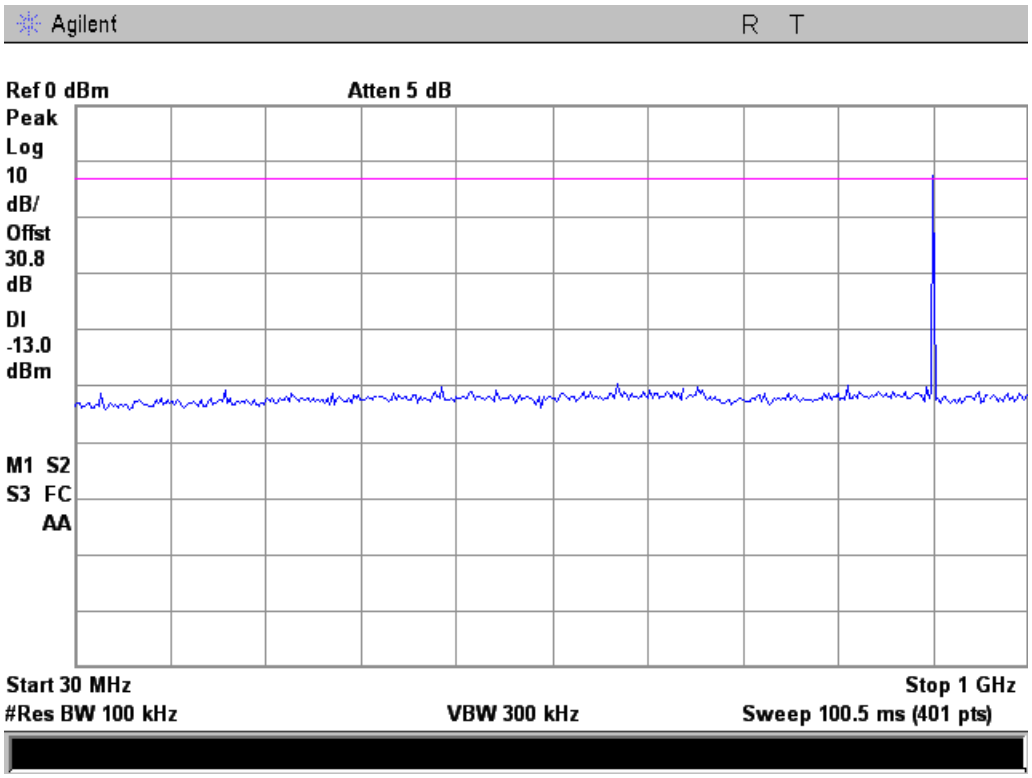
939.95 MHz

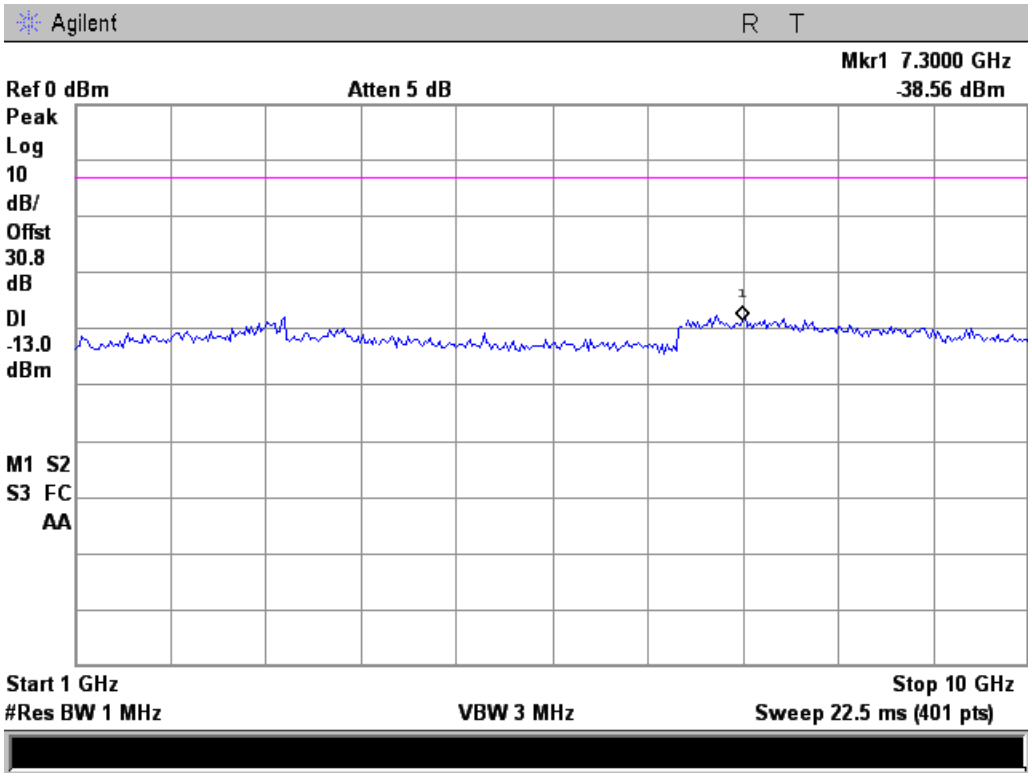

Agilent
R T
Ref 0 dBm
Atten 5 dB
Peak
Log
10
dB/
Offst
30.8
dB
Dl
-13.0
dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 100 kHz
VBW 300 kHz
Stop 1 GHz
Sweep 100.5 ms (401 pts)


Agilent
R T
Mkr1 7.2775 GHz
-37.52 dBm
Ref 0 dBm
Atten 5 dB
Peak
Log
10
dB/
Offst
30.8
dB
Dl
-13.0
dBm
M1 S2
S3 FC
AA
Start 1 GHz
#Res BW 1 MHz
VBW 3 MHz
Stop 10 GHz
Sweep 22.5 ms (401 pts)

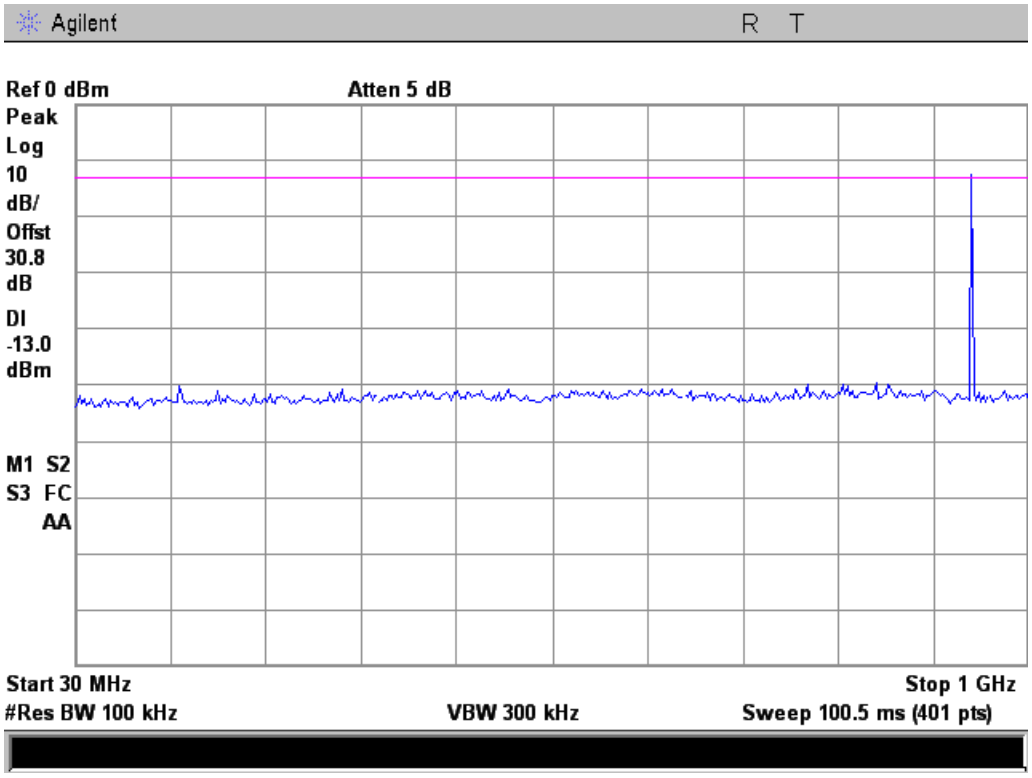
Part 24 Test Plots

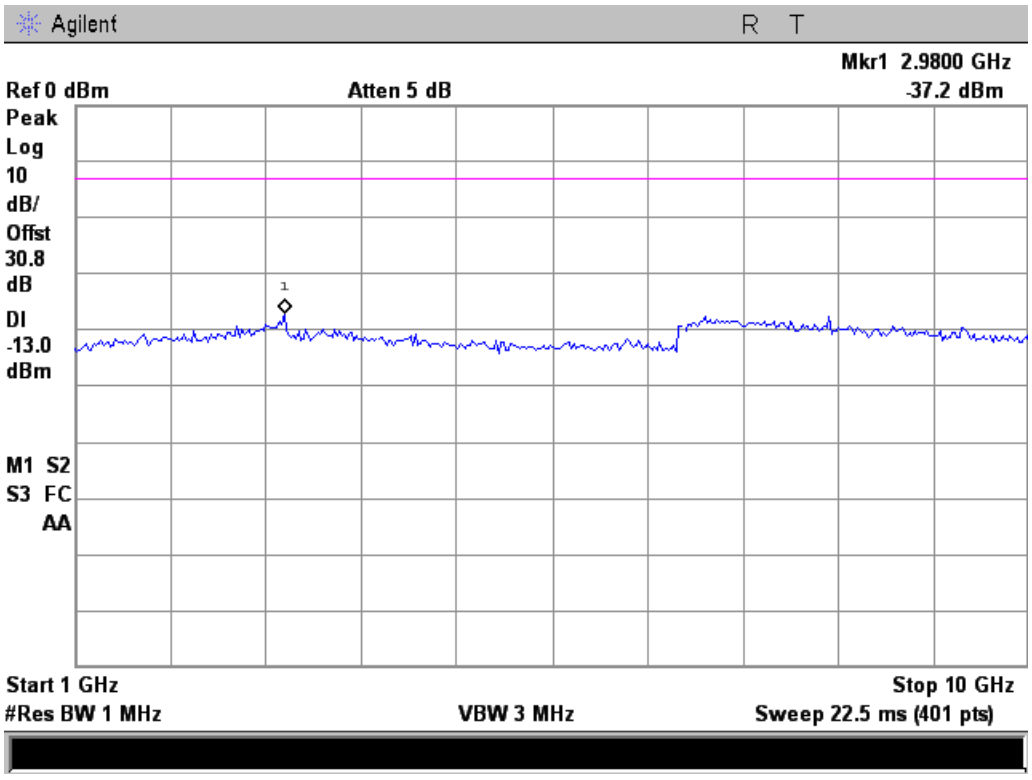
901.55 MHz





940.55 MHz


Agilent
R T
Ref 0 dBm
Atten 5 dB
Peak
Log
10
dB/
Offst
30.8
dB
Dl
-13.0
dBm
M1 S2
S3 FC
AA
Start 30 MHz
#Res BW 100 kHz
VBW 300 kHz
Stop 1 GHz
Sweep 100.5 ms (401 pts)


Agilent
R T
Mkr1 2.9800 GHz
-37.2 dBm
Ref 0 dBm
Atten 5 dB
Peak
Log
10
dB/
Offst
30.8
dB
Dl
-13.0
dBm
1
M1 S2
S3 FC
AA
Start 1 GHz
#Res BW 1 MHz
VBW 3 MHz
Stop 10 GHz
Sweep 22.5 ms (401 pts)

Field Strength of Spurious Radiation

Name of Test:	Field Strength of Spurious Radiation	
Specification:	2.1053	**Engineer:** John Erhard
Test Equipment Utilized:	i00103, i00331	**Test Date:** 9/26/2011

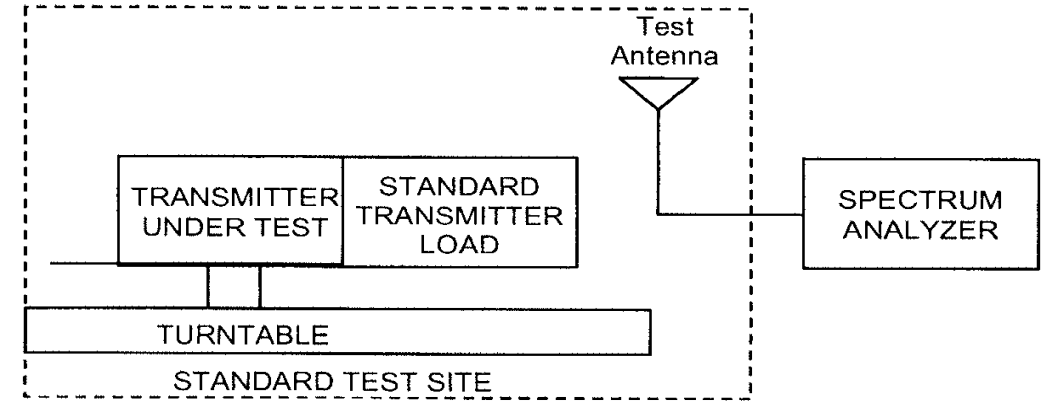
Test Procedure

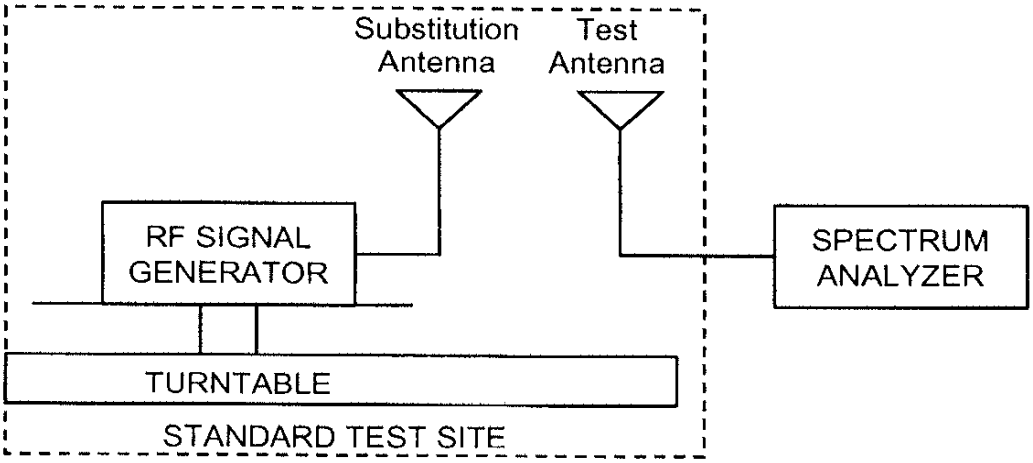
A) Connect the equipment as illustrated
B) Adjust the spectrum analyzer for the following settings:
   1) Resolution Bandwidth 100 kHz (< 1 GHZ), 1 MHZ (> 1GHz)
   2) Video Bandwidth ≥ 3 times Resolution Bandwidth, or 30 kHz
   3) Sweep Speed ≤2000 Hz/second
   4) Detector Mode = Mean or Average Power
C) Place the transmitter to be tested on the turntable in the standard test site. The transmitter is transmitting into a non- radiating load that is placed on the turntable. The RF cable to this load should be of minimum length.
D) For each spurious measurement the test antenna should be adjusted to the correct length for the frequency involved. This length may be determined from a calibration ruler supplied with the equipment. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier, except for the region close to the carrier equal to ± the test bandwidth (see section 1.3.4.4).
E) For each spurious frequency, raise and lower the test antenna from 1 m to 4 m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.
F) Repeat step E) for each spurious frequency with the test antenna polarized vertically.
G) Reconnect the equipment as illustrated.
H) Keep the spectrum analyzer adjusted as in step B).
I) Remove the transmitter and replace it with a substitution antenna (the antenna should be half wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground.
J) Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output.
K) Repeat step J) with both antennas vertically polarized for each spurious frequency.
L) Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps J) and K) by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna.
M) The levels recorded in step L) are absolute levels of radiated spurious emissions in dBm. The radiated spurious emissions in dB can be calculated by the following:

Radiated spurious emissions dB = $10\log_{10}$ (TX power in watts/0.001) – the levels in step I)

NOTE: It is permissible that the other antennas provided can be referenced to a dipole.

Test Setup


Test
Antenna
TRANSMITTER
UNDER TEST
STANDARD
TRANSMITTER
LOAD
SPECTRUM
ANALYZER
TURNTABLE
STANDARD TEST SITE


Substitution
Antenna
Test
Antenna
RF SIGNAL
GENERATOR
SPECTRUM
ANALYZER
TURNTABLE
STANDARD TEST SITE

Part 90 Test Results

896.05 MHz

Emission Frequency (MHz)	Measured Level (dBm)	Limit (dBm) EIRP	Result
1792.05	-42.93	-13	Pass
2687.10	-42.34	-13	Pass
3582.15	-38.90	-13	Pass

900.95 MHz

Emission Frequency (MHz)	Measured Level (dBm)	Limit (dBm) EIRP	Result
1801.90	-45.27	-13	Pass
2702.85	-47.26	-13	Pass
3603.80	-41.89	-13	Pass

935.05 MHz

Emission Frequency (MHz)	Measured Level (dBm)	Limit (dBm) EIRP	Result
1870.10	-49.96	-13	Pass
2805.15	-43.78	-13	Pass
3675.25	-41.11	-13	Pass

939.95 MHz

Emission Frequency (MHz)	Measured Level (dBm)	Limit (dBm) EIRP	Result
1879.90	-47.52	-13	Pass
2819.85	-41.18	-13	Pass
3759.80.	-40.24	-13	Pass

Part 24 Test Results

901.55 MHz

Emission Frequency (MHz)	Measured Level (dBm)	Limit (dBm) EIRP	Result
1803.10	-44.43	-13	Pass
2704.65	-43.62	-13	Pass
3606.20	-41.77	-13	Pass

940.55 MHz

Emission Frequency (MHz)	Measured Level (dBm)	Limit (dBm) EIRP	Result
1881.10	-45.42	-13	Pass
2821.65	-43.54	-13	Pass
3762.20	-42.04	-13	Pass

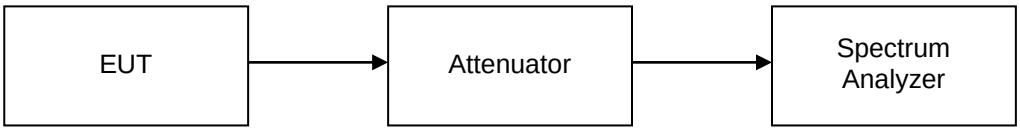
No other emissions were detected. All emissions were greater than –13 dBm and -20 dBc.

Emission Masks (Occupied Bandwidth)

Name of Test:	Emission Masks (Occupied Bandwidth)	
Specification:	90.210 / 24.133	**Engineer:** John Erhard
Test Equipment Utilized:	i00331, i00347	**Test Date:** 9/26/2011

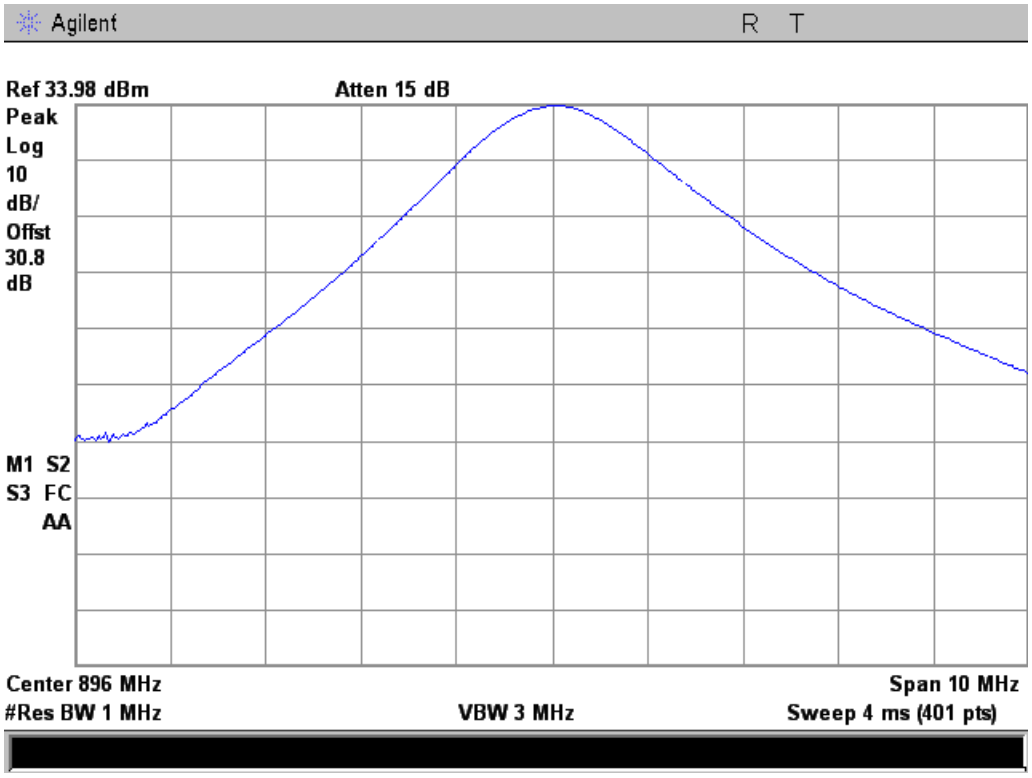
The EUT was connected directly to a spectrum analyzer to verify that the EUT meets the required emissions mask. A reference level plot is provided to verify that the peak power was established prior to testing the mask. A modulation frequency of 2.5 kHz at a level of 100 mVPP was input into the EUT for the analog tests and an internal test pattern was utilized for the digital input.

Test Setup

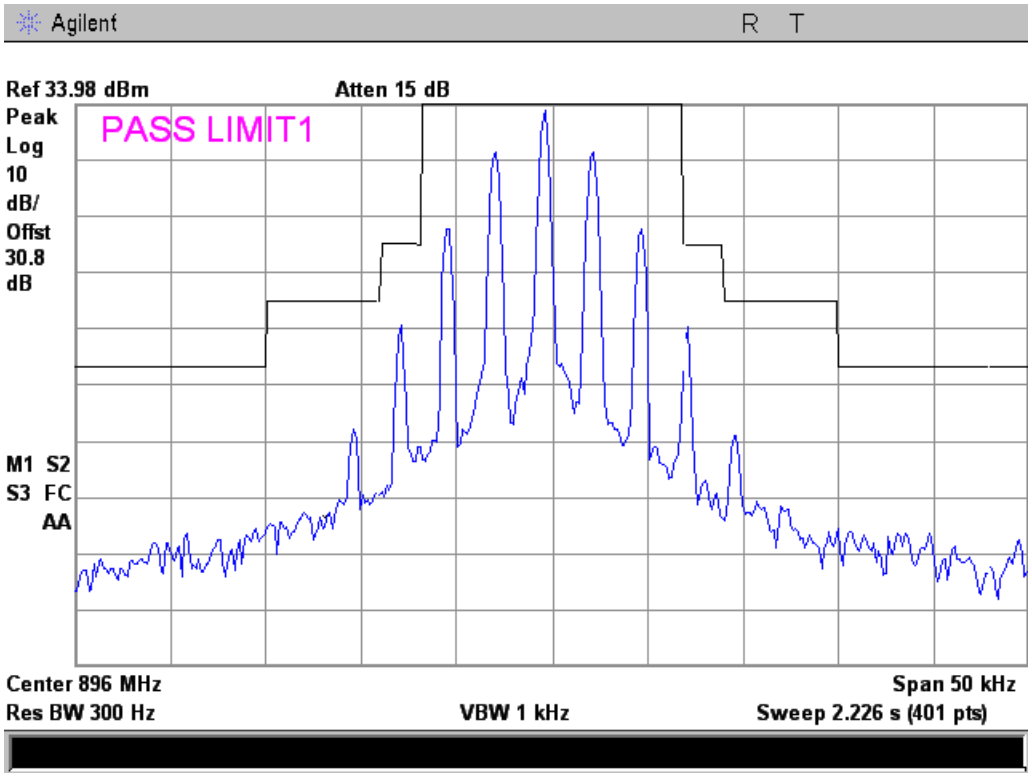


Pat 90 Occupied Bandwidth Plots

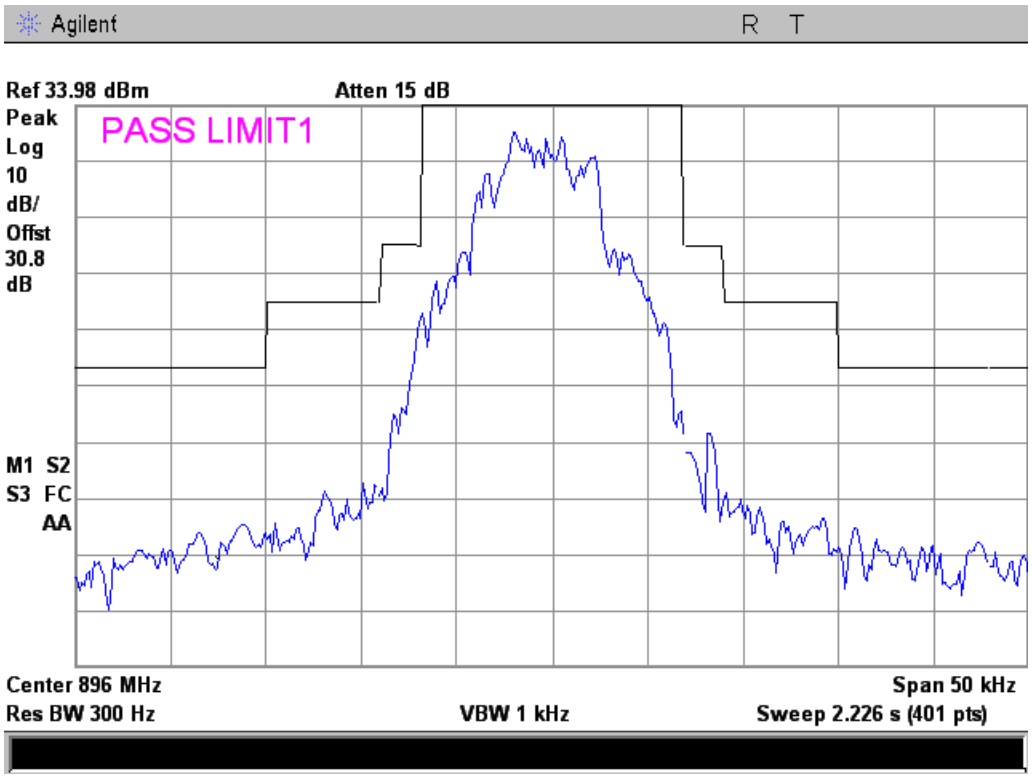
896.05 MHz Reference



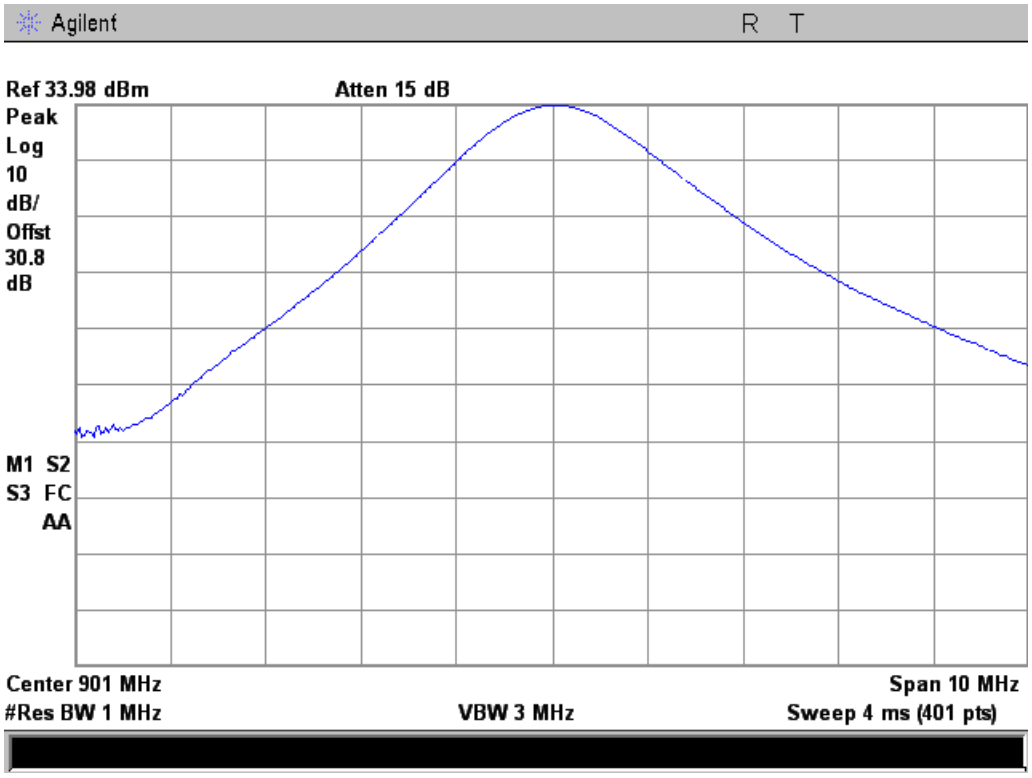
Mask 896.05 MHz Analog



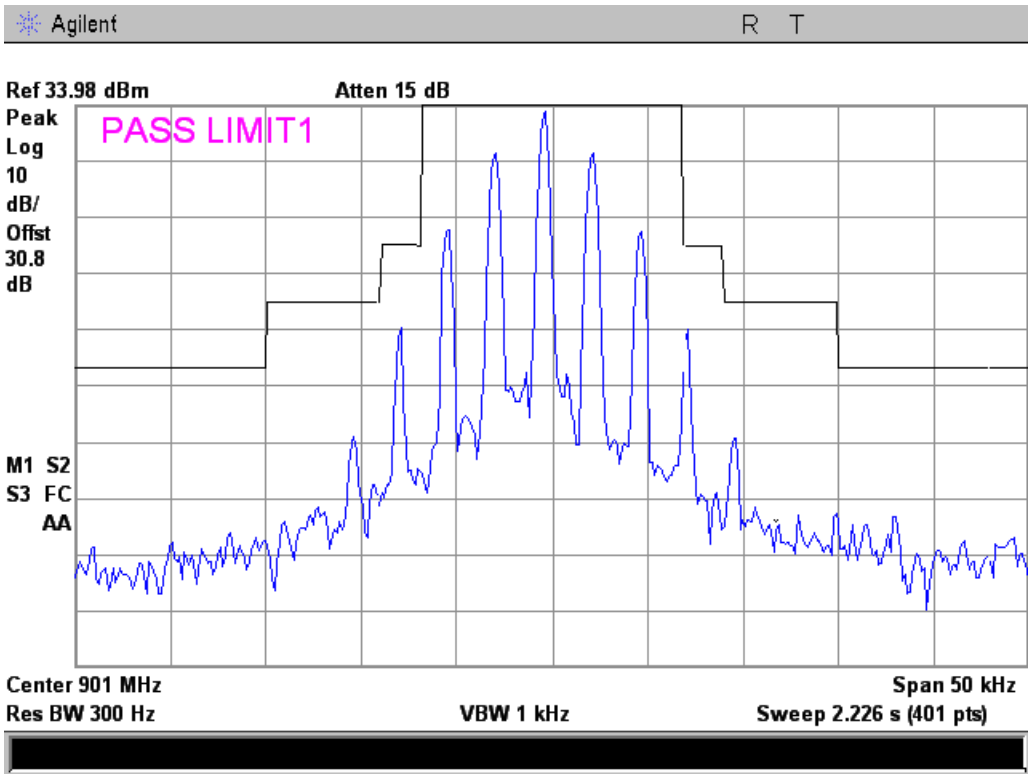
Mask 896.05 MHz Wideband Digital



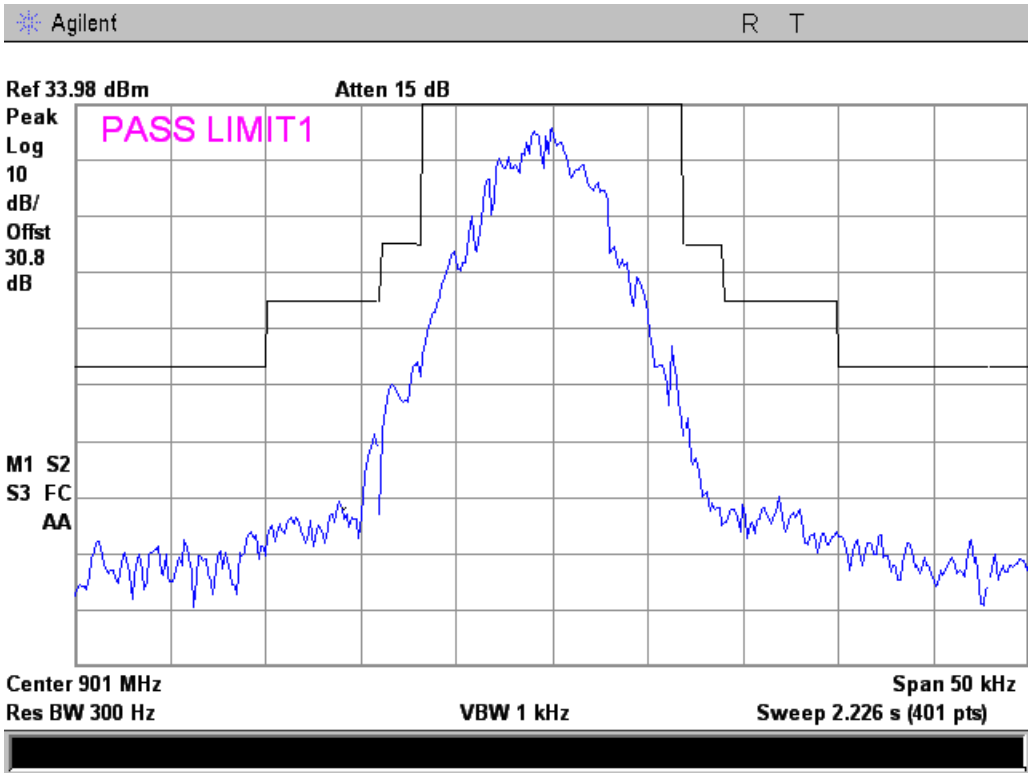
900.95 MHz Reference



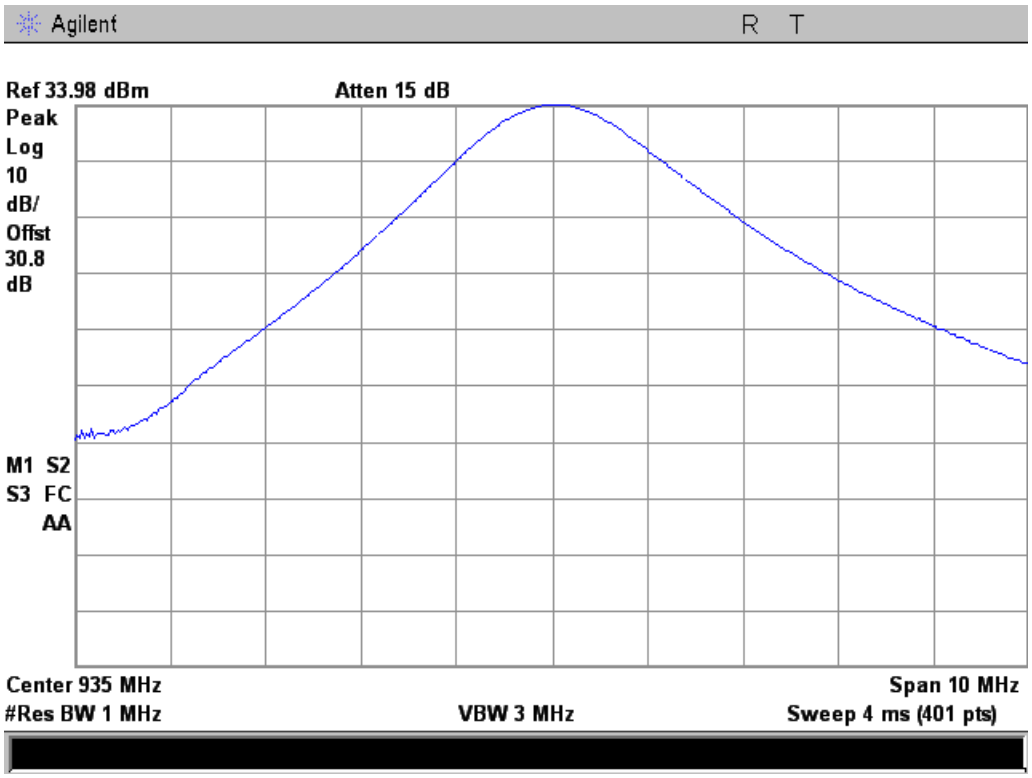
Mask 900.95 MHz Analog



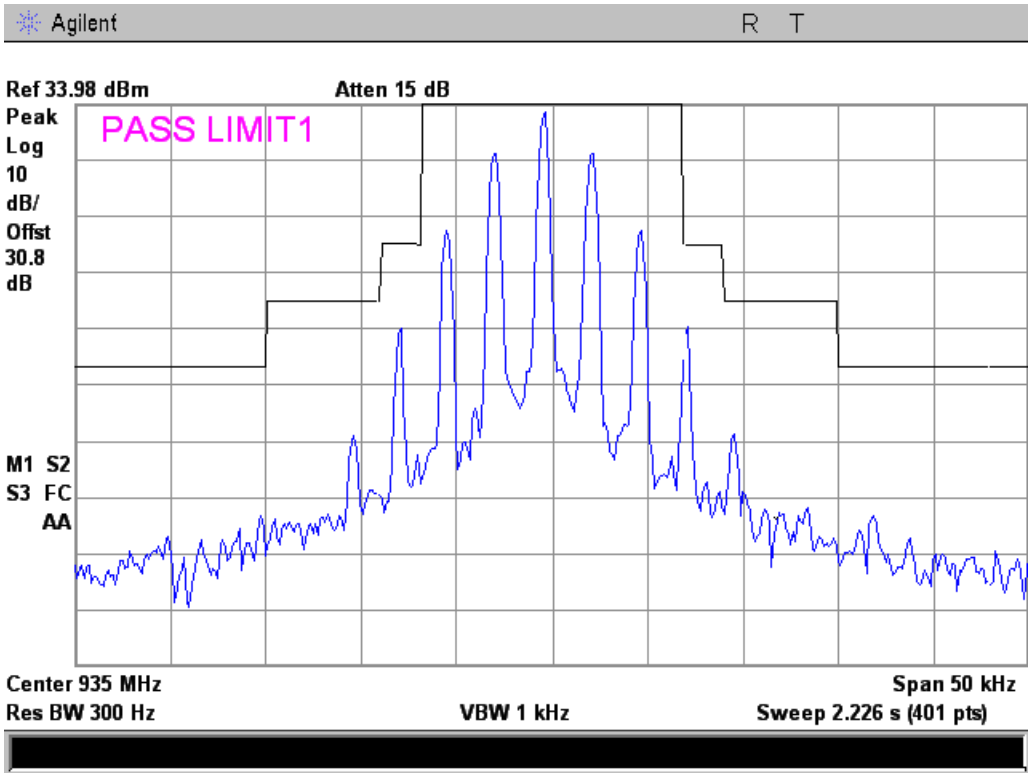
Mask 900.95 MHz Wideband Digital



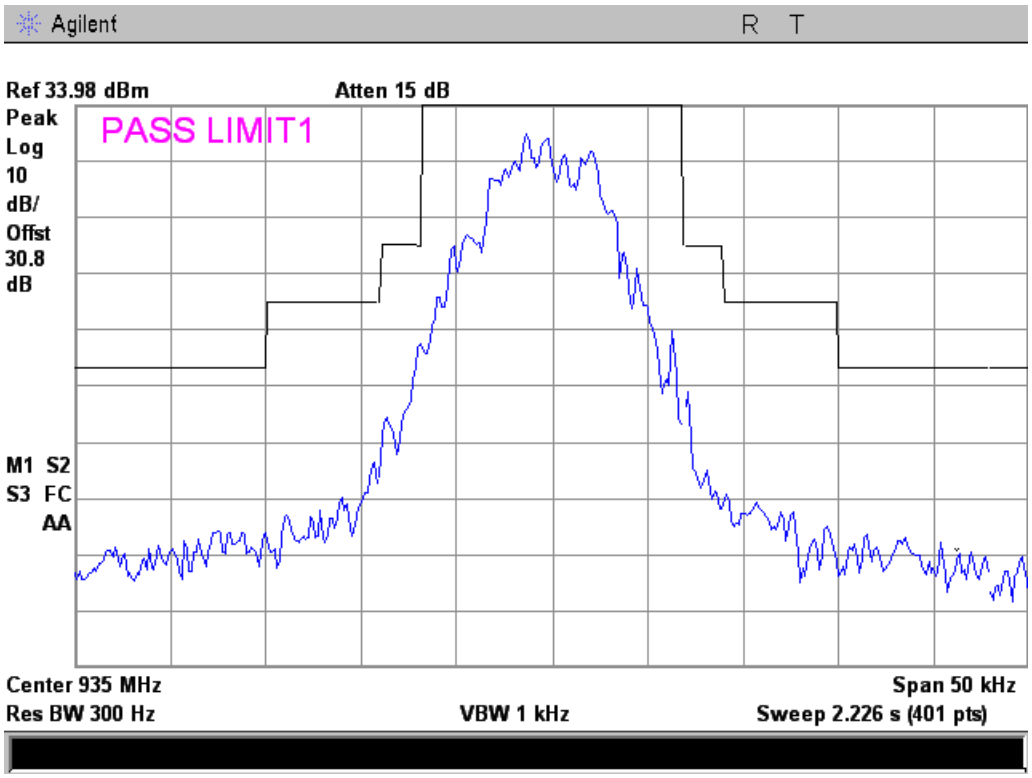
935.05 MHz Reference



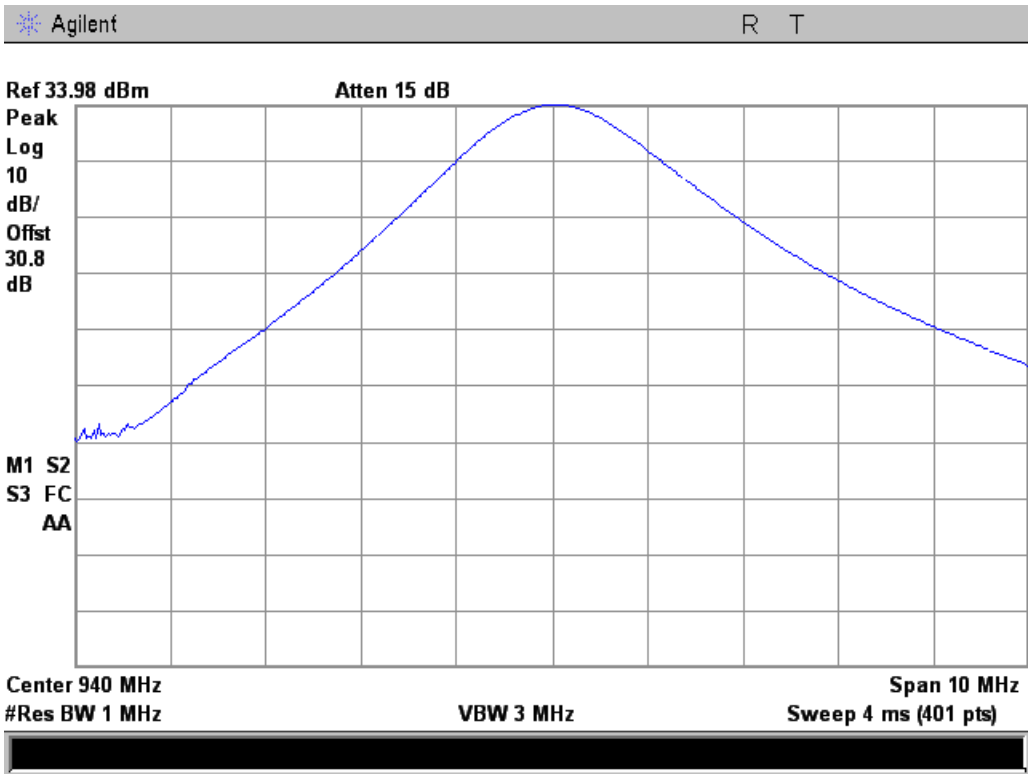
Mask 935.05 MHz Analog



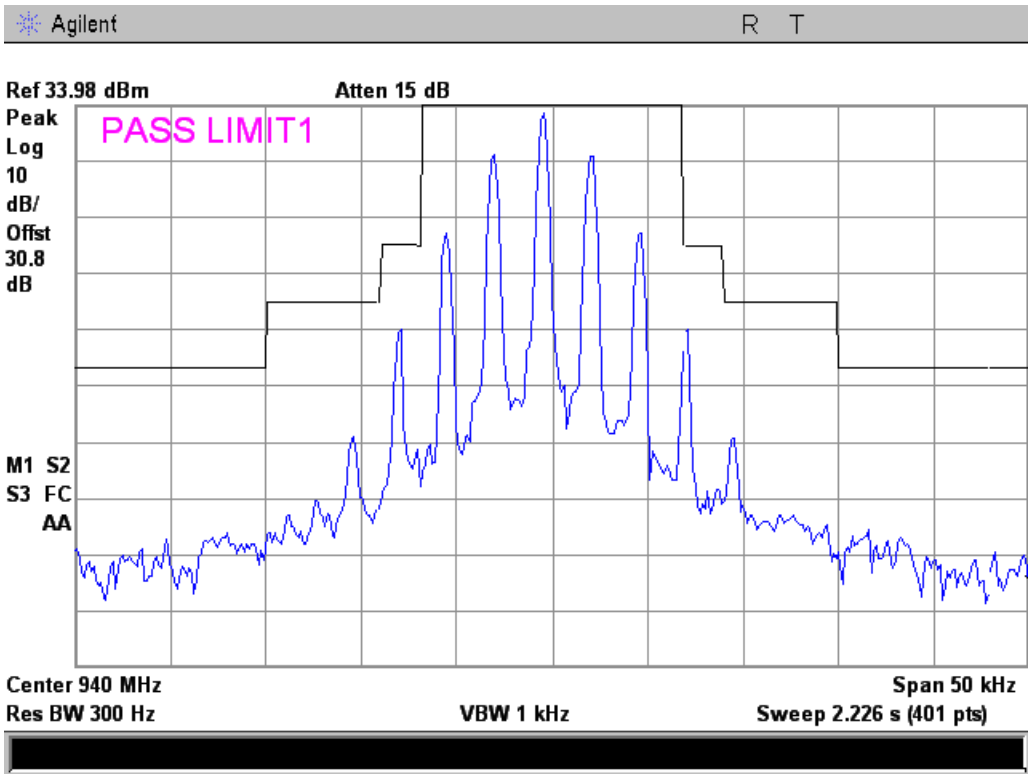
Mask 935.05 MHz Wideband Digital



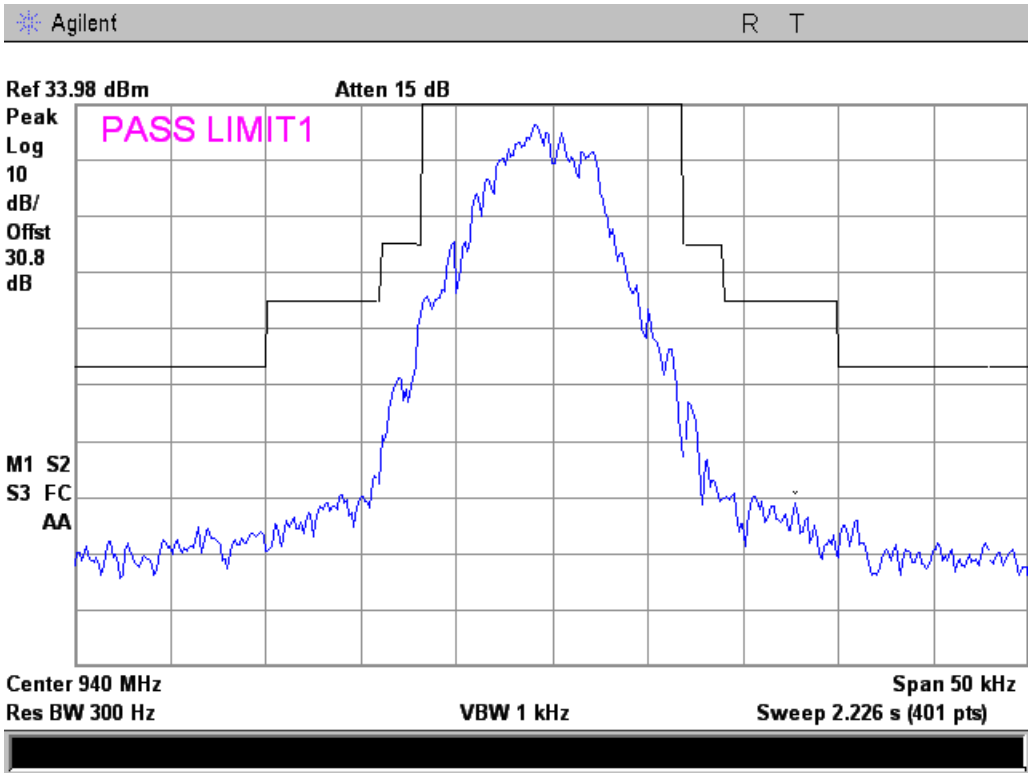
939.95 MHz Reference



Mask 939.95 MHz Analog

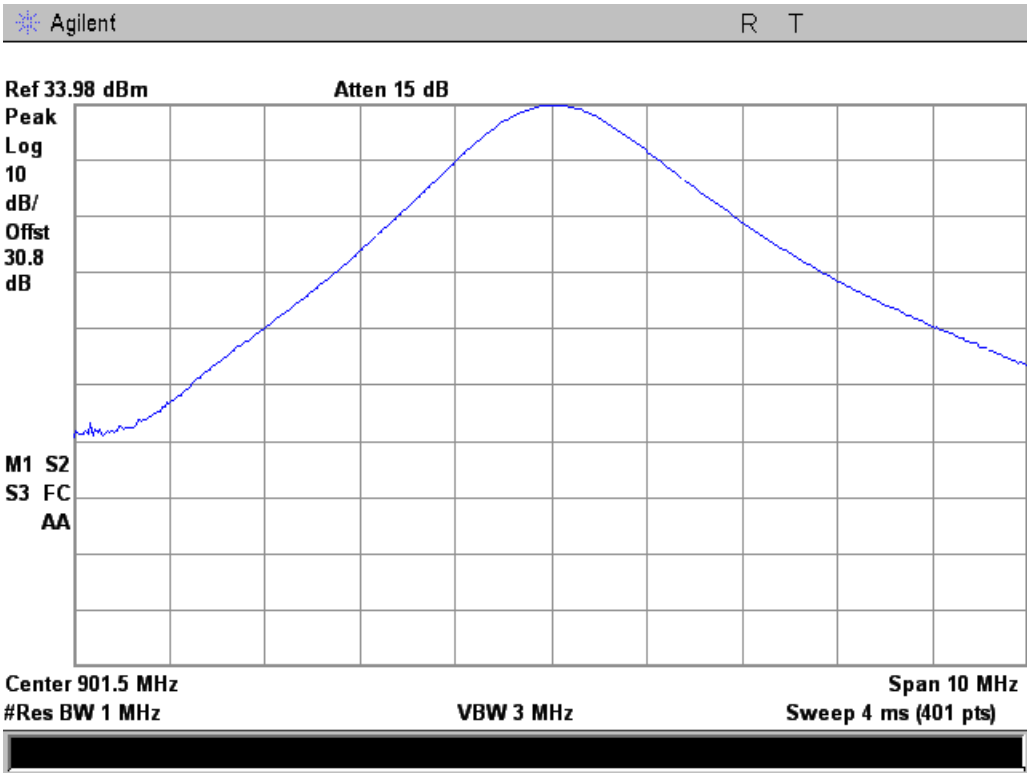


Mask 939.95 MHz Wideband Digital

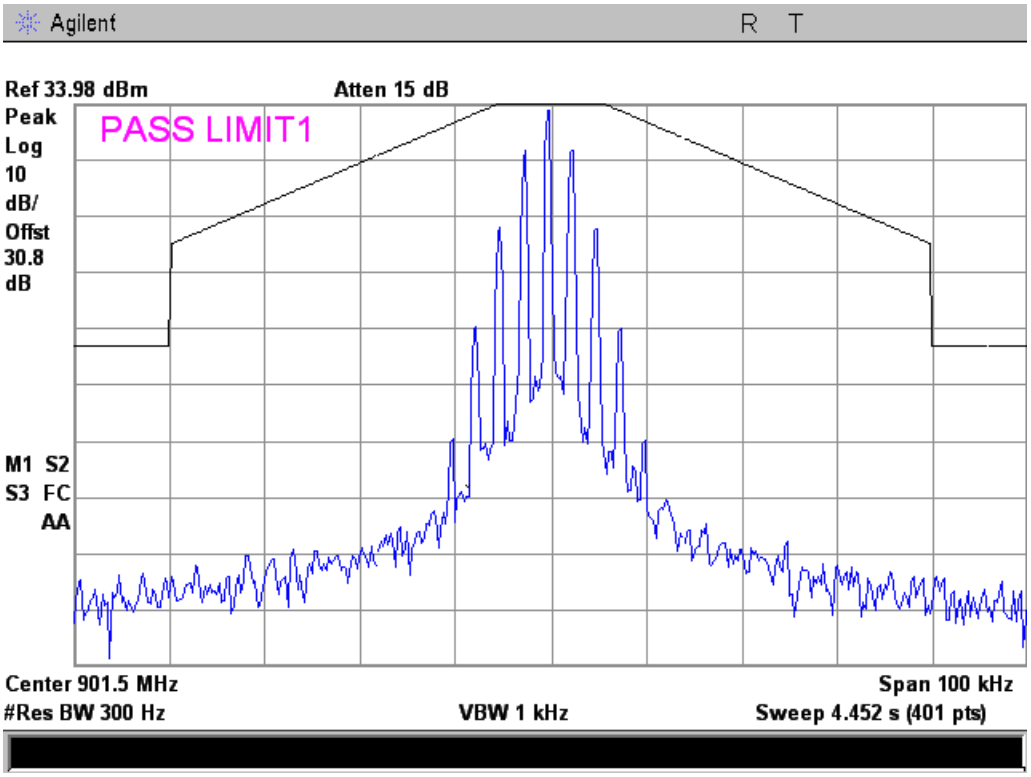


Pat 24 Occupied Bandwidth Plots

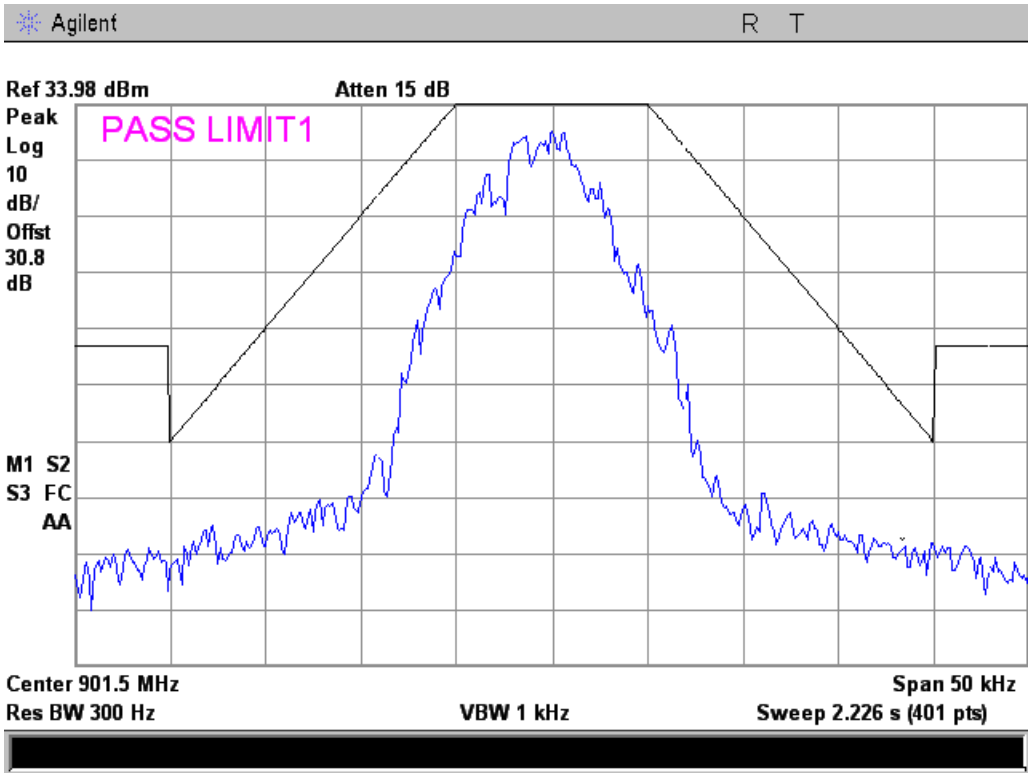
901.55 MHz Reference



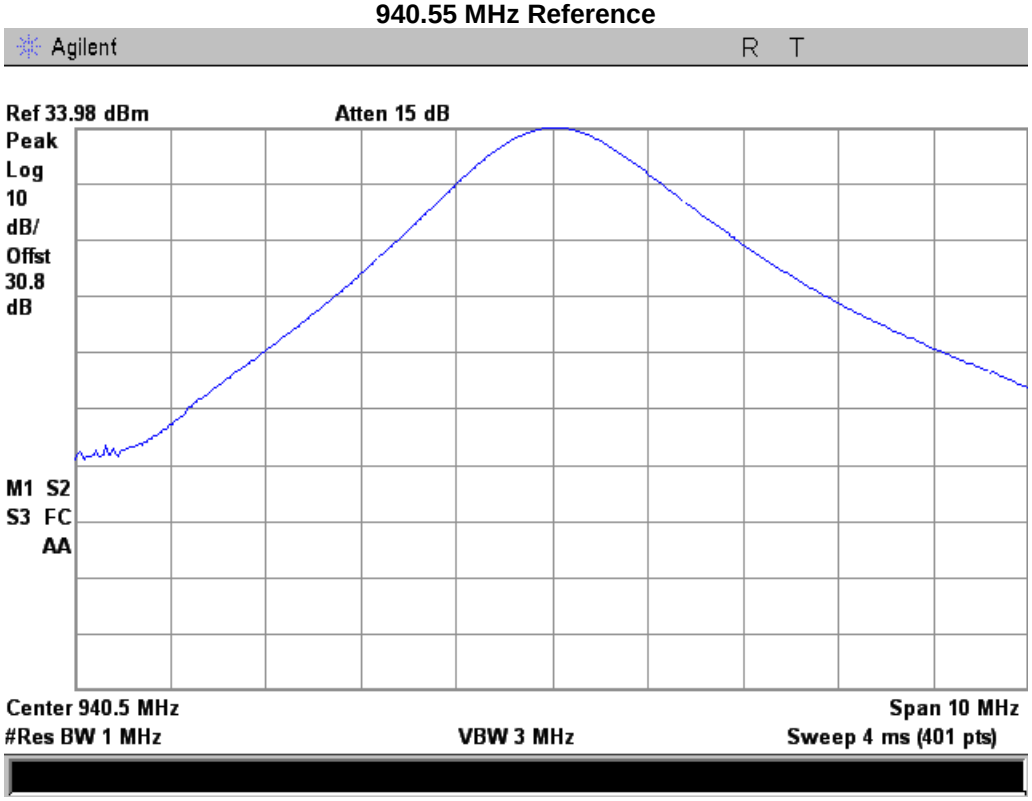
Mask 901.55 MHz Analog



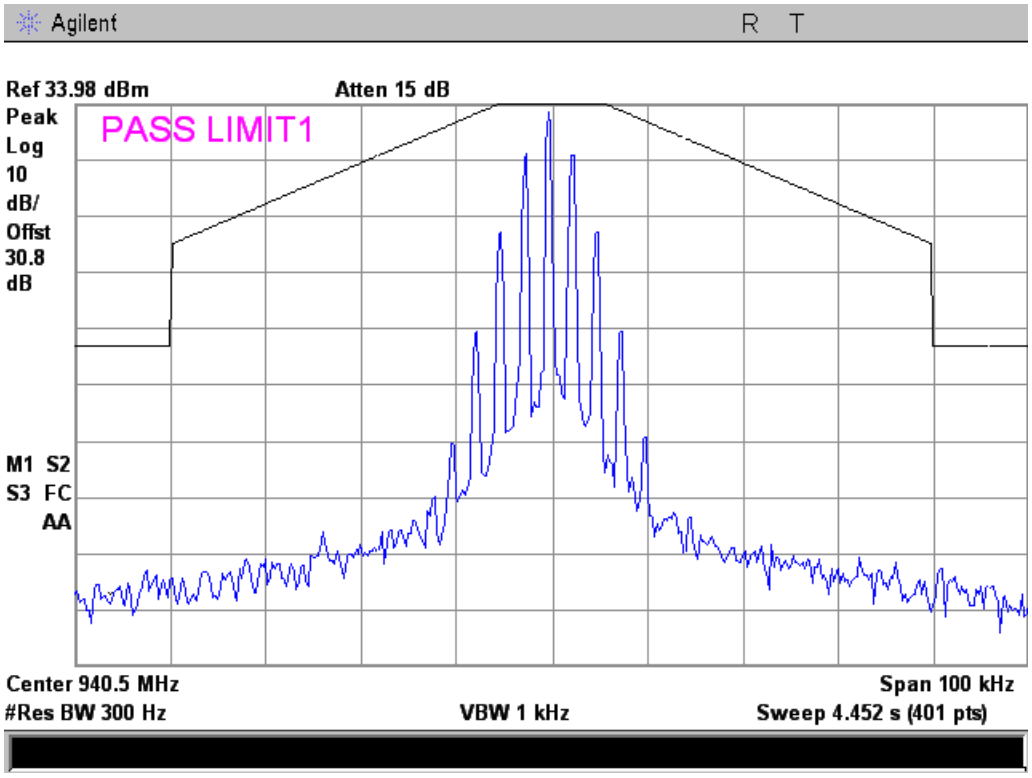
Mask 901.55 MHz Wideband Digital



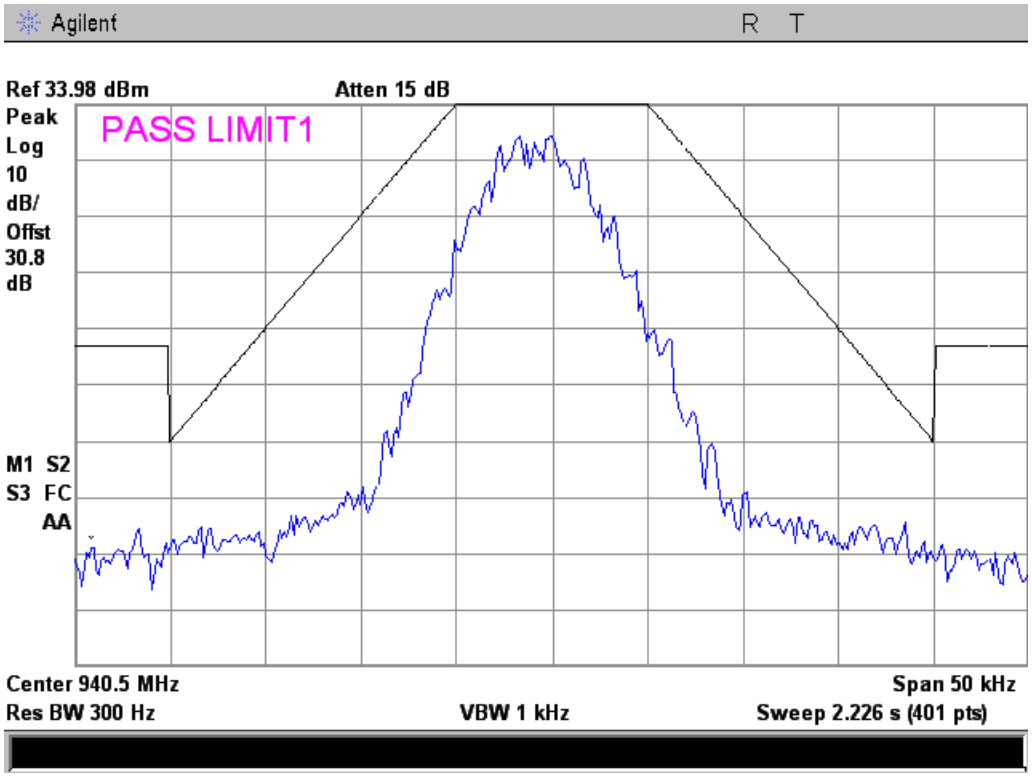
940.55 MHz Reference



Mask 940.55 MHz Analog



Mask 940.55 MHz Wideband Digital



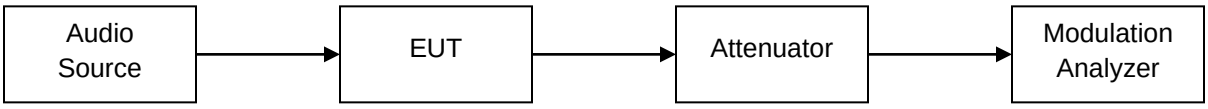
Audio Low Pass Filter (Voice Input)

Name of Test:	Audio Low Pass Filter (Voice Input)	
Specification:	2.1047	**Engineer:** John Erhard
Test Equipment Utilized:	i00345, i00347	**Test Date:** 9/22/2011

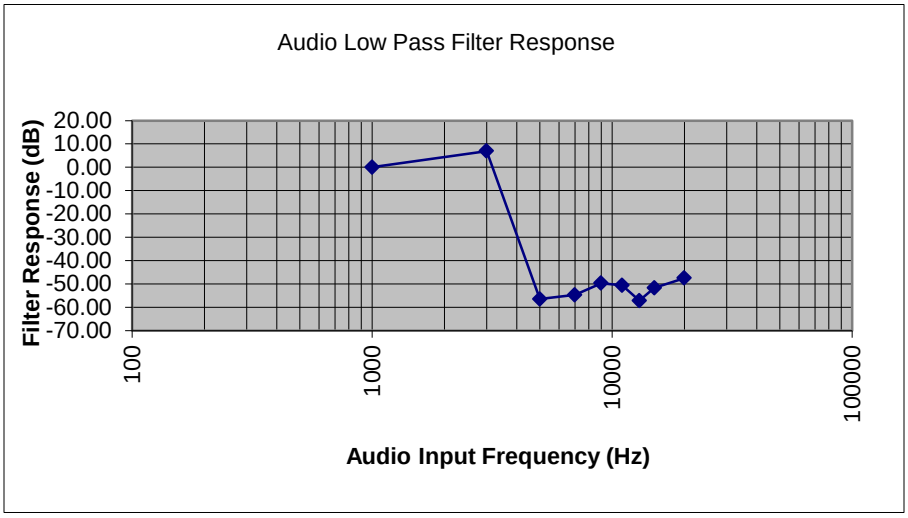
Measurement Procedure

The EUT was connected directly to a modulation analyzer through an attenuator. The audio source was tuned across the required audio frequency range and the audio low pass filter response was measured and plotted.
The modulation analyzer is a real time spectrum analyzer with integrated demodulation, audio measurement capabilities, and timing analysis.

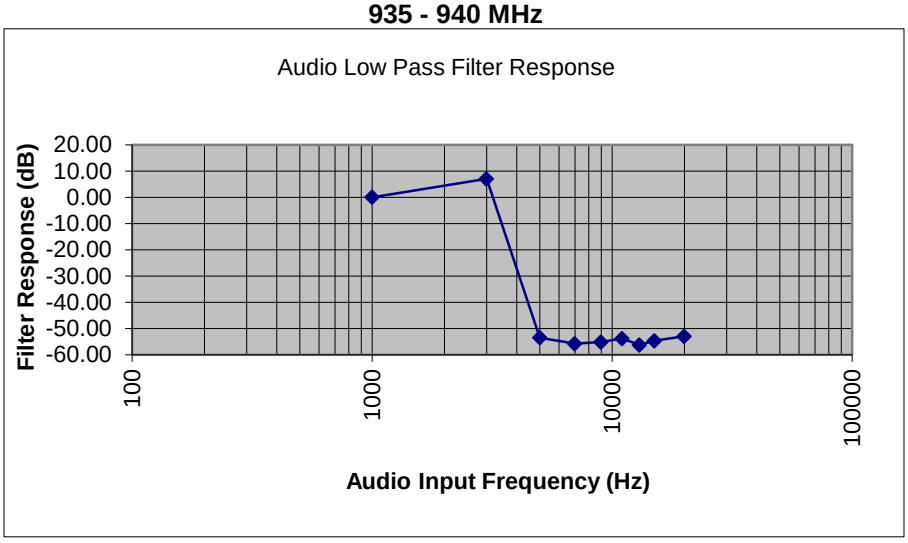
Test Setup



Part 90 Test Results
896 - 901 MHz



935 - 940 MHz



This unit is a digital radio and the roll-off for the filter is very linear in the operational band and sharp out of band.

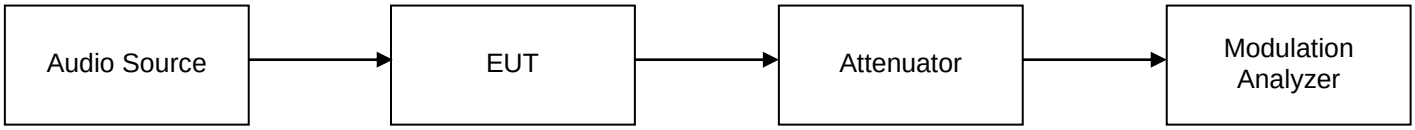
Audio Frequency Response

Name of Tests: Audio Frequency Response
Specification: 2.1047 **Engineer:** John Erhard
Test Equipment Utilized: i00345, i00347 **Test Date:** 9/22/2011

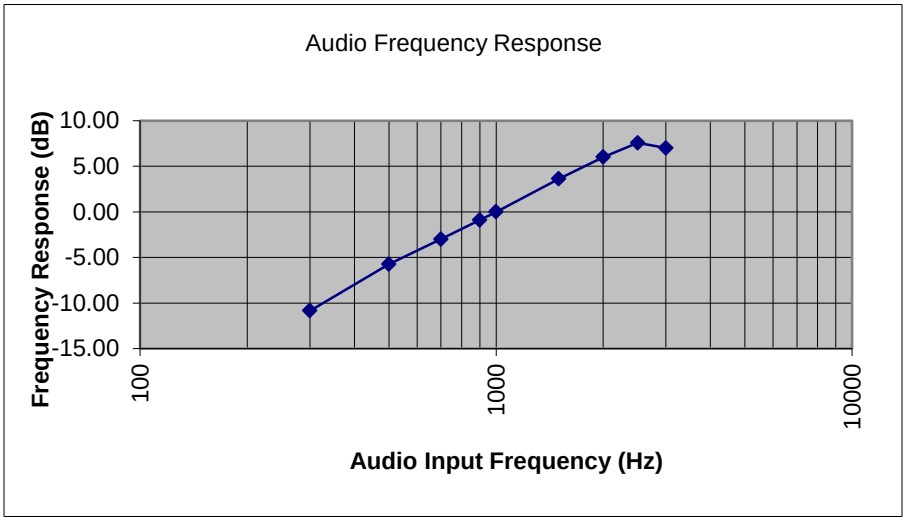
Measurement Procedure

The EUT was connected directly to a modulation analyzer through an attenuator. The audio source was tuned across the required audio frequency range and the audio frequency response was measured and plotted.
The modulation analyzer is a real time spectrum analyzer with integrated demodulation, audio measurement capabilities, and timing analysis.

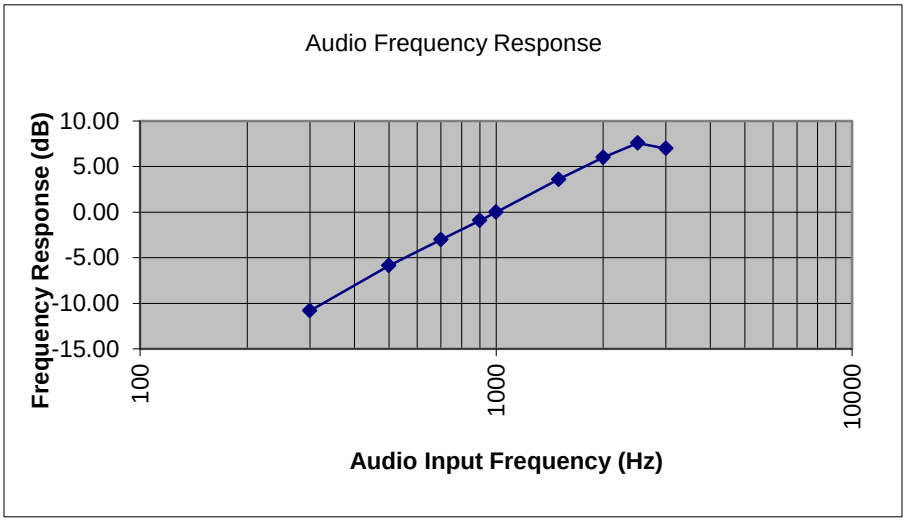
Test Set-Up



Part 90 Test Results
896 - 901 MHz



935 - 940 MHz



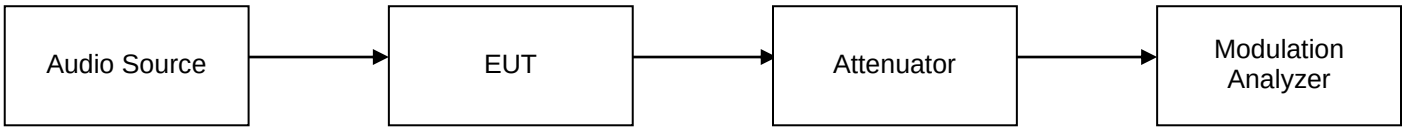
Modulation Limiting

Name of Test: Modulation Limiting
Specification: 2.1047(a)
Engineer: John Erhard
Test Equipment Utilized: i00345, i00347
Test Date: 9/22/2011

Measurement Procedure

The EUT was connected directly to a modulation analyzer through an attenuator. The audio source was tuned across the required audio frequency range and the modulation limiting response was measured and plotted.
The modulation analyzer is a real time spectrum analyzer with integrated demodulation, audio measurement capabilities, and timing analysis.

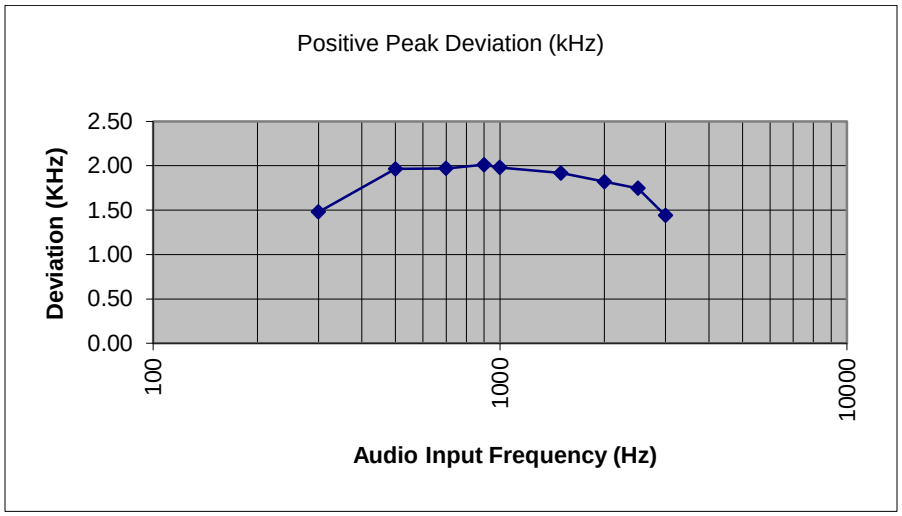
Test Setup



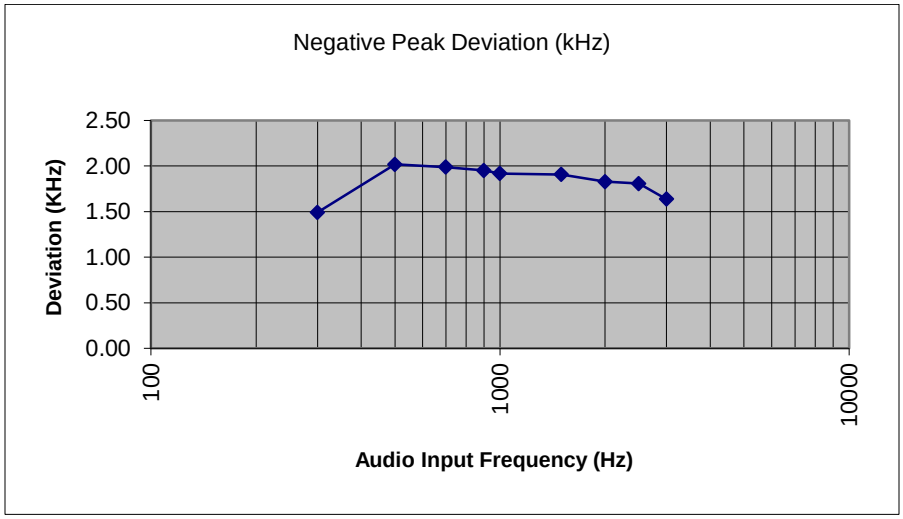
Part 90 Test Results

896 - 901 MHz

Positive Peaks

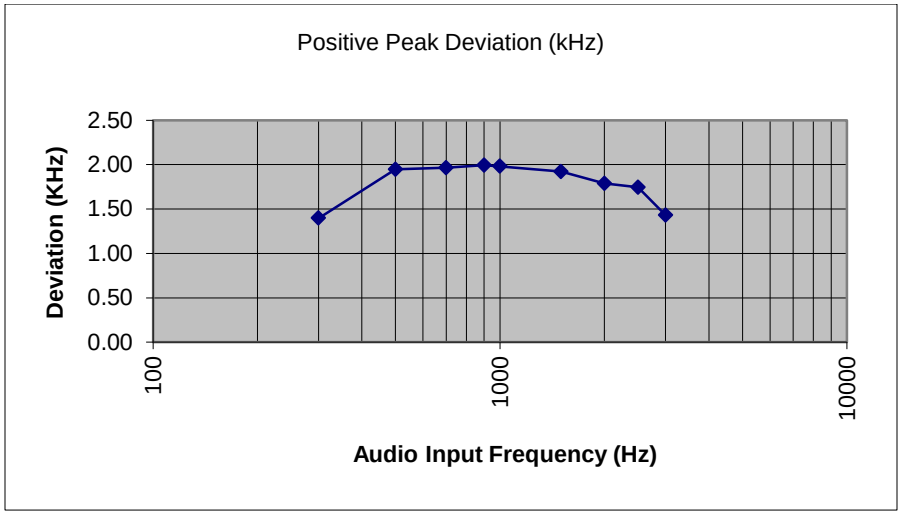


Negative Peaks

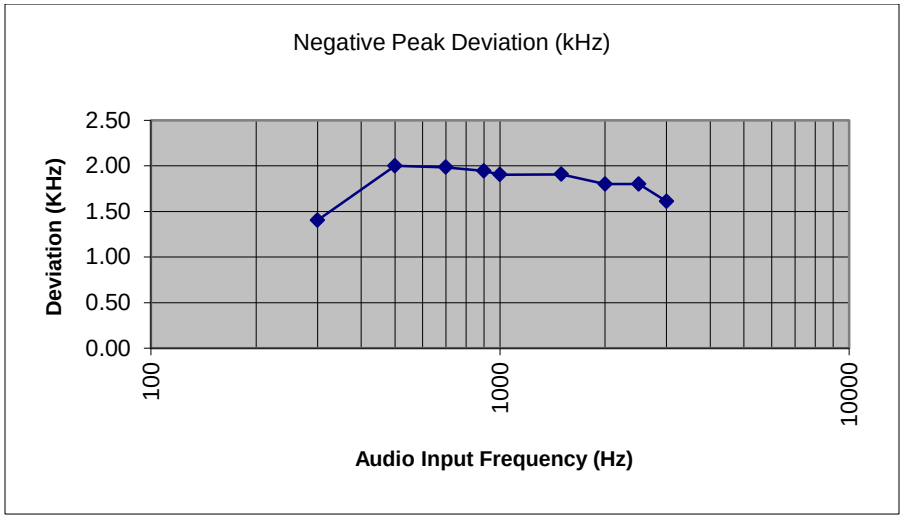


935 - 940 MHz

Positive Peaks



Negative Peaks



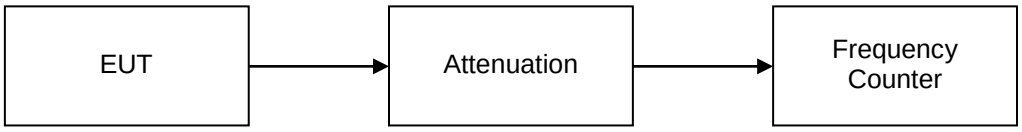
Frequency Stability (Temperature Variation)

Name of Test:	Frequency Stability (Temperature Variation)	
Specification:	90.213	**Engineer:** John Erhard
Test Equipment Utilized:	i00008, i00019, i00027, i00320, i00343, i00347	**Test Date:** 9/14/2011

Measurement Procedure

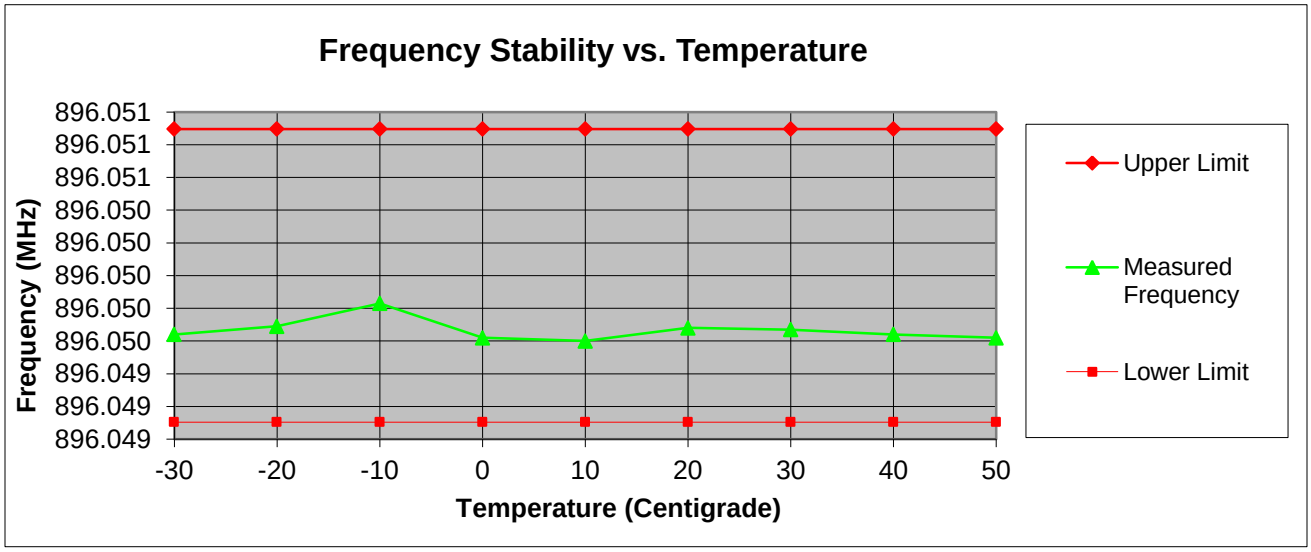
The EUT was placed in an environmental test chamber and the RF output was connected directly to a frequency counter. The temperature was varied from -30°C to 50°C in 10°C increments. After a sufficient time for temperature stabilization the RF output frequency was measured.

Measurement Setup

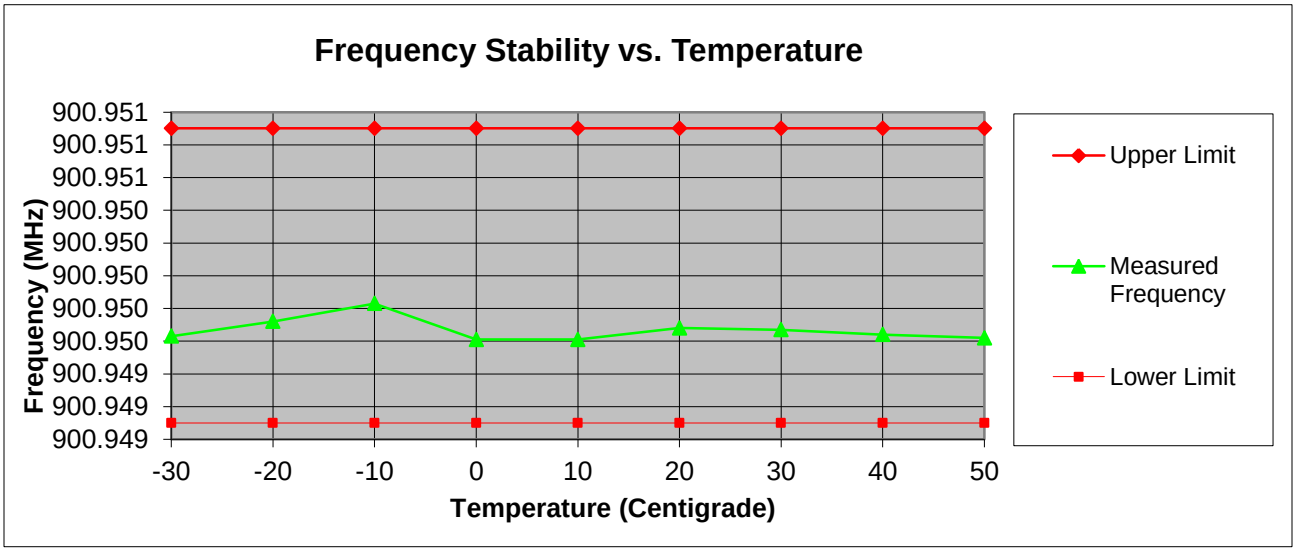


Part 90 Test Plots

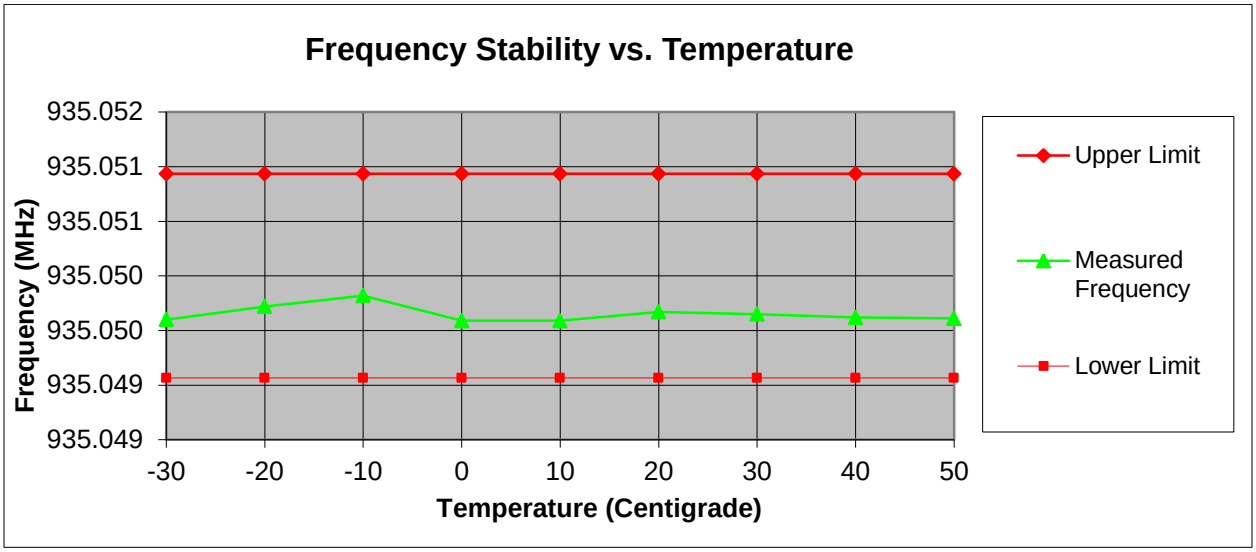
896.05 MHz



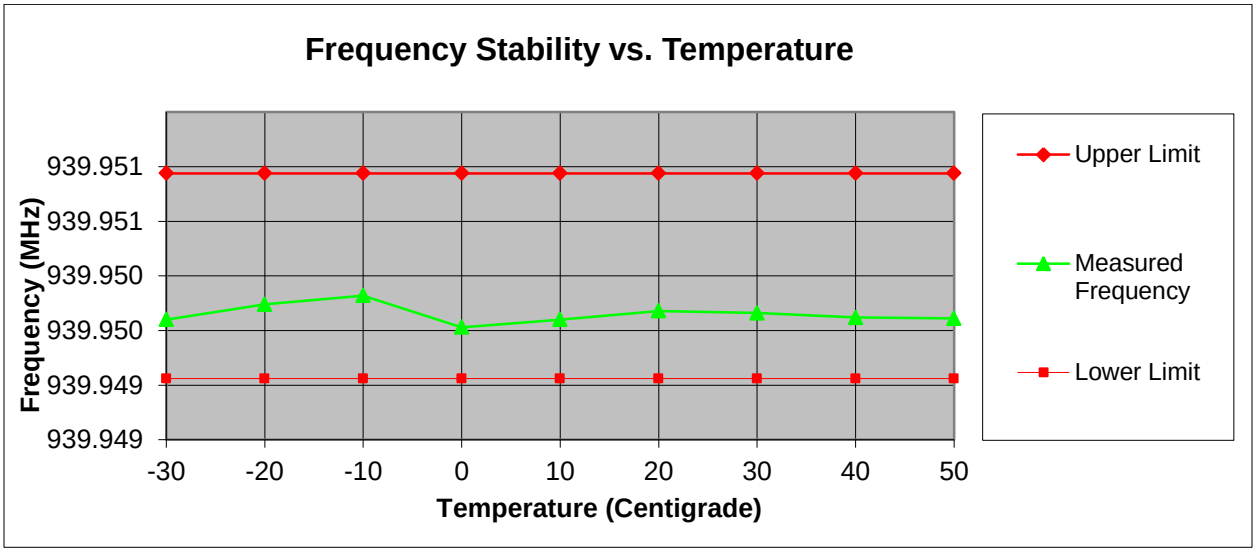
900.95 MHz



935.05 MHz

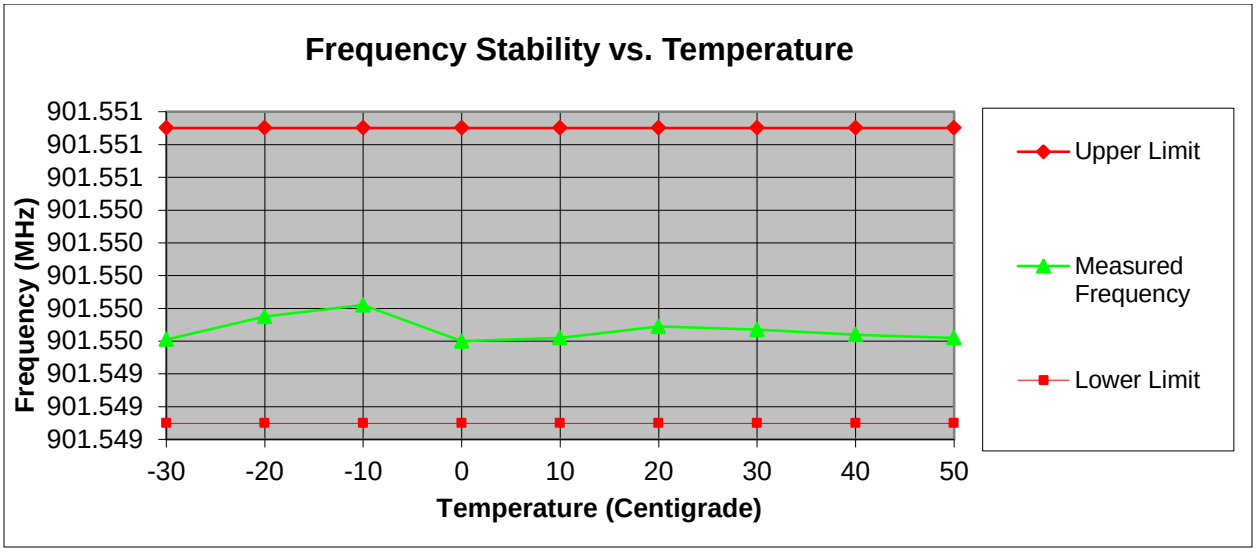


939.95 MHz

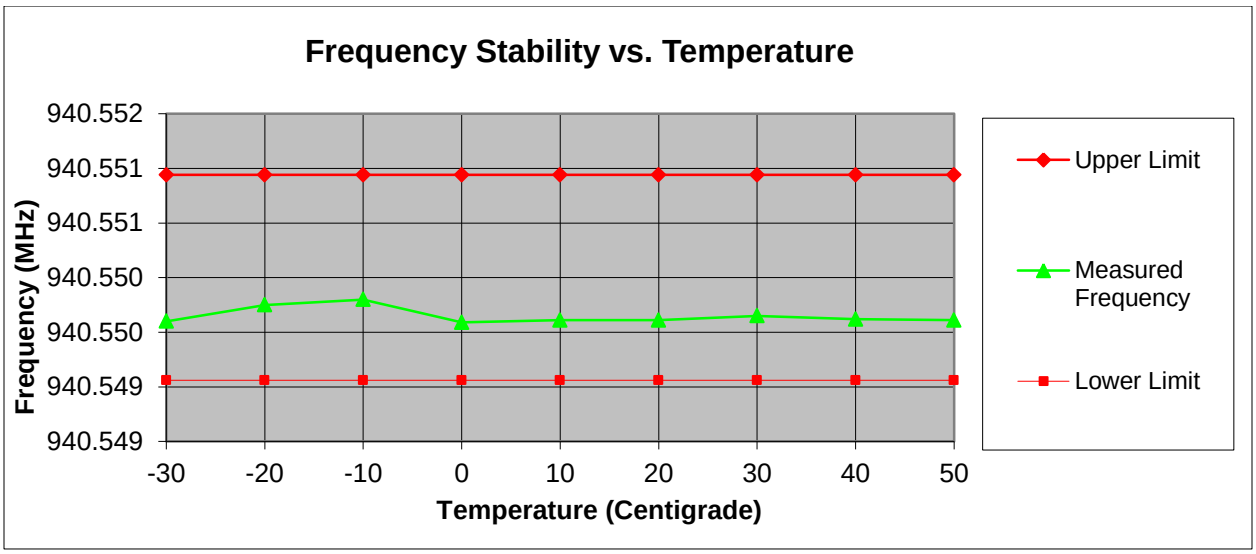


Part 24 Test Plots

901.55 MHz



940.55 MHz



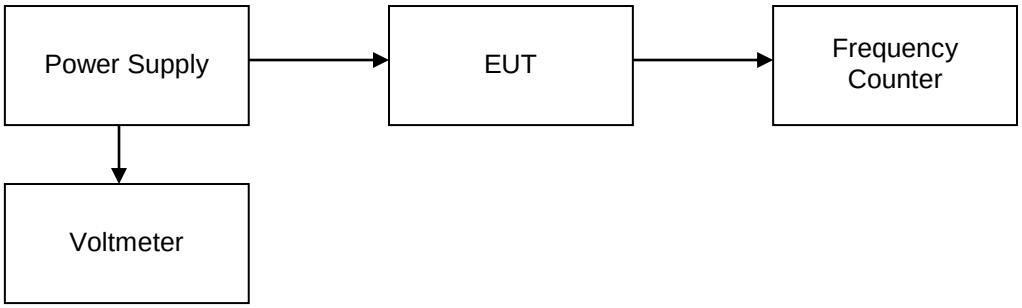
Frequency Stability (Voltage Variation)

Name of Test:	Frequency Stability (Voltage Variation)	
Specification:	90.213	**Engineer:** John Erhard
Test Equipment Utilized:	i00008, i00019, i00027, i00320, i00343, i00347	**Test Date:** 9/14/2011

Measurement Procedure

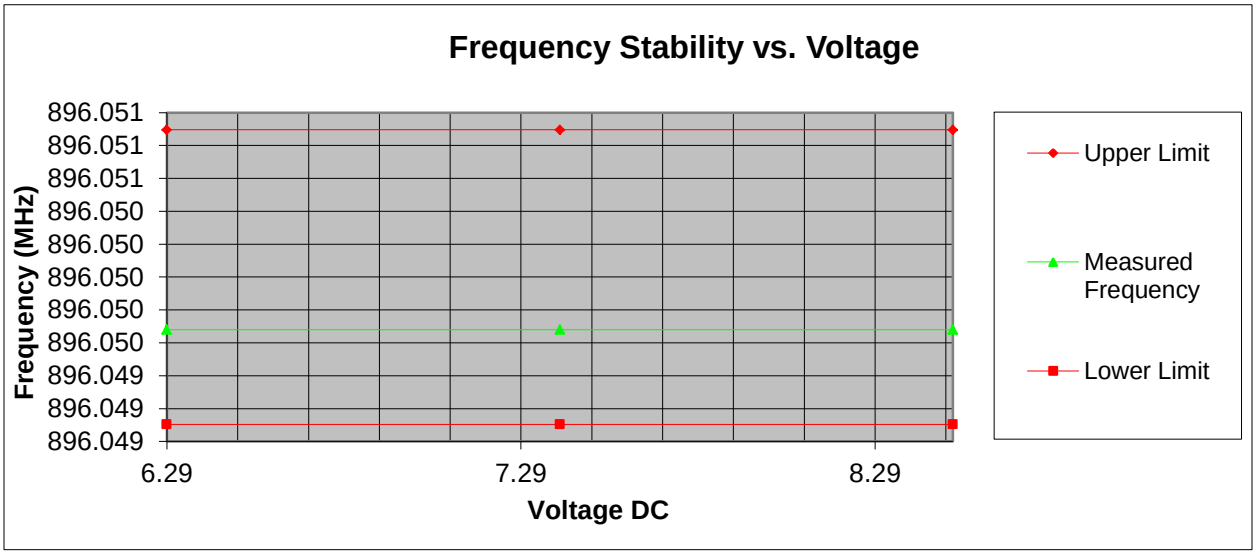
The EUT was placed in a temperature chamber at 25±5°C and connected directly to a frequency counter and variable power supply. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value and the RF output was measured.

Measurement Setup

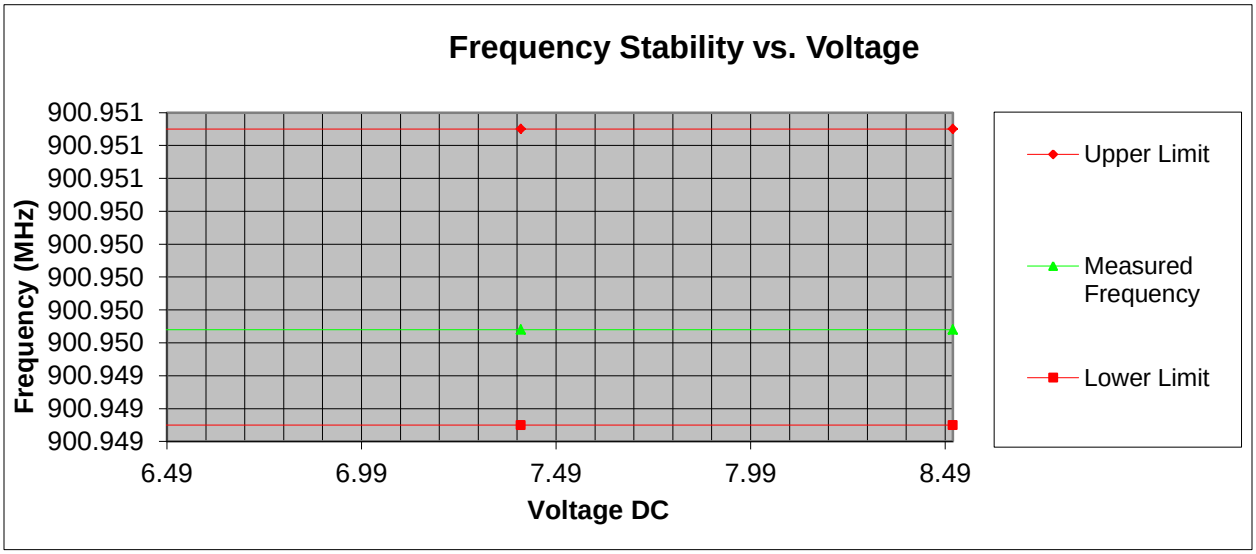


Part 90 Test Plots

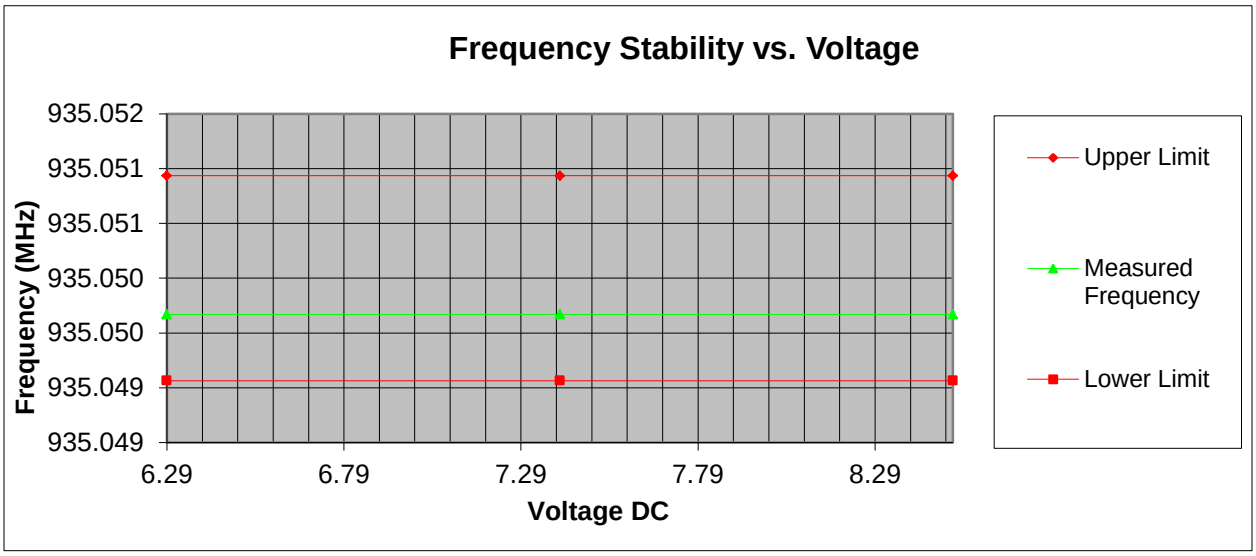
896.05 MHz



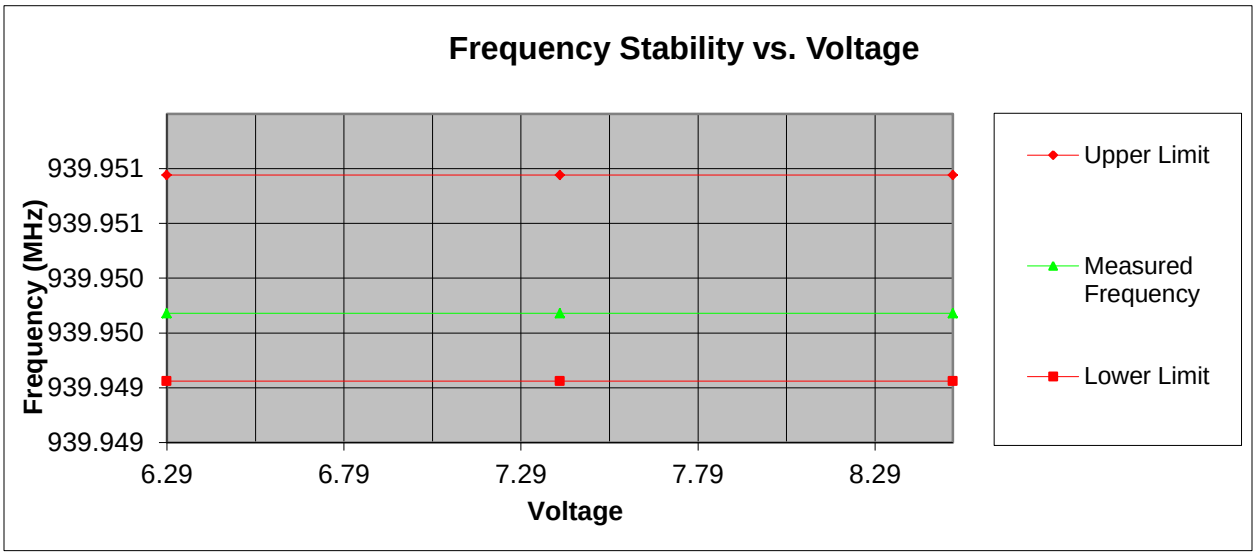
900.95 MHz



935.05 MHz

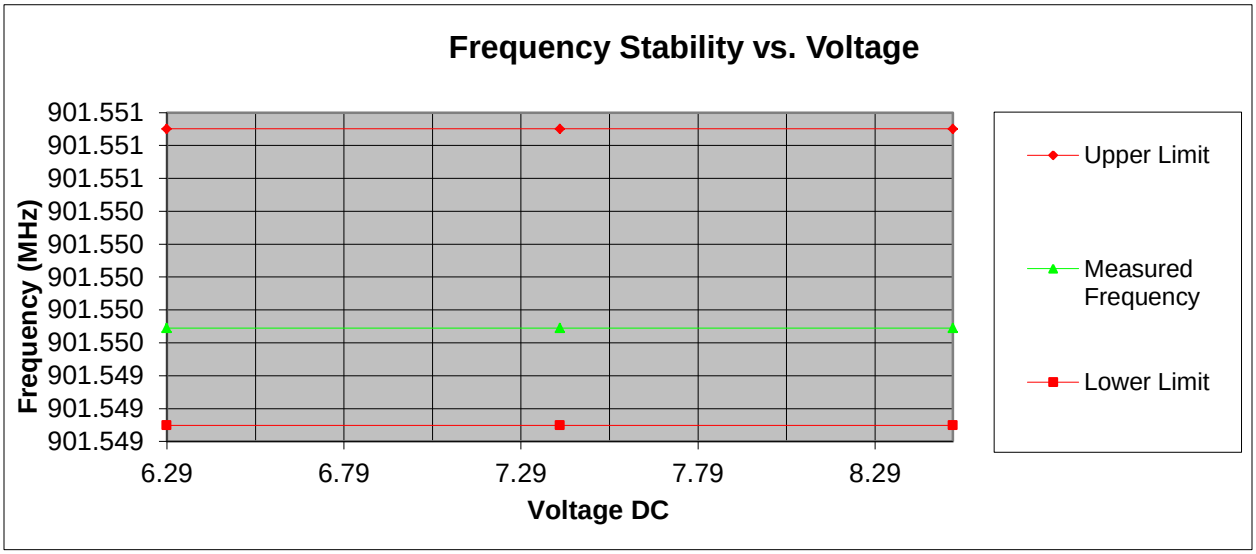


939.95 MHz

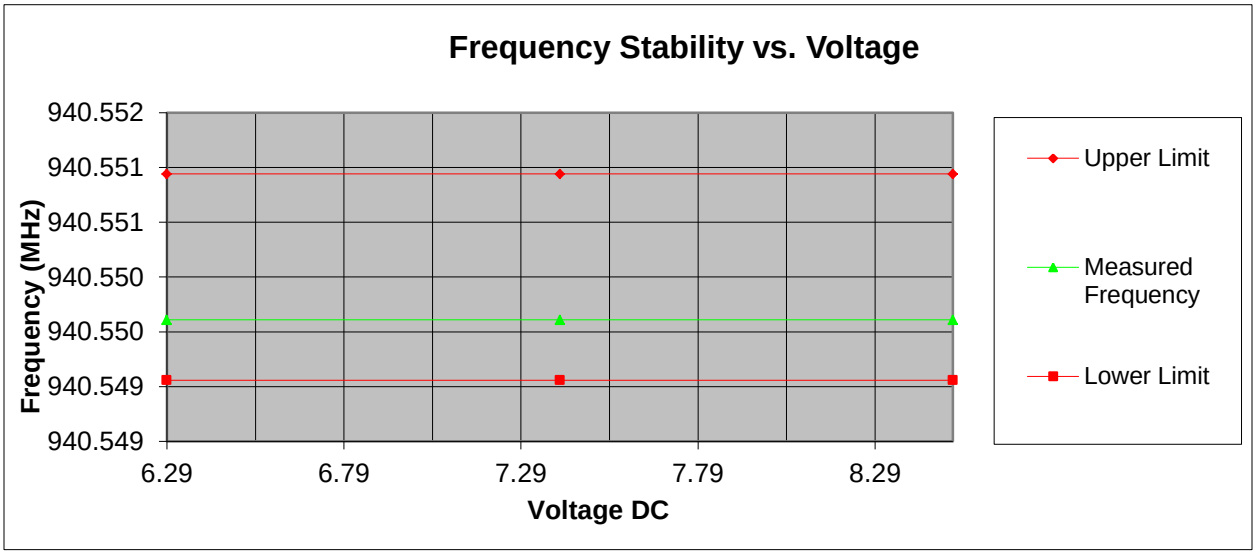


Part 24 Test Plots

901.55 MHz



940.55 MHz



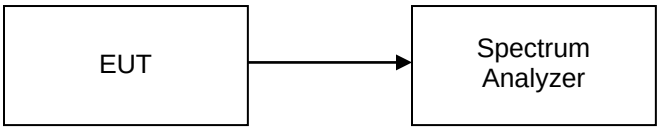
Receiver Spurious Emissions

Name of Test:	Receiver Spurious Emissions		
Specification:	RSS-GEN	**Engineer:** John Erhard	
Test Equipment Utilized:	i00331	**Test Date:** 9/23/2011	

Test Procedure

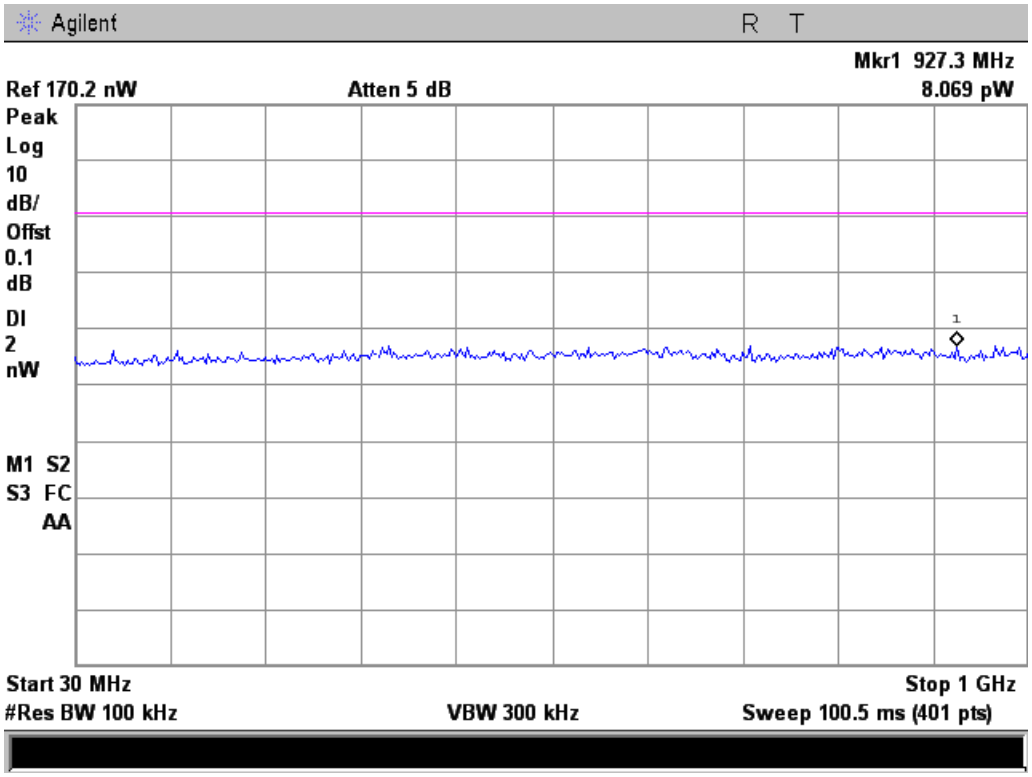
The Equipment under Test (EUT) was connected directly to a spectrum analyzer.
The cable loss was input into the analyzer as a reference level offset to ensure accurate readings.

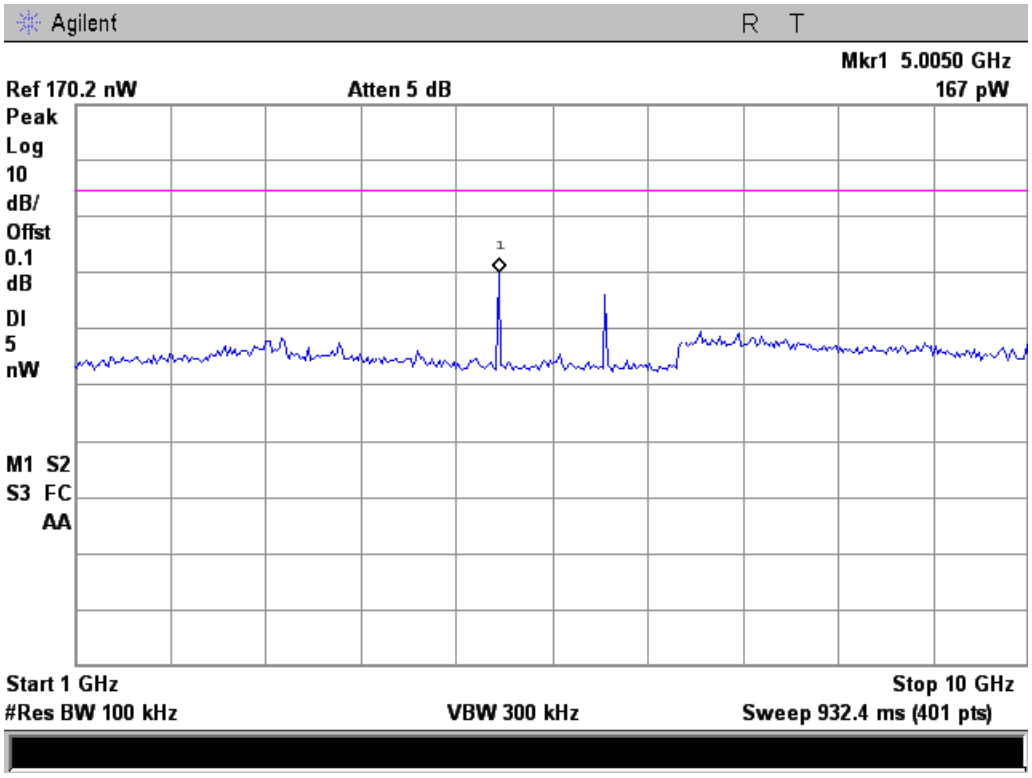
Test Setup



Test Results

Emission Frequency (MHz)	Measured Level	Limit	Result
927.3	8.069 pW	2 nW	Pass
5005	167 pW	5 nW	Pass


Agilent
R T
Mkr1 927.3 MHz
Ref 170.2 nW
Atten 5 dB
8.069 pW
Peak
Log
10
dB/
Offst
0.1
dB
Dl
2
nW
M1 S2
S3 FC
AA
Start 30 MHz
Stop 1 GHz
#Res BW 100 kHz
VBW 300 kHz
Sweep 100.5 ms (401 pts)


Agilent
R T
Mkr1 5.0050 GHz
Ref 170.2 nW
Atten 5 dB
167 pW
Peak
Log
10
dB/
Offst
0.1
dB
Dl
5
nW
M1 S2
S3 FC
AA
Start 1 GHz
Stop 10 GHz
#Res BW 100 kHz
VBW 300 kHz
Sweep 932.4 ms (401 pts)

Necessary Bandwidth Calculation

Name of Test: Necessary Bandwidth Calculations
Specification: 2.202 **Engineer:** John Erhard
Test Equipment Utilized: N/A **Test Date:** 9/23/2011

Modulation = 11K0F3E		
Necessary Bandwidth Calculation:		
Maximum Modulation (M), kHz	=	3
Maximum Deviation (D), kHz	=	2.5
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	(2xM)+(2xDxK)
	=	11.0

Modulation = 8K30F1E		
Necessary Bandwidth Calculation:		
Maximum Modulation (M), kHz	=	1.65
Maximum Deviation (D), kHz	=	2.5
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	(2xM)+(2xDxK)
	=	8.3

Modulation = 8K30F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	2.3
Maximum Deviation (D), kHz	=	2.5
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	8.3

Modulation = 8K30F7W		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	3.973
Maximum Deviation (D), kHz	=	2.5
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	($R/\log_2 S$)+2DK
	=	8.3

Modulation =4K00F1E		
Necessary Bandwidth Calculation:		
Maximum Modulation (M), kHz	=	.75
Maximum Deviation (D), kHz	=	1.25
Constant Factor (K)	=	
Necessary Bandwidth (B_N), kHz	=	(2xM)+(2xDxK)
	=	4.0

Modulation =4K00F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	1.0
Maximum Deviation (D), kHz	=	1.25
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	4.0

Modulation =4K00F7W		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	1.806
Maximum Deviation (D), kHz	=	1.25
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	8.3

Modulation =4K00F2D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	1.0
Maximum Deviation (D), kHz	=	1.25
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	4.0

Test Equipment Utilized

Description	MFG	Model Number	CT Asset #	Last Cal Date	Cal Due Date
Power Supply	HP	PR18-3A	i00008	NCR	NCR
Frequency Counter	HP	5334B	i00019	1/26/11	1/26/2012
Temperature Chamber	Tenney	Tenney Jr.	i00027	NCR	NCR
Horn Antenna	EMCO	3115	i00103	11/3/2010	11/3/2012
Arbitrary Waveform Generator	HP	33120A	i00118	NCR	NCR
DMM	Fluke	75III	i00320	1/26/2011	1/26/2012
Data Bucket	Fluke	Hydra	i00343	11/10/2010	11/10/2011
Spectrum Analyzer	Agilent	E4407B	i00331	5/24/2010	5/24/2011
Real Time Spectrum Analyzer	Tektronix	RSA3308A	i00345	9/16/2011	9/16/2012
Power Attenuator	Narda	769-30	i00347	NCR	NCR
Tunable Notch Filter	Eagle	TNF240MFMF	i00364	NCR	NCR
Oscilloscope	Tektronix	DPO3012	i00366	12/14/2010	12/14/2011

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