Test Report

Prepared for: Space Data Corporation

Model: SKS-900-MK2

Description: Narrowband PCS, Multi-Protocol SkySite

FCC ID: RY9SKS900MK2

To

FCC Part 24

Date of Issue: April 9, 2013

On the behalf of the applicant:	**Space Data Corporation** **2535 W. Fairview Street** **Suite 101** **Chandler, AZ 85224**
Attention of:	**Jerry Knoblach, Chairman / CEO** **Ph: (480)722-2100** **E-Mail: knoblach@spacedata**

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Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	April 9, 2013	Greg Corbin	Original Document
2.0	May 2, 2013	Greg Corbin	Removed reference to an obsolete test procedure on page 6. Removed antenna requirements statement from page 8. Clarified spectrum analyzer settings and added a graph to page 10. Clarified statement at end of the test data on Page 18

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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 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 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, 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, the sections of Part 24 as noted in the test summary table.

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		
Temp (ºC)	Humidity (%)	Pressure (mbar)
23.3 – 28.0	17.5 – 27.7	950.7 – 970.8

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

EUT Description

Model: SKS-900-MK2
Description: Narrowband PCS, Multi-Protocol SkySite
Firmware:
Code revision for the AS_1947 board: V1.00
Code revision for the AS_1953 board: V1.00

Additional Information

The EUT is a transceiver that mounts on a weather balloon to provide narrowband communication services to remote areas.
The SkySite® transceiver receives radio FSK encoded digital packets from a ground station or subscriber devices, converts these FSK signals into digital data, corrects errors, and retransmits the corrected data to the intended ground station or subscriber device.
Refer to Table 1 for the list of all the Emission Types that are available with this EUT.
The EUT operates in the following 3 frequency bands, 901 – 902 MHz, 930 – 931 MHz, 940 – 941 MHz.
The EUT was tested at the center of each band.

EUT Operation during Tests

The EUT is powered by batteries that cannot be re-charged.. The nominal operating voltage is 9.2 vdc. During some of the testing the batteries were replaced with a power supply.
The EUT was controlled via a serial data cable connected to a PC. The PC runs a user interface program called LCB Control Panel. This interface allows the user to set the parameters listed in Table 2 as required.
The EUT has 2 types of antennas available.

1. Antenna 1 - Omni-directional dipole, manufacturer=Pulse, P/N:SPDA24918, Gain = 2 dBi
2. Antenna 2 – Co-Linear Dipole Array, manufacturer: Space Data, P/N: N/A, Gain = 9.2 dB

Table 1 - EUT Modulation Types

Table 1 lists all the possible Modulation Types available for the EUT

	Emission Designator	Data Rate	Frequency Deviation (kHz)	Frequency Deviation (kHz)	Channel BW (kHz)	Modulation
1	12K0F1D	512	4.8	N/A	25	2FSK-NRZ
2	12K7F1D	1200	4.8	N/A	25	2FSK-NRZ
3	13K9F1D	2400	4.8	N/A	25	2FSK-NRZ
4	13K1F1D	1600	4.8	N/A	25	2FSK-NRZ
5	14K7F1D	3200	4.8	N/A	25	2FSK-NRZ
6	11K2F1D	3200	1.6	4.8	25	4FSK-NRZ
7	12K8F1D	6400	1.6	4.8	25	4FSK-NRZ
8	7K40F1D	1600	2.4	N/A	12.5	2FSK-NRZ
9	9K00F1D	3200	2.4	N/A	12.5	2FSK-NRZ
10	6K40F1D	3200	0.8	2.4	12.5	4FSK-NRZ
11	8K00F1D	6400	0.8	2.4	12.5	4FSK-NRZ
12	5K20F1D	800	0.8	2.4	12.5	4FSK-NRZ
13	5K60F1D	1600	0.8	2.4	12.5	4FSK-NRZ
14	8K00F1D	6400	0.8	2.4	12.5	4FSK-NRZ
15	9K60F1D	9600	0.8	2.4	12.5	4FSK-NRZ
16	12K3F1D	800	4.8	N/A	25	3FSK
17	9K00F1D	3200	2.4	N/A	12.5	3FSK
18	15K4F1D	9600	2.4	N/A	12.5	3FSK
19	8K69FXD	9600	0.648	1.944	12.5	4FSK
20	8K69FXE	9600	0.648	1.944	12.5	4FSK
21	16K0F1D	10,000	2.500	N/A	25	2FSK
22	32K0F1D	20,000	5.0000	N/A	40	2FSK
23	8K40F1W	9600	0.60	1.80	12.5	4FSK
24	4K50F1W	4800	0.350	1.050	6.25	4FSK
25	7K20F1W	4800	0.800	2.400	12.5	4FSK

Table 2 – EUT Modulation Types tested

From Table 1, the EUT modulation types were condensed down to the modulation types that were tested.
These modulation types are listed in Table 2.
The test data throughout this report refers to Test Parameters used.
This is referring to Table 2, column 1 “Test Parameters”.

Test Parameters	ADF7021 Modulation Type	Modulation	Channel BW (kHz)	Data Rate (Symrate) (Hz)	Frequency Deviation (kHz)
2	5	2FSK	12.5	3200	2.4
3	5	2FSK	25	512	4.8
4	5	2FSK	25	3200	4.8
5	5	2FSK	25	20000	5
6	6	3FSK	12.5	9600	2.4
7	6	3FSK	25	800	4.8
8	7	4FSK	12.5	4800	0.8
9	7	4FSK	25	3200	1.6

Accessories:

Qty	Description	Mfg	Model	S/N
1	Laptop PC	Dell	Latitude D820	N/A
1	AC to DC Adapter	Dell	PA-12	N/A
1	GPS Antenna, active	Antenna Factor	SH series	N/A
1	GPS Antenna, passive	Space Data	N./A	N/A

Cables:

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Termination
1	DB9 serial cable	8	N	N	N/A

Modifications: None

Test Result Summary

Specification	Test Name	Pass, Fail, N/A	Comments
2.1046 24.132(a)(b)	Output Power (Conducted)	Pass	
2.1051 24.133(a)	Conducted Spurious Emissions	Pass	
2.1053 24.133(a)	Field Strength of Spurious Radiation	Pass	
2.1049(h) 24.133(a)	Emission Limits (Occupied BW)	Pass	
24.135(a)	Frequency Stability (Temperature Variation)	Pass	
24.135(b)	Frequency Stability (Voltage Variation)	N/A	EUT is battery powered. Per 24.135(b) varying the voltage is not required.
	Intermodulation Test	N/A	The EUT converts the RF to baseband, so there will be no IF intermodulation products
2.202	Necessary Bandwidth Calculation	Pass	

Carrier Output Power (Conducted)

Name of Test:	Output Power (Conducted)	**Engineer:** Greg Corbin
Test Equipment Utilized:	i00379	**Test Date:** 4/1/2013

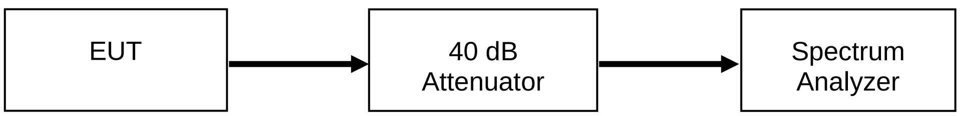
Measurement Procedure

The Equipment under Test (EUT) was connected as shown.

The correction factors for the attenuator and cable were input to the spectrum analyzer as reference level offsets before recording the Output Power.

The spectrum analyzer settings used were:
RBW = 100 kHz
VBW – 300 kHz
Detector = RMS average

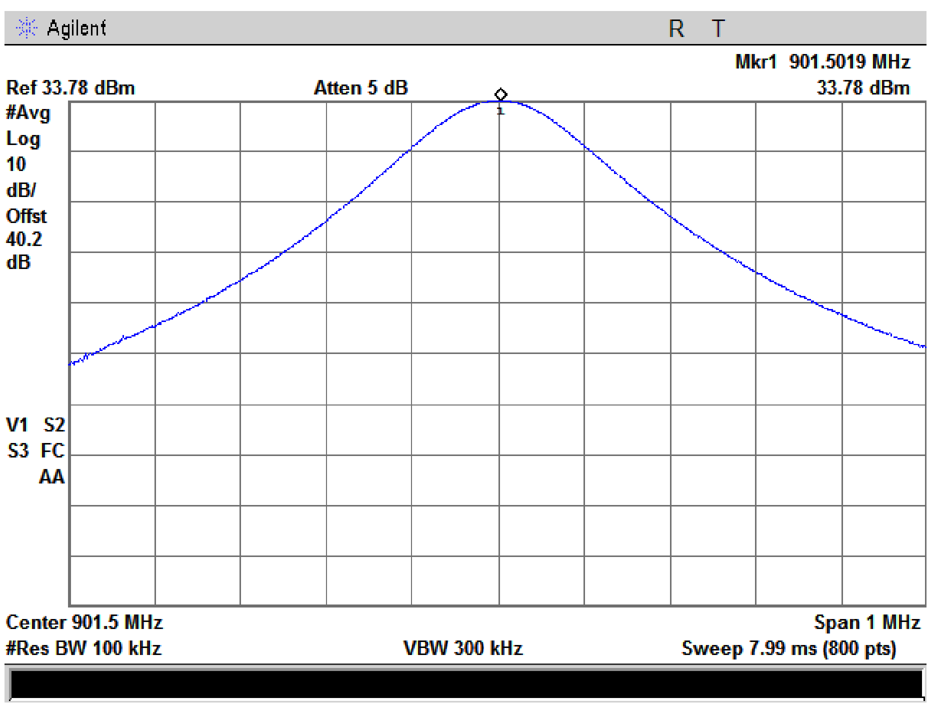
Test Setup



The graph below is the graph for the maximum output power that was measured as noted in the Average Output Power Test Results Table.
All the remaining output power graphs looked the same except for the absolute power measured, which is listed in the Average Output Power Test Results Table following the graph.

Average Output Power sample graph

EUT was set to Test Parameters #6 operating conditions. Refer to Table 2 on page 7, for details.



Average Output Power Test Results

Test Parameters Refer to page 7 Table 2	Tuned Frequency (MHz)	Recorded Measurement (dBm)	Limit (dBm)	Result
2	901.5	33.75	38.45	Pass
2	930.5	33.22	38.45	Pass
2	940.5	32.86	38.45	Pass
3	901.5	33.72	38.45	Pass
3	930.5	33.19	38.45	Pass
3	940.5	32.92	38.45	Pass
4	901.5	33.72	38.45	Pass
4	930.5	33.19	38.45	Pass
4	940.5	32.91	38.45	Pass
5	901.5	33.72	38.45	Pass
5	930.5	33.22	38.45	Pass
5	940.5	32.91	38.45	Pass
6	901.5	33.78	38.45	Pass
6	930.5	33.33	38.45	Pass
6	940.5	32.89	38.45	Pass
7	901.5	33.71	38.45	Pass
7	930.5	33.17	38.45	Pass
7	940.5	32.86	38.45	Pass
8	901.5	33.71	38.45	Pass
8	930.5	33.15	38.45	Pass
8	940.5	32.86	38.45	Pass
9	901.5	33.69	38.45	Pass
9	930.5	33.15	38.45	Pass
9	940.5	32.85	38.45	Pass

Conducted Spurious Emissions

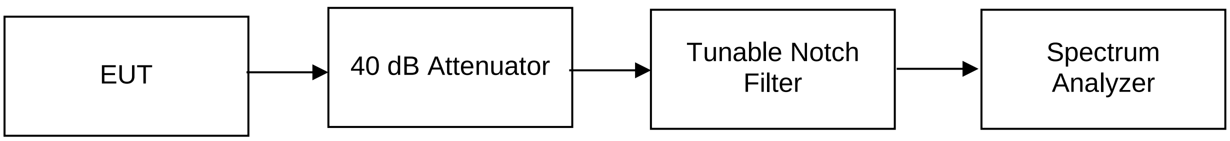
Name of Test: Conducted Spurious Emissions **Engineer:** Greg Corbin

Test Equipment Utilized: i00364, i00379 **Test Date:** 4/2/2013

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 was set to 30- kHz per 24.133 (d) 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 Parameters 5 was used for Conducted spurious emissions.
The correction factors for attenuator and cables were input to the spectrum analyzer before recording final data

Test Setup

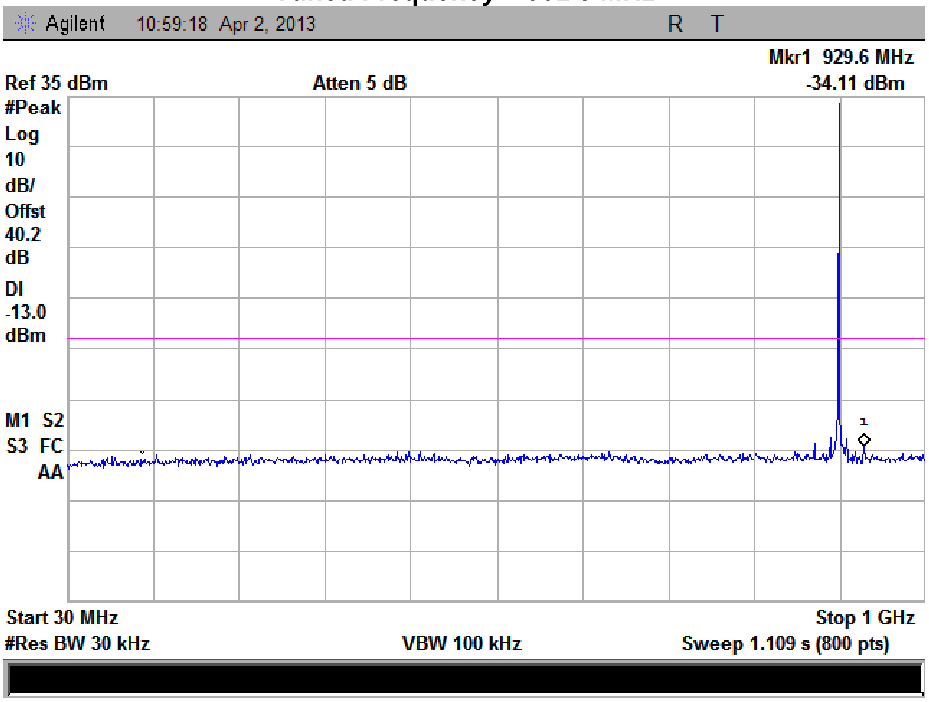


High Power Conducted Spurious Emissions Summary Test Table

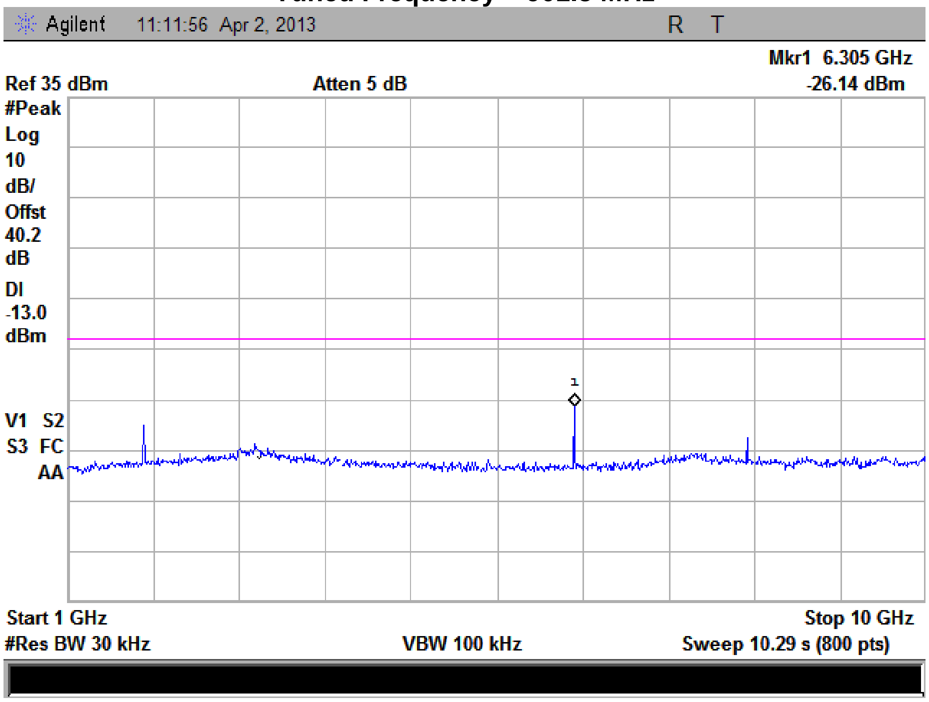
Tuned Frequency (MHz)	Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Specification Limit (dBm)	Result
901.5	6305	-26.1	-13	Pass
930.5	5584	-28.1	-13	Pass
940.5	6587	-26.8	-13	Pass

Conducted Emissions Test Plots

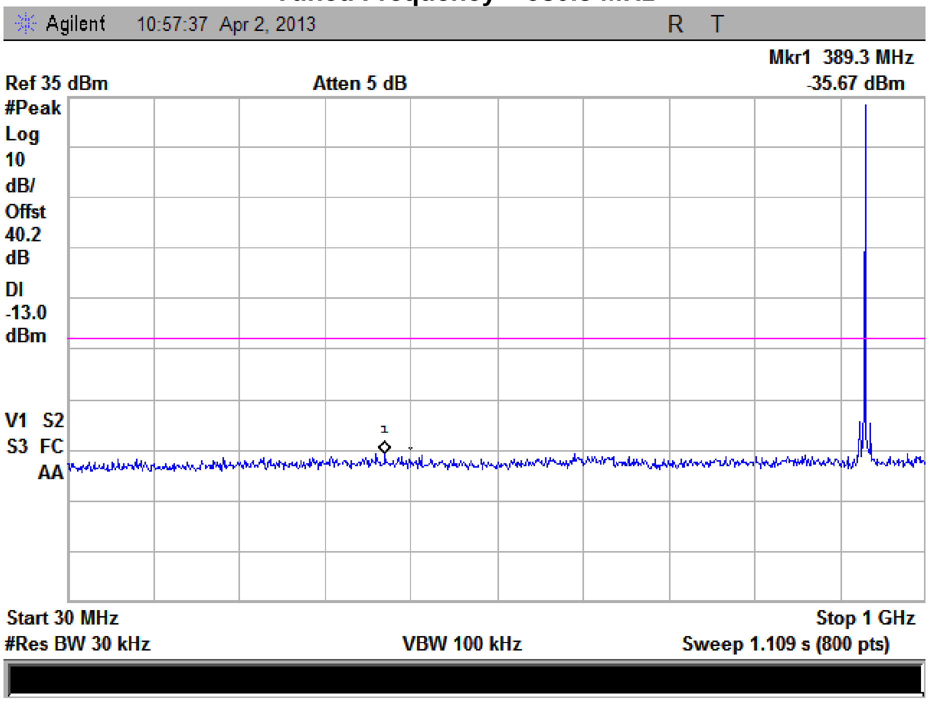
30 – 1000 MHz
Tuned Frequency – 901.5 MHz



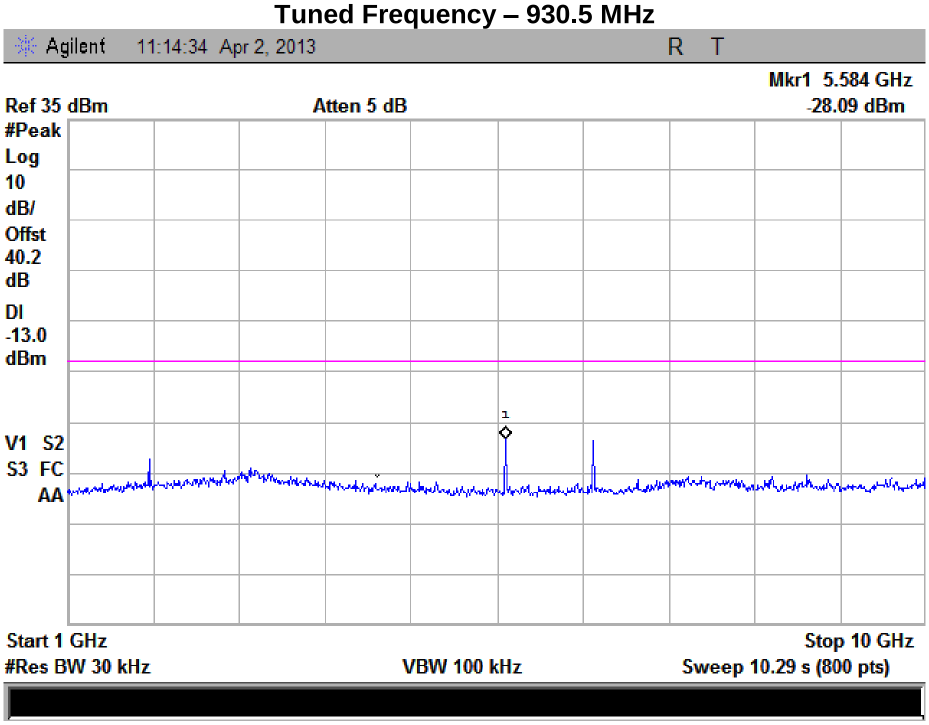
1 – 10 GHz
Tuned Frequency – 901.5 MHz



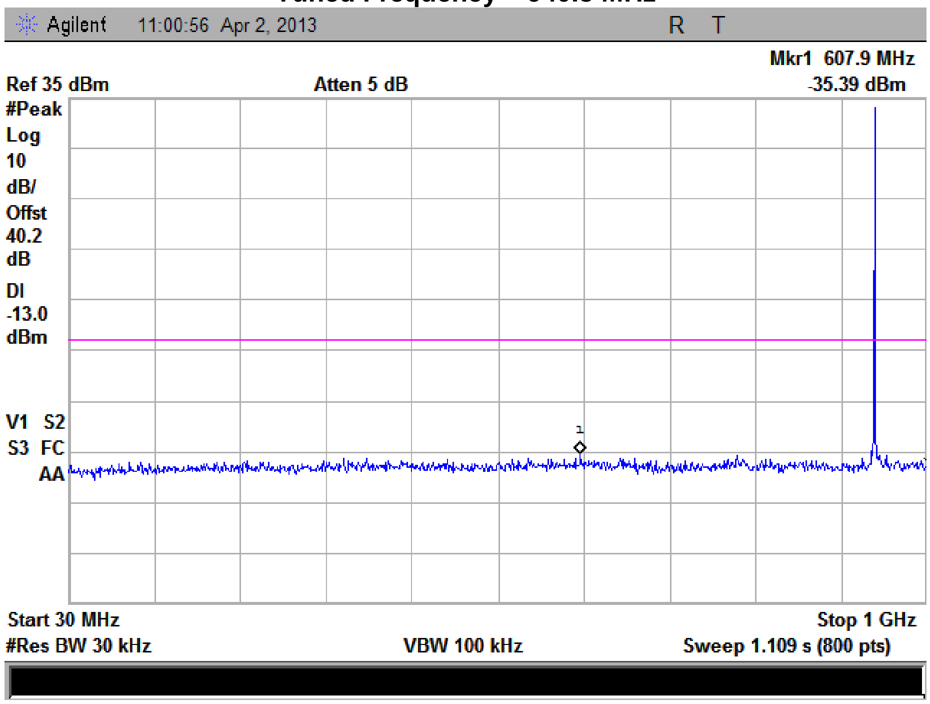
30 – 1000 MHz
Tuned Frequency – 930.5 MHz



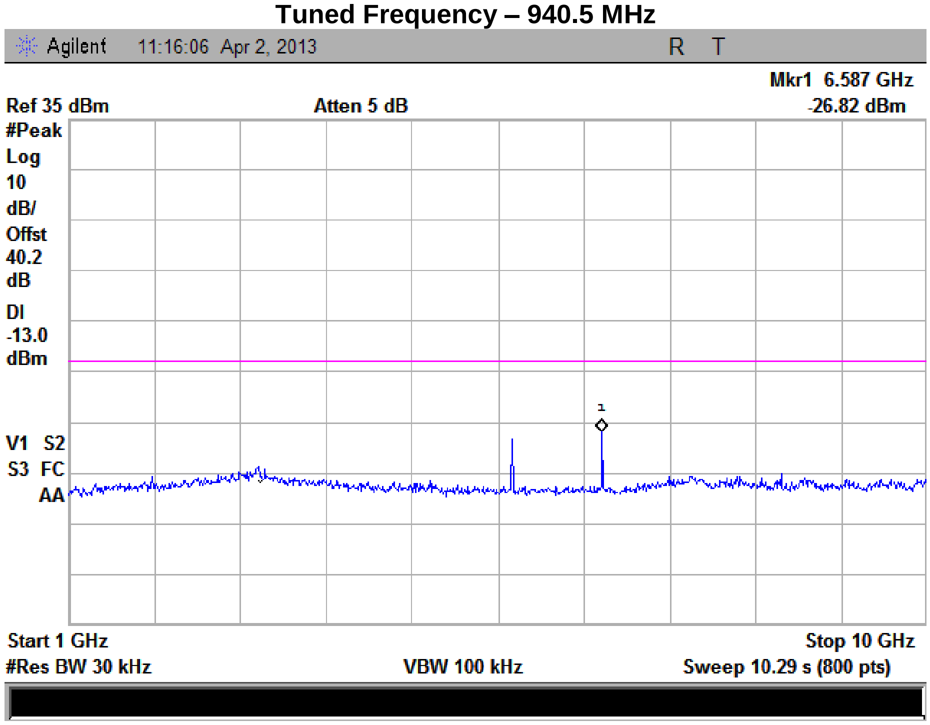
1 – 10 GHz
Tuned Frequency – 930.5 MHz



30 – 1000 MHz
Tuned Frequency – 940.5 MHz



1 – 10 GHz
Tuned Frequency – 940.5 MHz



Field Strength of Spurious Radiation

Name of Test:	Field Strength of Spurious Radiation	**Engineer:** Greg Corbin
Test Equipment Utilized:	i00033, i00267, i00271, i00364, i00379	**Test Date:** 4/8/2013

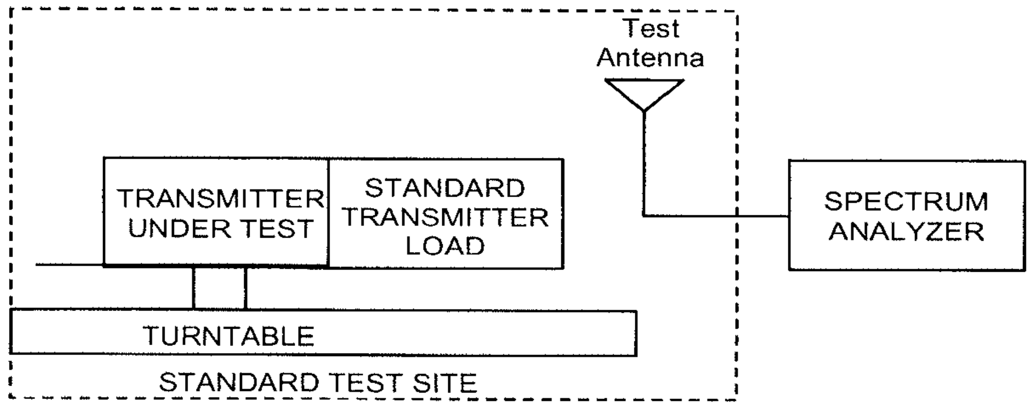
Test Procedure

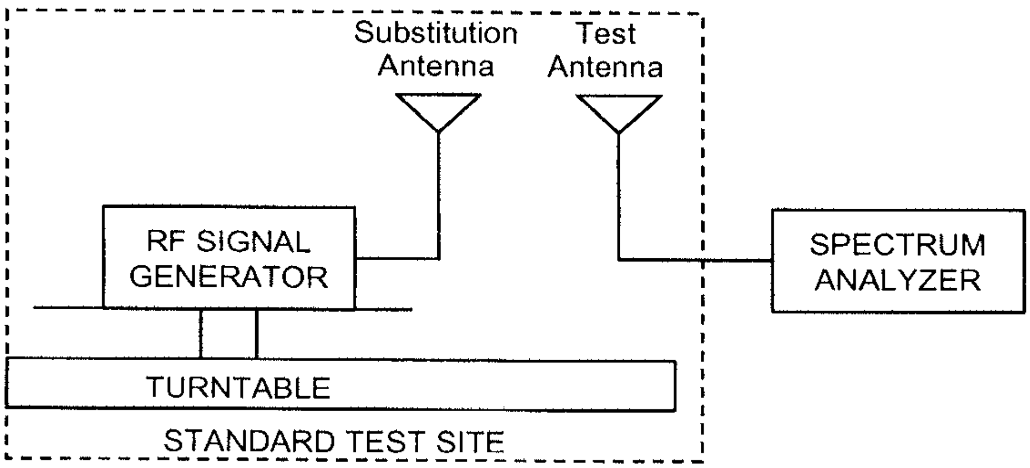
A) Connect the equipment as illustrated below.
B) Adjust the spectrum analyzer to the following settings:
   1) Resolution Bandwidth 100 kHz (< 1 GHZ), 1 MHZ (> 1GHz)
   2) Video Bandwidth ≥ 3 times Resolution Bandwidth, or 30 kHz
   3) Sweep Speed ≤2000 Hz/second
   4) Detector Mode = Mean or Average 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

Test Results

Tuned Frequency = 901.5 MHz
Test Parameters 5

Emission Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
1803	-81.9	-13	Pass
2704.5	-76.3	-13	Pass
3606	-83.9	-13	Pass

Tuned Frequency = 930.5 MHz
Test Parameters 5

Emission Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
1861	-81.1	-13	Pass
2791.5	-78.2	-13	Pass
3722	-84.2	-13	Pass

Tuned Frequency = 940.5 MHz
Test Parameters 5

Emission Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
1881	-80.4	-13	Pass
2821.5	-76.8	-13	Pass
3762	-84.4	-13	Pass

No other emissions were detected. All emissions were below the -13 dBm limit.

Emission Masks (Occupied Bandwidth)

Name of Test:	Emission Mask (Occupied Bandwidth)	**Engineer:** Greg Corbin
Test Equipment Utilized:	i00379	**Test Date:** 4/5/2013

Measurement Procedure

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.
The correction factors for the cable and attenuator were input to the spectrum analyzer as reference level offsets before recording the emission masks.

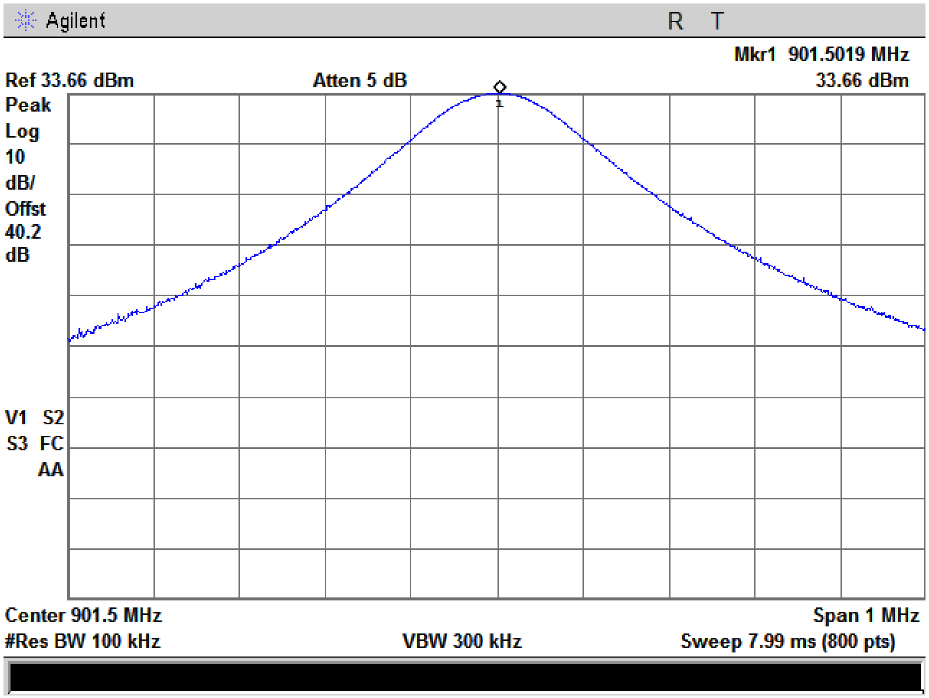
The EUT was internally modulated with the test parameters set as shown Table 2 on page 7.

Test Setup

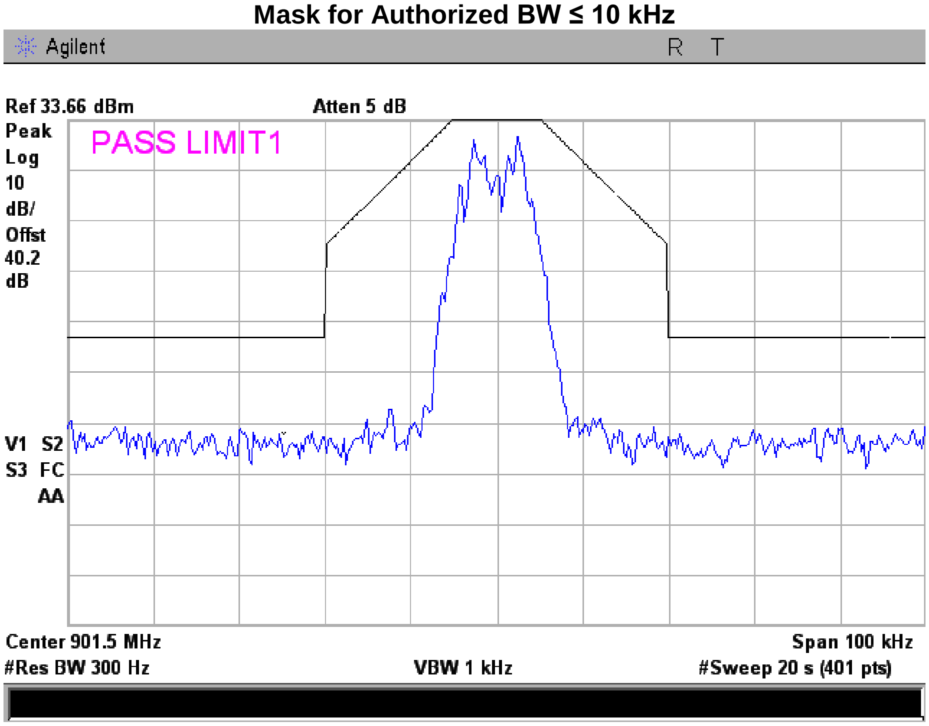
Occupied Bandwidth Plots for Authorized BW ≤ 10 kHz

Test Parameters 2
Tuned Frequency = 901.5 MHz

Reference Plot

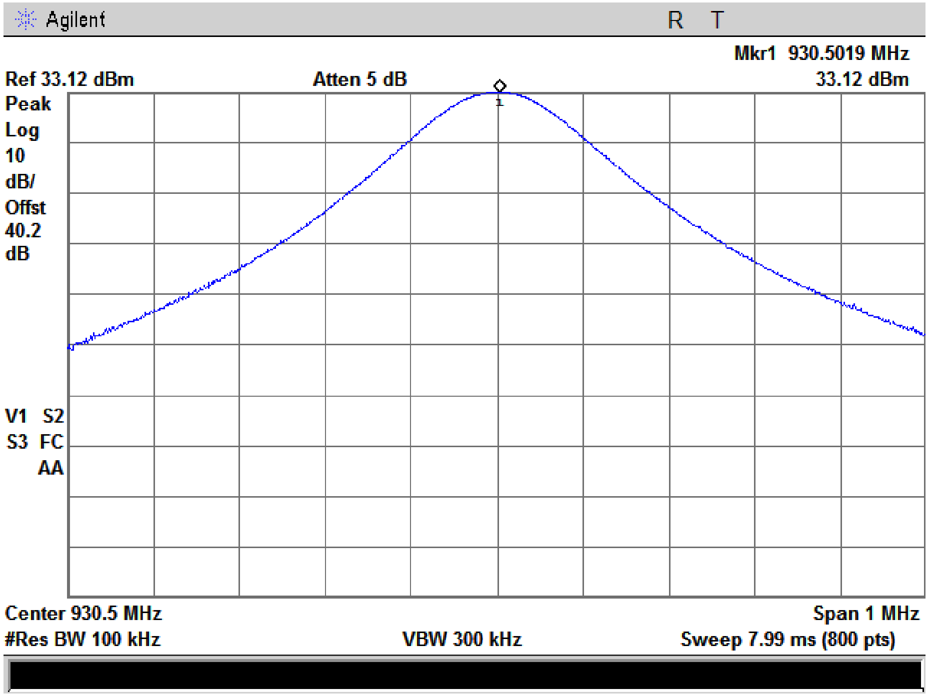


Mask for Authorized BW ≤ 10 kHz

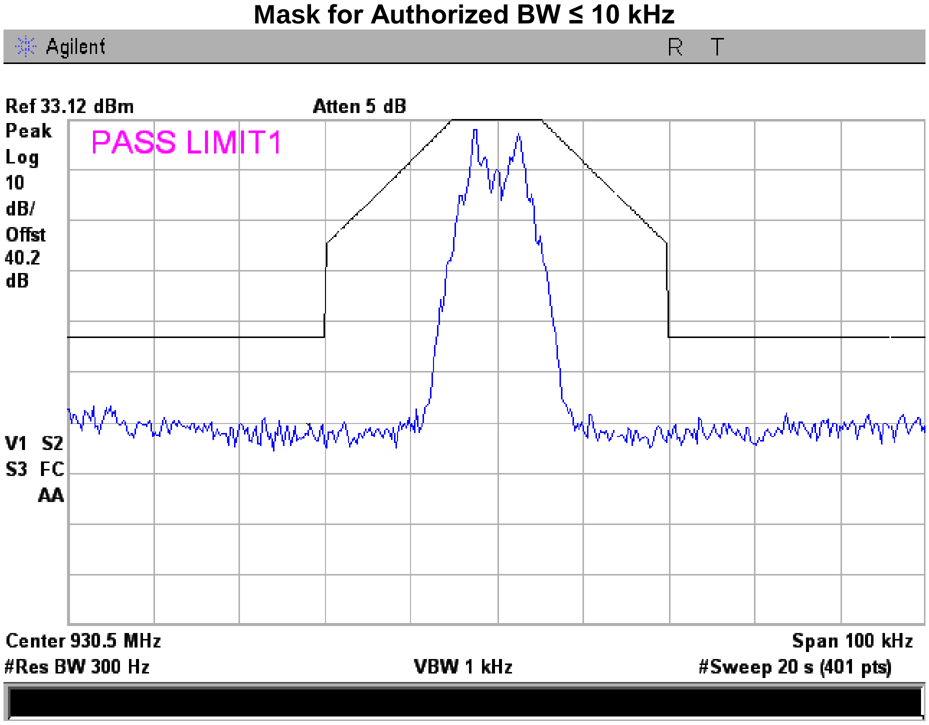


Test Parameters 2
Tuned Frequency = 930.5 MHz

Reference Plot

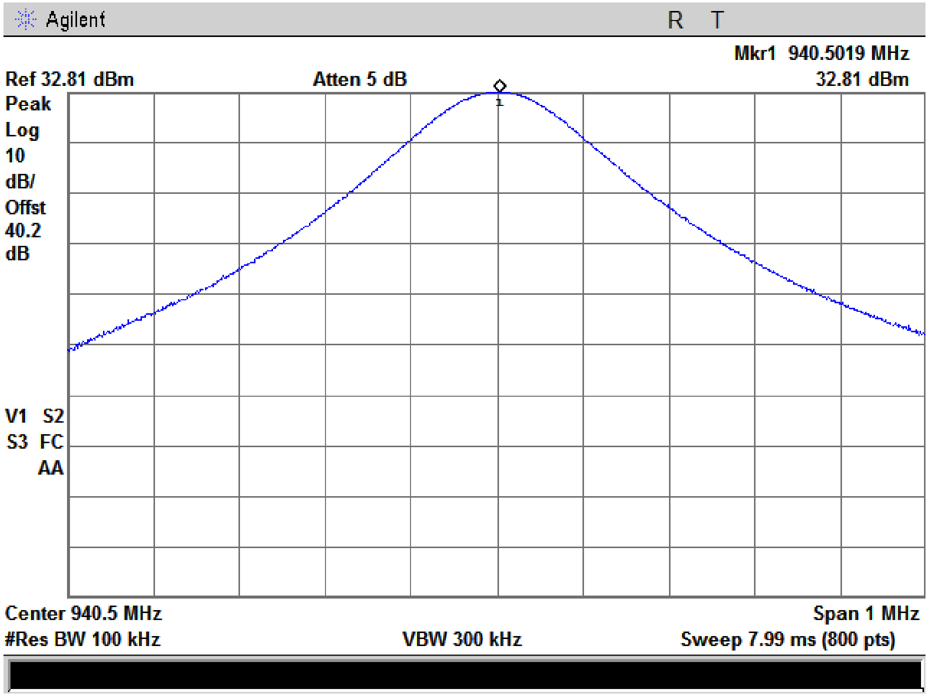


Mask for Authorized BW ≤ 10 kHz

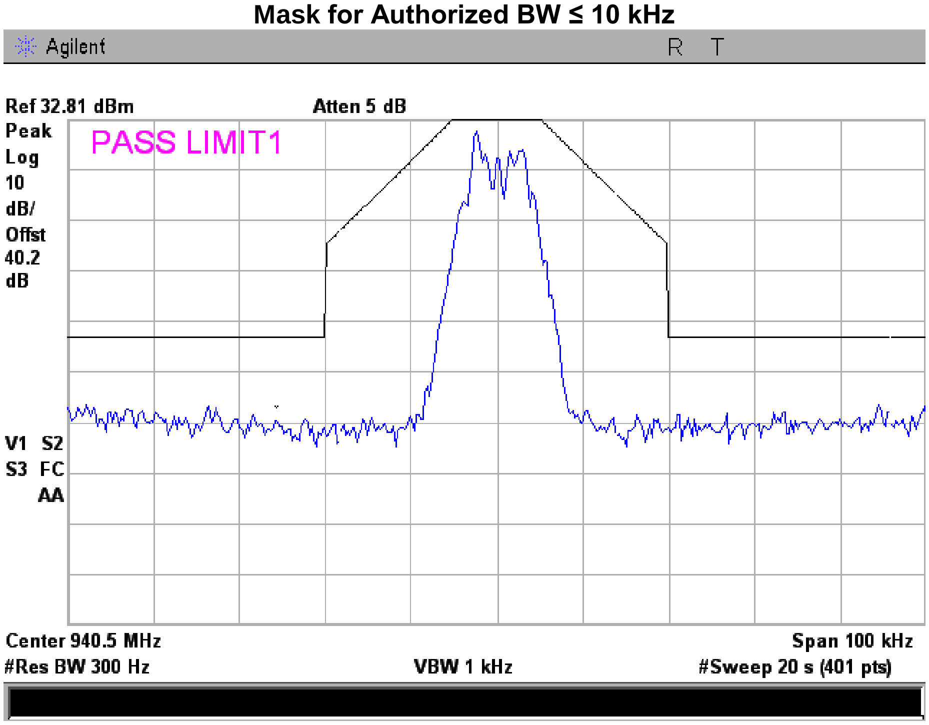


Test Parameters 2
Tuned Frequency = 940.5 MHz

Reference Plot

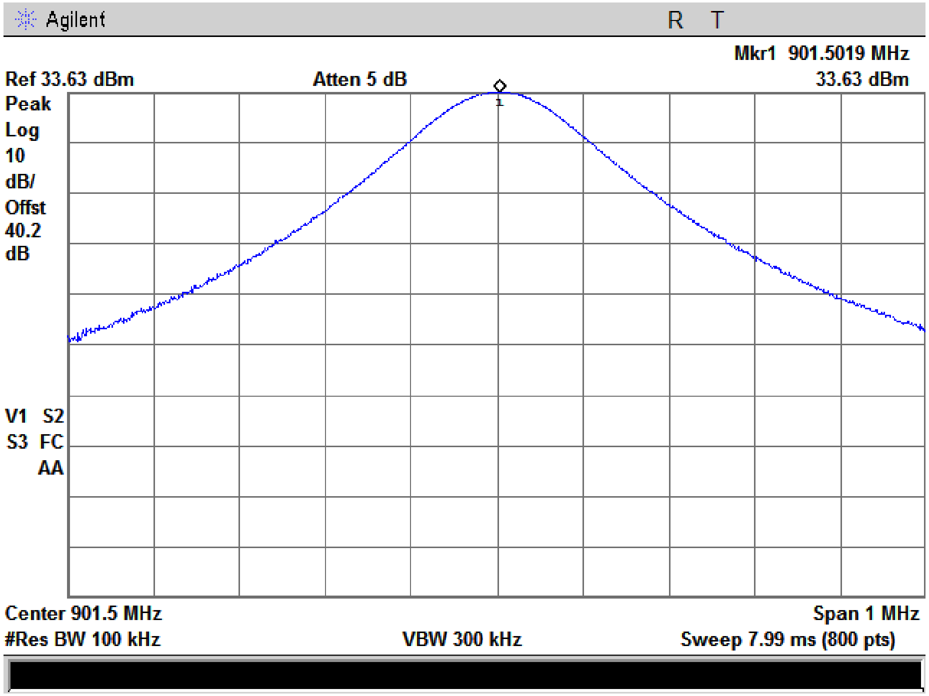


Mask for Authorized BW ≤ 10 kHz

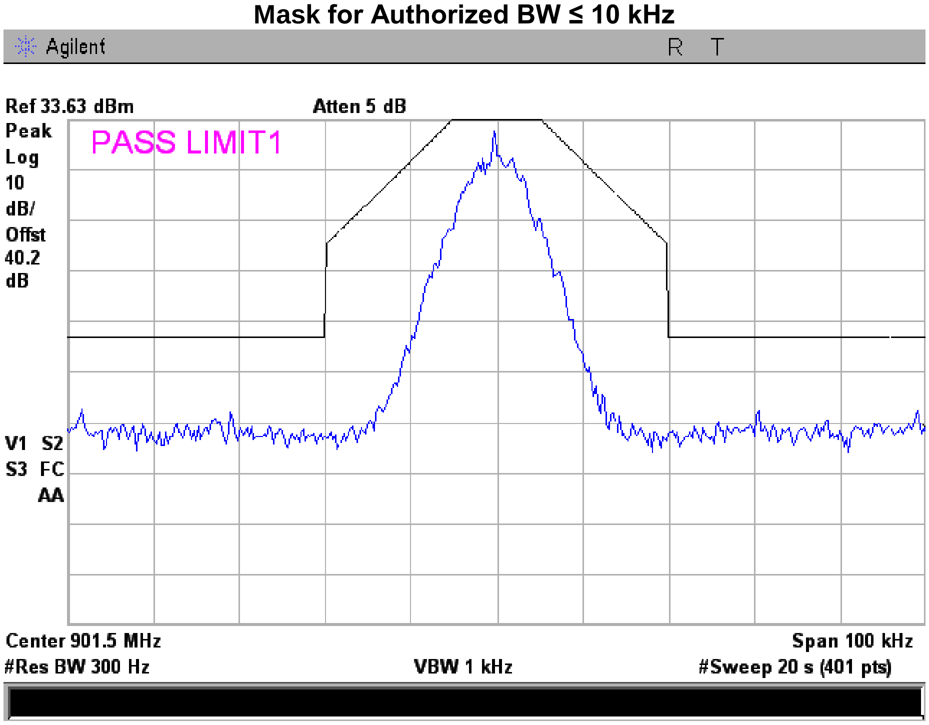


Test Parameters 6
Tuned Frequency = 901.5 MHz

Reference Plot

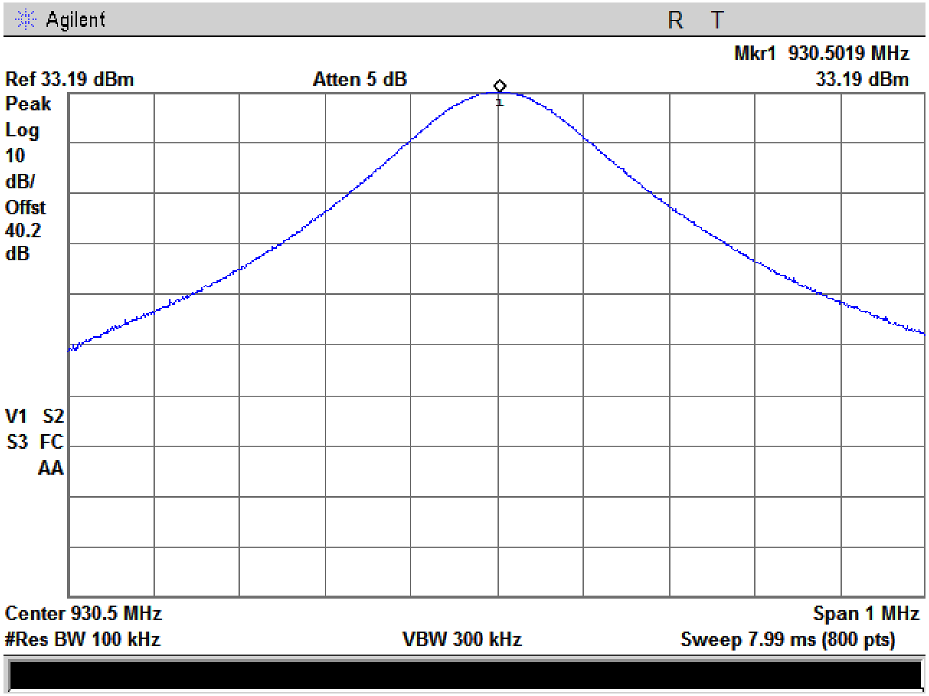


Mask for Authorized BW ≤ 10 kHz

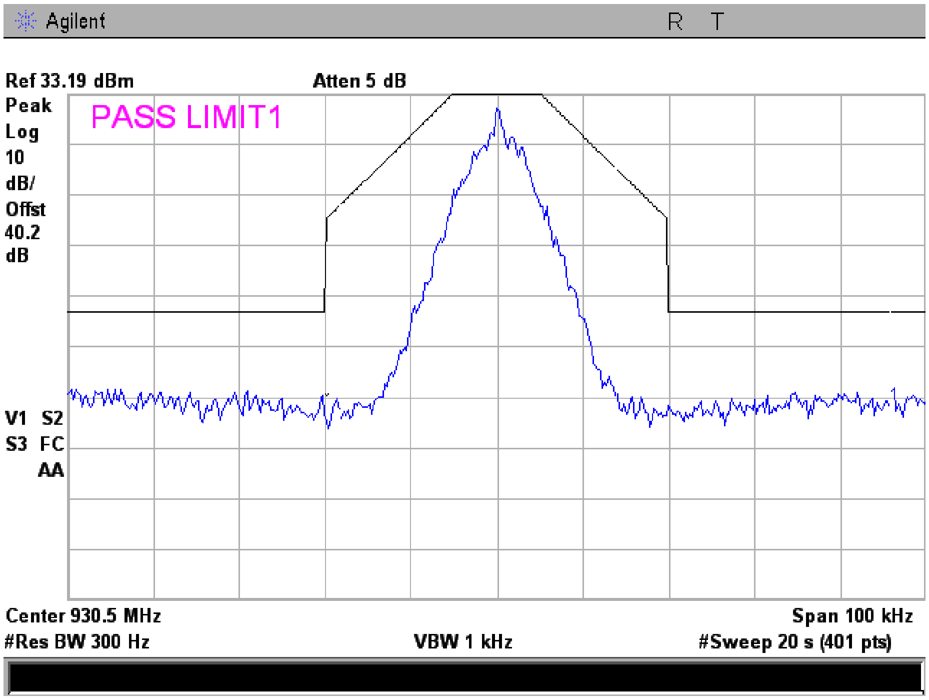


Test Parameters 6
Tuned Frequency = 930.5 MHz

Reference Plot

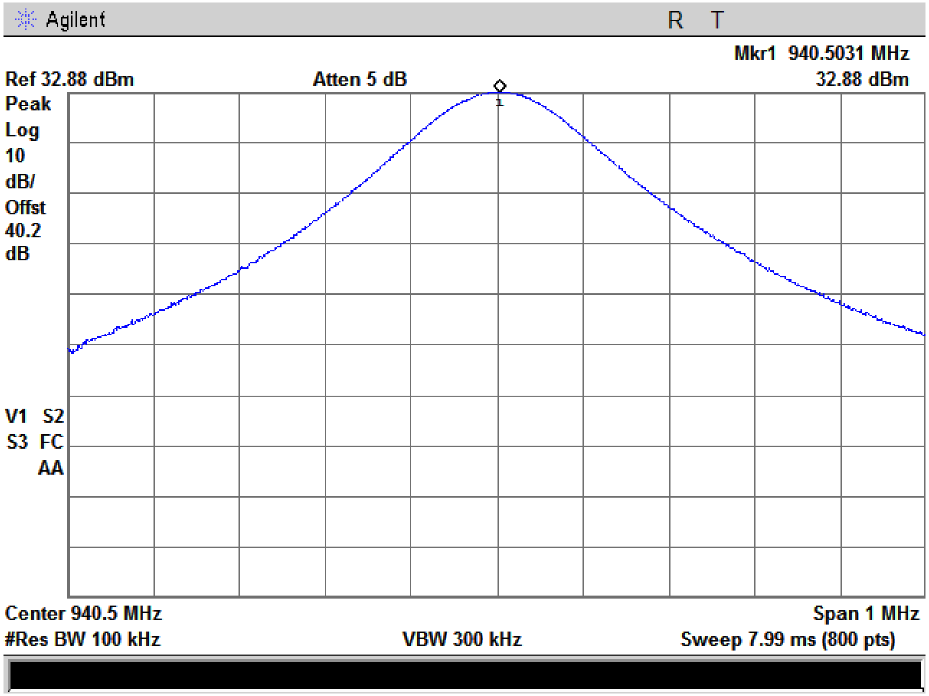


Mask for Authorized BW ≤ 10 kHz

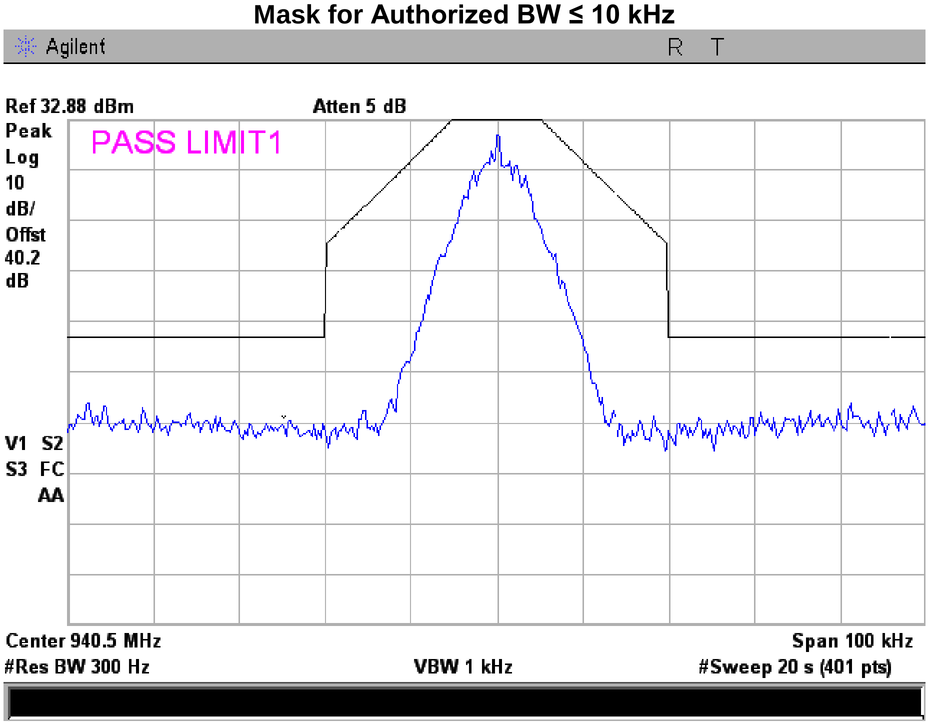


Test Parameters 6
Tuned Frequency = 940.5 MHz

Reference Plot

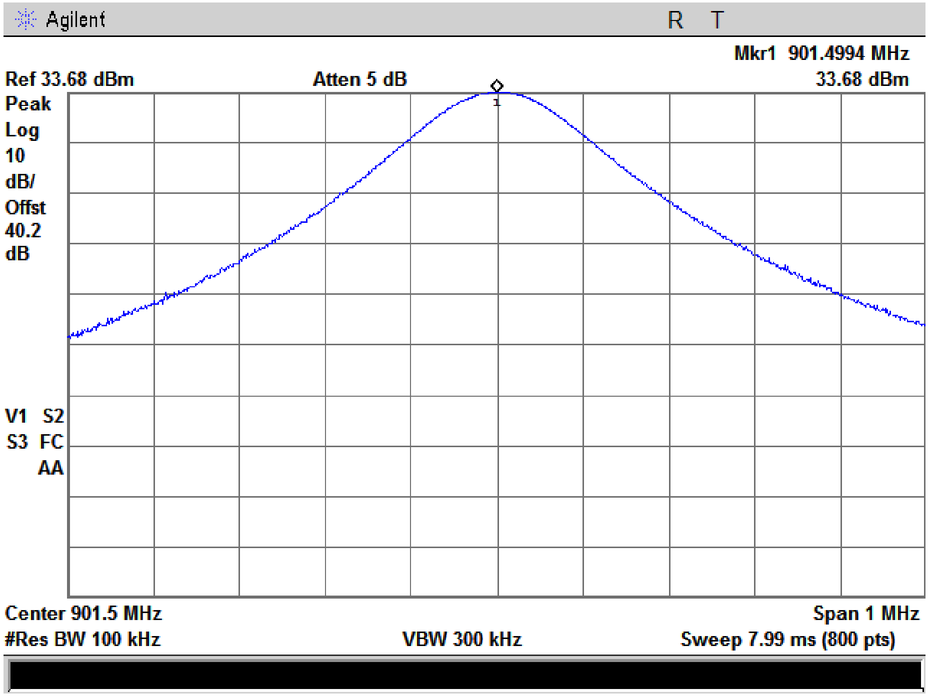


Mask for Authorized BW ≤ 10 kHz

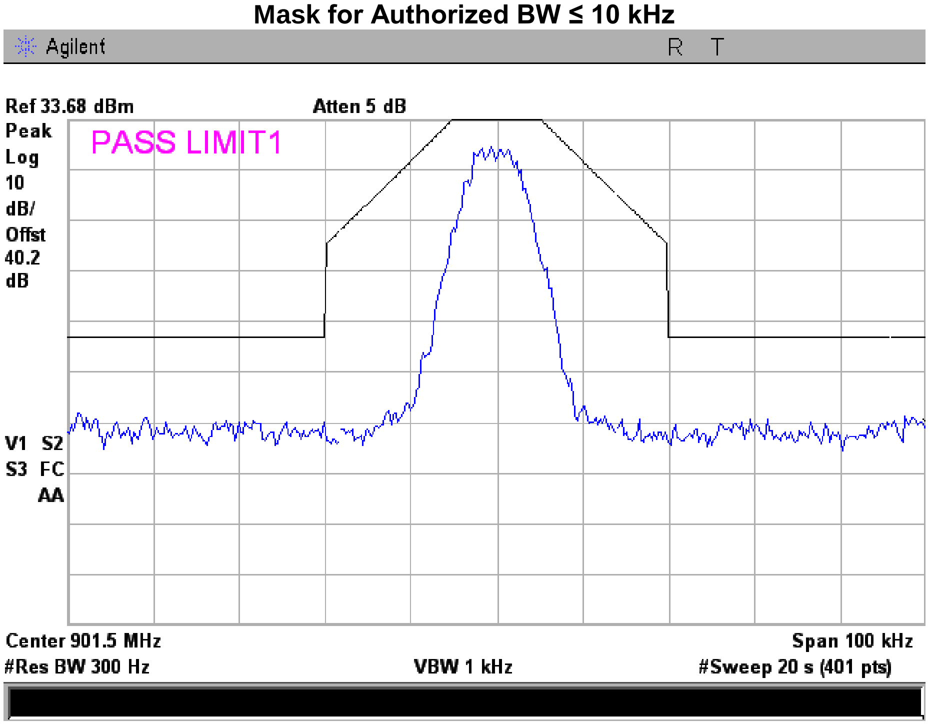


Test Parameters 8
Tuned Frequency = 901.5 MHz

Reference Plot

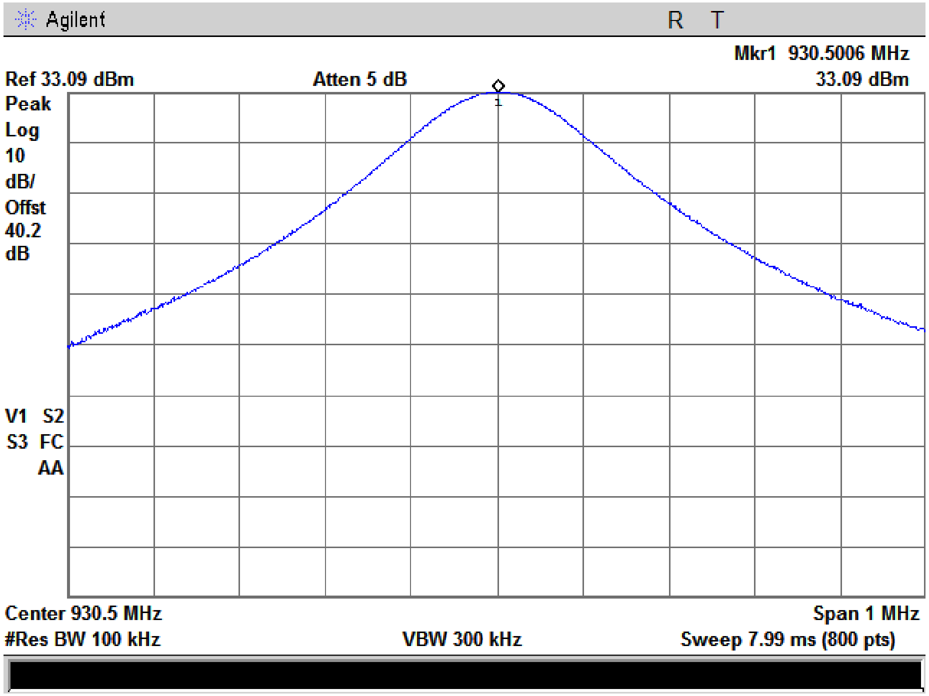


Mask for Authorized BW ≤ 10 kHz

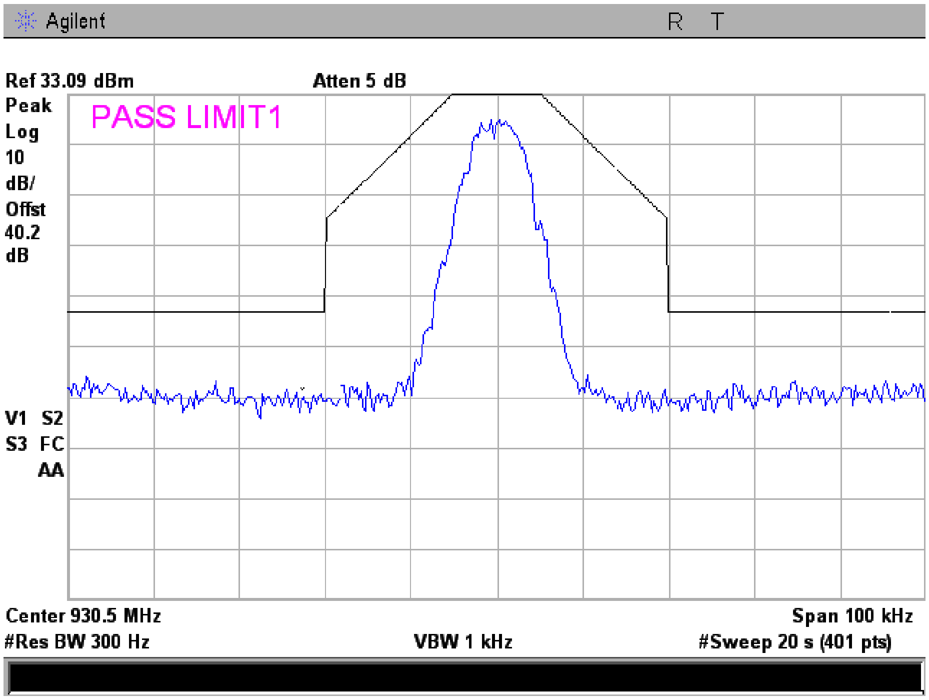


Test Parameters 8
Tuned Frequency = 930.5 MHz

Reference Plot

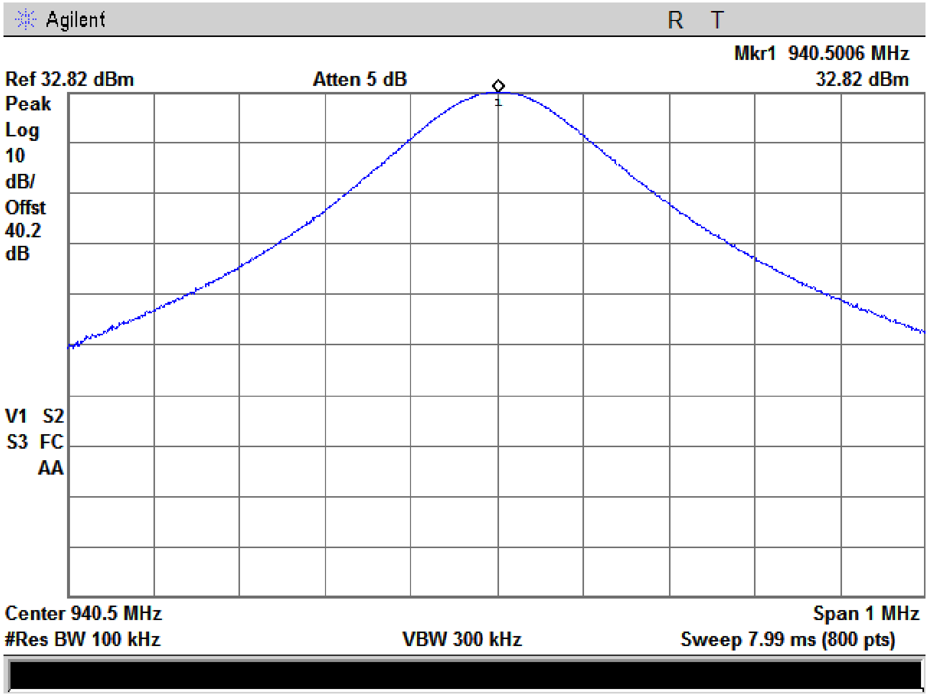


Mask for Authorized BW ≤ 10 kHz

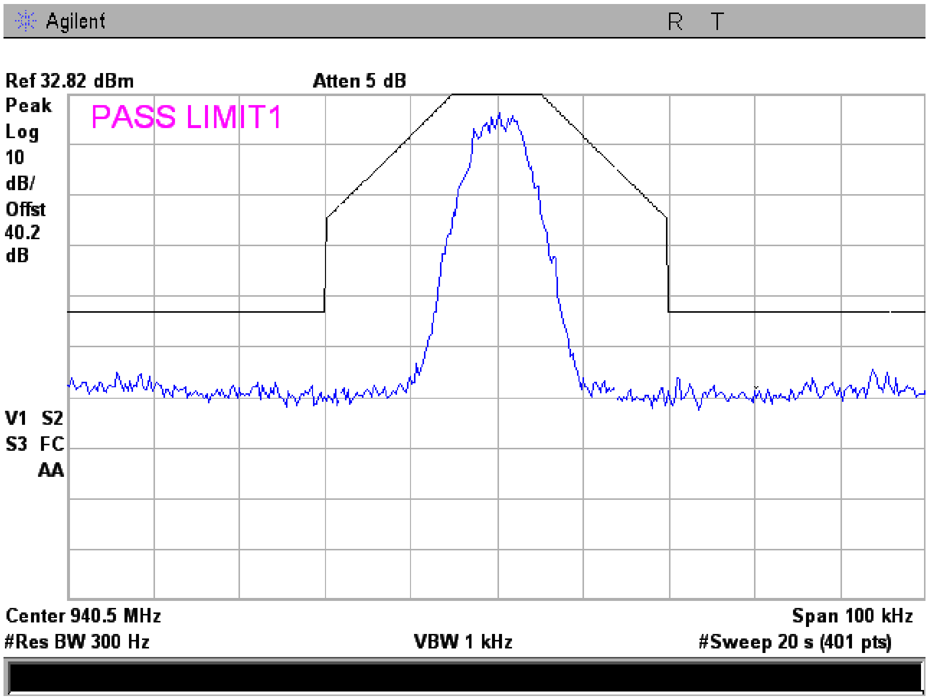


Test Parameters 8
Tuned Frequency = 940.5 MHz

Reference Plot



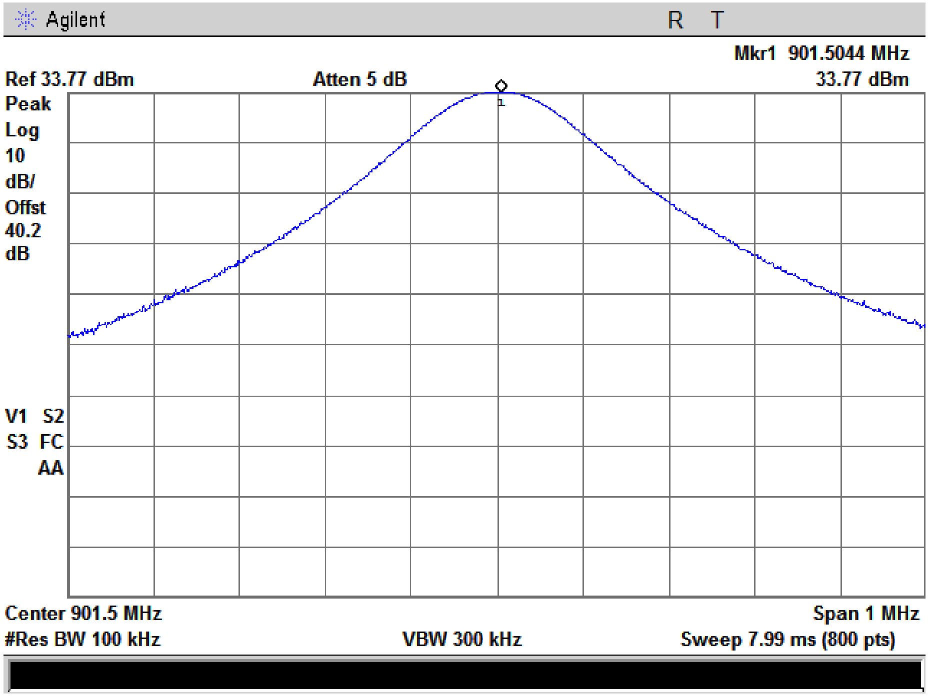
Mask for Authorized BW ≤ 10 kHz



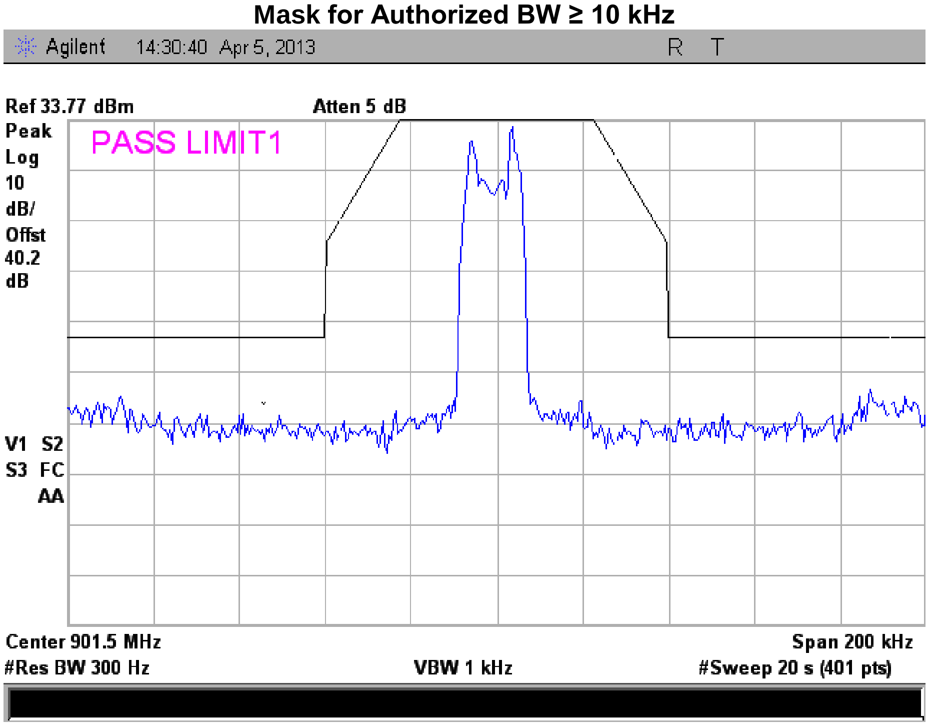
Occupied Bandwidth Plots for Authorized BW ≥ 10 kHz

Test Parameters 3
Tuned Frequency = 901.5 MHz

Reference Plot

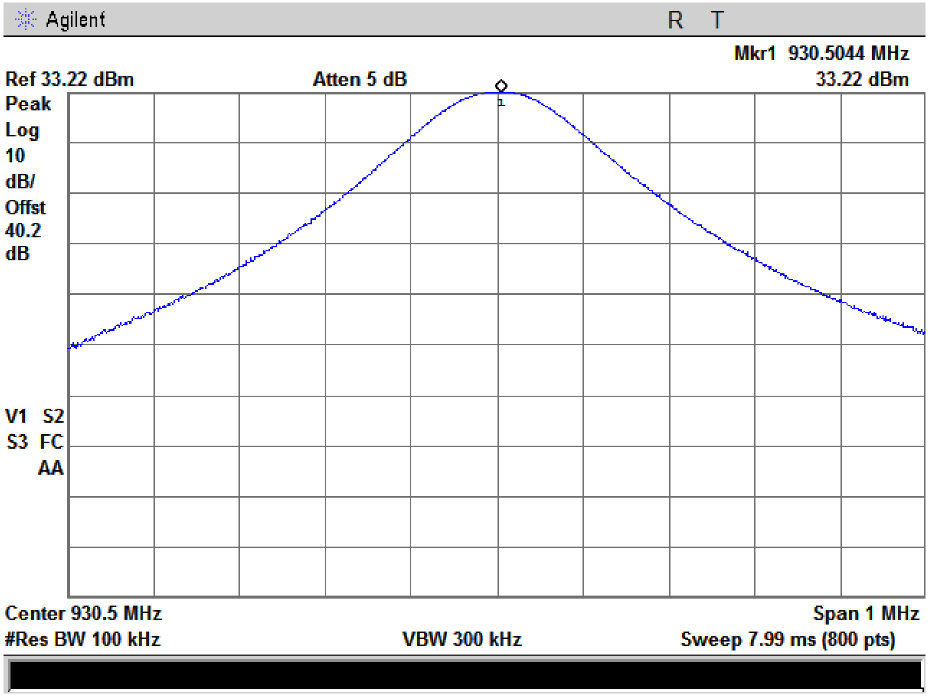


Mask for Authorized BW ≥ 10 kHz

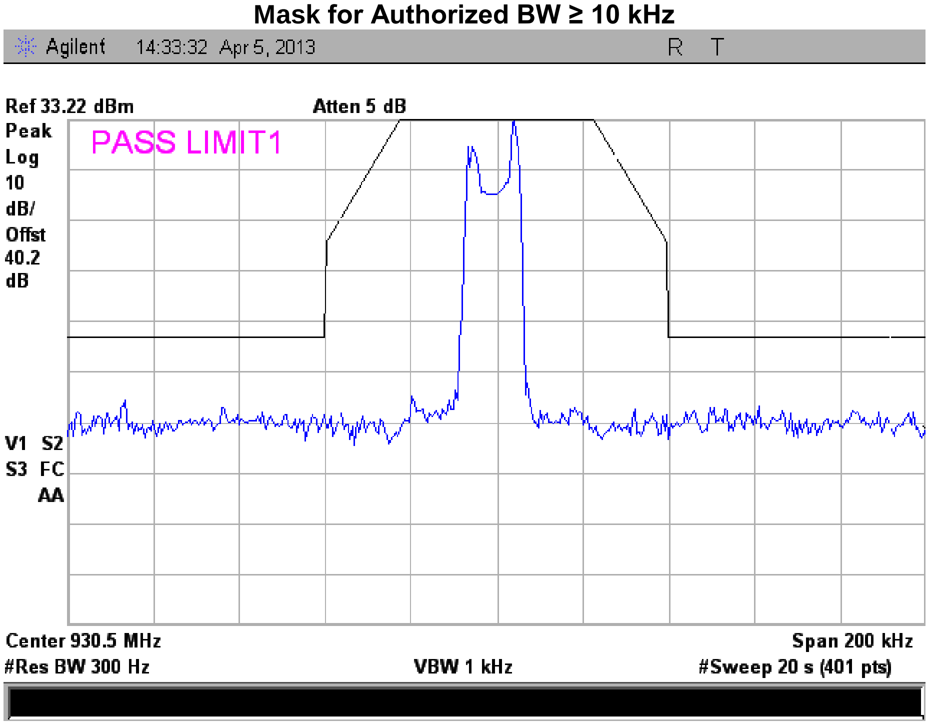


Test Parameters 3
Tuned Frequency = 930.5 MHz

Reference Plot

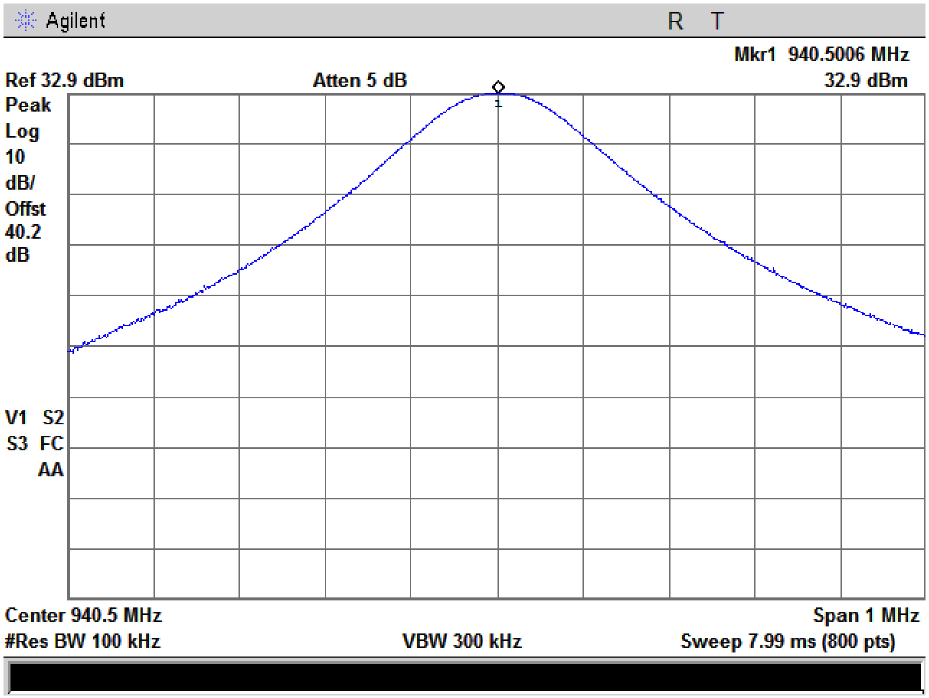


Mask for Authorized BW ≥ 10 kHz

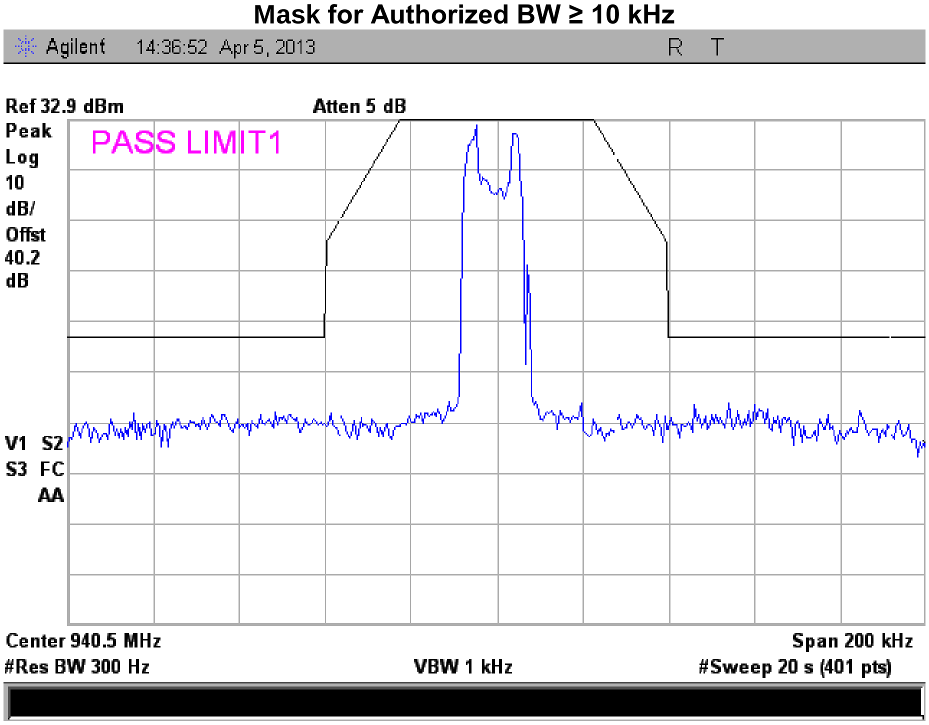


Test Parameters 3
Tuned Frequency = 940.5 MHz

Reference Plot



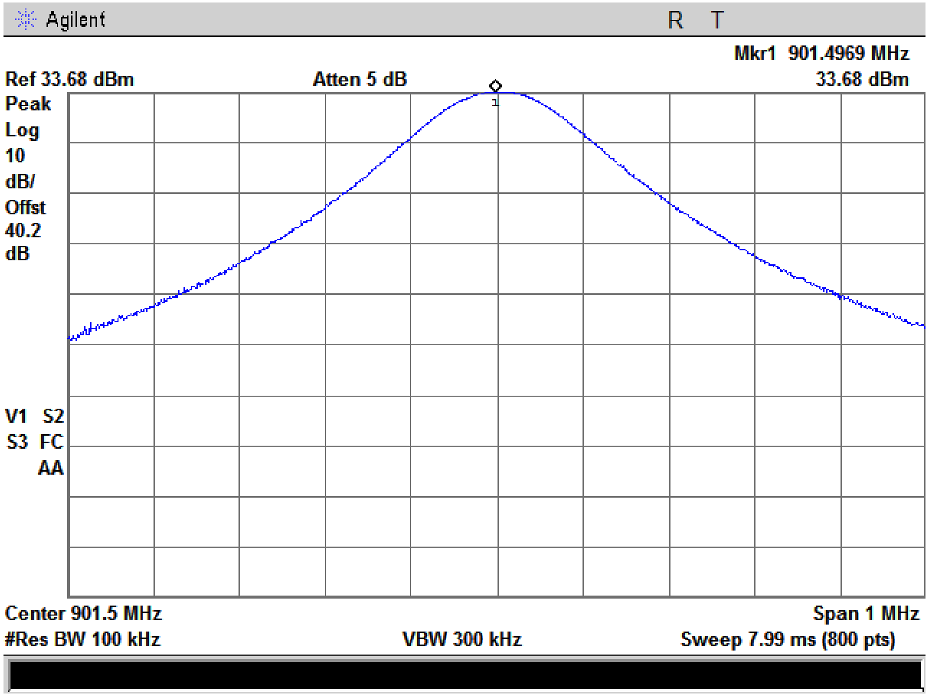
Mask for Authorized BW ≥ 10 kHz



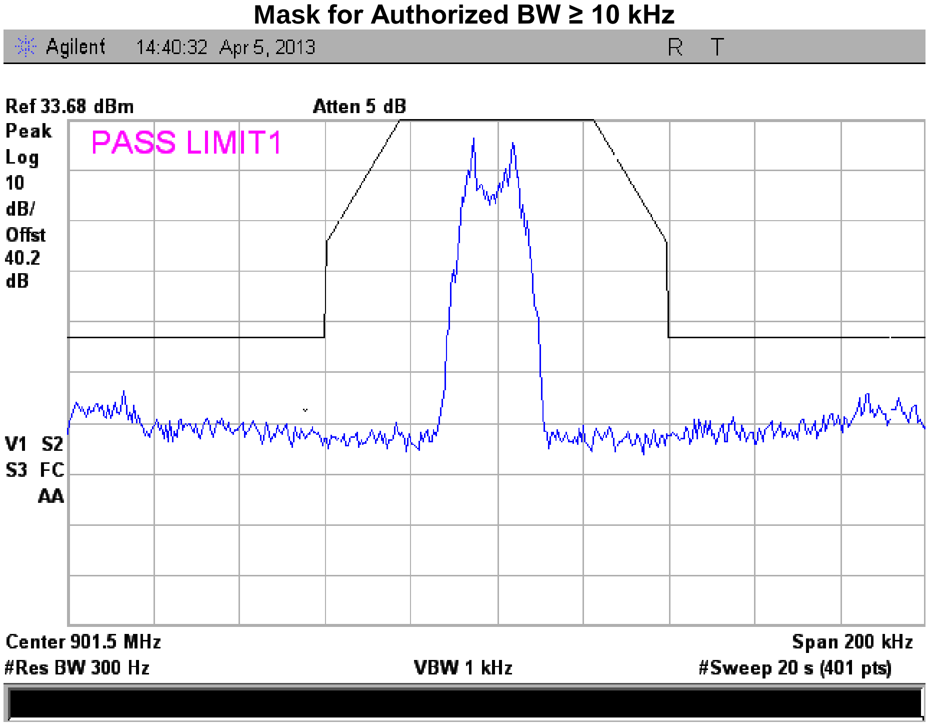
Occupied Bandwidth Plots for Authorized BW ≥ 10 kHz

Test Parameters 4
Tuned Frequency = 901.5 MHz

Reference Plot

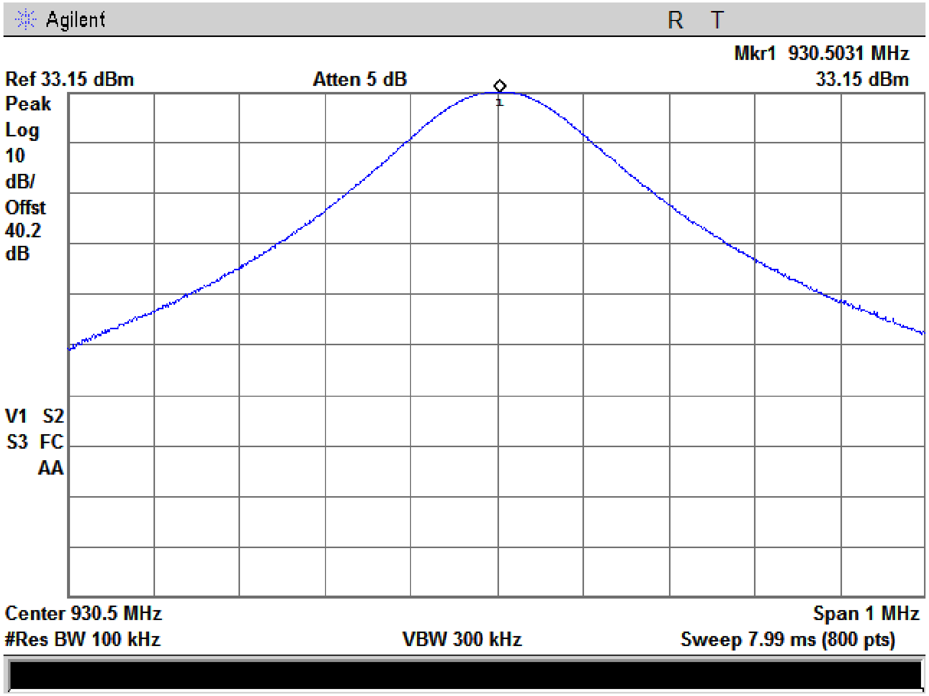


Mask for Authorized BW ≥ 10 kHz

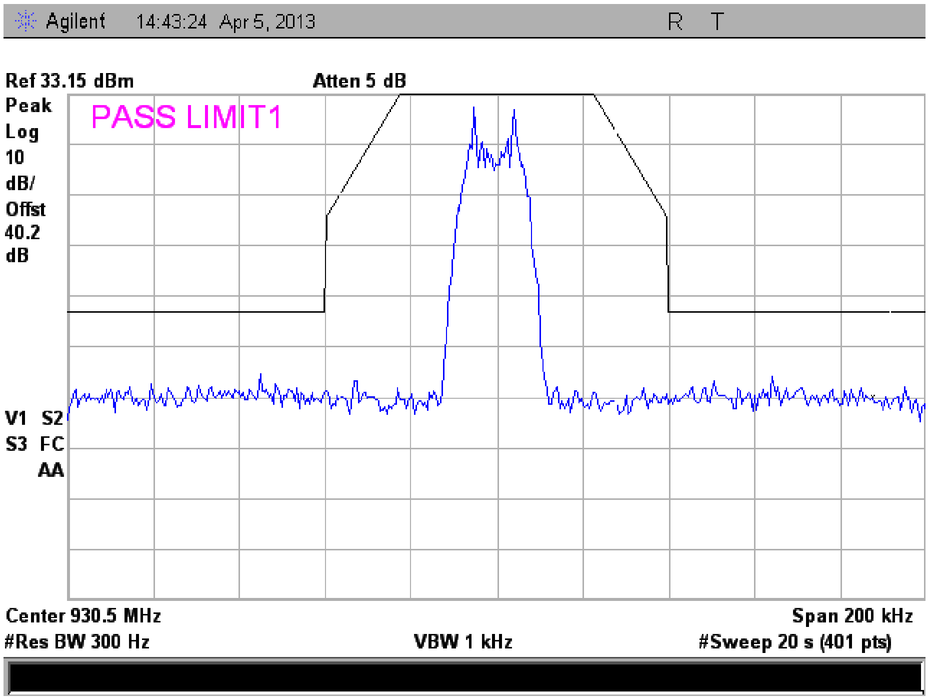


Test Parameters 4
Tuned Frequency = 930.5 MHz

Reference Plot

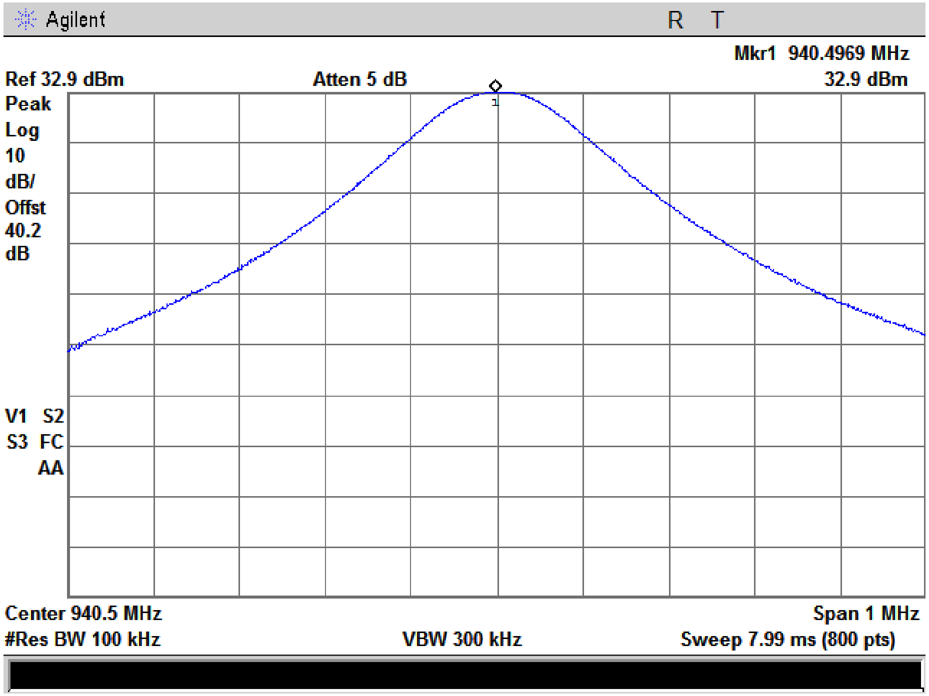


Mask for Authorized BW ≥ 10 kHz

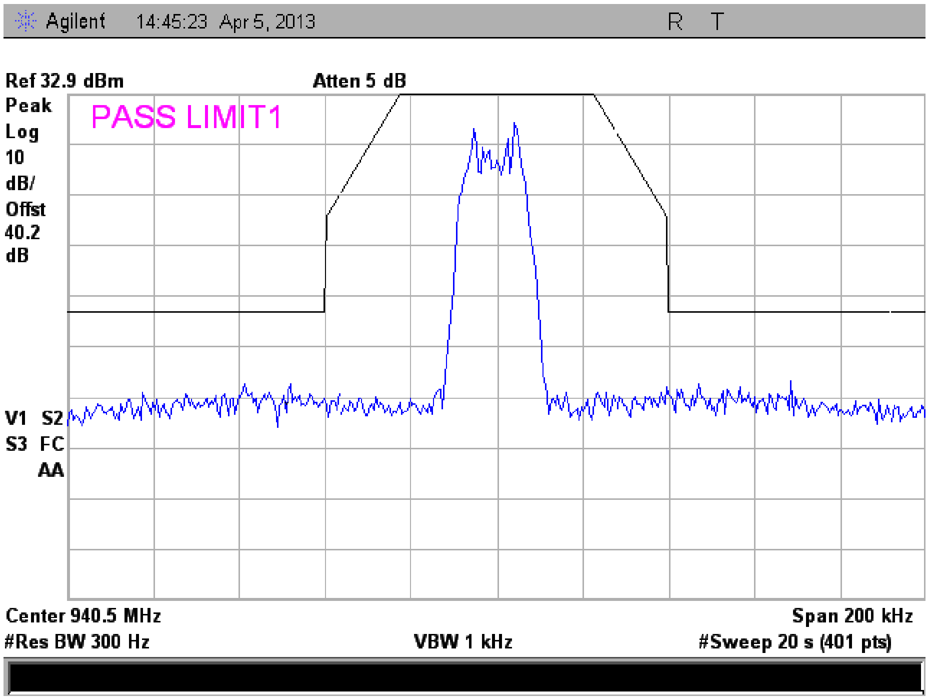


Test Parameters 4
Tuned Frequency = 940.5 MHz

Reference Plot



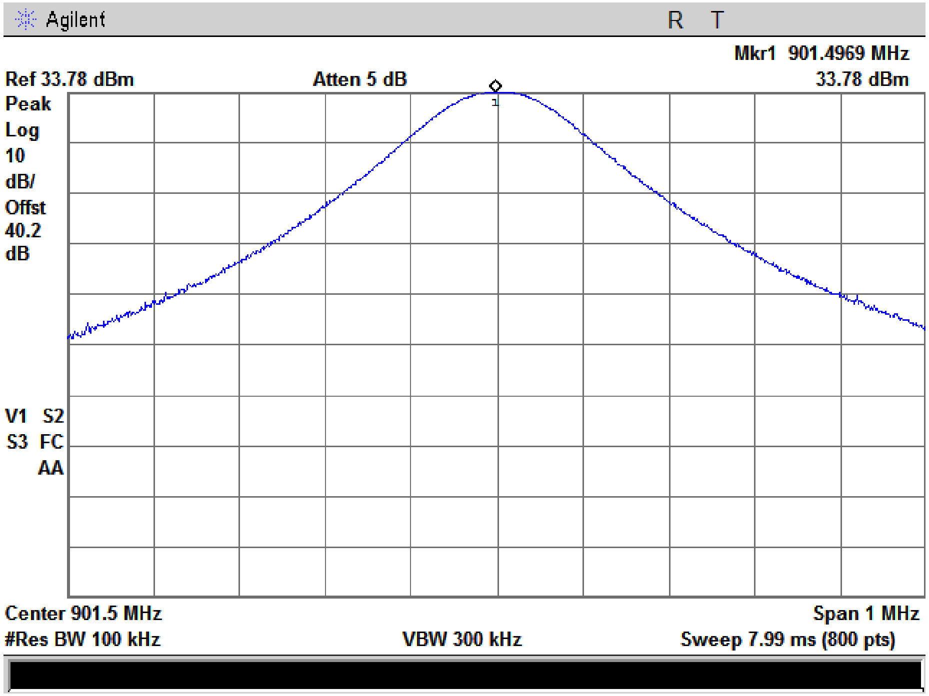
Mask for Authorized BW ≥ 10 kHz



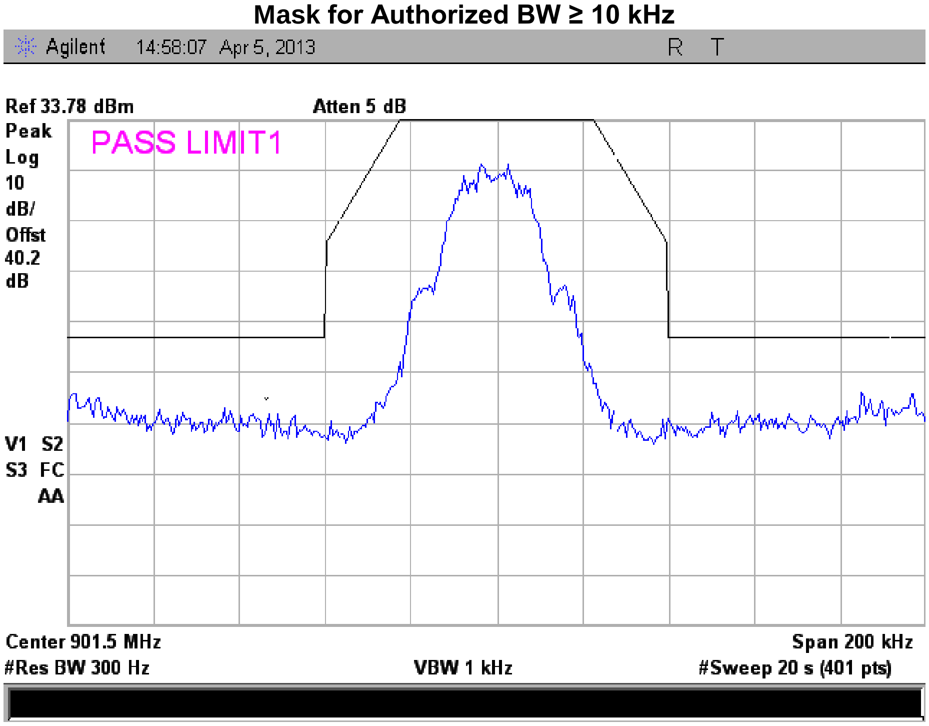
Occupied Bandwidth Plots for Authorized BW ≥ 10 kHz

Test Parameters 5
Tuned Frequency = 901.5 MHz

Reference Plot

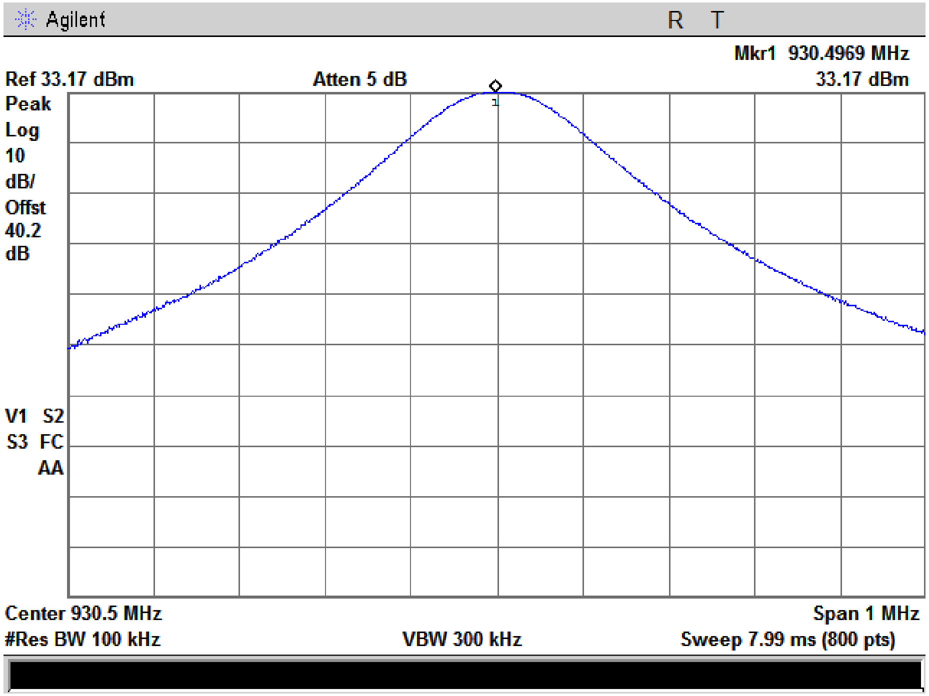


Mask for Authorized BW ≥ 10 kHz

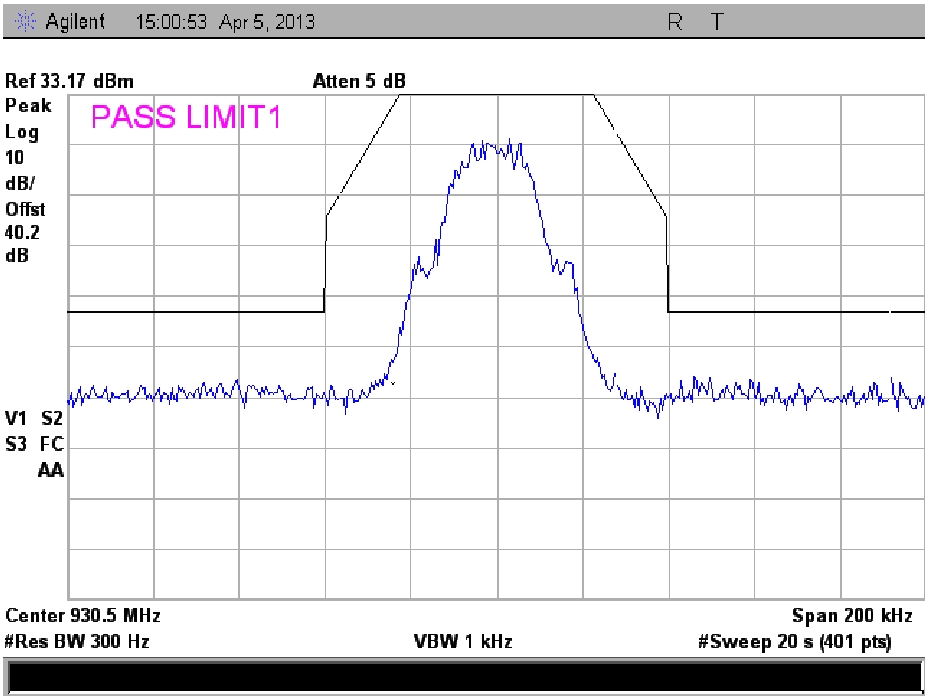


Test Parameters 5
Tuned Frequency = 930.5 MHz

Reference Plot

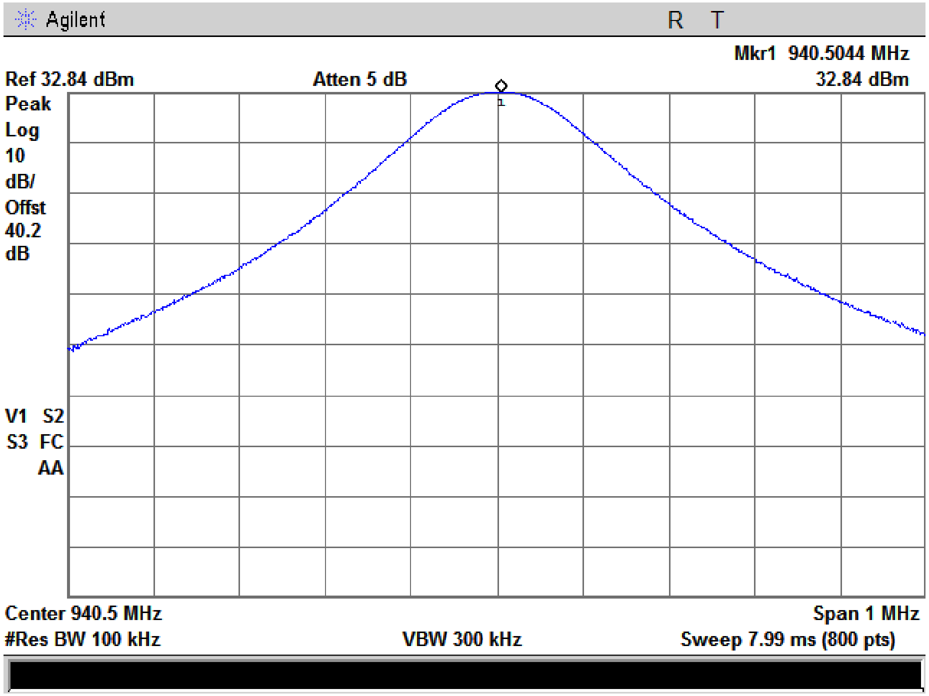


Mask for Authorized BW ≥ 10 kHz

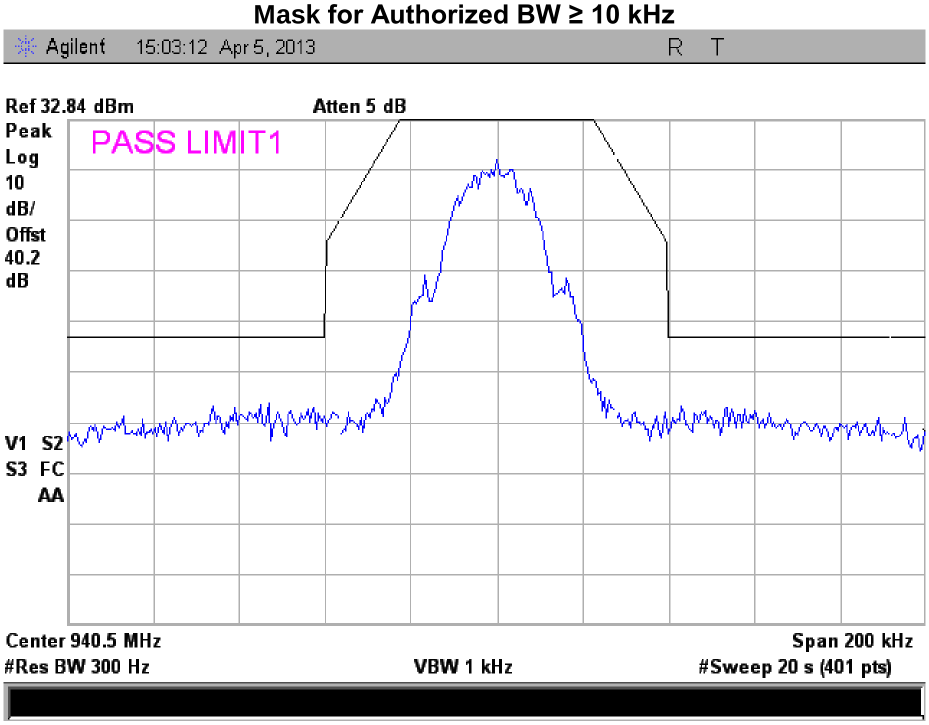


Test Parameters 5
Tuned Frequency = 940.5 MHz

Reference Plot



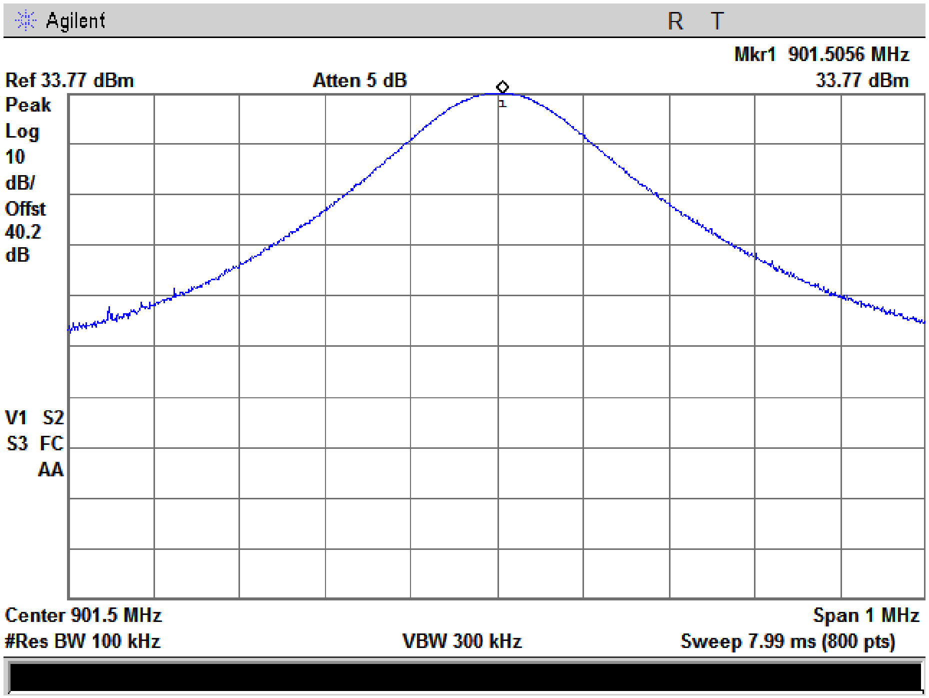
Mask for Authorized BW ≥ 10 kHz



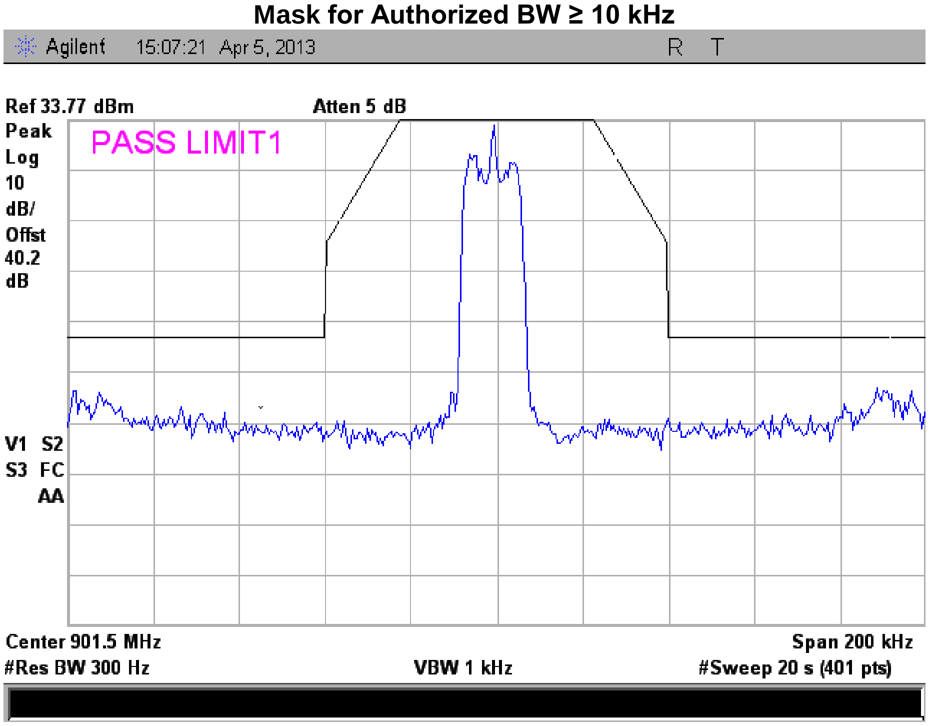
Occupied Bandwidth Plots for Authorized BW ≥ 10 kHz

Test Parameters 7
Tuned Frequency = 901.5 MHz

Reference Plot

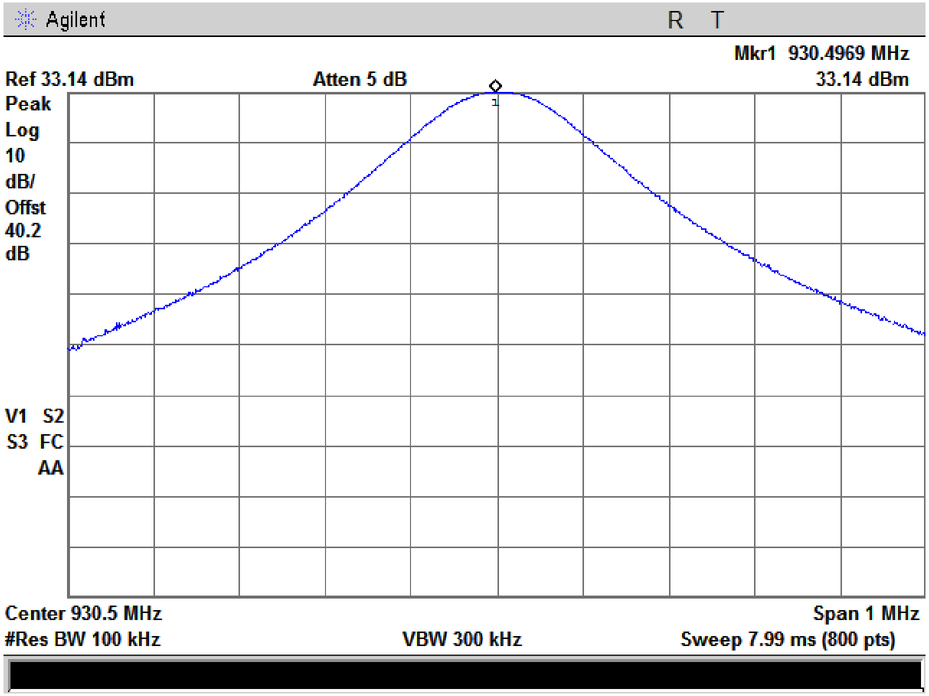


Mask for Authorized BW ≥ 10 kHz

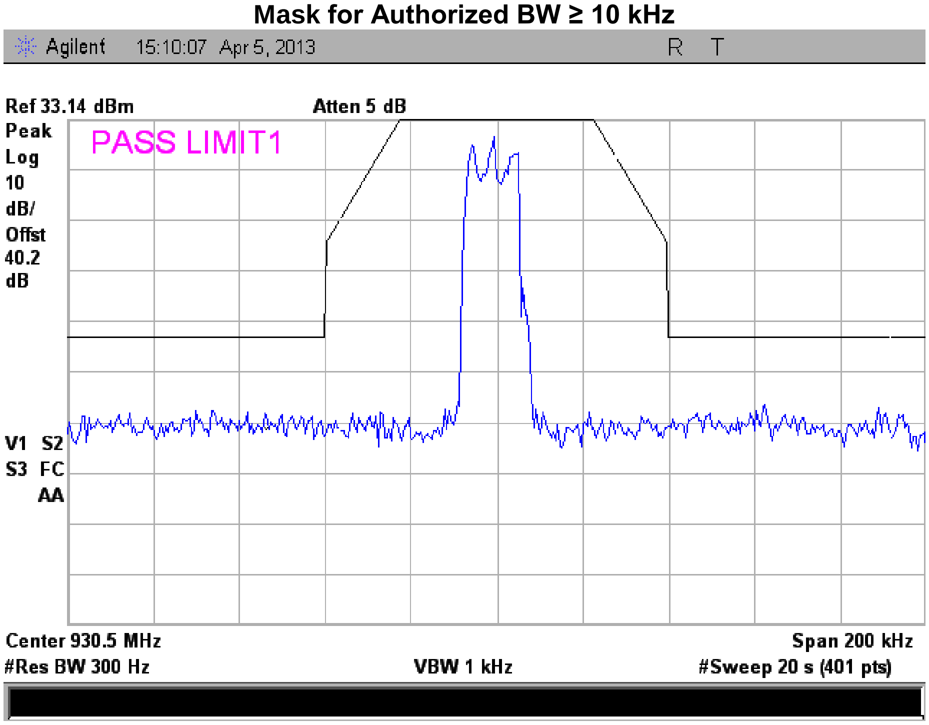


Test Parameters 7
Tuned Frequency = 930.5 MHz

Reference Plot

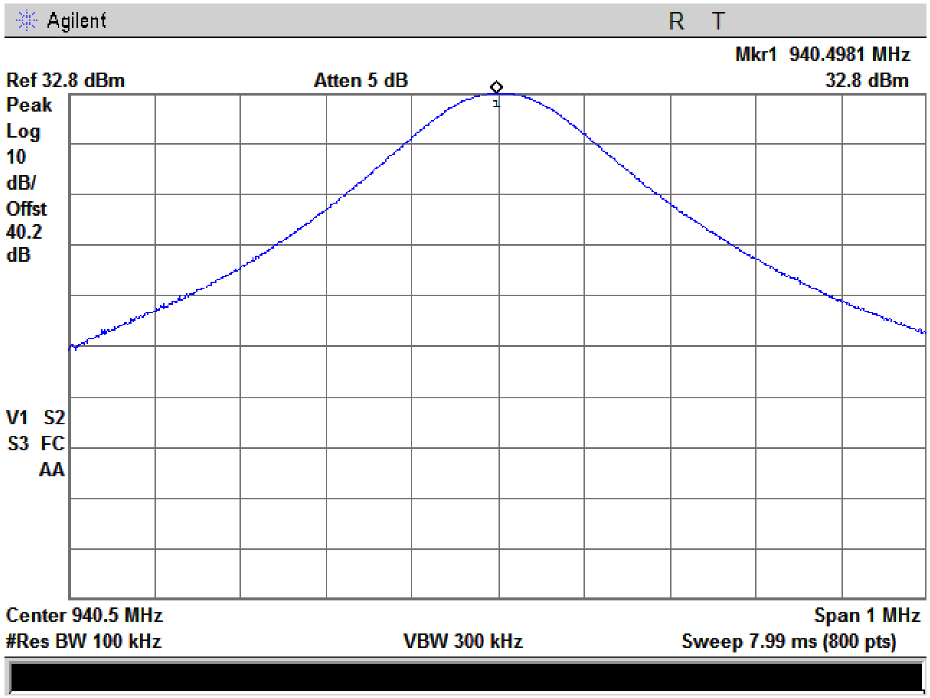


Mask for Authorized BW ≥ 10 kHz

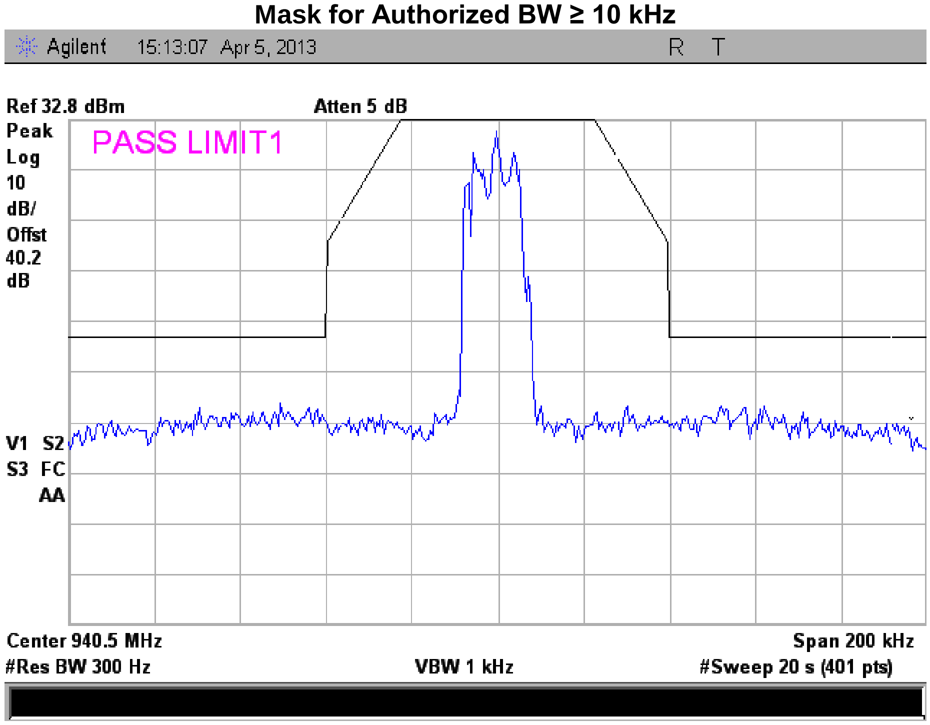


Test Parameters 7
Tuned Frequency = 940.5 MHz

Reference Plot



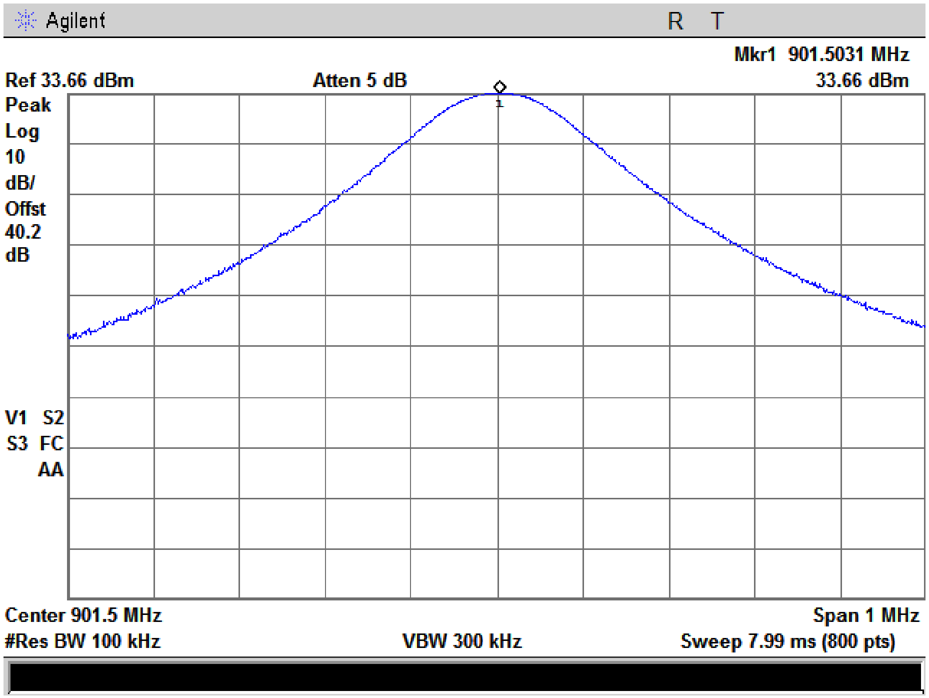
Mask for Authorized BW ≥ 10 kHz



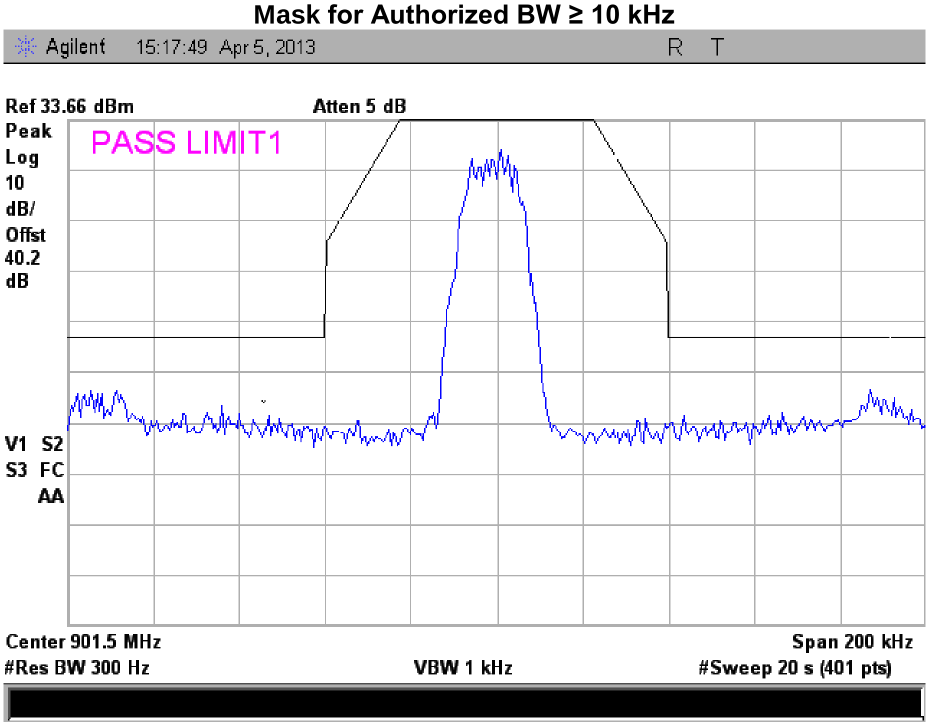
Occupied Bandwidth Plots for Authorized BW ≥ 10 kHz

Test Parameters 9
Tuned Frequency = 901.5 MHz

Reference Plot

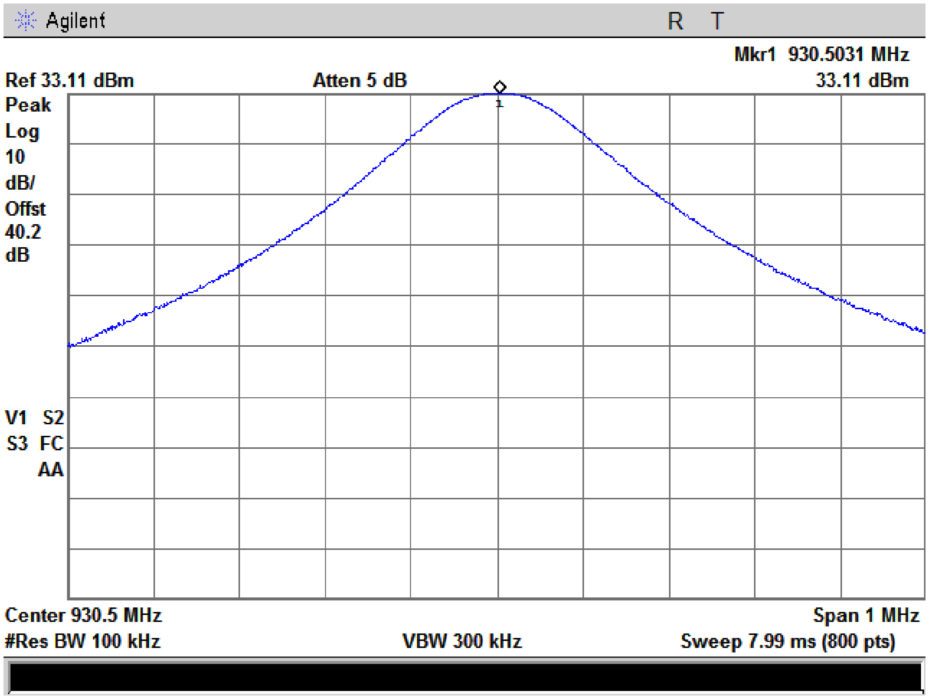


Mask for Authorized BW ≥ 10 kHz

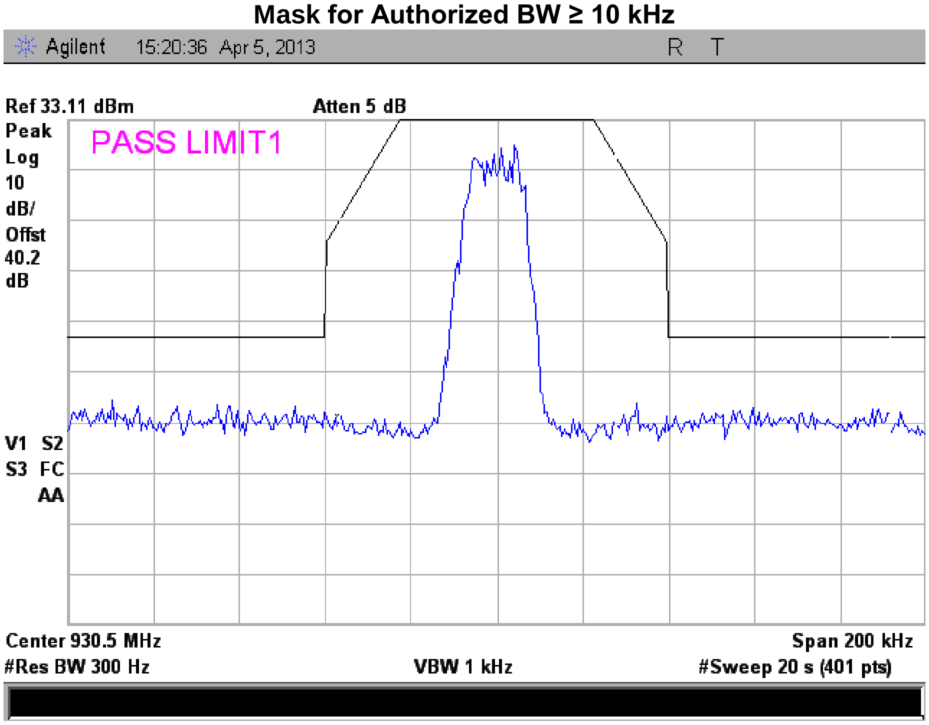


Test Parameters 9
Tuned Frequency = 930.5 MHz

Reference Plot

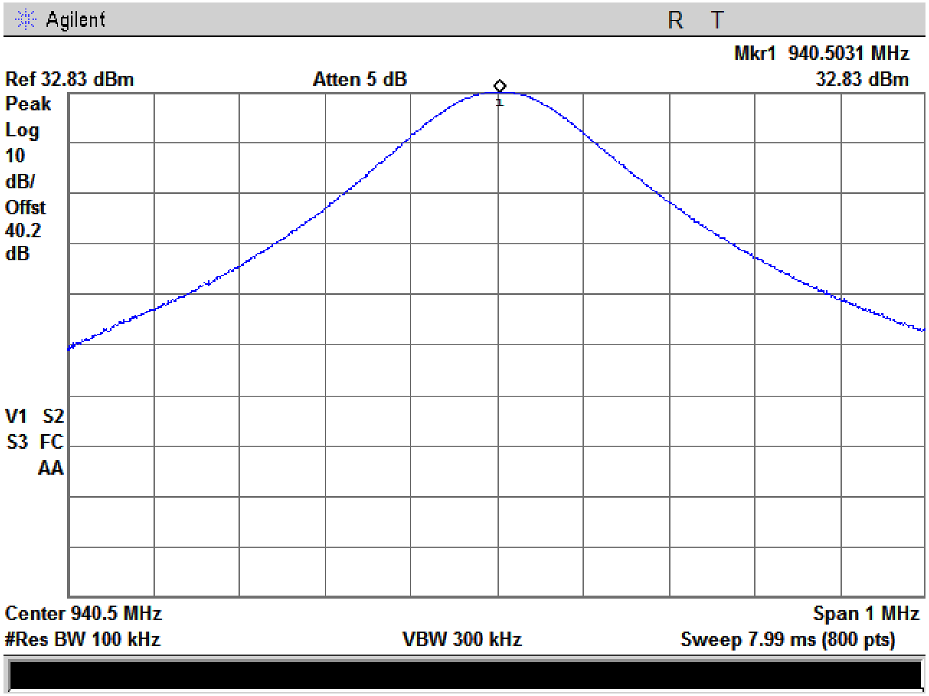


Mask for Authorized BW ≥ 10 kHz

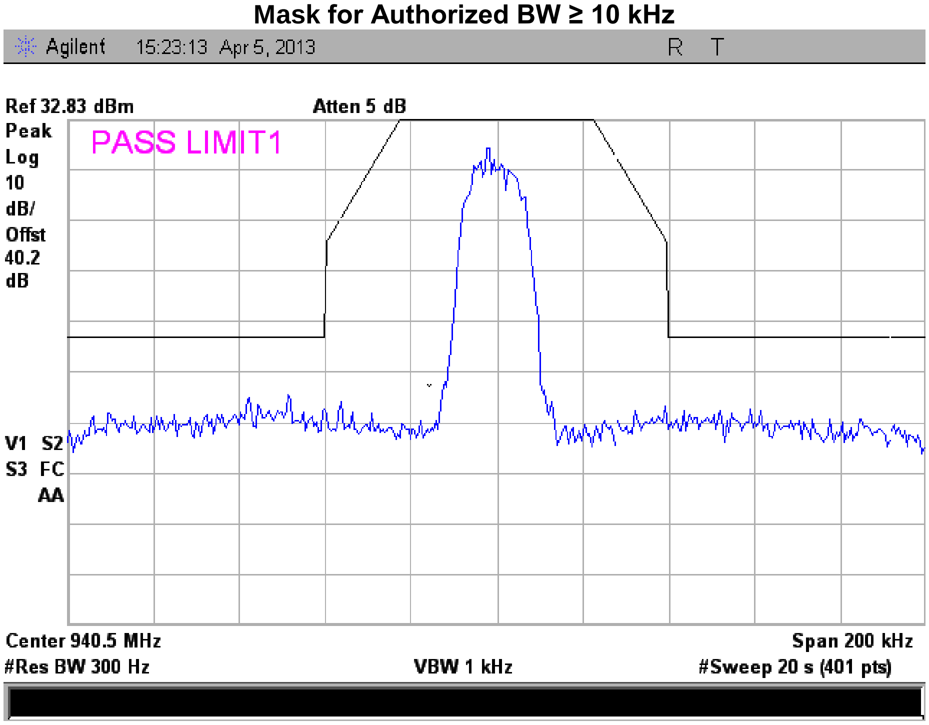


Test Parameters 9
Tuned Frequency = 940.5 MHz

Reference Plot



Mask for Authorized BW ≥ 10 kHz



Frequency Stability (Temperature Variation)

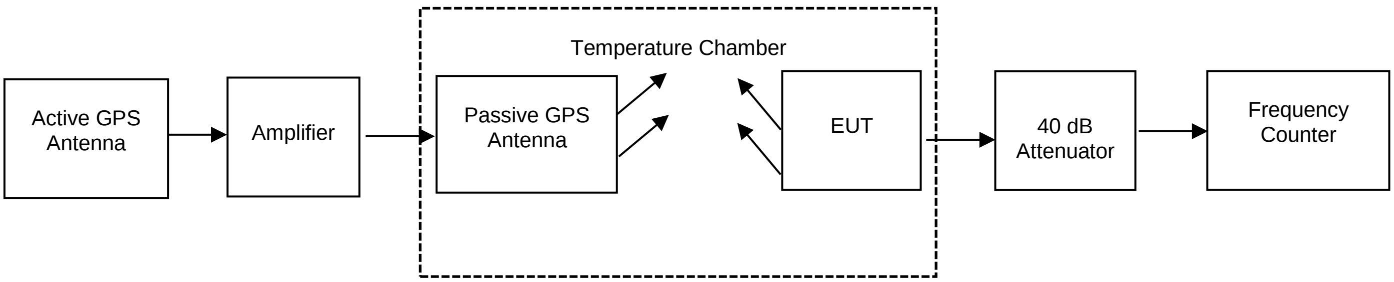
Name of Test: Frequency Stability (Temperature Variation) **Engineer:** Greg Corbin

Test Equipment Utilized: i00019, i00027, i00343 **Test Date:** 4/5/2013

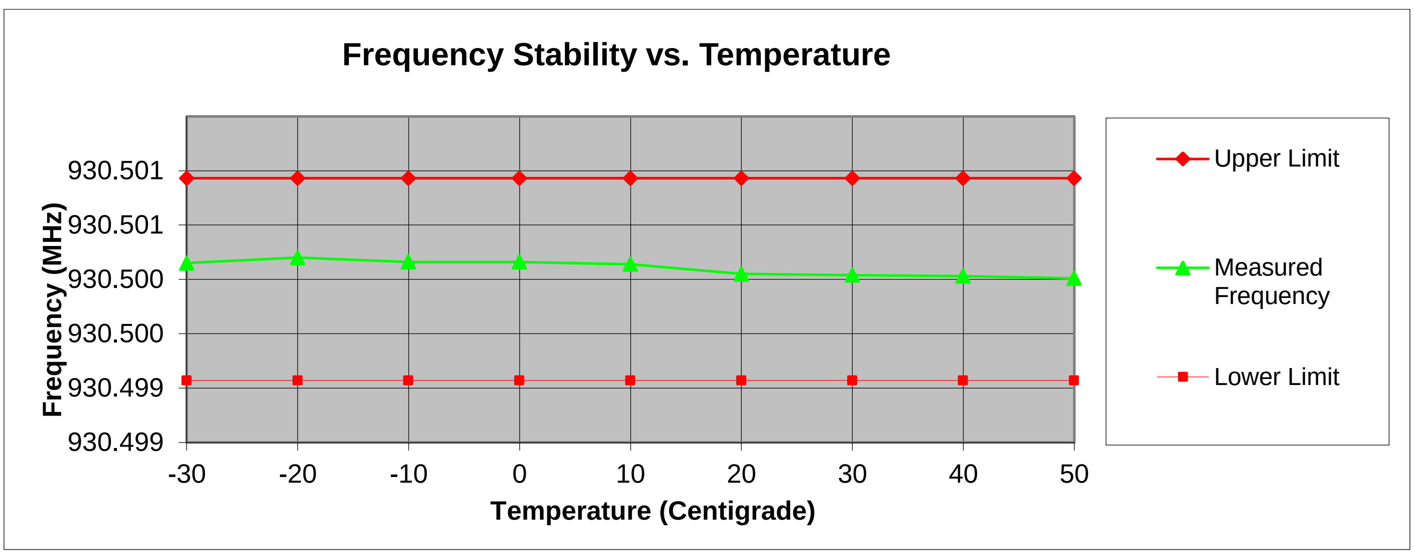
Measurement Procedure

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. The EUT requires a GPS signal to lock to as part of the temperature stability circuitry. A GPS signal was provided for the EUT to lock to.
The Frequency Stability Limit is 1 ppm.

Measurement Setup



Measurement Results



Necessary Bandwidth Calculations

Name of Test: Necessary Bandwidth Calculations **Engineer:** Greg Corbin

Test Specification: 2.202 **Test Date:** 4/14/2013

Modulation = 7K40F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	1.6
Maximum Deviation (D), kHz	=	2.4
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	7.4

Modulation = 9K00F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	3.2
Maximum Deviation (D), kHz	=	2.4
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	9.0

Modulation =12K0F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	0.512
Maximum Deviation (D), kHz	=	4.8
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	12.0

Modulation = 12K7F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	1.2
Maximum Deviation (D), kHz	=	4.8
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	12.7

Modulation = 13K1F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	1.6
Maximum Deviation (D), kHz	=	4.8
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	13.1

Modulation = 13K9F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	2.4
Maximum Deviation (D), kHz	=	4.8
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	13.9

Modulation = 14K7F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	3.2
Maximum Deviation (D), kHz	=	4.8
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	14.7

Modulation = 16K0F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	10
Maximum Deviation (D), kHz	=	2.5
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	16.0

Modulation = 32K0F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	20
Maximum Deviation (D), kHz	=	5
Necessary Bandwidth (B_N), kHz	=	2.4D+1.0R
	=	32.0

Modulation = 9K00F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	3.2
Maximum Deviation (D), kHz	=	2.4
Signaling States	=	3
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	9.0

Modulation = 12K3F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	0.8
Maximum Deviation (D), kHz	=	4.8
Signaling States	=	3
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	8.3

Modulation = 15K4F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	9.6
Maximum Deviation (D), kHz	=	2.4
Signaling States	=	3
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	15.4

Modulation = 5K20F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	0.8
Maximum Deviation (D), kHz	=	2.4
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	5.2

Modulation = 5K60F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	1.6
Maximum Deviation (D), kHz	=	2.4
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	5.6

Modulation = 6K40F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	3.2
Maximum Deviation (D), kHz	=	2.4
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	6.4

Modulation = 8K00F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	6.4
Maximum Deviation (D), kHz	=	2.4
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	8.0

Modulation = 9K60F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	9.6
Maximum Deviation (D), kHz	=	2.4
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	9.6

Modulation = 11K2F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	3.2
Maximum Deviation (D), kHz	=	4.8
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	11.2

Modulation = 12K8F1D		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	6.4
Maximum Deviation (D), kHz	=	4.8
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	12.8

Modulation = 4K50F1W		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	4.8
Maximum Deviation (D), kHz	=	1.05
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	4.5

Modulation = 7K20F1W		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	4.8
Maximum Deviation (D), kHz	=	2.4
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	7.2

Modulation = 8K40F1W		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	9.6
Maximum Deviation (D), kHz	=	1.8
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	8.4

Modulation = 8K69FXD, 8K69FXE		
Necessary Bandwidth Calculation:		
Data Rate (R) Kbps	=	9.6
Maximum Deviation (D), kHz	=	1.944
Signaling States	=	4
Constant Factor (K)	=	1
Necessary Bandwidth (B_N), kHz	=	$(R/\log_2 S)+2DK$
	=	8.69

Test Equipment Utilized

Description	Manufacturer	Model Number	CT Asset #	Last Cal Date	Cal Due Date
Frequency Counter	HP	5334B	i00019	1/19/13	1/19/14
Temperature Chamber	Tenney	Tenney Jr	i00027	Verified on: 4/5/13	
EMI Receiver	HP	8546A	i00033	12/27/12	12/27/13
Bi-Log Antenna	Schaffner	CBL611C	i00267	12/19/11	12/19/13
Horn Antenna, Amplified	ARA	DRG-118/A	i00271	4/19/12	4/19/14
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	12/4/12	12/4/13
Voltmeter	Fluke	87III	i00319	7/3/12	7/3/13
Data Logger	Fluke	Hydra Data Bucket	i00343	12/19/12	12/19/13
Tunable Notch Filter	Eagle	TNF-240MFMF	i00364	Verified on: 4/2/13	
EMI Analyzer	Agilent	E7405A	i00379	11/21/12	11/21/13
Attenuator	Weinschel	24-40-12	S/N: AY 330 5	Verified on: 4/2/13	
Amplifier	Mini-Circuits	ZX60-2531M-S+	N/A	Verified on: 4/5/13	

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