Testing Tomorrow's Technology

Title 47 FCC Part 2, Subpart J, and FCC Part 90, Subpart J Certification for Private Land Mobile Radio Services, Travelers' Information Stations and ANSI/TIA-603-C-2004, Equipment Measurement and Performance Standards Permissive Change Report

For the

Radio Systems Inc.
Model: TR-6000
AM Broadcast Transmitter

FCC ID: B7MTR-6000TIS-WB

UST Project No: 15-0297
February 2, 2015

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

Testing Tomorrow's Technology

I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

UNITED STATES TECHNOLOGIES, INC. (Agent Responsible For Test):

By: 

Name: Alan Ghasiani

Title: President- Consulting Engineer

Date: February 2, 2015

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

Testing Tomorrow's Technology

MEASUREMENT/TECHNICAL REPORT

This report concerns (check one): Original grant_____

Class II change__X___

Reevaluation_____

Equipment type: **Part 90.242 TIS Transceiver**

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No_____ N/A

If yes, defer until:_____
date

__N/A__ agrees to notify the Commission by__N/A

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

TABLE OF CONTENTS

List of Figures

List of Tables

1 General Information

1.1 Purpose of this Report

The purpose of this report is to demonstrate the Radio Systems Inc. Model TR-6000 will comply with the current Part 90.242(b)(8) requirements. The requirement relaxes the filtering from 3 kHz to 5 kHz and requires a new roll-off curve, which specifies that a 50 dB attenuation be kept at 20 kHz, be maintained.

Radio Systems Inc. plans to meet the following requirements by including new filtering designs. The filter details are explained in the Theory of Operation exhibit. There are two filter options that will be sold with this product; both options were tested. The test results are shown herein.

1.2 Product Description

The Equipment Under Test (EUT) is Radio Systems Inc. Model TR-6000. The EUT is a transmitter for Information Radio Stations (TIS/HAR) for High Quality Audio Applications. The EUT is capable of 0-10 watt operation, Class D, high efficiency output, internal components rated to 3 times operating wattage, utilizing 2 output devices. The EUT operates at 510-530 kHz, 1610-1710 kHz.

1.3 Related Submittal(s)/Grant(s)

The EUT is already approved under FCC ID: B7MTR-6000TIS-WB and is being submitted here for a Class 2 Permissive Change. A copy of the original grant is attached as an exhibit with the report submission file.

2 Test and Measurements

2.1 Configuration of Tested System

A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious emissions measurements are shown in Figure 2. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions.

2.2 Characterization of Tested System

The samples used for testing was received by US Tech on December 21, 2015 in good condition.

2.3 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. Conducted and digital device testing was performed at US Tech's OATS measurement facility. This site has been fully described and registered by the FCC under Registration Number 186022. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

2.4 Test Equipment

Table 2 describes test equipment used to evaluate this product.

2.5 Modifications to Equipment Under Test (EUT)

No modifications were made by US Tech to bring the EUT into compliance with the FCC limits for the transmitter portion of the EUT.

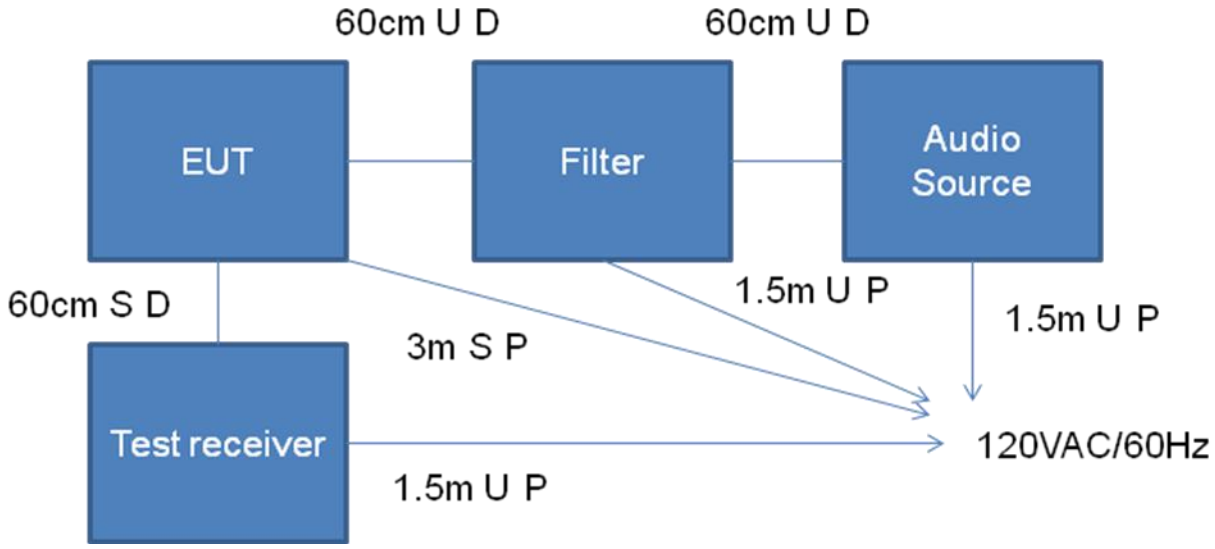

Figure 1. Block Diagram of Test Configuration

Note: There are two filter options: Active and Passive. The Passive filter will not have a power supply cord connection.

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID	CABLES P/D
EUT Radio Systems Inc.	TR-6000	104337 (0.53 kHz) 104334 (1.12 kHz) 103694 (1.70 kHz)	B7MTR-6000TIS-WB	1.5 m U P
EUT Power Supply Cincon Electronics Co. LTD	TRG70A240	70240-0225092	N/A	3 m U P
Audio Source Heathkit	IG-5218	IG5218-01	N/A	1.5 m U P
Filter #1 (Active)	See theory of operation exhibit for details regarding this filter			
Filter #2 (Passive)	See theory of operation exhibit for details regarding this filter.			

U= Unshielded, S= Shielded, P= Power cable, D= Data cable

Table 2. Test Instruments

EQUIPMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	1/28/15
SPECTRUM ANALYZER	3588A	HEWLETT-PACKARD	3005A01195	Verified before use
WAVEFORM GENERATOR	IG-5218	HEATHKIT	IG5218-01	Verified before use
MODULATION ANALYZER	8091B	HEWLETT-PACKARD	3749A06049	Verified before use
HIGH POWER ATTENUATOR	765-20	NARDA	9706	11/25/15
GRAPHICAL MULTI-METER	867B	FLUKE	DM7060268	7/30/15

Note: The calibration interval of the above test instruments is 12 months and all calibrations are traceable to NIST/USA.

2.6 Travelers' Information Stations, Technical Standards (FCC Section 90.242(b)(8))

The following parameters must be ensured in order to operate the TIS system under this subpart.

Each transmitter in a Travelers' Information Station shall be equipped with an audio low-pass filter. Such filter shall be installed either at the transmitter's audio input or between the modulation limiter and the modulated stage. At audio frequencies between 5 kHz and 20 kHz this filter shall have an attenuation greater than the attenuation at 1 kHz by at least:

83 log10 (f/5) decibels

where "f" is the audio frequency in kHz. At audio frequencies above 20 kHz, the attenuation shall be at least 50 decibels greater than the attenuation at 1 kHz.

Test data for filter option #1 (Active Filter)

Frequency (kHz)	RAW DATA	Corrected DATA	P90.242 Curve
1.00	-14.58	-0.58	0.0
2.00	-14.43	-0.43	0.0
3.00	-13.20	0.80	0.0
4.00	-14.96	-0.96	0.0
5.00	-15.02	-1.02	0.0
6.00	-52.21	-38.21	-6.6
7.00	-52.57	-38.57	-12.1
8.00	-53.60	-39.60	-16.9
9.00	-62.48	-48.48	-21.2
10.00	-64.58	-50.58	-25.0
11.00	-60.44	-46.44	-28.4
12.00	-57.03	-43.03	-31.6
13.00	-63.21	-49.21	-34.4
14.00	-55.62	-41.62	-37.1
15.00	-61.14	-47.14	-39.6
16.00	-62.18	-48.18	-41.9
17.00	-67.16	-53.16	-44.1
18.00	-68.36	-54.36	-46.2
19.00	-75.00	-61.00	-48.1
20.00	-72.53	-58.53	-50.0

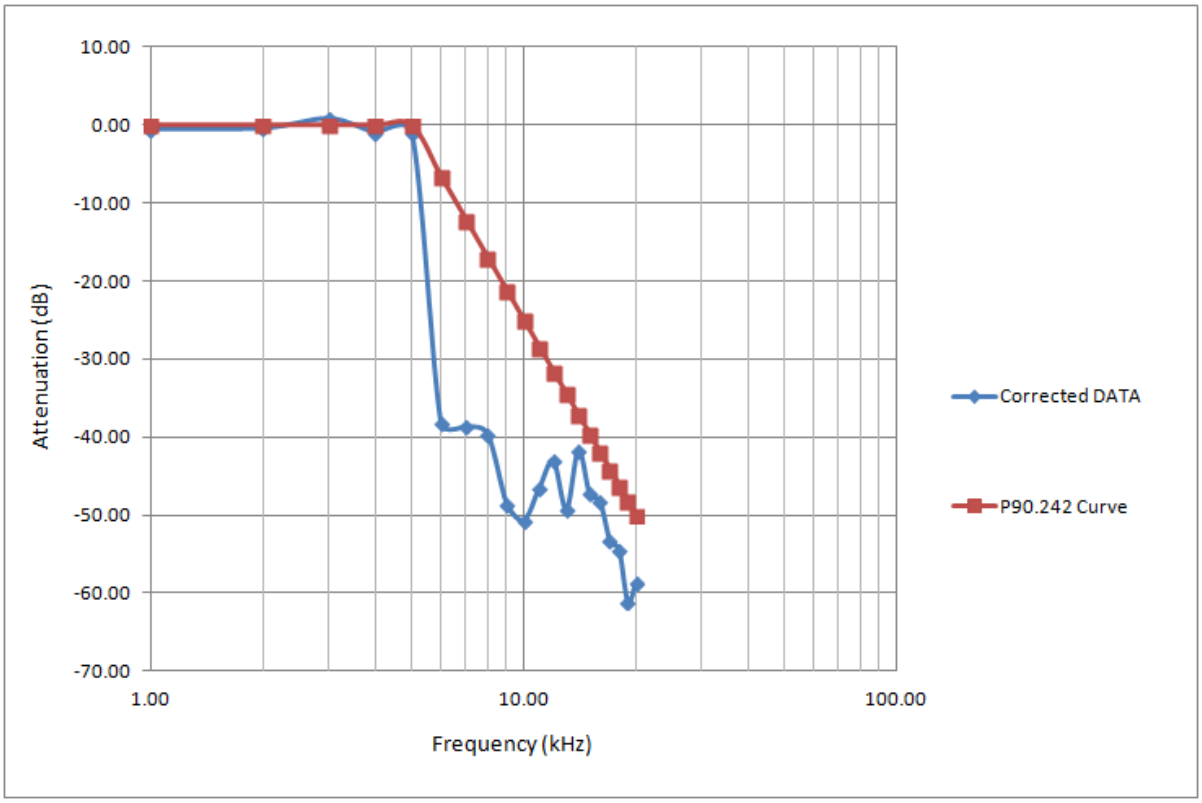

Figure 2. Active Filter Frequency Response

Test Data for Filter Option #2 (Passive Filter)

Frequency (kHz)	RAW DATA	Corrected DATA	P90.242 Curve
1	-22.91	0.00	0.0
2	-23.69	-0.78	0.0
3	-24.18	-1.27	0.0
4	-26.45	-3.54	0.0
5	-33.22	-10.31	0.0
6	-41.83	-18.92	-6.6
7	-48.95	-26.04	-12.1
8	-55.84	-32.93	-16.9
9	-63.62	-40.71	-21.2
10	-74.54	-51.63	-25.0
11	-80.22	-57.31	-28.4
12	-73.42	-50.51	-31.6
13	-72.00	-49.09	-34.4
14	-71.92	-49.01	-37.1
15	-71.77	-48.86	-39.6
16	-72.14	-49.23	-41.9
17	-72.81	-49.90	-44.1
18	-73.30	-50.39	-46.2
19	-73.58	-50.67	-48.1
20	-74.00	-51.09	-50.0

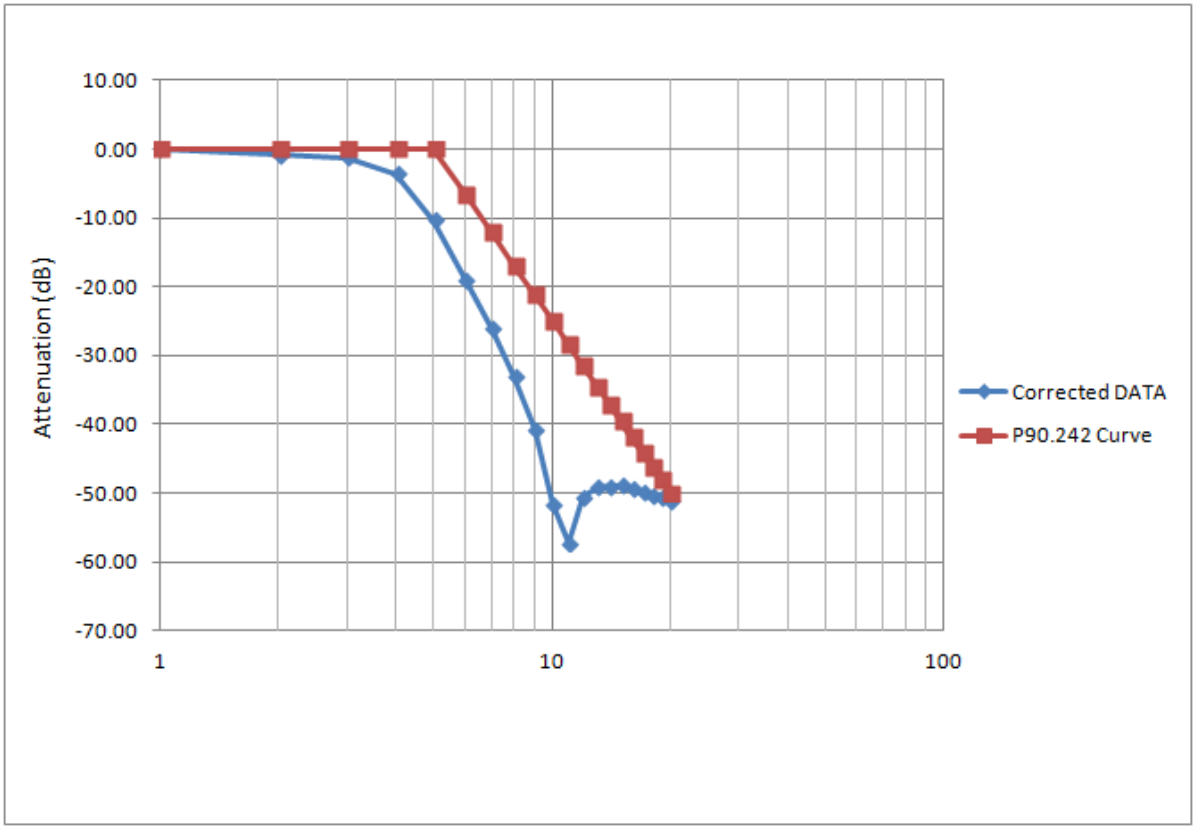

Figure 3. Passive Filter Frequency Response

2.7 Occupied Bandwidth (FCC Section 2.1049, 90.209, 90.210)

The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: +2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

The occupied bandwidth of the fundamental was measured using a spectrum analyzer, as shown in the figure below. The bandwidth measurement meets both of the following requirements:

FCC Part 90.209(5)(2) specifies: Bandwidths for radio-location stations in the 420-450 MHz band and for stations operating in bands subject to footnote #2 of 90.209(5) will be reviewed and authorized on a case-by-case basis.

EUT with Filter option #1 (Active Filter)
Occupied Bandwidth= < 6kHz

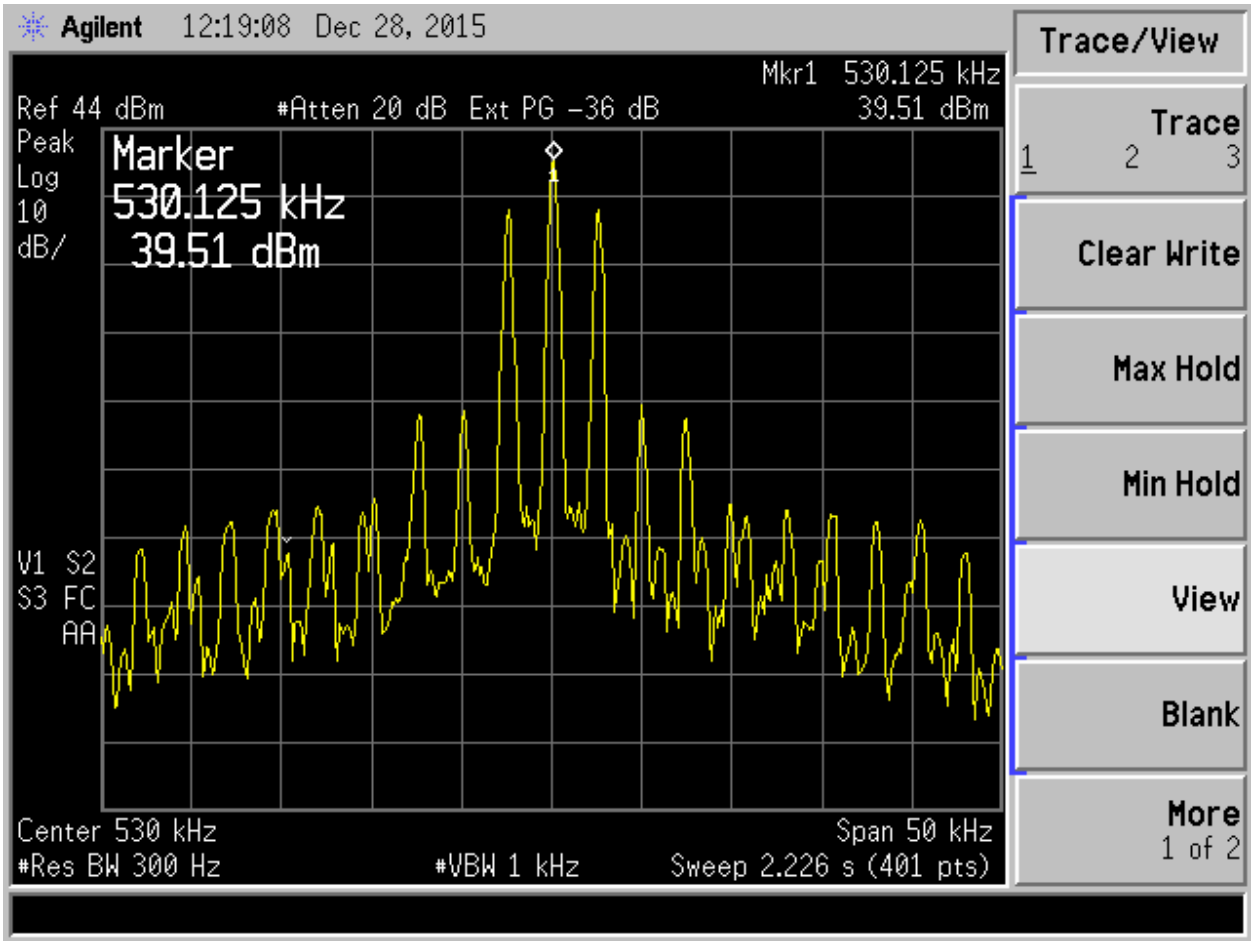

Figure 4. Active Filter, 530 kHz Occupied Bandwidth

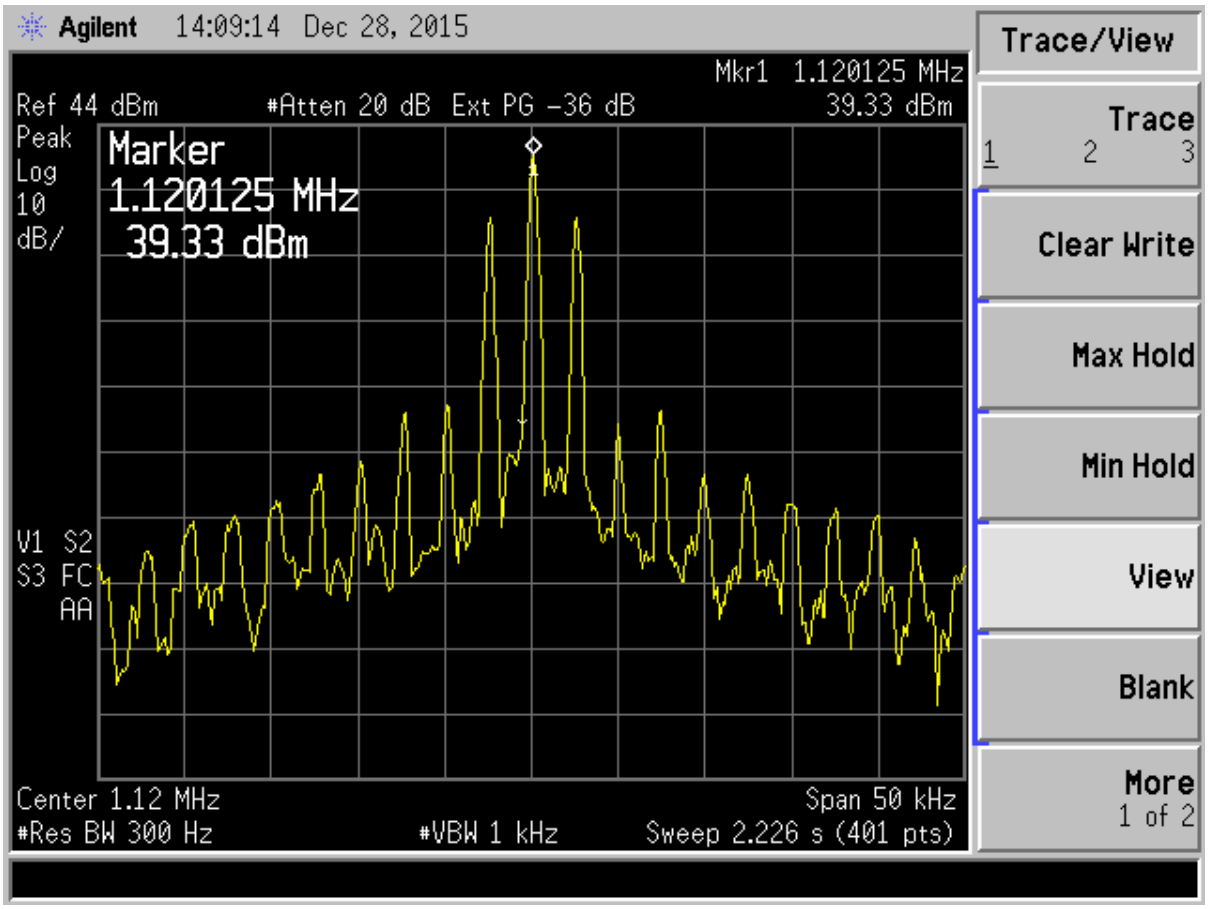

Figure 5. Active Filter, 1120 kHz Occupied Bandwidth

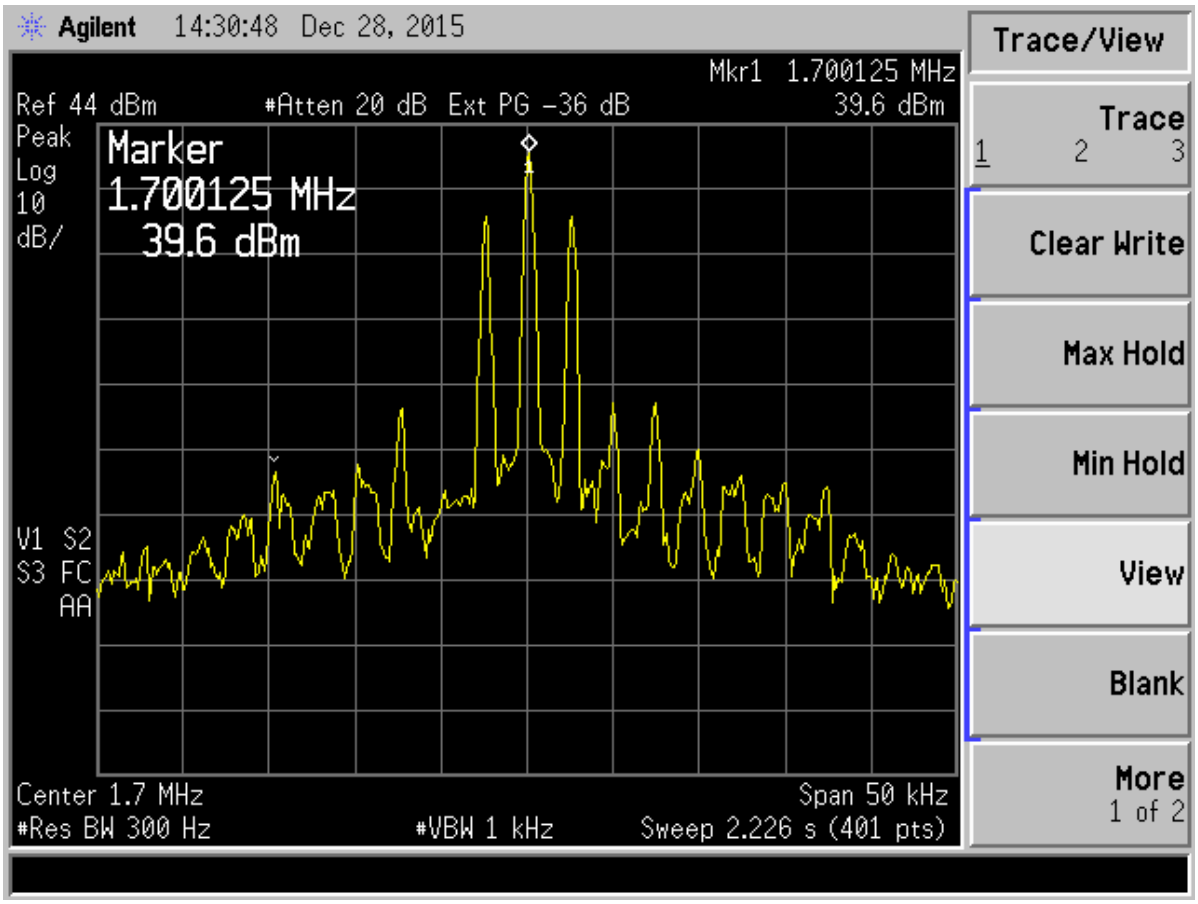

Figure 6. Active Filter, 1700 kHz Occupied Bandwidth

EUT with Filter option #2 (Passive Filter)
Occupied Bandwidth= <6kHz

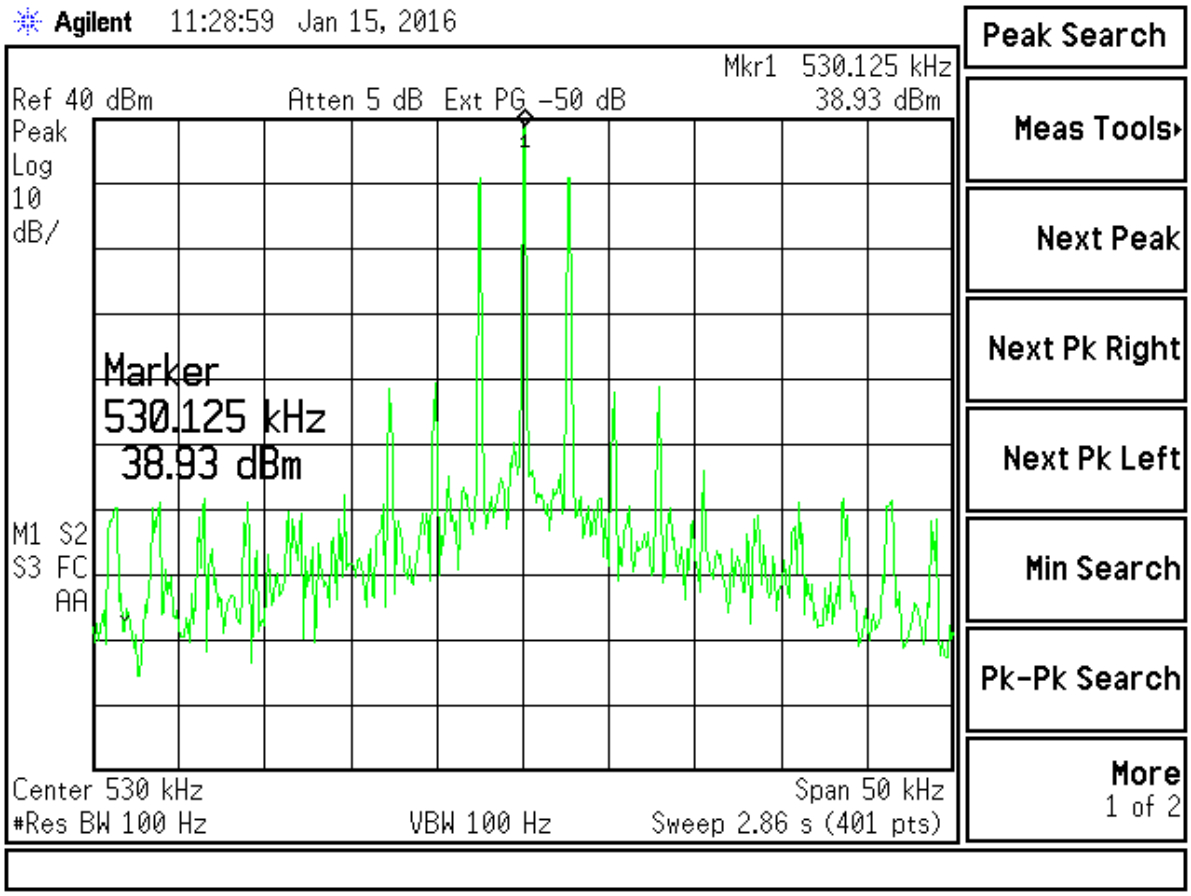

Figure 7. Passive Filter, 530 kHz Occupied Bandwidth

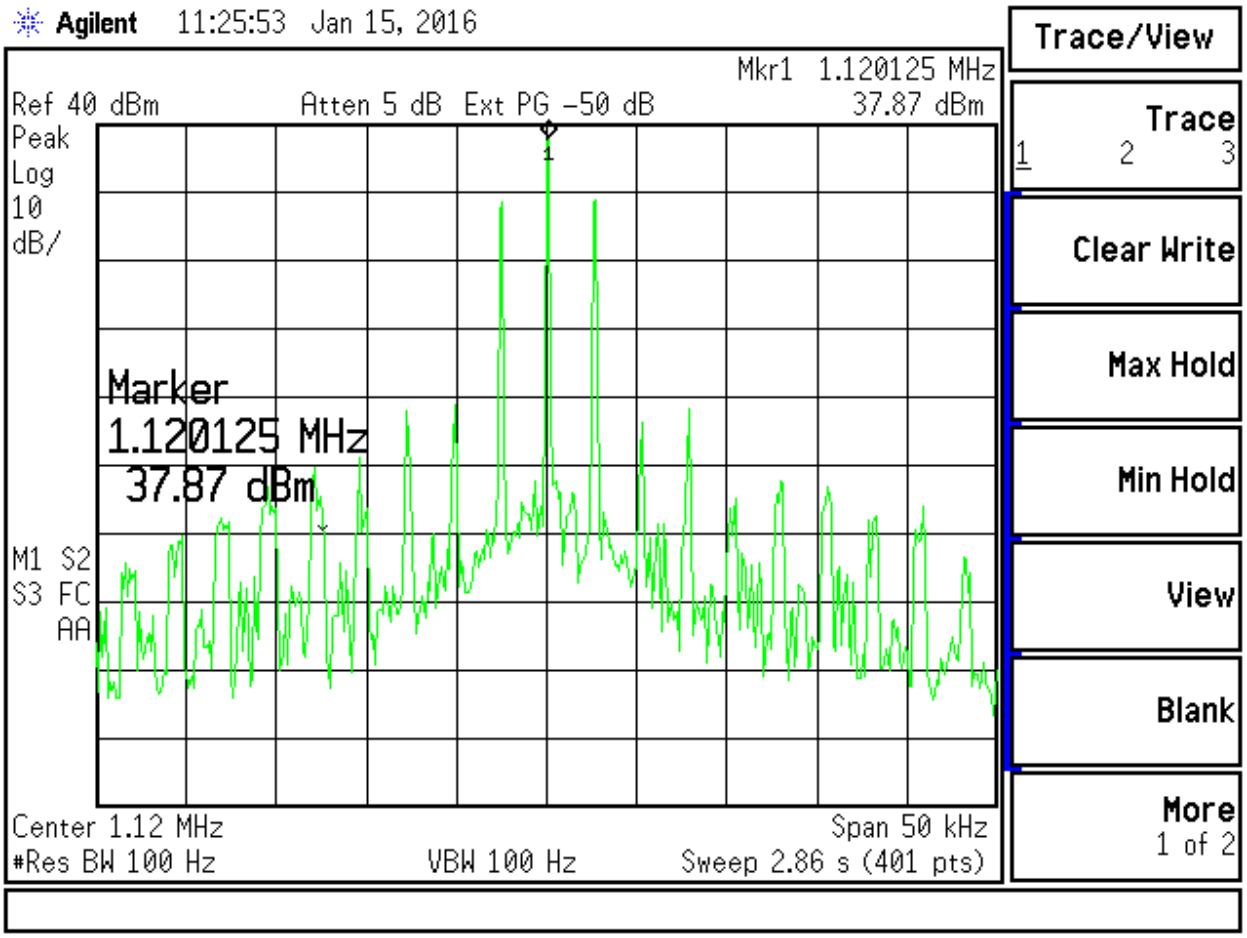

Figure 8. Passive Filter, 1120 kHz Occupied Bandwidth

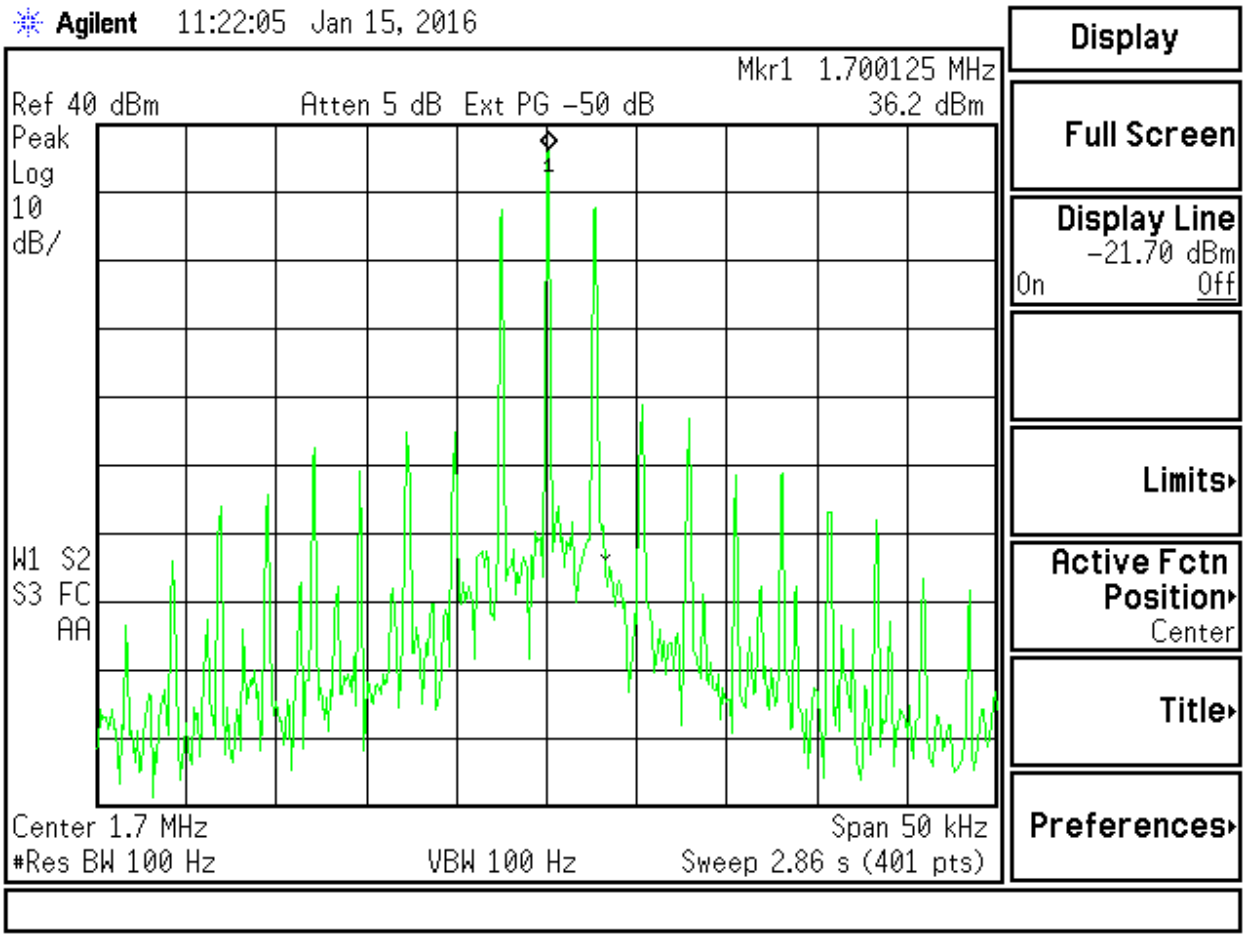

Figure 9. Passive Filter, 1700 kHz Occupied Bandwidth

3 Conclusion

3.1 Test Outcome

Based on the test results shown above, the EUT is deemed to comply with all relevant requirements.