H.B. Compliance Solutions

Intentional Radiator Test Report

For the

Wilson Electronics.

Quint Band Bi-Directional Amplifier Model # 460019

Tested under

FCC Part 20 Class II Permissive Change

For Direct Connect Consumer Signal Booster

Prepared for:

Wilson Electronics

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St. George, UT 8479085224

Prepared By:

H.B. Compliance Solutions

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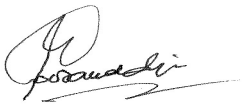
Reviewed By:



Hoosamuddin Bandukwala

Cert # ATL-0062-E

Engineering Statement: The measurements shown in this report were made in accordance with the procedure indicated, I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

Report Status Sheet

Revision #	Report Date	Reason for Revision
Ø	November 04, 2016	Initial Issue
1	January 19, 2017	Corrected Output Power

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EXECUTIVE SUMMARY

1. Testing Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 20. All tests were conducted using measurement procedure from FCC Signal Booster Measurement KDB 935210 D03 v04 Feb 12, 2016 as appropriate.

Test Name	Test Method/Standard	Result	Comments
Authorized Frequency Band	20.21(e)(3)	Pass	
Maximum Power & Booster Gain	20.21(e)(8)(i)(B) 20.21(e)(8)(i)(C) 20.21(e)(8)(i)(D)	Pass	
Conducted Spurious Emissions	2.1051	Pass	
Noise Limits	20.21(e)(8)(i)(A) 20.21(e)(9)(i)(I)	Pass	
Radiated Spurious Emissions	2.1053	Pass	

EQUIPMENT CONFIGURATION

1. Overview

H.B Compliance Solutions was contracted by Wilson Electronics to perform testing on the Bi-Directional Amplifier Model # 460019 under the purchase order number PO460019-HB.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Wilson Electronics, Bi-Directional Amplifier Model # 460019.

The tests were based on FCC Part 20 Rules. The tests described in this document were formal tests as described with the objective of the testing was to evaluate compliance of the Equipment Under Test (EUT) to the requirements of the aforementioned specifications. Wilson Electronics should retain a copy of this document and it should be kept on file for at least five years after the manufacturing of the EUT has been permanently discontinued. The results obtained relate only to the item(s) tested.

Product Name:	Quint Band Bi-Directional Amplifier
Model(s) Tested:	460019
FCC ID:	PWO460019
Supply Voltage Input:	Primary Power : 5.0 Vdc
Frequency Range:	Uplink 824-849MHz, 1850-1915MHz, 1710-1755, 698-716 & 776-787MHz Downlink 728-746MHz, 746-757MHz, 869-894MHz, 1930-1995MHz & 2110-2155MHz
No. of Channels:	N/A
Type(s) of Modulation:	CDMA, GSM, EDGE, HSPA, EVDO, LTE
Range of Operation Power:	0.254 – 0.362W
Emission Designator:	F9W, GXW, G7W & G7D
Channel Spacing(s)	N/A
Test Item:	Pre-Production
Type of Equipment :	Direct Connect
Antenna Requirement	External
Environmental Test Conditions:	Temperature: 15-35°C Humidity: 30-60% Barometric Pressure: 860-1060 mbar
Modification to the EUT:	None
Evaluated By:	Staff at H.B. Compliance Solutions
Test Date(s):	10/18/16 till 11/07/16

2. Test Facility

Radiated Emission testing was performed at Artesyn Embedded Technologies. This facility is located at 2900 S. Diablo Way, Suite 190, Tempe, AZ 85282. All equipment used in making physical determination is accurate and bears recent traceability to the National Institute of Standards and Technology.

Test facility at Artesyn Product Testing Services is an A2LA accredited test site. The A2LA certificate number is 2716.01. The scope of accreditation covers the FCC Method - 47 CFR Part 15, ICES-003, CISPR 22, AS/NZS 3548 and VCCI.

Conducted testing was performed at H.B. Compliance Solutions. This facility is located at 5005 S. Ash Avenue, Suite # A-10, Tempe AZ 85282.

Radiated Emissions measurements were performed in a semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at Artesyn Product Testing Services.

3. Description of Test Sample

The Wilson Electronics is a quint band bi-directional amplifier used for enhancing the range of cell phones and data communication devices in in-building applications. The components are contained in a metal enclosure. It runs off 5 volt DC power

4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
# 1	Quint Band Bi-Directional Amplifier	460019	460019E1013688447

Table 1. Equipment Configuration

5. Support Equipment

All support equipment supplied is listed in the following Support Equipment List.

Ref ID	Name / Description	Manufacturer	Model #	Serial #
N/A	-	-	-	-

Table 2. Support Equipment

6. Ports and Cabling Information

Ref ID	Port name on the EUT	Cable Description	Qty.	Length (m)	Shielded? (Y/N)	Termination Box ID & Port ID
#2	Power	2 wire	1	1	N	DC Power Supply

Table 3. Ports and Cabling Information

7. Method of Monitoring EUT Operation

A test receiver will be used to monitor the data transmission from the EUT.

8. Mode of Operation

The EUT will be configured as defined in the FCC KDB 935210 D03 guidance document. These settings were created for testing purpose only.

9. Modifications

9.1 Modifications to EUT

No modifications were made to the EUT

9.2 Modifications to Test Standard

No Modifications were made to the test standard.

10. Disposition of EUT

The test sample including all support equipment submitted to H.B Compliance Solutions for testing will be returned to Wilson Electronics upon completion of testing & certification

1. Authorized Frequency Band

Test Requirement(s):	§20.21(e)(3)	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	Oct/18/16

Test Procedures: As required by 47 CFR §20.21(e)(3), Authorized frequency band measurements were made at the RF output terminals of the EUT.

The EUT was connected through an attenuator to a Spectrum Analyzer. A signal generator was used for the input to the EUT to provide a CW signal tuned to the center channel of each uplink and downlink operational band. Measurements were made at the low and high channels of each uplink and downlink frequency band.

Test Setup:

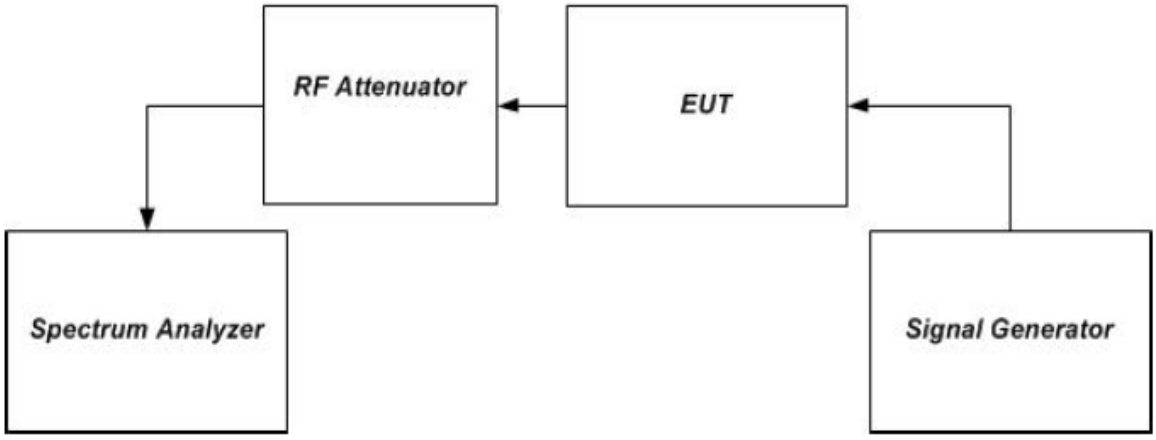
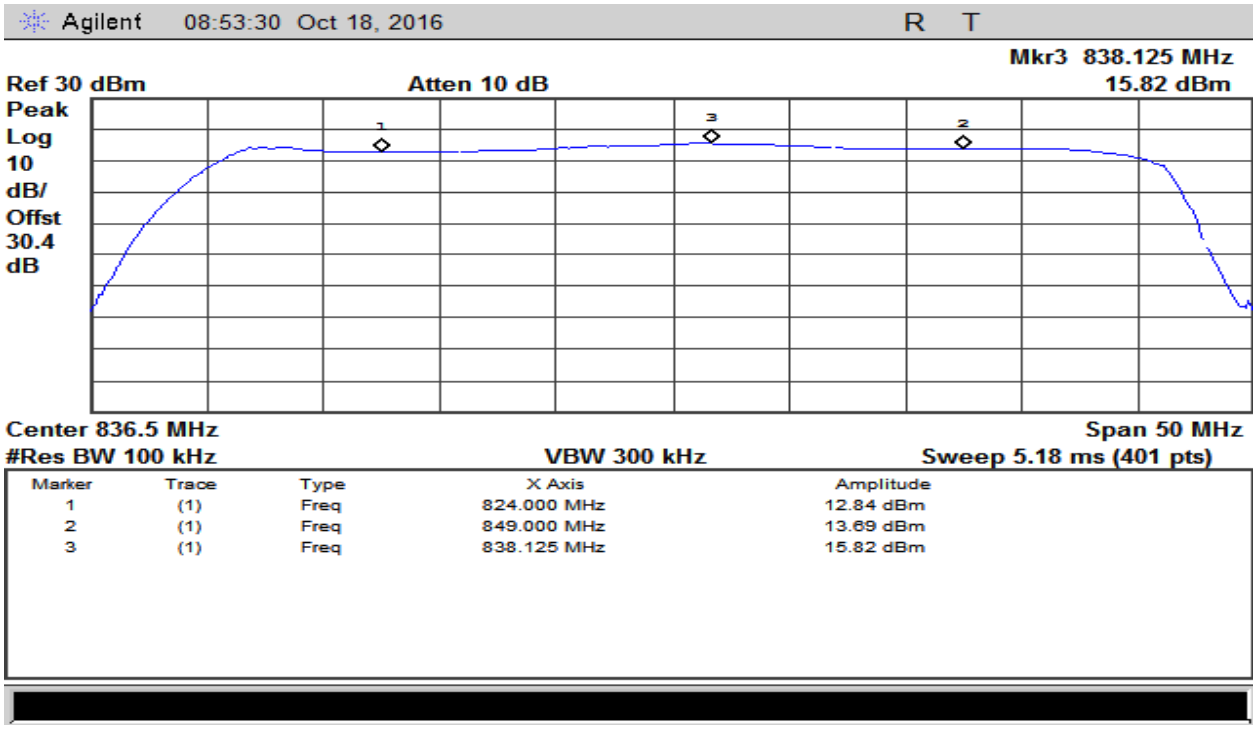
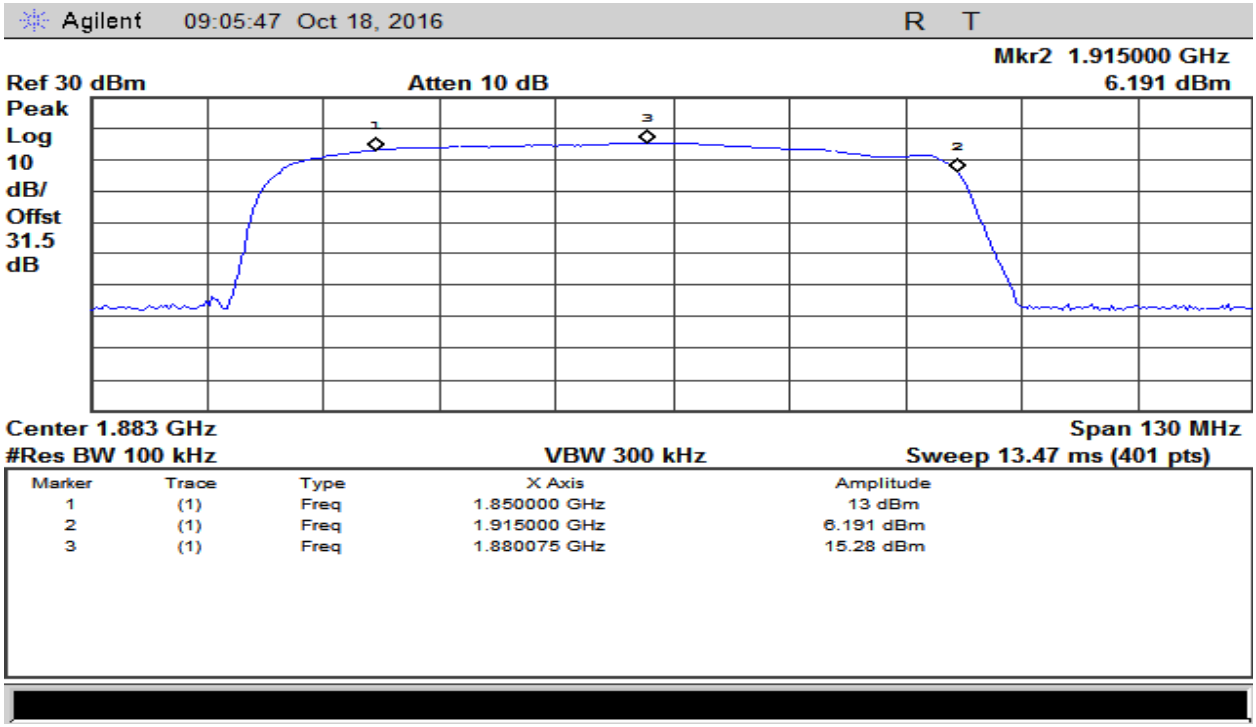


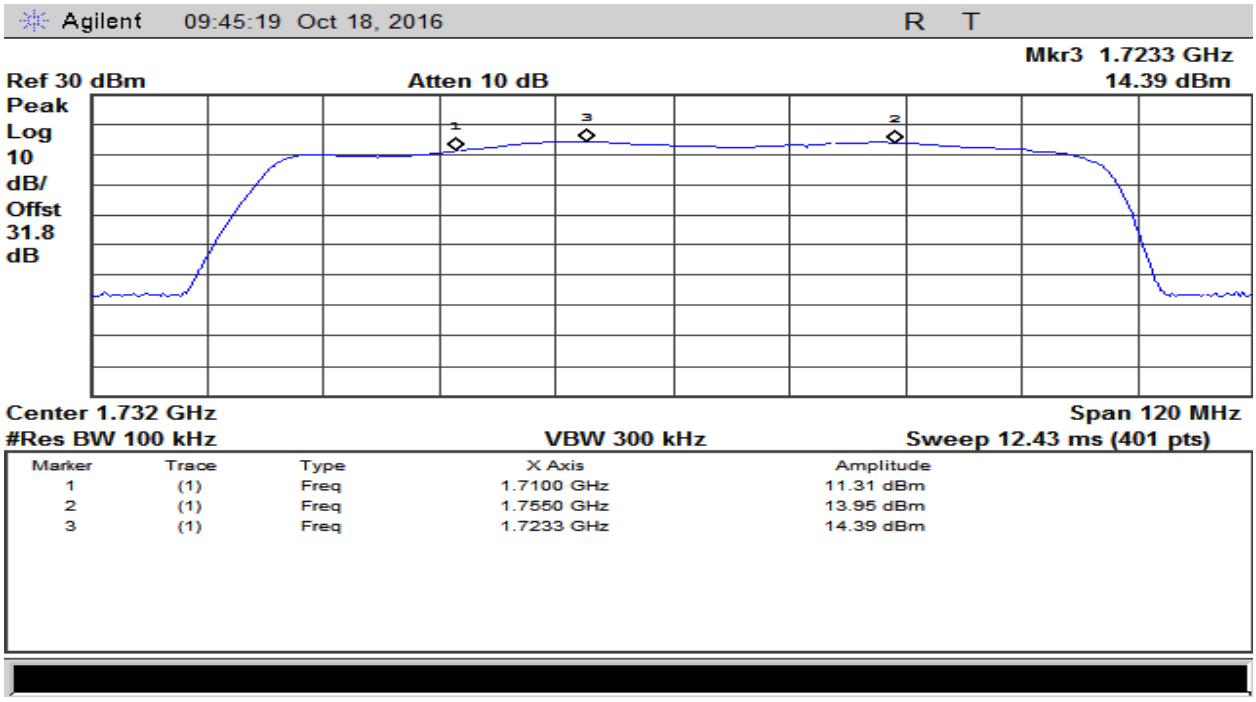
Figure 1 – Band Verification



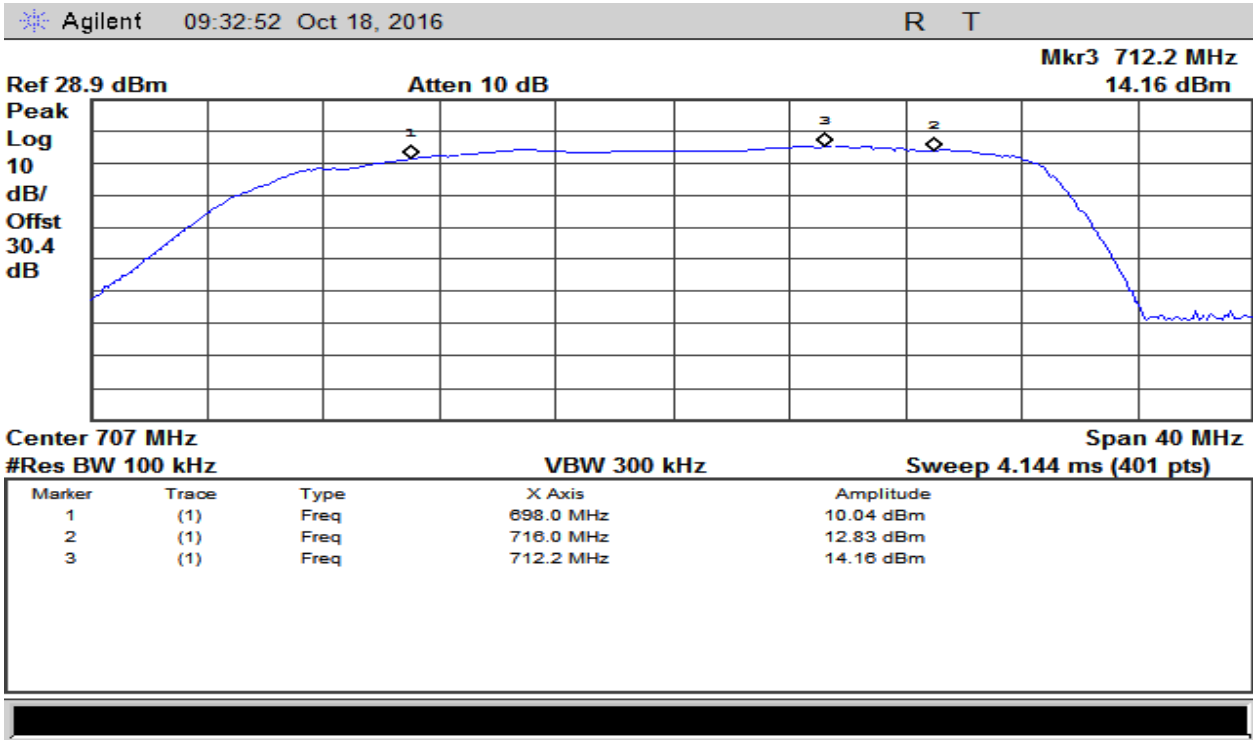
Plot 1 – 824-849MHz Band – Uplink



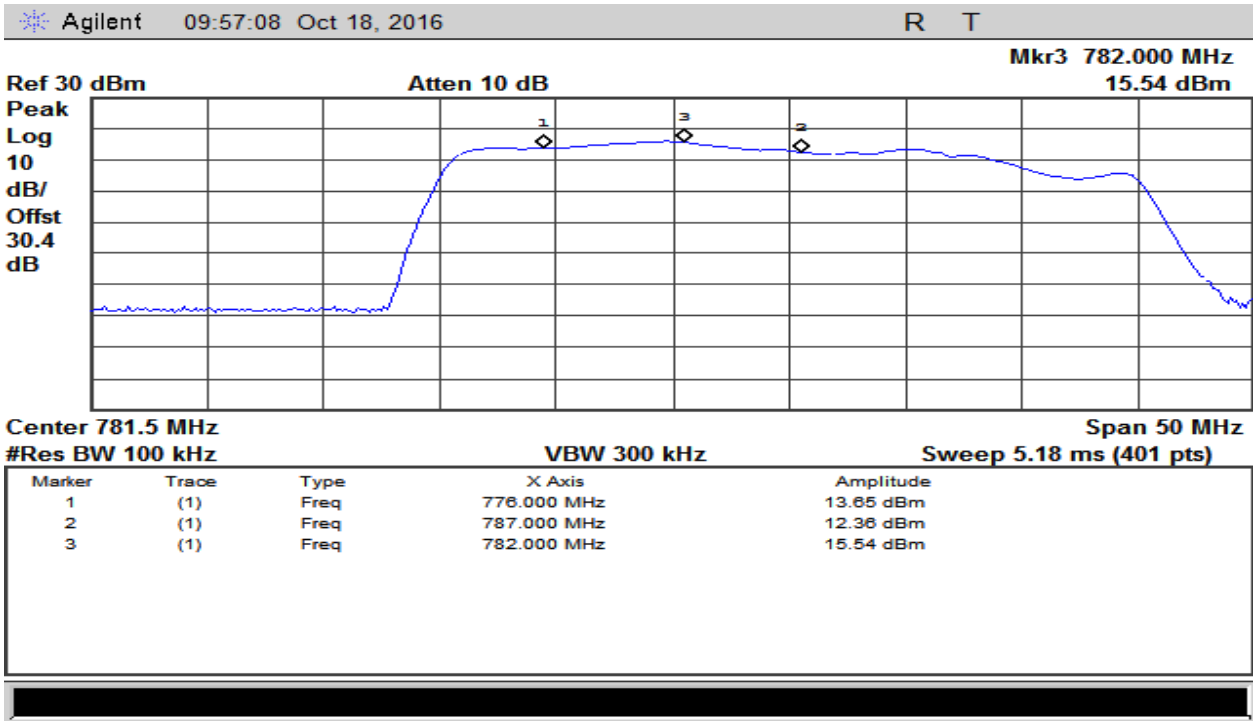
Plot 2 – 1850-1915MHz Band – Uplink



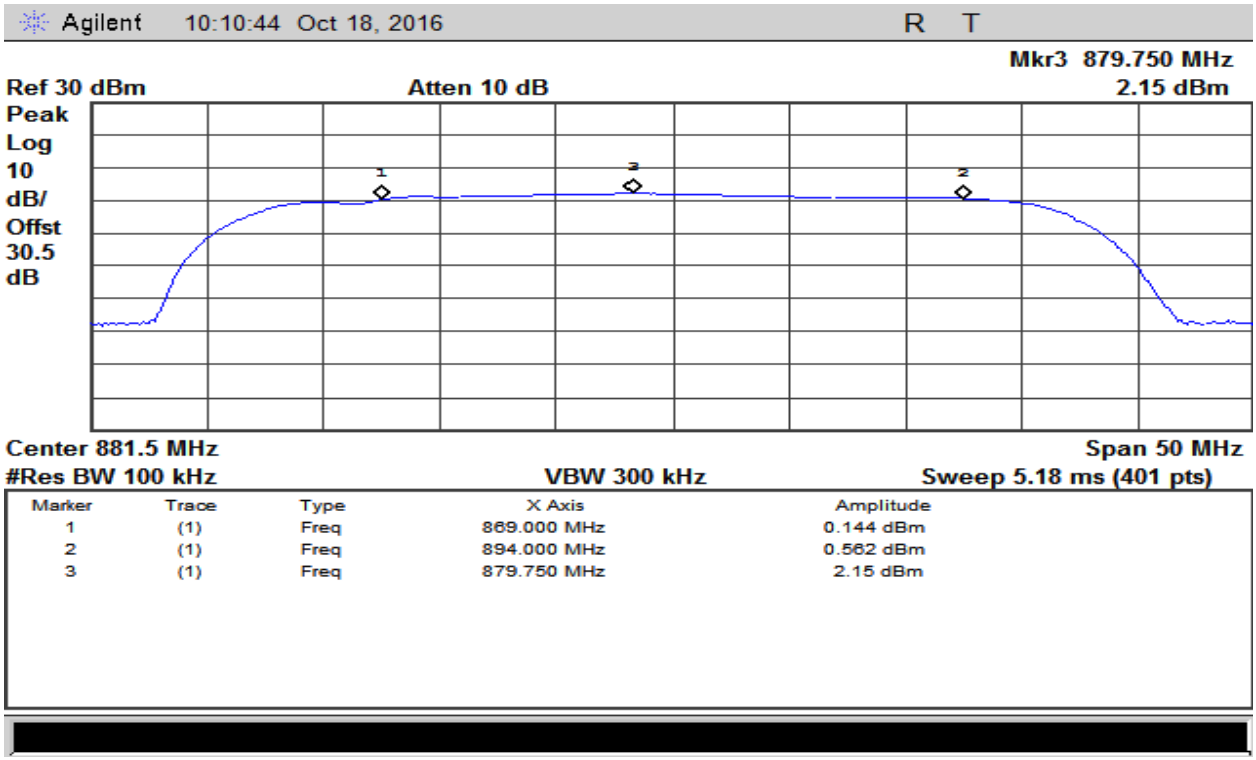
Plot 3 – 1710-1755MHz Band – Uplink



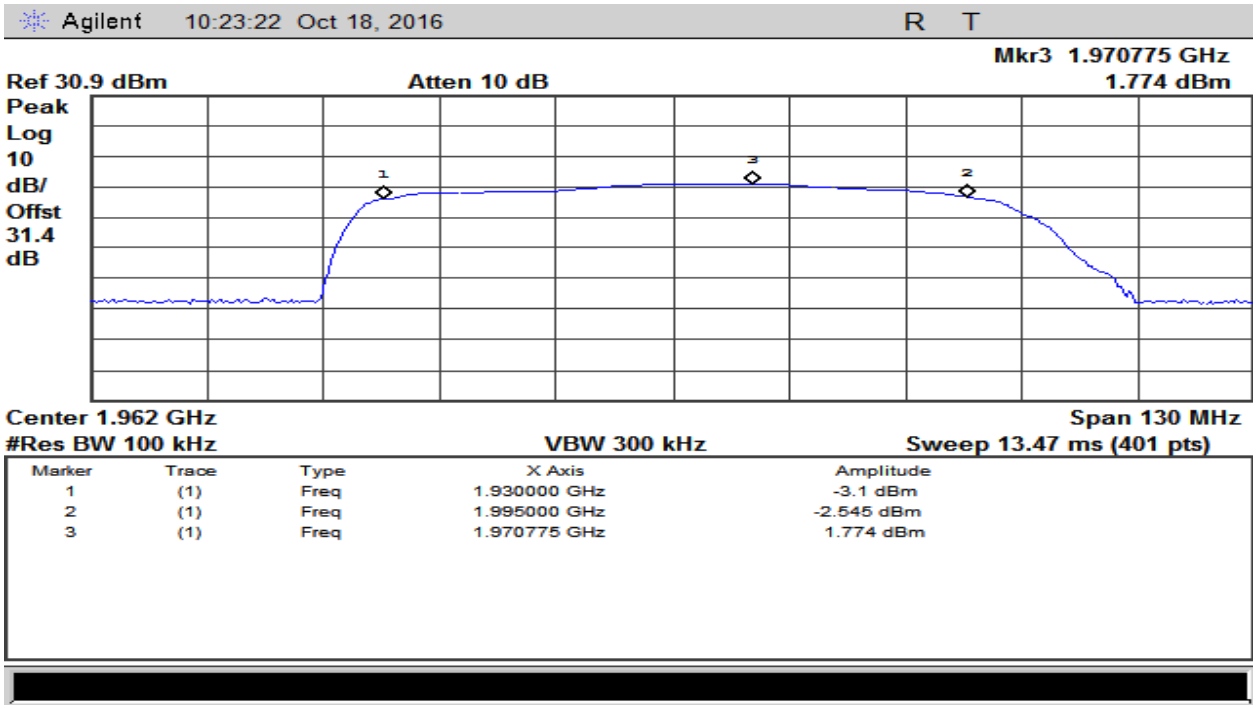
Plot 4 – 698-716MHz Band – Uplink



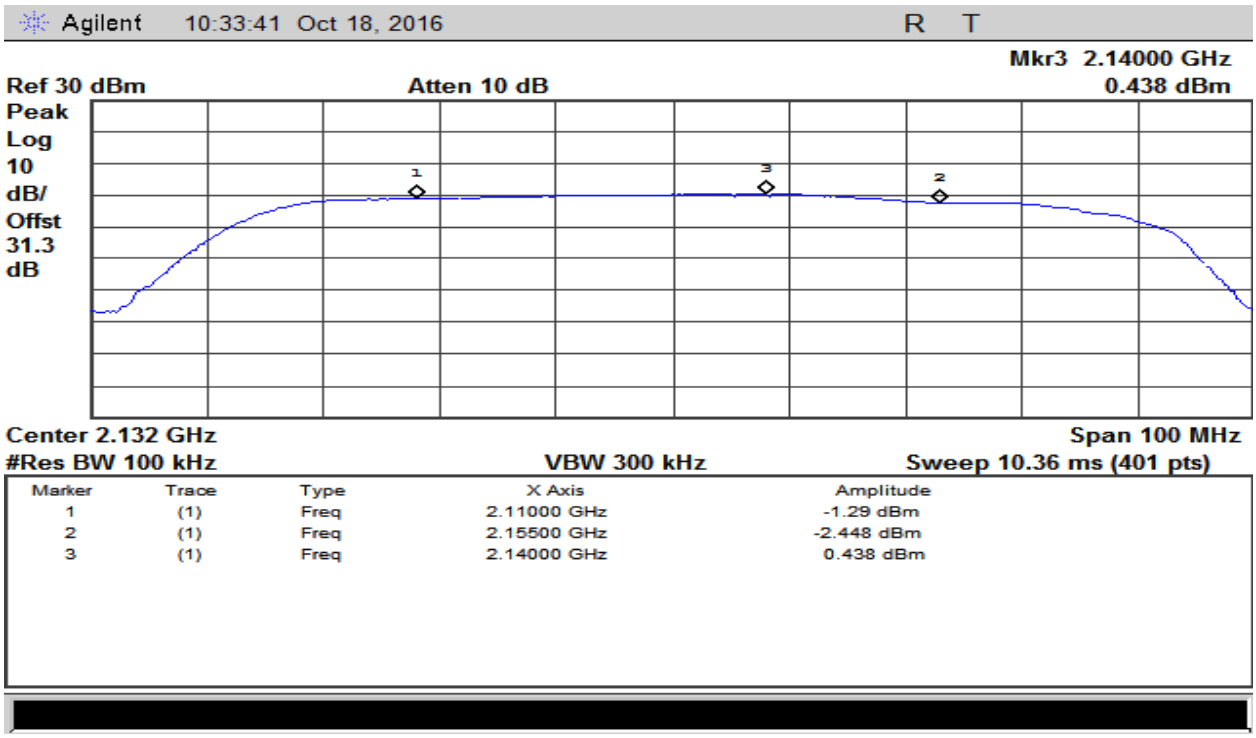
Plot 5 – 776-787MHz Band – Uplink



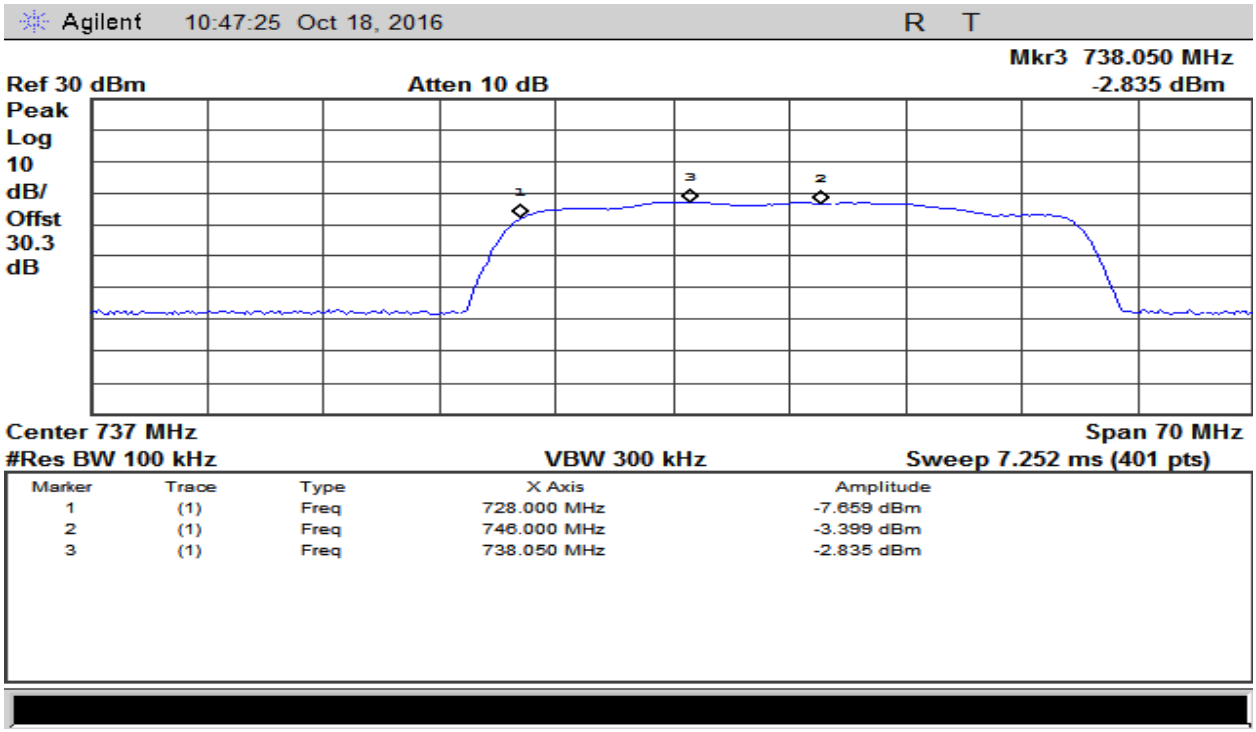
Plot 6 – 869-894MHz Band – Downlink



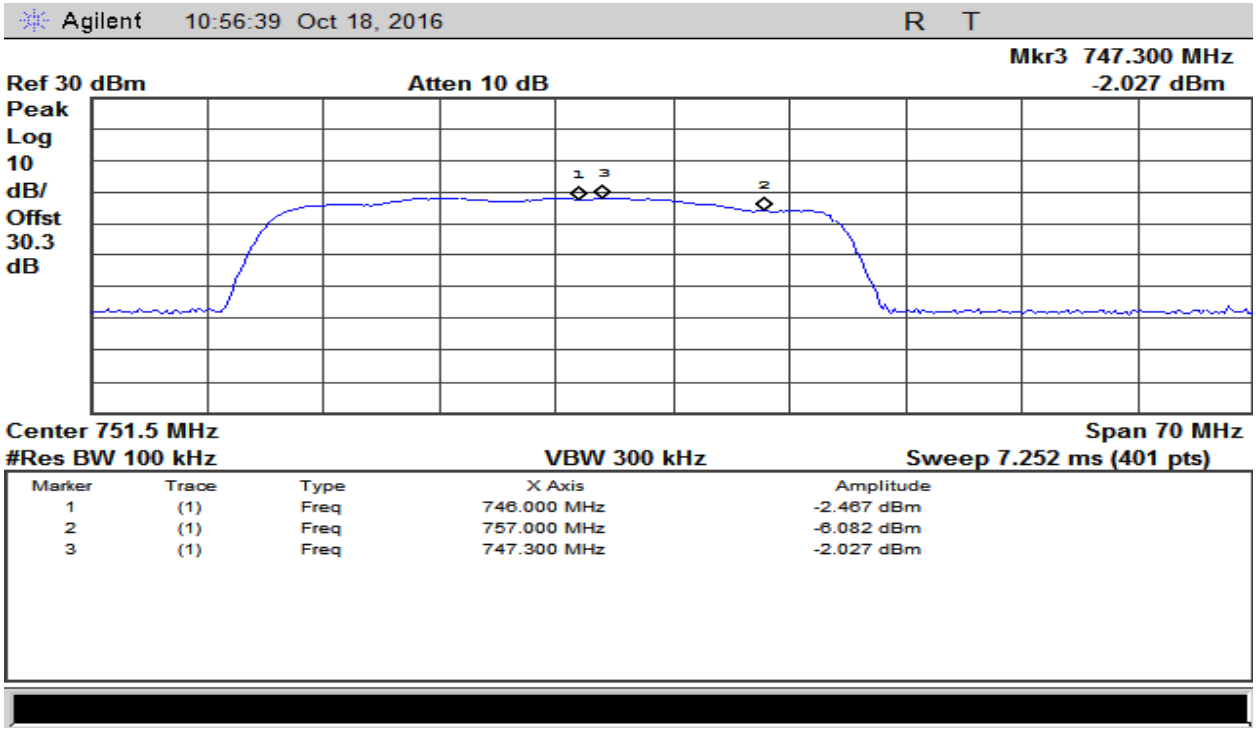
Plot 7 – 1930-1995MHz Band – Downlink



Plot 8 – 2110-2155MHz Band – Downlink



Plot 9 – 728-746MHz Band – Downlink



Plot 10 – 746-757MHz Band – Downlink

2. Maximum Power and Gain

Test Requirement(s):	§20.21(e)(8)(i)(D)	Test Engineer(s):	Keith T.
Test Results:	Pass	Test Date(s):	Oct/19/16

Test Procedure: As required by 47 CFR 20.21(e)(8)(i)(D): Maximum power measurements were made at the RF output terminals of the EUT.

The EUT was connected as per Figure 1 through an attenuator to a Spectrum Analyzer. A signal generator was used for the input to the EUT to provide a GSM & AWGN with 4.1MHz bandwidth signal tuned to the highest frequency measured in Authorized frequency band test of each uplink and downlink operational band.

KDB Procedure 935210 D03 §7.2.2 and §7.3 was used to measure the maximum power and to calculate the maximum gain.

Test Results:

Frequency (MHz)	Input Level (dBm)	Output Power (dBm)	Lower Limit (dBm)	Upper Limit (dBm)
698-716 GSM	11.0	24.6	17	30
698-716 AWGN	9.0	20.7	17	30
776-787 GSM	11.3	24.9	17	30
776-787 AWGN	9.0	20.3	17	30
824-849 GSM	9.5	23.9	17	30
824-849 AWGN	6.5	20.0	17	30
1710-1755 GSM	13.0	23.9	17	30
1710-1755 AWGN	8.0	18.9	17	30
1850-1915 GSM	9.5	23.5	17	30
1850-1915 AWGN	6.0	19.2	17	30

Table 1. Uplink Max Power Test Results

Frequency (MHz)	Input Level (dBm)	Output Power (dBm)	Upper Limit (dBm)
728-746 GSM	-20.0	-6.27	17
728-746 AWGN	-20.0	-6.77	17
746-757 GSM	-20.0	-6.06	17
746-757 AWGN	-20.0	-7.62	17
869-894 GSM	-20.0	-6.5	17
869-894 AWGN	-20.0	-7.30	17
1930-1995 GSM	-20.0	-6.7	17
1930-1995 AWGN	-20.0	-6.91	17
2110-2155 GSM	-20.0	-6.8	17
2110-2155 AWGN	-20.0	-7.78	17

Table 2. Downlink Max Power Test Results

Modulation	Uplink Frequency (MHz	Downlink Frequency (MHz)	Uplink Gain (dB)	Uplink Limit (dB)	Downlink Gain (dB)	Downlink Limit (dB)	UL Gain - DL Gain (Delta in dB	Limit (dB)	Margin (dB)
GSM	712.2	738.05	13.6	15	13.73	15	0.13	9	-8.87
AWGN	712.2	738.05	11.7	15	13.23	15	1.53	9	-7.47
GSM	782.0	747.3	13.1	15	12.69	15	0.41	9	-8.59
AWGN	7820	747.3	11.3	15	12.38	15	1.08	9	-7.92
GSM	838.12	879.75	14.4	15	12.84	15	1.56	9	-7.44
AWGN	838.12	879.75	13.5	15	12.7	15	0.8	9	-8.2
GSM	1880.07	1970.7	14.0	15	13.17	15	0.83	9	-8.17
AWGN	1880.07	1970.7	13.2	15	13.09	15	0.11	9	-8.89
GSM	1723.3	2140.0	10.9	15	12.25	15	1.35	9	-7.65
AWGN	1723.3	2140.0	10.9	15	12.22	15	1.32	9	-7.68

Table 3. Maximum Booster Gain Test Results

3. Conducted Spurious Emissions

Test Requirement(s):	§2.1051	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	Nov/02/16

Test Procedures: As required by 47 CFR §2.1051, Spurious emissions measurements were made at antenna terminals in accordance with the procedures of the KDB 935210 D03.

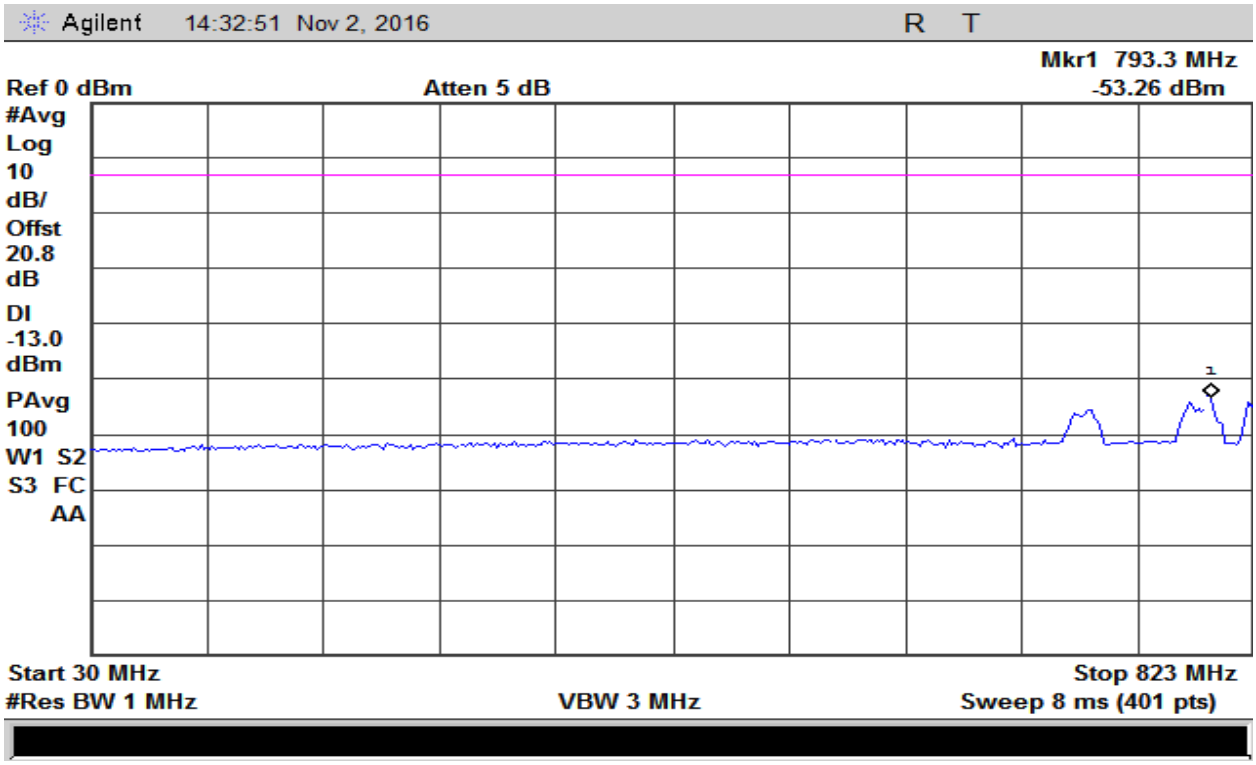
The EUT was connected through an attenuator to a spectrum analyzer. A signal generator was used at the input of the EUT to produce a 4.1MHz AWGN signal at the center of each CMRS operating band. Measurements were made at the low and high frequency of the uplink and downlink operational band.

Frequency Band (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin
824-849	793.3	-53.26	-13	-40.26
1850-1915	1849	-49.47	-13	-36.47
1710-1755	1709	-46.33	-13	-33.33
698-716	697	-43.1	-13	-30.1
776-787	872.2	-41.06	-13	-28.06

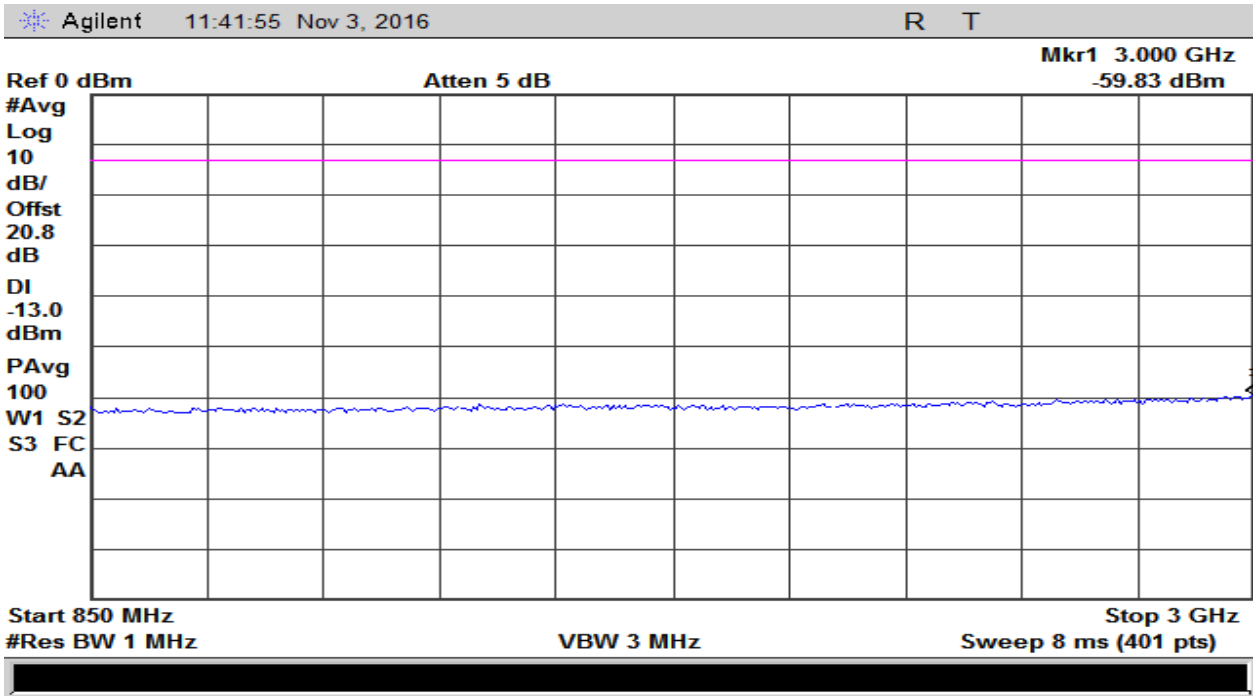
Table 4 – Conducted Spurious Emission Data – Uplink Summary

Frequency Band (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin
869-894	2995	-60.04	-13	-47.04
1930-1995	747	-58.58	-13	-45.58
2110-2155	737	-57.94	-13	-44.94
728-746	727.0	-40.08	-13	-27.08
746-757	745	-34.01	-13	-21.01

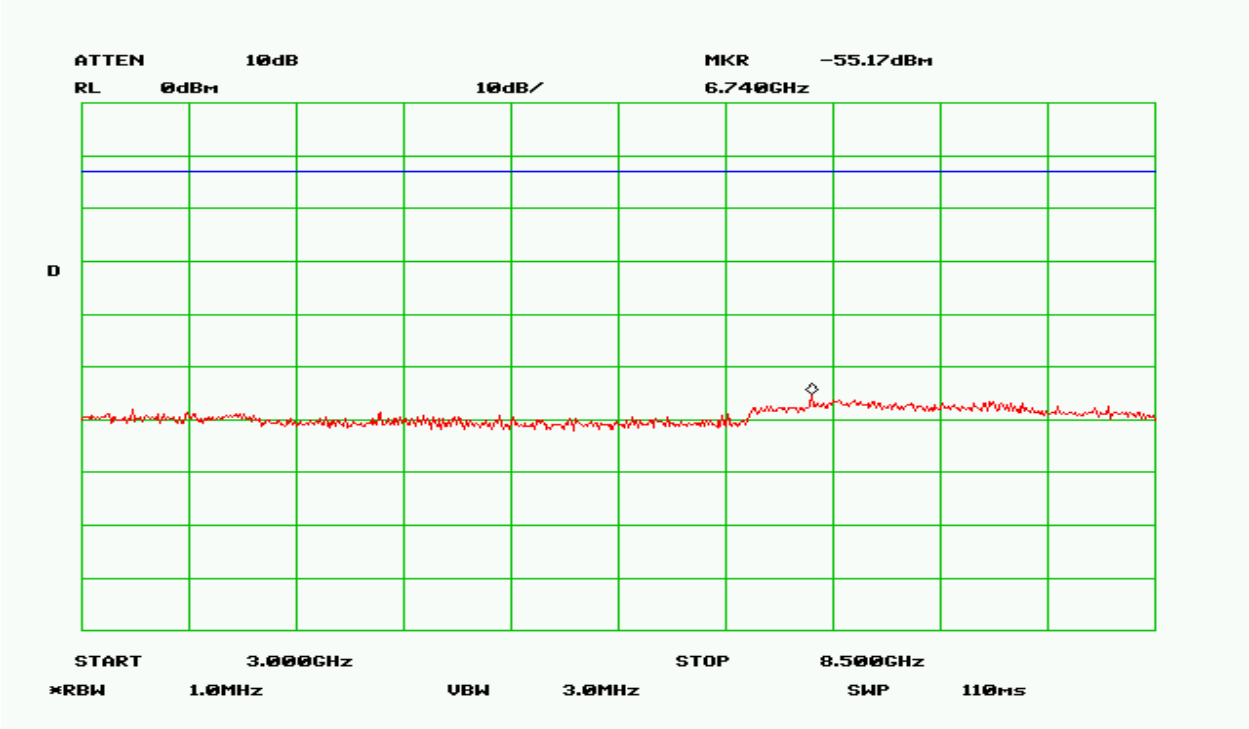
Table 5 – Conducted Spurious Emission Data – Downlink Summary



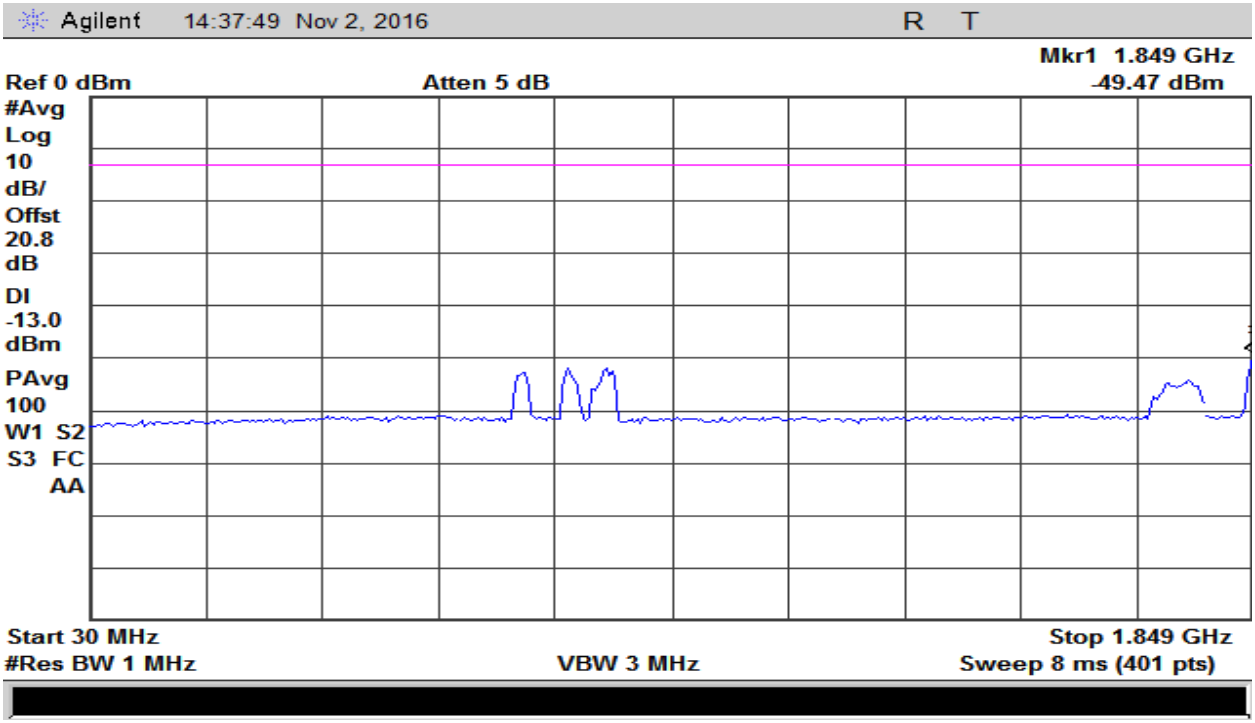
Plot 11 – 824-849MHz Band – Uplink



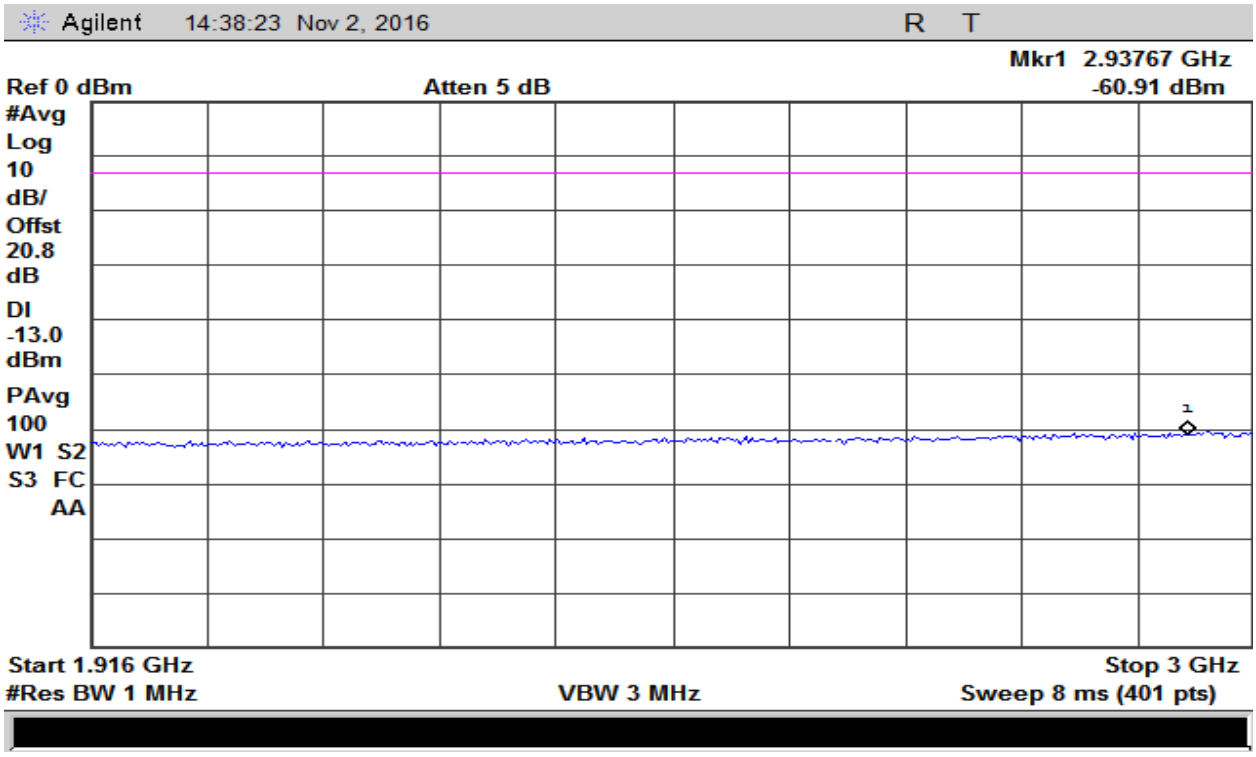
Plot 12 – 824-849MHz Band – Uplink



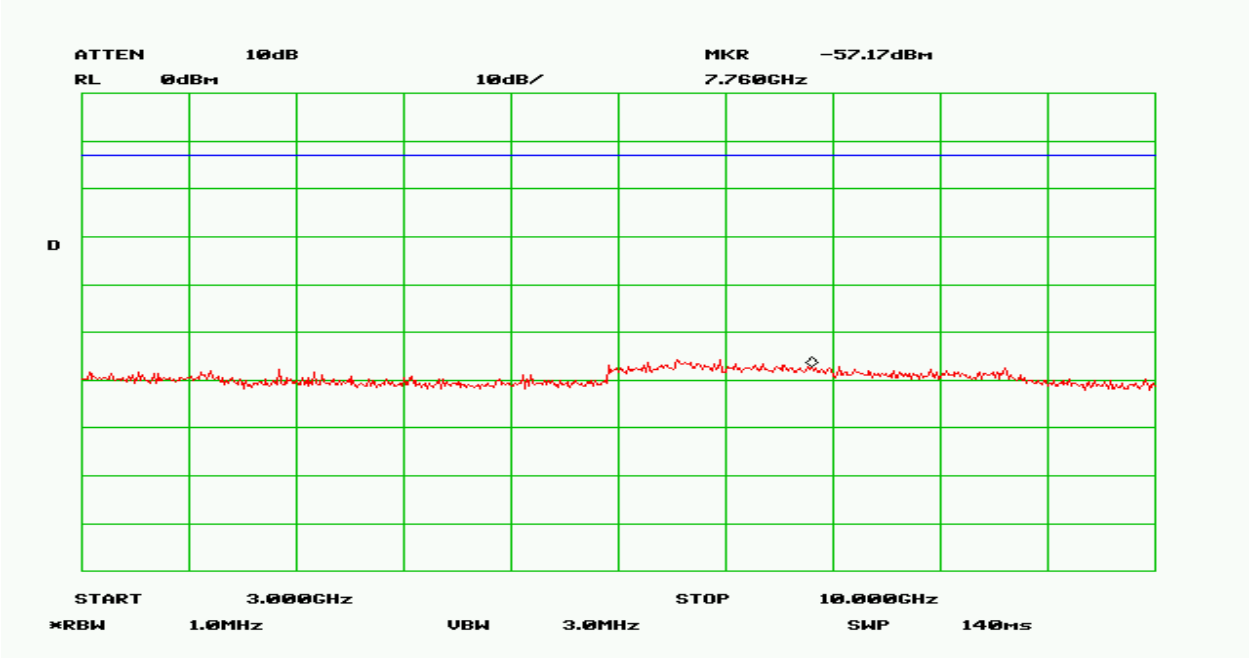
Plot 13 – 824-849MHz Band – Uplink



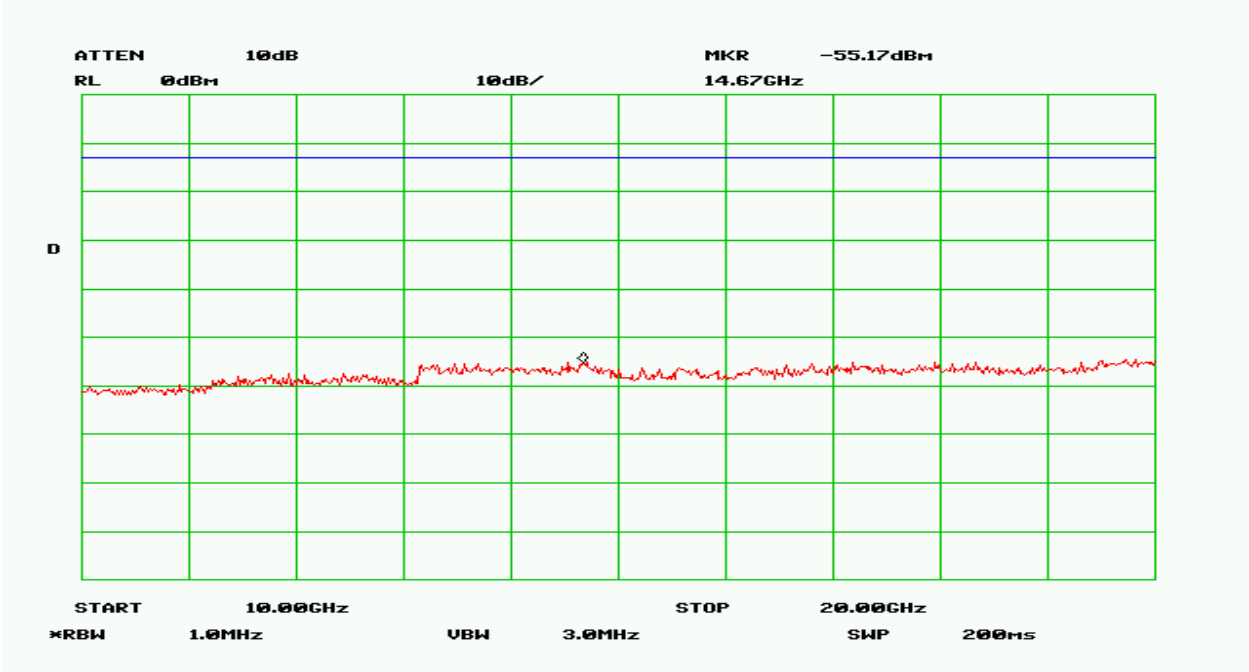
Plot 14 – 1850-1915MHz Band – Uplink



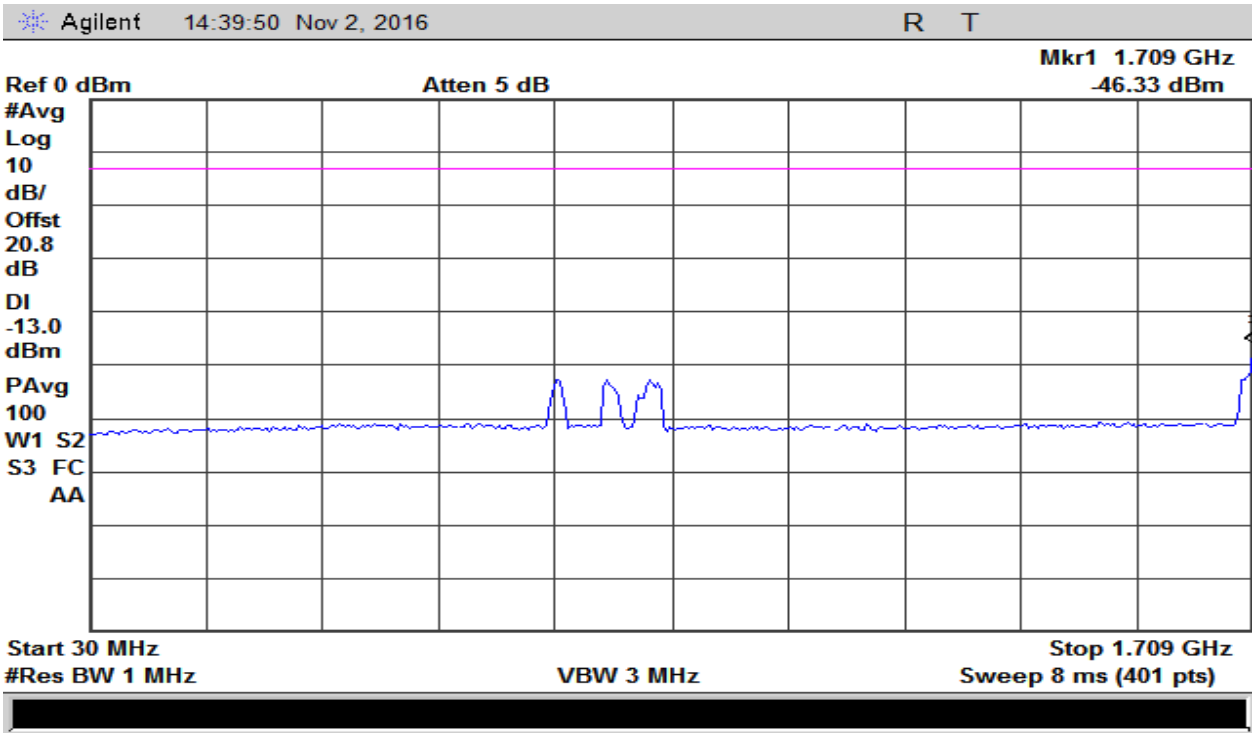
Plot 15 – 1850-1915 Band – Uplink



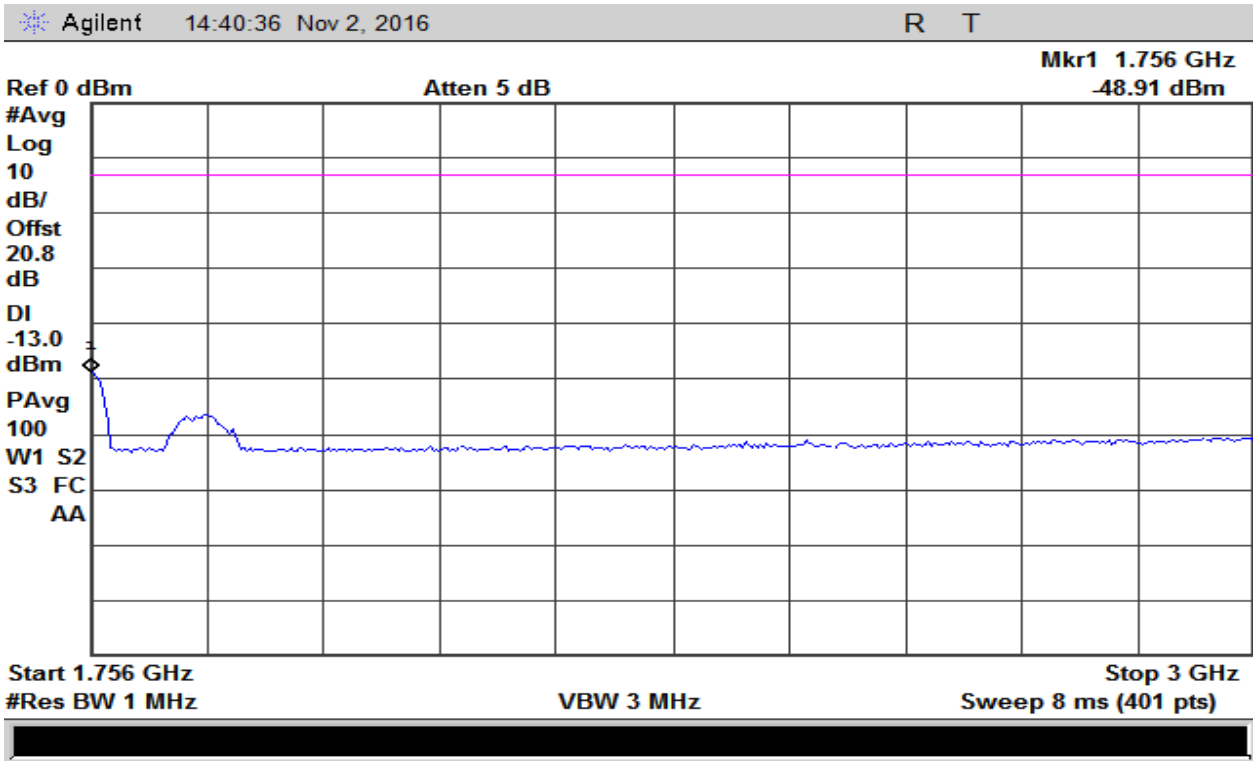
Plot 16 – 1850-1915MHz Band – Uplink



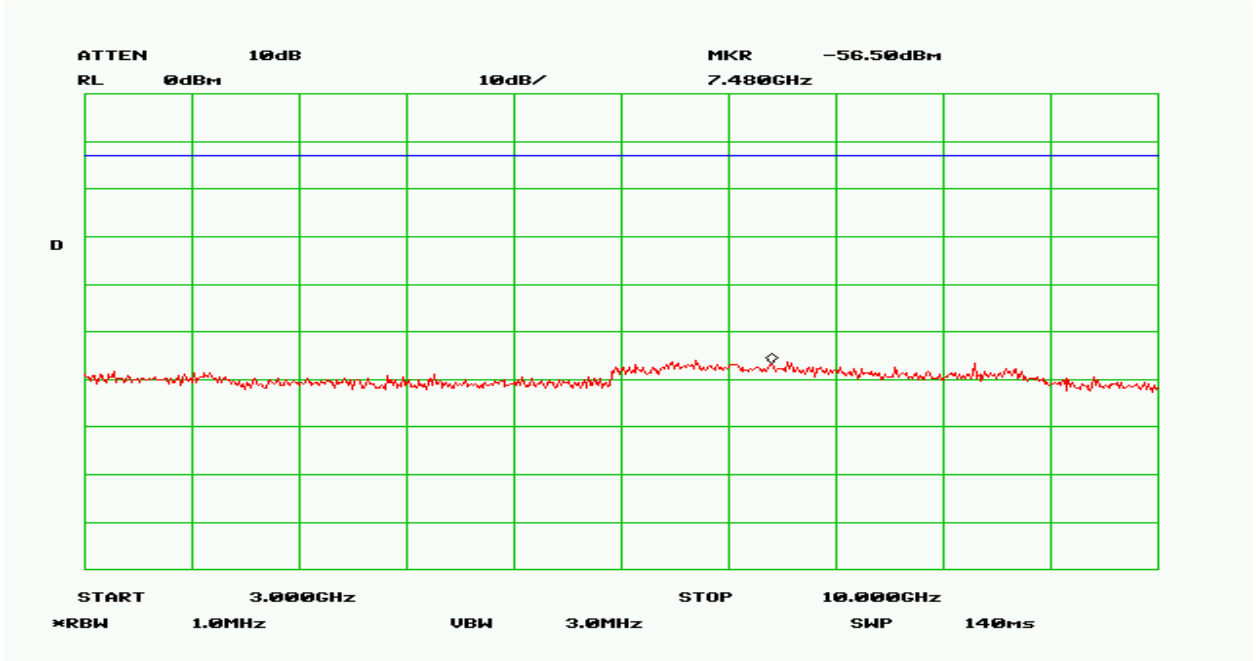
Plot 17 – 1850-1915MHz Band – Uplink



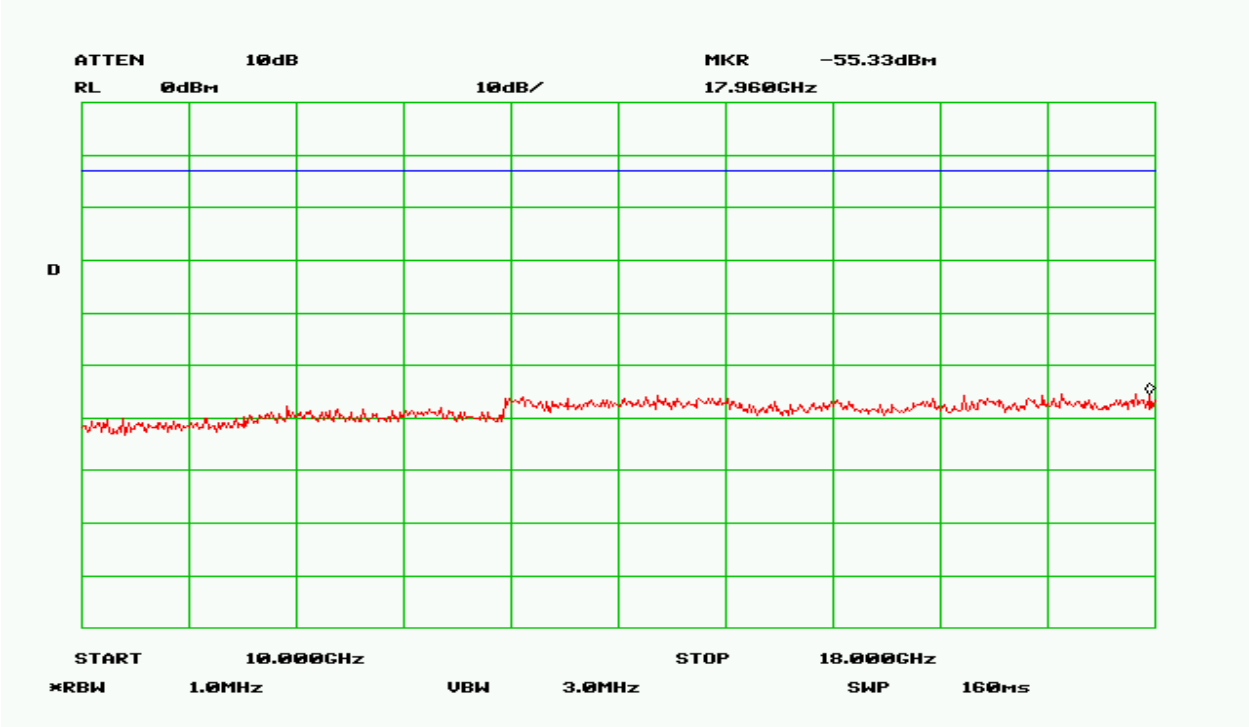
Plot 18 – 1710-1755MHz Band – Uplink



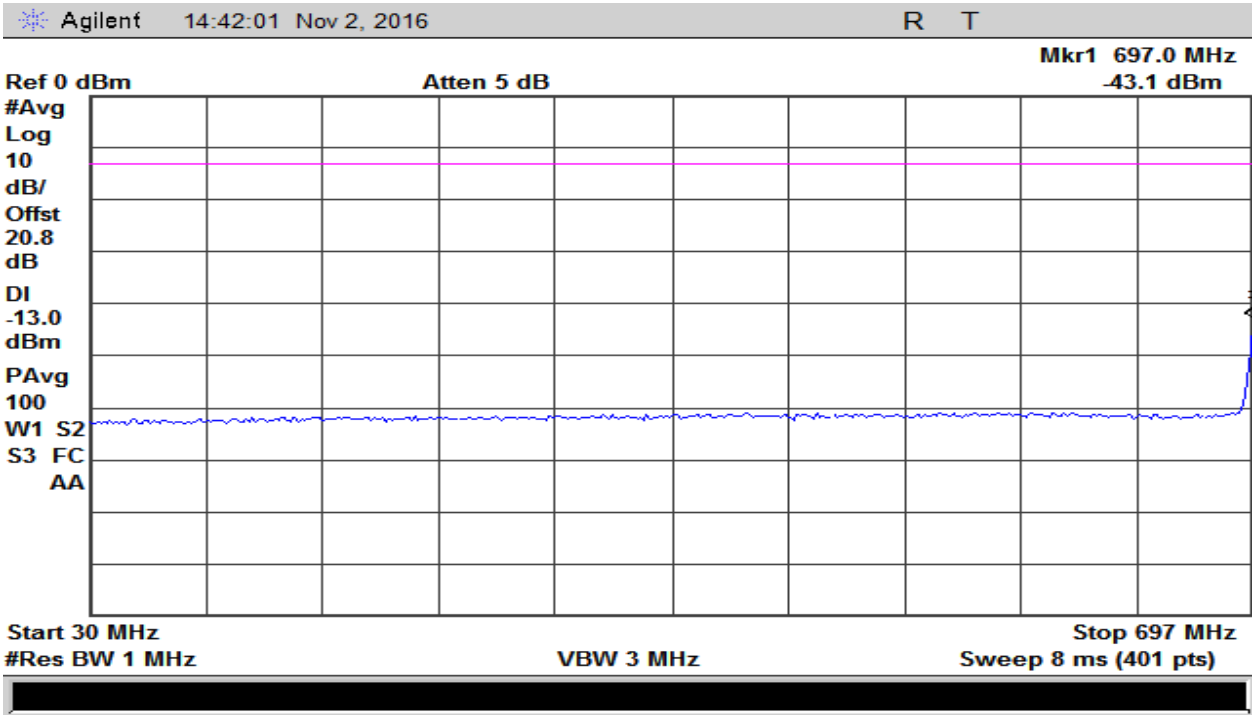
Plot 19 – 1710-1755MHz Band –Uplink



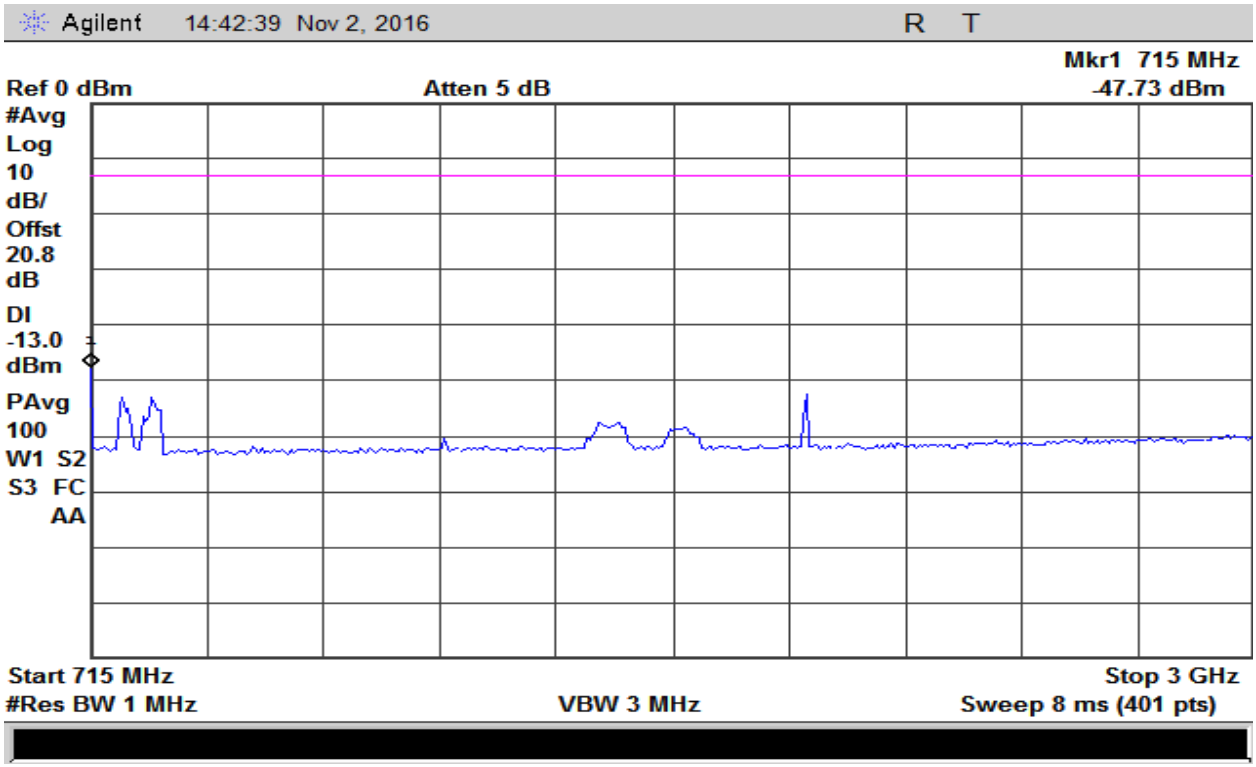
Plot 20 – 1710-1755MHz Band – Uplink



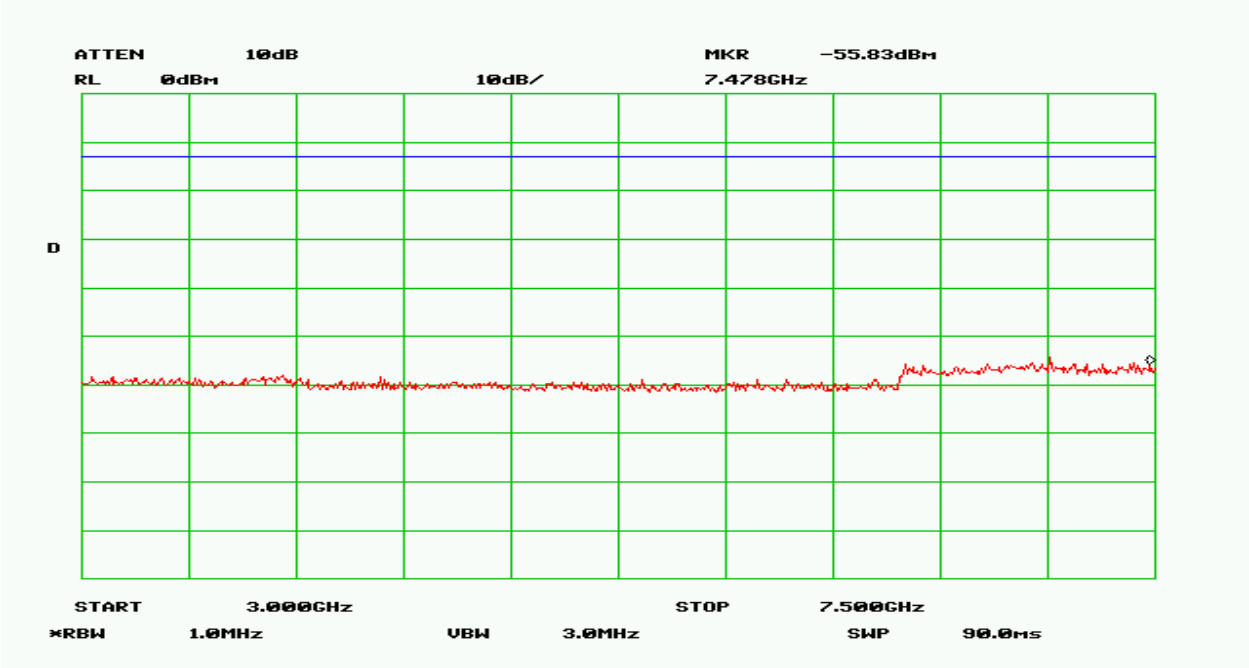
Plot 21 – 1710-1755MHz Band – Uplink



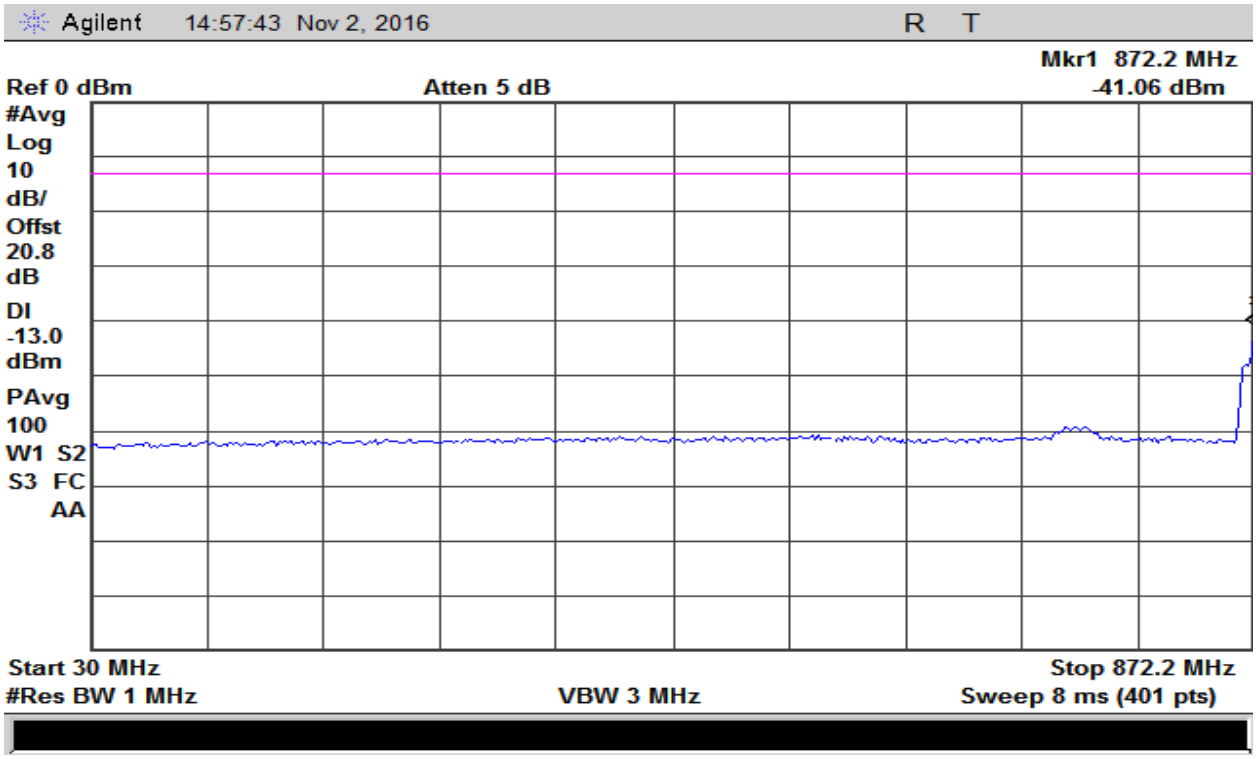
Plot 22 – 698-716MHz Band – Uplink



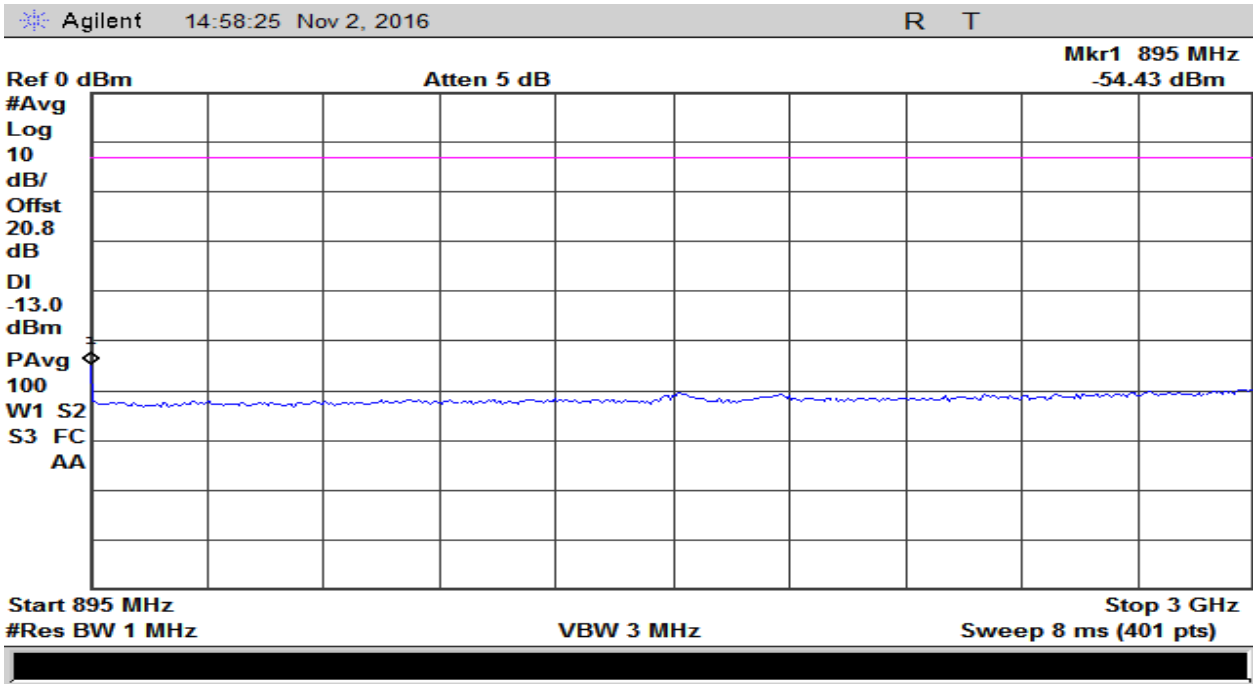
Plot 23 – 698-716MHz Band – Uplink



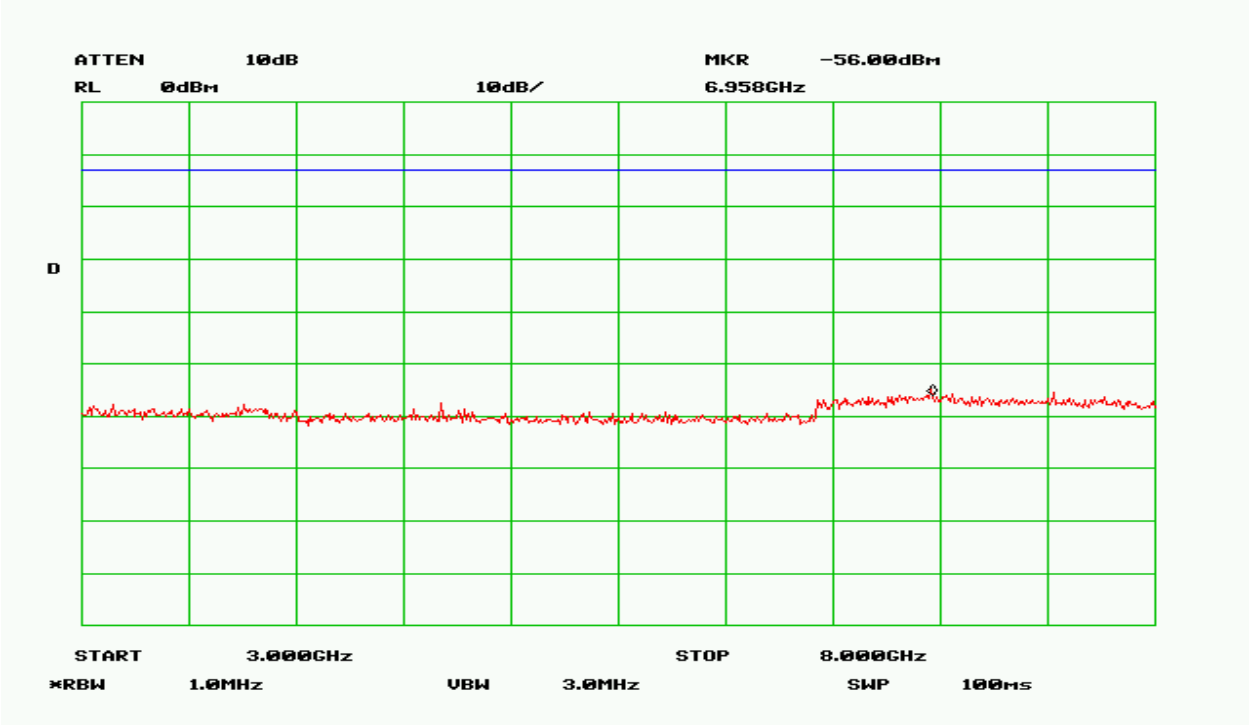
Plot 24 – 698-716MHz Band – Uplink



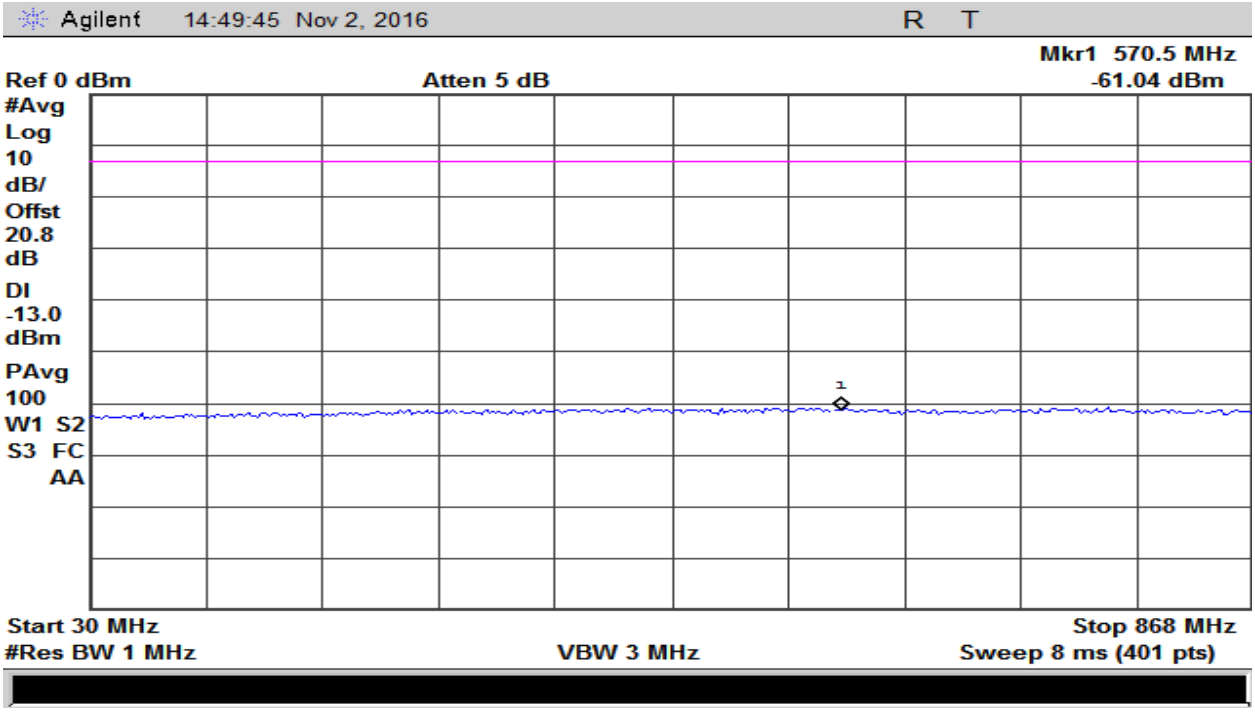
Plot 25 – 776-787MHz Band – Uplink



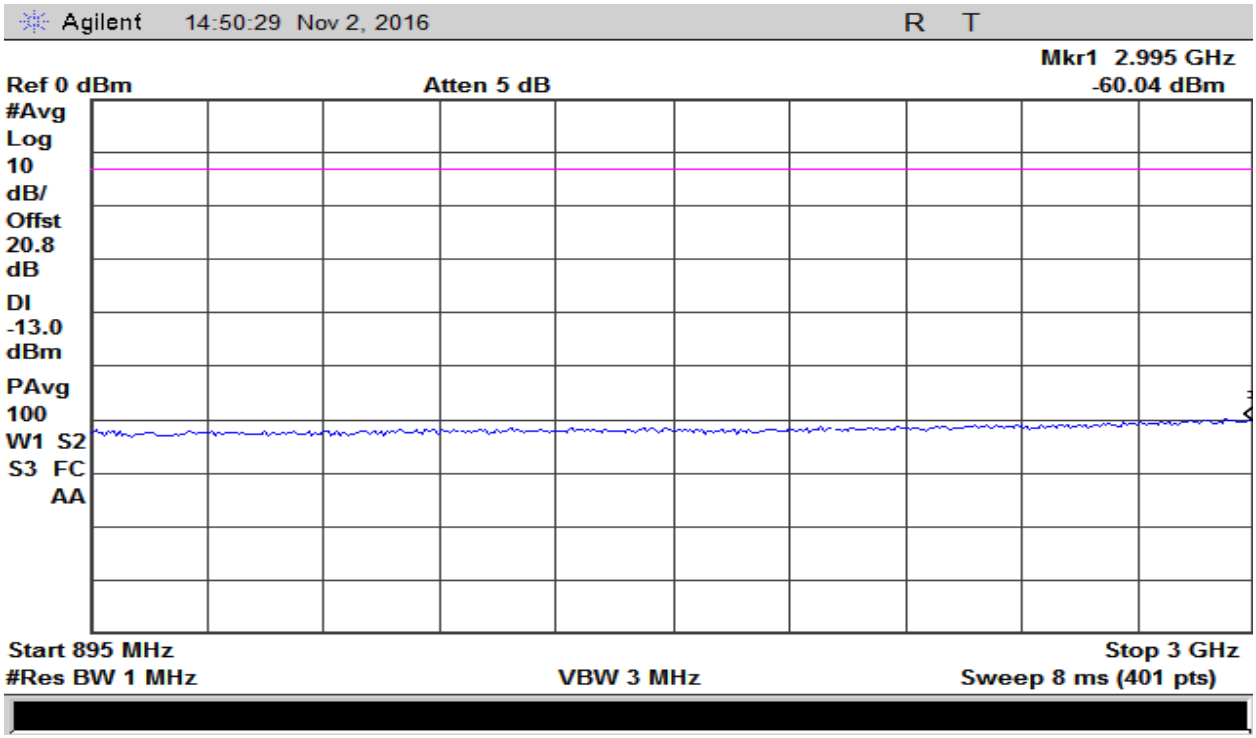
Plot 26 – 776-787MHz Band – Uplink



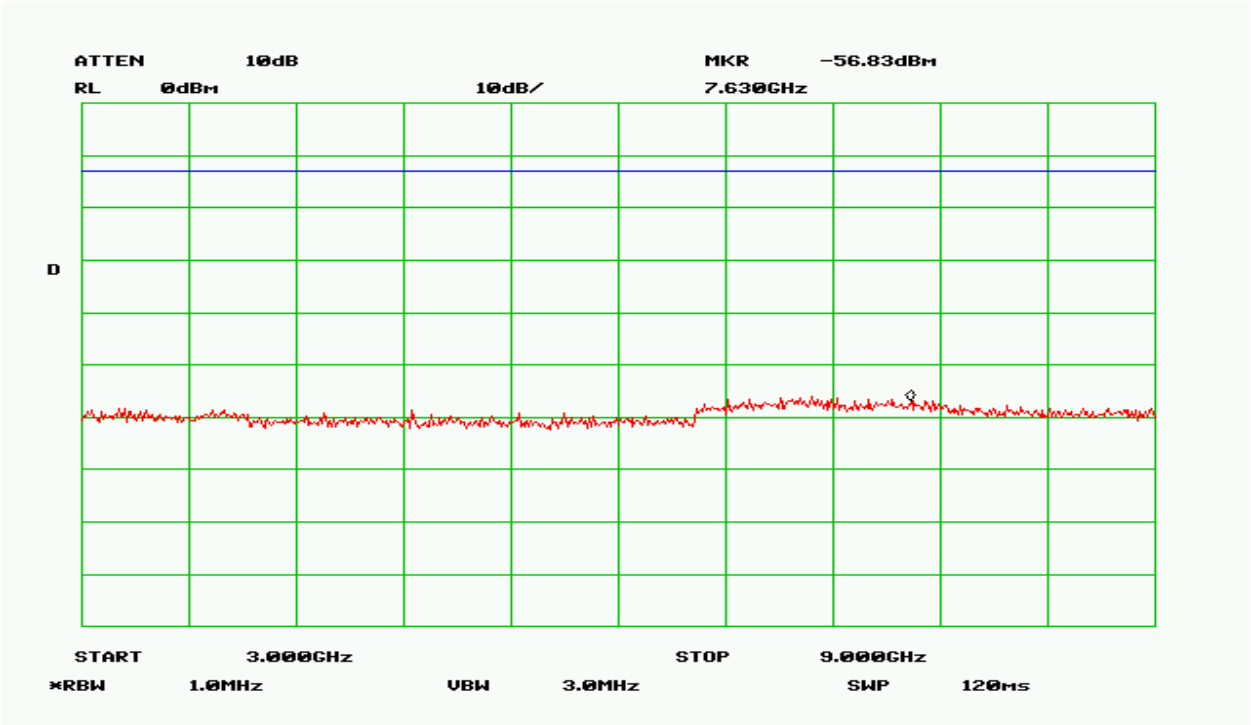
Plot 27 – 776-787MHz Band – Uplink



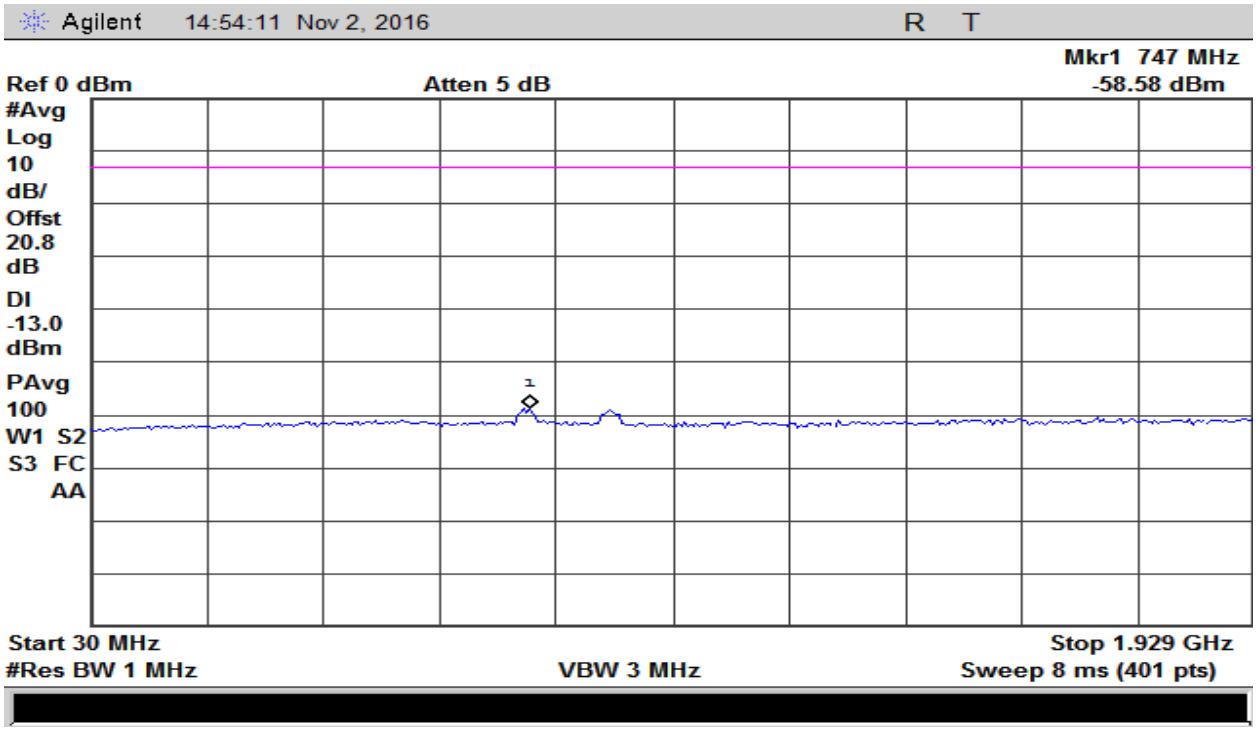
Plot 28 – 869-894MHz Band – Downlink



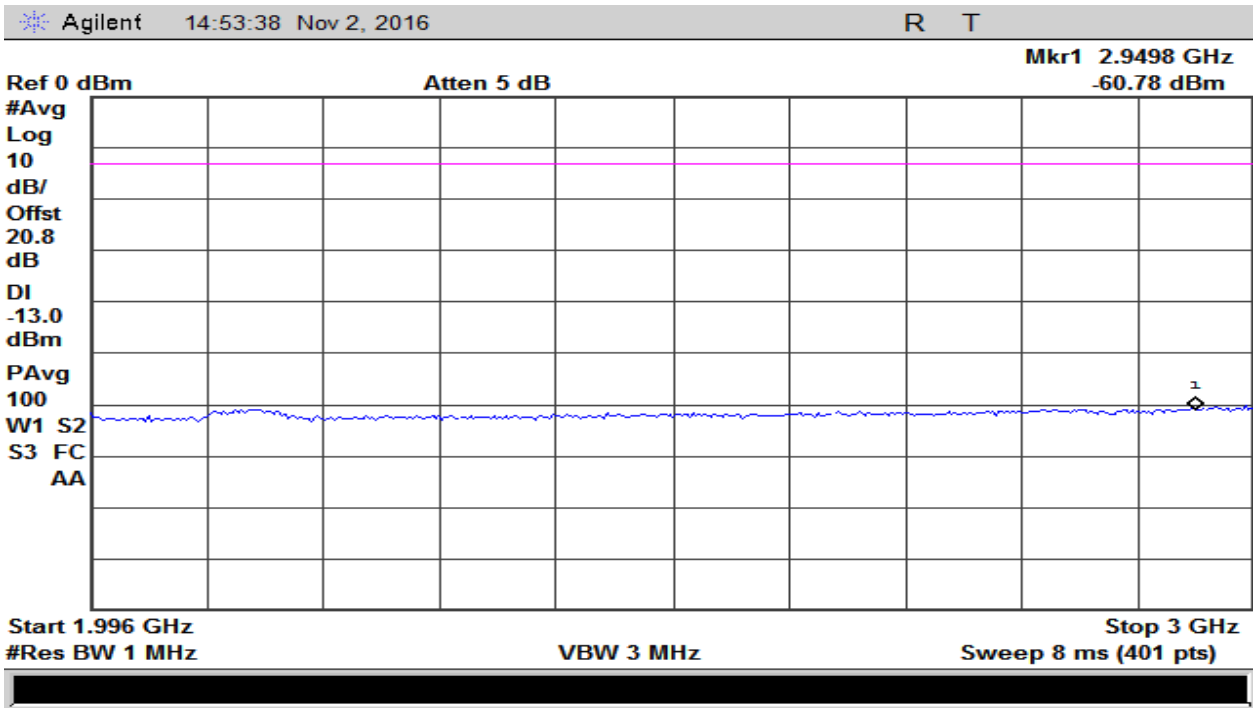
Plot 29 – 869-894MHz Band – Downlink



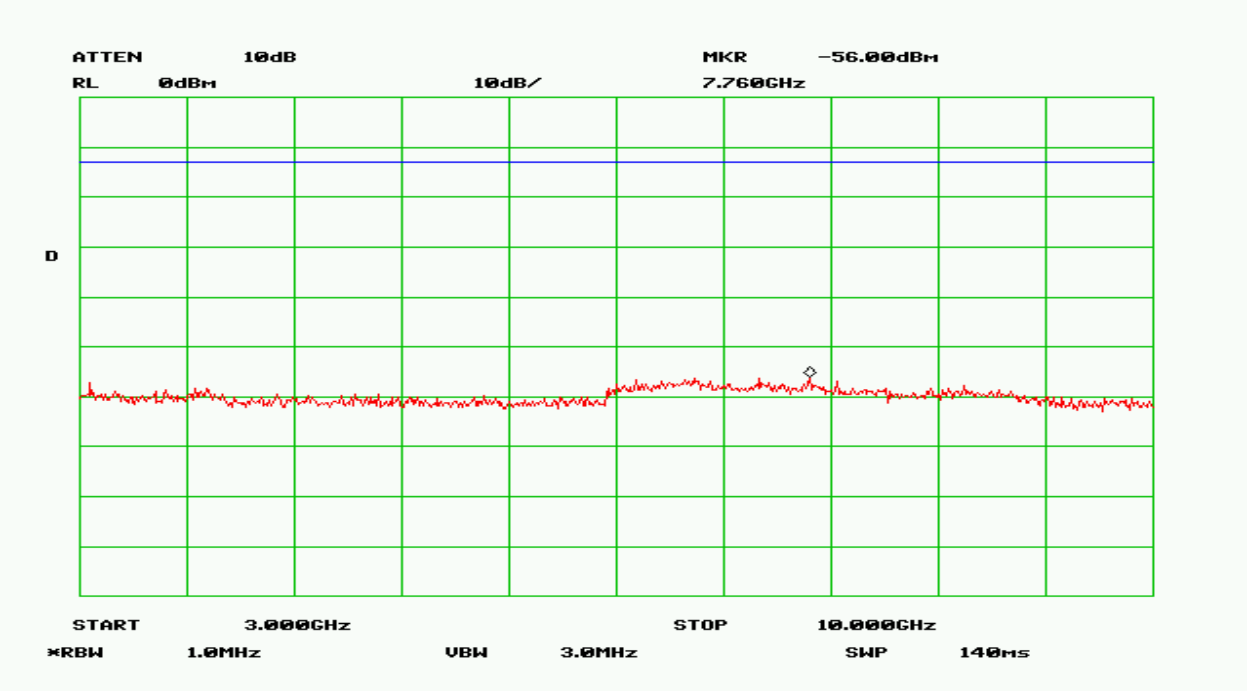
Plot 30 – 869-894MHz Band – Downlink



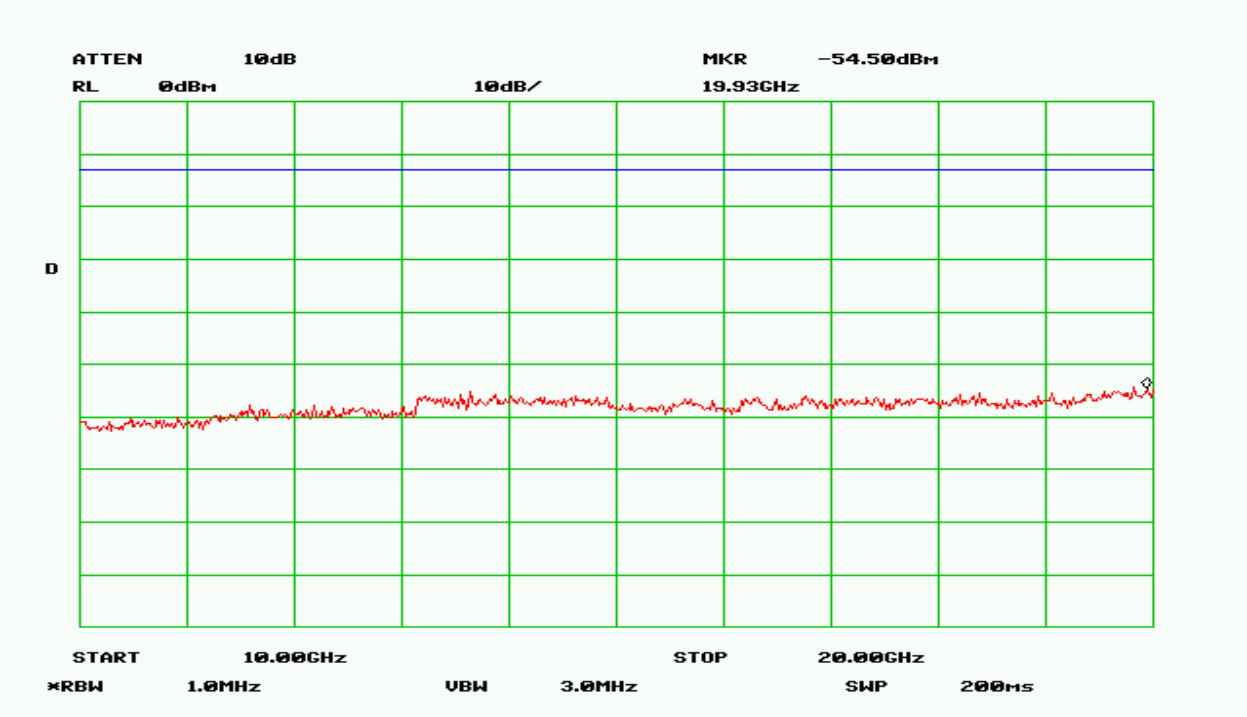
Plot 31 – 1930-1995MHz Band – Downlink



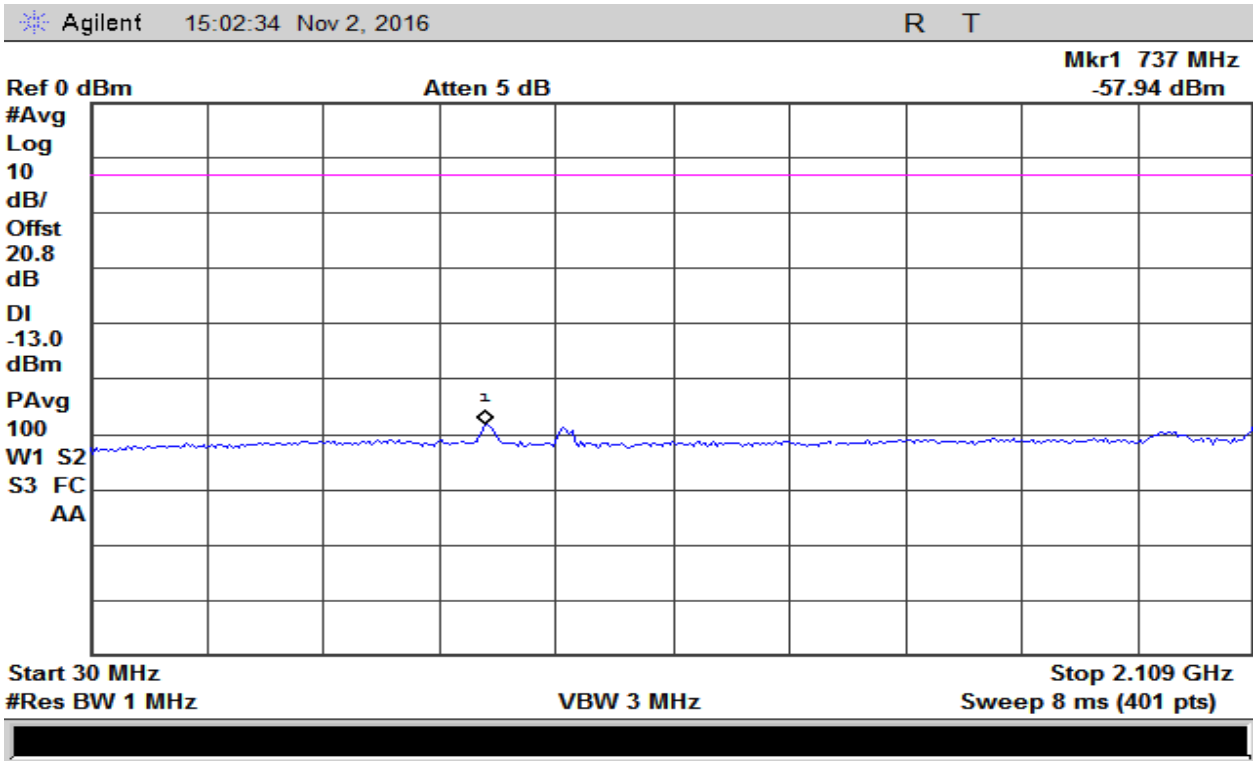
Plot 32 – 1930-1995MHz Band – Downlink



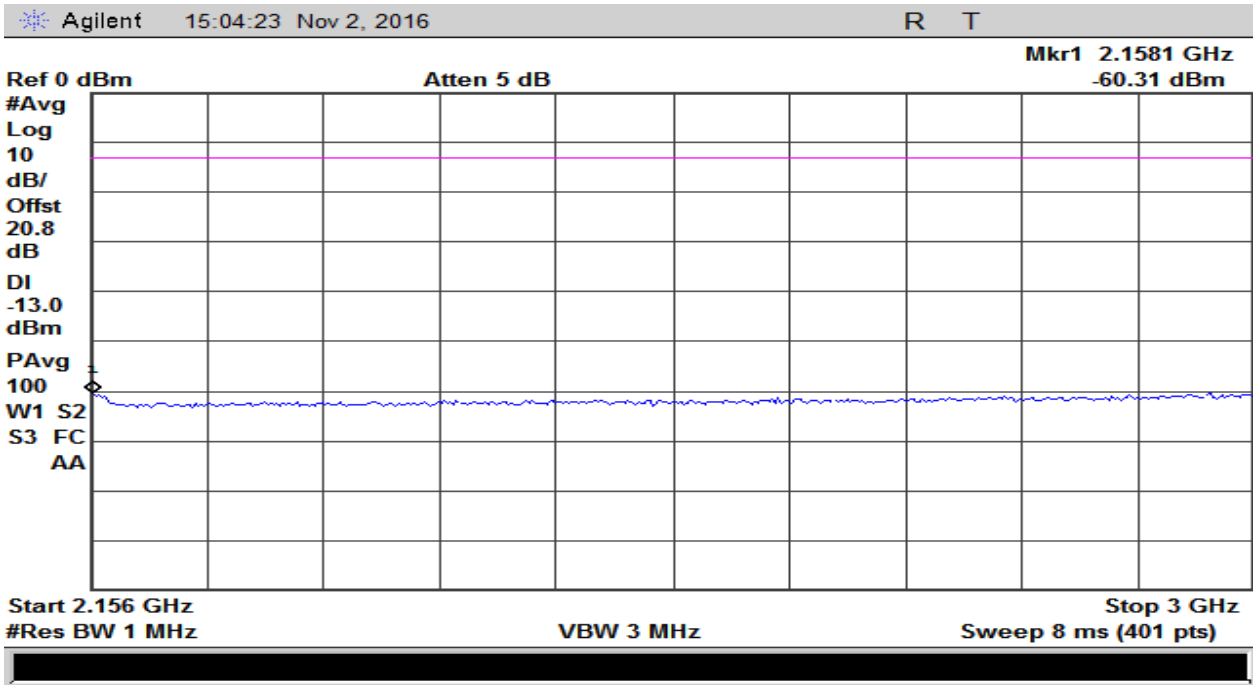
Plot 33 – 1930-1995MHz Band – Downlink



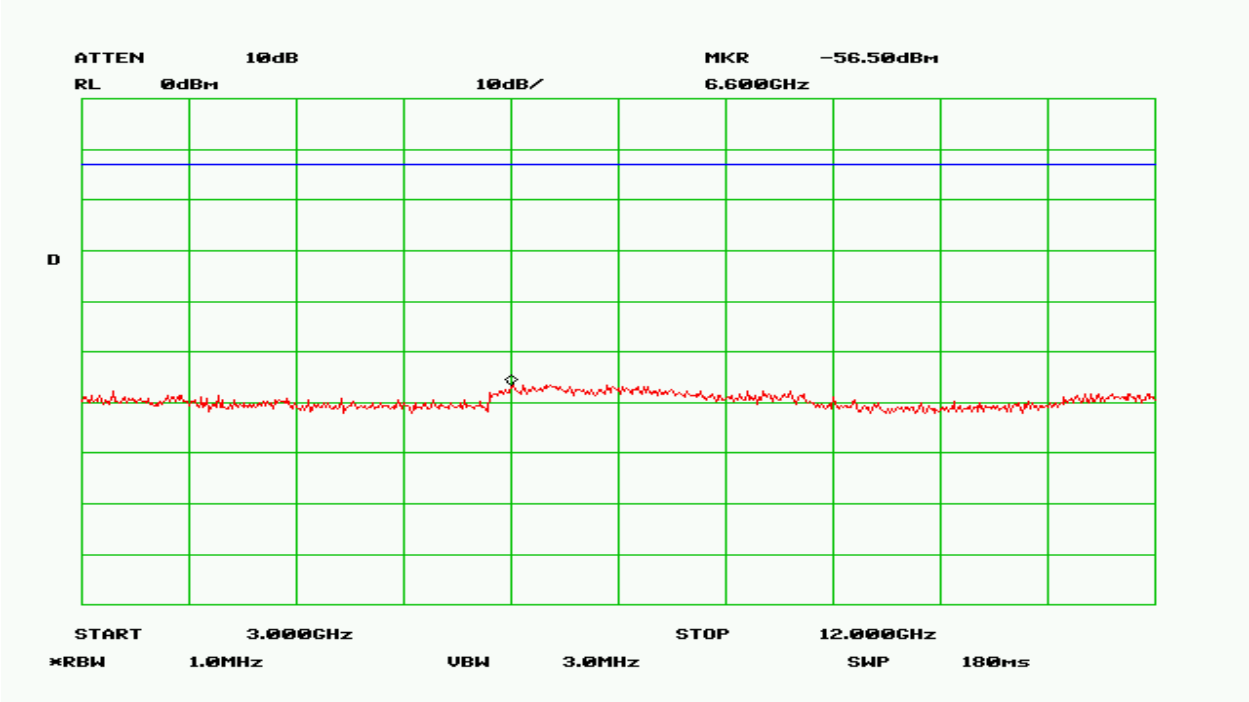
Plot 34 – 1930-1995MHz Band – Downlink



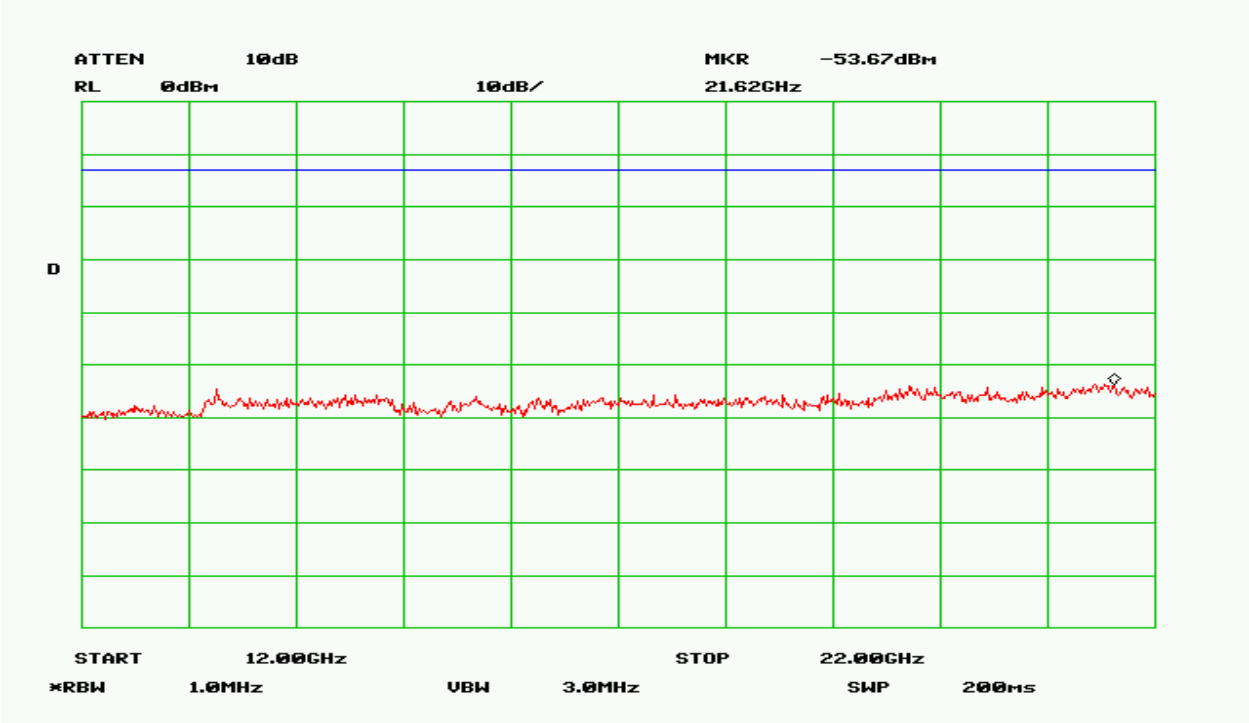
Plot 35 – 2110-2155MHz Band – Downlink



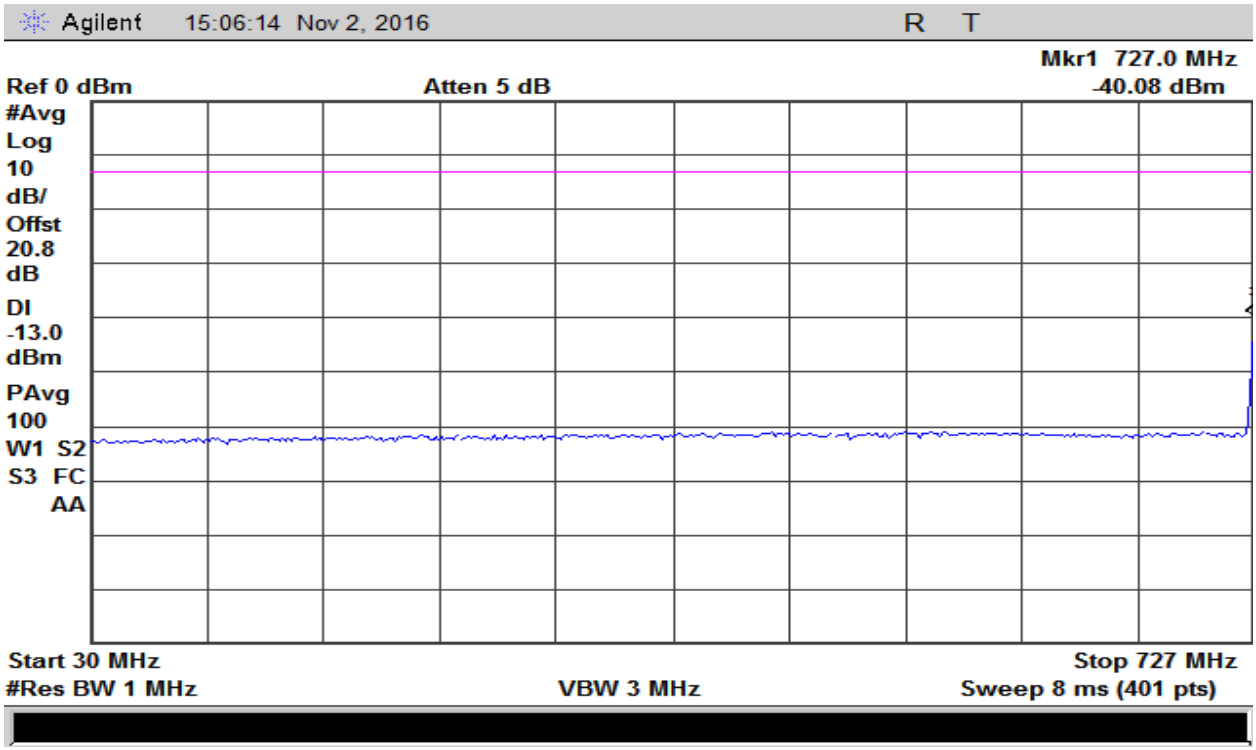
Plot 36 – 2110-2155MHz Band – Downlink



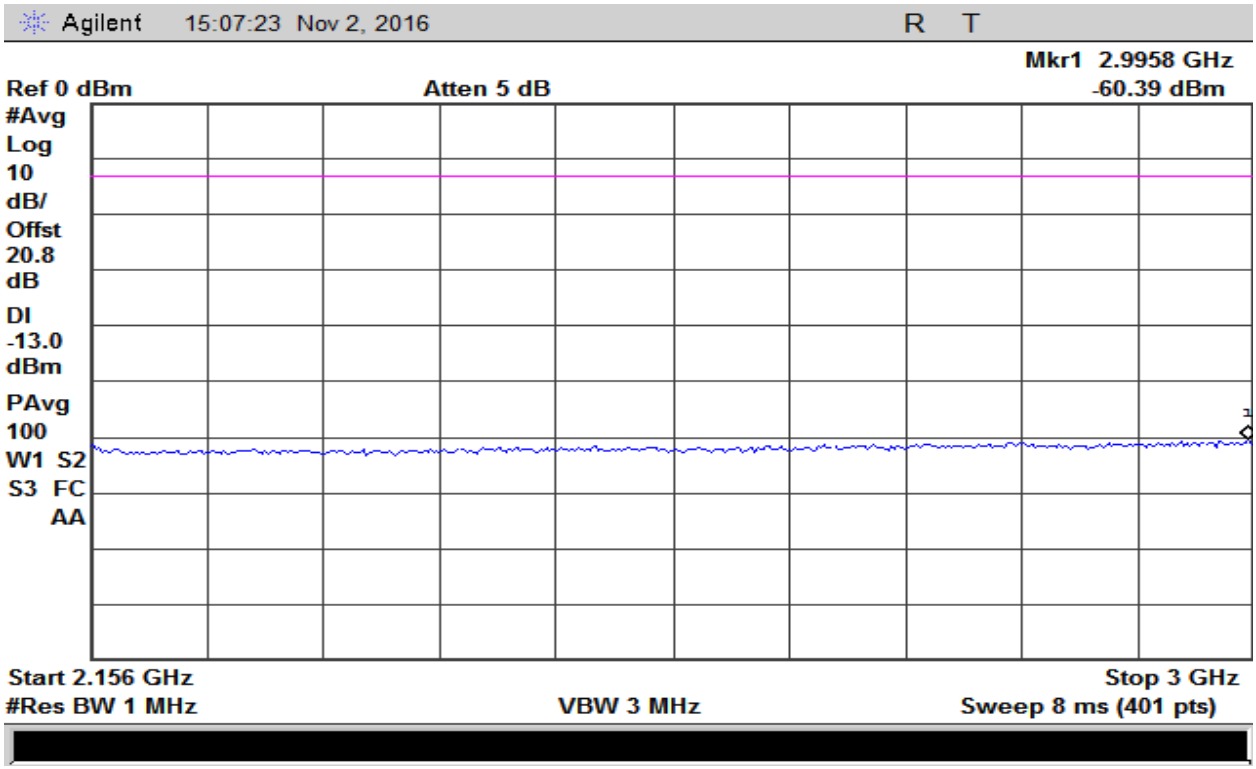
Plot 37 – 2110-2155MHz Band – Downlink



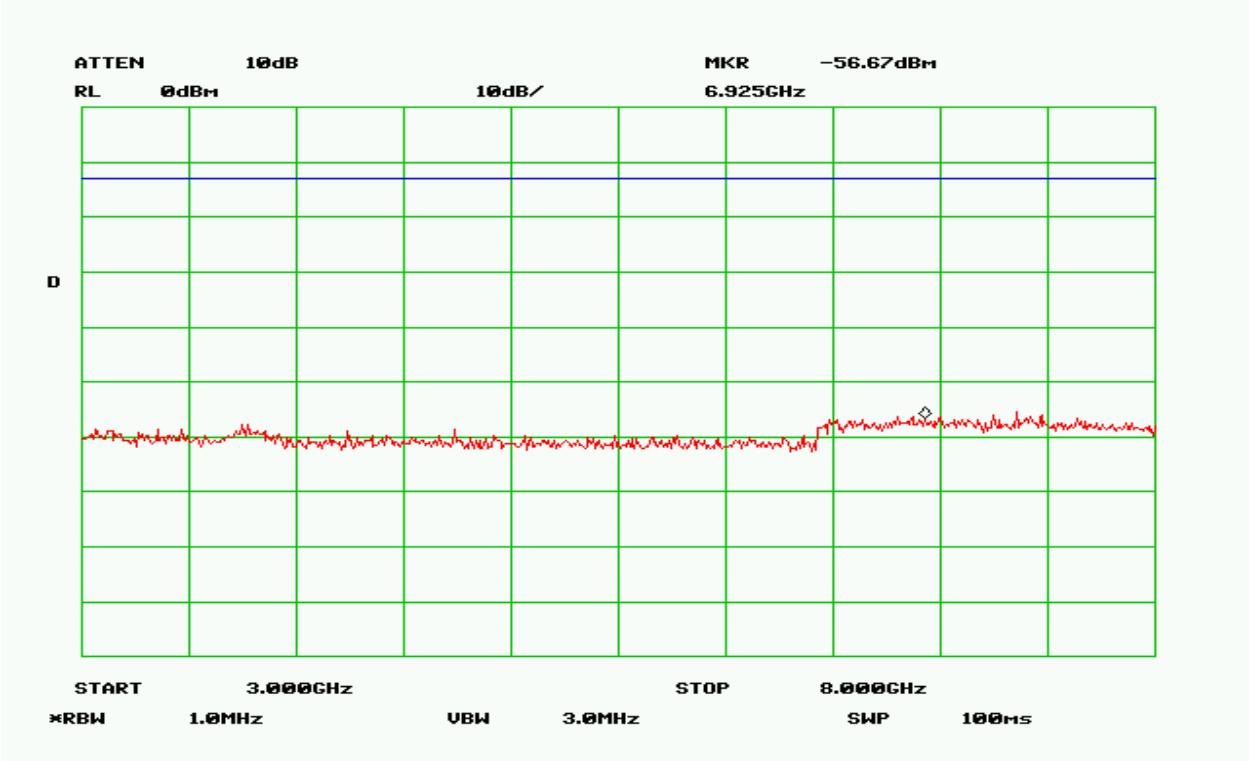
Plot 38 – 2110-2155MHz Band – Downlink



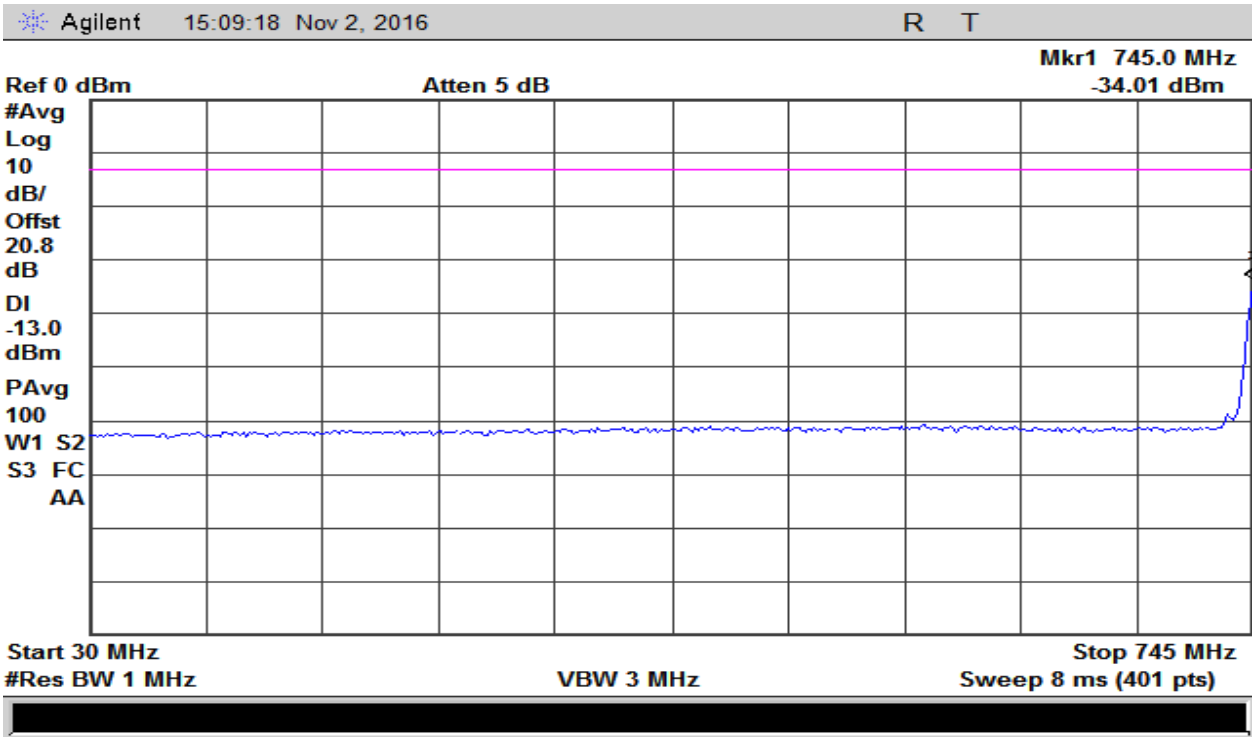
Plot 39 – 728-746MHz Band – Downlink



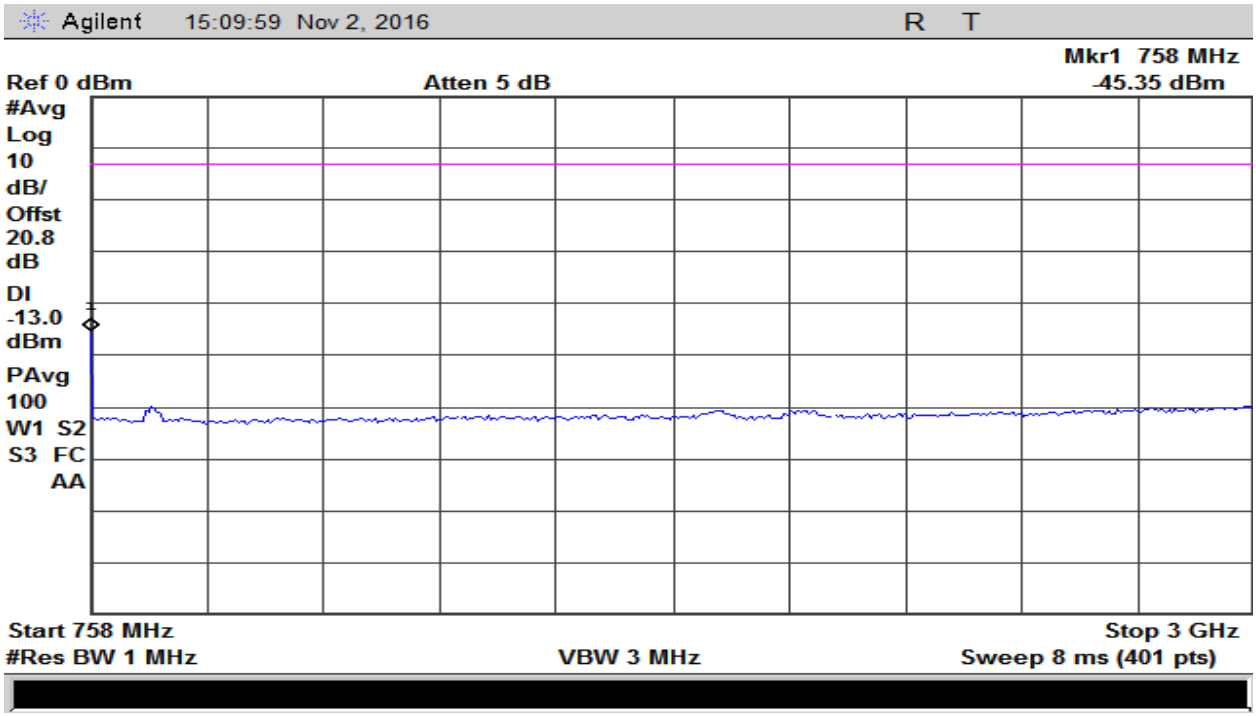
Plot 40 – 728-746MHz Band – Downlink



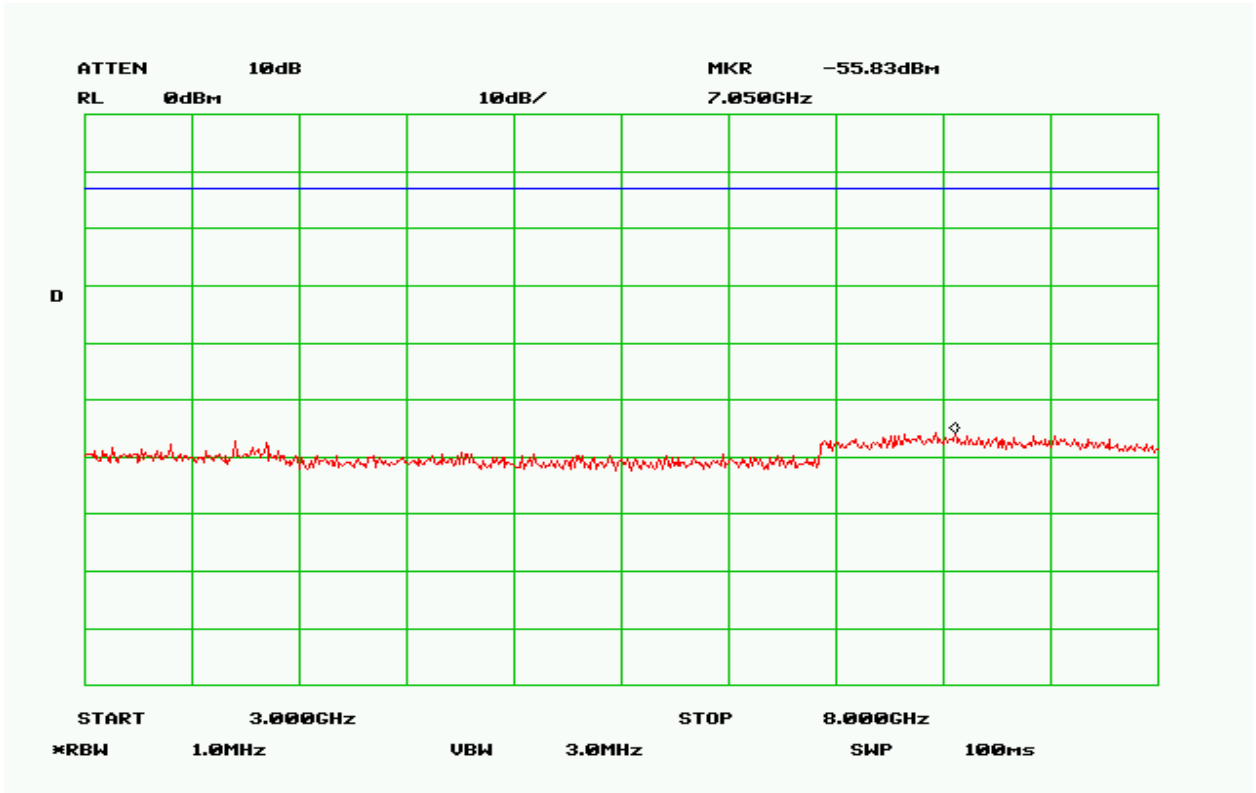
Plot 41 – 728-746MHz Band – Downlink



Plot 42 –746-757MHz Band – Downlink



Plot 43 –746-757MHz Band – Downlink



Plot 44 –746-757MHz Band – Downlink

6. Noise Limits

Test Requirement(s):	§20.21(e)(8)(i)(A	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	Nov/03/16

Test Procedures: As required by 47 CFR §20.21(e)(8)(i)(A), Noise limits measurements were made as per the FCC KDB 935210 D03 procedures defined in §7.7.

The EUT was set up as per Figure 2 and 3.

Test Setup:

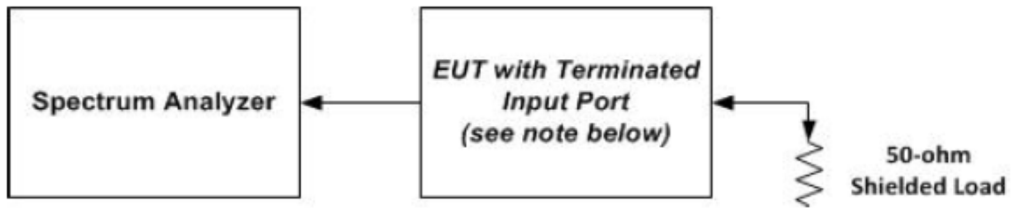


Figure 2 – Noise Limit

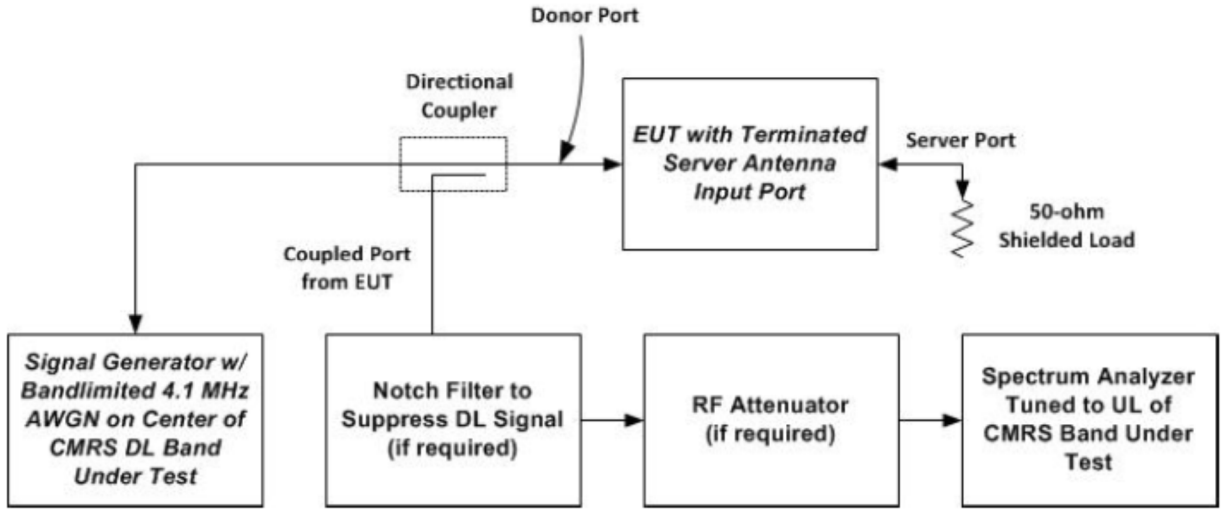
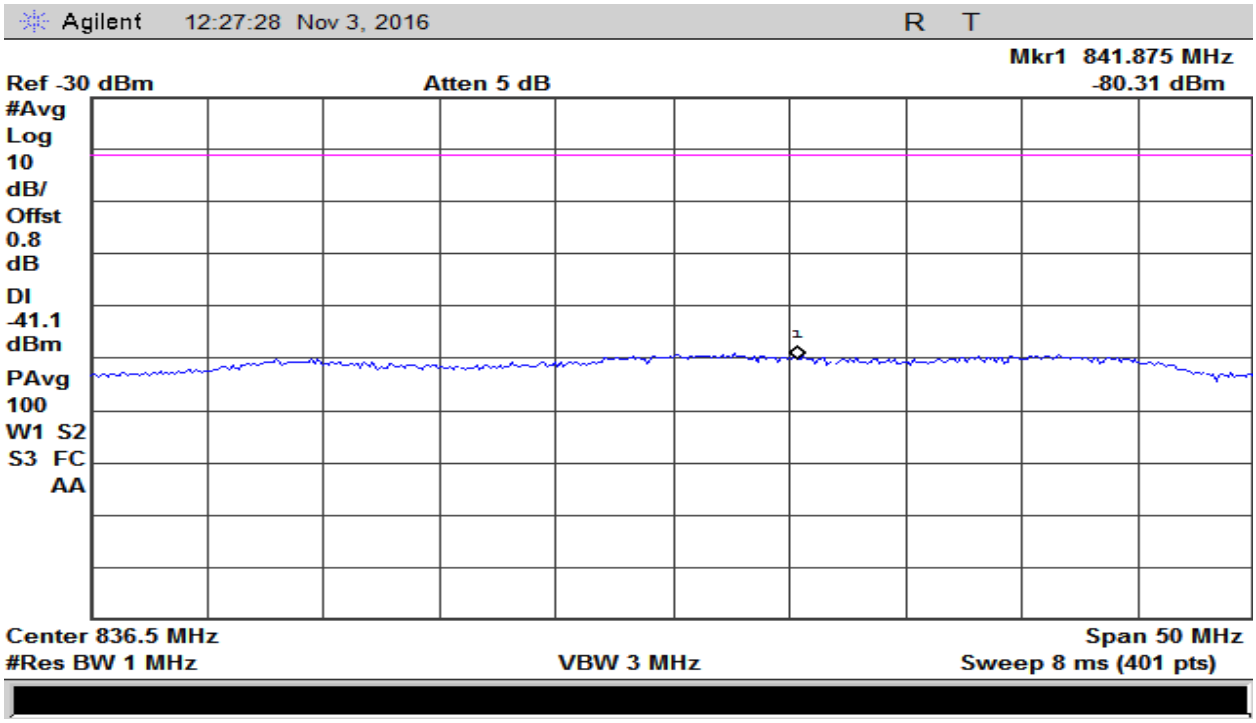


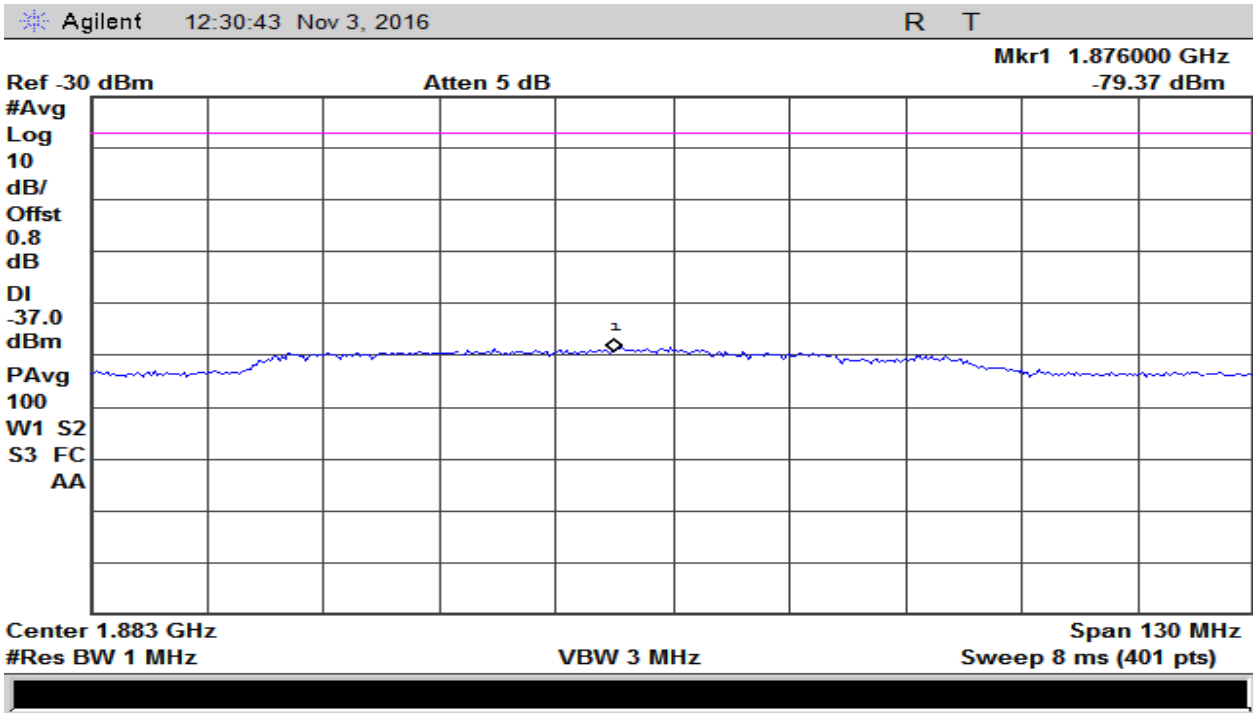
Figure 3 – Uplink Noise power in presence of a downlink signal

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dB)
824-849	-80.31	-59	-21.31
1850-1915	-79.37	-59	-20.37
1710-1755	-79.87	-59	-20.87
698-716	-78.29	-59	-19.29
776-787	-81.0	-59	-22.0

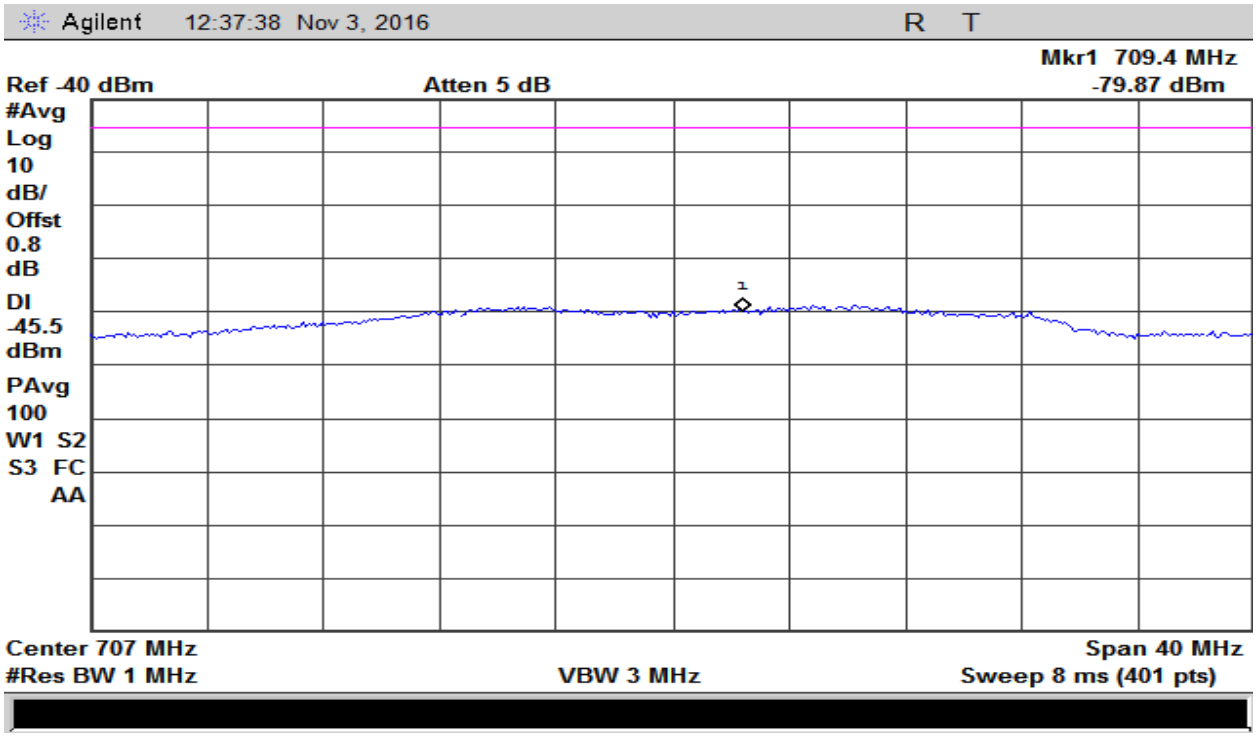
Table 6 – Maximum Uplink Noise Summary



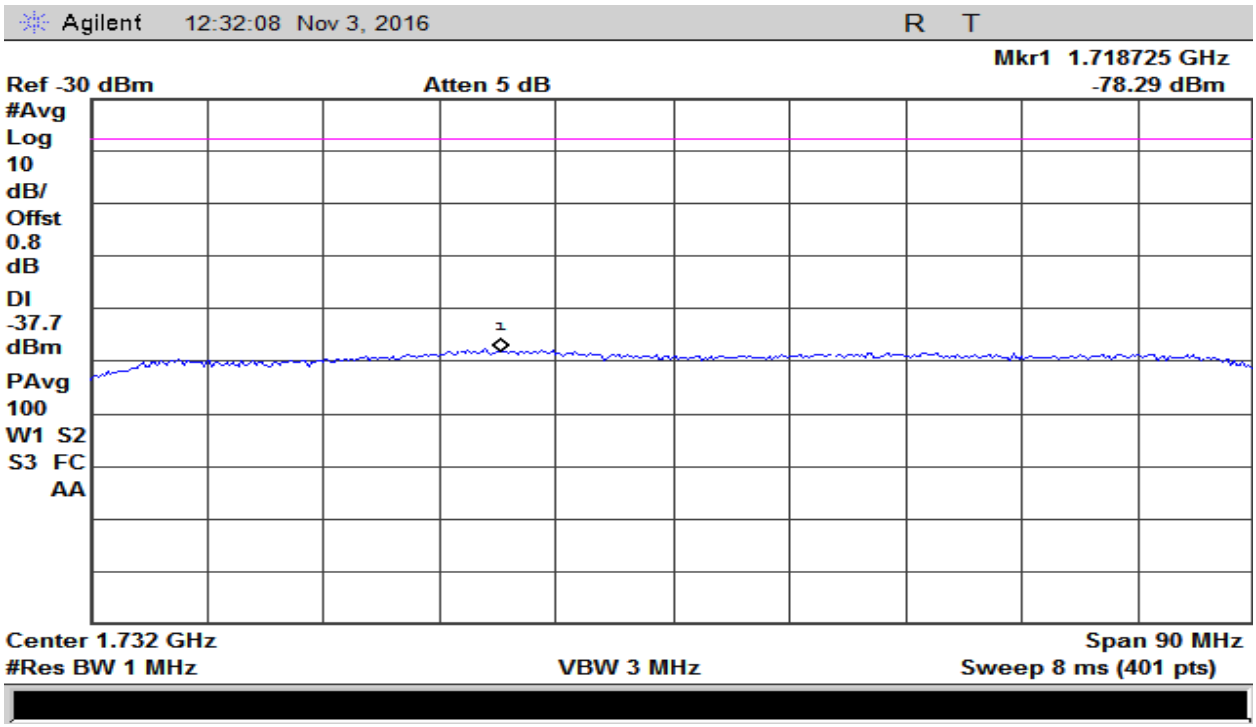
Plot 45 – 824-849MHz Band – Maximum Uplink Noise



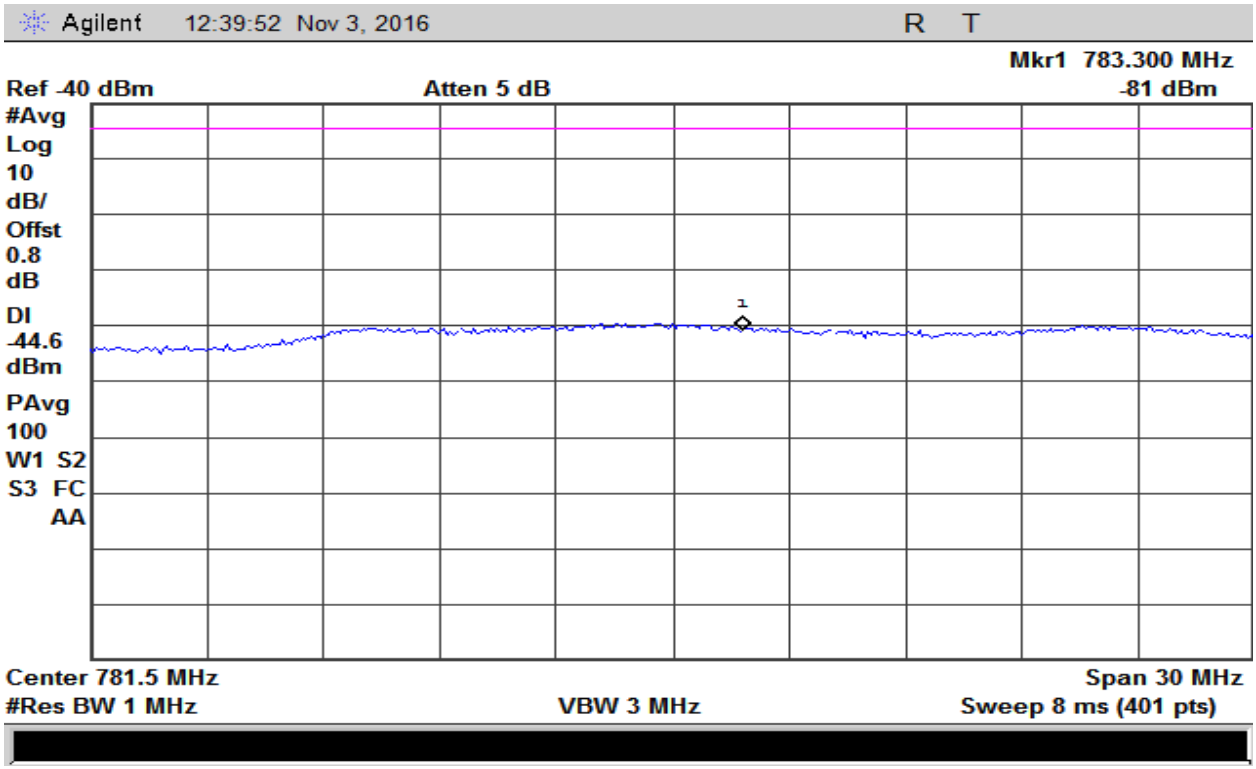
Plot 46 – 1850-1915MHz Band – Maximum Uplink Noise



Plot 47 – 1710-1755MHz Band – Maximum Uplink Noise



Plot 48 – 698-716MHz Band – Maximum Uplink Noise



Plot 49 – 776-787MHz Band – Maximum Uplink Noise

7. Radiated Spurious Emissions

Test Requirement(s):	§2.1053	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	11/07/16

Test Procedures: As required by 47 §2.1053, Radiated Spurious Emissions measurement were made in accordance with the procedures of TIA-603 and KDB 935210 D03 §7.12 .

The EUT was placed on a wooden table inside a 3 meter semi-anechoic chamber. The EUT was transmitting into a 50Ω non-radiating load which was directly connected to the EUT antenna port as shown in figure 4.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3 orthogonal axis. The frequency range up to the 10^{th} harmonic was investigated.

Spurious attenuation limit in dB = P1- (43 + 10 $\log_{10}$ (P2) = -13dBm

Where P1 = Transmitter Power in dBm and P2= Power in Watt

Test Setup:

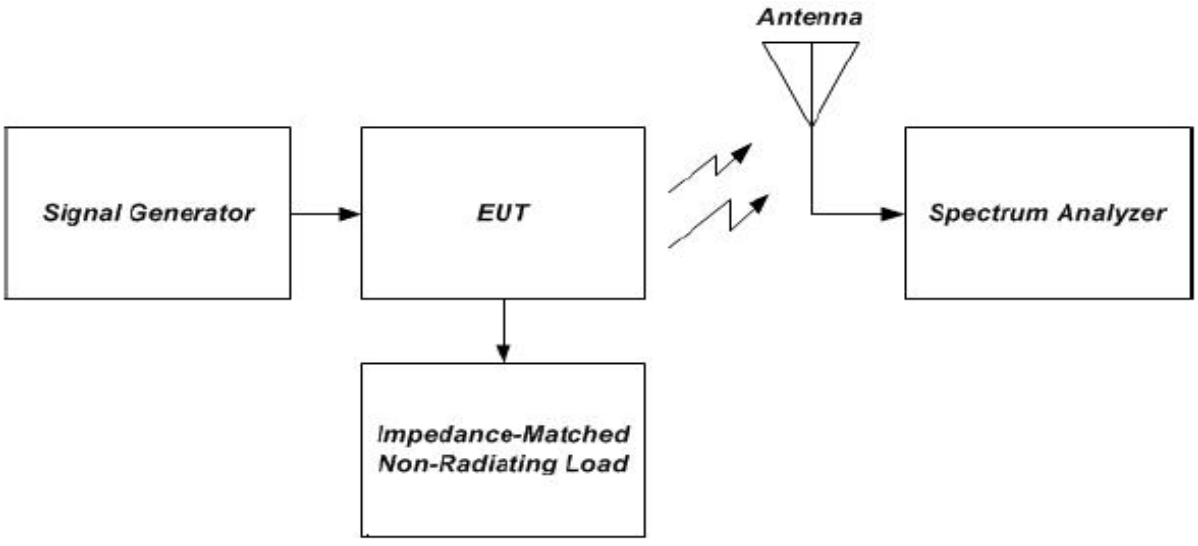


Figure 5 – Radiated Spurious Emission Test Setup

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
1673	-65.0	-13	-52.0
2509	-65.0	-13	-52.0
3346	-60	-13	-47.0

Table 7 – 824-849MHz Uplink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
3765	-59.0	-13	-46.0
5647	-59.0	-13	-46.0
7530	-59.0	-13	-46.0

Table 8 – 1850-1915MHz Uplink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
3465	-60.0	-13	-47.0
5197	-59.0	-13	-46.0
6930	-59.0	-13	-46.0

Table 9 – 1710-1755MHz Uplink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
1414	-65.0	-13	-52.0
2121	-65.0	-13	-52.0
2828	-60.0	-13	-47.0

Table 10 – 698-716MHz Uplink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
1563	-63.0	-13	-50.0
2344	-65.0	-13	-52.0
3126	-60.0	-13	-47.0

Table 11 – 776-787MHz Uplink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
1763	-65.0	-13	-52.0
2644	-65.0	-13	-52.0
3526	-60	-13	-47.0

Table 12 – 869-894MHz Downlink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
3925	-59.0	-13	-46.0
5887	-59.0	-13	-46.0
7850	-59.0	-13	-46.0

Table 13 – 1930-1995MHz Downlink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
4265	-55.82	-13	-42.82
6397	-53.23	-13	-40.23
8530	-49.38	-13	-36.38

Table 14 – 2110-2155MHz Downlink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
1474	-60.0	-13	-47.0
2211	-59.0	-13	-46.0
2948	-59.0	-13	-46.0

Table 15 – 728-746MHz Downlink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dBm)
1503	-63.0	-13	-50.0
2254	-65.0	-13	-52.0
3006	-60.0	-13	-47.0

Table 16 – 746-757MHz Downlink Band – Radiated Spurious Test Data

NOTE: There were no detectable emissions above the 2nd harmonic. Measurement was made above 2nd harmonic to show the Receiver Noise Floor (N.F)

I. Test Equipment

Equipment	Manufacturer	Model	Serial #	Last Cal Date	Cal Due Date
Spectrum Analyzer	Agilent	E4402B	US41192757	Feb/10/16	Feb/15/17
Spectrum Analyzer	Hewlett Packard	8563E	3821A09316	Oct/07/15	Nov/07/16
Directional Coupler	Andrew	C-10-CPUS-N	150503142544	NCR	None
Attenuator 20dB	Weinschel	41-20-12	86332	NCR	None
**Variable Attenuator	JFW	50DR-061	223632-9740	NCR	None
Signal Generator	Agilent	E4432B	US40053021	NCR	None
Signal Generator	Hewlett Packard	8340B	2804A00782	NCR	None
Horn Antenna	Com-Power	AHA-118	071150	May/10/16	May/10/18
Bilog Antenna	Chase	CBL6140	1040	Nov/28/15	Nov/28/16
Attenuator 10dB	Huber+Suhner	6810.17.A	747300	NCR	None
Digital Multimeter	Fluke	77 III	72550270	Nov/30/15	Nov/30/16
Power Supply	Hewlett Packard	6236B	2735A-19608	NCR	None

Table 17 – Test Equipment List

** Customer supplied Equipment

***Statement of Traceability:** Test equipment is maintained and calibrated on a regular basis. All calibrations have been performed by a 17025 accredited test facility, traceable to National Institute of Standards and Technology (NIST)

END OF TEST REPORT