H.B. Compliance Solutions

Intentional Radiator Test Report

For the

Wilson Electronics.

Quint Band Bi-Directional Amplifier Model # 460035

Tested under

FCC Part 20

For Direct Contact Coupling Consumer Signal Booster

Prepared for:

Wilson Electronics

3301 E. Desert Drive,

St. George, UT 8479085224

Prepared By:

H.B. Compliance Solutions

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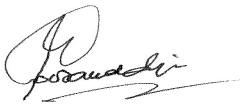
Tempe, Arizona 85282

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. It is further stated that upon the basis of the measurement made, the equipment tested is capable of operation in accordance with the requirements of Part 20 of the FCC Rules under normal use and maintenance. All results contained herein relate only to the sample tested.

Report Status Sheet

Revision #	Report Date	Reason for Revision
Ø	July 12, 2017	Initial Issue
1	July 26, 2017	TCB Comments, Correction of few typos
2	February 22, 2018	Intermodulation Re-Test with more sweep points

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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	
Intermodulation	20.21(e)(8)(i)(F)	Pass	
Out-of-Band Emissions	20.21(e)(8)(i)(E)	Pass	
Conducted Spurious Emissions	2.1051	Pass	
Noise Limits	20.21(e)(8)(i)(A) 20.21(e)(9)(i)(I)	Pass	If noise is less than -70dBm/MHz then EUT will not shut off therefore following test are N/A 1) Variable Uplink Noise Power Test 2) Noise Timing Test
Uplink Inactivity	20.21(e)(8)(i)(I) 20.21(e)(9)(i)(J)	N/A	Since noise is less than -70dBm/MHz in normal mode the EUT will not exceed this level after 5 mins when not serving an active device therefore following test are N/A
Variable Booster Gain	20.21(e)(8)(i)(C)	Pass	
Occupied Bandwidth	2.1049	Pass	
Oscillation Detection	20.21(e)(8)(ii)(A)	Pass	
Radiated Spurious Emissions	2.1053	Pass	
Spectrum Block Filtering	20.21(e)(8)(i)(B)	N/A	Applies to devices utilizing spectrum block filtering, In this case this is not applicable

EQUIPMENT CONFIGURATION

1. Overview

H.B Compliance Solutions was contracted by Wilson Electronics to perform testing on the Bi-Directional Amplifier Model # 460035 under the purchase order number 0033674.

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 # 460035.

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:	460035
FCC ID:	None
Supply Voltage Input:	Primary Power : 12.0 Vdc
Frequency Range:	Uplink 698-716, 776-787MHz, 824-849MHz, 1710-1755 & 1850-1915MHz, 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:	0.051 – 0.36W
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):	06/14/2017 till 07/07/2017

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 Embedded Technologies 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 Emerson Network Power.

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 only mobile applications. On the inside antenna port of the booster there is 15' of permanently attach cable. Connection to the host device is accomplished wirelessly by an antenna inside the cradle (the only antenna available with this device) that couples signals to and from the host device. The amplifier is connected to an external antenna mounted outside the vehicle. Power for the amplifier is obtained from external 12 VDC power adapter that is connected to the vehicle's 12 VDC battery. The components are contained in a plastic enclosure.

4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
# 1	Quint Band Bi-Directional Amplifier	460035	N/A

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):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	Jun/14/17

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:

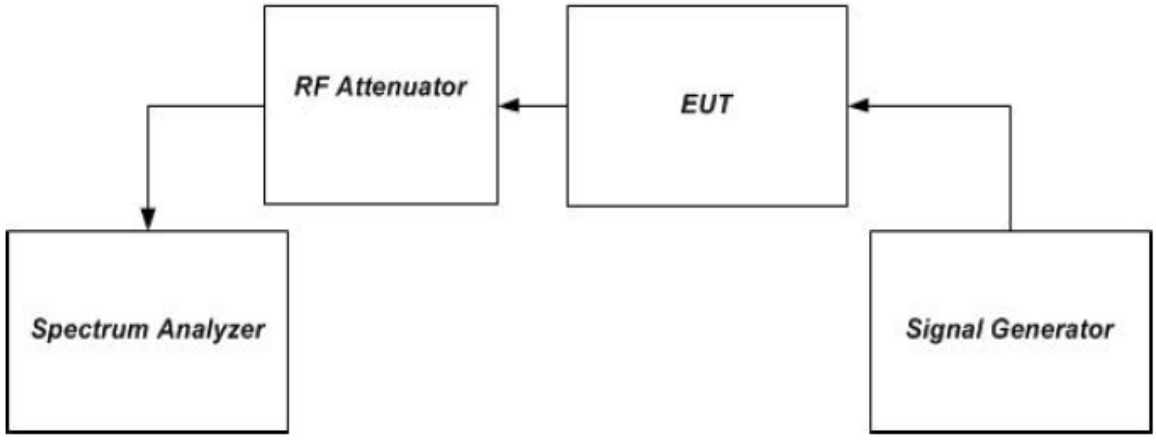
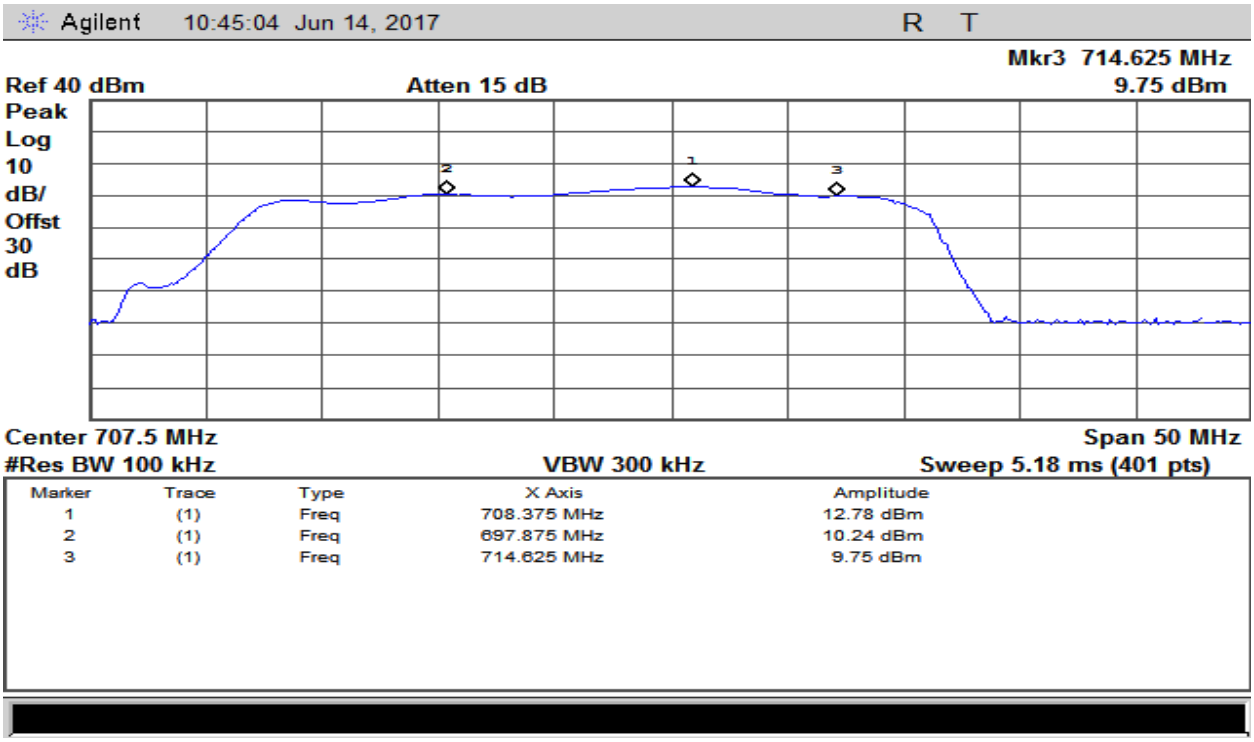
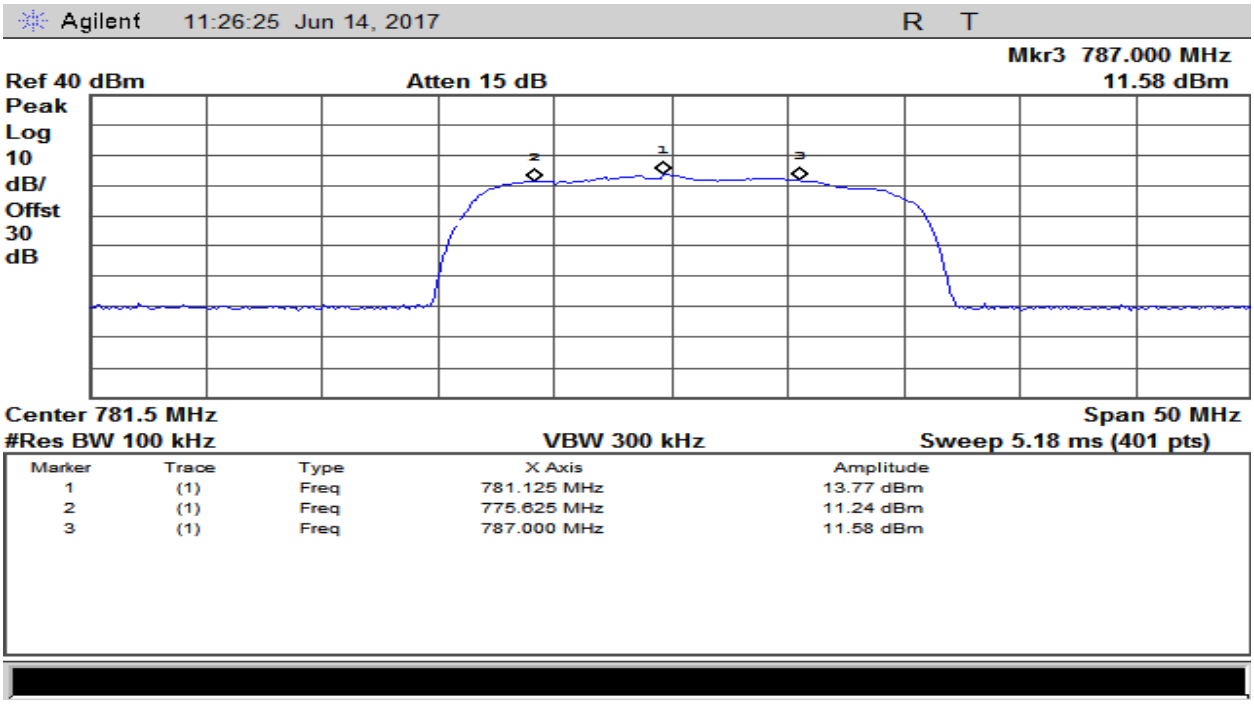


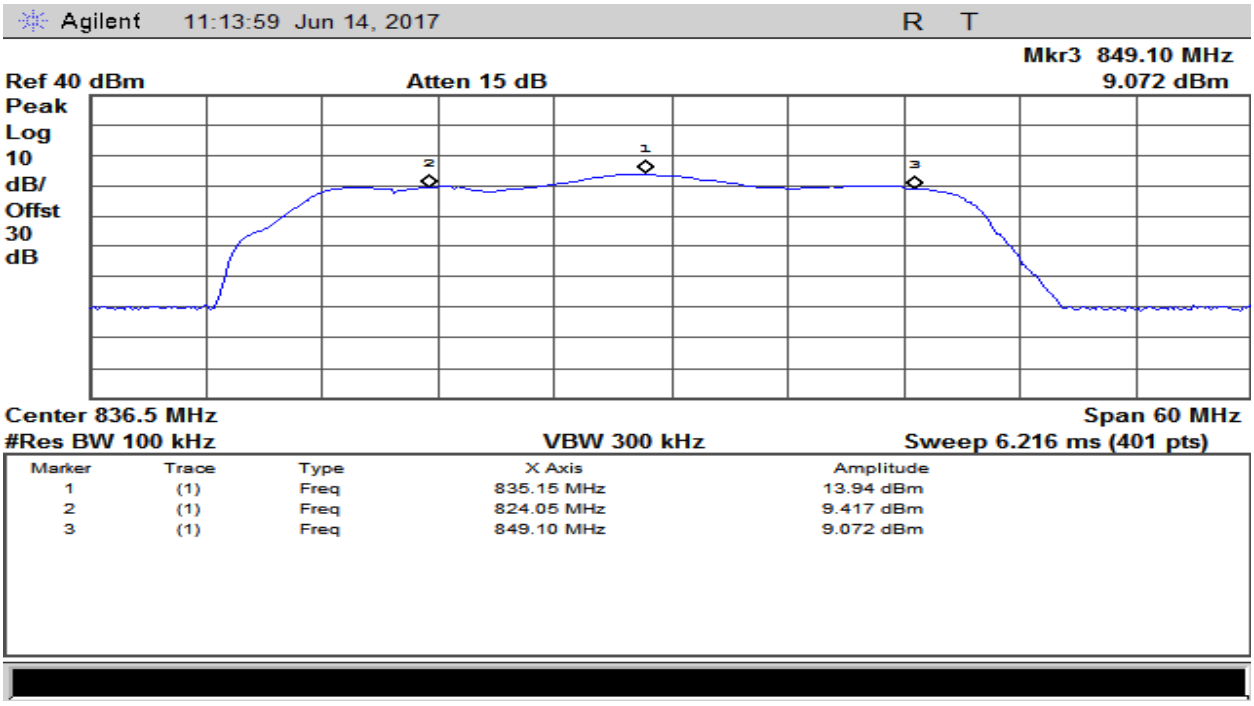
Figure 1 – Band Verification



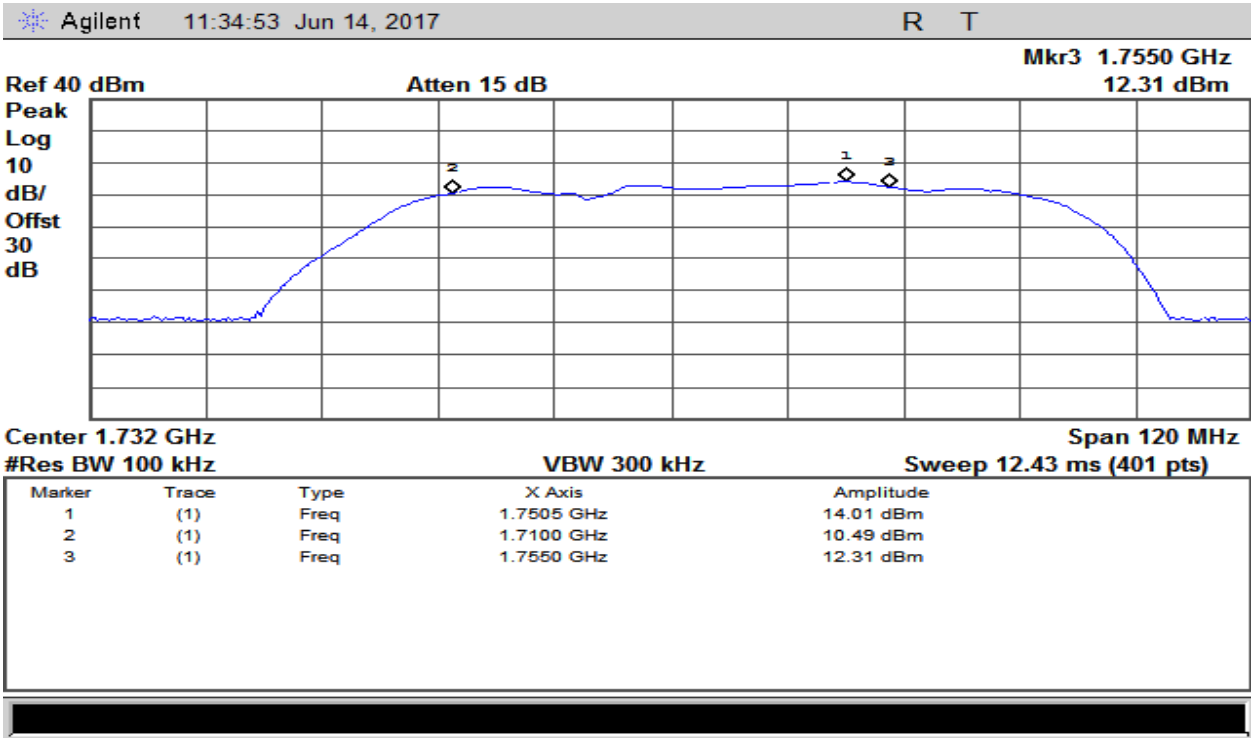
Plot 1 – 698-716MHz Band – Uplink



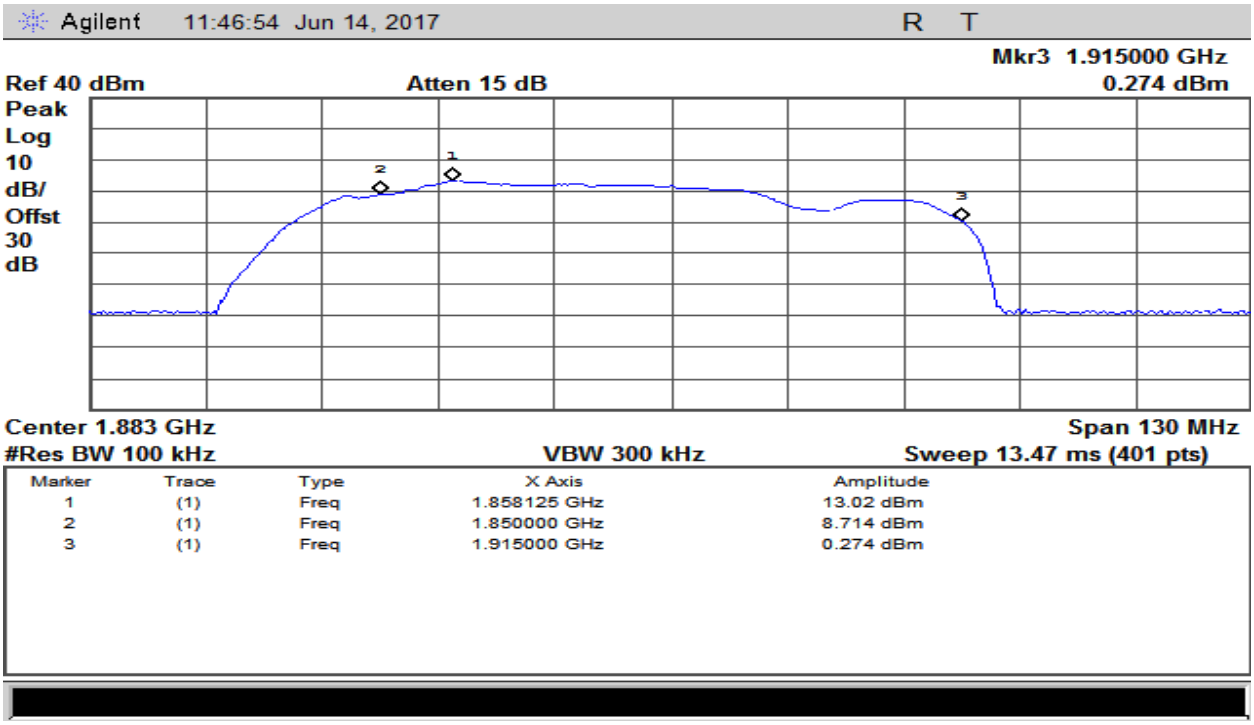
Plot 2 – 776-787MHz Band – Uplink



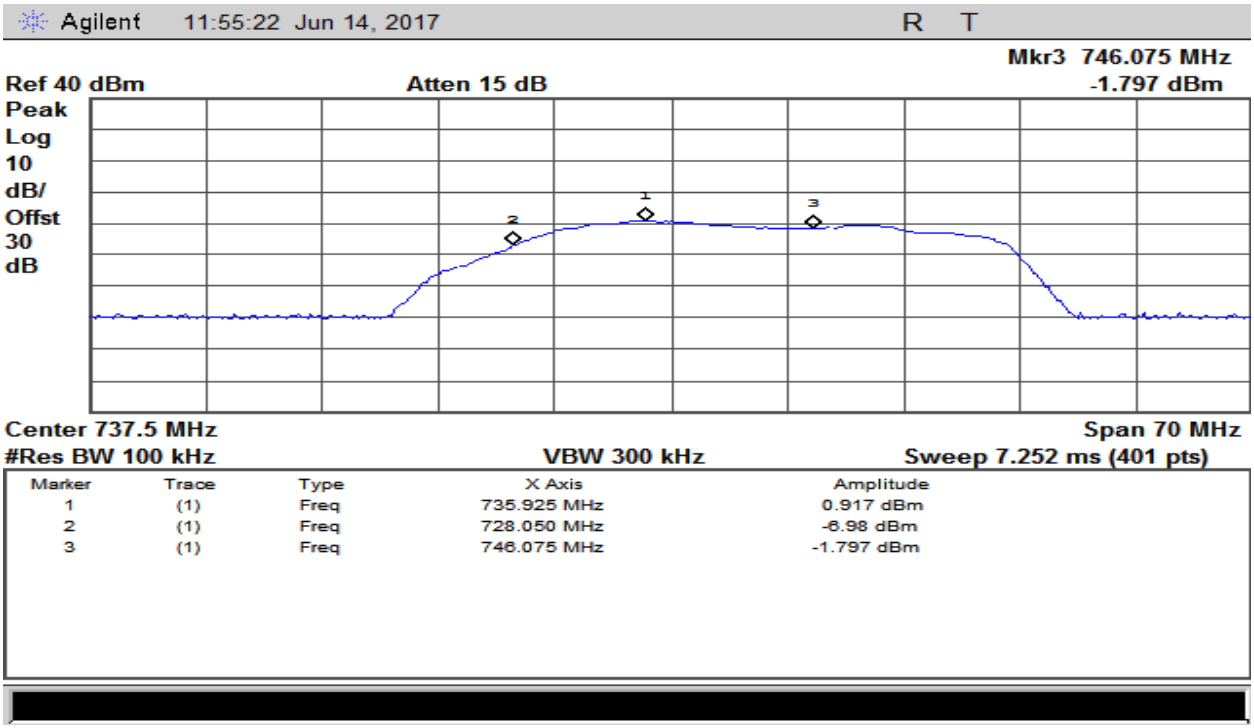
Plot 3 – 824-849MHz Band – Uplink



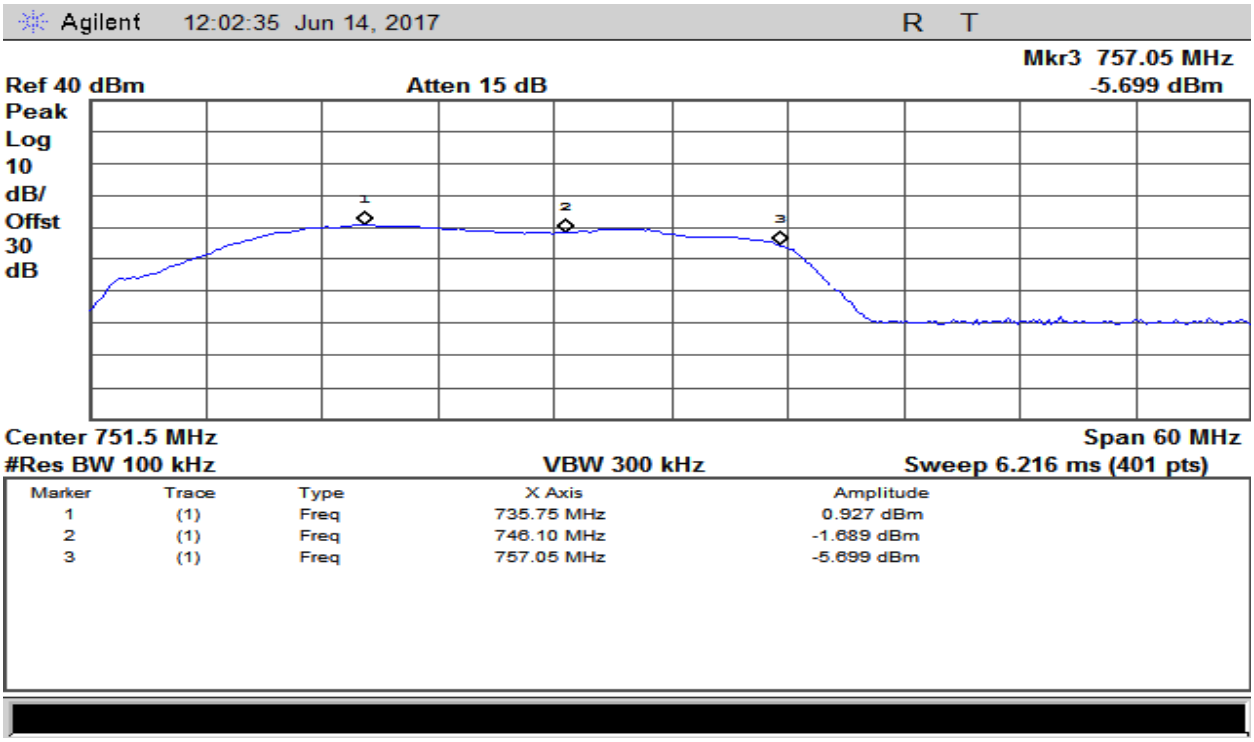
Plot 4 – 1710-1755MHz Band – Uplink



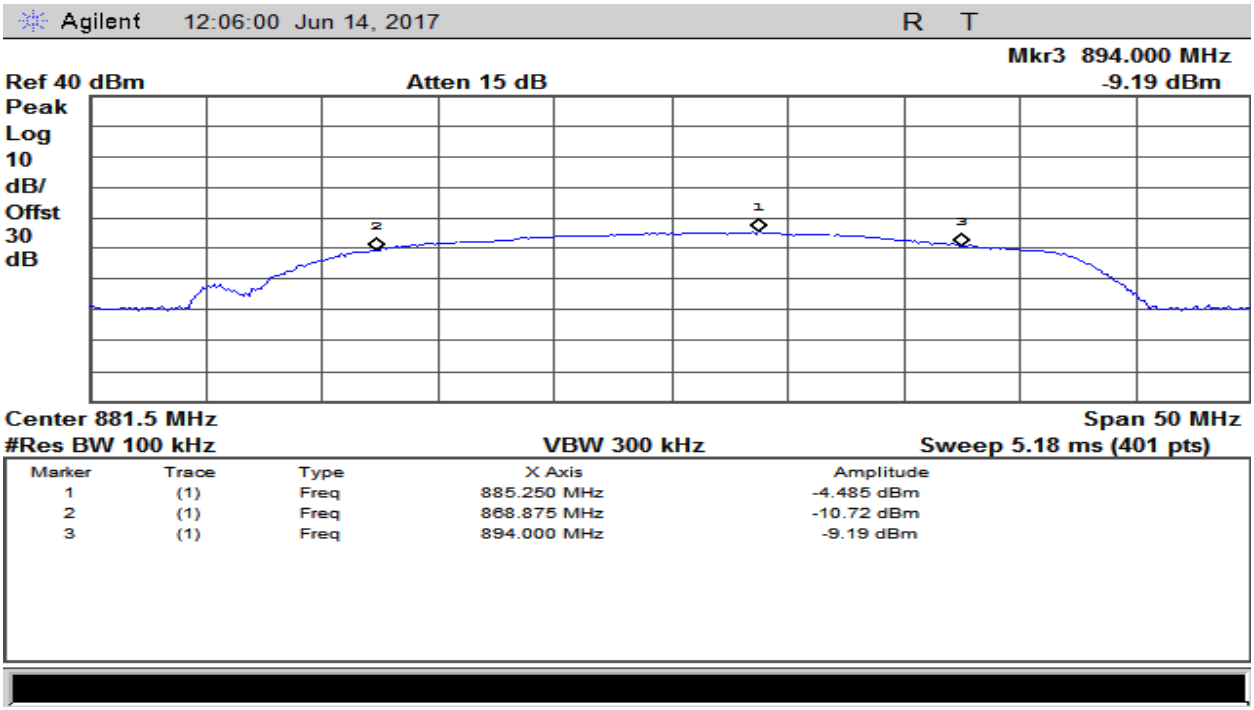
Plot 5 – 1850-1915MHz Band – Uplink



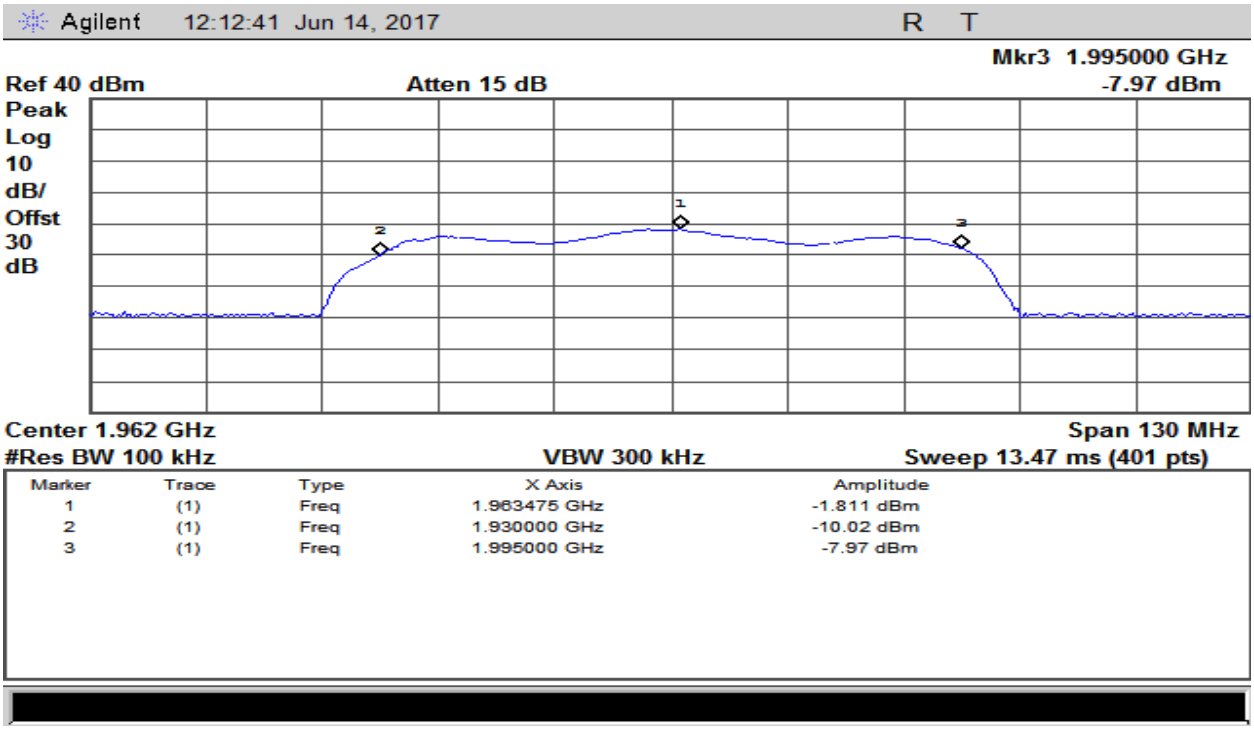
Plot 6 – 728-746MHz Band – Downlink



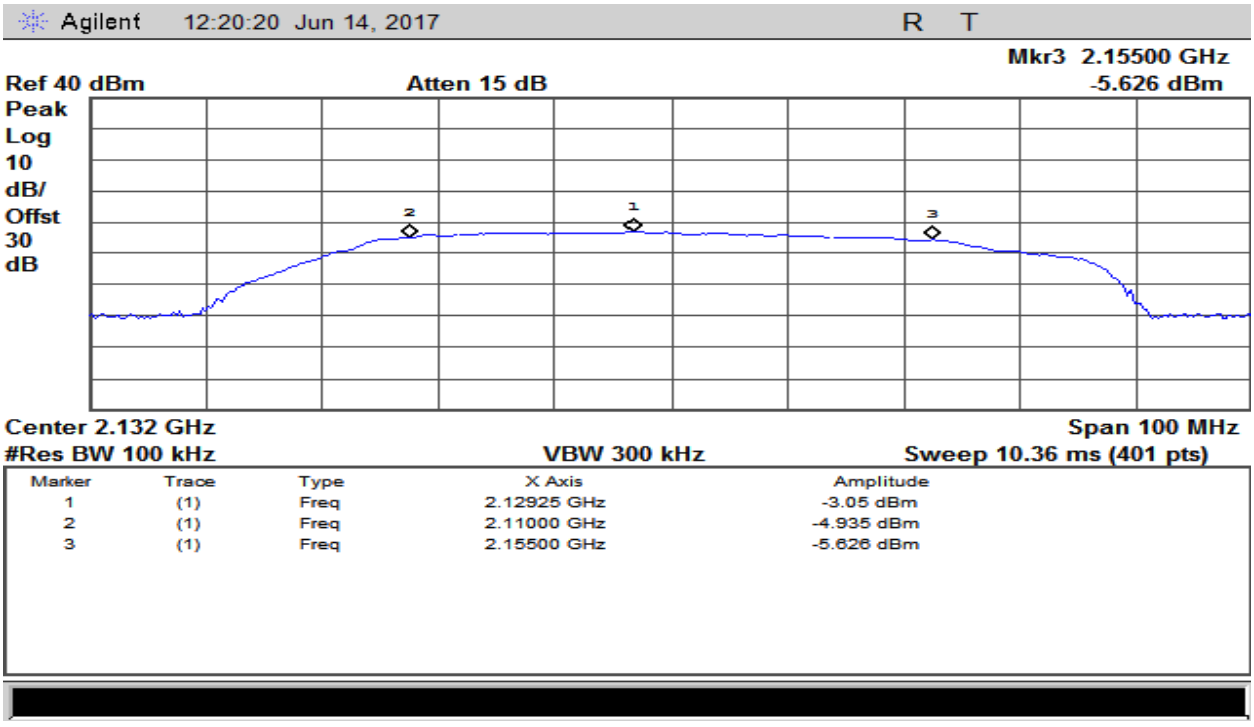
Plot 7 – 746-757MHz Band – Downlink



Plot 8 – 869-894MHz Band – Downlink



Plot 9 – 1930-1995MHz Band – Downlink



Plot 10 – 2110-2155MHz Band – Downlink

2. Maximum Power and Gain

Test Requirement(s):	§20.21(e)(8)(i)(D)	Test Engineer(s):	Hoosam B.
Test Results:	Pass	Test Date(s):	Jun/15/17

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	-4.7	17.04	17	30
698-716 AWGN	-2.34	18.74	17	30
776-787 GSM	0.9	21.57	17	30
776-787 AWGN	1.96	18.89	17	30
824-849 GSM	0.5	22.65	17	30
824-849 AWGN	0.7	19.44	17	30
1710-1755 GSM	7.2	25.56	17	30
1710-1755 AWGN	2.1	23.15	17	30
1850-1915 GSM	-0.2	19.19	17	30
1850-1915 AWGN	0.56	18.4	17	30

Table 1. Uplink Max Power Test Results

Frequency (MHz)	Input Level (dBm)	Output Power (dBm)	Upper Limit (dBm)
728-746 GSM	-20	2.07	17
728-746 AWGN	-20	0.97	17
746-757 GSM	-20	2.05	17
746-757 AWGN	-20	0.51	17
869-894 GSM	-20	-2.5	17
869-894 AWGN	-20	-2.91	17
1930-1995 GSM	-20	2.5	17
1930-1995 AWGN	-20	2.1	17
2110-2155 GSM	-20	-0.6	17
2110-2155 AWGN	-20	-0.62	17

333Table 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	708.37	735.92	21.74	23	22.07	23	1.81	9	-1.51
AWGN	708.37	735.92	21.08	23	20.97	23	0.29	9	-0.11
GSM	781.12	735.75	20.67	23	22.05	23	0.39	9	-1.38
AWGN	781.12	735.75	16.93	23	20.51	23	-0.25	9	-3.58
GSM	835.15	885.25	22.15	23	17.5	23	1.11	9	-4.65
AWGN	835.15	8885.25	18.74	23	17.09	23	0.01	9	-1.65
GSM	1750.5	1963.47	18.36	23	22.5	23	-0.03	9	-4.14
AWGN	1750.5	1963.47	21.04	23	22.1	23	-0.1	9	-1.056
GSM	1858.12	2129.25	19.39	23	19.4	23	0.87	9	-0.01
AWGN	1858.12	2129.25	17.84	23	19.38	23	-0.14	9	-1.54

Table 3. Maximum Booster Gain Test Results

3. Intermodulation

Test Requirement(s):	CFR §20.21(e)(8)(i)(F)	Test Engineer(s):	Keith T.
Test Results:	Pass	Test Date(s):	Feb/21/2018

Test Procedures: As required by 47 CFR §20.21(e)(8)(i)(F), Intermodulation measurements were made at the RF output terminals of the EUT.

The EUT was connected through an attenuator to a Spectrum Analyzer. Signal generator was setup for a two tone CW signal with 300kHz offset below and above the operational band frequency. Measurements were made as per KDB 935210 D03 §7.4 procedure.

Detector Setting	Resolution Bandwidth	Video Bandwidth	Span
RMS	3kHz	≥3 x RBW	5MHz

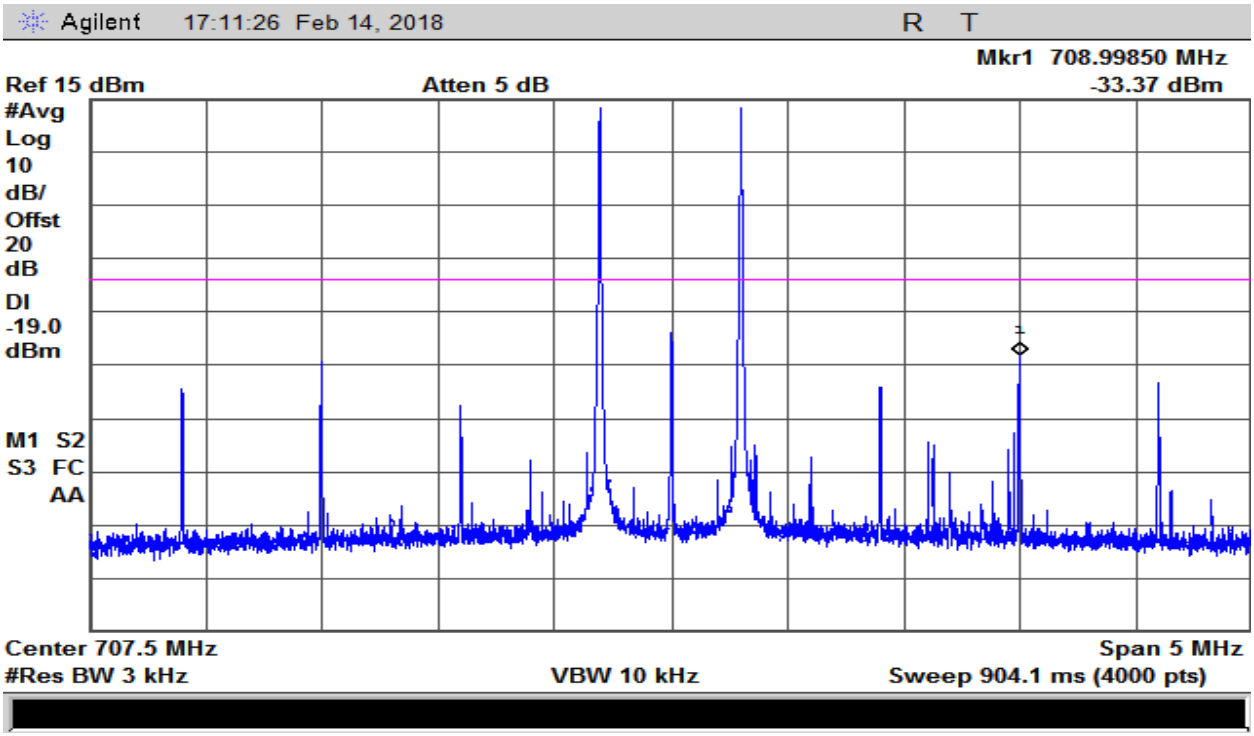
Table 4 – Analyzer Settings

Frequency Band (MHz)	Intermodulation Level (dBm)	Limit (dBm)	Margin (dB)
698-716	-33.37	-19	-14.37
776-787	-22.7	-19	-3.7
824-849	-20.8	-19	-1.8
1710-1755	-26.09	-19	-7.09
1850-1915	-28.88	-19	-9.88

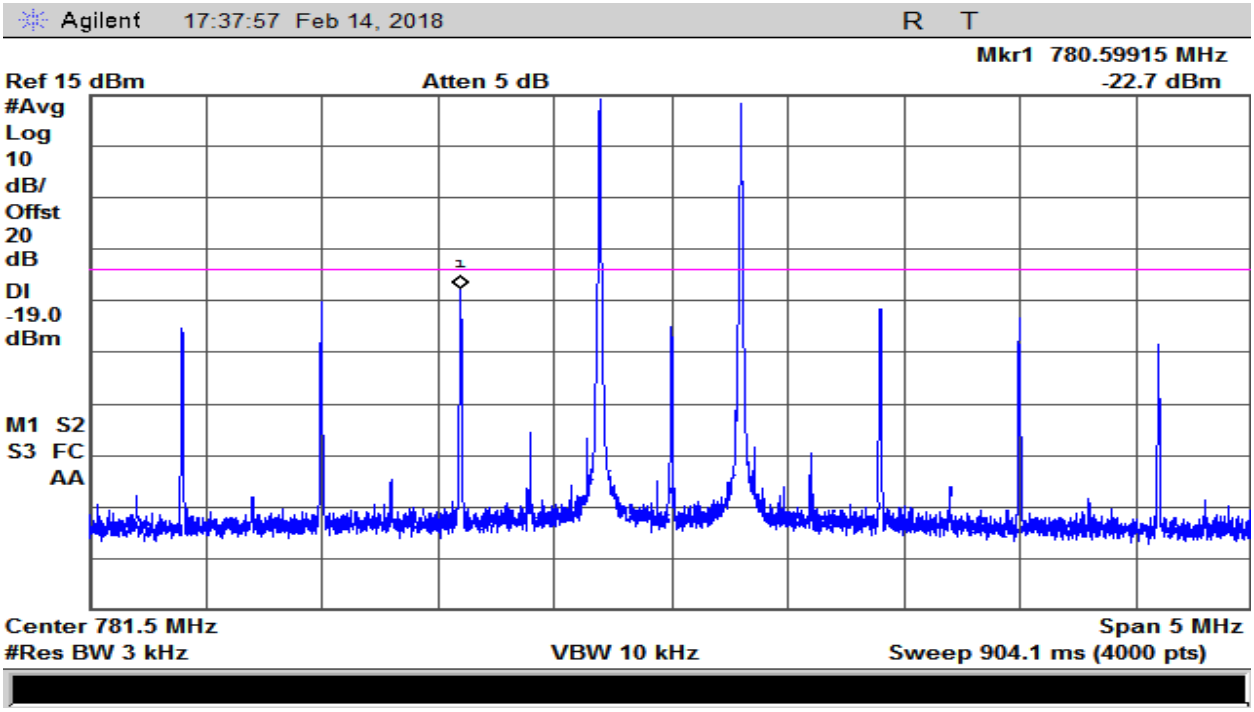
Table 5. Summary Uplink Intermodulation, Test Results

Frequency (MHz)	Intermodulation Level (dBm)	Limit (dBm)	Margin (dB)
728-746	-32.83	-19	-13.22
746-757	-40.28	-19	-21.28
869-894	-49.03	-19	-30.03
1930-1995	-36.81	-19	-17.81
2110-2155	-44.12	-19	-25.12

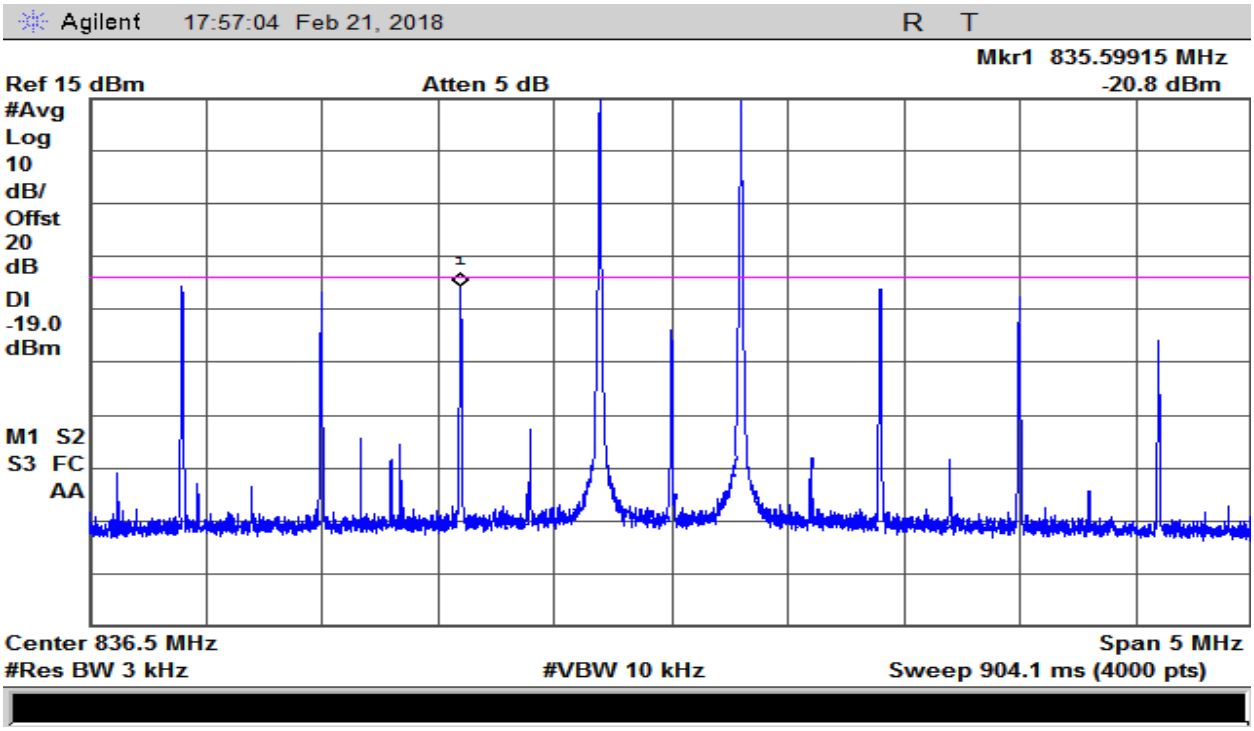
Table 6. Summary Downlink Intermodulation Test Results



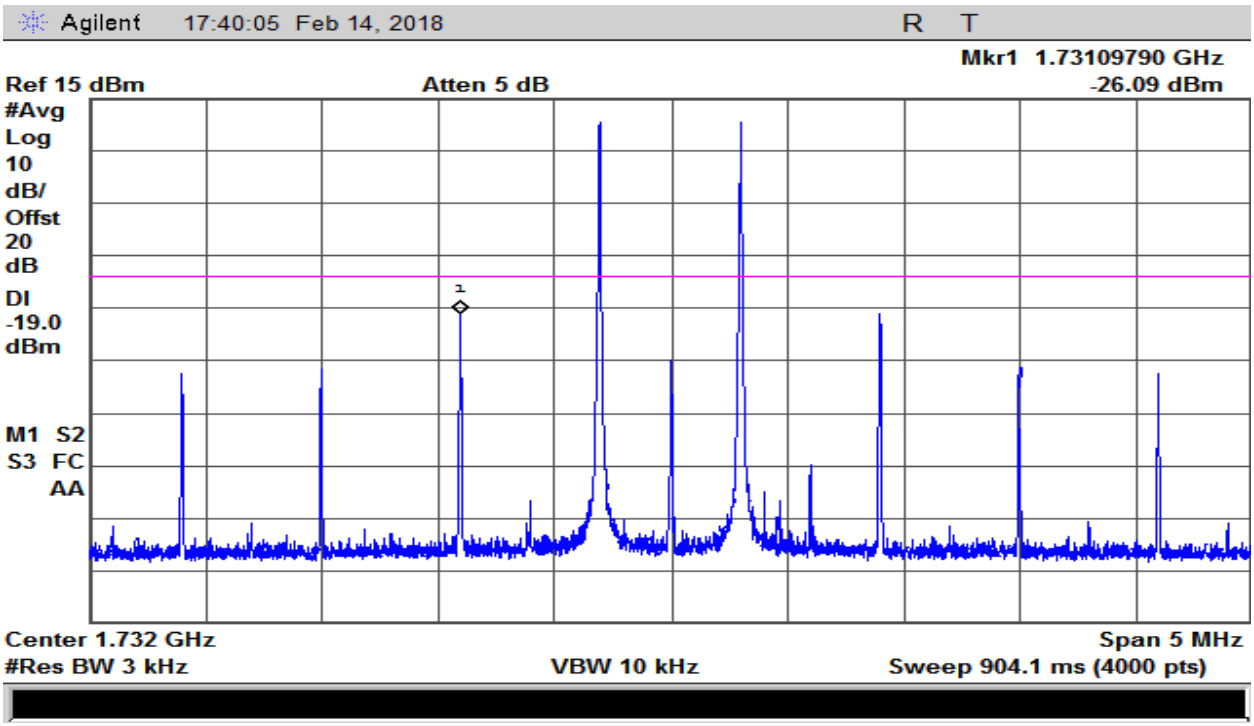
Plot 11 698-716MHz Band – Uplink



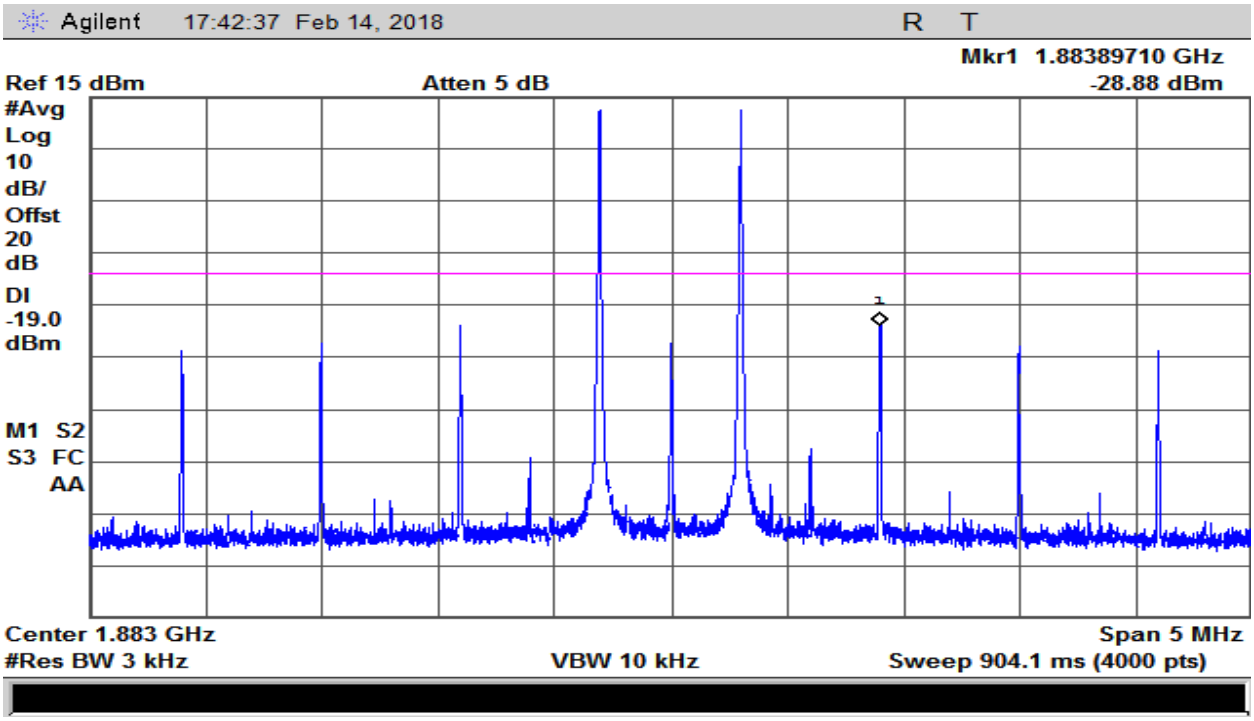
Plot 12 – 776-787MHz Band – Uplink



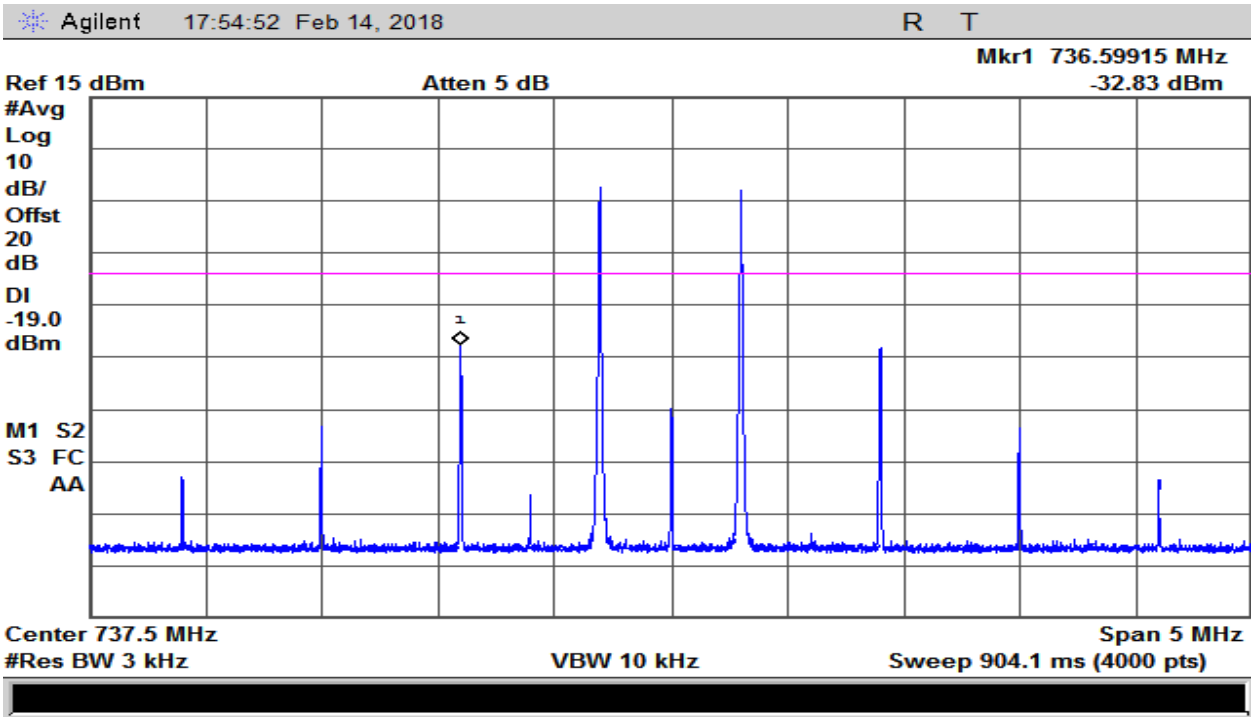
Plot 13 – 824-849MHz Band – Uplink



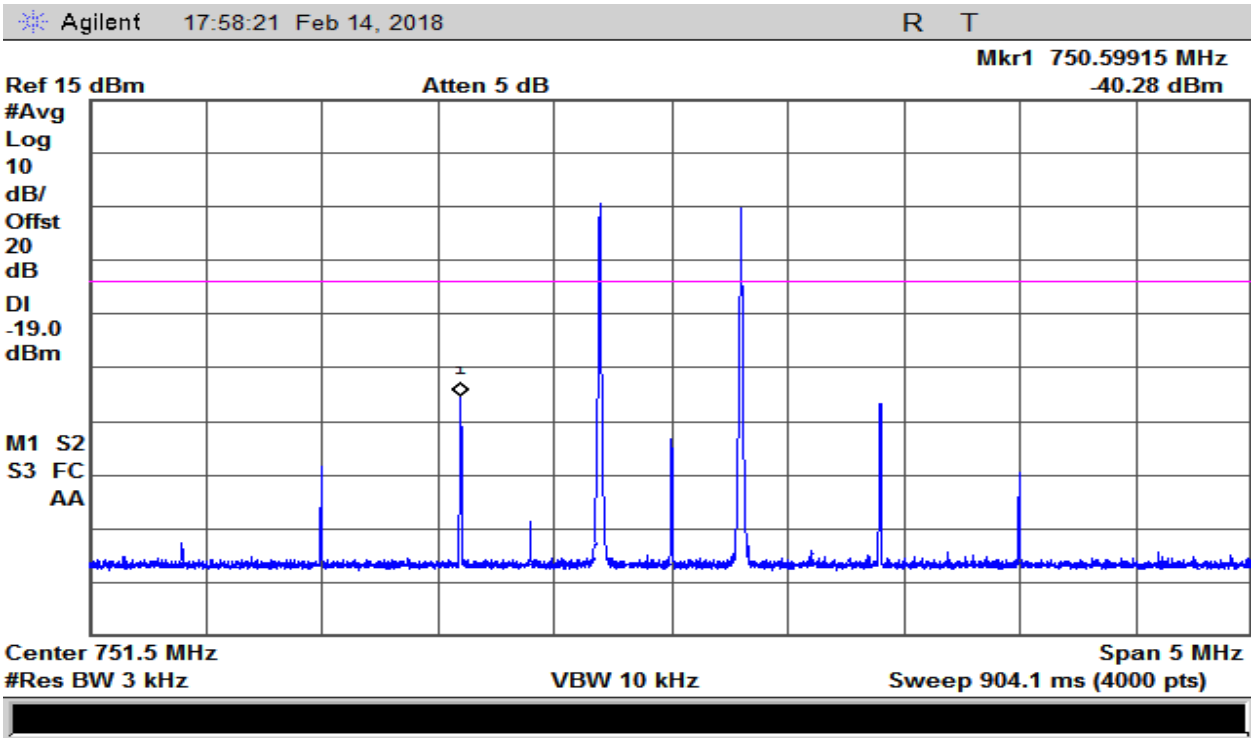
Plot 14 – 1710-1755MHz Band – Uplink



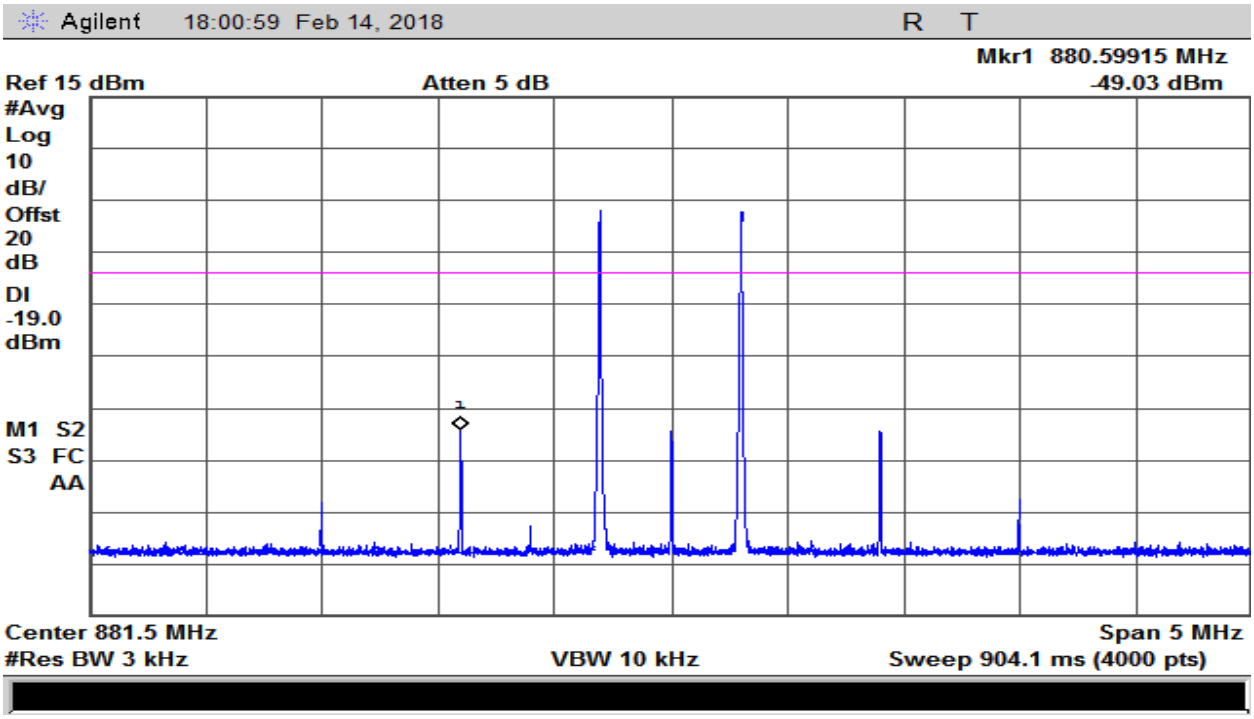
Plot 15 – 1850-1915MHz Band – Uplink



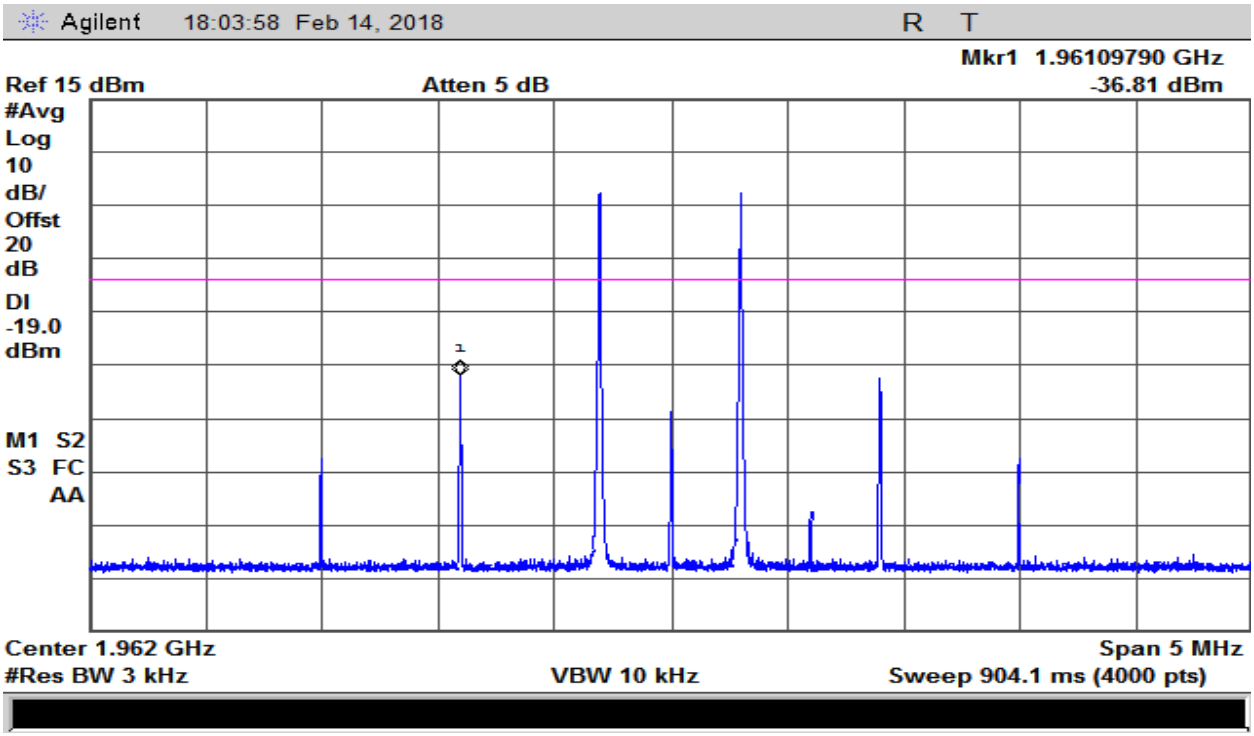
Plot 16 – 728-746MHz Band – Downlink



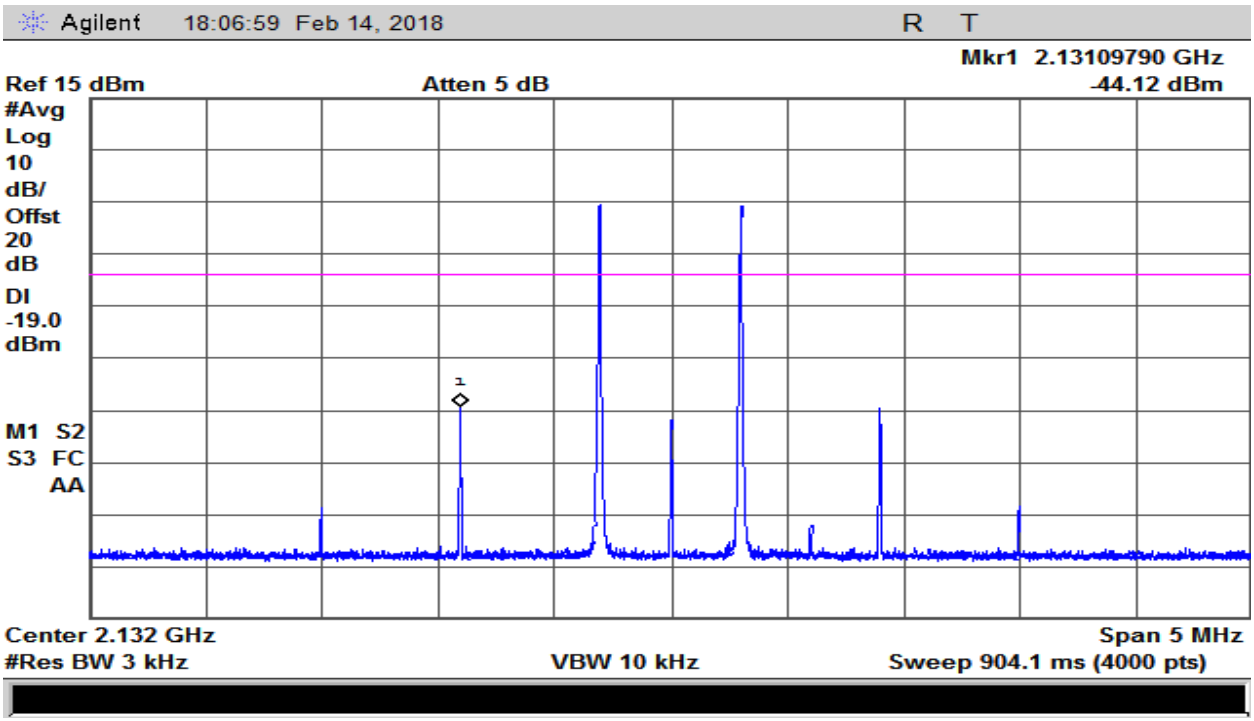
Plot 17 – 746-757MHz Band – Downlink



Plot 18 – 869-894MHz Band – Downlink



Plot 19 – 1930-1995MHz Band – Downlink



Plot 20 – 2110-2155MHz Band – Downlink

4. Out-of-band emissions

Test Requirement(s):	§20.21§(8)(i)(E)	**Test Engineer(s):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	Jun/20/2017

Test Procedures:

As required by 47 CFR §20.21(8)(i)(E), Out-of-band emissions measurements were made at the RF output terminals of the EUT.

The EUT was connected through an attenuator to a Spectrum Analyzer as per figure 1. Signal generator was setup to produce GSM, LTE & CDMA signals for all uplink and downlink bands. Measurements were made as per procedure defined in KDB 935210 D03 §7.5.

Out of Band Emission Limits = P1 - 6 – (43 _ 10log (P2) = -19dBm

Where P1 = Power in dBm and P2 = Power in Watts

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)
698-716	Lower	-29.67	-19
698-716	Upper	-29.22	-19
776-787	Lower	-29.03	-19
776-787	Upper	-28.46	-19
824-849	Lower	-43.01	-19
824-849	Upper	-42.04	-19
1710-1755	Lower	-35.91	-19
1710-1755	Upper	-37.57	-19
1850-1915	Lower	-45.33	-19
1850-1915	Upper	-55.15	-19

Table 7. GSM Uplink – Out-of band Emissions, Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)
698-716	Lower	-34.45	-19
698-716	Upper	-35.37	-19
776-787	Lower	-24.97	-19
776-787	Upper	-21.68	-19
824-849	Lower	-21.05	-19
824-849	Upper	-23.49	-19
1710-1755	Lower	-27.25	-19
1710-1755	Upper	-19.54	-19
1850-1915	Lower	-35.12	-19
1850-1915	Upper	-49.04	-19

Table 8. CDMA Uplink – Out-of band Emissions, Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)
698-716	Lower	-35.84	-19
698-716	Upper	-37.48	-19
776-787	Lower	-33.82	-19
776-787	Upper	-29.24	-19
824-849	Lower	-23.82	-19
824-849	Upper	-21.49	-19
1710-1755	Lower	-27.73	-19
1710-1755	Upper	-20.38	-19
1850-1915	Lower	-28.75	-19
1850-1915	Upper	-46.59	-19

Table 9. LTE Uplink – Out-of band Emissions, Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)
728-746	Lower	-53.49	-19
728-746	Upper	-48.26	-19
746-757	Lower	-47.69	-19
746-757	Upper	-50.9	-19
869-894	Lower	-65.72	-19
869-894	Upper	-66.41	-19
1930-1995	Lower	-71.37	-19
1930-1995	Upper	-74.65	-19
2110-2155	Lower	-61.85	-19
2110-2155	Upper	-64.34	-19

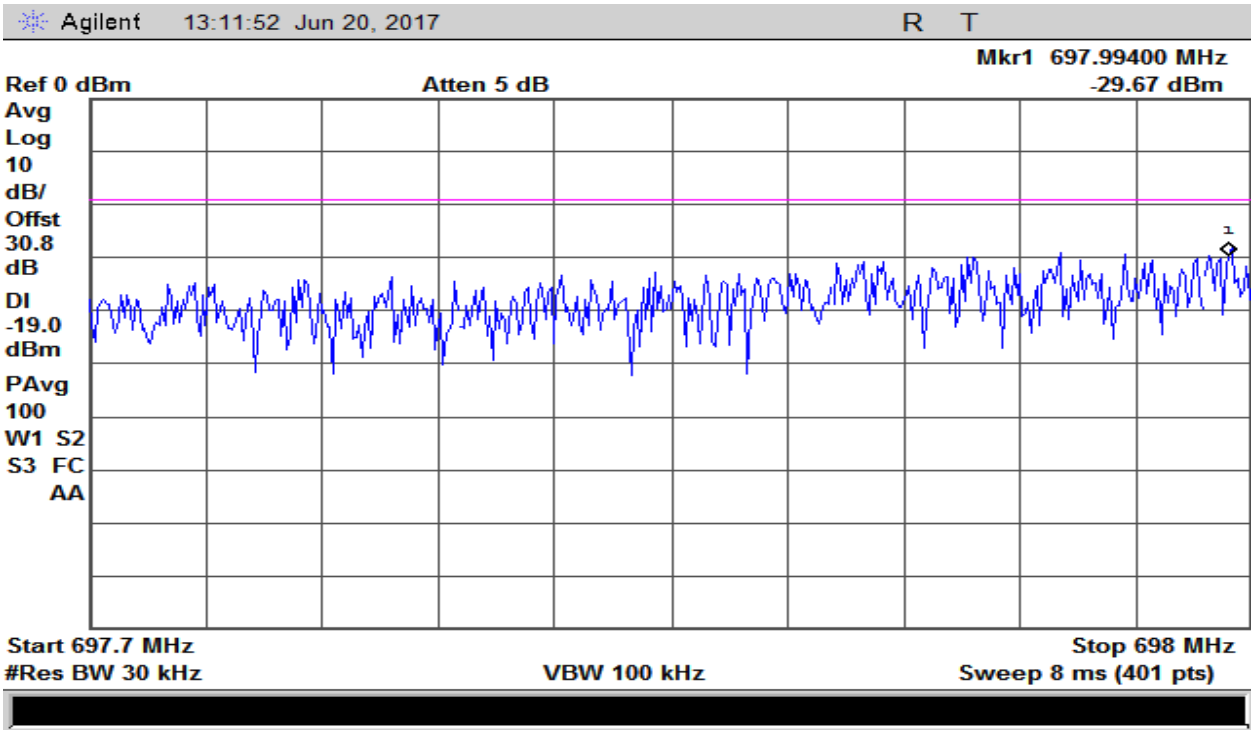
Table 10. GSM Downlink – Out-of band Emissions, Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)
728-746	Lower	-60.22	-19
728-746	Upper	-49.85	-19
746-757	Lower	-49.3	-19
746-757	Upper	-57.26	-19
869-894	Lower	-68.95	-19
869-894	Upper	-65.96	-19
1930-1995	Lower	-77.67	-19
1930-1995	Upper	-81.41	-19
2110-2155	Lower	-57.33	-19
2110-2155	Upper	-59.11	-19

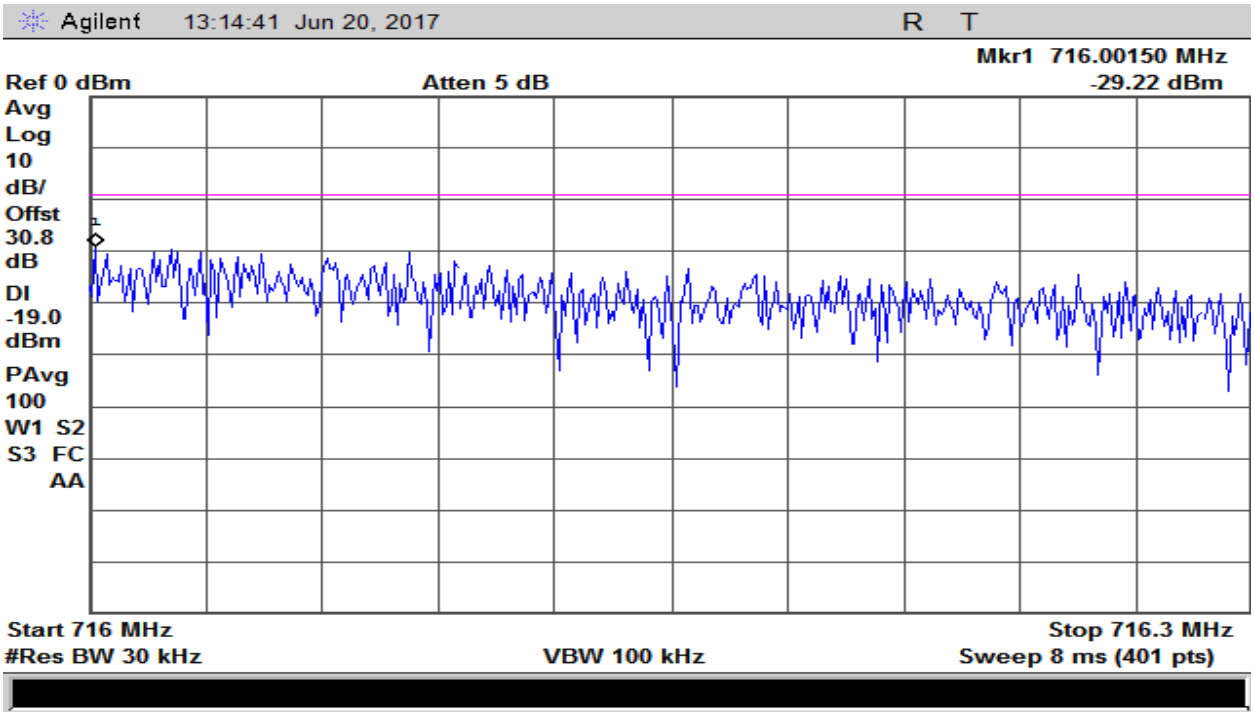
Table 11. CDMA Downlink – Out-of band Emissions, Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)
728-746	Lower	-35.36	-19
728-746	Upper	-30.0	-19
746-757	Lower	-29.49	-19
746-757	Upper	-34.13	-19
869-894	Lower	-30.01	-19
869-894	Upper	-30.65	-19
1930-1995	Lower	-33.43	-19
1930-1995	Upper	-36.56	-19
2110-2155	Lower	-25.61	-19
2110-2155	Upper	-27.43	-19

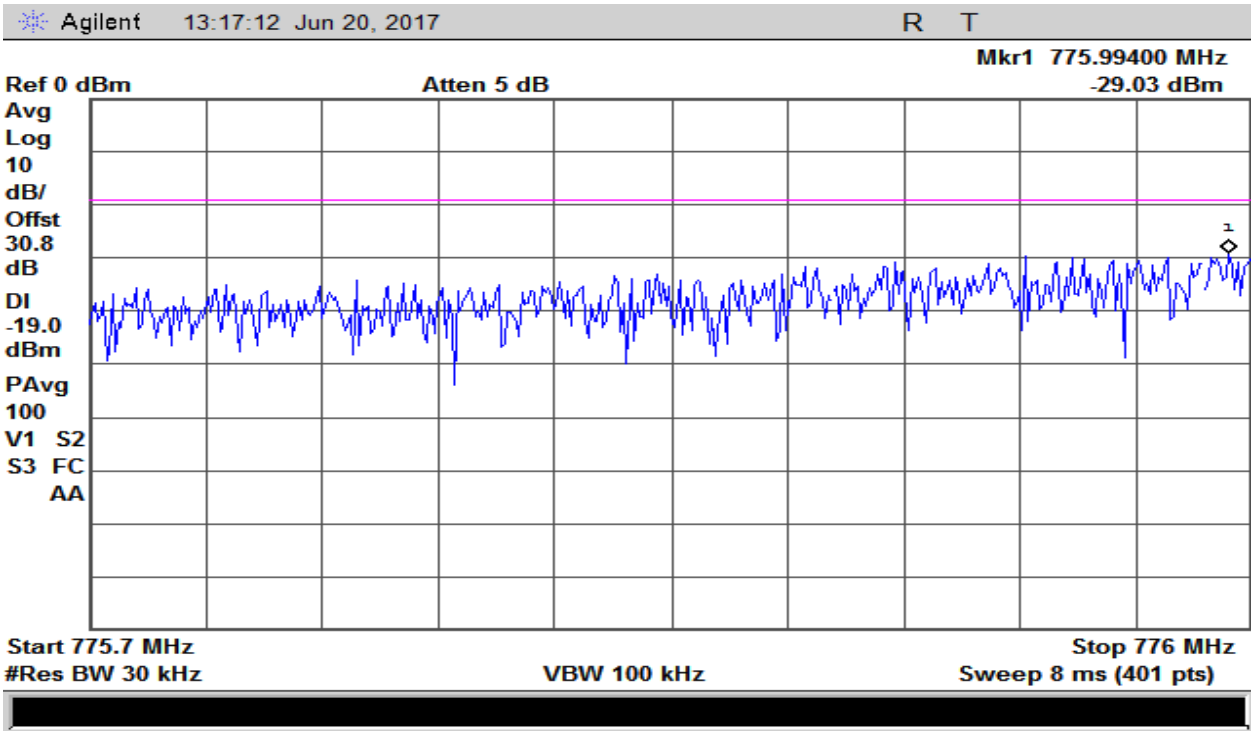
Table 12. LTE Downlink – Out-of band Emissions, Test Results



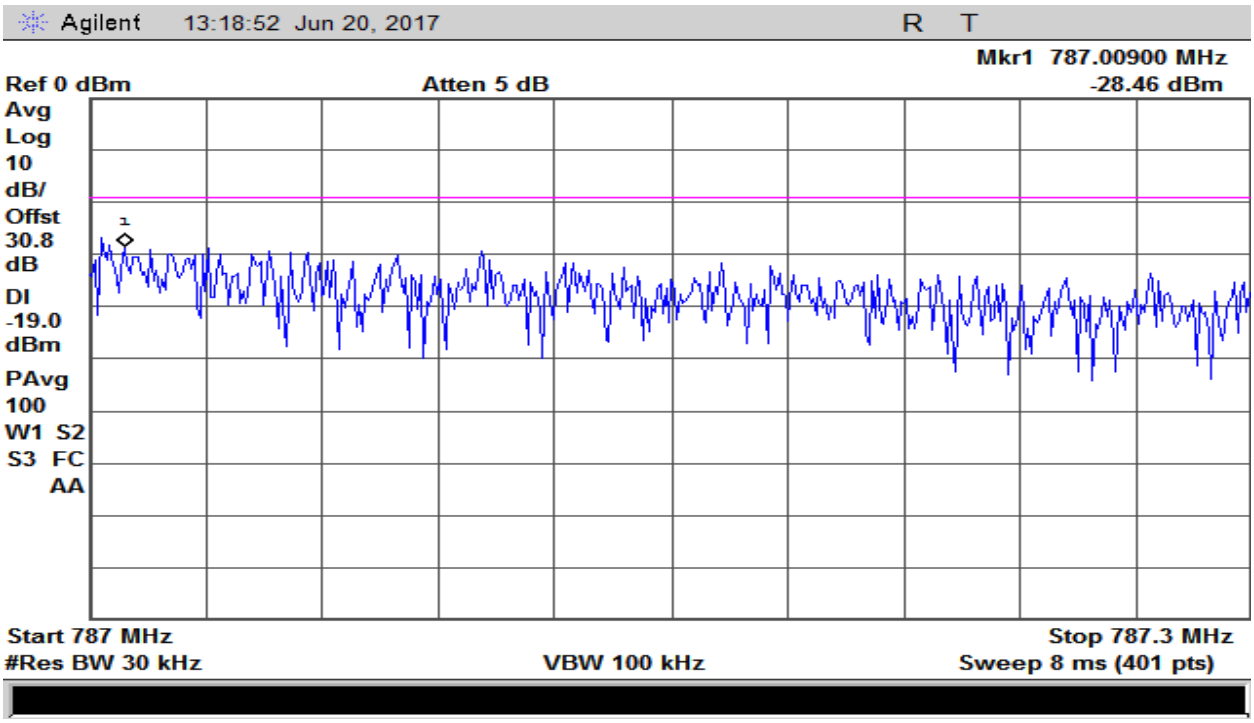
Plot 21 – 698-716MHz Band – GSM Uplink Lower Band Edge



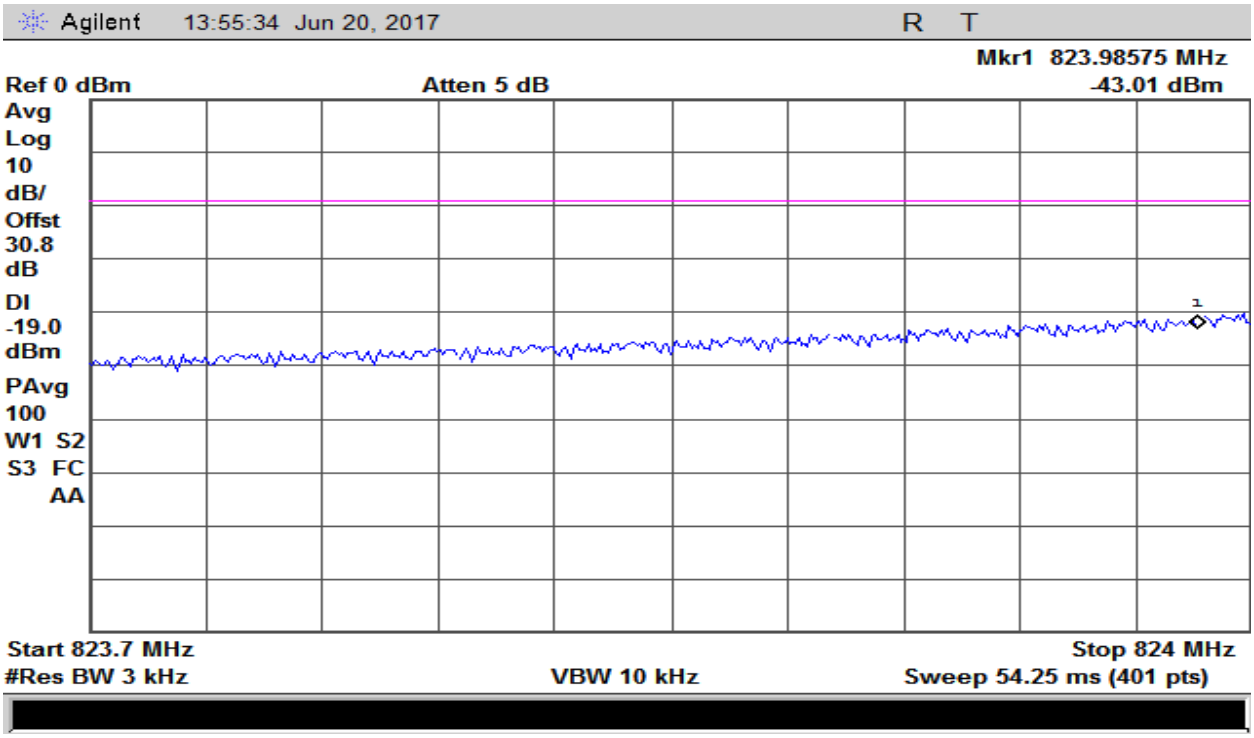
Plot 22 - 698-716MHz Band – GSM Uplink Upper Band Edge



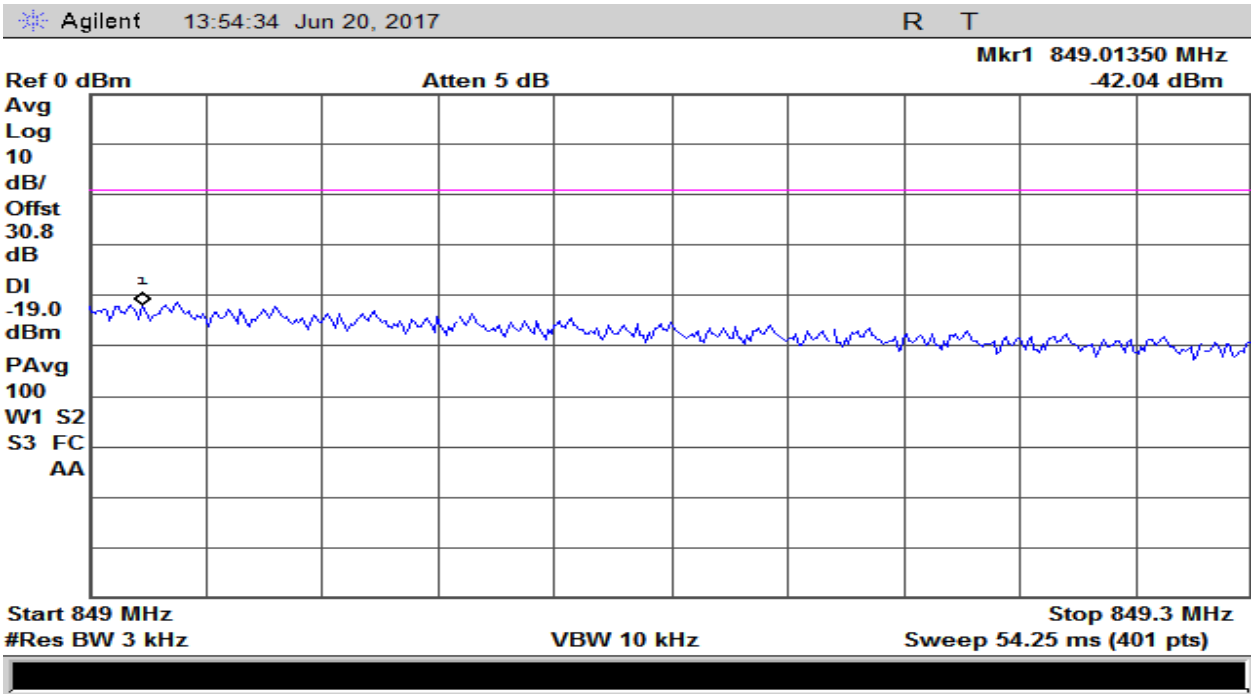
Plot 23 – 776-787MHz Band – GSM Uplink Lower Band Edge



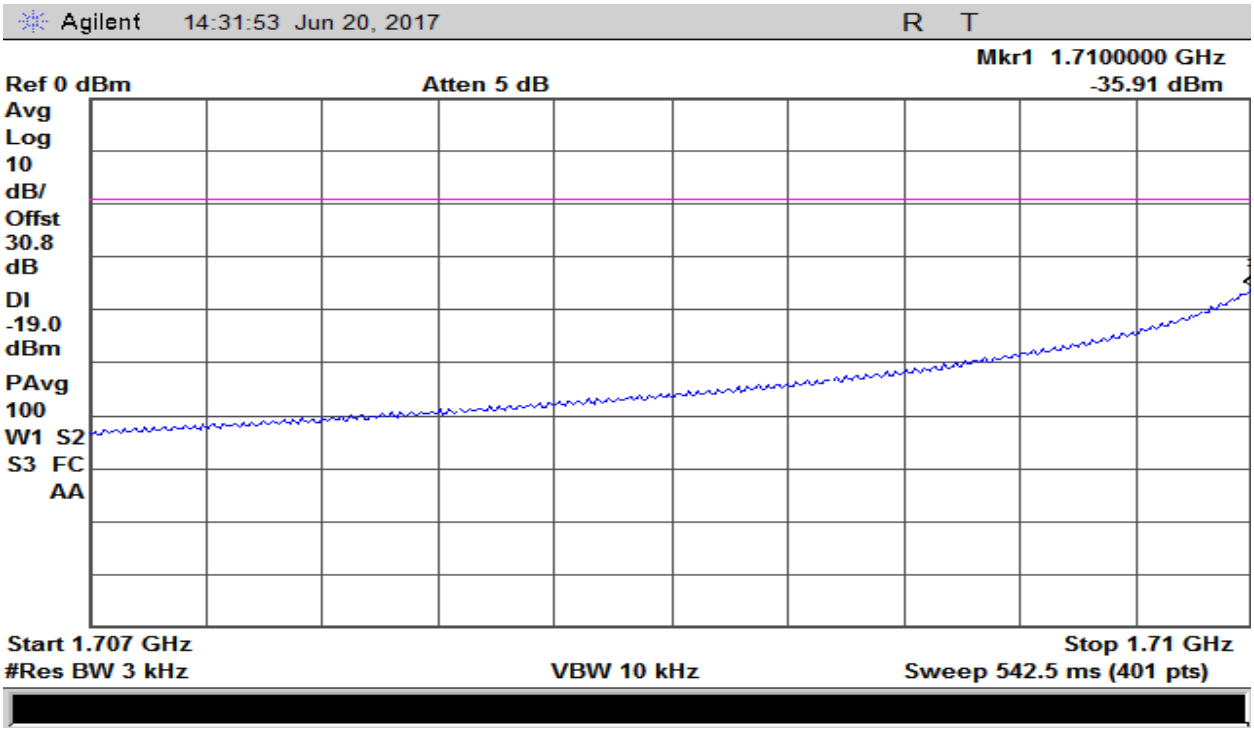
Plot 24 – 776-787MHz Band – GSM Uplink Upper Band Edge



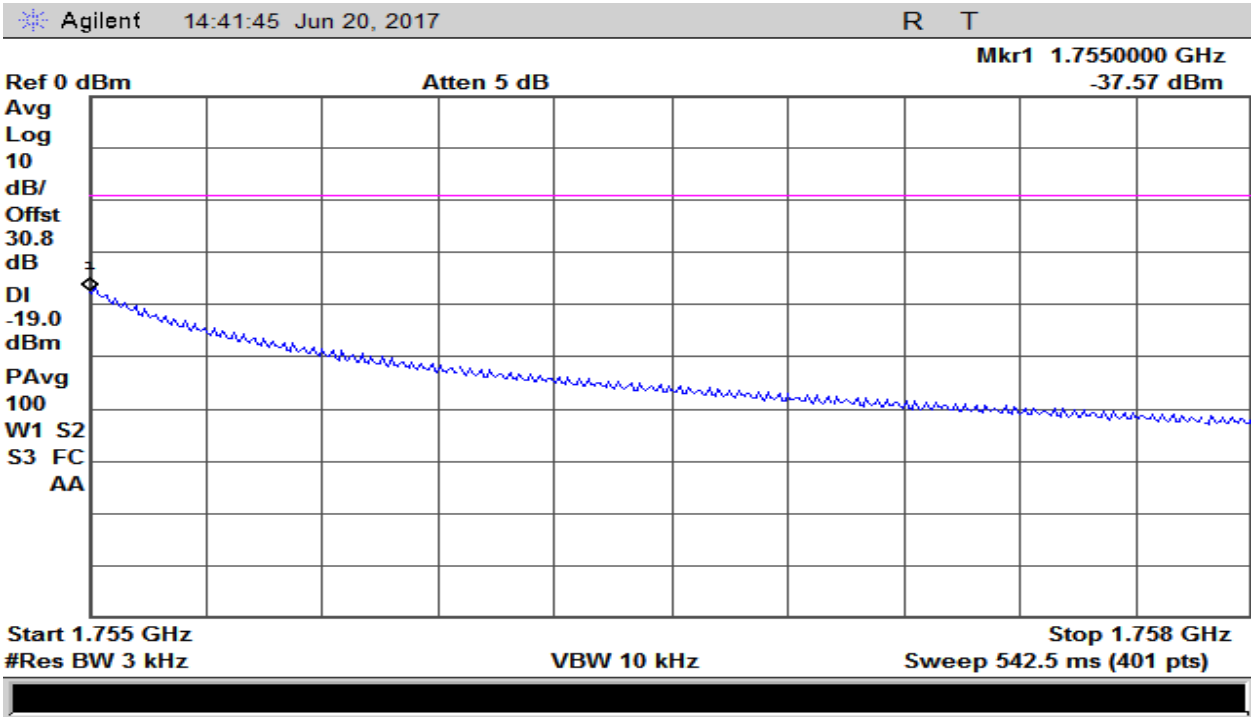
Plot 25 – 824-849MHz Band – GSM Uplink Lower Band Edge



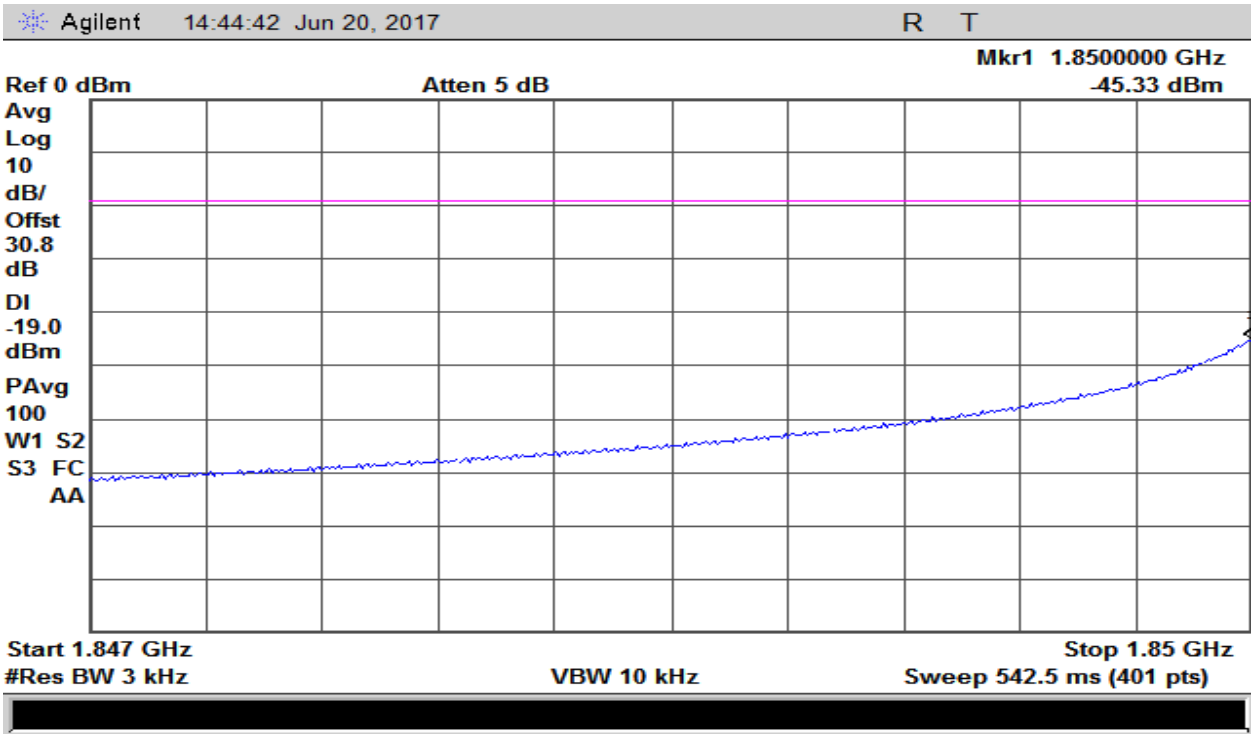
Plot 26 – 824-849MHz Band – GSM Uplink Upper Band Edge



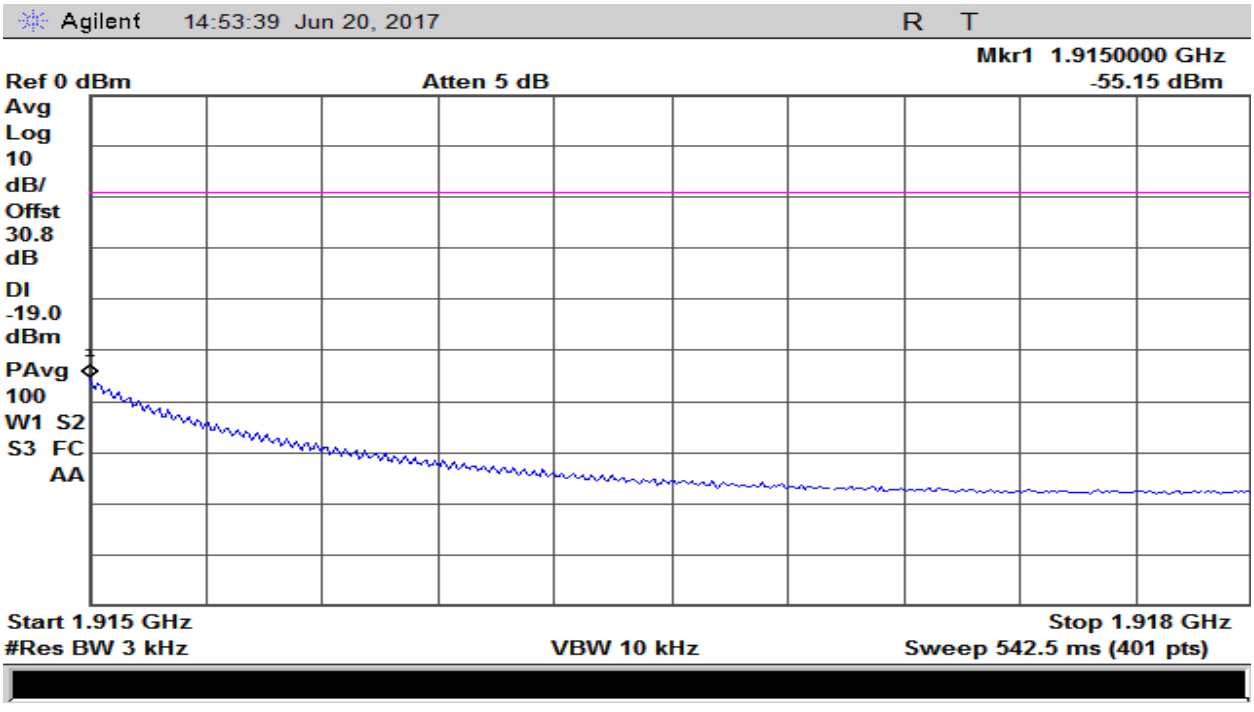
Plot 26 – 1710-1755MHz Band – GSM Uplink Lower Band Edge



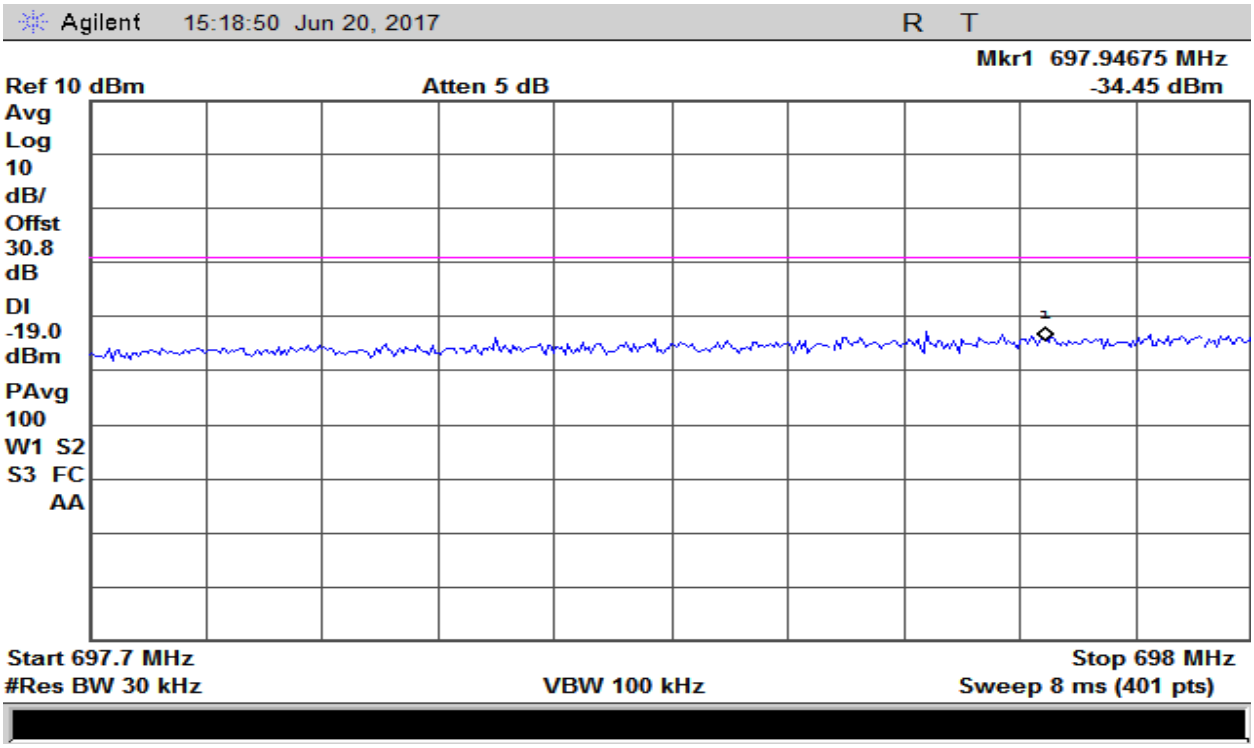
Plot 27 – 1710-1755MHz Band – GSM Uplink Upper Band Edge



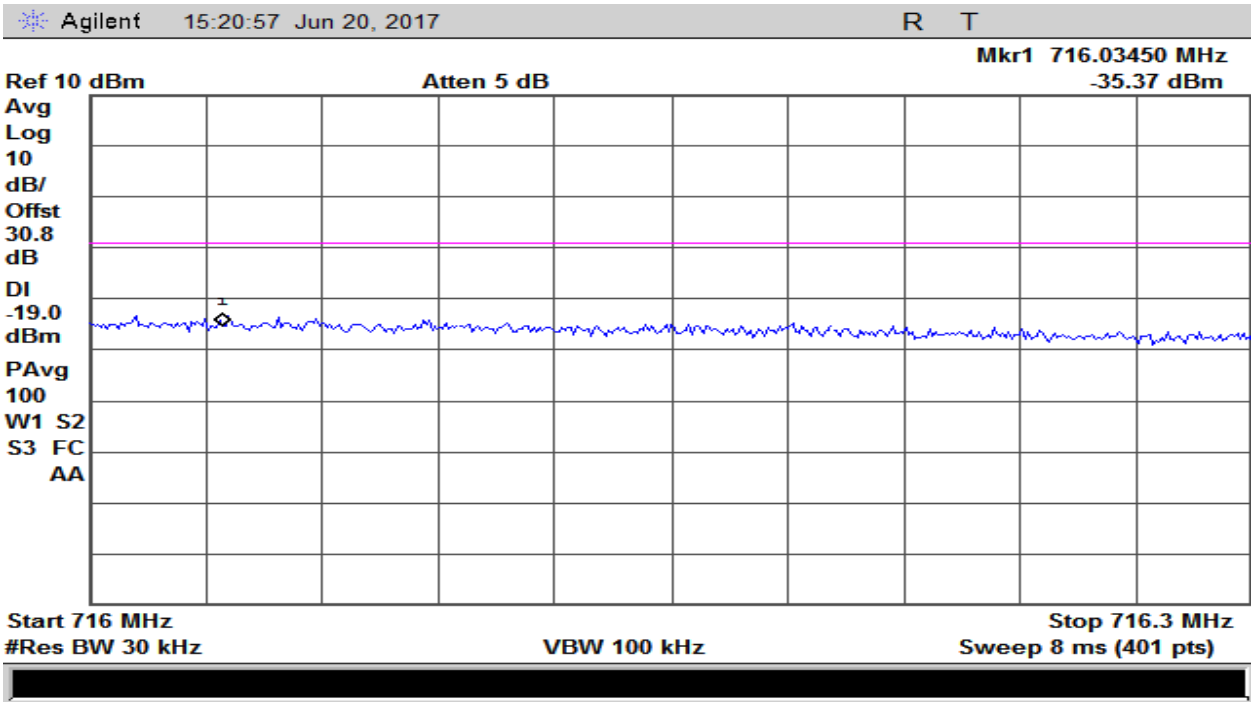
Plot 28 – 1850-1915MHz Band – GSM Uplink Lower Band Edge



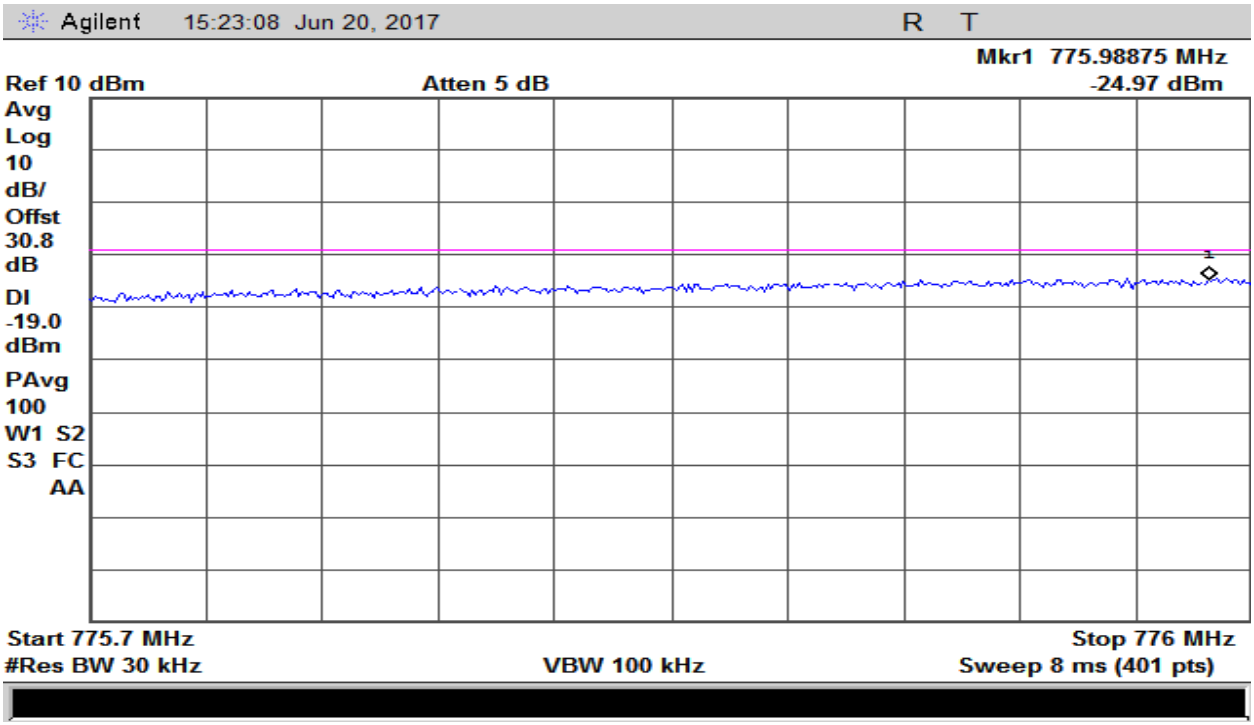
Plot 29 – 1850-1915MHz Band – GSM Uplink Upper Band Edge



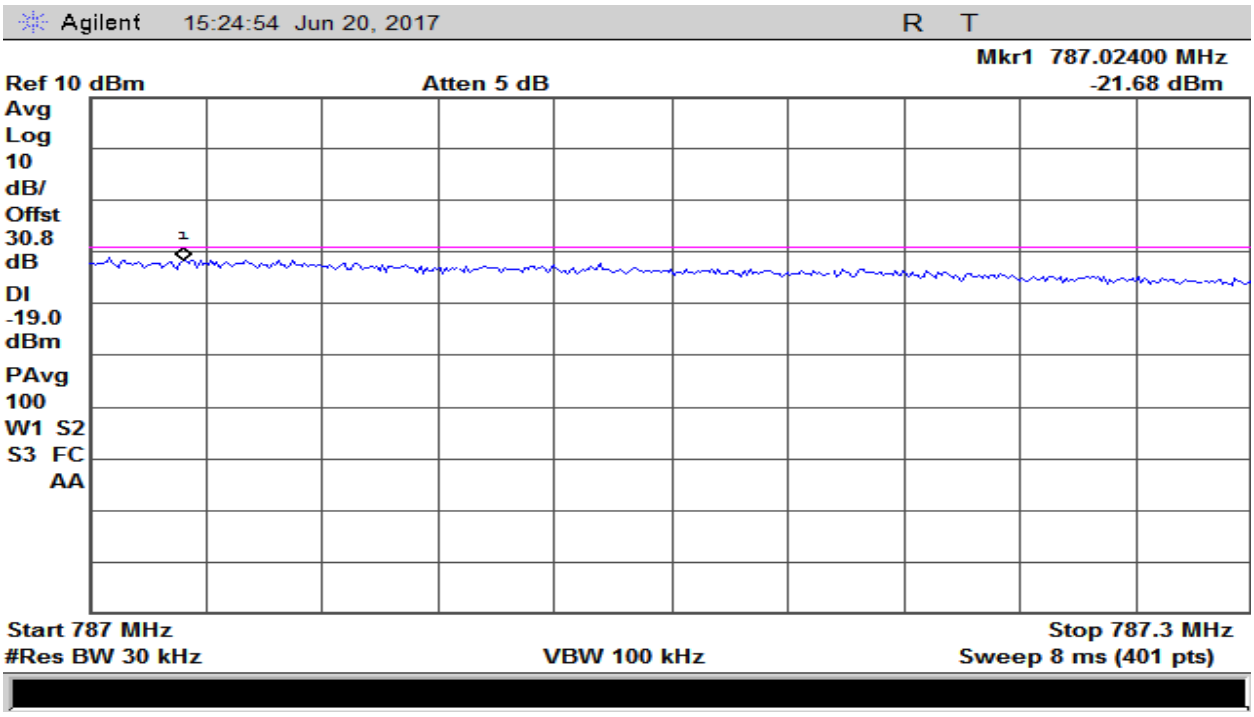
Plot 30 – 698-716MHz Band – CDMA Uplink Lower Band Edge



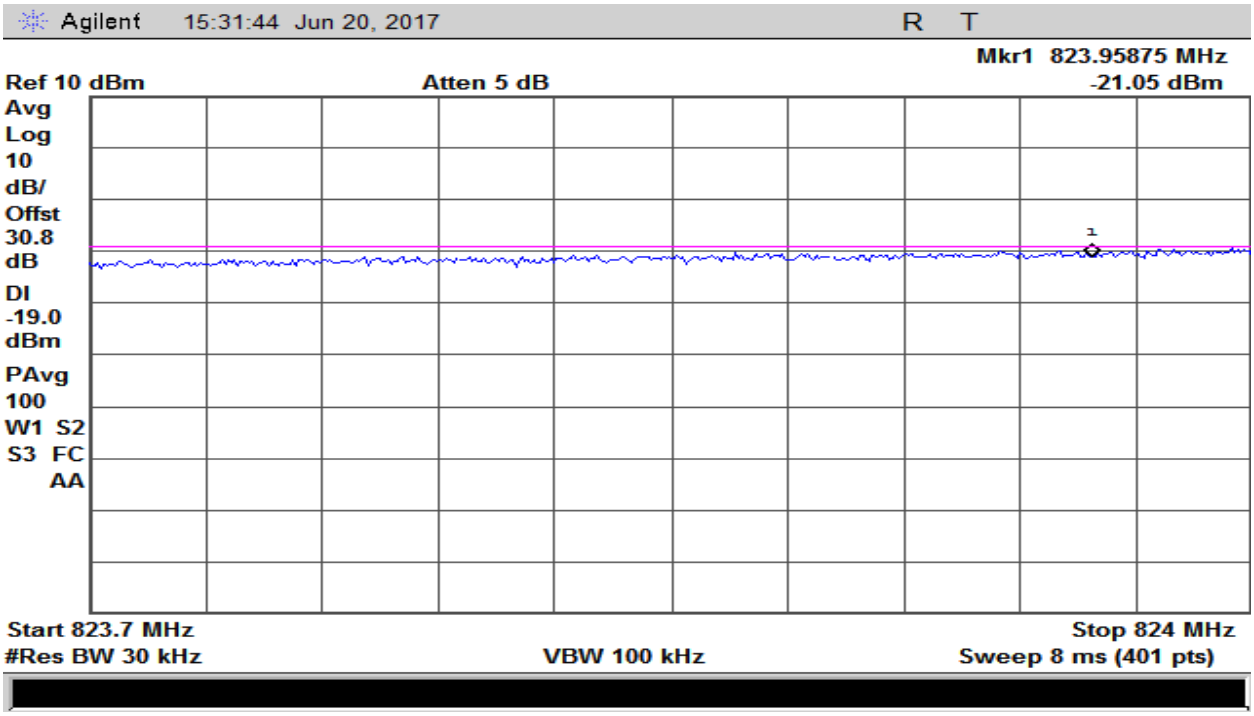
Plot 31 – 698-716MHZ Band – CDMA Uplink Upper Band Edge



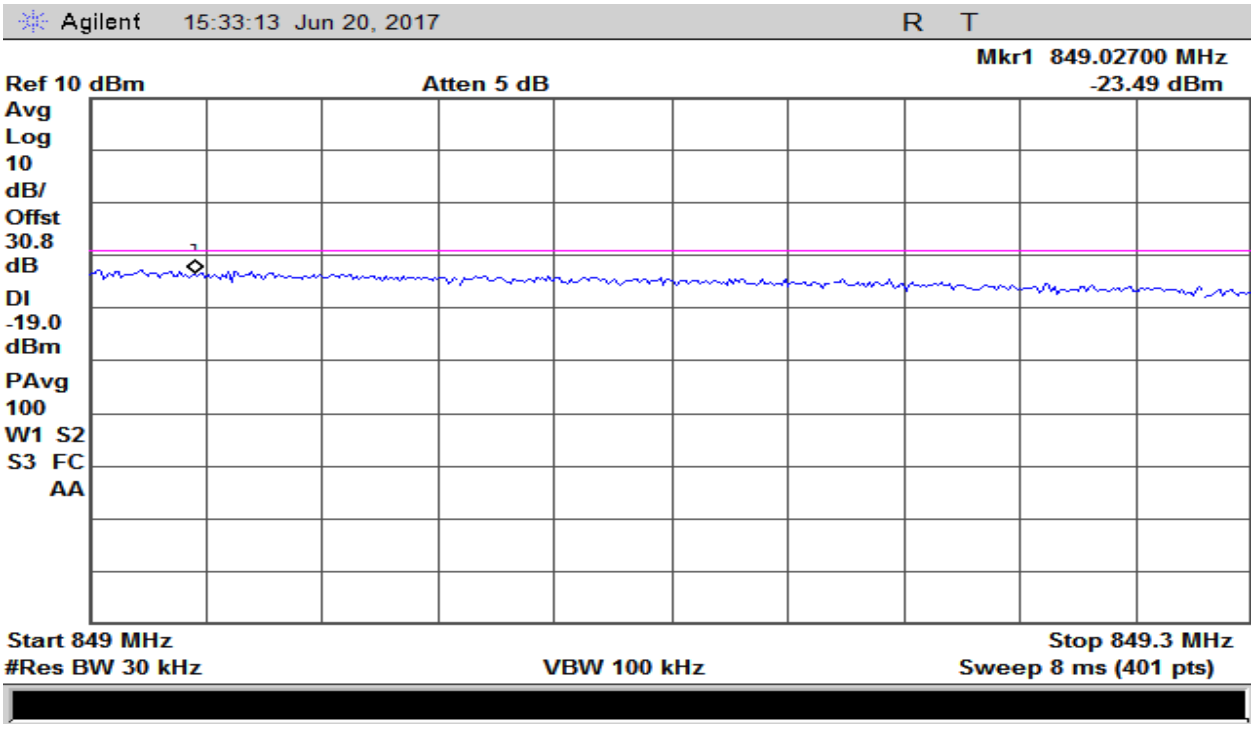
Plot 32 – 776-787MHz Band – CDMA Uplink Lower Band Edge



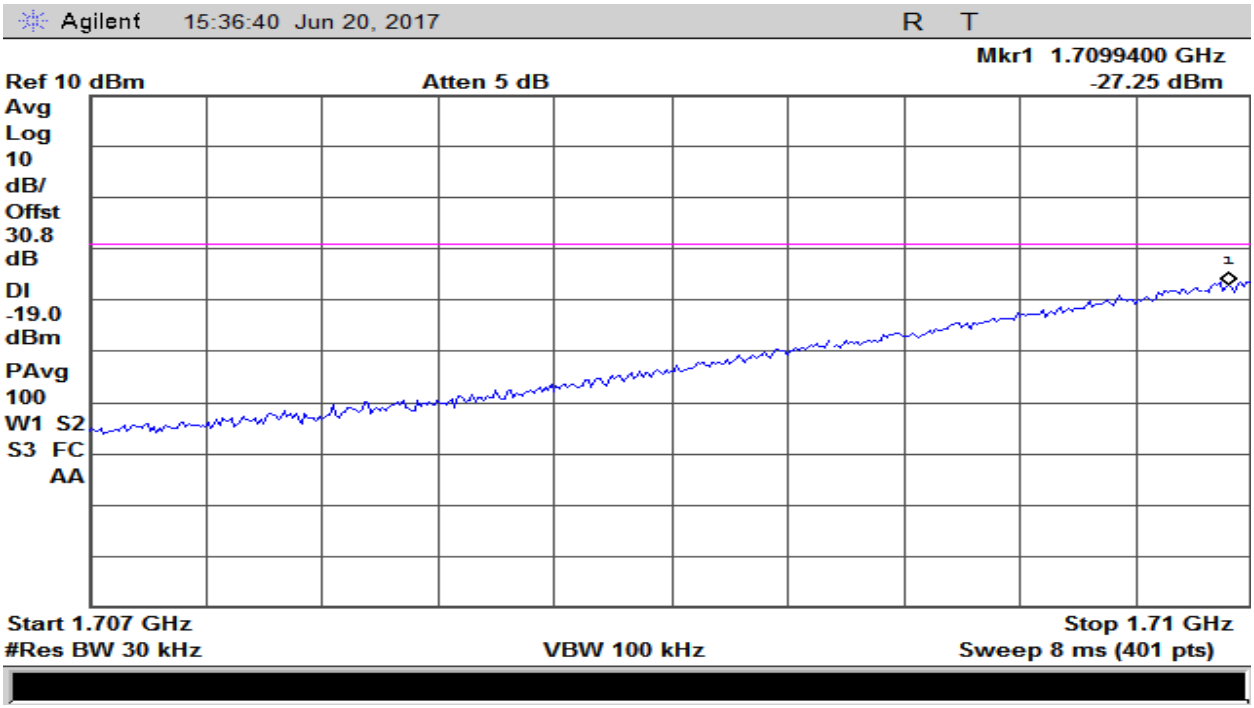
Plot 33 – 776-787MHz Band – CDMA Uplink Upper Band Edge



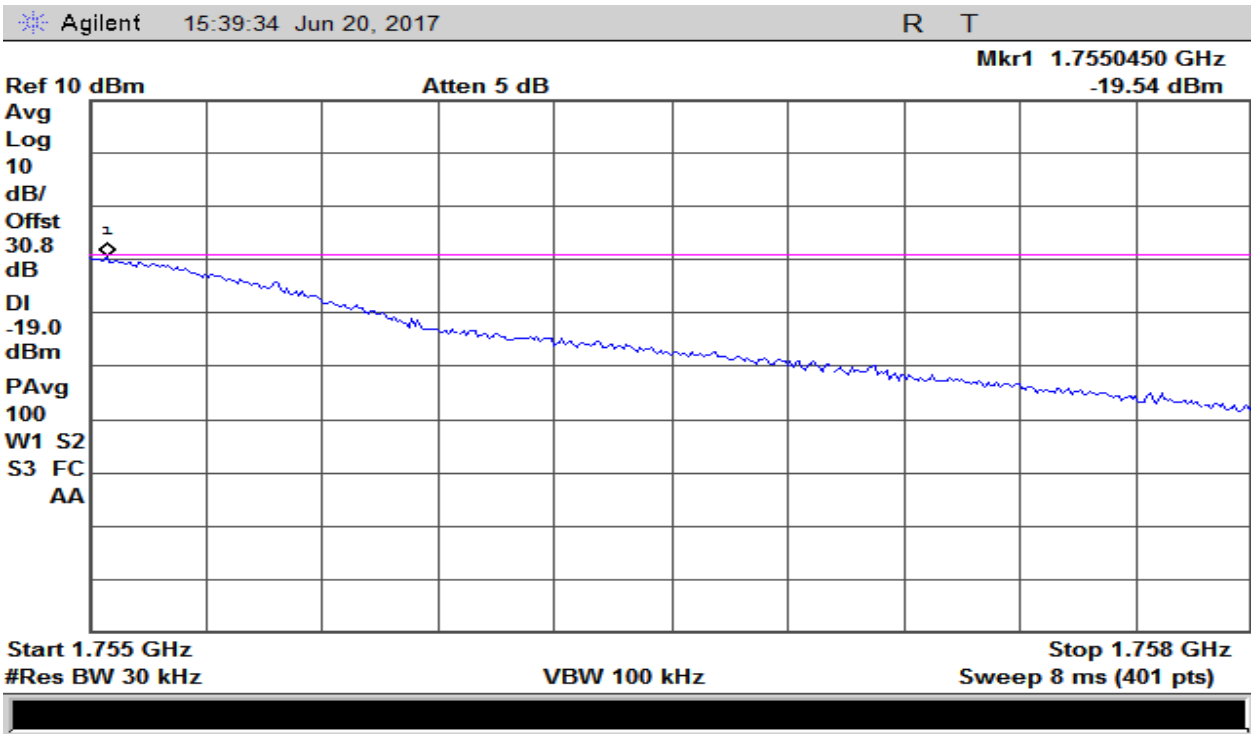
Plot 34 – 824-849MHz Band – CDMA Uplink Lower Band Edge



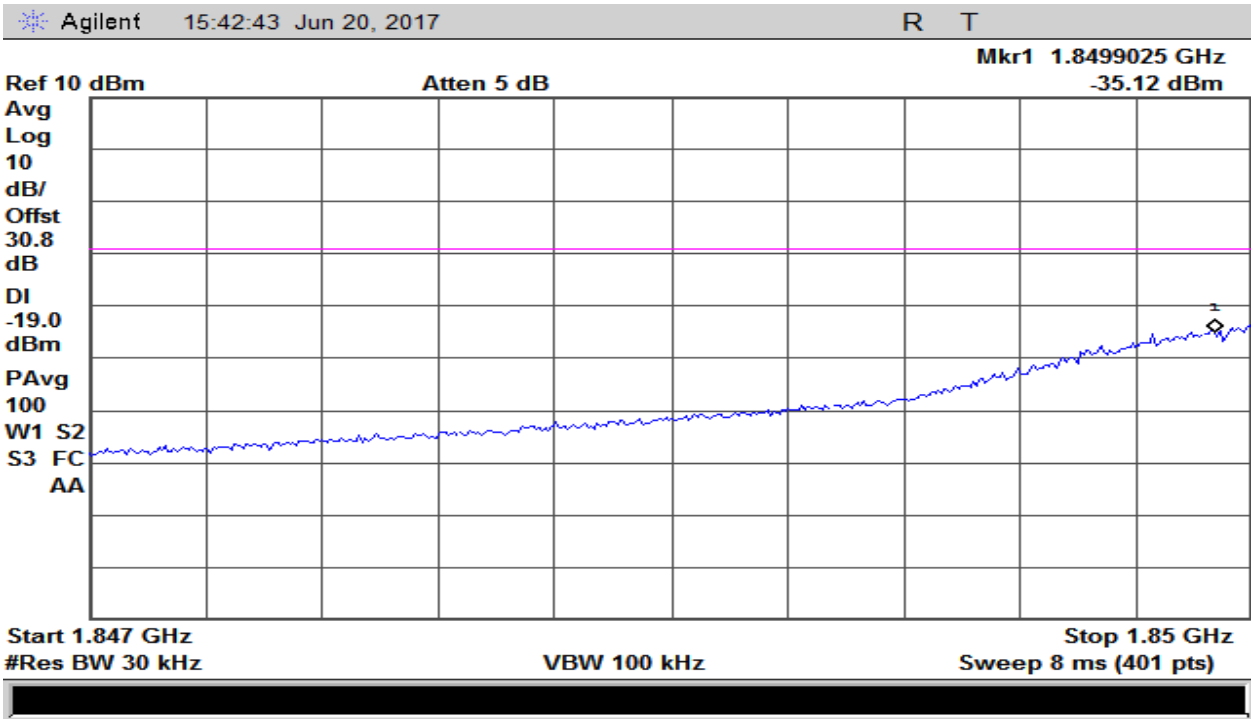
Plot 35 – 824-849MHz Band – CDMA Uplink Upper Band Edge



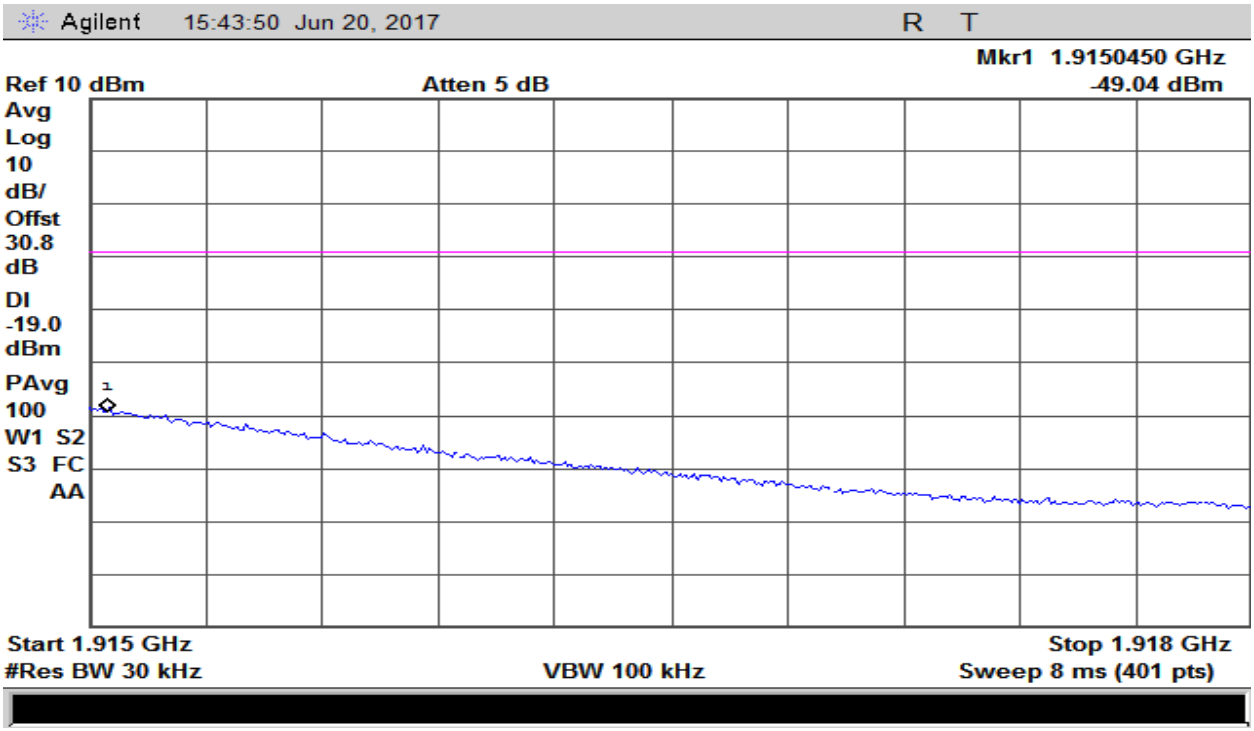
Plot 36 – 1710-1755MHz Band – CDMA Uplink Lower Band Edge



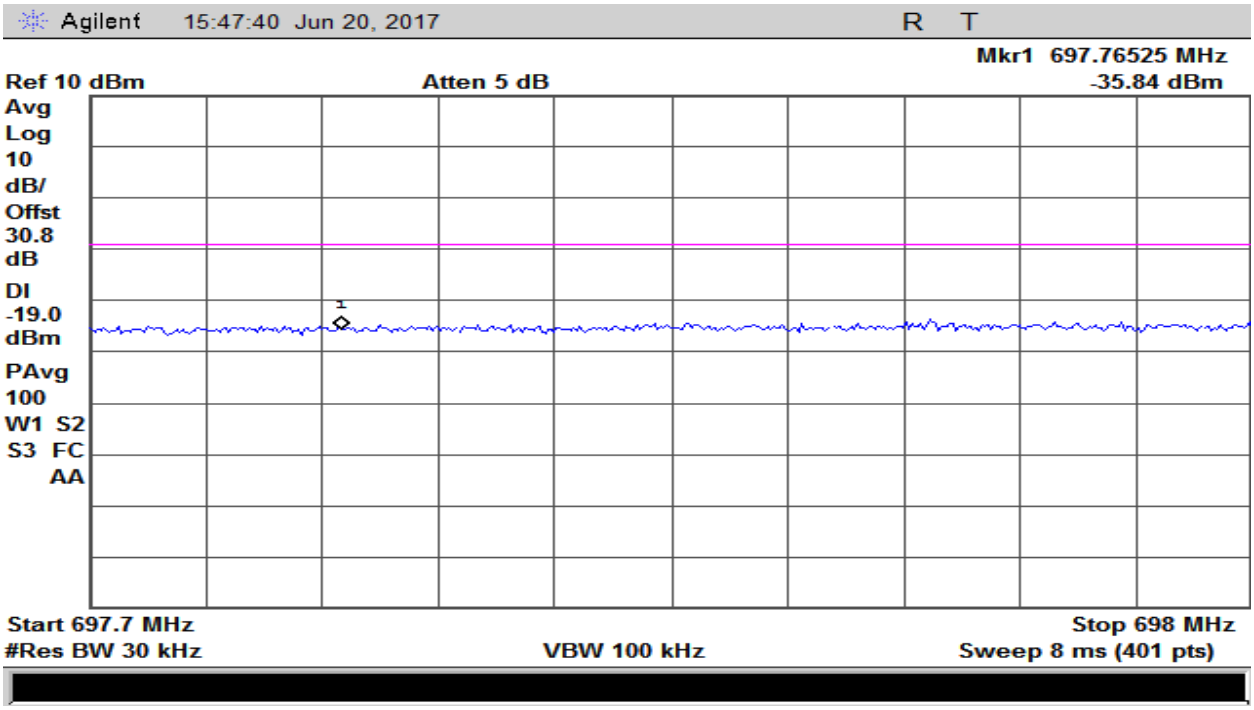
Plot 37 – 1710-1755MHz Band – CDMA Uplink Upper Band Edge



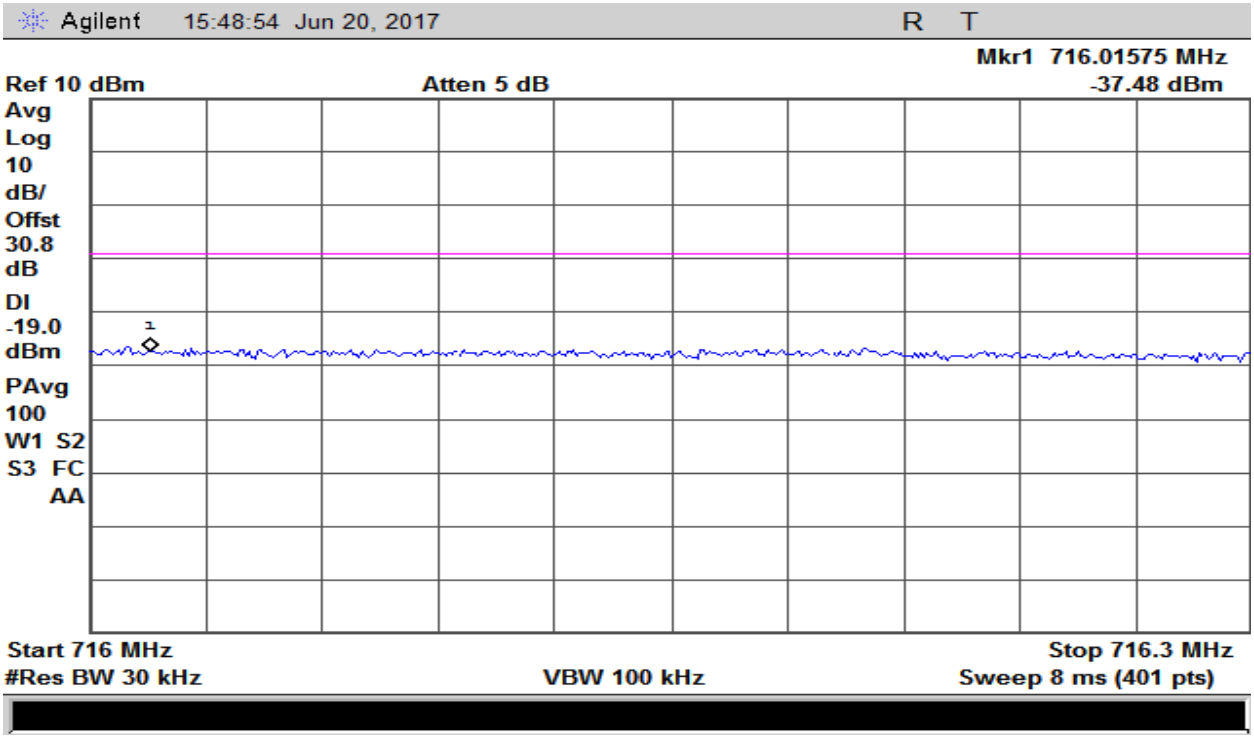
Plot 38 – 1850-1915MHz Band – CDMA Uplink Lower Band Edge



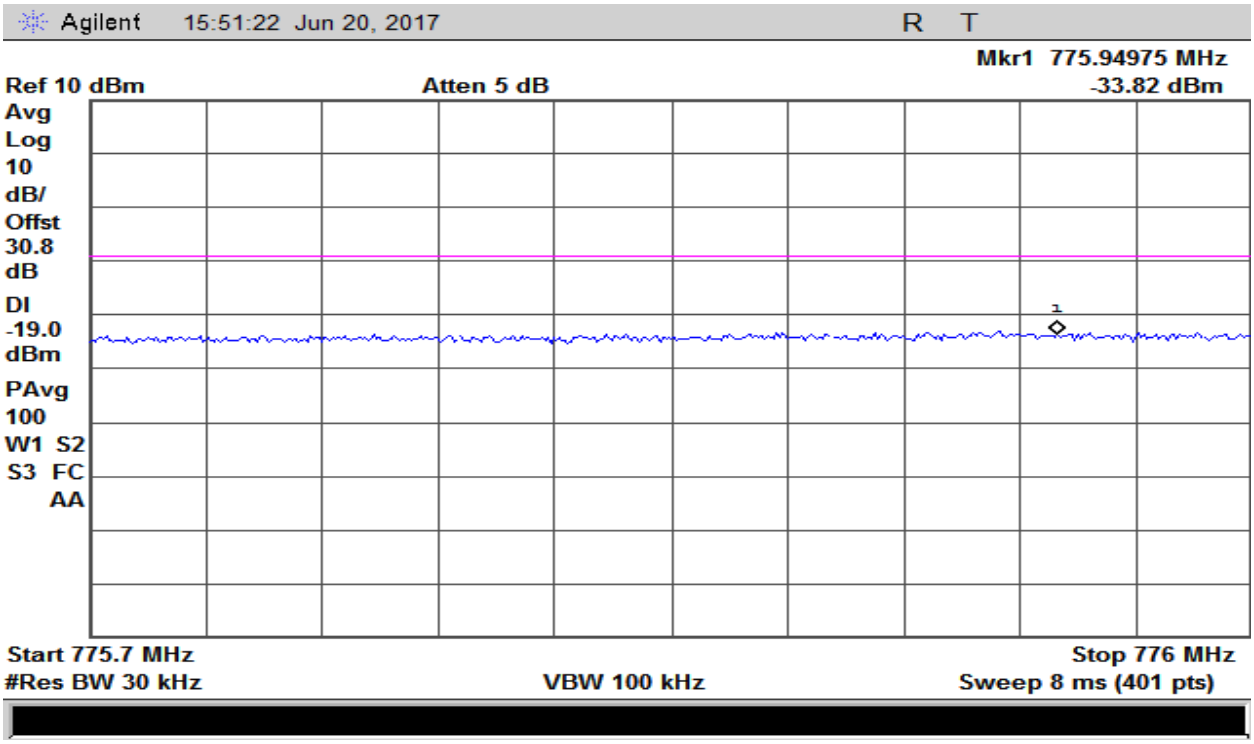
Plot 39 – 1850-1915MHz Band – CDMA Uplink Upper Band Edge



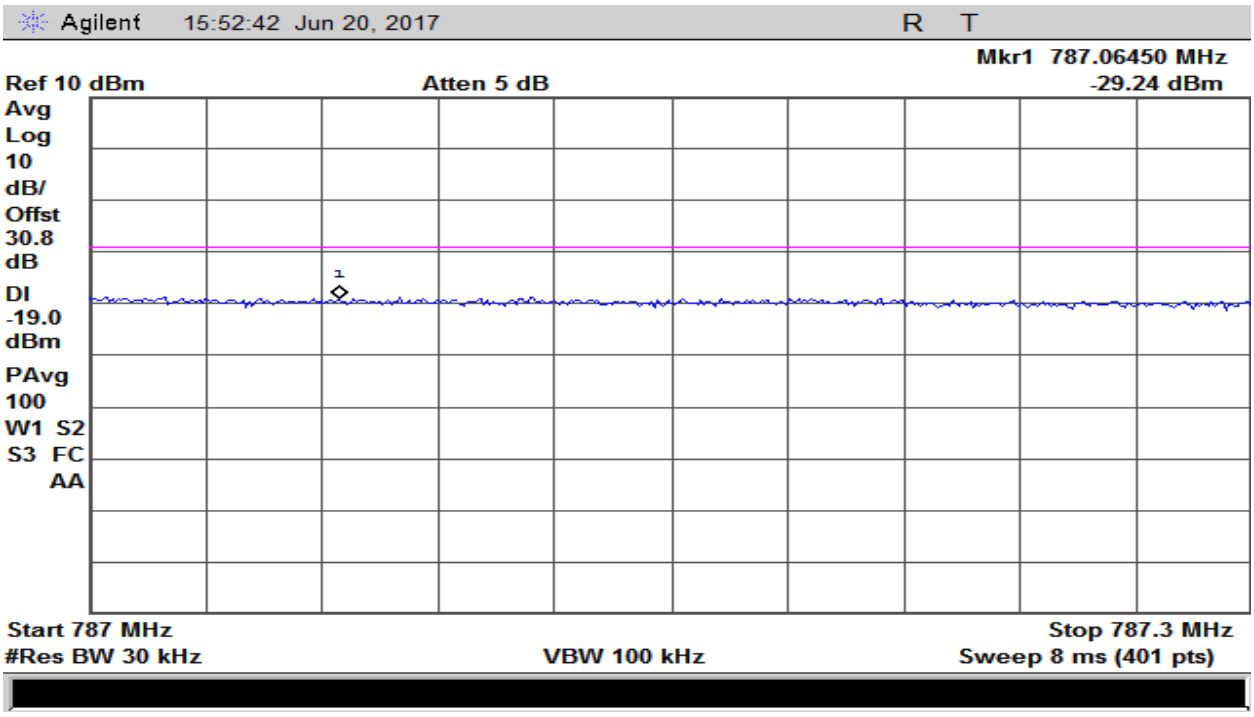
Plot 40 – 698-716MHz Band – LTE Uplink Lower Band Edge



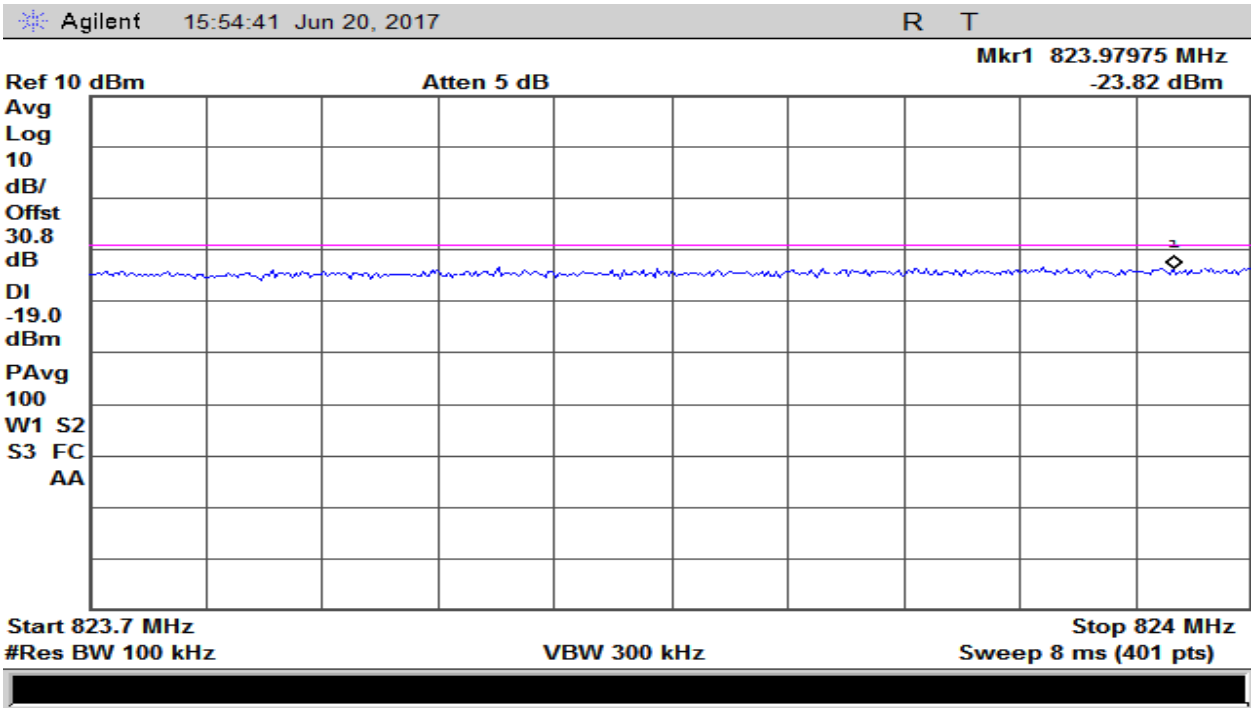
Plot 41 – 698-716MHz Band – LTE Uplink Upper Band Edge



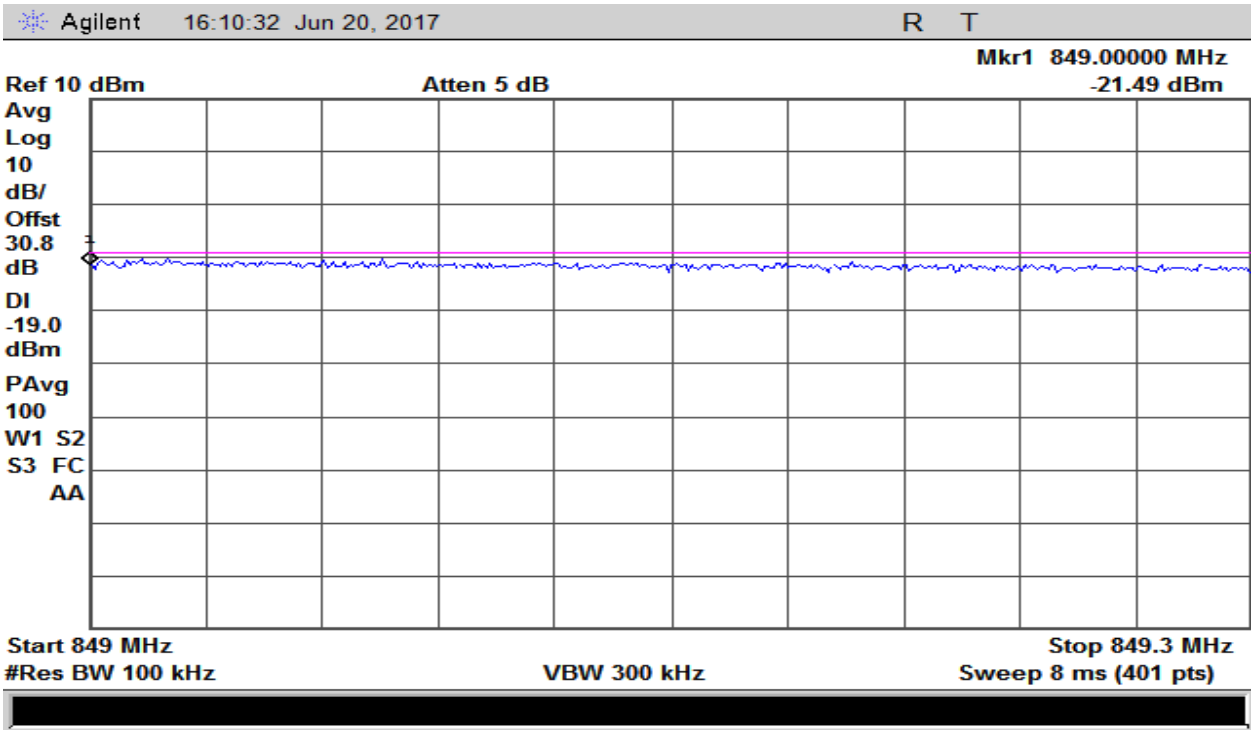
Plot 42 – 776-787MHz Band – LTE Uplink Lower Band Edge



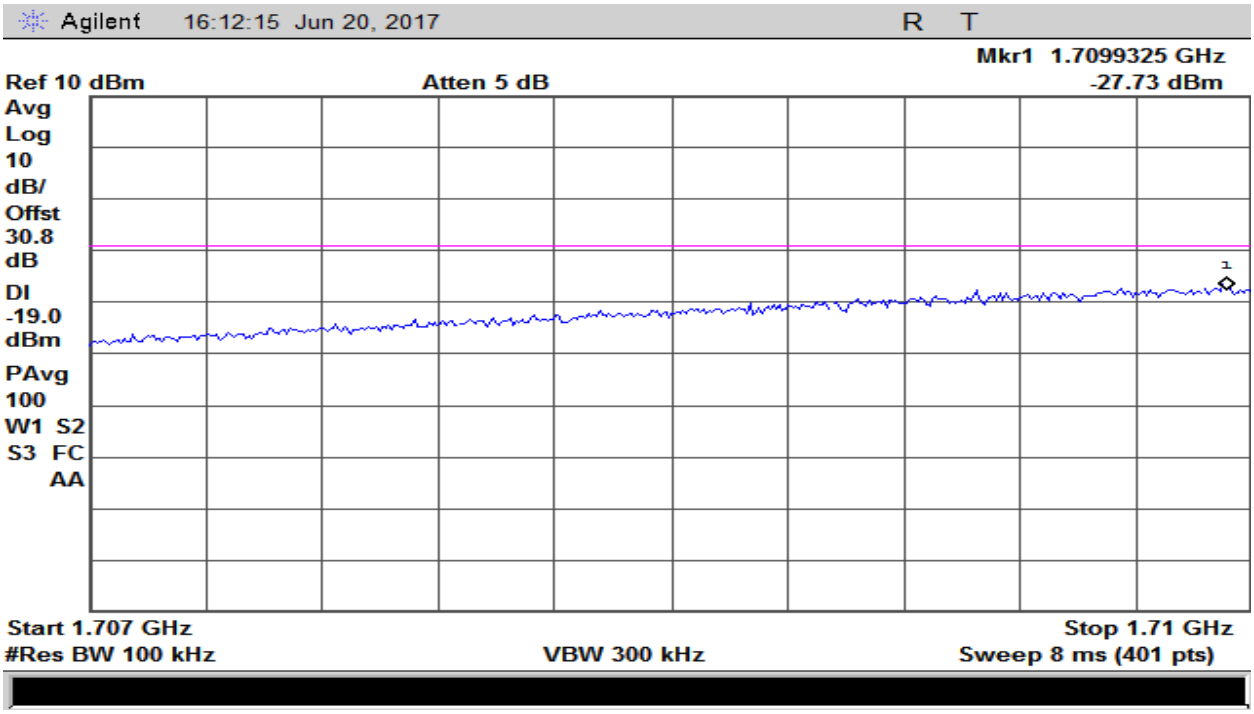
Plot 43 – 776-787MHz Band – LTE Uplink Upper Band Edge



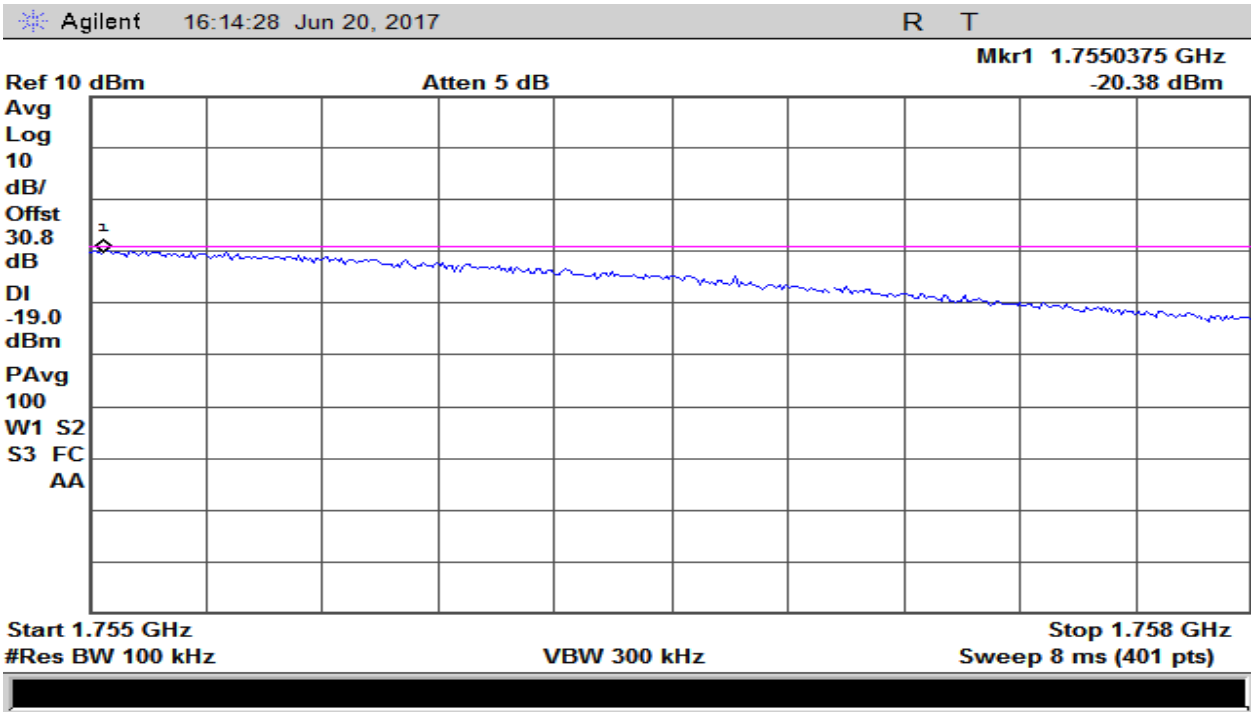
Plot 44 – 824-849MHz Band – LTE Uplink Lower Band Edge



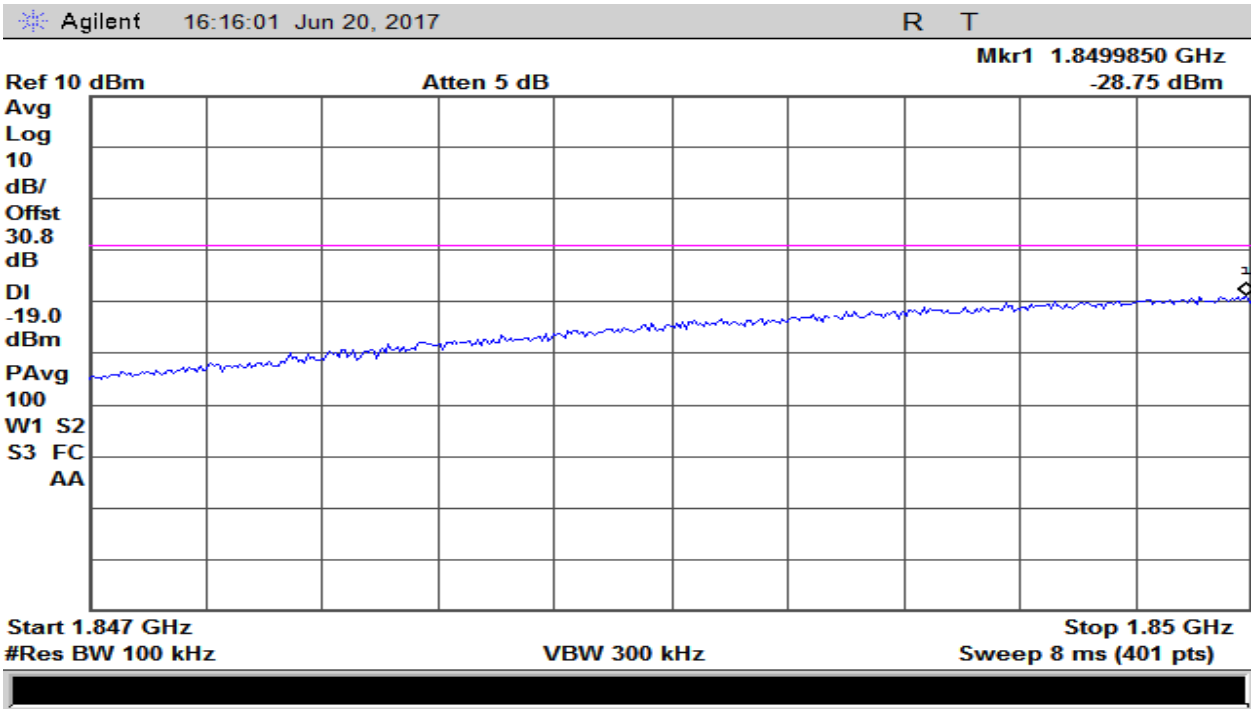
Plot 45 – 824-849MHz Band – LTE Uplink Upper Band Edge



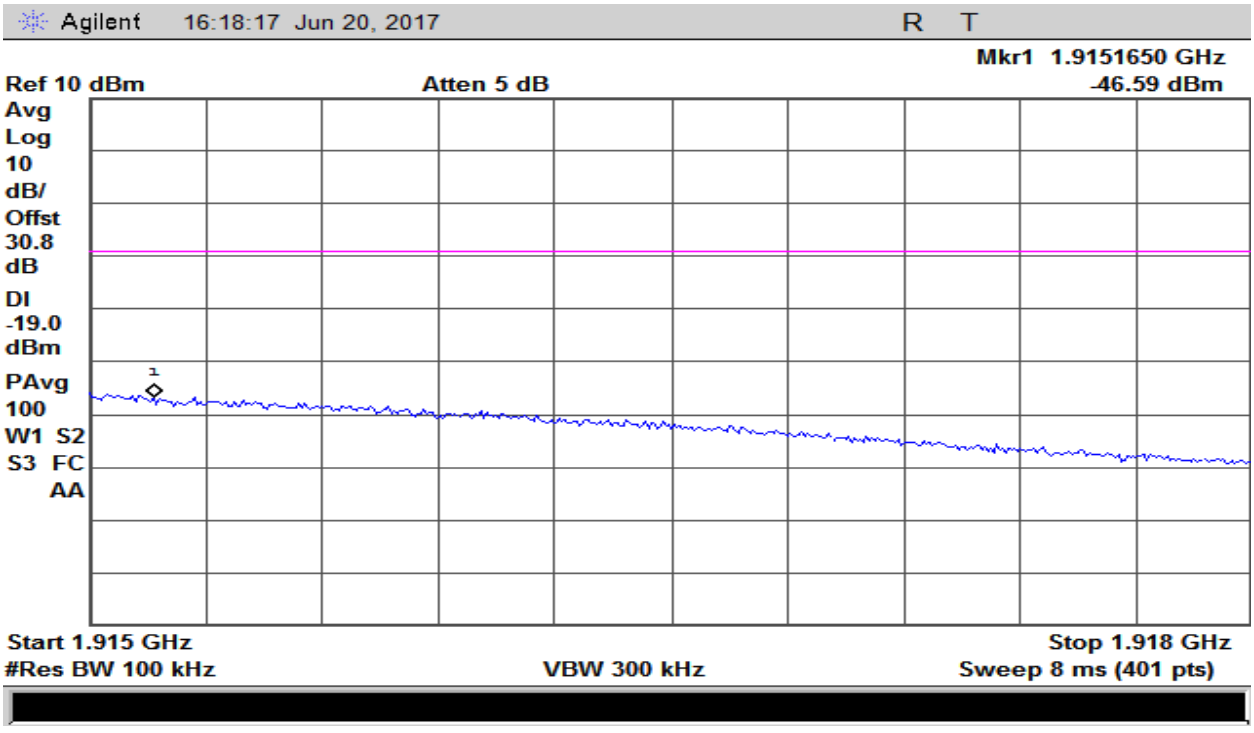
Plot 46 – 1710-1755MHz Band – LTE Uplink Lower Band Edge



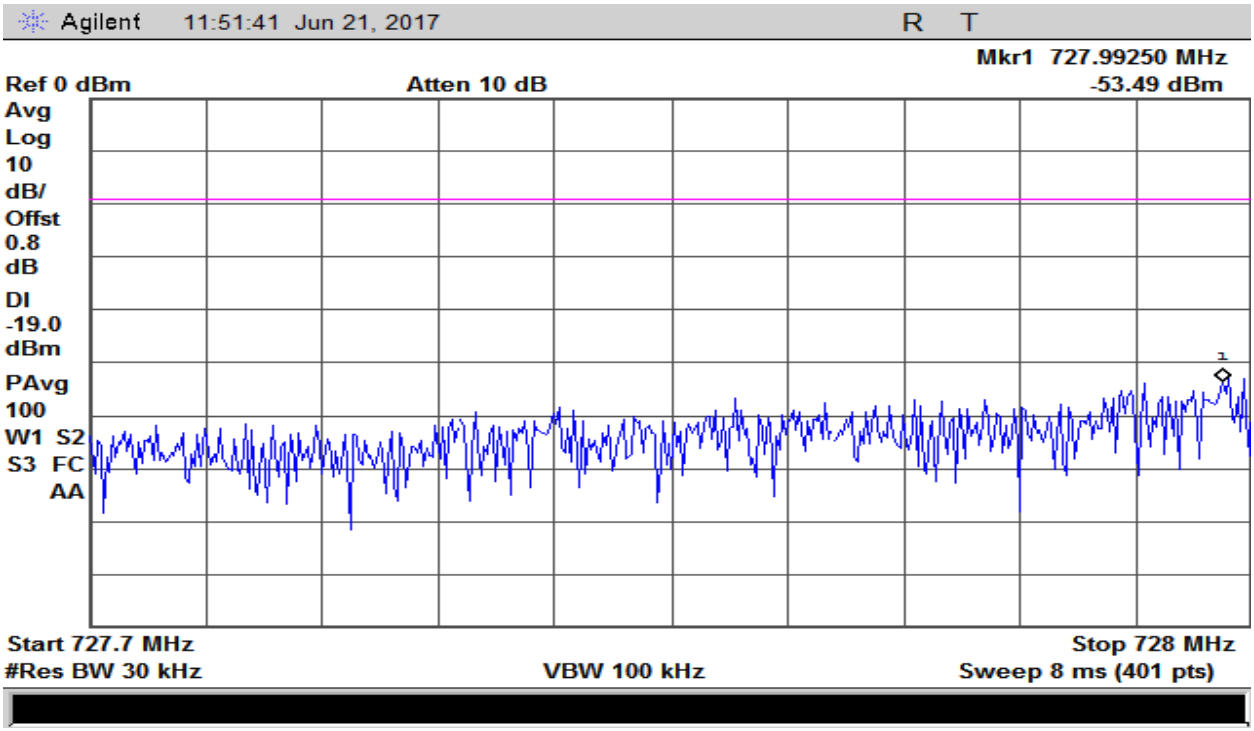
Plot 47 – 1710-1755MHz Band – LTE Uplink Upper Band Edge



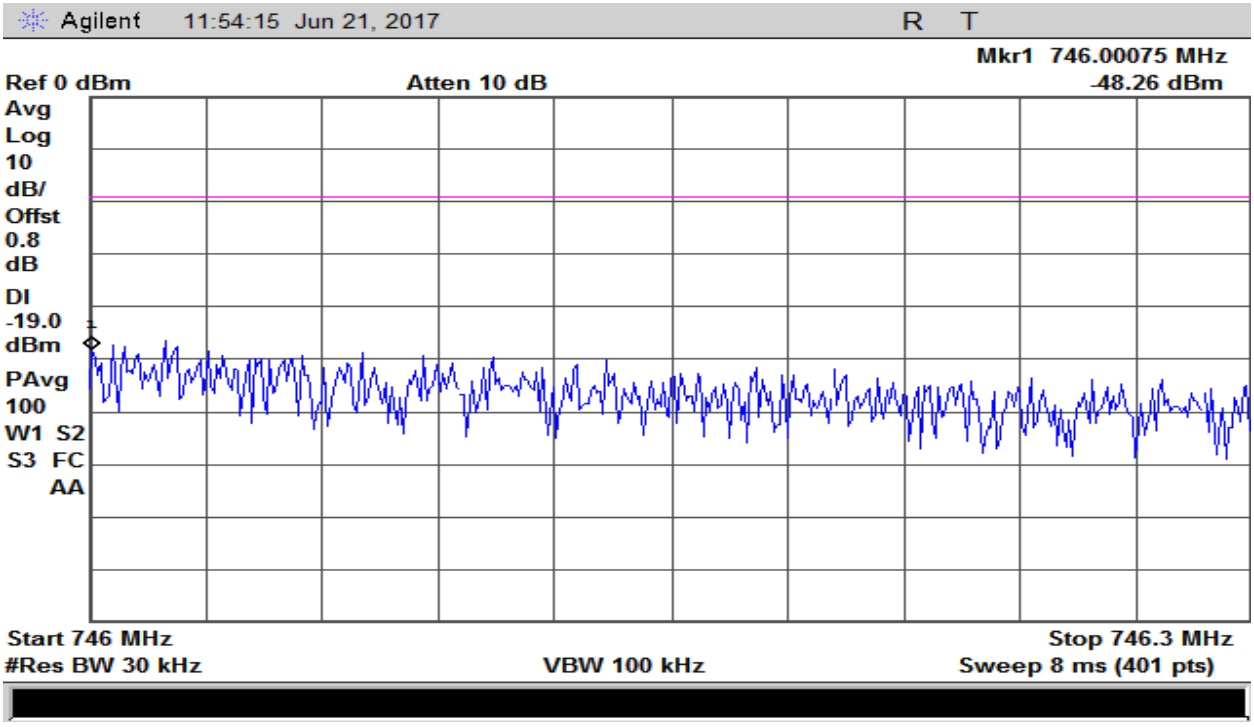
Plot 48 – 1850-1915MHz Band – LTE Uplink Lower Band Edge



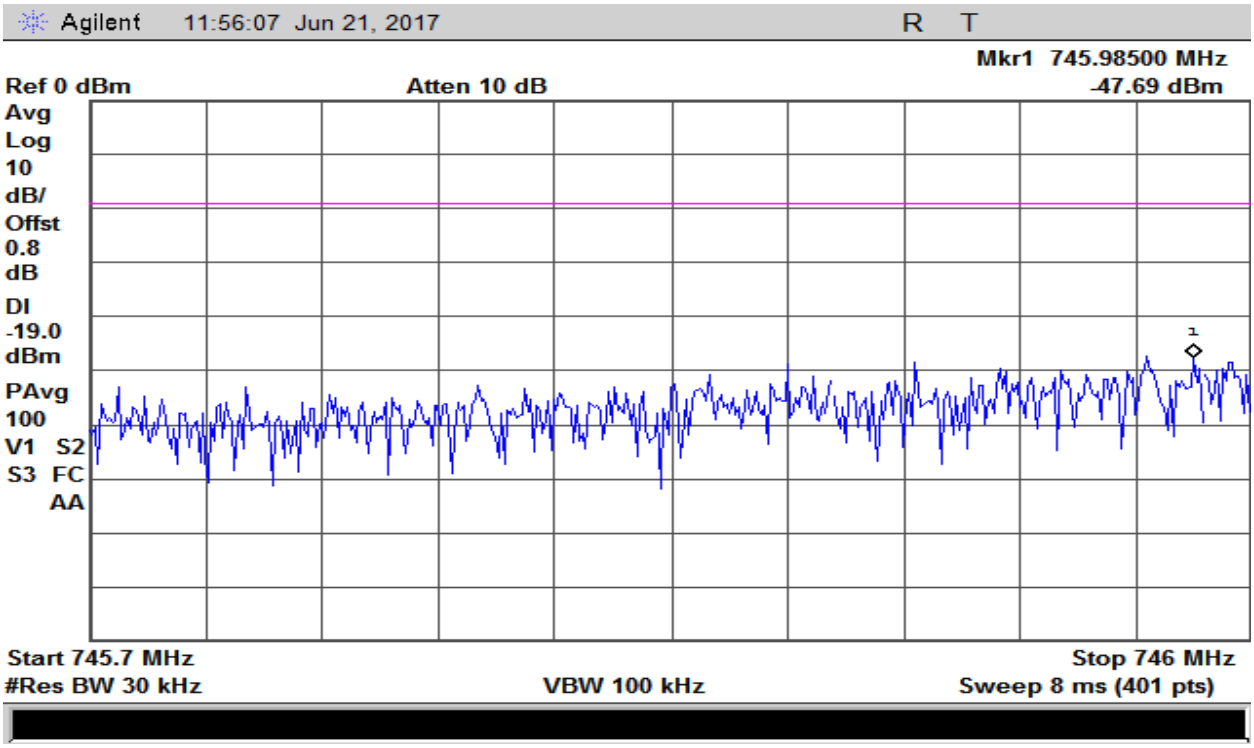
Plot 49 – 1850-1915MHz Band – LTE Uplink Upper Band Edge



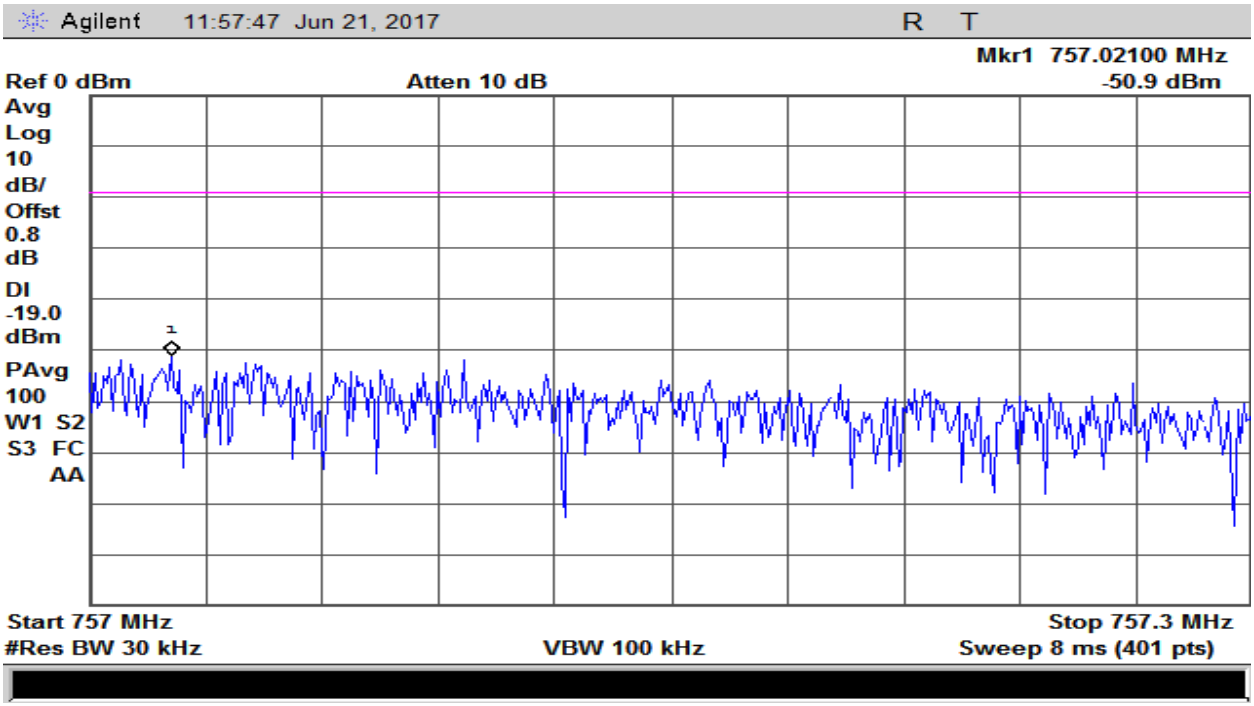
Plot 50 – 728-746MHz Band – GSM Downlink Lower Band Edge



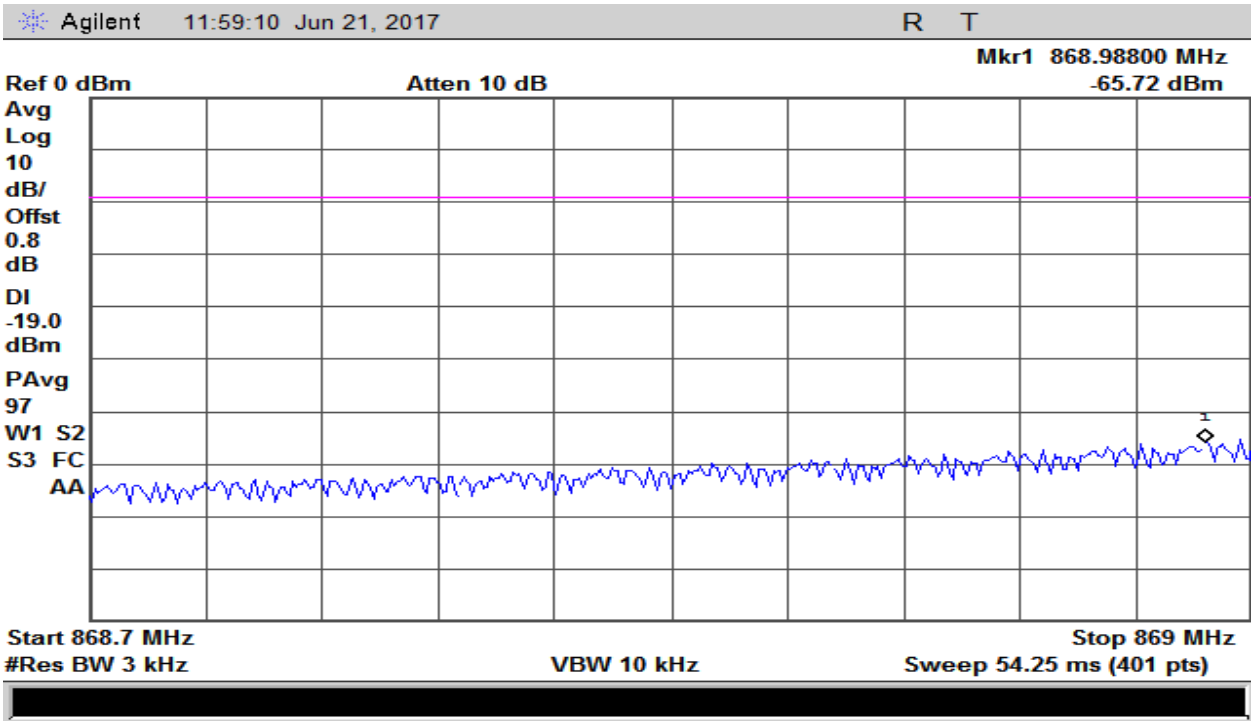
Plot 51 – 728-746MHz Band – GSM Downlink Upper Band Edge



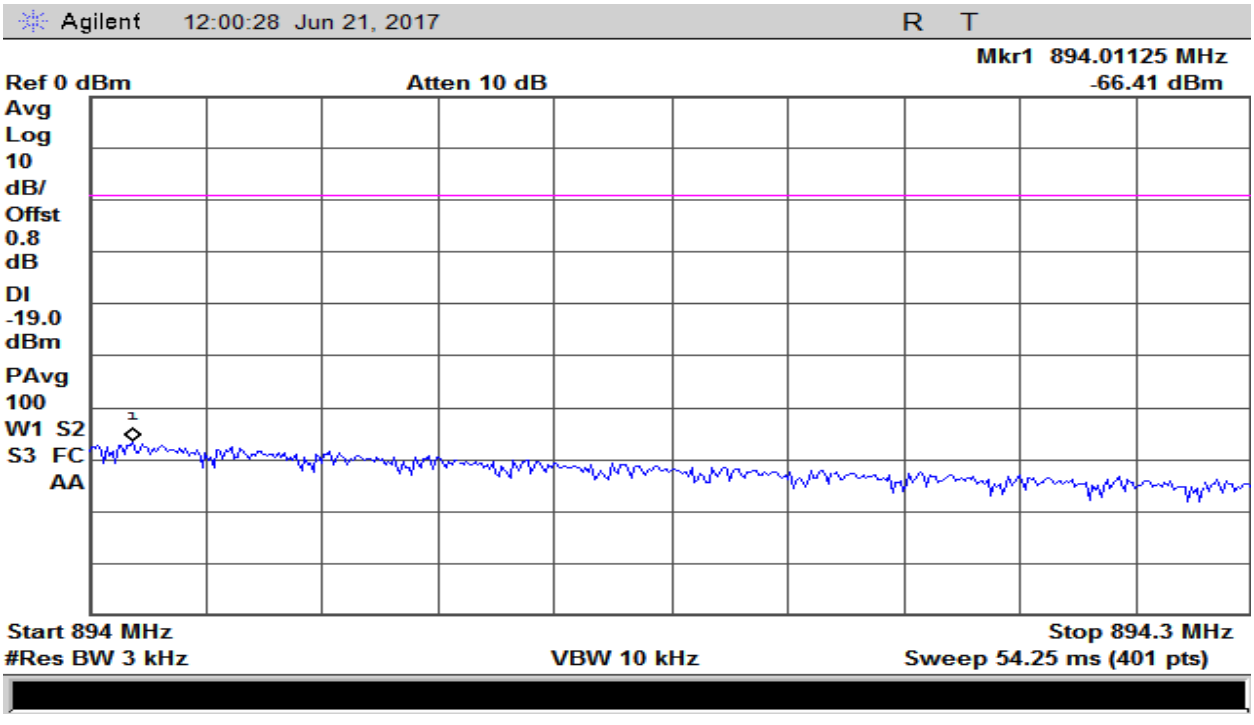
Plot 52 – 746-757MHz Band – GSM Downlink Lower Band Edge



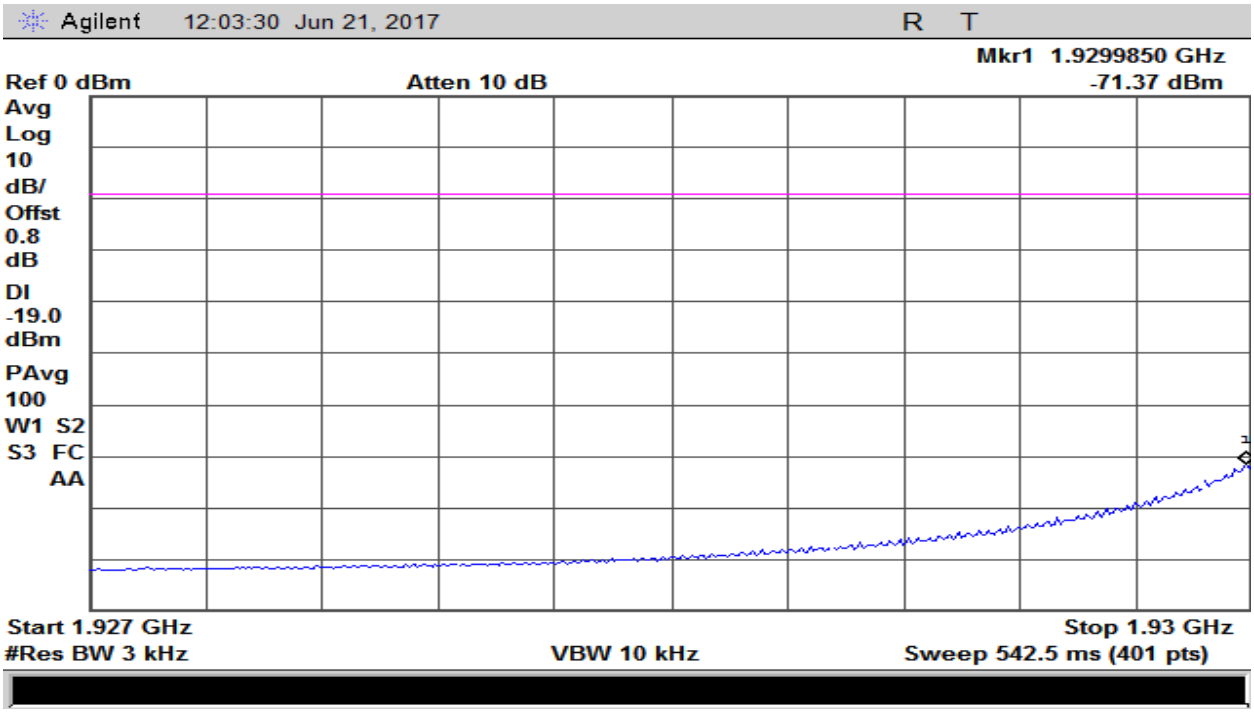
Plot 53 – 746-757MHz Band – GSM Downlink Upper Band Edge



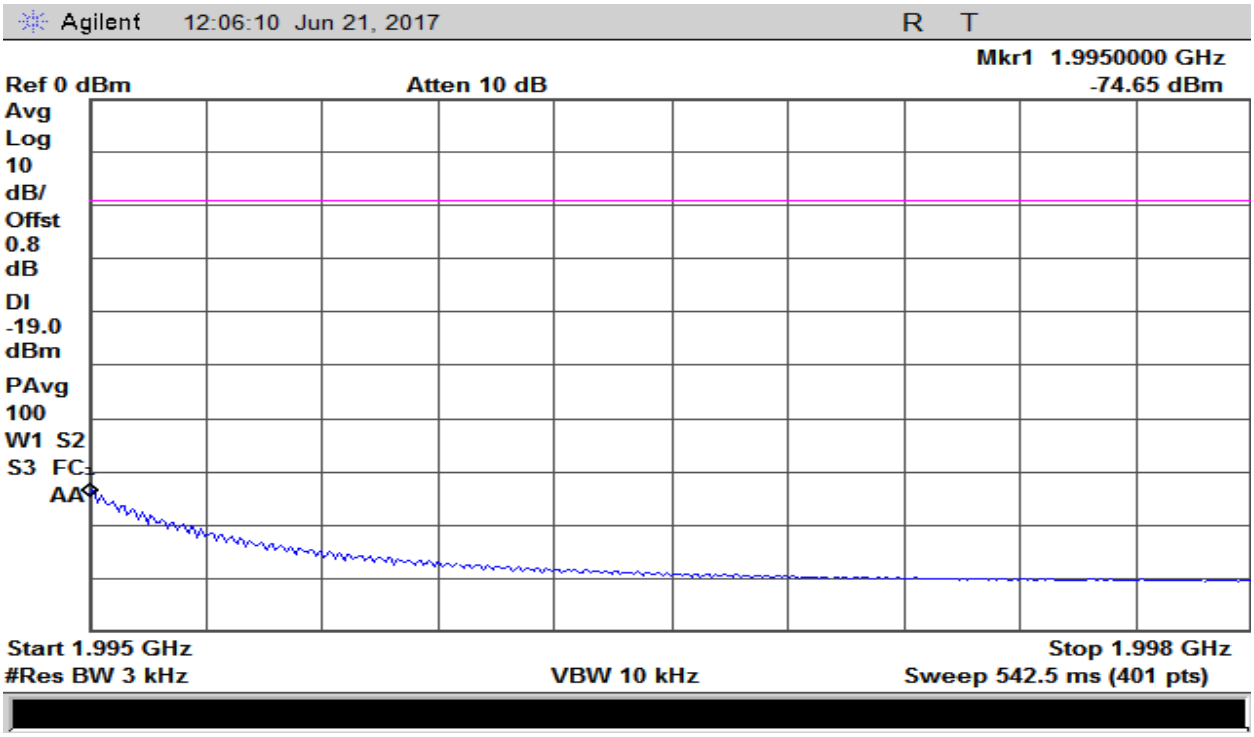
Plot 54 – 869-894MHz Band – GSM Downlink Lower Band Edge



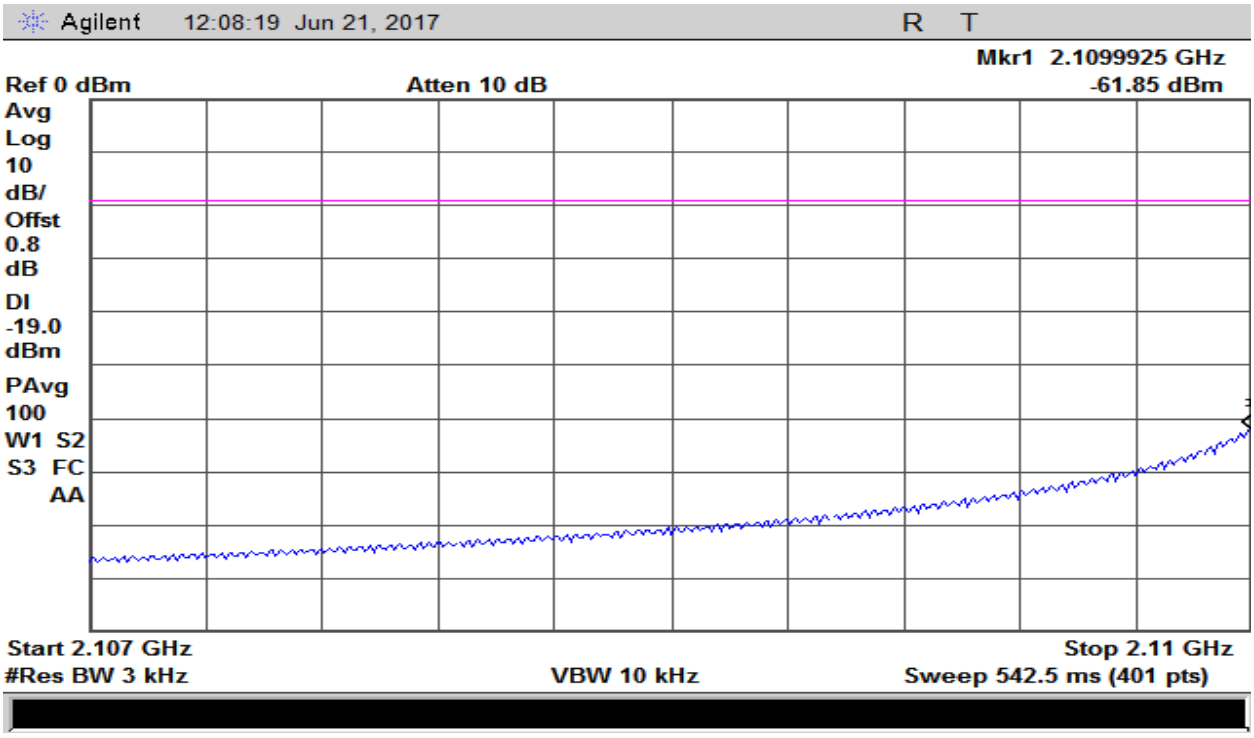
Plot 55 – 869-894MHz Band – GSM Downlink Upper Band Edge



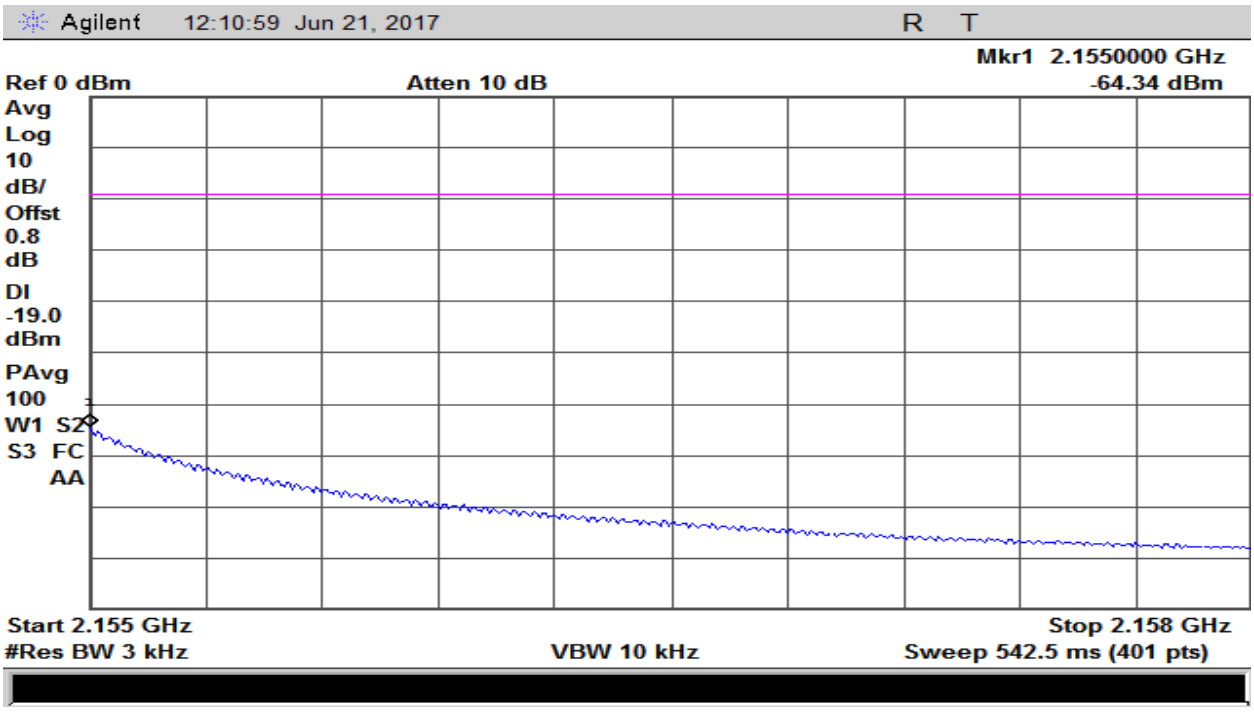
Plot 56 – 1930-1995MHz Band – GSM Downlink Lower Band Edge



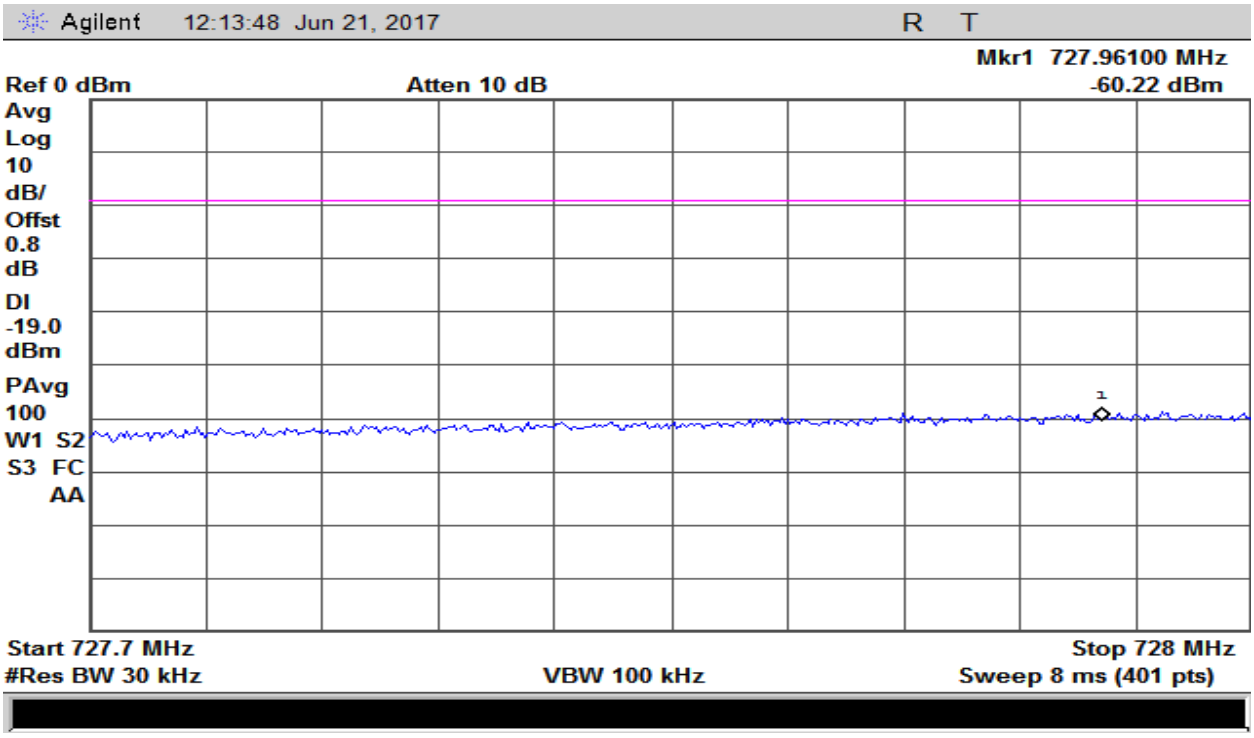
Plot 57 – 1930-1995MHz Band – GSM Downlink Upper Band Edge



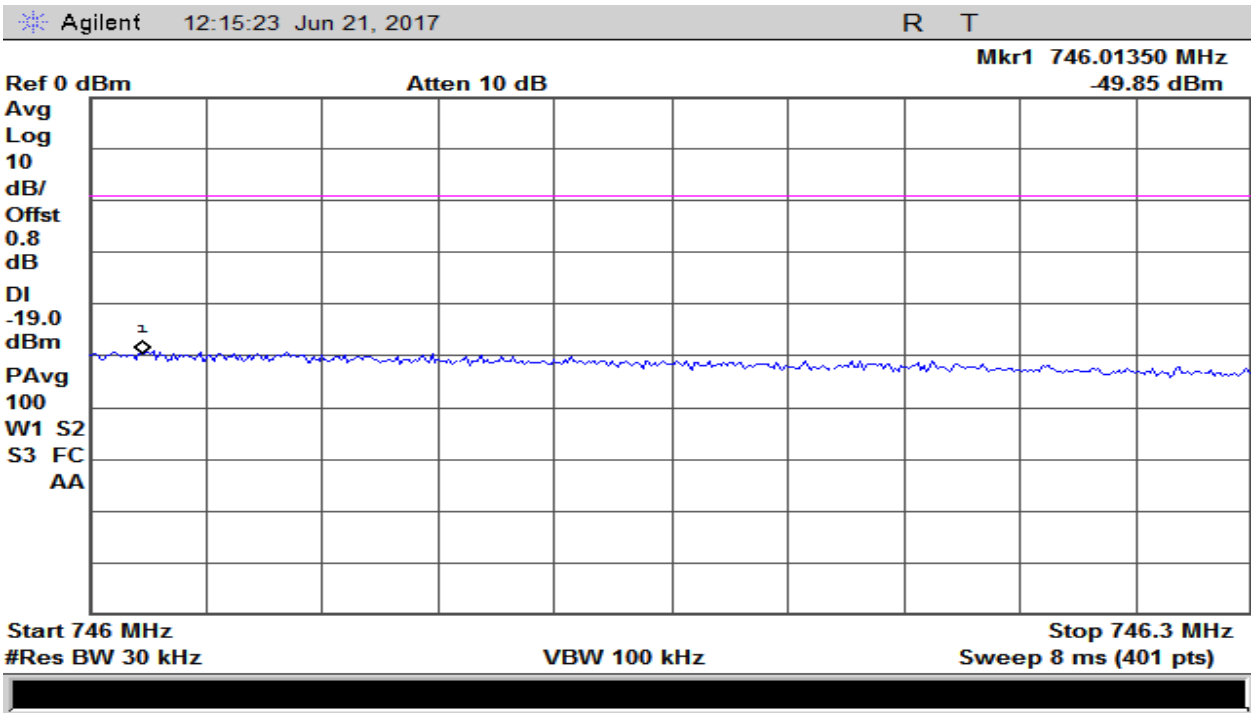
Plot 58 – 2110-2155MHz Band – GSM Downlink Lower Band Edge



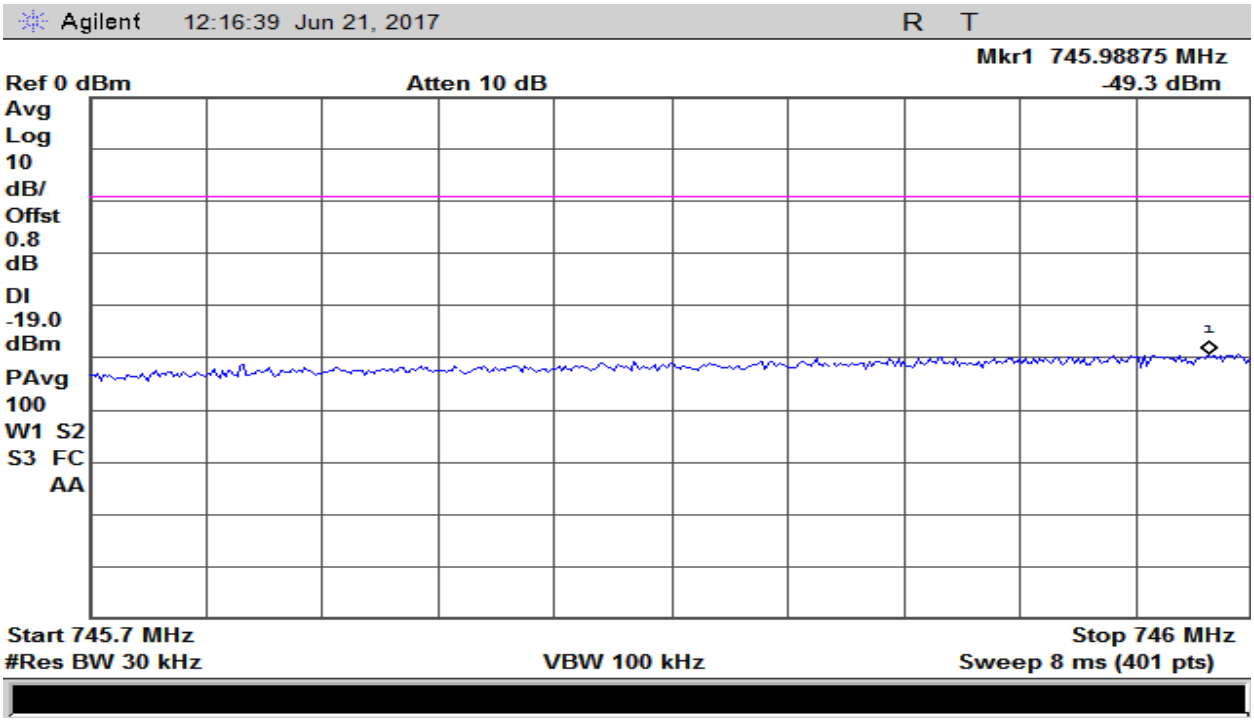
Plot 59 – 2110-2155MHz Band – GSM Downlink Upper Band Edge



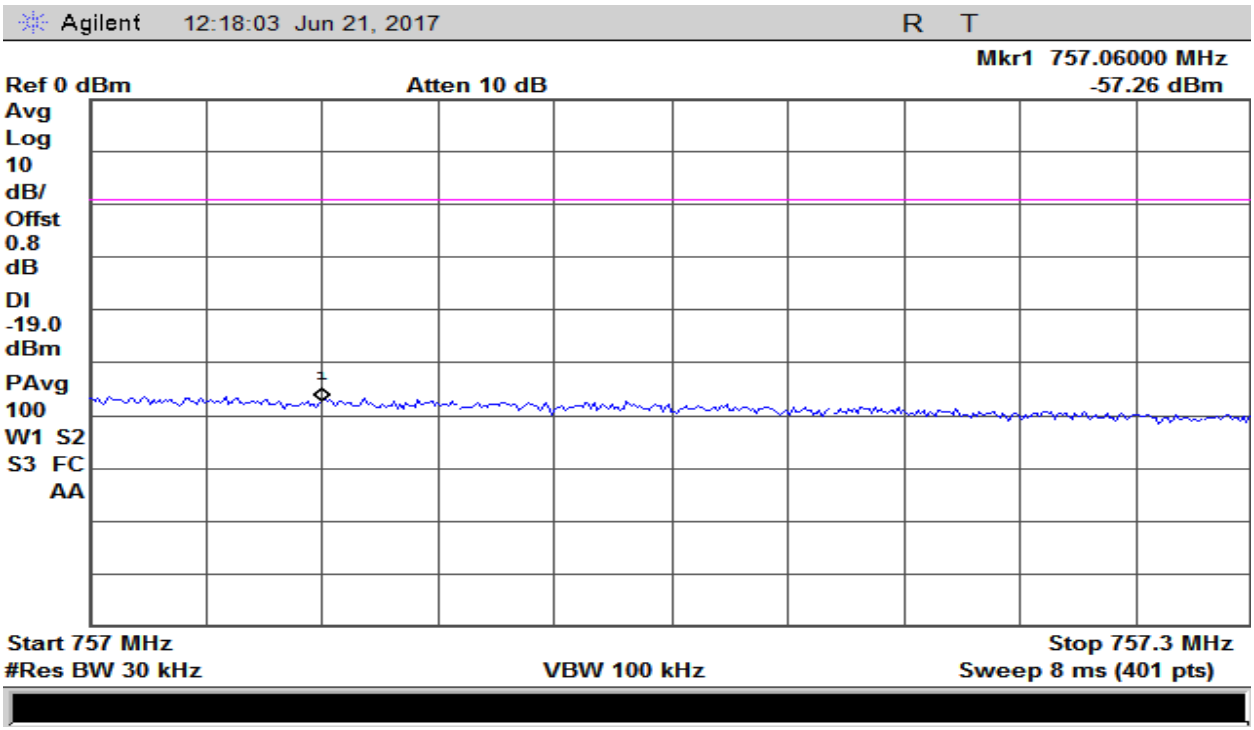
Plot 60 – 728-746MHz Band – CDMA Downlink Lower Band Edge



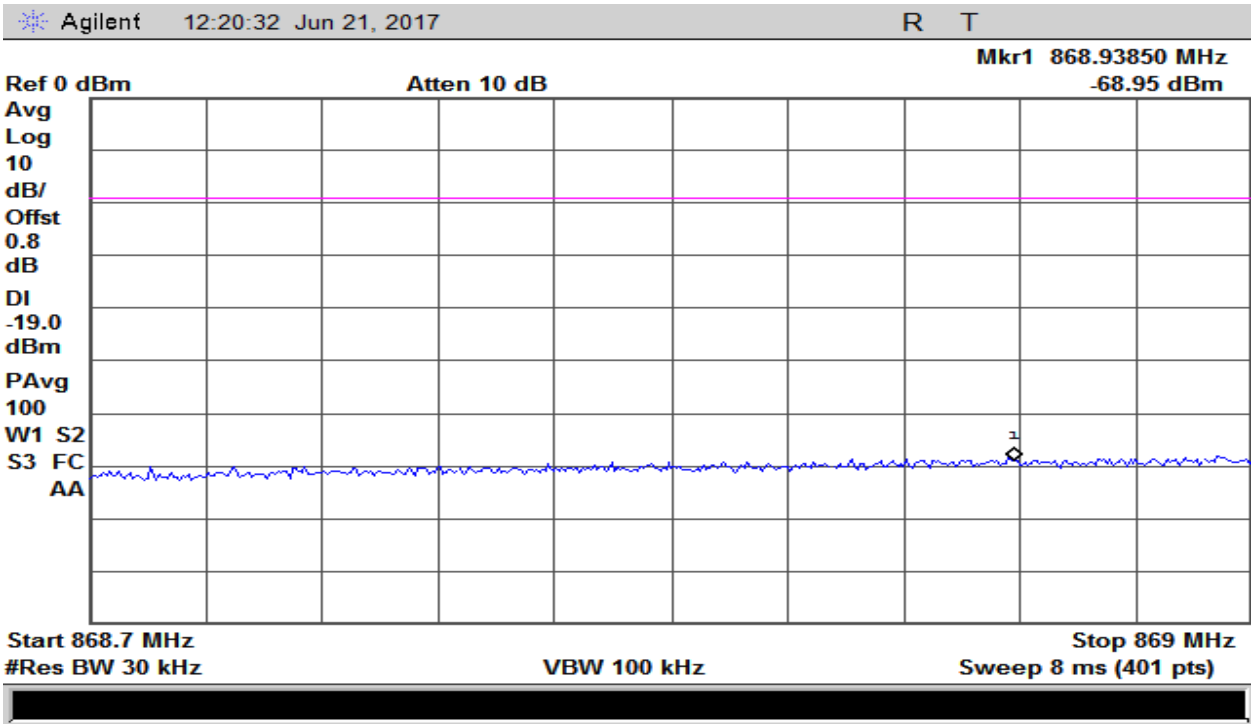
Plot 61 – 728-746MHz Band – CDMA Downlink Upper Band Edge



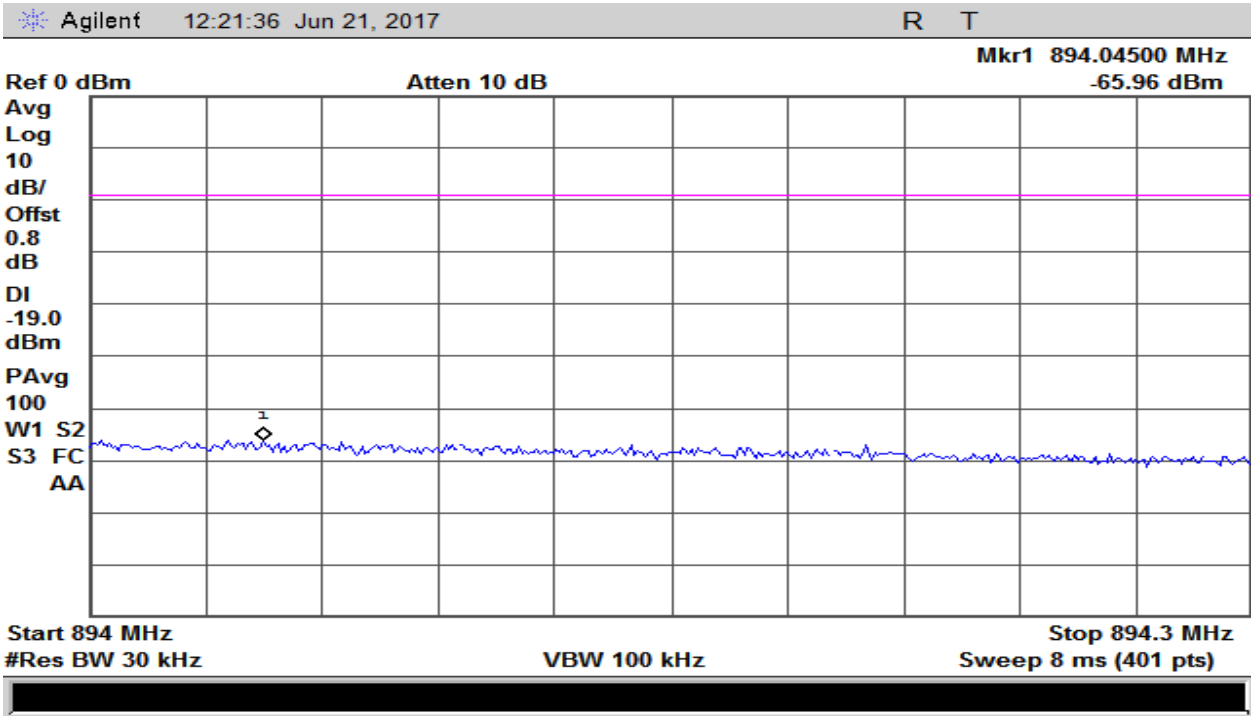
Plot 62 –746-757MHz Band – CDMA Downlink Lower Band Edge



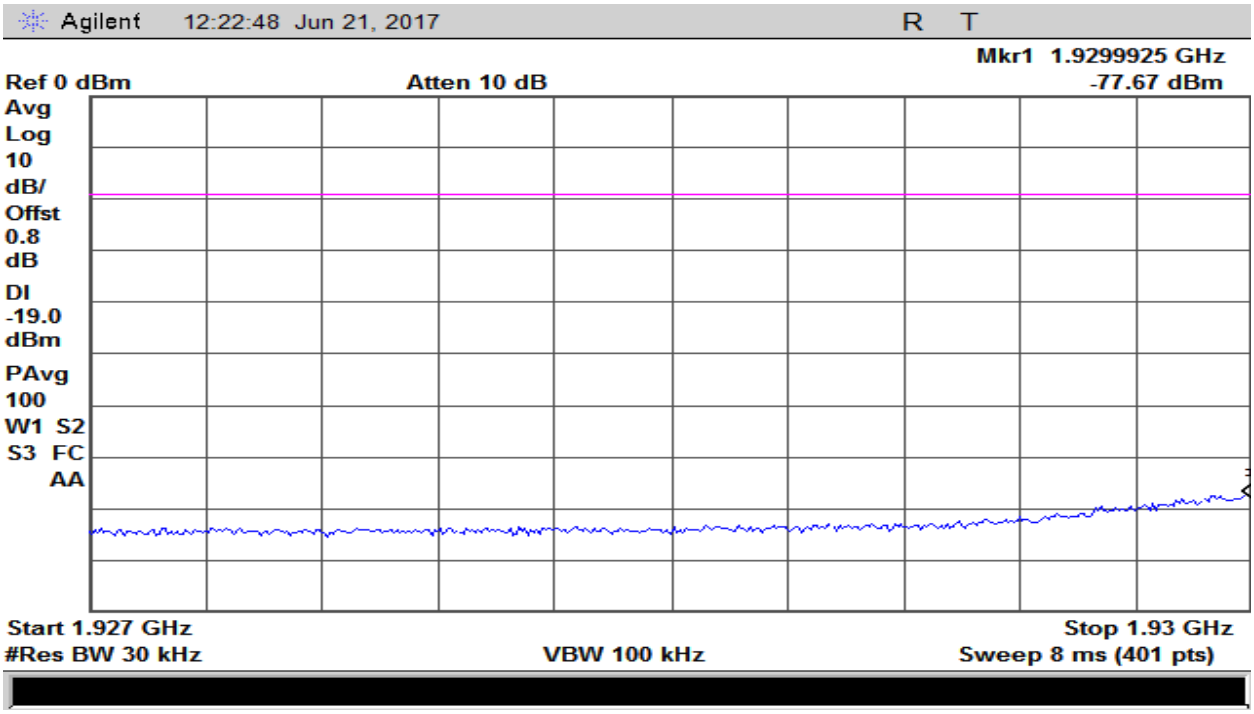
Plot 63 – 746-757MHz Band – CDMA Downlink Upper Band Edge



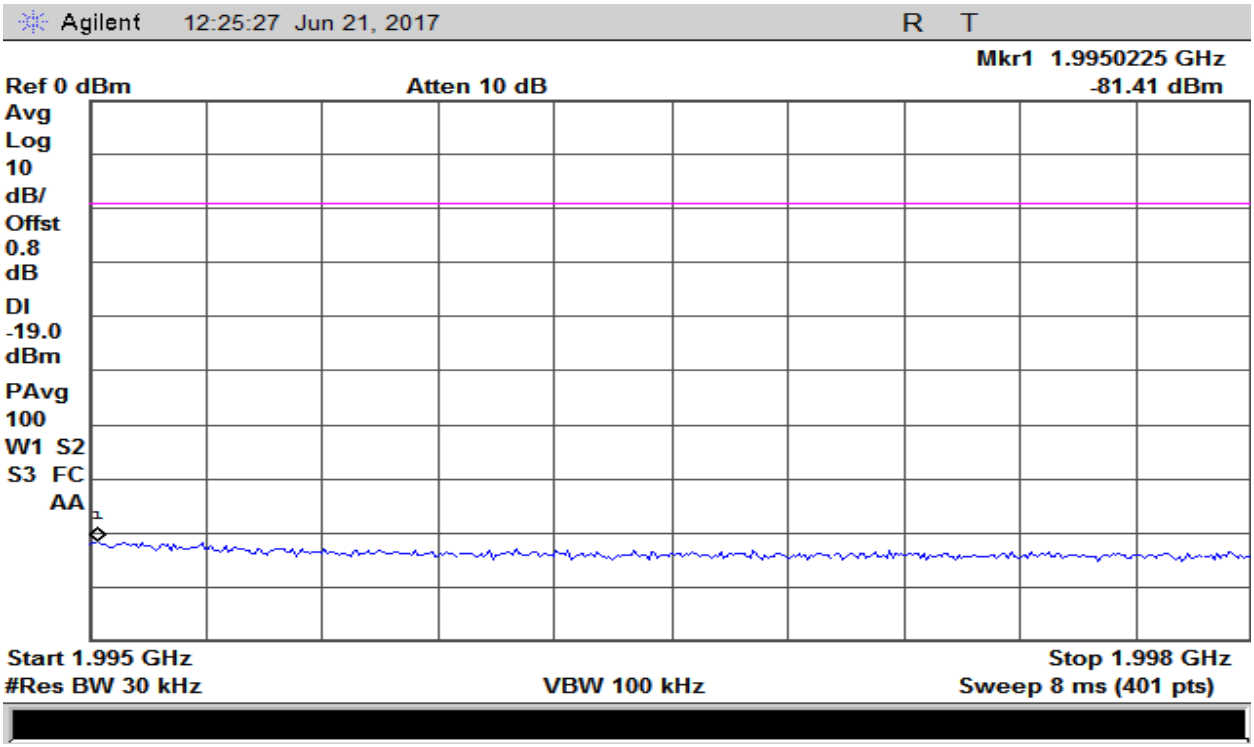
Plot 64 – 869-894MHz Band – CDMA Downlink Lower Band Edge



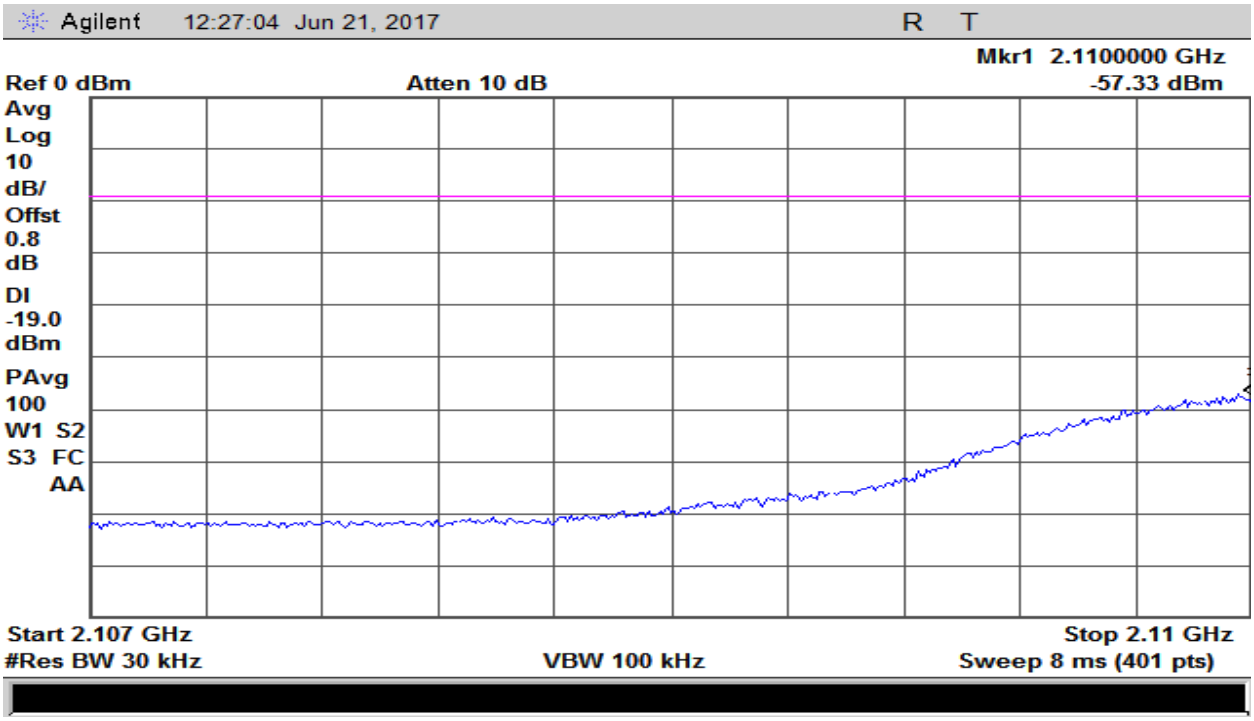
Plot 65 – 869-894MHz Band – CDMA Downlink Upper Band Edge



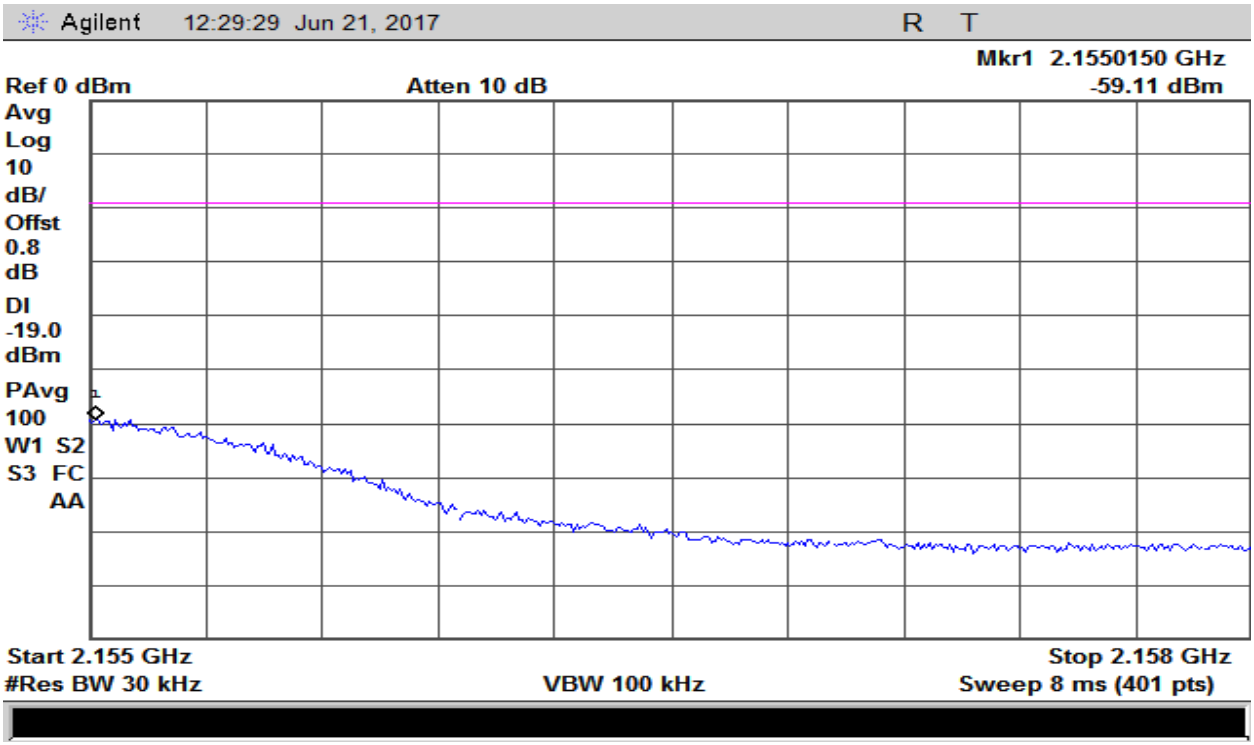
Plot 66 – 1930-1955MHz Band – CDMA Downlink Lower Band Edge



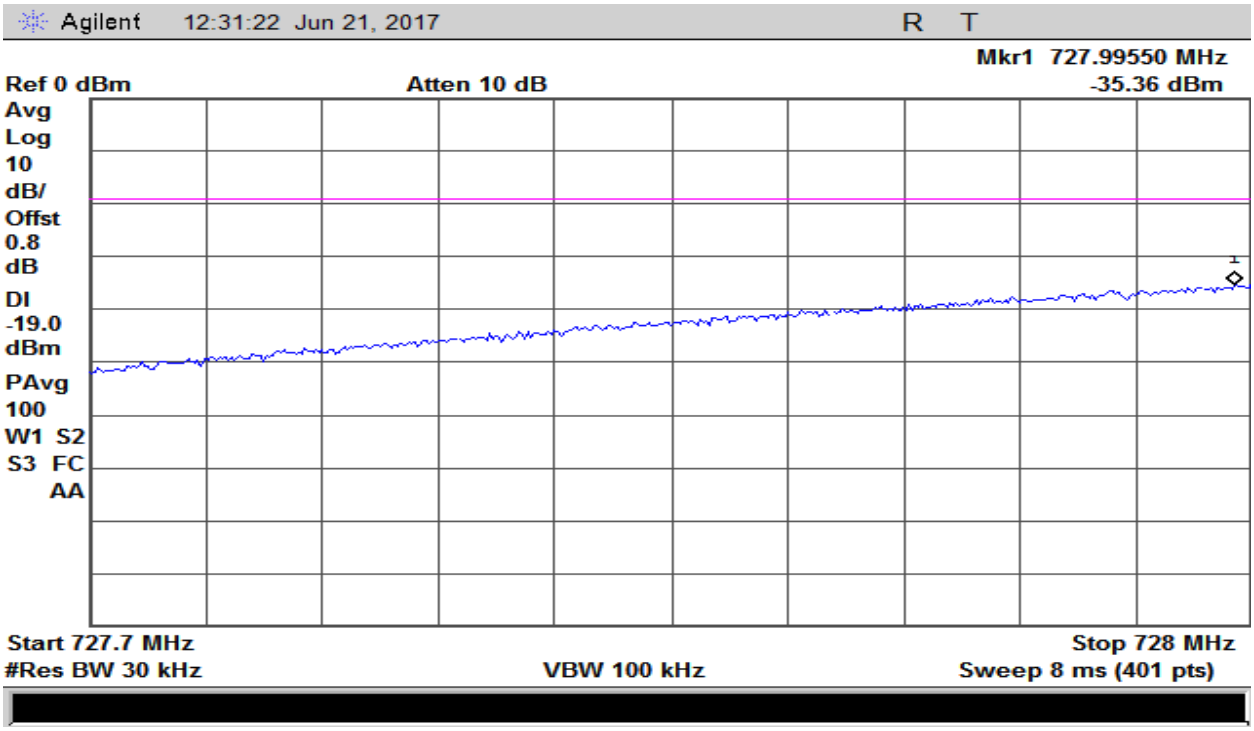
Plot 67 – 1930-1955MHz Band – CDMA Downlink Upper Band Edge



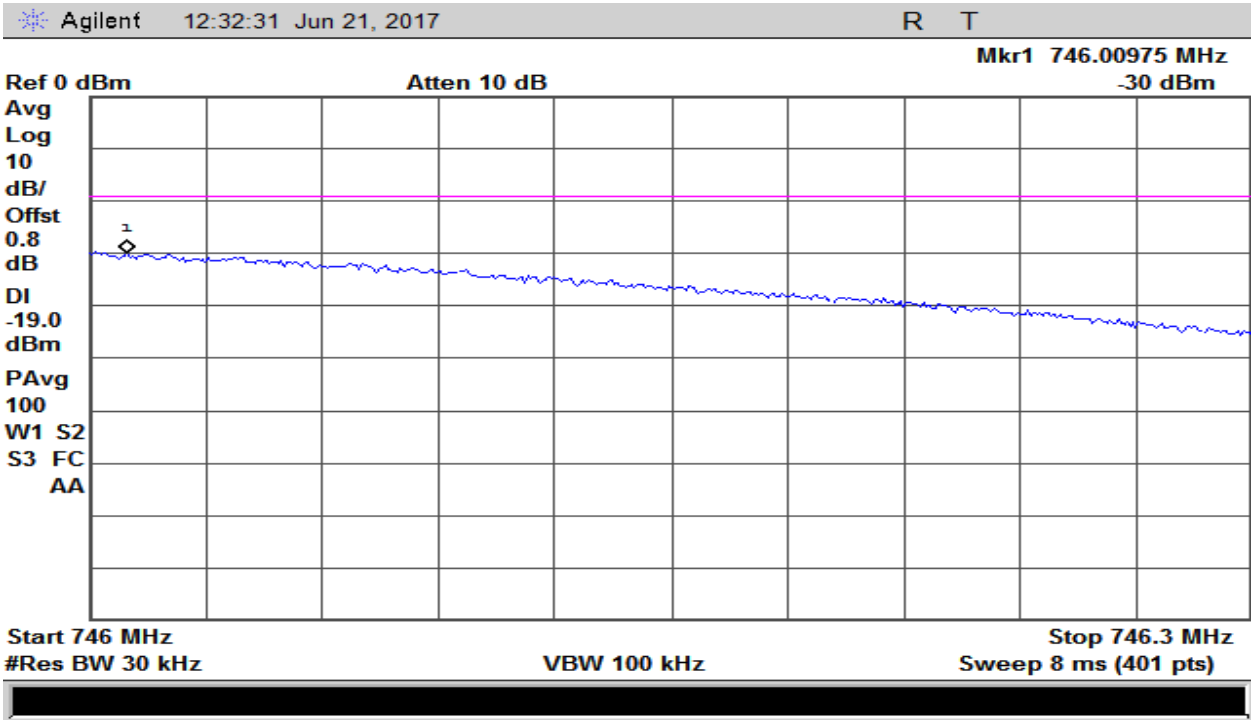
Plot 68 – 2110-2155MHz Band – CDMA Downlink Lower Band Edge



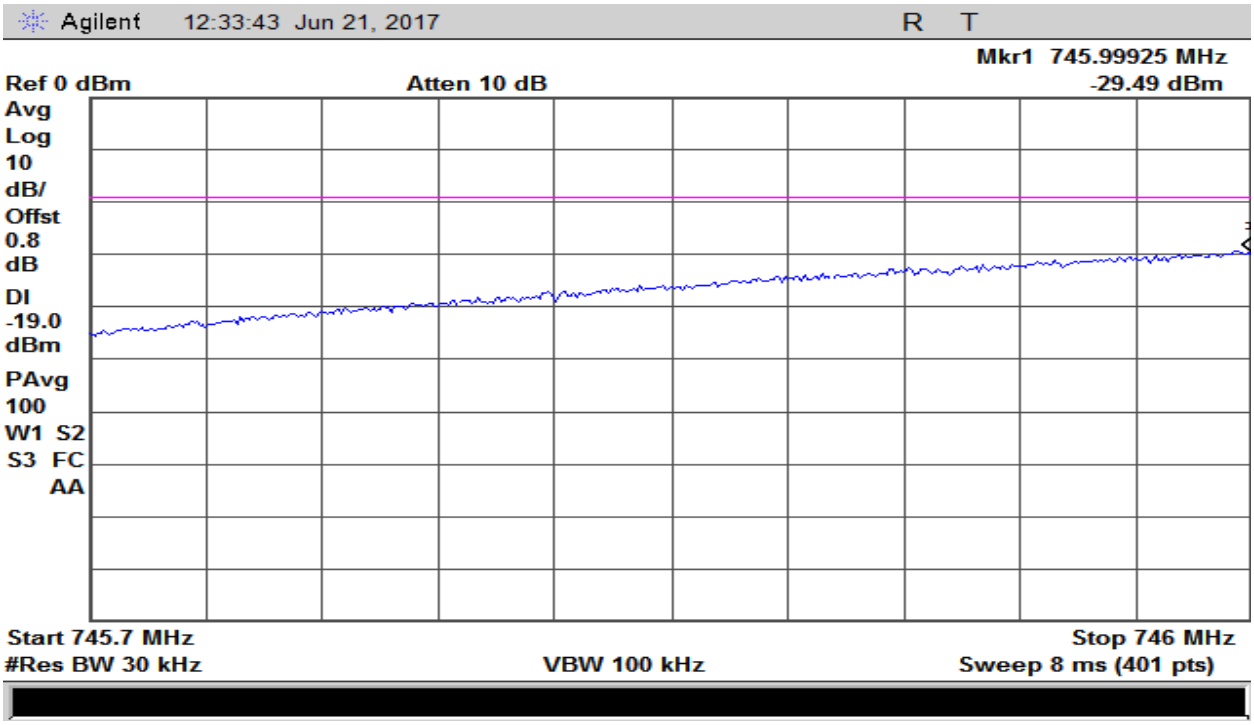
Plot 69 – 2110-2155MHz Band – CDMA Downlink Upper Band Edge



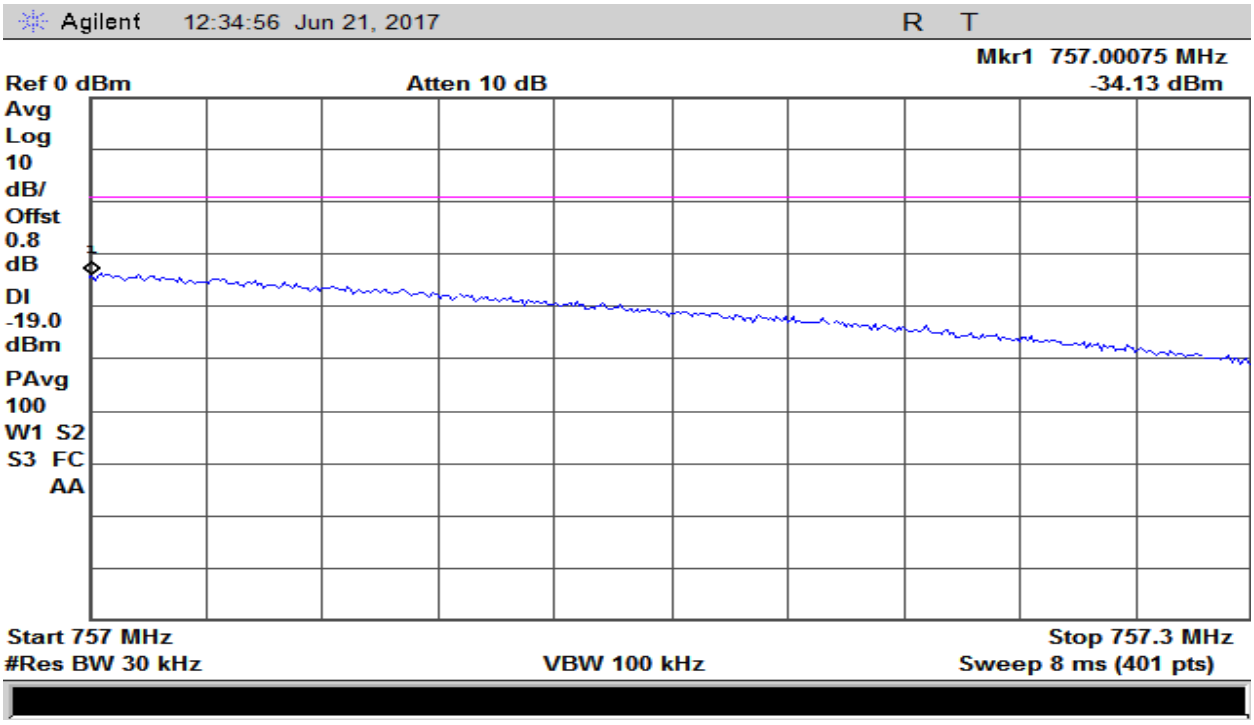
Plot 70 – 728-746MHz Band – LTE Downlink Lower Band Edge



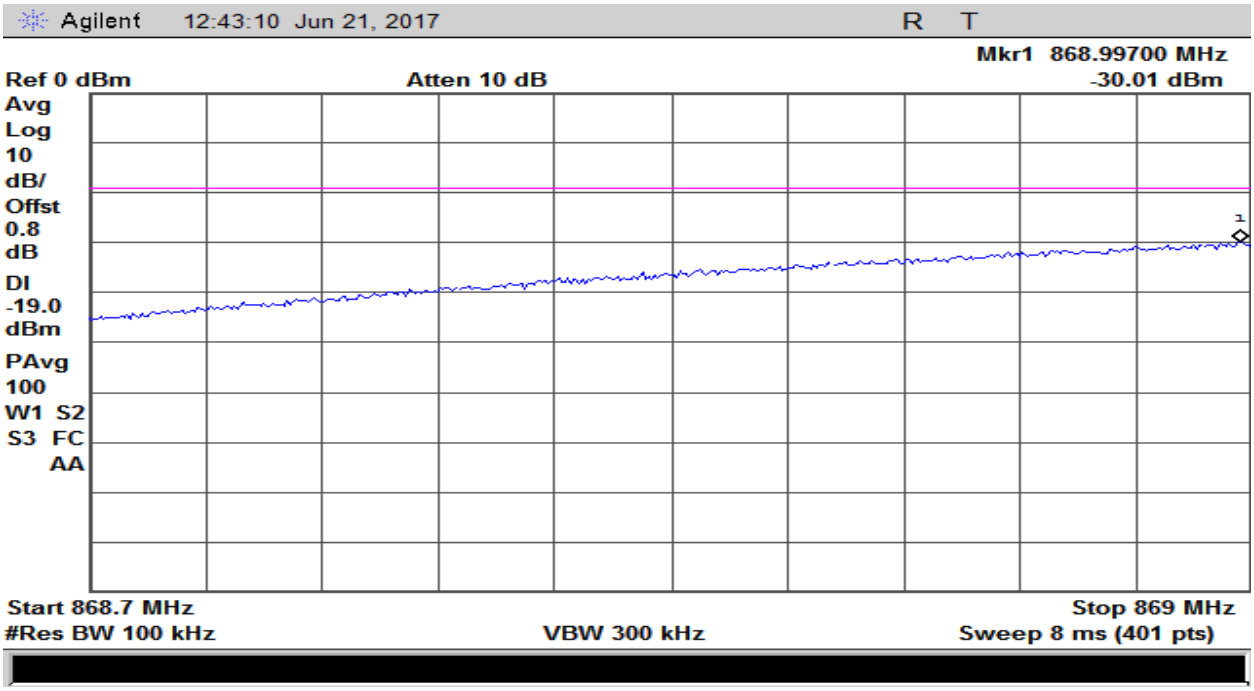
Plot 71 – 728-746MHz Band – LTE Downlink Upper Band Edge



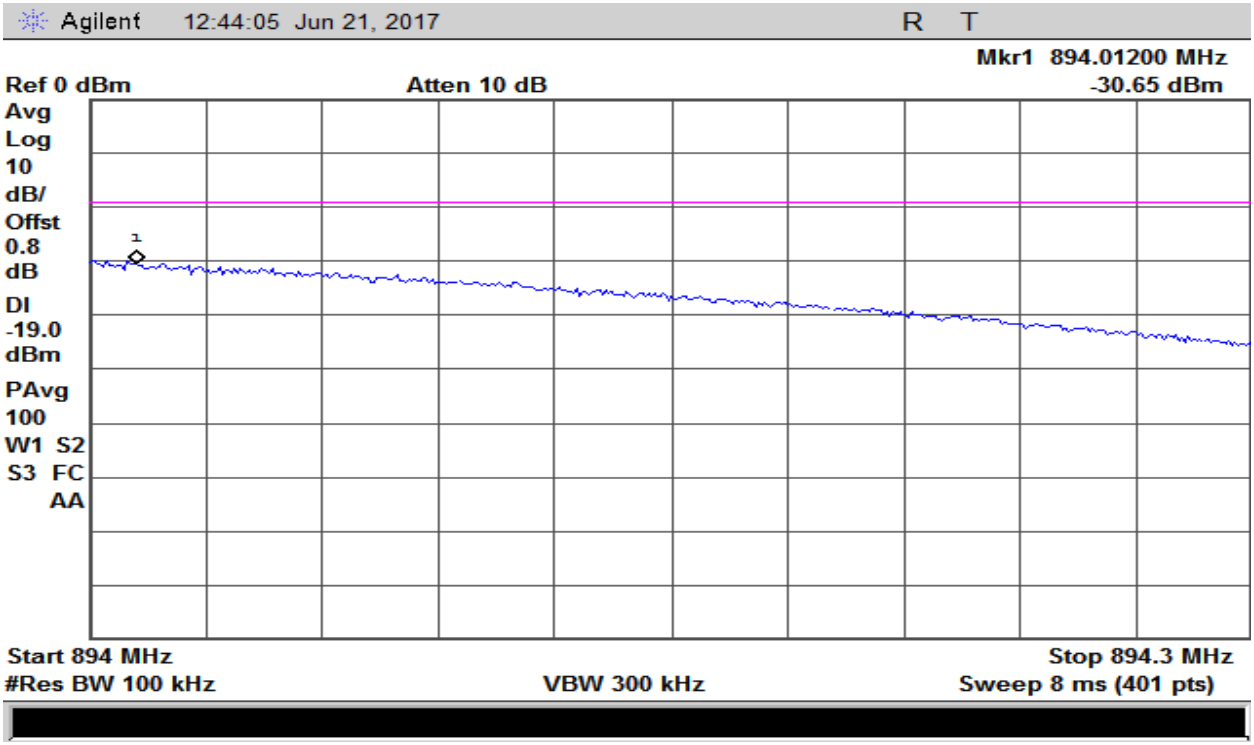
Plot 72 – 746-757MHz Band – LTE Downlink Lower Band Edge



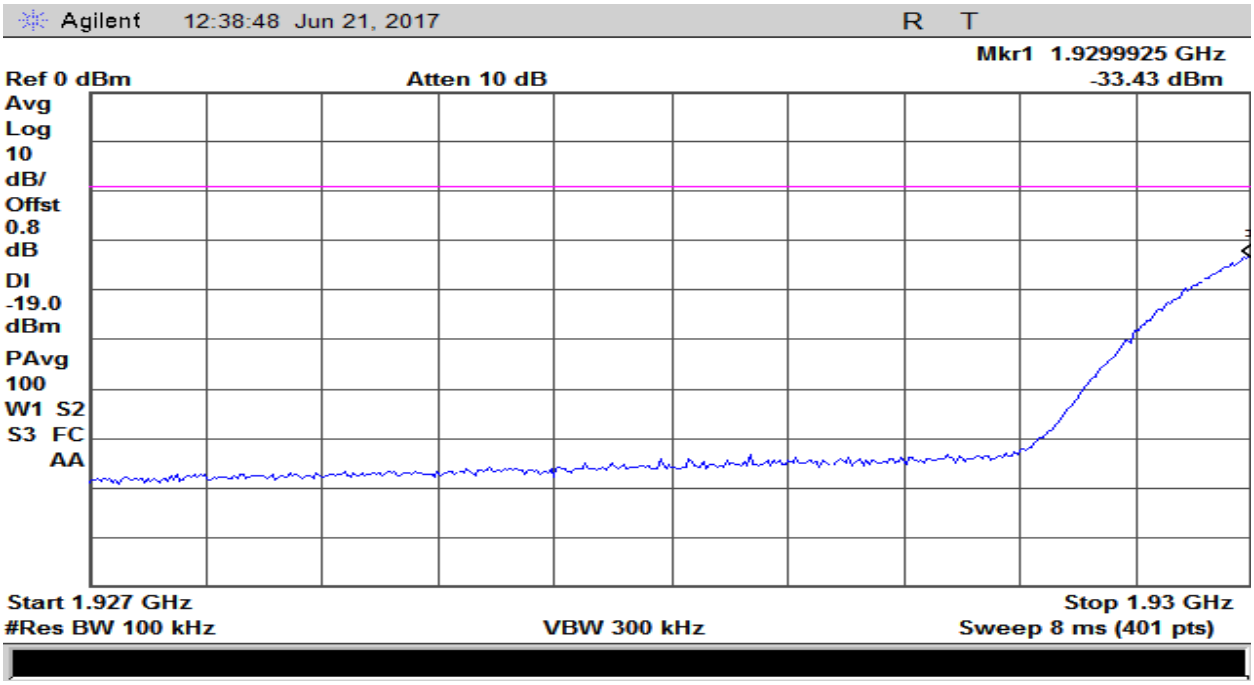
Plot 73 – 746-757MHz Band – LTE Downlink Upper Band Edge



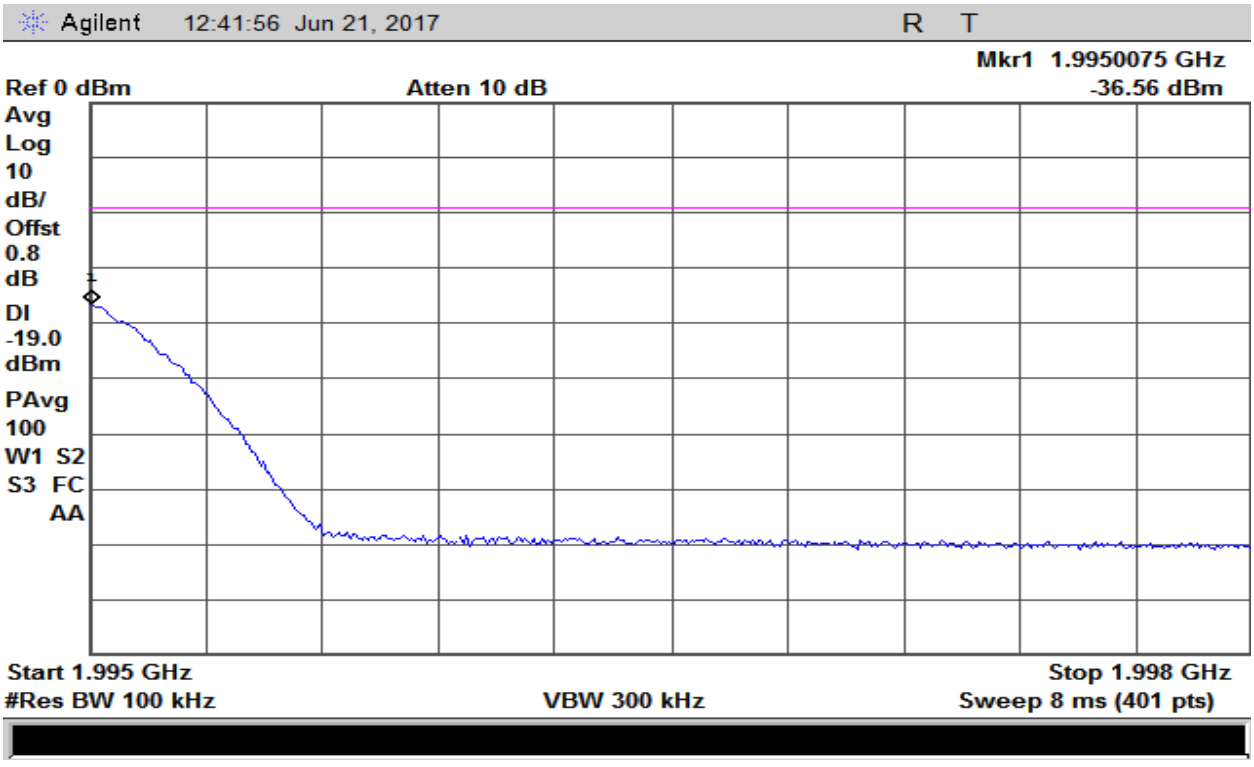
Plot 74 – 869-894MHz Band – LTE Downlink Lower Band Edge



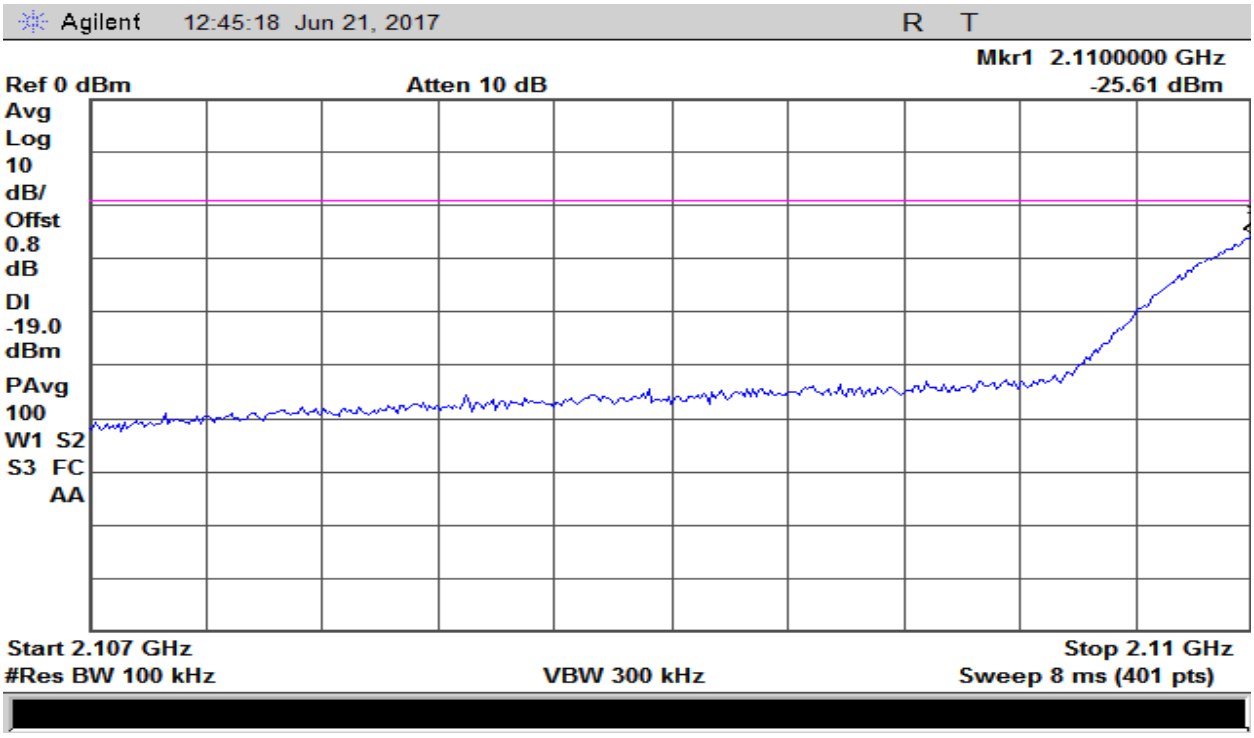
Plot 75 – 869-894MHz Band – LTE Downlink Upper Band Edge



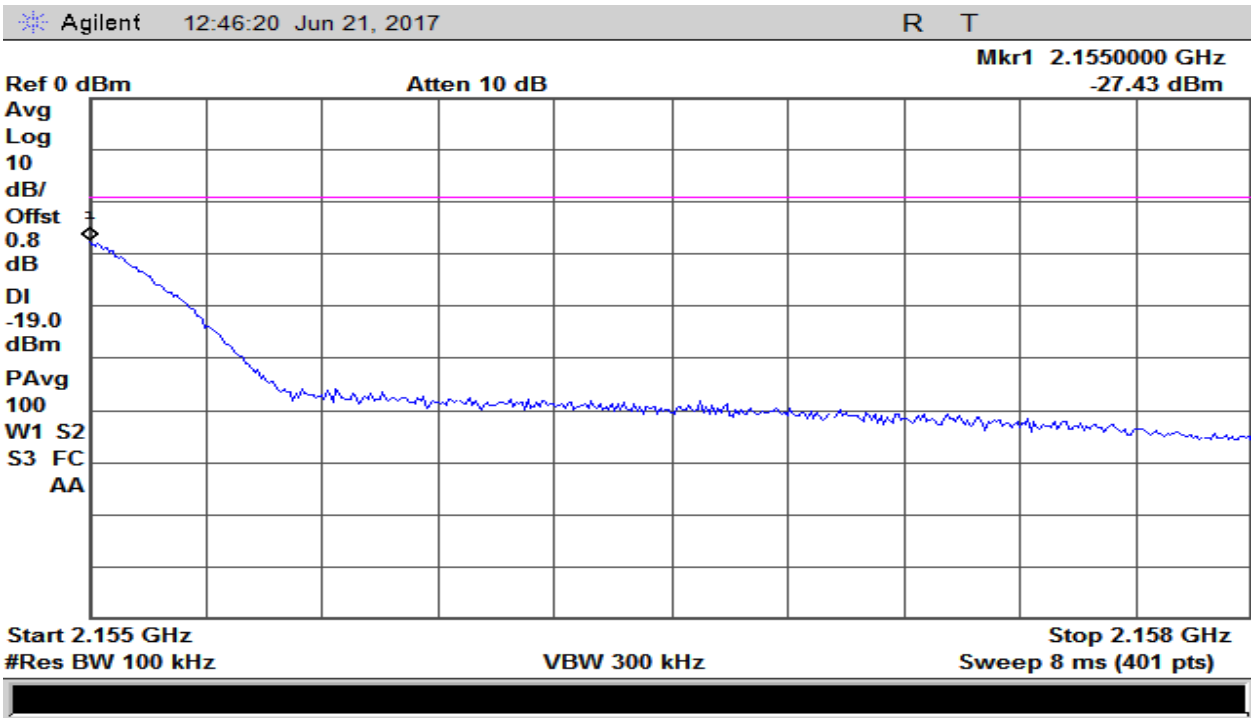
Plot 76 – 1930-1995MHz Band – LTE Downlink Lower Band Edge



Plot 77 – 1930-1995MHz Band – LTE Downlink Upper Band Edge



Plot 78 – 2110-2155MHz Band – LTE Downlink Lower Band Edge



Plot 79 – 2110-2155MHz Band – LTE Downlink Upper Band Edge

5. Conducted Spurious Emissions

Test Requirement(s):	§2.1051	**Test Engineer(s):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	Jun/21/2017

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
698-716	6825	-26.33	-13	-13.33
776-787	775	-22.38	-13	-9.38
824-849	7831	-28.33	-13	-15.33
1710-1755	6940	-25.67	-13	-12.67
1850-1915	19830	-24.17	-13	-11.17

Table 13 – Conducted Spurious Emission Data – Uplink Summary

Frequency Band (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin
728-746	6848	-55.83	-13	-42.83
746-757	745	-50.11	-13	-37.11
869-894	6740	-57.5	-13	-44.5
1930-1995	19970	-55.5	-13	-42.5
2110-2155	21480	-54.50	-13	-41.5

Table 14 – Conducted Spurious Emission Data – Downlink Summary

Per FCC § 27.53 (C) for frequency operating in 746 – 758MHz and 776-788MHz band following additional requirements apply

As per § 27.53 (C)(4) On all frequencies between 763-775MHz and 793-895MHz, by a factor not less than 65 + 10log (P) dB in a 6.25kHz band segment, for mobile and portable stations.

BW correction for 6.25kHz to 10kHz RBW is following

BW correction factor = 10log B1/B2

Therefore BW correction factor = 10log 6.25/10 = -2.04

Frequency Range (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	RBW correction Factor (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
763-775	774.94	-43.0	-2.04	-45.04	-35	-10.04
793-805	794.59	-65.9	-2.04	-67.94	-35	-32.94

Table 15 – Conducted Spurious Emission Data – 776-787MHz Uplink Band Summary

Frequency Range (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	RBW correction Factor (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
763-775	769.24	-73.3	-2.04	-75.3	-35	-40.3
793-805	802.27	-73.2	-2.04	-75.24	-35	-40.24

Table 16 – Conducted Spurious Emission Data – 746-757MHz Downlink Band Summary

Per FCC § 27.53 (f) for frequency operating in 746 – 763MHz and 775-793MHz emissions in the band 1559-1610MHz shall be limited to -70dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80dBW EIRP for discrete emissions of less than 700Hz bandwidth.

Since the limit is in EIRP, the MSCL (Cable Loss) information supplied by manufacturer is added along with the bandwidth correction factor.

BW correction for 700Hz to 10kHz RBW is following

BW correction factor = 10log B1/B2

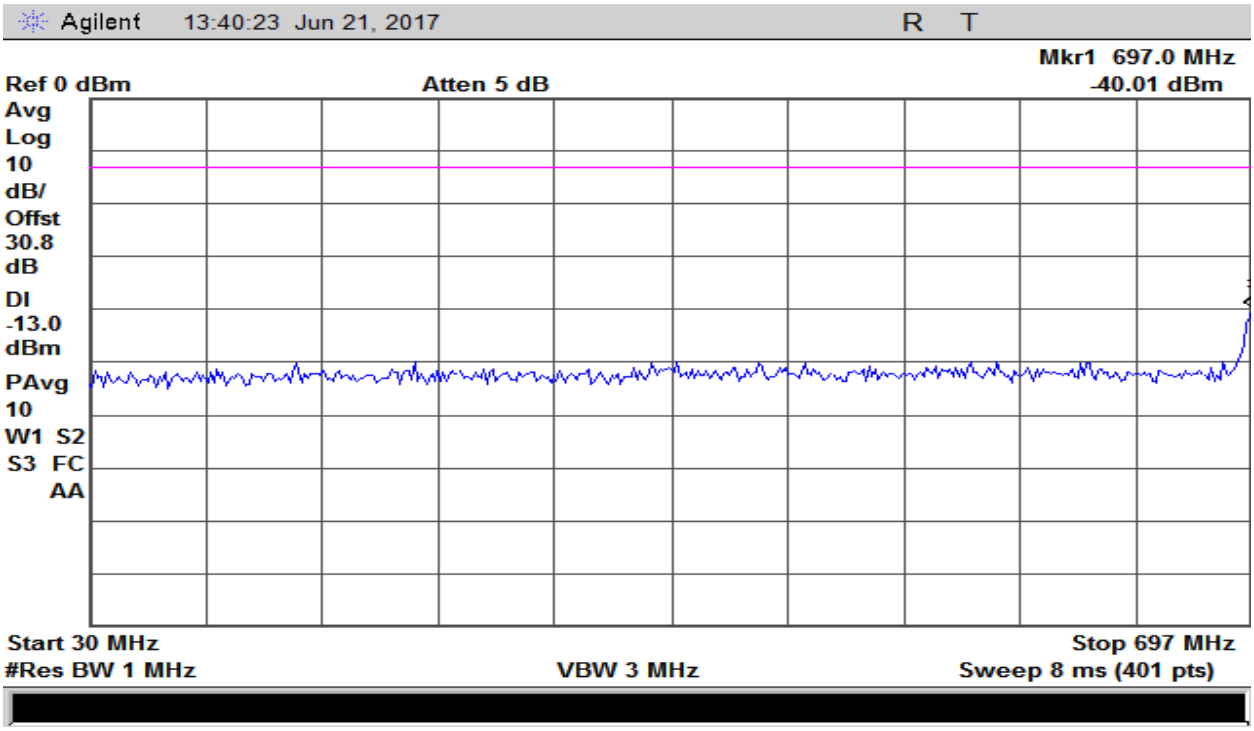
Therefore BW correction factor = 10log 700/1000 = -11.55

Frequency Range (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	RBW correction Factor (dB)	Gain/Loss (dB) from Antenna Kitting Info (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
1559-1610 (Wideband)	1565.76	-71.64	0	10	-61.64	-40	-21.64
1559-1610 (Narrowband)	1567.29	-52.08	-11.55	10	-53.63	-50	-3.63

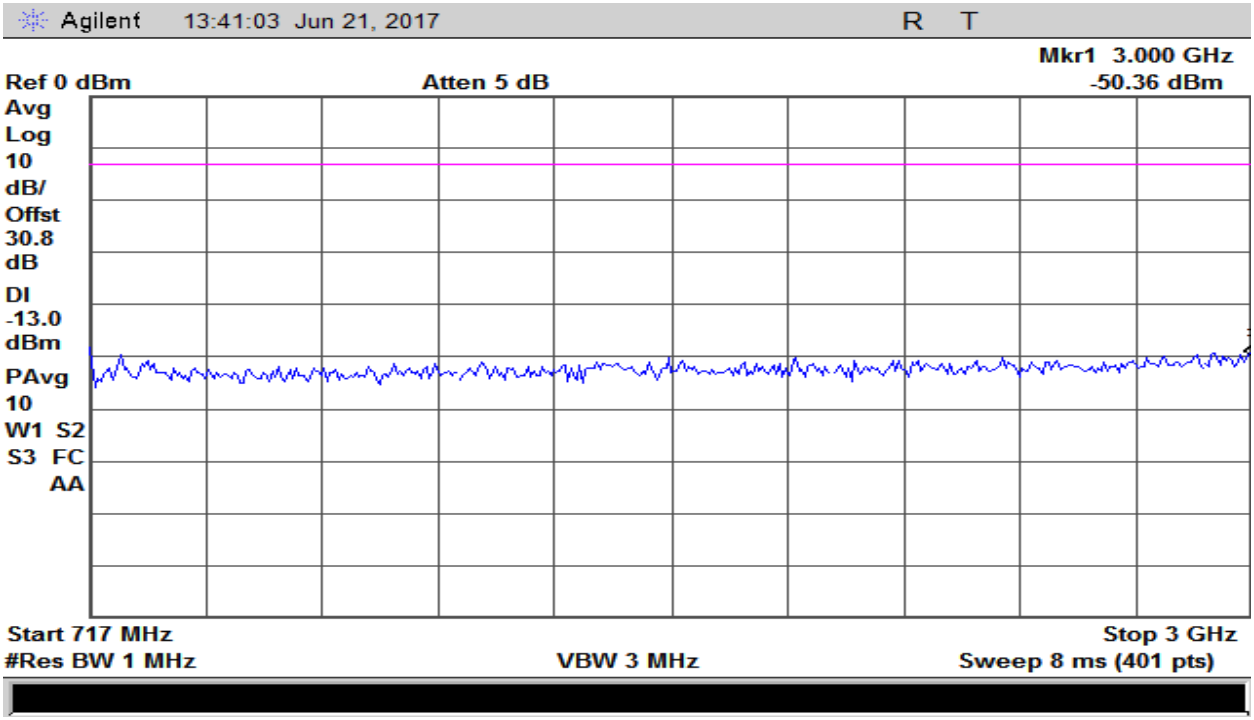
Table 17 – Conducted Spurious Emission Data – 776-787MHz Uplink Band Summary

Frequency Range (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	RBW correction Factor (dB)	MSCL (dB)	Corrected Level (dBm)	Limit (dBm)	Margin (dB)
1559-1610 (Wideband)	1562.44	-72.64	0	0	-72.64	-40	-32.64
1559-1610 (Narrowband)	1579.15	-53.54	-11.55	0	-65.09	-50	-15.09

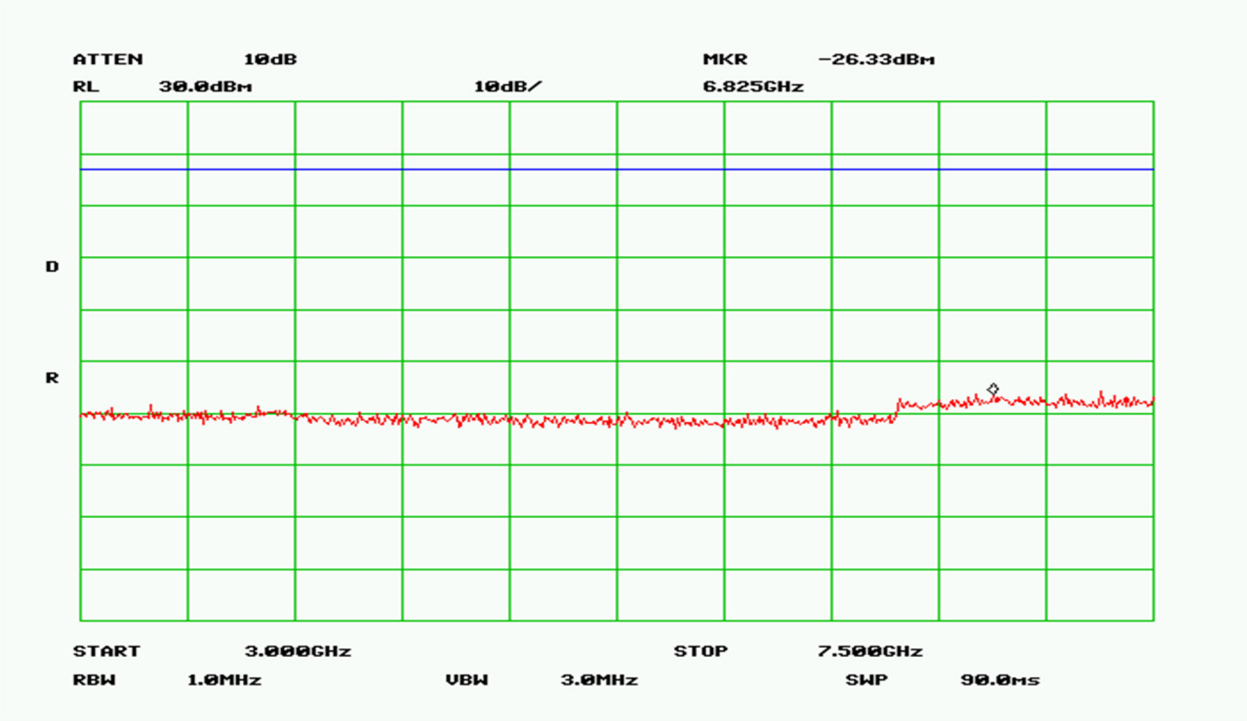
Table 18 – Conducted Spurious Emission Data – 746-757MHz Downlink Band Summary



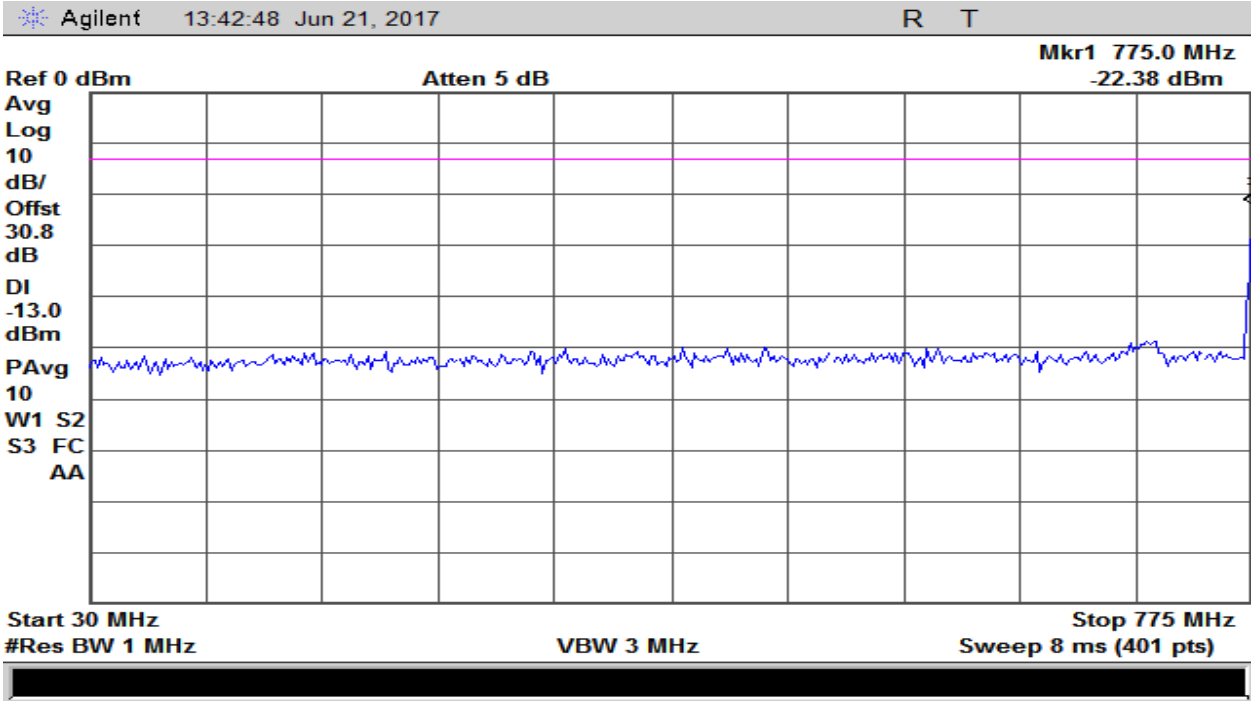
Plot 80 – 698-716MHz Band – Uplink



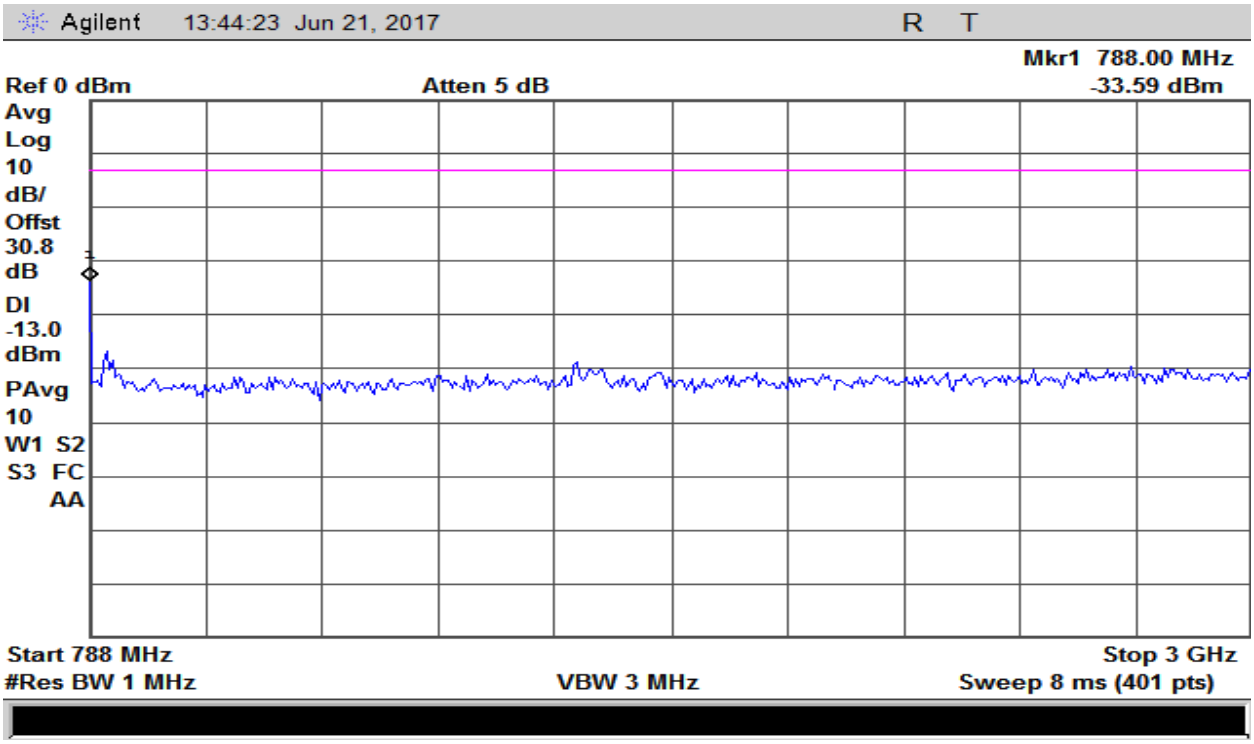
Plot 81 - 698-716MHz Band – Uplink



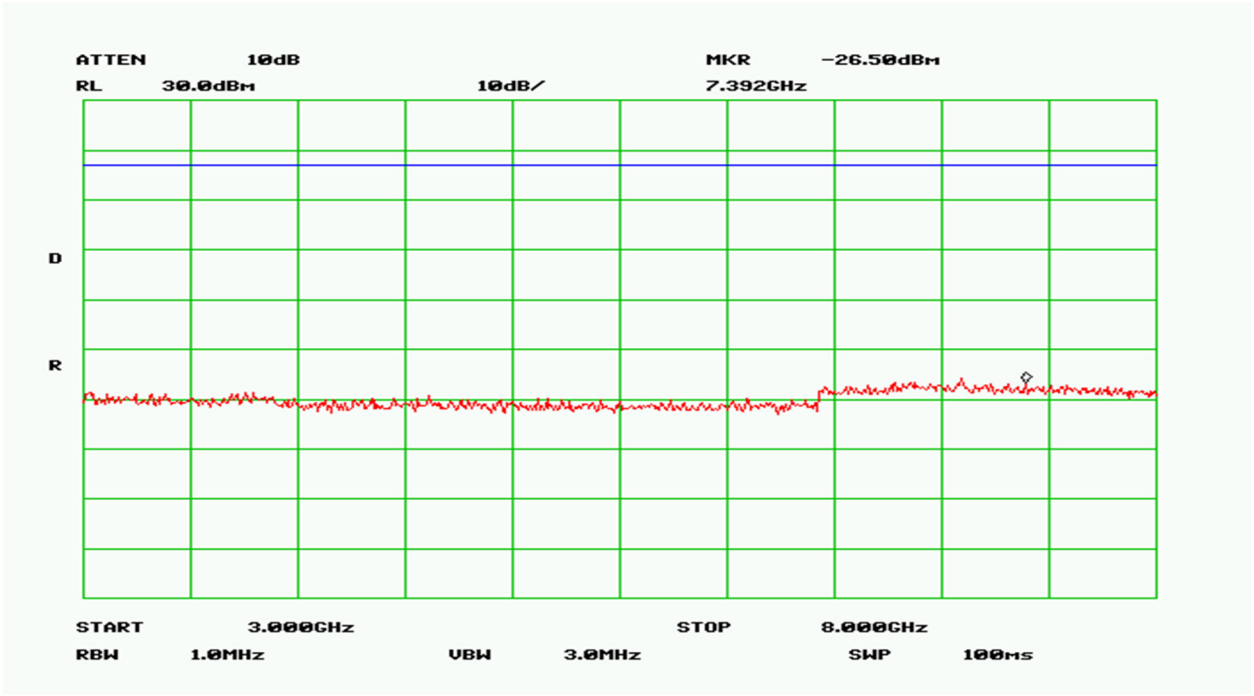
Plot 82 – 698-716MHz Band – Uplink



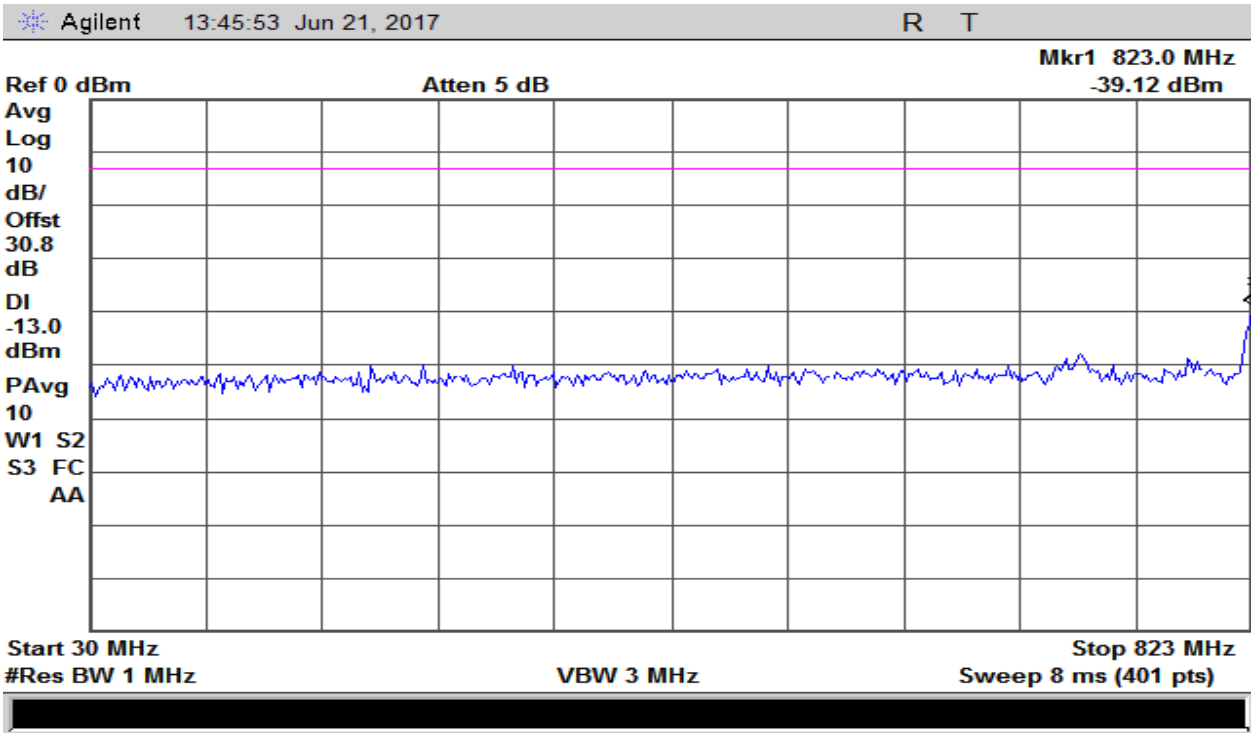
Plot 83 – 776-787MHz Band – Uplink



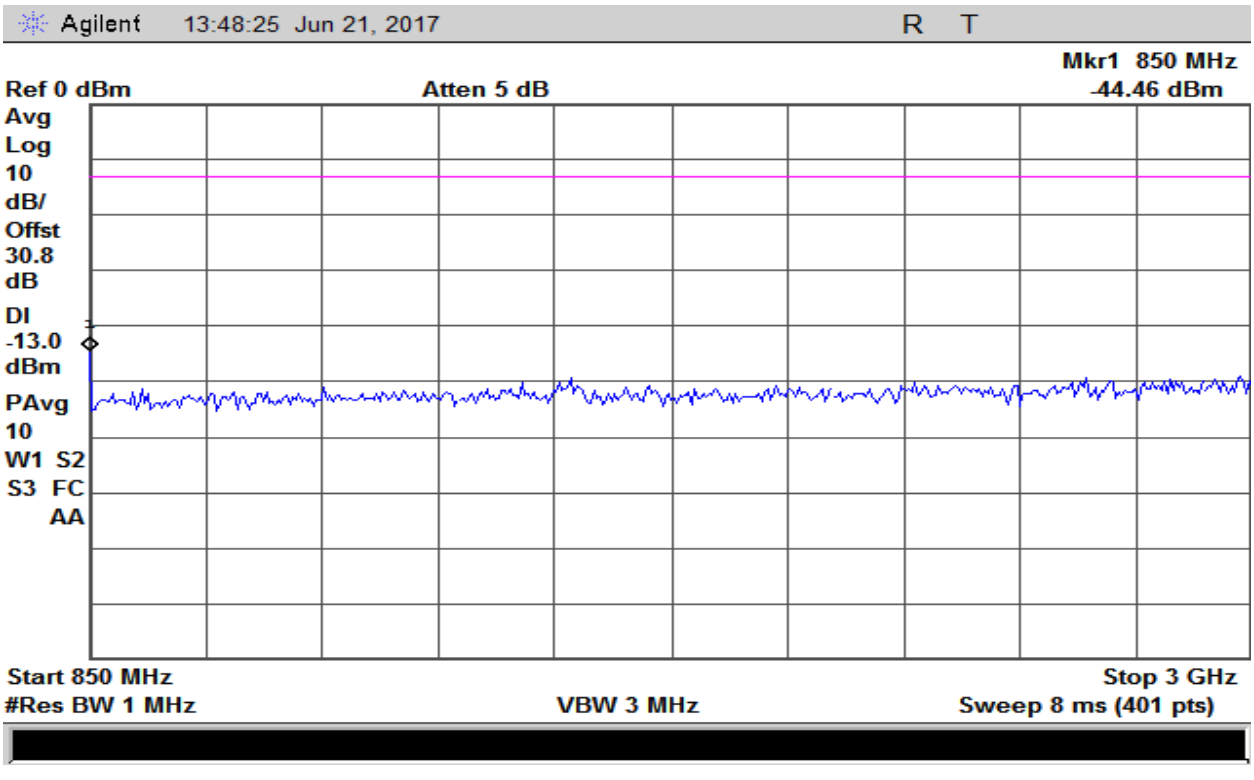
Plot 84 – 776-787MHz Band – Uplink



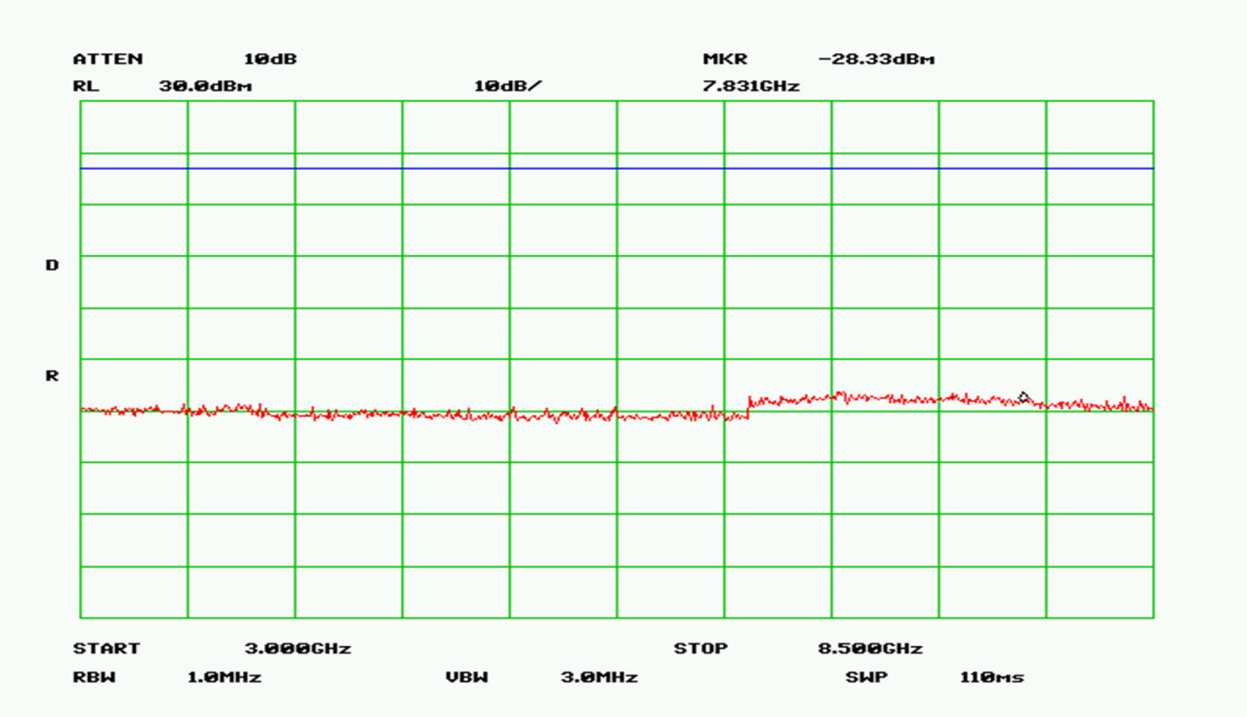
Plot 85 – 776-787MHz Band – Uplink



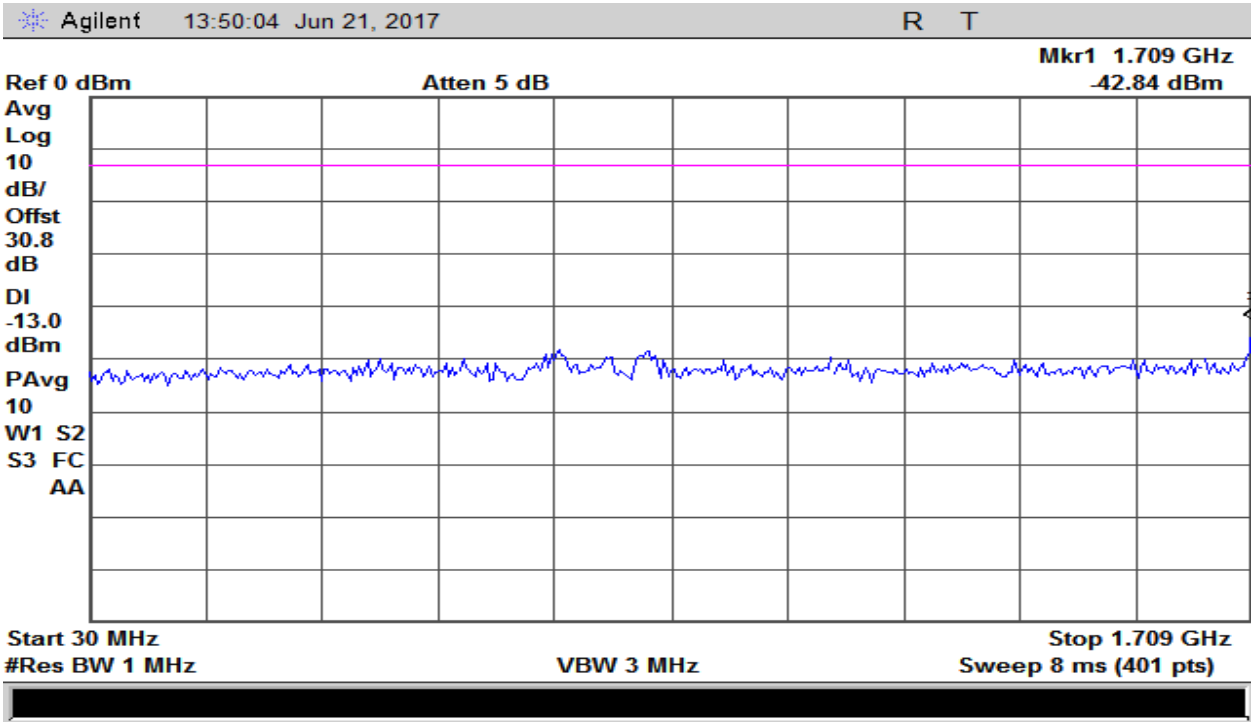
Plot 86 – 824-849MHz Band – Uplink



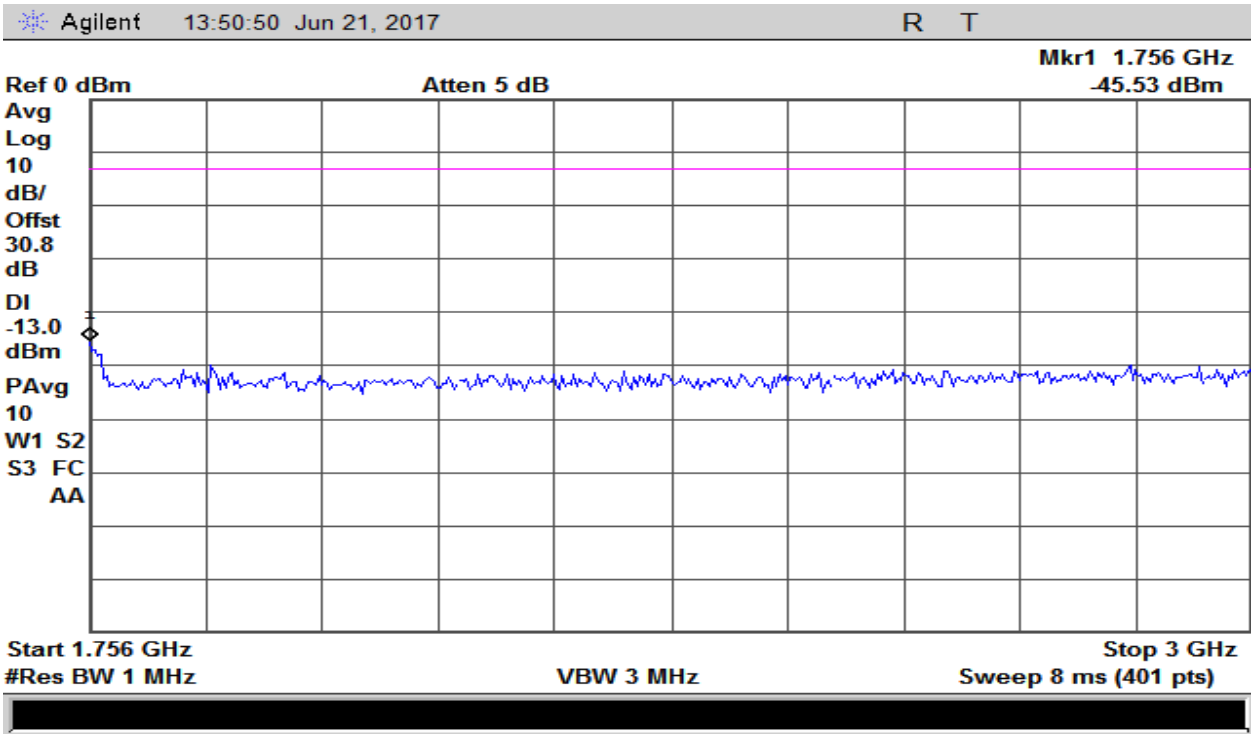
Plot 87 – 824-849MHz Band –Uplink



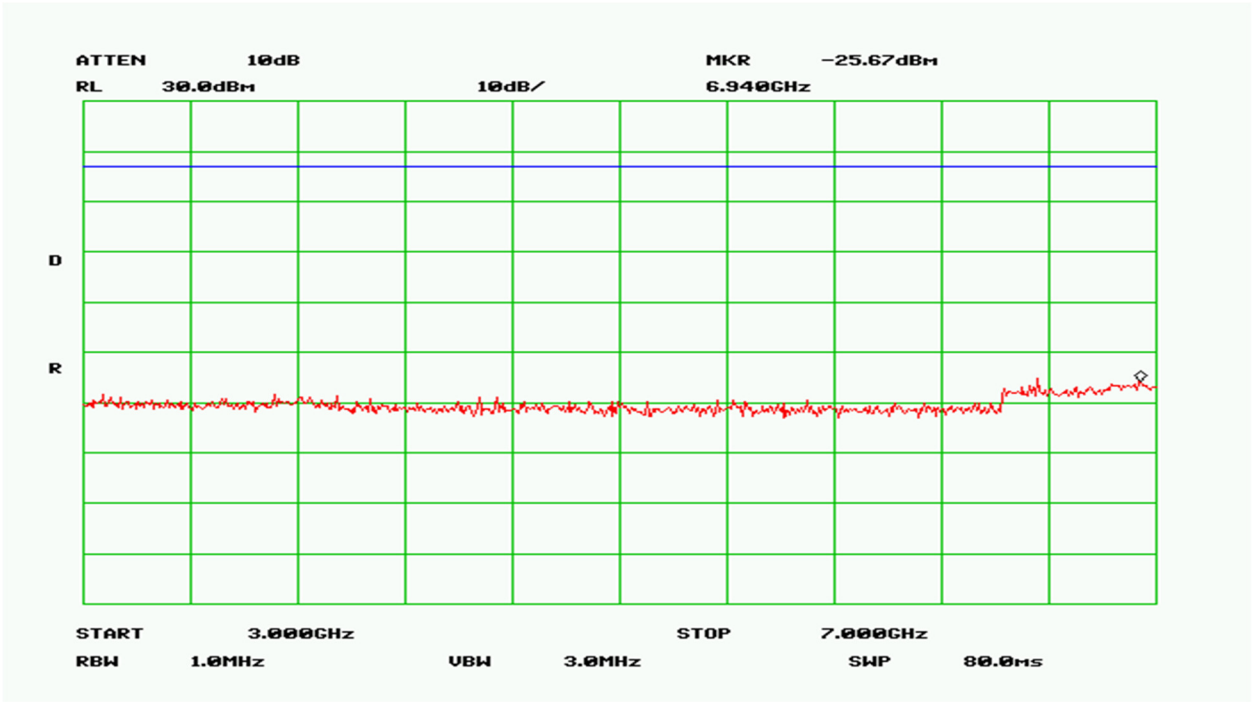
Plot 88 - 824-849MHz Band – Uplink



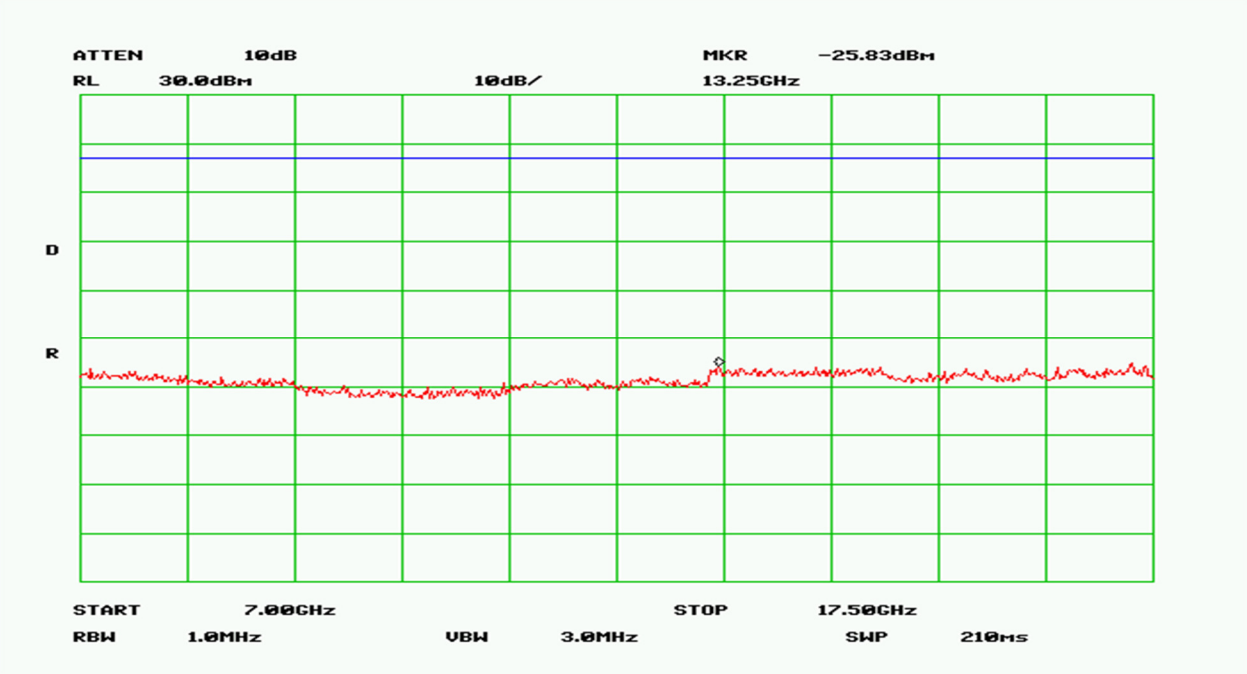
Plot 89 – 1710-1755MHz Band – Uplink



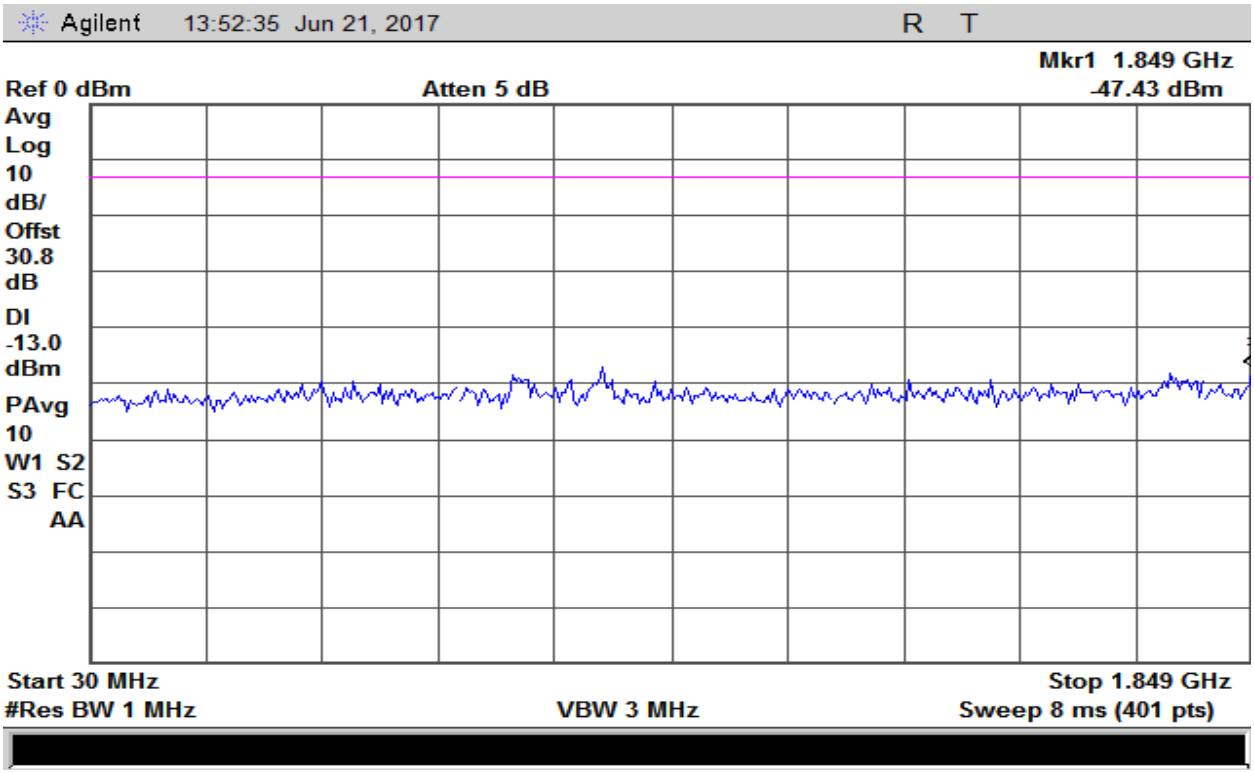
Plot 90 – 1710-1755MHz Band – Uplink



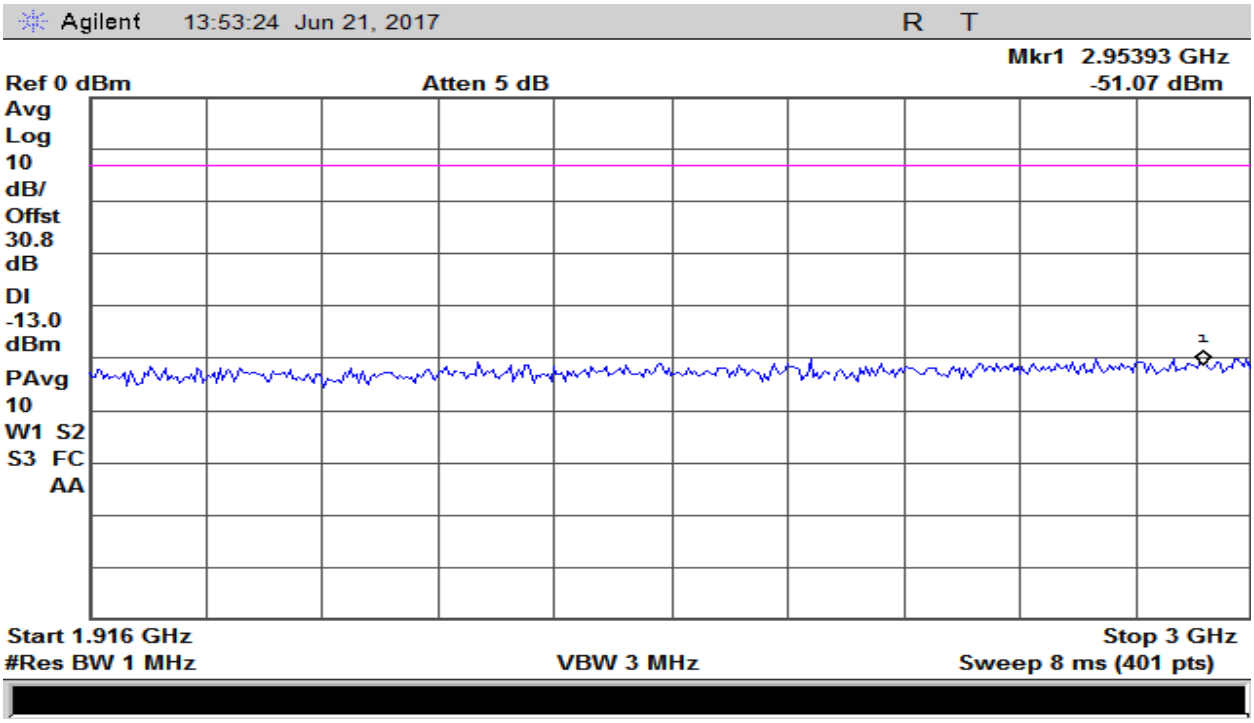
Plot 91 - 1710-1755MHz Band – Uplink



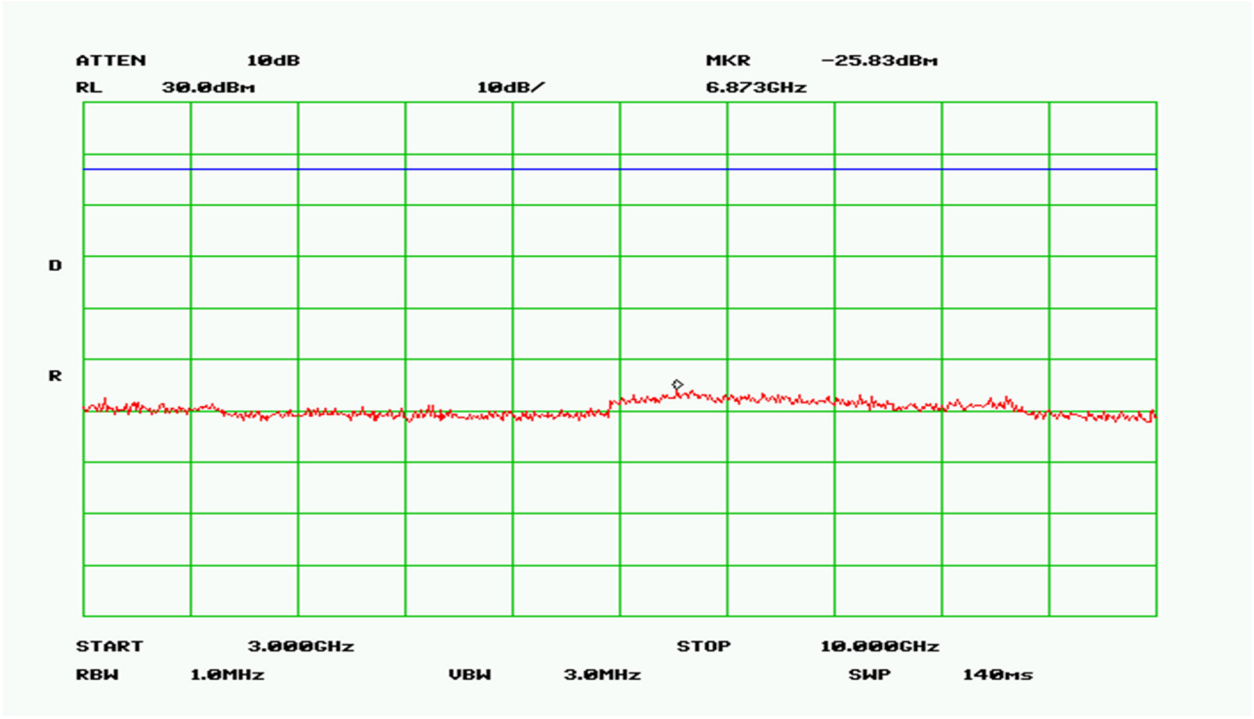
Plot 92 - 1710-1755MHz Band – Uplink



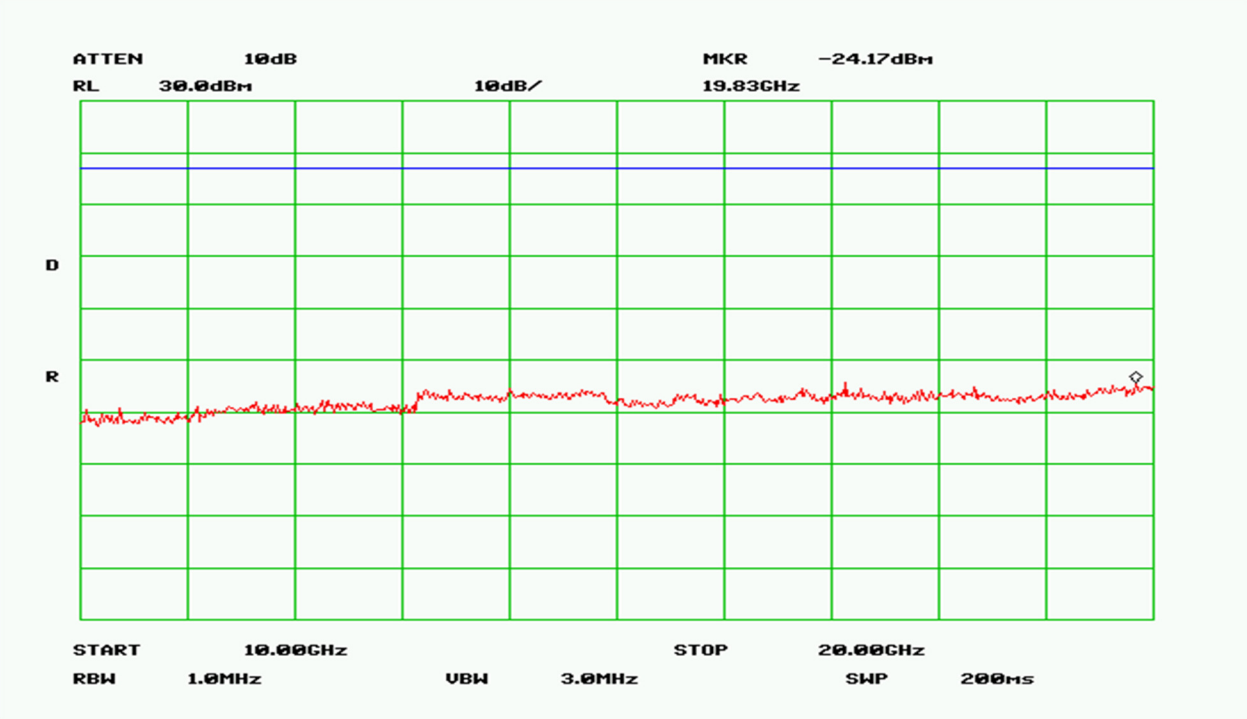
Plot 93 – 1850-1915MHz Band – Uplink



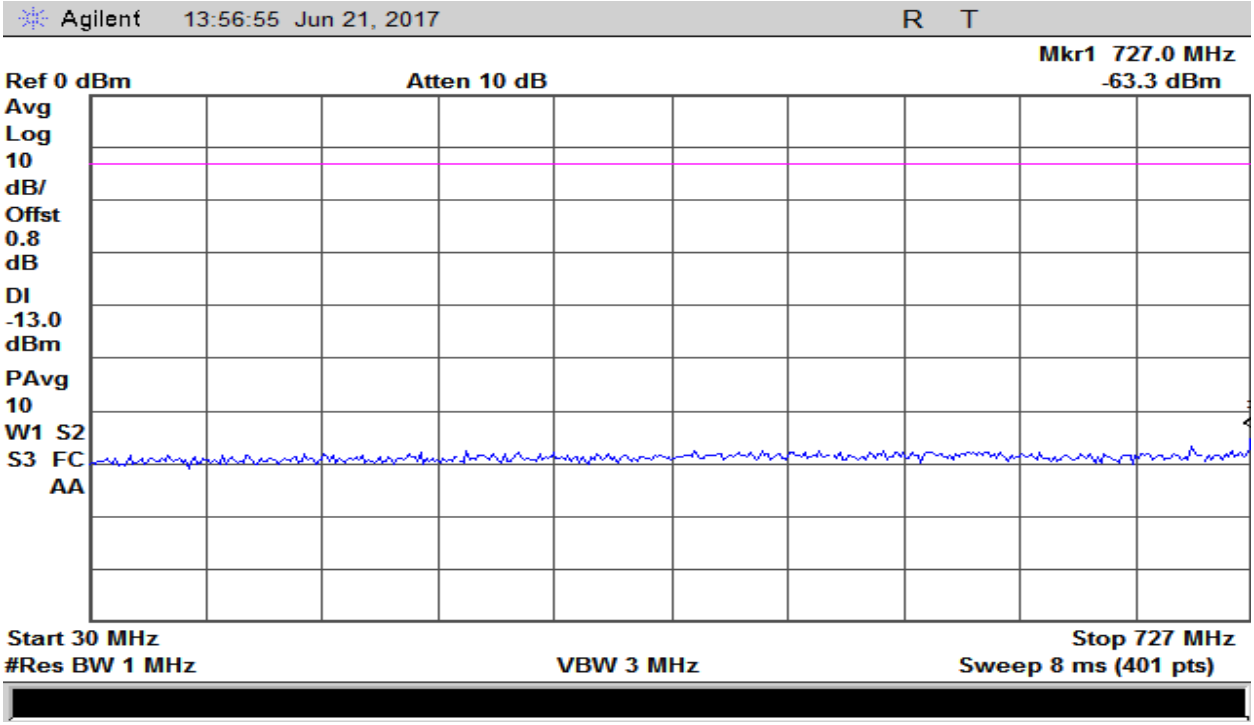
Plot 94 – 1850-1915MHz Band – Uplink



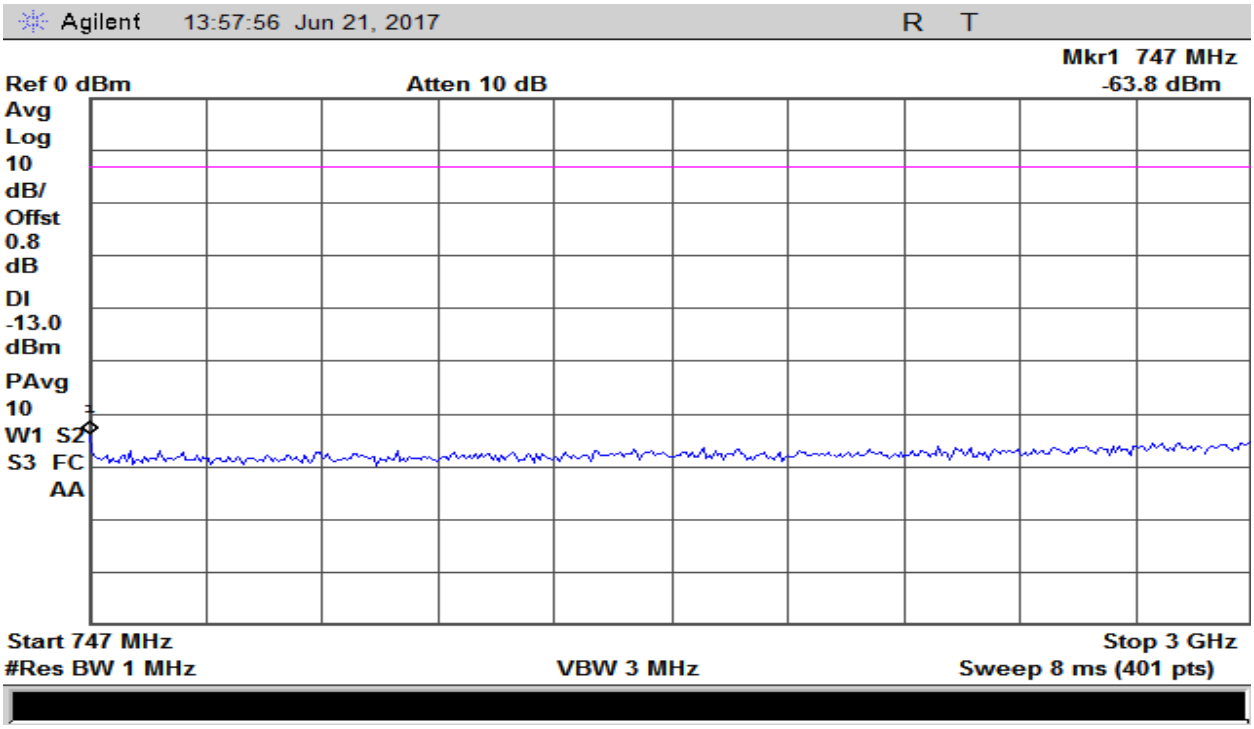
Plot 95 – 1850-1915MHz Band – Uplink



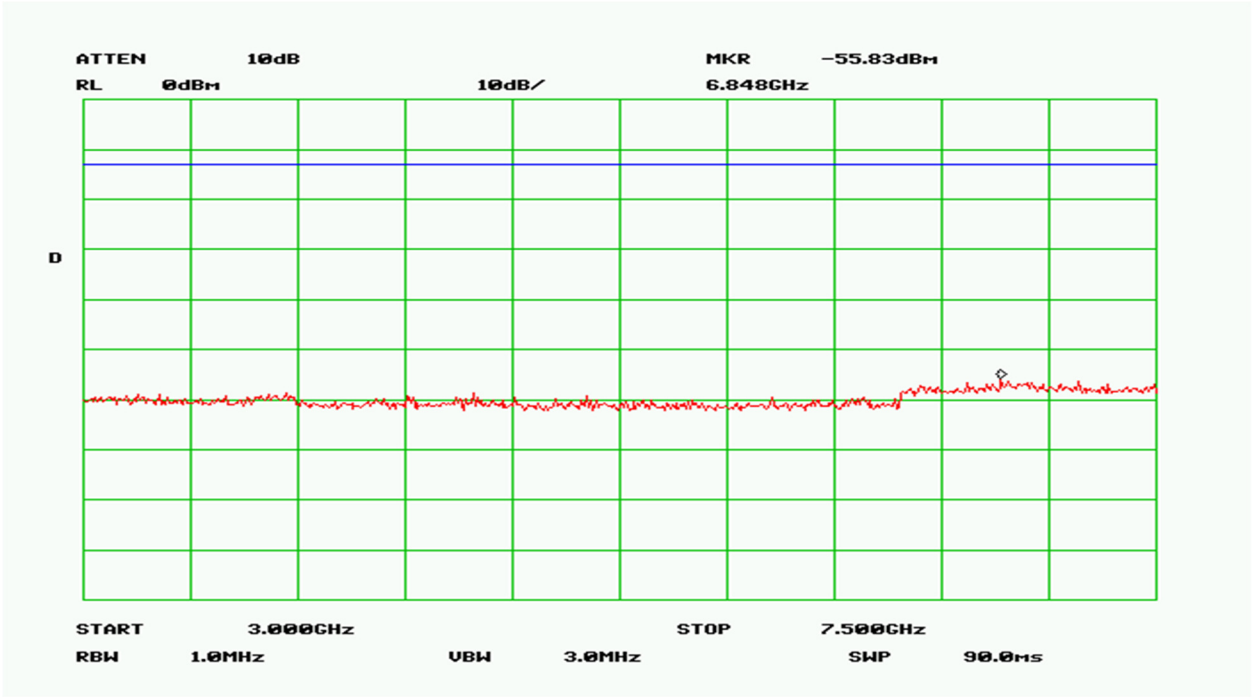
Plot 96 – 1850-1915MHz Band – Uplink



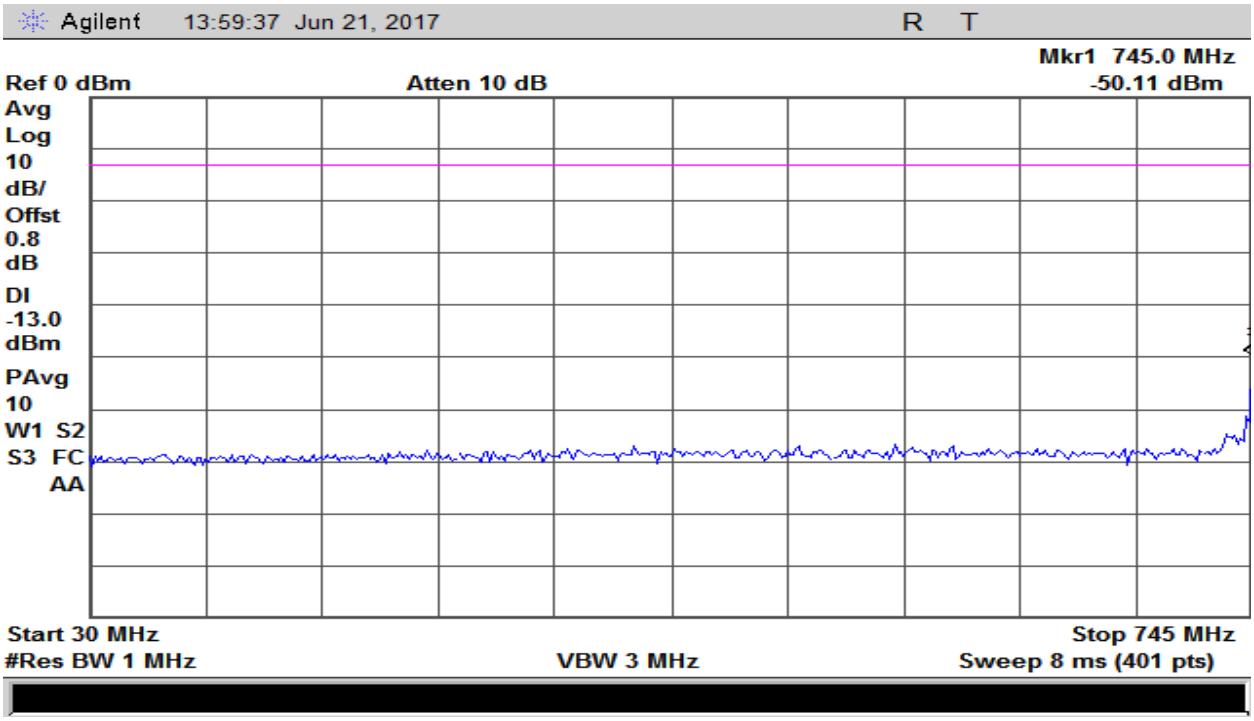
Plot 97 – 728-746MHz Band – Downlink



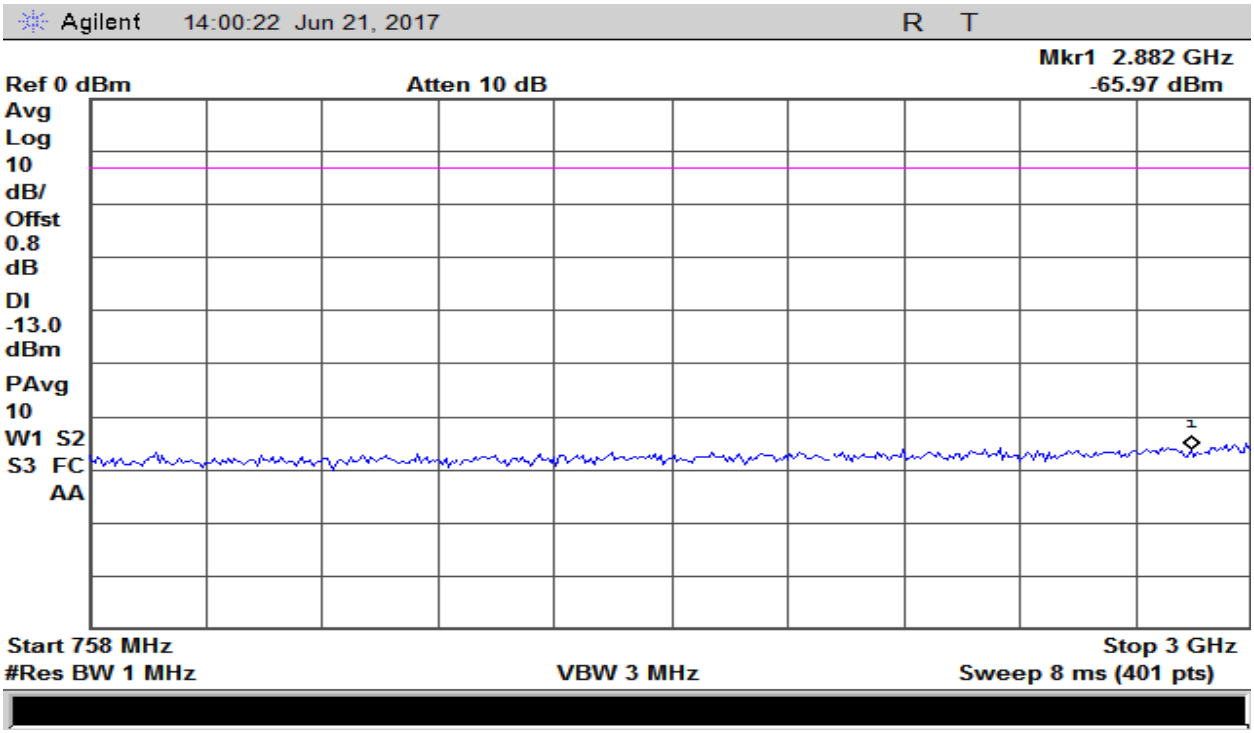
Plot 98 – 728-746MHz Band – Downlink



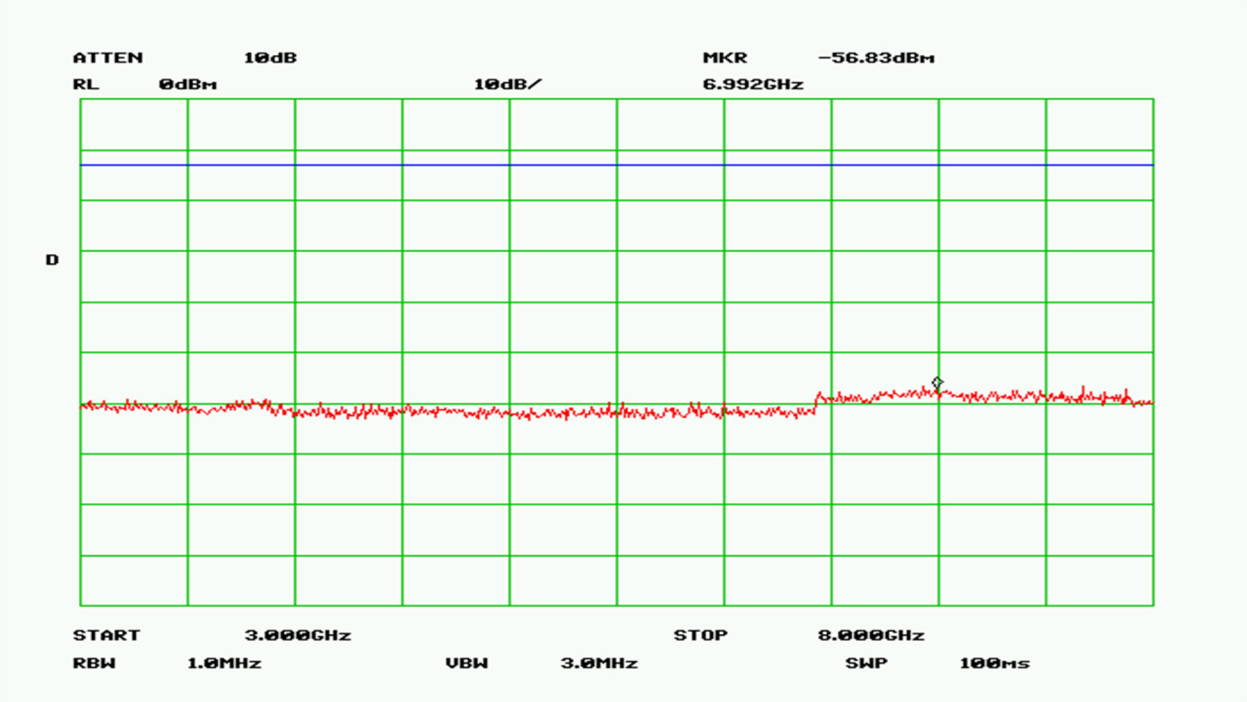
Plot 99 – 728-746MHz Band – Downlink



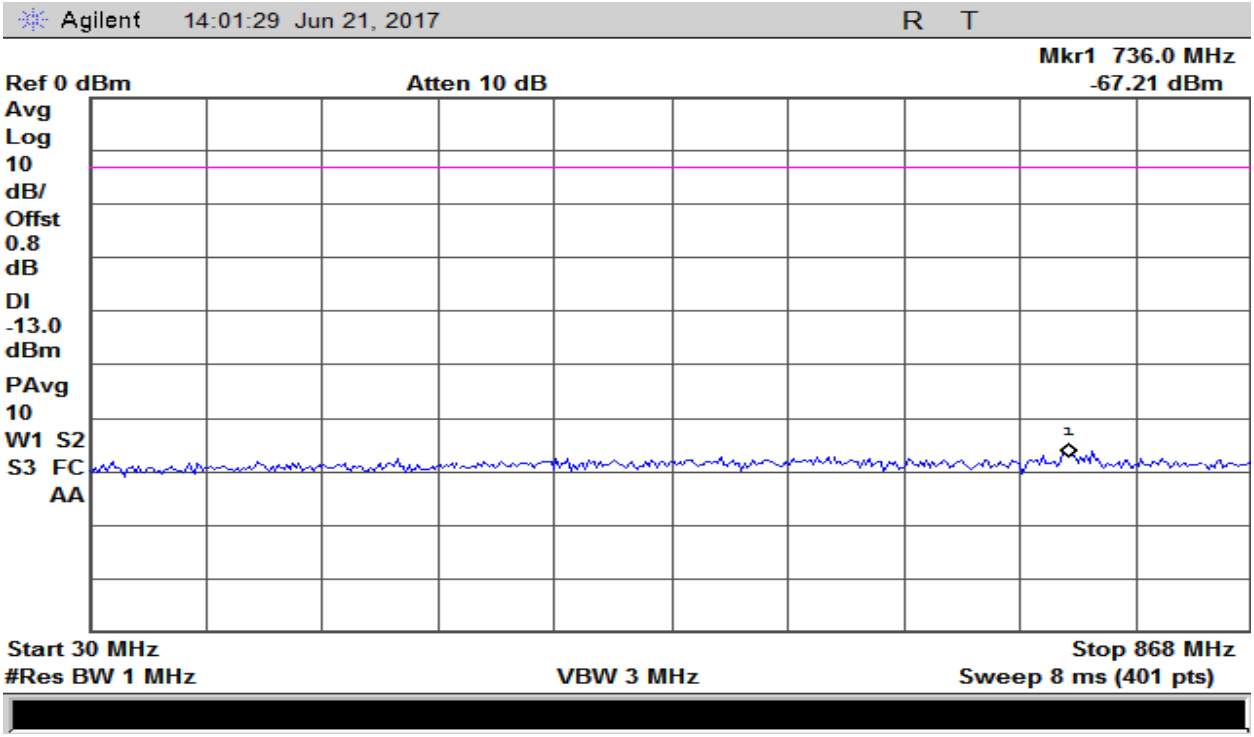
Plot 100 – 746-757MHz Band – Downlink



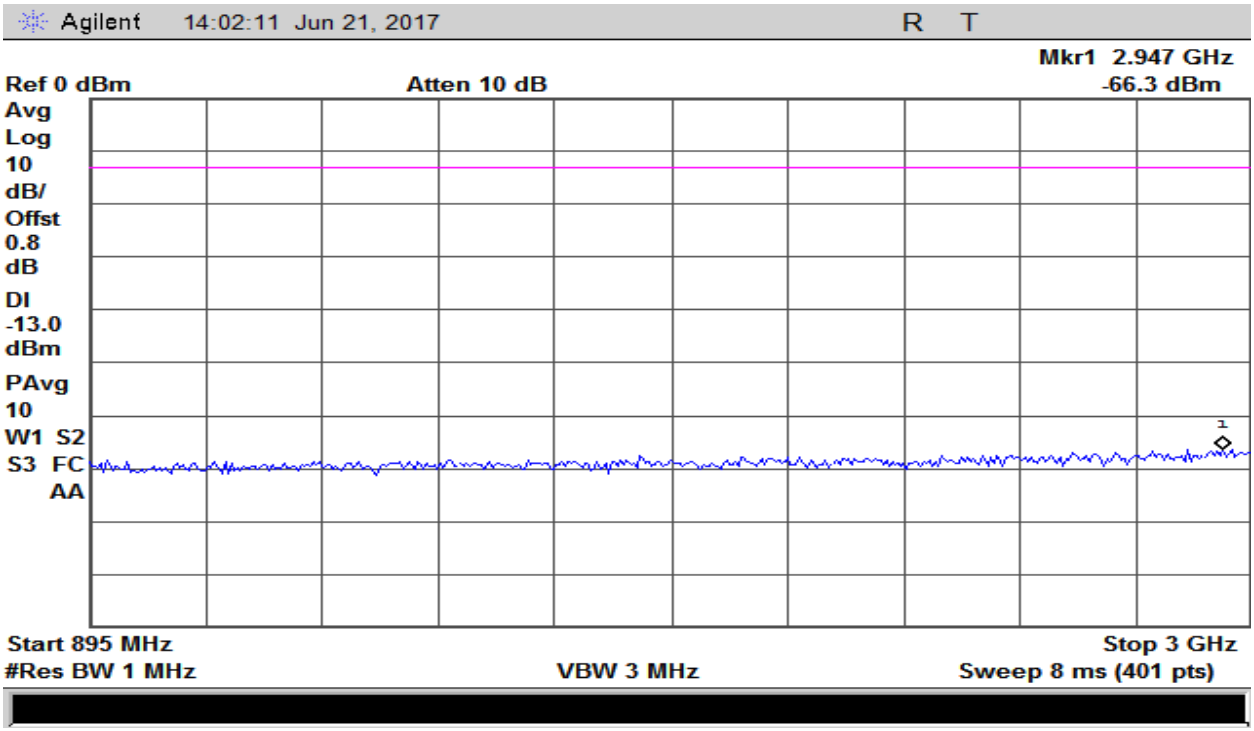
Plot 101 – 746-757MHz Band – Downlink



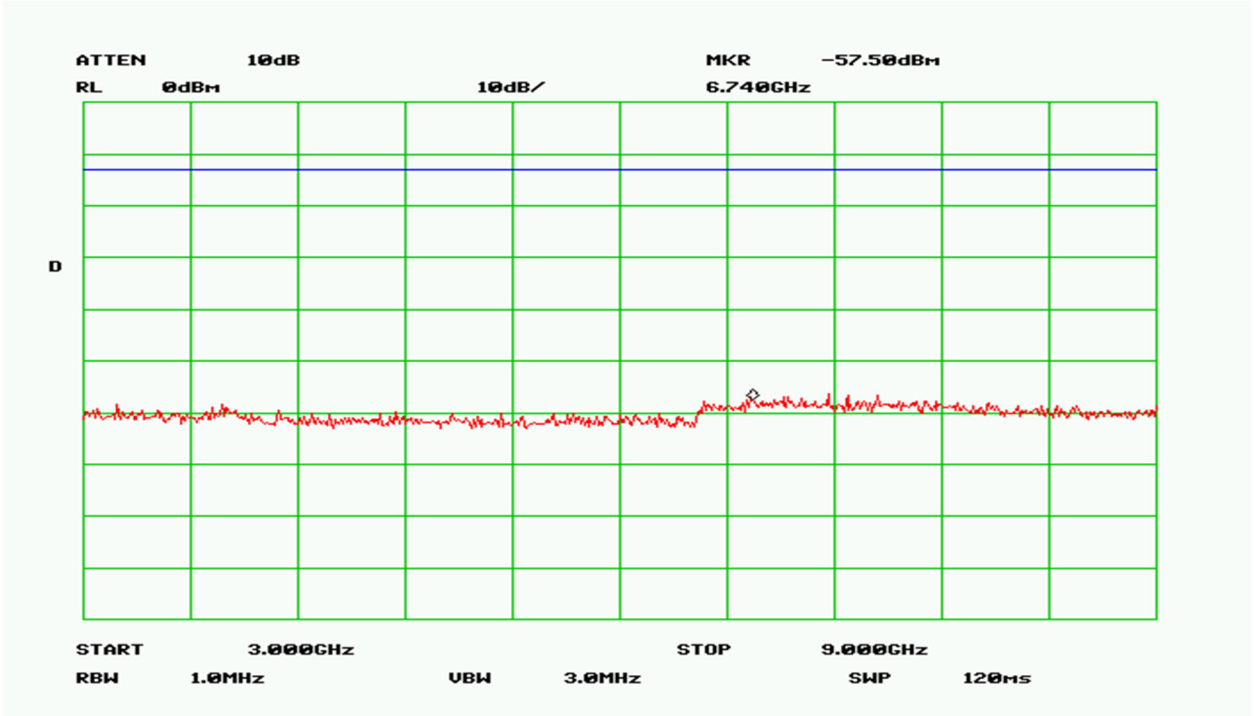
Plot 102 – 746-757MHz Band – Downlink



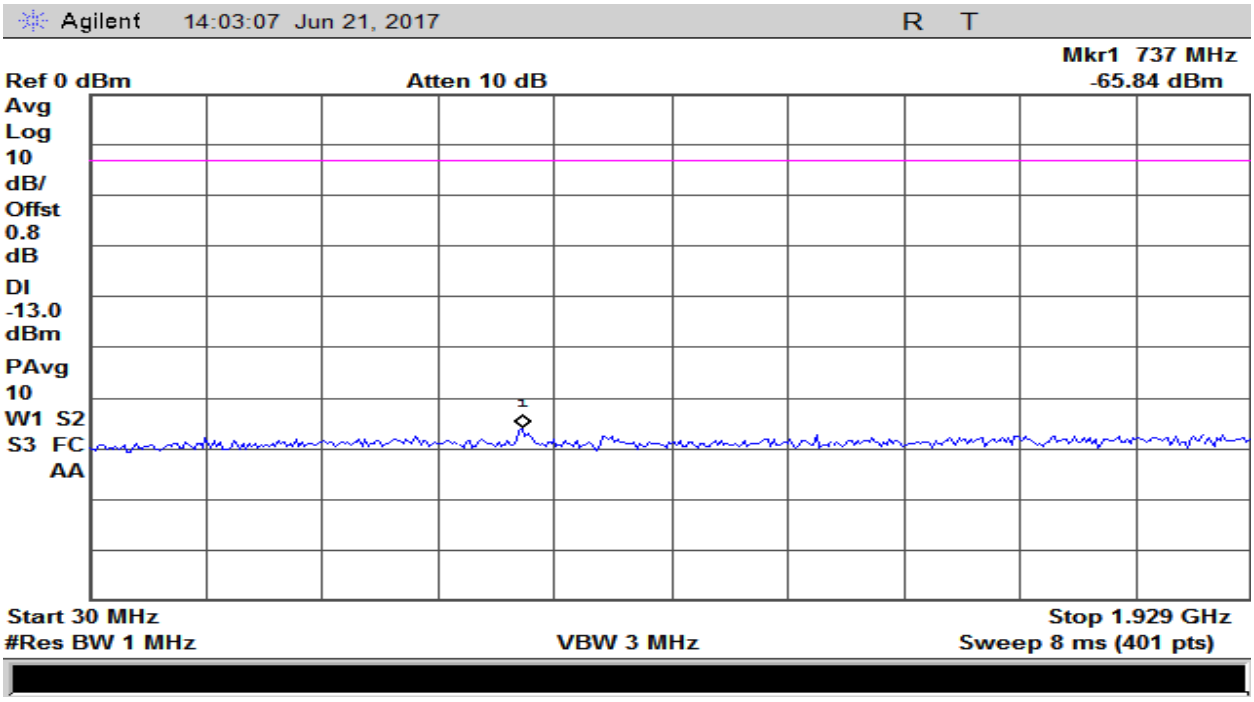
Plot 103 – 869-894MHz Band – Downlink



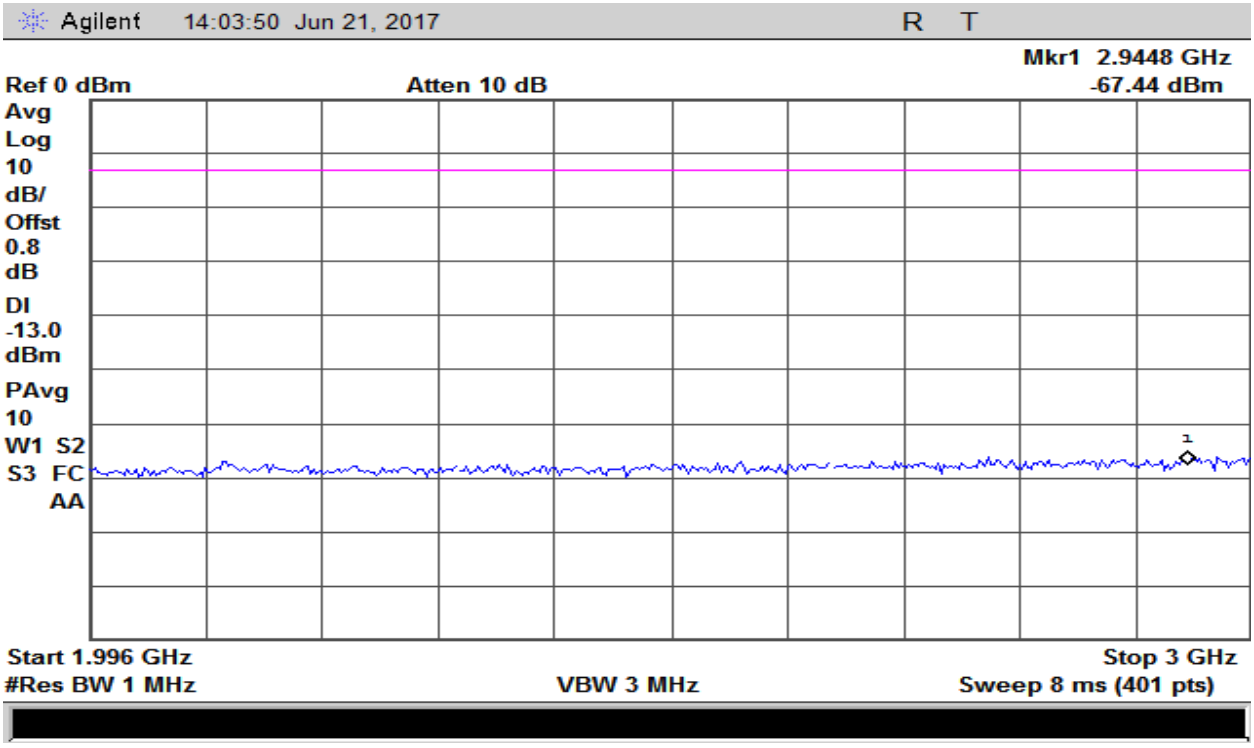
Plot 104 – 869-894MHz Band – Downlink



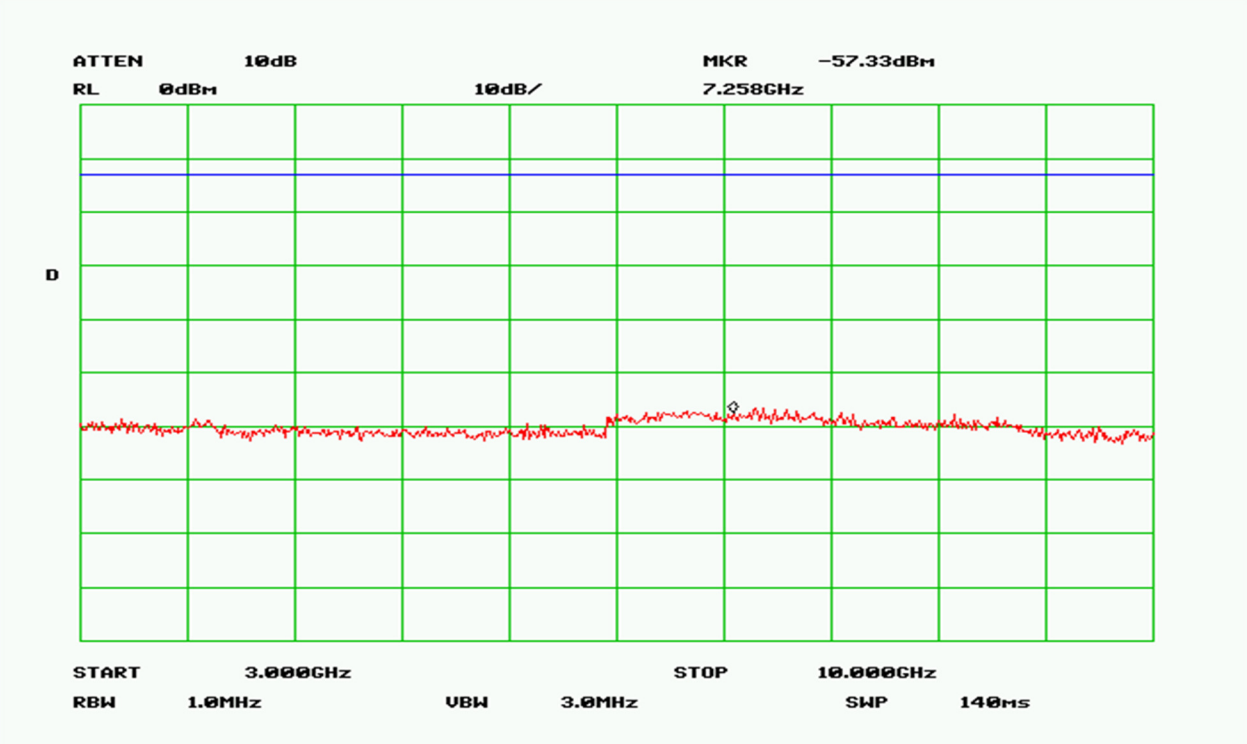
Plot 105 – 869-894MHz Band – Downlink



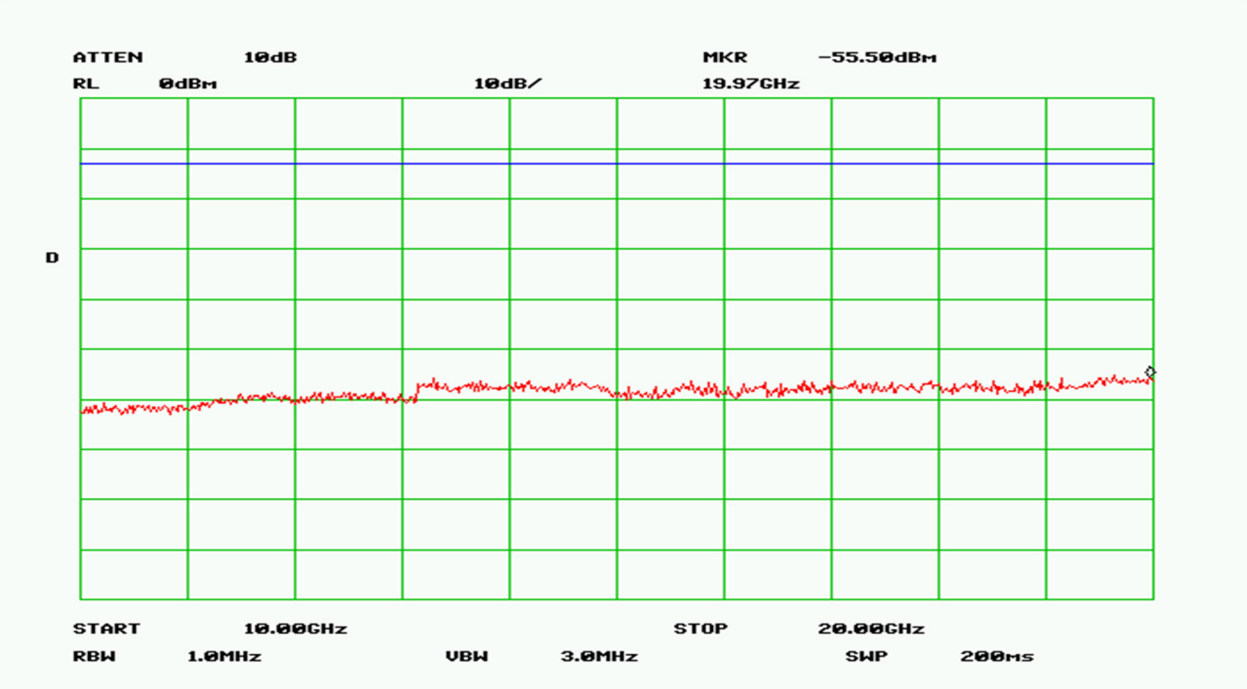
Plot 106 – 1930-1995MHz Band – Downlink



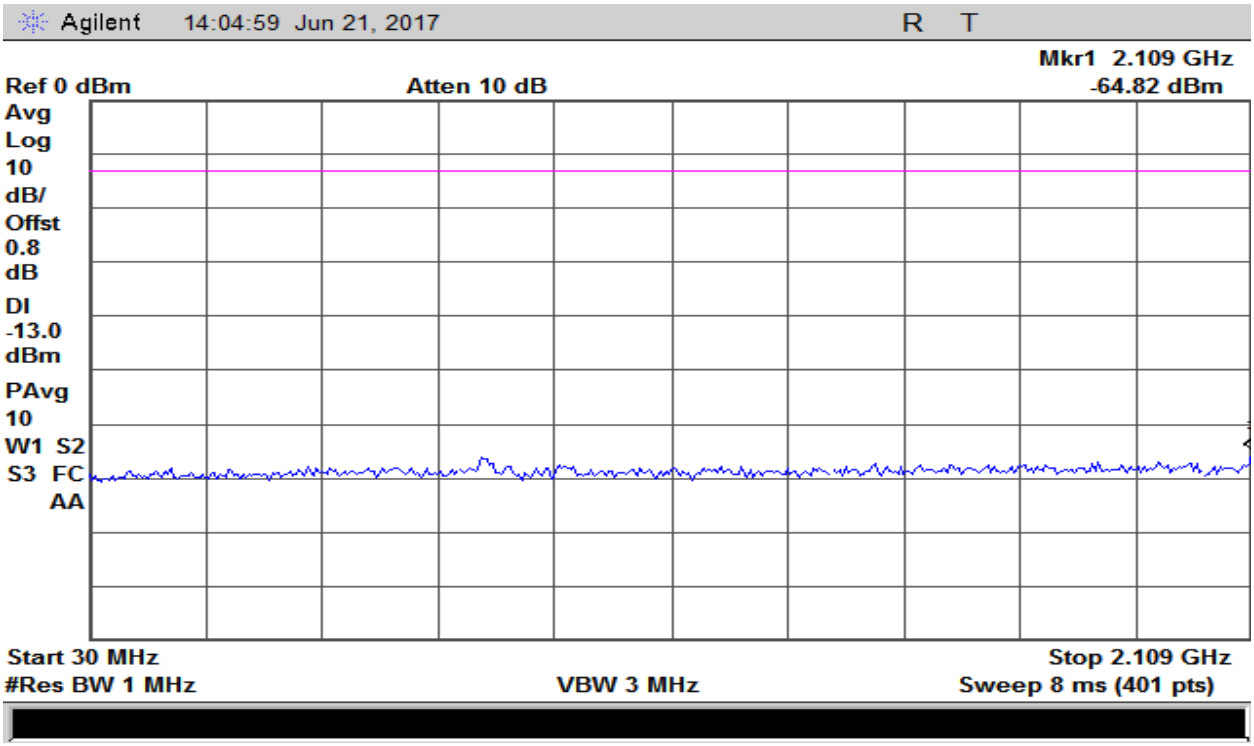
Plot 107 – 1930-1995MHz Band – Downlink



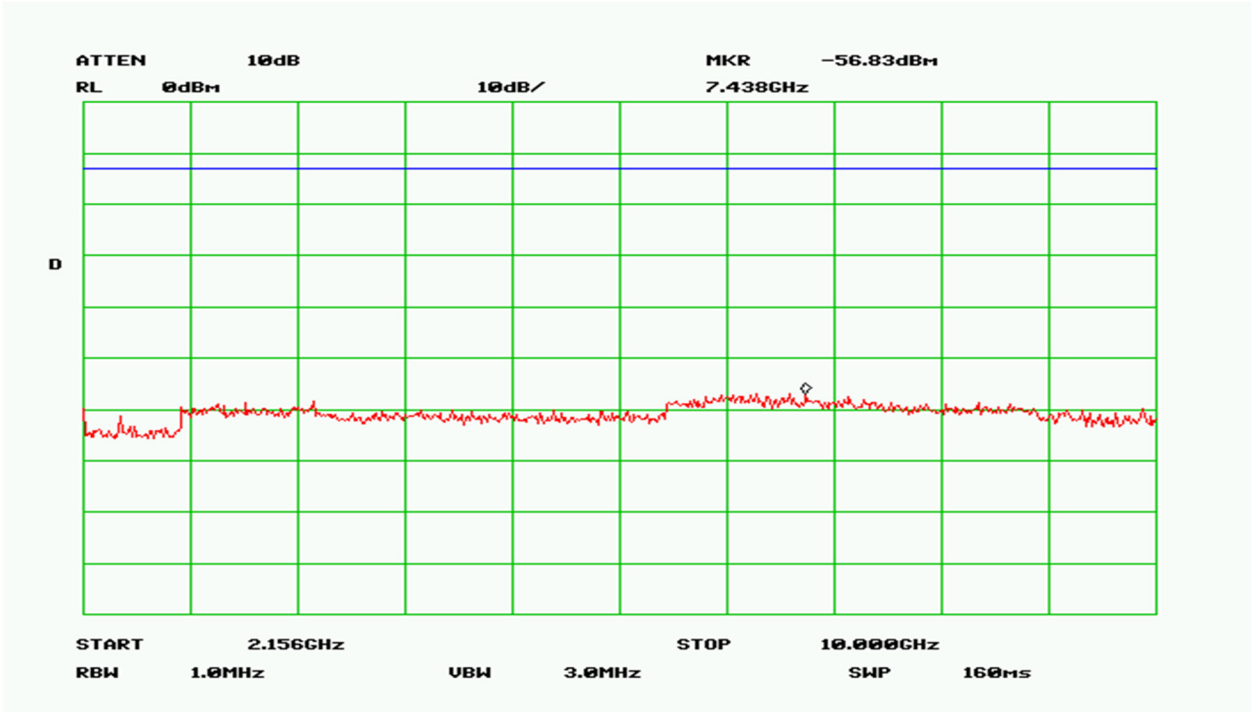
Plot 108 – 1930-1995MHz Band – Downlink



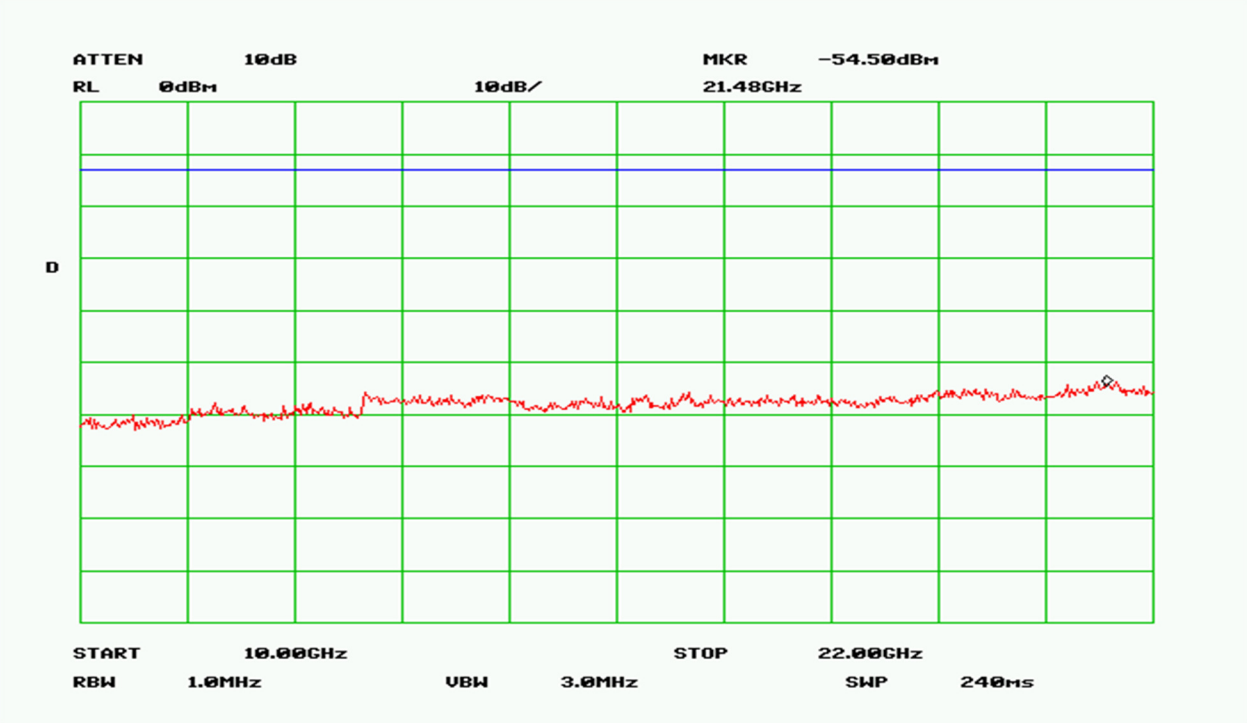
Plot 109 – 1930-1995MHz Band – Downlink



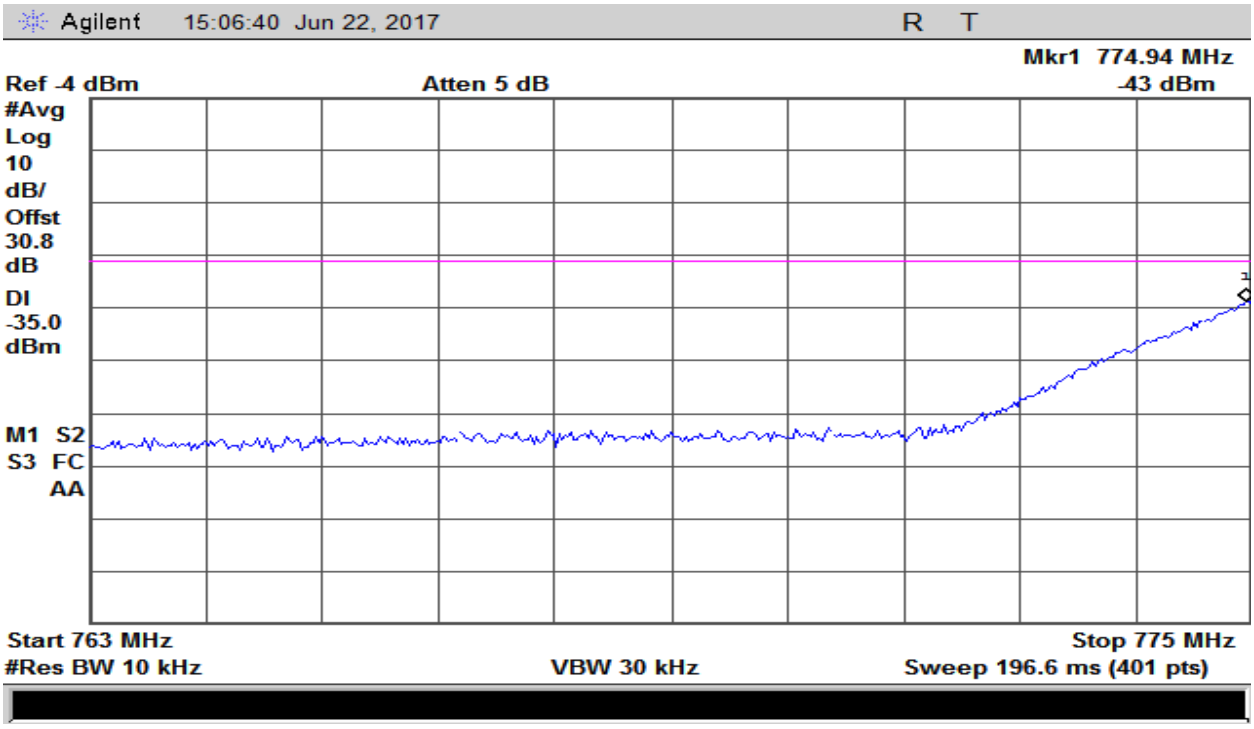
Plot 110 – 2110-2155MHz Band – Downlink



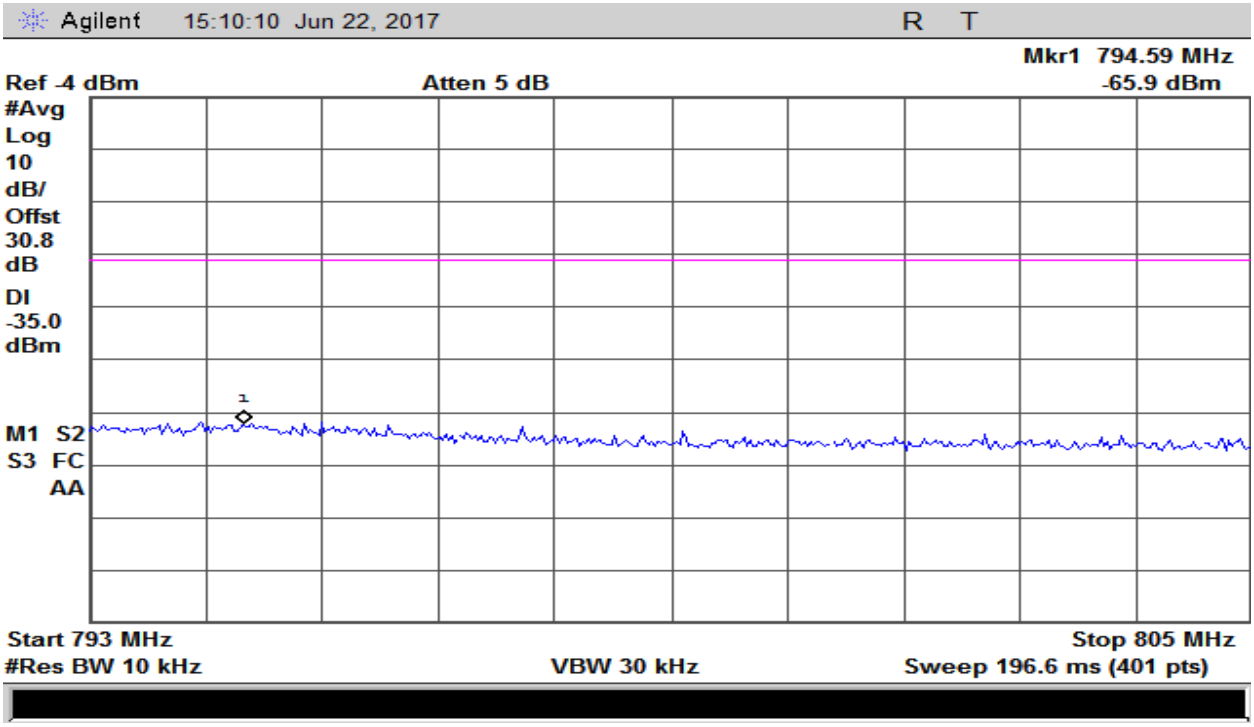
Plot 111 –2110-2155MHz Band – Downlink



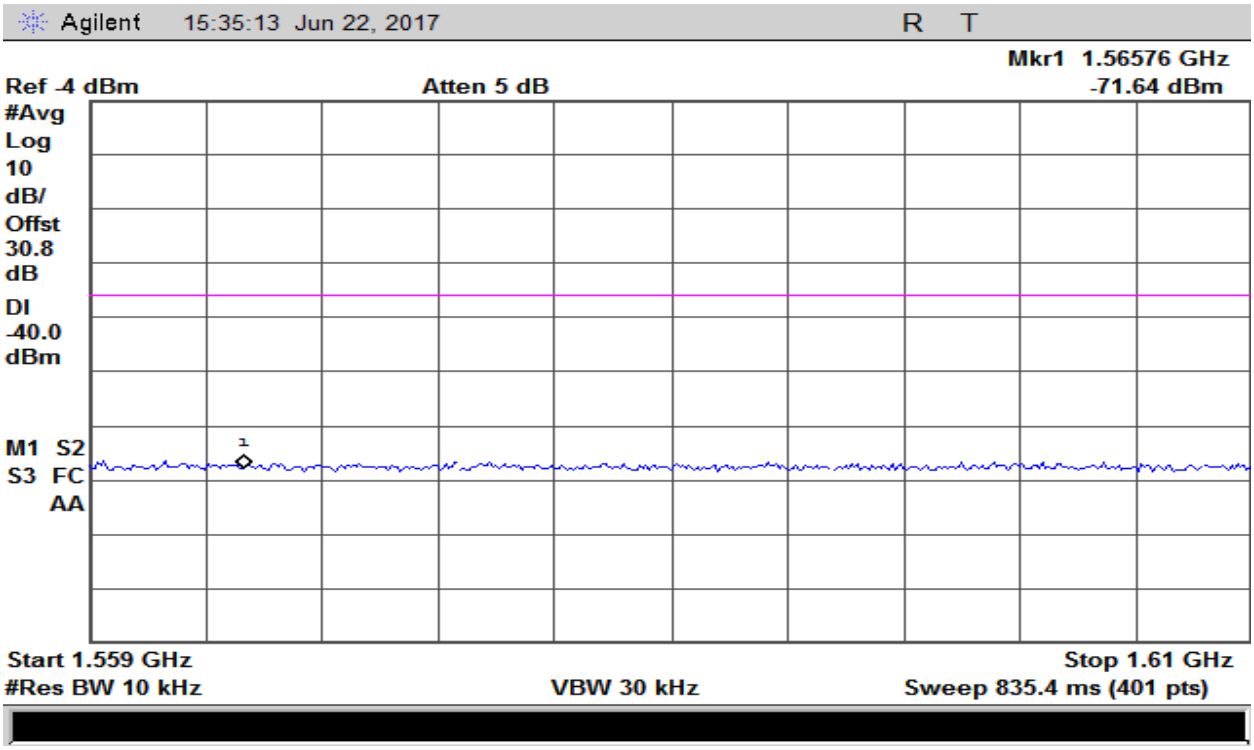
Plot 112 –2110-2155MHz Band – Downlink



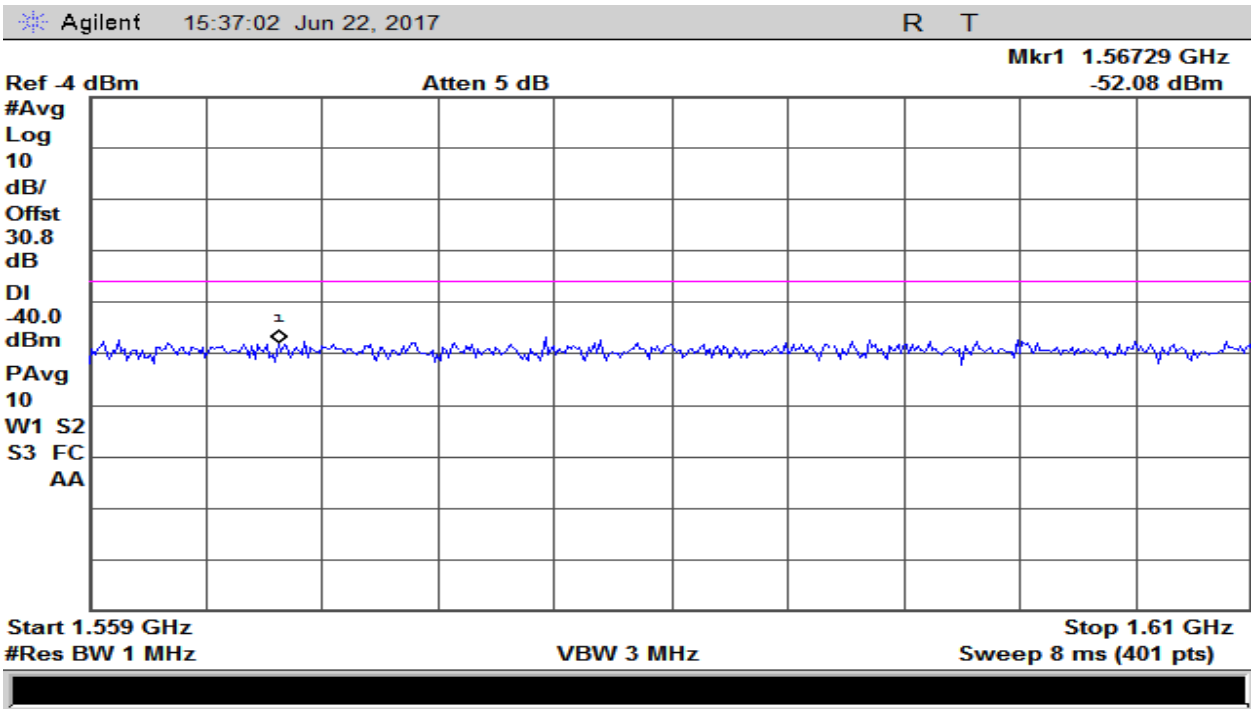
Plot 113 –27.53c4 – Uplink



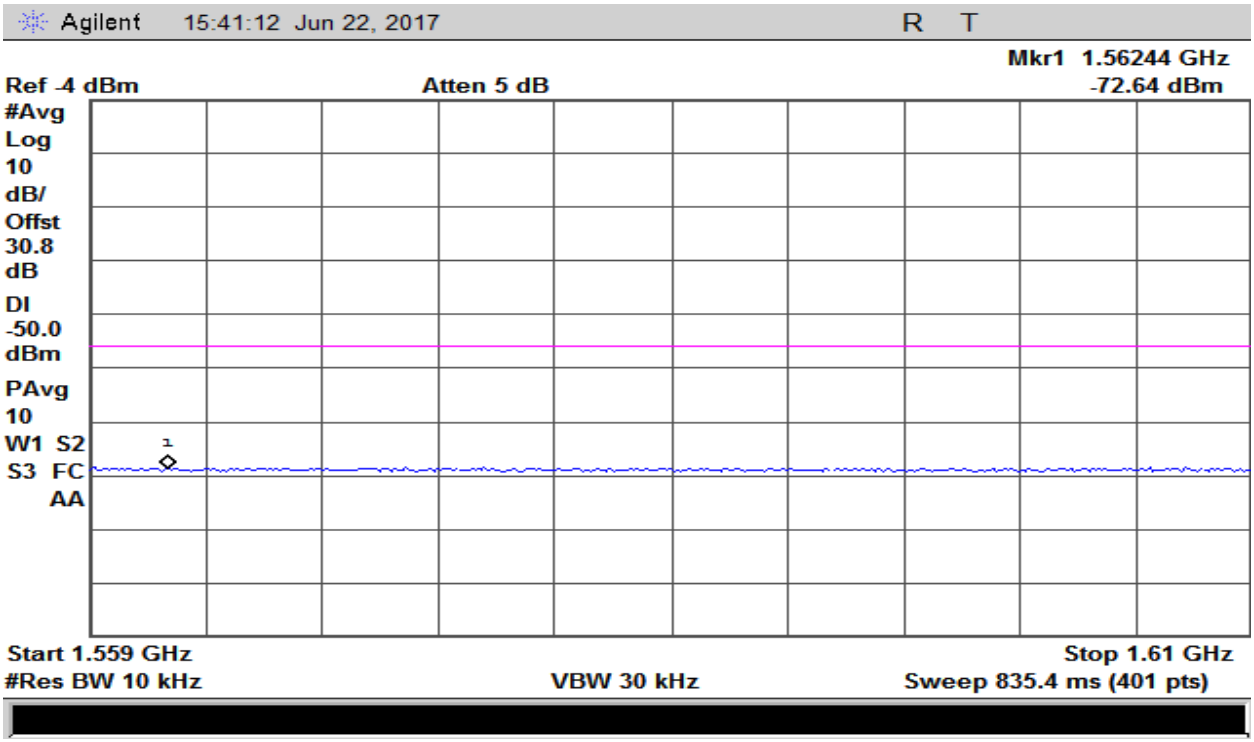
Plot 114 –27.53c4 – Uplink



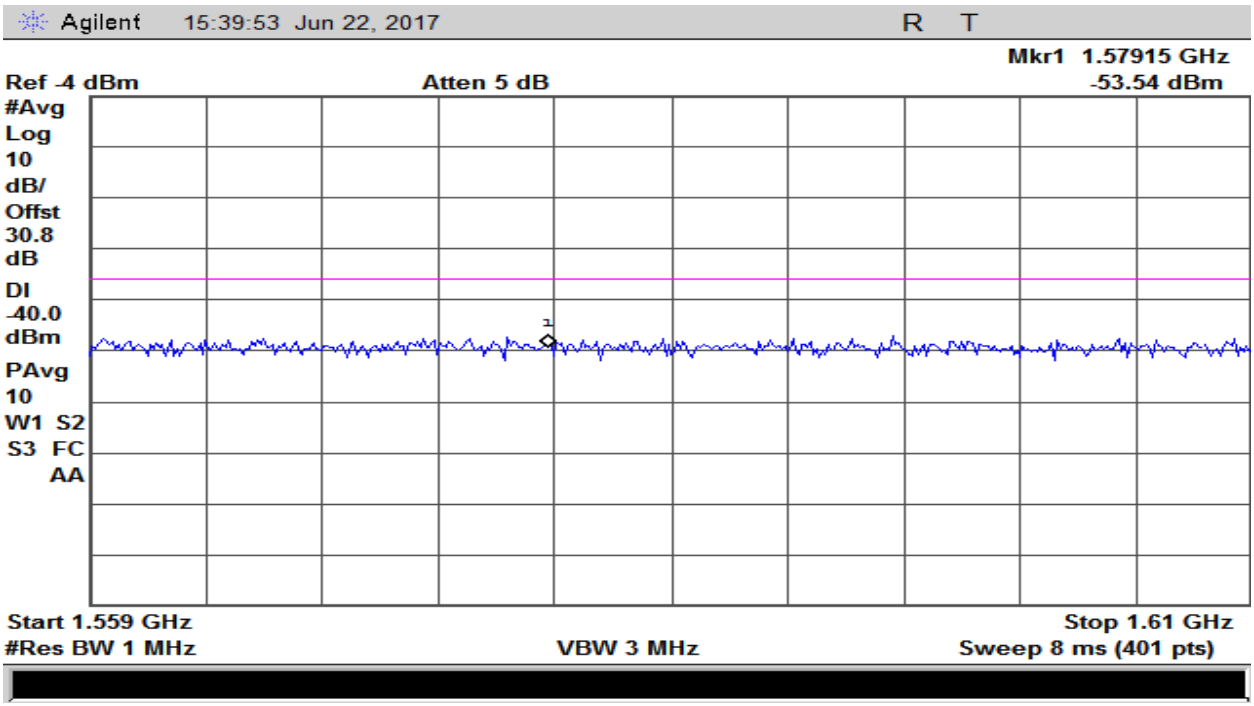
Plot 115 –27.53f – Uplink Narrowband



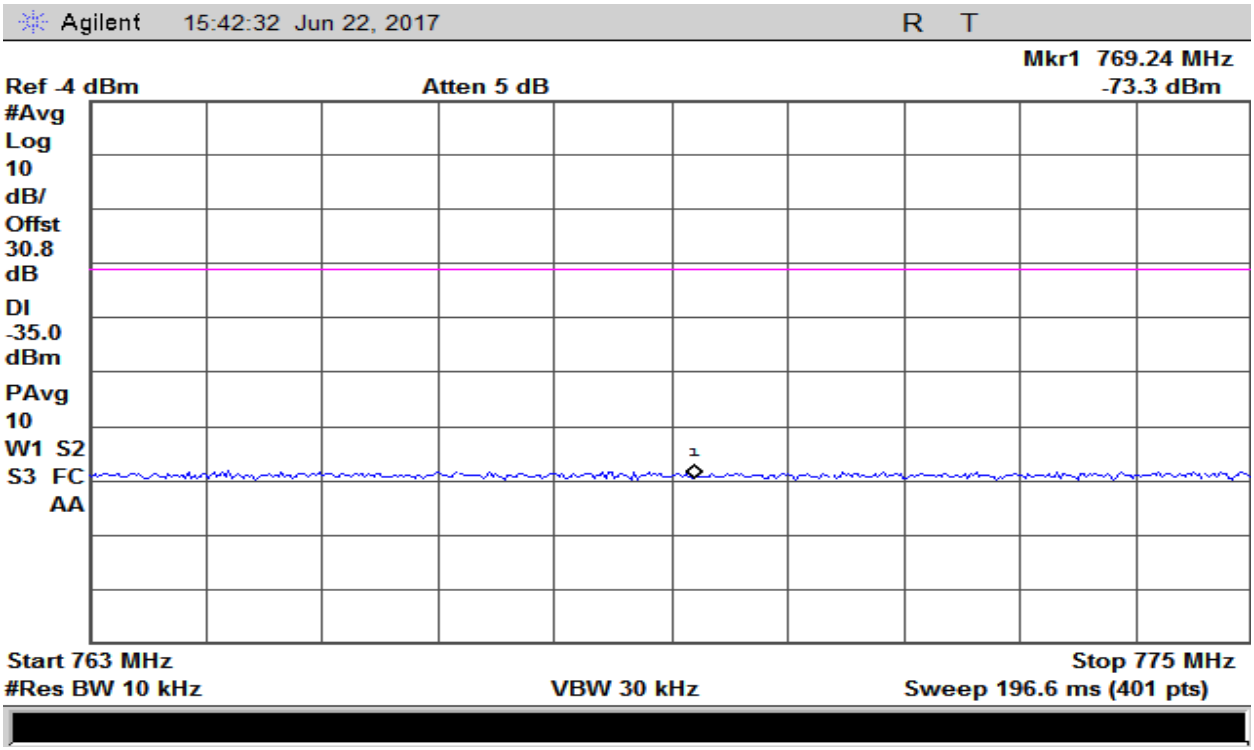
Plot 116 –27.53f – Uplink Wideband



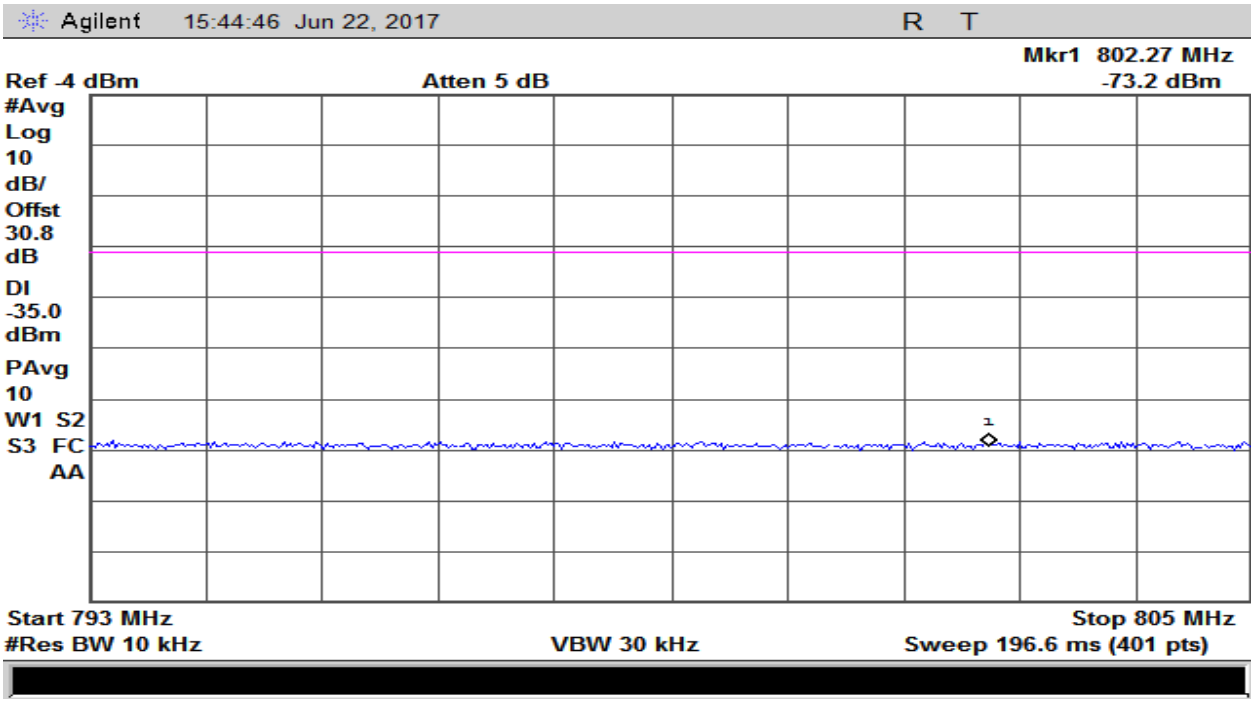
Plot 117 –27.53f – Downlink Narrowband



Plot 118 –27.53f – Downlink Wideband



Plot 119 –27.53c4 – Downlink



Plot 120 –27.53c4 – Downlink

6. Noise Limits

Test Requirement(s):	§20.21(e)(8)(i)(A	**Test Engineer(s):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	Jun/16/2017

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:

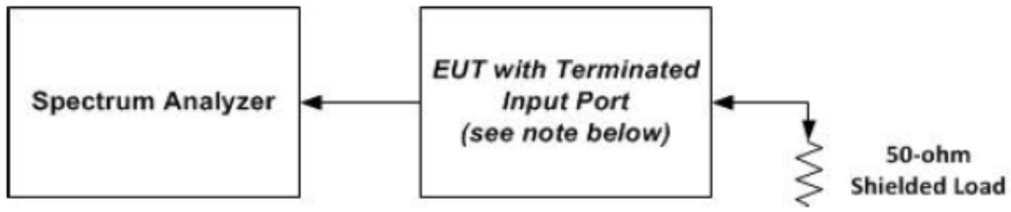


Figure 2 – Noise Limit

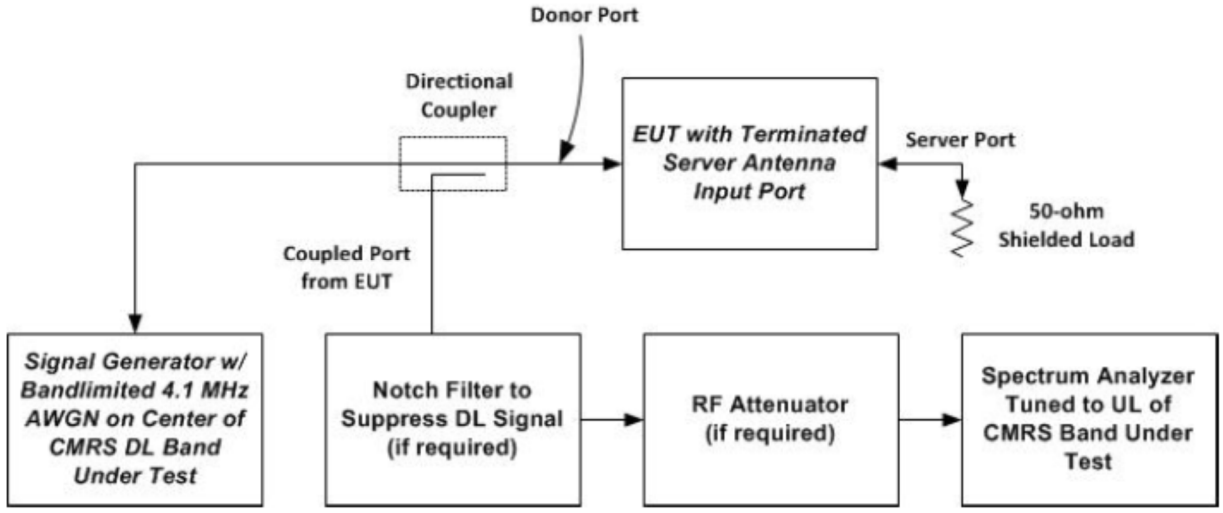
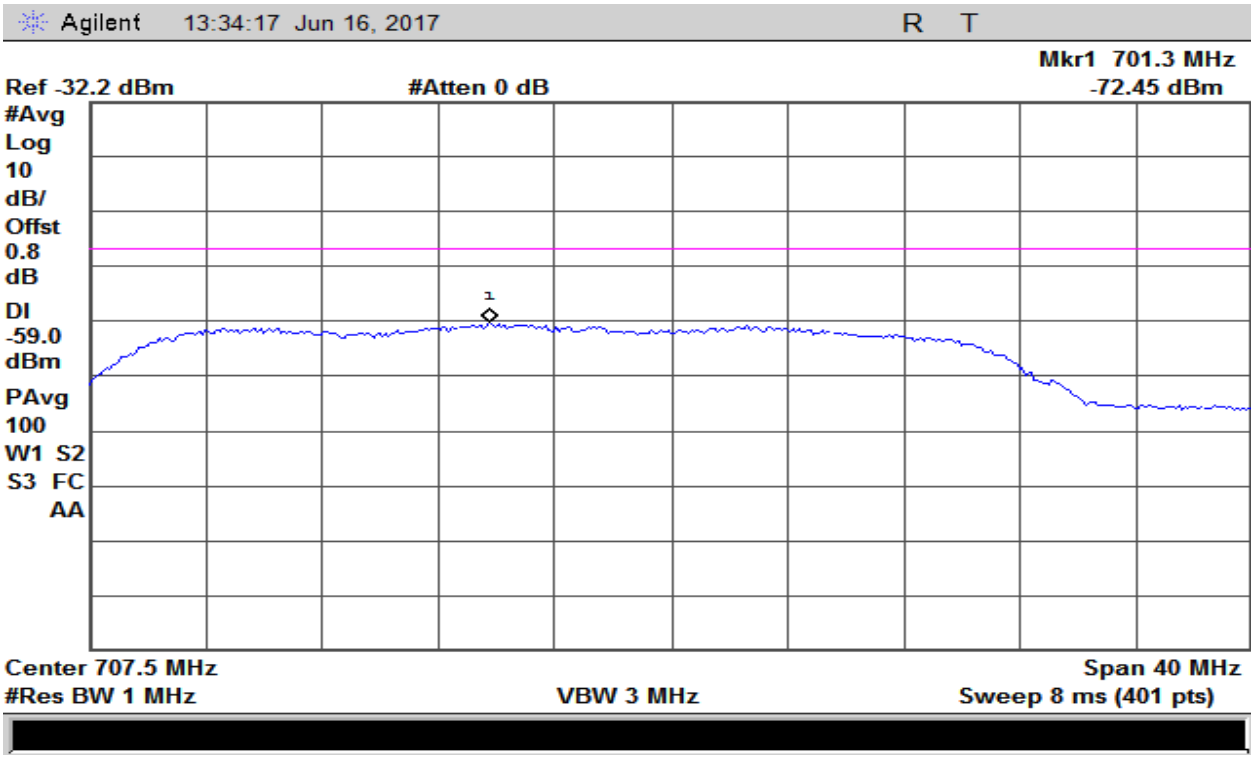


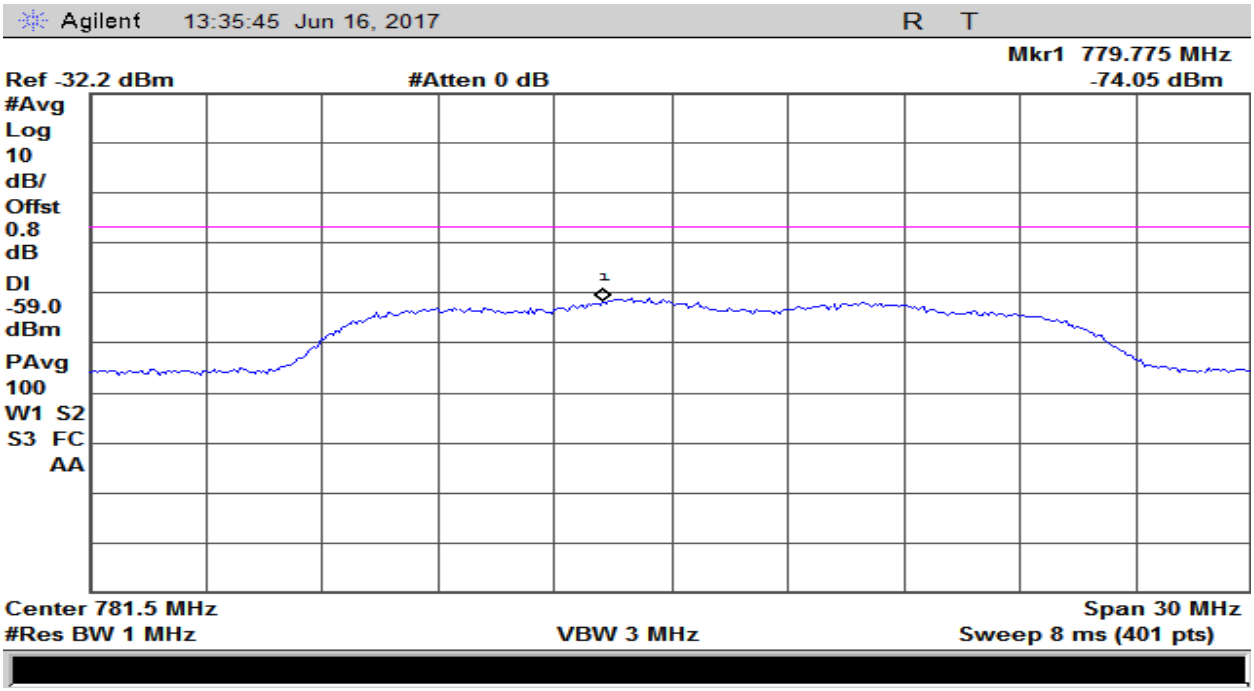
Figure 3 – Uplink Noise power in presence of a downlink signal

Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dB)
698-716	-72.45	-59	-13.45
776-787	-74.05	-59	-15.05
824-849	-73.94	-59	-14.94
1710-1755	-71.86	-59	-12.86
1850-1915	-73.68	-59	-14.68

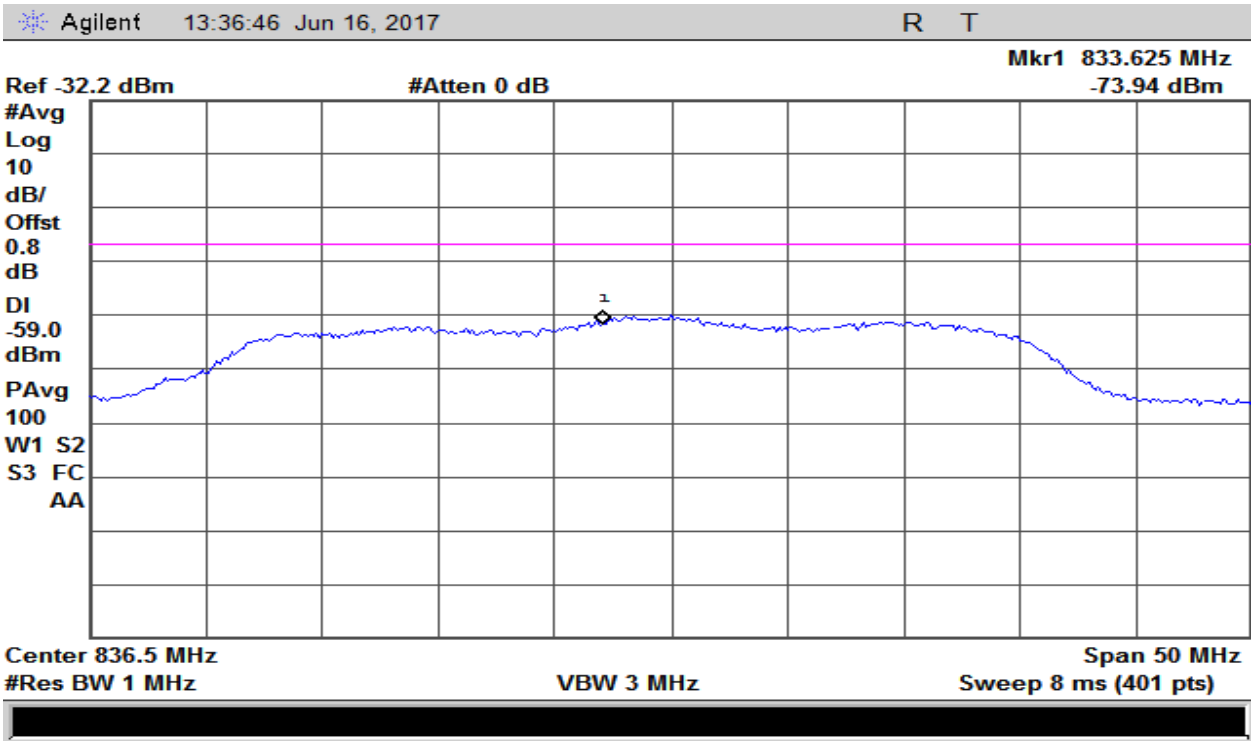
Table 19 – Maximum Uplink Noise Summary



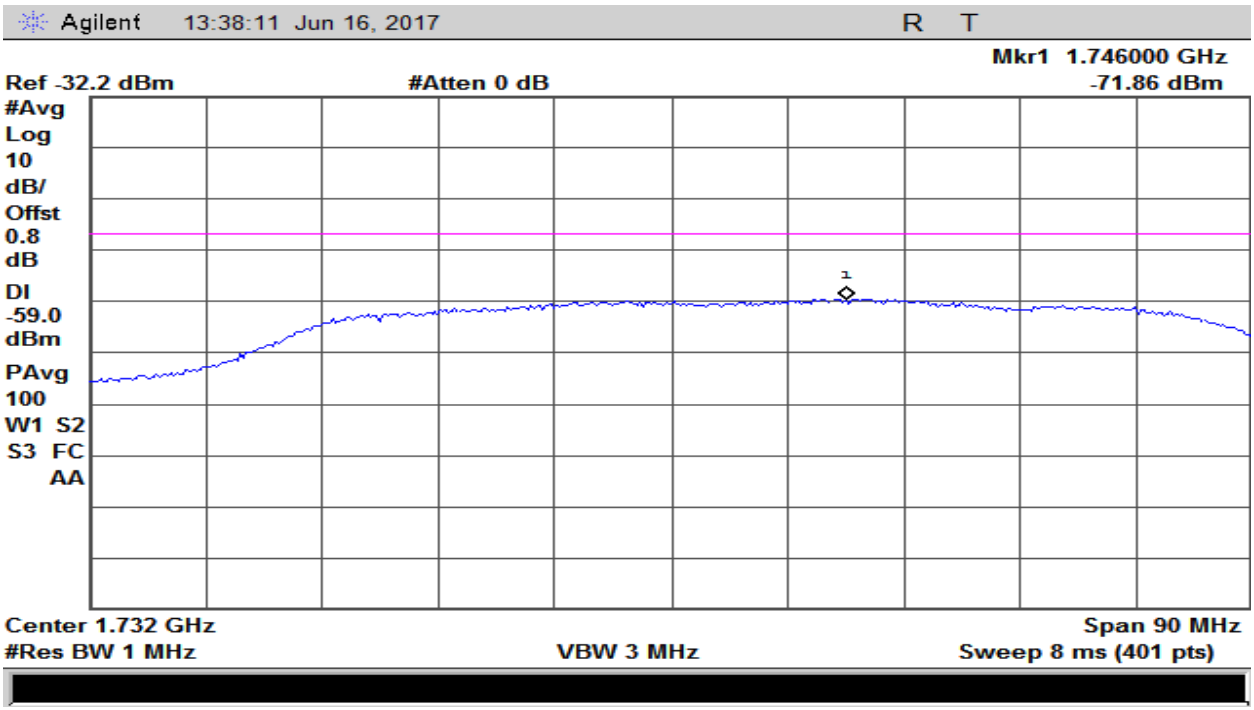
Plot 121 – 698-716MHz Band – Maximum Uplink Noise



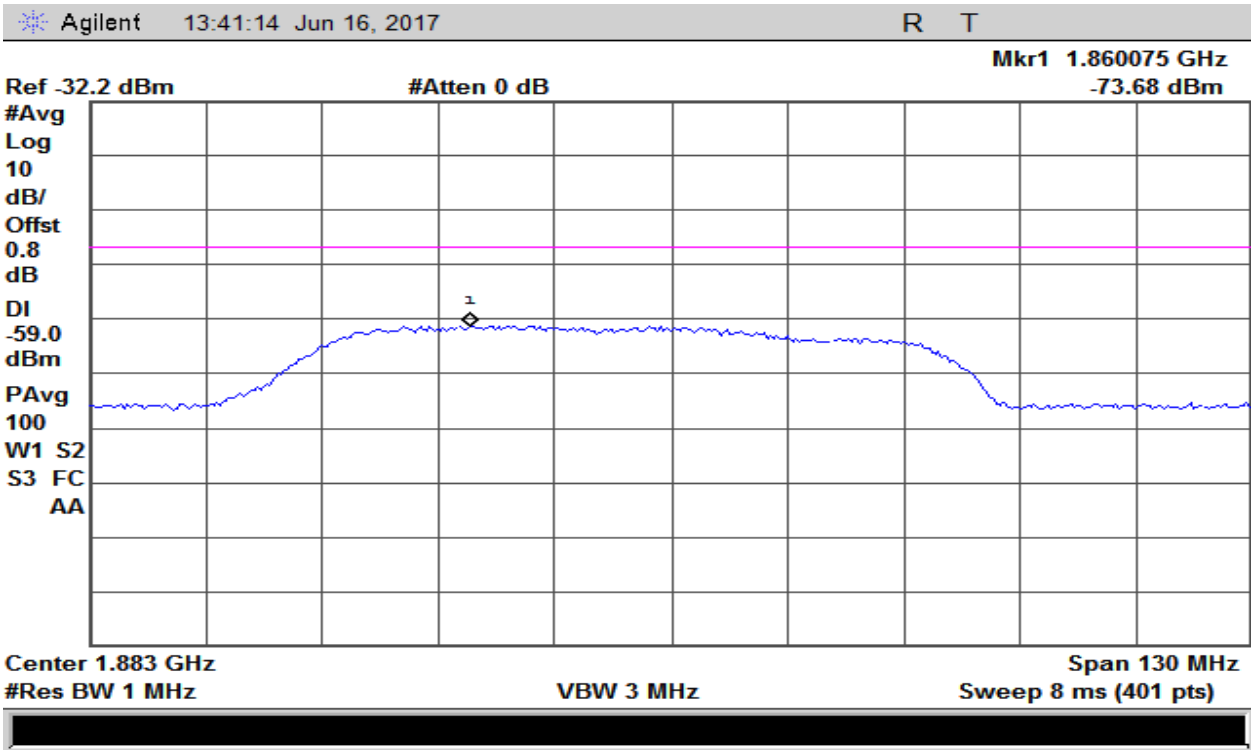
Plot 122 – 776-787MHz Band – Maximum Uplink Noise



Plot 123 – 824-849MHz Band – Maximum Uplink Noise



Plot 124 – 1710-1755MHz Band – Maximum Uplink Noise



Plot 125 – 1850-1915MHz Band – Maximum Uplink Noise

7. Variable Booster Gain

Test Requirement(s):	§20.21(e)(8)(i)(c)(1)	Test Engineer(s):	Hoosam B.
Test Results:	Pass	Test Date(s):	Jun/16/2017

Test Procedures: As required by 47 §20.21(e)(8)(i)(c)(1), Variable Booster Gain measurements were made as per FCC KDB procedures 935210 D03 defined in §7.9.

The EUT was set up as per Figure 4.

Gain limits are based on §20.21(e)(8)(i)(C)(2)(iii) for Direct Contact coupling 23dB or 15dB.

Test Setup:

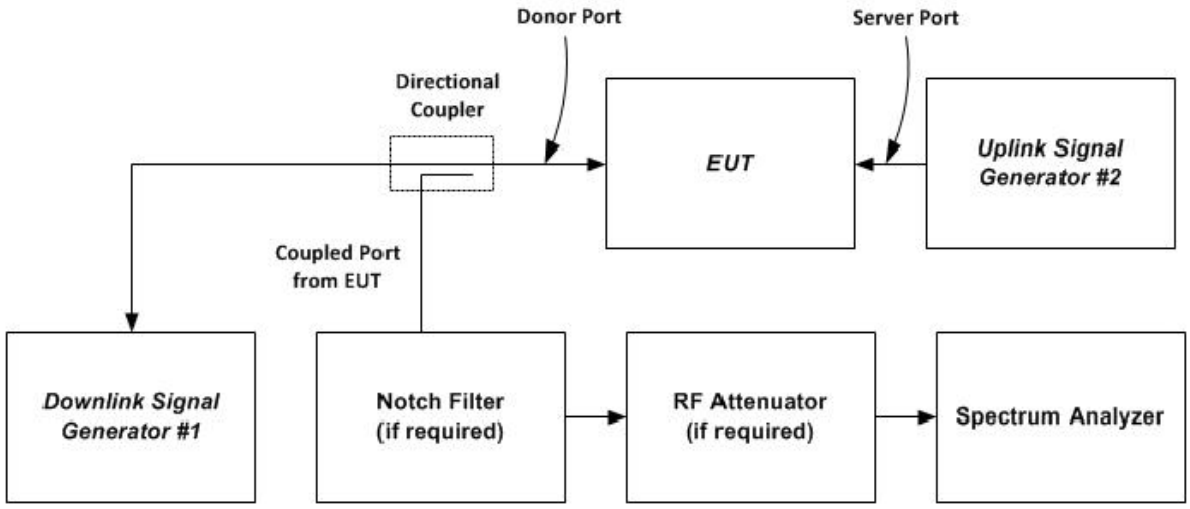


Figure 4 – Variable Gain

Detector Setting	Resolution Bandwidth	Video Bandwidth	Sweep Time
RMS	100 kHz	300 kHz	Auto

Table 20 – Analyzer Settings

RSSI (dBm)	Gain Limit (dBm)	P(in) (dBm)	P(out) dBm	Gain (dB)	Margin (dB)
-30	6	-7.34	-3.7	3.64	-2.36
-32	8	-7.34	0.3	7.64	-0.36
-35	11	-7.34	2.6	9.94	-1.06
-40	16	-7.34	7.5	14.84	-1.16
-43	19	-7.34	10.11	17.45	-1.55
-47	23	-7.34	13.8	21.14	-1.86

Table 21 – 698-716MHz Band – Uplink Data

RSSI (dBm)	Gain Limit (dBm)	P(in) (dBm)	P(out) dBm	Gain (dB)	Margin (dB)
-30	6	-3.04	-0.9	2.14	-3.86
-32	8	-3.04	1.23	4.27	-3.73
-35	11	-3.04	3.9	6.94	-4.06
-40	16	-3.04	8.87	11.91	-4.09
-43	19	-3.04	11.6	14.64	-4.36
-47	23	-3.04	13.88	16.92	-6.08

Table 22 – 776-787MHz Band – Uplink Data

RSSI (dBm)	Gain Limit (dBm)	P(in) (dBm)	P(out) dBm	Gain (dB)	Margin (dB)
-30	6	-4.3	-1.04	3.26	-2.74
-32	8	-4.3	1.73	6.03	-1.97
-35	11	-4.3	5.01	9.31	-1.69
-40	16	-4.3	10.06	14.36	-1.64
-43	19	-4.3	12.78	17.08	-1.92
-47	23	-4.3	16.72	21.02	-1.98

Table 23 – 824-849MHz Band – Uplink Data

RSSI (dBm)	Gain Limit (dBm)	P(in) (dBm)	P(out) dBm	Gain (dB)	Margin (dB)
-30	6	2.2	-1.14	-3.34	-9.34
-32	8	2.2	0.54	-1.66	-9.66
-35	11	2.2	3.22	1.02	-9.98
-40	16	2.2	8.8	6.6	-9.4
-43	19	2.2	11.59	9.39	-9.61
-47	23	2.2	14.4	12.2	-10.8

Table 24 – 1710-1755MHz Band – Uplink Data

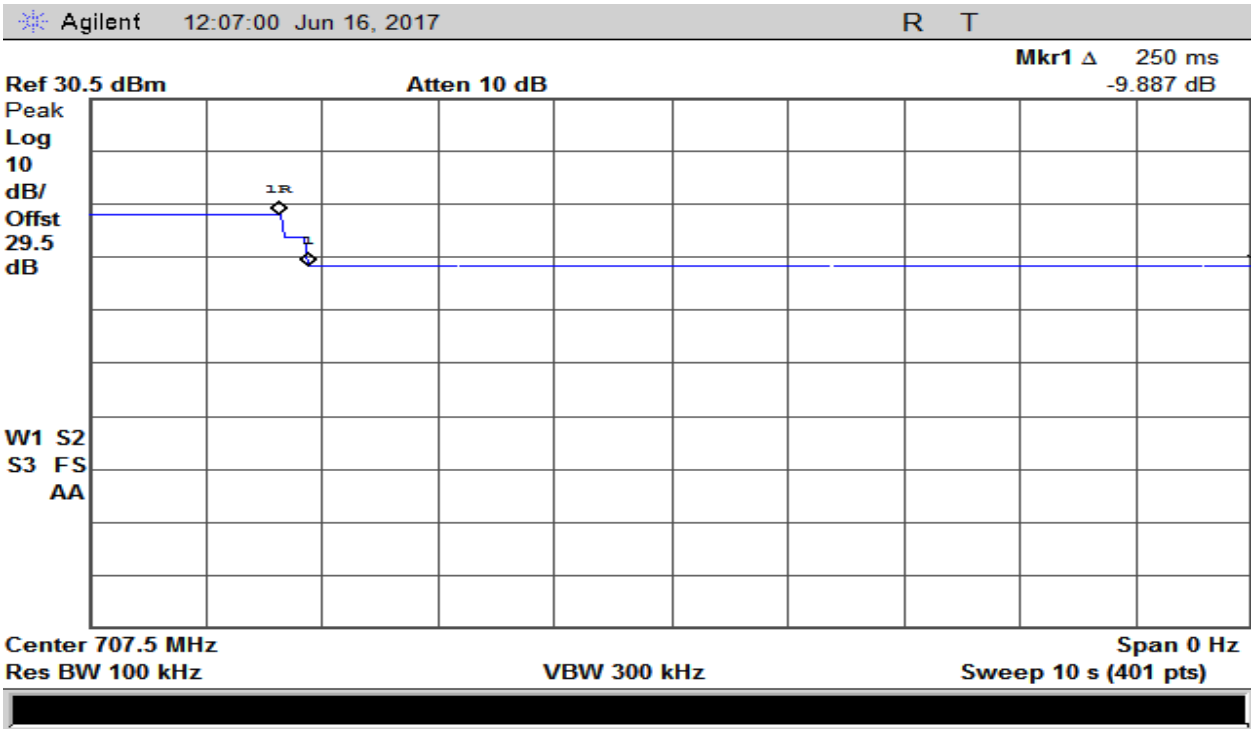
RSSI (dBm)	Gain Limit (dBm)	P(in) (dBm)	P(out) dBm	Gain (dB)	Margin (dB)
-30	6	-4.44	-9.6	-5.16	-11.16
-32	8	-4.44	-7.85	-3.41	-11.41
-35	11	-4.44	-4.6	-0.16	-11.16
-40	16	-4.44	0.58	5.02	-10.98
-43	19	-4.44	3.24	7.68	-11.32
-47	23	-4.44	6.3	10.74	-12.26

Table 25 – 776-787MHz Band – Uplink Data

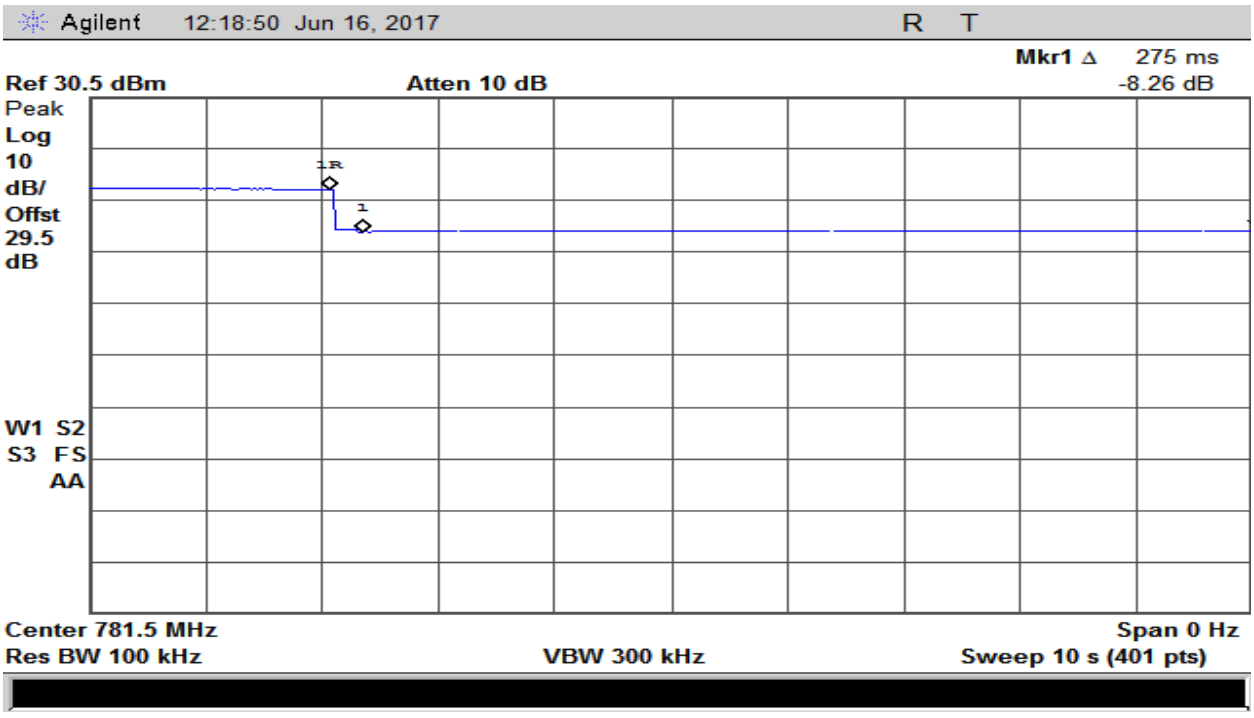
Frequency Band (MHz)	Measured Timing (Seconds)	Limit (Seconds)	Margin (Seconds)
698-716	0.250	1.0	-0.75
776-787	0.275	1.0	-0.725
824-849	0.275	1.0	-0.725
1710-1755	0.050	1.0	-0.95
1850-1915	0.225	1.0	-0.775

Table 26 – Variable Uplink Gain Timing - Summary Table

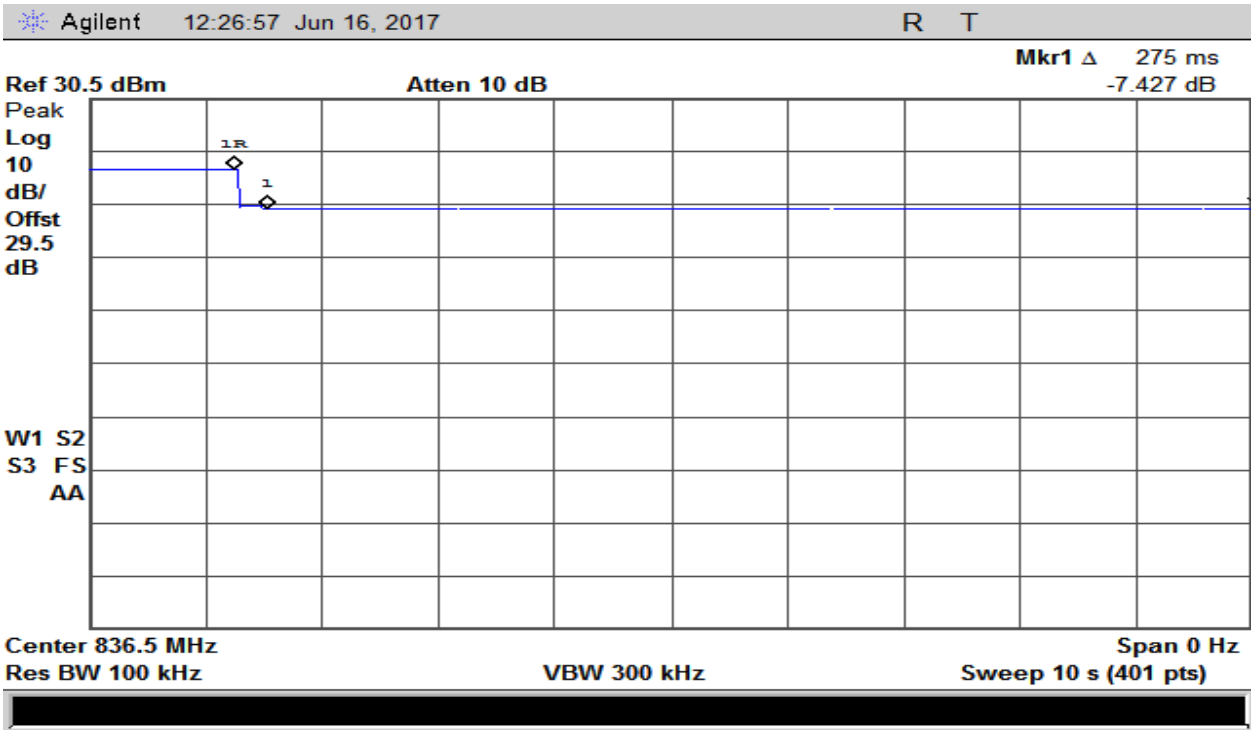
The following pages show measurements of Variable Booster Gain Timing plots:



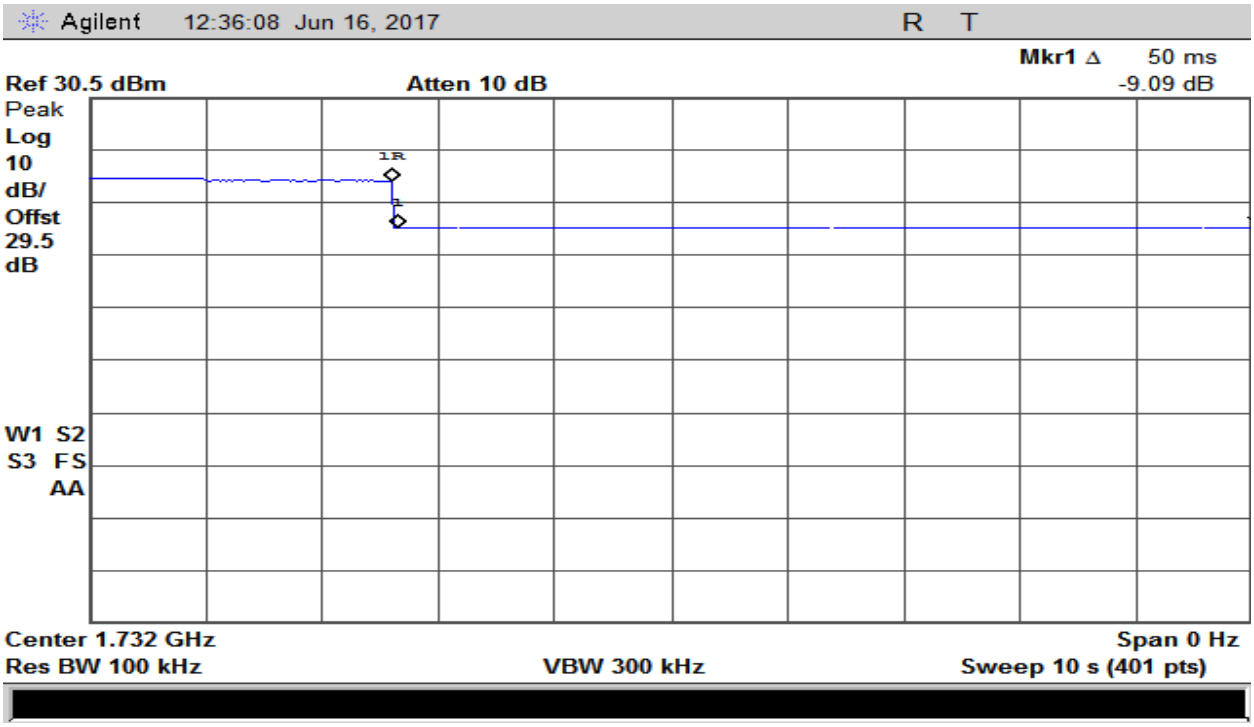
Plot 126 – 698-716MHz Band – Uplink Gain Timing



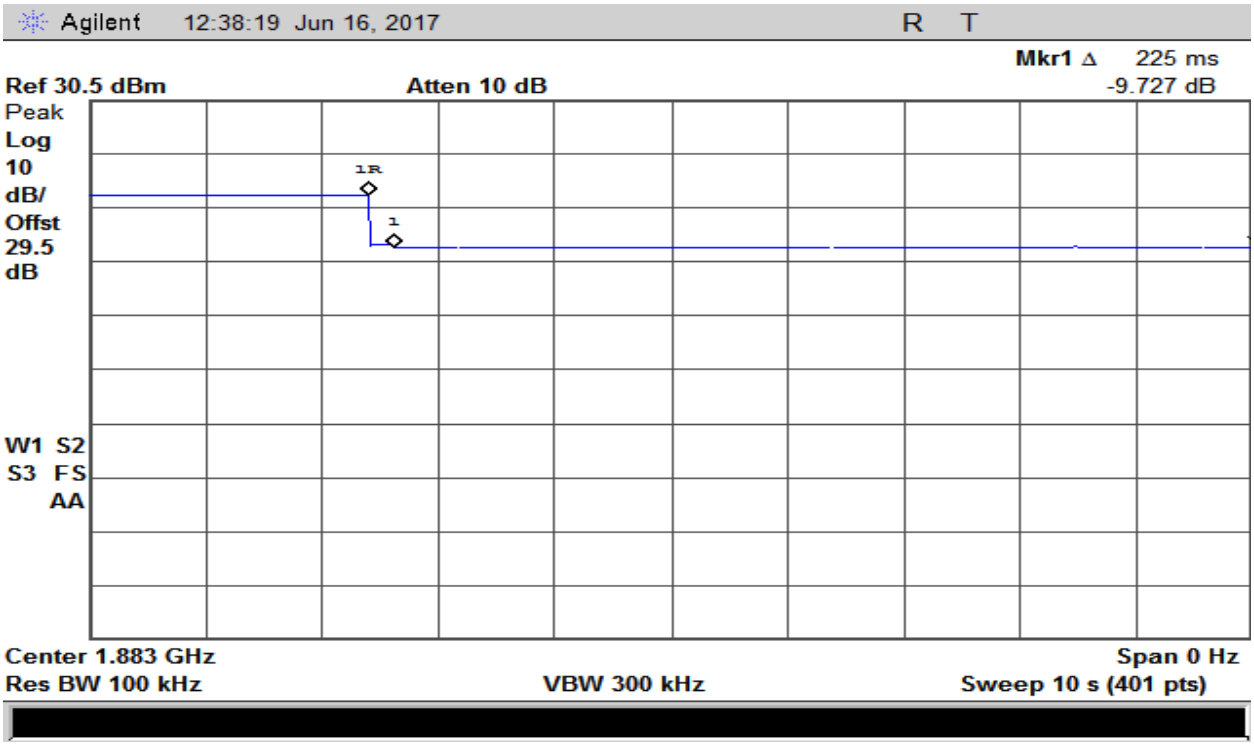
Plot 127 – 776-787MHz Band – Uplink Gain Timing



Plot 128 – 824-849MHz Band – Uplink Gain Timing



Plot 129 – 1710-1755MHz Band – Uplink Gain Timing



Plot 130 – 776-787MHz Band – Uplink Gain Timing

8. Occupied Bandwidth

Test Requirement(s):	§2.1049	Test Engineer(s):	Hoosam B.
Test Results:	Pass	Test Date(s):	Jun/22/2017

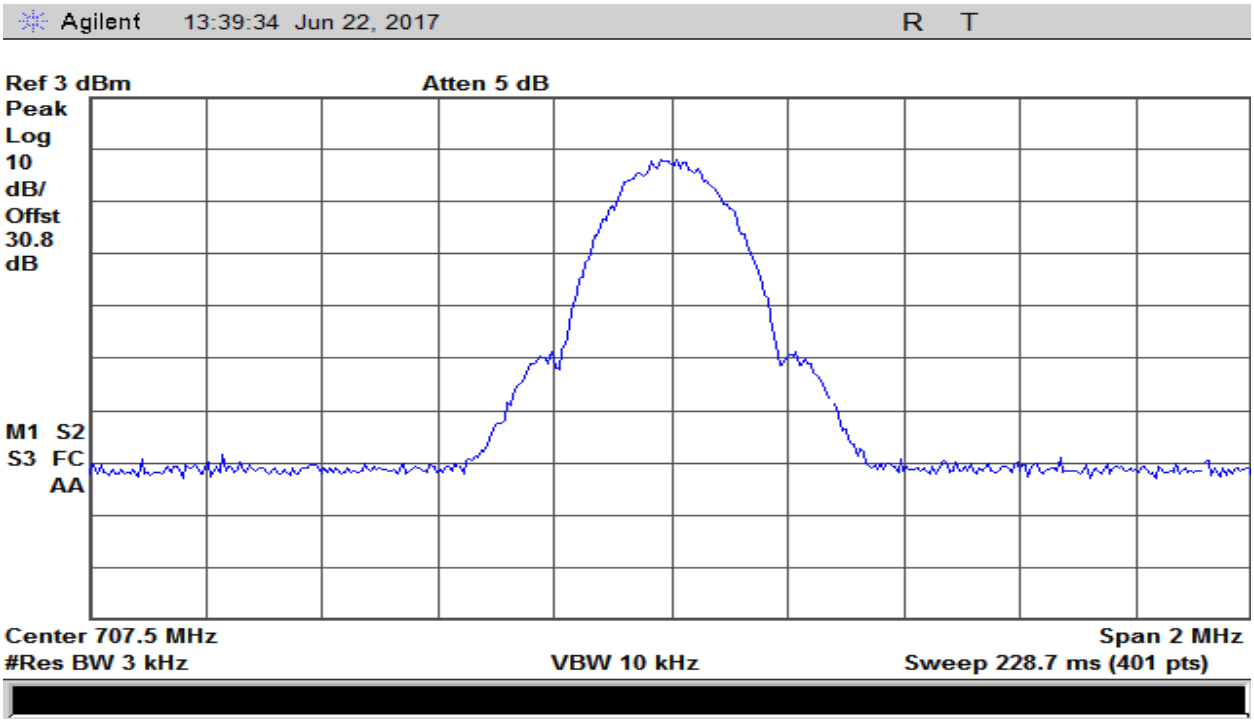
Test Procedures: As required by CFR47 §2.1049, Occupied Bandwidth were made at the RF antenna output terminals of the EUT. Measurements were made as per the FCC KDB 935210 D03 procedures defined in §7.10

The EUT output was connected directly to a spectrum analyzer through an attenuator. A signal generator was connected to the EUT to produce GSM, CDMA & LTE signals to show the input and output signals were similar.

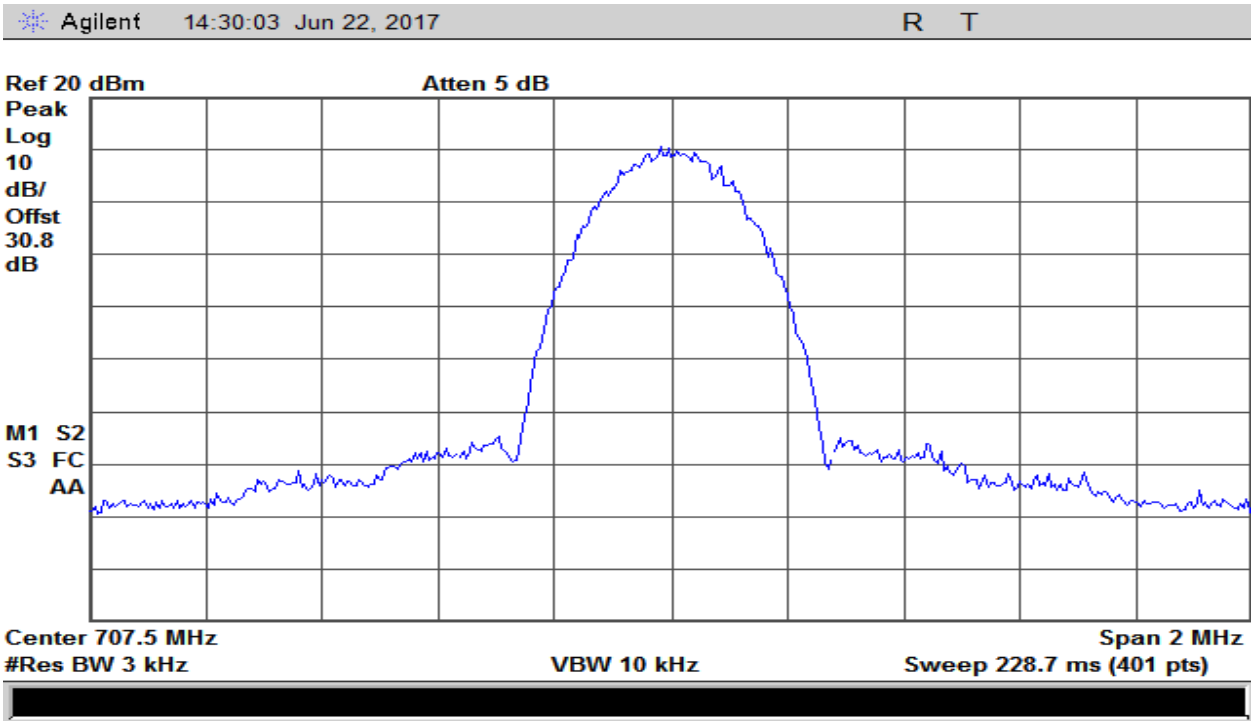
The following pages show measurements of Occupied Bandwidth plots:

Detector Setting	Resolution Bandwidth	Video Bandwidth	Sweep Time	Span
Peak	1% - 5%	≥3 x RBW	Auto	As per Modulation Type

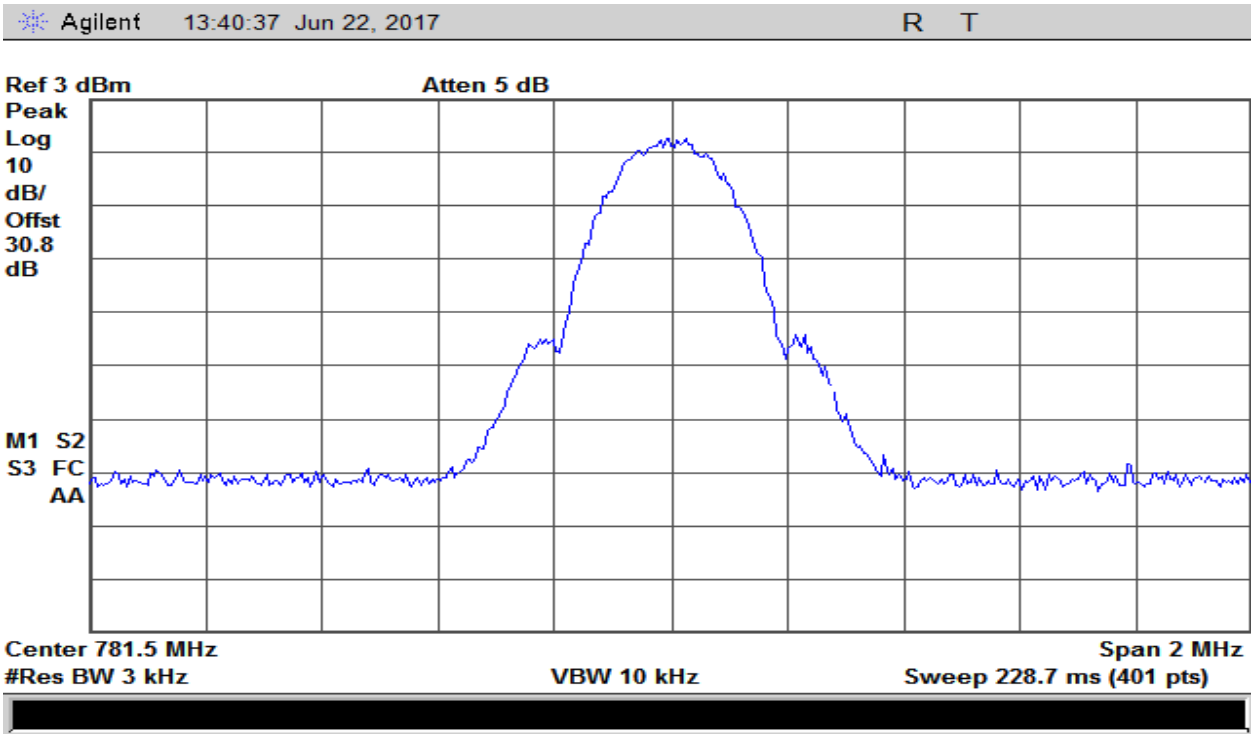
Table 27 – Analyzer Settings



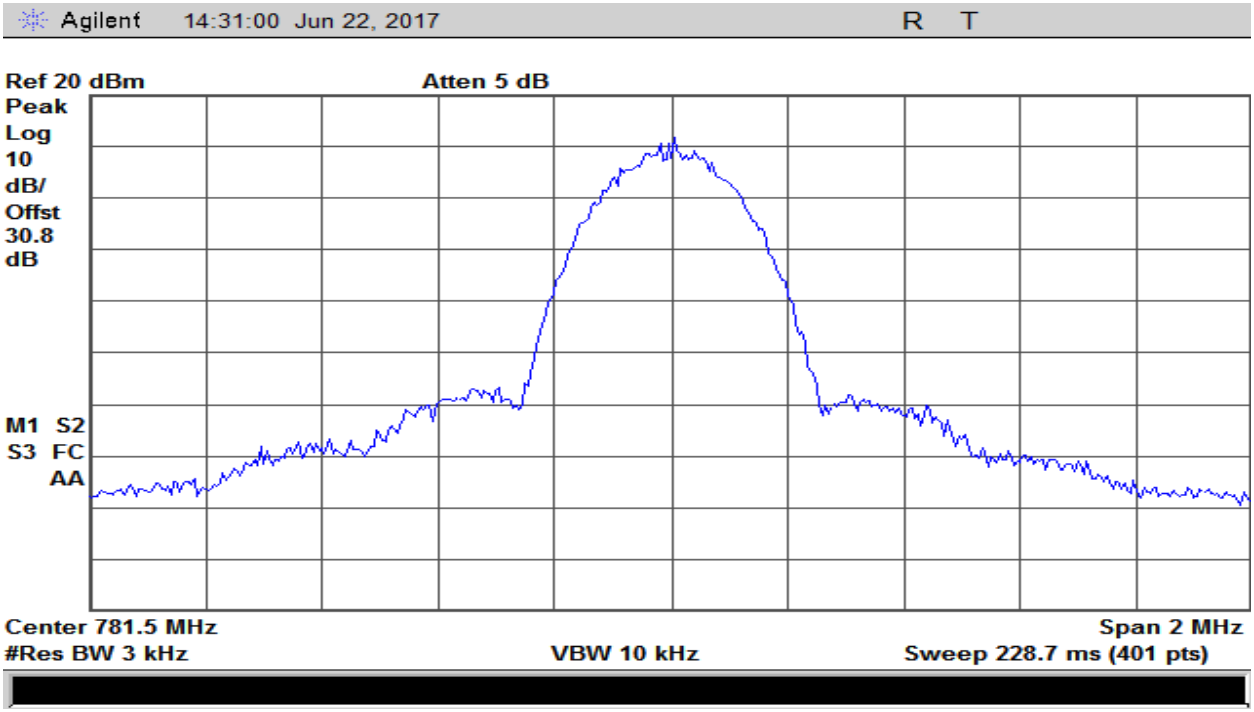
Plot 131 – 698-716MHz Band – Uplink Input – GSM



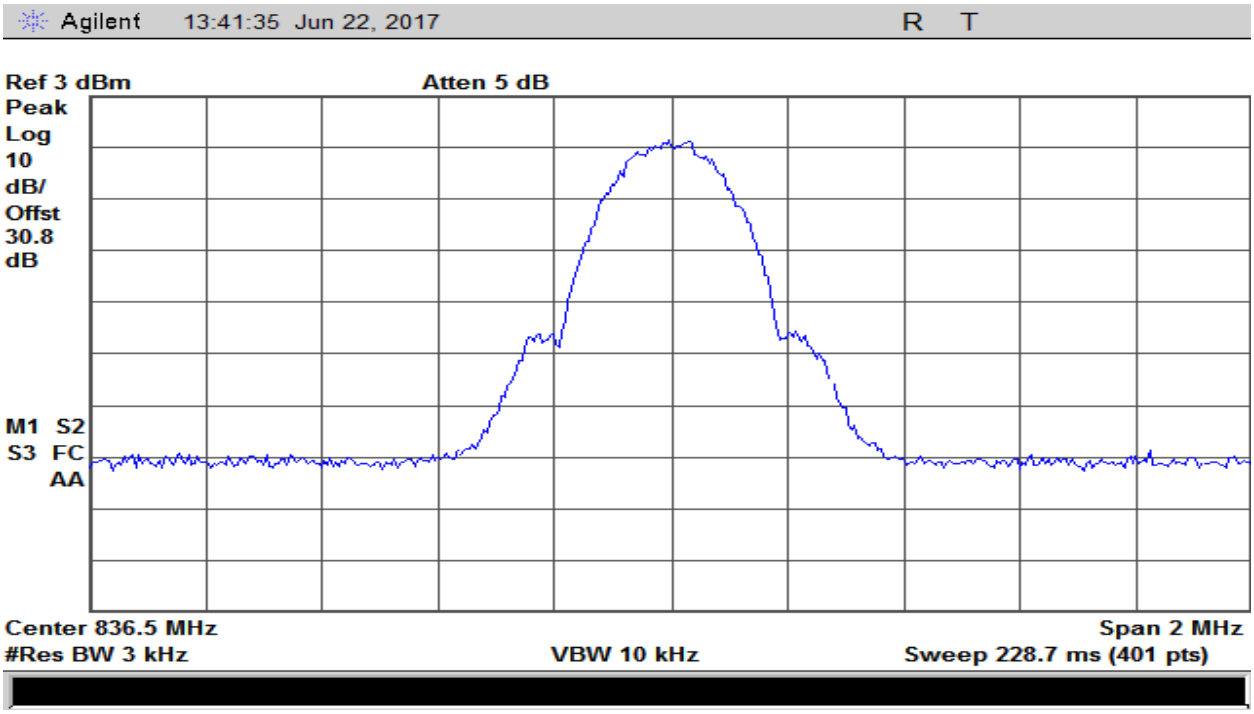
Plot 132 – 698-716MHz Band – Uplink Output – GSM



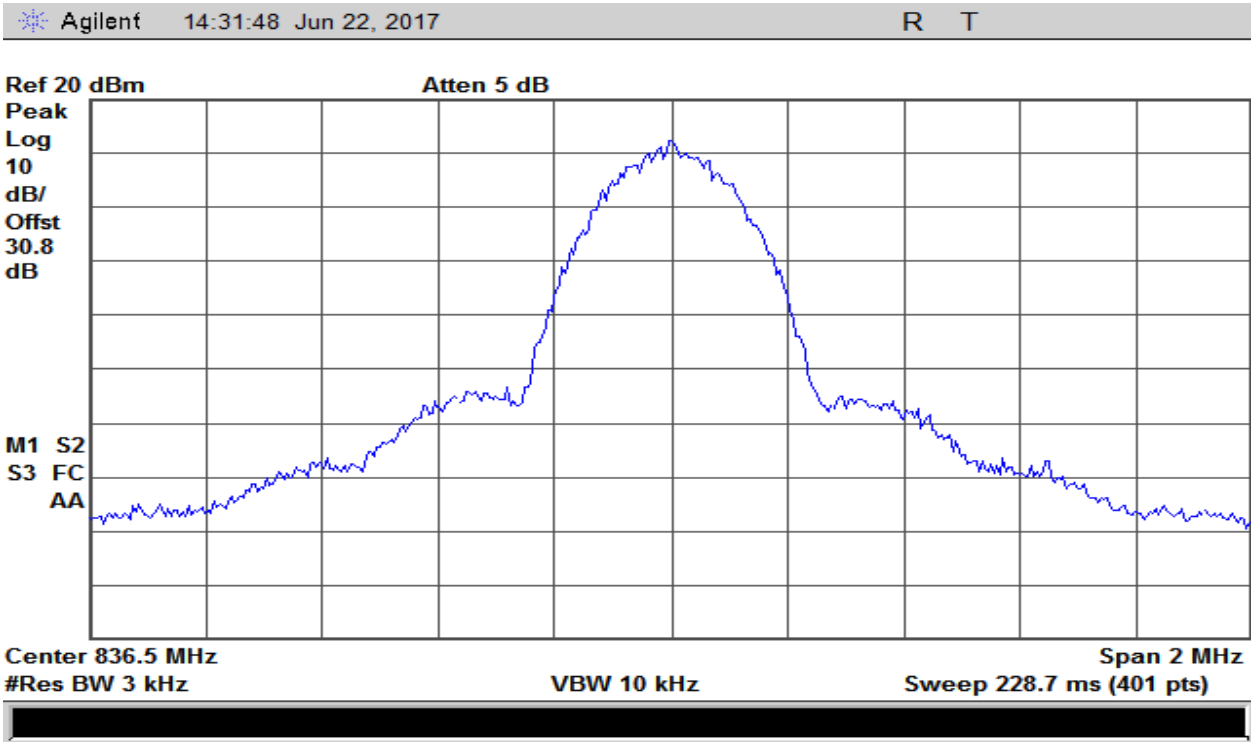
Plot 133 – 776-787MHz Band – Uplink Input – GSM



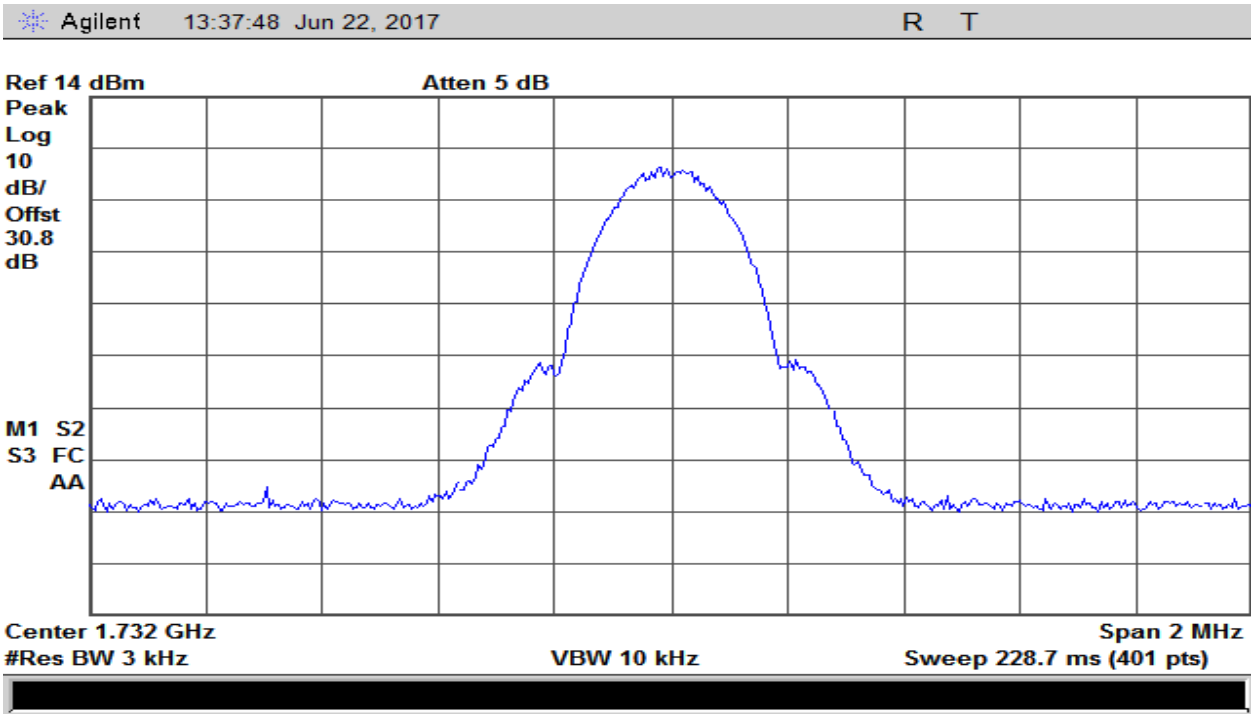
Plot 134 – 776-787MHz Band – Uplink Output – GSM



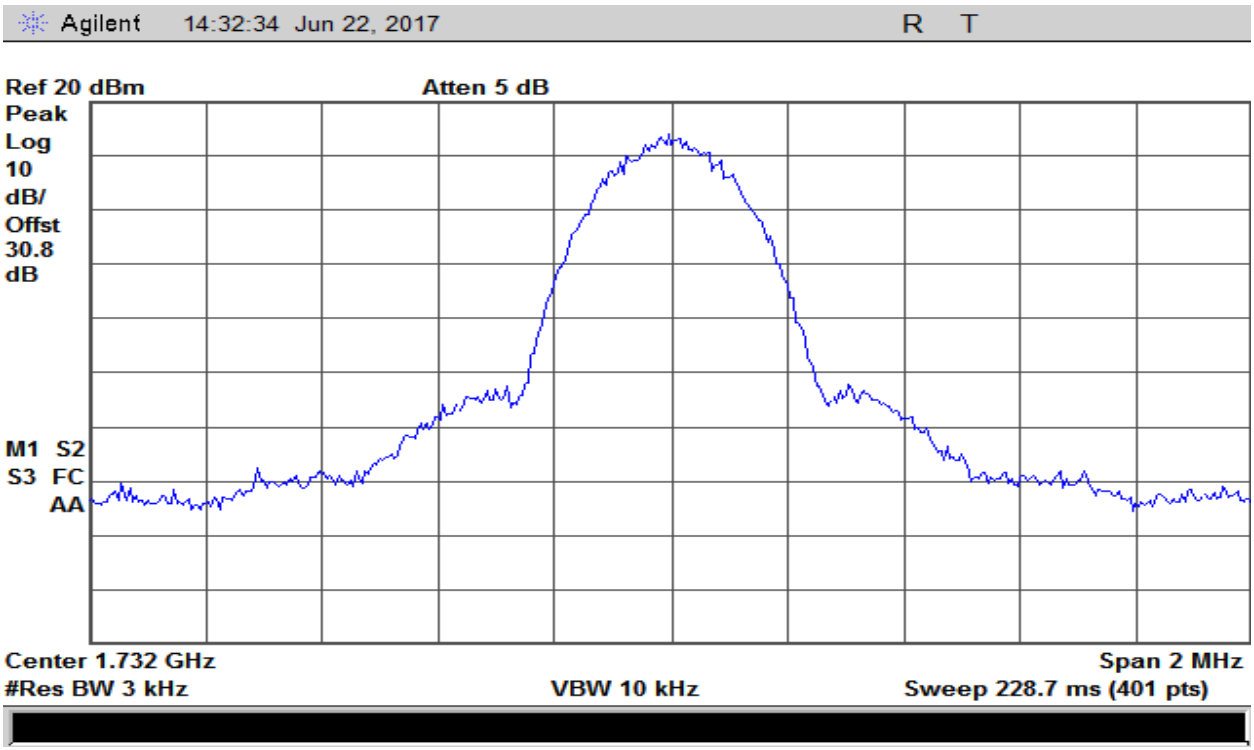
Plot 135 – 824-849MHz Band – Uplink Input – GSM



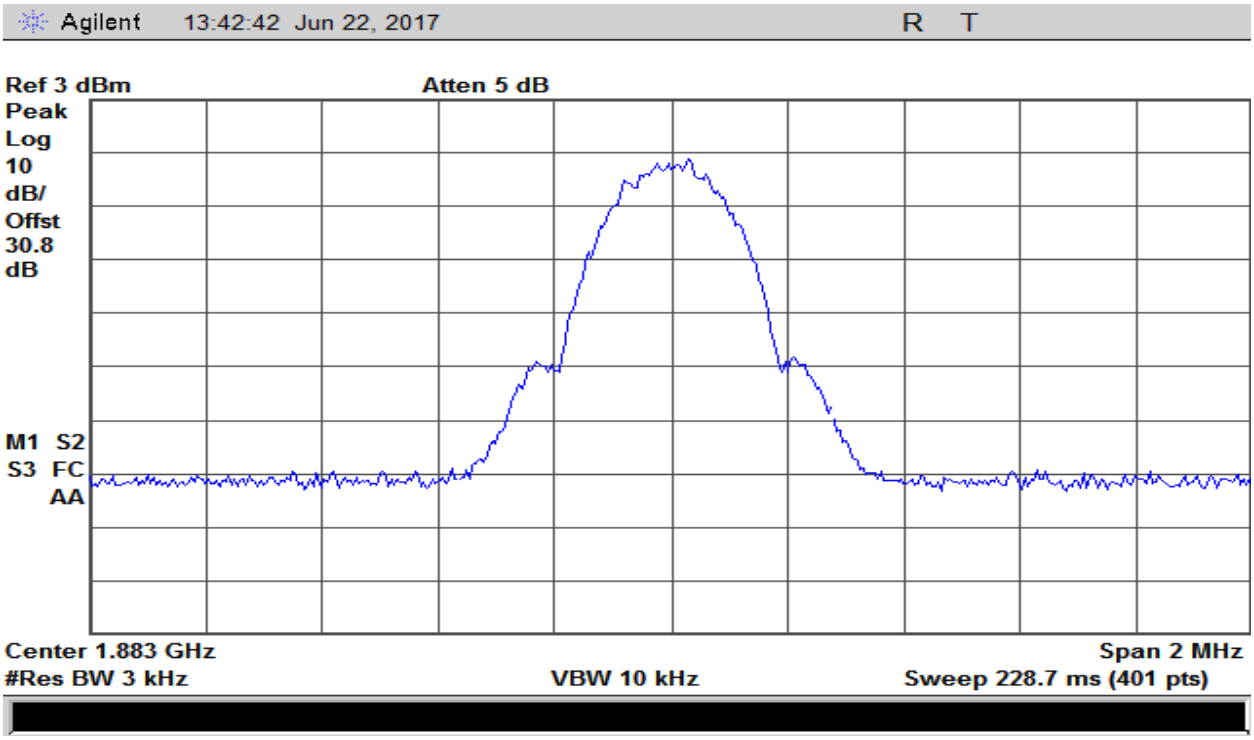
Plot 136 – 824-849MHz Band – Uplink Output – GSM



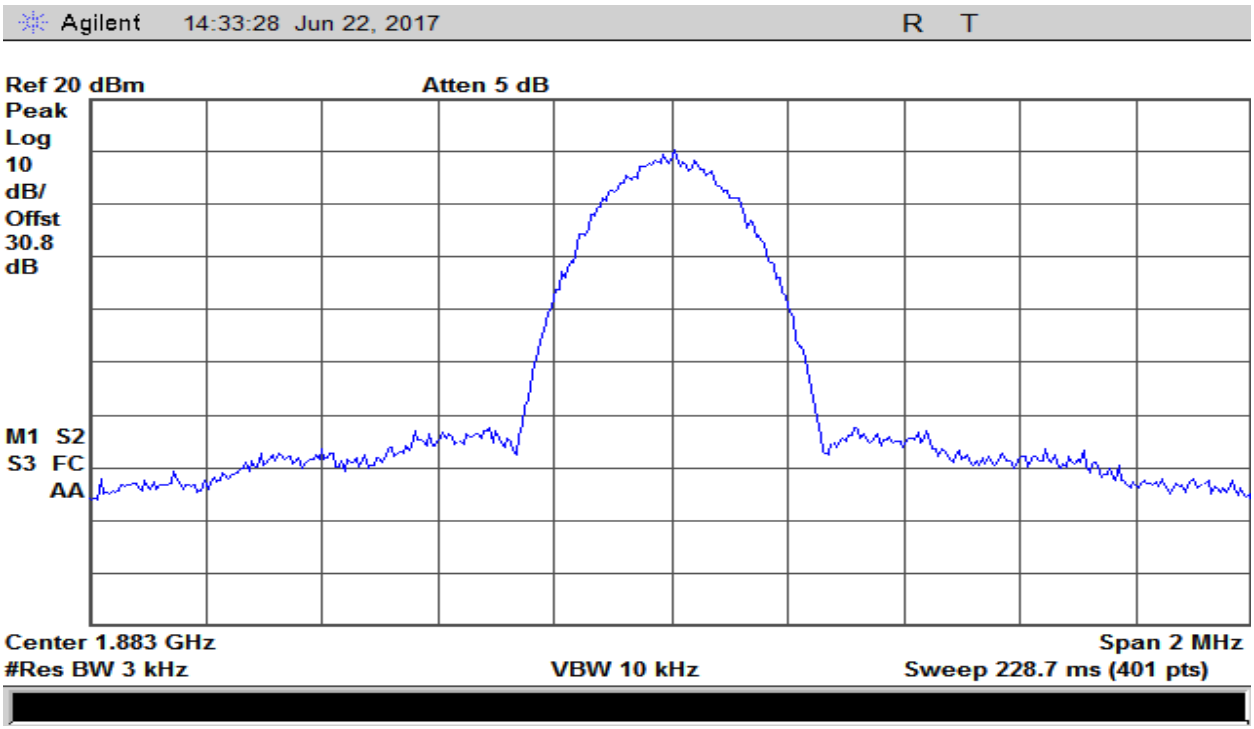
Plot 137 – 1710-1755MHz Band – Uplink Input – GSM



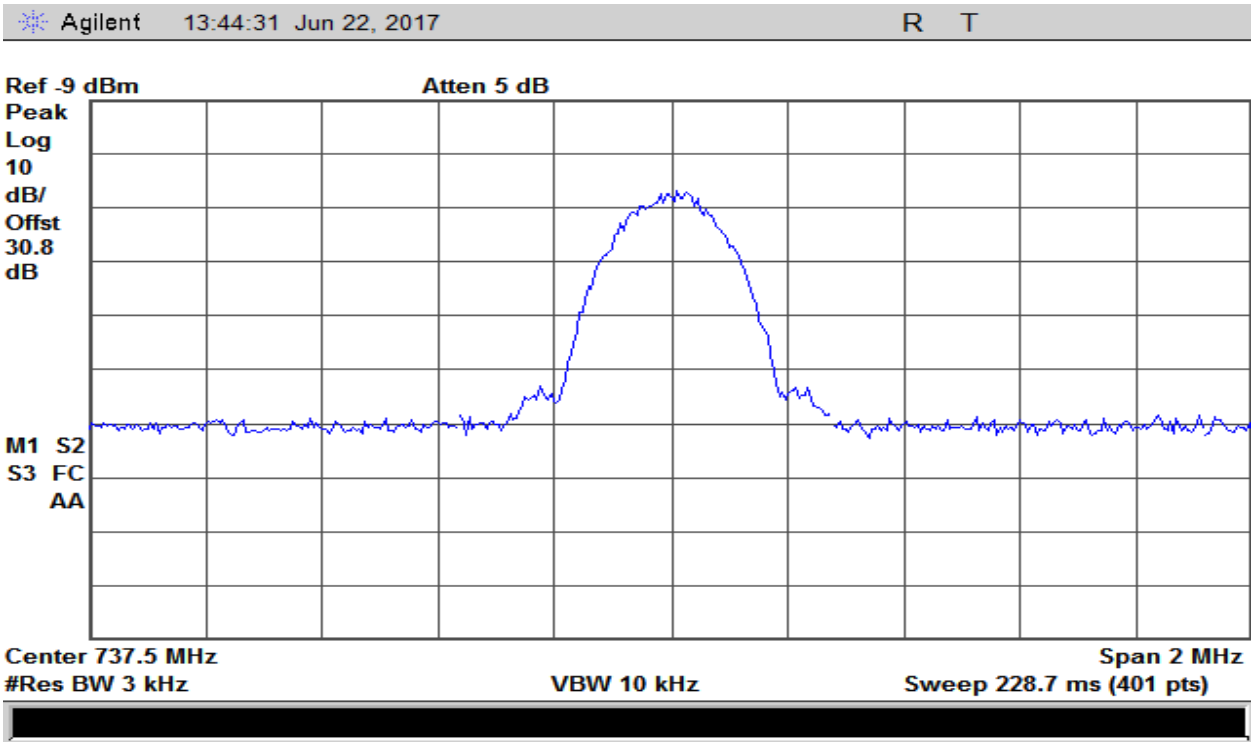
Plot 138 – 1710-1755MHz Band – Uplink Output – GSM



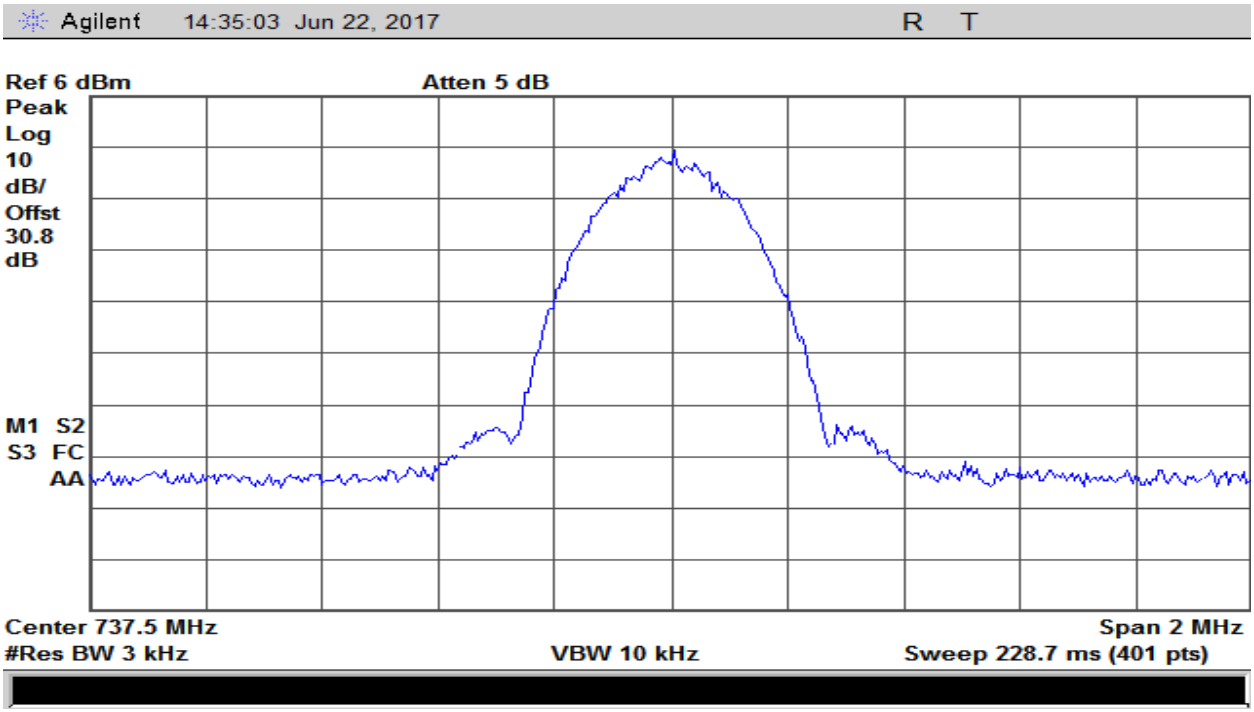
Plot 139 – 1850-1915MHz Band – Uplink Input – GSM



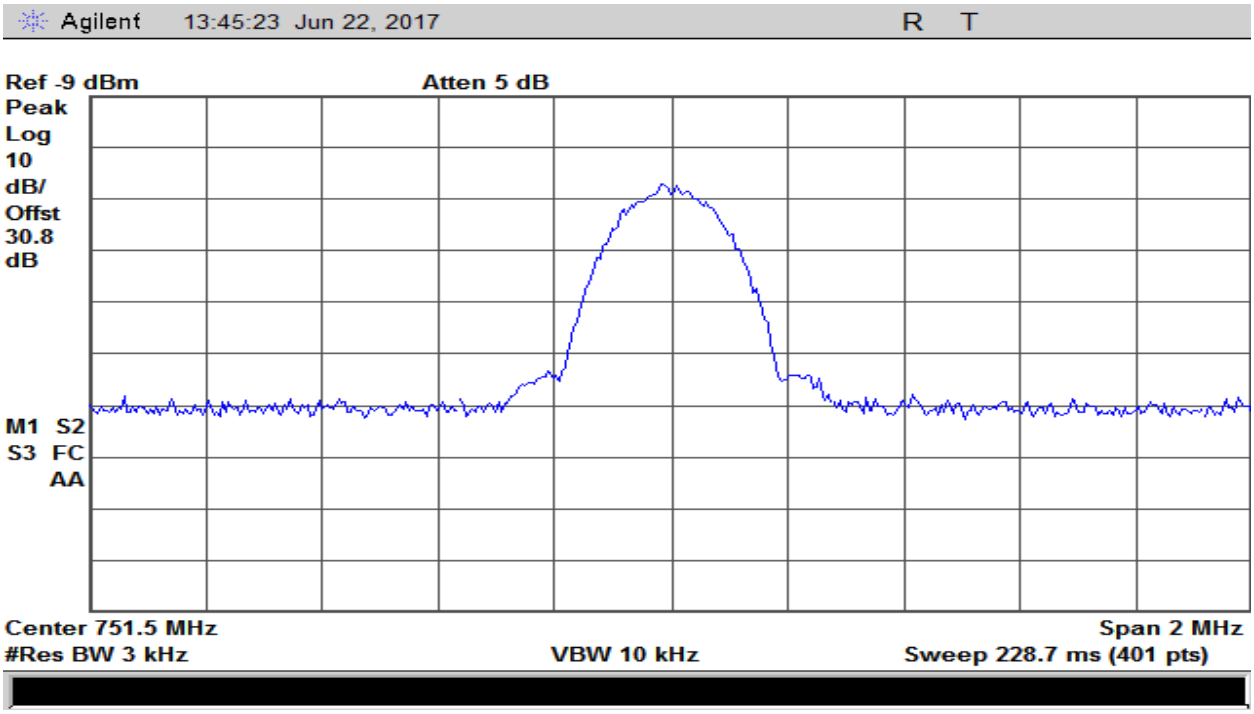
Plot 140 – 1850-1915MHz Band – Uplink Output – GSM



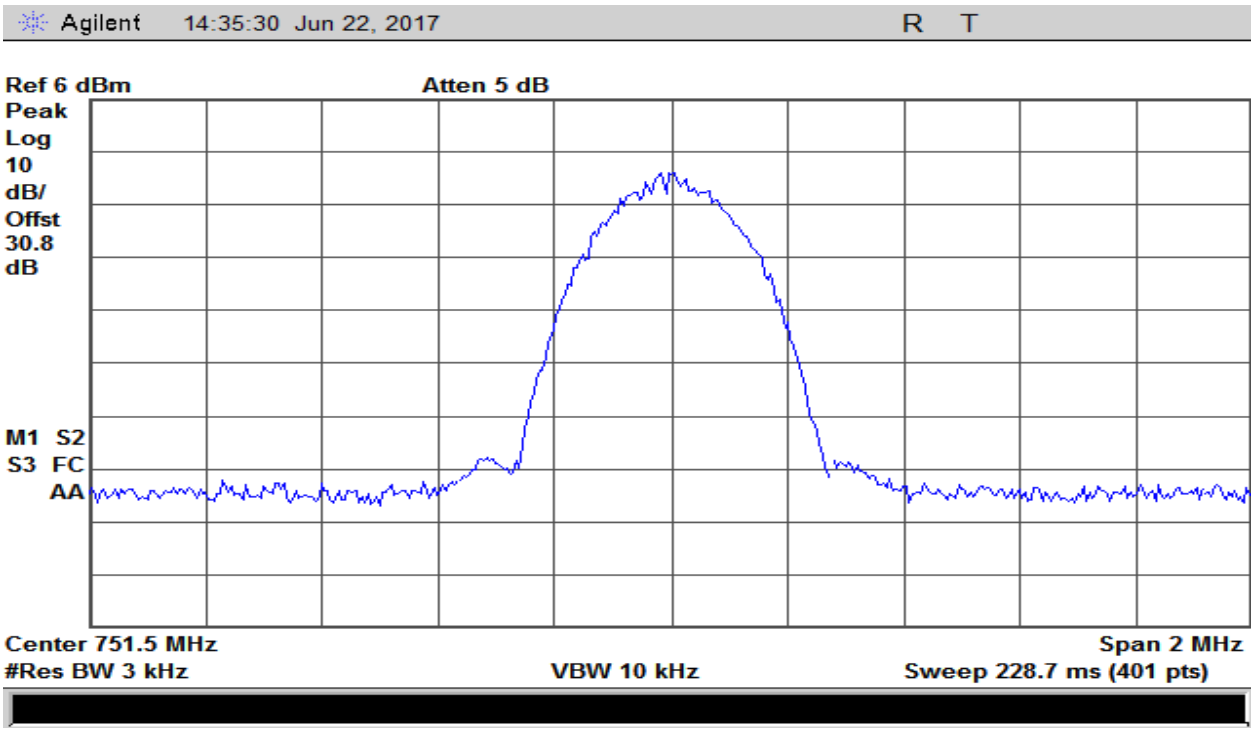
Plot 141 – 728-746MHz Band – Downlink Input – GSM



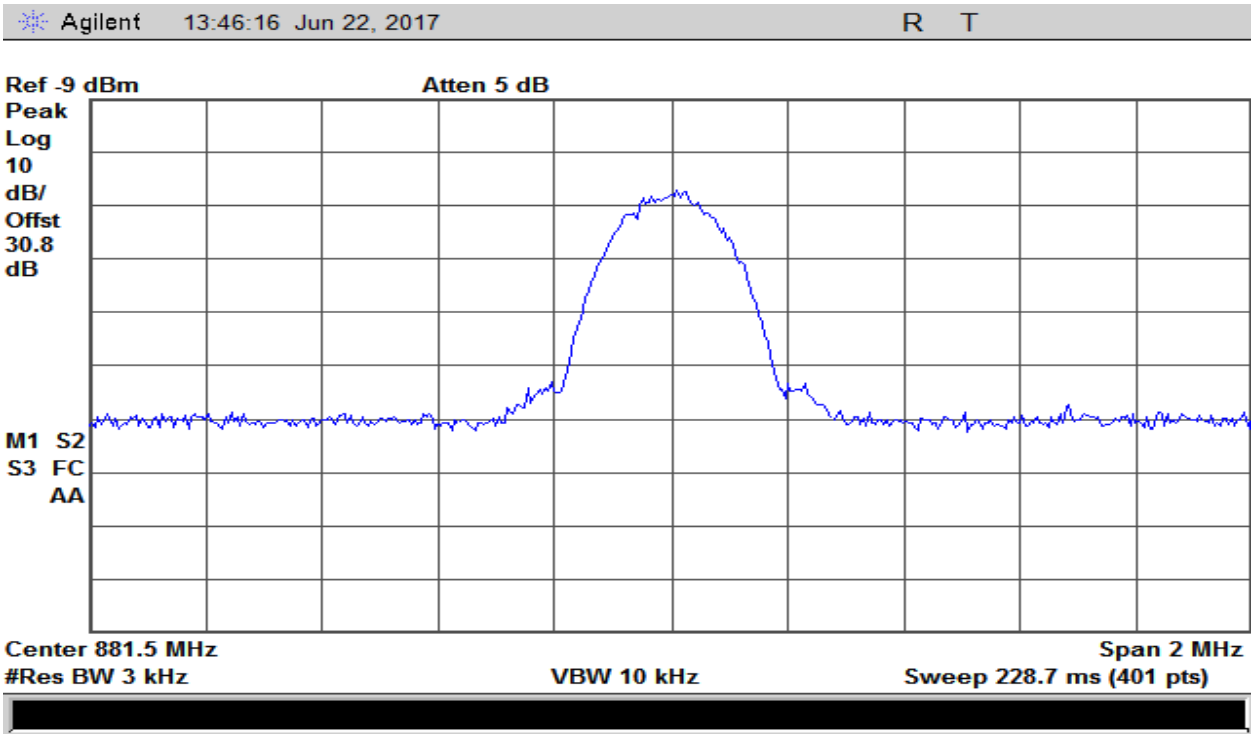
Plot 142 – 728-746MHz Band – Downlink Output – GSM



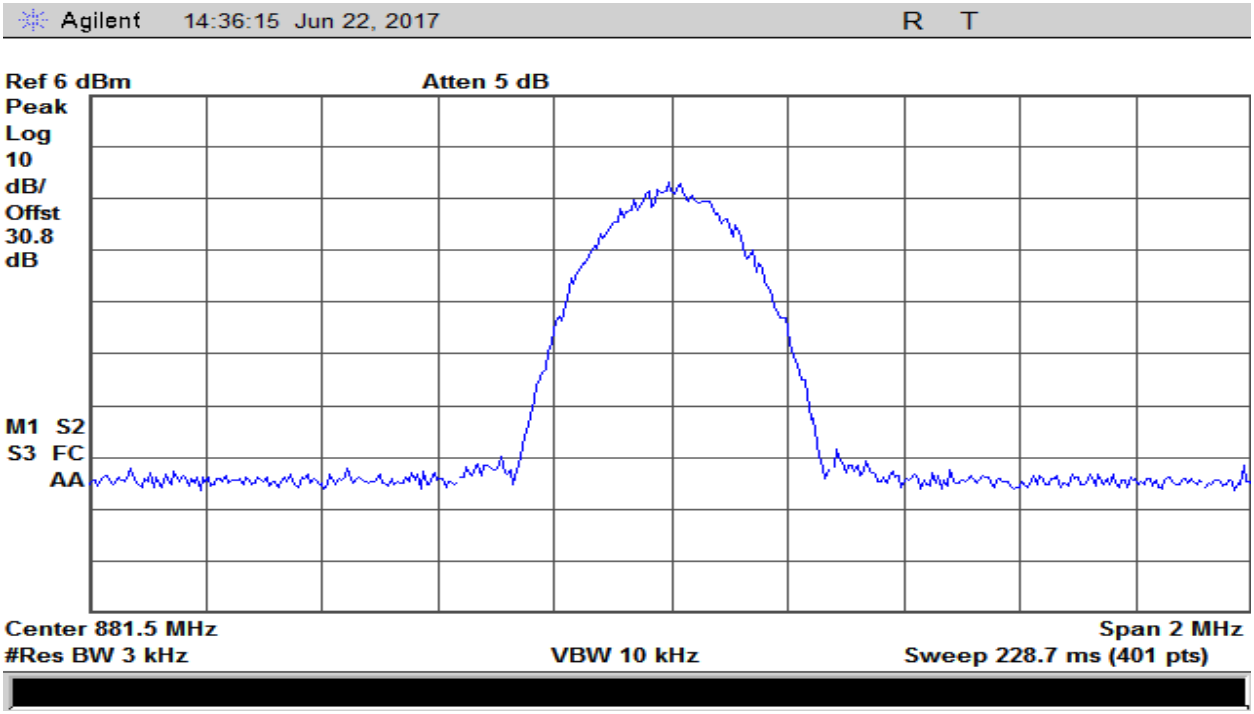
Plot 143 – 746-757MHz Band – Downlink Input – GSM



Plot 144 – 746-757MHz Band – Downlink Output – GSM



Plot 145 – 869-894MHz Band – Downlink Input – GSM



Plot 146 – 869-894MHz Band – Uplink Output – GSM