H.B. Compliance Solutions

Intentional Radiator Test Report

For the

Wilson Electronics.

IoT 5-Band Signal Booster

Tested under

The FCC Rules contained in Title 47 of the CFR, Part 20 and ISED RSS-131 Issue 4

For Mobile Direct Connect Wideband Consumer Signal Booster

Prepared for:

Wilson Electronics

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St. George, UT 84790

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, and the emissions from this equipment were found to be within the limits applicable. 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	May 30, 2024	Initial Issue

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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 and RSS-GEN Issue 5 and RSS-131 Issue 4. All tests were conducted using measurement procedure from ANSI C.63.26 2015 and FCC Signal Booster Measurement KDB 935210 D03 v04r04 Apr 03, 2020 as appropriate.

Test Name	Test Method/FCC Standard	ISED Standard	Result	Comments
Authorized Frequency Band	20.21(e)(3)	§4.7.2	Pass	
Maximum Power & Booster Gain	20.21(e)(8)(i)(B) 20.21(e)(8)(i)(C) 20.21(e)(8)(i)(D)	§6.2, §7.2 & §7.4	Pass	
Intermodulation	20.21(e)(8)(i)(F)	§7.6	Pass	
Out-of-Band Emissions	20.21(e)(8)(i)(E)	§7.5	Pass	
Conducted Spurious Emissions	2.1051	§7.5	Pass	
Noise Limits/Transmit power off mode	20.21(e)(8)(i)(A) 20.21(e)(9)(i)(I)	§7.1, §7.3 & §7.7	Pass	Noise is less than -70dBm/MHz
Uplink Inactivity	20.21(e)(8)(i)(I) 20.21(e)(9)(i)(J)	§7.7	Pass	
Variable Booster Gain	20.21(e)(8)(i)(C)	§6.1.2 & §7.2	Pass	
Occupied Bandwidth	2.1049	RSS-Gen §6.7	Pass	
Oscillation Detection	20.21(e)(8)(ii)(A)	§6.1.1	Pass	
Radiated Spurious Emissions	2.1053	RSS-Gen §6.13	Pass	
Spectrum Block Filtering	20.21(e)(8)(i)(B)	§6.2	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 IoT 5-Band Signal Booster under the purchase order number PO012682.

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, IoT 5-Band Signal Booster.

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:	IoT 5-Band Signal Booster
Model(s) Tested:	460079 Signal
FCC ID:	PWO079
IC ID:	4726A-079
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:	0.0002 – 0.23W
Emission Designator:	F9W, GXW, G7W & G7D, W7D
Channel Spacing(s)	N/A
Test Item:	Pre-Production
Type of Equipment:	Mobile Direct Connect Wideband Consumer Booster
Firmware Version:	V4.04
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):	03/11/2024 – 05/21/2024

2. Test Facility

All testing was performed at H.B. Compliance Solutions. This facility is located at 5005 S. Ash Avenue, Suite # A-10, Tempe AZ-85282. All equipment used in making physical determination is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements from 30MHz to 1GHz were performed in a GTEM chamber (equivalent to an Open Area Test Site). Radiated Emission above 1GHz were performed on an Open Area Test Site (OATS). In accordance with §2.948(a)(3), a complete site description is contained at H.B. Compliance Solutions.

Test facility H.B. Compliance Solutions is an ANAB accredited test site. The ANAB certificate number is L2458. The scope of accreditation can be found on ANAB website www.anab.org

ISED Test Site Registration number is 9481A

3. Description of Test Sample

The WilsonPro IoT 5-Band is a "Direct-Connect" solution for amplifying cellular network capable equipment and devices, including vending machines, ATMs, security panels, and cellular "hotspots". The amplifier's outside Donor port is connected to an external antenna and inside server port is connected to host devices located inside the building. The components are contained in a metal enclosure.

4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
# 1	IoT 5-Band Bi-Directional Amplifier	460079	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 #
# 2	AC/DC Power Adaptor	Frontpower	YL241-1202000U	-

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
# 3	Power	2 wire	1	1.5	N	AC/DC Power Adaptor

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 each section of this 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

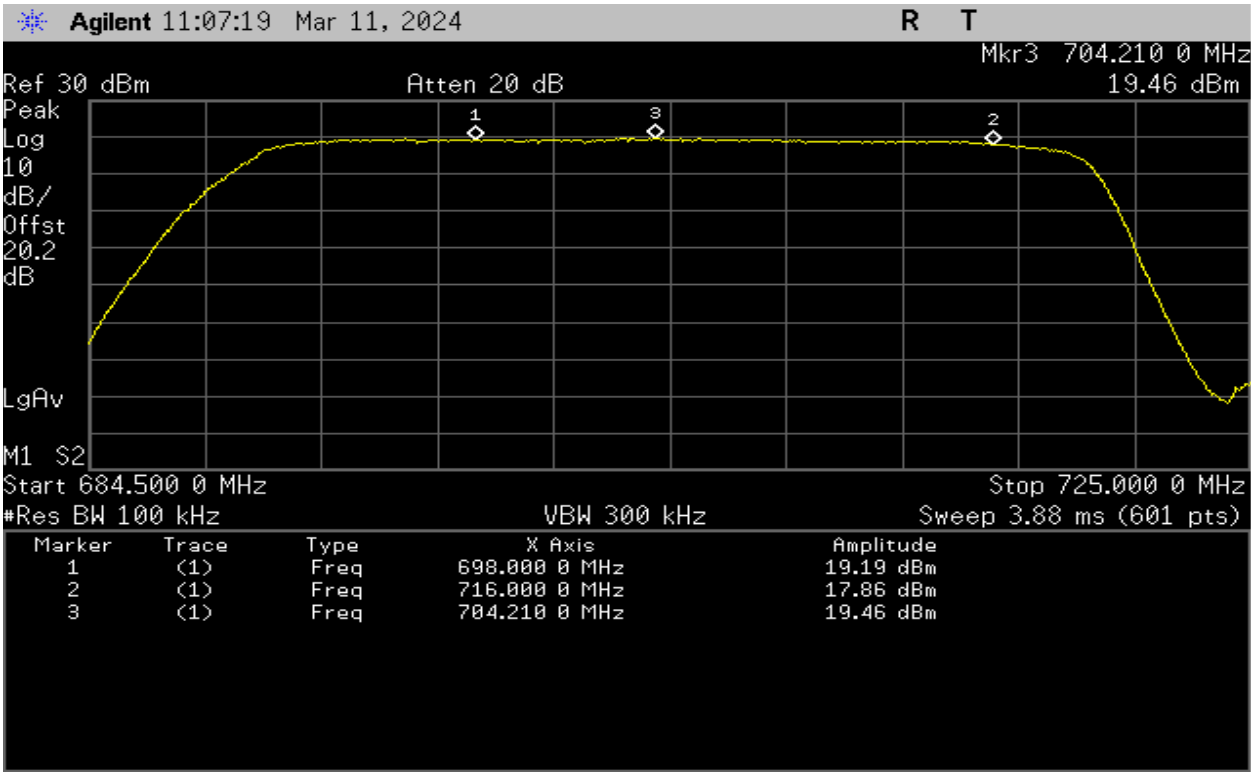
Test Requirement(s):	§20.21(e)(3) and RSS-131 §4.7.2	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	March 11, 2024

Test Procedures: As required by 47 CFR §20.21(e)(3) and RSS-131 §4.7.2, Authorized frequency band measurements were made at the RF output terminals of the EUT.

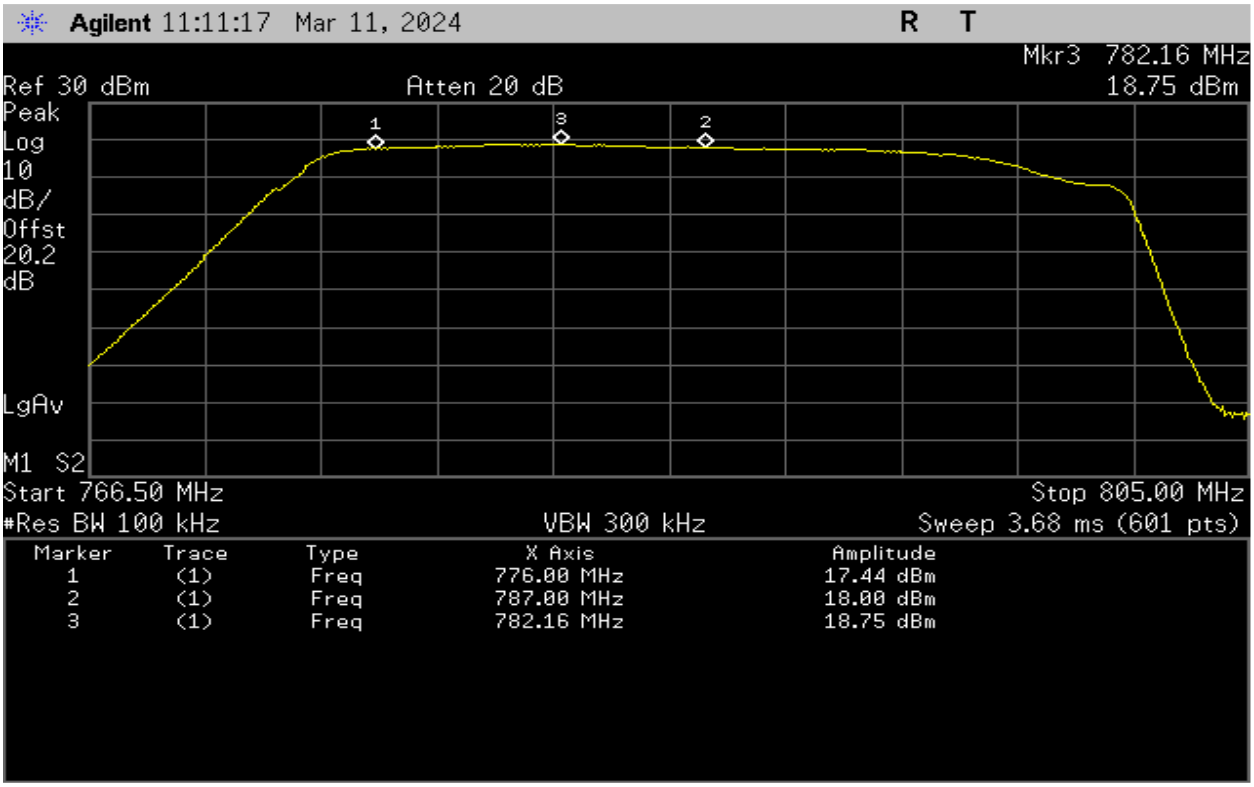
The EUT was connected through an attenuator to a Spectrum Analyzer. A signal generator was used for the input to the EUT to provide a CW signal swept over twice the width of each uplink and downlink operational band. Measurements were made at the low and high channels of each uplink and downlink frequency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

Test Setup:

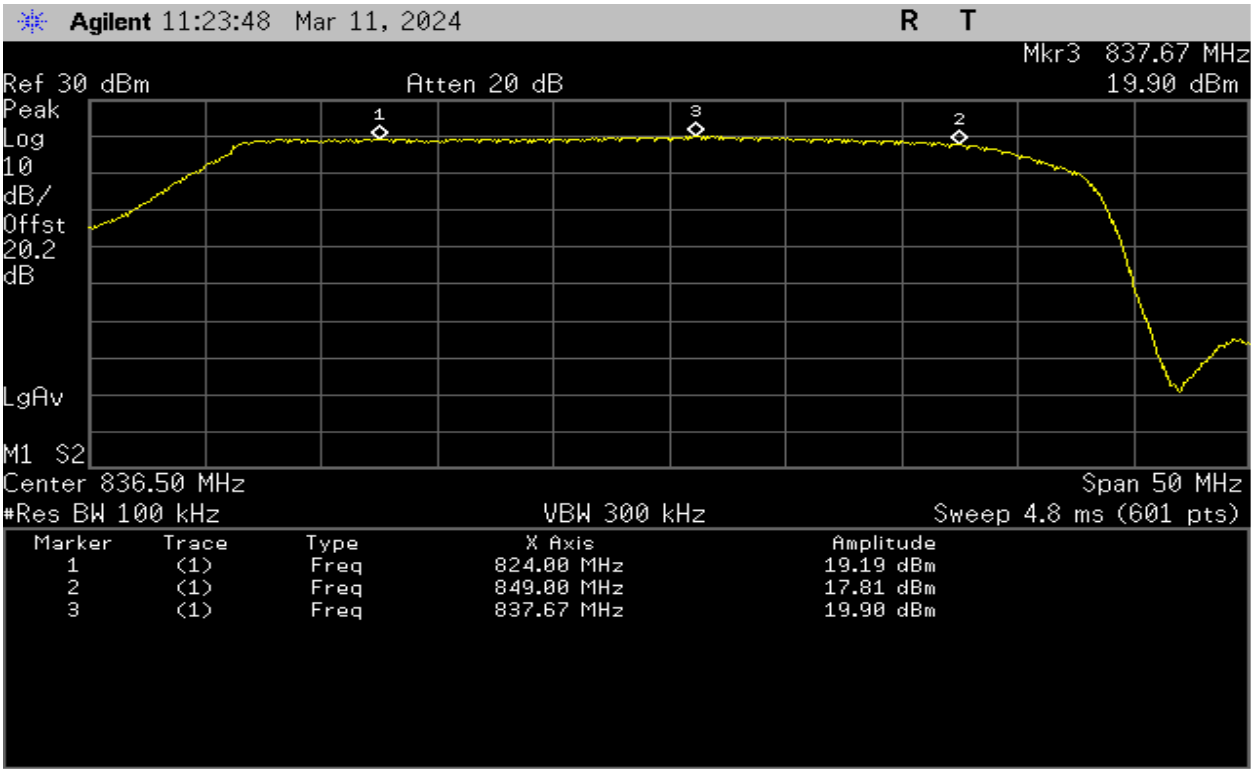
Figure 1 – Band Verification



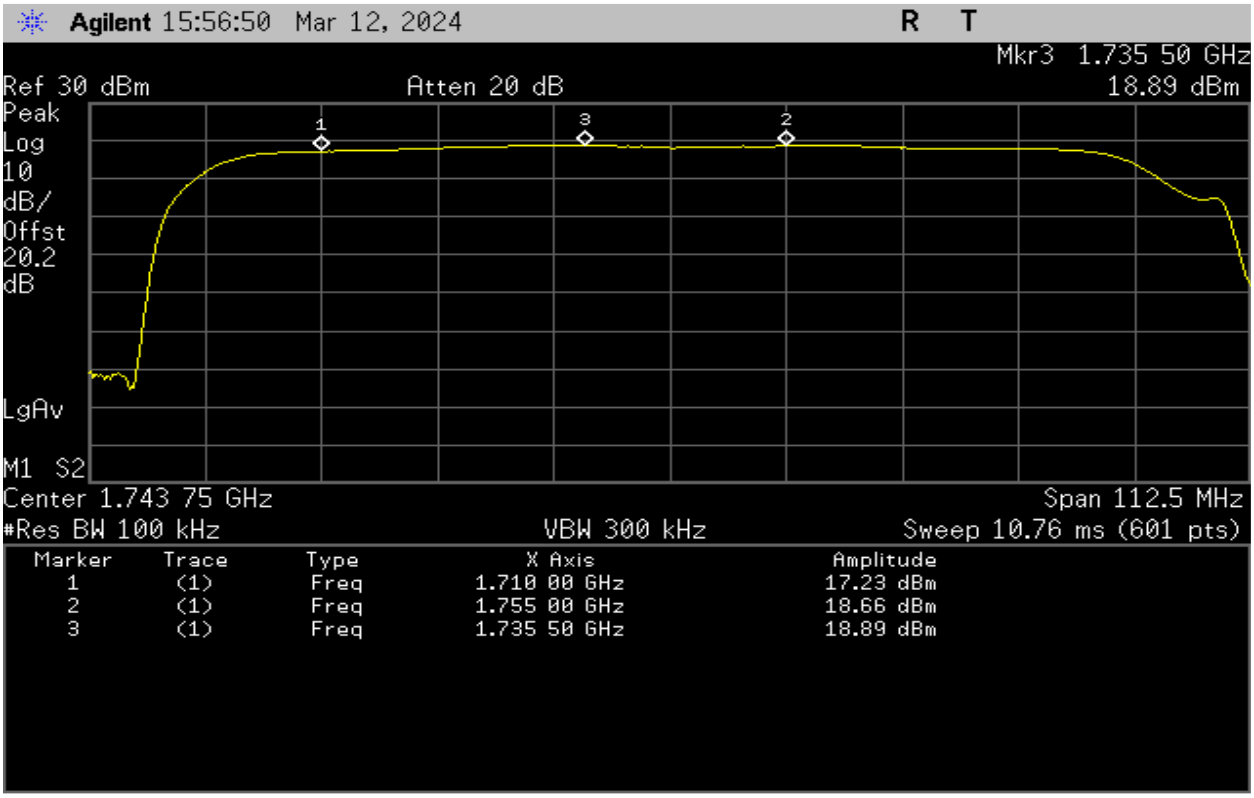
Plot 1 – 698-716MHz Band – Uplink



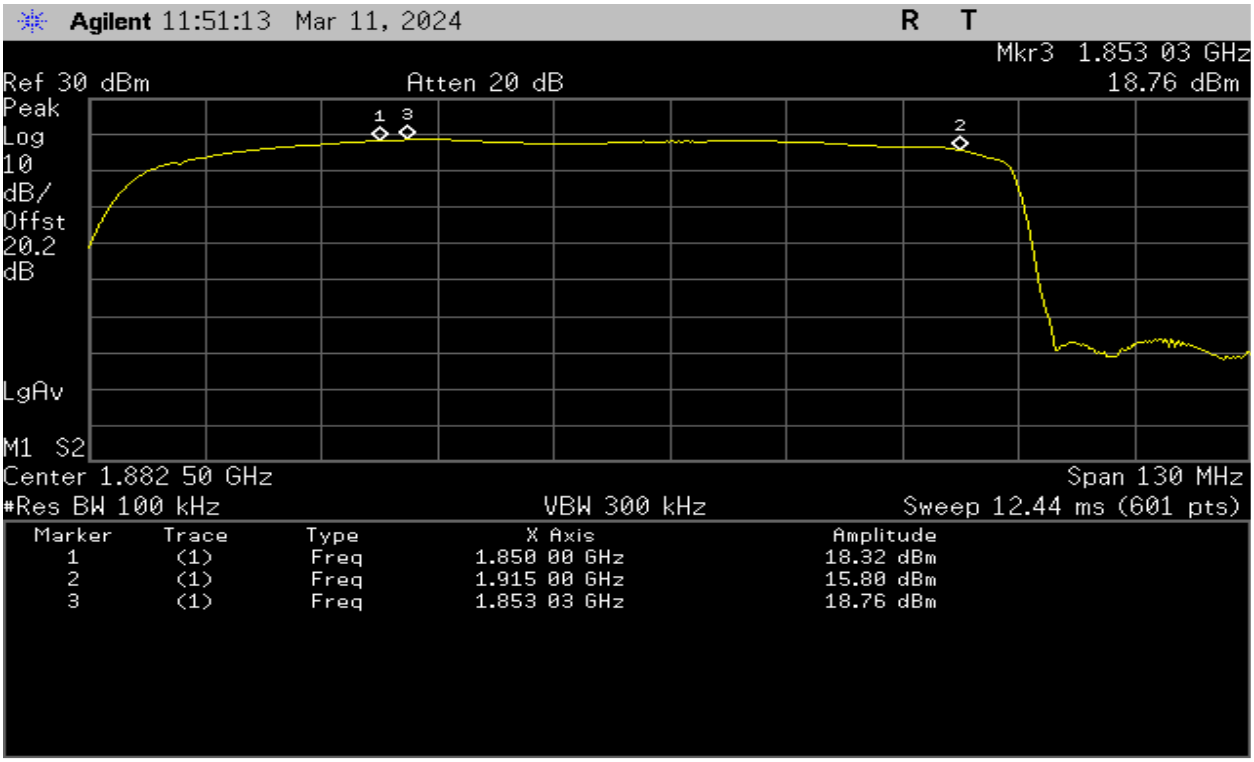
Plot 2 – 776-787MHz Band – Uplink



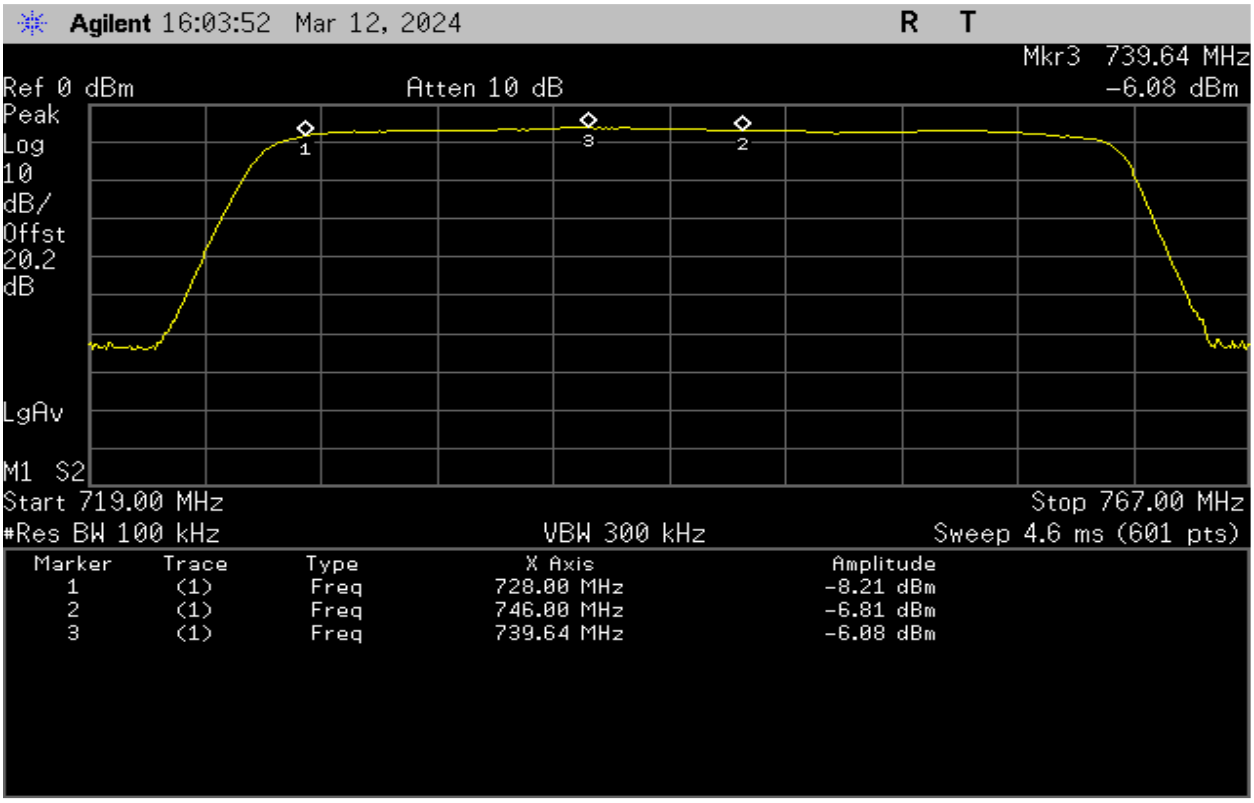
Plot 3 – 824-849MHz Band – Uplink



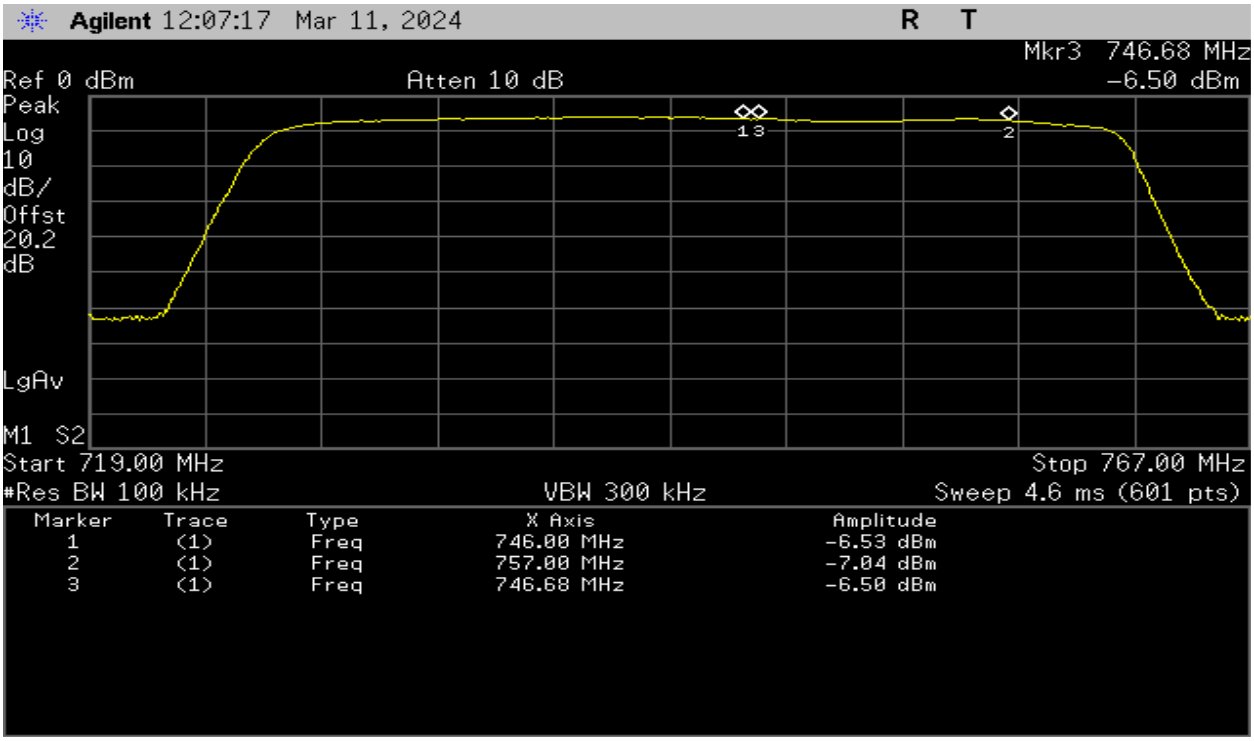
Plot 4 – 1710-1755MHz Band – Uplink



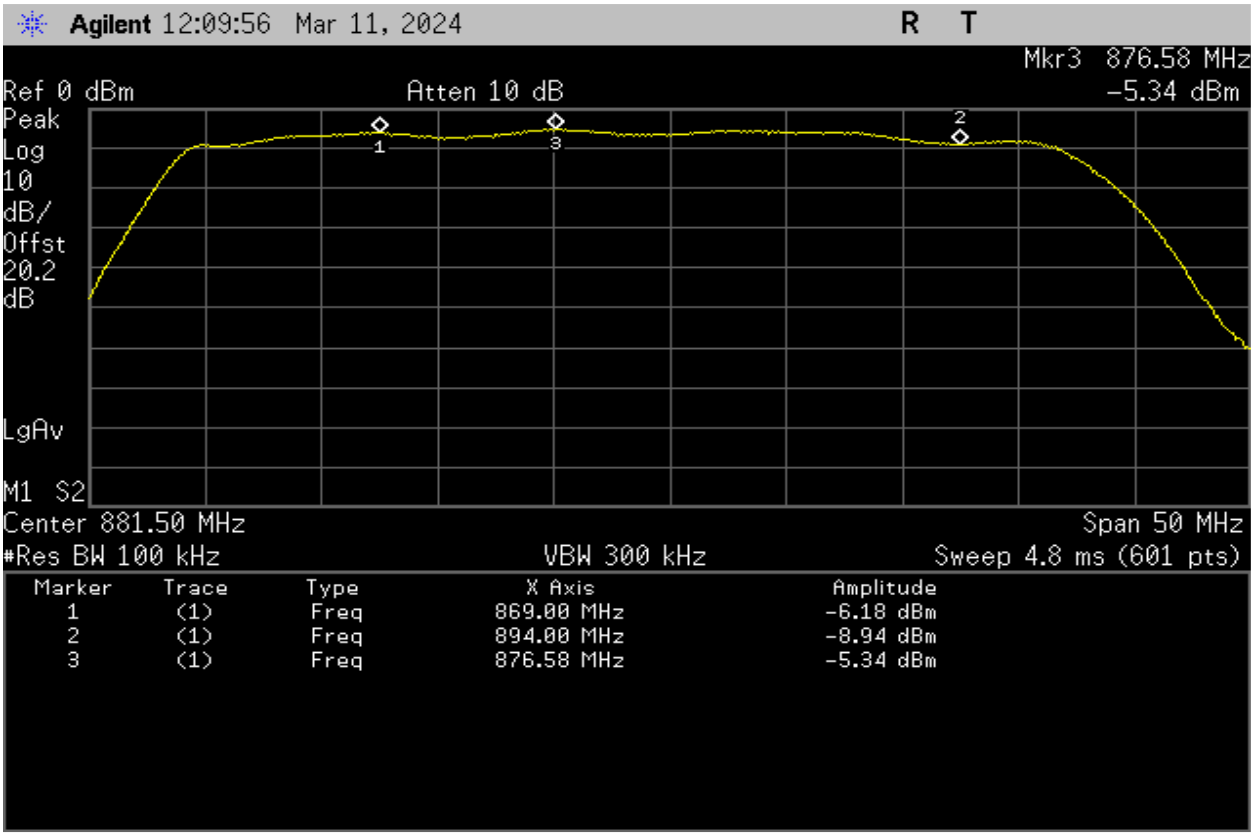
Plot 5 – 1850-1915MHz Band – Uplink



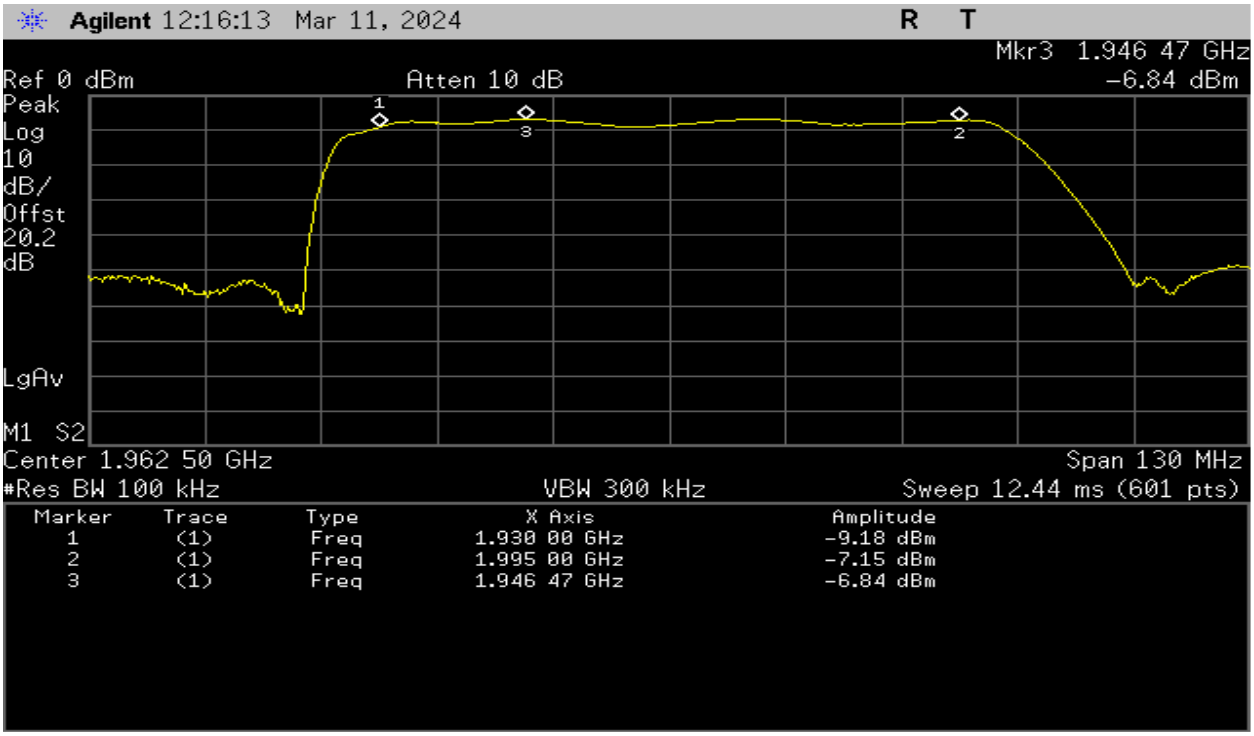
Plot 6 – 728-746MHz Band – Downlink



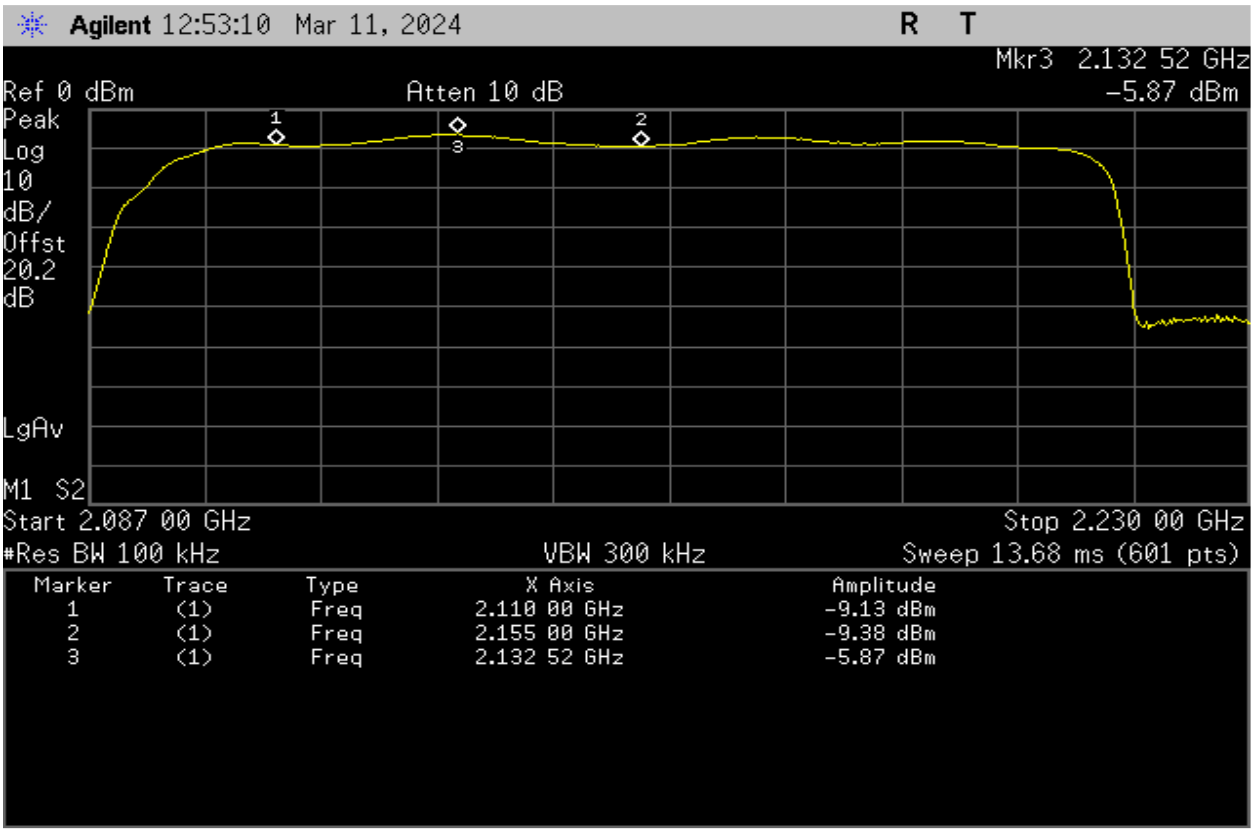
Plot 7 – 746-757MHz Band – Downlink



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) and RSS-131 §6.2, §7.2 & §7.4	Test Engineer(s):	Sean E.
Test Results:	Pass	Test Date(s):	March 12, 2024

Test Procedure: As required by 47 CFR 20.21(e)(8)(i)(D) and RSS-131 §6.2, §7.2 & §7.4: 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 99% of 4.1MHz bandwidth signal tuned to the highest gain 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 of Mobile Direct Connect Booster and to calculate the maximum gain.

Test Results:

Frequency (MHz)	Input Level (dBm)	Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Lower Limit (dBm)	Upper Limit (dBm)
698-716 GSM	8.7	23.11	2.0	25.11	17	30
698-716 AWGN	9.4	23.14	2.0	25.14	17	30
776-787 GSM	8.9	23.61	2.0	25.61	17	30
776-787 AWGN	9.4	23.32	2.0	25.32	17	30
824-849 GSM	8.6	22.77	2.0	24.77	17	30
824-849 AWGN	9.4	22.82	2.0	24.82	17	30
1710-1755 GSM	8.9	23.4	5.0	28.4	17	30
1710-1755 AWGN	9.6	23.77	5.0	28.77	17	30
1850-1915 GSM	8.4	22.78	5.0	27.78	17	30
1850-1915 AWGN	9.5	23.58	5.0	28.58	17	30

Table 1. Uplink Max Power Test Results

Frequency (MHz)	Input Level (dBm)	Output Power (dBm)	Upper Limit (dBm)
728-746 GSM	-20	-6.16	17
728-746 AWGN	-20	-6.28	17
746-757 GSM	-20	-6.67	17
746-757 AWGN	-20	-6.76	17
869-894 GSM	-20	-5.57	17
869-894 AWGN	-20	-5.76	17
1930-1995 GSM	-20	-6.88	17
1930-1995 AWGN	-20	-7.04	17
2110-2155 GSM	-20	-6.75	17
2110-2155 AWGN	-20	-6.82	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	704.21	739.64	14.41	15	13.84	15	0.57	9	-8.43
AWGN	704.21	739.64	13.74	15	13.72	15	0.02	9	-8.98
GSM	782.16	746.68	14.71	15	13.33	15	1.38	9	-7.62
AWGN	782.16	746.68	13.92	15	13.24	15	0.68	9	-8.32
GSM	837.67	879.87	14.17	15	14.43	15	0.26	9	-8.74
AWGN	837.67	879.97	13.42	15	14.24	15	0.82	9	-8.18
GSM	1735.50	2132.52	14.5	15	13.12	15	1.38	9	-7.62
AWGN	1735.50	2132.52	14.17	15	12.96	15	1.21	9	-7.79
GSM	1853.03	1946.47	14.38	15	13.25	15	1.13	9	-7.87
AWGN	1853.03	1946.47	14.08	15	13.18	15	0.9	9	-8.1

Table 3. Maximum Booster Gain Test Results

Statement: Device complies with 10dB above AGC power level for both uplink and downlink bands

3. Intermodulation

Test Requirement(s):	CFR §20.21(e)(8)(i)(F) and RSS-131 §7.6	Test Engineer(s):	Sean E.
Test Results:	Pass	Test Date(s):	March 13, 2024

Test Procedures: As required by 47 CFR §20.21(e)(8)(i)(F) and RSS-131 §7.6, 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

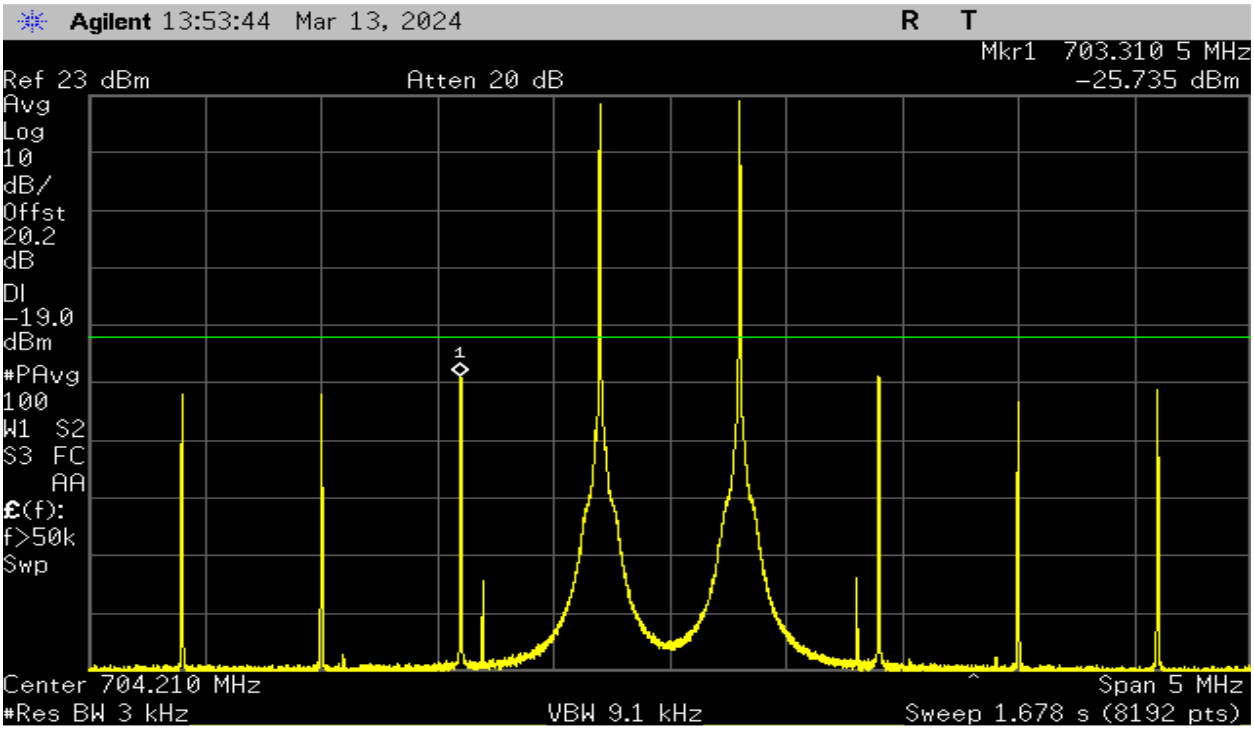
Frequency Band (MHz)	Intermodulation Level (dBm)	Limit (dBm)	Margin (dB)
698-716	-25.73	-19	-6.73
776-787	-30.04	-19	-11.04
824-849	-31.30	-19	-12.3
1710-1755	-26.88	-19	-7.88
1850-1915	-25.83	-19	-6.83

Table 5. Summary Uplink Intermodulation, Test Results

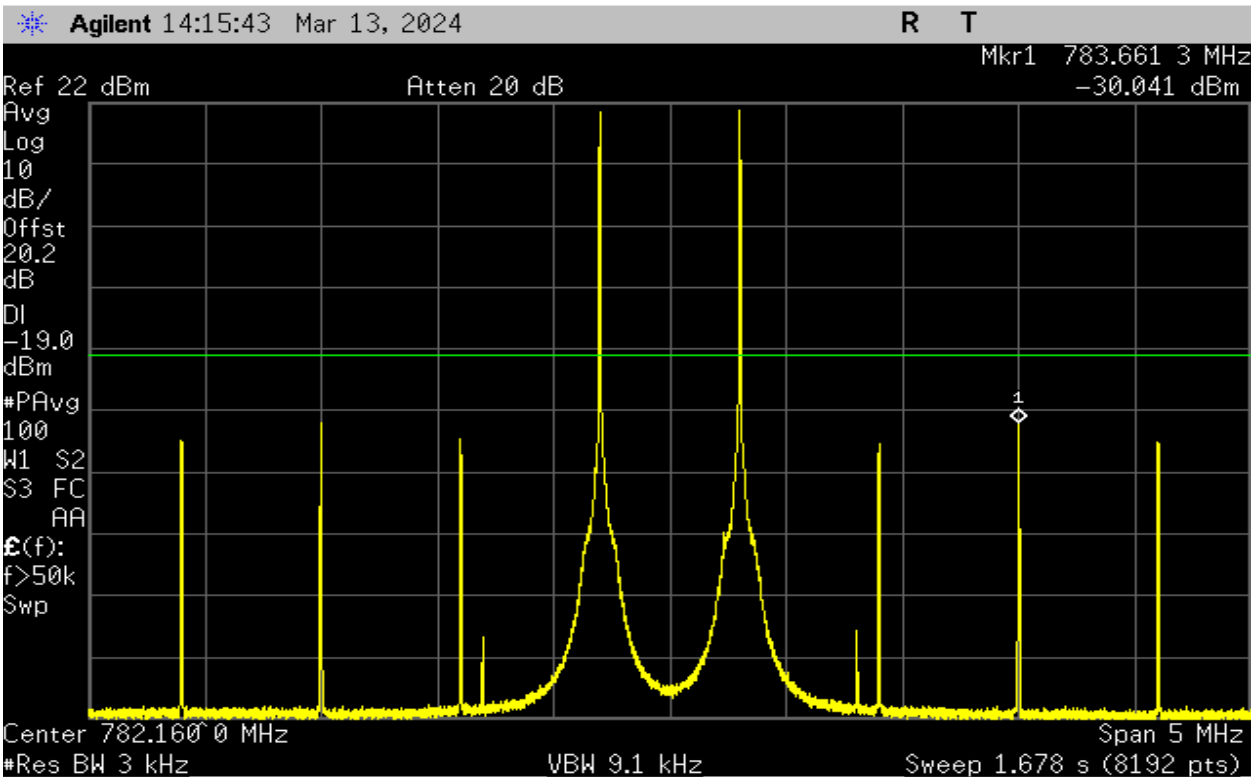
Frequency (MHz)	Intermodulation Level (dBm)	Limit (dBm)	Margin (dB)
728-746	-74.03	-19	-55.03
746-757	-70.83	-19	-51.83
869-894	-75.75	-19	-56.75
1930-1995	-59.56	-19	-40.56
2110-2155	-59.60	-19	-40.60

Table 6. Summary Downlink Intermodulation Test Results

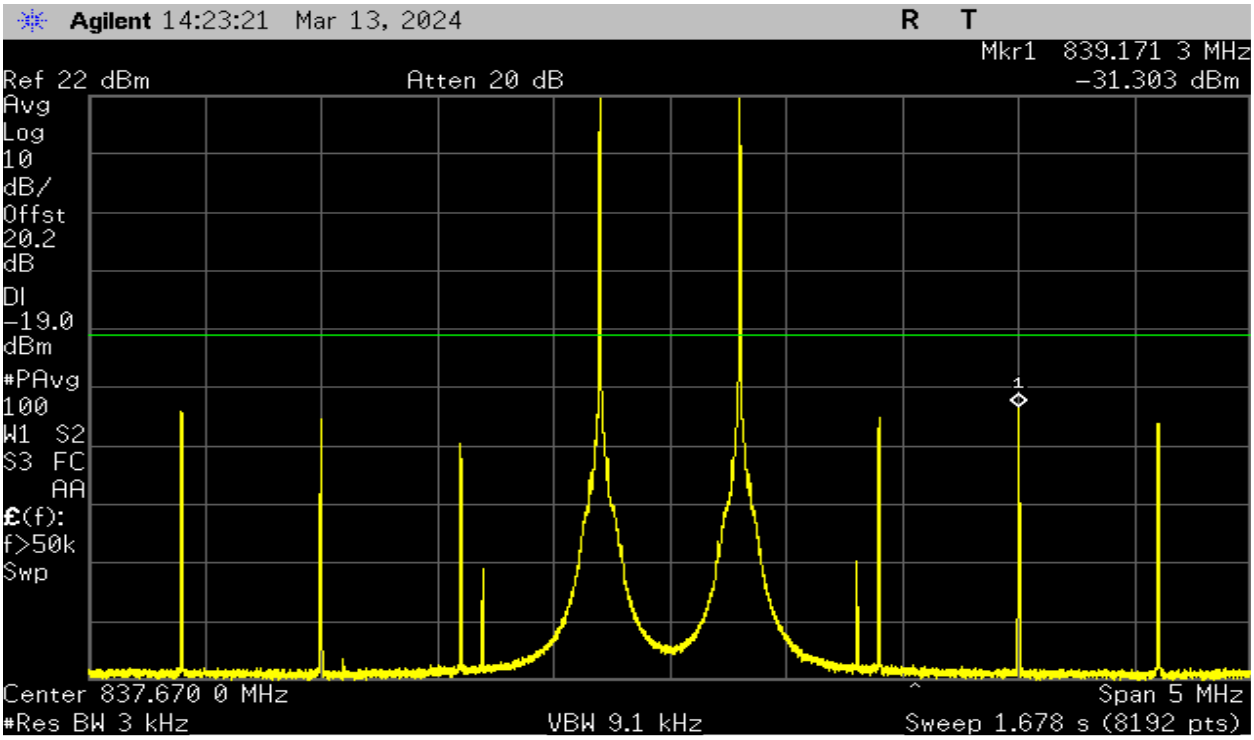
Statement: Device complies with 10dB above AGC power level for both uplink and downlink bands



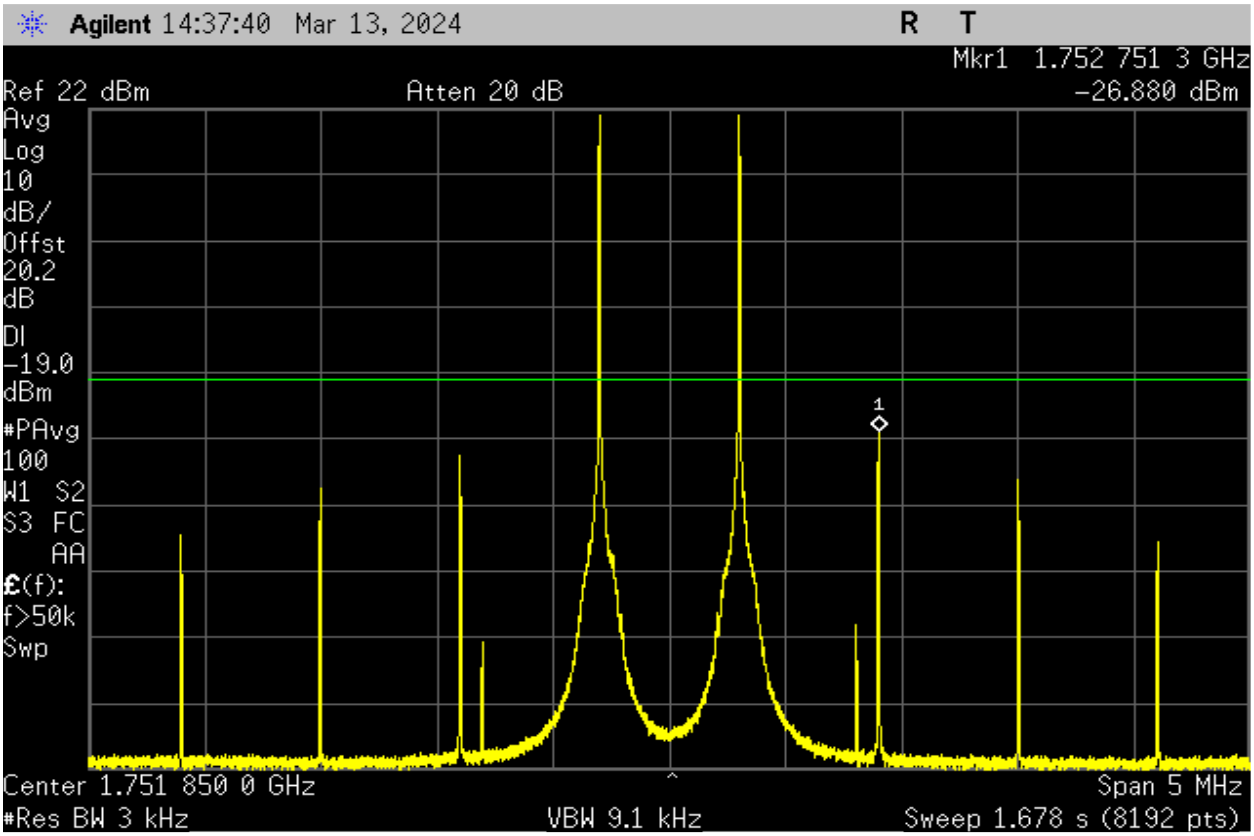
Plot 11 698-716MHz Band – Uplink



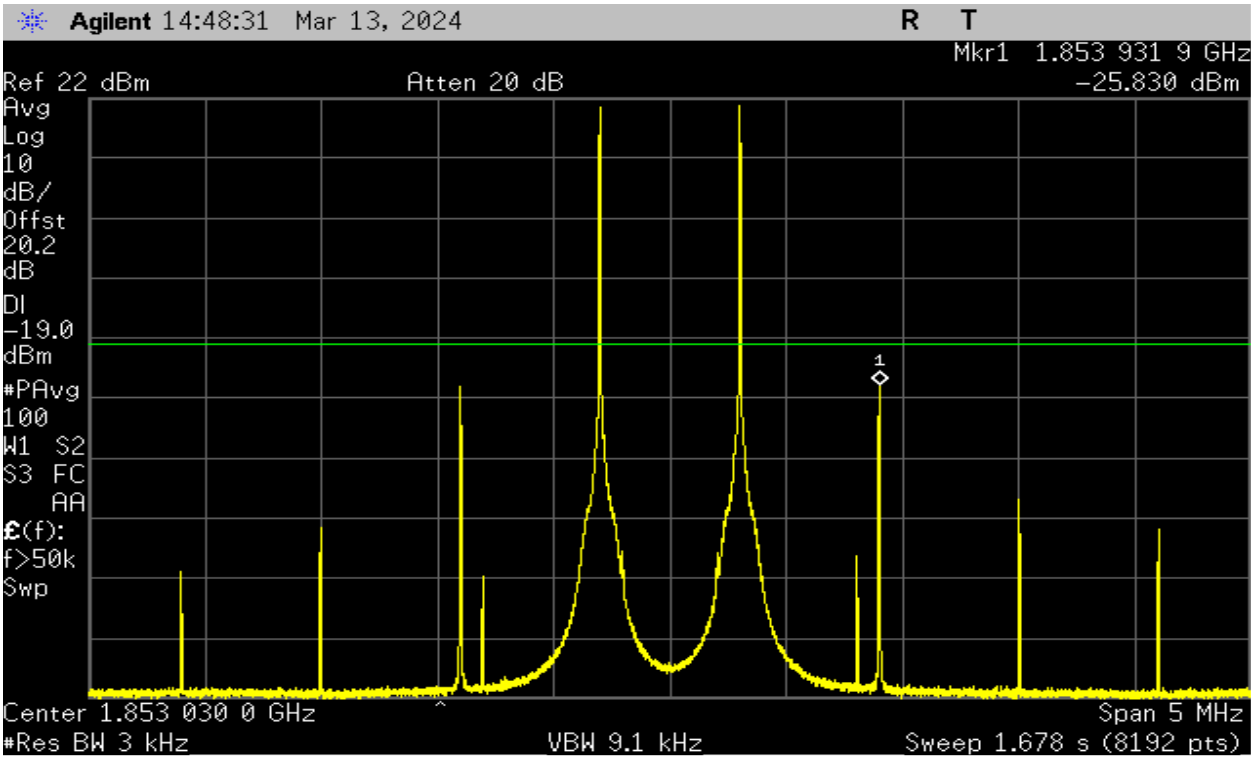
Plot 12 – 776-787MHz Band – Uplink



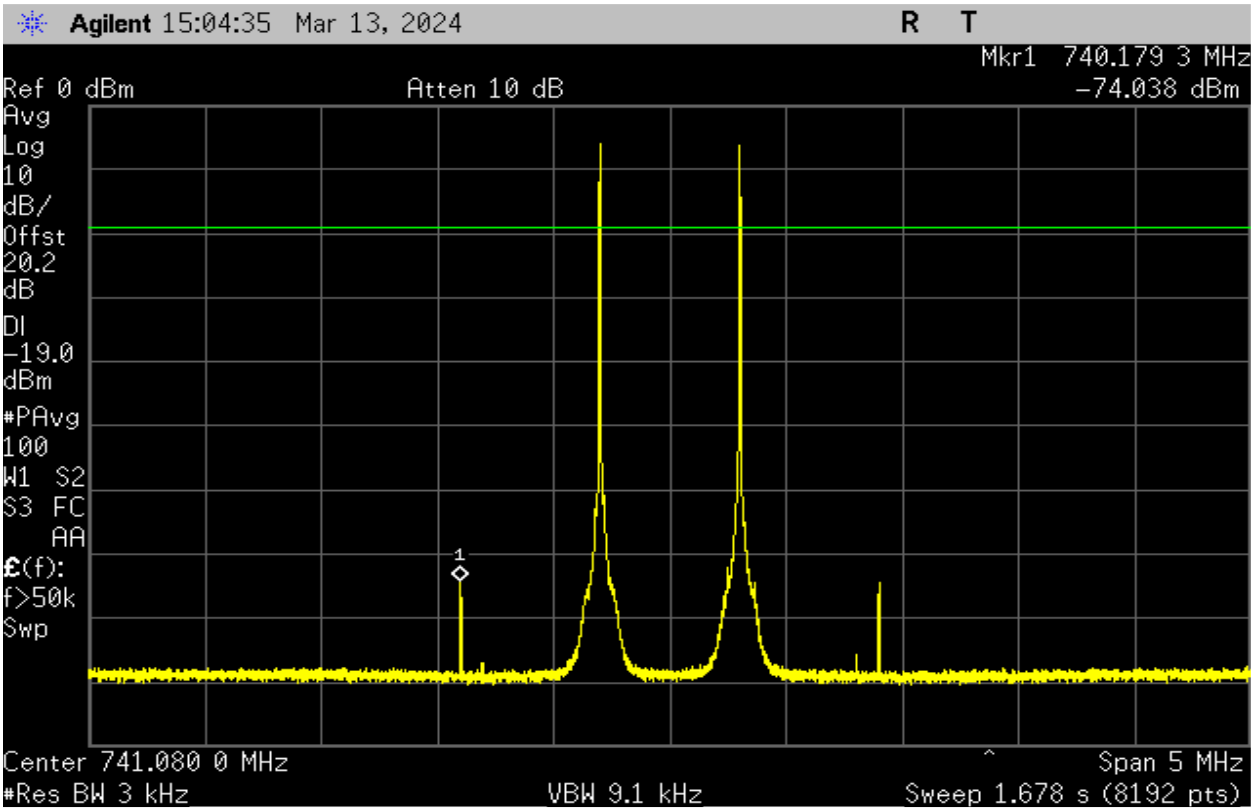
Plot 13 – 824-849MHz Band – Uplink



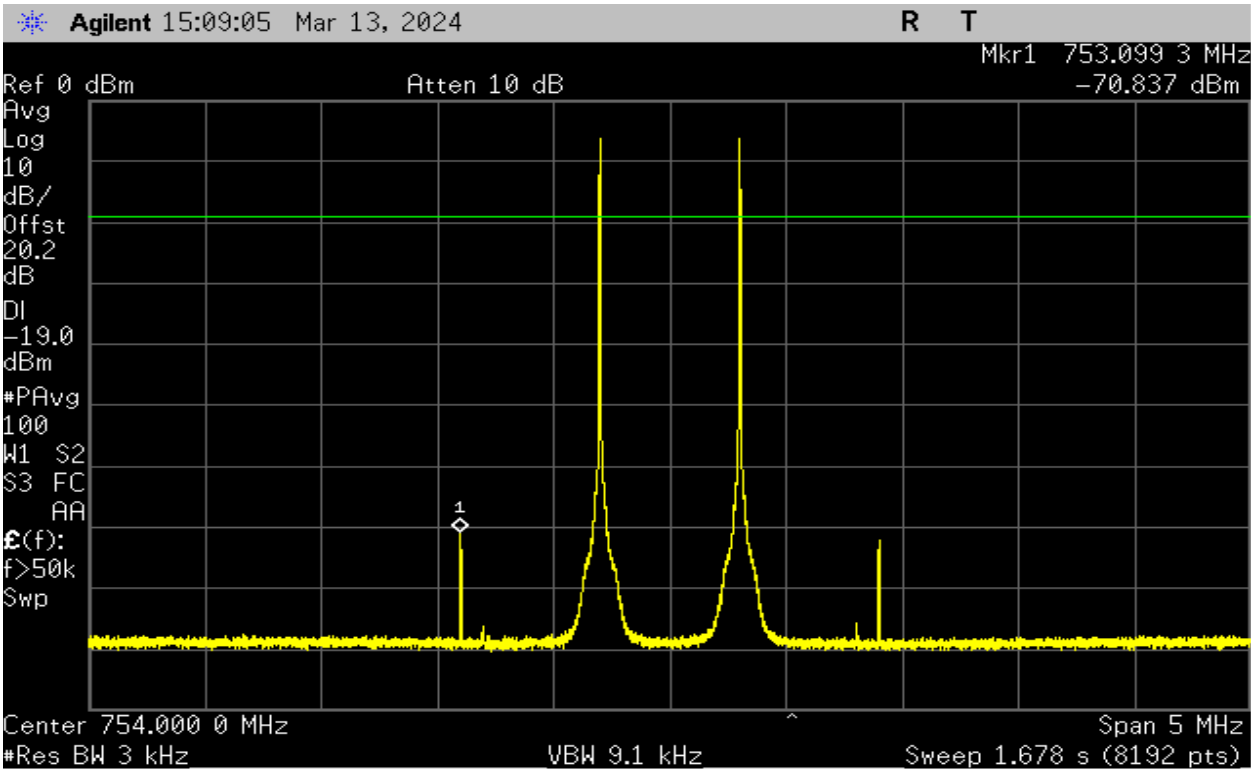
Plot 14 – 1710-1755MHz Band – Uplink



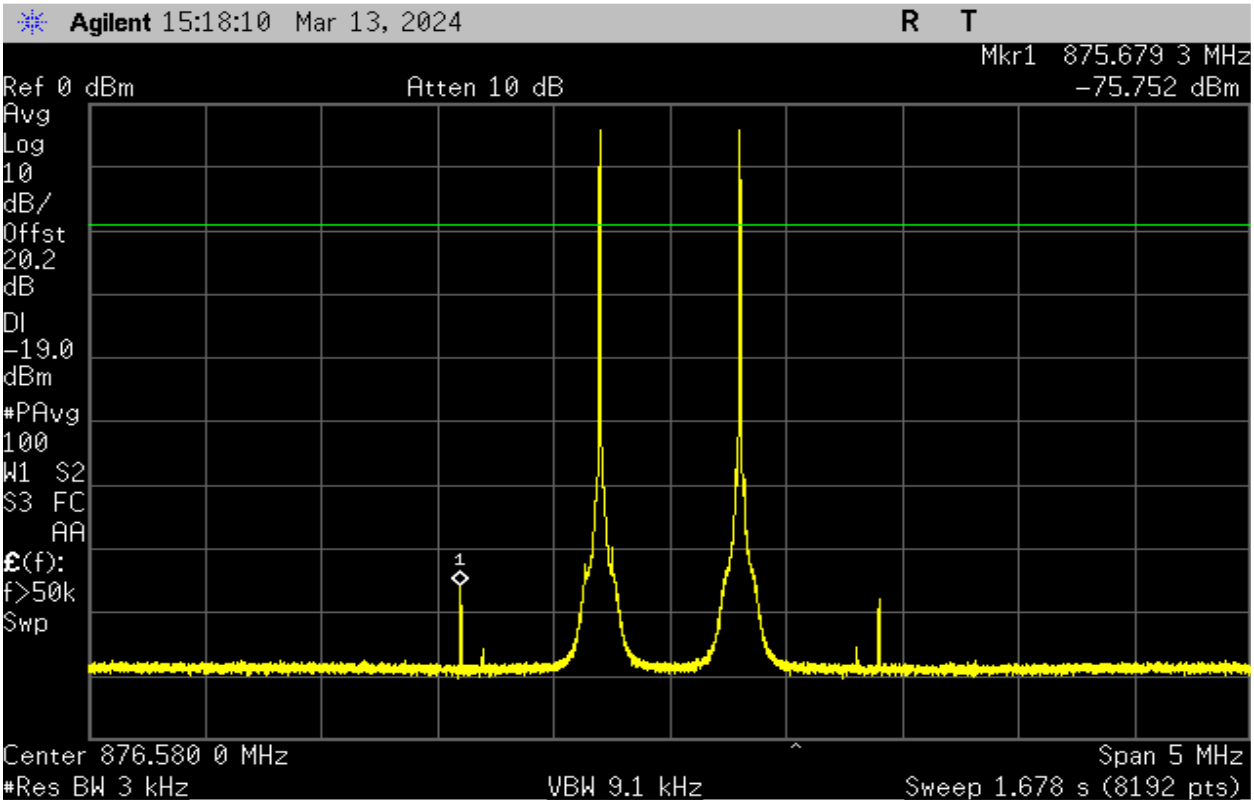
Plot 15 – 1850-1915MHz Band – Uplink



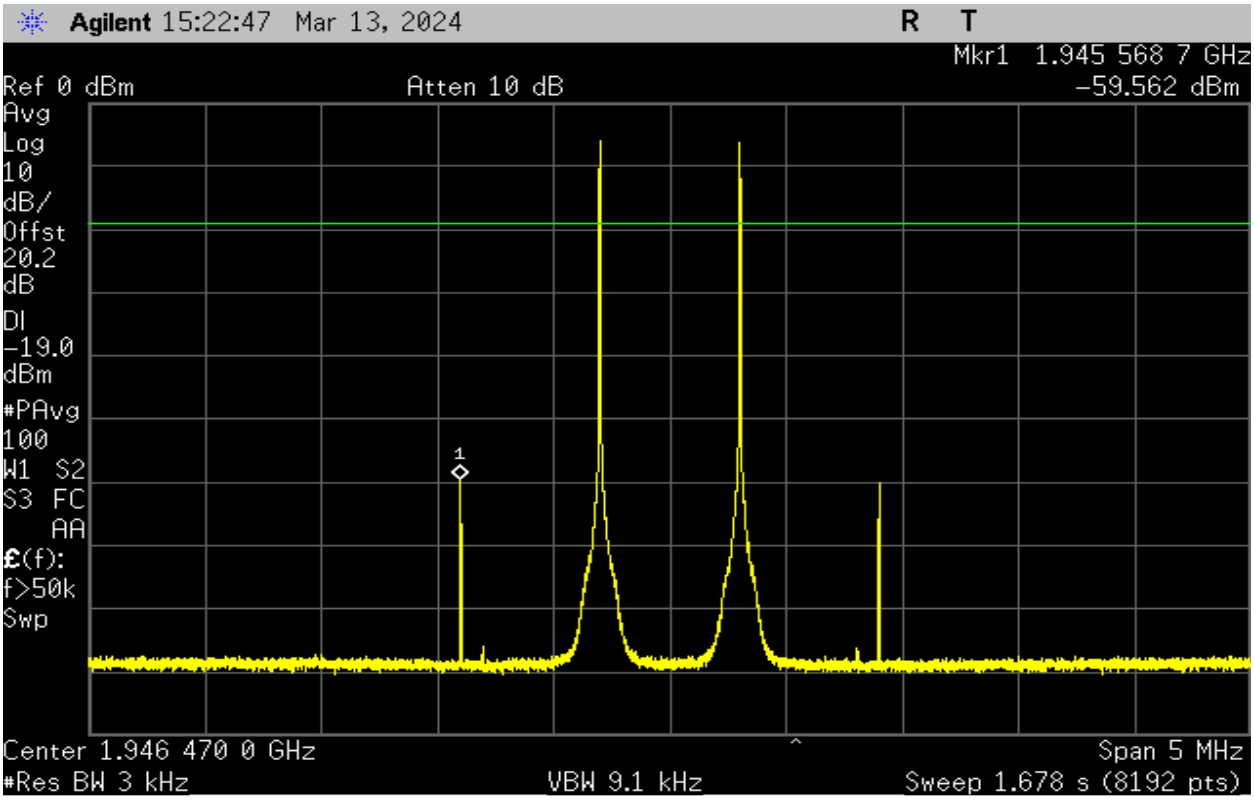
Plot 16 – 728-746MHz Band – Downlink



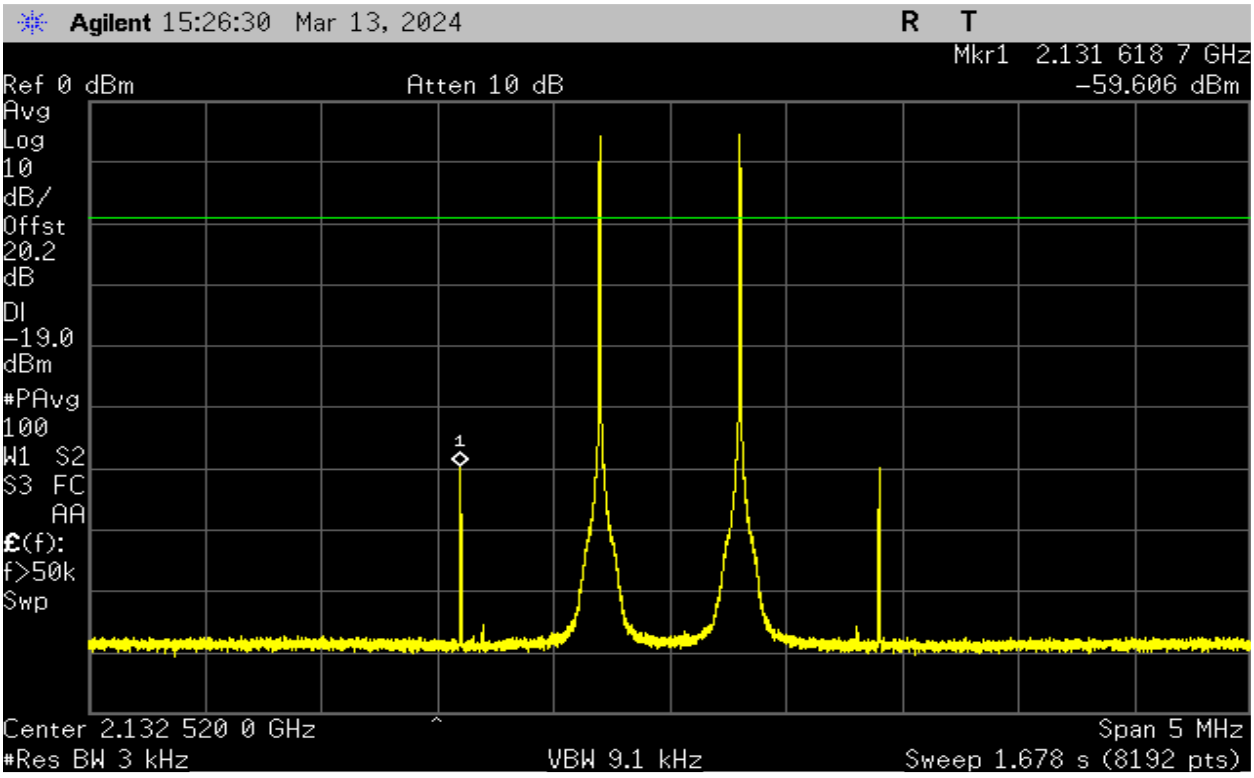
Plot 17 – 746-757MHz Band – Downlink



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) and RSS-131 §7.5	Test Engineer(s):	Sean E.
Test Results:	Pass	Test Date(s):	March 14-18, 2024

Test Procedures:

As required by 47 CFR §20.21(8)(i)(E) and RSS-131 §7.5, 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	-24.54	-19
698-716	Upper	-25.86	-19
776-787	Lower	-25.09	-19
776-787	Upper	-24.56	-19
824-849	Lower	-37.03	-19
824-849	Upper	-38.80	-19
1710-1755	Lower	-36.66	-19
1710-1755	Upper	-36.36	-19
1850-1915	Lower	-35.53	-19
1850-1915	Upper	-39.00	-19

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

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)
698-716	Lower	-36.97	-19
698-716	Upper	-38.40	-19
776-787	Lower	-36.37	-19
776-787	Upper	-35.84	-19
824-849	Lower	-32.89	-19
824-849	Upper	-37.74	-19
1710-1755	Lower	-33.06	-19
1710-1755	Upper	-31.04	-19
1850-1915	Lower	-28.30	-19
1850-1915	Upper	-31.74	-19

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

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)
698-716	Lower	-33.54	-19
698-716	Upper	-34.76	-19
776-787	Lower	-32.33	-19
776-787	Upper	-33.19	-19
824-849	Lower	-30.17	-19
824-849	Upper	-32.26	-19
1710-1755	Lower	-22.83	-19
1710-1755	Upper	-20.10	-19
1850-1915	Lower	-20.35	-19
1850-1915	Upper	-23.46	-19

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

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)
728-746	Lower	-56.45	-19
728-746	Upper	-54.44	-19
746-757	Lower	-53.56	-19
746-757	Upper	-54.84	-19
869-894	Lower	-51.67	-19
869-894	Upper	-56.74	-19
1930-1995	Lower	-48.41	-19
1930-1995	Upper	-49.07	-19
2110-2155	Lower	-56.36	-19
2110-2155	Upper	-56.62	-19

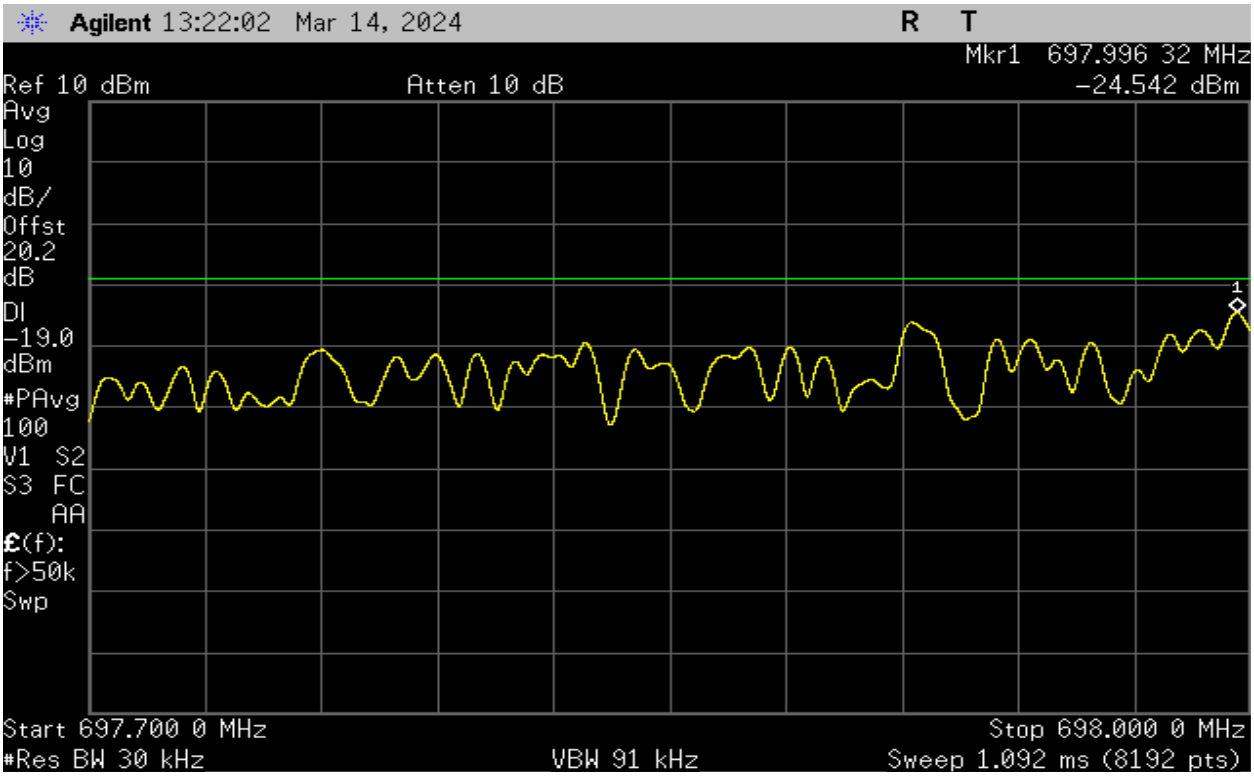
Table 10. GSM Downlink – Out-of-band Emissions, Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)
728-746	Lower	-77.72	-19
728-746	Upper	-77.43	-19
746-757	Lower	-77.46	-19
746-757	Upper	-77.53	-19
869-894	Lower	-77.25	-19
869-894	Upper	-77.55	-19
1930-1995	Lower	-76.43	-19
1930-1995	Upper	-75.49	-19
2110-2155	Lower	-76.96	-19
2110-2155	Upper	-77.20	-19

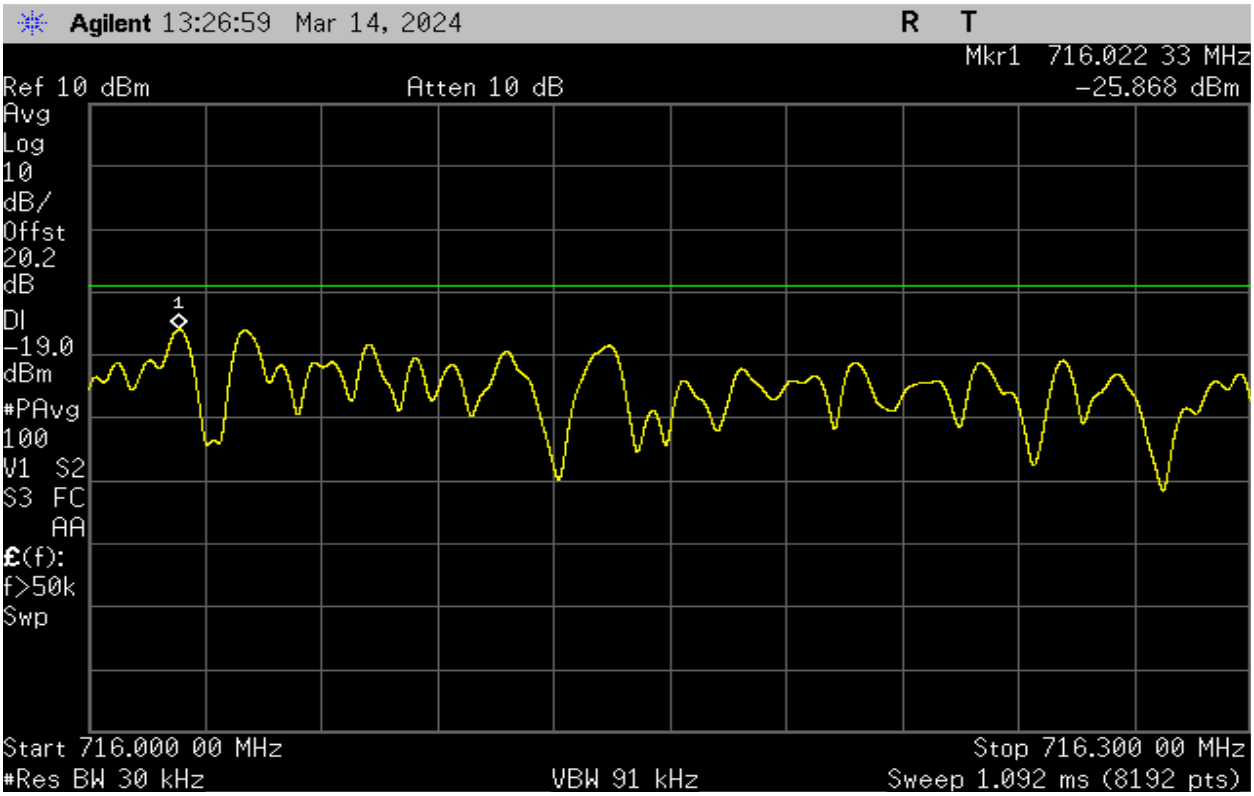
Table 11. CDMA Downlink – Out-of-band Emissions, Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)
728-746	Lower	-73.72	-19
728-746	Upper	-72.13	-19
746-757	Lower	-72.15	-19
746-757	Upper	-73.15	-19
869-894	Lower	-63.04	-19
869-894	Upper	-65.51	-19
1930-1995	Lower	-65.65	-19
1930-1995	Upper	-65.07	-19
2110-2155	Lower	-65.54	-19
2110-2155	Upper	-66.42	-19

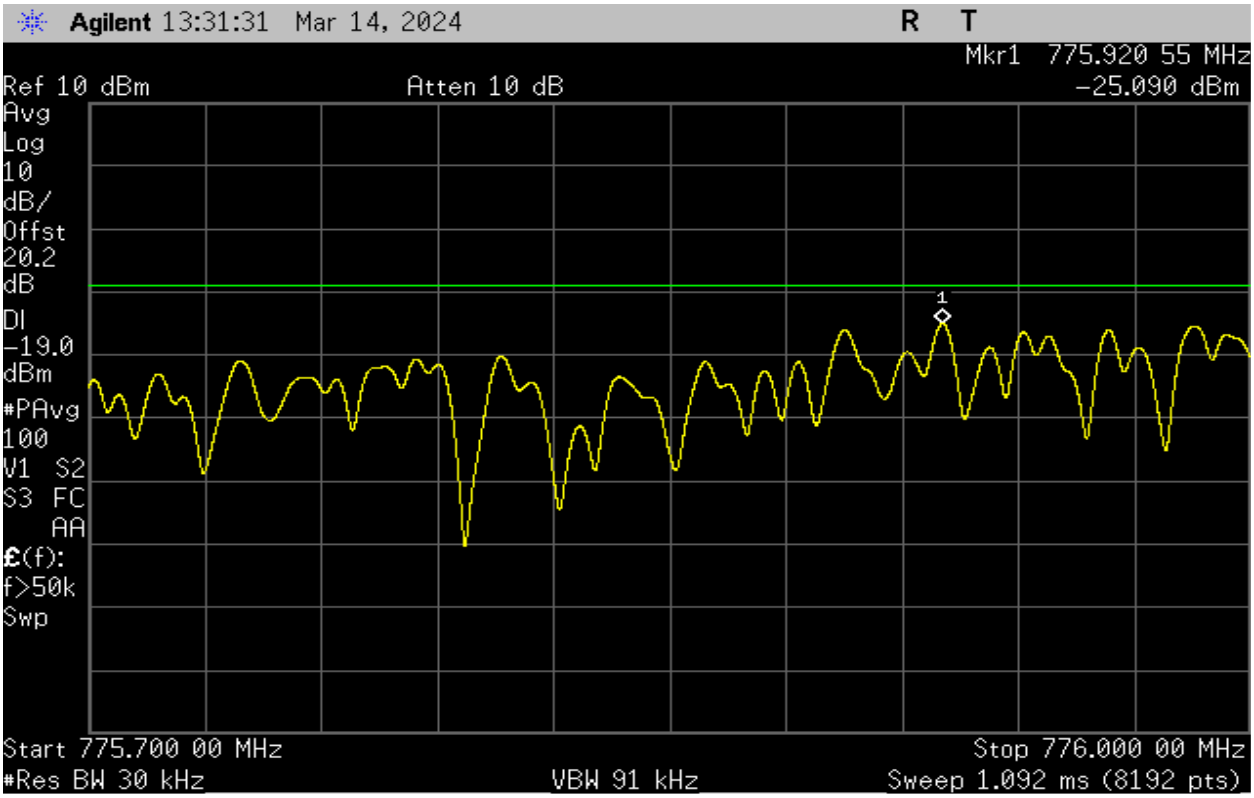
Table 12. LTE Downlink – Out-of-band Emissions, Test Results



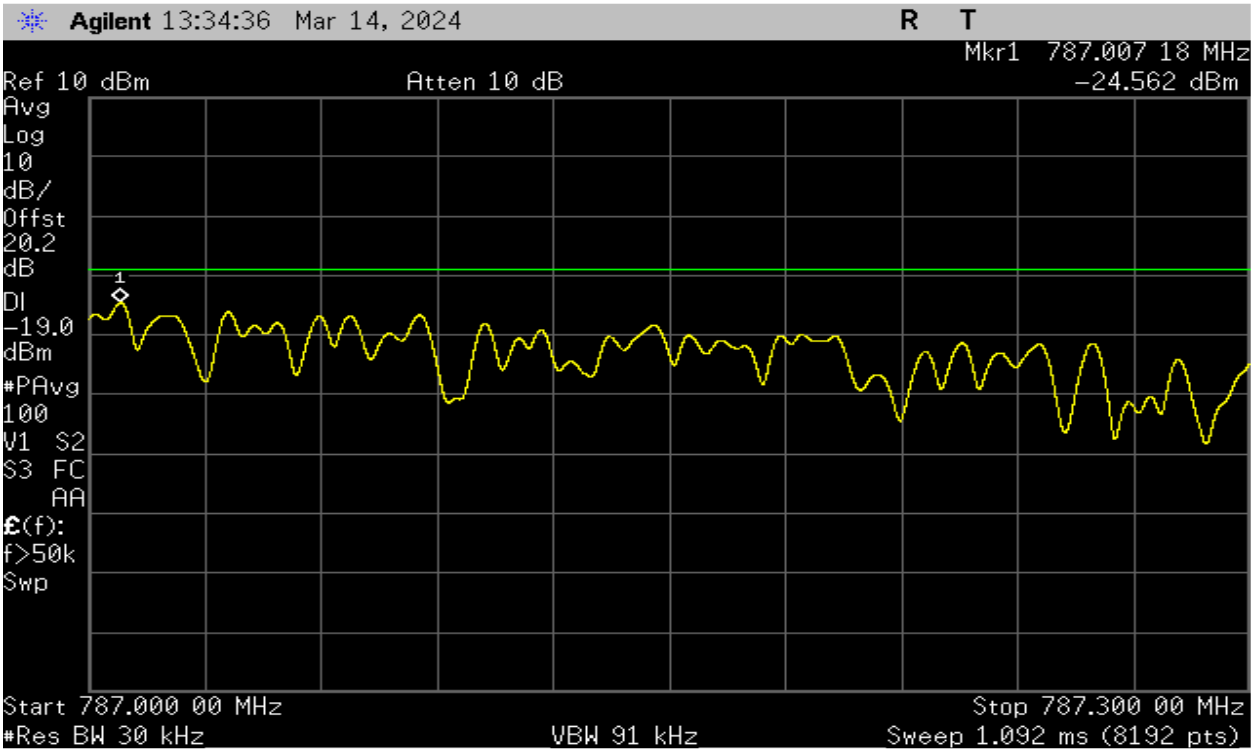
Plot 21 – 698-716MHz Band – GSM Uplink Lower Band Edge



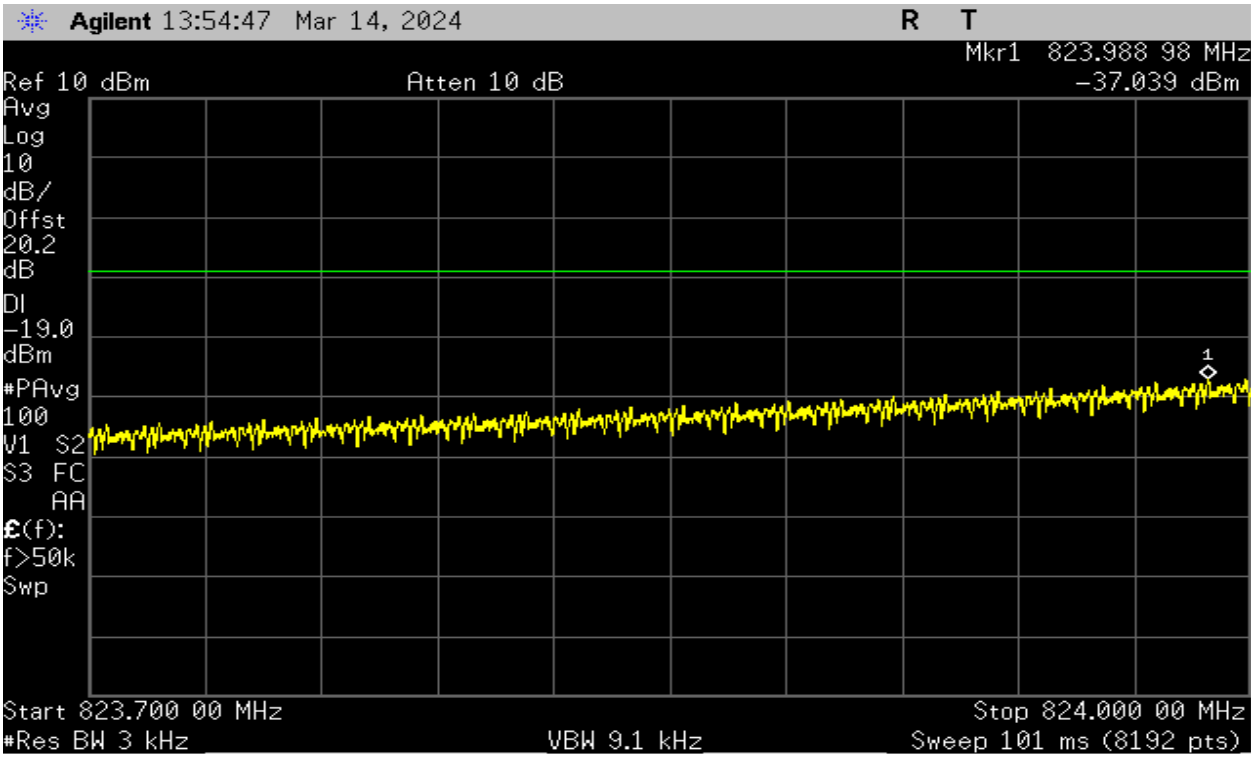
Plot 22 - 698-716MHz Band – GSM Uplink Upper Band Edge



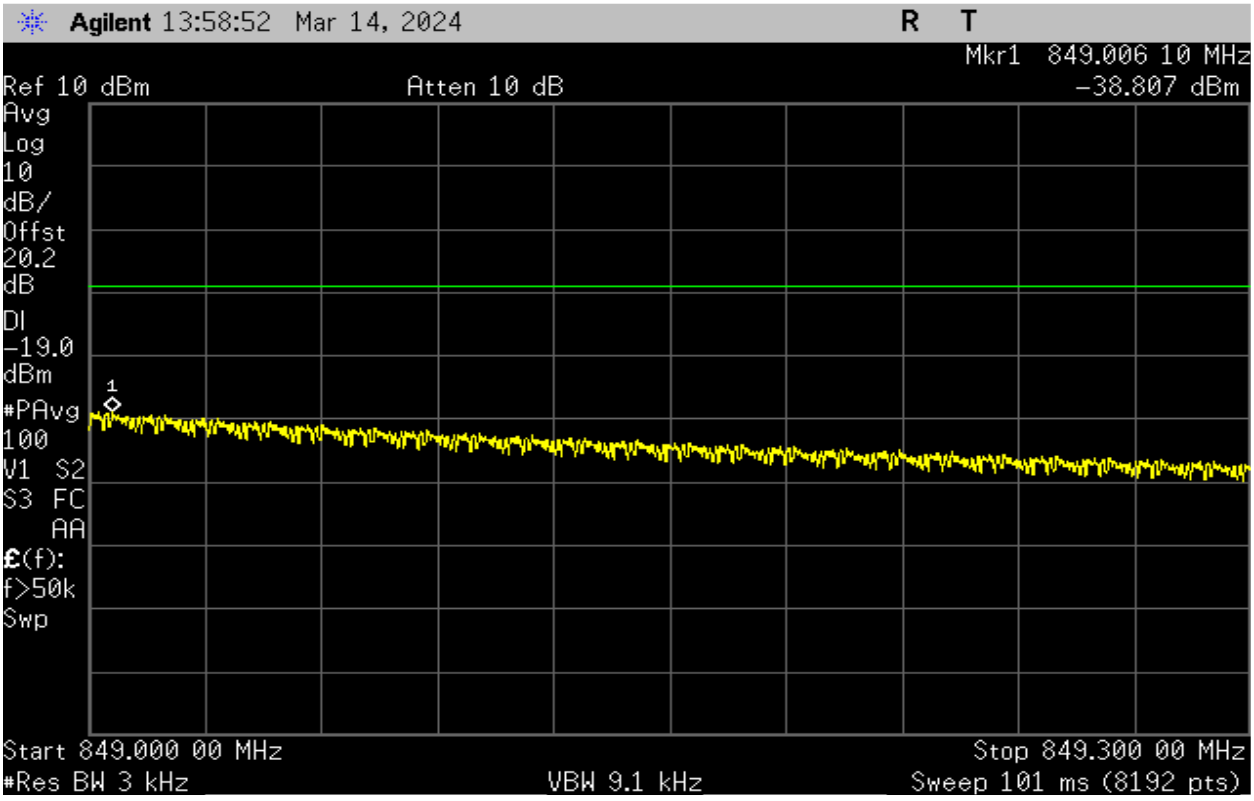
Plot 23 – 776-787MHz Band – GSM Uplink Lower Band Edge



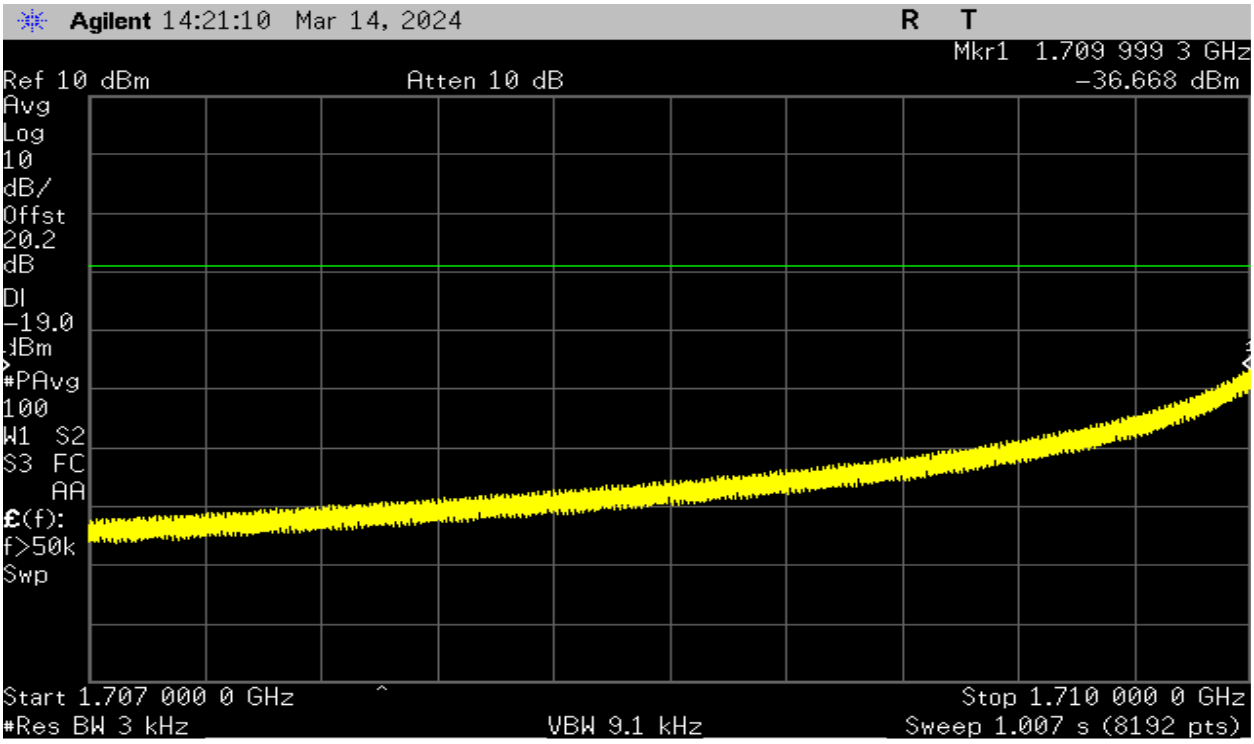
Plot 24 – 776-787MHz Band – GSM Uplink Upper Band Edge



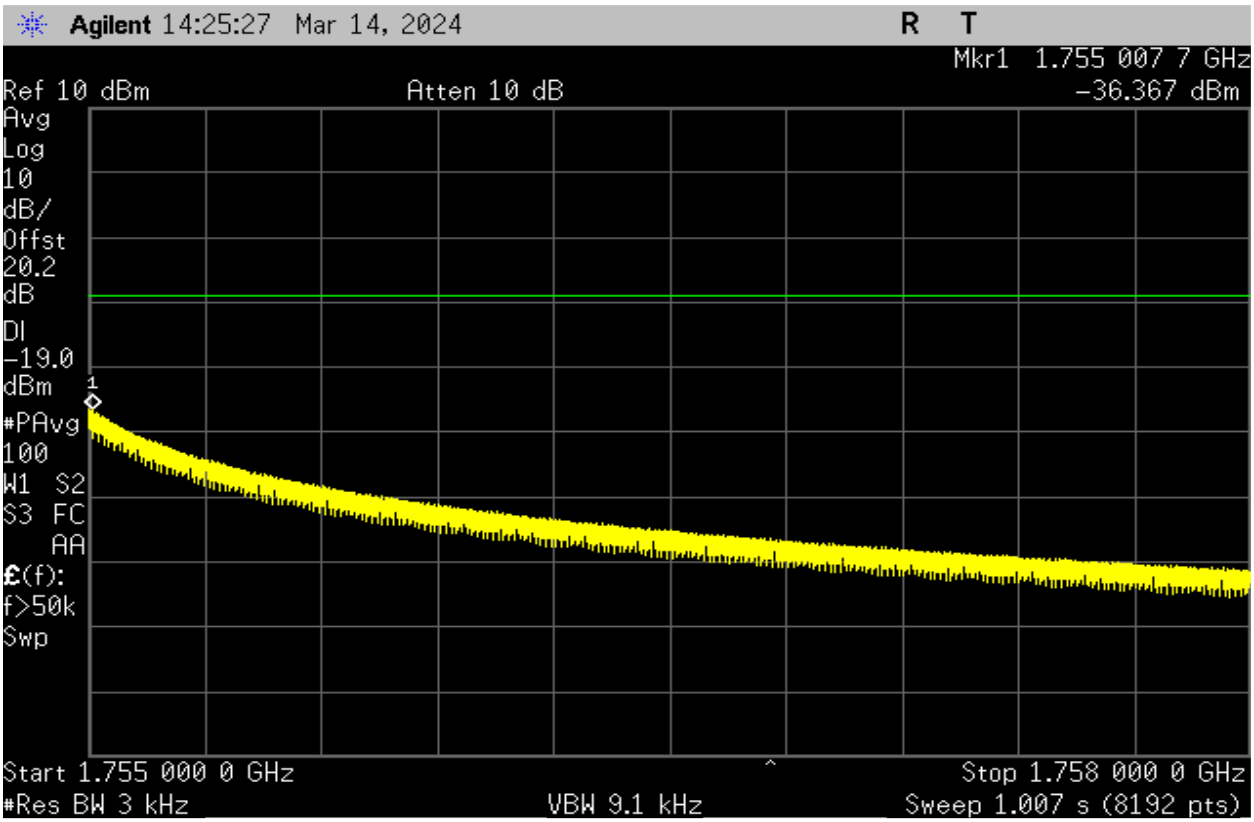
Plot 25 – 824-849MHz Band – GSM Uplink Lower Band Edge



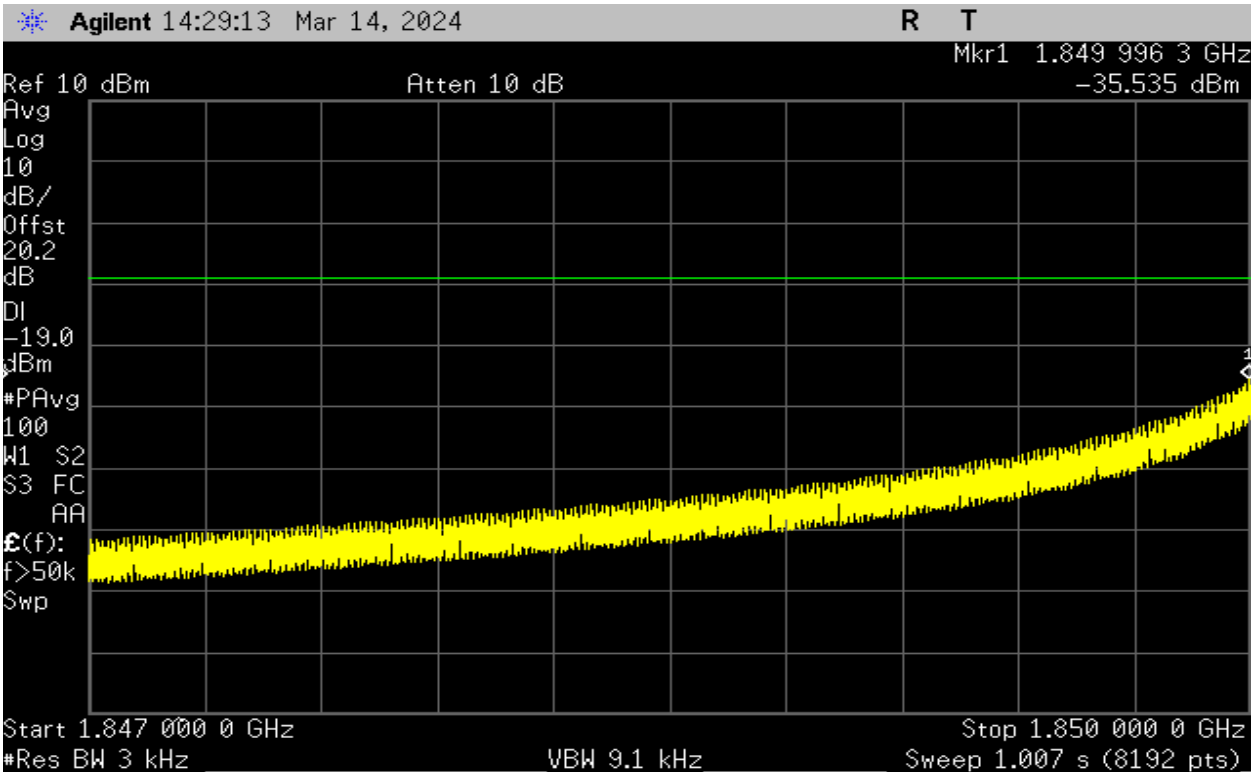
Plot 26 – 824-849MHz Band – GSM Uplink Upper Band Edge



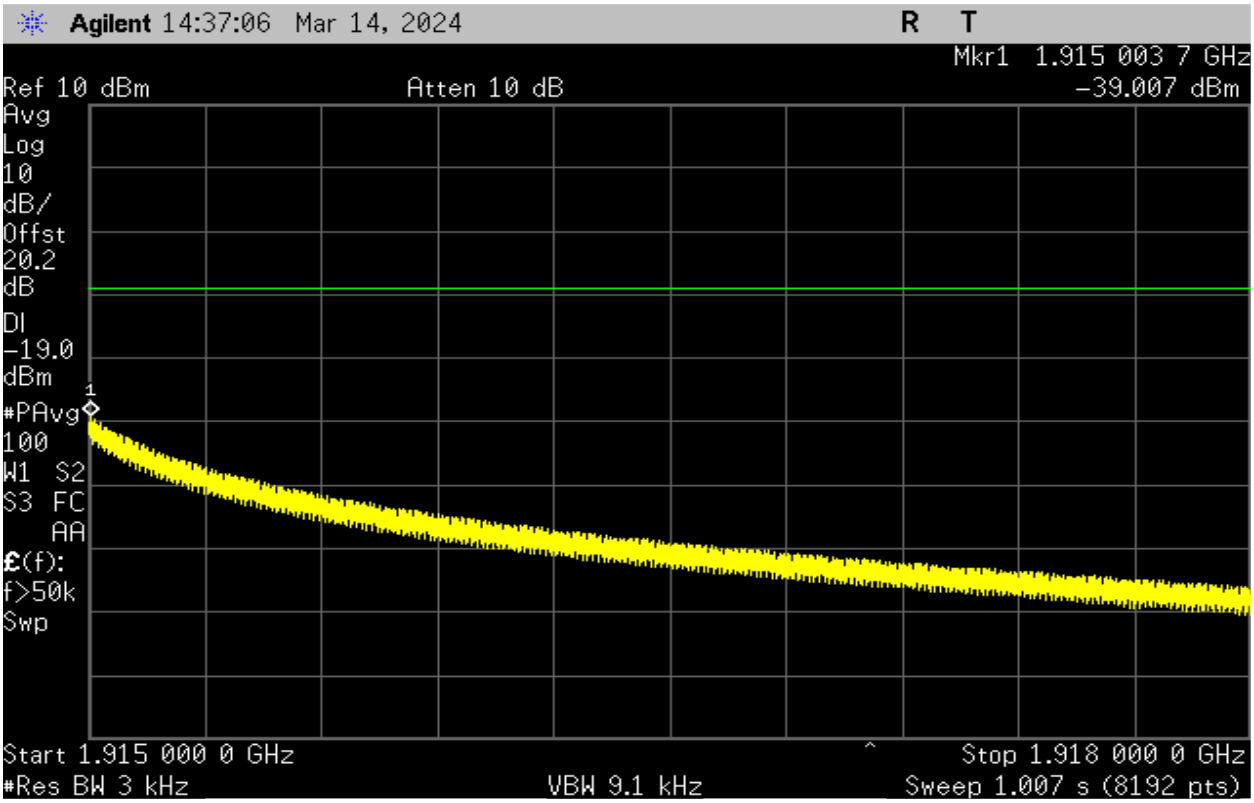
Plot 27 – 1710-1755MHz Band – GSM Uplink Lower Band Edge



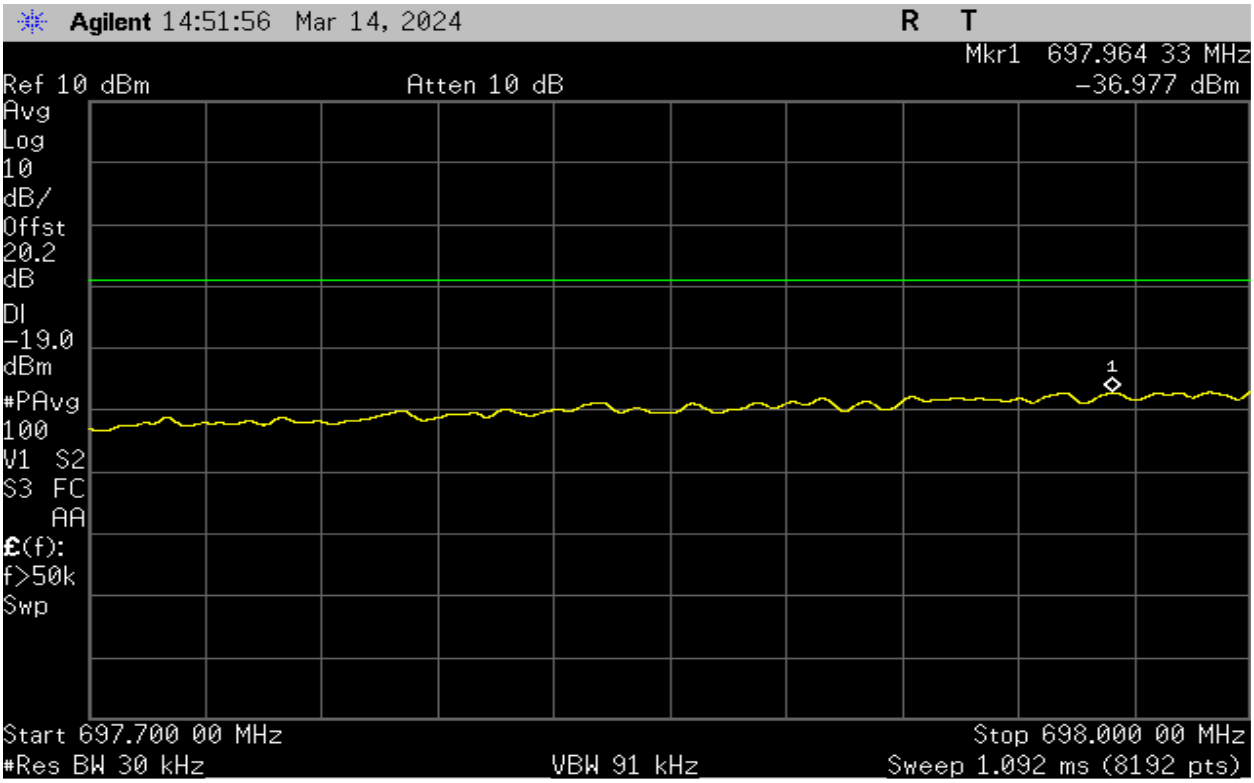
Plot 28 – 1710-1755MHz Band – GSM Uplink Upper Band Edge



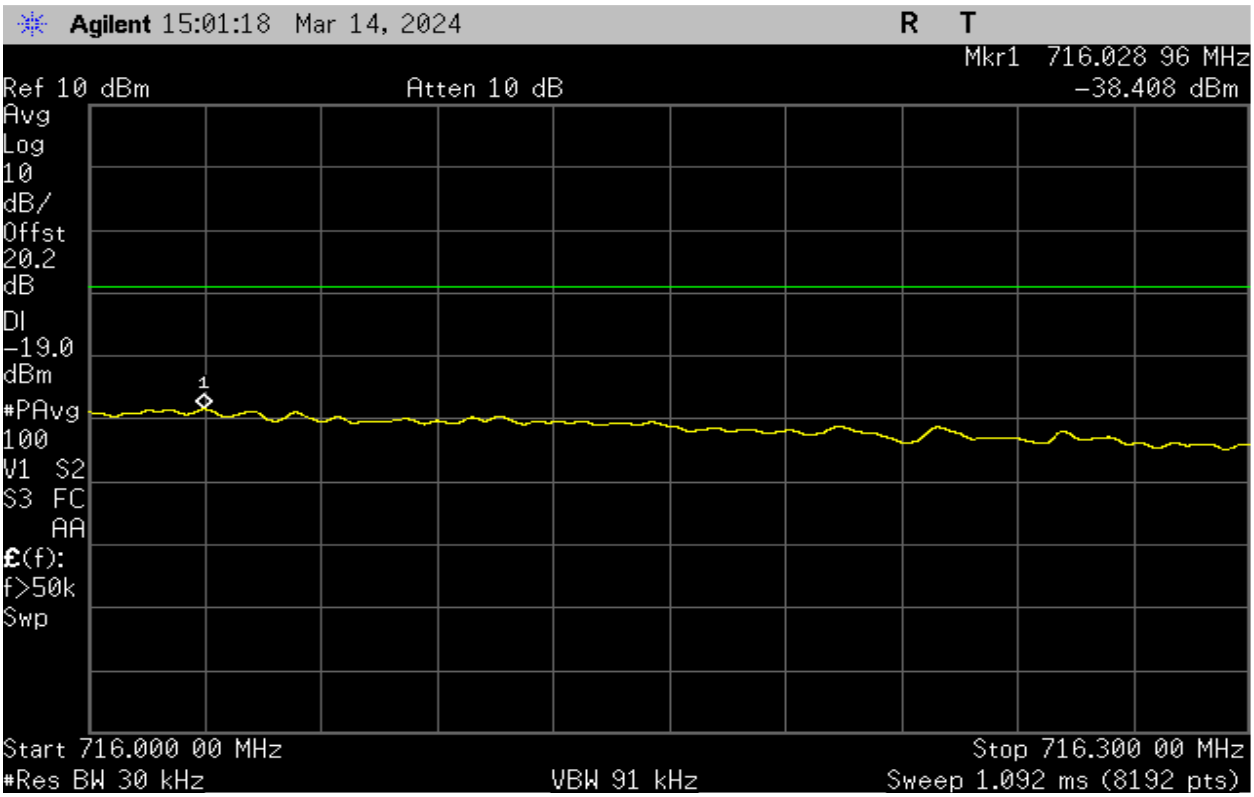
Plot 29 – 1850-1915MHz Band – GSM Uplink Lower Band Edge



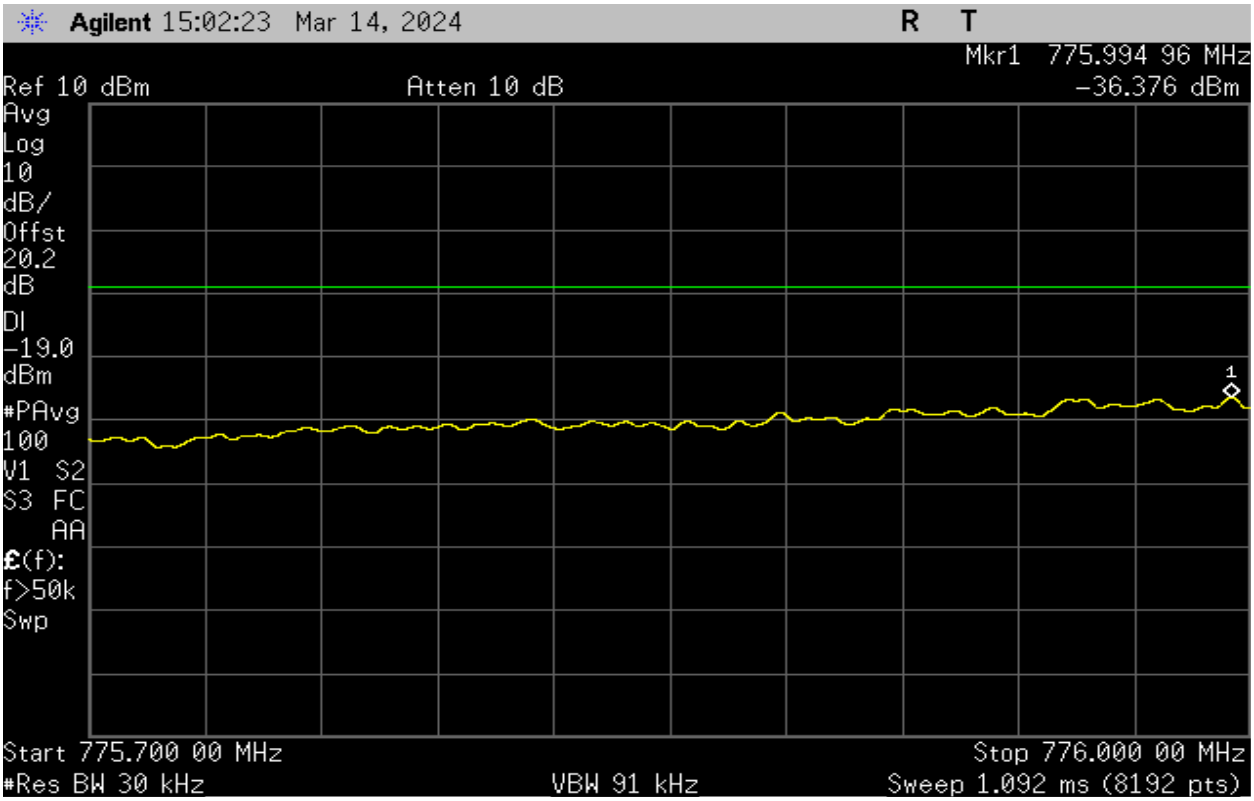
Plot 30 – 1850-1915MHz Band – GSM Uplink Upper Band Edge



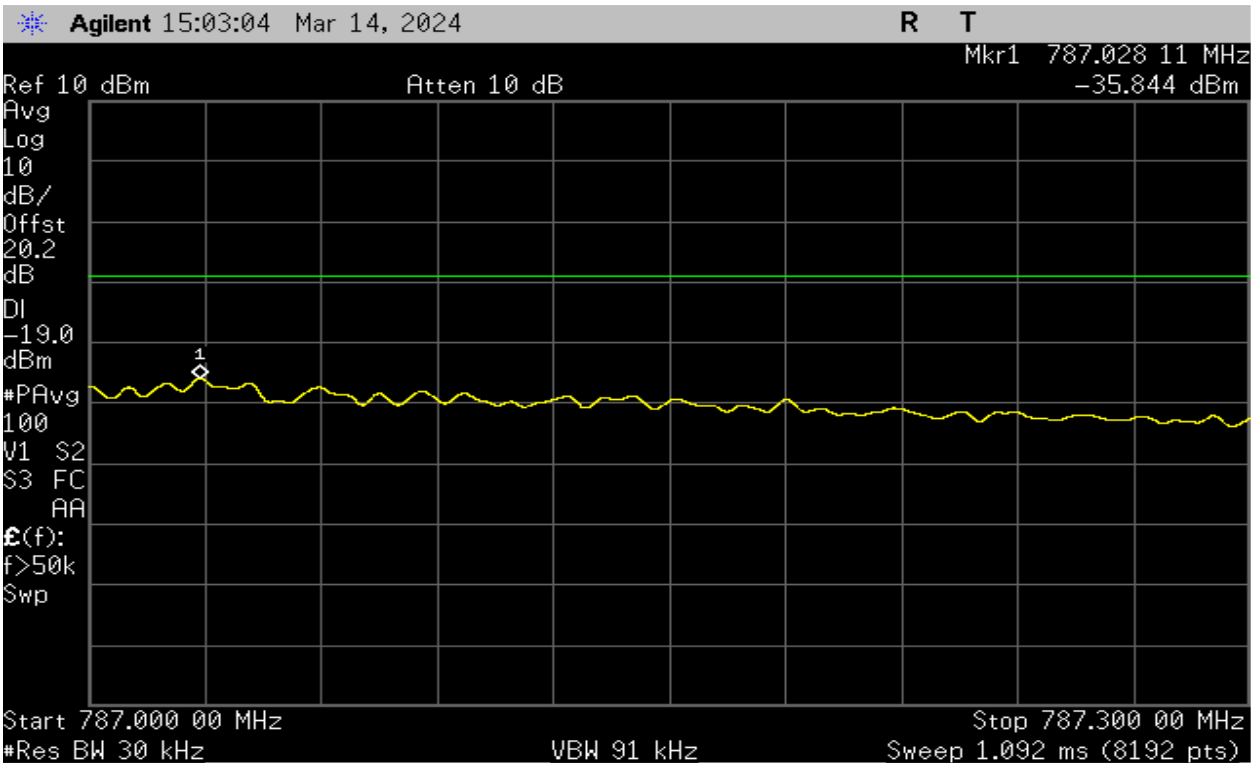
Plot 31 – 698-716MHz Band – CDMA Uplink Lower Band Edge



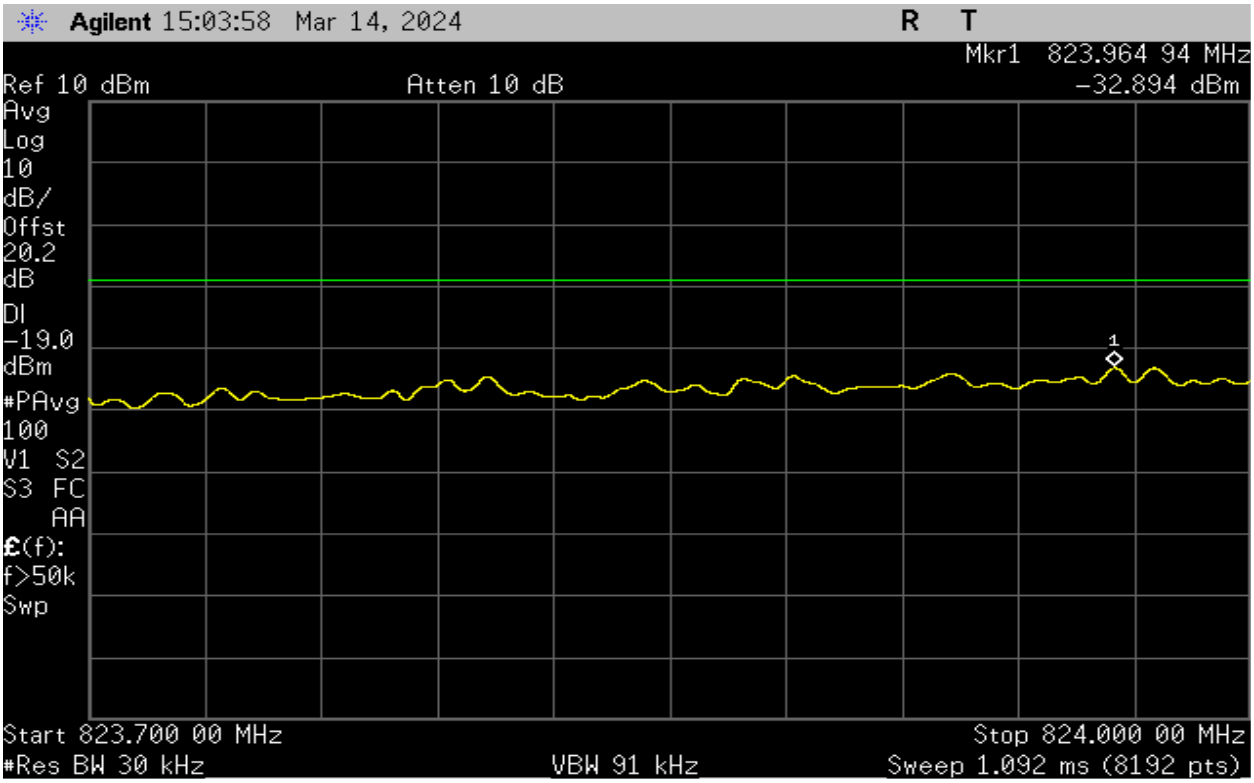
Plot 32 – 698-716MHZ Band – CDMA Uplink Upper Band Edge



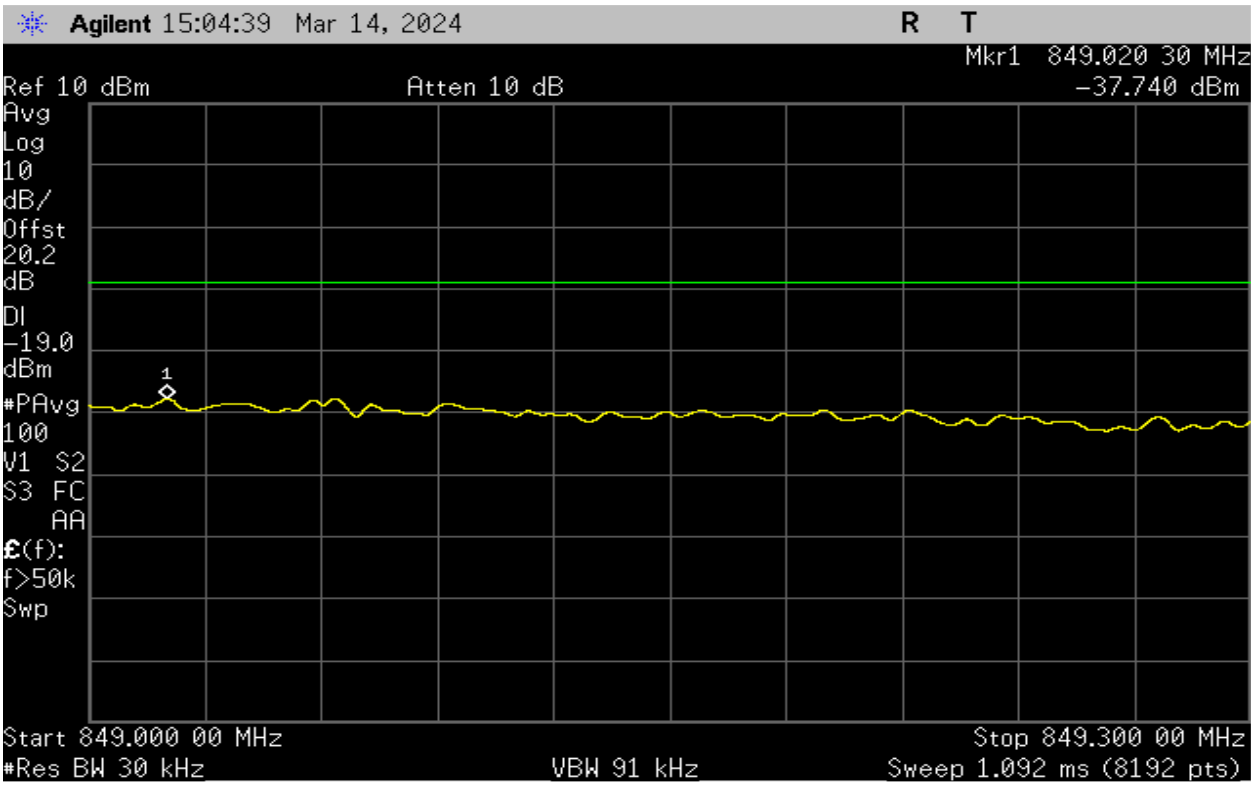
Plot 33 – 776-787MHz Band – CDMA Uplink Lower Band Edge



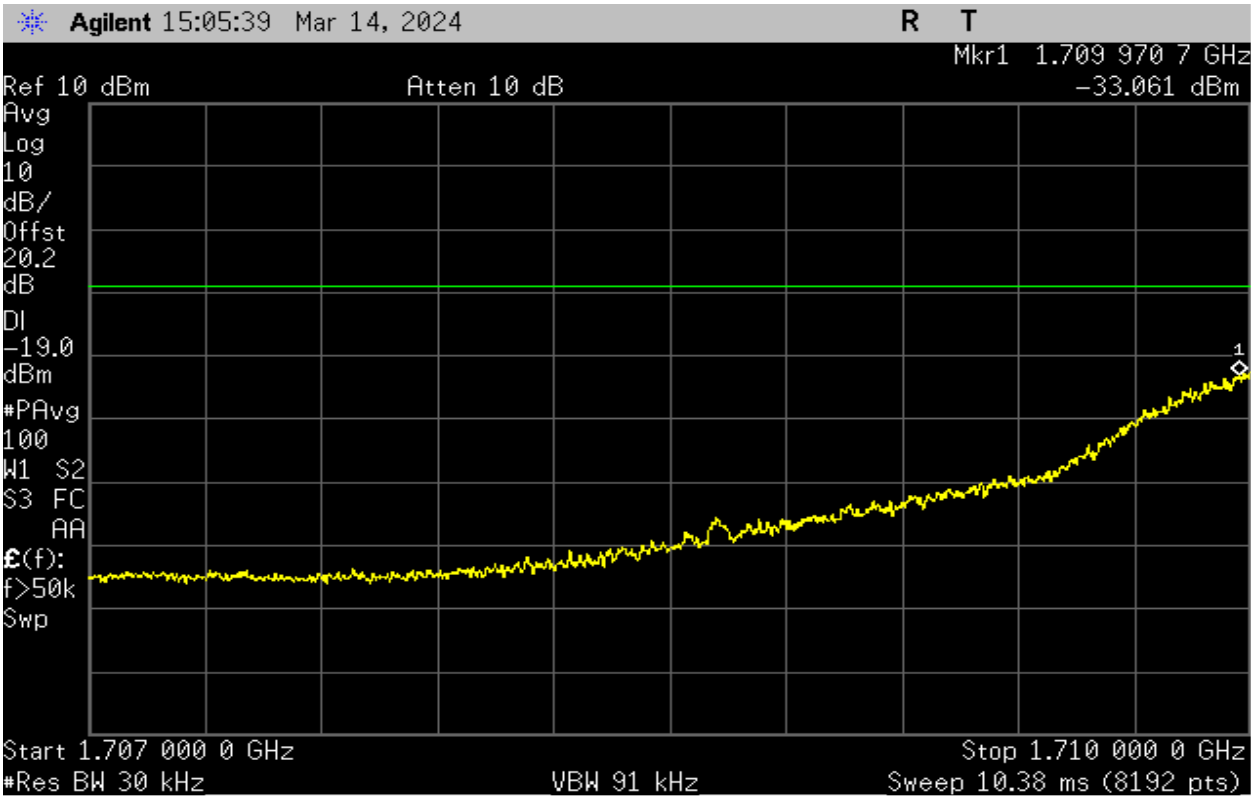
Plot 34 – 776-787MHz Band – CDMA Uplink Upper Band Edge



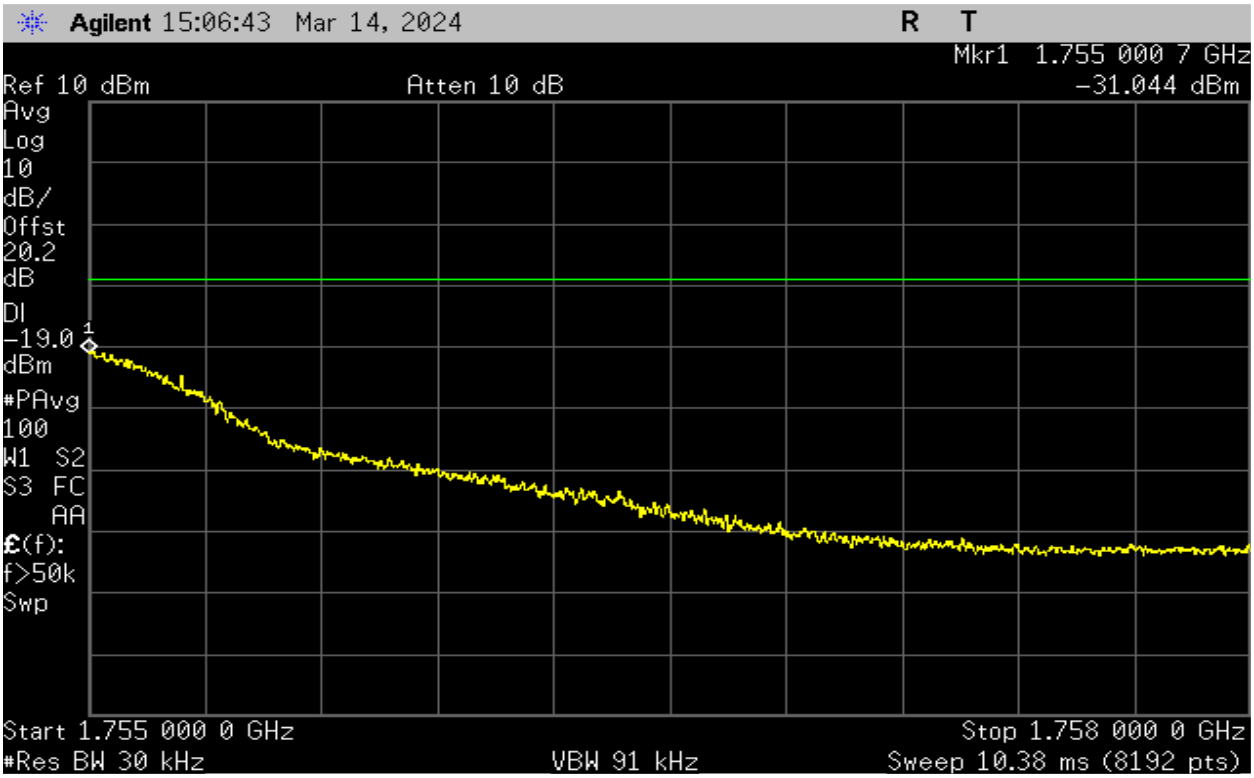
Plot 35 – 824-849MHz Band – CDMA Uplink Lower Band Edge



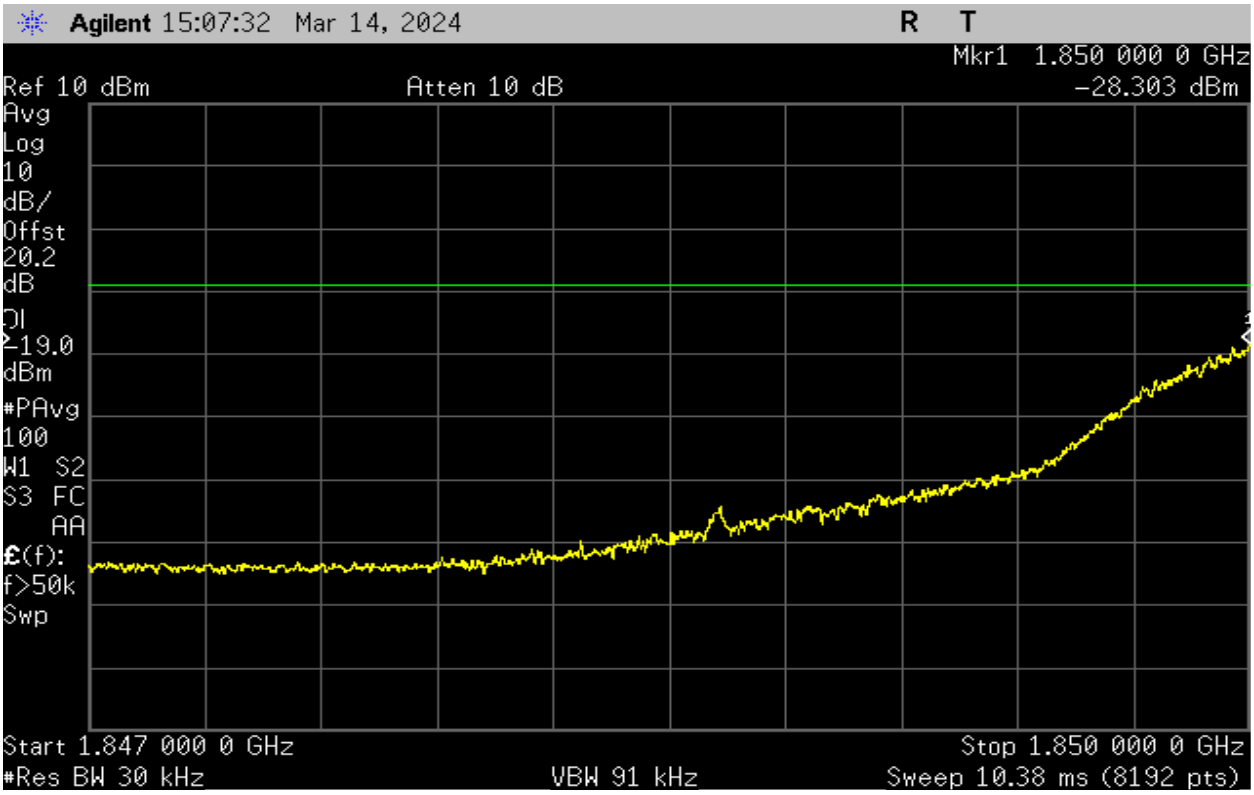
Plot 36 – 824-849MHz Band – CDMA Uplink Upper Band Edge



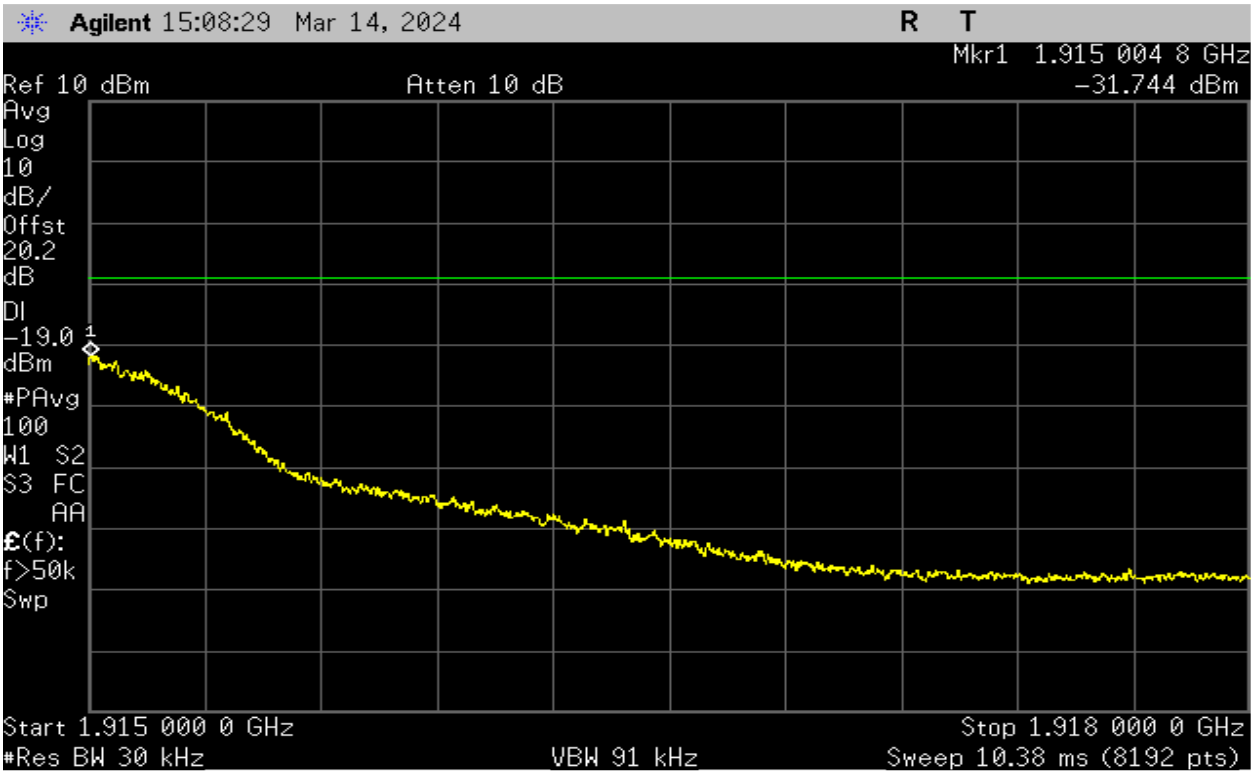
Plot 37 – 1710-1755MHz Band – CDMA Uplink Lower Band Edge



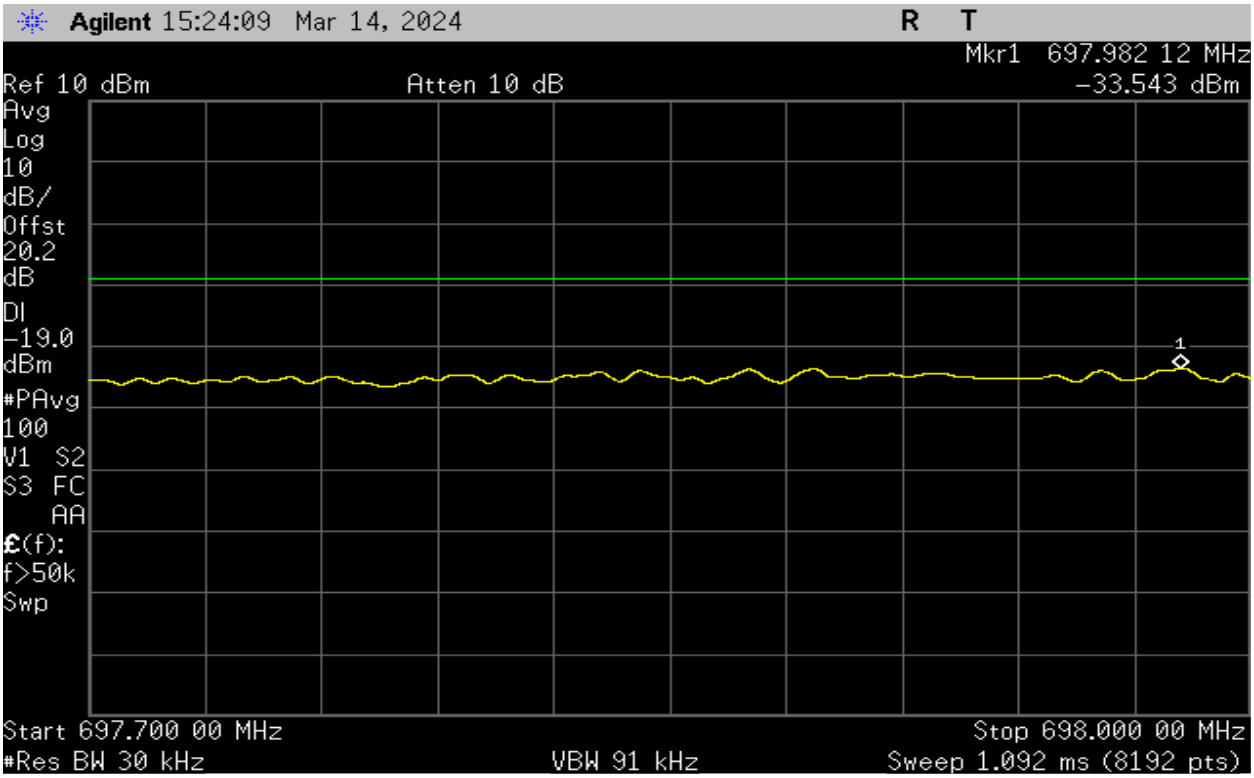
Plot 38 – 1710-1755MHz Band – CDMA Uplink Upper Band Edge



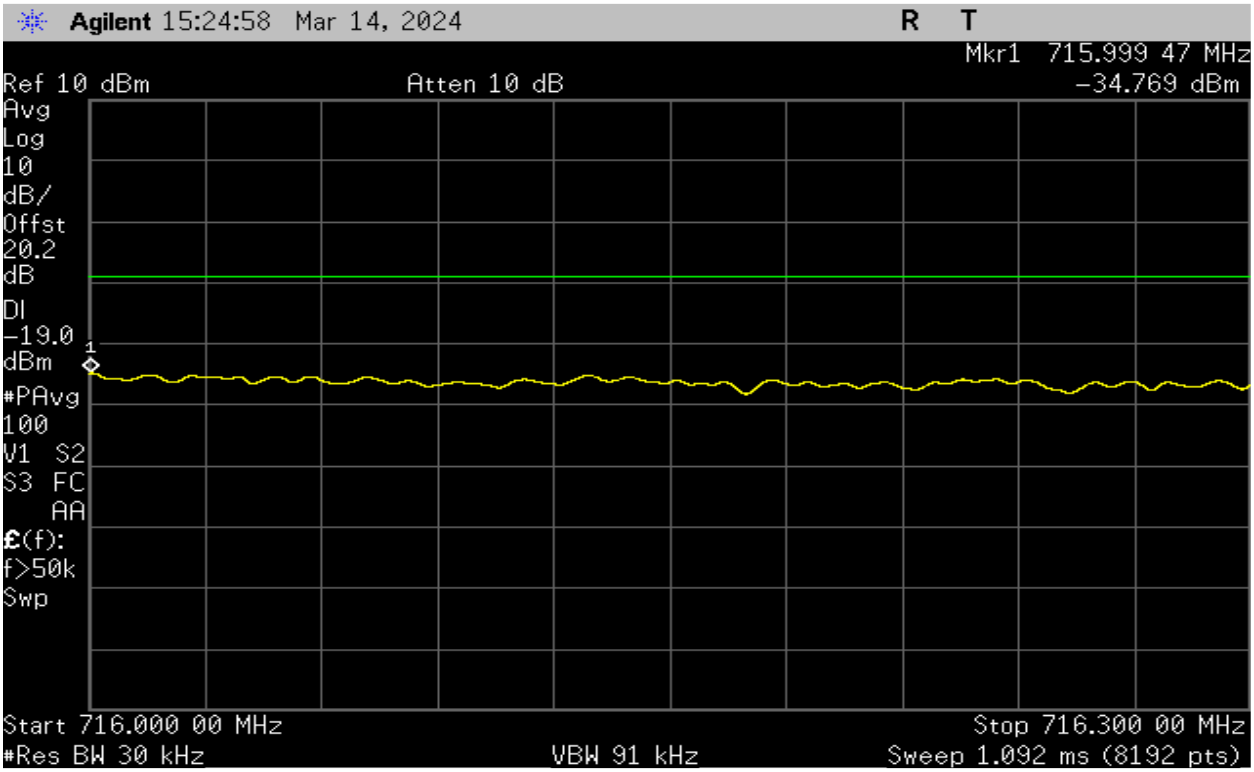
Plot 39 – 1850-1915MHz Band – CDMA Uplink Lower Band Edge



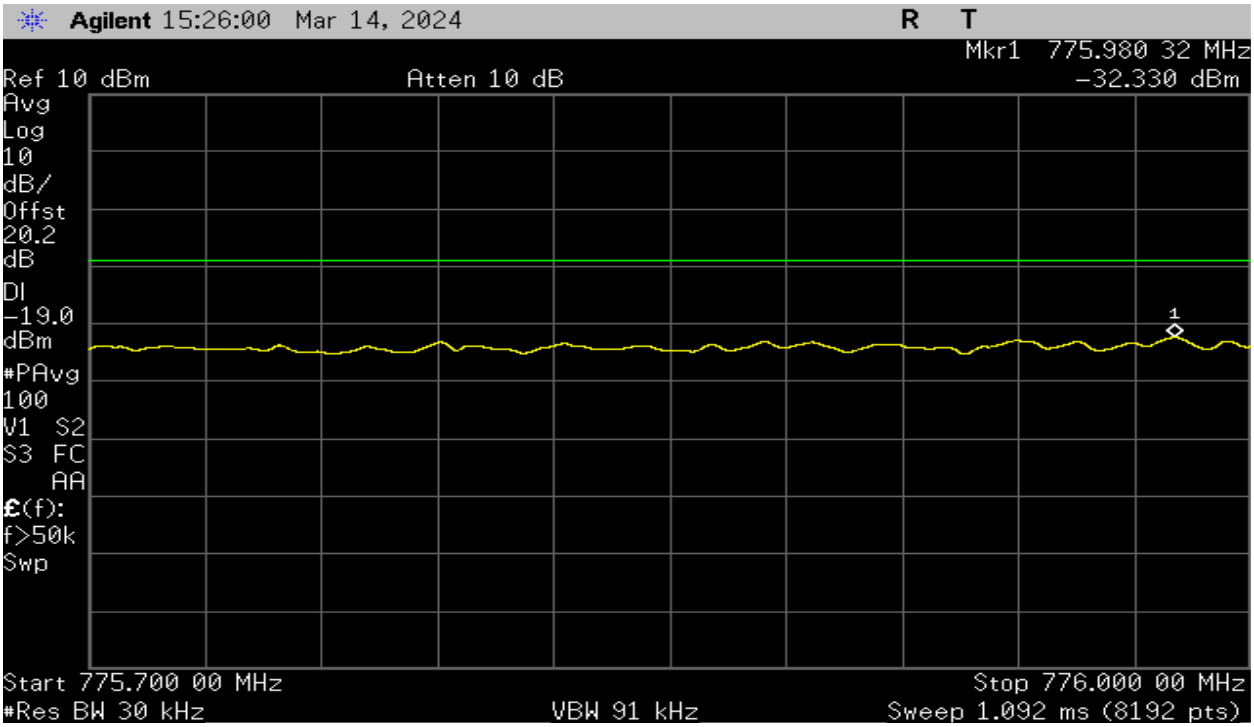
Plot 40 – 1850-1915MHz Band – CDMA Uplink Upper Band Edge



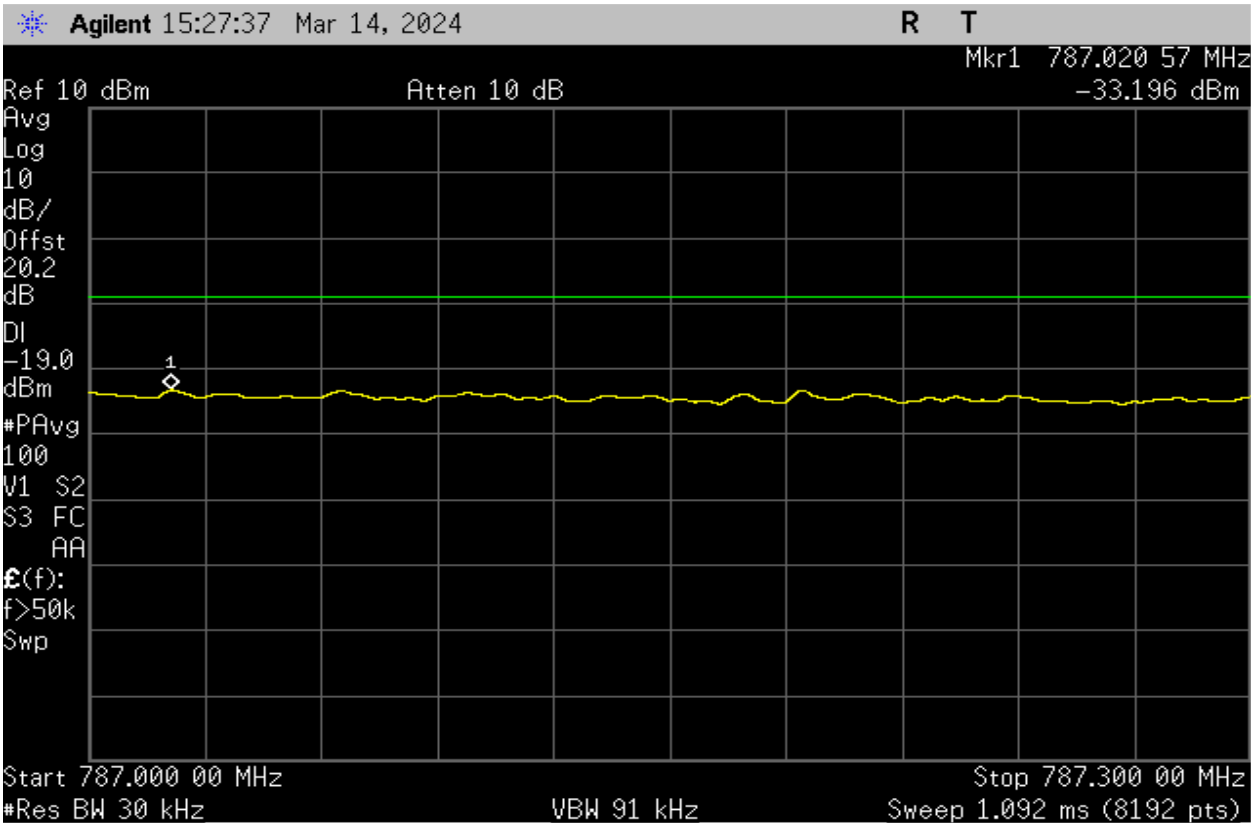
Plot 41 – 698-716MHz Band – LTE Uplink Lower Band Edge



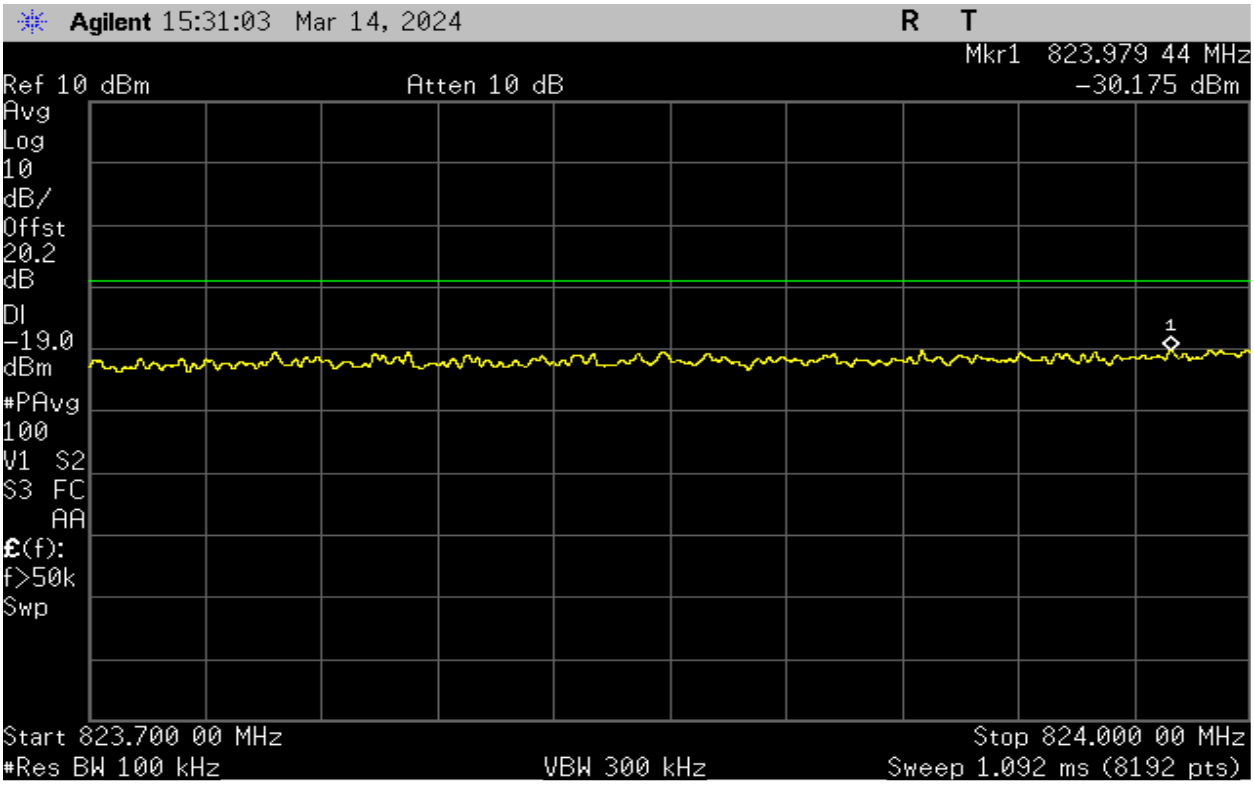
Plot 42 – 698-716MHz Band – LTE Uplink Upper Band Edge



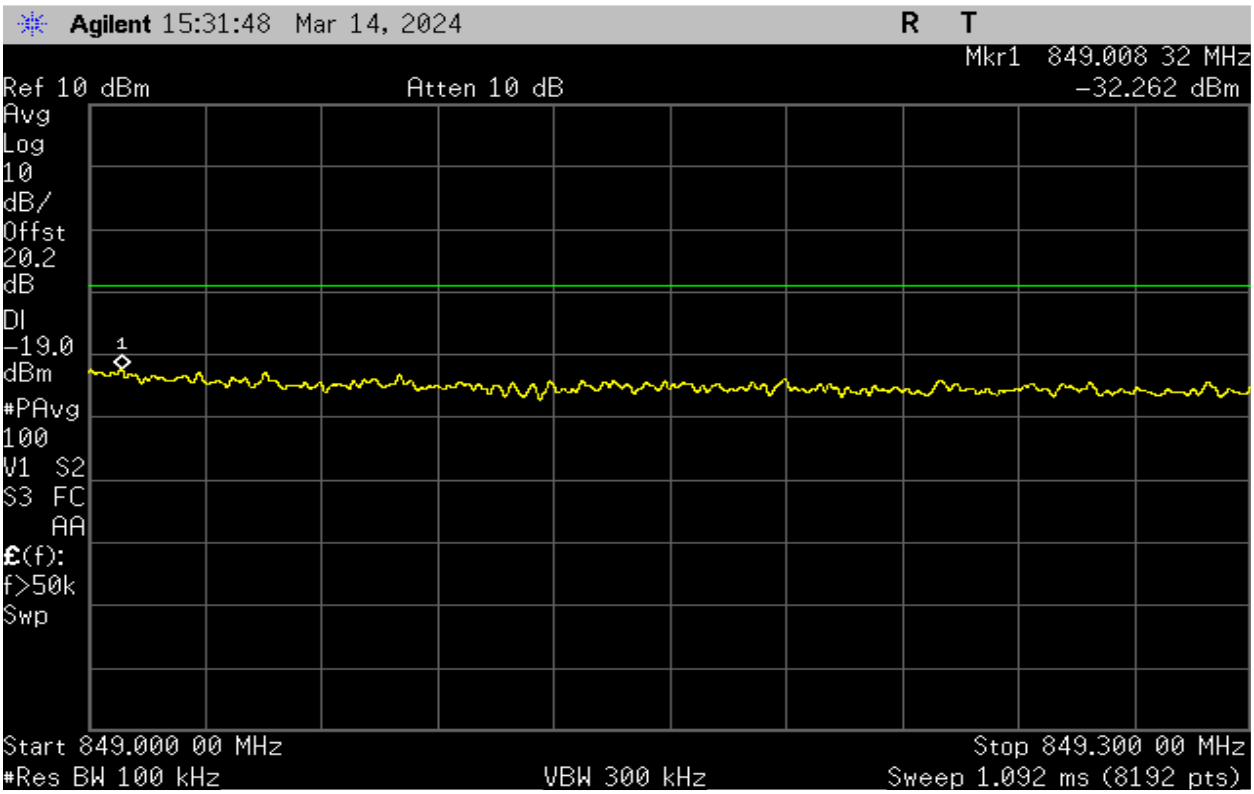
Plot 43 – 776-787MHz Band – LTE Uplink Lower Band Edge



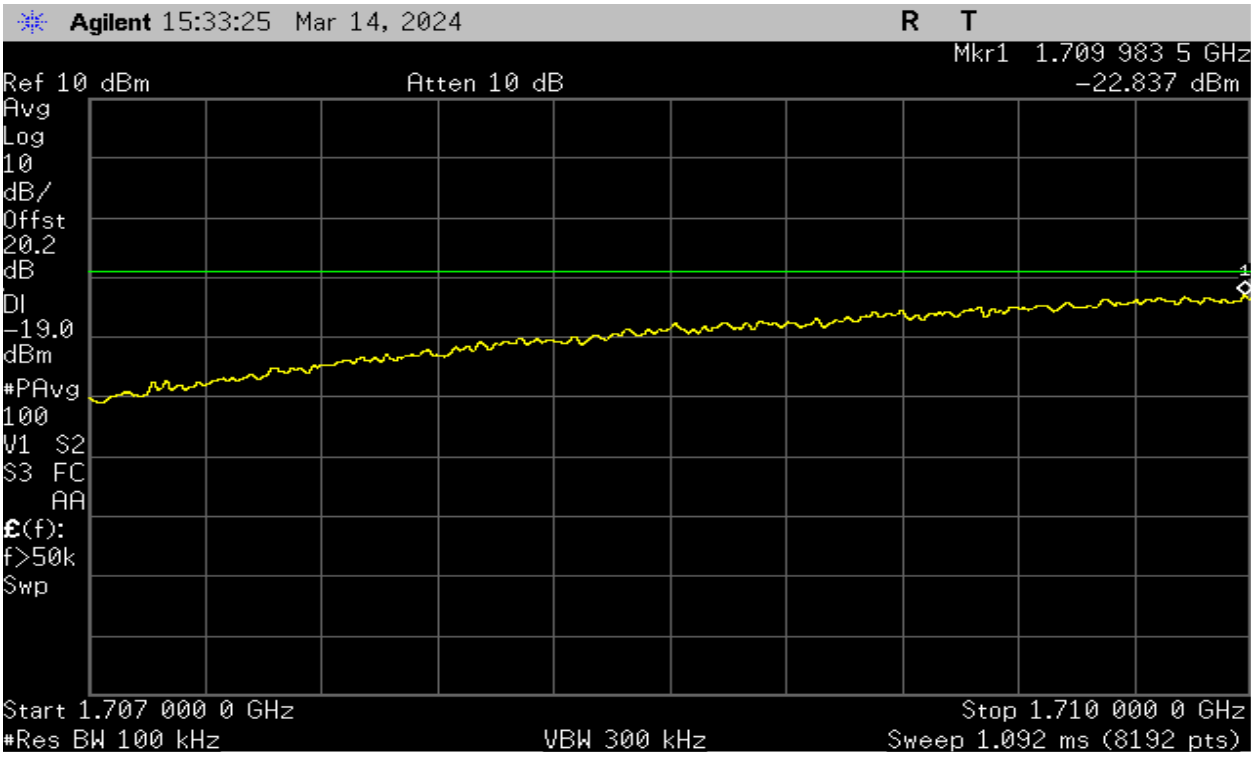
Plot 44 – 776-787MHz Band – LTE Uplink Upper Band Edge



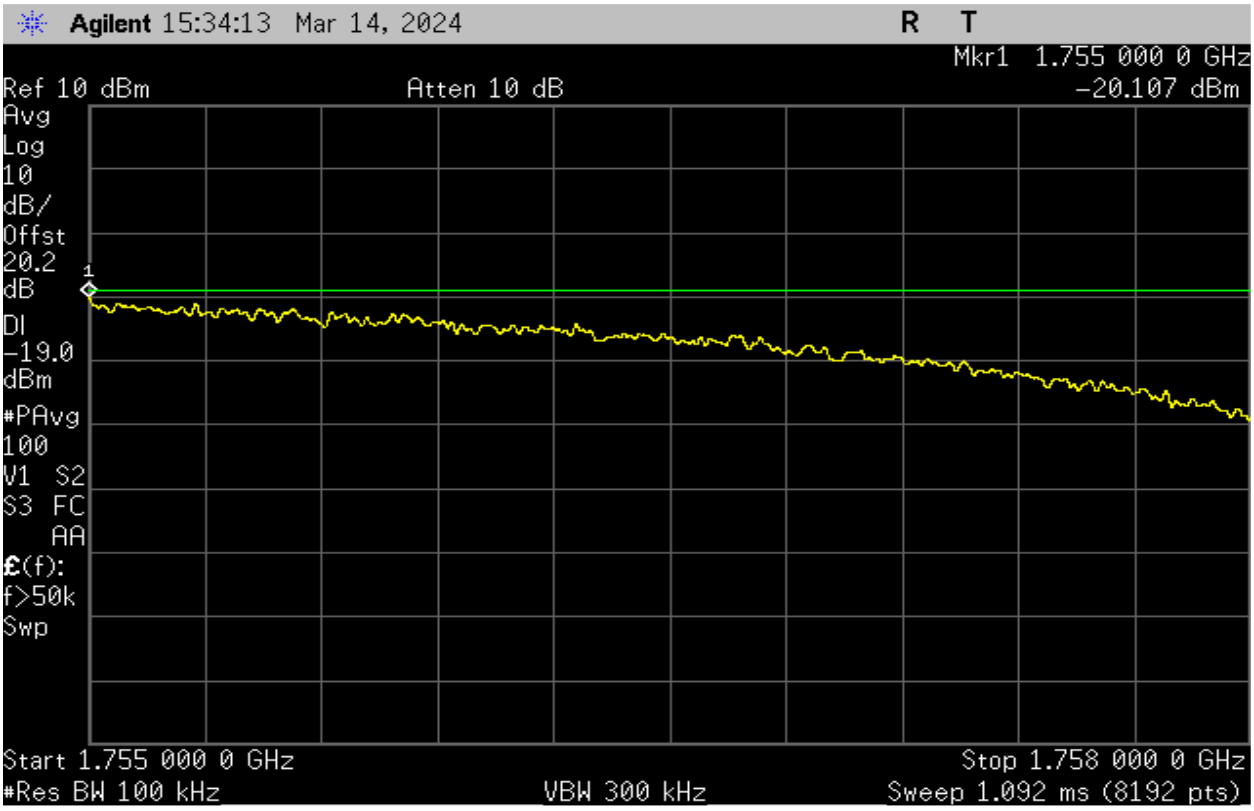
Plot 45 – 824-849MHz Band – LTE Uplink Lower Band Edge



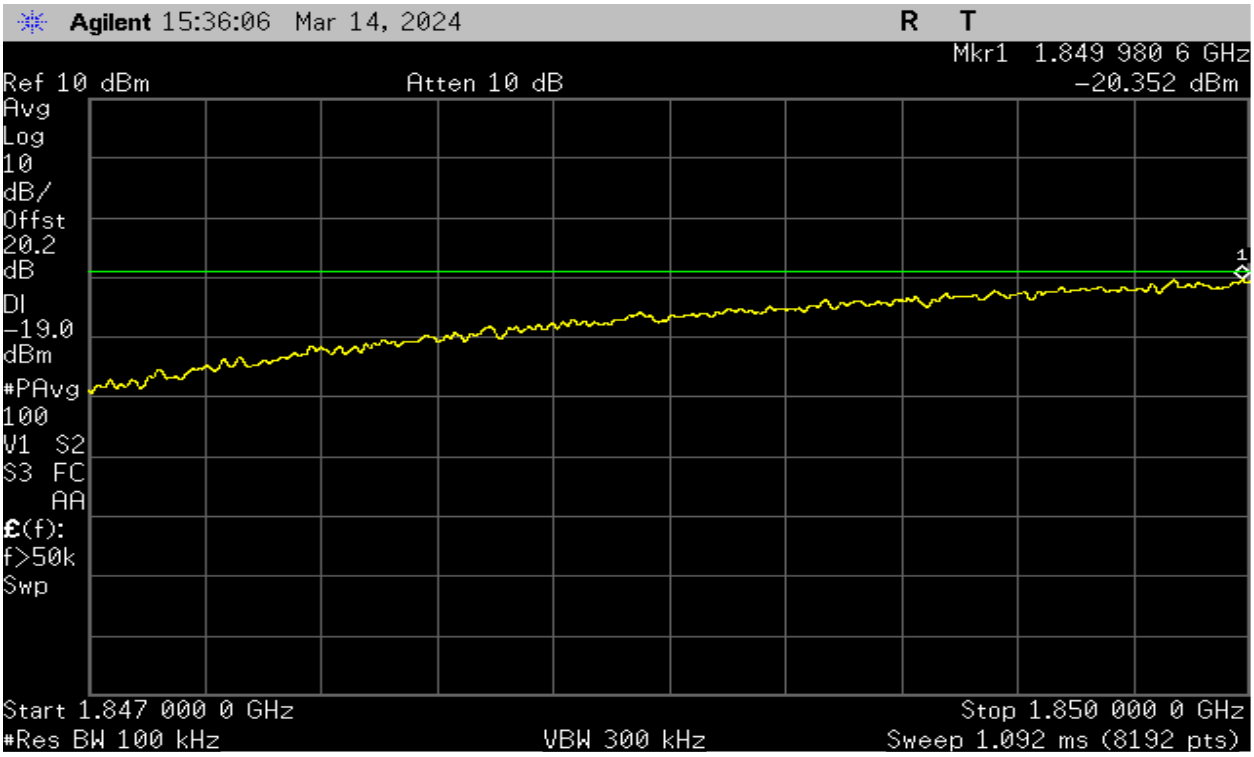
Plot 46 – 824-849MHz Band – LTE Uplink Upper Band Edge



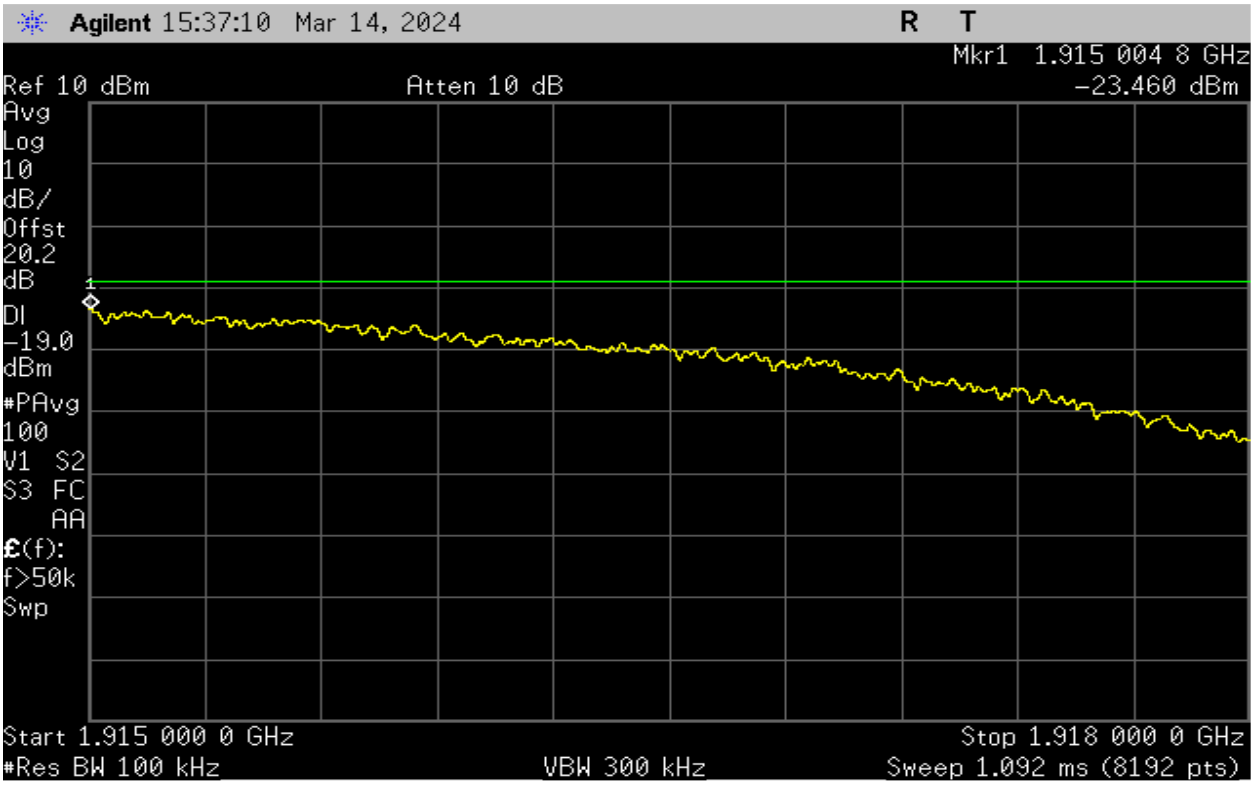
Plot 47 – 1710-1755MHz Band – LTE Uplink Lower Band Edge



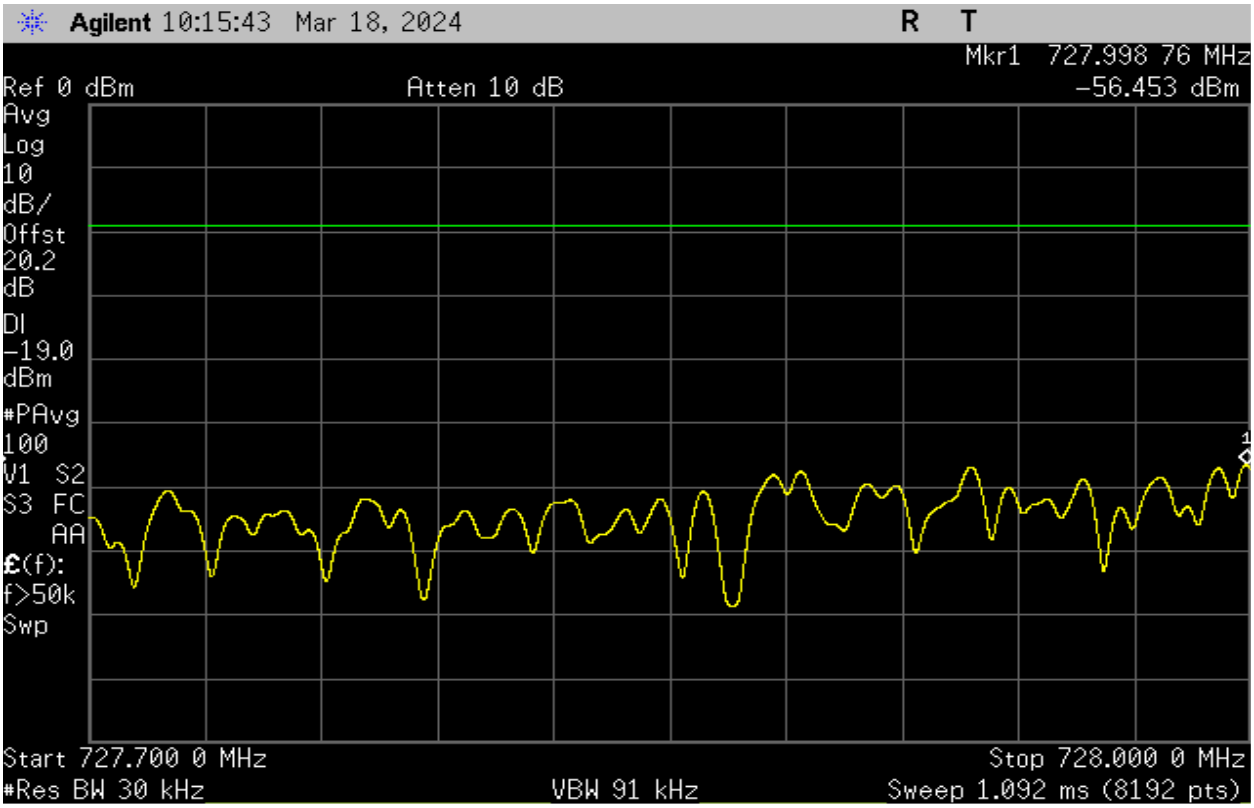
Plot 48 – 1710-1755MHz Band – LTE Uplink Upper Band Edge



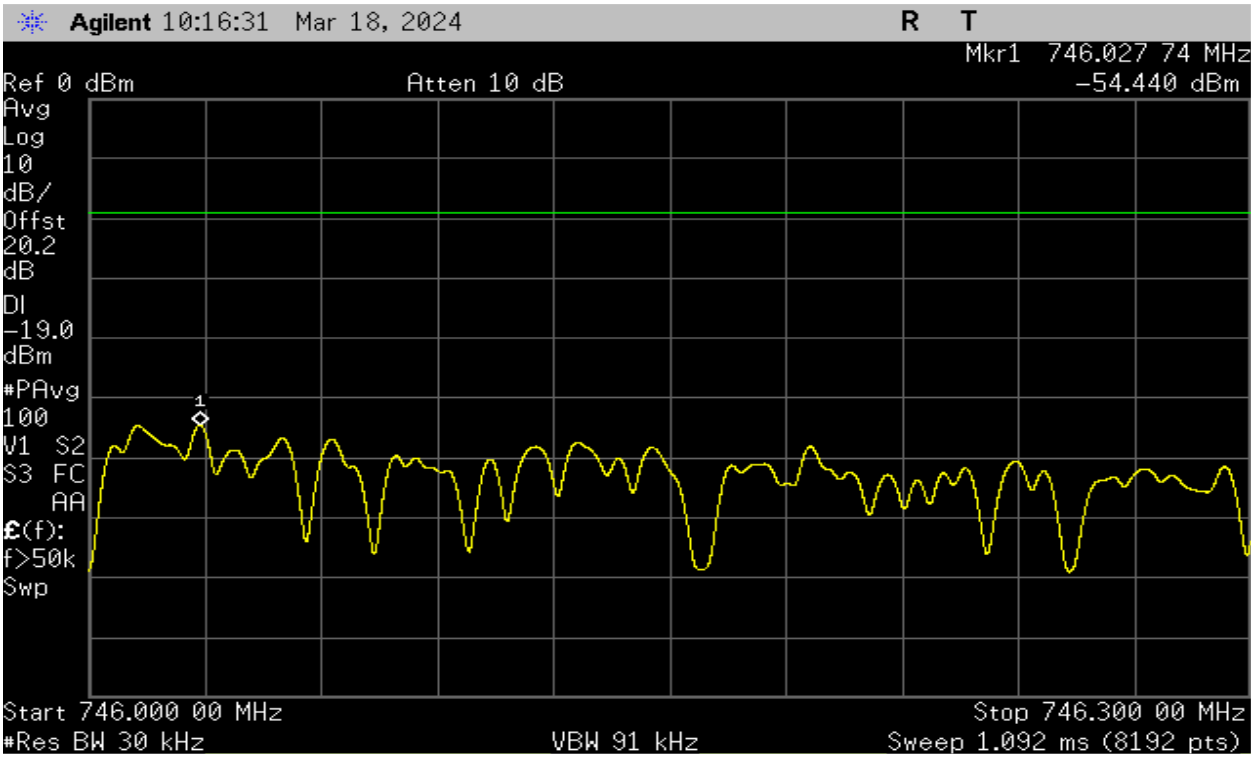
Plot 49 – 1850-1915MHz Band – LTE Uplink Lower Band Edge



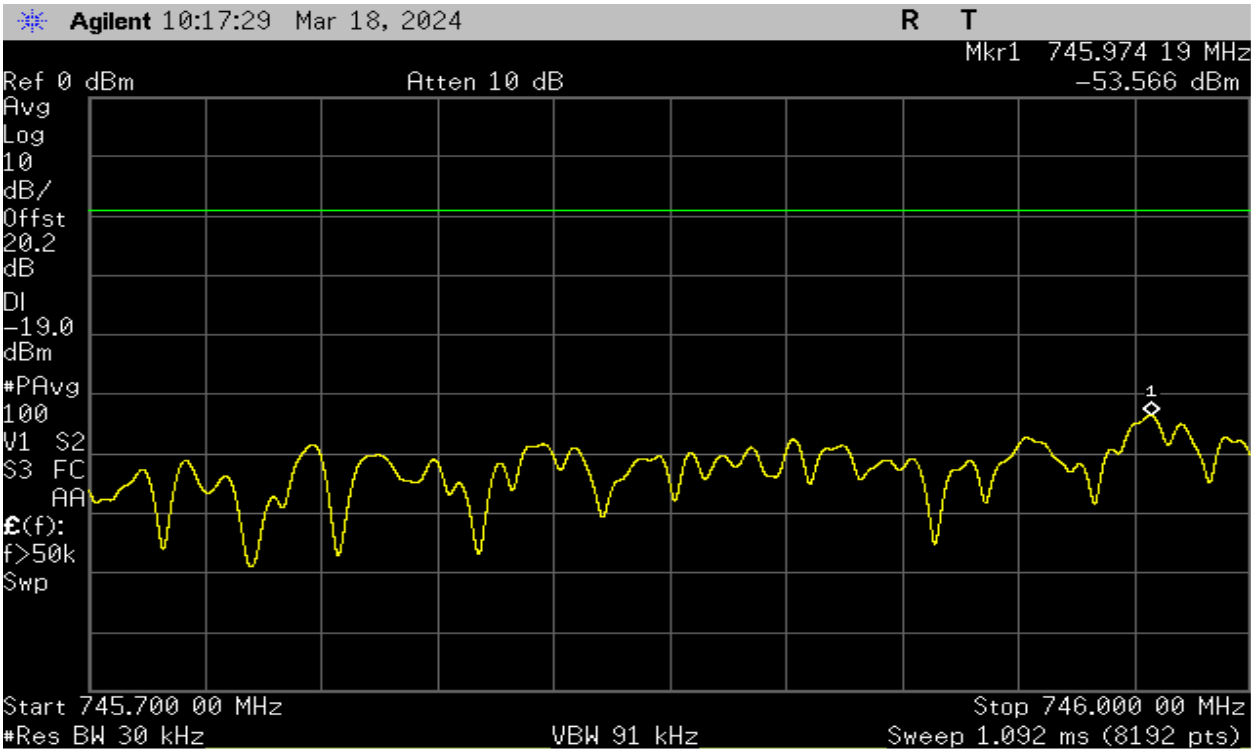
Plot 50 – 1850-1915MHz Band – LTE Uplink Upper Band Edge



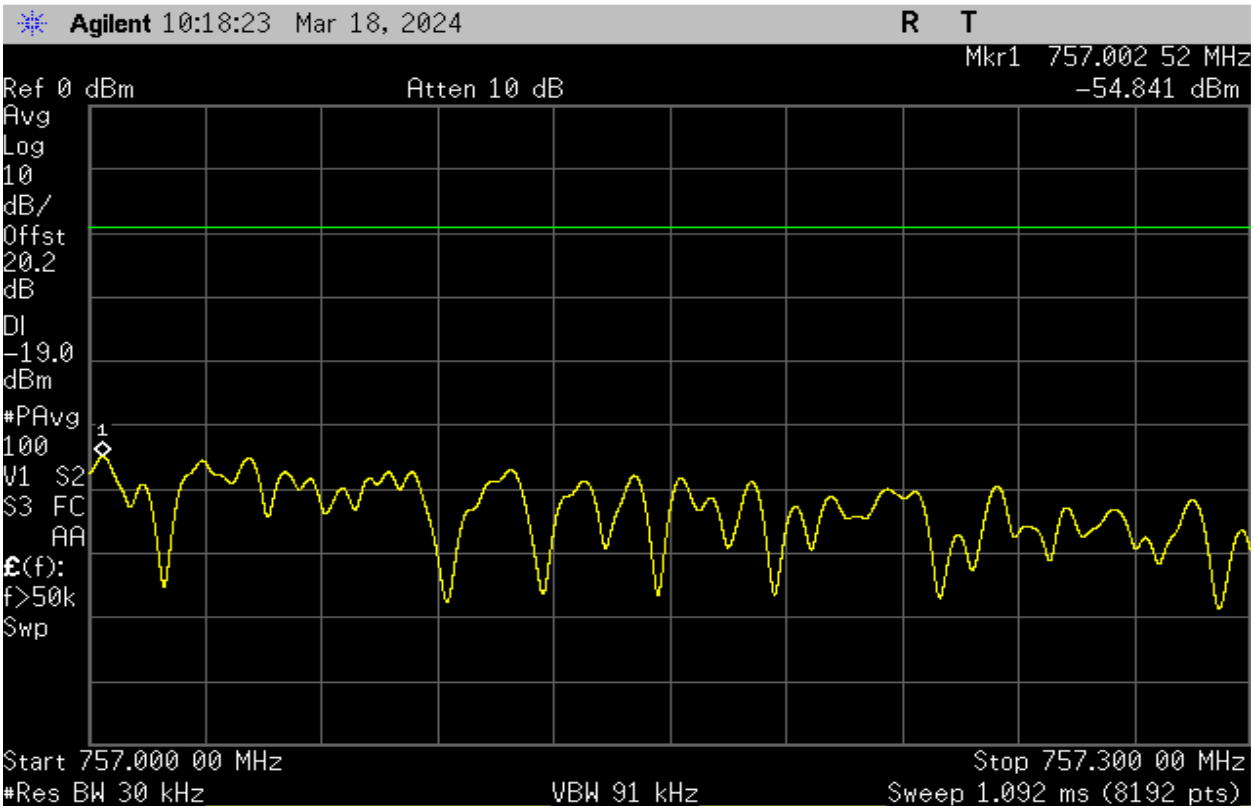
Plot 51 – 728-746MHz Band – GSM Downlink Lower Band Edge



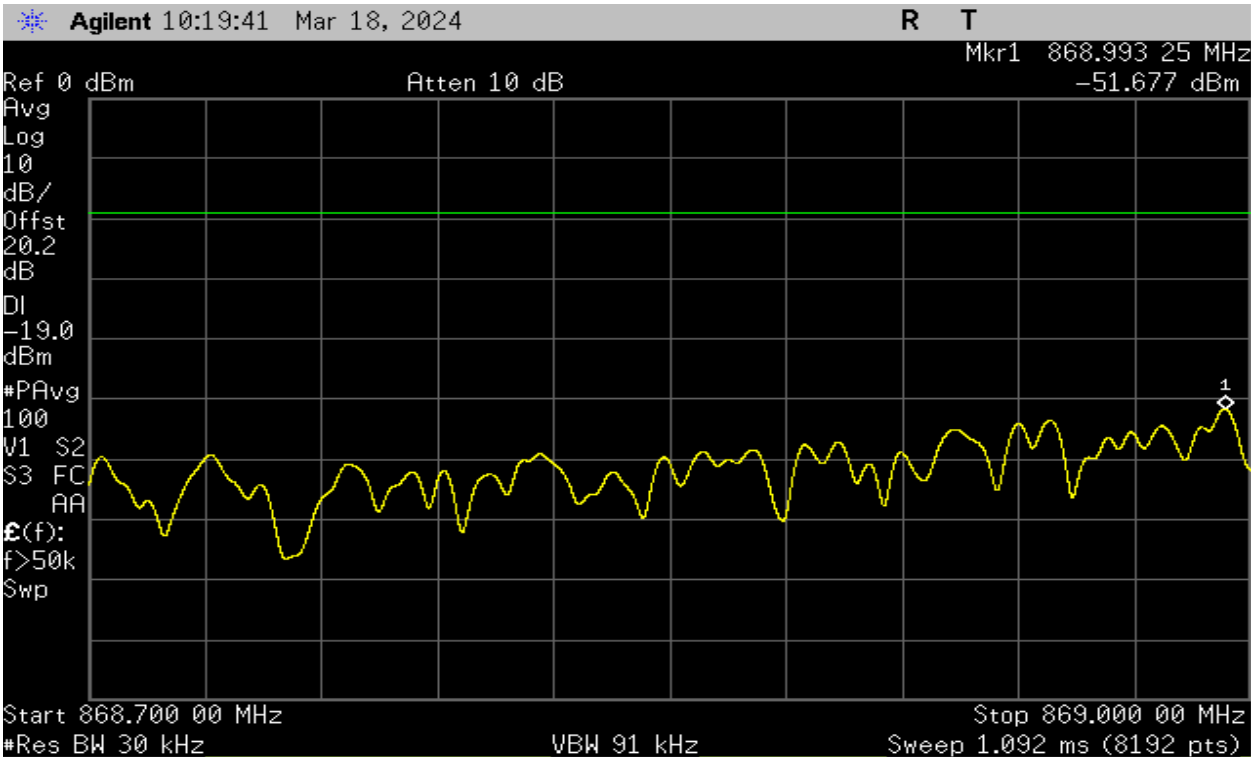
Plot 52 – 728-746MHz Band – GSM Downlink Upper Band Edge



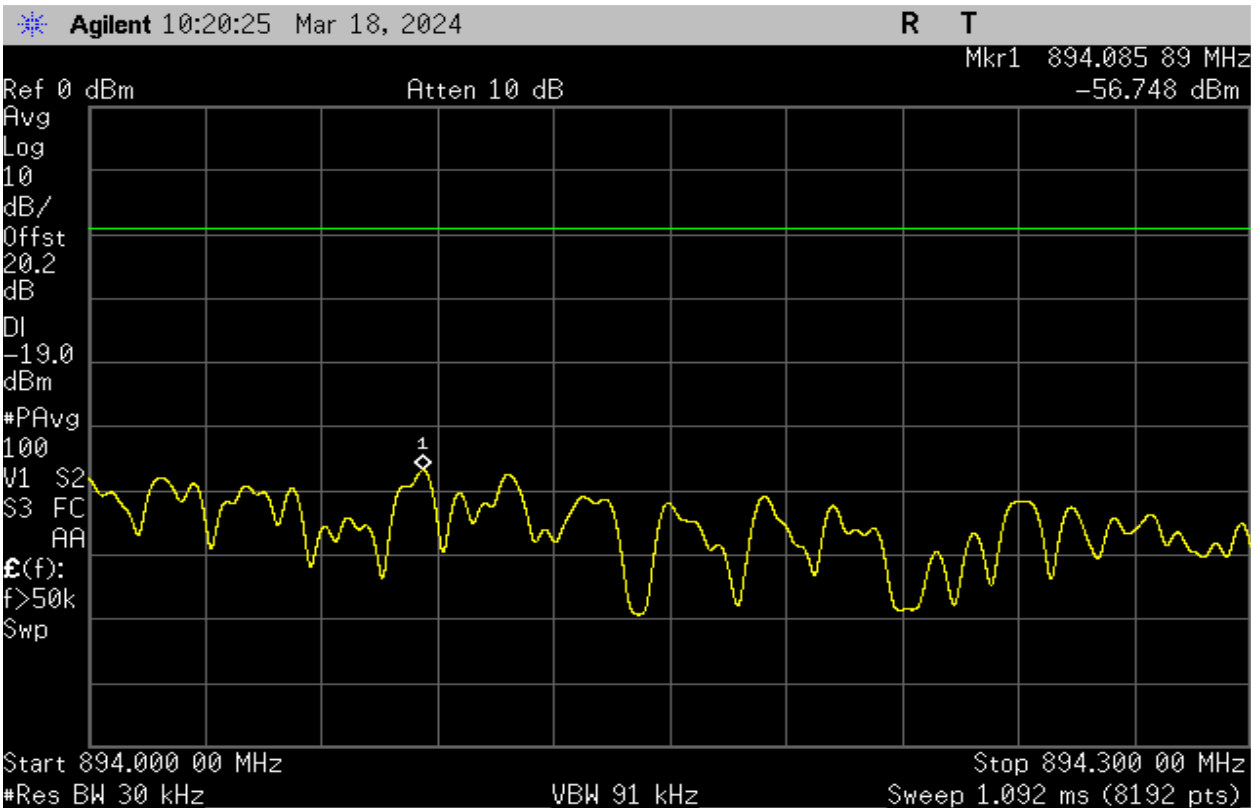
Plot 53 – 746-757MHz Band – GSM Downlink Lower Band Edge



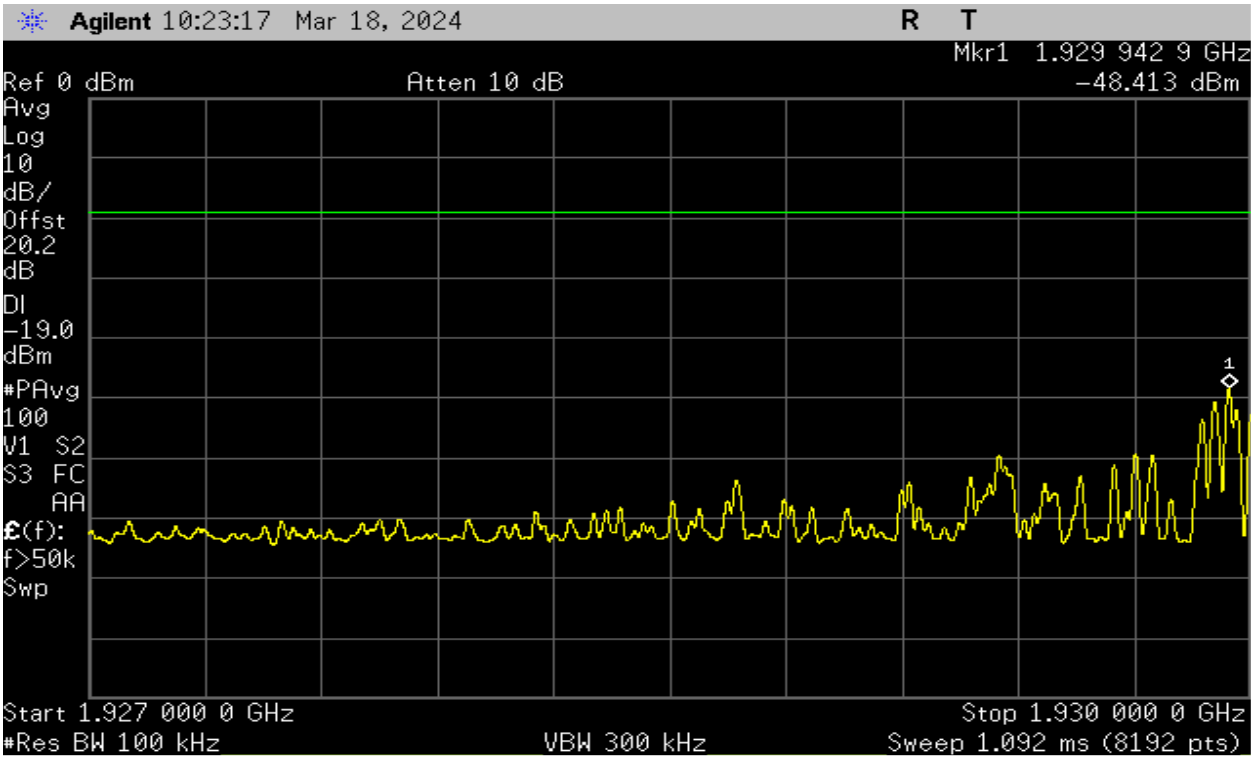
Plot 54 – 746-757MHz Band – GSM Downlink Upper Band Edge



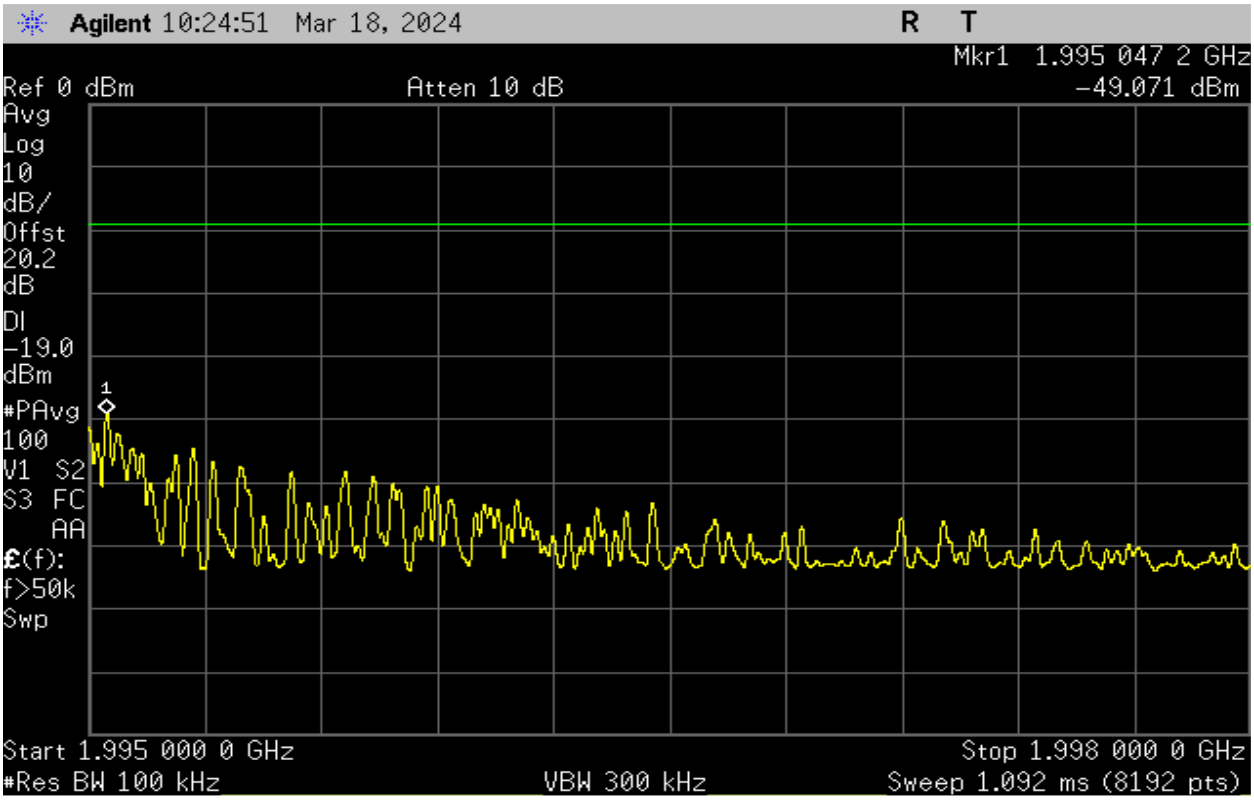
Plot 55 – 869-894MHz Band – GSM Downlink Lower Band Edge



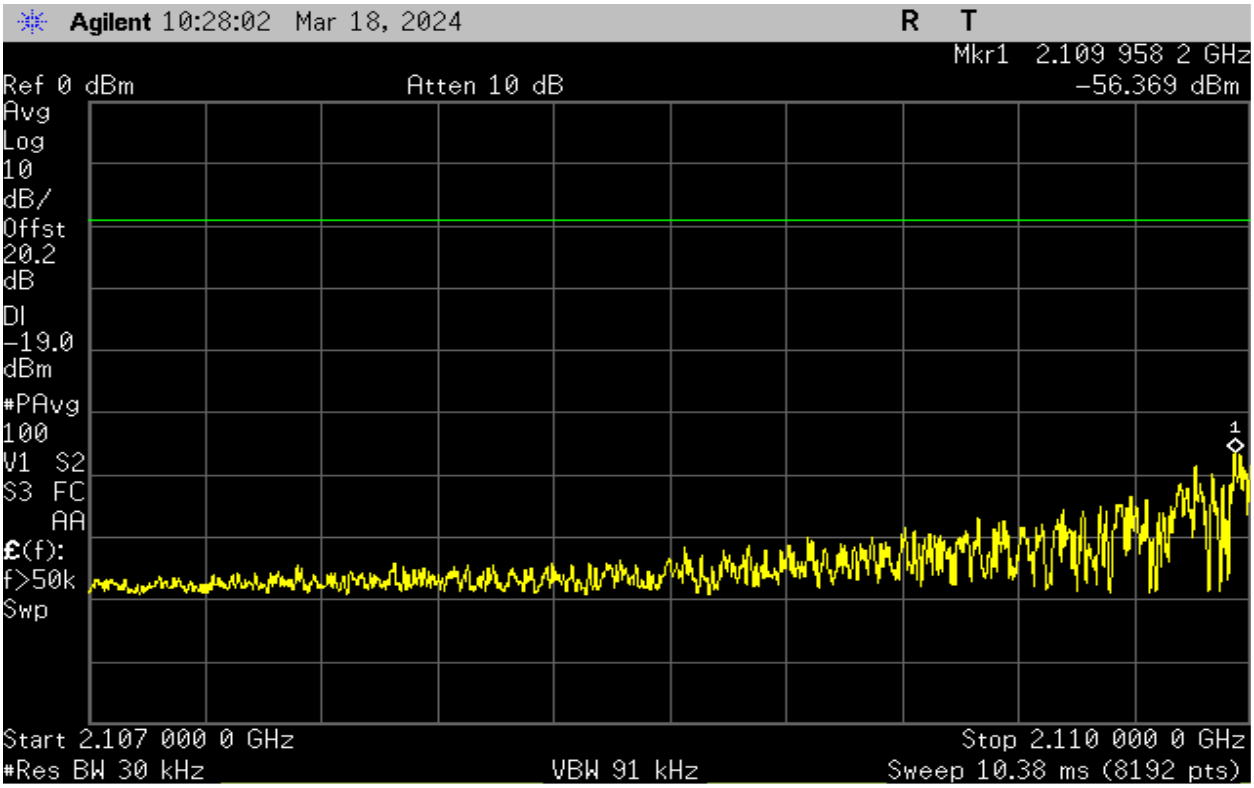
Plot 56 – 869-894MHz Band – GSM Downlink Upper Band Edge



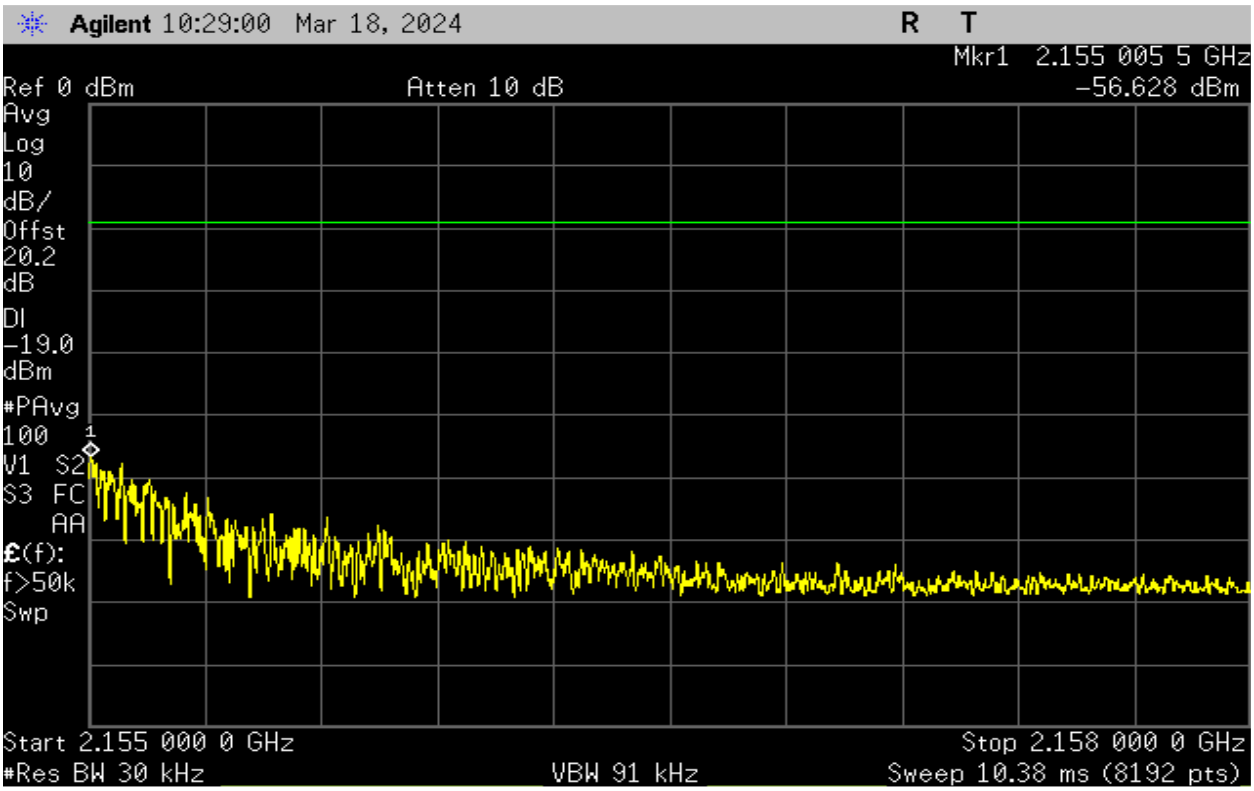
Plot 57 – 1930-1995MHz Band – GSM Downlink Lower Band Edge



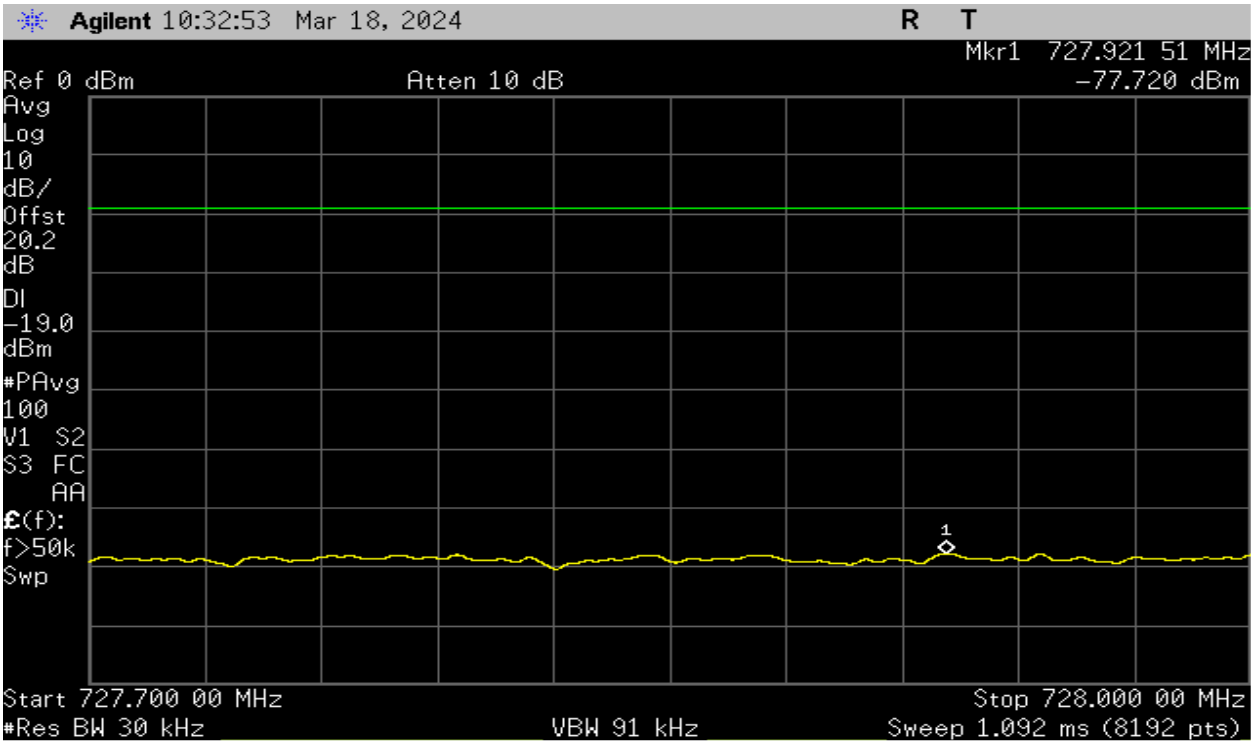
Plot 58 – 1930-1995MHz Band – GSM Downlink Upper Band Edge



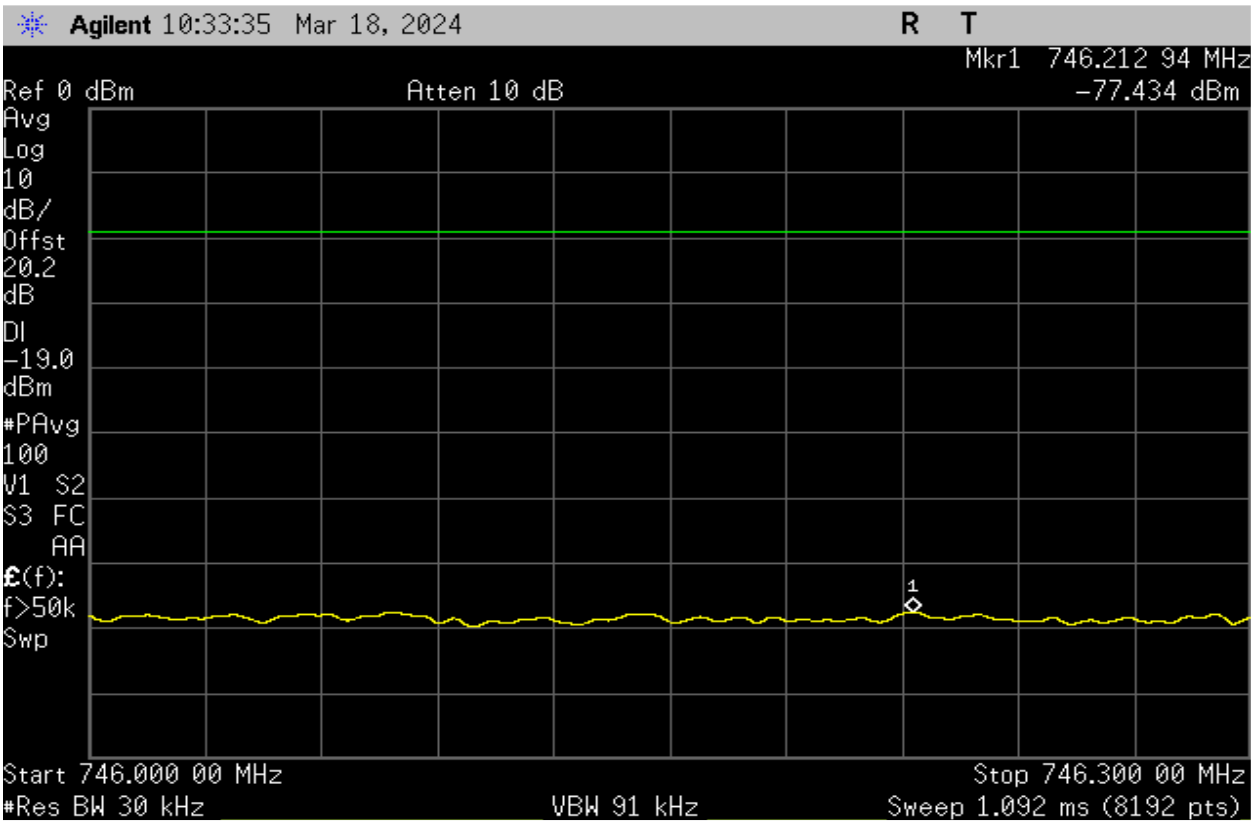
Plot 59 – 2110-2155MHz Band – GSM Downlink Lower Band Edge



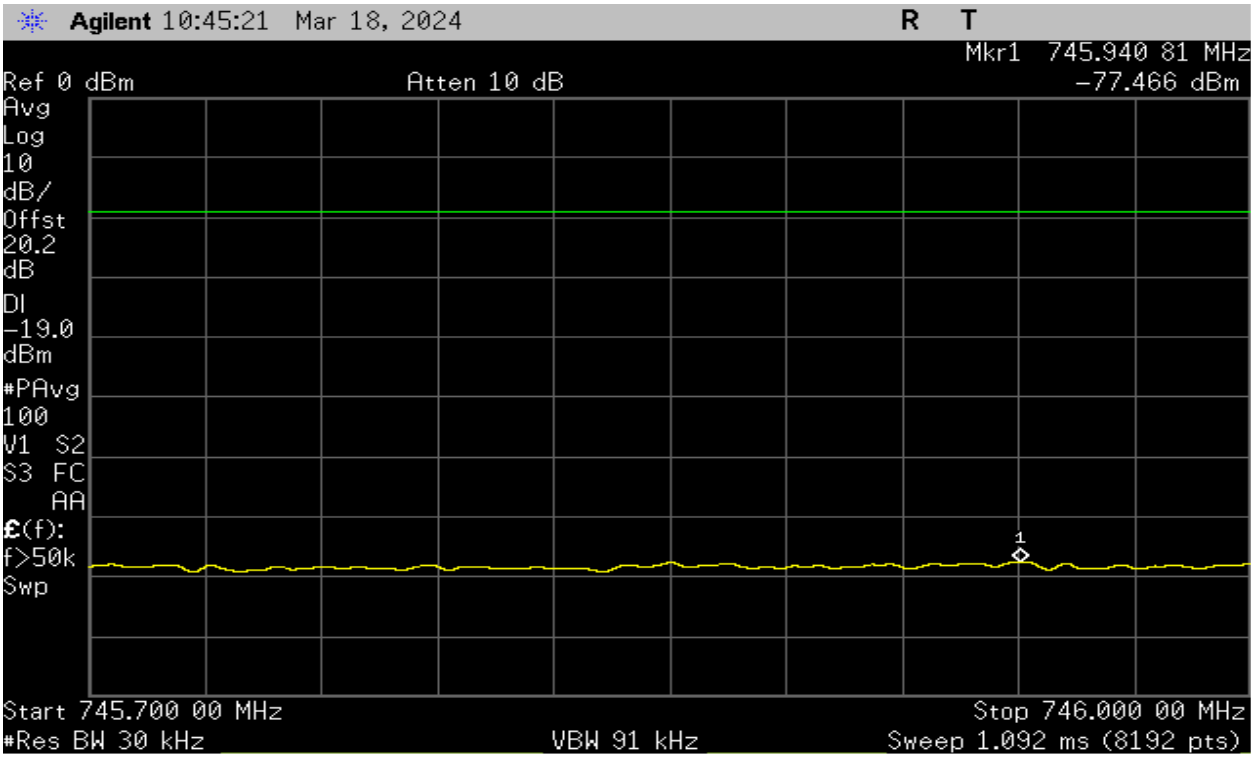
Plot 60 – 2110-2155MHz Band – GSM Downlink Upper Band Edge



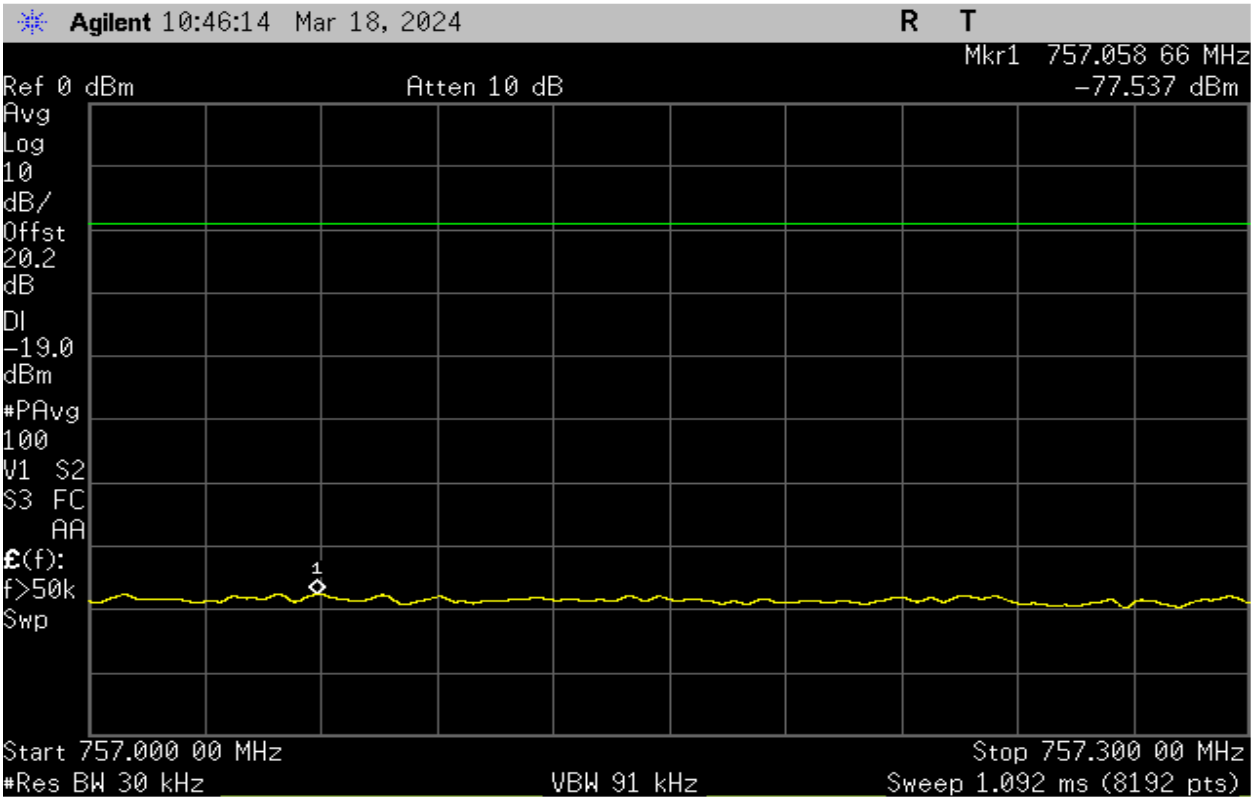
Plot 61 – 728-746MHz Band – CDMA Downlink Lower Band Edge



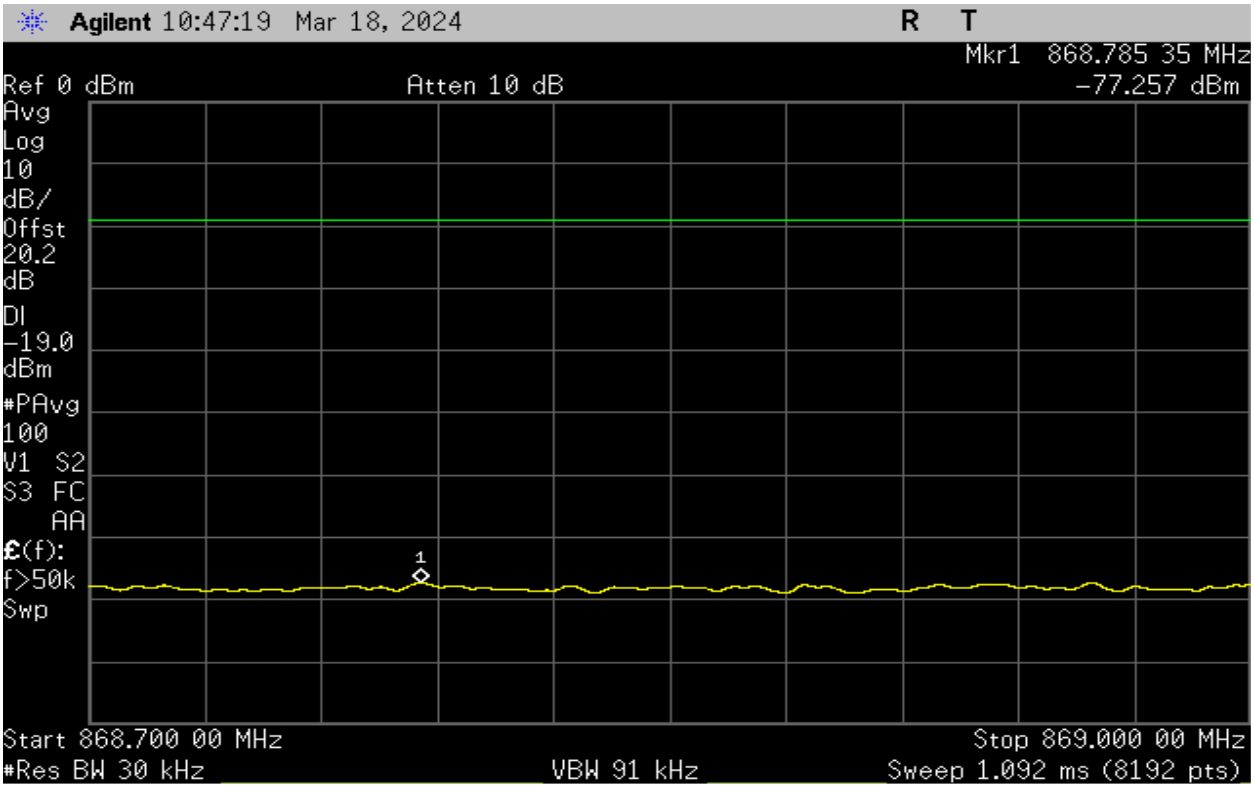
Plot 62 – 728-746MHz Band – CDMA Downlink Upper Band Edge



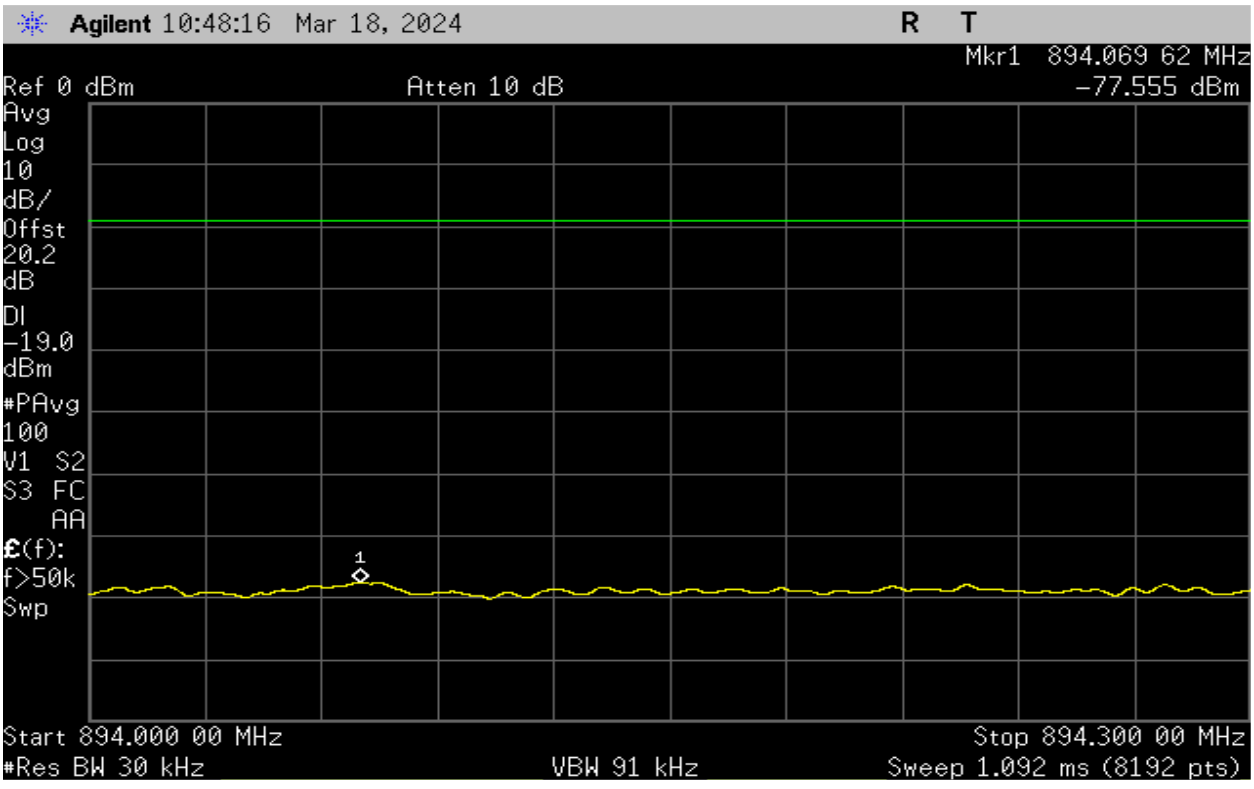
Plot 63 –746-757MHz Band – CDMA Downlink Lower Band Edge



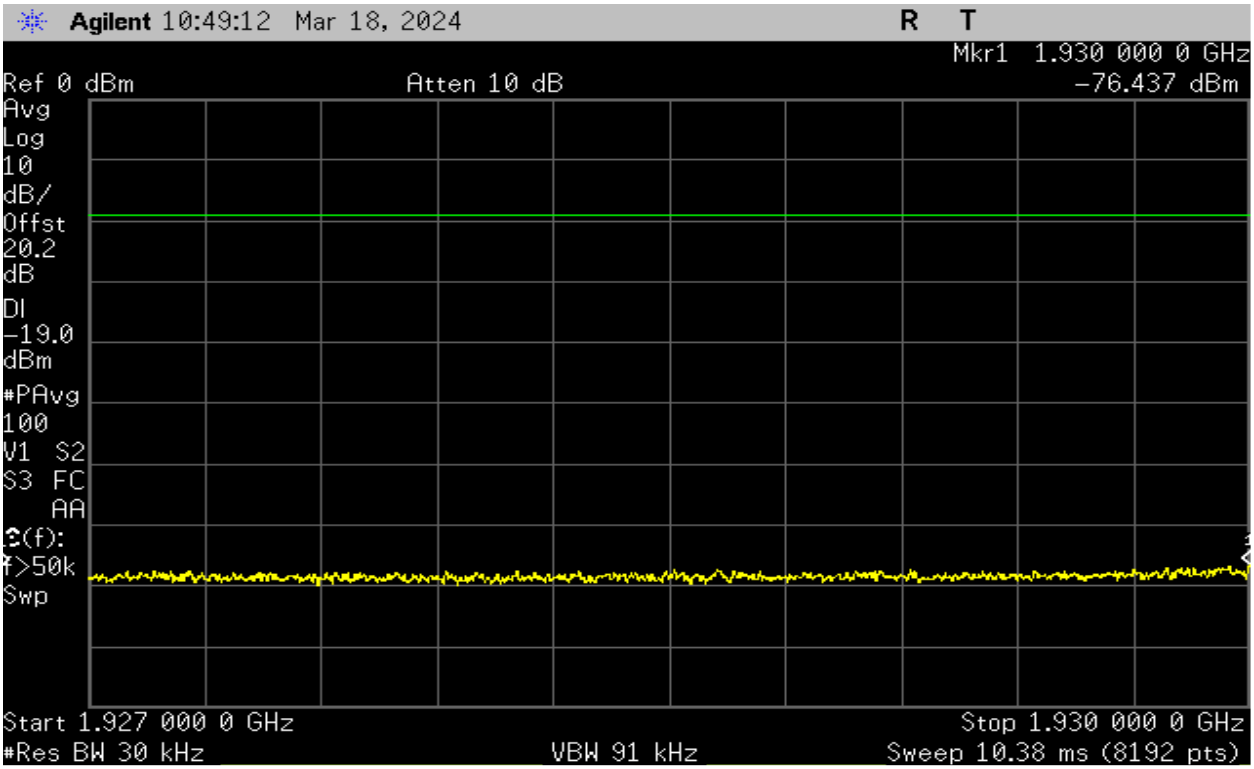
Plot 64 – 746-757MHz Band – CDMA Downlink Upper Band Edge



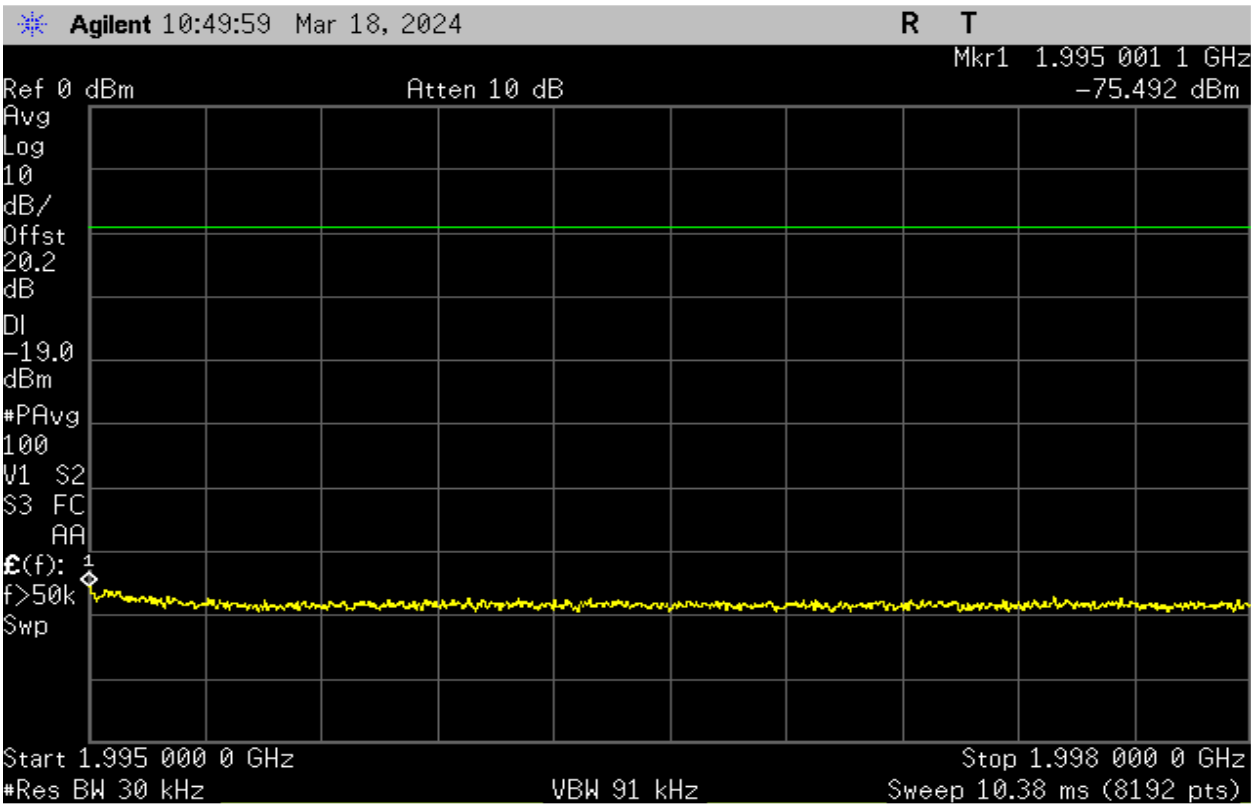
Plot 65 – 869-894MHz Band – CDMA Downlink Lower Band Edge



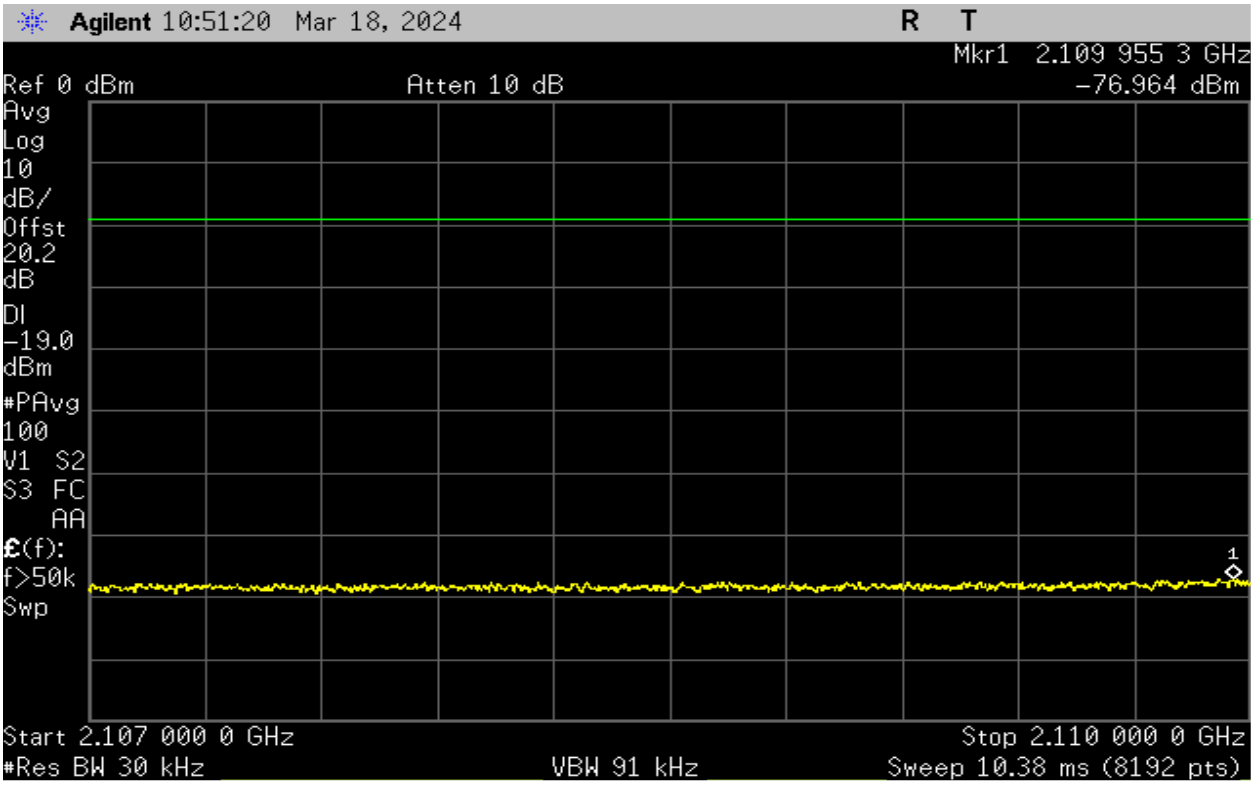
Plot 66 – 869-894MHz Band – CDMA Downlink Upper Band Edge



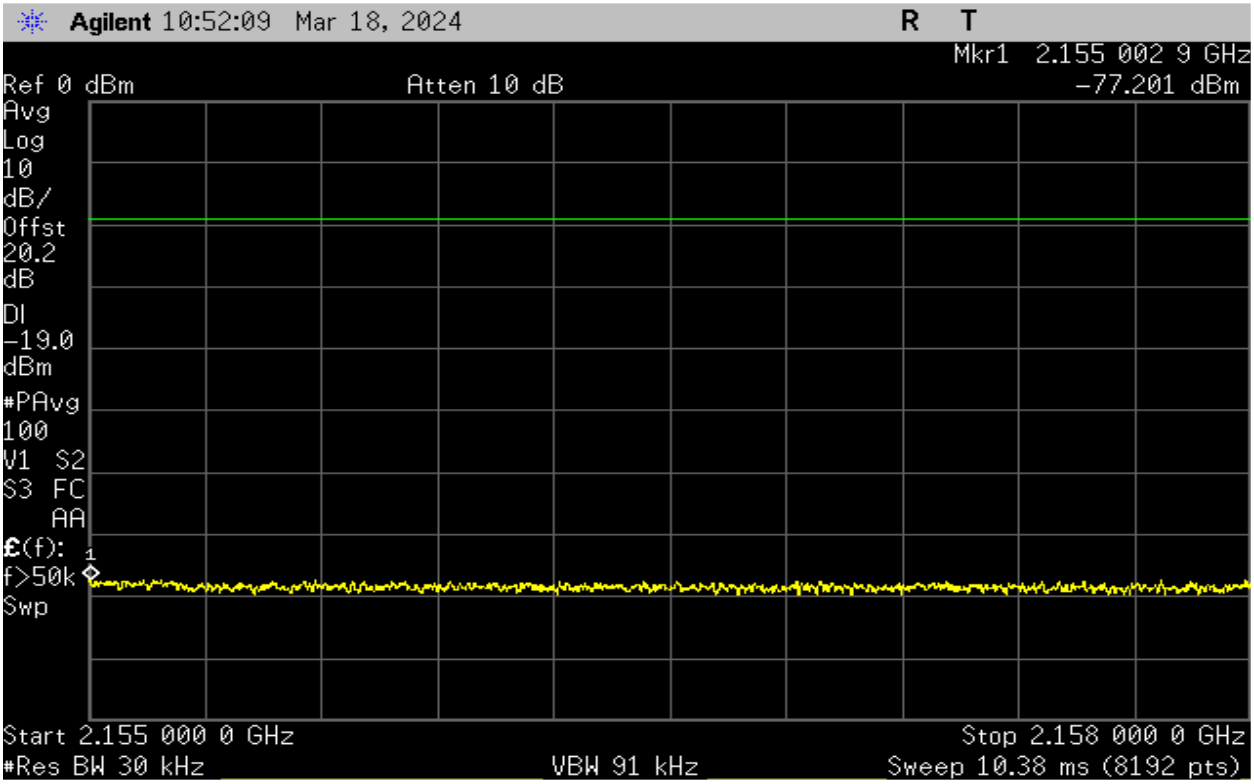
Plot 67 – 1930-1955MHz Band – CDMA Downlink Lower Band Edge



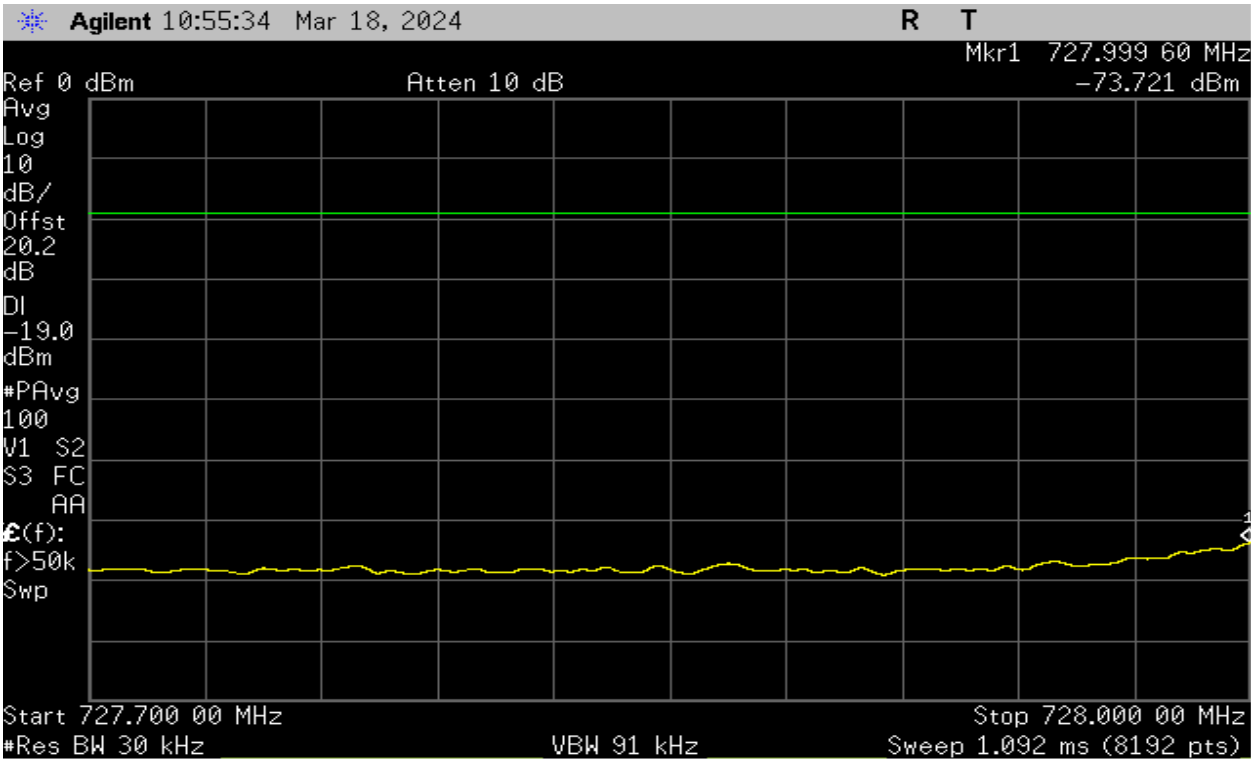
Plot 68 – 1930-1955MHz Band – CDMA Downlink Upper Band Edge



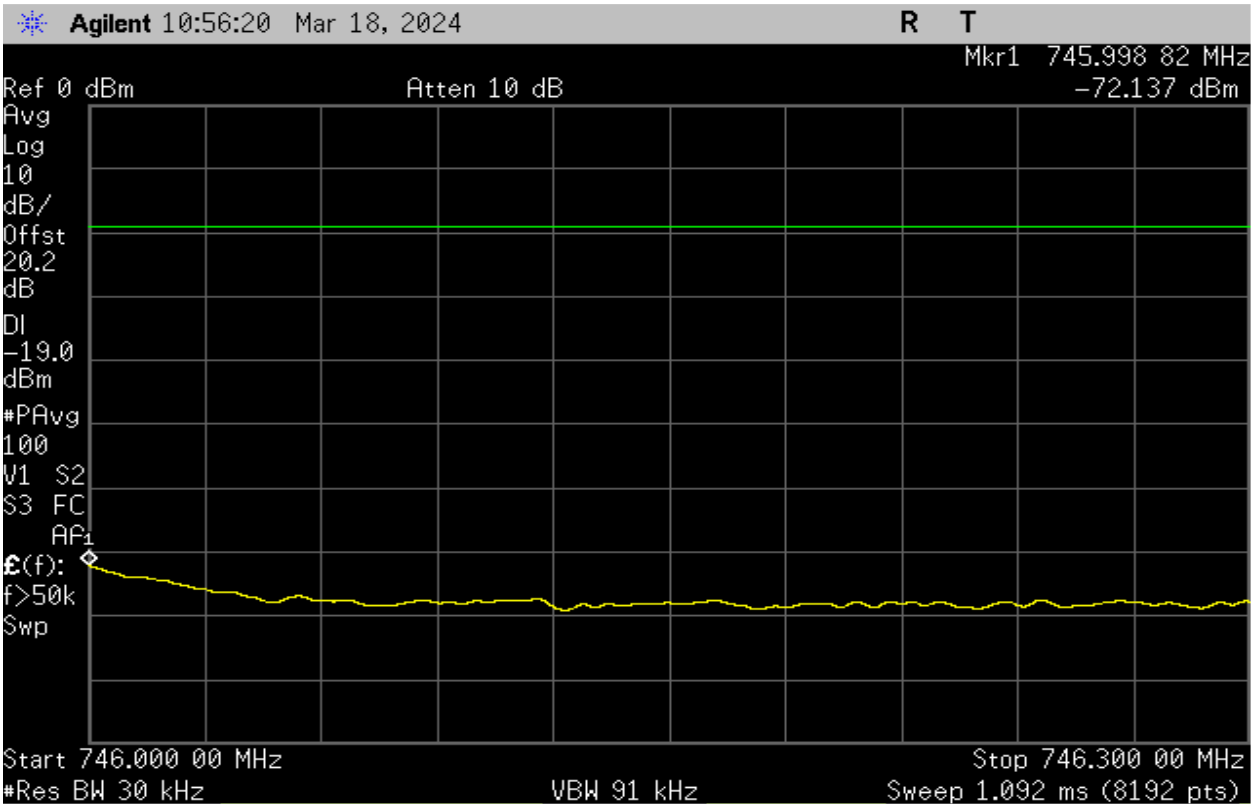
Plot 69 – 2110-2155MHz Band – CDMA Downlink Lower Band Edge



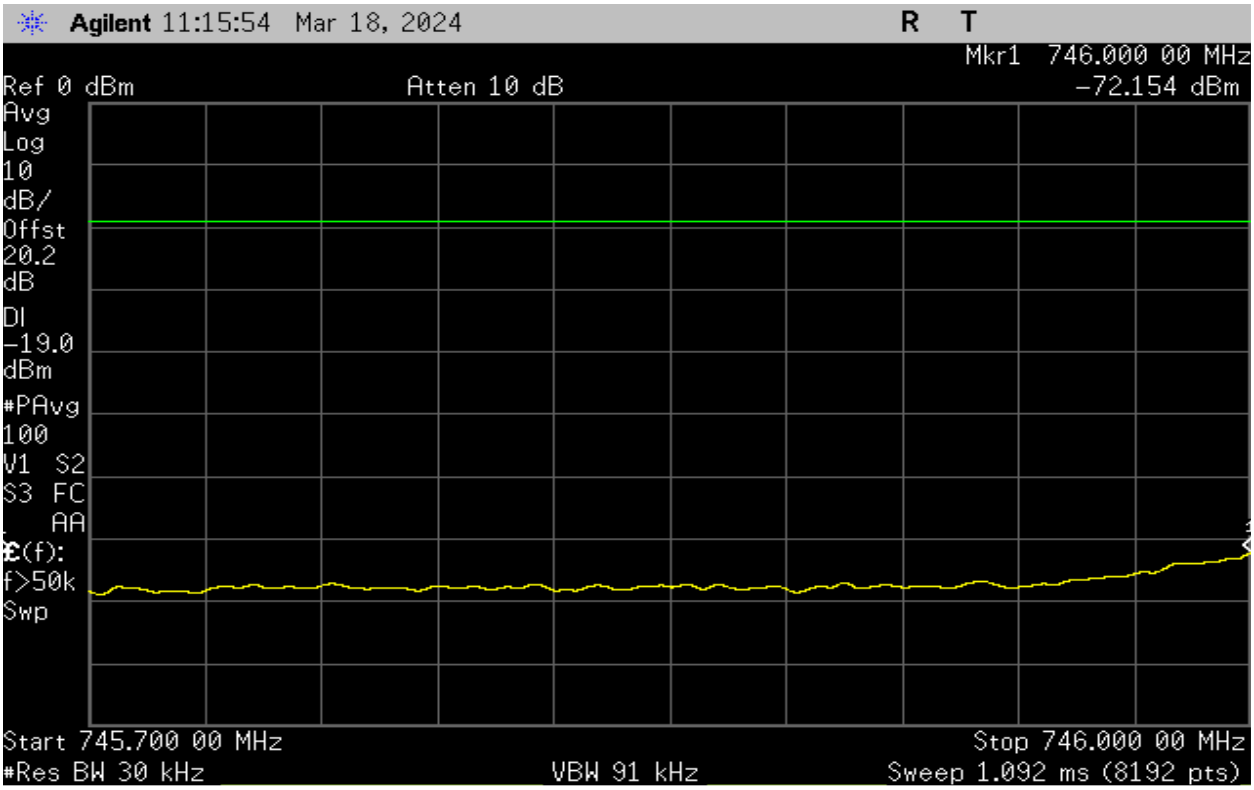
Plot 70 – 2110-2155MHz Band – CDMA Downlink Upper Band Edge



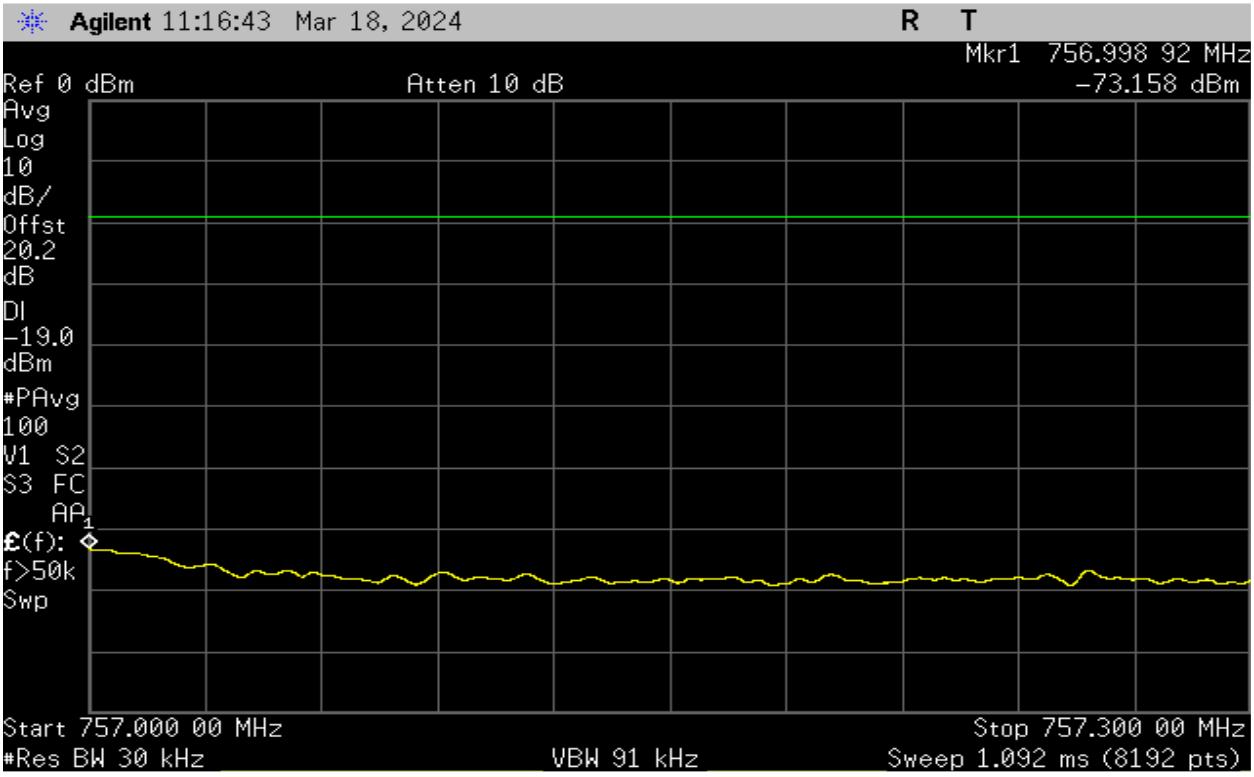
Plot 71 – 728-746MHz Band – LTE Downlink Lower Band Edge



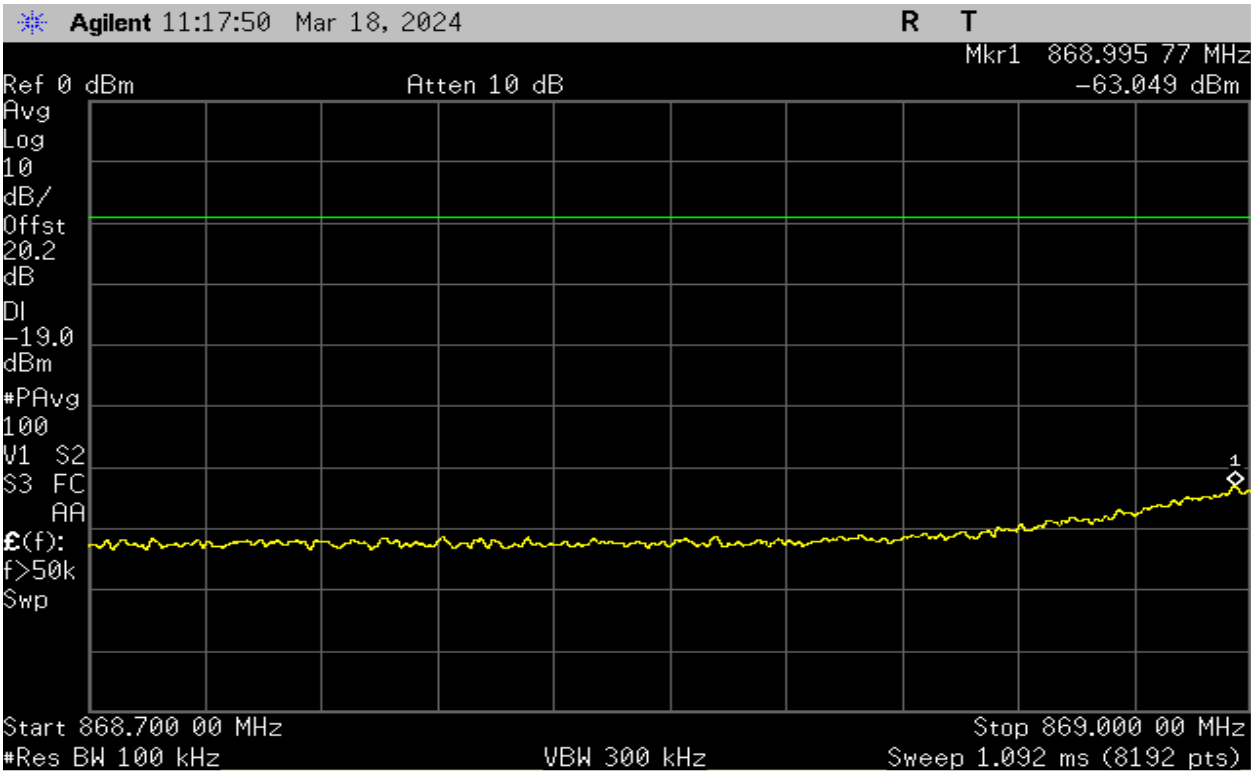
Plot 72 – 728-746MHz Band – LTE Downlink Upper Band Edge



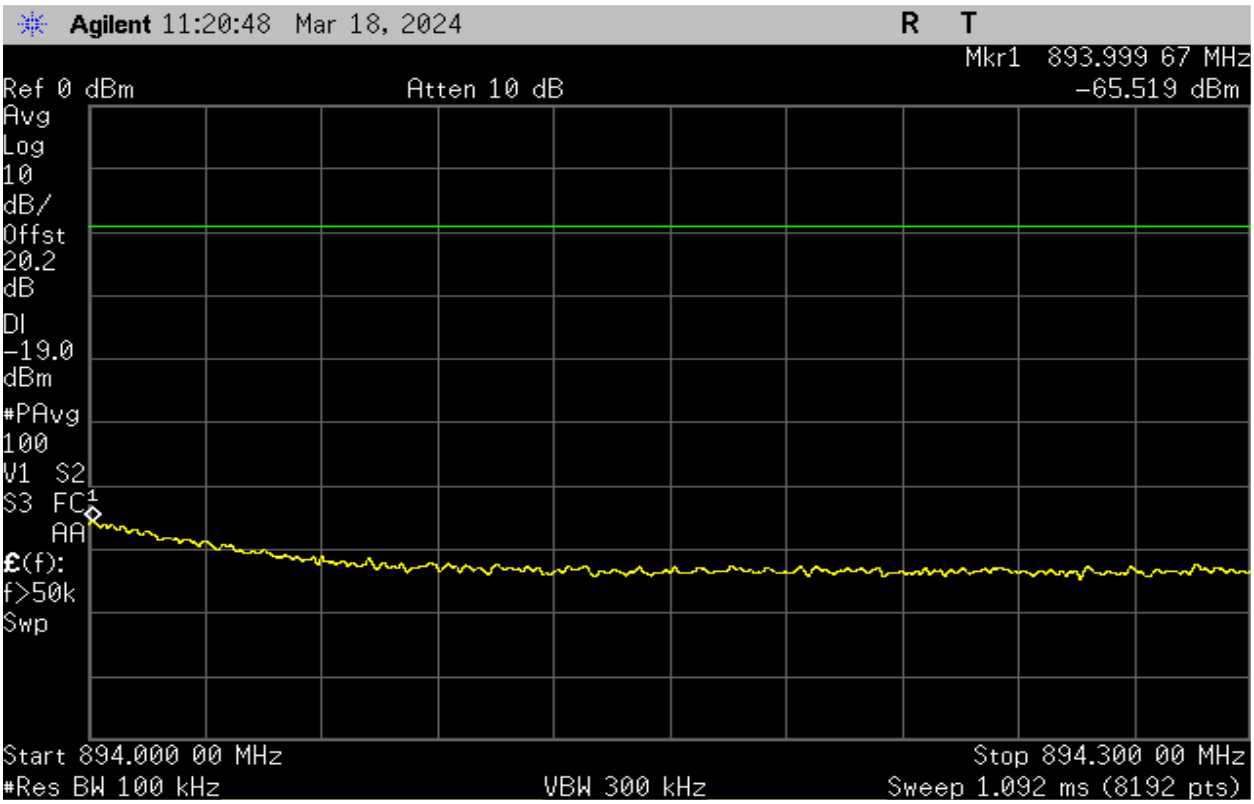
Plot 73 – 746-757MHz Band – LTE Downlink Lower Band Edge



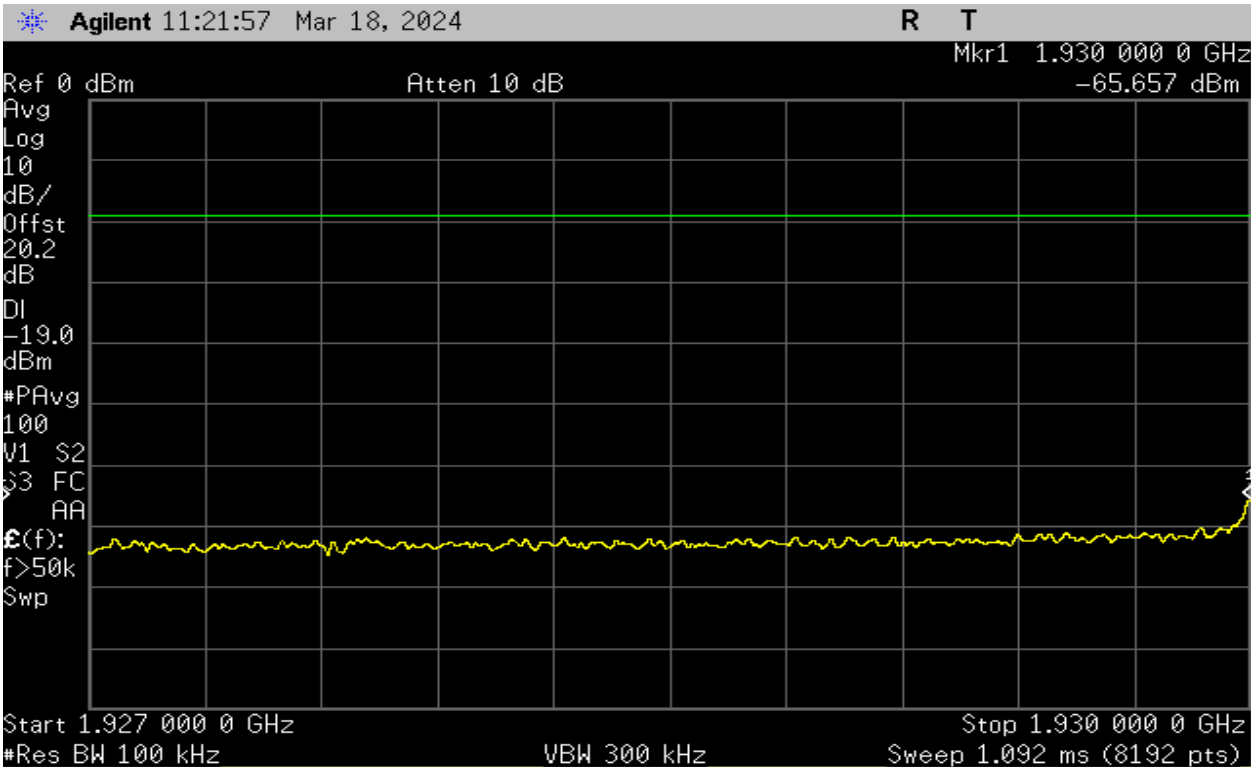
Plot 74 – 746-757MHz Band – LTE Downlink Upper Band Edge



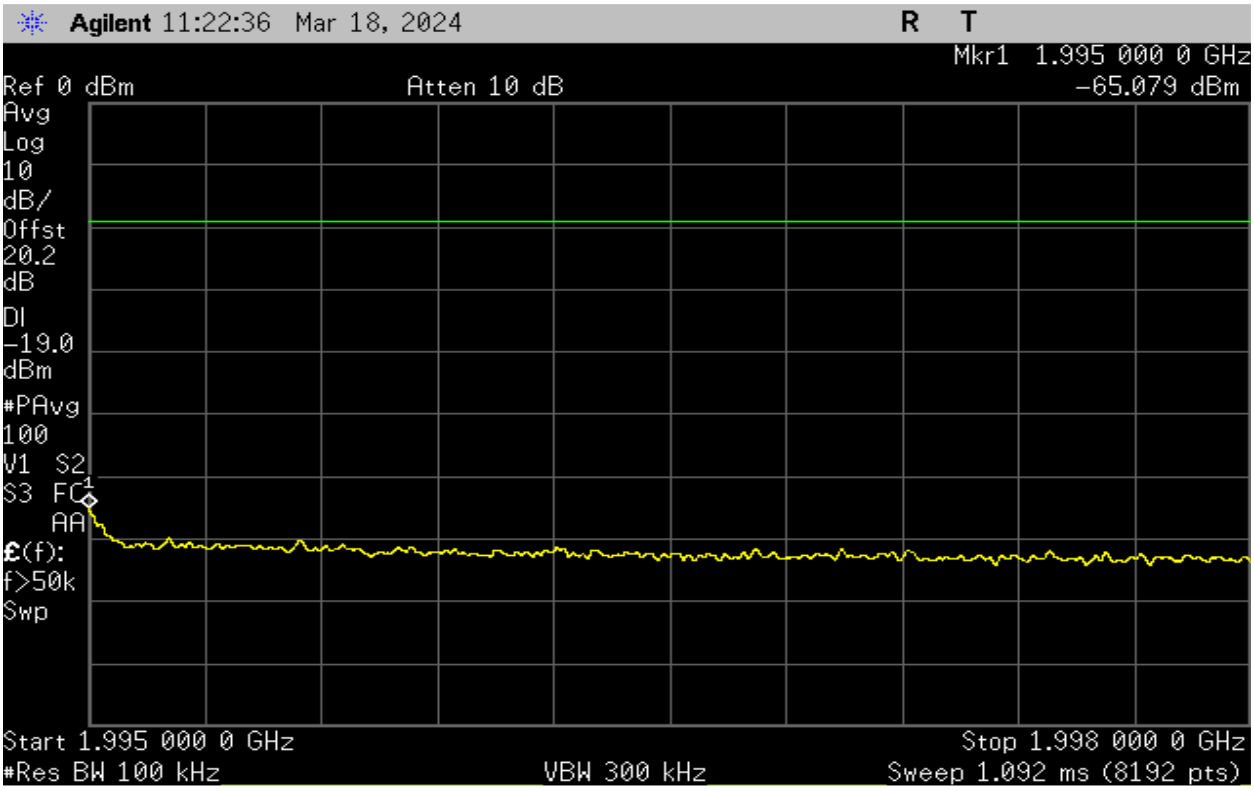
Plot 75 – 869-894MHz Band – LTE Downlink Lower Band Edge



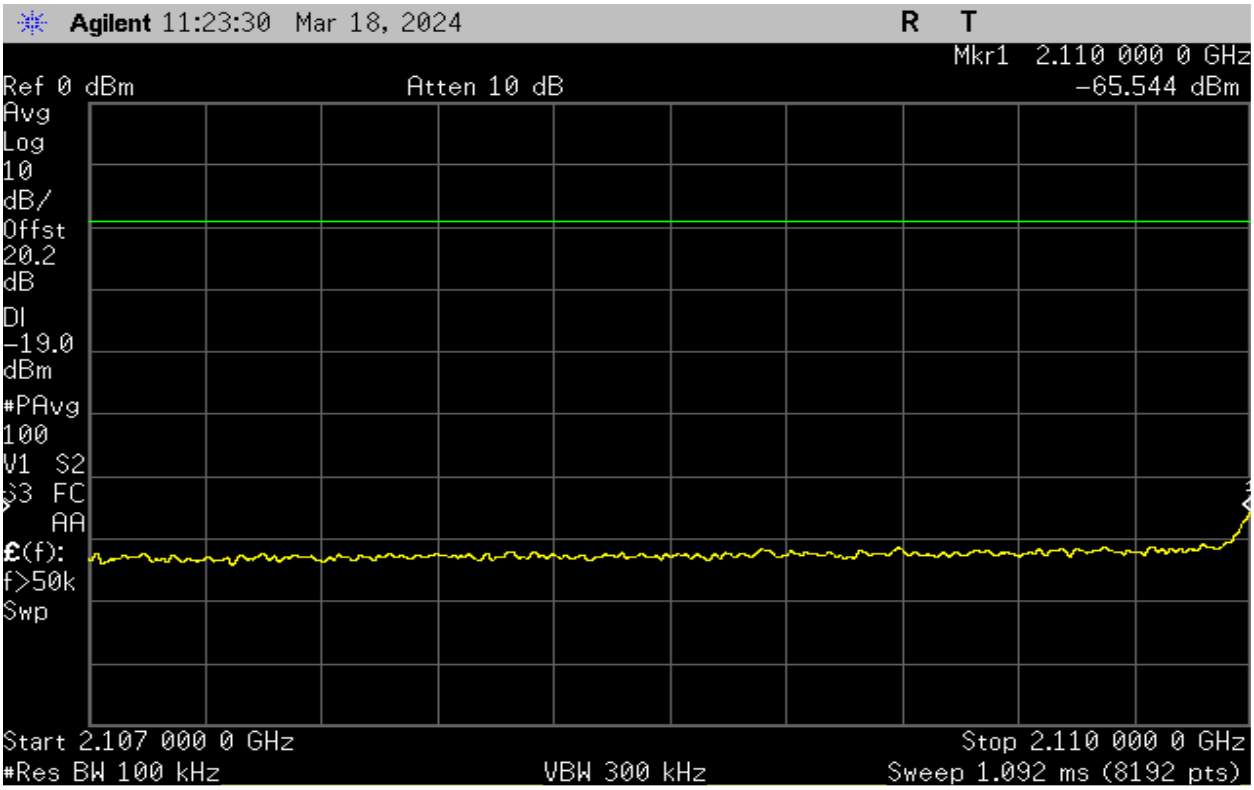
Plot 76 – 869-894MHz Band – LTE Downlink Upper Band Edge



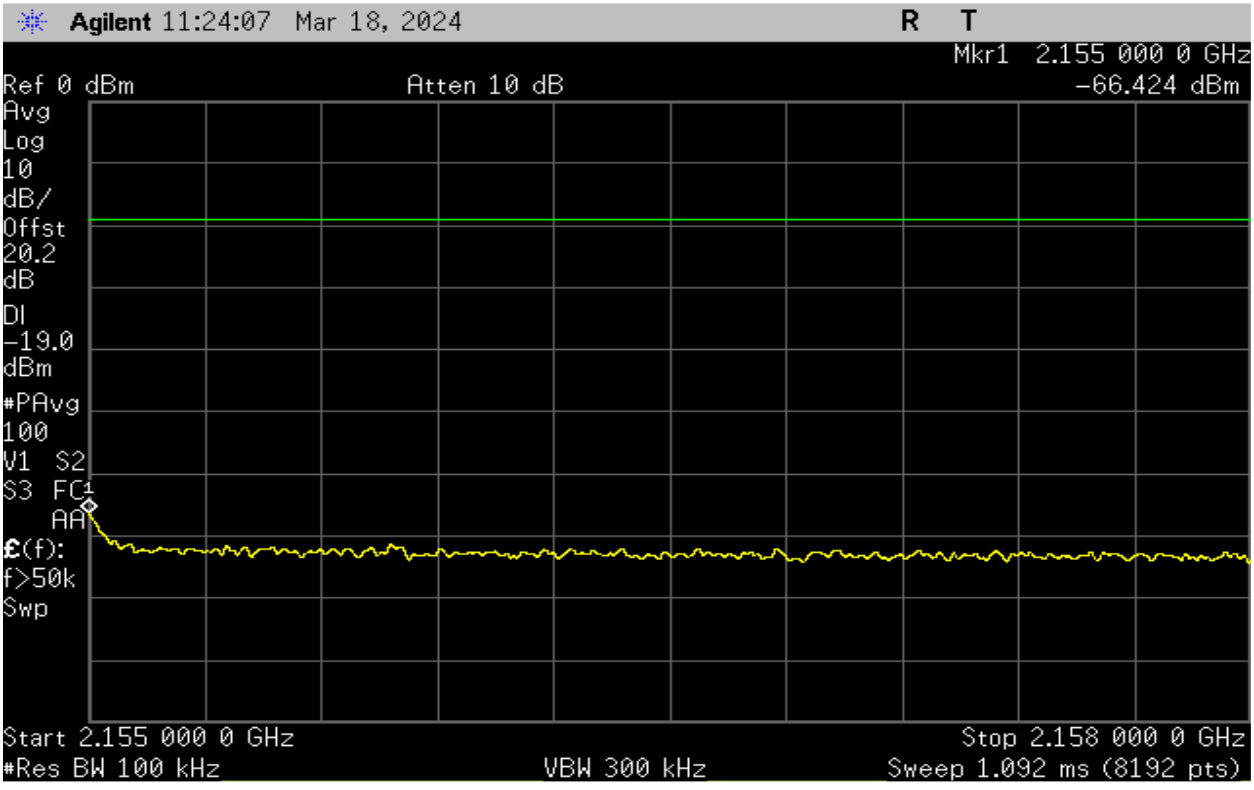
Plot 77 – 1930-1995MHz Band – LTE Downlink Lower Band Edge



Plot 78 – 1930-1995MHz Band – LTE Downlink Upper Band Edge



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



Plot 80 – 2110-2155MHz Band – LTE Downlink Upper Band Edge

5. Conducted Spurious Emissions

Test Requirement(s):	§2.1051 and RSS-131 §7.5	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	March 18, 2024

Test Procedures: As required by 47 CFR §2.1051 and RSS-131 §7.5, 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. The required minimum resolution bandwidth was used as stated by different rule part (i.e. Part 22, 27, 24 etc.)

Frequency Band (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin
698-716	6373	-27.50	-13	-14.50
776-787	2342	-28.02	-13	-15.02
824-849	2510	-31.98	-13	-18.98
1710-1755	5196	-25.71	-13	-12.71
1850-1915	9410	-18.83	-13	-5.83

Table 13 – Conducted Spurious Emission Data – Uplink Summary

Frequency Band (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Margin
728-746	6477	-53.17	-13	-40.17
746-757	6493	-52.67	-13	-39.67
869-894	6460	-53.50	-13	-40.50
1930-1995	18370	-51.83	-13	-38.83
2110-2155	21733	-49.50	-13	-36.50

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	774.60	-51.82	-2.04	-53.86	-35	-18.86
793-805	793.13	-62.83	-2.04	-64.87	-35	-29.87

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	764.66	-80.33	-2.04	-82.37	-35	-47.37
793-805	804.08	-80.55	-2.04	-82.59	-35	-47.59

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

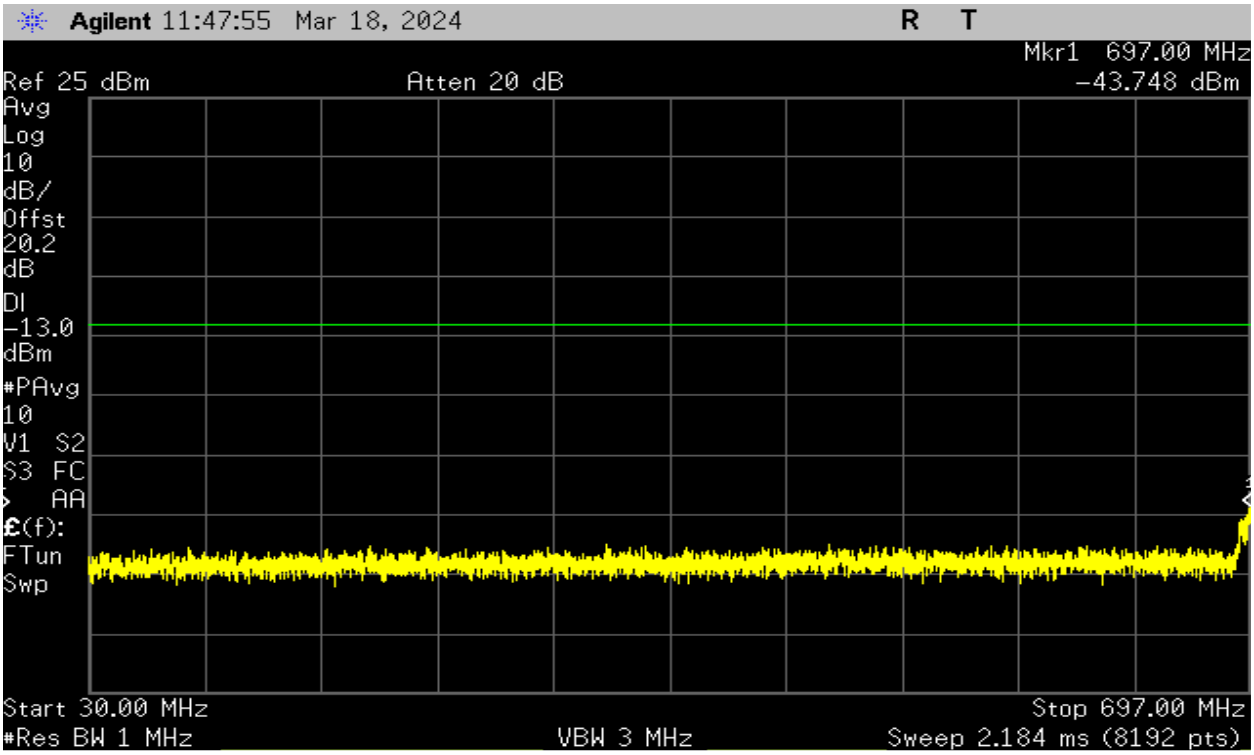
Therefore, BW correction factor = 10log 700/10000 = -11.55

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)	1562.00	-40.76	0	-3	-43.76	-40	-3.76
1559-1610 (Narrowband)	1562.76	-57.14	-11.55	-3	-71.69	-50	-21.69

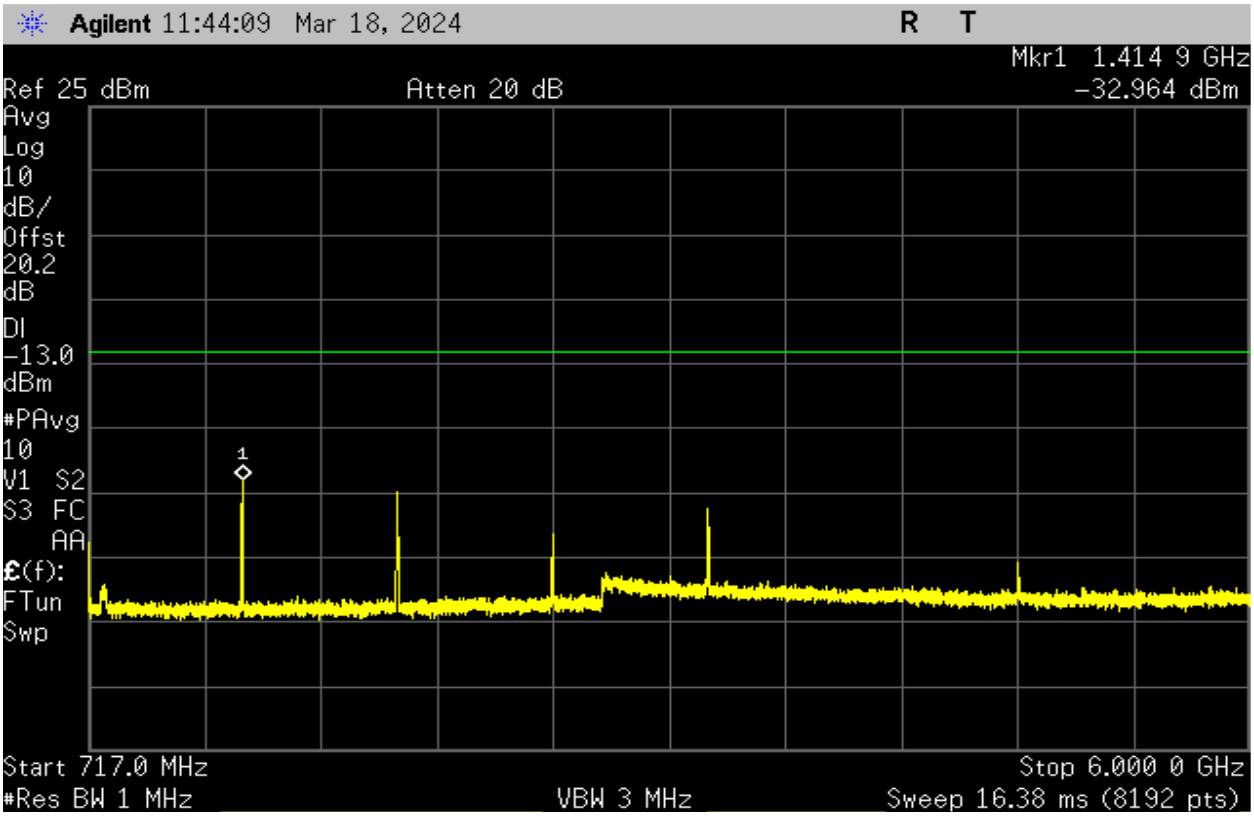
Table 17 – Conducted Spurious Emission Data – 776-787MHz Uplink Band Summary

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)	1591.57	-62.10	0	-3	-65.10	-40	-25.10
1559-1610 (Narrowband)	1597.72	-81.05	-11.55	-3	-95.60	-50	-45.6

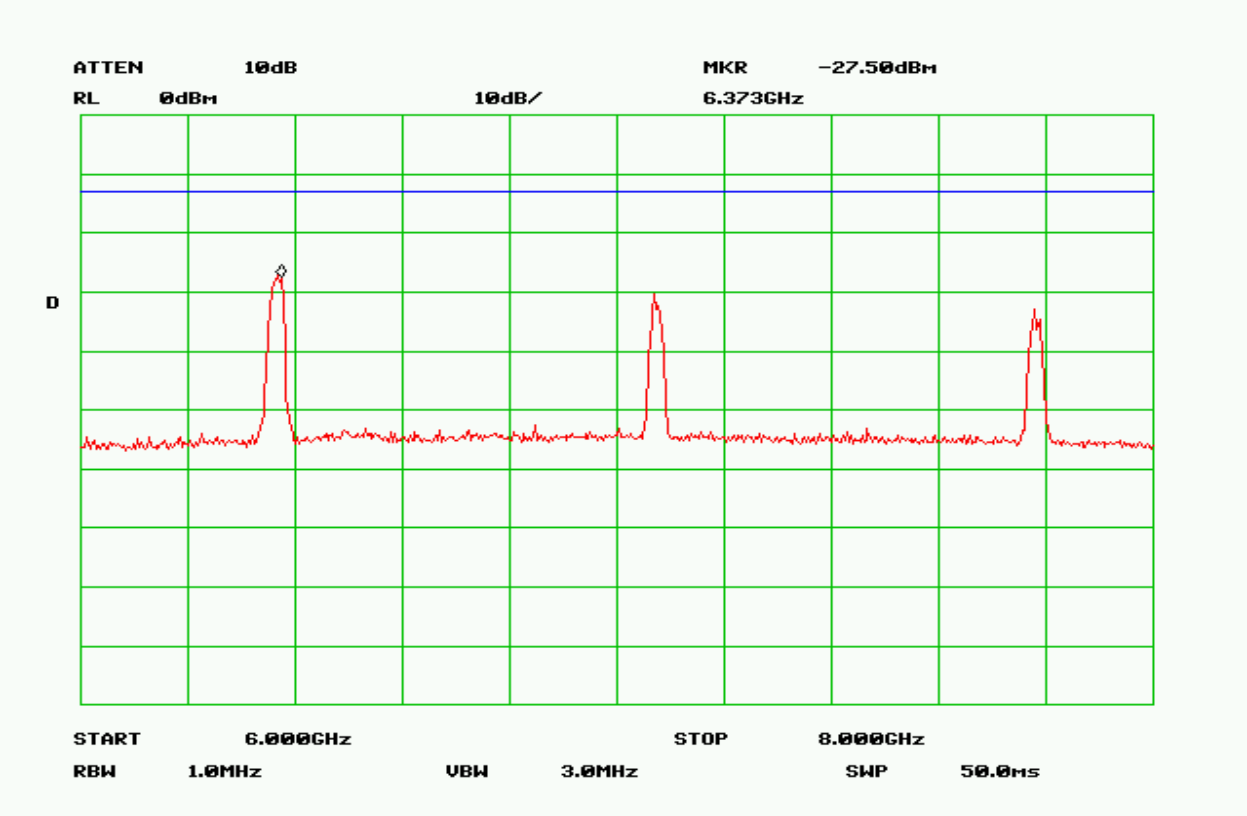
Table 18 – Conducted Spurious Emission Data – 746-757MHz Downlink Band Summary



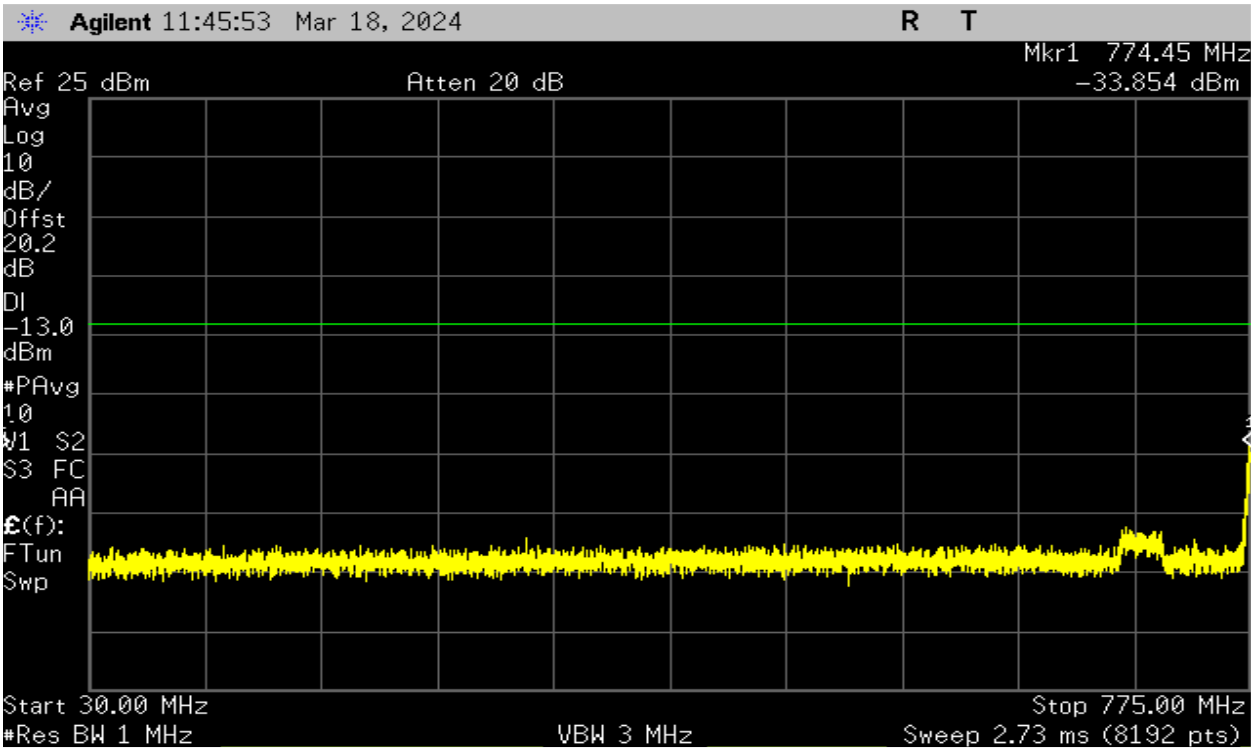
Plot 81 – 698-716MHz Band – Uplink



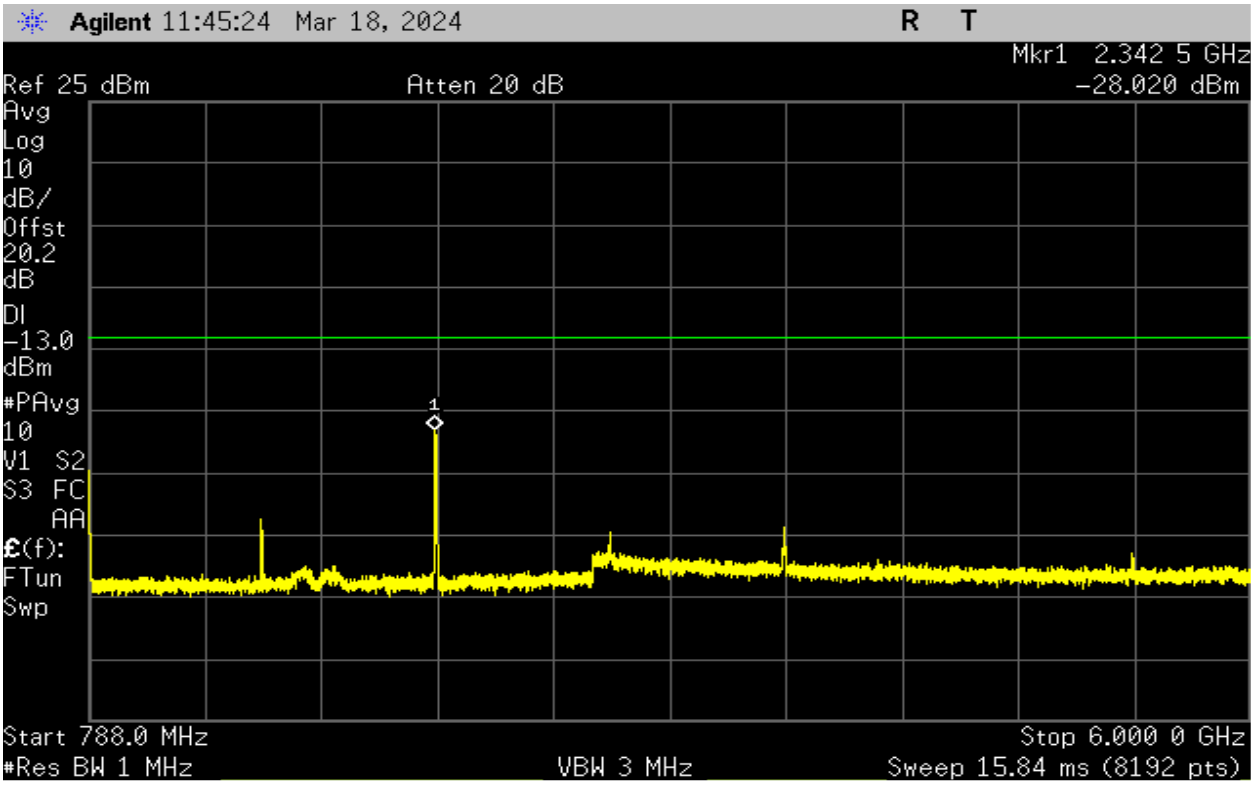
Plot 82 - 698-716MHz Band – Uplink



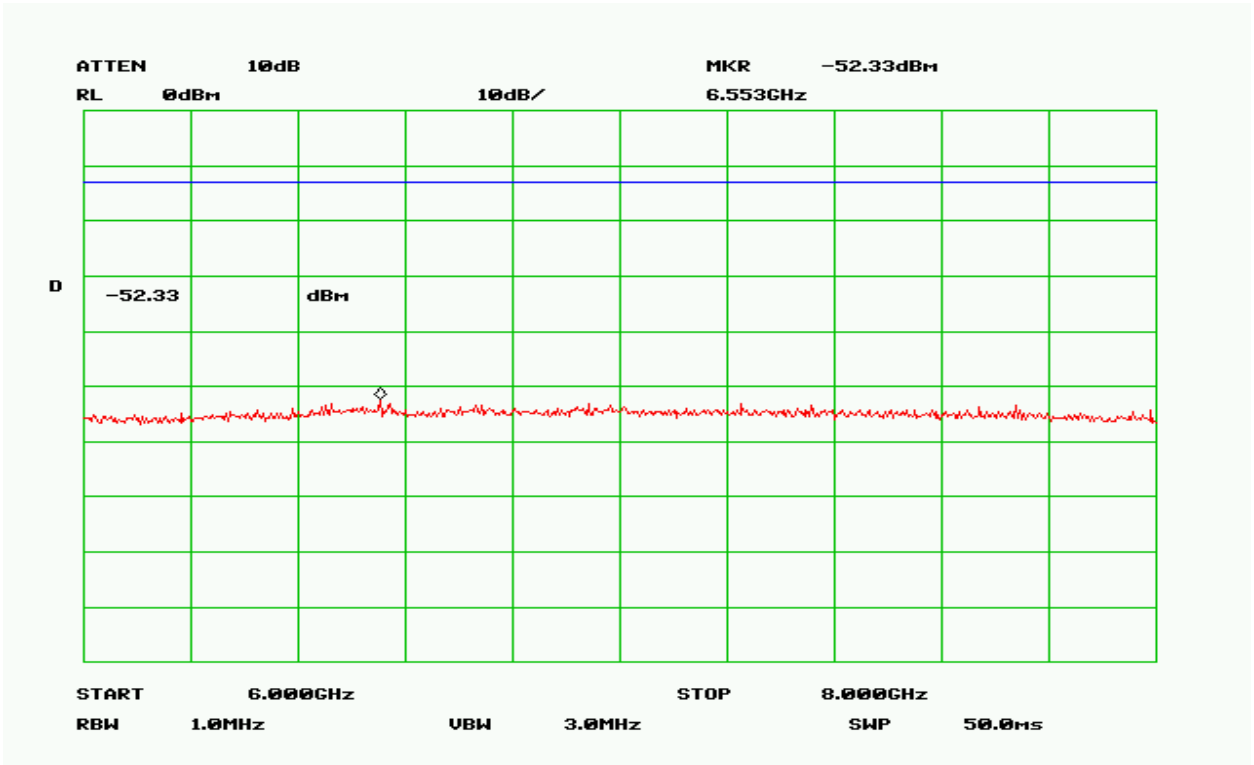
Plot 83 – 698-716MHz Band – Uplink



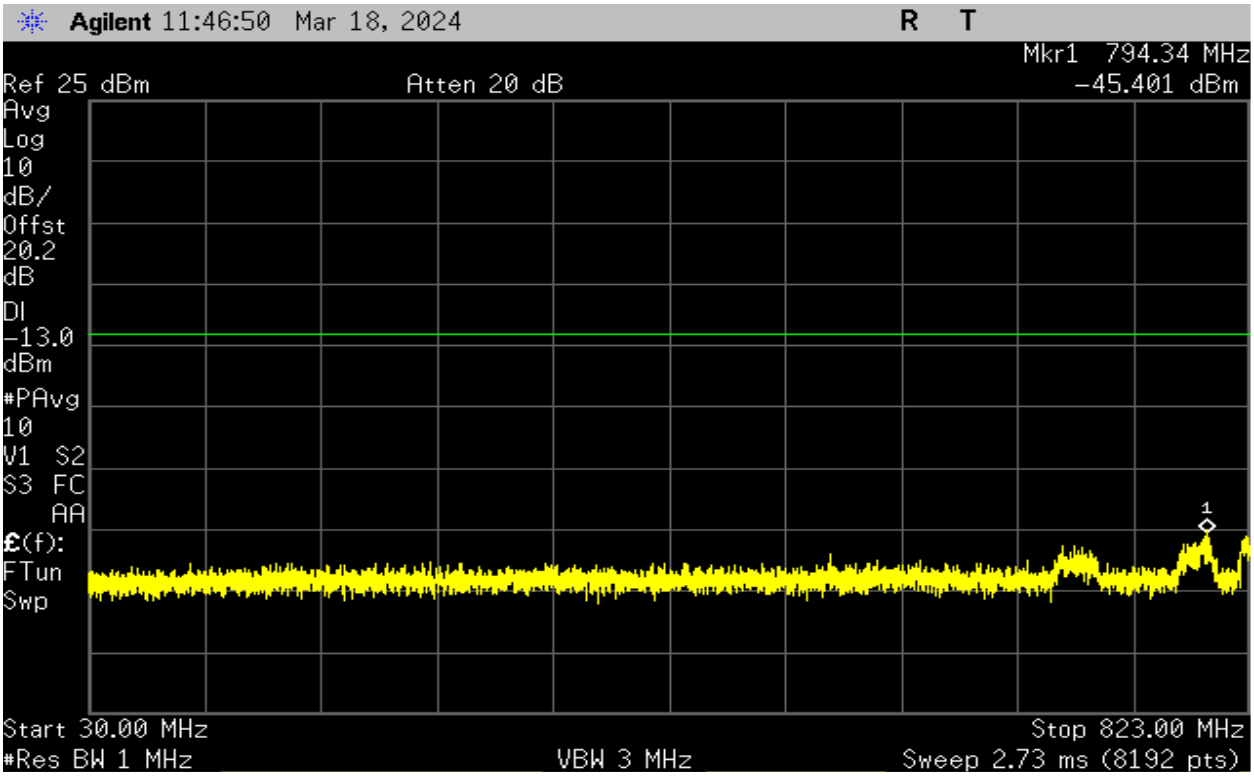
Plot 84 – 776-787MHz Band – Uplink



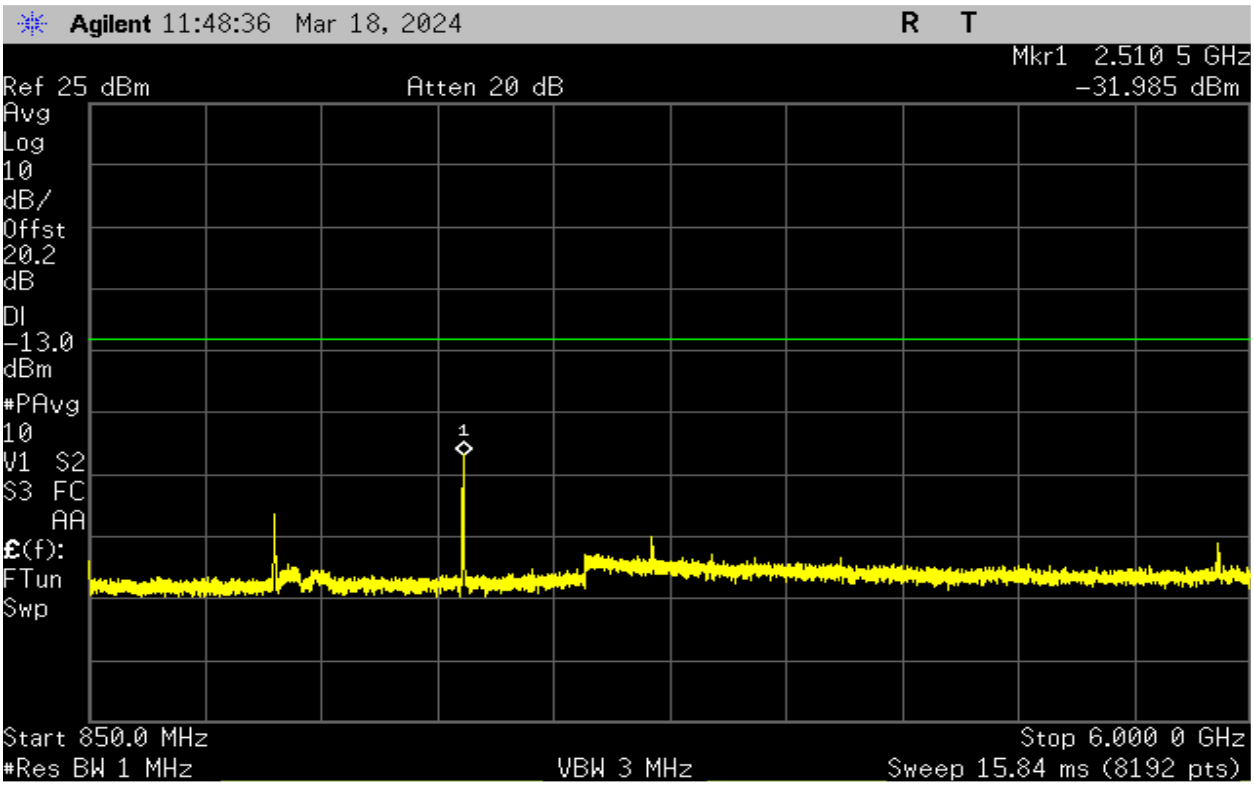
Plot 85 – 776-787MHz Band – Uplink



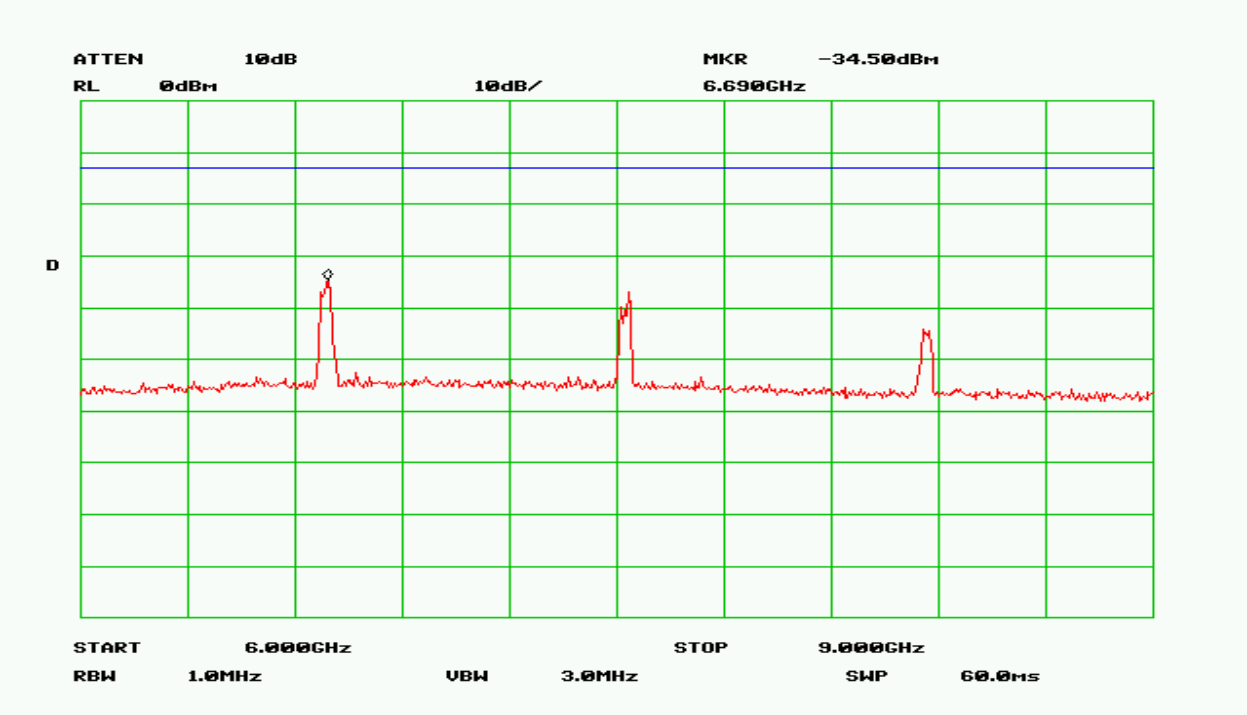
Plot 86 – 776-787MHz Band – Uplink



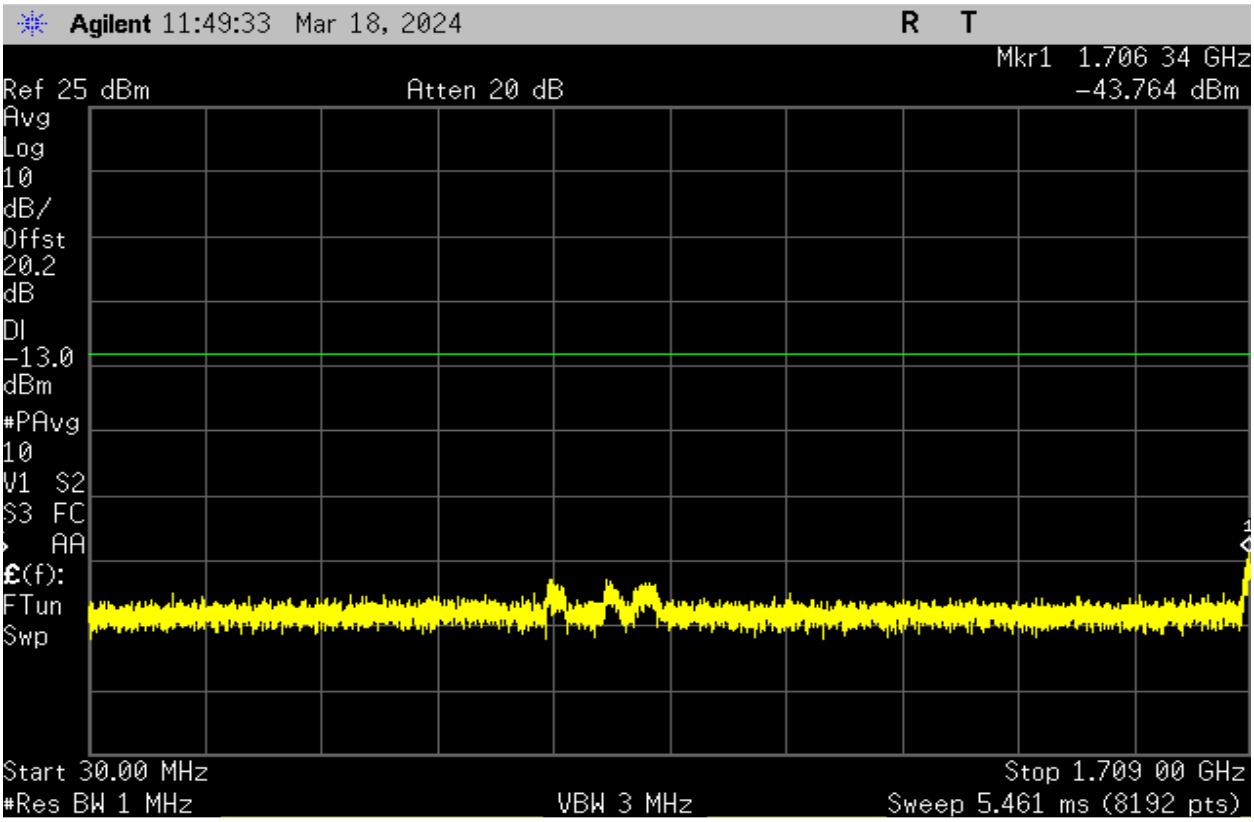
Plot 87 – 824-849MHz Band – Uplink



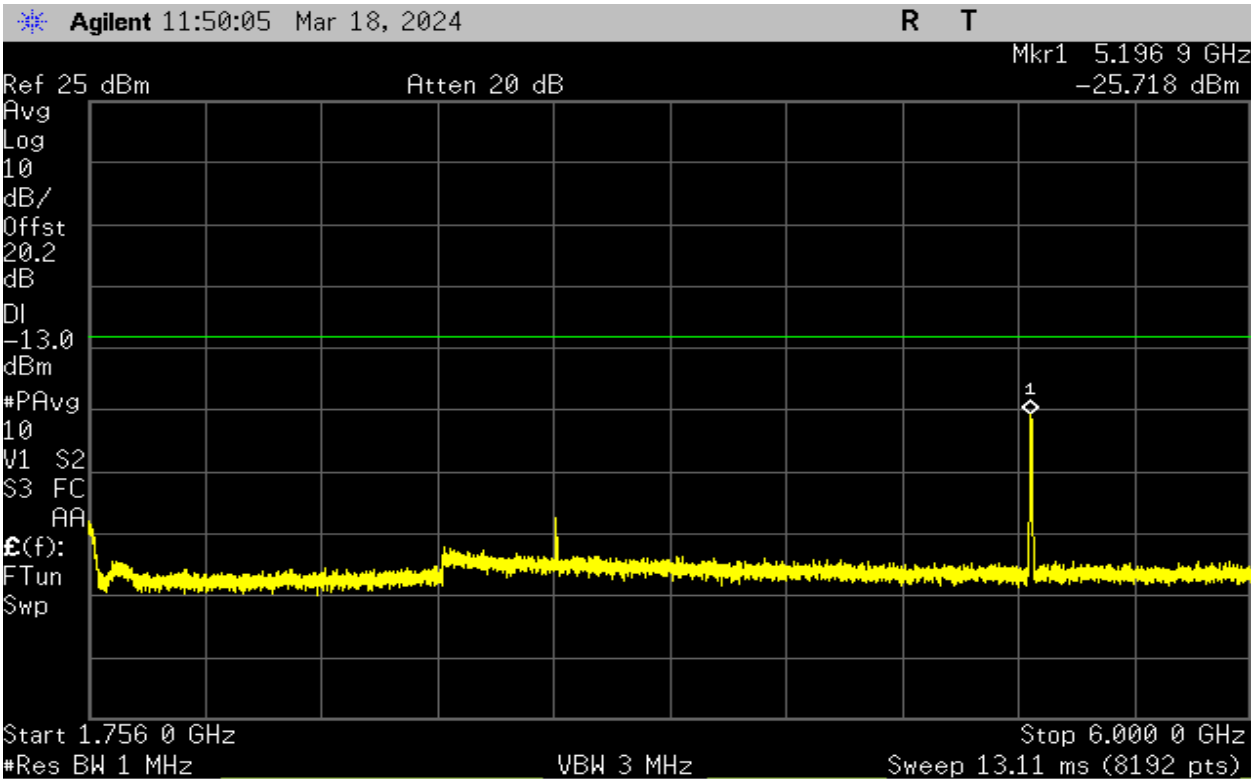
Plot 88 – 824-849MHz Band –Uplink



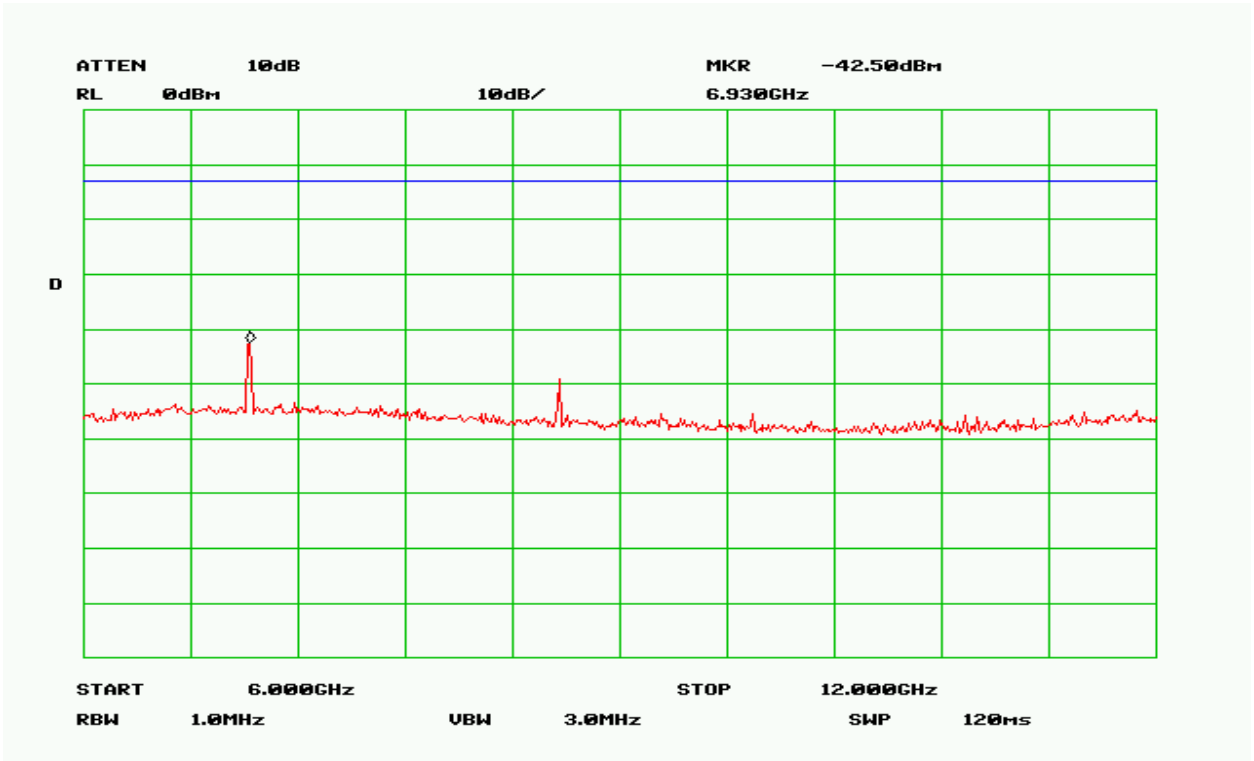
Plot 89 - 824-849MHz Band – Uplink



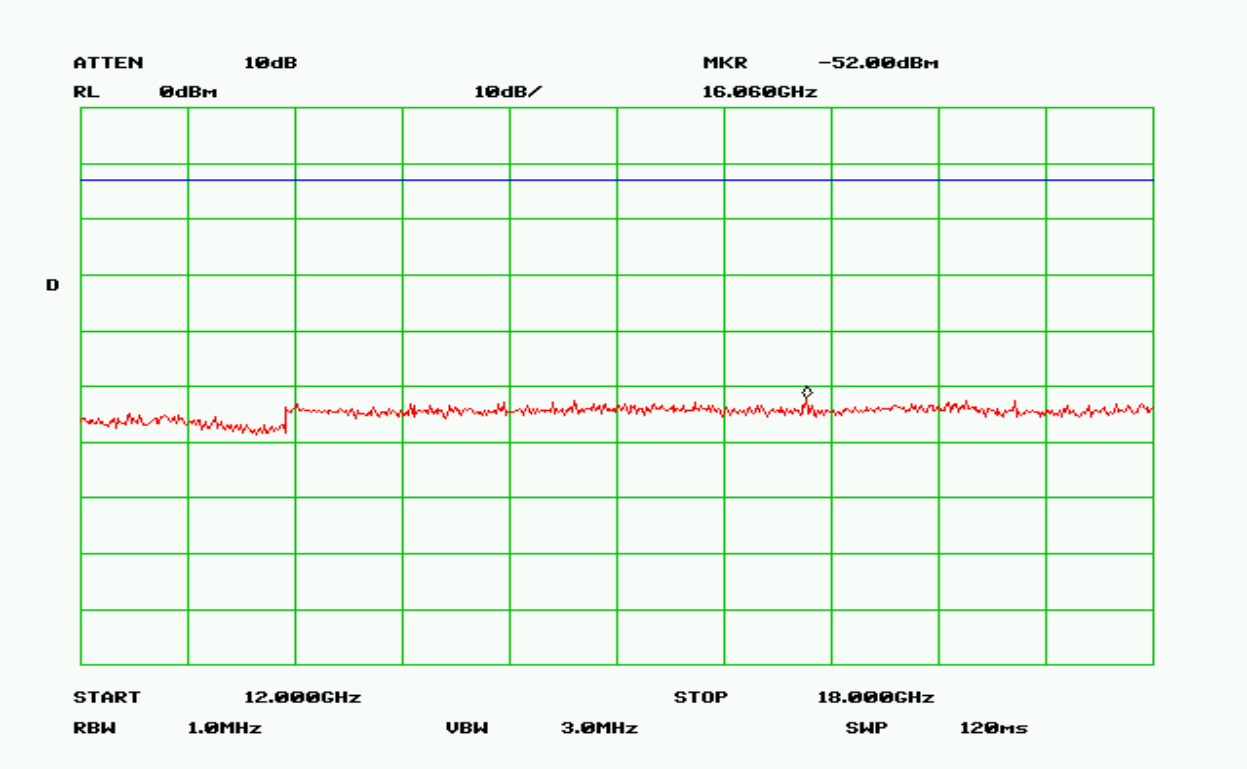
Plot 90 – 1710-1755MHz Band – Uplink



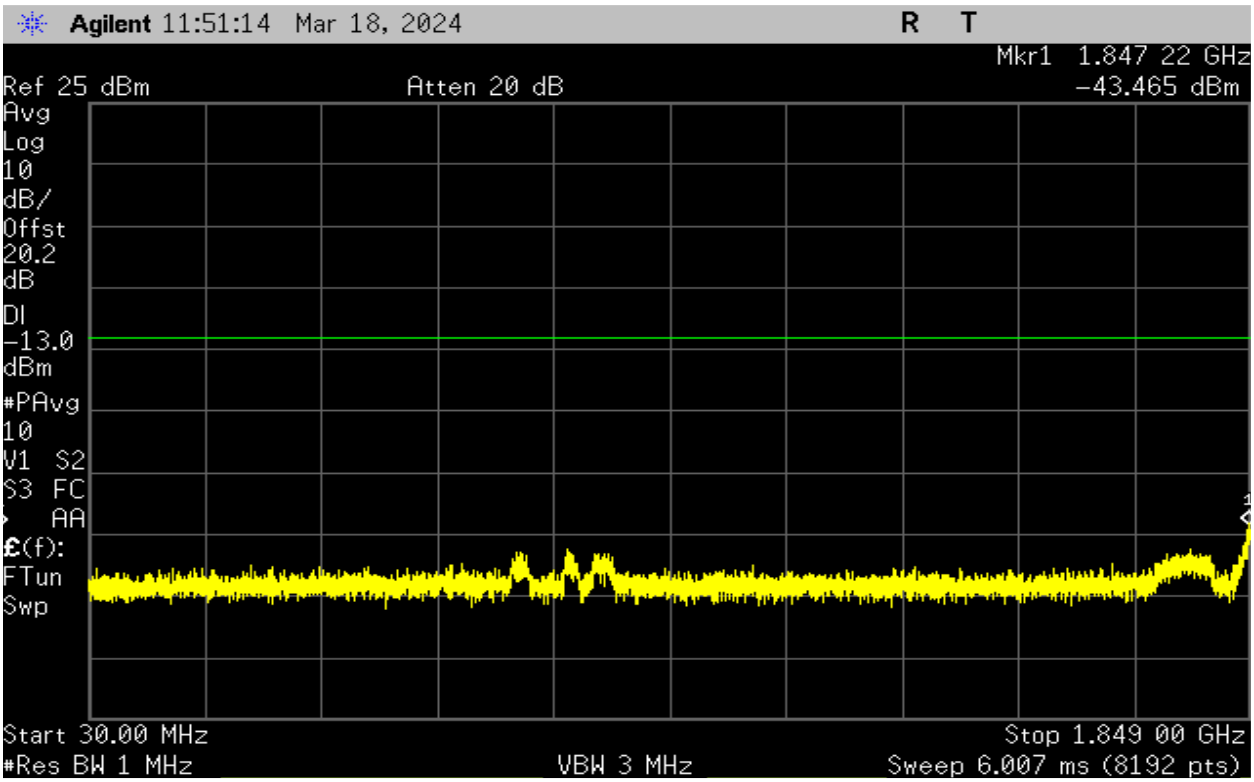
Plot 91 – 1710-1755MHz Band – Uplink



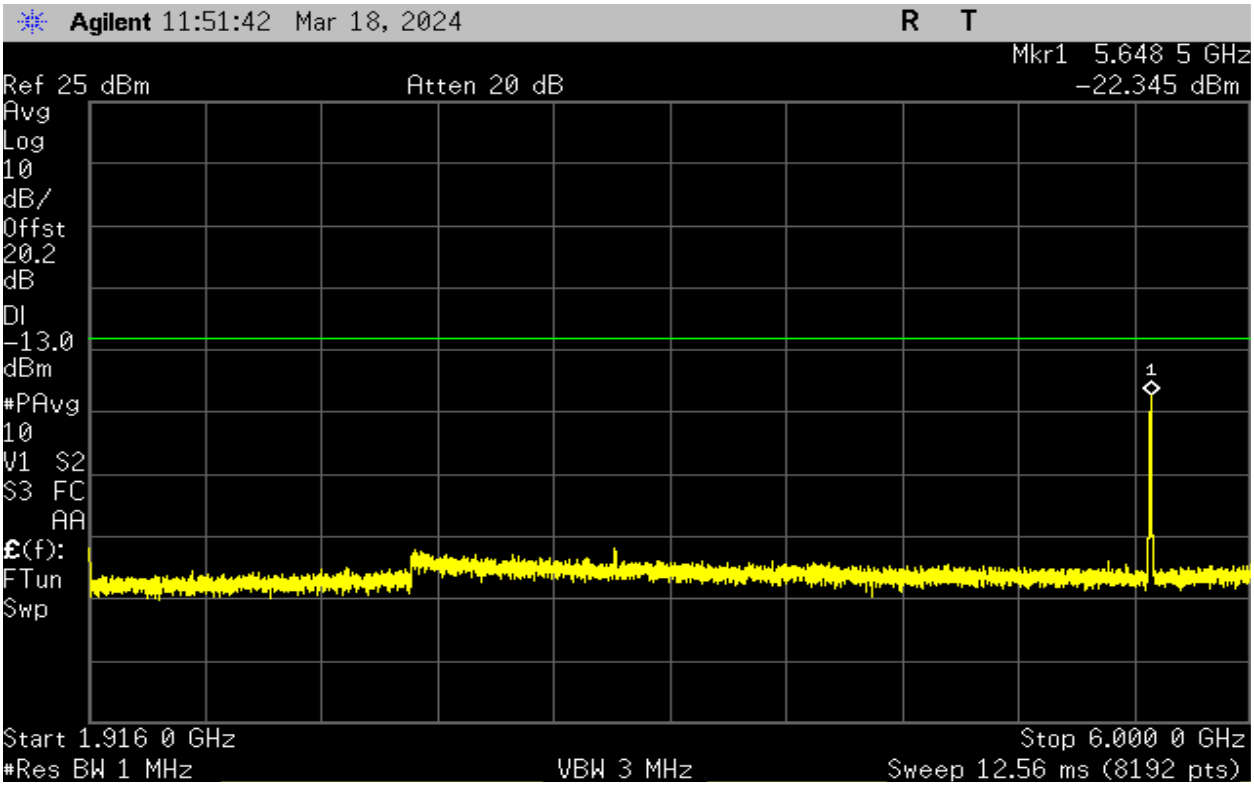
Plot 92 - 1710-1755MHz Band – Uplink



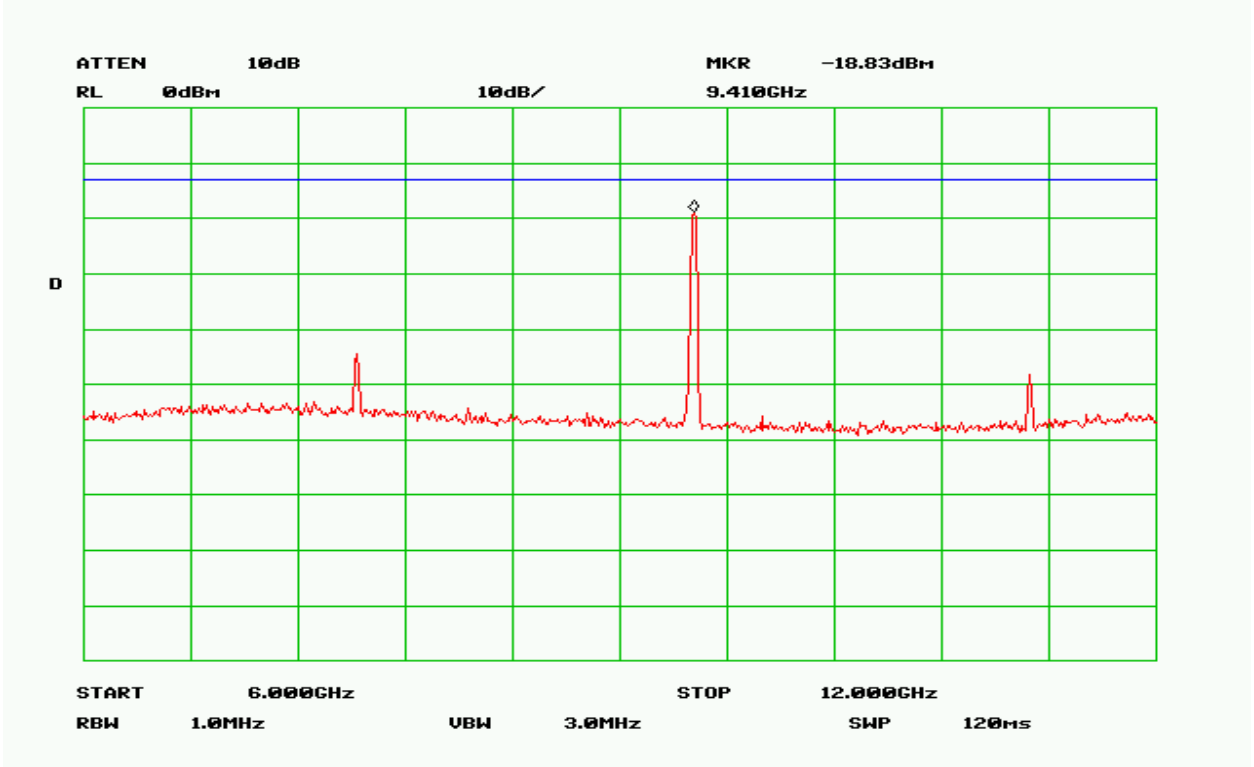
Plot 93 - 1710-1755MHz Band – Uplink



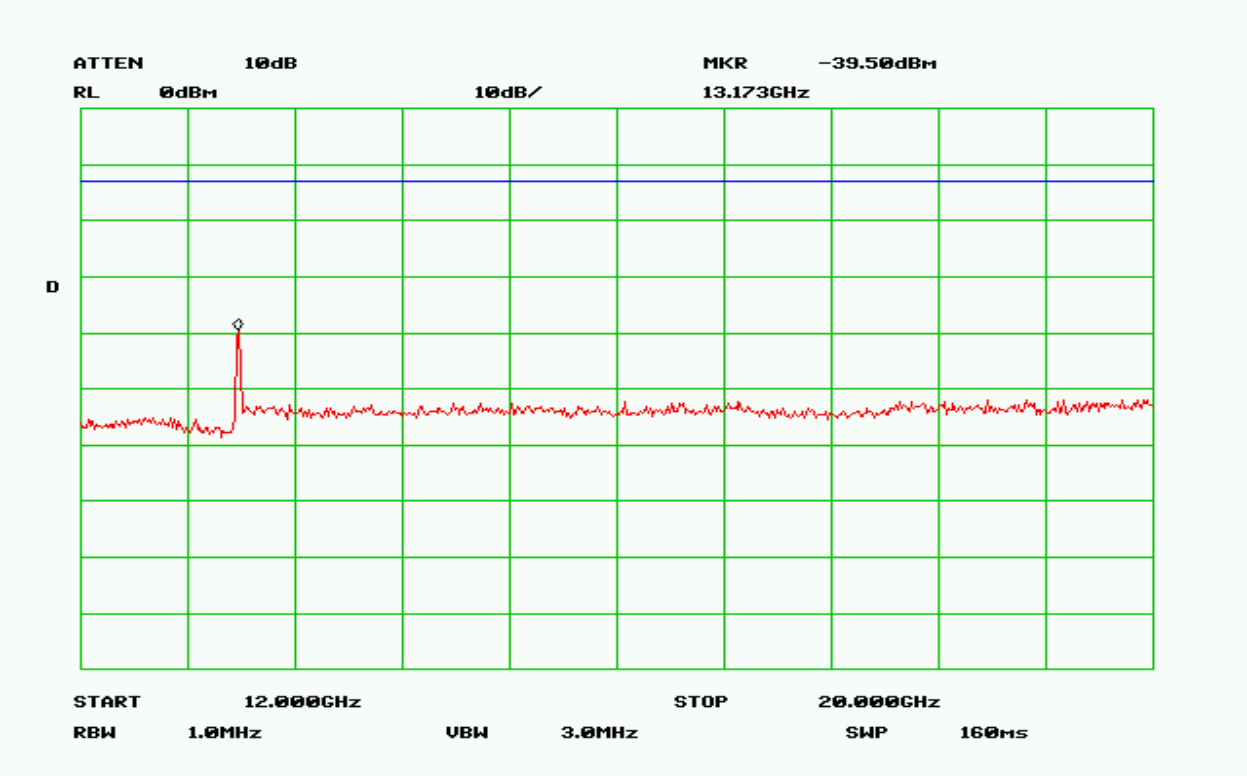
Plot 94 – 1850-1915MHz Band – Uplink



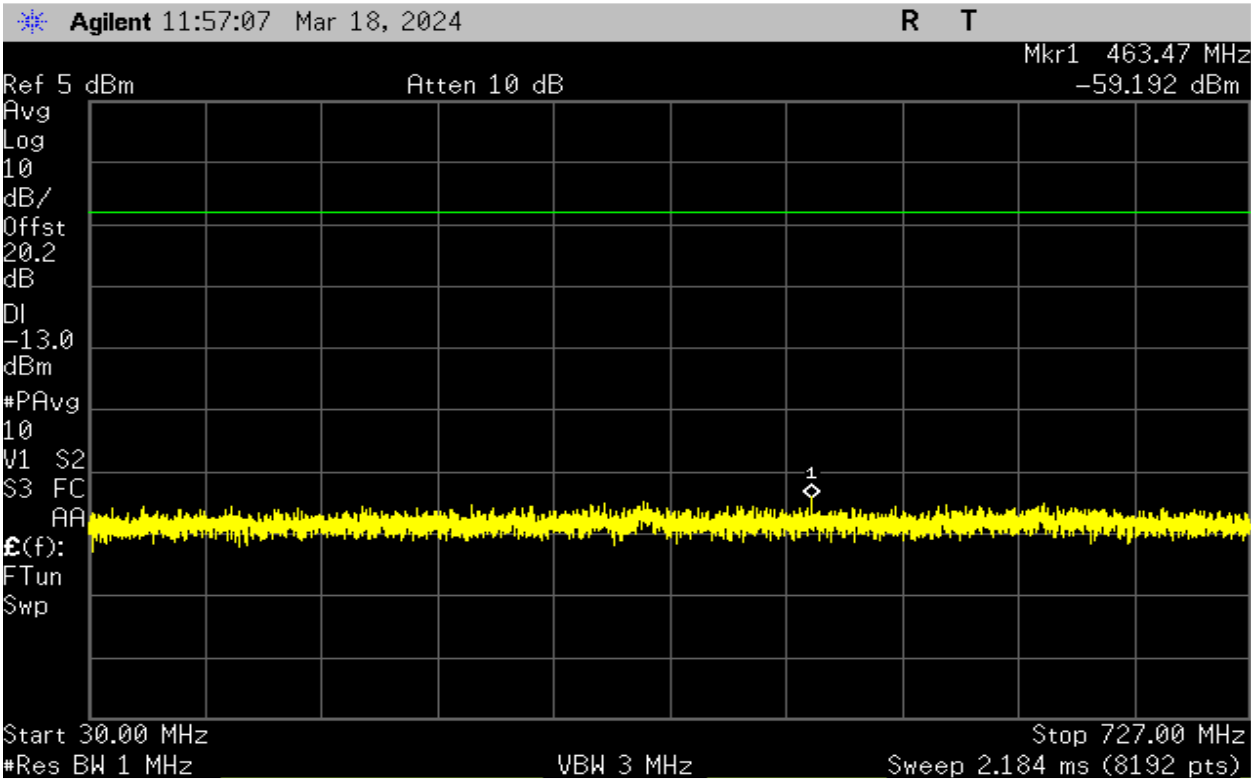
Plot 95 – 1850-1915MHz Band – Uplink



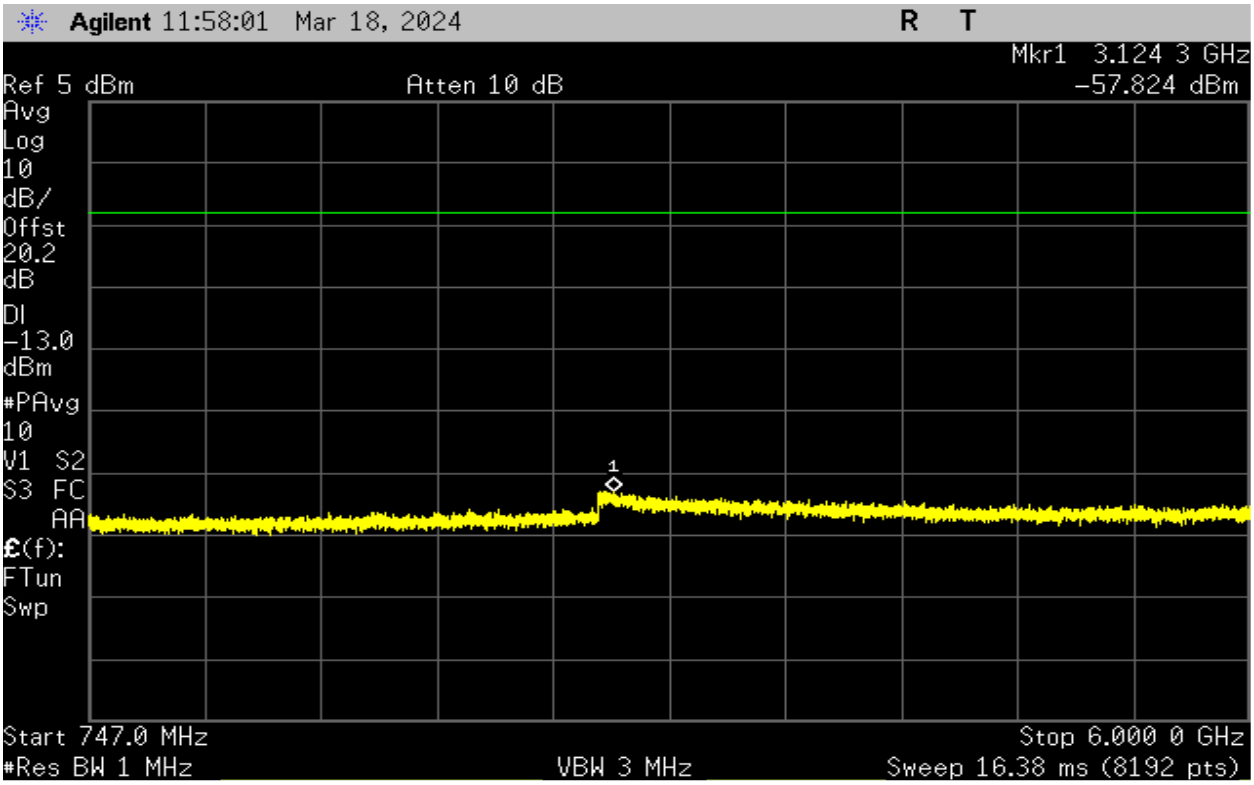
Plot 96 – 1850-1915MHz Band – Uplink



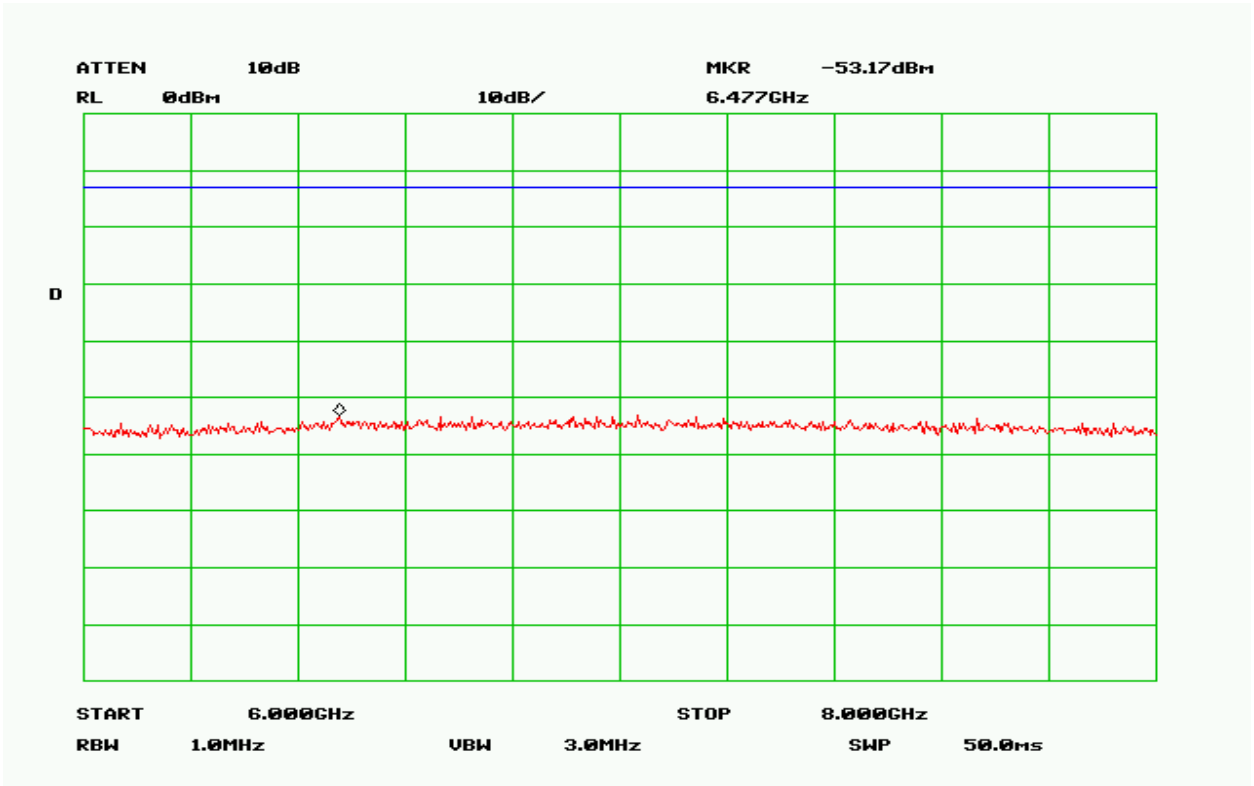
Plot 97 – 1850-1915MHz Band – Uplink



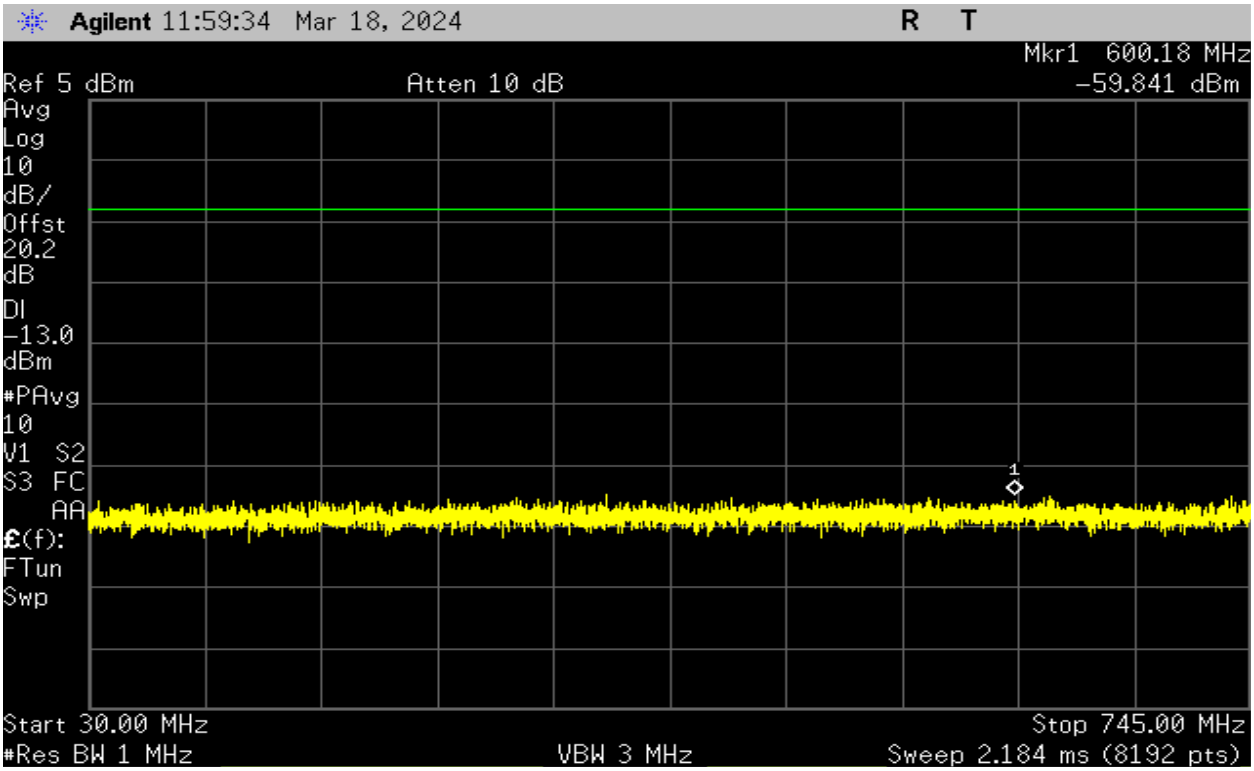
Plot 98 – 728-746MHz Band – Downlink



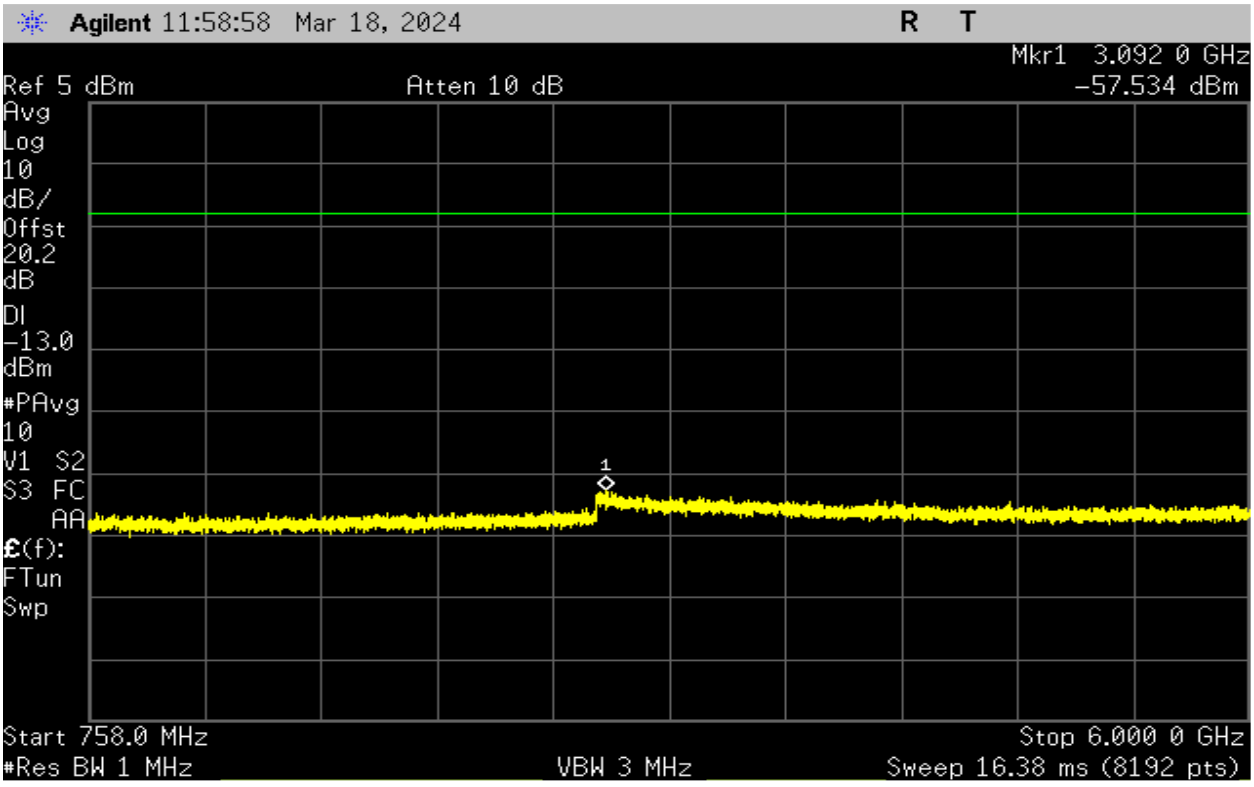
Plot 99 – 728-746MHz Band – Downlink



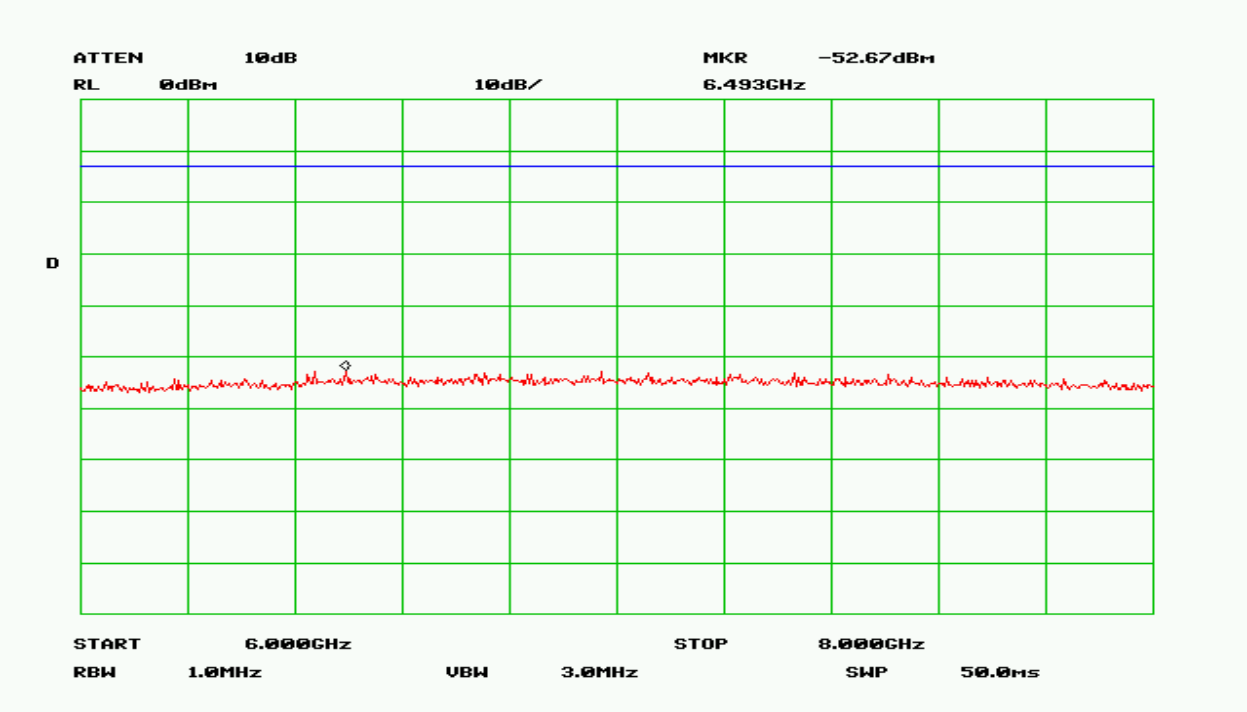
Plot 100 – 728-746MHz Band – Downlink



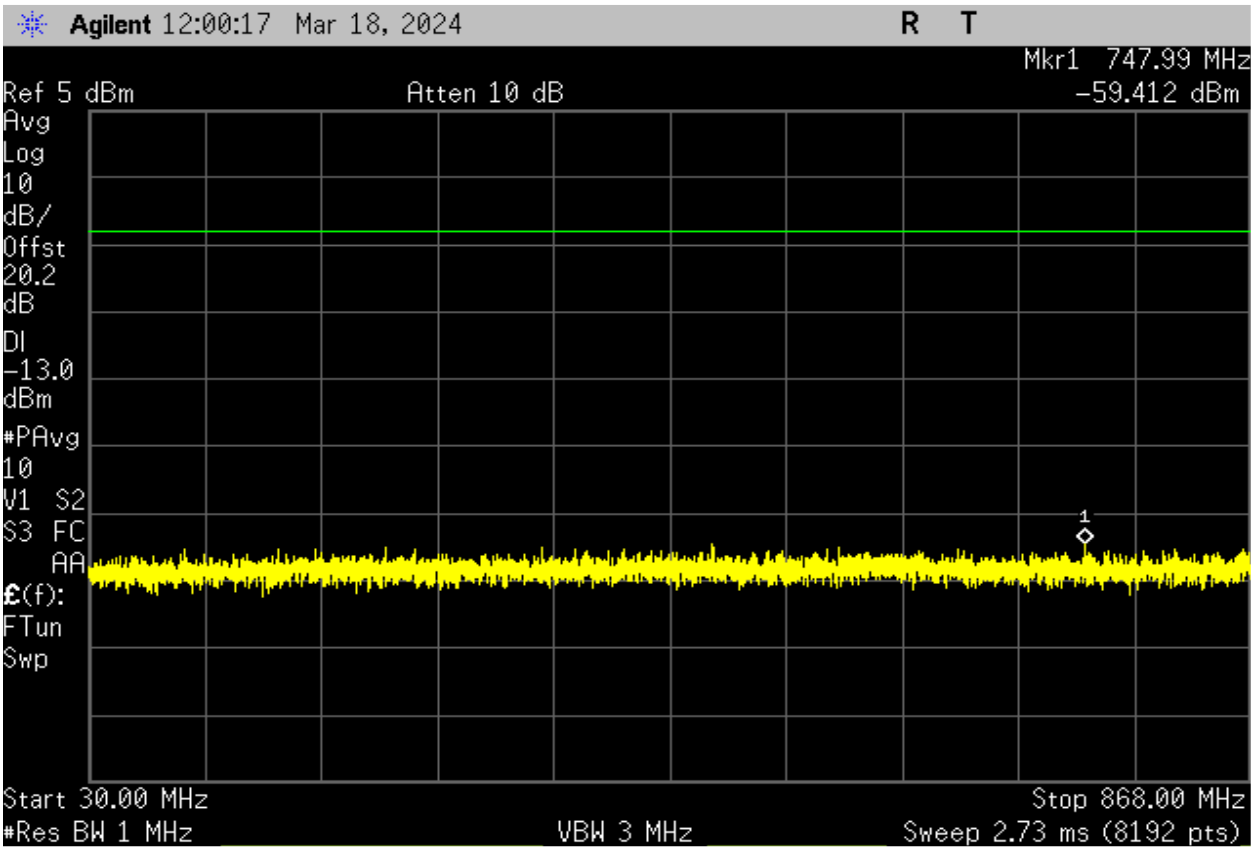
Plot 101 – 746-757MHz Band – Downlink



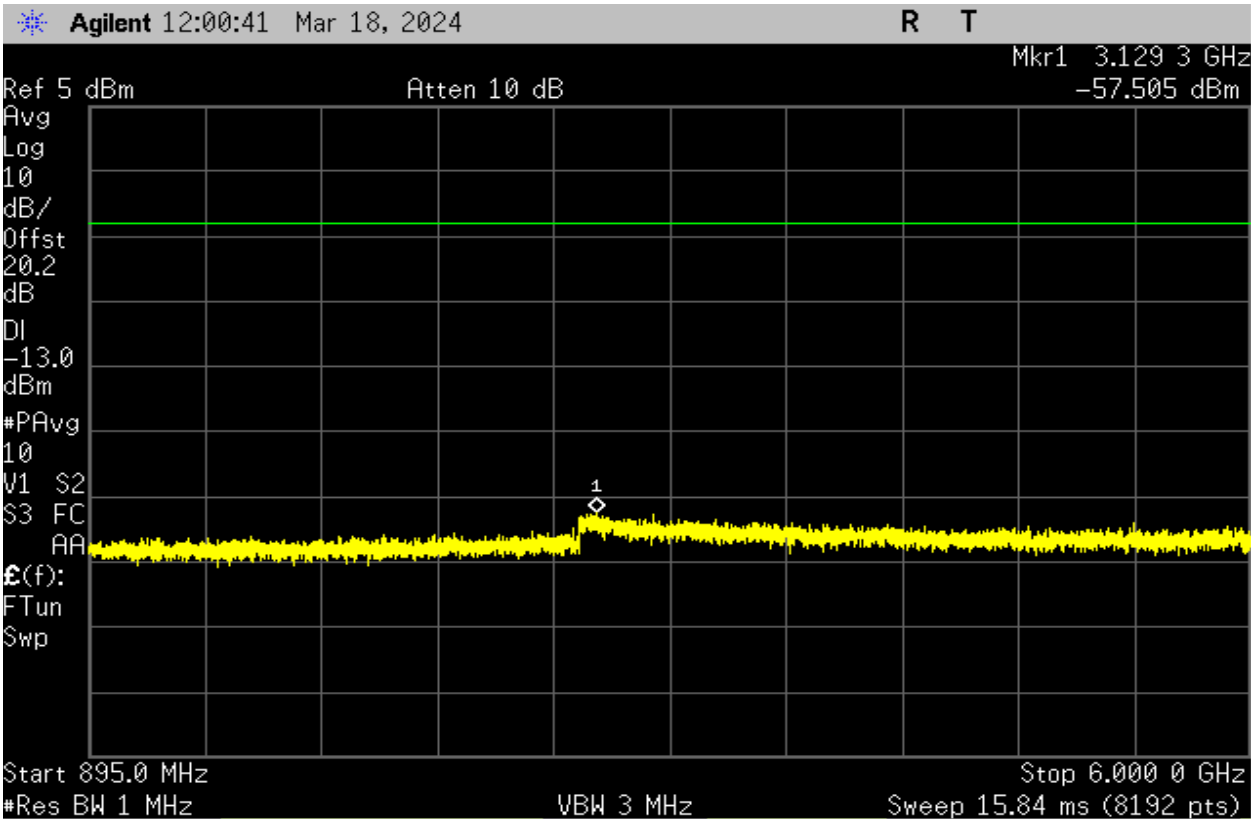
Plot 102 – 746-757MHz Band – Downlink



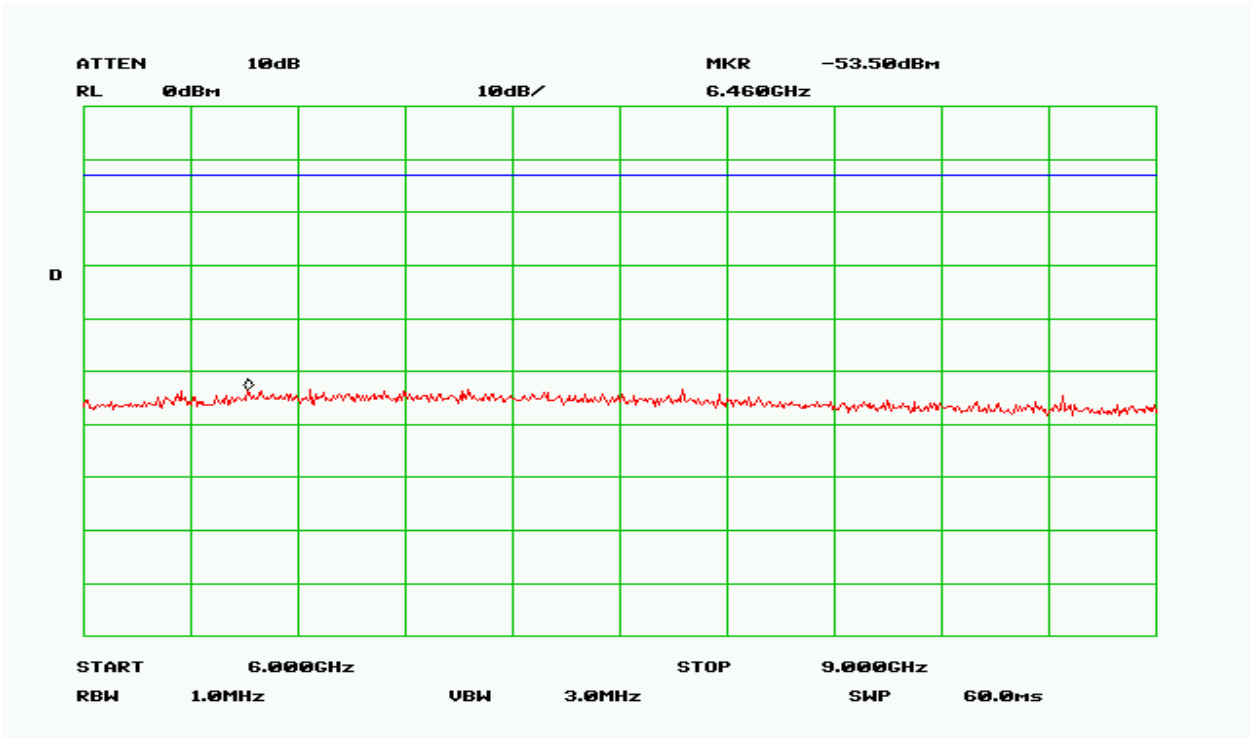
Plot 103 – 746-757MHz Band – Downlink



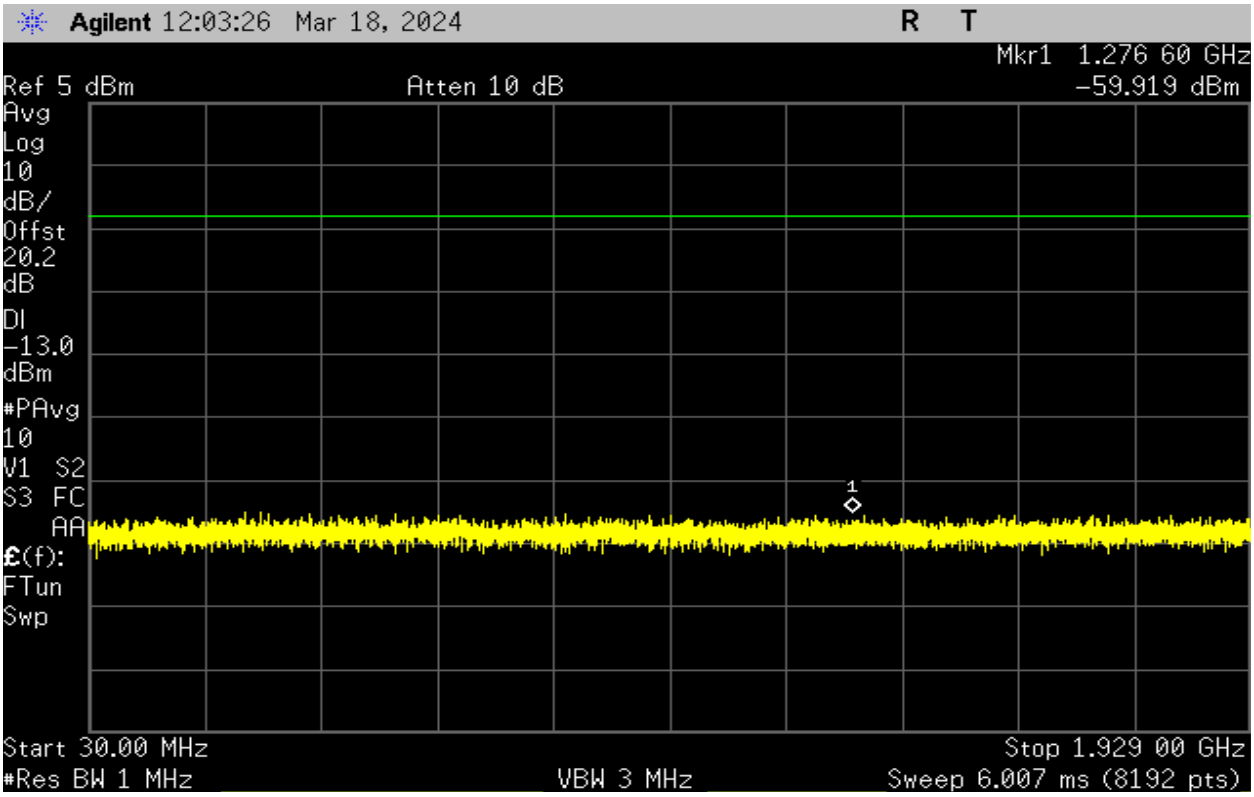
Plot 104 – 869-894MHz Band – Downlink



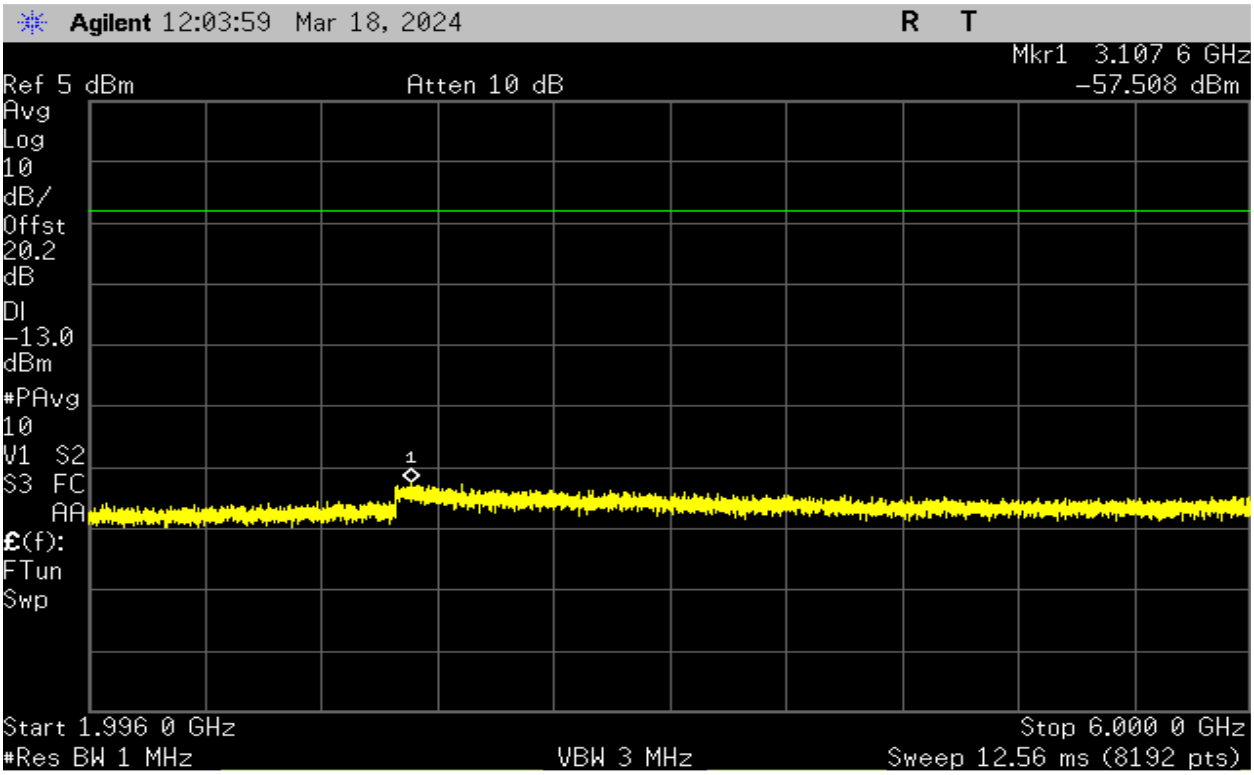
Plot 105 – 869-894MHz Band – Downlink



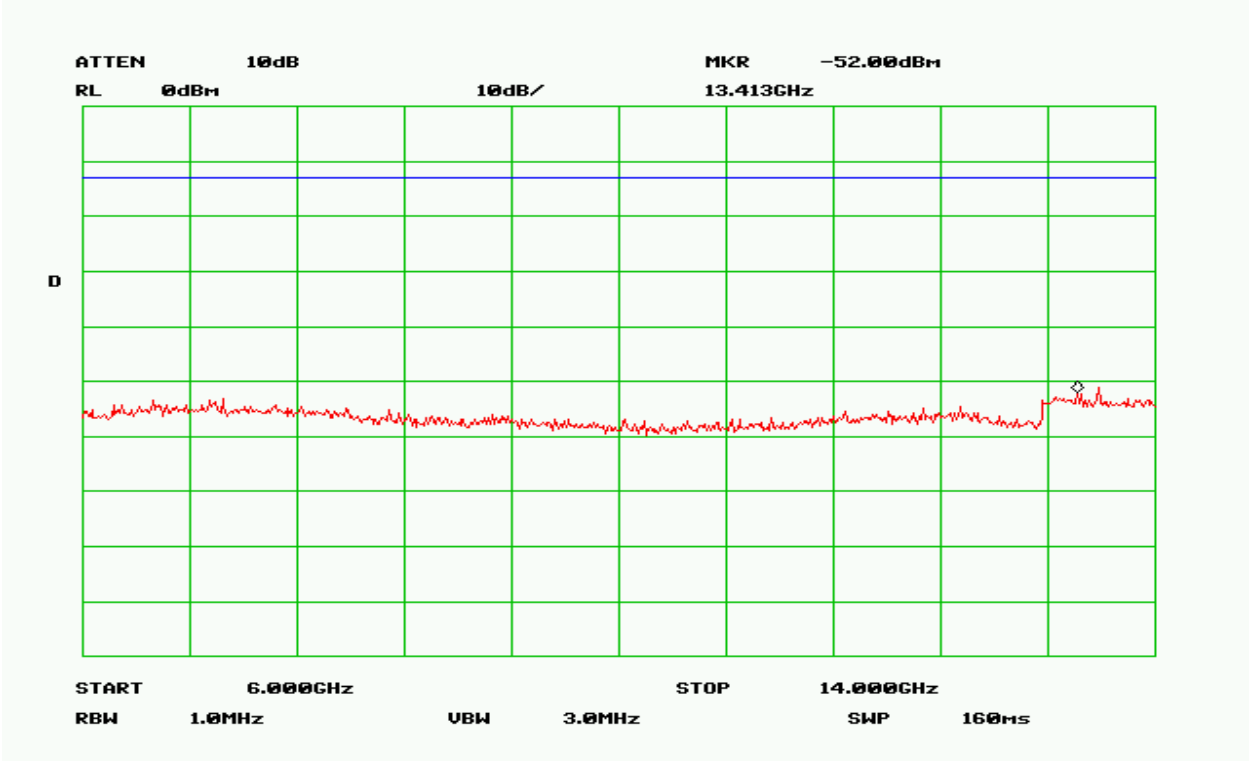
Plot 106 – 869-894MHz Band – Downlink



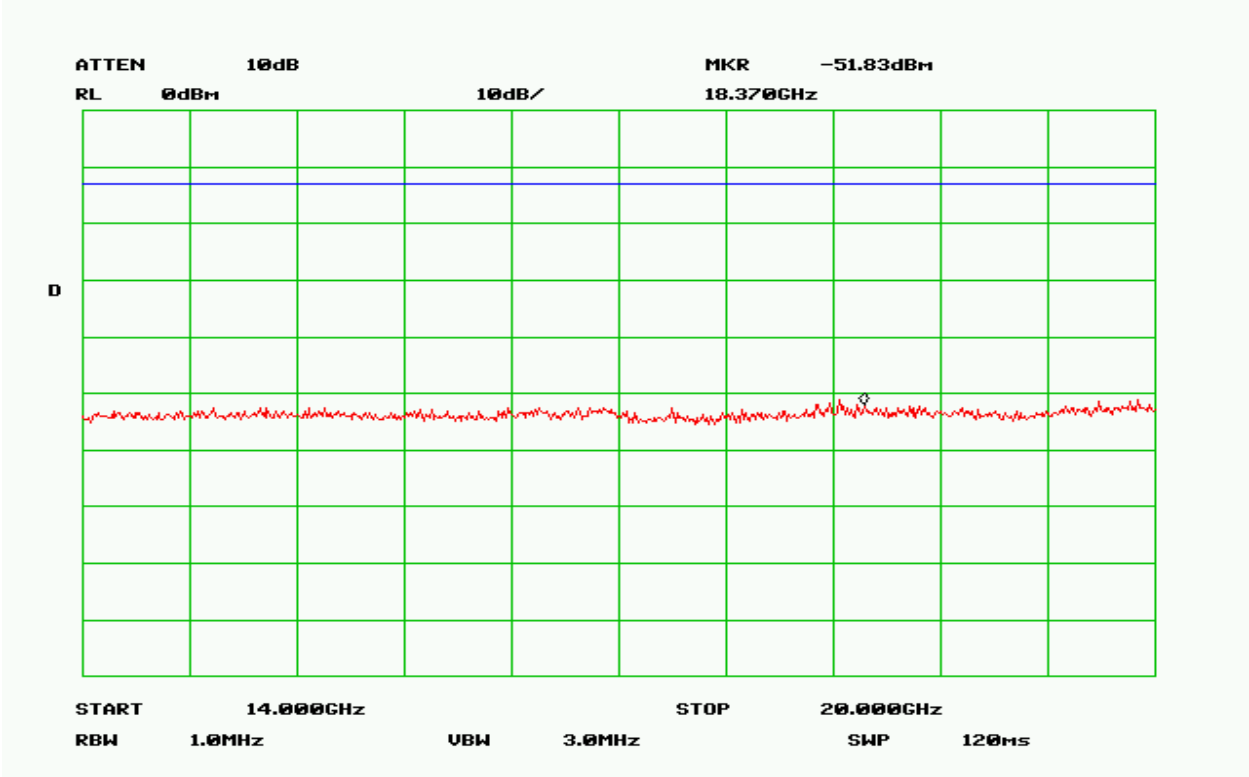
Plot 107 – 1930-1995MHz Band – Downlink



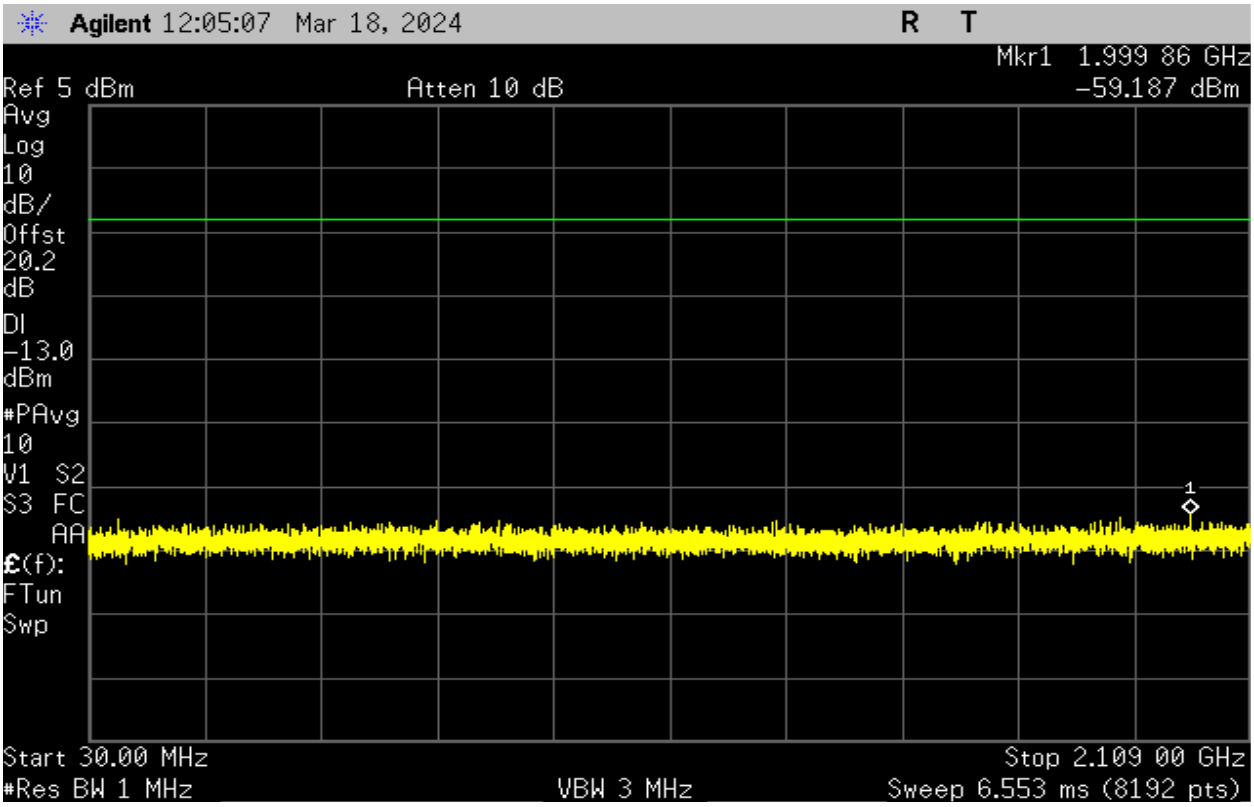
Plot 108 – 1930-1995MHz Band – Downlink



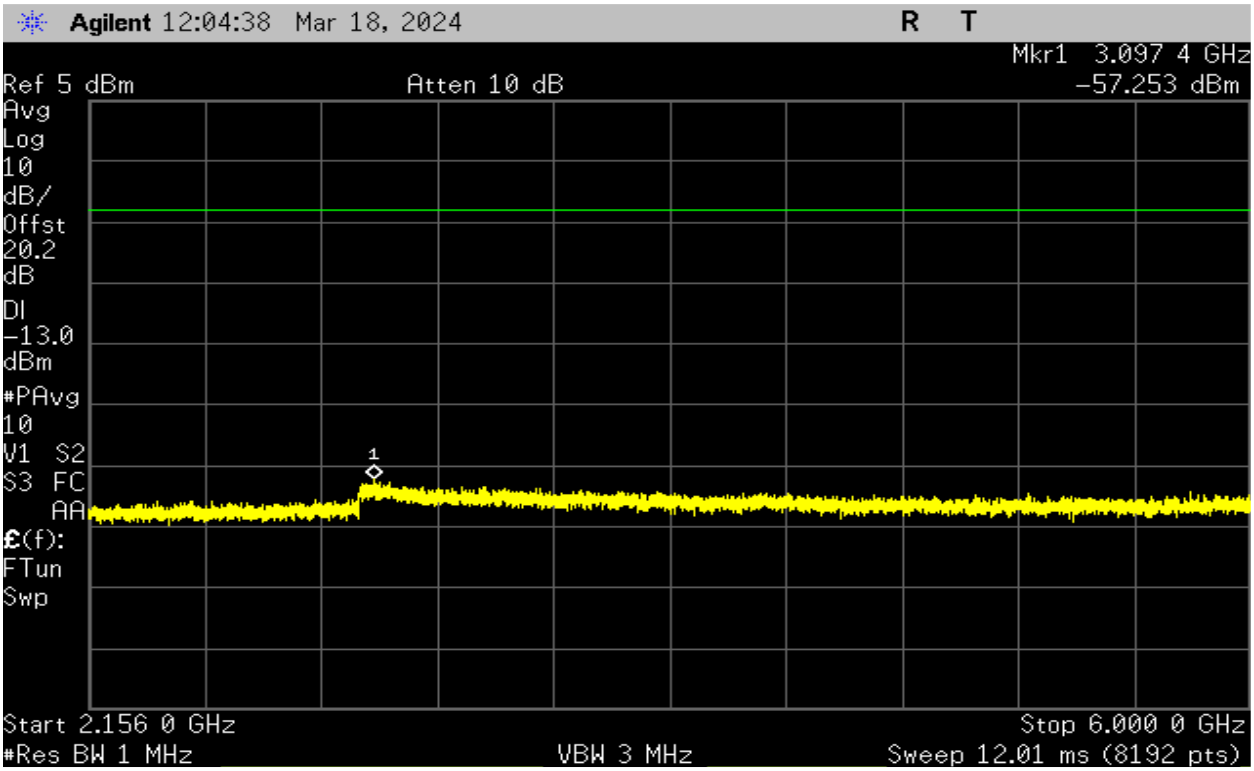
Plot 109 – 1930-1995MHz Band – Downlink



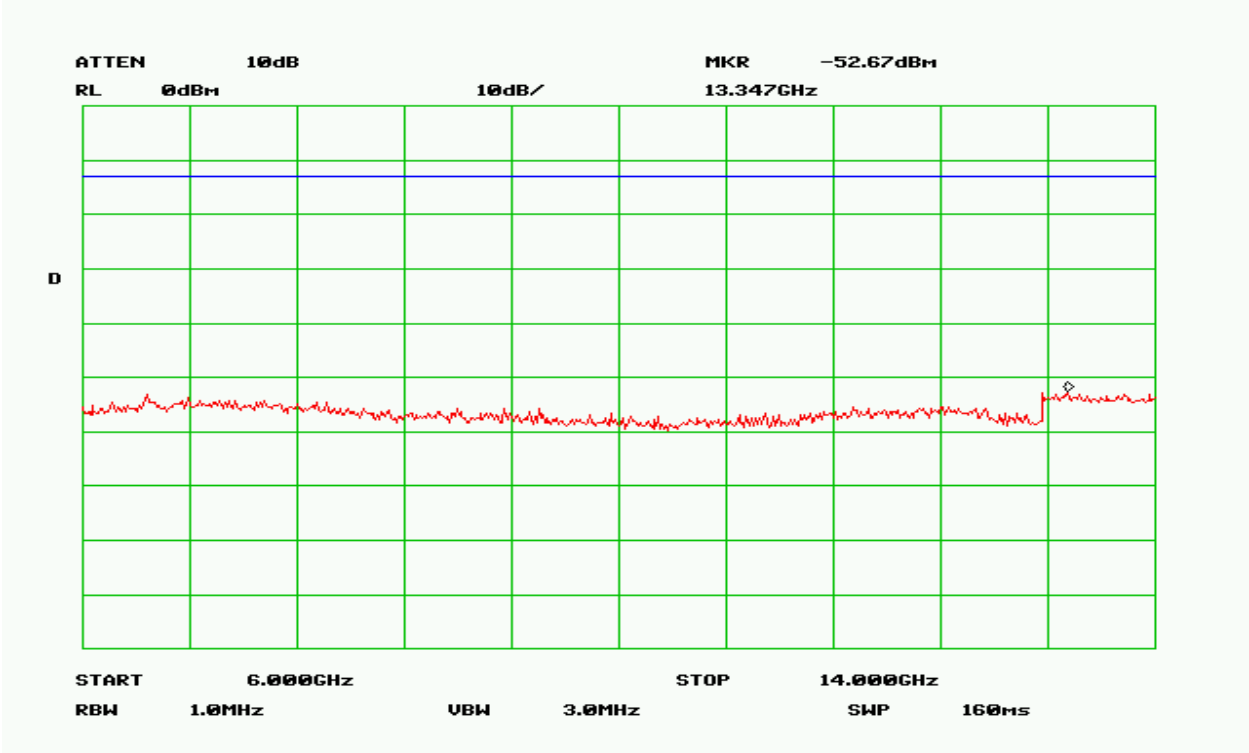
Plot 110 – 1930-1995MHz Band – Downlink



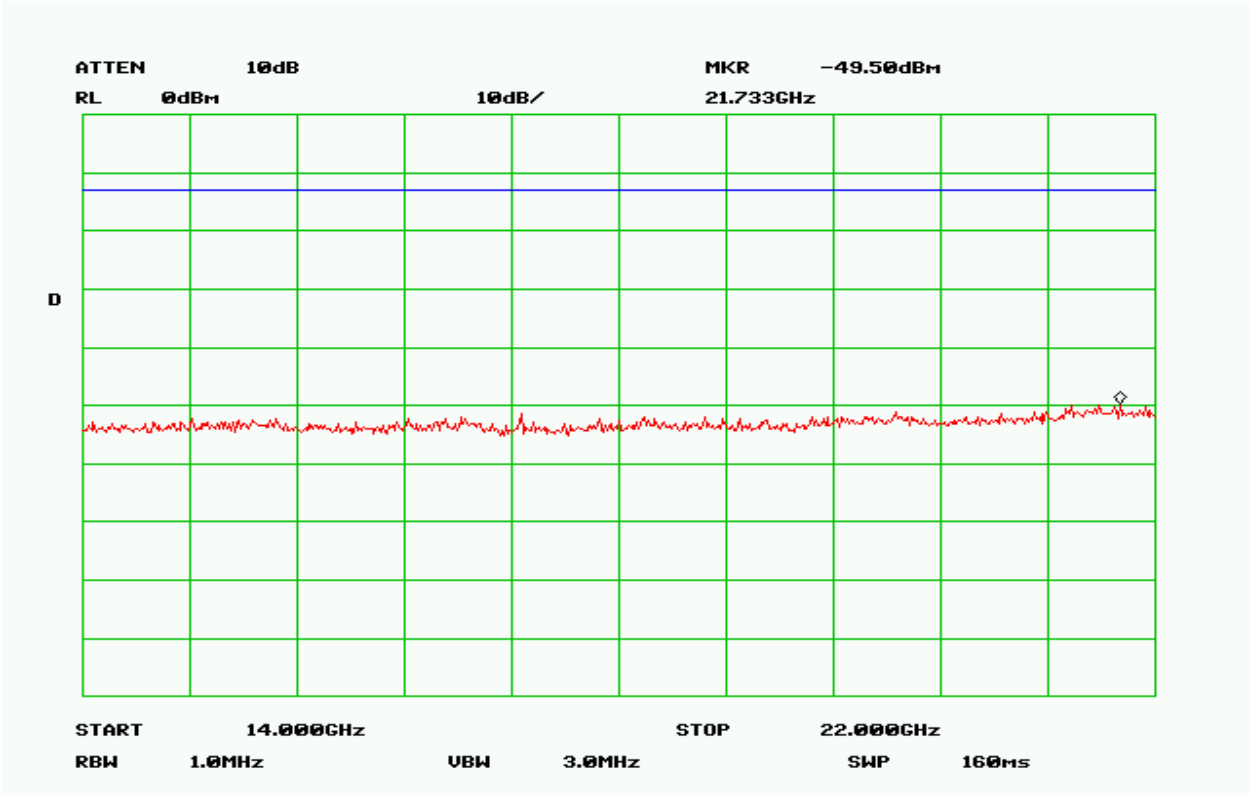
Plot 111 – 2110-2155MHz Band – Downlink



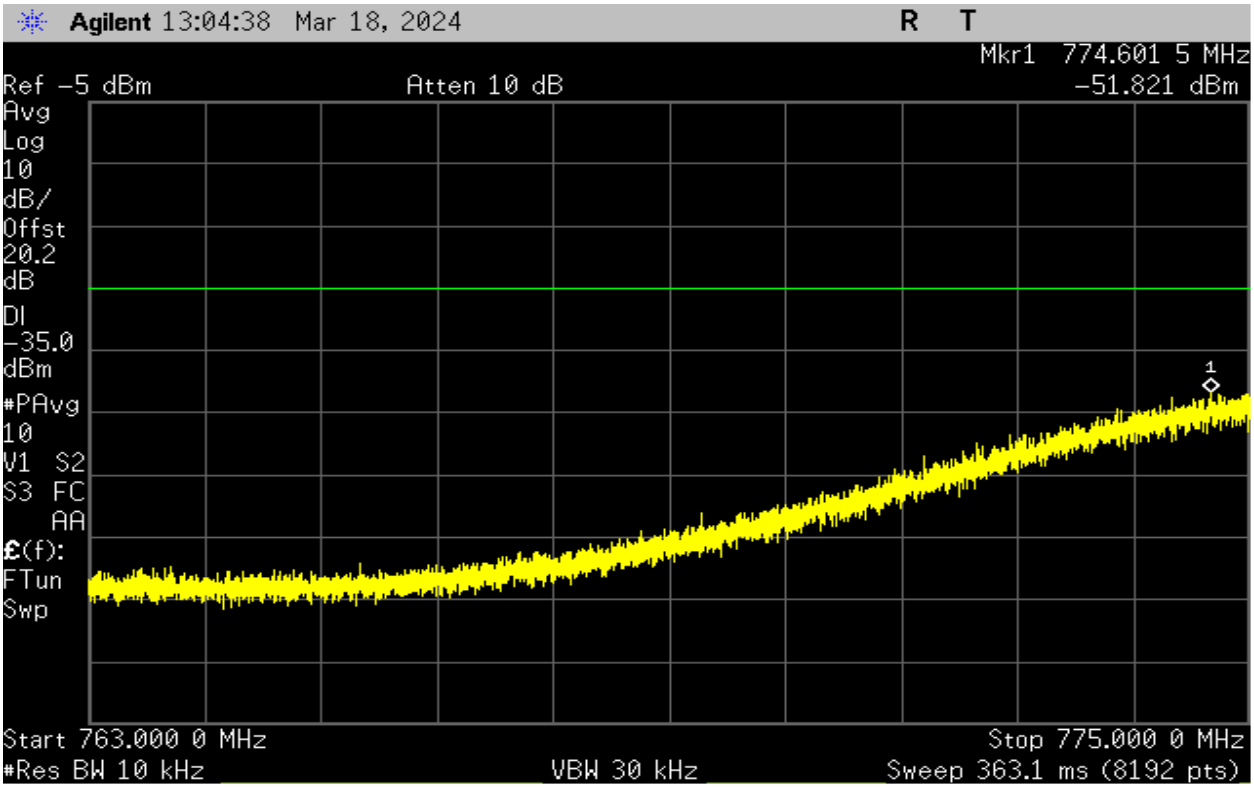
Plot 112 – 2110-2155MHz Band – Downlink



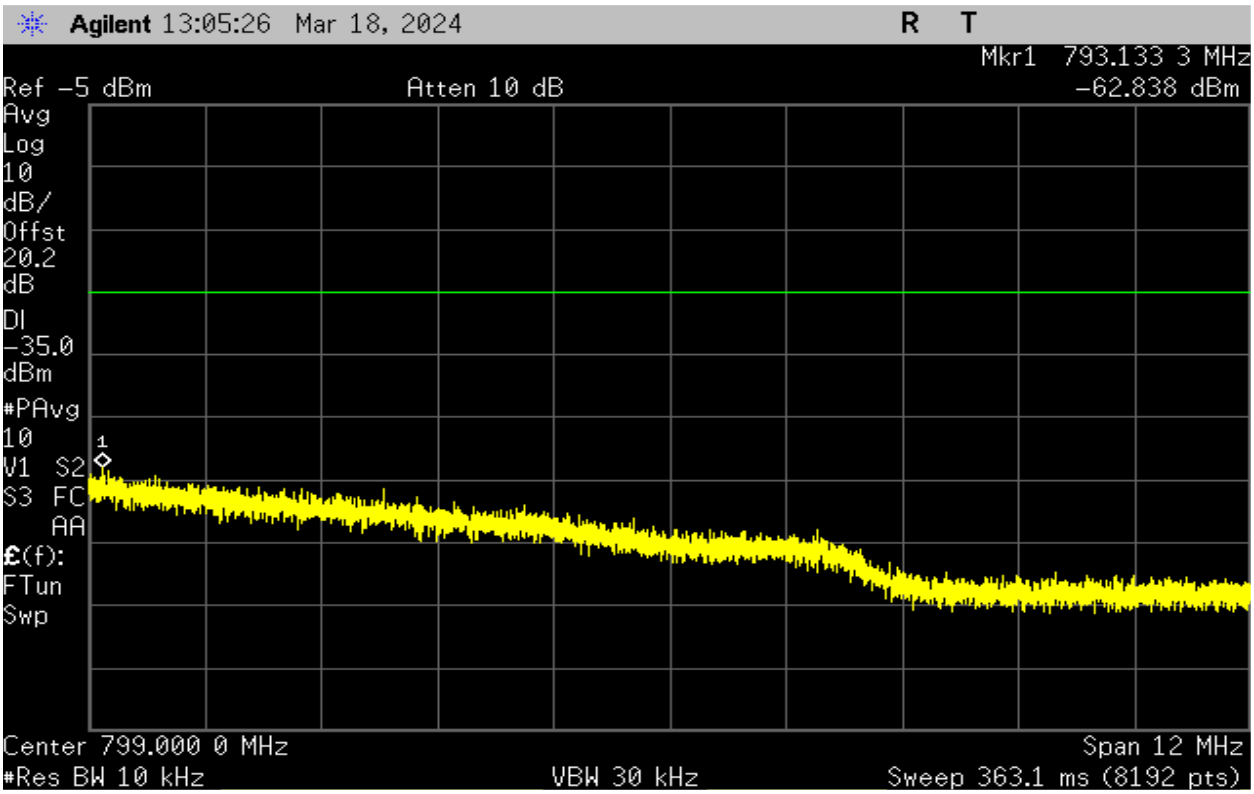
Plot 113 –2110-2155MHz Band – Downlink



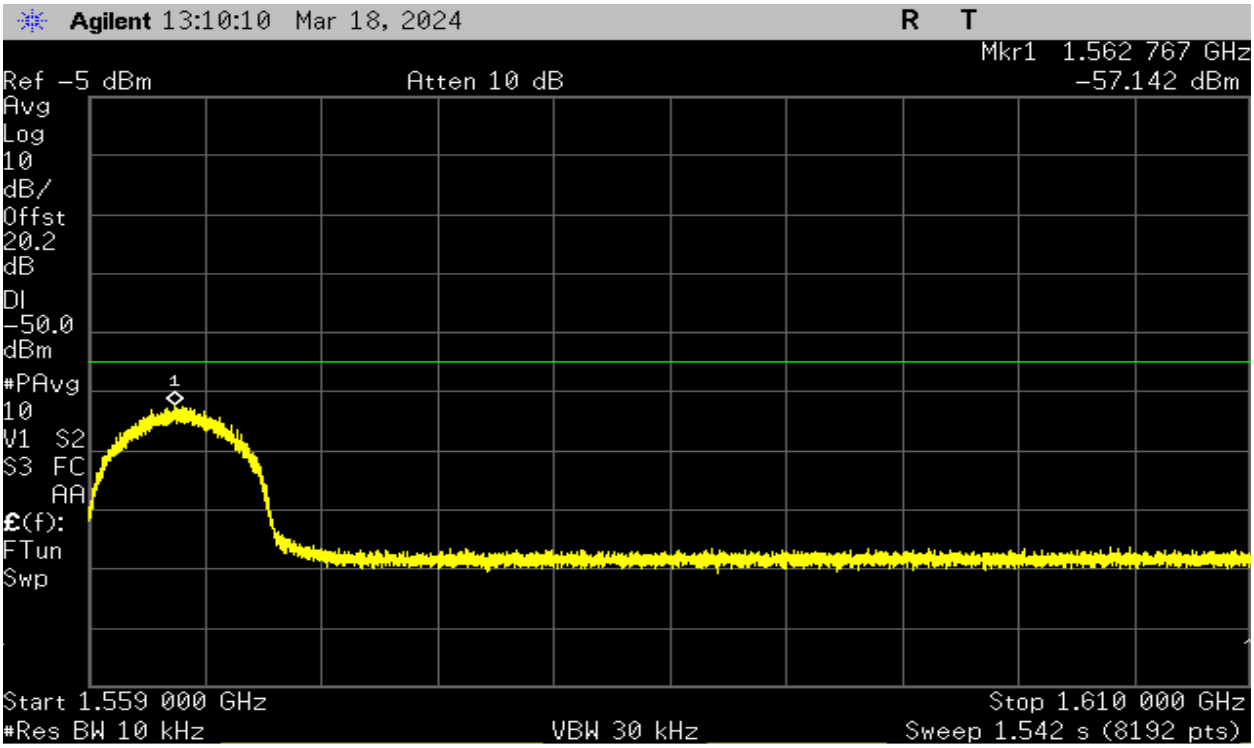
Plot 114 –2110-2155MHz Band – Downlink



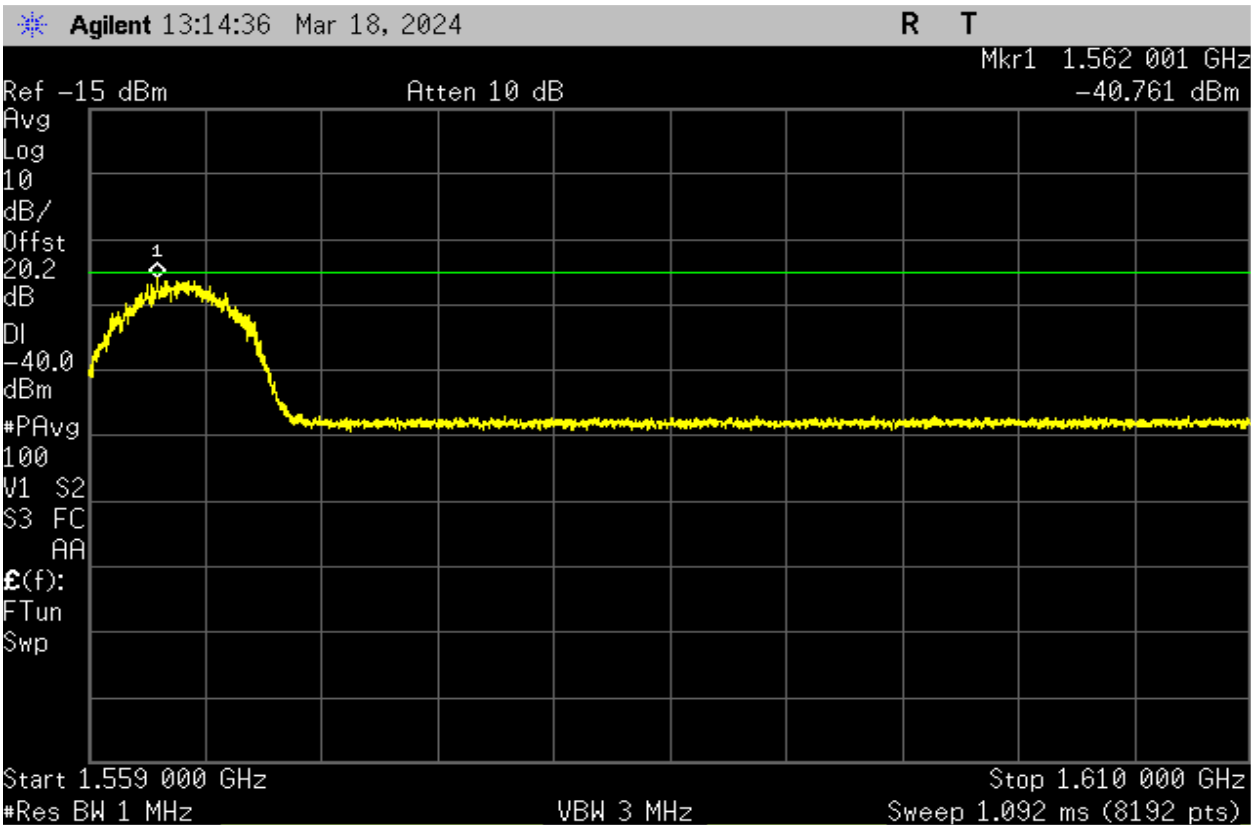
Plot 115 –27.53c4 – Uplink



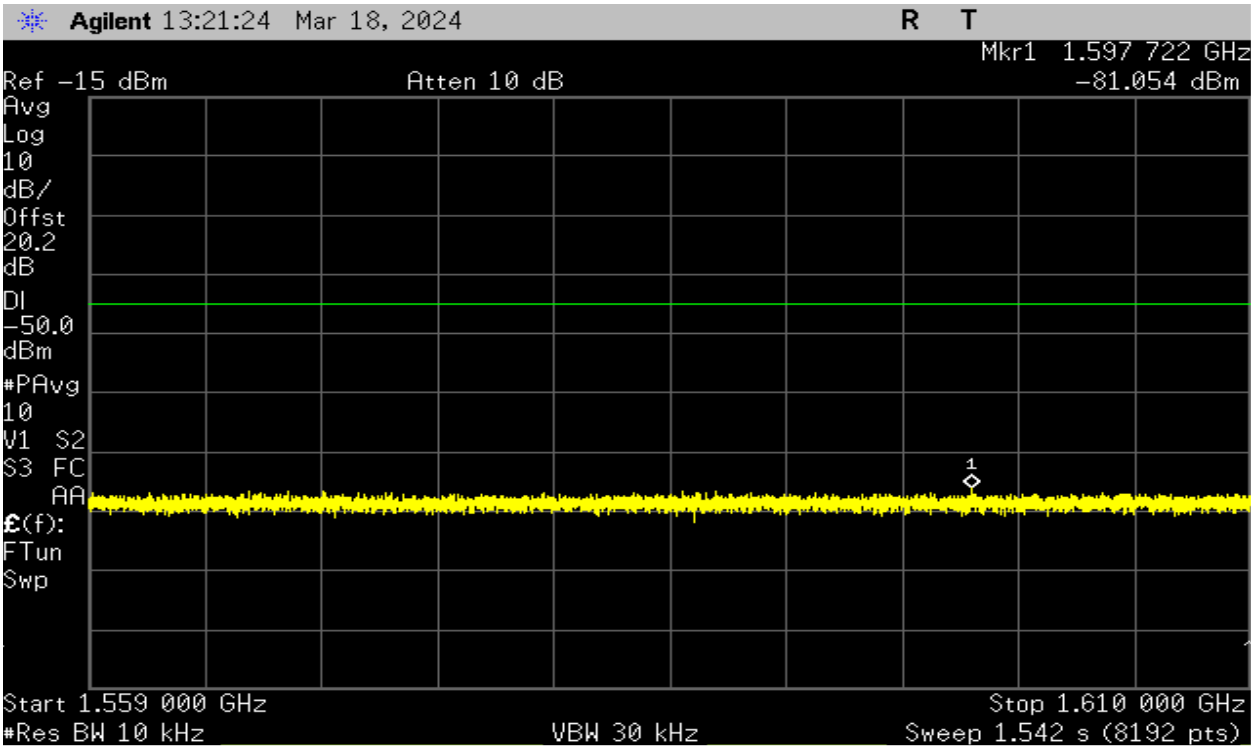
Plot 116 –27.53c4 – Uplink



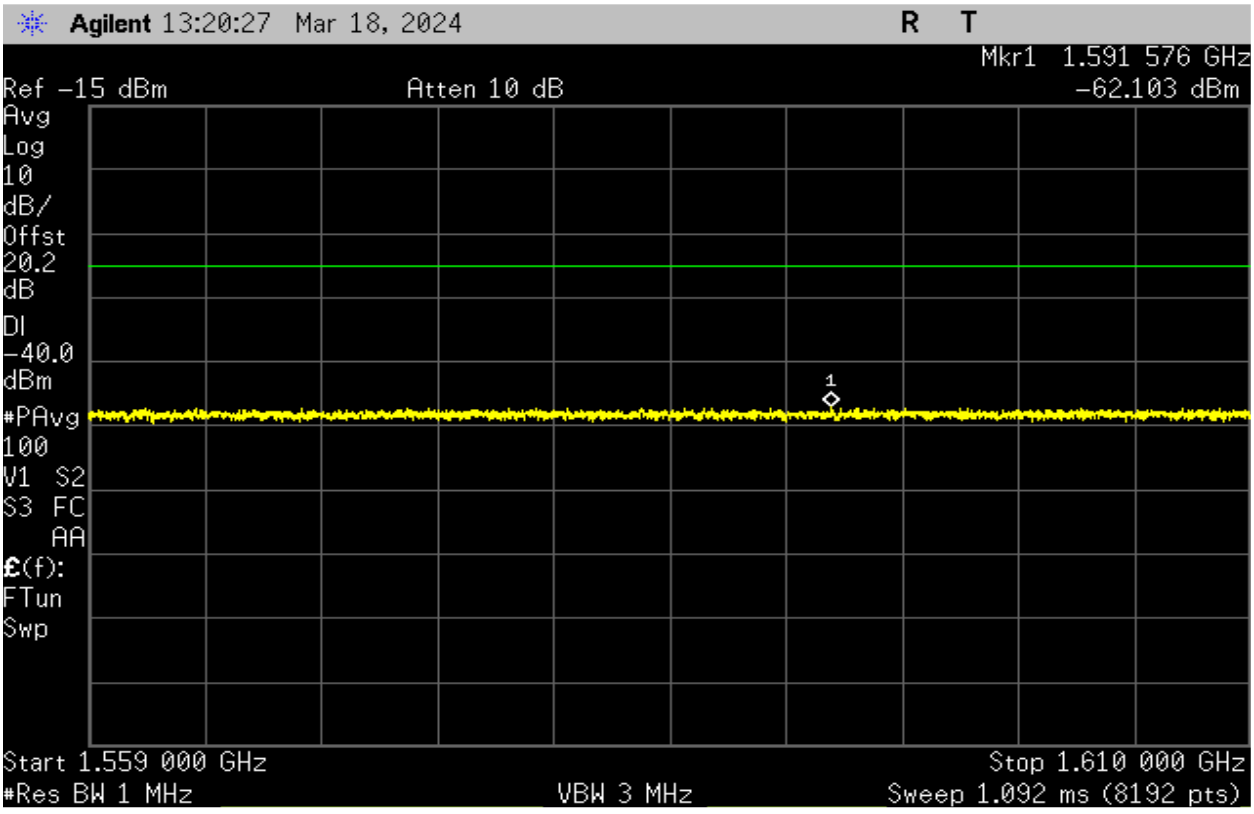
Plot 117 –27.53f – Uplink Narrowband



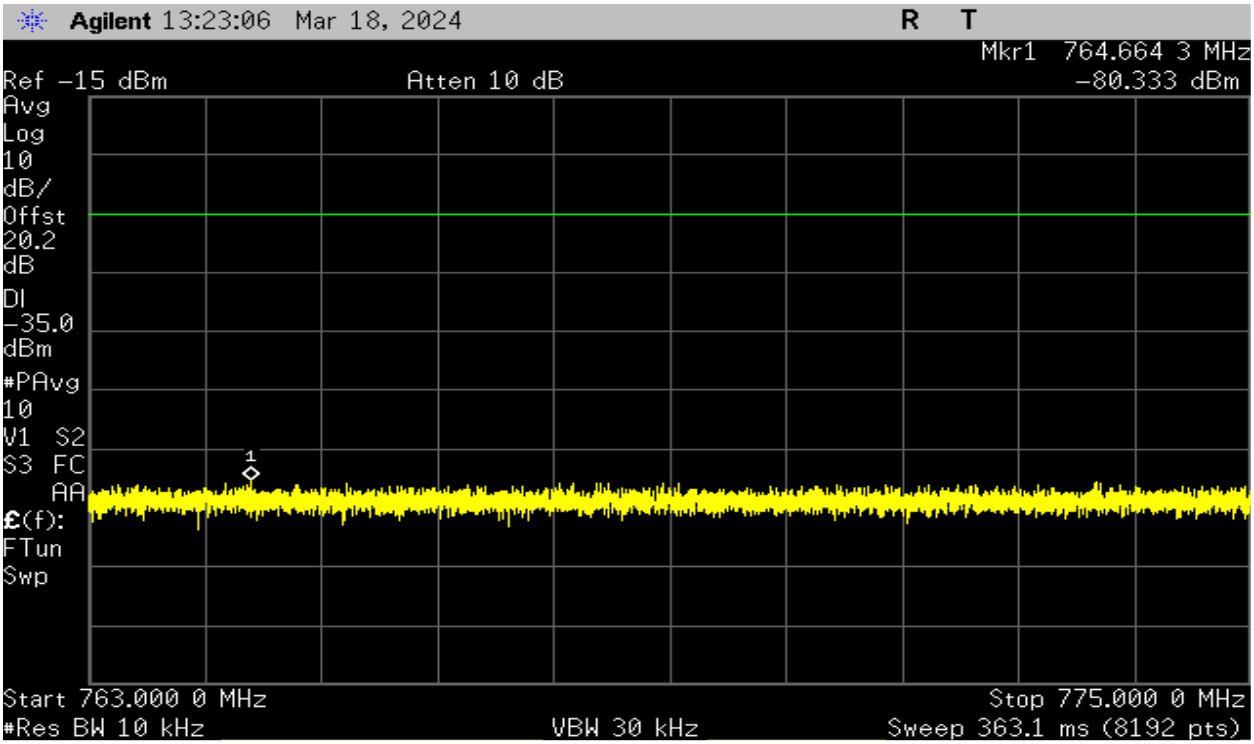
Plot 118 –27.53f – Uplink Wideband



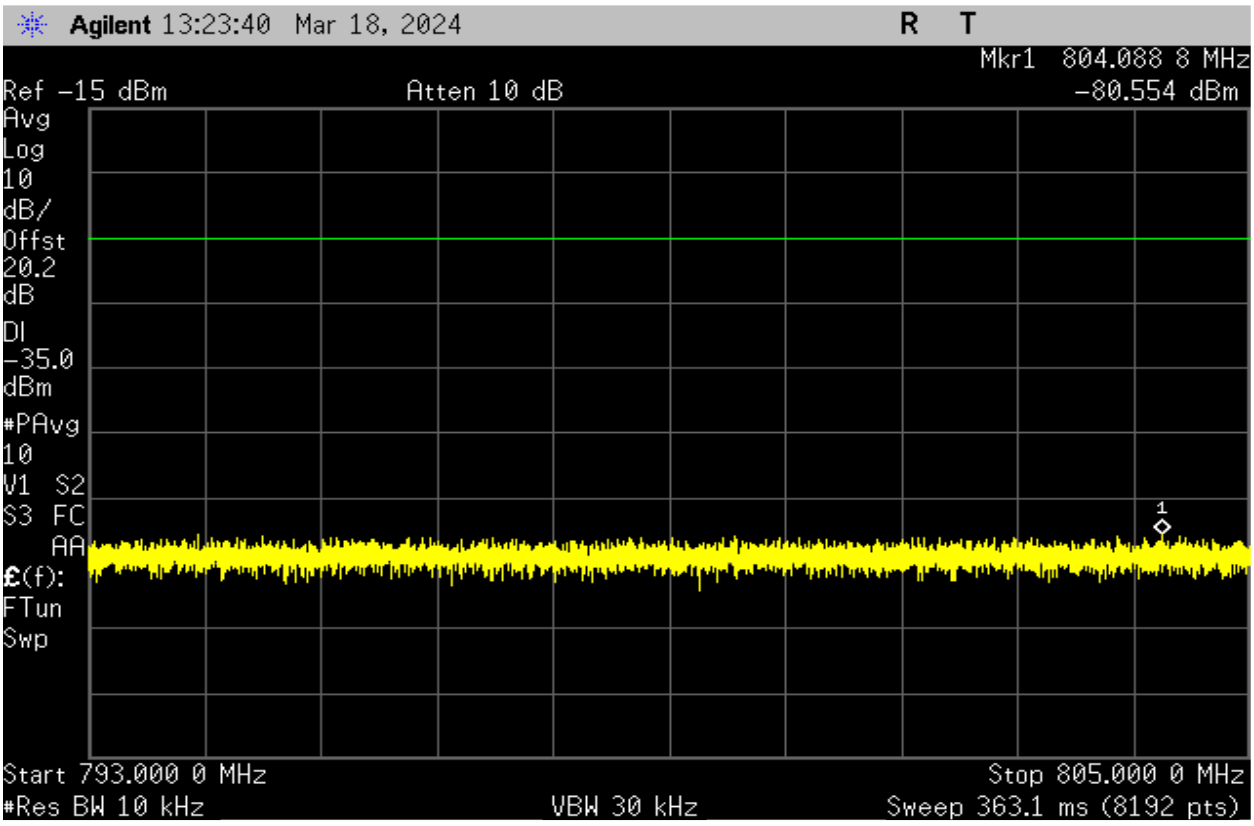
Plot 119 –27.53f – Downlink Narrowband



Plot 120 –27.53f – Downlink Wideband



Plot 121 –27.53c4 – Downlink



Plot 122 –27.53c4 – Downlink

6. Noise Limits/Transmit Power Off Mode

Test Requirement(s):	§20.21(e)(8)(i)(A) and RSS-131 §7.1, §7.3 & §7.7	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	March 19, 2024

Test Procedures: As required by 47 CFR §20.21(e)(8)(i)(A) and RSS-131 §7.1, §7.3 & §7.7, 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:

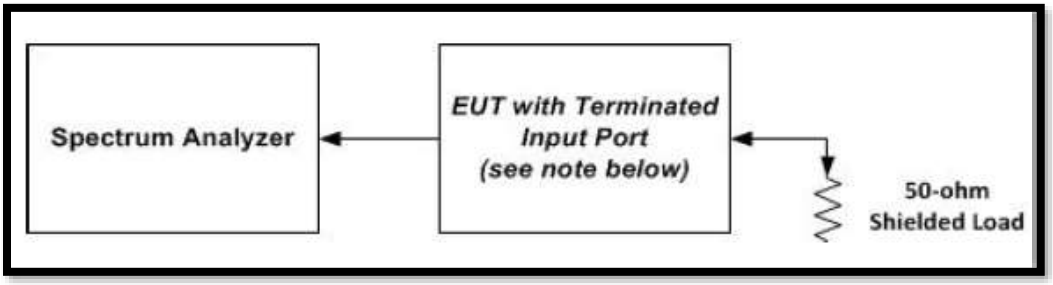


Figure 2 – Noise Limit

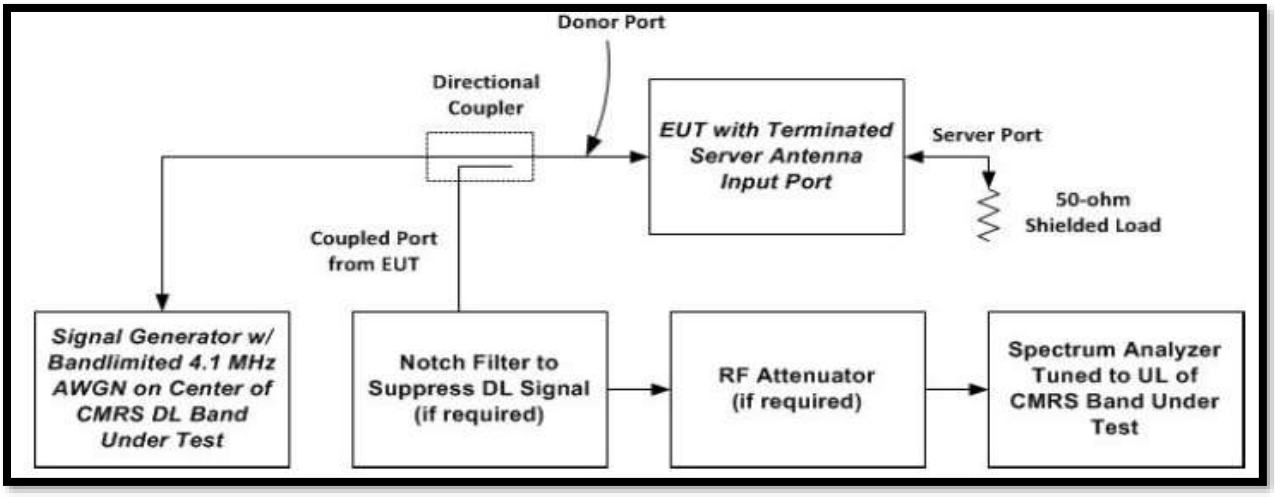


Figure 3 – Uplink Noise power in presence of a downlink signal

Limit: -59dBm/MHz

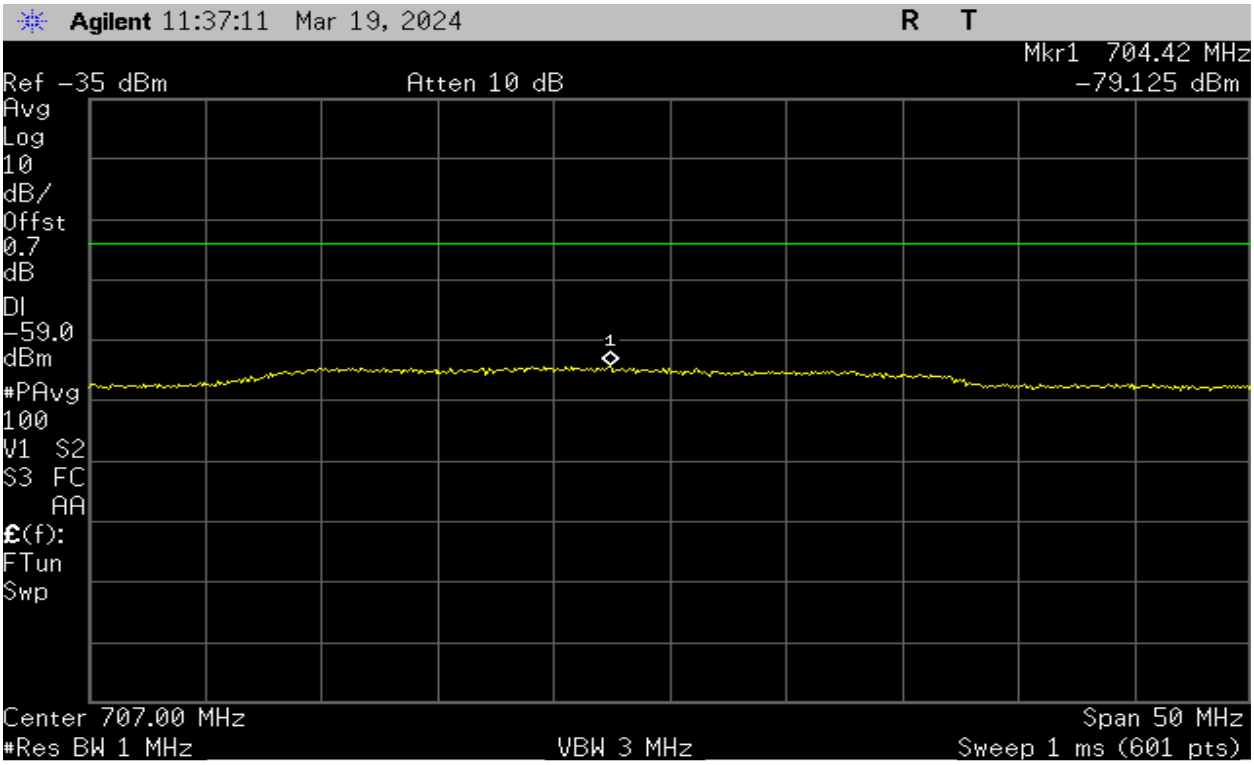
Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dB)
698-716	-79.12	-59	-20.12
776-787	-80.33	-59	-21.33
824-849	-81.21	-59	-22.21
1710-1755	-81.40	-59	-22.40
1850-1915	-81.56	-59	-22.56

Table 19 – Maximum Uplink Noise Summary

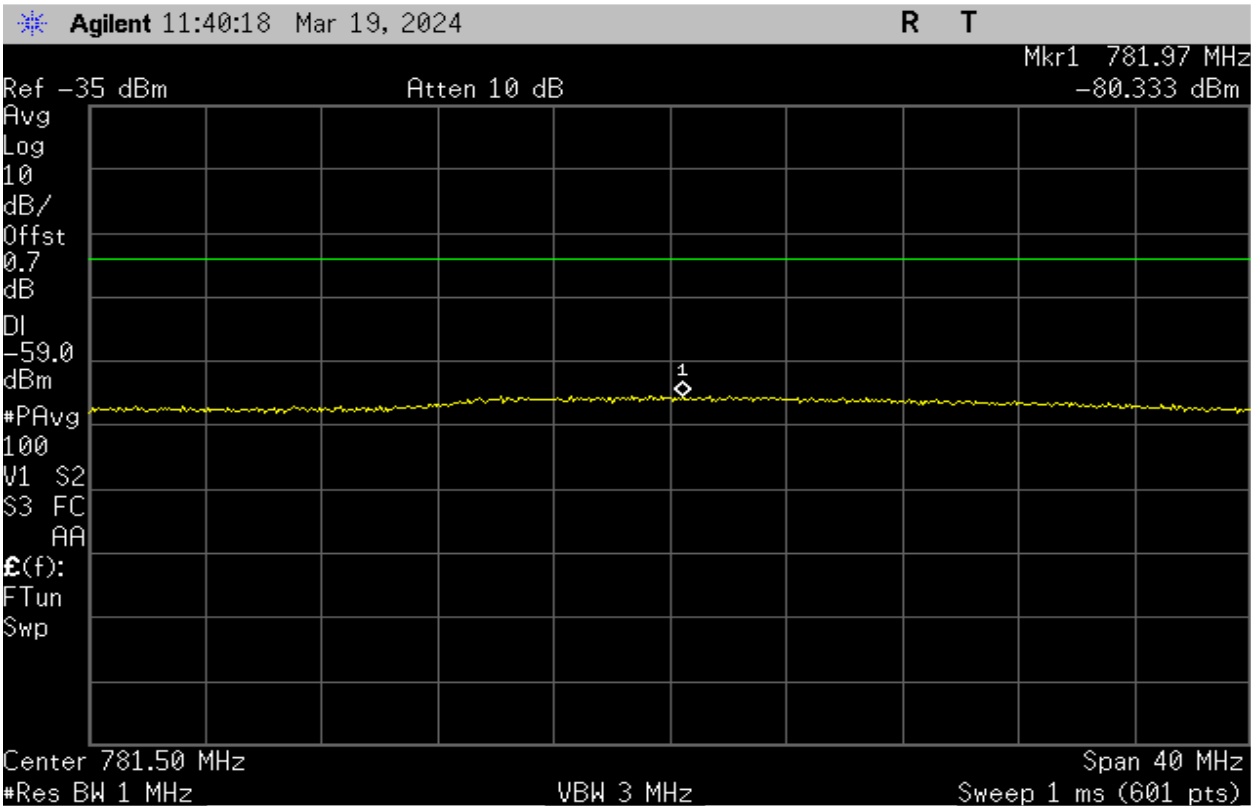
Frequency Band (MHz)	Measured Level (dBm)	Limit (dBm)	Margin (dB)
728-746	-81.79	-59	-22.79
746-757	-81.73	-59	-22.73
869-894	-81.58	-59	-22.58
1930-1995	-81.85	-59	-22.85
2110-2155	-81.51	-59	-22.51

Table 20 – Maximum Downlink Noise Summary

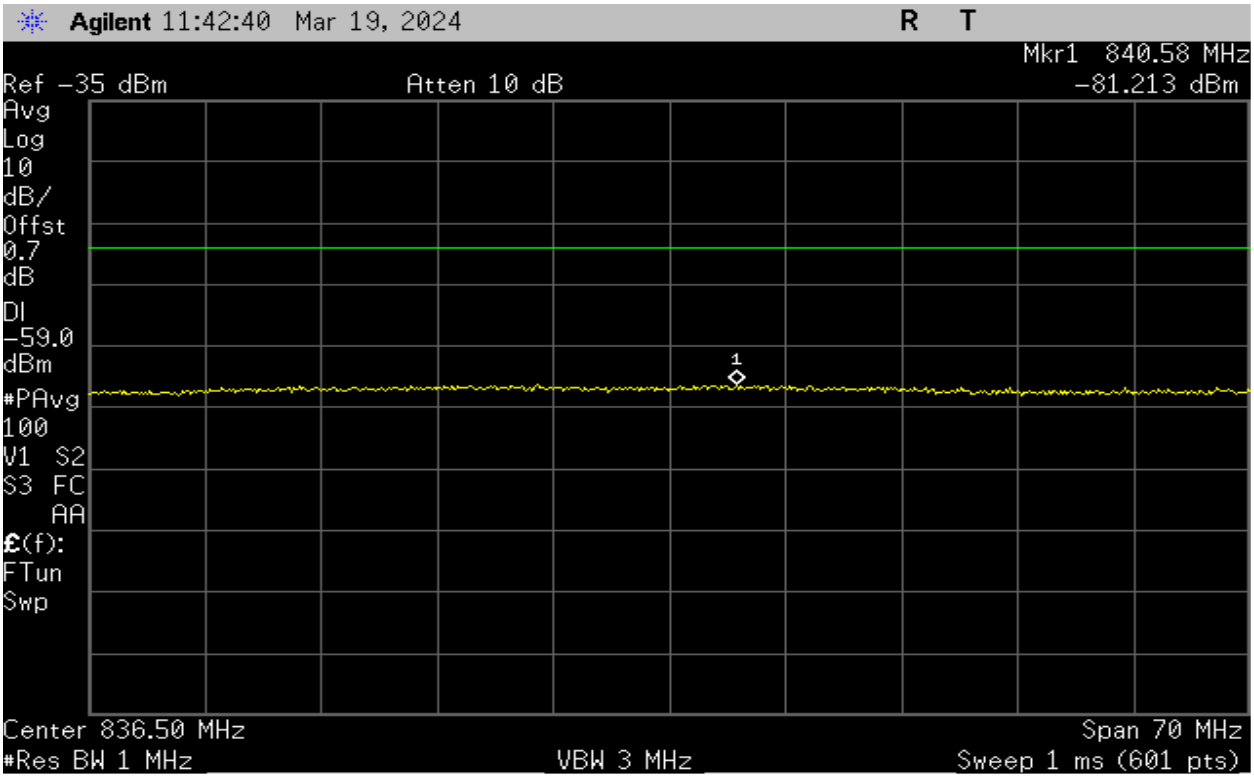
Note: Maximum Uplink Noise was tested with a downlink RSSI of -20 dBm. As all noise levels are below the Power Off Mode of -70 dBm requirement, the RSSI dependent portion and variable uplink gain timing tests were omitted.



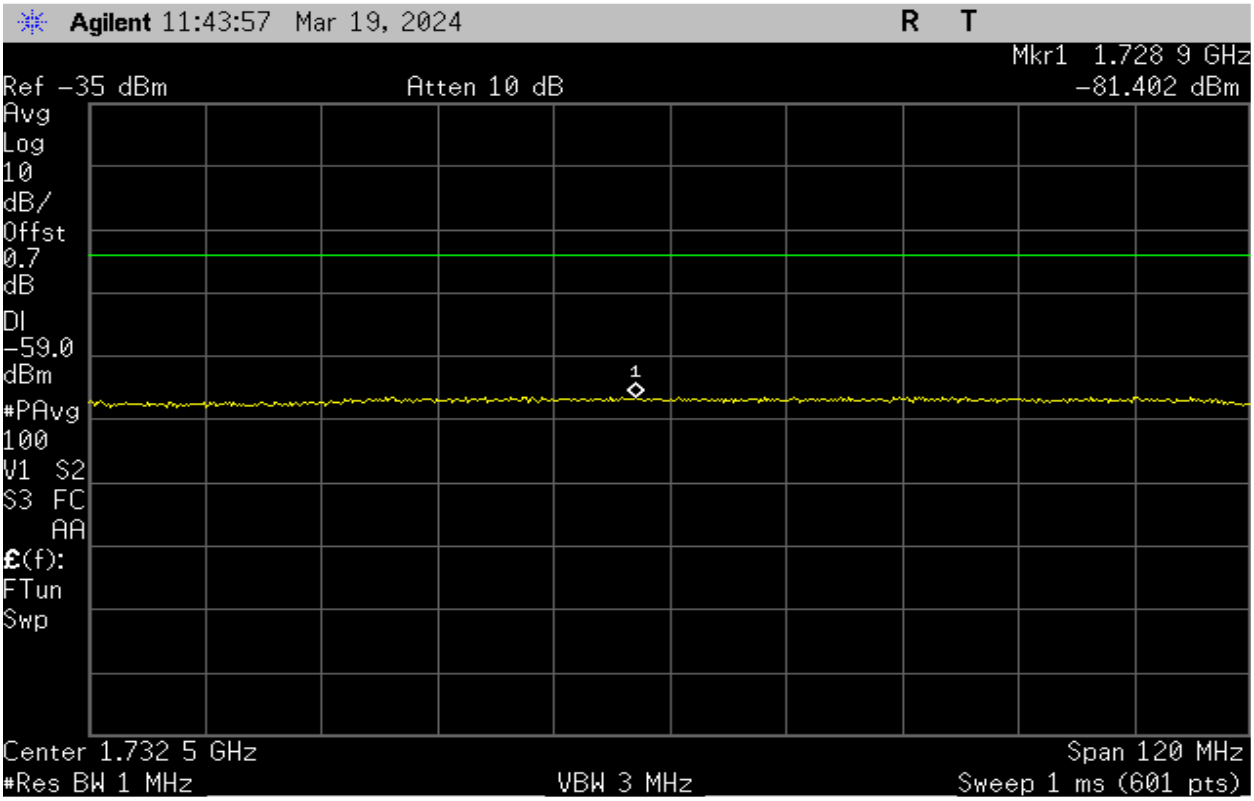
Plot 123 – 698-716MHz Band – Maximum Uplink Noise



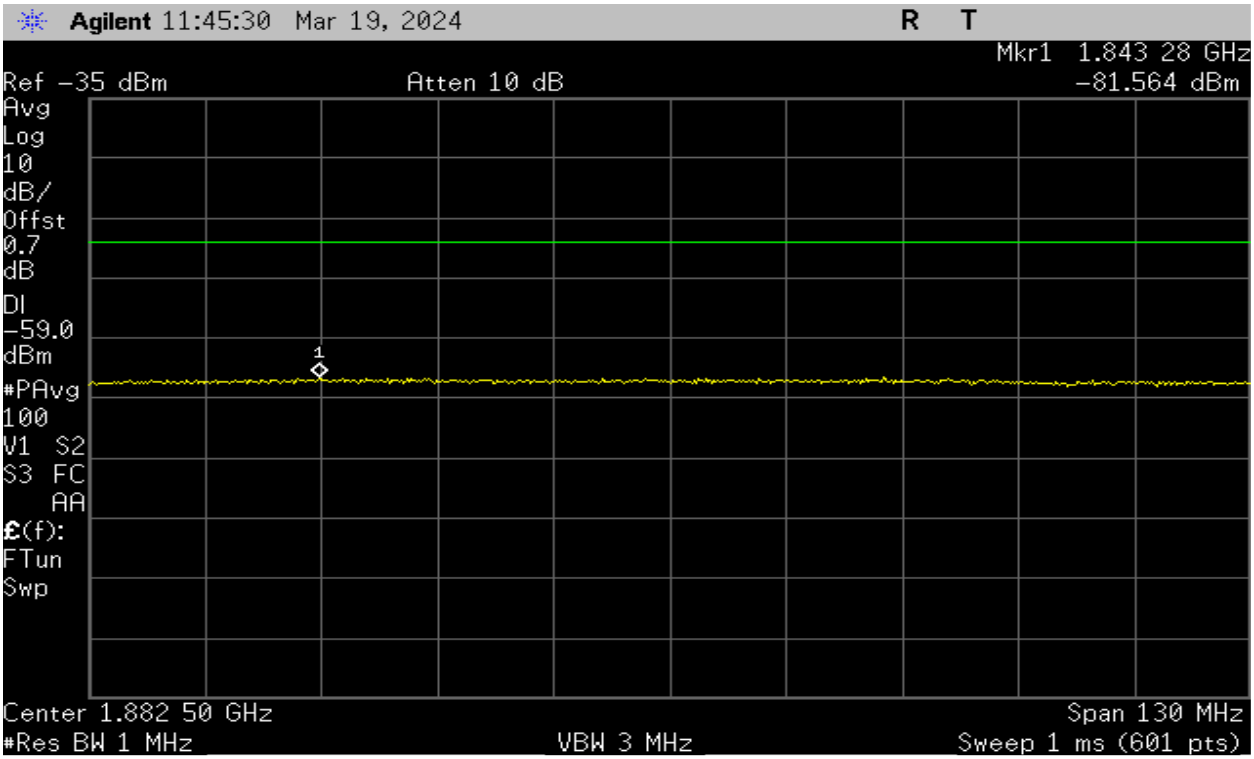
Plot 124 – 776-787MHz Band – Maximum Uplink Noise



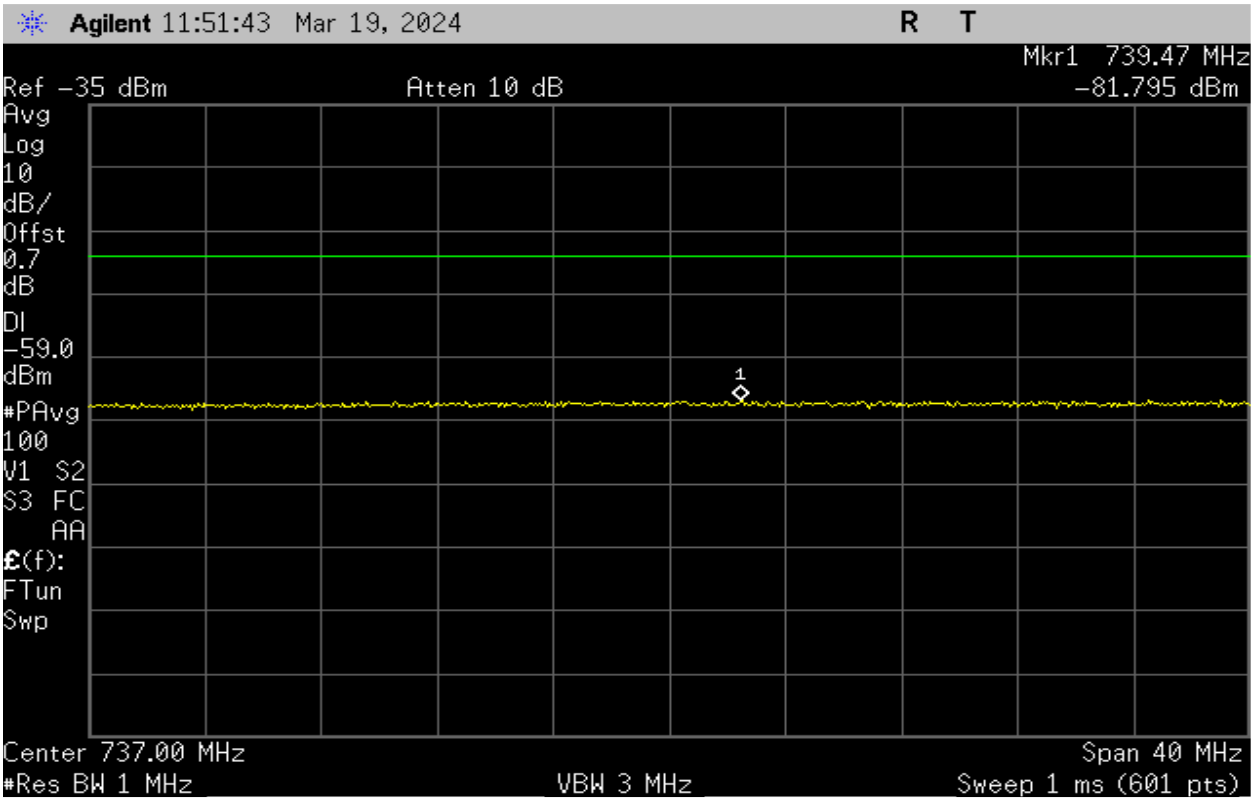
Plot 125 – 824-849MHz Band – Maximum Uplink Noise



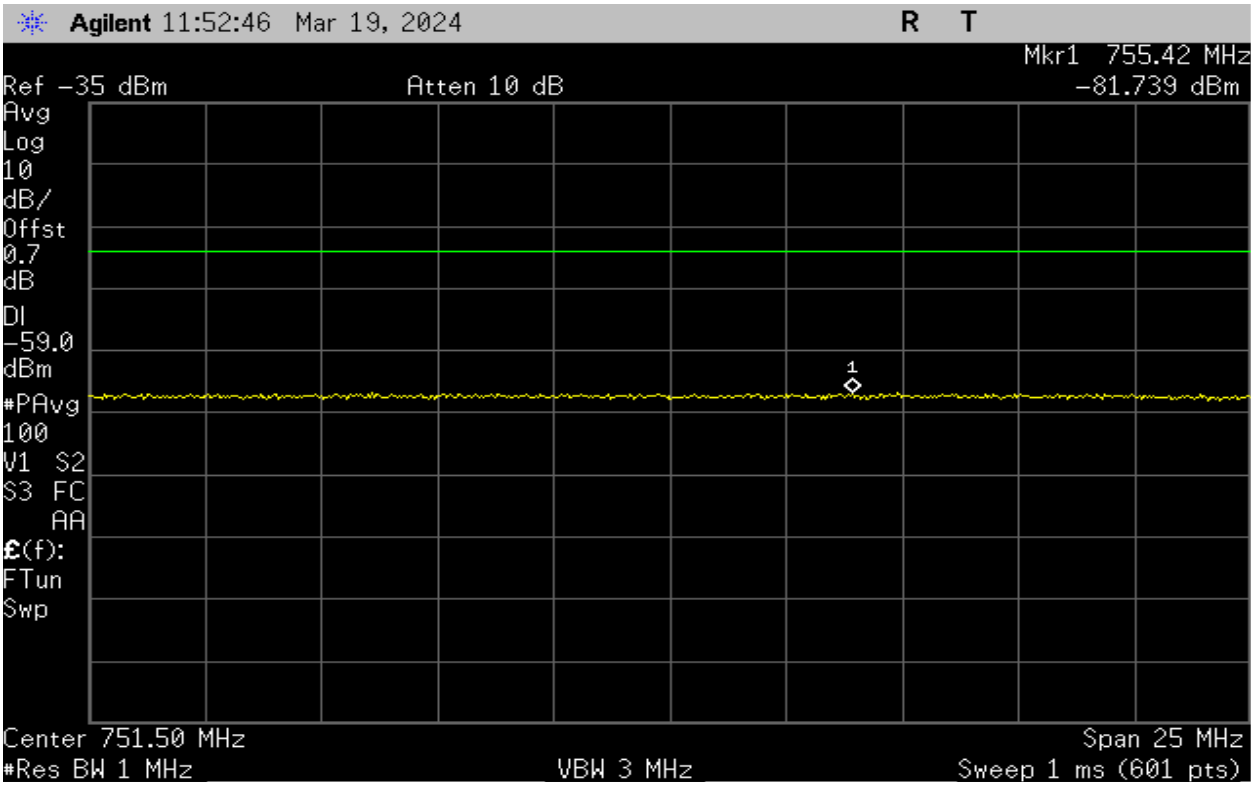
Plot 126 – 1710-1755MHz Band – Maximum Uplink Noise



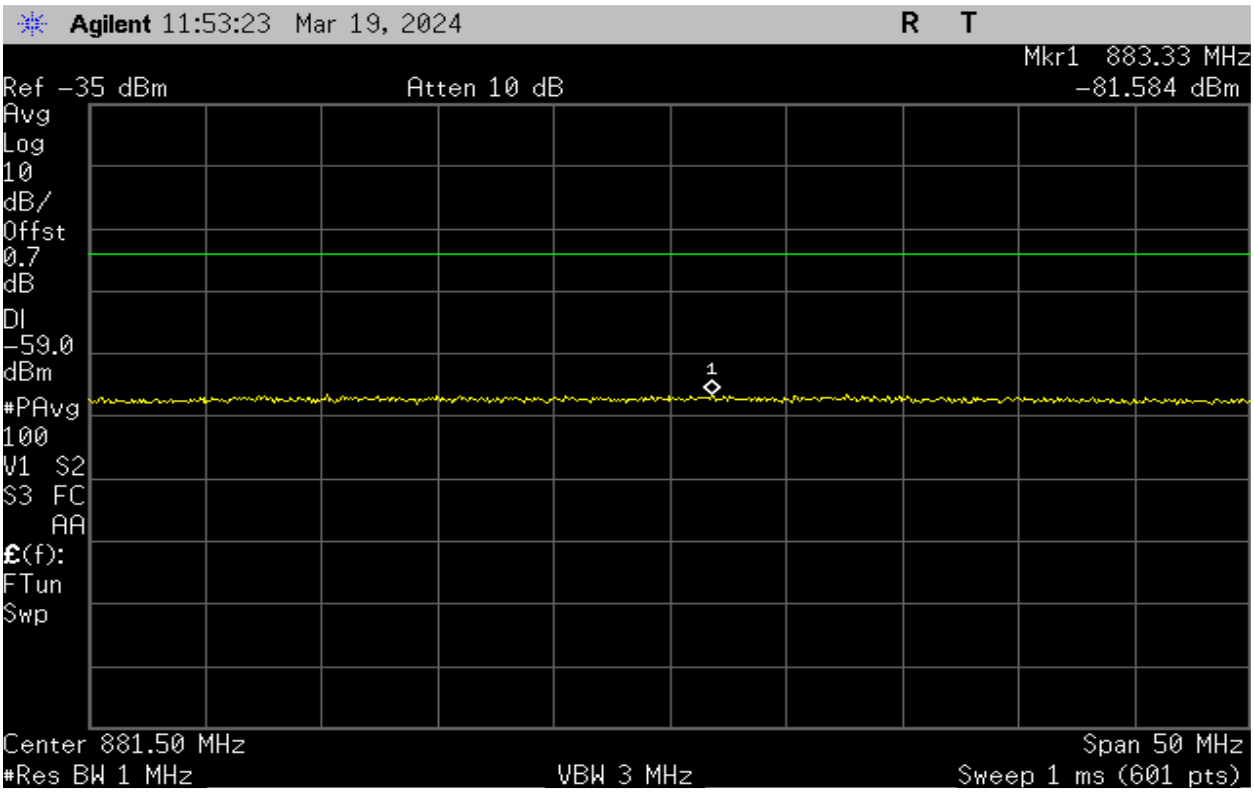
Plot 127 – 1850-1915MHz Band – Maximum Uplink Noise



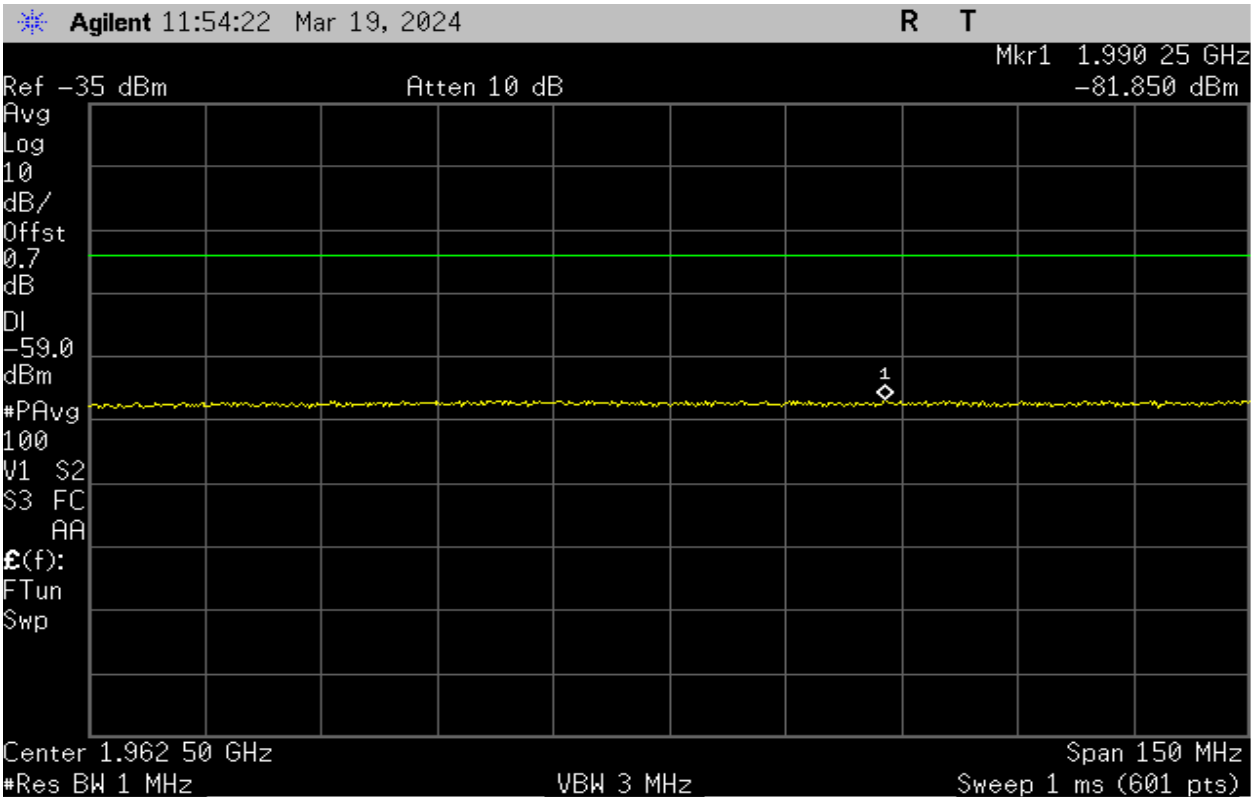
Plot 128 – 728-746MHz Band – Maximum Downlink Noise



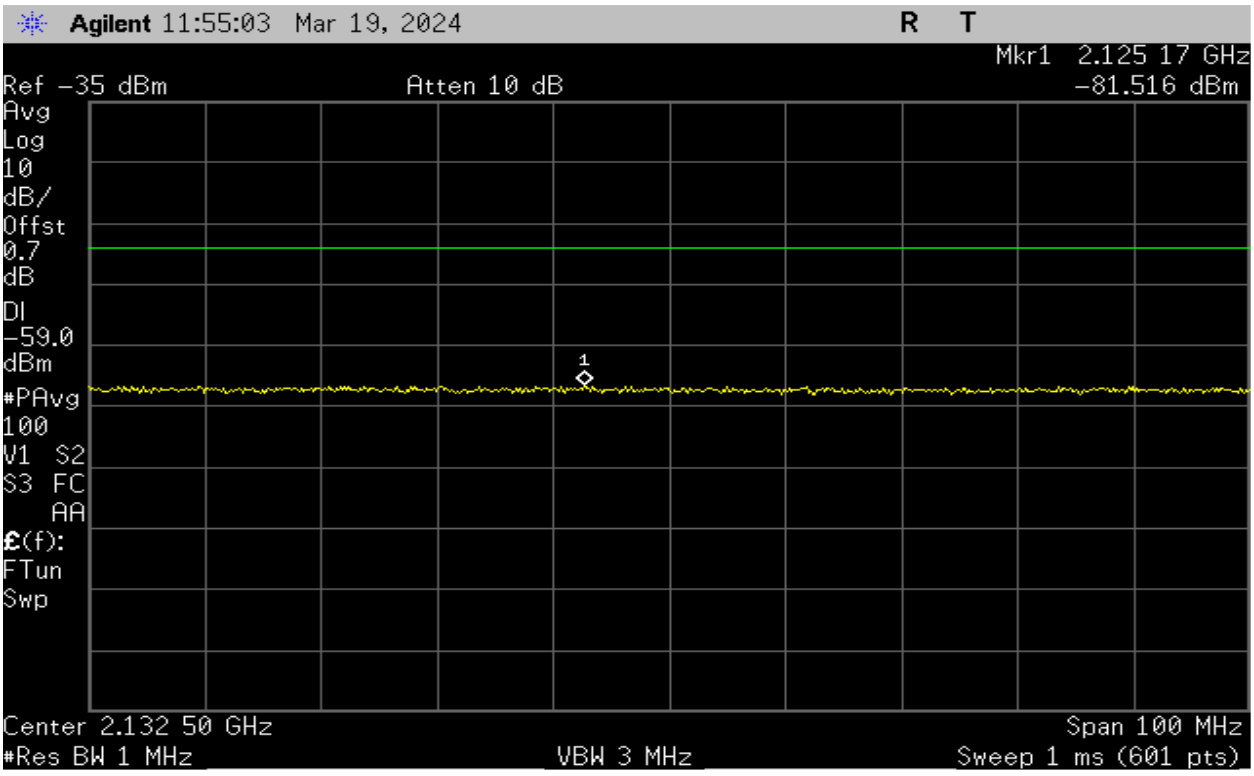
Plot 129 – 746-757MHz Band – Maximum Downlink Noise



Plot 130 – 869-894MHz Band – Maximum Downlink Noise



Plot 131 – 1930-1995MHz Band – Maximum Downlink Noise



Plot 132 – 2110-2155MHz Band – Maximum Downlink Noise

7. Uplink Inactivity

Test Requirement(s):	§20.21(e)(8)(i)(I) and RSS-131 §7.7	Test Engineer(s):	Sean E.
Test Results:	Pass	Test Date(s):	March 19, 2024

Test Procedures: As required by 47 CFR §20.21(e)(8)(i)(I) and RSS-131 §7.7, Uplink Inactivity measurements were made as per the FCC KDB 935210 D03 procedures defined in §7.8.

The EUT was set up as per Figure 4.

Test Setup:

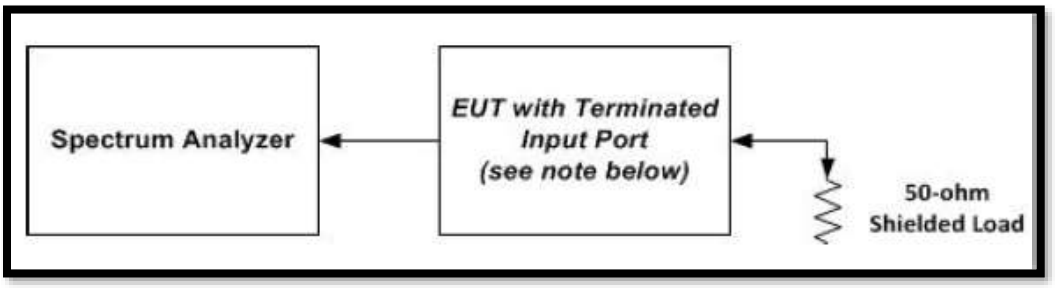
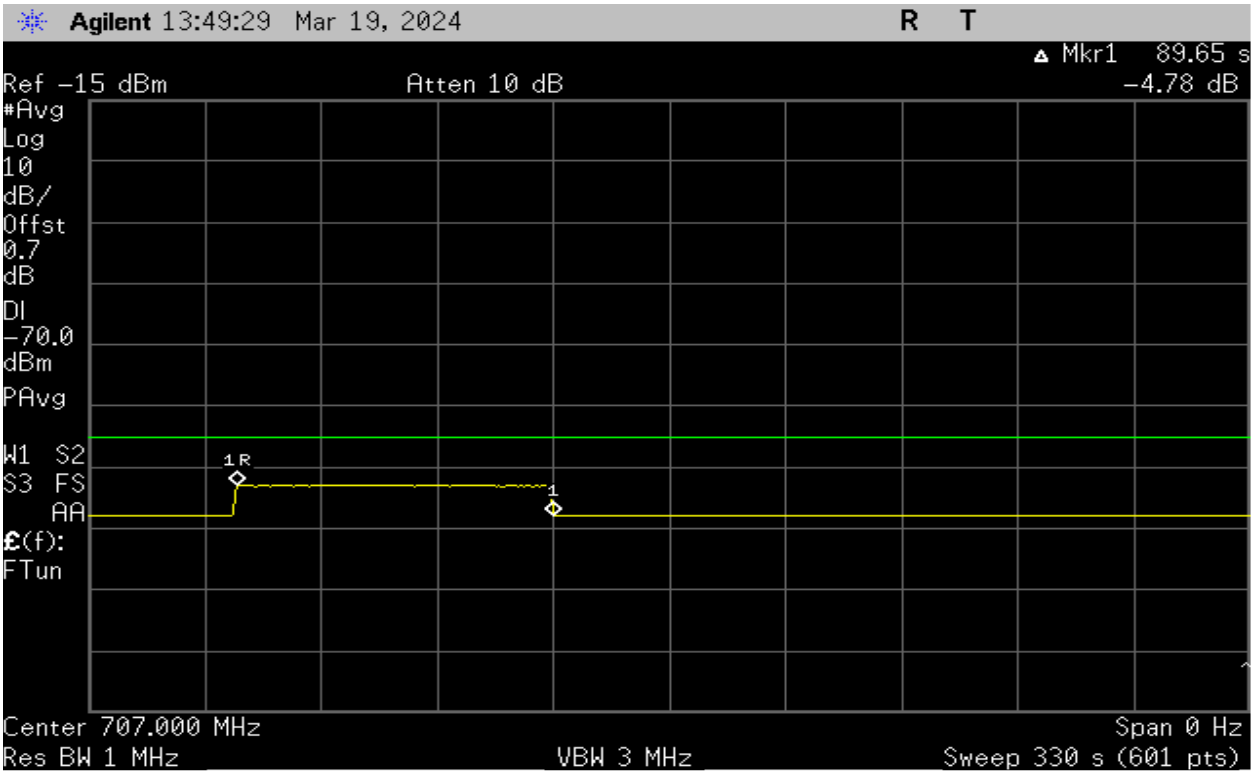


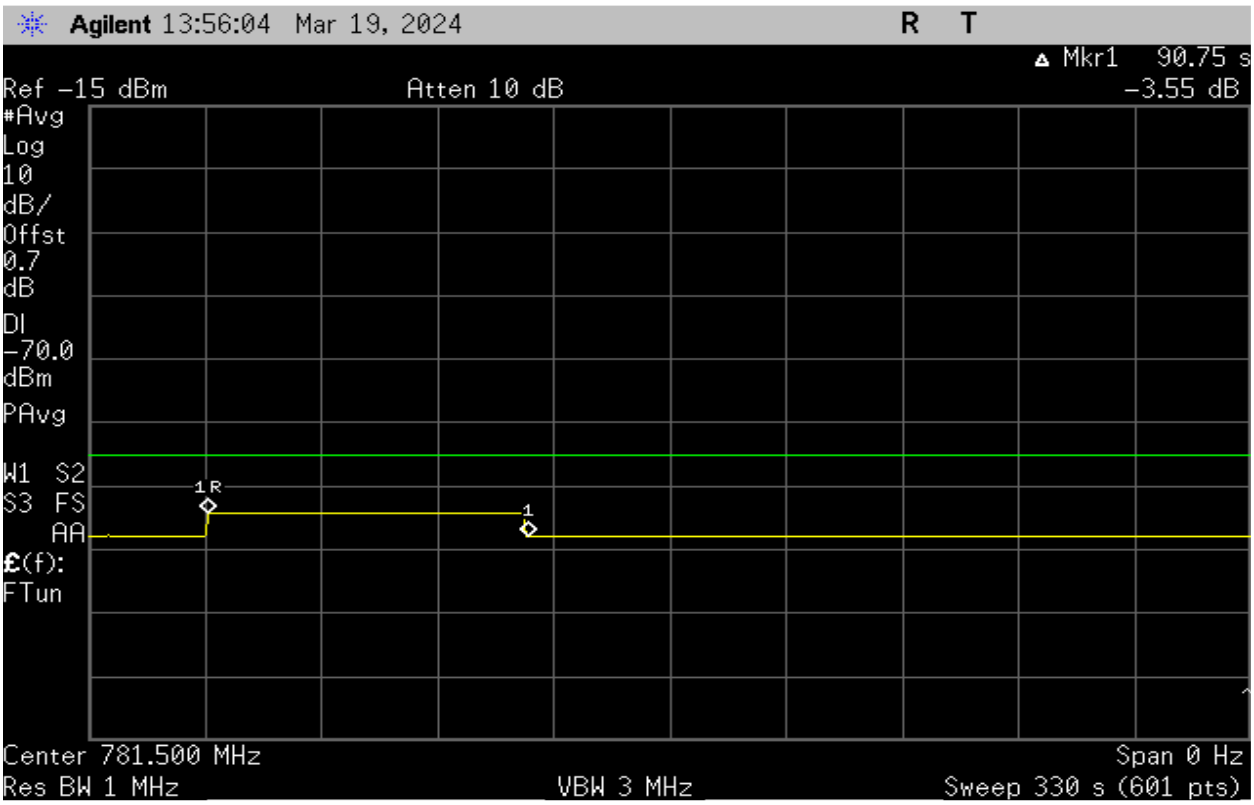
Figure 4 – Uplink Inactivity

Frequency Band (MHz)	Measured Time (Seconds)	Limit (Seconds)
698 – 716	89.65	300
776 - 787	90.75	300
824 - 849	90.2	300
1710 - 1755	90.2	300
1850 - 1915	90.2	300

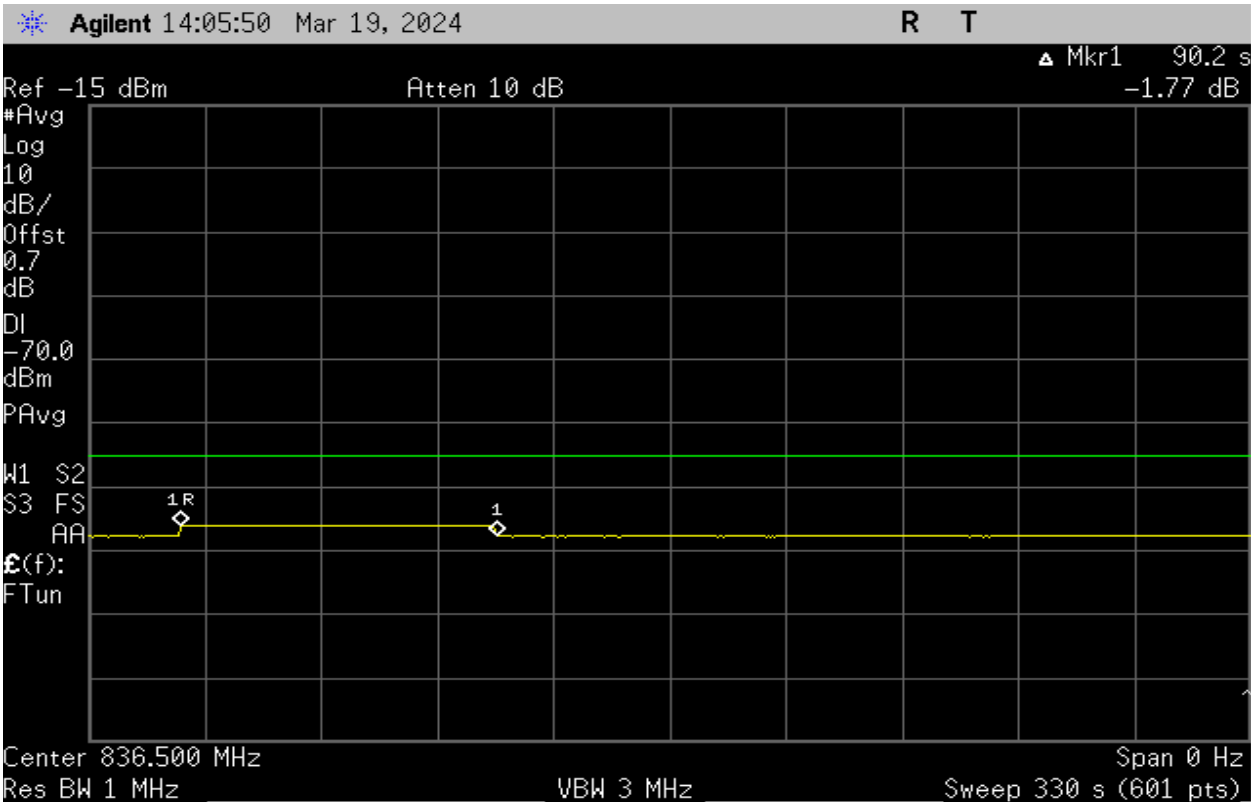
Table 21 – Uplink Inactivity Data



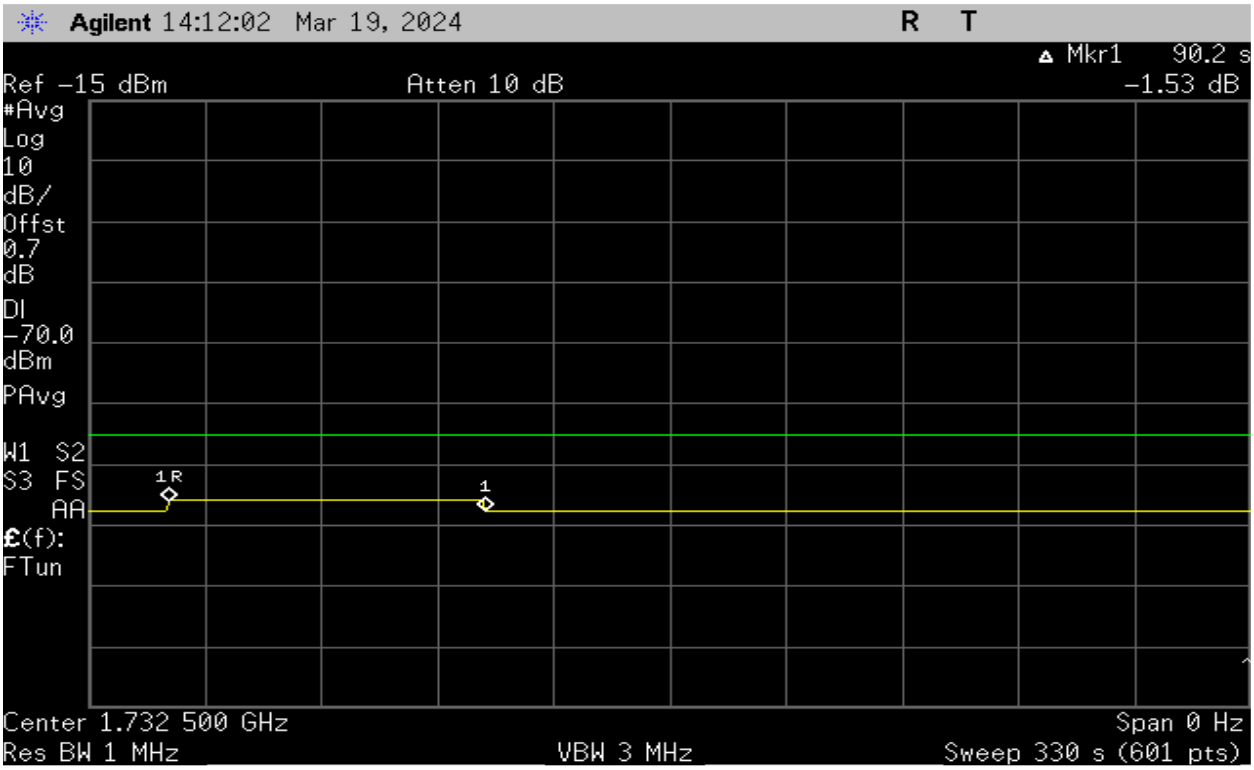
Plot 133 – 698-716MHz Band – Uplink Inactivity



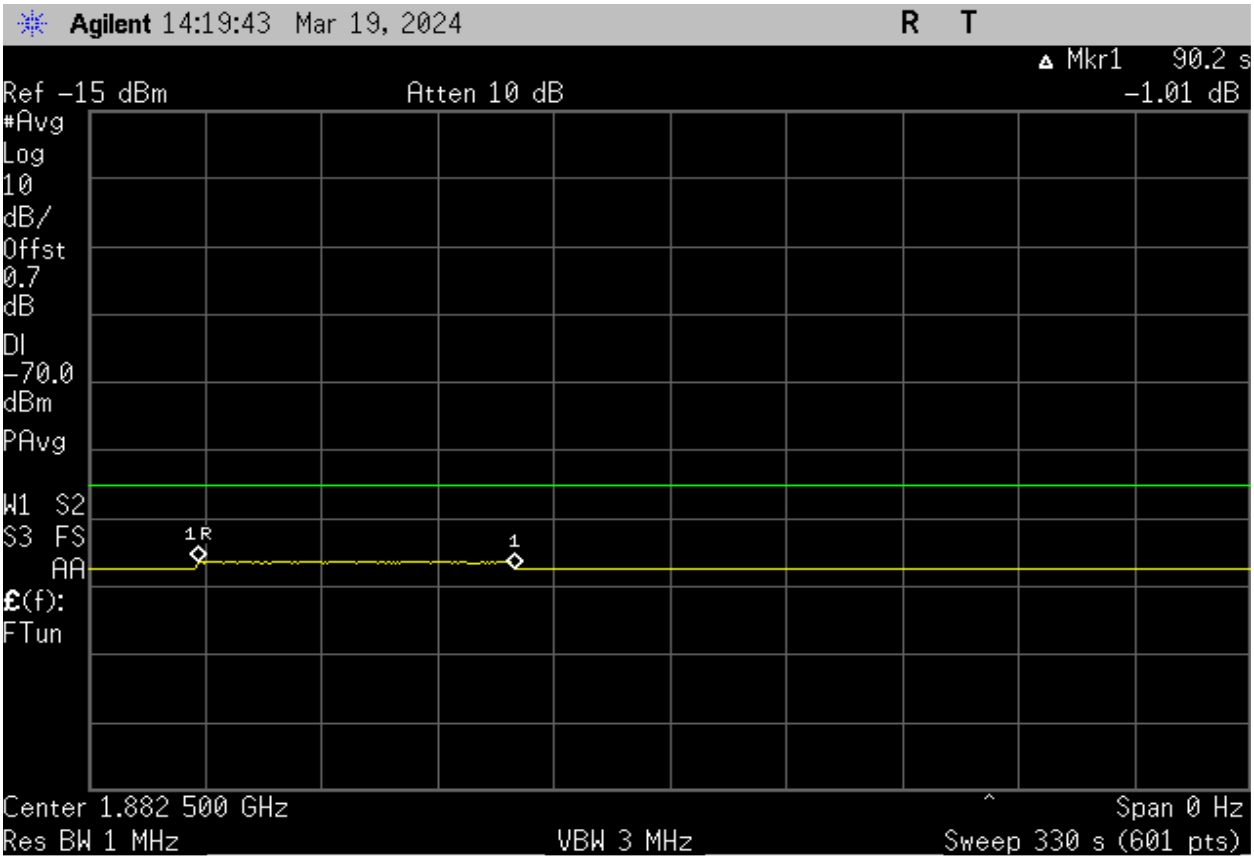
Plot 134 – 776-787MHz Band – Uplink Inactivity



Plot 135 – 824-849MHz Band – Uplink Inactivity



Plot 136 – 1710-1755MHz Band – Uplink Inactivity



Plot 137 – 1850-1915MHz Band – Uplink Inactivity

8. Variable Booster Gain

Test Requirement(s):	§20.21(e)(8)(i)(c)(1) and RSS-131 §6.1.2& 7.2	Test Engineer(s):	Sean Eggleston
Test Results:	Pass	Test Date(s):	May 20, 2024

Test Procedures: As required by 47 §20.21(e)(8)(i)(c)(1) and RSS-131 §6.1.2 & 7.2, 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) for consumer booster Fixed devices shall not exceed -34dB – RSSI + MSCL.

Test Setup:

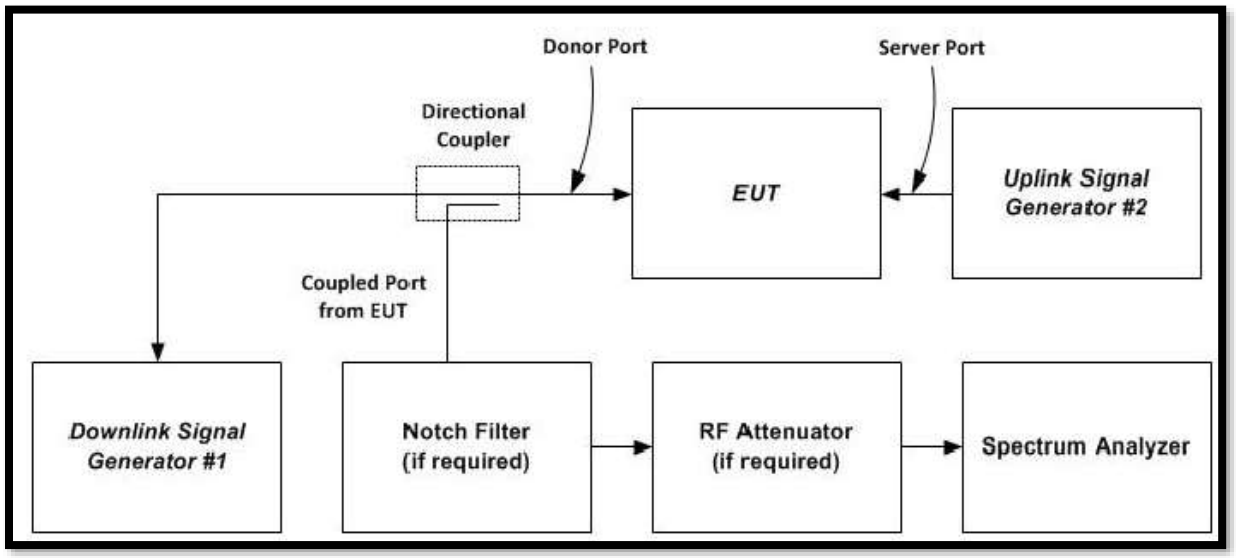


Figure 5 – Variable Gain

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

Table 28 – Analyzer Settings

Statement: Device when operating in shutoff mode it complies with uplink and downlink gain limits of transmit power off mode.

Note: All bands were tested with an MSCL value of 3 dBm.

RSSI (dBm)	Gain Limit (dBm)	P(in) (dBm)	P(out) dBm	Gain (dB)	Margin (dB)
-20	3	4.5	-6.21	-10.71	-13.71
-37	7	4.5	8.84	4.34	-2.66
-41	11	4.5	13.18	8.68	-2.32
-42	12	4.5	9.64	5.14	-6.86
-47	15	4.5	18.5	14.0	-1.0
-50	15	4.5	19.02	14.52	-0.48

Table 22 – 698-716MHz Band – Uplink Data

RSSI (dBm)	Gain Limit (dBm)	P(in) (dBm)	P(out) dBm	Gain (dB)	Margin (dB)
-20	3	4.4	-8.21	-12.61	-15.61
-36	6	4.4	8.55	4.15	-1.85
-38	8	4.4	10.95	6.55	-1.45
-41	11	4.4	13.94	9.54	-1.46
-46	15	4.4	18.88	14.48	-0.52
-50	15	4.4	19.29	14.89	-0.11

Table 23 – 776-787MHz Band – Uplink Data

RSSI (dBm)	Gain Limit (dBm)	P(in) (dBm)	P(out) dBm	Gain (dB)	Margin (dB)
-20	3	4.4	-8.45	-12.85	-15.85
-44	14	4.4	14.2	9.8	-4.2
-47	15	4.4	17.32	12.92	-2.08
-48	15	4.4	18.34	13.94	-1.06
-49	15	4.4	18.84	14.44	-0.56
-50	15	4.4	19.37	14.97	-0.03

Table 24 – 824-849MHz Band – Uplink Data

RSSI (dBm)	Gain Limit (dBm)	P(in) (dBm)	P(out) dBm	Gain (dB)	Margin (dB)
-20	3	4.6	-7.72	-12.32	-15.32
-40	10	4.6	9.07	4.47	-5.53
-44	14	4.6	13.99	9.39	-4.61
-47	15	4.6	17.97	13.37	-1.63
-48	15	4.6	18.51	13.91	-1.09
-50	15	4.6	19.44	14.84	-0.16

Table 25 – 1710-1755MHz Band – Uplink Data

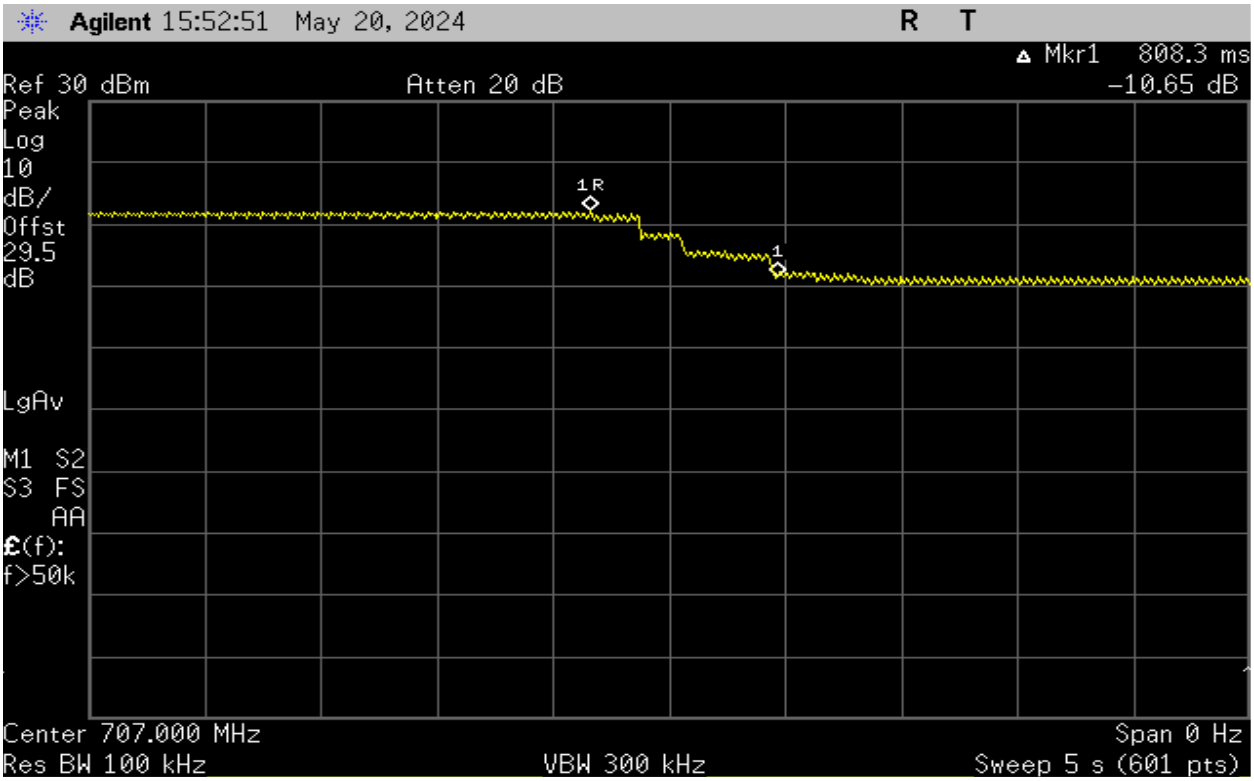
RSSI (dBm)	Gain Limit (dBm)	P(in) (dBm)	P(out) dBm	Gain (dB)	Margin (dB)
-20	3	4.5	-10.49	-14.99	-17.99
-42	12	4.5	12.25	7.75	-4.25
-45	15	4.5	15.63	11.13	-3.87
-46	15	4.5	17.06	12.56	-2.44
-47	15	4.5	18.02	13.52	-1.48
-50	15	4.5	19.12	14.62	-0.38

Table 26 – 1850-1915MHz Band – Uplink Data

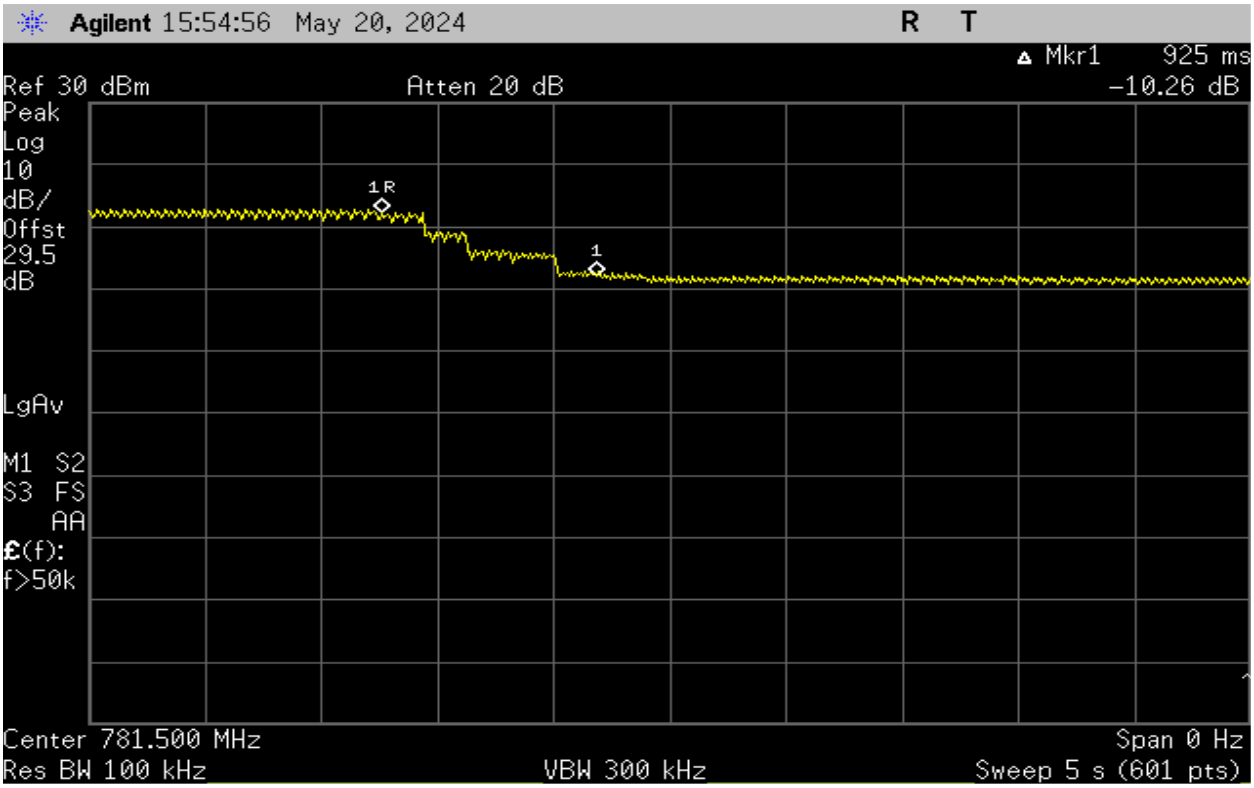
Frequency Band (MHz)	Measured Timing (Seconds)	Limit (Seconds)	Margin (Seconds)
698-716	0.808	1.0	-0.192
776-787	0.925	1.0	-0.075
824-849	0.666	1.0	-0.334
1710-1755	0.750	1.0	-0.250
1850-1915	0.791	1.0	-0.209

Table 27 – Variable Uplink Gain Timing - Summary Table

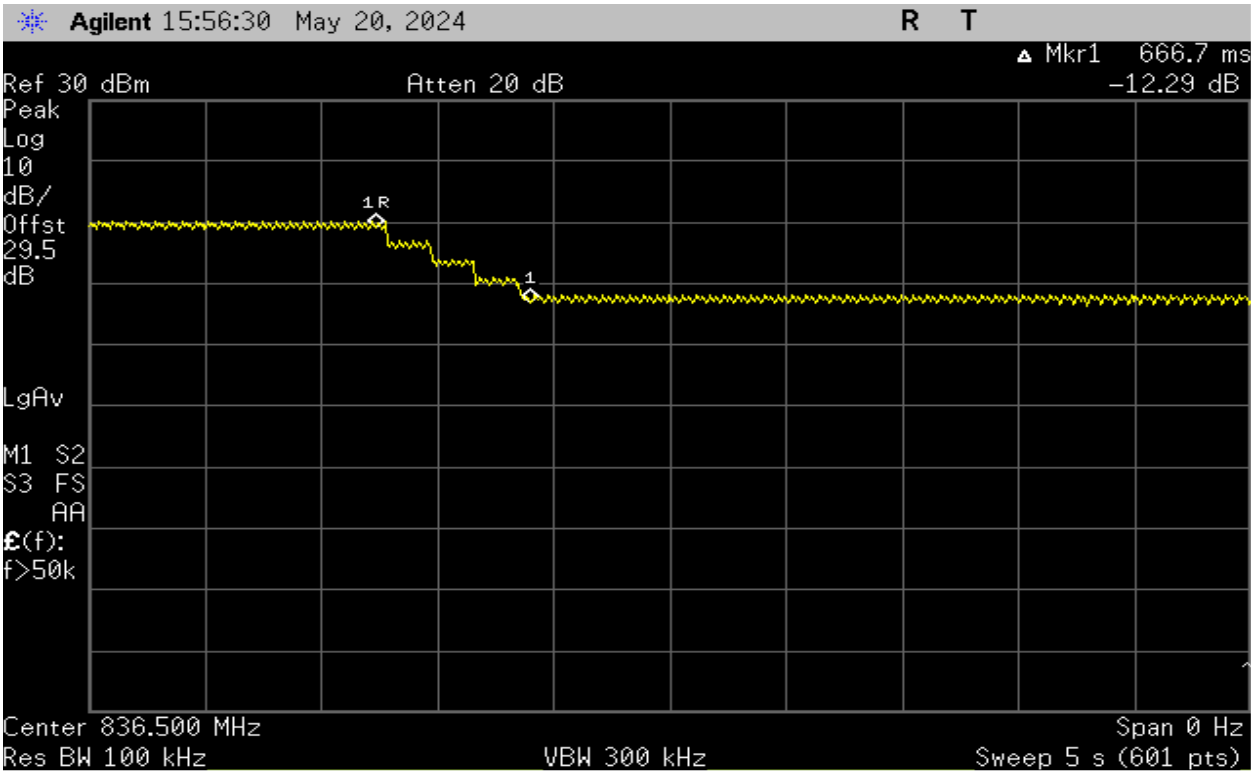
The following pages show measurements of Variable Booster Gain Timing plots:



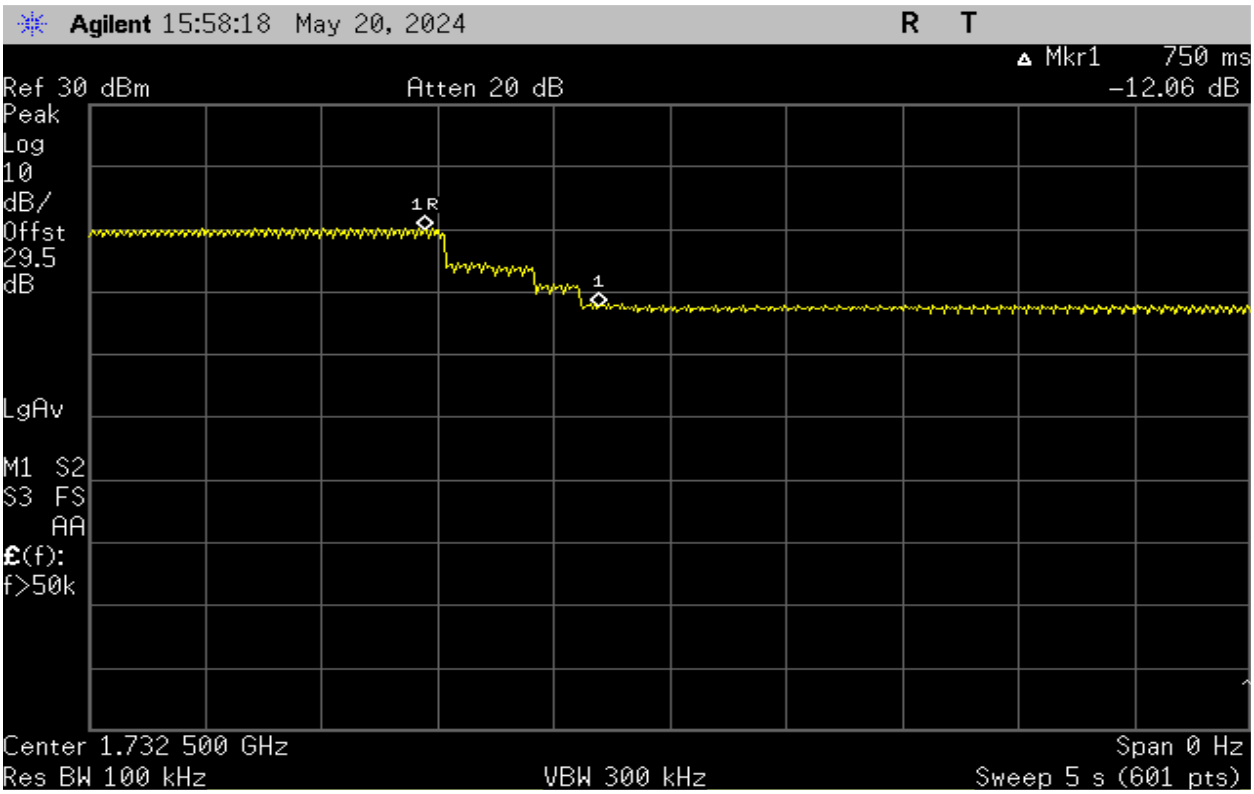
Plot 138 – 698-716MHz Band – Uplink Gain Timing



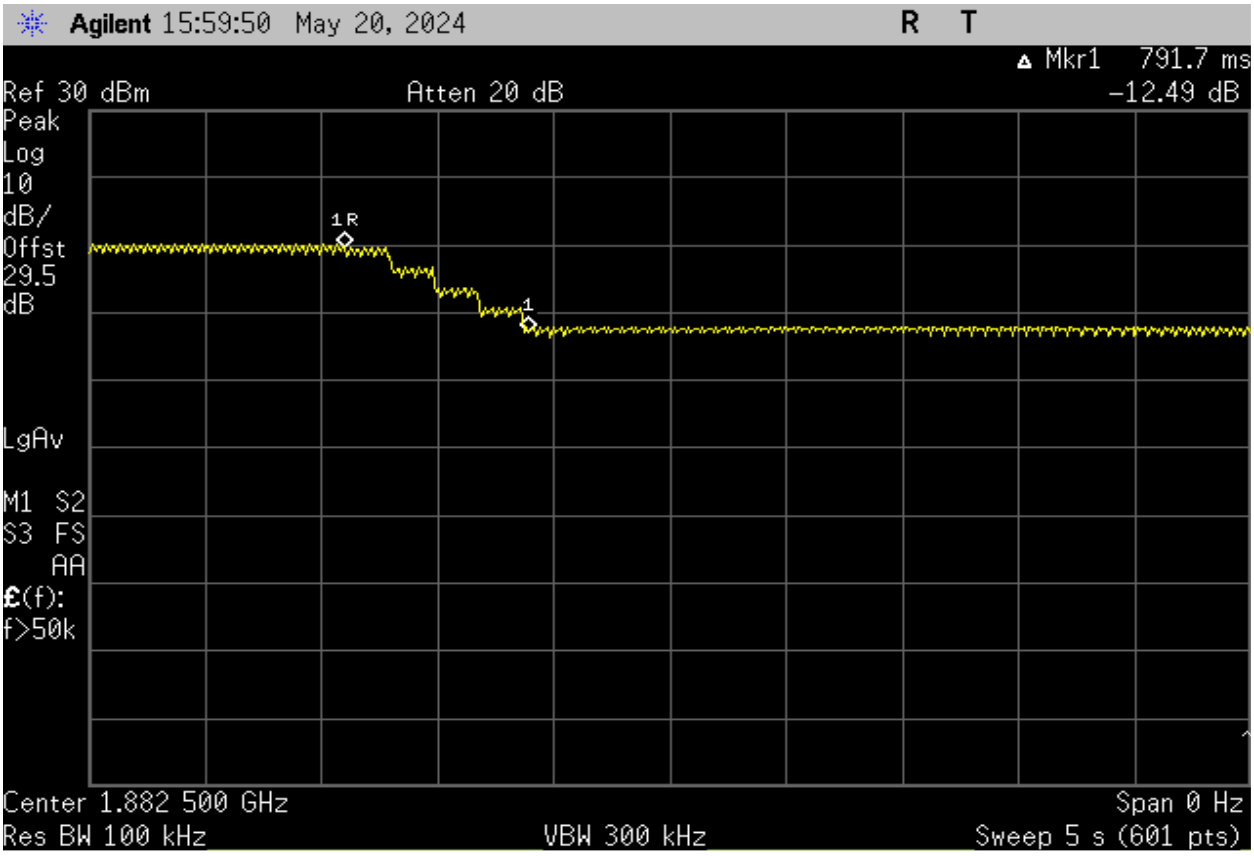
Plot 139 – 776-787MHz Band – Uplink Gain Timing



Plot 140 – 824-849MHz Band – Uplink Gain Timing



Plot 141 – 1710-1755MHz Band – Uplink Gain Timing



Plot 142 – 1850-1915MHz Band – Uplink Gain Timing

9. Occupied Bandwidth

Test Requirement(s):	§2.1049 and RSS-Gen §6.7	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	March 20-21, 2024

Test Procedures: As required by CFR47 §2.1049 and RSS-Gen §6.7, 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.

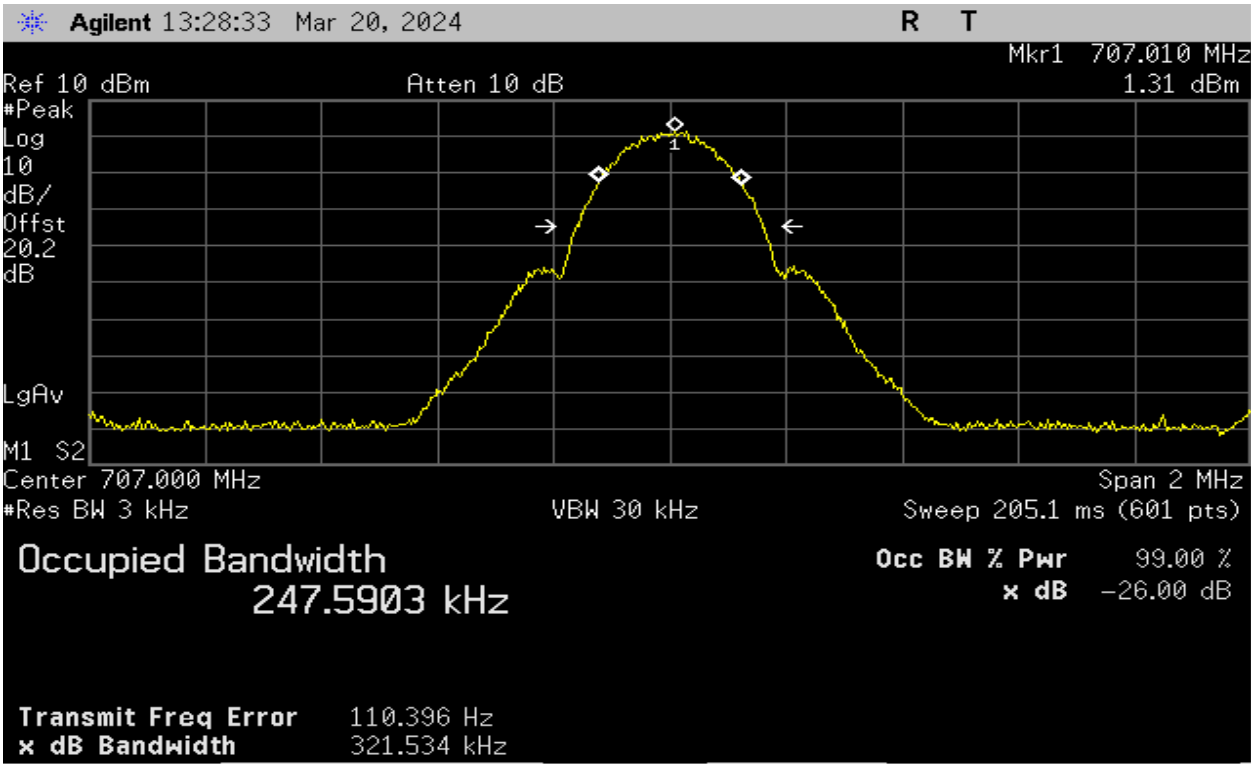
The following pages show measurements of Occupied Bandwidth plots:

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

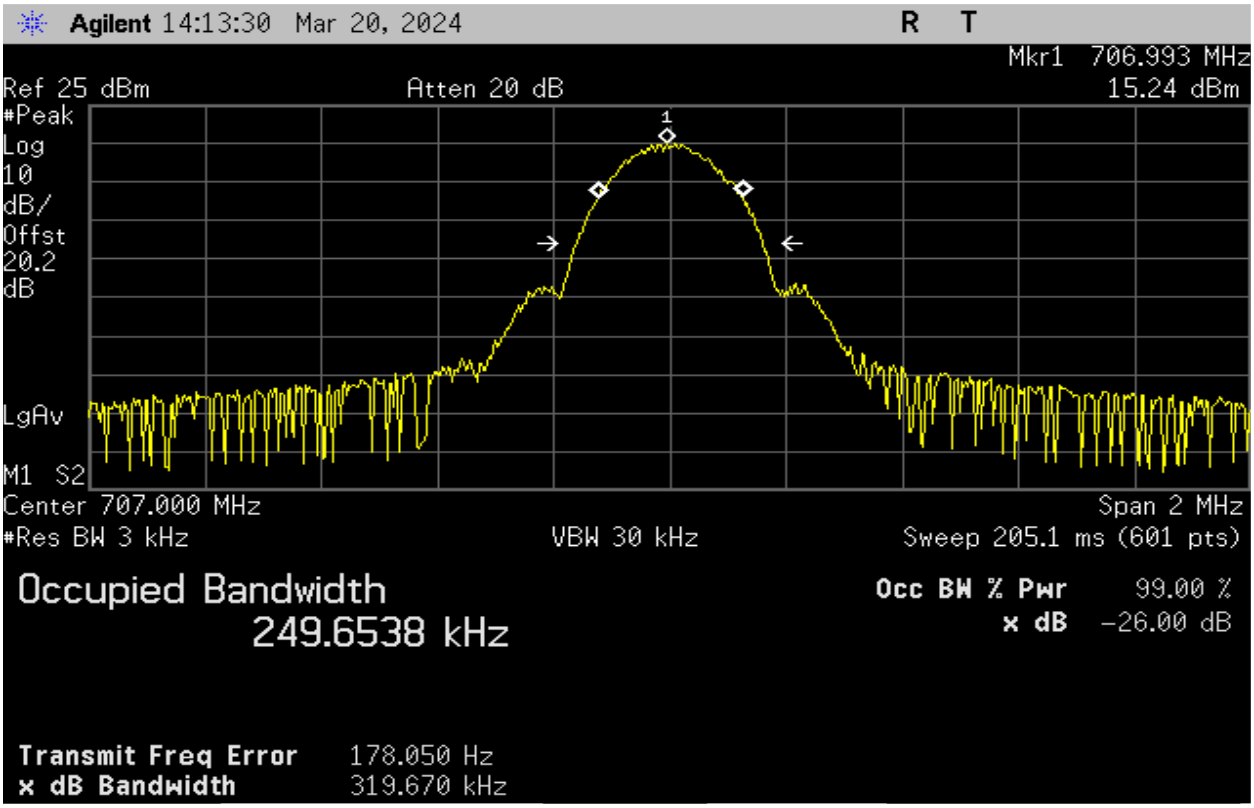
Table 28 – Analyzer Settings

Test Setup:

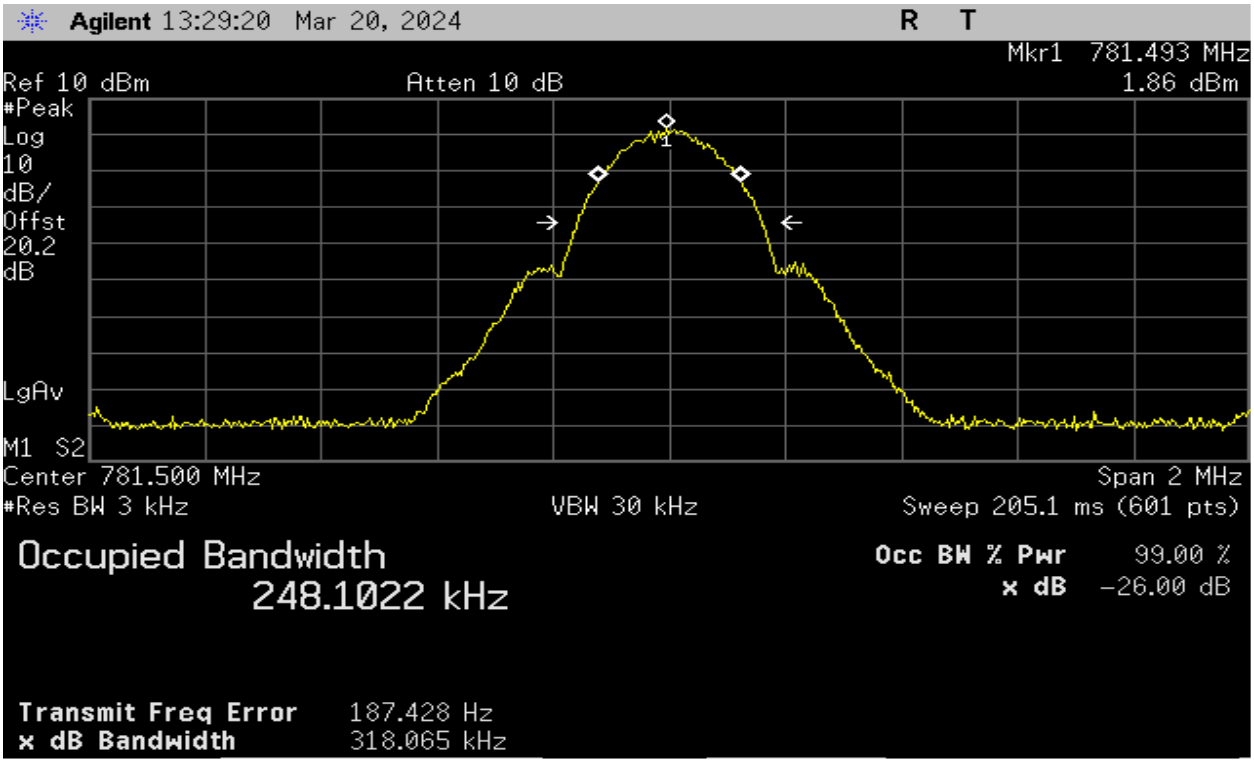
Figure 6 – Characteristics of test signals used for subsequent EUT



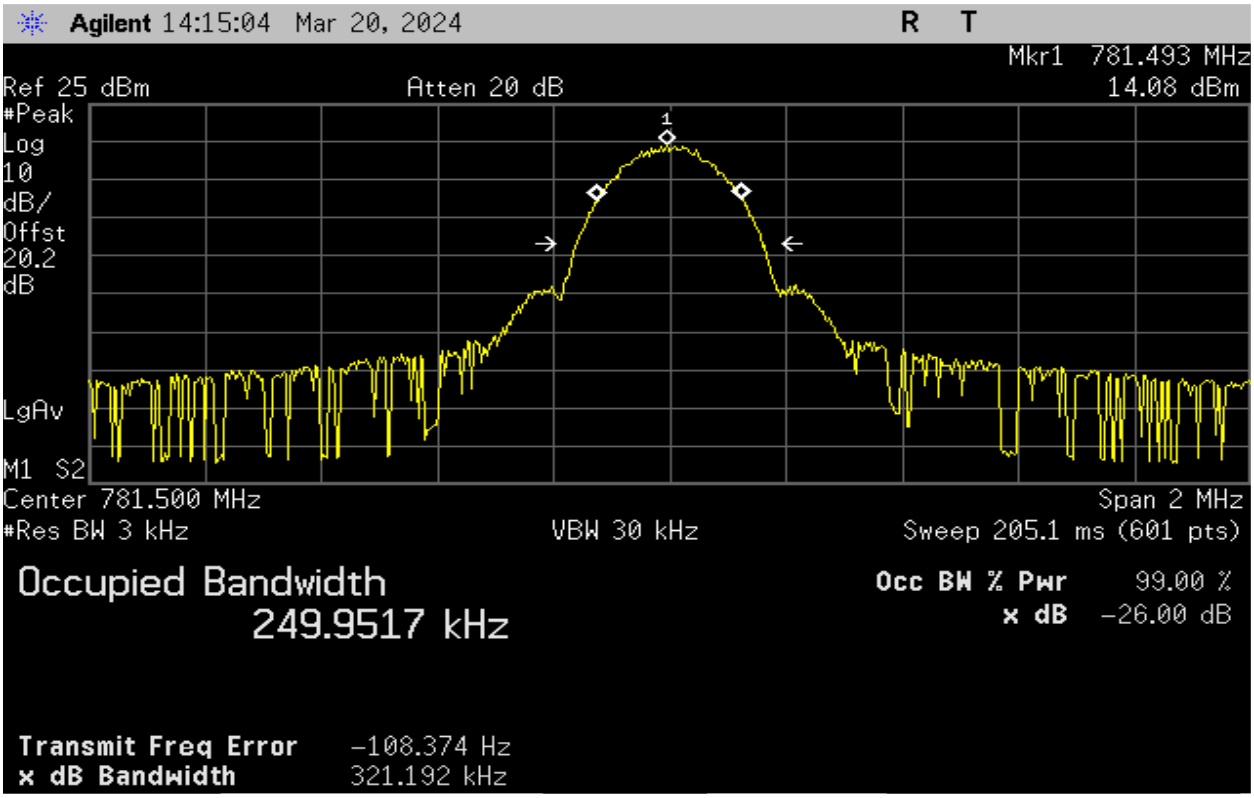
Plot 143 – 698-716MHz Band – Uplink Input – GSM



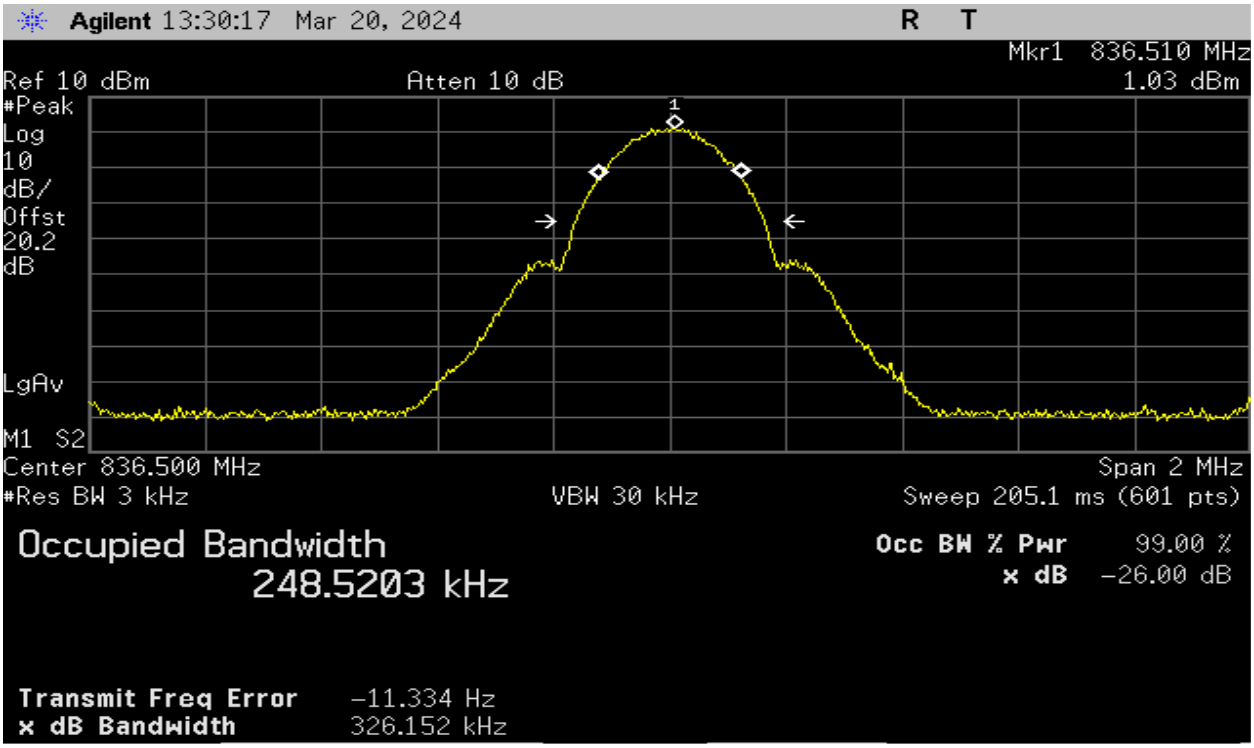
Plot 144 – 698-716MHz Band – Uplink Output – GSM



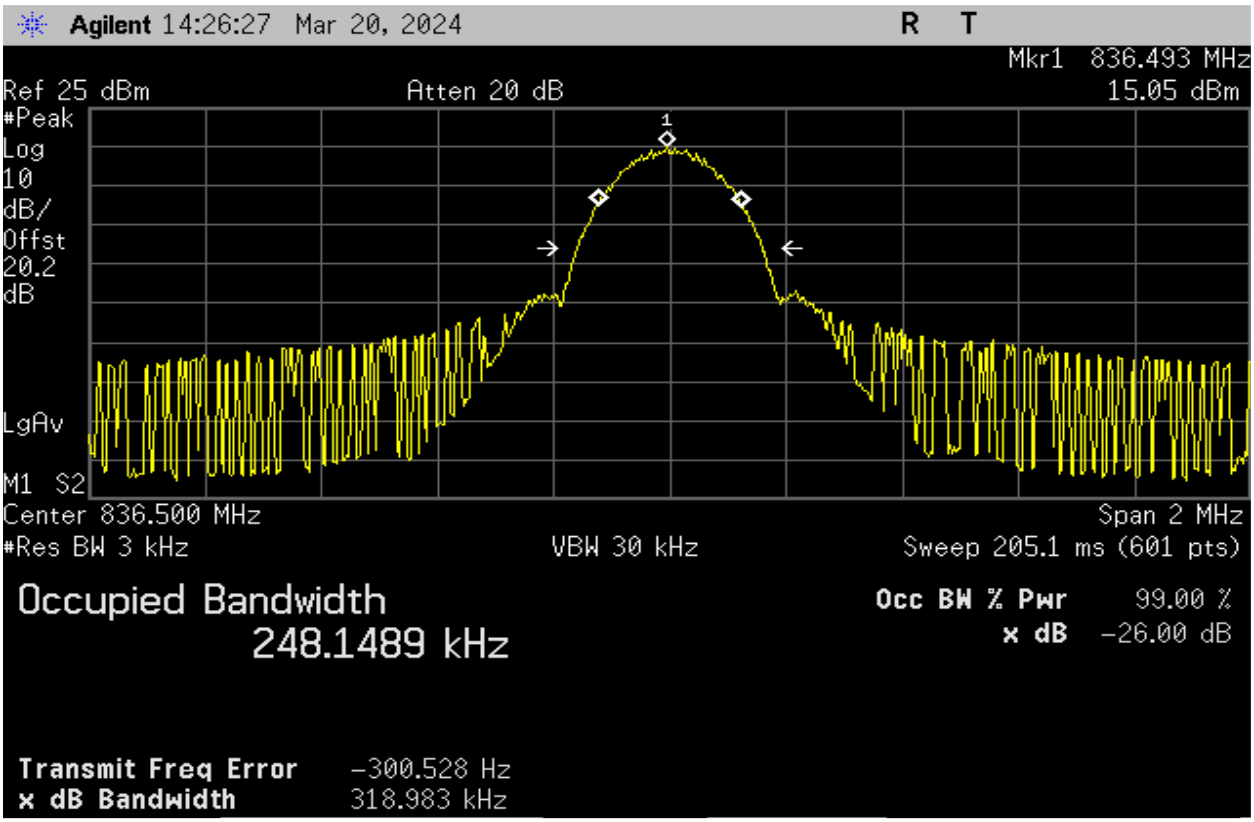
Plot 145 – 776-787MHz Band – Uplink Input – GSM



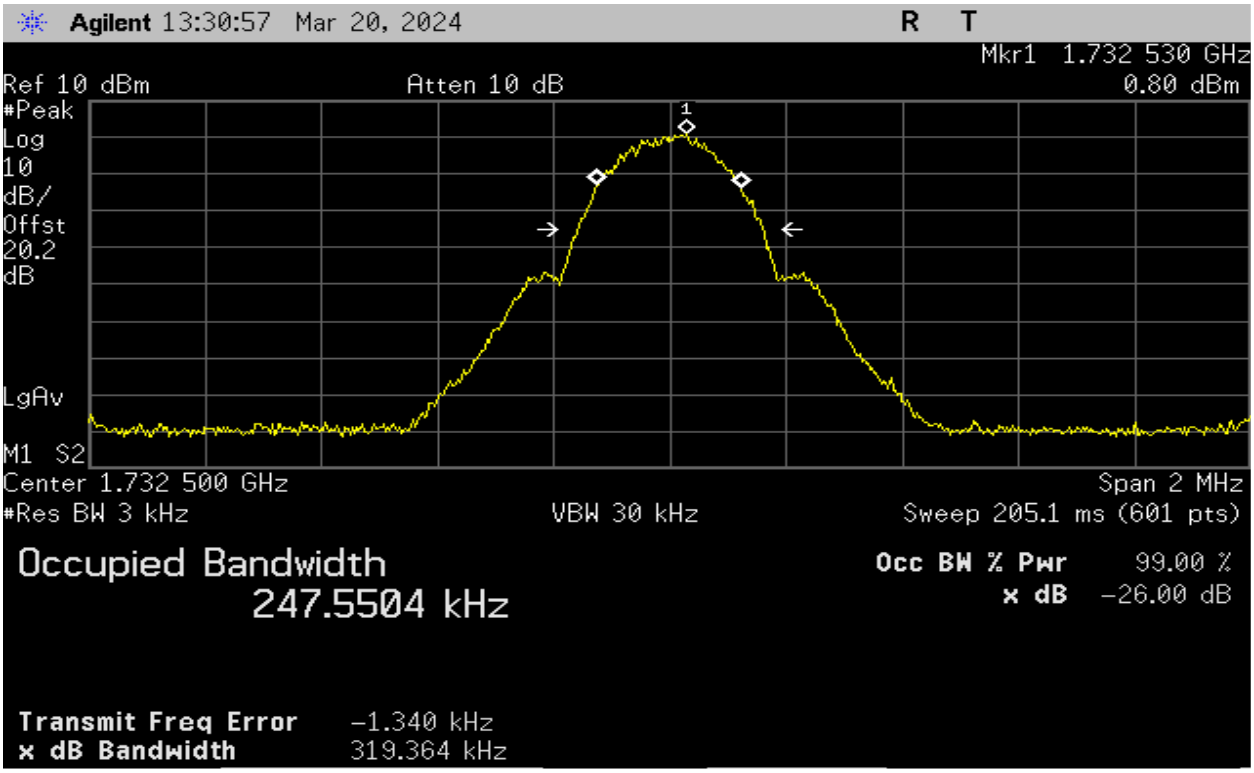
Plot 146 – 776-787MHz Band – Uplink Output – GSM



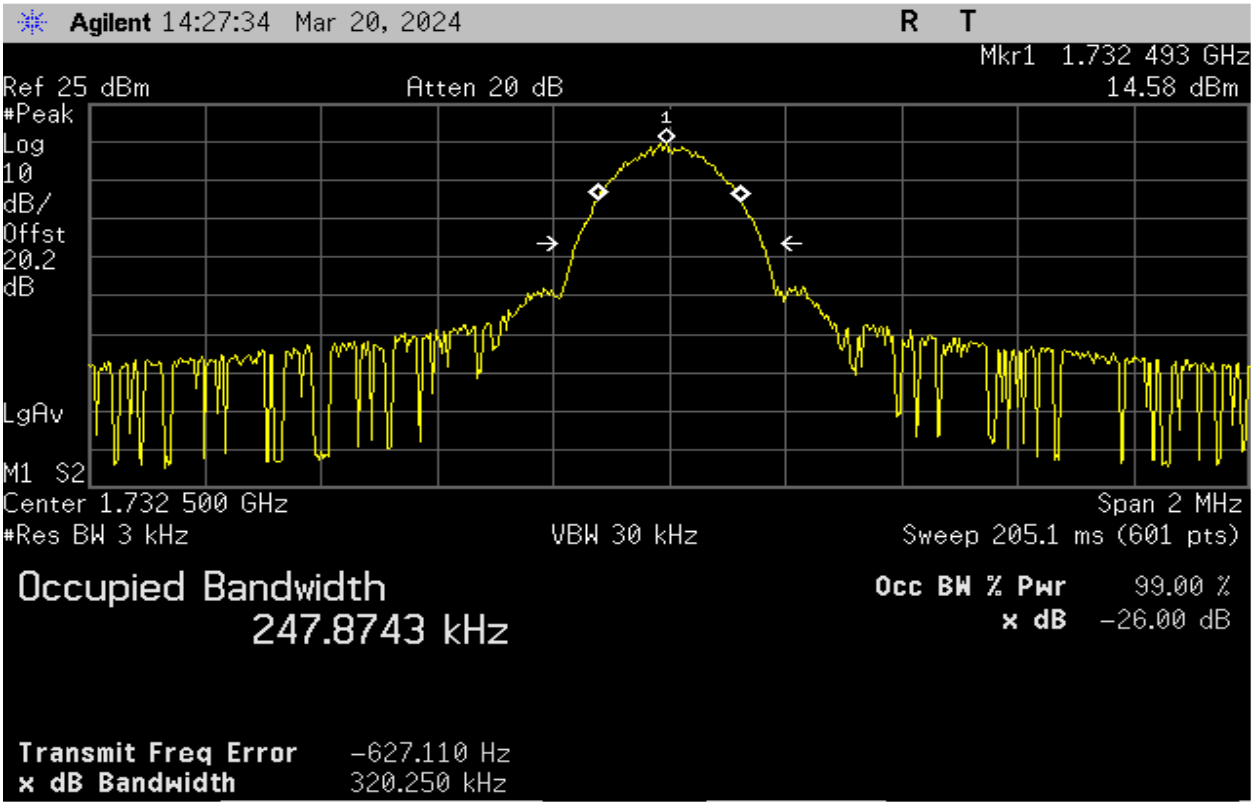
Plot 147 – 824-849MHz Band – Uplink Input – GSM



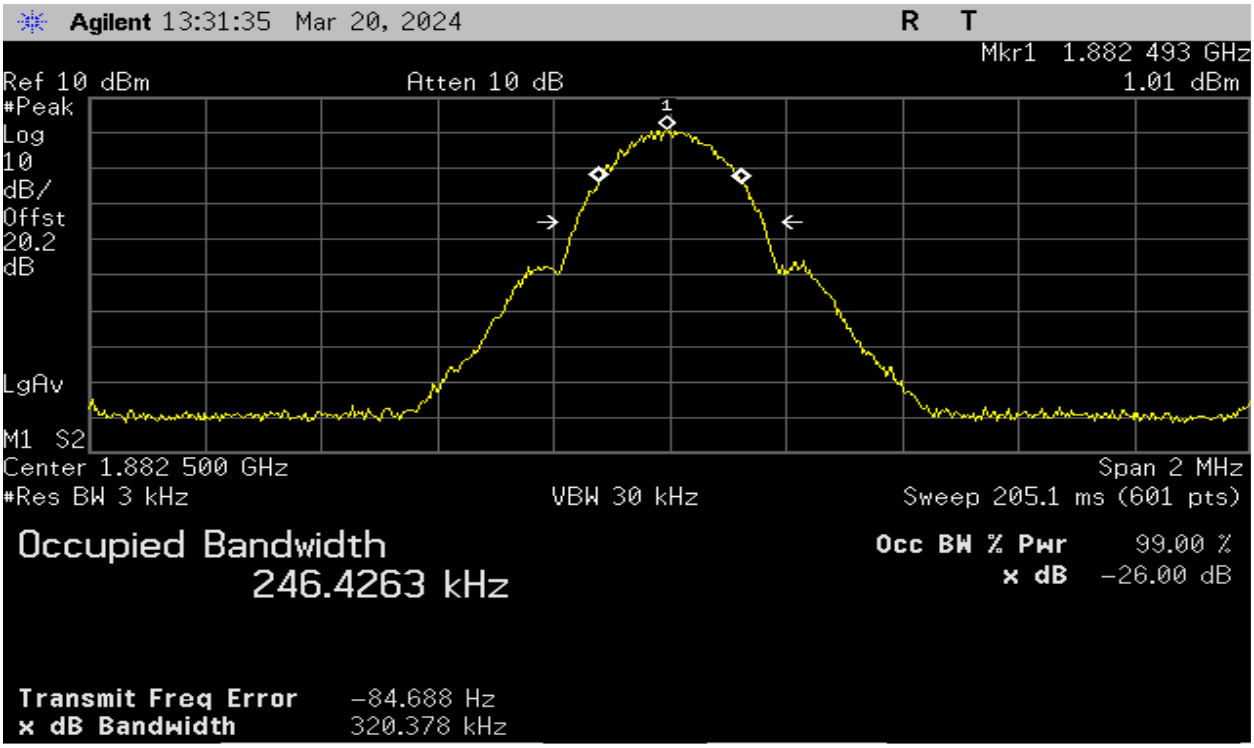
Plot 148 – 824-849MHz Band – Uplink Output – GSM



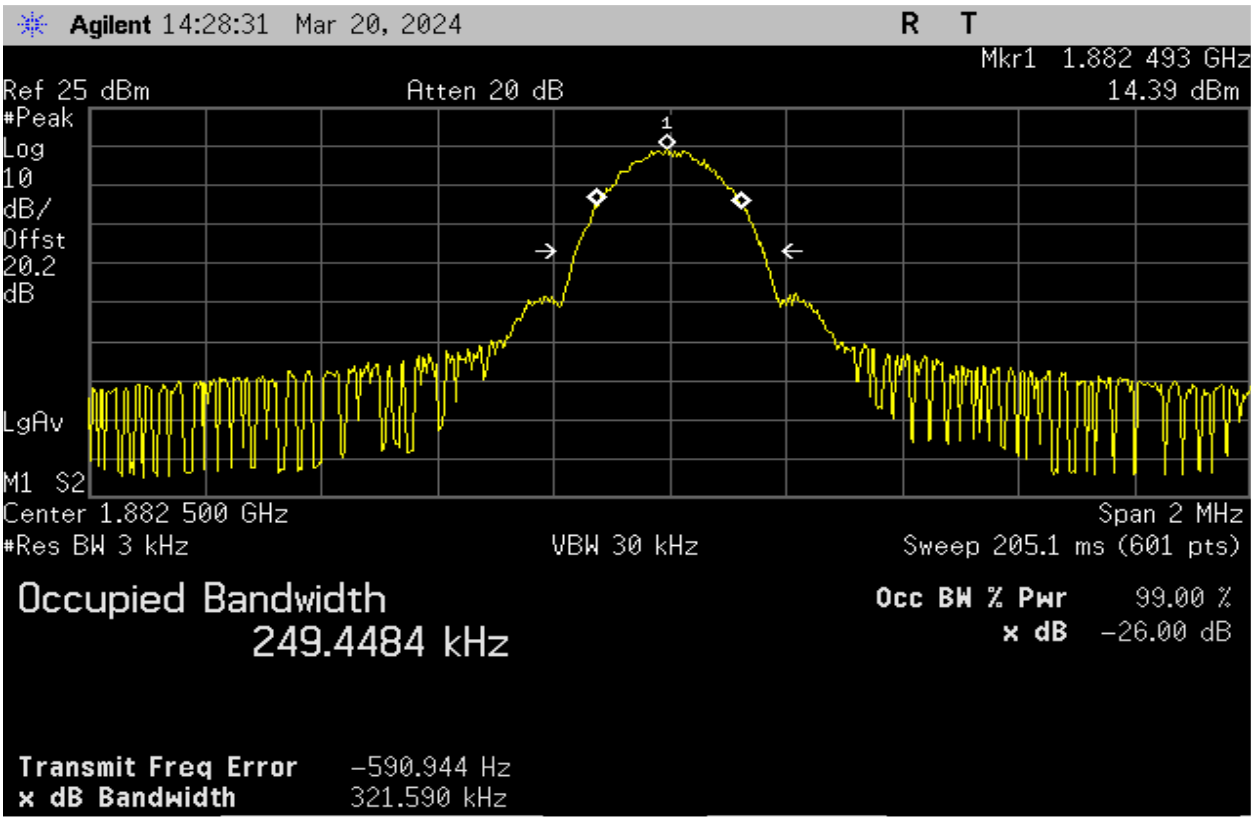
Plot 149 – 1710-1755MHz Band – Uplink Input – GSM



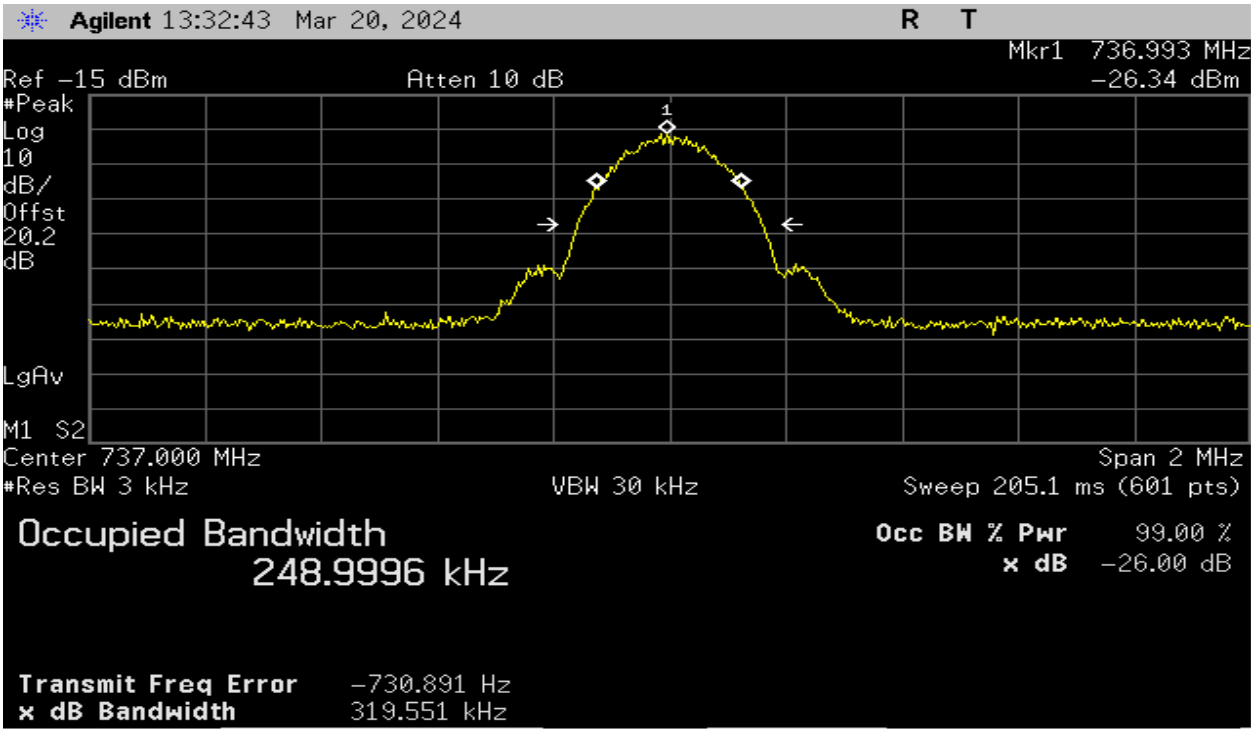
Plot 150 – 1710-1755MHz Band – Uplink Output – GSM



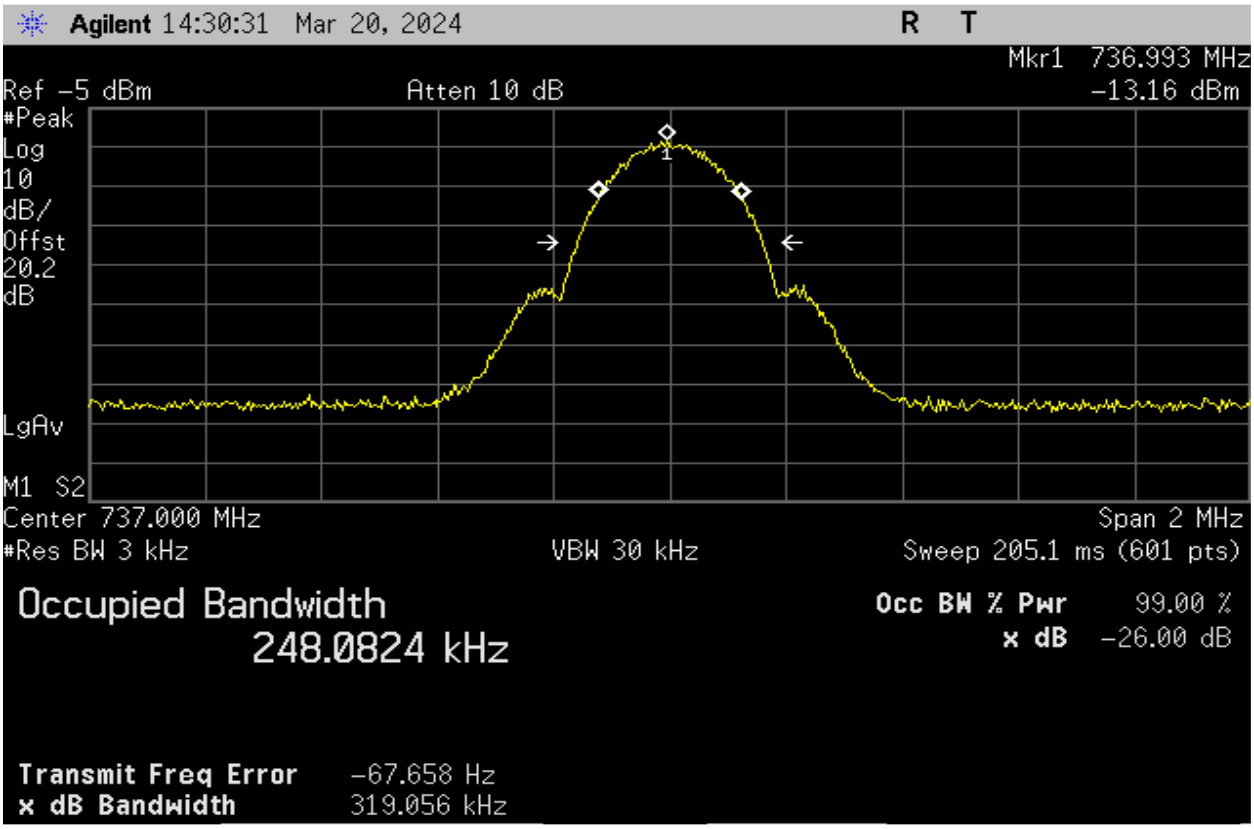
Plot 151 – 1850-1915MHz Band – Uplink Input – GSM



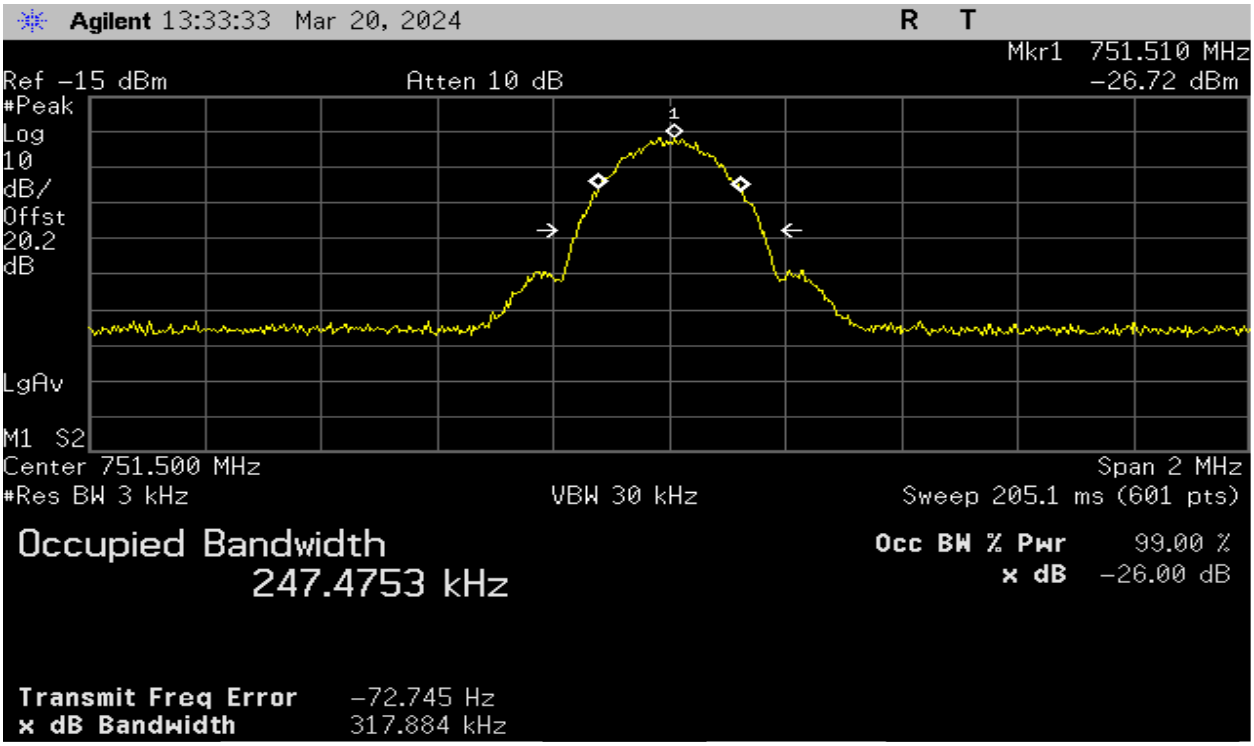
Plot 152 – 1850-1915MHz Band – Uplink Output – GSM



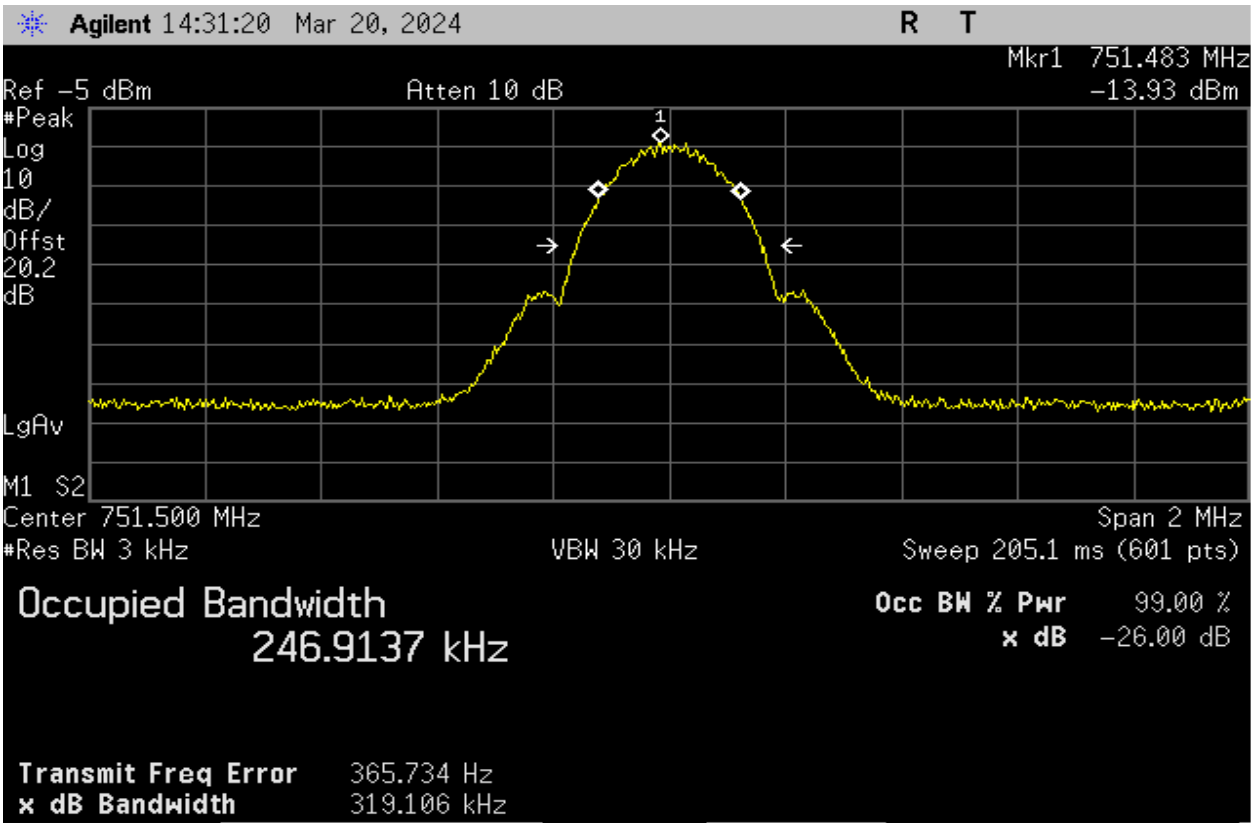
Plot 153 – 728-746MHz Band – Downlink Input – GSM



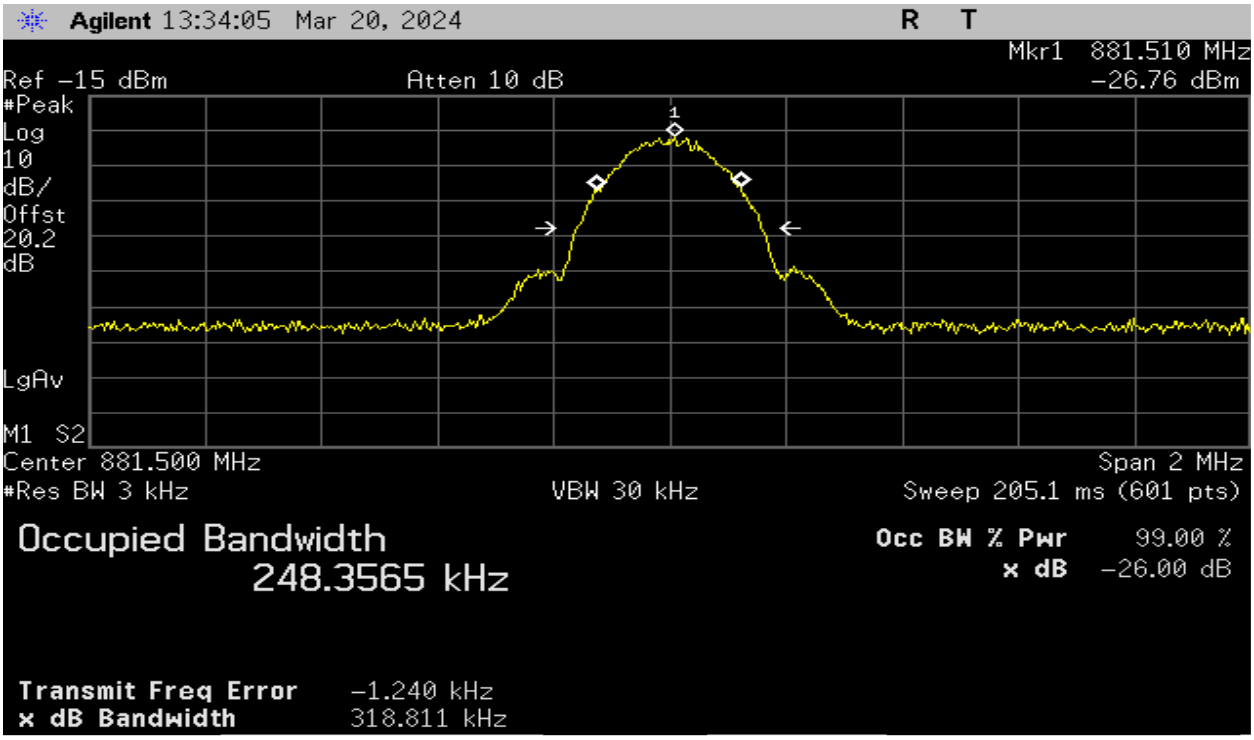
Plot 154 – 728-746MHz Band – Downlink Output – GSM



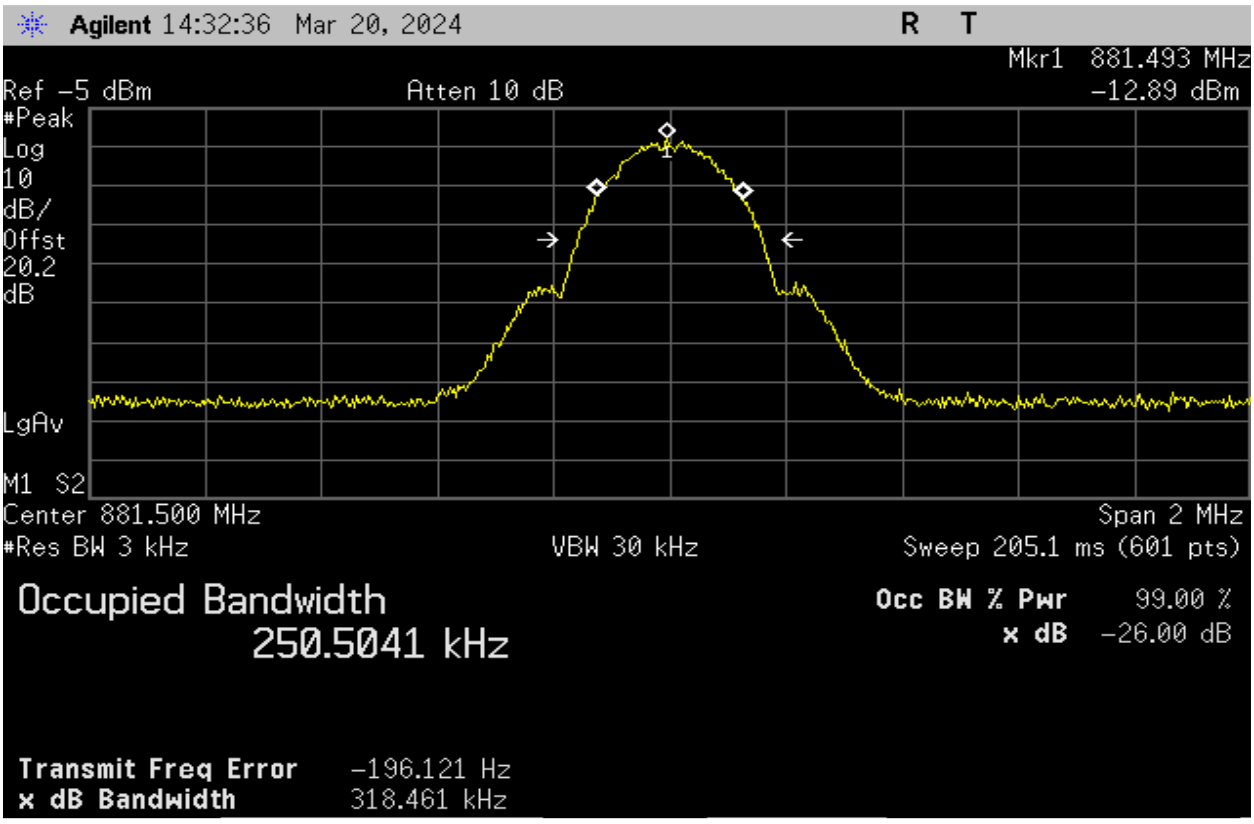
Plot 155 – 746-757MHz Band – Downlink Input – GSM



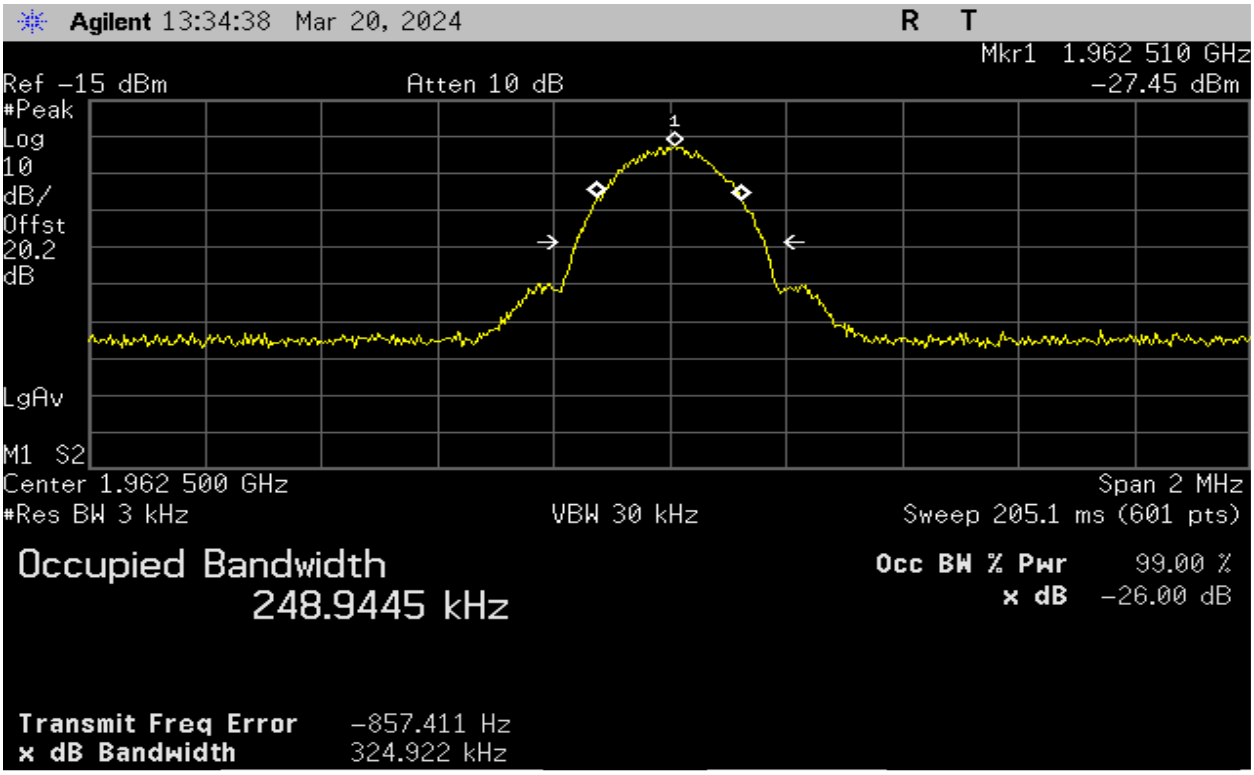
Plot 156 – 746-757MHz Band – Downlink Output – GSM



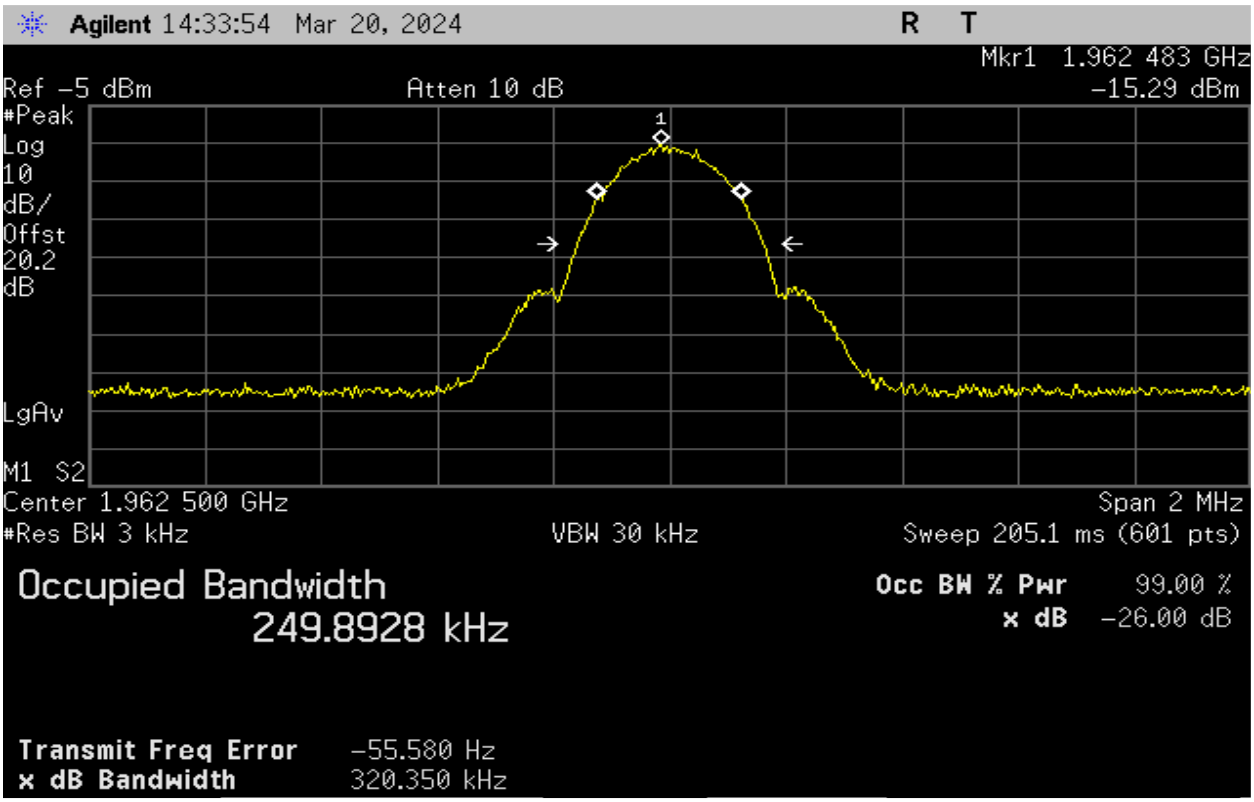
Plot 157 – 869-894MHz Band – Downlink Input – GSM



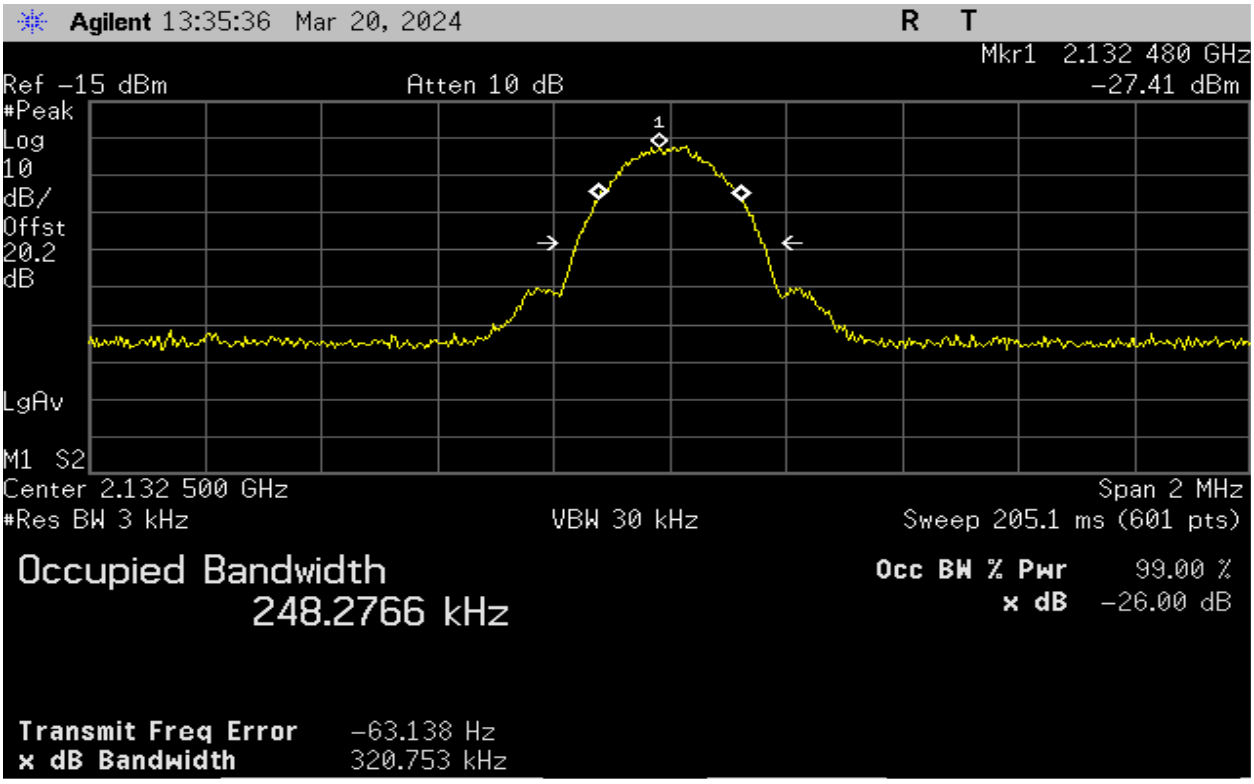
Plot 158 – 869-894MHz Band – Uplink Output – GSM



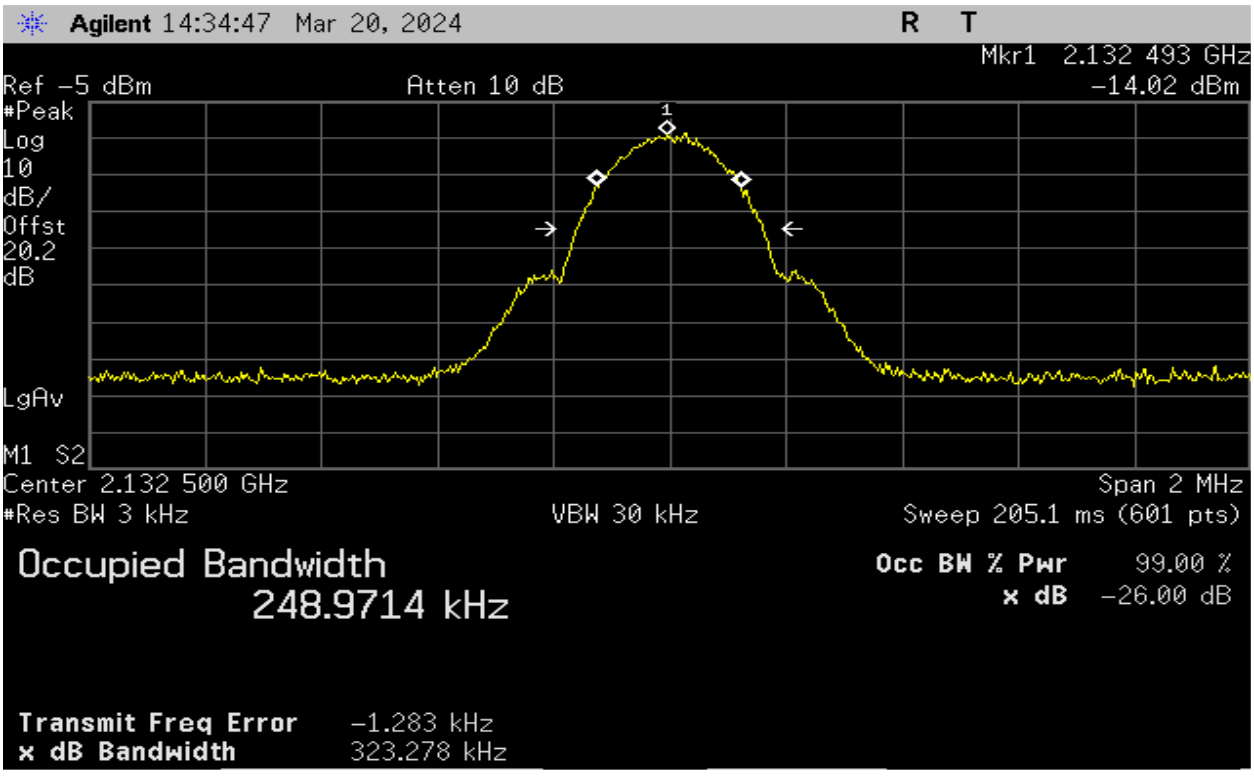
Plot 159 – 1930-1995MHz Band – Downlink Input – GSM



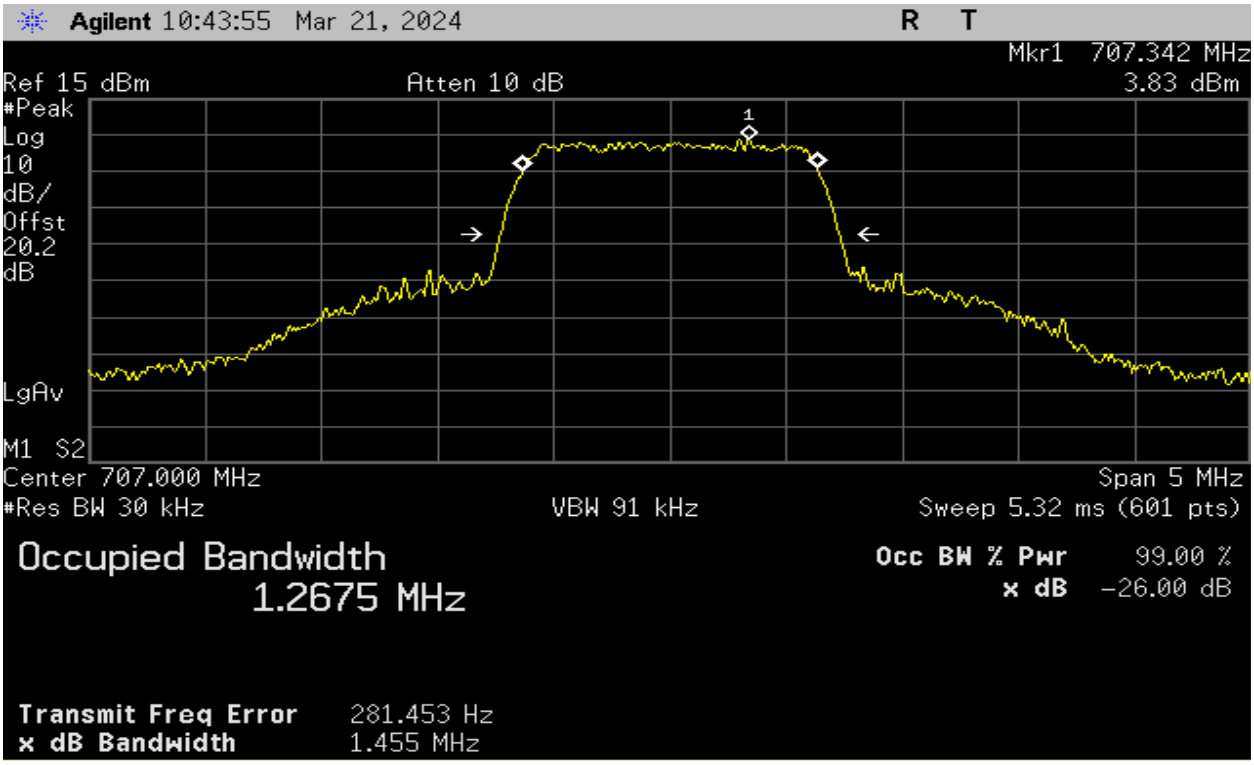
Plot 160 – 1930-1995MHz Band – Downlink Output – GSM



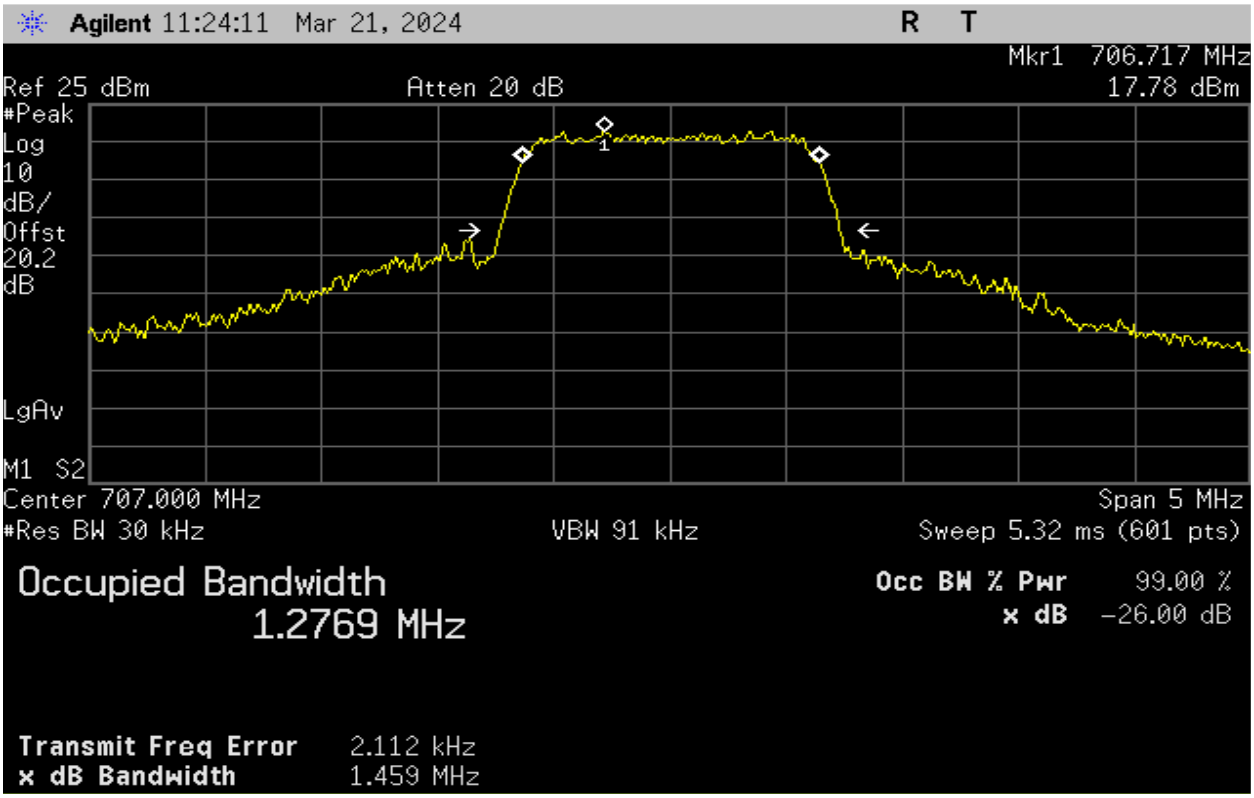
Plot 161 – 2110-2155MHz Band – Downlink Input – GSM



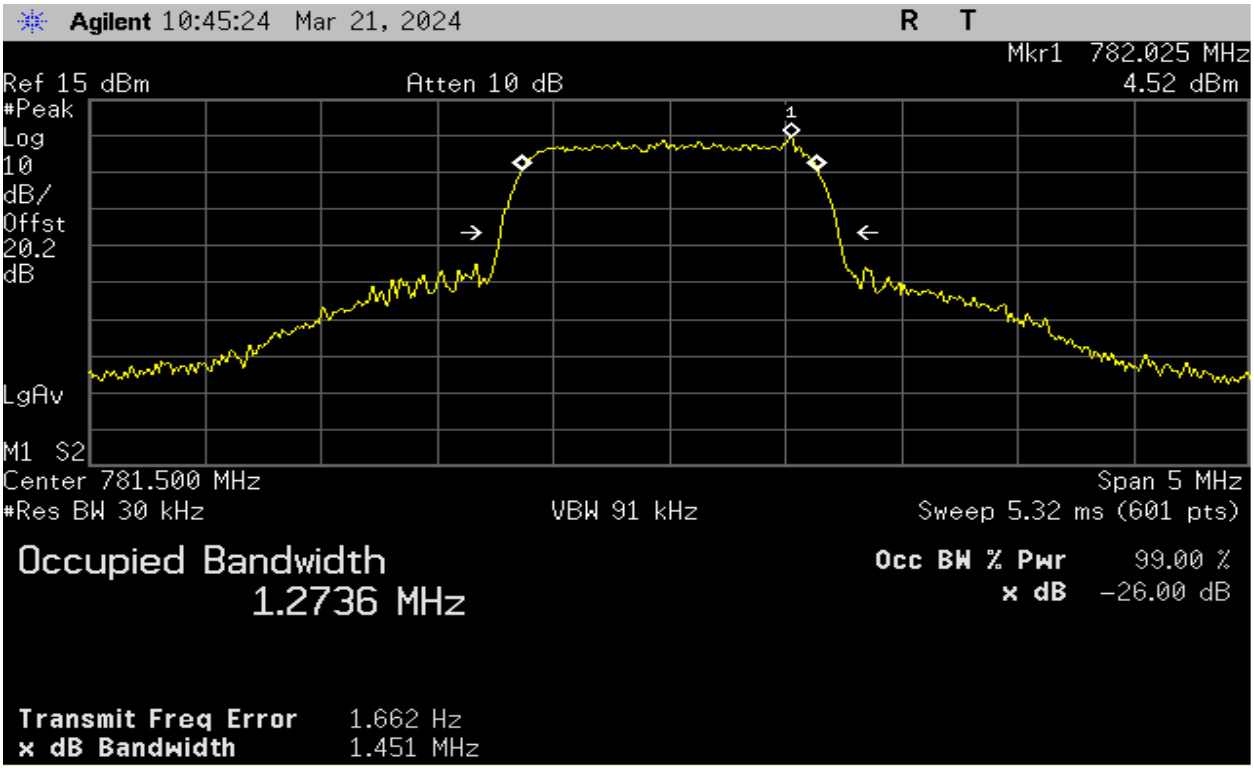
Plot 162 – 2110-2155MHz Band – Downlink Output – GSM



Plot 163 – 698-716MHz Band – Uplink Input – CDMA

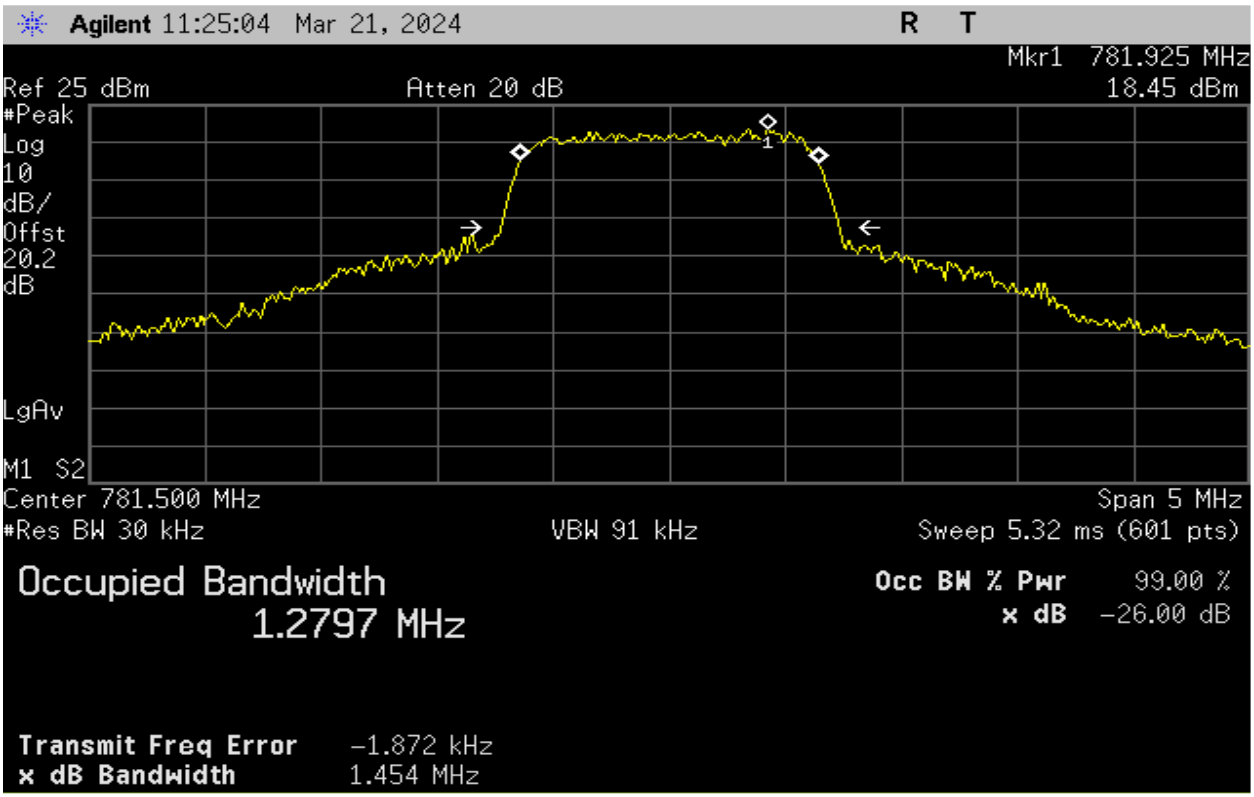


Plot 164 – 698-716MHz Band – Uplink Output – CDMA

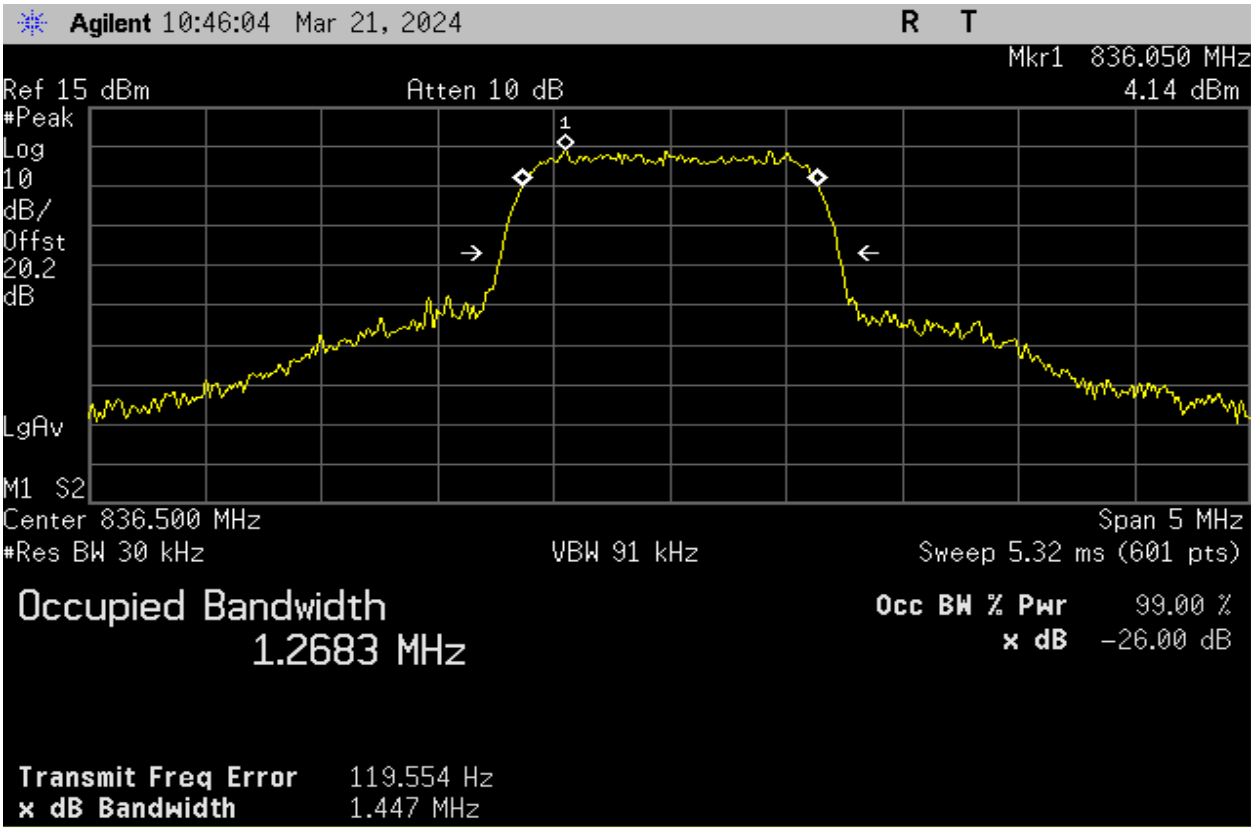


Plot 165 – 776-787MHz Band – Uplink Input – CDMA

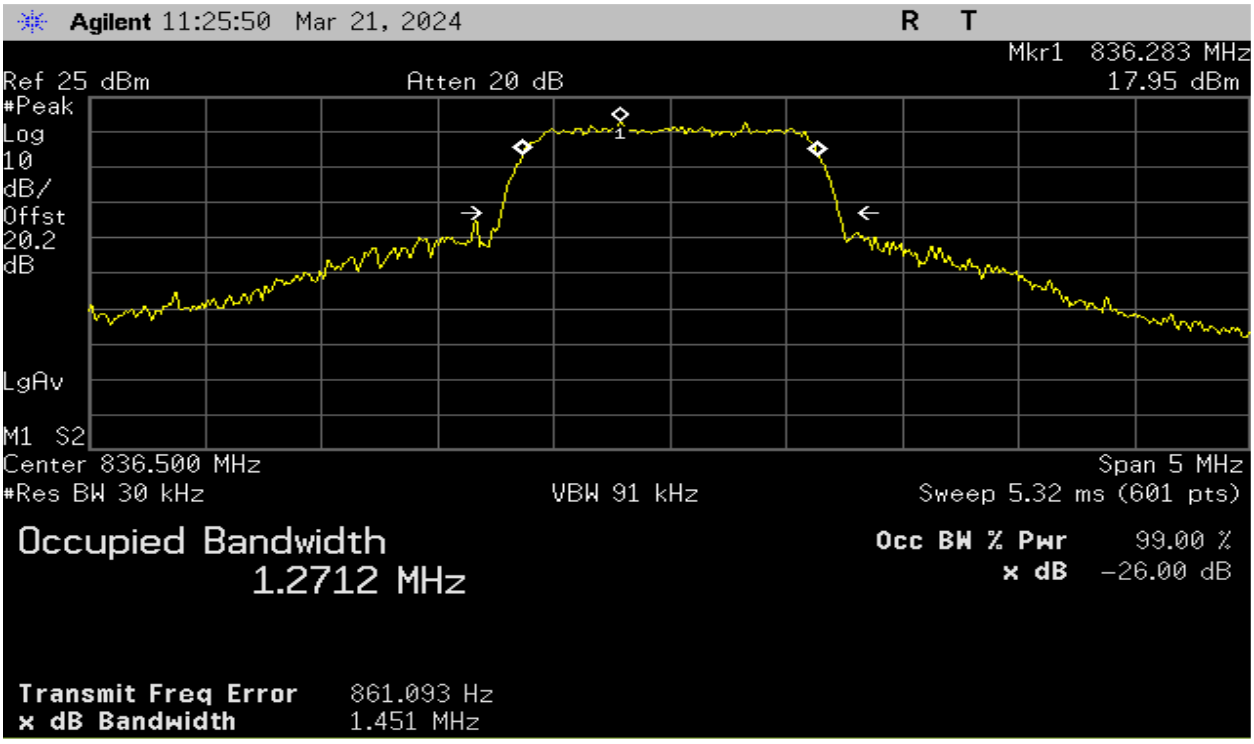
v



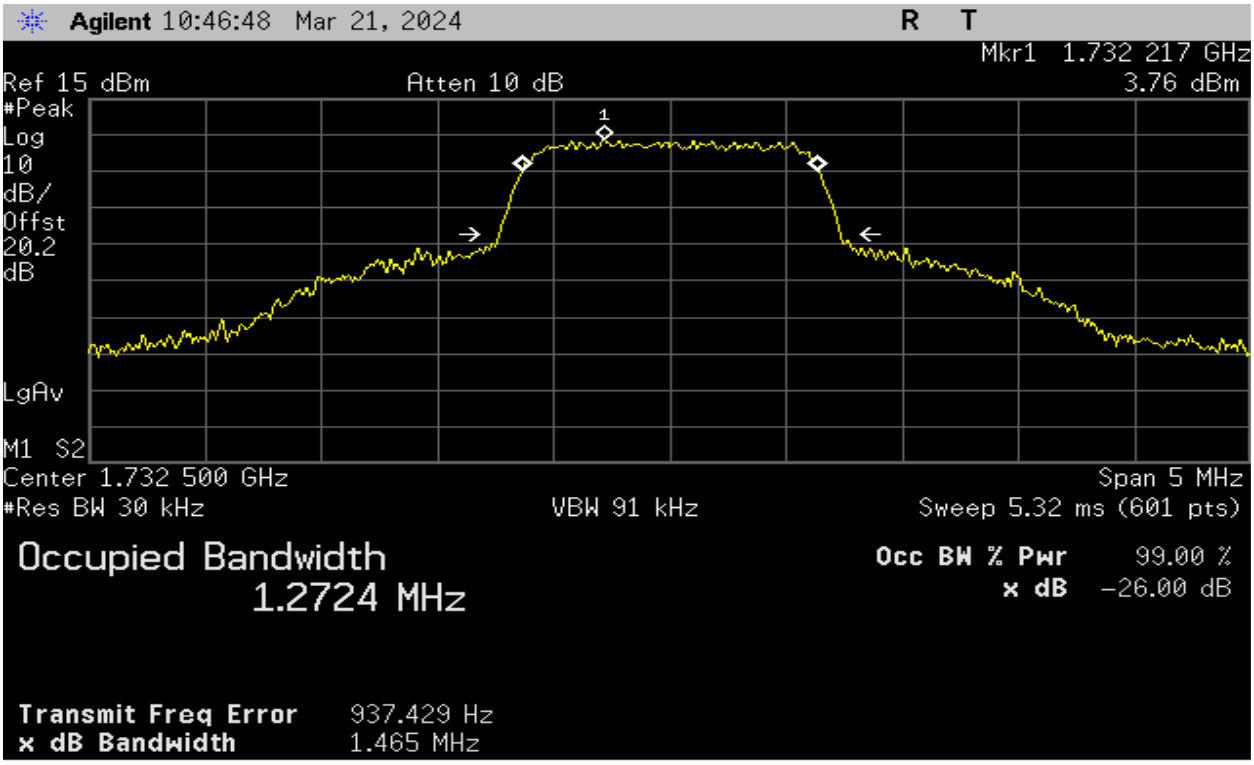
Plot 166 – 776-787MHz Band – Uplink Output – CDMA



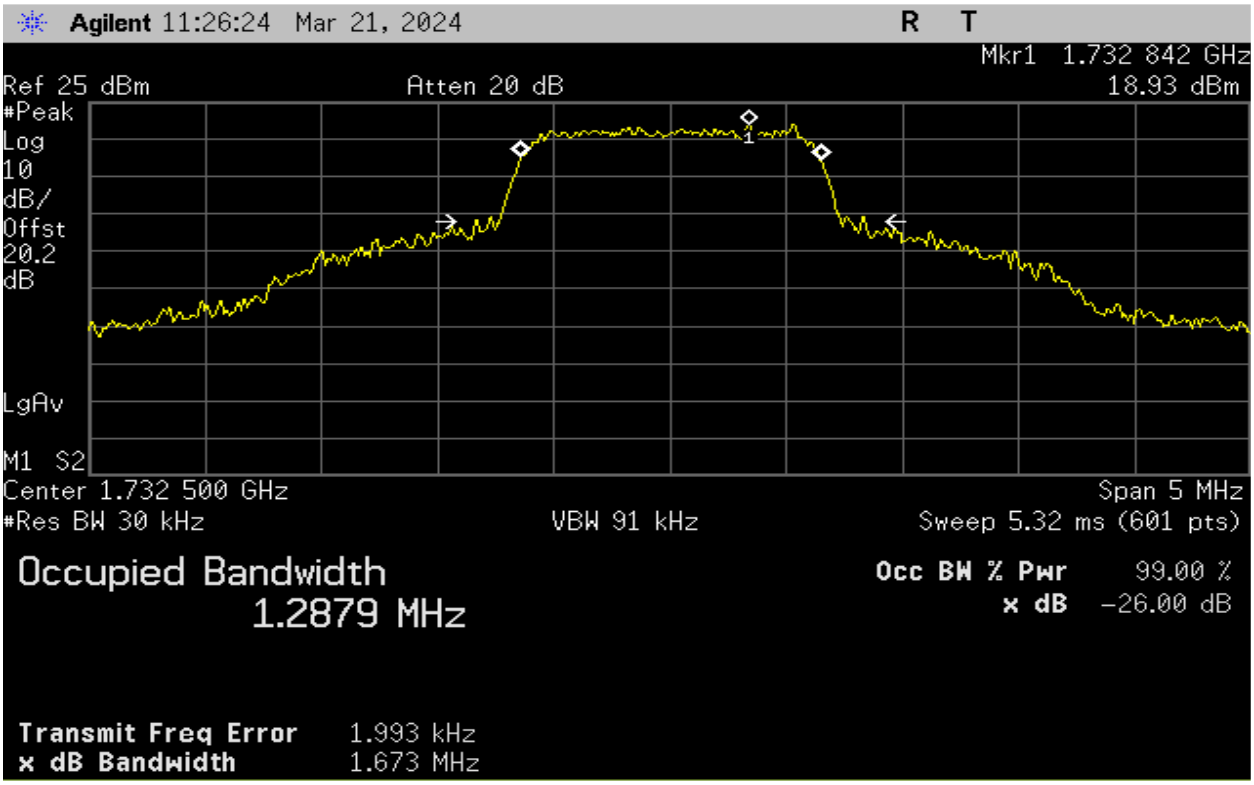
Plot 167 – 824-849MHz Band – Uplink Input – CDMA



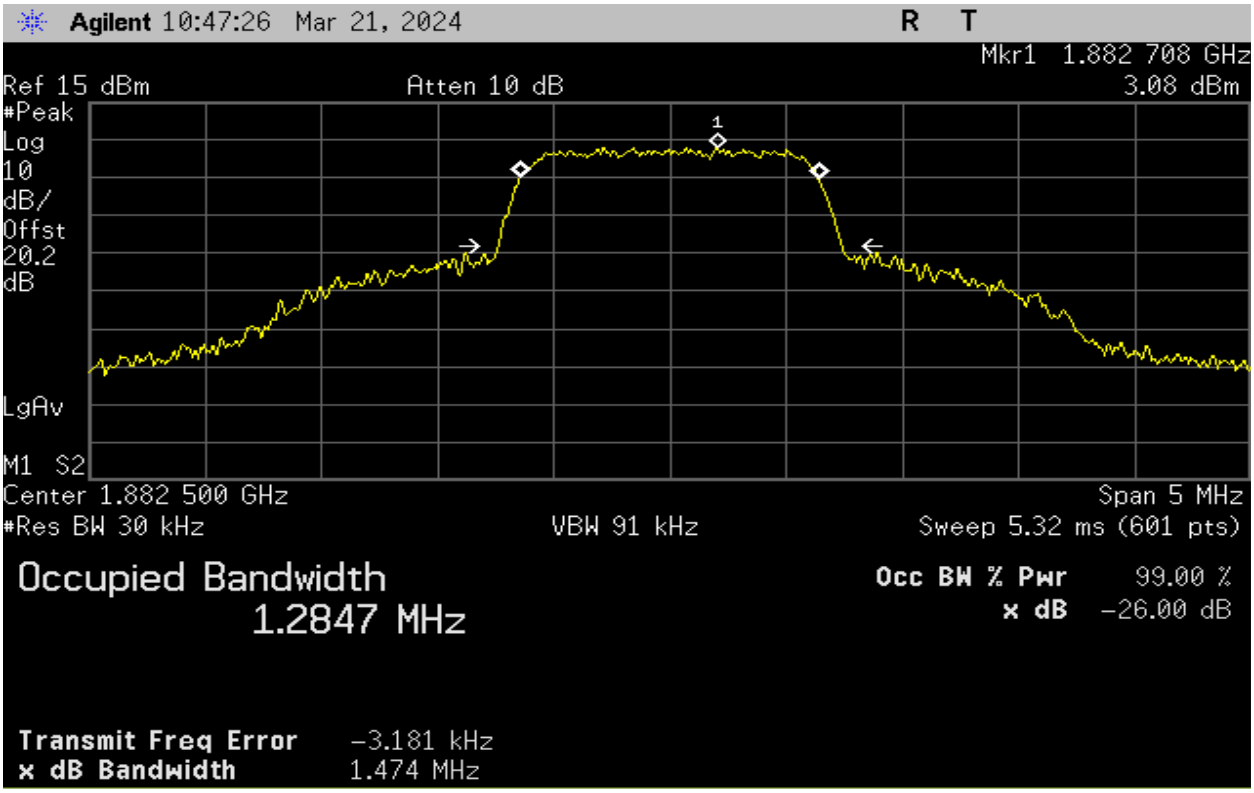
Plot 168 – 824-849MHz Band – Uplink Output – CDMA



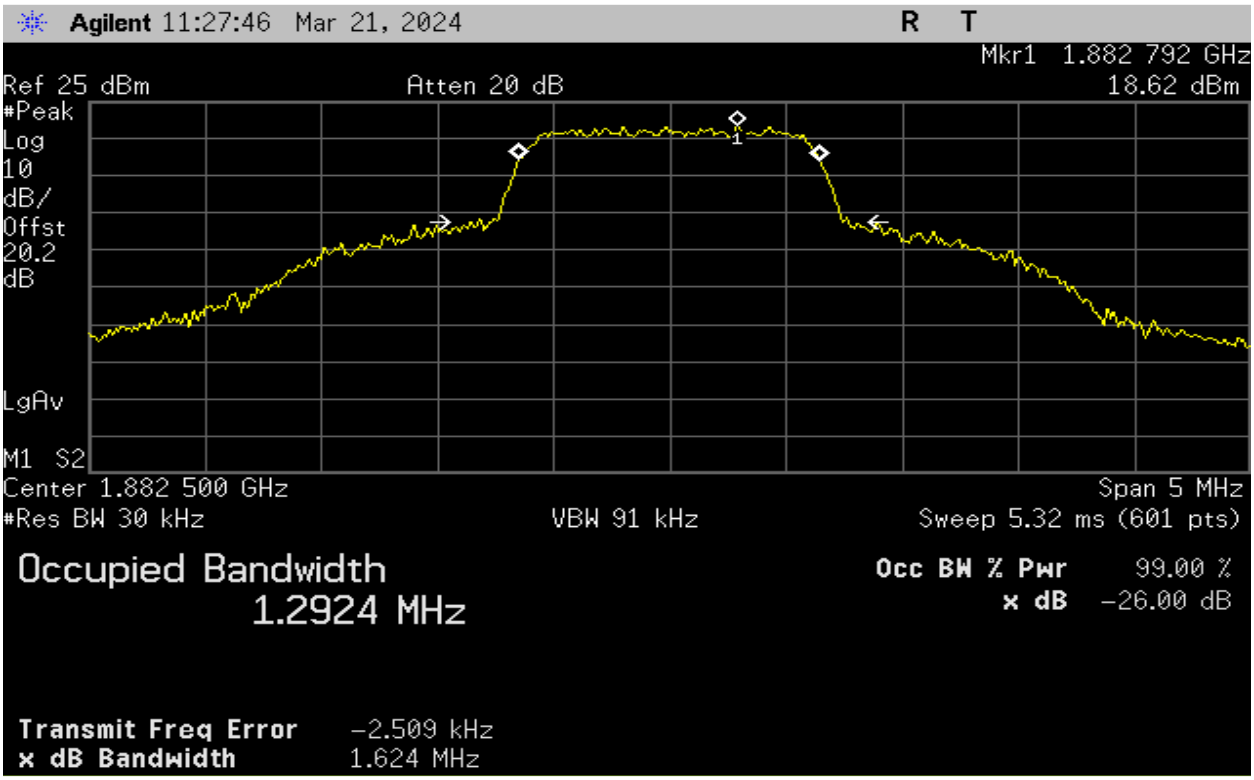
Plot 169 – 1710-1755MHz Band – Uplink Input – CDMA



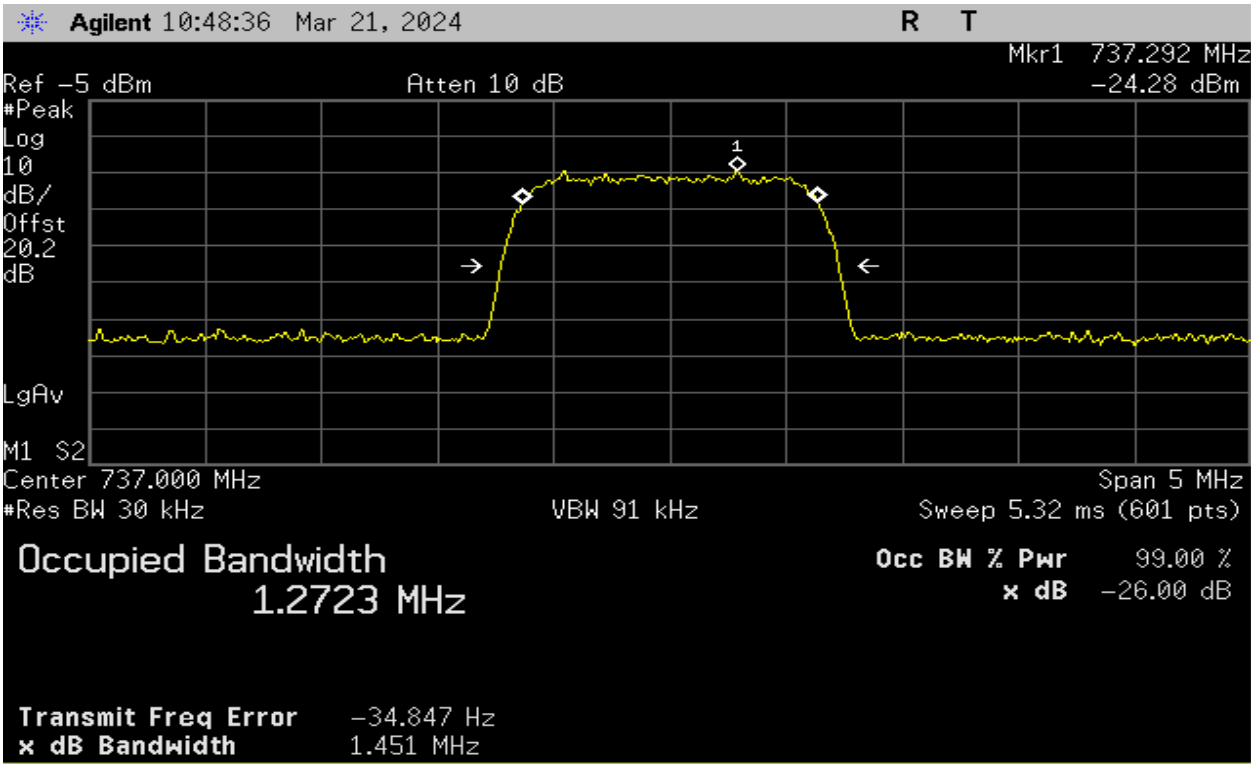
Plot 170 – 1710-1755MHz Band – Uplink Output – CDMA



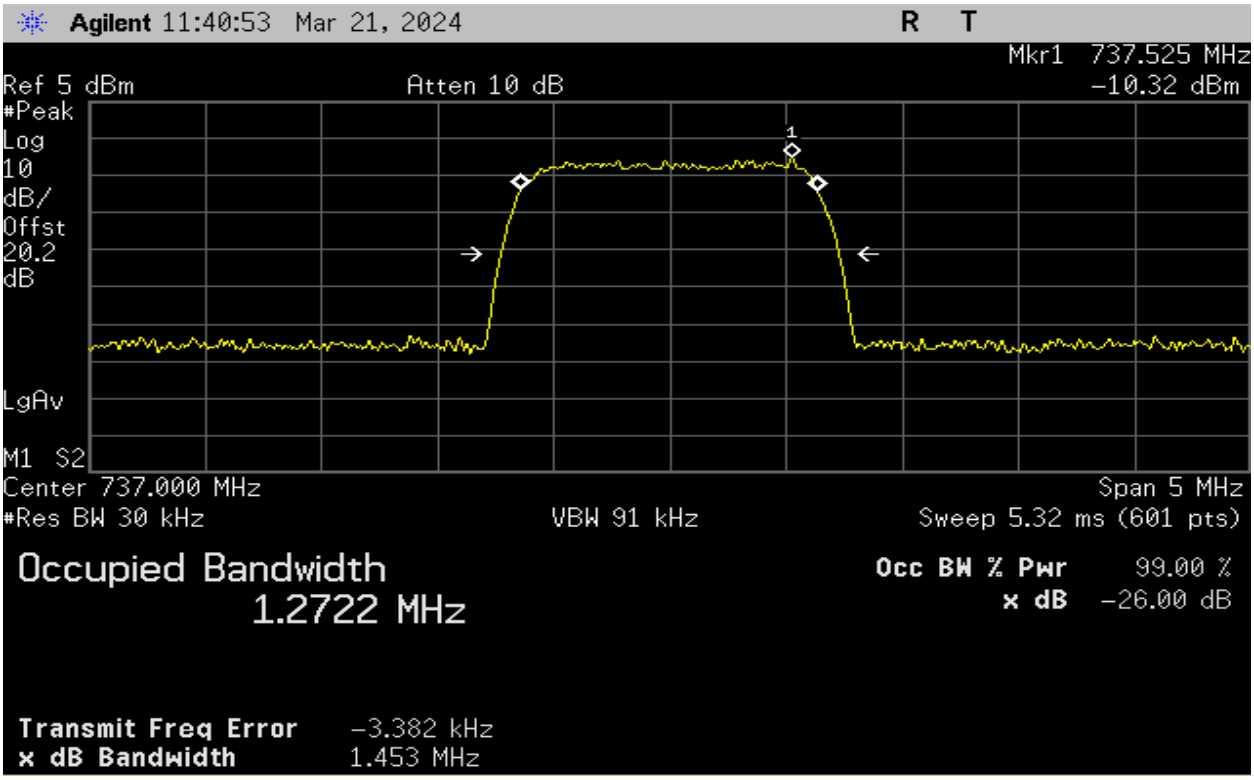
Plot 171 – 1850-1915MHz Band – Uplink Input – CDMA



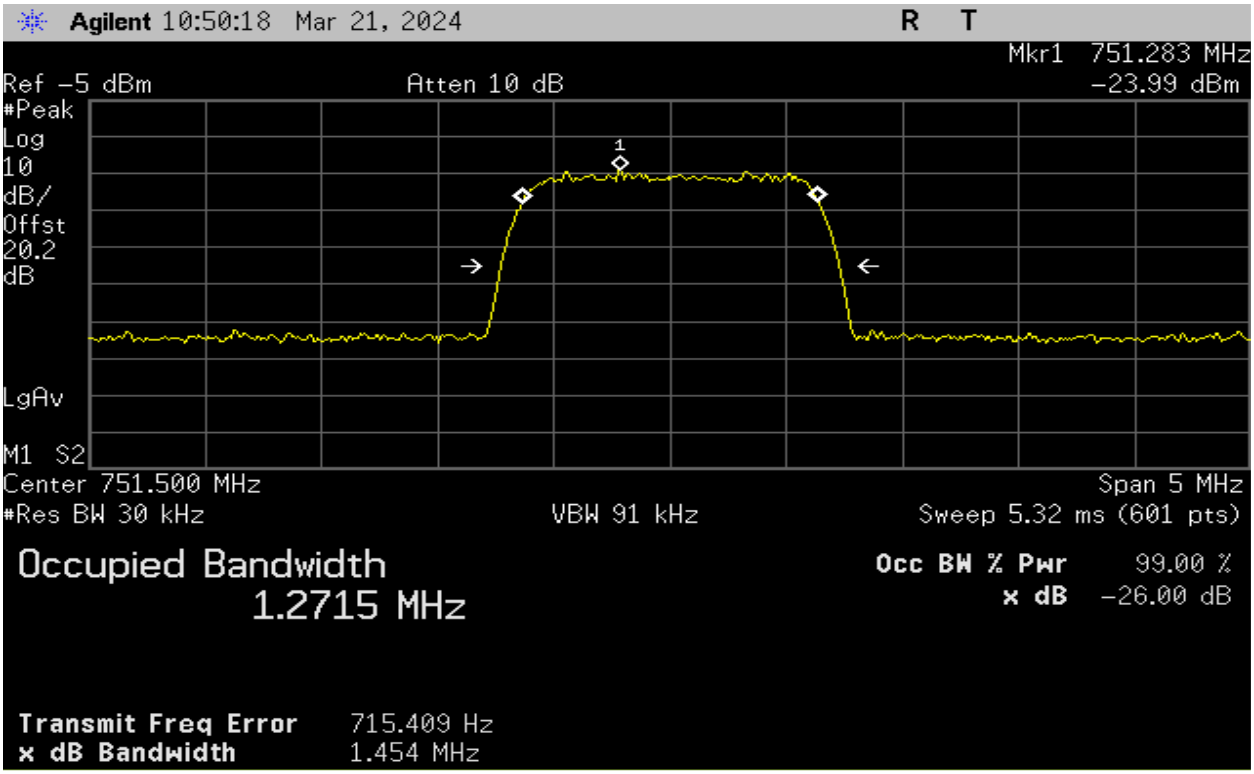
Plot 172 – 1850-1915MHz Band – Uplink Output – CDMA



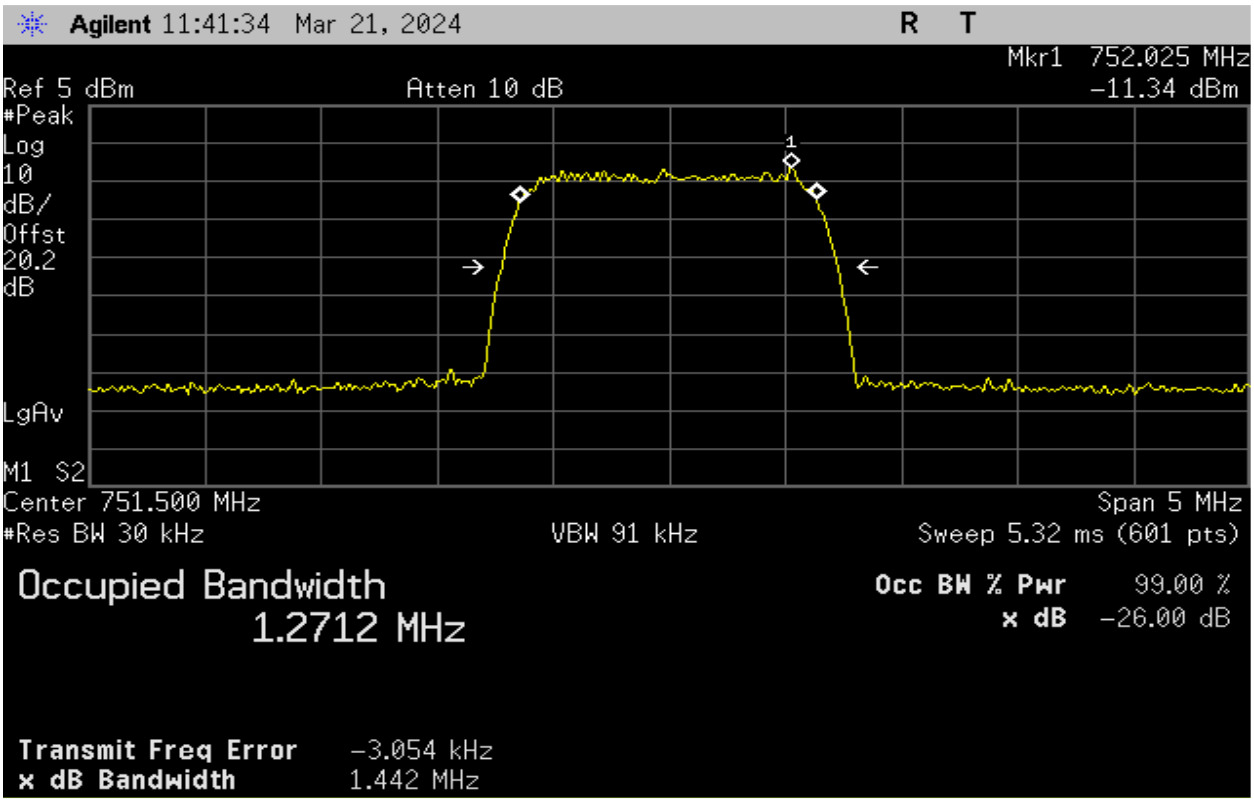
Plot 173 – 728-746MHz Band – Downlink Input – CDMA



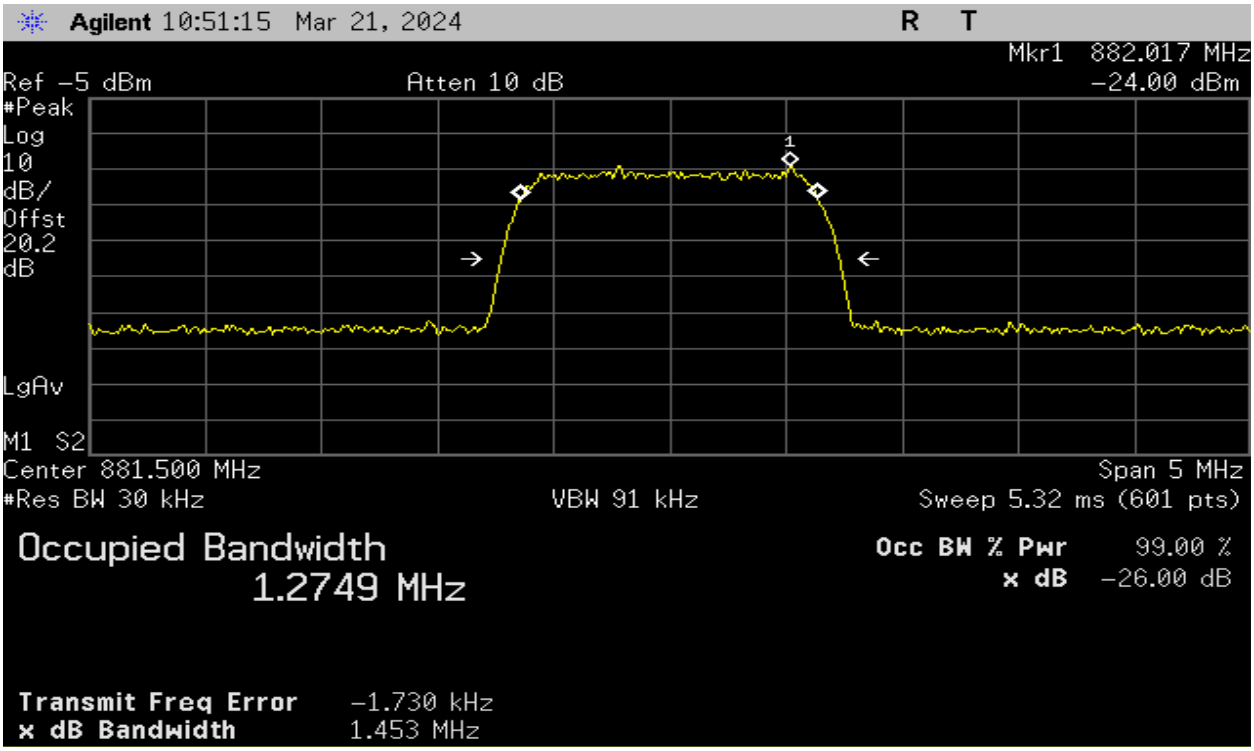
Plot 174 – 728-746MHz Band – Downlink Output – CDMA



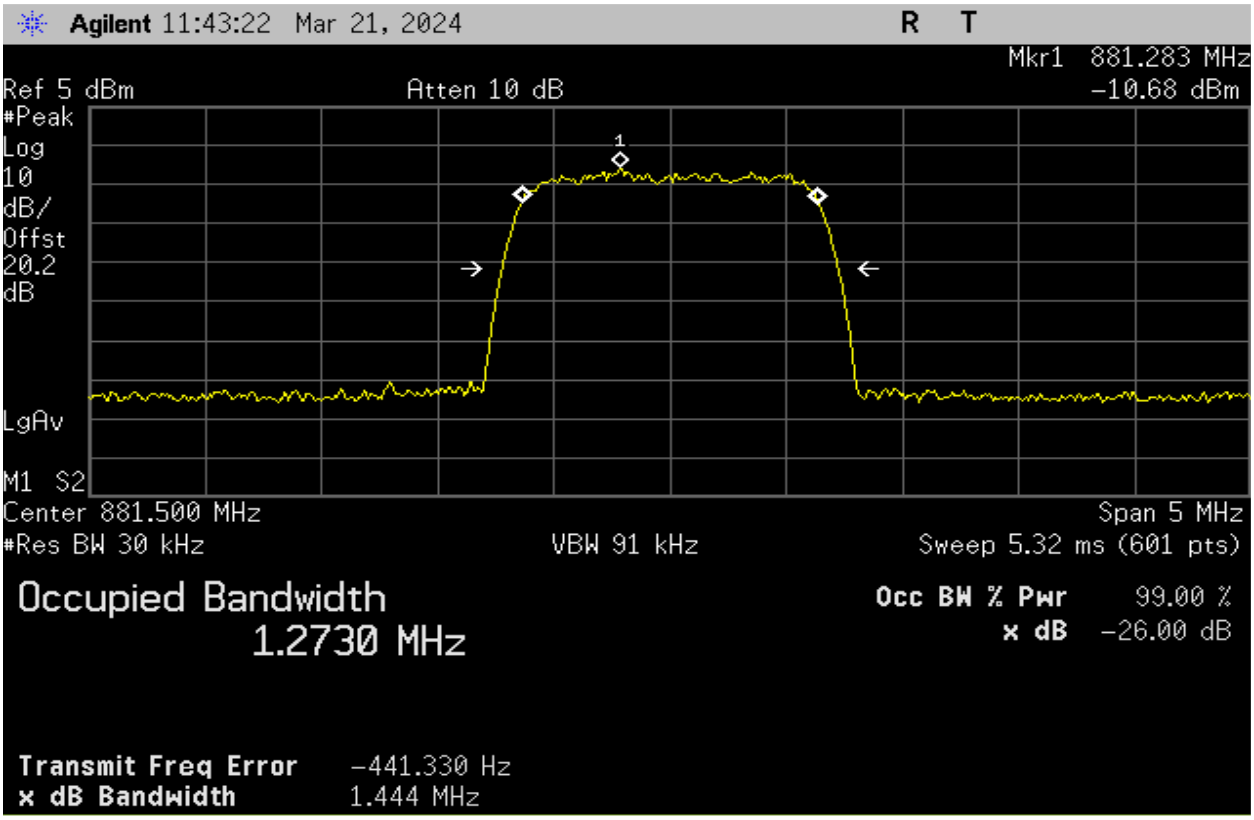
Plot 175 – 746-757MHz Band – Downlink Input – CDMA



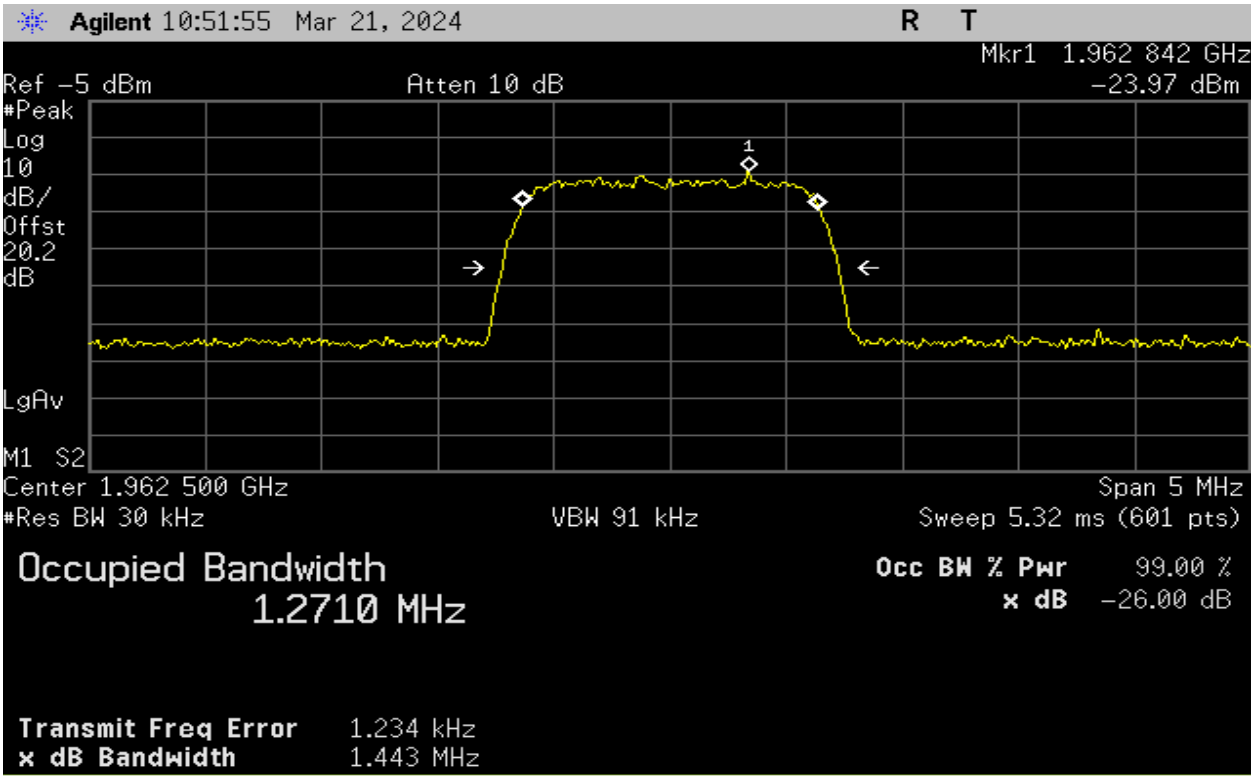
Plot 176 – 746-757MHz Band – Downlink Output – CDMA



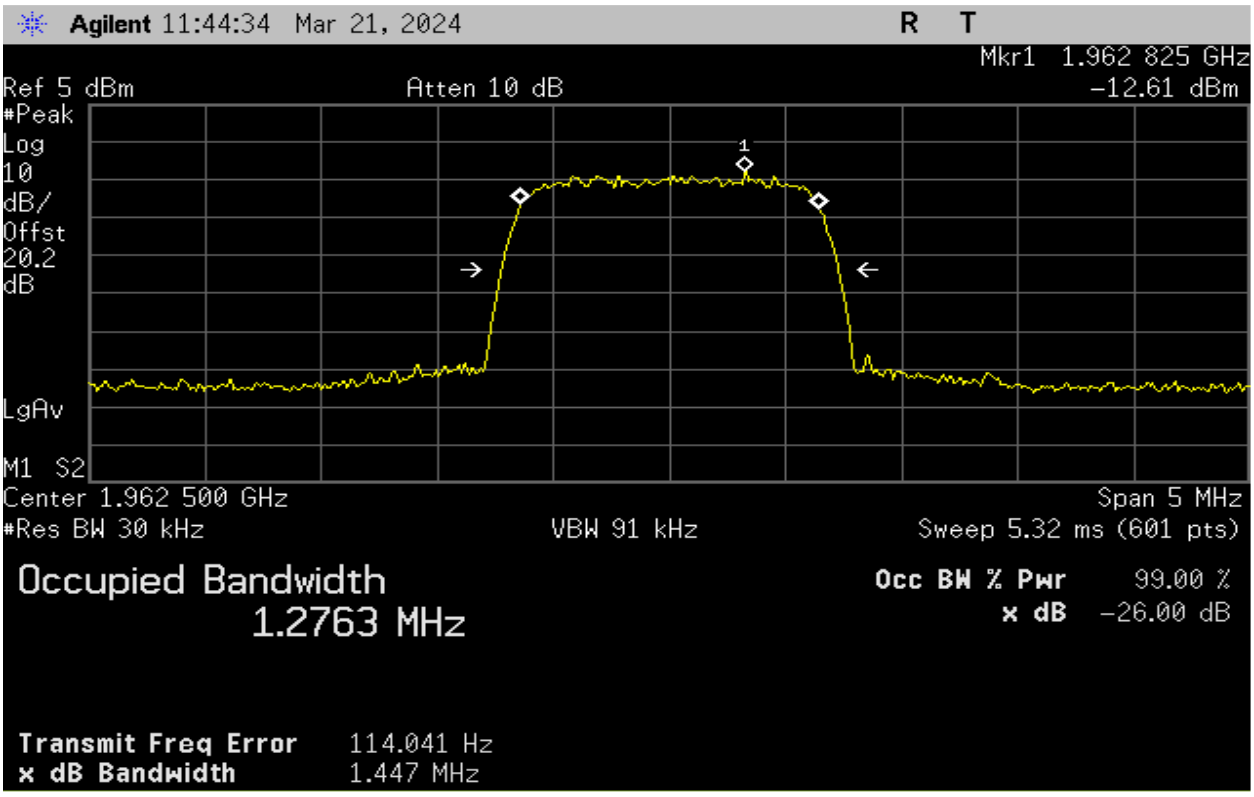
Plot 177 – 869-894MHz Band – Downlink Input – CDMA



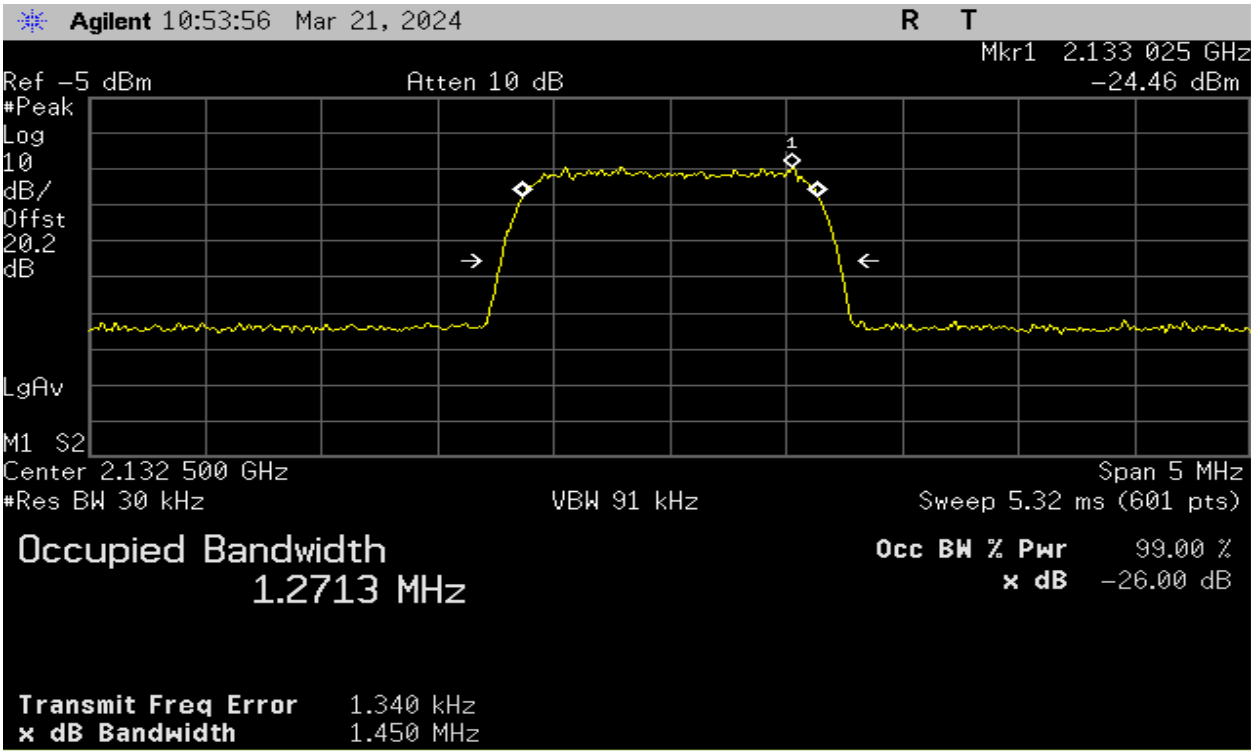
Plot 178 – 869-894MHz Band – Downlink Output – CDMA



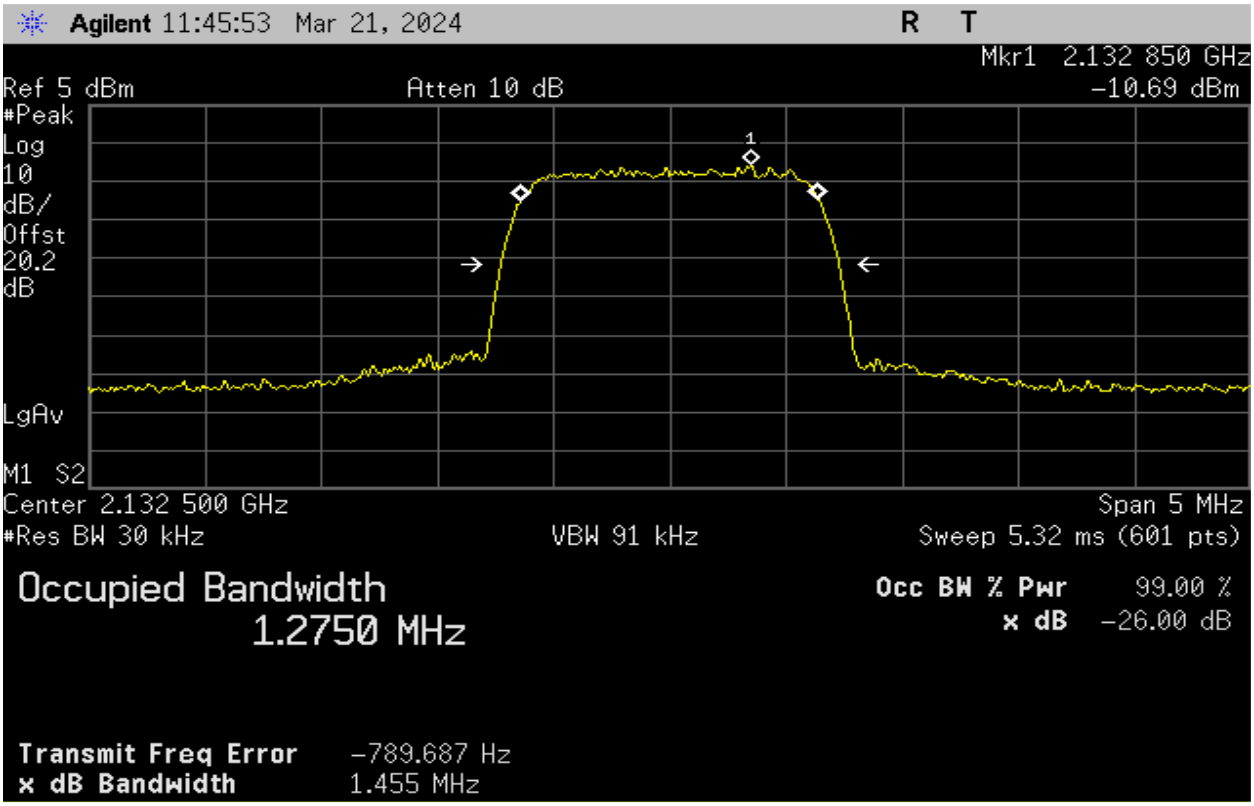
Plot 179 – 1930-1995MHz Band – Downlink Input – CDMA



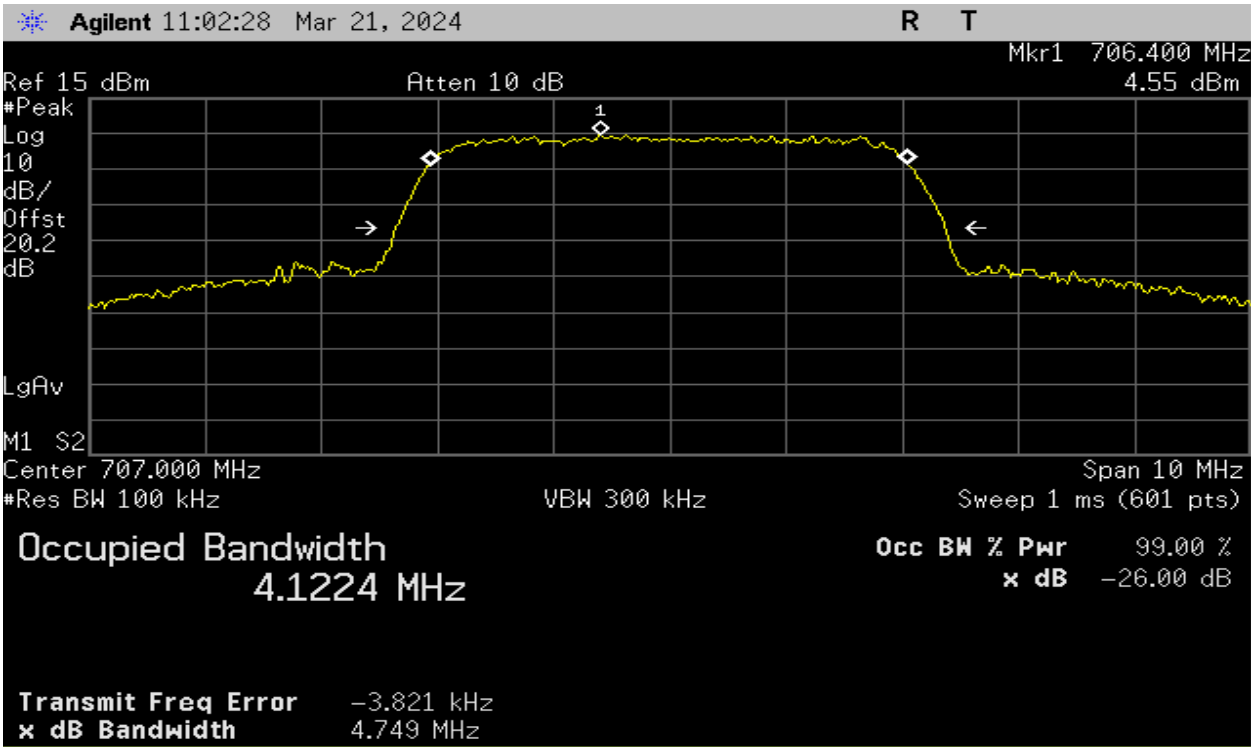
Plot 180 – 1930-1995MHz Band – Downlink Output – CDMA



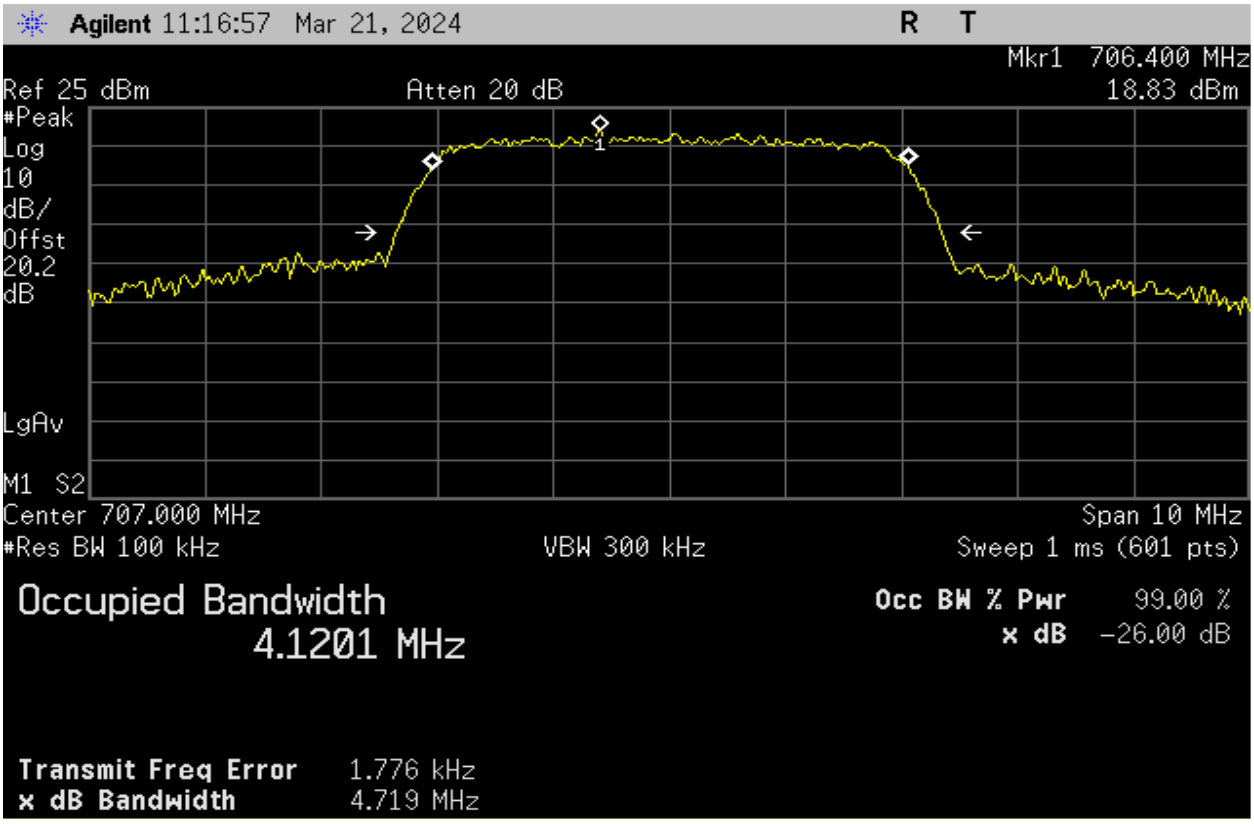
Plot 181 – 2110-2155MHz Band – Downlink Input – CDMA



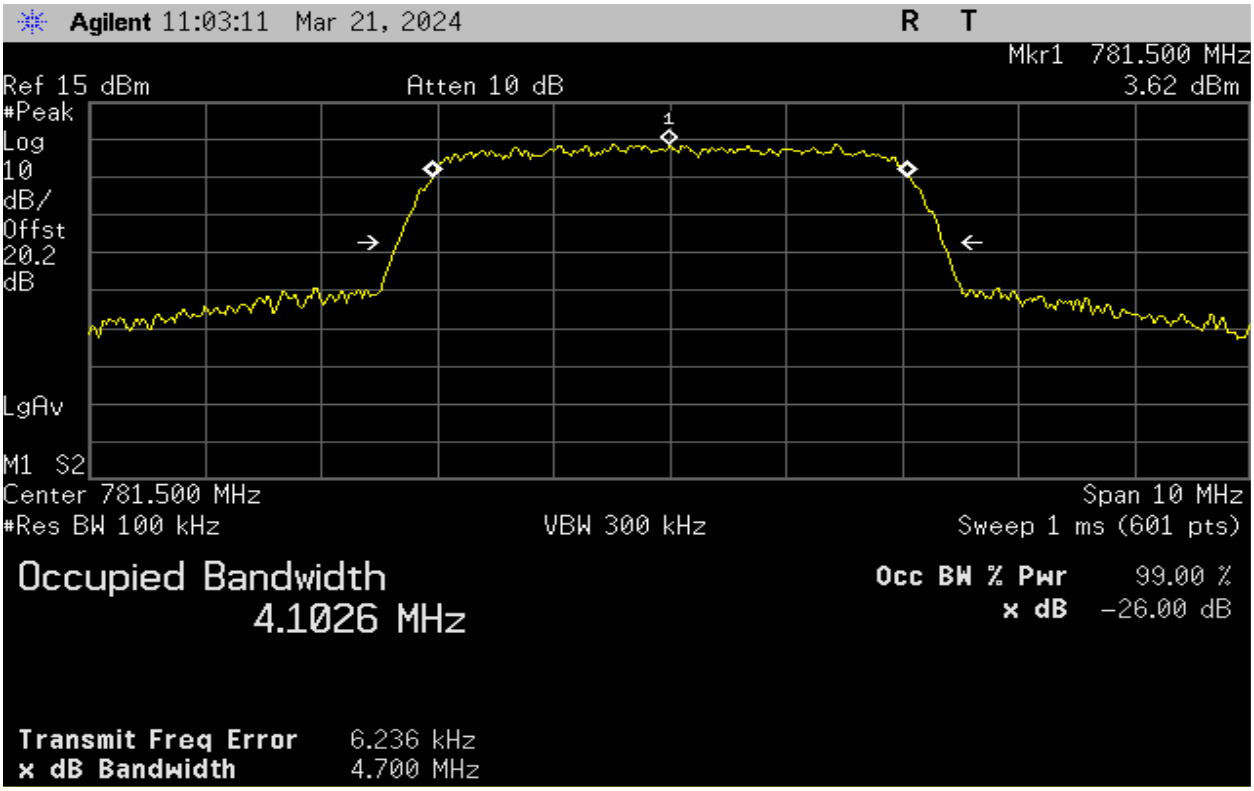
Plot 182 – 2110-2155MHz Band – Downlink Output – CDMA



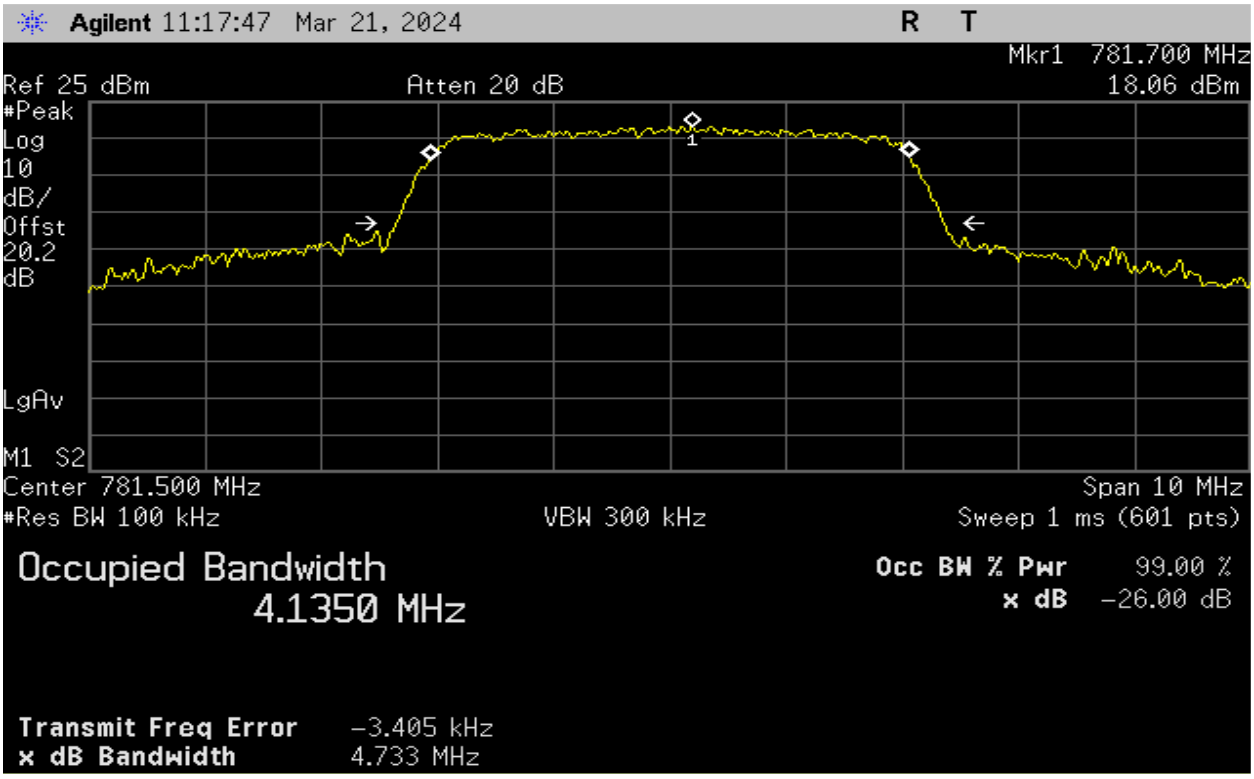
Plot 183 – 698-716MHz Band – Uplink Input – LTE



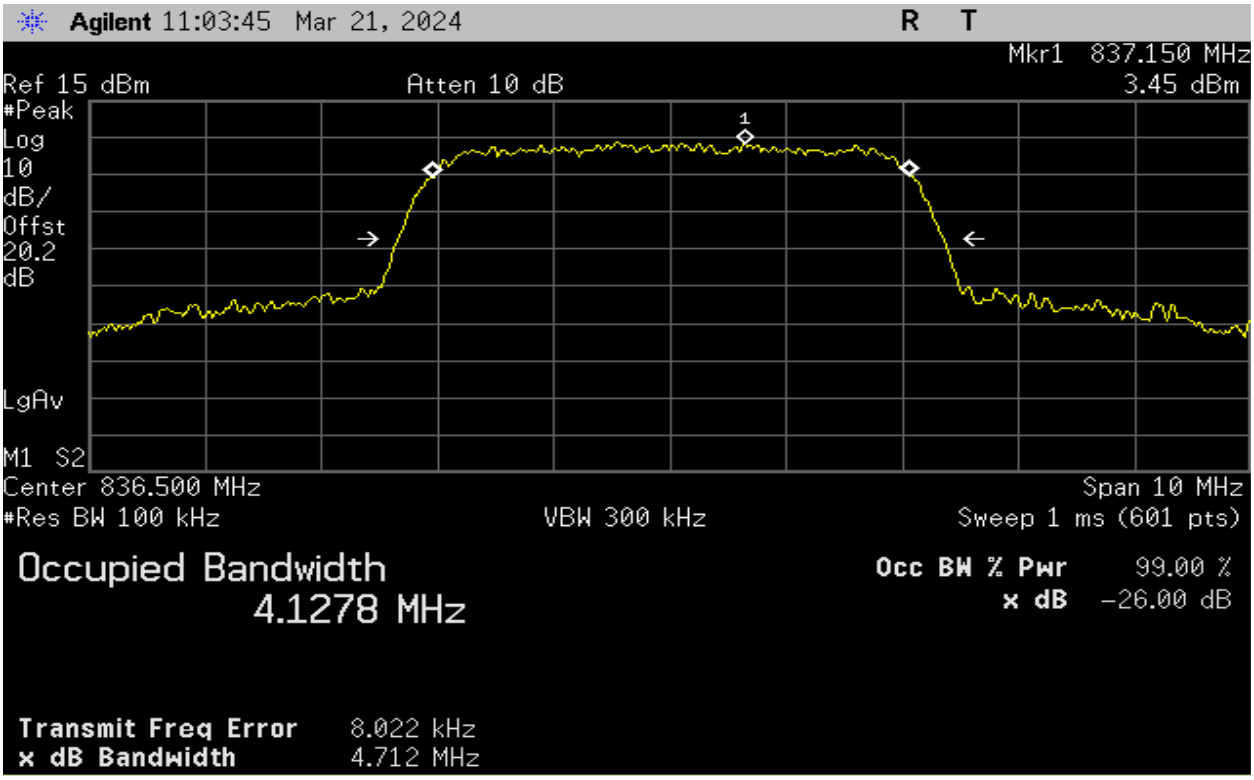
Plot 184 – 698-716MHz Band – Uplink Output – LTE



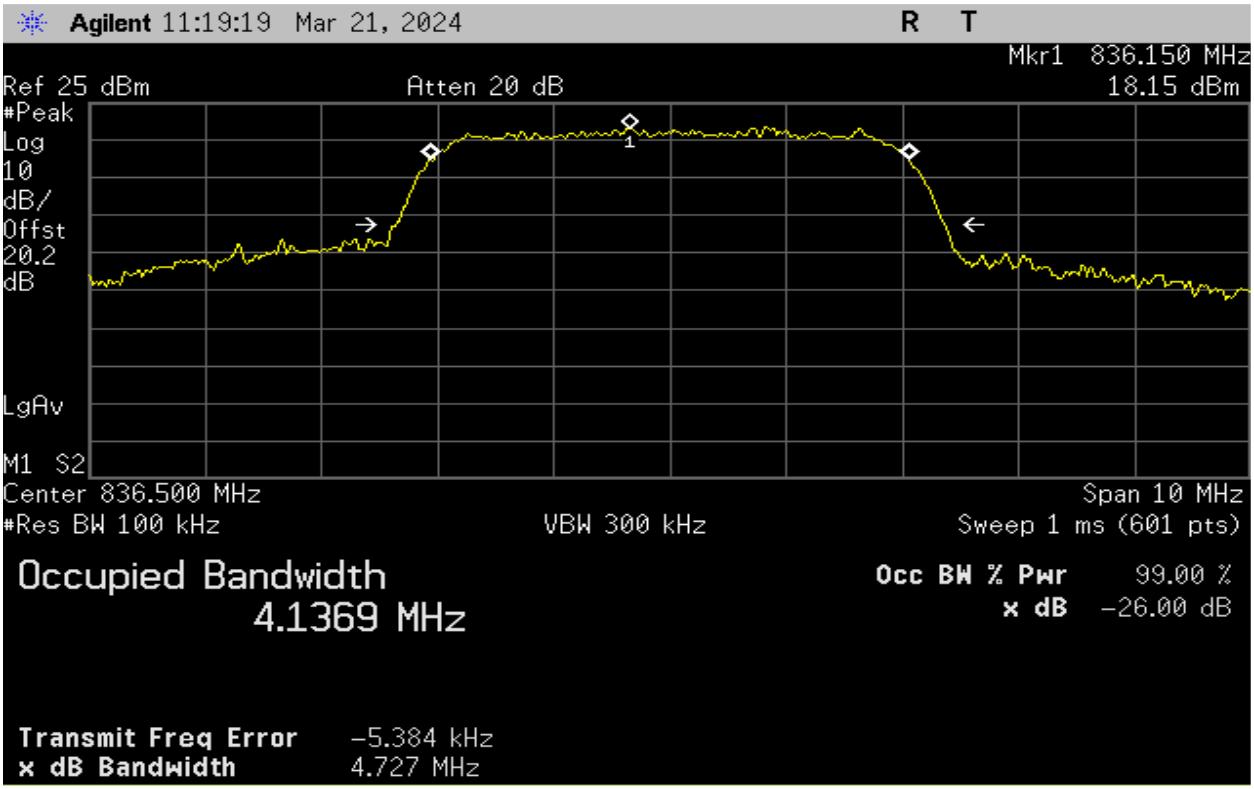
Plot 185 – 776-787MHz Band – Uplink Input – LTE



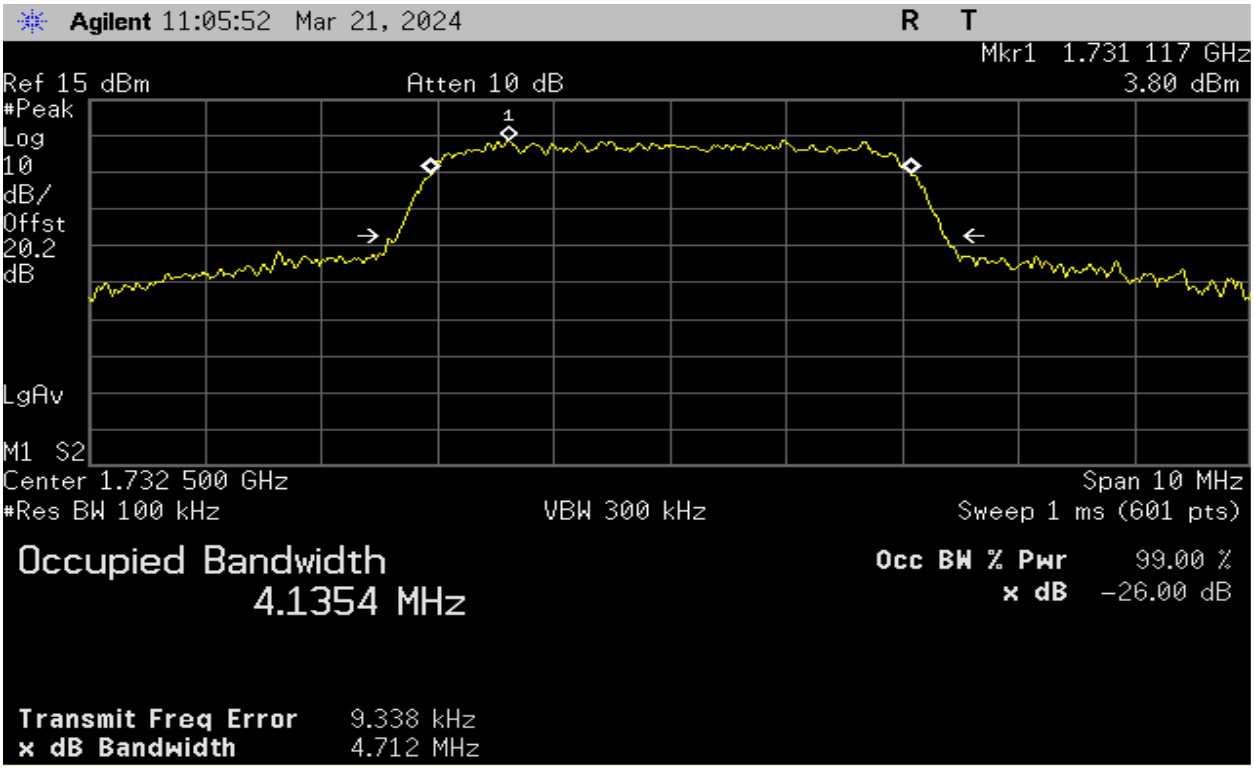
Plot 186 – 776-787MHz Band – Uplink Output – LTE



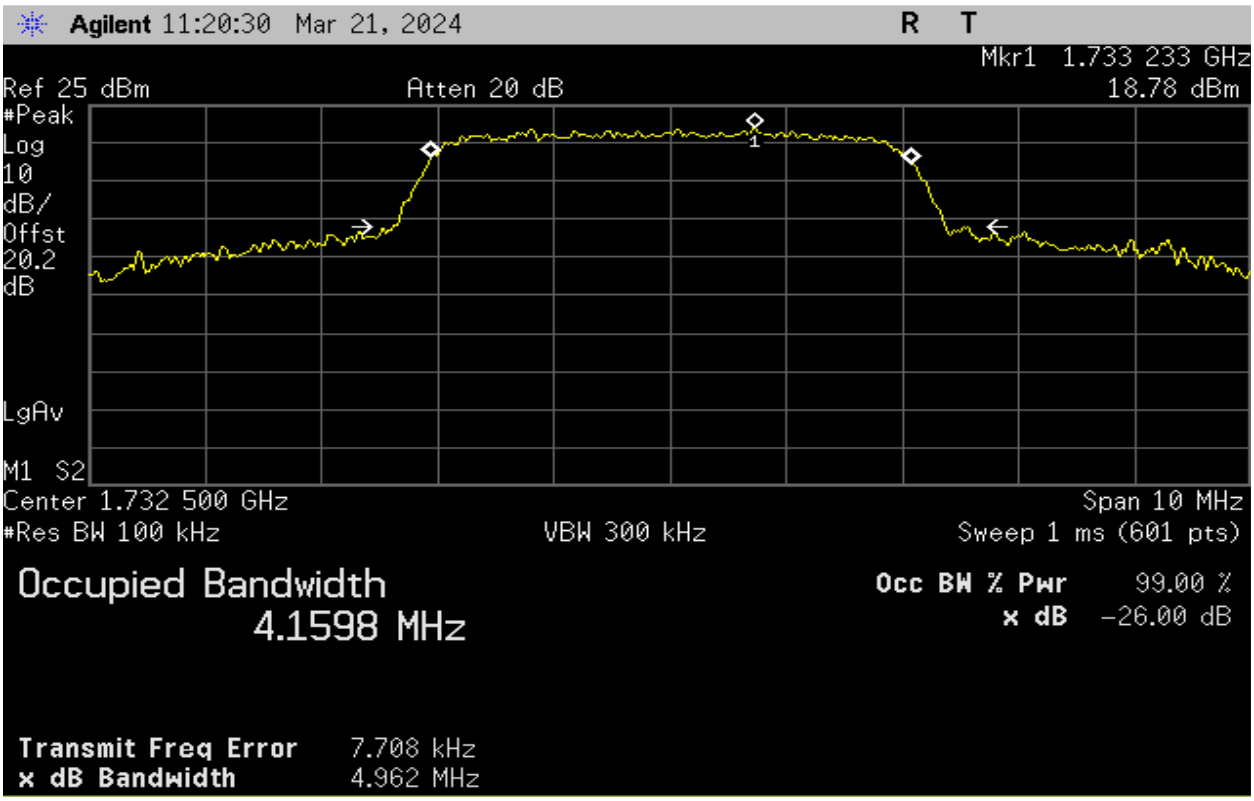
Plot 187 – 824-849MHz Band – Uplink Input – LTE



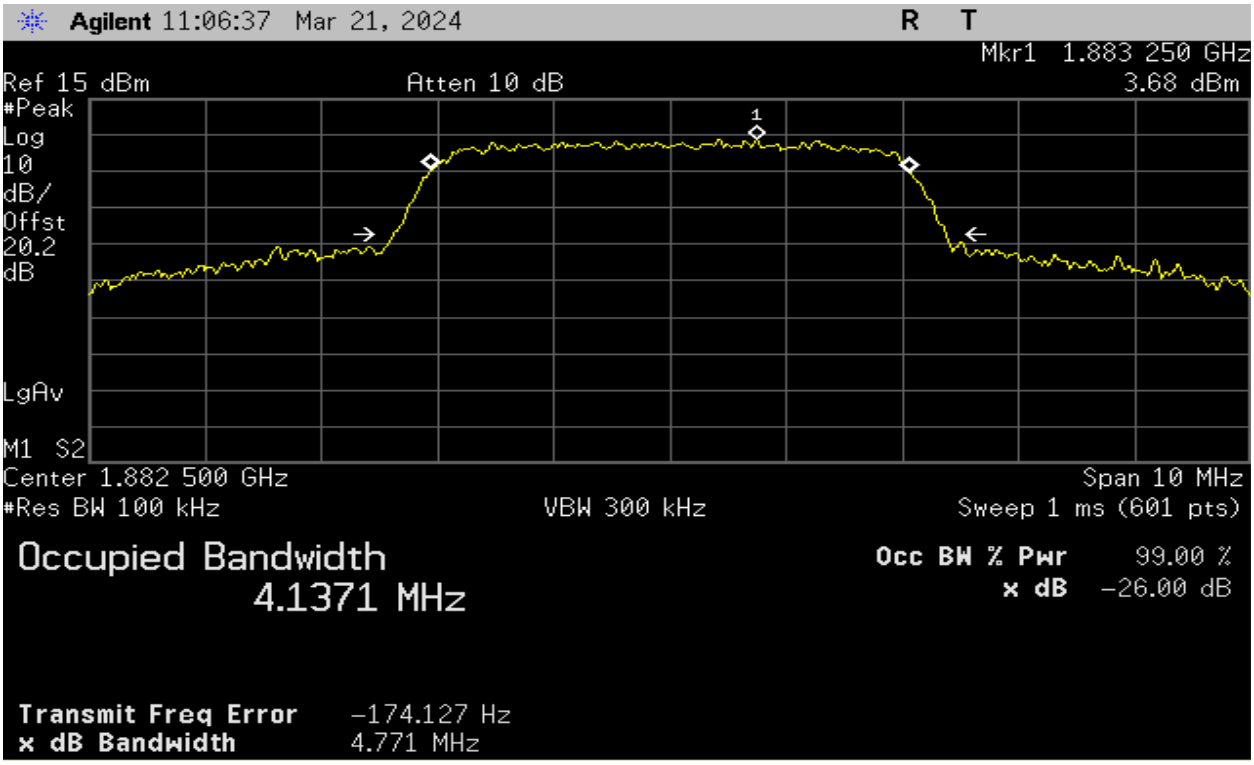
Plot 188 – 824-849MHz Band – Uplink Output – LTE



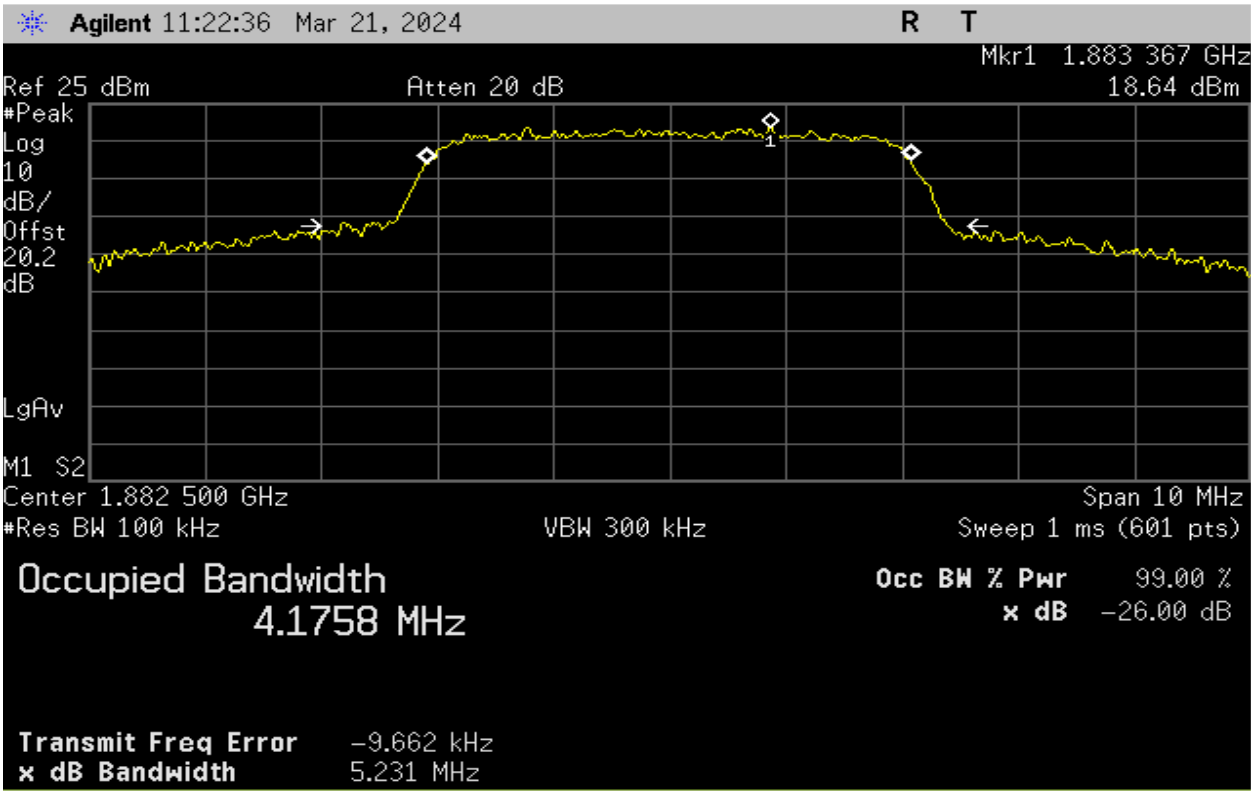
Plot 189 – 1710-1755MHz Band – Uplink Input – LTE



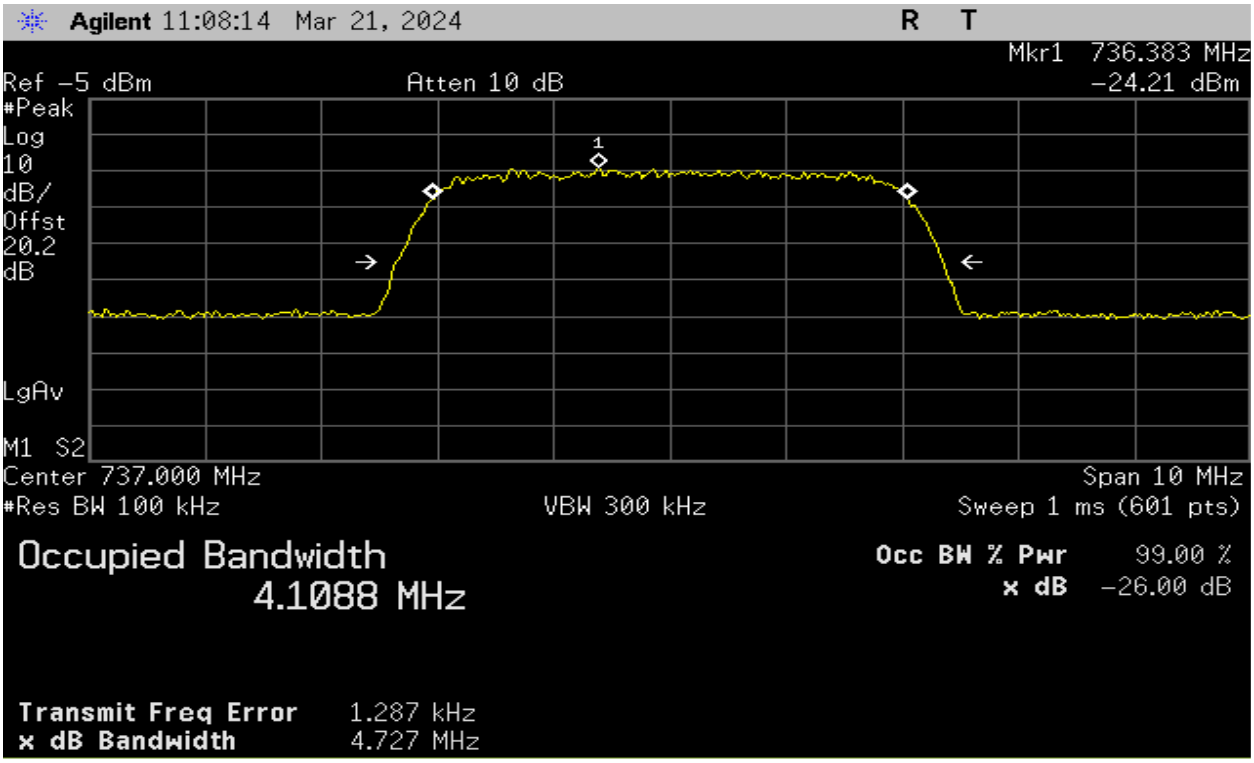
Plot 190 – 1710-1755MHz Band – Uplink Output – LTE



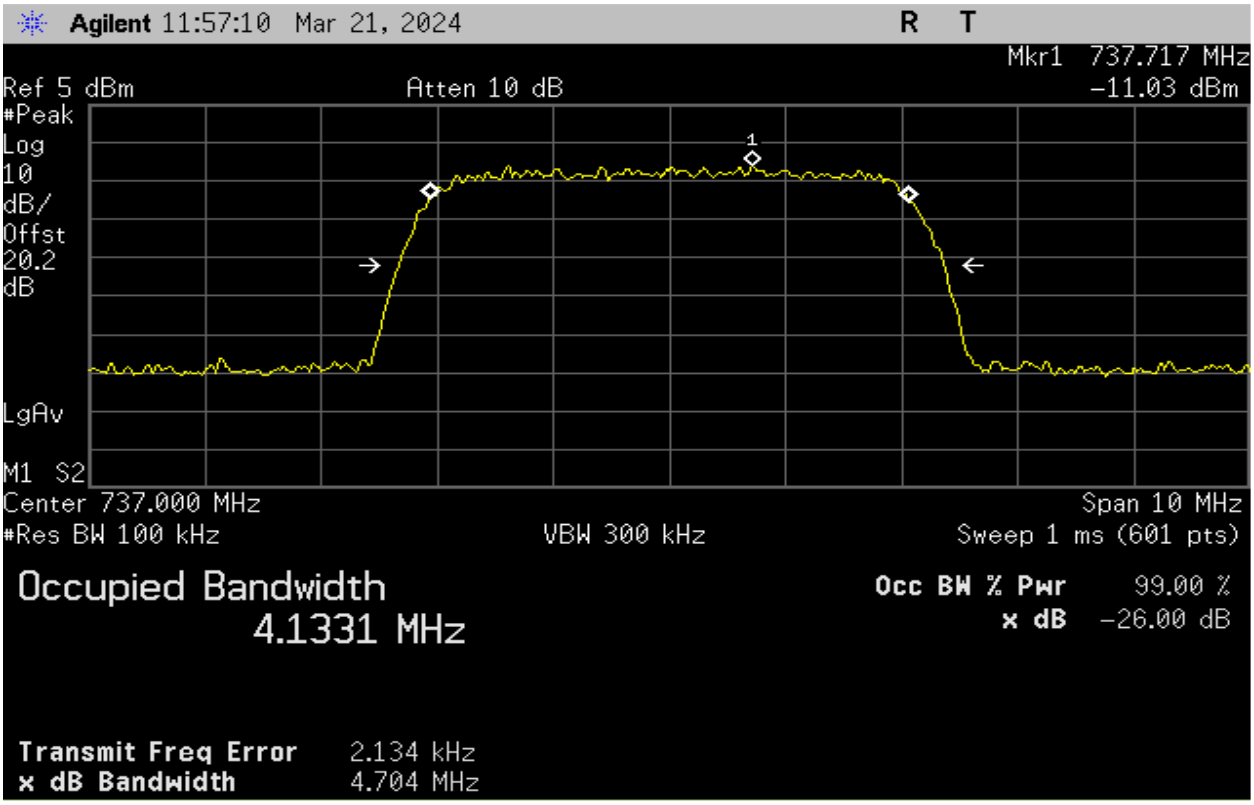
Plot 191 – 1850-1915MHz Band – Uplink Input – LTE



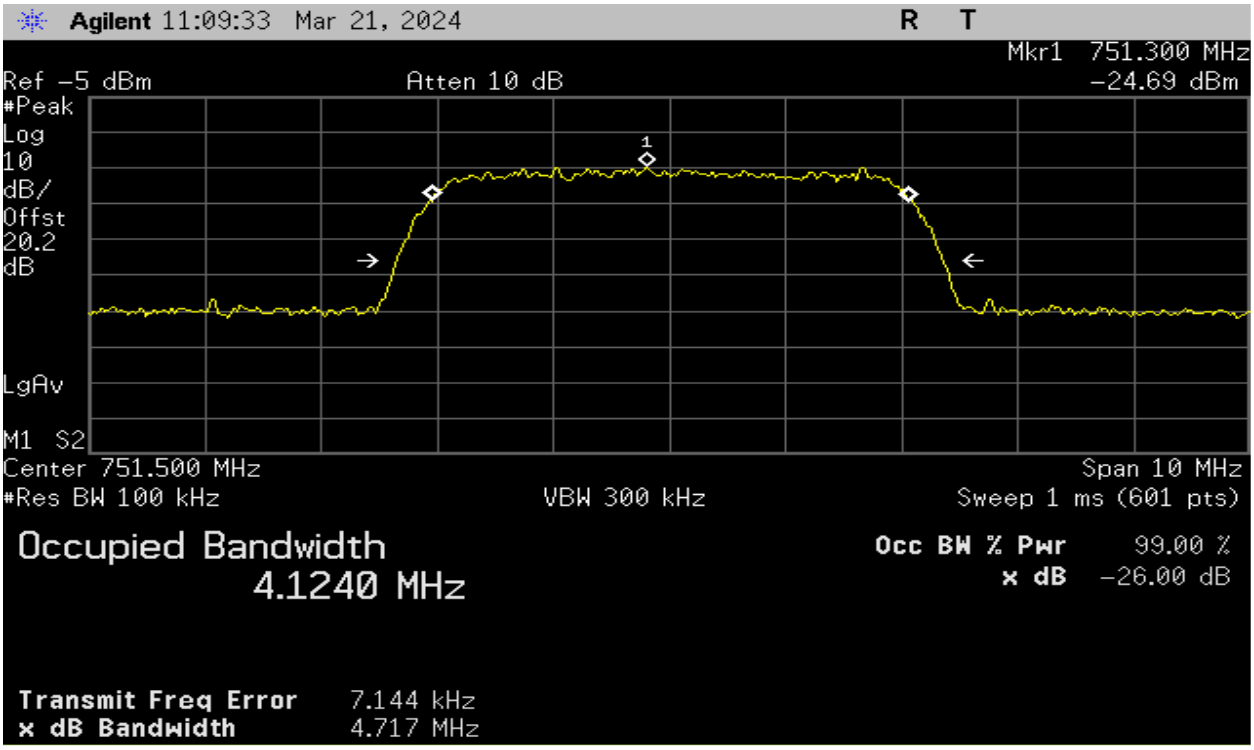
Plot 192 – 1850-1915MHz Band – Uplink Output – LTE



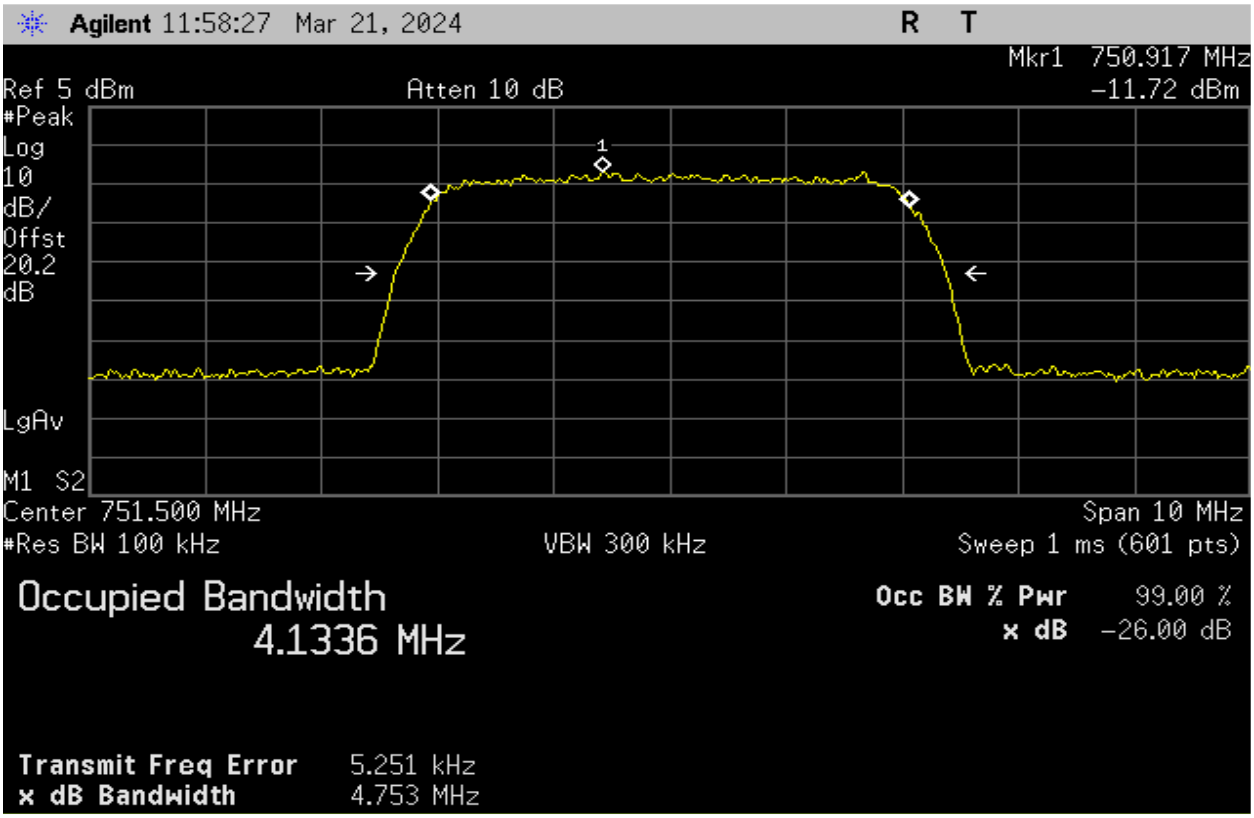
Plot 193 – 728-746MHz Band – Downlink Input – LTE



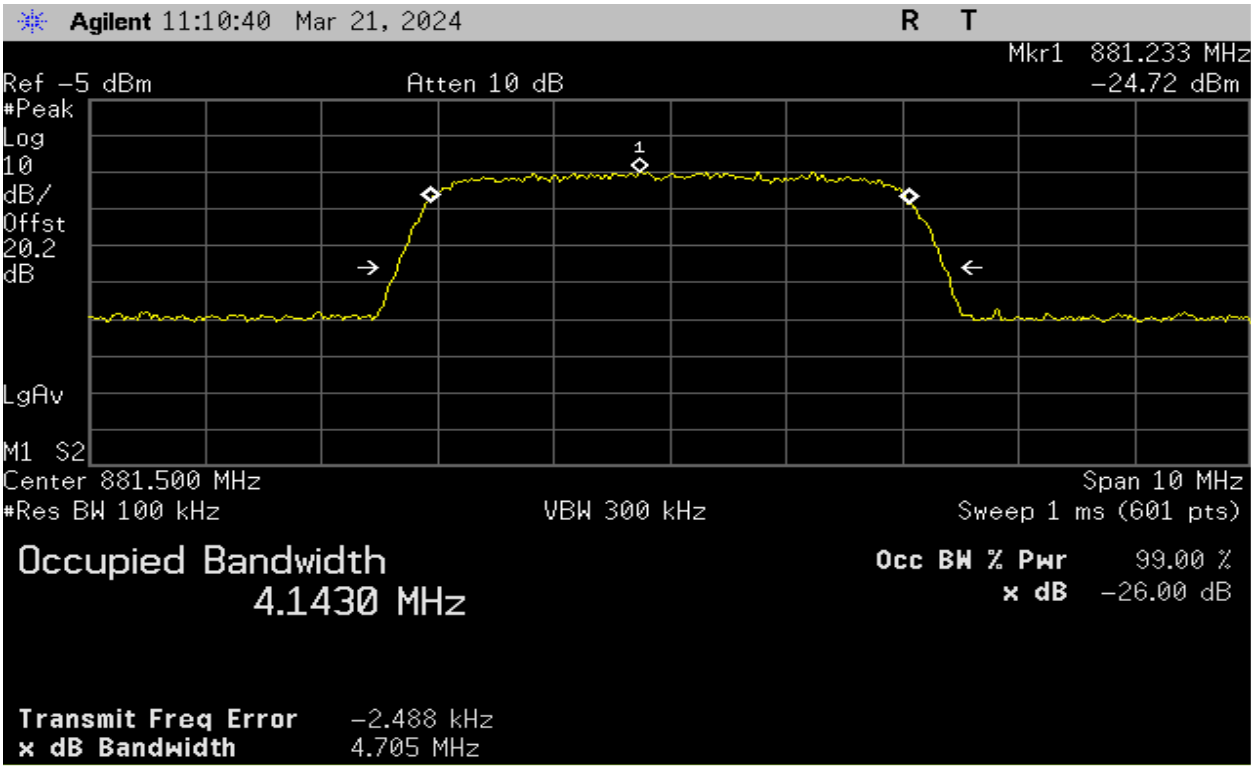
Plot 194 – 728-746MHz Band – Downlink Output – LTE



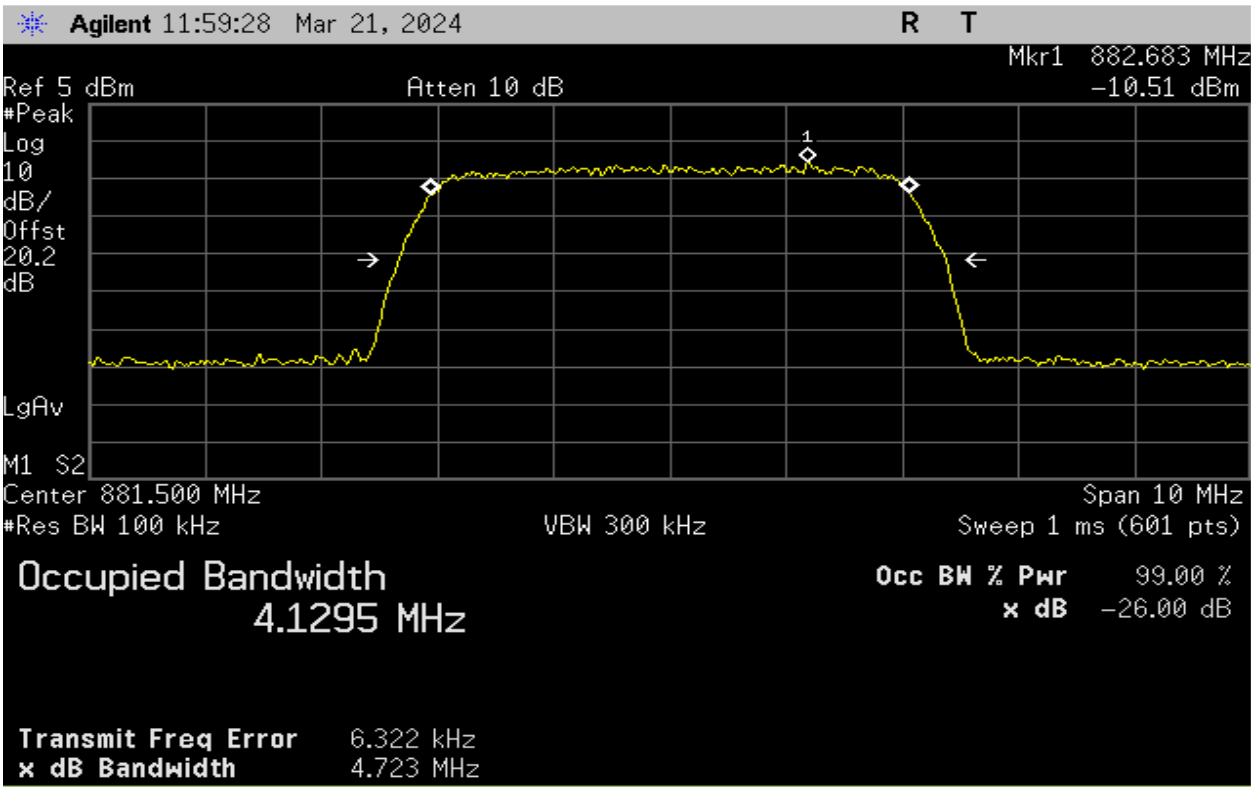
Plot 195 – 746-757MHz Band – Downlink Input – LTE



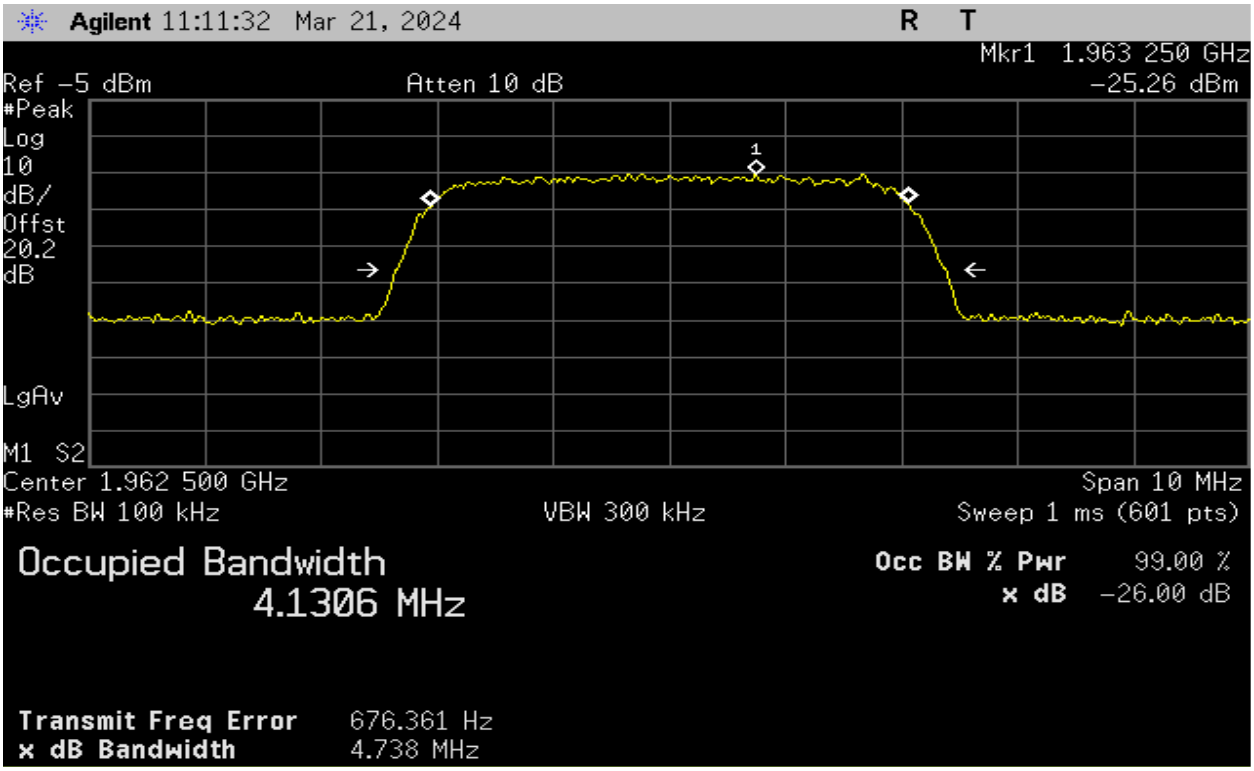
Plot 196 – 746-757MHz Band – Downlink Output – LTE



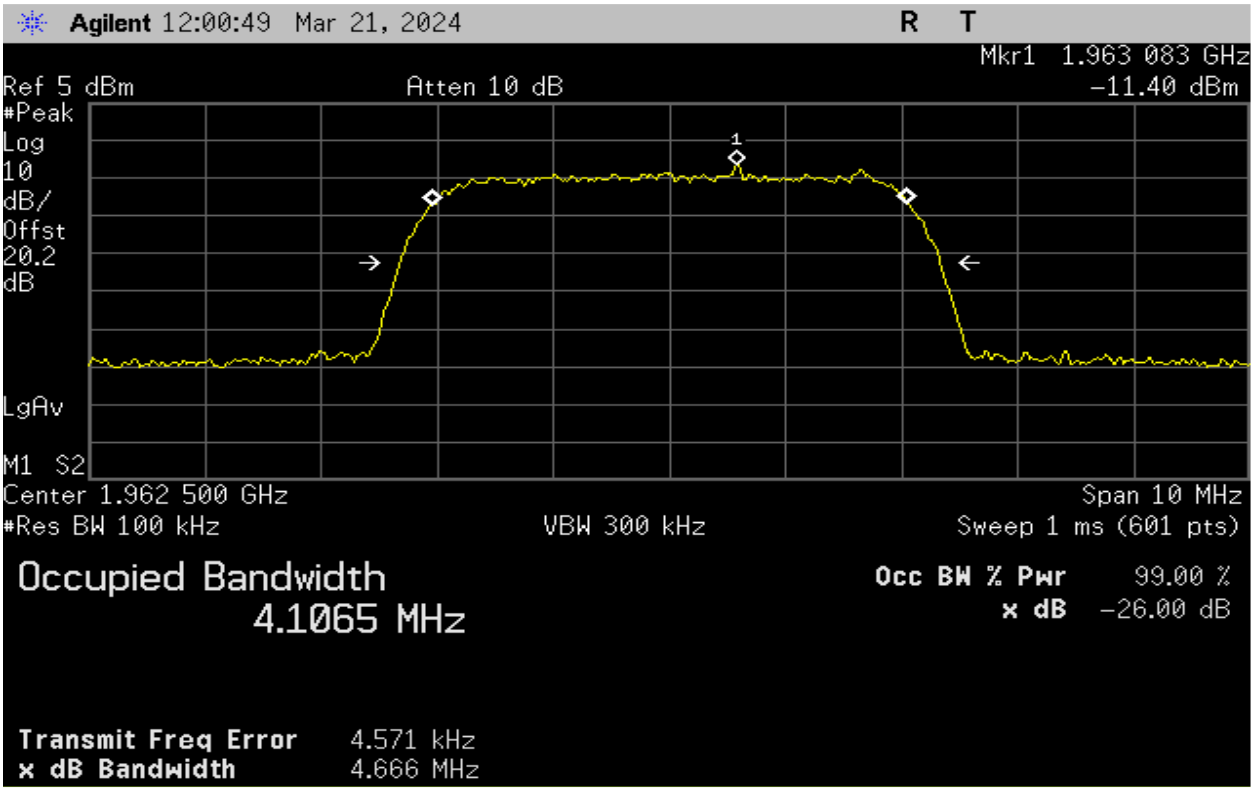
Plot 197 – 869-894MHz Band – Downlink Input – LTE



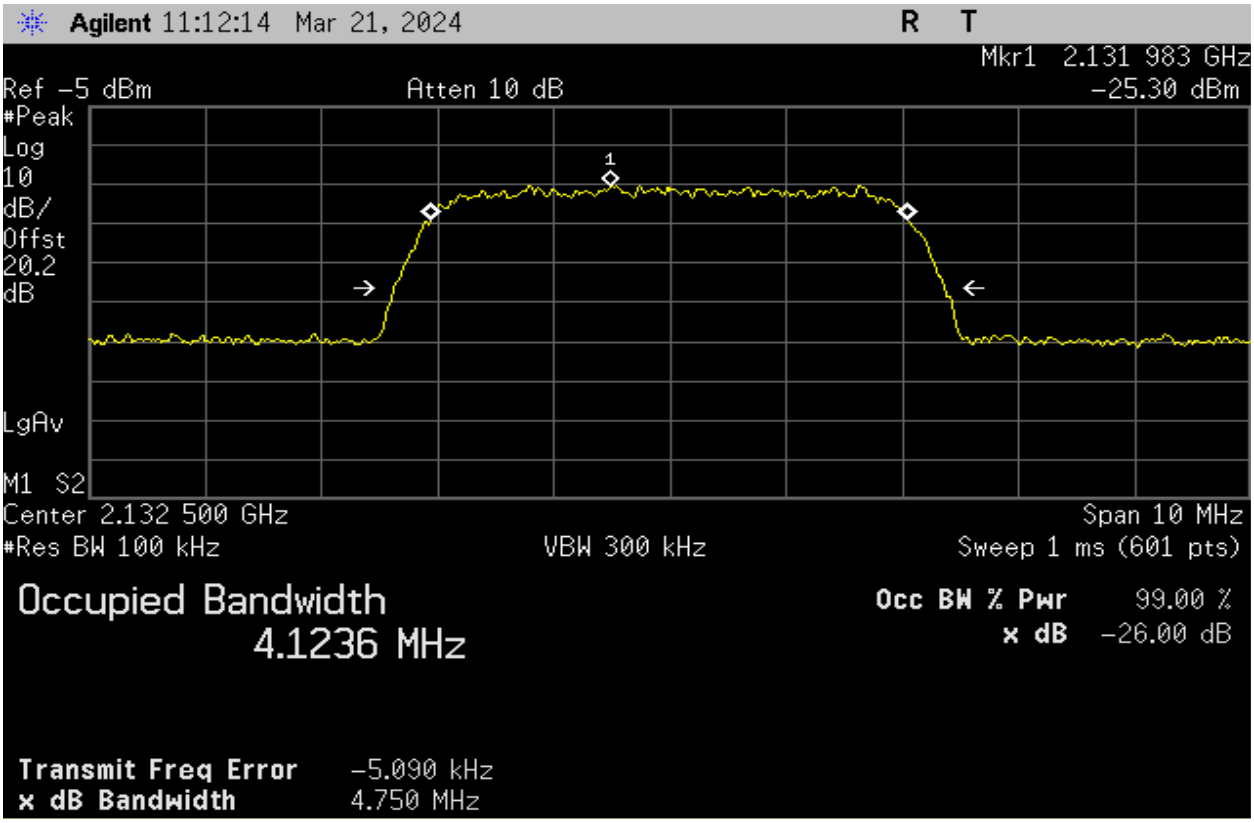
Plot 198 – 869-894MHz Band – Downlink Output – LTE



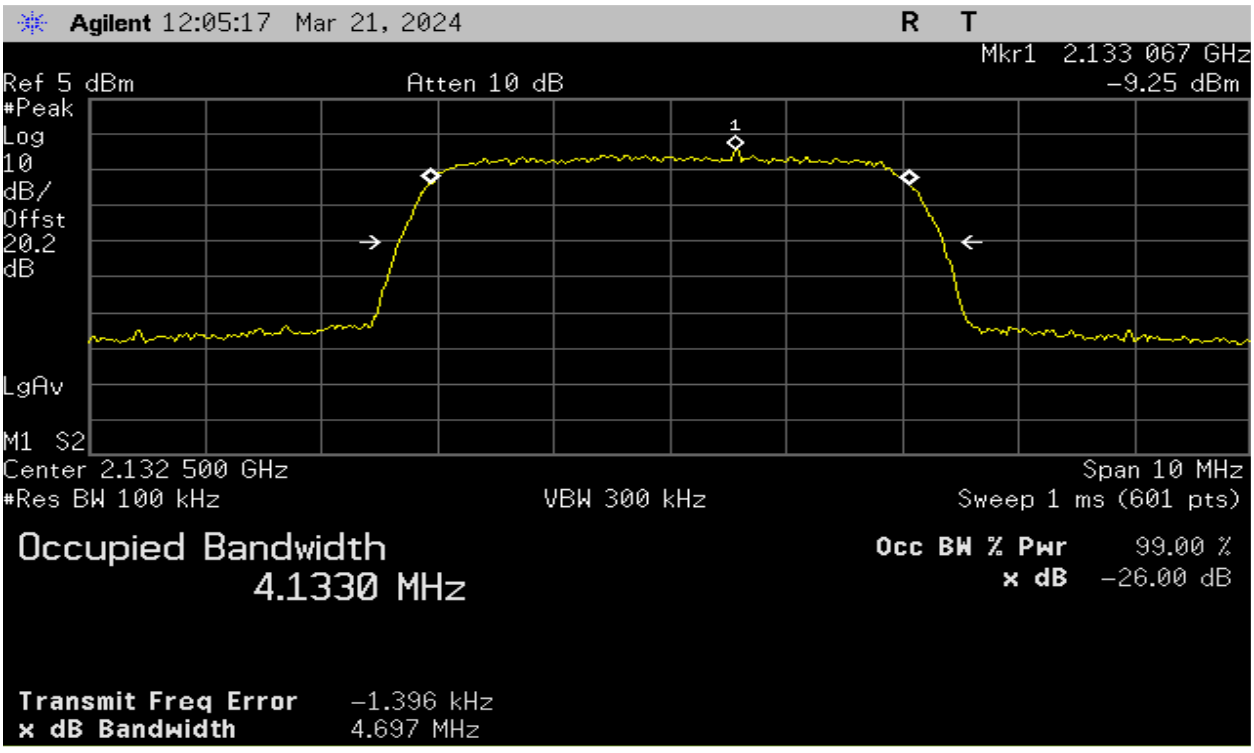
Plot 199 – 1930-1995MHz Band – Downlink Input – LTE



Plot 200 – 1930-1995MHz Band – Downlink Output – LTE



Plot 201 – 2110-2155MHz Band – Downlink Input – LTE



Plot 202 – 2110-2155MHz Band – Downlink Output – LTE

10. Oscillation Detection

Test Requirement(s):	§20.21(e)(8)(ii)(A) and RSS-131 §6.1.1	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	May 16-17, 2024

Test Procedures: As required by 47 §20.21(e)(8)(ii)(A) and RSS-131 §6.1.1, Oscillation detection measurement were made at the RF antenna output terminals of the EUT.

The EUT output was connected to the spectrum analyzer through a 30dB coupled directional coupler. The measurements were made as per procedure defined in KDB 935210 D03 §7.11.

Detector Setting	Resolution Bandwidth	Video Bandwidth	Sweep Time
Peak	≥1 MHz	>3X RBW	Auto

Table 29 – Analyzer settings – Oscillation Detection

Test Setup:

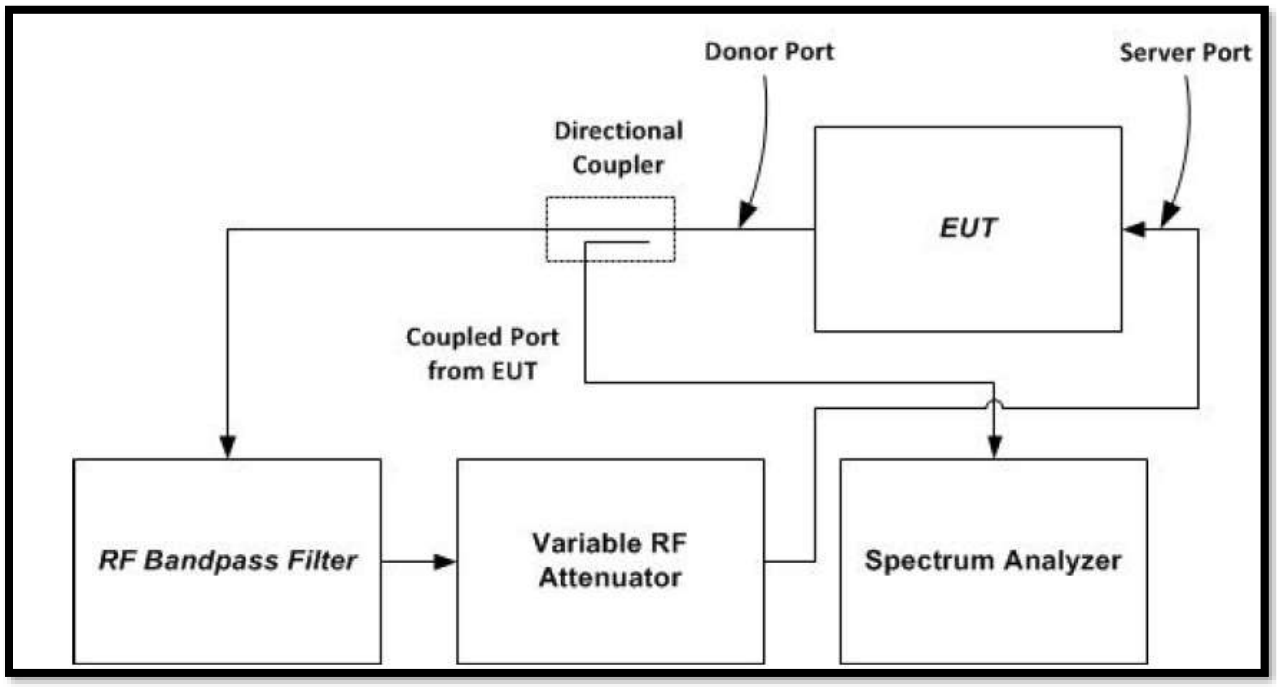


Figure 7 – Oscillation detection

Note: Oscillation mitigation/shutdown testing was not performed as the EUT is a direct-connection mobile booster having a gain of less than or equal to 15 dB.

The device does not restart without manual power cycling after detecting oscillations. Plots of 90 seconds including initial oscillation are provided to show compliance with the >60 second restart time.

Frequency Band (MHz)	Measured Time (mS)	Limit (mS)
698-716	230.2	300
776-787	153.4	300
824-849	226.8	300
1710-1755	116.7	300
1850-1915	200.1	300

Table 30 –Uplink Detection Time – Summary

Frequency Band (MHz)	Measured Time (mS)	Limit (Second)
728-746	213.5	1.0
746-757	176.8	1.0
869-894	153.4	1.0
1930-1995	216.8	1.0
2110-2155	70.05	1.0

Table 31 –Downlink Detection Time – Summary

Frequency Band (MHz)	Measured Time (Second)	Limit (Second)
698-716	Does not Restart	≥60
776-787	Does not Restart	≥60
824-849	Does not Restart	≥60
1710-1755	Does not Restart	≥60
1850-1915	Does not Restart	≥60

Table 32 –Uplink Restart Time – Summary

Frequency Band (MHz)	Measured Time (Second)	Limit (Second)
728-746	Does not Restart	≥60
746-757	Does not Restart	≥60
869-894	Does not Restart	≥60
1930-1995	Does not Restart	≥60
2110-2155	Does not Restart	≥60

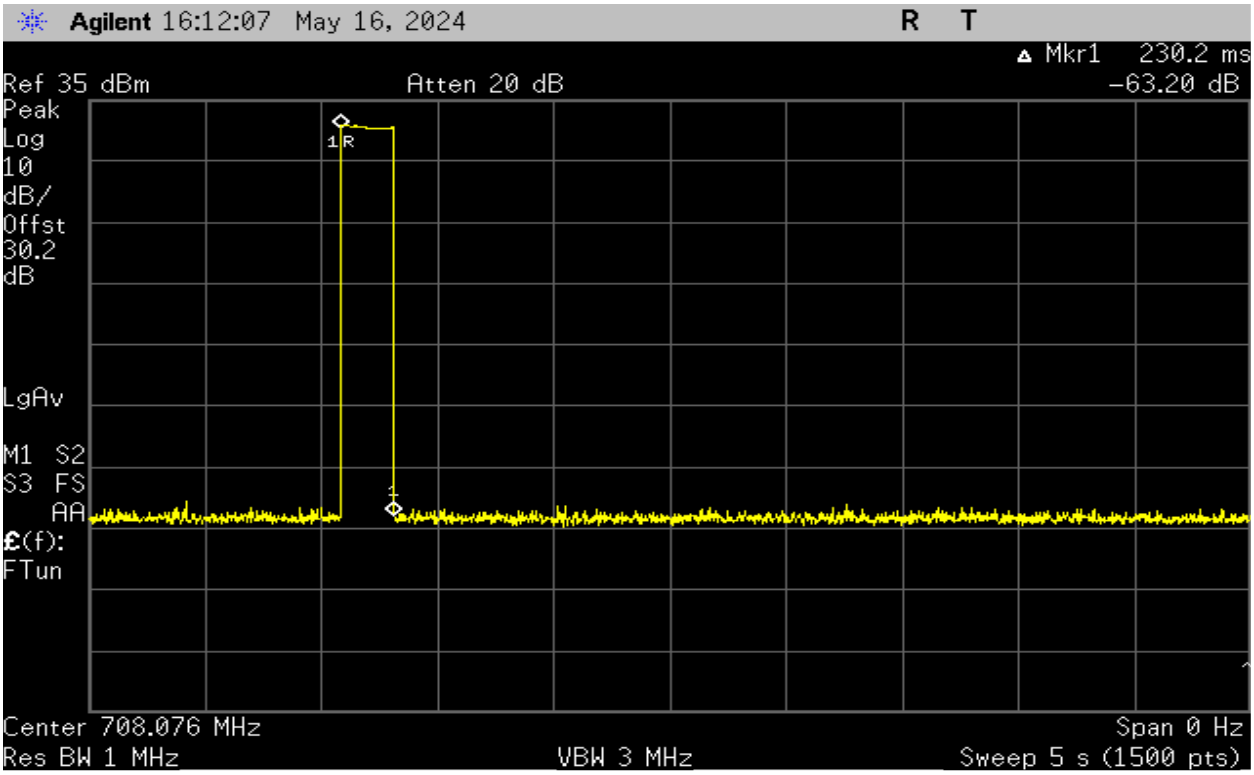
Table 33 –Downlink Restart Time – Summary

Frequency Band (MHz)	Restart	Limit
698-716	0	≤5
776-787	0	≤5
824-849	0	≤5
1710-1755	0	≤5
1850-1915	0	≤5

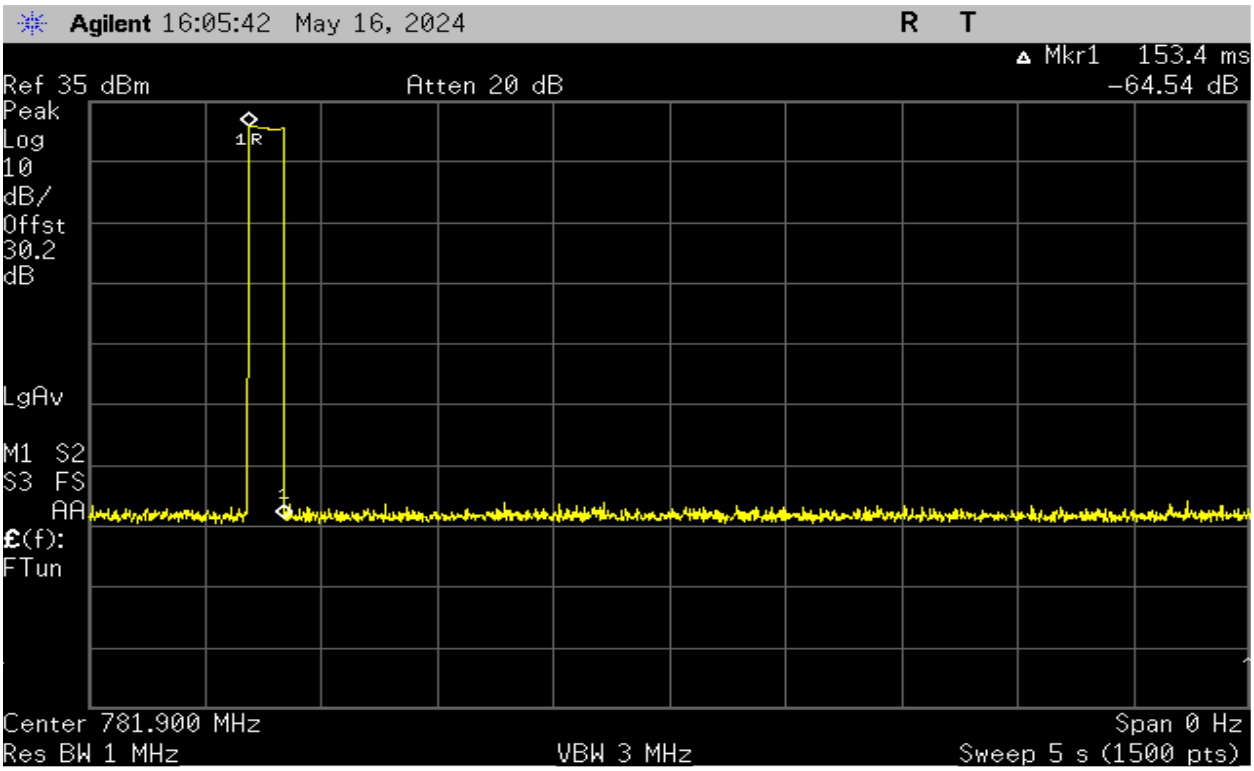
Table 34 –Uplink Restart Count – Summary

Frequency Band (MHz)	Restart	Limit
728-746	0	≤5
746-757	0	≤5
869-894	0	≤5
1930-1995	0	≤5
2110-2155	0	≤5

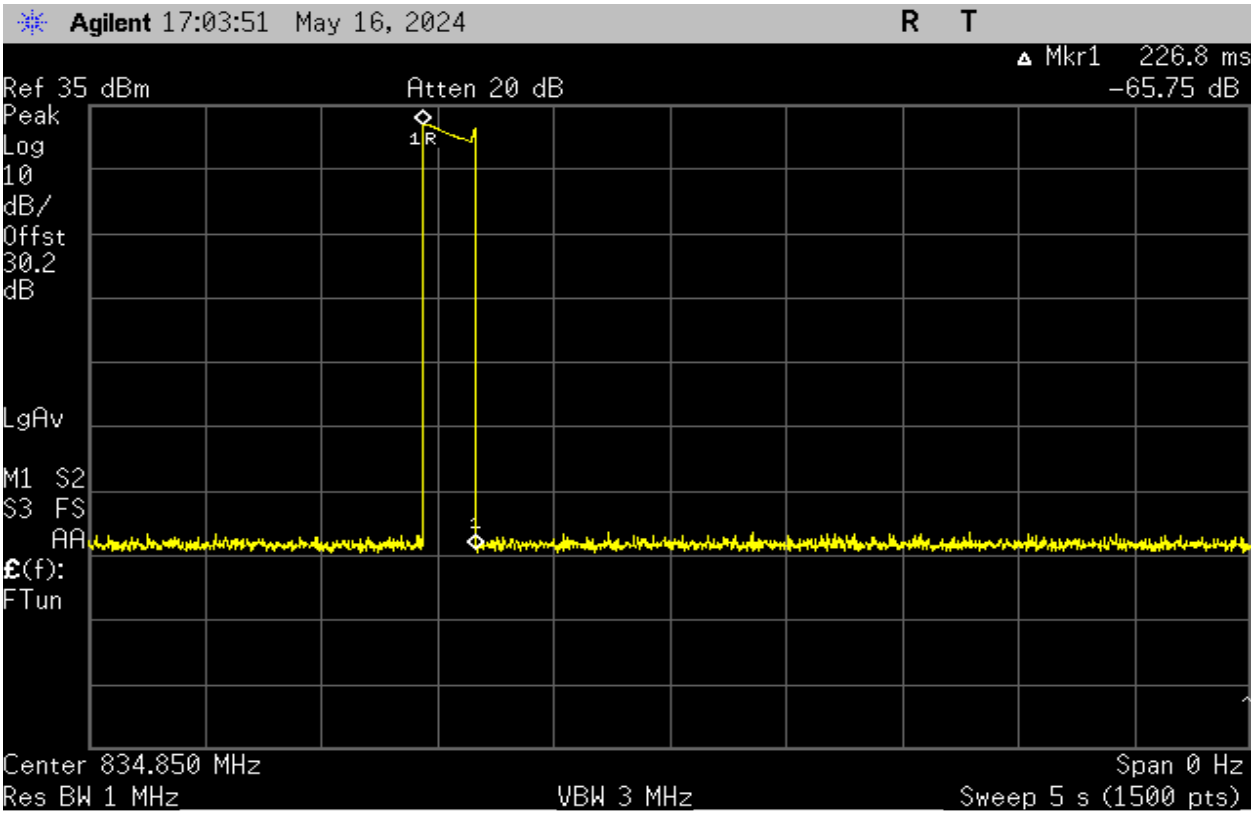
Table 35 –Downlink Restart Count – Summary



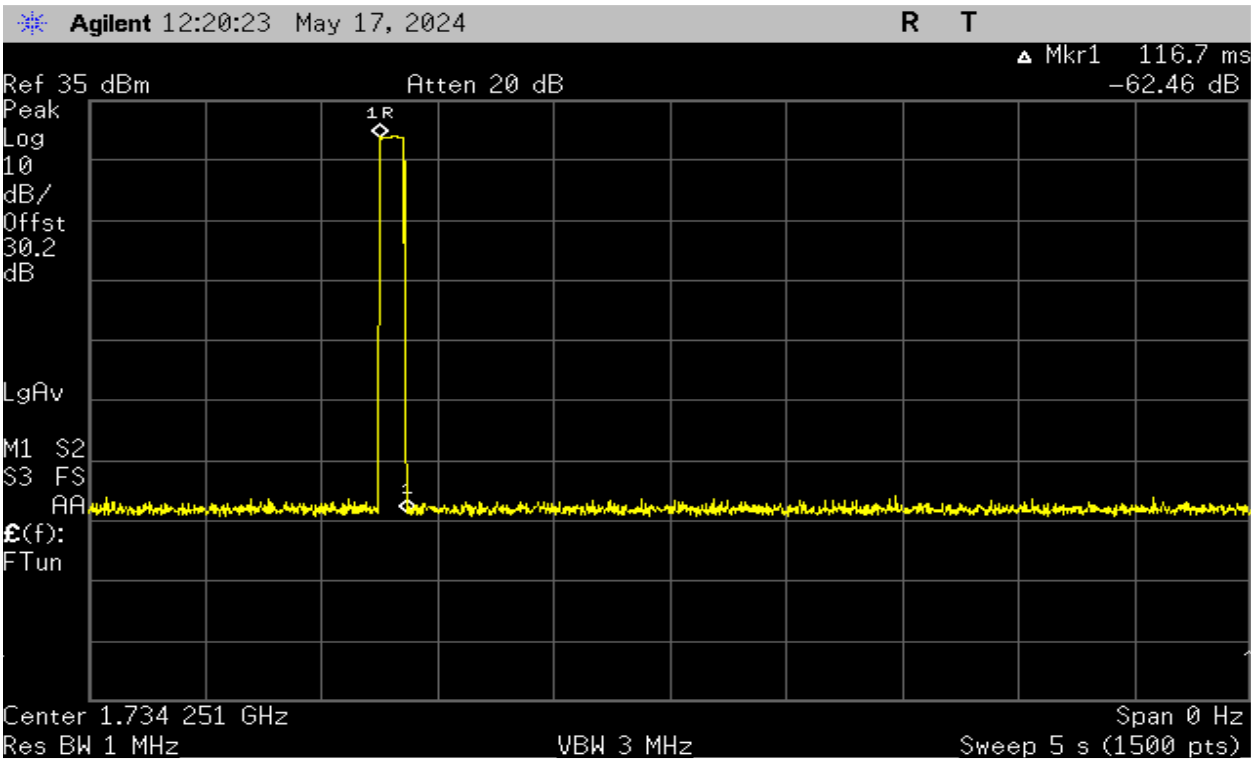
Plot 203 – 698-716MHz Band – Uplink Oscillation Detection Time



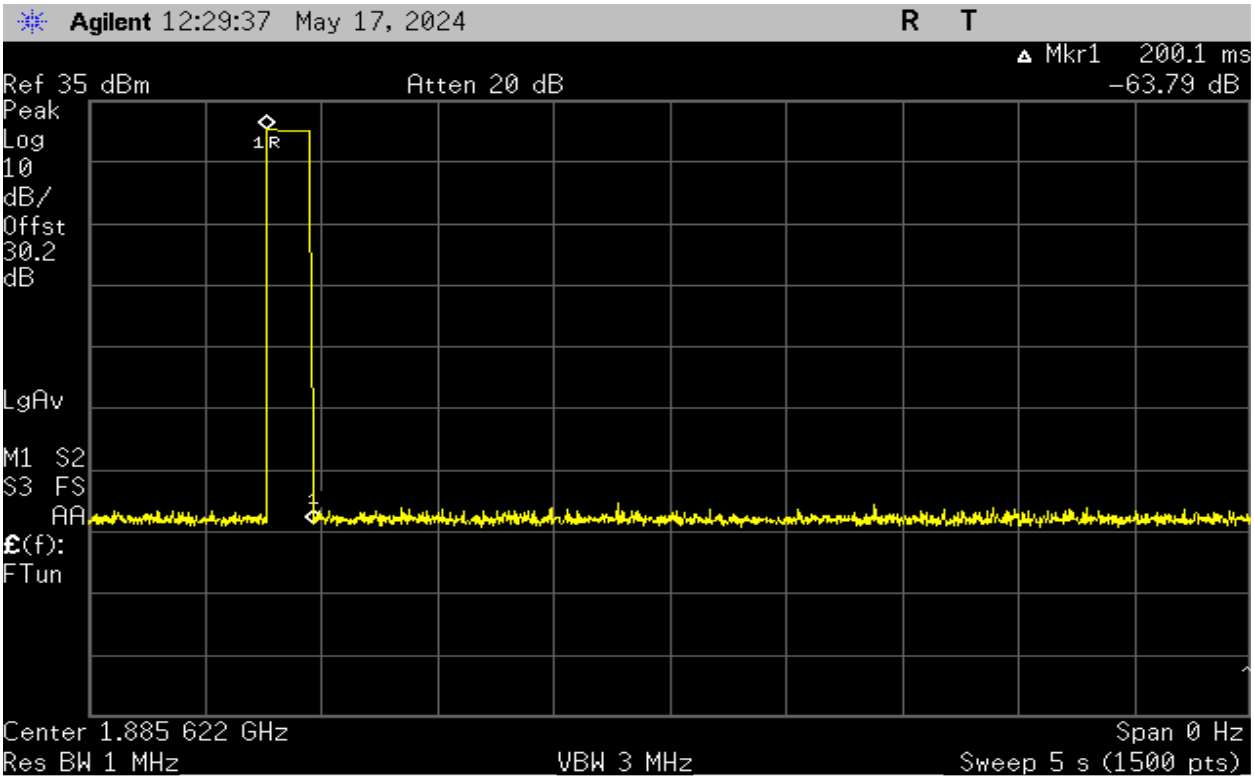
Plot 204 – 776-787MHz Band – Uplink Oscillation Detection Time



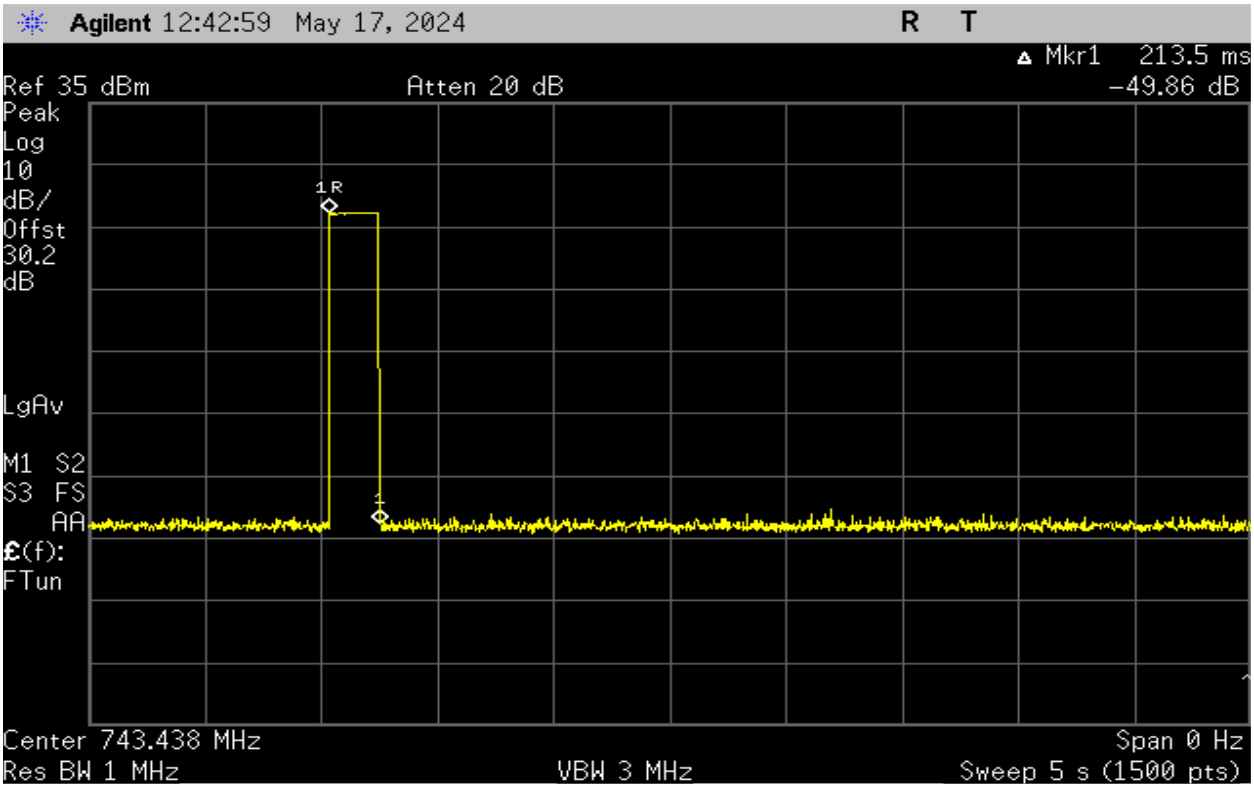
Plot 205 – 824-849MHz Band – Uplink Oscillation Detection Time



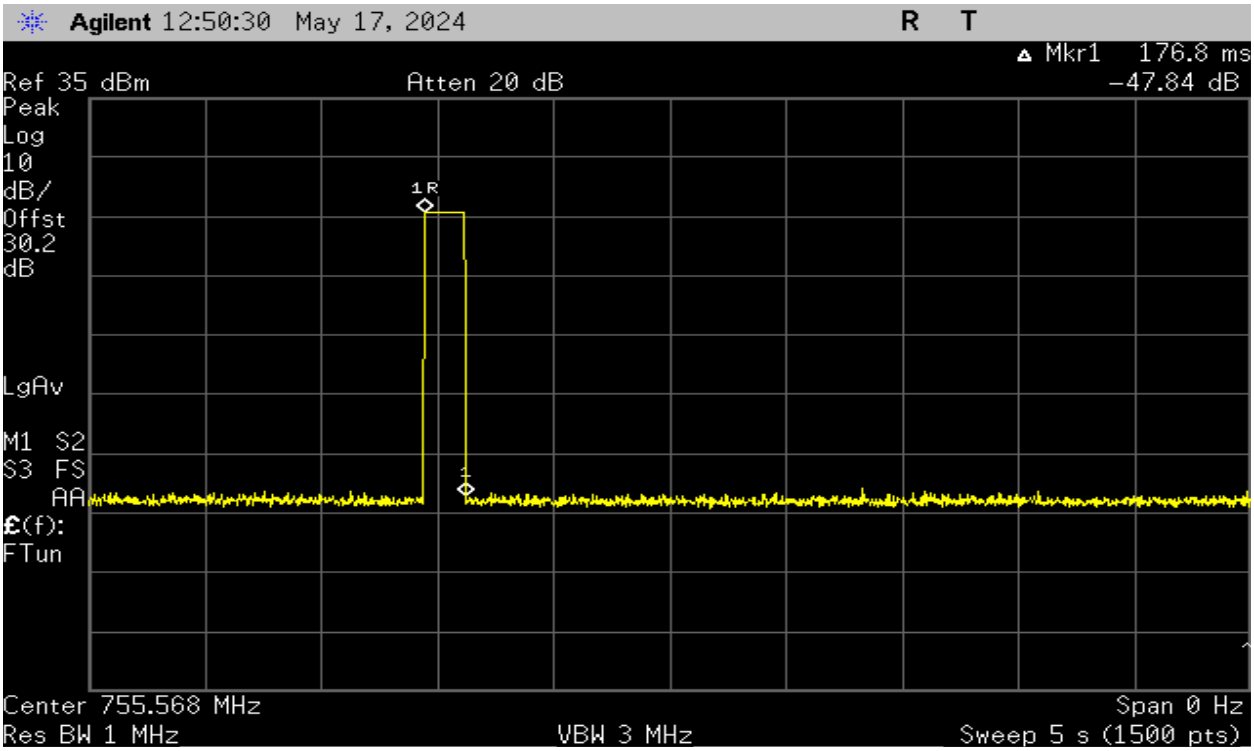
Plot 206 – 1710-1755MHz Band – Uplink Oscillation Detection Time



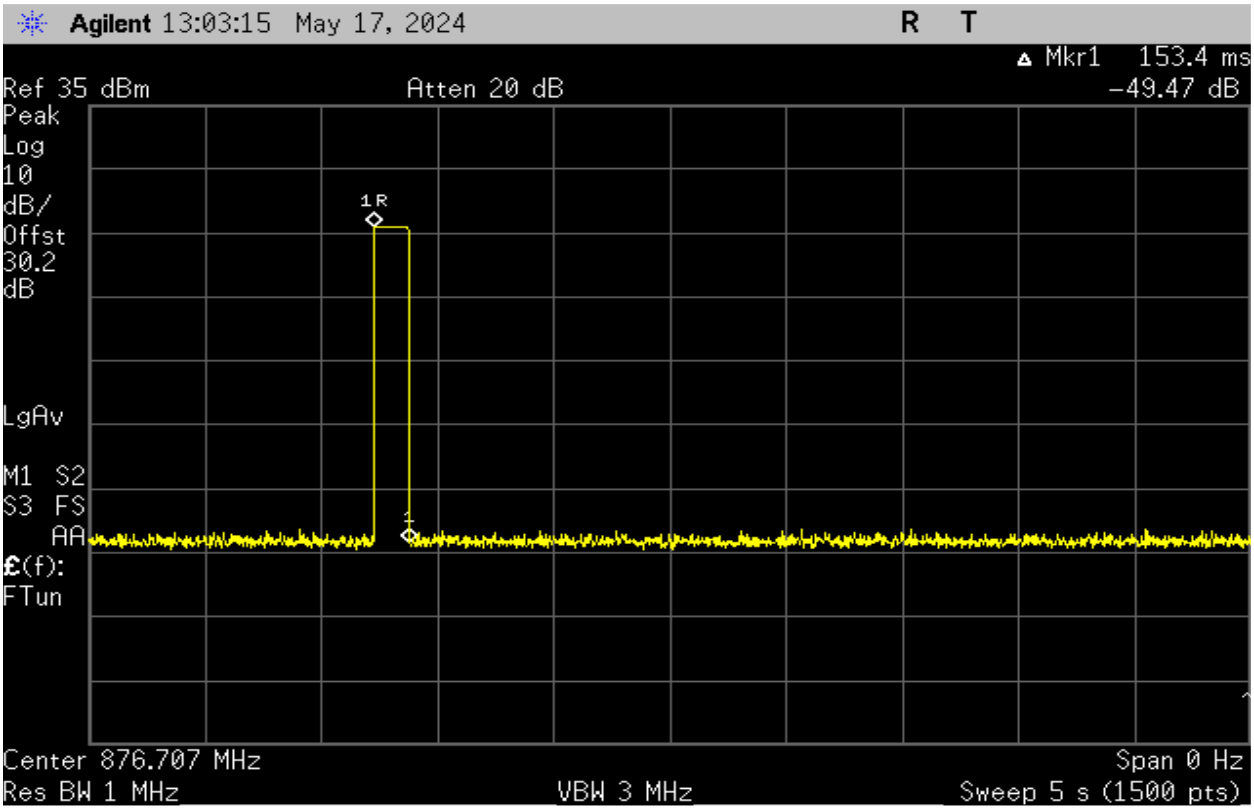
Plot 207 – 1850-1915MHz Band – Uplink Oscillation Detection Time



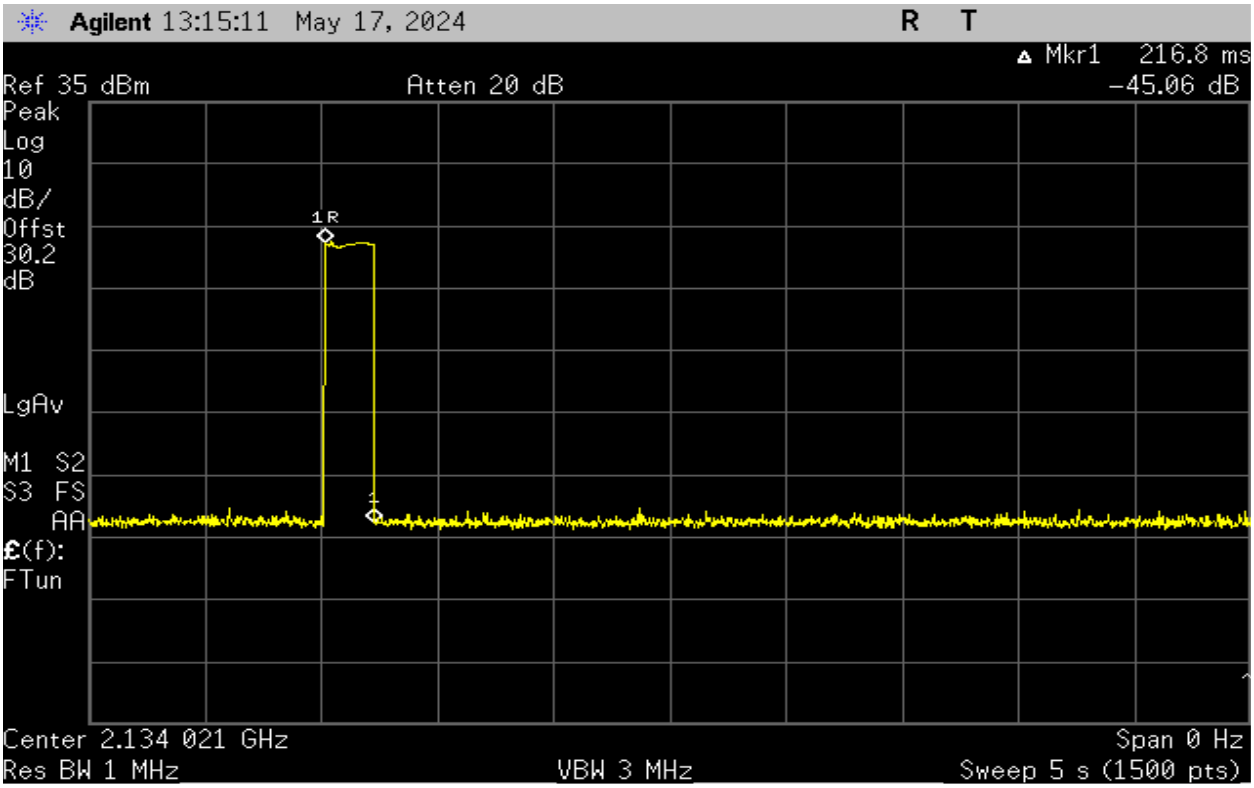
Plot 208 – 728-746MHz Band – Downlink Oscillation Detection Time



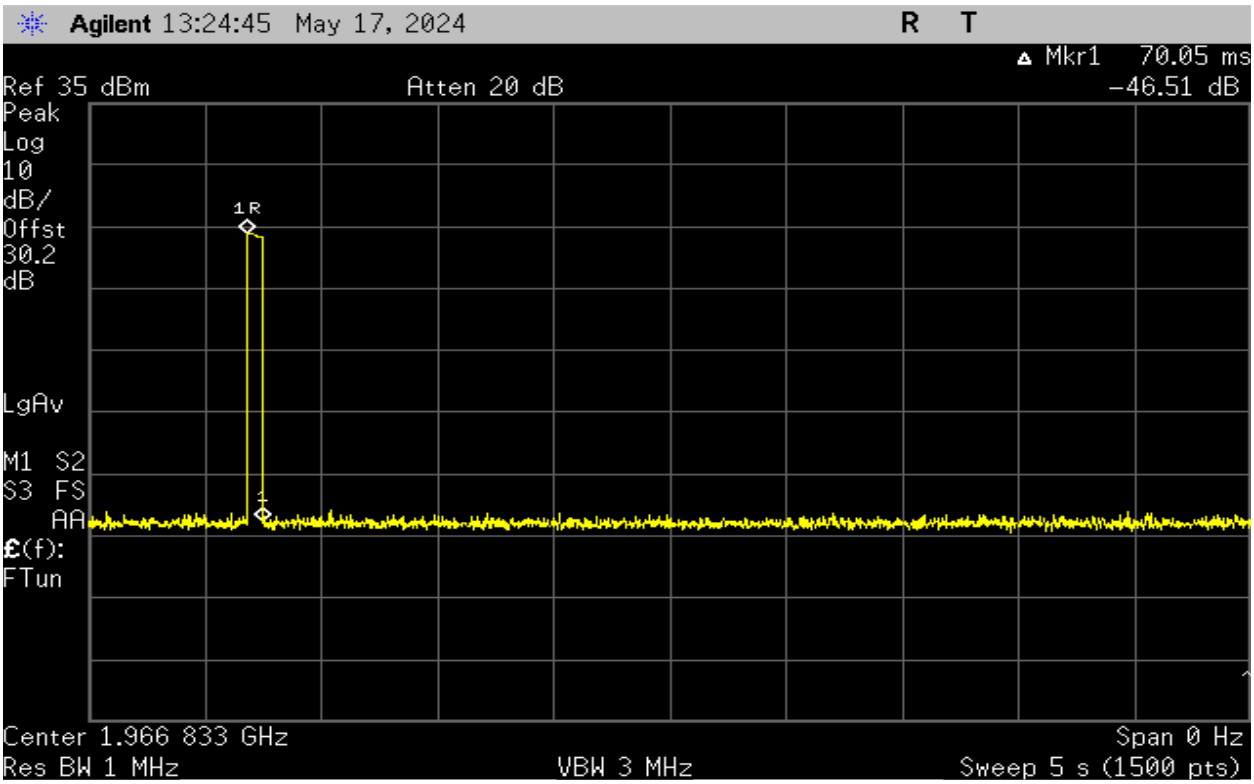
Plot 209 – 746-757MHz Band – Downlink Oscillation Detection Time



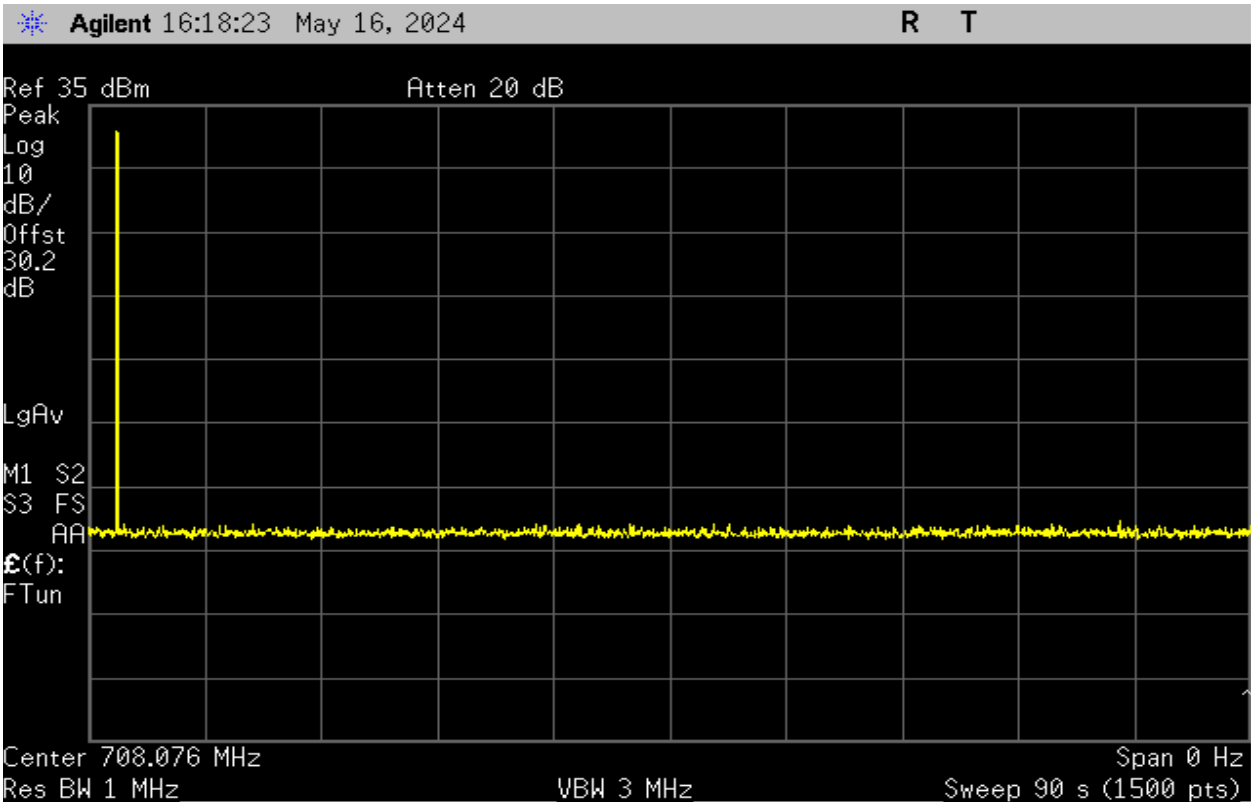
Plot 210 – 869-894MHz Band – Downlink Oscillation Detection Time



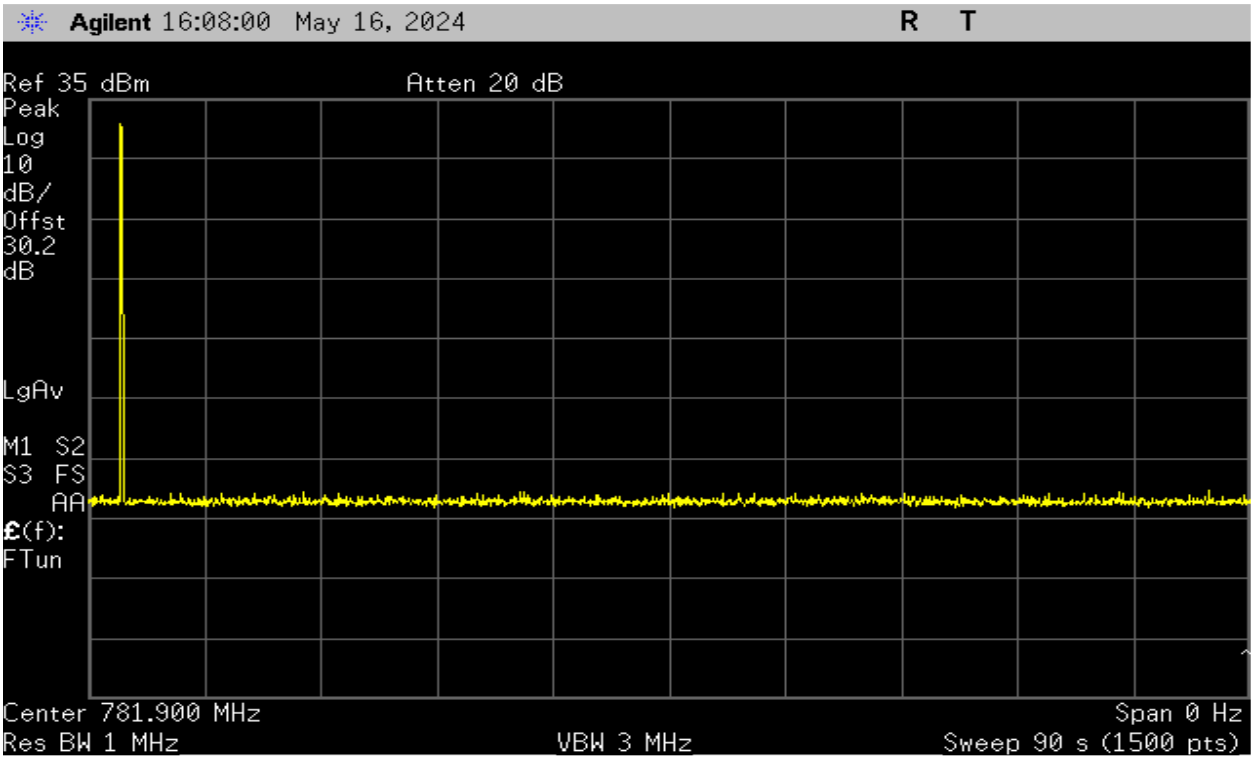
Plot 211 – 1930-1995MHz Band – Downlink Oscillation Detection Time



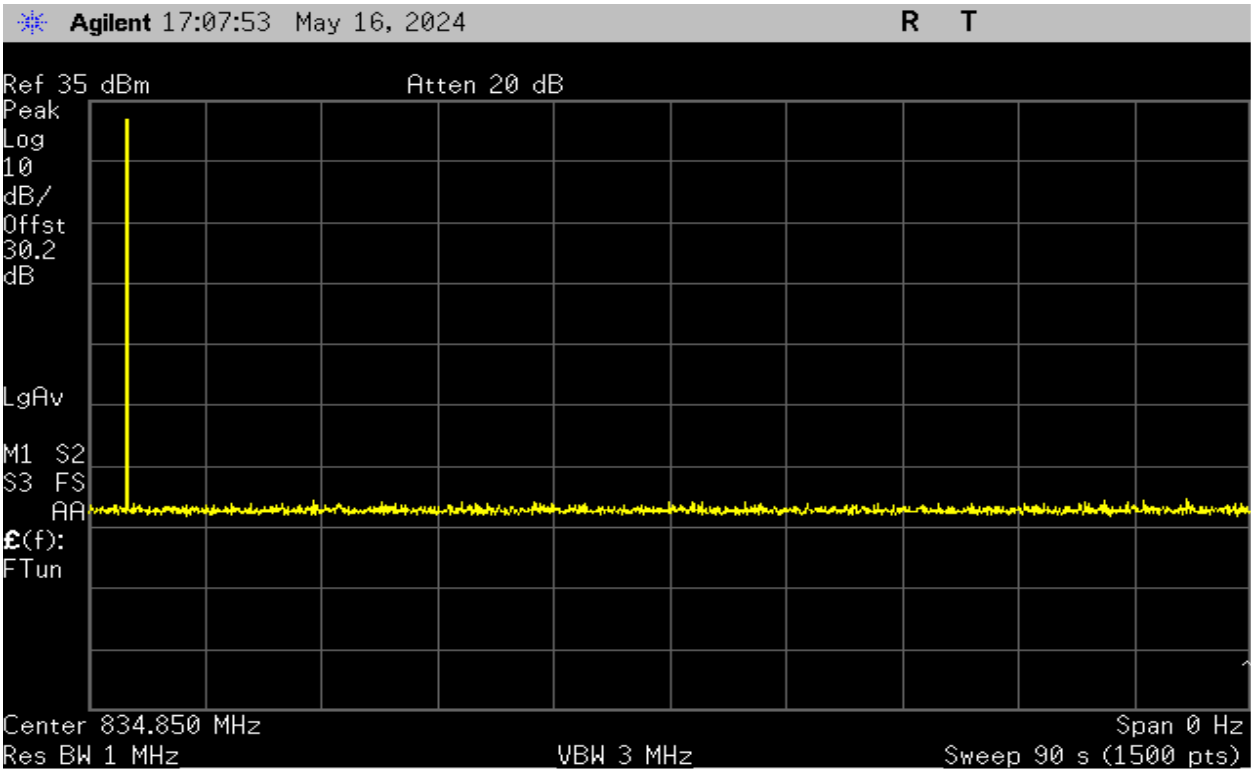
Plot 212 – 2110-2155MHz Band – Downlink Oscillation Detection Time



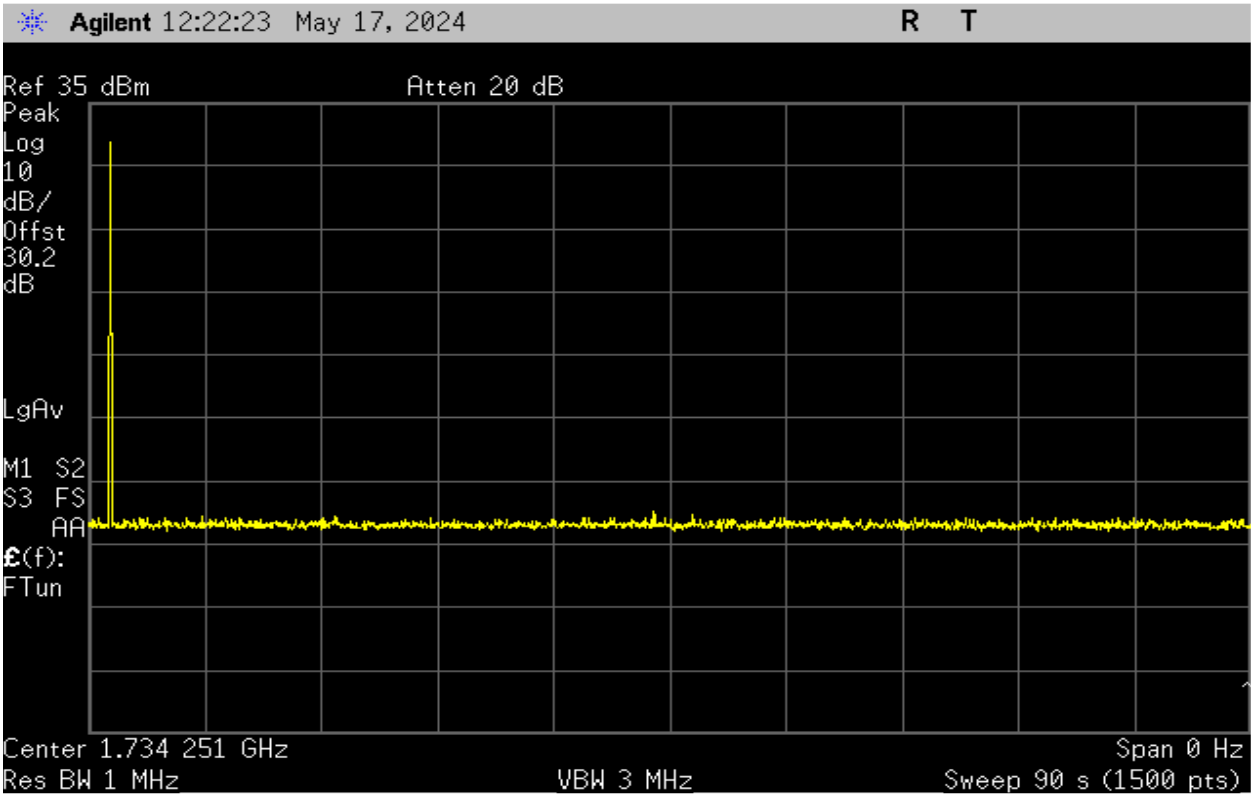
Plot 213 – 698-716MHz Band –Uplink Restart Time



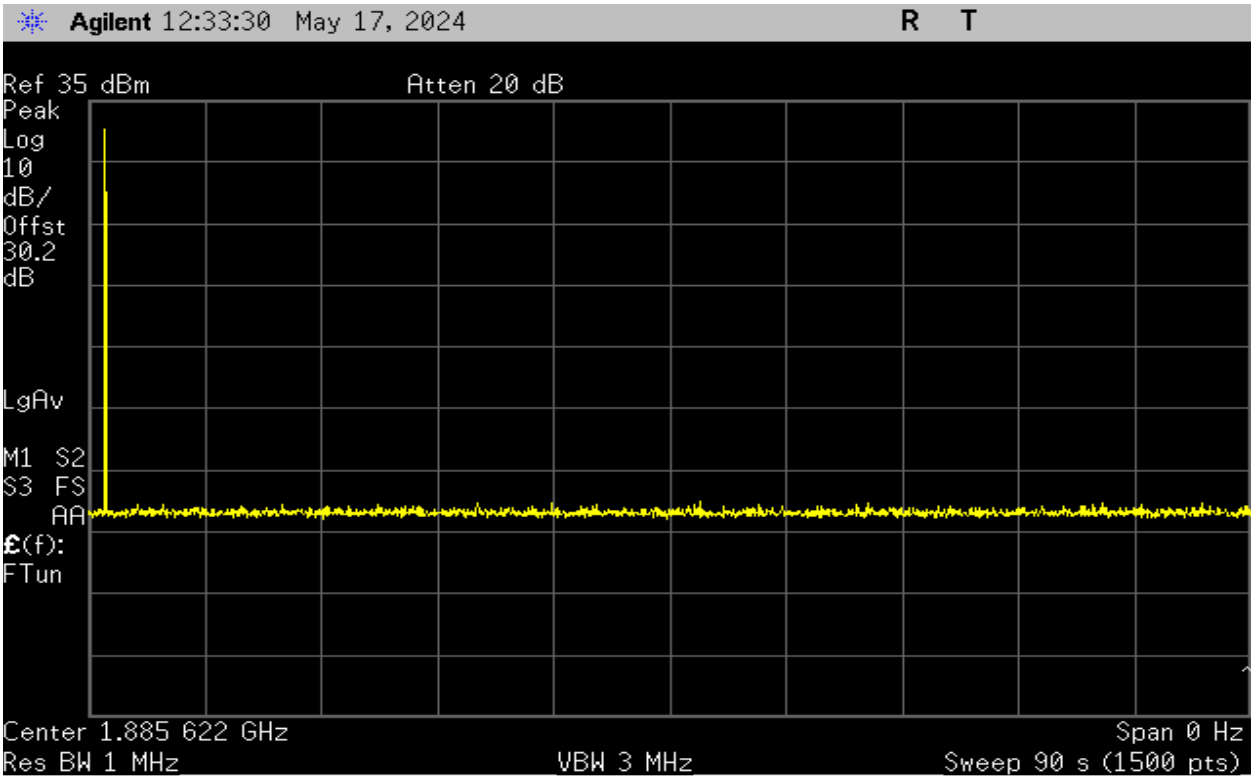
Plot 214 – 776-787MHz Band –Uplink Restart Time



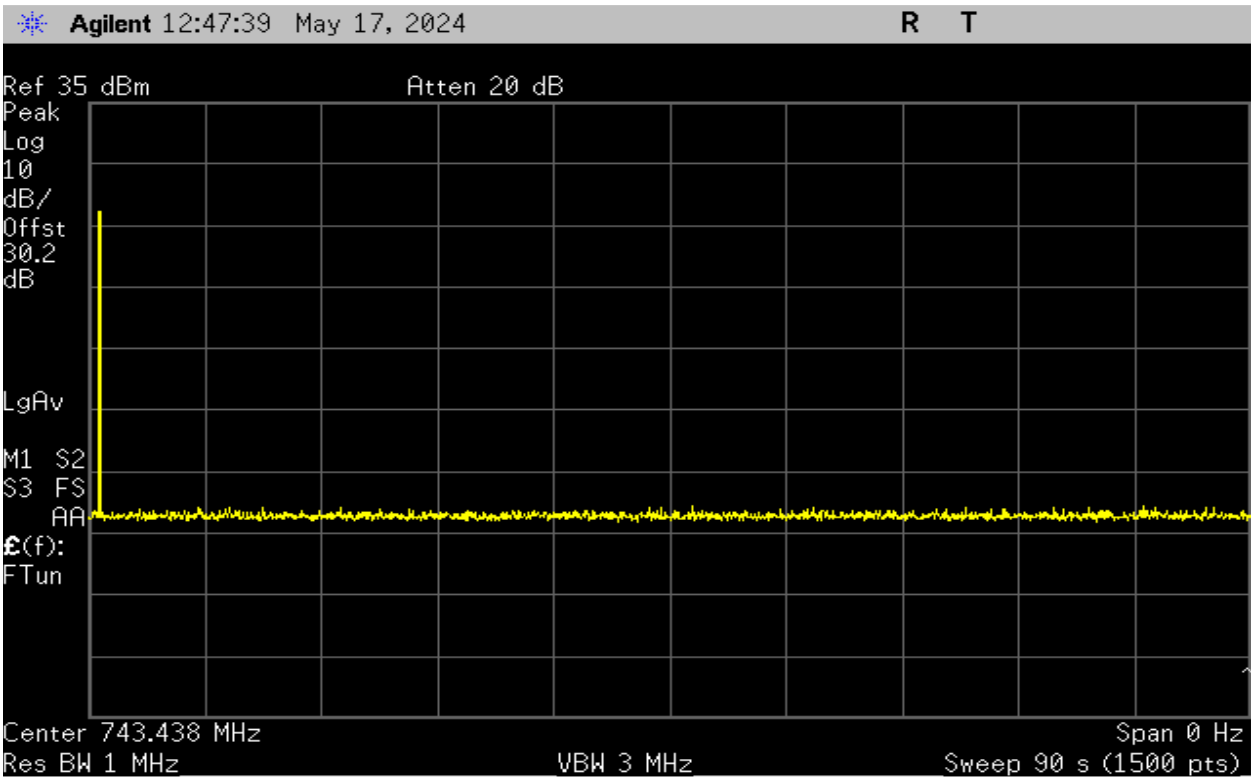
Plot 215 – 824-849MHz Band –Uplink Restart Time



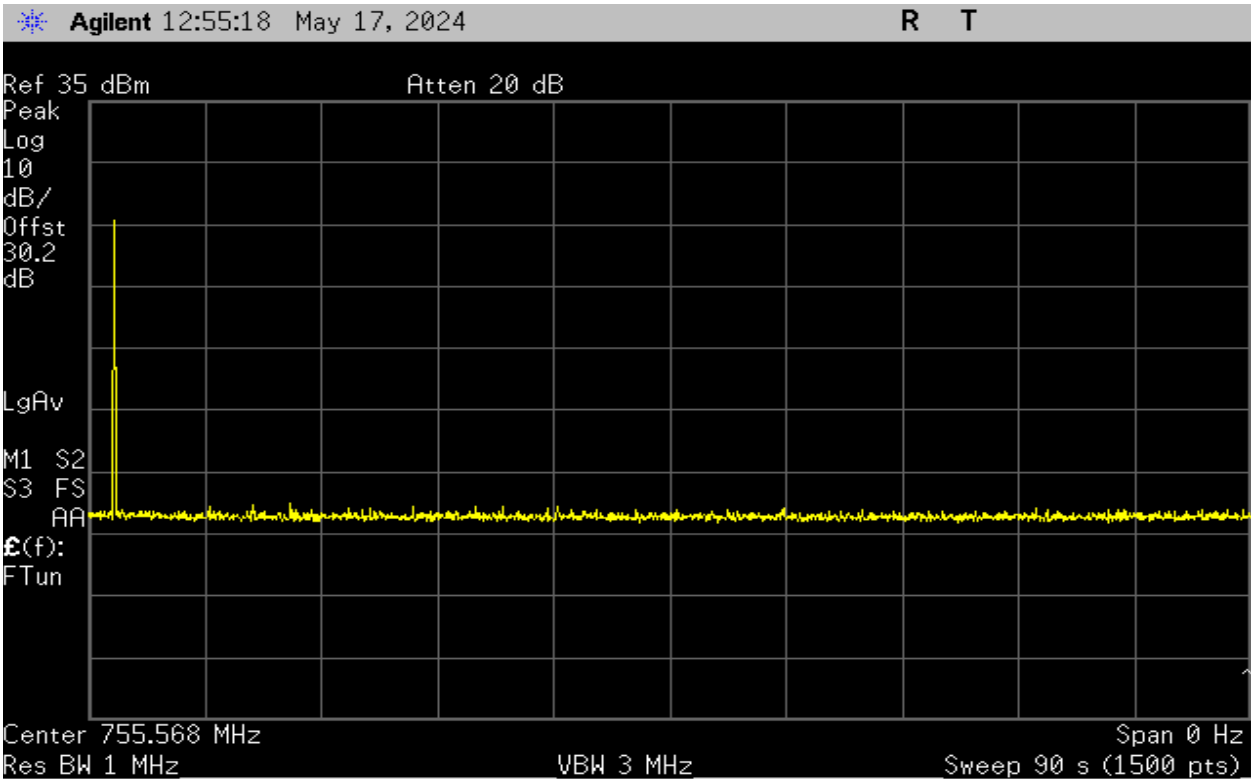
Plot 216 – 1710-1755MHz Band –Uplink Restart Time



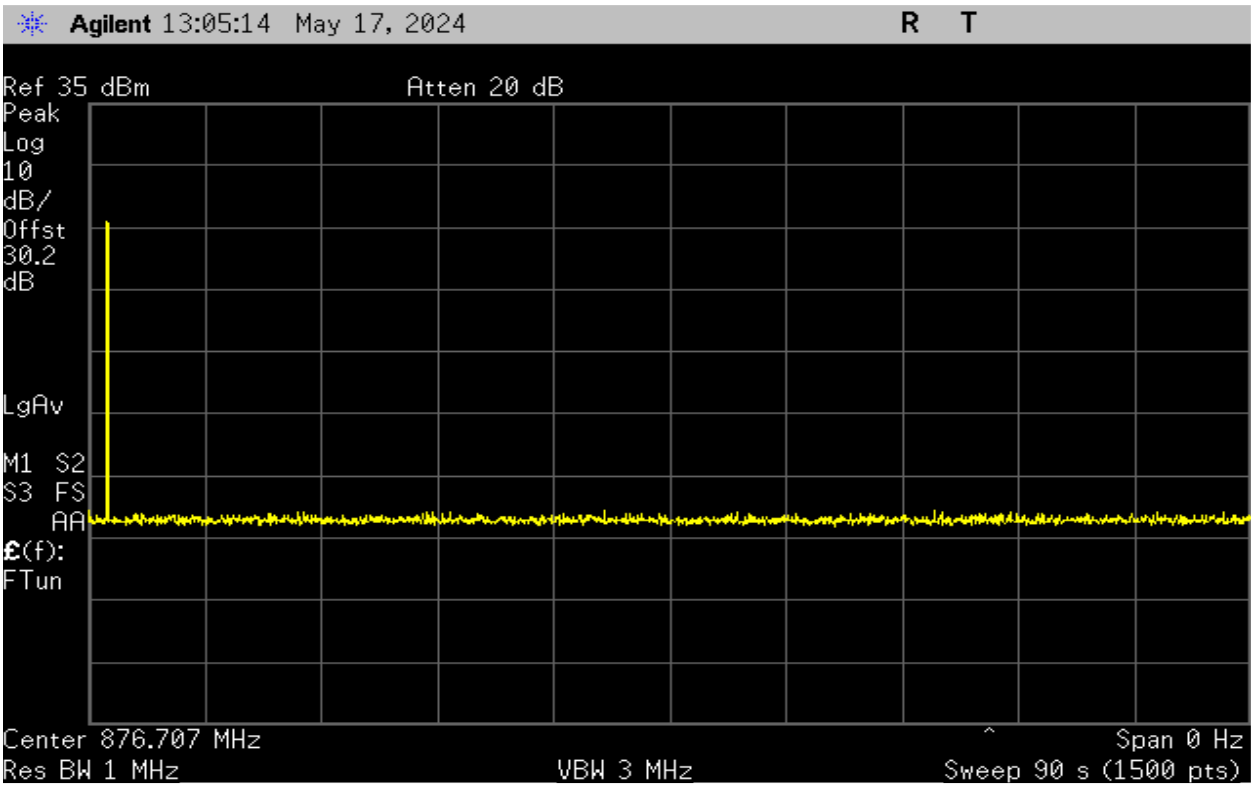
Plot 217 – 1850-1915MHz Band –Uplink Restart Time



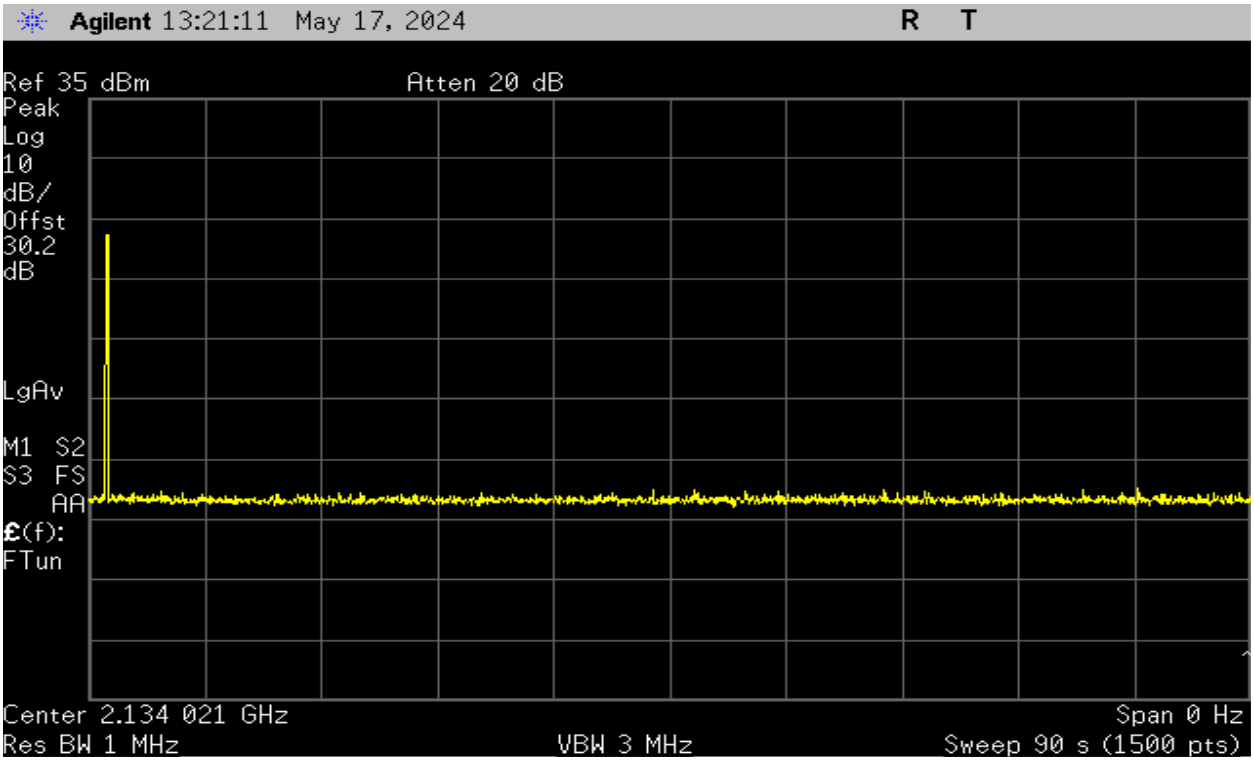
Plot 218 – 728-746MHz Band –Downlink Restart Time



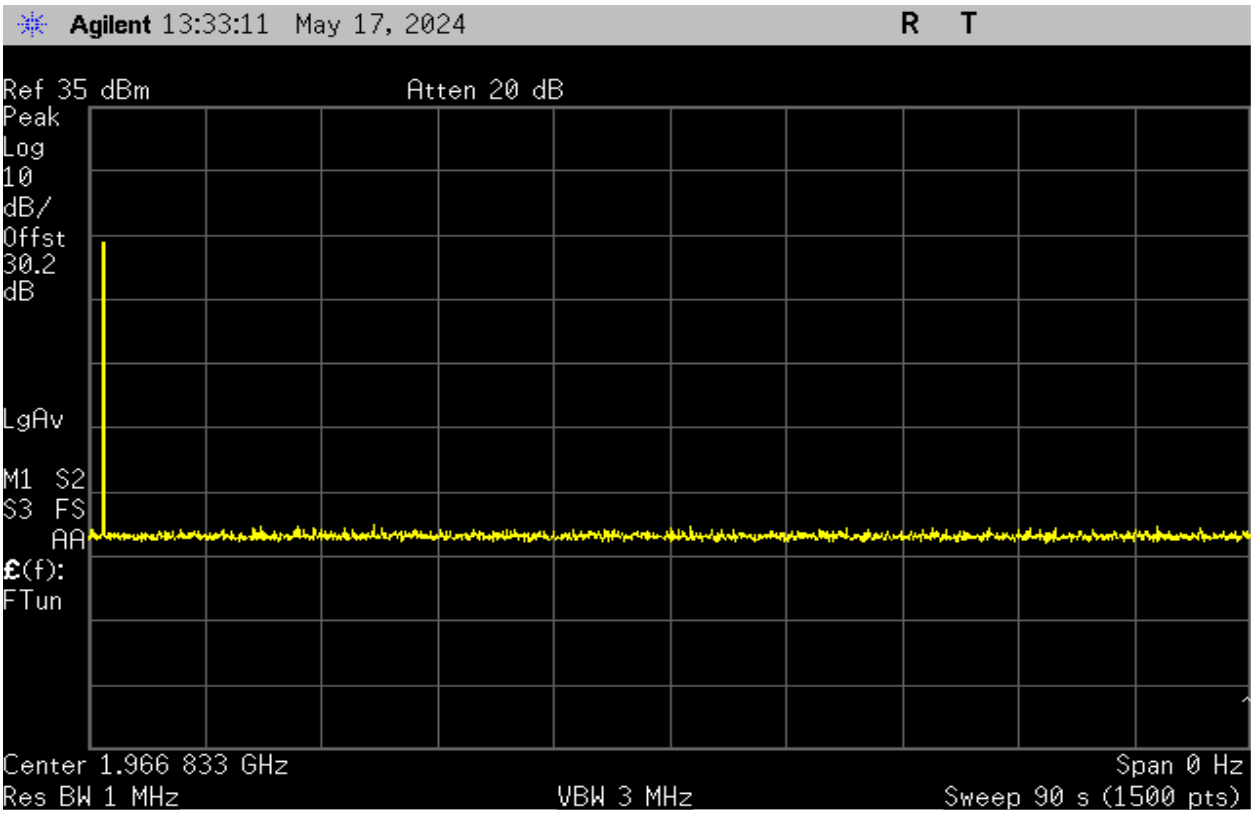
Plot 219 – 746-757MHz Band –Downlink Restart Time



Plot 220 – 869-894MHz Band –Downlink Restart Time



Plot 221 – 1930-1995MHz Band –Downlink Restart Time



Plot 222 – 2110-2155MHz Band –Downlink Restart Time

11. Radiated Spurious Emissions

Test Requirement(s):	§2.1053	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	May 20, 2024

Test Procedures:

As required by 47 §2.1053, Radiated Spurious Emissions measurement were made in accordance with the procedures of ANSI C63.26-2015 and KDB 935210 D03 §7.12.

The EUT was placed on a wooden table inside a 3-meter open area alternate test site. 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:

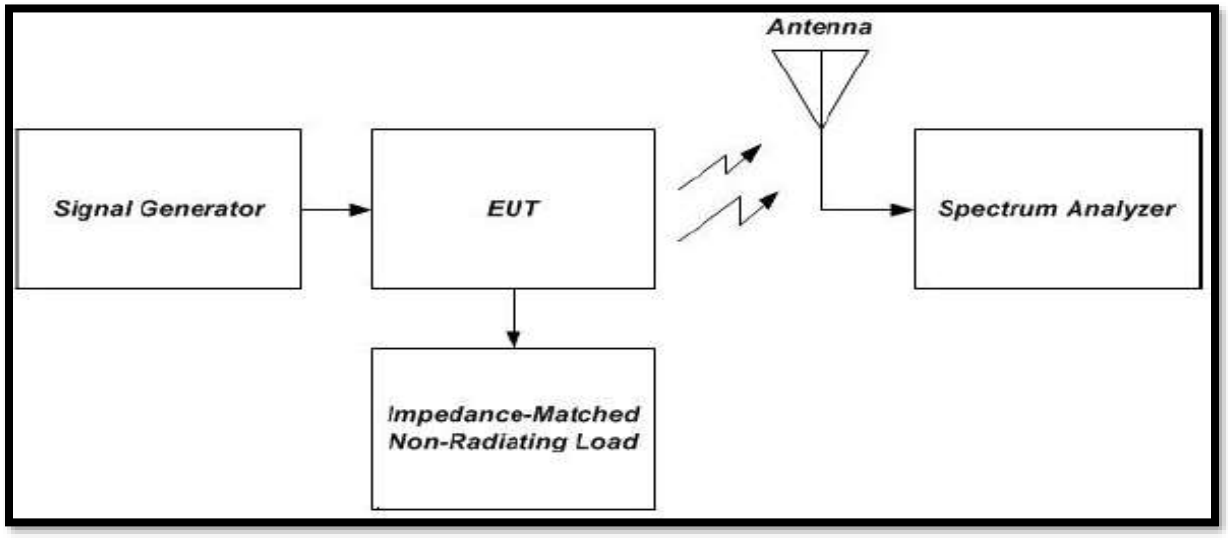
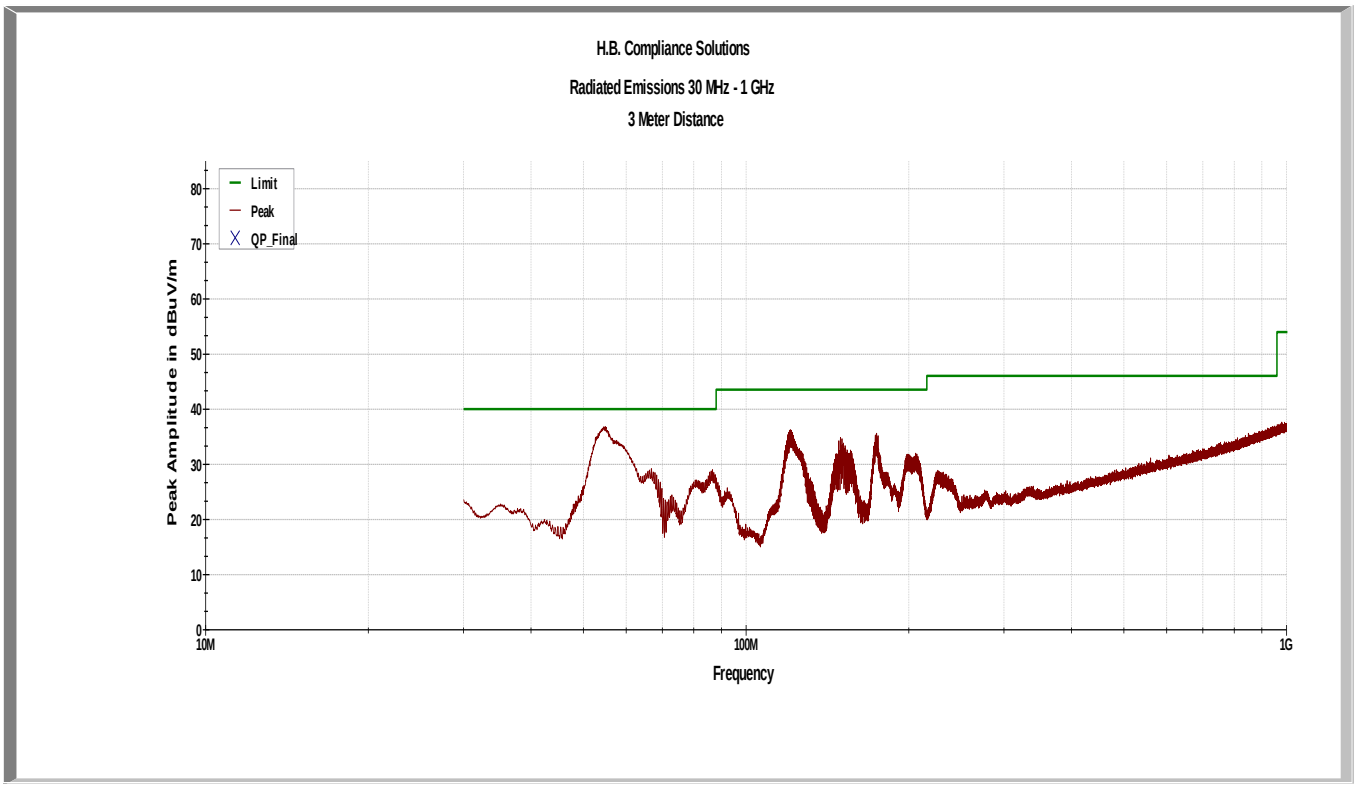


Figure 8 – Radiated Spurious Emission Test Setup



Plot 223 – Radiated Emissions – 30MHz to 1GHz

Frequency Band (MHz)	Measured Level (dBm)	Antenna Polarity (V/H)	Limit (dBm)	Margin (dBm)
1673	-63.47	V	-13	-50.47
2509	-64.0	V	-13	-51.0

Table 36 – 824-849MHz Uplink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Antenna Polarity (V/H)	Limit (dBm)	Margin (dBm)
3765	-58.09	V	-13	-45.09
5647.5	-67.84	V	-13	-54.84

Table 37 – 1850-1915MHz Uplink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Antenna Polarity (V/H)	Limit (dBm)	Margin (dBm)
3465	-67.02	V	-13	-54.02
5197	-68.14	V	-13	-55.14

Table 38 – 1710-1755MHz Uplink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Antenna Polarity (V/H)	Limit (dBm)	Margin (dBm)
1414	-66.16	V	-13	-53.16
2121	Noise Floor	-	-13	-
2828	-67.76	V	-13	-54.76

Table 39 – 698-716MHz Uplink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Antenna Polarity (V/H)	Limit (dBm)	Margin (dBm)
1563	-66.95	V	-13	-53.95
2344.5	-66.31	V	-13	-53.31

Table 40 – 776-787MHz Uplink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Antenna Polarity (V/H)	Limit (dBm)	Margin (dBm)
1763	NF	V	-13	-
2644.5	NF	V	-13	-

Table 41 – 869-894MHz Downlink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Antenna Polarity (V/H)	Limit (dBm)	Margin (dBm)
3925	NF	V	-13	-
5887.5	NF	V	-13	-

Table 42 – 1930-1995MHz Downlink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Antenna Polarity (V/H)	Limit (dBm)	Margin (dBm)
4265	NF	V	-13	-
6397.5	NF	V	-13	-

Table 43 – 2110-2155MHz Downlink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Antenna Polarity (V/H)	Limit (dBm)	Margin (dBm)
1474	NF	V	-13	-
2211	NF	V	-13	-

Table 44 – 728-746MHz Downlink Band – Radiated Spurious Test Data

Frequency Band (MHz)	Measured Level (dBm)	Antenna Polarity (V/H)	Limit (dBm)	Margin (dBm)
1503	NF	V	-13	-
2254.5	NF	V	-13	-

Table 45 – 746-757MHz Downlink Band – Radiated Spurious Test Data

NOTE: There were no detectable emissions above the 3rd harmonic. Measurement was made above 2nd harmonic to show the Receiver Noise Floor (N.F).

For the Downlink, no emissions were detected above the noise floor of the system more than 40 dBm below the applicable limit.

12. Test Equipment

Equipment	Manufacturer	Model	Serial #	Last Cal Date	Cal Due Date
Spectrum Analyzer	Agilent	E4443A	US41420164	Jun-01-23	Jun-01-24
Spectrum Analyzer	Hewlett Packard	8563E	3821A09316	May-08-23	May-08-24
Directional Coupler	Andrew	C-10-CPUS-N	150503142544	Verified	
Attenuator 20dB	Weinschel	41-20-12	86332	Verified	
Variable Attenuator	JFW	50R-320-SMA	7054221439	Verified	
Signal Generator	Agilent	E4432B	US40053021	Apr-22-22	May-22-24
Signal Generator	Agilent	E4432B	US38220446	Verified	
Horn Antenna	Com-Power	AHA-118	071150	Jan-09-23	Jan-09-25
GTEM Antenna	EMCO	5417	1063	Dec-19-22	Dec-19-25
EMI Receiver	Rohde & Schwarz	ESMI26	840607/005	Nov-15-23	Nov-15-24
Spectrum Analyzer	Hewlett Packard	8566B	2747A05264/ 2318A04952	Feb-01-24	Feb-01-25

Table 46 – Test Equipment List

***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)

13. Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. These measurements figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2. Instrumentation measurement uncertainty has **not** been taken into account to determine compliance.

The following measurement uncertainty values have been calculated as show in the table below:

Measured Parameter	Measurement Unit	Frequency Range	Expanded Uncertainty
Conducted Emissions (AC Power)	dBuV or dBuA	150kHz – 30MHz	± 4.3dB
Radiated Emissions below 1GHz	dBuV/m	30 – 1000MHz	± 5.6dB
Radiated Emissions above 1GHz	dBuV/m	1 – 26.5GHz	± 4.1dB

The reported expanded uncertainty has been estimated at a 95% confidence level (k=2)

END OF TEST REPORT