

Cellphone-Mate, Inc.

REVISED TEST REPORT TO 104002-11

Active Antenna
Model: SC-LTE-V

Tested to The Following Standard:

FCC Part 20.21 / 22H / 24E / 27

Report No.: 104002-11A

Date of issue: June 25, 2020



Test Certificate # 803.01

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Cellphone-Mate, Inc.
48346 Milmont Drive
Fremont CA 94538

Representative: Dennis Findley
Customer Reference Number: CKC20200519

DATE OF EQUIPMENT RECEIPT:**DATE(S) OF TESTING:****REPORT PREPARED BY:**

Terri Rayle
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 104002

May 20, 2020

May 20-28, 2020 and June 8, 2020

Revision History

Original: Testing of the Model: SC-LTE-V to FCC Part 20.21 / 22H / 24E / 27

Revision A: The manufacturer declares the device name given at the time of testing was in error and should have been referenced as, Active Antenna. The manufacturer declares that any differences between the names does not affect their EMC characteristics and therefore meets the level of testing equivalent to the tested device name.

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.

A handwritten signature in black ink, reading "Steve Behm", is written over a horizontal line.

Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information



Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
1120 Fulton Place
Fremont, CA 94539

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.12
EMITest Immunity	5.03.10

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Japan
Canyon Park, Bothell, WA	US0081	US1022	A-0136
Brea, CA	US0060	US1025	A-0136
Fremont, CA	US0082	US1023	A-0136
Mariposa, CA	US0103	US1024	A-0136

*CKC's list of NIST designated countries can be found at: <https://standards.gov/cabs/designations.html>

SUMMARY OF RESULTS

Standard / Specification: FCC Part 20.21/22H/24E/27

Wideband Consumer Signal Booster Measurement Guidance: KDB 935210 D03 Signal Booster Measurements v04r04, dated April 03, 2020

Correlation Matrix & Results					
Guidance Section	Guidance Description	FCC Section	FCC Rule Description	Mods	Results
7.1 a) - k)	Authorized Frequency Band Verification Test	20.21(e)(3)	Frequency Bands	NA	Pass
7.2.2 a) - k)	Maximum Power Measurement Procedure	2.1046/20.21(e)(8)(i)(D)	Power Limit	NA	Pass
7.3 a) - d)	Maximum Booster Gain Computation	20.21(e)(8)(i)(B)	Bidirectional Capabilities	NA	Pass
7.4 a) - n)	Intermodulation Product	20.21(e)(8)(i)(F)	Intermodulation Limit	NA	Pass
7.5 a) - n)	Out of Band Emissions	20.21(e)(8)(i)(E)	Out of Band Emission	NA	Pass
7.6 a) - e)	Conducted Spurious Emission	2.1051/22H/24E/27	Spurious emission	NA	Pass
7.7.1 a) - g) 7.7.1 h) - n) 7.7.2 a) - g)	Noise Limit Procedure Variable Noise Variable Noise Timing	20.21(e)(8)(i)(A)(2)(i) 20.21(e)(8)(i)(A)(1) 20.21(e)(8)(i)(H)	Noise Limits Transmit Power Off Mode	NA	Pass
7.8 a) - l)	Uplink inactivity	20.21(e)(8)(i)(I)	Uplink Inactivity	NA	Pass
7.9.1 a) - l) 7.9.2 a) - f)	Variable Booster Gain Variable Uplink Gain Timing	20.21(e)(8)(i)(C) (1), (2)(i) 20.21(e)(8)(i)(H)	Booster Gain Transmit Power Off Mode	NA	Pass
7.10.a) - j)	Occupied Band Width	2.1049/22H/24E/27	Occupied Band Width	NA	Pass
7.11.2 a) - r) 7.11.3 a) - h) 7.11.4 a) - h) (alternate to 7.11.3) 7.11.13 a) - h)	Anti-Oscillation	20.21(e)(8)(ii)(A)	Anti-Oscillation	NA	Pass
					NA4

SUMMARY OF RESULTS - continued

Standard / Specification: FCC Part 20.21/22H/24E/27

Wideband Consumer Signal Booster Measurement Guidance: KDB 935210 D03 Signal Booster Measurements v04r04, dated April 03, 2020.

Correlation Matrix & Results					
Guidance Section	Guidance Description	FCC Section	FCC Rule Description	Mods	Results
7.12a) - f)	Radiated Spurious Emission	2.1053/ 22H/24E/27	Spurious Emission	NA	Pass
7.13 a) - c)	Spectrum Block Filter			NA	NA1
7.14.2	Verification of self-monitoring	NA2	NA2	NA	NA2
7.14.3	Verification of two-enclosure booster system operation				
7.15	Additional requirements for Single donor port multiple server port single enclosure consumer signal booster	NA3	NA3	NA	NA3

NA = Not applicable

NA1 = Not applicable because this device does not employ spectrum block filter.

NA2 = Not applicable because this device does not employ dual enclosure operation.

NA3 = Not applicable because this device does not a Single donor port multiple server port single enclosure consumer signal booster.

NA4 = Not applicable because the max gain of the device is less than or equal to 15dB

ISO/IEC 17025 Decision Rule
The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions
No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions
None

EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
Active Antenna*	Cellphone-Mate, Inc.	SC-LTE-V	1

* See Revision History for Manufacturer Declaration

Support Equipment:

Device	Manufacturer	Model #	S/N
Power Supply	SureCall	GME12E-12100FUR-1	NA

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Equipment	Direct Connect, Mobile Wideband Consumer booster/Zone Enhancer
Operating Frequency Range:	UL: 824-849MHz DL: 869-894MHz UL: 1850-1915MHz DL: 1930-1995MHz UL: 1710-1755MHz, 776-787MHz DL: 2110-2155MHz, , 746-757MHz
Emissions Type(s):	GXW (GSM) G7W (EDGE) F9W(CDMA) F9W(WCDMA) W7D (LTE)
Modulation Type(s):	0.3 GMSK (GSM) 3p/8 8-PSK (EDGE) QPSK (CDMA) BPSK/QPSK (WCDMA) OFDM (LTE)
Number of TX Chains:	1
Antenna Type(s) and Gain:	Dedicated, See antenna kitting information
Beamforming Type:	NA
Antenna Connection Type:	Donor/Outdoor antenna/ UL: 50 ohm UFL (integral antenna) Server / indoor antenna/ DL: 50 ohm SMA
Nominal Input Voltage:	12V DC from support power supply
Firmware used for Test:	M2M_30_V2.hex v3.2

FCC PART 20.21/22H/24E/27

General Test Setup

Summary of Conditions

The equipment under test (EUT) is a Direct Connect, Mobile Wideband Consumer Booster intended for automotive.

The EUT is placed on the Styrofoam platform for radiated emission and a test bench for conducted emission measurement.

Conducted measurement performed at the Outside (Donor) and Inside (Server) antenna port.

The EUT Server port is a SMA connector at the end of a non-removal RF cable and 50-ohm impedance.

The EUT Donor port is UFL connector with integral antenna 50-ohm impedance.

UL: 824-849MHz

DL: 869-894MHz

UL: 1850-1915MHz

DL: 1930-1995MHz

UL: 1710-1755MHz, 776-787MHz

DL: 2110-2155MHz, 746-757MHz

The test was performed in accordance with the FCC document: 935210 D03 Signal Booster Measurements v04r0, dated April 03, 2020.

Test environment conditions:

Temperature: 21.8°C

Relative Humidity: 44 %

Pressure: 102kPa

Device is powered by a support 12V DC power supply

7.1 Authorized Frequency Band Verification

Test Setup/Conditions

Test Engineer:	E. Wong
Test Date(s):	5/20/2020
Configuration:	1
Test Setup:	See General Test Setup

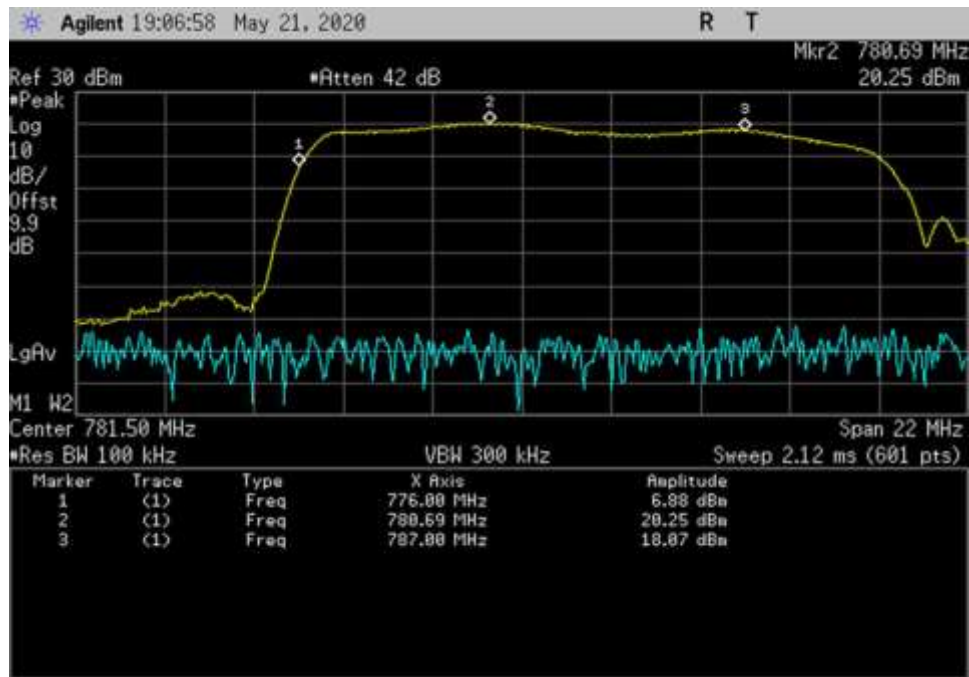
Test Equipment

Asset #	Description	Model	Calibration Date	Cal Due Date
02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
P05411	Attenuator	54A-10	11/27/2019	11/27/2021
P06898	Cable	32022-29094K-29094K-48TC	3/25/2020	3/25/2022
P07192	Cable	32022-29094K-29094K-48TC	11/27/2019	11/27/2021
C00032	Signal Generator	E4433B	3/30/2020	3/30/2022

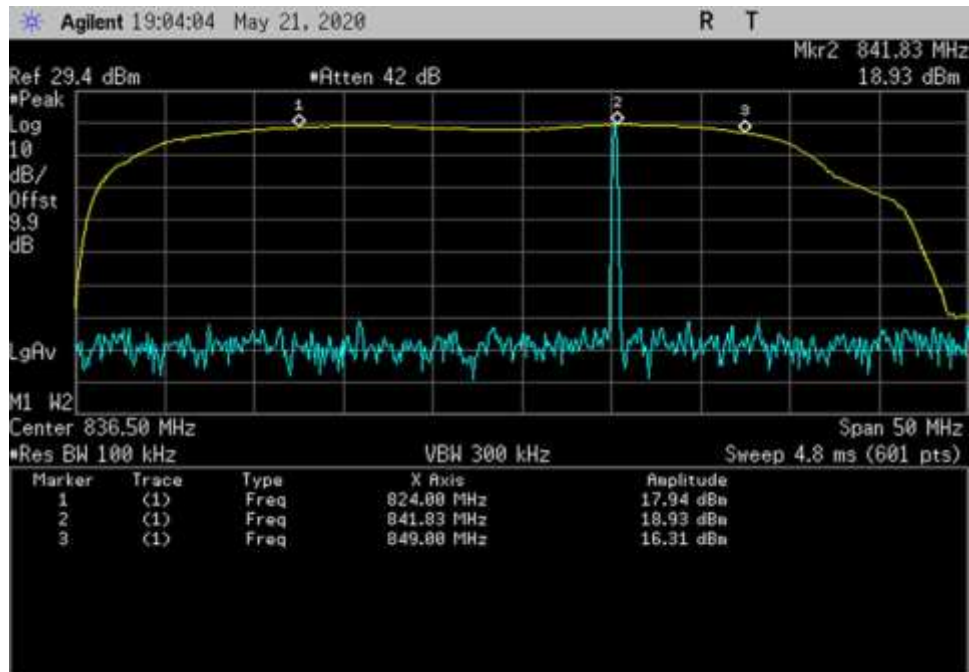
Summary of Results

Pass: The plots below show the device only operates on the CMRS frequency bands authorized for use by the NPS.

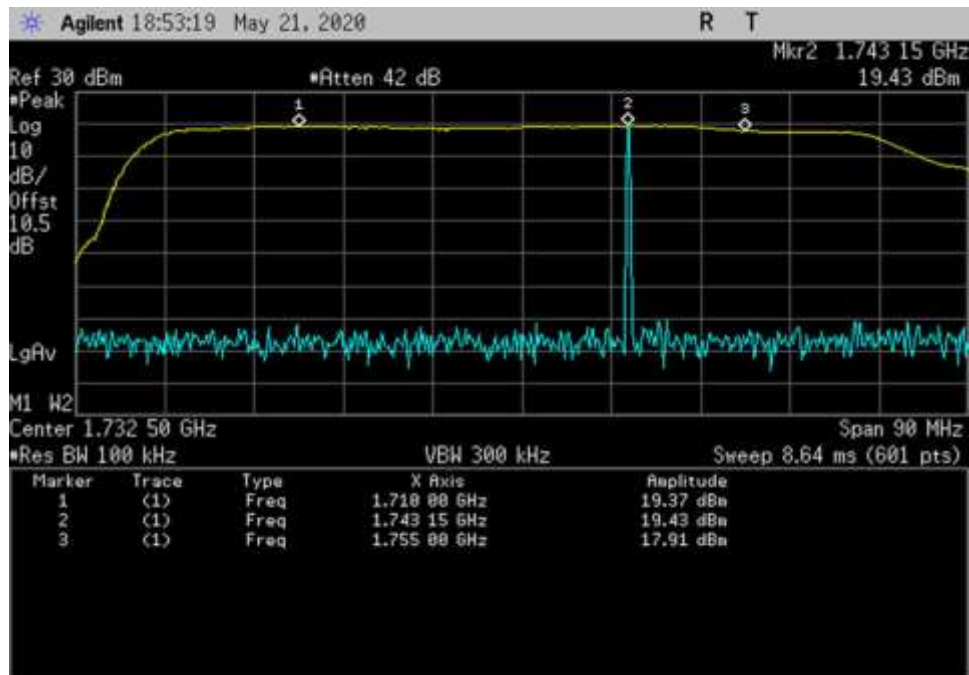
Plots



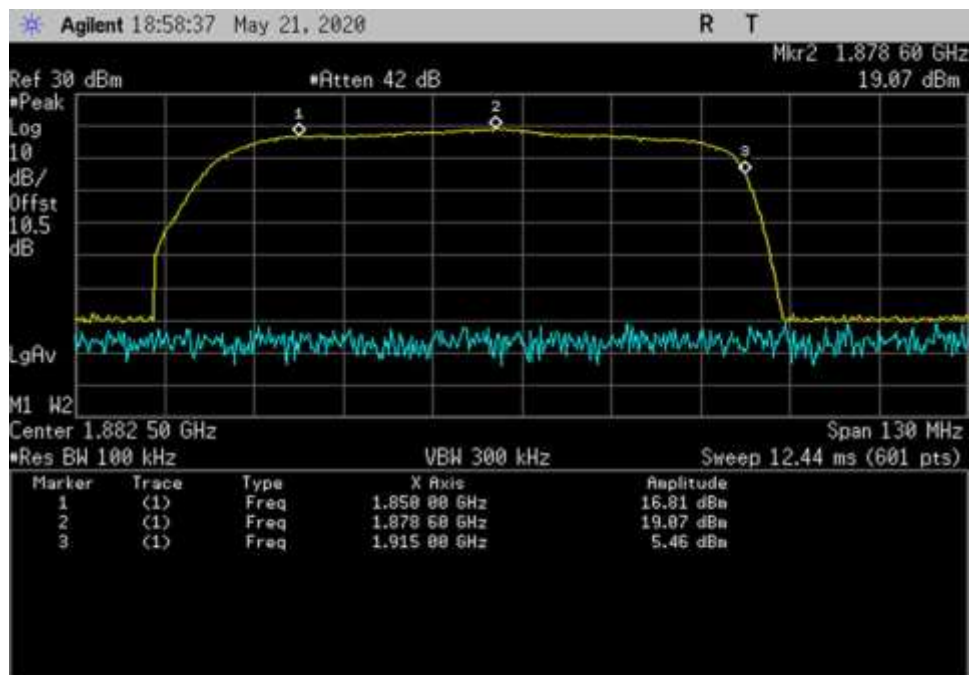
UL_776-787_ 776- 780.69MHz



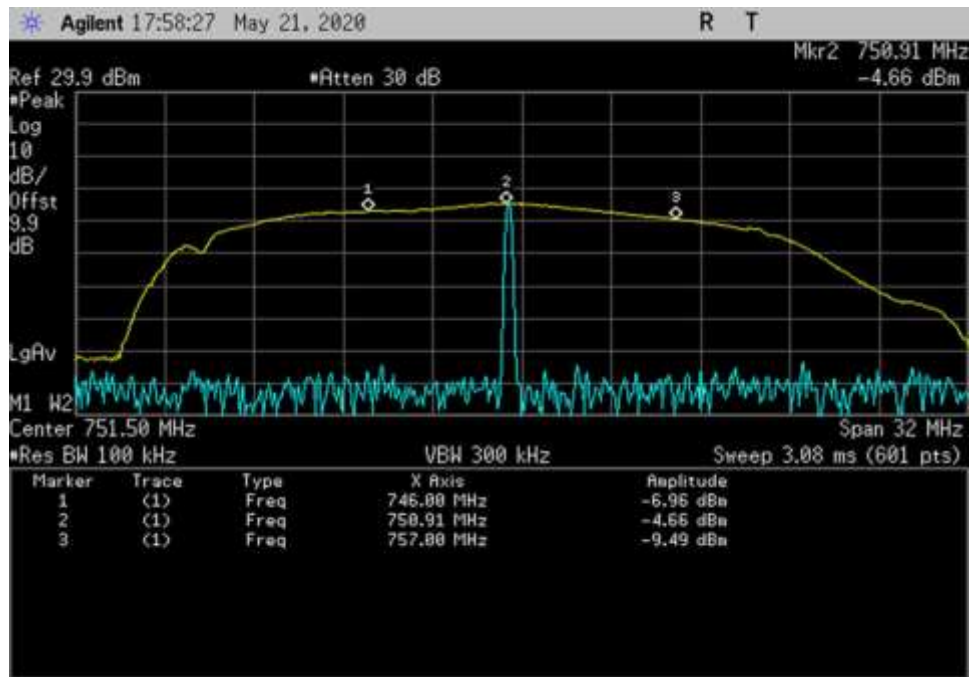
UL_824-849_ 824- 841.83MHz



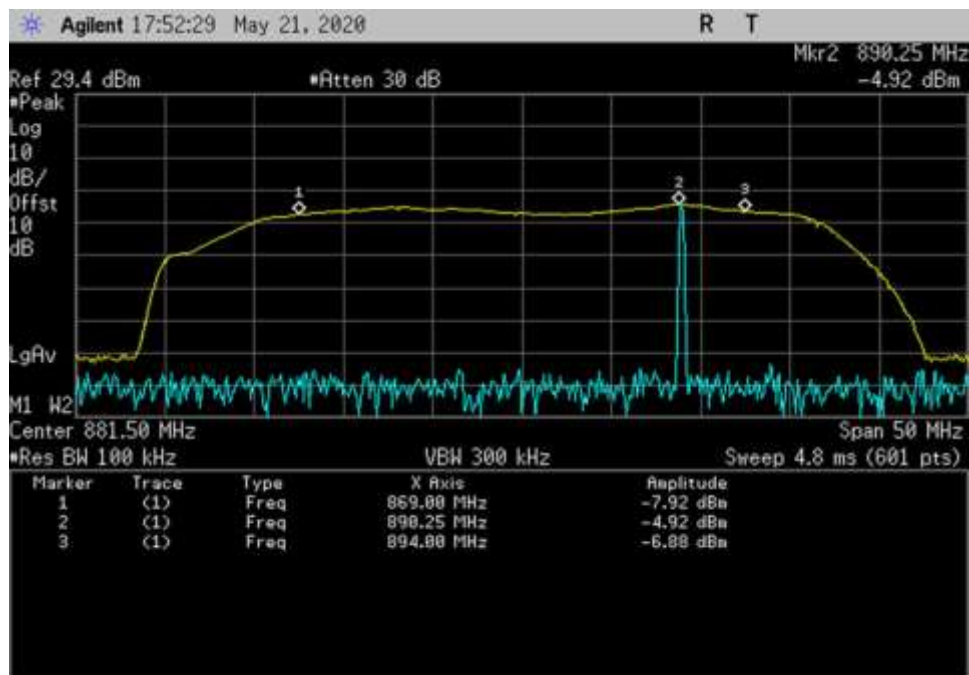
UL_1710-1755_ 1710- 1743.15MHz



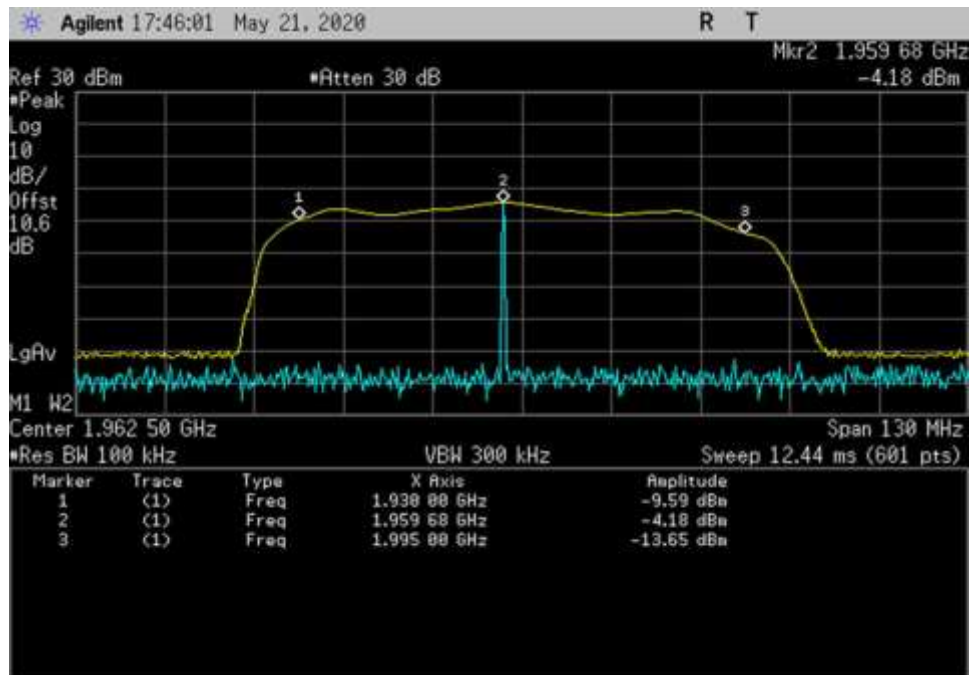
UL_1850-1915_ 1850- 1878.6MHz



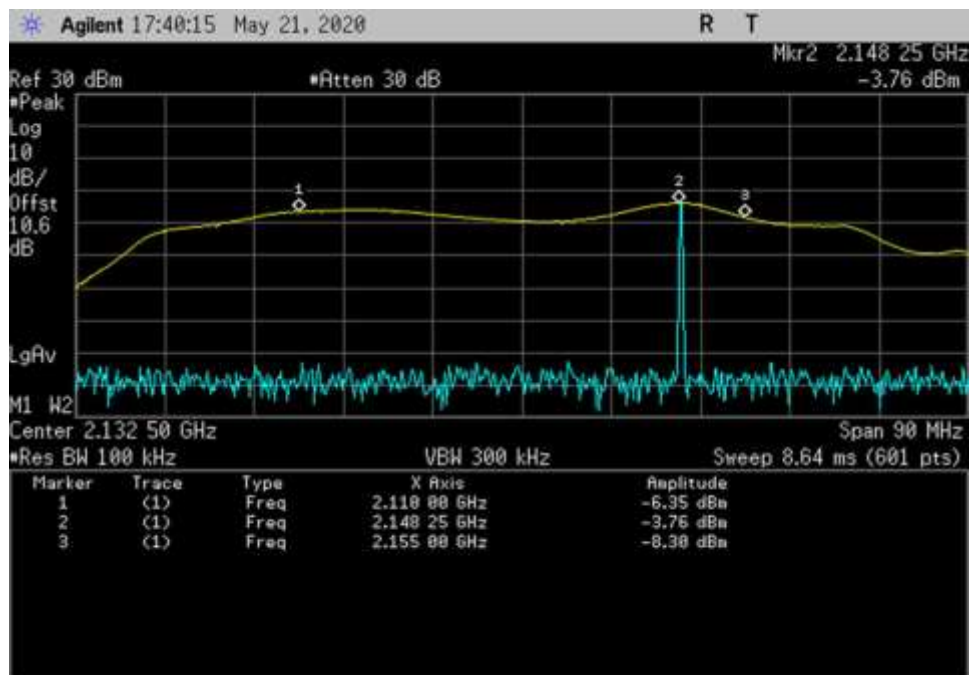
DL_746-757_ 746- 750.91MHz



DL_869-894_ 869- 890.25MHz



DL_1930-1995_ 1930- 1959.68MHz



DL_2110-2155_ 2110- 2148.25MHz

7.2 and 7.3 Maximum Power and Power Gain

Test Setup/Conditions

Test Engineer:	E. Wong
Test Date(s):	5/20/2020
Configuration:	1
Test Setup:	A RF amplifier was used to provide UL signal per section 5.5 Max Input Power. DL power measured at DL signal -20dBm per Section 5.5 Max Input Power . DL path never go into AGC at this power level.

Test Equipment

Asset #	Description	Model	Calibration Date	Cal Due Date
02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
P05411	Attenuator	54A-10	11/27/2019	11/27/2021
P06898	Cable	32022-29094K-29094K-48TC	3/25/2020	3/25/2022
P07192	Cable	32022-29094K-29094K-48TC	11/27/2019	11/27/2021
02688	RF Amplifier	5161F	8/27/2018	8/27/2020
C00032	Signal Generator	E4433B	3/30/2020	3/30/2022

Summary of Results

Pass: as summarized in table below, measured EIRP, Gain and UL/DL gain ratio are within limits.

Pre AGC				Pre AGC		
Pulse GSM				4.1 MHz AWGN		
Frequency (MHz)	Input (dBm)	Output (dBm)	Gain (dB)	Input (dBm)	Output (dBm)	Gain (dB)
UL 1710-1755	12.1	26.1	14.0	14.9	25.0	10.1
UL 1850-1915	12.1	25.6	13.5	14.1	23.9	9.8
UL 824-894	10.4	24.6	14.2	12.4	23.8	11.4
UL 776-787	12.4	26.9	14.5	13.4	25.5	12.1
DL 2110-2155	-20.0*	-5.4	14.6	-20.0*	-5.9	14.1
DL 1930-1995	-20.0*	-5.6	14.4	-20.0*	-6.0	14.0
DL 869-894	-20.0*	-5.3	14.7	-20.0*	-5.5	14.5
DL 746-757	-20.0*	-5.2	14.8	-20.0*	-5.2	14.8

Maximum Direct connect, Mobile Gain limit: 15dB

*Per section 5.5 Max DL power = -20dBm

Pulse GSM					Conducted	Conducted and EIRP
Frequency (MHz)	Output Power (dBm)	*Ant Gain (dBi)	Cable loss (dB)	EIRP (dBm)	Limit Min (dBm)	Limit Max (dBm)
UL 1710-1755	26.1	3.0	0	29.1	17	30
UL 1850-1915	25.6	3.0	0	28.6	17	30
UL 824-894	24.6	2.0	0	26.6	17	30
UL 776-787	26.9	2.0	0	28.9	17	30
DL 2110-2155	-5.4	0	4.0	-9.4	NA	17
DL 1930-1995	-5.6	0	4.0	-9.6	NA	17
DL 869-894	-5.3	0	3.0	-8.3	NA	17
DL 746-757	-5.2	0	3.0	-8.2	NA	17

4.1MHz AWGN					Conducted	Conducted and EIRP
Frequency (MHz)	Output Power (dBm)	*Ant Gain-	Cable loss (dBi)	EIRP (dBm)	Limit Min (dBm)	Limit Max (dBm)
UL 1710-1755	25.0	3.0	0.0	28.0	17	30
UL 1850-1915	23.9	3.0	0.0	26.9	17	30
UL 824-894	23.8	2.0	0.0	25.8	17	30
UL 776-787	25.5	2.0	0.0	27.5	17	30
DL 2110-2155	-5.9	0.0	4.0	-9.9	NA	17
DL 1930-1995	-6.0	0.0	4.0	-10.0	NA	17
DL 869-894	-5.5	0.0	3.0	-8.5	NA	17
DL 746-757	-5.2	0.0	3.0	-8.2	NA	17

* Direct connect booster with Server port connected to section of RF cable for direct connector to cellular device and integral Outdoor/ Donor antennal.

Section 5.5 power						
Frequency (MHz)	Pulse GSM			4.1 MHz AWGN		
	Input (dBm)	Output (dBm)	Gain (dB)	Input (dBm)	Output (dBm)	Gain (dB)
UL 1710-1755	20.8**	26.1	5.3	20.6**	25.0	4.4
UL 1850-1915	19.3**	25.6	6.3	19.1**	23.6	4.5
UL 824-894	17.0**	23.6	6.6	17.4**	23.2	5.8
UL 776-787	20.1**	26.4	6.3	20.5**	25.2	4.7
DL 2110-2155	-20.0*	-5.4	14.6	-20.0*	-5.9	14.1
DL 1930-1995	-20.0*	-5.6	14.4	-20.0*	-6.0	14.0
DL 869-894	-20.0*	-5.3	14.7	-20.0*	-5.5	14.5
DL 746-757	-20.0*	-5.2	14.8	-20.0*	-5.2	14.8

* Per section 5.5b Max DL power = -20dBm

** : The booster went into Transmitter off mode at Max input power IAW section 5.5. Results presented in the above table are at 1 dB below the Transmit off RF input level.

UL gain vs DL gain	Pulse GSM (dB)	4.1MHz AWGN (dB)	Limit (dB)
UL gain vs DL gain 1710/2110	-0.6	-4.0	9.0
UL gain vs DL gain 1850/1930	-0.9	-4.2	9.0
UL gain vs DL gain 824/869	-0.5	-3.1	9.0
UL gain vs DL gain 776/746	-0.3	-2.7	9.0

7.4 Intermodulation Product

Test Setup/Conditions

Test Engineer:	E. Wong
Test Date(s):	5/22/2020
Configuration:	1
Test Setup:	A RF amplifier was used to provide UL signal per section 5.5 Max Input Power. DL power measured at DL signal -20dBm per Section 5.5 Max Input Power. DL path never go into AGC at this power level.

Test Equipment

Asset #	Description	Model	Calibration Date	Cal Due Date
02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
P05411	Attenuator	54A-10	11/27/2019	11/27/2021
P06898	Cable	32022-29094K-29094K-48TC	3/25/2020	3/25/2022
P07192	Cable	32022-29094K-29094K-48TC	11/27/2019	11/27/2021
02688	RF Amplifier	5161F	8/27/2018	8/27/2020
C00032	Signal Generator	E4433B	3/30/2020	3/30/2022

Summary of Results

Pass: As shown on the plots, all intermodulation product measured are below -19dbm limit.

Inter Modulation Product			
Frequency (MHz)	Pre AGC (dBm)	Limit (dBm)	Results
UL 1710-1755	-19.6	-19	Pass
UL 1850-1915	-22.4	-19	Pass
UL 824-894	-22.9	-19	Pass
UL 776-787	-22.0	-19	Pass
DL 2110-2155	-56.7	-19	Pass
DL 1930-1995	-57.0	-19	Pass
DL 869-894	-53.2	-19	Pass
DL 746-757	-53.1	-19	Pass

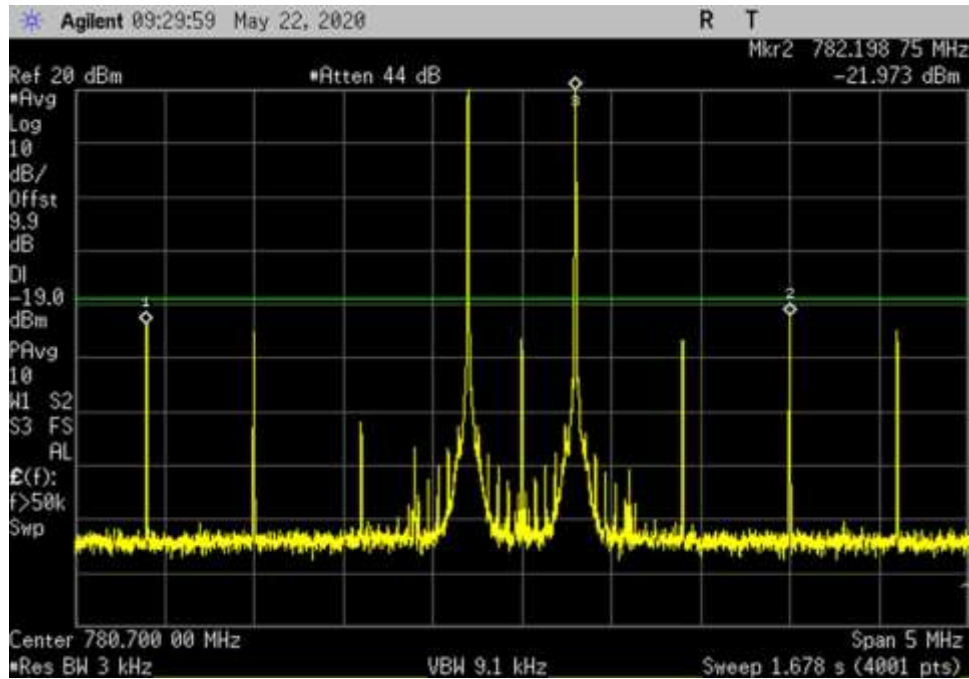
DL performed at max DL power of -20dBm

Inter Modulation Product (AGC +10dB)			
Frequency (MHz)	Pre AGC (dBm)	Limit (dBm)	Results
UL 1710-1755	-19.5 (**4dB)	-19	Pass
UL 1850-1915	-23.6 (**4dB)	-19	Pass
UL 824-894	-27.4 (**6dB)	-19	Pass
UL 776-787	-20.3 (**7dB)	-19	Pass
DL 2110-2155	NA*	-	-
DL 1930-1995	NA*	-	-
DL 869-894	NA*	-	-
DL 746-757	NA*	-	-

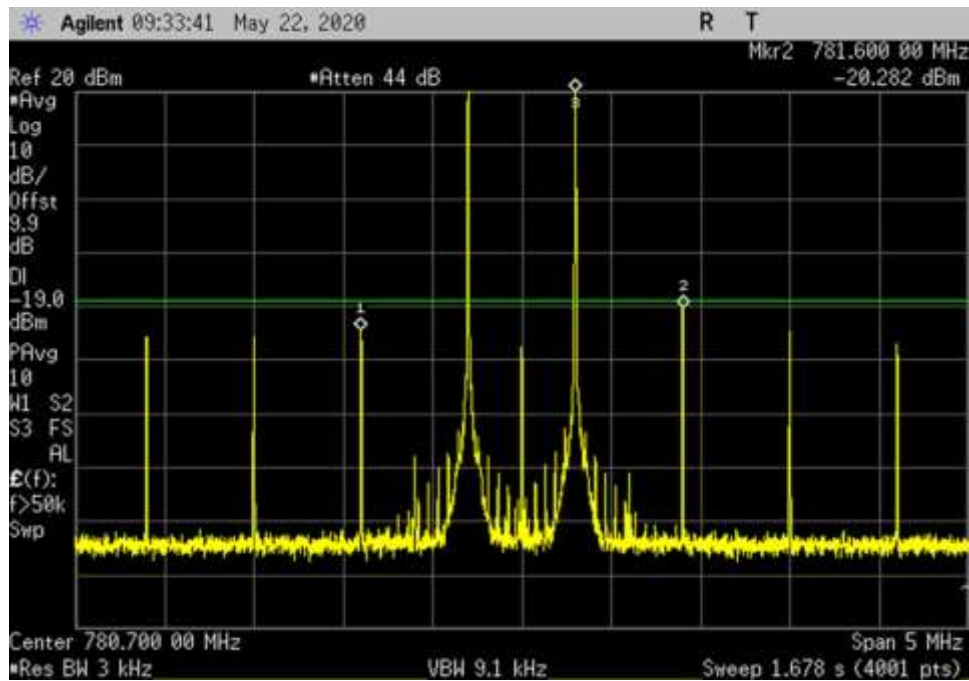
* NA: Not applicable, the intermodulation was already performed at max DL power of -20dBm.

** Input signal above AGC level and 1dB before shutdown occurs. Device shut down prior to 10dB above AGC or section 5.5 Max UL power (27dBm)

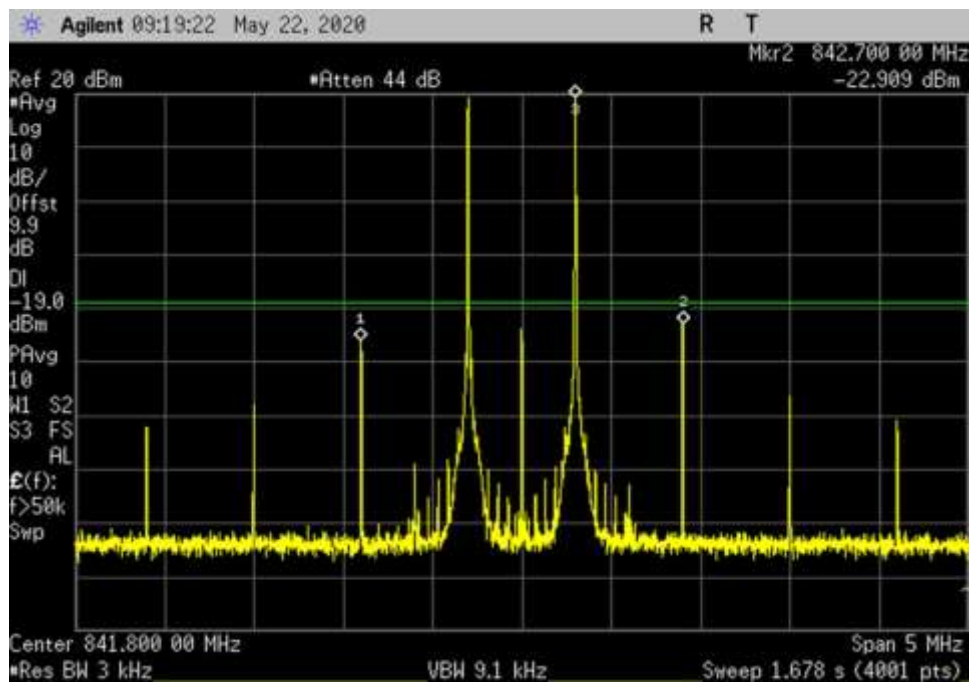
Plots



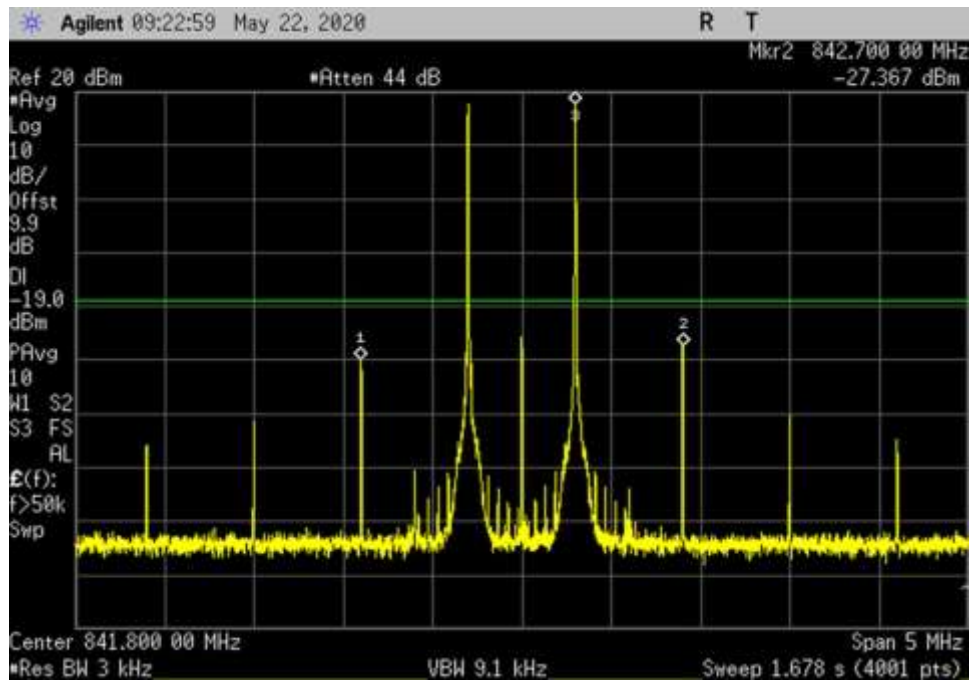
UL_776-787_ 780.7MHz



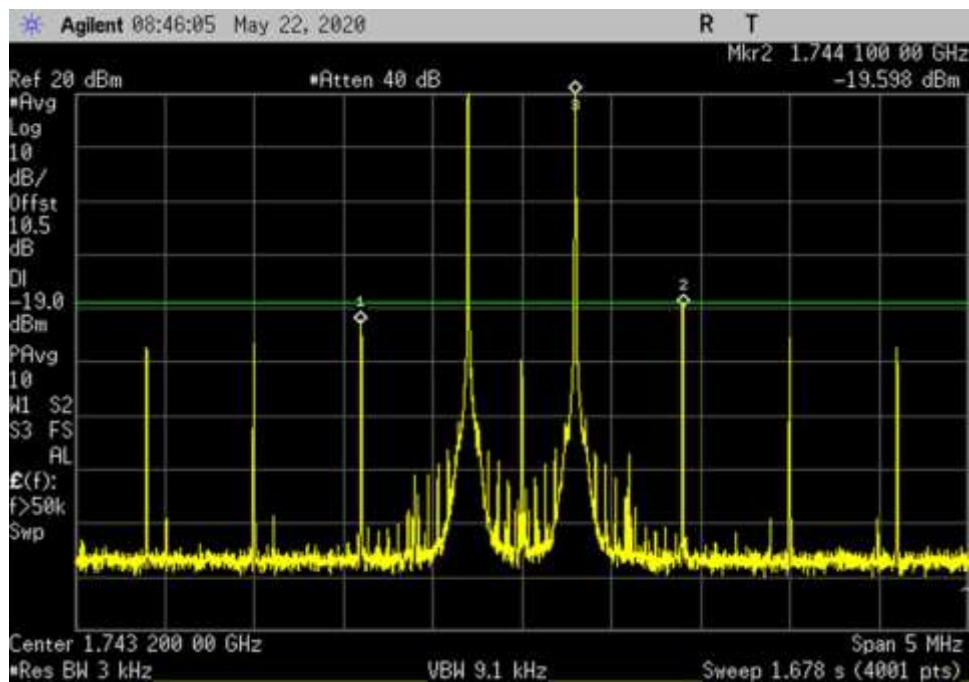
UL_776-787_+10dB_780.7MHz



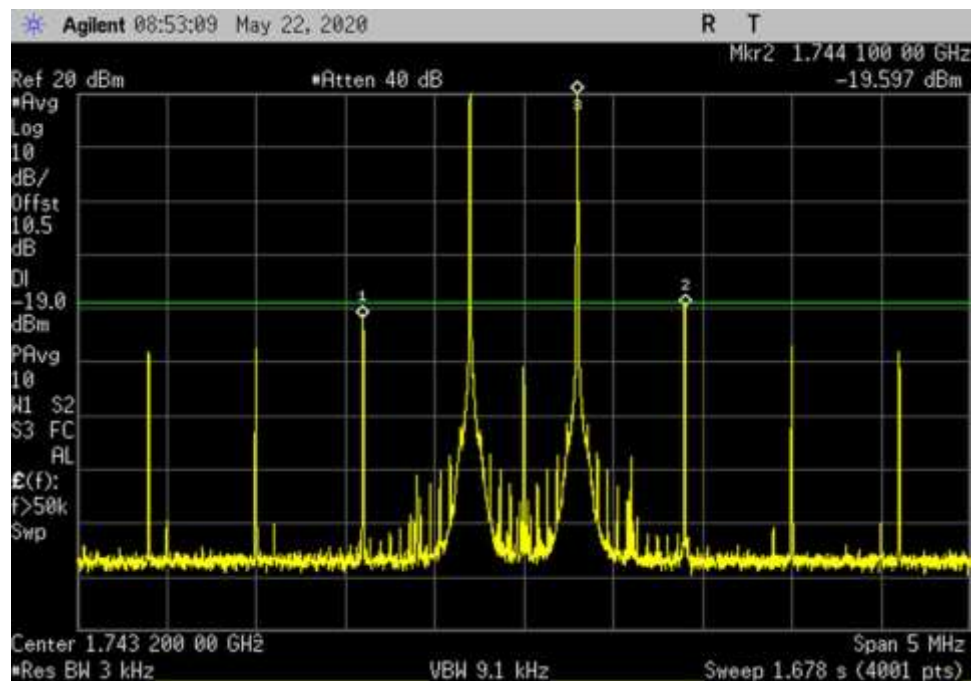
UL_824-849_841.8MHz



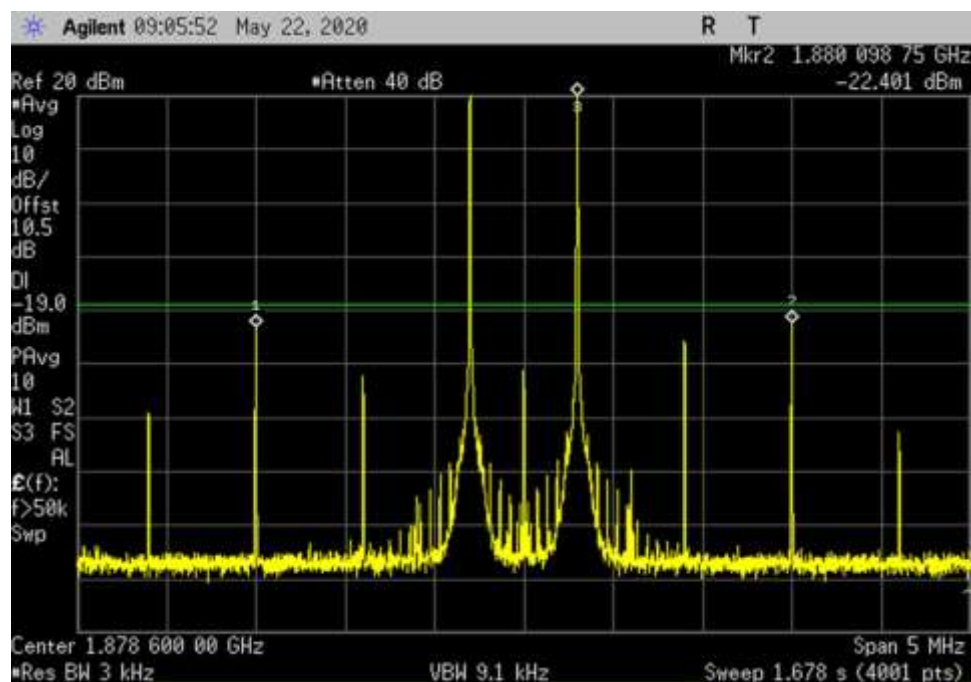
UL_824-849_+10dB_841.8MHz



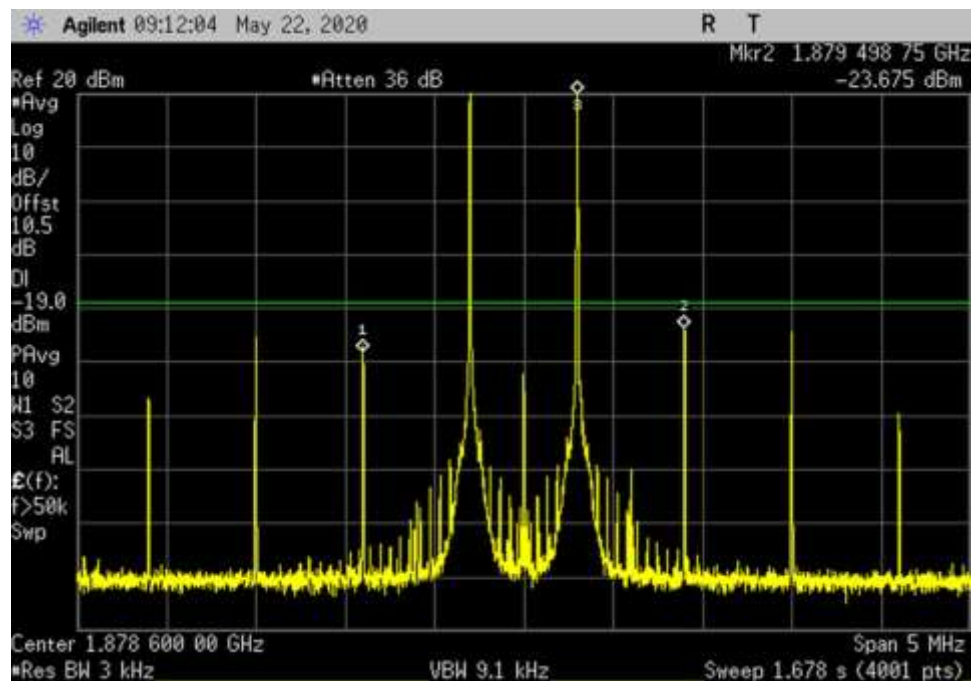
UL_1710-1755_1743.2MHz



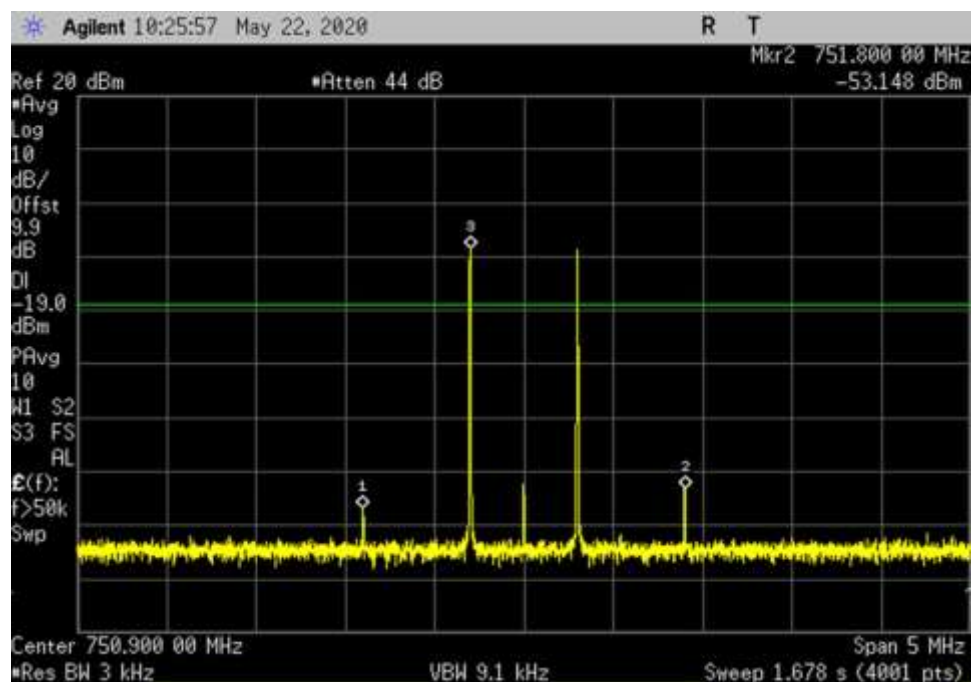
UL_1710-1755__+10dB_1743.2MHz



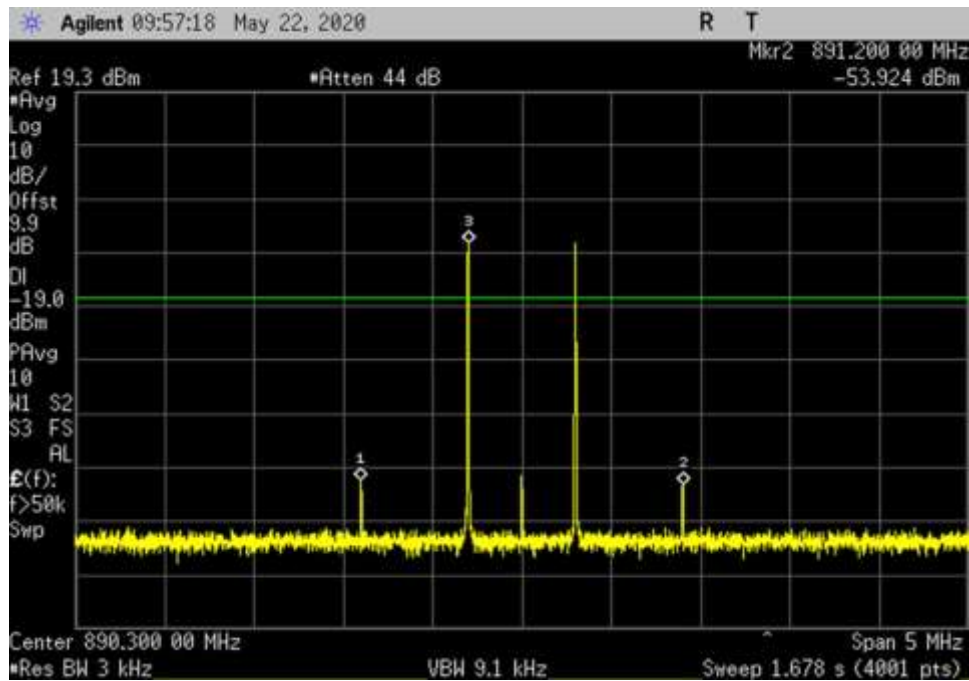
UL_1850-1915_1878.6MHz



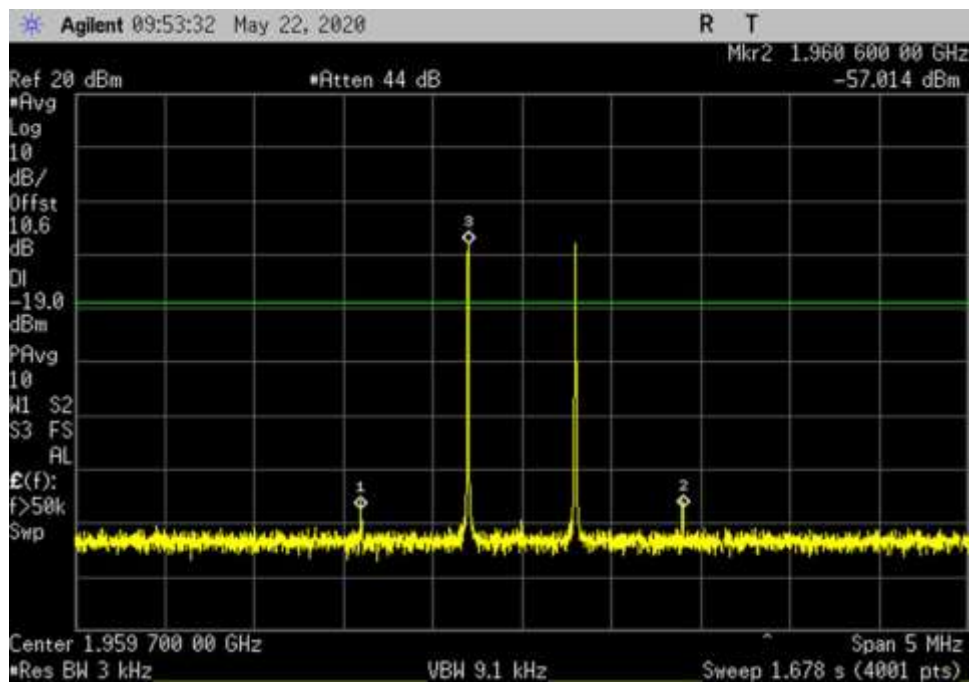
UL_1850-1915_+10dB1878.6MHz



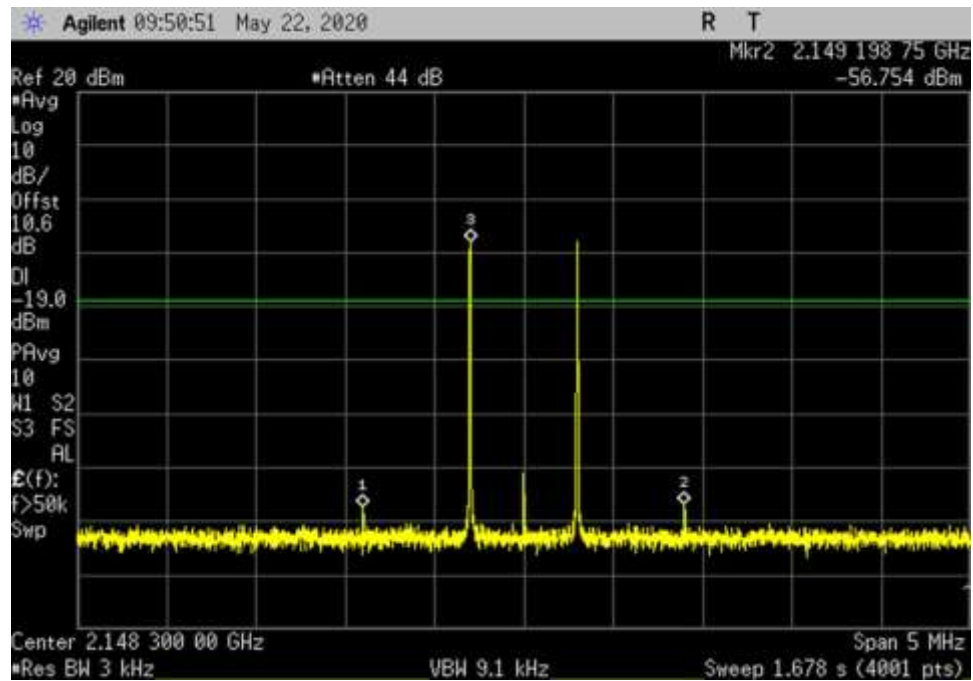
DL_746-757_ 750.9MHz



DL_869-894_ 890.3MHz



DL_1930-1995_ 1959.7MHz



DL_2110-2155_ 2148.3MHz

7.5 Out of Band Emissions

Test Setup/Conditions

Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	5/26 and 27/2020
Configuration:	1
Test Setup:	See General Test Setup

Environmental Conditions 5/26/2020

Temperature (°C)	21	Relative Humidity (%):	43	Pressure: kPa	102.5
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Environmental Conditions 5/27/2020

Temperature (°C)	24.3	Relative Humidity (%):	38	Pressure: kPa	101.8
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Test Equipment

Asset #	Description	Model	Calibration Date	Cal Due Date
P05411	Attenuator	54A-10	11/27/2019	11/27/2021
02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
P06897	Cable	32022-29094K-29094K-48TC	3/25/2020	3/25/2022
P07192	Cable	32022-29094K-29094K-48TC	11/27/2019	11/27/2021
03697	Spectrum Analyzer	E4404B	8/27/2018	8/27/2020
02691	RF Amplifier	5162F	3/19/2020	3/19/2022
P05302	Directional Coupler	C223E-20	2/20/2019	2/20/2021
03360	Cable	32022-2-29094-36TC	4/9/2020	4/9/2022
03418	Signal Generator	E4438C	5/13/2019	5/13/2021

Summary of Results

Pass: As indicated in plots below, all OBE are under the limit of -19dBm.

GSM

Low				High			
Out of Band Emission				Out of Band Emission			
Frequency (MHz)	Pre AGC	Limit (dBm)	Results	Frequency (MHz)	Pre AGC	Limit (dBm)	Results
UL 1710-1755	-19.05	-19	Pass	UL 1710-1755	-19.1	-19	Pass
UL 1850-1915	-20.7	-19	Pass	UL 1850-1915	-25.9	-19	Pass
UL 824-849	-20.7	-19	Pass	UL 824-849	-22.8	-19	Pass
UL 776-787	-24.3	-19	Pass	UL 776-787	-20.9	-19	Pass
DL 2110-2155	-50.2	-19	Pass	DL 2110-2155	-53.6	-19	Pass
DL 1930-1995	-54.0	-19	Pass	DL 1930-1995	-58.7	-19	Pass
DL 869-894	-51.4	-19	Pass	DL 869-894	-51.2	-19	Pass
DL 746-757	-50.4	-19	Pass	DL 746-757	-53.3	-19	Pass

CDMA (alternative 1.25 MHz AWGN)

Low				High			
Out of Band Emission				Out of Band Emission			
Frequency (MHz)	Pre AGC	Limit (dBm)	Results	Frequency (MHz)	Pre AGC	Limit (dBm)	Results
UL 1710-1755	-27.4	-19	Pass	UL 1710-1755	-21.7	-19	Pass
UL 1850-1915	-21.2	-19	Pass	UL 1850-1915	-20.4	-19	Pass
UL 824-849	-20.7	-19	Pass	UL 824-849	-21.8	-19	Pass
UL 776-787	-23.8	-19	Pass	UL 776-787	-22.1	-19	Pass
DL 2110-2155	-68.6	-19	Pass	DL 2110-2155	-72.0	-19	Pass
DL 1930-1995	-72.4	-19	Pass	DL 1930-1995	-72.3	-19	Pass
DL 869-894	-67.3	-19	Pass	DL 869-894	-69.1	-19	Pass
DL 746-757	-69.5	-19	Pass	DL 746-757	-68.1	-19	Pass

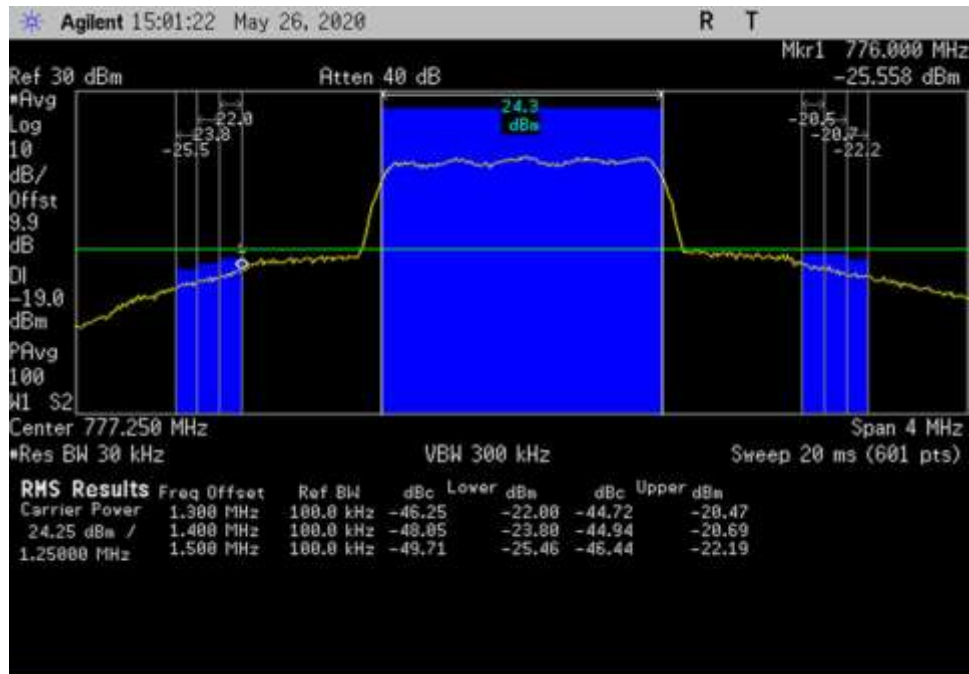
LTE (alternative 4.1MHz AWGN)

Low				High			
Out of Band Emission				Out of Band Emission			
Frequency (MHz)	Pre AGC	Limit (dBm)	Results	Frequency (MHz)	Pre AGC	Limit (dBm)	Results
UL 1710-1755	-22.4	-19	Pass	UL 1710-1755	-22.2	-19	Pass
UL 1850-1915	-19.2	-19	Pass	UL 1850-1915	-21.5	-19	Pass
UL 824-849	-25.8	-19	Pass	UL 824-849	-29.7	-19	Pass
UL 776-787	-23.8	-19	Pass	UL 776-787	-22.4	-19	Pass
DL 2110-2155	-58.5	-19	Pass	DL 2110-2155	-62.6	-19	Pass
DL 1930-1995	-62.2	-19	Pass	DL 1930-1995	-68.3	-19	Pass
DL 869-894	-63.4	-19	Pass	DL 869-894	-60.7	-19	Pass
DL 746-757	-60.8	-19	Pass	DL 746-757	-60.7	-19	Pass

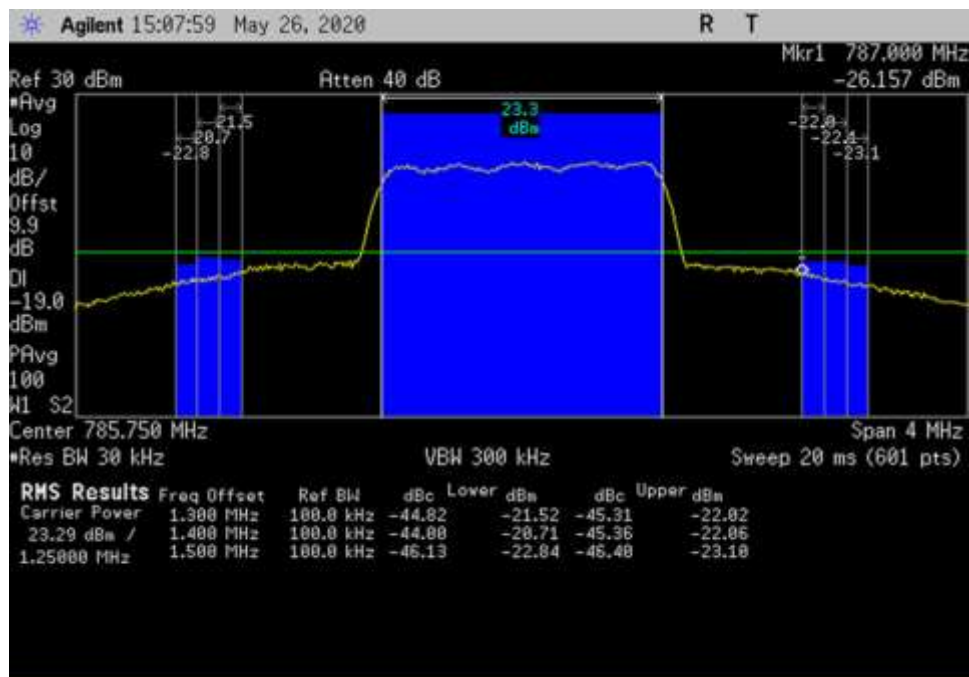
Note: The EUT also maintains compliance with the out-of-band emissions limit at input power indicated in section 5.5.

Plots

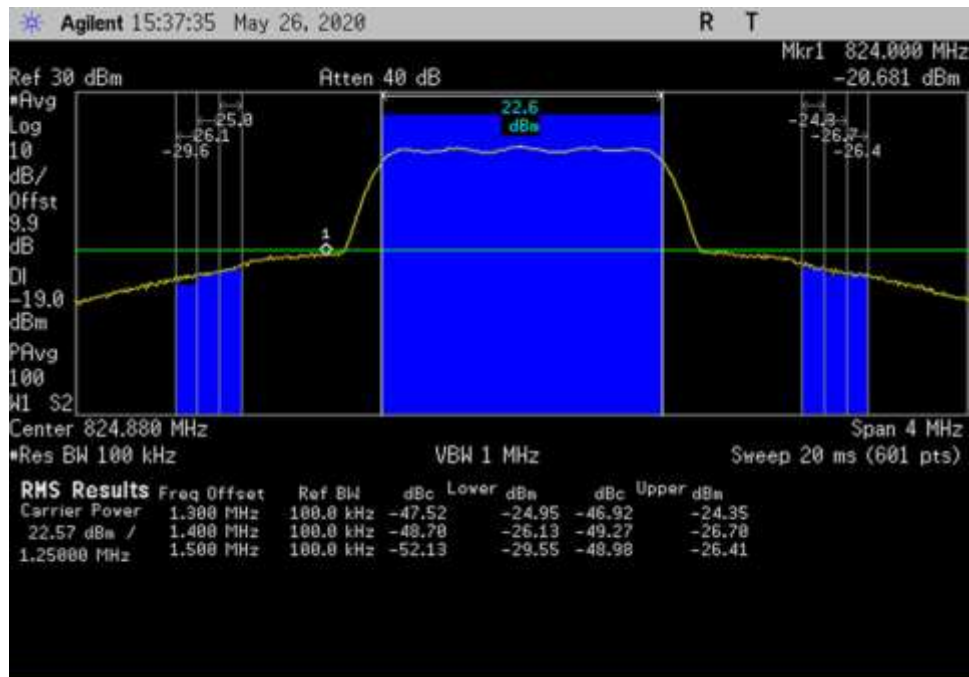
CDMA



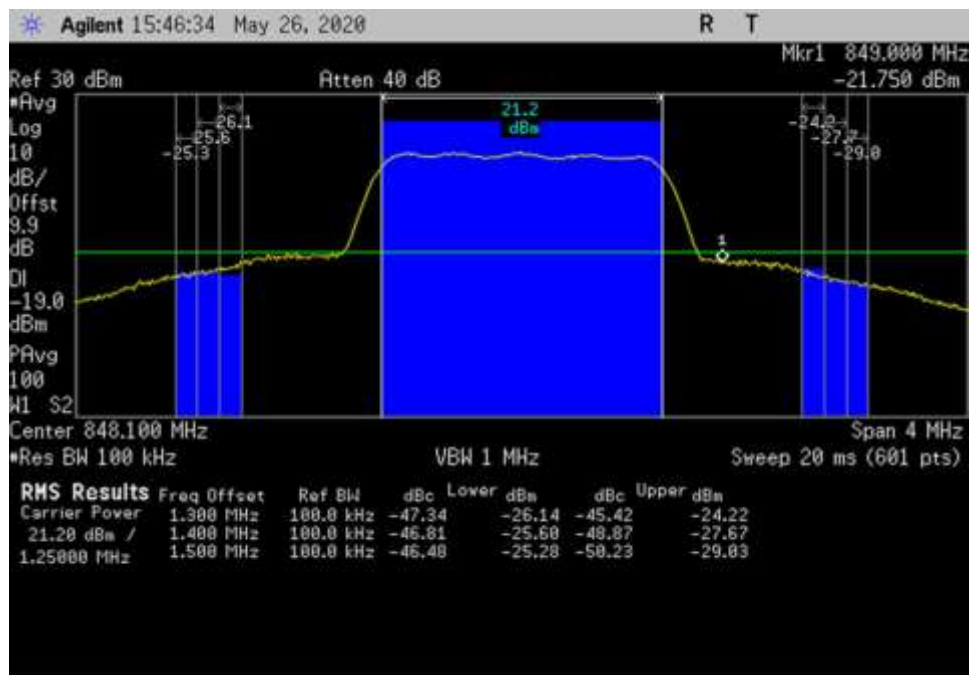
UL_776-787_CDMA_775.25-779.25MHz



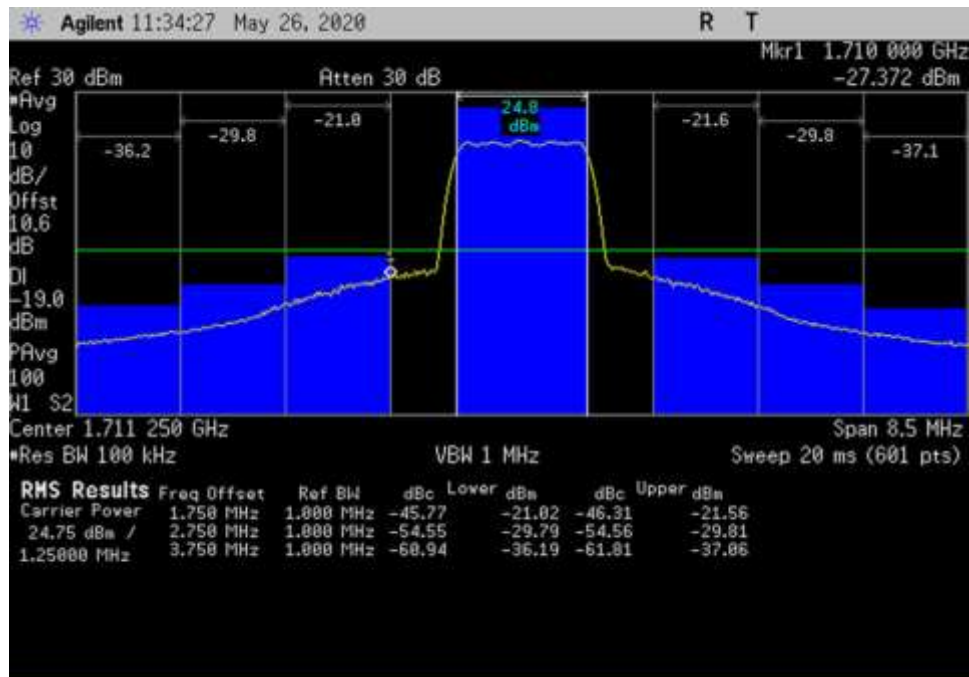
UL_776-787_CDMA_783.75-787.75MHz



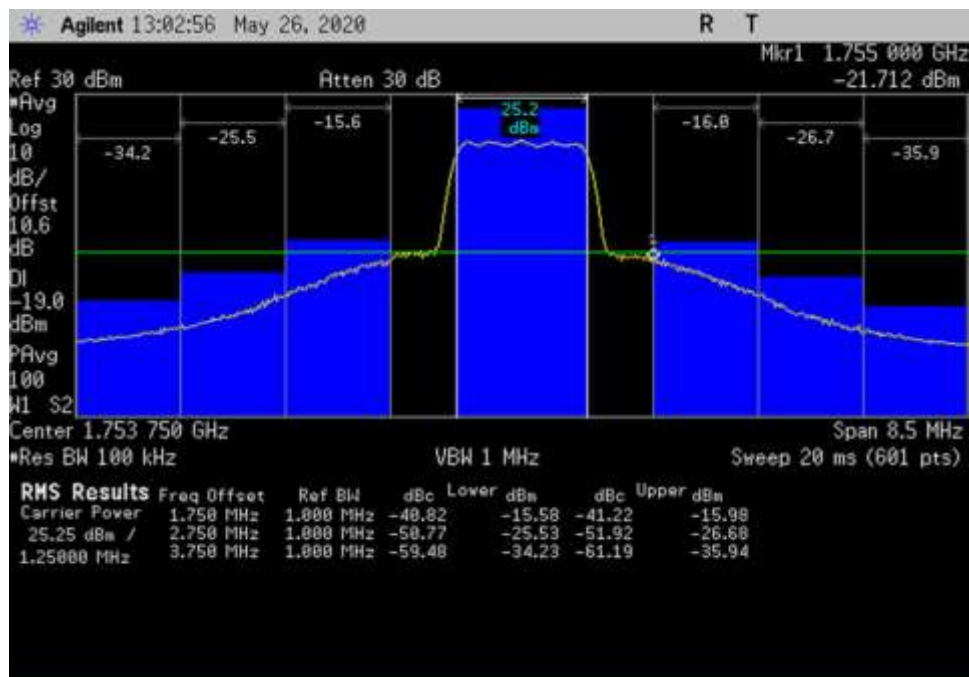
UL_824-849_CDMA_ 822.88- 826.88MHz



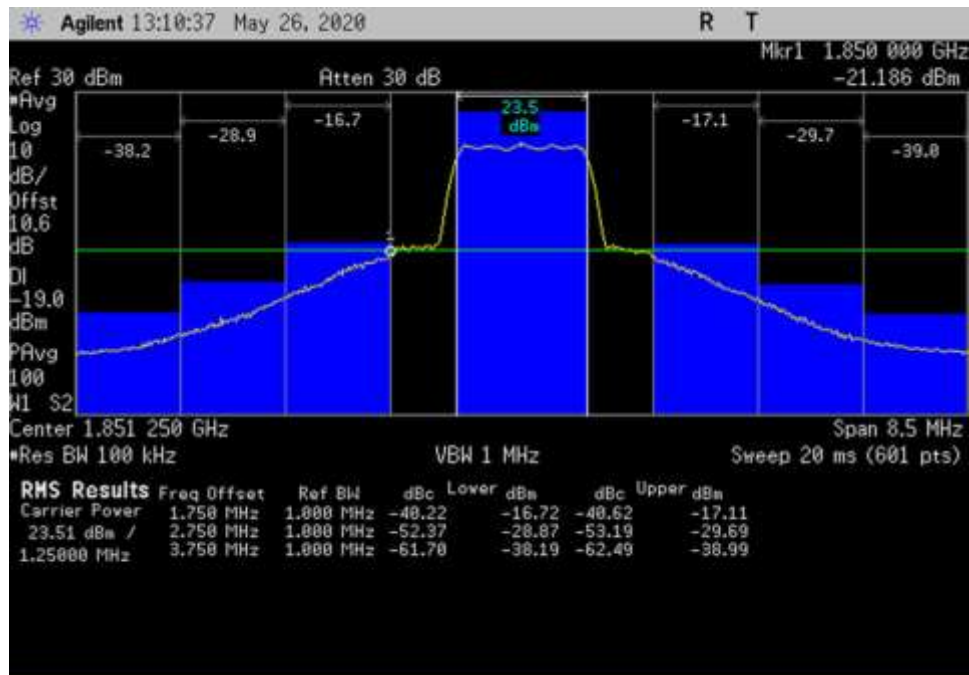
UL_824-849_CDMA_ 846.1- 850.1MHz



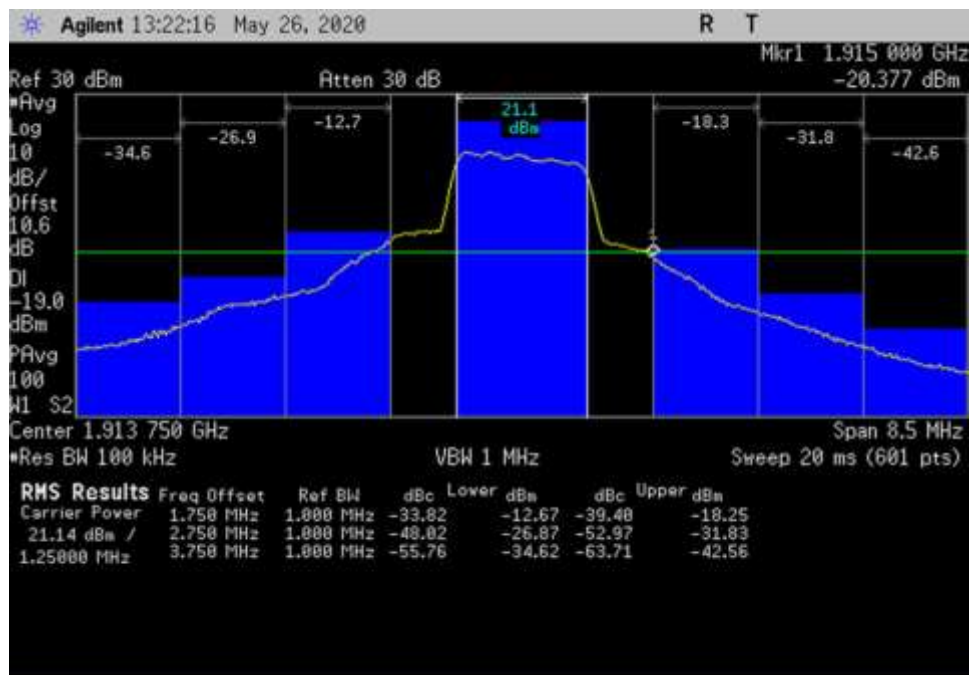
UL_1710-1755_CDMA_ 1707- 1715.5MHz



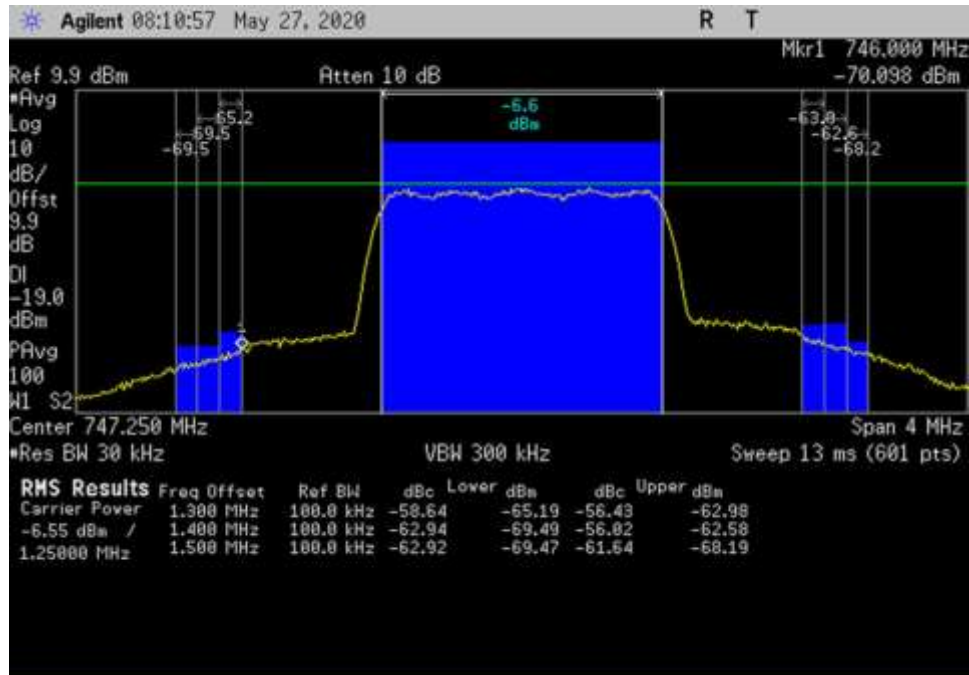
UL_1710-1755_CDMA_ 1749.5- 1758MHz



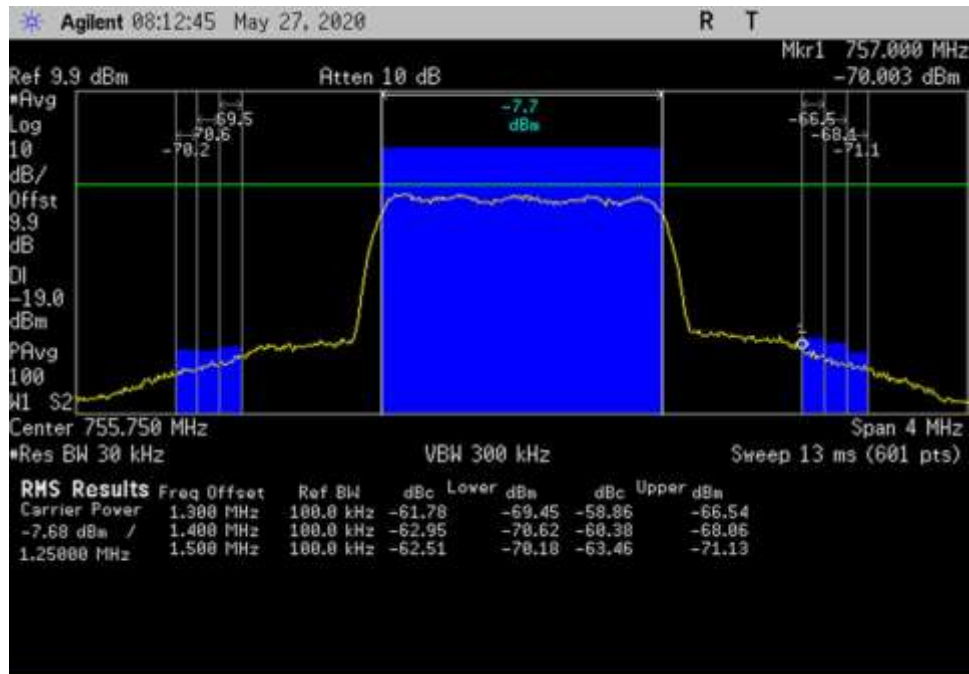
UL_1850-1915_CDMA_1847-1855.5MHz



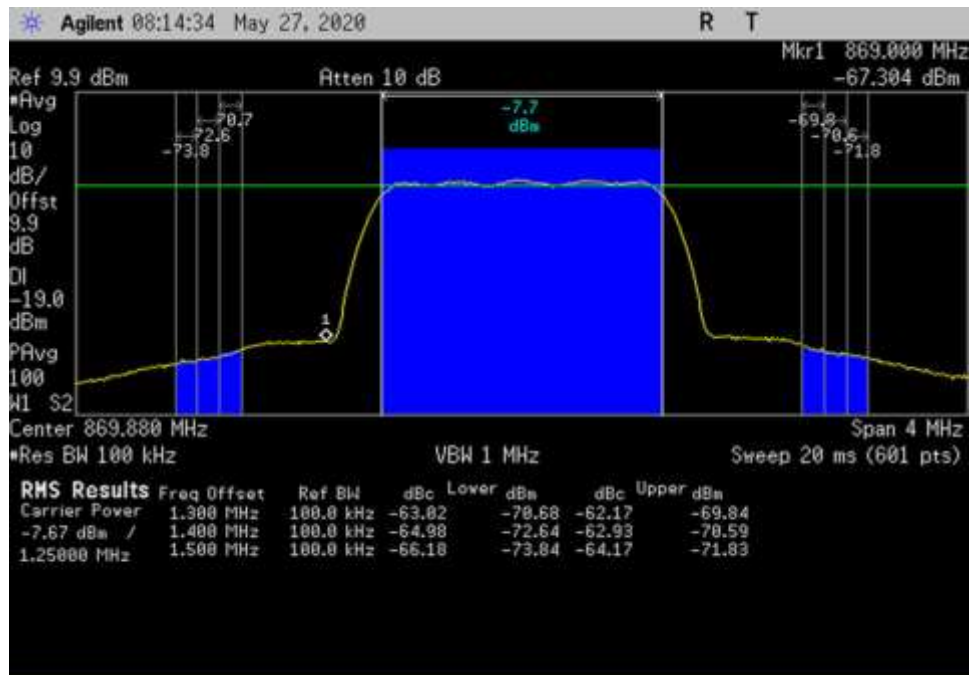
UL_1850-1915_CDMA_1909.5-1918MHz



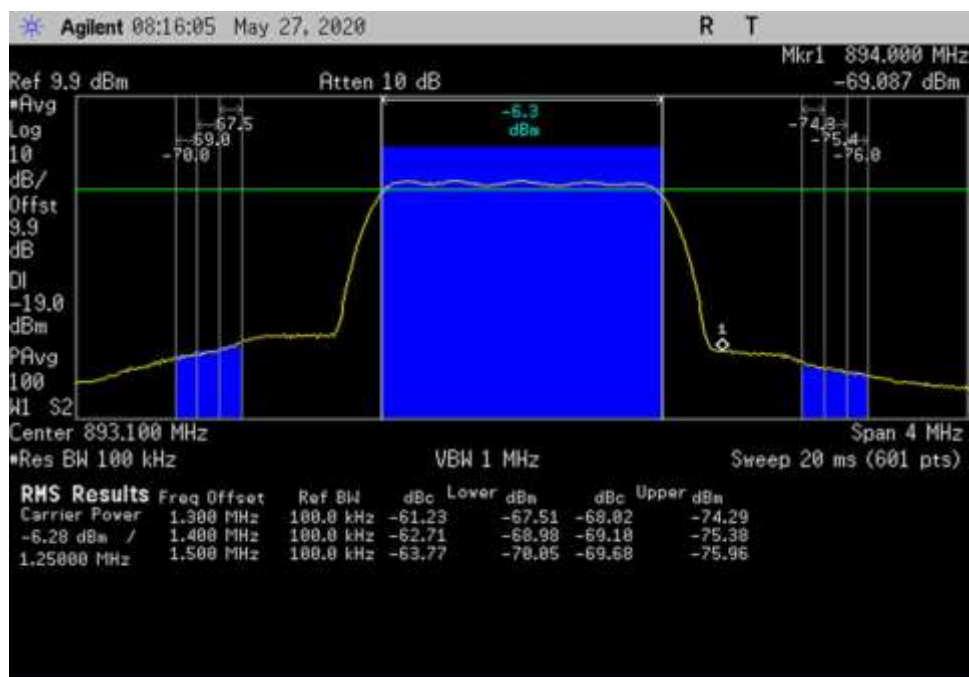
DL_746-757_CDMA_747.25MHz



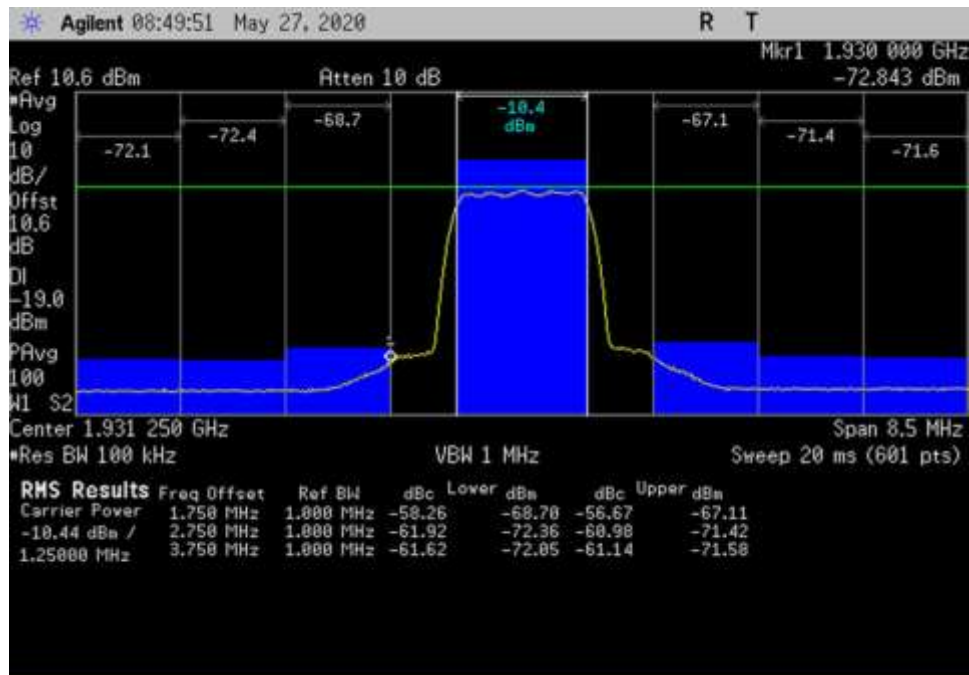
DL_746-757_CDMA_755.75MHz



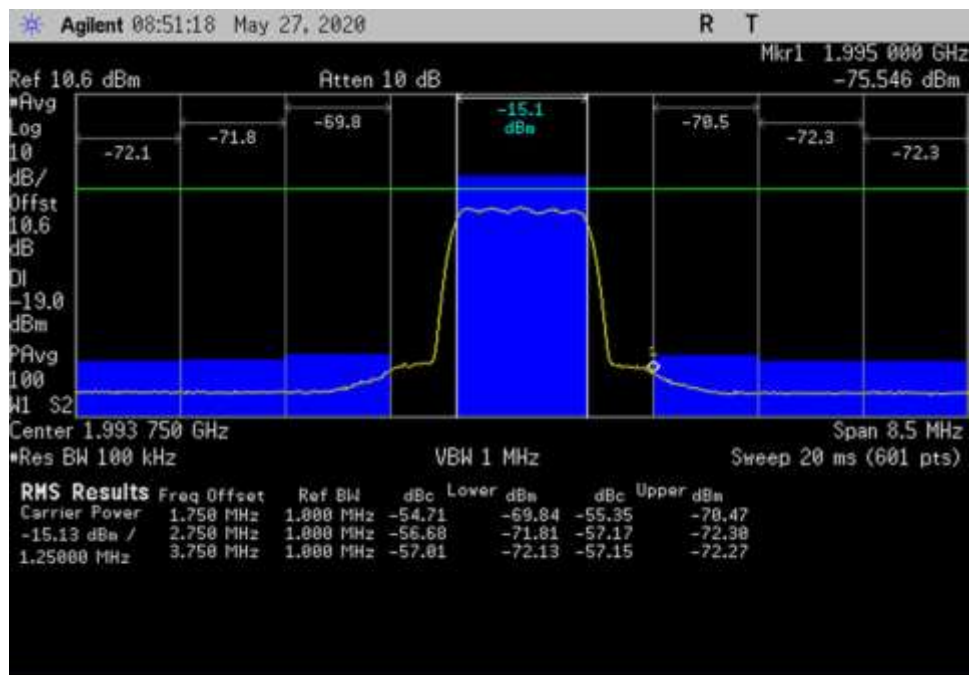
DL_869-894_CDMA_869.88MHz



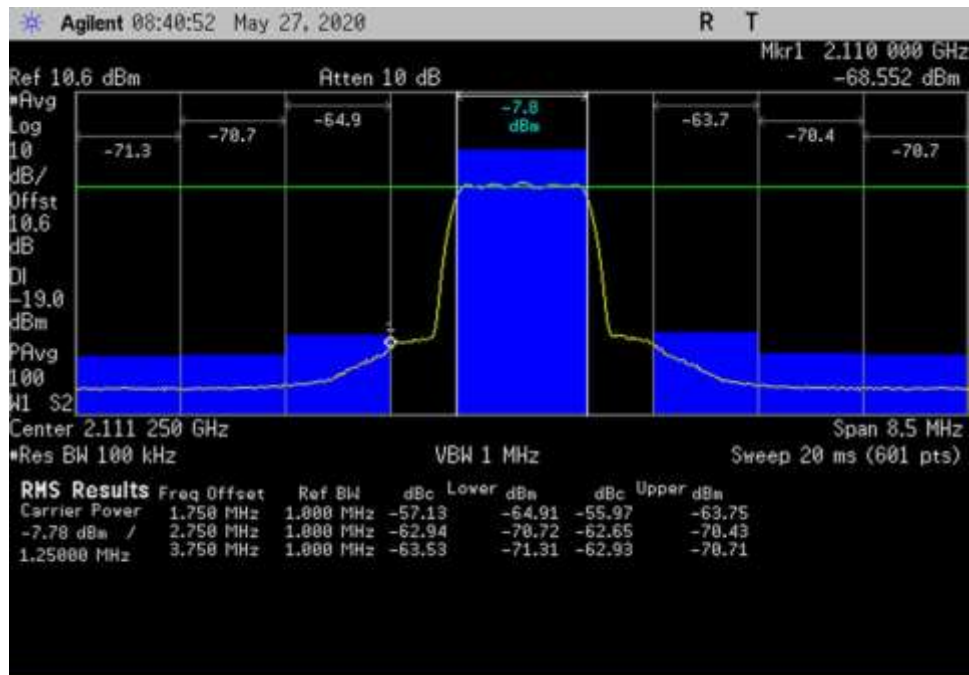
DL_869-894_CDMA_893.1MHz



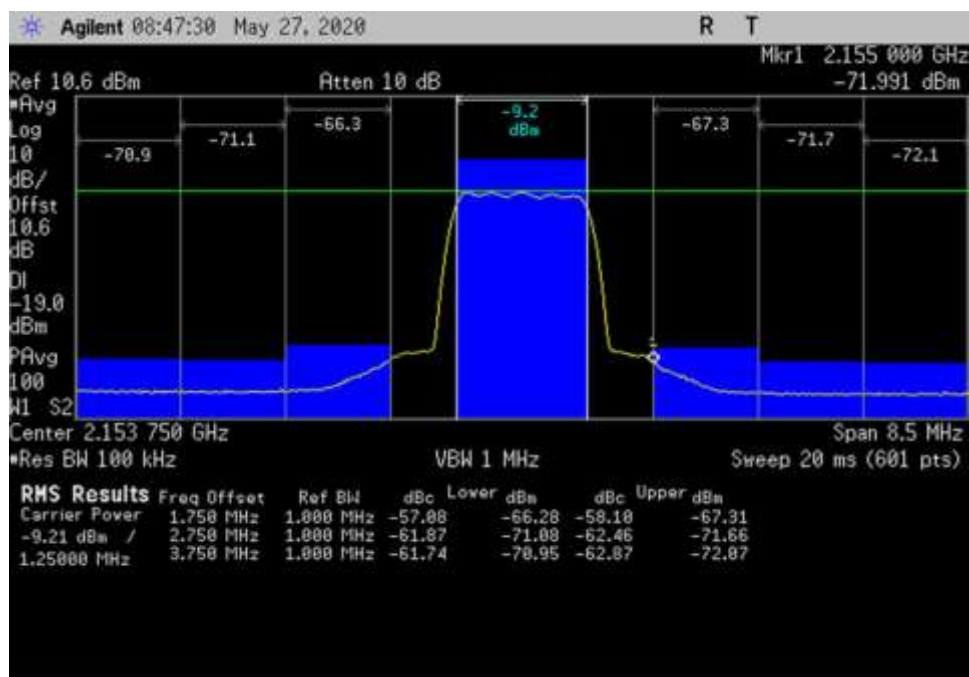
DL_1930-1995_CDMA_1931.25MHz



DL_1930-1995_CDMA_1993.75MHz

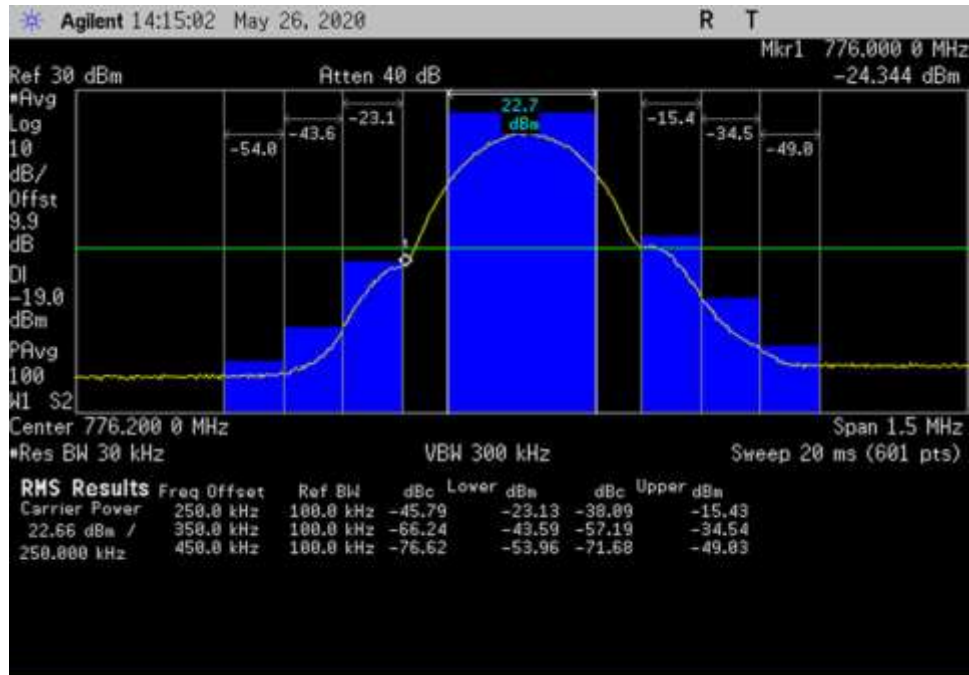


DL_2110-2155_CDMA_2111.25MHz

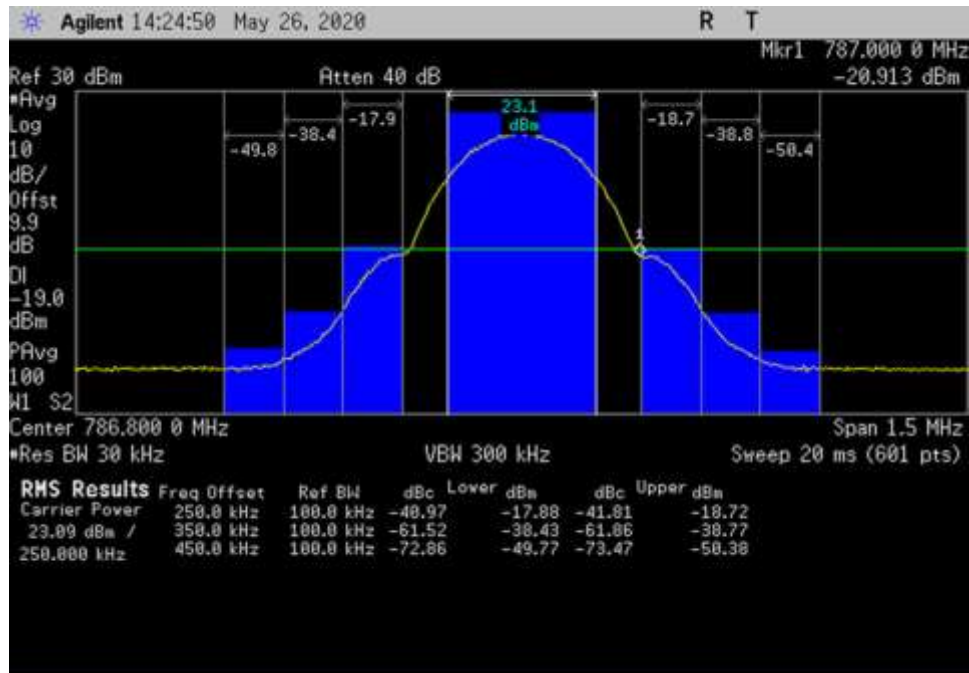


DL_2110-2155_CDMA_2153.75MHz

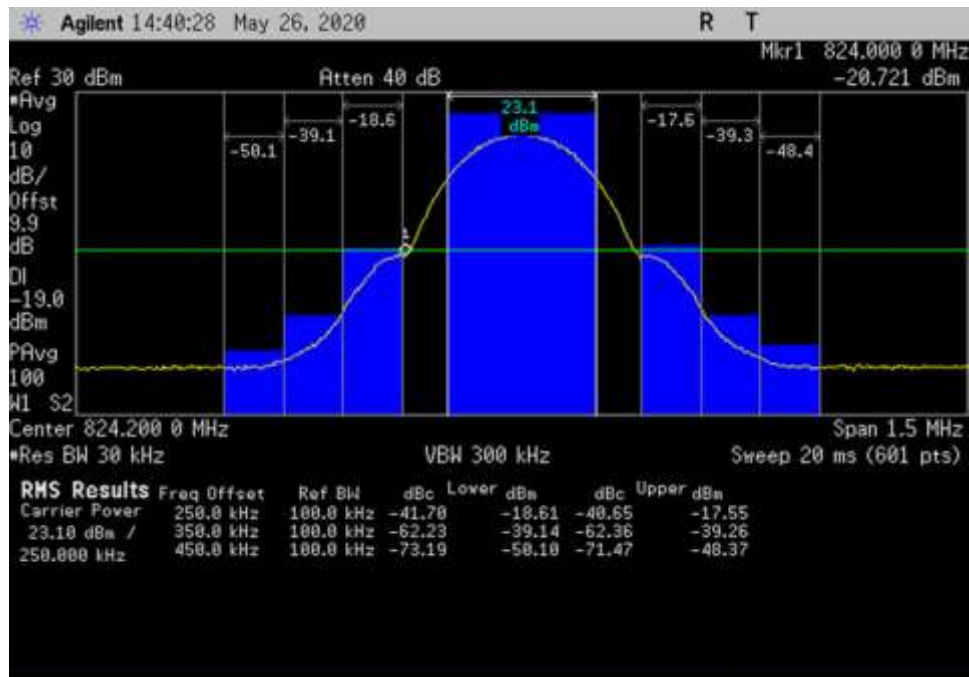
GSM



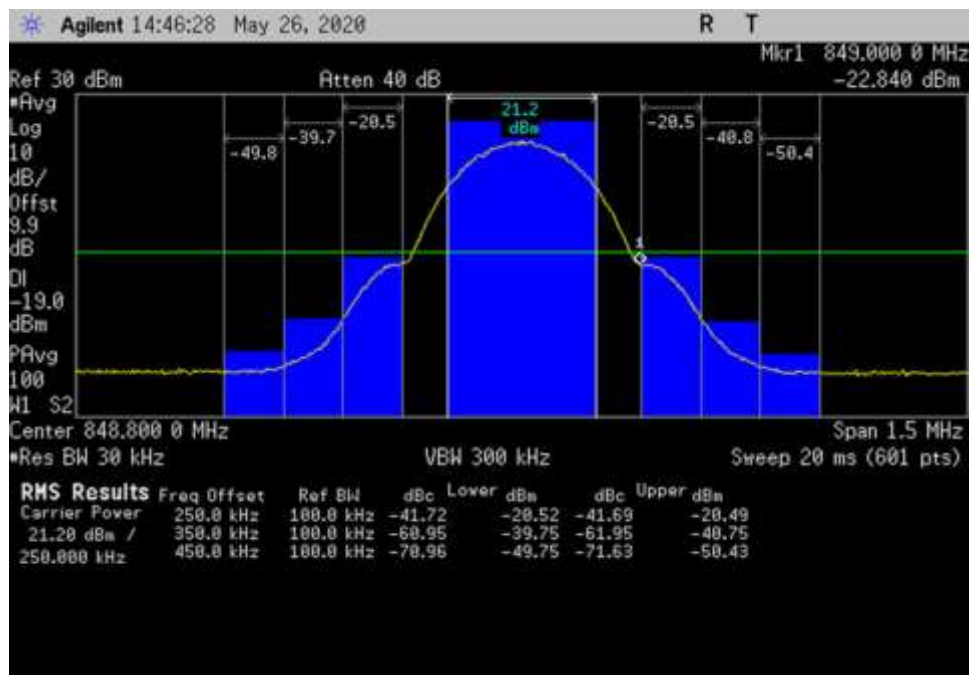
UL_776-787_GSM_775.45-776.95MHz



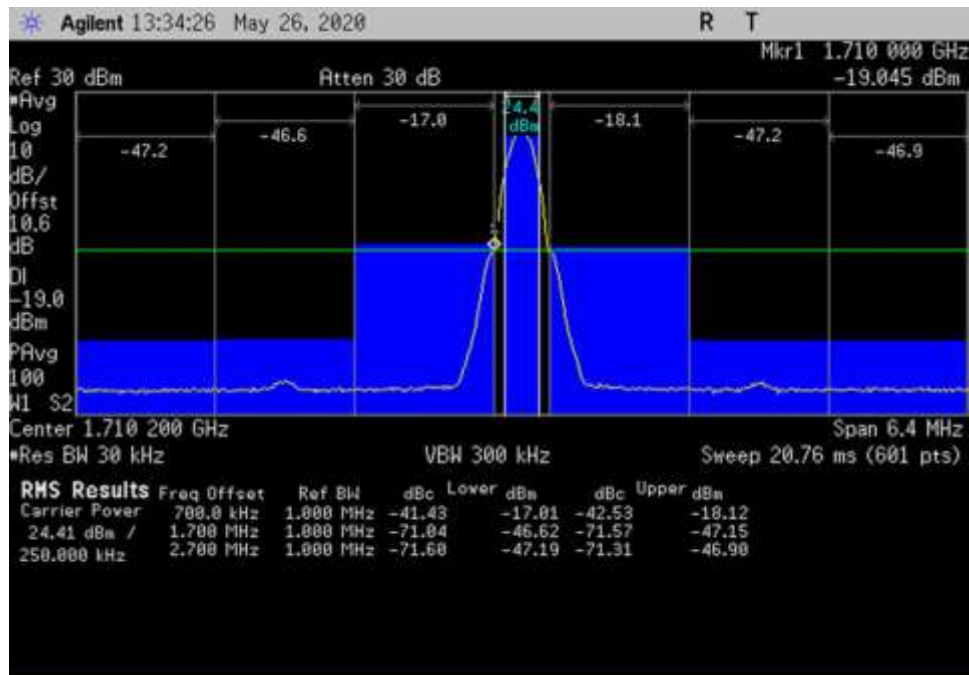
UL_776-787_GSM_786.05-787.55MHz



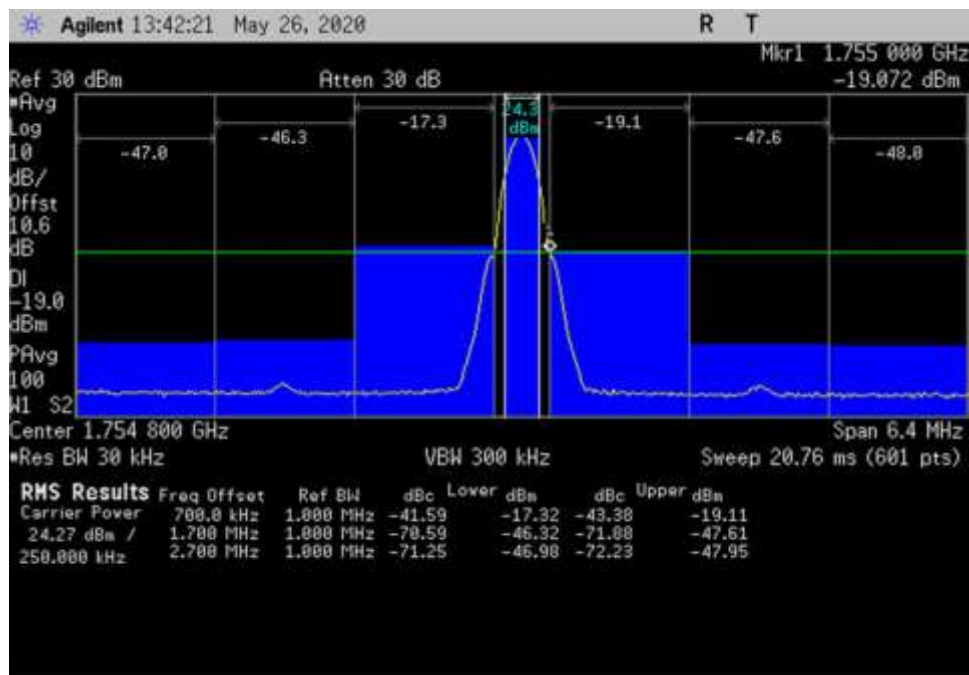
UL_824-849_GSM_ 823.45- 824.95MHz



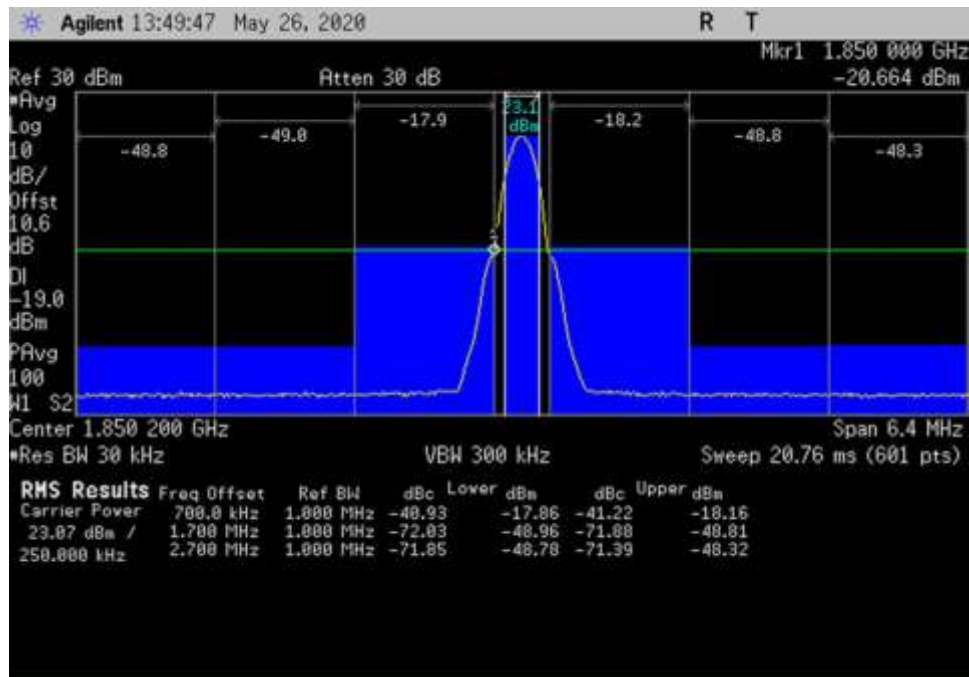
UL_824-849_GSM_ 848.05- 849.55MHz



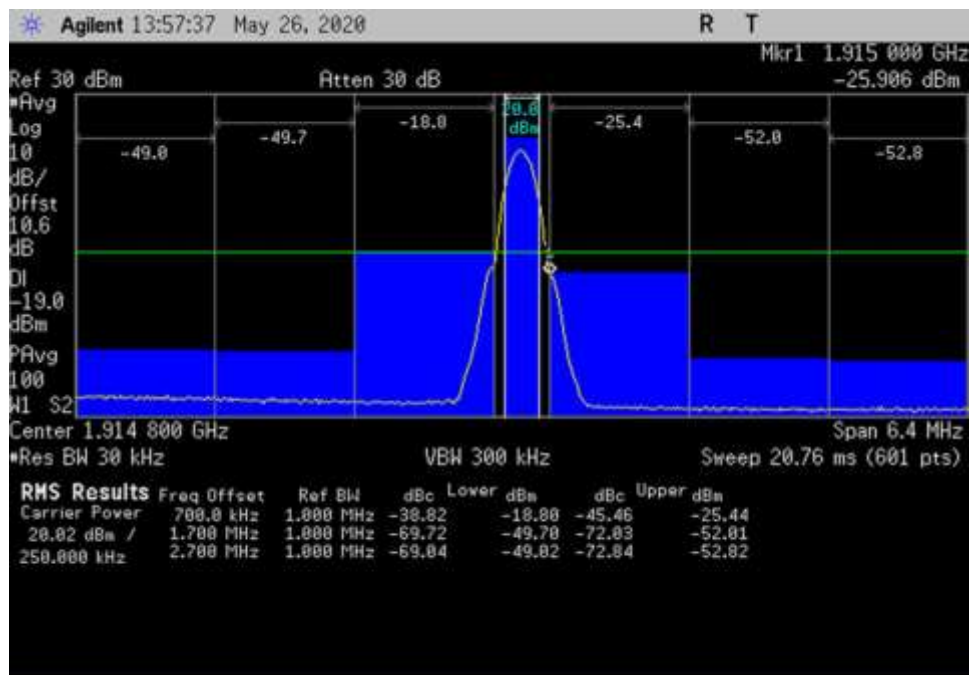
UL_1710-1755_GSM_1707-1713.4MHz



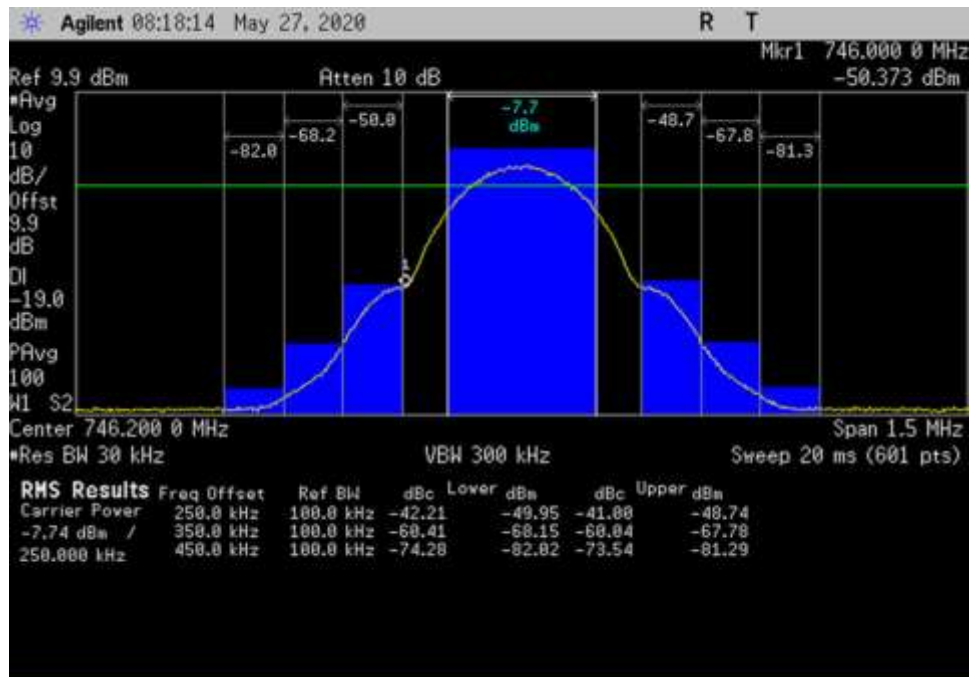
UL_1710-1755_GSM_1751.6-1758MHz



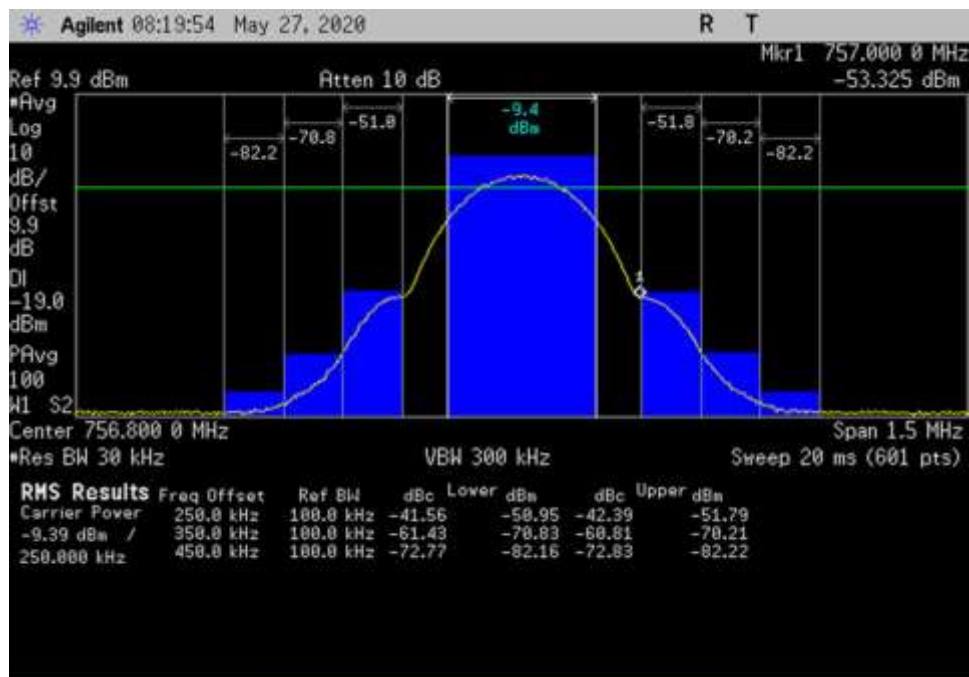
UL_1850-1915_GSM_1847-1853.4MHz



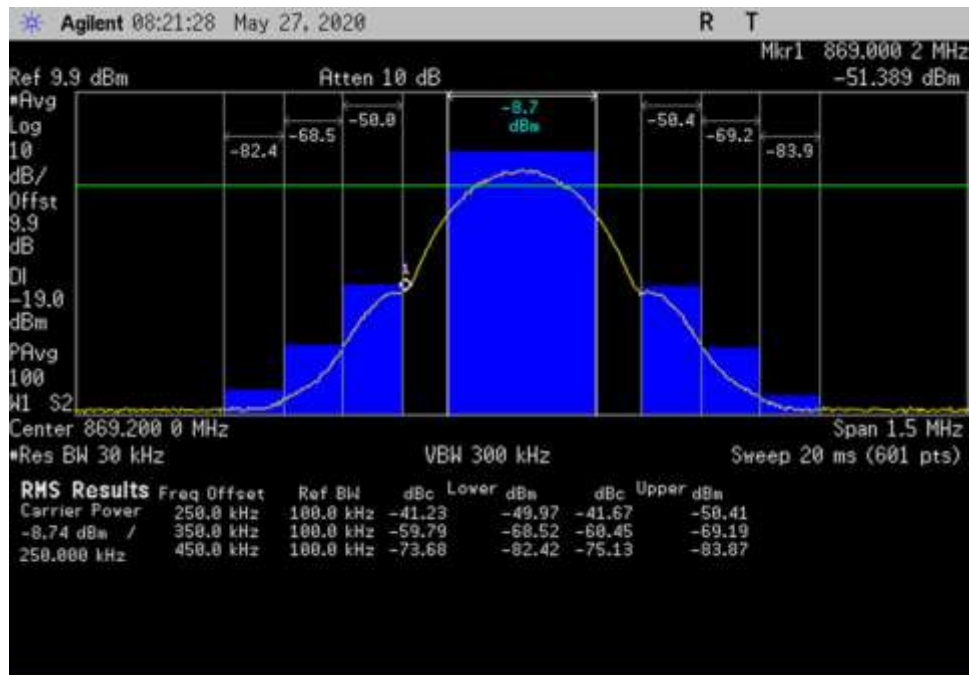
UL_1850-1915_GSM_1911.6-1918MHz



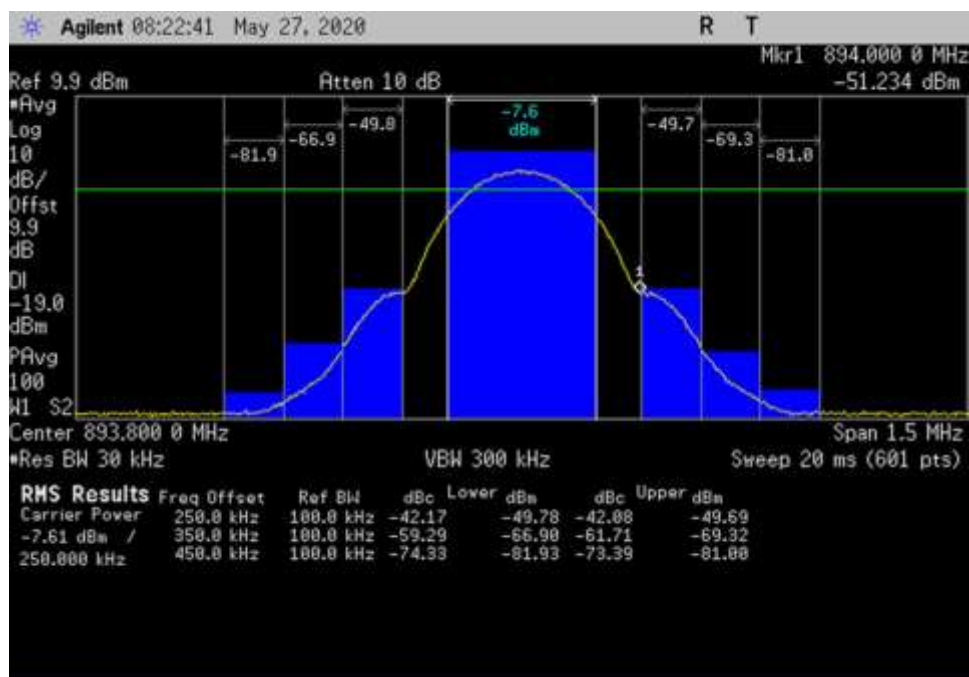
DL_746-757_GSM_ 746.2MHz



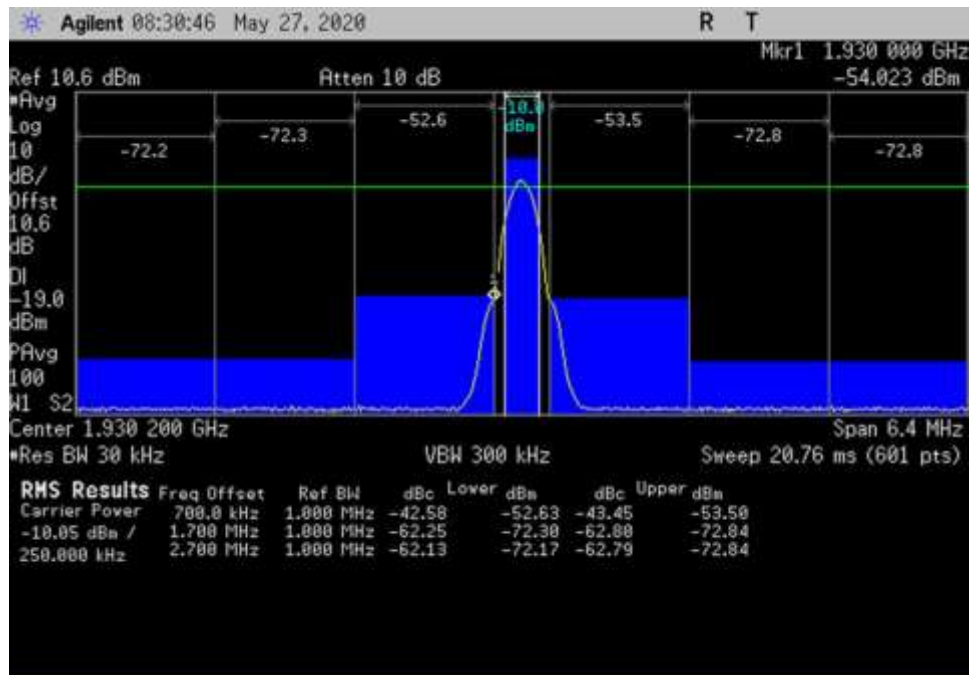
DL_746-757_GSM_ 756.8MHz



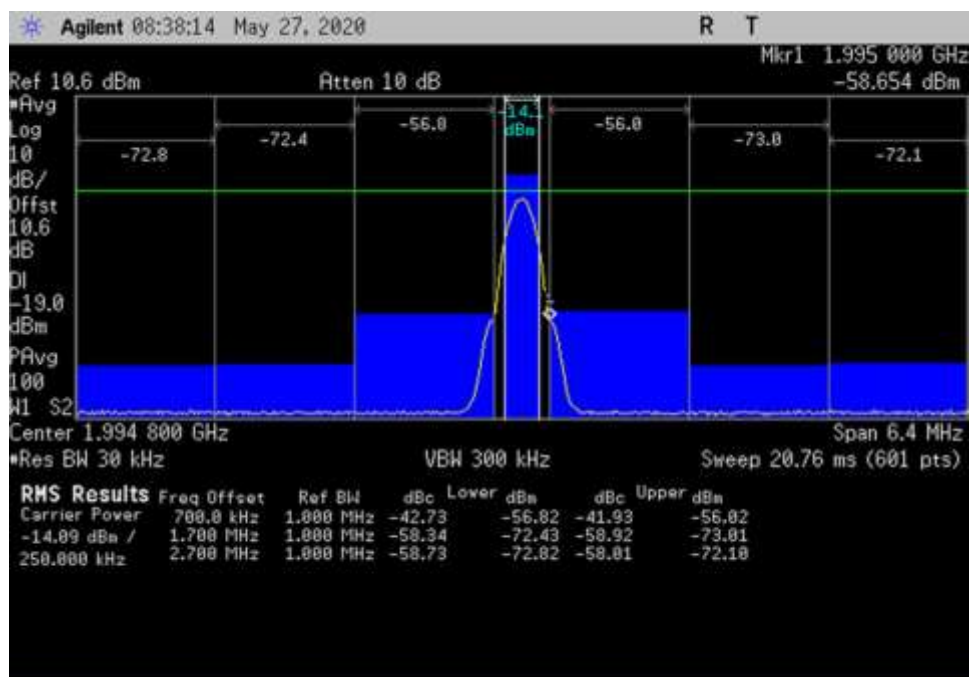
DL_869-894_GSM_ 869.2MHz



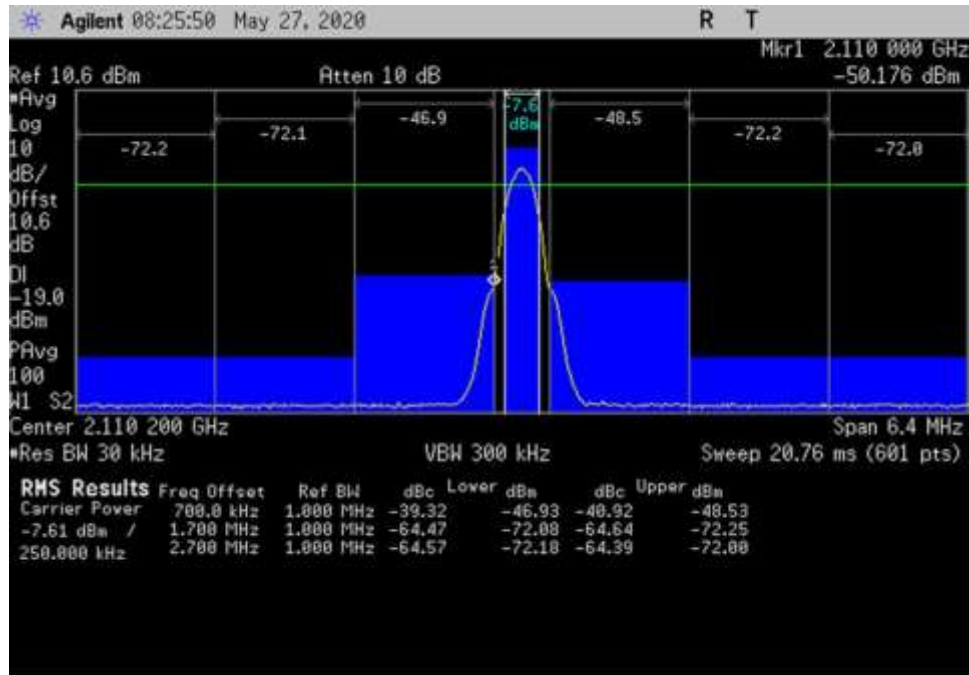
DL_869-894_GSM_ 893.8MHz



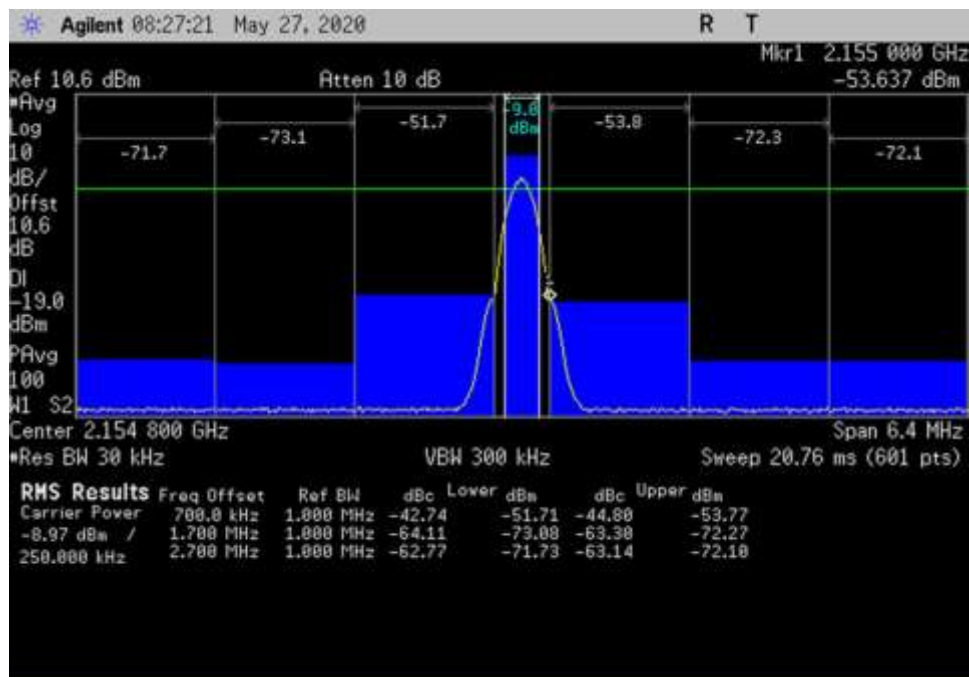
DL_1930-1995_GSM_1930.2MHz



DL_1930-1995_GSM_1994.8MHz

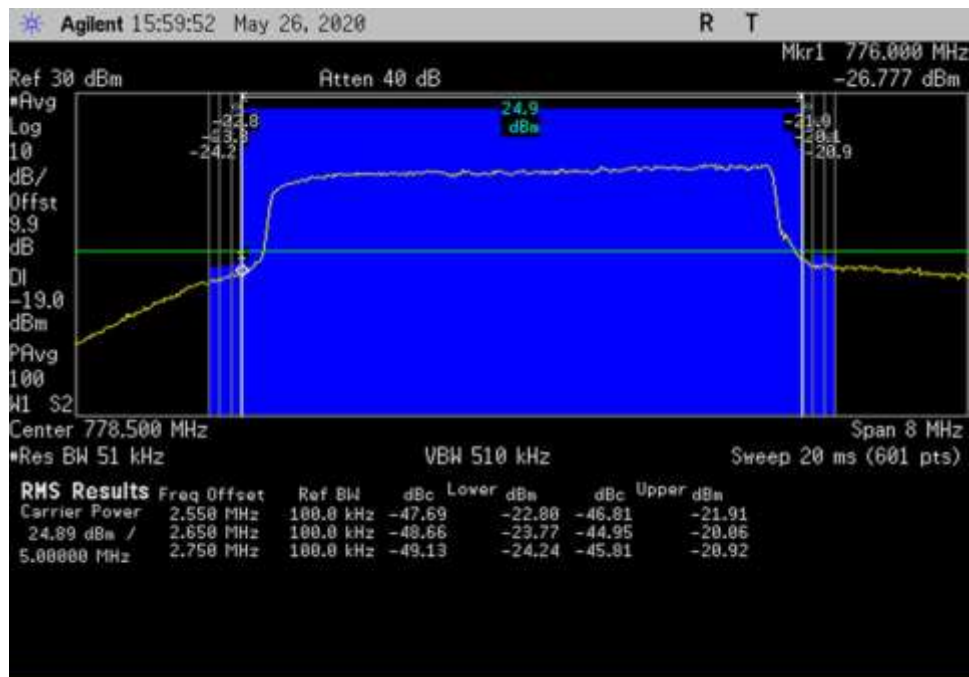


DL_2110-2155_GSM_2110.2MHz

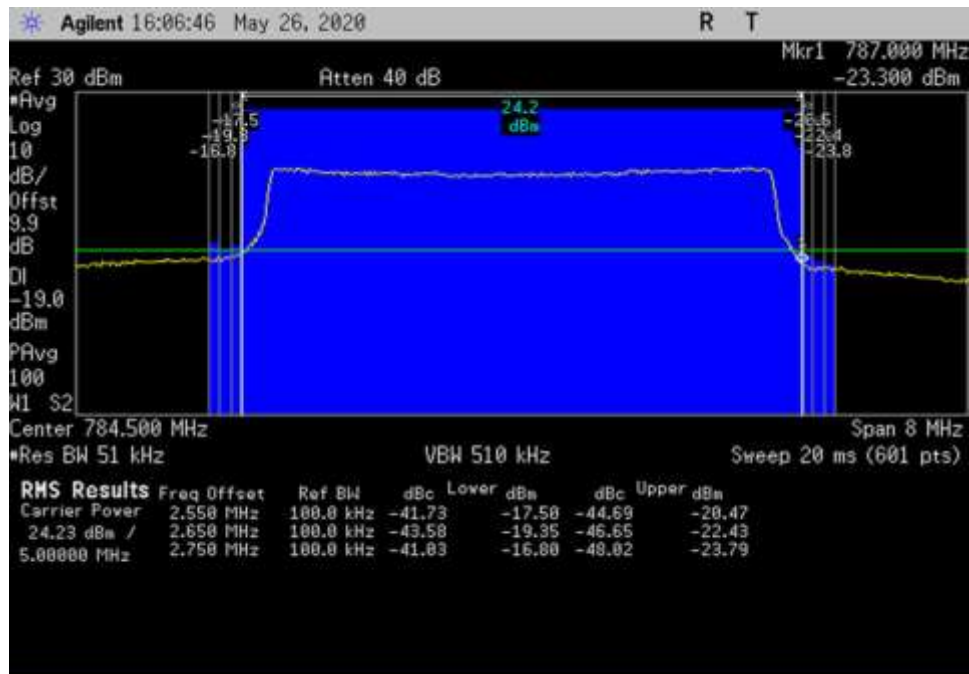


DL_2110-2155_GSM_2154.8MHz

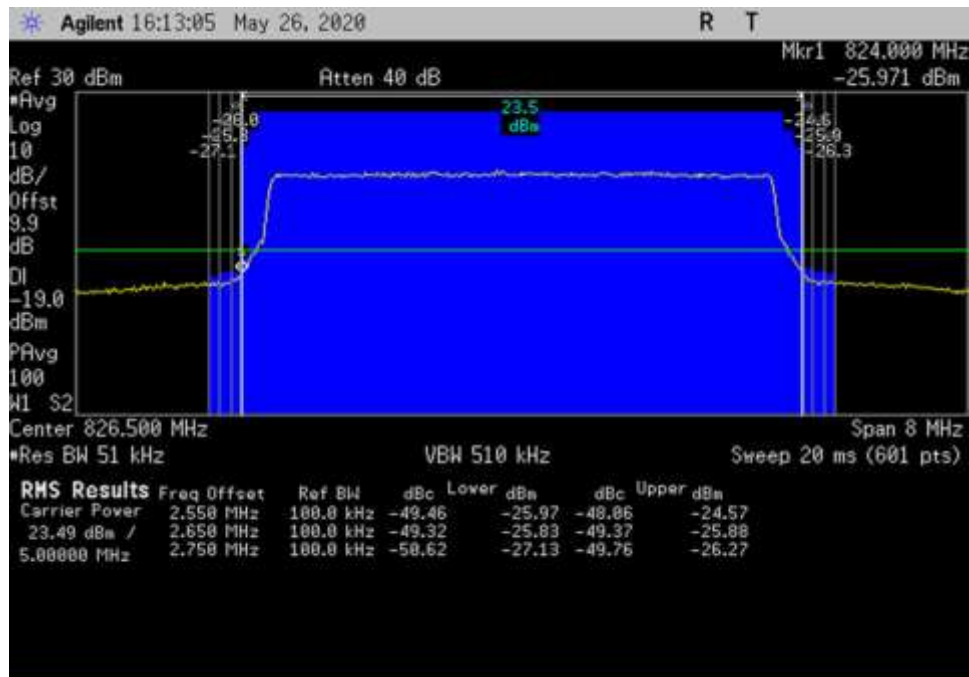
LTE



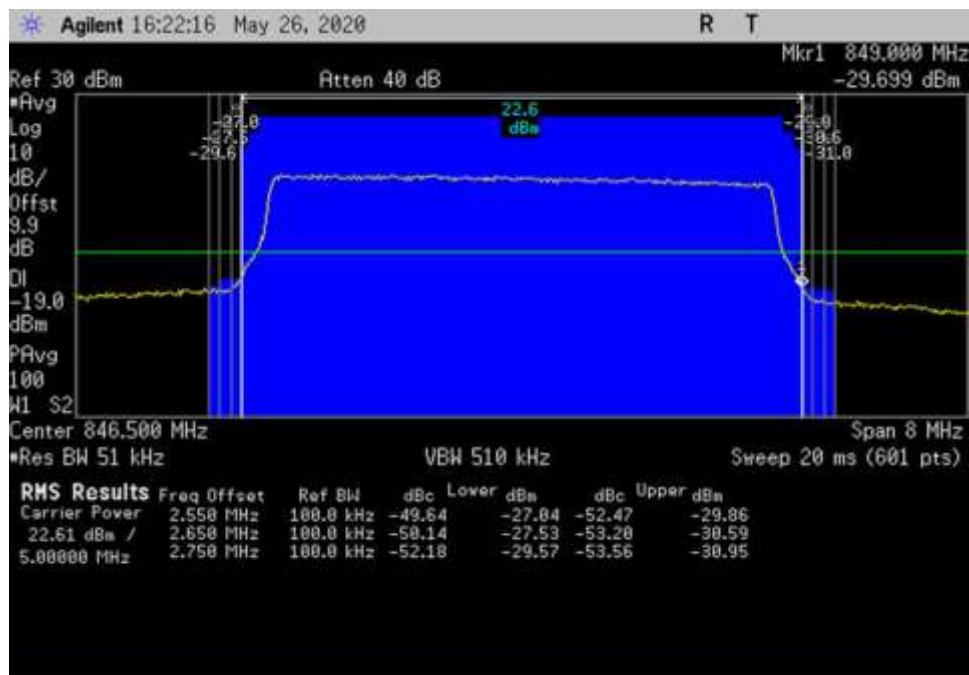
UL_776-787_LTE_774.5- 782.5MHz



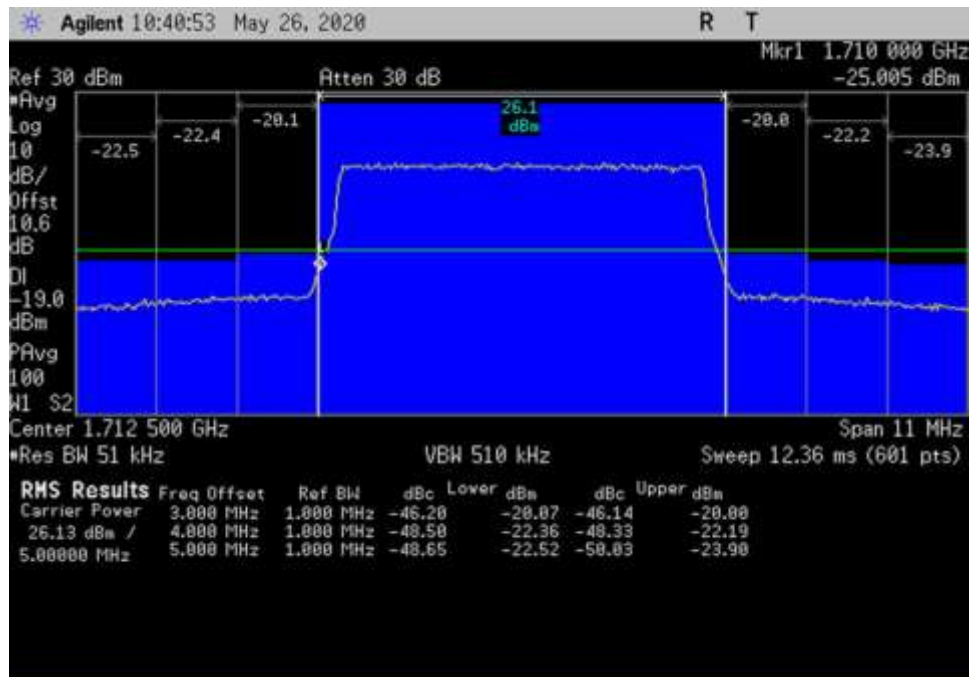
UL_776-787_LTE_780.5- 788.5MHz



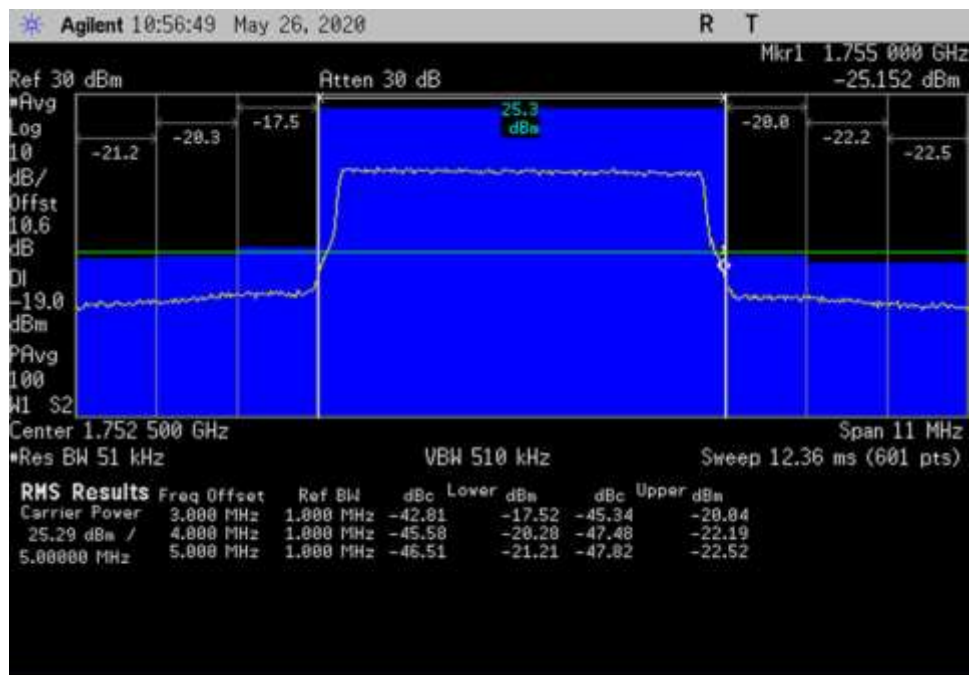
UL_824-849_LTE_ 822.5- 830.5MHz



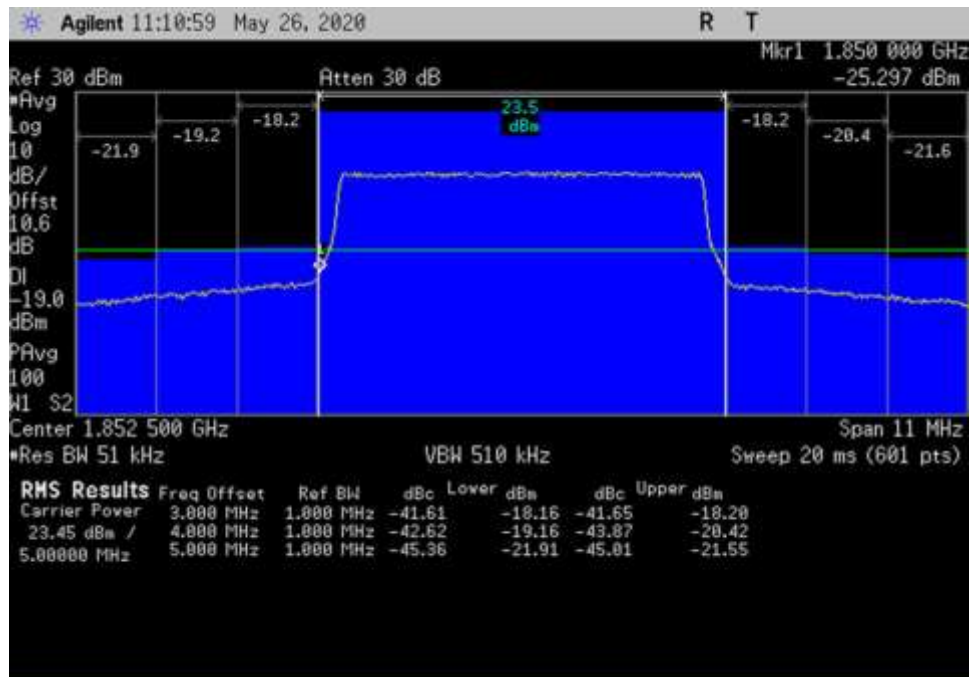
UL_824-849_LTE_ 842.5- 850.5MHz



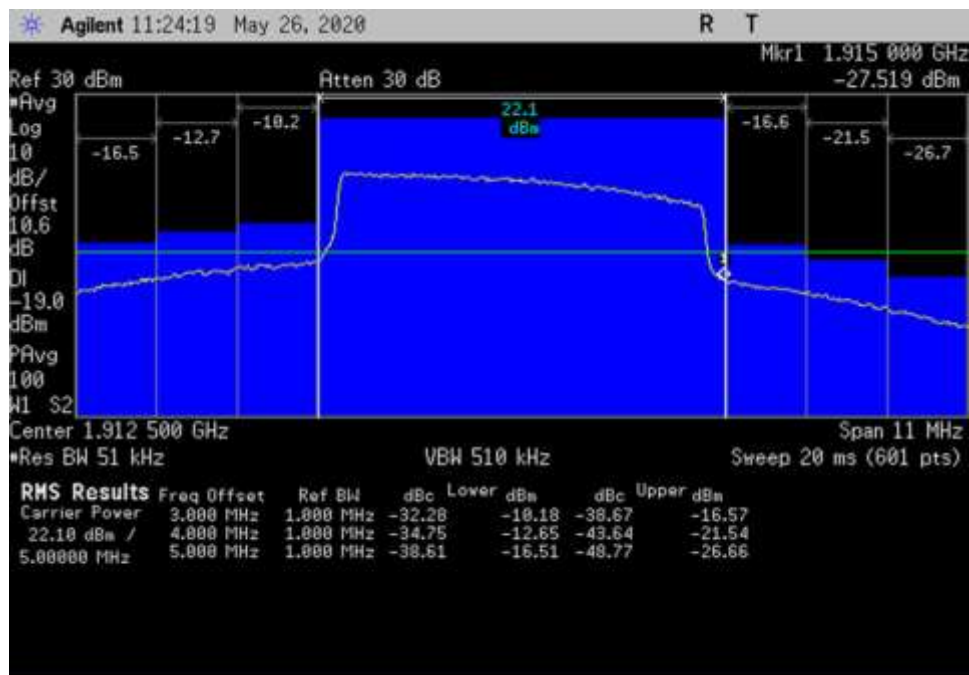
UL_1710-1755_LTE_1707-1718MHz



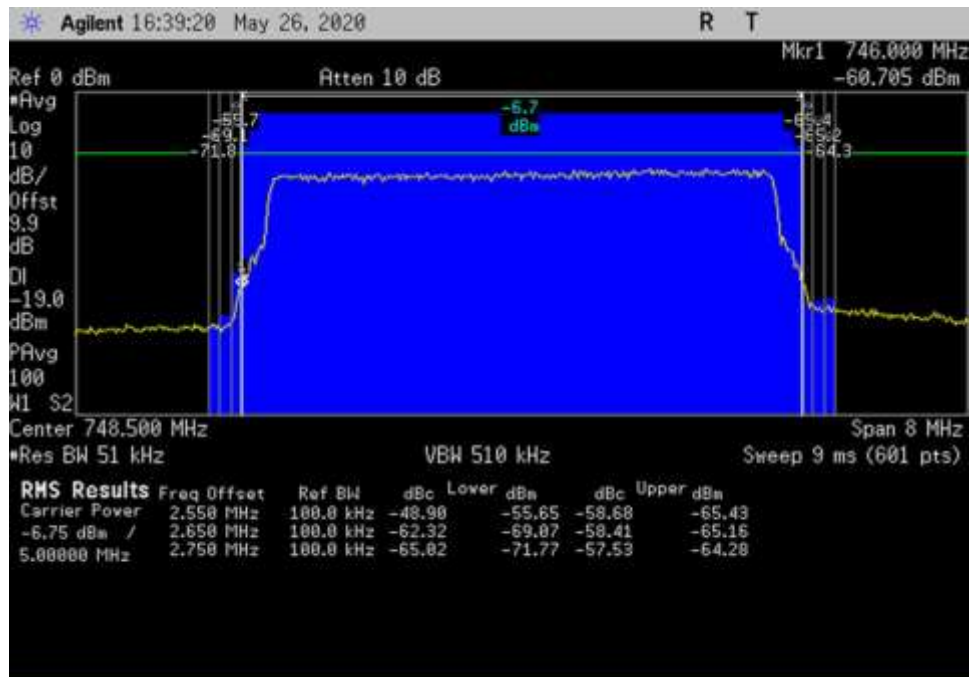
UL_1710-1755_LTE_1747-1758MHz



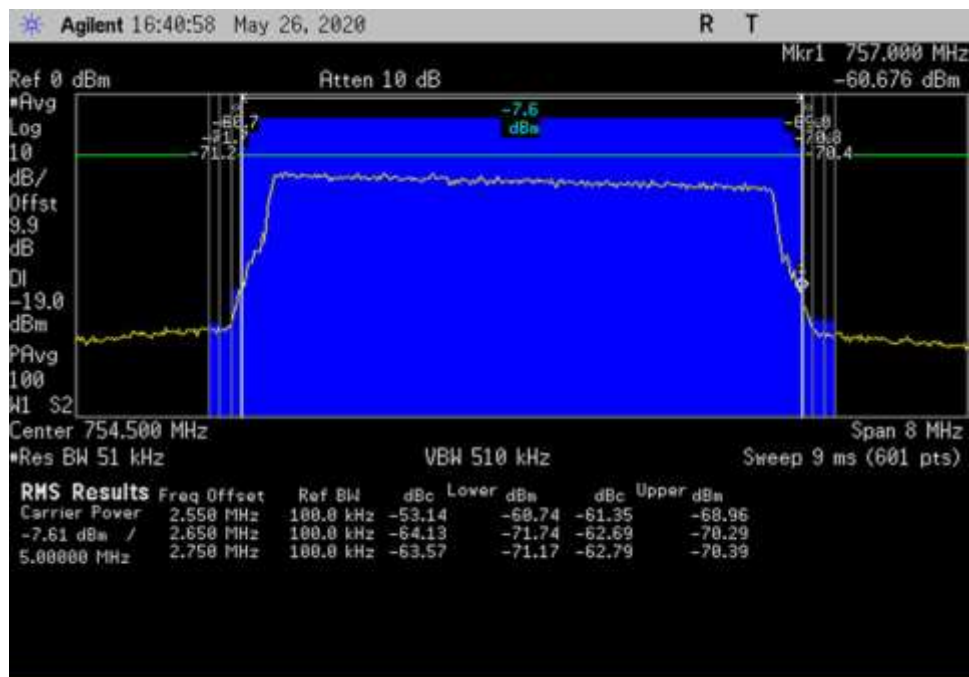
UL_1850-1915_LTE_1847-1858MHz



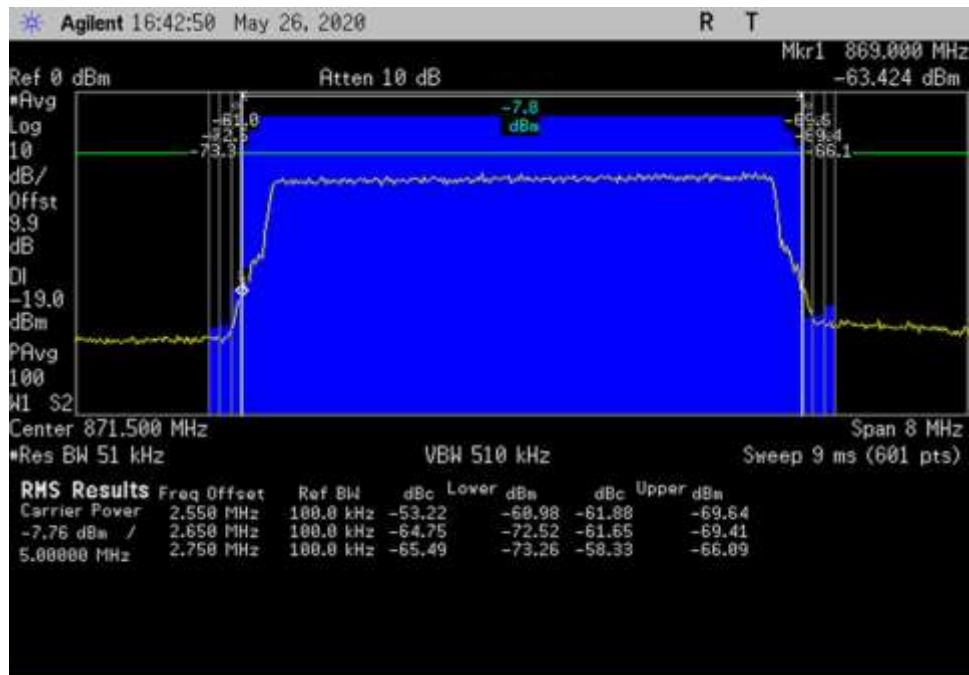
UL_1850-1915_LTE_1907-1918MHz



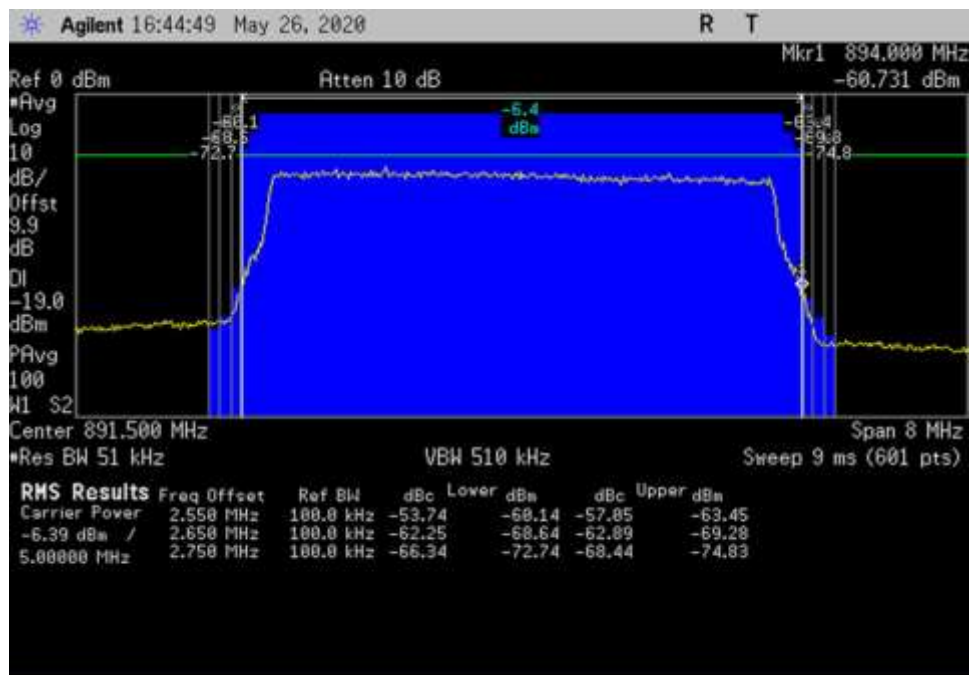
DL_746-757_LTE_ 744.5- 752.5MHz



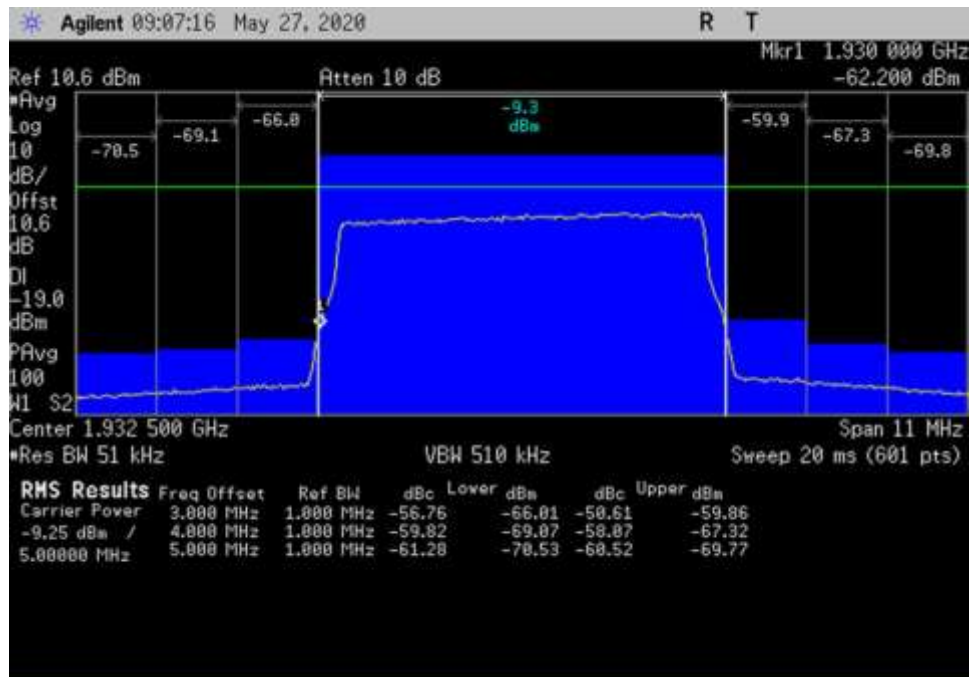
DL_746-757_LTE_ 750.5- 758.5MHz



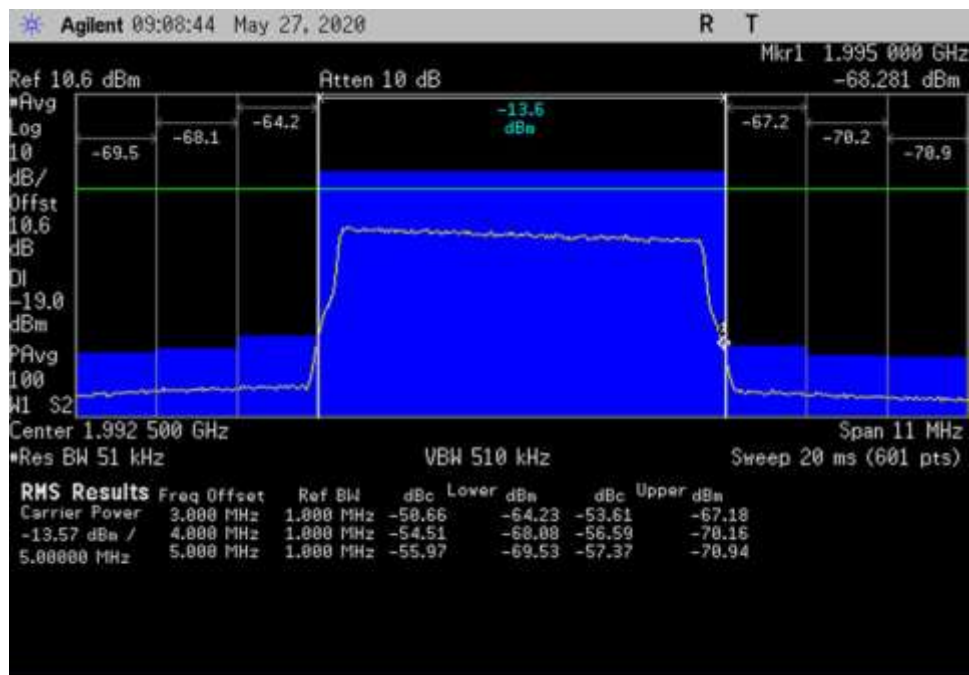
DL_869-894_LTE_ 867.5- 875.5MHz



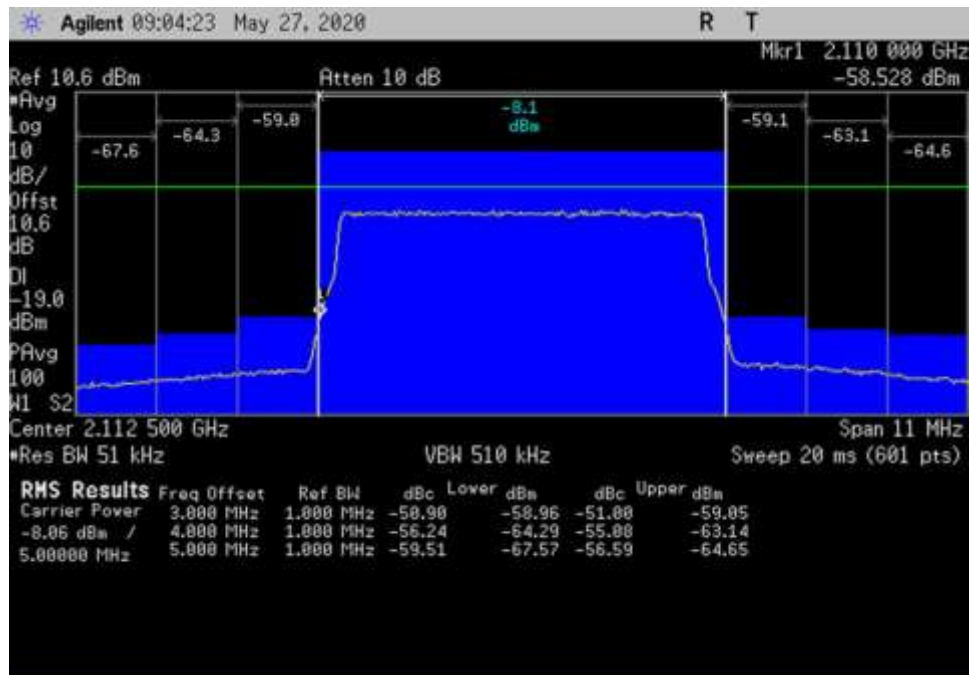
DL_869-894_LTE_ 887.5- 895.5MHz



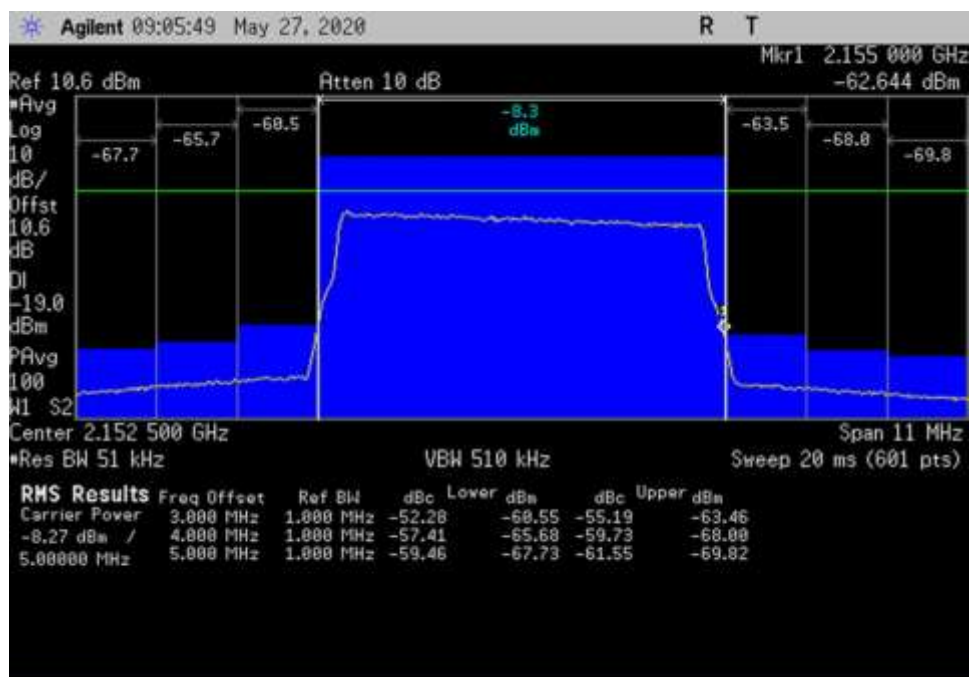
DL_1930-1995_LTE_1927-1938MHz



DL_1930-1995_LTE_1987-1998MHz



DL_2110-2155_LTE_2107-2118MHz



DL_2110-2155_LTE_2147-2158MHz

7.6 Conducted Spurious Emissions

Test Setup/Conditions	
Test Engineer:	Hieu S Nguyenpham
Test Date(s):	5/27/2020
Configuration:	1
Test Setup:	Frequency range of measurement = 9kHz- 22GHz. 9 kHz - 150 kHz -> RBW= 200Hz VBW= 200Hz 150 kHz - 30 MHz -> RBW= 9kHz VBW= 9kHz 30 MHz - 1000MHz -> RBW*= 1MHz VBW= 3MHz 1000 MHz - 22000MHz ->RBW= 1MHz VBW= 3MHz For 9 kHz-30 MHz testing: No Conducted Spurious Emissions were found within 20dB of the limit. *Note: As specified on 7.6 Conducted spurious emissions test procedure of 935210 D03 Signal Booster Measurements v04r04, for frequencies below 1 GHz, an RBW of 1 MHz may be used in a preliminary measurement. If non-compliant emissions are detected, a final measurement shall be made with a 100 kHz RBW. Additionally, a peak detector may also be used for the preliminary measurement. If non-compliant emissions are detected, then a final measurement of these emissions shall be made with the power averaging (RMS) detector. 27.53 (f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

Environmental Conditions					
Temperature (°C)	24.3	Relative Humidity (%):	38	Pressure: kPa	101.8

Test Equipment				
Asset #	Description	Model	Calibration Date	Cal Due Date
P05411	Attenuator	54A-10	11/27/2019	11/27/2021
02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
P06897	Cable	32022-29094K-29094K-48TC	3/25/2020	3/25/2022
P07192	Cable	32022-29094K-29094K-48TC	11/27/2019	11/27/2021
03697	Spectrum Analyzer	E4404B	8/27/2018	8/27/2020
02691	RF Amplifier	5162F	3/19/2020	3/19/2022
P05302	Directional Coupler	C223E-20	2/20/2019	2/20/2021
03360	Cable	32022-2-29094-36TC	4/9/2020	4/9/2022
03418	Signal Generator	E4438C	5/13/2019	5/13/2021

Summary of Results

Pass: As summarized in plots below, the conducted spurious emissions are within limits.

For 9kHz-30MHz testing: **No Conducted Spurious Emissions were found within 20dB of the limit.**

Per section 27.53 (f), the 1559-1610 band was also investigated and found emission within limits using applied correction (see calculation below).

Limit Line Calculation*				
Frequency (MHz)	Antenna Gain- cable loss (dBi)	Limit line EIRP (dBW/MHz)	Limit line EIRP (dBm)	Limit line EIRP corrected (dBm)
UL 776-787	2	-70.0	-40	-42

LIMIT LINE FOR SPURIOUS CONDUCTED EMISSION

$$\text{REQUIRED ATTENUATION} = 43 + 10 \log P \text{ DB}$$

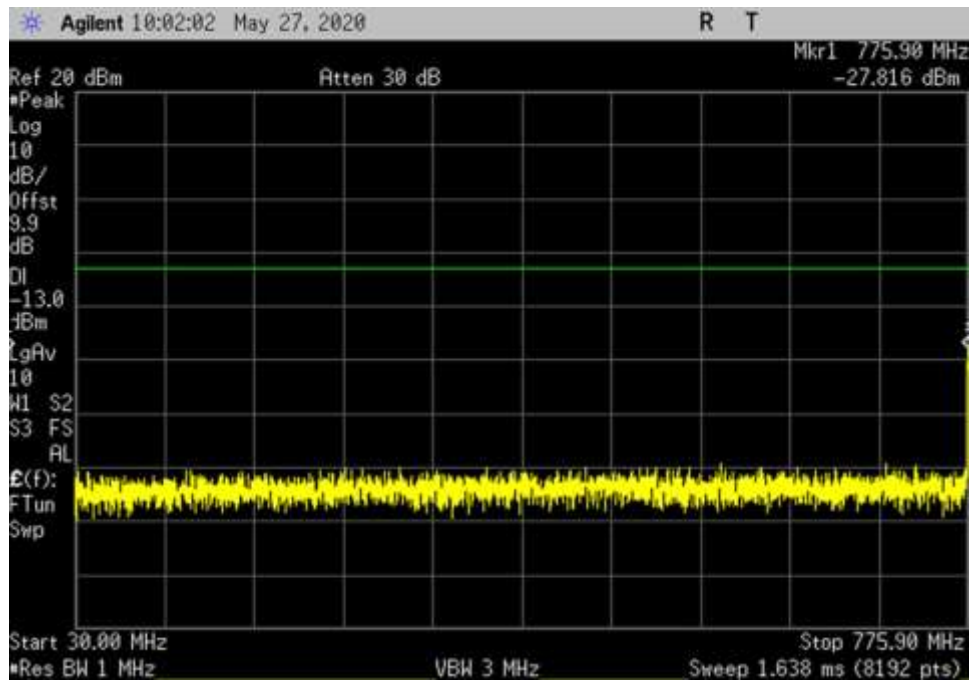
$$\text{Limit line (dBuV)} = V_{\text{dBuV}} - \text{Attenuation}$$

$$\begin{aligned} V_{\text{dBuV}} &= 20 \log \frac{V}{1 \times 10^{-6}} \\ &= 20 (\log V - \log 1 \times 10^{-6}) \\ &= 20 \log V - 20 \log 1 \times 10^{-6} \\ &= 20 \log V - 20 (-6) \\ &= 20 \log V + 120 \end{aligned}$$

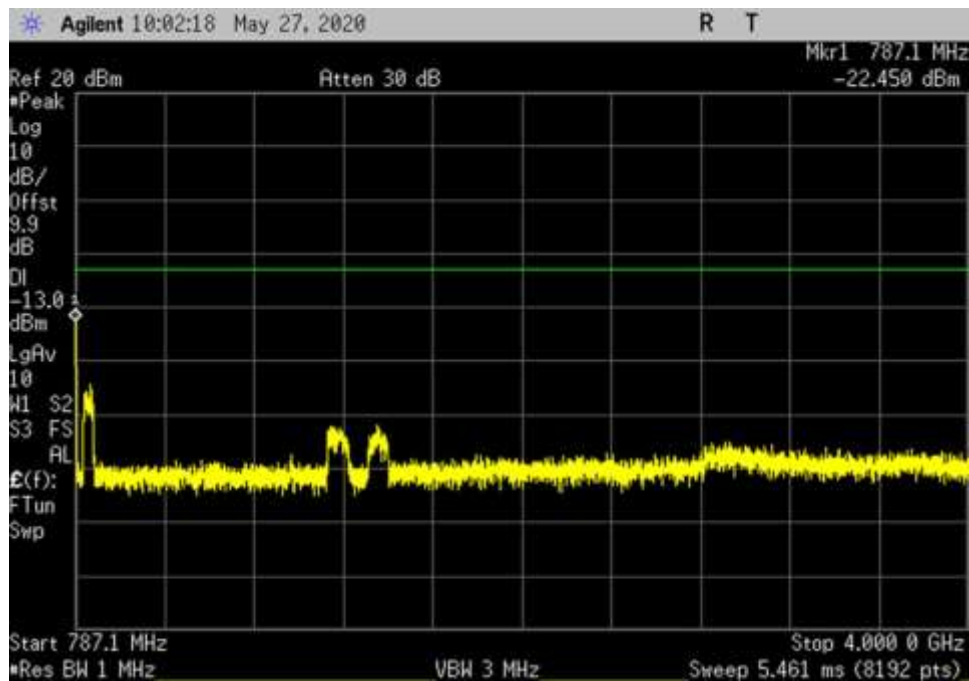
$$\begin{aligned} \text{Attenuation} &= 43 + 10 \log P \\ &= 43 + 10 \log \frac{V^2}{R} \\ &= 43 + 10 (\log V^2 - \log R) \\ &= 43 + 10 (2 \log V - \log R) \\ &= 43 + 20 \log V - 10 \log R \end{aligned}$$

$$\begin{aligned} \text{Limit line} &= V_{\text{dBuV}} - \text{Attenuation} \\ &= 20 \log V + 120 - (43 + 20 \log V - 10 \log R) \\ &= 20 \log V + 120 - 43 - 20 \log V + 10 \log R \\ &= 20 \log V + 120 - 43 - 20 \log V + 10 \log R \\ &= 120 - 43 + 10 \log 50 \quad \text{Note : } R = 50 \Omega \\ &= 120 - 43 + 16.897 \\ &= 94 \text{ dBuV at any power level} \end{aligned}$$

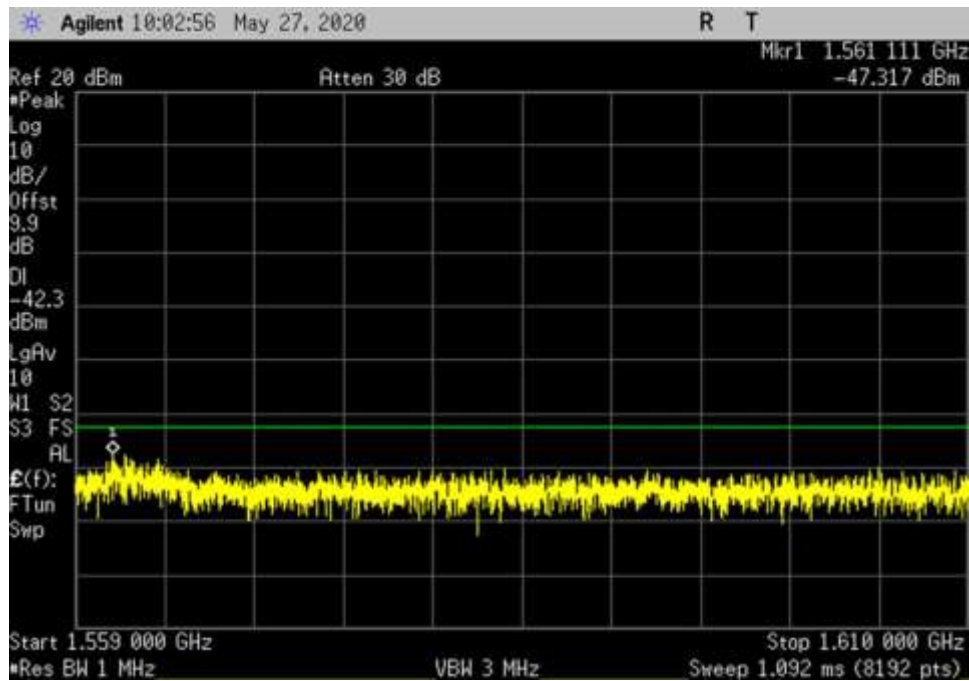
Plots



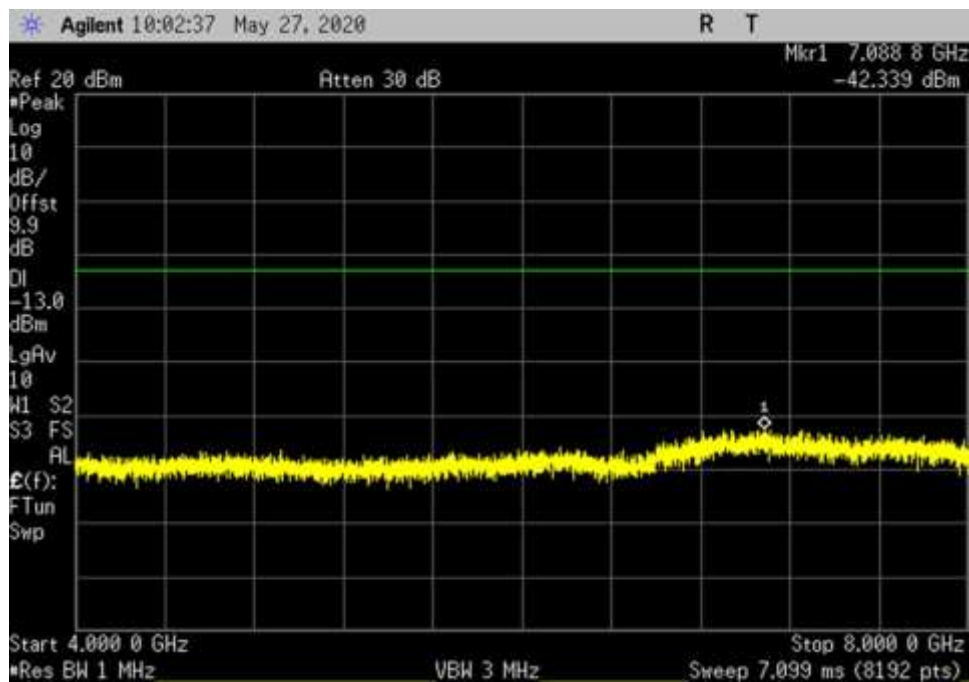
UL_776-787_30- 775.9MHz



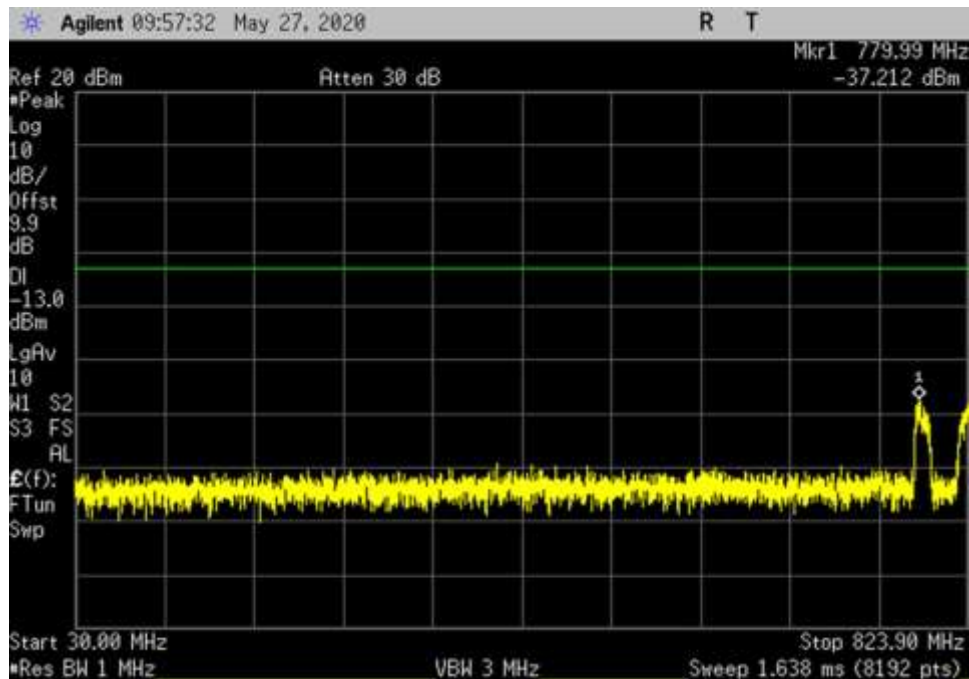
UL_776-787_ 787.1- 4000MHz



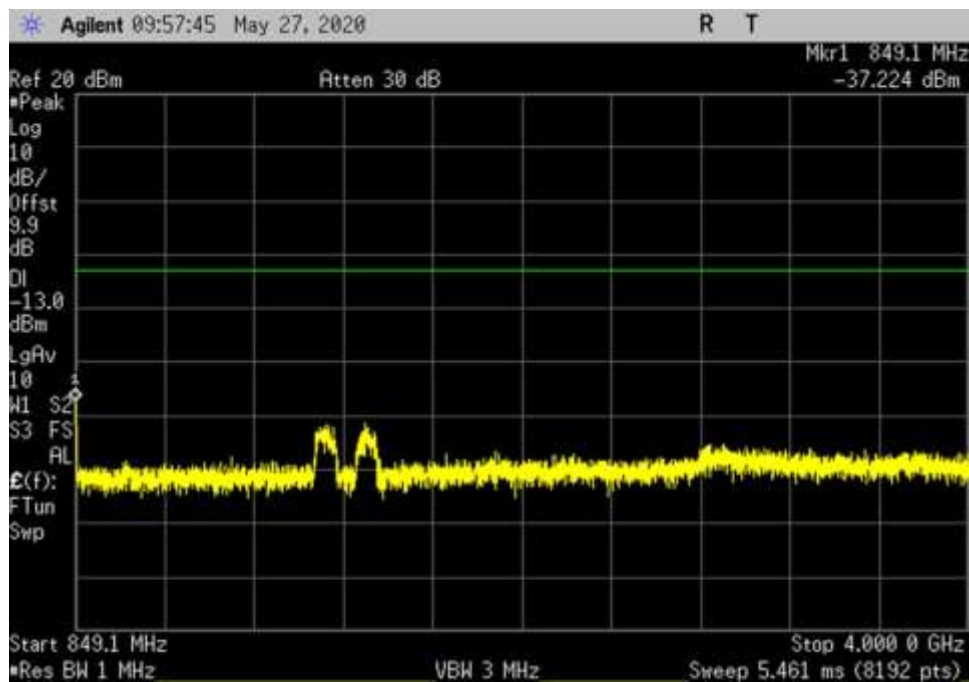
UL_776-787_ 1559- 1610MHz



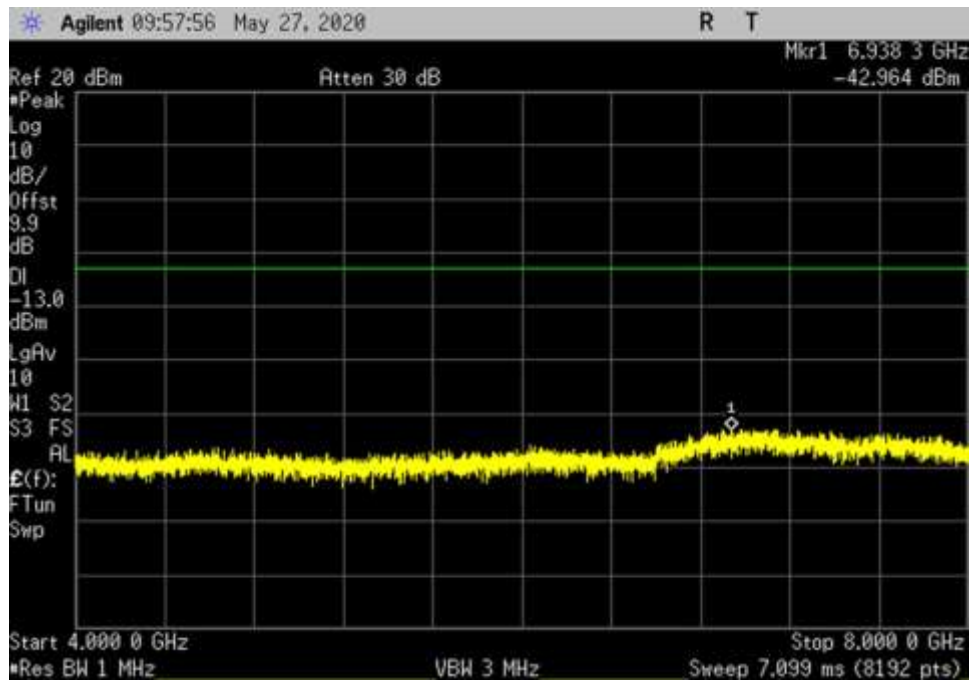
UL_776-787_ 4000- 8000MHz



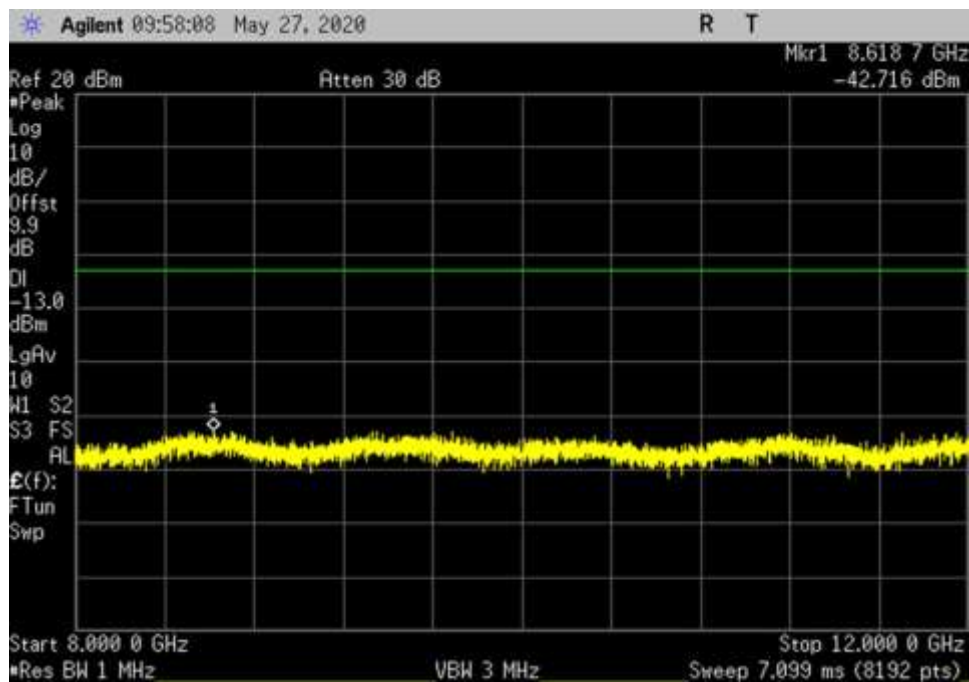
UL_824-849_ 30- 823.9MHz



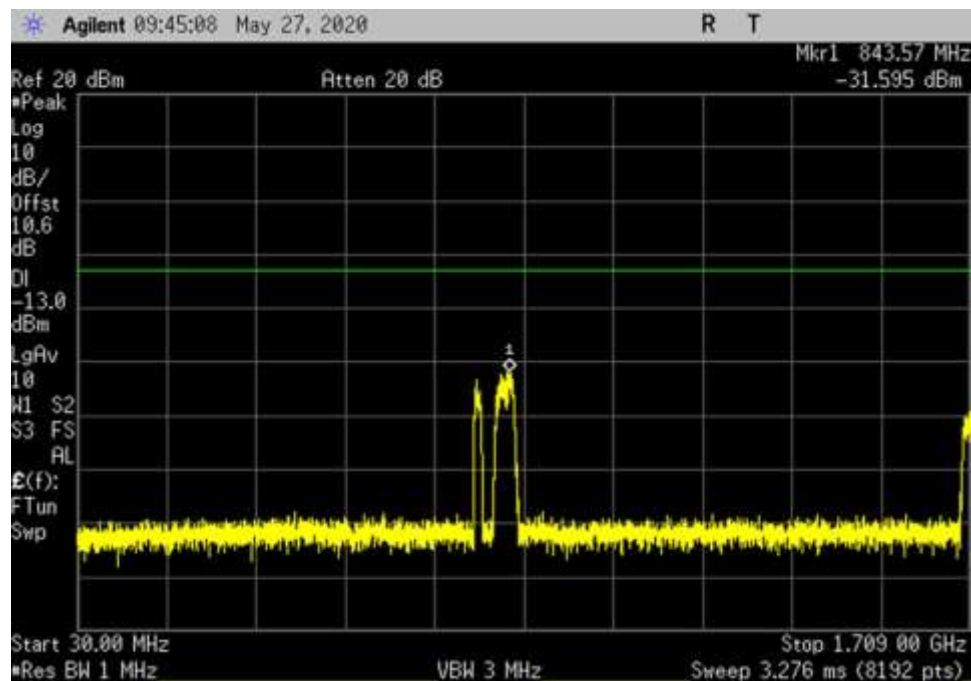
UL_824-849_ 849.1- 4000MHz



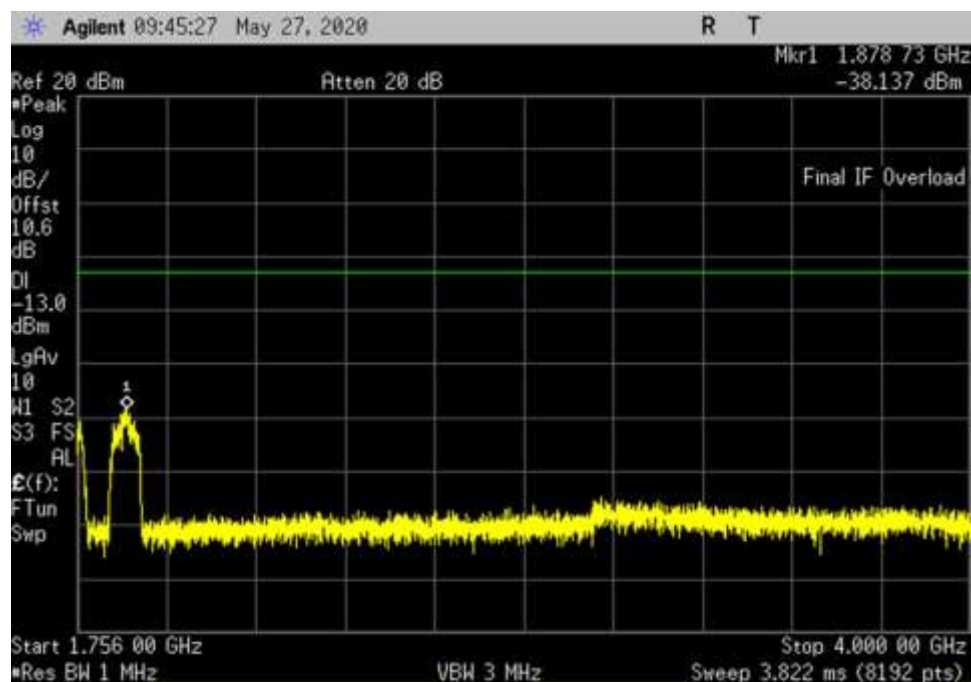
UL_824-849_ 4000- 8000MHz



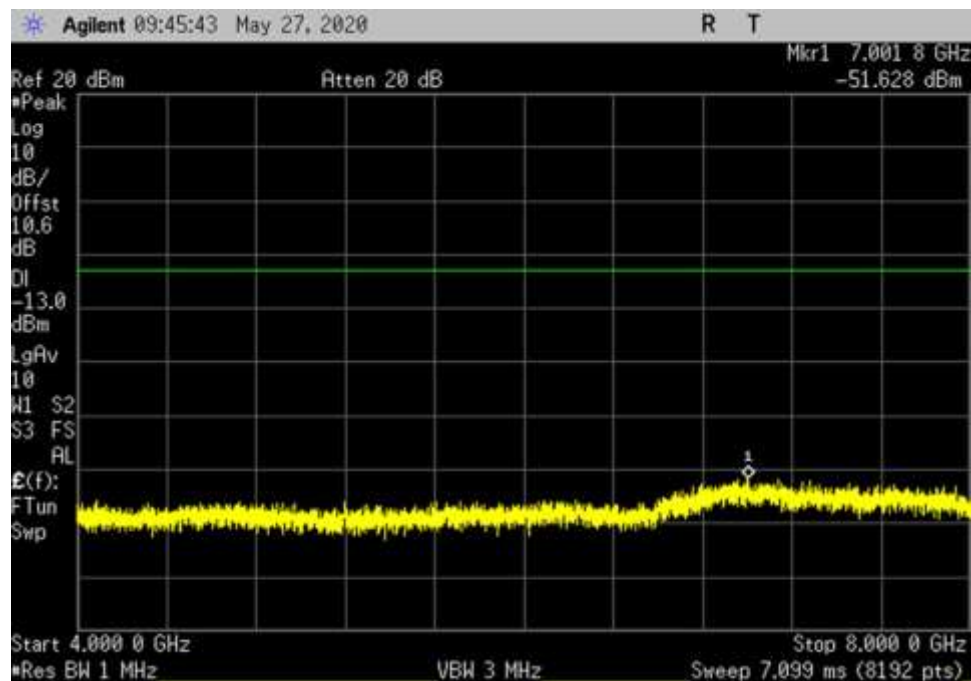
UL_824-849_ 8000- 12000MHz



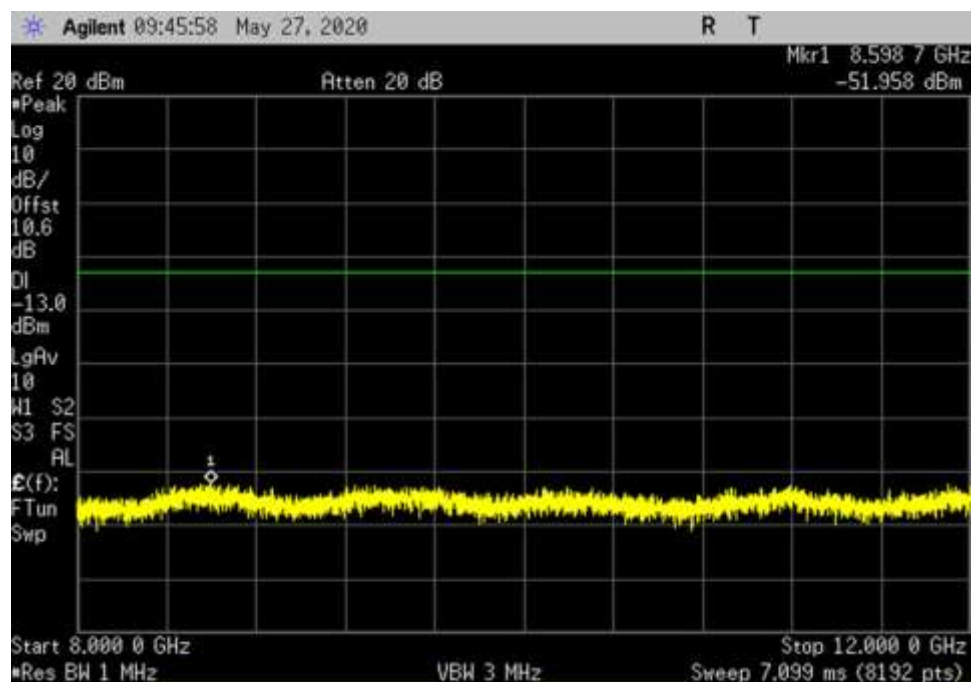
UL_1710-1755_ 30- 1709MHz



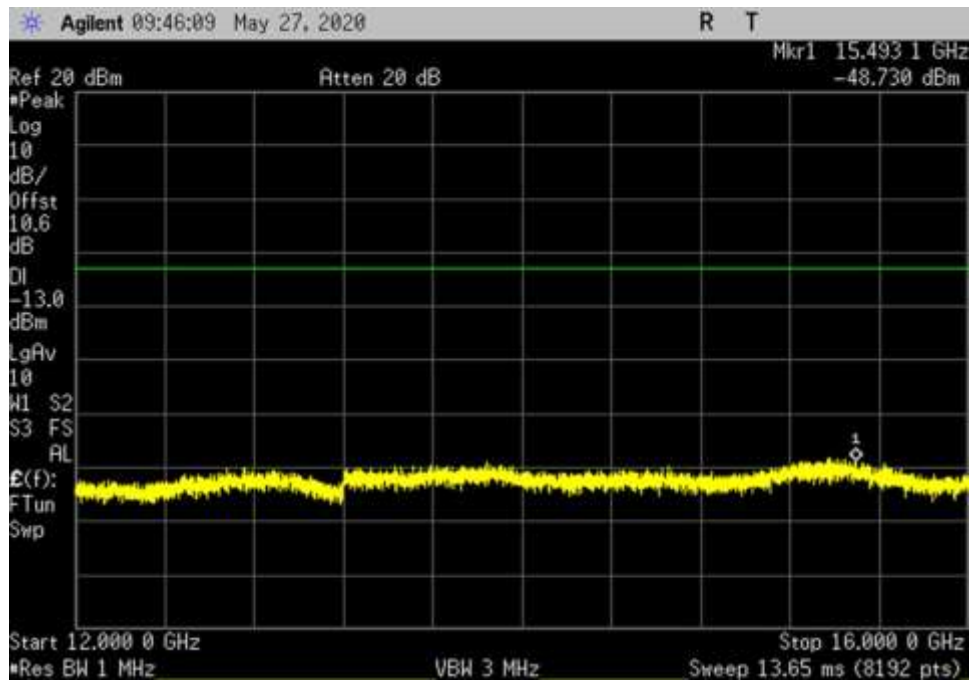
UL_1710-1755_ 1756- 4000MHz



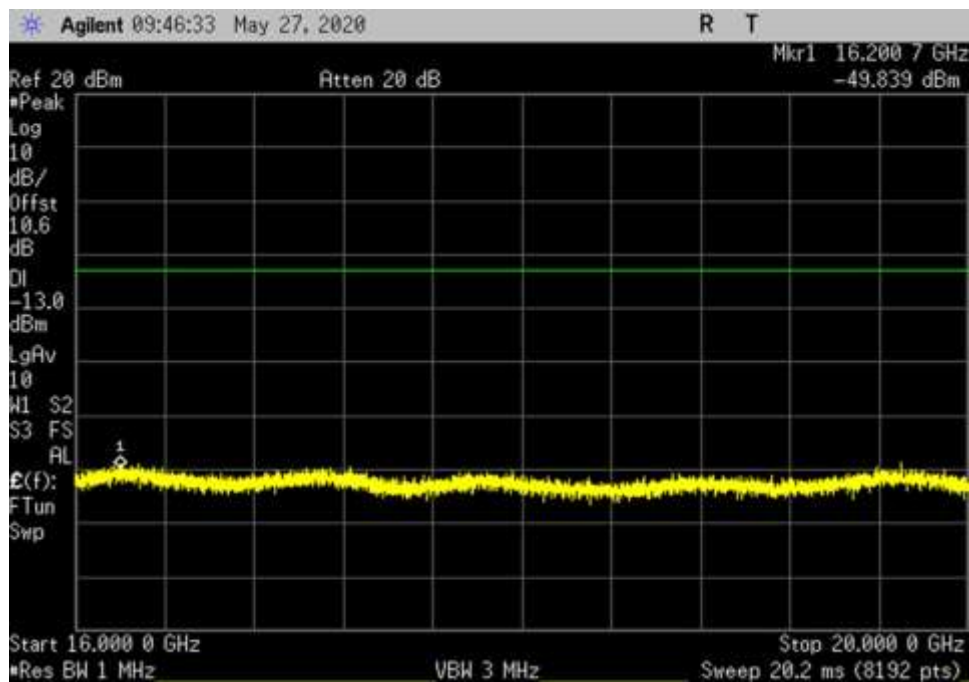
UL_1710-1755_ 4000- 8000MHz



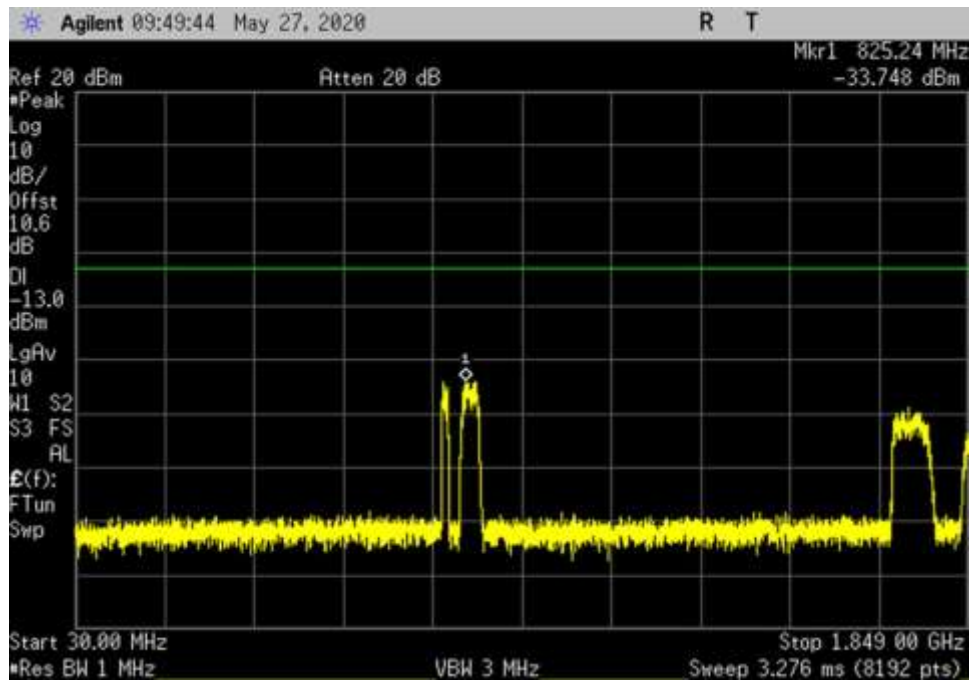
UL_1710-1755_ 8000- 12000MHz



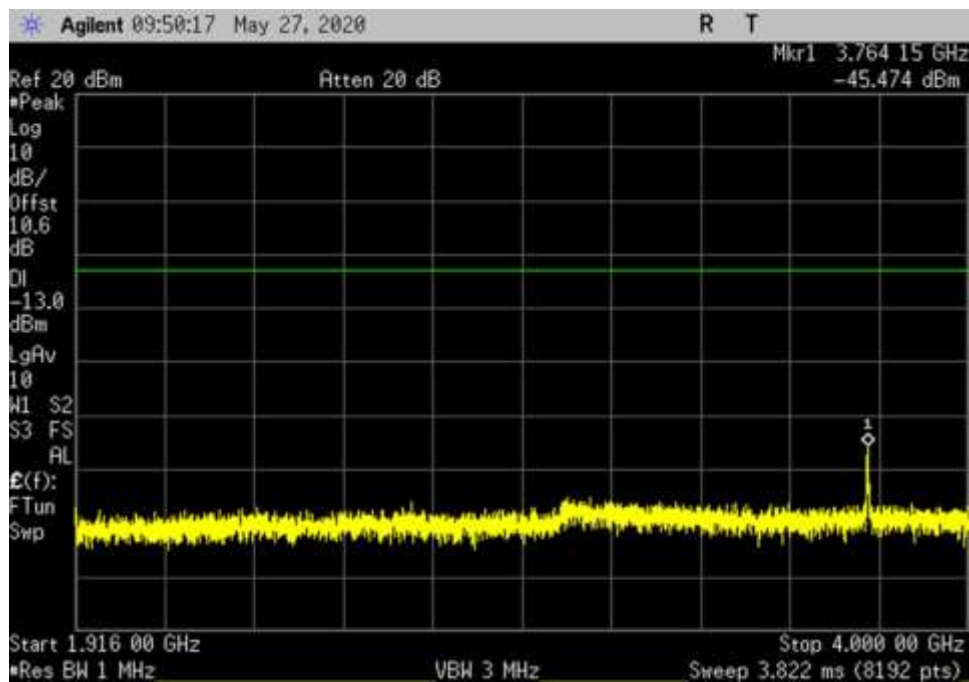
UL_1710-1755_ 12000- 16000MHz



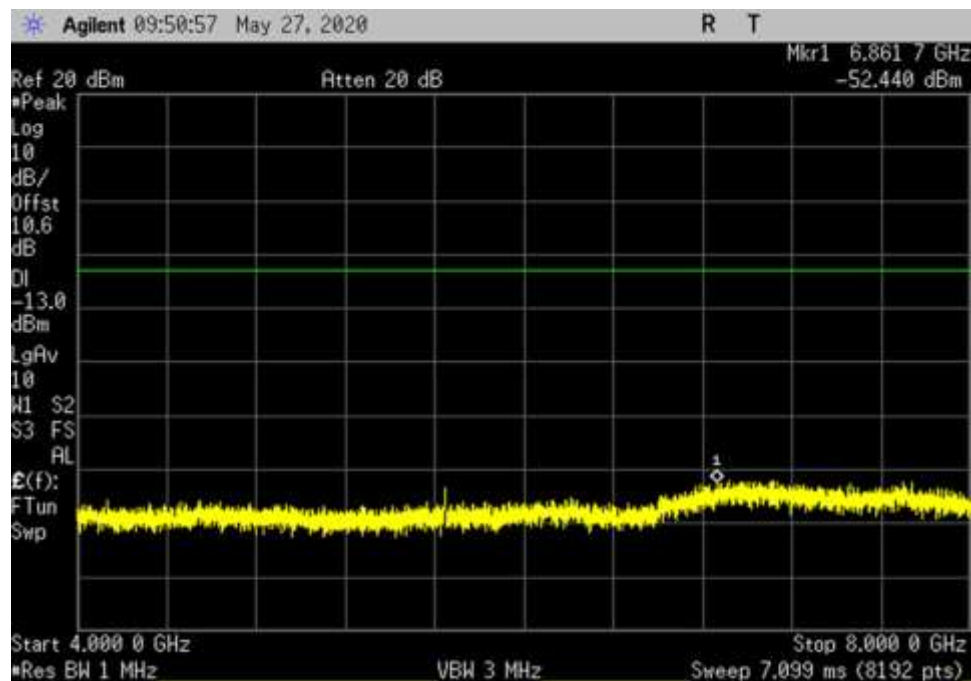
UL_1710-1755_ 16000- 20000MHz



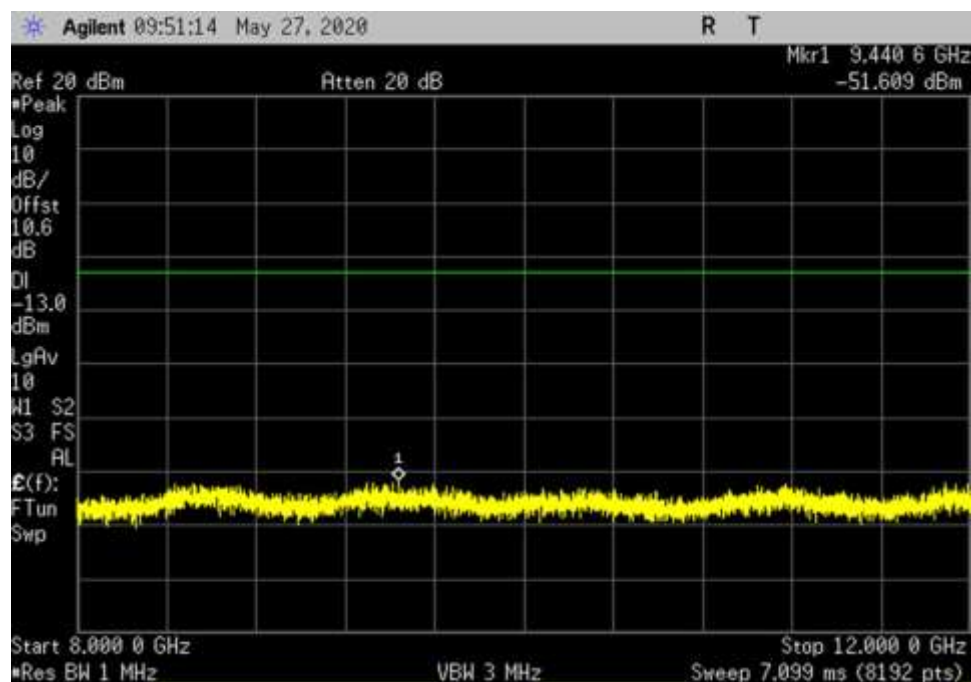
UL_1850-1915_ 30- 1849MHz



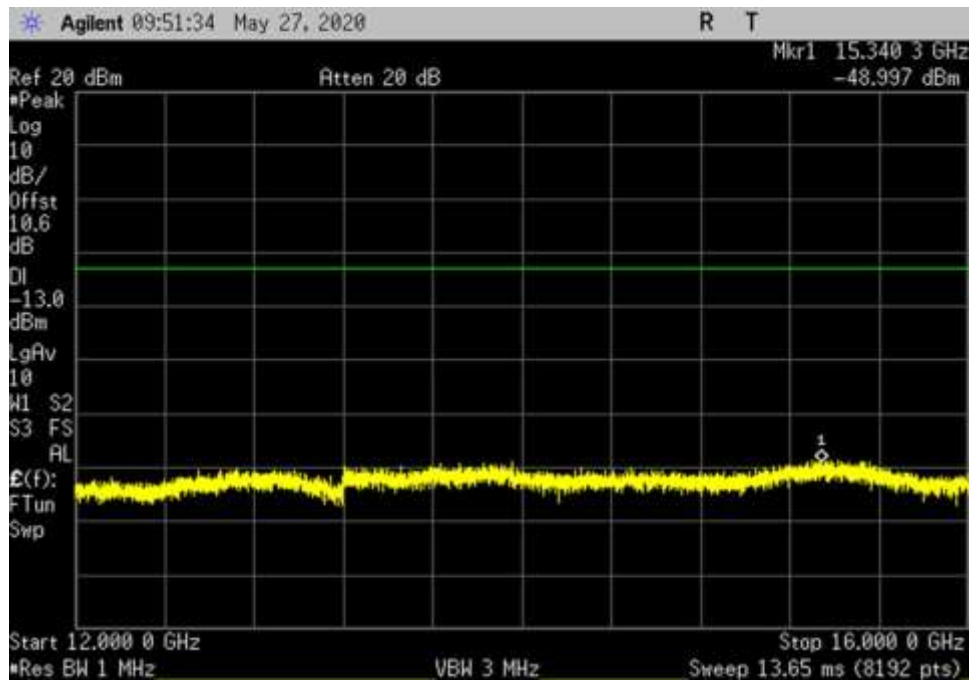
UL_1850-1915_ 1916- 4000MHz



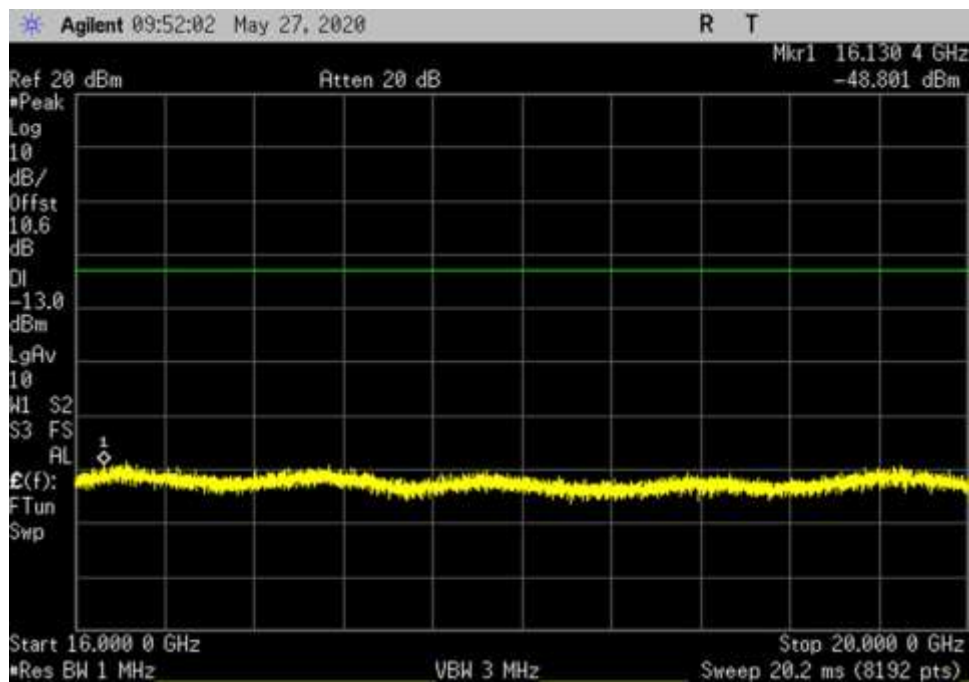
UL_1850-1915_ 4000- 8000MHz



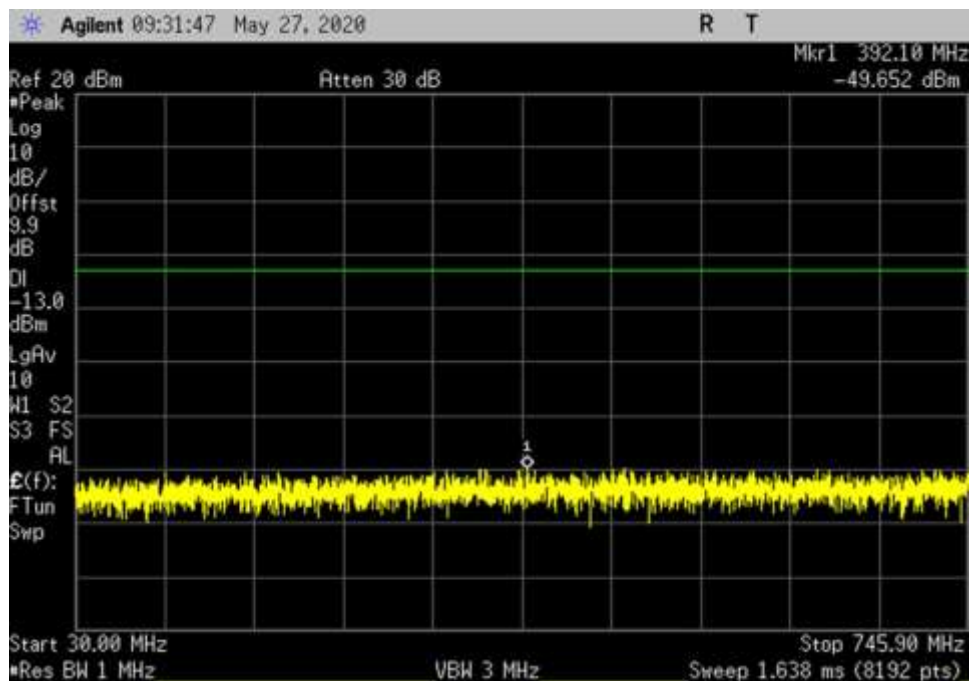
UL_1850-1915_ 8000- 12000MHz



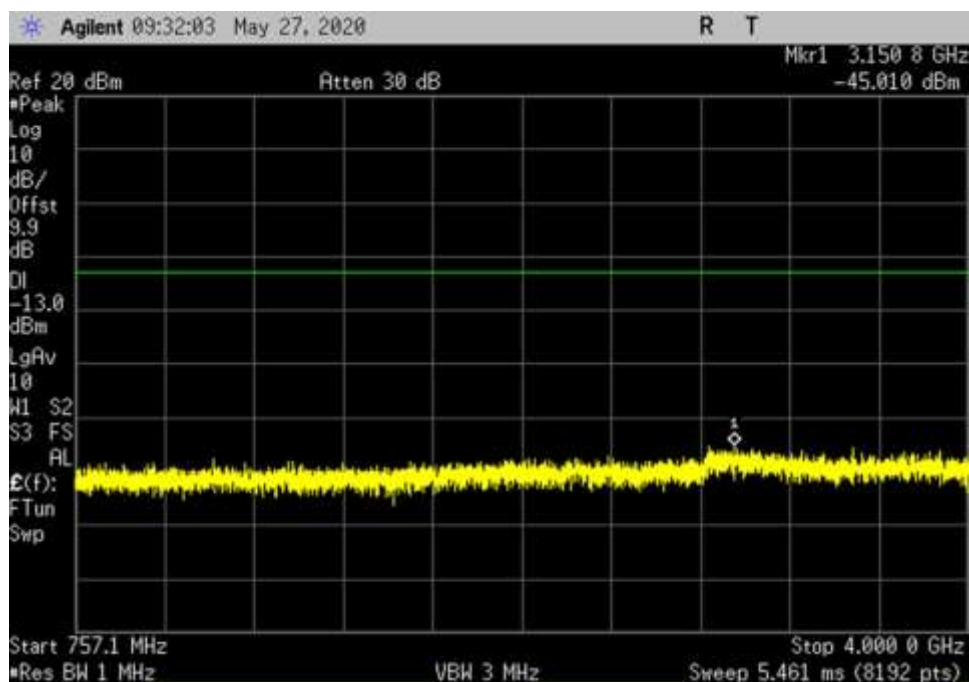
UL_1850-1915_ 12000- 16000MHz



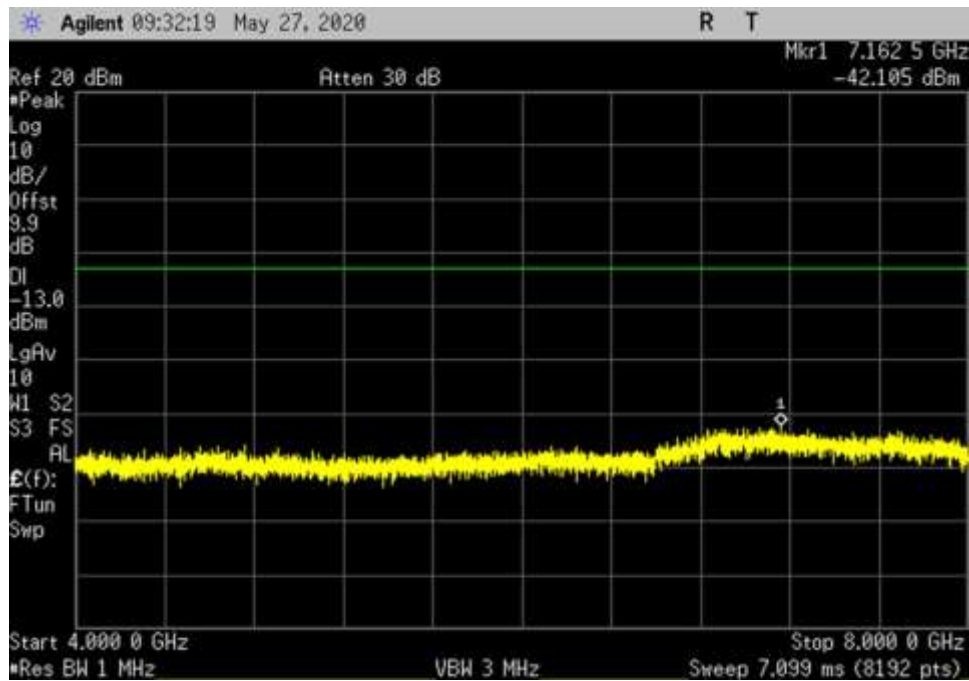
UL_1850-1915_ 16000- 20000MHz



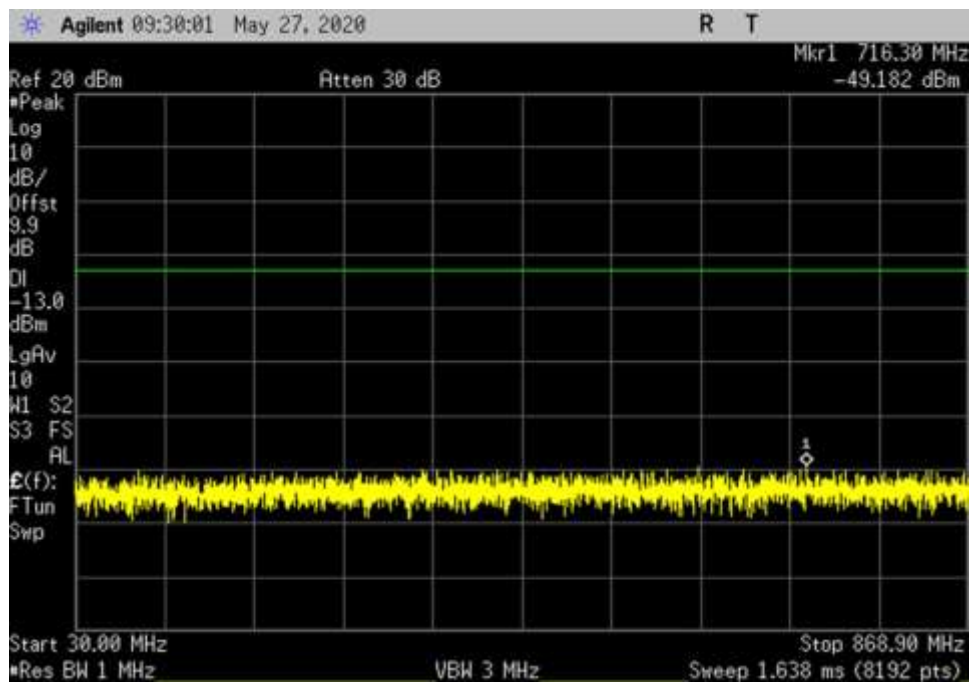
DL_746-757_ 30- 745.9MHz



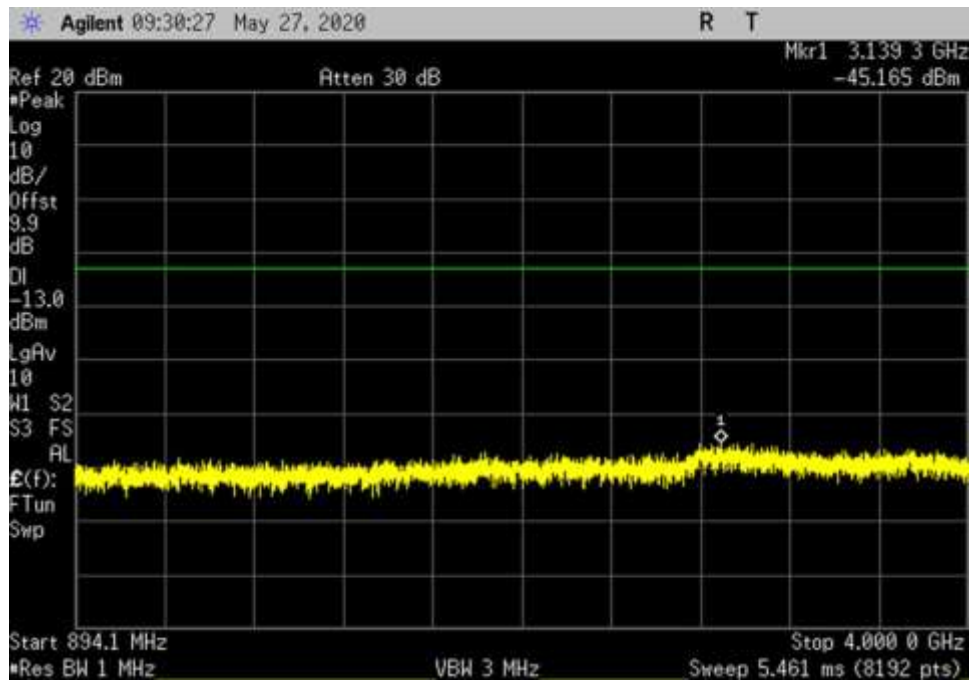
DL_746-757_ 757.1- 4000MHz



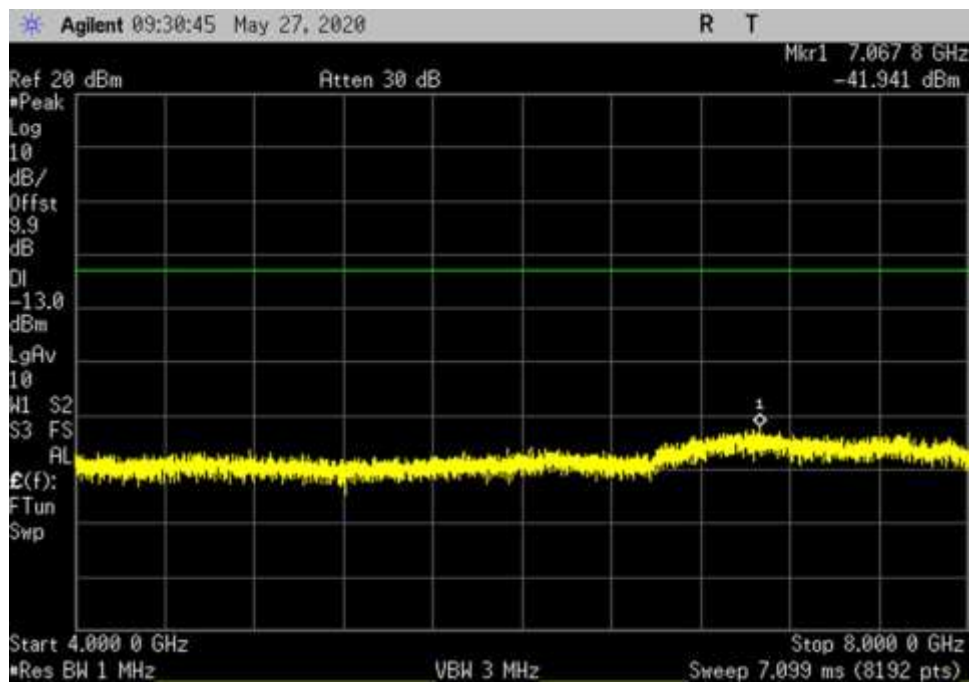
DL_746-757_ 4000- 8000MHz



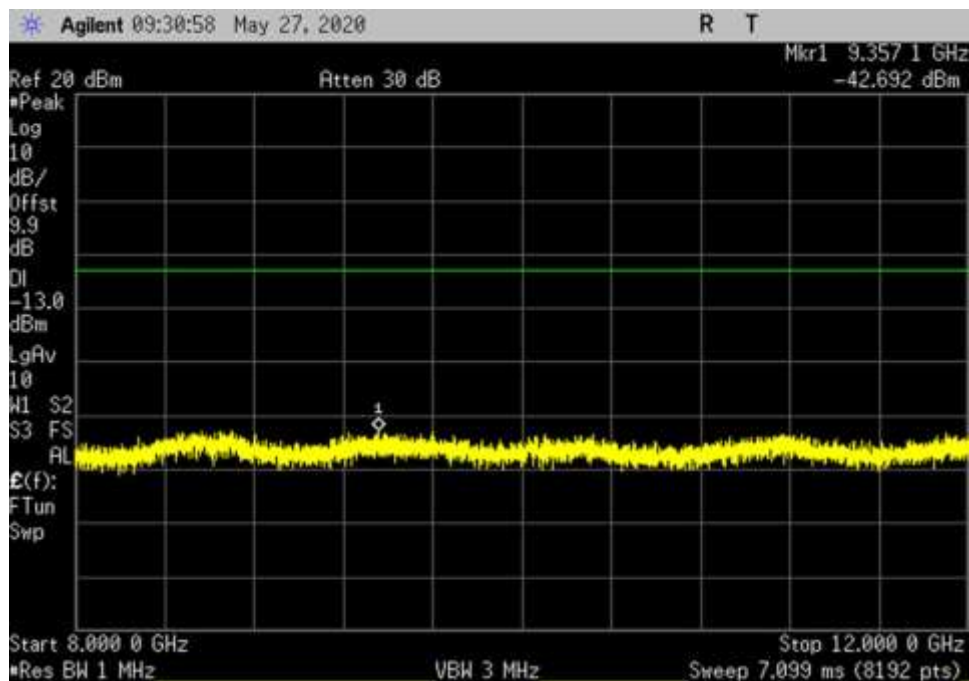
DL_869-894_ 30- 868.9MHz



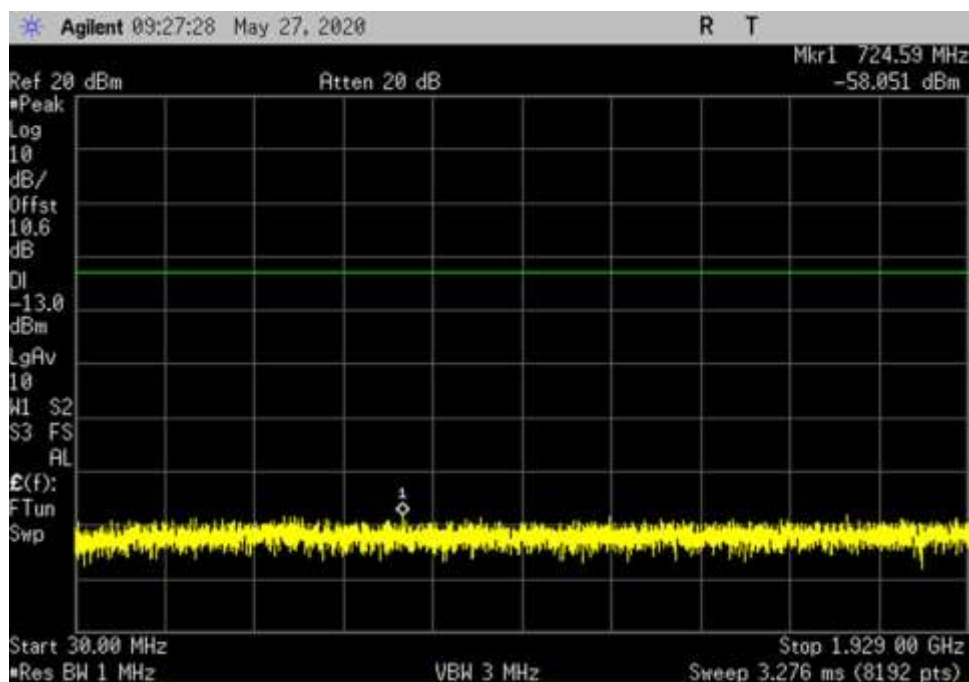
DL_869-894_ 894.1- 4000MHz



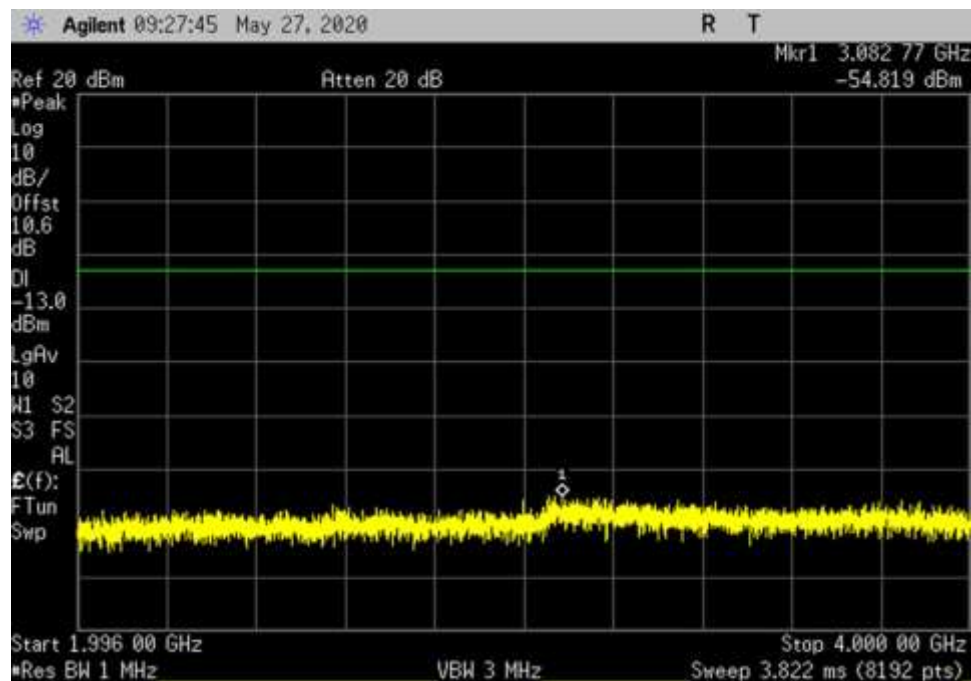
DL_869-894_ 4000- 8000MHz



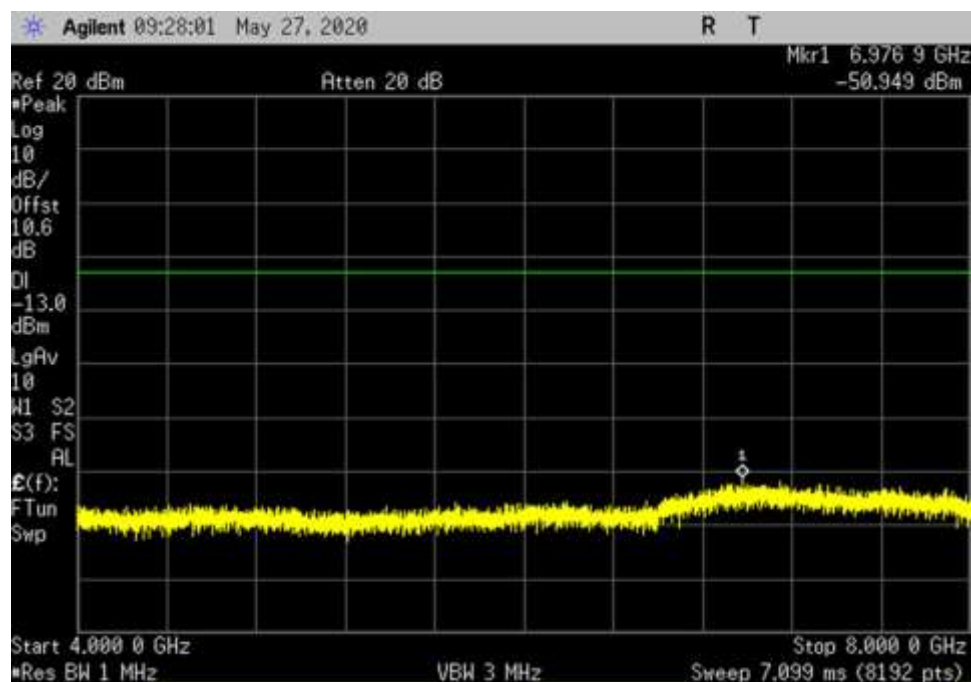
DL_869-894_ 8000- 12000MHz



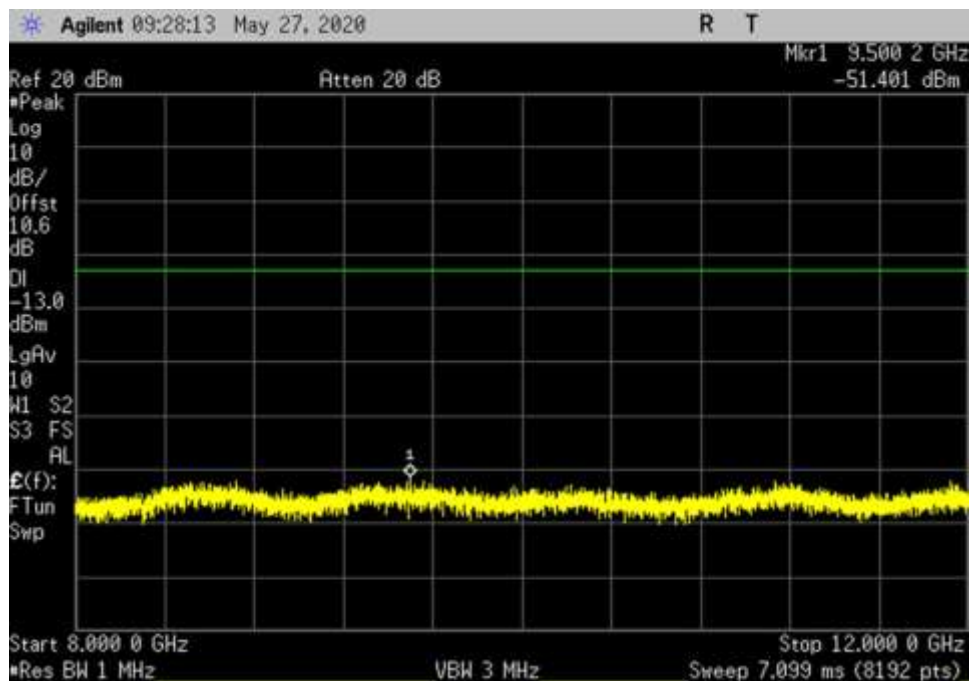
DL_1930-1995_ 30- 1929MHz



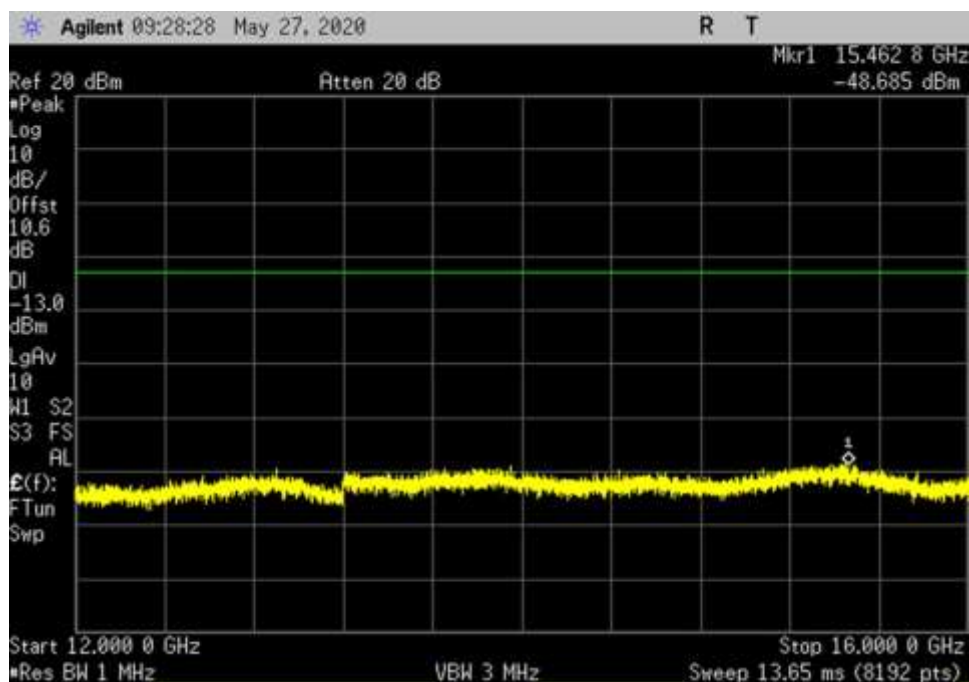
DL_1930-1995_ 1996- 4000MHz



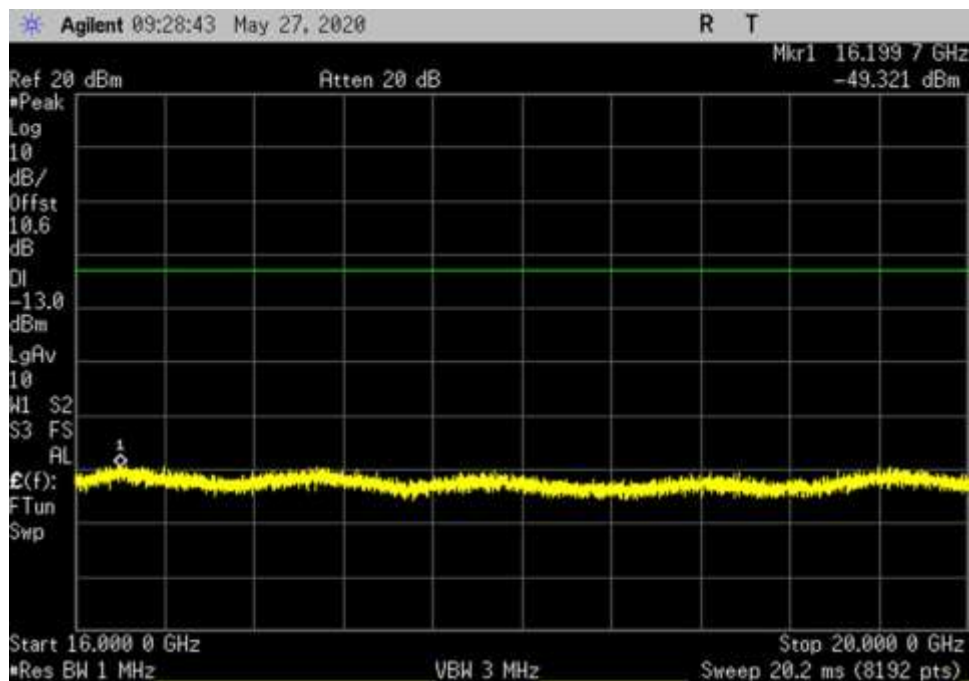
DL_1930-1995_ 4000- 8000MHz



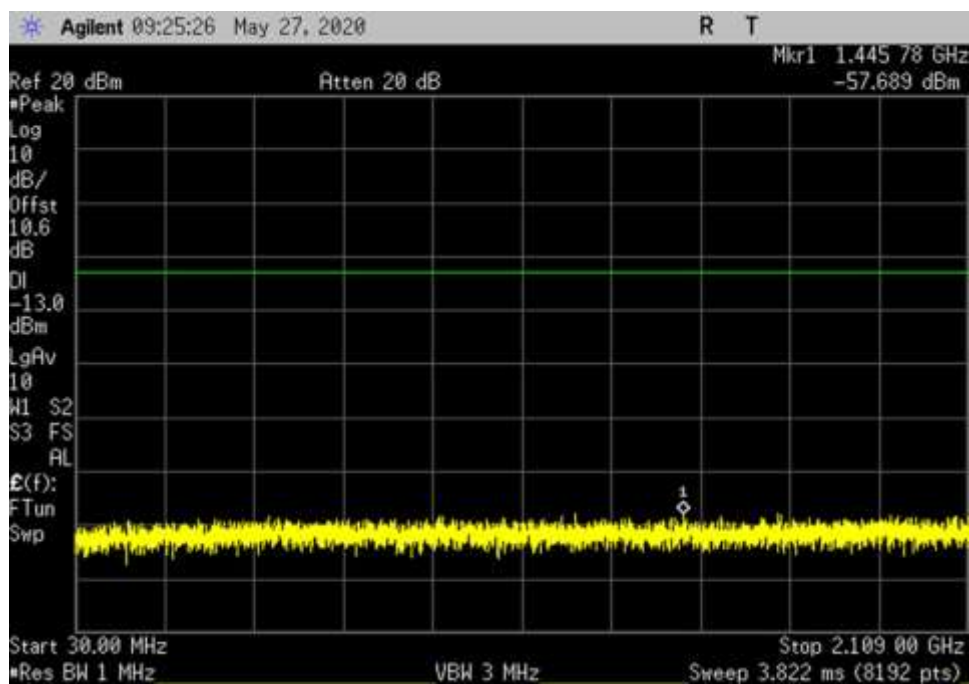
DL_1930-1995_ 8000- 12000MHz



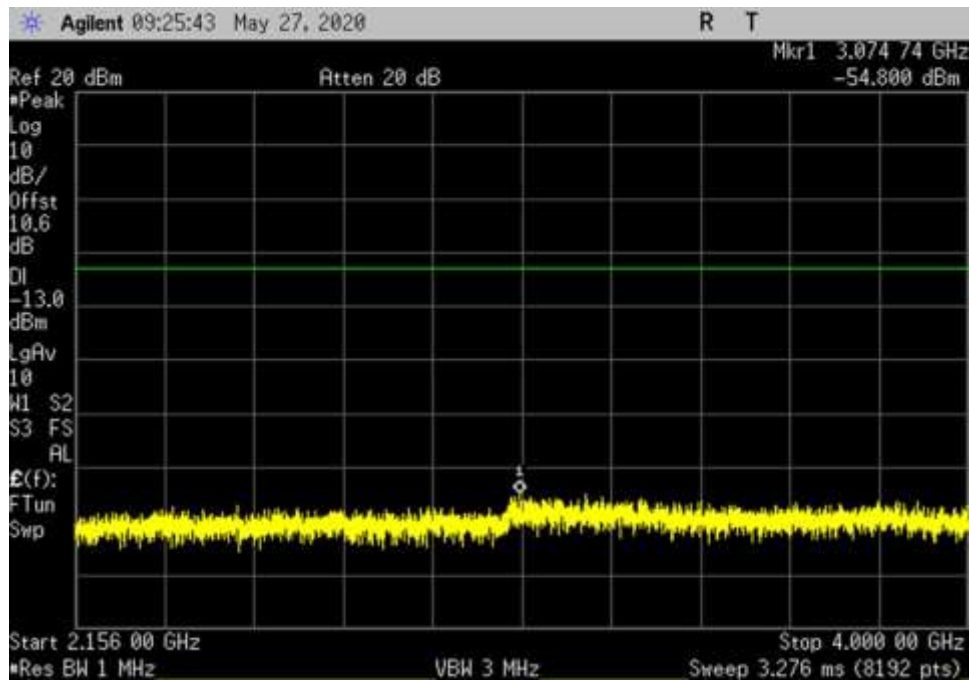
DL_1930-1995_ 12000- 16000MHz



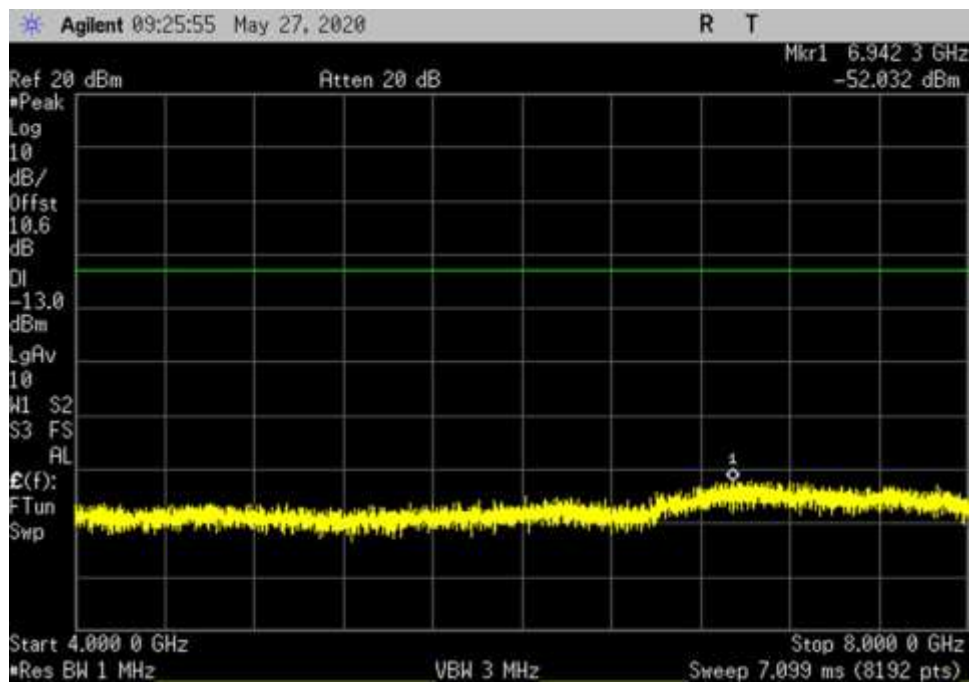
DL_1930-1995_ 16000- 20000MHz



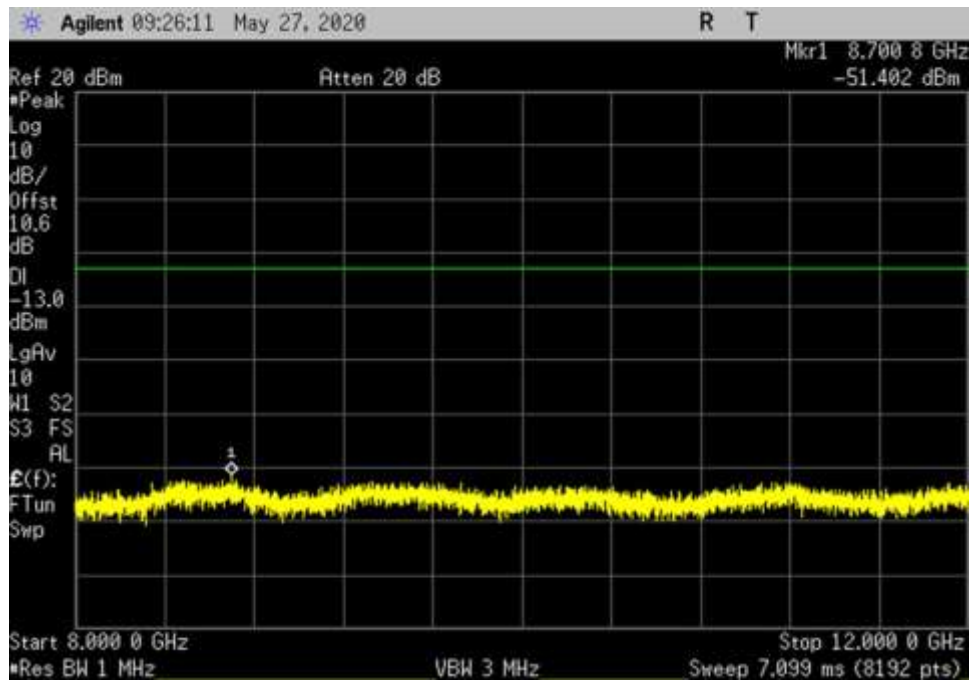
DL_2110-2155_ 30- 2109MHz



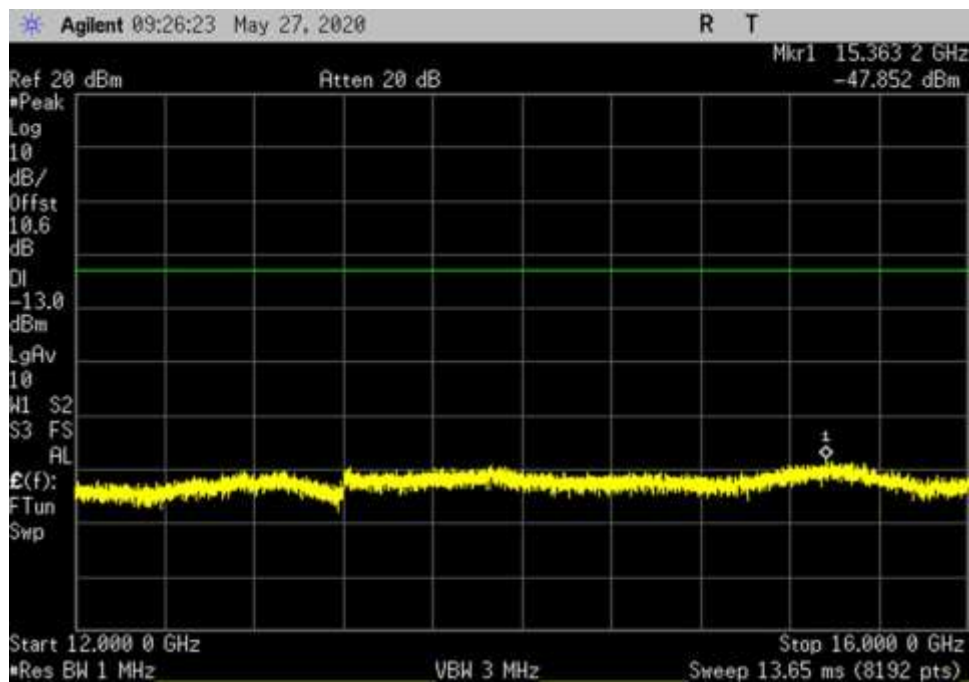
DL_2110-2155_ 2156- 4000MHz



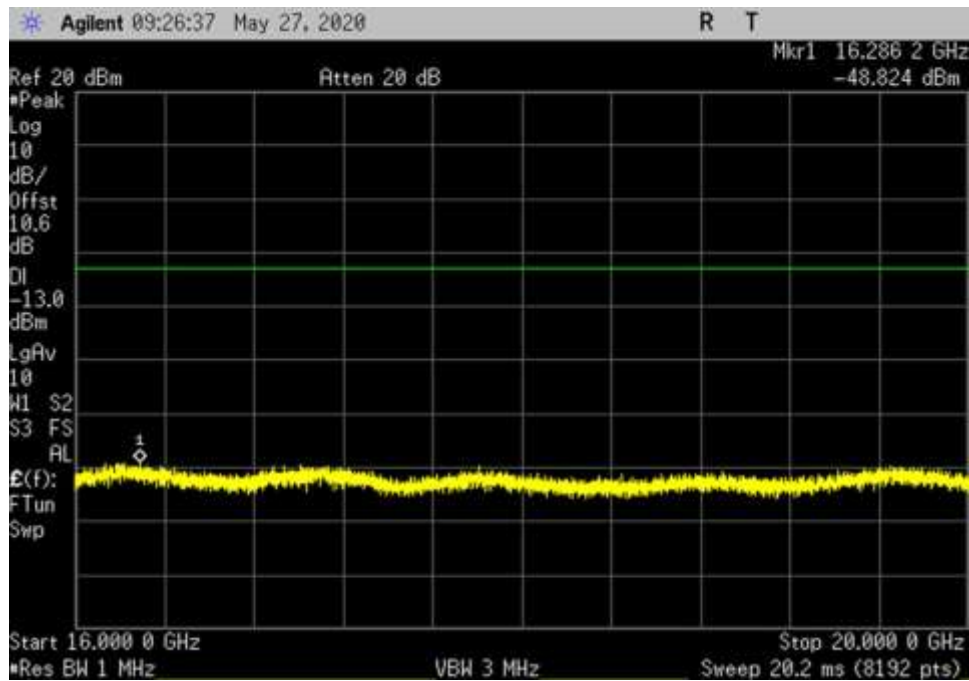
DL_2110-2155_ 4000- 8000MHz



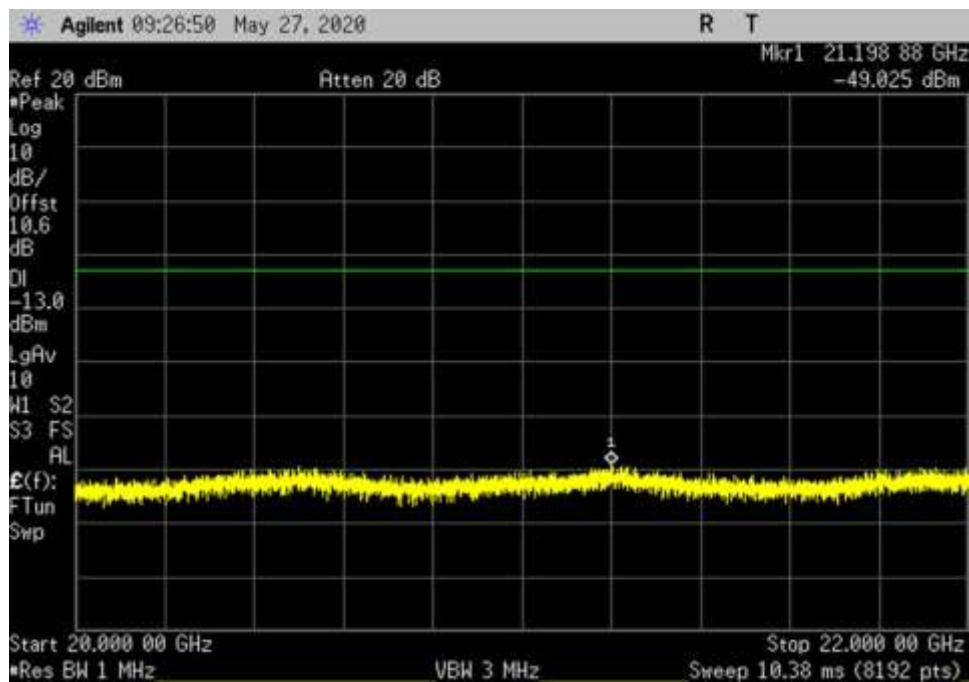
DL_2110-2155_ 8000- 12000MHz



DL_2110-2155_ 12000- 16000MHz



DL_2110-2155_ 16000- 20000MHz



DL_2110-2155_ 20000- 22000MHz

7.7 Noise limit

Test Setup/Conditions

Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	5/28/2020
Configuration:	1
Test Setup:	Maximum noise is below TX power off limit. Section 7.7.2. Variable uplink noise timing measurement is not applicable.

Environmental Conditions

Temperature (°C)	24.3	Relative Humidity (%):	38	Pressure: kPa	101.8
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Test Equipment

Asset #	Description	Model	Calibration Date	Cal Due Date
02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
P06897	Cable	32022-29094K-29094K-48TC	3/25/2020	3/25/2022
P07192	Cable	32022-29094K-29094K-48TC	11/27/2019	11/27/2021
C00082	Directional Coupler	722-10-1.500V	11/27/2019	11/27/2021
03418	Signal Generator	E4438C	5/13/2019	5/13/2021

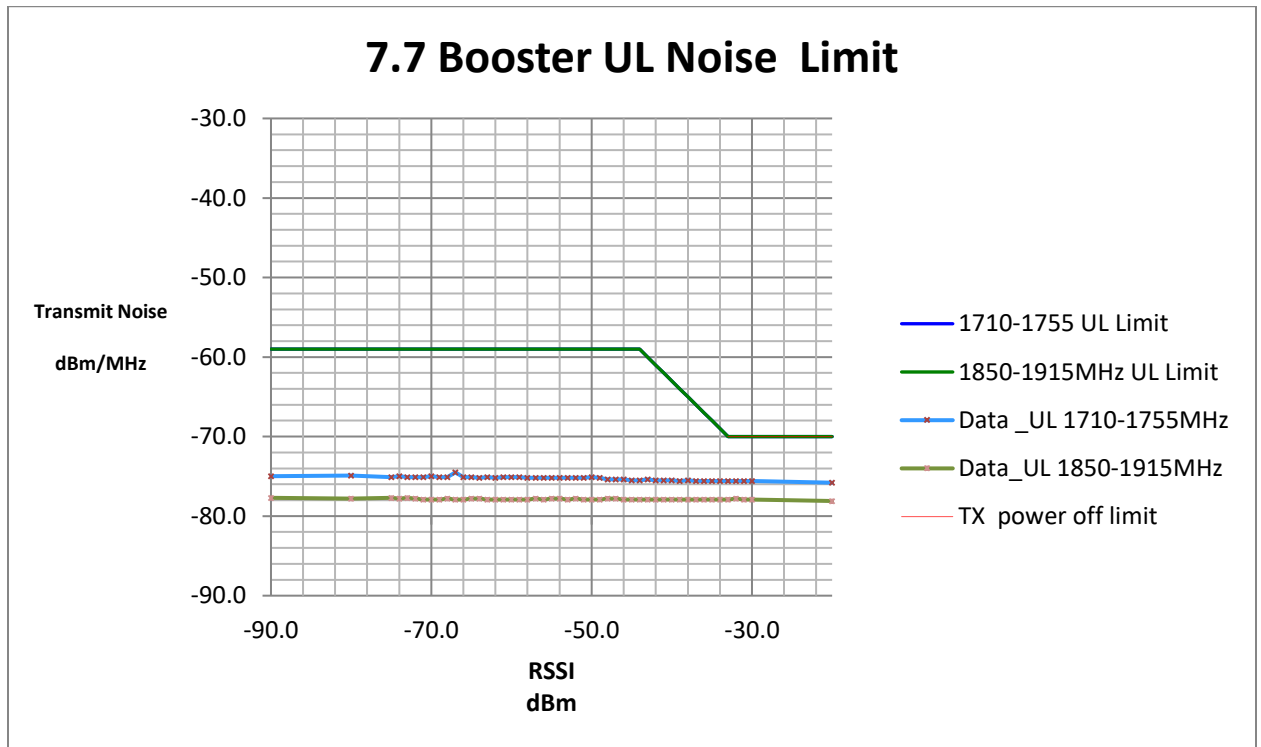
Summary of Results

7.7.1 Maximum transmitter noise power level

- 7.7.1 a-g: Maximum transmitter noise with 50-ohm shielded load

Maximum Noise Power			
Frequency MHz	Measured dBm./MHz	Limit dBm/MHz	Margin
UL 1710-1755	-74.4	-59.0	-15.4
UL 1850-1915	-76.8	-59.0	-17.8
UL 824-849	-71.6	-59.0	-12.6
UL 776-787	-71.7	-59.0	-12.7
DL 2110-2155	-85.6	-59.0	-26.6
DL 1930-1995	-82.9	-59.0	-23.9
DL 869-894	-85.9	-59.0	-26.9
DL 746-757	-85.9	-59.0	-26.9

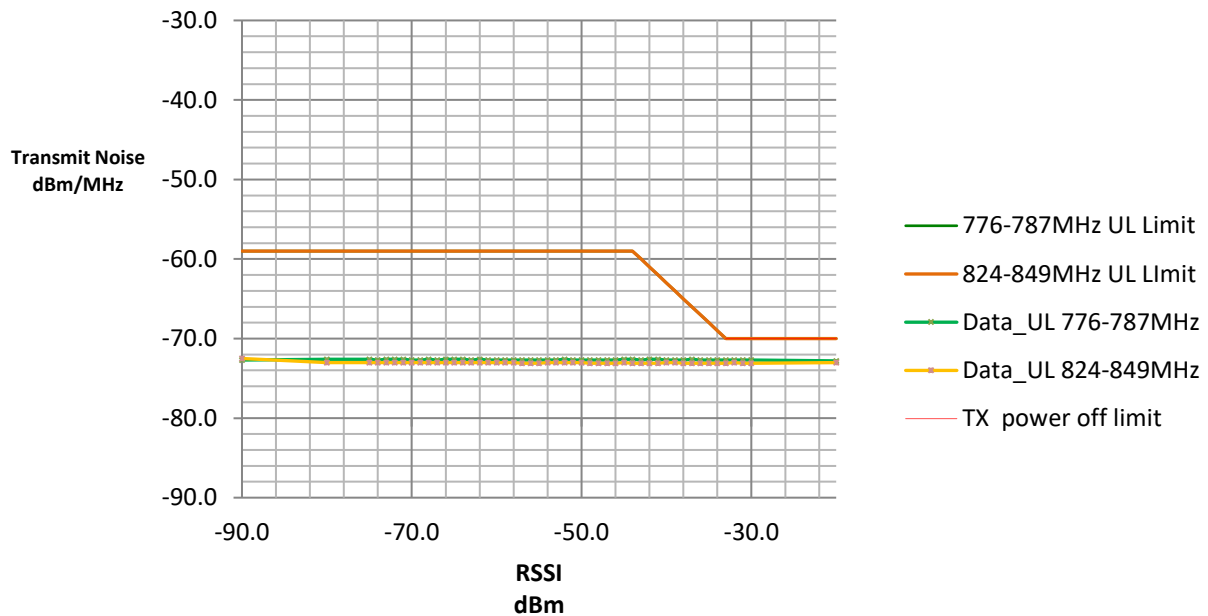
- 7.7.1 h-n: Maximum transmitter noise when varying the DL signal generator output level with a 4.1MHz AWGN signal



1710.0 - 1755.0 MHz					
RSSI (dBm)	Measured Noise (dBm/MHz)	Limit			Margin
		RSSI Dependent	Mobile Booster Limit	TX off	
-90.0	-75.0	-	-59.0	-	-16.0
-80.0	-74.9	-	-59.0	-	-15.9
-34.0	-75.6	-69.0	-59.0	-	-6.6
-33.0	-75.6	-70.0	-59.0	-	-5.6
-32.0	-75.6	-	-	-70	-5.6
-31.0	-75.6	-	-	-70	-5.6

1850.0 - 1915.0 MHz					
RSSI (dBm)	Measured Noise (dBm/MHz)	Limit			Margin
		RSSI Dependent	Mobile Booster Limit	TX off	
-90.0	-77.7	-	-59.0	-	-18.7
-80.0	-77.8	-	-59.0	-	-18.8
-34.0	-77.9	-69.0	-59.0	-	-8.9
-33.0	-77.9	-70.0	-59.0	-	-7.9
-32.0	-77.8	-	-	-70	-7.8
-31.0	-77.9	-	-	-70	-7.9

7.7 Booster UL Noise Limit



824.0 - 849.0 MHz					
		Limit			Margin
RSSI (dBm)	Measured Noise (dBm/MHz)	RSSI Dependent	Mobile Booster Limit	TX off	
-90.0	-72.5	-	-59.0	-	-13.5
-80.0	-73.0	-	-59.0	-	-14.0
-34.0	-73.1	-69.0	-59.0	-	-4.1
-33.0	-73.1	-70.0	-59.0	-	-3.1
-32.0	-73.0	-	-	-70	-3.0
-31.0	-73.1	-	-	-70	-3.1

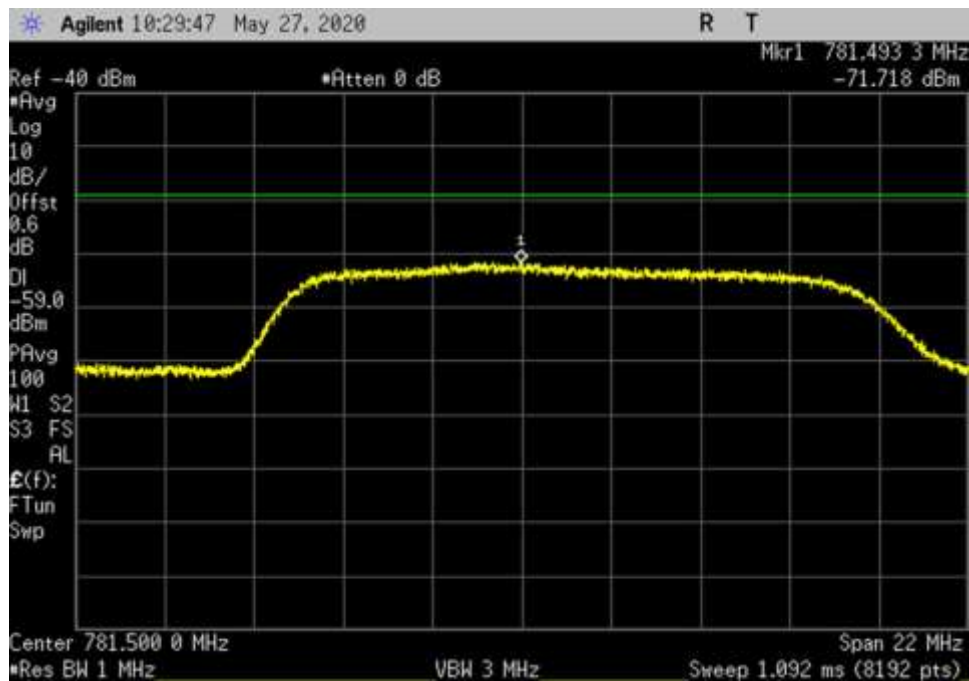
776.0 - 787.0 MHz					
		Limit			Margin
RSSI (dBm)	Measured Noise (dBm/MHz)	RSSI Dependent	Mobile Booster Limit	TX off	
-90.0	-72.7	-	-59.0	-	-13.7
-80.0	-72.6	-	-59.0	-	-13.6
-34.0	-72.7	-69.0	-59.0	-	-3.7
-33.0	-72.7	-70.0	-59.0	-	-2.7
-32.0	-72.7	-	-	-70	-2.7
-31.0	-72.7	-	-	-70	-2.7

7.7.2 Variable uplink noise timing

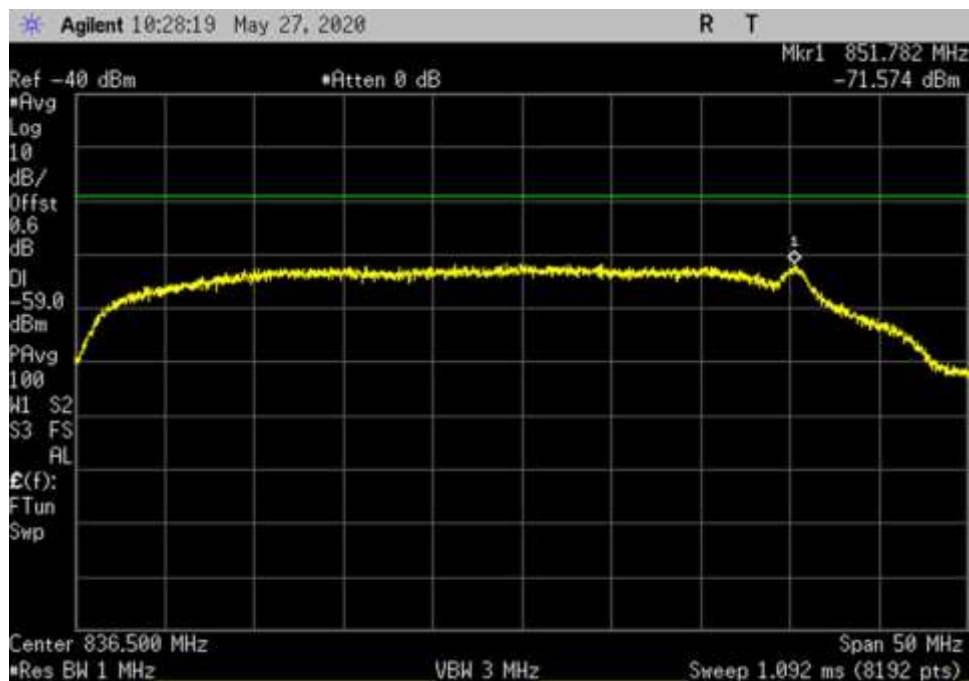
Maximum noise is below TX power off limit, 7.7.2. Variable uplink noise timing measurement is not applicable.

7.7.1 Maximum Transmitter Noise Power Level

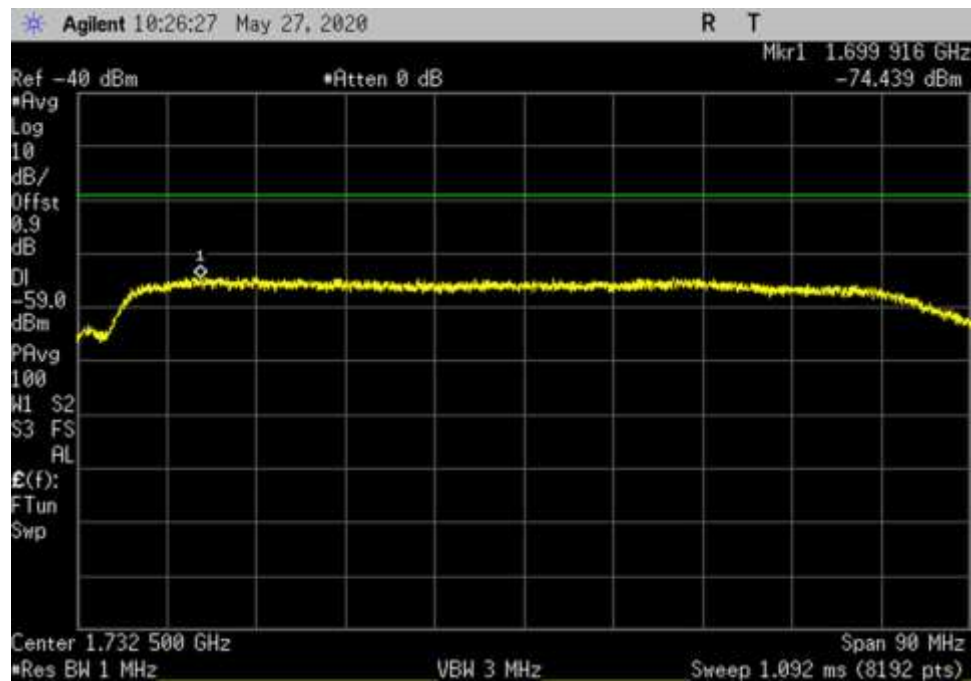
Plots



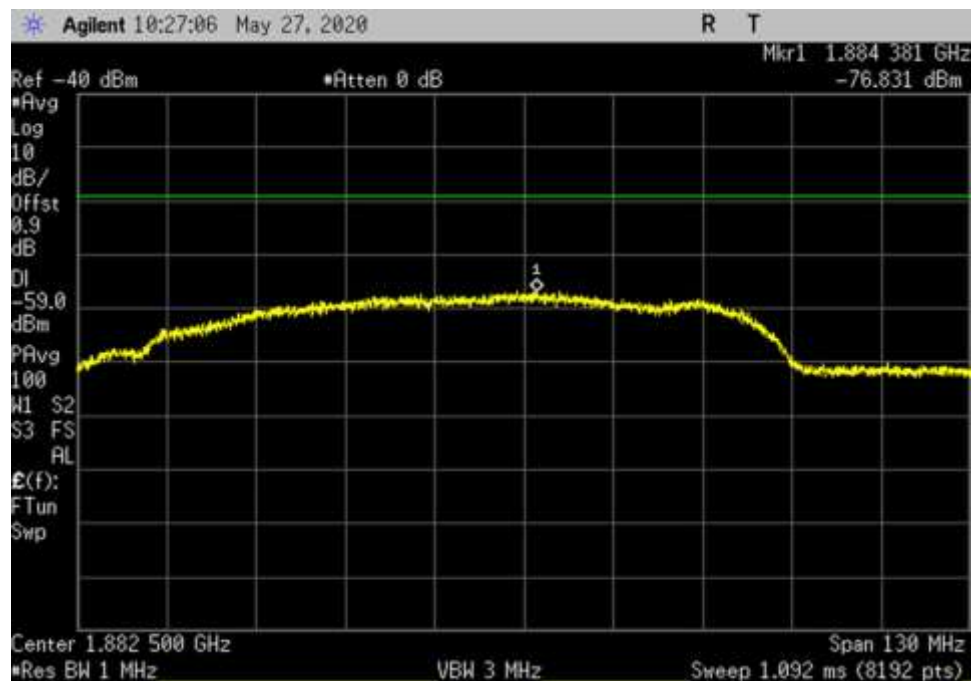
UL_776-787_ 781.5MHz



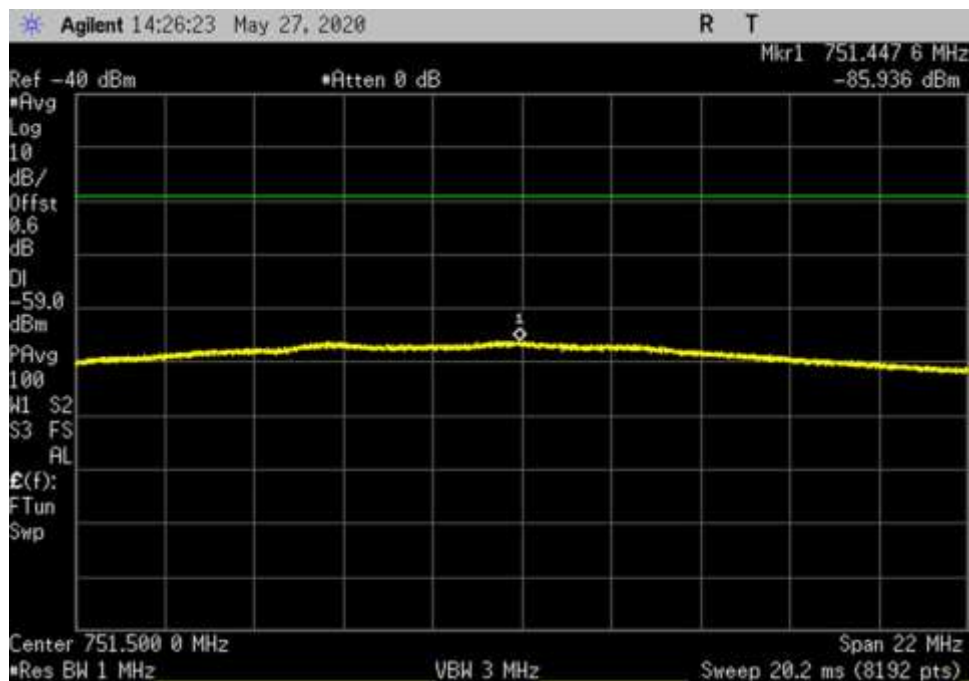
UL_824-849_ 836.5MHz



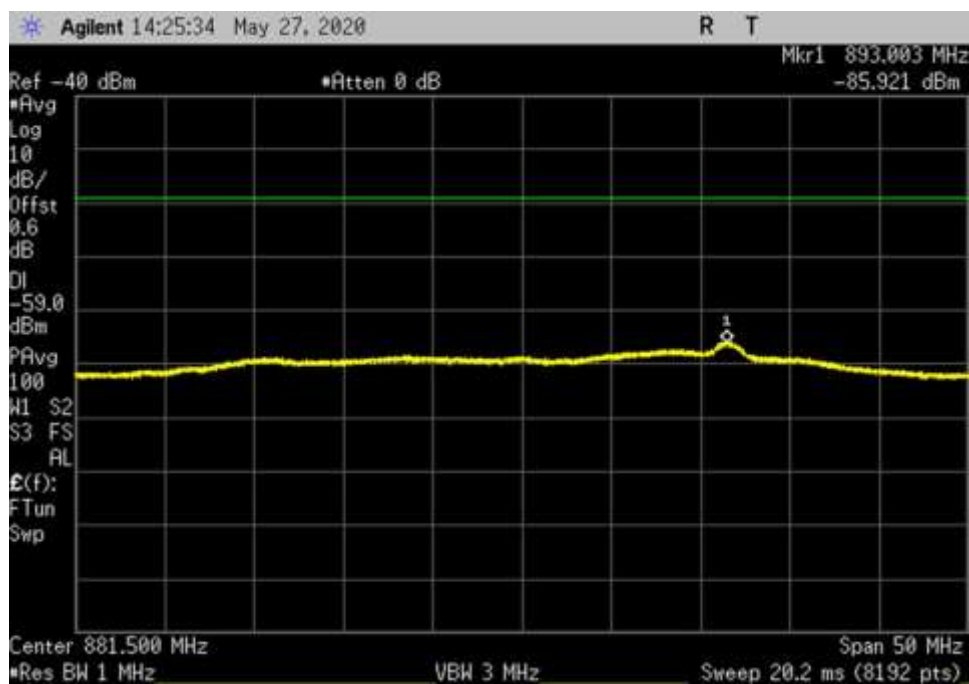
UL_1710-1755_ 1732.5MHz



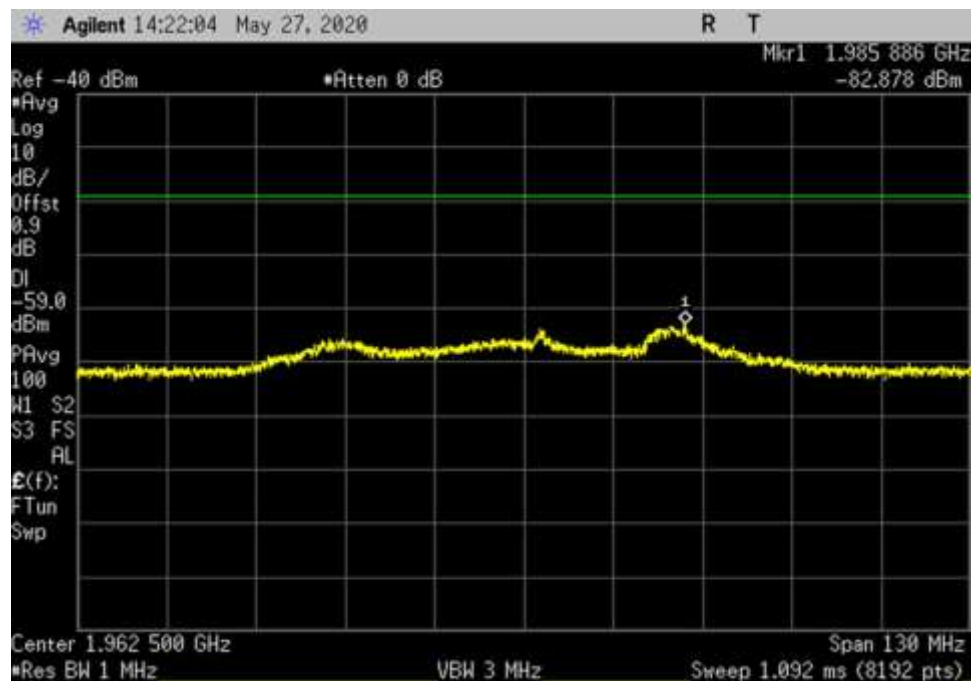
UL_1850-1915_ 1882.5MHz



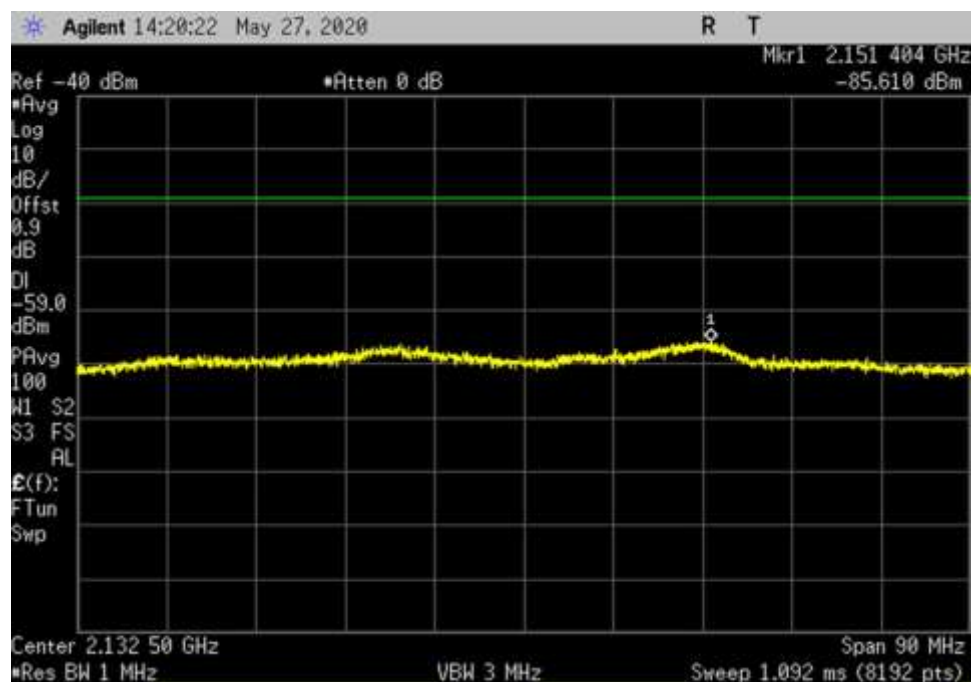
DL_746-757_ 751.5MHz



DL_869-894_ 881.5MHz



DL_1930-1995_ 1962.5MHz



DL_2110-2155_ 2132.5MHz

7.8 Uplink Inactivity

Test Setup/Conditions

Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	5/27/2020
Configuration:	1
Test Setup:	See General Test Setup

Environmental Conditions

Temperature (°C)	24.3	Relative Humidity (%):	38	Pressure: kPa	101.8
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Test Equipment

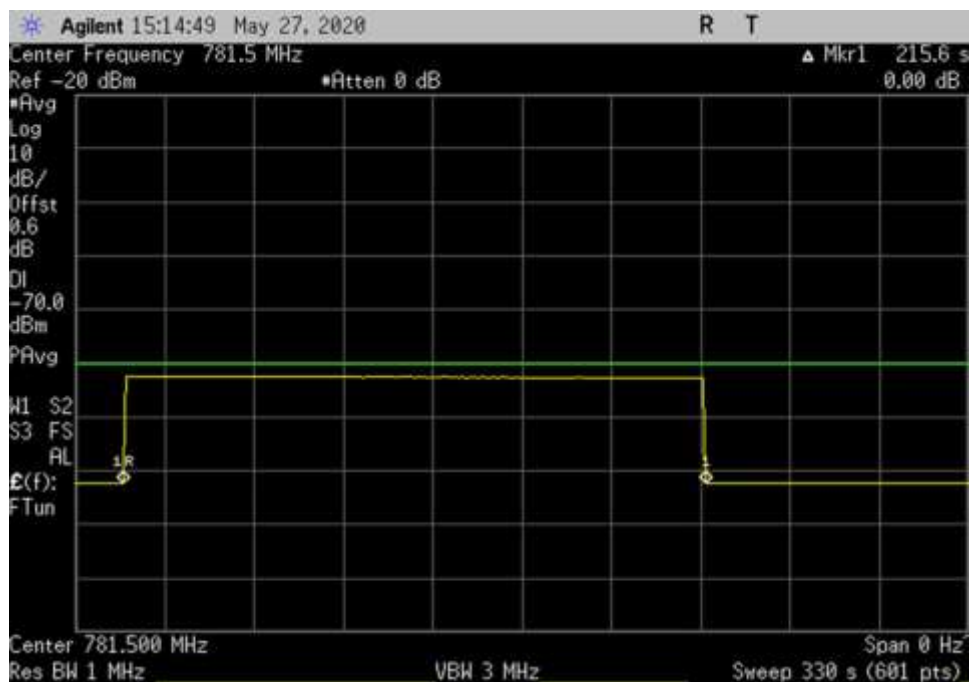
Asset #	Description	Model	Calibration Date	Cal Due Date
02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
P06897	Cable	32022-29094K-29094K-48TC	3/25/2020	3/25/2022
P07192	Cable	32022-29094K-29094K-48TC	11/27/2019	11/27/2021
03418	Signal Generator	E4438C	5/13/2019	5/13/2021

Summary of Results

Pass: As demonstrated, when the booster is not serving an active device connection after 5 minutes the uplink noise power does not exceed -70dBm/MHz

Uplink Inactivity		
Frequency MHz	Measured Min	Limit Min
UL 1710-1755	3.6	5.0
UL 1850-1915	3.6	5.0
UL 824-849	3.6	5.0
UL 776-787	3.6	5.0

Plots



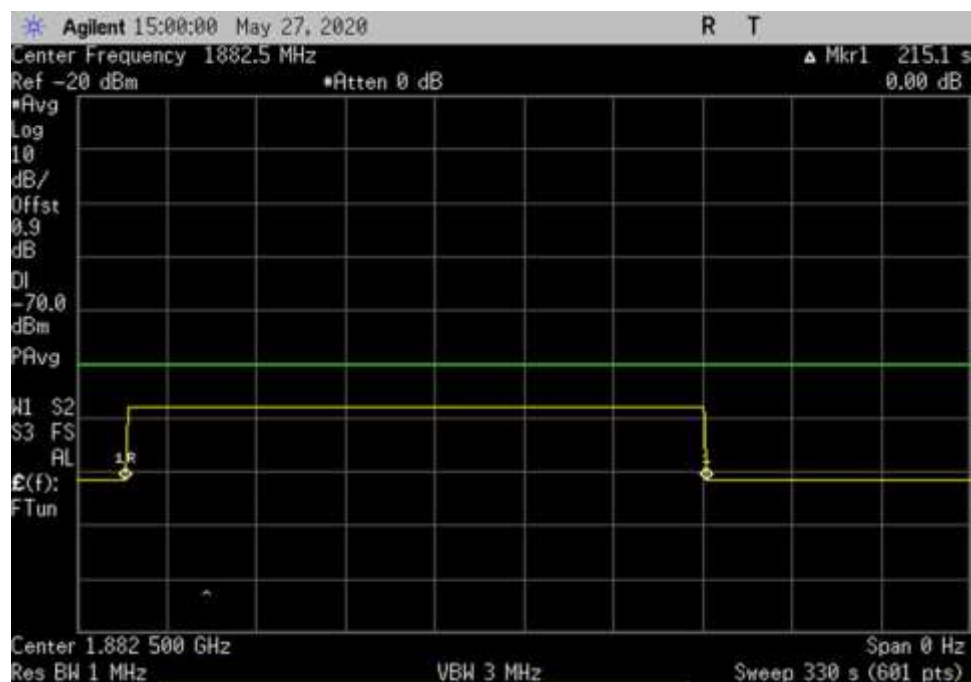
UL_776-787_781.5MHz



UL_824-849_836.5MHz



UL_1710-1755_ 1732.5MHz



UL_1850-1915_ 1882.5MHz

7.9 Booster Gain Limit

Test Setup/Conditions

Test Engineer:	Hieu Song Nguyenpham										
Test Date(s):	5/28/2020										
Configuration:	1										
Test Setup:	<table border="1"> <thead> <tr> <th>Frequency (MHz)</th><th>MSCL (dB)</th></tr> </thead> <tbody> <tr> <td>PCS (1850-1915)</td><td>4</td></tr> <tr> <td>Cellular (824-849)</td><td>3</td></tr> <tr> <td>LTE (776-787)</td><td>3</td></tr> <tr> <td>AWS (1710-1755)</td><td>4</td></tr> </tbody> </table>	Frequency (MHz)	MSCL (dB)	PCS (1850-1915)	4	Cellular (824-849)	3	LTE (776-787)	3	AWS (1710-1755)	4
Frequency (MHz)	MSCL (dB)										
PCS (1850-1915)	4										
Cellular (824-849)	3										
LTE (776-787)	3										
AWS (1710-1755)	4										

Environmental Conditions

Temperature (°C)	24.1	Relative Humidity (%):	36	Pressure: kPa	101.5
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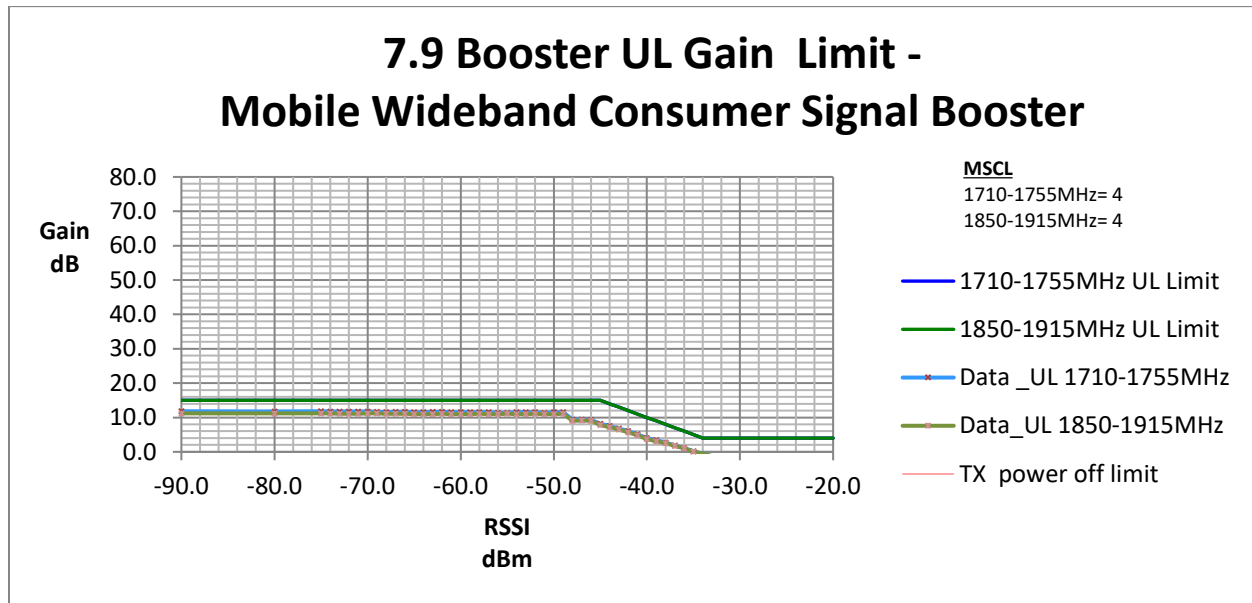
Test Equipment

Asset #	Description	Model	Calibration Date	Cal Due Date
02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
P06897	Cable	32022-29094K-29094K-48TC	3/25/2020	3/25/2022
P07192	Cable	32022-29094K-29094K-48TC	11/27/2019	11/27/2021
C00082	Directional Coupler	722-10-1.500V	11/27/2019	11/27/2021
03418	Signal Generator	E4438C	5/13/2019	5/13/2021
C00032	Arbitrary Waveform Generator	E4433B	3/30/2020	3/30/2022

Summary of Results

Pass: As demonstrated, computed gains are within the gain limit. All maximum variable uplink gain timings are within 1 second limit.

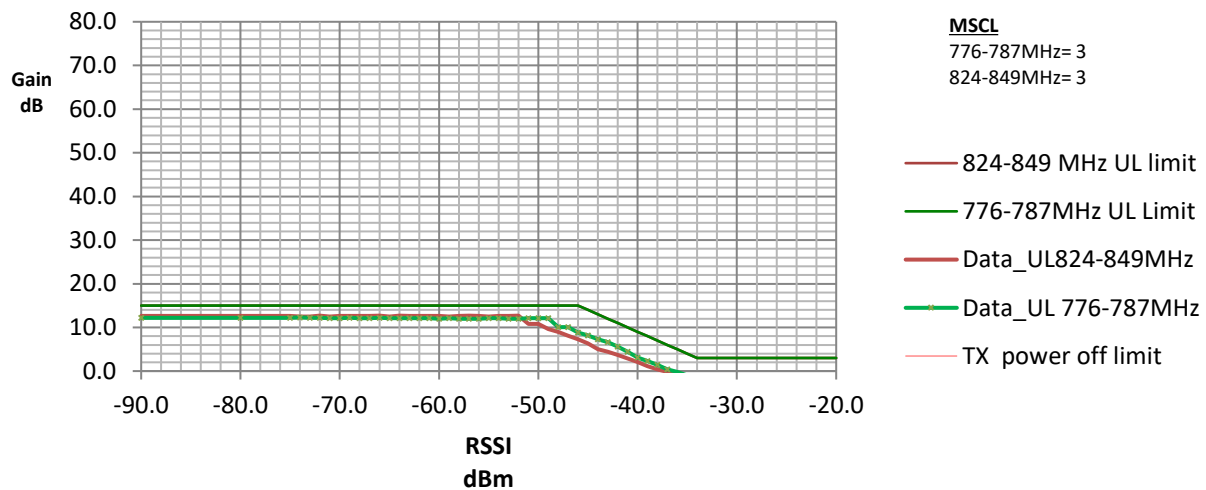
7.9.1 Maximum gain



1710.0 - 1755.0 MHz							
				Limit			Margin
RSSI (dBm)	Input (dBm)	Measured Output (dBm)	Measured Gain (dBm)	RSSI Dependent	Mobile Booster Limit	TX off	
-90.0	9.9	21.7	11.8		15.0		-3.2
-80.0	9.9	21.6	11.7		15.0		-3.3
-75.0	9.9	21.7	11.8		15.0		-3.2
-37.0	9.9	11.8	1.9	7.0			-5.1
-36.0	9.9	11.0	1.1	6.0			-4.9
-35.0	9.9	10.1	0.2	5.0			-4.8

1850.0 - 1915.0 MHz							
RSSI (dBm)	Input (dBm)	Measured Output (dBm)	Measured Gain (dBm)	Limit			Margin
				RSSI Dependent	Mobile Booster Limit	TX off	
-90.0	9.9	21.1	11.2		15.0		-3.8
-80.0	9.9	21.1	11.2		15.0		-3.8
-75.0	9.9	21.1	11.2		15.0		-3.8
-37.0	9.9	11.7	1.8	7.0			-5.2
-36.0	9.9	10.9	1.0	6.0			-5.0
-35.0	9.9	10.0	0.1	5.0			-4.9

7.9 Booster UL Gain Limit - Mobile Wideband Consumer Signal Booster



824.0 - 849.0 MHz							
RSSI (dBm)	Input (dBm)	Measured Output (dBm)	Measured Gain (dBm)	Limit			Margin
				RSSI Dependent	Mobile Booster Limit	TX off	
-90.0	6.9	19.5	12.6		15.0		-2.4
-80.0	6.9	19.5	12.6		15.0		-2.4
-75.0	6.9	19.5	12.6		15.0		-2.4
-40.0	6.9	9.0	2.1	9.0			-6.9
-39.0	6.9	8.0	1.1	8.0			-6.9
-38.0	6.9	7.3	0.4	7.0			-6.6

776.0 - 787.0 MHz							
RSSI (dBm)	Input (dBm)	Measured Output (dBm)	Measured Gain (dBm)	Limit			Margin
				RSSI Dependent	Mobile Booster Limit	TX off	
-90.0	7.7	19.9	12.2		15.0		-2.8
-80.0	7.7	19.9	12.2		15.0		-2.8
-75.0	7.7	19.9	12.2		15.0		-2.8
-39.0	7.7	10.0	2.3	8.0			-5.7
-38.0	7.7	9.1	1.4	7.0			-5.6
-37.0	7.7	8.1	0.4	6.0			-5.6

7.9.2 Variable uplink gain timing

Uplink Gain Timing		
Frequency (MHz)	Measured (Sec)	Limit (Sec)
UL 1710-1755	0.43	1.00
UL 1850-1915	0.35	1.00
UL 824-849	0.45	1.00
UL 776-787	0.37	1.00

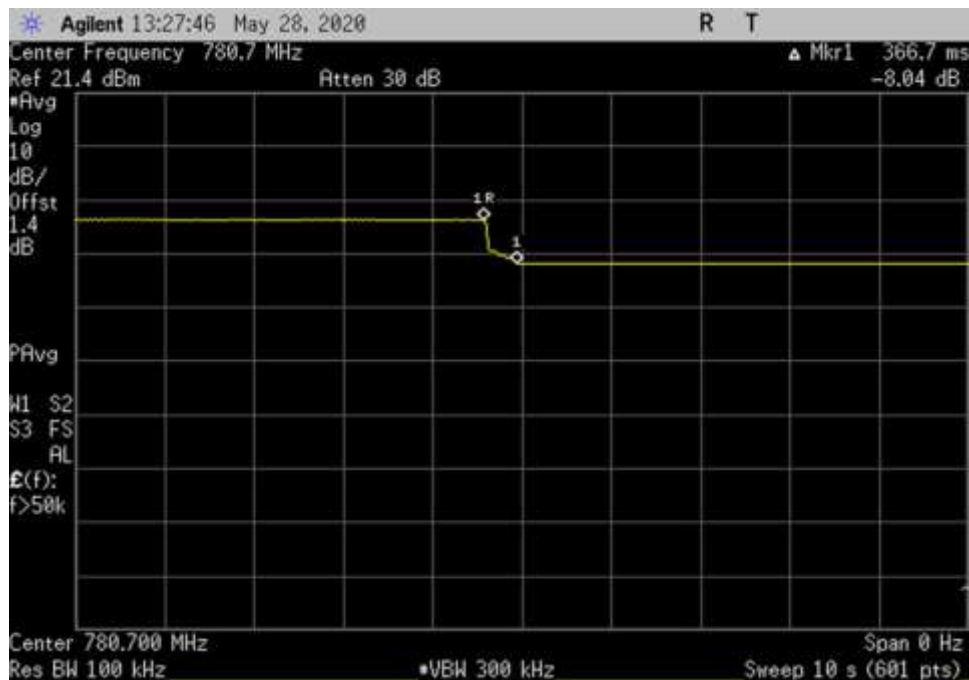
7.9.1 Maximum Gain

For this subsection, see summary of results of 7.9

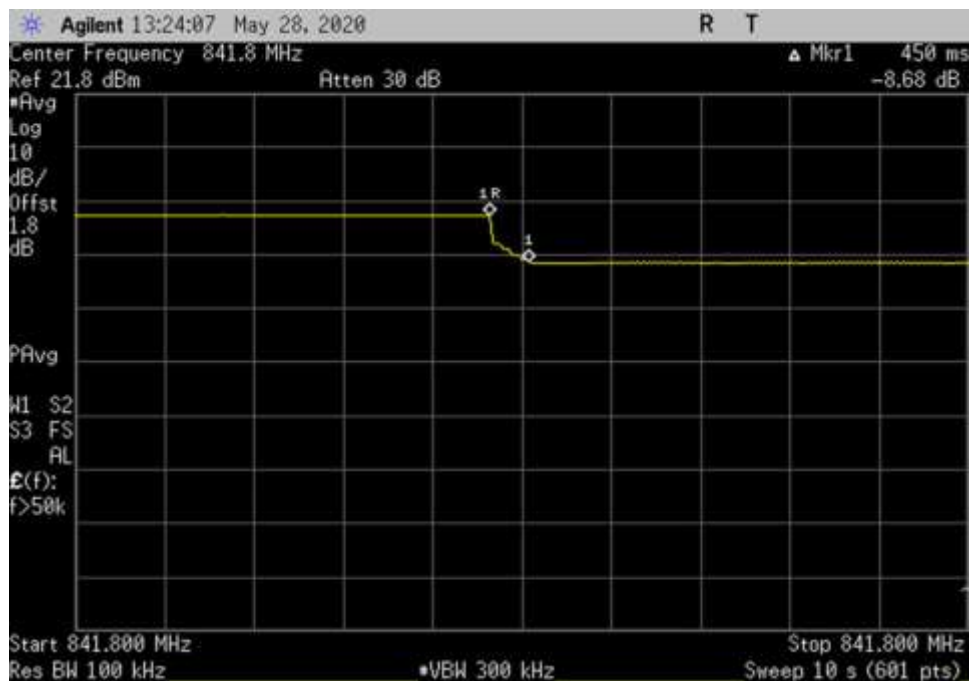
7.9.1 Maximum gain

7.9.2 Variable uplink Gain Timing

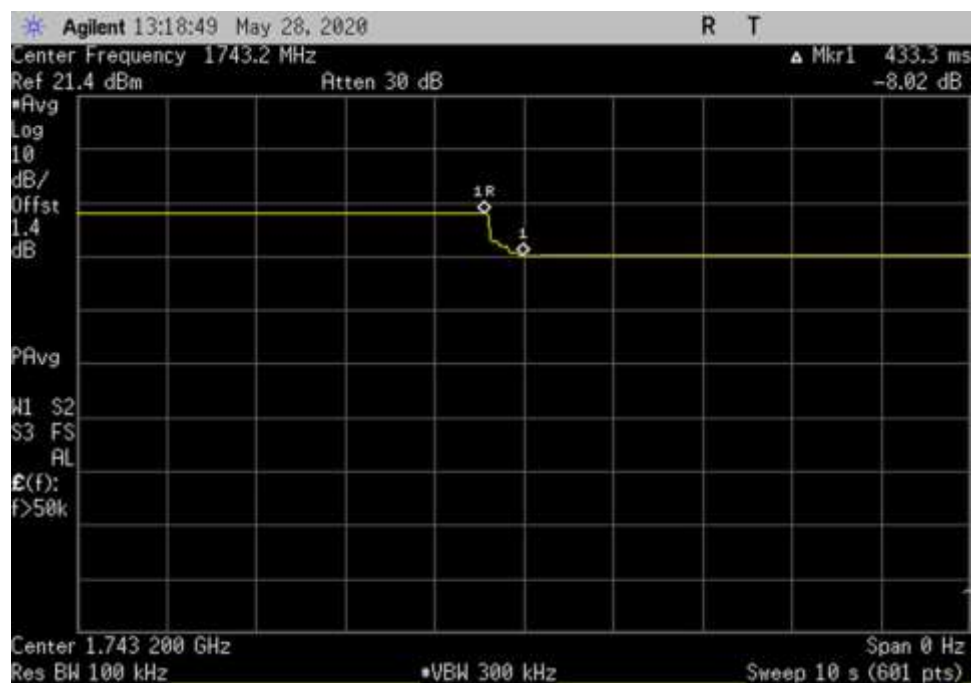
Plots



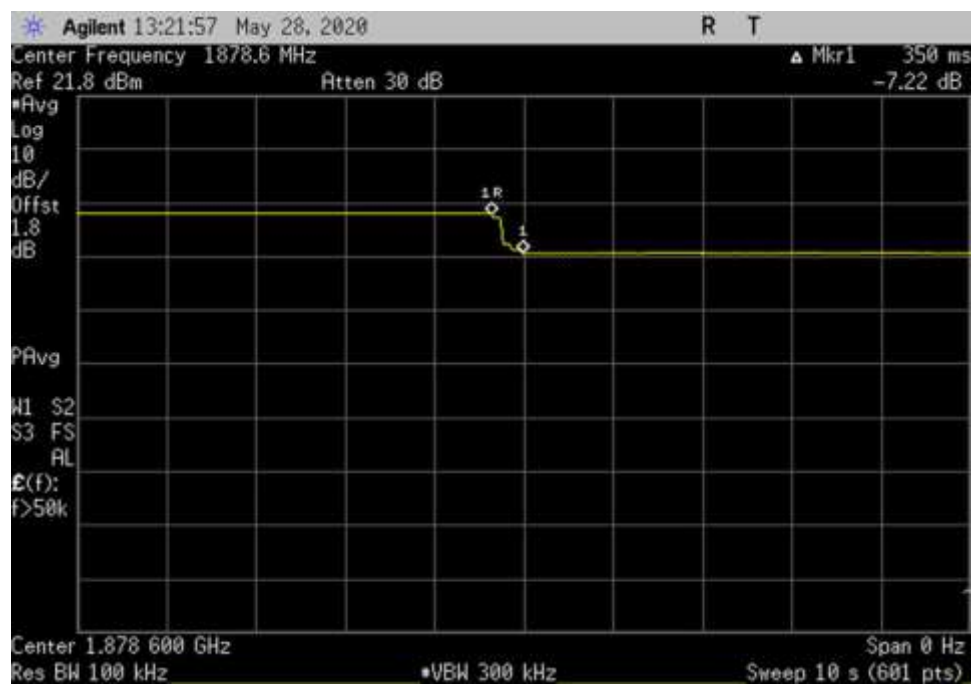
UL_776-787_780.7MHz_Timing



UL_824-849_841.8MHz_Timing



UL_1710-1755_ 1743.2MHz_Timing



UL_1850-1915_ 1878.6MHz_Timing

7.10 Occupied Band Width

Test Setup/Conditions

Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	5/28/2020
Configuration:	1
Test Setup:	See General Test Setup

Environmental Conditions

Temperature (°C)	21.1	Relative Humidity (%):	36	Pressure: kPa	101.5
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Test Equipment

Asset #	Description	Model	Calibration Date	Cal Due Date
02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
P06897	Cable	32022-29094K-29094K-48TC	3/25/2020	3/25/2022
P07192	Cable	32022-29094K-29094K-48TC	11/27/2019	11/27/2021
P05411	Attenuator	54A-10	11/27/2019	11/27/2021
03418	Signal Generator	E4438C	5/13/2019	5/13/2021

Summary of Results

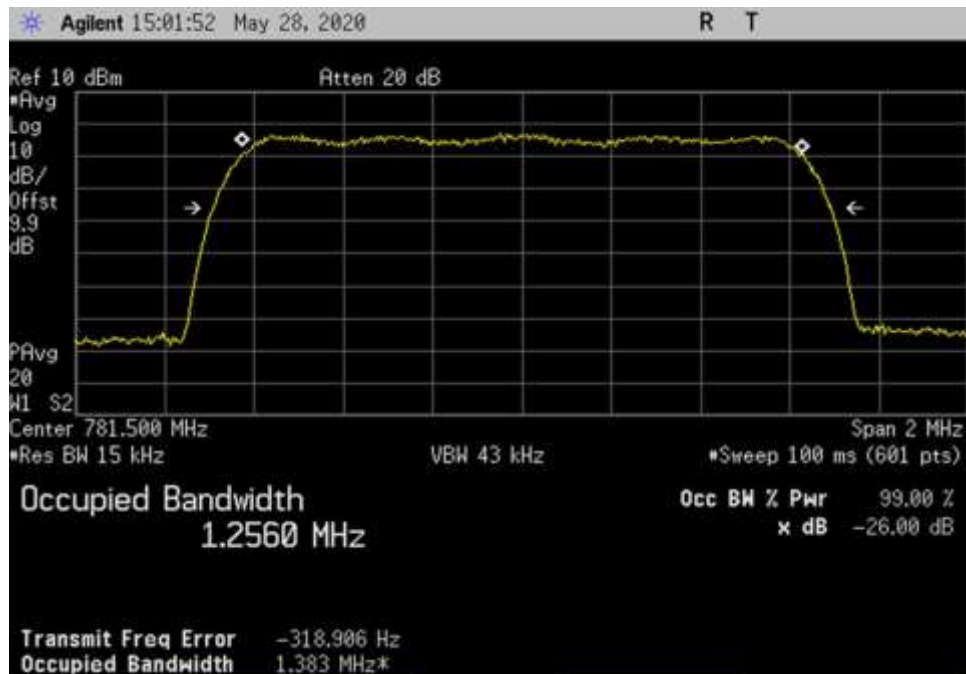
Pass: As summarized in plots and tables below, the uniformity of the output signal relative to the input signal are practically identical. Therefore, the comparison is within limits.

OBW-Input (Hz)					OBW-Output (Hz)				
EDGE	GSM	CDMA	AWGN	LTE	EDGE	GSM	CDMA	AWGN	LTE
243307	249360	1251581	4157551	4448954	251984	242833	1259603	4167615	4455929
245310	245187	1264059	4166472	4444349	247480	242740	1257254	4170463	4448426
245019	247738	1263310	4165545	4460271	248106	241707	1262249	4183242	4445463
245153	245423	1256000	4150888	4447896	248593	243209	1256693	4114391	4420546
245799	247207	1263311	4168001	4456327	245665	246738	1263899	4156287	4463614
244132	247151	1261676	4146023	4457000	246366	246833	1262050	4136855	4443890
244066	248595	1255487	4160701	4445332	246774	247665	1258771	4169271	4450171
246698	247910	1259292	4165182	4458888	249508	248820	1255930	4140663	4442741

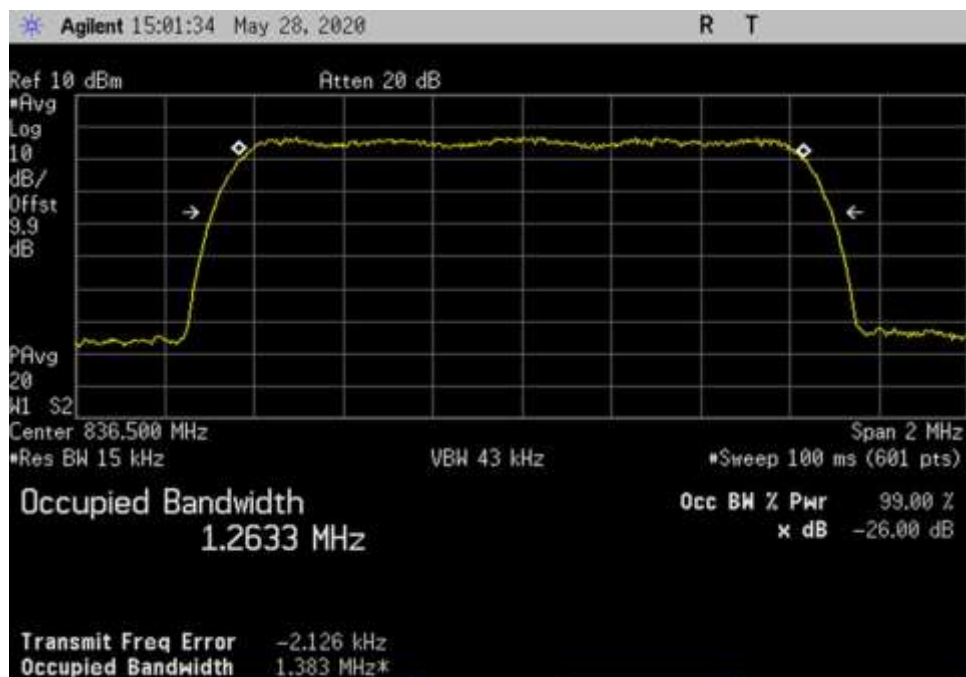
Max Difference In&Out Occ BW 99% Pwr					
Frequency Range	EDGE	GSM	CDMA	AWGN	LTE
UL_1710-1755MHz	3.57%	2.62%	0.64%	0.24%	0.16%
UL_1850-1915MHz	0.88%		0.54%	0.10%	0.09%
UL_824-849MHz	1.26%	2.43%	0.08%	0.42%	0.33%
UL_777-787MHz	1.40%	0.90%	0.06%	0.88%	0.61%
DL_2110-2155MHz	0.05%	0.19%	0.05%	0.28%	0.16%
DL_1930-1995MHz	0.92%	0.13%	0.03%	0.22%	0.29%
DL_869-894MHz	1.11%	0.37%	0.26%	0.21%	0.11%
DL_746-756MHz	1.14%	0.37%	0.27%	0.59%	0.36%

Plots

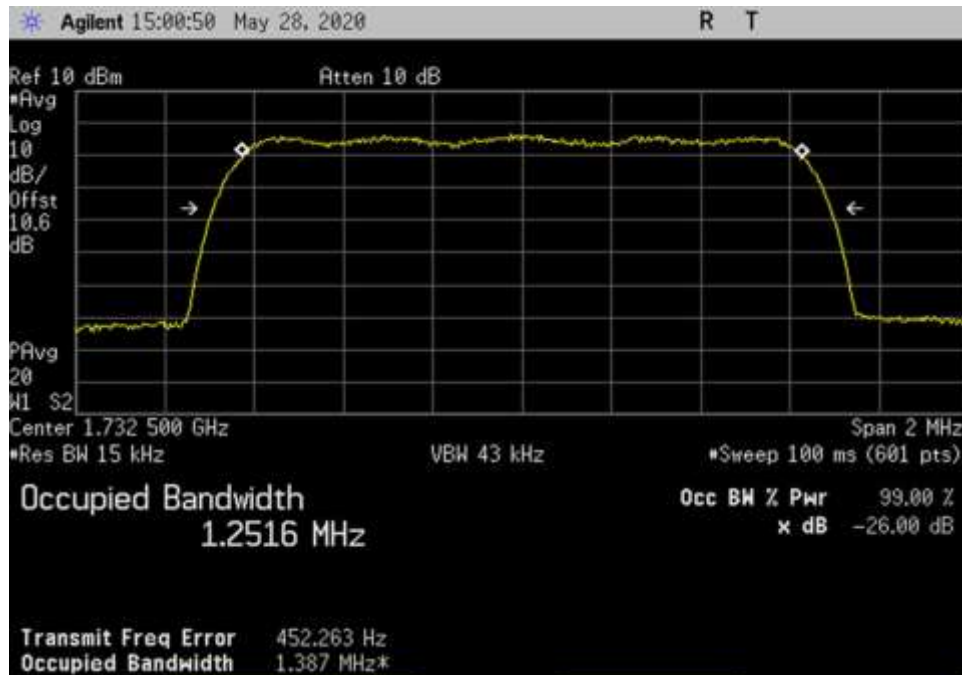
CDMA Input



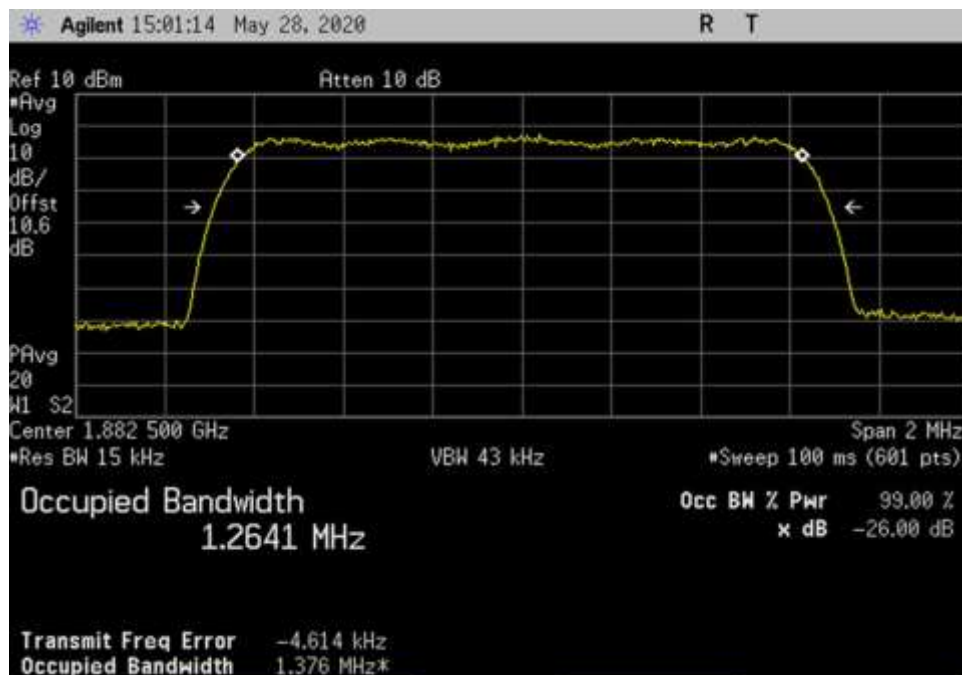
UL_776-787_CDMA_781.5MHz



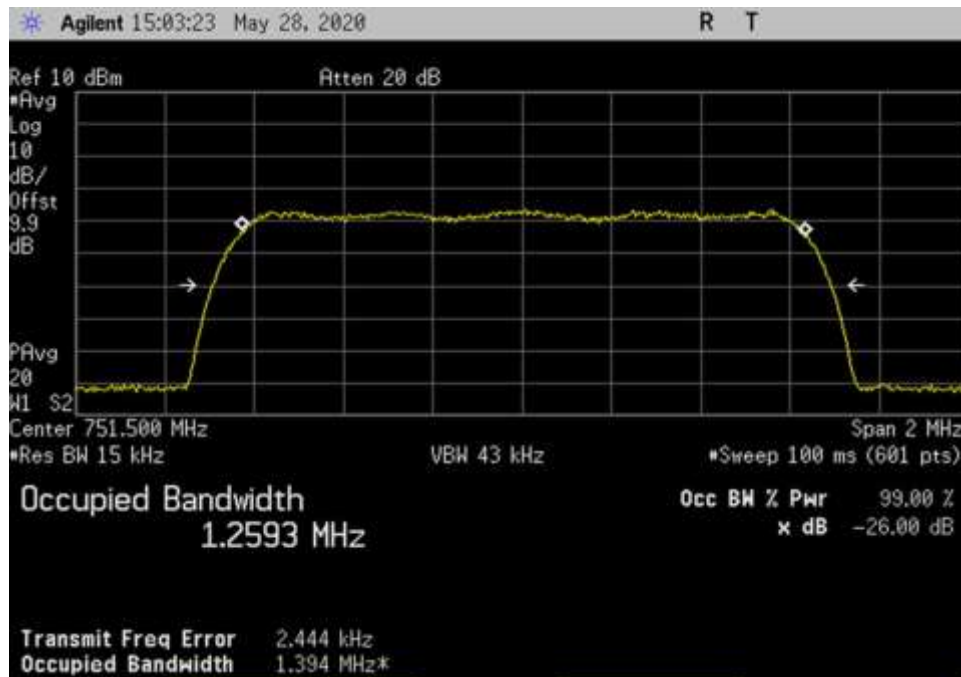
UL_824-849_CDMA_836.5MHz



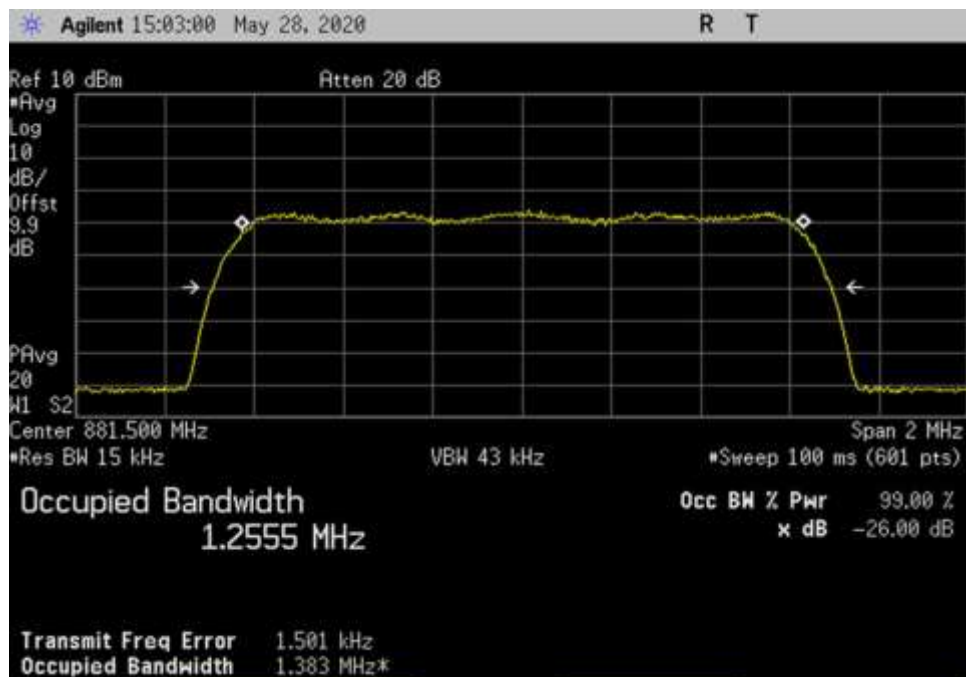
UL_1710-1755_CDMA_1732.5MHz



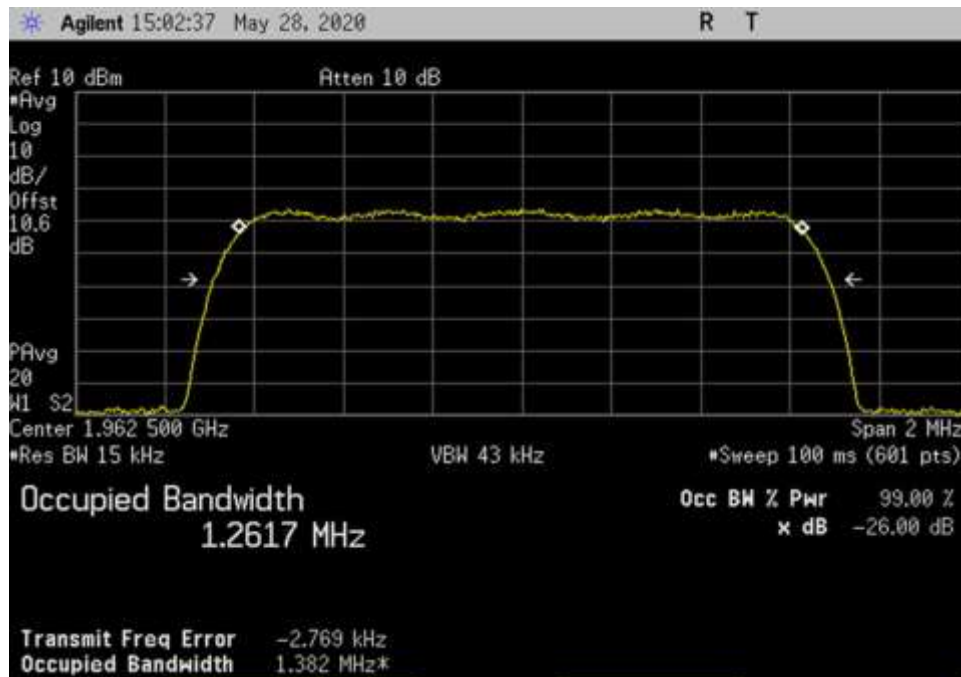
UL_1850-1915_CDMA_1882.5MHz



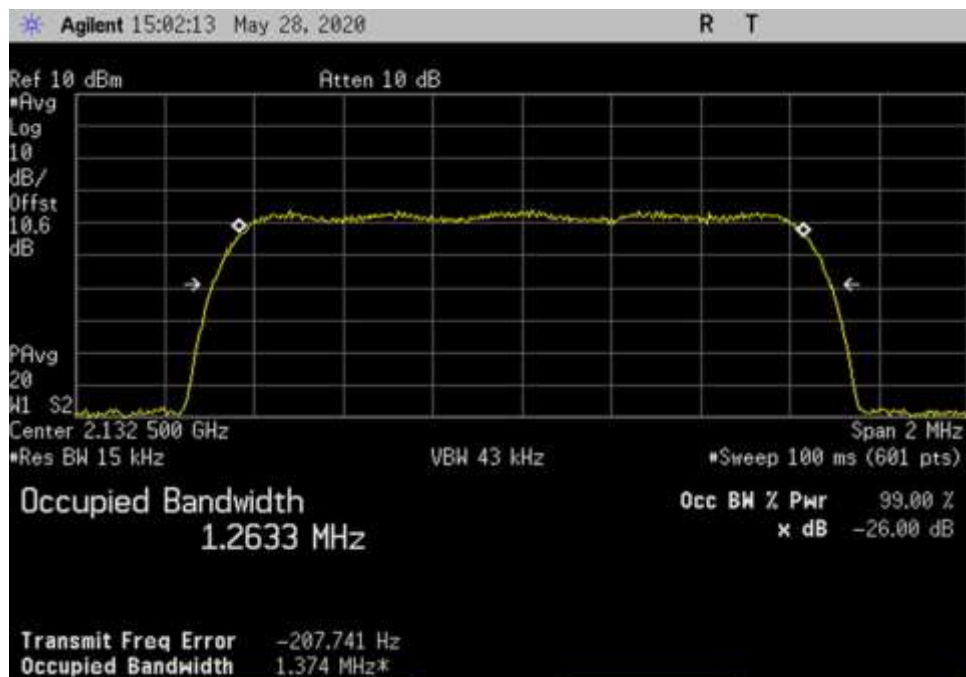
DL_746-757_CDMA_751.5MHz



DL_869-894_CDMA_881.5MHz

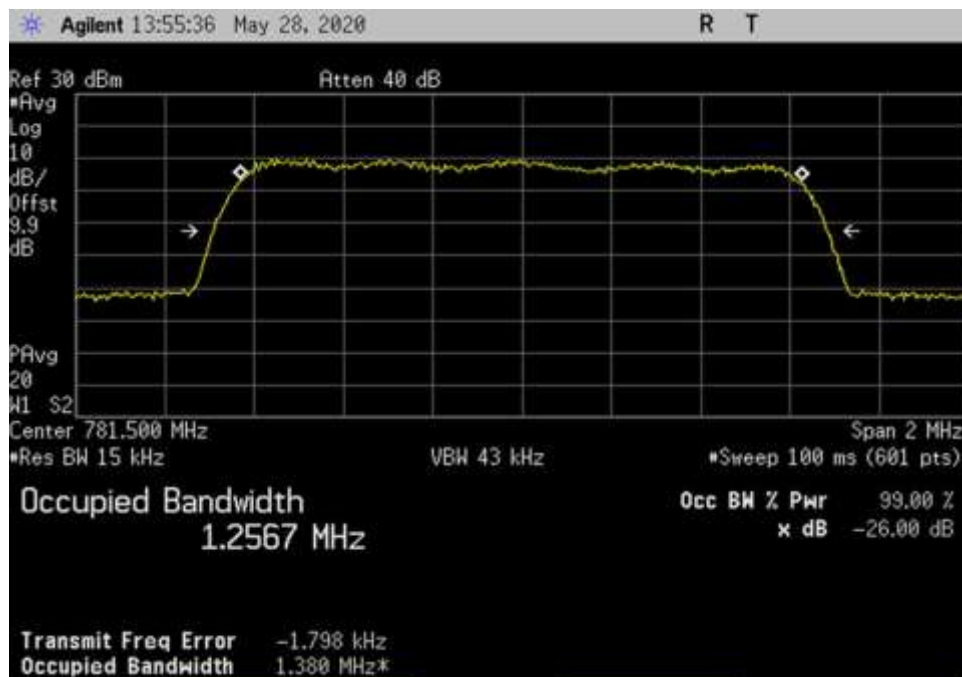


DL_1930-1995_CDMA_ 1962.5MHz

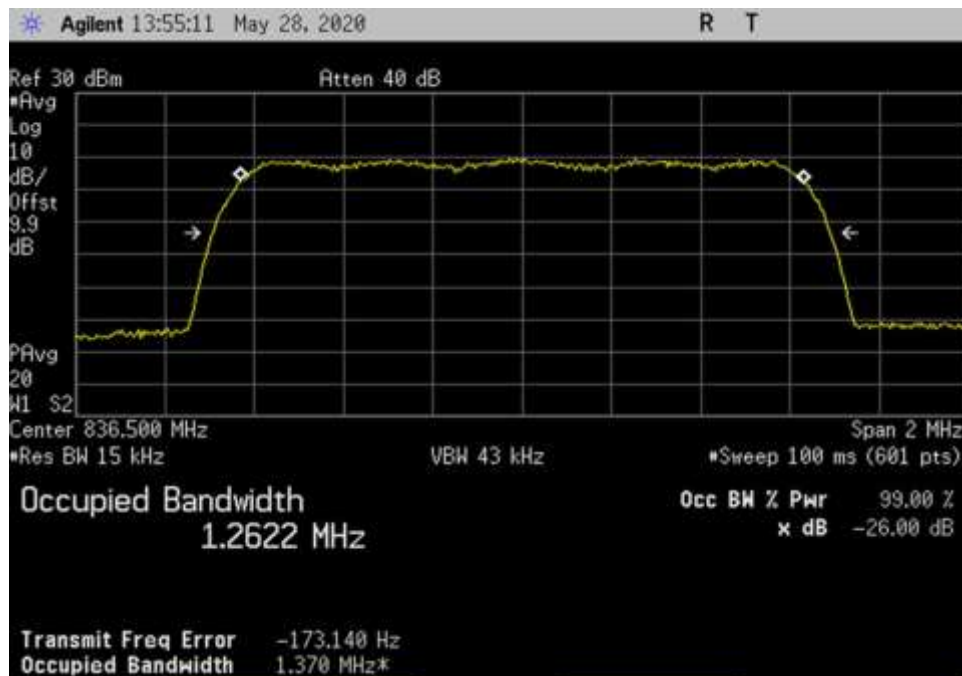


DL_2110-2155_CDMA_ 2132.5MHz

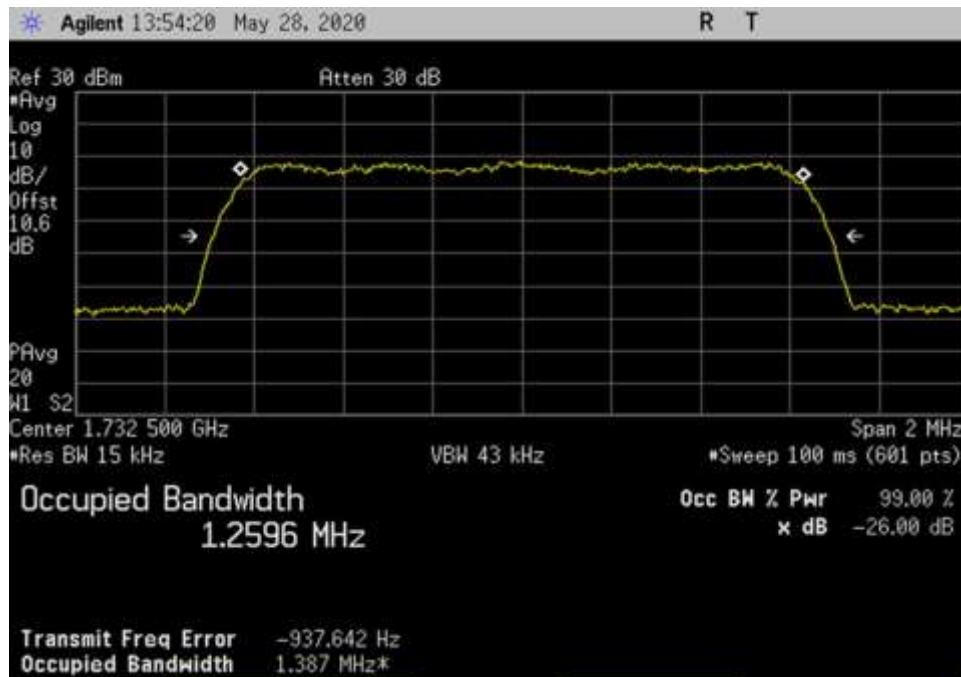
CDMA Output



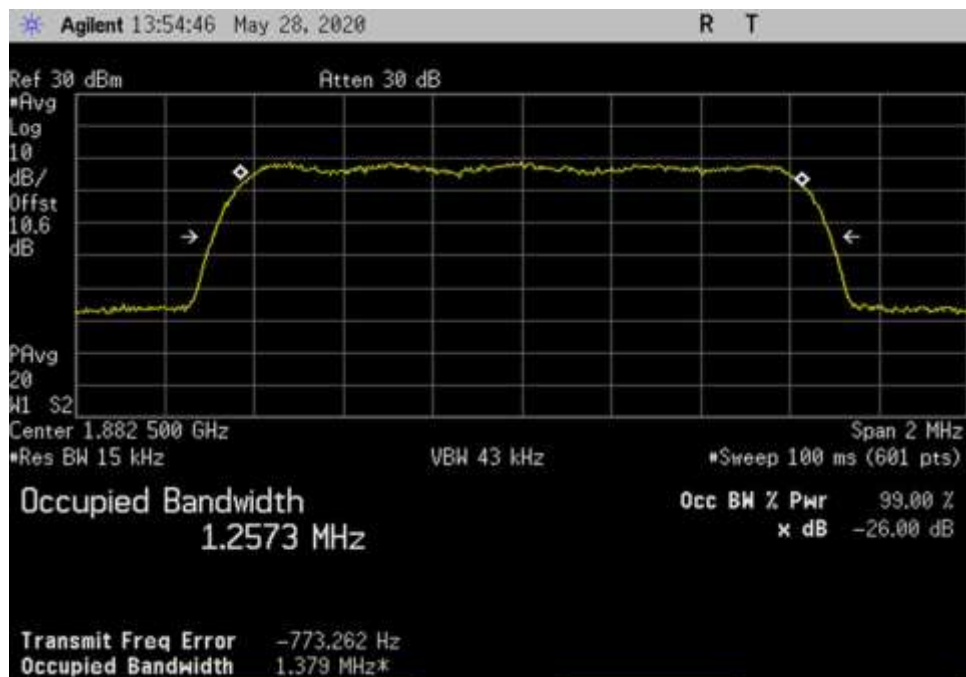
UL_776-787_CDMA_781.5MHz



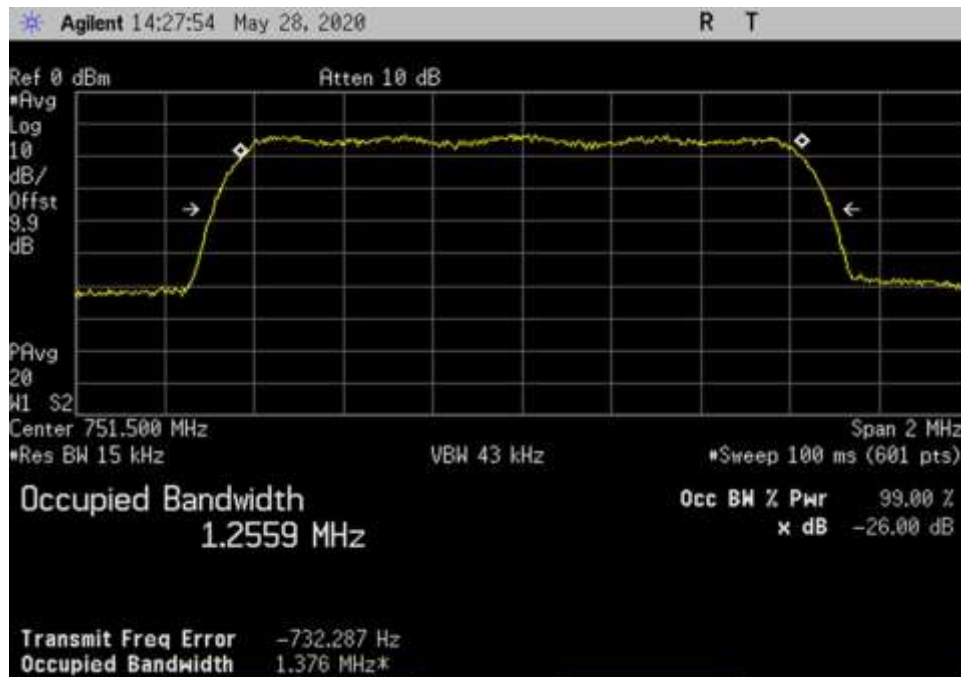
UL_824-849_CDMA_836.5MHz



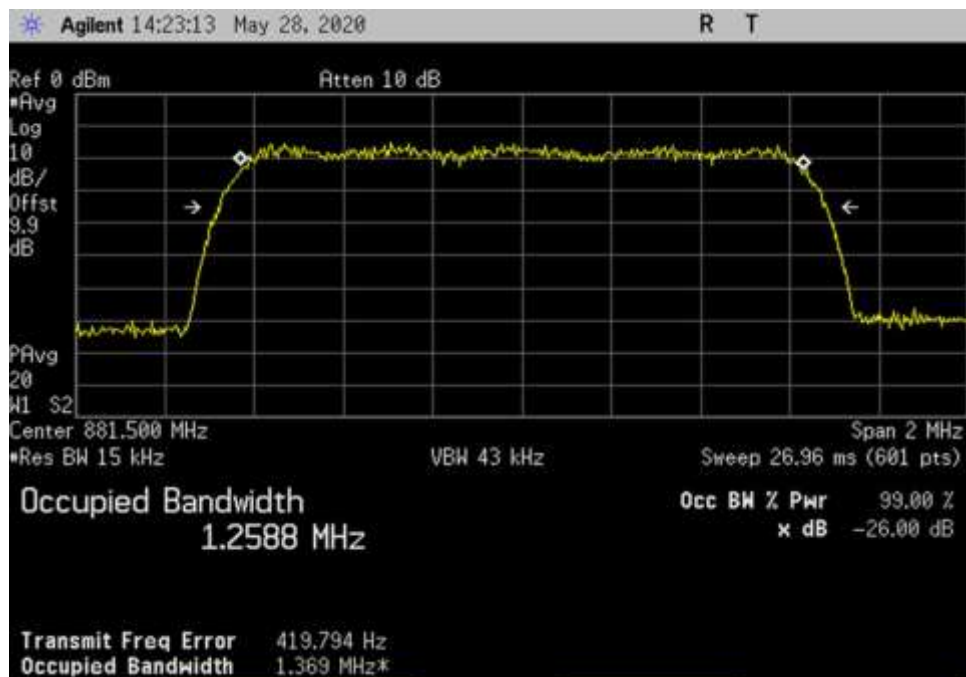
UL_1710-1755_CDMA_1732.5MHz



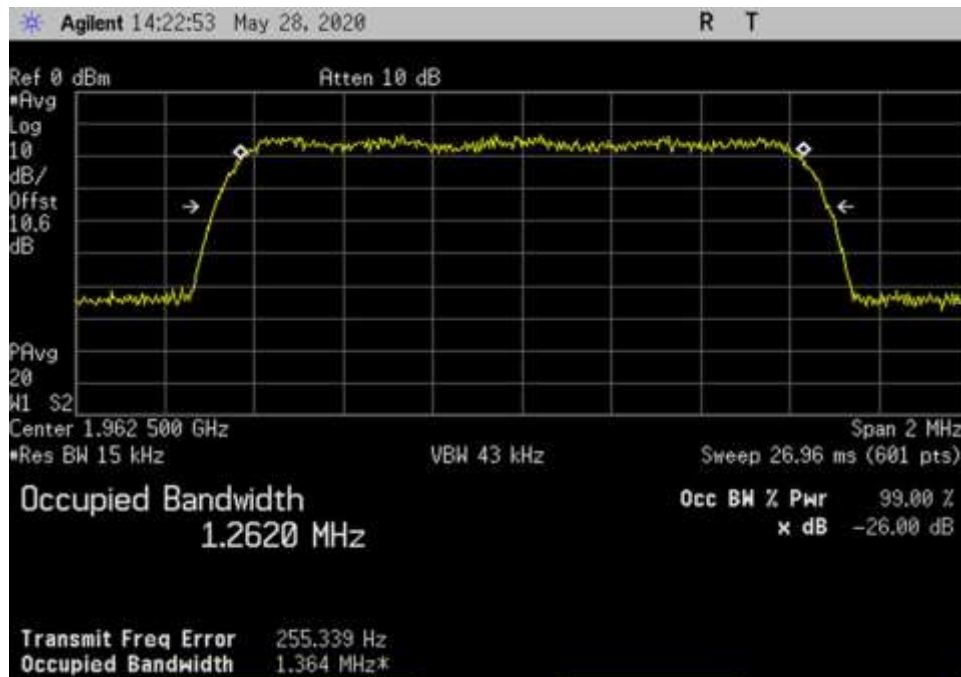
UL_1850-1915_CDMA_1882.5MHz



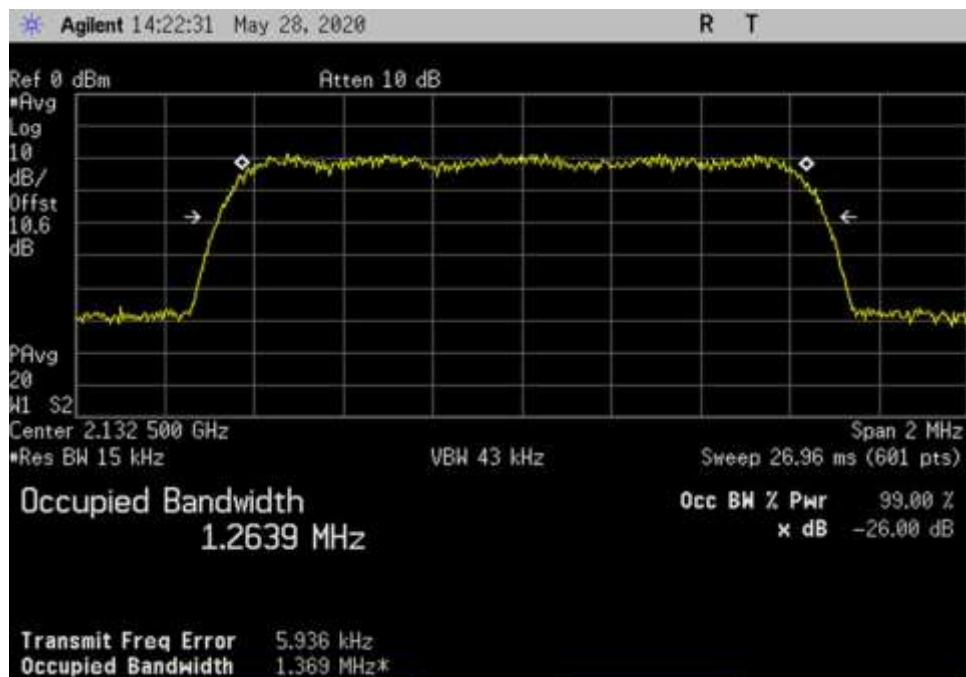
DL_746-757_CDMA_751.5MHz



DL_869-894_CDMA_881.5MHz

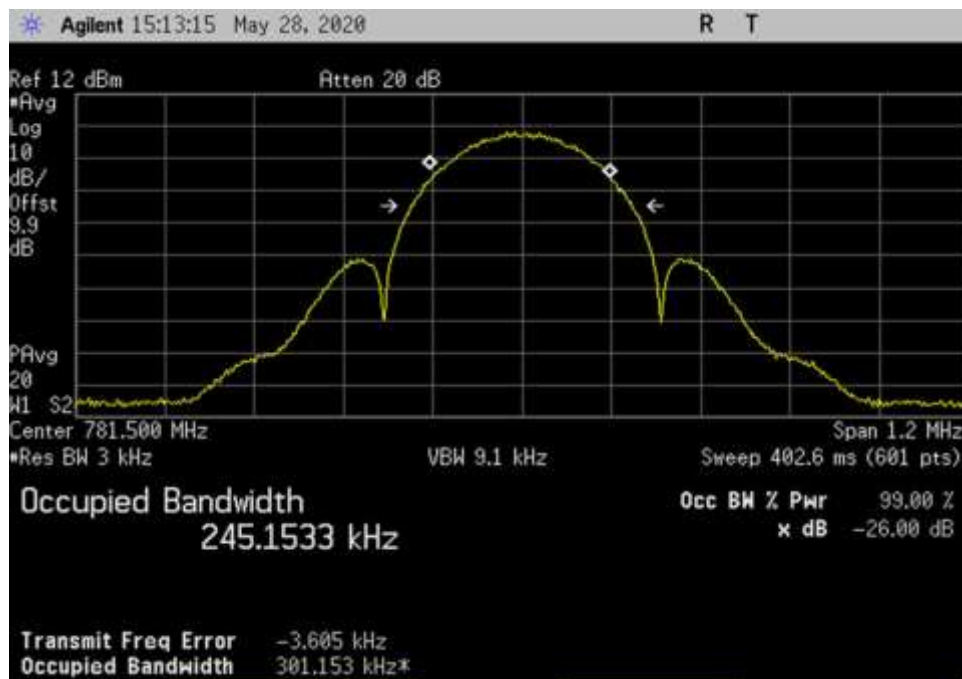


DL_1930-1995_CDMA_ 1962.5MHz

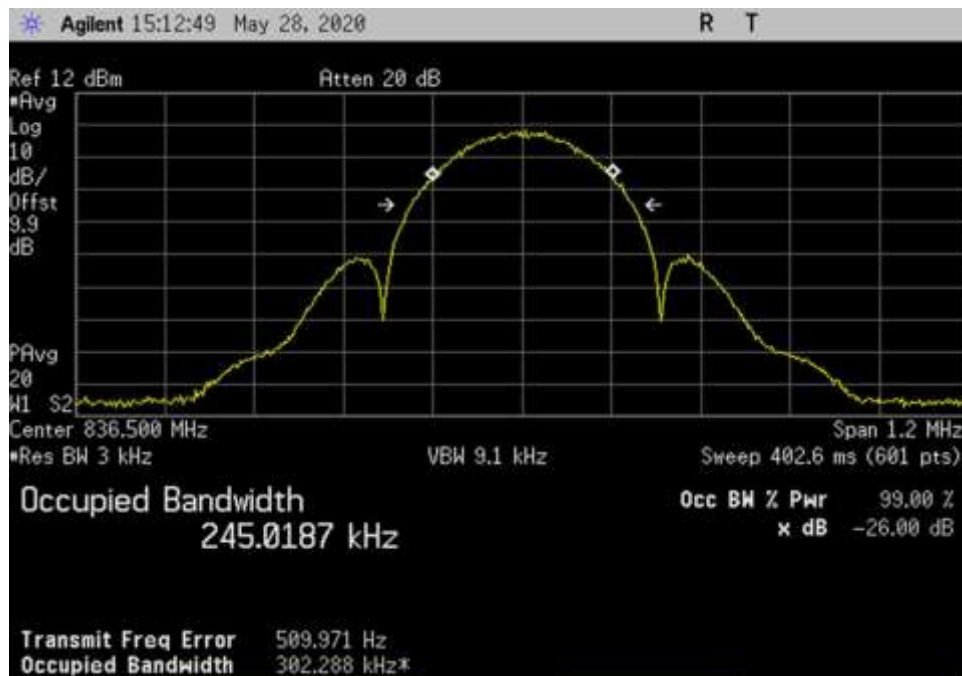


DL_2110-2155_CDMA_ 2132.5MHz

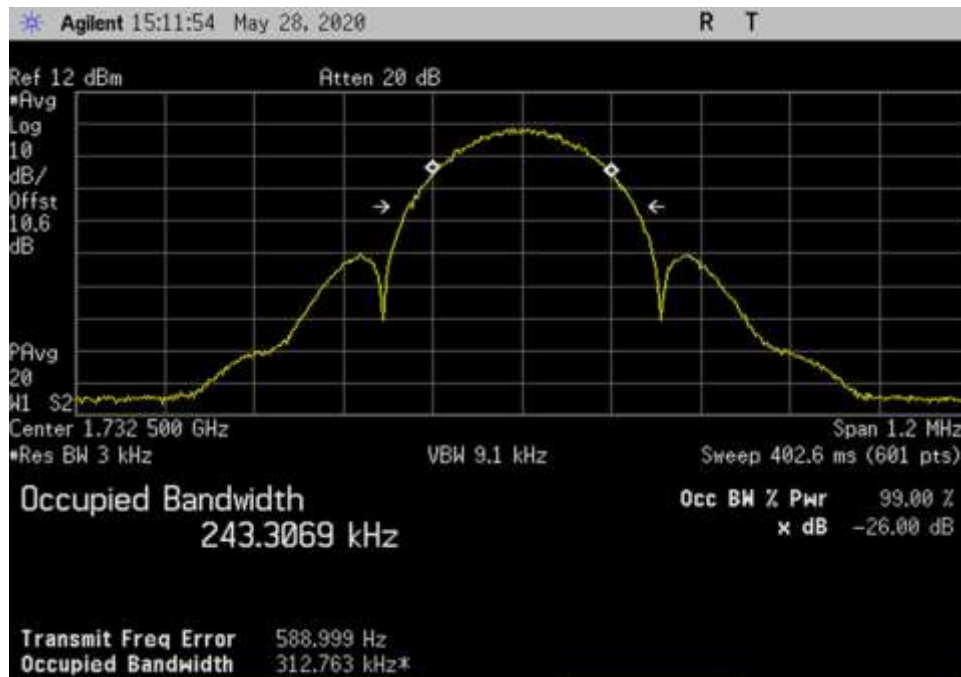
EDGE Input



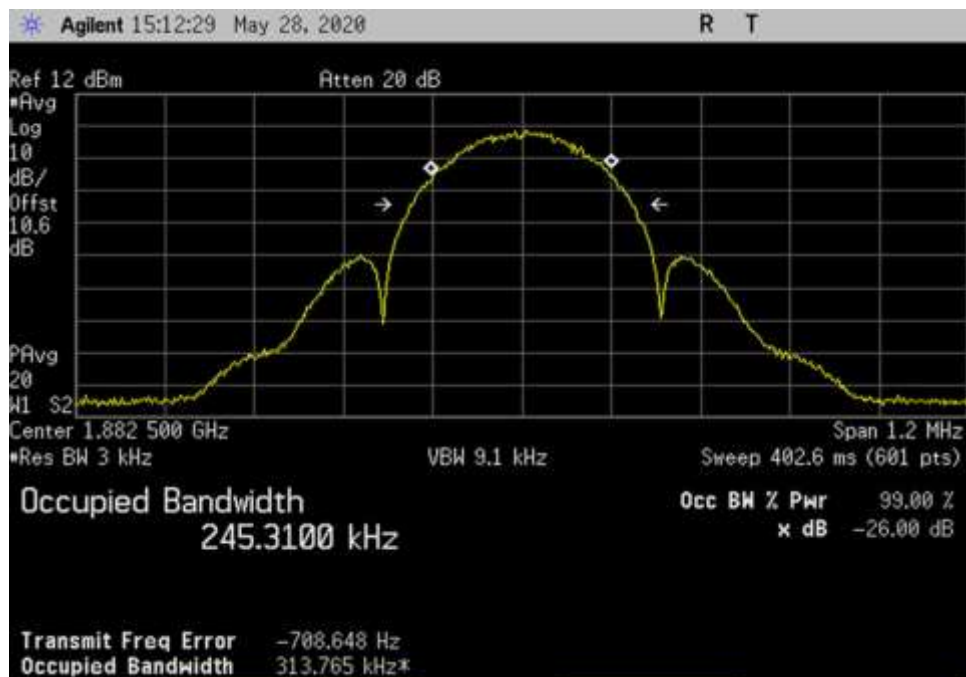
UL_776-787_EDGE_781.5MHz



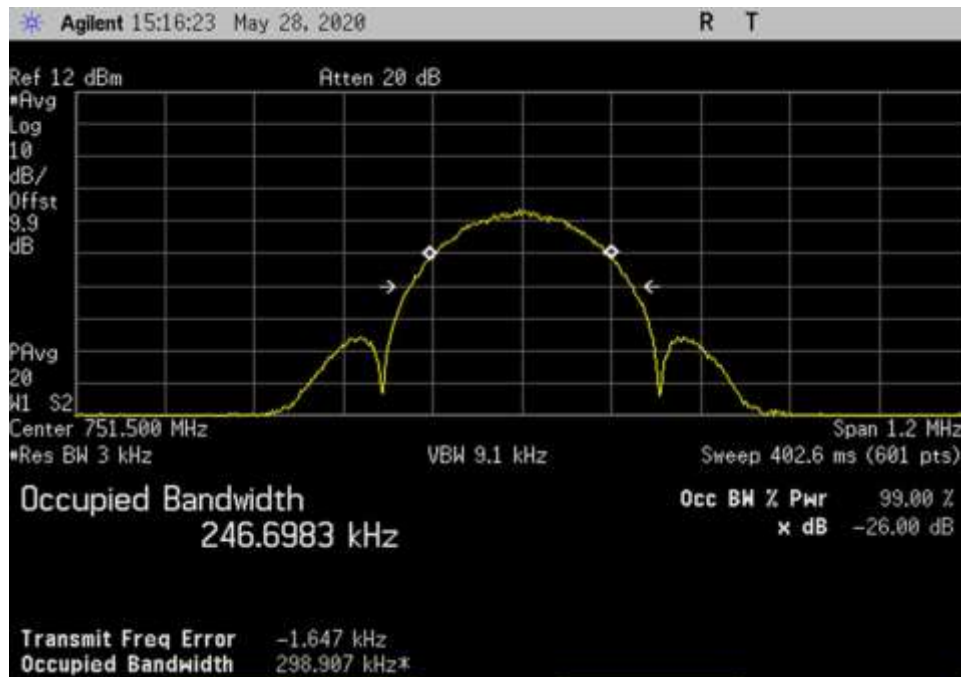
UL_824-849_EDGE_836.5MHz



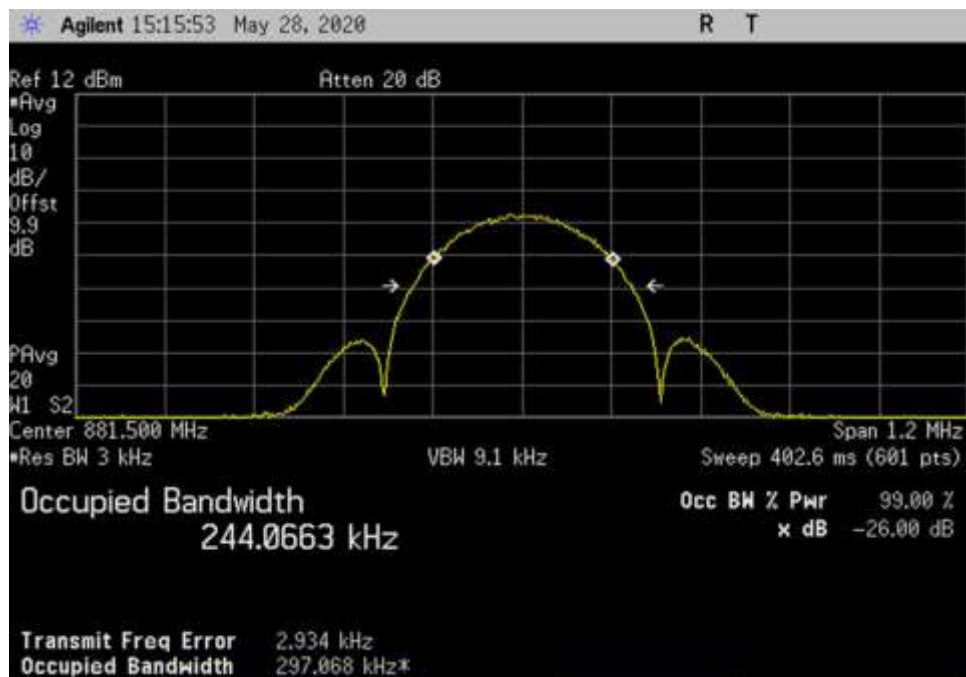
UL_1710-1755_EDGE_1732.5MHz



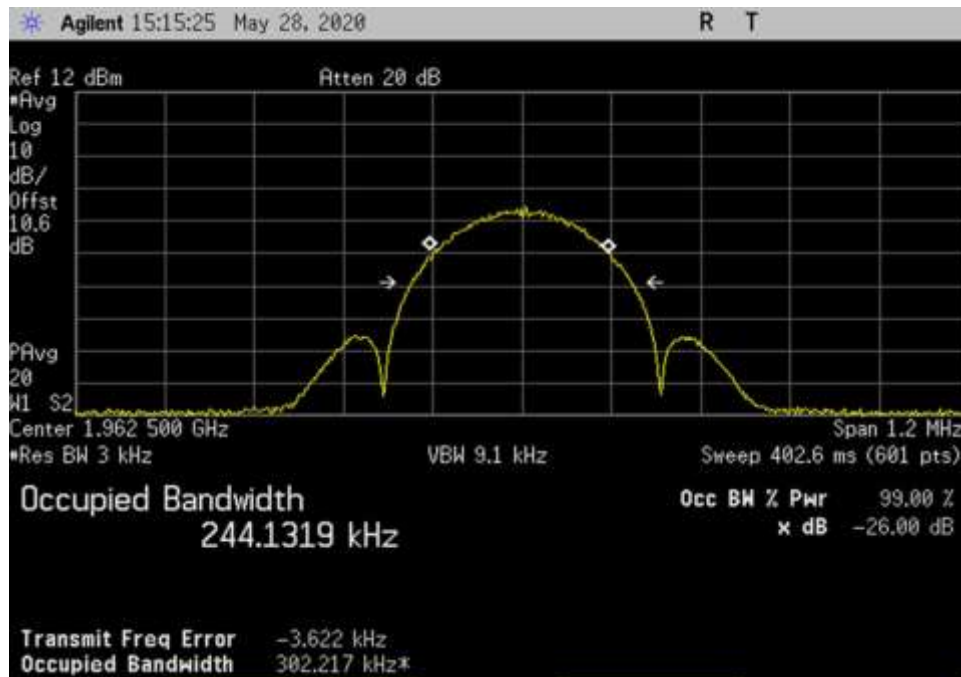
UL_1850-1915_EDGE_1882.5MHz



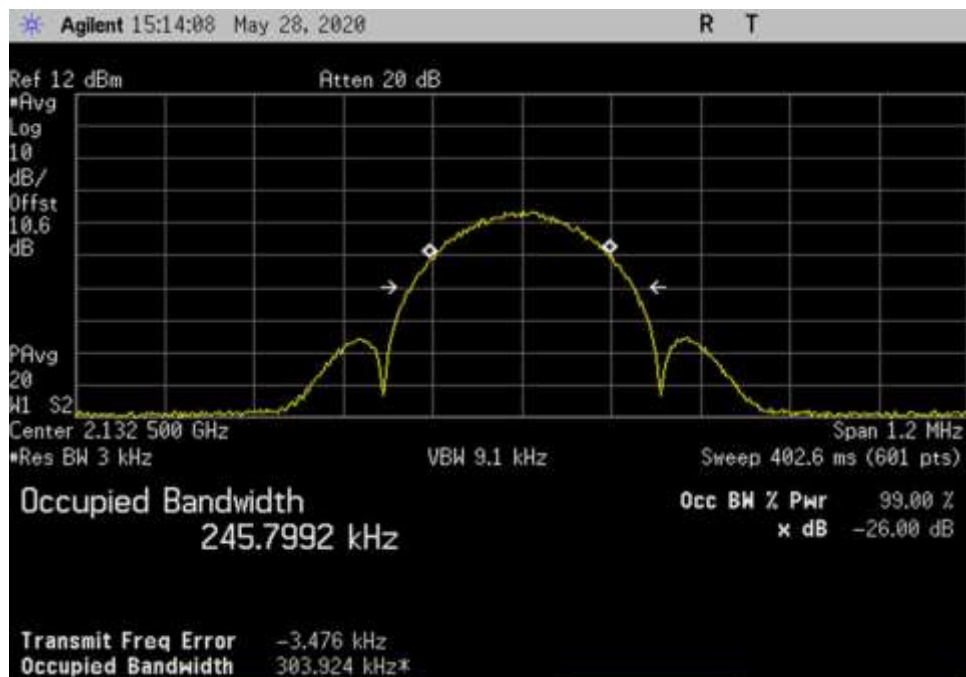
DL_746-757_EDGE_ 751.5MHz



DL_869-894_EDGE_ 881.5MHz

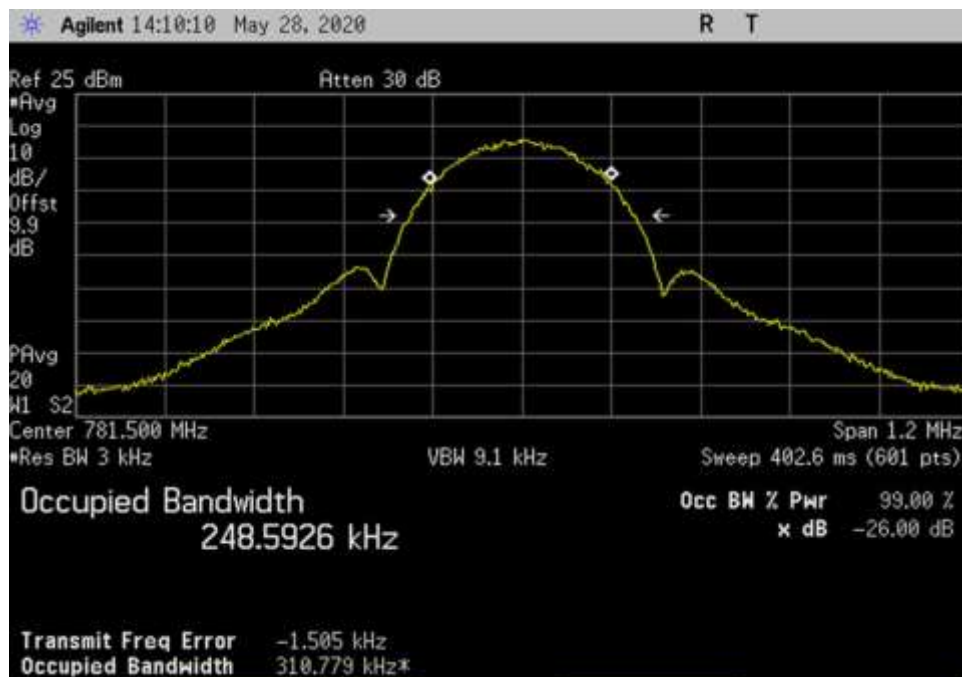


DL_1930-1995_EDGE_1962.5MHz

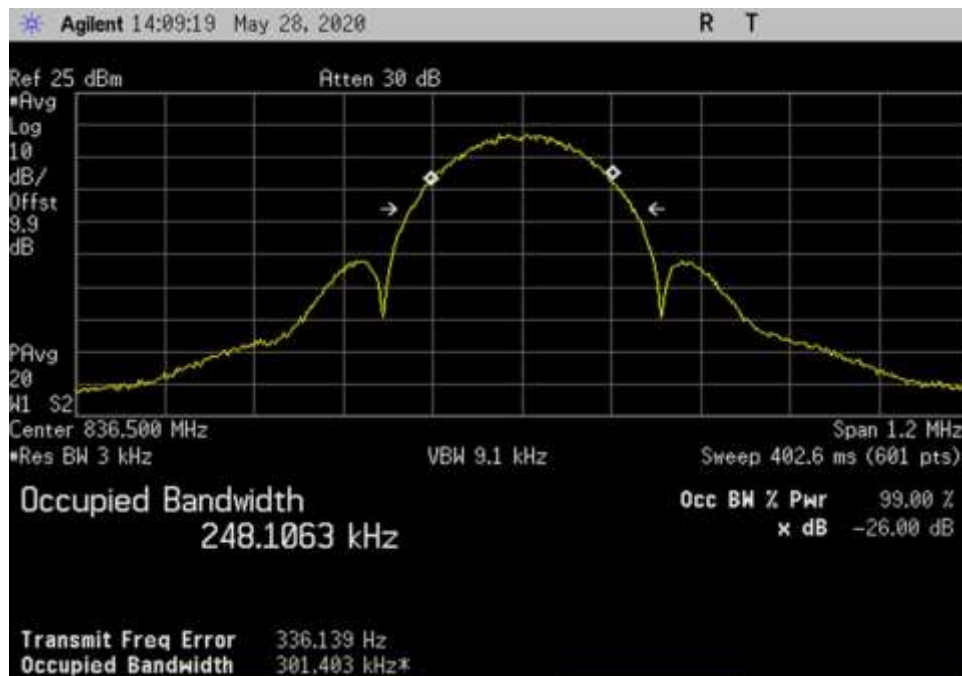


DL_2110-2155_EDGE_2132.5MHz

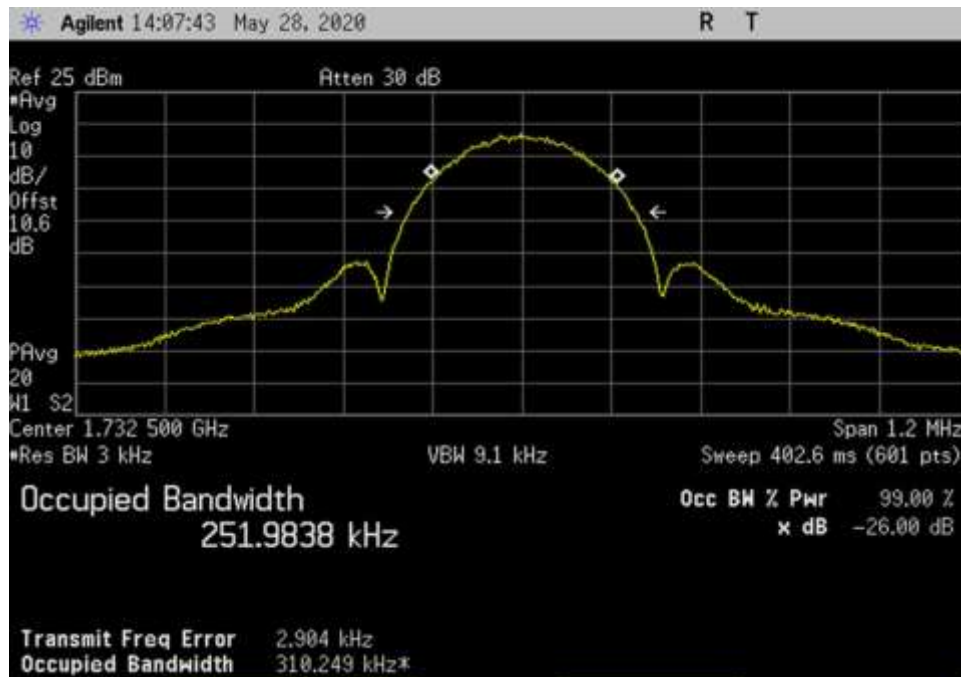
EDGE Output



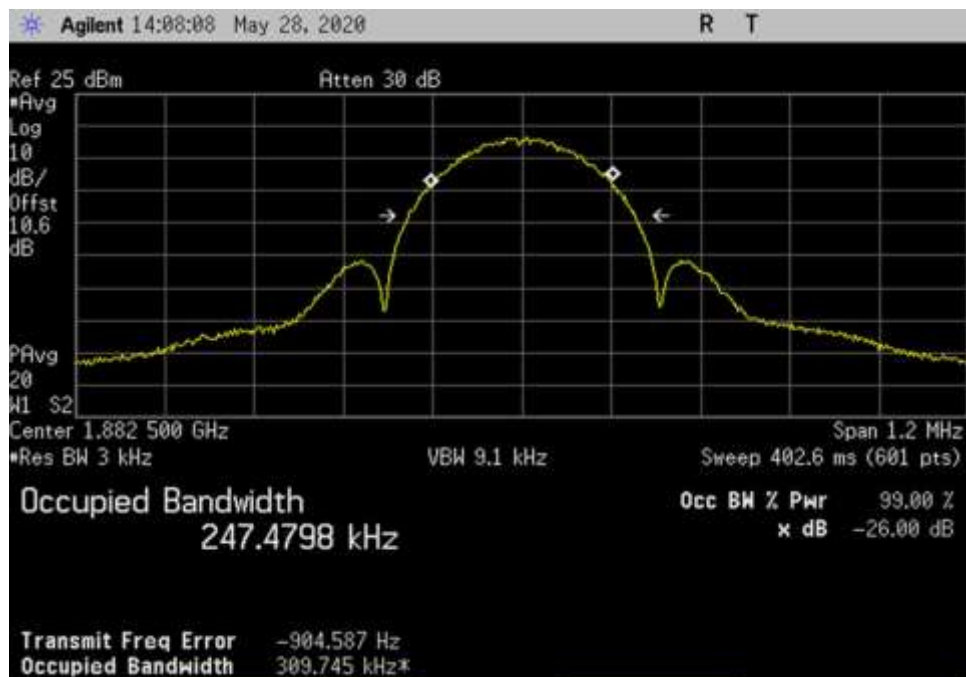
UL_776-787_EDGE_ 781.5MHz



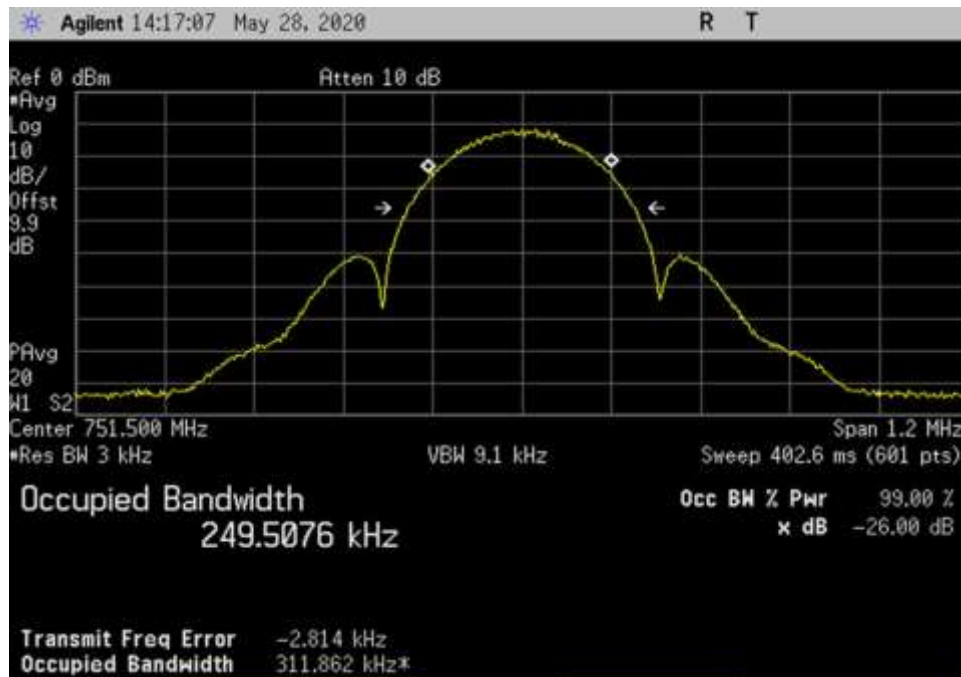
UL_824-849_EDGE_ 836.5MHz



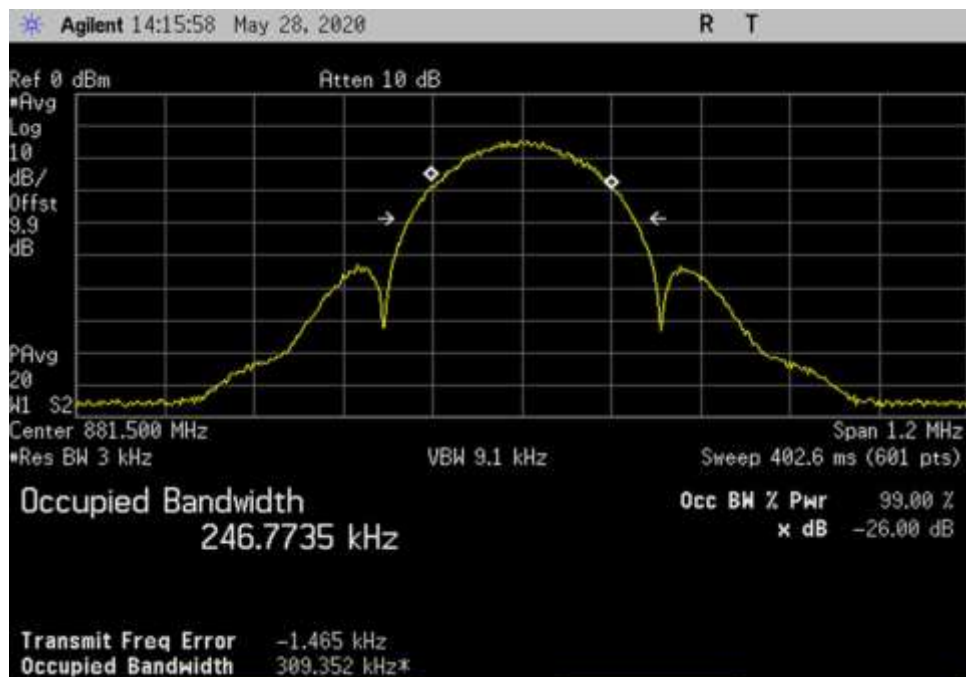
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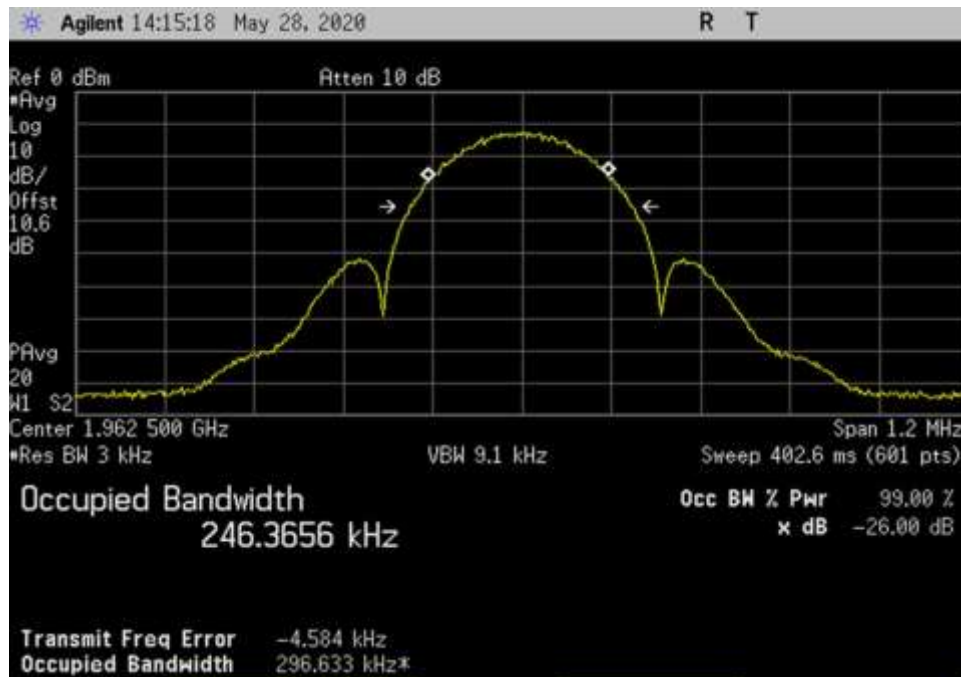
UL_1850-1915_EDGE_1882.5MHz



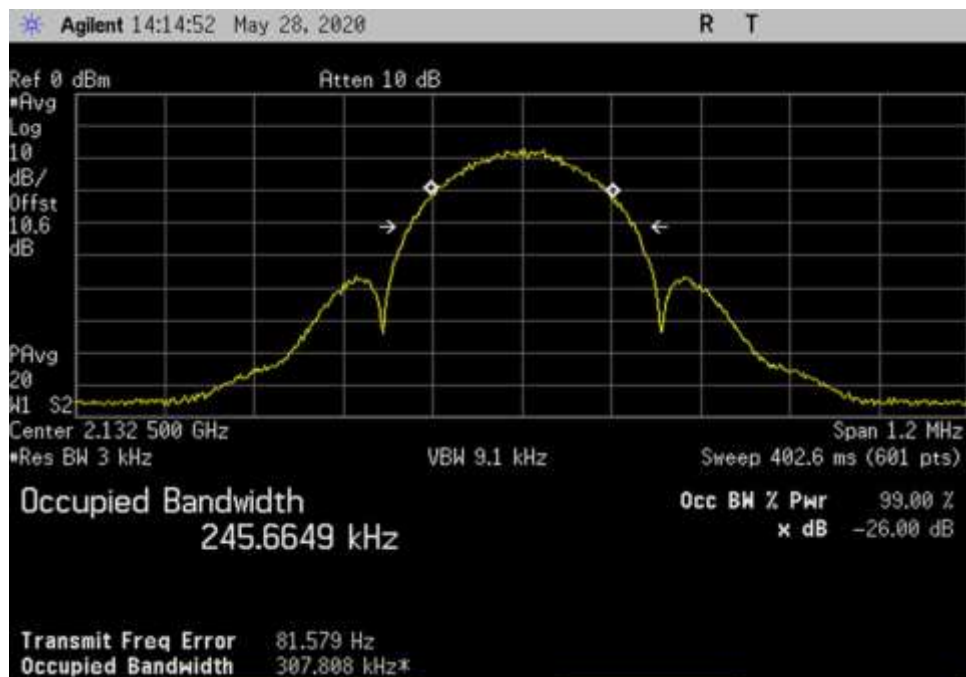
DL_746-757_EDGE_ 751.5MHz



DL_869-894_EDGE_ 881.5MHz

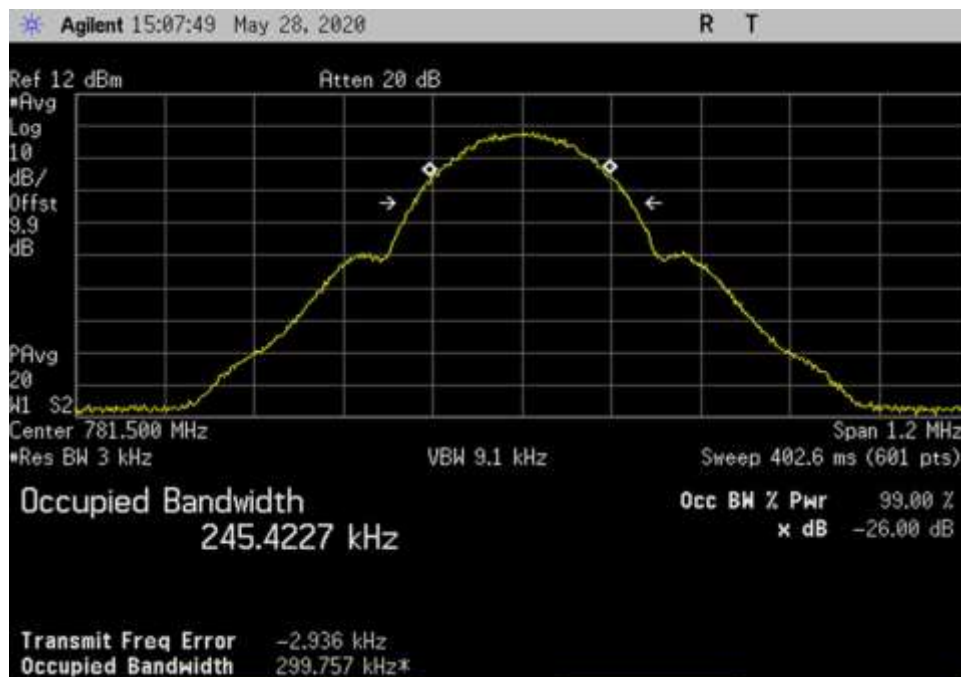


DL_1930-1995_EDGE_1962.5MHz

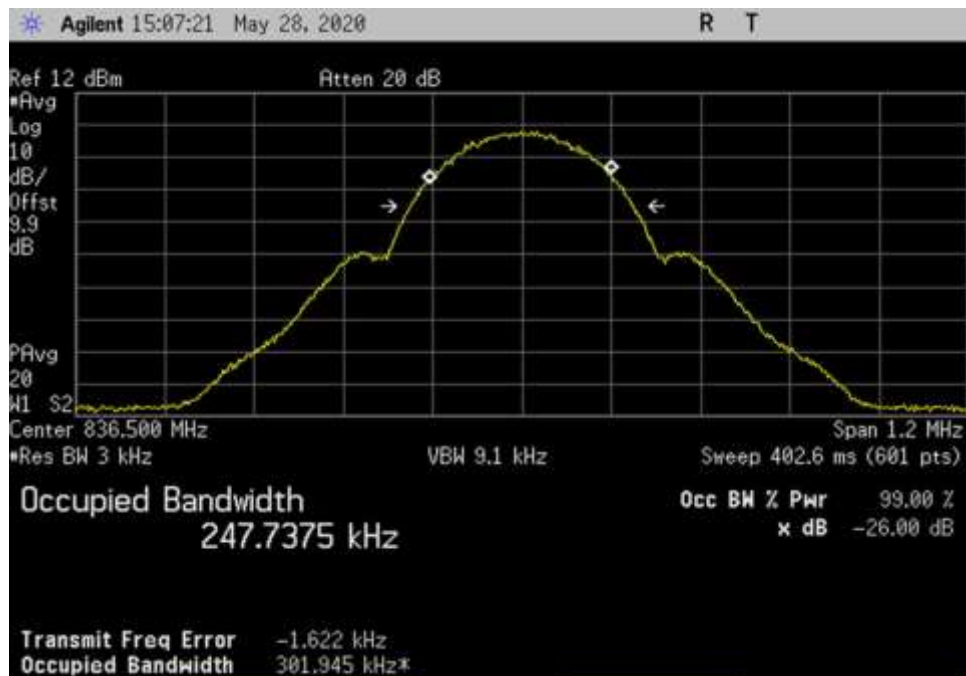


DL_2110-2155_EDGE_2132.5MHz

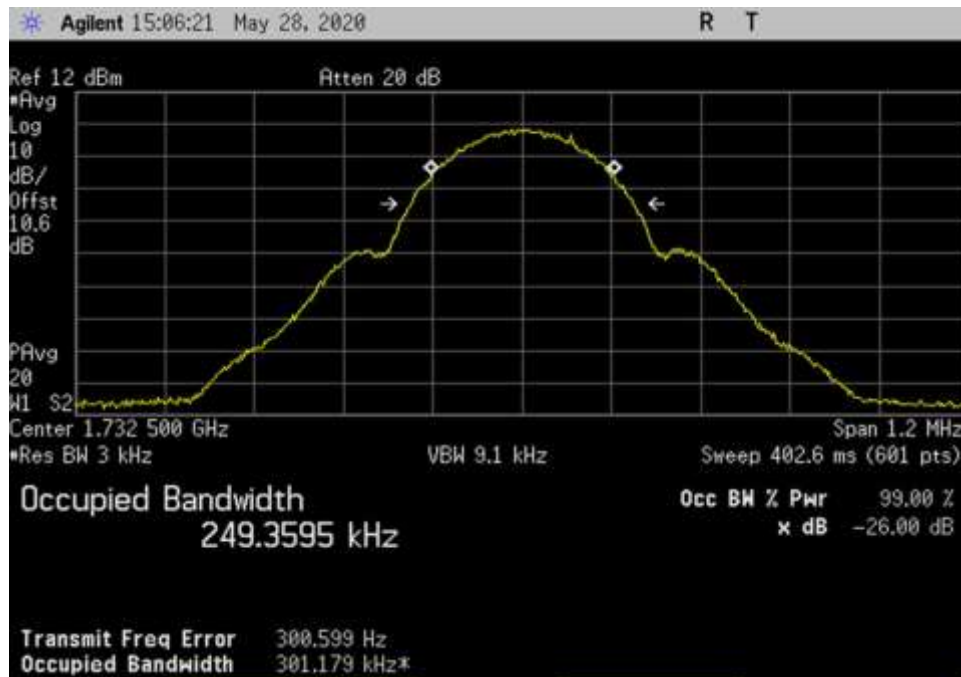
GSM Input



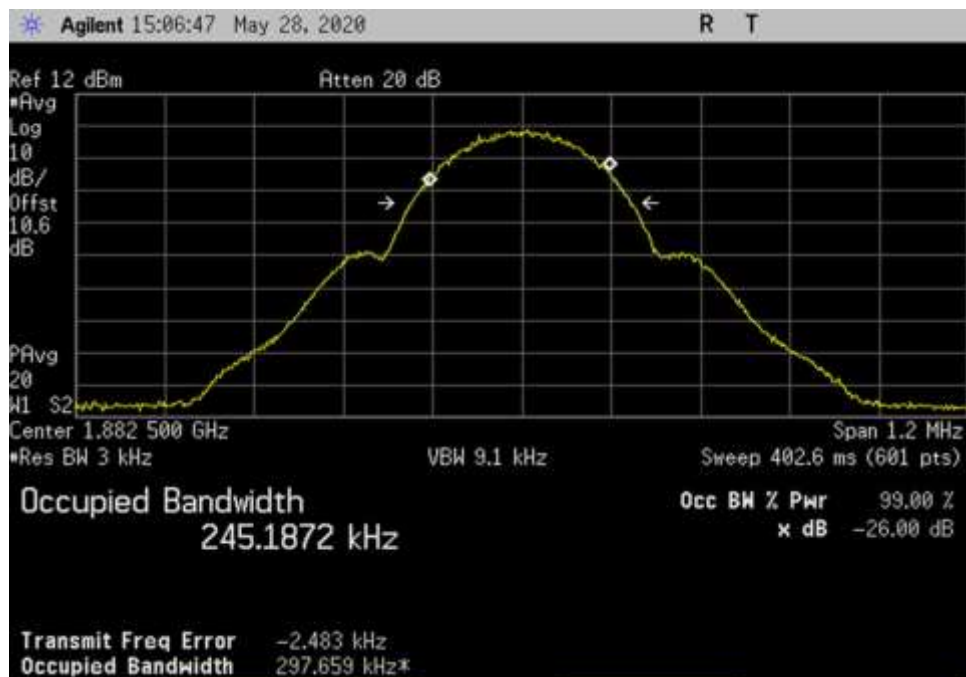
UL_776-787_GSM_ 781.5MHz



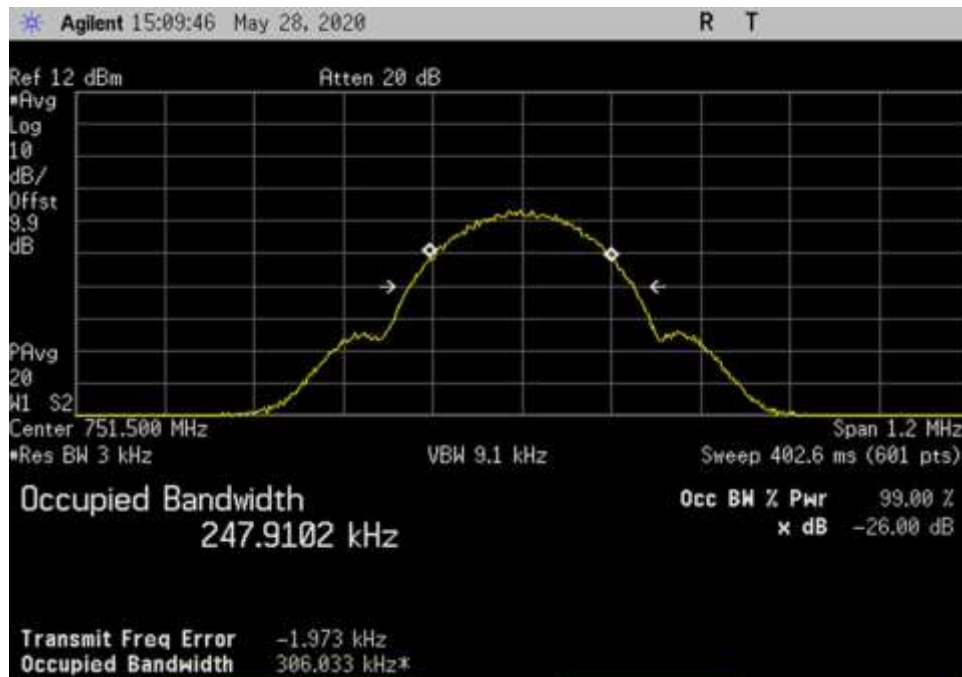
UL_824-849_GSM_ 836.5MHz



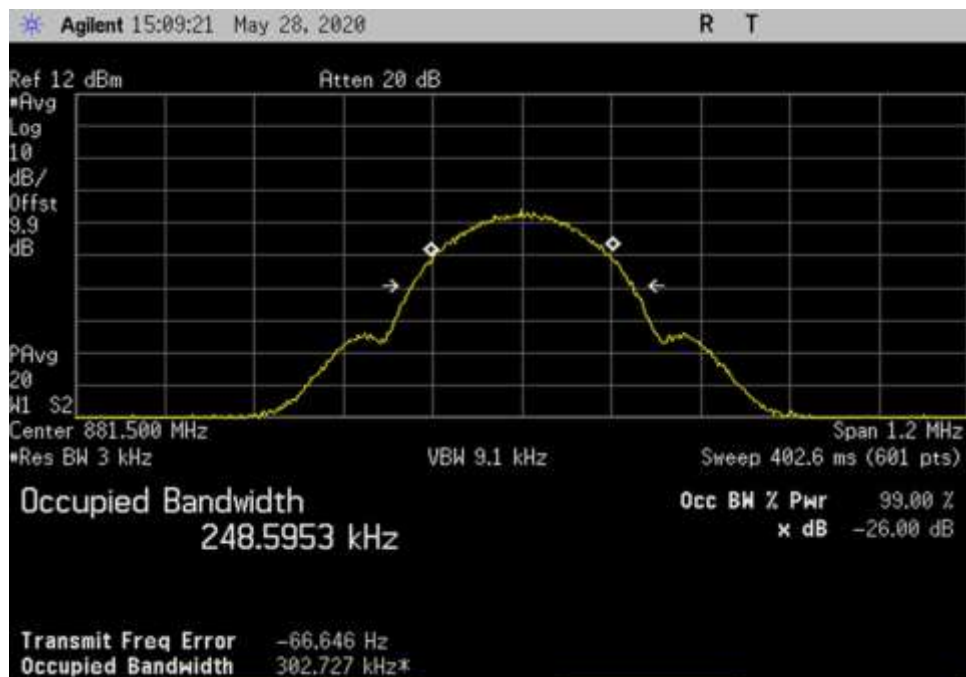
UL_1710-1755_GSM_1732.5MHz



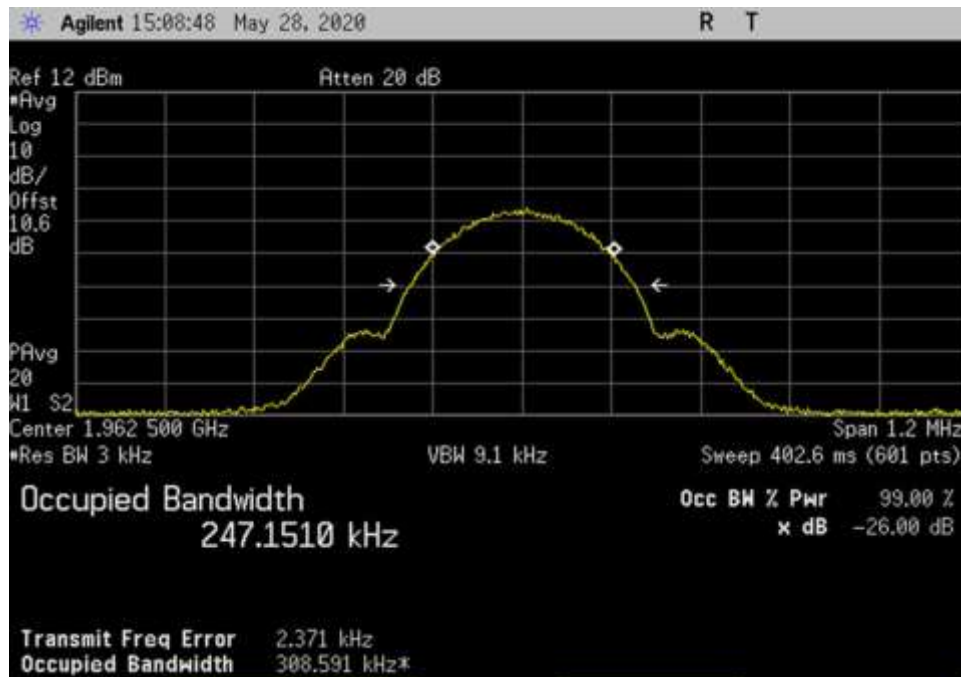
UL_1850-1915_GSM_1882.5MHz



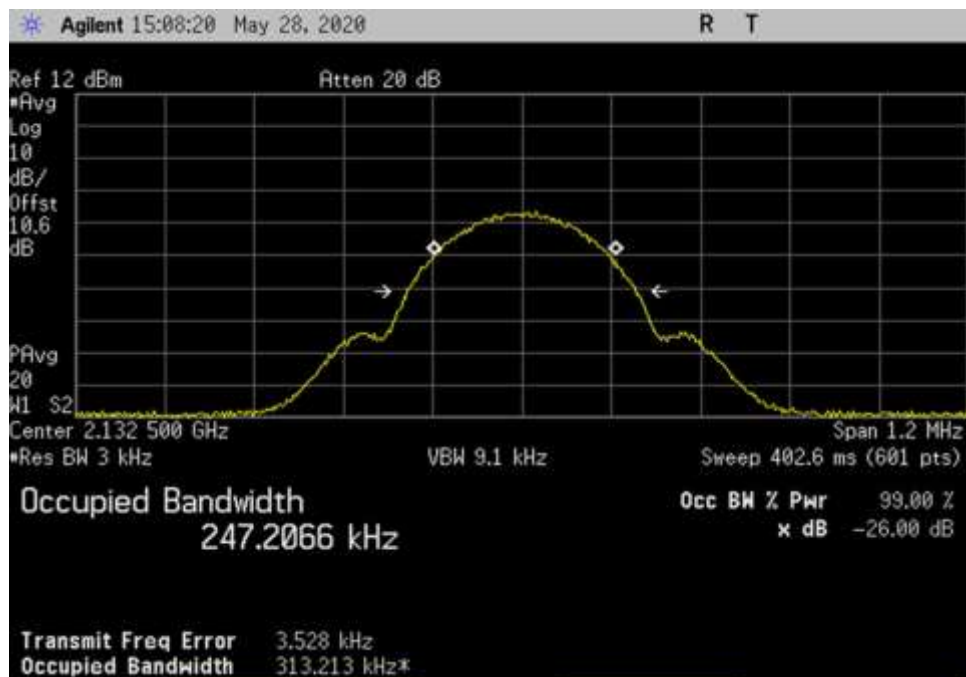
DL_746-757_GSM_ 751.5MHz



DL_869-894_GSM_ 881.5MHz

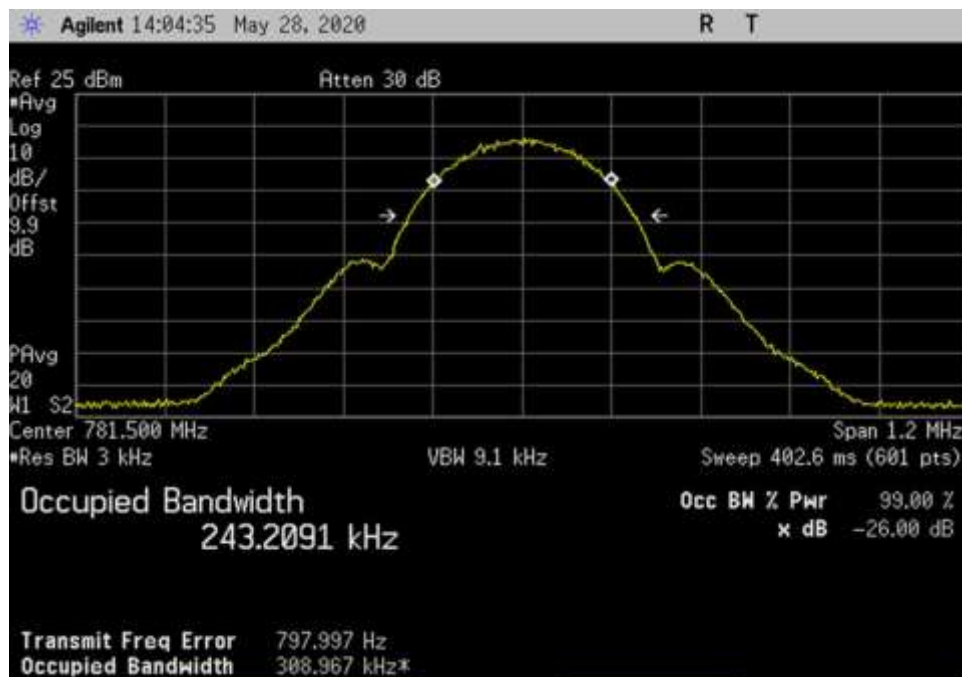


DL_1930-1995_GSM_1962.5MHz

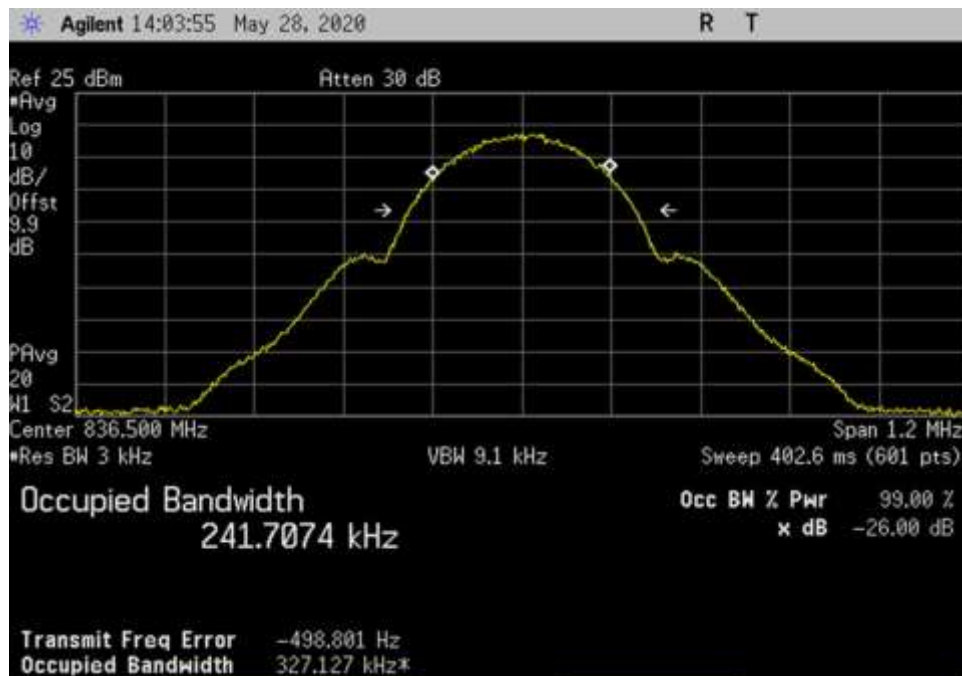


DL_2110-2155_GSM_2132.5MHz

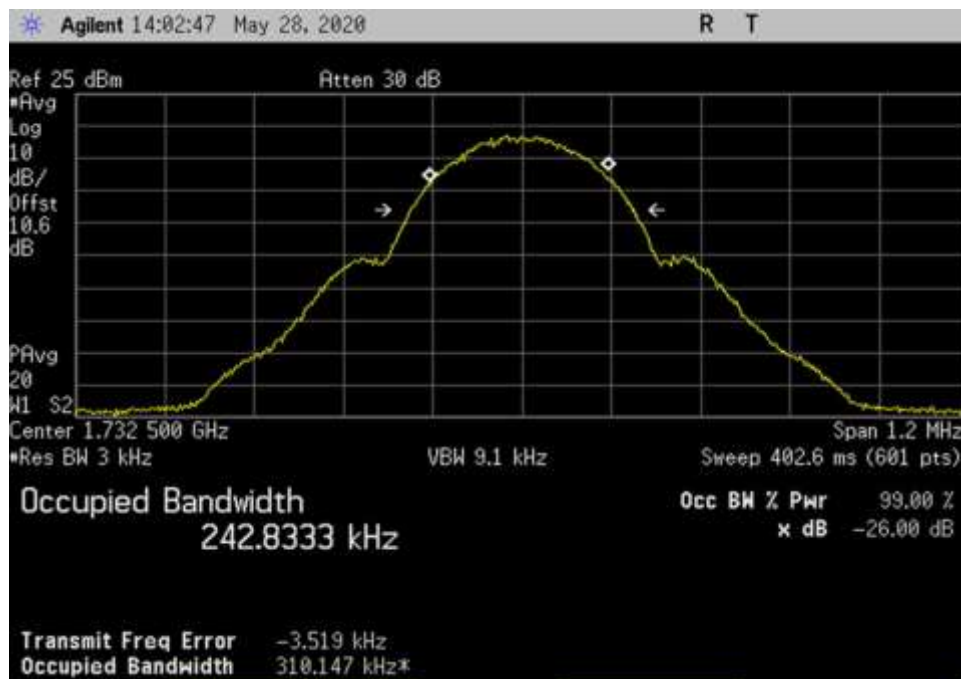
GSM Output



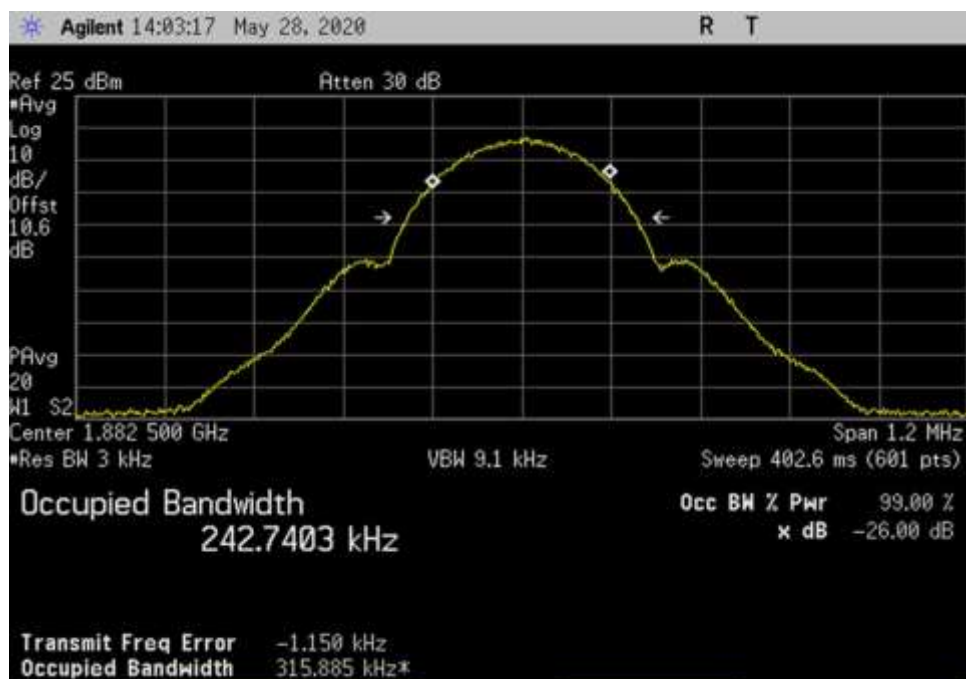
UL_776-787_GSM_ 781.5MHz



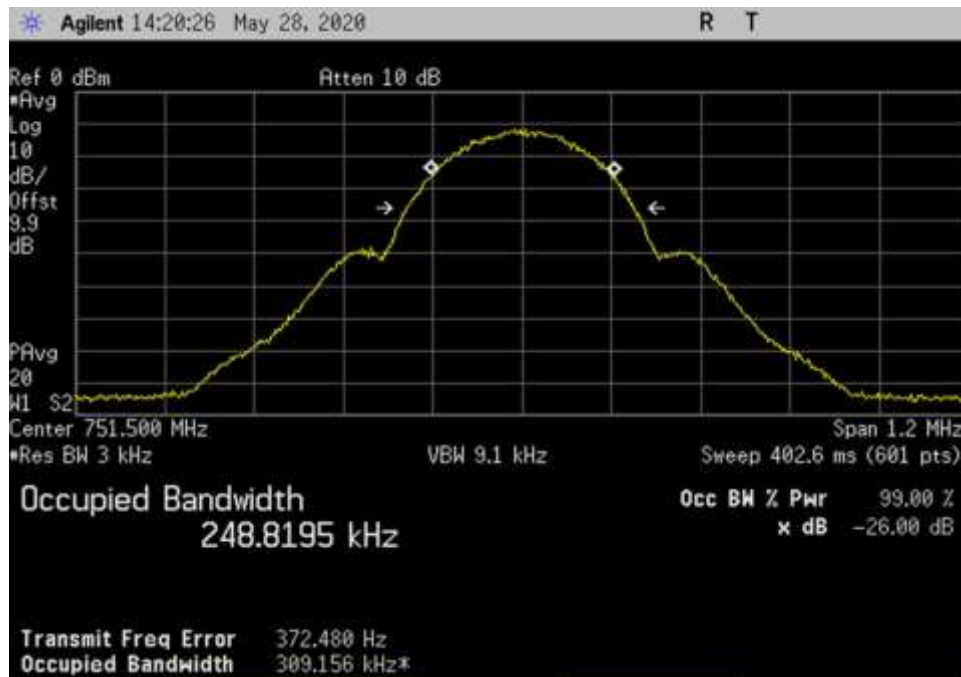
UL_824-849_GSM_ 836.5MHz



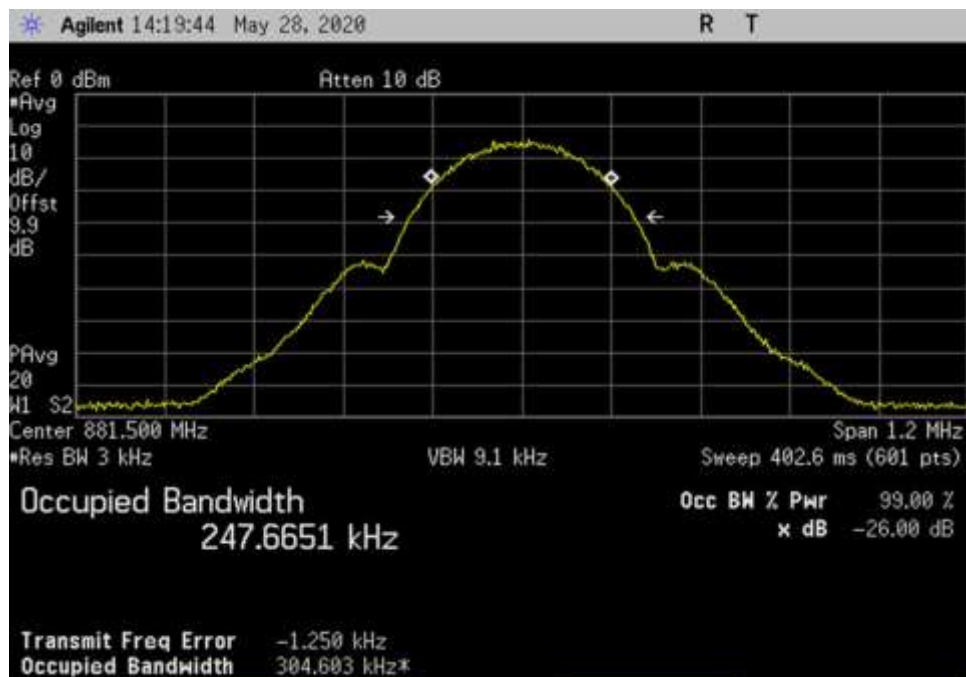
UL_1710-1755_GSM_1732.5MHz



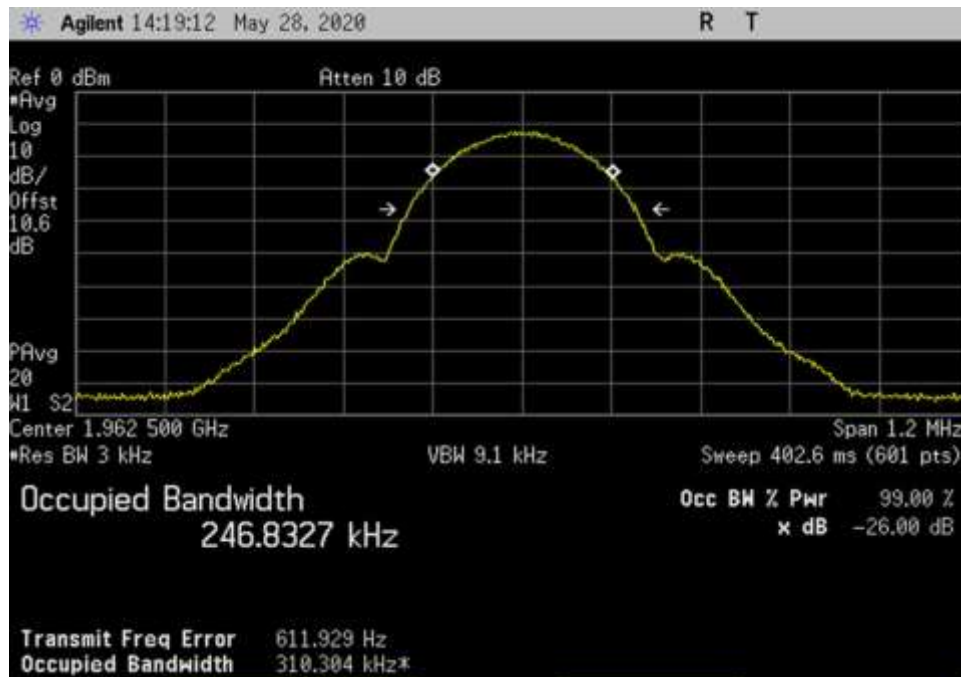
UL_1850-1915_GSM_1882.5MHz



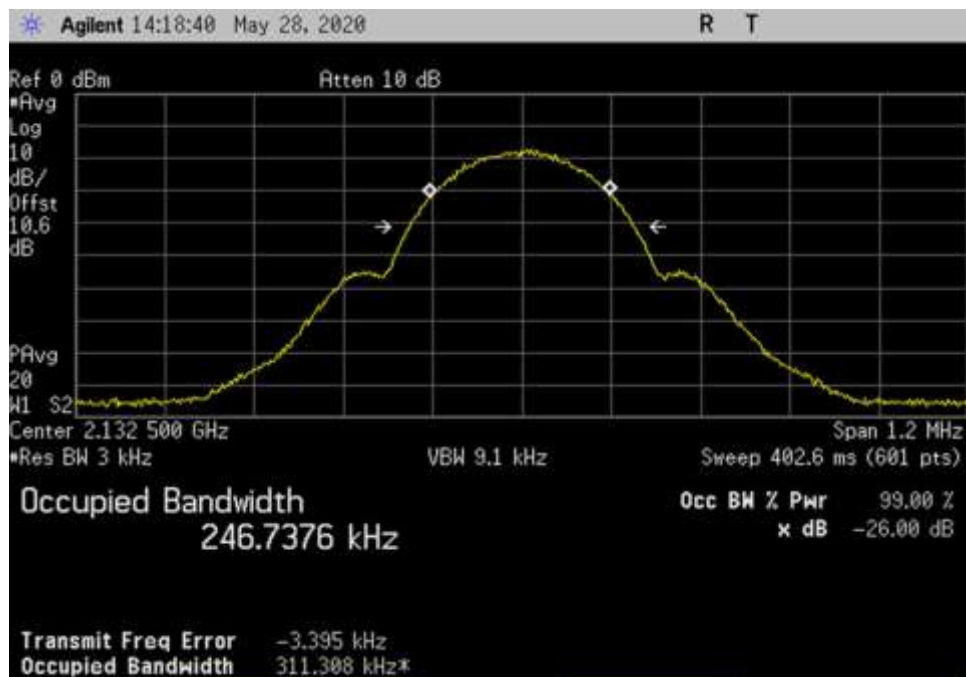
DL_746-757_GSM_751.5MHz



DL_869-894_GSM_881.5MHz

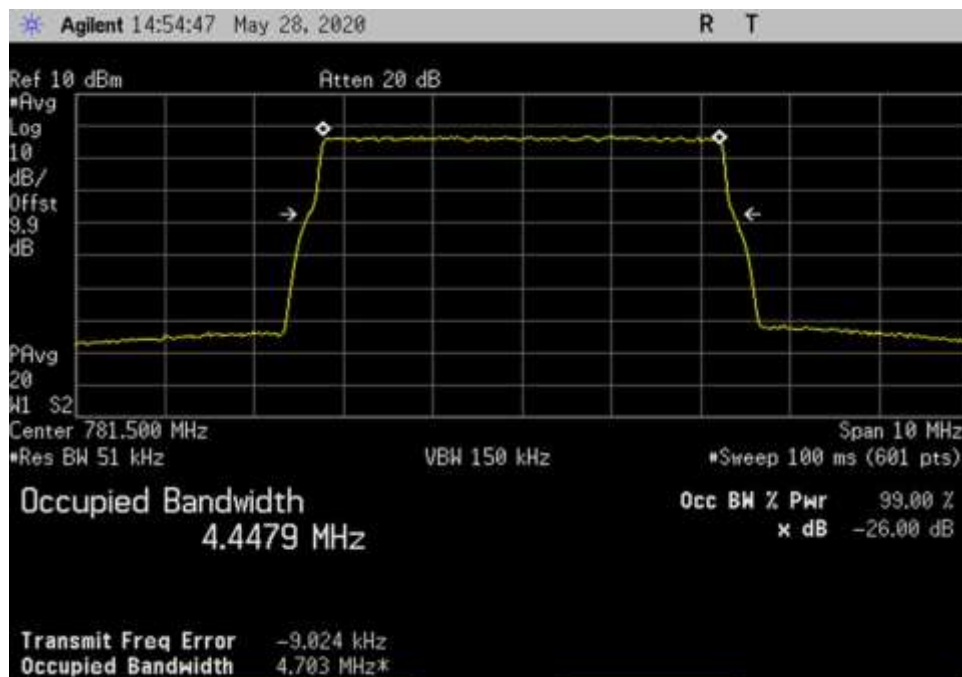


DL_1930-1995_GSM_1962.5MHz

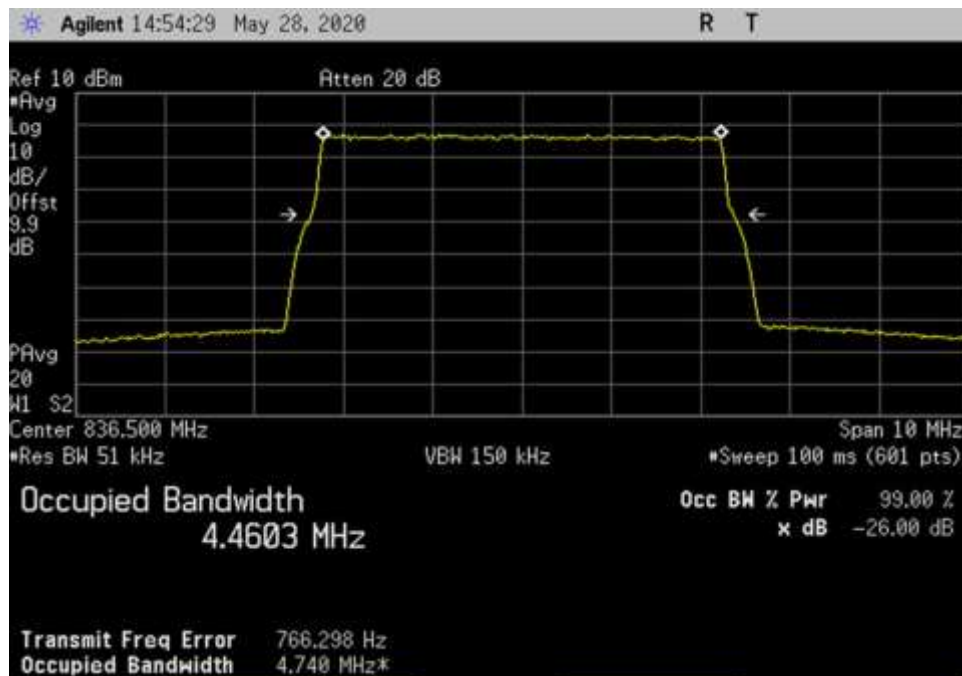


DL_2110-2155_GSM_2132.5MHz

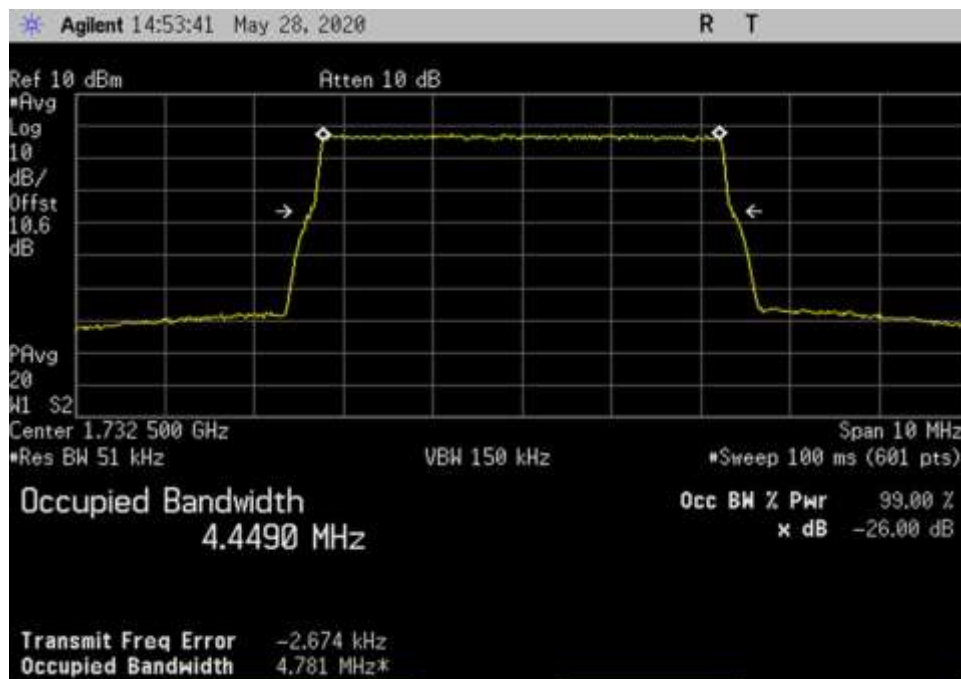
LTE Input



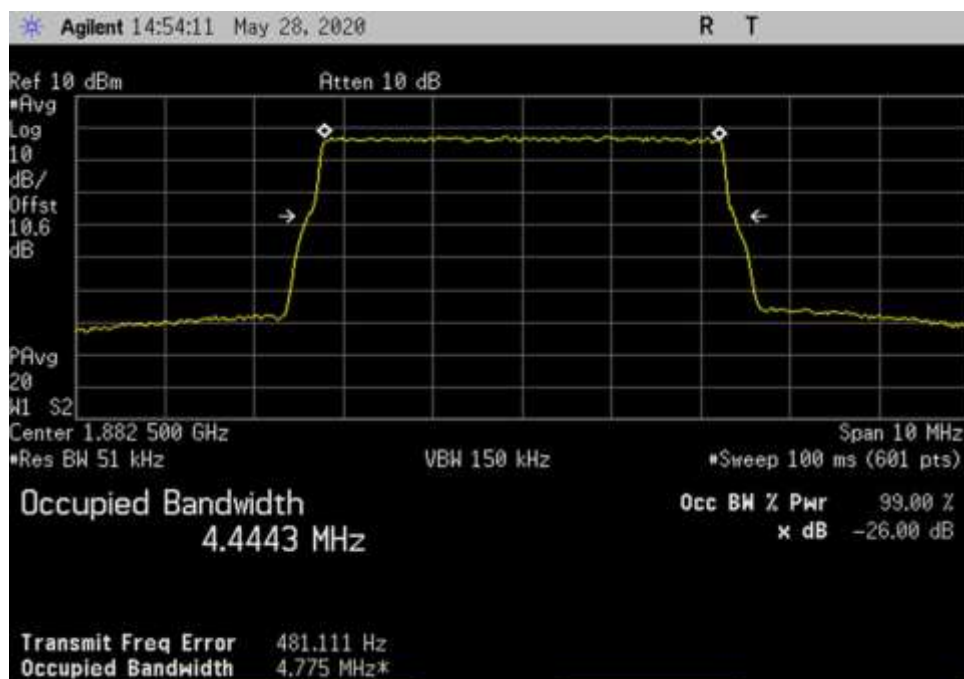
UL_776-787_LTE_ 781.5MHz



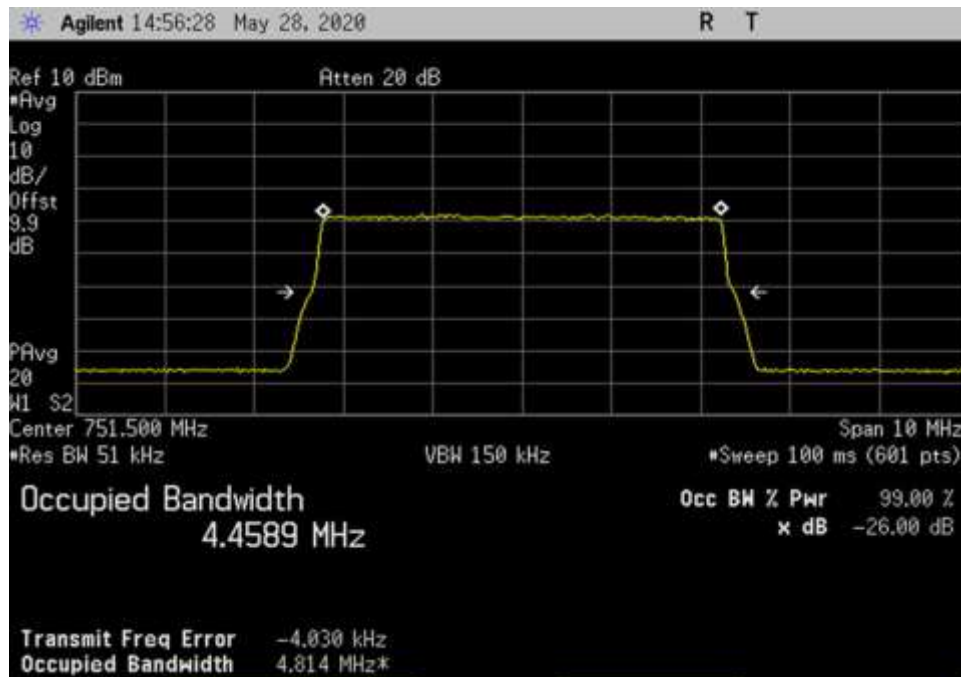
UL_824-849_LTE_ 836.5MHz



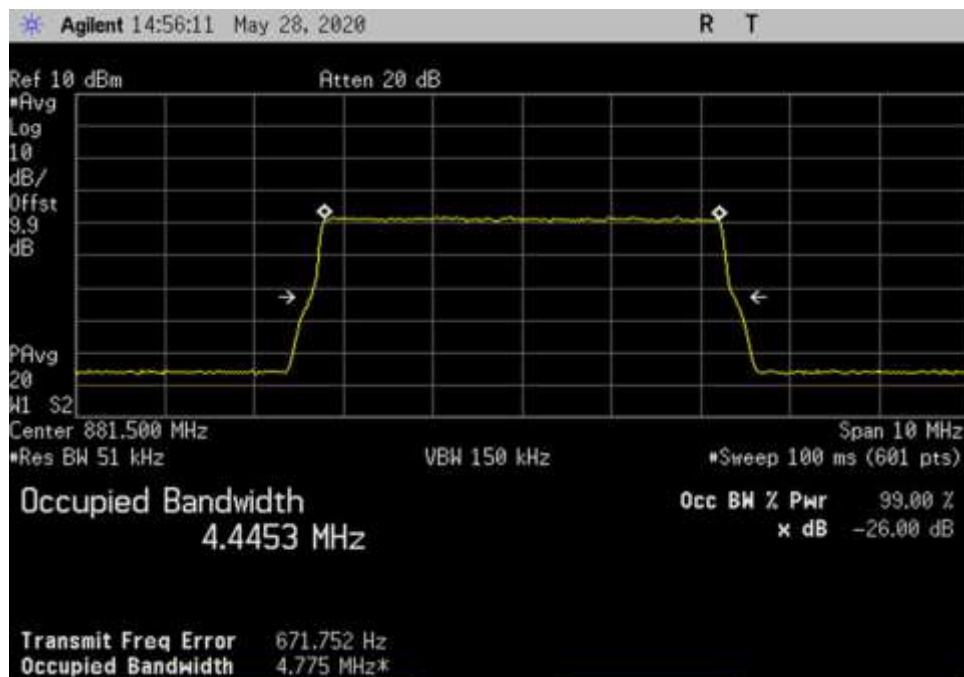
UL_1710-1755_LTE_1732.5MHz



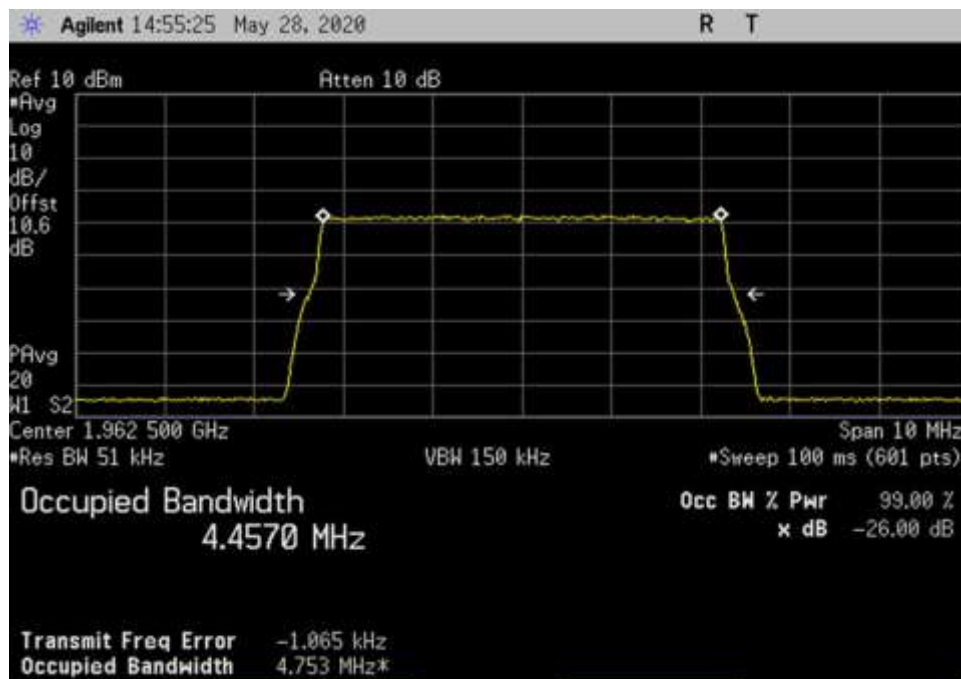
UL_1850-1915_LTE_1882.5MHz



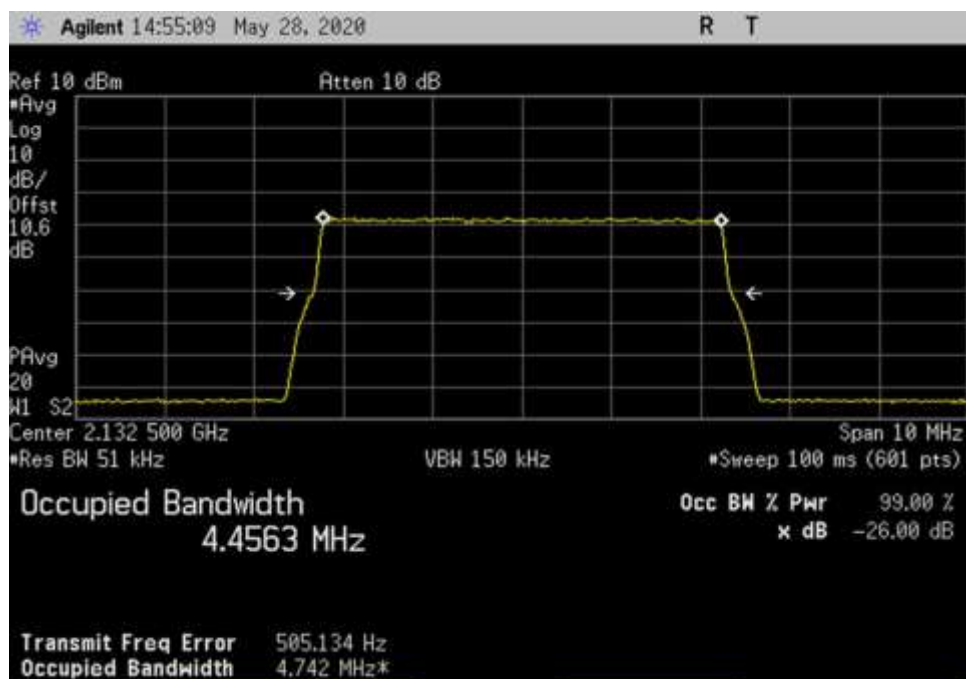
DL_746-757_LTE_ 751.5MHz



DL_869-894_LTE_ 881.5MHz

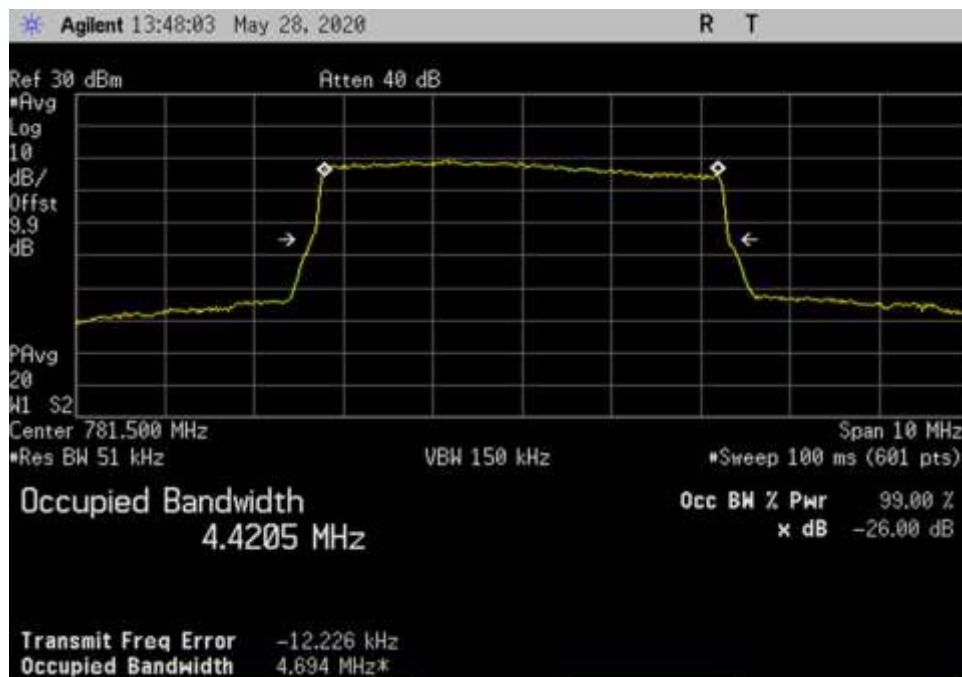


DL_1930-1995_LTE_ 1962.5MHz

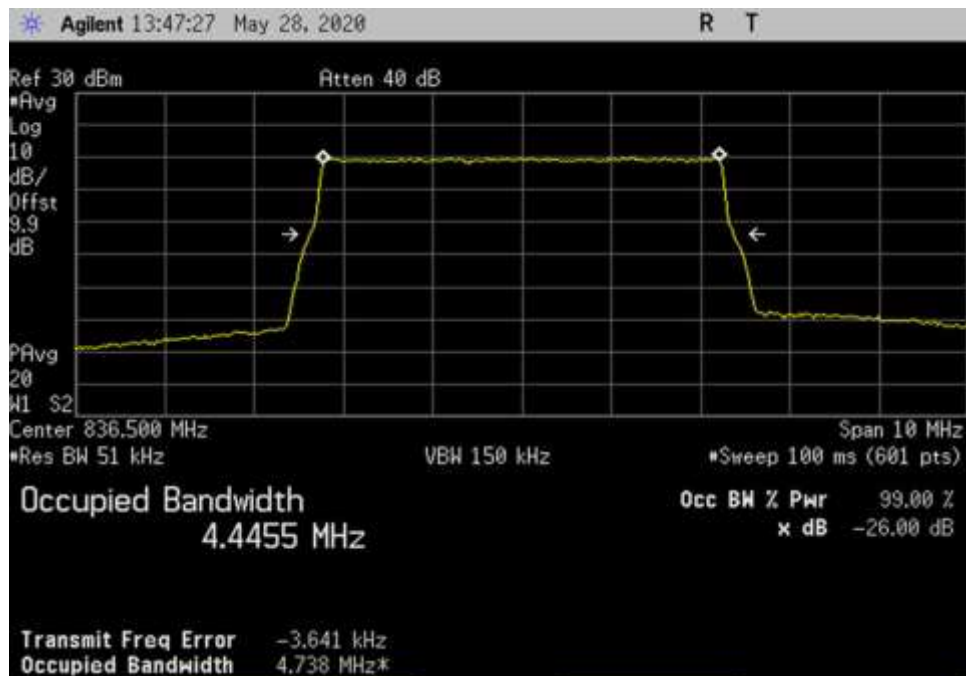


DL_2110-2155_LTE_ 2132.5MHz

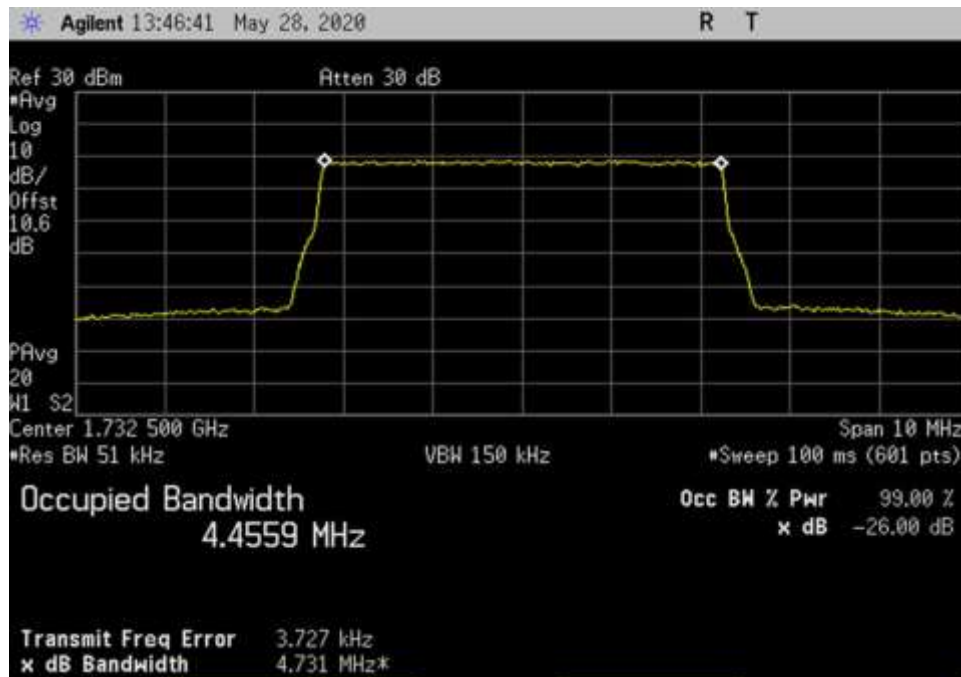
LTE Output



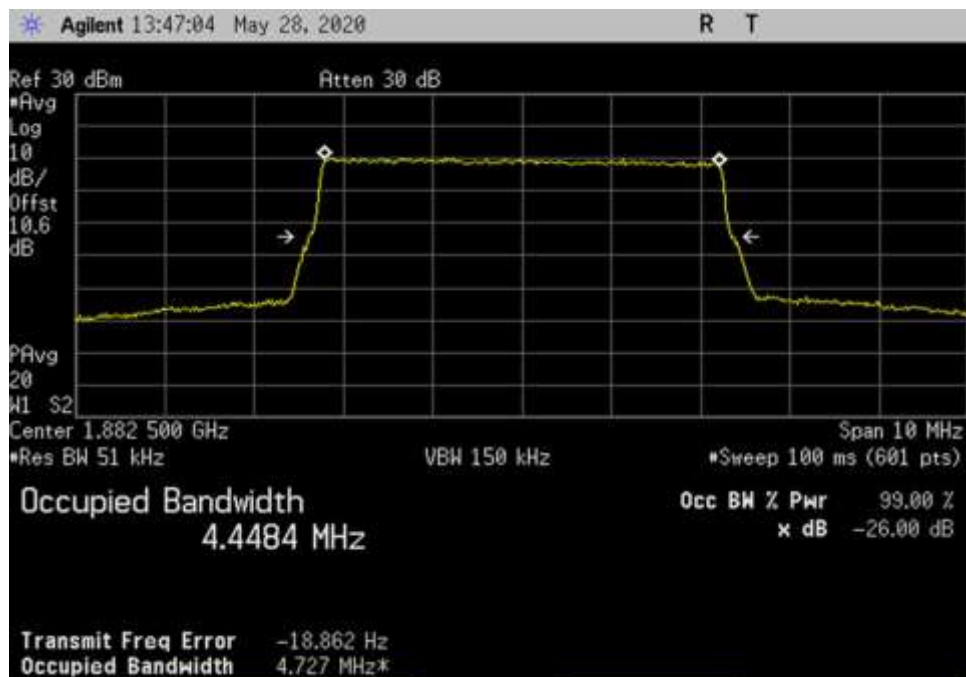
UL_776-787_LTE_ 781.5MHz



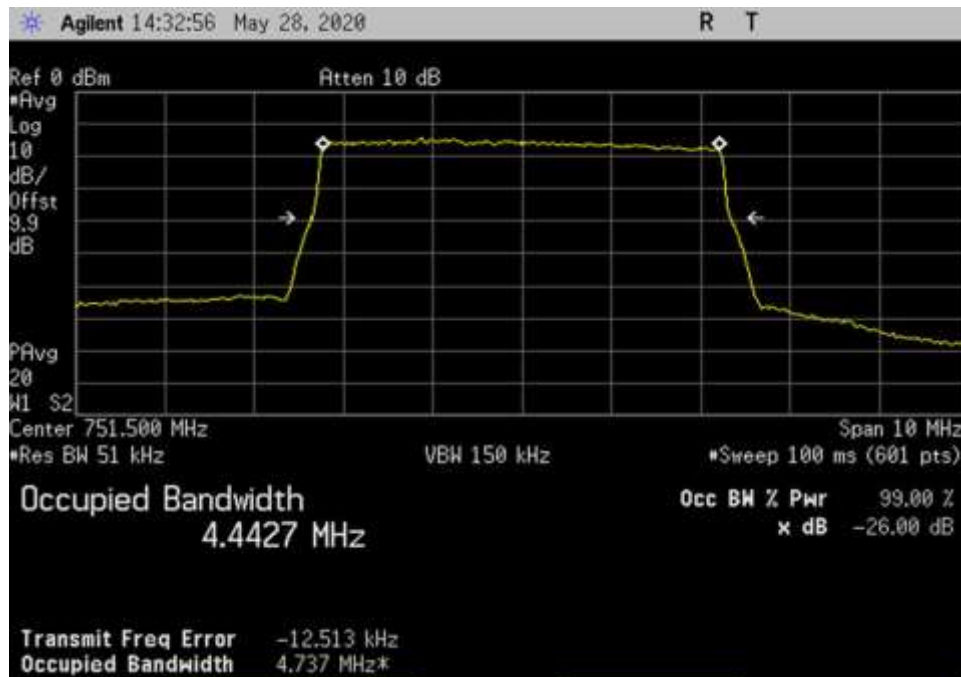
UL_824-849_LTE_ 836.5MHz



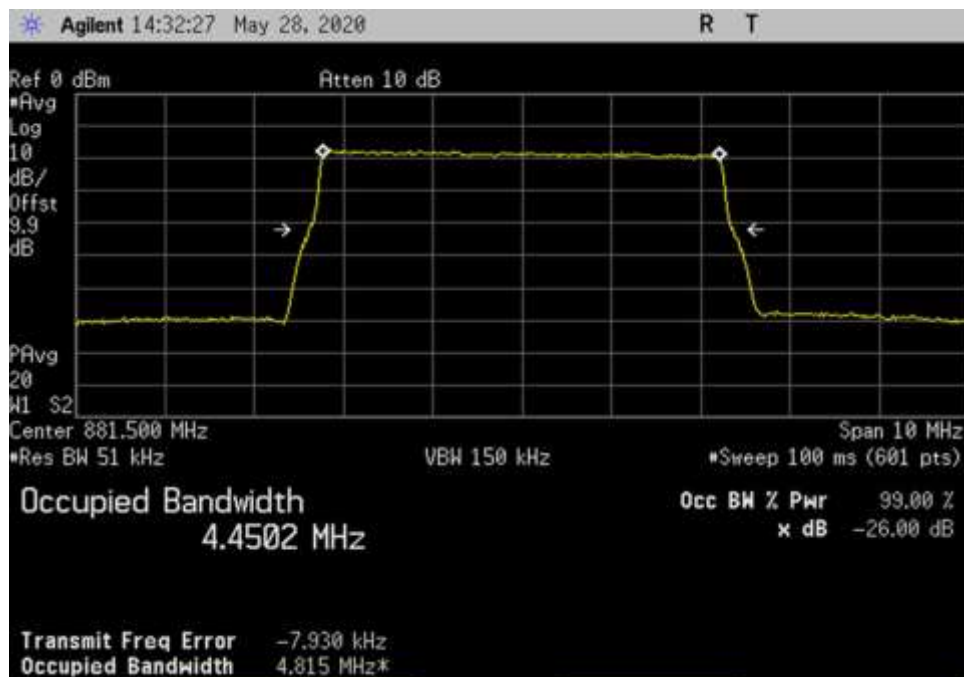
UL_1710-1755_LTE_ 1732.5MHz



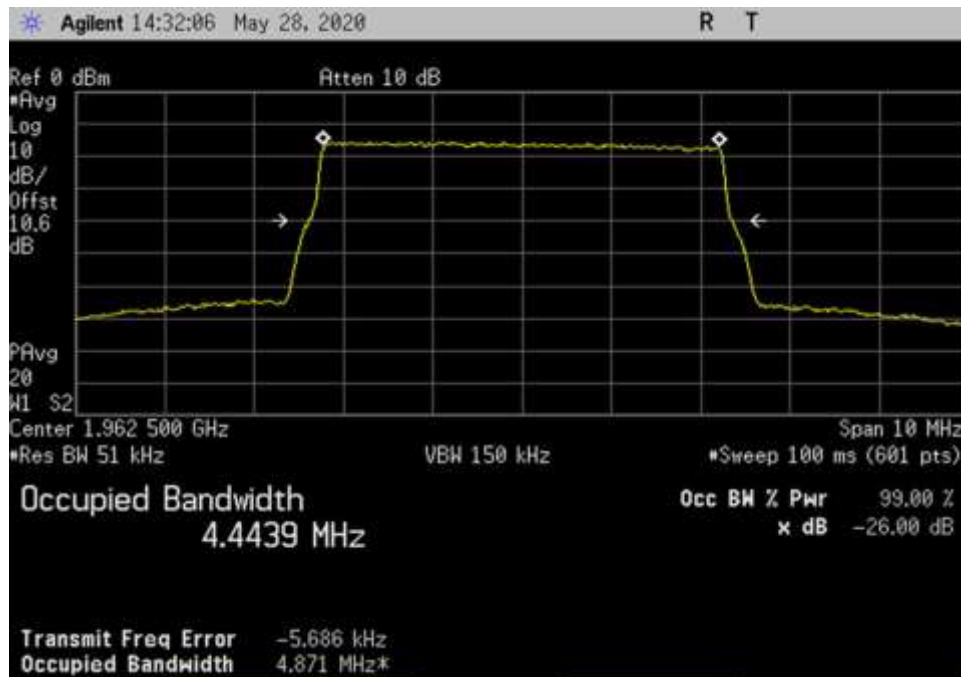
UL_1850-1915_LTE_ 1882.5MHz



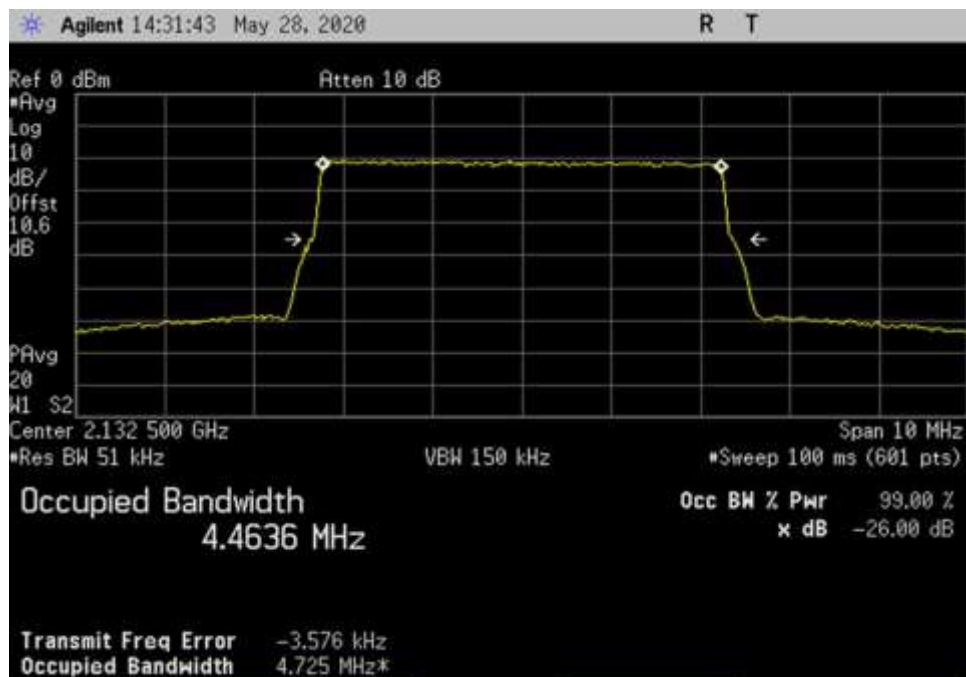
DL_746-757_LTE_751.5MHz



DL_869-894_LTE_881.5MHz

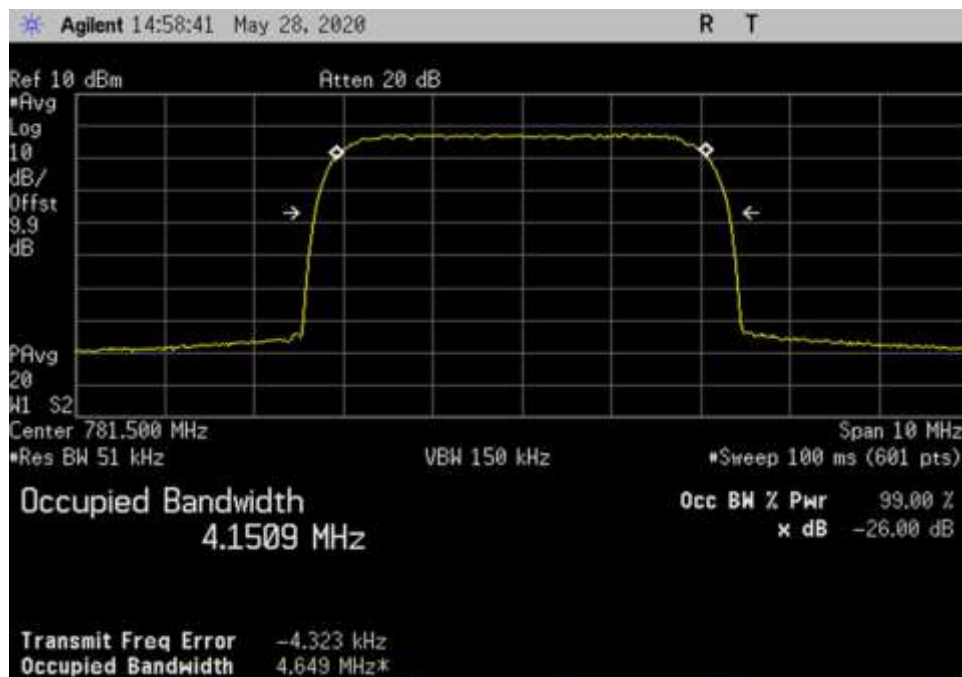


DL_1930-1995_LTE_ 1962.5MHz

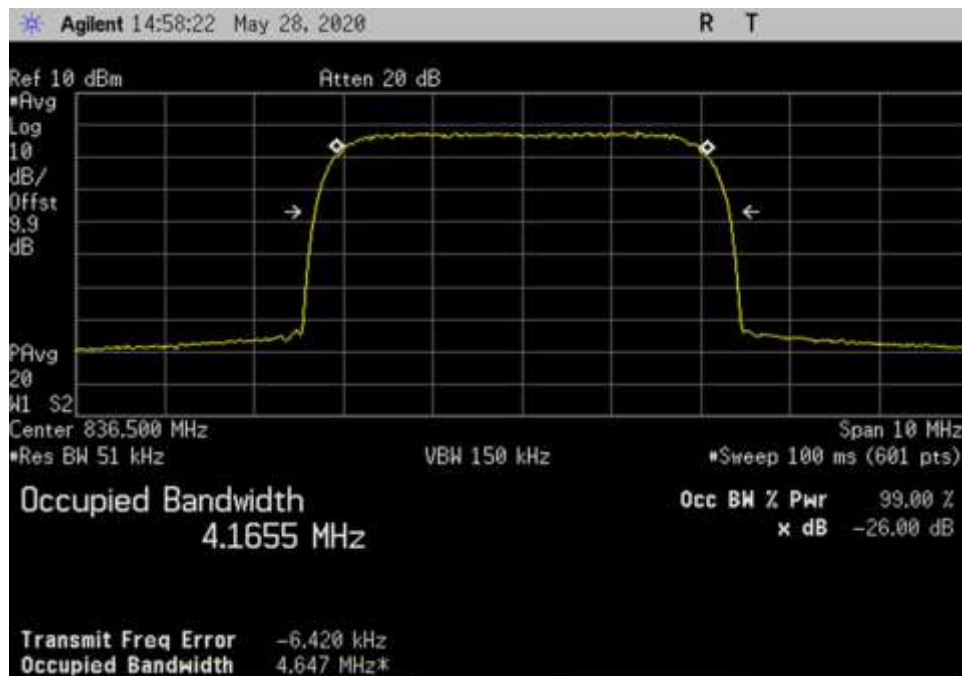


DL_2110-2155_LTE_ 2132.5MHz

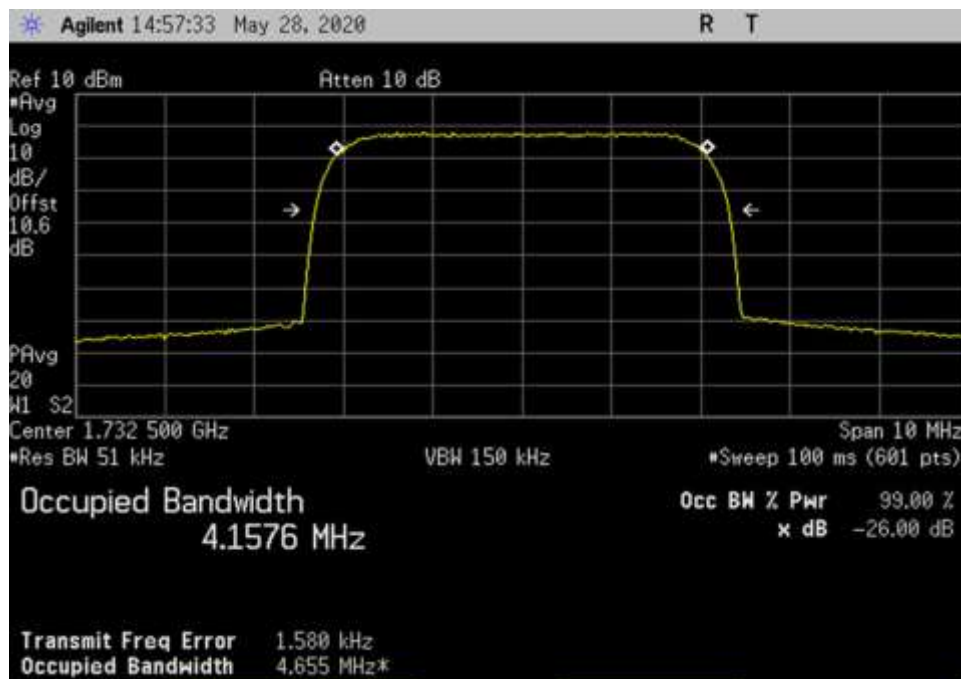
WCDMA Input



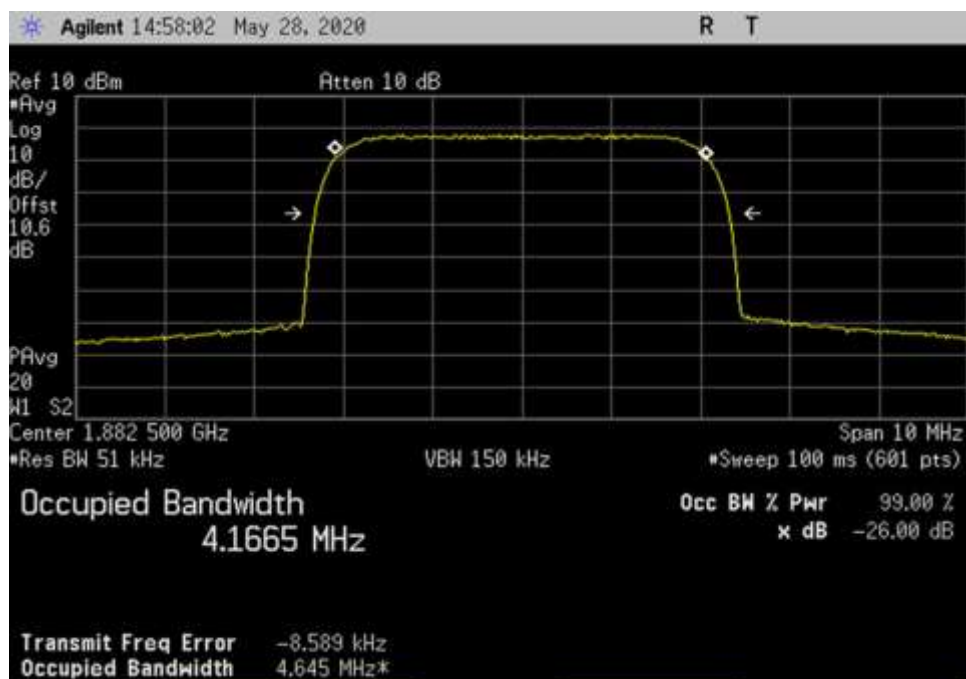
UL_776-787_WCDMA_781.5MHz



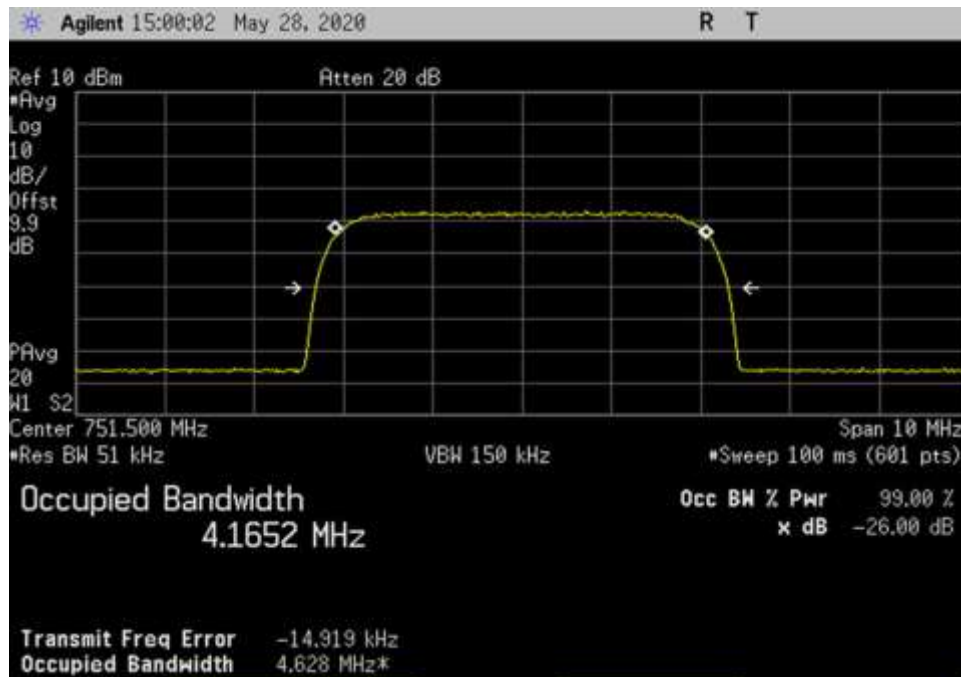
UL_824-849_WCDMA_836.5MHz



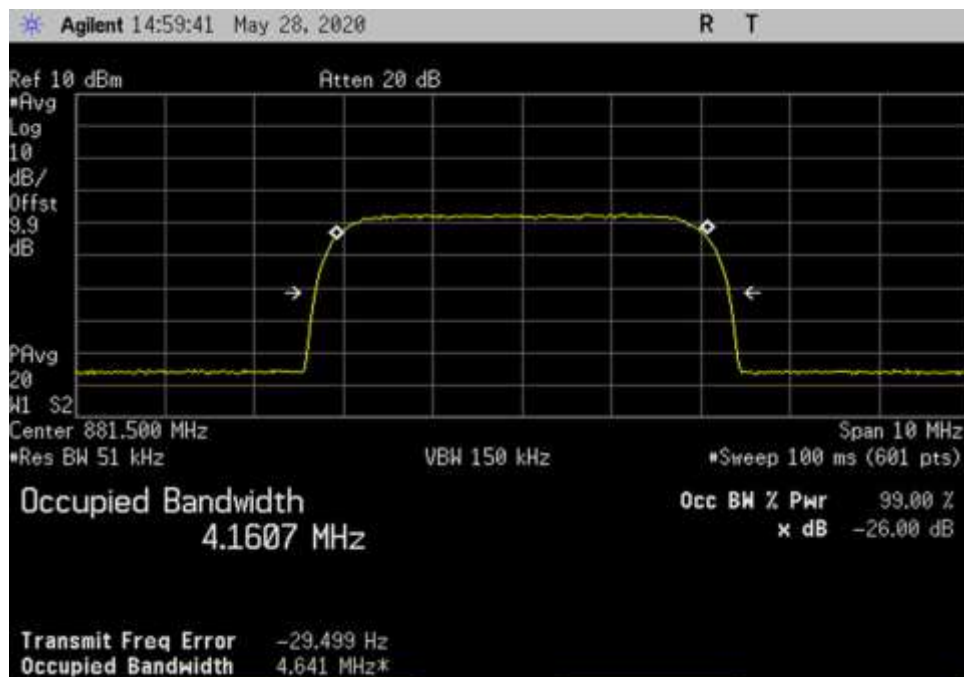
UL_1710-1755_WCDMA_ 1732.5MHz



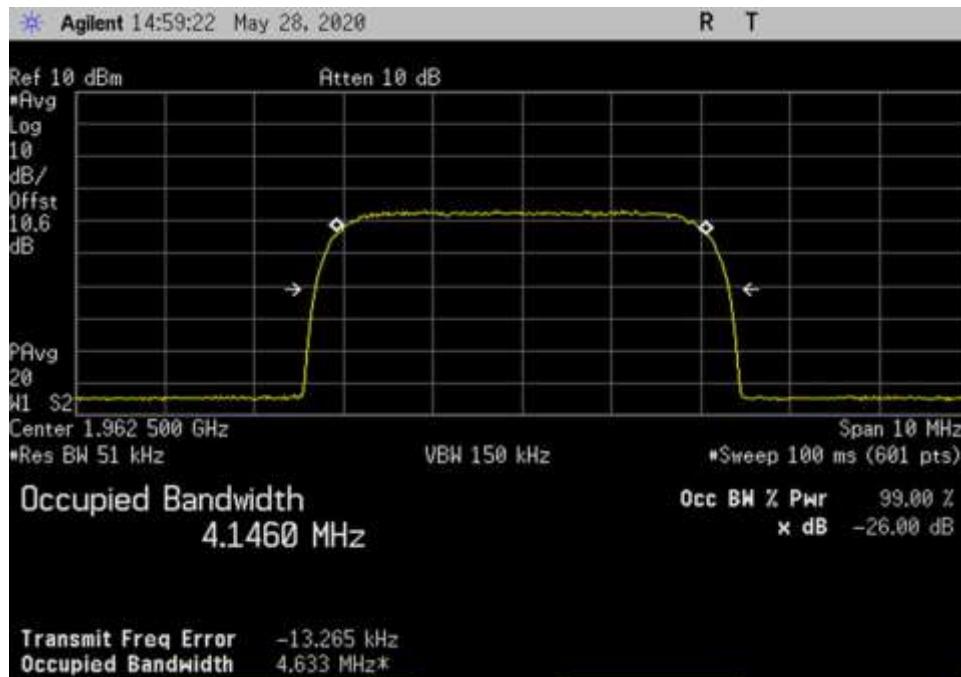
UL_1850-1915_WCDMA_ 1882.5MHz



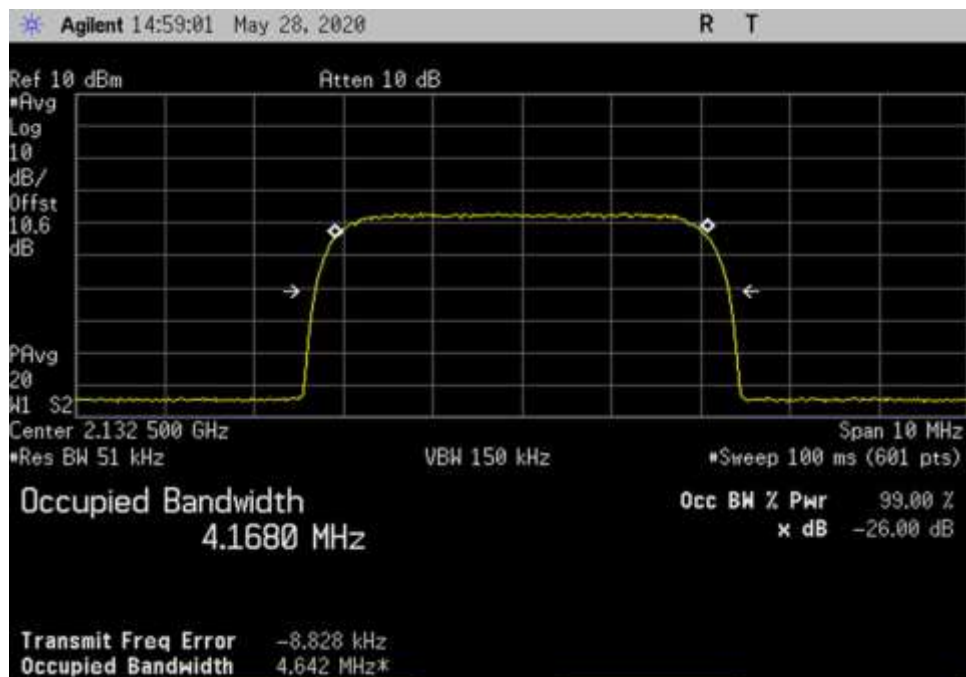
DL_746-757_WCDMA_751.5MHz



DL_869-894_WCDMA_881.5MHz

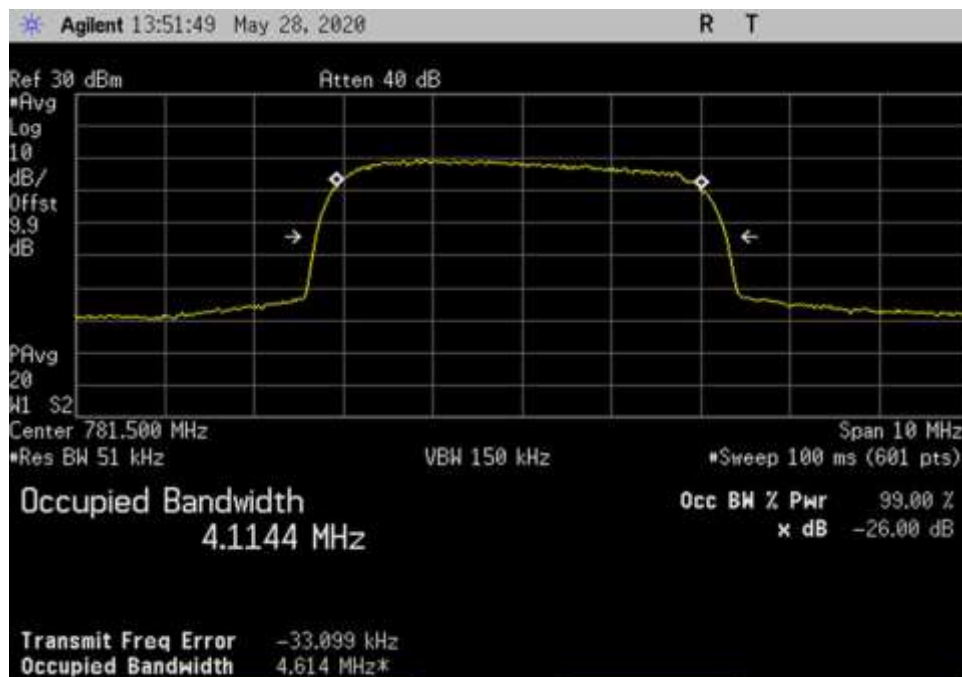


DL_1930-1995_WCDMA_ 1962.5MHz

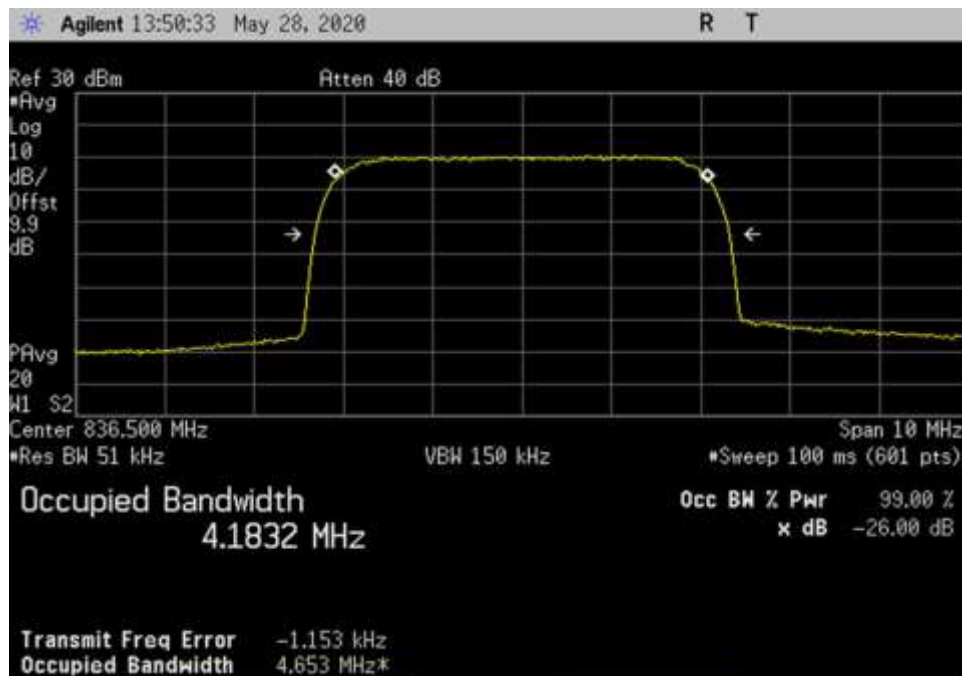


DL_2110-2155_WCDMA_ 2132.5MHz

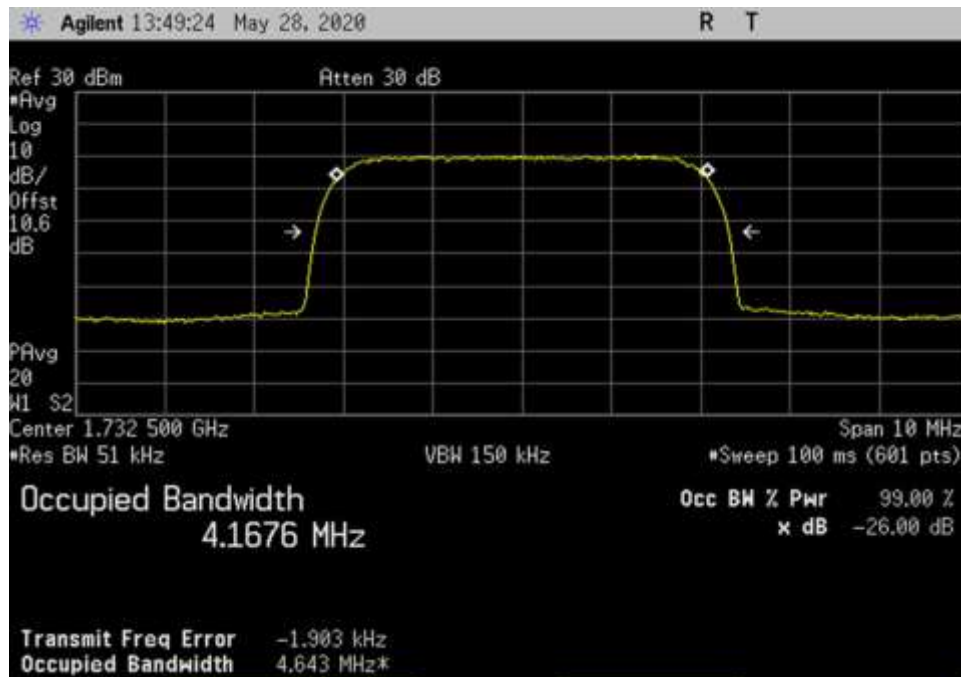
WCDMA Output



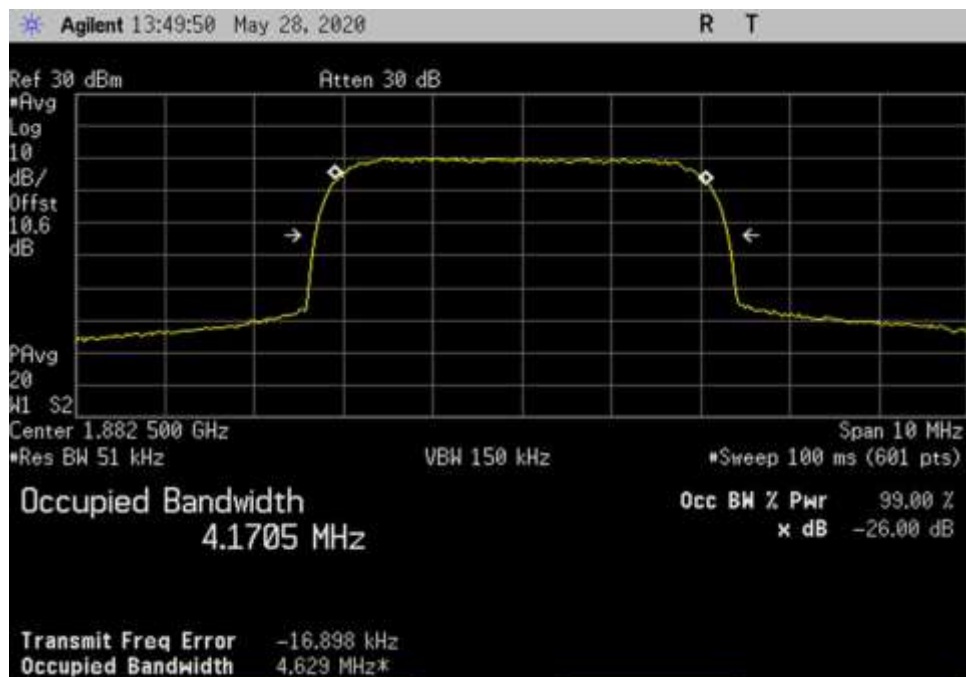
UL_776-787_WCDMA_781.5MHz



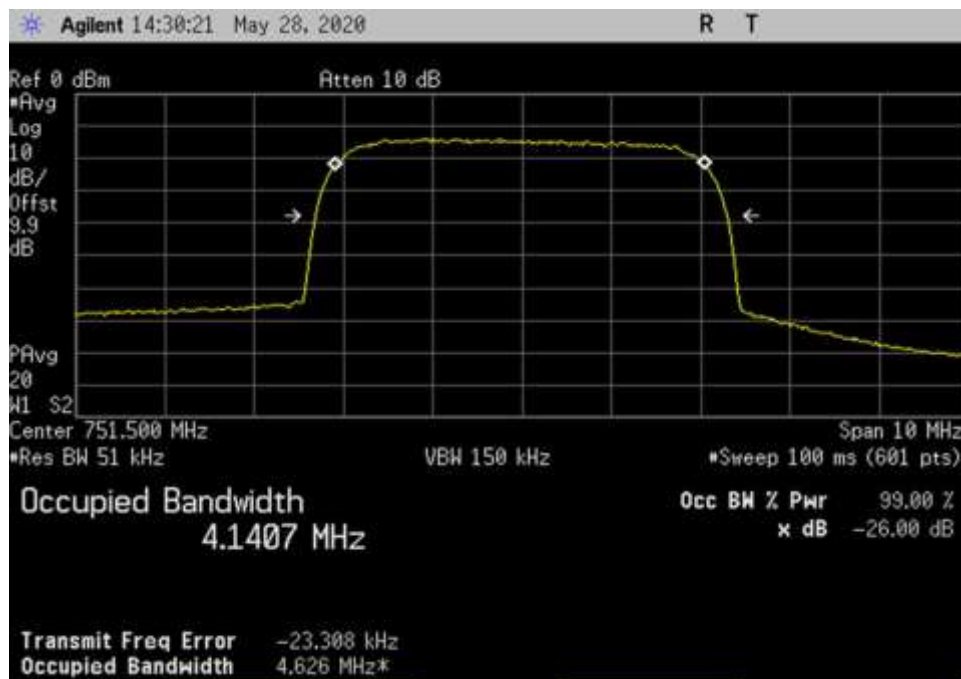
UL_824-849_WCDMA_836.5MHz



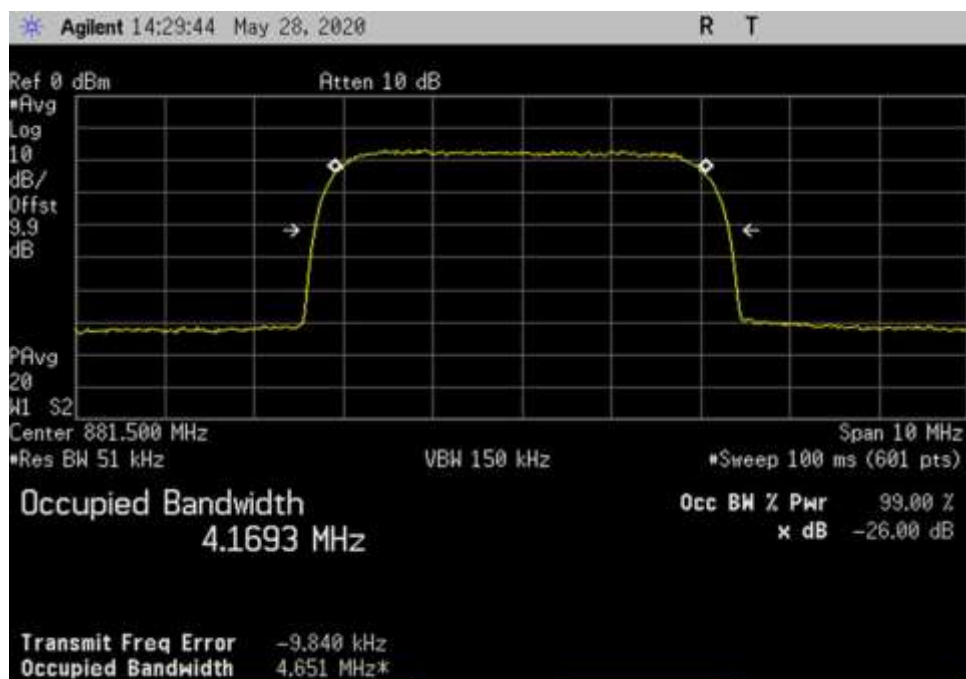
UL_1710-1755_WCDMA_ 1732.5MHz



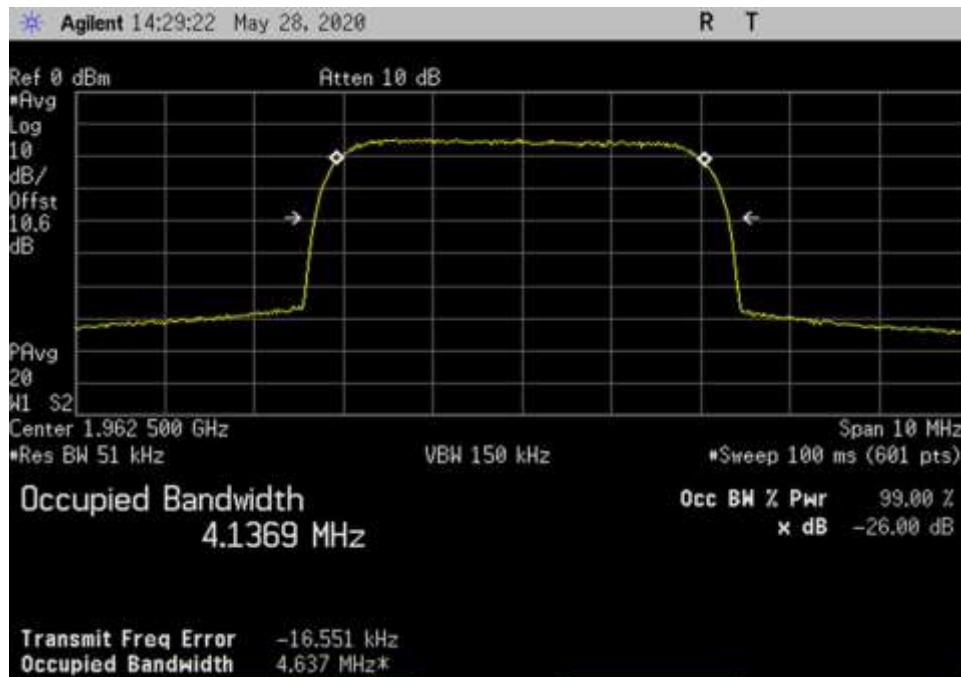
UL_1850-1915_WCDMA_ 1882.5MHz



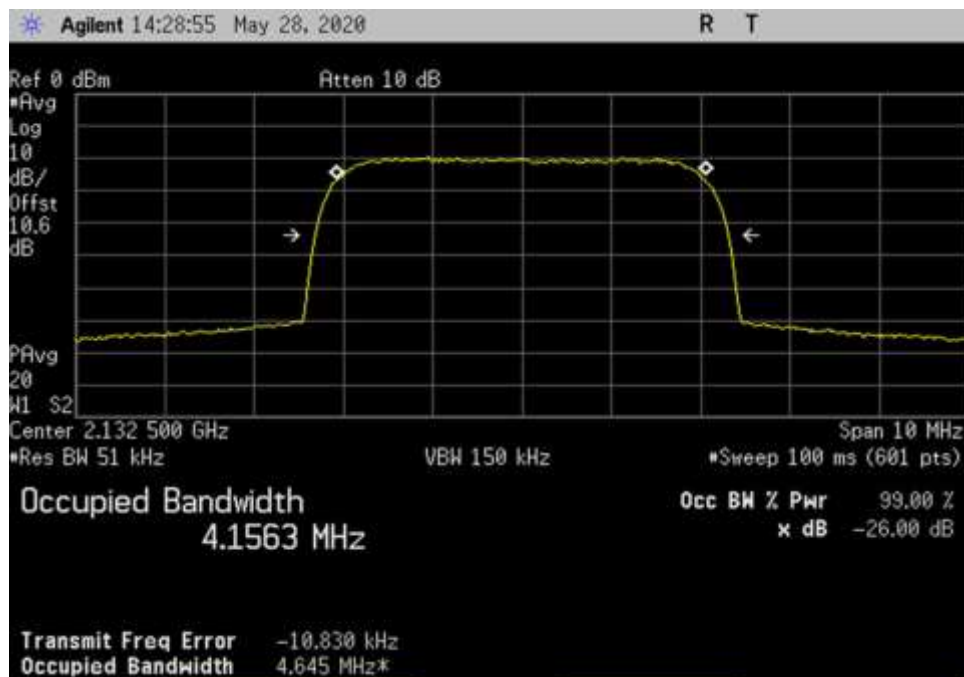
DL_746-757_WCDMA_751.5MHz



DL_869-894_WCDMA_881.5MHz



DL_1930-1995_WCDMA_ 1962.5MHz



DL_2110-2155_WCDMA_ 2132.5MHz

7.11 Oscillation Detection

Test Setup/Conditions	
Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	5/29/2020
Configuration:	1
Test Setup:	See General Test Setup 7.11.3 Test procedure for measuring oscillation mitigation or shutdown is Not Applicable since the gain of the EUT is less than 15dB.

Environmental Conditions					
Temperature (°C)	20.5	Relative Humidity (%):	43	Pressure: kPa	101.9

Test Equipment				
Asset #	Description	Model	Calibration Date	Cal Due Date
02660	Spectrum Analyzer	E4446A	10/19/2018	10/19/2020
P06897	Cable	32022-29094K-29094K-48TC	3/25/2020	3/25/2022
P07192	Cable	32022-29094K-29094K-48TC	11/27/2019	11/27/2021
C00082	Directional Coupler	722-10-1.500V	11/27/2019	11/27/2021
03412	Band Pass Filter	PE8705	7/15/2019	7/15/2021
03413	Band Pass Filter	PE8706	7/15/2019	7/15/2021
03414	Band Pass Filter	PE8707	7/15/2019	7/15/2021
03415	Band Pass Filter	PE8708	7/15/2019	7/15/2021
03447	Band Pass Filter	PE8710	7/15/2019	7/15/2021
03467	High Pass Filter	4FV50-731/H30-O/O	7/15/2019	7/15/2021
03468	High Pass Filter	4CS10-781.5/E12.2-O/O	7/15/2019	7/15/2021
03469	High Pass Filter	4CS10-751.5/E12-O/O	7/15/2019	7/15/2021
02475	Attenuator	8494B	4/12/2019	4/12/2021
03429	Attenuator	8496B	4/12/2019	4/12/2021

Summary of Results

Pass: All oscillations detections and mitigations occur within 0.3 seconds in uplink bands, within 1 second in the downlink bands and the noise level is below the -70dBm/MHz limit.

7.11.2 Oscillation restart tests

Oscillation detection				Time Between restart		Number of restart	
Frequency MHz	Measured Sec	Limit Sec	Peak Level dBm	Measured Sec	Limit At least sec	Measured	Limit
UL 1710-1755	0.108	0.3	31.9	75	60	2	5
UL 1850-1915	0.100	0.3	14.8	72	60	3	5
UL 824-894	0.175	0.3	29.6	73	60	2	5
UL 776-787	0.125	0.3	30.0	70	60	2	5
DL 2110-2155	0.208	1.0	5.6	75	60	2	5
DL 1930-1995	0.175	1.0	13.2	71	60	2	5
DL 869-894	0.250	1.0	10.7	73	60	2	5
DL 746-757	0.075	1.0	13.6	70	60	2	5

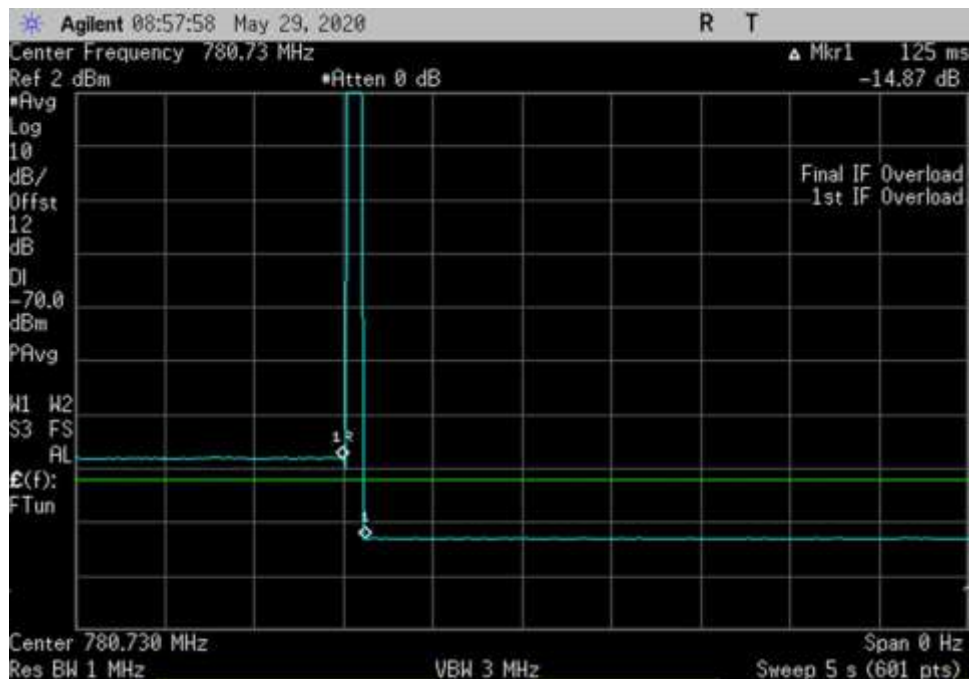
The booster continues to mitigate at least 1 minute before restarting. The plots demonstrate after 1 restart (the limit is 5 restart), the booster does not resume operation until manually reset.

7.11.3 Test procedure for measuring oscillation mitigation or shutdown

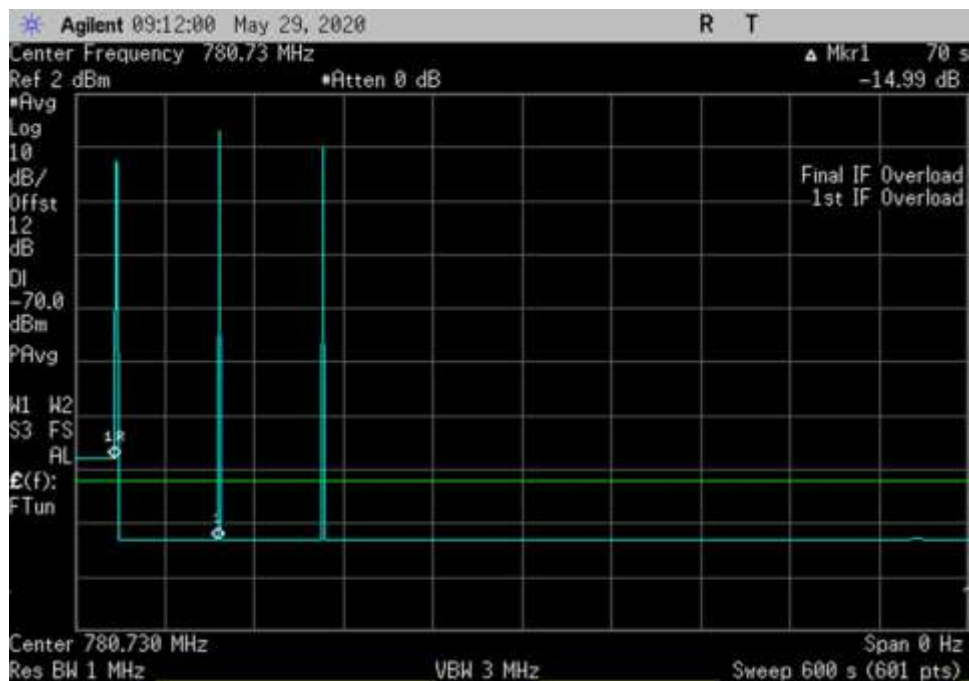
Not Applicable since the gain of the EUT is less than 15dB

7.11.2 Oscillation Restart Tests

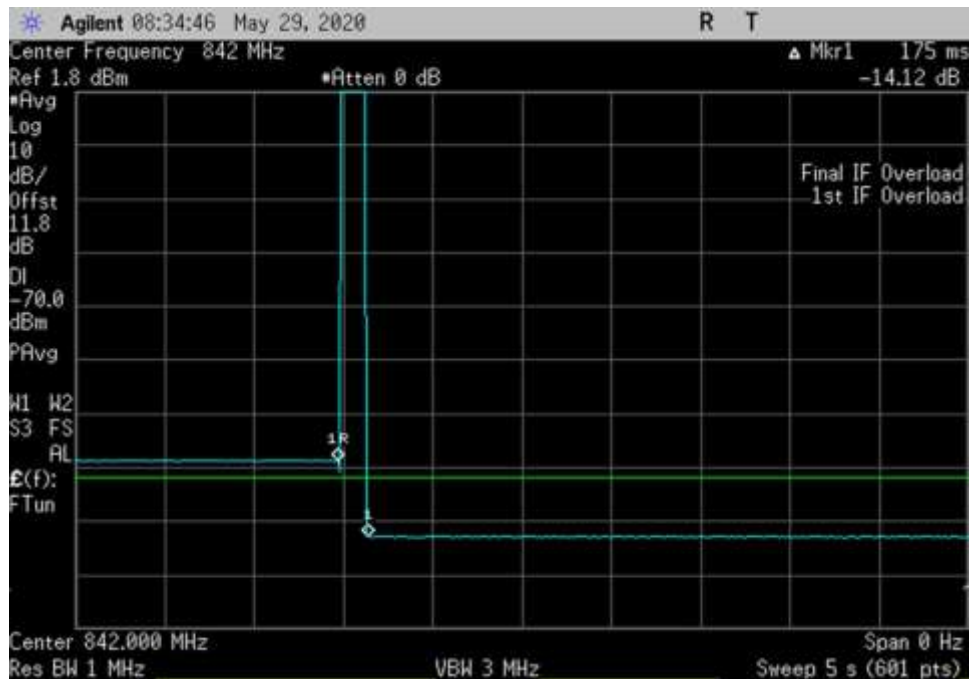
Plots



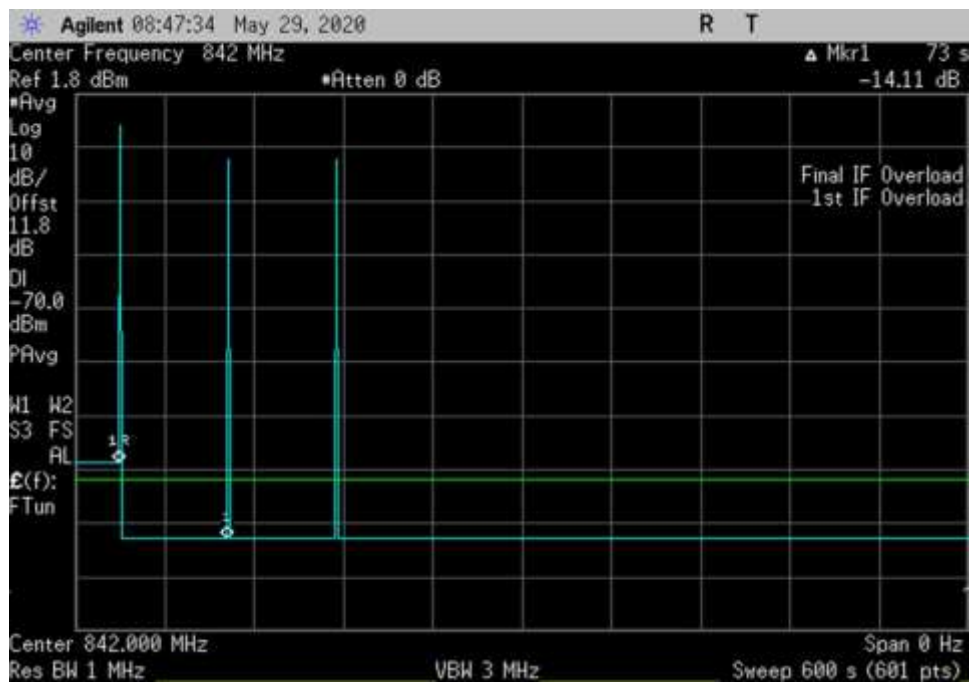
UL_776-787_ 780.73MHz



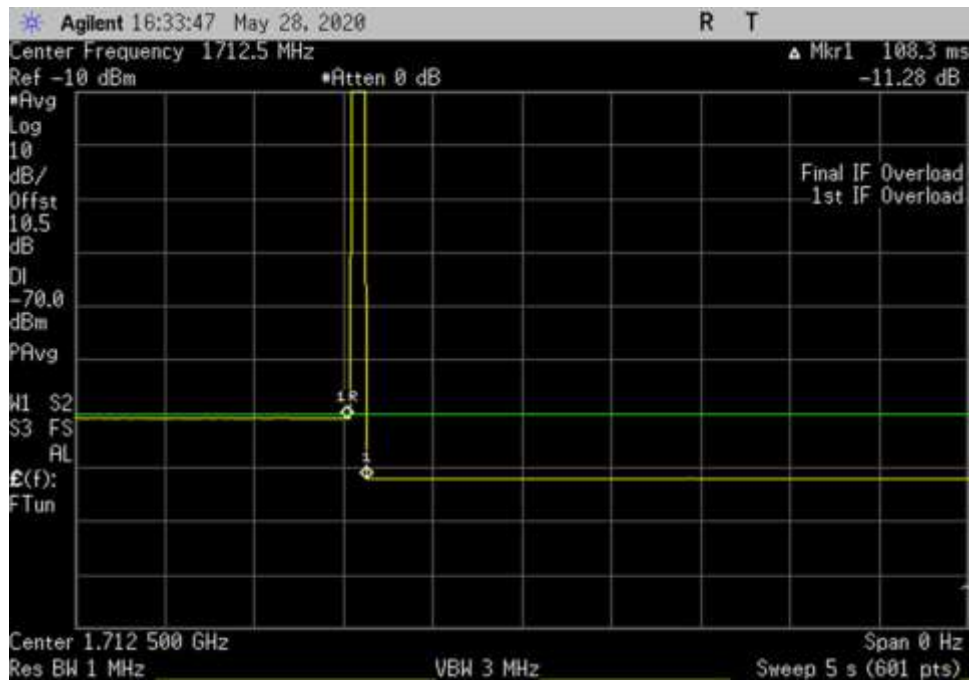
UL_776-787_600sec_ 780.73MHz



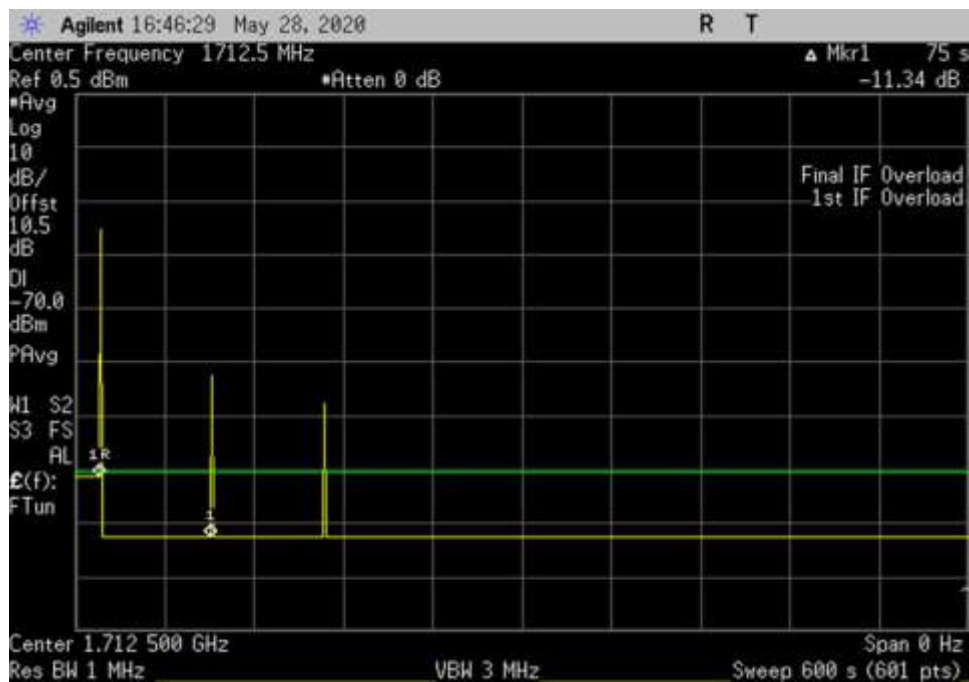
UL_824-849_842MHz



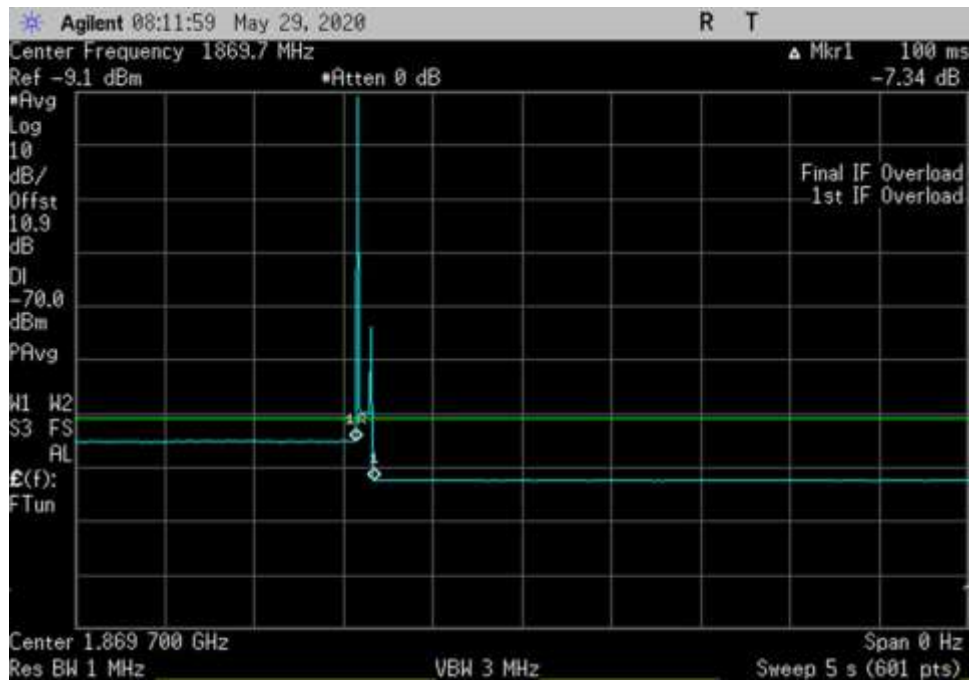
UL_824-849_600sec_842MHz



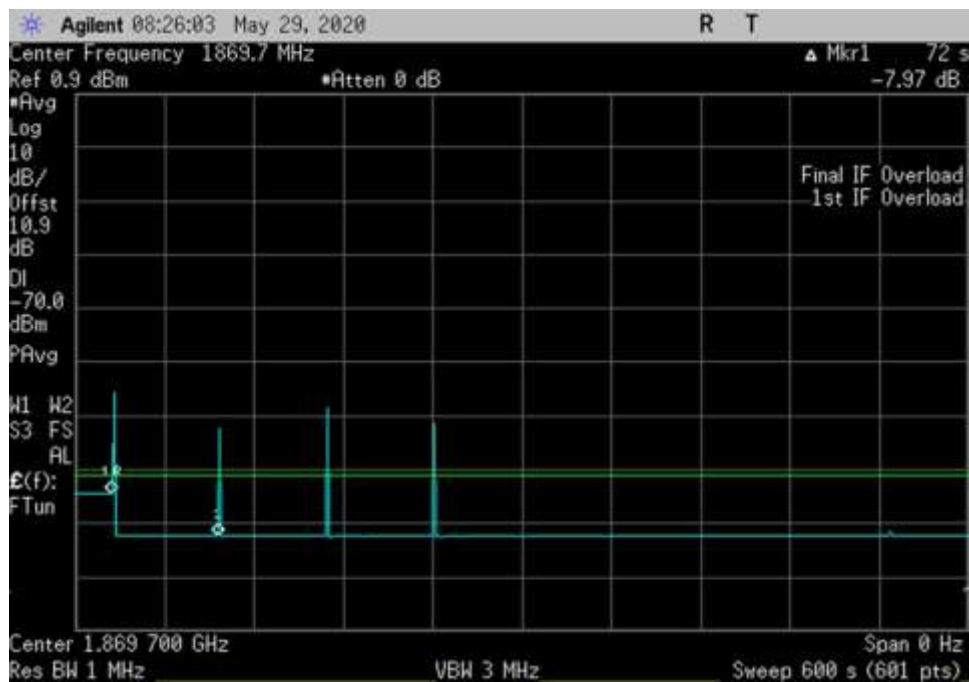
UL_1710-1755_ 1712.5MHz



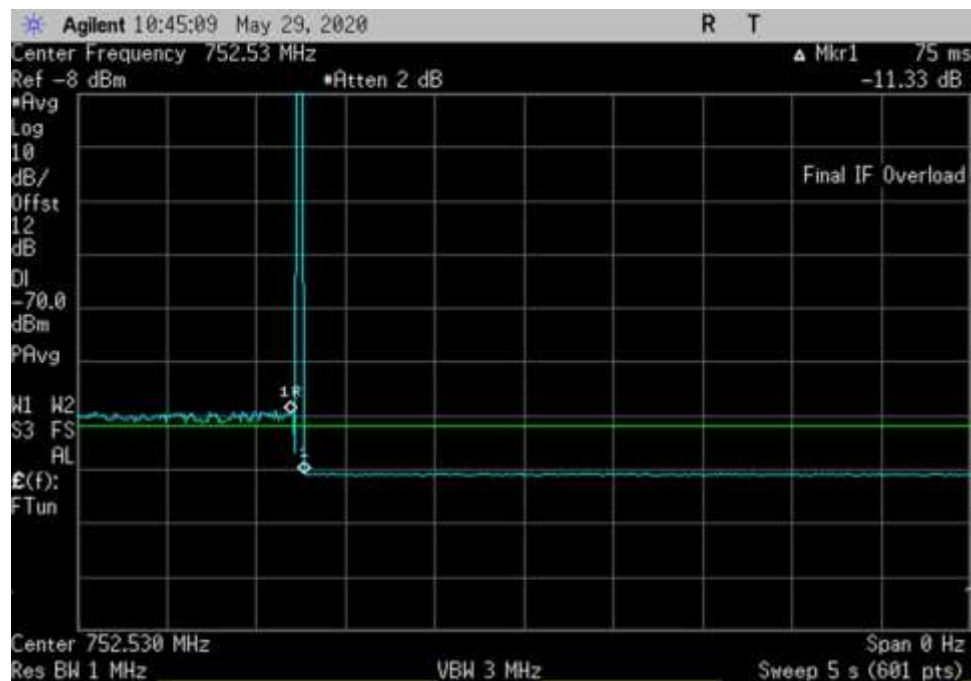
UL_1710-1755_600sec_ 1712.5MHz



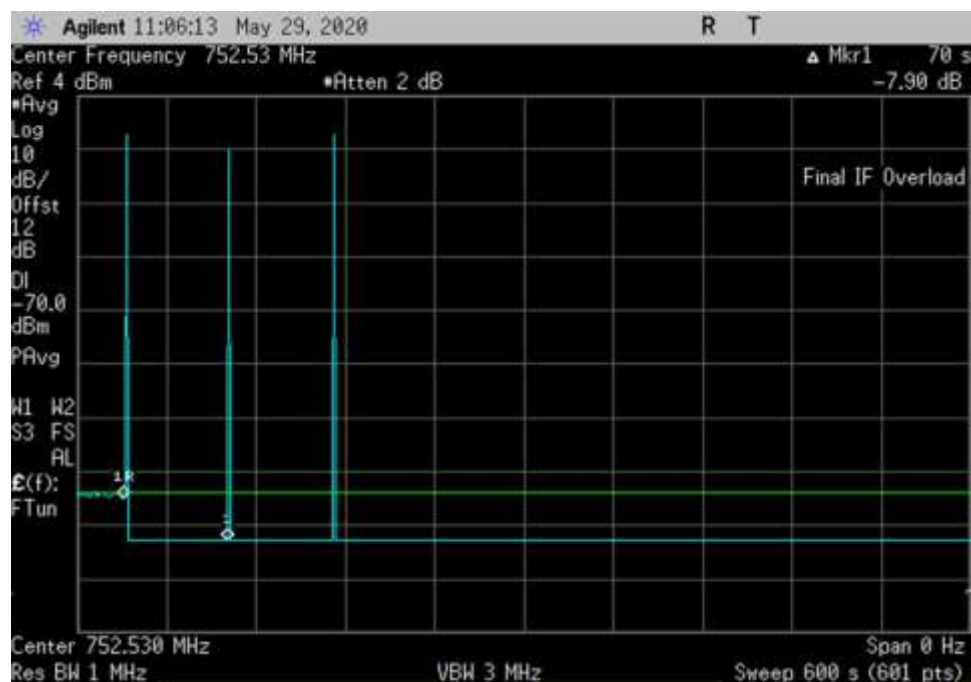
UL_1850-1915_ 1869.7MHz



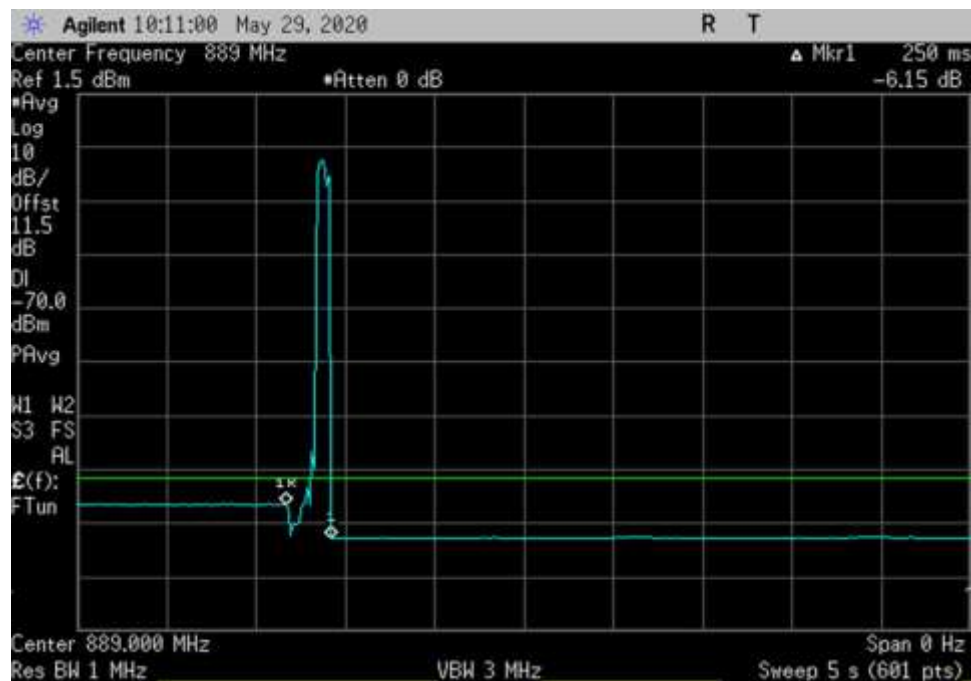
UL_1850-1915_600sec_ 1869.7MHz



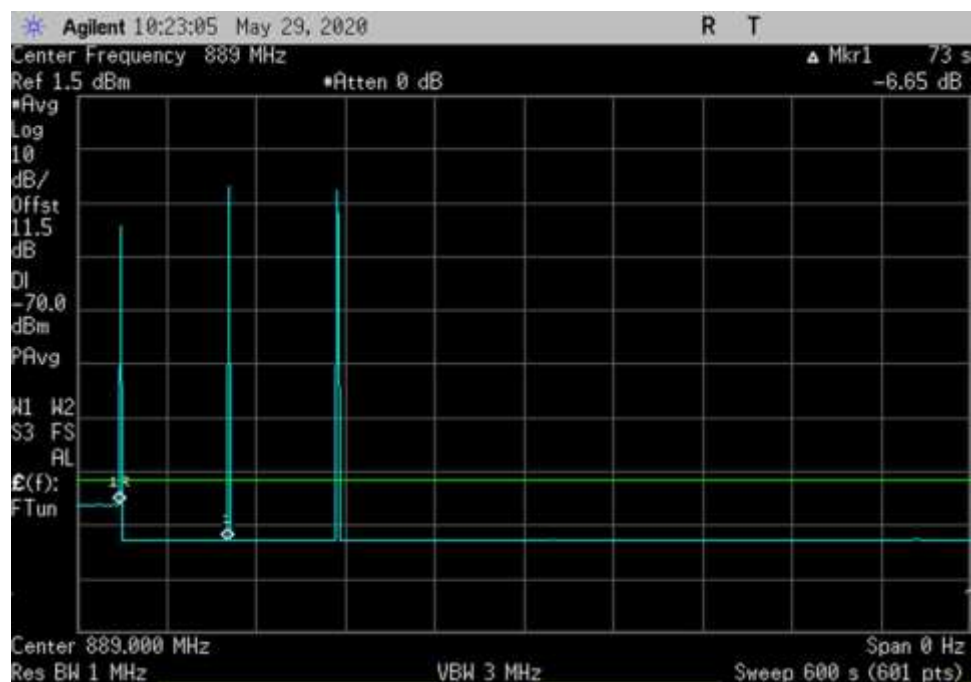
DL_746-757_ 752.53MHz



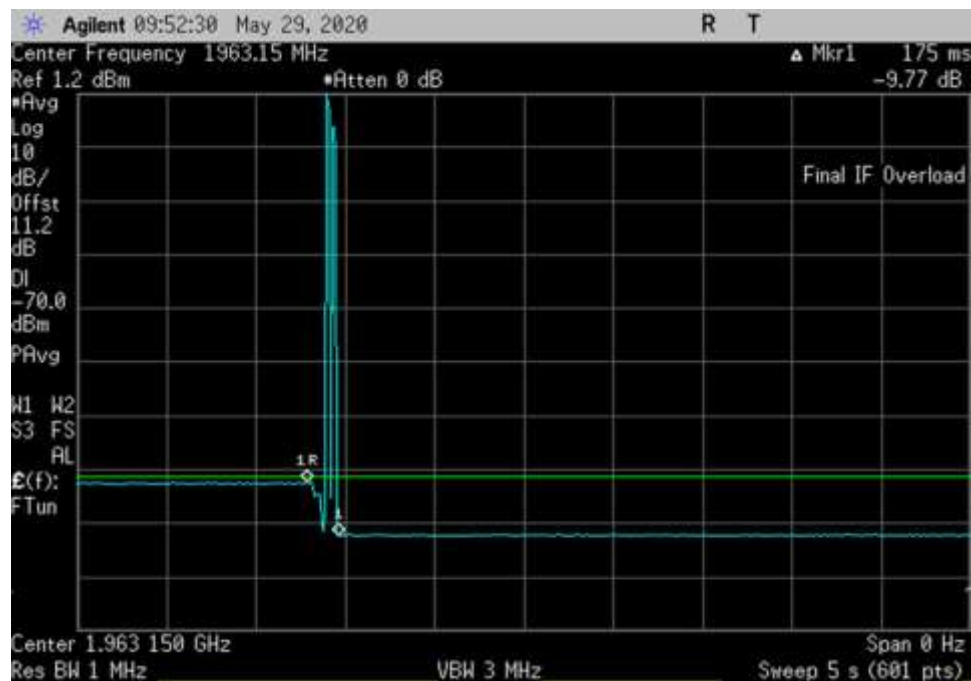
DL_746-757_600sec_ 752.53MHz



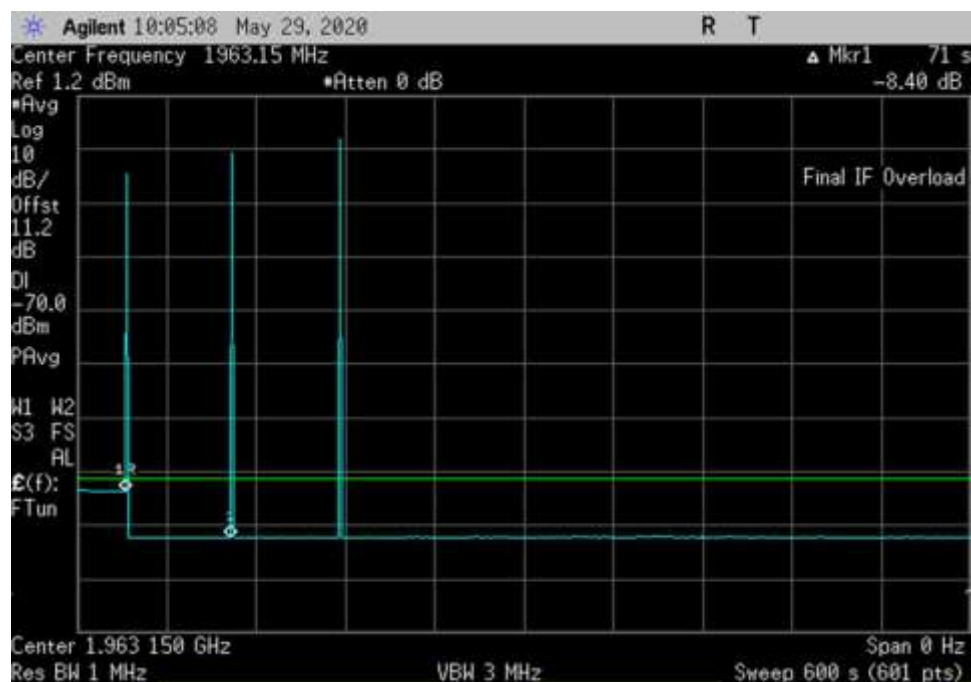
DL_869-894_889MHz



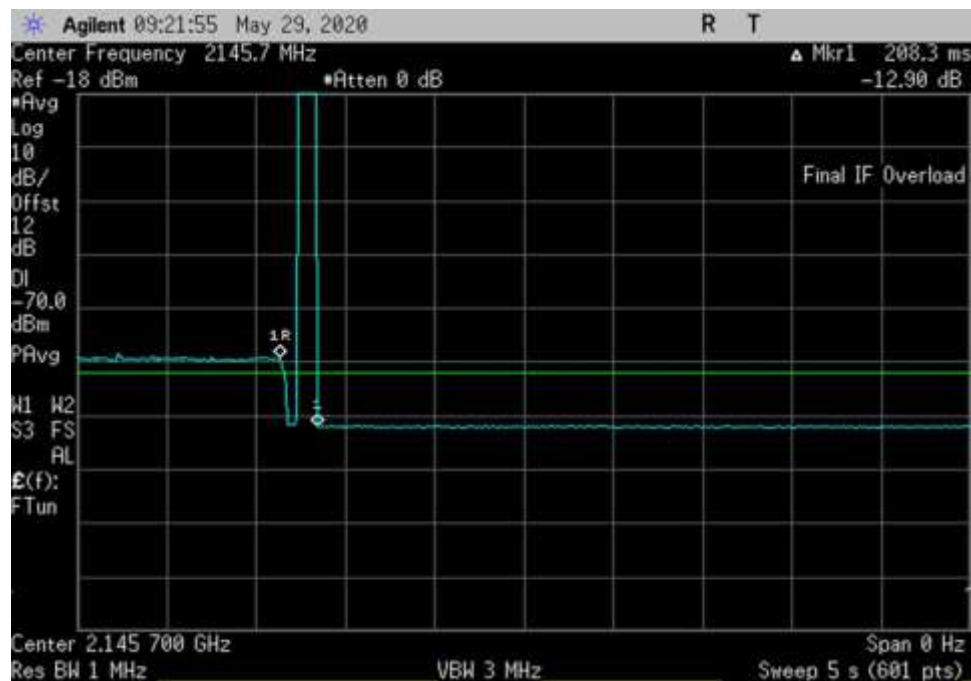
DL_869-894_600sec_889MHz



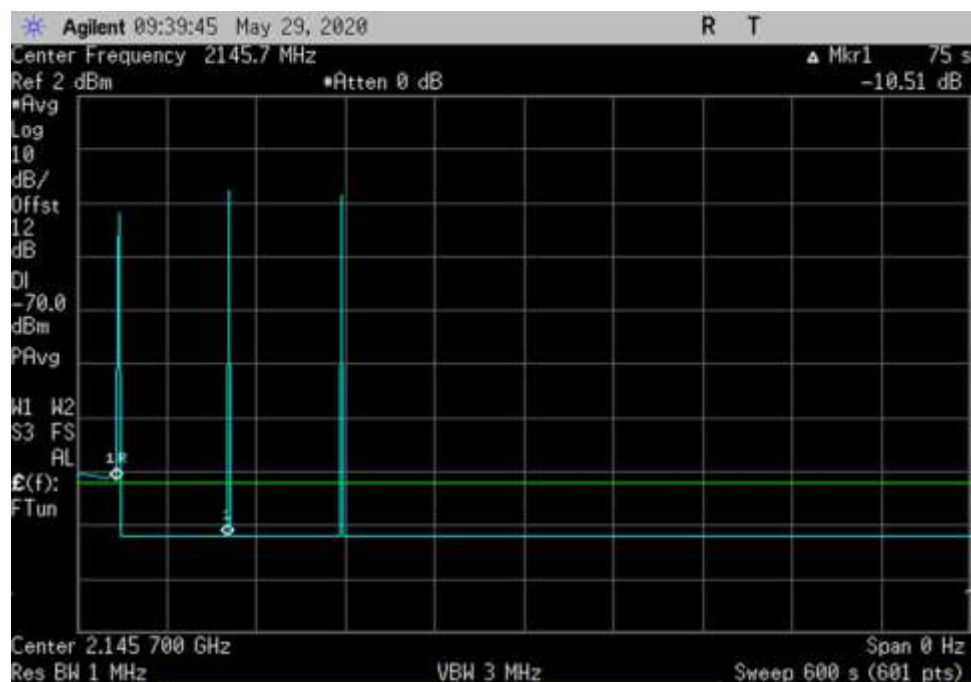
DL_1930-1995_1963.15MHz



DL_1930-1995_600sec_1963.15MHz



DL_2110-2155_ 2145.7MHz



DL_2110-2155_600sec_ 2145.7MHz

7.12 Radiated Spurious Emissions

Test Setup/Conditions	
Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	6/8/2020
Configuration:	1
Test Setup:	Frequency range of measurement = 9 kHz- 22 GHz. 9 kHz - 150 kHz -> RBW=200 Hz VBW=200 Hz 150 kHz - 30 MHz -> RBW=9 kHz VBW=9 kHz 30 MHz - 1000MHz -> RBW=120 kHz VBW=120 kHz 1000 MHz-22000MHz -> RBW=1 MHz VBW=1 MHz Note: No spurious emissions were found within 20dB of the limit line. Emissions in the band 1559-1610 MHz were investigated and these were not found within 20dB of the limit line. 27.53(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth.

Environmental Conditions					
Temperature (°C)	21.8	Relative Humidity (%)	38	Pressure: kPa	102.1

Test Equipment				
Asset #	Description	Model	Calibration Date	Cal Due Date
03471	Spectrum Analyzer	E4440A	2/11/2020	2/11/2022
00852	Biconilog Antenna	CBL 6111C	4/14/2020	4/14/2022
P06049	Attenuator	PE7002-6	5/11/2020	5/11/2022
P06691	Cable	PE3062-180	3/25/2020	3/25/2022
P00880	Cable	RG214U	3/25/2020	3/25/2022
P07508	Preamp	310N	10/15/2018	10/15/2020
P01187	Cable	CNT-195	8/20/2018	8/20/2020
02157	Horn Antenna	3115	1/15/2019	1/15/2021
P06897	Cable	32022-29094K-29094K-48TC	3/25/2020	3/25/2022
P01210	Cable	FSJ1P-50A-4A	12/18/2018	12/18/2020
03713	Preamp	01001800-221055-202525	5/22/2019	5/22/2021
03302	Cable	32026-29094K-29094K-72TC	1/9/2020	1/9/2022
P06899	Cable	32022-29094K-29094K-72TC	1/7/2020	1/7/2022
P06126	Cable	32022-29094K-29094K-168TC	4/29/2020	4/29/2022
00432	Loop Antenna	6502	2/19/2019	2/19/2021
P00928	Cable	various	1/9/2020	1/9/2022
P00929	Cable	various	1/9/2020	1/9/2022
02693	Active Horn Antenna	AMFW-5F-12001800-20-10P	8/15/2019	8/15/2021
02694	Horn Antenna	AMFW-5F-18002650-20-10P	8/15/2019	8/15/2021

Summary of Results

Pass: All Radiated Spurious Emissions were found with more than 20dB margin of the limit line.

Frequency Range of measurement 9kHz – 22GHz

LIMIT LINE FOR SPURIOUS RADIATED EMISSION

$$\text{REQUIRED ATTENUATION} = 43+10 \text{ LOG } P \text{ (DB)}$$

For radiated spurious emission measured at 3 meter test distance,

$$\text{Required attenuation} = 43+10 \text{ Log } P_{t \text{ at 3 meter}} \text{ dB}$$

$$\text{Limit line (dBuV)} = E_{\text{dBuV}} - \text{Attenuation}$$

E_{dBuV} = Measured field strength at 3 meter in dBuV/m

Power Density (Isotropic)

$$P_D = \frac{P_t}{4\pi r^2}$$

P_D = Power Density in Watts /m²

P_t = Average Transmit Power

r = Test distance

Field Intensity E (V/m)

$$E = \sqrt{P_D \times 377}$$

$$E = \frac{\sqrt{P_t \times 377}}{4\pi r^2}$$

$$E = \sqrt{\frac{P_t \times 30}{r^2}}$$

$$P_t = \left(\frac{E^2 \times r^2}{30} \right)$$

$$10 \log P_t = 10 \log E^2 (\text{V/m}) + 10 \log r^2 - 10 \log 30$$

$$10 \log P_t = 20 \log E (\text{V/m}) + 20 \log r - 10 \log 30$$

At 3 meter, $r = 3 \text{ m}$

$$10 \log P_t = 20 \log E (\text{V/m}) + 20 \log 3 - 10 \log 30$$

$$10 \log P_t = 20 \log E (\text{V/m}) + 9.54 - 14.77$$

$$10 \log P_t = 20 \log E (\text{V/m}) - 5.23$$

Since $20 \log E (\text{V/m}) = 20 \log E (\mu\text{V/m}) - 120$

$$10 \log P_t = 20 \log E (\mu\text{V/m}) - 120 - 5.23$$

$$10 \log P_t = 20 \log E (\mu\text{V/m}) - 125.23$$

$$\begin{aligned} \text{Limit line (dBuV) at 3 meter} &= E_{\text{dBuV}} - \text{Attenuation} \\ &= E_{\text{dBuV}} - (43 + 10 \log P_t \text{ at 3 meter}) \\ &= E_{\text{dBuV}} - 43 - 10 \log P_t \text{ at 3 meter} \\ &= E_{\text{dBuV}} - 43 - (20 \log E (\mu\text{V/m}) - 125.23) \\ &= E_{\text{dBuV}} - 43 - 20 \log E (\mu\text{V/m}) + 125.23 \\ &= E_{\text{dBuV}} - 20 \log E (\mu\text{V/m}) + 82.23 \end{aligned}$$

$$\text{Since } 20 \log E (\mu\text{V/m}) = E \text{ in dBuV/m} = E_{\text{dBuV}} - E_{\text{dBuV}} + 82.23$$

$$\text{Radiated Emission limit 3 meter} = 82.23 \text{ dBuV at any power level measured in dBuV}$$

Exhibit A: Test Setup Photos



Section 7.1 UL Test Setup



Section 7.1 DL Test Setup



Section 7.2-7.3 UL Test Setup



Section 7.2-7.3 UL Test Setup, Max Power



Section 7.2-7.3 UL Test Setup, Max Power Input Signal



Section 7.2-7.3 DL Test Setup



Section 7.4 UL Test Setup



Section 7.4 DL Test Setup



Section 7.5 UL Test Setup



Section 7.5 DL Test Setup



Section 7.6 UL Test Setup



Section 7.6 DL Test Setup



Section 7.7 Max Noise Test Setup



Section 7.7 Variable Max Noise Test Setup



Section 7.8 Test Setup



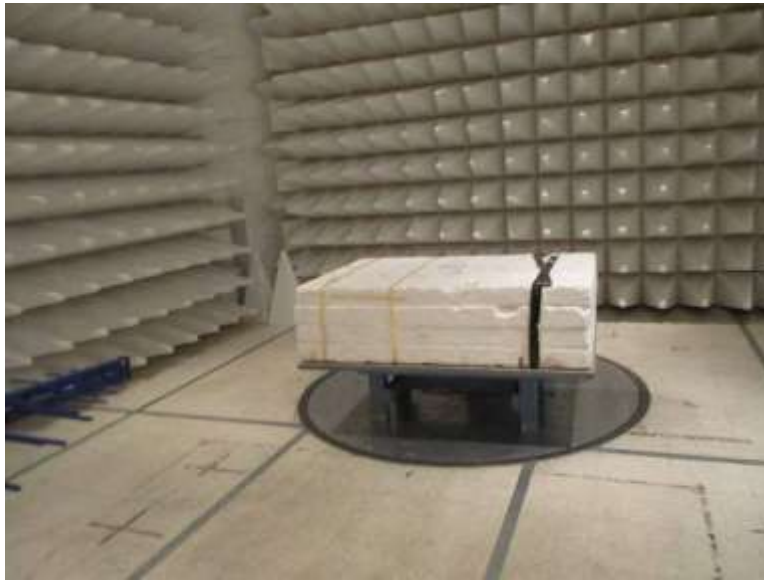
Section 7.9 Test Setup



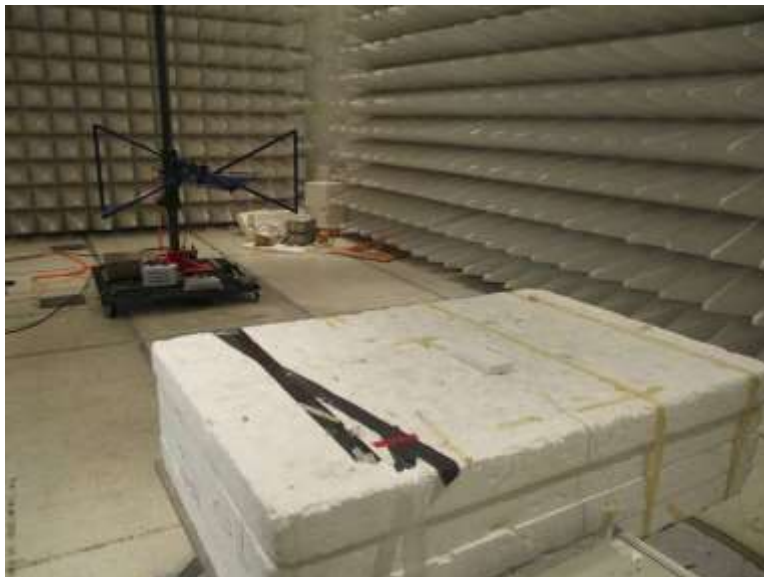
Section 7.10 Test Setup



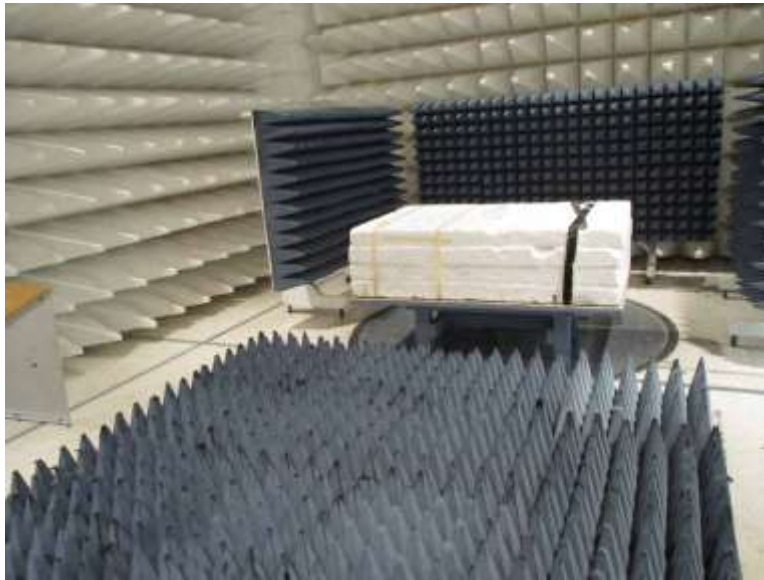
Section 7.11 Test Setup



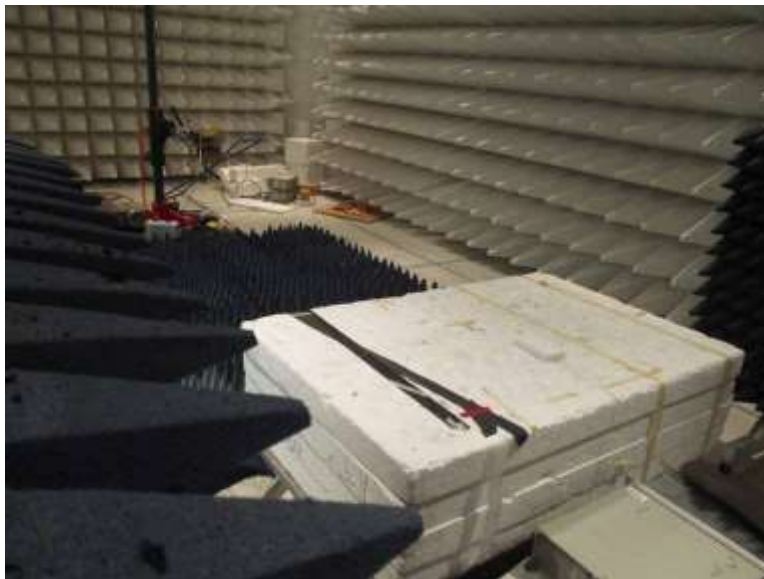
Section 7.12 Below 1GHz



Section 7.12 Below 1GHz



Section 7.12 Above 1GHz



Section 7.12 Above 1GHz