7.10 Occupied Band Width

Test Conditions / Setup

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place. Brea, CA 92821• 714 993 6112
Customer:	Huaptec
Specification:	Section 2.1049 Measurement required: Occupied bandwidth
Work Order #:	**100428** Date: 3/26/2018
Test Type:	**Conducted Emissions**
Tested By:	E. Wong
Software:	EMITest 5.03.11

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

General test condition.
The equipment under test (EUT) is a Mobile Wideband Consumer Booster with direct contact coupling (cradle-type) antenna.
The EUT is placed on the test bench. Evaluation performed at the Outside (Donor) and Inside (Server) antenna port.
The EUT Donor port is a MCX type connector and 50-ohm impedance.
The EUT Server/DL port /is type UFL connector and 50-ohm impedance.

Part 22
UL: 824-849MHz
DL: 869-894MHz
Part 24
UL: 1850-1915MHz
DL: 1930-1995MHz
Part 27
UL: 1710-1755MHz, 698-716MHz, 776-787MHz
DL: 2110-2155MHz, 728-746MHz, 746-757MHz

Test procedure:
The test was performed in accordance with the FCC document: 935210 D03 Signal Booster Measurements v04r01, dated October 27, 2017.
Firmware: 2.0

Test environment conditions:
Temperature: 20 -25°C
Relative Humidity: 37-45 %
Pressure: 100kPa

Device is powered by a provided 5V USB/12V Automotive adaptor

Test Equipment:

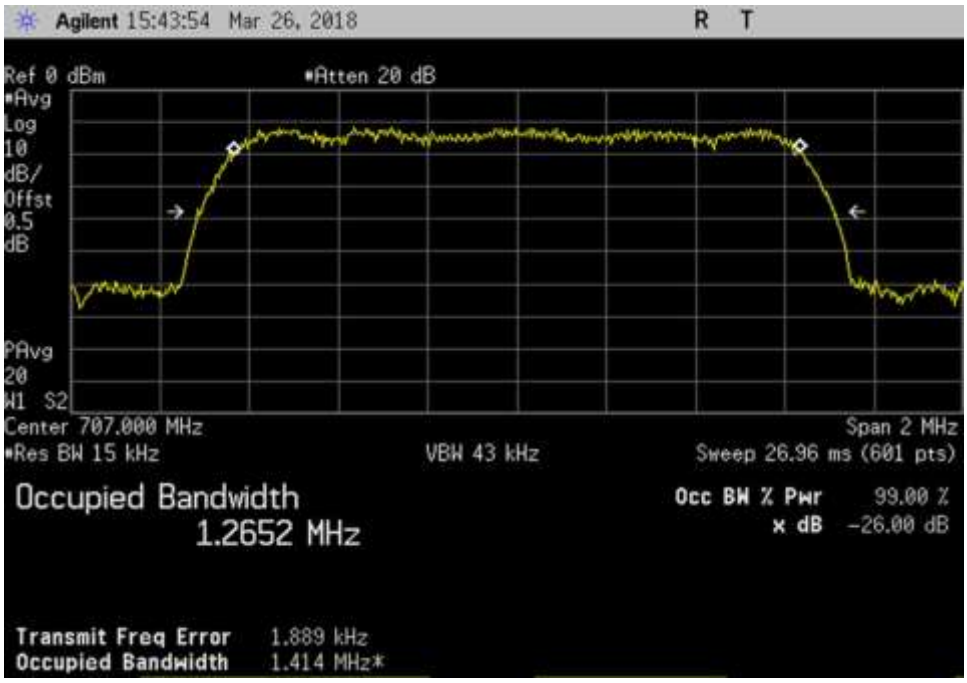
Asset #	Description	Manufacturer	Model	Calibration Date	Cal Due Date
03420	Signal Generator	Agilent	E4438C	6/9/2017	6/9/2019
P07037	RF Signal Generator	Agilent	E4432B	10/6/2016	10/6/2018
P06544	Cable	Astro Steel	32026-29094K-29094K-36TC	12/21/2017	12/21/2019
02946	Cable	Astro Steel	32026-29094K-29094K-36TC	12/21/2017	12/21/2019
02672	Spectrum Analyzer	Agilent	E4446A	3/2/2017	3/2/2019

Summary of Results

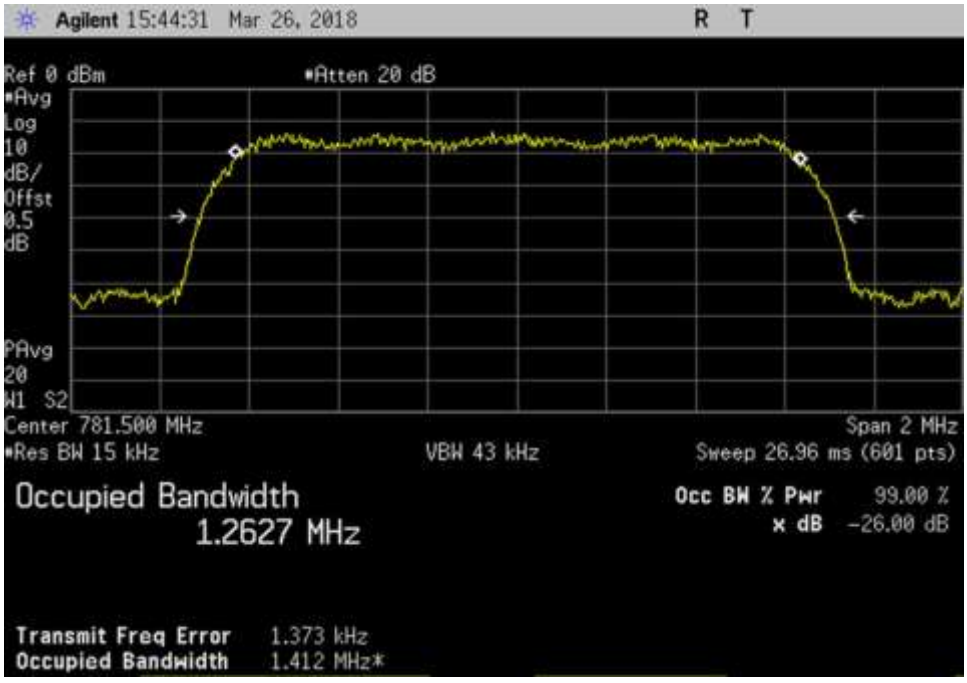
Pass: As summarized in plots below, the uniformity of the output signal relative to the input signal are practically identical. Therefore, the comparison is within limits.

Plots

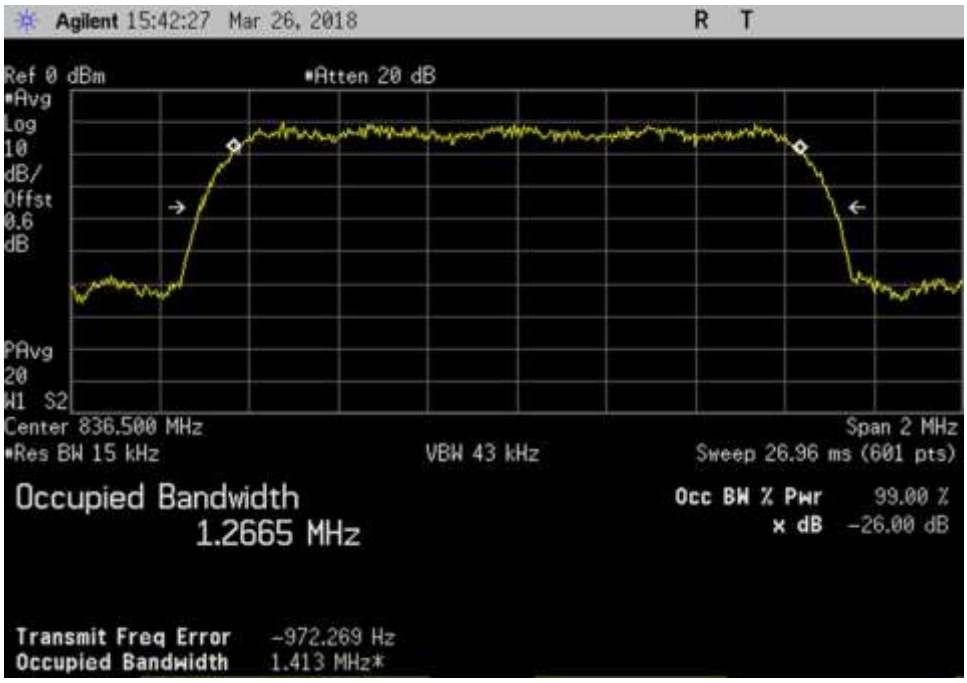
CDMA Input



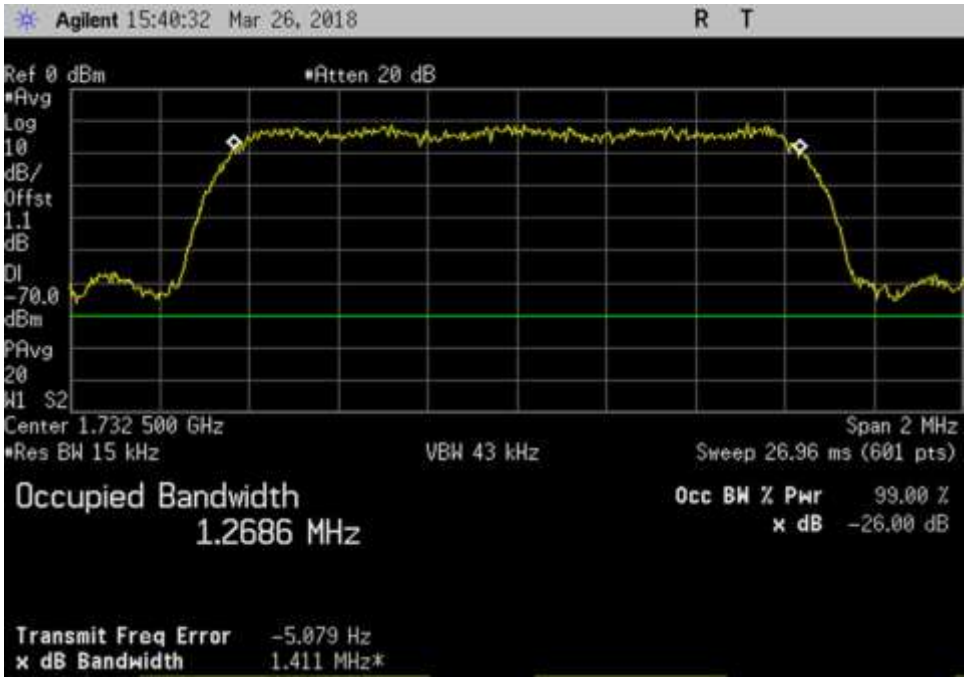
UL_698-716_CDMA_ 707MHz



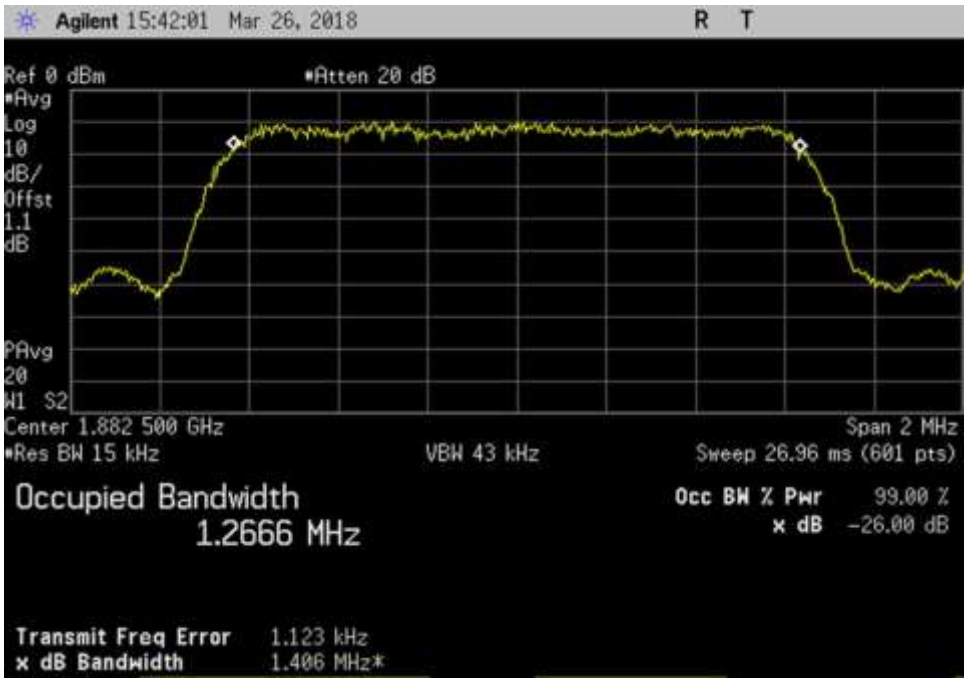
UL_776-787_CDMA_ 781.5MHz



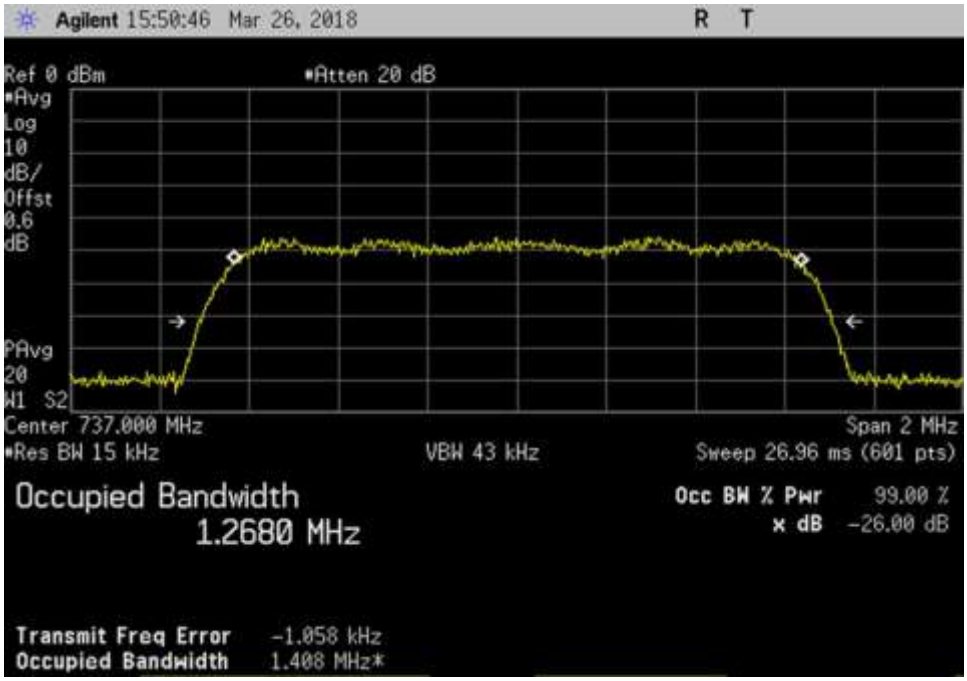
UL_824-849_CDMA_ 836.5MHz



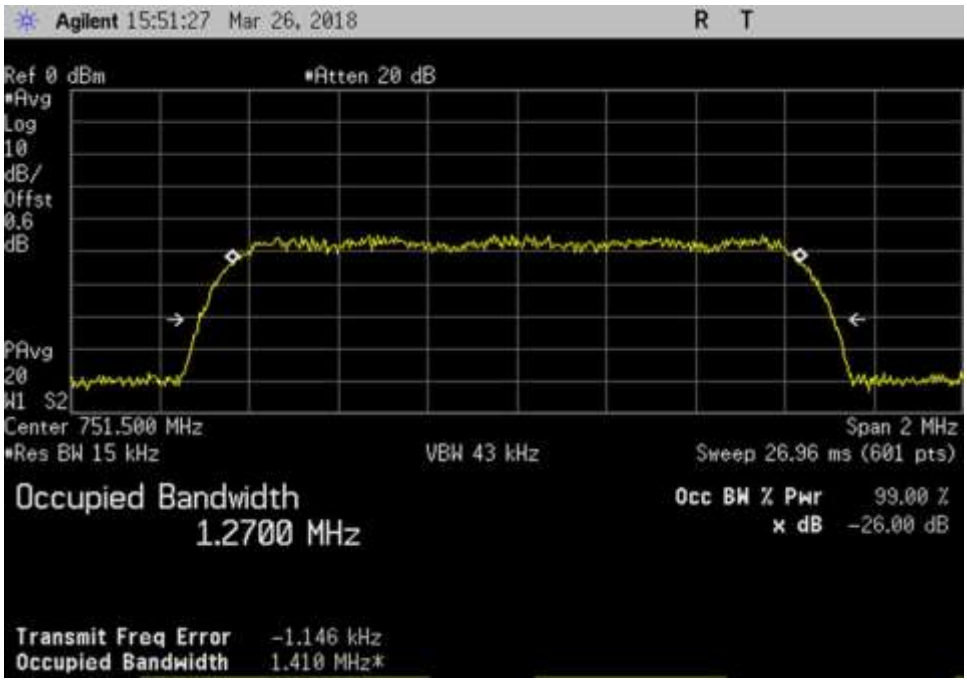
UL_1710-1755_CDMA_ 1732.5MHz



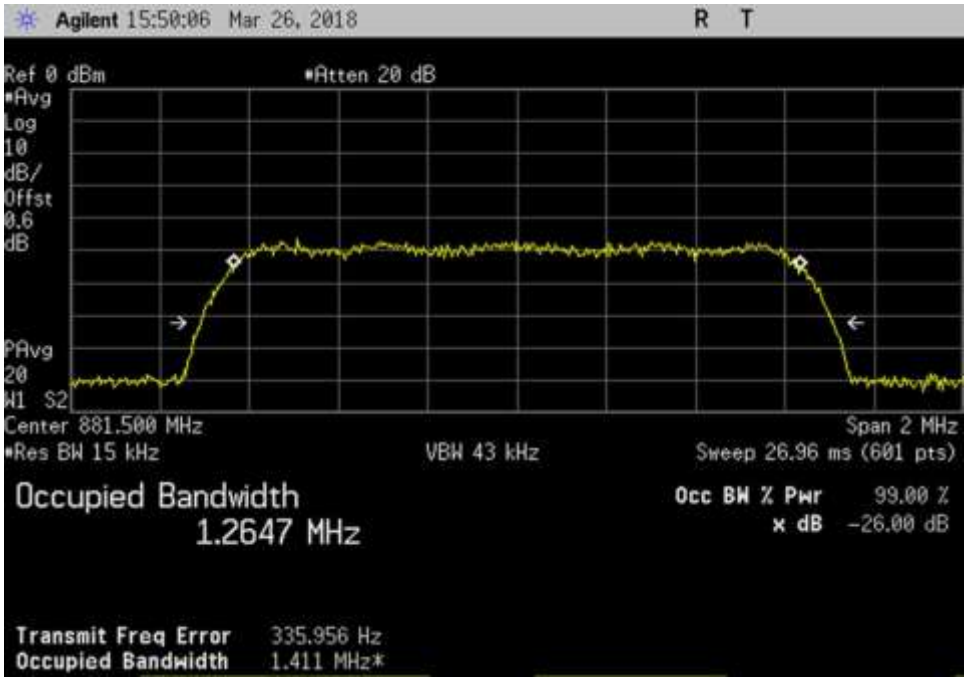
UL_1850-1915_CDMA_ 1882.5MHz



DL_728-746_CDMA_ 737MHz

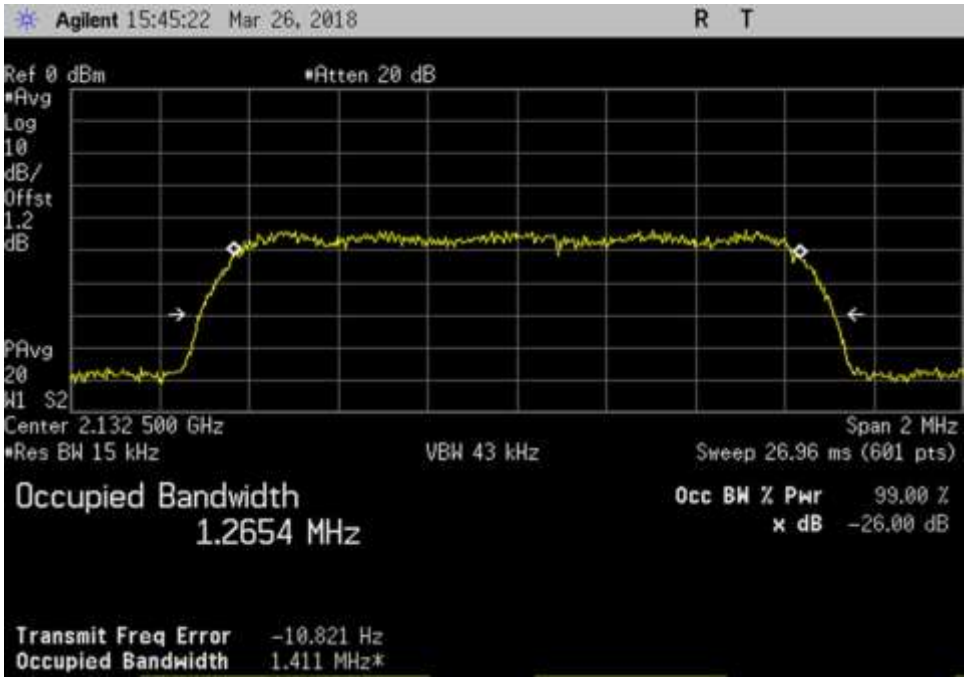


DL_746-757_CDMA_ 751.5MHz



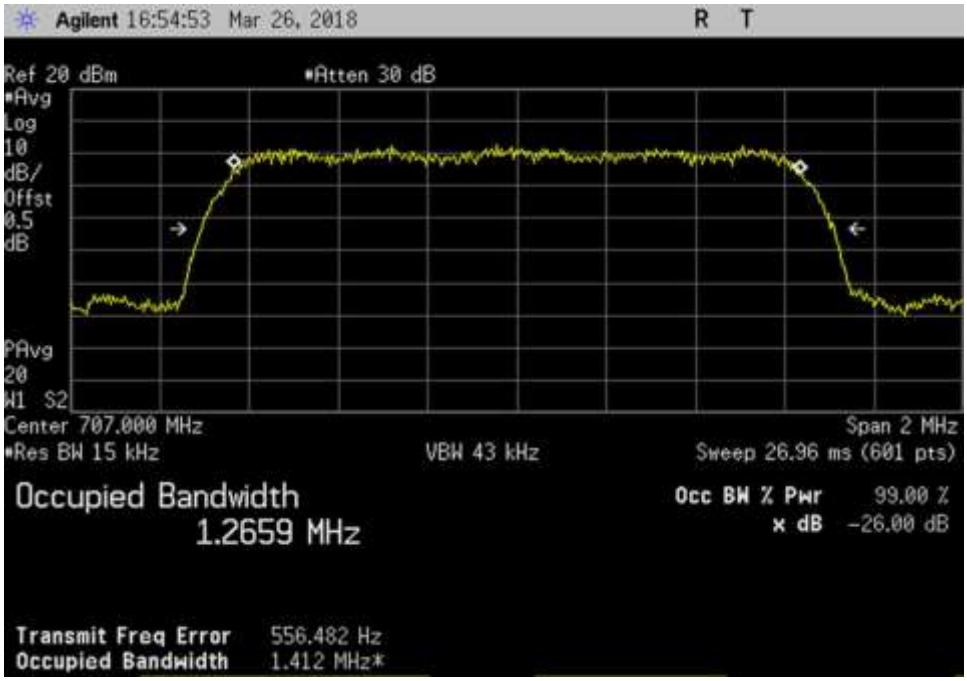
DL_869-894_CDMA_ 881.5MHz

DL_1930-1995_CDMA_ 1962.5MHz

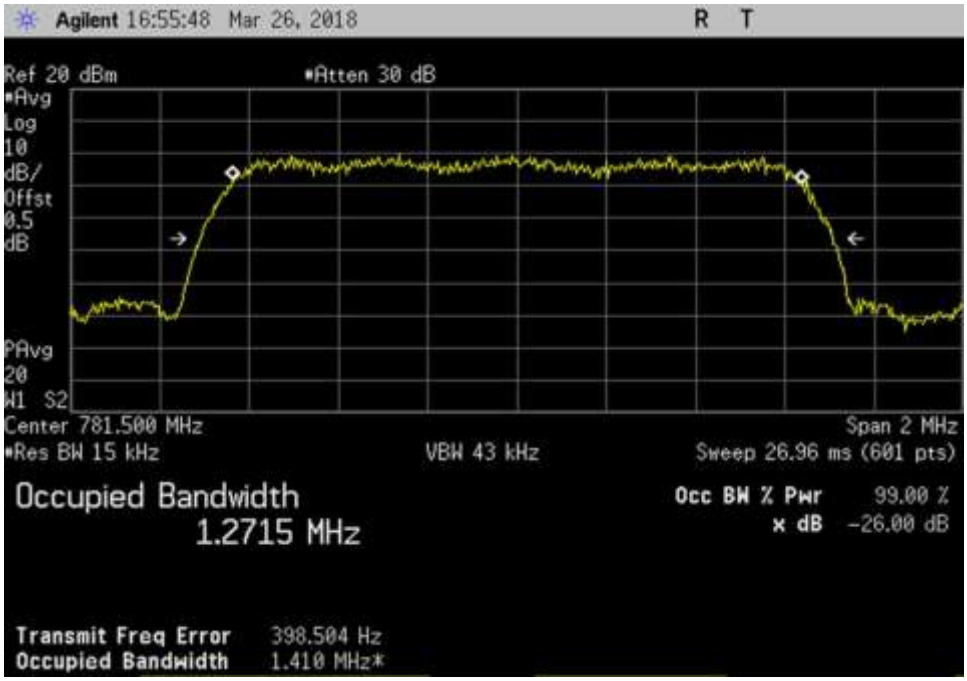


DL_2110-2155_CDMA_ 2132.5MHz

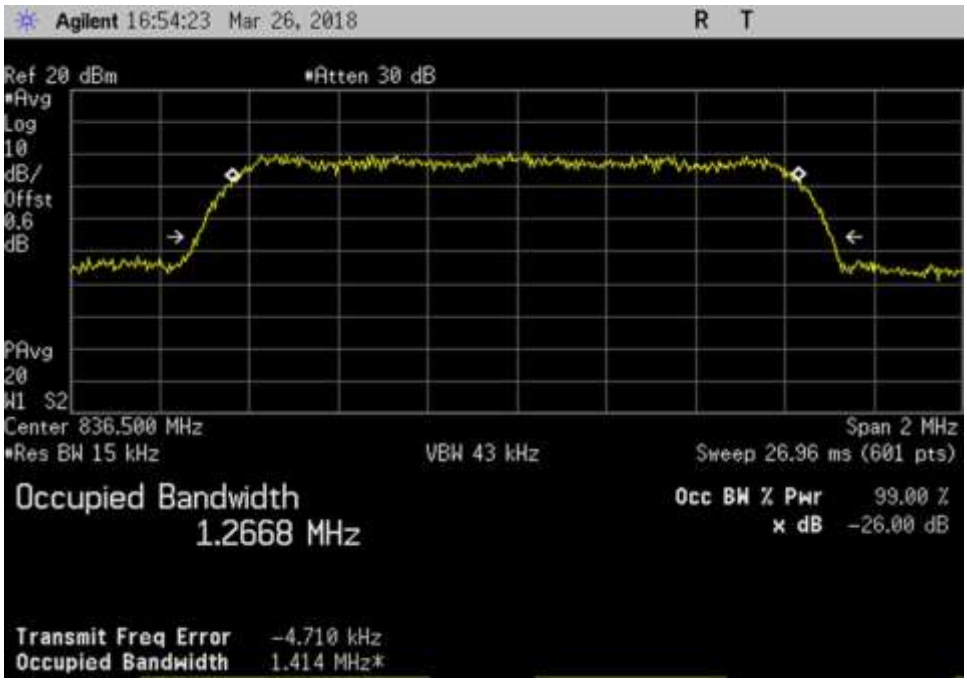
CDMA Output



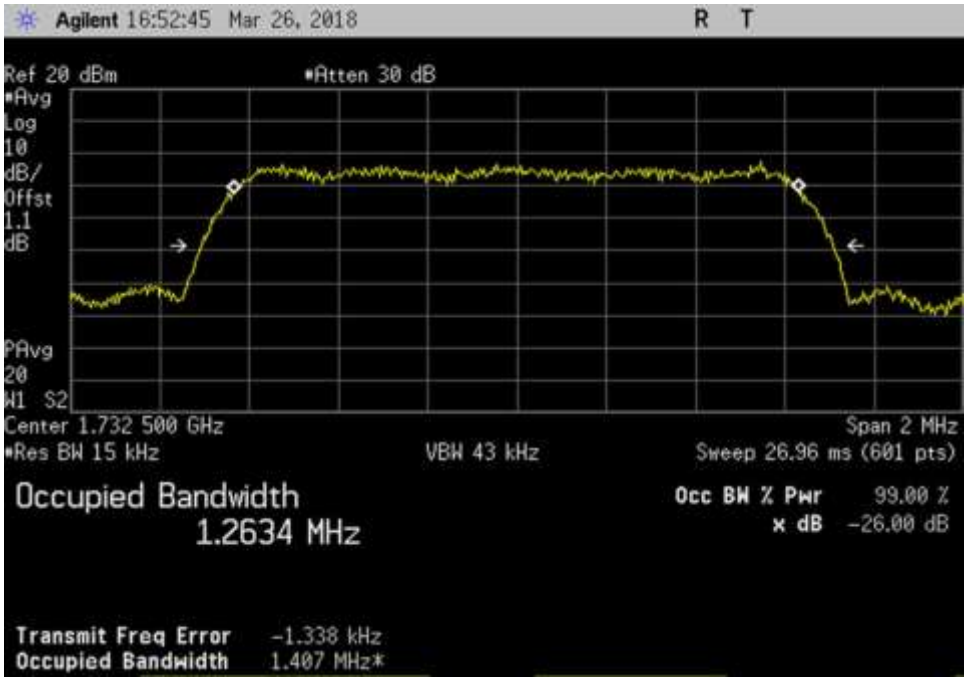
UL_698-716_CDMA_ 707MHz



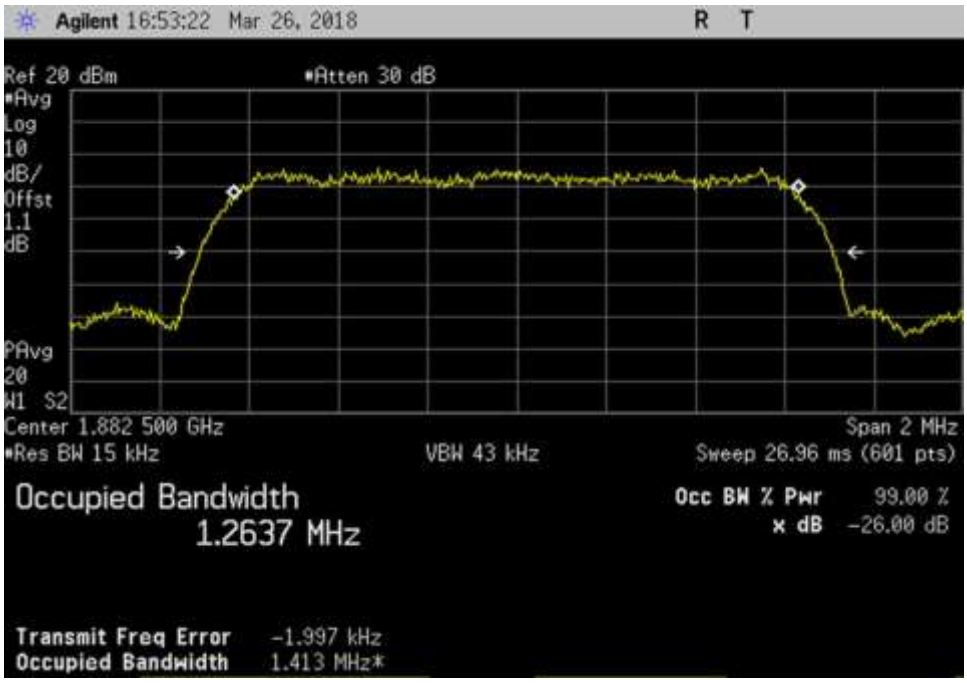
UL_776-787_CDMA_ 781.5MHz



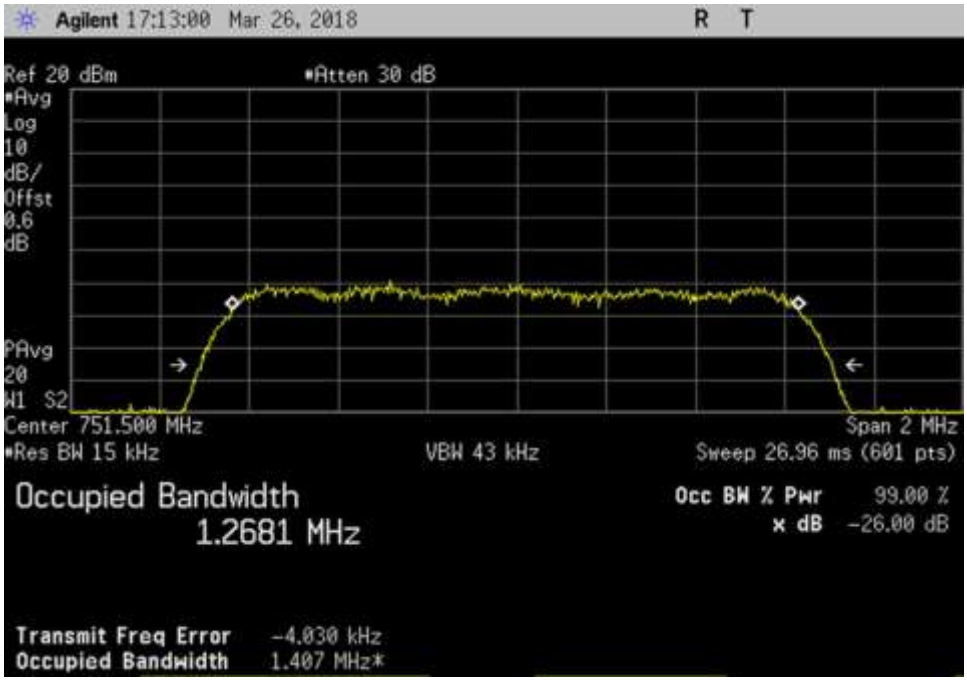
UL_824-849_CDMA_ 836.5MHz



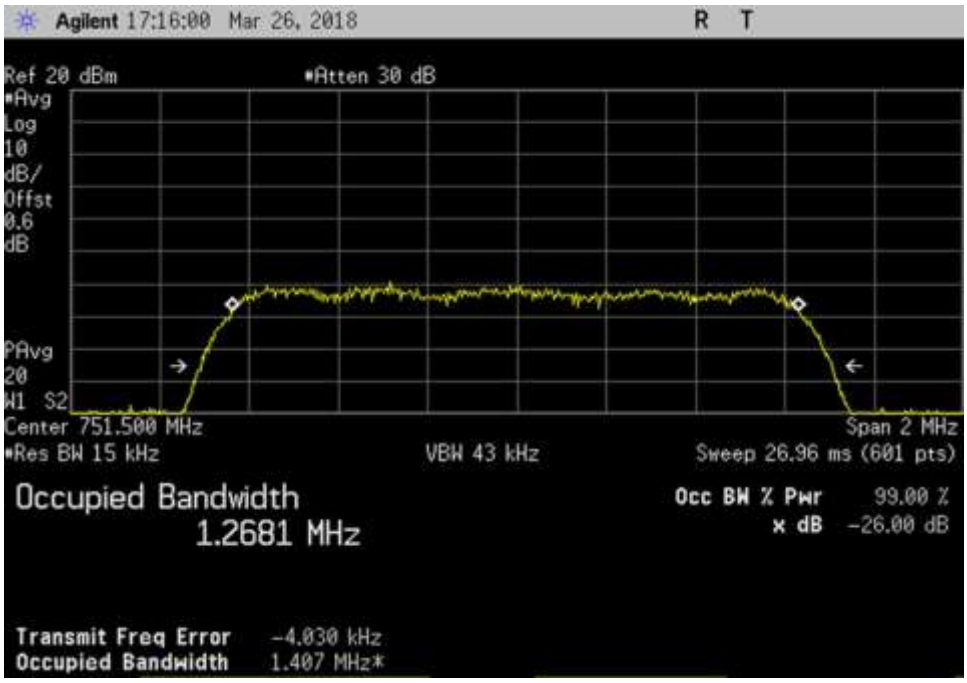
UL_1850-1915_CDMA_ 1732.5MHz



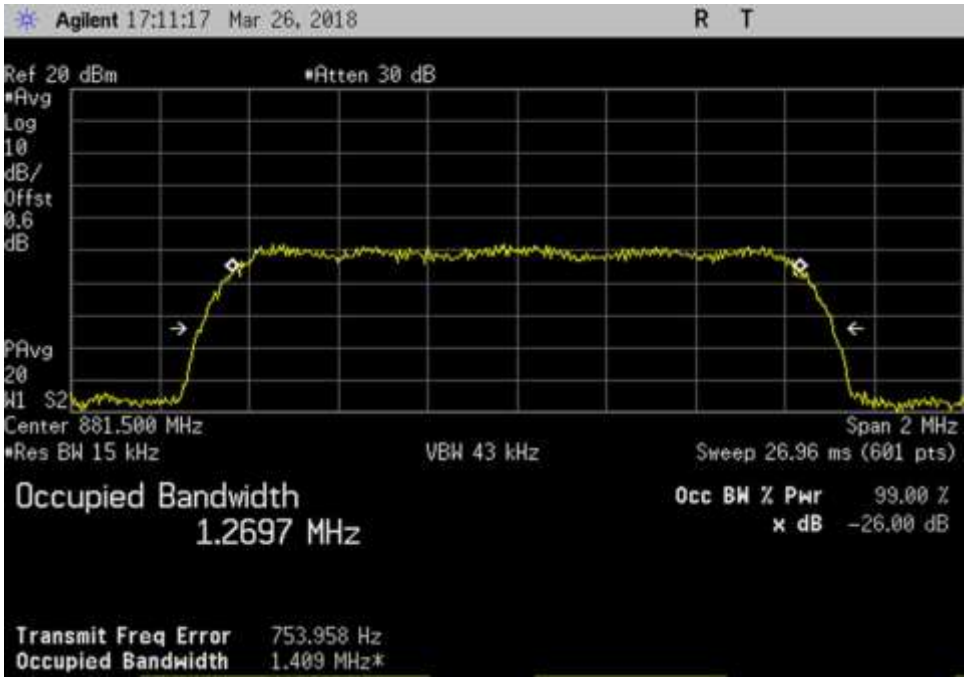
UL_1850-1915_CDMA_ 1882.5MHz



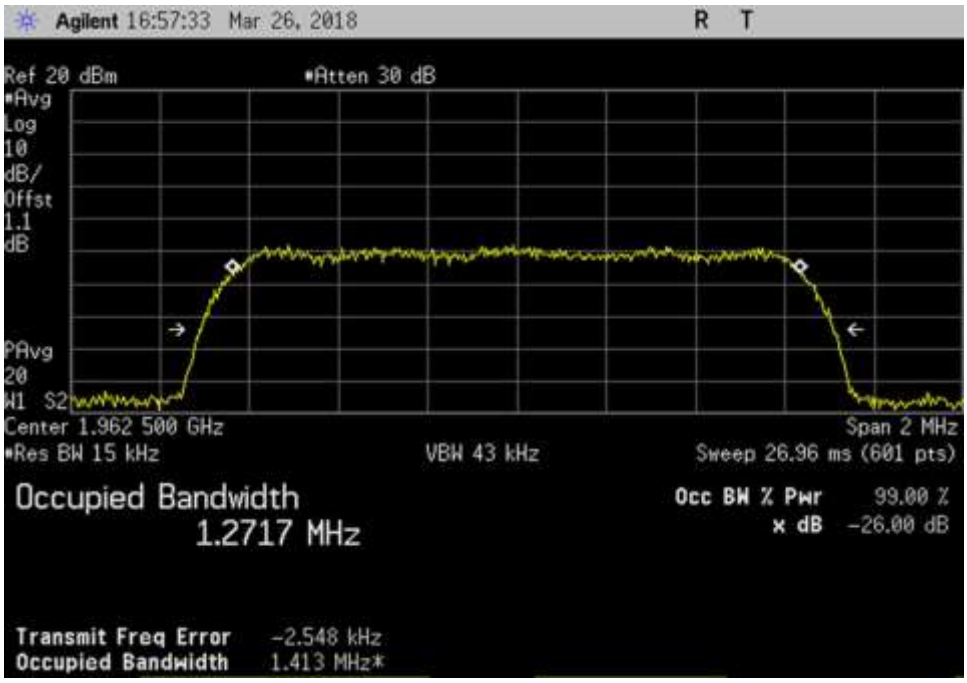
DL_728-746_CDMA_ 751.5MHz_2



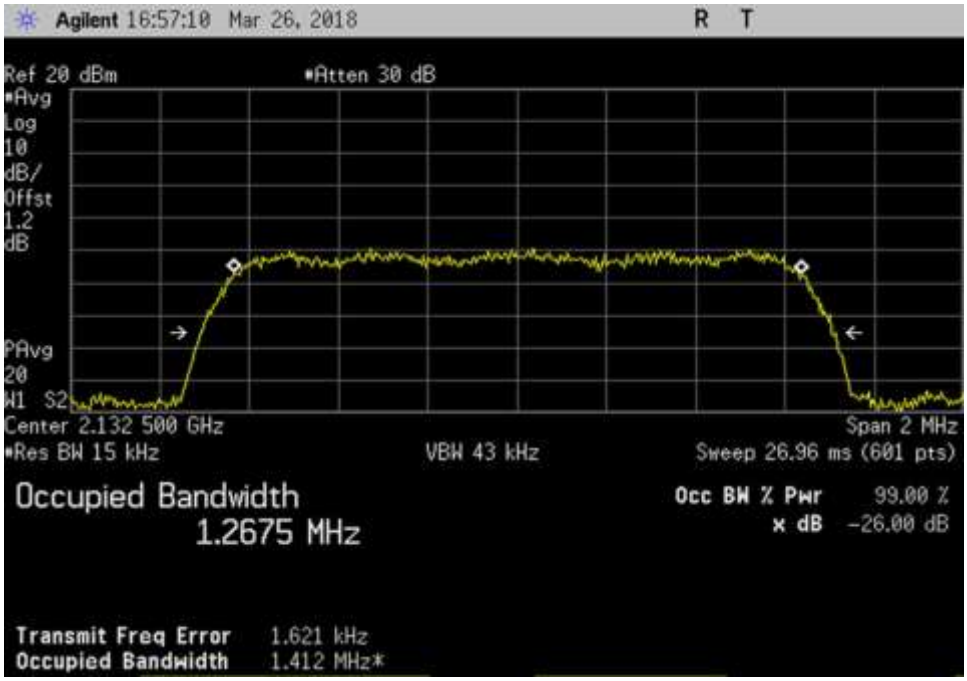
DL_746-757_CDMA_ 751.5MHz



DL_869-894_CDMA_ 881.5MHz

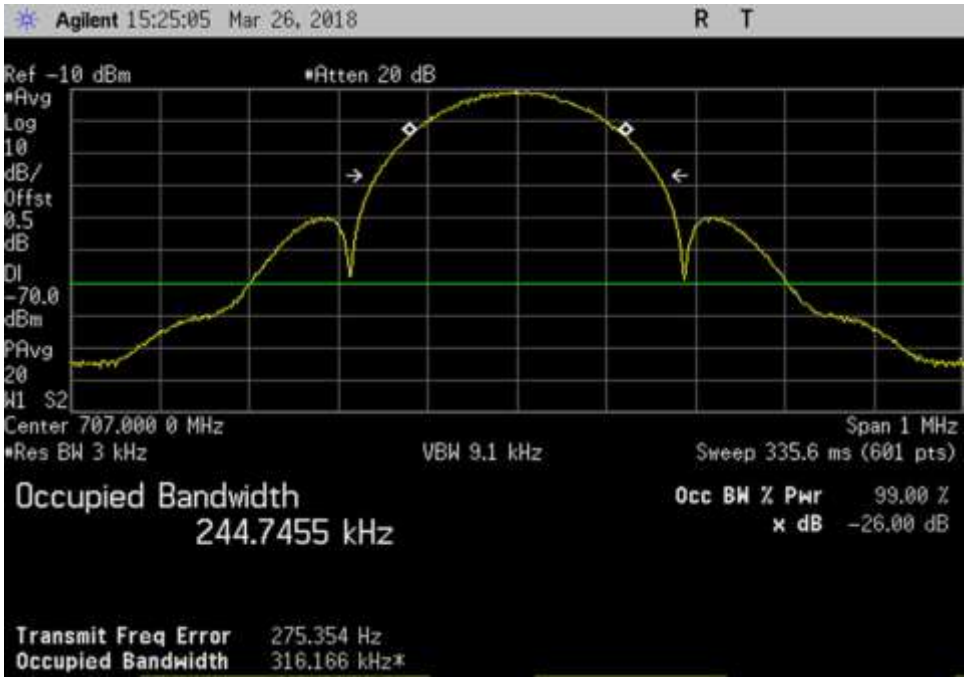


DL_1930-1995_CDMA_ 1962.5MHz

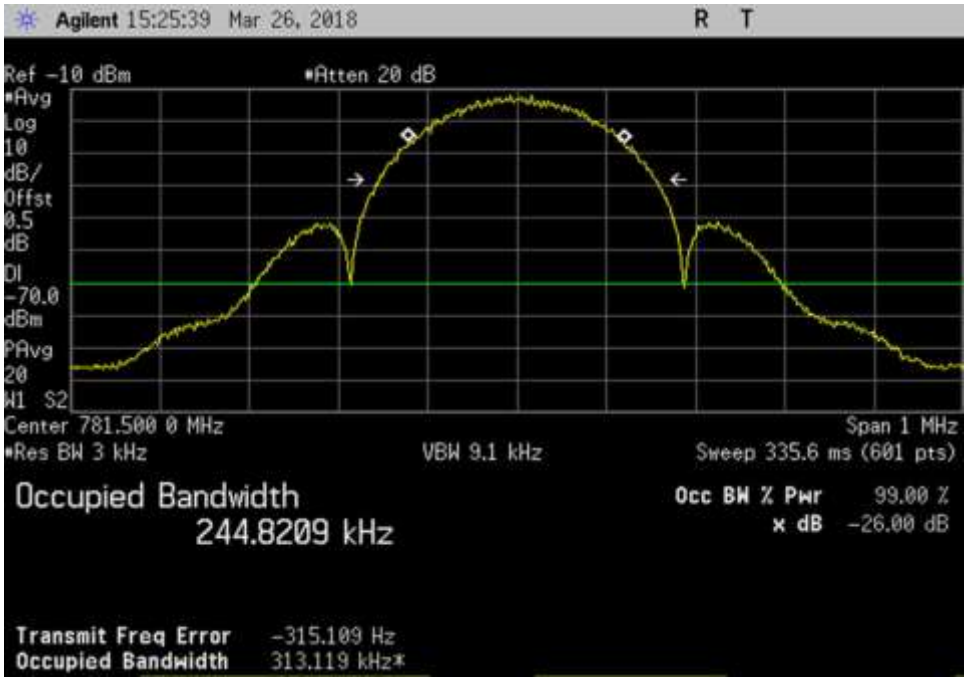


DL_2110-2155_CDMA_ 2132.5MHz

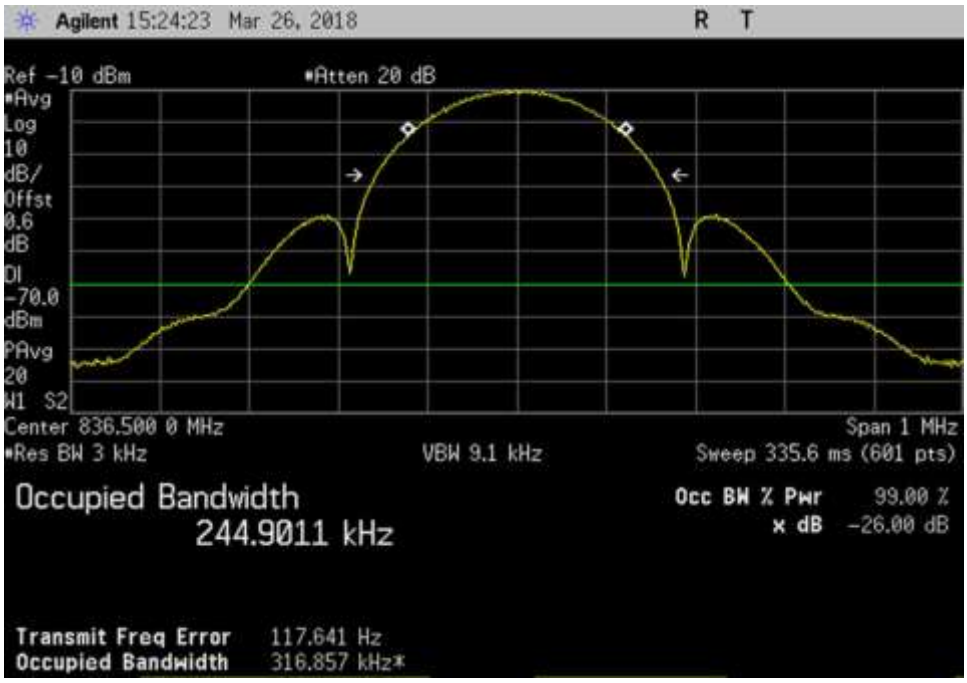
EDGE Input



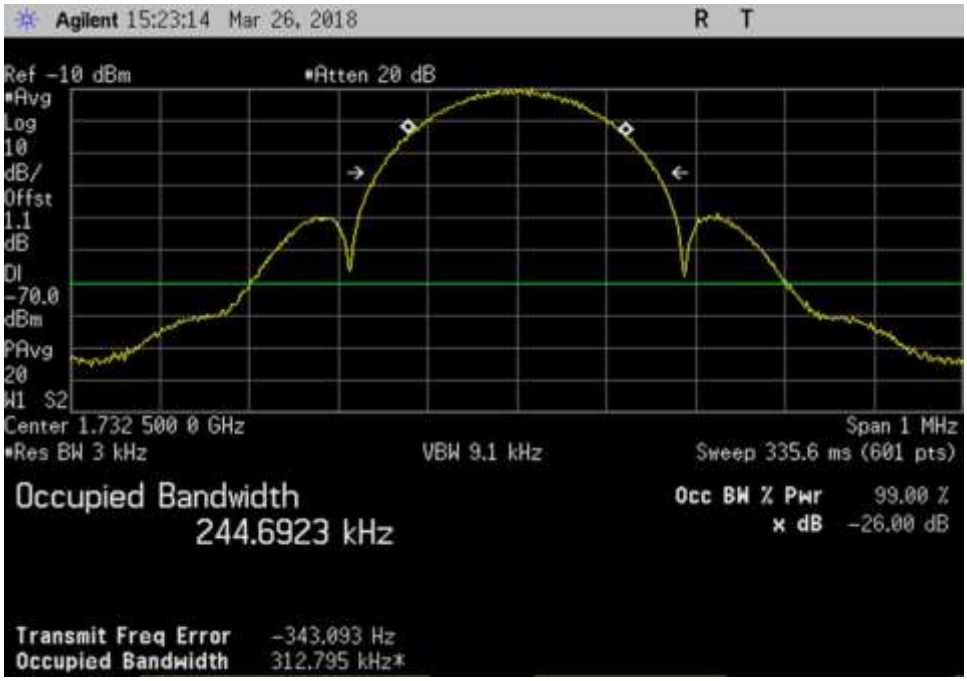
UL_698-716_EDGE_ 707MHz



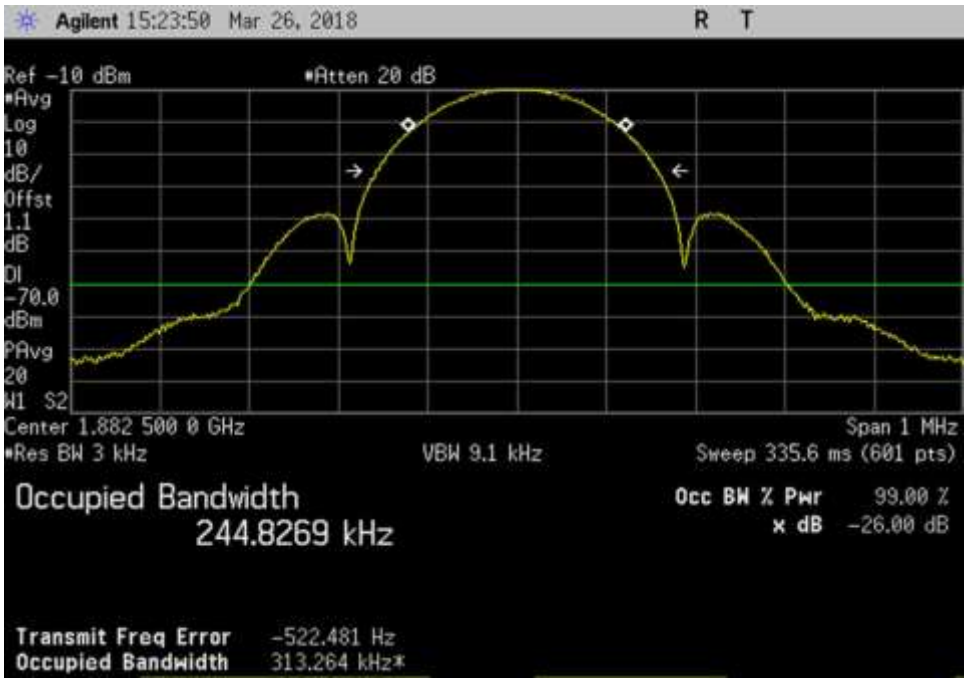
UL_776-787_EDGE_ 781.5MHz



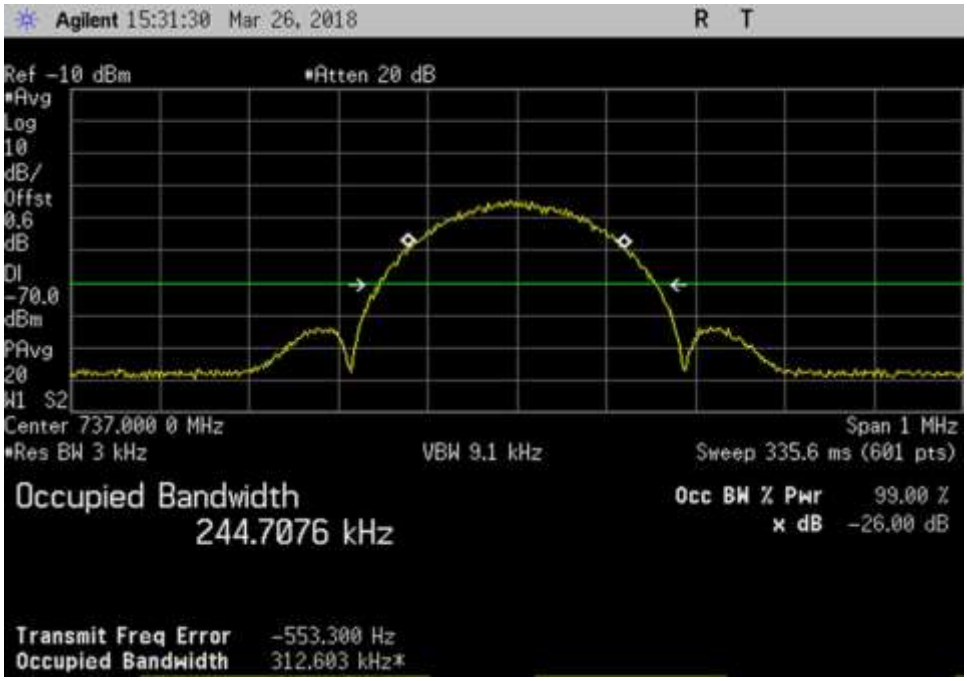
UL_824-849_EDGE_ 836.5MHz



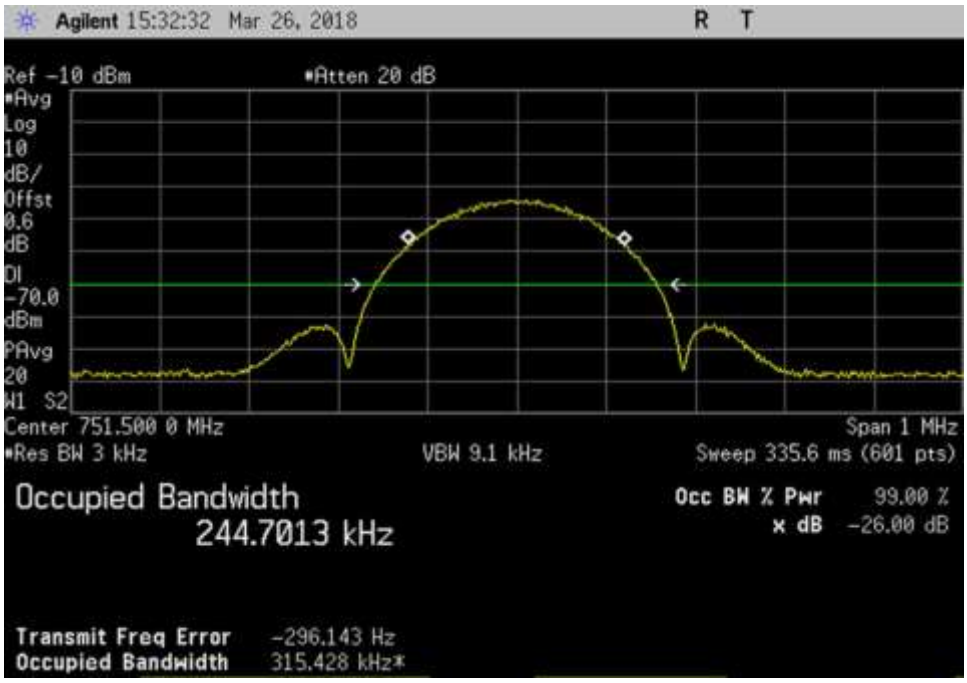
UL_1710-1755_EDGE_ 1732.5MHz



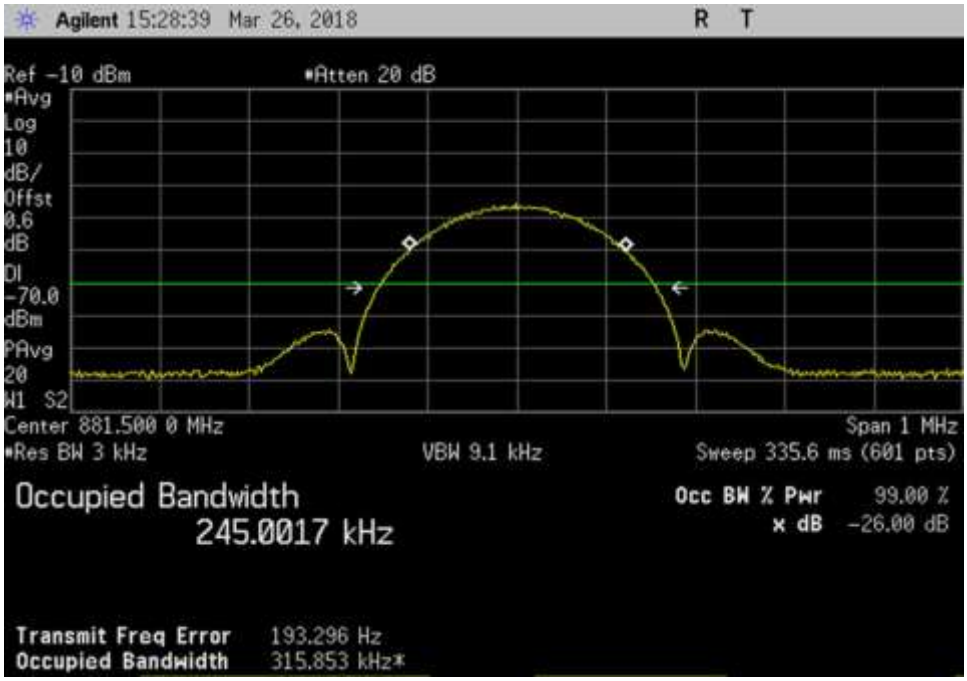
UL_1850-1915_EDGE_ 1882.5MHz



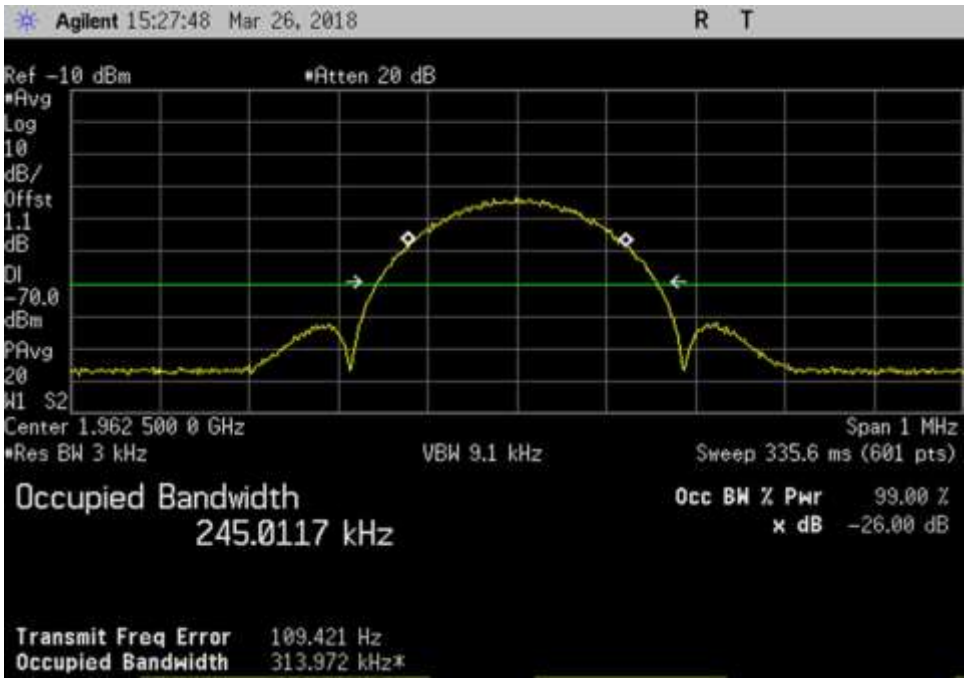
DL_728-746_EDGE_ 737MHz



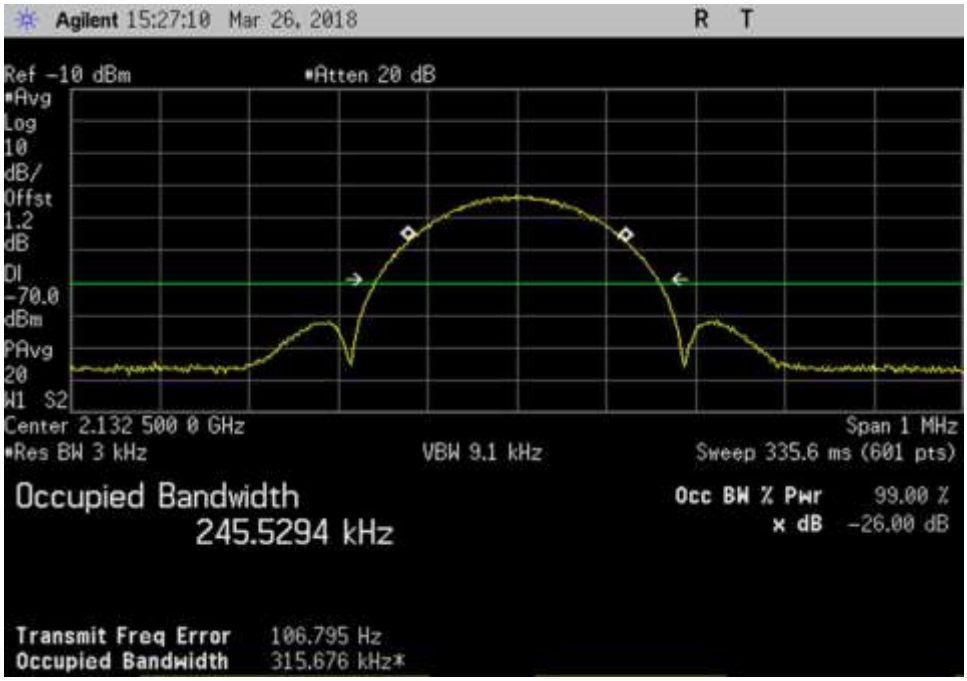
DL_746-757_EDGE_ 751.5MHz



DL_869-894_EDGE_ 881.5MHz

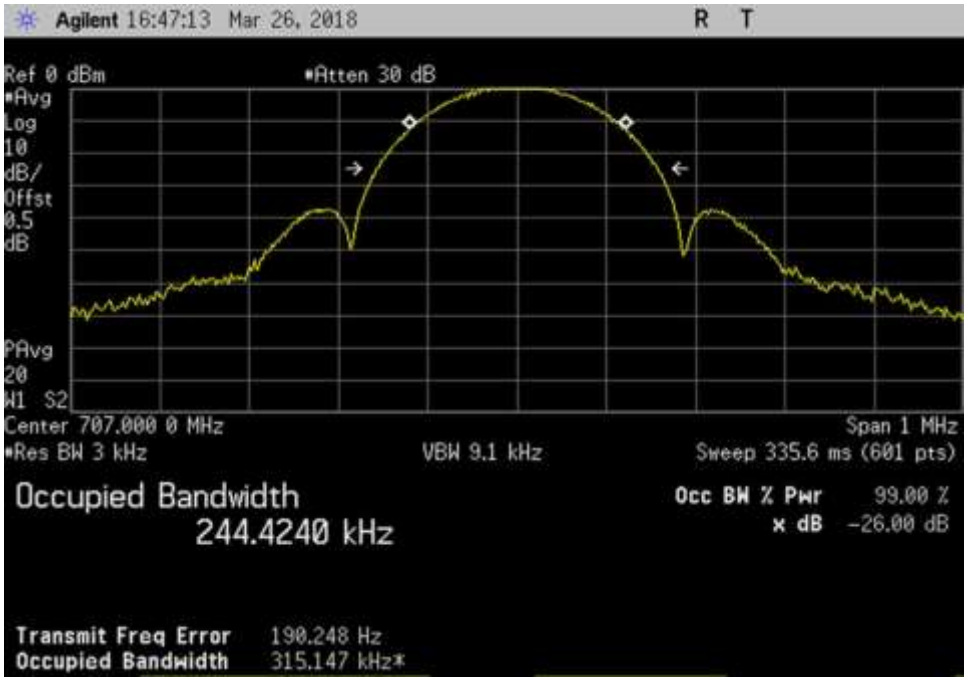


DL_1930-1995_EDGE_ 1962.5MHz

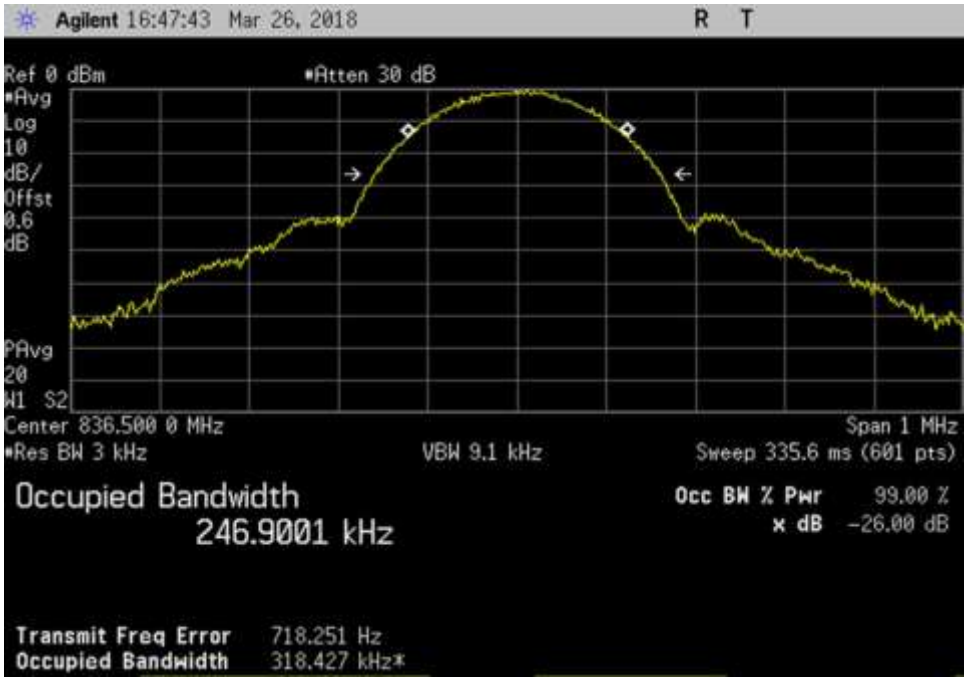


DL_2110-2155_EDGE_ 2132.5MHz

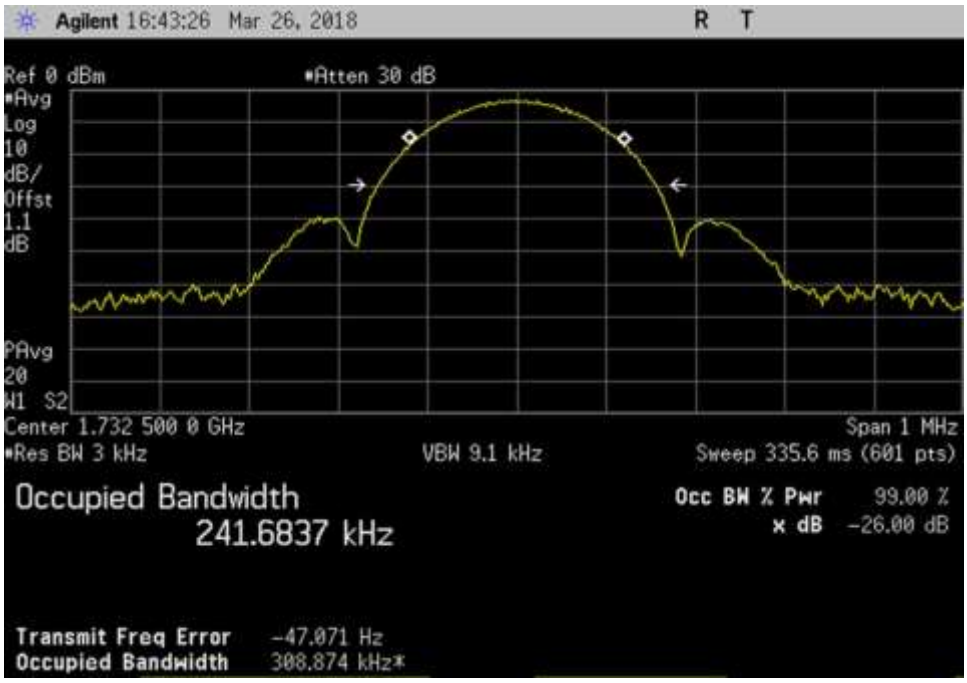
EDGE Output



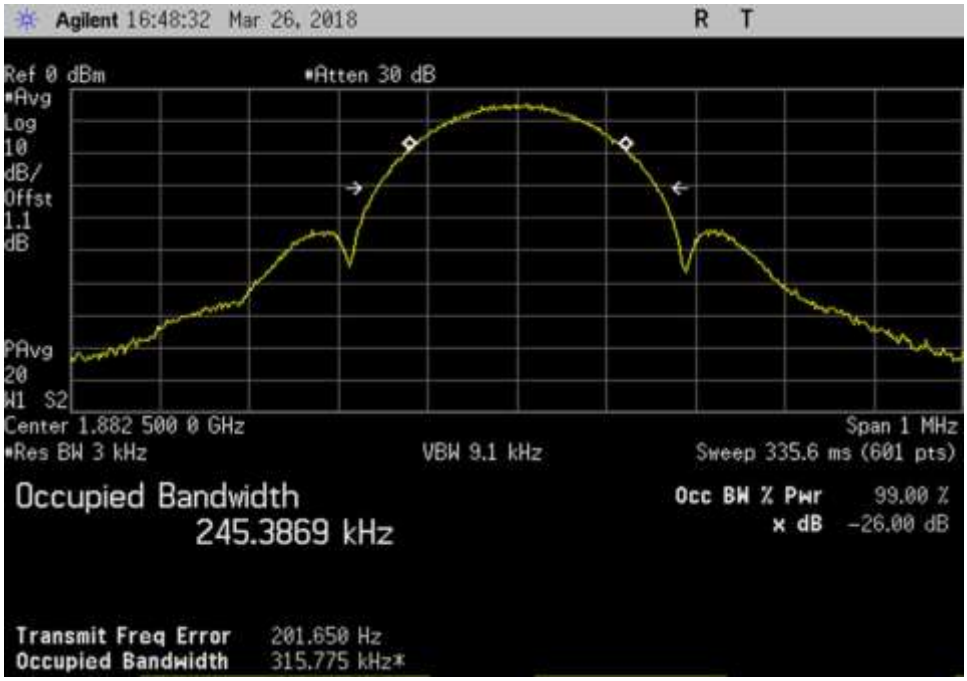
UL_698-716_EDGE_ 707MHz



UL_824-849_EDGE_ 836.5MHz

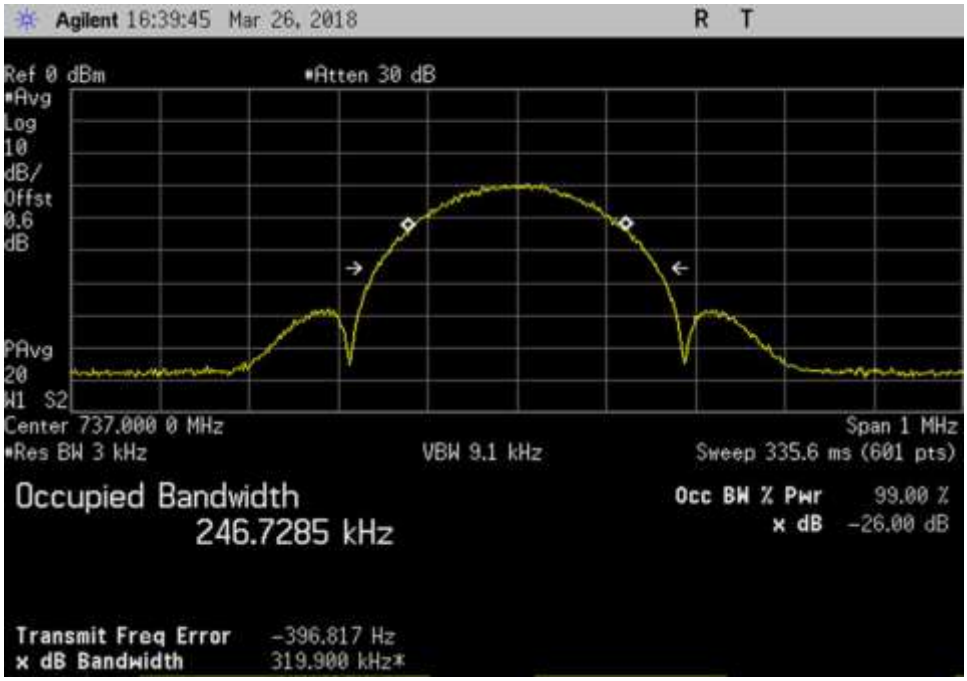


UL_1710-1755_EDGE_ 1732.5MHz

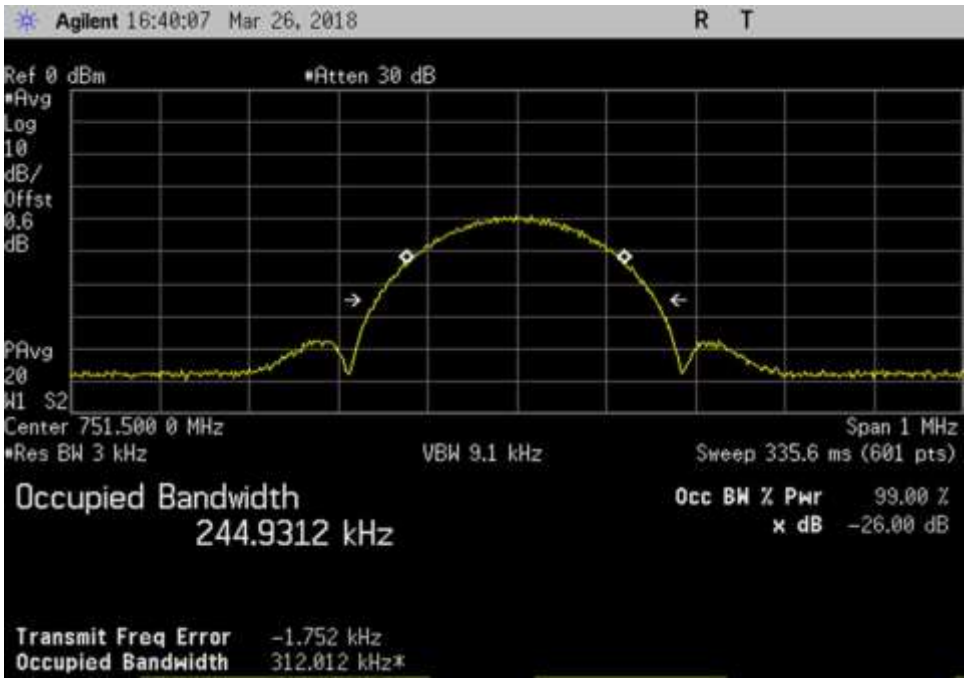


UL_1850-1915_EDGE_ 1882.5MHz

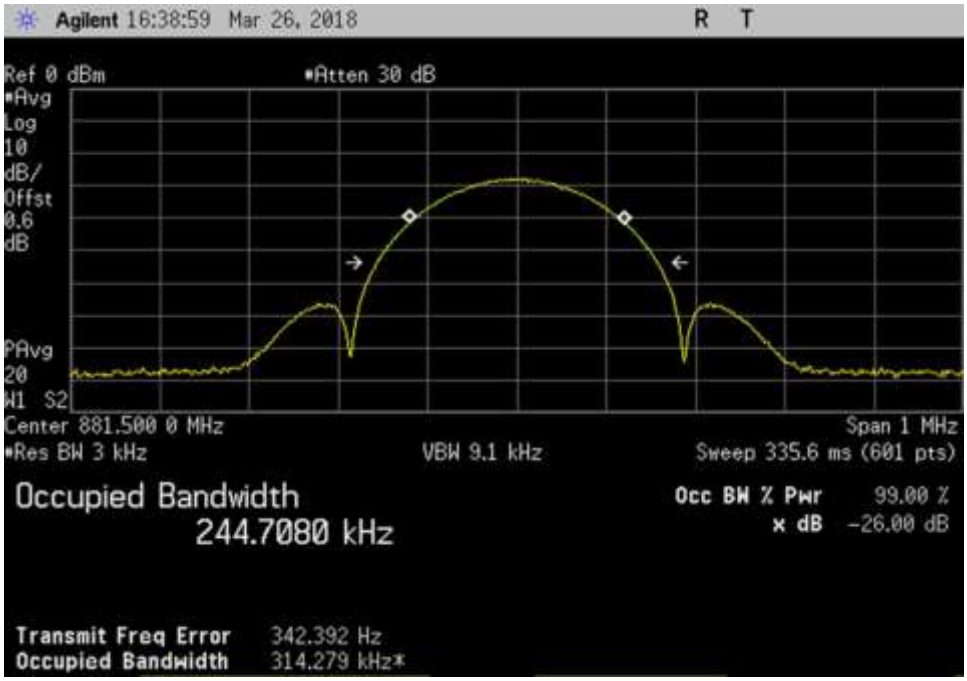
UL_L_1710-1755__EDGE_ 1732.5MHz



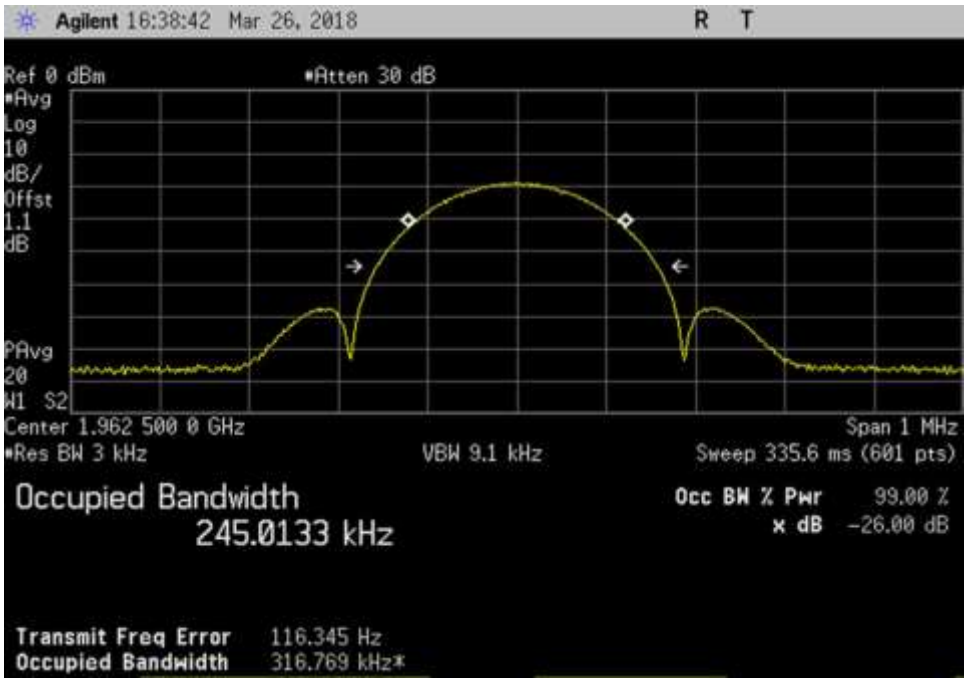
DL_728-746_EDGE_ 737MHz



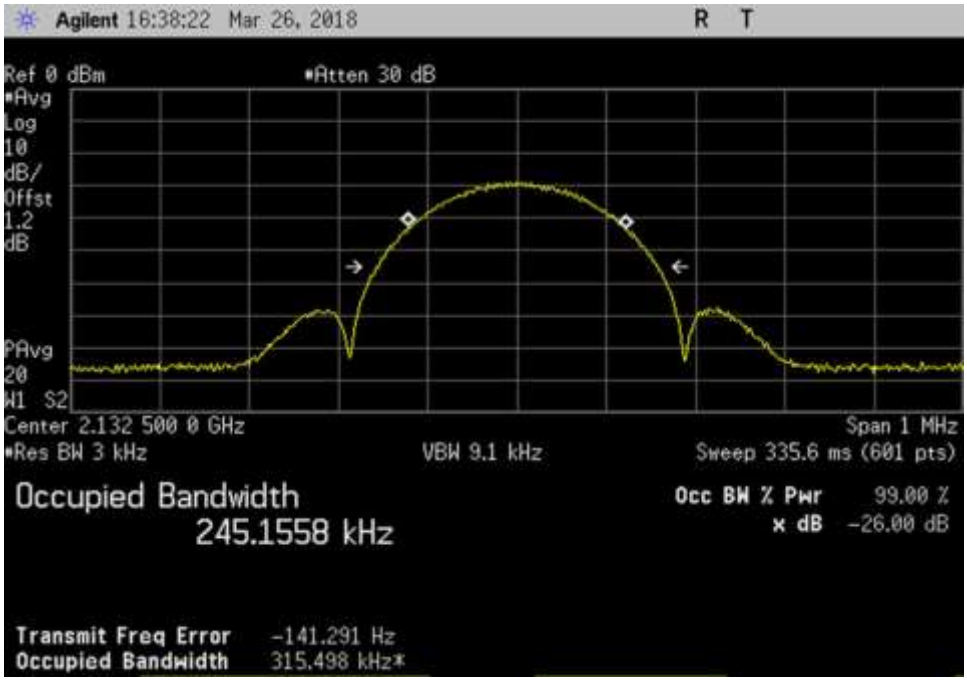
DL_746-757_EDGE_ 751.5MHz



DL_869-894_EDGE_ 881.5MHz

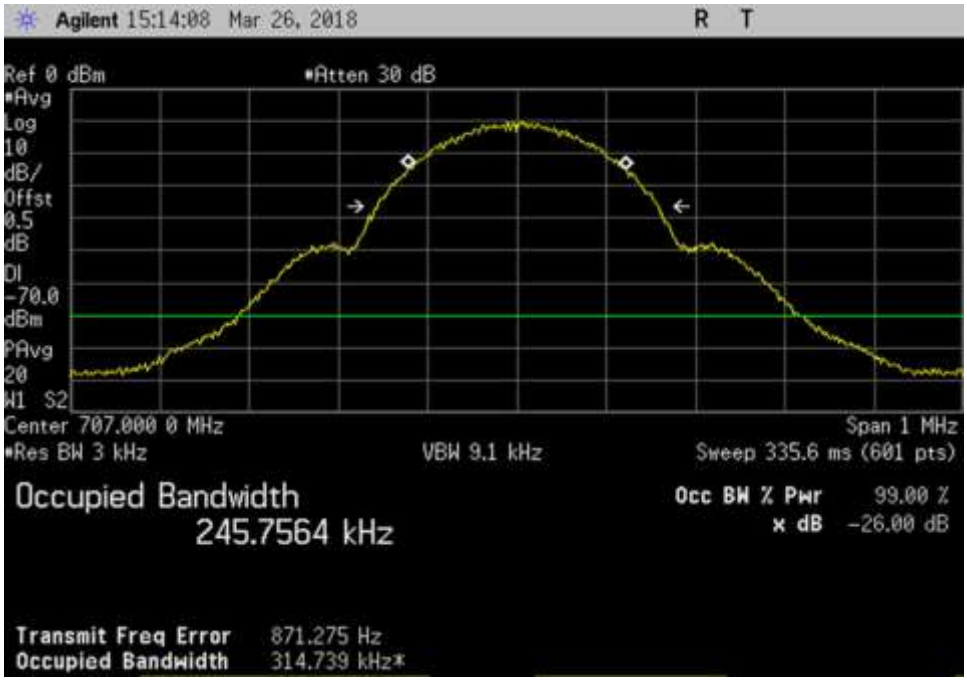


DL_1930-1995_EDGE_ 1962.5MHz

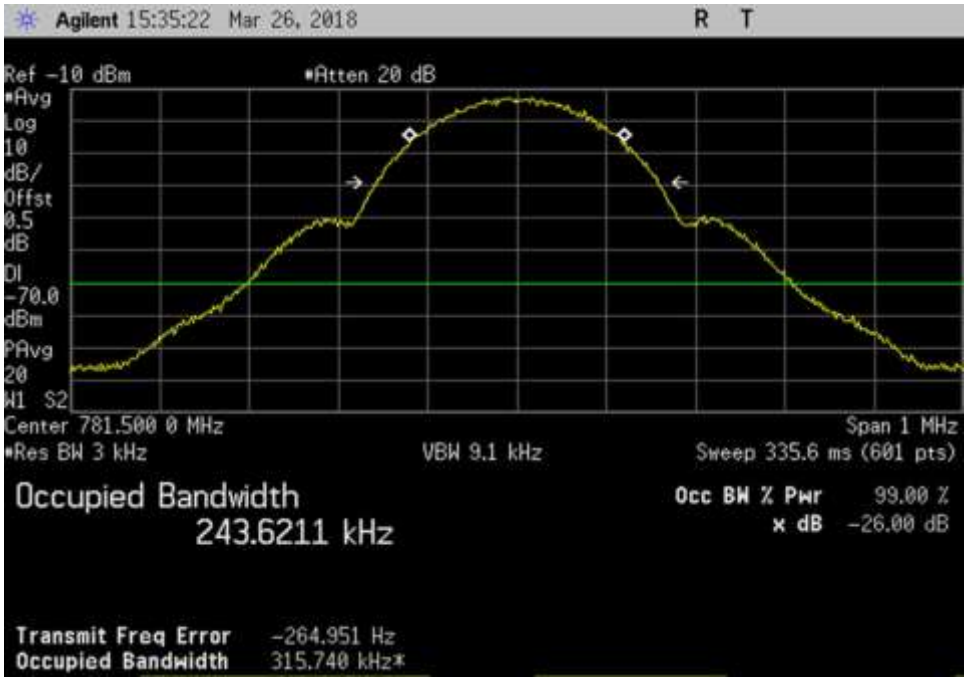


DL_2110-2155_EDGE_ 2132.5MHz

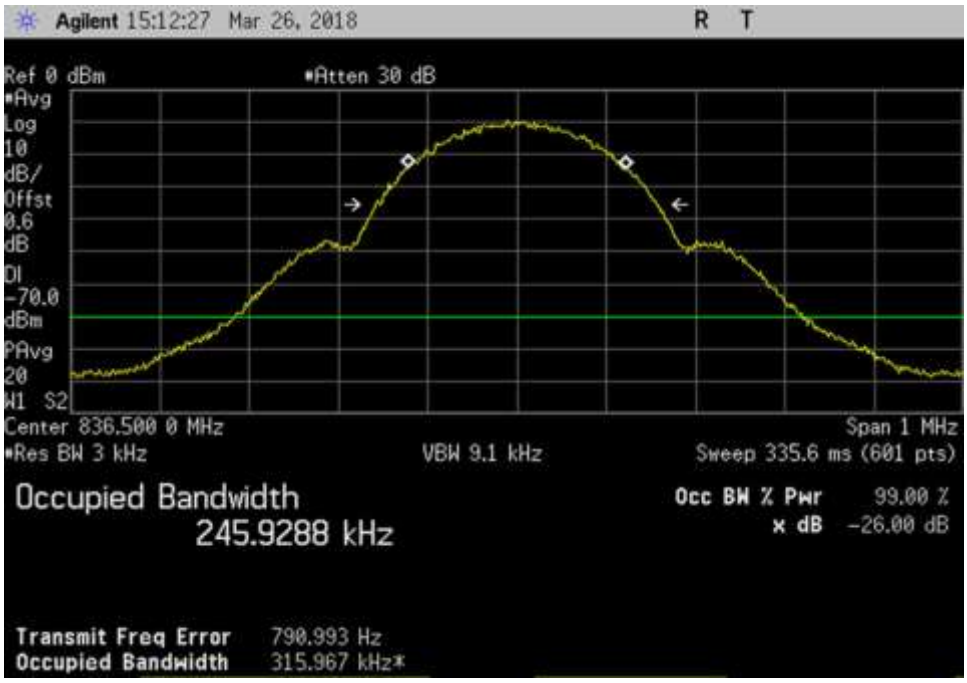
GSM Input



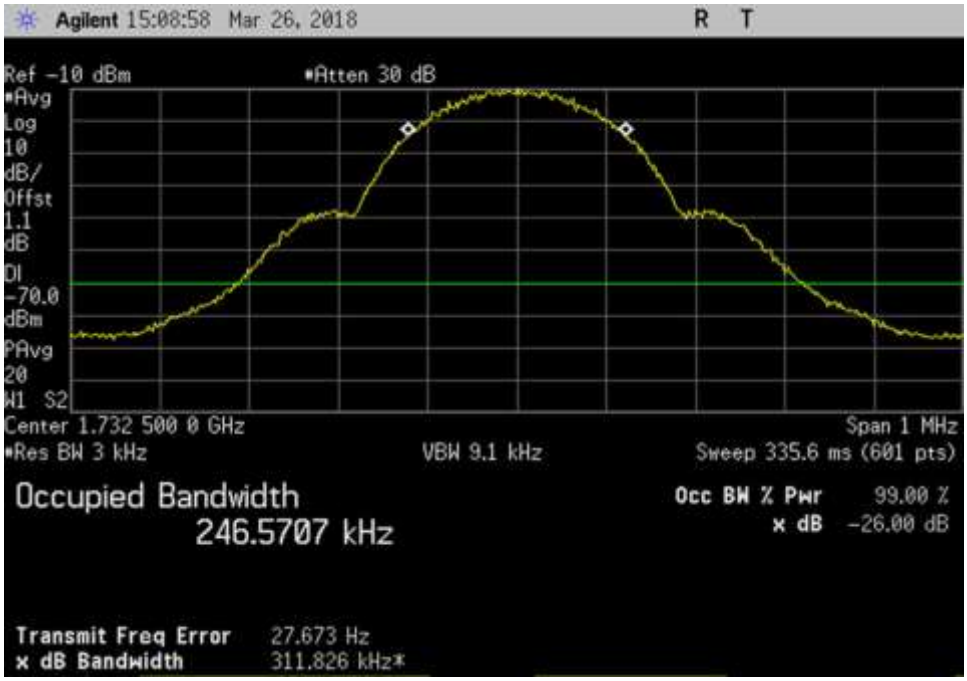
UL_698-716_GSM_ 707MHz



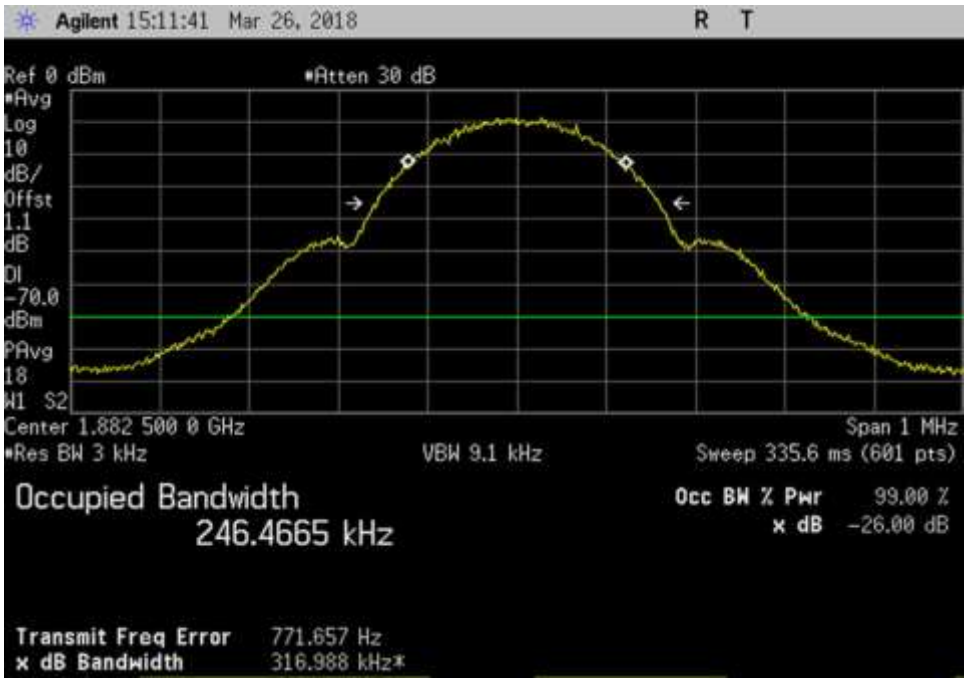
UL_776-787_GSM_ 781.5MHz



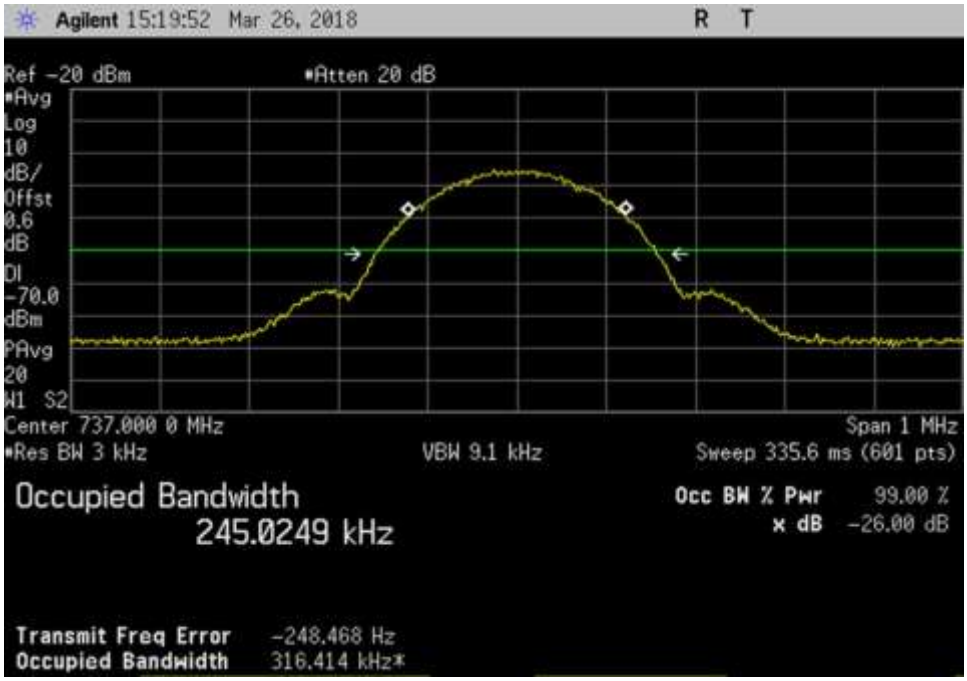
UL_824-849_GSM_ 836.5MHz



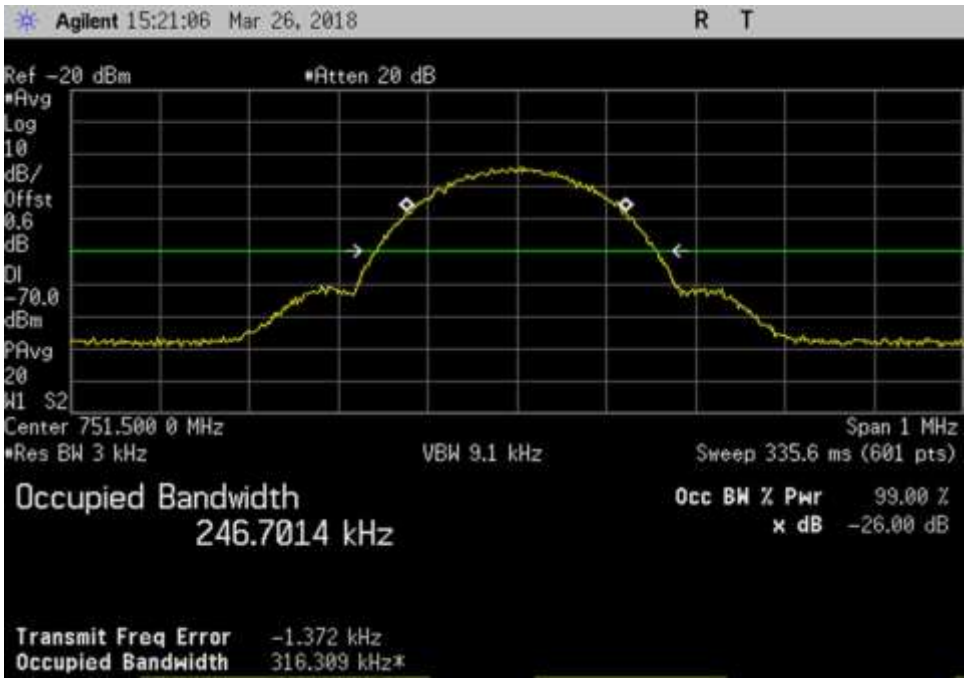
UL_1710-1755_GSM_ 1732.5MHz



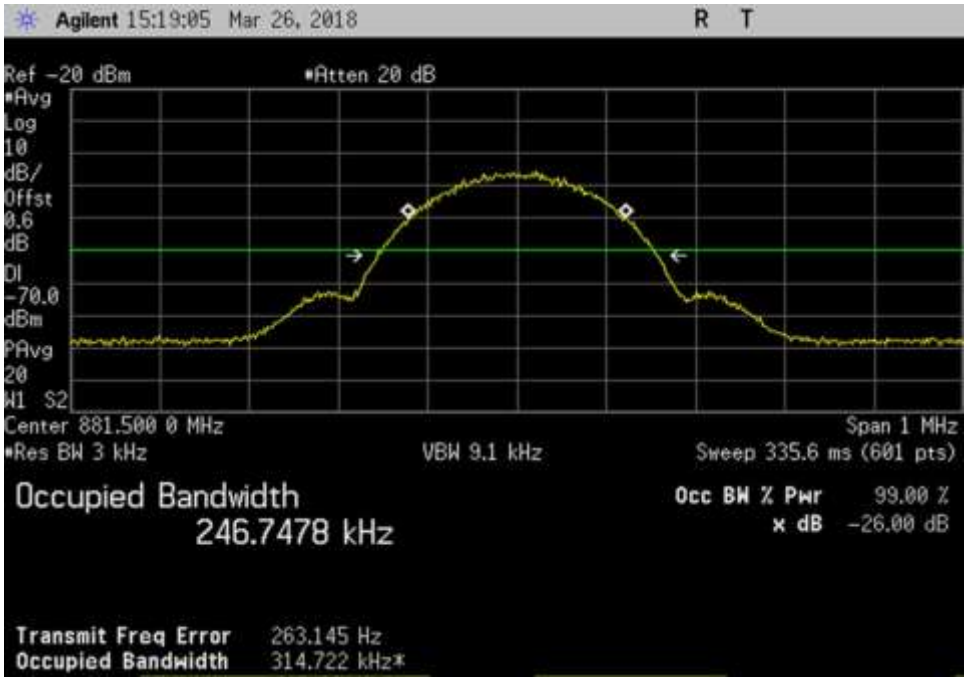
UL_1850-1915_GSM_ 1882.5MHz



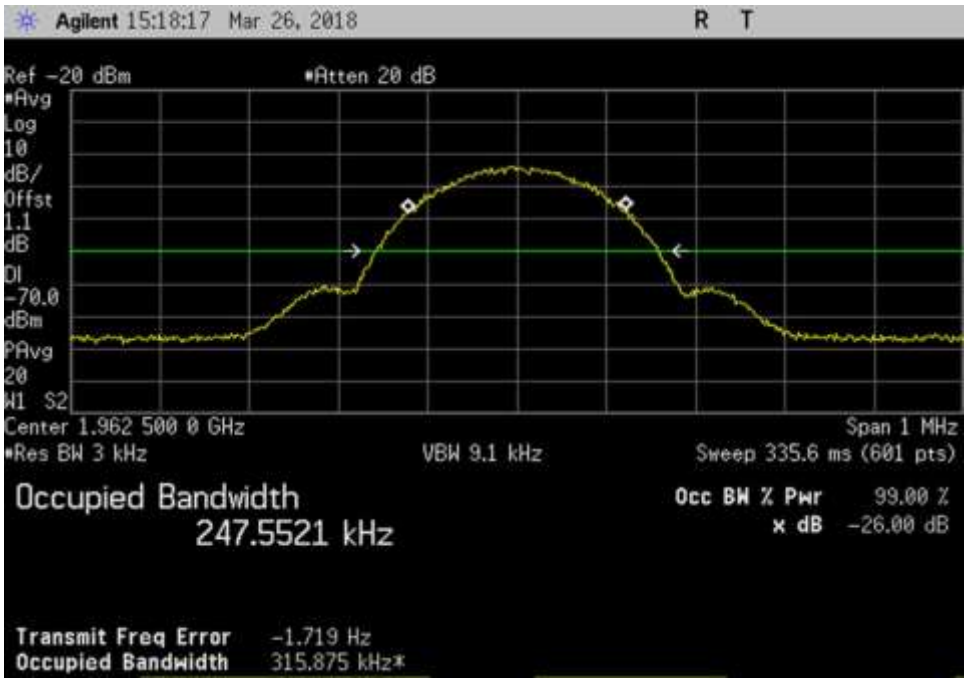
DL_728-746_GSM_ 737MHz



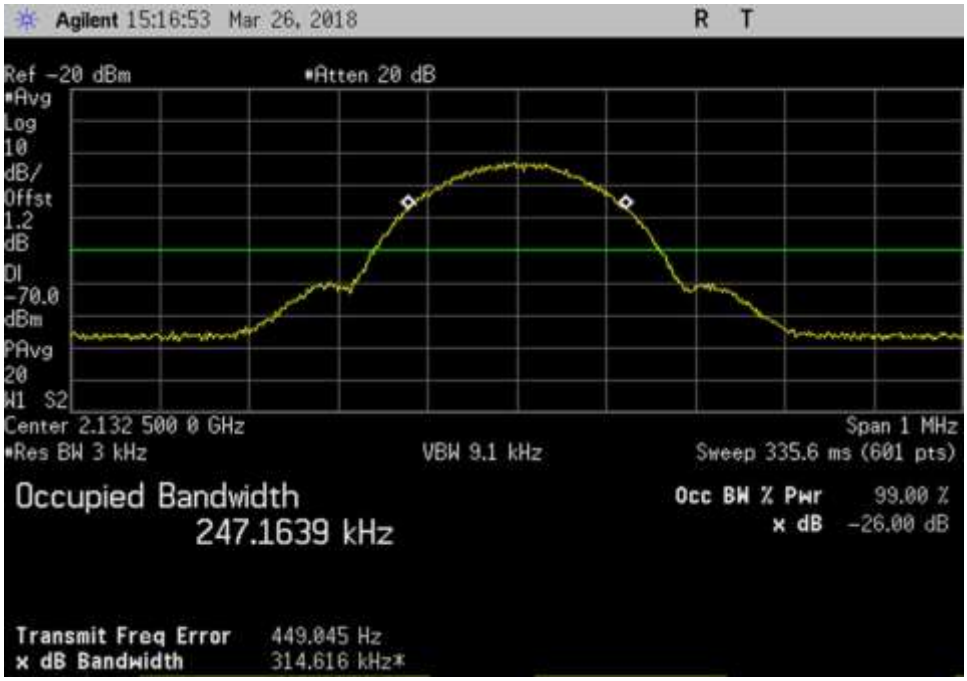
DL_746-757_GSM_ 751.5MHz



DL_869-894_GSM_ 881.5MHz

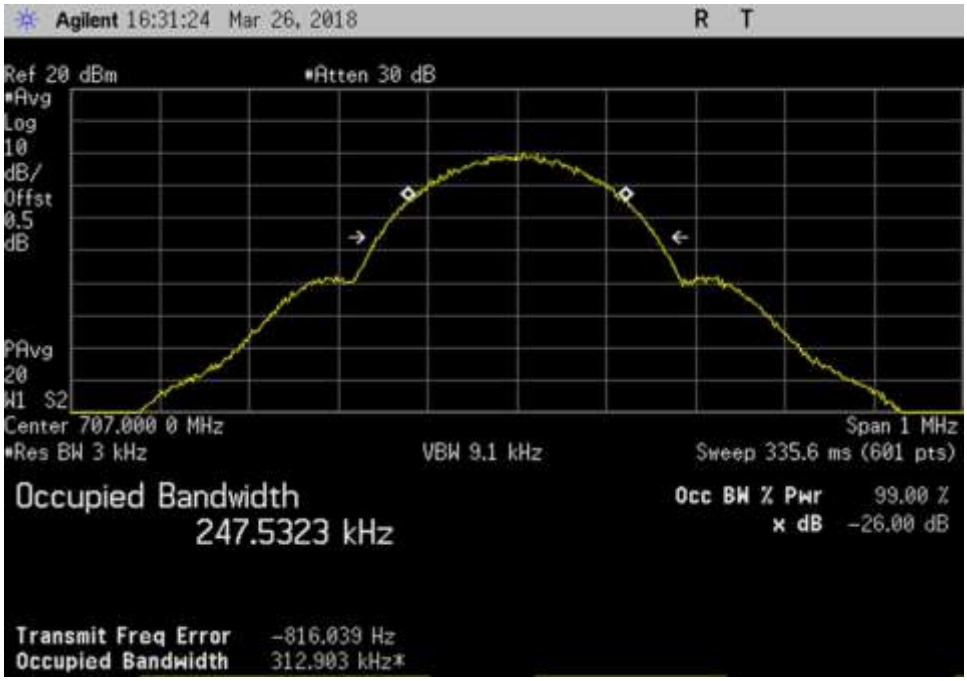


DL_1930-1995_GSM_ 1962.5MHz

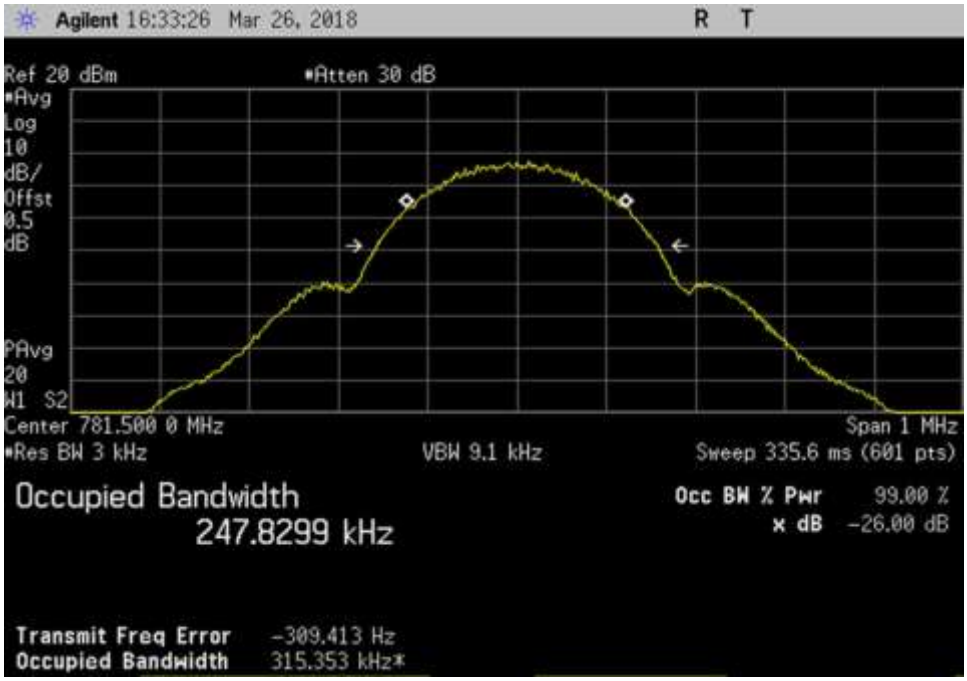


DL_2110-2155_GSM_ 2132.5MHz

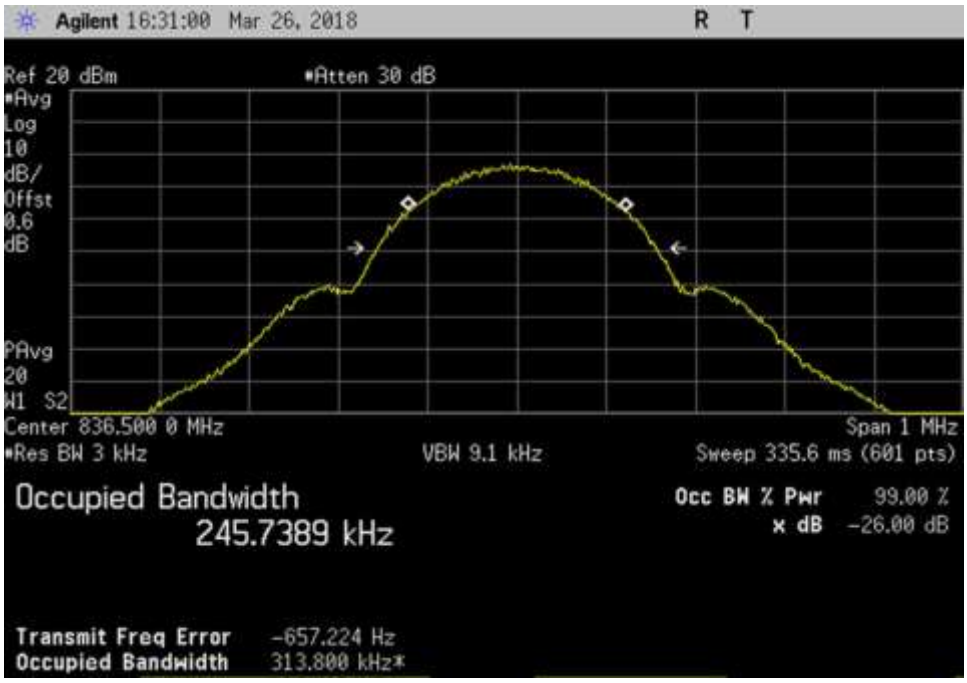
GSM Output



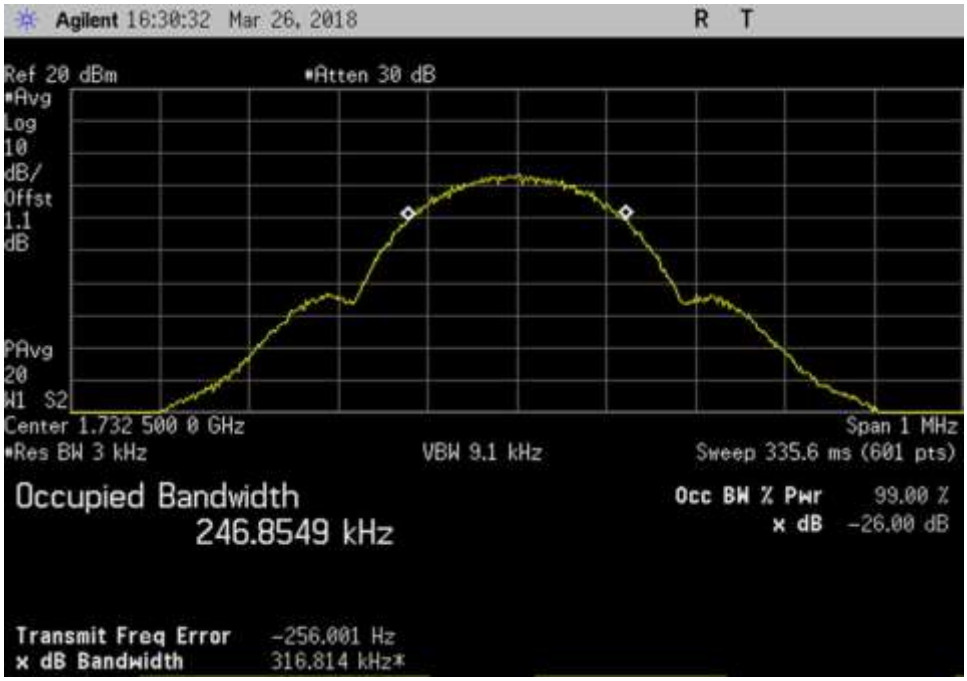
UL_698-716_GSM_ 707MHz



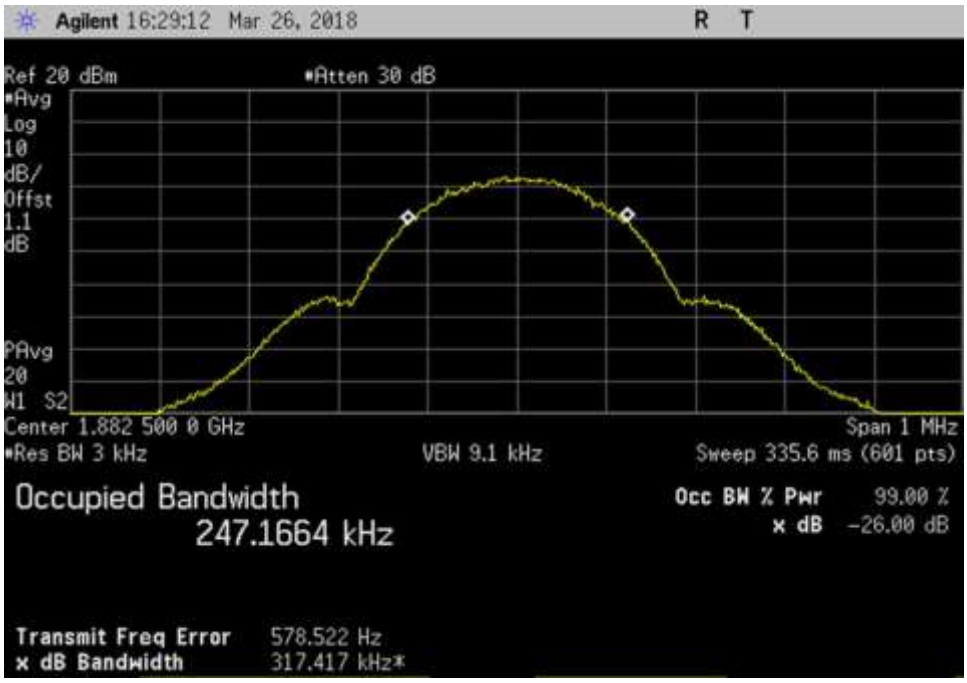
UL_776-787_GSM_ 781.5MHz



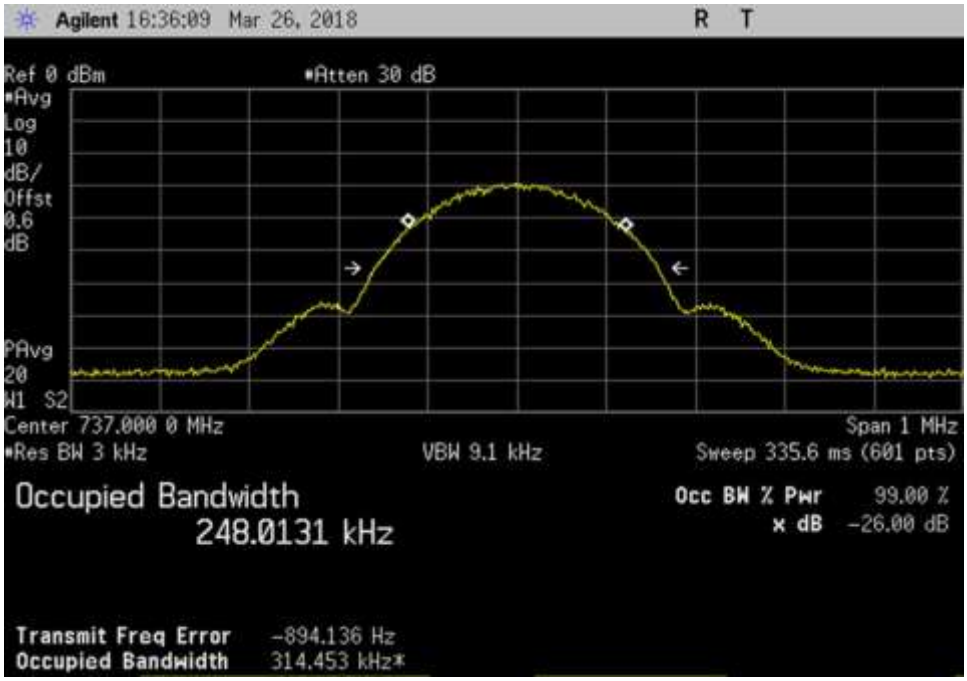
UL_824-849_GSM_ 836.5MHz



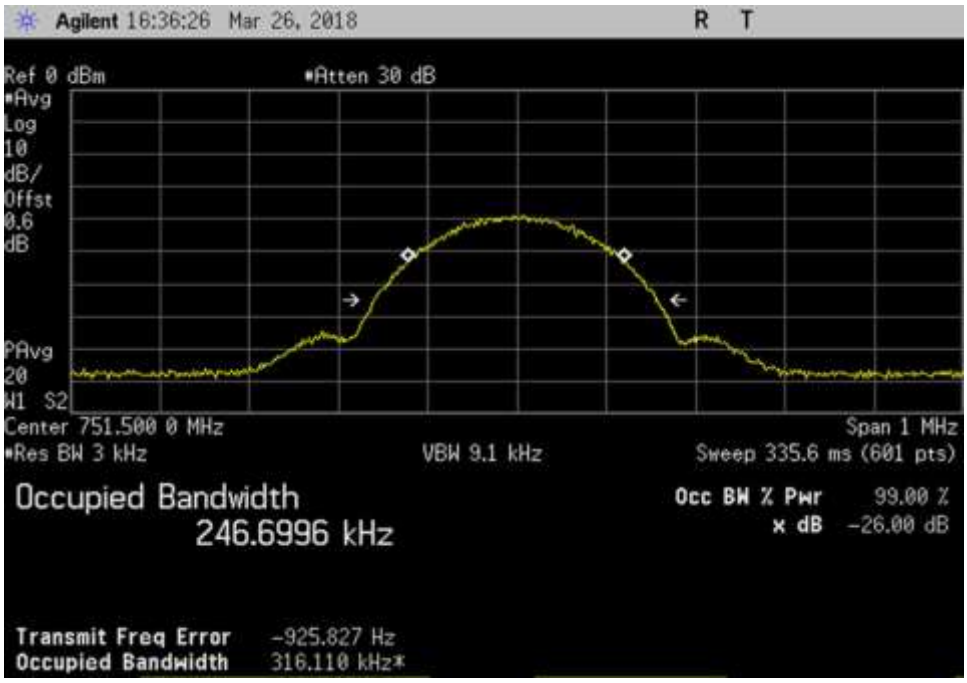
UL_1710-1755_GSM_ 1732.5MHz



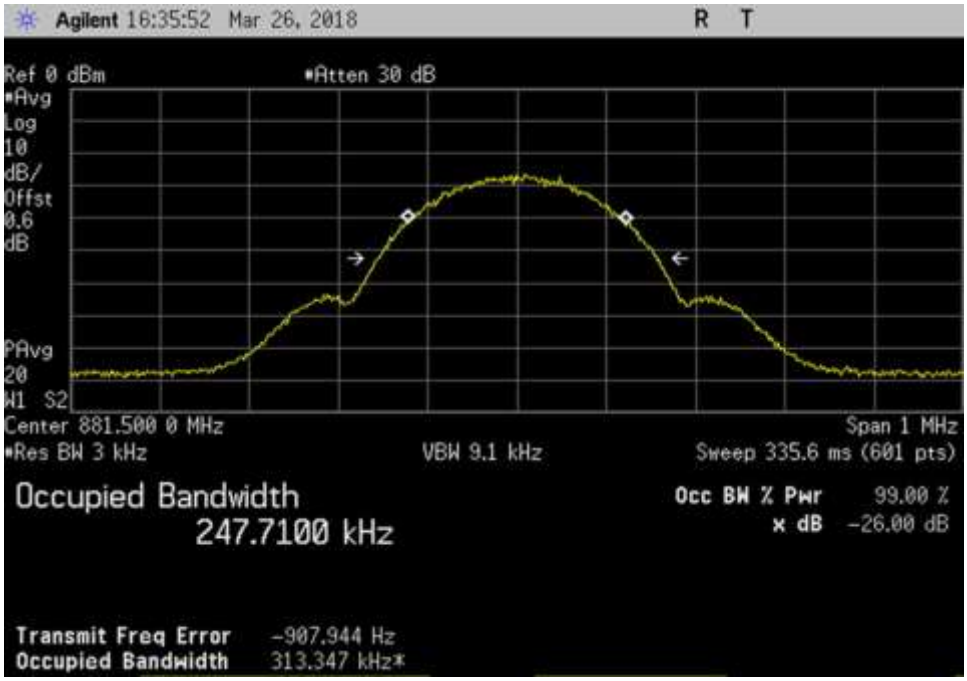
UL_1850-1915_GSM_ 1882.5MHz



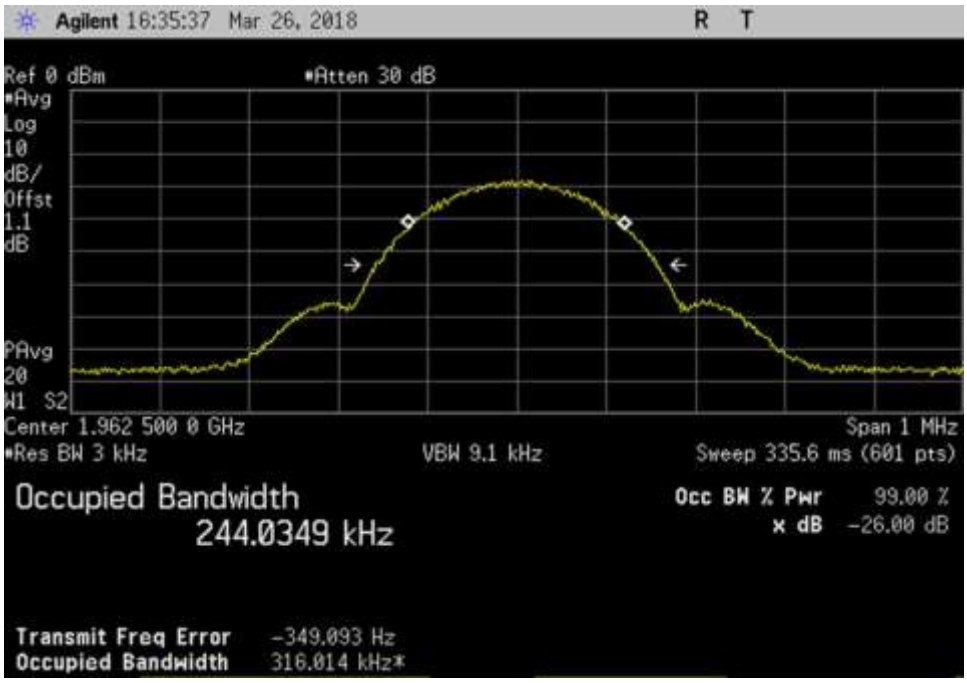
DL_728-746_GSM_ 737MHz



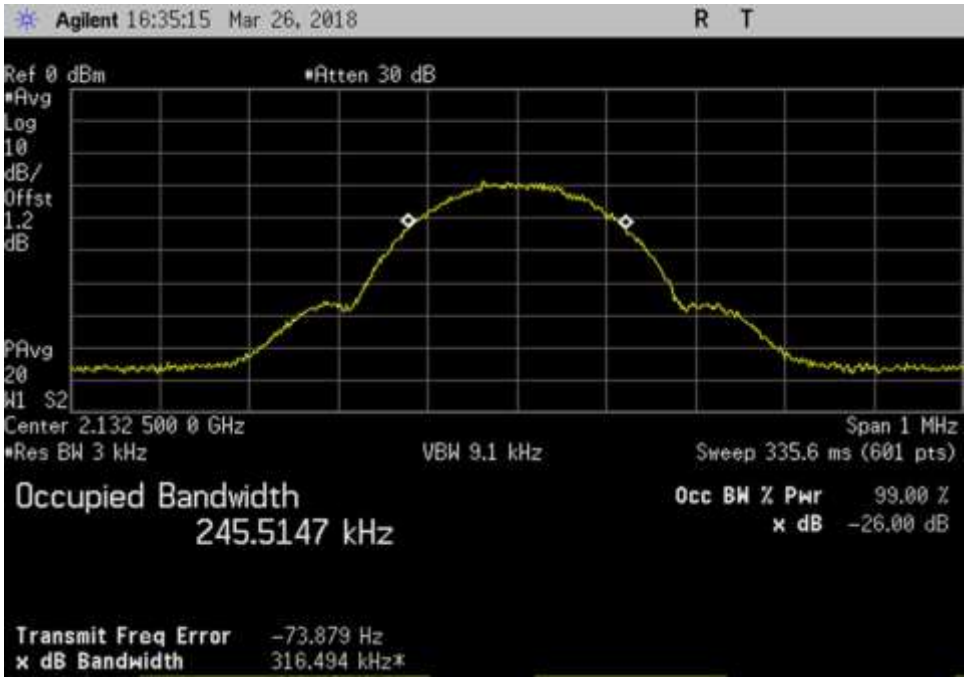
DL_746-757_GSM_ 751.5MHz



DL_869-894_GSM_ 881.5MHz

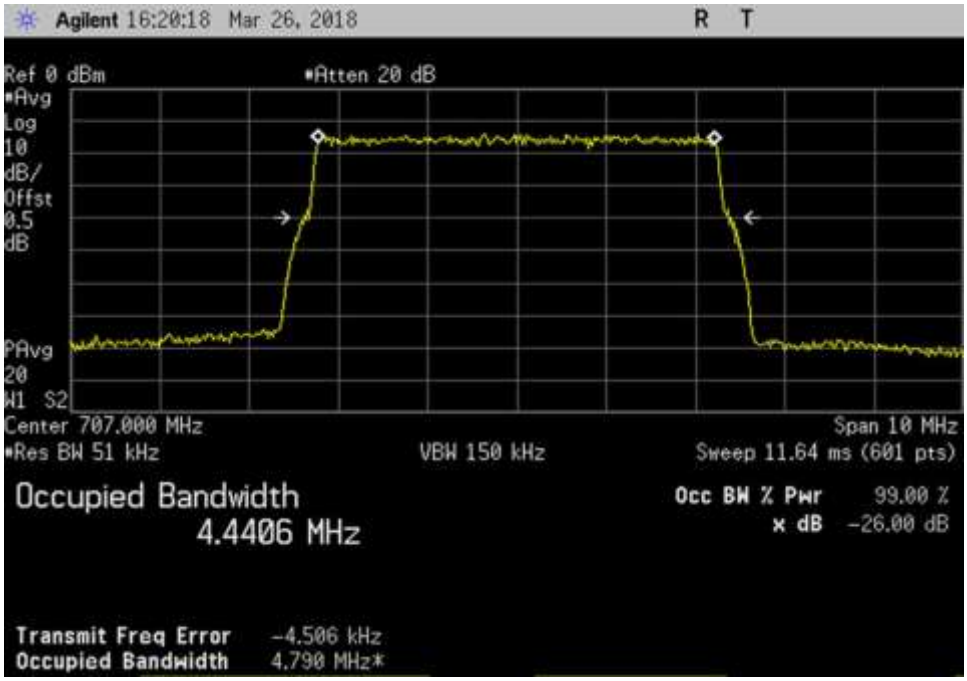


DL_1930-1995_GSM_ 1962.5MHz

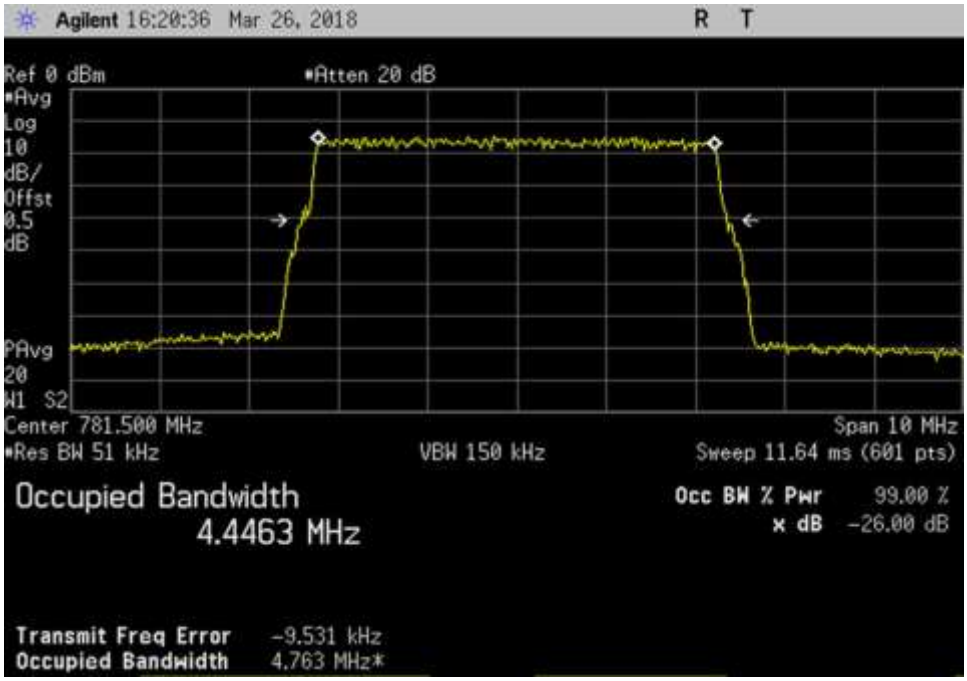


DL_2110-2155_GSM_ 2132.5MHz

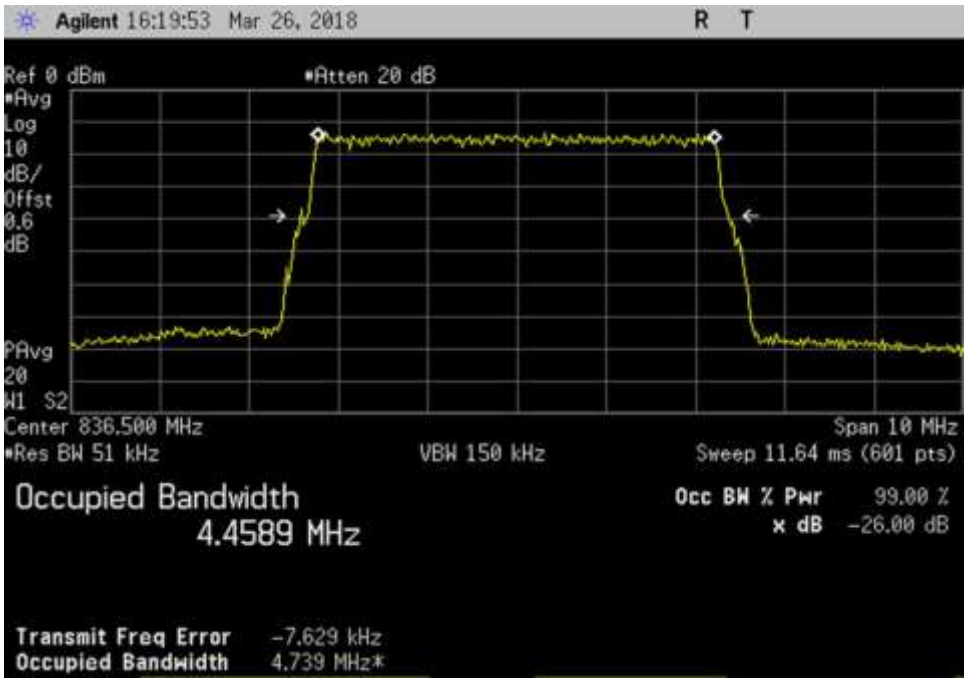
LTE Input



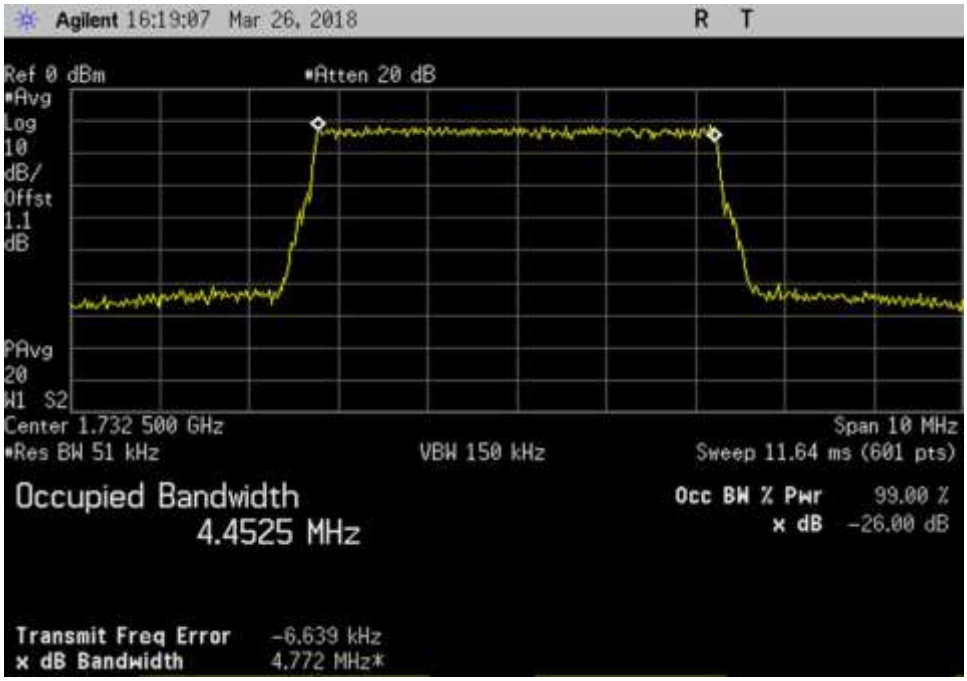
UL_698-716_LTE_ 707MHz



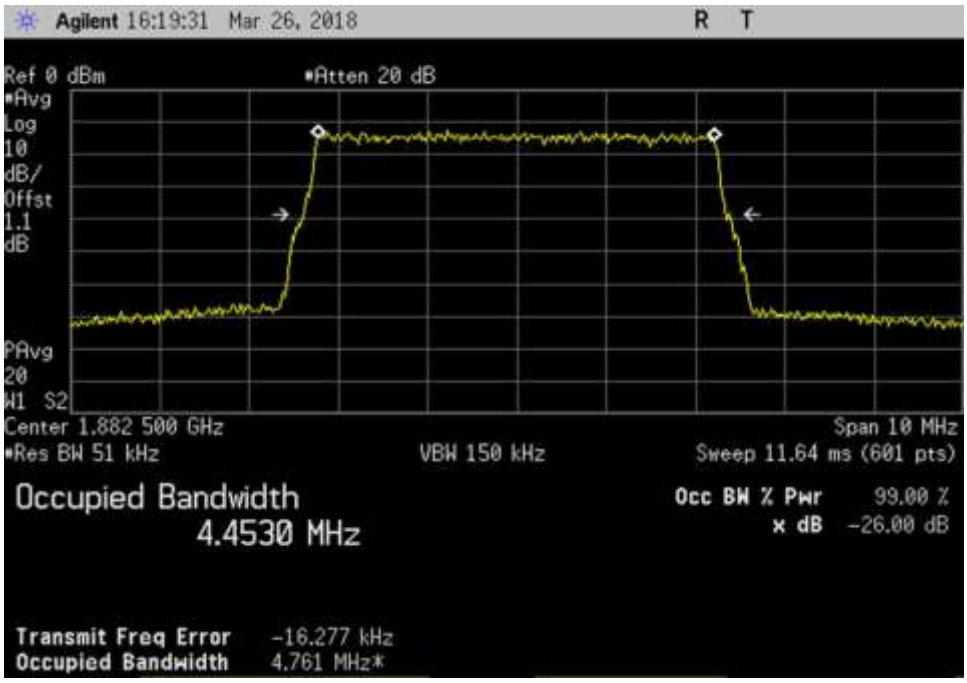
UL_776-787_LTE_ 781.5MHz



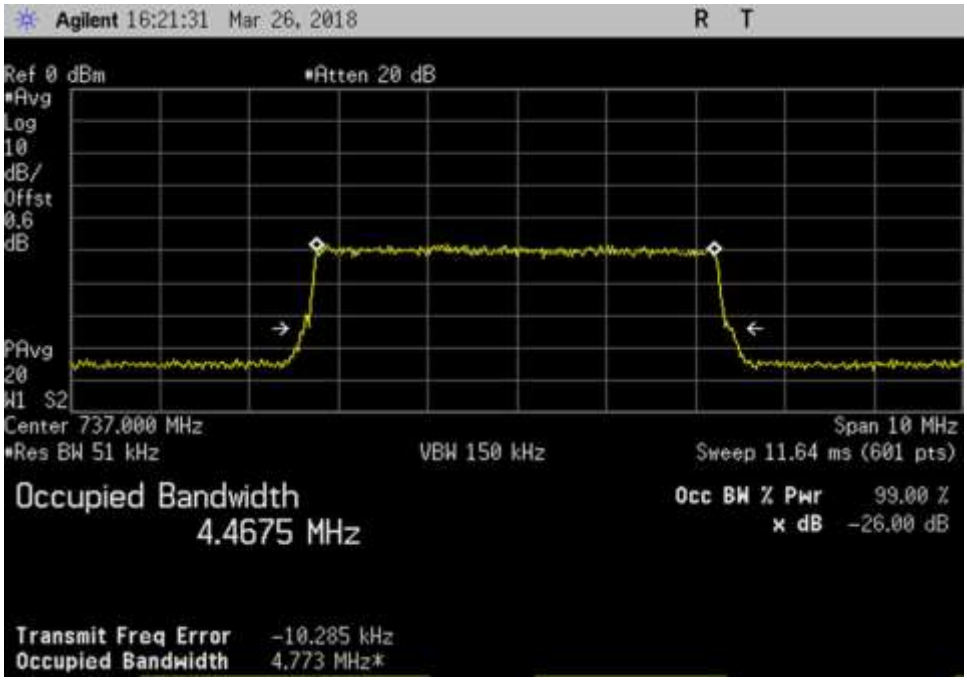
UL_824-849_LTE_ 836.5MHz



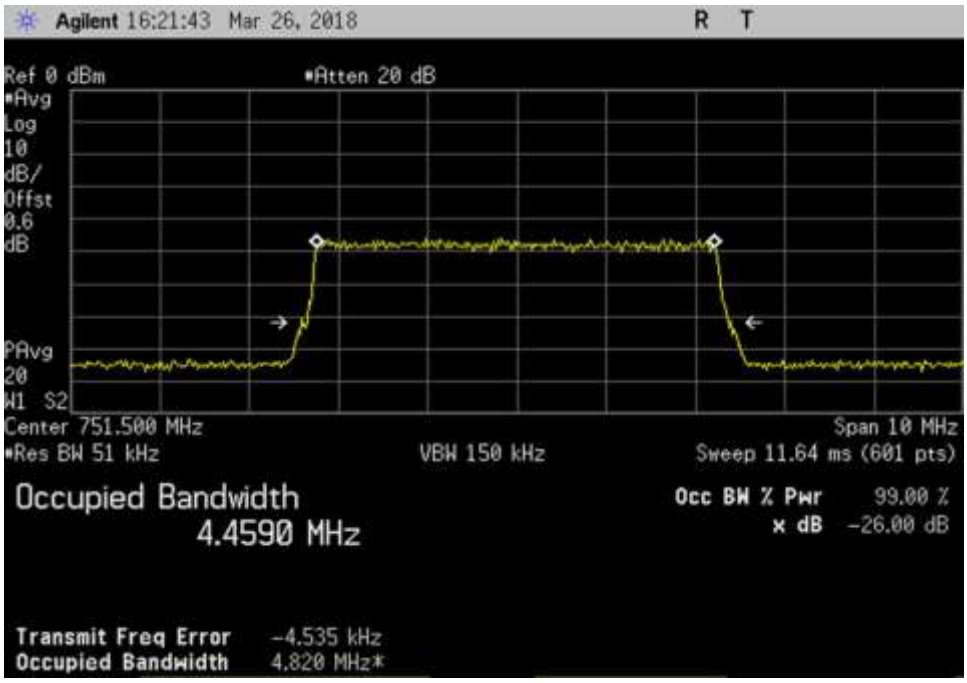
UL_1710-1755_LTE_ 1732.5MHz



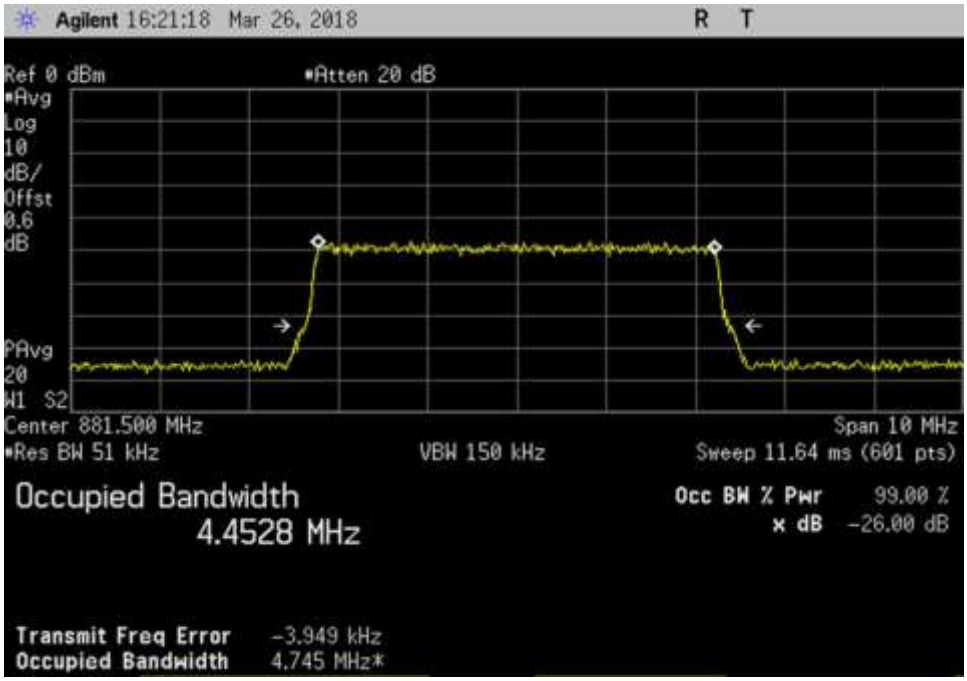
UL_1850-1915_LTE_ 1882.5MHz



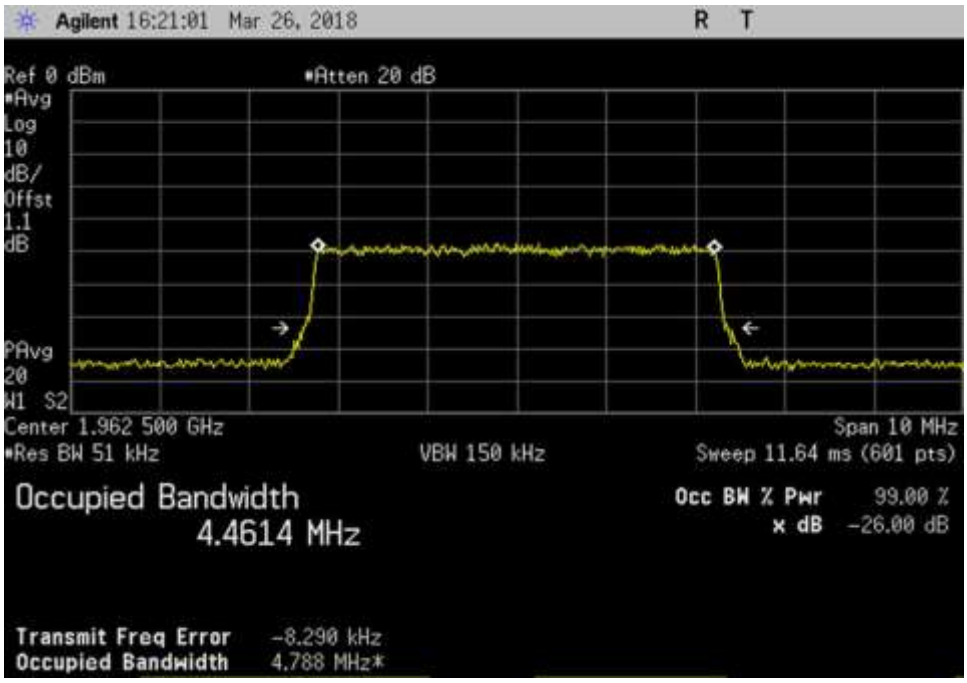
DL_728-746_LTE_ 737MHz



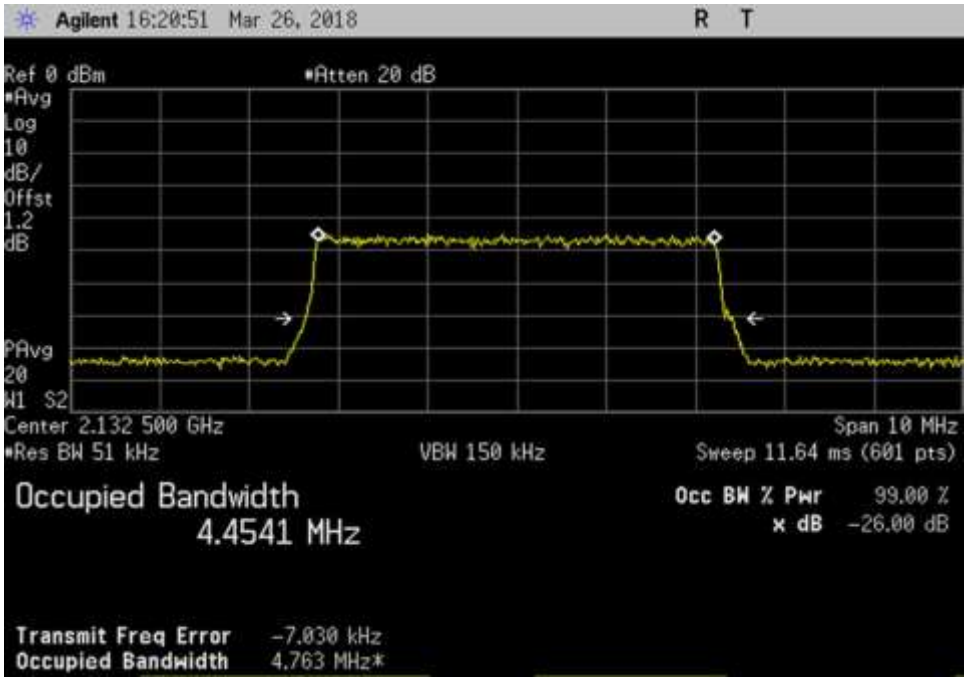
DL_746-757_LTE_ 751.5MHz



DL_869-894_LTE_ 881.5MHz

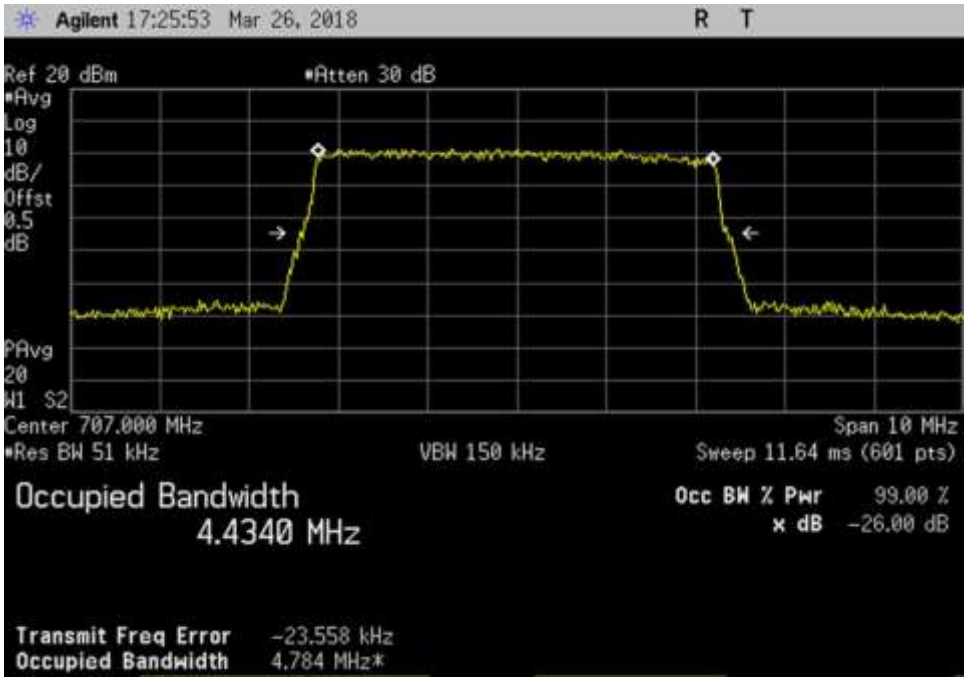


DL_1930-1995_LTE_ 1962.5MHz

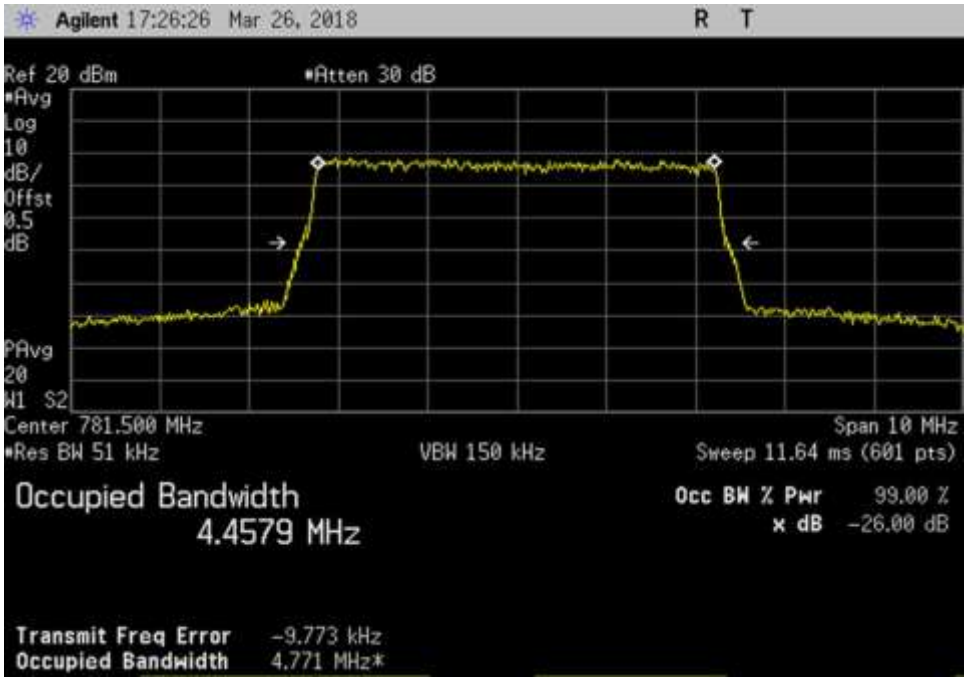


DL_2110-2155_LTE_ 2132.5MHz

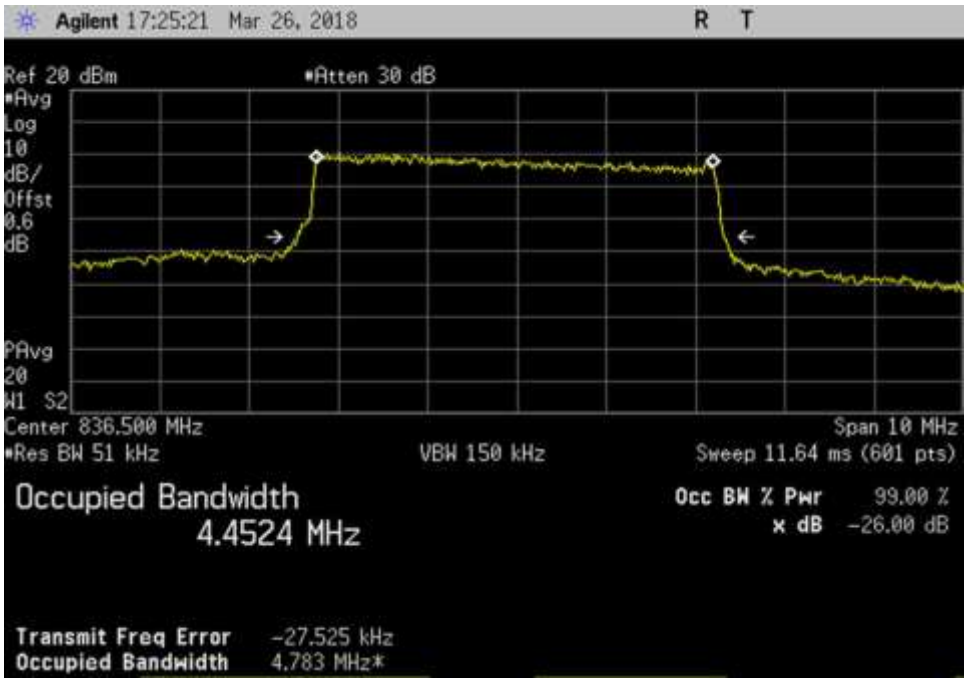
LTE Output



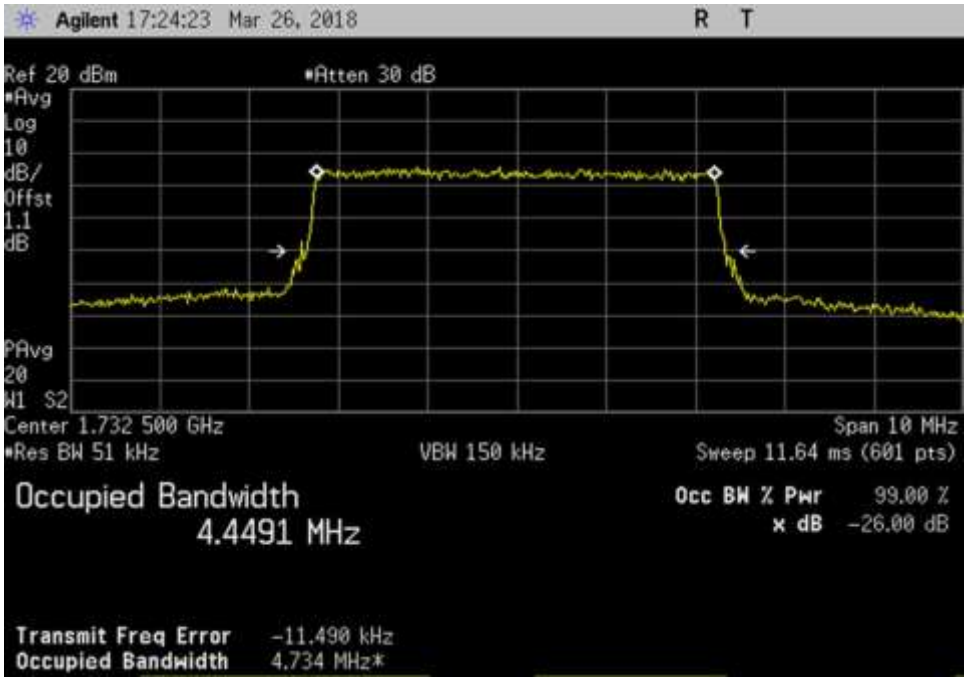
UL_698-716_LTE_ 707MHz



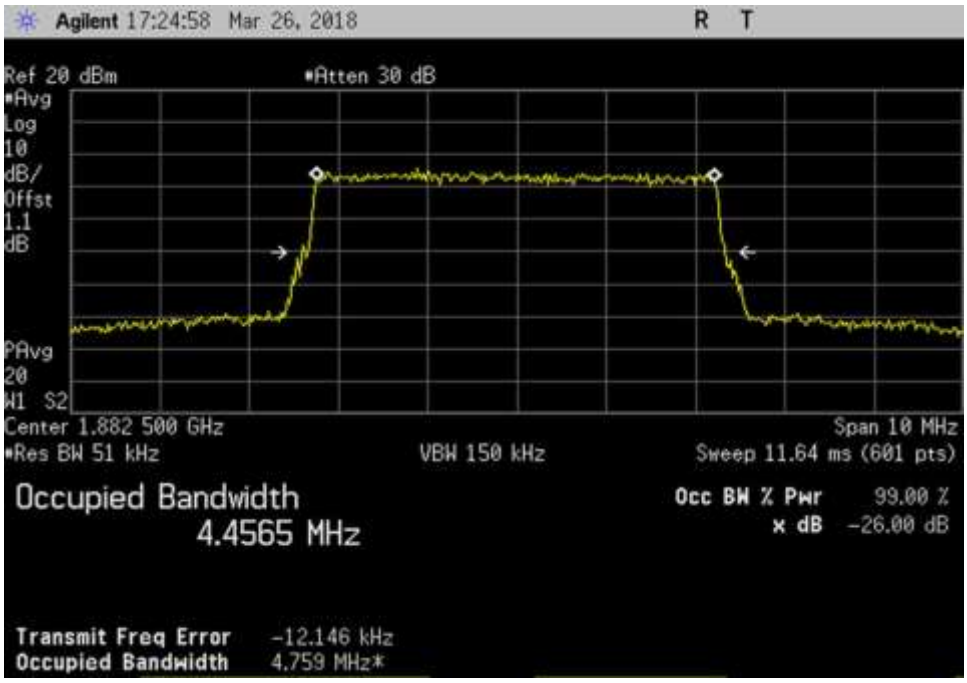
UL_776-787_LTE_ 781.5MHz



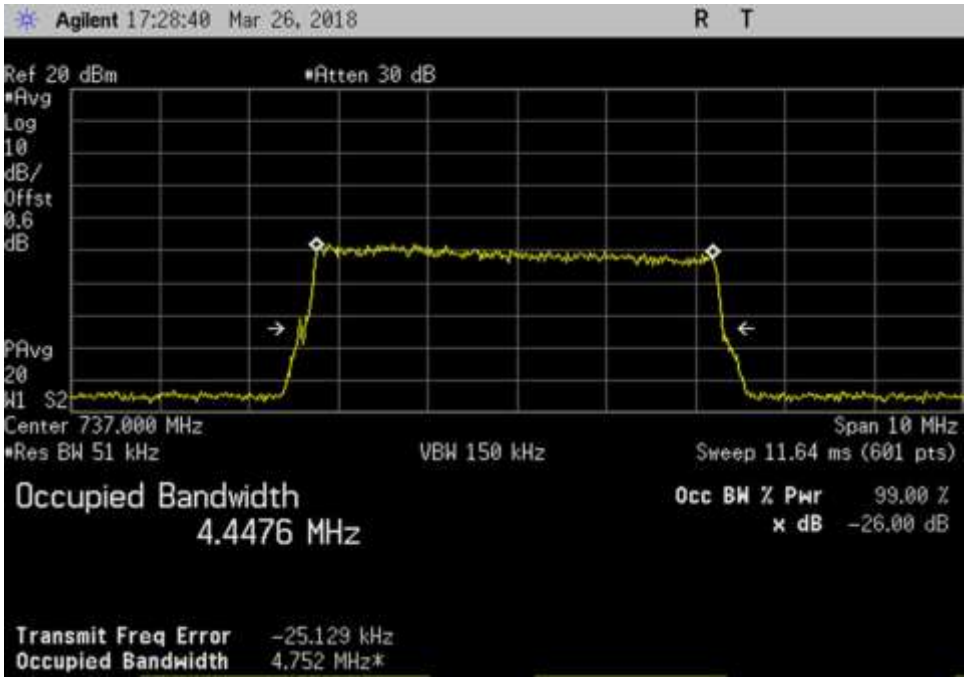
UL_824-849_LTE_ 836.5MHz



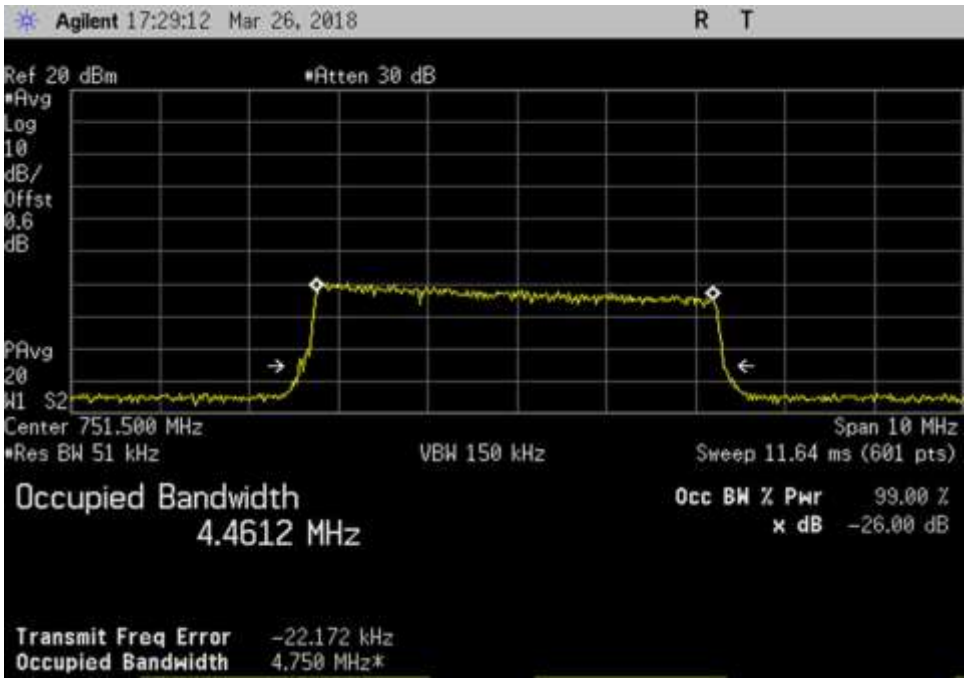
UL_1710-1755_LTE_ 1732.5MHz



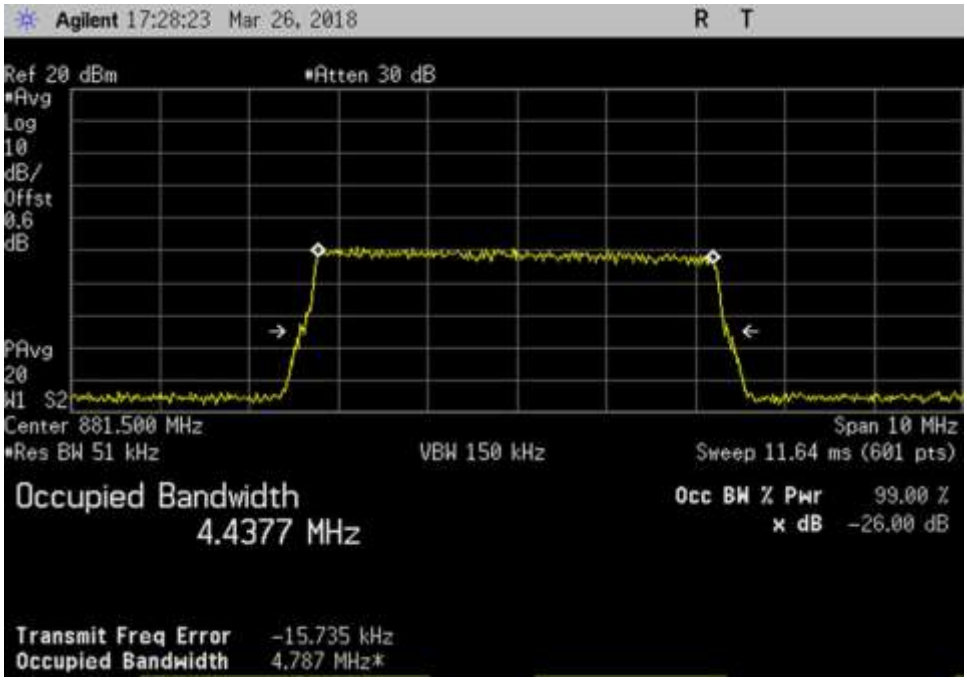
UL_1850-1915_LTE_ 1882.5MHz



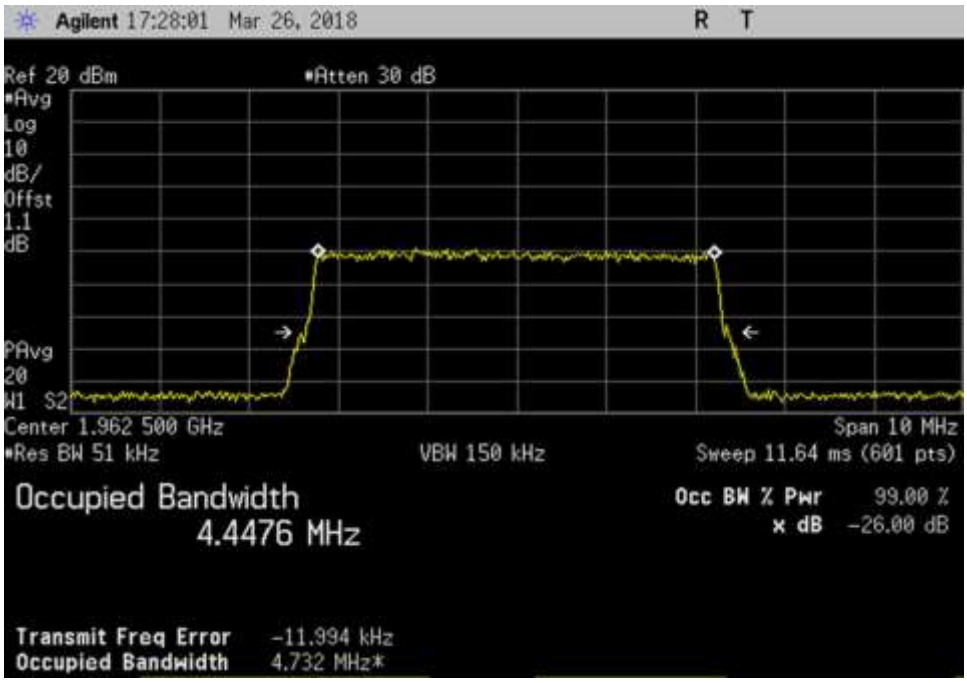
DL_728-746_LTE_ 737MHz



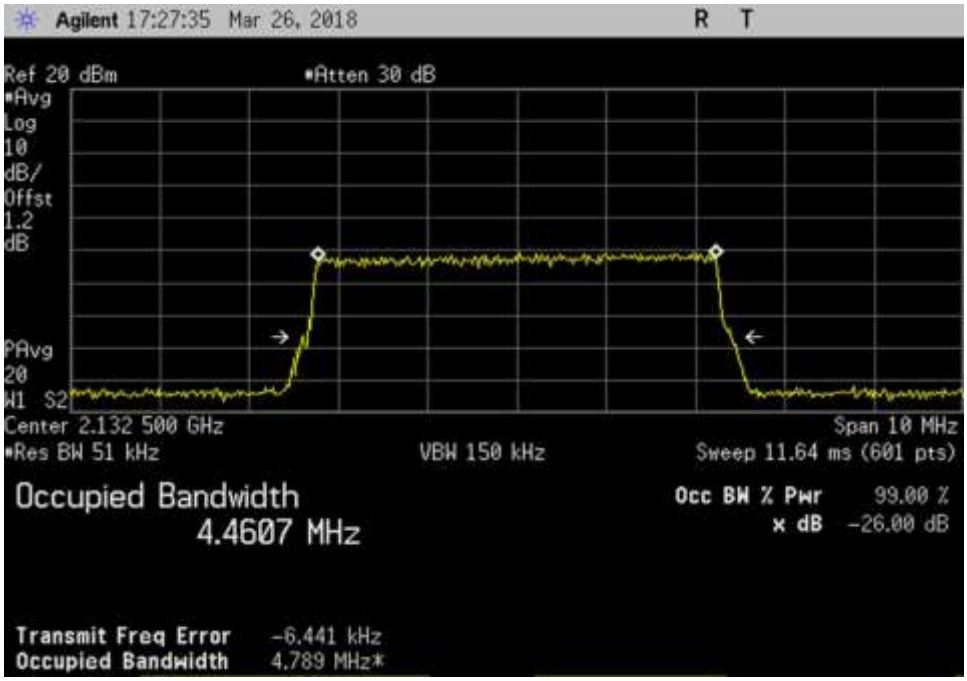
DL_746-757_LTE_ 751.5MHz



DL_869-894_LTE_ 881.5MHz

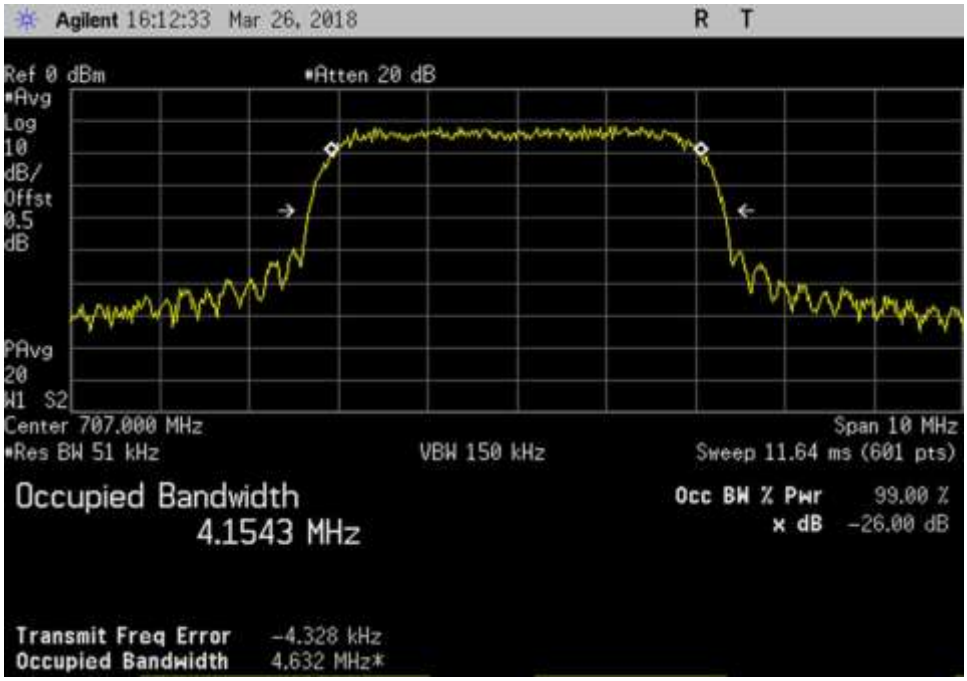


DL_1930-1995_LTE_ 1962.5MHz

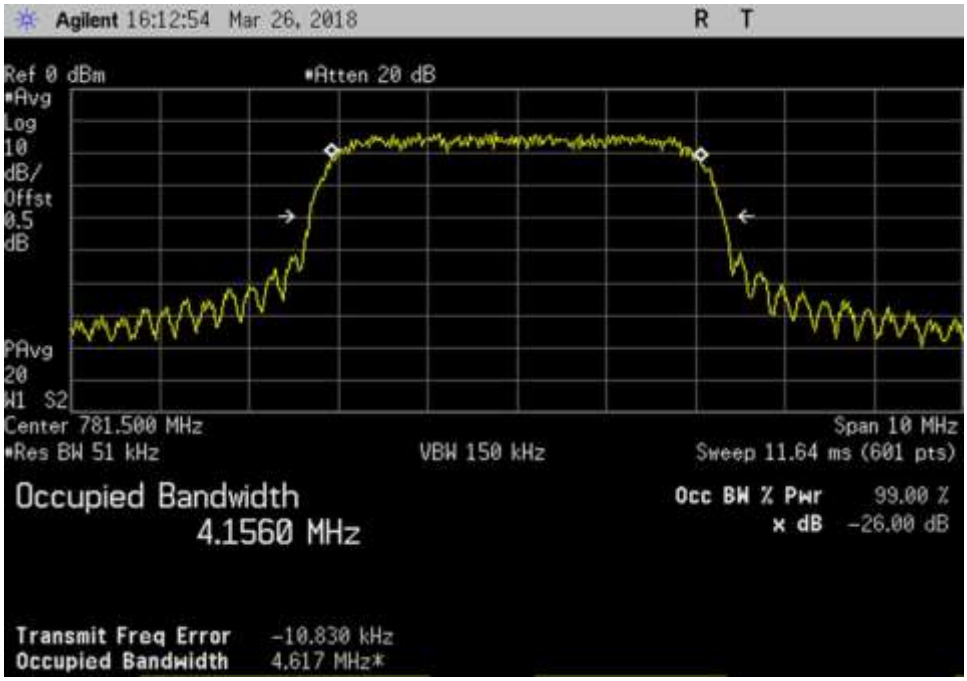


DL_1930-1995_LTE_ 2132.5MHz

WCDMA Input



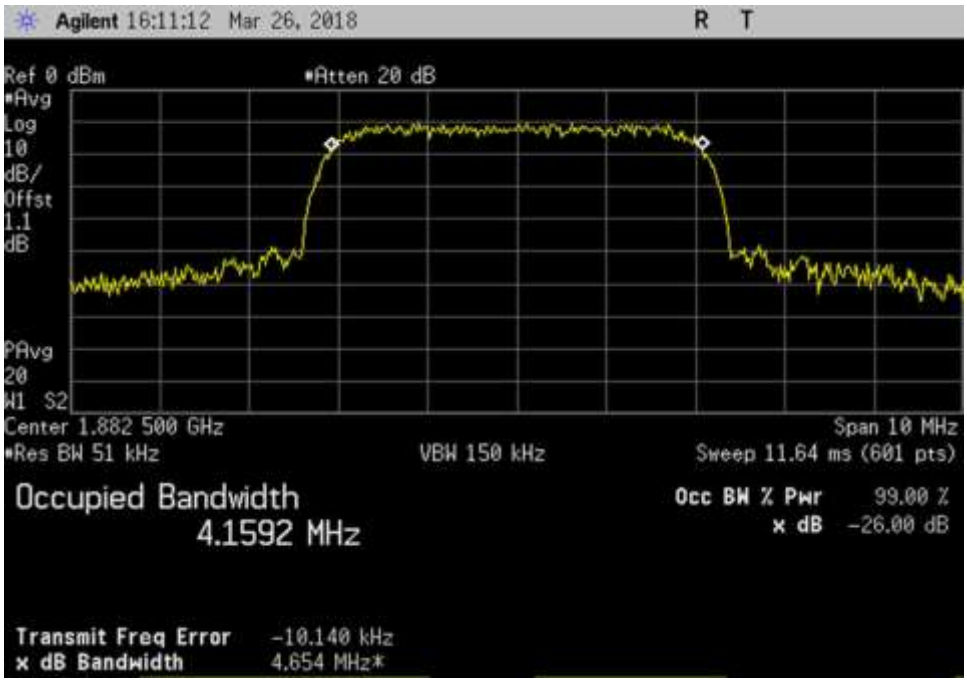
UL_698-716_WCDMA_ 707MHz



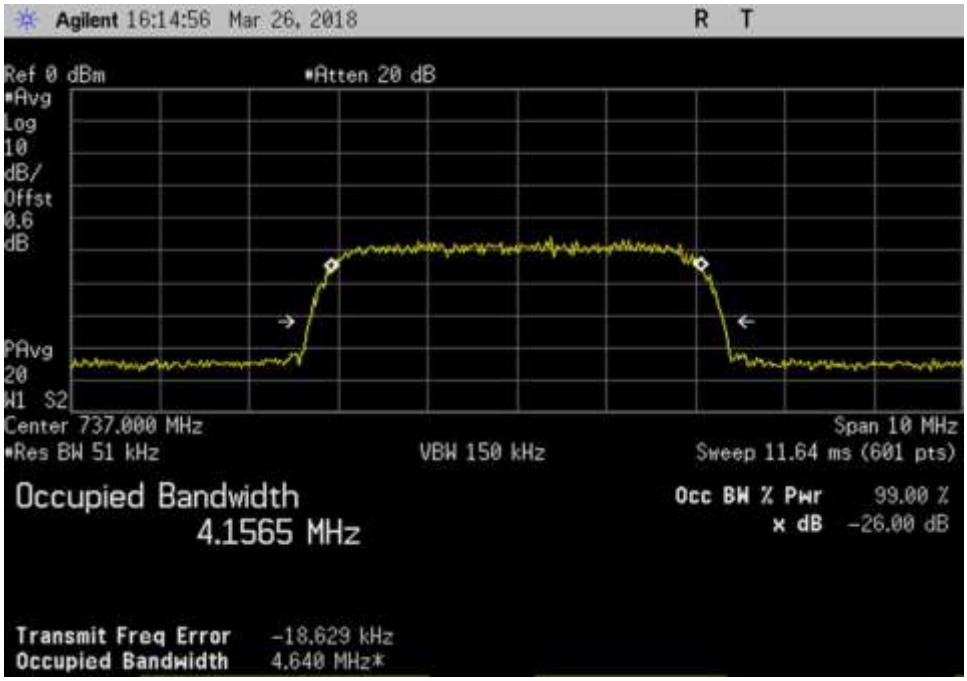
UL_776-787_WCDMA_ 781.5MHz

UL_824-849_WCDMA_ 836.5MHz

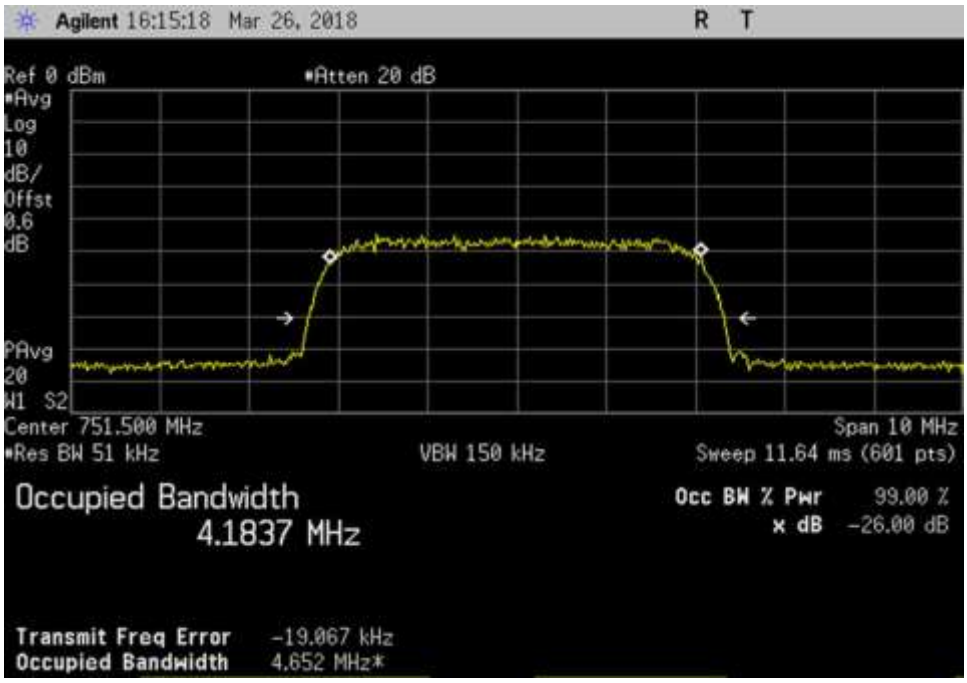
UL_1710-1755_WCDMA_ 1732.5MHz



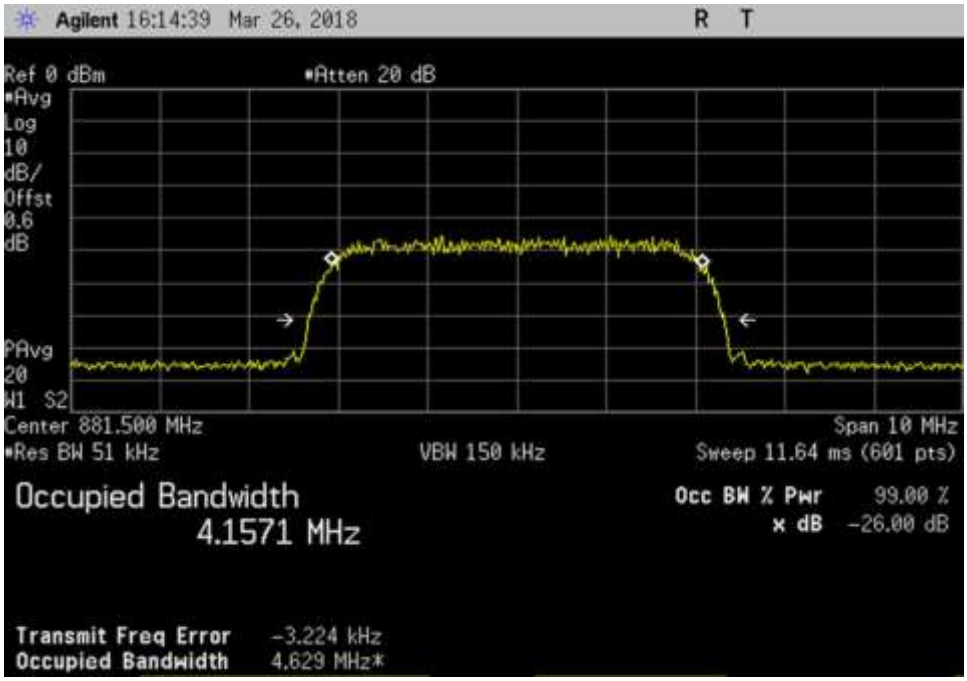
UL_1850-1915_WCDMA_ 1882.5MHz



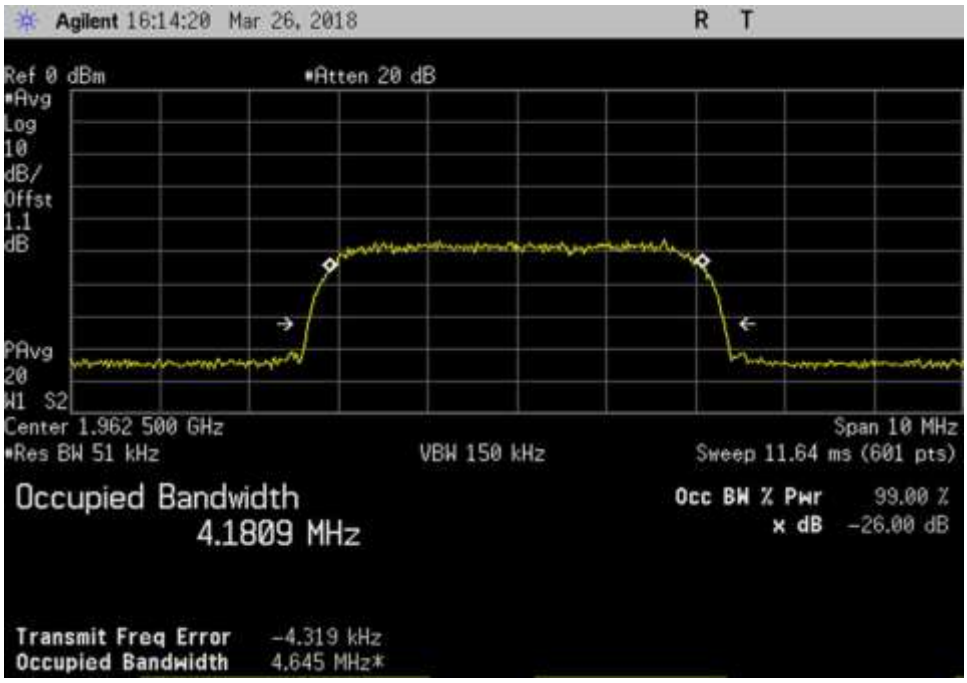
DL_728-746_WCDMA_ 737MHz



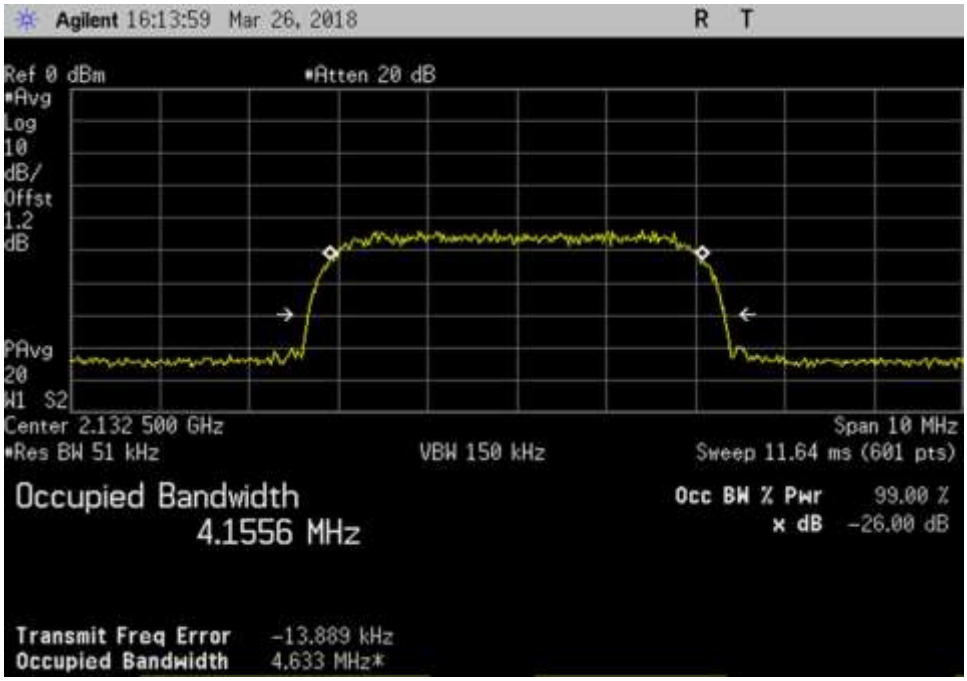
DL_746-757_WCDMA_ 751.5MHz



DL_869-894_WCDMA_ 881.5MHz

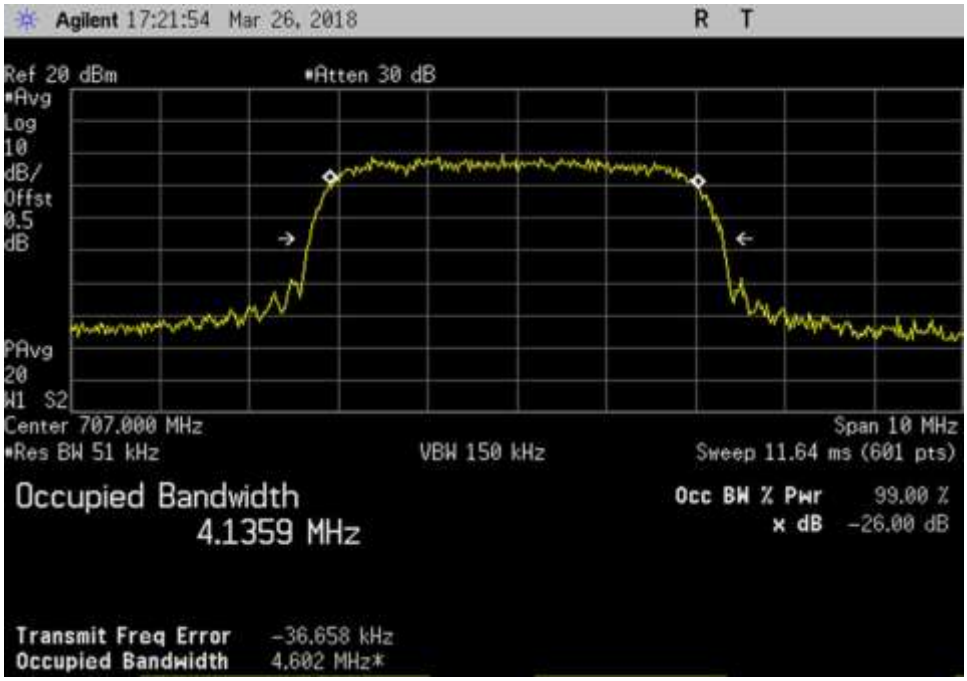


DL_1930-1995_WCDMA_ 1962.5MHz

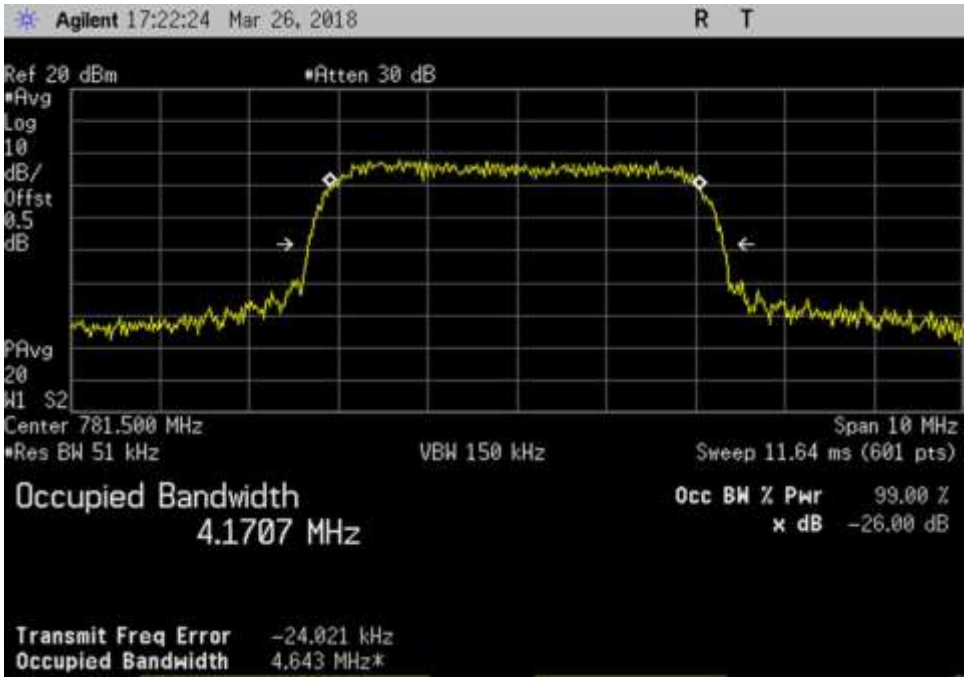


DL_2110-2155_WCDMA_ 2132.5MHz

WCDMA Output

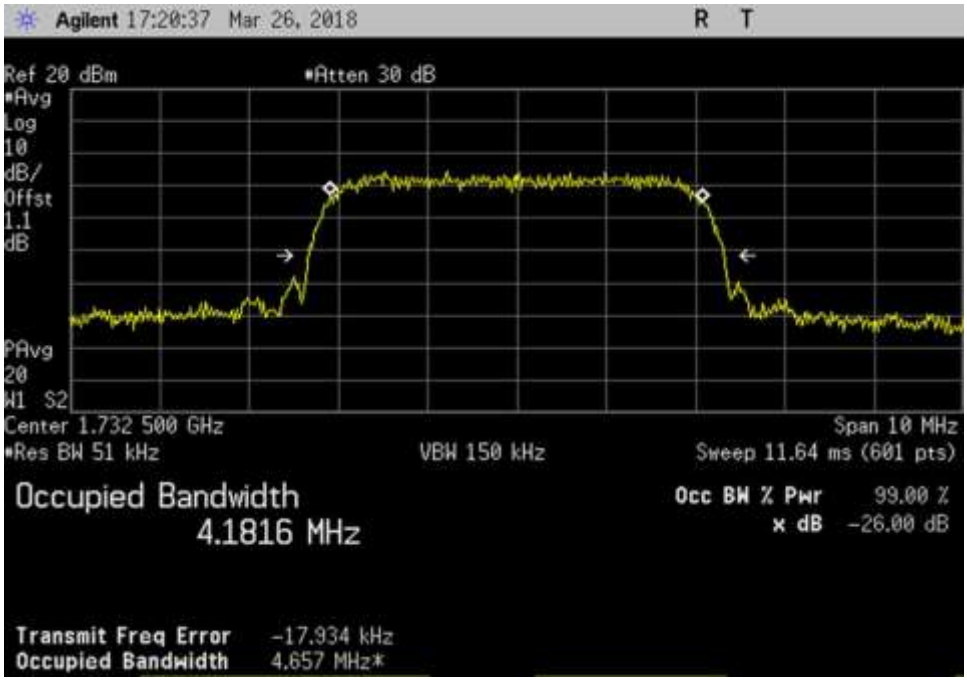


UL_698-716_WCDMA_ 707MHz

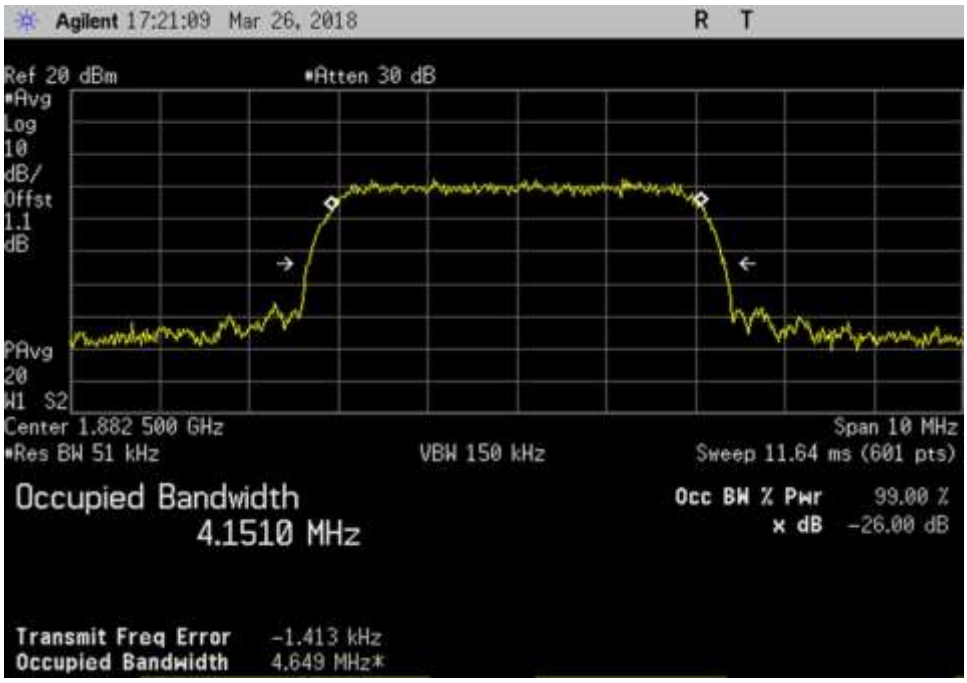


UL_776-787_WCDMA_ 781.5MHz

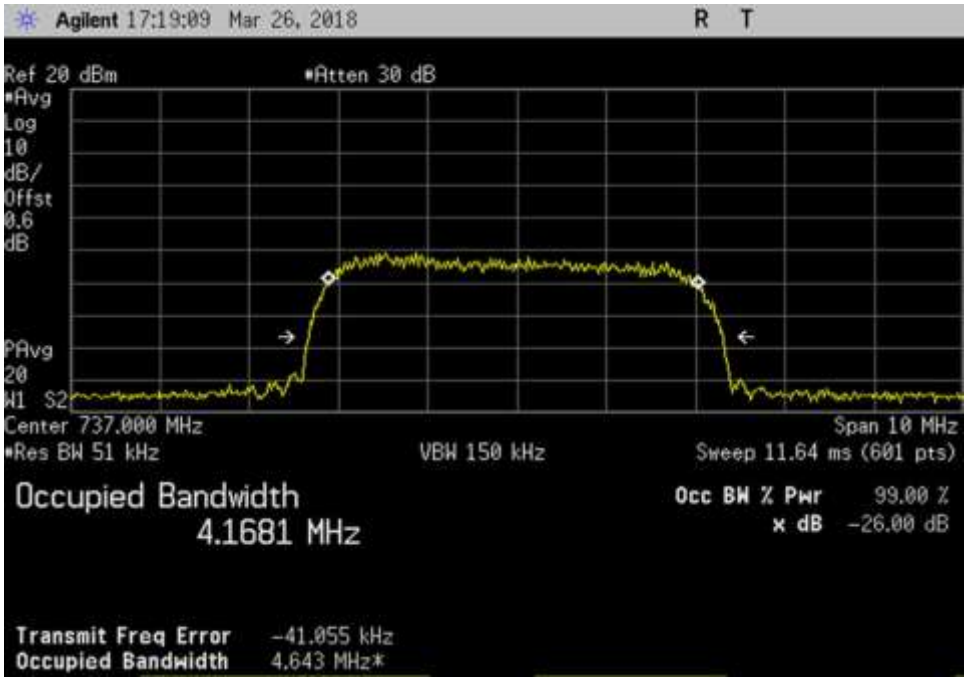
UL_824-849_WCDMA_ 836.5MHz



UL_1710-1755_WCDMA_ 1732.5MHz

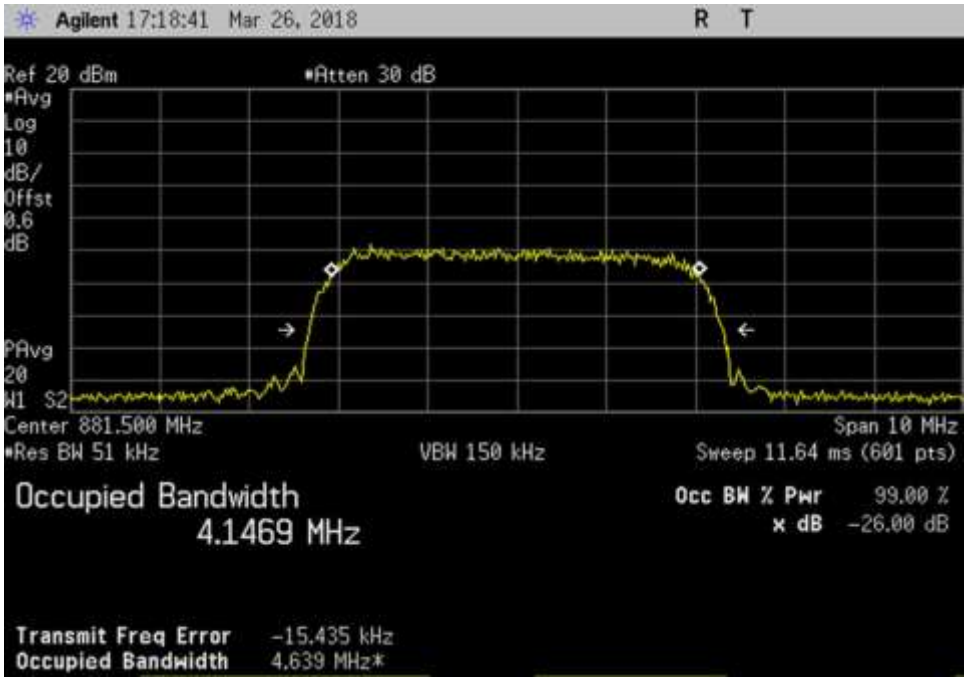


UL_1850-1915_WCDMA_ 1882.5MHz



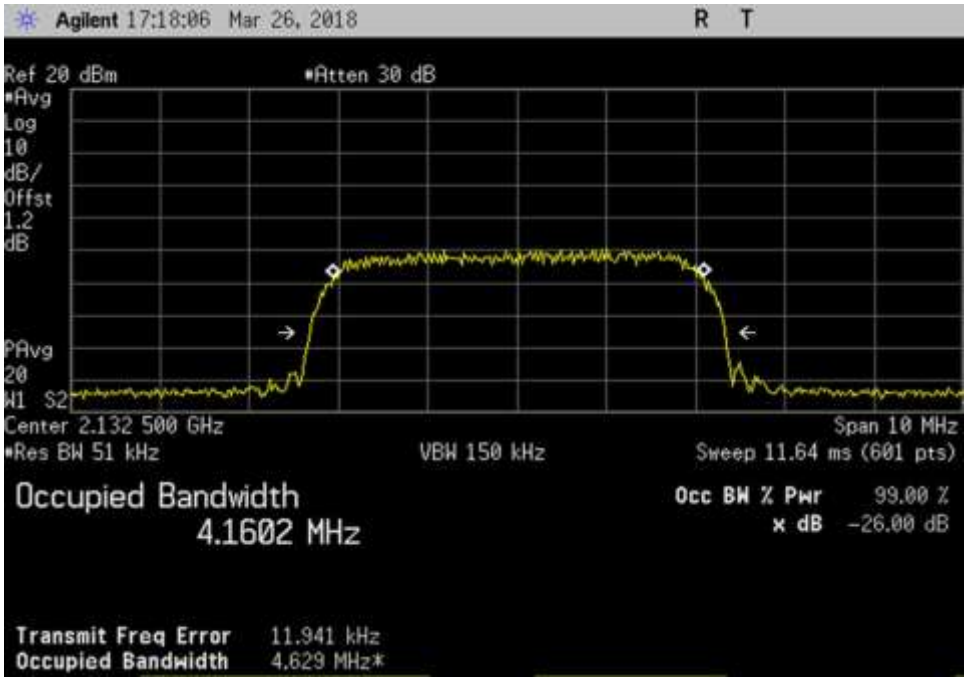
DL_728-746_WCDMA_ 737MHz

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 Conditions / Setup

Test Location:	CKC Laboratories, Inc. • 110 N. Olinda Place. Brea, CA 92821• 714 993 6112		
Customer:	Huaptec		
Specification:	Section 20.21(e)(8)(ii)(A) Anti-Oscillation		
Work Order #:	**100428**	Date:	3/27 and 28, 2018, 5/15/2018, and 6/12/2018
Test Type:	**Conducted Emissions**		
Tested By:	E. Wong / S. Yamamoto		
Software:	EMITest 5.03.11		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

General test condition.
The equipment under test (EUT) is a Mobile Wideband Consumer Booster with direct contact coupling (cradle-type) antenna.
The EUT is placed on the test bench. Evaluation performed at the Outside (Donor) and Inside (Server) antenna port.
The EUT Donor port is a MCX type connector and 50-ohm impedance.
The EUT Server/DL port /is type UFL connector and 50-ohm impedance.

Part 22
UL: 824-849MHz
DL: 869-894MHz
Part 24
UL: 1850-1915MHz
DL: 1930-1995MHz
Part 27
UL: 1710-1755MHz, 698-716MHz, 776-787MHz
DL: 2110-2155MHz, 728-746MHz, 746-757MHz

Test procedure:
The test was performed in accordance with the FCC document: 935210 D03 Signal Booster Measurements v04r01, dated October 27, 2017.
Firmware: 2.0

Test environment conditions:
Temperature: 20 -25°C
Relative Humidity: 37-45 %
Pressure: 100kPa

Device is powered by a provided 5V USB/12V Automotive adaptor

Modification #2 was in place during testing.

Test Equipment:

Asset #	Description	Manufacturer	Model	Calibration Date	Cal Due Date
P07037	RF Signal Generator	Agilent	E4432B	10/6/2016	10/6/2018
P06660	Cable	Gore	PHASEFLEX FJR01N01036.0	3/31/2018	3/31/2020
P06977	Cable	Gore	PHASEFLEX EJR01N01036.0	3/31/2018	3/31/2020
P06662	Cable	Gore	PHASEFLEX EJR01N01024.0	3/31/2018	3/31/2020
02946	Cable	Astro Steel	32026-29094K-29094K-36TC	12/21/2017	12/21/2019
P07089	Power Divider/Combiner	Narda-Miteq	3372A-2	1/24/2017	1/24/2019
02672	Spectrum Analyzer	Agilent	E4446A	3/2/2017	3/2/2019
C00082	Directional Coupler	MECA Electronics, Inc.	722-10-1.500V	9/18/2017	9/18/2019
C00121	Step Attenuator, 10 dB	HP	8496B	11/27/2017	11/27/2019
C00122	Step Attenuator	HP	8494B	11/27/2017	11/27/2019
03446	Band Pass Filter	K & L	4FV50-707/H18-O/O	8/16/2017	8/16/2019
03468	Band Pass Filter	K & L	4CS10-781.5/E12.2-O/O	8/16/2017	8/16/2019
03412	Band Pass Filter	Pasternack	PE8705	8/16/2017	8/16/2019
03447	Band Pass Filter	Pasternack	PE8710	8/16/2017	8/16/2019
03414	Band Pass Filter	Pasternack	PE8707	8/16/2017	8/16/2019
03469	Band Pass Filter	K & L	4CS10-751.5/E12-O/O	8/16/2017	8/16/2019
03467	Band Pass Filter	K & L	4FV50-731/H30-O/O	8/16/2017	8/16/2019
03448	Band Pass Filter	Pasternack	PE8711	8/16/2017	8/16/2019
03413	Band Pass Filter	Pasternack	PE8706	8/16/2017	8/16/2019
03415	Band Pass Filter	Pasternack	PE8708	8/16/2017	8/16/2019

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	0.033	0.30	26.2	62	60	3	5
UL 1850-1915	0.050	0.30	20.9	62	60	3	5
UL 824-894	0.050	0.30	22.4	62	60	3	5
UL 698-716	0.067	0.30	26.4	62	60	3	5
UL 776-787	0.058	0.30	26.5	62	60	3	5
DL 2110-2155	0.083	1.00	5.7	62	60	3	5
DL 1930-1995	0.058	1.00	8.5	62	60	3	5
DL 869-894	0.050	1.00	7.1	62	60	3	5
DL 728-746	0.058	1.00	5.1	62	60	3	5
DL 746-757	0.075	1.00	8.9	62	60	3	5

The booster continues to mitigate at least 1 minute before restarting. The plots demonstrate after 3 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

	UL 1710-1755	UL1850-1915	UL 824-894	UL 698-716	UL 776-787	
Max Gain Isolation dB	Pk-Pk Difference dB	Pk-Pk Difference dB	Pk-Pk Difference dB	Pk-Pk Difference dB	Pk-Pk Difference dB	Limit dB
+5dB	3.4	1.8	5.7	5.3	4.3	12.0
+4dB	4.2	2.2	7.3	5.3	4.3	12.0
+3dB	4.4	2.4	8.8	5.3	4.4	12.0
+2dB	4.5	2.5	9	5.6	4.9	12.0
+1dB	5.6	2.8	11.4	6.1	5.1	12.0
0dB	6.2	3.0	12.5*	7.7	6.2	12.0
-1dB	6.8	3.3	14.4*	10.3	7.4	12.0
-2dB	8.9	4.1	18.4*	14.7*	10.4	12.0
-3dB	10.5	5.5	**	22.9*	17.0*	12.0
-4dB	22.0*	6.9	**	**	**	12.0
-5dB	**	12.6*	**	**	**	12.0

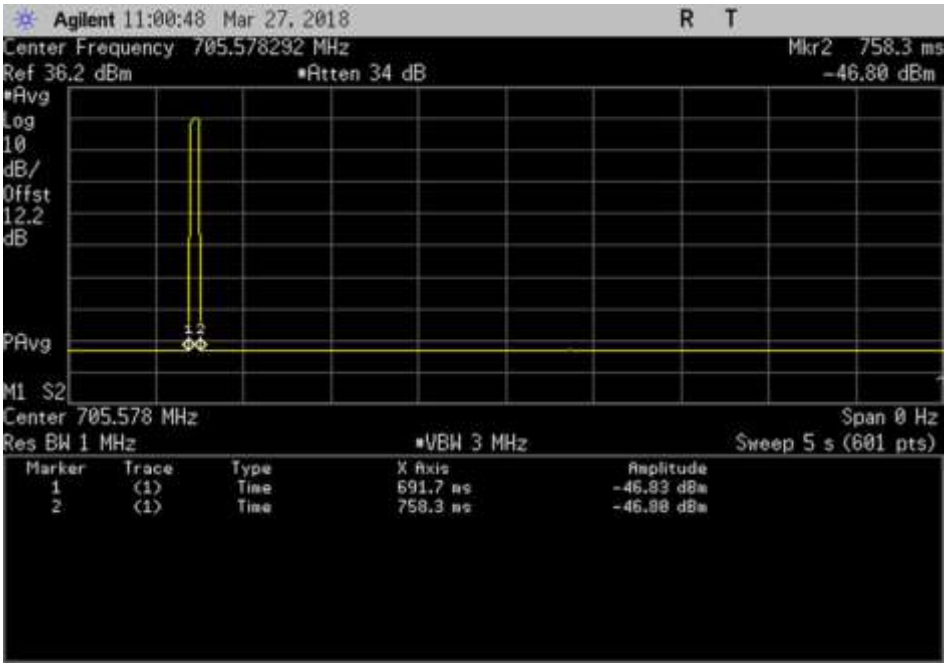
	DL 2110-2155	DL 1930-1995	DL 869-894	DL 728-746	DL 746-775	
Max Gain Isolation dB	Pk-Pk Difference dB	Pk-Pk Difference dB	Pk-Pk Difference dB	Pk-Pk Difference dB	Pk-Pk Difference dB	Limit dB
+5dB	9.0	1.3	1.4	3.1	2.5	12.0
+4dB	10.0	1.9	1.9	3.5	3.5	12.0
+3dB	11.9	2.9	2.4	4.6	3.8	12.0
+2dB	15.0*	3.4	4.2	7.9	4.7	12.0
+1dB	17.0*	23.5*	9.2	21.3*	7.2	12.0
0dB	**	**	**	**	19.8*	12.0
-1dB	**	**	**	**	**	12.0
-2dB	**	**	**	**	**	12.0
-3dB	**	**	**	**	**	12.0
-4dB	**	**	**	**	**	12.0
-5dB	**	**	**	**	**	12.0

* The measured difference exceeds the limit for a period of less than 300 second before device mitigates or shuts down. The maximum recorded time prior to shutdown was 61 seconds for the Uplink bands and 69 seconds for the Downlink bands.

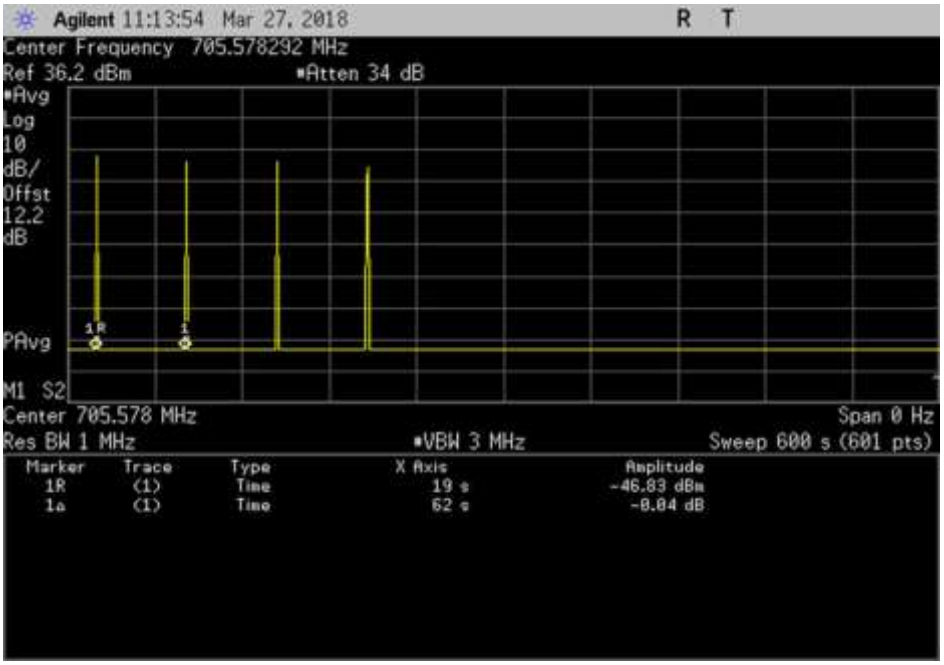
** The device shuts down immediately.

7.11.2 Oscillation Restart Tests

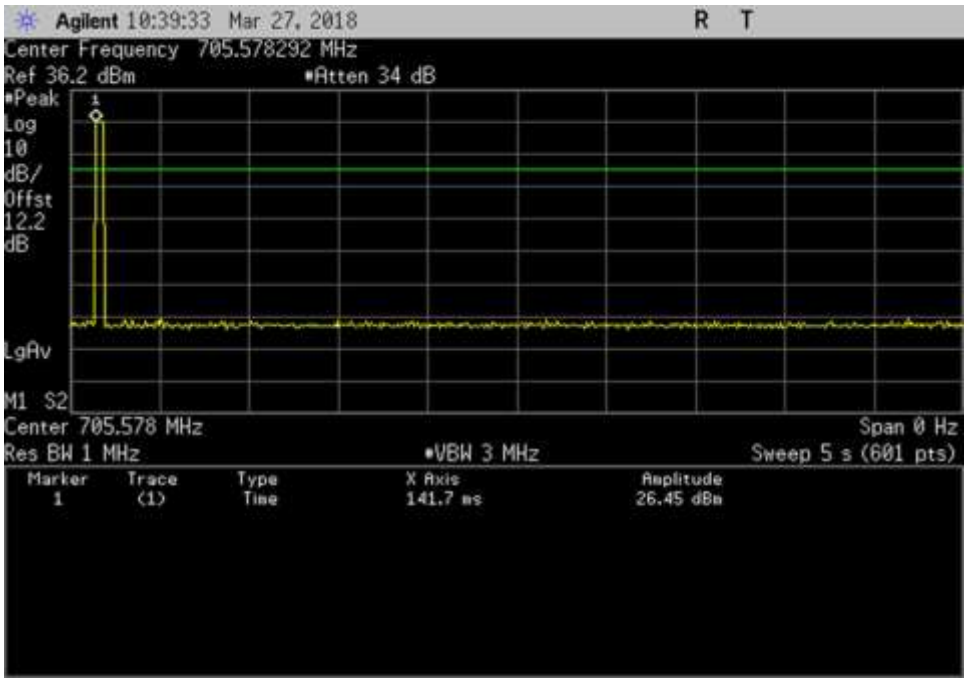
Plots



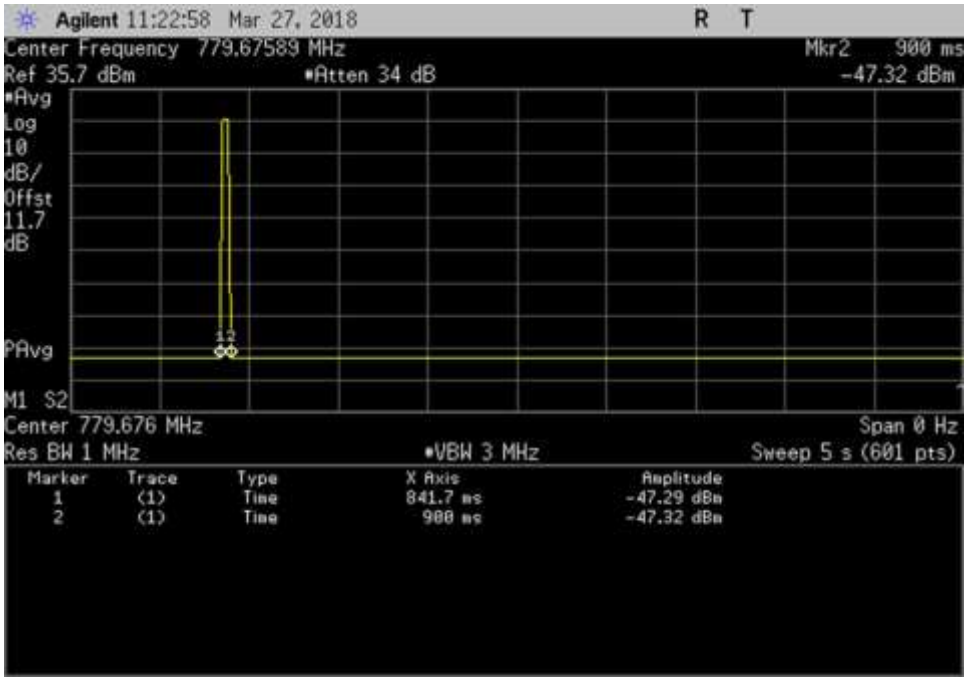
UL_698-716_ 705.578292MHz



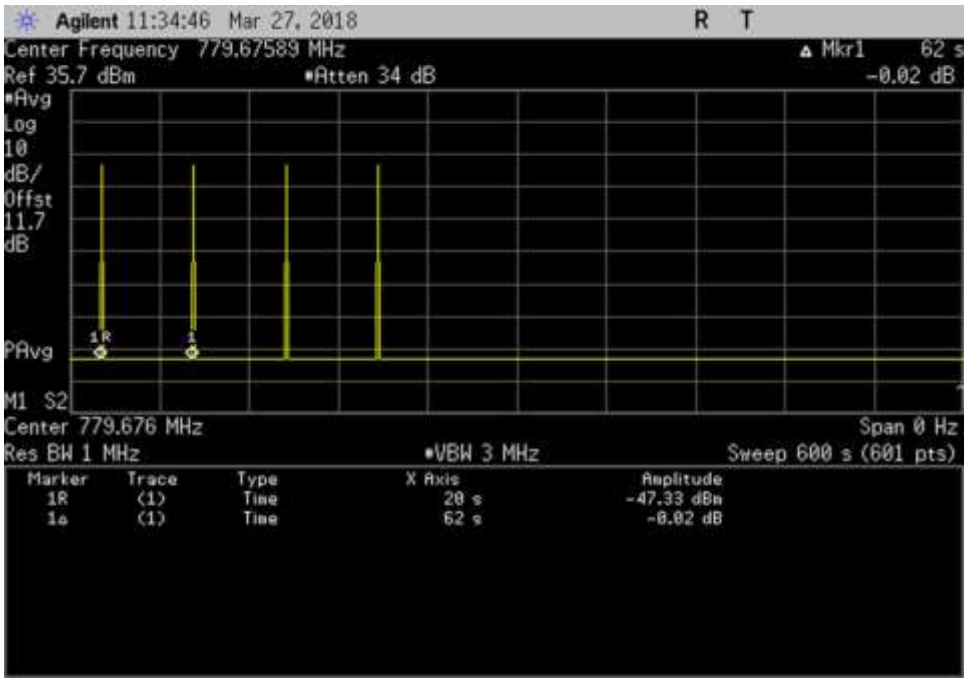
UL_698-716_ 705.578292MHz_600s



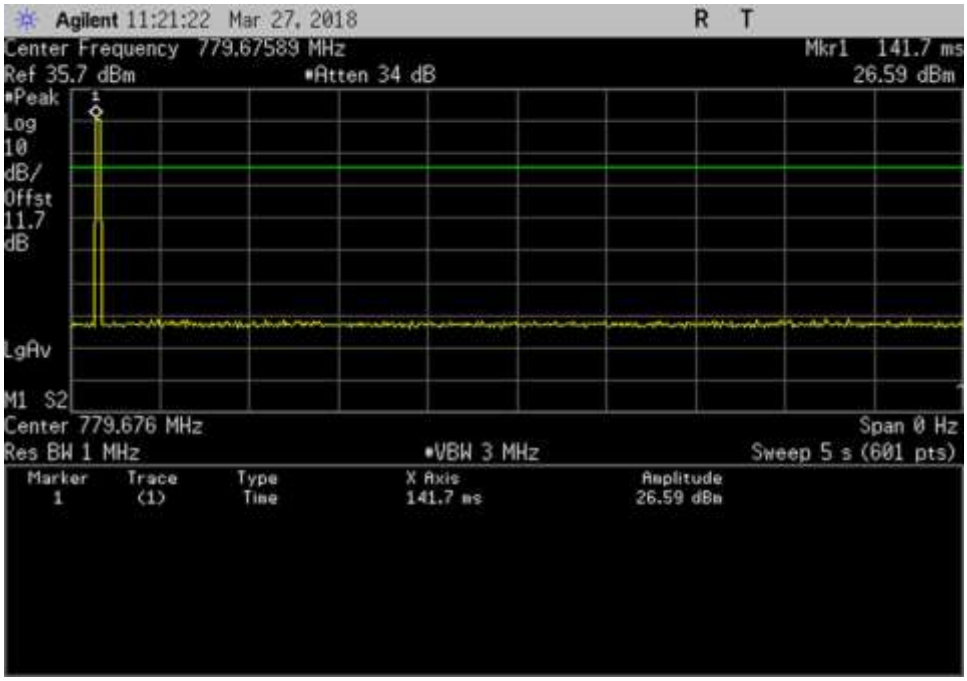
UL_698-716_ 705.578292MHz_Pk



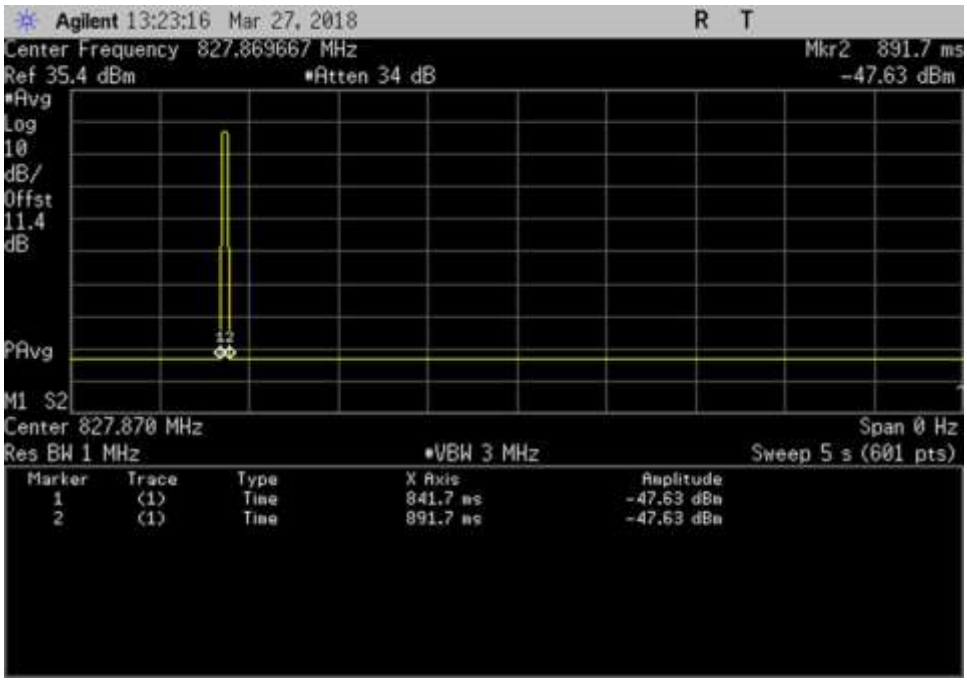
UL_776-787_ 779.67589MHz



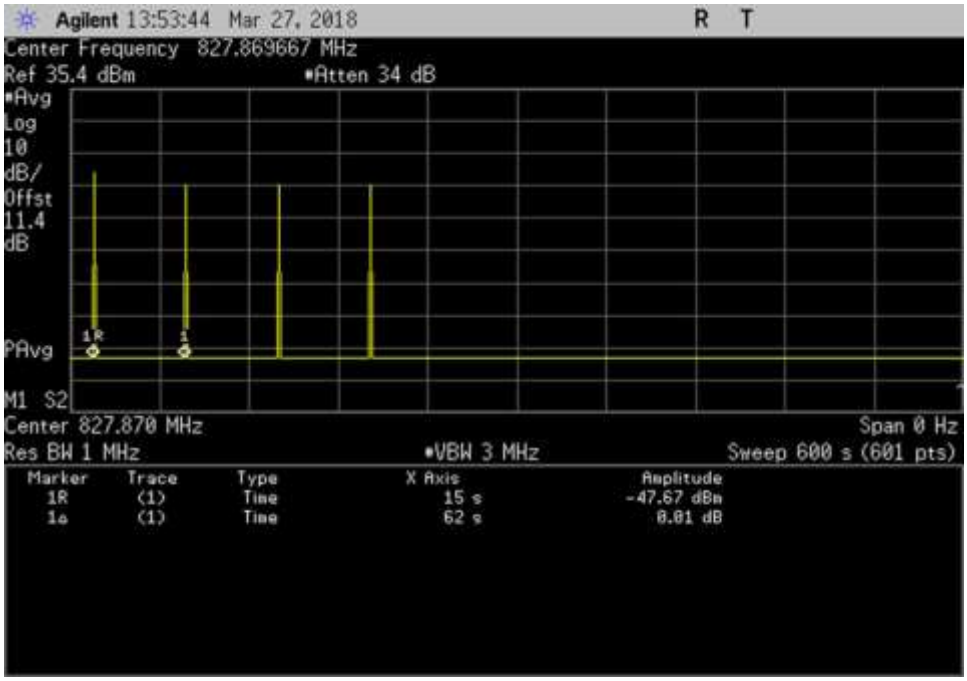
UL_776-787_ 779.67589MHz_600s



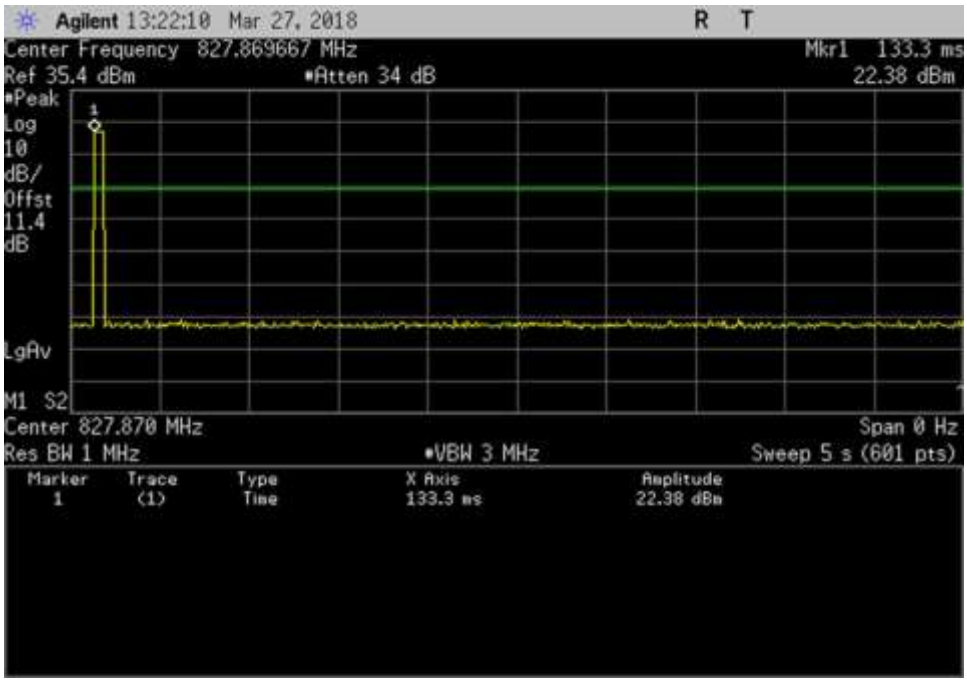
UL_776-787_ 779.67589MHz_Pk



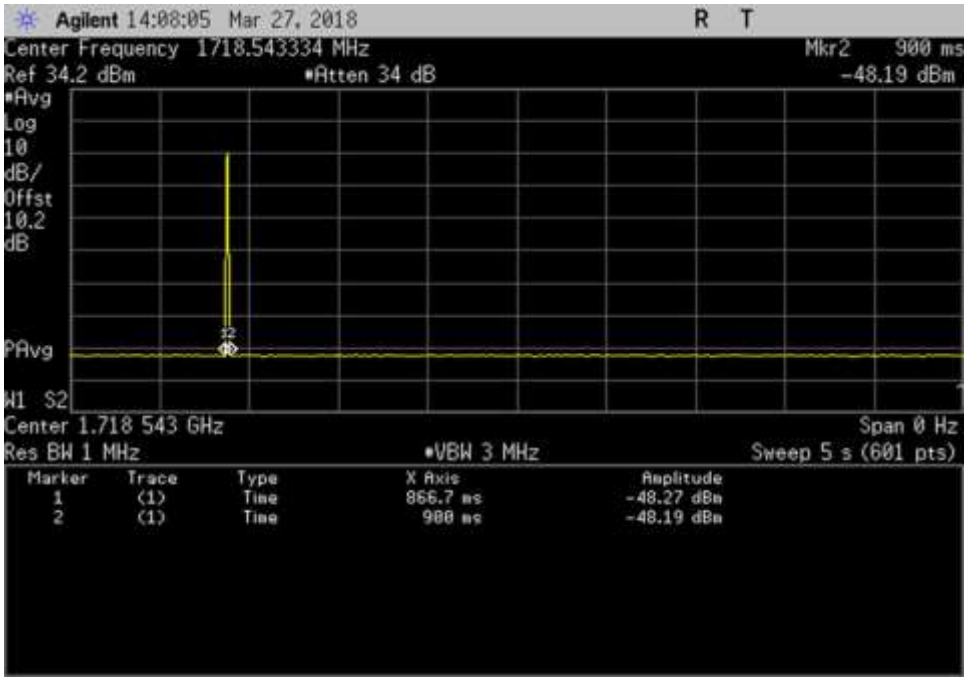
UL_824-849_ 827.869667MHz



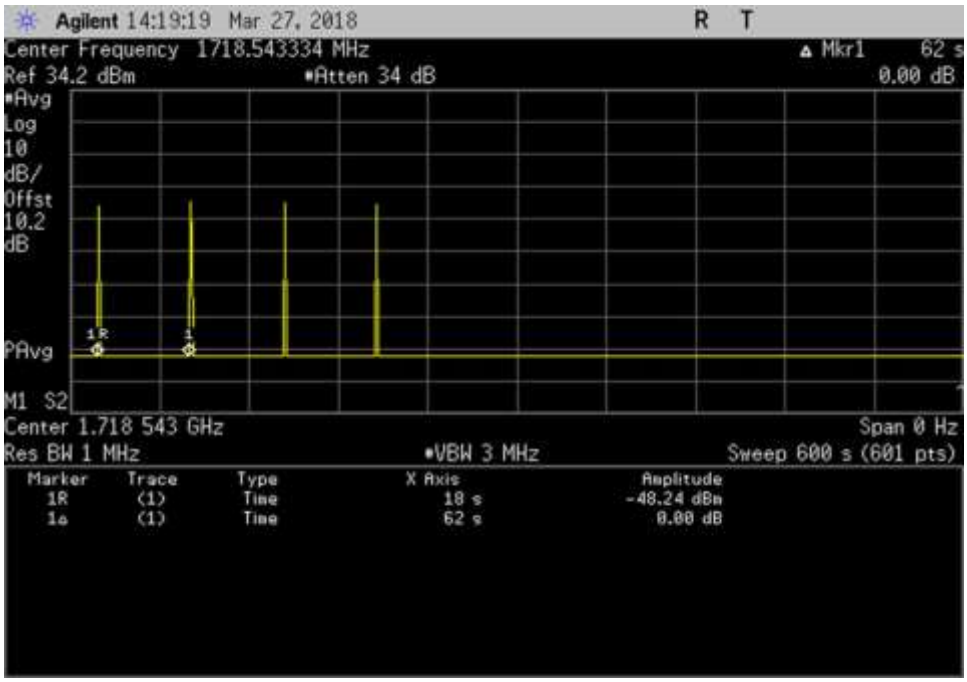
UL_824-849_ 827.869667MHz_600s



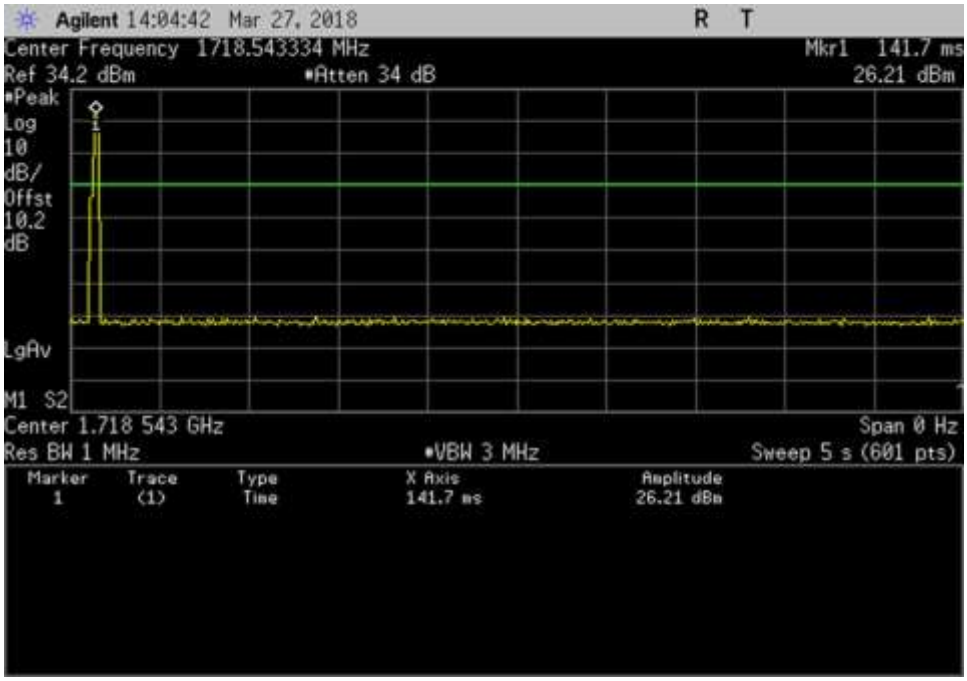
UL_824-849_ 827.869667MHz_Pk



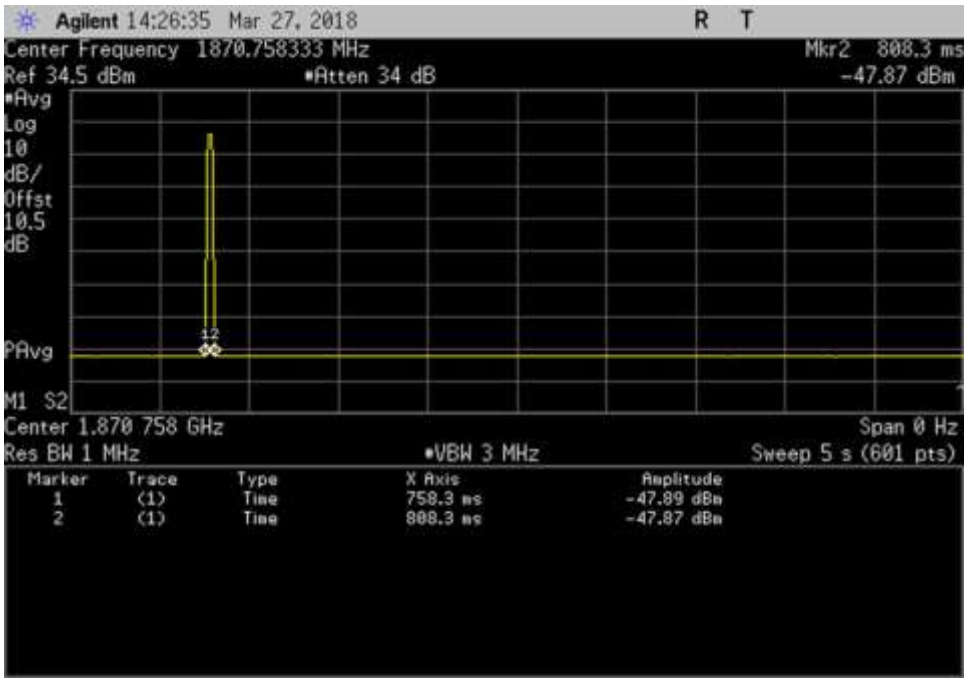
UL_1710-1755_ 1718.543334MHz



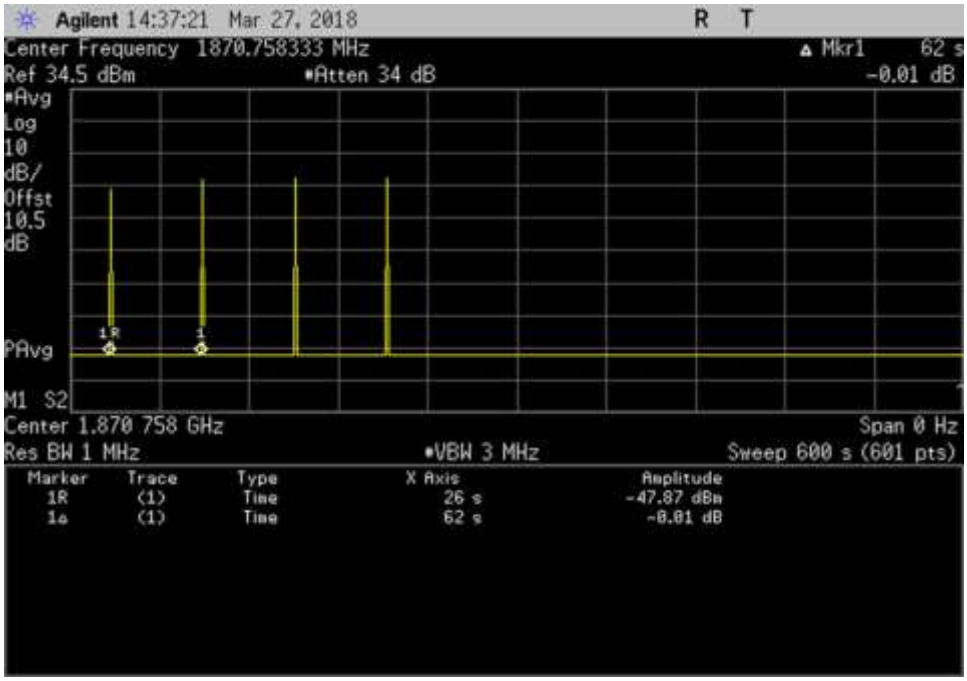
UL_1710-1755_ 1718.543334MHz_600s



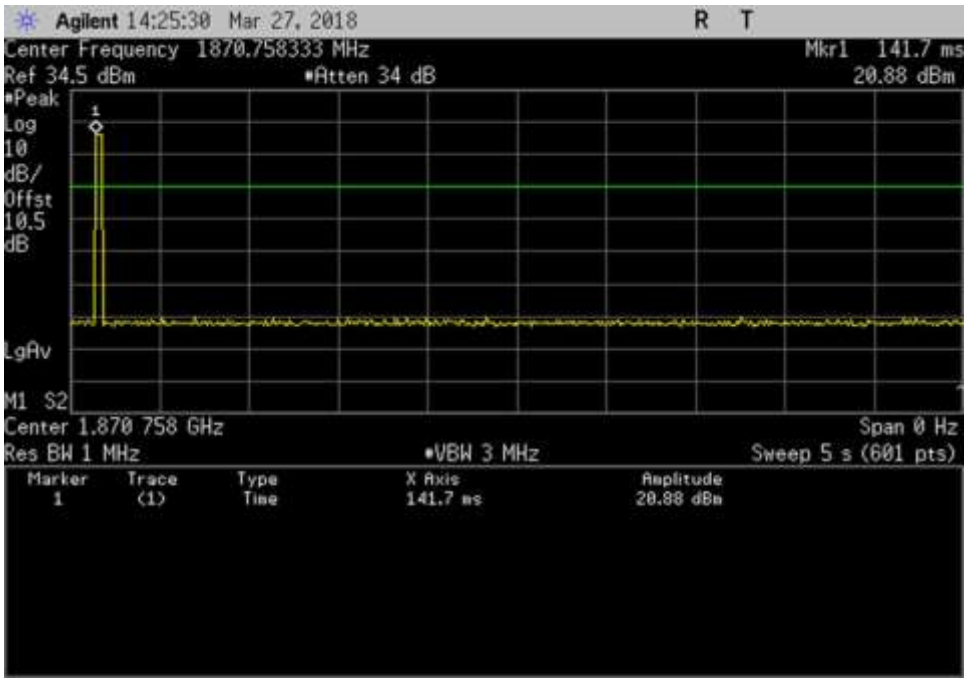
UL_1710-1755_ 1718.543334MHz_Pk



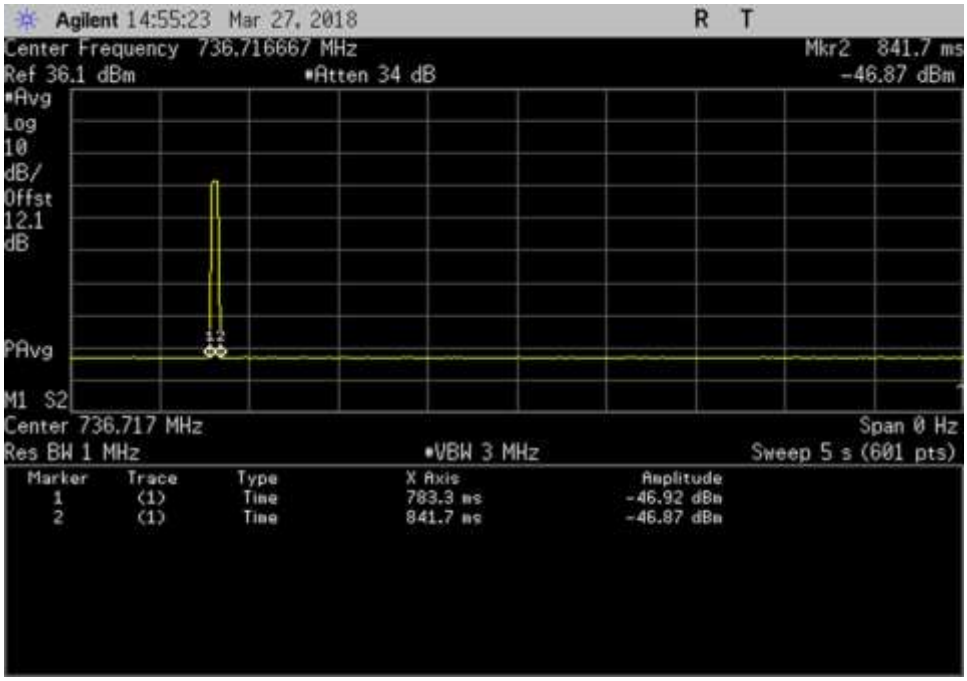
UL_1850-1915_ 1870.758333MHz



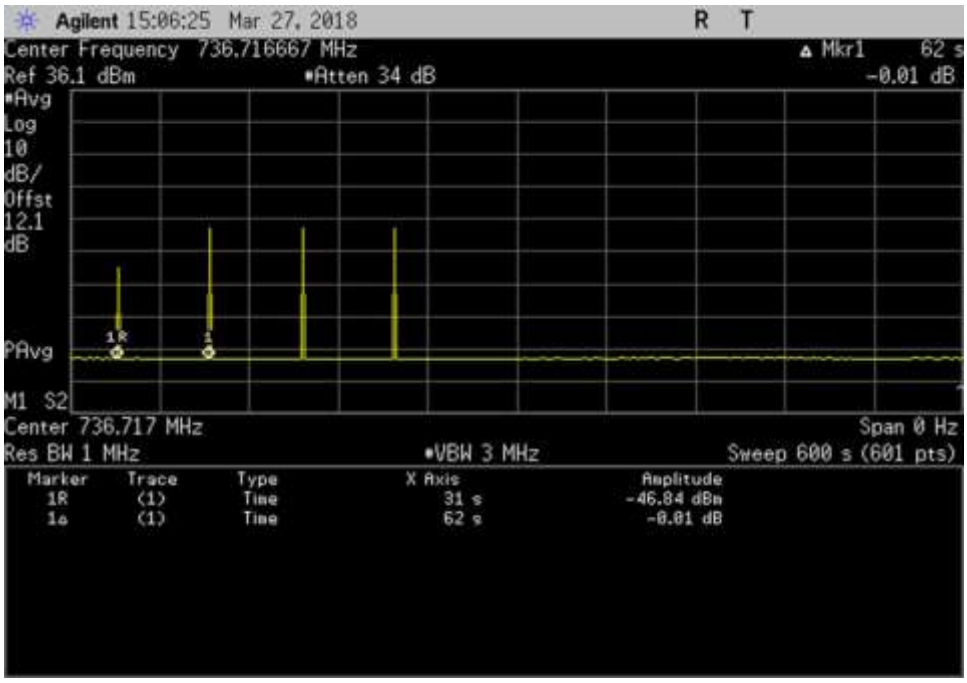
UL_1850-1915_ 1870.758333MHz_600s



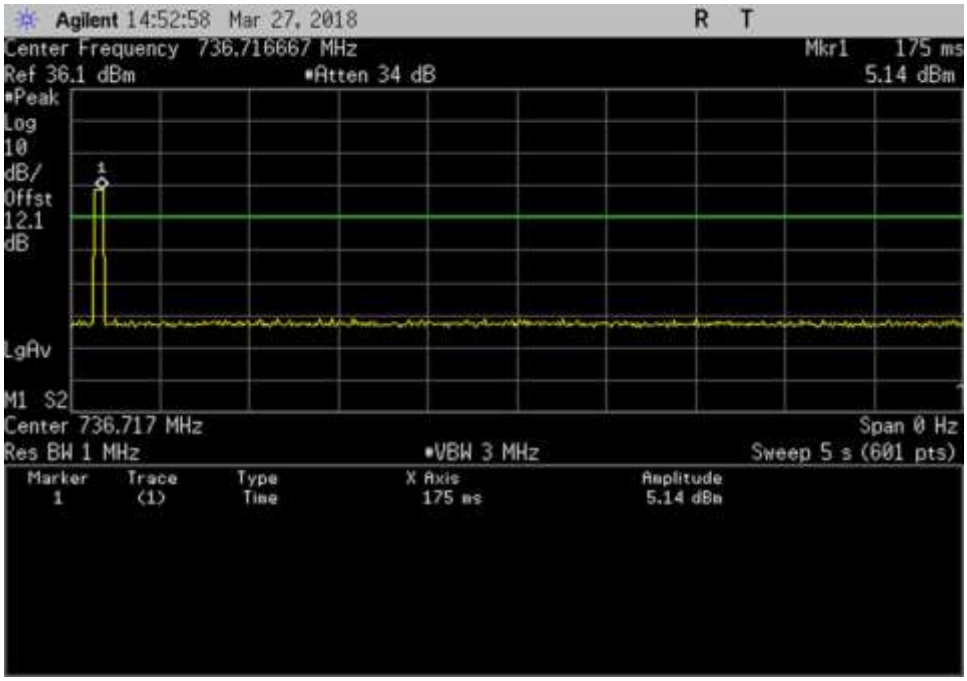
UL_1850-1915_ 1870.758333MHz_Pk



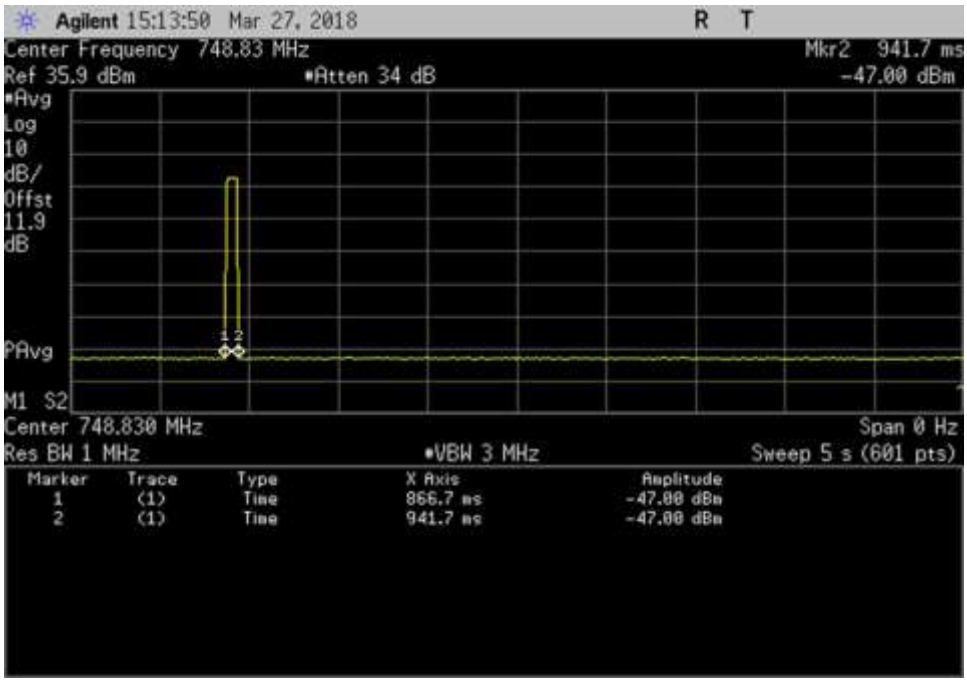
DL_728-746_ 736.716667MHz



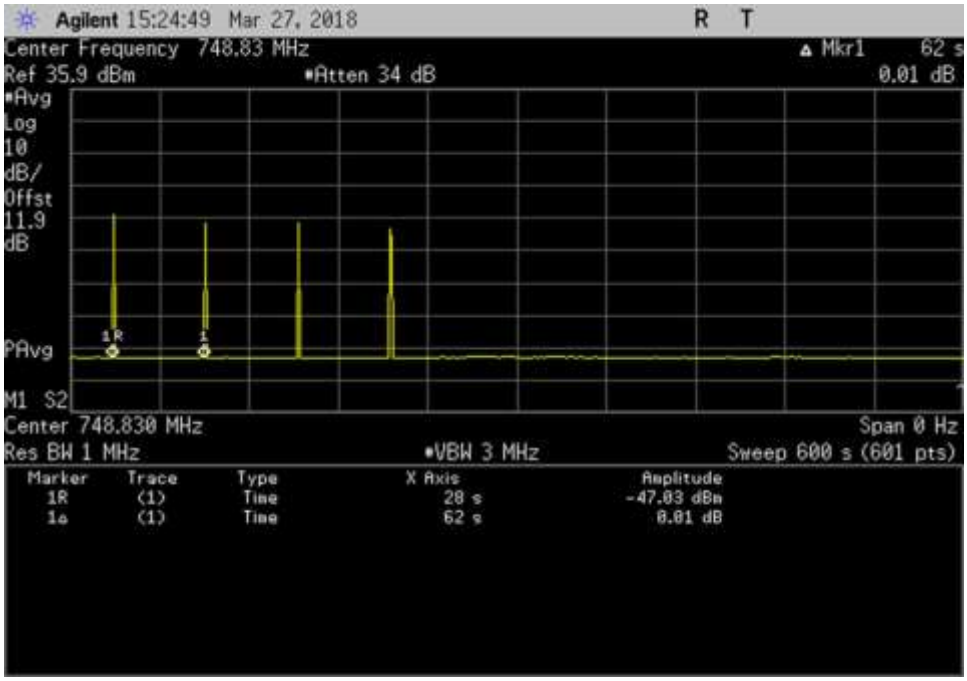
DL_728-746_ 736.716667MHz_600s



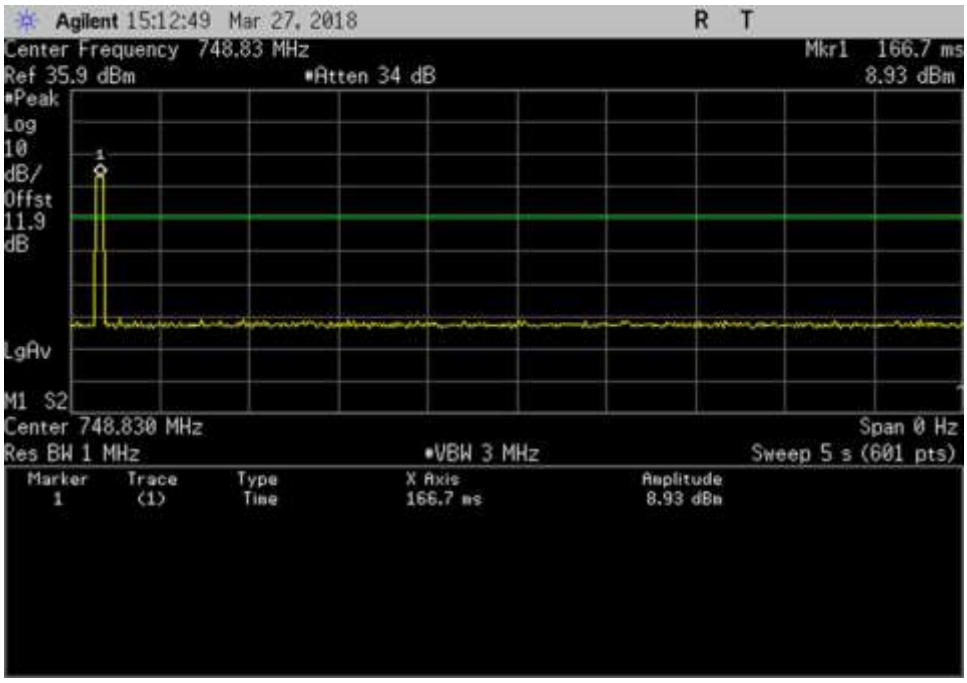
DL_728-746_ 736.716667MHz_Pk



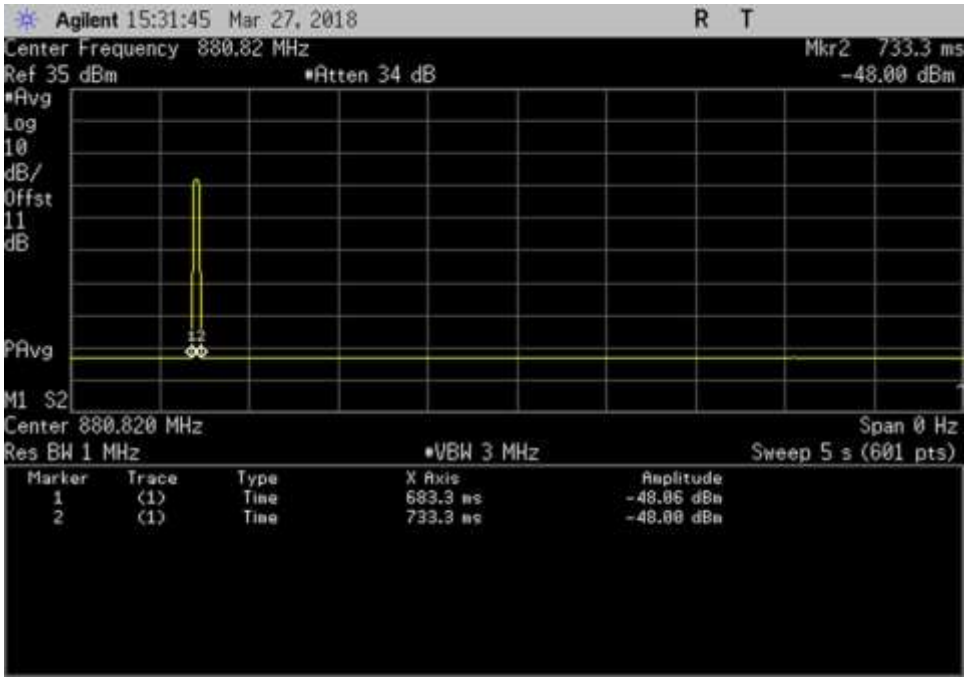
DL_746-757_ 748.83MHz



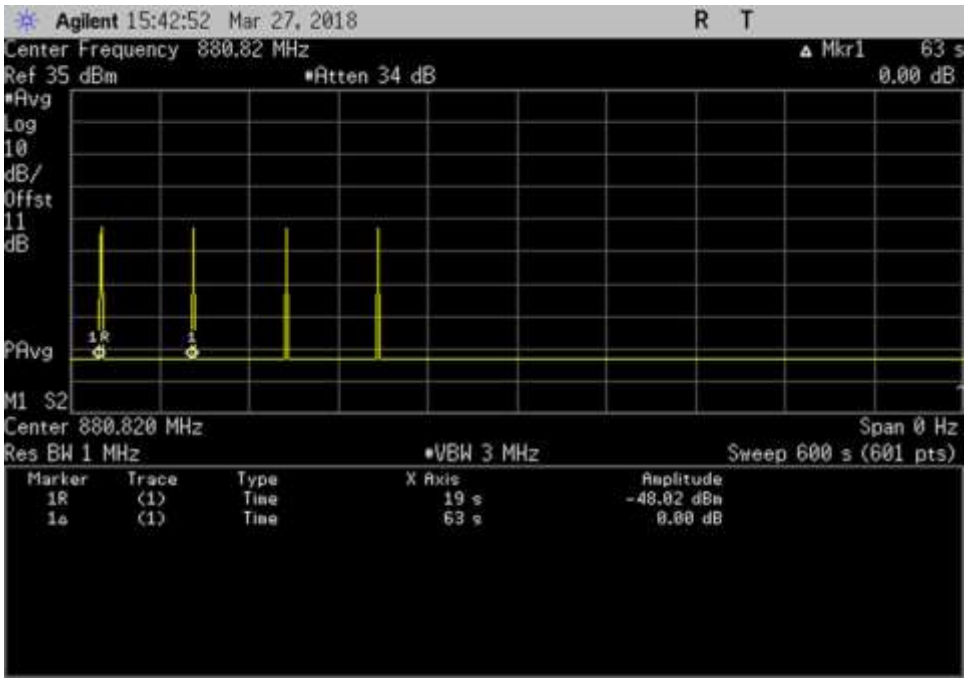
DL_746-757_ 748.83MHz_600s



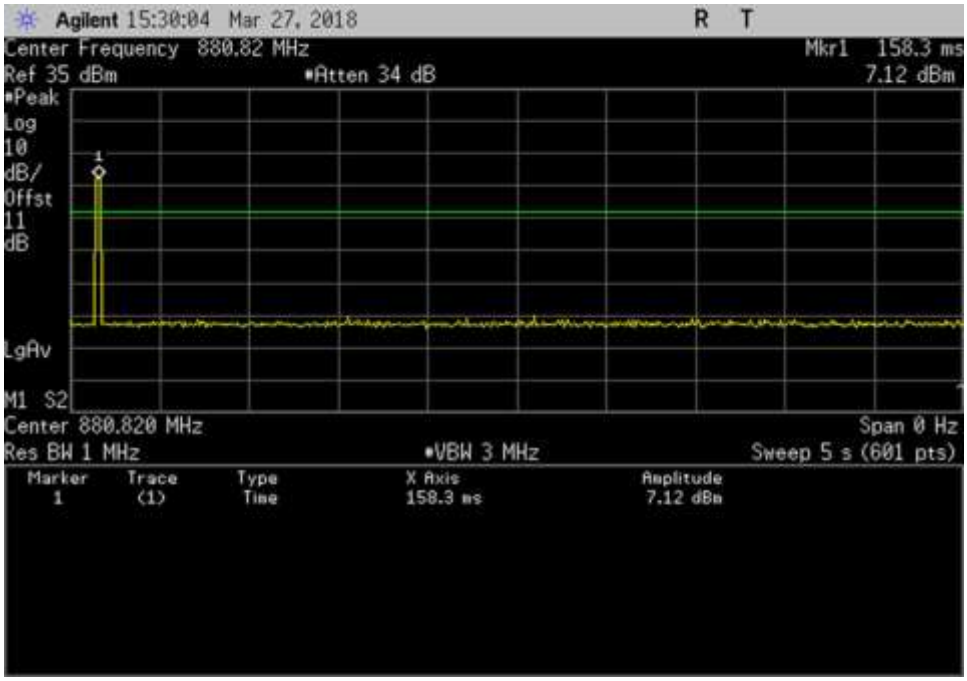
DL_746-757_ 748.83MHz_Pk



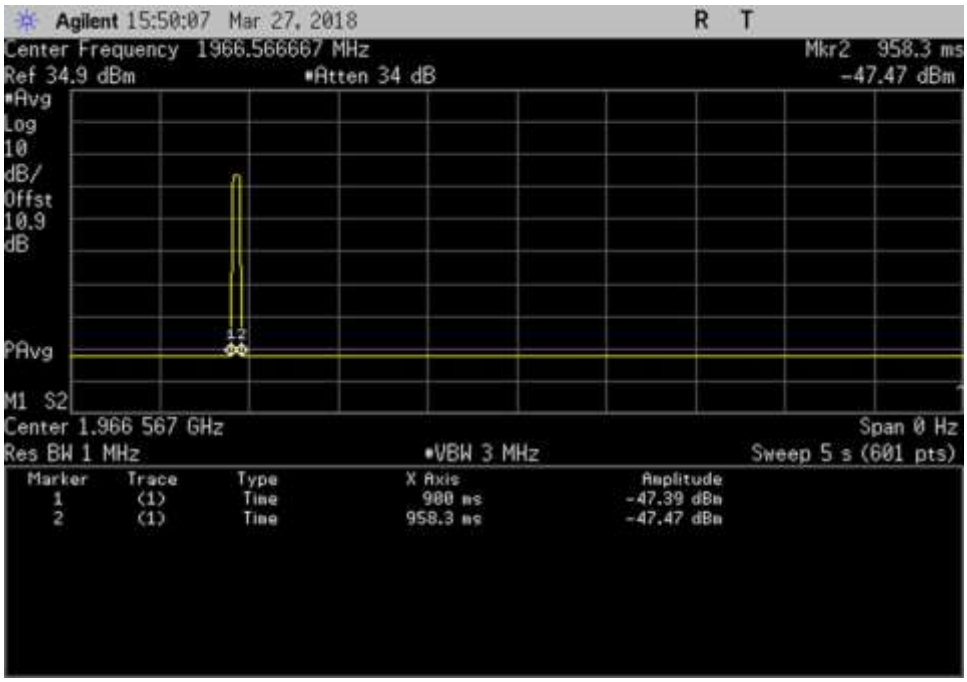
DL_869-894_ 880.82MHz



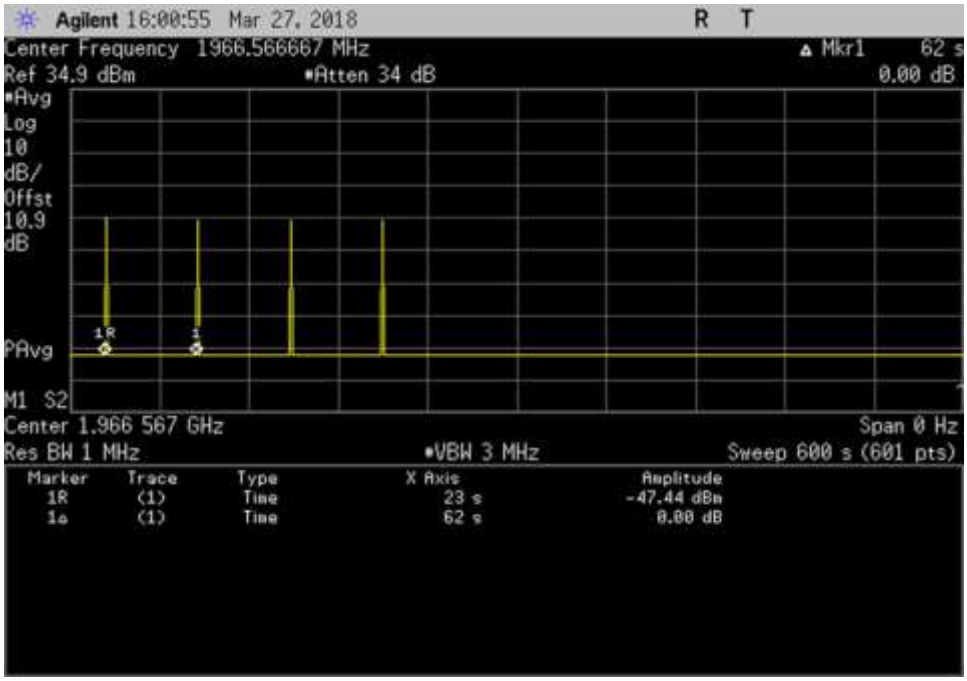
DL_869-894_ 880.82MHz_600s



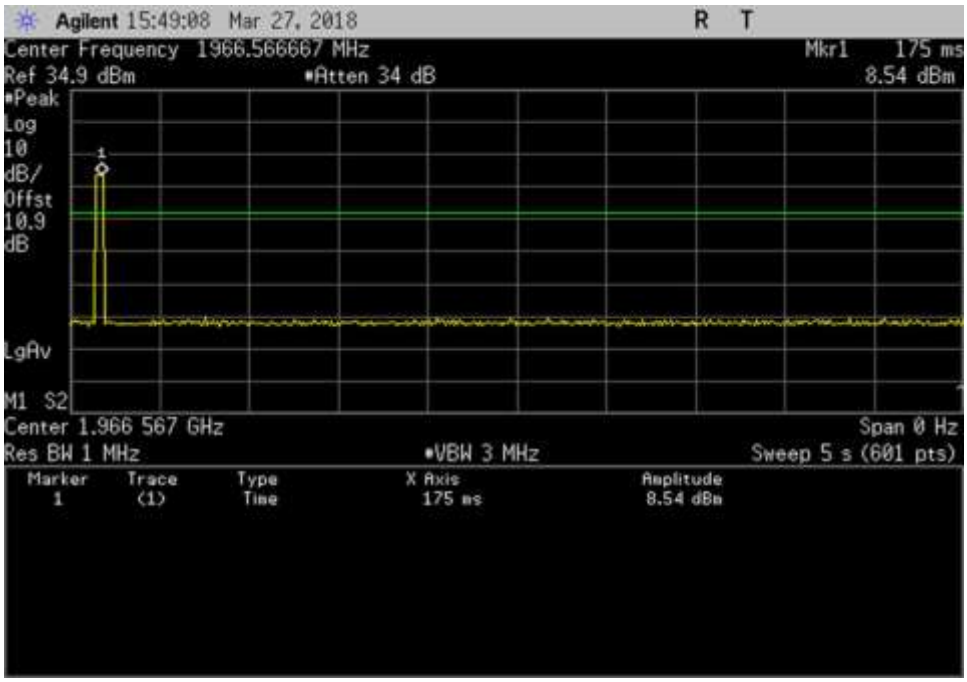
DL_869-894_ 880.82MHz_Pk



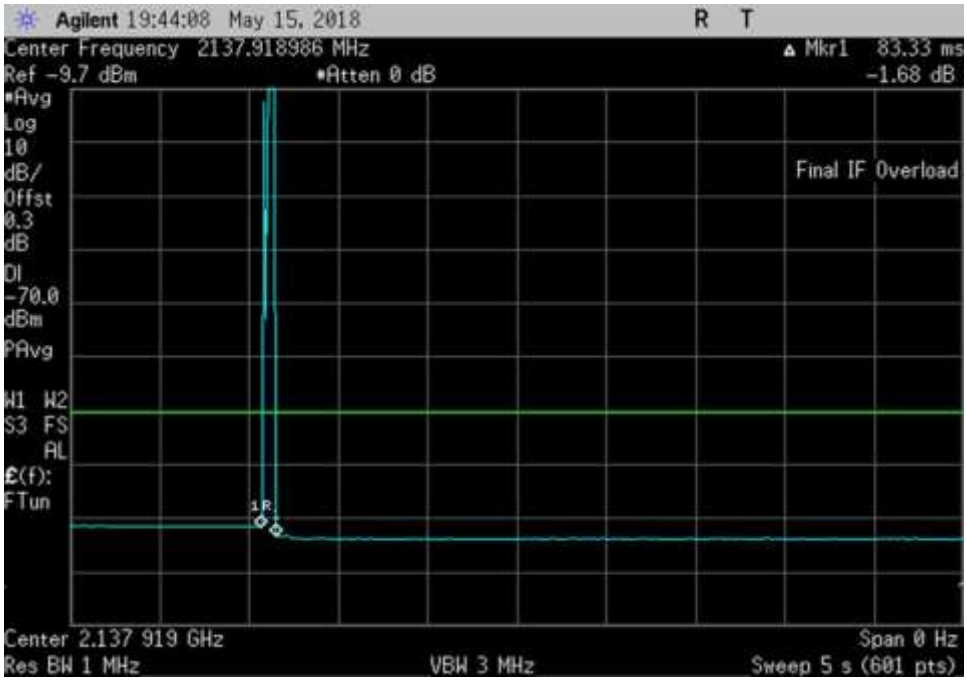
DL_1930-1995_ 1966.566667MHz



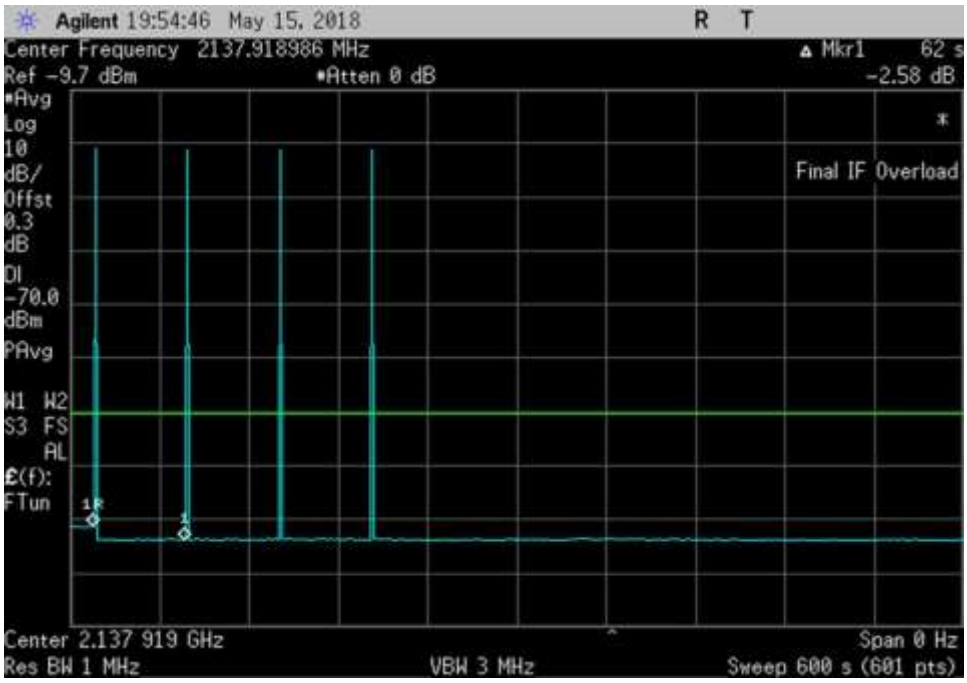
DL_1930-1995_ 1966.566667MHz_600s



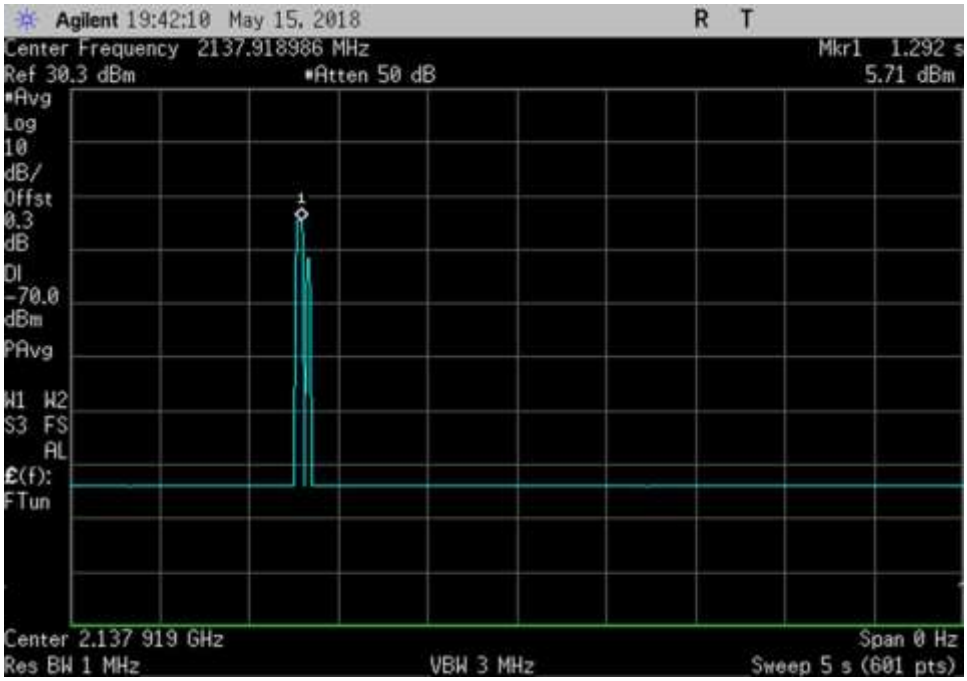
DL_1930-1995_ 1966.566667MHz_Pk



DL_2110-2155_ 2137.9MHz



DL_2110-2155_600sec_ 2137.9MHz



DL_2110-2155_Pk_ 2137.9MHz

7.12 Radiated Spurious Emissions

Test Conditions / Setup

Test Location:	CKC Laboratories, Inc. 110 N. Olinda Pl, Brea CA 92823
Customer:	**Huaptec**
Specification:	**7.12 Radiated Spurious Emissions / 2.1053 Radiated Spurious Emissions** **47 CFR §22.917(a) Radiated Spurious Emissions** **47 CFR §24.238(a) Radiated Spurious Emissions** **47 CFR §27.53(c), (f), (g) and (h) Spurious Emissions**
Work Order #:	**100428** Date: 03/29/2018
Test Type:	**Radiated Emissions**
Tested By:	S. Yamamoto
Software:	EMITest 5.03.11

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

General test condition.
The equipment under test (EUT) is a Mobile Wideband Consumer Booster with direct contact coupling (cradle-type) antenna.
The EUT is placed on the test bench. Evaluation performed at the Outside (Donor) and Inside (Server) antenna port.
The EUT Donor port is a MCX type connector and 50-ohm impedance.
The EUT Server/DL port /is type UFL connector and 50-ohm impedance.

Part 22
UL: 824-849MHz
DL: 869-894MHz
Part 24
UL: 1850-1915MHz
DL: 1930-1995MHz
Part 27
UL: 1710-1755MHz, 698-716MHz, 776-787MHz
DL: 2110-2155MHz, 728-746MHz, 746-757MHz

Test procedure:
The test was performed in accordance with the FCC document: 935210 D03 Signal Booster Measurements v04r01, dated October 27, 2017.
Firmware: 2.0

Test environment conditions:
Temperature: 20 -25°C
Relative Humidity: 37-45 %
Pressure: 100kPa

Device is powered by a provided 5V USB/12V Automotive adaptor
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.

Test Equipment:

Asset #	Description	Manufacturer	Model	Calibration Date	Cal Due Date
00314	Loop Antenna	EMCO	6502	5/20/2016	5/20/2018
02672	Spectrum Analyzer	Agilent	E4446A	3/2/2017	3/2/2019
P05050	Cable	Pasternack	RG223/U	1/20/2017	1/20/2019
00309	Preamp	HP	8447D	2/19/2018	2/19/2020
P05198	Cable	Belden	8268	12/7/2016	12/7/2018
01995	Biconilog Antenna	Chase	CBL6111C	5/10/2016	5/10/2018
P05275	Attenuator	Weinschel	1W	5/5/2016	5/5/2018
00046	Bicon Antenna	A&H	SAS-200/540	5/22/2017	5/22/2019
00300	Log Periodic Antenna	A & H	SAS-200/516	2/18/2017	2/18/2019
P06661	Cable	Andrew	LDF1-50	5/6/2016	5/6/2018
00849	Horn Antenna	ETS	3115	3/14/2018	3/14/2020
00786	Preamp	HP	83017A	5/9/2016	5/9/2018
01413	Horn Antenna	HP	84125-80008	10/7/2016	10/7/2018
P06544	Cable	Astro Steel	32026-29094K-29094K-36TC	12/21/2017	12/21/2019
03367	Horn Antenna	Dorado	62-GH-62-25.	8/24/2017	8/24/2019
P07139	Cable	Andrew	ANDL1-PNMNM-48	3/1/2017	3/1/2019
P05563	Cable	Andrews	ANDL-1-PNMN-48	6/6/2016	6/6/2018

Summary of Results

No spurious emissions were found within 20dB of the limit line.

LIMIT LINE FOR SPURIOUS RADIATED EMISSION

REQUIRED ATTENUATION = 43+10 LOG P (DB)
FOR RADIATED SPURIOUS EMISSION MEASURED AT 3 METER TEST DISTANCE,

Required attenuation = 43+10 Log $P_{t\ at\ 3\ meter}$ dB
Limit line (dBuV) = E_{dBuv} - 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 /m^2
Pt = 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 (V/m)+ 10 Log r^2 – 10 Log 30
10 Log P_t = 20 Log E (V/m) + 20 Log r – 10 Log 30

At 3 meter, r = 3 m
10 Log P_t = 20 Log E (V/m) + 20 Log 3 – 10 Log 30
10 Log P_t = 20 Log E (V/m) + 9.54 – 14.77
10 Log P_t = 20 Log E (V/m) - 5.23

Since 20 Log E (V/m) = 20 Log E (uV/m) –120
10 Log P_t = 20 Log E (uV/m) - 120 - 5.23
10 Log P_t = 20 Log E (uV/m) –125.23

Limit line (dBuV) at 3 meter = E_{dBuv} – Attenuation

= E_{dBuv} - (43+10 Log $P_{t\ at\ 3\ meter}$)

= E_{dBuv} - 43 - 10 Log $P_{t\ at\ 3\ meter}$

= E_{dBuv} - 43 – (20 Log E (uV/m) –125.23)

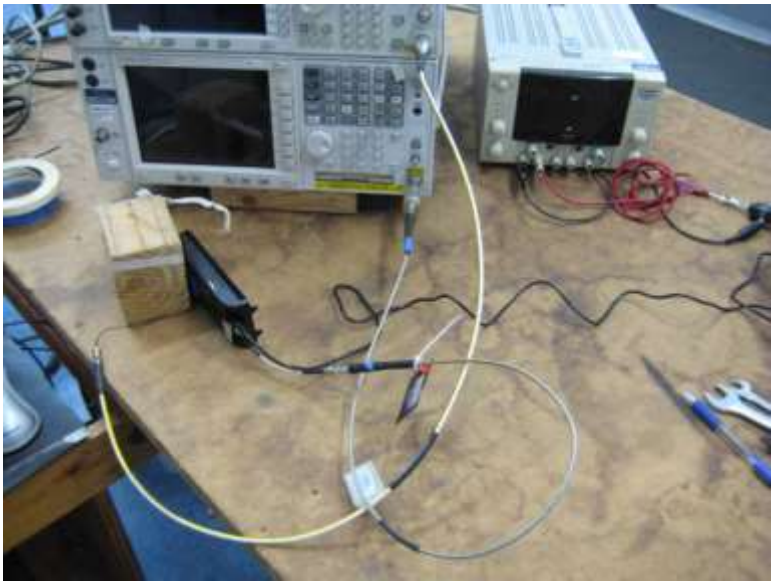
= E_{dBuv} - 43 - 20 Log E (uV/m) + 125.23

= E_{dBuv} - 20 Log E (uV/m) + 82.23

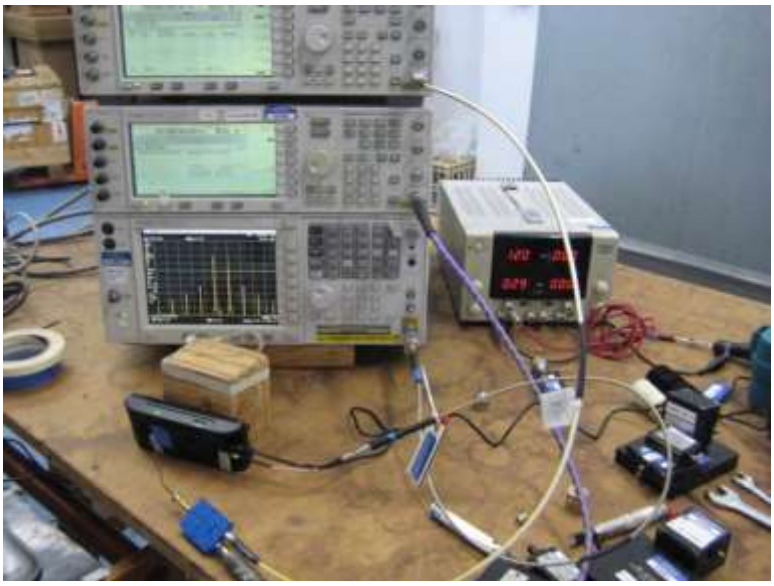
Since 20 Log E (uV/m) = E in dBuV/m= ~~E_{dBuv}~~ - ~~E_{dBuv}~~ + 82.23

Radiated Emission limit 3 meter = 82.23 dBuV at any power level measured in dBuV

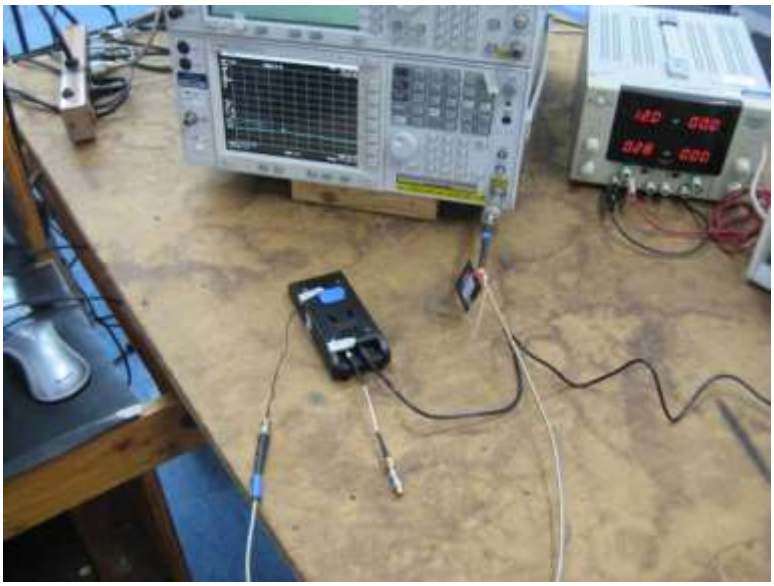
Exhibit A: Test Setup Photos



Section 7.1, 7.2-7.3, 7.5, 7.6, and 7.10 Test Setup

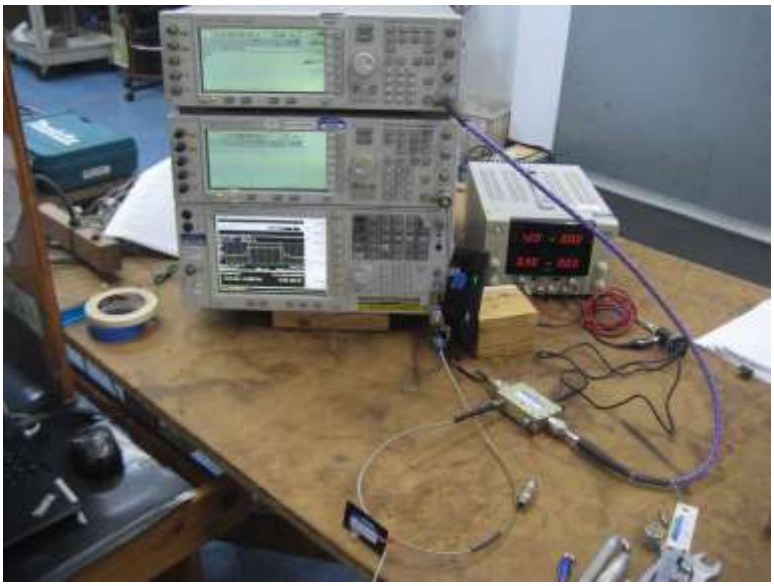


Section 7.4 Test Setup

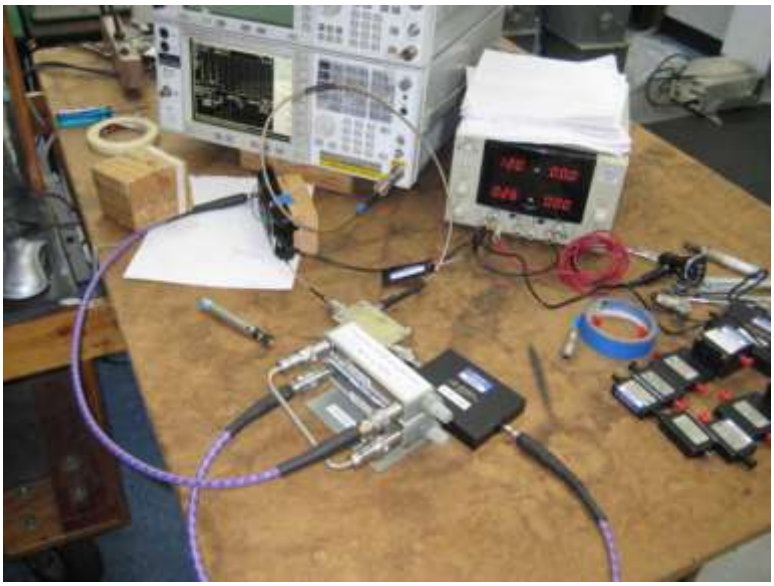


Section 7.7 and 7.8 Test Setup

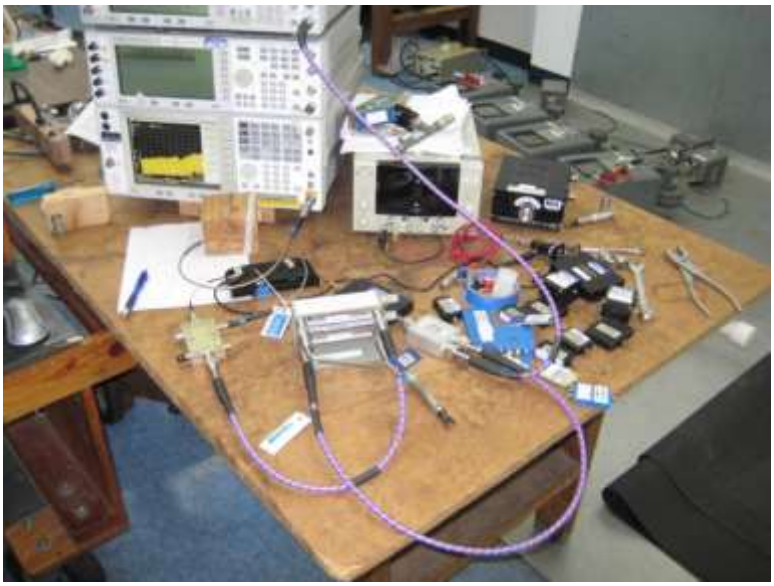
Section 7.7 Test Setup



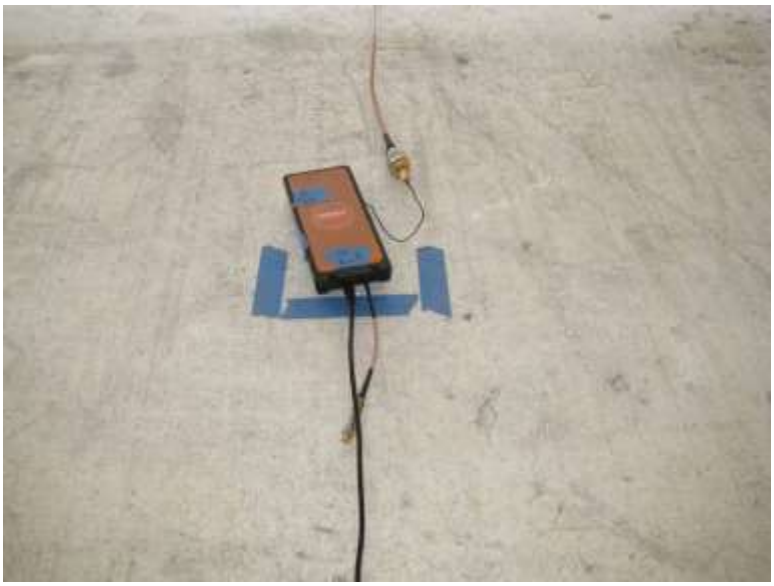
Section 7.9 Test Setup



Section 7.11 Test Setup



Section 7.11 Test Setup



Section 7.12 Below 1GHz Test Setup

Section 7.12, Below 1GHz Test Setup

Section 7.12, Above 1GHz Cone placement Test Setup

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBµV)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point, the measuring device is set into the linear mode and the scan time is reduced.