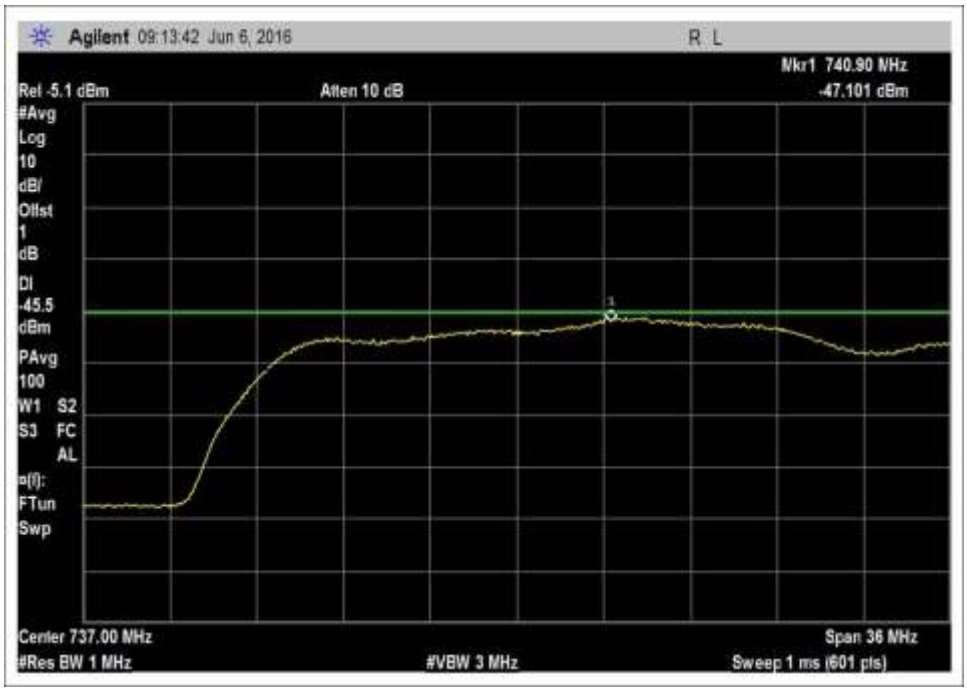
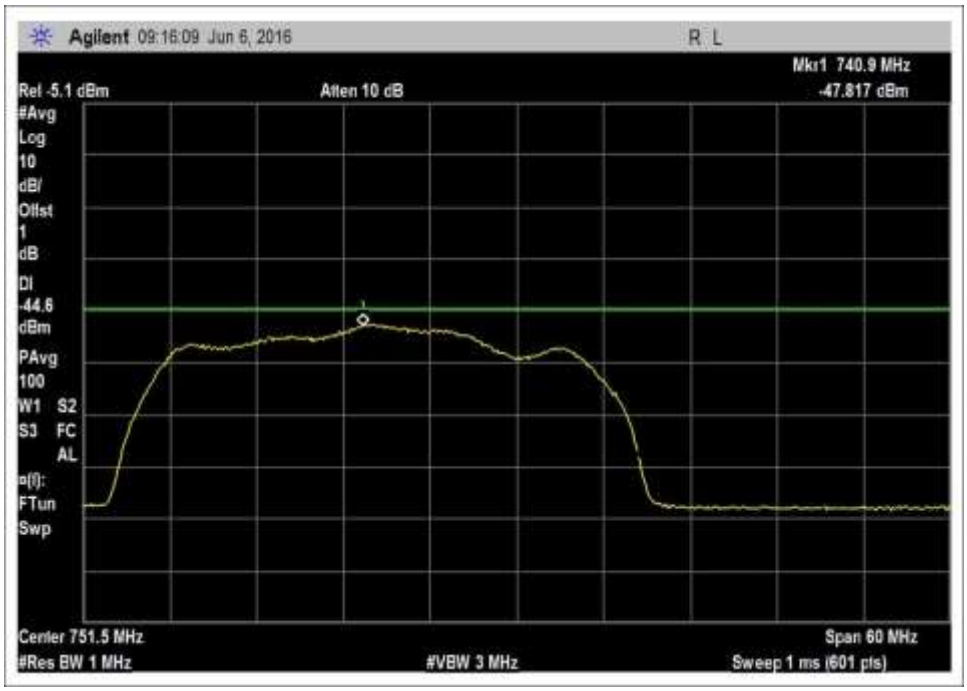
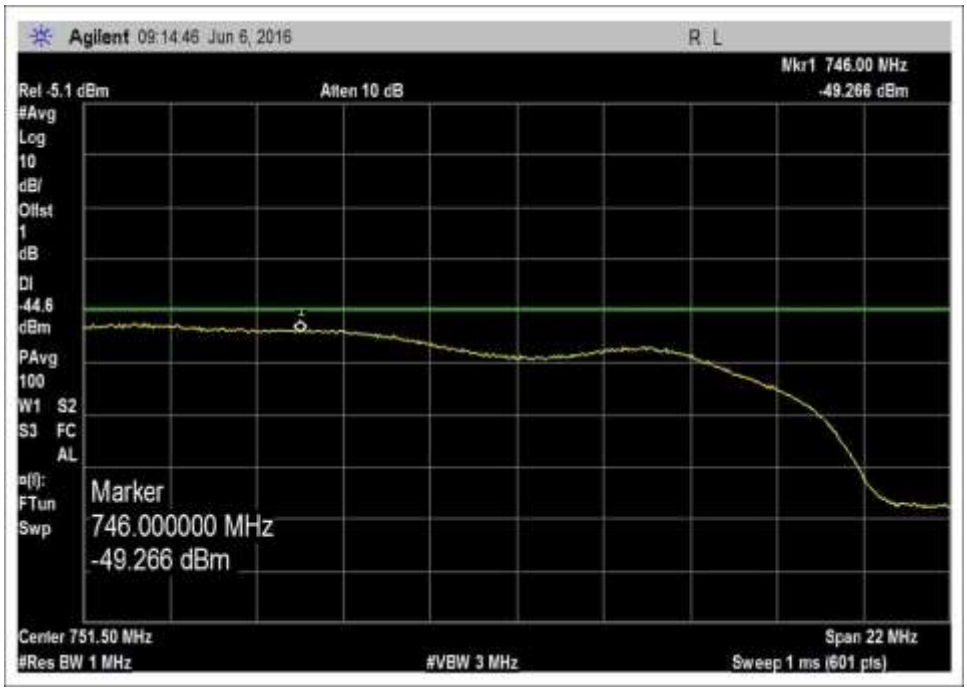
a – g Noise 50, DL



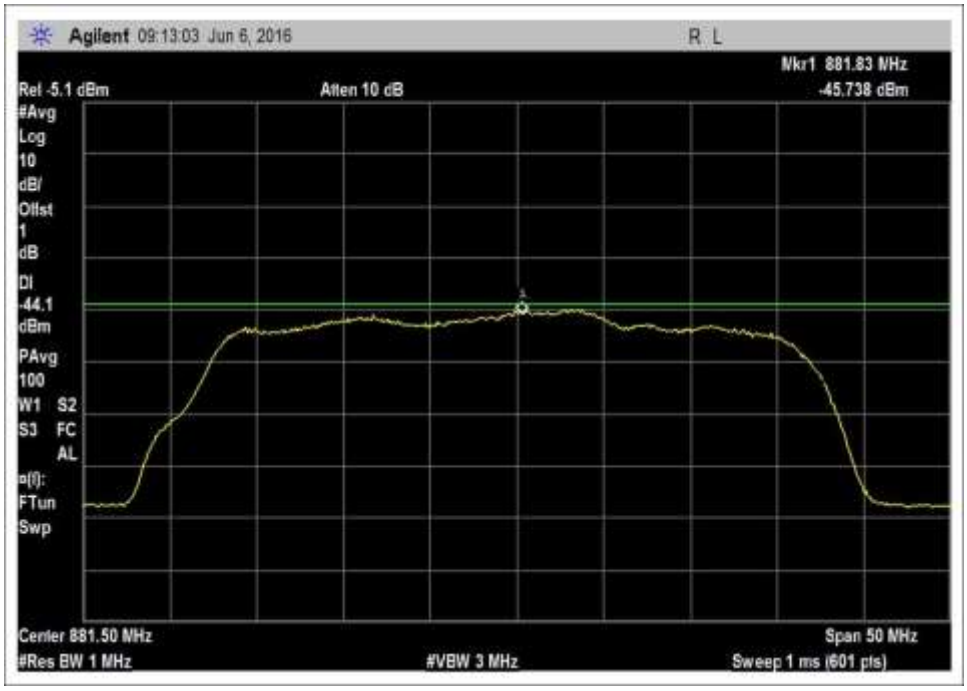
7.7_Noise_DL_728-746MHz



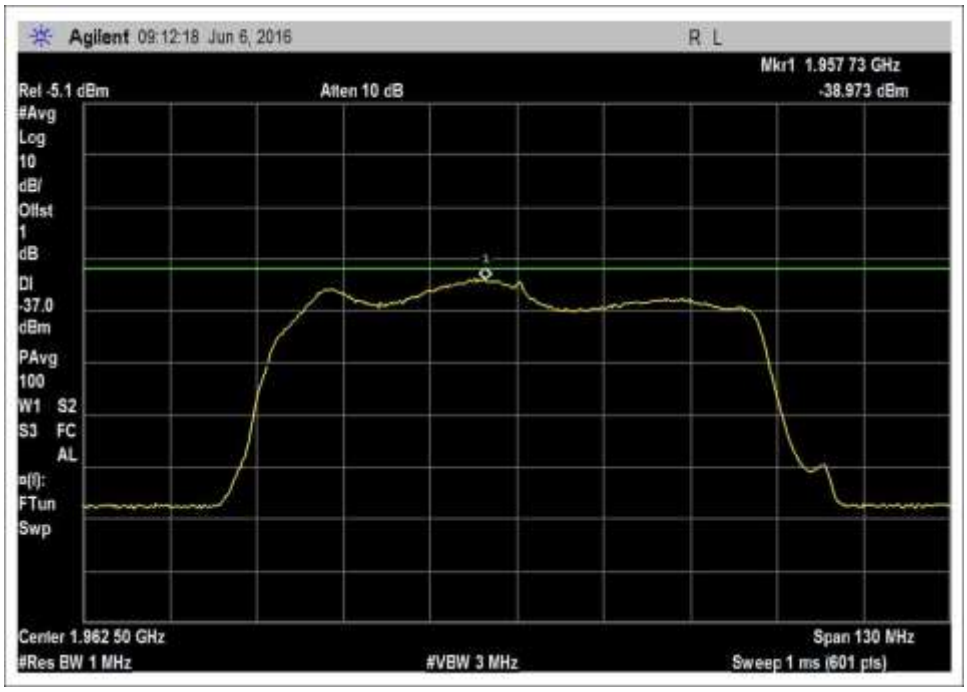
7.7_Noise_DL_728-757MHz-Zoom



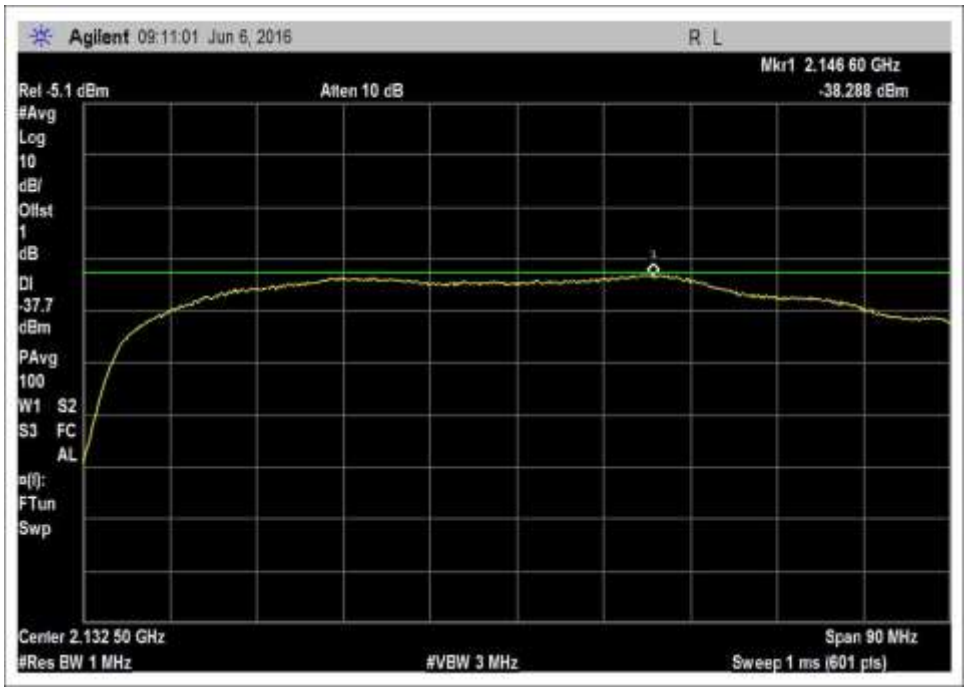
7.7_Noise_DL_746-757MHz



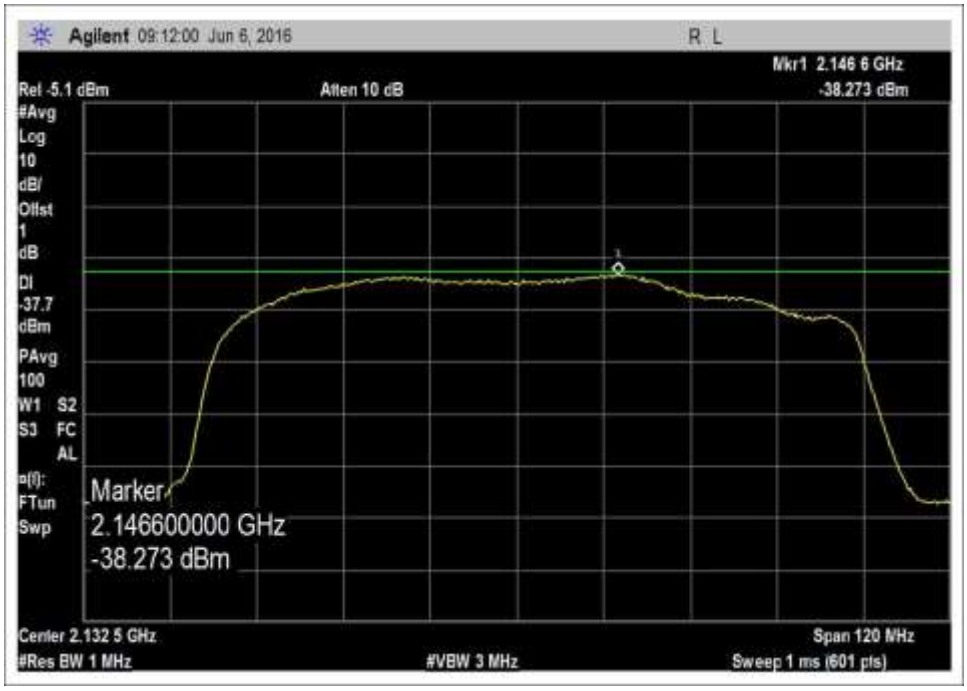
7.7_Noise_DL_869-894MHz



7.7_Noise_DL_1930-1995MHz



7.7_Noise_DL_2110-2155MHz



7.7_Noise_DL_2110-2155MHz-Zoom

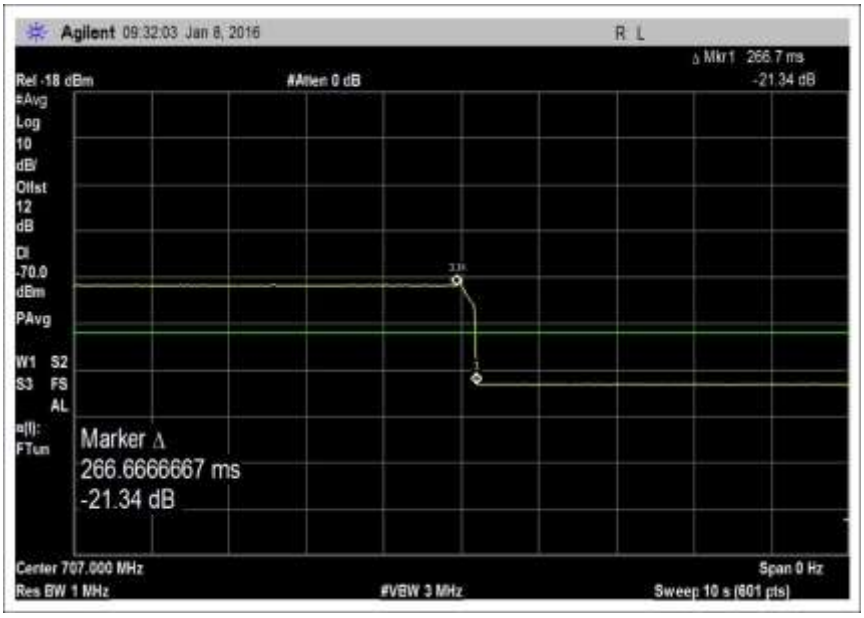
h – n Tx Noise

Note: For this subsection, see summary of results of 7.7.
7.7.1 h-n: Maximum transmitter noise when varying the DL signal generator output level with a 4.1MHz AWGN signal.

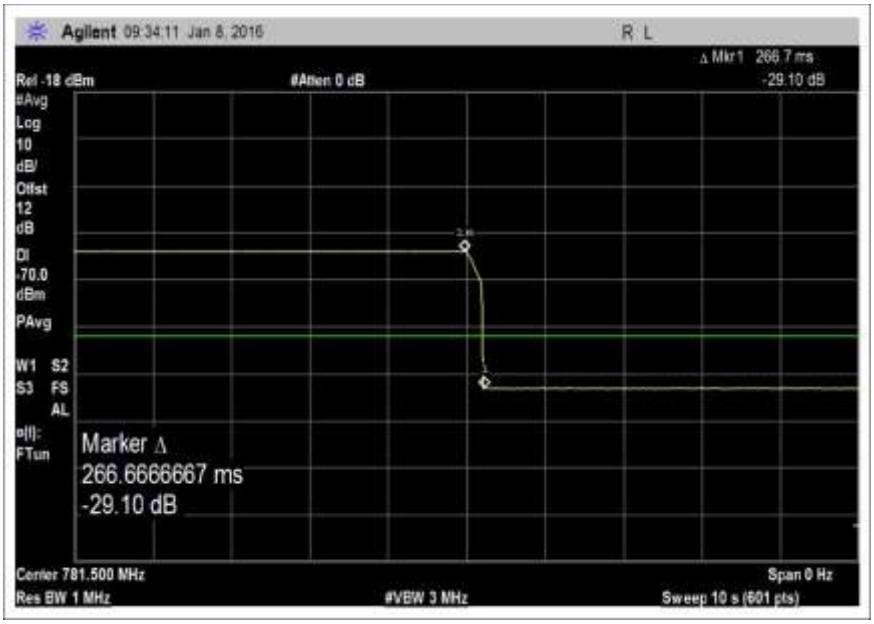
7.7.2 Variable UL Noise Timing

Plots

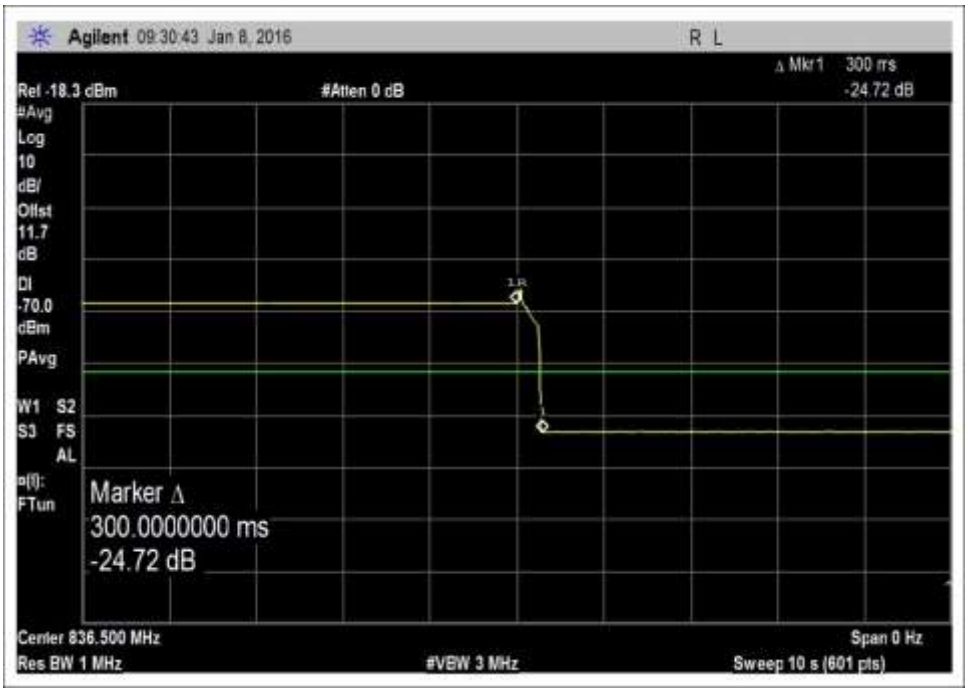
a – g Timing, UL



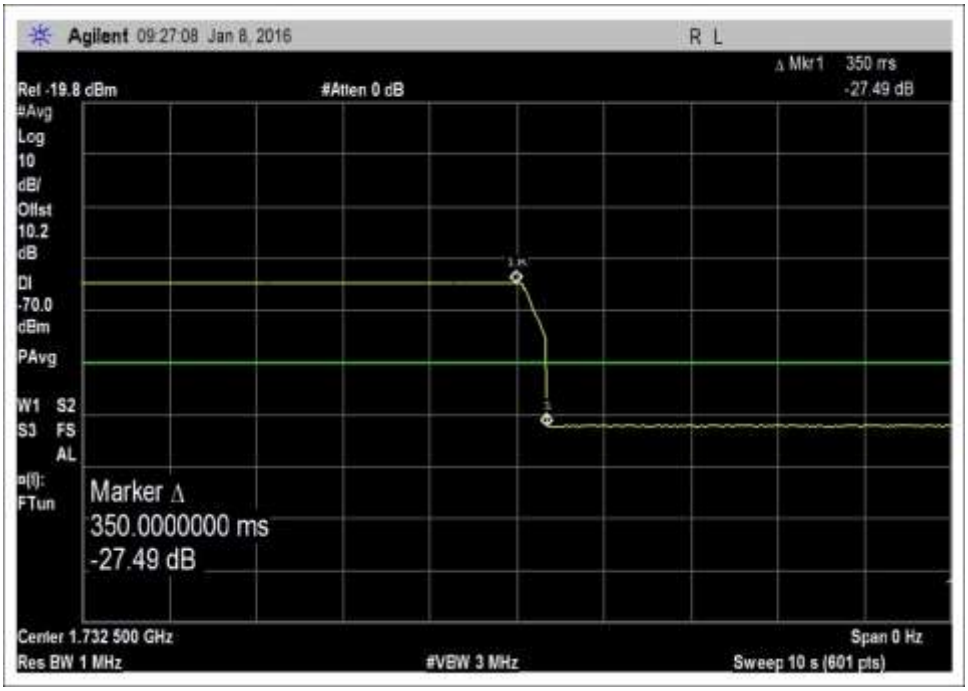
7.7_VarNoise_UL_698-716MHz



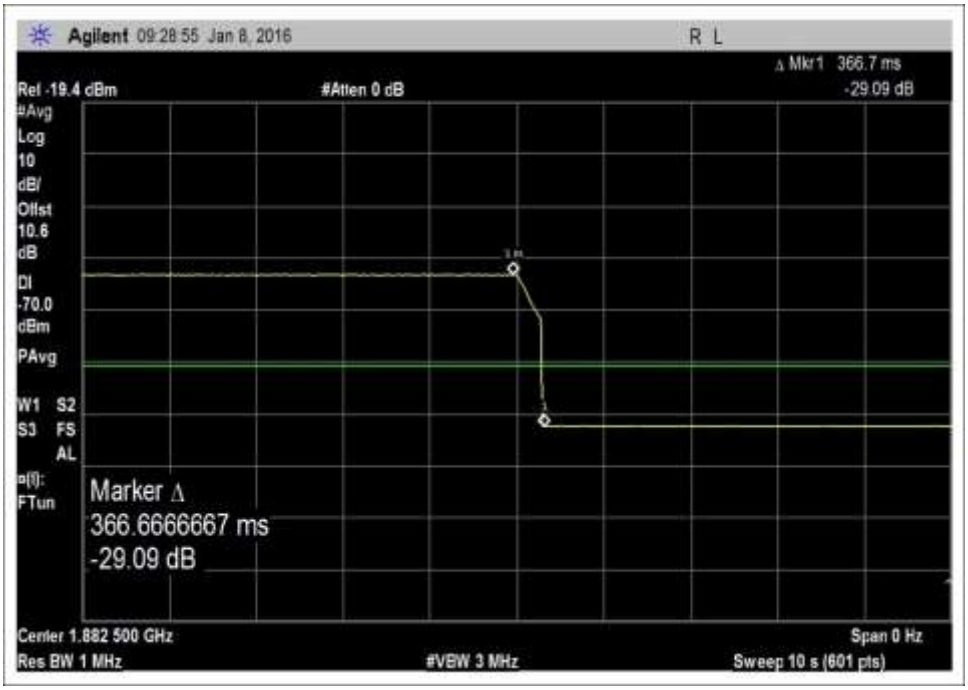
7.7_VarNoise_UL_776-787MHz



7.7_VarNoise_UL_824-849MHz



7.7_VarNoise_UL_1710-1755MHz



7.7_VarNoise_UL_1850-1915MHz

7.8 Uplink Inactivity

Test Conditions / Setup

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170		
Customer:	Cellphone-Mate, Inc.		
Specification:	**7.8 Uplink Inactivity**		
Work Order #:	**98648**	Date:	06/06/2016
Test Type:	**Conducted Emissions**	Time:	11:51:23
Tested by:	Daniel Bertran	Sequence#:	1
Software:	EMITest 5.03.02		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is a Fixed Wideband Consumer Booster.
The EUT is placed on the test bench. Evaluation performed at the Outside (Donor) and Inside (Server) antenna port.
The EUT Server port is a type SMA connector and 50-ohm impedance.
The EUT Donor port is type F connector and 75-ohm impedance.
During testing there is a 75 ohm to 50 ohm matching pad connected to the EUT type F connector.
This matching pad has a 5.8dB correction factor.
Firmware: V1.0

Test environment conditions:
Temperature: 22.3°C
Relative Humidity: 40%
101.1 kPa

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 section 7.8 of the FCC document: 935210 D03 Wideband Consumer Signal Booster Measurement Guidance v04 Dated February 12, 2016.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	ANP06709	Cable	32026-29094K-29094K-72TC	9/18/2014	9/18/2016
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018
	ANP05411	Attenuator	54A-10	1/18/2016	1/18/2018

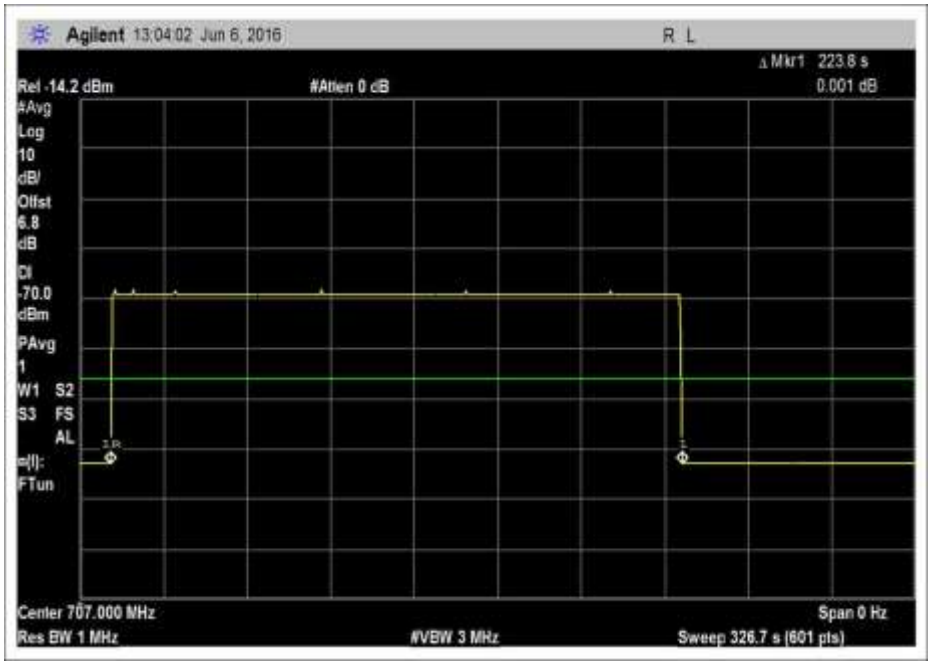
Summary of Results

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

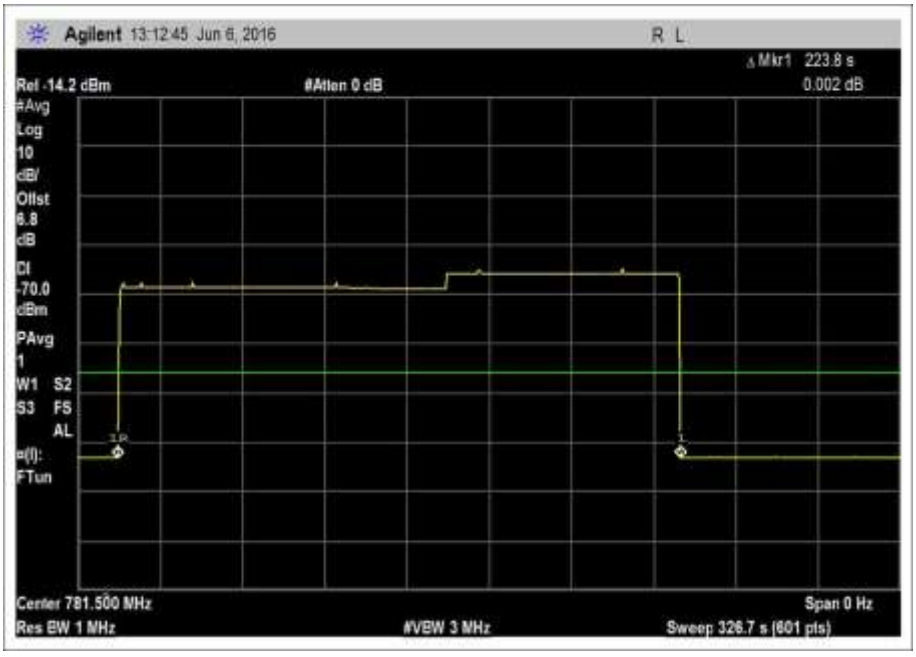
Uplink Inactivity		
Freq	**Measured**	**Limit**
MHz	**Min**	**Min**
UL1710-1755	3.7	5.0
UL1850-1915	3.7	5.0
UL824-849	3.7	5.0
UL 698-716	3.7	5.0
UL776-787	3.7	5.0

Plots

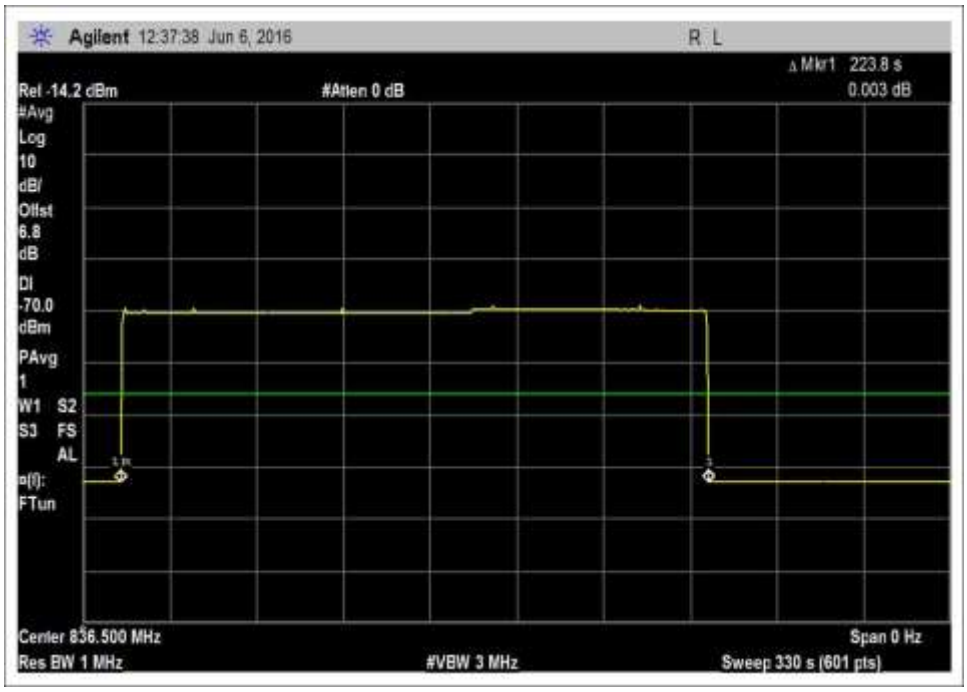
UL



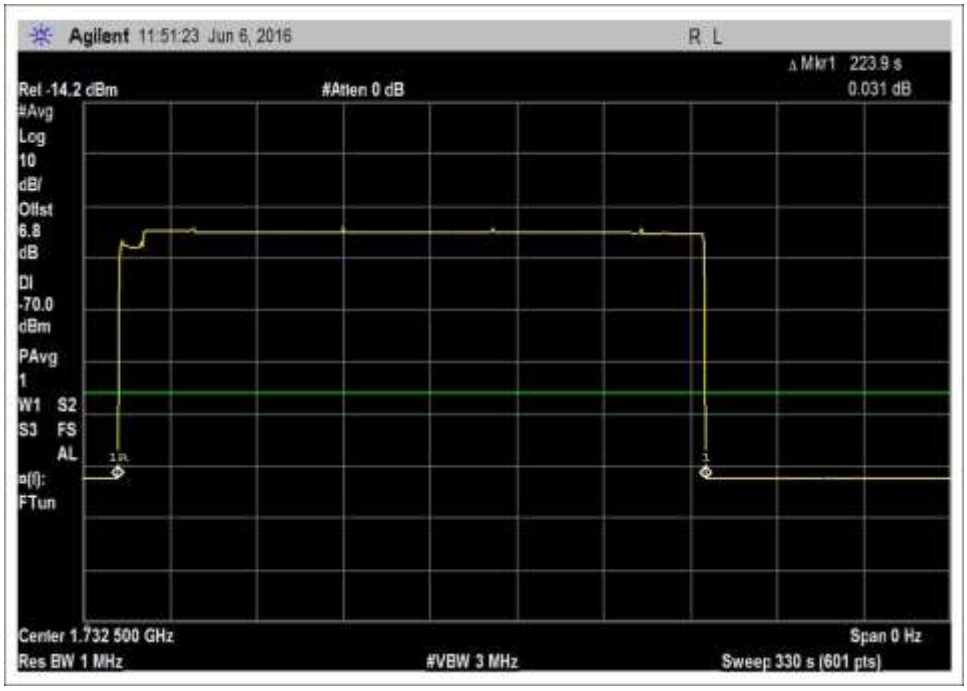
7.8_Inactivity_UL_698-707MHz



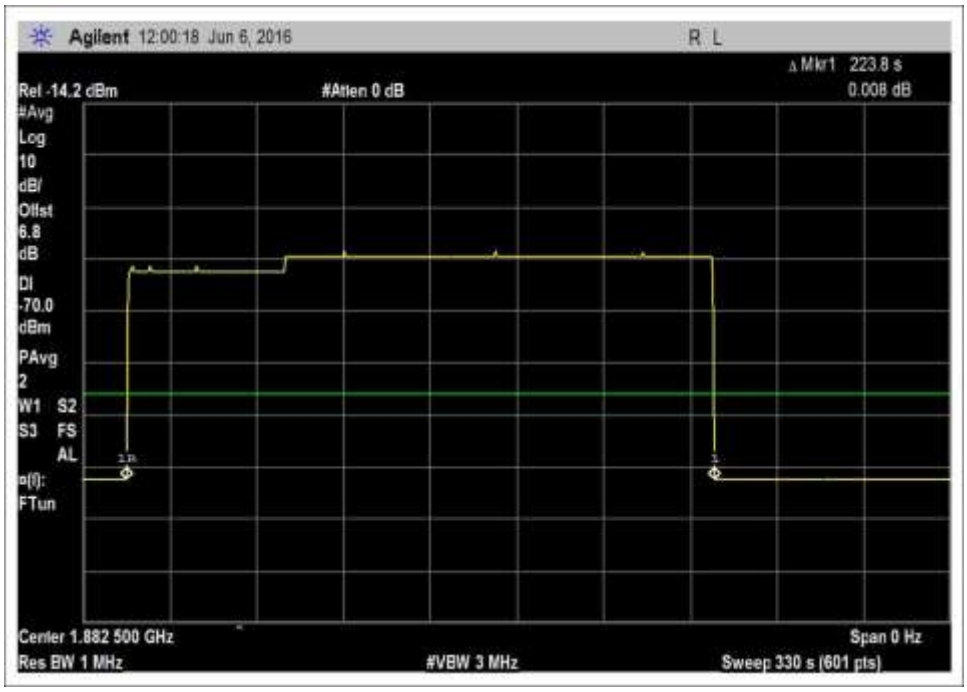
7.8_Inactivity_UL_776-787MHz



7.8_Inactivity_UL_824-849MHz



7.8_Inactivity_UL_1710-1755MHz



7.8_Inactivity_UL_1850-1915MHz

7.9 Booster Gain Limit

Test Conditions / Setup

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170		
Customer:	Cellphone-Mate, Inc.		
Specification:	**7.9 Variable Booster gain(Max Gain / Variable Uplink Gain Timing)**		
Work Order #:	**98648**	Date:	06/06/2016
Test Type:	**Conducted Emissions**	Time:	08:22:06
Tested by:	Daniel Bertran	Sequence#:	1
Software:	EMITest 5.03.02		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is a Fixed Wideband Consumer Booster.
The EUT is placed on the test bench. Evaluation performed at the Outside (Donor) and Inside (Server) antenna port.
The EUT Server port is a type SMA connector and 50-ohm impedance.
The EUT Donor port is type F connector and 75-ohm impedance.
During testing there is a 75 ohm to 50 ohm matching pad connected to the EUT type F connector.
This matching pad has a 5.8dB correction factor.
Firmware: V1.0
Test environment conditions:
Temperature: 22.3°C
Relative Humidity: 40%
101.1 kPa

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 section 7.9 of the FCC document: 935210 D03 Wideband Consumer Signal Booster Measurement Guidance v04 Dated February 12, 2016.
Note: Used MSCL provided by the manufacture's antenna kitting.

Mobile station coupling loss (MSCL): *the minimum coupling loss (in dB) between the wireless device and the input (server) port of the consumer booster. MSCL must be calculated or measured for each band of operation and provided in compliance test reports. MSCL includes the path loss from the wireless device, and the booster's server antenna gain and cable loss. The wireless device is assumed to be an isotropic (0 dBi) antenna reference. Minimum standoff distances from inside wireless devices to the booster's server antenna must be reasonable and specified by the manufacturer in customer provided installation manuals.*

L P = 20logf + 20logd – 27.5
Where:

L P = basic free space path loss,
f = Center frequency,
d = 2 meters.

MSCL

Frequency (MHz)	MSCL (dB)
1850-1915	41.8
824-849	36.8
698-716	35.8
779-787	36.8
1710-1755	42.1

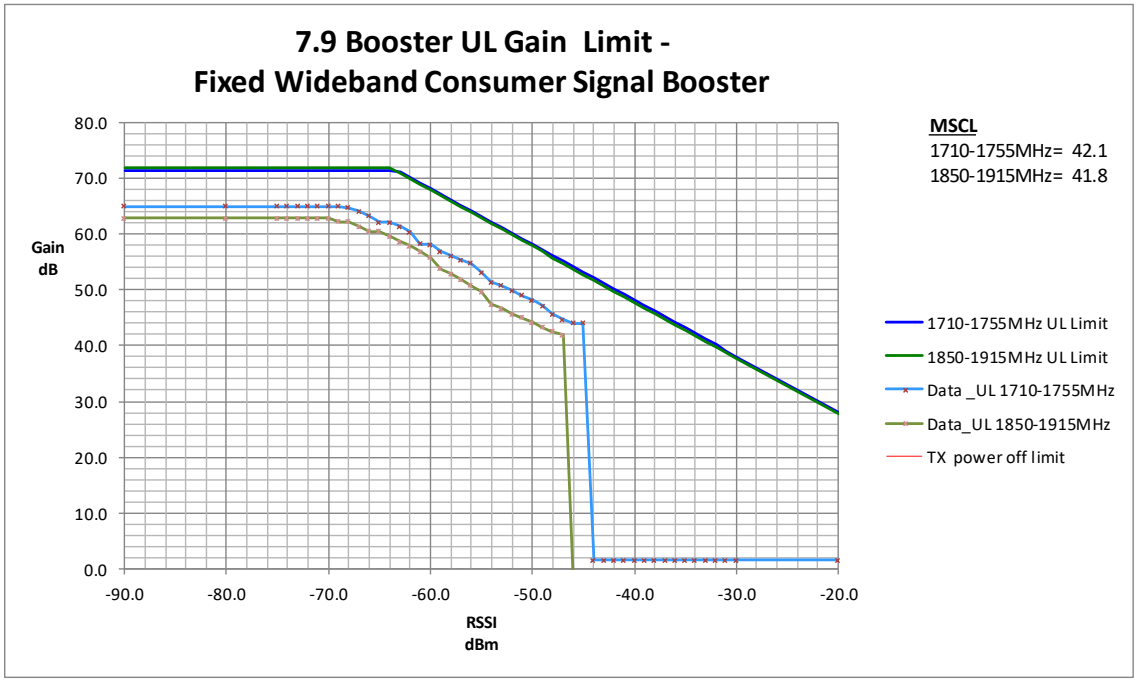
Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN03418	Signal Generator	E4438C	7/30/2015	7/30/2017
	ANC00032	Signal Generator	E4433B	2/26/2016	2/26/2018
	ANP06709	Cable	32026-29094K-29094K-72TC	9/18/2014	9/18/2016
	ANP06710	Cable	32026-29094K-29094K-72TC	9/18/2014	9/18/2016
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018
	ANP06467	Attenuator	PE7014-10	5/13/2015	5/13/2017
	ANP05411	Attenuator	54A-10	1/18/2016	1/18/2018
	ANC00087	Combiner	44000	1/7/2016	1/7/2018
	ANC00082	RF Coupler	722-10-1.500V	8/26/2015	8/26/2017
	ANP06138	Cable	32022-29094K-29094K-72TC	3/18/2015	3/18/2017

Summary of Results

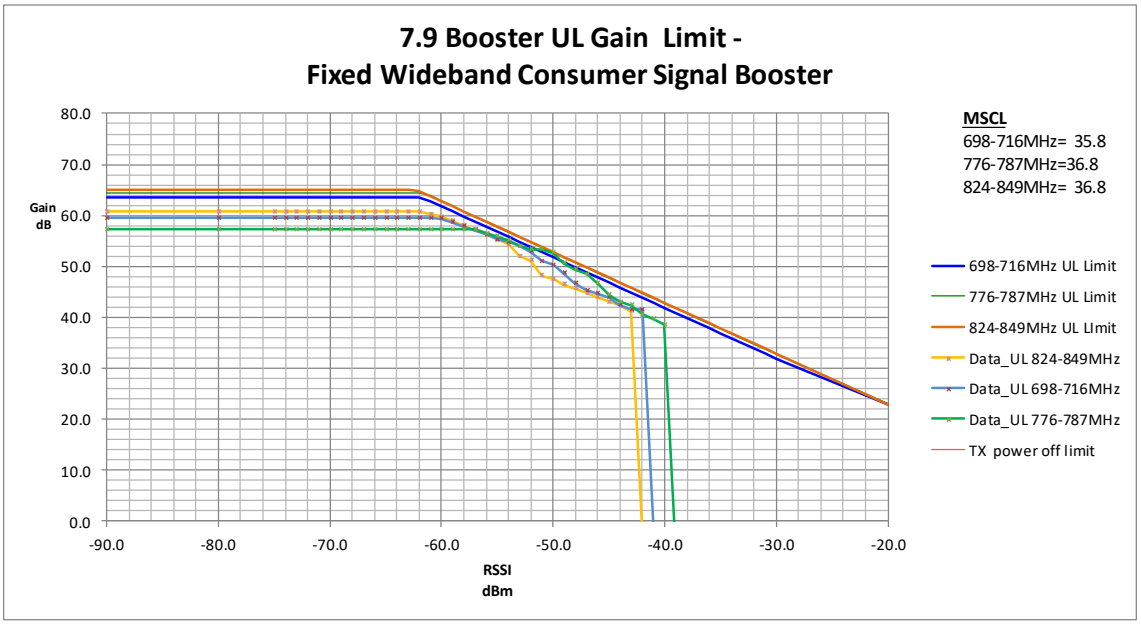
Pass: As demonstrated, computed gains are within the gain limit. All maximum variable uplink gain timings are within 3 second limit.

7.9.1 Maximum gain



1850.0			1915.0 MHz				
				Limit			Margin
RSSI (dBm)	Input (dBm)	Measured Output (dBm)	Measured Gain (dBm)	RSSI Dependent	Fixed Booster Limit	TX off	
-74.0	-50.1	12.8	62.9		72.0		-9.1
-71.0	-50.1	12.8	62.9		72.0		-9.1
-63.0	-50.1	8.5	58.6	70.8			-12.2
-62.0	-50.1	7.8	57.9	69.8			-11.9
-61.0	-50.1	6.8	56.9	68.8			-11.9
-60.0	-50.1	5.6	55.7	67.8			-12.1

1710.0			1755.0 MHz				
				Limit			Margin
RSSI (dBm)	Input (dBm)	Measured Output (dBm)	Measured Gain (dBm)	RSSI Dependent	Fixed Booster Limit	TX off	
-74.0	-52.5	12.4	64.9		71.3		-6.4
-70.0	-52.5	12.4	64.9		71.3		-6.4
-62.0	-52.5	7.9	60.4	70.1			-9.7
-57.0	-52.5	2.9	55.4	65.1			-9.7
-56.0	-52.5	2.2	54.7	64.1			-9.4
-45.0	-52.5	-8.5	44.0	53.1			-9.1



824.0			849.0 MHz				
				Limit			Margin
RSSI (dBm)	Input (dBm)	Measured Output (dBm)	Measured Gain (dBm)	RSSI Dependent	Fixed Booster Limit	TX off	
-74.0	-48.0	12.8	60.8		64.9		-4.1
-69.0	-48.0	12.8	60.8		64.9		-4.1
-57.0	-48.0	9.1	57.1	59.8			-2.7
-56.0	-48.0	8.3	56.3	58.8			-2.5
-55.0	-48.0	7.3	55.3	57.8			-2.5
-54.0	-48.0	6.2	54.2	56.8			-2.6

698.0			716.0 MHz				
				Limit			Margin
RSSI (dBm)	Input (dBm)	Measured Output (dBm)	Measured Gain (dBm)	RSSI Dependent	Fixed Booster Limit	TX off	
-74.0	-47.5	12.0	59.5		63.5		-4.0
-69.0	-47.5	12.0	59.5		63.5		-4.0
-55.0	-47.5	7.8	55.3	56.8			-1.5
-54.0	-47.5	7.2	54.7	55.8			-1.1
-53.0	-47.5	6.5	54.0	54.8			-0.8
-52.0	-47.5	5.4	52.9	53.8			-0.9

776.0			787.0 MHz				
				Limit			Margin
RSSI (dBm)	Input (dBm)	Measured Output (dBm)	Measured Gain (dBm)	RSSI Dependent	Fixed Booster Limit	TX off	
-75.0	-45.3	12.0	57.3		64.4		-7.1
-72.0	-45.3	12.0	57.3		64.4		-7.1
-51.0	-45.3	8.1	53.4	53.8			-0.4
-50.0	-45.3	7.3	52.6	52.8			-0.2
-49.0	-45.3	5.3	50.6	51.8			-1.2
-47.0	-45.3	3.2	48.5	49.8			-1.3

7.9.2 Variable Uplink Gain Timing

Uplink Gain Timing		
Frequency (MHz)	Measured (Sec)	Limit (Sec)
UL 1710-1755	2.3	3
UL 1850-1915	2.3	3
UL 824-849	2.3	3
UL 698-716	2.3	3
UL 776-787	2.3	3

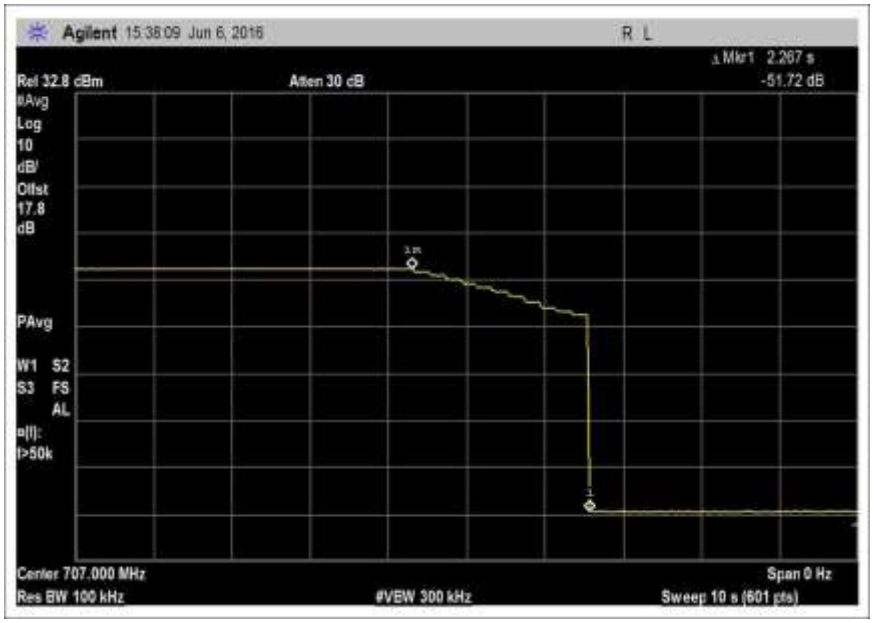
7.9.1 Maximum Gain

Note: For this subsection, see summary of results of 7.9.
7.9.1 Maximum gain

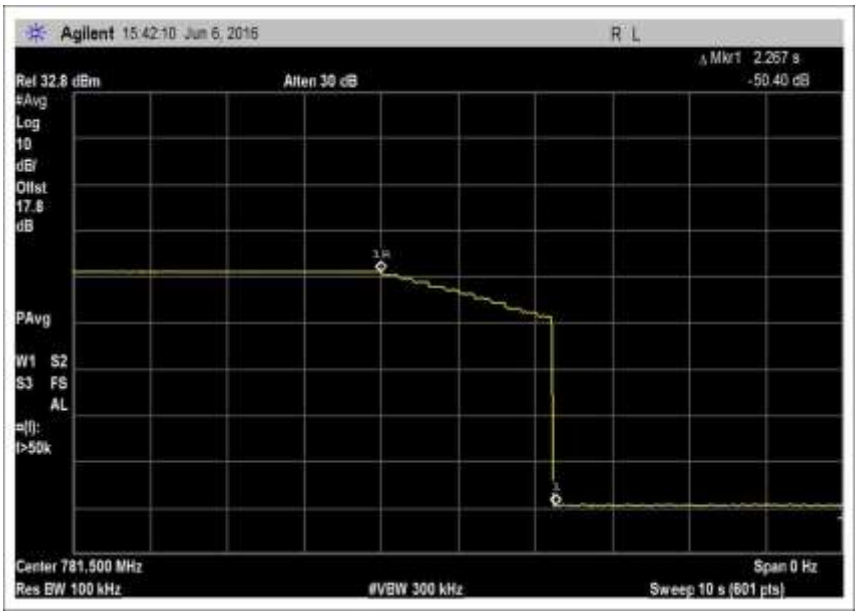
7.9.2 Variable uplink Gain Timing

Plots

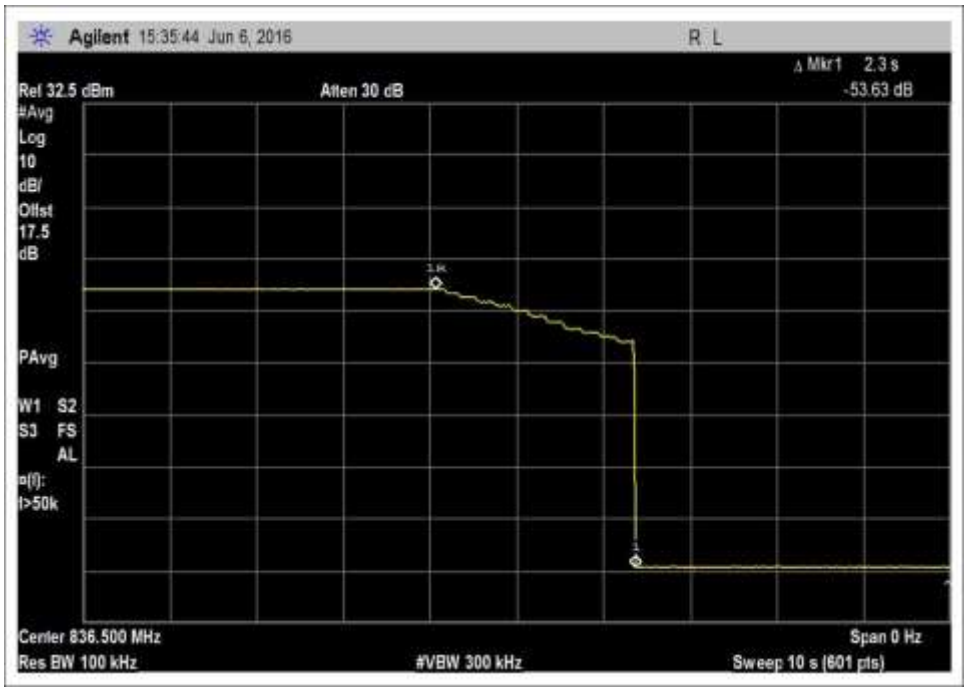
UL



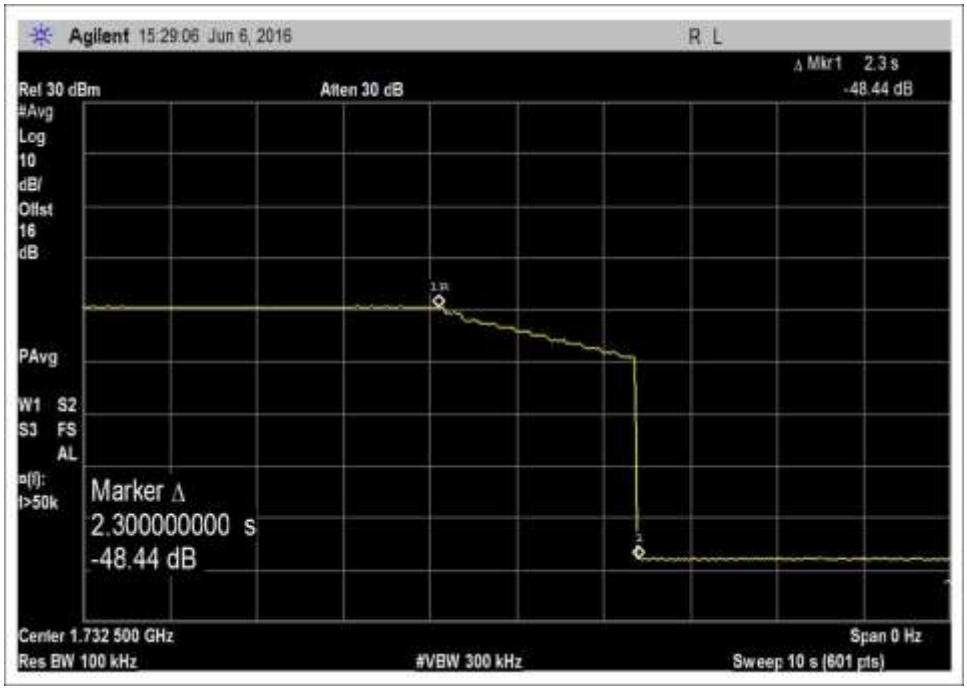
7.9.2_VarULGainTiming_UL_698-716MHz



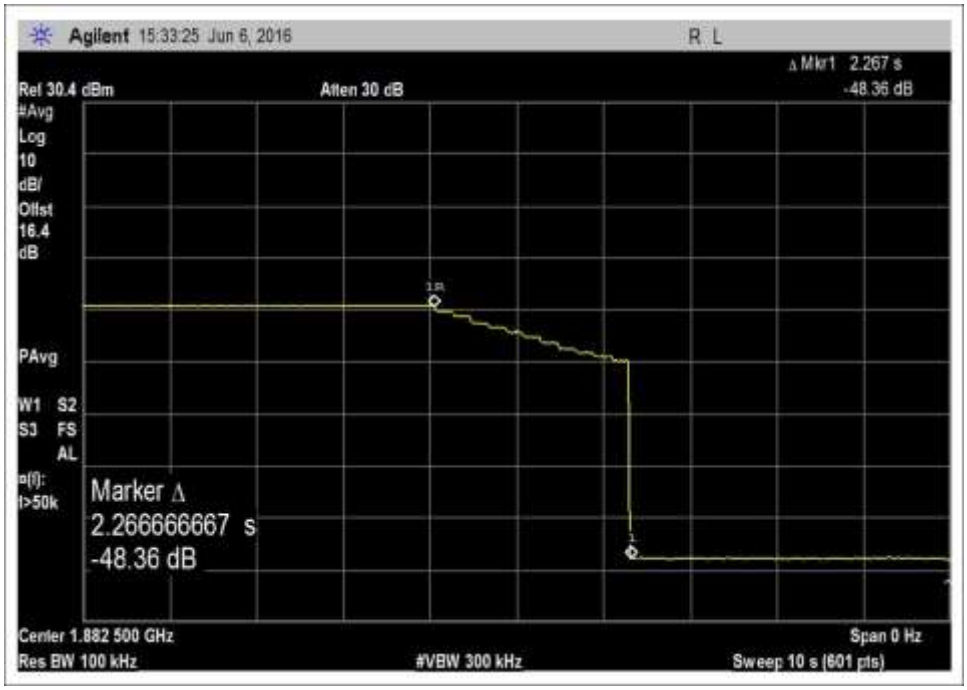
7.9.2_VarULGainTiming_UL_776-787MHz



7.9.2_VarULGainTiming_UL_824-849MHz



7.9.2_VarULGainTiming_UL_1710-1755MHz



7.9.2_VarULGainTiming_UL_1850-1915MHz

7.10 - Occupied Band Width

Test Conditions / Setup

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170		
Customer:	Cellphone-Mate, Inc.		
Specification:	**7.10 Occupied Band Width / 47 CFR §2.1049 Occupied Band Width**		
Work Order #:	**98648**	Date:	06/08/2016
Test Type:	**Conducted Emissions**	Time:	14:43:16
Tested by:	Daniel Bertran	Sequence#:	1
Software:	EMITest 5.03.02		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is a Fixed Wideband Consumer Booster.
The EUT is placed on the test bench. Evaluation performed at the Outside (Donor) and Inside (Server) antenna port.
The EUT Server port is a type SMA connector and 50-ohm impedance.
The EUT Donor port is type F connector and 75-ohm impedance.
During testing there is a 75 ohm to 50 ohm matching pad connected to the EUT type F connector.
This matching pad has a 5.8dB correction factor.
Firmware: V1.0
Test environment conditions:
Temperature: 23.1°C
Relative Humidity: 42%
101.2 kPa

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 section 7.10 of the FCC document: 935210 D03 Wideband Consumer Signal Booster Measurement Guidance v04 Dated February 12, 2016.

Test Equipment:

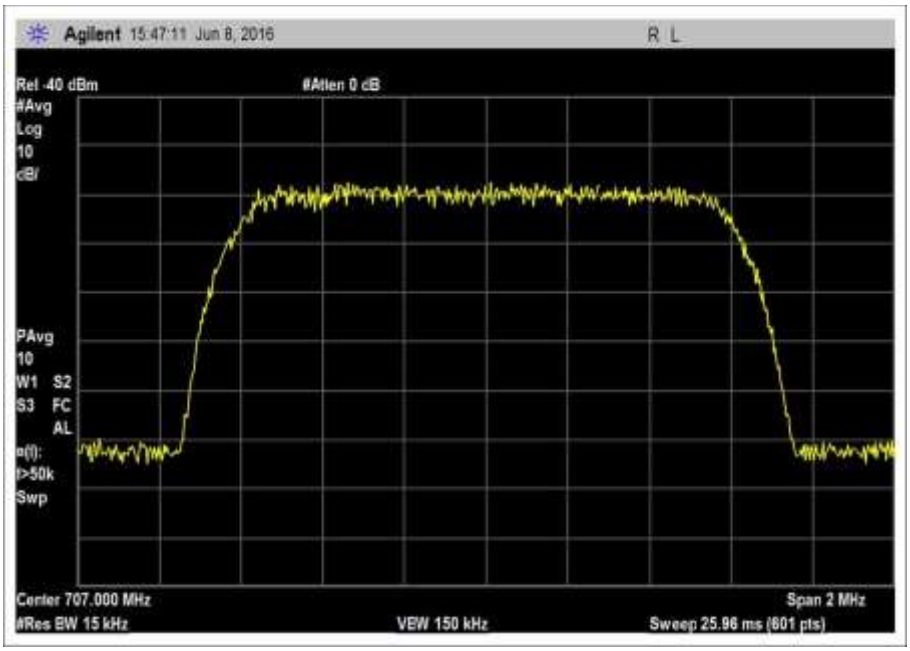
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN03418	Signal Generator	E4438C	7/30/2015	7/30/2017
	ANP06709	Cable	32026-29094K-29094K-72TC	9/18/2014	9/18/2016
	ANP06710	Cable	32026-29094K-29094K-72TC	9/18/2014	9/18/2016
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018
	ANP06467	Attenuator	PE7014-10	5/13/2015	5/13/2017
	ANP05411	Attenuator	54A-10	1/18/2016	1/18/2018

Summary of Results

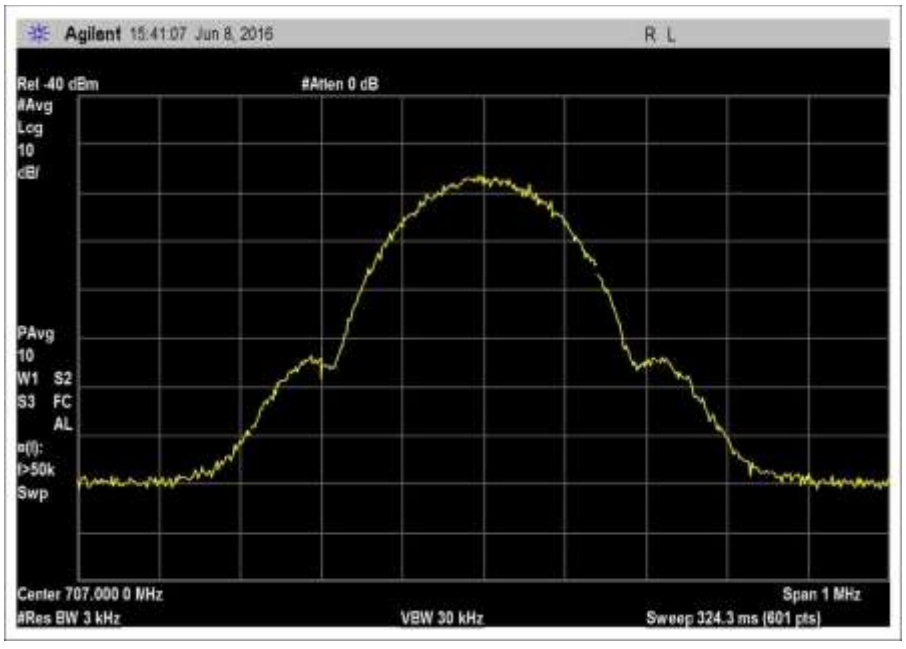
Pass: As summarized in plots below, the uniformity of the output signal relative to the input signal are practically identical. Therefore, the comparison is within limits.

Plots

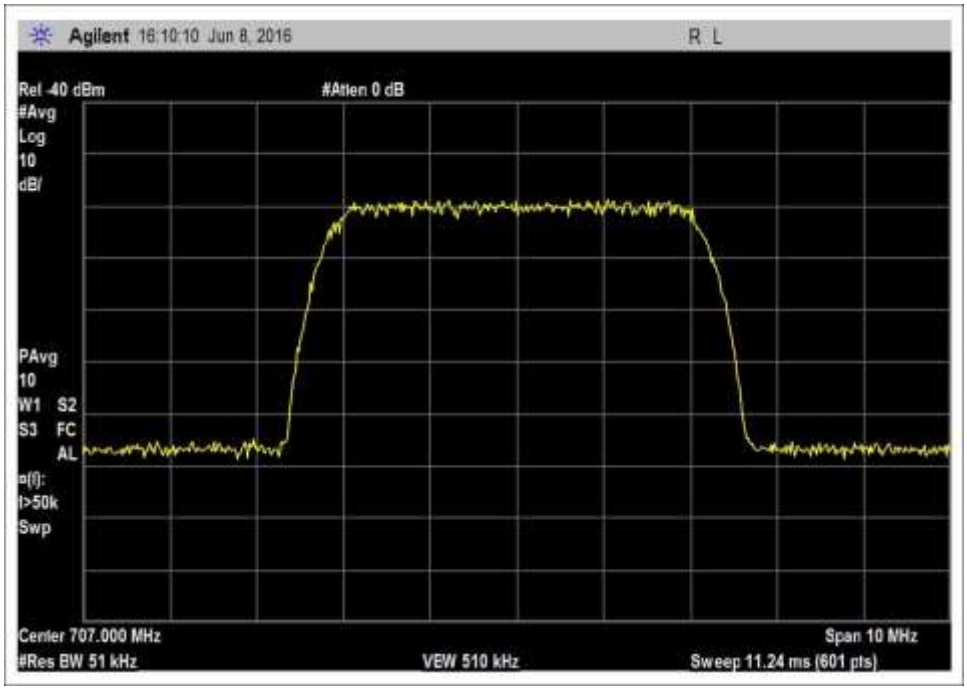
Input - UL



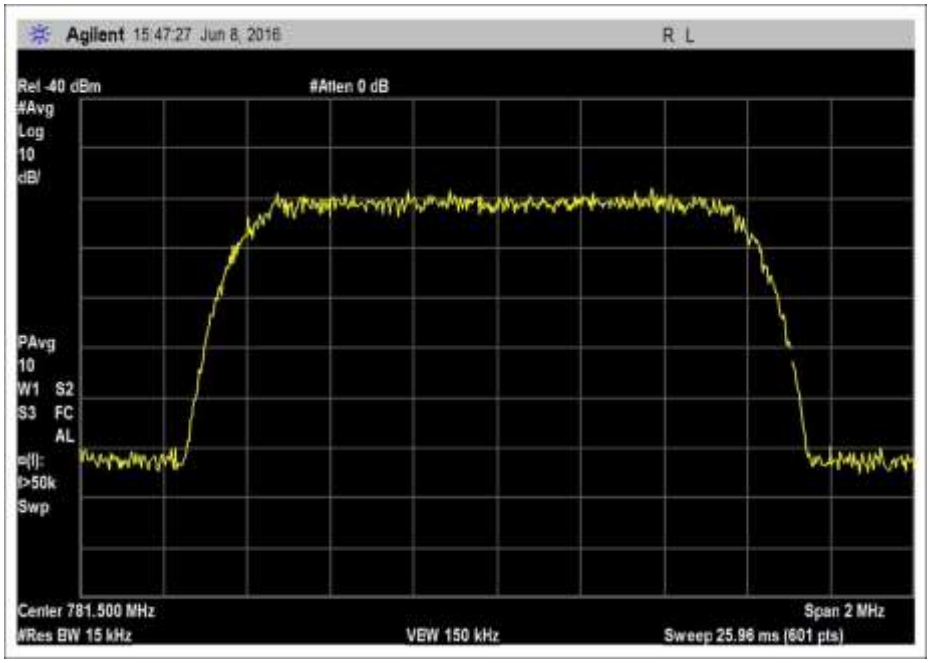
7.10_OBW_UL_698-716MHz_CDMA



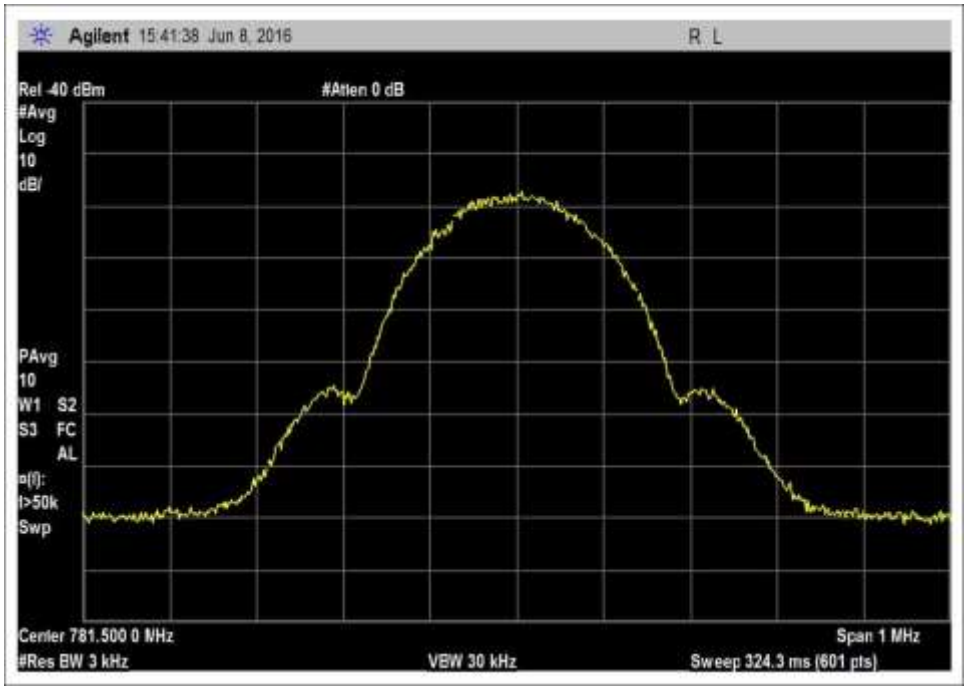
7.10_OBW_UL_698-716MHz_GSM



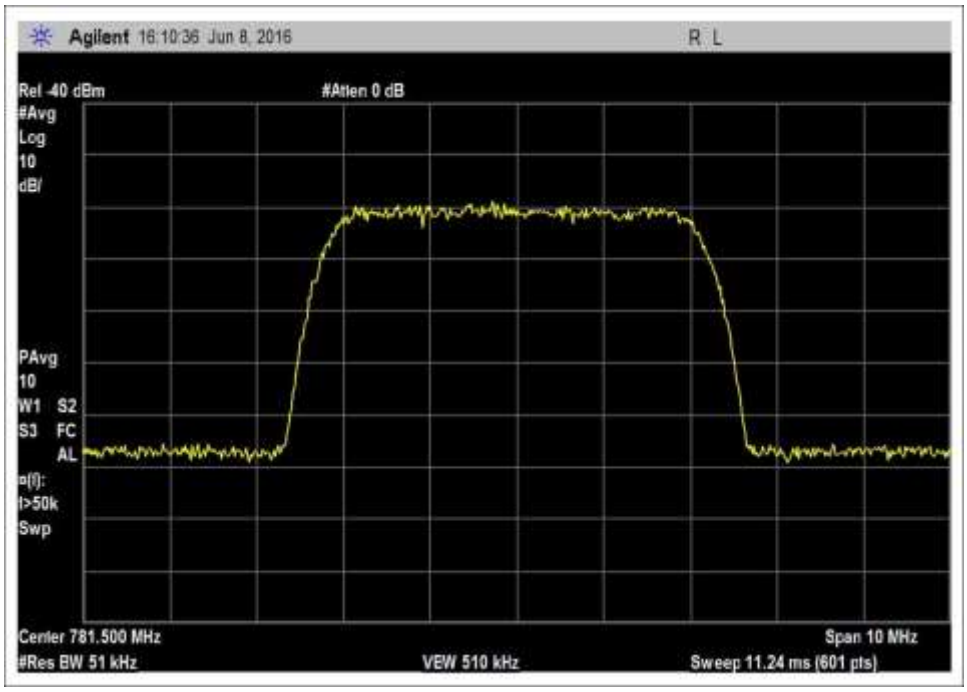
7.10_OBW_UL_698-716MHz_WCDMA



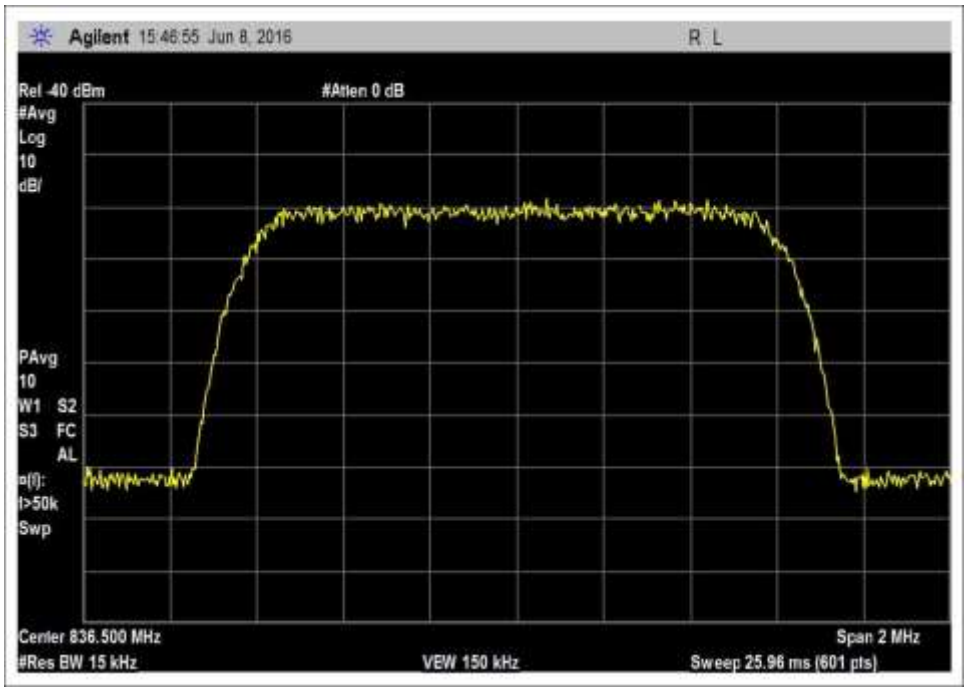
7.10_OBW_UL_776-787MHz_CDMA



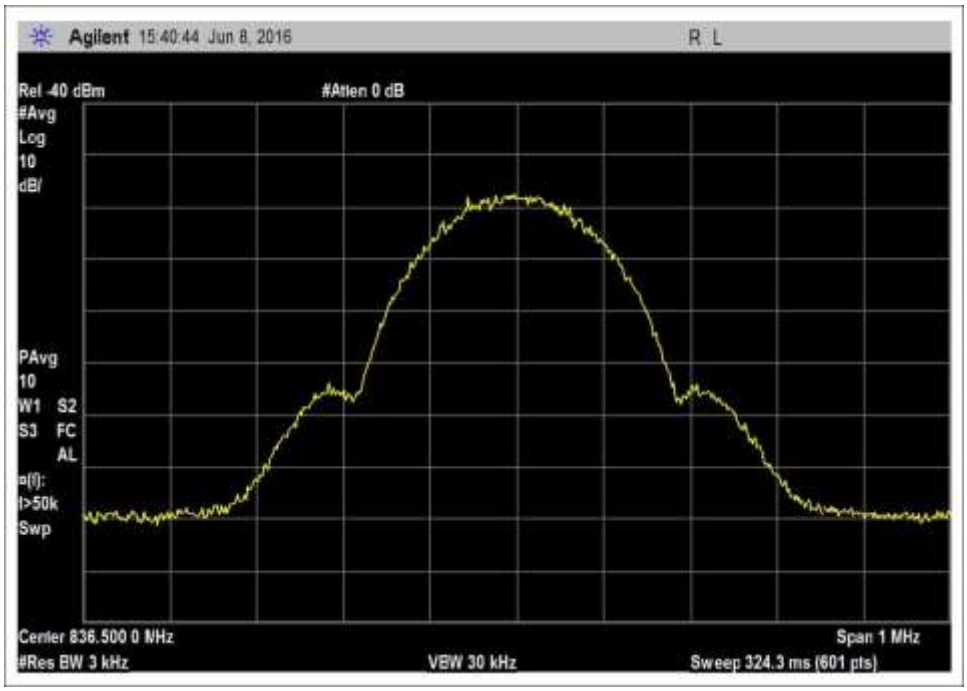
7.10_OBW_UL_776-787MHz_GSM



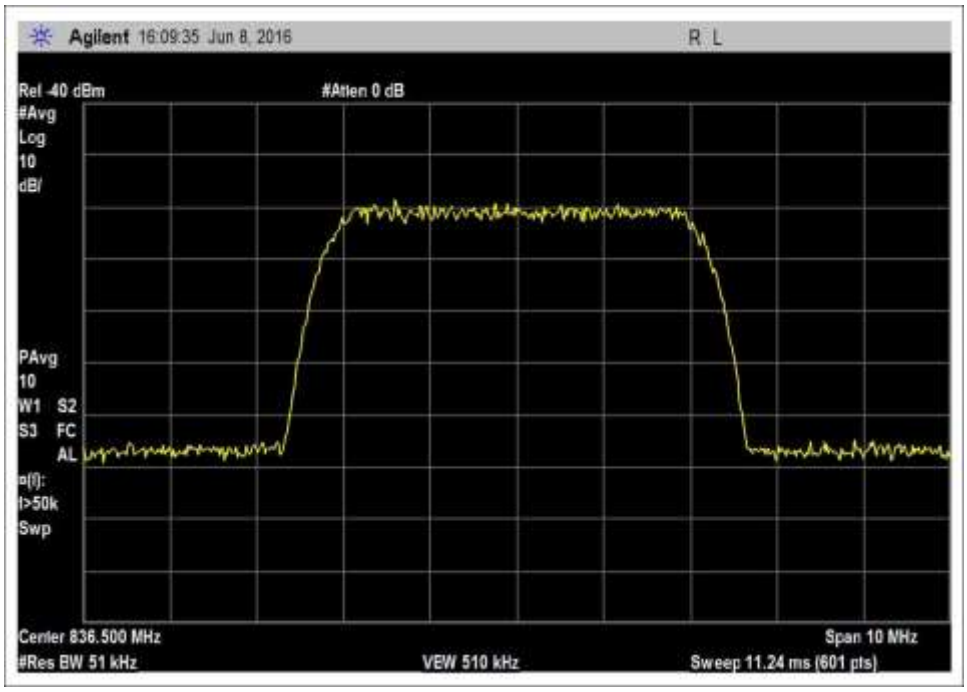
7.10_OBW_UL_776-787MHz_WCDMA



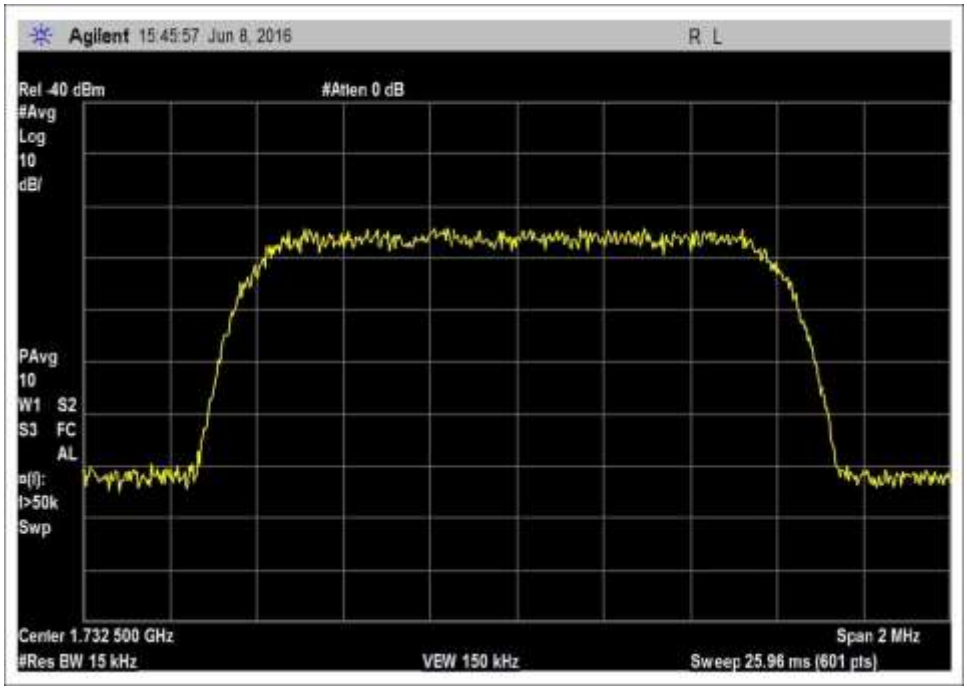
7.10_OBW_UL_824-849MHz_CDMA



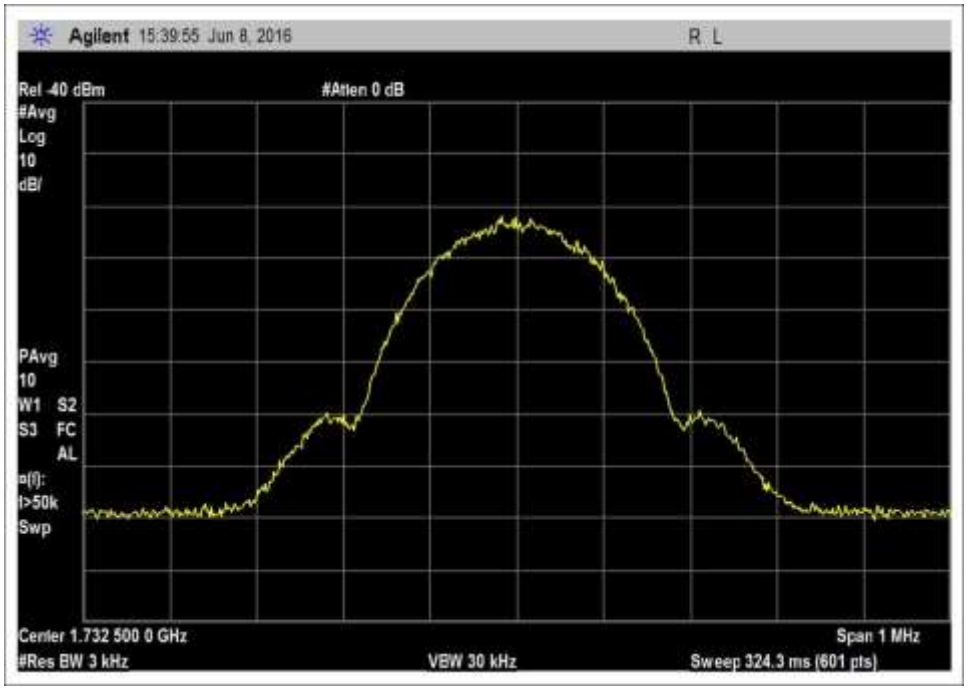
7.10_OBW_UL_824-849MHz_GSM



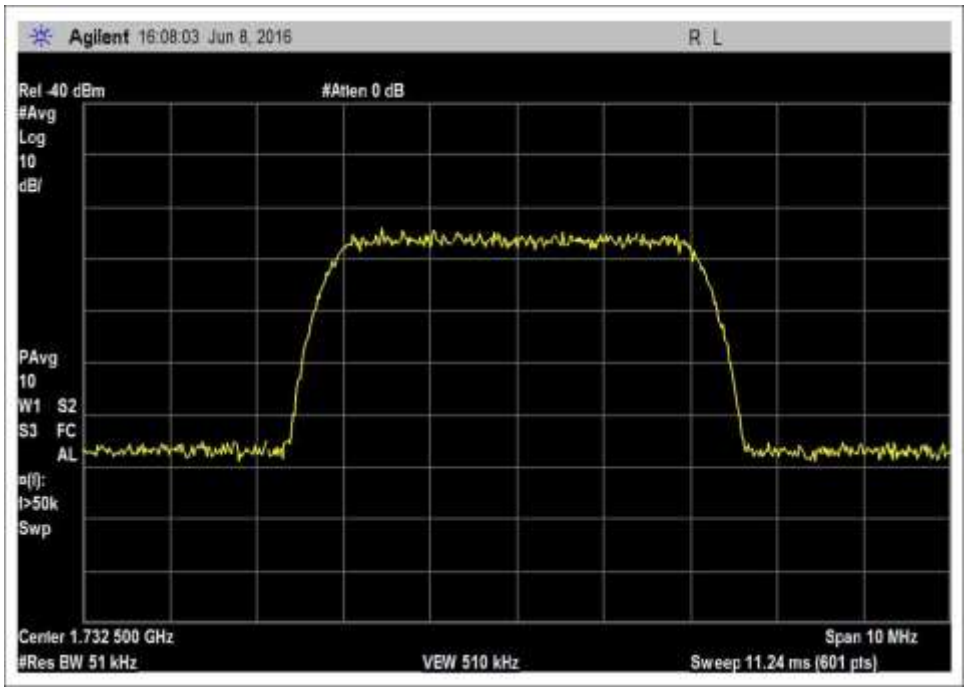
7.10_OBW_UL_824-849MHz_WCDMA



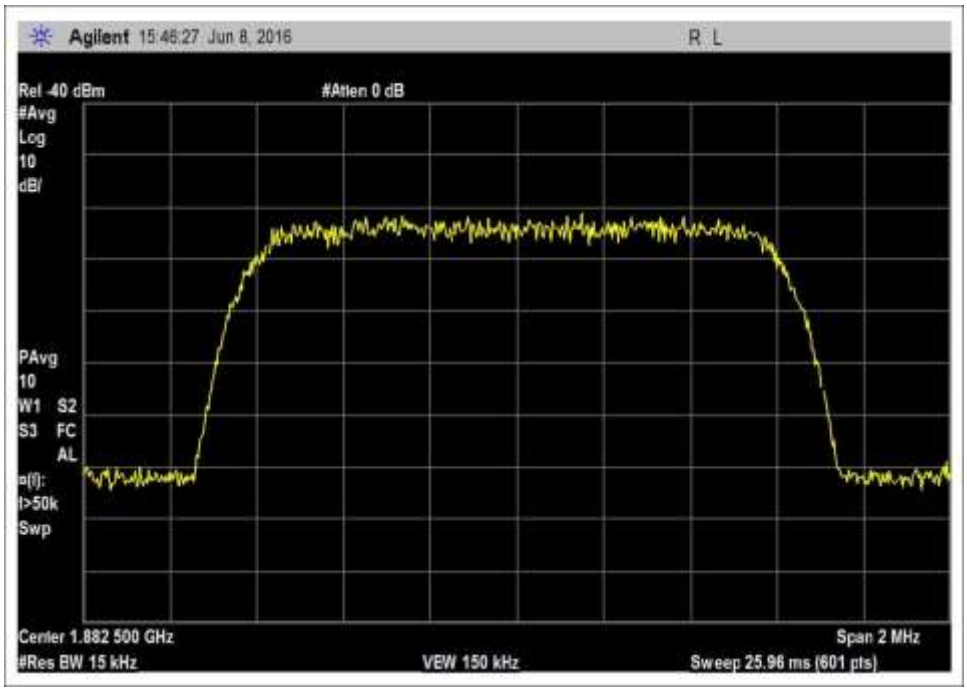
7.10_OBW_UL_1710-1755MHz_CDMA



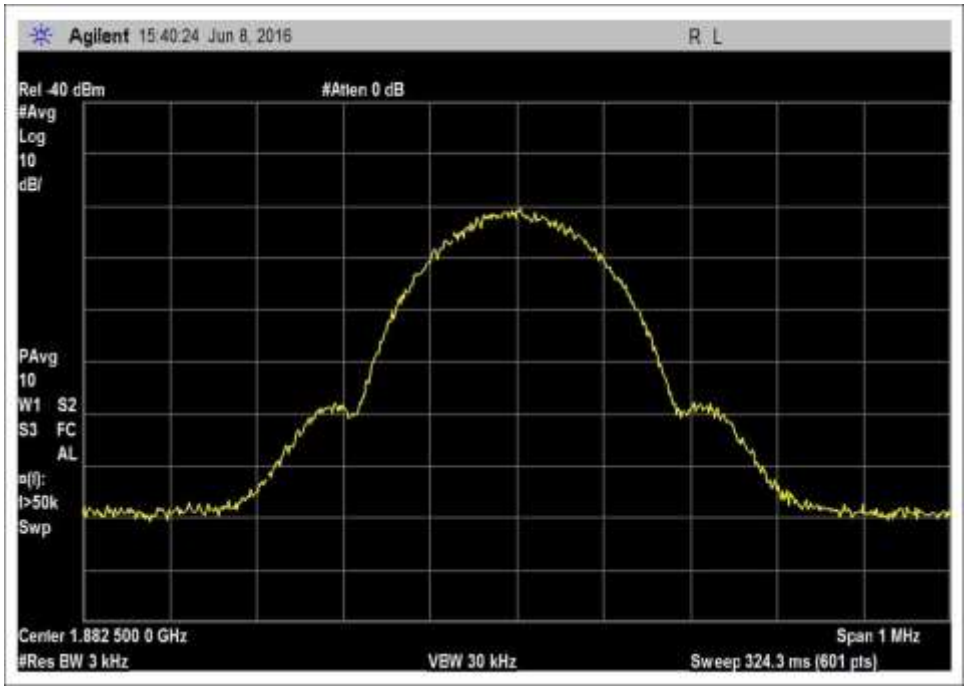
7.10_OBW_UL_1710-1755MHz_GSM



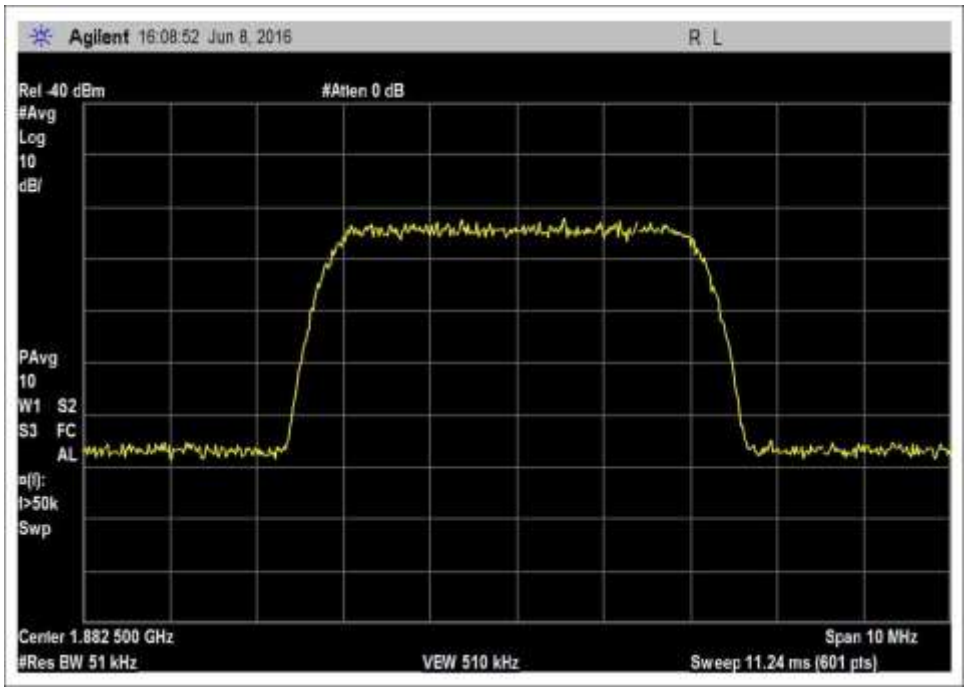
7.10_OBW_UL_1710-1755MHz_WCDMA



7.10_OBW_UL_1850-1915MHz_CDMA

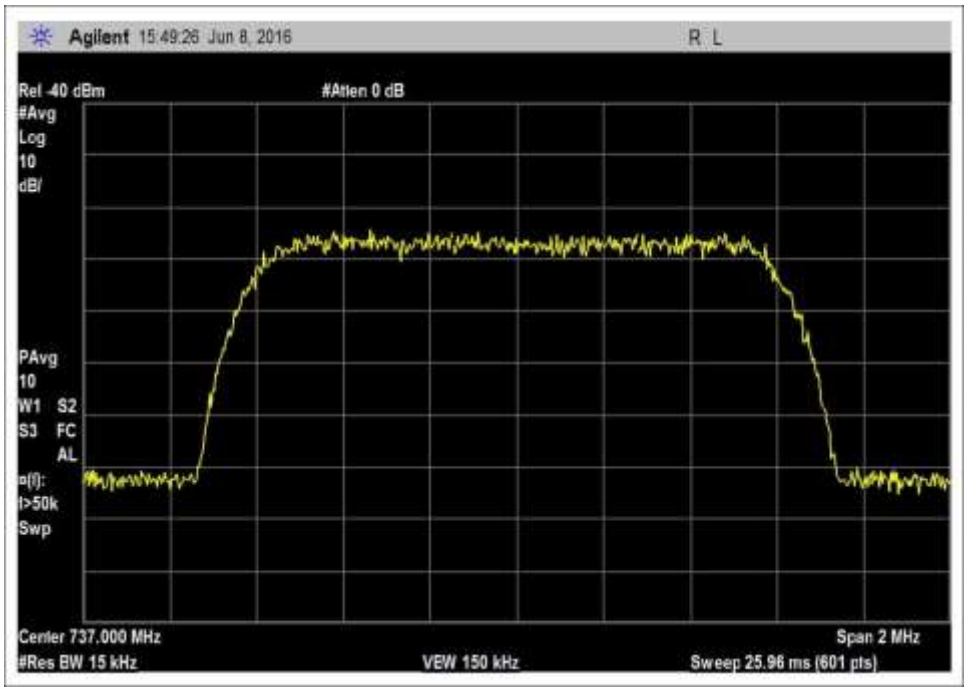


7.10_OBW_UL_1850-1915MHz_GSM

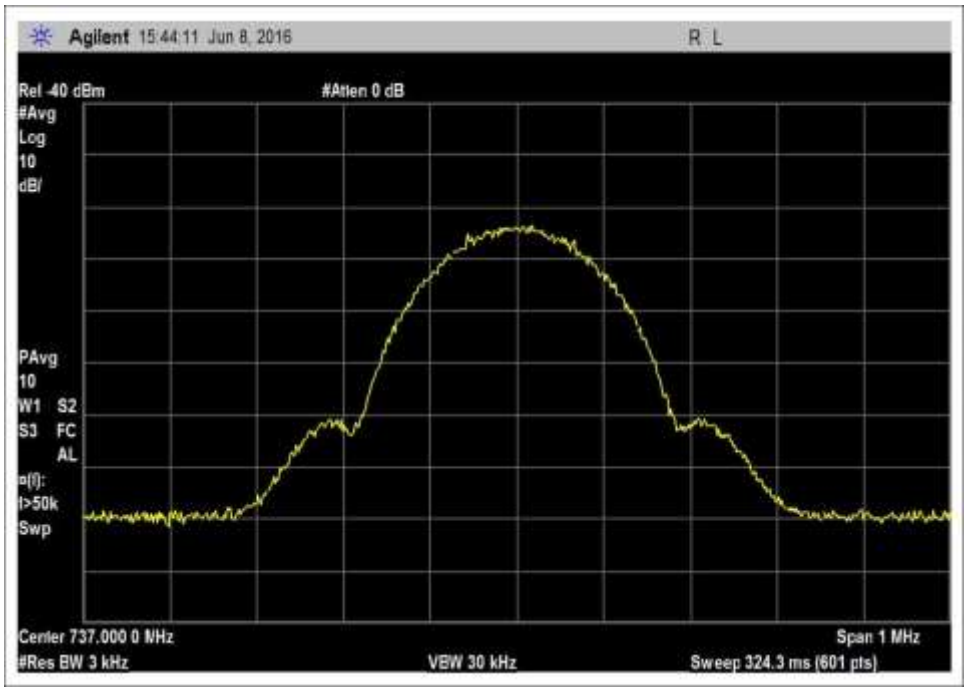


7.10_OBW_UL_1850-1915MHz_WCDMA

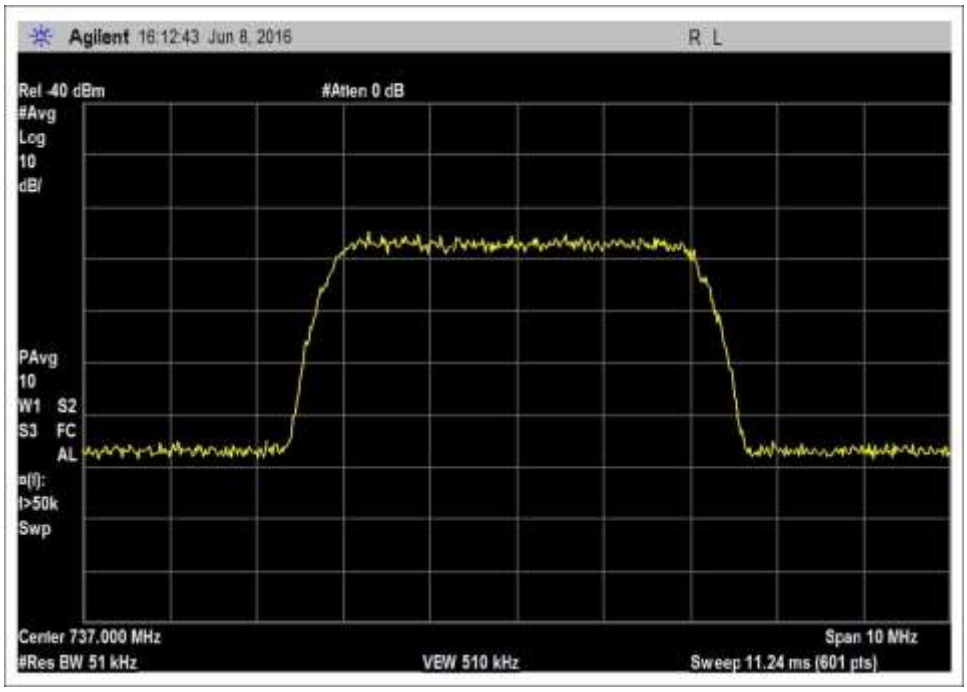
Input - DL



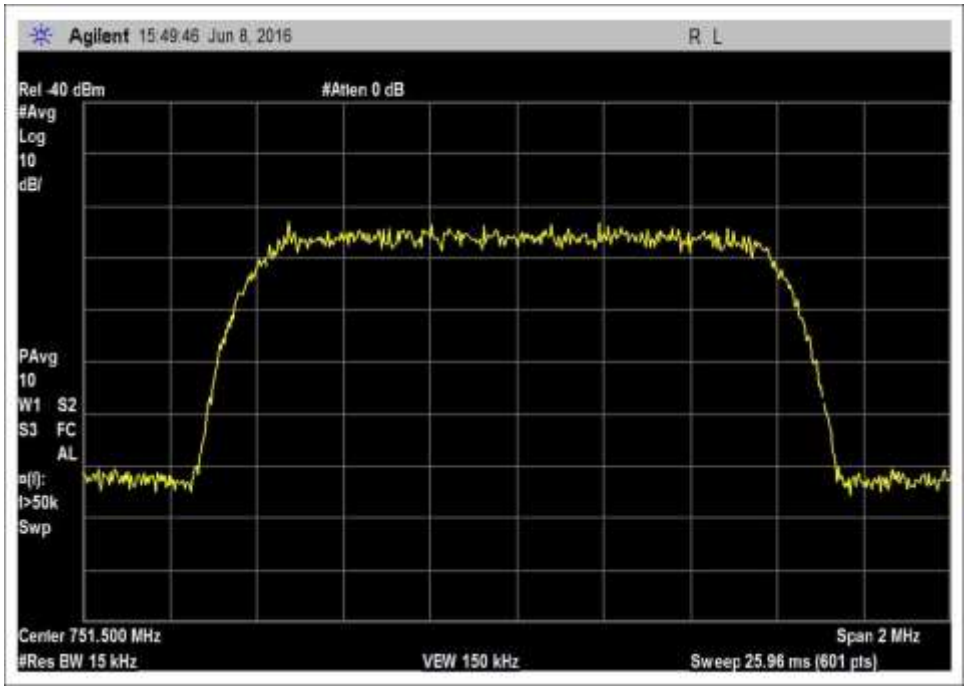
7.10_OBW_DL_728-746MHz_CDMA



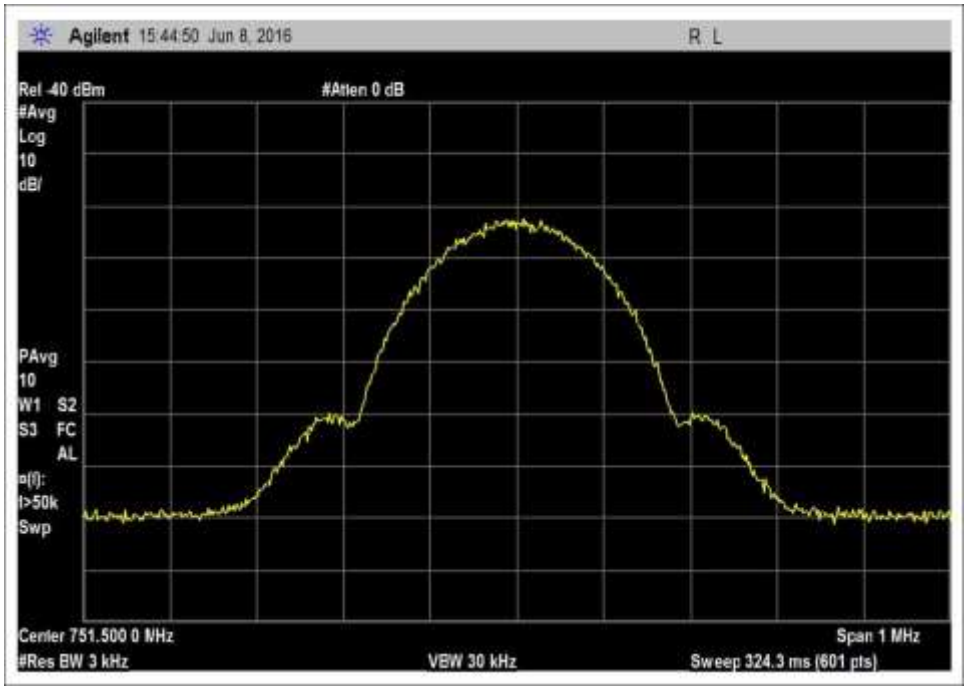
7.10_OBW_DL_728-746MHz_GSM



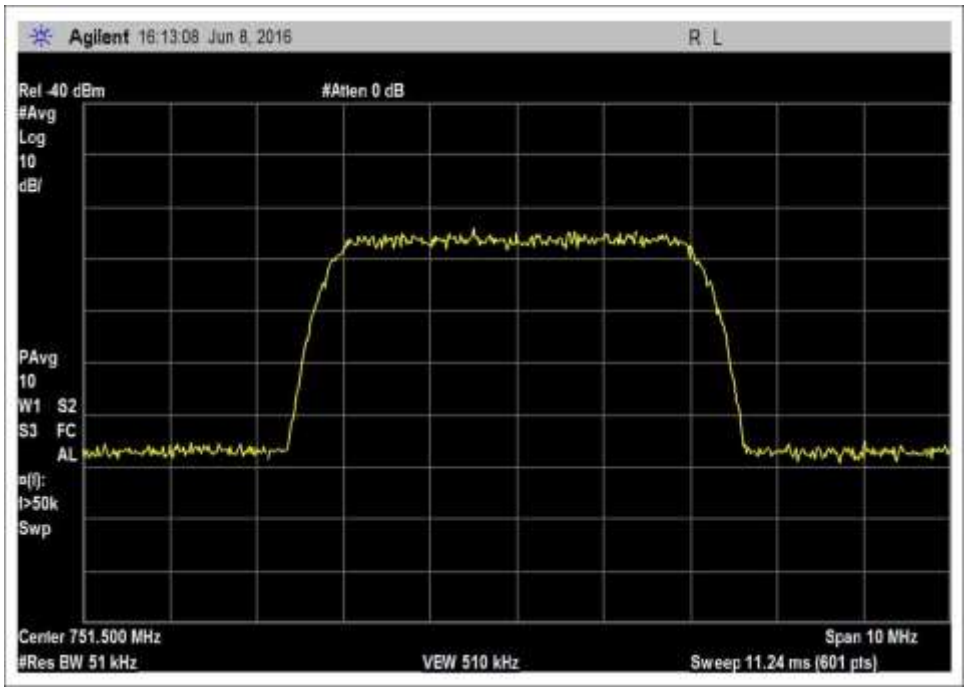
7.10_OBW_DL_728-746MHz_WCDMA



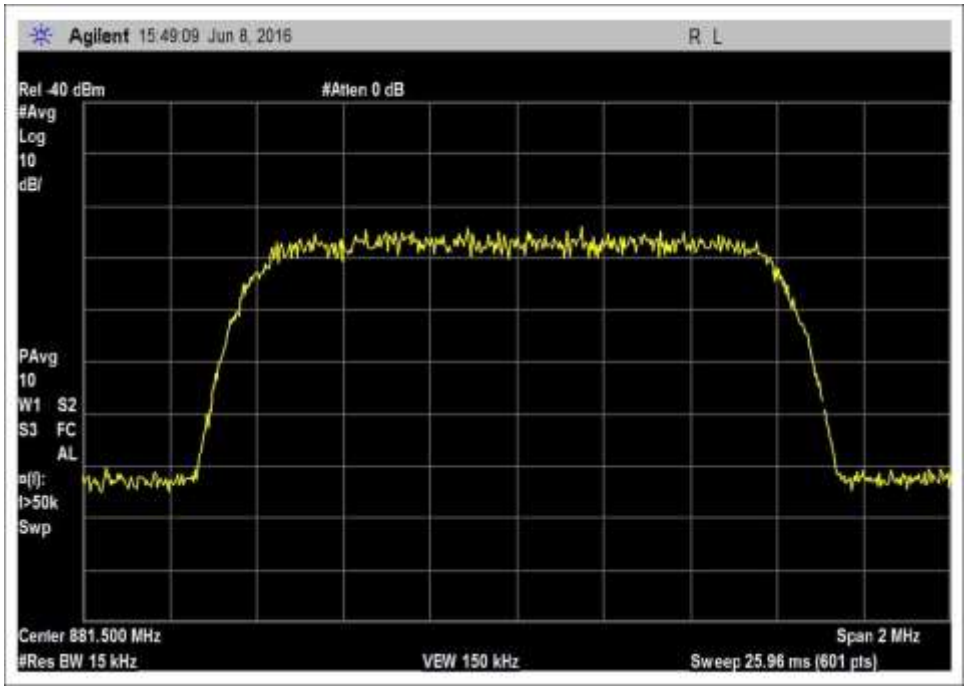
7.10_OBW_DL_746-757MHz_CDMA



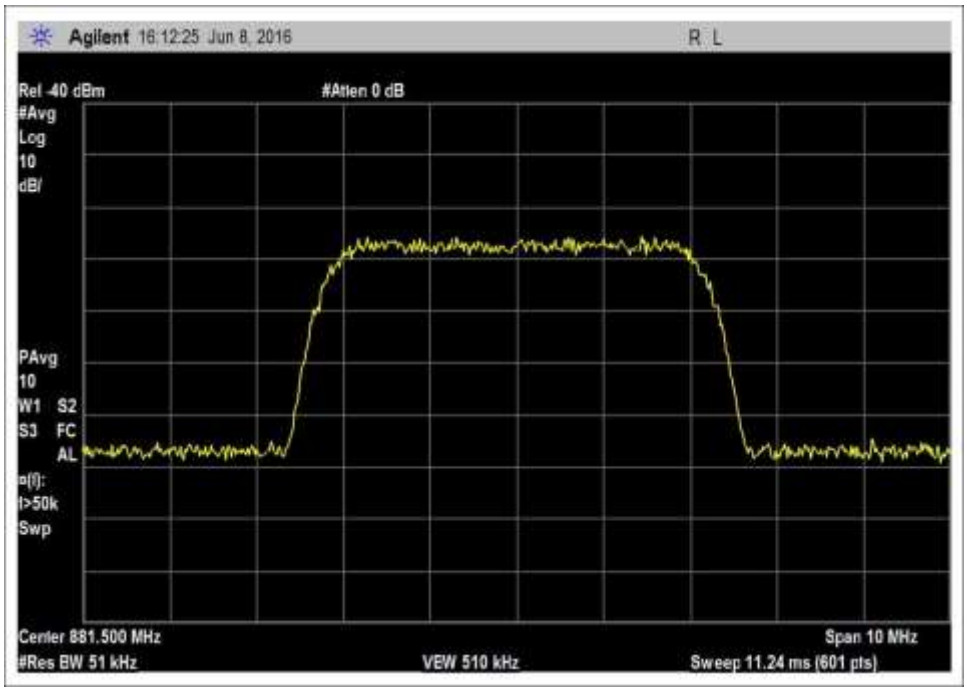
7.10_OBW_DL_746-757MHz_GSM



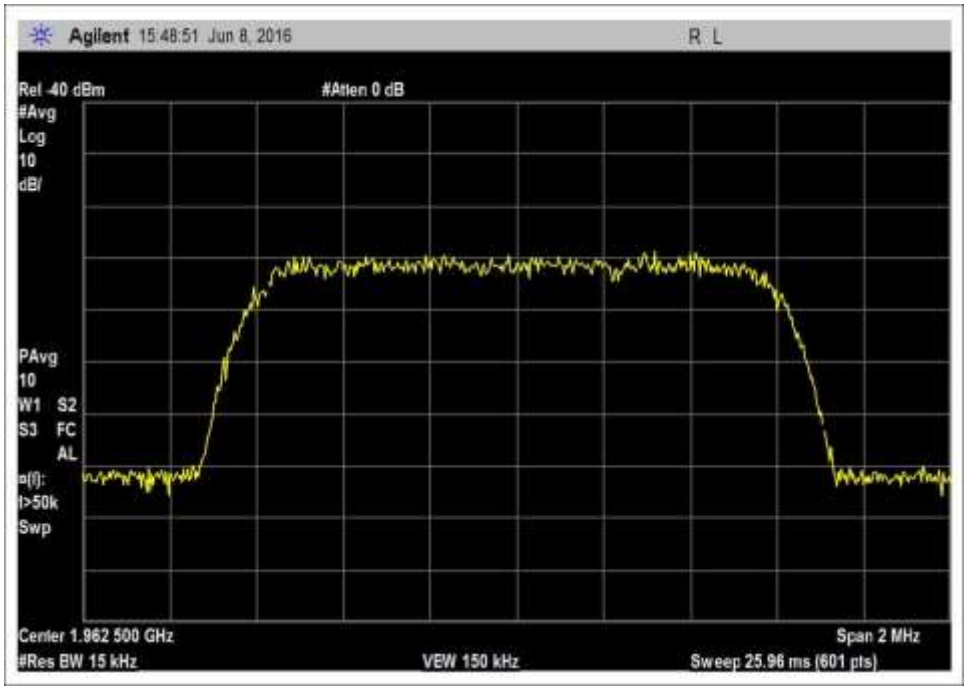
7.10_OBW_DL_746-757MHz_WCDMA



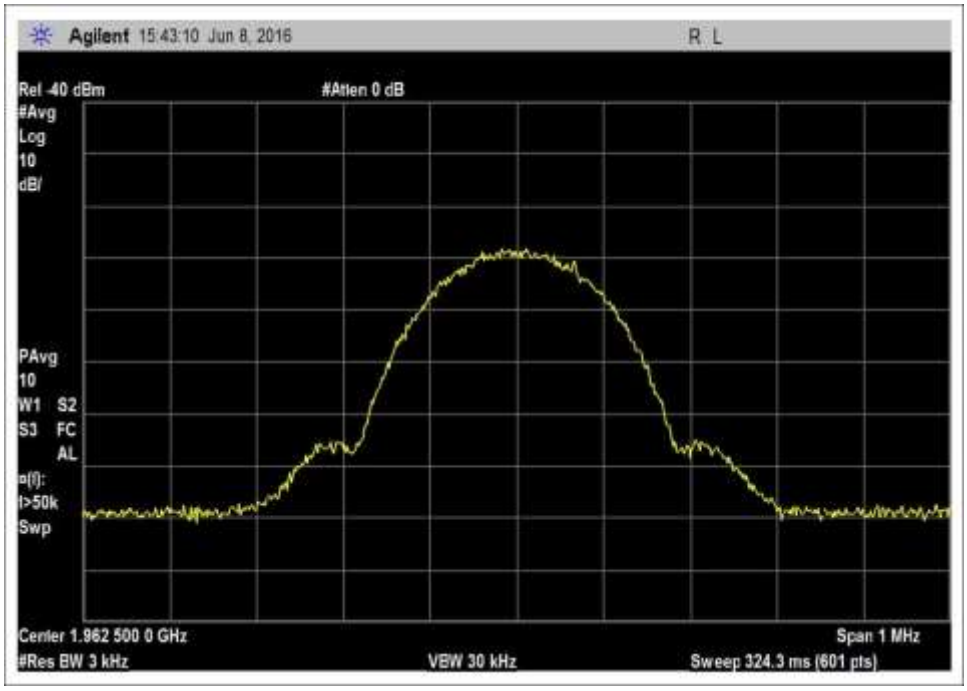
7.10_OBW_DL_869-894MHz_CDMA



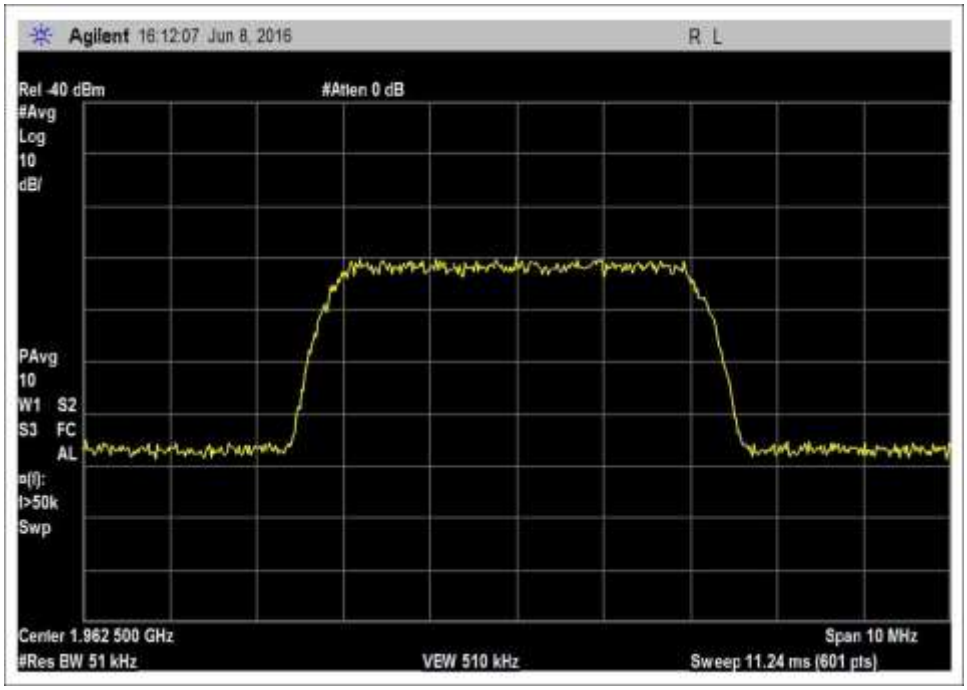
7.10_OBW_DL_869-894MHz_WCDMA



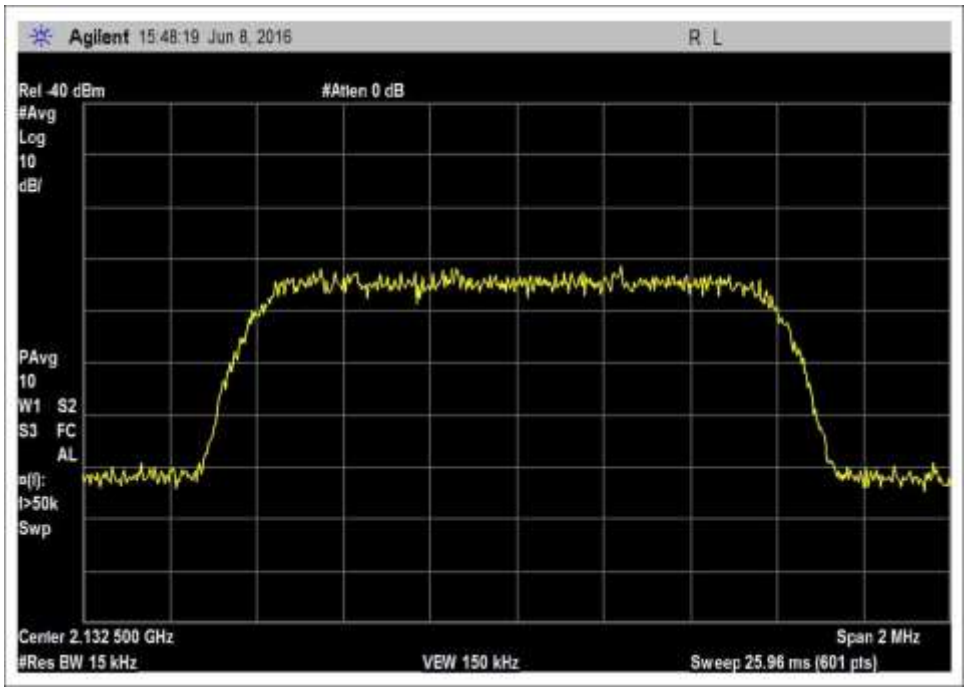
7.10_OBW_DL_1930-1995MHz_CDMA



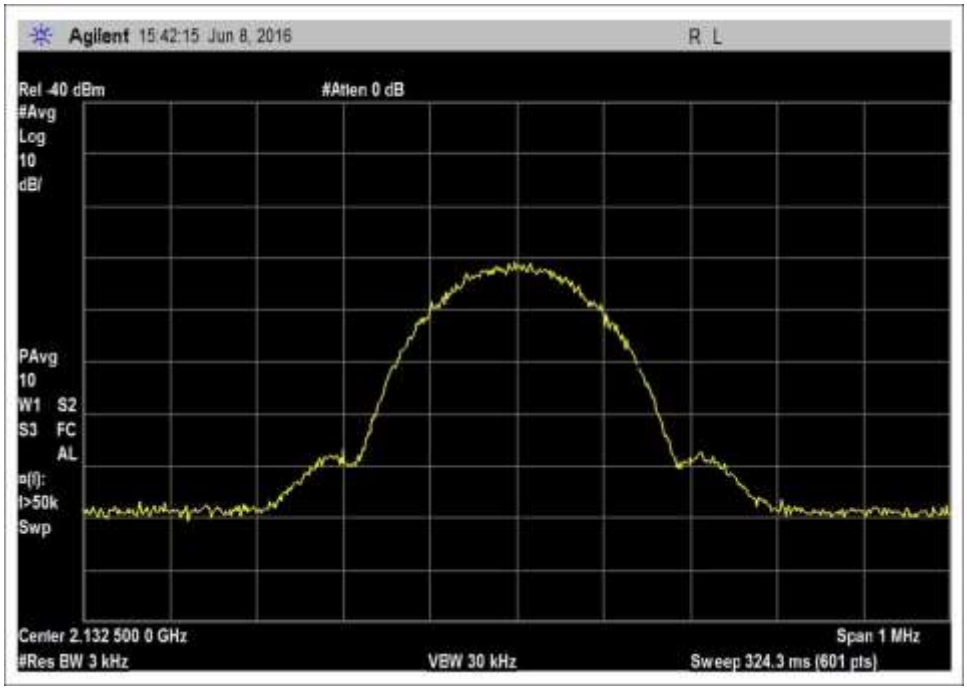
7.10_OBW_DL_1930-1995MHz_GSM



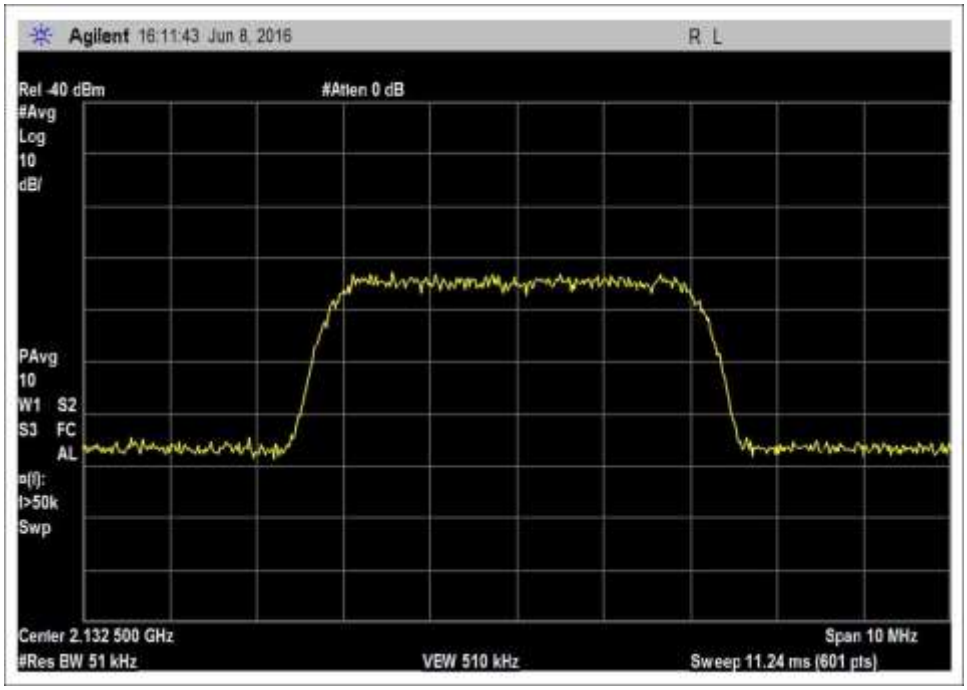
7.10_OBW_DL_1930-1995MHz_WCDMA



7.10_OBW_DL_2110-2155MHz_CDMA

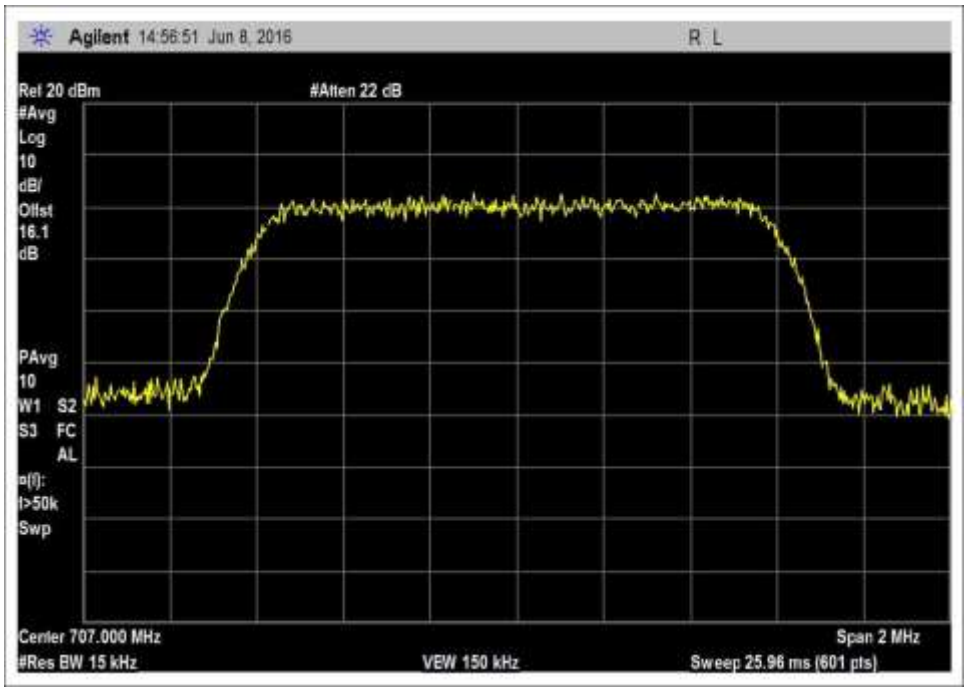


7.10_OBW_DL_2110-2155MHz_GSM

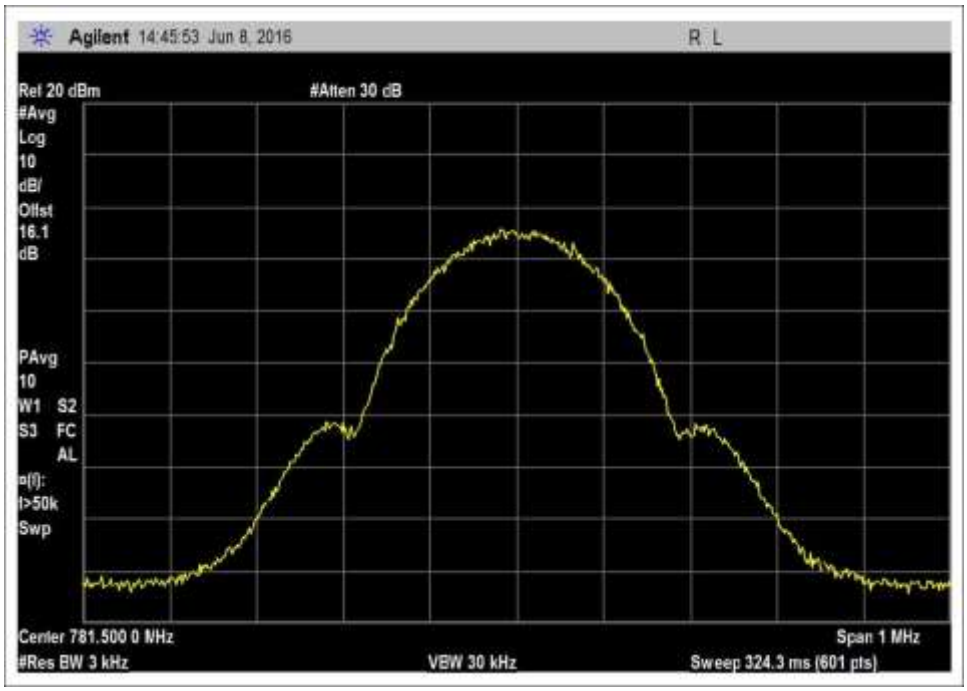


7.10_OBW_DL_2110-2155MHz_WCDMA

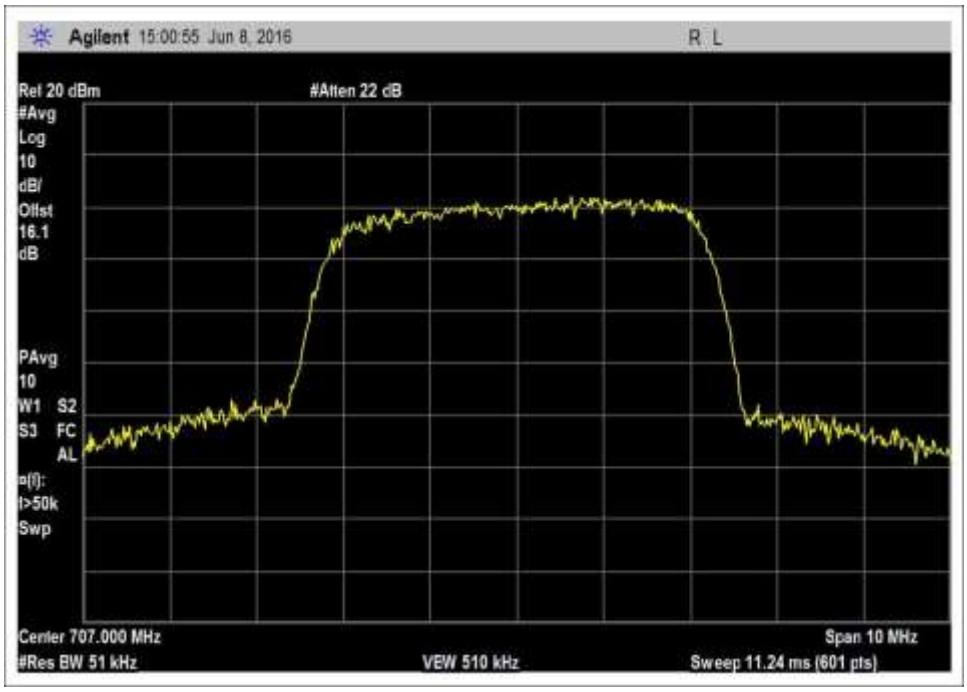
Output, UL



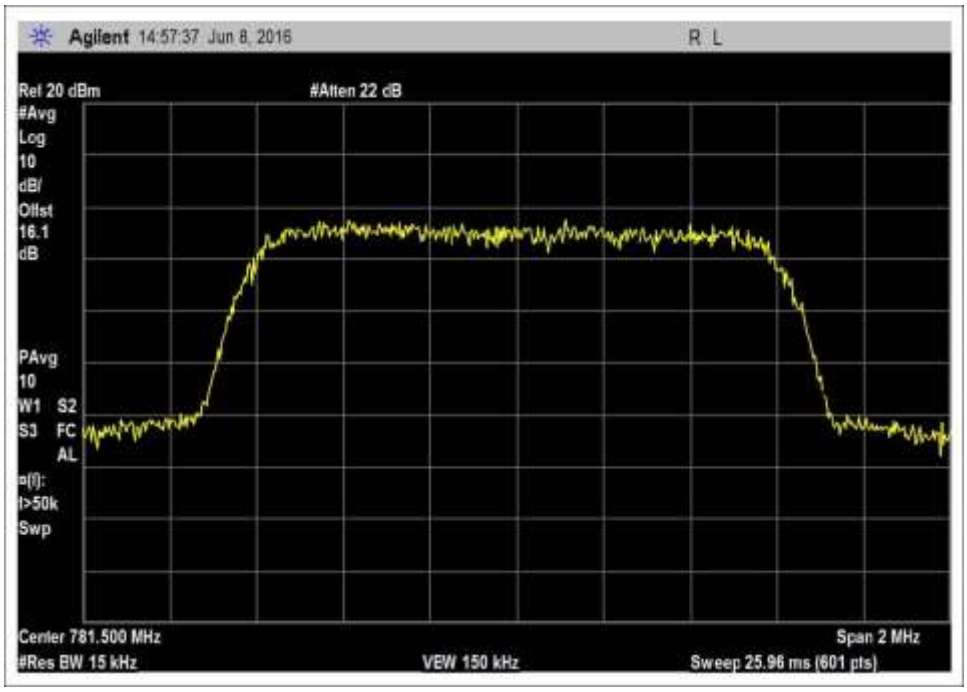
7.10_OBW_UL_698-716MHz_CDMA



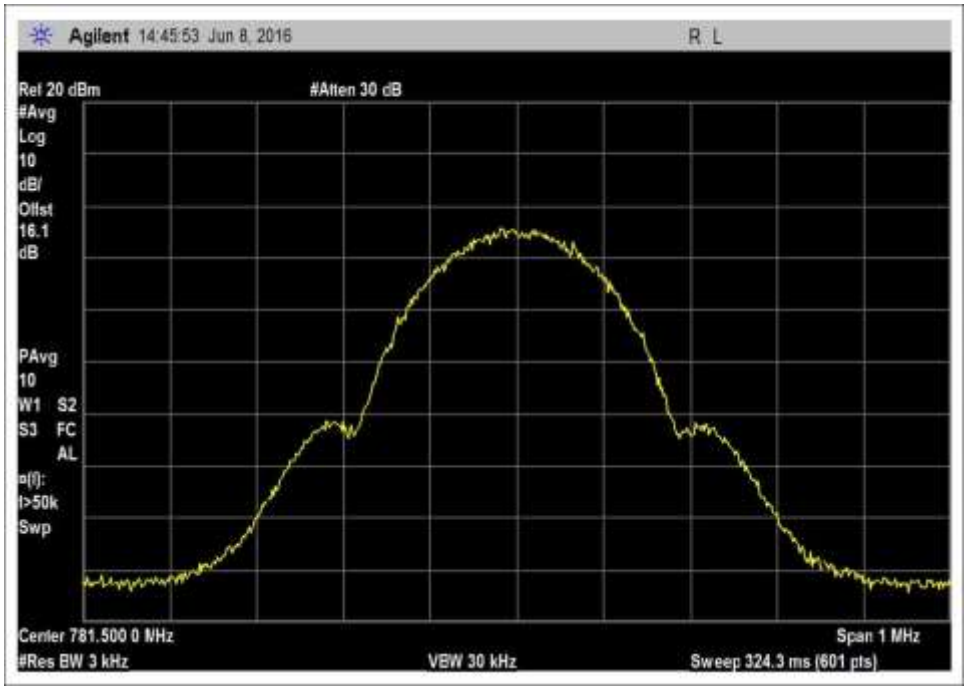
7.10_OBW_UL_698-716MHz_GSM



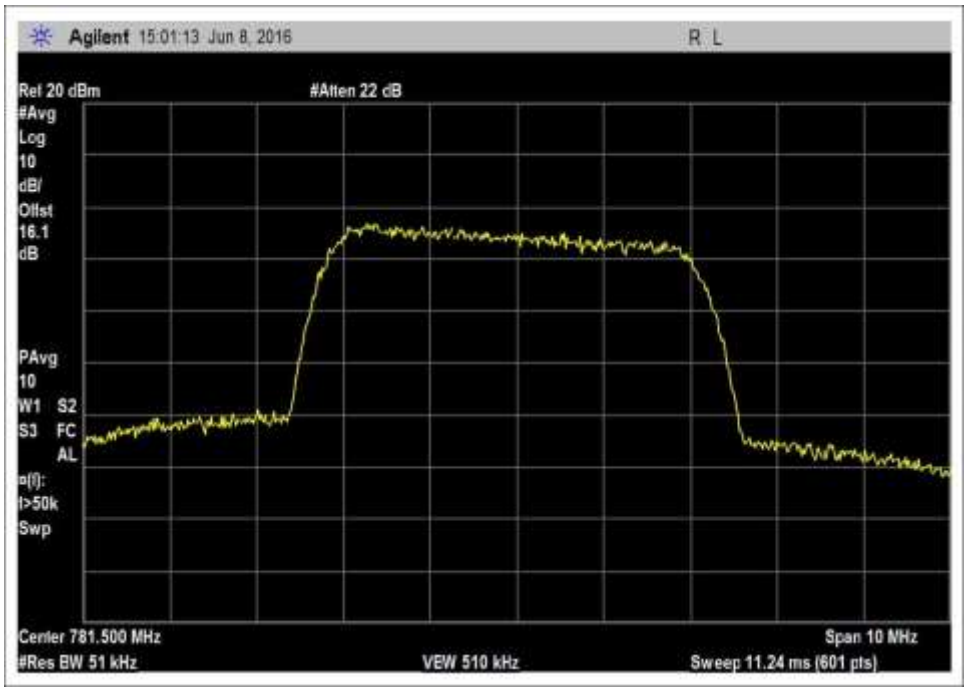
7.10_OBW_UL_698-716MHz_WCDMA



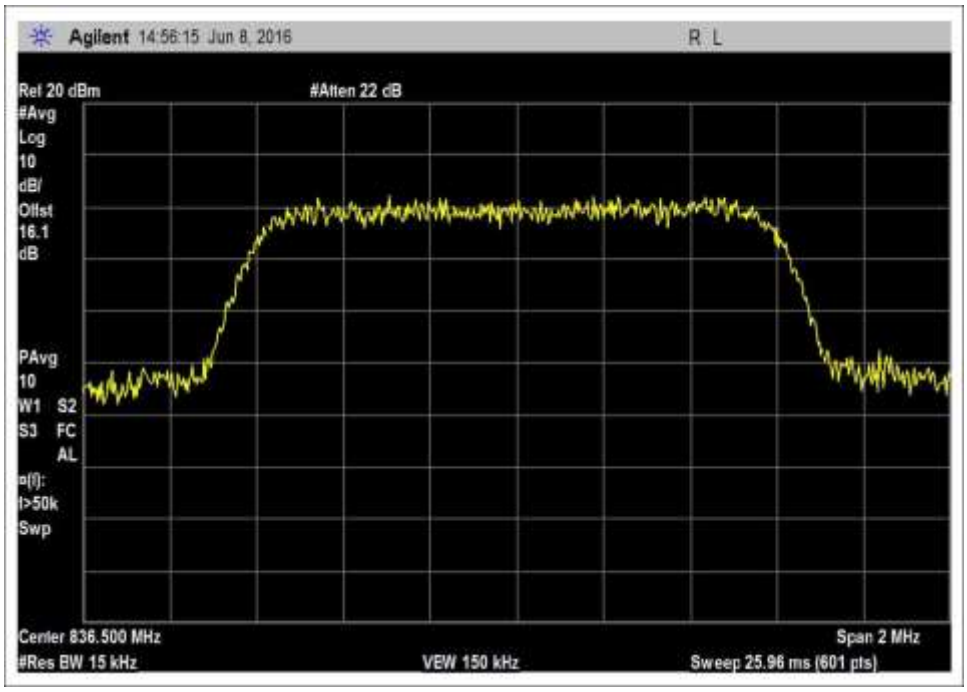
7.10_OBW_UL_776-787MHz_CDMA



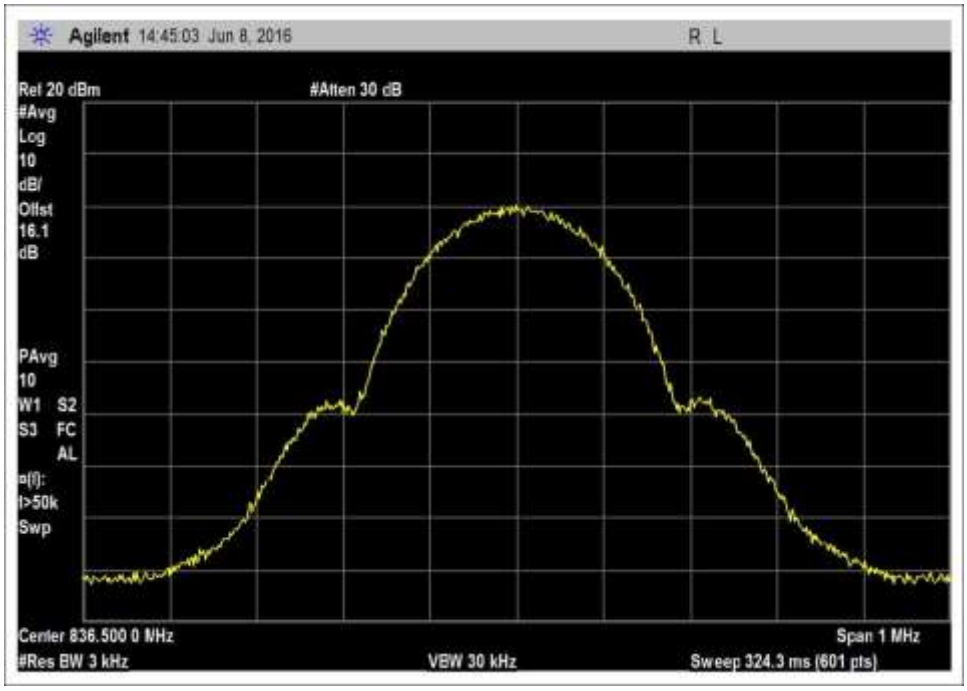
7.10_OBW_UL_776-787MHz_GSM



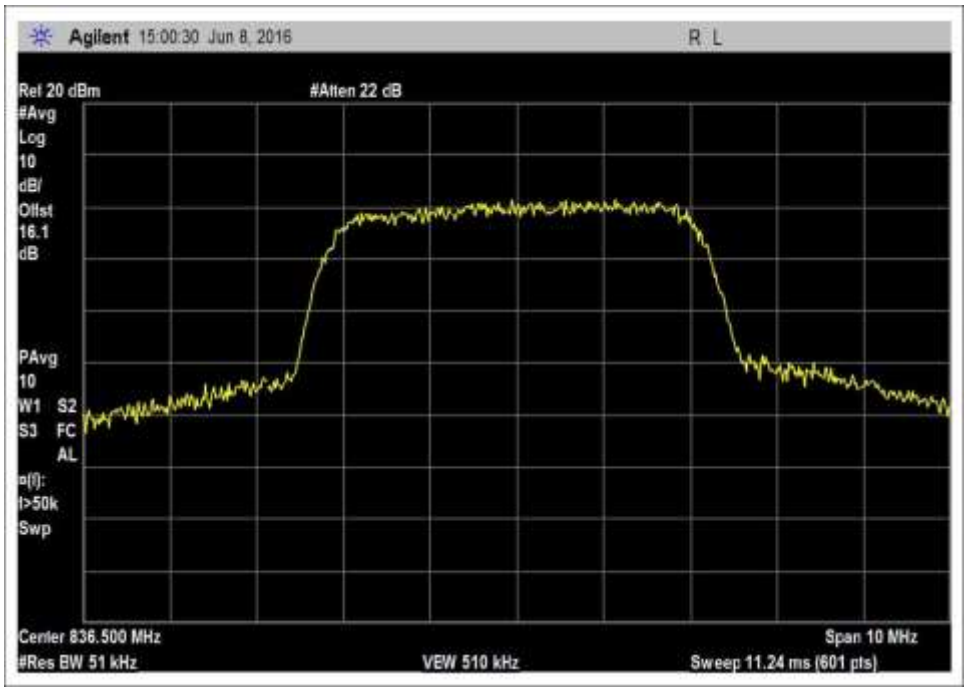
7.10_OBW_UL_776-787MHz_WCDMA



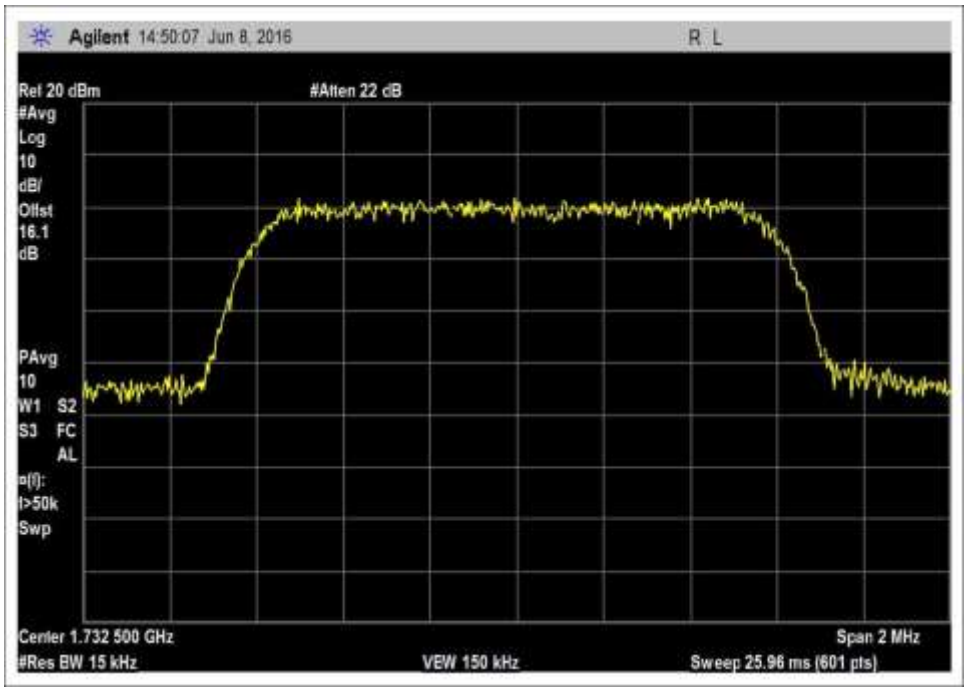
7.10_OBW_UL_824-849MHz_CDMA



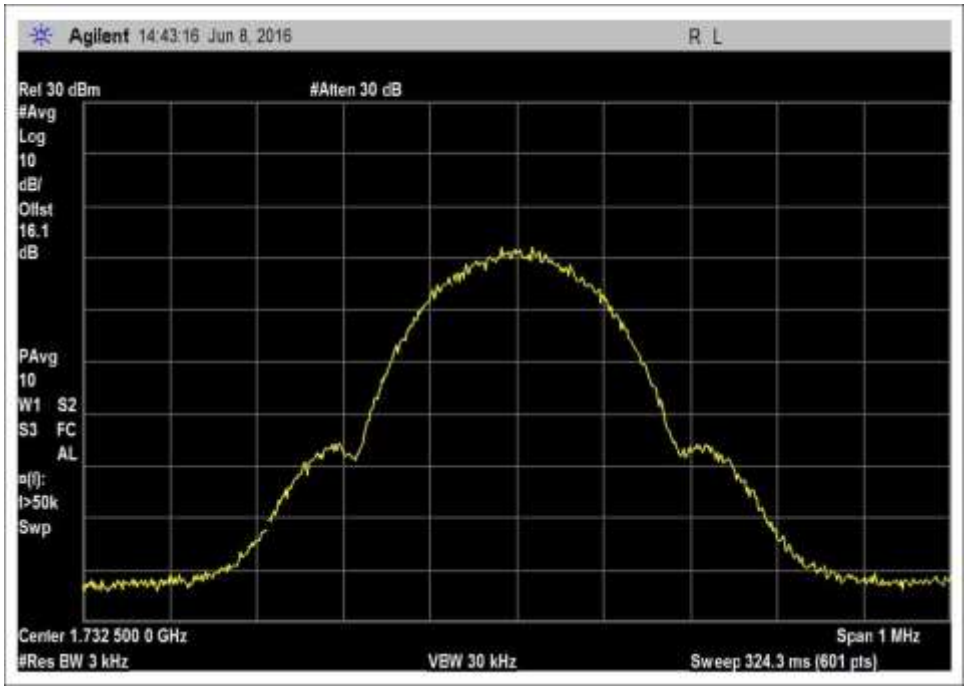
7.10_OBW_UL_824-849MHz_GSM



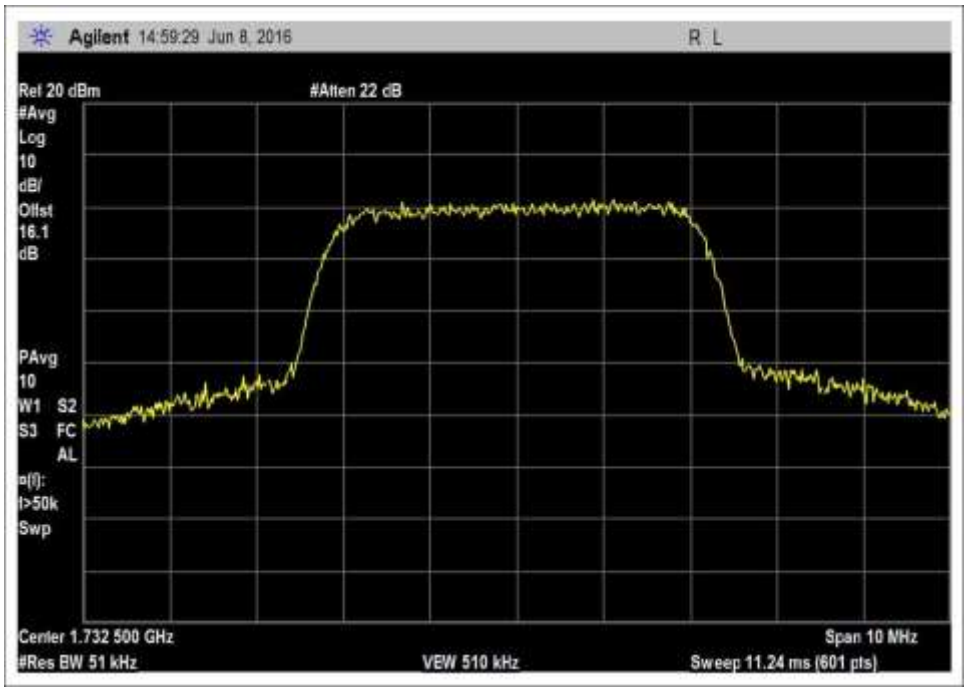
7.10_OBW_UL_824-849MHz_WCDMA



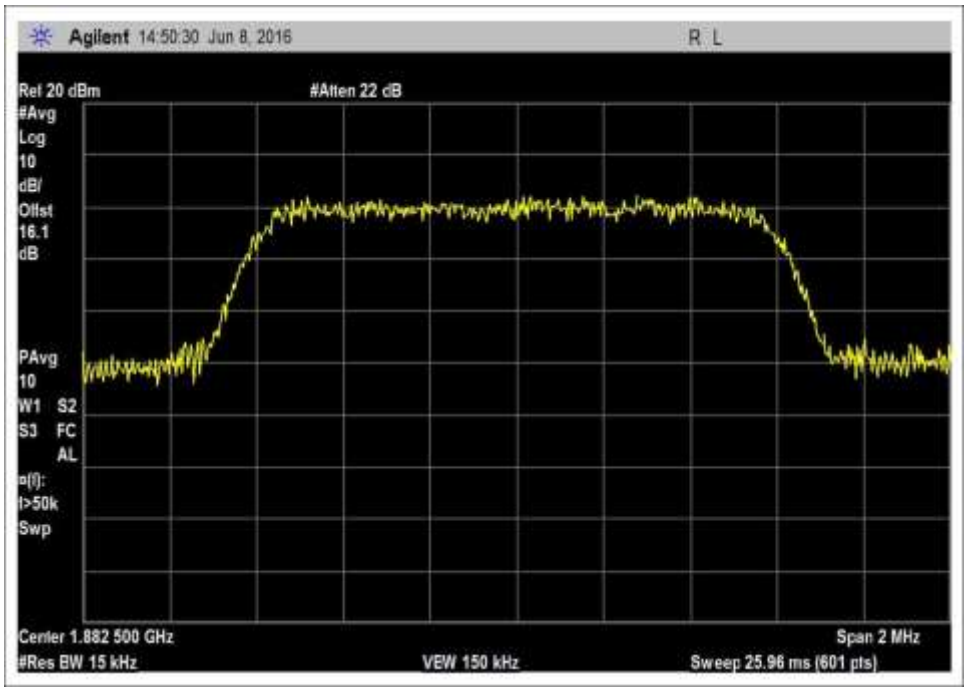
7.10_OBW_UL_1710-1755MHz_CDMA



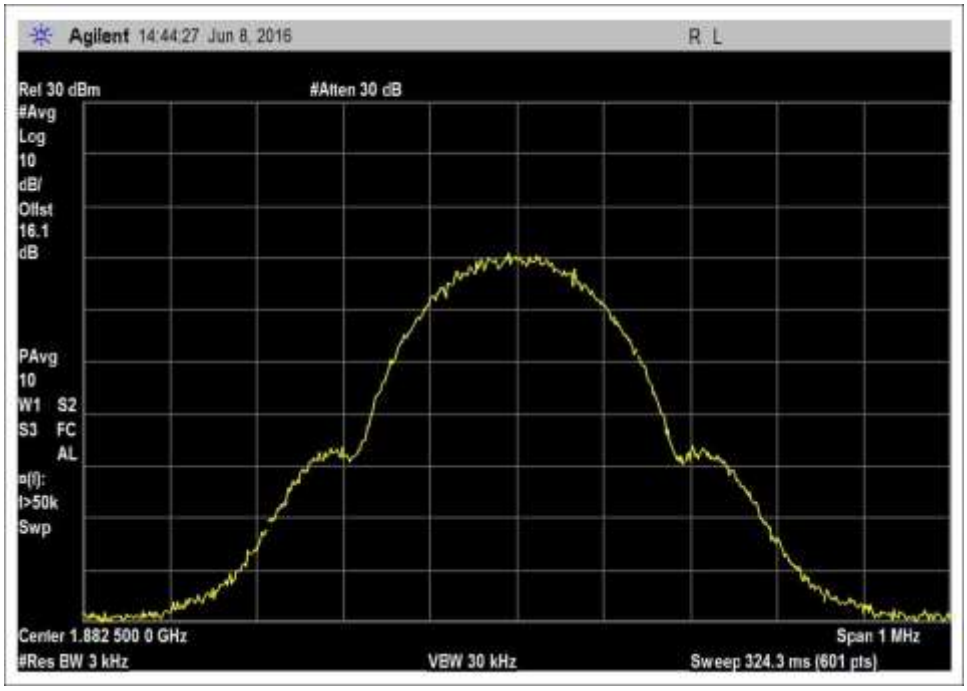
7.10_OBW_UL_1710-1755MHz_GSM



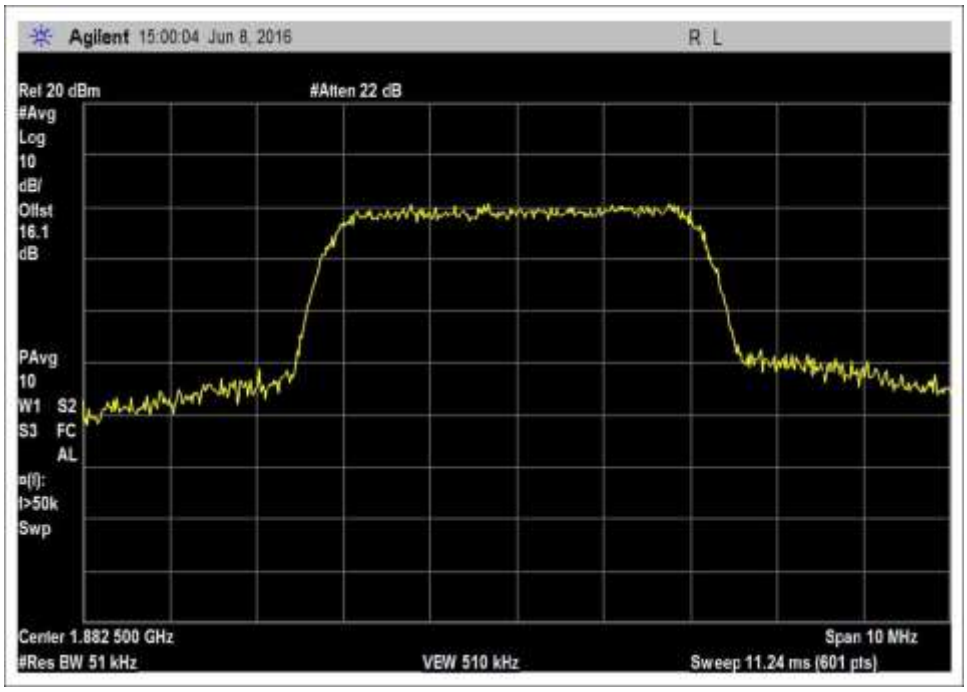
7.10_OBW_UL_1710-1755MHz_WCDMA



7.10_OBW_UL_1850-1915MHz_CDMA

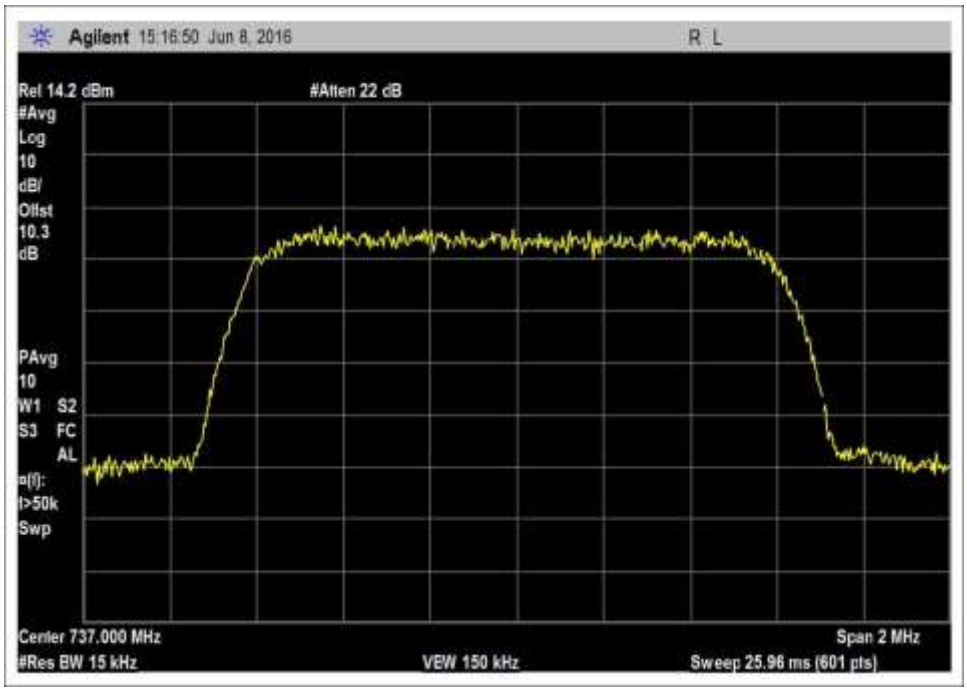


7.10_OBW_UL_1850-1915MHz_GSM

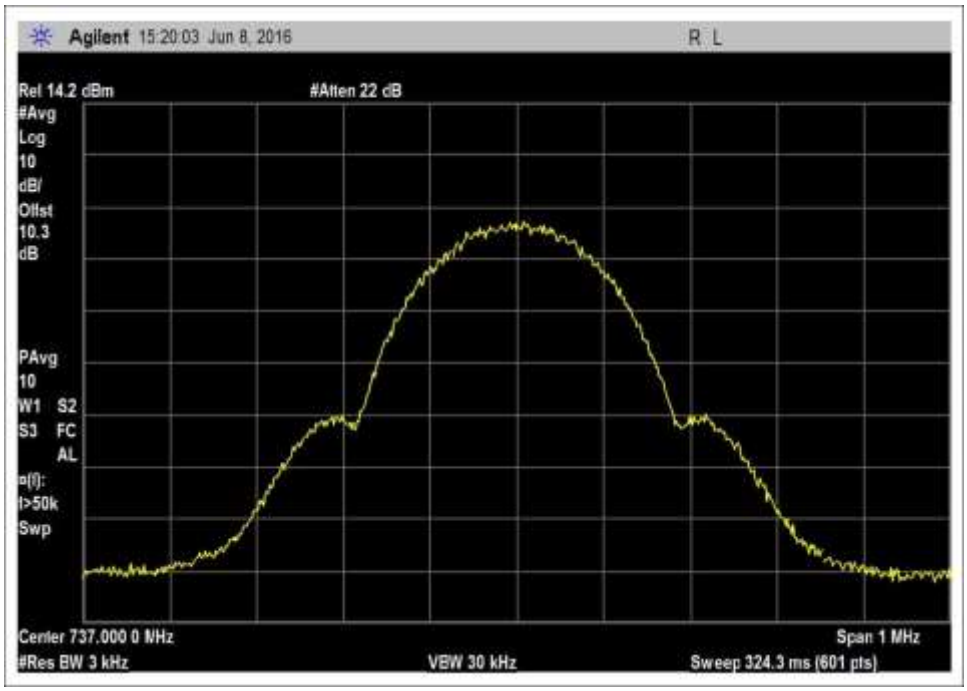


7.10_OBW_UL_1850-1915MHz_WCDMA

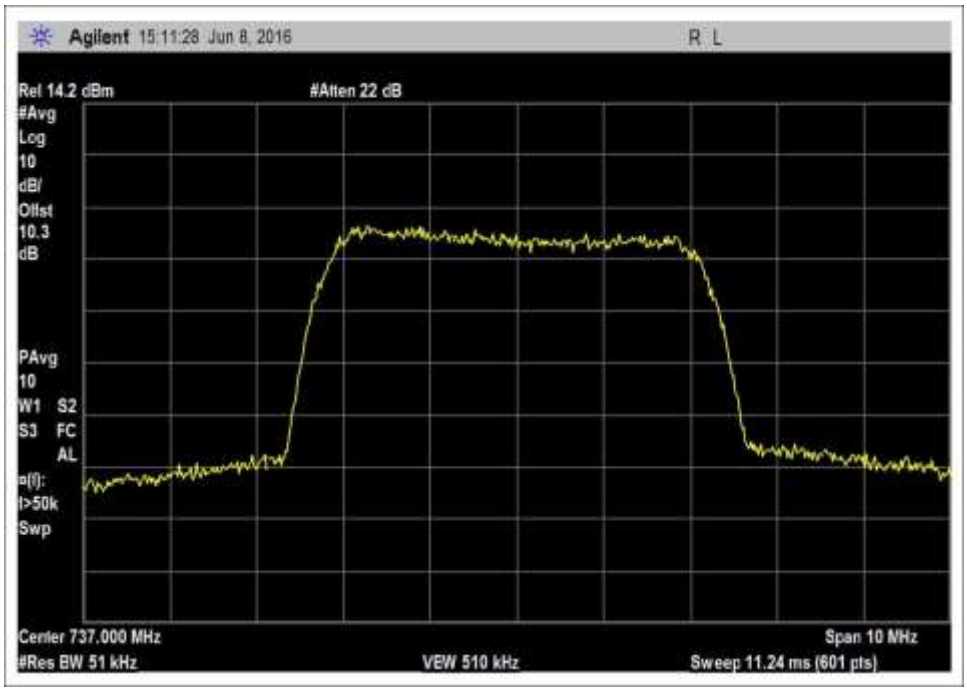
Output, DL



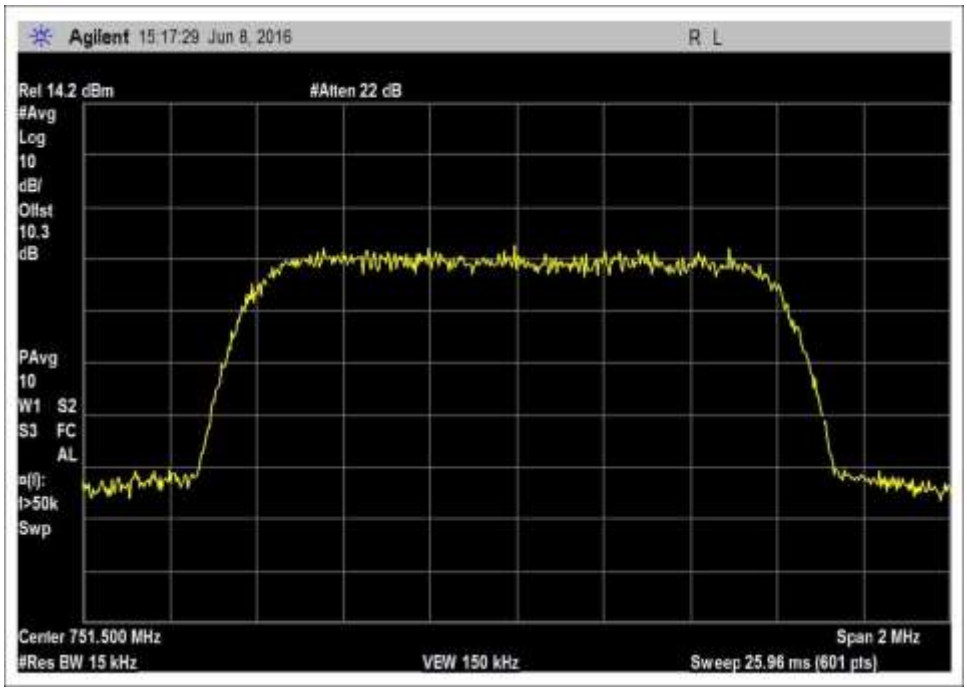
7.10_OBW_DL_728-746MHz_CDMA



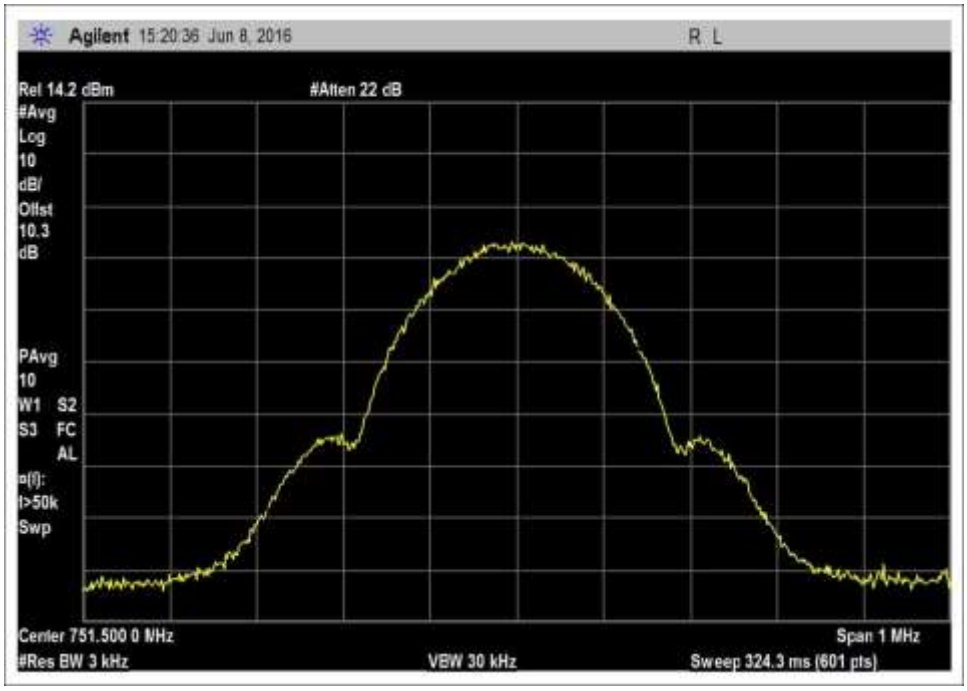
7.10_OBW_DL_728-746MHz_GSM



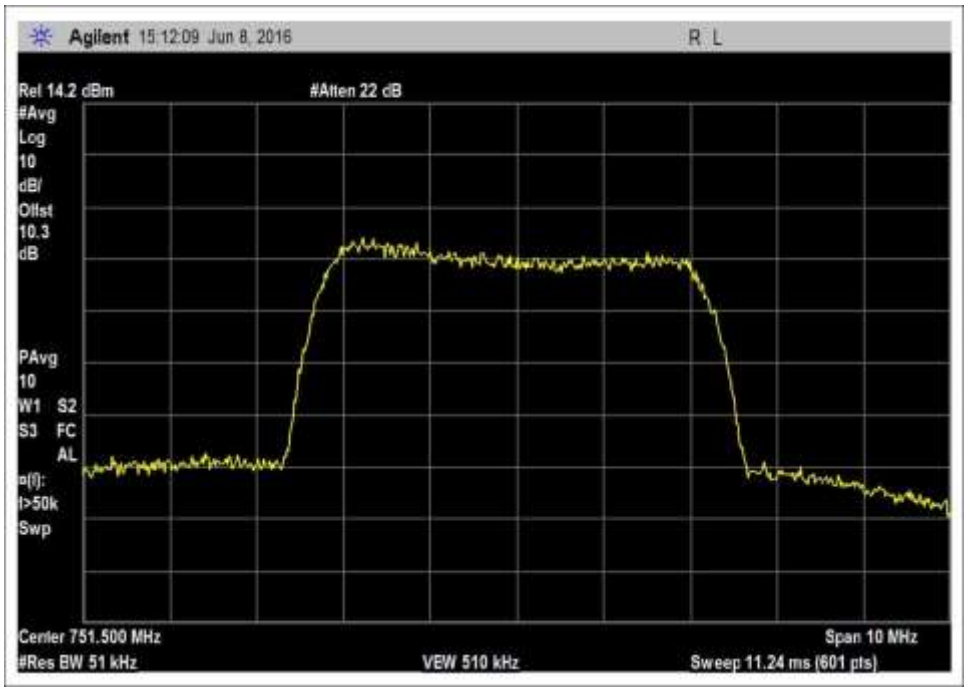
7.10_OBW_DL_728-746MHz_WCDMA



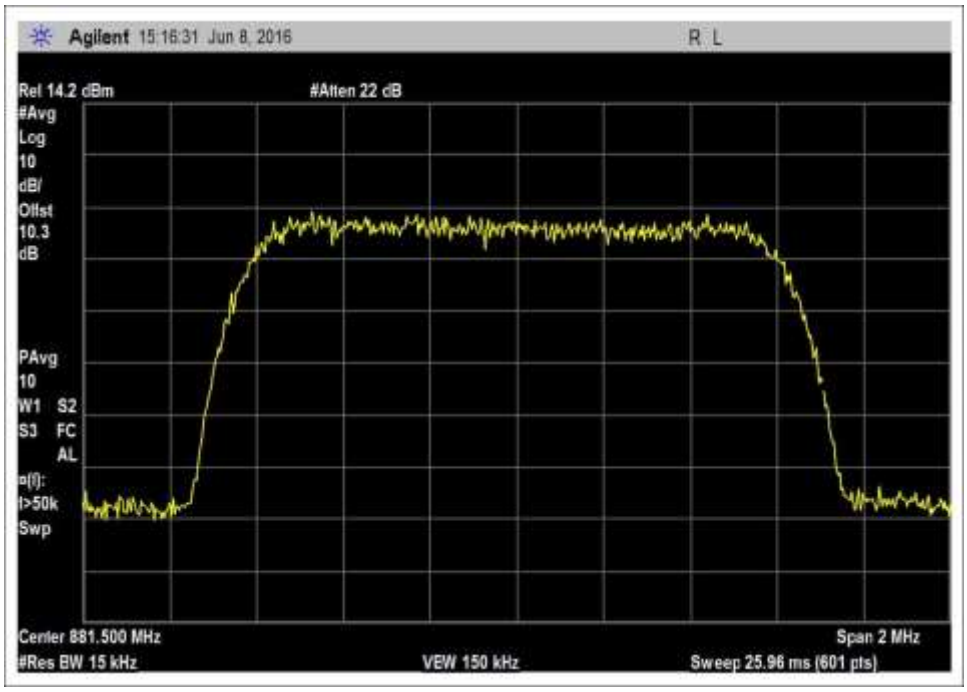
7.10_OBW_DL_746-757MHz_CDMA



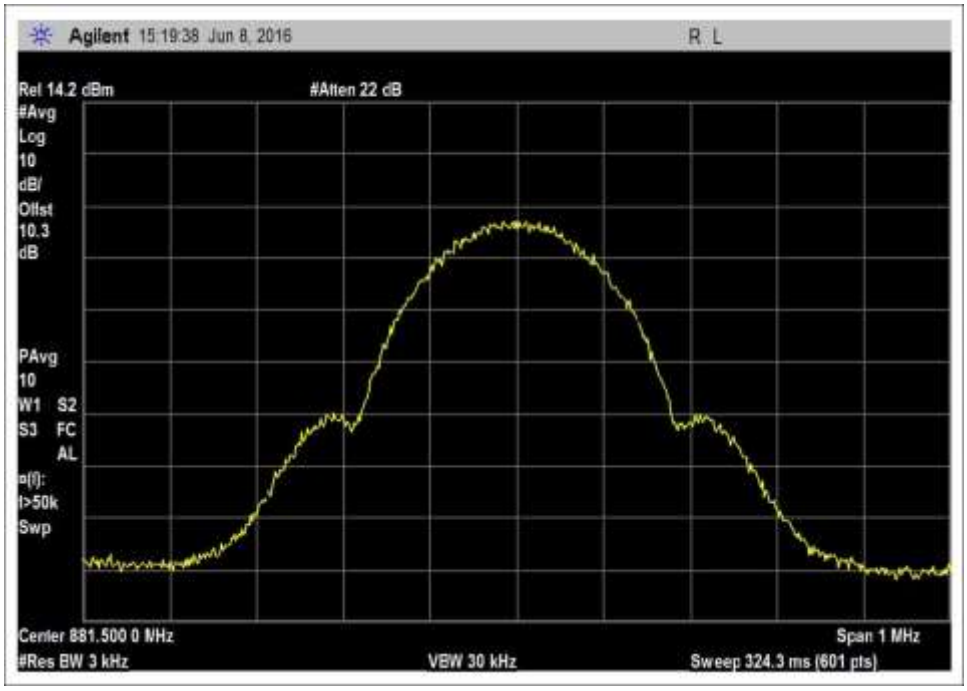
7.10_OBW_DL_746-757MHz_GSM



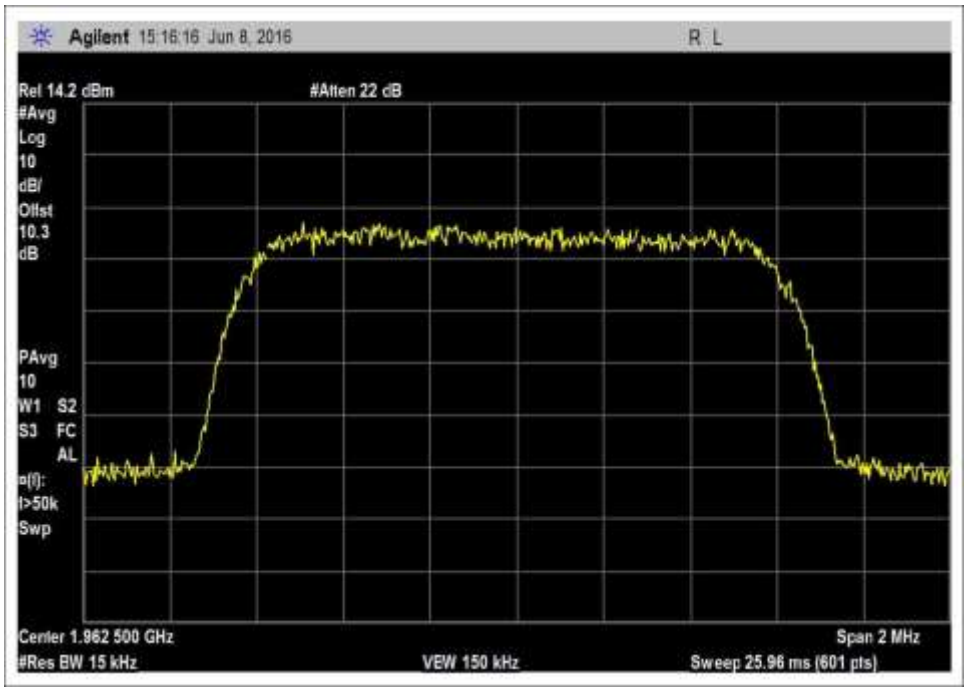
7.10_OBW_DL_746-757MHz_WCDMA



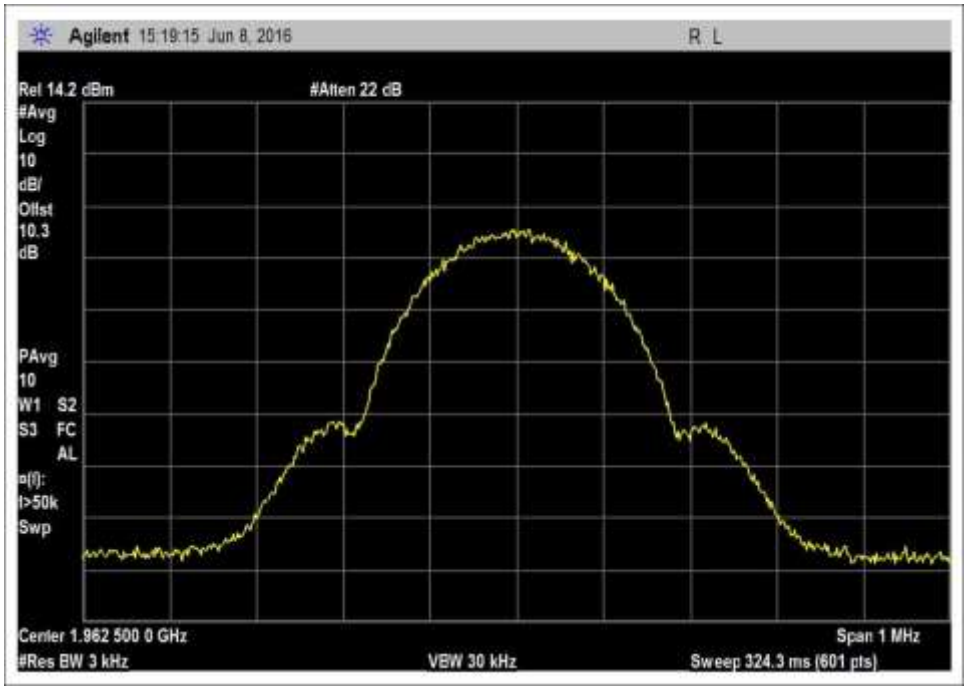
7.10_OBW_DL_869-894MHz_CDMA



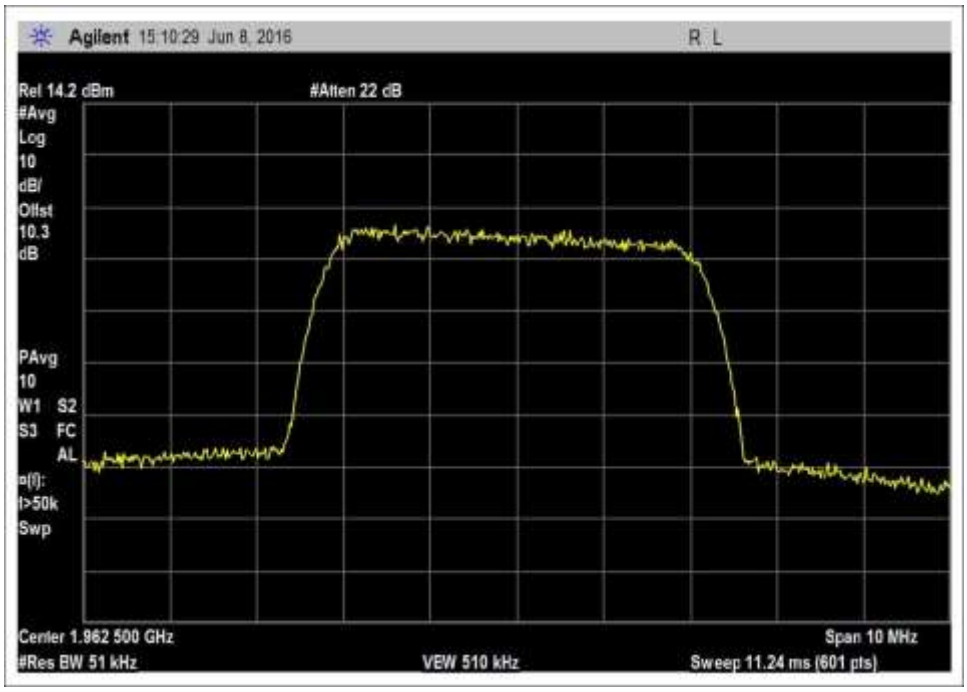
7.10_OBW_DL_869-894MHz_GSM



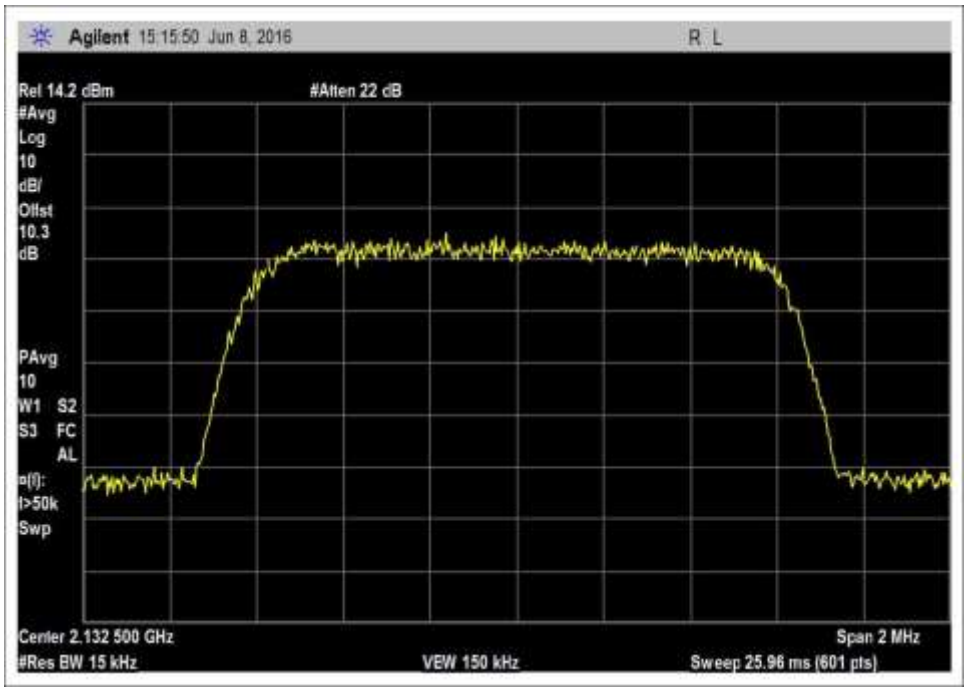
7.10_OBW_DL_1930-1995MHz_CDMA



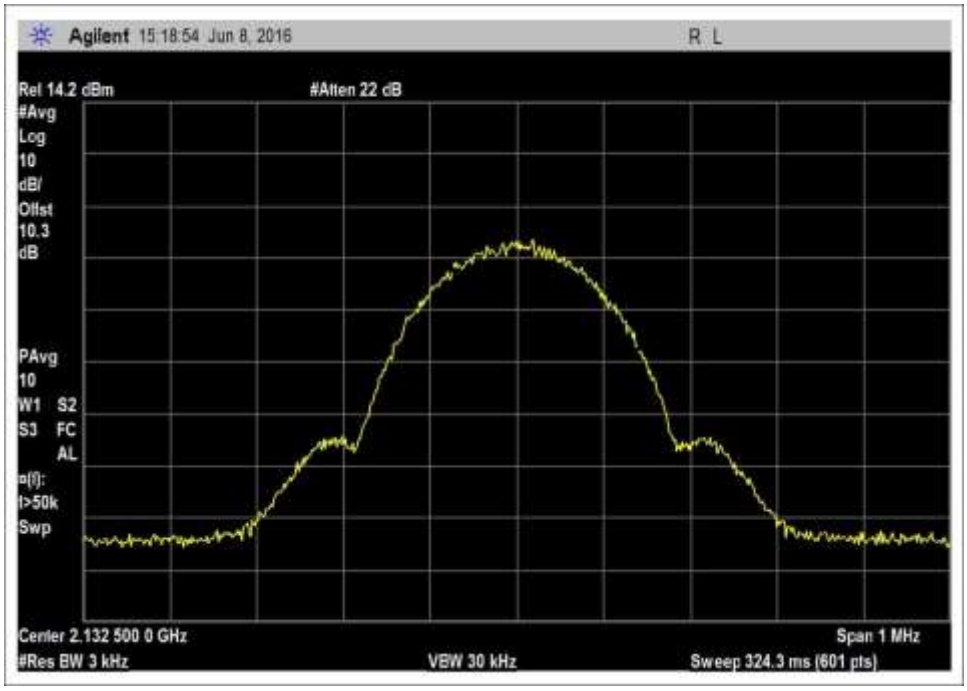
7.10_OBW_DL_1930-1995MHz_GSM



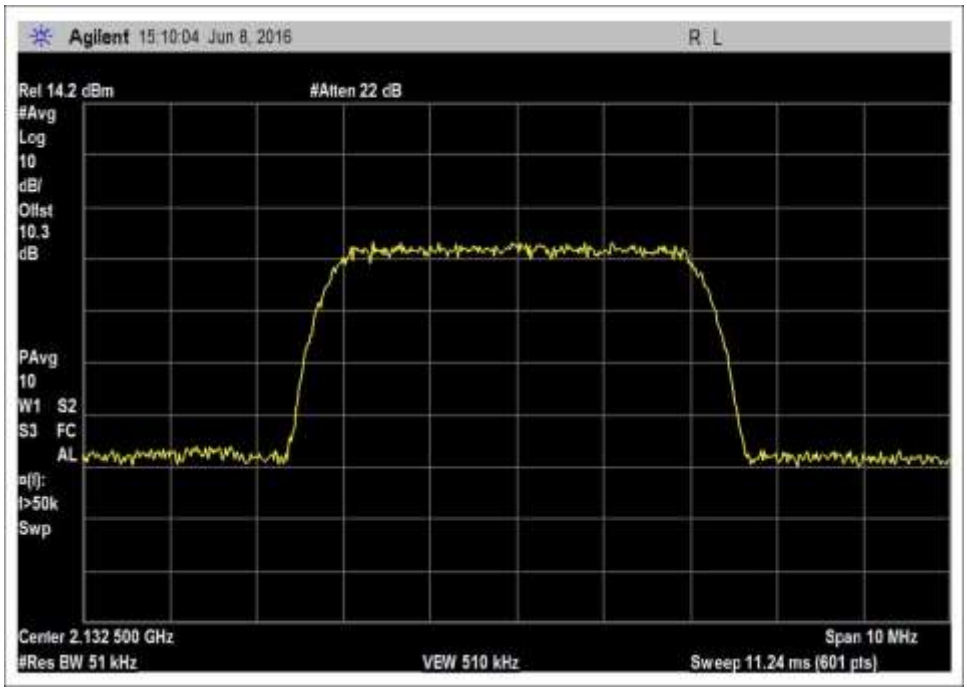
7.10_OBW_DL_1930-1995MHz_WCDMA



7.10_OBW_DL_2110-2155MHz_CDMA



7.10_OBW_DL_2110-2155MHz_GSM



7.10_OBW_DL_2110-2155MHz_WCDMA

7.11 Oscillation Detection

Test Conditions / Setup

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170		
Customer:	Cellphone-Mate, Inc.		
Specification:	**7.11 Anti-Oscillation (Oscillation Restarts / Oscillation mitigation or shutdown)**		
Work Order #:	**98648**	Date:	06/06/2016
Test Type:	**Conducted Emissions**	Time:	16:14:26
Tested by:	Daniel Bertran	Sequence#:	1
Software:	EMITest 5.03.02		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is a Fixed Wideband Consumer Booster.
The EUT is placed on the test bench. Evaluation performed at the Outside (Donor) and Inside (Server) antenna port.
The EUT Server port is a type SMA connector and 50-ohm impedance.
The EUT Donor port is type F connector and 75-ohm impedance.
During testing there is a 75 ohm to 50 ohm matching pad connected to the EUT type F connector.
This matching pad has a 5.8dB correction factor.
Firmware: V1.0

Test environment conditions:
Temperature: 22.3°C
Relative Humidity: 40%
101.1 kPa

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 section 7.11 of the FCC document: 935210 D03 Wideband Consumer Signal Booster Measurement Guidance v04 Dated February 12, 2016.

Note: UL1850-1915MHz -**AWGNL+5**:

- **AWGNL** denotes a 4.1MHz AWGN signal (99% occupied bandwidth) tuned to the frequency of 2.5 MHz above the lower edge of the operating band 1850-1915MHz
- **+5** denotes a variable attenuator adjusted such that the insertion loss for center of band under test (isolation) between the booster's donor and server ports is 5 dB greater than the maximum gain, as recorded in the maximum gain test procedure, for the band under test.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	ANP06902	Cable	32022-29094K-29094K-36TC	12/30/2015	12/30/2017
	ANP06903	Cable	32022-29094K-29094K-36TC	12/30/2015	12/30/2017
	ANP06899	Cable	32022-29094K-29094K-72TC	12/30/2015	12/30/2017
	ANP06709	Cable	32026-29094K-29094K-72TC	9/18/2014	9/18/2016
	ANP06710	Cable	32026-29094K-29094K-72TC	9/18/2014	9/18/2016
	AN03471	Spectrum Analyzer	E4440A	1/4/2016	1/4/2018
	AN03412	Band Pass Filter	PE8705	8/12/2015	8/12/2017
	AN03413	Band Pass Filter	PE8706	8/12/2015	8/12/2017
	AN03414	Band Pass Filter	PE8707	8/12/2015	8/12/2017
	AN03415	Band Pass Filter	PE8708	8/12/2015	8/12/2017
	AN03447	Band Pass Filter	PE8710	8/12/2015	8/12/2017
	AN03448	Band Pass Filter	PE8711	8/12/2015	8/12/2017
	AN03446	Band Pass Filter	4FV50-707/H18-O/O	1/4/2016	1/4/2018
	AN03467	Band Pass Filter	4FV50-731/H30-O/O	1/4/2016	1/4/2018
	AN03468	Band Pass Filter	4CS10-781.5/E12.2-O/O	1/4/2016	1/4/2018
	AN03469	Band Pass Filter	4CS10-751.5/E12-O/O	1/4/2016	1/4/2018
	AN02475	1 dB step Attenuator	8494B	6/29/2015	6/29/2017
	AN03429	10dB step Attenuator	8496B	8/27/2015	8/27/2017
	ANP06467	Attenuator	PE7014-10	5/13/2015	5/13/2017
	ANP05411	Attenuator	54A-10	1/18/2016	1/18/2018
	ANC00082	RF Coupler	722-10-1.500V	8/26/2015	8/26/2017
	ANC00087	Combiner	44000	1/7/2016	1/7/2018

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	
Freq	Measured	Limit	Peak Level	Measured	Limit	Measured	Limit
MHz	Sec	Sec	dBm	Sec	At least sec		
UL1710-1755	0.10	0.30	23.0	78	60	3	5
UL1850-1915	0.08	0.30	20.1	74	60	3	5
UL824-894	0.24	0.30	26.9	73	60	3	5
UL 698-716	0.18	0.30	26.0	72	60	3	5
UL776-787	0.22	0.30	25.3	72	60	3	5
DL2110-2155	0.14	1.00	23.0	76	60	3	5
DL1930-1995	0.18	1.00	23.6	75	60	3	5
DL869-894	0.10	1.00	23.4	72	60	3	5
DL:728-746	0.20	1.00	20.3	72	60	3	5
DL 746-757	0.24	1.00	20.7	72	60	3	5

The booster continues to mitigate at least 1 minute before restarting. The plots demonstrate after 3 restarts (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 MHz				
Max Gain Isolation	Peak	Min	Diff	Limit
dB	dBm	dBm	dB	dB
+5dB	-53.6	-63.5	9.9	12.0
+4dB	-50.1	-64.0	(13.9)*	12.0
+3dB	-47.7	-63.9	(16.2)*	12.0
+2dB	-46.2	-64.2	(18.0)*	12.0
+1dB	-45.1	-64.7	(19.6)*	12.0
0dB	-42.4	-64.9	(22.6)*	12.0
-1dB	-38.4	-64.5	(26.2)*	12.0
-2dB	-1.5	-65.5	(64.0)*	12.0
-3dB	**	**	0.0	12.0
-4dB	**	**	0.0	12.0
-5dB	**	**	0.0	12.0

DL 2110-2155 MHz				
Max Gain Isolation	Peak	Min	Diff	Limit
dB	dBm	dBm	dB	dB
+5dB	-48.3	-58.6	10.4	12.0
+4dB	-47.8	-58.3	10.5	12.0
+3dB	-46.1	-59.3	(13.2)*	12.0
+2dB	-44.0	-59.3	(15.3)*	12.0
+1dB	-42.5	-59.8	(17.3)*	12.0
0dB	-34.7	-60.3	(25.6)*	12.0
-1dB	**	**	0.0	12.0
-2dB	**	**	0.0	12.0
-3dB	**	**	0.0	12.0
-4dB	**	**	0.0	12.0
-5dB	**	**	0.0	12.0

UL1850-1915 MHz				
Max Gain Isolation	Peak	Min	Diff	Limit
dB	dBm	dBm	dB	dB
+5dB	-50.6	-60.3	9.7	12.0
+4dB	-49.3	-60.5	11.2	12.0
+3dB	-47.7	-61.2	(13.5)*	12.0
+2dB	-44.9	-60.9	(15.9)*	12.0
+1dB	-42.7	-60.9	(18.2)*	12.0
0dB	-38.2	-61.5	(23.3)*	12.0
-1dB	**	**	0.0	12.0
-2dB	**	**	0.0	12.0
-3dB	**	**	0.0	12.0
-4dB	**	**	0.0	12.0
-5dB	**	**	0.0	12.0

DL 1930-1995 MHz				
Max Gain Isolation	Peak	Min	Diff	Limit
dB	dBm	dBm	dB	dB
+5dB	-51.1	-60.8	9.7	12.0
+4dB	-50.7	-60.9	10.2	12.0
+3dB	-48.9	-61.4	(12.5)*	12.0
+2dB	-47.9	-61.3	(13.4)*	12.0
+1dB	-46.1	-61.8	(15.7)*	12.0
0dB	-43.3	-62.1	(18.8)*	12.0
-1dB	-40.1	-62.7	(22.6)*	12.0
-2dB	-30.2	-62.7	(32.5)*	12.0
-3dB	**	**	0.0	12.0
-4dB	**	**	0.0	12.0
-5dB	**	**	0.0	12.0

Note:
* The measured difference exceeds the limit for a period of less than 300 second before device mitigates and shuts down. The maximum recorded time prior to shutdown was 46 seconds for the Uplink bands and 26 seconds for the Downlink bands.

** The device shuts down immediately.

UL 824-894 MHz				
Max Gain Isolation dB	Peak dBm	Min dBm	Diff dB	Limit dB
+5dB	-56.7	-65.4	8.7	12.0
+4dB	-55.8	-66.1	10.3	12.0
+3dB	-54.0	-65.6	11.6	12.0
+2dB	-53.1	-66.1	(13.0)*	12.0
+1dB	-49.5	-66.2	(16.8)*	12.0
0dB	-44.8	-67.1	(22.3)*	12.0
-1dB	-33.0	-66.7	(33.7)*	12.0
-2dB	**	**	0.0	12.0
-3dB	**	**	0.0	12.0
-4dB	**	**	0.0	12.0
-5dB	**	**	0.0	12.0

DL 869-894 MHz				
Max Gain Isolation dB	Peak dBm	Min dBm	Diff dB	Limit dB
+5dB	-60.6	-66.9	6.3	12.0
+4dB	-59.9	-67.6	7.7	12.0
+3dB	-59.4	-67.7	8.4	12.0
+2dB	-58.7	-67.7	9.0	12.0
+1dB	-57.9	-67.9	10.0	12.0
0dB	-56.5	-68.2	(11.7)*	12.0
-1dB	-54.7	-68.0	(13.3)*	12.0
-2dB	-52.5	-68.8	(16.3)*	12.0
-3dB	-49.8	-68.6	(18.7)*	12.0
-4dB	-44.3	-68.7	(24.4)*	12.0
-5dB	**	**	0.0	12.0

UL 698-716 MHz				
Max Gain Isolation dB	Peak dBm	Min dBm	Diff dB	Limit dB
+5dB	-57.2	-67.3	10.2	12.0
+4dB	-56.8	-67.2	10.4	12.0
+3dB	-55.1	-67.6	(12.5)*	12.0
+2dB	-53.9	-68.3	(14.4)*	12.0
+1dB	-50.2	-67.8	(17.6)*	12.0
0dB	-45.7	-68.0	(22.3)*	12.0
-1dB	-35.1	-67.9	(32.8)*	12.0
-2dB	**	**	0.0	12.0
-3dB	**	**	0.0	12.0
-4dB	**	**	0.0	12.0
-5dB	**	**	0.0	12.0

DL 728-746 MHz				
Max Gain Isolation dB	Peak dBm	Min dBm	Diff dB	Limit dB
+5dB	-58.3	-64.1	5.8	12.0
+4dB	-58.6	-68.1	9.5	12.0
+3dB	-57.5	-67.9	10.4	12.0
+2dB	-56.0	-68.8	(12.9)*	12.0
+1dB	-53.6	-68.9	(15.3)*	12.0
0dB	-50.6	-68.7	(18.0)*	12.0
-1dB	-46.7	-69.3	(22.6)*	12.0
-2dB	-36.0	-69.5	(33.5)*	12.0
-3dB	**	**	0.0	12.0
-4dB	**	**	0.0	12.0
-5dB	**	**	0.0	12.0

Note:
* The measured difference exceeds the limit for a period of less than 300 second before device mitigates and shuts down. The maximum recorded time prior to shutdown was 46 seconds for the Uplink bands and 26 seconds for the Downlink bands.
** The device shuts down immediately.

UL 776-787 MHz				
Max Gain Isolation dB	Peak dBm	Min dBm	Diff dB	Limit dB
+5dB	-55.4	-64.9	9.5	12.0
+4dB	-53.7	-65.2	(11.5)*	12.0
+3dB	-51.7	-65.4	(13.7)*	12.0
+2dB	-49.0	-65.4	(16.4)*	12.0
+1dB	-44.1	-65.7	(21.6)*	12.0
0dB	-30.6	-66.7	(36.1)*	12.0
-1dB	**	**	0.0	12.0
-2dB	**	**	0.0	12.0
-3dB	**	**	0.0	12.0
-4dB	**	**	0.0	12.0
-5dB	**	**	0.0	12.0

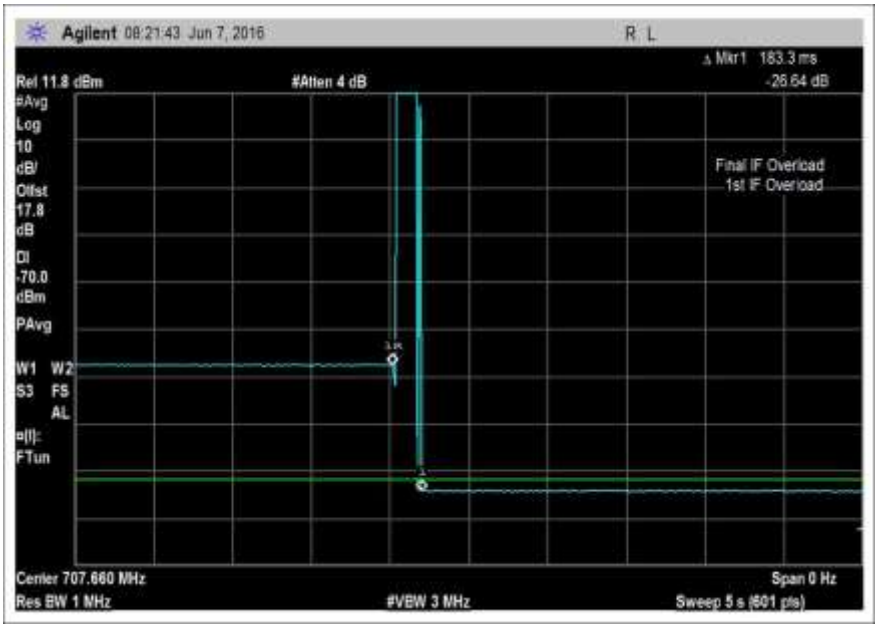
DL 746-775 MHz				
Max Gain Isolation dB	Peak dBm	Min dBm	Diff dB	Limit dB
+5dB	-60.0	-67.0	7.0	12.0
+4dB	-59.9	-67.6	7.7	12.0
+3dB	-59.4	-67.3	7.9	12.0
+2dB	-59.0	-69.0	10.0	12.0
+1dB	-57.0	-68.9	(11.9)*	12.0
0dB	-55.4	-69.1	(13.7)*	12.0
-1dB	-53.6	-69.4	(15.8)*	12.0
-2dB	**	**	0.0	12.0
-3dB	**	**	0.0	12.0
-4dB	**	**	0.0	12.0
-5dB	**	**	0.0	12.0

Note:
* The measured difference exceeds the limit for a period of less than 300 second before device mitigates and shuts down. The maximum recorded time prior to shutdown was 46 seconds for the Uplink bands and 26 seconds for the Downlink bands.
** The device shuts down immediately.

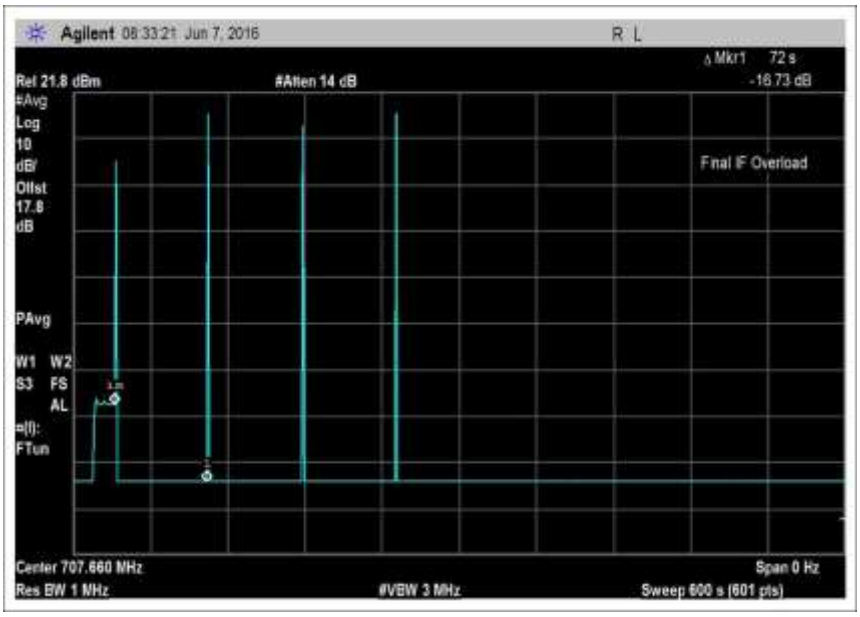
7.11.2 Oscillation Restart Tests

Plots

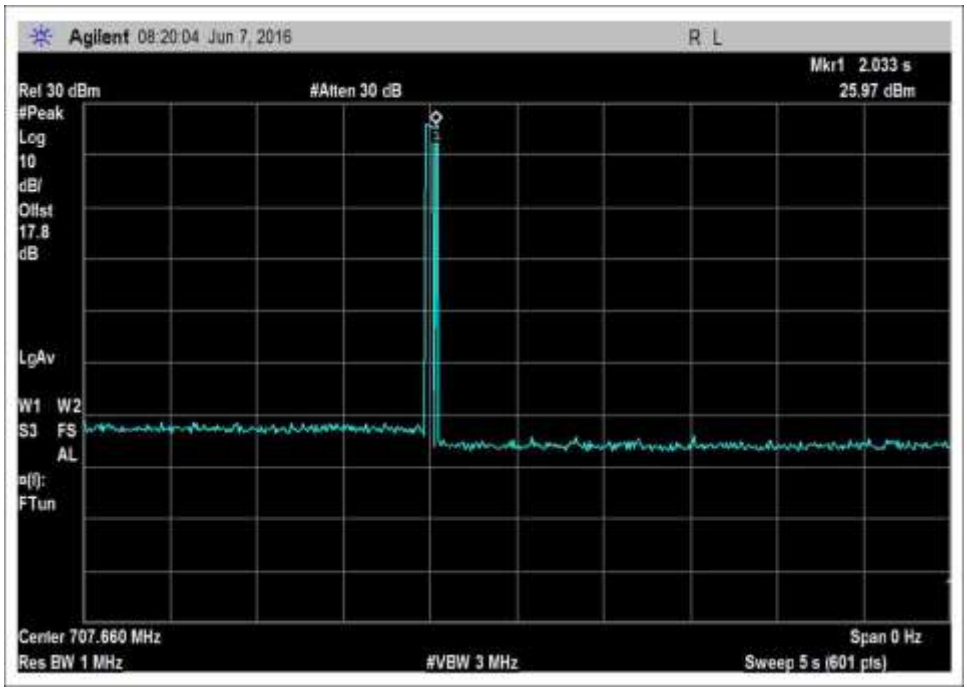
UL



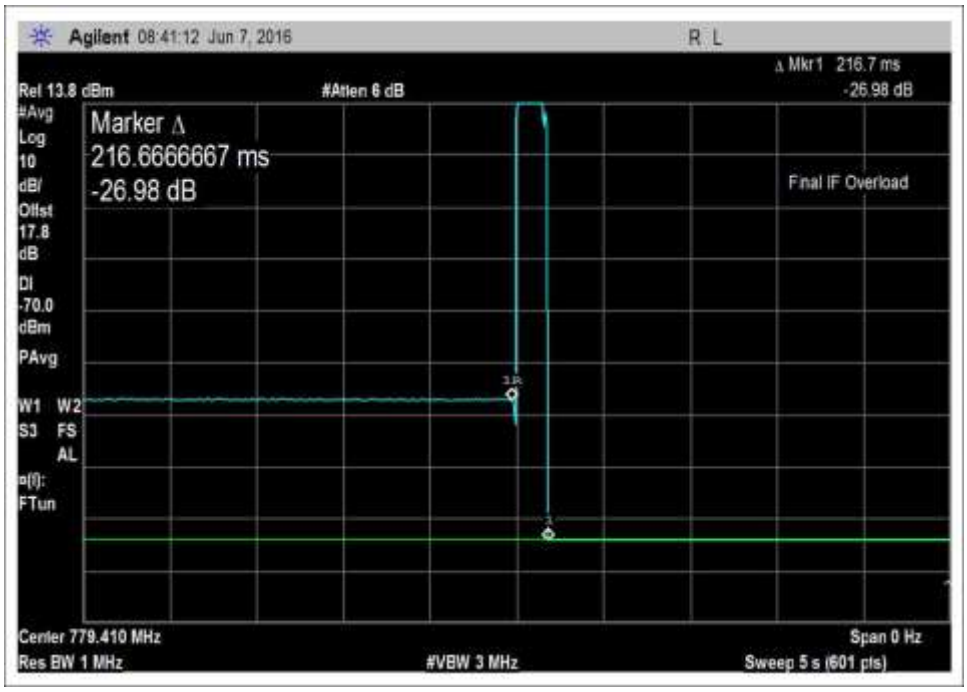
7.11_osc_UL-698-716MHz



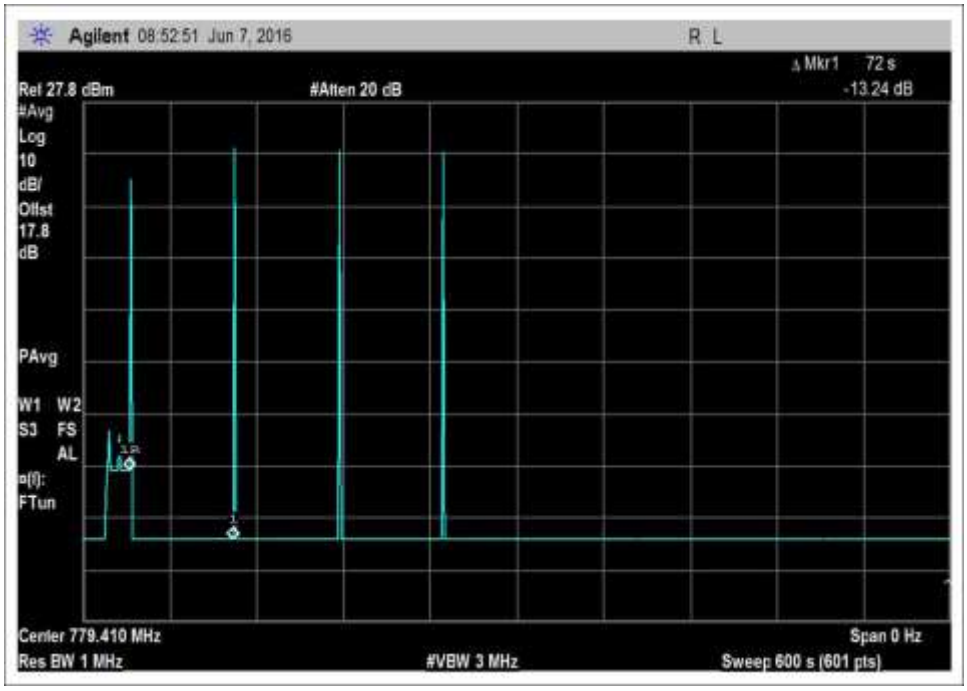
7.11_osc_UL-698-716MHz-600sec



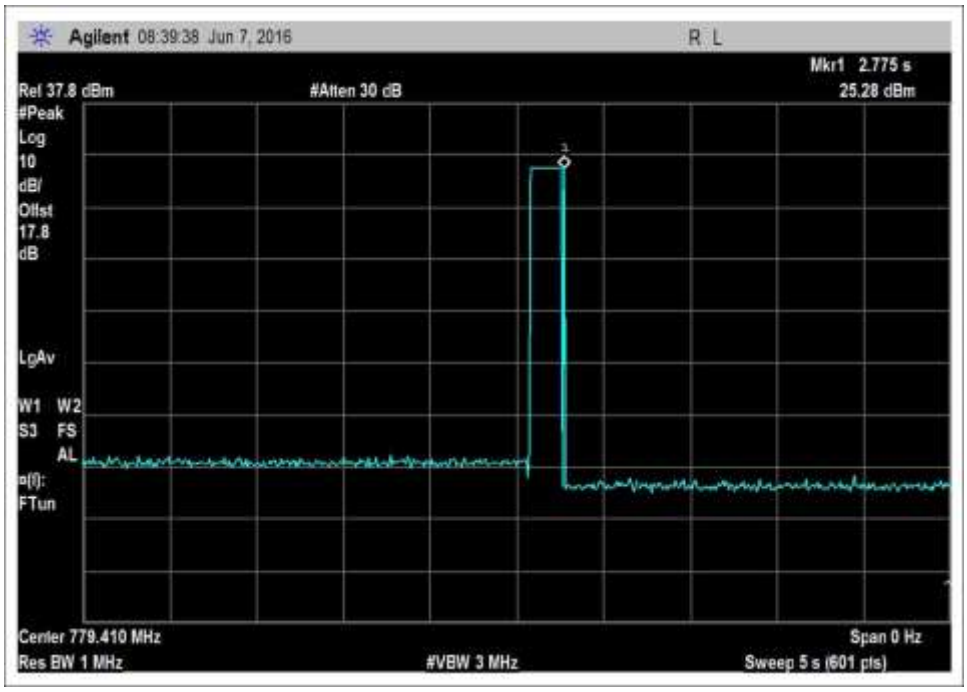
7.11_osc_UL-698-716MHz-Pk



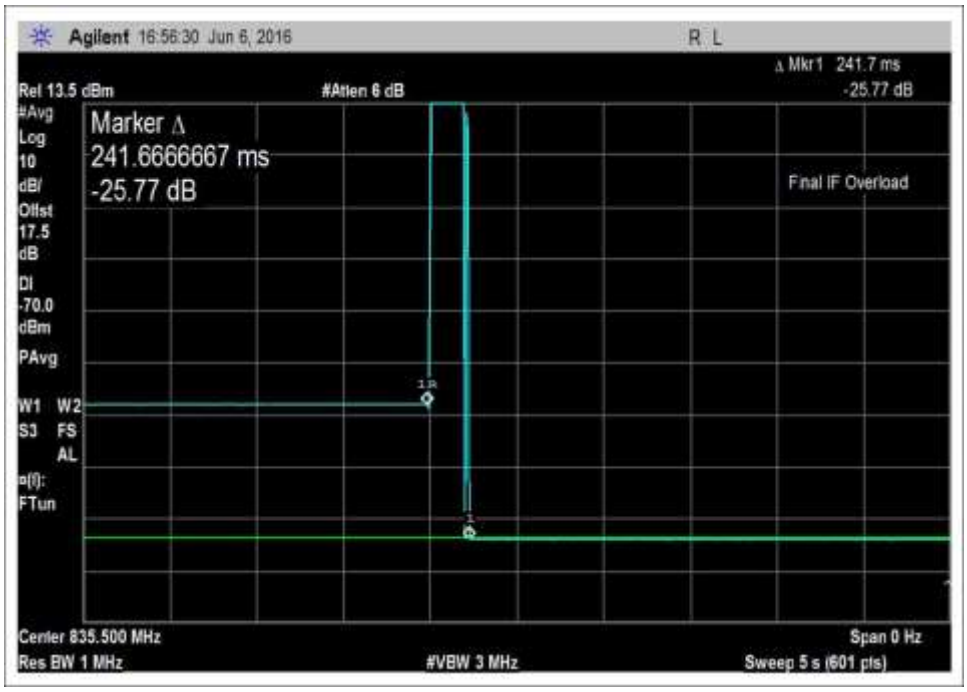
7.11_osc_UL-776-787MHz



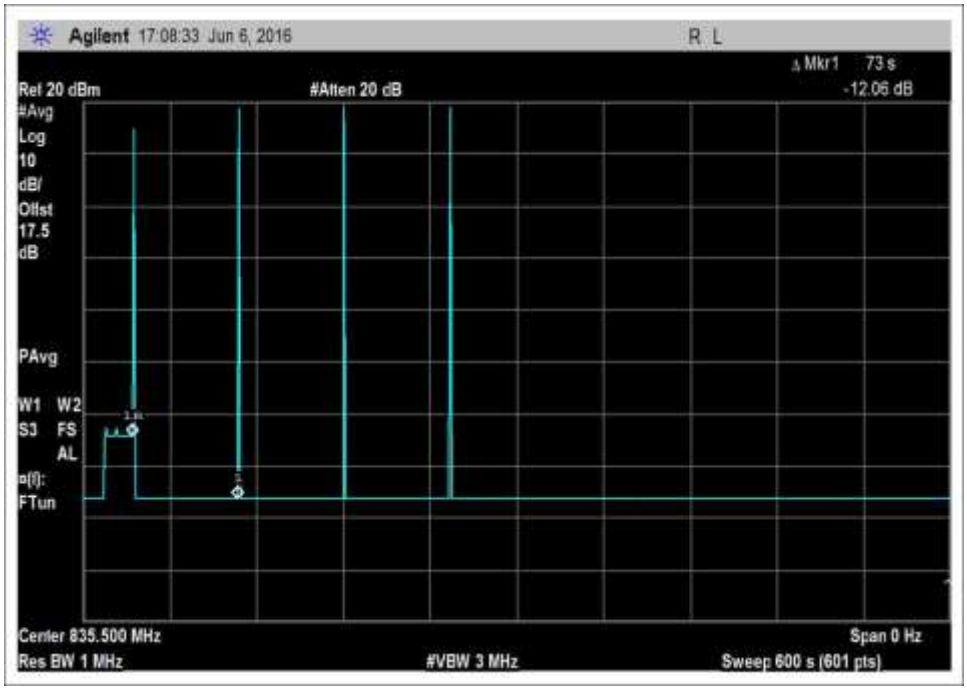
7.11_osc_UL-776-787MHz-600sec



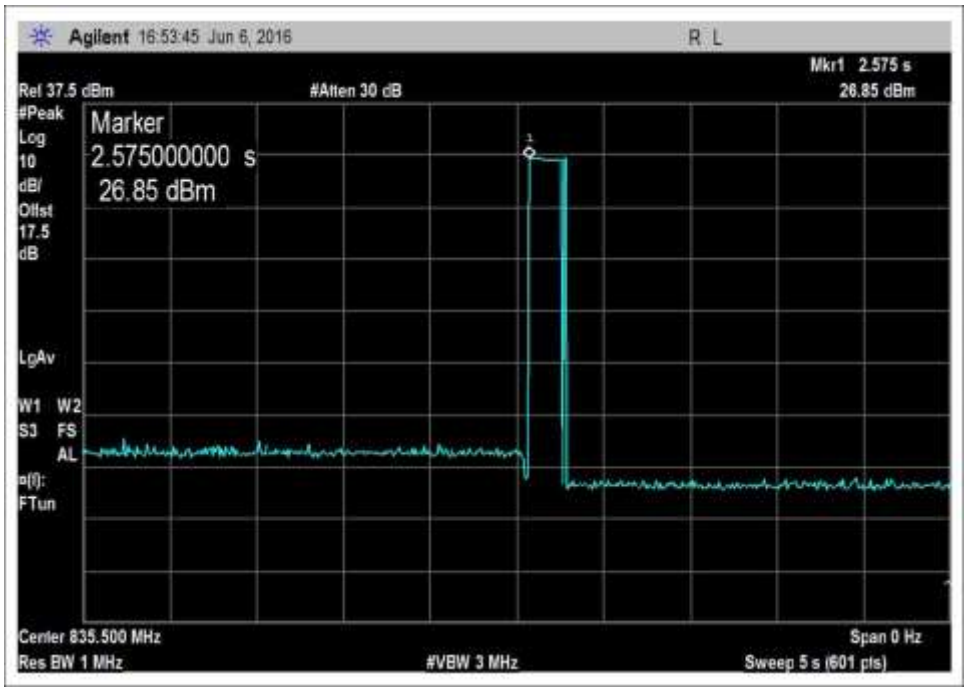
7.11_osc_UL-776-787MHz-Pk



7.11_osc_UL-824-849MHz



7.11_osc_UL-824-849MHz-600sec



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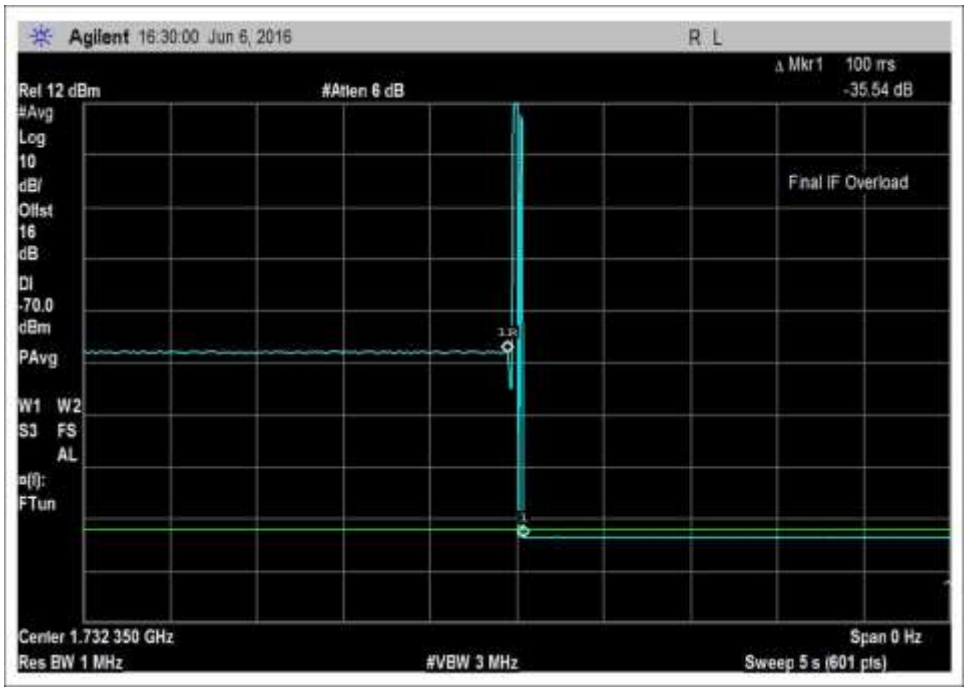
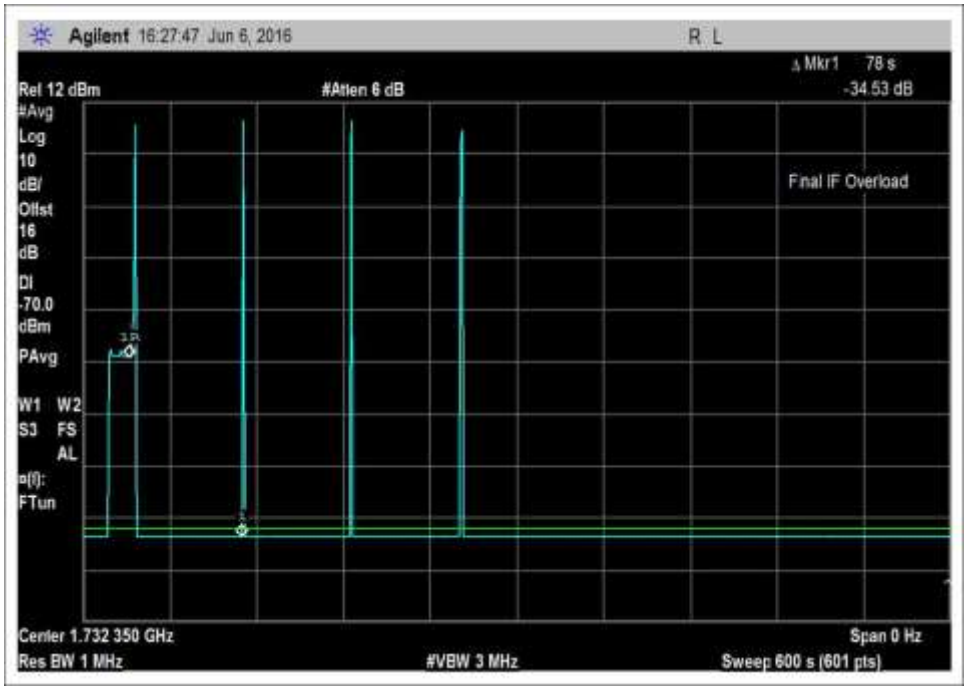
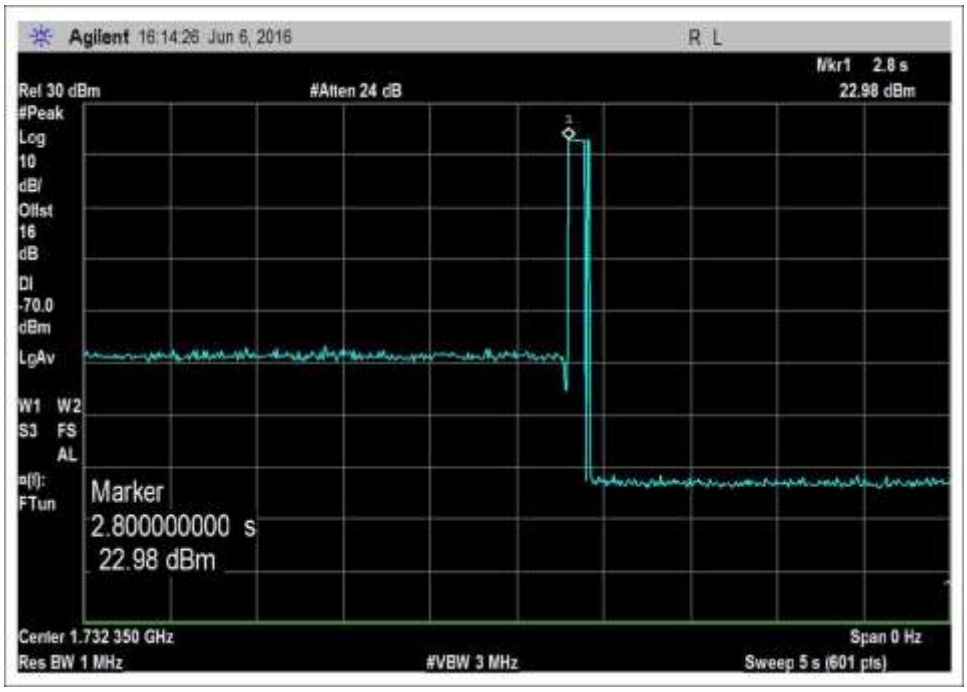


7.11_osc_UL-1710-1755MHz



7.11_osc_UL-1710-1755MHz-600sec



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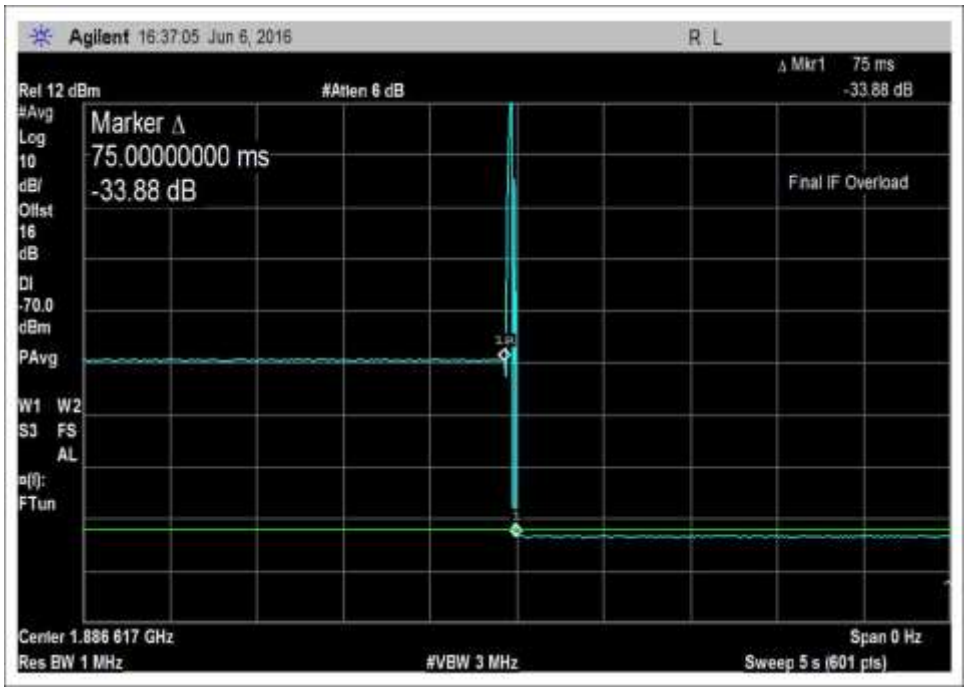
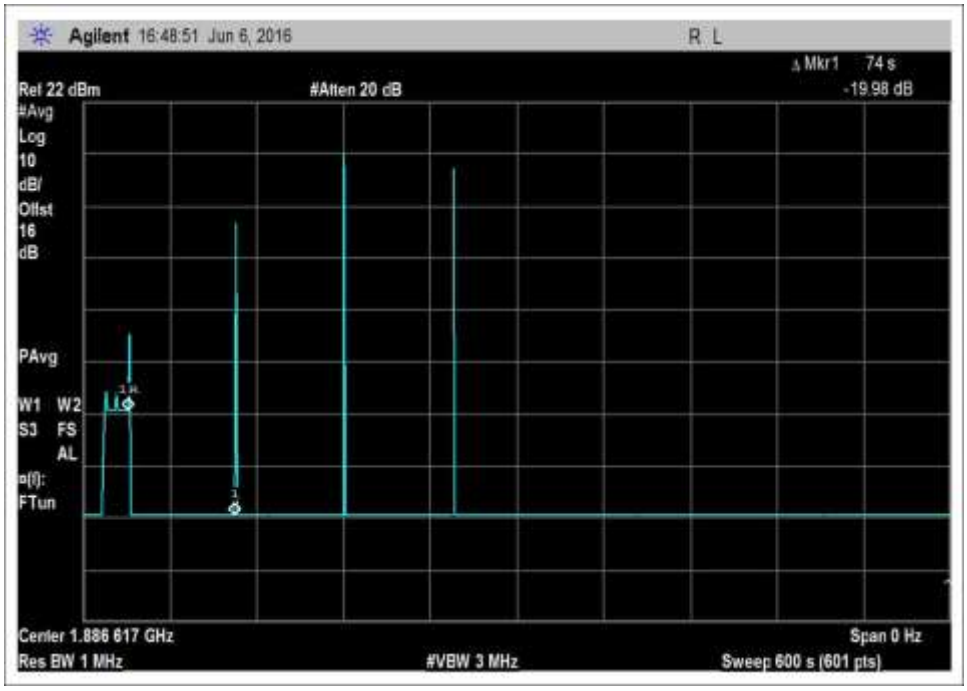
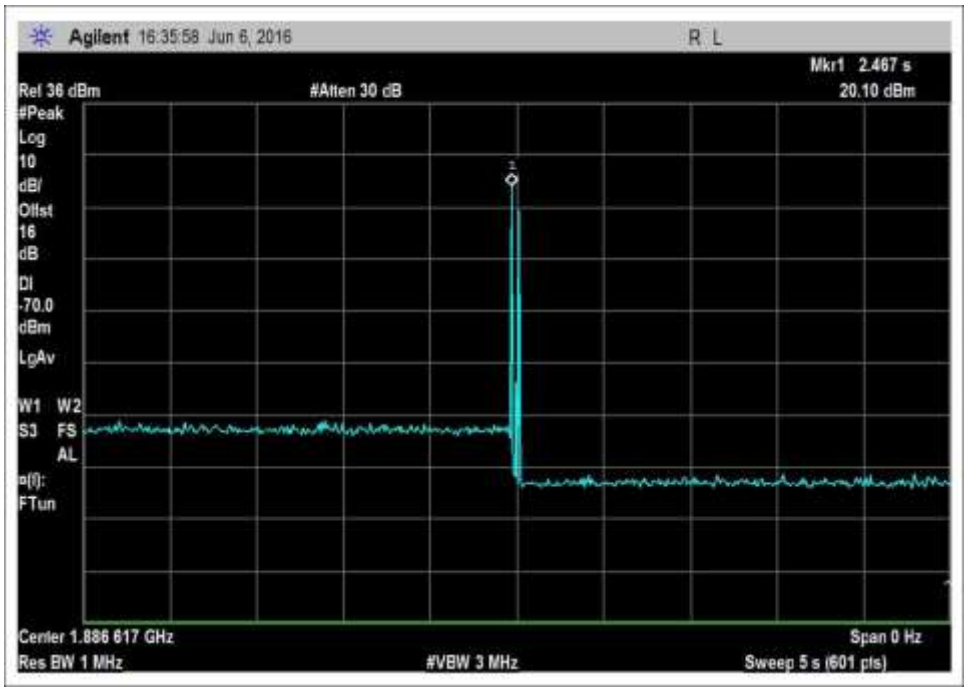


7.11_osc_UL-1850-1915MHz

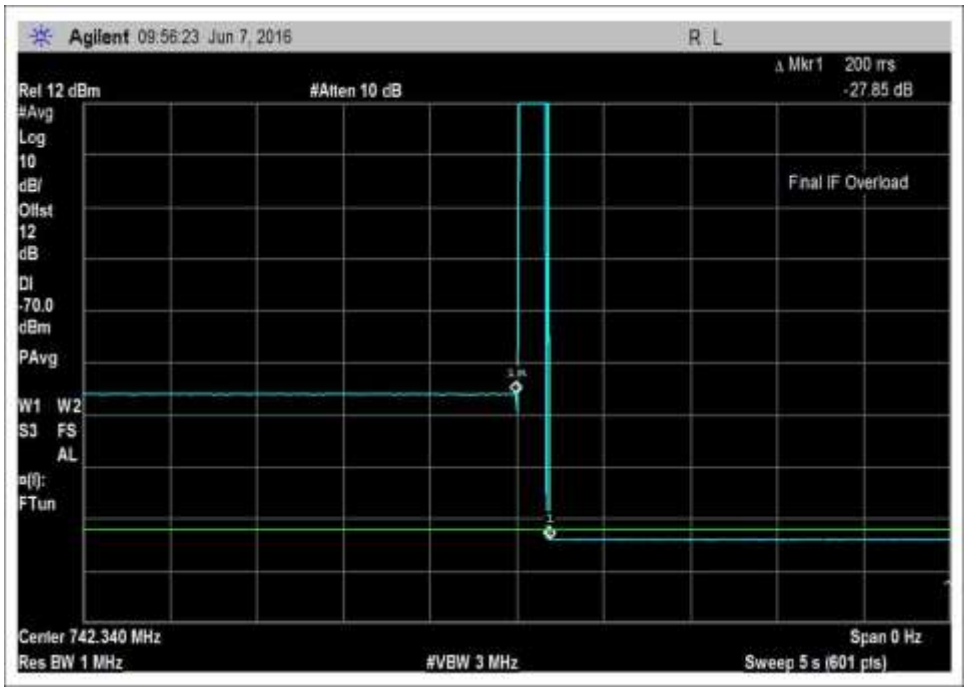


7.11_osc_UL-1850-1915MHz_600sec

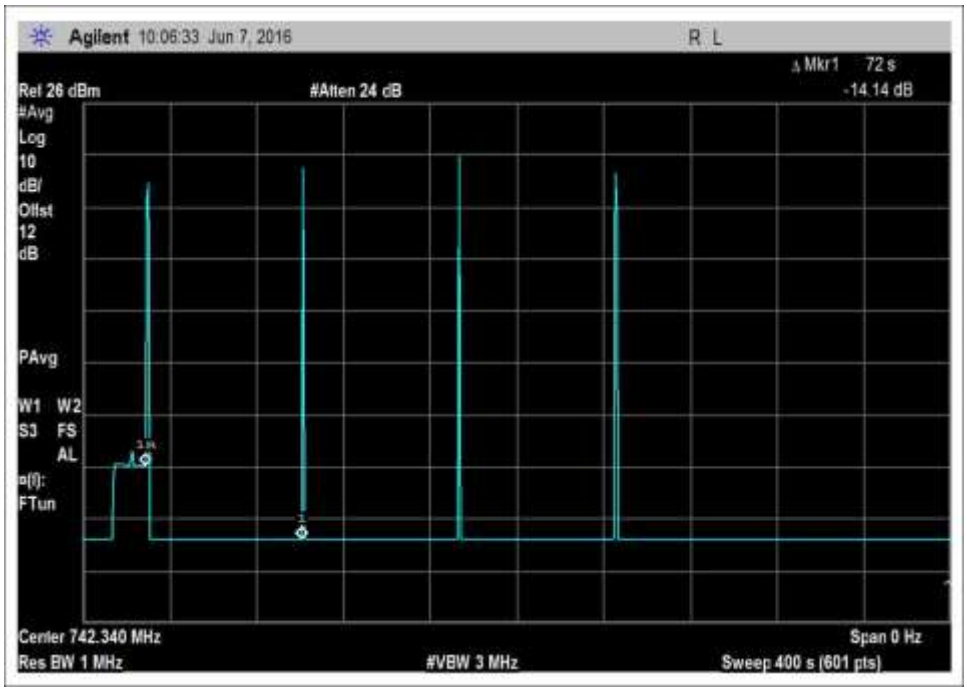


7.11_osc_UL-1850-1915MHz-Pk

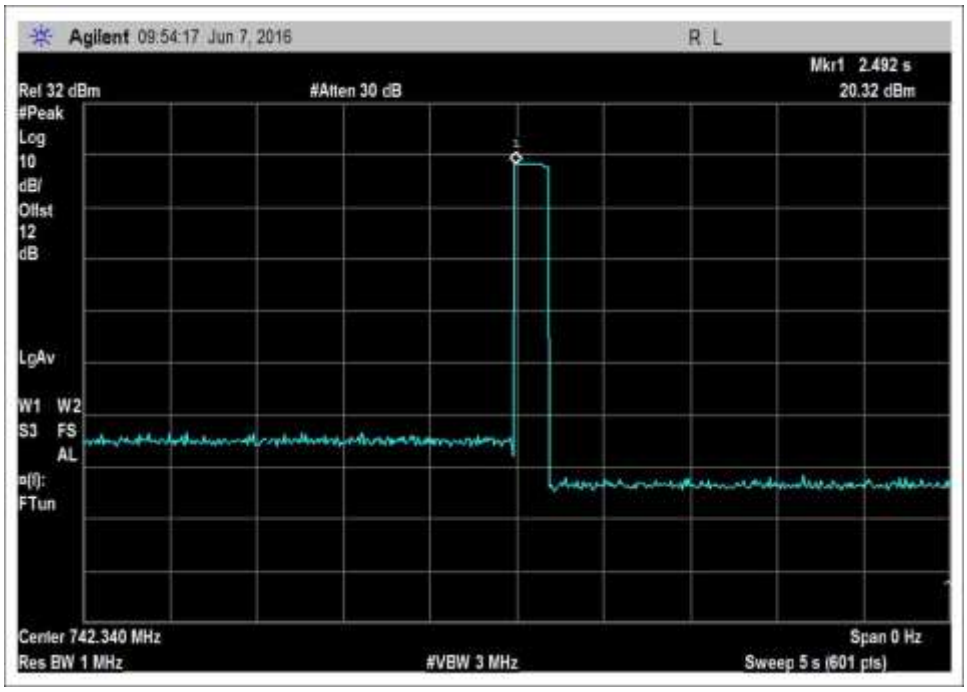
DL



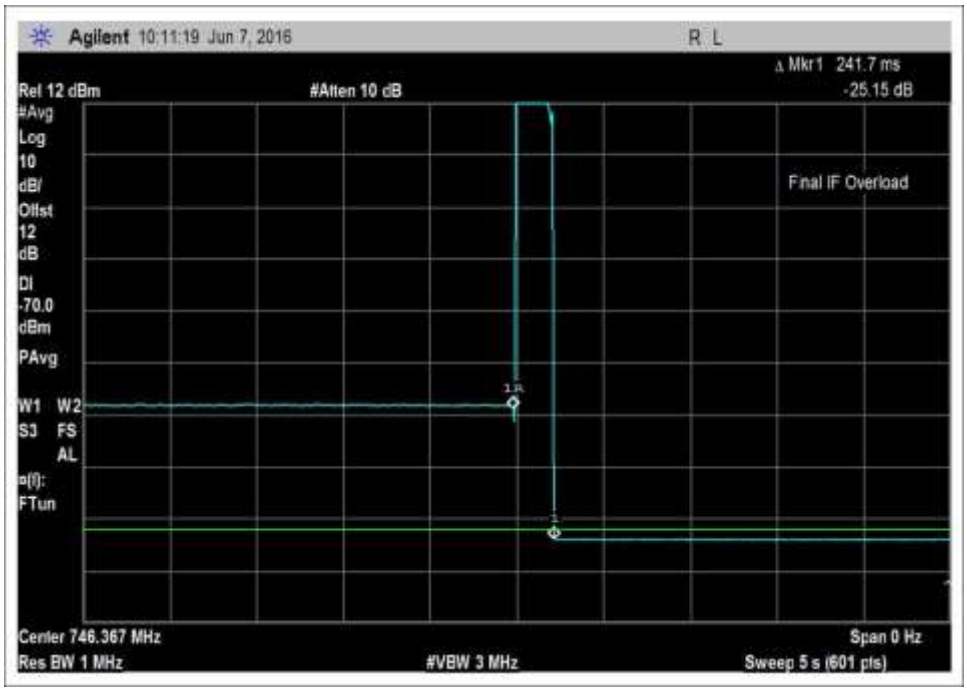
7.11_osc_DL-728-746MHz



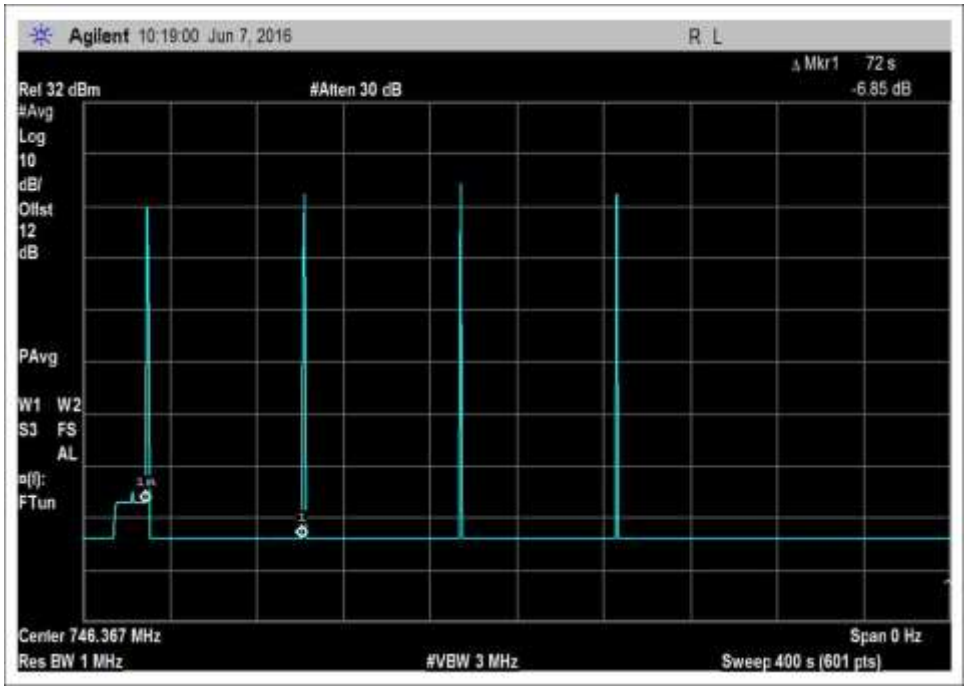
7.11_osc_DL-728-746MHz-400sec



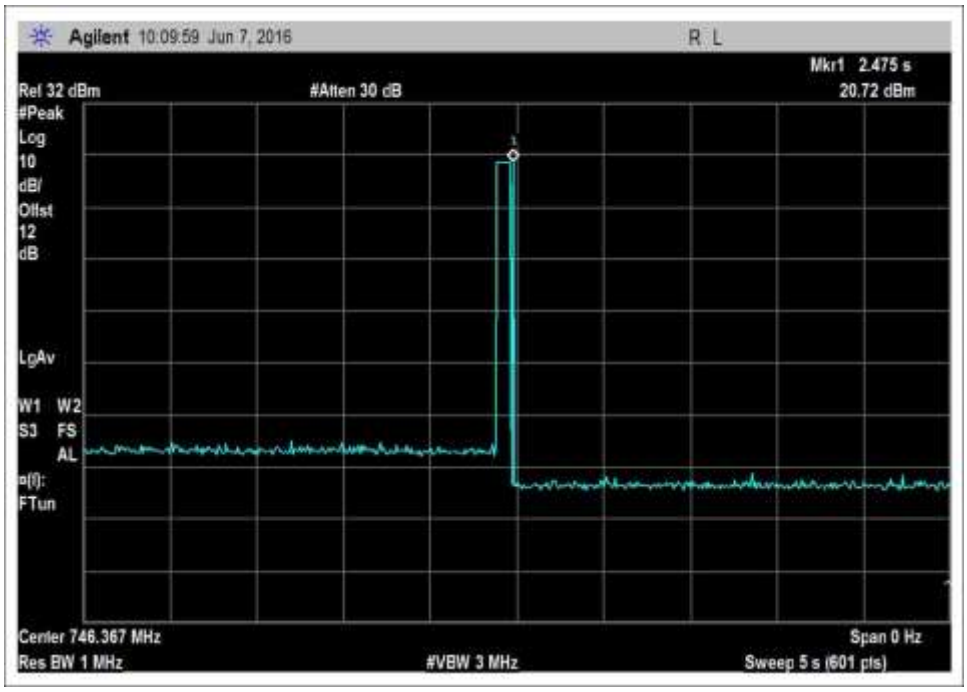
7.11_osc_DL-728-746MHz-Pk



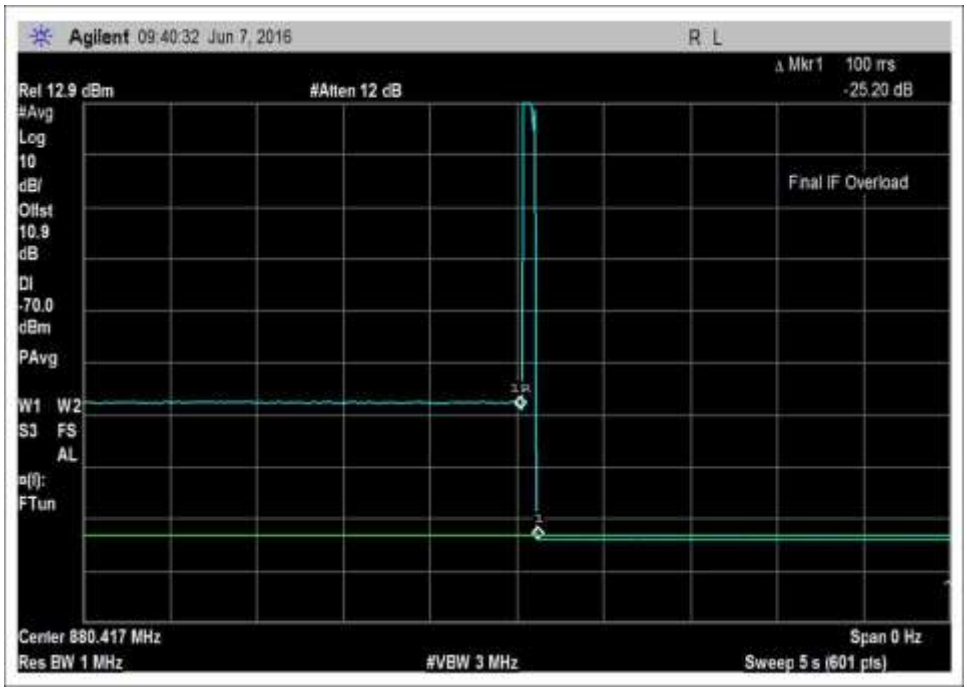
7.11_osc_DL-746-757MHz



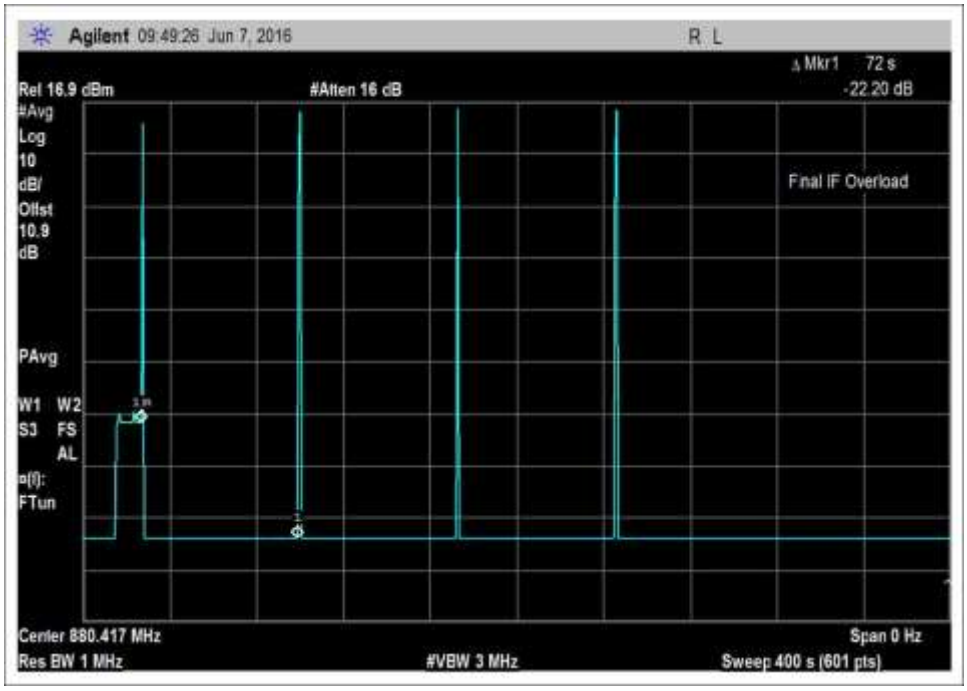
7.11_osc_DL-746-757MHz-400



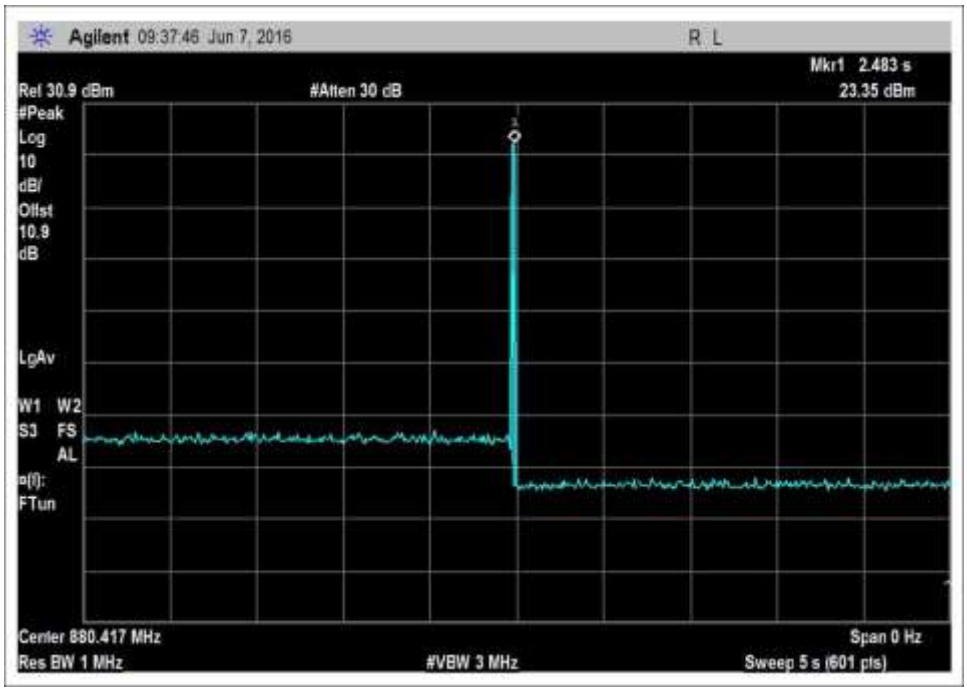
7.11_osc_DL-746-757MHz-Pk



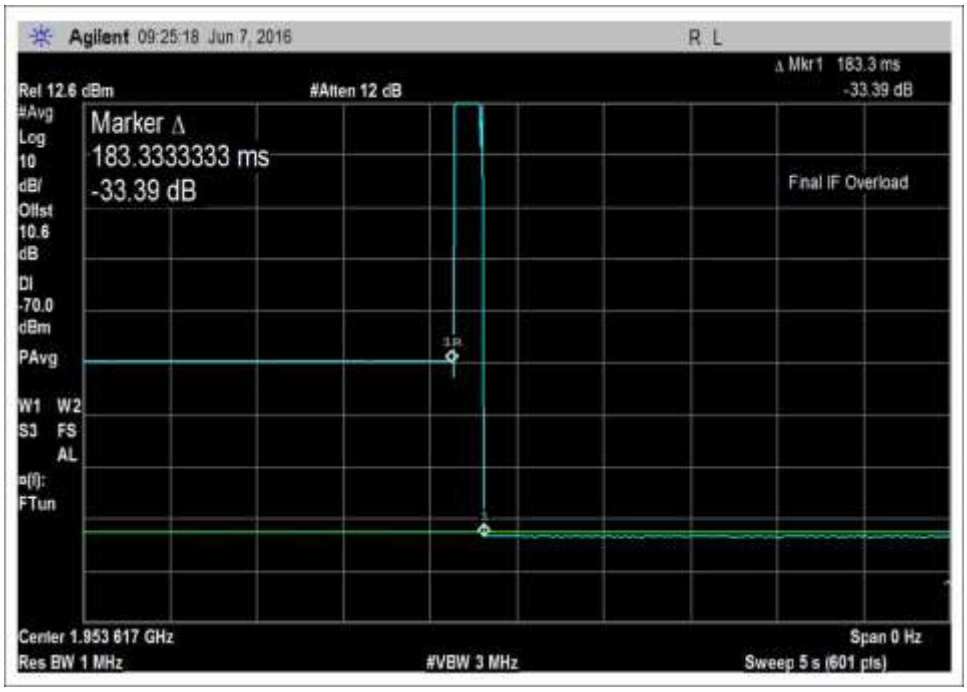
7.11_osc_DL-869-894MHz



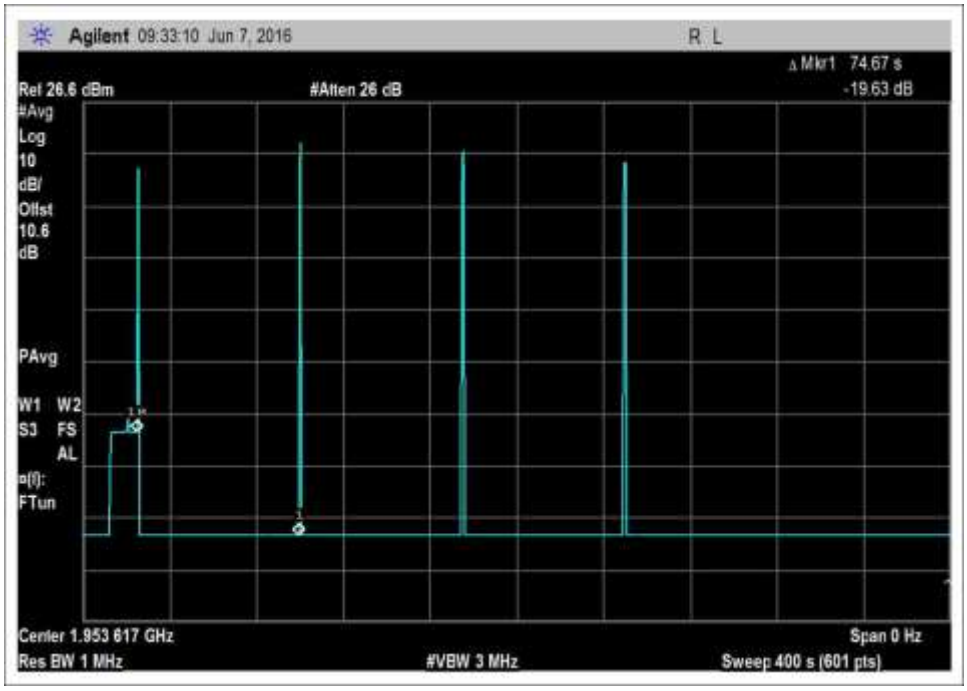
7.11_osc_DL-869-894MHz-400



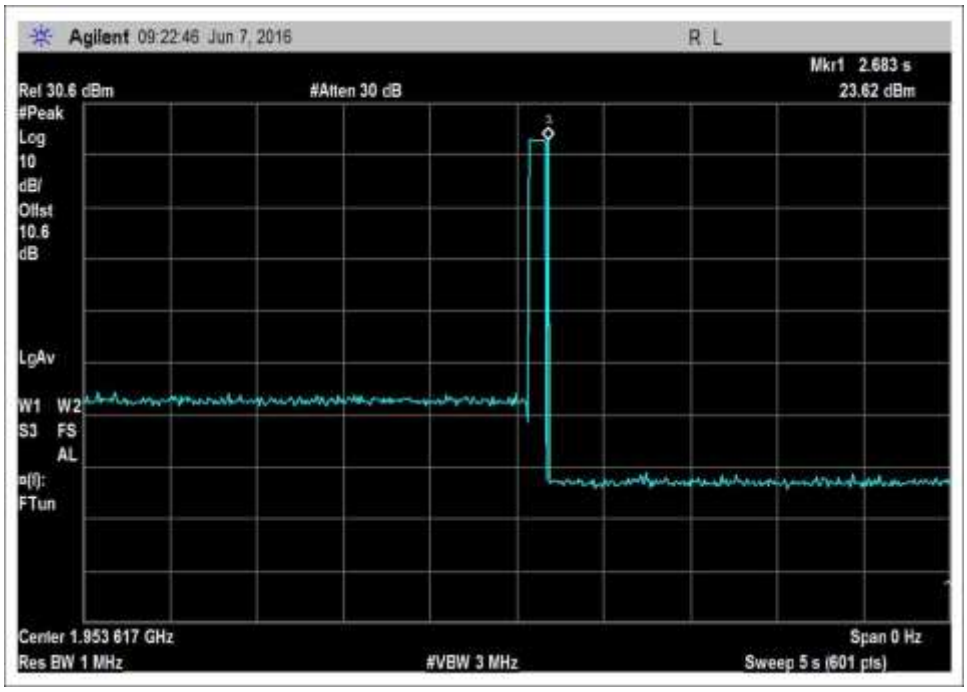
7.11_osc_DL-869-894MHz-Pk



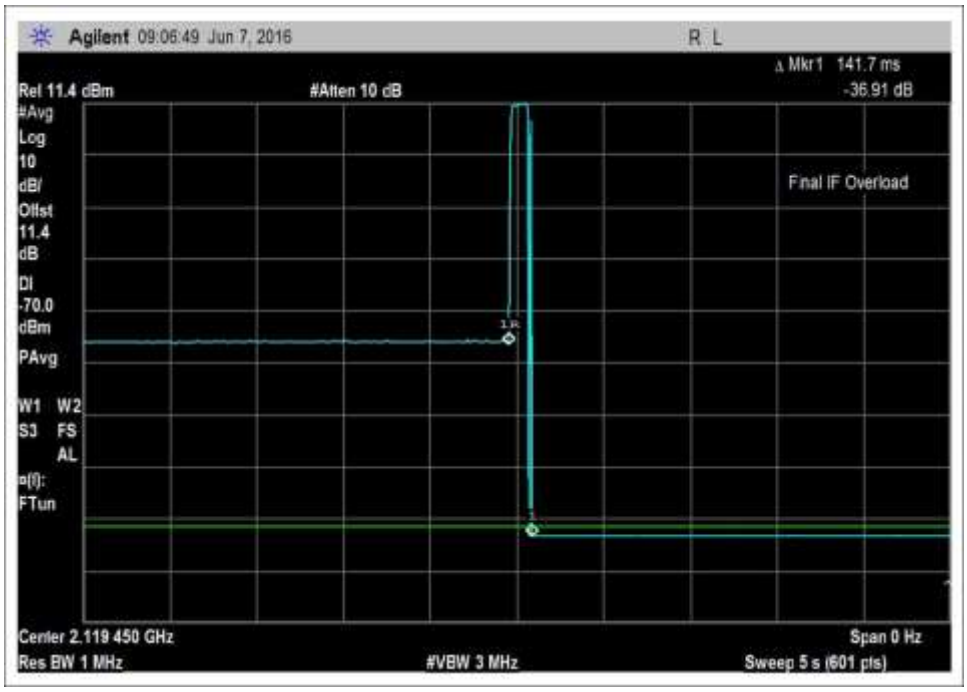
7.11_osc_DL-1930-1995MHz



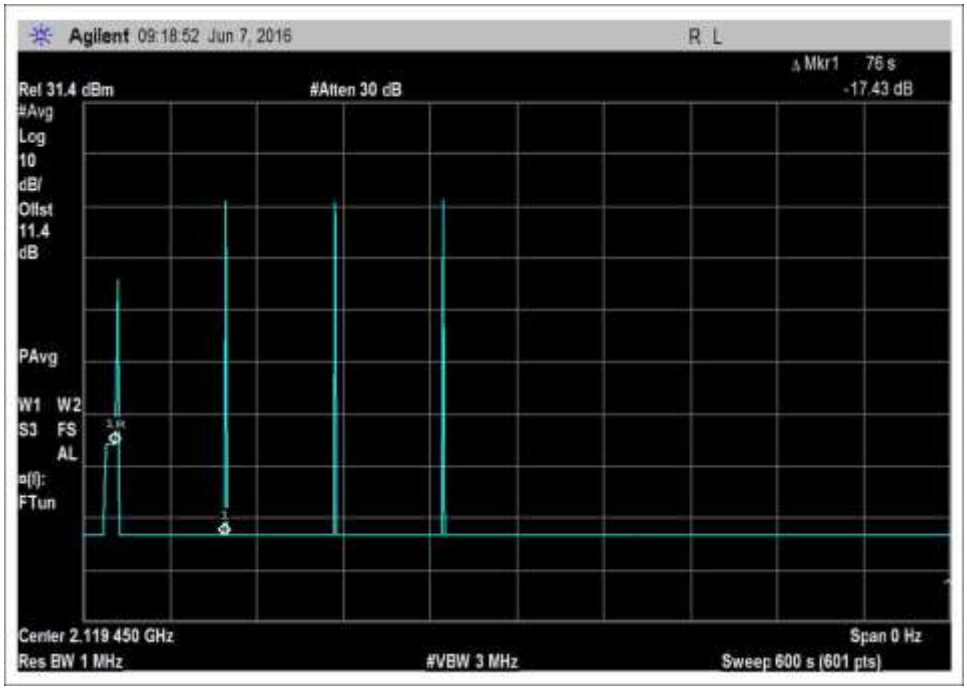
7.11_osc_DL-1930-1995MHz-400sec



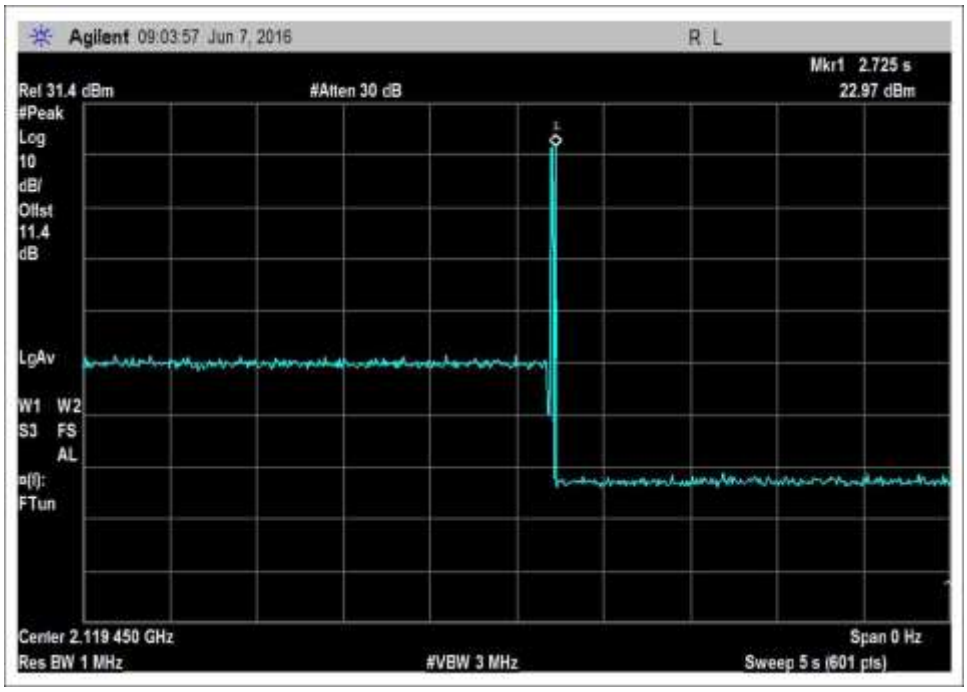
7.11_osc_DL-1930-1995MHz-Pk



7.11_osc_DL-2110-2155MHz



7.11_osc_DL-2110-2155MHz-600sec

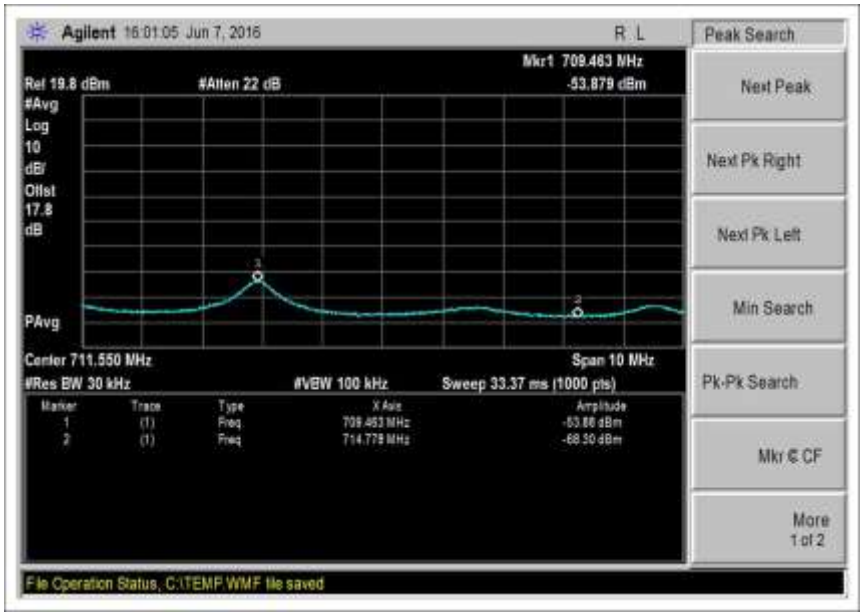


7.11_osc_DL-2110-2155MHz-Pk

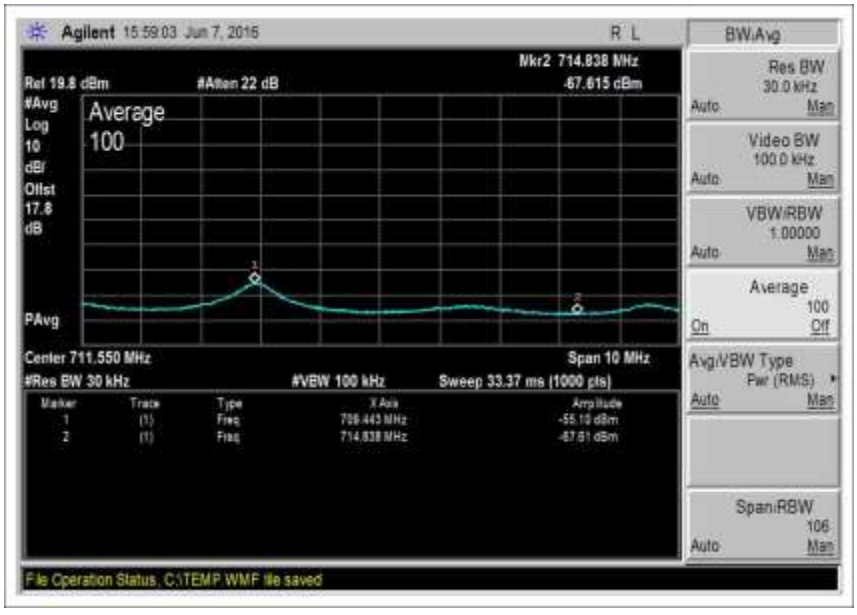
7.11.3 Measuring Oscillation Mitigation or Shutdown

Plots

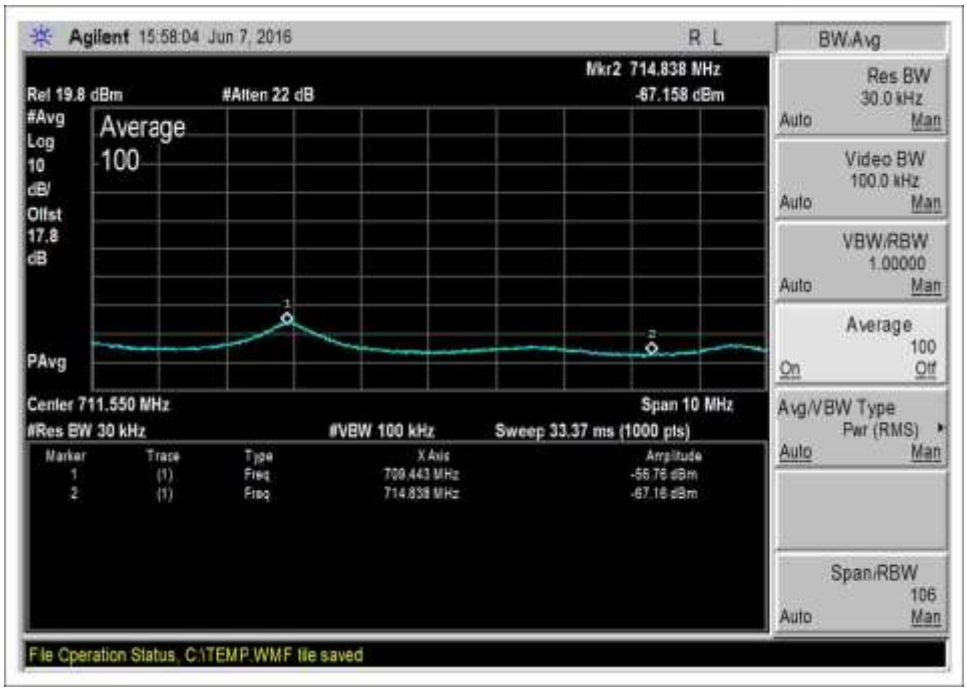
UL



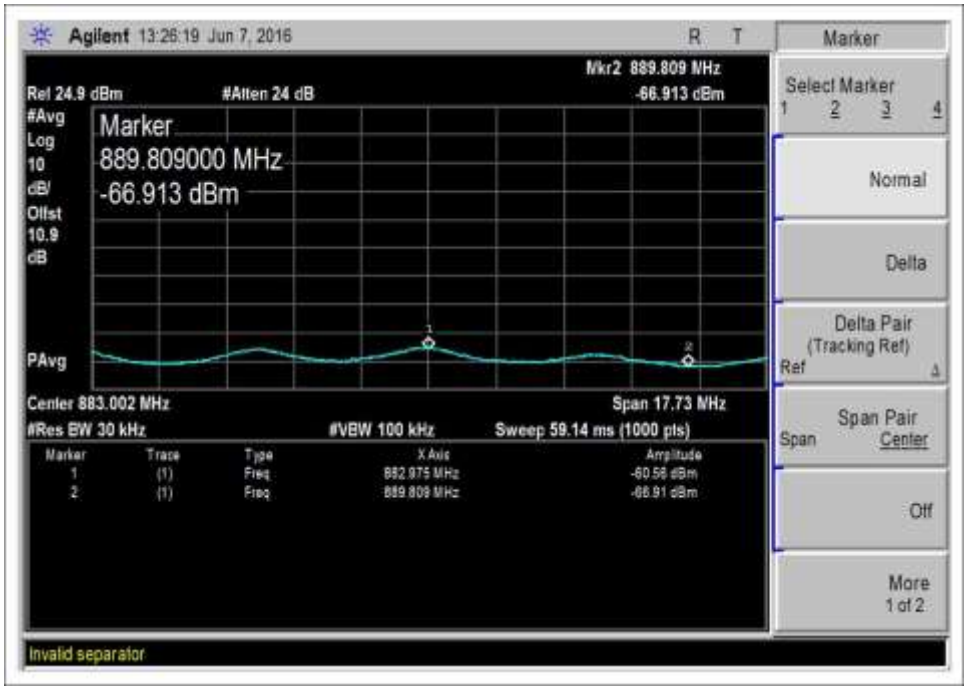
UL-698-716-AWGNL+2



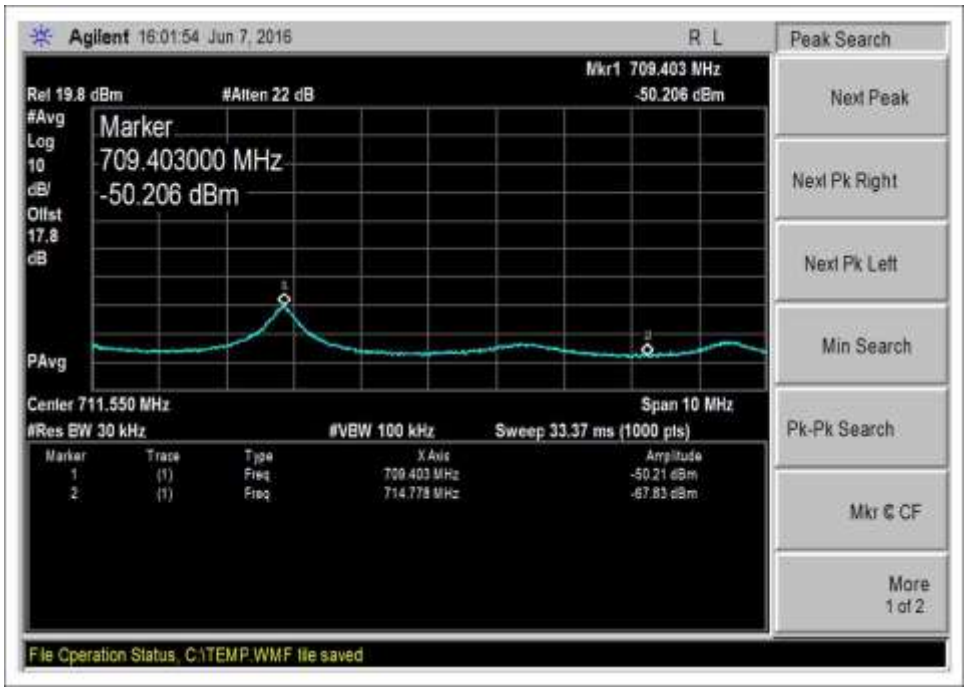
UL-698-716-AWGNL+3



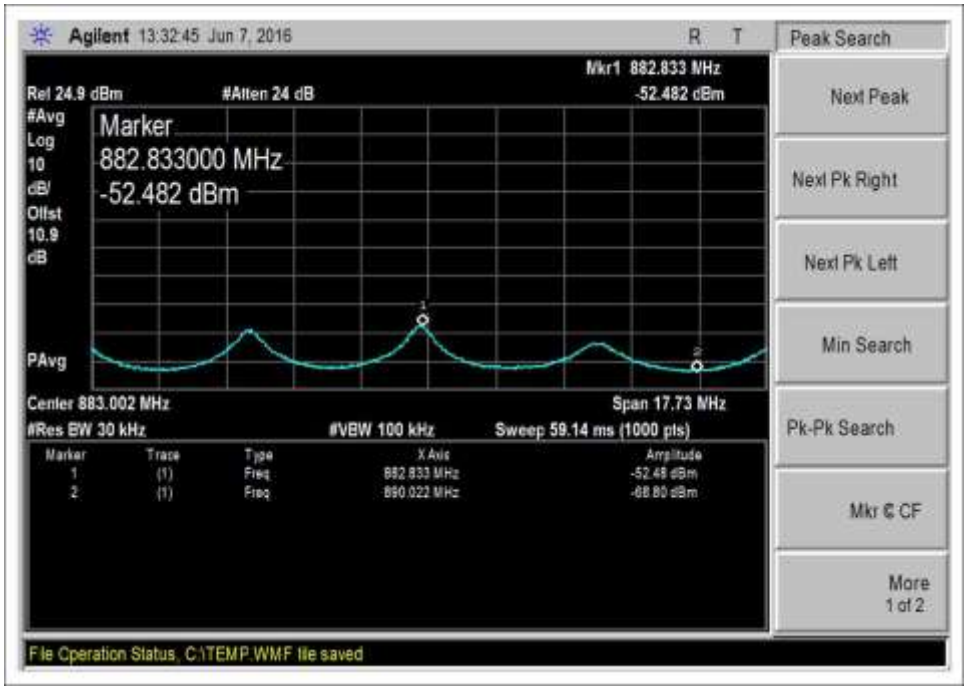
UL-698-716-AWGNL+4



UL-698-716-AWGNL+5



UL-698-716-AWGNL-1



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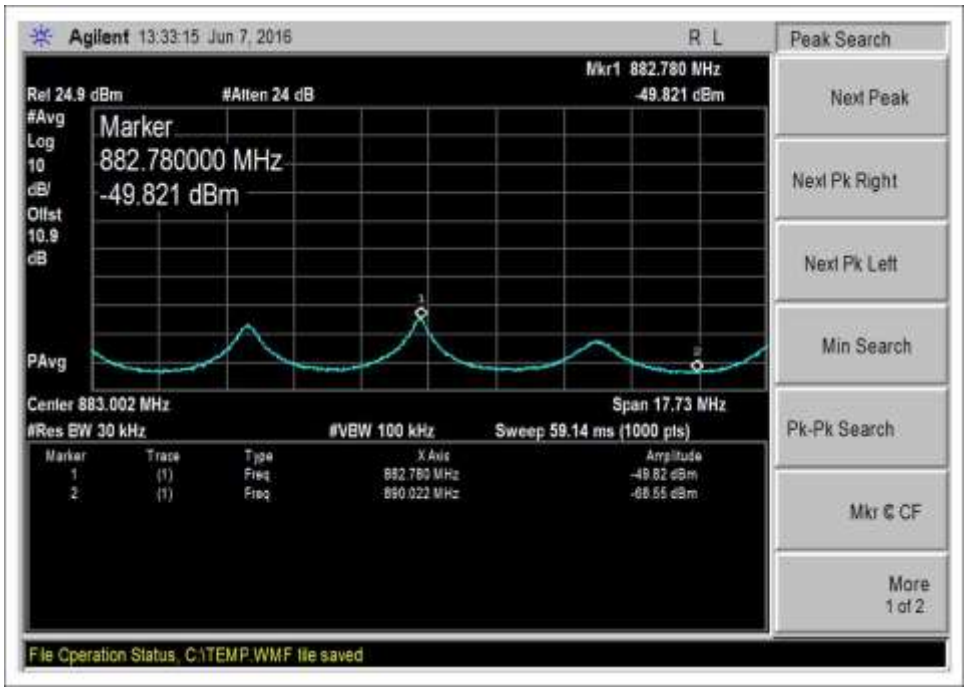
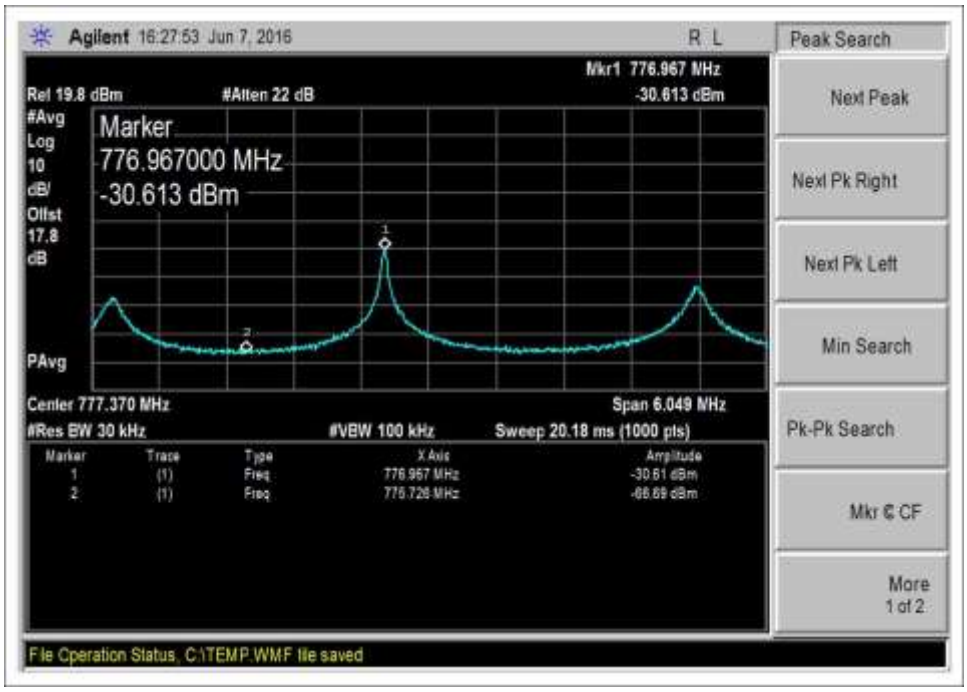
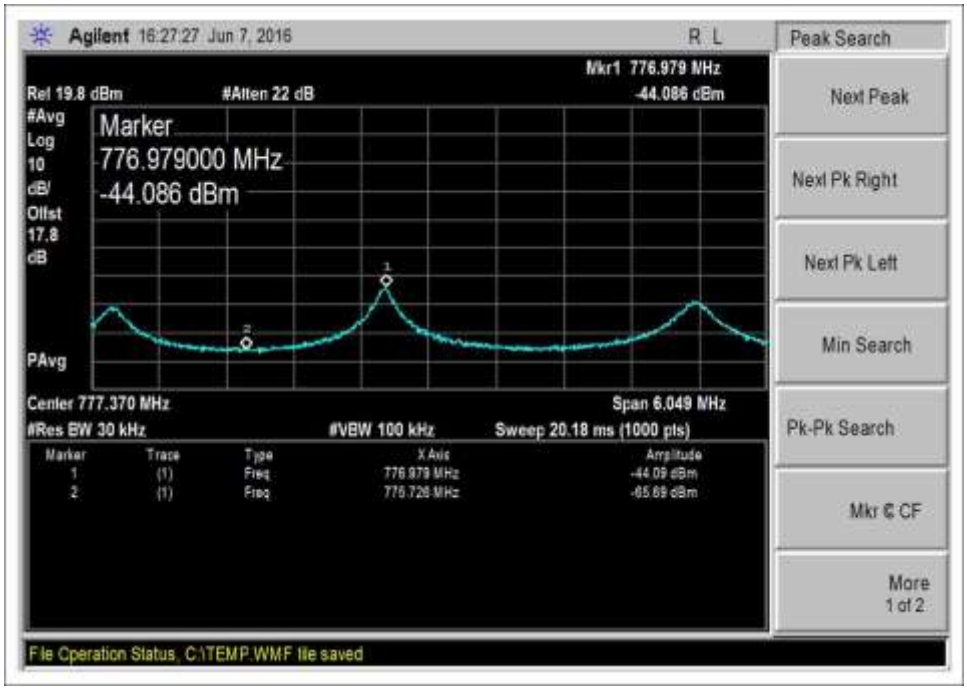


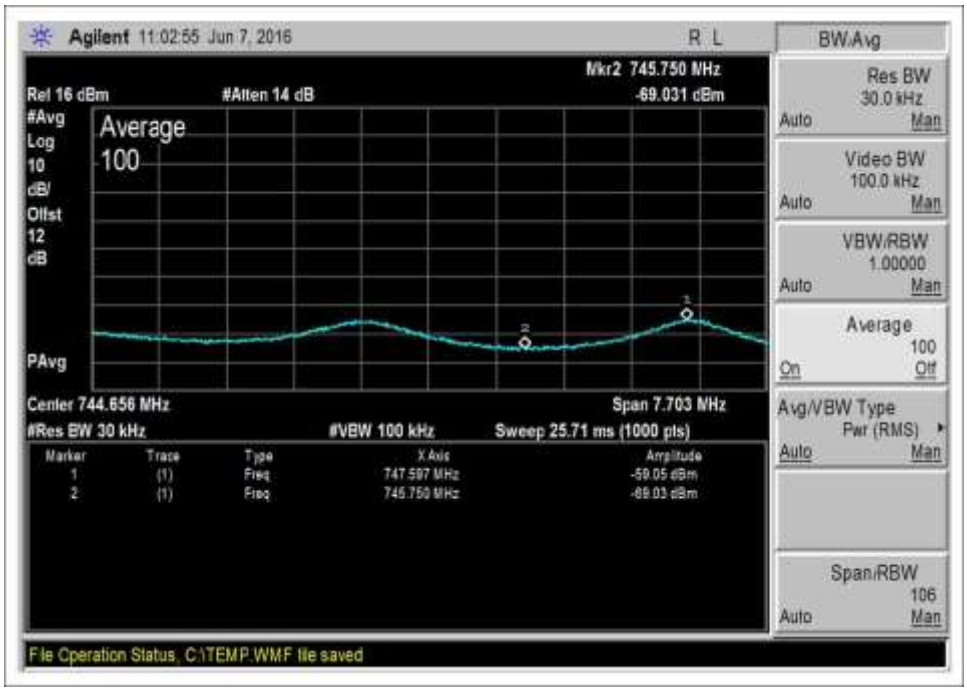
UL-698-716-AWGNL-3



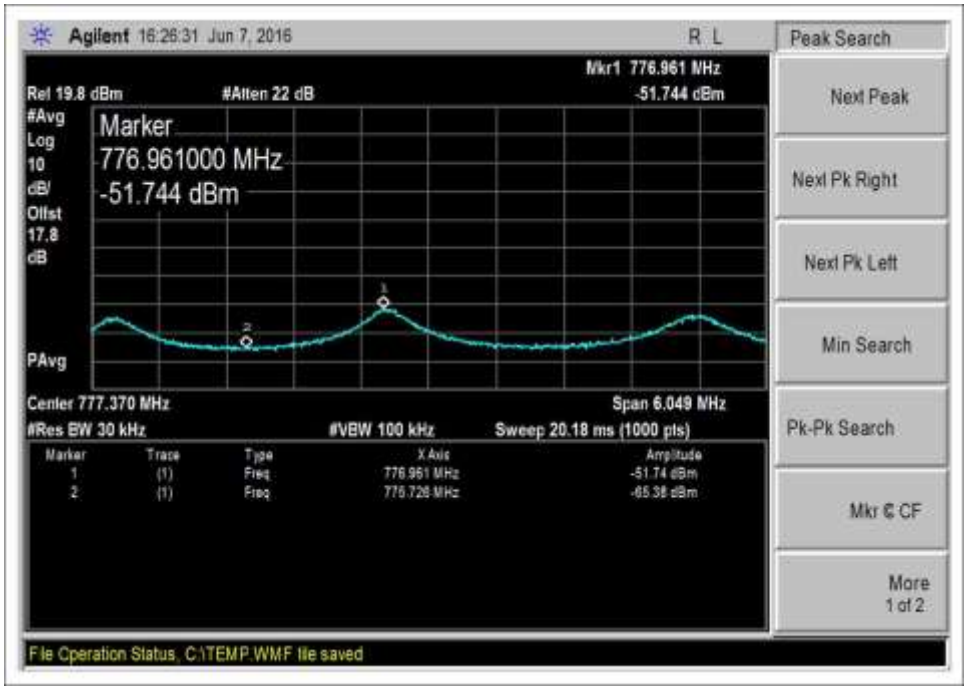
UL-776-787-AWGNR+0



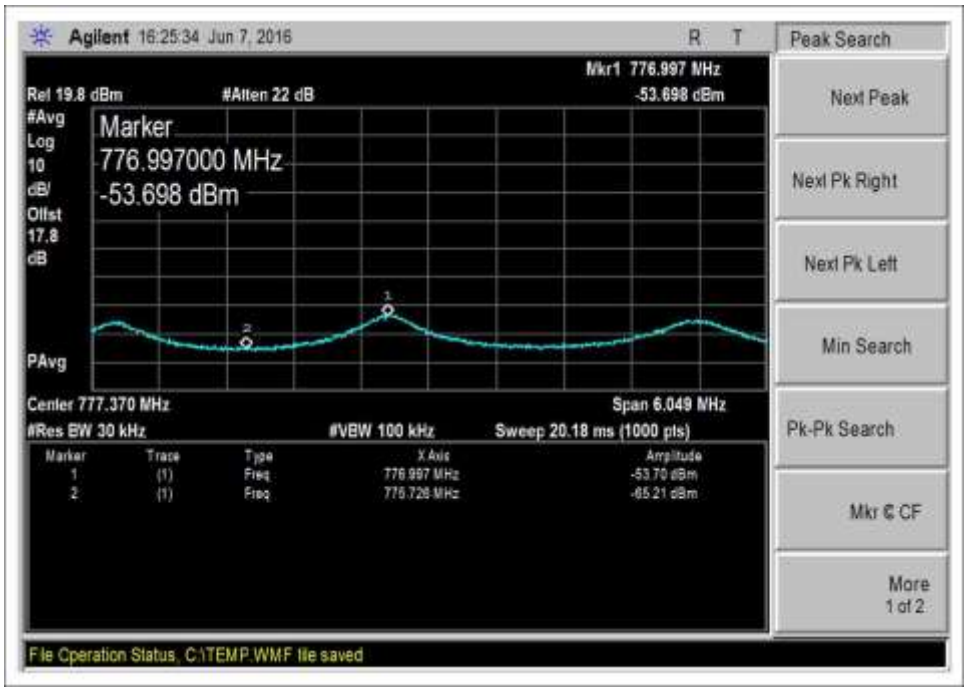
UL-776-787-AWGNR+1



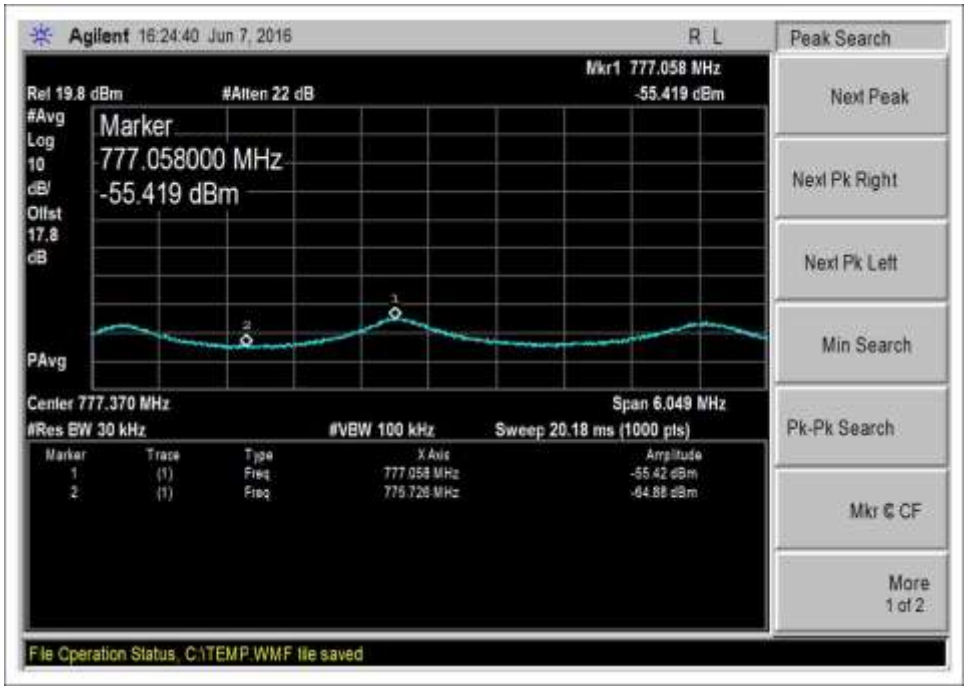
UL-776-787-AWGNR+2



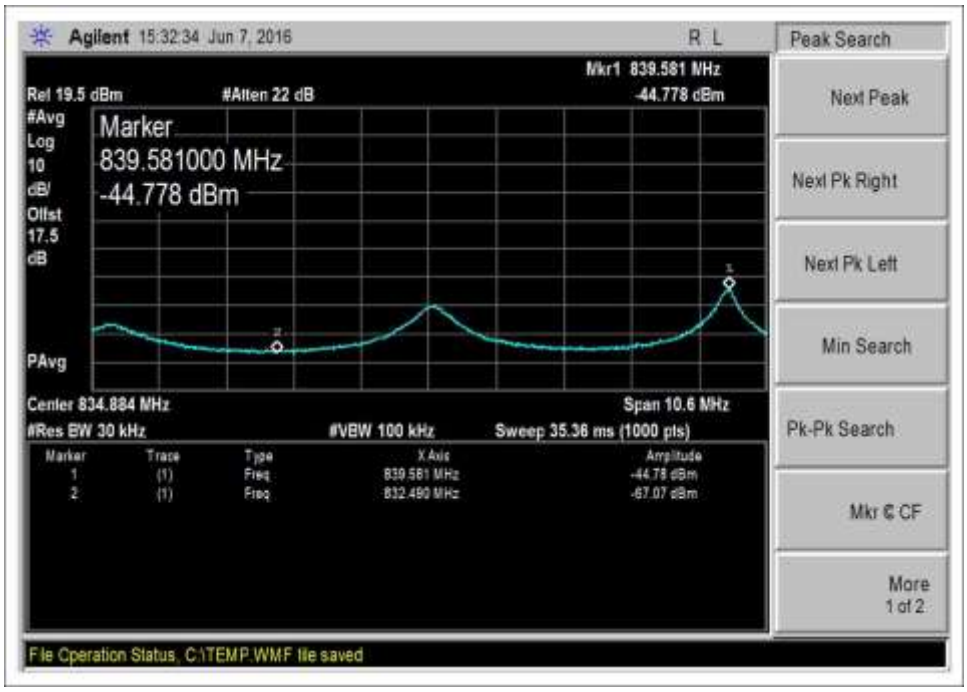
UL-776-787-AWGNR+3



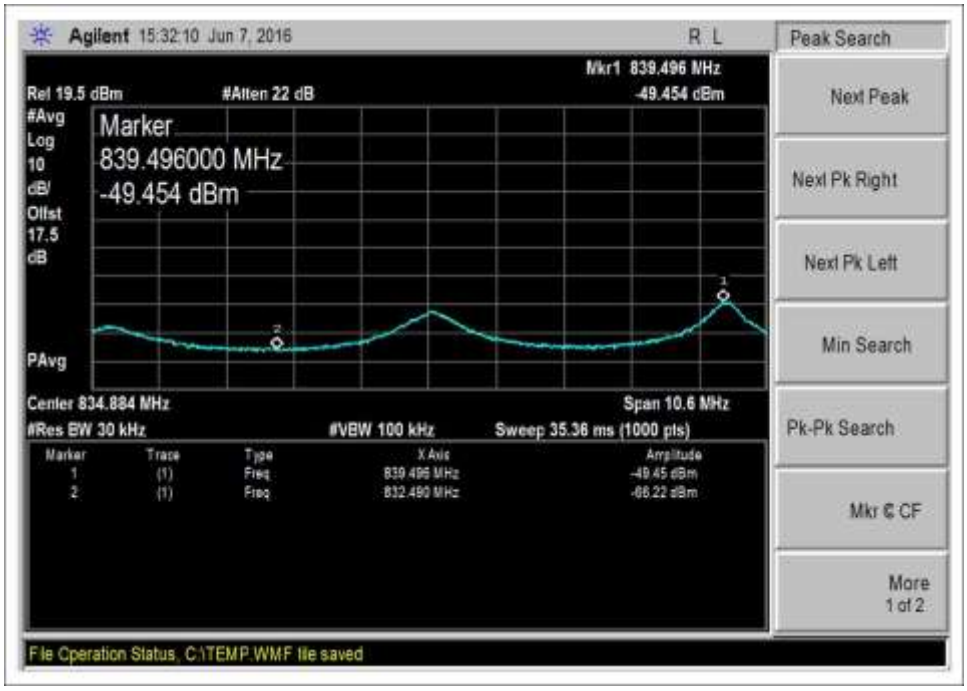
UL-776-787-AWGNR+4



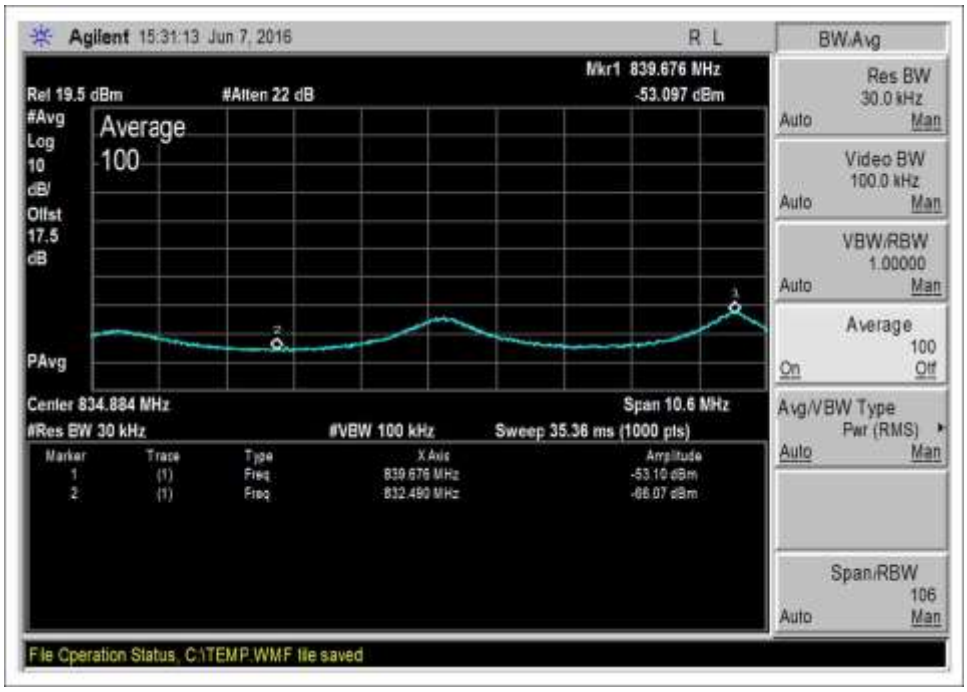
UL-776-787-AWGNR+5



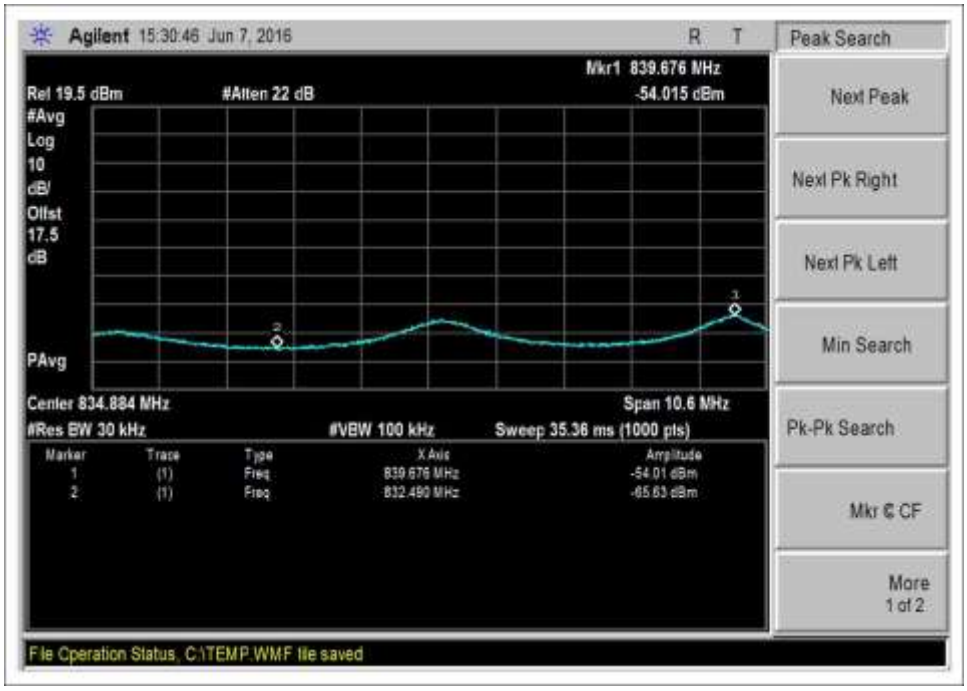
UL-824-849-AWGNL+0



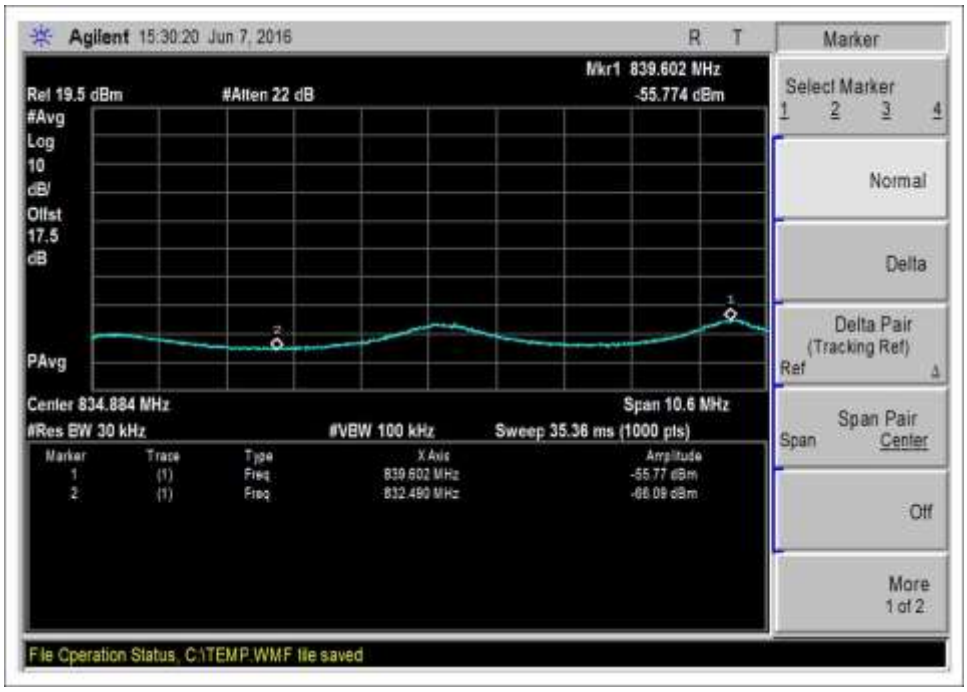
UL-824-849-AWGNL+1



UL-824-849-AWGNL+2



UL-824-849-AWGNL+3



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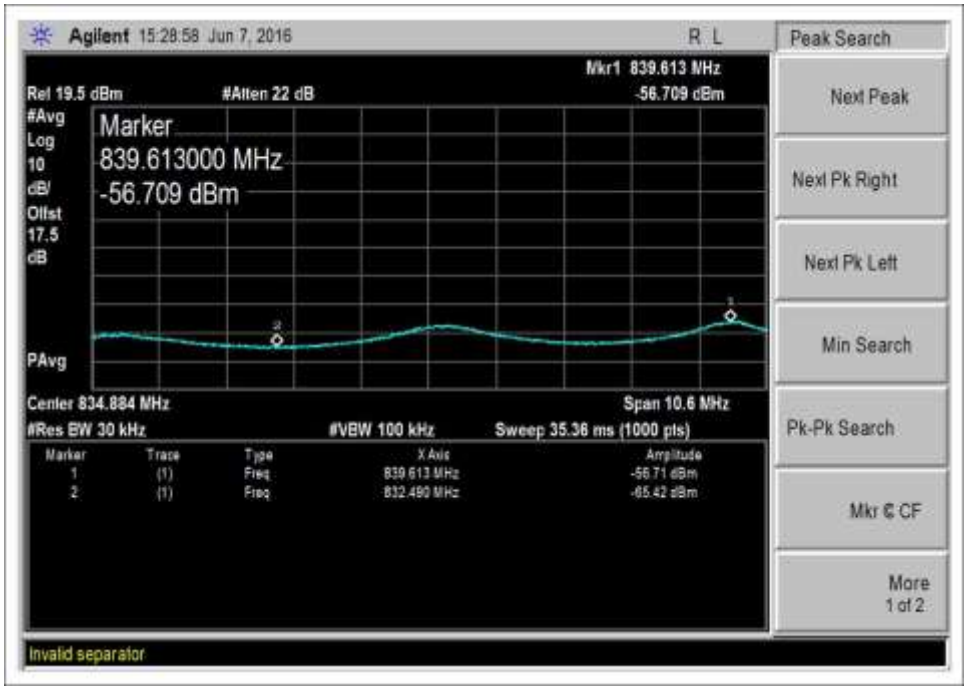

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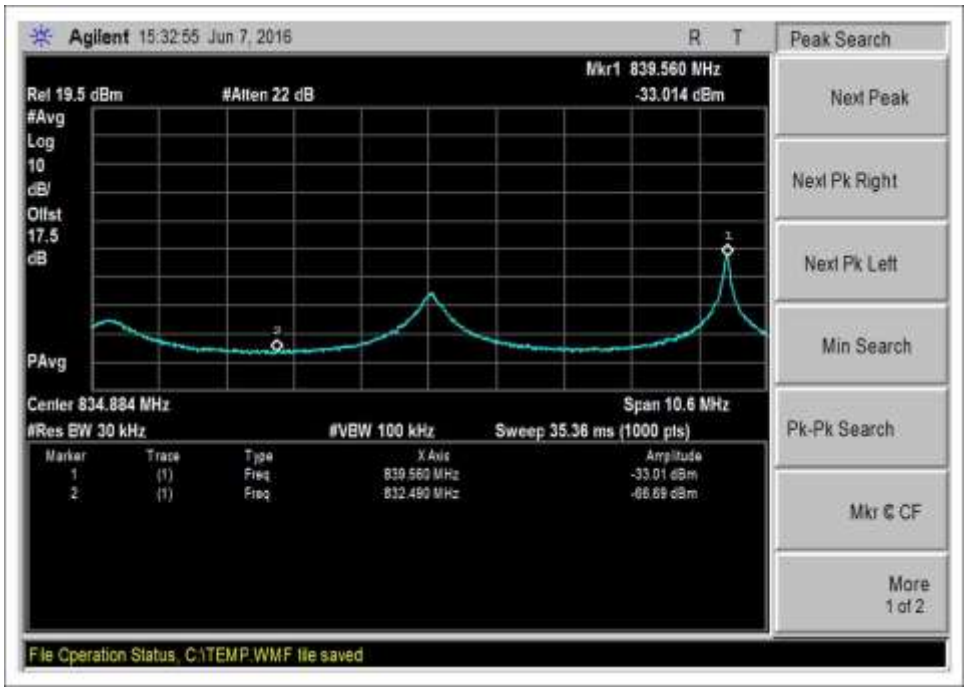

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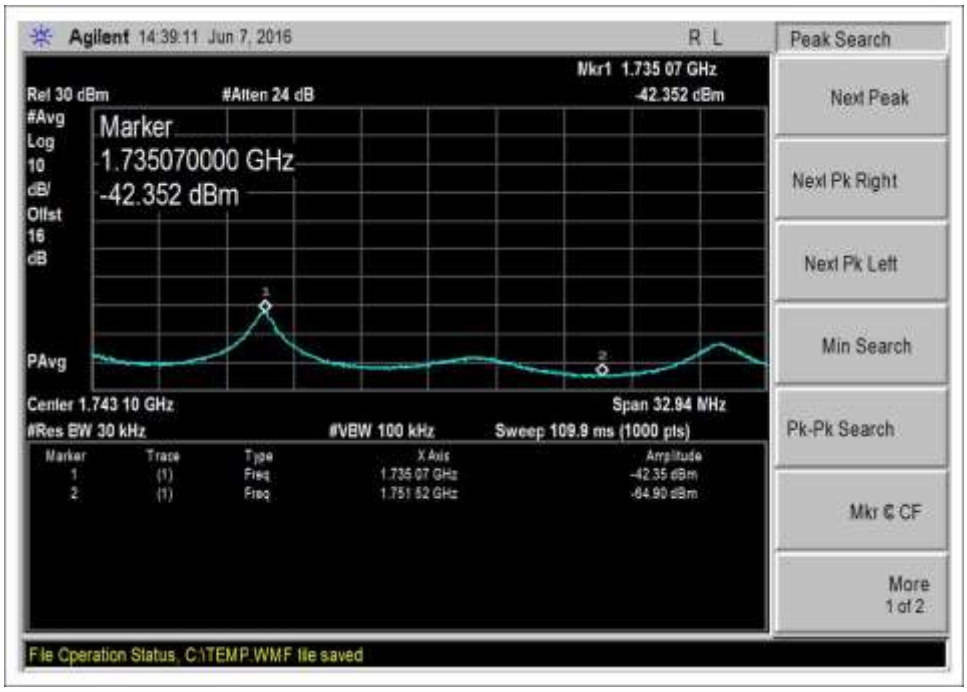
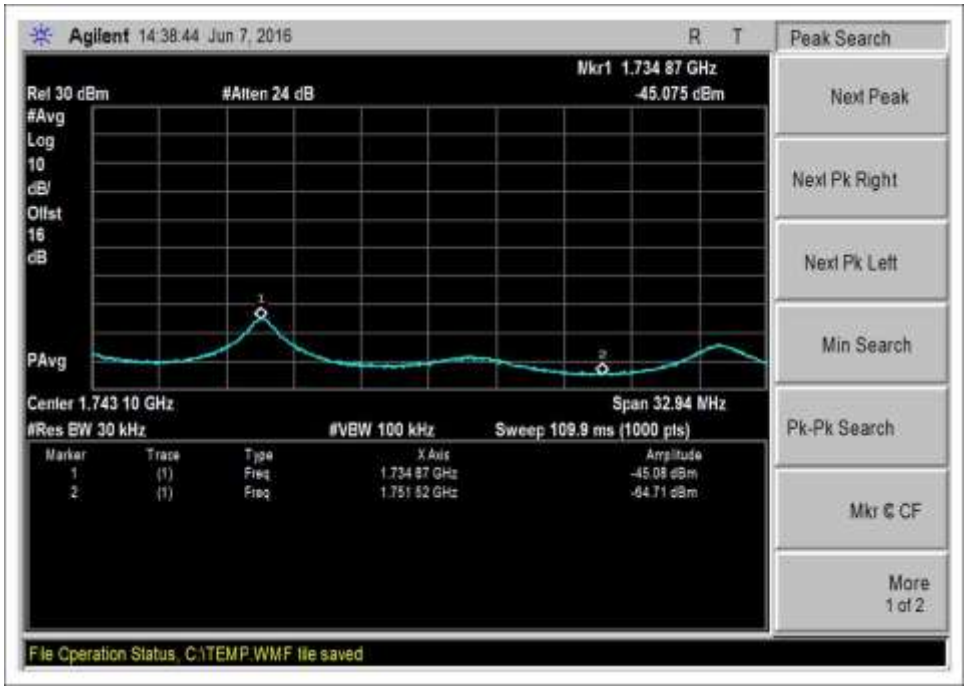
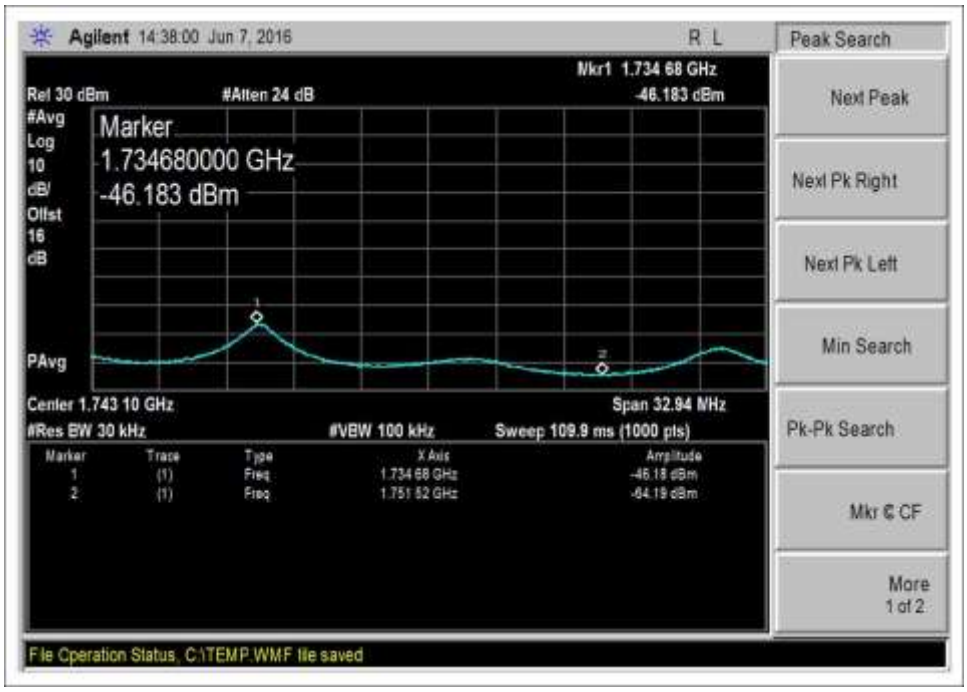


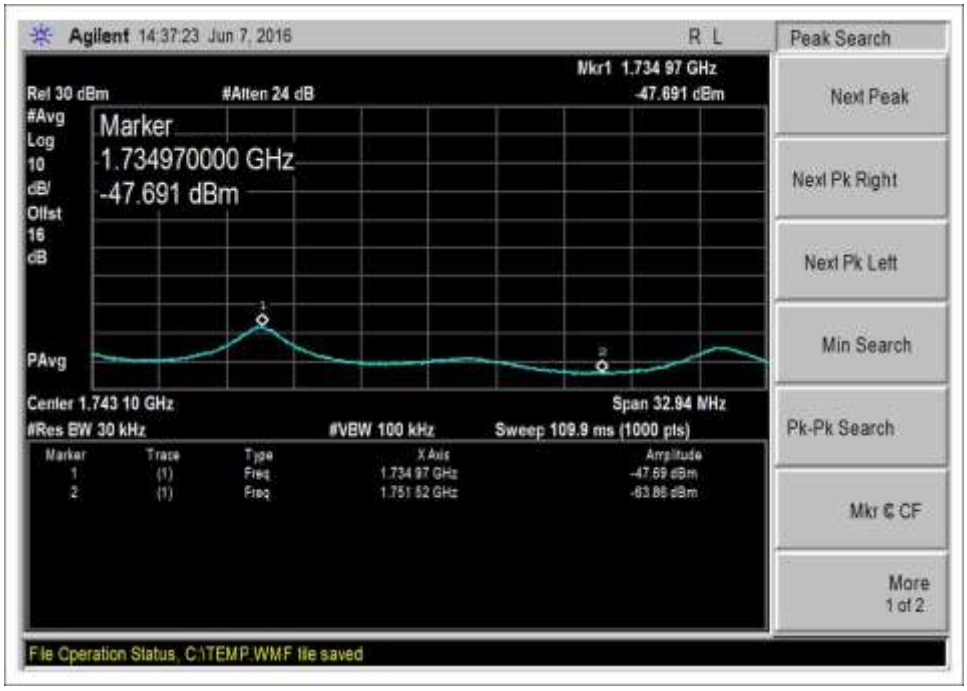
UL-1710-1755-AWGNL+0



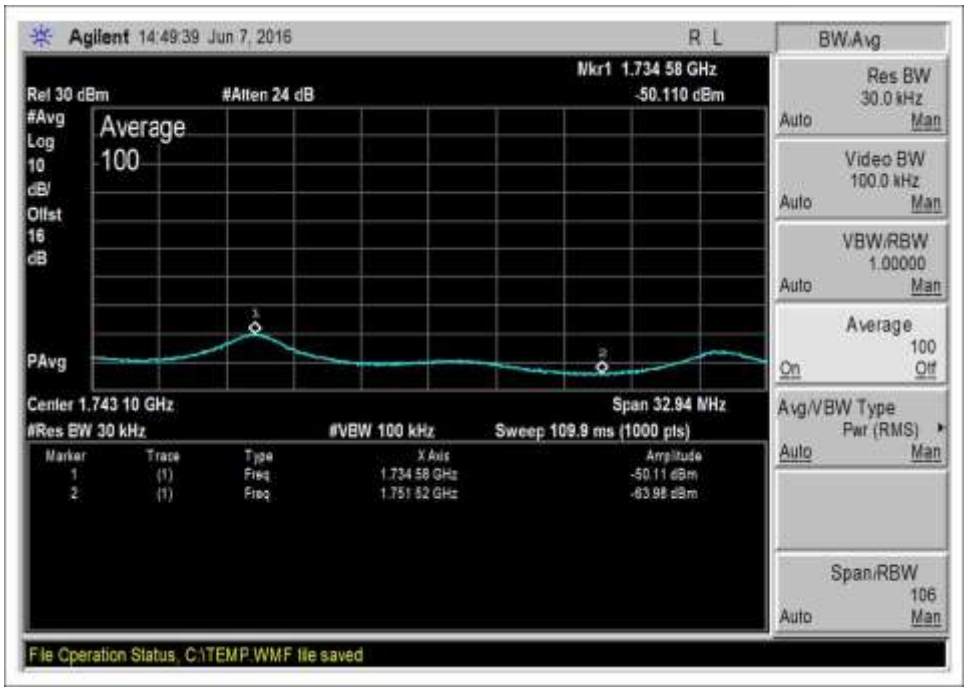
UL-1710-1755-AWGNL+1



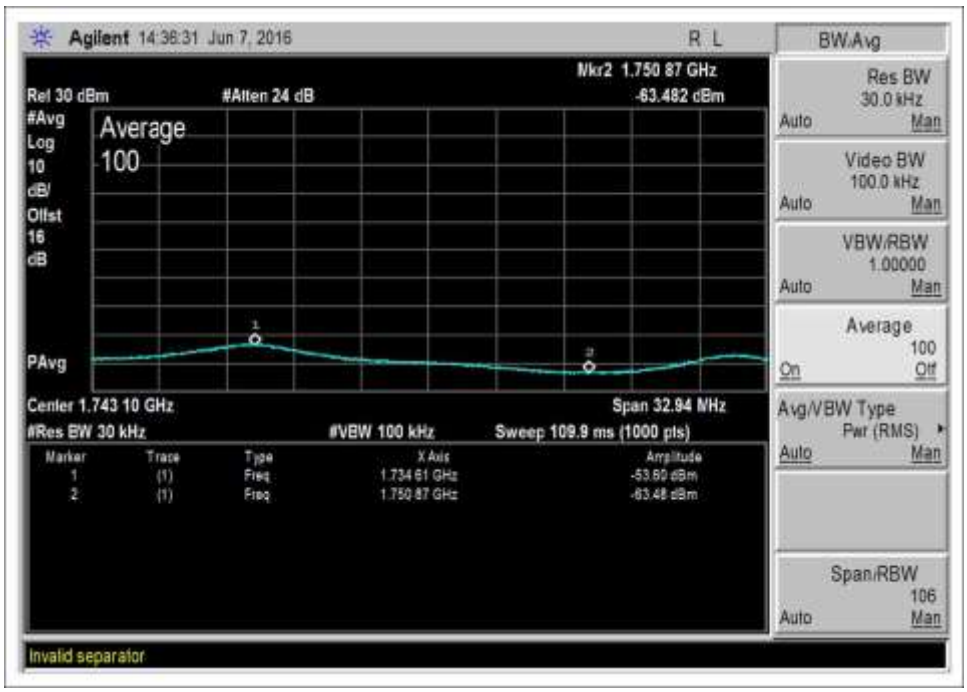
UL-1710-1755-AWGNL+2



UL-1710-1755-AWGNL+3



UL-1710-1755-AWGNL+4



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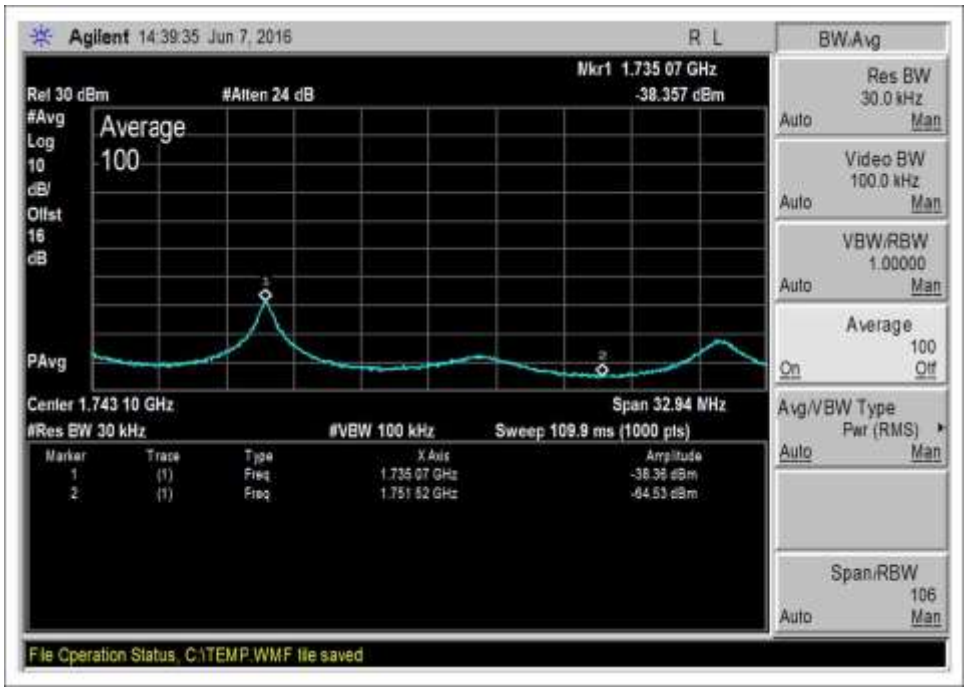

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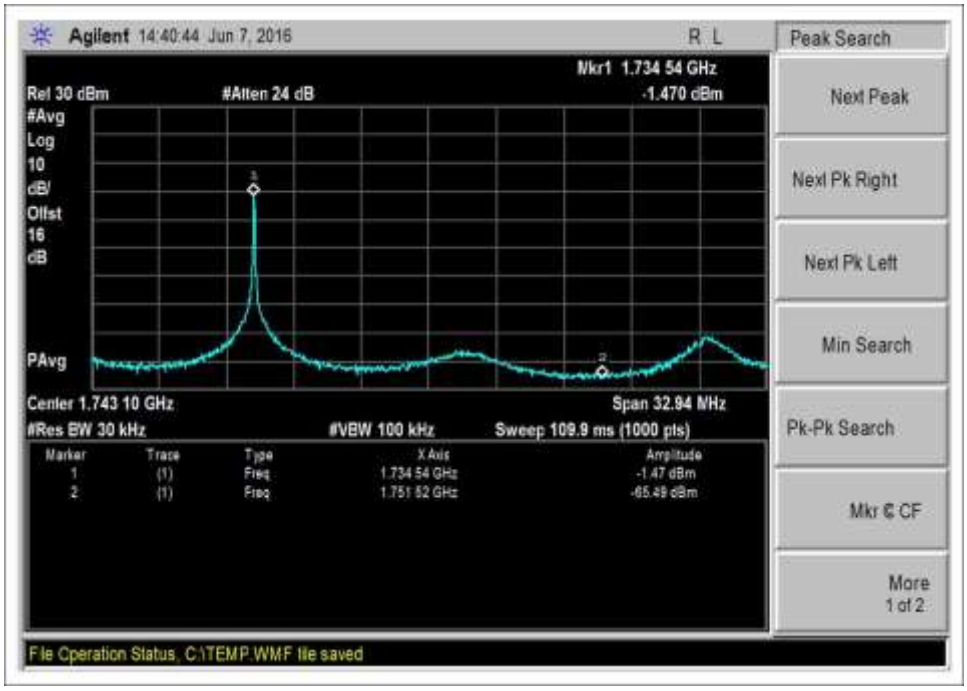
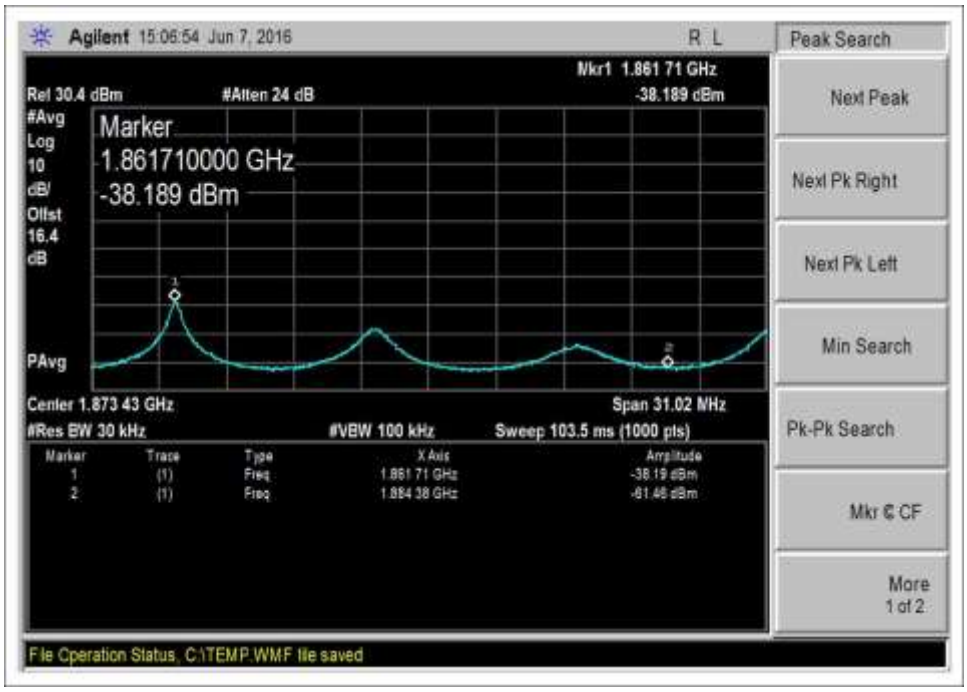
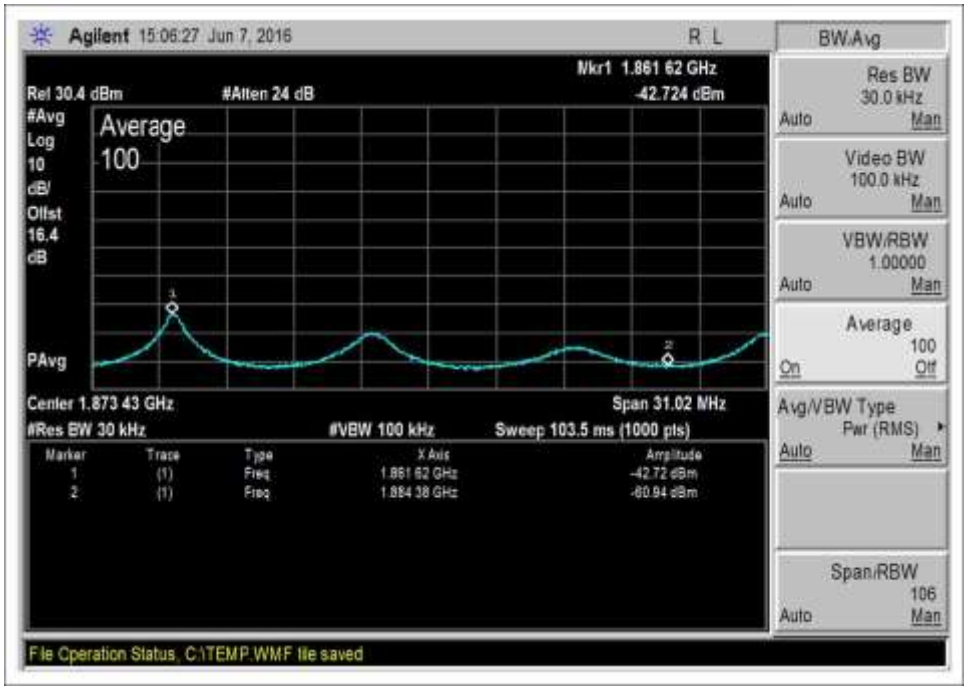


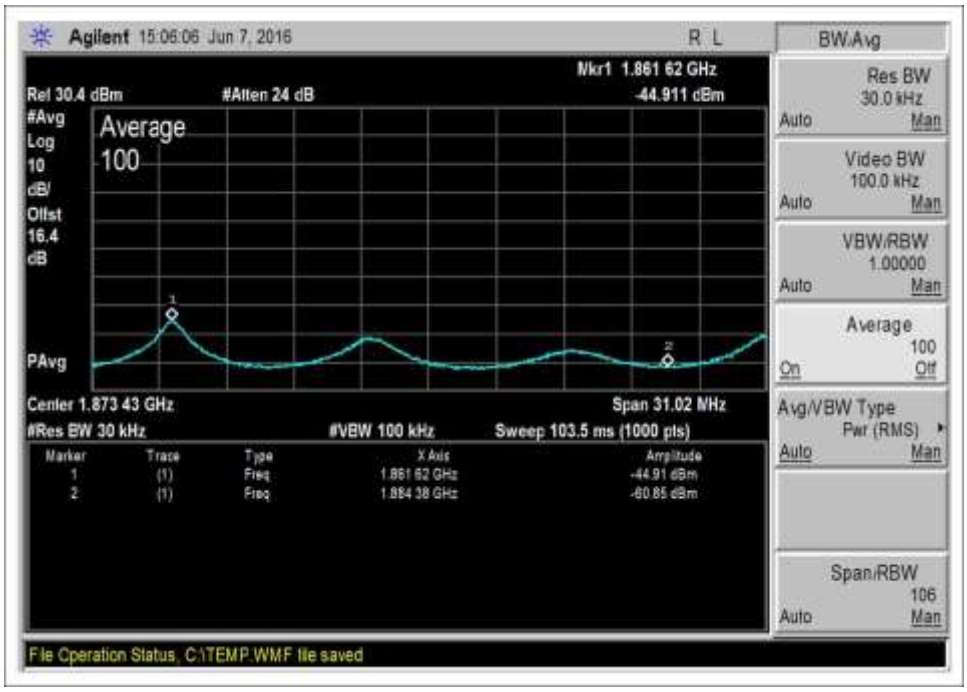
UL-1710-1755-AWGNL-2



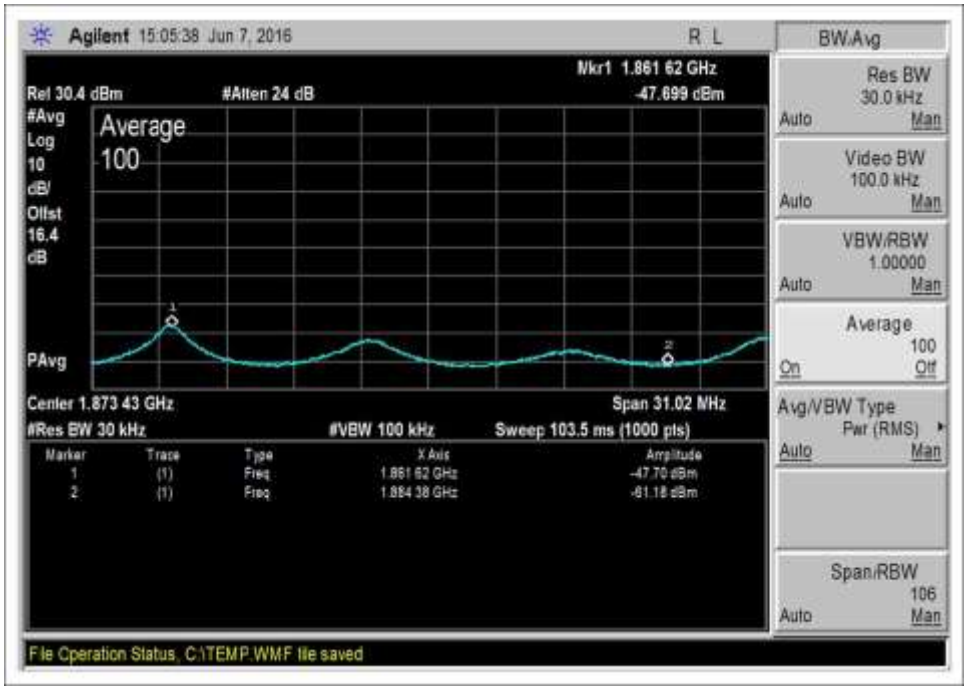
UL-1850-1915-AWGNL+0



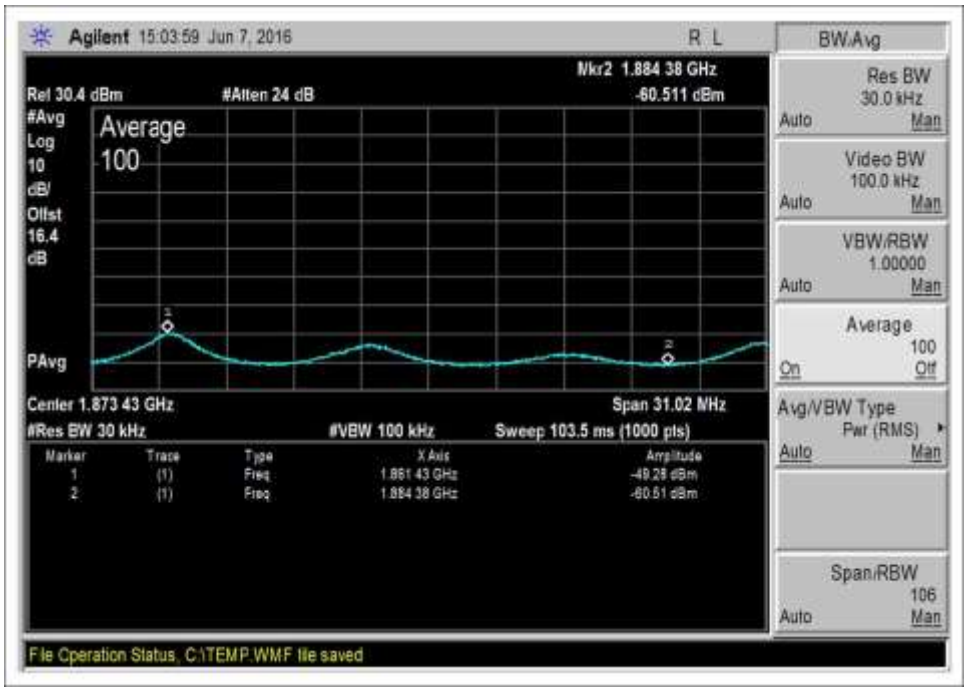
UL-1850-1915-AWGNL+1



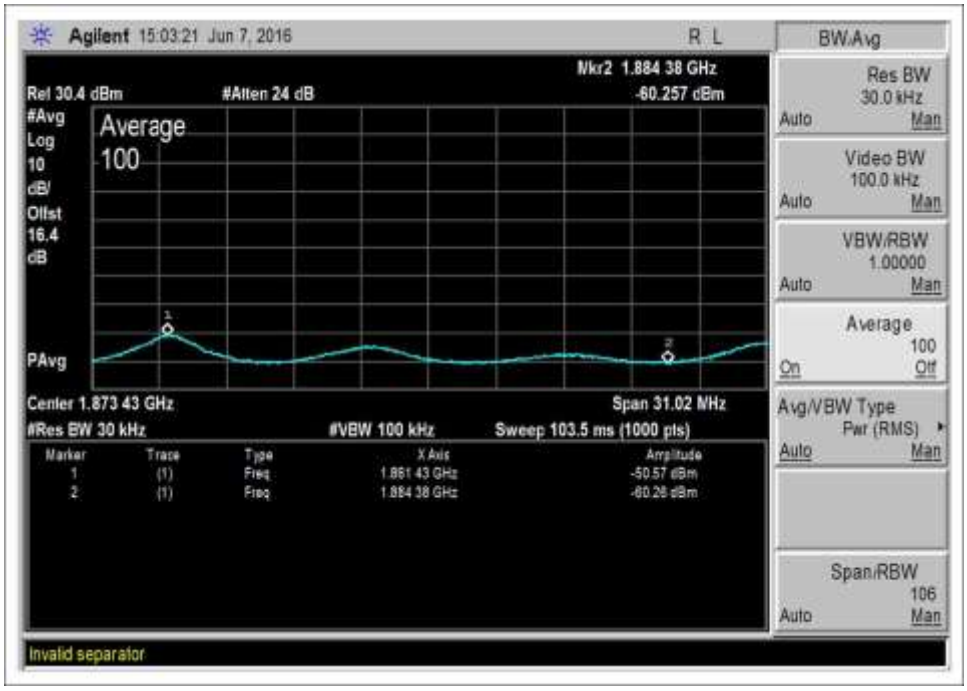
UL-1850-1915-AWGNL+2



UL-1850-1915-AWGNL+3

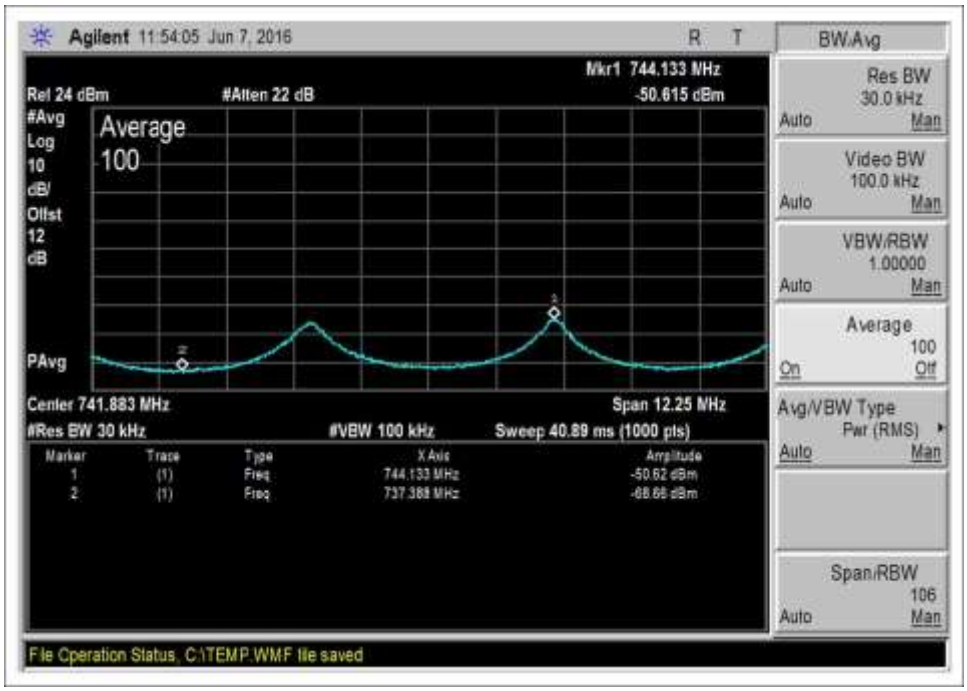


UL-1850-1915-AWGNL+4

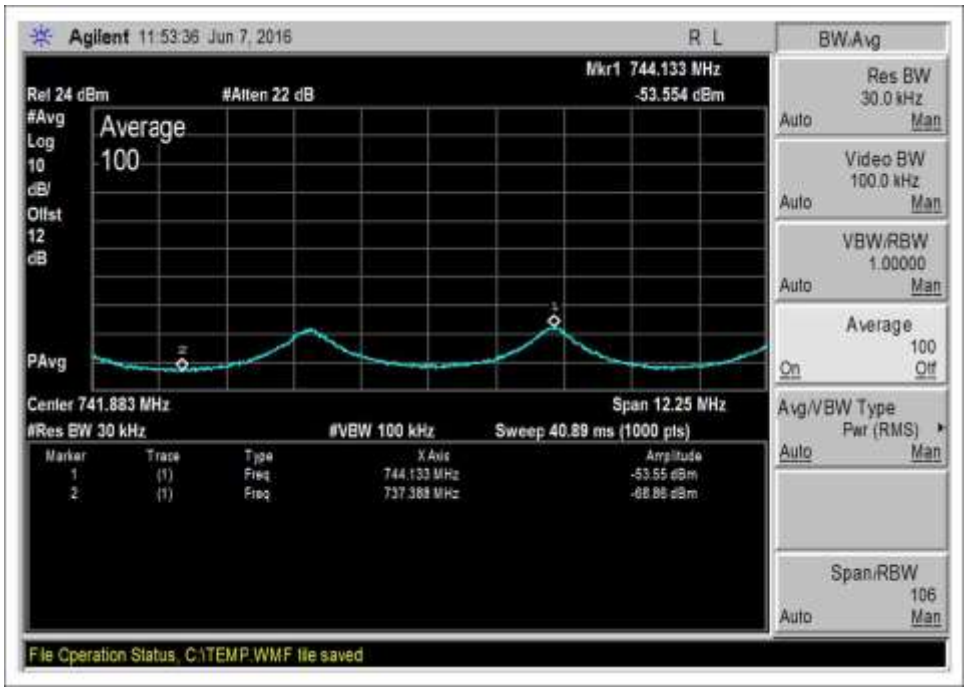


UL-1850-1915-AWGNL+5

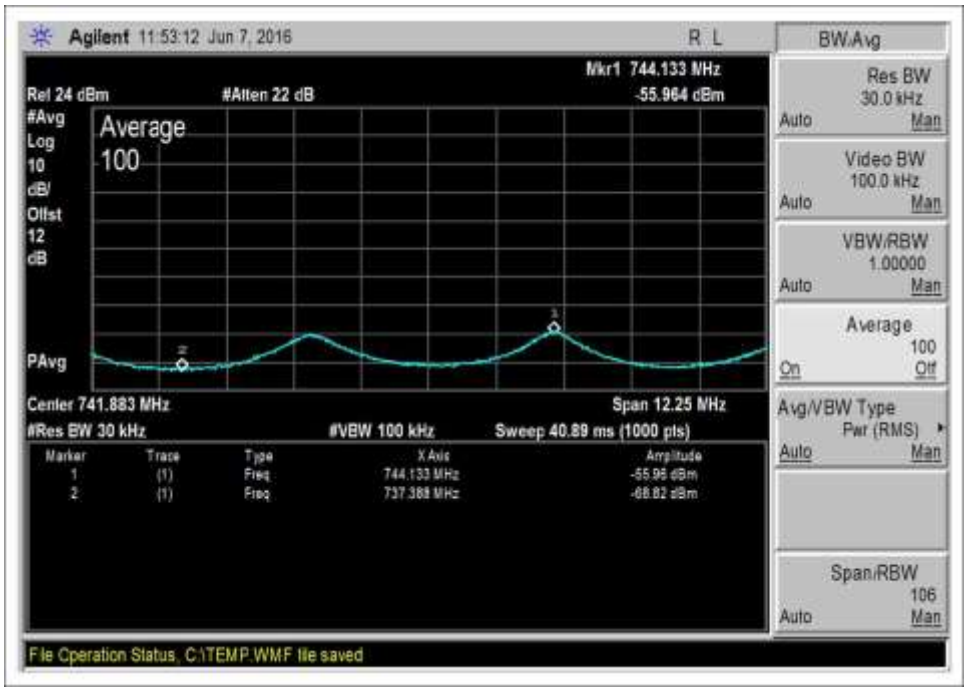
DL



DL-728-746-AWGNL+0



DL-728-746-AWGNL+1



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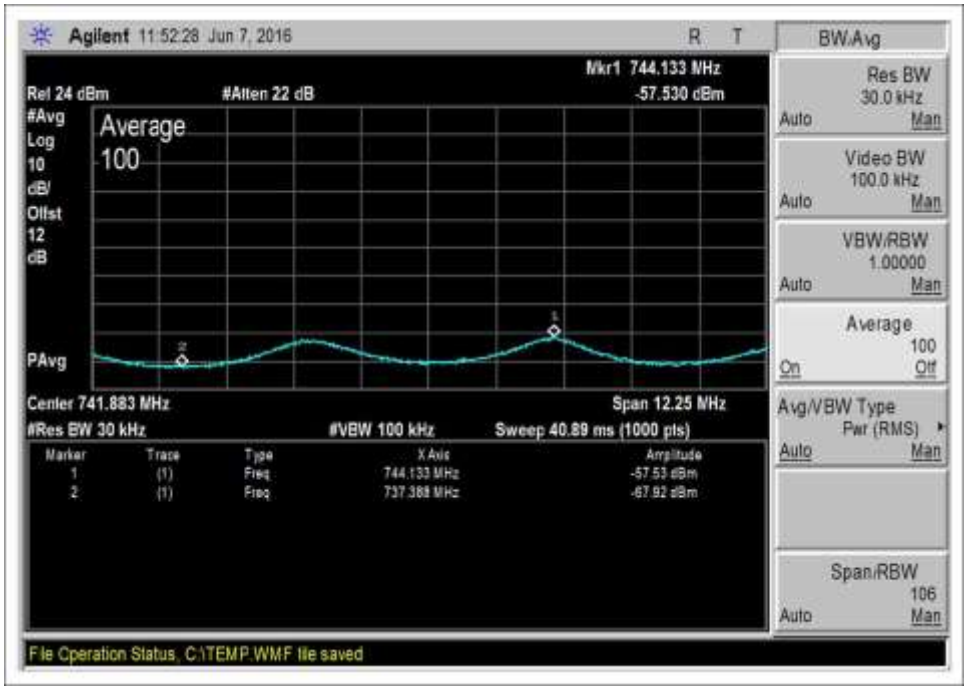
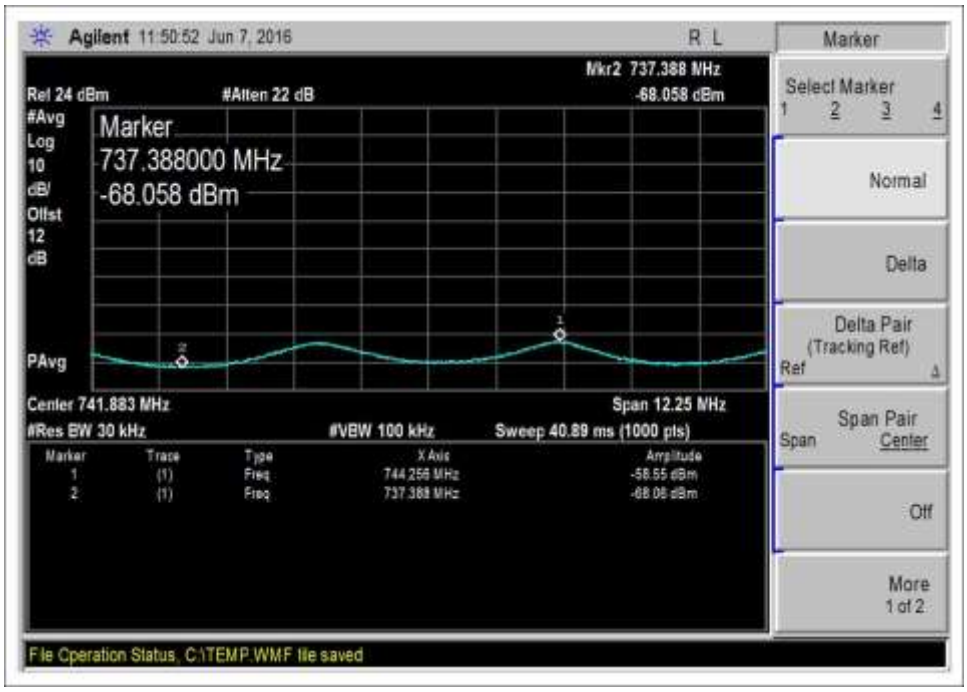
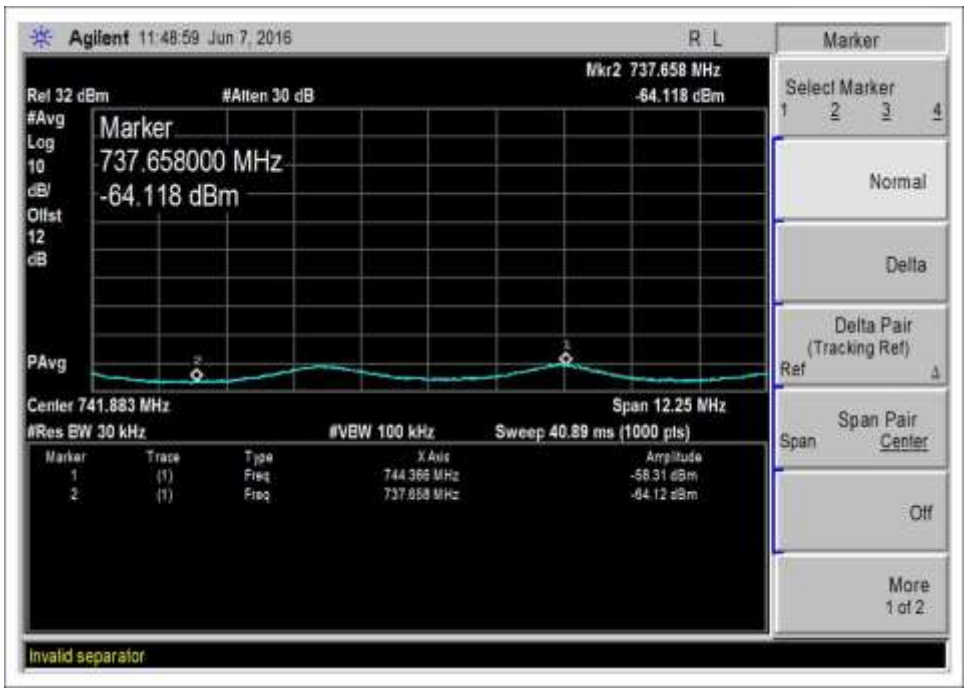


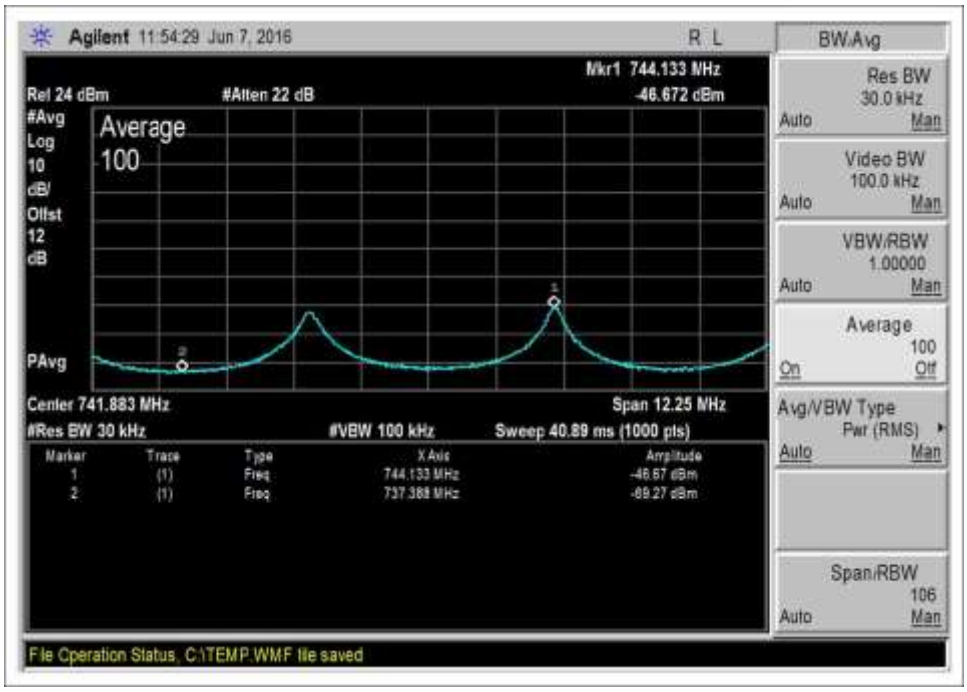
DL-728-746-AWGNL+3



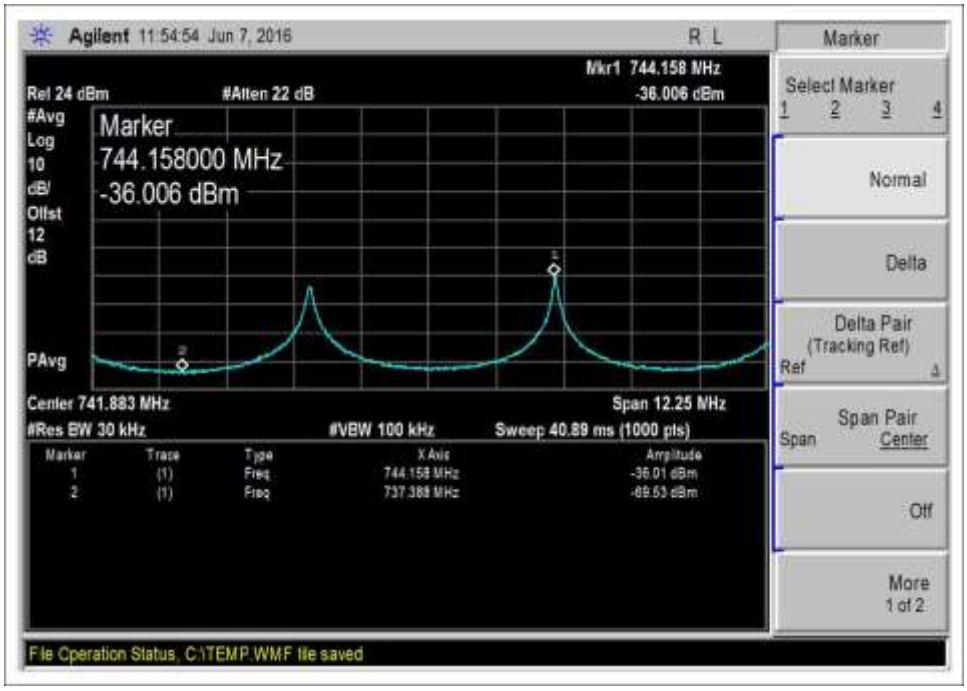
DL-728-746-AWGNL+4



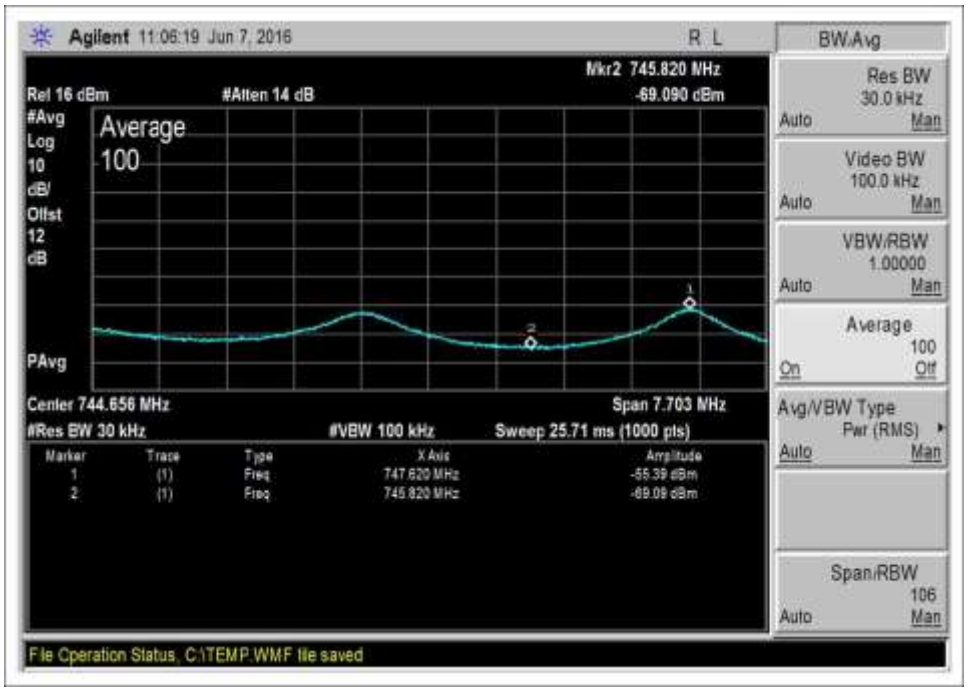
DL-728-746-AWGNL+5



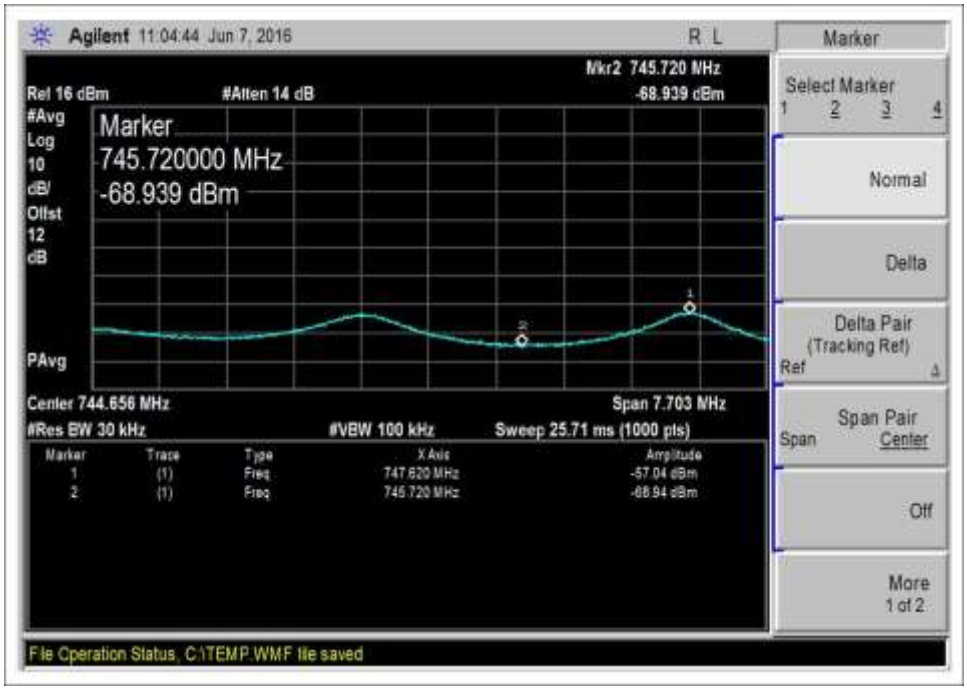
DL-728-746-AWGNL-1



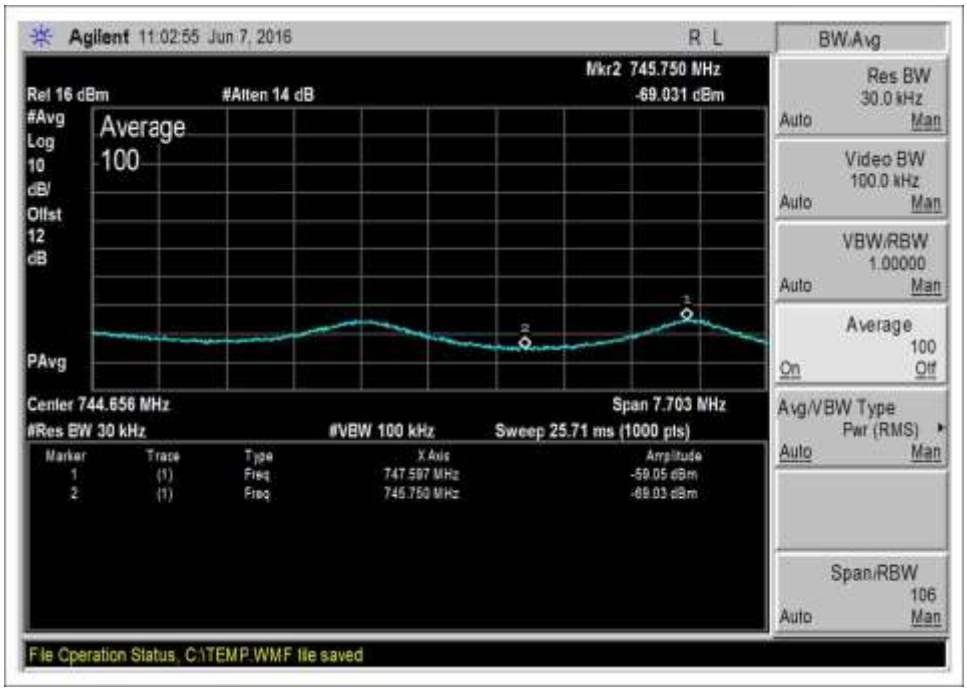
DL-728-746-AWGNL-2



DL-746-757-AWGNR+0



DL-746-757-AWGNR+1



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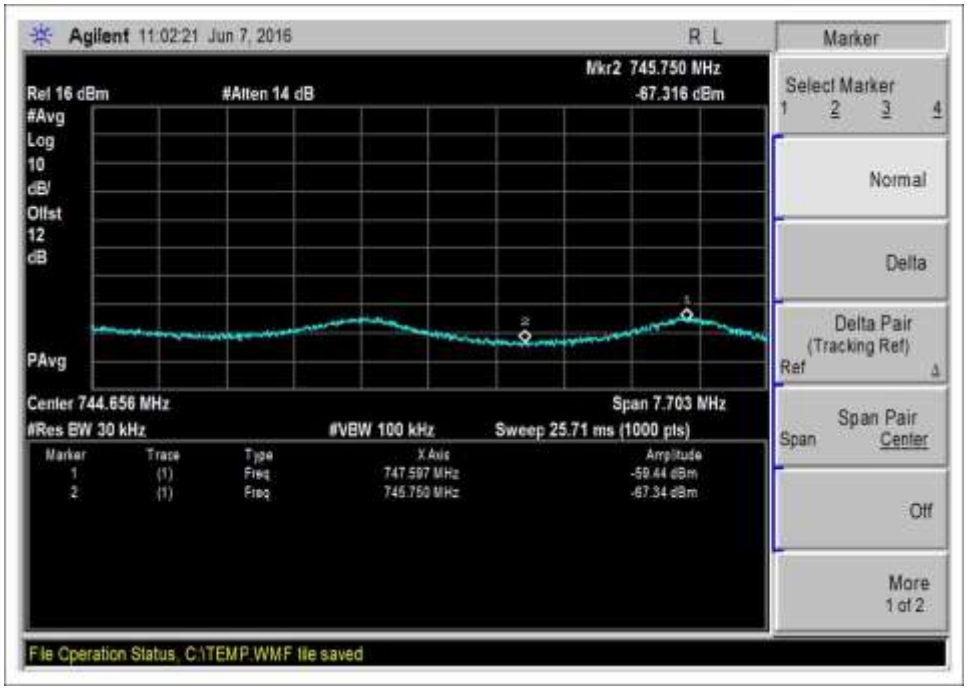
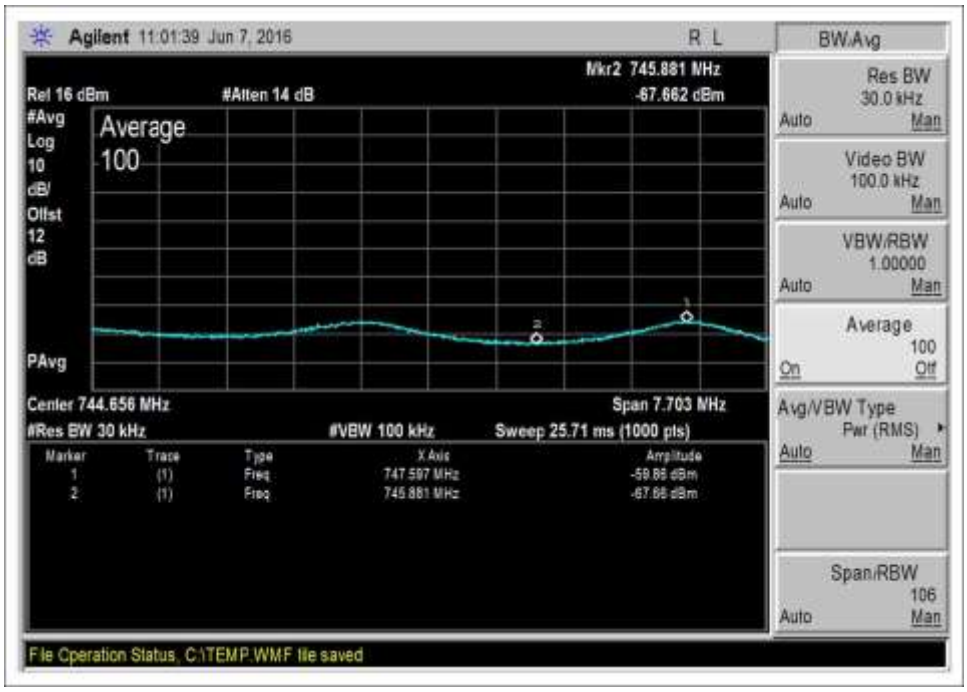


DL-746-757-AWGNR+3



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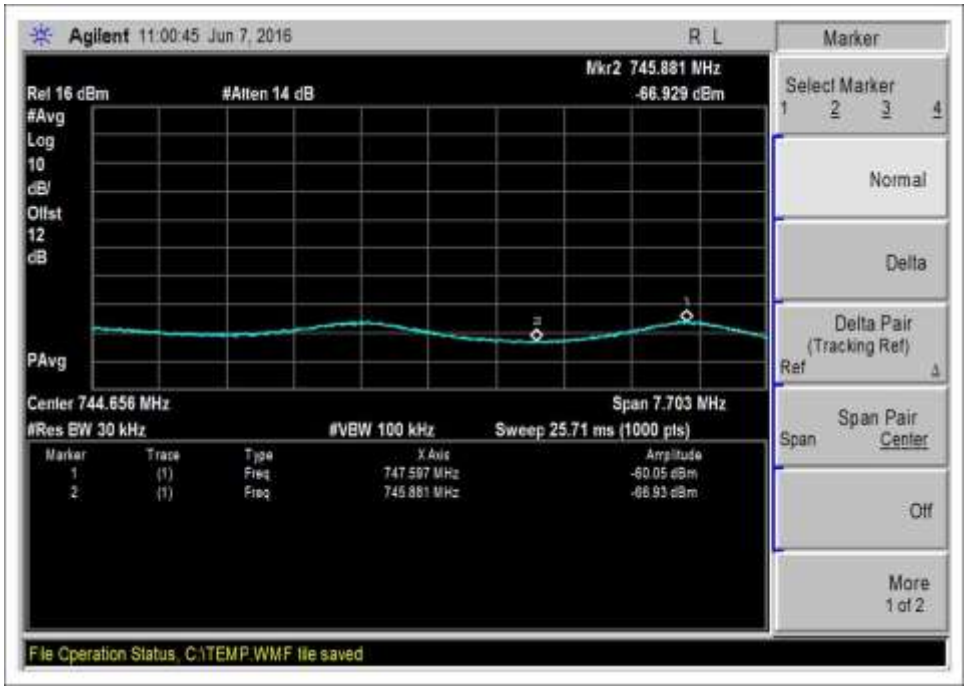

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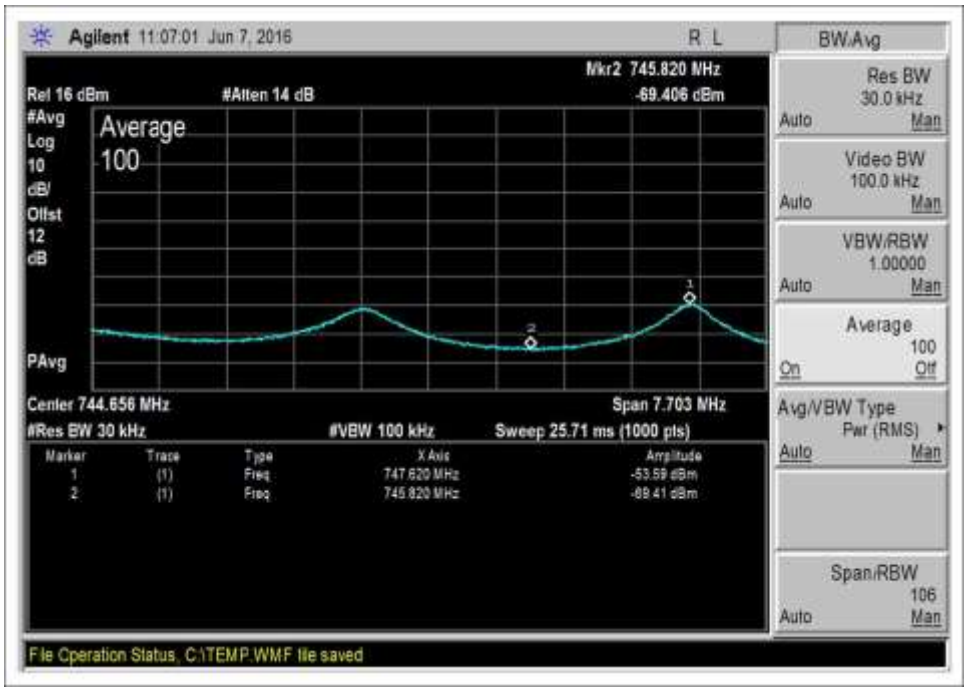
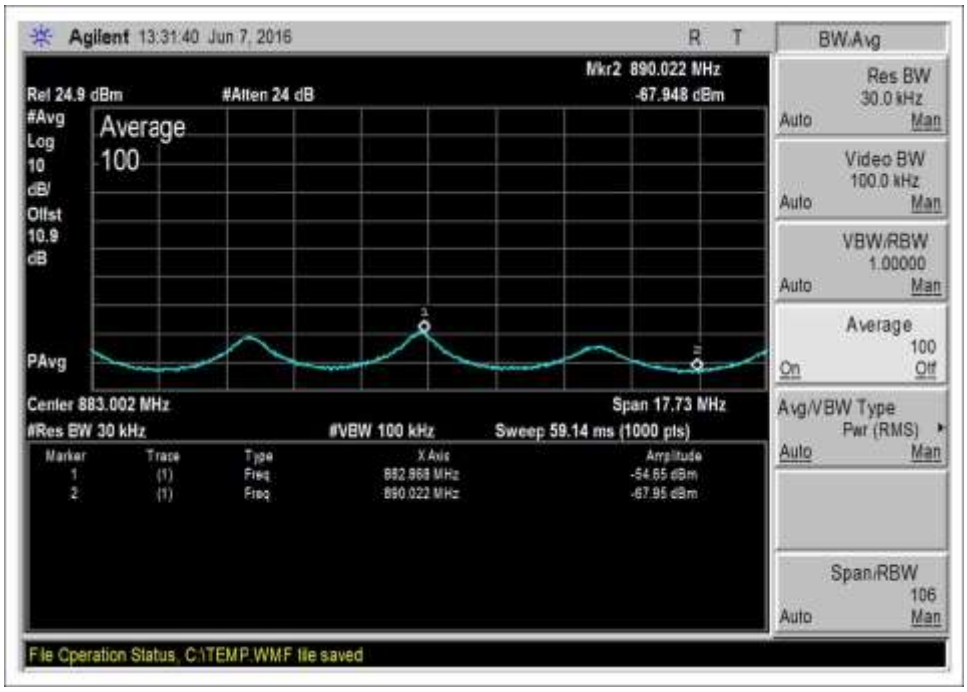


DL-746-757-AWGNR-1



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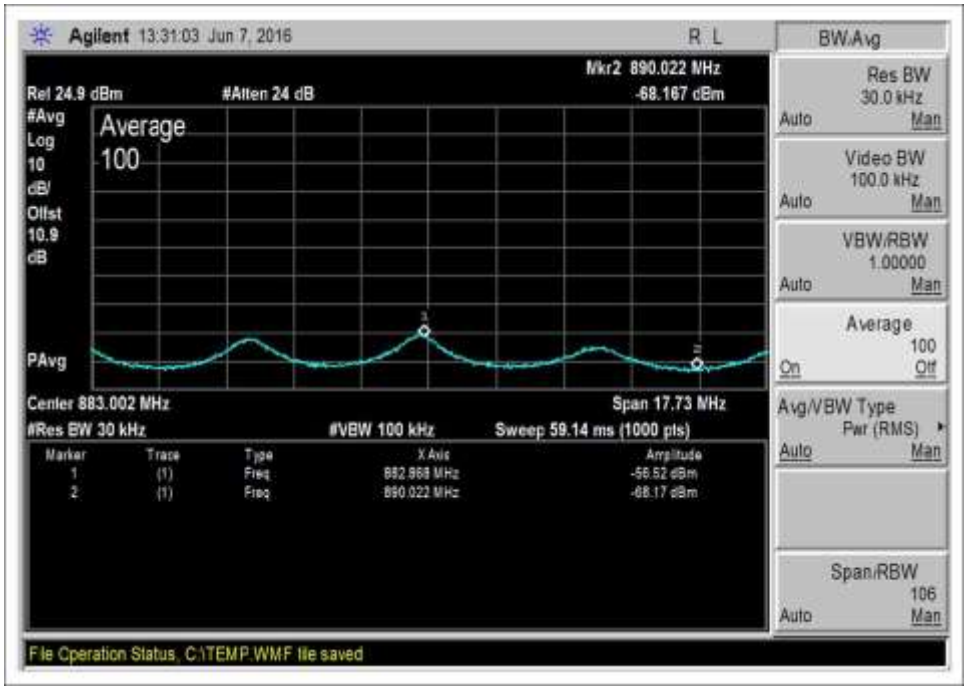

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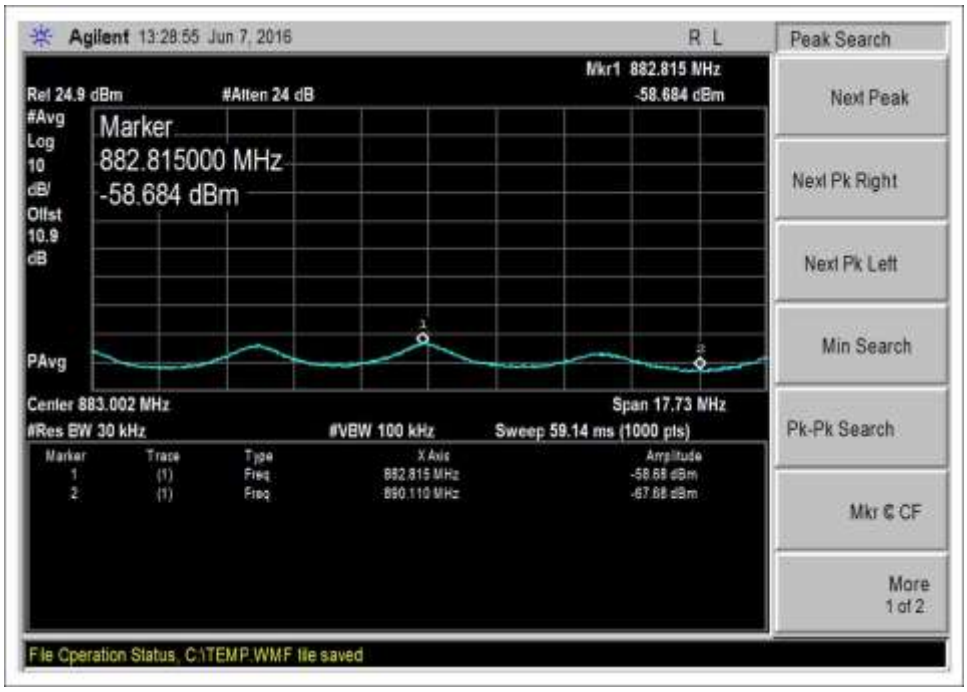

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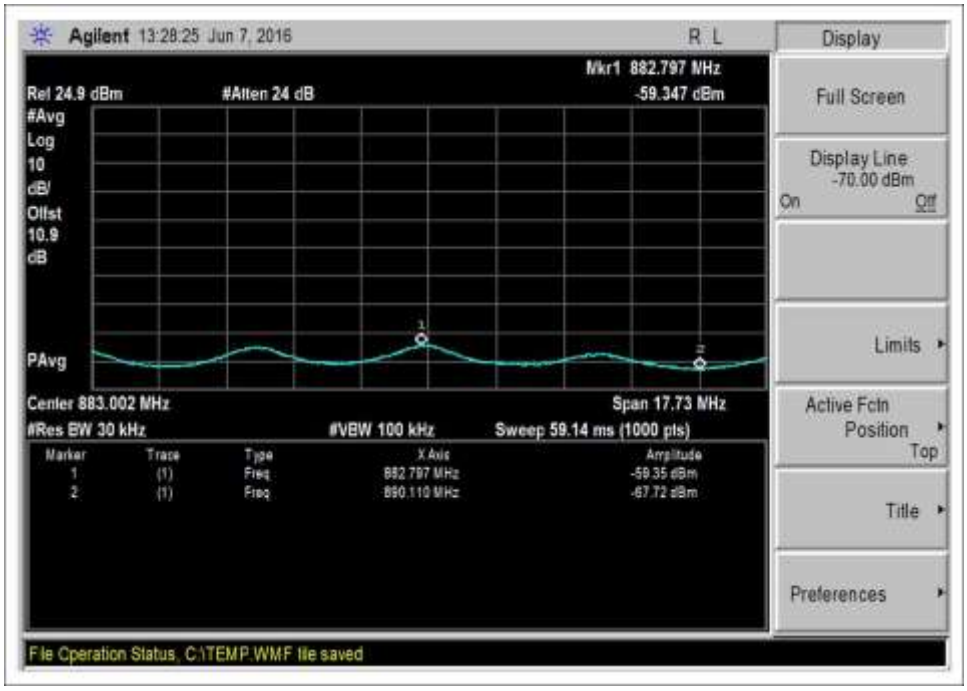

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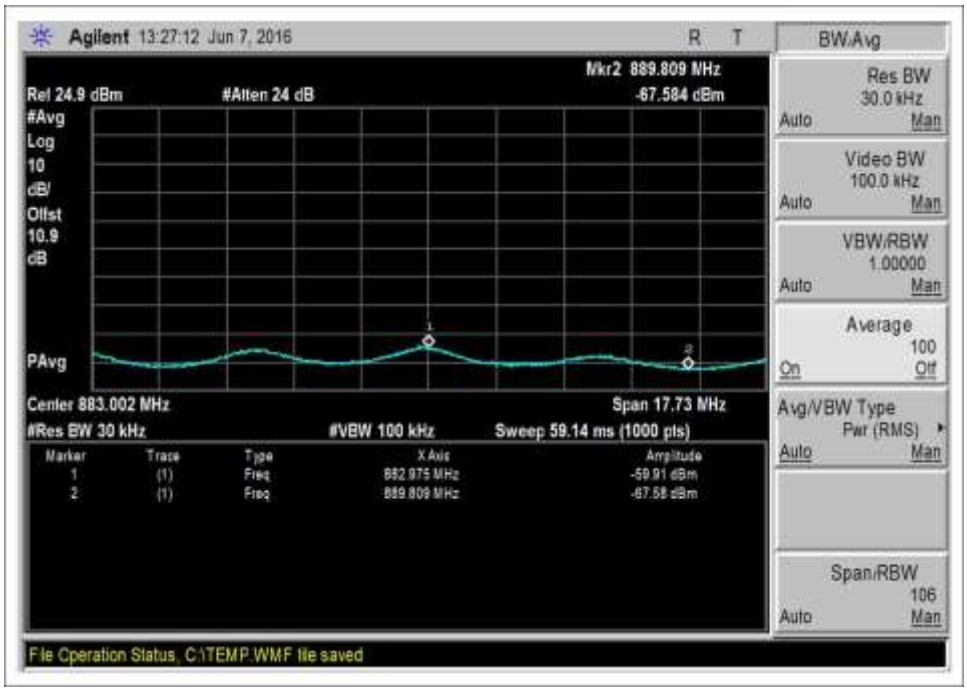

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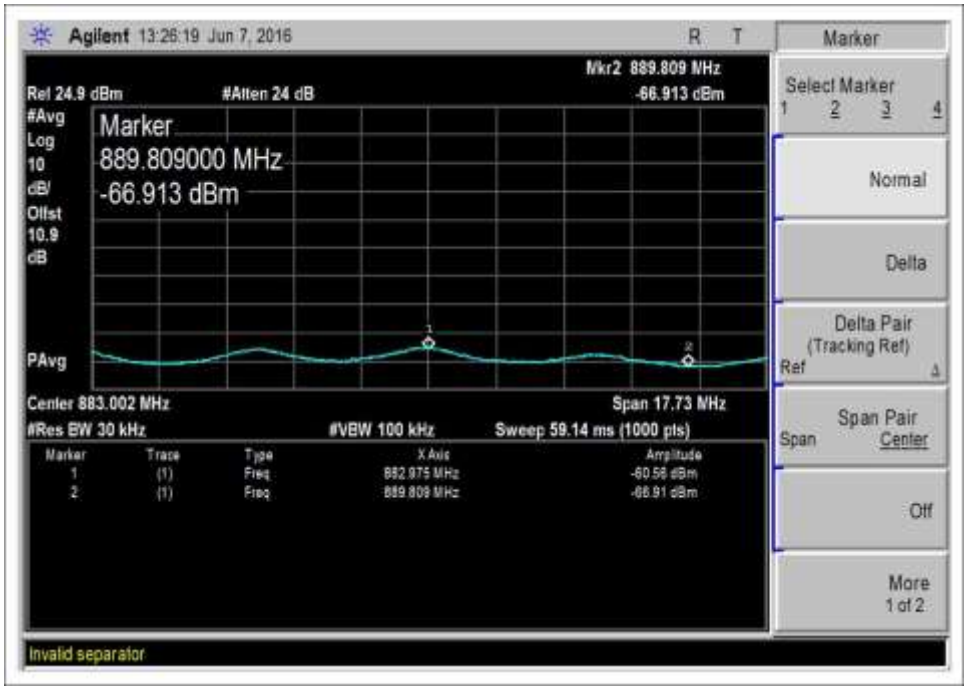

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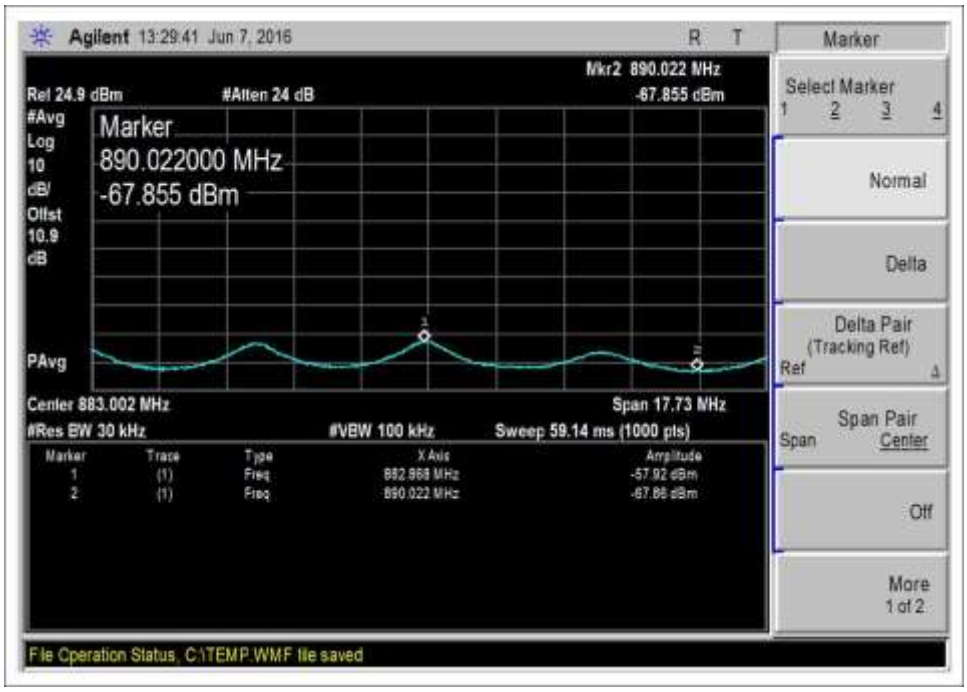

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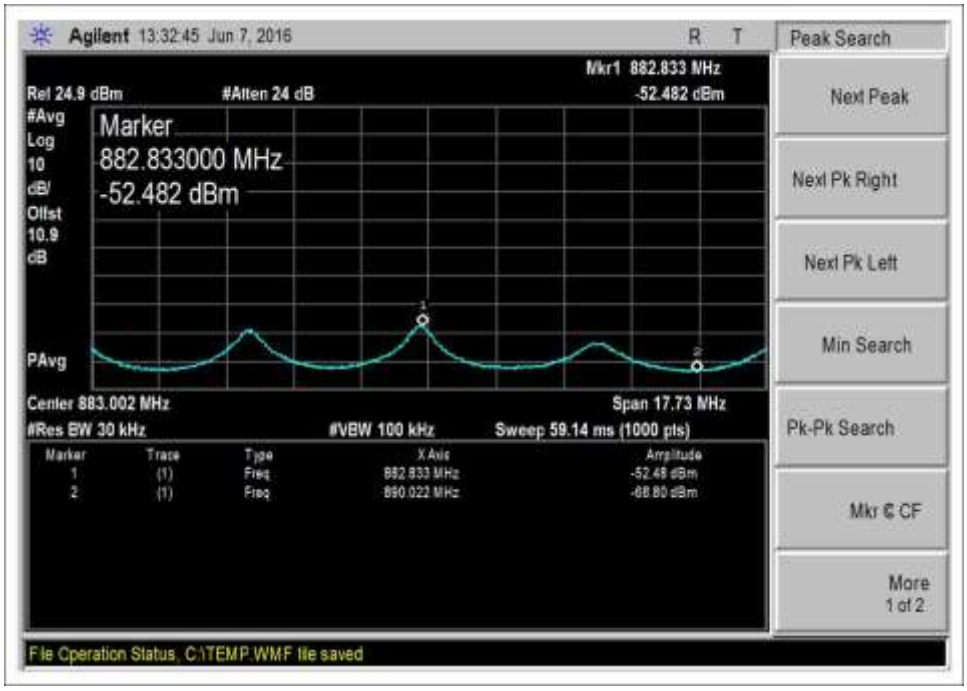

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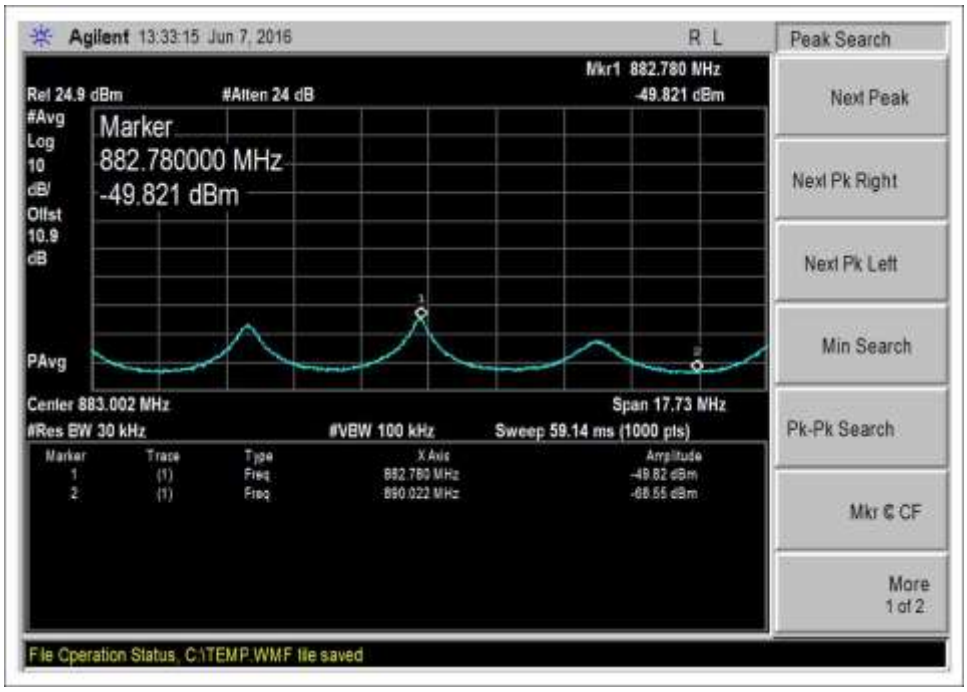

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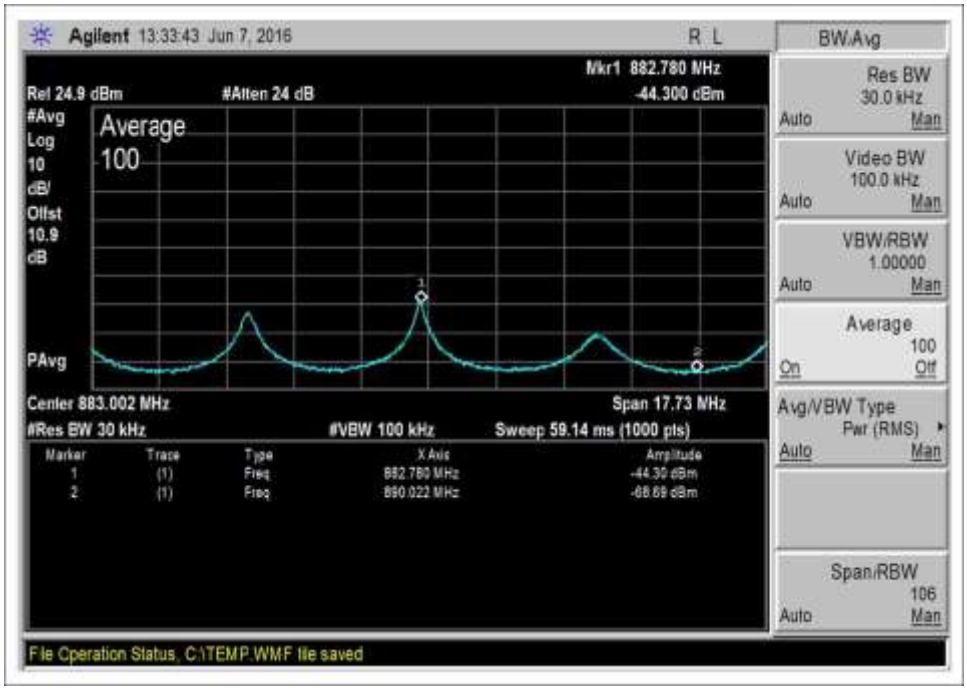

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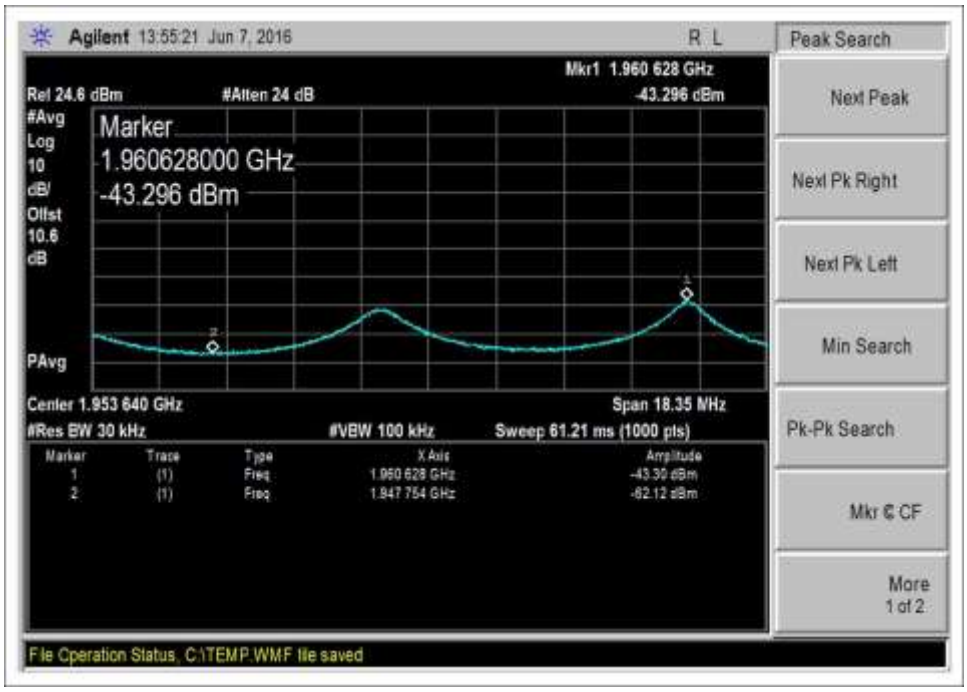

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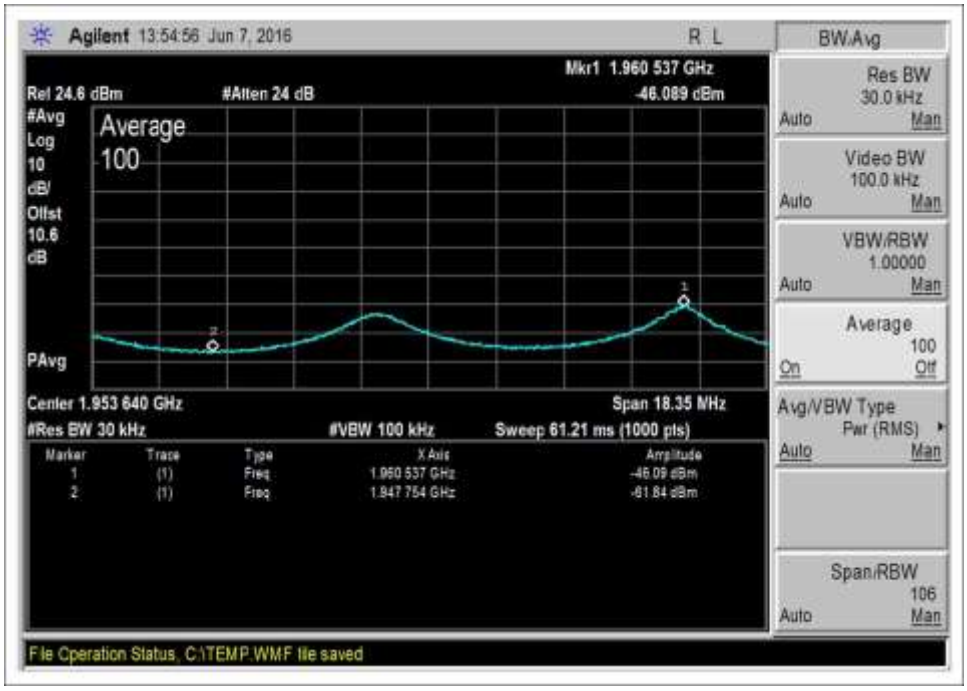
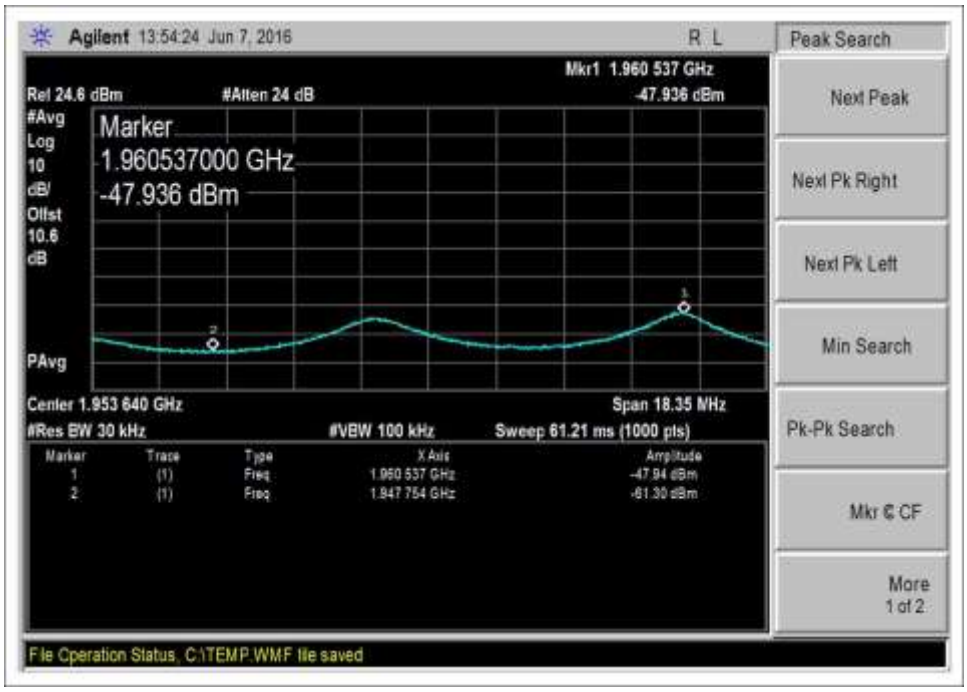


DL-1930-1995-AWGNR+1



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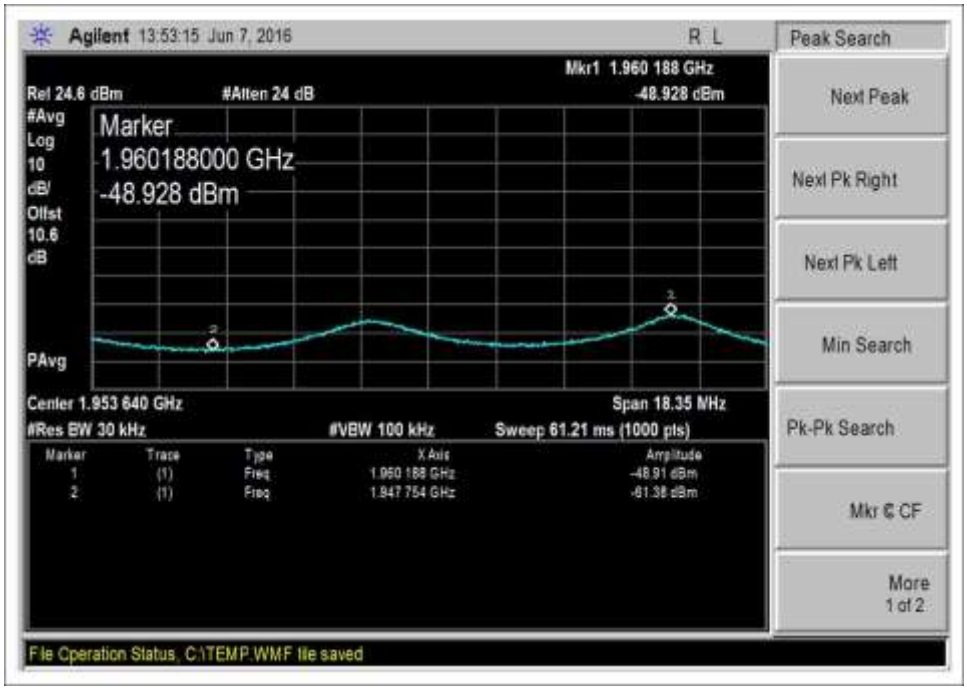
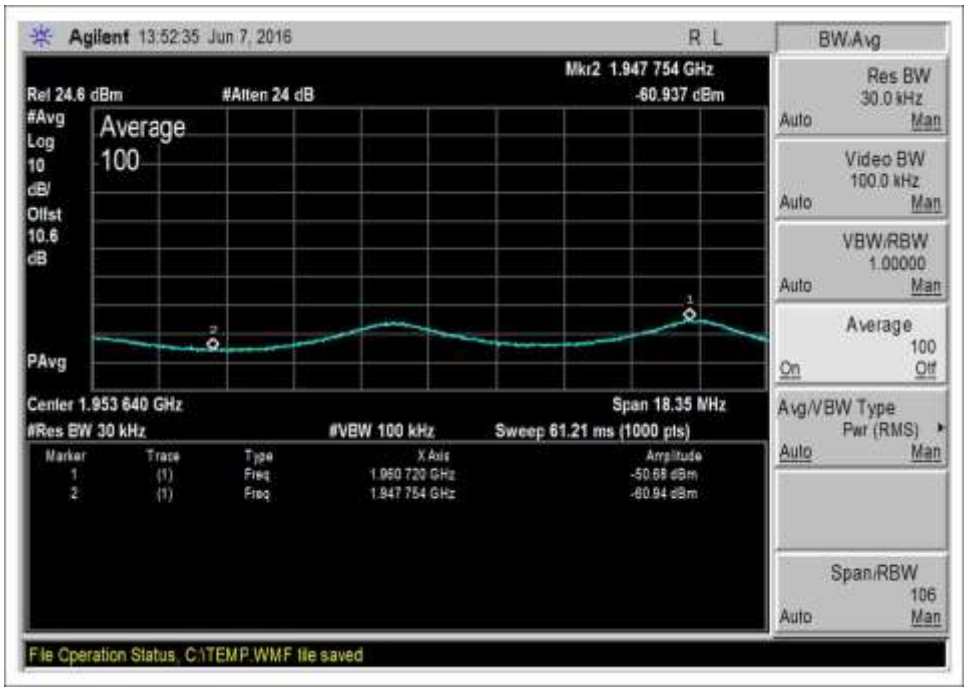
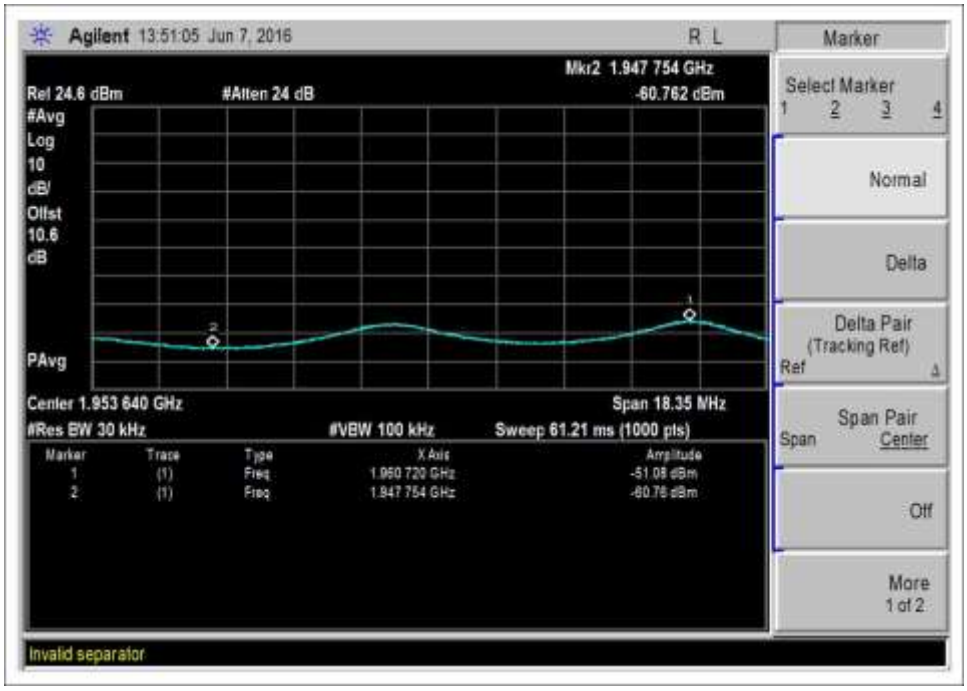


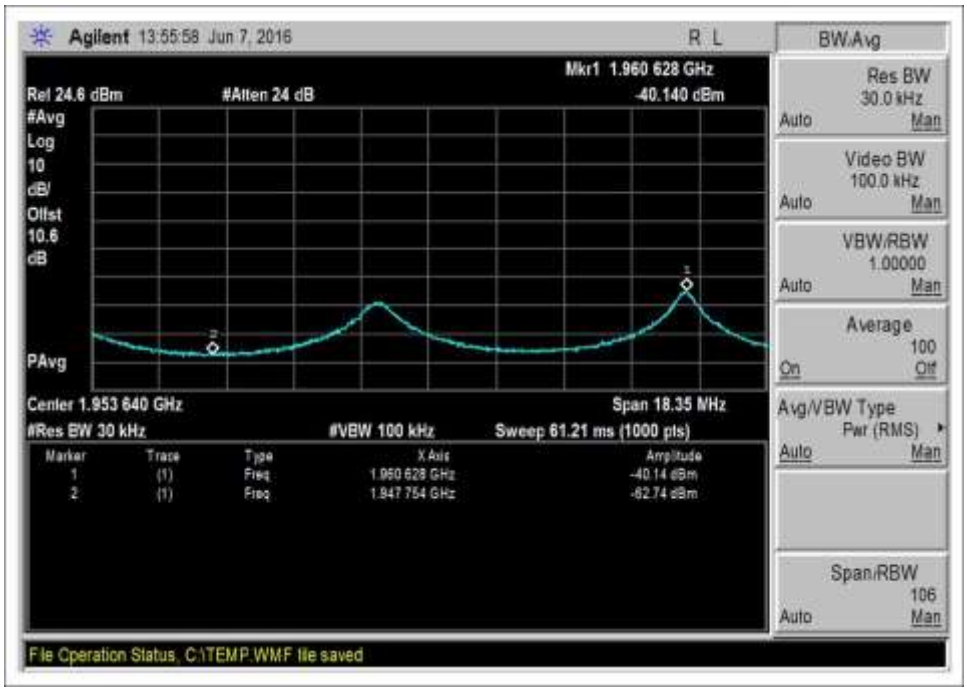
DL-1930-1995-AWGNR+3



DL-1930-1995-AWGNR+4



DL-1930-1995-AWGNR+5



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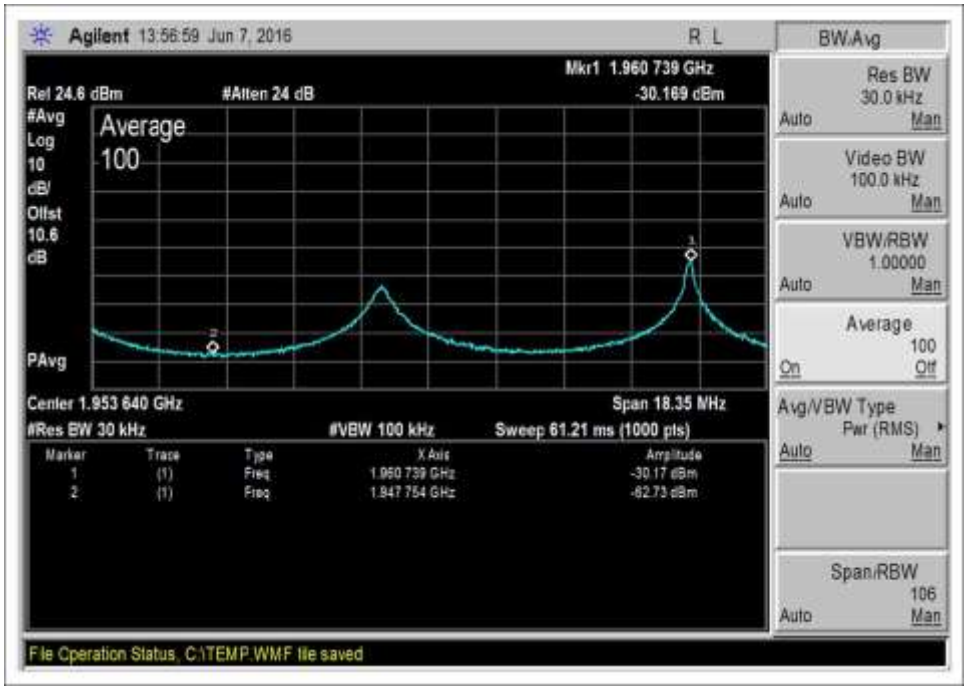
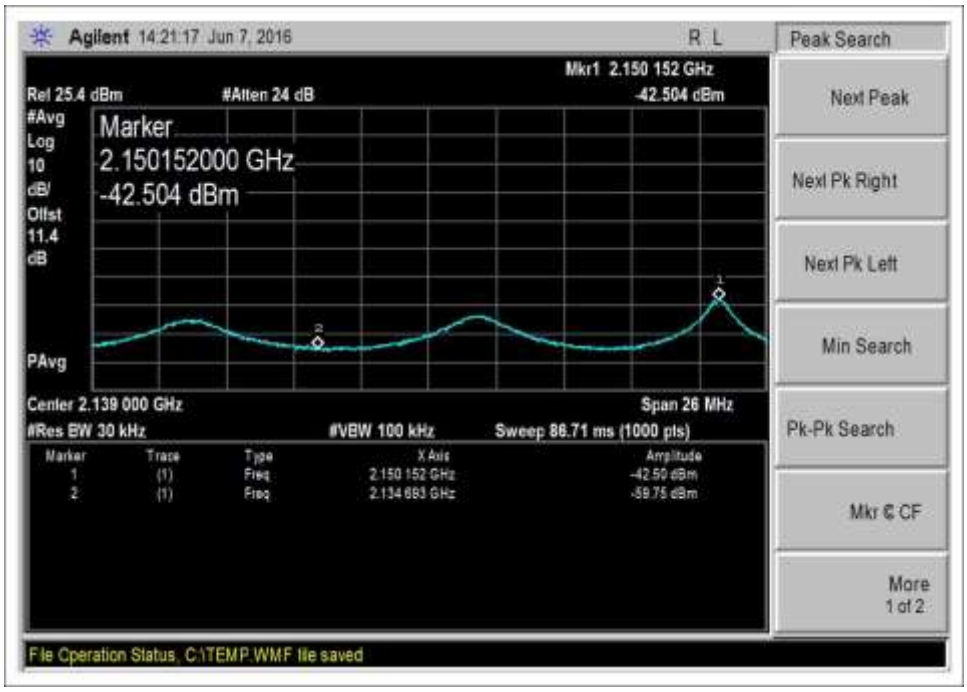
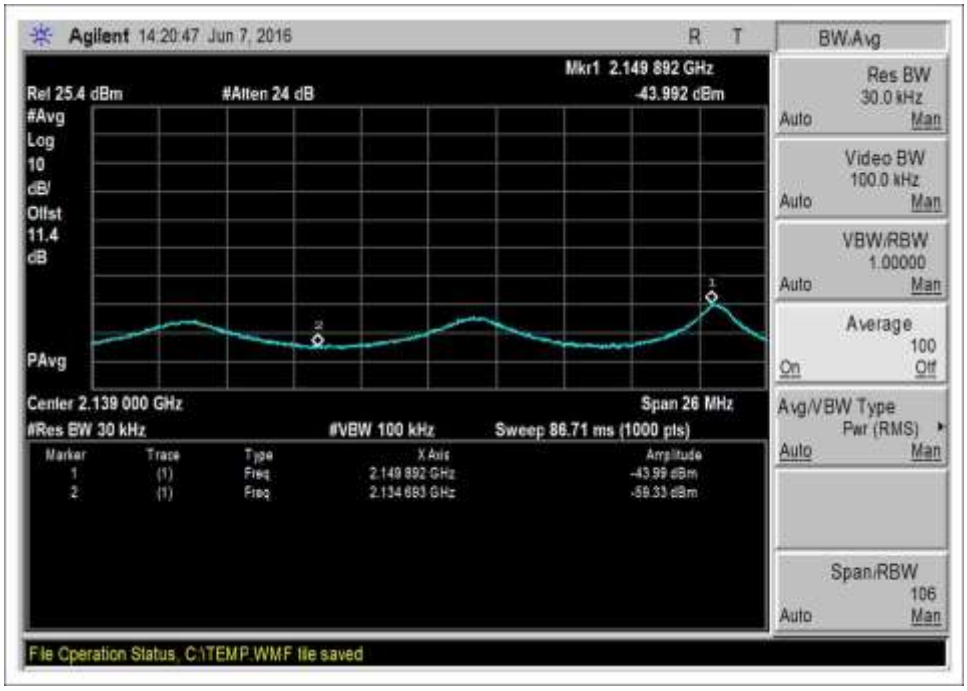
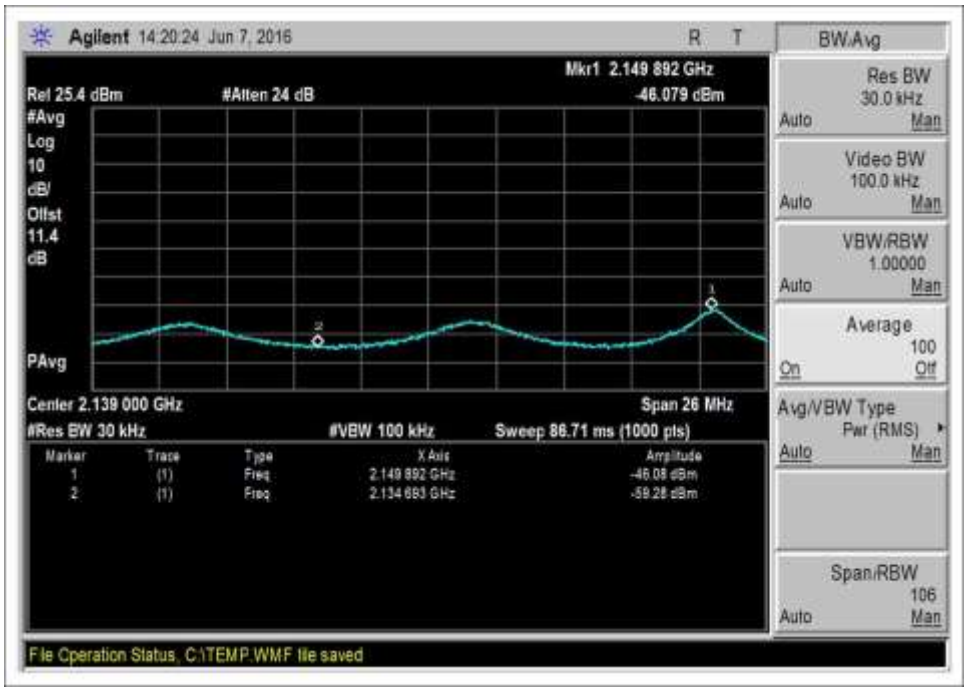




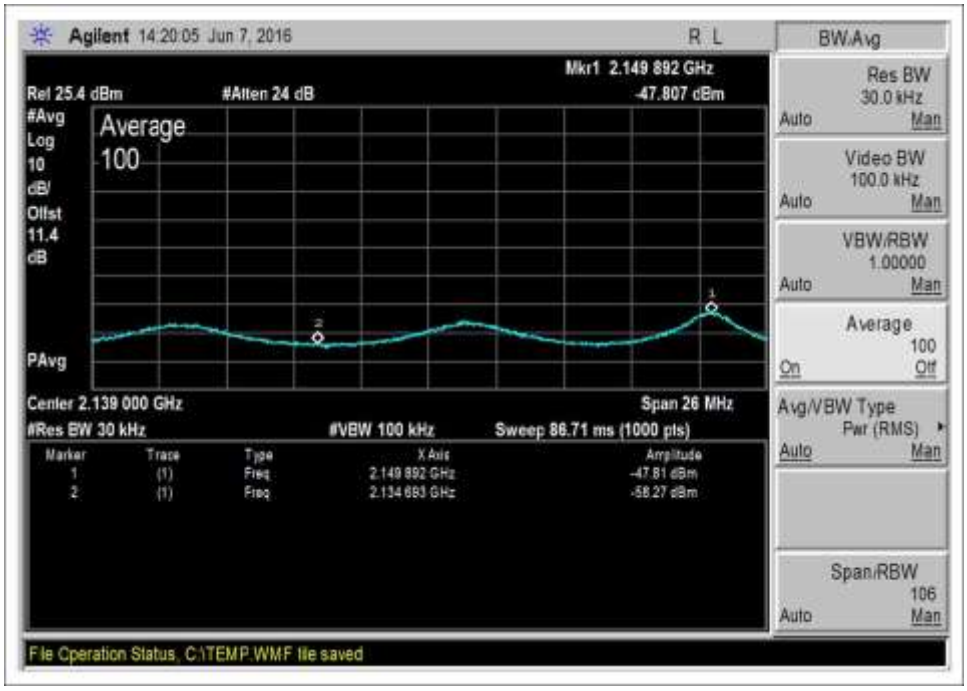
DL-2110-2155-AWGNL+1



DL-2110-2155-AWGNL+2



DL-2110-2155-AWGNL+3



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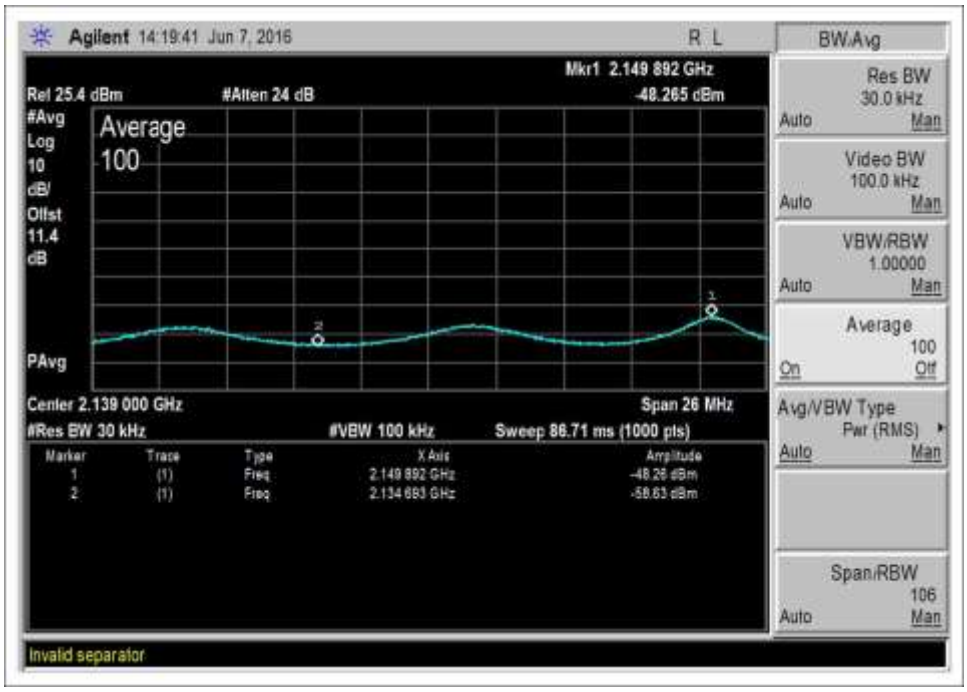

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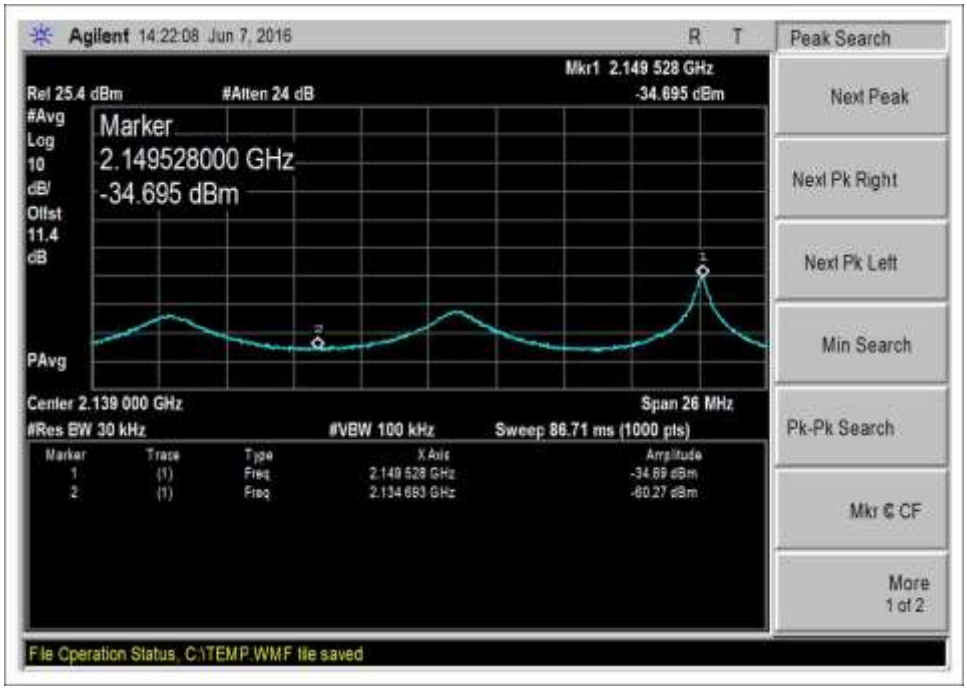


DL-2110-2155-AWGNL-1

7.12 - Radiated Spurious Emissions

Test Conditions / Setup

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170		
Customer:	Cellphone-Mate, Inc.		
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 #:	**98648**	Date:	06/15/2016
Test Type:	**Radiated Emissions**	Time:	08:36:36
Tested by:	Daniel Bertran	Sequence#:	1
Software:	EMITest 5.03.02		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The equipment under test (EUT) is a Fixed CMRS Wideband Consumer Booster.
During testing, the (EUT) is placed on the Styrofoam table top.
Five different CW signals (one per each band) are injected sequentially to the input port of EUT using a signal generator. The signal generator is set to produce a CW signal with the frequency set to the center of each operational band under test and the power level is set at Pin as determined from 7.2 section of the test procedure indicated further below.
Evaluation of DL path was performed with signals fed into the Outside antenna port while Inside antenna port was terminated with equivalent 50 Ohm Pasternack load (MN: PE6187 / SN: 1443).
Evaluation of UL path was performed with signal fed into the Inside antenna port while Outside antenna port was terminated with the same above 50 Ohm load via a 75/50 Ohm impedance matching pad.

Test environment conditions: Temperature: 21°C, Relative Humidity: 48% and Atmospheric Pressure: 101.4 kPa

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
TX Freq = > Center frequency of above listed bands.

Test Conditions / Notes Continued:

Modulation=> CW
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

Test procedure: The test was performed in accordance with section 7.12 of the FCC document: 935210 D03 Wideband Consumer Signal Booster Measurement Guidance v04 Dated February 12, 2016.

Note:
Modification 1 was in place during testing.
Placement of the PCB is identical to test setup which is encased in a plastic housing in the final host.
Chassis is made out of material with dielectric constant near air.

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.

Test Equipment:

ID	Asset #	Description	Model	Cal Date	Cal Due Date
	AN00852	Biconilog Antenna	CBL 6111C	11/24/2014	11/24/2016
	ANP06049	Attenuator	PE7002-6	5/9/2016	5/9/2018
	ANP00880	Cable	RG214U	5/10/2016	5/10/2018
	ANP06691	Cable	PE3062-180	8/8/2014	8/8/2016
	AN00567	Preamp	8447D	1/2/2015	1/2/2017
	ANP01187	Cable	CNT-195	12/30/2014	12/30/2016
	AN02871	Spectrum Analyzer	E4440A	8/25/2015	8/25/2017
	AN02113	Horn Antenna	3115	2/3/2015	2/3/2017
	ANP06900	Cable	32022-29094K-29094K-36TC	12/30/2015	12/30/2017
	AN03303	Preamp	AMF-7D-00101800-30-10P	1/4/2016	1/4/2018
	ANP01210	Cable	FSJ1P-50A-4A	1/15/2015	1/15/2017
	AN03302	Cable	32026-29094K-29094K-72TC	1/29/2016	1/29/2018
	AN02693	Active Horn Antenna-ANSI C63.5 3m	AMFW-5F-12001800-20-10P	5/6/2015	5/6/2017
	AN02694	Horn Antenna-ANSI C63.5 3m	AMFW-5F-18002650-20-10P	5/7/2015	5/7/2017
	ANP00928	Cable	various	1/25/2016	1/25/2018
	ANP00929	Cable	various	1/25/2016	1/25/2018
	ANP06126	Cable	32022-29094K-29094K-168TC	3/18/2015	3/18/2017
	ANP06901	Cable	32022-29094K-29094K-36TC	12/30/2015	12/30/2017
	AN00432	Loop Antenna	6502	5/8/2015	5/8/2017
	ANP06710	Cable	32026-29094K-29094K-72TC	9/18/2014	9/18/2016
	ANP06467	Attenuator	PE7014-10	5/13/2015	5/13/2017

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

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)

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

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

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

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

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 $P_{t \text{ at 3 meter}}$)

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

= 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

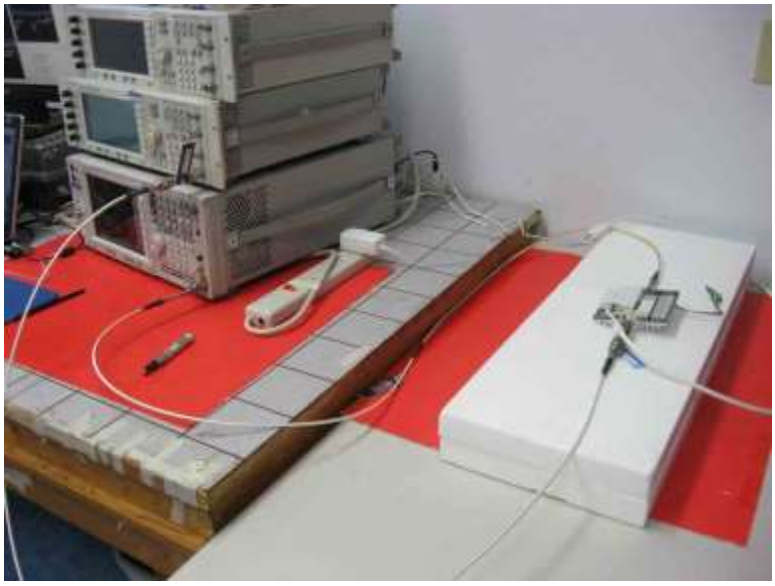
= ~~E_{dBuv}~~ - ~~E_{dBuv}~~ + 82.23

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

7.13 Spectrum Block Filter

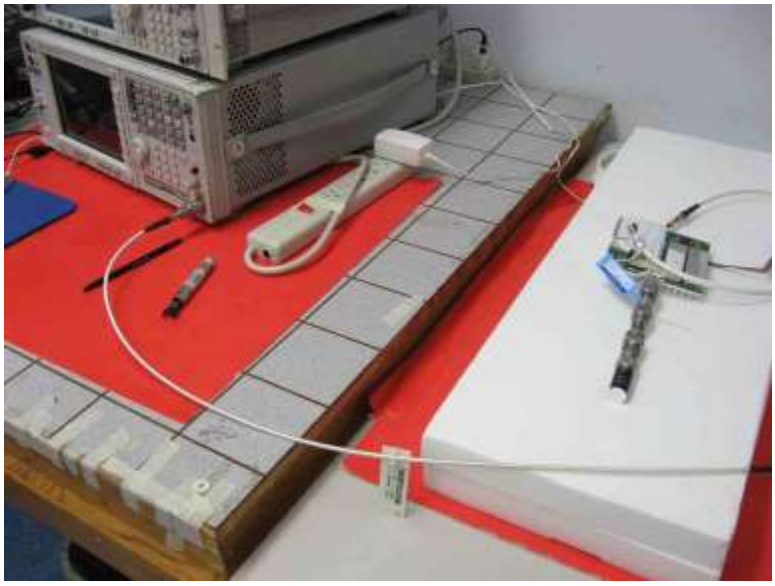
Section 7.13 not applicable because the EUT does not utilize spectrum block filtering.

EXHIBIT A: TEST SETUP PHOTOS



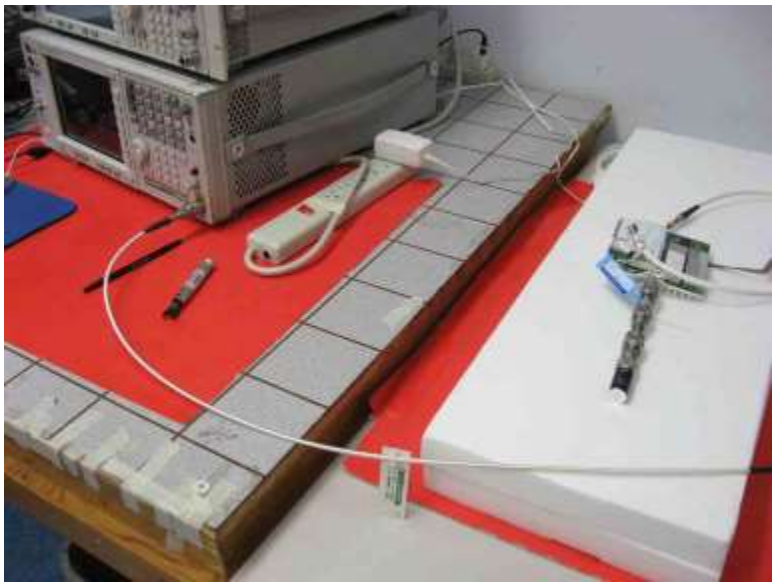
7.1, 7.2, 7.3, 7.5, 7.6 & 7.10

7.4



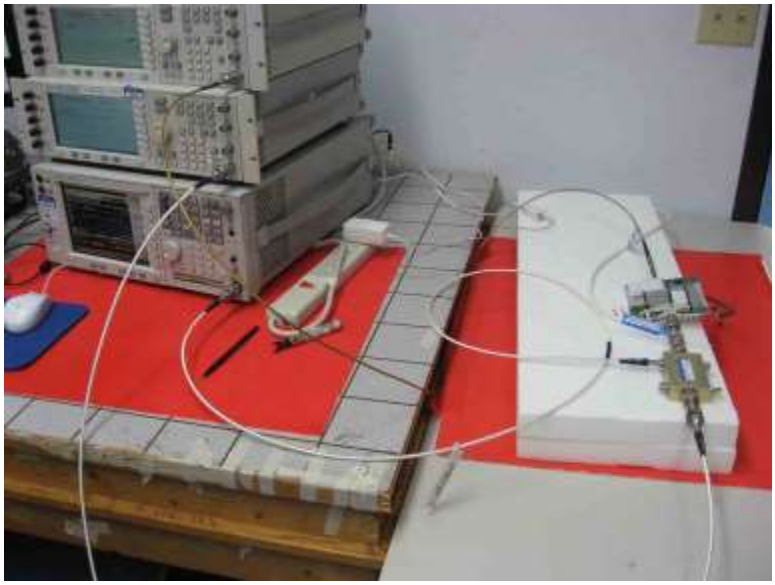
7.7.1 Noise Fig 3

7.7.1 Noise Fig 3

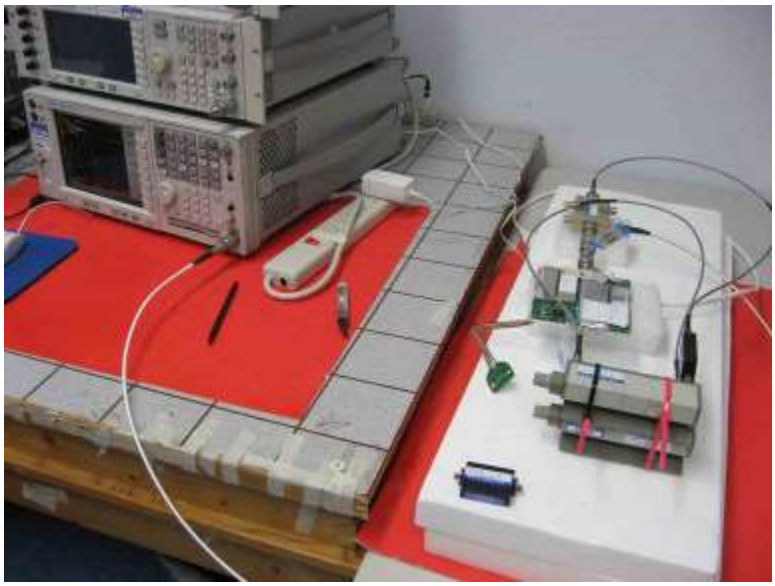


7.8 Uplink

7.9.1 Max Gain

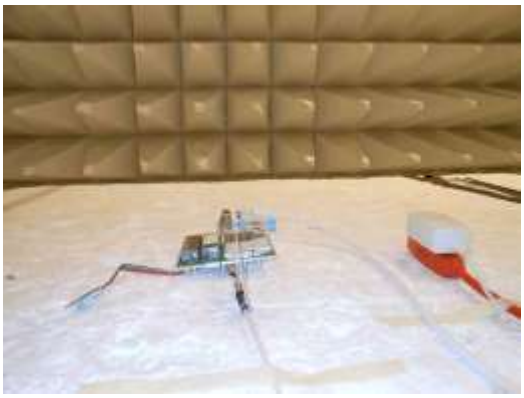


7.9.2 Variable Gain



7.11.2

7.11.3



7.12

Intended chassis installed in the final host

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

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

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2.