Spurious

Link	Operation Frequency (MHz)	Frequency range of spurious emission (MHz)	Measured Frequency (MHz)	Emission Level (dBm)	Limit (dBm)
Uplink	751.5	10-775	775.00	-59.23	-13
		788-10 000	788.00	-28.24	
Downlink	781.5	10-745	742.80	-49.30	
		758-10 000	758.00	-40.81	
Uplink	751.5	763 to 775	774.90	-59.16	-46
Downlink	781.5		763.02	-67.68	
Uplink	751.5	793 to 805	793.11	-73.02	-46
Downlink	781.5		799.72	-73.19	

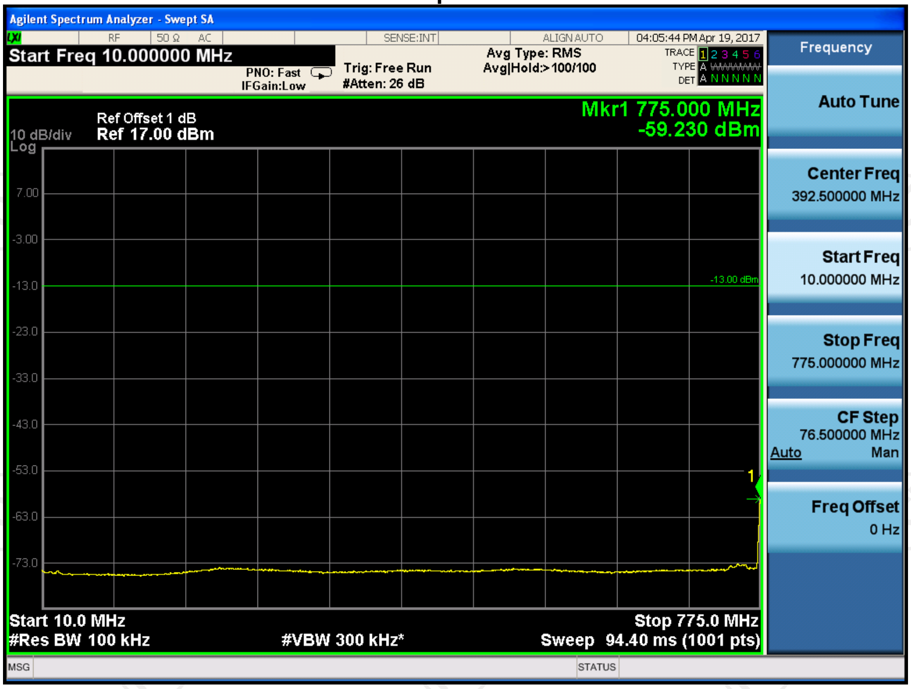
Note: The spurious level bellow 10MHz is too low, so not show in this report.

Link	Operation Frequency (MHz)	Frequency range of spurious emission (MHz)	Measured Frequency (MHz)	Emission Level (dBm)	Gain/Loss from antenna Kitting information	Final Value	Limit (dBm)
Uplink	751.5	1 559 to 1 610 Narrowband	1575.83	-82.36	12.12	-70.24	-50
Downlink	781.5		1609.59	-81.42	9.46	-71.96	
Uplink	751.5	1 559 to 1 610 Wideband	1605.67	-52.75	8.69	-44.06	-40
Downlink	781.5		1571.95	-52.16	10.16	-42.00	

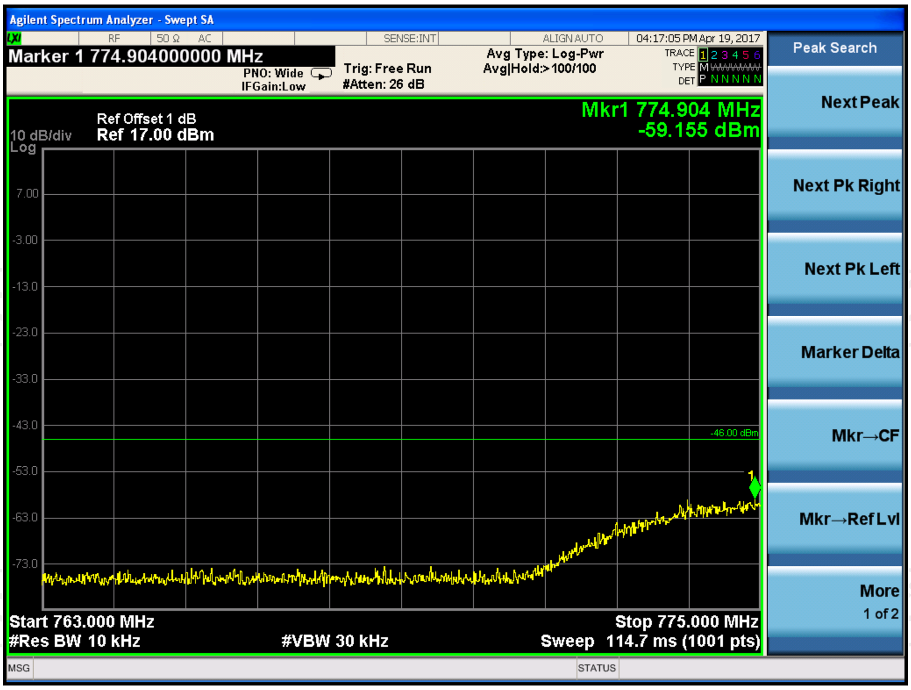
Hotline: 400-6611-140 Tel: 86-755-27673339 Fax: 86-755-27673332 http://www.tct-lab.com

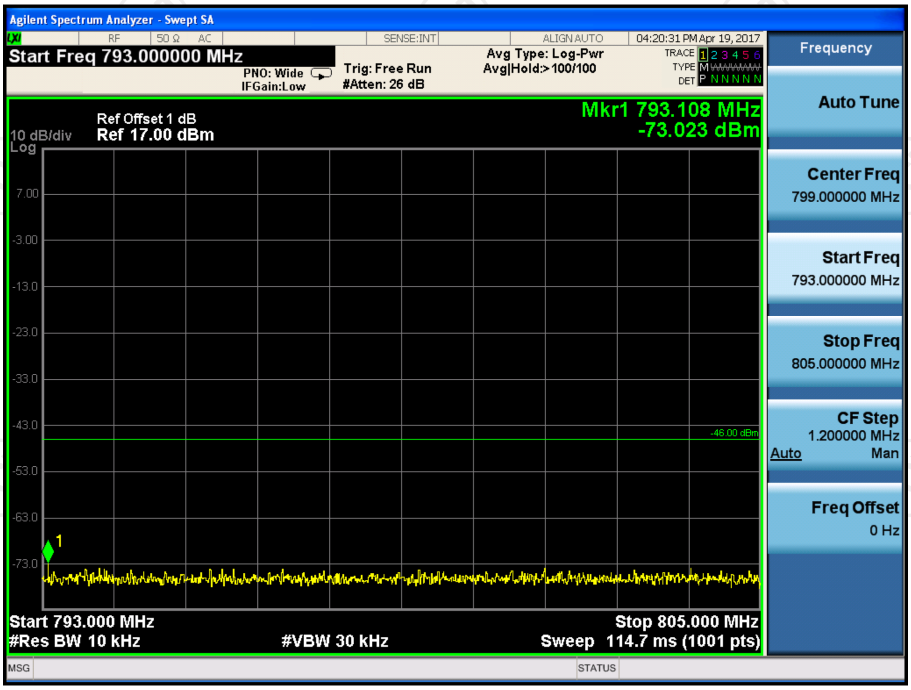
Plot

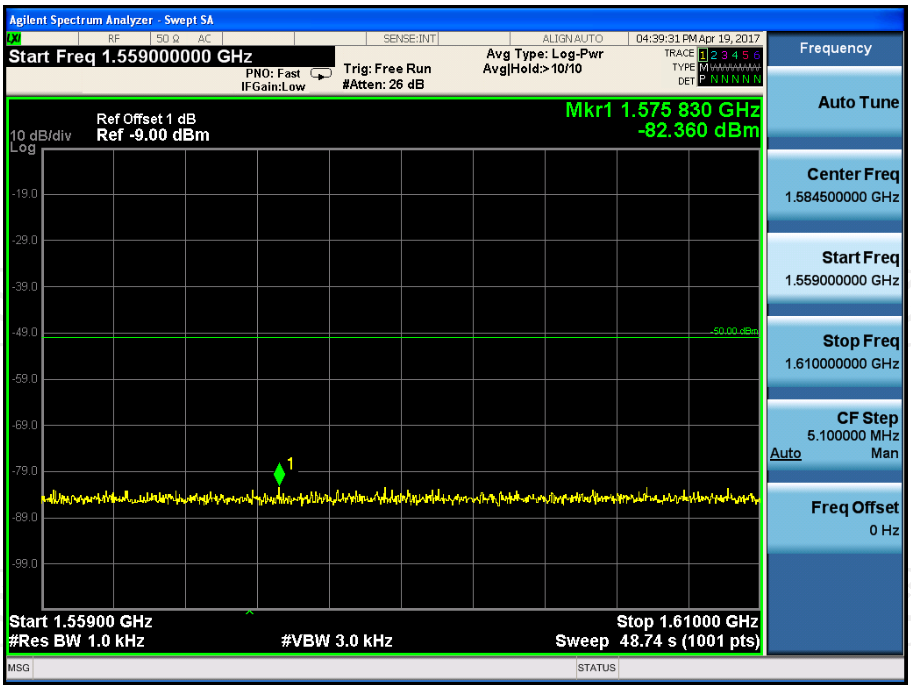
Uplink

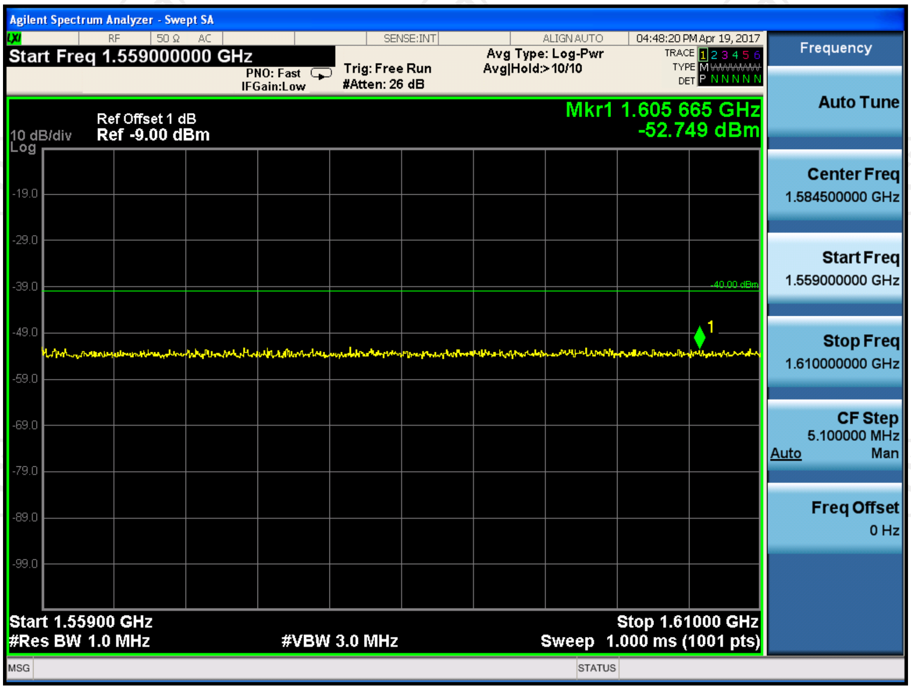

Agilent Spectrum Analyzer - Swept SA
Start Freq 10.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 26 dB
Avg Type: RMS
Avg|Hold:>100/100
04:05:44 PM Apr 19, 2017
Frequency
Ref Offset 1 dB
10 dB/div
Ref 17.00 dBm
Log
Mkr1 775.000 MHz
-59.230 dBm
-13.00 dBm
Start 10.0 MHz
#Res BW 100 kHz
#VBW 300 kHz*
Stop 775.0 MHz
Sweep 94.40 ms (1001 pts)
Auto Tune
Center Freq
392.500000 MHz
Start Freq
10.000000 MHz
Stop Freq
775.000000 MHz
CF Step
76.500000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
Start Freq 788.000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 26 dB
Avg Type: RMS
Avg|Hold:>100/100
04:15:03 PM Apr 19, 2017
Frequency
Ref Offset 1 dB
10 dB/div
Ref 17.00 dBm
Log
Mkr1 788 MHz
-28.242 dBm
-13.00 dBm
Start 788 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 10.000 GHz
Sweep 15.40 ms (1001 pts)
Auto Tune
Center Freq
5.394000000 GHz
Start Freq
788.000000 MHz
Stop Freq
10.000000000 GHz
CF Step
921.200000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS


Agilent Spectrum Analyzer - Swept SA
Marker 1 774.904000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 26 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
04:17:05 PM Apr 19, 2017
Peak Search
Ref Offset 1 dB
10 dB/div
Ref 17.00 dBm
Log
Mkr1 774.904 MHz
-59.155 dBm
-46.00 dBm
Start 763.000 MHz
#Res BW 10 kHz
#VBW 30 kHz
Stop 775.000 MHz
Sweep 114.7 ms (1001 pts)
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→RefLvl
More
1 of 2
MSG
STATUS

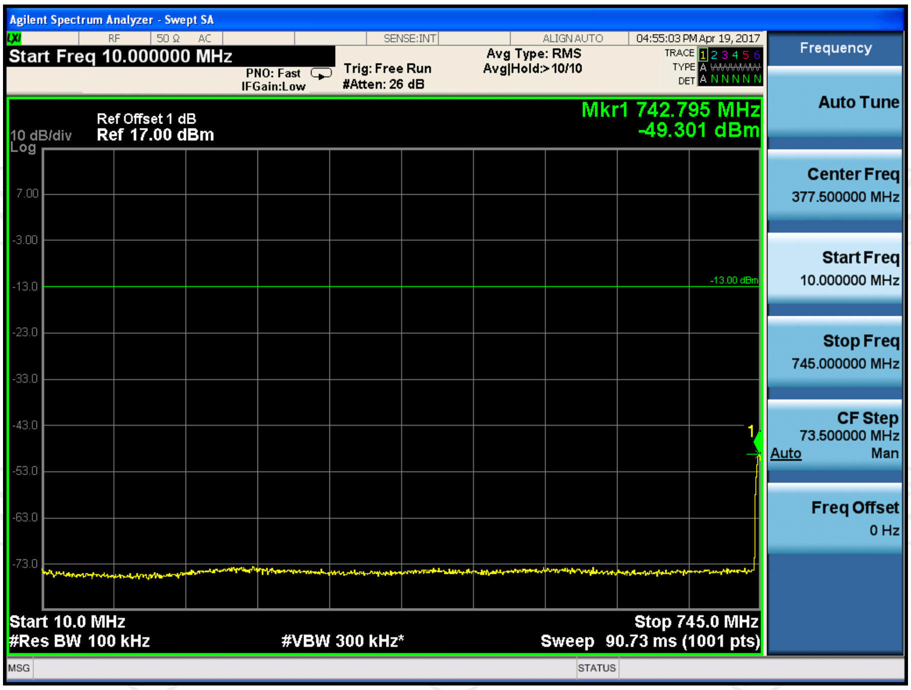

Agilent Spectrum Analyzer - Swept SA
Start Freq 793.000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 26 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
04:20:31 PM Apr 19, 2017
Frequency
Ref Offset 1 dB
10 dB/div
Ref 17.00 dBm
Log
Mkr1 793.108 MHz
-73.023 dBm
-46.00 dBm
Start 793.000 MHz
#Res BW 10 kHz
#VBW 30 kHz
Stop 805.000 MHz
Sweep 114.7 ms (1001 pts)
Auto Tune
Center Freq
799.000000 MHz
Start Freq
793.000000 MHz
Stop Freq
805.000000 MHz
CF Step
1.200000 MHz
Auto
Man
Freq Offset
0 Hz
MSG
STATUS

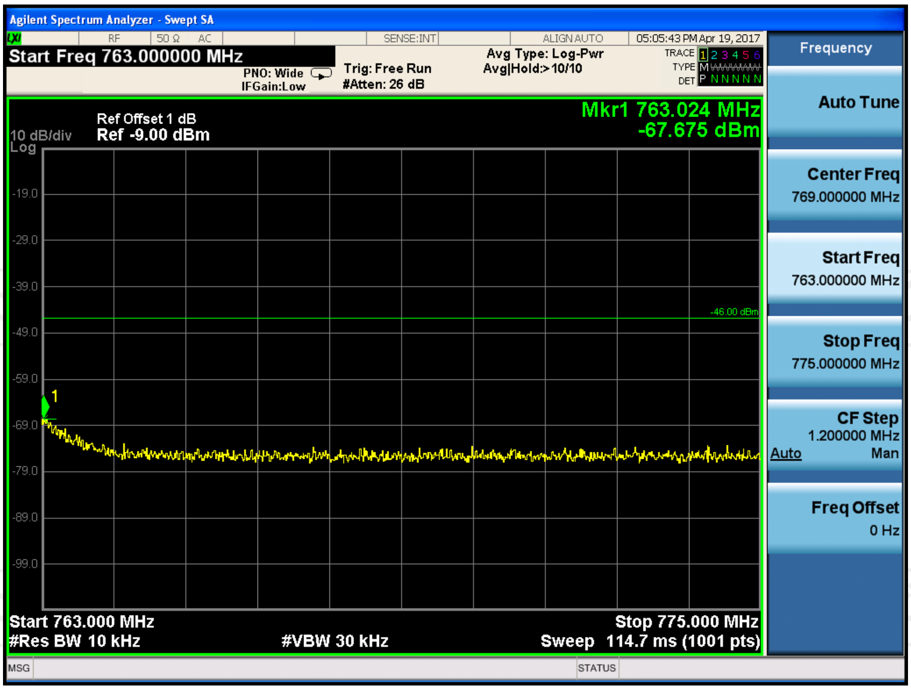

Agilent Spectrum Analyzer - Swept SA
Start Freq 1.559000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 26 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
04:39:31 PM Apr 19, 2017
Frequency
Ref Offset 1 dB
10 dB/div Ref -9.00 dBm
Log
Mkr1 1.575 830 GHz
-82.360 dBm
Start 1.55900 GHz
#Res BW 1.0 kHz
#VBW 3.0 kHz
Stop 1.61000 GHz
Sweep 48.74 s (1001 pts)
Auto Tune
Center Freq
1.584500000 GHz
Start Freq
1.559000000 GHz
Stop Freq
1.610000000 GHz
CF Step
5.100000 MHz
Auto
Man
Freq Offset
0 Hz

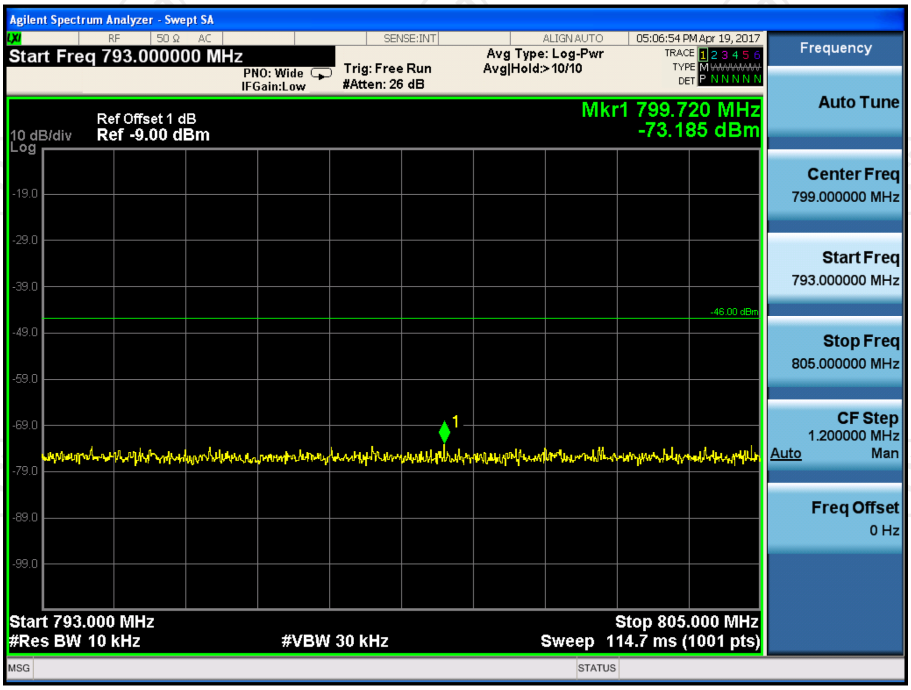

Agilent Spectrum Analyzer - Swept SA
Start Freq 1.559000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 26 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
04:48:20 PM Apr 19, 2017
Frequency
Ref Offset 1 dB
10 dB/div Ref -9.00 dBm
Log
Mkr1 1.605 665 GHz
-52.749 dBm
Start 1.55900 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 1.61000 GHz
Sweep 1.000 ms (1001 pts)
Auto Tune
Center Freq
1.584500000 GHz
Start Freq
1.559000000 GHz
Stop Freq
1.610000000 GHz
CF Step
5.100000 MHz
Auto
Man
Freq Offset
0 Hz

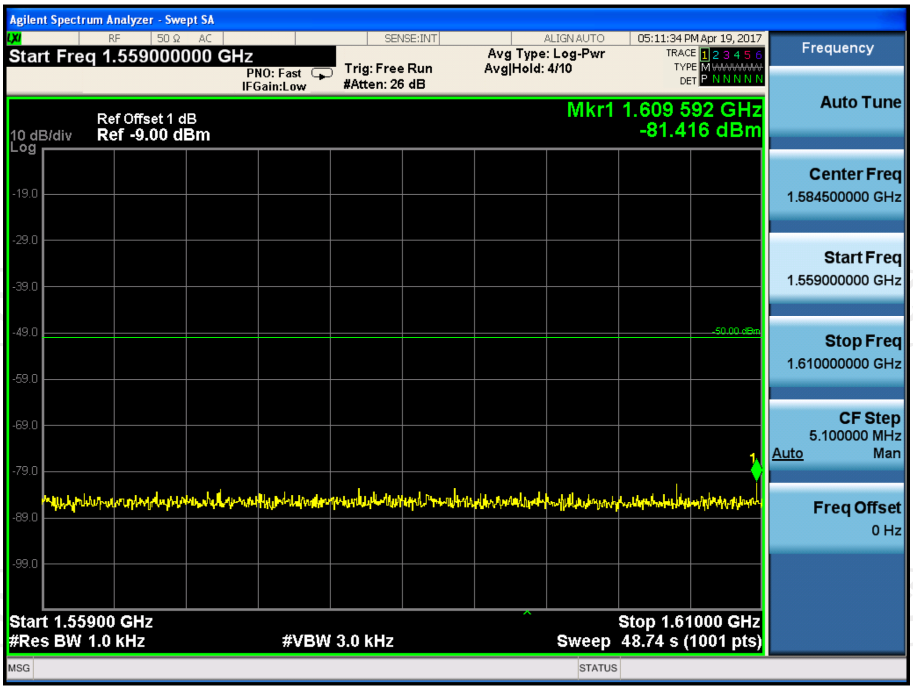
Plot

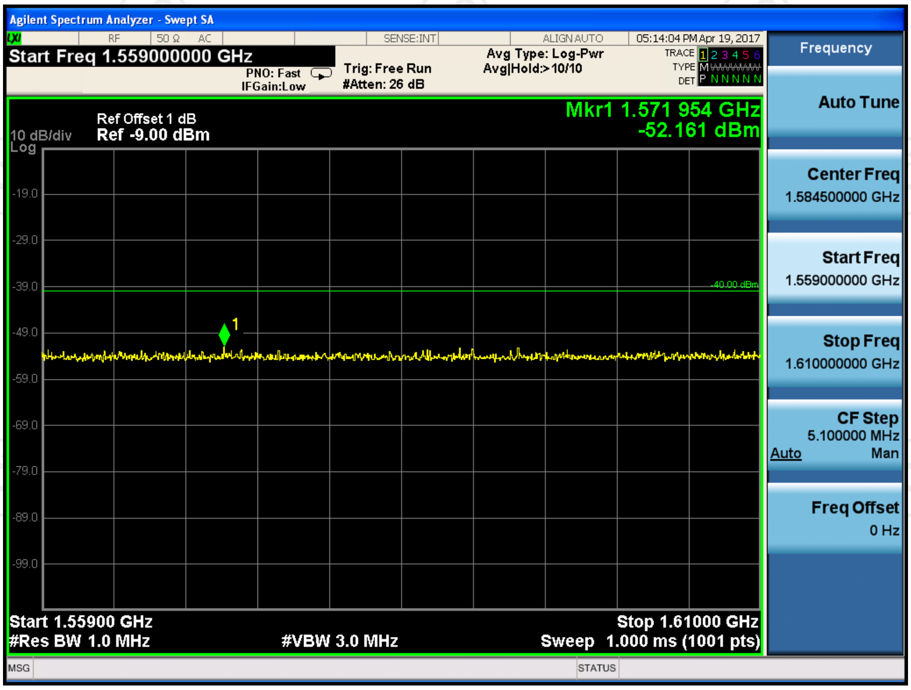
Downlink




Agilent Spectrum Analyzer - Swept SA
Start Freq 763.000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 26 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
05:05:43 PM Apr 19, 2017
Ref Offset 1 dB
10 dB/div
Log
Ref -9.00 dBm
Mkr1 763.024 MHz
-67.675 dBm
-46.00 dBm
Start 763.000 MHz
#Res BW 10 kHz
#VBW 30 kHz
Stop 775.000 MHz
Sweep 114.7 ms (1001 pts)
Frequency
Auto Tune
Center Freq
769.000000 MHz
Start Freq
763.000000 MHz
Stop Freq
775.000000 MHz
CF Step
1.200000 MHz
Auto
Man
Freq Offset
0 Hz


Agilent Spectrum Analyzer - Swept SA
Start Freq 793.000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 26 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
05:06:54 PM Apr 19, 2017
Ref Offset 1 dB
10 dB/div
Log
Ref -9.00 dBm
Mkr1 799.720 MHz
-73.185 dBm
-46.00 dBm
Start 793.000 MHz
#Res BW 10 kHz
#VBW 30 kHz
Stop 805.000 MHz
Sweep 114.7 ms (1001 pts)
Frequency
Auto Tune
Center Freq
799.000000 MHz
Start Freq
793.000000 MHz
Stop Freq
805.000000 MHz
CF Step
1.200000 MHz
Auto
Man
Freq Offset
0 Hz


Agilent Spectrum Analyzer - Swept SA
Start Freq 1.559000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 26 dB
Avg Type: Log-Pwr
Avg|Hold: 4/10
05:11:34 PM Apr 19, 2017
Ref Offset 1 dB
10 dB/div
Ref -9.00 dBm
Mkr1 1.609 592 GHz
-81.416 dBm
-50.00 dBm
Start 1.55900 GHz
#Res BW 1.0 kHz
#VBW 3.0 kHz
Stop 1.61000 GHz
Sweep 48.74 s (1001 pts)
Frequency
Auto Tune
Center Freq
1.584500000 GHz
Start Freq
1.559000000 GHz
Stop Freq
1.610000000 GHz
CF Step
5.100000 MHz
Auto
Man
Freq Offset
0 Hz


Agilent Spectrum Analyzer - Swept SA
Start Freq 1.559000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 26 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
05:14:04 PM Apr 19, 2017
Ref Offset 1 dB
10 dB/div
Ref -9.00 dBm
Mkr1 1.571 954 GHz
-52.161 dBm
-40.00 dBm
Start 1.55900 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 1.61000 GHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
1.584500000 GHz
Start Freq
1.559000000 GHz
Stop Freq
1.610000000 GHz
CF Step
5.100000 MHz
Auto
Man
Freq Offset
0 Hz

6.6. Noise Limits

6.6.1. Test Specification

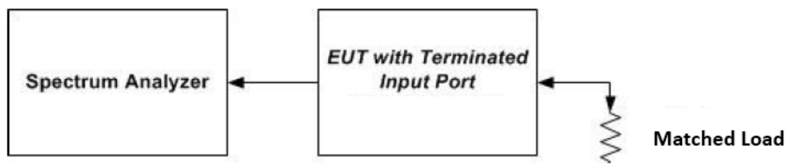
<table>
<tr><td>Test Requirement:</td><td>FCC Part20 Section 20.21(e)(8)(i)(A); 20.21(e)(8)(i)(H)</td></tr>
<tr><td>Test Method:</td><td>KDB D03 signal Booster Measurements V04</td></tr>
<tr><td>Limit:</td><td>§20.21(e)(8)(i)(A)(1), The transmitted noise power in dBm/MHz of consumer boosters at their uplink and downlink ports shall not exceed −103 dBm/MHz—RSSI.
§20.21(e)(8)(i)(A)(2)(i), Fixed booster maximum noise power shall not exceed −102.5 dBm/MHz + 20 log (F), where Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.</td></tr>
<tr><td>Test Setup:</td><td>

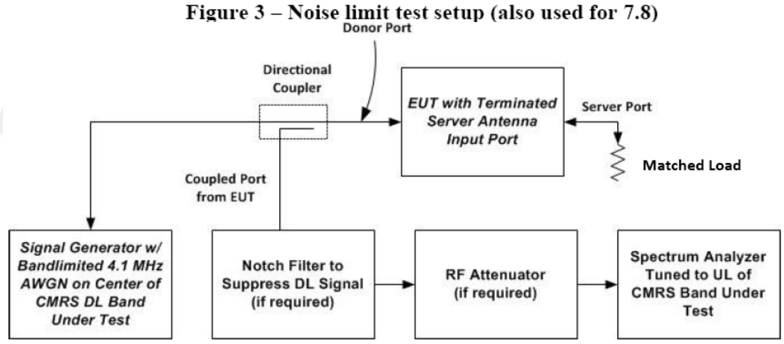
Figure 3 – Noise limit test setup (also used for 7.8)


Figure 4 – Test setup for uplink noise power measurement in the presence of a downlink signal</td></tr>
<tr><td>Test Procedure:</td><td>a) Connect the EUT to the test equipment as shown in Figure 3. Begin with the uplink output (donor) port connected to the spectrum analyzer. When measuring downlink noise, connect the downlink output (server) port to the spectrum analyzer.
b) Set the spectrum analyzer RBW to 1 MHz with the VBW ≥ 3 . RBW.
c) Select the power averaging (rms) detector and trace average over at least 100 traces.
d) Set the center frequency of the spectrum analyzer to the center of the CMRS band under test with the span ≥ 2 . the CMRS band.
e) Measure the maximum transmitter noise power level.
f) Save the spectrum analyzer plot as necessary for inclusion in the final test report.
g) Repeat 7.7b) to 7.7f) for all operational uplink and downlink bands.
h) Connect the EUT to the test equipment as shown in Figure 4 for uplink noise power measurement in the presence a downlink signal. Affirm the coupled path of the RF coupler is connected to the spectrum analyzer.
i) Configure the signal generator for AWGN operation with a 99%</td></tr>
</table>

	OBW of 4.1 MHz. j) Set the spectrum analyzer RBW for 1 MHz, VBW ≥ 3 . RBW, with a power averaging (rms) detector with at least 100 trace averages. k) Set the center frequency of the spectrum analyzer to the center of the CMRS band under test, with the span ≥ 2 the CMRS band. This shall include all spectrum blocks in the particular CMRS band under test (see Appendix A). l) For uplink noise measurements, set the spectrum analyzer center frequency for the uplink band under test, and tune the signal generator to the center of the paired downlink band. m) Measure the maximum transmitter noise power level while varying the downlink signal generator output level from −90 dBm to −20 dBm, as measured at the input port (i.e., downlink signal level at the booster donor port node of Figure 4), in 1 dB steps inside the RSSI-dependent region, and in 10 dB steps outside the RSSI-dependent region. Report the six values closest to the limit, with at least two points within the RSSI-dependent region of the limit. See Appendix D for noise limits graphs. n) Repeat 7.7.1h) through 7.7.1m) for all operational uplink bands. **Variable uplink noise timing** Variable uplink noise timing is to be measured as follows, using the test setup shown in Figure 4. a) Set the spectrum analyzer to the uplink frequency to be measured. b) Set the span to 0 Hz, with a sweep time of 10 seconds. c) Set the power level of signal generator to the lowest level of the RSSI-dependent noise [see 7.7.1m)]. d) Select MAX HOLD and increase the power level of signal generator by 10 dB for mobile boosters, and 20 dB for fixed boosters. e) Confirm that the uplink noise decreases to the specified level within 1 second for mobile devices, and within 3 seconds for fixed devices.12 f) Repeat 7.7.2a) to 7.7.2e) for all operational uplink bands. g) Include plots and summary table in test report.
Test Result:	PASS

6.6.2. Test Instruments

Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Signal Generator	Agilent	N5182	MY47070282	Aug. 15, 2016	Aug. 11, 2017
Spectrum Analyzer	Agilent	N9020A	MY49100060	Aug. 15, 2016	Aug. 11, 2017
Attenuation	AF115A-09-34	JFW	907763	Aug. 15, 2016	Aug. 11, 2017
RF Combiner	SUNVNDN	SUD-CS 0800	16230009	Aug. 15, 2016	Aug. 11, 2017

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

6.6.3. Test Data

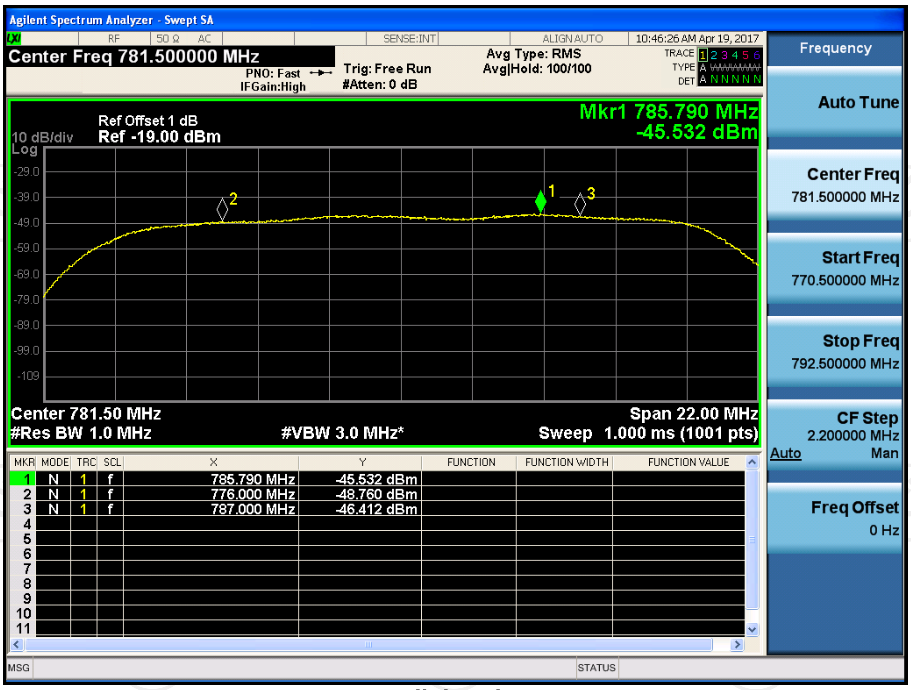
Max Noise Power			
Frequency (MHz)	Measured dBm/MHz	Limit dBm/MHz	Margin (dB)
Uplink 776-787	-45.53	-44.6	PASS
Downlink 776-787	-47.58	-44.6	PASS

776-787MHz					
		Limit			
RSSI (dBm)	Measured dBm/MHz	RSSI dependent	Fix Booster Limit (dBm)	TX off	Margin (dB)
-74.0	-47.02	--	-44.6	--	-2.42
-64.0	-46.53	--	-44.6	--	-1.93
-48.0	-56.24	-55.0	--	--	-1.24
-47.0	-56.80	-56.0	--	--	-0.80
-46.0	-58.21	-57.0	--	--	-1.21
-45.0	-58.65	-58.0			-0.65
-40.0	-64.58	-63.0			-1.58
-30.0	-75.60		--	-70	-5.60

Variable Uplink Noise Timing

Frequency MHz	Measured Sec	Limit Sec
UL 776-787	0.08	3

Plot



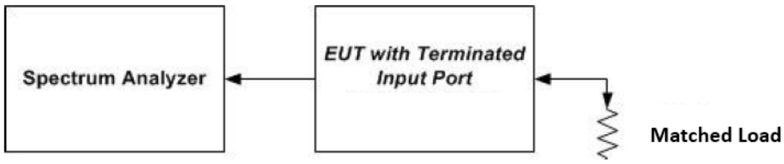
Uplink Noise

Downlink Noise

Variable Noise Timing Plot

6.7. Uplink Inactivity

6.7.1. Test Specification

Test Requirement:	FCC Part20 Section 20.21(e)(8)(i)(I)
Test Method:	KDB835210 D03 Signal Booster Measurement V04
Limit:	20.21(e), When a consumer booster is not serving an active device connection after 5 minutes the uplink noise power shall not exceed .70 dBm/MHz.
Test Setup:	 Figure 3 – Noise limit test setup (also used for 7.8)
Test Procedure:	a) Connect the EUT to the test equipment as shown in Set-Up with the uplink output connected to the spectrum analyzer. b) Select the RMS power averaging detector. c) Set the spectrum analyzer RBW for 1 MHz with the VBW ≥ 3X RBW. d) Set the center frequency of the spectrum analyzer to the center of the uplink operational band. e) Set the span for 0 Hz with a single sweep time for a minimum of 330 seconds. f) Start to capture a new trace using MAX HOLD. g) After approximately 15 seconds turn on the EUT power. h) Once the full spectrum analyzer trace is complete place a MARKER on the leading edge of the pulse and use the DELTA MARKER METHOD to measure the time until the uplink was squelched. i) Ensure the noise level for the squelched signal is below the uplink inactivity noise power limit, as specified by the rules. j) Capture the plot for inclusion in the test report. k) Measure noise using procedures in a) to e). l) Repeat steps c) to k) for all operational uplink bands.
Test Result:	PASS

6.7.2. Test Instruments

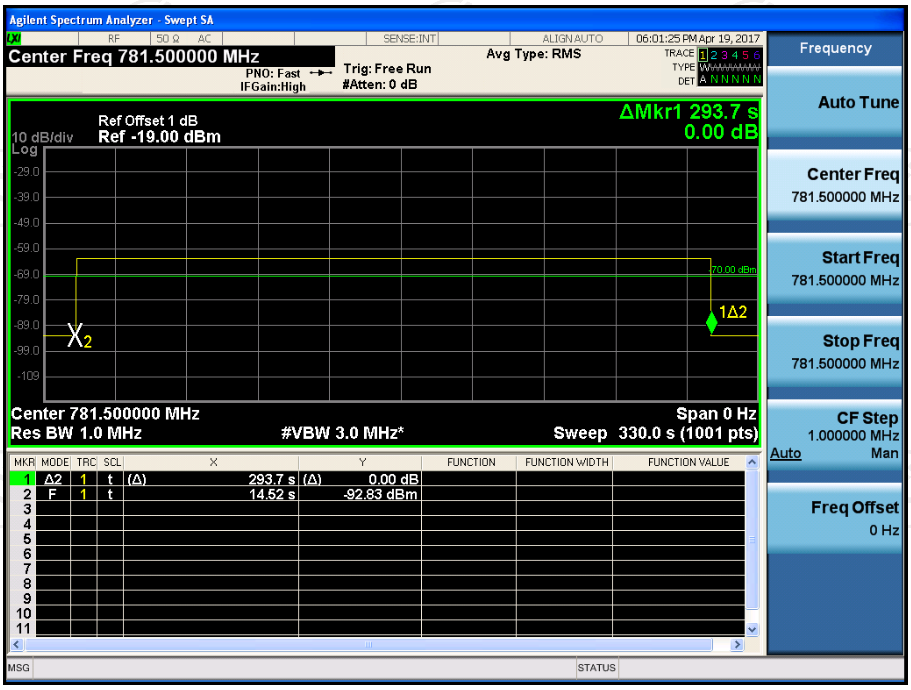
RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	Agilent	N9020A	MY49100060	Aug. 11, 2017

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

6.7.3. Test Data

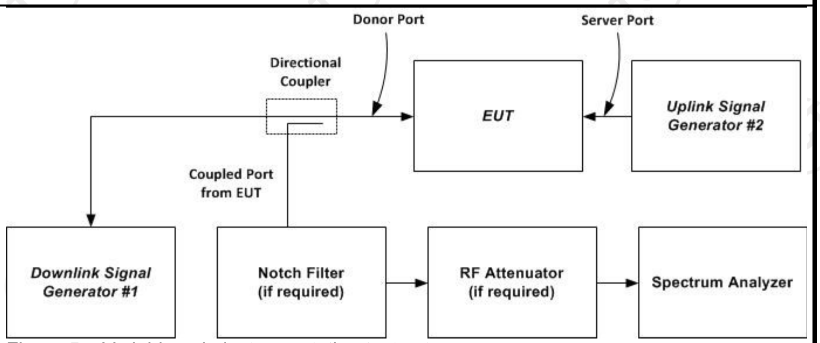
Uplink Inactivity		
Frequency (MHz)	Measured (s)	Limit (s)
776-787	293.7	300.0

Plot



6.8. Variable Booster Gain

6.8.1. Test Specification

Test Requirement:	FCC Part20 Section 120.21(e)(8)(i)(C)(1) FCC Part20 Section 120.21(e)(8)(i)(H)
Test Method:	KDB835210 D03 Signal booster measurements v04
Limit:	-34 dB - RSSI + MSCL.
Test Setup:	 Figure 5 – Variable gain instrumentation test setup
Test Procedure:	**Variable gain:** a) Connect the EUT to the test equipment as shown in Figure 5 with the uplink output (donor) port connected to signal generator #1. Affirm that the coupled path of the RF coupler is connected to the spectrum analyzer. b) Configure downlink signal generator #1 for AWGN operation with a 99% OBW of 4.1 MHz, tuned to the center of the operational band. c) Set the power level and frequency of signal generator #2 to a value that is 5 dB below the AGC level determined from 7.2. The signal type is AWGN with a 99% OBW of 4.1 MHz. d) Set RBW = 100 kHz. e) Set VBW ⩾ 300 kHz. f) Select the CHANNEL POWER measurement mode. g) Select the power averaging (rms) detector. h) Affirm that the number of measurement points per sweep ⩾ (2 . span)/RBW. i) Sweep time = auto couple or as necessary (but no less than auto couple value). j) Trace average at least 10 traces in power averaging (i.e., rms) mode. k) Measure the maximum channel power and compute maximum gain when varying the signal generator #1 output to a level from .90 dBm to .20 dBm, as measured at the input port (i.e., downlink signal level at the booster donor port node of Figure 5), in 1 dB steps inside the RSSI-dependent region, and 10 dB steps outside the RSSI-dependent region. Report the six values closest to the limit, including at least two points from within the RSSI-dependent region of operation. See gain limit in charts in Appendix D for uplink gain requirements. Additionally, document that the EUT provides equivalent uplink and downlink gain, and when operating in shutoff mode that the uplink and downlink gain is within the transmit power off mode gain limits. l) Repeat 7.9.1b) to 7.9.1k) for all operational uplink bands. **Variable uplink gain timing:** Variable uplink gain timing is to be measured as follows, using the test setup shown in Figure 5.

	a) Set the spectrum analyzer to the uplink frequency to be measured. b) Set the span to 0 Hz with a sweep time of 10 seconds. c) Set the power level of signal generator #1 to the lowest level of the RSSI-dependent gain [see 7.9.1k)]. d) Select MAX HOLD and increase the power level of signal generator #1 by 10 dB for mobile boosters, and by 20 dB for fixed indoor boosters. Signal generator #2 remains same, as described in 7.9.1c). e) Confirm that the uplink gain decreases to the specified levels, within 1 second for mobile devices, and within 3 seconds for fixed devices.13 f) Repeat 7.9.2a) to 7.9.2e) for all operational uplink bands.
Test Result:	PASS

6.8.2. Test Instruments

Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Signal Generator	Agilent	E4421B	GB39340839	Aug. 15, 2016	Aug. 11, 2017
Signal Generator	Agilent	N5182	MY47070282	Aug. 15, 2016	Aug. 11, 2017
Spectrum Analyzer	Agilent	N9020A	MY49100060	Aug. 15, 2016	Aug. 11, 2017
Attenuation	AF115A-09-34	JFW	907763	Aug. 15, 2016	Aug. 11, 2017
RF Combiner	SUNVNDN	SUD-CS 0800	16230009	Aug. 15, 2016	Aug. 11, 2017

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

6.8.3. Test Data

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.*

$L\,p = 20\log f + 20\log d - 27.5$

Where:

$L\,P$ = *basic free space path loss,*

f = *Center frequency (MHz),*

d = *2 meters.*

MSCL for 776-787MHz

$Lp=20\log(781.5)+20\log(2)-27.5=36.38$

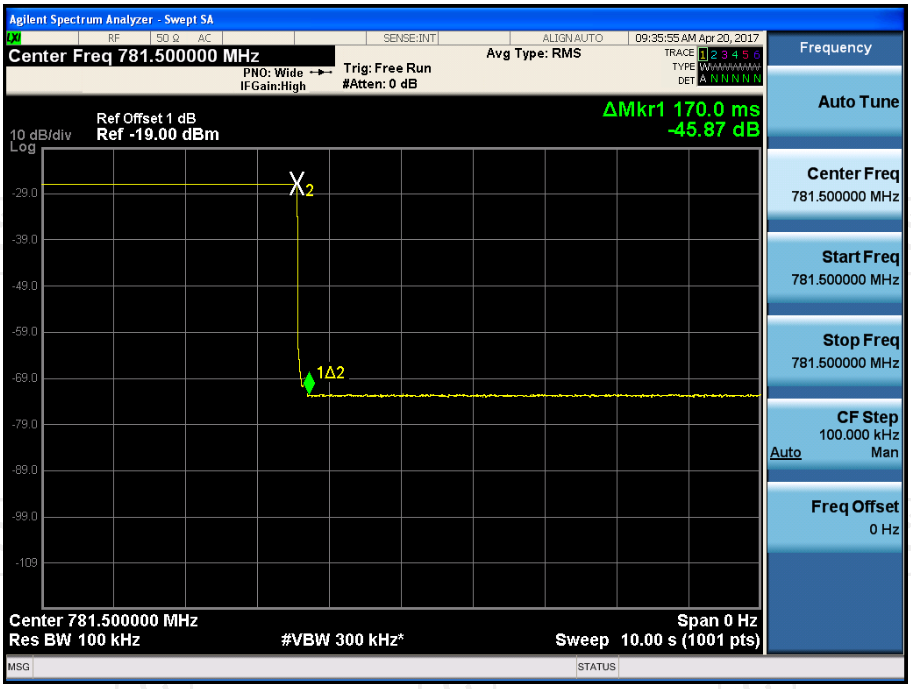
RSSI=Downlink output power – Downlink gain

776MHz~787MHz							
				Limit			Margin (dB)
RSSI (dBm)	Input (dBm)	Measured Output Power (dBm)	Measured Gain (dB)	RSSI Dependent (dB)	Fix Booster Limit	TX off	
-70.0	-45.00	13.48	58.48	--	64.4	--	-5.92
-62.0	-45.00	13.48	58.48	--	64.4	--	-5.92
-49.0	-45.00	5.62	50.62	55.5	--	--	-4.88
-48.0	-45.00	5.40	50.40	54.5	--	--	-4.10
-46.0	-45.00	3.21	48.21	52.5	--	--	-4.29
-45.0	-45.00	3.57	48.57	51.5	--	--	-2.93

Variable Uplink Gain Timing

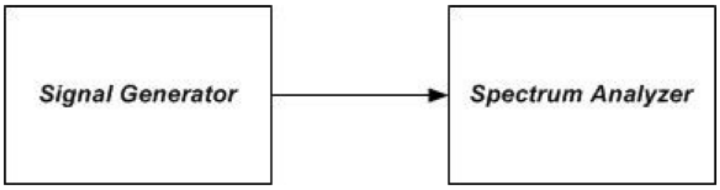
Frequency MHz	Measured Sec	Limit Sec
UL 776-787	0.17	3

Variable Uplink Gain Timing Plot



6.9. Occupied Bandwidth

6.9.1. Test Specification

Test Requirement:	FCC Part2 Section 2.1049
Test Method:	KDB835210 D03 Signal booster measurements v04
Limit:	N/A
Test setup:	 **Figure 6 – Test setup for measuring characteristics of test signals used for subsequent EUT occupied bandwidth testing**
Test Procedure:	a) Connect the test equipment as shown in Figure 6 to firstly measure the characteristics of the test signals produced by the signal generator. b) Set VBW ≥ 3 . RBW. c) Set the center frequency of the spectrum analyzer to the center of the operational band. The span will be adjusted for each modulation type and OBW as necessary for accurately viewing the signals. d) Set the signal generator for power level to match the values obtained from the tests of 7.2. e) Set the signal generator modulation type for GSM with a PRBS pattern and allow the trace on the signal generator to stabilize adjusting the span as necessary. f) Set the spectrum analyzer RBW for 1% to 5% of the EBW. g) Capture the spectrum analyzer trace for inclusion in the test report. h) Repeat 7.10c) to 7.10g) for CDMA and W-CDMA modulation, adjusting the span as necessary. AWGN or LTE may be used in place of W-CDMA, as an option. i) Repeat 7.10c) to 7.10h) for all uplink and downlink operational bands. j) Connect the test equipment as shown in Figure 1, with the uplink output (donor) port connected to the spectrum analyzer, and the server port connected to the signal generator. k) Repeat 7.10c) to 7.10i) with this EUT uplink path test setup. l) Connect the test equipment as shown in Figure 1, with the downlink output (server) port connected to the spectrum analyzer, and the donor port connected to the signal generator. m) Repeat 7.10c) to 7.10i) with this EUT downlink path test setup.
Test results:	PASS

6.9.2. Test Instruments

Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Signal Generator	Agilent	N5182	MY47070282	Aug. 15, 2016	Aug. 11, 2017
Spectrum Analyzer	Agilent	N9020A	MY49100060	Aug. 15, 2016	Aug. 11, 2017
RF Combiner	SUNVNDN	SUD-CS 0800	16230009	Aug. 15, 2016	Aug. 11, 2017

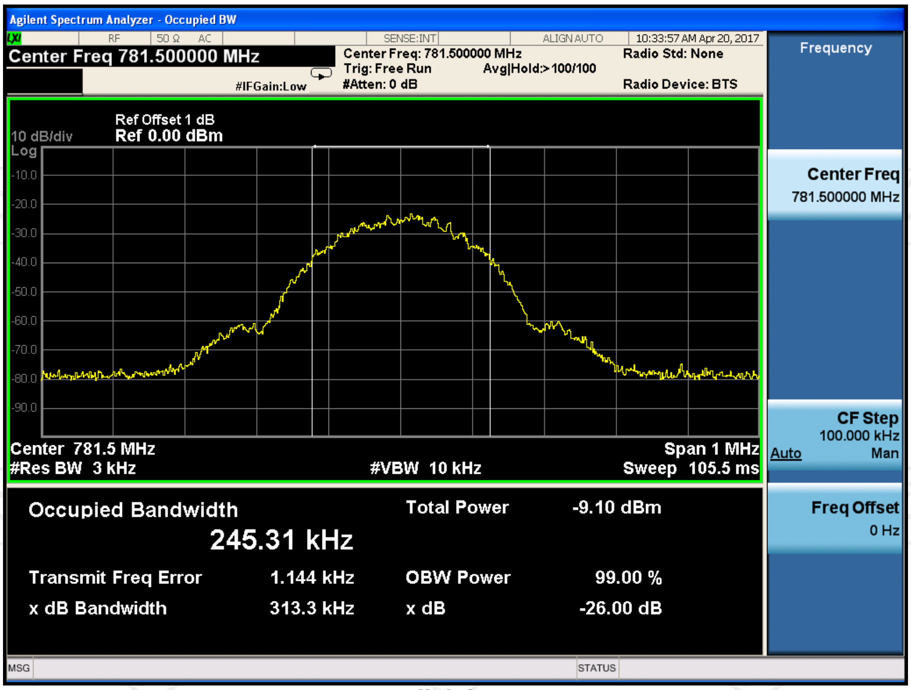
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

6.9.3. Test Data

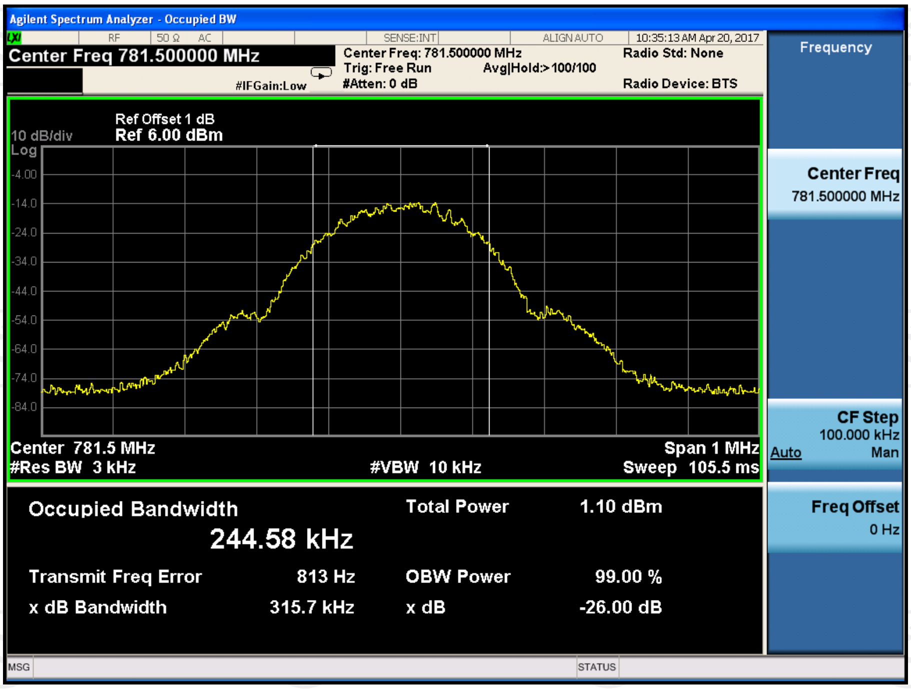
Link	Signal Type	Frequency [MHz]	Input OBW [MHz]	Output OBW [MHz]
Uplink	GSM	781.5	0.245	0.245
	CDMA	781.5	1.247	1.256
	AWGN	781.5	4.538	4.530
Downlink	GSM	751.5	0.286	0.246
	CDMA	751.5	1.270	1.249
	AWGN	751.5	4.721	4.572

Plot

GSM UL

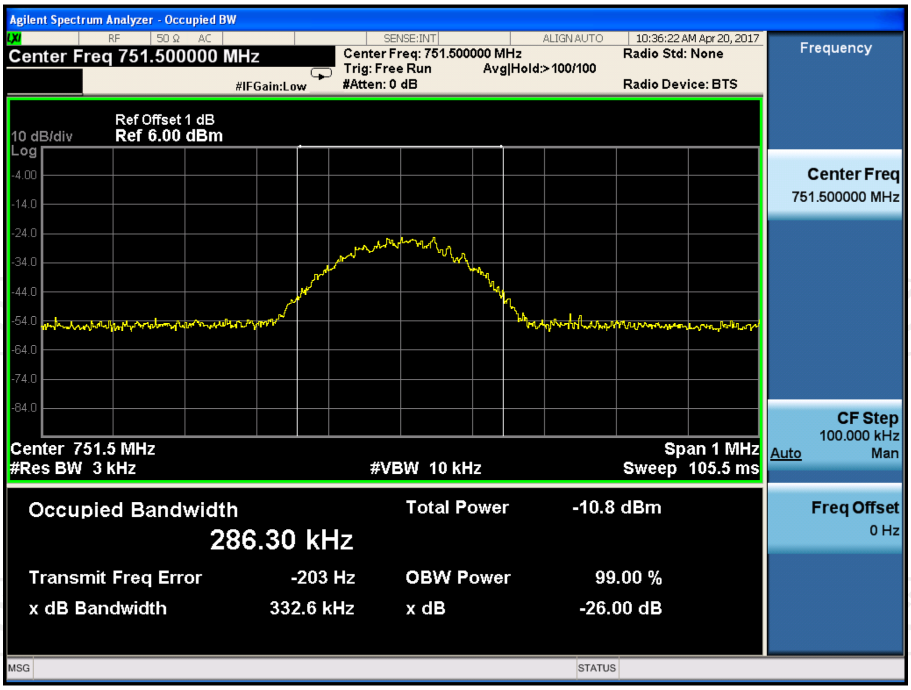


Uplink-input

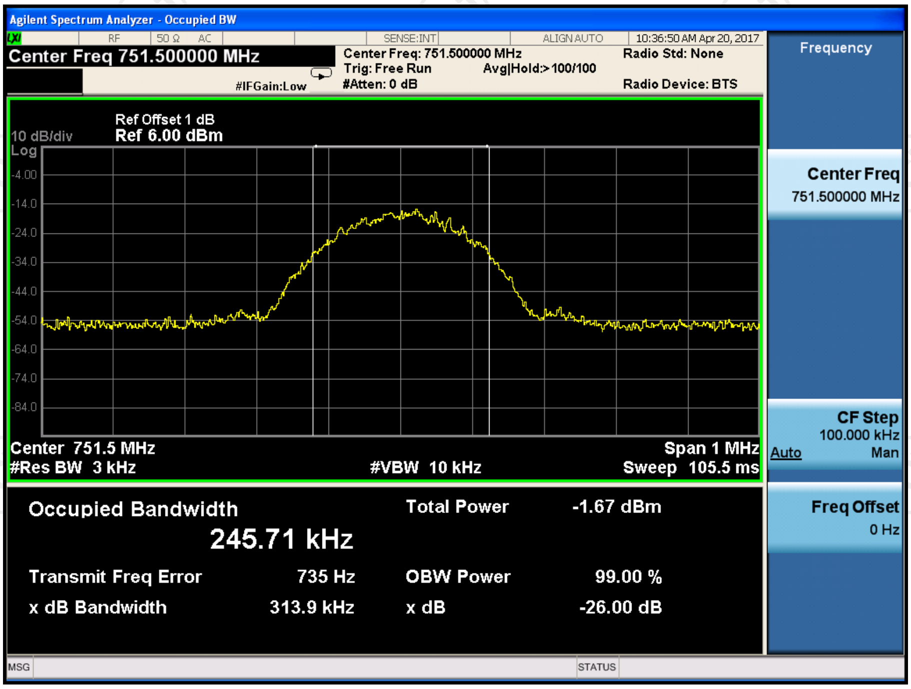


Uplink-output

GSM Downlink



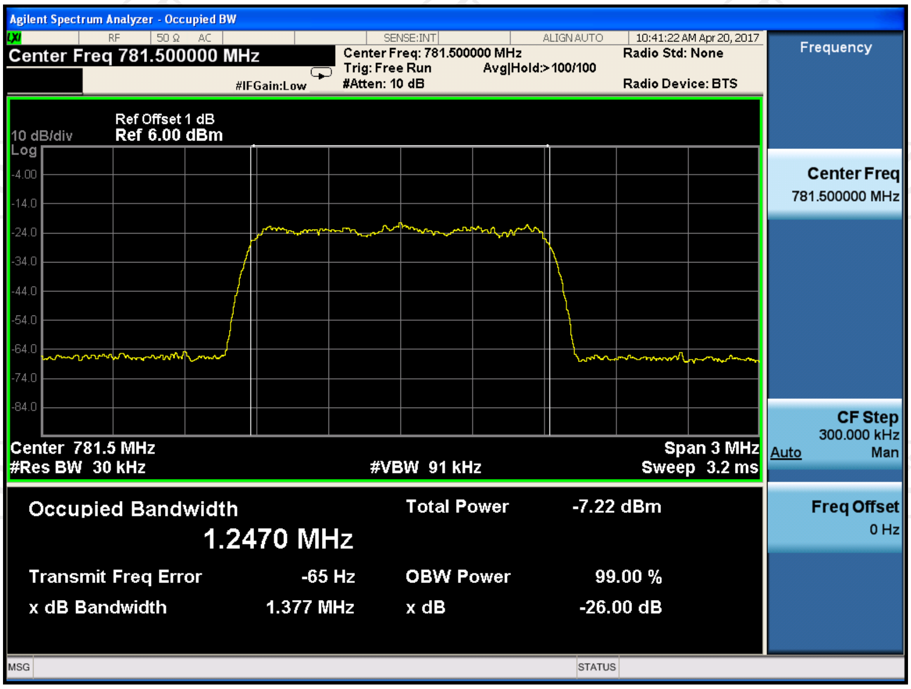
Downlink-input



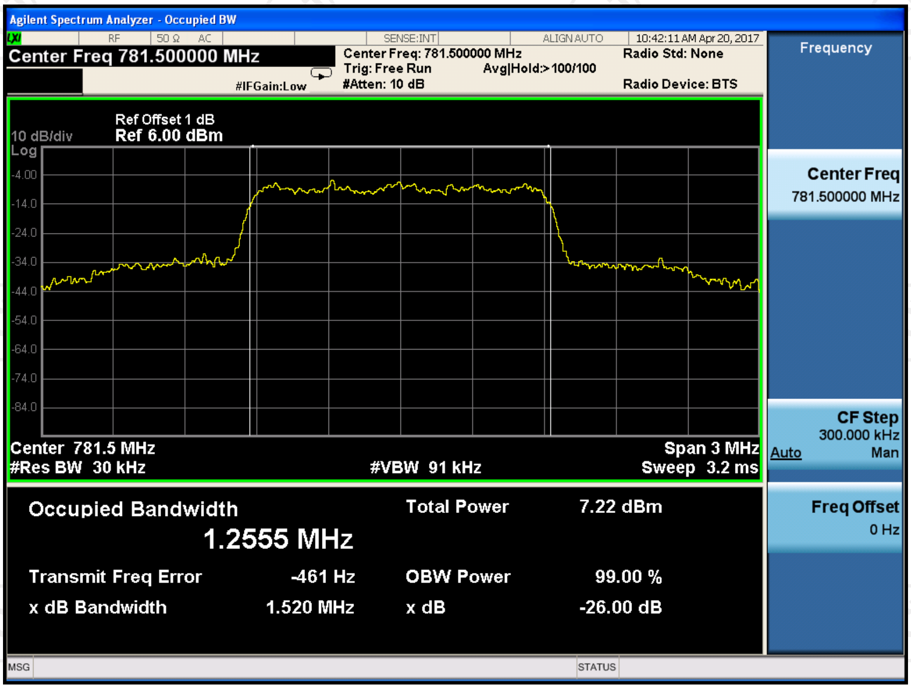
Downlink-input

Plot

CDMA UL

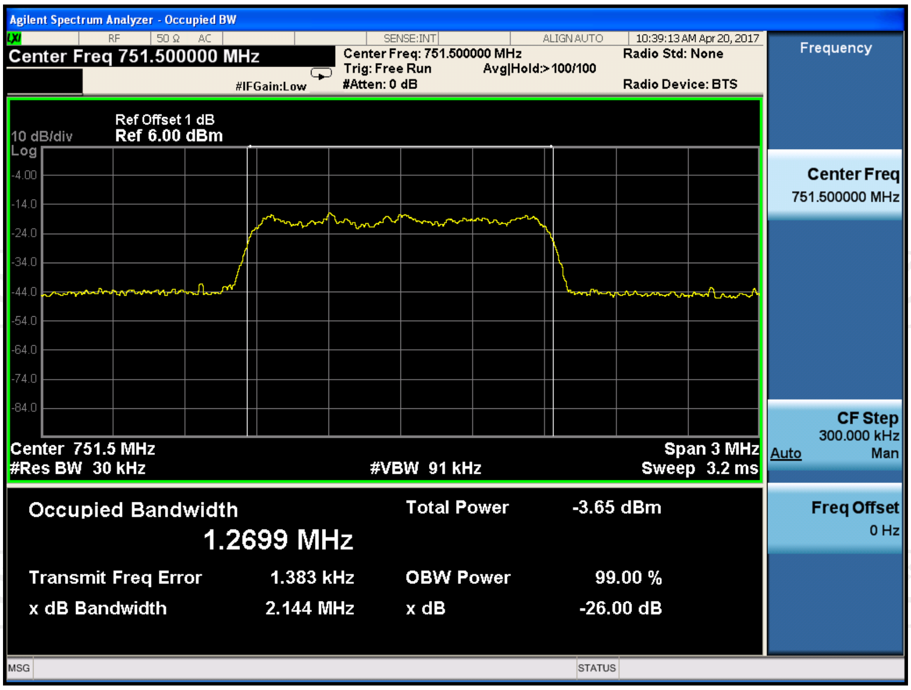


Uplink-input

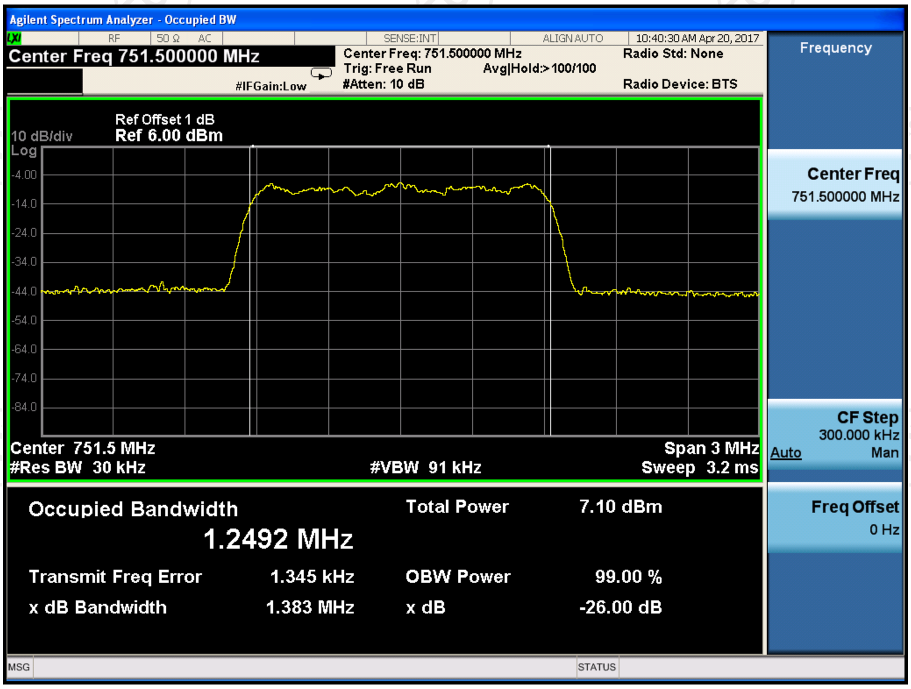


Uplink-output

CDMA Downlink



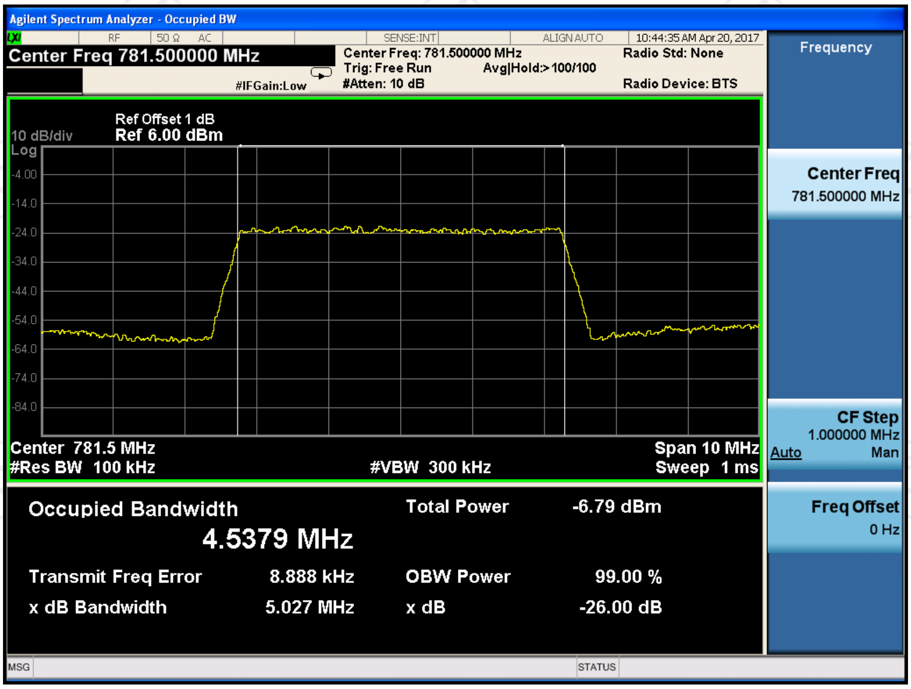
Downlink-input



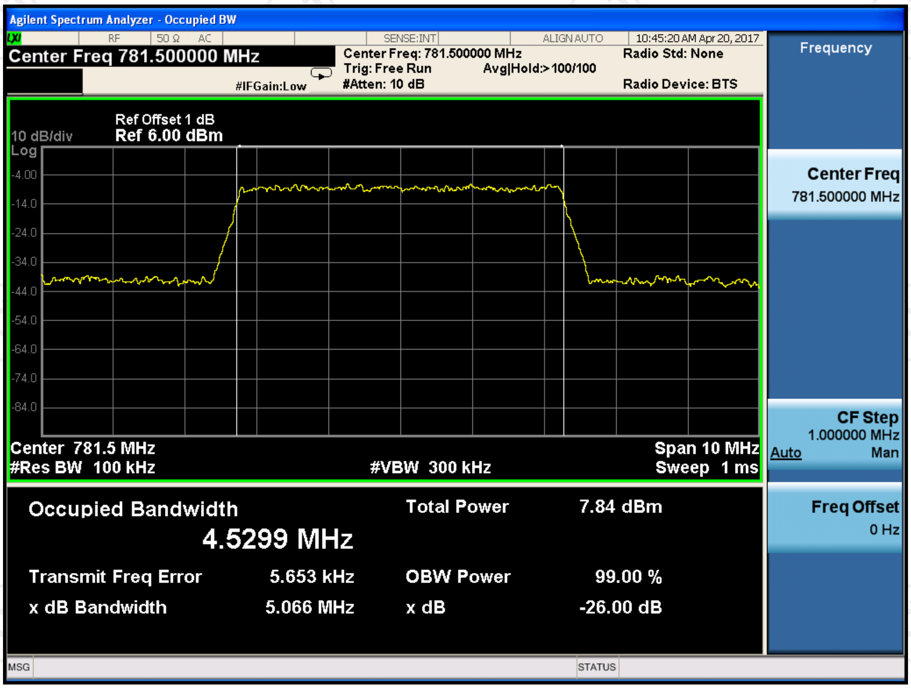
Downlink-input

Plot

AWGN UL

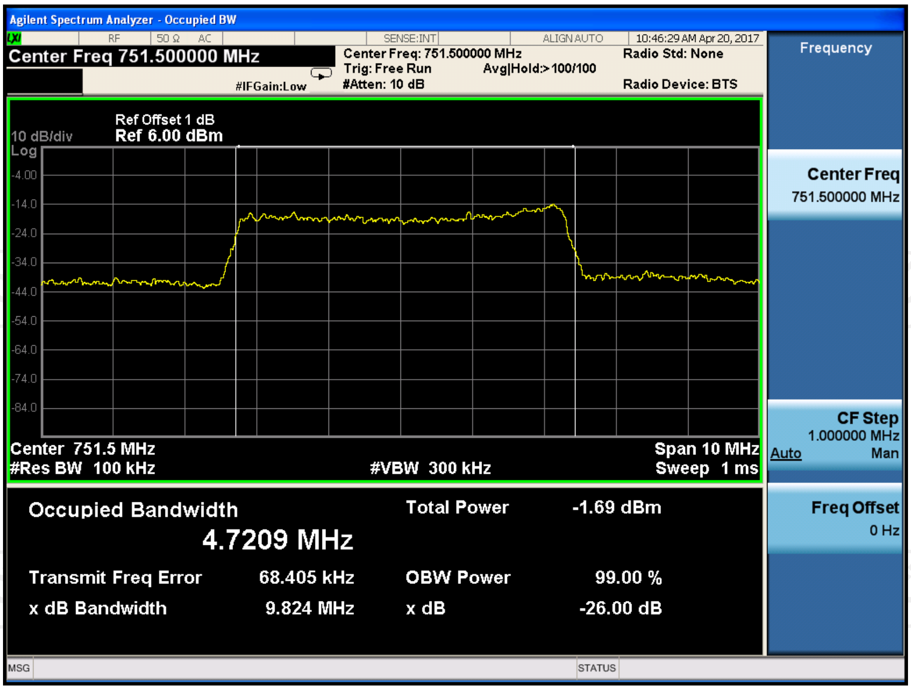


Uplink-input



Uplink-output

AWGN Downlink

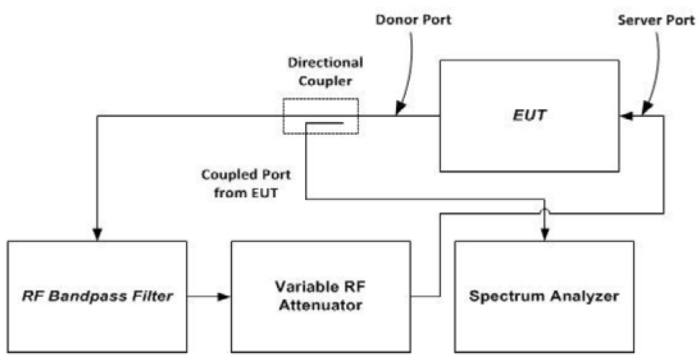
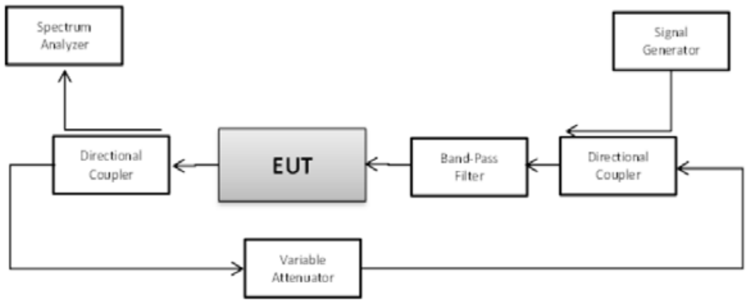


Downlink-input

Downlink-input

6.10. Oscillation Detection and Mitigation

6.10.1. Test Specification

Test Requirement:	FCC Part20 Section 20.21(e)(8)(iii)(A)
Test Method:	KDB835210 D03 Signal booster measurements v04
Limit:	Reference to test data bellow
Test setup:	 NOTE—This figure shows the test setup for uplink bands transmission path tests; i.e., signal flow is out from the donor port into the directional coupler. For downlink bands transmission path tests, the feedback signal flow path direction and equipment connections shall be reversed, i.e., signal flow is out from the server port into the directional coupler, and signal flow is into the donor port from the variable RF attenuator. **Figure 7 – Oscillation detection (7.11.2) test setup**  **Figure 8 – Oscillation mitigation/shutdown test setup**
Test Procedure:	**Oscillation restart tests** a) Connect the normal-operating mode EUT to the test equipment as shown in Figure 7 beginning with the spectrum analyzer on the uplink output (donor) port. Confirm that the RF coupled path is connected to the spectrum analyzer. NOTE–The band-pass filter shall provide sufficient out-of-band rejection to prevent oscillations from occurring in bands not under test. b) Spectrum analyzer settings: 1) Center frequency at the center of the band under test 2) Span equal or slightly exceeding the width of the band under test 3) Continuous sweep, max-hold 4) RBW≥1 MHz, VBW > 3xRBW c) Decrease the variable attenuator until the spectrum analyzer displays a signal within the band under test. Using a marker, identify the approximate center frequency of this signal on the max-hold display, increase the attenuation by 10 dB, then reset the EUT (e.g., cycle ac/dc power). d) Repeat 7.11.2c) twice to ensure that the center of the signal

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	created by the booster remains within 250 kHz of the spectrum analyzer display center frequency. If the frequency of the signal is unstable, confirm that the spectrum analyzer display is centered between the frequency extremes observed. If the signal is wider than 1 MHz, ensure that the spectrum analyzer display is centered on the signal by increasing the RBW. Reset the EUT (e.g., cycle ac/dc power) after each oscillation event, if necessary. Set the spectrum analyzer sweep trigger level to just below the peak amplitude of the displayed EUT oscillation signal. e) Set the spectrum analyzer to zero-span, with a sweep time of 5 seconds, and single-sweep with max-hold. The spectrum analyzer sweep trigger level in this and the subsequent steps shall be the level identified in 7.11.2d). f) Decrease the variable attenuator until the spectrum analyzer sweep is triggered, increase the attenuation by 10 dB, then reset the EUT (e.g., cycle ac/dc power). g) Reset the zero-span trigger of the spectrum analyzer, then repeat 7.11.2f) twice to ensure that the spectrum analyzer is reliably triggered, resetting the EUT (e.g., cycle ac/dc power) after each oscillation event if necessary. h) Reset the zero-span sweep trigger of the spectrum analyzer, and reset the EUT (e.g., cycle ac/dc power). i) Force the EUT into oscillation by reducing the attenuation. j) Use the marker function of the spectrum analyzer to measure the time from the onset of oscillation until the EUT turns off, by setting Marker 1 on the leading edge of the oscillation signal and Marker 2 on the trailing edge. The spectrum analyzer sweep time may be adjusted to improve the time resolution of these cursors. k) Capture the spectrum analyzer zero-span trace for inclusion in the test report. Report the power level associated with the oscillation separately if it can't be displayed on the trace. l) Repeat 7.11.2b) to 7.11.2k) for all operational uplink and downlink bands. m) Set the spectrum analyzer zero-span sweep time for longer than 60 seconds, then measure the restart time for each operational uplink and downlink band. n) Replace the normal-operating mode EUT with the EUT that supports an anti-oscillation test mode. o) Set the spectrum analyzer zero-span time for a minimum of 120 seconds, and a single sweep. p) Manually trigger the spectrum analyzer zero-span sweep, and manually force the booster into oscillation as described in 7.11.2i). q) When the sweep is complete, place cursors between the first two oscillation detections, and save the plot for inclusion in the test report. The time between restarts must match the manufacturer's timing for the test mode, and there shall be no more than 5 restarts. r) Repeat 7.11.2m) to 7.11.2q) for all operational uplink and downlink bands. **Test procedure for measuring oscillation mitigation or shutdown** a) Connect the normal-operating mode EUT to the test equipment as shown in Figure 8. b) Set the spectrum analyzer center frequency to the center of band under test, and use the following settings: 1) RBW=30 kHz, VBW ⩾ 3 × RBW, 2) power averaging (rms) detector, 3) trace averages ⩾ 100, 4) span ⩾ 120% of operational band under test

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	5) number of sweep points ⩾ 2 × Span/RBW. c) Configure the signal generator for AWGN operation with a 99% OBW of 4.1 MHz, tuned to the frequency of 2.5 MHz above the lower edge or below the upper edge of the operating band under test. Adjust the RF output level of the signal generator such that the measured power level of the AWGN signal at the output port of the booster is 30 dB less than the maximum power of the booster for the band under test. Affirm that the input signal is not obstructing the measurement of the strongest oscillation peak in the band, and is not included within the span in the measurement. 1) Boosters with operating spectrum passbands of 10 MHz or less may use a CW signal source at the band edge rather than AWGN. 2) For device passbands greater than 10 MHz, standard CMRS signal sources (i.e., CDMA, W-CDMA, LTE) may be used instead of AWGN at the band edge. d) Set the variable attenuator to a high attenuation setting such that the booster will operate at maximum gain when powered on. Reset the the EUT (e.g., cycle ac/dc power). Allow the EUT to complete its boot-up process, to reach full operational gain, and to stabilize its operation. e) Set the variable attenuator such that the insertion loss for the center of the band under test (isolation) between the booster donor port and server port is 5 dB greater than the maximum gain, as recorded in the maximum gain test procedure (see 7.3), for the band under test. f) Verify the EUT shuts down, i.e., to mitigate the oscillations. If the booster does not shut down, measure and verify the peak oscillation level as follows. 1) Allow the spectrum analyzer trace to stabilize. 2) Place the marker at the highest oscillation level occurring within the span, and record its output level and frequency. 3) Set the spectrum analyzer center frequency to the frequency with the highest oscillation signal level, and reduce the span such that the upper and lower adjacent oscillation peaks are within the span. 4) Use the Minimum Search Marker function to find the lowest output level that is within the span, and within the operational band under test, and record its output level and frequency. 5) Affirm that the peak oscillation level measured in 7.11.3f2), does not exceed by 12.0 dB the minimal output level measured in 7.11.3f)4). Record the measurement results of 7.11.3f2) and 7.11.3f4) in tabular format for inclusion in the test report. 6) The procedure of 7.11.3f1) to 7.11.3.f5) allows the spectrum analyzer trace to stabilize, and verification of shutdown or oscillation level measurement must occur within 300 seconds.14 g) Decrease the variable attenuator in 1 dB steps, and repeat step 7.11.3f) for each 1 dB step. Continue testing to the level when the insertion loss for the center of band under test (isolation) between the booster donor port and server port is 5 dB lower than the maximum gain (see 7.3). h) Repeat 7.11.3a) to 7.11.3g) for all operational uplink and downlink bands.
Test results:	PASS

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6.10.2. Test Instruments

Equipment	Manufacturer	Model	S/N	Calibration Date	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Aug. 15, 2016	Aug. 11, 2017
Attenuation	AF115A-09-34	JFW	907763	Aug. 15, 2016	Aug. 11, 2017
RF Combiner	SUNVNDN	SUD-CS0800	16230009	Aug. 15, 2016	Aug. 11, 2017
AN03468	Band Pass Filter	4CS10-781.5/E12.2-O/O	N/A	Aug. 15, 2016	Aug. 11, 2017
AN03469	Band Pass Filter	4CS10-751.5/E12-O/O	N/A	Aug. 15, 2016	Aug. 11, 2017
AN02475	1 dB step Attenuator	8494B	N/A	Aug. 15, 2016	Aug. 11, 2017
AN03429	10dB step Attenuator	8496B	N/A	Aug. 15, 2016	Aug. 11, 2017
ANC00082	RF Coupler	722-10-1.500V	N/A	Aug. 15, 2016	Aug. 11, 2017

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

6.10.3. Test Data

Test results of detection time

Link	Detection Time (s)	Limit (s)	Result
Uplink	0.100	0.300	PASS
Downlink	0.090	1.000	PASS

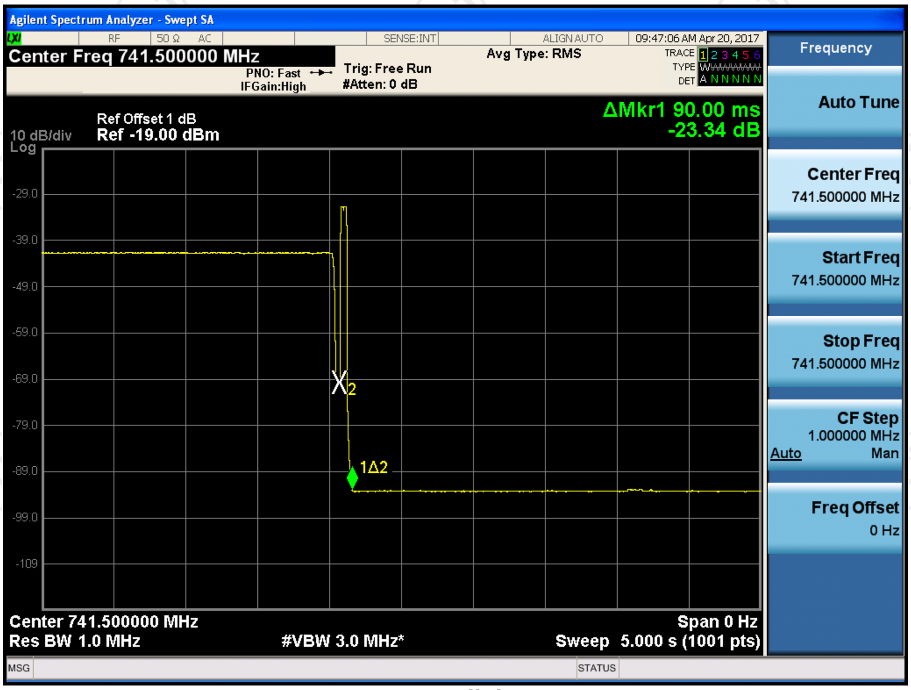
Test results of restarting time

Link	Restarting Time (s)	Limit (s)	Result
Uplink	112.2	⩾60.0	PASS
Downlink	112.2	⩾60.0	PASS

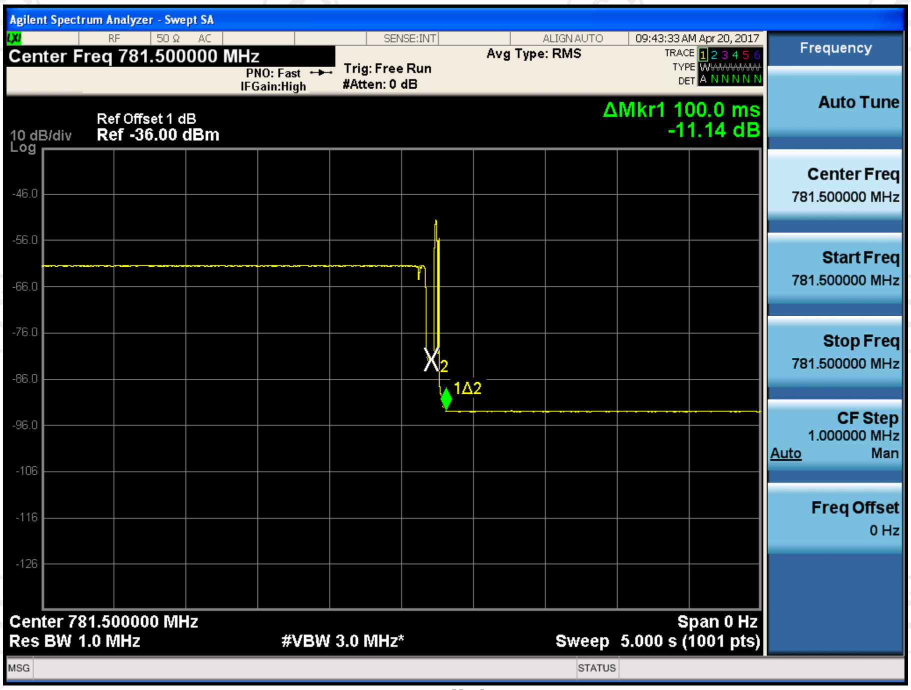
Test results of restarting count

Link	Restarting Counts	Limit	Result
Uplink	3	⩽5	PASS
Downlink	3	⩽5	PASS

Test Plots of detection time

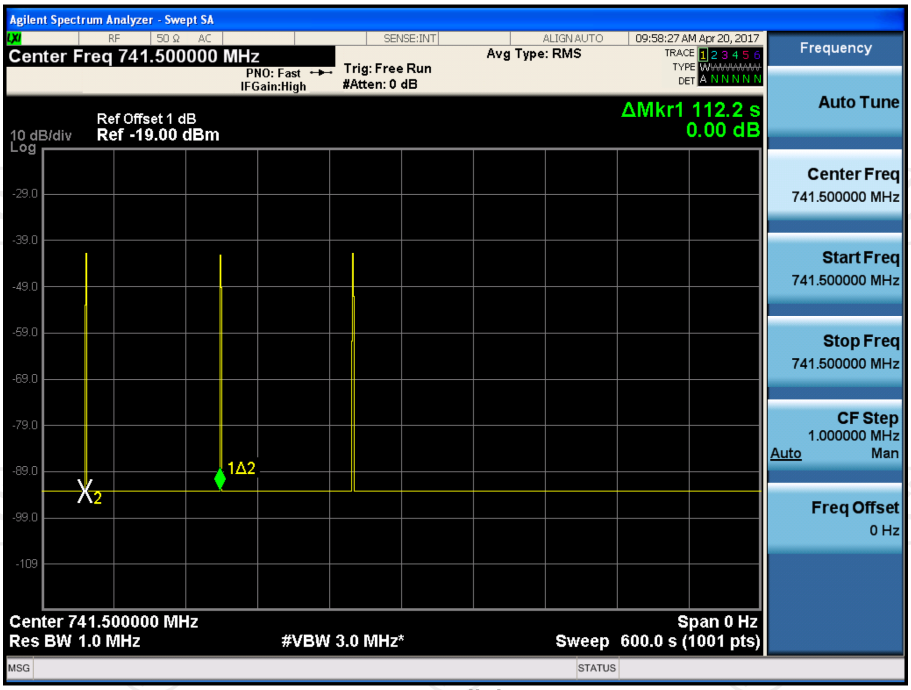


Downlink

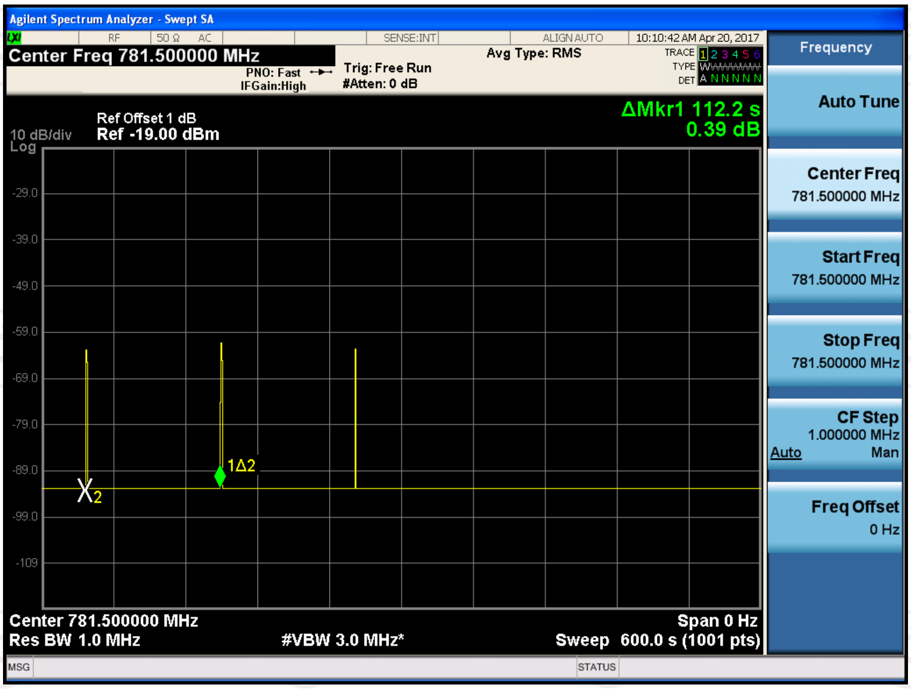


Uplink

Test Plots of restarting time



Downlink



Uplink

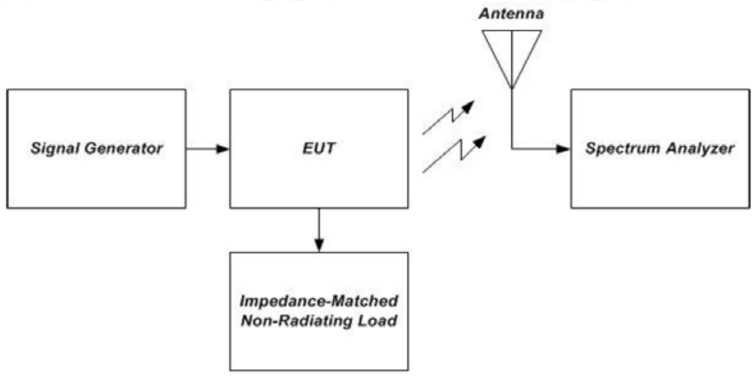
Test results of Mitigation or Shutdown

Oscillation Mitigation - Uplink									
Band	776-787MHz								
Test Signal Type	WCDMA								
Variable Attenuator Setting	Oscillations		Lowest Output Power Level		Margin	Limit	Time to Mitigate Oscillation	Mitigation Time Limit	Result
	Freq.	Level	Freq.	Level					
dB	MHz	dBm	MHz	dBm	dB	dB	sec	sec	
+5	780.5	-56	779.1	-66	-10	<12	116	< 300	Pass
+4	780.5	-70	779.1	-74	-4	<12	NA	< 300	Pass
+3	780.5	-71	779.1	-73	-2	<12	NA	< 300	Pass
+2	780.5	-69	779.1	-72	-3	<12	NA	< 300	Pass
+1	780.5	-68	779.1	-73	-5	<12	NA	< 300	Pass
+0	780.5	-68	779.1	-73	-5	<12	NA	< 300	Pass
-1	780.5	-67	779.1	-73	-6	<12	NA	< 300	Pass
-2	780.5	-73	779.1	-73	0	<12	NA	< 300	Pass
-3	780.5	-73	779.1	-72	1	<12	NA	< 300	Pass
-4	780.5	-73	779.1	-73	0	<12	NA	< 300	Pass
-5	780.5	-73	779.1	-72	1	<12	NA	< 300	Pass

Oscillation Mitigation - Downlink									
Band	746-757MHz								
Test Signal Type	WCDMA								
Variable Attenuator Setting	Oscillations		Lowest Output Power Level		Margin	Limit	Time to Mitigate Oscillation	Mitigation Time Limit	Result
	Freq.	Level	Freq.	Level					
dB	MHz	dBm	MHz	dBm	dB	dB	sec	sec	
+5	745.3	-56	742.9	-63	7	<12	NA	< 300	Pass
+4	745.3	-55	742.9	-68	-13	<12	NA	< 300	Pass
+3	745.3	-57	742.9	-69	-12	<12	NA	< 300	Pass
+2	745.3	-54	742.9	-63	-9	<12	NA	< 300	Pass
+1	745.3	-55	742.9	-68	-13	<12	84	< 300	Pass
+0	745.3	-71	742.9	-73	-2	<12	NA	< 300	Pass
-1	745.3	-71	742.9	-75	-4	<12	NA	< 300	Pass
-2	745.3	-74	742.9	-75	-1	<12	NA	< 300	Pass
-3	745.3	-71	742.9	-75	-4	<12	NA	< 300	Pass
-4	745.3	-75	742.9	-72	3	<12	NA	< 300	Pass
-5	745.3	-76	742.9	-76	0	<12	NA	< 300	Pass

7. Radiation Spurious Emission

7.1.1. Test Specification

Test Requirement:	FCC Part2 Section 2.1053
Test Method:	KDB835210 D03 Signal booster measurements v04
Limit:	-13dBm
Test setup:	 Figure 10 – Radiated spurious emissions test and instrumentation setup
Test Procedure:	a) Place the EUT on an OATS or semi-anechoic chamber turntable 3 m from the receiving antenna.15 b) Connect the EUT to the test equipment as shown in Figure 10 beginning with the uplink output (donor) port. c) Set the signal generator to produce a CW signal with the frequency set to the center of the operational band under test, and the power level set at PIN as determined from measurement results per 7.2. d) Measure the radiated spurious emissions from the EUT from the lowest to the highest frequencies as specified in § 2.1057. Maximize the radiated emissions by using the procedures described in ANSI C63.4. e) Capture the peak emissions plots using a peak detector with Max-Hold for inclusion in the test report. Tabular data is acceptable in lieu of spectrum analyzer plots. f) Repeat 7.12c) through 7.12e) for all uplink and downlink operational bands.
Test results:	PASS

7.1.2. Test Instruments

Radiated Emission				
Name	**Model No.**	**Manufacturer**	**Date of Cal.**	**Due Date**
Test Receiver	ESVD	R&S	Aug. 12, 2016	Aug. 11, 2017
Spectrum Analyzer	FSEM	R&S	Aug. 12, 2016	Aug. 11, 2017
Pre-amplifier	8447D	H.P.	Aug. 12, 2016	Aug. 11, 2017
BiConiLog Antenna	VULB9163	Schwarzbeck Mess-Elecktronik	Aug. 14, 2016	Aug. 13, 2017
Coaxial Cable	N/A	TCT	Aug. 13, 2016	Aug. 12, 2017
Coaxial Cable	N/A	TCT	Aug. 13, 2016	Aug. 12, 2017
Coaxial Cable	N/A	TCT	Aug. 13, 2016	Aug. 12, 2017
Coaxial Cable	N/A	TCT	Aug. 13, 2016	Aug. 12, 2017
Loop antenna	ZN30900A	ZHINAN	Aug. 14, 2016	Aug. 13, 2017
Signal Generator	N5182A	Agilent	Aug. 13, 2016	Aug. 12, 2017

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

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7.1.1. Test data

Frequency [MHz]	Antenna polarity [H/V]	Level [dBm]	Limit [dBm]	Margin [dB]
Downlink				
39.70	V	-50.69	-13.00	37.00
47.94	H	-42.37		29.99
105.66	H	-50.26		37.66
142.03	H	-48.54		35.98
--	--	--		--
Uplink				
39.70	V	-56.33	-13.00	43.92
73.16	V	-55.69		42.64
104.20	H	-53.67		40.27
141.55	H	-50.50		37.93
--	--	--		--

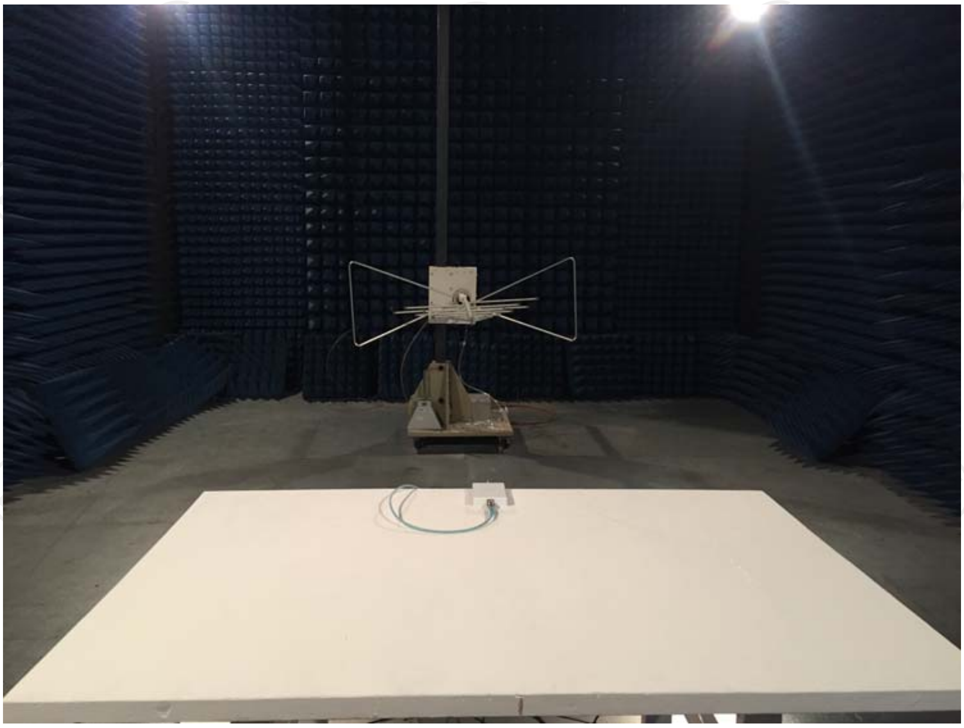
Note: *Test Frequency range is up to 10GHz, and the test data below 30MHz and above 1000MHz is too lower than the limit, so not show in this report.*

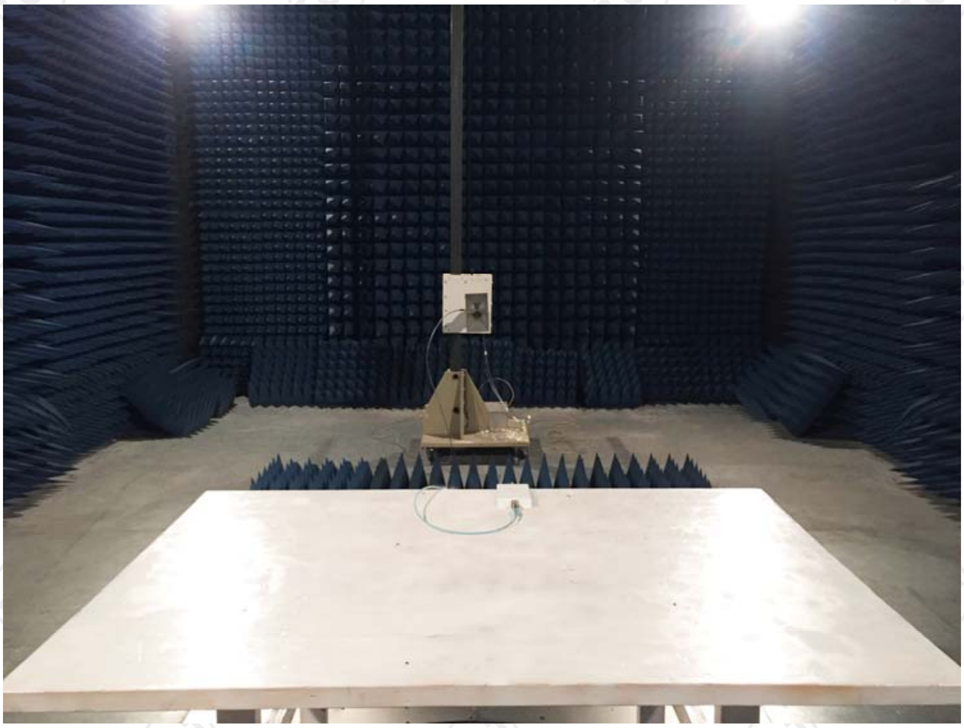
Appendix A: Photographs of Test Setup

Product: Cell phone signal booster

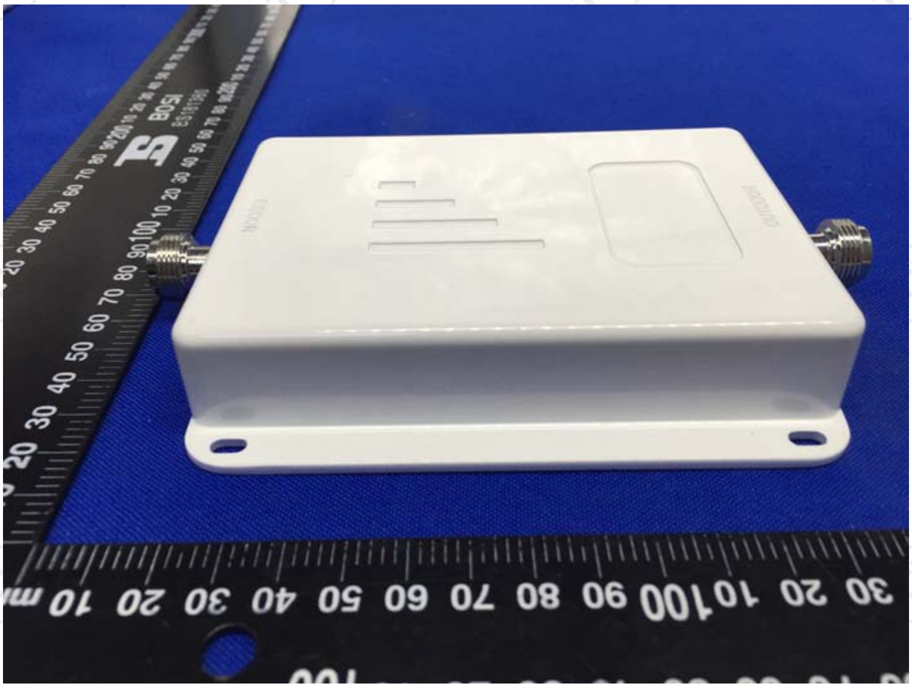
Model: PLX-XWV70

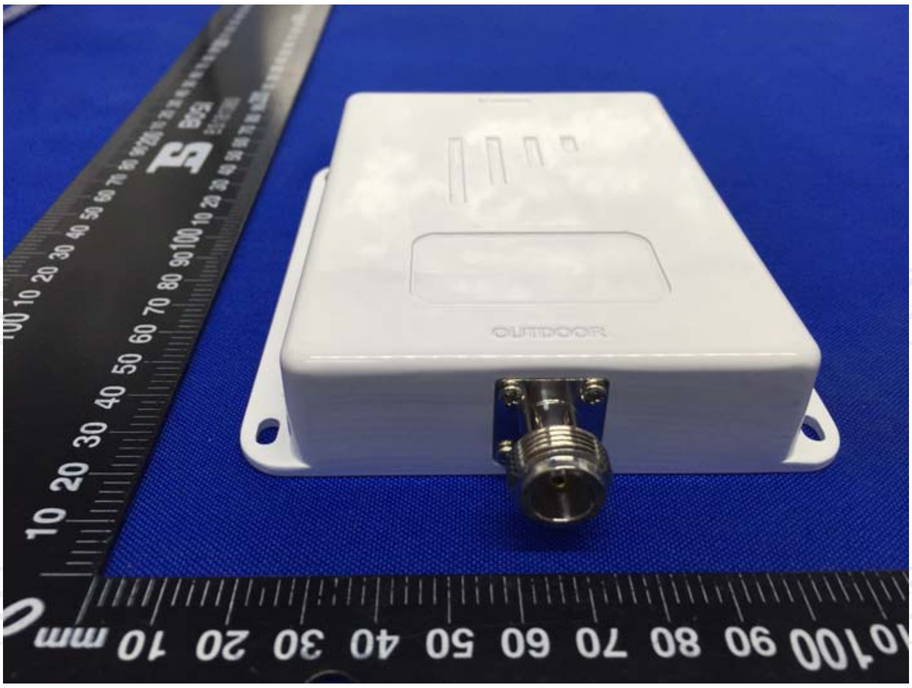
Radiated Emission

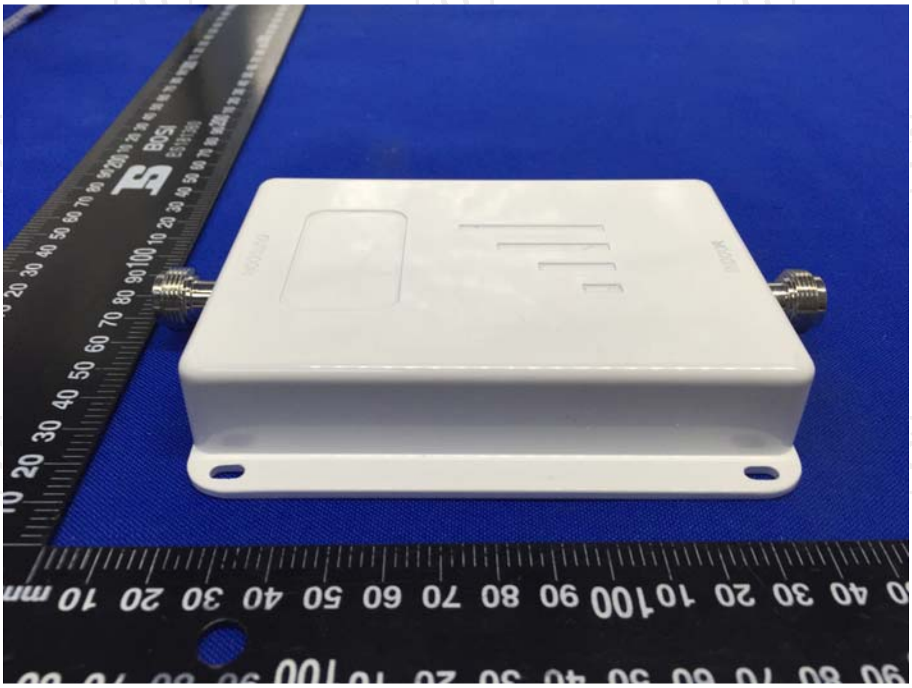


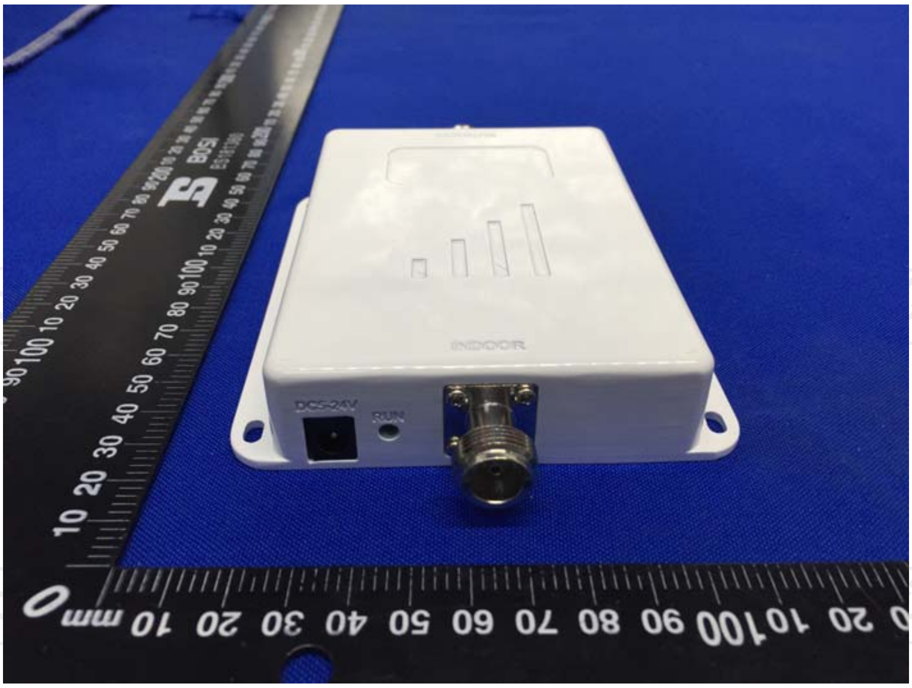


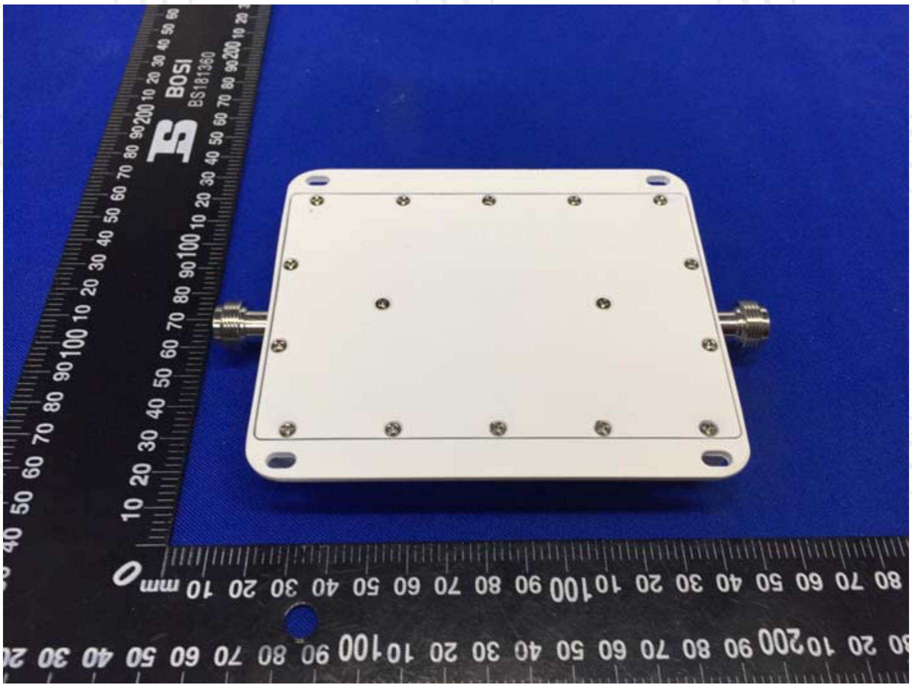
Appendix B: Photographs of EUT
Product: Cell phone signal booster
Model: PLX-XWV70
External Photos



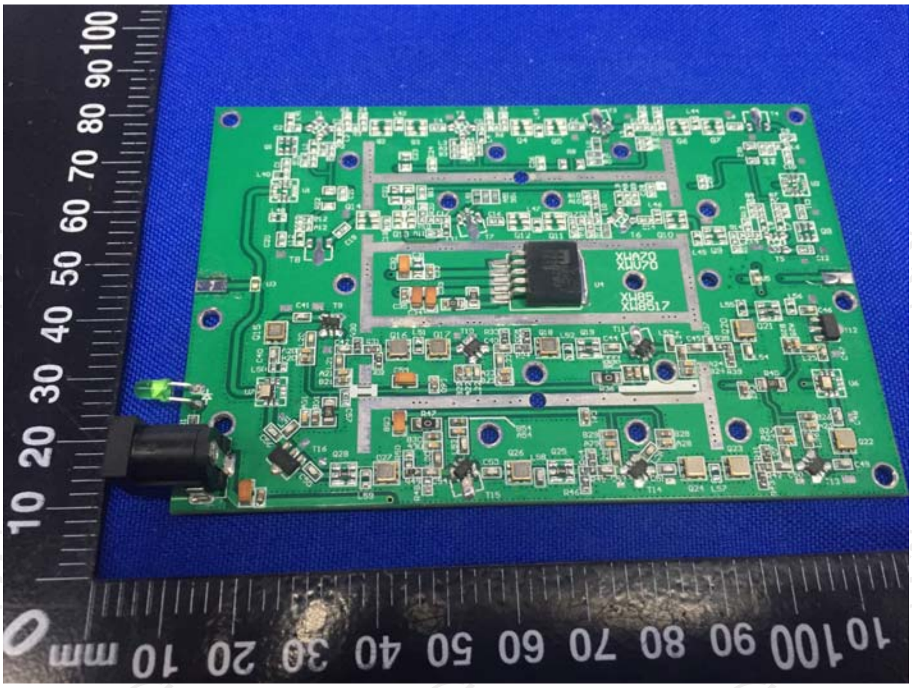

OUTDOOR

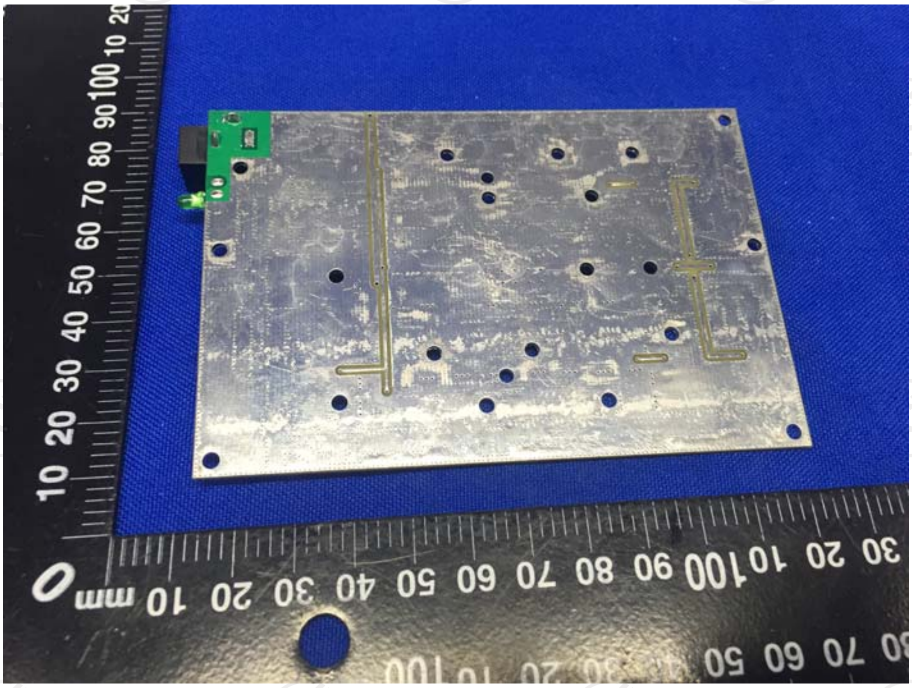



DC5-24V
RUN
INDOOR



Product: Cell phone signal booster
Model No.: PLX- XWV70
Internal Photos





*****END OF REPORT*****