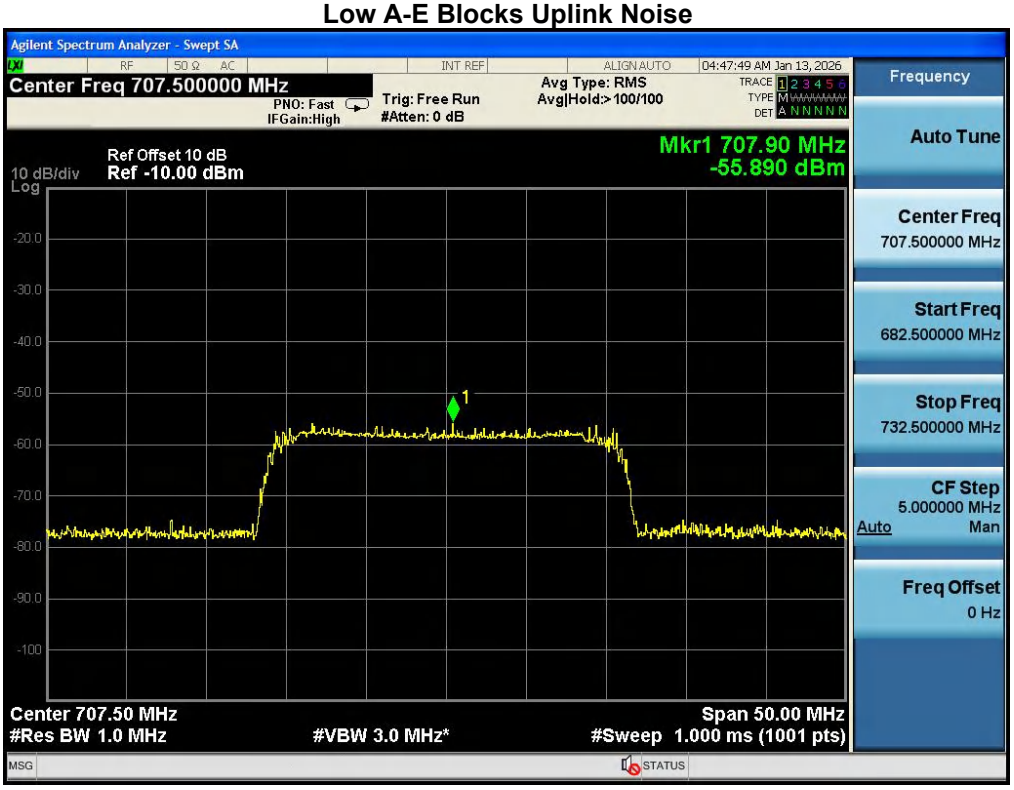
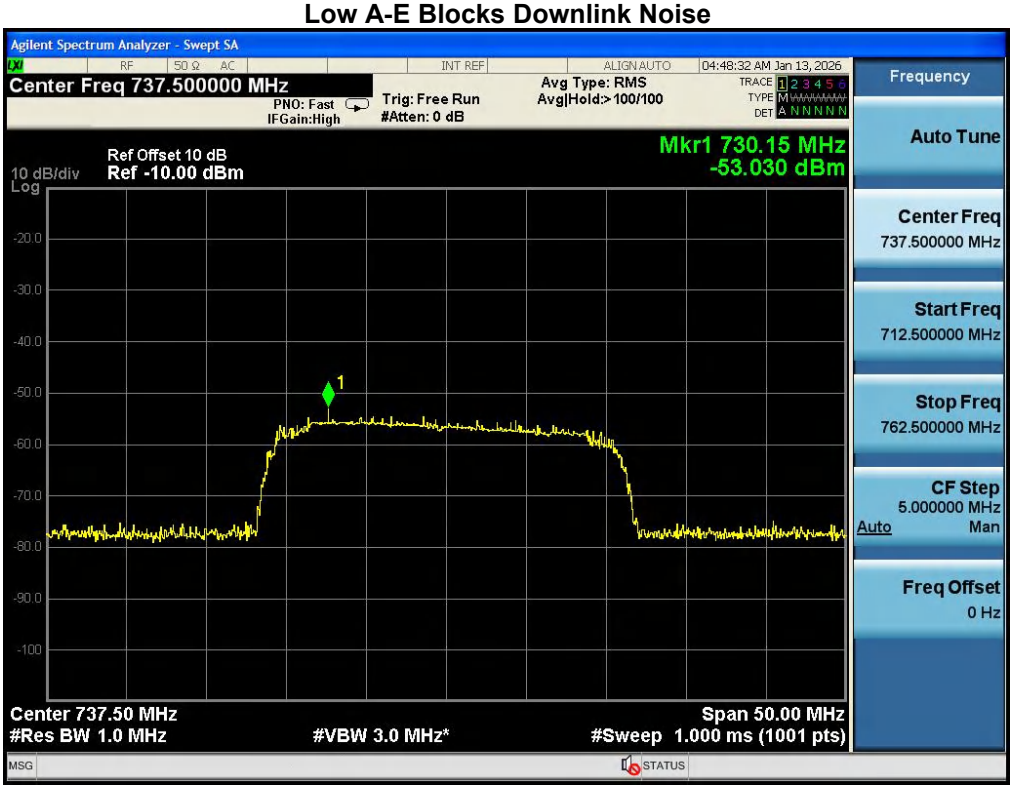
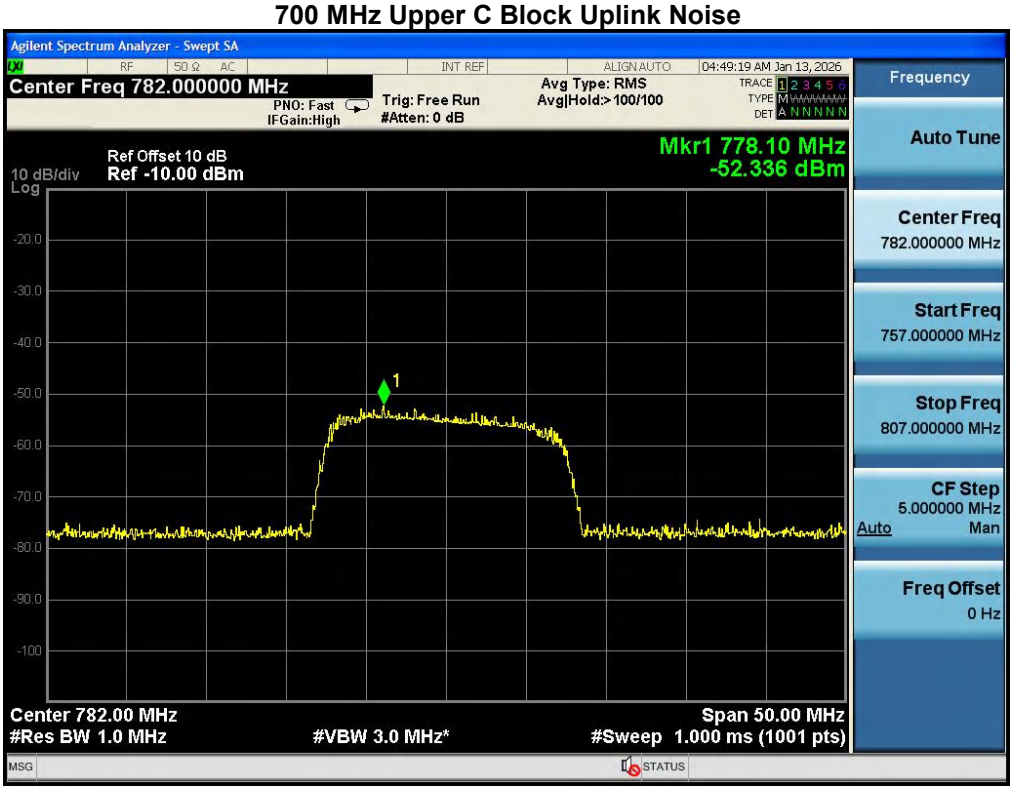
Low A-E Blocks Uplink Noise



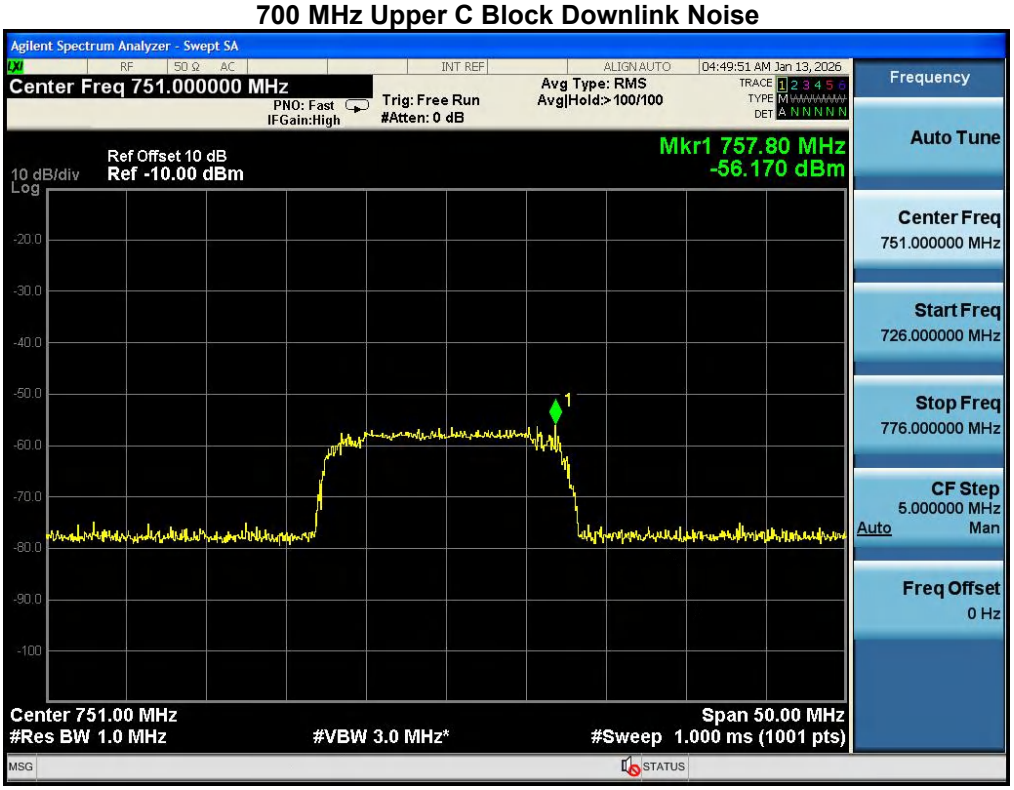
Low A-E Blocks Downlink Noise



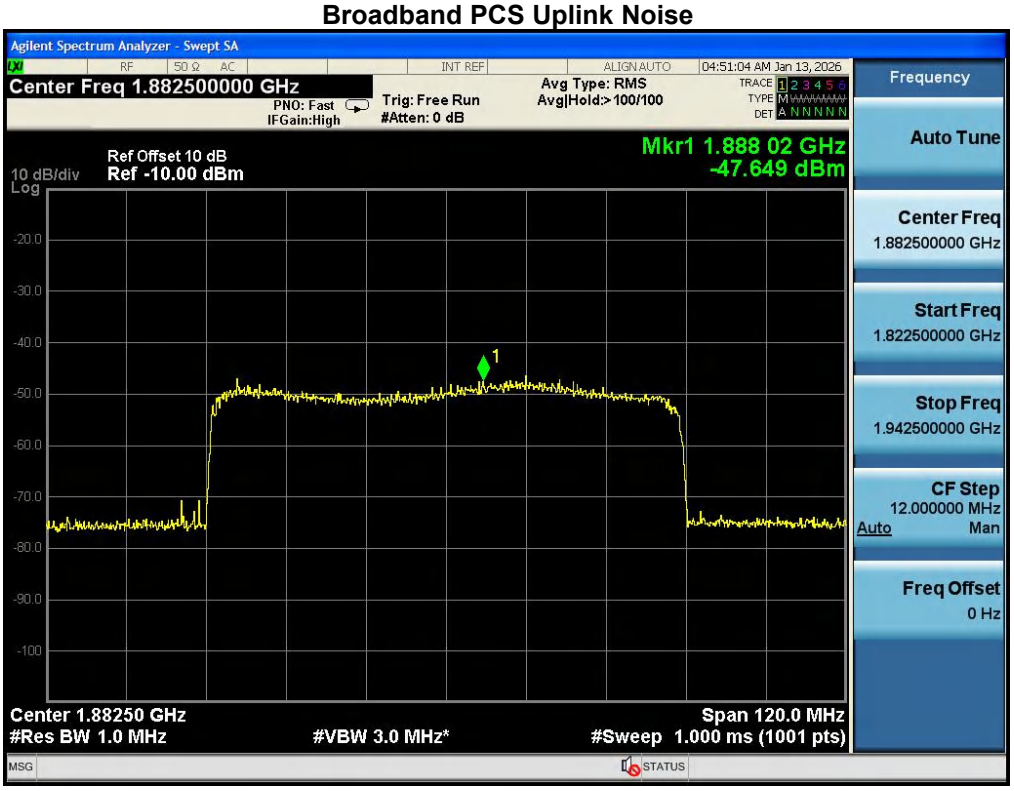
700 MHz Upper C Block Uplink Noise



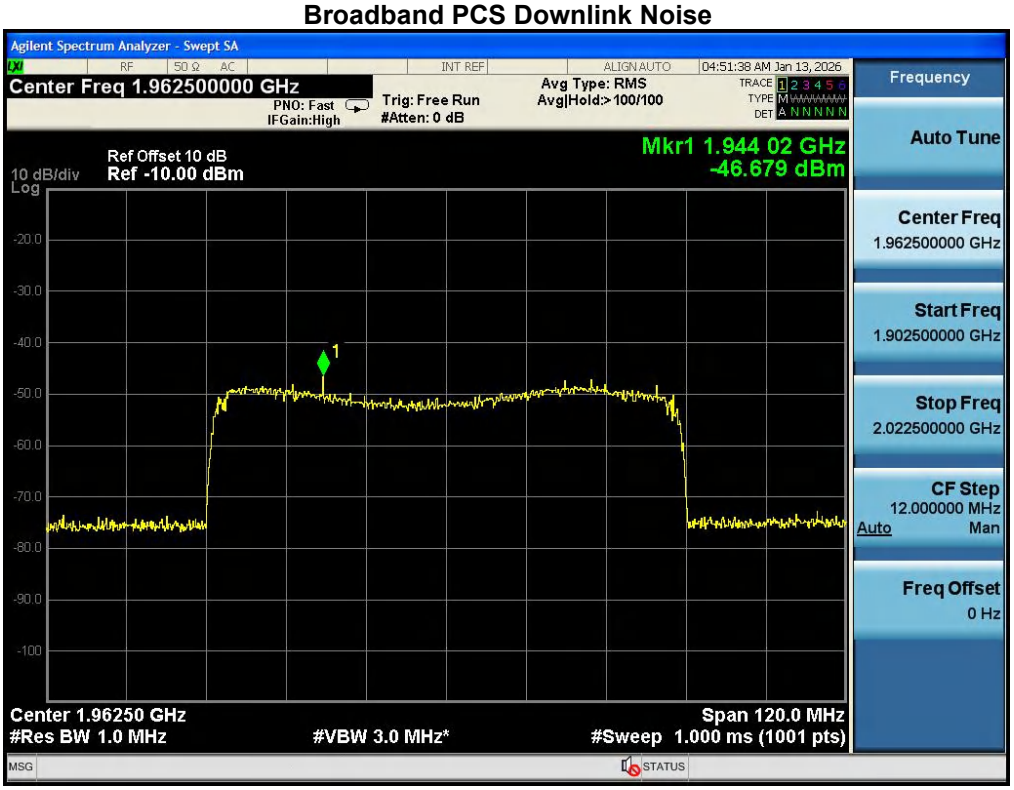
700 MHz Upper C Block Downlink Noise



Broadband PCS Uplink Noise



Broadband PCS Downlink Noise



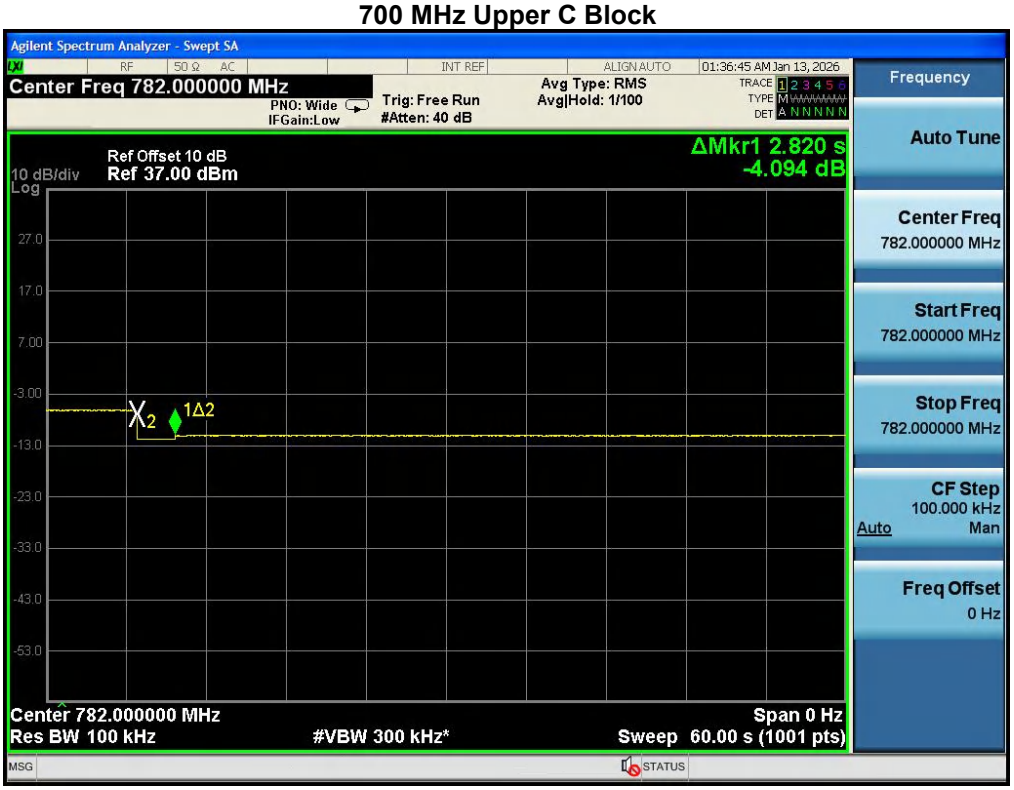
Variable Noise Timing Test Plots

Cellular

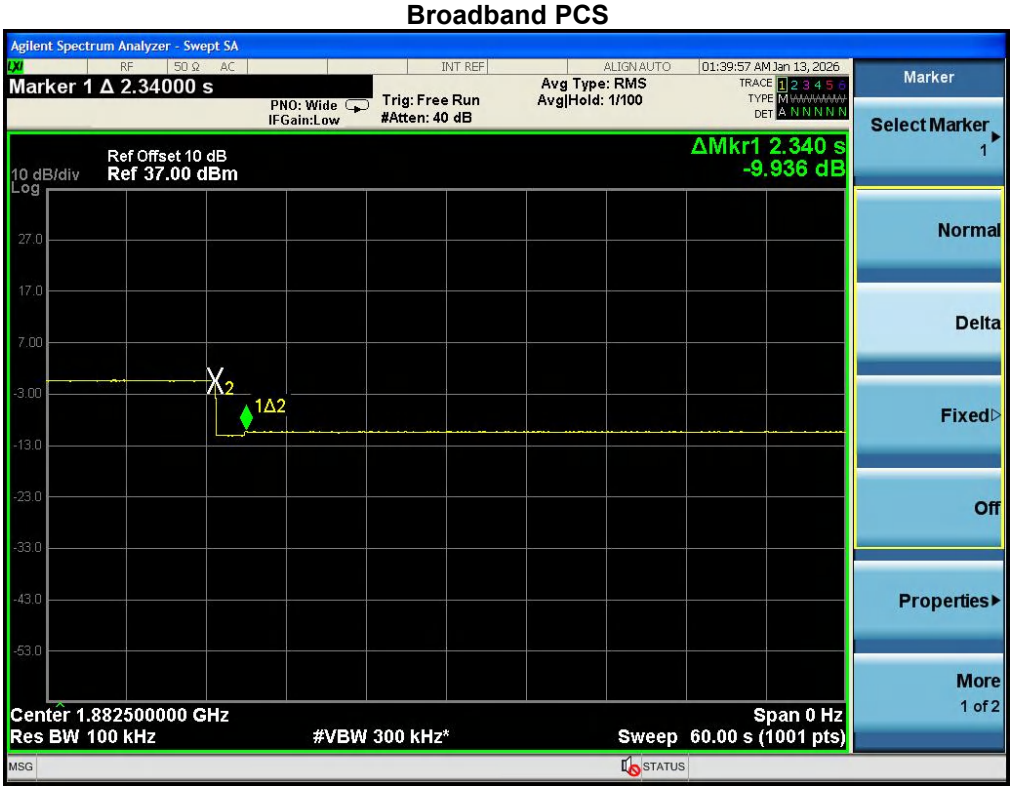
AWS-1

Low A-E Blocks

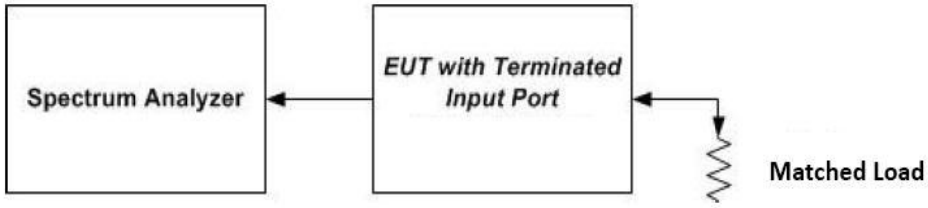
700 MHz Upper C Block



Broadband PCS



6.8 Uplink Inactivity

Test Requirement:	This measurement procedure is intended to demonstrate compliance to the uplink inactivity requirements specified for Wideband Consumer Signal Boosters in §20.21(e)(8)(i)(I).
Limit:	20.21(e), When a consumer booster is not serving an active device connection after 5 minutes the uplinknoise power shall not exceed -70 dBm/MHz.
Test Setup:	 Figure 3 – Noise limit test setup (also used for 7.8)
Procedure:	a) Connect the EUT to the test equipment as shown in Figure 3 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 sections 7.7.1- 7.7.5. l) Repeat steps 7.8.3 to 7.8.10 for all operational uplink bands. Note: Some signal boosters will require a signal generator input as they will not operate unless a signal is received at the input terminals. If this is the case connect a signal generator and cycle the RF output to simulate this function.

6.8.1 E.U.T. Operation:

Operating Environment:	
Temperature:	−30 °C and +50
Humidity:	46.3 %
Atmospheric Pressure:	1010 mbar

6.8.2 Test Data:

Operation Bands			
	Uplink Inactivity Measured(s)	Limit(s)	Result
Cellular	188.7	300.0	PASS
AWS-1	123.6	300.0	PASS
Low A-E Blocks	158.6	300.0	PASS
700 MHz Upper C Block	145.3	300.0	PASS
Broadband PCS	143.2	300.0	PASS

Cellular

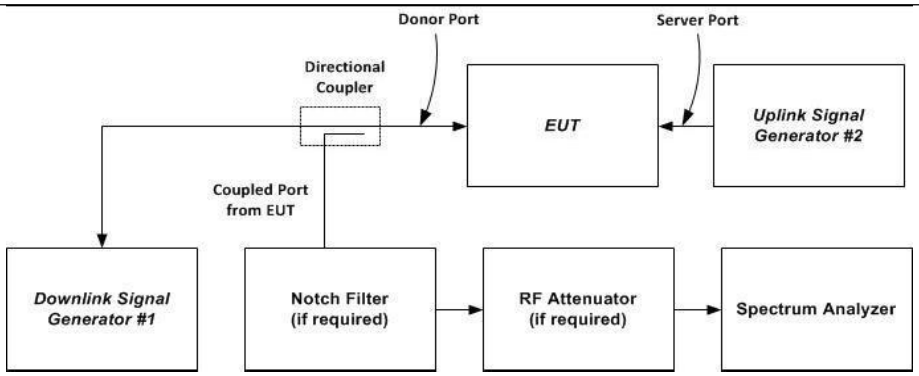
AWS-1

Low A-E Blocks

700 MHz Upper C Block

Broadband PCS

6.9 Variable Booster Gain

Test Requirement:	This procedure shall be used to demonstrate compliance to the Booster Gain Limits specified for Wideband Consumer Signal Boosters in §21(e)(8)(i)(C). The variable booster gain limits are expressed as a function of RSSI and MSCL. The RSSI is varied over a range of values as specified within the procedure. Refer to Annex B of this document for guidance with respect to determining the applicable MSCL value.
Limit:	-34 dB -RSSI + MSCL
Test Setup:	
Procedure:	a) Connect the EUT to the test equipment as shown in Figure 6 with the uplink output connected to signal generator 1. Ensure the coupled path of the RF coupler is connected to the spectrum analyzer. b) Configure downlink signal generator #1 for AWGN operation with an 99% occupied bandwidth 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 5 dB below the AGC level from section 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 tool. g) Select the RMS (power averaging) detector. h) Ensure that the number of measurement points per sweep ≥ (2 x span)/RBW. i) Sweep time = auto couple or as necessary. 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 to a level from -90 to -10 dBm in 1 dB steps inside the RSSI dependent region and 10 dB steps outside the RSSI dependent region and report the six values closest to the limit, including at least two points from within the RSSI dependent region of operation. l) Repeat 7.9.3 – 7.9.11 for all operational uplink bands. m) Variable Uplink gain timing is to be measured as follows. n) Set the spectrum analyzer to the uplink frequency to be measured. o) Set the span to 0 Hz with a sweep time of 10 seconds. p) Set the power level of signal generator 1 to the lowest level of the RSSI dependent gain. q) Select MAX HOLD and increase the power level of signal generator 1 by 10 dB for mobile booster and 20 dB for fixed indoor boosters. r) Ensure that the Uplink gain decrease to the specified levels within 1 second for mobile devices and 3 seconds for fixed devices. s) Repeat 7.9.13 – 7.9.18 for all operational uplink bands.

6.9.1 E.U.T. Operation:

Operating Environment:	
Temperature:	−30 °C and +50
Humidity:	46.3 %
Atmospheric Pressure:	1010 mbar

6.9.2 Test Data:

MSCL Calculation							
Operation Bands	Frequency (MHz)	Distance (m)	Path loss (dB)	Indoor Antenna Gain(dBi)	Indoor Cable Loss(dB)	Polarity Loss(dB)	MSCL (dB)
Cellular	869	2	37.30	0	0	9.03	46.33
AWS-1	2110	2	45.01	1.8	0	9.03	52.24
Broadband PCS	1930	2	44.23	1.8	0	9.03	51.46
Low A-E Blocks	729	2	35.78	0	0	9.03	44.81
700 MHz Upper C Block	746	2	35.98	0	0	9.03	45.01

Note : Path loss = 20logf + 20logd – 27.5

Polarity loss = 20Log (2/Sin (45deg)) dB = 9.03dB

Variable booster gain							
Operation Band	RSSI (dBm)	Input Power (dBm)	Output Power (dBm)	Measured Gain (dB)	MSCL	Limit	Results
Cellular	-52	-41	11.89	52.89	46.33	64.33	PASS
	-51	-41	10.47	51.47	46.33	63.33	PASS
	-48	-41	9.98	50.98	46.33	60.33	PASS
	-46	-41	7.85	48.85	46.33	58.33	PASS
	-43	-41	5.58	46.58	46.33	55.33	PASS
	-41	-41	4.75	45.75	46.33	53.33	PASS
AWS-1	-52	-41	11.52	52.52	52.24	70.24	PASS
	-50	-41	10.21	51.21	52.24	68.24	PASS
	-47	-41	9.75	50.75	52.24	65.24	PASS
	-45	-41	8.14	49.14	52.24	63.24	PASS
	-43	-41	7.08	48.08	52.24	61.24	PASS
	-42	-41	6.58	47.58	52.24	60.24	PASS
Broadband PCS	-53	-41	10.86	51.86	51.46	70.46	PASS
	-51	-41	9.86	50.86	51.46	68.46	PASS
	-50	-41	7. 57	48.57	51.46	67.46	PASS
	-45	-41	6.39	47.39	51.46	62.46	PASS
	-40	-41	5.25	46.25	51.46	57.46	PASS
	-39	-41	4.22	45.22	51.46	56.46	PASS
Low A-E Blocks	-52	-41	11.28	52.28	44.81	62.81	PASS
	-50	-41	9.96	50.96	44.81	60.81	PASS
	-49	-41	8.08	49.08	44.81	59.81	PASS
	-46	-41	5.57	46.57	44.81	56.81	PASS
	-40	-41	4.86	45.86	44.81	50.81	PASS
	-38	-41	2.09	43.09	44.81	48.81	PASS
700 MHz Upper C Block	-52	-41	11.38	52.38	45.01	63.01	PASS
	-50	-41	9.57	50.57	45.01	61.01	PASS
	-49	-41	8.47	49.47	45.01	60.01	PASS
	-46	-41	6.58	47.58	45.01	57.01	PASS
	-40	-41	5.81	46.81	45.01	51.01	PASS
	-38	-41	3.55	44.55	45.01	49.01	PASS

Variable Uplink Gain Timing

Variable Uplink Gain Timing			
Operation Band	Measured Sec	Limit Sec	Result
Cellular	1.550	3.0	PASS
AWS-1	0.759	3.0	PASS
Low A-E Blocks	1.389	3.0	PASS
700 MHz Upper C Block	1.500	3.0	PASS
Broadband PCS	1.252	3.0	PASS

Cellular

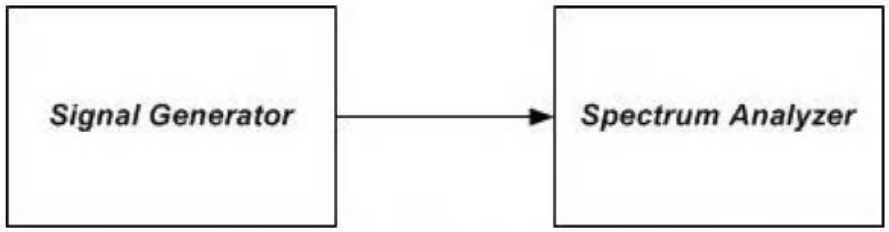
AWS-1

Low A-E Blocks

700 MHz Upper C Block

Broadband PCS

6.10 Occupied Bandwidth

Test Requirement:	This measurement is required to compare the uniformity of the output signal relative to the input signal and to satisfy the requirements of §2.1049.
Test setup:	 Figure 6 – Test setup for measuring characteristics of test signals used for subsequent EUT occupied bandwidth testing
Procedure:	a) Connect the test equipment as shown in Figure 7 to measure the characteristics of the test signals produced by the signal generator. b) Set VBW to ≥ 3X 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 occupied bandwidth as necessary for accurately viewing the signals. d) Set the signal generator for power level to match the values obtained in section 7.2. e) Set the signal generator modulation type for GSM with a PBRS 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 emissions bandwidth. g) Capture the spectrum analyzer trace for inclusion in the test report. h) Repeat steps 7.10.3 – 7.10.7 for CDMA and WCDMA modulation adjusting the span as necessary for all uplink and downlink operational bands. [AWGN or LTE may be used in place of WCDMA, as an option] i) Connect the test equipment as shown in Figure 1. Begin with the uplink output connected to the spectrum analyzer j) Repeat steps 7.10.3 – 7.10.8 in this new configuration.

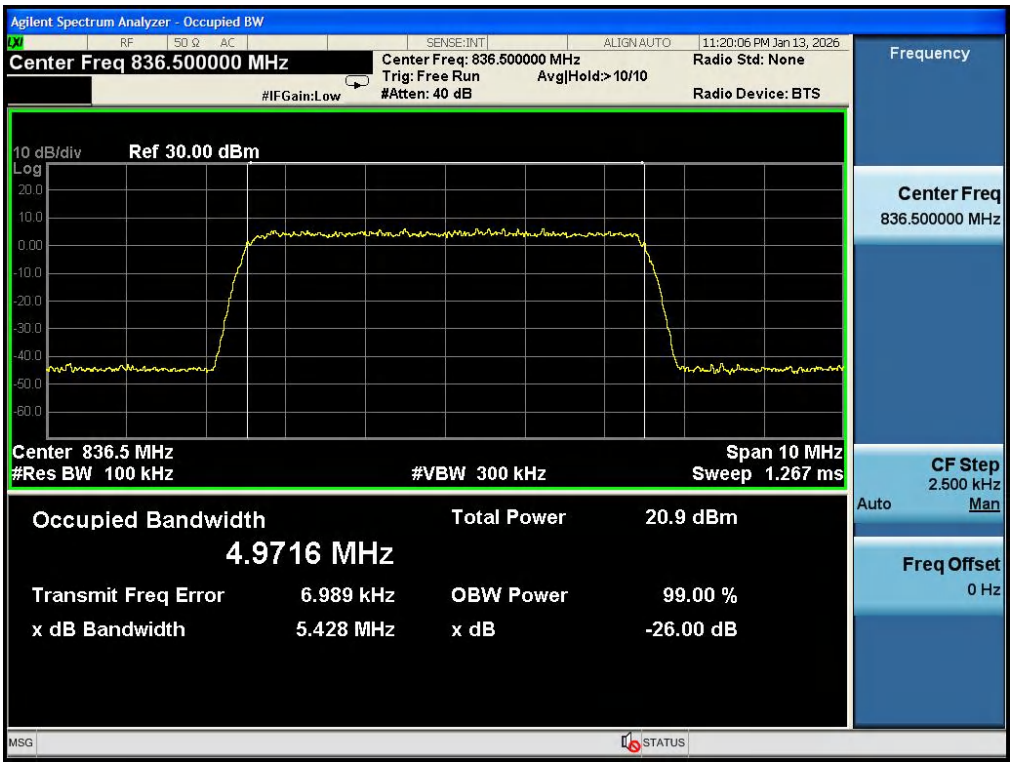
6.10.1E.U.T. Operation:

Operating Environment:	
Temperature:	−30 °C and +50
Humidity:	46.3 %
Atmospheric Pressure:	1010 mbar

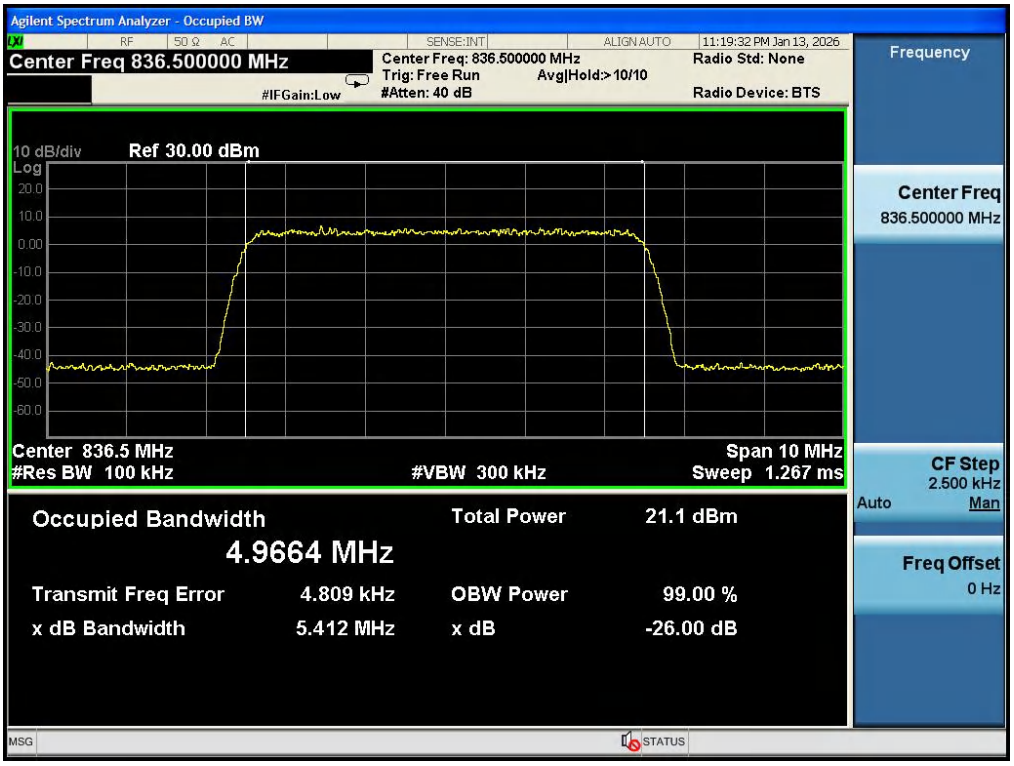
6.10.2Test Data:

Operation Band		Signal	Input OBW [MHz]	Output OBW [MHz]	Results
Uplink	Cellular	AWGN	4.9716	4.9664	PASS
	AWS-1	AWGN	4.9631	4.9541	PASS
	Low A-E Blocks	AWGN	4.9620	4.9571	PASS
	700 MHz Upper C Block	AWGN	4.9593	4.9679	PASS
	Broadband PCS	AWGN	4.9662	4.9683	PASS
Downlink	Cellular	AWGN	4.9573	4.9681	PASS
	AWS-1	AWGN	4.9643	4.9659	PASS
	Low A-E Blocks	AWGN	4.9580	4.9689	PASS
	700 MHz Upper C Block	AWGN	4.9575	4.9645	PASS
	Broadband PCS	AWGN	4.9549	4.9626	PASS

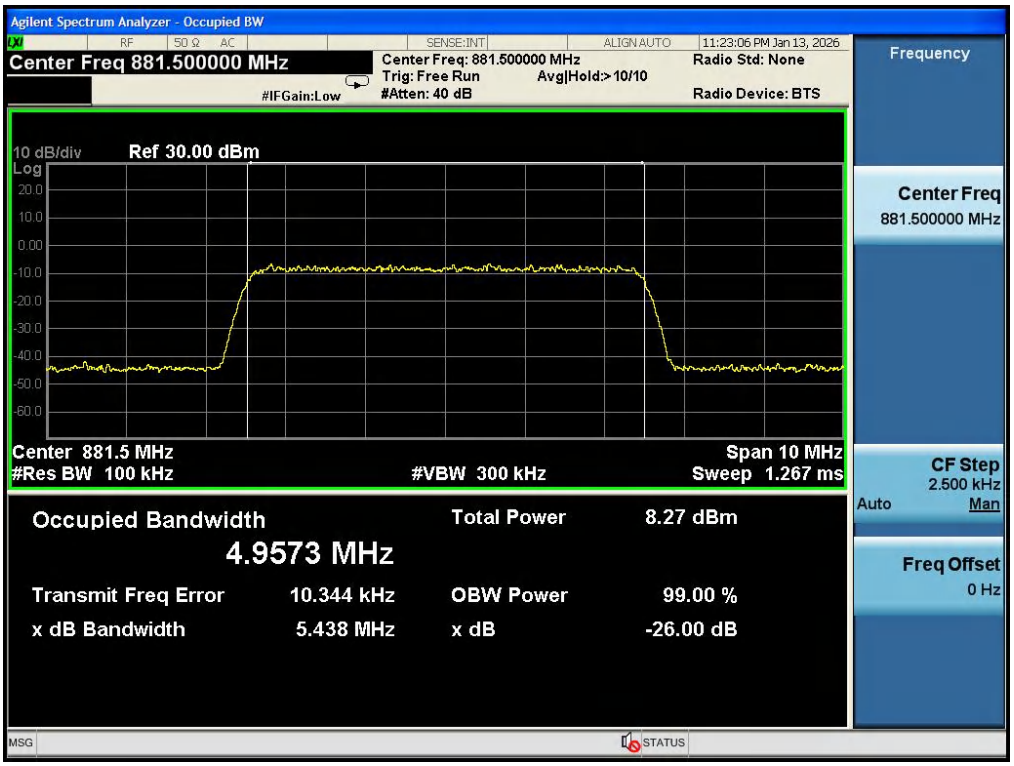
Cellular AWGN UL Input



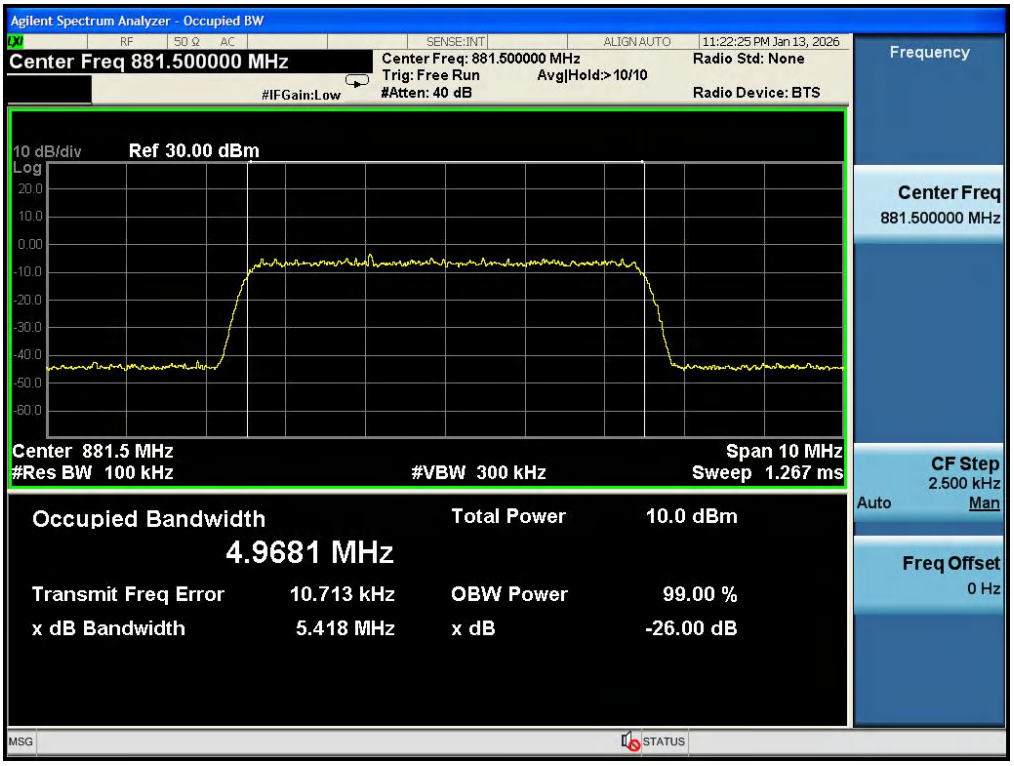
Cellular AWGN UL output



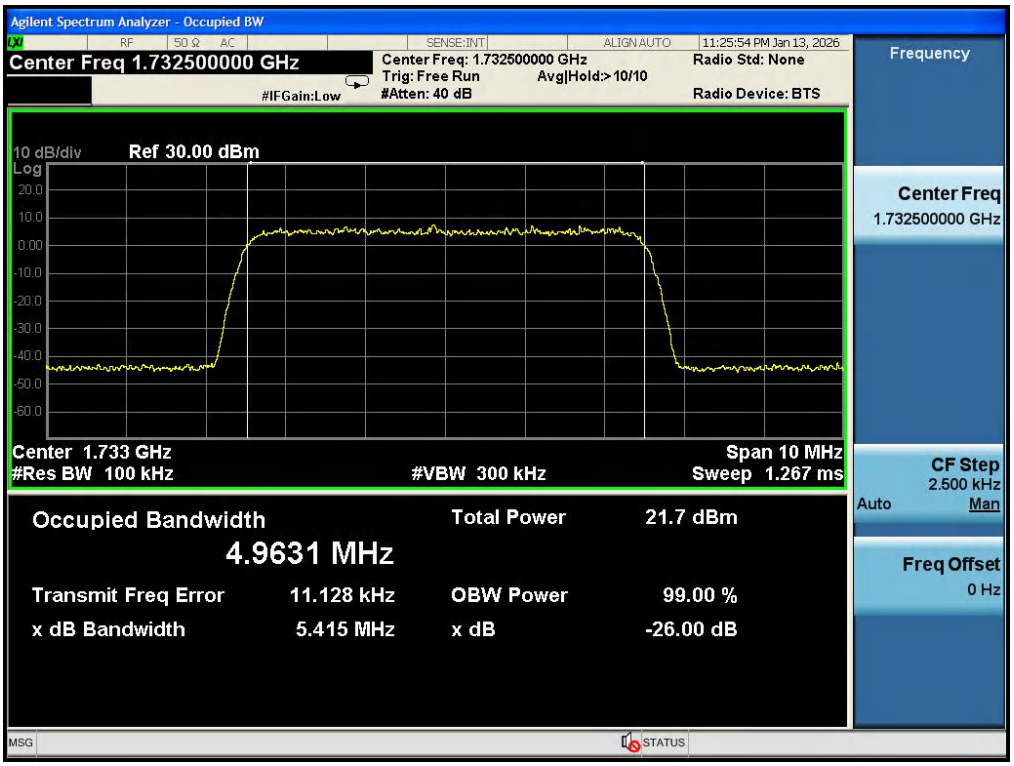
Cellular AWGN DL Input



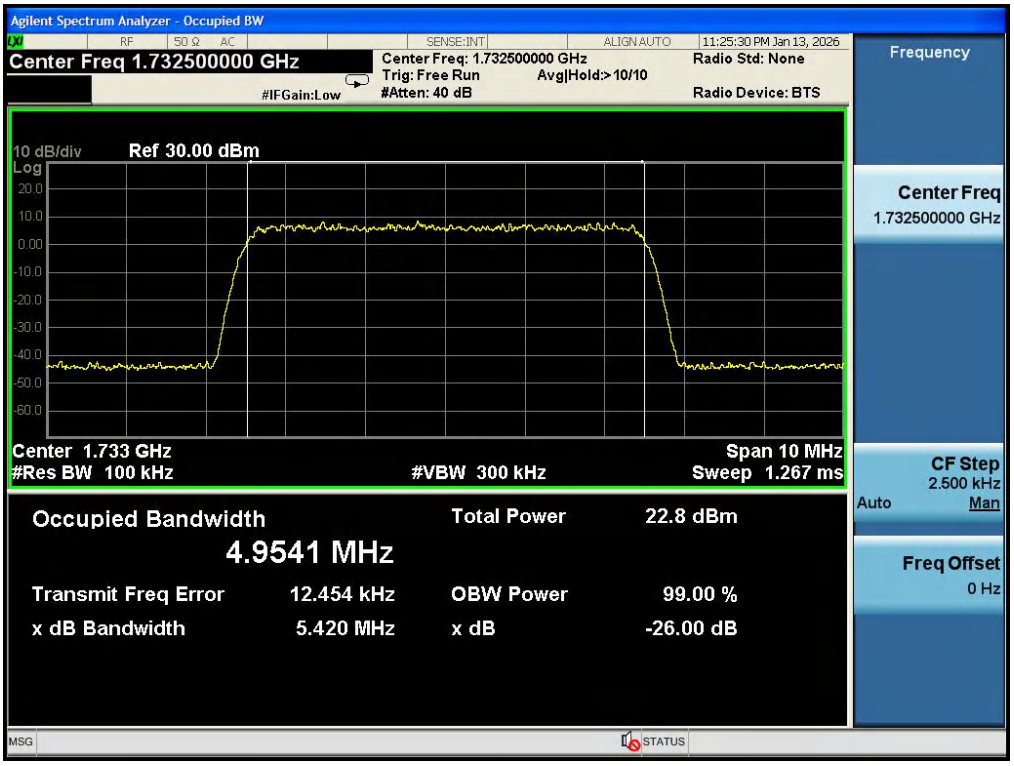
Cellular AWGN DL output



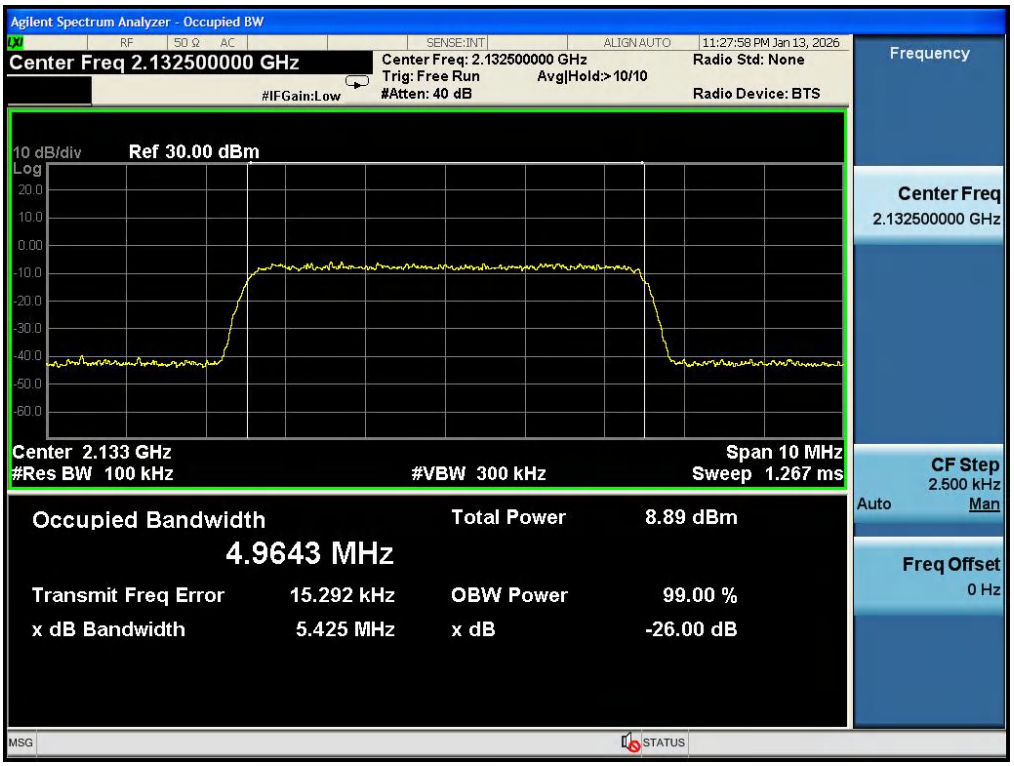
AWS-1 AWGN UL Input



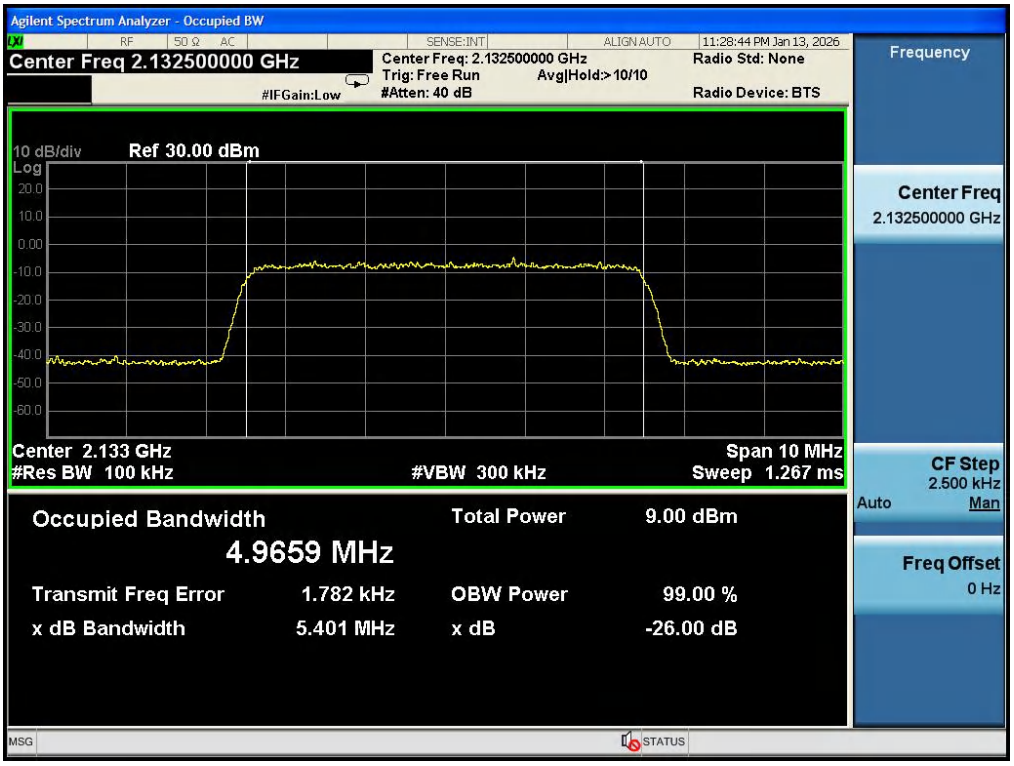
AWS-1 AWGN UL output



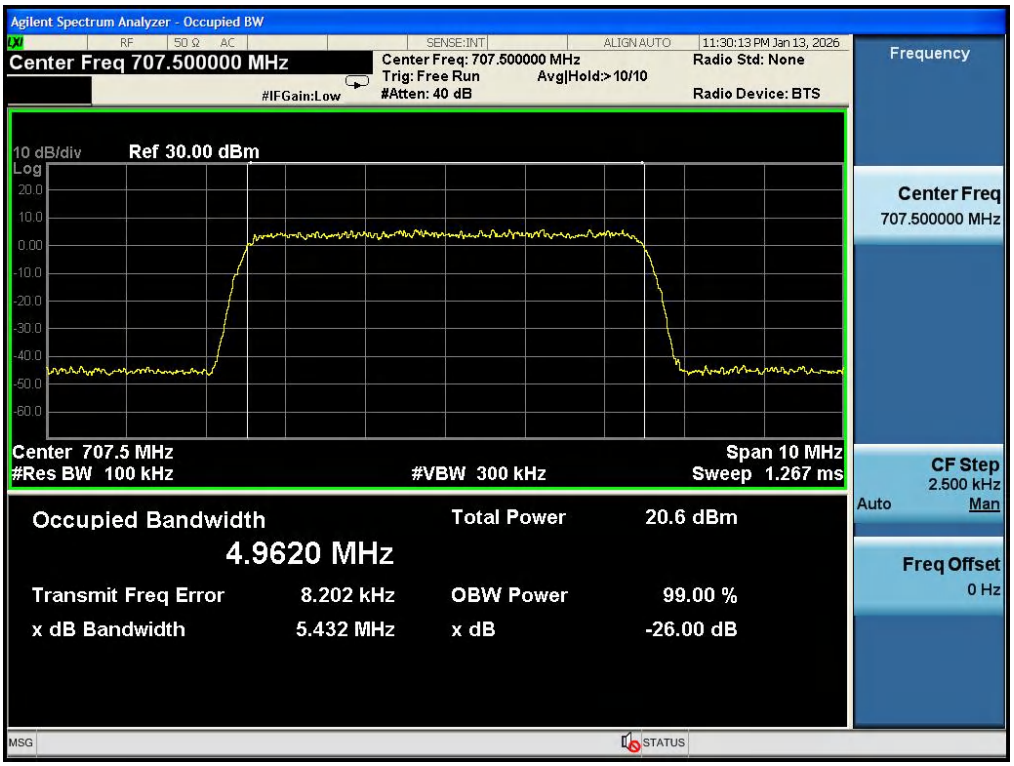
AWS-1 AWGN DL Input



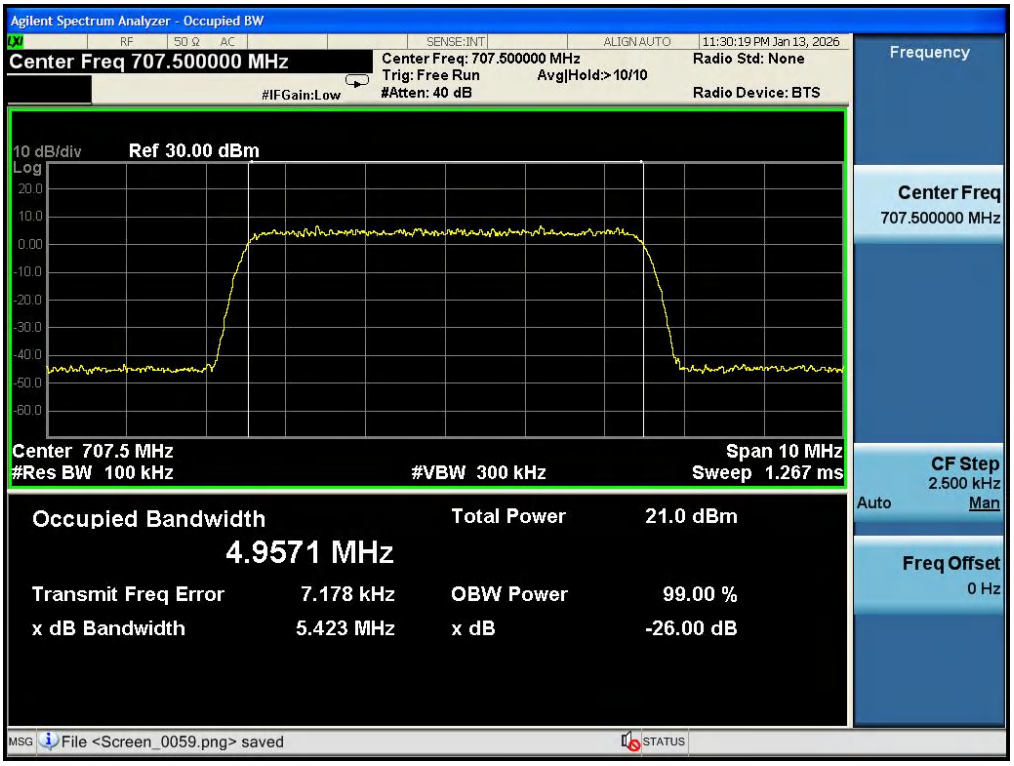
AWS-1 AWGN DL output



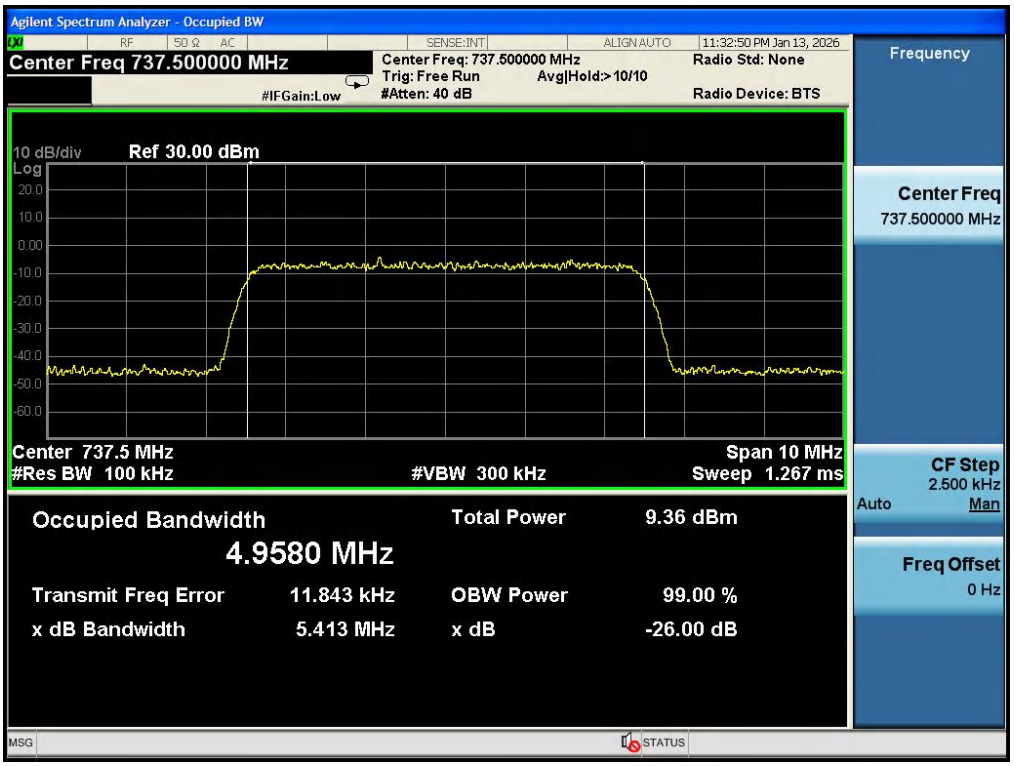
Low A-E Blocks UL Input



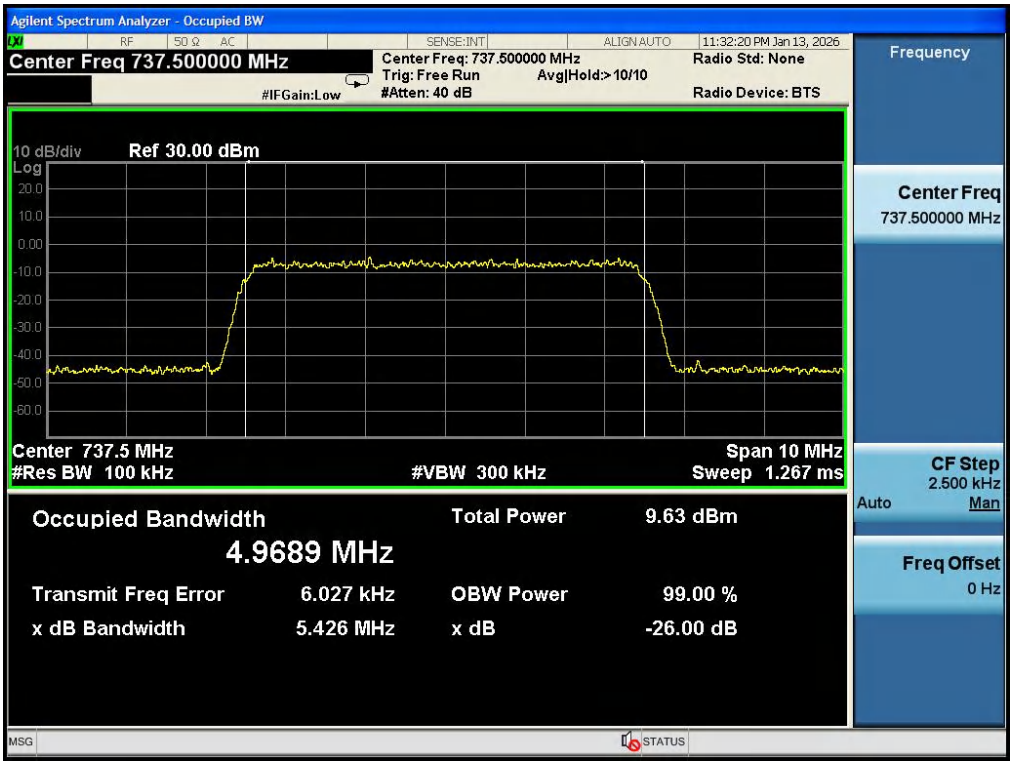
Low A-E Blocks UL output



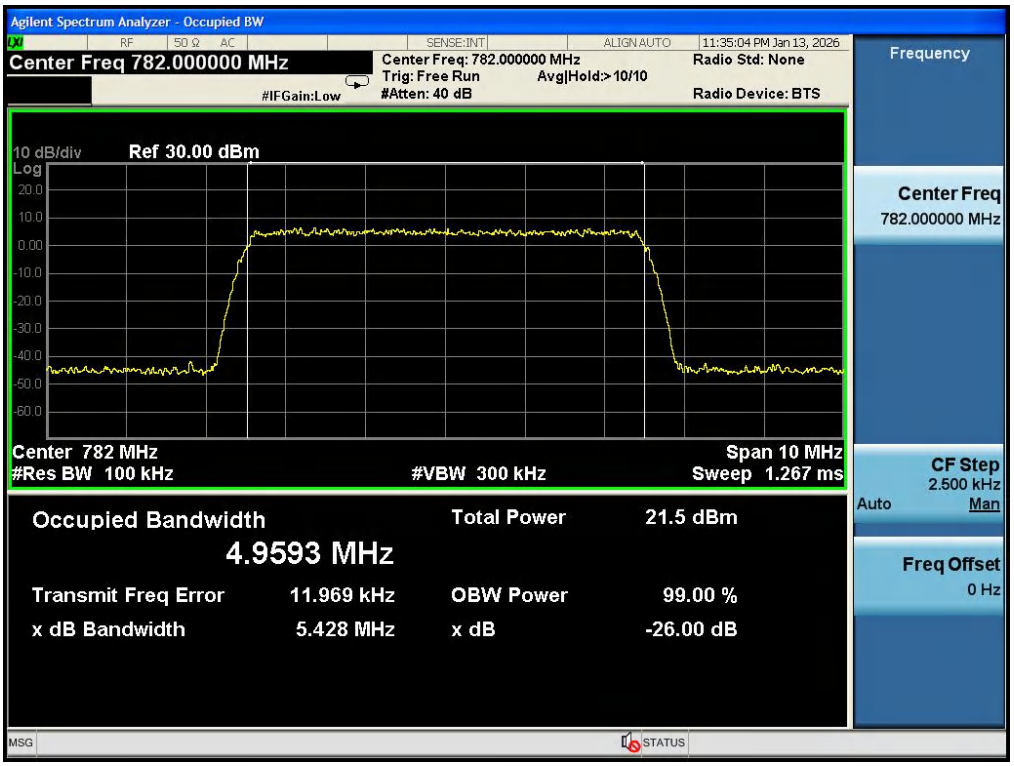
Low A-E Blocks DL Input



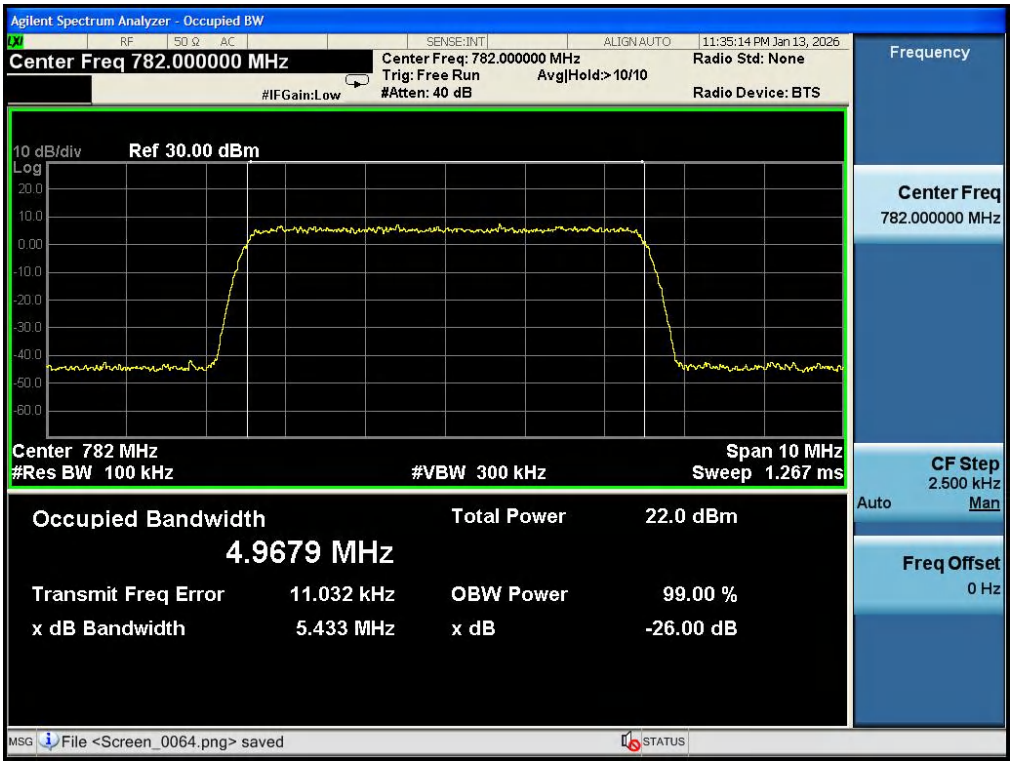
Low A-E Blocks DL output



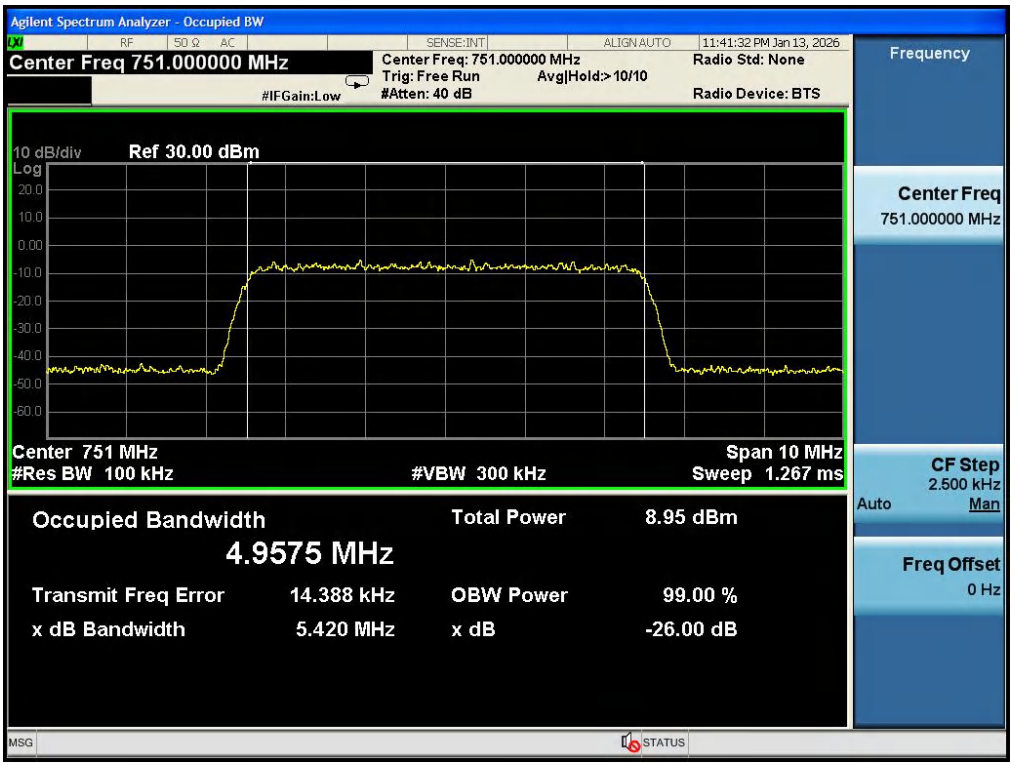
700 MHz Upper C Block UL Input



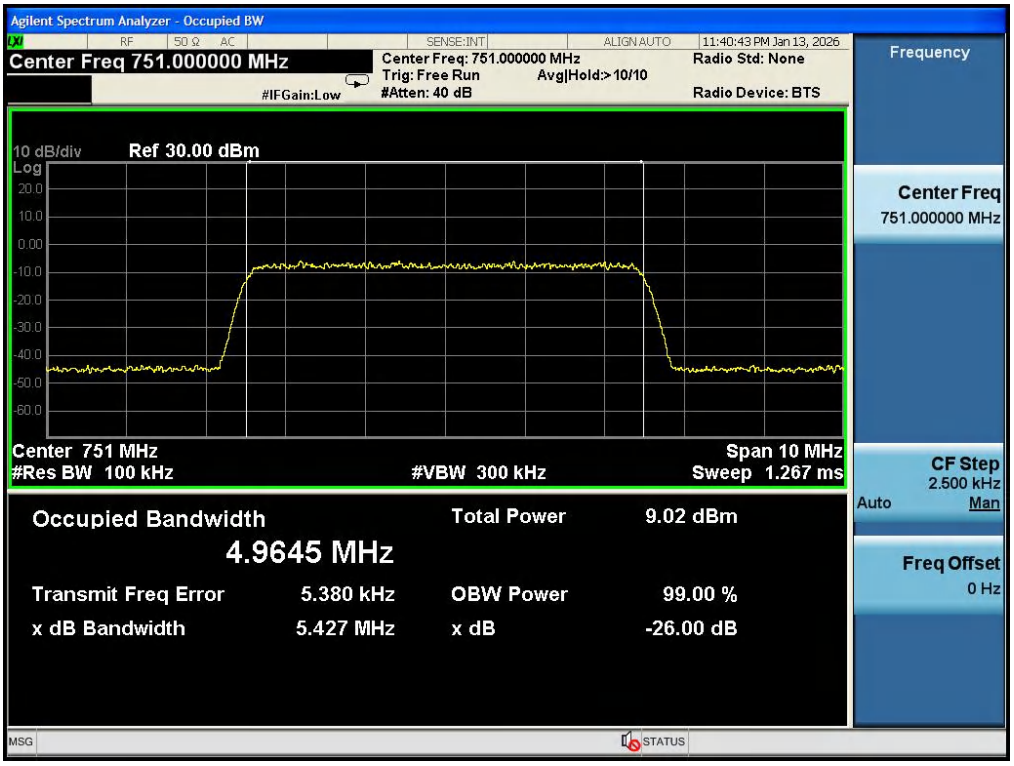
700 MHz Upper C Block UL output



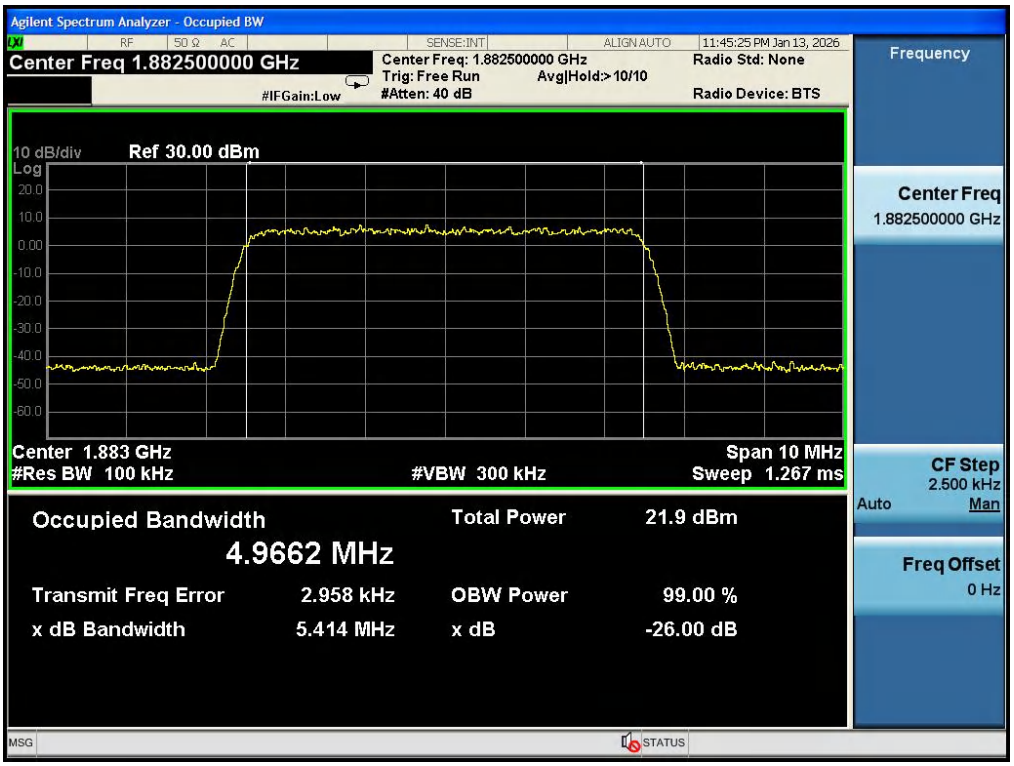
700 MHz Upper C Block DL Input



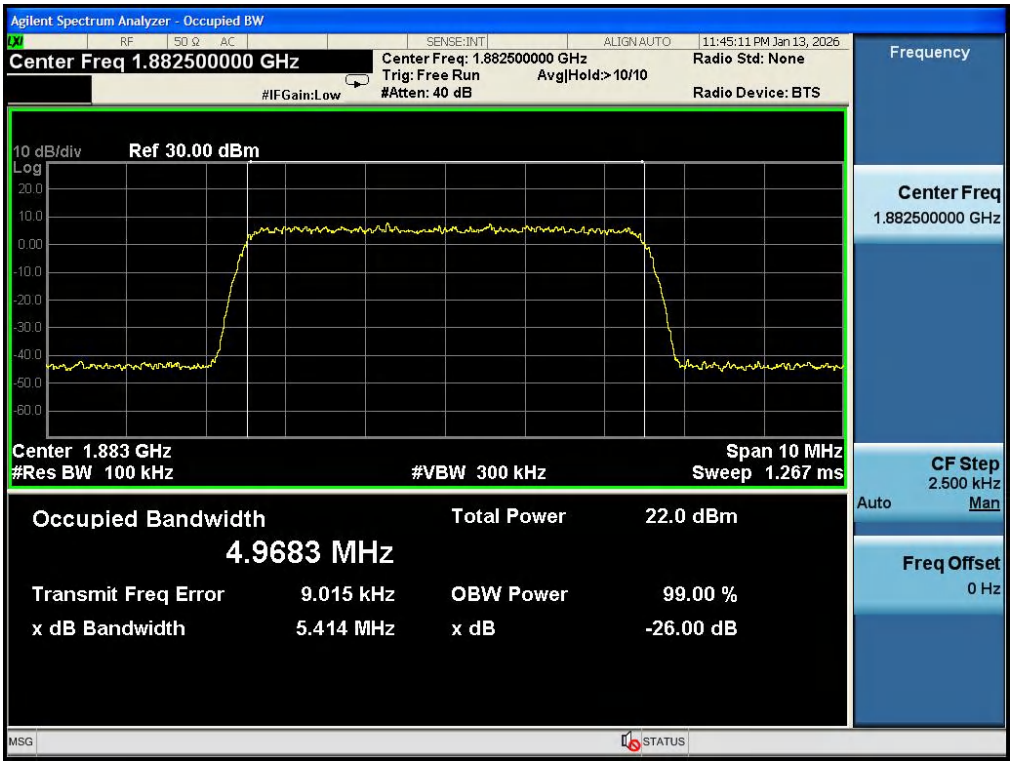
700 MHz Upper C Block DL output



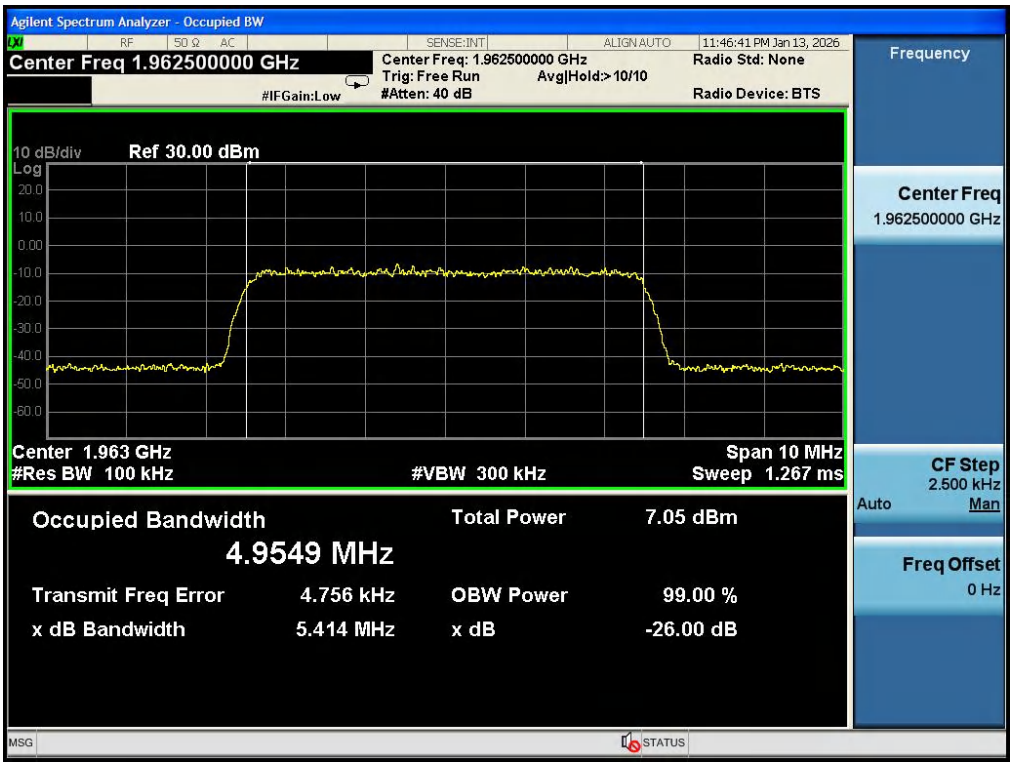
Broadband PCS UL Input



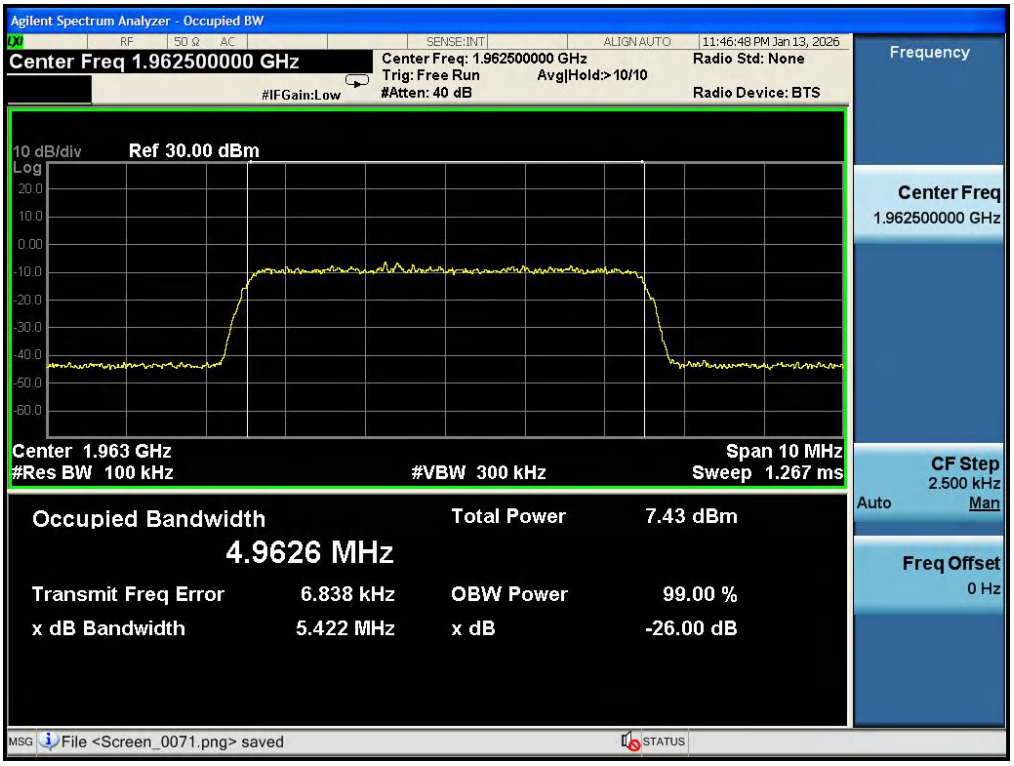
Broadband PCS UL output



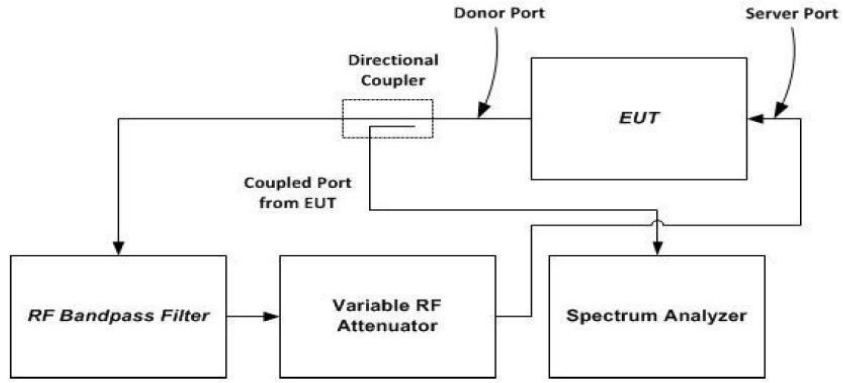
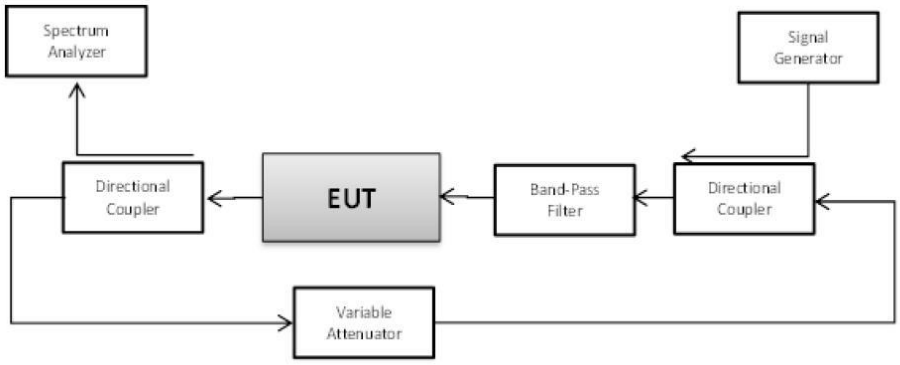
Broadband PCS DL Input



Broadband PCS DL output



6.11 Oscillation Detection

Test Requirement:	This measurement is required to demonstrate compliance to the Anti-Oscillation specification for Wideband Consumer Signal Boosters provided in §20.21(e)(8)(ii)(A) For this measurement two EUTs will be permitted, one operating in a normal mode and the second operating in a test mode that is capable of disabling the uplink inactivity squelching and or a reduction of the time between restarts to 5 seconds. This will greatly decrease the test time required.
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**
Procedure:	a) Connect the EUT set for normal operation to the test equipment as shown in Figure 8 beginning with the RF detector on the uplink output side of the RF path. Ensure that the RF coupled path is connected to the RF detector. Note: The band pass filter shall provide sufficient out-of-band rejection to prevent oscillations from occurring in bands not under test. b) Set the oscilloscope for a positive edge trigger and single trigger operation. c) Set the attenuation as necessary until the oscilloscope triggers and increase the attenuation level to a point 10 dB above that point. d) Reset the trigger of the oscilloscope and reset the EUT with a power cycle. e) Force the EUT to oscillate this will trigger the oscilloscope. f) Use the CURSOR function of the oscilloscope to measure the time from the detection of oscillation until the EUT turns off by setting CURSOR 1 on the leading edge of the signal and CURSOR 2 on the trailing edge. g) Capture the oscilloscope trace for inclusion in the test report. h) Repeat steps 7.11.2 to 7.11.7 for all operational uplink and downlink bands. i) Set the oscilloscope time base for longer than 1 minute and measure the restart time for each operational uplink and downlink band.