

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.

I) 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.

# Oscillation mitigation or shutdown

According to section 7.11.3 of KDB 935210 D03 Signal Booster Measurement v04r04:

a) Connect the normal-operating mode EUT to the test equipment as shown in Figure 7.

b) Set the spectrum analyzer center frequency to the center of band under test, and use the following settings:

1) RBW=30 kHz, VBW  $\ge$  3 × RBW,

2) power averaging (rms) detector,

3) trace averages  $\geq$  100,

4) span  $\geq$  120% of operational band under test,

5) number of sweep points  $\geq 2 \times \text{Span/RBW}$ .

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 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.

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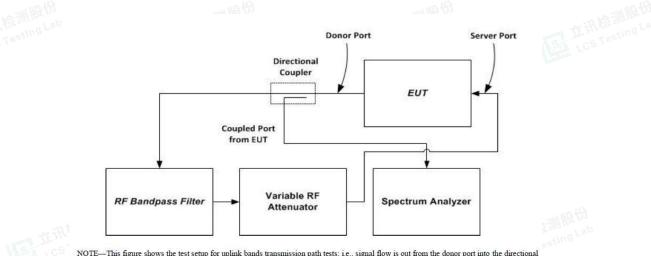
2) Place the marker at the highest oscillation level occurring within the span, and record its output level and frequency.

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.20

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.



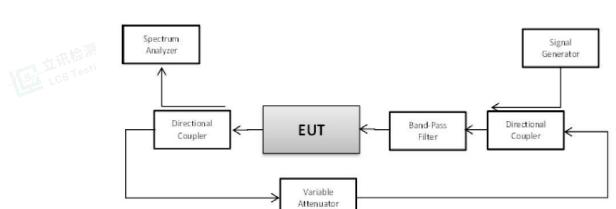
NOTE—This figure shows the test setup for uplink bands transmission path tests; i.e., signal flow is out from the donor port into the directional coupler. For downlink bands transmission path tests, the feedback signal flow path direction and equipment connections shall be reversed, i.e., signal flow is out from the server port into the directional coupler, and signal flow is into the donor port from the variable RF attenuator.

## Figure 6 – Oscillation detection (7.11.2) test setup



Scan code to check authenticity

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## 6.5.3 Test data

3 Test data	e 7 – Oscination mitigati		atup
	IST LCS Test	108	IST LCS Testing
Temperature	<b>23.6</b> ℃	Humidity	52.3%
Test Engineer	Paddi Chen	Test Mode	Transmitting

	Test	Results Of Detect	ion Time		
Opera	ation Band	Detection Time (s)	Limit (s)	Result	
	Lower 700 Band	0.270	0.300	PASS	
	Upper 700 Band	0.265	0.300	PASS	
Uplink	Cellular Band	0.255	0.300	PASS	则服金化
	PCS Band	0.165	0.300	PASS	ting <sub>La</sub>
	AWS Band	0.230	0.300	PASS	
	Lower 700 Band	0.250	1.000	PASS	
	Upper 700 Band	0.275	1.000	PASS	
Downlink	Cellular Band	0.240	1.000	PASS	
	PCS Band	0.270	1.000	PASS	
	AWS Band	0.255	1.000	PASS	

	Test Results Of Restarting Time									
Ope	ration Band	Restarting Time (s)	Limit (s)	Restarting Counts	Limit	Result				
Los I	Lower 700 Band	181	60	4	5	PASS				
	Upper 700 Band	have been a second s	60	4	5	PASS				
Uplink	Cellular Band		60	4	5	PASS				
	PCS Band	See Test	60	3	5	PASS				
	AWS Band	Graphs of	60	4	5	PASS				
	Lower 700 Band	Restarting	60	4	5	PASS				
	Upper 700 Band	Time	60	4	5	PASS				
Downlink	Cellular Band		60	4	5	PASS				
	PCS Band	a lb	60	3	5	PASS				
a the Fill Ble VD	AWS Band	the all the part	60	4	5	PASS				
S Testing	IS IN	Testing		L I WITESting	1	ILSS DESTOS				



Shenzhen LCS Compliance Testing Laboratory Ltd.

Add: 101, 201 Bldg A & 301 Bldg Č, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China

Tel: +(86) 0755-82591330 | E-mail: webmaster@lcs-cert.com | Web: www.lcs-cert.com Scan code to check authenticity

gilant Secut	um Analyzer Sweet Ch			lest Gr	aphs of	f Detection Time	
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G			STAT	rus		MSG STATUS	
	Detecti	on Time-Lo	ower 70	0 Band L	JL	Detection Time-Lower 700 Band	d DL
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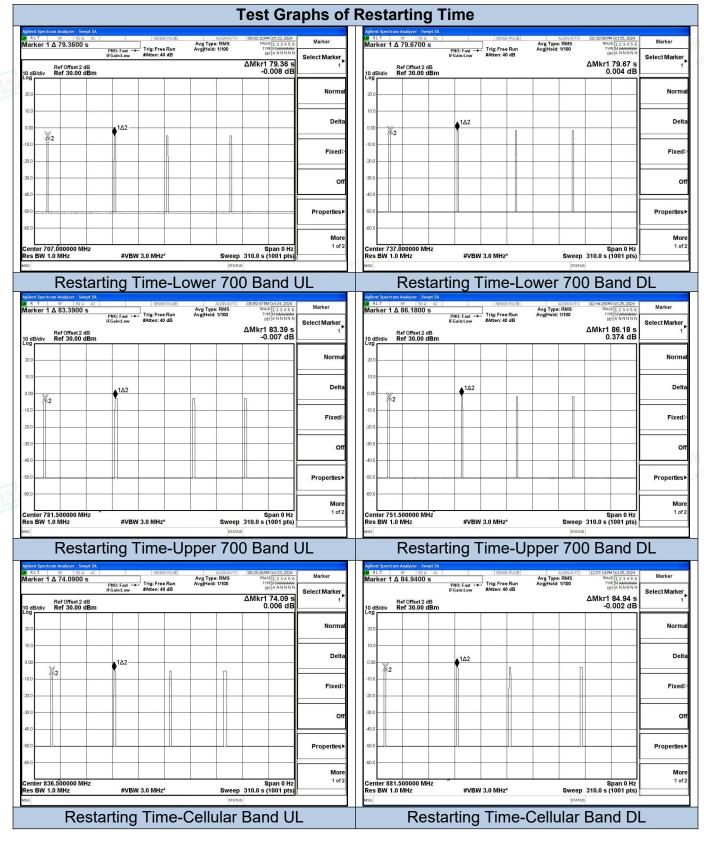
#### FCC ID: 2A34B-SFZN008

Report No.: LCSA10174024EA

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## FCC ID: 2A34B-SFZN008

#### Report No.: LCSA10174024EA

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# Oscillation mitigation or shutdown:

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+4	7.86	<12	Pass	
+3	7.54	<12	Pass	
+2	9.41	<12	Pass	
+1	10.02	<12	Pass	1
0	Ĭ	shutdown	Till 12 Ming Lab	1
Par res .	1991	CS 4 PT	Parce	-

Lower 700 Band		Downlink		]
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Isolation	Deffrence	Limit	Result	
dB	dB	dB		
+5	6.35	<12	Pass	]
+4	6.96	<12	Pass	STIM BE CO
+3	7.78	<12	Pass 5	esting Lab
+2	9.47	<12	Pass	
+1	10.21	<12	Pass	
0	11.18	<12	Pass	
-1		shutdown		]

Upper 700 Band	Uplink				
Signal Type	AWGN				
Isolation	Deffrence	Limit	Result		
dB	dB	dB			
+5	6.24	<12	Pass		
+4	7.09	<12	Pass		
+3	8.29	<12	Pass		
+2	9.02	<12	Pass		
+1	9.75	<12	Pass		
0	10.57	<12	Pass		
-1	- 52 B	shutdown			
sting Lab	立 其語 加加 Lab	立 讯 Mar Washing Lab	立讯检		





Upper 700 Band	Downlink					
Signal Type	AWGN					
Isolation	Deffrence	Limit	Result			
dB	dB	dB				
+5	6.27	<12	Pass			
+4	7.25	<12	Pass			
+3	8.42	<12	Pass			
+2	9.23	<12	Pass			
+1	10.84	<12	Pass			
0		shutdown	Till Testing Lau			
En Pro	-153	Leo .	Alex ree			

Cellular Band		Uplink		
Signal Type		AWGN		
Isolation	Deffrence	Limit	Result	
dB	dB	dB		
+5	7.09	<12	Pass	
+4	8.67	<12	Pass	
+3	9.36	<12	Pass	
+2	10.21	<12	Pass	
+1		shutdown		

Cellular Band		Downlink	
Signal Type		AWGN	
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	5.28	<12	Pass
+4	7.95	<12	Pass
+3	8.50	<12	Pass
+2	9.42	<12	Pass
+1	10.19	<12	Pass
0		shutdown	



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PCS Band	Uplink			
Signal Type	AWGN			2711182
Isolation	Deffrence	Limit	Result	ie sting
dB	dB	dB		
+5	5.97	<12	Pass	
+4	6.38	<12	Pass	
+3	7.11	<12	Pass	
+2	7.83	<12	Pass	
+1	9.53	<12	Pass	
0	10.15	<12	Pass	
-1	shutdown			

	PCS Band	Downlink		
	Signal Type	AWGN		
	Isolation	Deffrence	Limit	Result
	dB	dB	dB	
	+5	7.42	<12	Pass
工证所能	+4	8.83	<12	Pass
- Les I	+3	9.66	<12	Pass
	+2	10.28	<12	Pass
	+1	11.15	<12	Pass
	0	shutdown		

270 BE 19	tt 开检测版份	中 tt讯检测展th	市田检测
0	shutdown		
+1	10.61	<12	Pass
+2	9.79	<12	Pass
+3	9.42	<12	Pass
+4	8.66	<12	Pass
+5	7.26	<12	Pass
dB	dB	dB	
Isolation	Deffrence	Limit	Result
Signal Type	AWGN		
AWS Band	Uplink		



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AWS Band	Downlink		
Signal Type	AWGN		
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	6.77	<12	Pass
+4	7.78	<12	Pass
+3	8.32	<12	Pass
+2	9.52	<12	Pass
+1	10.43	<12	Pass
0	shutdown		and the second second
Sa Les Testing	NSI U	cs Testing "	NST LOS Testing















# 6.6 Intermodulation Limits

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# 6.6.1 Applicable Standard

According to §20.21(e)(8)(i)(F) Intermodulation Limits:

The transmitted intermodulation products of a consumer booster at its uplink and downlink ports shall not exceed the power level of -19 dBm for the supported bands of operation.

# 6.6.2 Test Procedure

According to section 7.4 of KDB 935210 D03 Signal Booster Measurement v04r04:

a) Connect the signal booster to the test equipment as shown in Figure 9. Begin with the uplink output (donor) port connected to the spectrum analyzer.

b) Set the spectrum analyzer RBW = 3 kHz.

c) Set the VBW  $\geq$  3 RBW.

d) Select the rms detector.

e) Set the spectrum analyzer center frequency to the center of the supported operational band under test.

f) Set the span to 5 MHz. Affirm that the number of measurement points per sweep  $\geq$  (2 × span)/RBW.

g) Configure the two signal generators for CW operation with generator #1 tuned 300 kHz below the operational band center frequency and generator #2 tuned 300 kHz above the operational band center frequency. If the maximum output power is not at the operational-band (booster pass band) center frequency, configure the test signal pair around the frequency with maximum output power as determined per 7.2.

h) Set the signal generator amplitudes so that the power from each into the EUT is equivalent, then turn on the RF output.

i) Simultaneously increase each signal generators' amplitude equally until just before the EUT begins AGC, then affirm that all intermodulation-product emissions (if any occur) are below the specified limit of -19 dBm.

j) Use the trace averaging function of the spectrum analyzer, and wait for the trace to stabilize. Place a marker at the highest amplitude intermodulation-product emission.

k) Record the maximum intermodulation product amplitude level that is observed.

I) Capture the spectrum analyzer trace for inclusion in the test report.

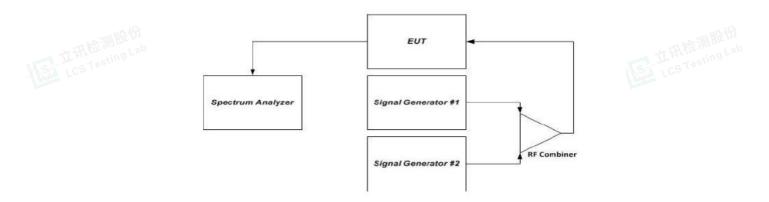
m) Repeat 7.4e) to 7.4l) for all uplink and downlink operational bands.

NOTE–If using a single signal generator with dual outputs, affirm that intermodulation products are not the result of the generator.

n) Increase the signal generator amplitude in 2 dB steps to 10 dB above the AGC threshold determined in 7.4i), but not exceeding the maximum input level of 5.5, to affirm that the EUT maintains compliance with the intermodulation limit. The test report shall include either a statement describing that the device complies at 10 dB above AGC or at the 5.5 power levels, or a table showing compliance at the additional input power(s) required.



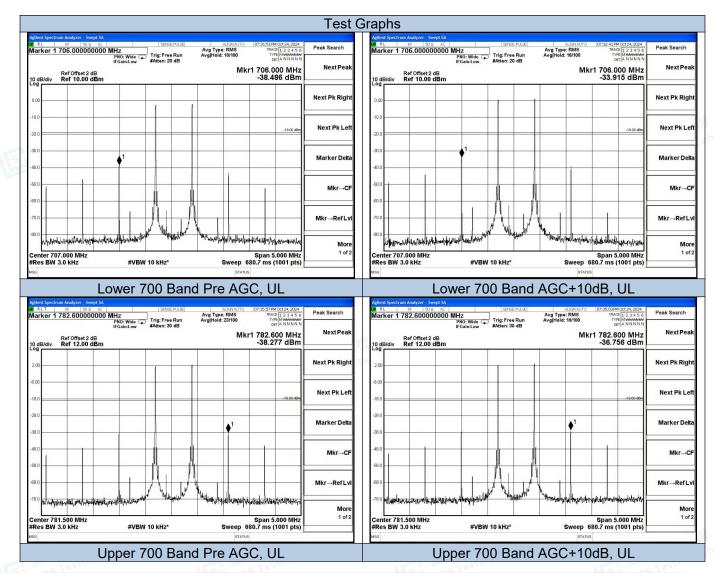




## Figure 9 – Intermodulation product instrumentation test setup

## 6.6.3 Test Data

Figure 9 – Intermodulation product instrumentation test setup				
6.6.3 Test Data				
Temperature	<b>23.6</b> ℃	Humidity	52.3%	
Test Engineer	Paddi Chen	Test Mode	Transmitting	



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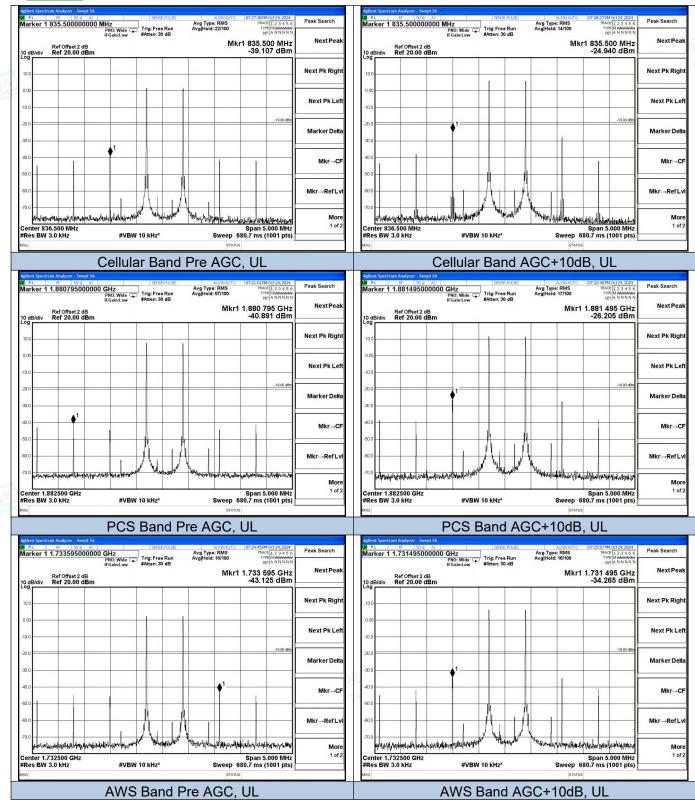
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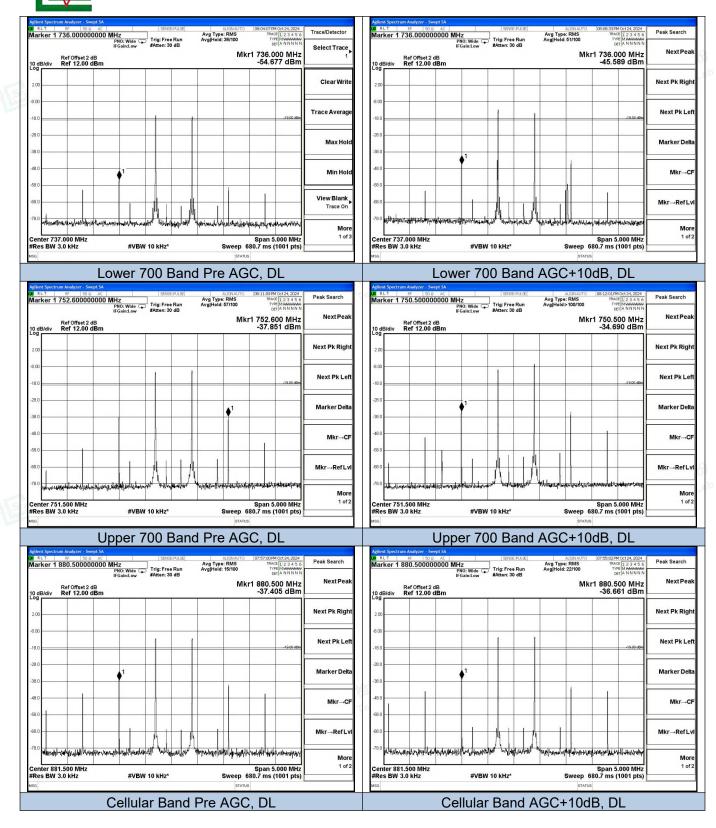






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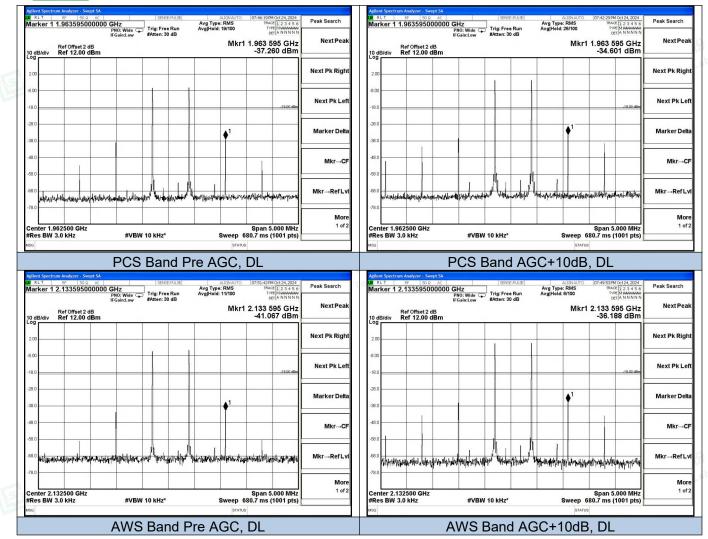




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# 6.7 Out of Band Emission

# 6.7.1 Applicable Standard

According to § 20.21(e)(8)(i)(E) Out of Band Emission Limits:

Booster out of band emissions (OOBE) shall be at least 6 dB below the FCC's mobile emission limits for the supported bands of operation. Compliance to OOBE limits will utilize high peak-to-average CMRS signal types.

For B2:Per FCC §24.238 the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10log(P) dB.

For B4: Per §27.53(h): For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 log10(P) dB.

For B5:Per FCC §22.917 the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10log(P) dB.

For B12: Per §27.53 (g): For operations in the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB.

For B13: Per §27.53 (c): For operations in the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following: On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB.

Calculation: Limit (dBm) =[P-43 + 10 log (P)] - 6= -19 dBm

# 6.7.2 Test Procedure

According to section 7.5 of KDB 935210 D03 Signal Booster Measurement v04r04:

a) Connect the EUT to the test equipment as shown in Figure 1. Begin with the uplink output (donor) port connected to the spectrum analyzer.

b) Configure the signal generator for the appropriate operation for all uplink and downlink bands:

1) GSM: 0.2 MHz from upper and lower band edges.

2) LTE (5 MHz): 2.5 MHz from upper and lower band edges.

3) CDMA: 1.25 MHz from upper and lower band edges, except for cellular band as follows (only the upper and lower frequencies need to be tested):

824.88 MHz, 845.73 MHz, 836.52 MHz, 848.10 MHz,

869.88 MHz, 890.73 MHz, 881.52 MHz, 893.10 MHz.

NOTE 1–Alternative test modulation types:

CDMA (alternative 1.25 MHz AWGN)

• LTE 5 MHz (alternative W-CDMA or 4.1 MHz AWGN)

NOTE 2–For LTE, the signal generator should use the uplink and downlink signal types for these modulations in uplink and downlink tests, respectively. LTE shall use 5 MHz signal, 25 resource blocks transmitting.



NOTE 3–When using an AWGN test signal, the bandwidth shall be the measured 99% OBW. c) Set the signal generator amplitude to the maximum power level prior to AGC similar to 7.2.2e) to7.2.2f) of the power measurement procedures for the appropriate modulations.

d) Set RBW = measurement bandwidth specified in the applicable rule section for the

supported frequency band (see Appendix A for cross-reference to applicable rule section).

e) NOTE 3–Within 300 kHz and 3 MHz away from band edge, if smaller RBW is used (i.e., RBW < 100 kHz or 1 MHz, for above and below 1 GHz, respectively), per Parts 24 and 27 the smaller RBW is applicable only for frequencies within 100 kHz or 1 MHz (for above and below 1 GHz, respectively) away from the band edge.

f) Set VBW = 3 RBW.

g) Select the power averaging (rms) detector.

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h) Sweep time = auto-couple.

i) Set the analyzer start frequency to the upper band/block edge frequency and the stop frequency to the upper band/block edge frequency plus: 300 kHz (when operational frequency is < 1 GHz), or 3 MHz (when operational frequency is < 1 GHz).

j) Trace average at least 100 traces in power averaging (i.e., rms) mode.

k) Use peak marker function to find the maximum power level.

I) Capture the spectrum analyzer trace of the power level for inclusion in the test report.

m) Increase the signal generator amplitude in 2 dB steps until the maximum input level per 5.5 is reached. Affirm that the EUT maintains compliance with the OOBE limits. The test report shall include either a statement describing that the device complies at 10 dB above AGC or at the 5.5 power levels, or a table showing compliance at the additional input power(s) required.

n) Reset the analyzer start frequency to the lower band/block edge frequency minus: 300 kHz (when operational frequency is < 1 GHz), or 3 MHz (when operational frequency is  $\geq$  1 GHz), and the stop frequency to the lower band/block edge frequency, then repeat 7.5i) to 7.5l). Repeat 7.5b) through 7.5m) for each uplink and downlink operational band.



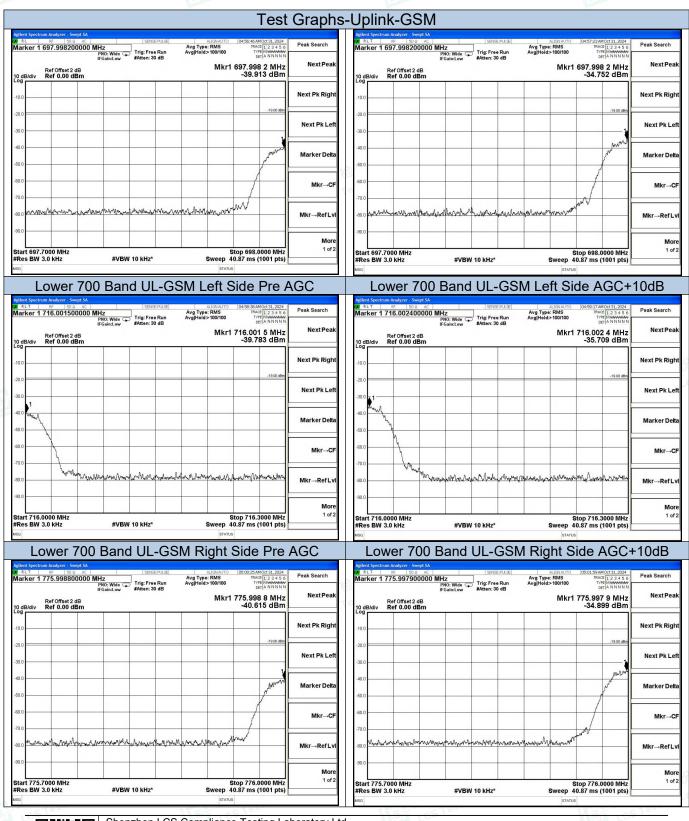
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#### 6.7.3 Test data

Temperature	<b>23.6</b> ℃	Humidity	52.3%
Test Engineer	Paddi Chen	Test Mode	Transmitting
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