



FCC TEST REPORT

FOR

Shenzhen Tongwei Electronics Co. Ltd

Cell Phone Signal Booster

Test Model: TB-700A

Additional Model No.: Please Refer to Page 6

Prepared for : Shenzhen Tongwei Electronics Co. Ltd
Address : 501, Bld. 16, Lihao Ind, Park, No.78 Ainan Rd, Longdong
Community, Baolong Str, Longgang Distr, Shenzhen, China

Prepared by : SHENZHEN STS TEST SERVICES CO.,LTD.
Address : 101, Building B, Zhuoke Science Park, No.190 Chongqing Road,
ZhanChengShequ, Fuhai Sub-District, Bao'an District, Shenzhen,
Guang Dong, China

Date of receipt of test sample : April 01, 2025
Number of tested samples : 2
Samples No. : A250324163-1, A250324163-2
Serial number : Prototype
Date of Test : April 01, 2025 ~ Sept. 21, 2025
Date of Report : Sept. 21, 2025



TEST REPORT

FCC CFR 47 PART 20.21

Report Reference No. : STS2509134W01
Date of Issue : Sept. 21, 2025
Testing Laboratory Name : SHENZHEN STS TEST SERVICES CO.,LTD.
Address : 101, Building B, Zhuoke Science Park, No.190 Chongqing Road,
ZhanChengShequ, Fuhai Sub-District, Bao'an District, Shenzhen,
Guang Dong, China
Testing Location/ Procedure : Full application of Harmonised standards ■
Partial application of Harmonised standards □
Other standard testing method □
Applicant's Name : Shenzhen Tongwei Electronics Co. Ltd
Address : 501, Bld. 16, Lihao Ind, Park, No.78 Ainan Rd, Longdong
Community, Baolong Str, Longgang Distr, Shenzhen, China
Test Specification
Standard : FCC CFR Title 47 Part 20.21

This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Shenzhen STS Test Services Co., Ltd.

Test Item Description. :
EUT : Cell Phone Signal Booster
Trade Mark : N/A
Test Model : TB-700A
For AC Adapter:
Ratings : Input: 100-240V~50/60Hz 0.8A
Output: 12V=2A
Result : PASS

Testing Engineer :

(Lenon Hou)

Technical Manager :

(Skylar Li)

Authorized Signatory :

(Bovey Yang)





TEST REPORT

Test Report No. :	STS2509134W01	Sept. 21, 2025 Date of issue
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Test Model.....	:	TB-700A
EUT.....	:	Cell Phone Signal Booster
Applicant.....	:	Shenzhen Tongwei Electronics Co. Ltd
Address.....	:	501, Bld. 16, Lihao Ind, Park, No.78 Ainan Rd, Longdong Community, Baolong Str, Longgang Distr, Shenzhen, China
Telephone.....	:	/
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Manufacturer.....	:	Shenzhen Tongwei Electronics Co. Ltd
Address.....	:	501, Bld. 16, Lihao Ind, Park, No.78 Ainan Rd, Longdong Community, Baolong Str, Longgang Distr, Shenzhen, China
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Factory.....	:	Shenzhen Tongwei Electronics Co. Ltd
Address.....	:	501, Bld. 16, Lihao Ind, Park, No.78 Ainan Rd, Longdong Community, Baolong Str, Longgang Distr, Shenzhen, China
Telephone.....	:	/
Fax.....	:	/

Test Result	PASS
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The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.



Revision History

Revision	Issue Date	Revisions	Revised By
000	Sept. 21, 2025	Initial Issue	---



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1. GENERAL INFORMATION

1.1 Description of Device (EUT)

EUT	:	Cell Phone Signal Booster
Equipment Type	:	Fixed Wideband Consumer Zone Enhancers
Test Model	:	TB-700A
Additional Model No.	:	TB-700V, TB-700D, TB-850, TB-1700, TB-1900, TB-7819V, TB-7819A, TB-US4G, TB-US5B, TB-US7B, TB-ECA8SD
Model Declaration	:	These models only differ in name and color, PCB board, structure and internal of these model(s) are the same, So no additional models were tested
Ratings	:	For AC Adapter: Input: 100-240V~50/60Hz 0.8A Output: 12V=2A
Hardware Version	:	/
Software Version	:	/
Frequency Range	:	Lower 700MHz Band (B12) Uplink: 698~716MHz, Downlink: 728~746MHz Upper 700MHz Band (B13) Uplink: 776~787MHz, Downlink: 746~757MHz Cellular Band (B5) Uplink: 824~849MHz, Downlink: 869~894MHz PCS Band (B25) Uplink: 1850~1915MHz, Downlink: 1930~1995MHz AWS Band(B4) Uplink: 1710~1755MHz, Downlink: 2110~2155MHz
Max Gain	:	Uplink: ≤63dB Downlink: ≤62dB
Mobile Antenna Gain	:	8dBi
Max Antenna Port Output Power	:	Uplink: ≤20dBm Downlink: ≤10dBm
Emission Designator	:	F9W, G7D, G7W, GXW, W7D
FCC Classification	:	B2W/Wideband Consumer Booster(CMRS)
Operating Temperature	:	-20°C~+65°C

Note: For a more detailed antenna description, please refer to the antenna specifications or the antenna report provided by the customer.



Antenna Information:

Antenna	/		Uplink Frequency(MHz)				
			698-716	776-787	824-849	1850-1915	1710-1755
Log Periodic Antenna	Outdoor Antenna Gain (Model:TB-6127-9)(dBi)		5	5	6.5	7.5	7.5
	Cable loss (dB)	3D-FB(50Feet)	3.7	3.8	4	4.5	4.2
		4D-FB(50Feet)	3.2	3.3	3.5	4	3.8
		5D-FB(50Feet)	3	3.2	3.2	3.8	3.2
Yagi Antenna	Outdoor Antenna Gain (Model:TB6127-8) (dBi)		5	5	5	6.5	6
	Cable loss (dB)	3D-FB(50Feet)	3.7	3.8	4	4.5	4.2
		4D-FB(50Feet)	3.2	3.3	3.5	4	3.8
		5D-FB(50Feet)	3	3.2	3.2	3.8	3.2
Panel Antenna	Outdoor Antenna Gain (Model:TB-6127-9) (dBi)		5	5	5	6.5	6.5
	Cable loss (dB)	3D-FB(50Feet)	3.7	3.8	4	4.5	4.2
		4D-FB(50Feet)	3.2	3.3	3.5	4	3.8
		5D-FB(50Feet)	3	3.2	3.2	3.8	3.2
Omni Antenna	Outdoor Antenna Gain (Model:TB6927-2) (dBi)		5	5	5	5.5	5.5
	Cable loss (dB)	3D-FB(50Feet)	3.7	3.8	4	4.5	4.2
		4D-FB(50Feet)	3.2	3.3	3.5	4	3.8
		5D-FB(50Feet)	3	3.2	3.2	3.8	3.2
Antenna	/		Downlink Frequency(MHz)				
			728-746	746-757	869-894	1930-1995	2110-2155
Right Angle Antenna-A	Indoor Antenna Gain (Model:TB-2518-1) (dBi)		1	1	1	1.5	1.5
	Cable loss (dB)	3D-FB(50Feet)	1.2	1.2	1.4	1.5	1.4
		4D-FB(50Feet)	1	1	1.2	1.2	1.2
		5D-FB(50Feet)	0.8	0.8	1	1	1
Right Angle Antenna-B	Indoor Antenna Gain (Model:TB-6527-6) (dBi)		1	1	1	1.2	1.2
	Cable loss (dB)	3D-FB(50Feet)	1.2	1.2	1.4	1.5	1.4
		4D-FB(50Feet)	1	1	1.2	1.2	1.2
		5D-FB(50Feet)	0.8	0.8	1	1	1
Right Angle Antenna-C	Indoor Antenna Gain (Model:TB-6826-9) (dBi)		1.2	1.2	1.3	1.2	1.3
	Cable loss (dB)	3D-FB(50Feet)	1.2	1.2	1.4	1.5	1.4
		4D-FB(50Feet)	1	1	1.2	1.2	1.2
		5D-FB(50Feet)	0.8	0.8	1	1	1
Panel Antenna	Indoor Antenna Gain (Model:TB-6127-10) (dBi)		5.5	5.5	5.5	6.5	6
	Cable loss (dB)	3D-FB(50Feet)	1.2	1.2	1.4	1.5	1.4
		4D-FB(50Feet)	1	1	1.2	1.2	1.2
		5D-FB(50Feet)	0.8	0.8	1	1	1
Top Suction Antenna	Indoor Antenna Gain (Model:TB-6127-2) (dBi)		3.5	3.5	3.5	4	4
	Cable loss	3D-FB(50Feet)	1.2	1.2	1.4	1.5	1.4
		4D-FB(50Feet)	1	1	1.2	1.2	1.2



	(dB)	5D-FB(50Feet)	0.8	0.8	1	1	1
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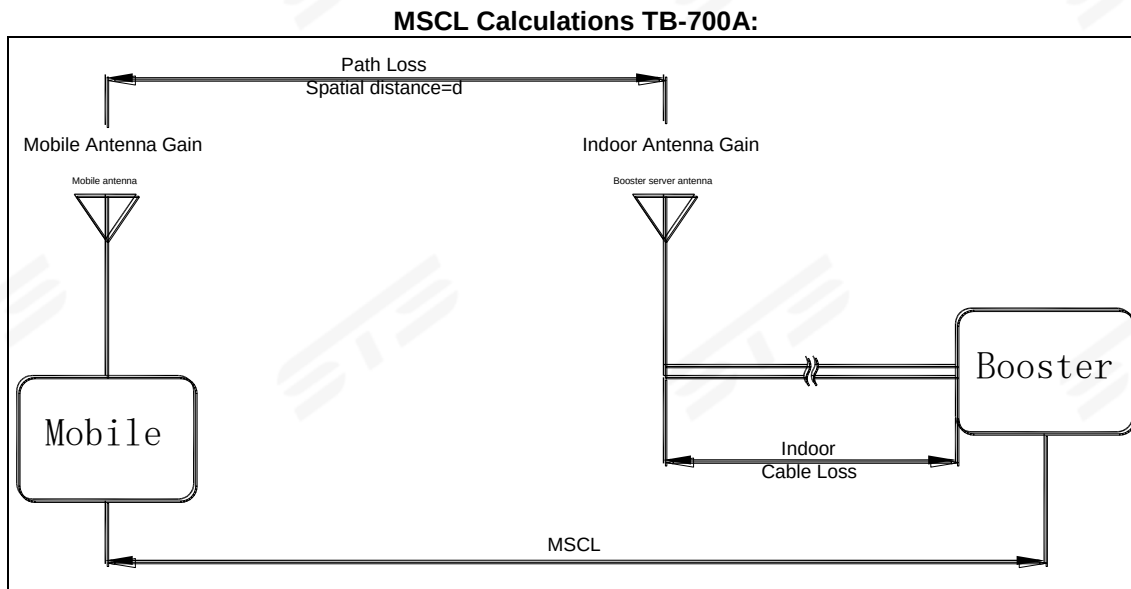


Figure 1

Remark: $MSCL = \text{Path loss} + \text{Indoor Cable Loss} - \text{Mobile Antenna Gain} - \text{Indoor Antenna Gain} + \text{Polarity Loss}$

Path loss=20Logf+20LogD-27.56				
Operation Band	Frequency (MHz)	D (m)	Constant (dB)	Path loss (dB)
Lower 700 Band (698-716)	698	2	27.56	35.34
Upper 700 Band (776-787)	776	2	27.56	36.30
Cellular Band (824-849)	824	2	27.56	36.78
PCS Band (1850-1915)	1850	2	27.56	43.80
AWS Band (1710-1755)	1710	2	27.56	43.12

Path loss=20Logf+20LogD-27.56						
MSCL Calculations of fixed booster TB-700A						
MSCL						
Operation Band	Path loss (dB)	Indoor Cable Loss (dB)	Mobile Antenna Gain (dBi)	Indoor Antenna Gain (dBi)	Polarity Loss (dB)	MSCL (dB)
Lower 700 Band (698-716)	35.34	1.2	8	5.5	3	26.04
Upper 700 Band (776-787)	36.30	1.2	8	5.5	3	27.00
Cellular Band (824-849)	36.78	1.4	8	5.5	3	27.68
PCS Band (1850-1915)	43.80	1.5	8	6.5	3	33.80
AWS(1710-1755)	43.12	1.4	8	6	3	33.52



1.2 Support equipment List

Manufacturer	Description	Model	Serial Number	Certificate
Shenzhen Tonve Electronics Co., Ltd.	AC Adapter	TB-1220A		

1.3 External I/O Cable

I/O Port Description	Quantity	Cable
Antenna Port	2	N/A
DC IN Port	1	N/A

1.4 Description of Test Facility

SHENZHEN STS TEST SERVICES CO., LTD

Add. : 101, Building B, Zhuoke Science Park, No.190 Chongqing Road, ZhanChengShequ, Fuhai Sub-District, Bao'an District, Shenzhen, Guang Dong, China

FCC test Firm Registration Number: 625569

IC test Firm Registration Number: 12108A

A2LA Certificate No.: 4338.01

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10:2013 and CISPR 16-1-4:2010 VSWR requirement for radiated emission above 1GHz.

1.5 Statement of the Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.



1.6 Measurement Uncertainty

No.	Item	Uncertainty
1	RF output power, conducted	$\pm 0.755\text{dB}$
2	Unwanted Emissions, conducted	$\pm 2.874\text{dB}$
3	All emissions, radiated 9K-30MHz	$\pm 3.80\text{dB}$
4	All emissions, radiated 30M-1GHz	$\pm 4.18\text{dB}$
5	All emissions, radiated 1G-6GHz	$\pm 4.90\text{dB}$
6	All emissions, radiated >6G	$\pm 5.24\text{dB}$
7	Conducted Emission (9KHz-150KHz)	$\pm 2.19\text{dB}$
8	Conducted Emission (150KHz-30MHz)	$\pm 2.53\text{dB}$
9	Occupied Channel Bandwidth	$\pm 3.5\%$
10	Power Spectral Density, conducted	$\pm 1.245\text{dB}$
11	Duty Cycle	$\pm 3.2\%$

(1). This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

1.7 Operation Band

Uplink Band Frequency (MHz)	Downlink Band Frequency (MHz)
Lower 700 Band (698-716MHz)	Lower 700 Band (728-746MHz)
Upper 700 Band (776-787MHz)	Upper 700 Band (746-757MHz)
Cellular Band (824-849MHz)	Cellular Band (869-894MHz)
PCS Band (1850-1915MHz)	PCS Band (1930-1995MHz)
AWS Band (1710-1755MHz)	AWS Band (2110-2155MHz)



2. TEST METHODOLOGY

All tests and measurements indicated in this document were performed in accordance with:

- 1) The Code of federal Regulations Title 47, Part 2, Part 22, Part 24, Part 27, Part 20.21;
- 2) ANSI C63.26-2015, American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services;
- 3) KDB 935210 D03 Signal Booster Measurements v04r04.

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2 General Test Procedures

2.2.1 Radiated spurious emissions

The EUT is placed on the turntable, which is 1.5 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated spurious emissions measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013



3. SYSTEM TEST CONFIGURATION

3.1 Justification

The system was configured for testing in a continuous transmits condition.

3.2 EUT Exercise Software

N/A

3.3 Special Accessories

Description				

3.4 Block Diagram/Schematics

Please refer to the related document.

3.5 Test Setup

Please refer to the test setup photo.



4. SUMMARY OF TEST RESULTS

Requirement	CFR 47 Section	Result
Noise Limits	§20.21(e)(8)(i)(A) §20.21(e)(8)(i)(H)	PASS
Authorized Frequency Band Verification Test	§20.21(e)(3)	PASS
Maximum Power Measurement	§20.21(e)(8)(i)(D) §20.21(e)(8)(i)(B)&§20.21(e)(4)	PASS
Gain Limits and Bidirectional Capability &Variable Gain &Variable Uplink Gain Timing	§20.21(e)(8)(i)(C)(2) §20.21(e)(8)(i)(B) §20.21(e)(8)(i)(C) (1) §20.21(e)(8)(i)(H)	PASS
Anti-Oscillation	§20.21(e)(8)(ii)(A)&§20.21(e)(4)	PASS
Intermodulation Limits	§20.21(e)(8)(i)(F)	PASS
Out of Band Emission	§20.21(e)(8)(i)(E)	PASS
Conducted Spurious Emission	§2.1051	PASS
Uplink inactivity	§20.21(e)(8)(i)(I)	PASS
Occupied Bandwidth	§2.1049	PASS
Radiated Spurious Emission	§2.1053	PASS
RF Exposure	RSS-102: 2.5.2	PASS
Spectrum Block Filter	N/A	N/A

Note:

1. PASS: Test item meets the requirement.
2. Fail: Test item does not meet the requirement.
3. N/A: Test case does not apply to the test object.
4. The test result judgment is decided by the limit of test standard.



5. SUMMARY OF TEST EQUIPMENT

RF Radiation Test Equipment					
Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibration	Calibrated Until
Temperature & Humidity	SW-108	SuWei	N/A	2025.02.24	2026.02.23
Wireless Communications Test Set	R&S	CMW 500	117239	2024.09.23	2025.09.22
Pre-Amplifier(0.1M-3GHz)	EM	EM330	060665	2025.02.22	2026.02.21
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2024.09.23	2025.09.22
Pre-Amplifier(18G-40GHz)	SKET	LNPA_1840-50	SK2018101801	2025.02.22	2026.02.21
Positioning Controller	MF	MF-7802	MF-780208587	N/A	N/A
Signal Analyzer	R&S	FSV 40-N	101823	2024.09.23	2025.09.22
Switch Control Box	N/A	N/A	N/A	N/A	N/A
Filter Box	BALUN Technology	SU319E	BL-SZ1530051	N/A	N/A
Video Controller	SKET	FCS C-3	N/A	N/A	N/A
Bilog Antenna	TESEQ	CBL6111D	34678	2024.09.30	2025.09.29
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2024.09.25	2025.09.24
Horn Antenna	A-INFOMW	LB-180400-KF	J211020657	2023.10.10	2025.10.09
Antenna Mast	MF	MFA-440H	N/A	N/A	N/A
Turn Table	MF	N/A	N/A	N/A	N/A
AC Power Source	APC	KDF-11010G	F214050035	N/A	N/A
DC Power Supply	Zhaoxin	RXN 605D	20R605D11010081	N/A	N/A
Test SW	EMC Test Software	15.2.0.339			
	EZ-EMC	Ver.STSLAB-03A1 RE			
RF Connected Test Equipment					
Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibration	Calibrated Until
Temperature & Humidity	SW-108	SuWei	N/A	2025.02.24	2026.02.23
Wireless Communications Test Set	R&S	CMW 500	131428	2025.02.22	2026.02.21
Signal Analyzer	Agilent	N9020A	MY52440124	2025.02.22	2026.02.21
RF Automatic Test System	Maiwei	MW200-SFCB	N/A	N/A	N/A
Temperature & Humidity Test Chamber	Safety test	AG80L	171200018	2025.02.22	2026.02.21
Programmable Power Supply	Agilent	E3642A	MY40002025	2024.09.23	2025.09.22
POWER DIVIDER	eastsheep	PD-0.5/0.6-2S	N/A	2025.02.25	2026.02.24
Test SW	MTS 8200	2.0.0.0			



6. MEASUREMENT RESULTS

6.1 Noise Limits

6.1.1 Applicable Standard

According to §20.21(e)(8)(i)(A) Noise Limits (uplink); §20.21(e)(8)(i)(H) Transmit Power Off Mode (uplink and downlink noise power):

1. The transmitted maximum noise power in dBm/MHz of consumer boosters at their uplink and downlink ports shall not exceed the following limits:

Fixed booster maximum noise power shall not exceed $-102.5 \text{ dBm/MHz} + 20 \text{ Log}_{10}(\text{Frequency})$, where Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

2. The transmitted noise power in dBm/MHz of consumer boosters at their uplink port shall not exceed $-103 \text{ dBm/MHz} - \text{RSSI}$.

6.1.2 Test Procedure

Maximum transmitter noise power level

According to section 7.7.1 of KDB 935210 D03 Signal Booster Measurement v04r04:

- a) Connect the EUT to the test equipment as shown in Figure 2. 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 3 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% 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 3), 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.

NOTE—Some signal boosters will require a signal generator input because they will not operate unless a

signal is received at the input terminals. If this is the case, for the setups shown in Figure 2 and Figure 3 connect a second signal generator at the server port, then cycle the RF output of the second signal generator to simulate this function.

NOTE-Some signal boosters have a maximum transmitter noise power level that is less than the Transmit Power Off Mode of -70 dBm. For these boosters it is still necessary to confirm that the uplink noise power limits are met in the presence of a downlink signal. Test reports should show measurement data demonstrating compliance. Alternatively the applicant may provide attestation with detailed design information and explanation justifying the omission of the variable uplink testing.

Variable uplink noise timing

According to section 7.7.2 of KDB 935210 D03 Signal Booster Measurement v04r04:

Variable uplink noise timing is to be measured as follows, using the test setup shown in Figure 3.

- Set the spectrum analyzer to the uplink frequency to be measured.
- Set the span to 0 Hz, with a sweep time of 10 seconds.
- Set the power level of signal generator to the lowest level of the RSSI-dependent noise [see 7.7.1m)].
- Select MAX HOLD and increase the power level of signal generator by 10 dB for mobile boosters, and 20 dB for fixed boosters.
- Confirm that the uplink noise decreases to the specified level within 1 second for mobile devices, and within 3 seconds for fixed devices.¹⁸
- Repeat 7.7.2a) to 7.7.2e) for all operational uplink bands.
- Include plots and summary table in test report.

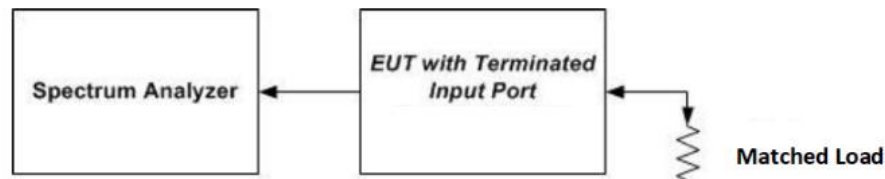


Figure 2 – Noise

limit test

setup

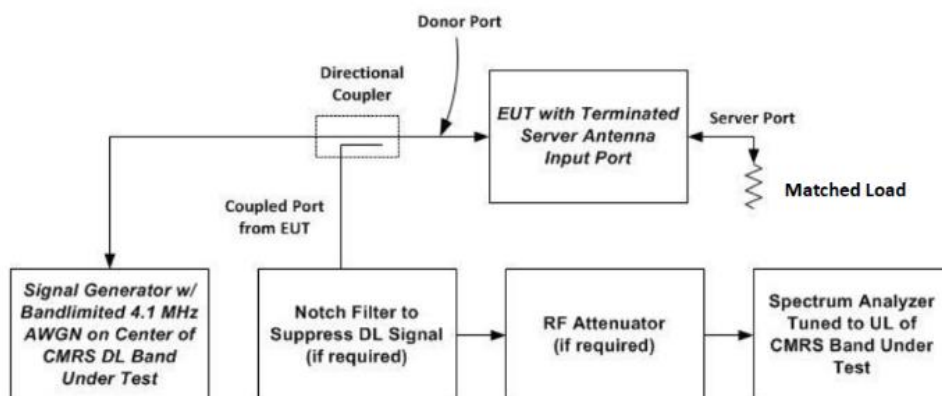


Figure 3 –
uplink

Test setup for
noise power

measurement



in the presence of a downlink signal



6.1.3 Test Data

Temperature	23.6℃	Humidity	52.3%
Test Engineer	Nick Peng	Test Mode	Transmitting

Max Noise Power				
Operation Band		Measured (dBm/MHz)	Limit (dBm/MHz)	Result (dB)
Uplink	Lower 700 Band	-48.060	-45.51	PASS
	Upper 700 Band	-45.627	-44.64	PASS
	Cellular Band	-45.847	-44.05	PASS
	PCS Band	-47.130	-37.00	PASS
	AWS Band	-46.409	-37.73	PASS
Downlink	Lower 700 Band	-45.795	-45.15	PASS
	Upper 700 Band	-46.181	-44.98	PASS
	Cellular Band	-48.893	-43.60	PASS
	PCS Band	-42.402	-36.64	PASS
	AWS Band	-44.687	-35.92	PASS

Variable Uplink Noise				
Operation Band	RSSI dBm	Measured dBm/MHz	Limit dBm/MHz	Results
Lower 700 Band	-63	-45.55	-40	PASS
	-64	-46.68	-39	PASS
	-65	-46.74	-38	PASS
	-66	-47.14	-37	PASS
	-67	-47.63	-36	PASS
	-68	-47.11	-35	PASS
Upper 700 Band	-63	-46.12	-40	PASS
	-64	-47.35	-39	PASS
	-65	-48.41	-38	PASS
	-66	-48.03	-37	PASS
	-67	-48.25	-36	PASS
	-68	-48.78	-35	PASS
Cellular Band	-62	-46.04	-41	PASS
	-63	-48.45	-40	PASS
	-64	-49.41	-39	PASS
	-65	-49.54	-38	PASS
	-66	-49.58	-37	PASS
	-67	-48.69	-36	PASS
PCS Band	-62	-45.27	-41	PASS
	-63	-45.96	-40	PASS
	-64	-46.38	-39	PASS
	-65	-46.95	-38	PASS
	-66	-47.86	-37	PASS
	-67	-47.78	-36	PASS
AWS Band	-63	-45.11	-40	PASS
	-64	-46.14	-39	PASS
	-65	-46.31	-38	PASS

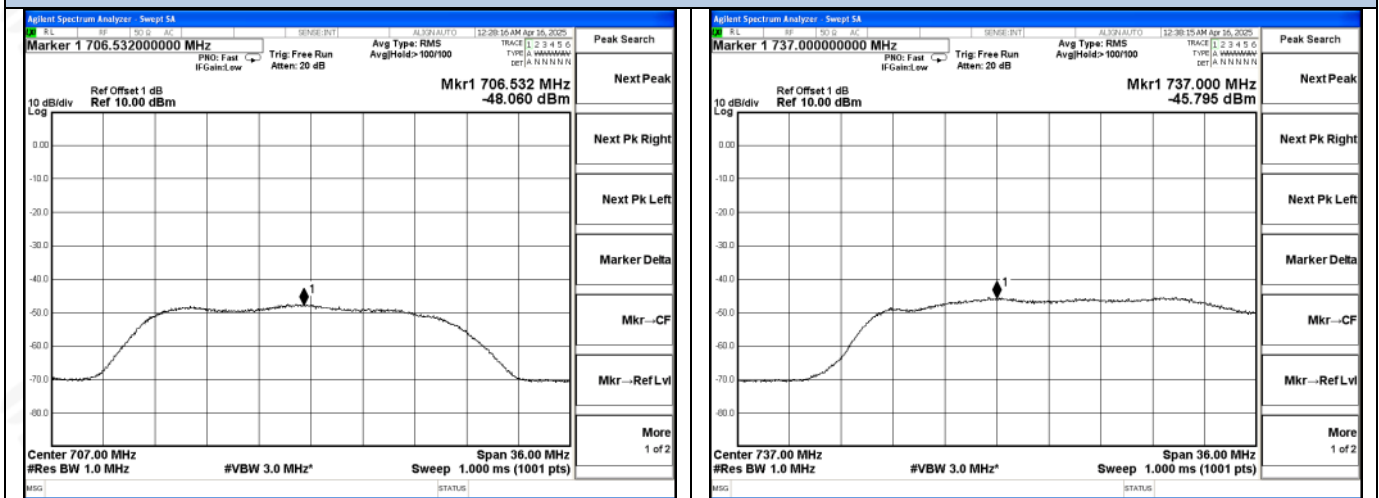


	-66	-47.08	-37	PASS
	-67	-47.66	-36	PASS
	-68	-47.59	-35	PASS

Variable Uplink Noise Timing			
Operation Band	Measured (s)	Limit (s)	Results
Lower 700 Band	0.020	3	PASS
Upper 700 Band	0.030	3	PASS
Cellular Band	0.020	3	PASS
PCS Band	0.020	3	PASS
AWS Band	0.020	3	PASS



Test Graphs

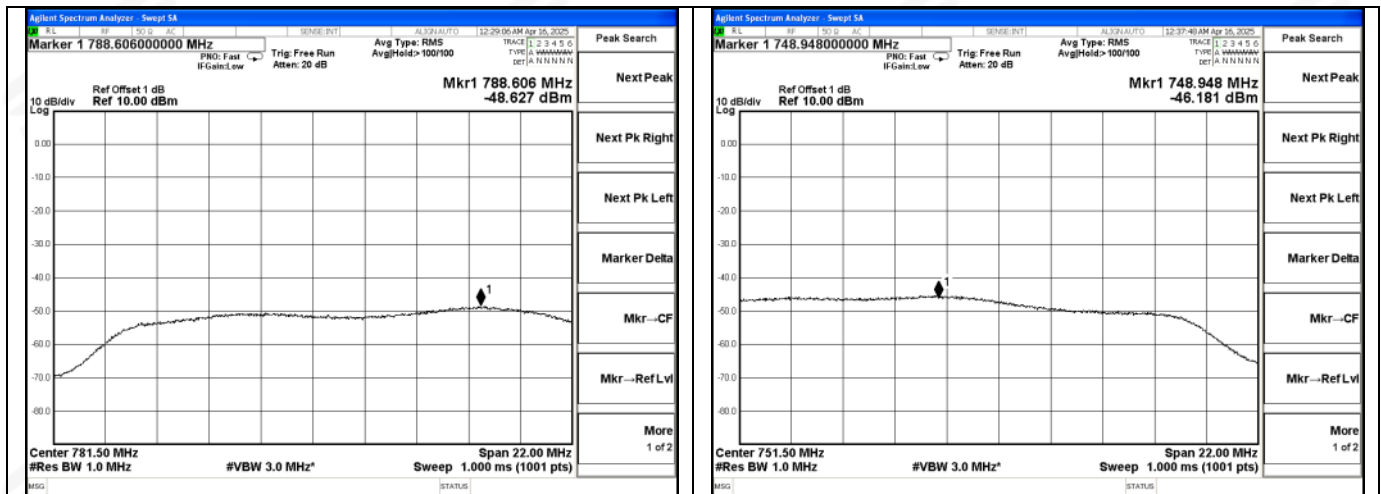


Lower 700 Band UL

Lower 700 Band DL

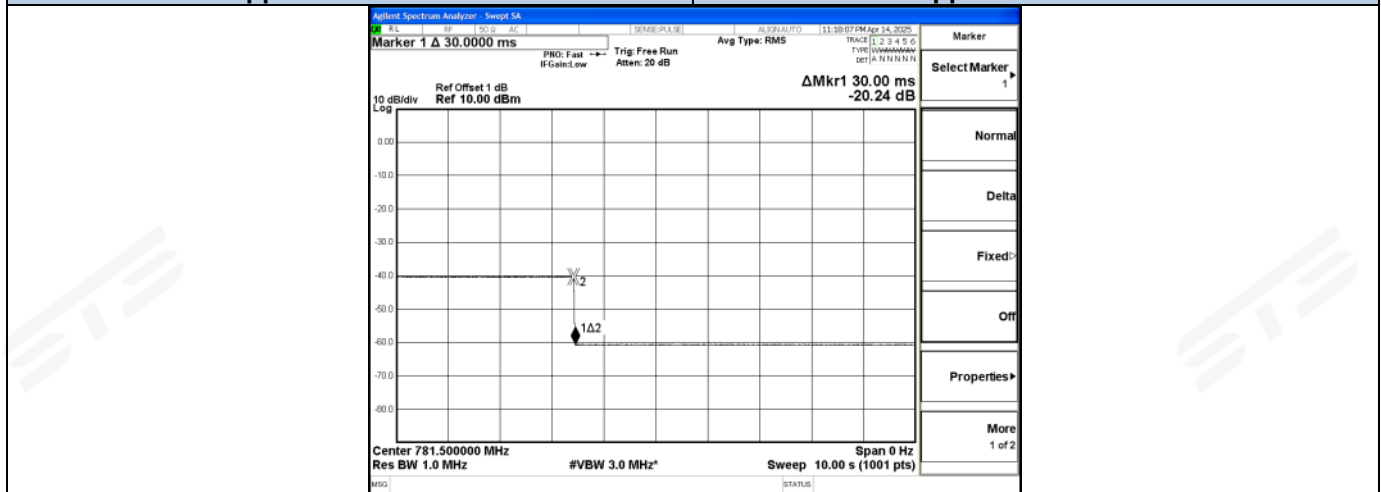


Lower 700 Band Variable Uplink Noise Timing

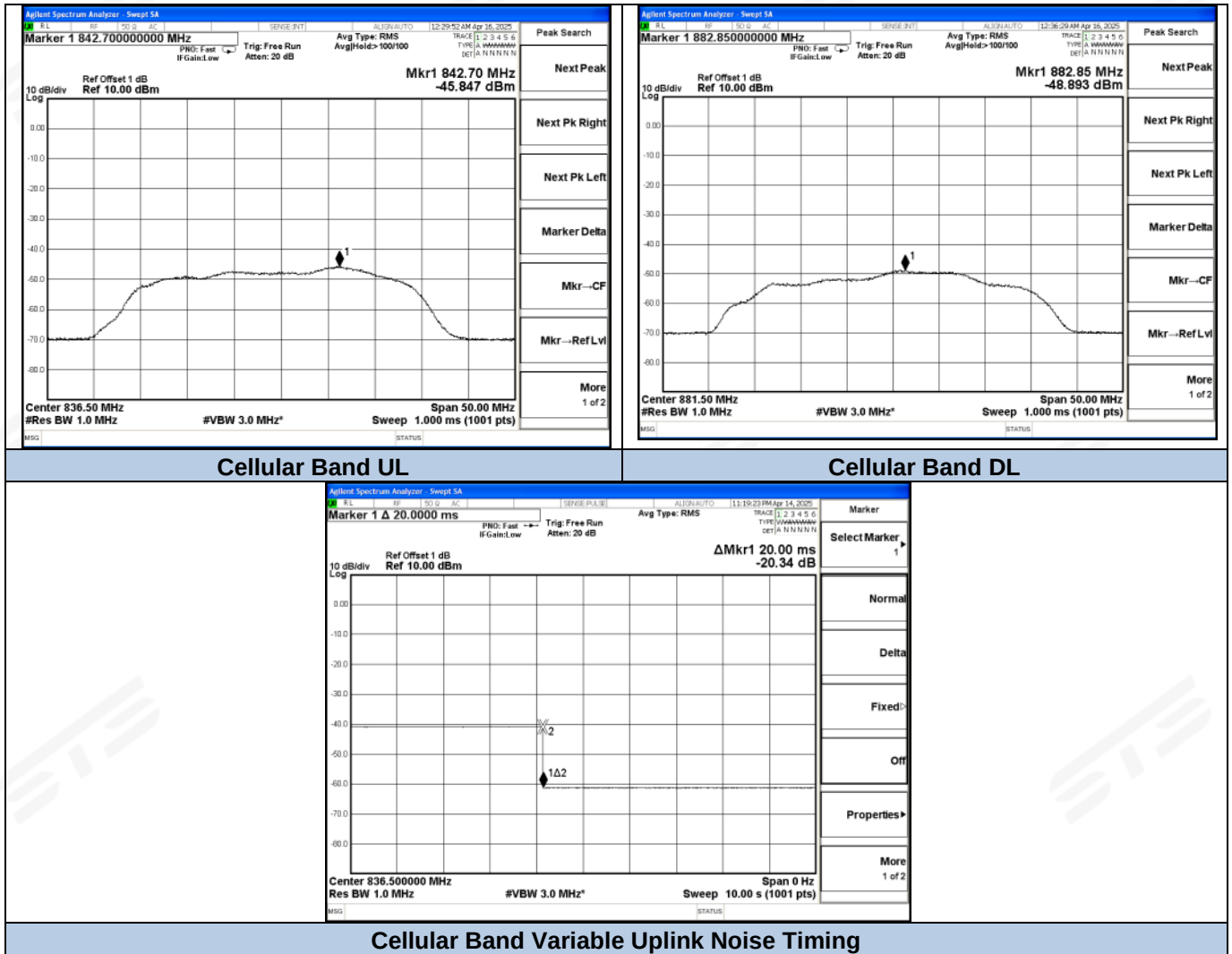


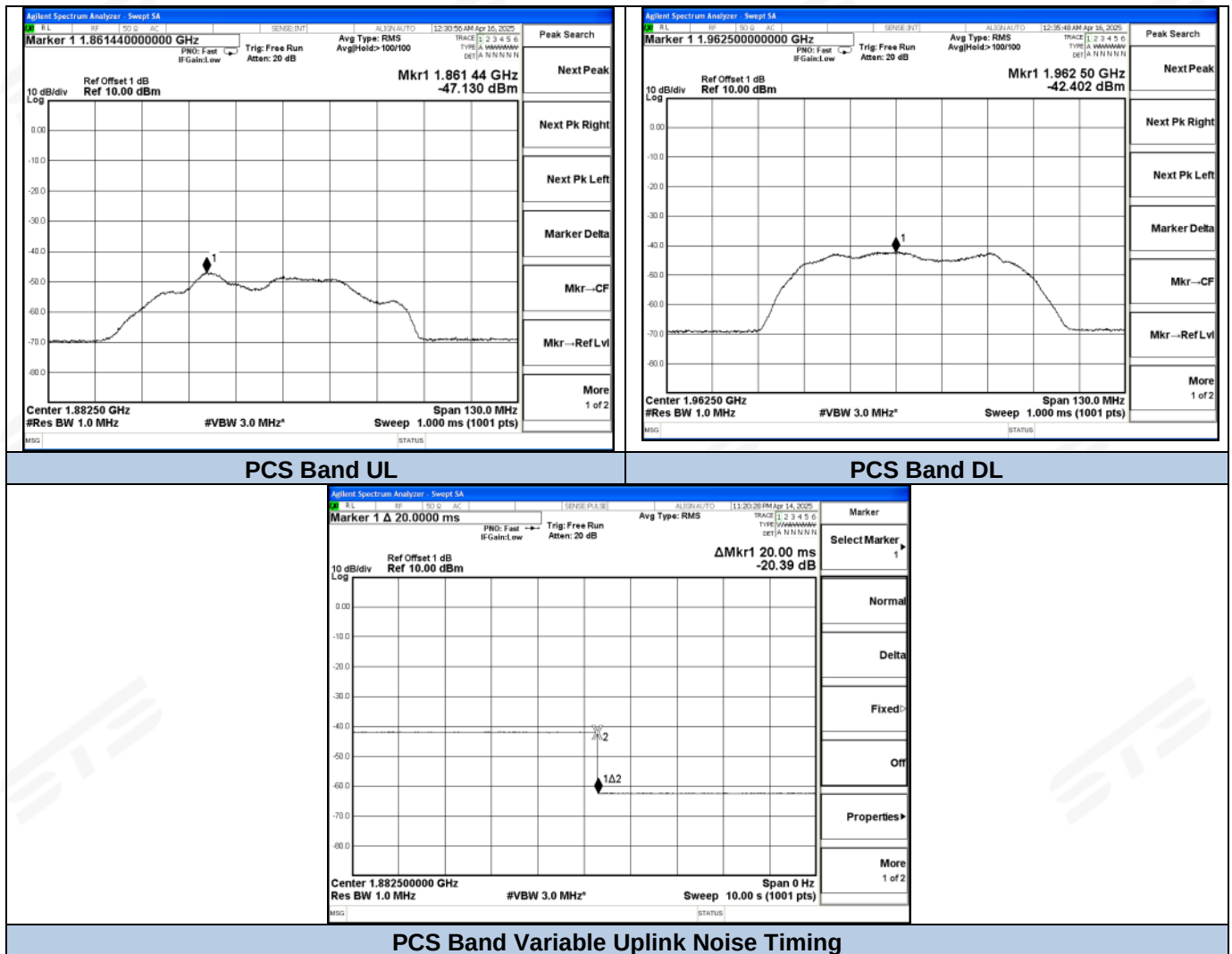
Upper 700 Band UL

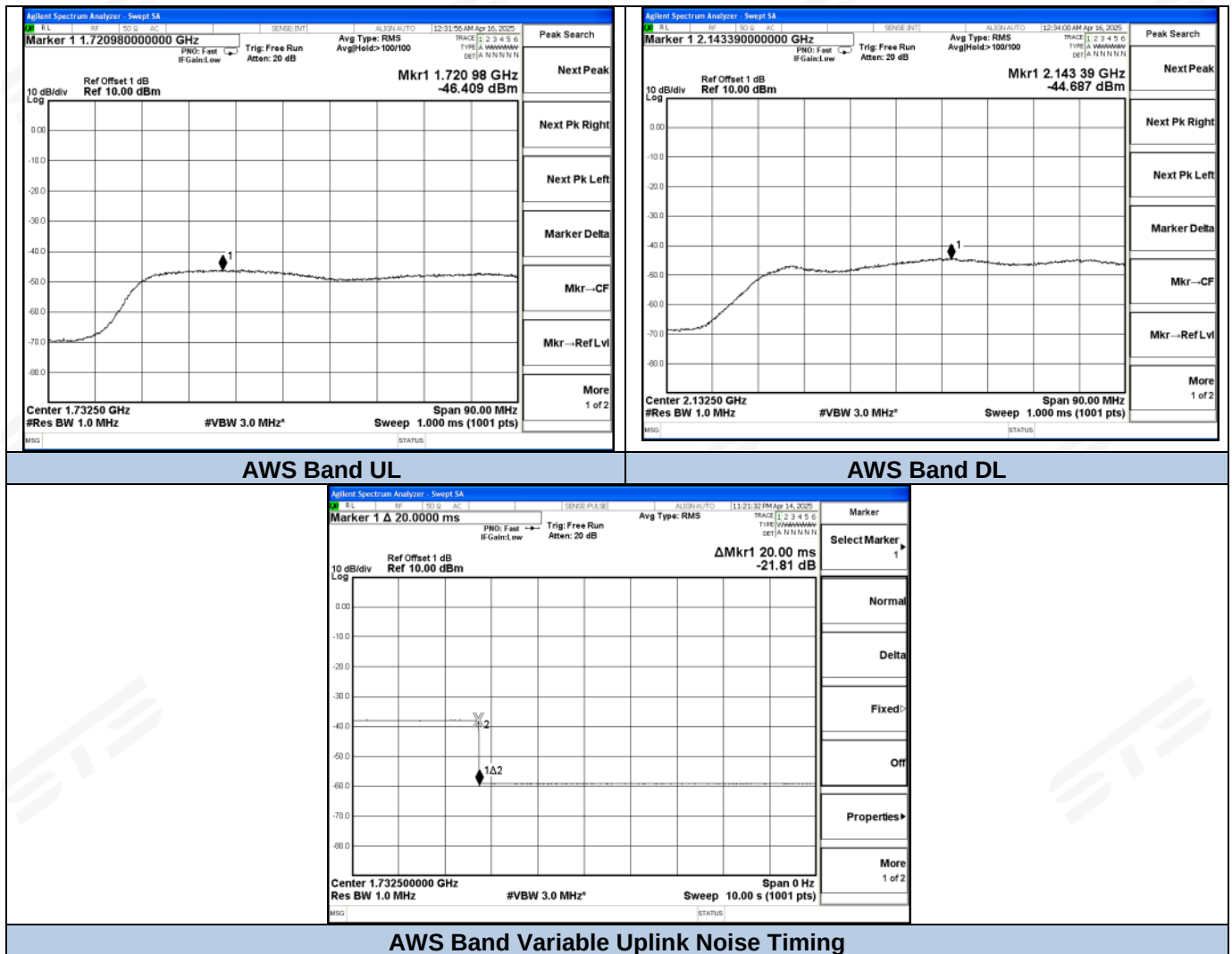
Upper 700 Band DL



Upper 700 Band Variable Uplink Noise Timing







6.2 Authorized Frequency Band Verification

6.2.1 Applicable Standard

According to § 20.21(e)(3) Frequency Bands.

This test is intended to confirm that the signal booster only operates on the CMRS frequency bands authorized for use by the NPS. In other words, the signal booster shall reject amplification of other signals outside of its passband. In addition, this test will identify the frequency at which the maximum gain is realized within each CMRS operational band, which then serves as a basis for subsequent tests.

6.2.2 Test Procedure

According to section 7.1 of KDB 935210 D03 Signal Booster Measurement v04r04:

- a) Connect the EUT to the test equipment as shown in Figure 4. Begin with the uplink output (donor) port connected to the spectrum analyzer.
- b) Set the spectrum analyzer resolution bandwidth (RBW) for 100 kHz with the video bandwidth (VBW) ≥ 3 the RBW, using a PEAK detector with the MAX HOLD function.
- c) Set the center frequency of the spectrum analyzer to the center of the operational band under test with a span of 1 MHz.
- d) Set the signal generator for CW mode and tune to the center frequency of the operational band under test.
- e) Set the initial signal generator power to a level that is at least 6 dB below the AGC level specified by the manufacturer.
- f) Slowly increase the signal generator power level until the output signal reaches the AGC operational level.
- g) Reduce the signal generator power to a level that is 3 dB below the level noted above, then manually reset the EUT (e.g., cycle ac/dc power).
- h) Reset the spectrum analyzer span to 2 the width of the CMRS band under test. Adjust the tuned frequency of the signal generator to sweep 2 the width of the CMRS band using the sweep function. The AGC must be deactivated throughout the entire sweep.
- i) Using three markers, identify the CMRS band edges and the frequency with the highest power. Affirm that the values of all markers are visible on the display of the spectrum analyzer (e.g., marker table set to on).
- j) Capture the spectrum analyzer trace for inclusion in the test report.
- k) Repeat 7.1c) to 7.1j) for all operational uplink and downlink bands.

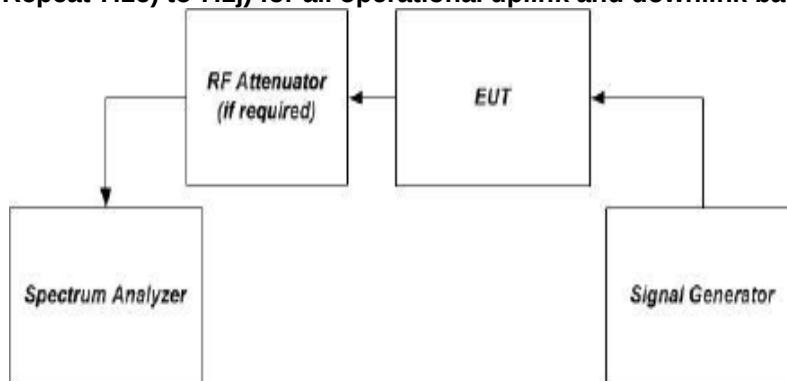


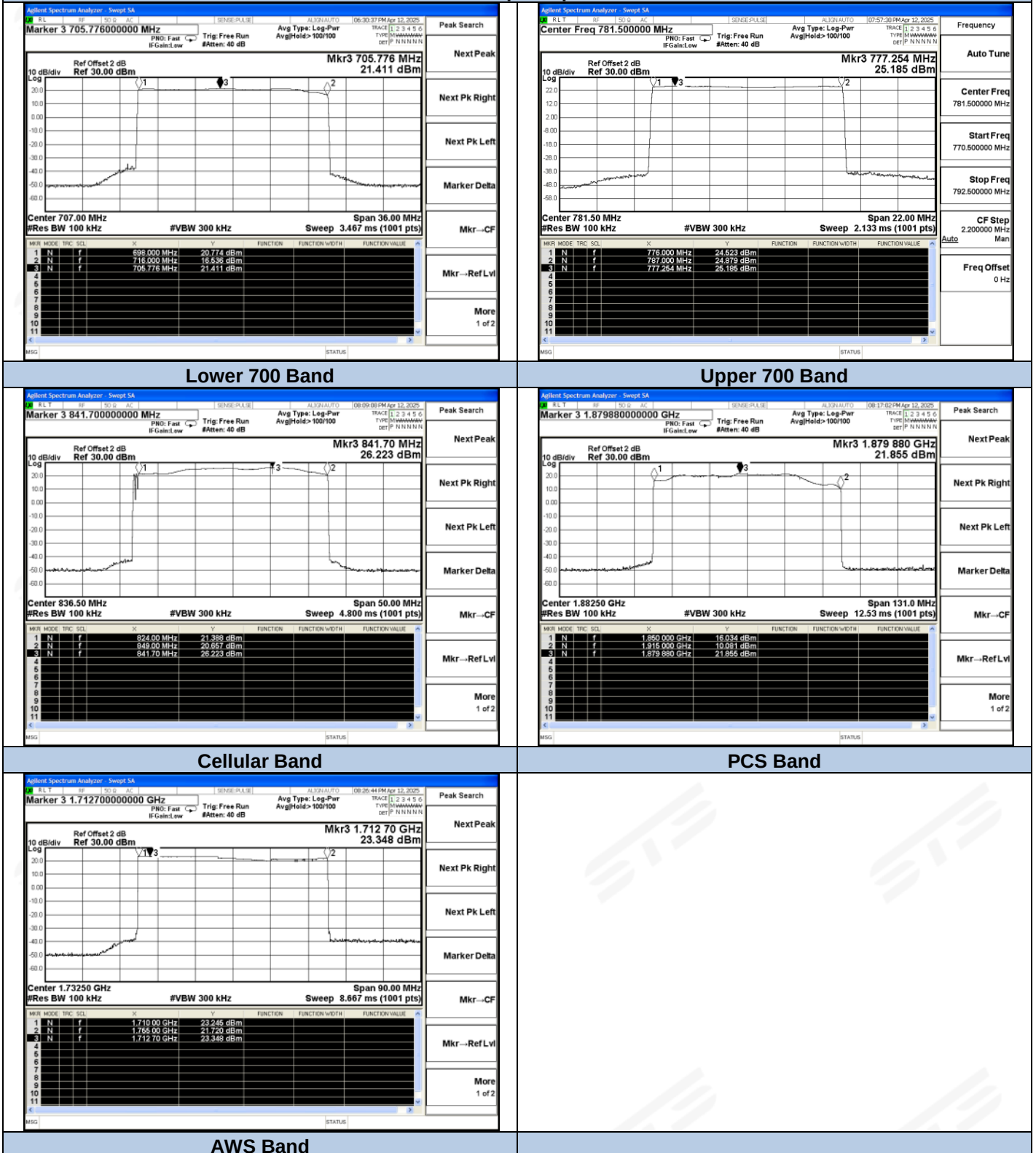
Figure 4 – Band verification test instrumentation setup

6.2.3 Test Data

Temperature	23.6°C	Humidity	52.3%
Test Engineer	Nick Peng	Test Mode	Transmitting

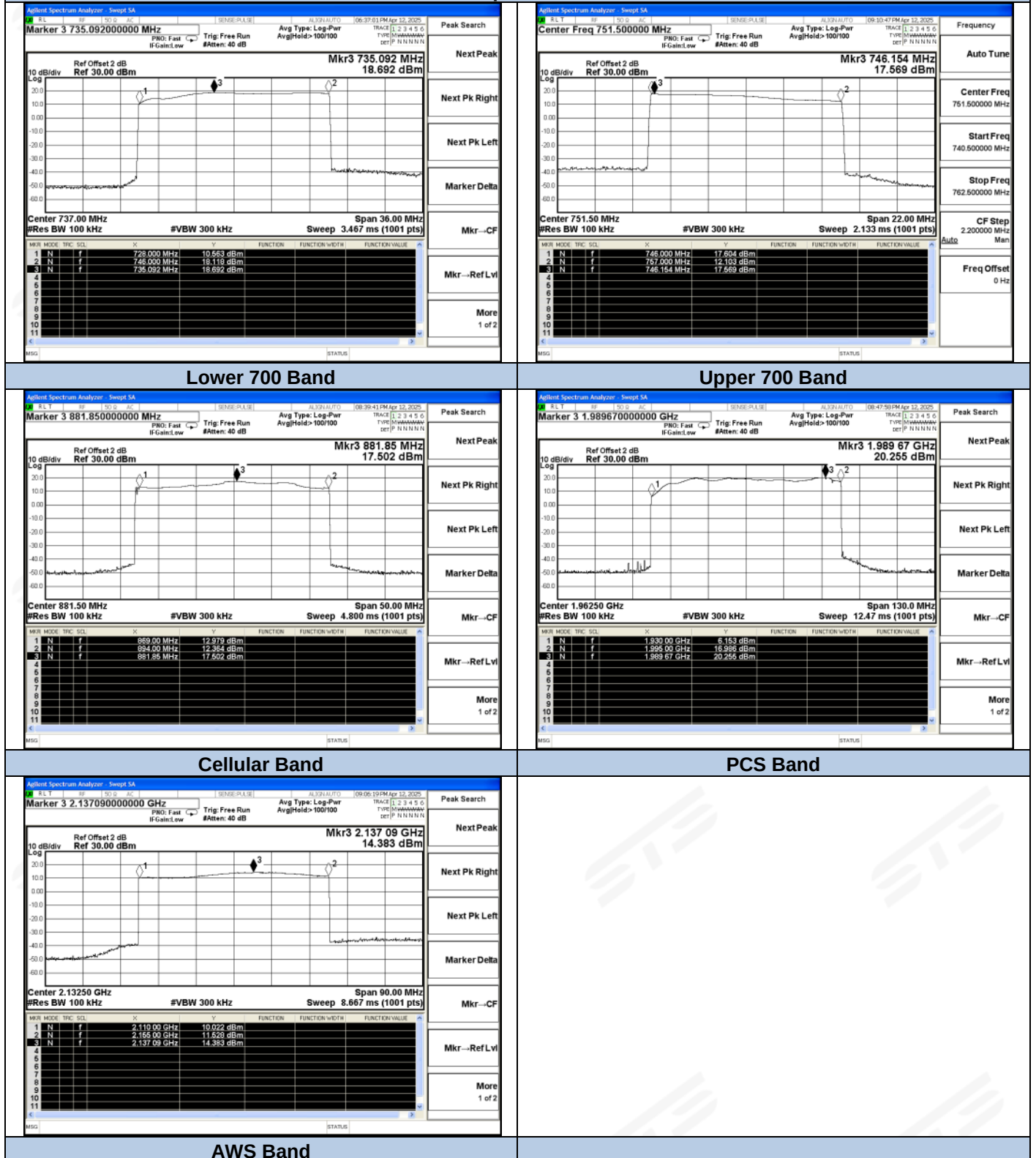


Test Graphs-Uplink





Test Graphs-Downlink





6.3 Maximum power measurement

6.3.1 Applicable Standard

According to §20.21(e)(8)(i)(D) Power Limits; §20.21(e)(8)(i)(B) Bidirectional Capability (uplink minimum conducted power output); §20.21(e)(4) Self-monitoring:

1. A booster's uplink power must not exceed 1 watt composite conducted power and equivalent isotropic radiated power (EIRP) for each band of operation. Composite downlink power shall not exceed 0.05 watt (17 dBm) conducted and EIRP for each band of operation.
2. Consumer Boosters must be able to provide equivalent uplink and downlink gain and conducted uplink power output that is at least 0.05 watts

This procedure shall be used to demonstrate compliance to the signal booster power limits and requirements as specified in Sections 20.21(e)(8)(i)(D) and 20.21(e)(8)(i)(B) for wideband consumer signal boosters.

6.3.2 Test Procedure

According to section 7.2.1 of KDB 935210 D03 Signal Booster Measurement v04r04:

Compliance to applicable EIRP limits must be shown using the highest gains from the list of antennas, cabling, and coupling devices declared by the manufacturer for use with the consumer booster.

- a) In addition, the maximum power levels measured in this procedure will be used in calculating the maximum gain as described in the next subclause.
- b) The frequency with the highest power level in each operational band as determined in 7.1 is to be measured discretely by applying the following procedure using the stated emission and power detector types independently.
 - c) Use a signal generator to create a pulsed CW or GSM signal with a pulse width of 570 μ s and a duty cycle of 12.5% (i.e., one GSM timeslot), then measure using the burst power function of the measuring instrument.
 - d) Use a signal generator to create an AWGN signal with a 99% occupied bandwidth (OBW) of 4.1 MHz, then measure using the channel power or band power function of the measuring instrumentation.
- f) All modes of operation must be verified to maintain operation within applicable limits at the maximum uplink and downlink test levels per device type as defined in 5.5, by increasing the power level in 2 dB steps from the AGC level to the maximum input level specified in 5.5.

According to section 7.2.2 of KDB 935210 D03 Signal Booster Measurement v04r04:

- a) Connect the EUT to the test equipment as shown in Figure 5. Begin with the uplink output (donor) port connected to the spectrum analyzer.
- b) Configure the signal generator and spectrum analyzer for operation on the frequency determined in 7.1 with the highest power level, but with the center frequency of the signal no closer than 2.5 MHz from the band edge. The spectrum analyzer span shall be set to at least 10 MHz.
- c) Set the initial signal generator power to a level well below that which causes AGC activation.
- d) Slowly increase the signal generator power level until the output signal reaches the AGC operational limit (from observation of signal behavior on the spectrum analyzer; i.e., no further increase in output power as input power is increased).
- e) Reduce power sufficiently on the signal generator to ensure that the AGC is not controlling the power output.
- f) Slowly increase the signal generator power to a level just below (and within 0.5 dB of) the AGC limit without triggering the AGC. Note the signal generator power level as P_{in} .
- g) Measure the output power, P_{out} , with the spectrum analyzer as follows.
 - 1) Set RBW = 100 kHz for AWGN signal type, or 300 kHz for CW or GSM signal type.
 - 2) Set VBW $\geq$ 3 RBW.
- 3) Select either the BURST POWER or CHANNEL POWER measurement mode, as required for



each signal type. For AWGN, the channel power integration bandwidth shall be the 99% OBW of the 4.1 MHz signal.

4) Select the power averaging (rms) detector.

5) Affirm that the number of measurement points per sweep $\geq (2 \text{ span})/\text{RBW}$.

NOTE—This requirement does not apply for BURST power measurement mode.

6) Set sweep time = auto couple, or as necessary (but no less than auto couple value).

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

8) Record the measured power level P_{out} , with one set of results for the GSM or CW input stimulus, and another set of results for the AWGN input stimulus.

6.3.3 Test Data

Temperature	23.6°C	Humidity	52.3%
Test Engineer	Nick Peng	Test Mode	Transmitting

	Max Output Power									
Mode	Operation Band	Signal Type	Conducted Output Power	Conducted Output Power limit(dBm)	Antenna Gain (dBi)	Cable Loss (dB)	EIRP (dBm)	ERP (dBm)	EIRP Limit (dBm)	Verdict
Uplink	Lower 700	CW	19.092	17-30	5	3.7	/	18.24	≤30	PASS
		AWGN	18.510		5	3.7		17.66		PASS
	Upper 700	CW	19.886		5	3.8		18.93		PASS
		AWGN	19.240		5	3.8		18.29		PASS
	Cellular	CW	19.551		6.5	4.0	/	19.90		PASS
		AWGN	19.350		6.5	4.0		19.7		PASS
	PCS	CW	19.125		7.5	4.5	22.125	/		PASS
		AWGN	18.230		7.5	4.5	21.230			PASS
	AWS	CW	19.485		7.5	4.2	22.785			PASS
		AWGN	19.150		7.5	4.2	22.450			PASS
Downlink	Lower 700	CW	8.814	/	5.5	1.2	/	10.96	≤17	PASS
		AWGN	8.220		5.5	1.2		10.37		PASS
	Upper 700	CW	8.777		5.5	1.2		10.92		PASS
		AWGN	8.640		5.5	1.2		10.79		PASS
	Cellular	CW	8.894		5.5	1.4	/	10.84		PASS
		AWGN	8.640		5.5	1.4		10.59		PASS
	PCS	CW	9.362		6.5	1.5	14.362	/		PASS
		AWGN	8.600		6.5	1.5	13.600			PASS
	AWS	CW	8.989		6	1.4	13.589			PASS
		AWGN	8.280		6	1.4	12.880			PASS

Note: EIRP = Conducted Output Power + Antenna Gain - Cable Loss

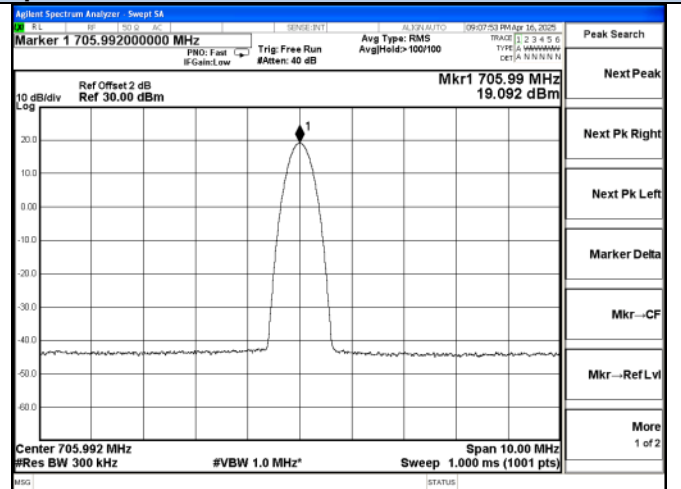
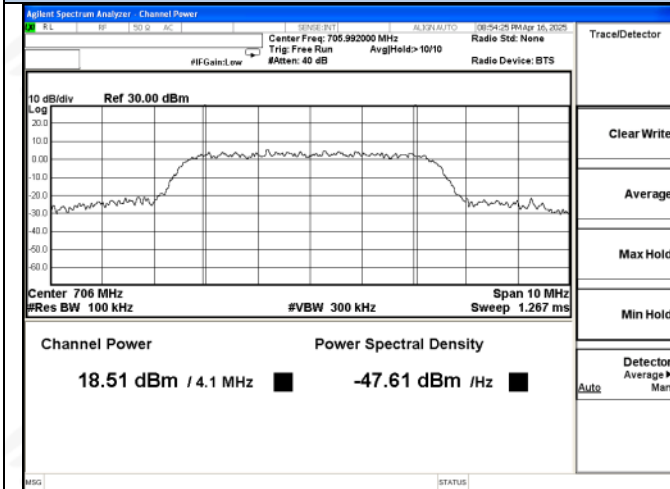
ERP = EIRP - 2.15dBi as EIRP by subtracting the gain of the dipole.



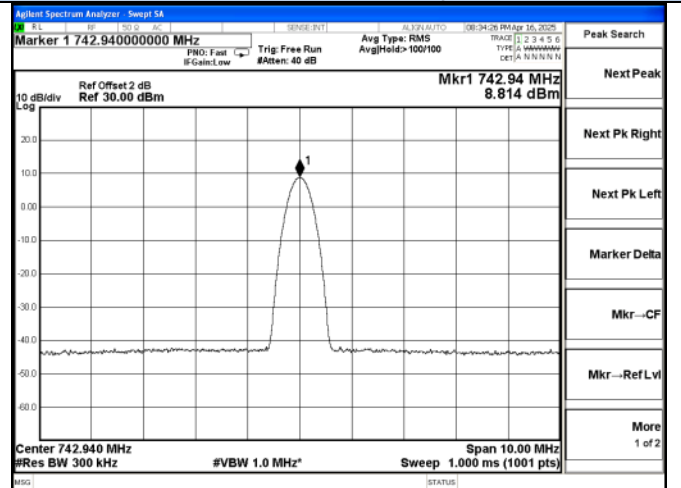
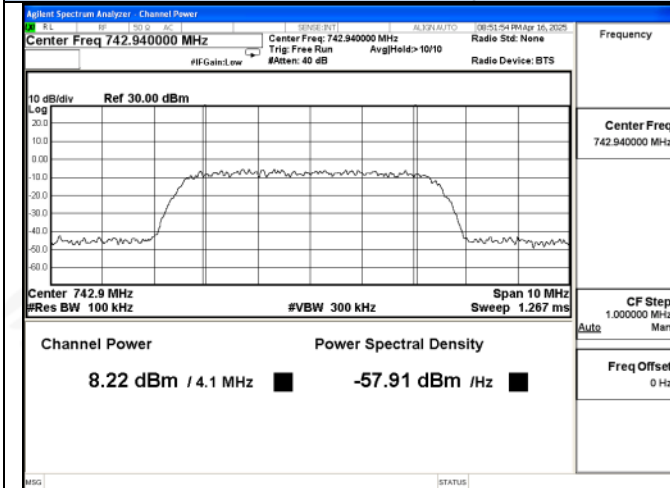
Max Input test level						
Mode	Operation Band	Signal Type	AGC Level (dBm)	Max Input Level (dBm)	Max Input Level limit (dBm)	Verdict
Uplink	Lower 700 Band	CW	-43	-20	≤27	PASS
		AWGN	-31	-20		PASS
	Upper 700 Band	CW	-39	-21		PASS
		AWGN	-28	-20		PASS
	Cellular Band	CW	-38	-19		PASS
		AWGN	-28	-18		PASS
	PCS Band	CW	-38	-20		PASS
		AWGN	-32	-18		PASS
	AWS Band	CW	-40	-21		PASS
		AWGN	-31	-22		PASS
Downlink	Lower 700 Band	CW	-46	-22	≤-20	PASS
		AWGN	-35	-21		PASS
	Upper 700 Band	CW	-46	-18		PASS
		AWGN	-35	-19		PASS
	Cellular Band	CW	-46	-21		PASS
		AWGN	-36	-20		PASS
	PCS Band	CW	-47	-21		PASS
		AWGN	-38	-18		PASS
	AWS Band	CW	-53	-22		PASS
		AWGN	-43	-22		PASS



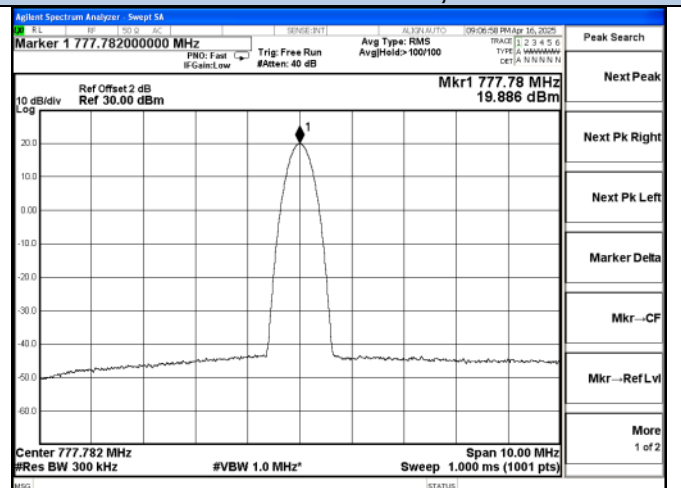
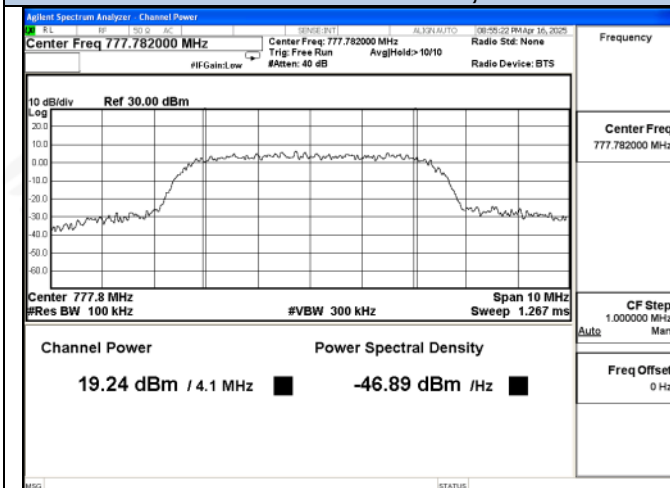
Test Graphs



Lower 700 Band AWGN, UL

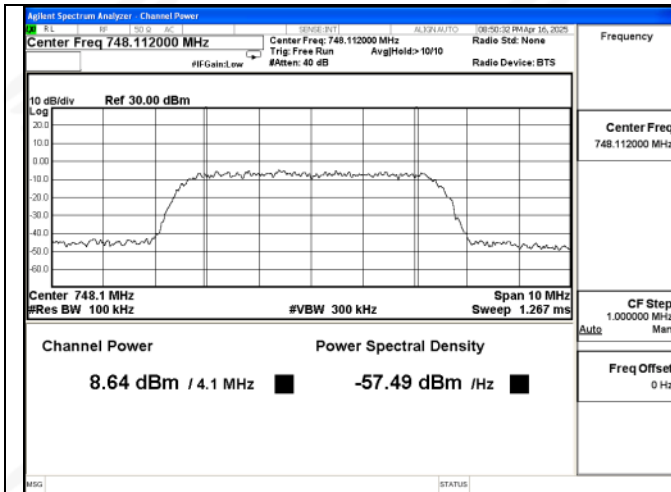


Lower 700 Band AWGN, DL

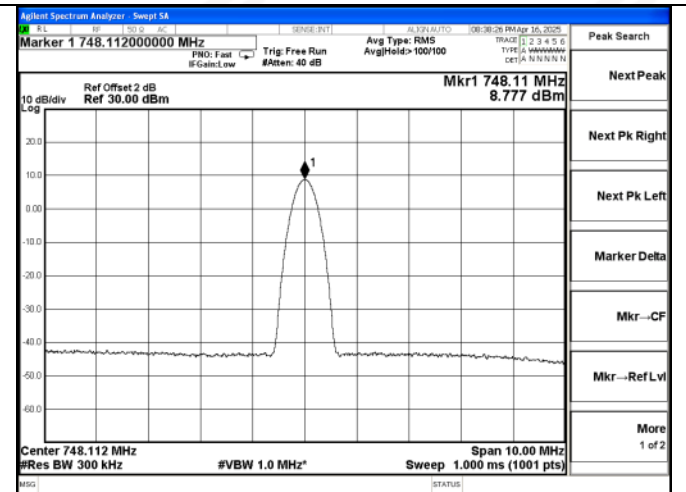


Upper 700 Band AWGN, UL

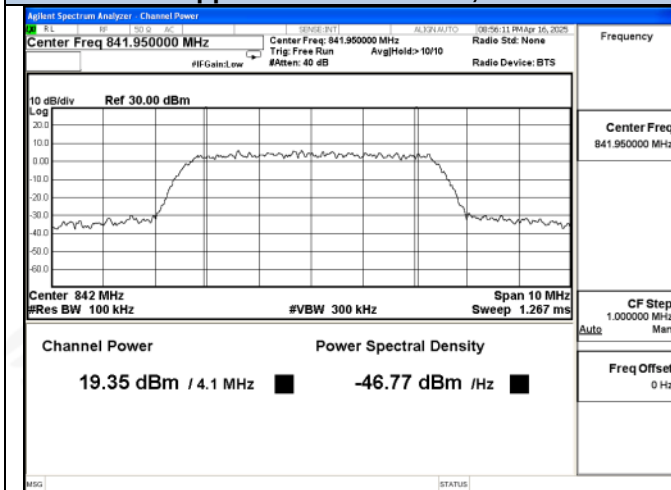
Upper 700 Band CW, UL



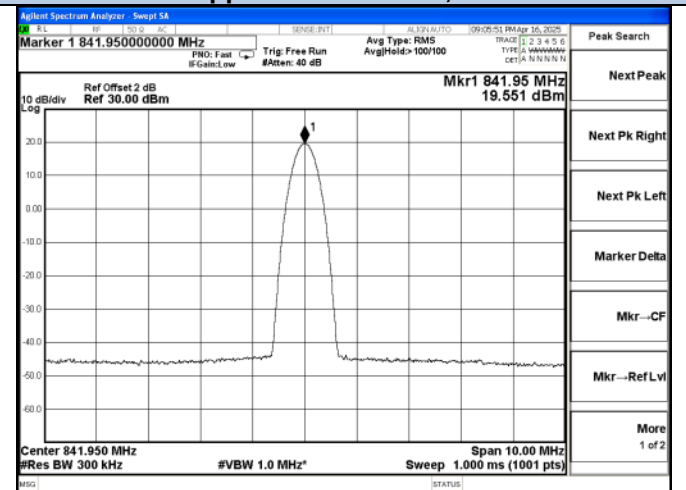
Upper 700 Band AWGN, DL



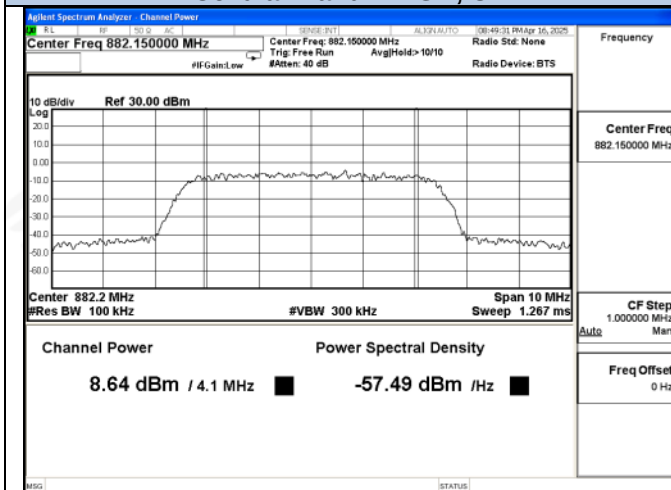
Upper 700 Band CW, DL



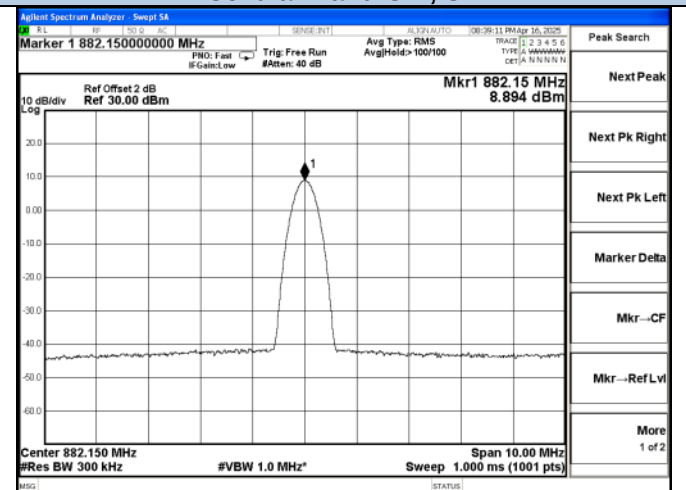
Cellular Band AWGN, UL



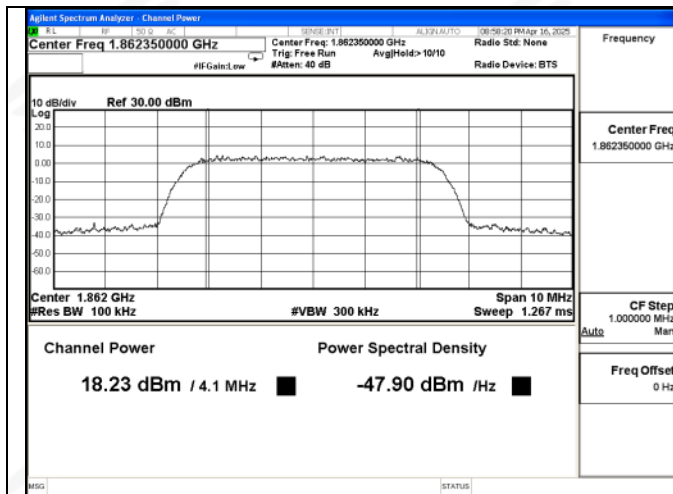
Cellular Band CW, UL



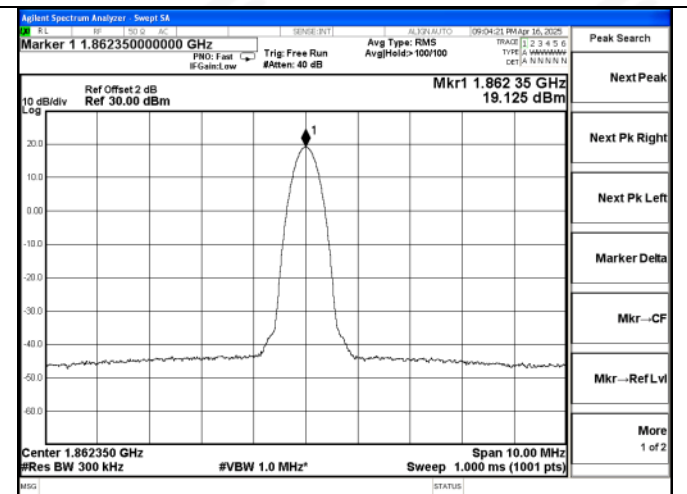
Cellular Band AWGN, DL



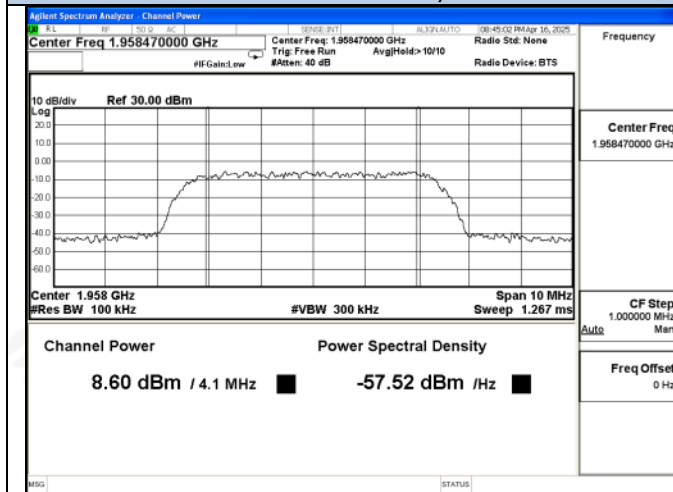
Cellular Band CW, DL



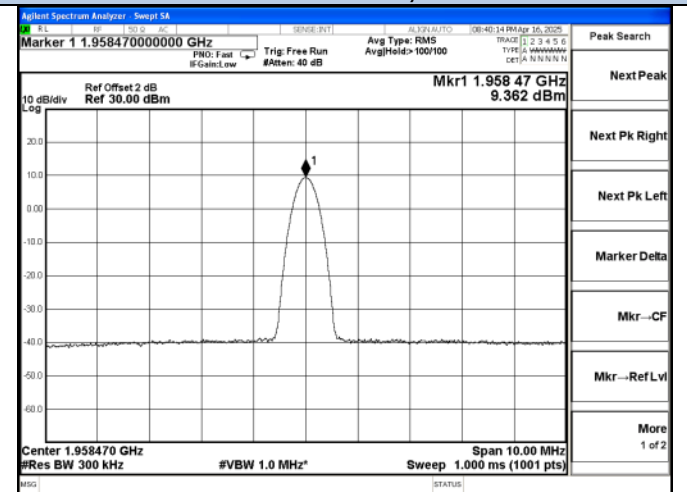
PCS Band AWGN, UL



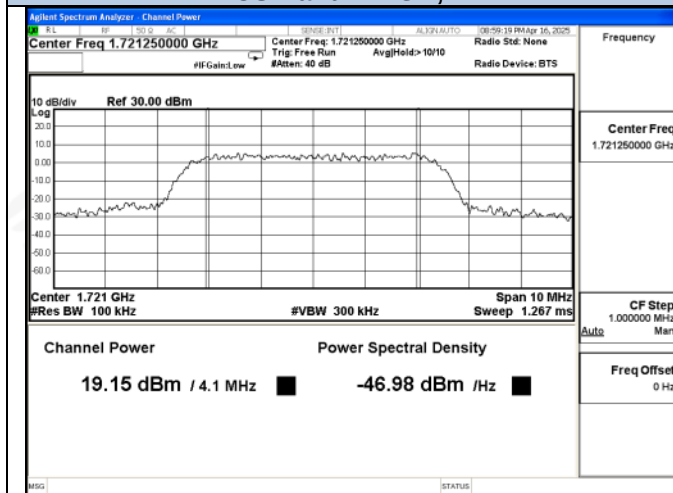
PCS Band CW, UL



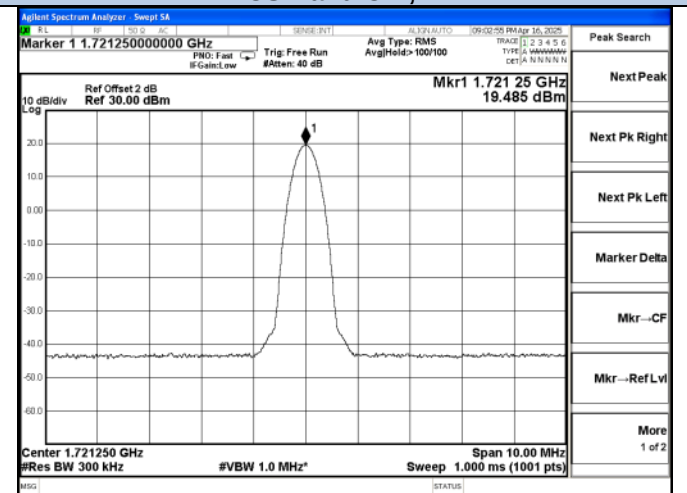
PCS Band AWGN, DL



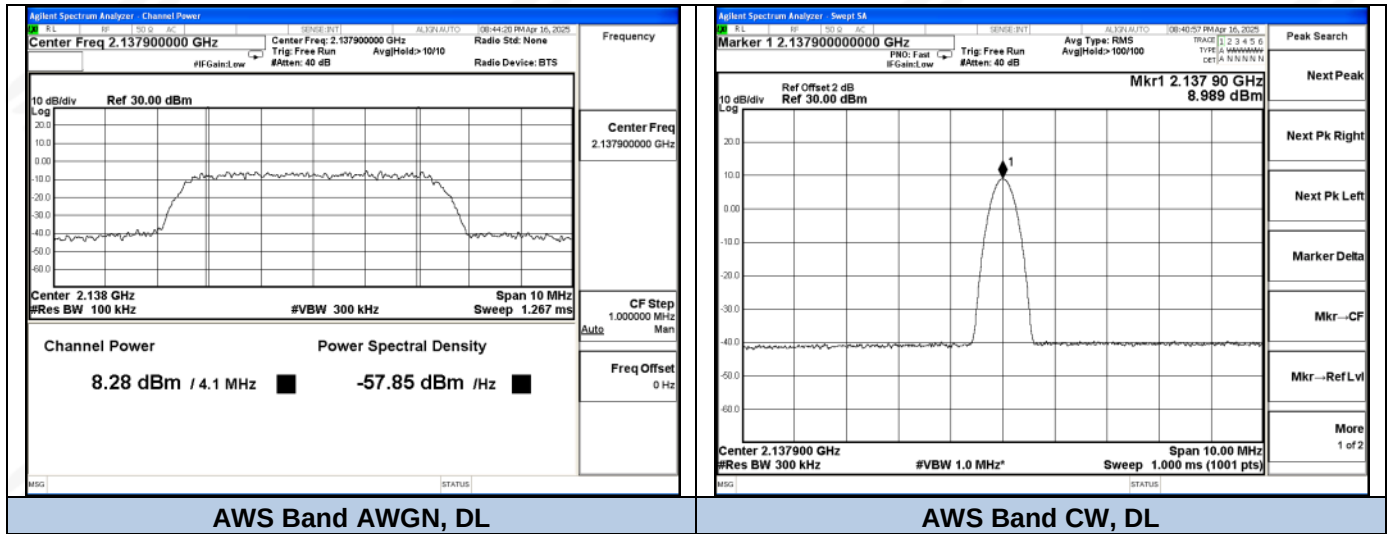
PCS Band CW, DL



AWS Band AWGN, UL



AWS Band CW, UL





6.4 Gain Limits and Bidirectional Capability&Variable Gain&Variable Uplink

Gain Timing

6.4.1 Applicable Standard

According to §20.21(e)(8)(i)(C)(2) Booster Gain Limits (maximum gain); §20.21(e)(8)(i)(B) Bidirectional Capability (equivalent uplink and downlink gain):

The uplink and downlink maximum gain of a Consumer Booster referenced to its input and output ports shall not exceed the following limits:

- (i) Fixed Booster maximum gain shall not exceed $6.5 \text{ dB} + 20 \text{ Log}_{10}(\text{Frequency})$;
- (ii) Where, Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

6.4.2 Test Procedure

According to section 7.3 of KDB 935210 D03 Signal Booster Measurement v04r04:

This subclause provides guidance for the calculation of the maximum gain, based on the results obtained from the 7.1 and 7.2 measurements. The NPS limits on maximum gain for fixed and mobile wideband consumer signal boosters are provided in §20.21(e)(8)(i)(C)(2). Additionally, §20.21(e)(8)(i)(B) requires that wideband consumer signal boosters be able to provide equivalent uplink and downlink gain, i.e., within 9 dB.

- a) Calculate the maximum gain of the booster as follows to demonstrate compliance to the applicable gain limits as specified.
- b) For both the uplink and downlink in each supported frequency band, use each of the POUT and PIN result pairs for all signal types used in 7.2 in the following equation to obtain the maximum gain, G:

$$G \text{ (dB)} = \text{POUT(dBm)} - \text{PIN(dBm)}.$$

- c) Record the maximum gain of the uplink and downlink paths for each supported frequency band, and verify that the each gain value complies with the applicable limit.
- d) Provide tabulated results in the test report

6.4.3 Test Data

Temperature	23.6°C	Humidity	52.3%
Test Engineer	Nick Peng	Test Mode	Transmitting



Max Gain							
Mode	Operation Band	Signal Type	Pre AGC Input Level (dBm)	Conducted Output Level (dBm)	Max Gain (dB)	Gain Limit (dB)	Verdict
Uplink	Lower 700 Band	CW	-43	19.092	62.092	≤63.49	PASS
		AWGN	-31	18.510	49.510		PASS
	Upper 700 Band	CW	-39	19.886	58.886	≤64.02	PASS
		AWGN	-28	19.240	47.240		PASS
	Cellular Band	CW	-38	19.551	57.551	≤64.94	PASS
		AWGN	-28	19.350	47.350		PASS
	PCS Band	CW	-38	19.125	57.125	≤71.99	PASS
		AWGN	-32	18.230	50.230		PASS
Downlink	Lower 700 Band	CW	-46	8.814	54.814	≤63.85	PASS
		AWGN	-35	8.220	43.220		PASS
	Upper 700 Band	CW	-46	8.777	54.777	≤64.36	PASS
		AWGN	-35	8.640	43.640		PASS
	Cellular Band	CW	-46	8.894	54.894	≤65.40	PASS
		AWGN	-36	8.640	44.640		PASS
	PCS Band	CW	-47	9.362	56.362	≤72.34	PASS
		AWGN	-38	8.600	46.600		PASS
	AWS Band	CW	-53	8.989	61.989	≤73.08	PASS
		AWGN	-43	8.280	51.280		PASS

Note: Fixed Booster maximum gain shall not exceed $6.5 \text{ dB} + 20 \text{ Log}_{10}(\text{Frequency})$, where Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

Uplink Gain VS Downlink Gain						
Band	Signal Type	Uplink Gain (dB)	Downlink Gain (dB)	Caculated (dB)	Limit (dB)	Verdict
Lower 700 Band	CW	62.092	54.814	7.278	≤9	PASS
	AWGN	49.51	43.22	6.290		PASS
Upper 700 Band	CW	58.886	54.777	4.109		PASS
	AWGN	47.24	43.64	3.600		PASS
Cellular Band	CW	57.551	54.894	2.657		PASS
	AWGN	47.35	44.64	2.710		PASS
PCS Band	CW	57.125	56.362	0.763		PASS
	AWGN	50.23	46.6	3.630		PASS
AWS Band	CW	59.485	61.989	-2.504		PASS
	AWGN	50.15	51.28	-1.130		PASS



6.4.4 Variable Gain Test Procedure

According to §20.21(e)(8)(i)(C)(1) Booster Gain Limits (variable gain); §20.21(e)(8)(i)(H) Transmit Power Off Mode (uplink gain):

The uplink gain in dB of a consumer booster referenced to its input and output ports shall not exceed $-34 \text{ dB} - \text{RSSI} + \text{MSCL}$.

- (i) Where RSSI is the downlink composite received signal power in dBm at the booster donor port for all base stations in the band of operation. RSSI is expressed in negative dB units relative to 1 mW.
- (ii) Where MSCL (Mobile Station Coupling Loss) is the minimum coupling loss in dB between the wireless device and input port of the consumer booster. MSCL must be calculated or measured for each band of operation and provided in compliance test reports.

According to section 7.9.1 of KDB 935210 D03 Signal Booster Measurement v04r04:

- 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 $\geq$ 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 $\geq (2 \text{ span})/\text{RBW}$.
 - 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.

6.4.5 Variable uplink gain timing Test Procedure

According to section 7.9.2 (Variable uplink gain timing) of KDB 935210 D03 Signal Booster Measurement v04r04:

- m) 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.
- n) Configure downlink signal generator #1 for AWGN operation with a 99% OBW of 4.1 MHz, tuned to the center of the operational band.
- o) 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.
- p) Set RBW = 100 kHz.
- q) Set VBW $\geq$ 300 kHz.
- r) Select the CHANNEL POWER measurement mode.
- s) Select the power averaging (rms) detector.
- t) Affirm that the number of measurement points per sweep $\geq$ (2 span)/RBW.
- u) Sweep time = auto couple or as necessary (but no less than auto couple value).
- v) Trace average at least 10 traces in power averaging (i.e., rms) mode.
- w) 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.
- x) Repeat 7.9.1b) to 7.9.1k) for all operational uplink bands.

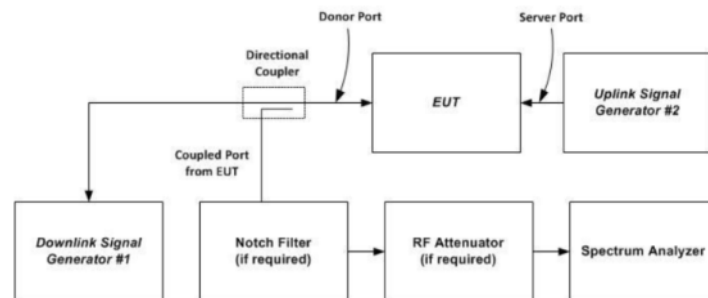


Figure 5 – Variable gain instrumentation test setup



6.4.6 Test data

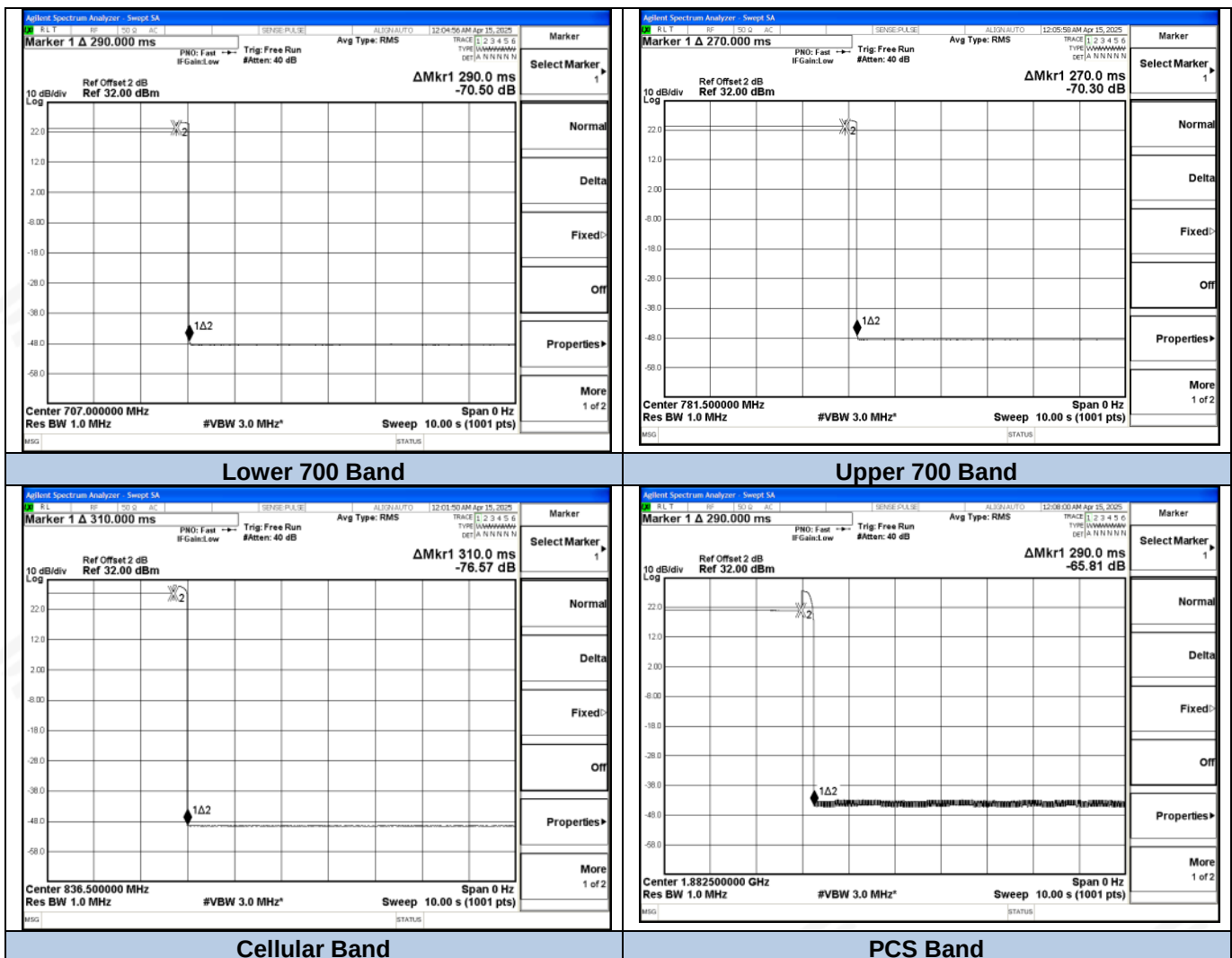
Temperature	23.6℃	Humidity	52.3%
Test Engineer	Nick Peng	Test Mode	Transmitting

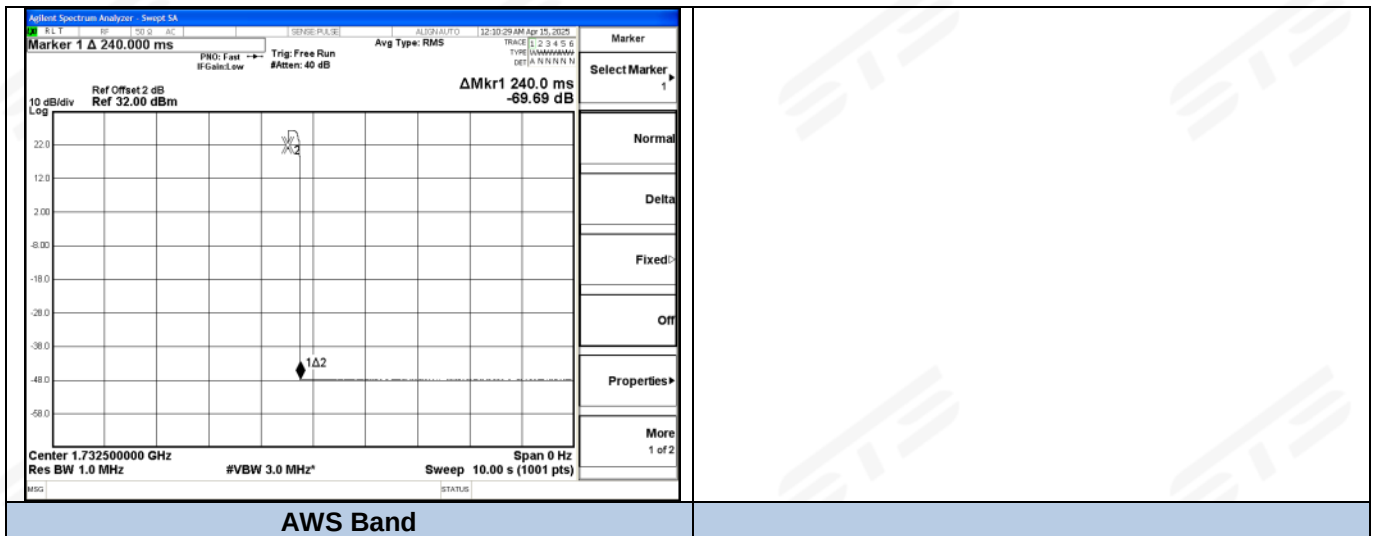
Variable booster Uplink gain								
Operation Band	Max Gain (dB)	Isolation (dB)	Difference (dB)	Variable booster gain (dB)	RSSI (dBm)	MSCL	Limit (dB)	Results
Lower 700 Band	62.09	+5	-3.87	58.22	-63	26.04	55.04	PASS
		+4	-4.08	58.01	-64	26.04	56.04	PASS
		+3	-2.73	59.36	-65	26.04	57.04	PASS
		+2	-2.14	59.95	-66	26.04	58.04	PASS
		+1	-1.99	60.10	-67	26.04	59.04	PASS
		0	-1.02	61.07	-68	26.04	60.04	PASS
Upper 700 Band	59.89	+5	-4.53	55.36	-63	27.00	56.00	PASS
		+4	-3.64	56.25	-64	27.00	57.00	PASS
		+3	-1.97	57.92	-65	27.00	58.00	PASS
		+2	-1.57	58.32	-66	27.00	59.00	PASS
		+1	0.06	59.95	-67	27.00	60.00	PASS
		0	0.1	59.99	-68	27.00	61.00	PASS
Cellular Band	57.55	+5	-2.34	55.21	-63	27.68	56.68	PASS
		+4	-1.31	56.24	-64	27.68	57.68	PASS
		+3	-0.6	56.95	-65	27.68	58.68	PASS
		+2	0.39	57.94	-66	27.68	59.68	PASS
		+1	0.6	58.15	-67	27.68	60.68	PASS
		0	1.17	58.72	-68	27.68	61.68	PASS
PCS Band	57.13	+5	-2.5	54.63	-63	33.80	62.80	PASS
		+4	-1.77	55.36	-64	33.80	63.80	PASS
		+3	-0.88	56.25	-65	33.80	64.80	PASS
		+2	0.11	57.24	-66	33.80	65.80	PASS
		+1	0.95	58.08	-67	33.80	66.80	PASS
		0	0.87	58.00	-68	33.80	67.80	PASS
AWS Band	59.49	+5	0.65	60.14	-63	33.52	62.52	PASS
		+4	1.05	60.54	-64	33.52	63.52	PASS
		+3	0.87	60.36	-65	33.52	64.52	PASS
		+2	2.22	61.71	-66	33.52	65.52	PASS
		+1	1.56	61.05	-67	33.52	66.52	PASS
		0	2.57	62.06	-68	33.52	67.52	PASS



Variable Uplink Gain Timing			
Operation Band	Measured (s)	Limit (s)	Result
Lower 700 Band	0.290	3.0	PASS
Upper 700 Band	0.270	3.0	PASS
Cellular Band	0.310	3.0	PASS
PCS Band	0.290	3.0	PASS
AWS Band	0.240	3.0	PASS

Variable Uplink Gain Timing-Test Graphs





6.5 Anti-Oscillation

6.5.1 Applicable Standard

According to §20.21(e)(8)(ii)(A) Anti-Oscillation:

1. Consumer boosters must be able to detect and mitigate (i.e., by automatic gain reduction or shut down), any oscillations in uplink and downlink bands. Oscillation detection and mitigation must occur automatically within 0.3 seconds in the uplink band and within 1 second in the downlink band. In cases where oscillation is detected, the booster must continue mitigation for at least one minute before restarting.

After five such restarts, the booster must not resume operation until manually reset.

2. Use of two EUTs is permitted for this measurement, which can greatly reduce the test time required. One EUT shall operate in a normal mode, and the second EUT shall operate in a test mode that is capable of disabling the uplink inactivity function and/or allows a reduction to 5 seconds of the time between restarts.

The procedures in 7.11.3 and 7.11.4 do not apply for devices that operate only as direct-connection mobile boosters having gain of less than or equal to 15 dB.

6.5.2 Test Procedure

Oscillation restart tests

According to section 7.11.2 of KDB 935210 D03 Signal Booster Measurement v04r04:

a) Connect the normal-operating mode EUT to the test equipment as shown in Figure 6 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) $RBW \geq 1$ MHz, $VBW > 3$ RBW
- 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 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.

Oscillation mitigation or shutdown

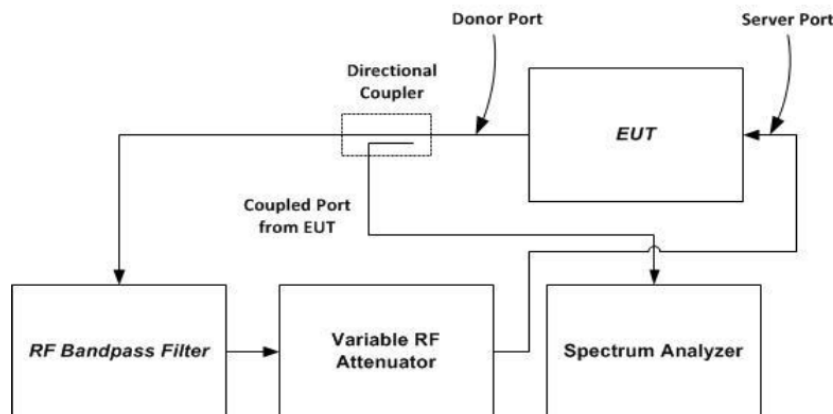
According to section 7.11.3 of KDB 935210 D03 Signal Booster Measurement v04r04:

- 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, $VBW \geq 3 \times RBW$,
 - 2) power averaging (rms) detector,
 - 3) trace averages ≥ 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.
 - 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 7.11.3f4). 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 7.11.3f5) allows the spectrum analyzer trace to stabilize, and verification of shutdown or oscillation level measurement must occur within 300 seconds.
 - 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

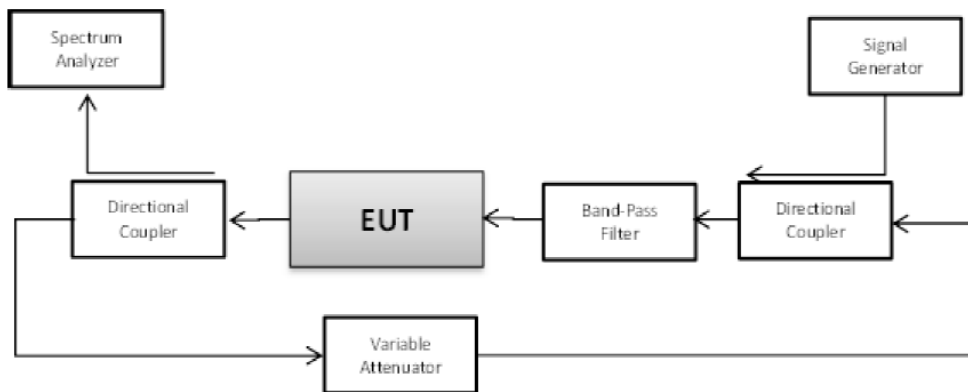


Figure 7 – Oscillation mitigation/shutdown test setup

6.5.3 Test data

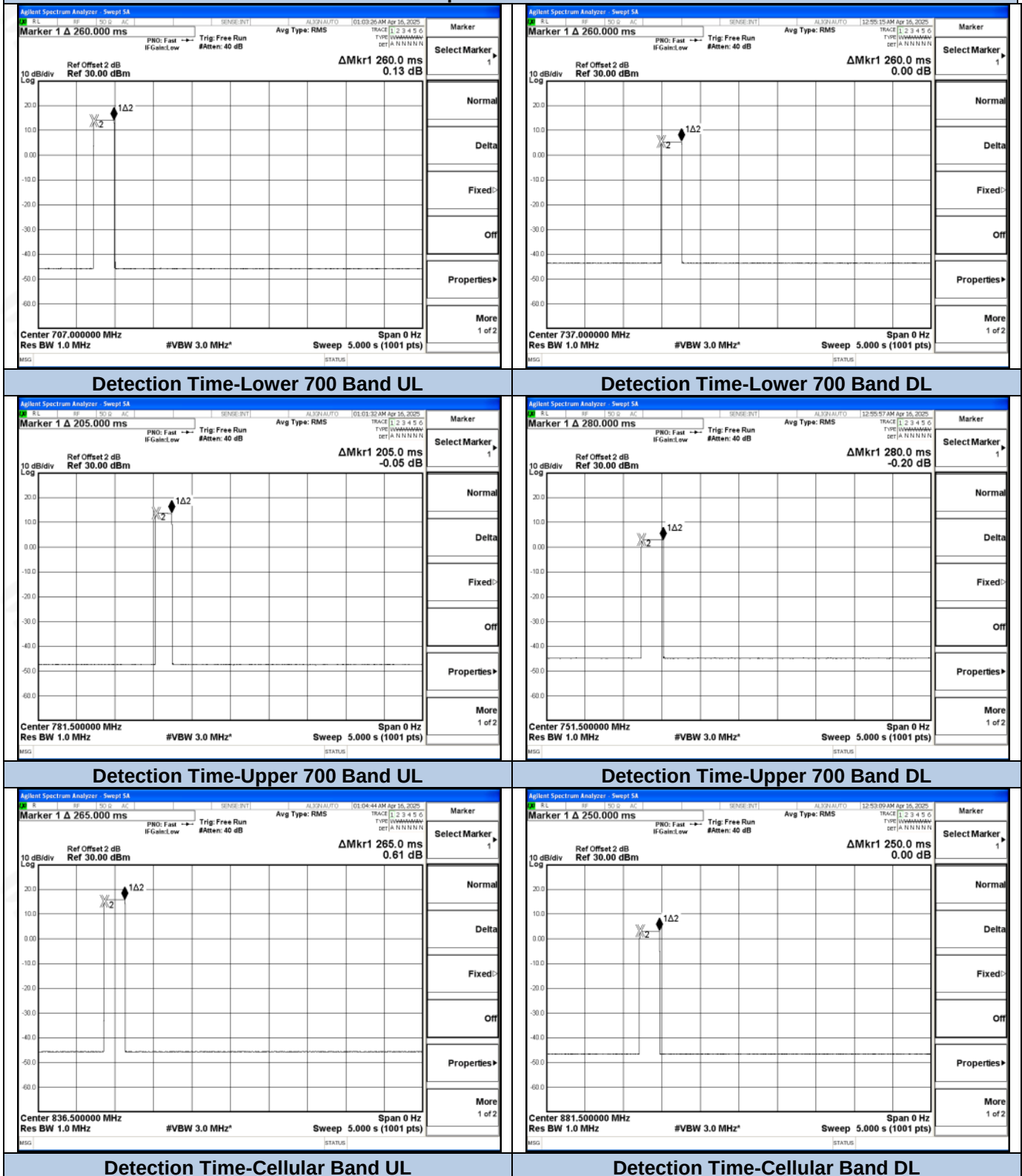
Temperature	23.6℃	Humidity	52.3%
Test Engineer	Nick Peng	Test Mode	Transmitting

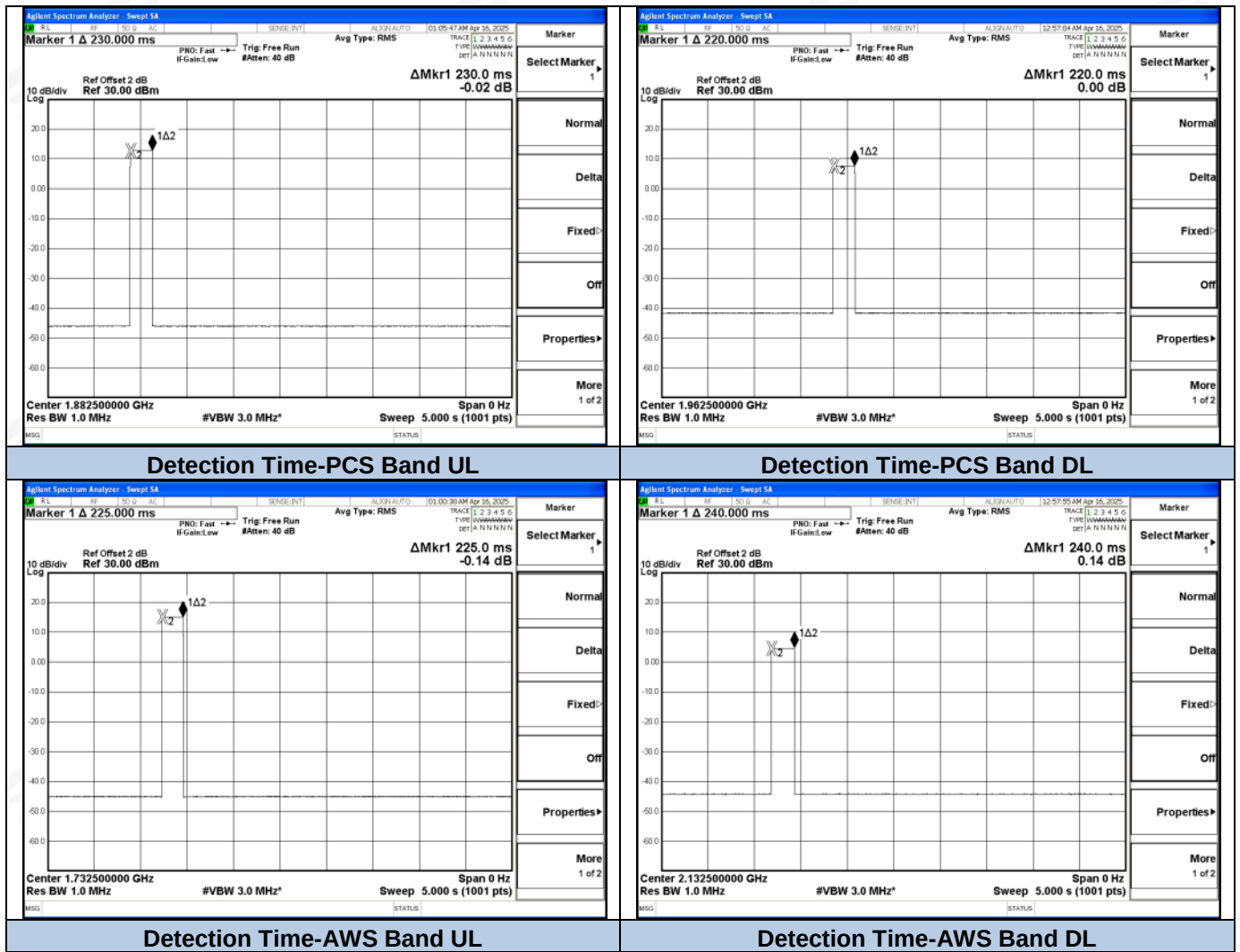
Test Results Of Detection Time				
Operation Band		Detection Time (s)	Limit (s)	Result
Uplink	Lower 700 Band	0.260	0.300	PASS
	Upper 700 Band	0.205	0.300	PASS
	Cellular Band	0.265	0.300	PASS
	PCS Band	0.230	0.300	PASS
	AWS Band	0.225	0.300	PASS
Downlink	Lower 700 Band	0.260	1.000	PASS
	Upper 700 Band	0.280	1.000	PASS
	Cellular Band	0.250	1.000	PASS
	PCS Band	0.220	1.000	PASS
	AWS Band	0.240	1.000	PASS

Test Results Of Restarting Time						
Operation Band		Restarting Time (s)	Limit (s)	Restarting Counts	Limit	Result
Uplink	Lower 700 Band	See Test Graphs of Restarting Time	60	4	5	PASS
	Upper 700 Band		60	4	5	PASS
	Cellular Band		60	4	5	PASS
	PCS Band		60	3	5	PASS
	AWS Band		60	4	5	PASS
Downlink	Lower 700 Band		60	4	5	PASS
	Upper 700 Band		60	4	5	PASS
	Cellular Band		60	4	5	PASS
	PCS Band		60	3	5	PASS
	AWS Band		60	4	5	PASS



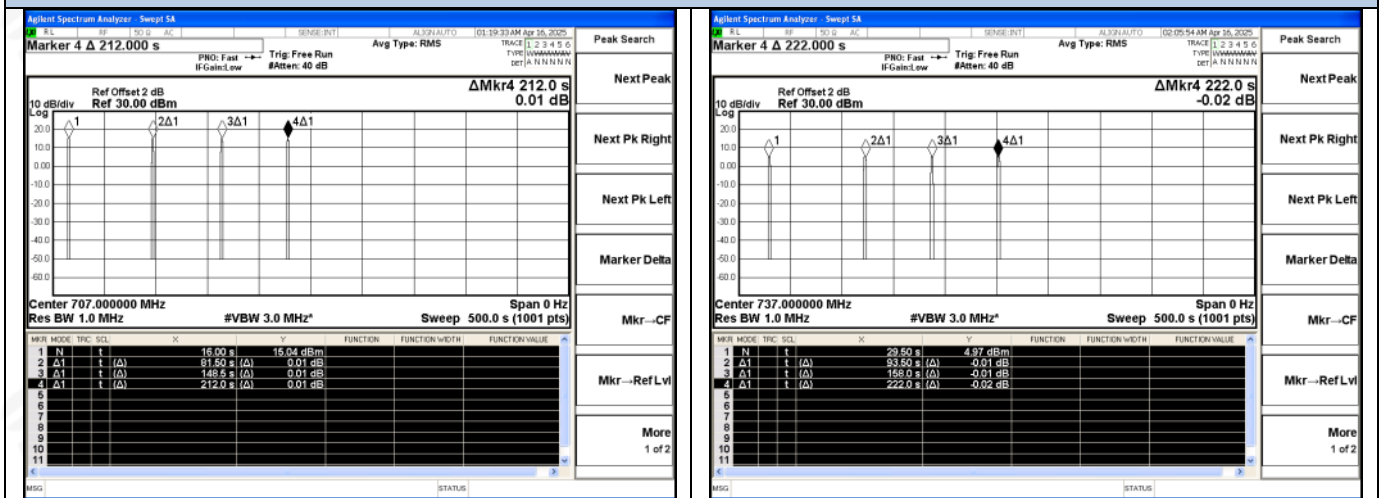
Test Graphs of Detection Time



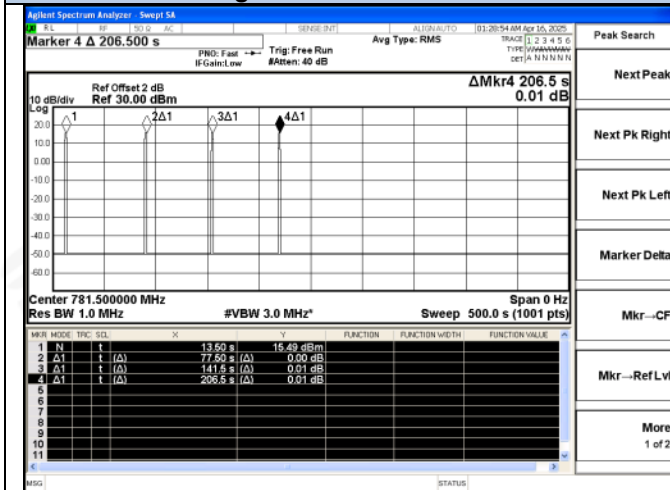




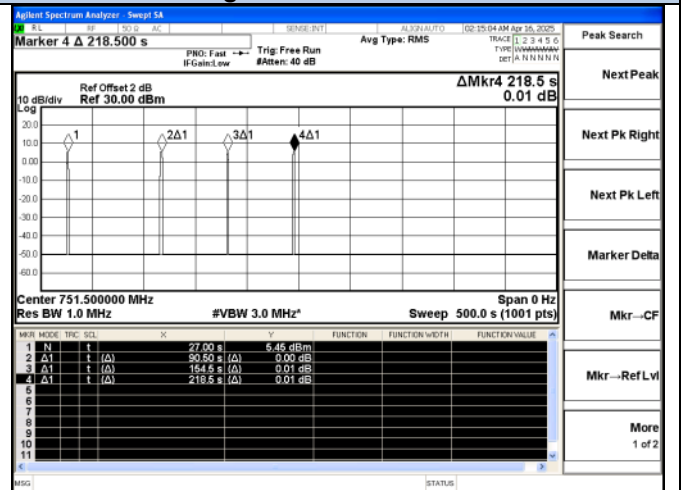
Test Graphs of Restarting Time



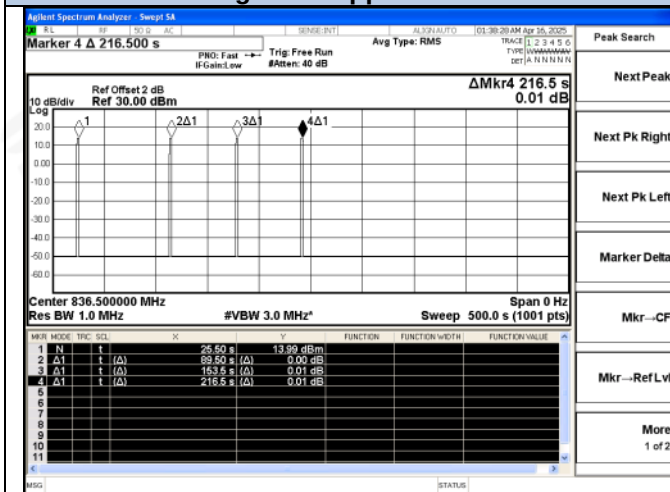
Restarting Time-Lower 700 Band UL



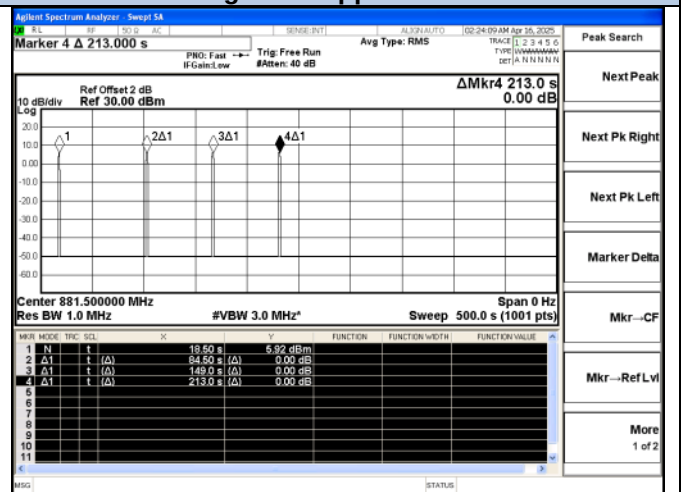
Restarting Time-Lower 700 Band DL



Restarting Time-Upper 700 Band UL



Restarting Time-Upper 700 Band DL



Restarting Time-Cellular Band UL

Restarting Time-Cellular Band DL



Oscillation mitigation or shutdown:

Lower 700 Band	Uplink		
Signal Type	AWGN		
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	6.65	<12	Pass
+4	7.89	<12	Pass
+3	7.15	<12	Pass
+2	8.52	<12	Pass
+1	9.75	<12	Pass
0	shutdown		

Lower 700 Band	Downlink		
Signal Type	AWGN		
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	6.65	<12	Pass
+4	7.15	<12	Pass
+3	7.96	<12	Pass
+2	8.22	<12	Pass
+1	8.69	<12	Pass
0	10.25	<12	Pass
-1	shutdown		

Upper 700 Band	Uplink		
Signal Type	AWGN		
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	5.36	<12	Pass
+4	6.52	<12	Pass
+3	6.84	<12	Pass
+2	8.36	<12	Pass
+1	9.14	<12	Pass
0	10.42	<12	Pass
-1	shutdown		



Upper 700 Band	Downlink		
Signal Type	AWGN		
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	6.63	<12	Pass
+4	7.35	<12	Pass
+3	8.14	<12	Pass
+2	9.24	<12	Pass
+1	10.11	<12	Pass
0	shutdown		

Cellular Band	Uplink		
Signal Type	AWGN		
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	6.25	<12	Pass
+4	6.95	<12	Pass
+3	7.85	<12	Pass
+2	8.54	<12	Pass
+1	9.25		Pass
0	shutdown		

Cellular Band	Downlink		
Signal Type	AWGN		
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	6.25	<12	Pass
+4	7.14	<12	Pass
+3	7.95	<12	Pass
+2	8.36	<12	Pass
+1	9.57	<12	Pass
0	shutdown		



PCS Band	Uplink		
Signal Type	AWGN		
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	6.25	<12	Pass
+4	6.85	<12	Pass
+3	7.14	<12	Pass
+2	7.68	<12	Pass
+1	8.25	<12	Pass
0	9.85	<12	Pass
-1	shutdown		

PCS Band	Downlink		
Signal Type	AWGN		
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	7.14	<12	Pass
+4	8.17	<12	Pass
+3	8.69	<12	Pass
+2	9.52	<12	Pass
+1	10.74	<12	Pass
0	shutdown		

AWS Band	Uplink		
Signal Type	AWGN		
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	7.25	<12	Pass
+4	8.25	<12	Pass
+3	9.35	<12	Pass
+2	9.64	<12	Pass
+1	10.14	<12	Pass
0	shutdown		



AWS Band	Downlink		
Signal Type	AWGN		
Isolation	Deffrence	Limit	Result
dB	dB	dB	
+5	6.93	<12	Pass
+4	7.84	<12	Pass
+3	8.62	<12	Pass
+2	8.37	<12	Pass
+1	9.58	<12	Pass
0	shutdown		

6.6 Intermodulation Limits

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:

- 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.
- Set the spectrum analyzer RBW = 3 kHz.
- Set the VBW ≥ 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 $\geq (2 \times \text{span})/\text{RBW}$.
- 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.
- l) 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.

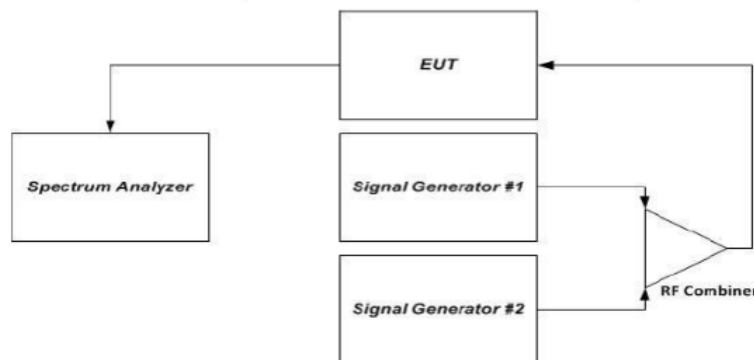


Figure 9 – Intermodulation product instrumentation test setup

6.6.3 Test Data

Temperature	23.6℃	Humidity	52.3%
Test Engineer	Nick Peng	Test Mode	Transmitting



Test Graphs

