TESTING LABORATORY
CERTIFICATE #4820.01

FCC PART 20.21

TEST REPORT

For

ShenZhen SolidRF Communications

No.8,shop D,Block C,Shan Shui Ju,Longwei RD

FCC ID: A7V-SR75702001

Report Type:	**Product Type:**
Original Report	Signal booster

Report Number:	RDG190402010-00
Report Date:	2019-04-26
Reviewed By:	Jerry Zhang EMC Manager
Prepared By:	Bay Area Compliance Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:		Signal booster
Equipment Type:		Fixed Wideband Consumer Signal Booster
EUT Model:		TRUE5-A
Mutiple Models:		TRUE5-B
Rated Input Voltage:		5.9V DC from adapter
Adapter In formation	**Model:**	MX24W1-0593000U
	Input:	AC 100-240V 0.7A
	Output:	DC 5.9V 3A
Serial Number:		190402010-1(Model: TRUE5-A) 190402010-2(Model: TRUE5-B)
EUT Received Date:		2019-04-08

Note: The series product, models TRUE5-A, TRUE5-B are electrically identical, The difference between them please refer to the declaration letter for details. We selected TRUE5-A for fully test, both model for radiation emission test.

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

Objective

This test report is prepared on behalf of *ShenZhen SolidRF Communications* in accordance with Part 2, part 20.21, part 22, part 24 and Part 27 of the Federal Communication Commissions rules.

Related Submittal(s)/Grant(s)

No related submittal(s).

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Applicable Standards: TIA 603-D, KDB 935210 D03 Signal Booster Measurements v04r03.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Dongguan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
RF conducted test with spectrum		±0.9dB
Radiated emission	30MHz~1GHz	±5.91dB
	Above 1G	±4.92dB
Occupied Bandwidth		±0.5kHz
Temperature		±1.0℃
Humidity		±6%

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier : CN0022.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode which has been done in the factory.

Antenna kitting requirement: EUT has multiple sets antenna kitting for marketing, the antenna gain for varier band were listed in user manual, fulfill the requirement of FCC Part 20.21(e)(8)(i)(G), more detail information please refer to the user manuals.

EUT Exercise Software

No exercise software was used.

Special Accessories

No special accessory was used.

Equipment Modifications

No modification was made to the EUT tested.

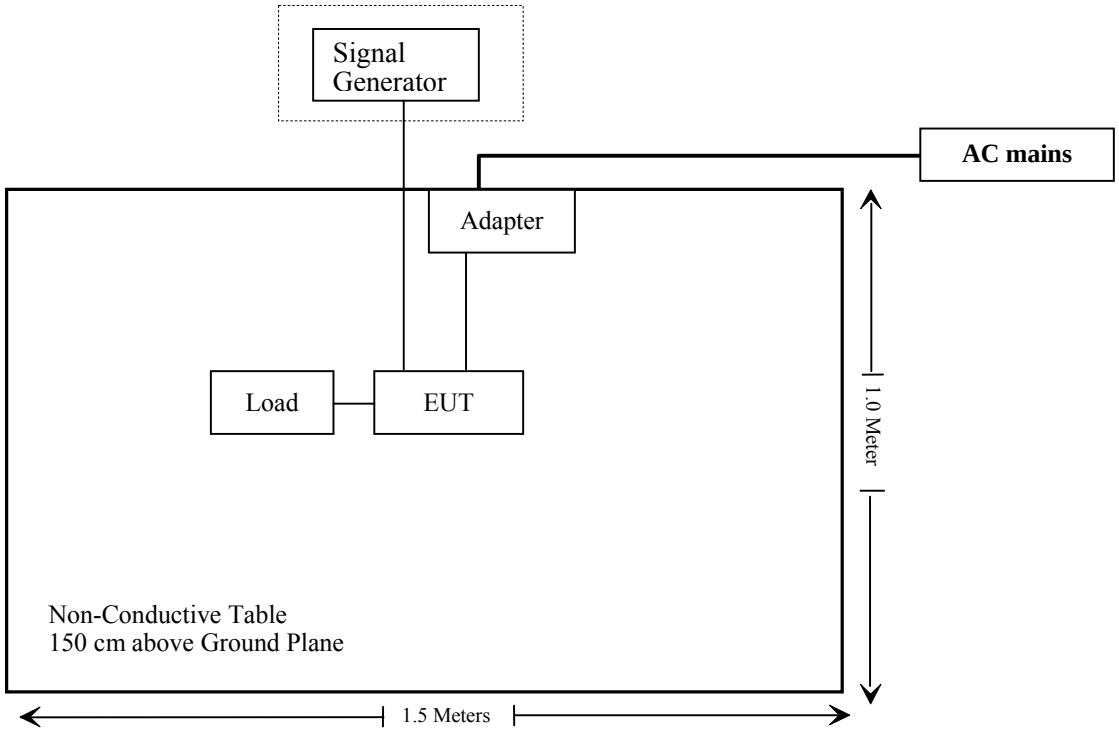
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
E-Microwave	Coaxial Attenuators	EMCA40-200SN-6	OE01201046
Unknown	Load	Unknown	Unknown
Agilent	MXG Vector Signal Generator	N5182B	MY51350188

External I/O Cable

Cable Description	Length (m)	From Port	To
Coaxial Cable	2.0	SG	EUT

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§20.21(e)(3)	7.1 Authorized Frequency Band Verification	Compliance
§ 20.21(e)(8)(i)(D) § 20.21(e)(8)(i)(B) & §20.21(e)(4)	7.2 Maximum Power Measurement	Compliance
§ 20.21(e)(8)(i)(C)(2) § 20.21(e)(8)(i)(B) & §20.21(e)(4)	7.9 Maximum Booster Gian Computation	Compliance
§ 20.21(e)(8)(i)(B) § 20.21(e)(3)	7.13 Spectrum block filtering test procedure	Not applicable
§ 20.21(e)(8)(i)(F)	7.4 Intermodulation Product	Compliance
§ 20.21(e)(8)(i)(E)	7.5 Out Of Band Emissions	Compliance
§ 20.21(e)(8)(i)(A) § 20.21(e)(8)(i)(H) &§20.21(e)(4)	7.7 Noise Limits	Compliance
§ 20.21(e)(8)(i)(I) &§20.21(e)(4)	7.8 Uplink Inactivity	Compliance
§ 20.21(e)(8)(i)(C)(1) & § 20.21(e)(8)(i)(H)	7.9 Variable Booster Gain	Compliance
§ 2.1049	7.10 Occupied Bandwidth	Compliance
§ 20.21(e)(8)(ii)(A) &§20.21(e)(4)	7.11 Oscillation Detection	Compliance
§2.1051	7.6 Spurious Emissions At Antenna Terminals	Compliance
§ 2.1053	7.12 Radiated Spurious Emissions	Compliance

Not applicable: This item only for wideband consumer boosters utilizing spectrum block filtering.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
R&S	EMI Test Receiver	ESCI	100224	2019-12-11	2020-12-11
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
EMCO	Adjustable Dipole Antenna	3121C	9109-753	N/A	N/A
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-02	2018-09-05	2019-09-05
HP	Amplifier	8447D	2727A05902	2018-09-05	2019-09-05
Agilent	Signal Generator	E8247C	MY43321350	2018-12-11	2019-12-11
Agilent	Spectrum Analyzer	E4440A	SG43360054	2019-01-04	2020-01-04
TDK RF	Horn Antenna	HRN-0118	130 084	2019-01-05	2021-01-04
ETS-Lindgren	Horn Antenna	3115	000 527 35	2019-01-05	2021-01-04
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2018-09-05	2019-09-05
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2018-09-05	2019-09-05
Ducommun Technolagies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Ducommun Technolagies	Horn Antenna	ARH-4223-02	1007726-02 1304	2016-11-18	2019-11-18
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2018-09-05	2019-09-05
RF Conducted test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2018-08-03	2019-08-03
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	/
Unknown	Coaxial Cable	C-SJ00-0010	C0010/02	Each time	/
Unknown	Coaxial Cable	C-SJ00-0010	C0010/03	Each time	/
Unknown	Coaxial Cable	C-SJ00-0010	C0010/04	Each time	/
Unknown	Coaxial Cable	C-SJ00-0010	C0010/05	Each time	/
E-Microwave	Coaxial Attenuators	EMCA10-5RN-6	OE01203239	Each time	/
R&S	Wideband Radio Communication Tester	CMW500	147473	2018-08-31	2019-08-31
HP	Setp Attenuator	8494B	1510A05007	2018-09-05	2019-09-05
Agilent	Setp Attenuator	8496B	2815A10904	2018-09-05	2019-09-05
Unknown	Combiner	Unknown	Combiner 1	Each time	/

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Unknown	Combiner	Unknown	Combiner 2	Each time	/
E-Microwave	Coaxial Attenuators	EMCA10-5RN-6	OE01203239	Each time	/
Narda	Directional coupler	4242-10	C1	Each time	/
Narda	Directional coupler	4242-10	C2	Each time	/
Narda	Directional coupler	4243B-10	C3	Each time	/
Narda	Directional coupler	4243B-10	C4	Each time	/
Agilent	MXG Vector Signal Generator	N5182B	MY51350142	2018-05-04	2019-05-04

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

§ 20.21(E)(3) – AUTHORIZED FREQUENCY BAND VERIFICATION

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 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.

Test Procedure

a) Connect the EUT to the test equipment as shown in Figure 1. Begin with the uplink output connected to the spectrum analyzer.
b) Set the spectrum analyzer RBW for 100 kHz with the 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 and manually reset the EUT.
h) Reset the spectrum analyzer span to 2 × the CMRS band under test. Adjust the tuned frequency of the signal generator to sweep 2 × the CMRS band using the sweep function. The AGC must not be activated 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.

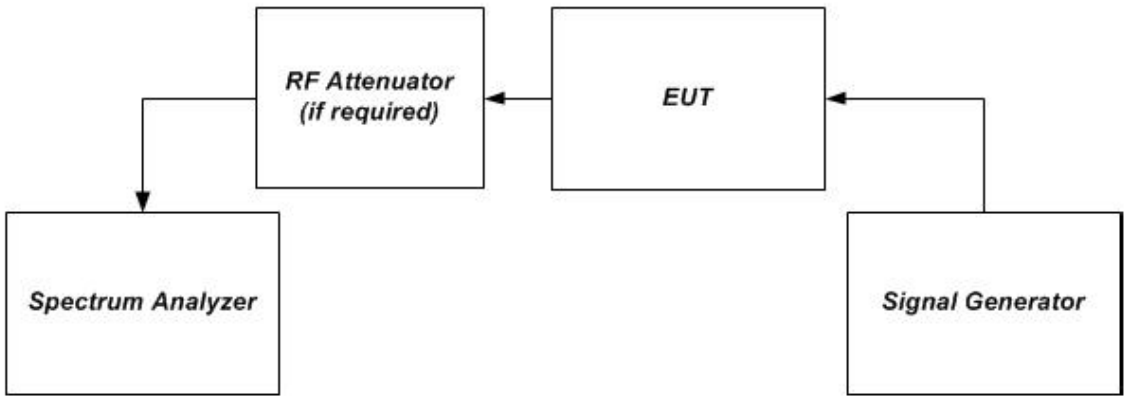


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

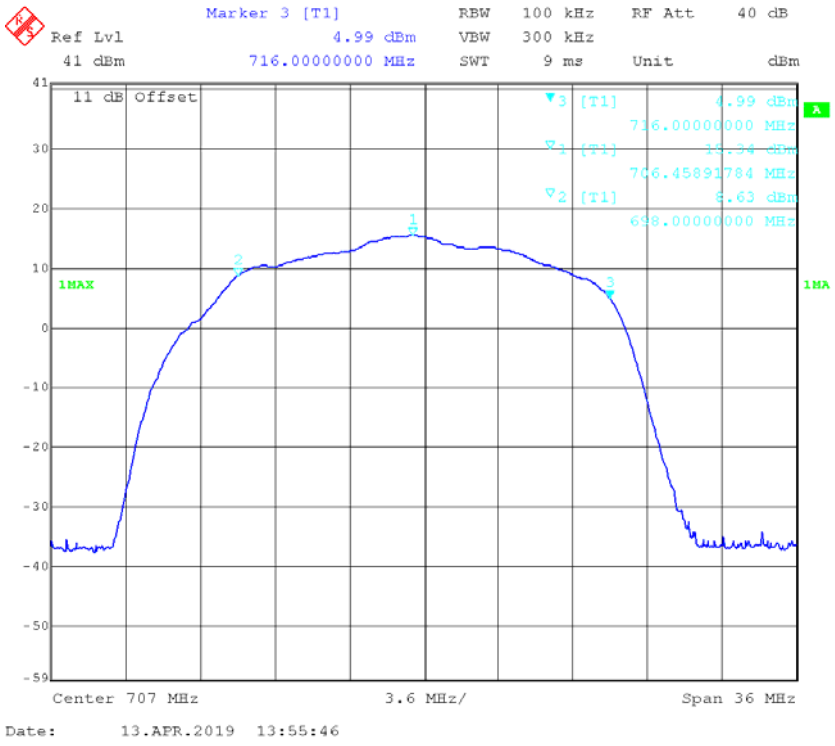
Temperature:	27.8 ℃
Relative Humidity:	66 %
ATM Pressure:	101.1 kPa

The testing was performed by Blake Yang on 2019-04-13.

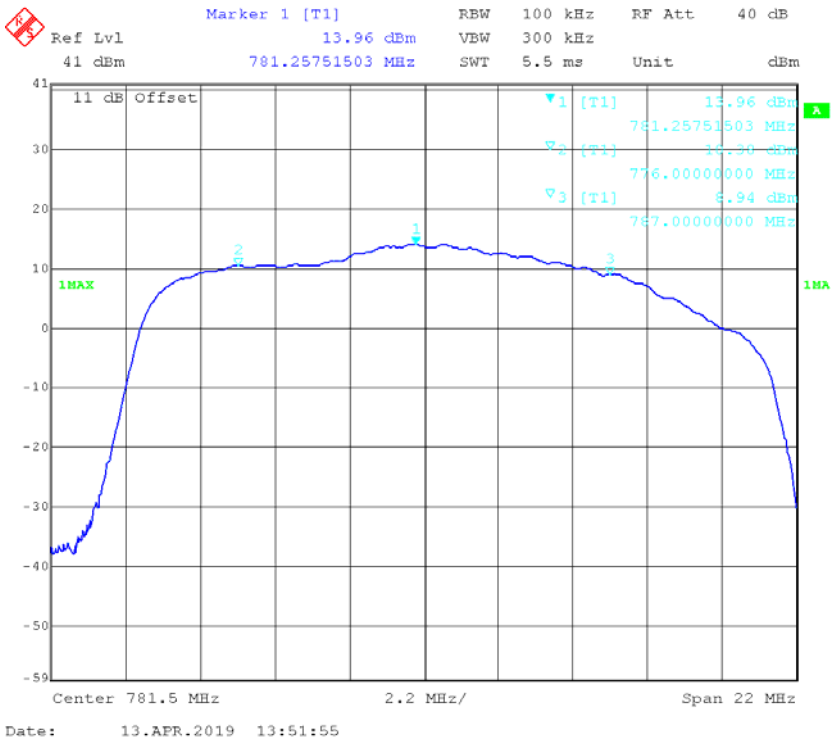
Test Result: Compliance. Please refer to following plots.

Uplink:

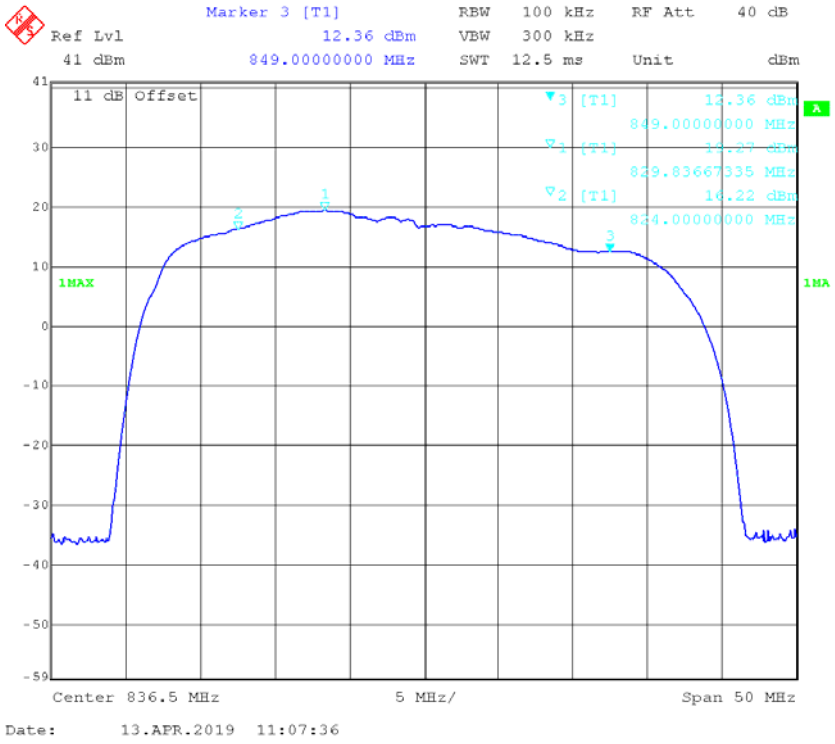
Lower 700MHz Band



Upper 700MHz Band

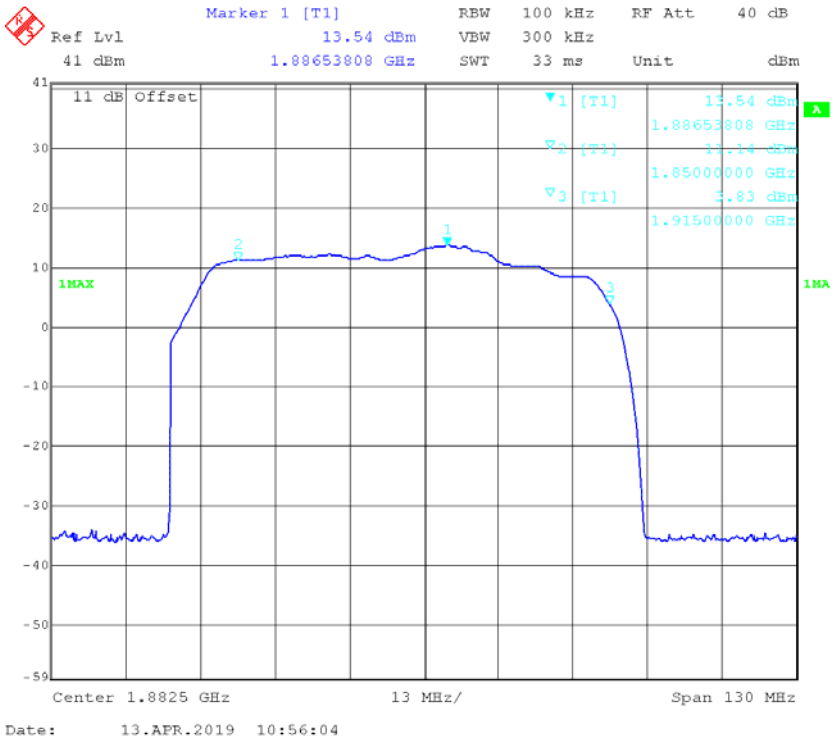


Cellular Band



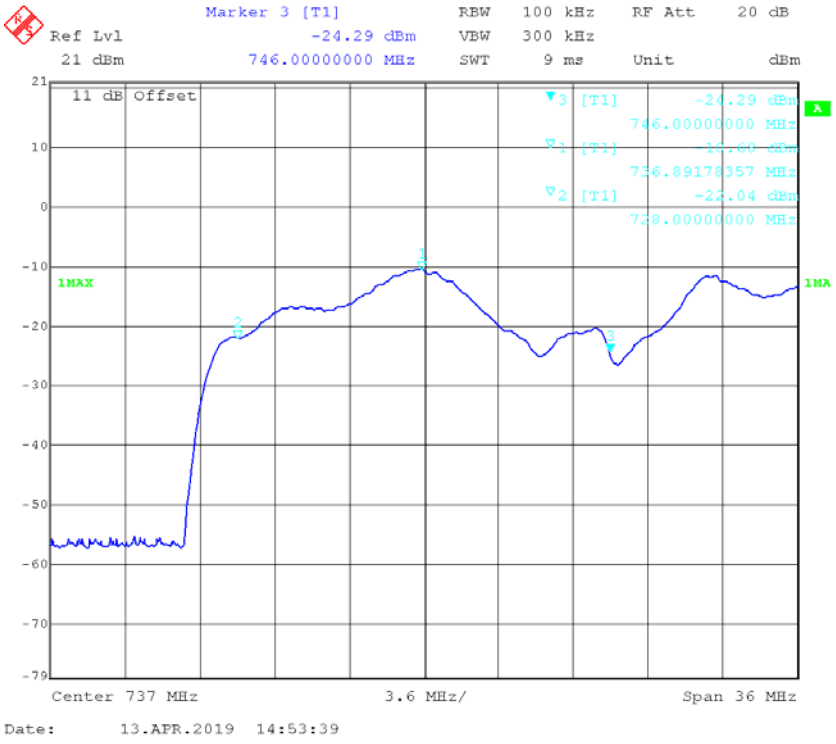
AWS Band

PCS Band

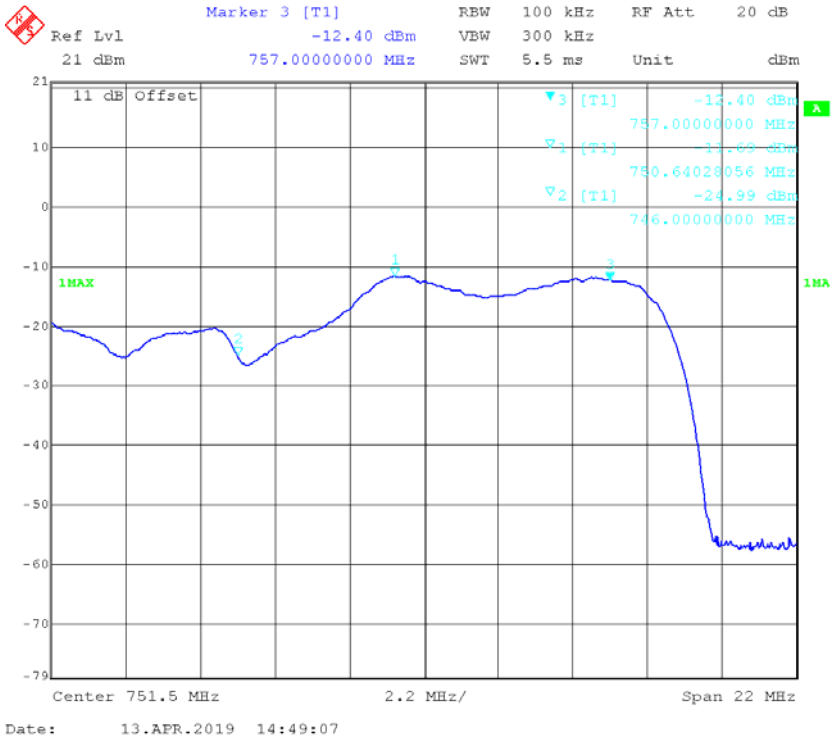


Downlink:

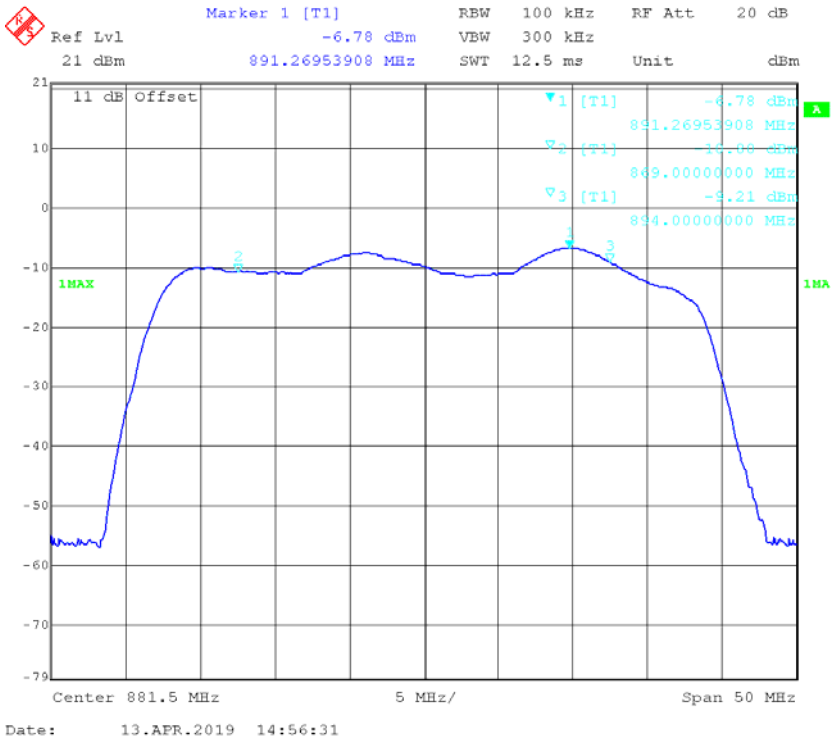
Lower 700MHz Band



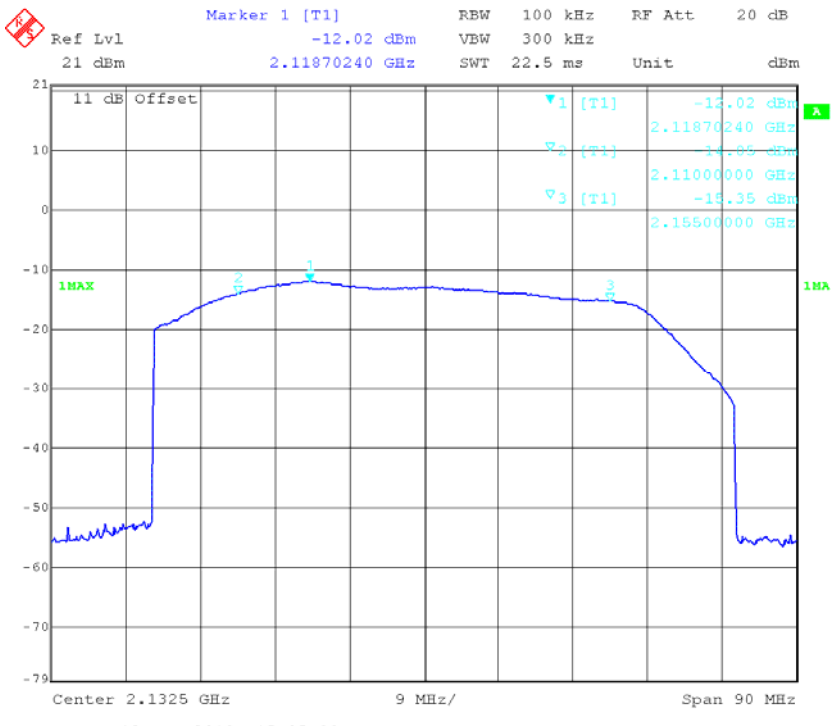
Upper 700MHz Band



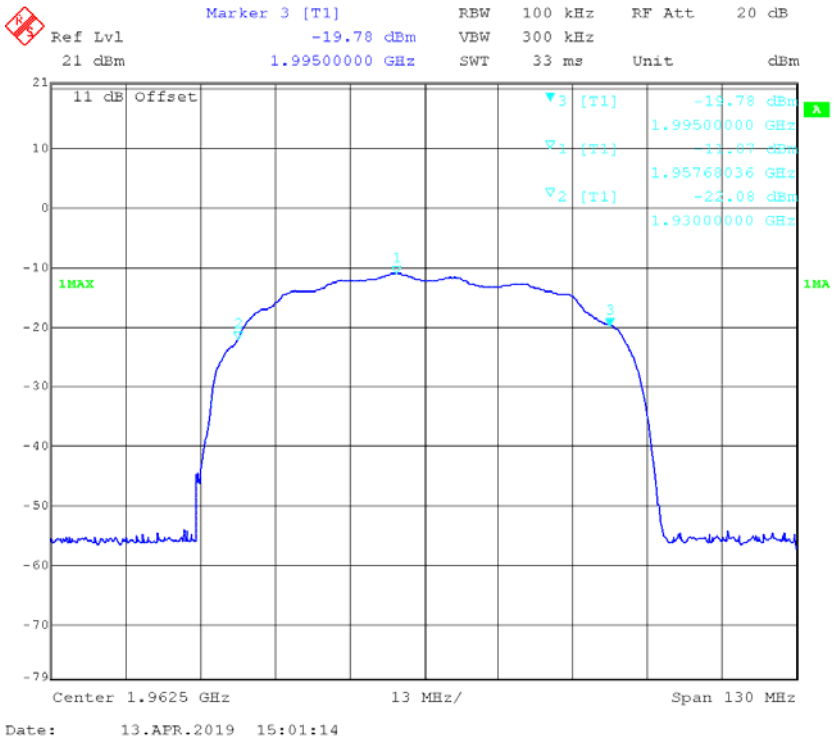
Cellular Band



AWS Band



PCS Band


Marker 3 [T1]
RBW 100 kHz
RF Att 20 dB
Ref Lvl
-19.78 dBm
VBW 300 kHz
21 dBm
1.99500000 GHz
SWT 33 ms
Unit dBm
11 dB Offset
3 [T1] -19.78 dBm
1.99500000 GHz
1 [T1] -11.07 dBm
1.95768036 GHz
2 [T1] -23.08 dBm
1.93000000 GHz
1MAX
1MA
Center 1.9625 GHz
13 MHz/
Span 130 MHz
Date: 13.APR.2019 15:01:14

§ 20.21(e)(8)(i)(D) ,§ 20.21(e)(8)(i)(B)& §20.21(e)(4)– MAXIMUM POWER MEASUREMENT

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.

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

a) Compliance to authorized 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.
b) In addition, the maximum power levels measured in this procedure will be utilized in calculating the maximum gain as described in the next subclause.
c) 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 utilizing the stated emission and power detector types independently.
d) Use a signal generator to create a pulsed CW or GSM signal with a pulse width of 570 μs and a duty cycle of 12.5% (i.e., one GSM timeslot), then measure utilizing the burst power function of the measuring instrument.
e) Use a signal generator to create an AWGN signal with a 99% occupied bandwidth of 4.1 MHz, then measure utilizing the channel power or band power function of the measuring instrumentation.
f) All modes of operation must be verified to maintain operation within authorized limits at the maximum uplink and downlink test levels per device type as defined in 5.4, by increasing the power level in 2 dB steps from the AGC level to the maximum input level specified in 5.5.

Test Procedure

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 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 control.
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 (within 0.5 dB of) the AGC limit without triggering the AGC. Note the signal generator power level as Pin.
g) Measure the output power Pout with the spectrum analyzer as follows.

1) Set RBW = 100 kHz for AWGN signal type and 300 kHz for CW or GSM signal type.
2) Set VBW ≥ 3 × RBW.
3) Select either the BURST POWER or CHANNEL POWER measurement tool, as required for each signal type. The channel power integration bandwidth shall be 99% occupied bandwidth (4.1 MHz).
4) Select the RMS (power averaging) detector.
5) Ensure that the number Note: This requirement
6) Set sweep time = auto

7) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
h) Record the measured power level as P_{OUT} with one set of results for the GSM or CW input stimulus and another set of results for the AWGN input stimulus.
i) Repeat step h) while increasing the signal generator amplitude in 2 dB steps until the maximum input level indicated in 5.5 is reached. If the booster has shut down at any point during the input power steps it should be noted and step h) shall be repeated at an input level 1 dB less than that found to cause the shutdown.
j) Repeat the entire procedure for each operational uplink and downlink frequency band supported by the booster.
k) Provide tabulated results in the test report.

Test Data

Environmental Conditions

Temperature:	27.5 ℃
Relative Humidity:	58 %
ATM Pressure:	102 kPa

The testing was performed by Blake Yang on 2019-04-17.

Test Result: Compliance. Please refer to the following tables and plots

Output Power:

Mode	Operation Band	Signal type	Pre AGC Input level	Conducted Output level	Antenna Gain	Cable loss	Lightning Protector Loss	EIRP	Limit
			dBm	dBm	dBi	dB	dB	dBm	dBm
Uplink	PCS	AWGN	-34.23	20.21	10	2.9	0.18	27.13	17-30
		GSM	-33.52	22.04	10	2.9	0.18	28.96	
	AWS	AWGN	-35.12	19.29	10	2.55	0.16	26.58	
		GSM	-33.48	22.34	10	2.55	0.16	29.63	
	Cellular	AWGN	-35.67	20.00	9	1.95	0.1	26.95	
		GSM	-33.15	22.46	9	1.95	0.1	29.41	
	Lower 700	AWGN	-37.15	20.00	9	1.9	0.1	27	
		GSM	-35.76	21.87	9	1.9	0.1	28.87	
	Upper 700	AWGN	-36.87	19.10	9	1.9	0.1	26.1	
		GSM	-36.52	20.83	9	1.9	0.1	27.83	
Downlink	PCS	AWGN	-63.45	-5.55	10	1.8	/	2.65	≤17
		GSM	-63.14	-4.57	10	1.8	/	3.63	
	AWS	AWGN	-64.04	-6.60	10	1.9	/	1.5	
		GSM	-62.16	-2.31	10	1.9	/	5.79	
	Cellular	AWGN	-59.31	-2.76	9	1.35	/	4.89	
		GSM	-58.12	-0.73	9	1.3	/	6.97	
	Lower 700	AWGN	-63.41	-6.31	9	1.3	/	1.39	
		GSM	-62.18	-3.39	9	1.3	/	4.31	
	Upper 700	AWGN	-62.42	-6.43	9	1.3	/	1.27	
		GSM	-60.31	-3.52	9	1.3	/	4.18	

Note:
Compliance to applicable EIRP limits used highest gains from the list of antennas, cabling, and coupling devices declared by the manufacturer for use with the consumer booster.
The Lightning Protector only installed for outside port.

Maximum Input level:

Mode	Operation Band	Signal type	Maximum Input level	Maximum Input level Limits	Conducted Output level
			dBm	dBm	dBm
Uplink	PCS	AWGN	-16	27.0	19.36
		GSM	-15		20.36
	AWS	AWGN	-19		17.45
		GSM	-17		18.57
	Cellular	AWGN	-18		19.24
		GSM	-16		20.21
	Lower 700	AWGN	-19		20.05
		GSM	-18		20.89
	Upper 700	AWGN	-19		18.25
		GSM	-18		19.31
Downlink	PCS	AWGN	-49	-20	-7.16
		GSM	-47		-6.56
	AWS	AWGN	-49		-8.79
		GSM	-48		-7.31
	Cellular	AWGN	-42		-3.89
		GSM	-41		-2.45
	Lower 700	AWGN	-46		-6.31
		GSM	-44		-5.48
	Upper 700	AWGN	-44		-7.68
		GSM	-42		-6.14

§ 20.21(e)(8)(i)(C)(2), § 20.21(e)(8)(i)(B)&§20.21(e)(4) – MAXIMUM BOOSTER GIAN COMPUTATION

Applicable Standards

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); §20.21(e)(4) Self-monitoring.

This subclause provides guidance on the computation of the maximum gain based on the results obtained from previous 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 (within 9 dB)

Test Procedure

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 P_{OUT} and P_{IN} result pairs for all signal types used in 7.2 in the following equation to determine the maximum gain (G) of the booster:
$G\ (dB) = P_{OUT}(dBm) - P_{IN}(dBm)$.
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.

Test Data

Environmental Conditions

Temperature:	27.2 ℃
Relative Humidity:	66 %
ATM Pressure:	101.1 kPa

The testing was performed by Blake Yang on 2019-04-17.

Test Result: Compliance. Please refer to the following tables.

Maximum gain:

Mode	Operation Band	Signal type	Pre AGC Input level	Conducted Output level	Gain	Limit
			dBm	dBm	dB	dB
Uplink	PCS	AWGN	-34.23	20.21	54.44	71.99
		GSM	-33.52	22.04	55.56	
	AWS	AWGN	-35.12	19.29	54.41	71.27
		GSM	-33.48	22.34	55.82	
	Cellular	AWGN	-35.67	20.00	55.67	64.95
		GSM	-33.15	22.46	55.61	
	LOWER 700	AWGN	-37.15	20.00	57.15	63.49
		GSM	-35.76	21.87	57.63	
	UPPER 700	AWGN	-36.87	19.10	55.97	63.36
		GSM	-36.52	20.83	57.35	
Downlink	PCS	AWGN	-63.45	-5.55	57.90	71.99
		GSM	-63.14	-4.57	58.57	
	AWS	AWGN	-64.04	-6.60	57.44	71.27
		GSM	-62.16	-2.31	59.85	
	Cellular	AWGN	-59.31	-2.76	56.55	64.95
		GSM	-58.12	-0.73	57.39	
	LOWER 700	AWGN	-63.41	-6.31	57.10	63.49
		GSM	-62.18	-3.39	58.79	
	UPPER 700	AWGN	-62.42	-6.43	55.99	63.36
		GSM	-60.31	-3.52	56.79	

Note: Fixed Booster maximum gain shall not exceed 6.5 dB + 20 Log10 (Frequency), Where, Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

Equivalent Uplink and downlink gain:

Operating Band	Signal type	Uplink Gain	Downlink Gain	Caculated Value	Limit
MHz		dB	dB	dB	dB
PCS	AWGN	54.44	57.9	-3.46	±9
	GSM	55.56	58.57	-3.01	
AWS	AWGN	54.41	57.44	-3.03	
	GSM	55.82	59.85	-4.03	
Cellular	AWGN	55.67	56.55	-0.88	
	GSM	55.61	57.39	-1.78	
LOWER 700	AWGN	57.15	57.10	0.05	
	GSM	57.63	58.79	-1.16	
UPPER 700	AWGN	55.97	55.99	-0.02	
	GSM	57.35	56.79	0.56	

§ 20.21(e)(8)(i)(F)- INTERMODULATION PRODUCT

Applicable Standards

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

Test Procedure

The following procedures shall be used to demonstrate compliance to the intermodulation limit specified in § 20.21(e)(8)(i)(F) for wideband consumer signal boosters.

a) Connect the signal booster to the test equipment as shown in **Figure 2**. Begin with the uplink output connected to the spectrum analyzer.
b) Set the spectrum analyzer RBW = 3 kHz.
c) 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 ≥ (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.
h) Set the signal generator amplitudes so that the power from each into the RF combiner is equivalent, then turn on the RF output.
i) Increase the signal generators' amplitudes equally until just before the EUT begins AGC and affirm that all intermodulation products (if any exist) are below the specified limit of −19 dBm.
j) Utilize the trace averaging function of the spectrum analyzer and wait for the trace to stabilize. Place a marker at the highest amplitude intermodulation product.
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 to not to exceed the maximum input level in 5.5, to affirm that the EUT maintains compliance with the intermodulation limit

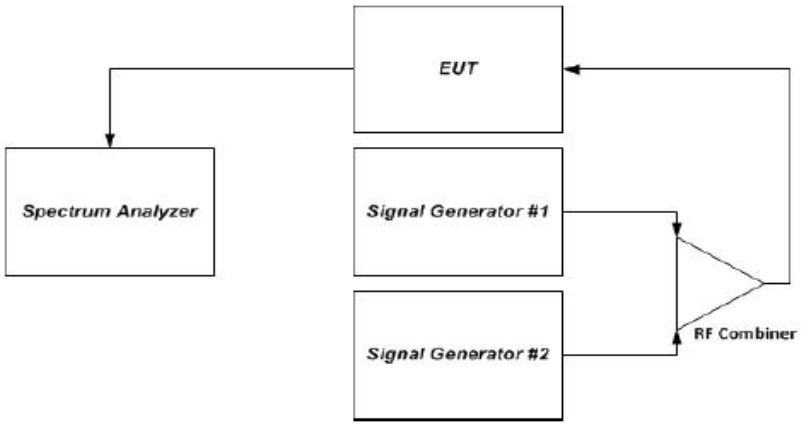


Figure 2 – Intermodulation product instrumentation test setup

Test Data

Environmental Conditions

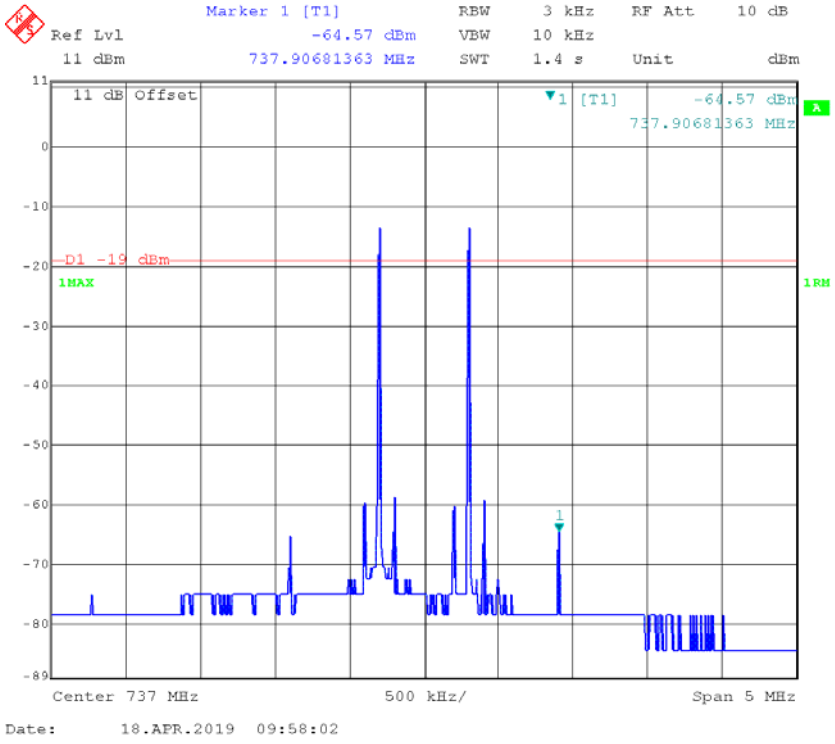
Temperature:	28.3 ℃
Relative Humidity:	64 %
ATM Pressure:	100.8 kPa

The testing was performed by Blake Yang on 2019-04-18.

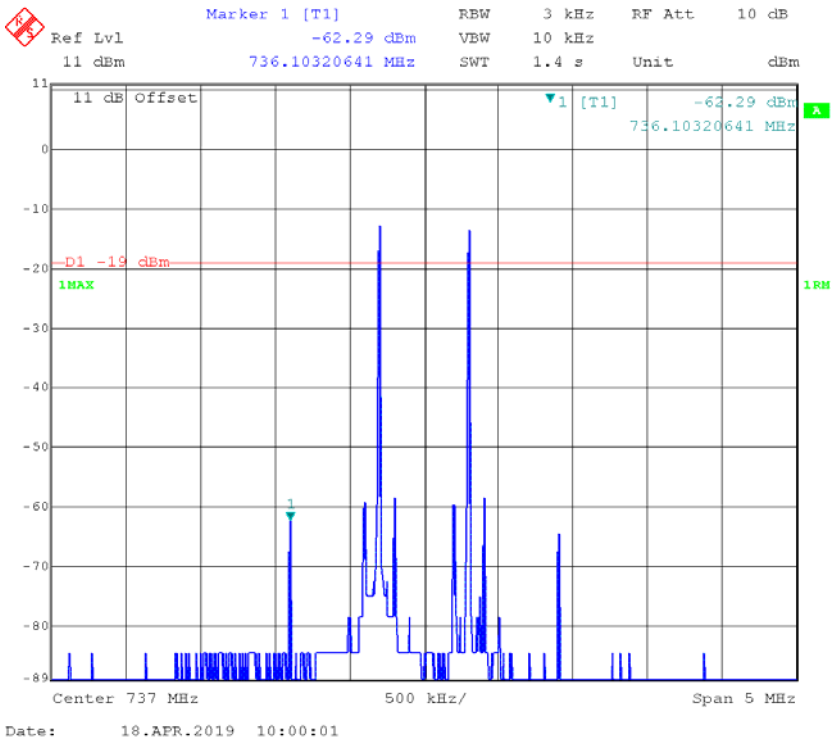
Test Result: Compliance. Please refer to following plots.

Downlink

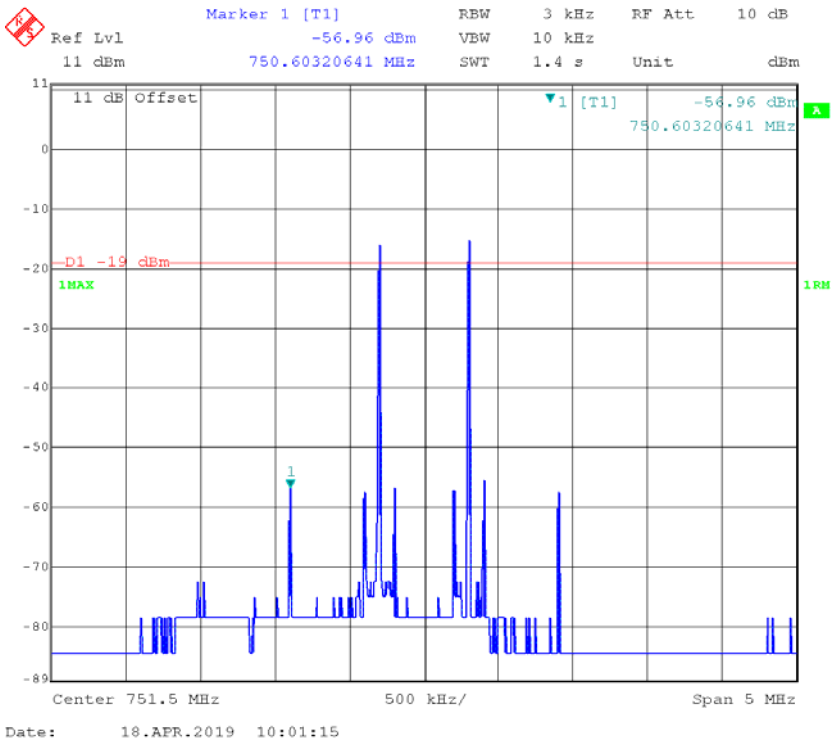
Lower 700MHz-Pre AGC



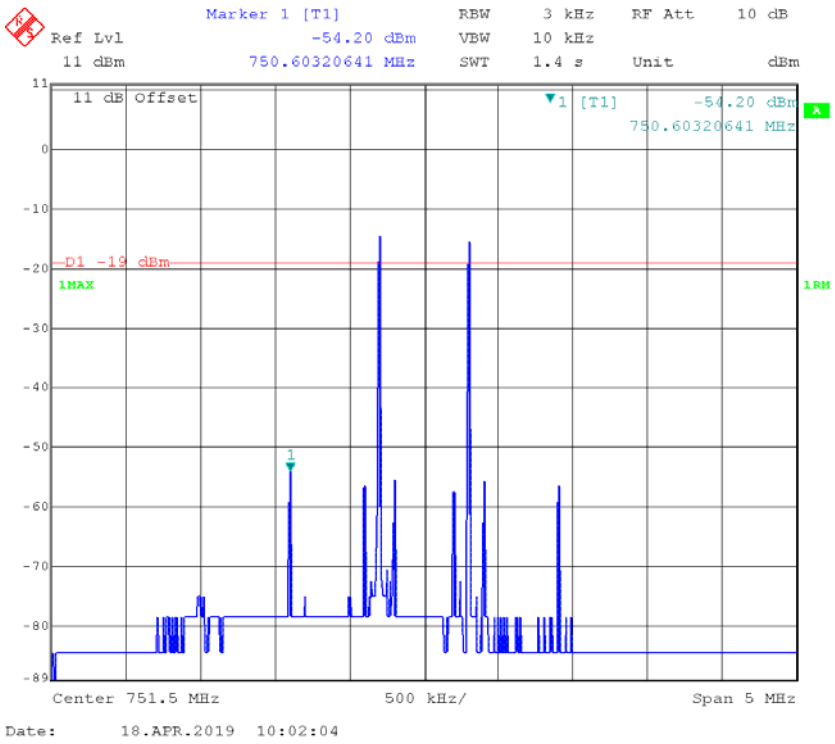
Lower 700MHz-Above AGC



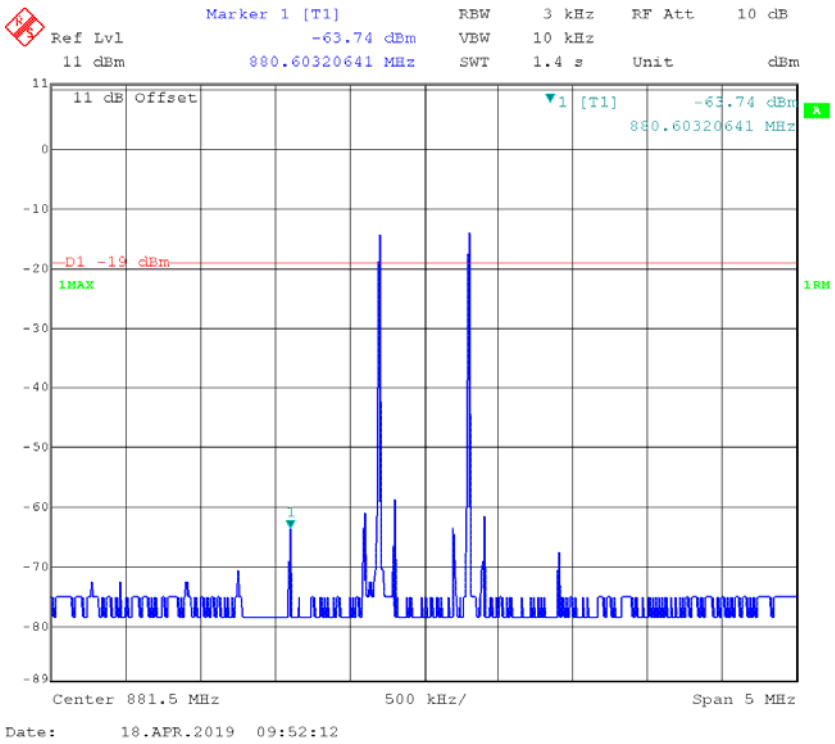
Upper 700MHz-Pre AGC



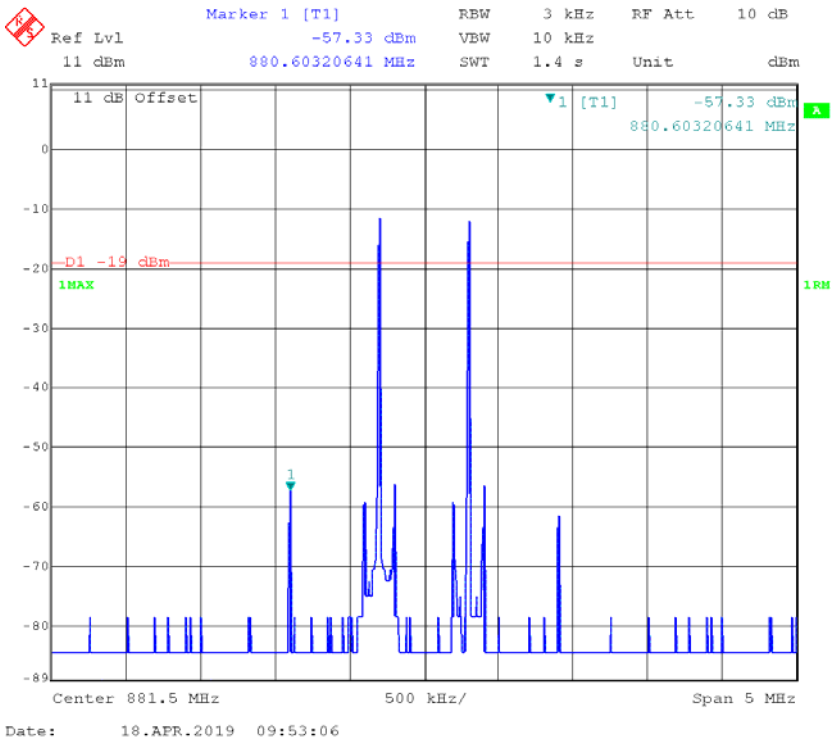
Upper 700MHz-Above AGC



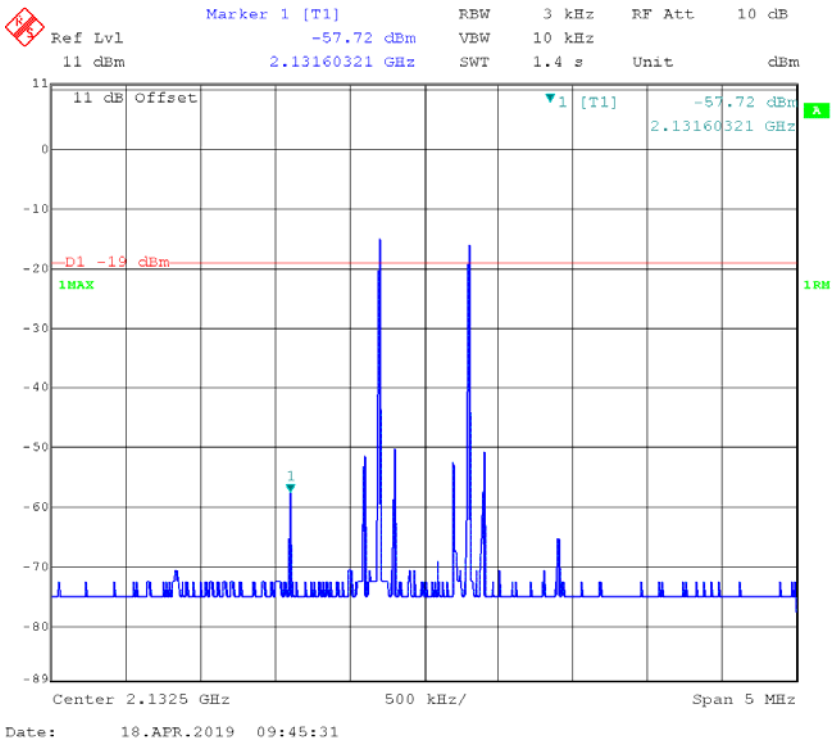
Cellular-Pre AGC



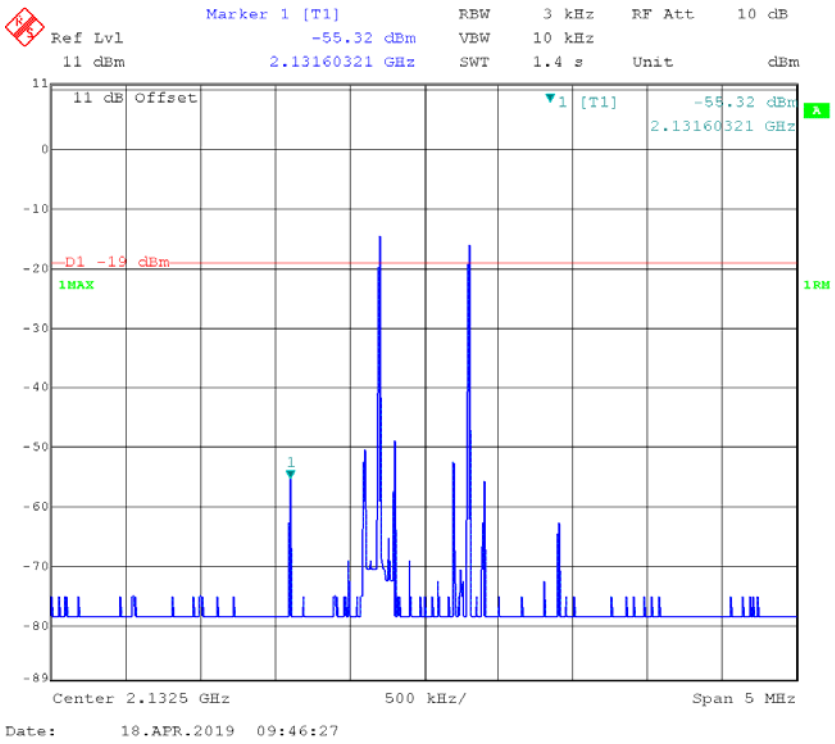
Cellular-Above AGC



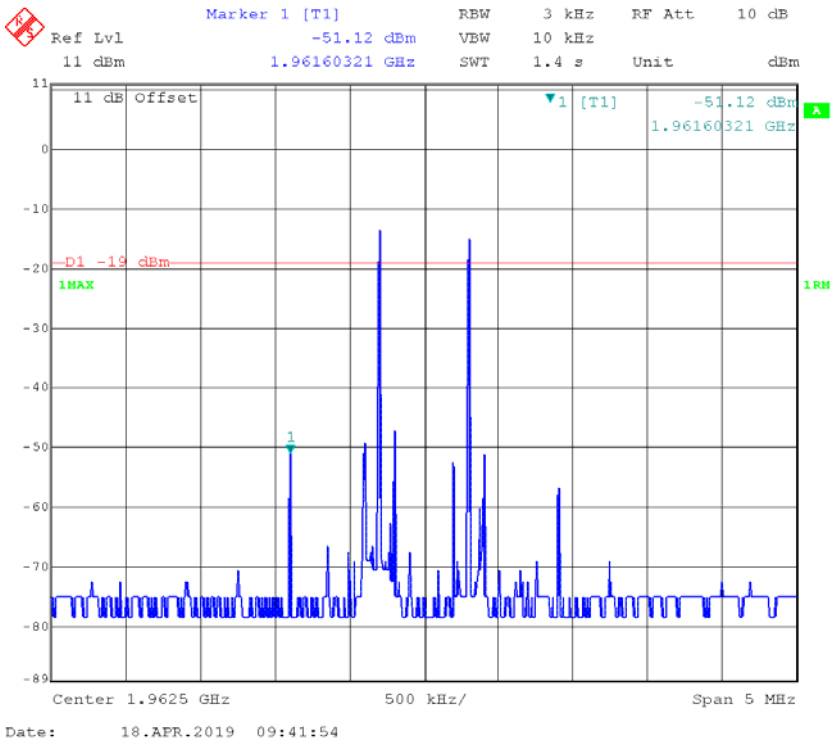
AWS-Pre AGC



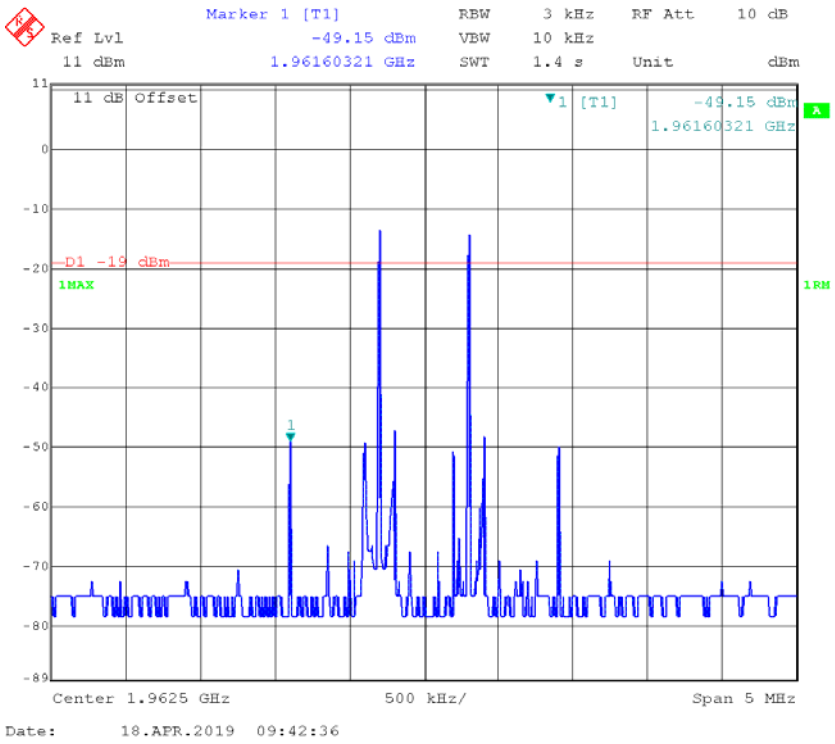
AWS-Above AGC



PCS-Pre AGC

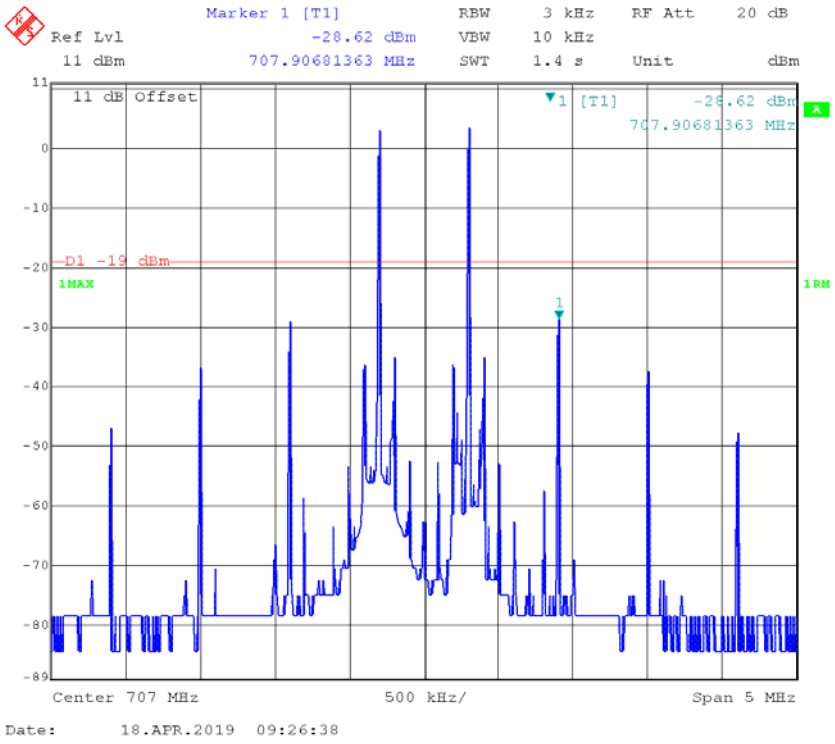


PCS-Above AGC

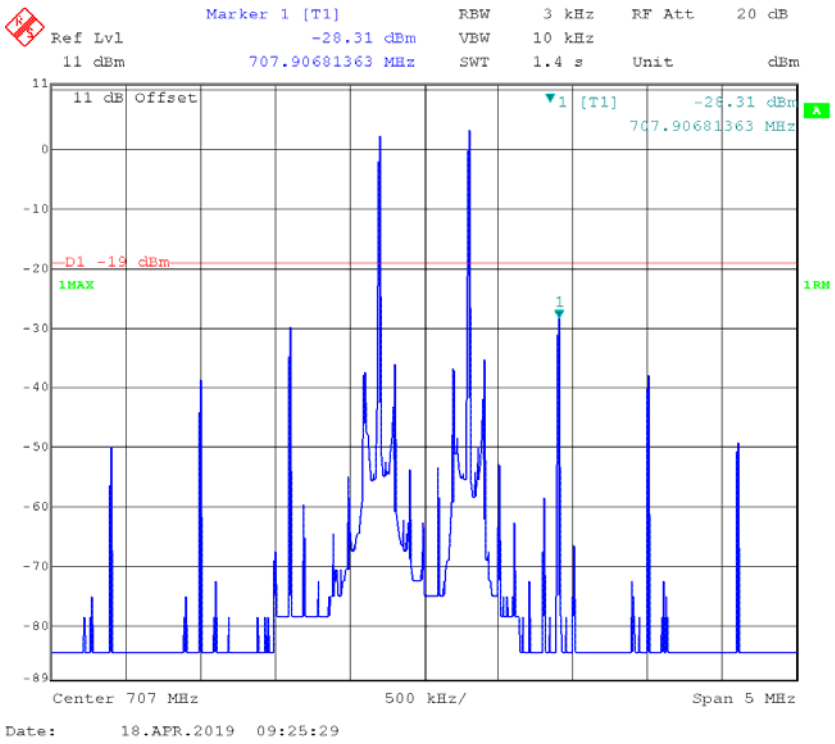


Uplink

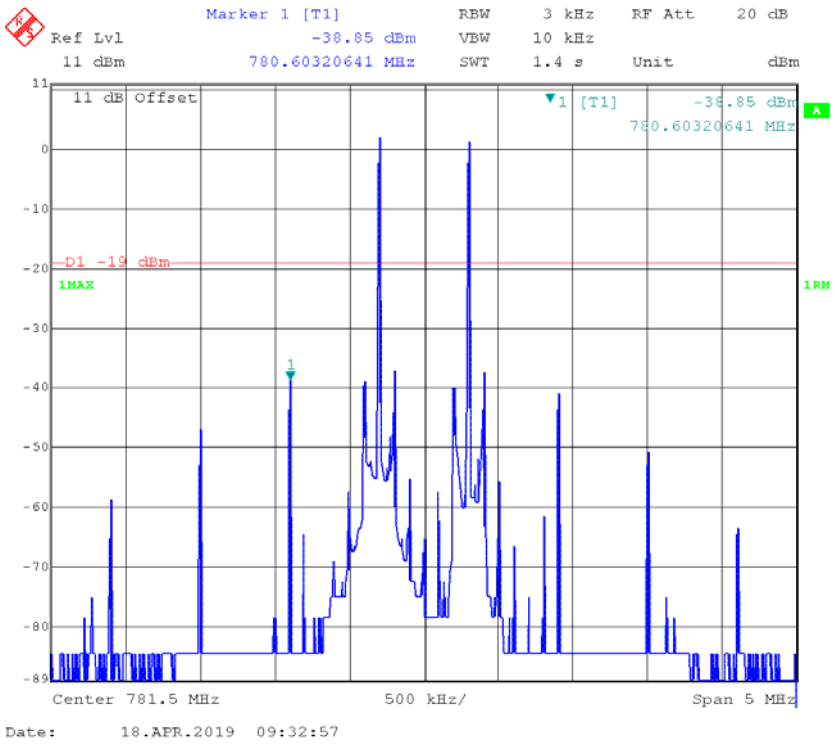
Lower 700MHz- Pre AGC



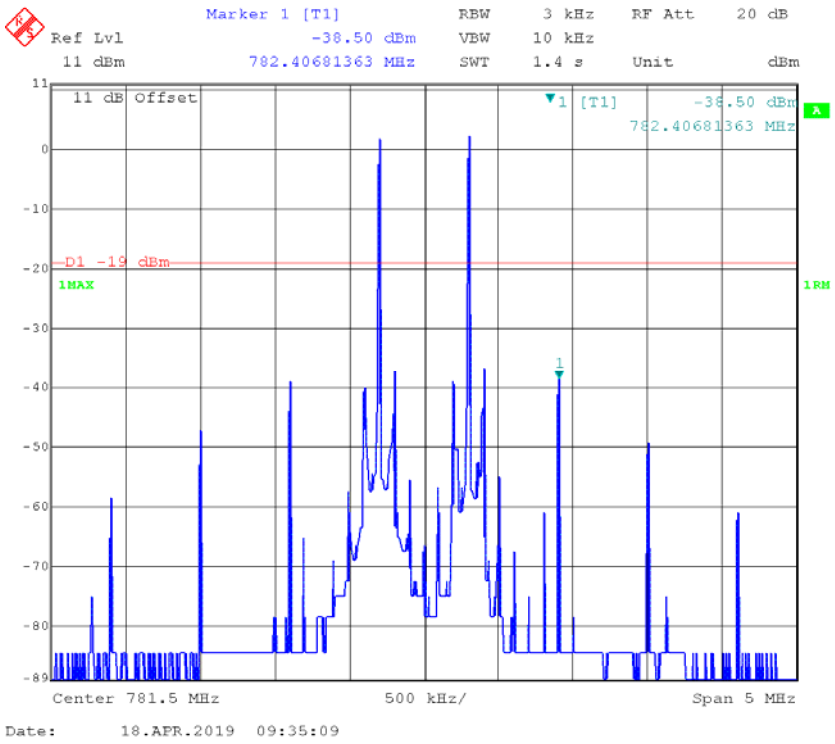
Lower 700MHz-Above AGC



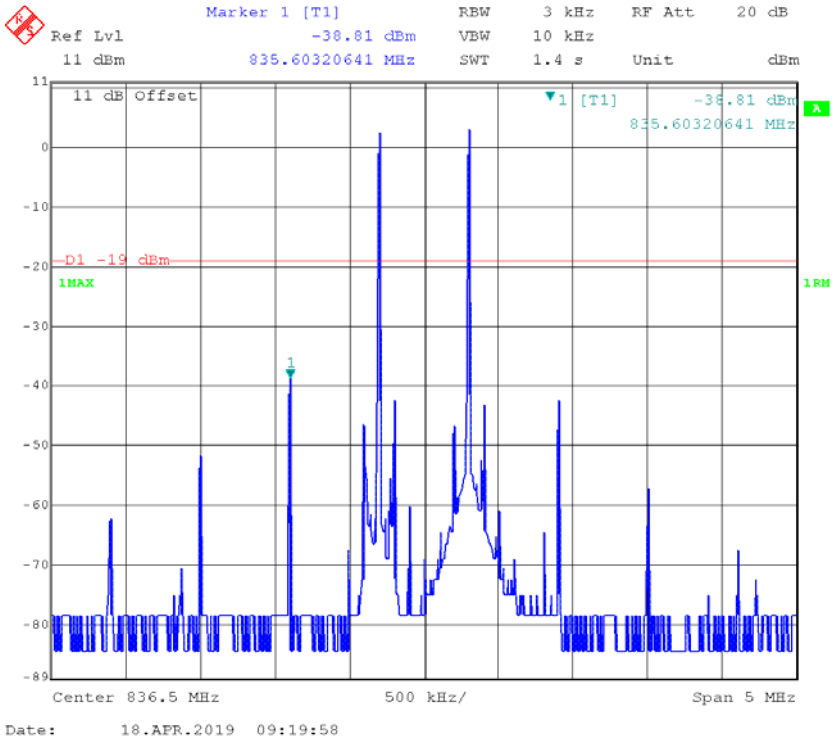
Upper 700MHz-Pre AGC



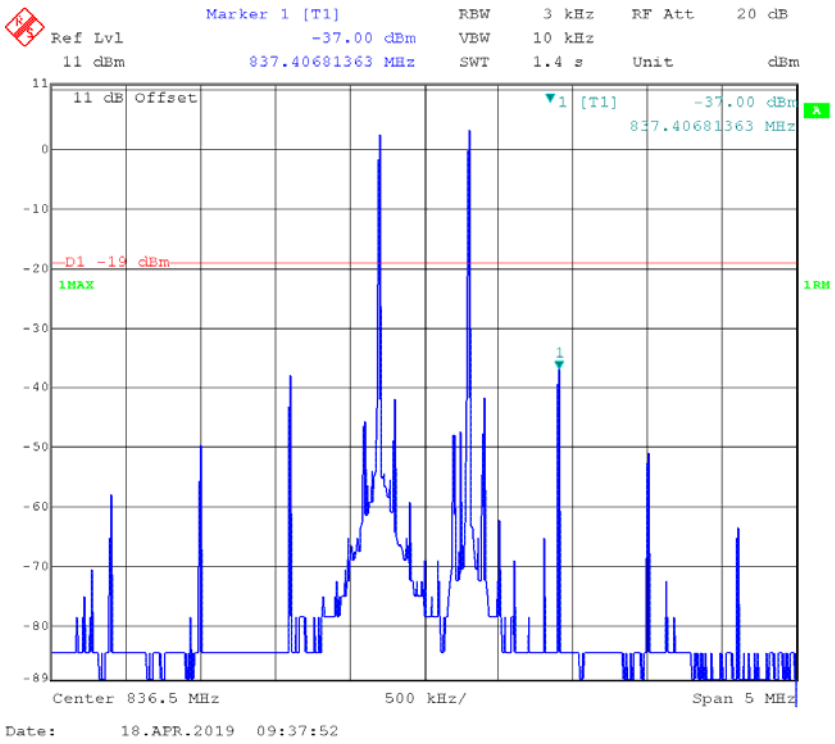
Upper 700MHz-Above AGC



Cellular- Pre AGC



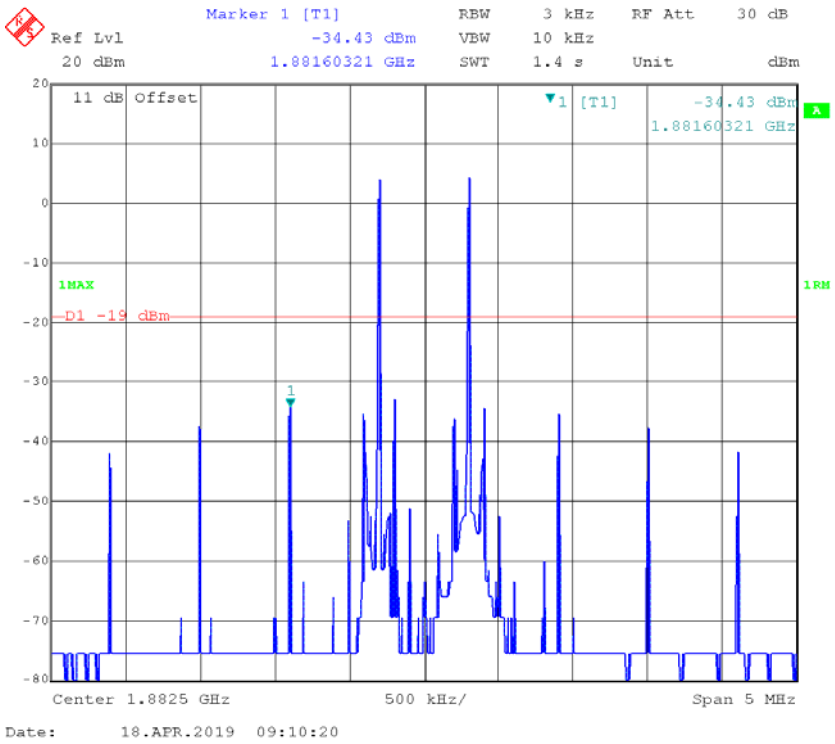
Cellular-Above AGC



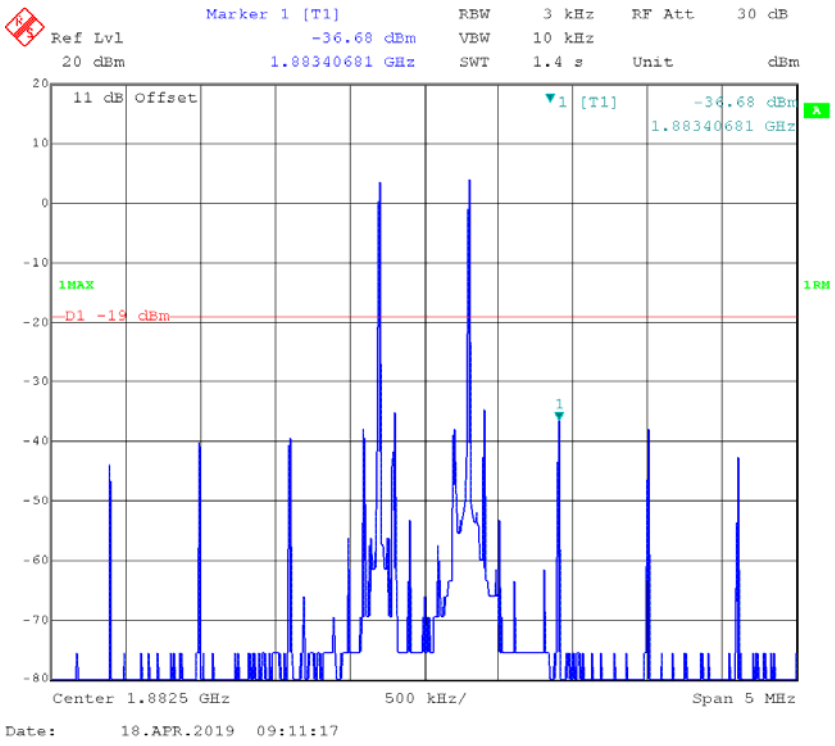
AWS-Pre AGC

AWS-Above AGC

PCS- Pre AGC



PCS-Above AGC



§ 20.21(e)(8)(i)(E)- OUT OF BAND EMISSIONS

Applicable Standards

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

Test Procedure

This measurement is intended to demonstrate compliance to the limit specified in § 20.21(e)(8)(i)(E). The mobile emission limit applicable to the supported band of operation can be determined from the applicable rule part as listed in Annex A for each authorized operating band.

a) Connect the EUT to the test equipment as shown in **Figure 1**. Begin with the uplink output connected to the spectrum analyzer.
b) Configure the signal generator for the appropriate operation for all uplink and downlink bands:
i) GSM: 0.2 MHz from upper and lower band edges.
ii) LTE (5 MHz): 2.5 MHz from upper and lower band edges.
iii) 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 utilize 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% occupied bandwidth.*

c) Set the signal generator amplitude to the maximum power level prior to AGC similar to the procedures in 7.2.2e) to 7.2.2f) of power measurement procedure for appropriate modulations.
d) Set RBW = measurement bandwidth specified in the applicable rule section for the supported frequency band (*see Annex A for cross-reference to applicable rule section*).
e) Set VBW = 3 × RBW.
f) Select the RMS (power averaging) detector.
g) Sweep time = auto-couple.
h) 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).
i) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
j) Use peak marker function to find the maximum power level.
k) Capture the spectrum analyzer trace of the power level for inclusion in the test report.
l) Increase the signal generator amplitude in 2 dB steps until the maximum input level indicated in 5.5 is reached. Affirm that the EUT maintains compliance with the OOBE limits.
m) 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 ≥ 1 GHz), and the stop frequency to the lower band/block edge frequency and repeat 7.5j) to 7.5l).
n) Repeat 7.5b) through 7.5m) for each uplink and downlink operational band.

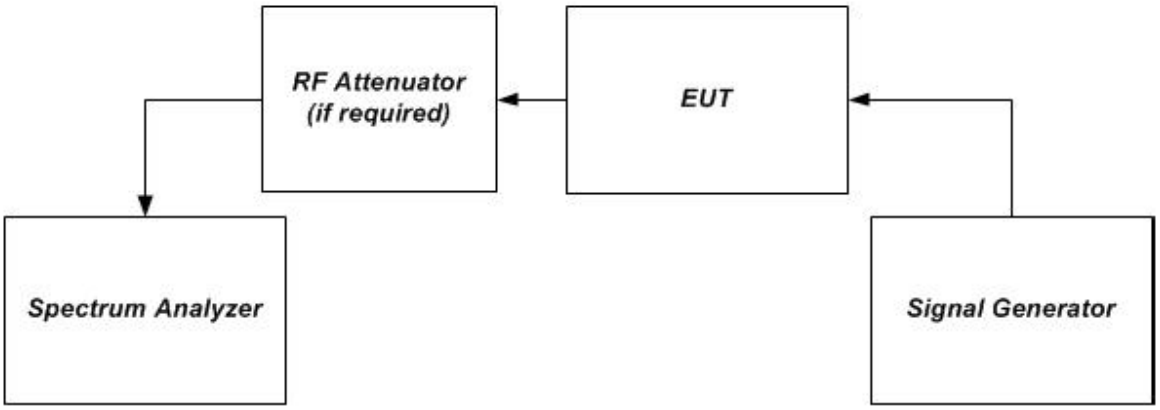


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

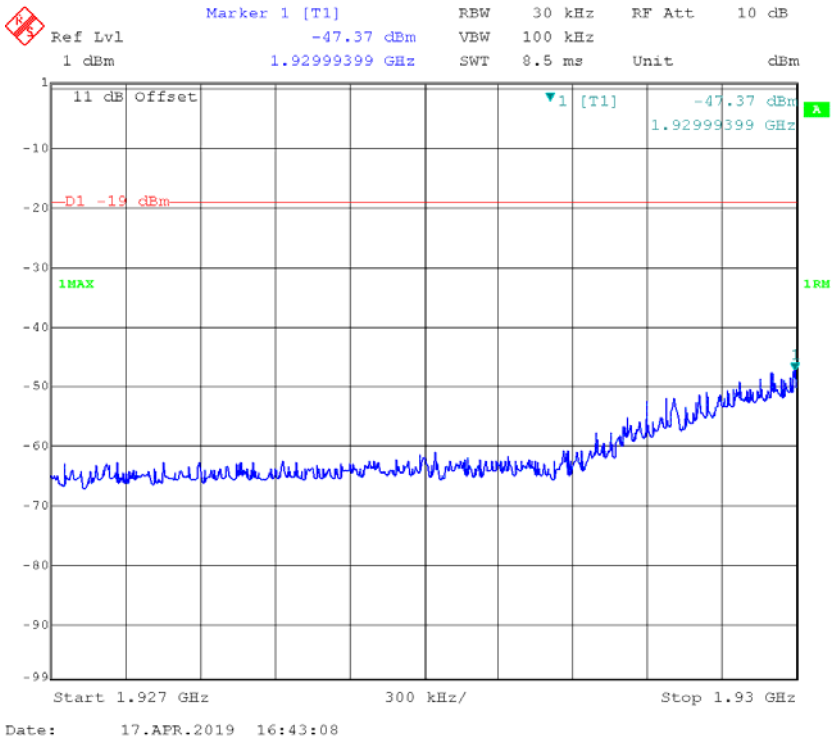
Temperature:	26.4~27.6 ℃
Relative Humidity:	52~61 %
ATM Pressure:	101.2~102.1 kPa

The testing was performed by Blake Yang from 2019-04-15 to 2019-04-17.

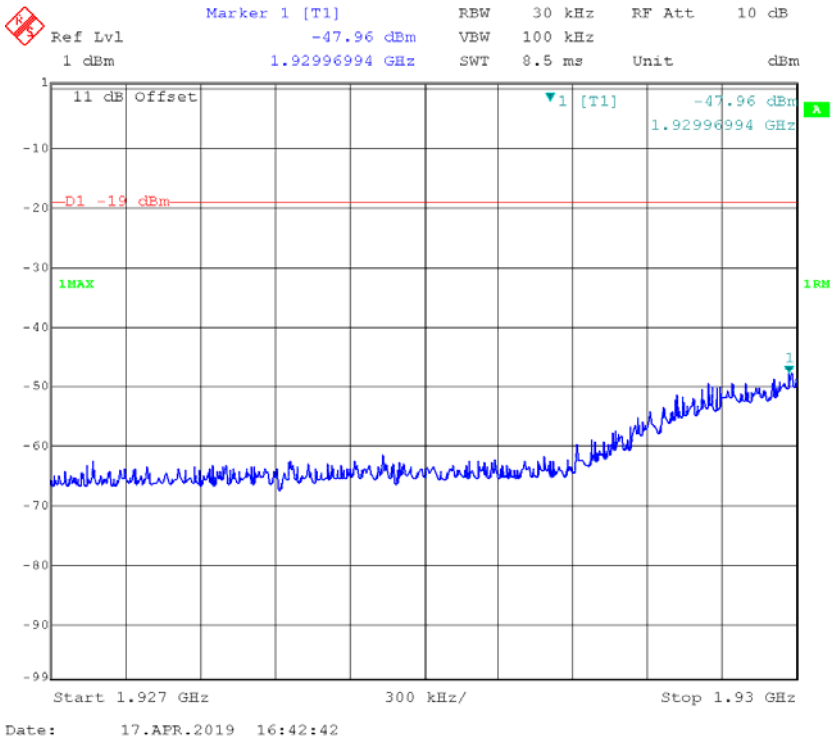
Test Result: Compliance. Please refer to following plots.

Downlink

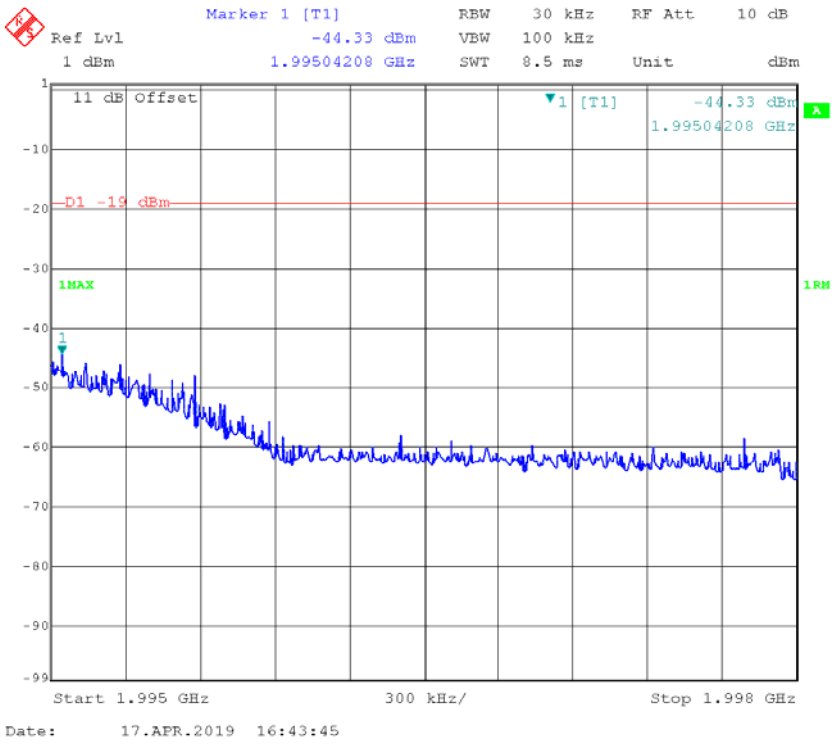
PCS Band CDMA Left Side 1931.25MHz Pre-AGC



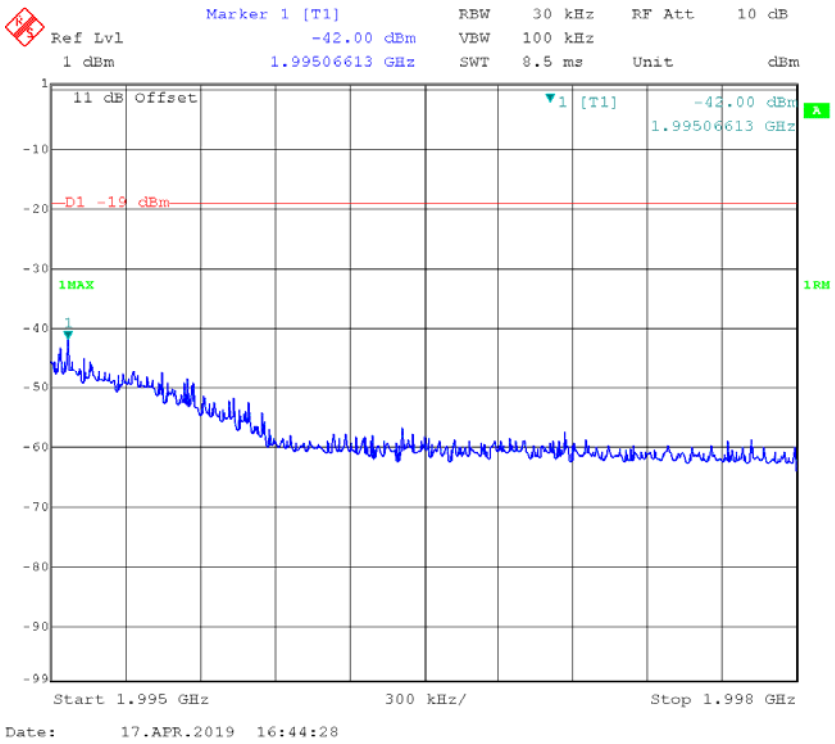
PCS Band CDMA Left Side 1931.25MHz Above AGC



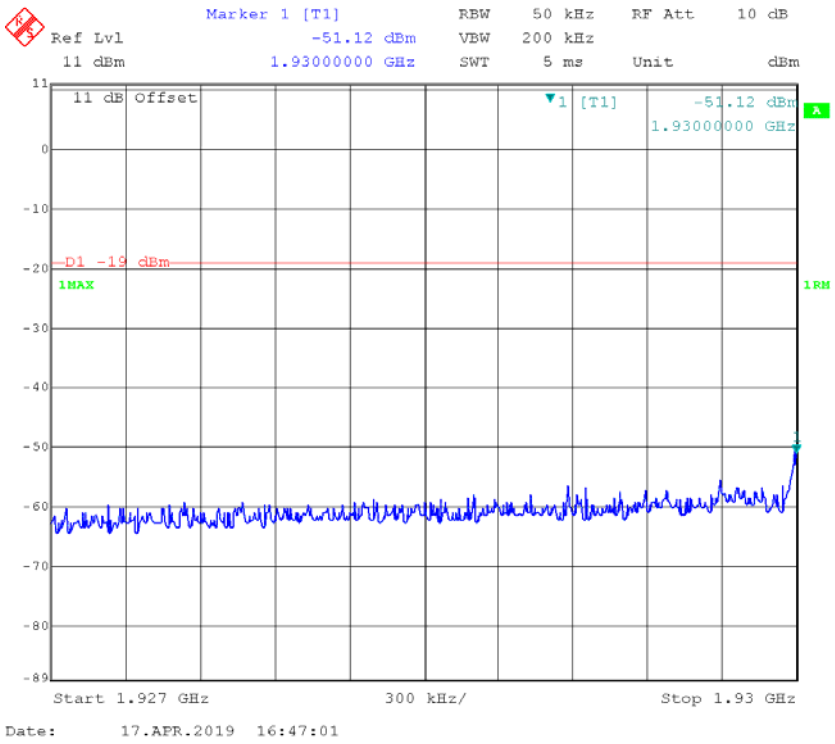
PCS Band CDMA Right Side 1993.75MHz Pre-AGC



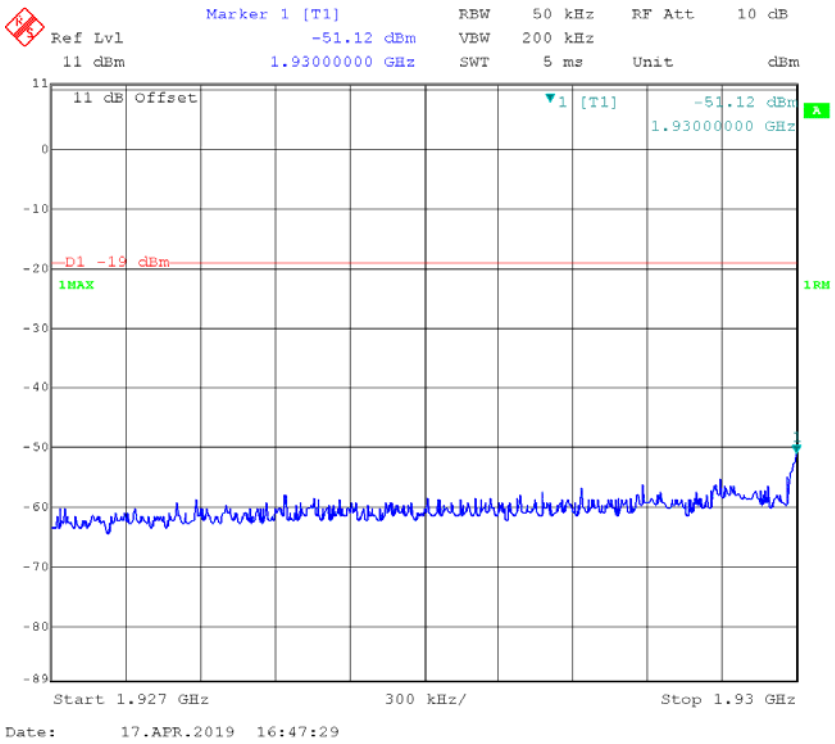
PCS Band CDMA Right Side 1993.75MHz Above AGC



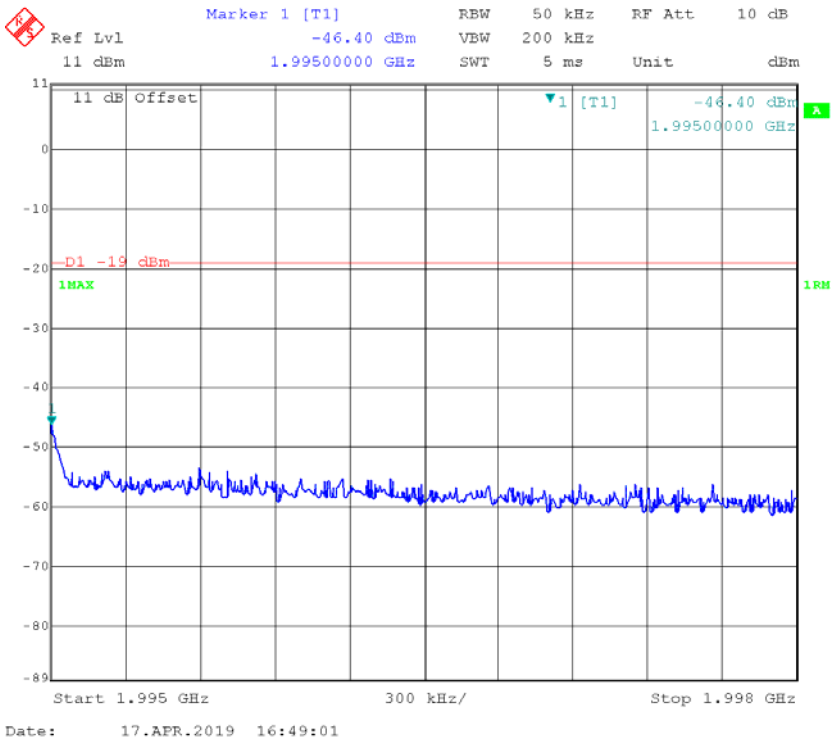
PCS Band LTE Left Side 1932.5MHz Pre-AGC



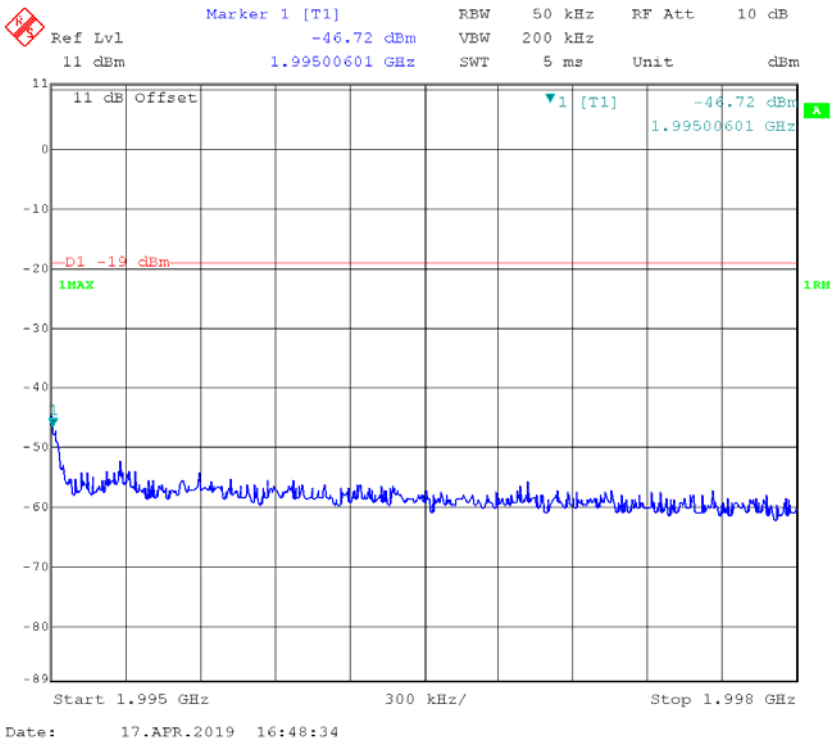
PCS Band LTE Left Side 1932.5MHz Above AGC



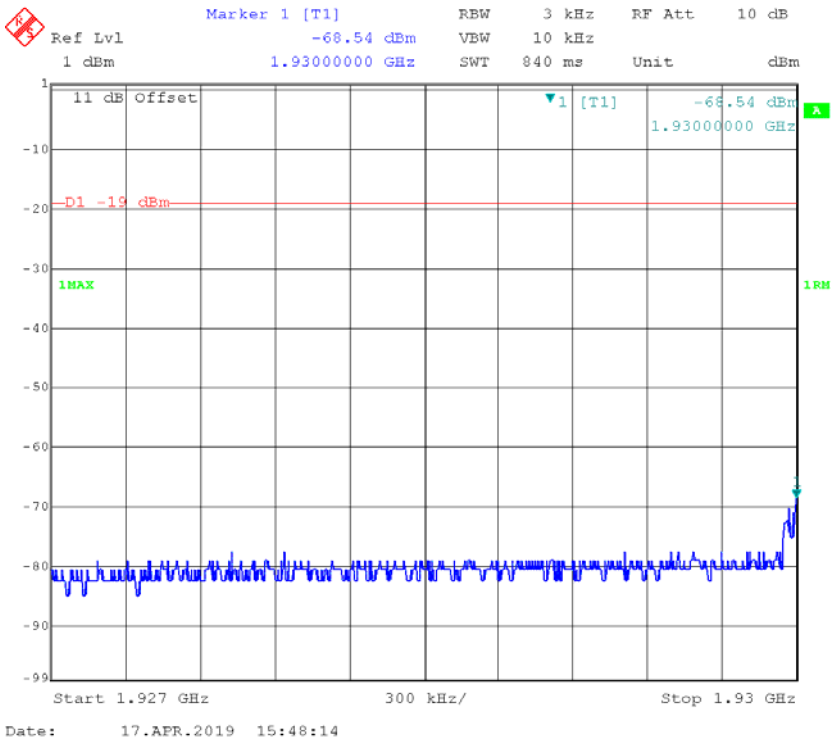
PCS Band LTE Right Side 1992.5MHz Pre-AGC



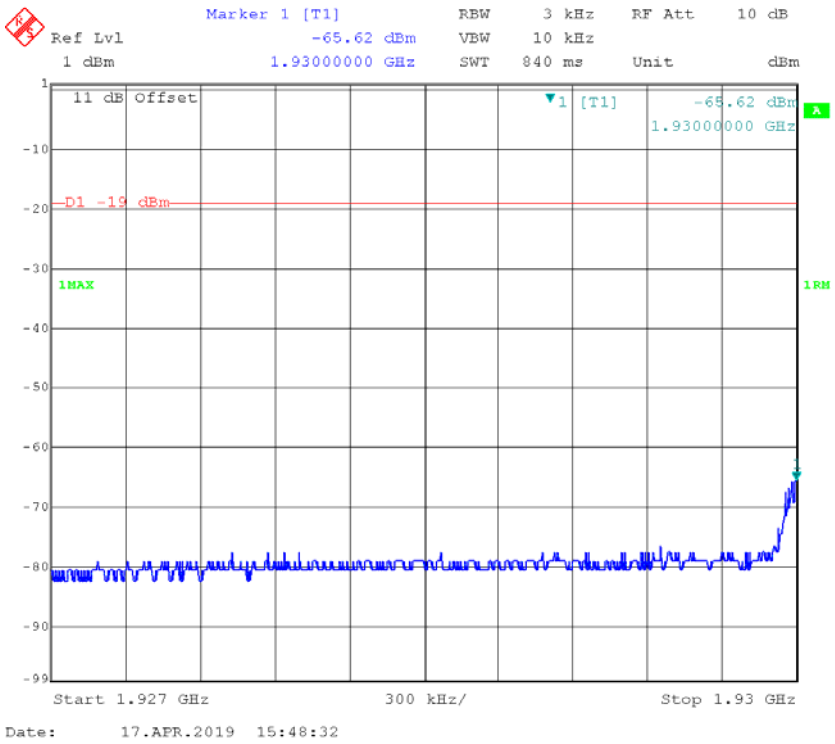
PCS Band LTE Right Side 1992.5MHz Above AGC



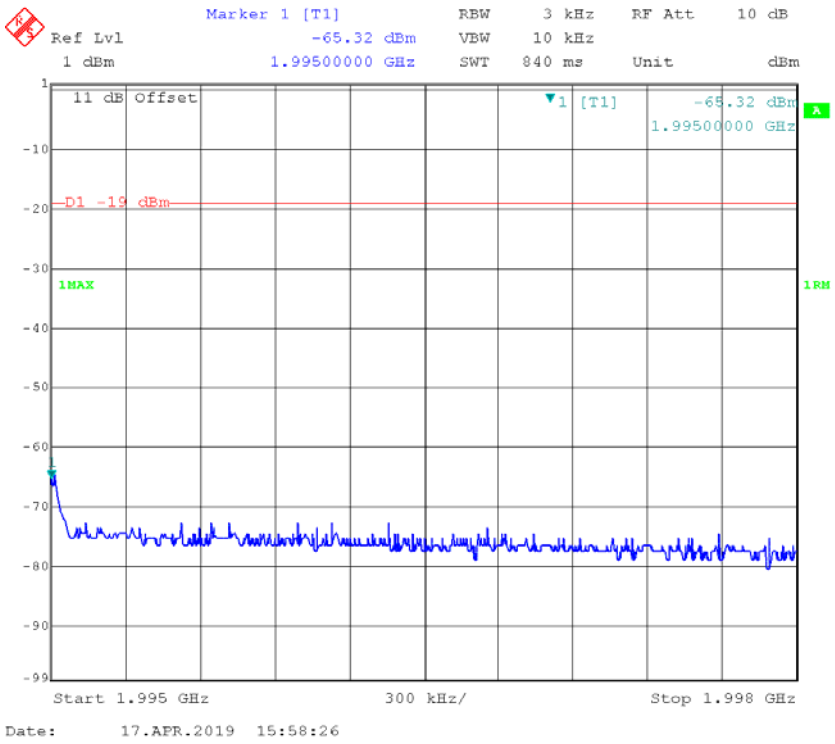
PCS Band GSM Left Side 1930.2MHz Pre-AGC



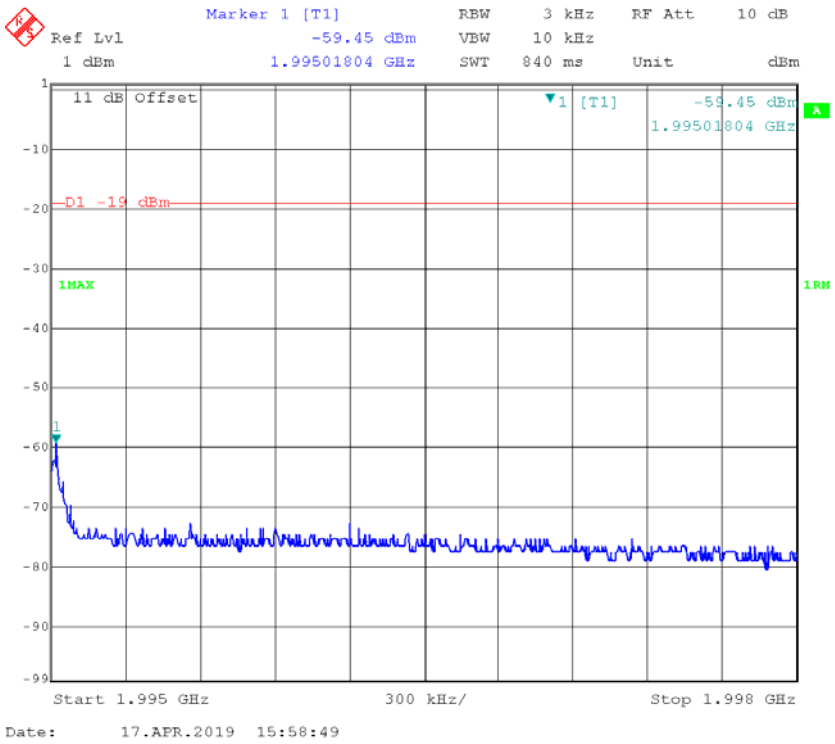
PCS Band GSM Left Side 1930.2MHz Above AGC



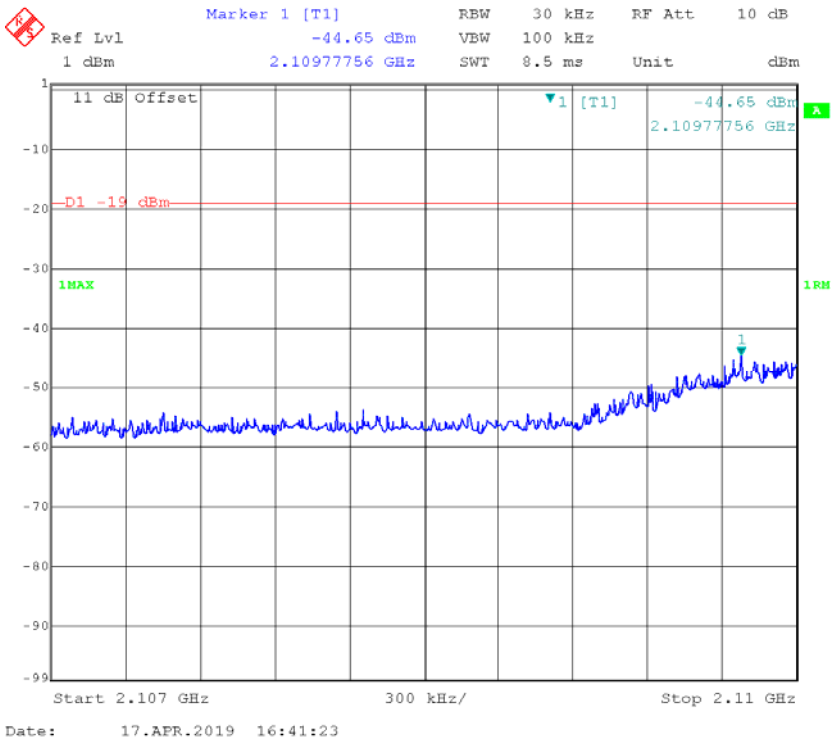
PCS Band GSM Right Side 1994.8MHz Pre-AGC



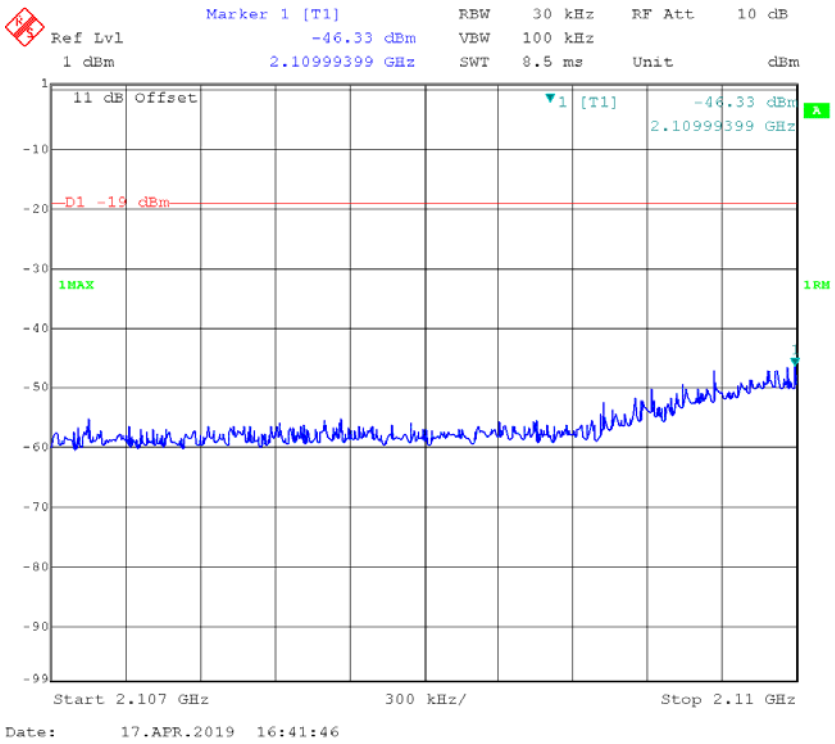
PCS Band GSM Right Side 1994.8MHz Above AGC



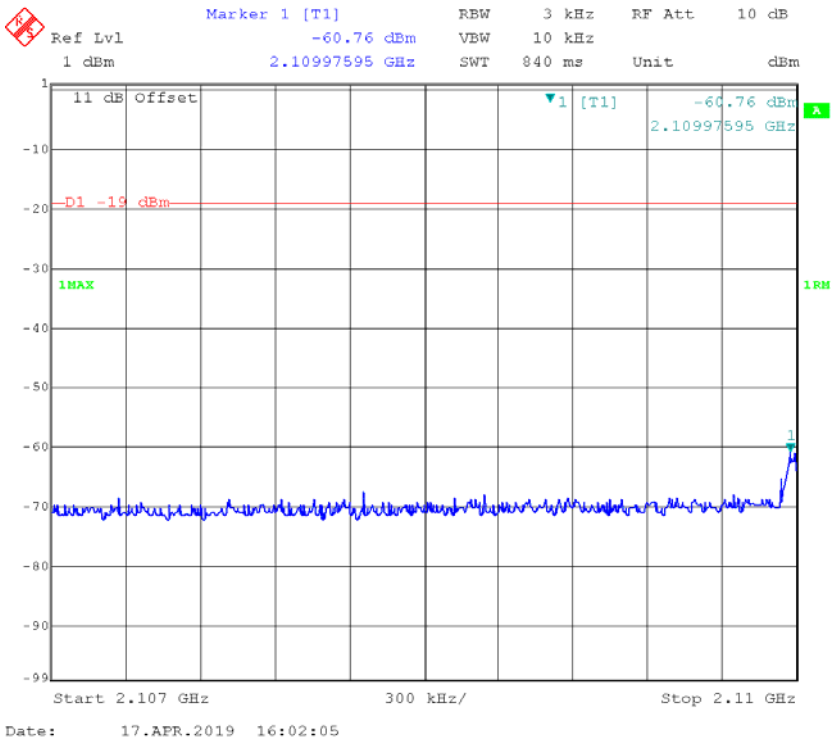
AWS Band CDMA Left Side 2111.25MHz Pre-AGC



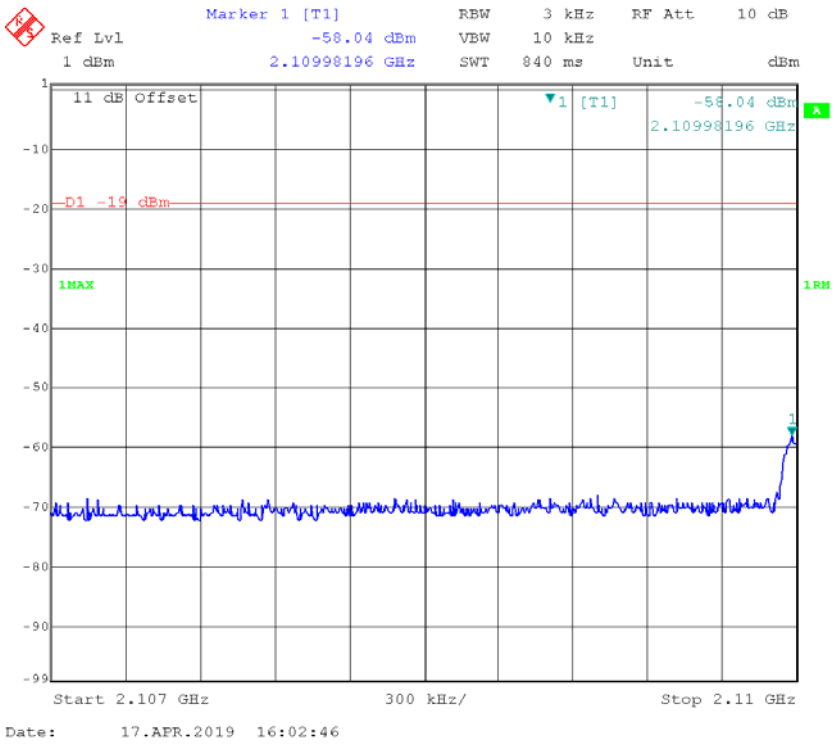
AWS Band CDMA Left Side 2111.25MHz Above AGC



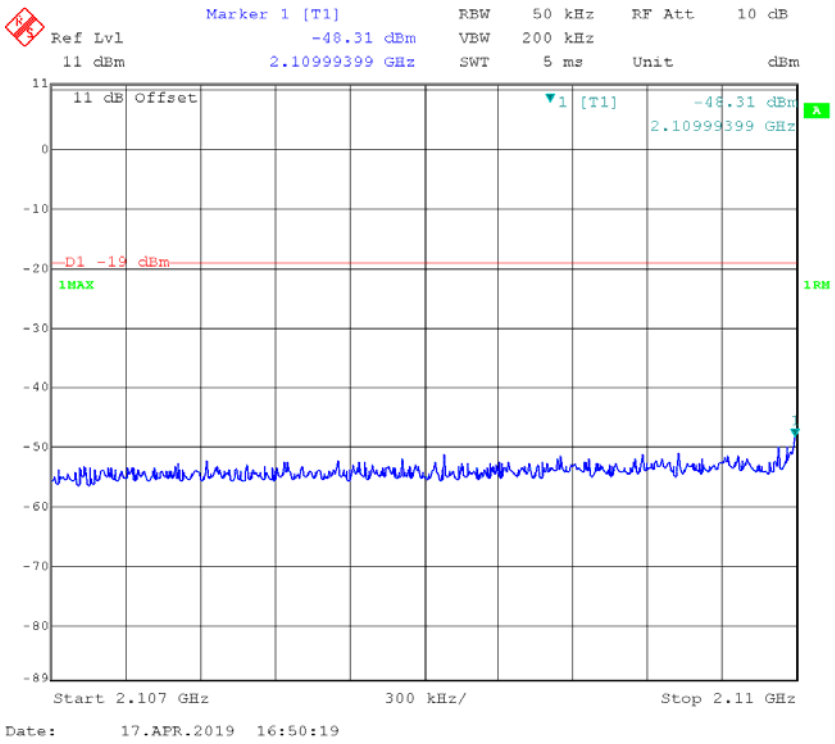
AWS Band GSM Left Side 2110.2MHz Pre-AGC



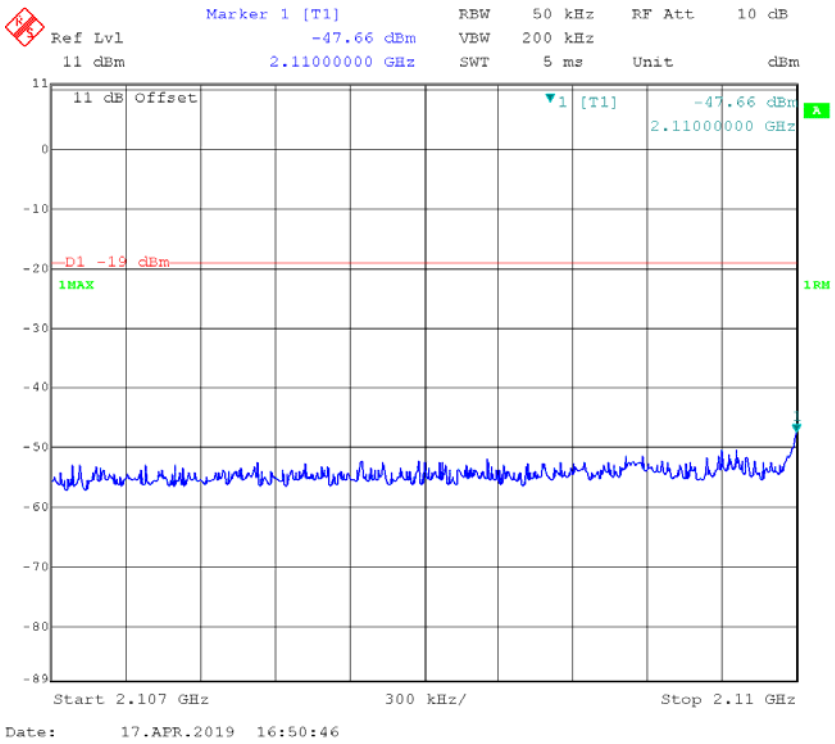
AWS Band GSM Left Side 2110.2MHz Above AGC



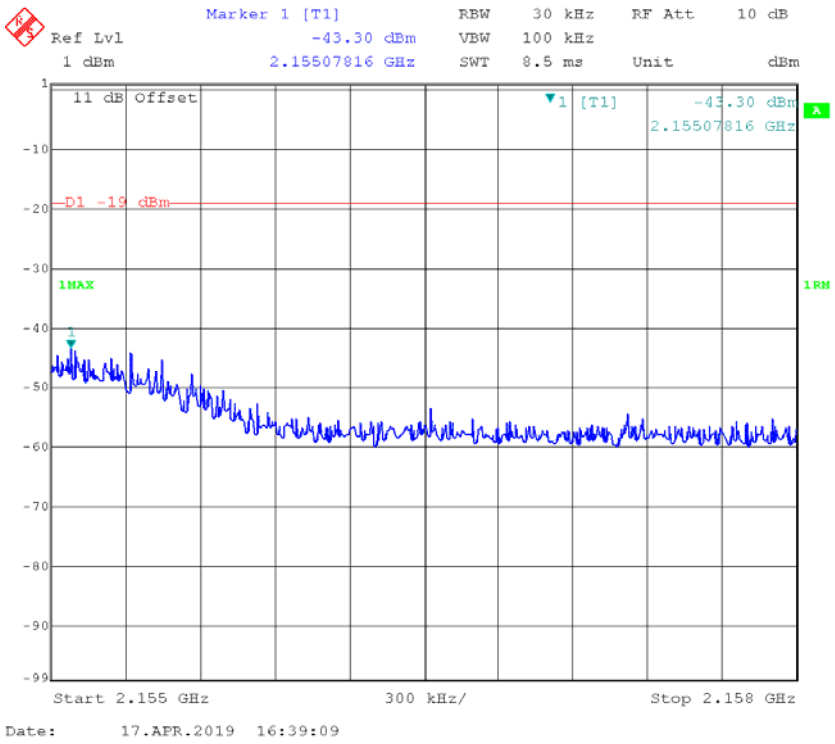
AWS Band LTE Left Side 2112.5MHz Pre-AGC



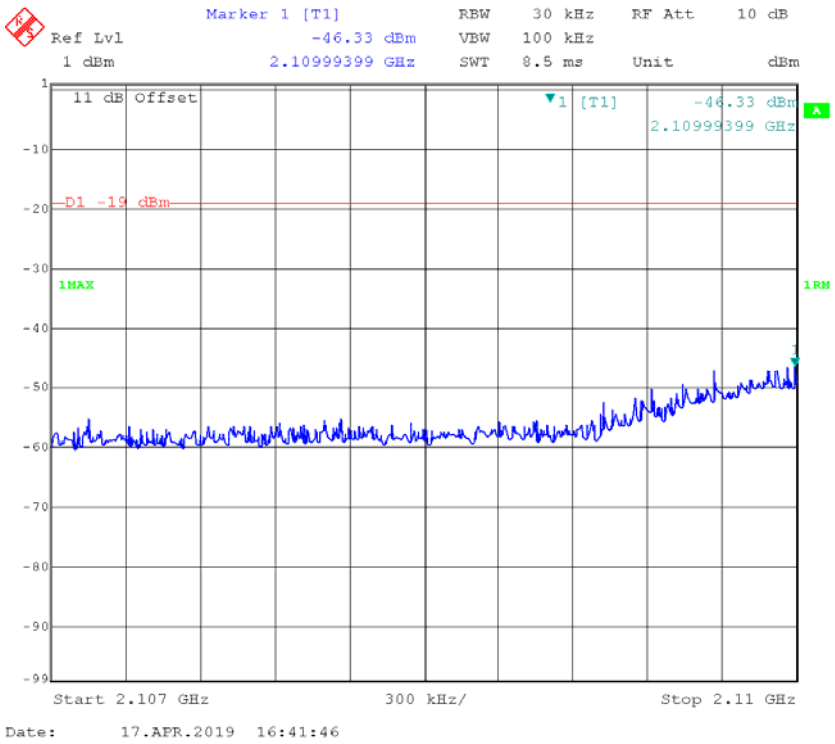
AWS Band LTE Left Side 2112.5MHz Above AGC



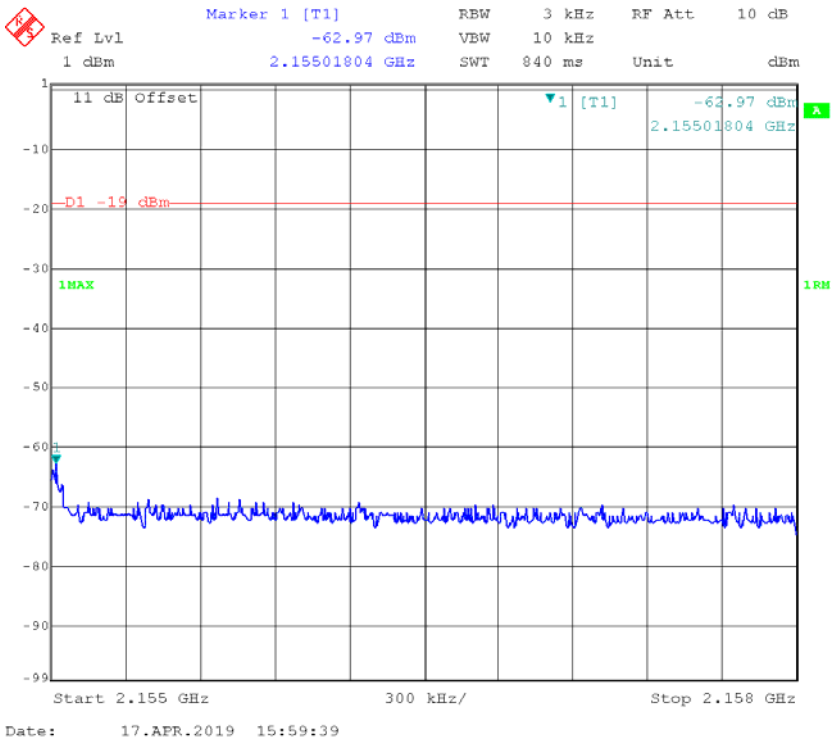
AWS Band CDMA Right Side 2153.75MHz Pre-AGC



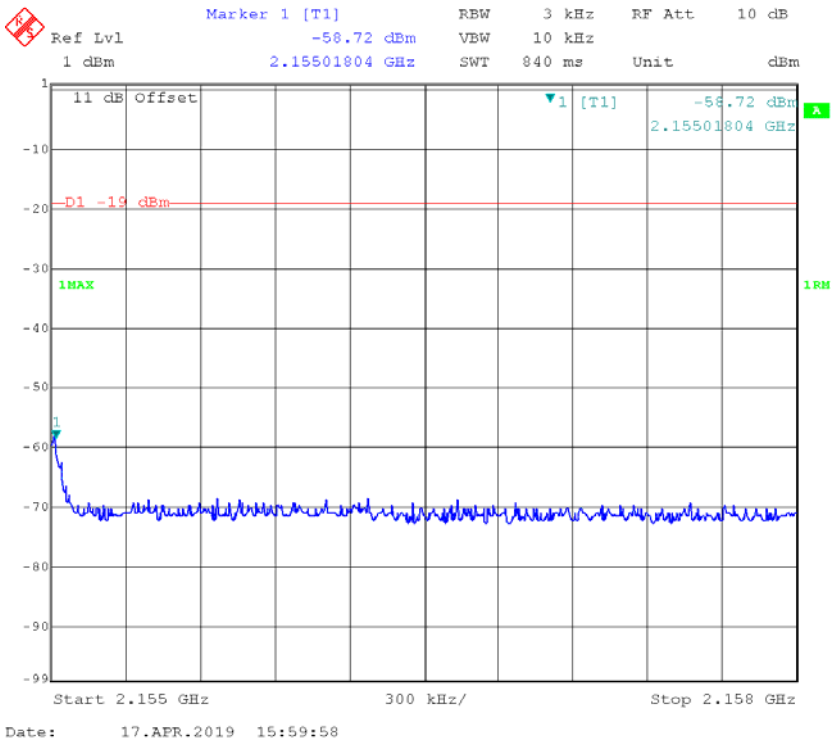
AWS Band CDMA Right Side 2153.75MHz Above AGC



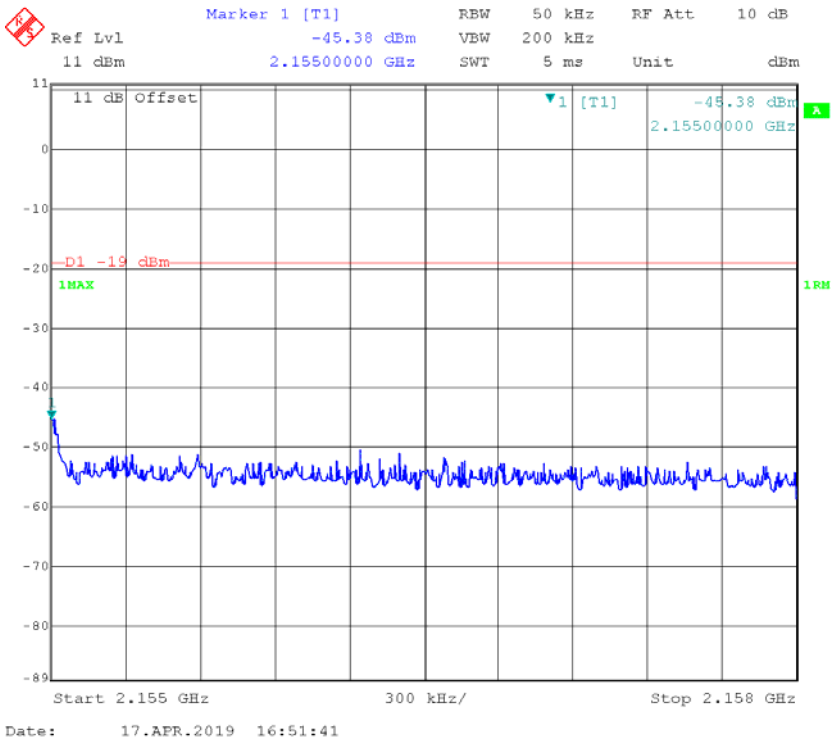
AWS Band GSM Right Side 2154.8MHz Pre-AGC



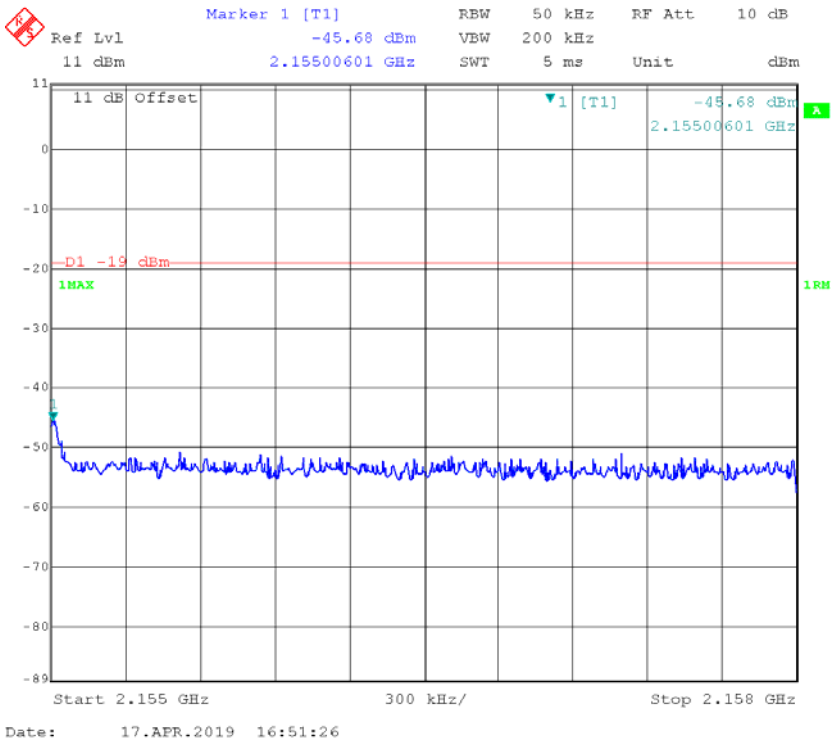
AWS Band GSM Right Side 2154.8MHz Above AGC



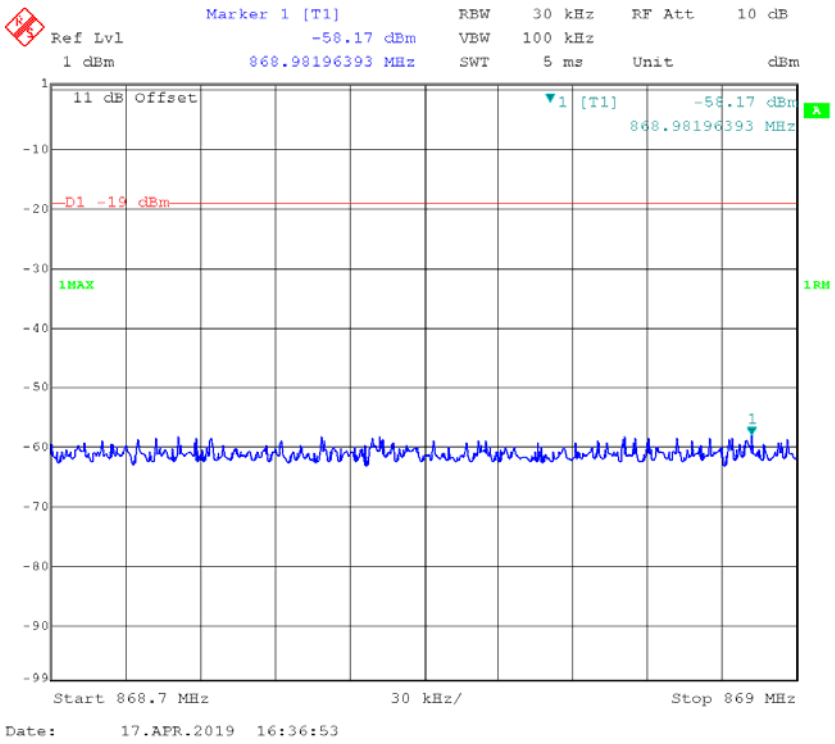
AWS Band LTE Right Side 2152.5MHz Pre-AGC



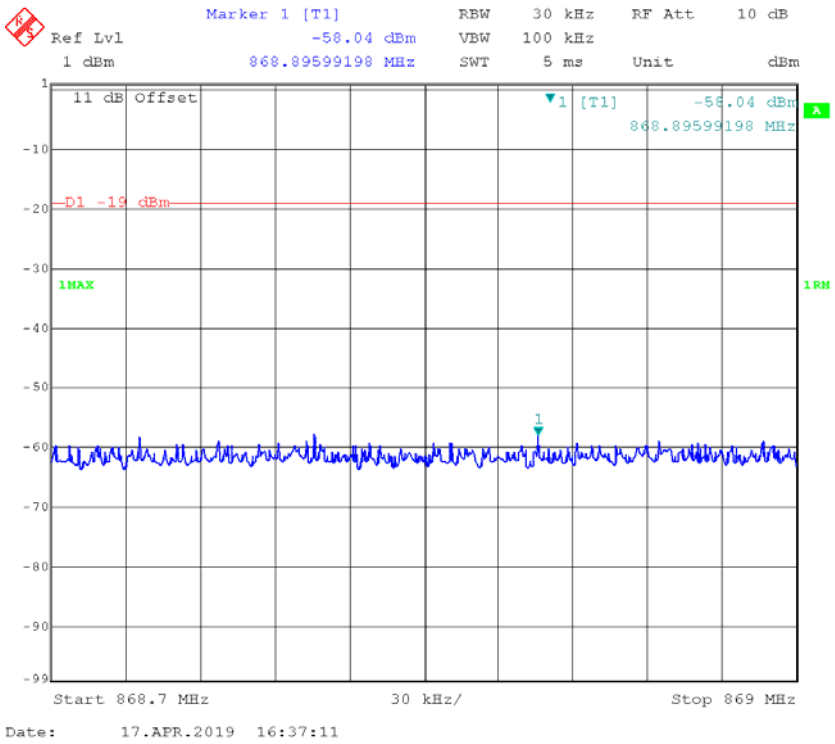
AWS Band LTE Right Side 2152.5MHz Above AGC



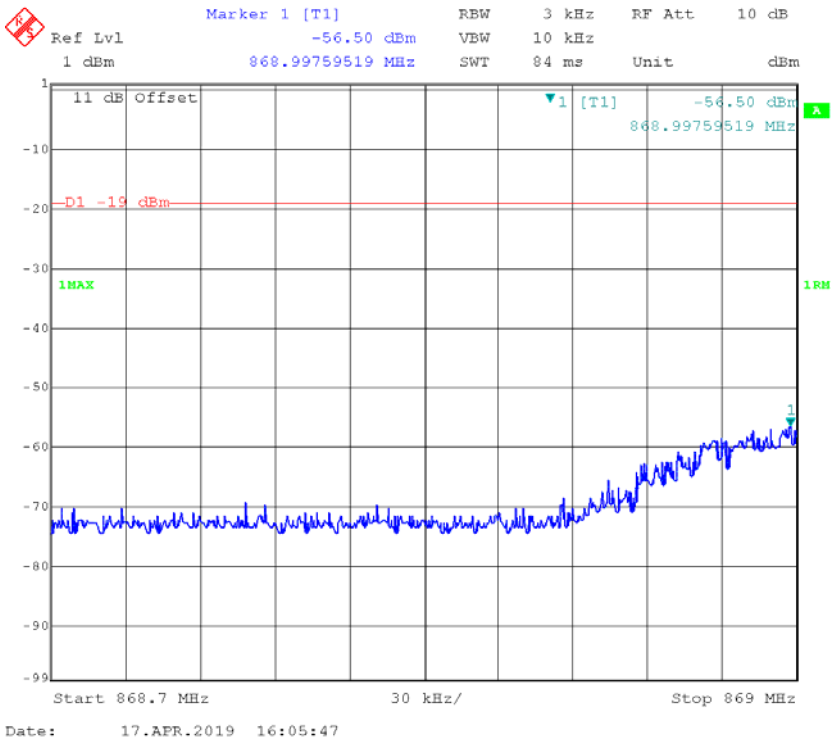
Cellular Band CDMA Left Side 869.88 MHz Pre-AGC



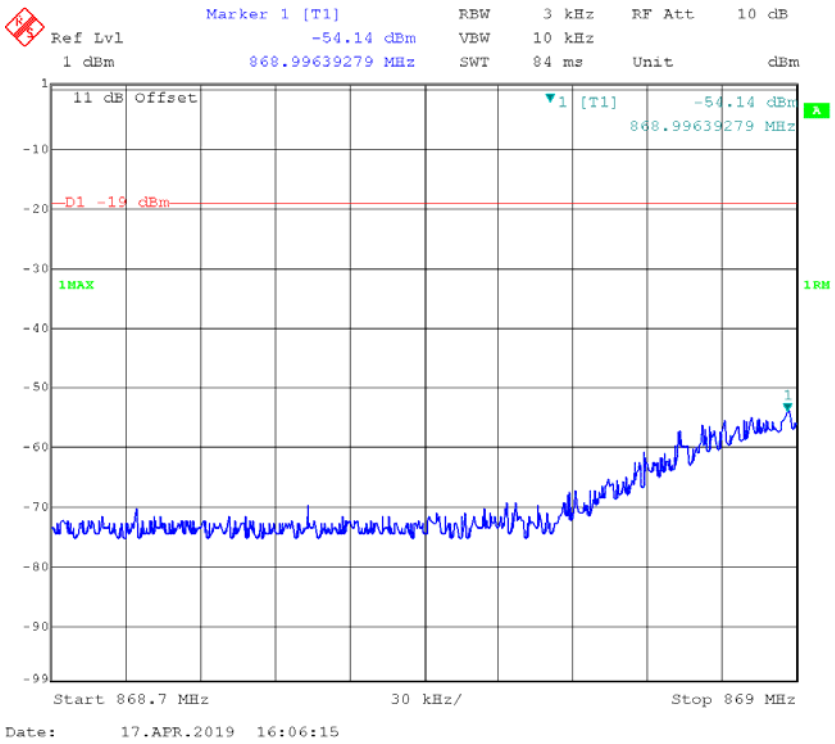
Cellular Band CDMA Left Side 869.88 MHz Above AGC



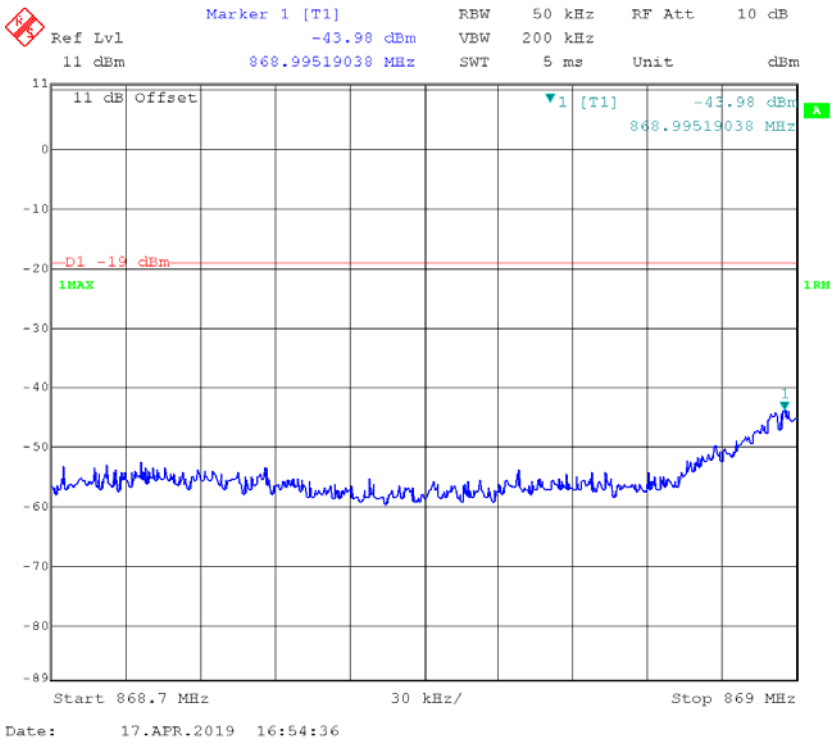
Cellular Band GSM Left Side 869.2MHz Pre-AGC



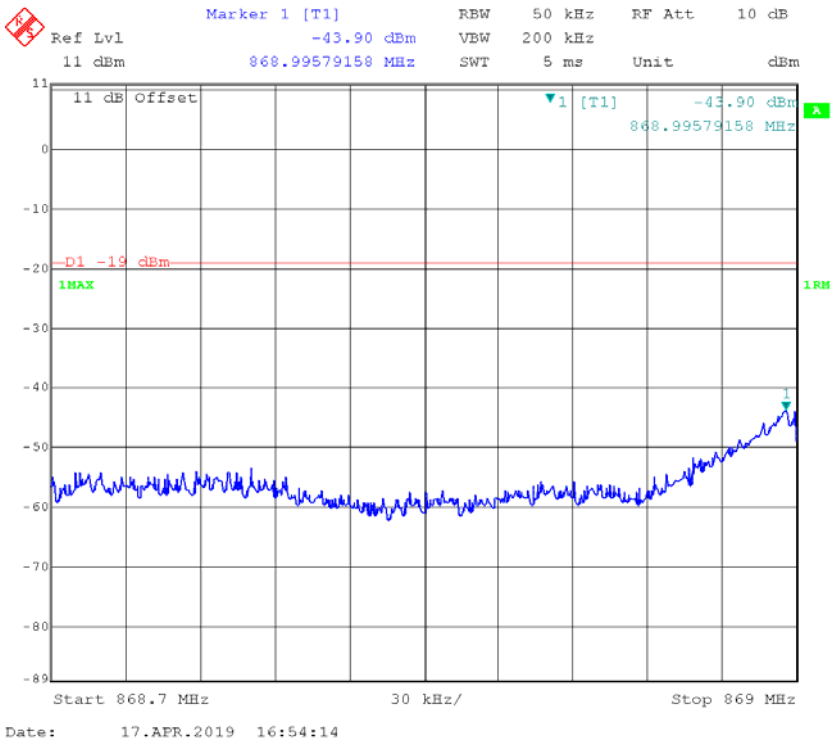
Cellular Band GSM Left Side 869.2MHz Above AGC



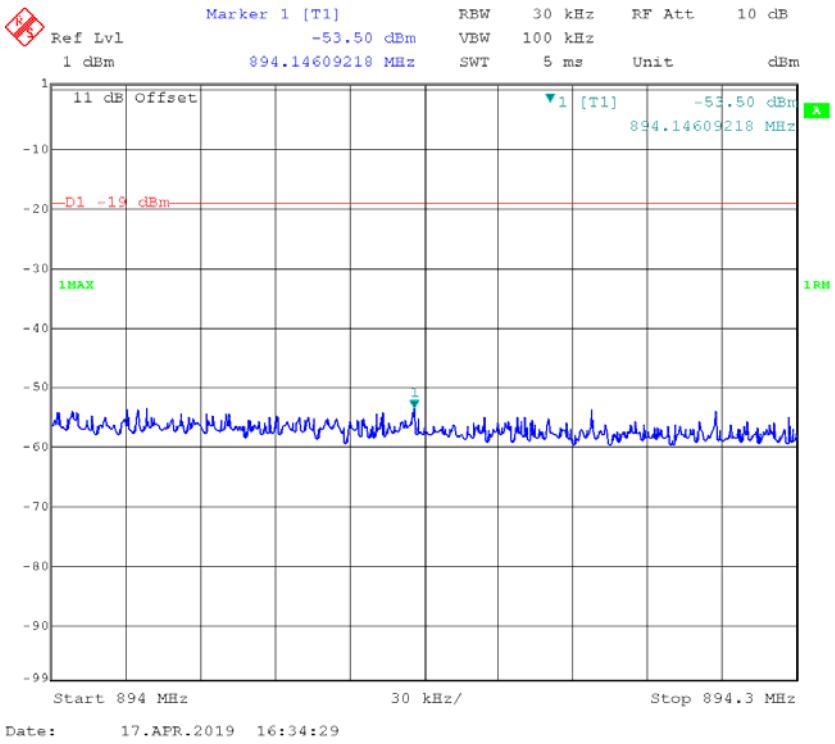
Cellular Band LTE Left Side 871.5MHz Pre-AGC



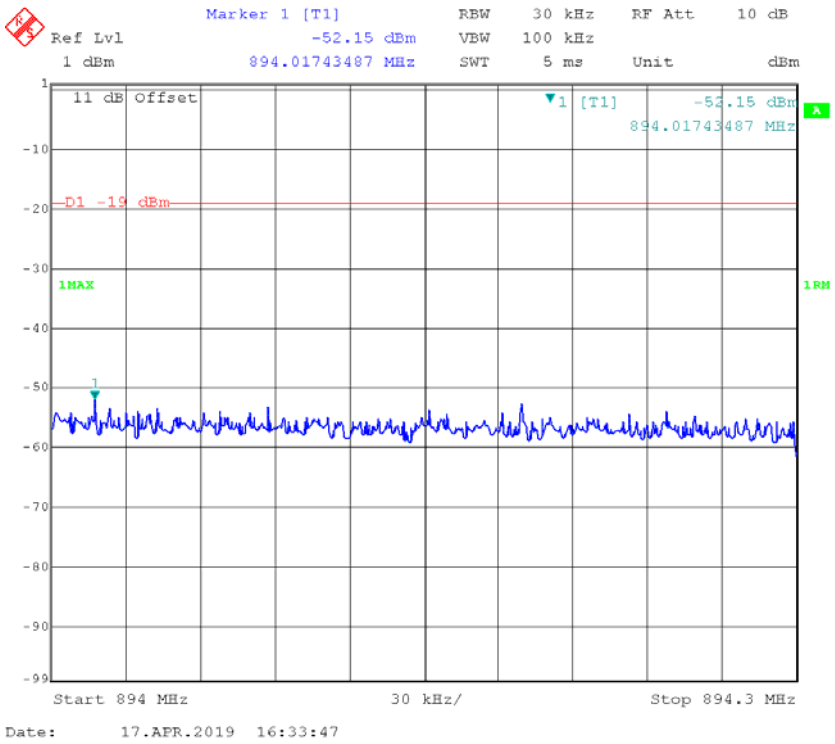
Cellular Band LTE Left Side 871.5MHz Above AGC



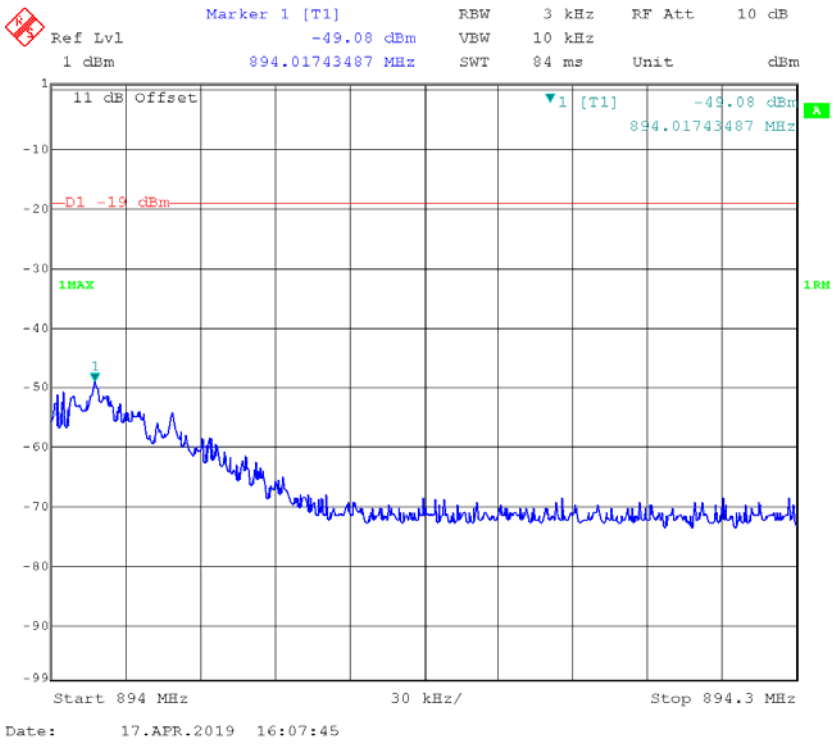
Cellular Band CDMA Right Side 893.1MHz Pre-AGC



Cellular Band CDMA Right Side 893.1MHz Above AGC

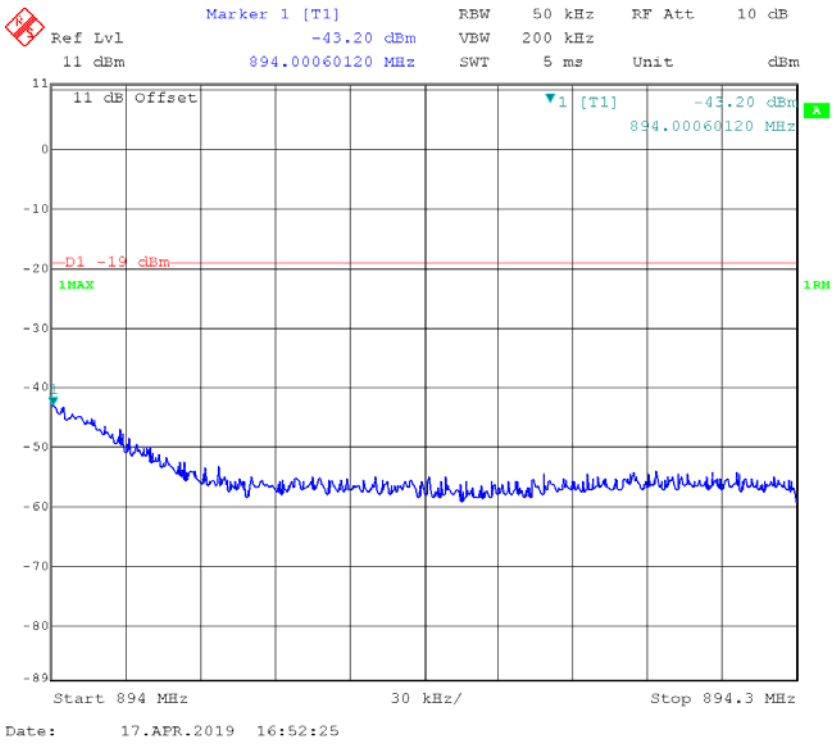


Cellular Band GSM Right Side 893.8MHz Pre-AGC

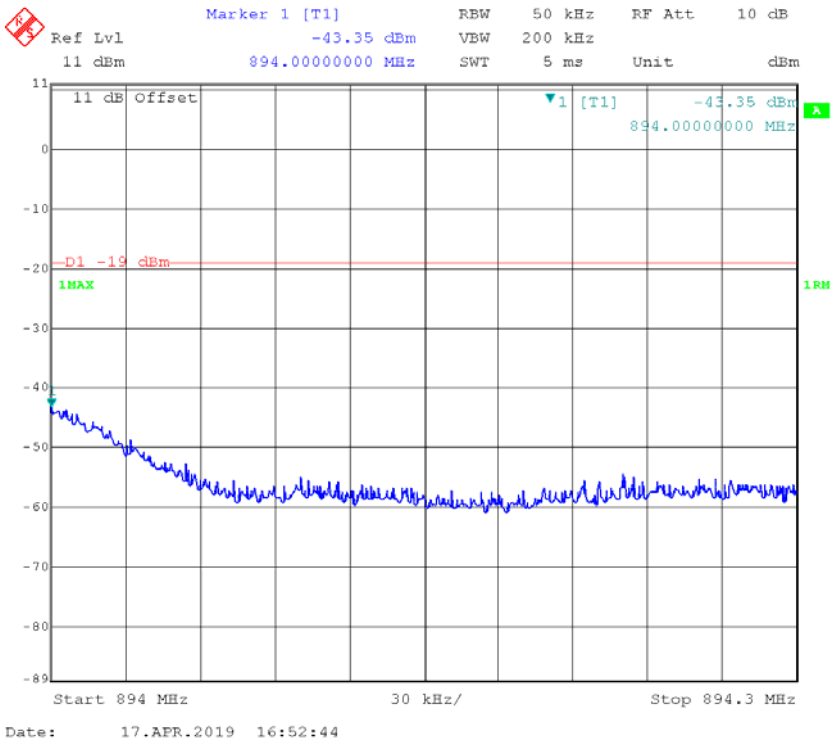


Cellular Band GSM Right Side 893.8MHz Above AGC

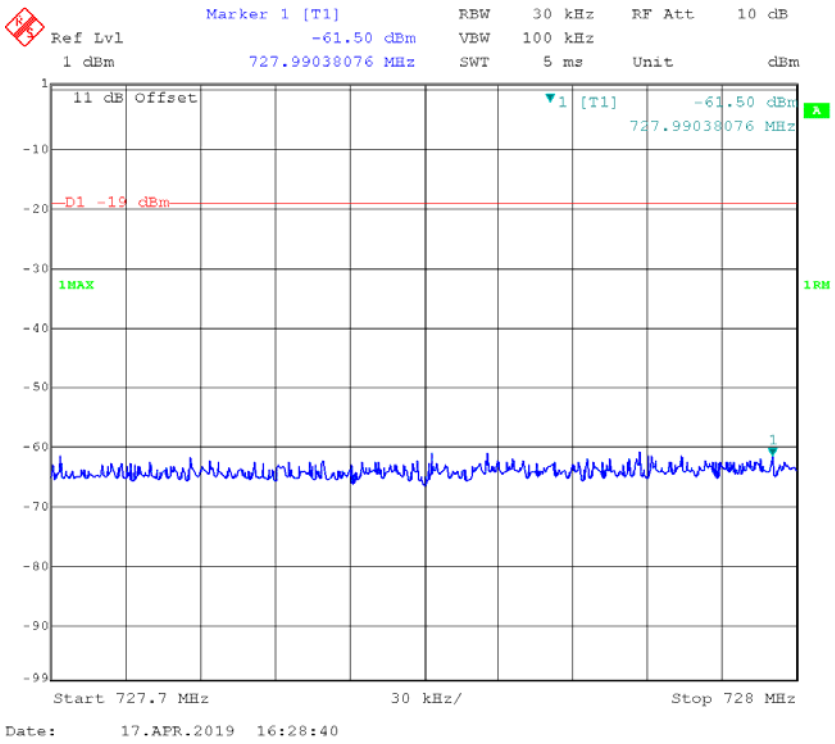
Cellular Band LTE Right Side 891.5MHz Pre-AGC



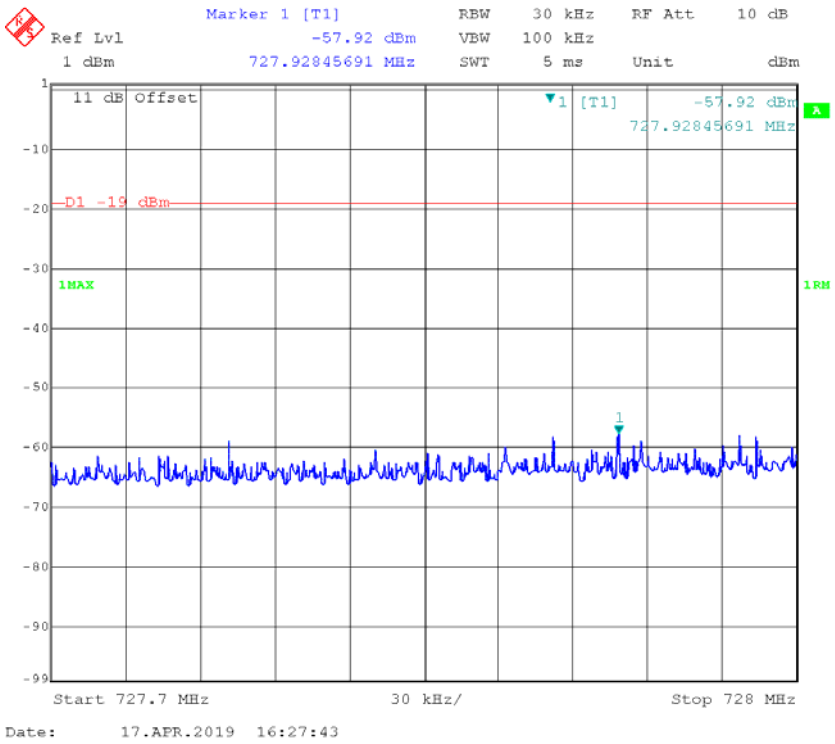
Cellular Band LTE Right Side 891.5MHz Above AGC



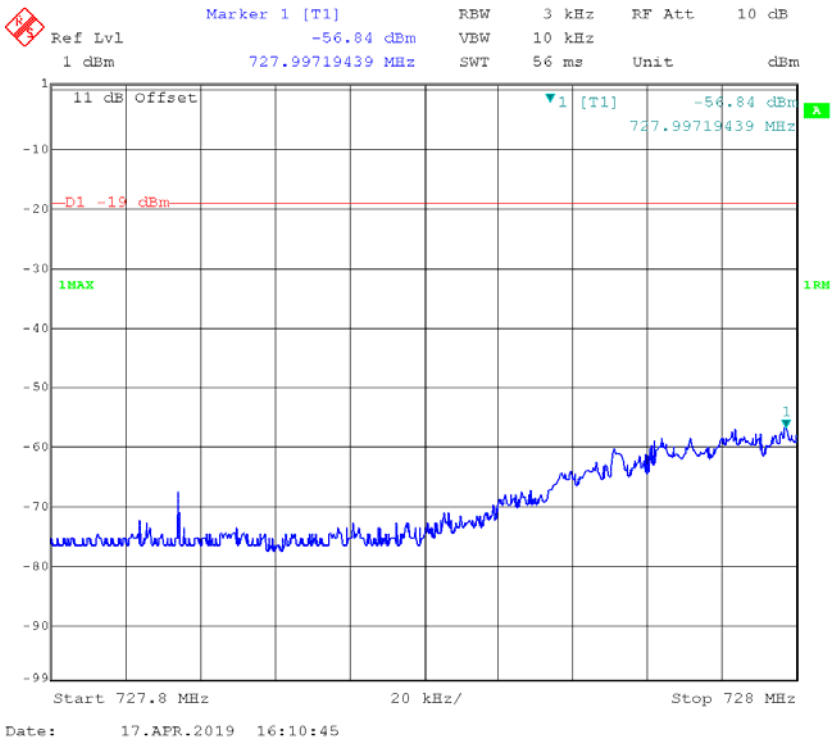
Upper 700MHz Band CDMA Left Side 747.25MHz Pre-AGC



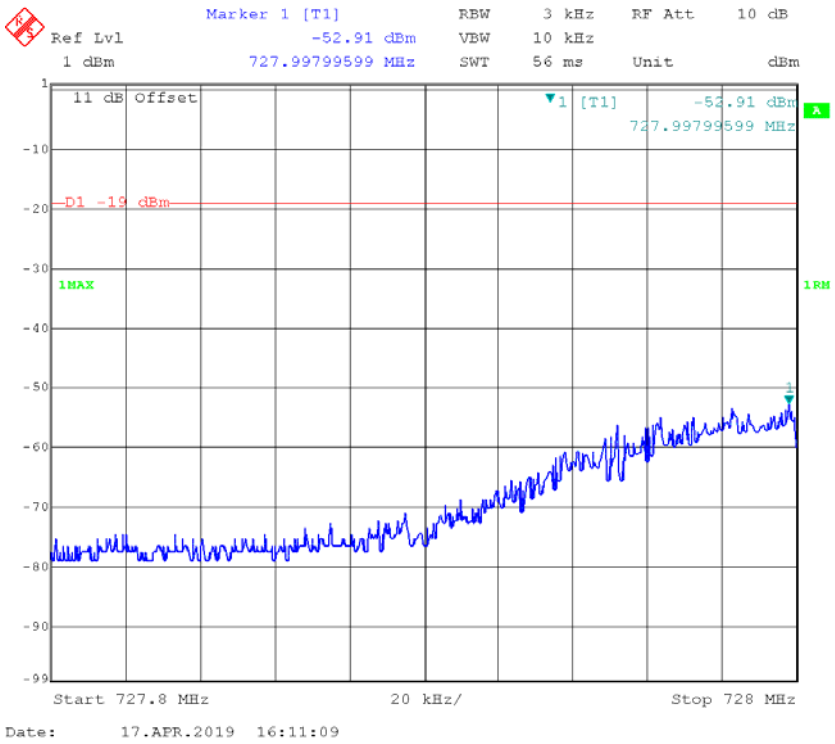
Upper 700MHz Band CDMA Left Side 747.25MHz Above AGC



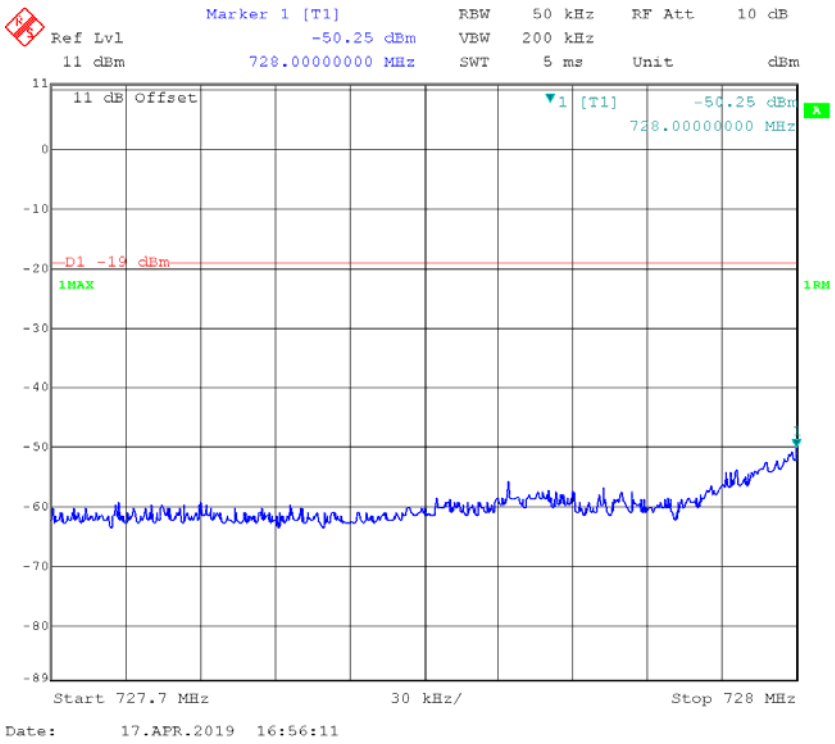
Upper 700MHz Band GSM Left Side 746.2MHz Pre-AGC



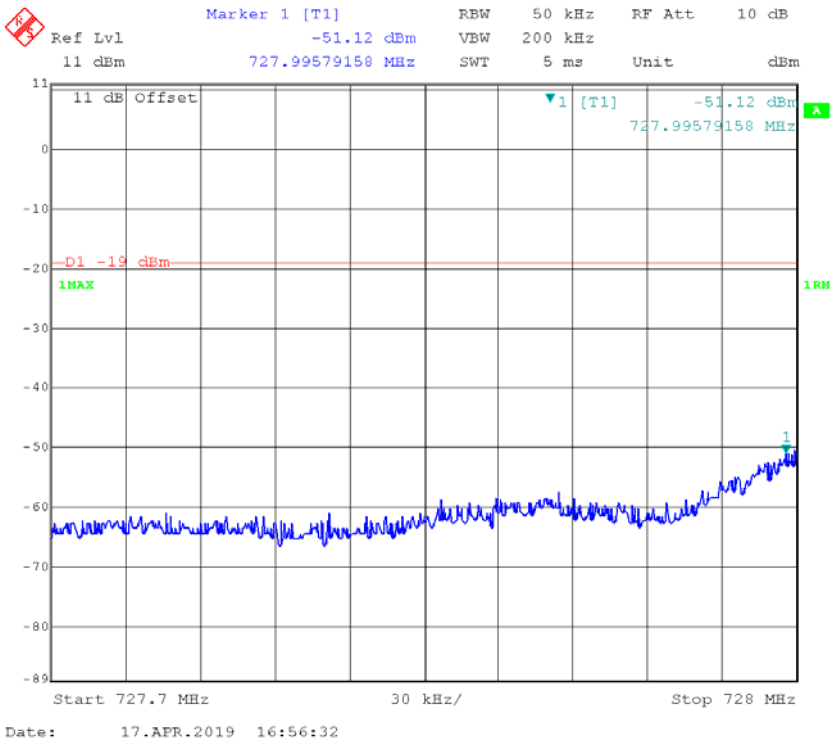
Upper 700MHz Band GSM Left Side 746.2MHz Above AGC



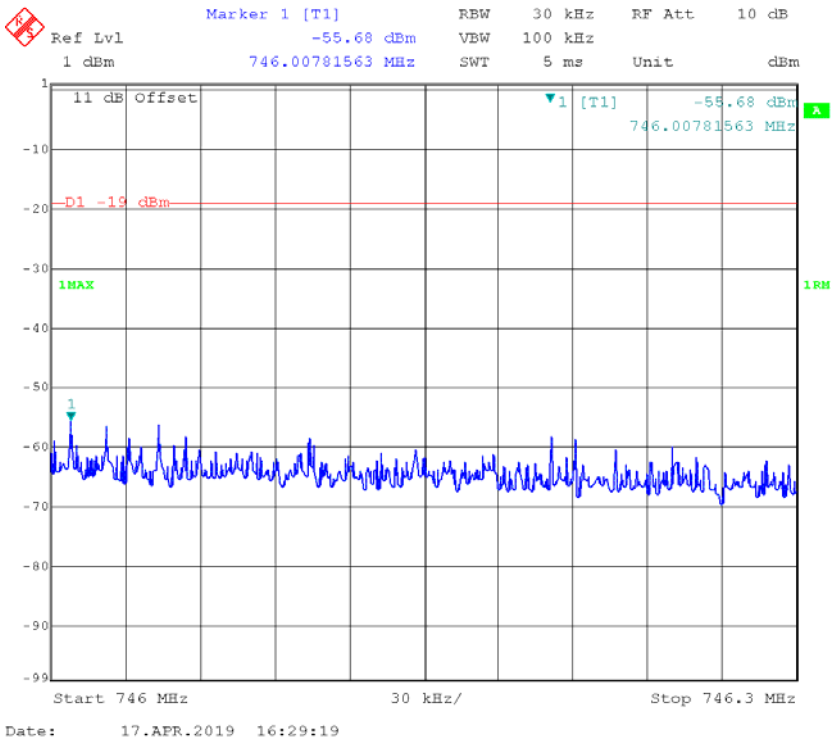
Upper 700MHz Band LTE Left Side 748.5MHz Pre-AGC



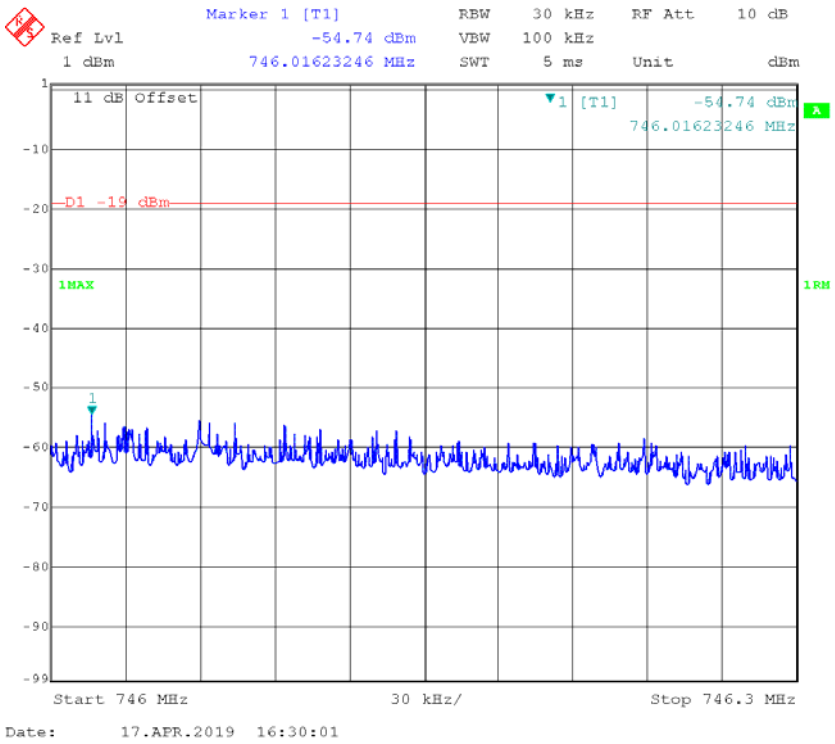
Upper 700MHz Band LTE Left Side 748.5MHz Above AGC



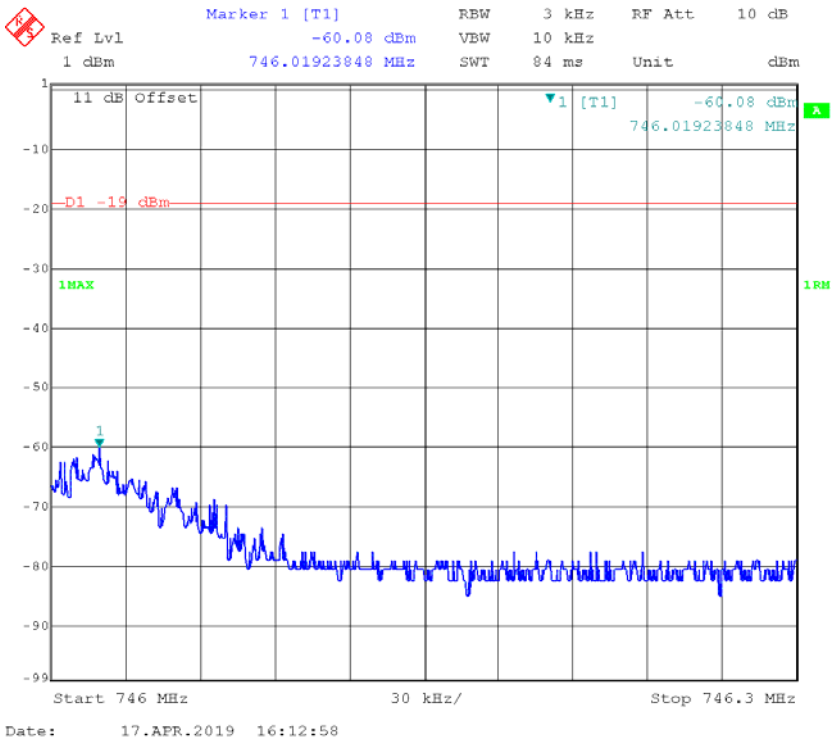
Upper 700MHz Band CDMA Right Side 755.75MHz Pre-AGC



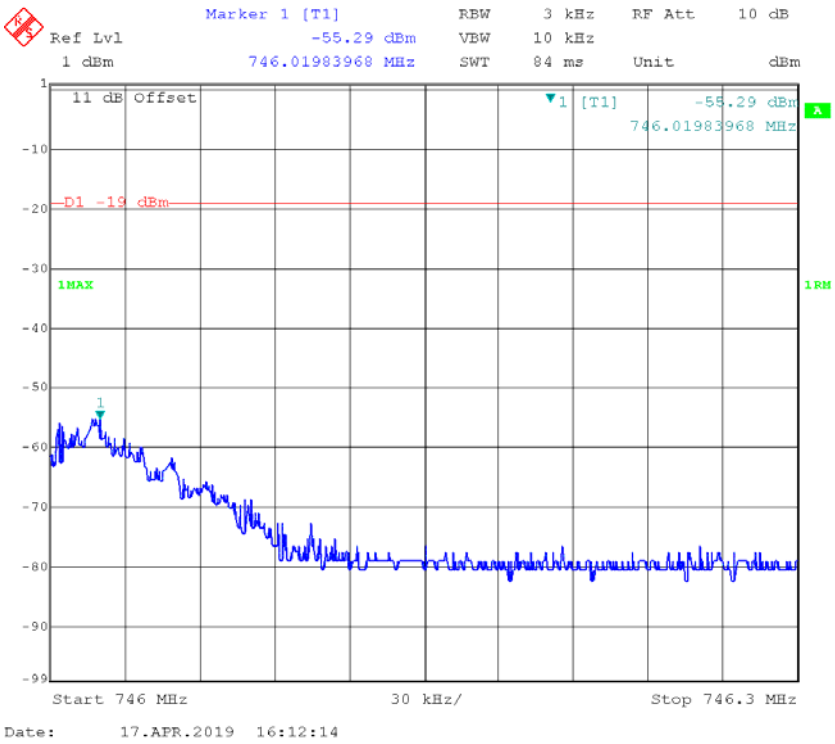
Upper 700MHz Band CDMA Right Side 755.75MHz Above AGC



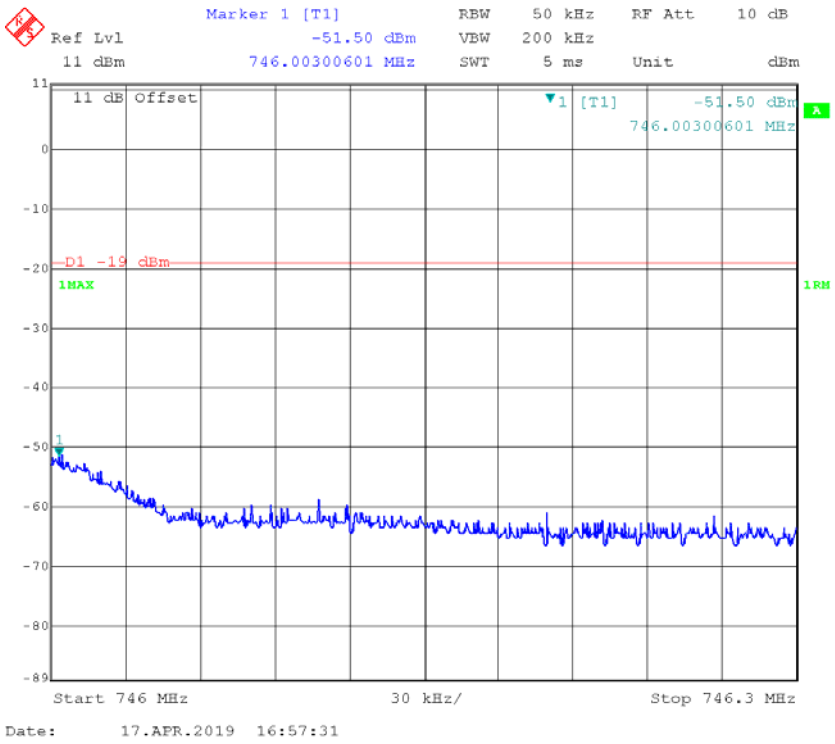
Upper 700MHz Band GSM Right Side 756.8MHz Pre-AGC



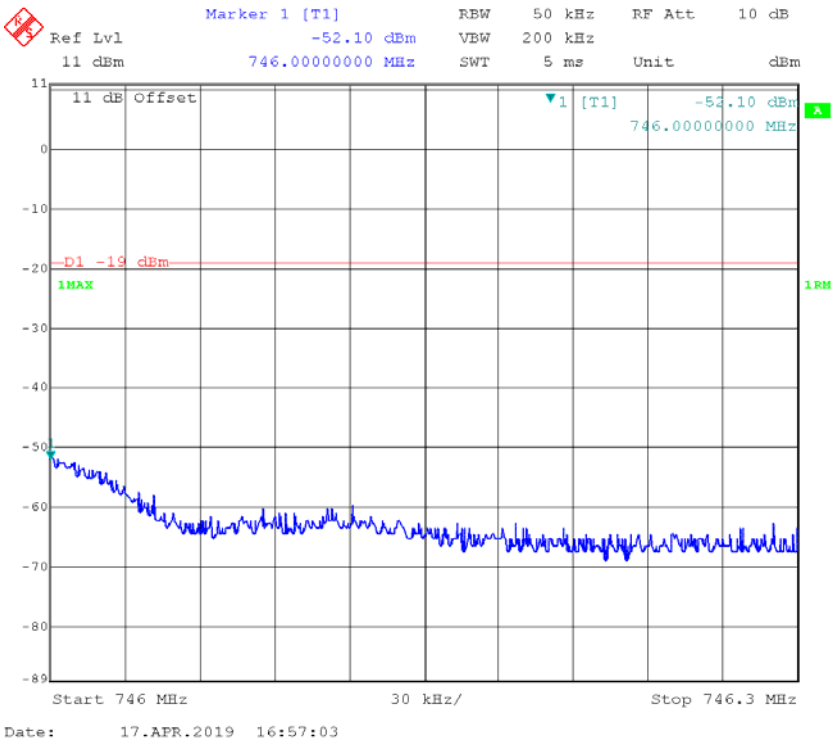
Upper 700MHz Band GSM Right Side 756.8MHz Above AGC



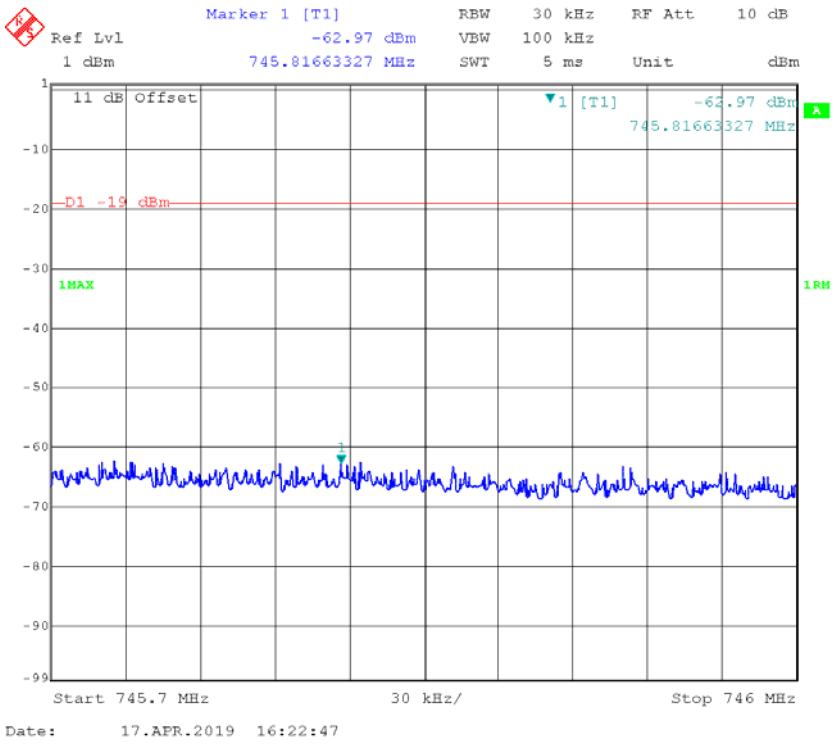
Upper 700MHz Band LTE Right Side 754.5MHz Pre-AGC



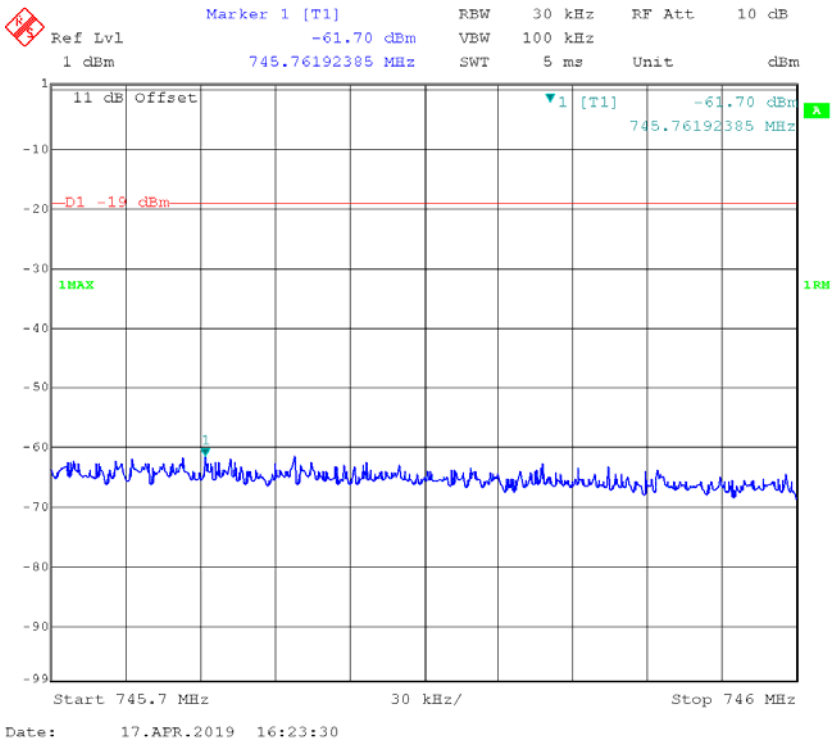
Upper 700MHz Band LTE Right Side 754.5MHz Above AGC



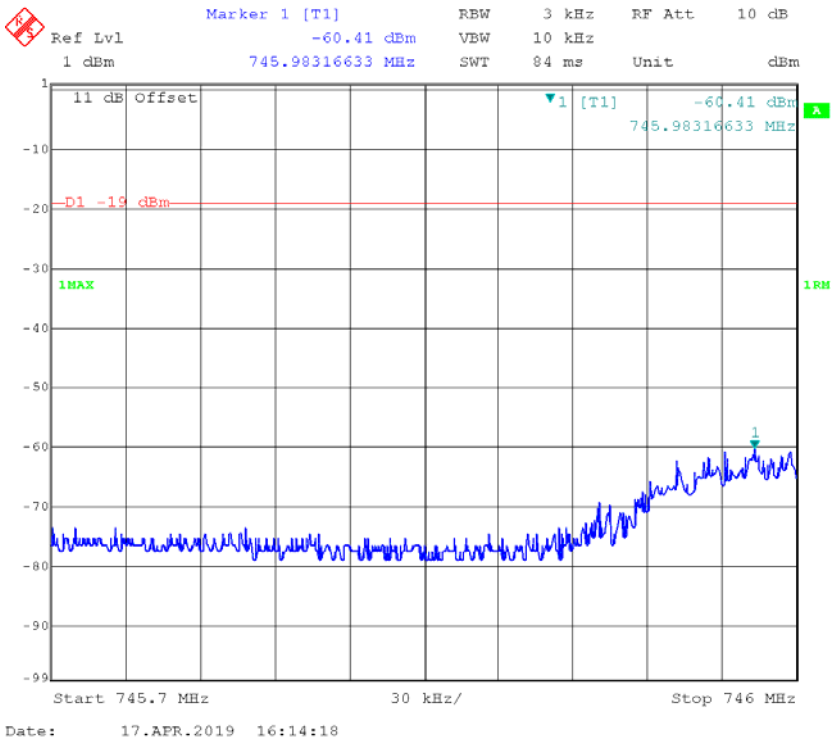
Lower 700MHz Band CDMA Left Side 729.25MHz Pre-AGC



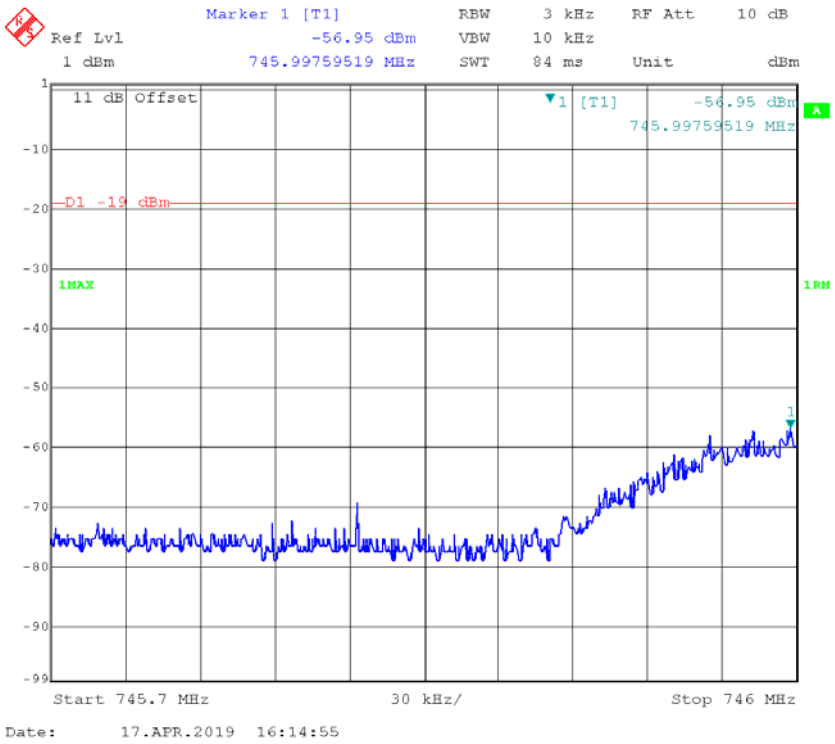
Lower 700MHz Band CDMA Left Side 729.25MHz Above AGC



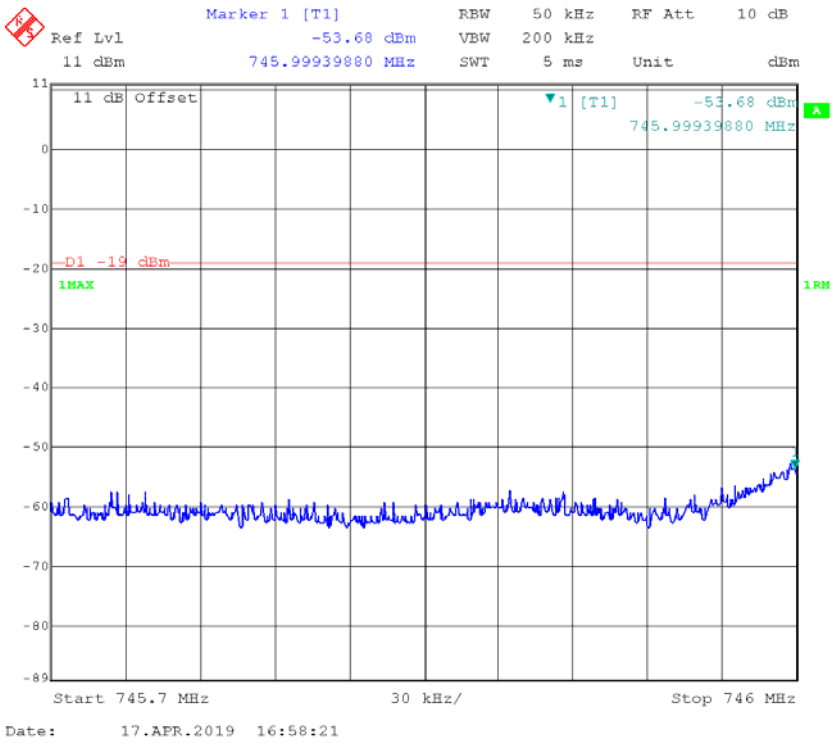
Lower 700MHz Band GSM Left Side 728.2MHz Pre-AGC



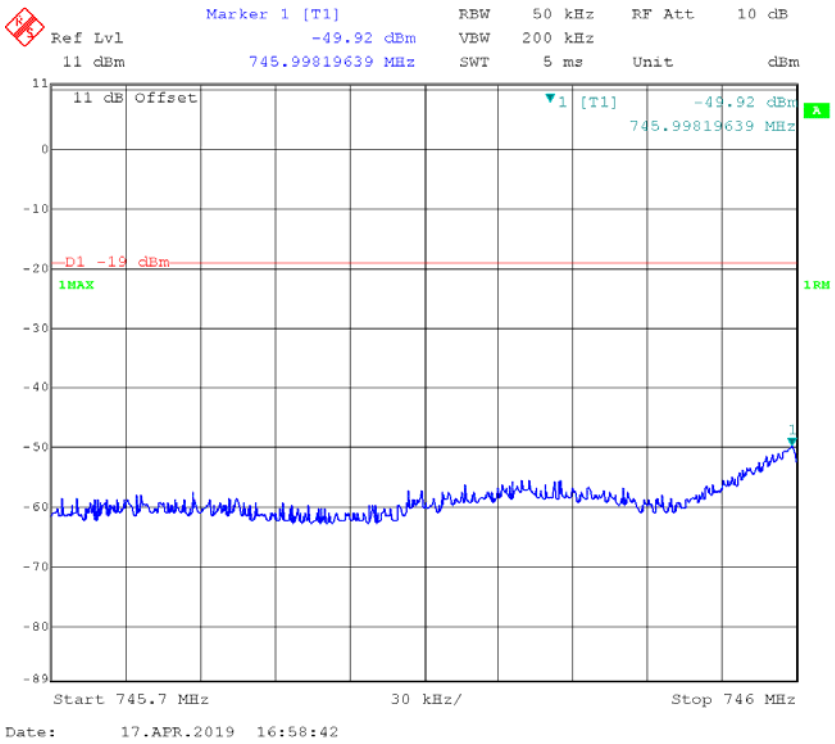
Lower 700MHz Band GSM Left Side 728.2MHz Above AGC



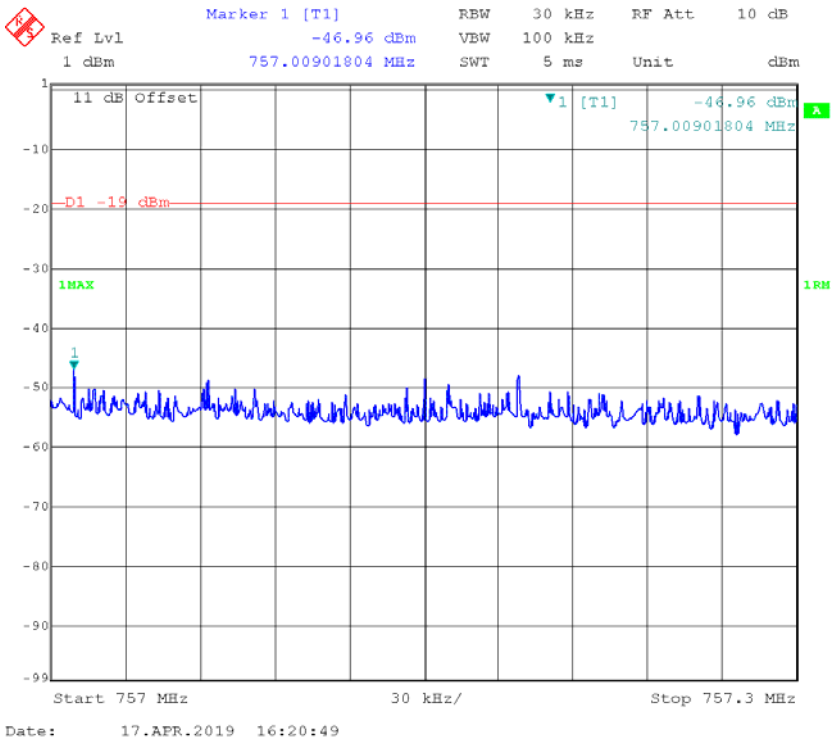
Lower 700MHz Band LTE Left Side 730.5MHz Pre-AGC



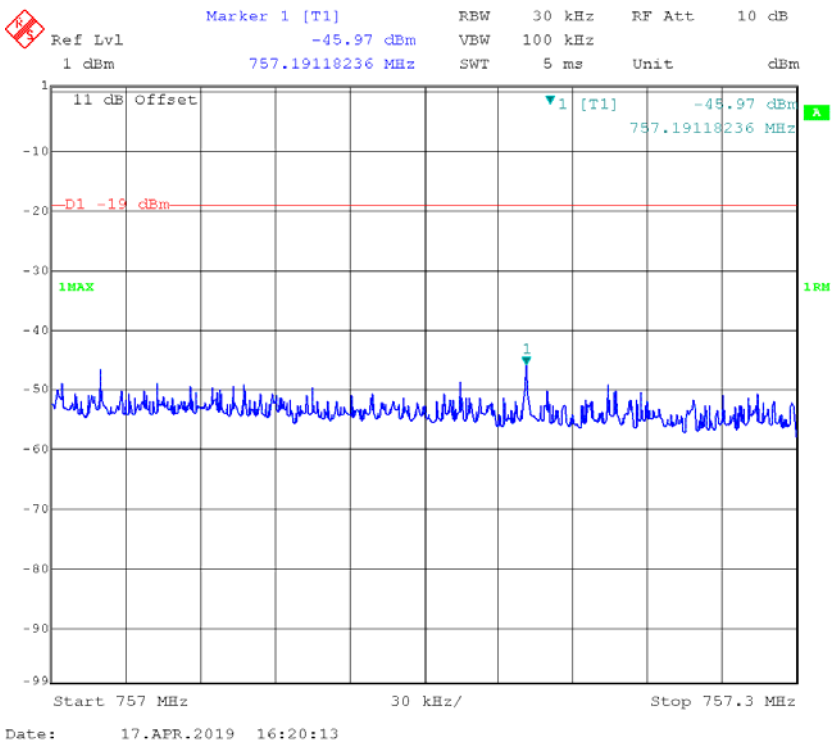
Lower 700MHz Band LTE Left Side 730.5MHz Above AGC



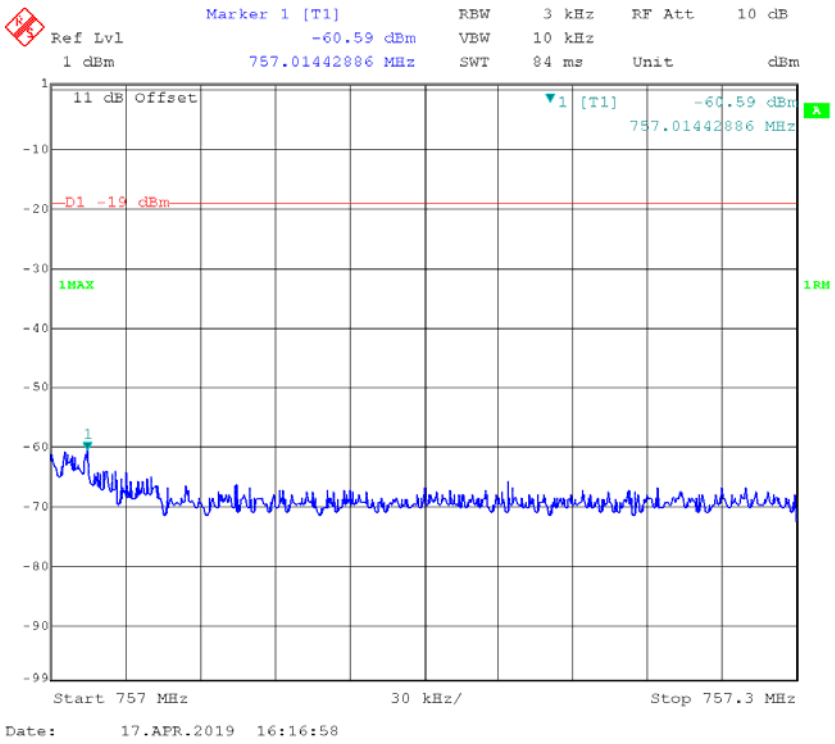
Lower 700MHz Band CDMA Right Side 744.75MHz Pre-AGC



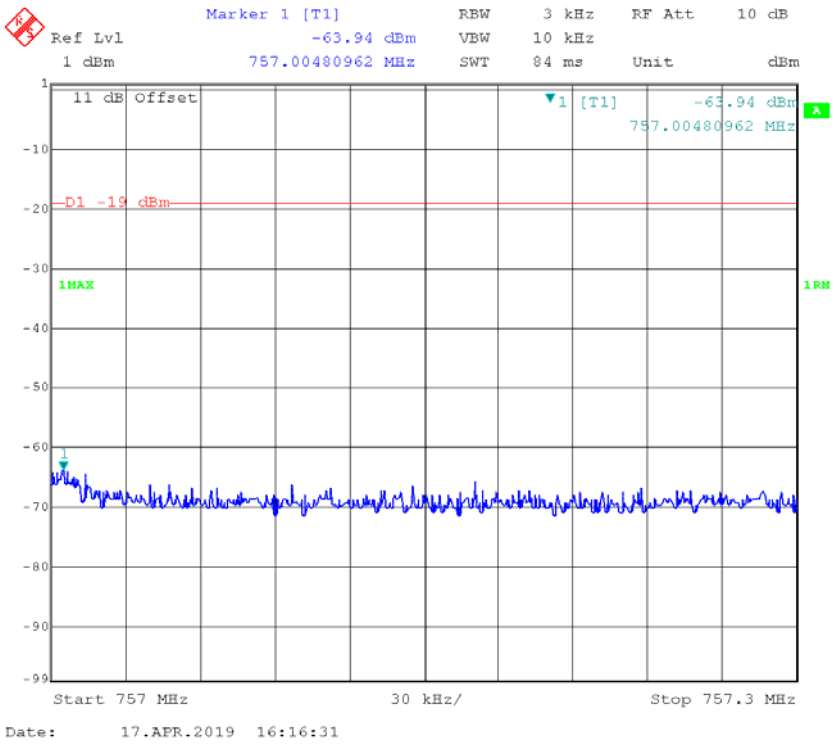
Lower 700MHz Band CDMA Right Side 744.75MHz Above AGC



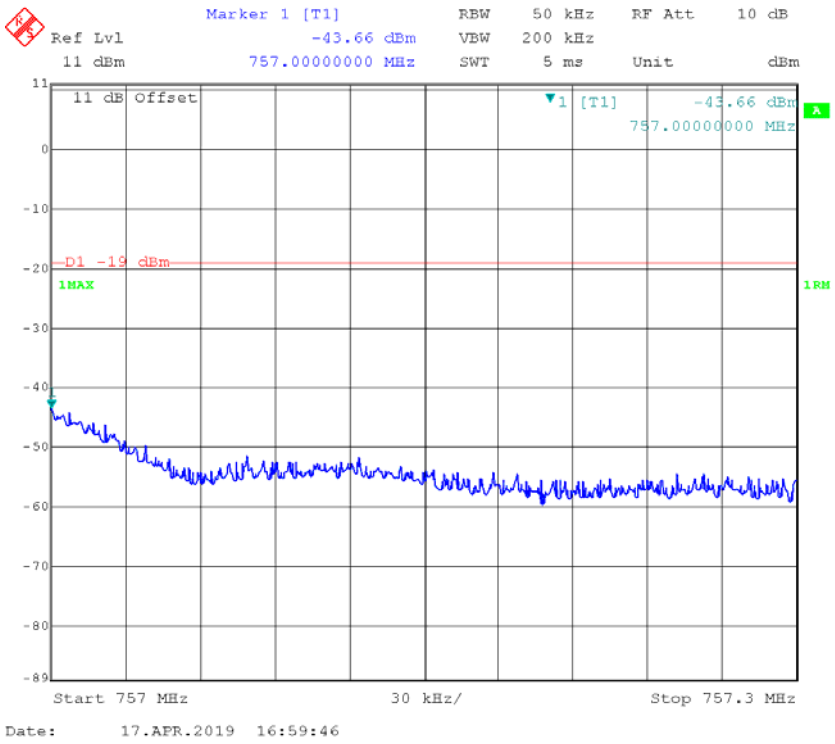
Lower 700MHz Band GSM Right Side 745.8MHz Pre-AGC



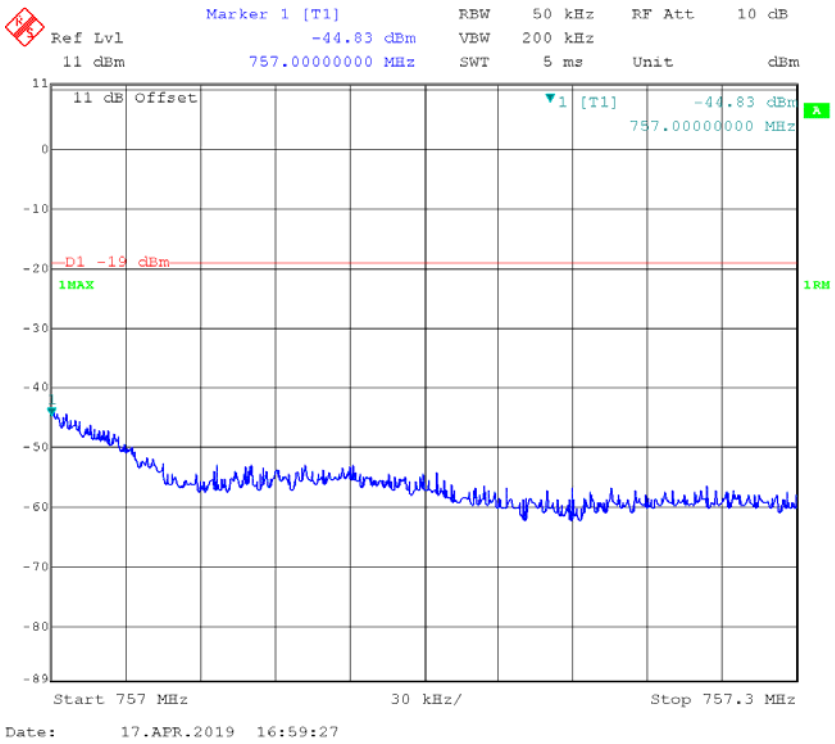
Lower 700MHz Band GSM Right Side 745.8MHz Above AGC



Lower 700MHz Band LTE Right Side 743.5MHz Pre-AGC

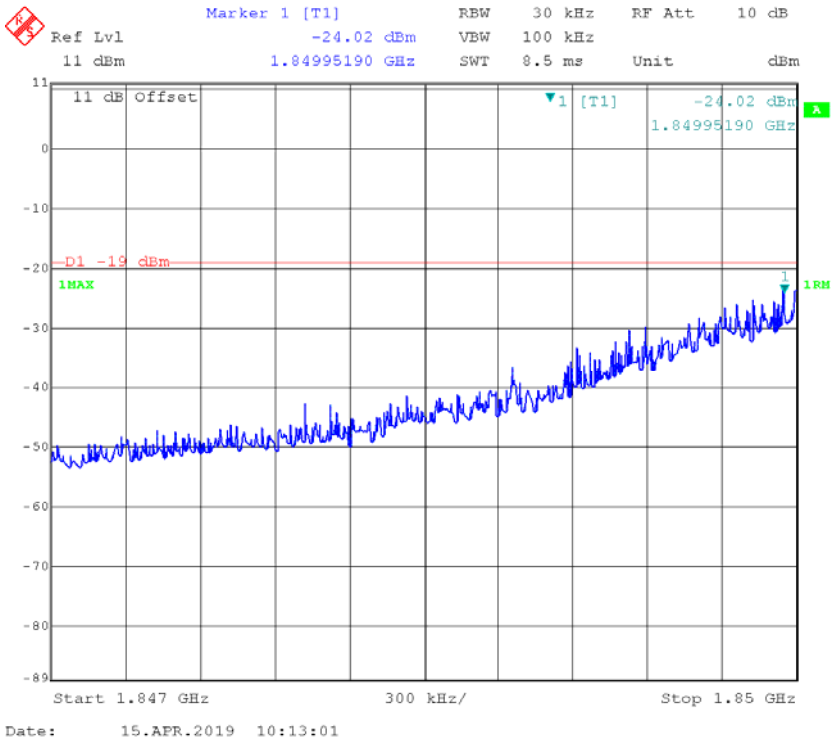


Lower 700MHz Band LTE Right Side 743.5MHz Above AGC

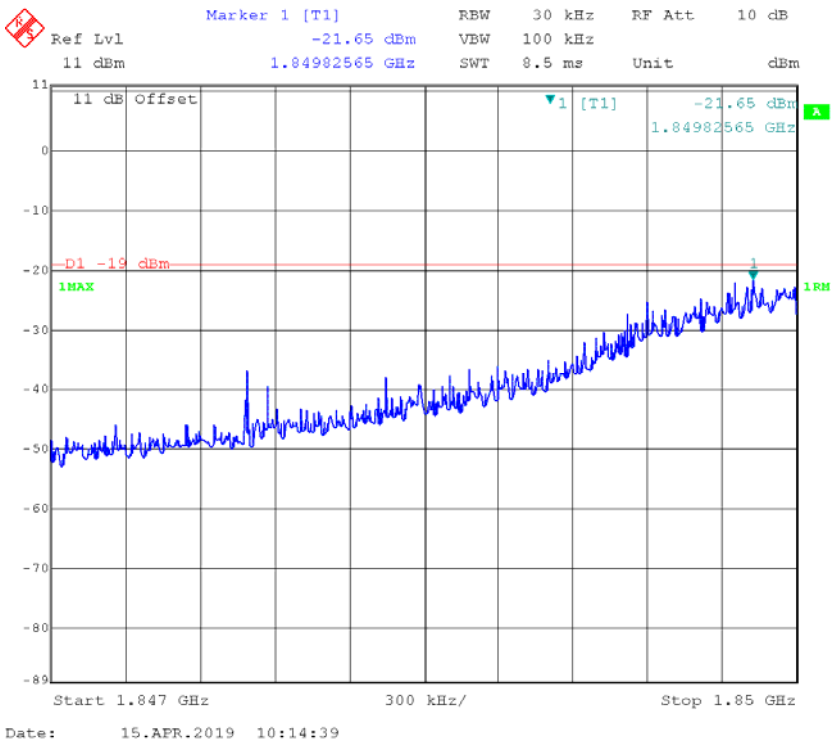


Uplink

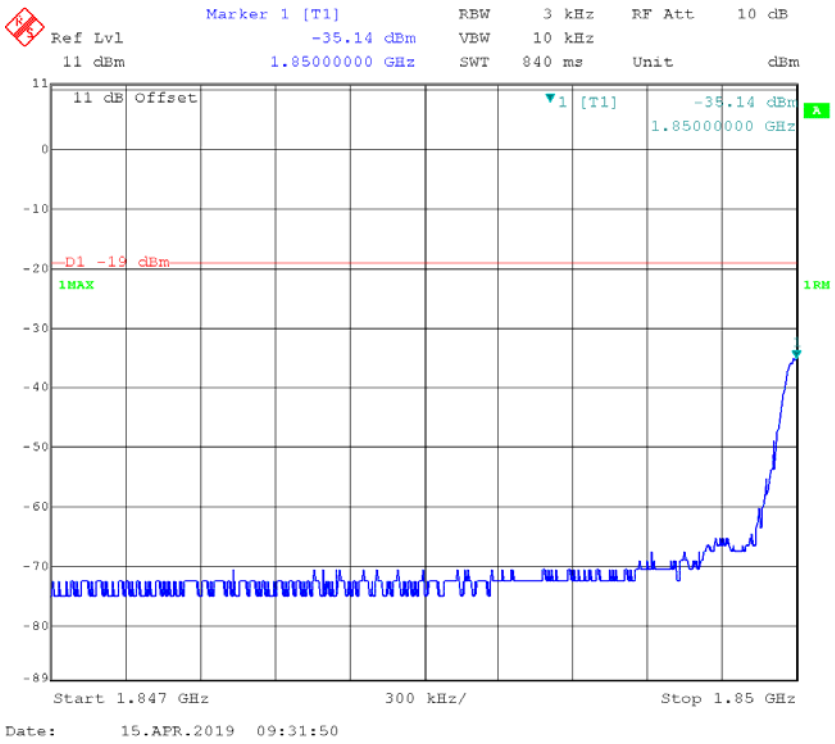
PCS Band CDMA Left Side 1851.25MHz Pre-AGC



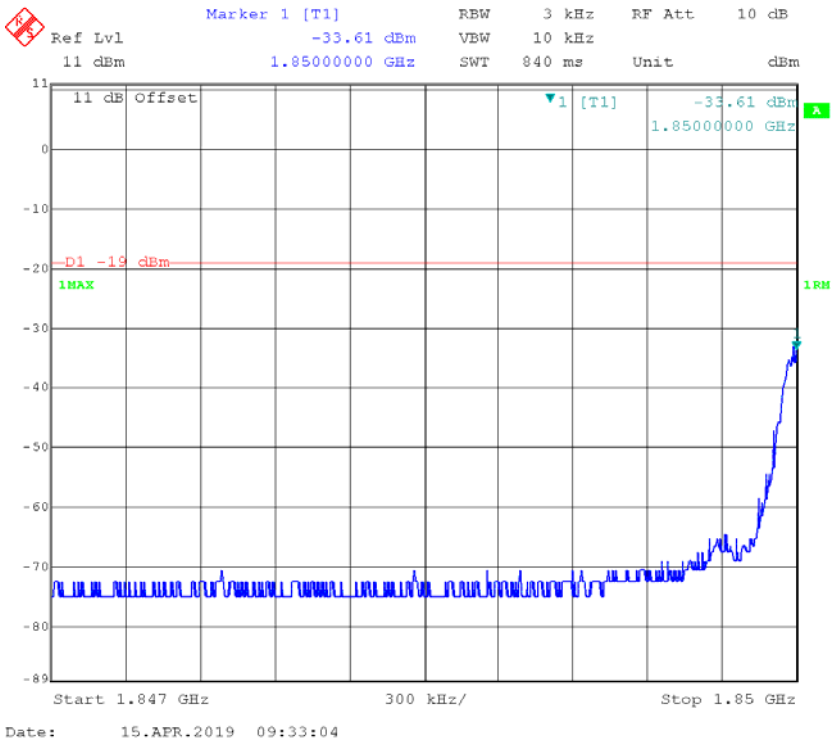
PCS Band CDMA Left Side 1851.25MHz Above AGC



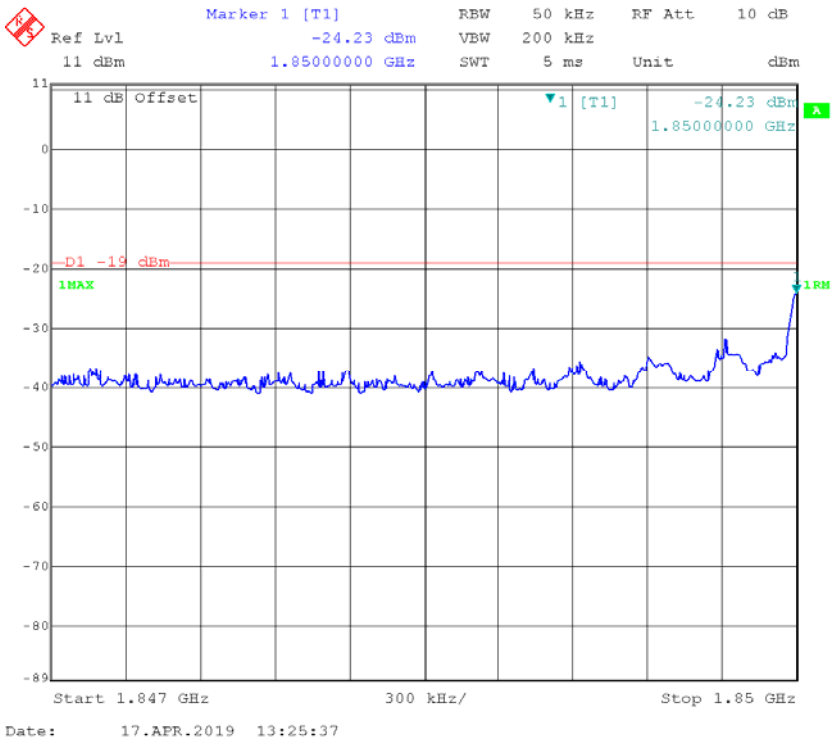
PCS Band GSM Left Side 1850.2MHz Pre-AGC



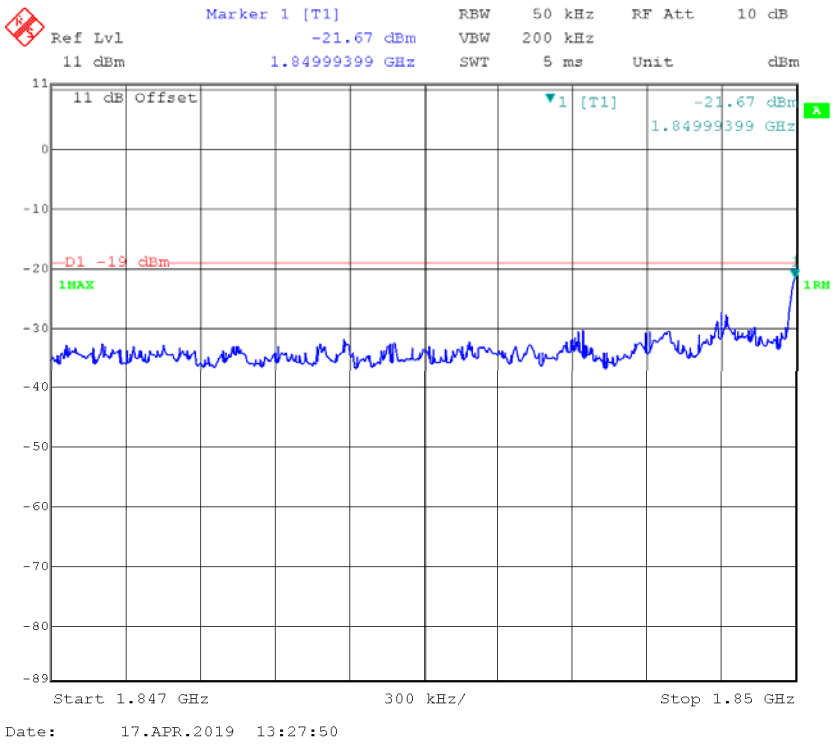
PCS Band GSM Left Side 1850.2MHz Above AGC



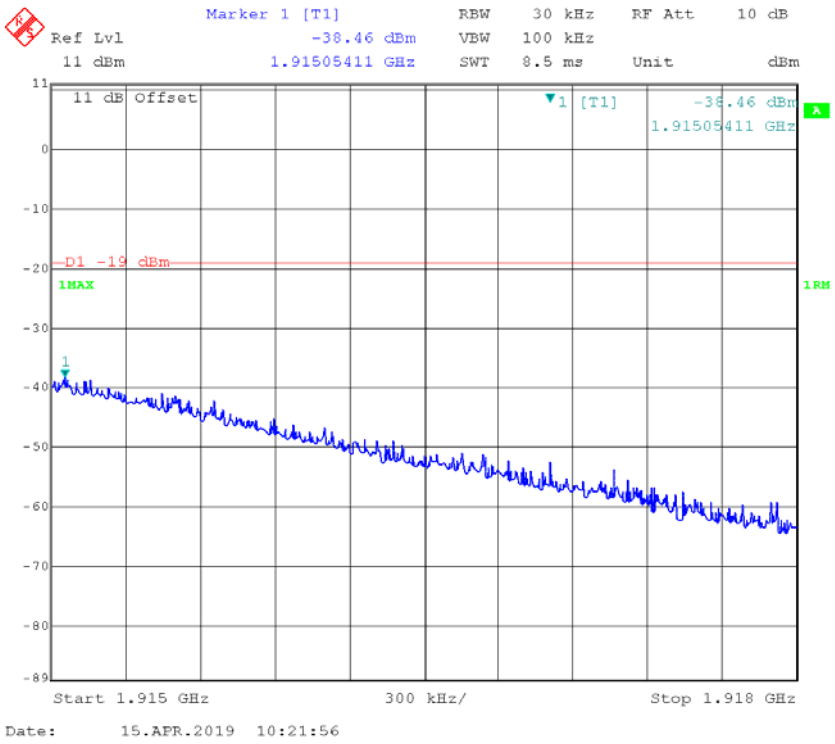
PCS Band LTE Left Side 1852.5MHz Pre-AGC



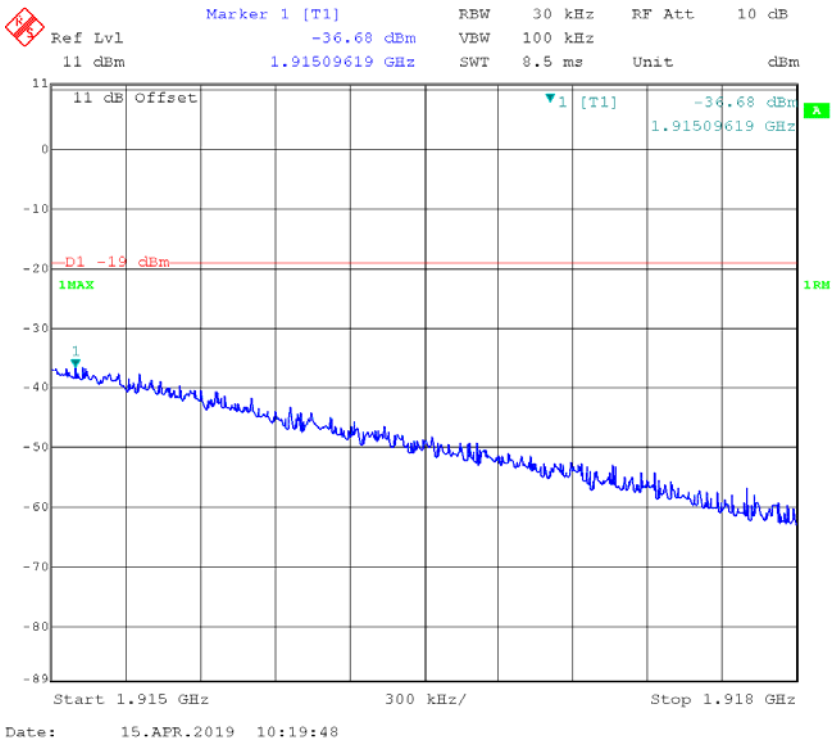
PCS Band LTE Left Side 1852.5MHz Above AGC



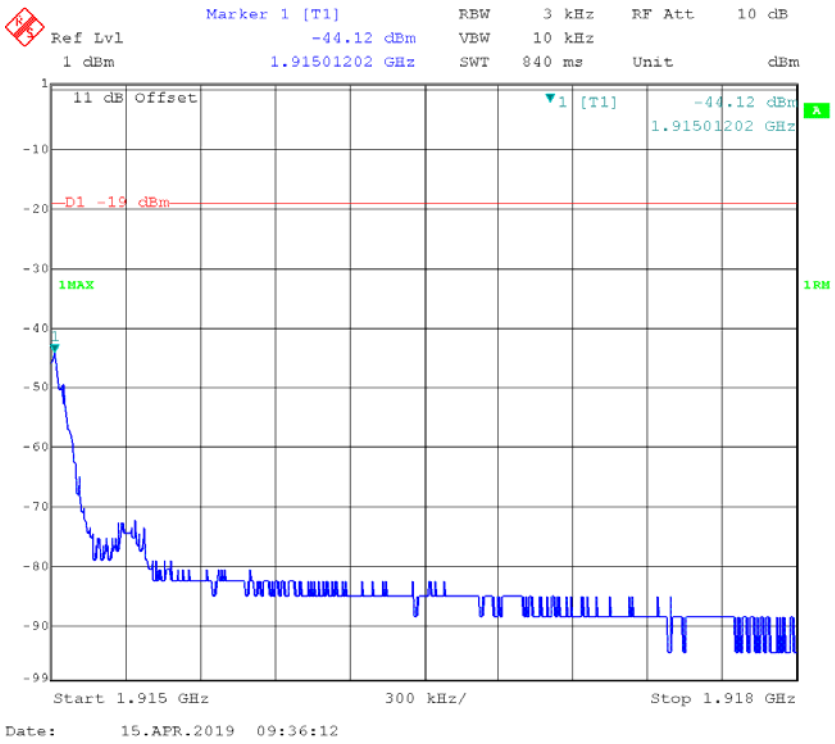
PCS Band CDMA Right Side 1913.75MHz Pre-AGC



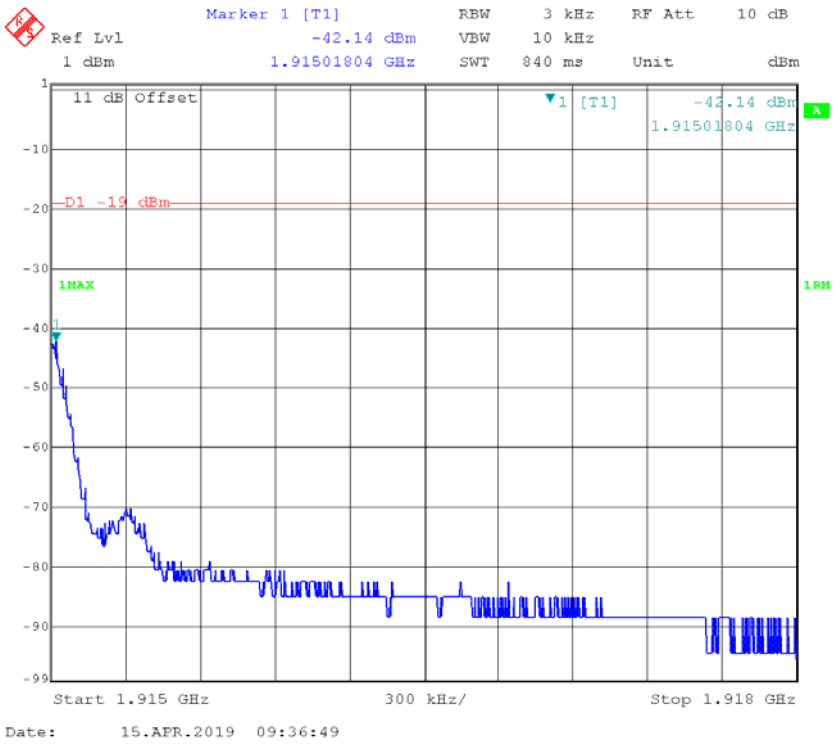
PCS Band CDMA Right Side 1913.75MHz Above AGC



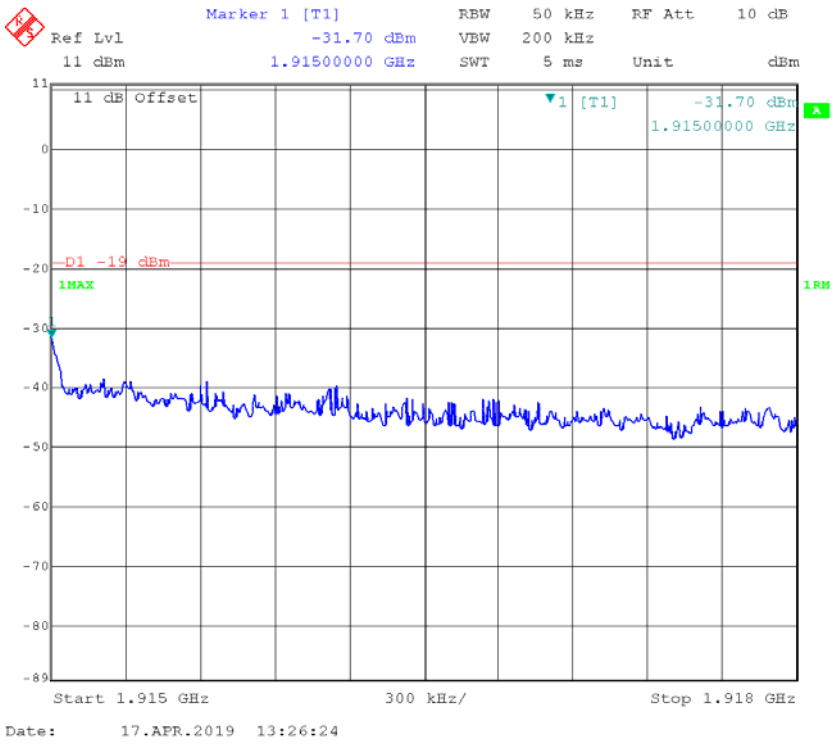
PCS Band GSM Right Side 1914.8MHz Pre-AGC



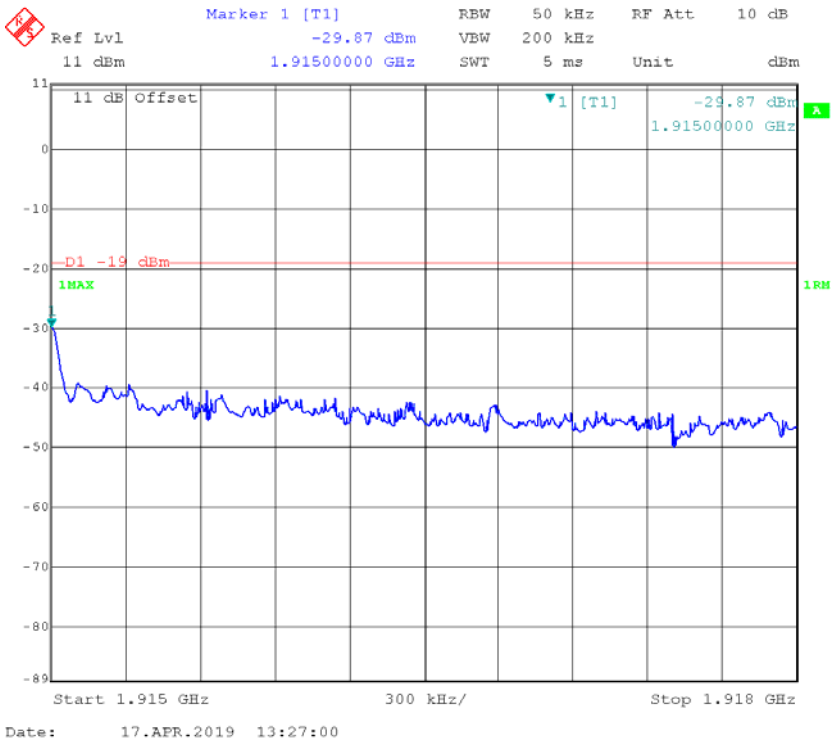
PCS Band GSM Right Side 1914.8MHz Above AGC



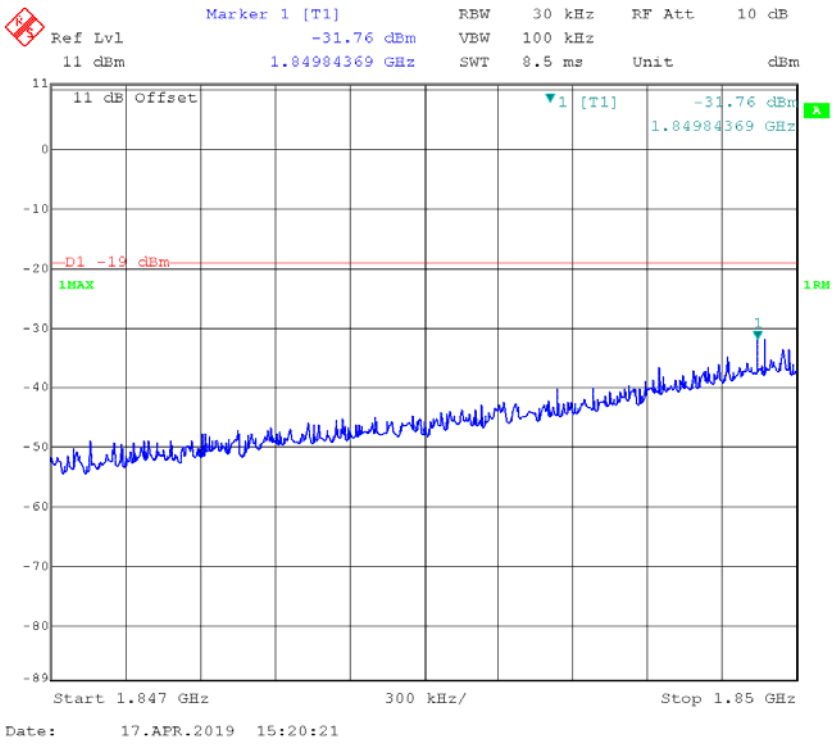
PCS Band LTE Right Side 1912.5MHz Pre-AGC



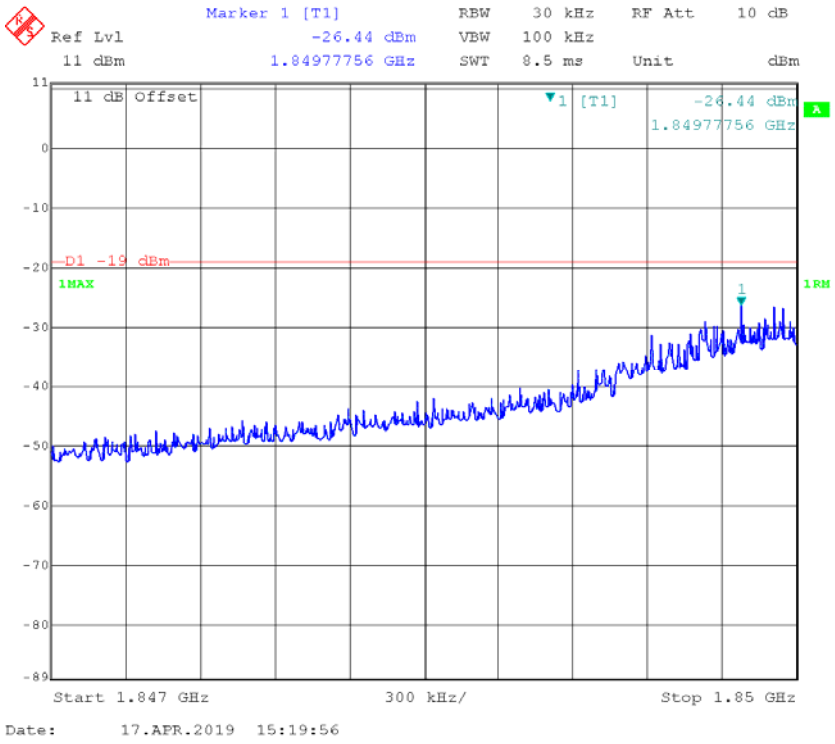
PCS Band LTE Right Side 1912.5MHz Above AGC



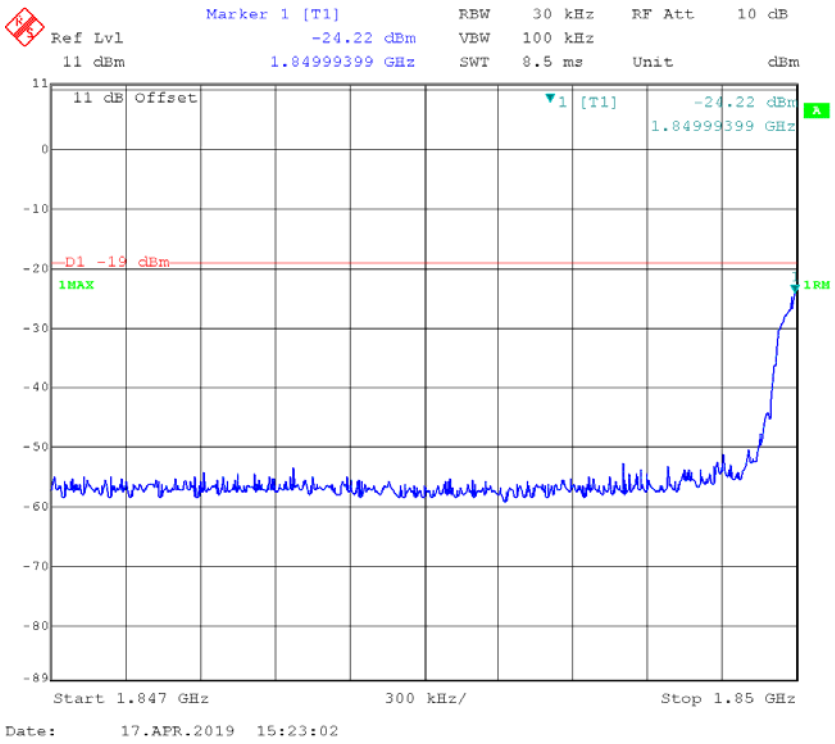
AWS Band CDMA Left Side 1711.25MHz Pre-AGC



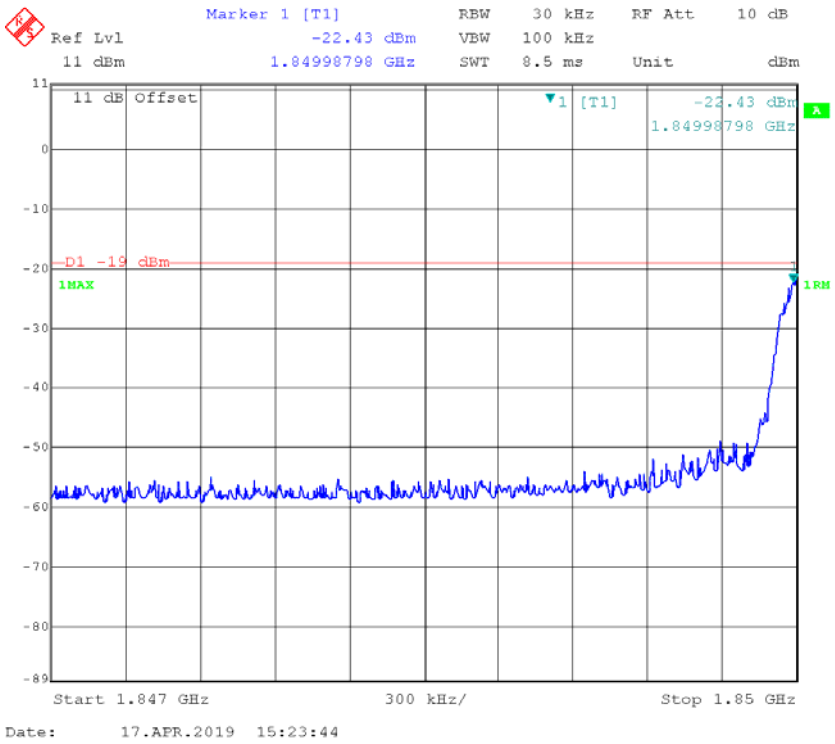
AWS Band CDMA Left Side 1711.25MHz Above AGC



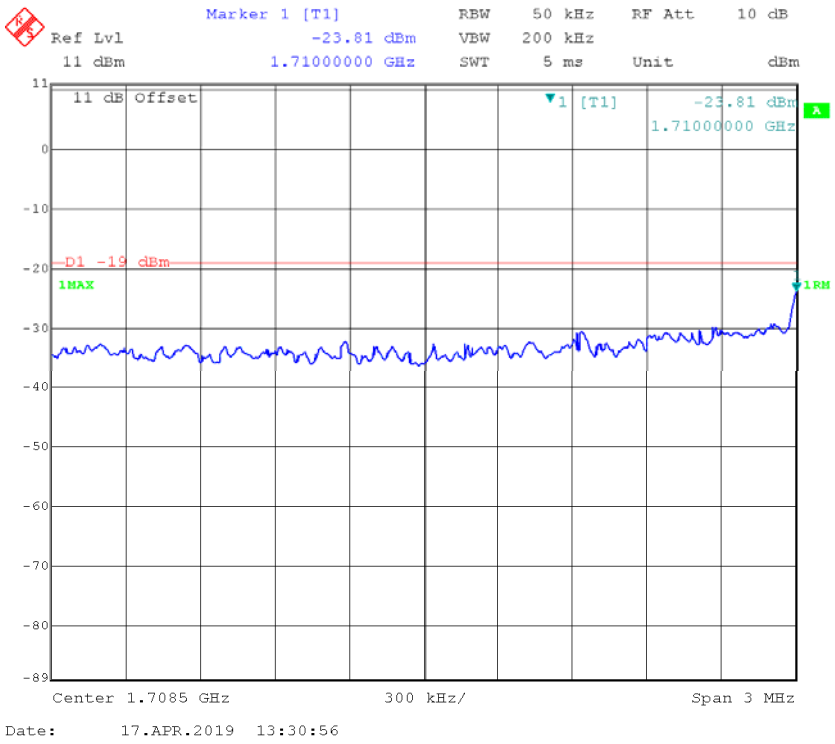
AWS Band GSM Left Side 1710.2MHz Pre-AGC



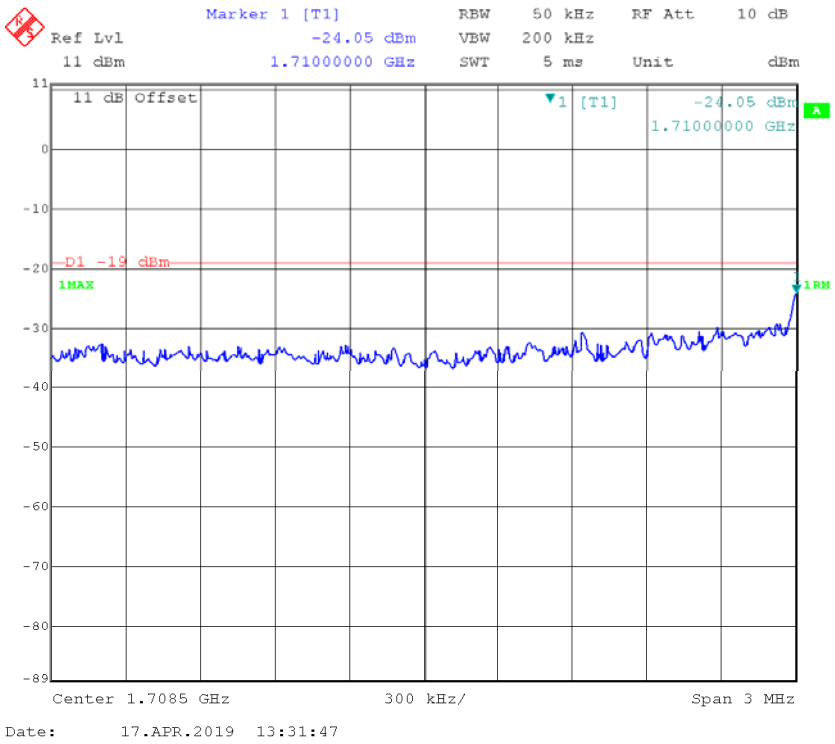
AWS Band GSM Left Side 1710.2MHz Above AGC



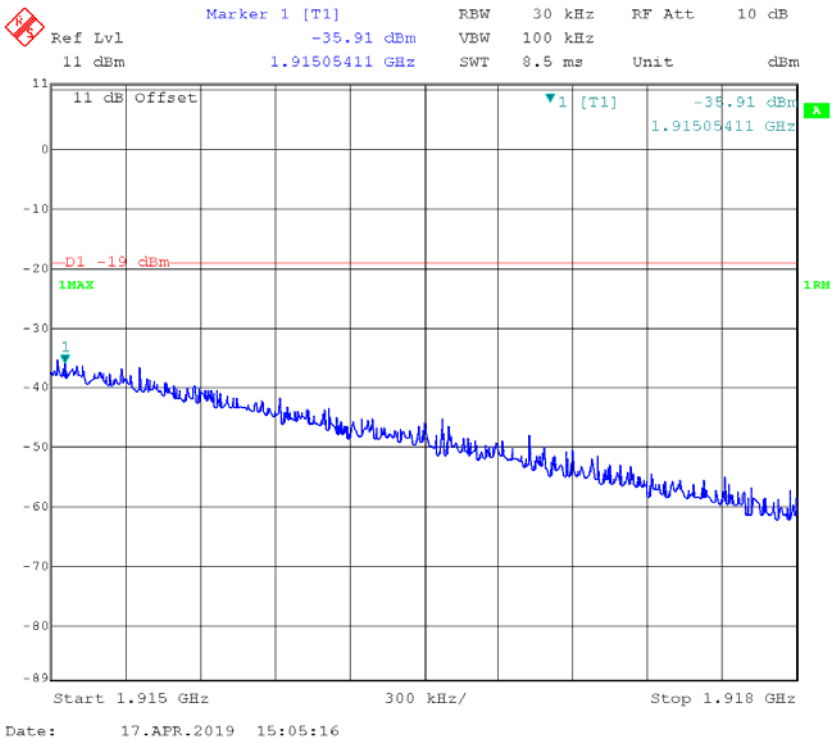
AWS Band LTE Left Side 1712.5MHz Pre-AGC



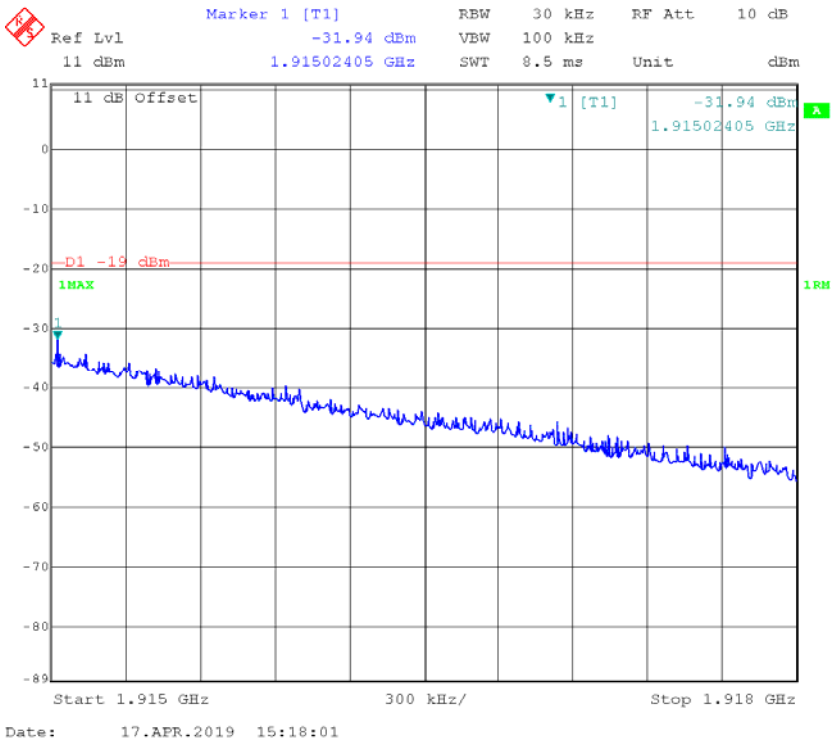
AWS Band LTE Left Side 1712.5MHz Above AGC



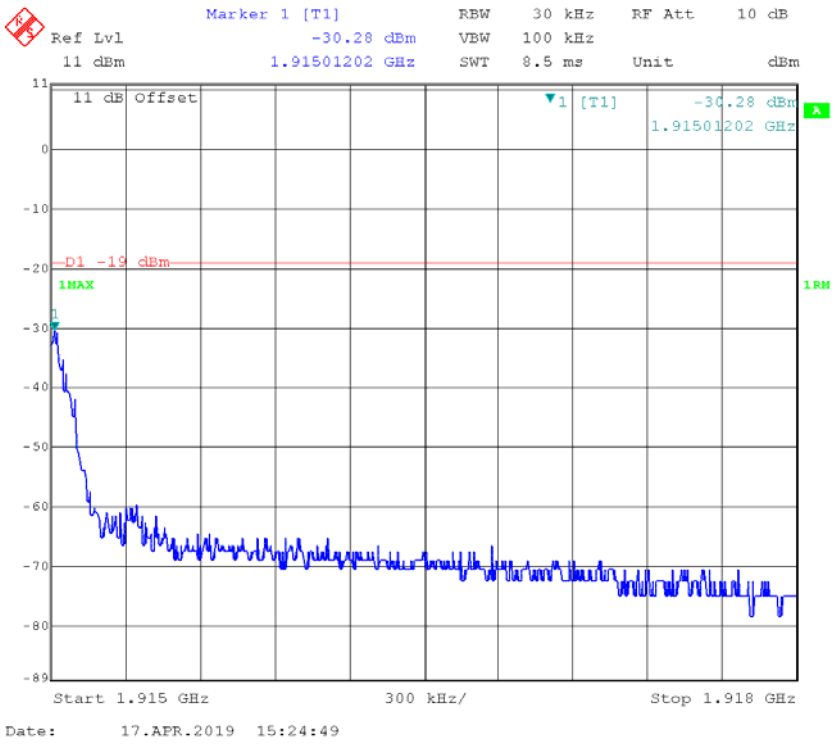
AWS Band CDMA Right Side 1753.75MHz Pre-AGC



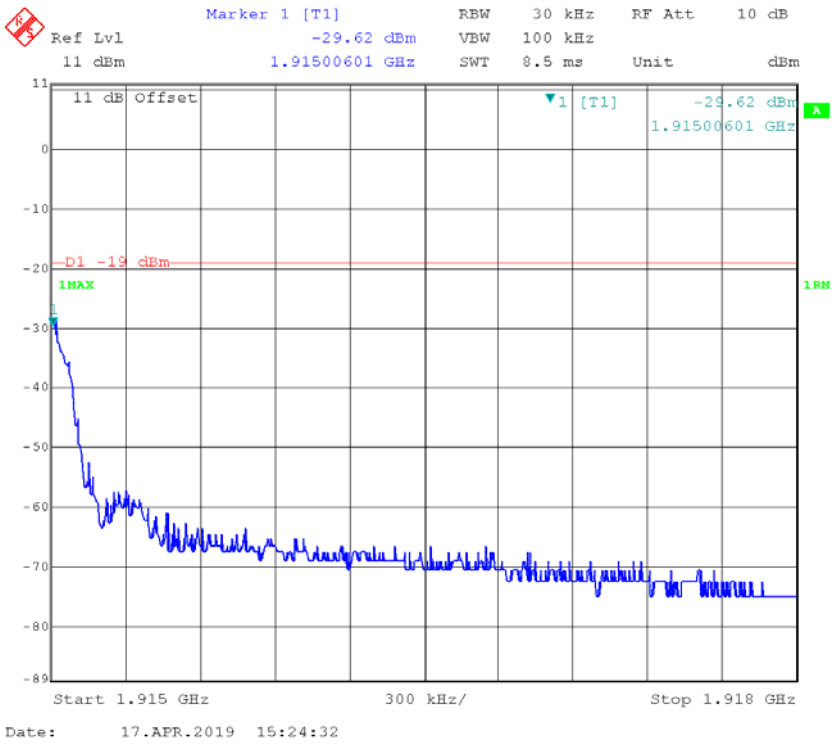
AWS Band CDMA Right Side 1753.75MHz Above AGC



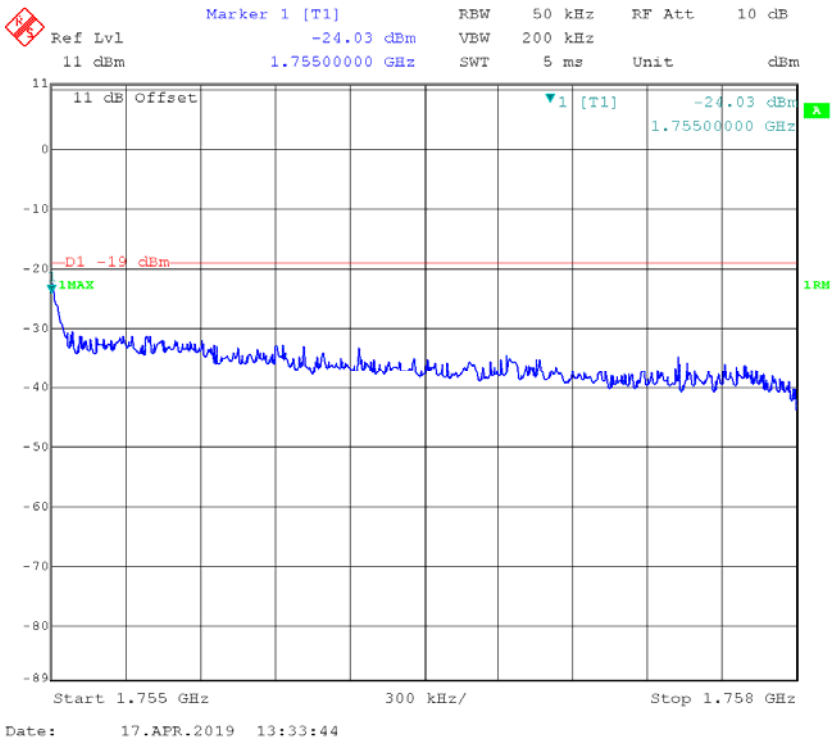
AWS Band GSM Right Side 1754.8MHz Pre-AGC



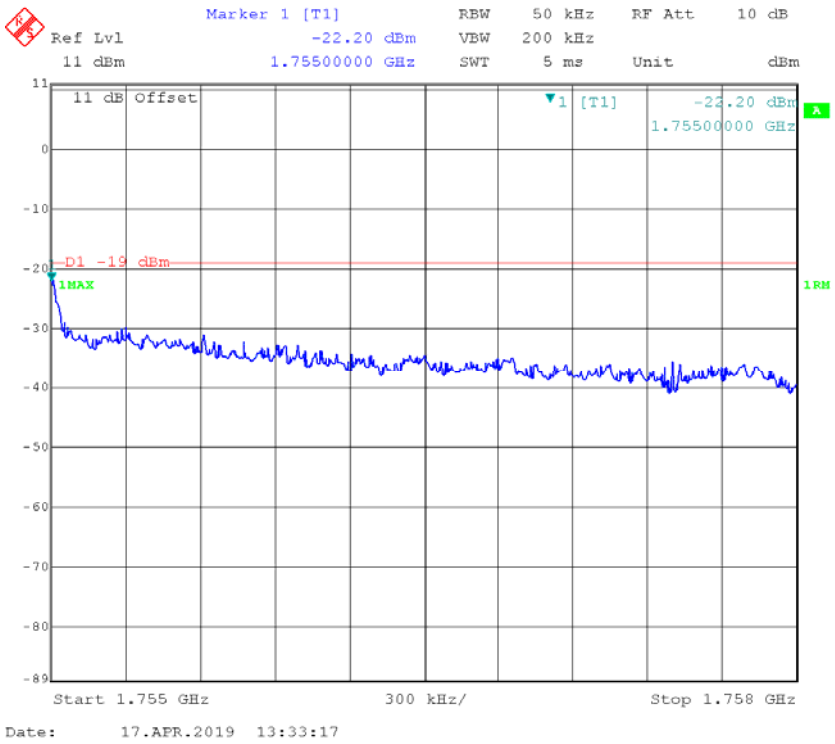
AWS Band GSM Right Side 1754.8MHz Above AGC



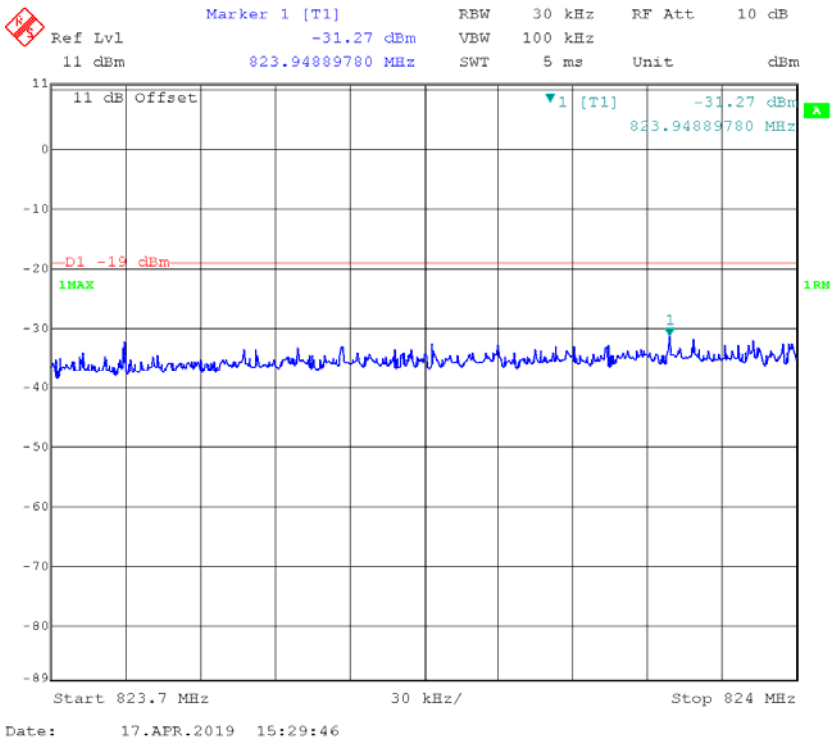
AWS Band LTE Right Side 1752.5MHz Pre-AGC



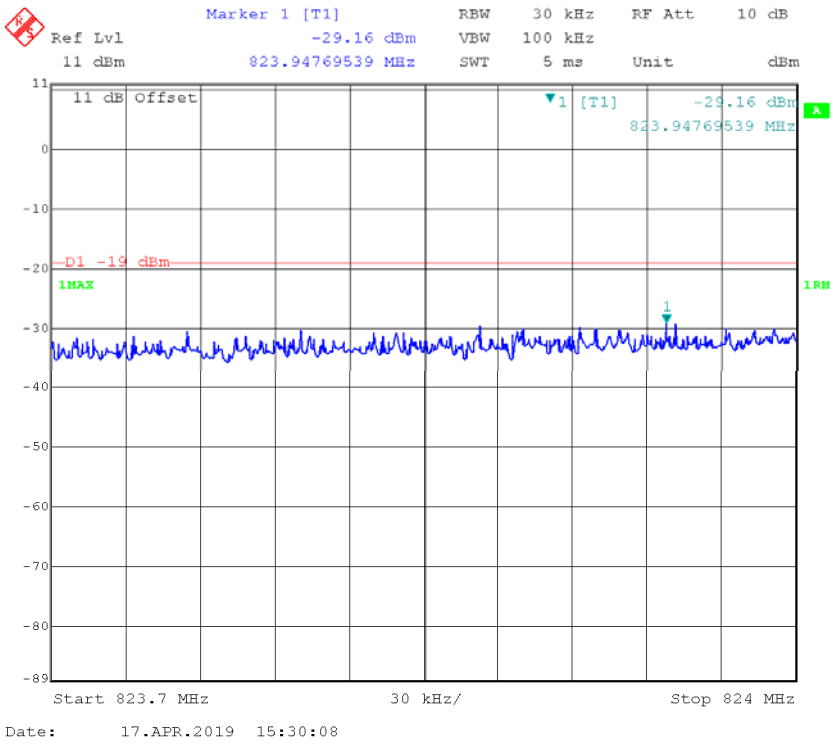
AWS Band LTE Right Side 1752.5MHz Above AGC



Cellular Band CDMA Left Side 824.88MHz Pre-AGC



Cellular Band CDMA Left Side 824.88MHz Above AGC



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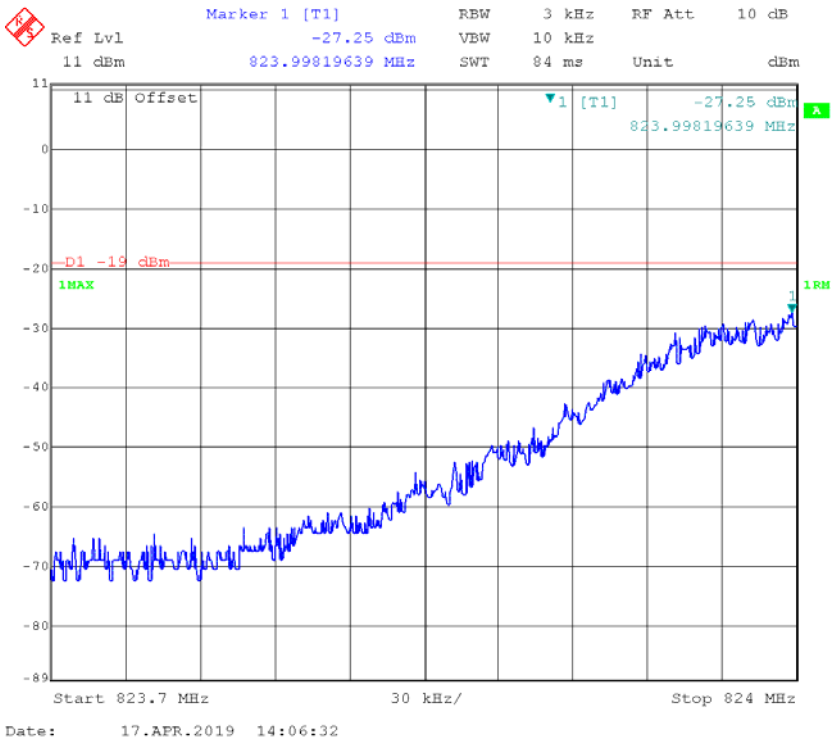
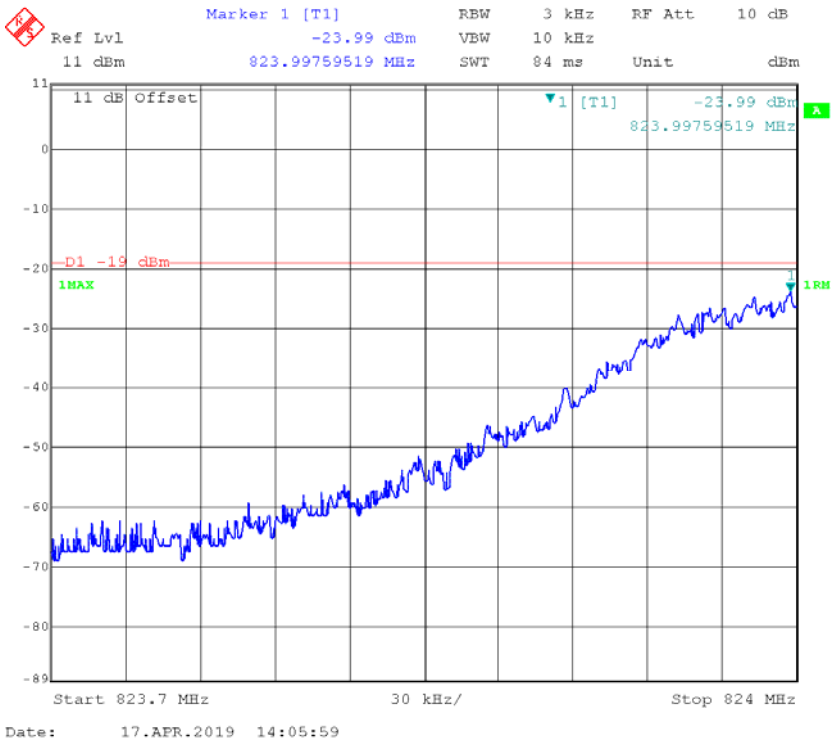
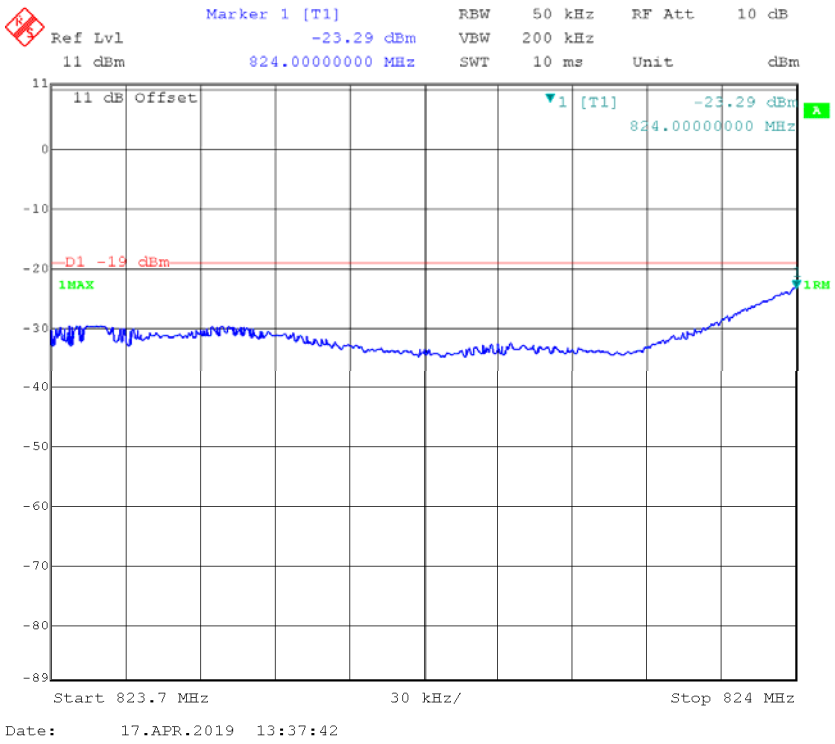


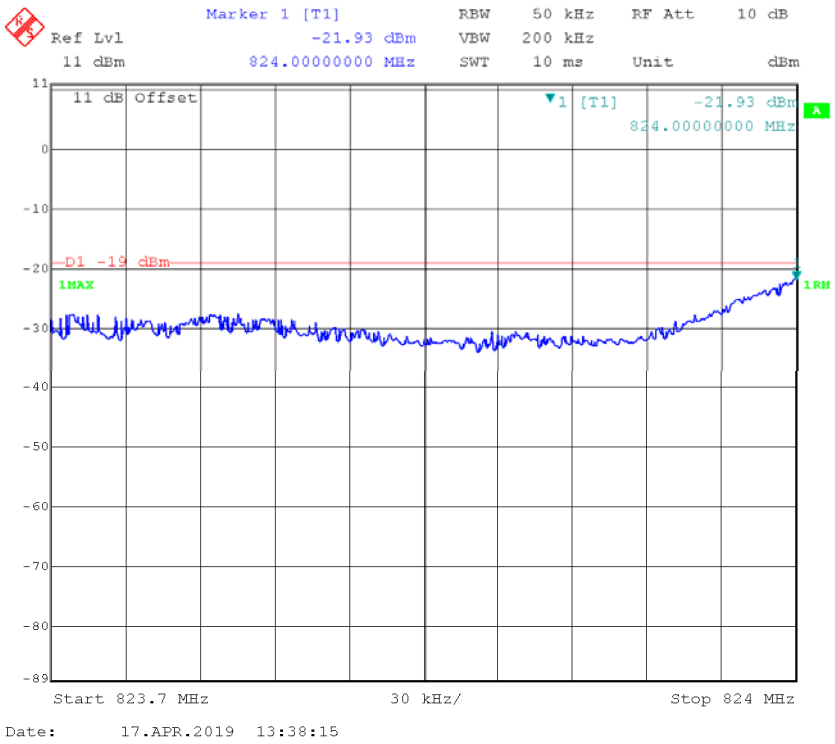
Cellular Band GSM Left Side 824.2MHz Above AGC



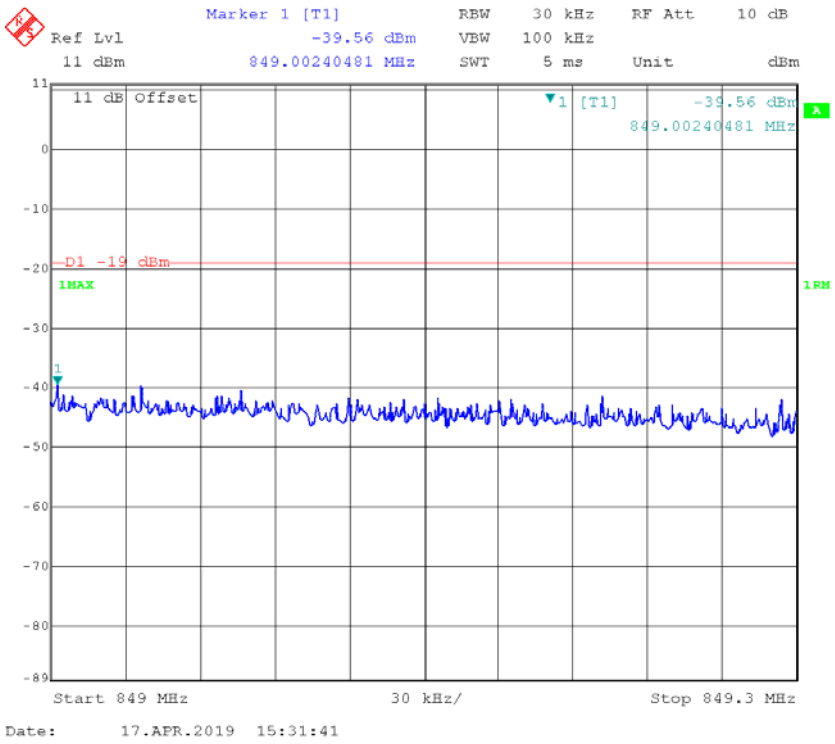
Cellular Band LTE Left Side 826.5MHz Pre-AGC



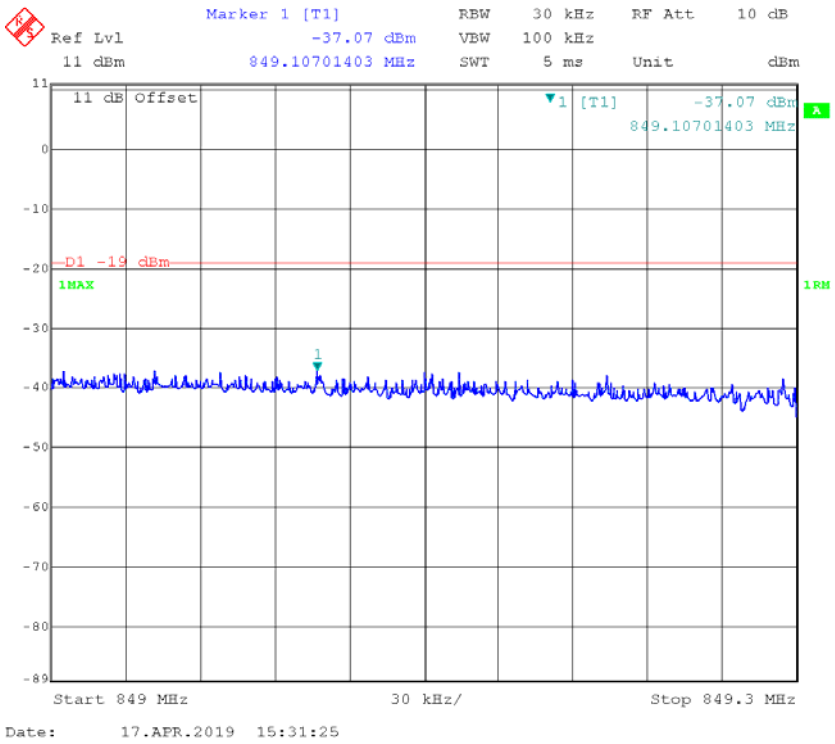
Cellular Band LTE Left Side 826.5MHz Above AGC



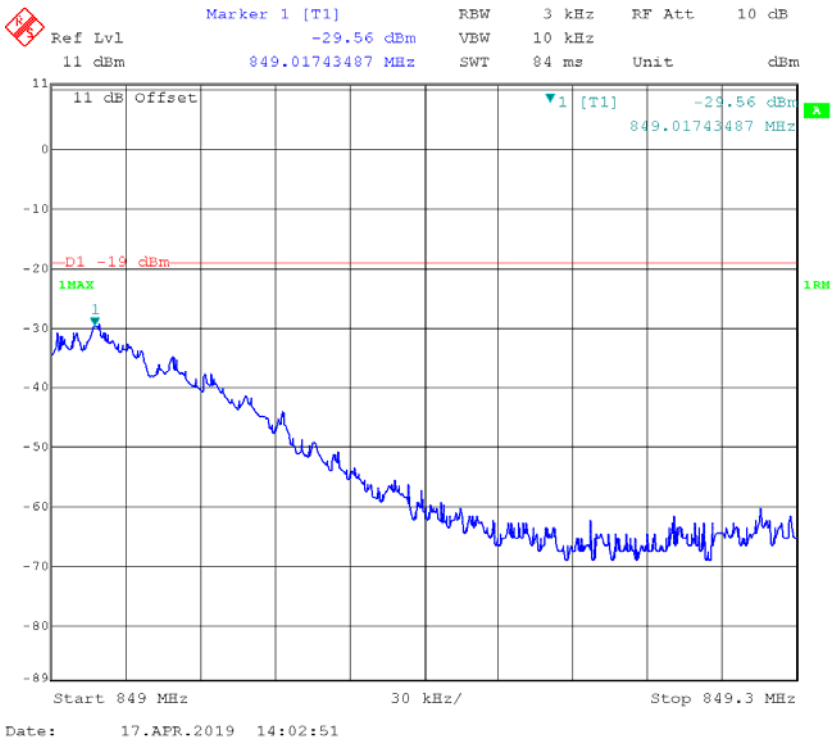
Cellular Band CDMA Right Side 848.10MHz Pre-AGC



Cellular Band CDMA Right Side 848.10MHz Above AGC

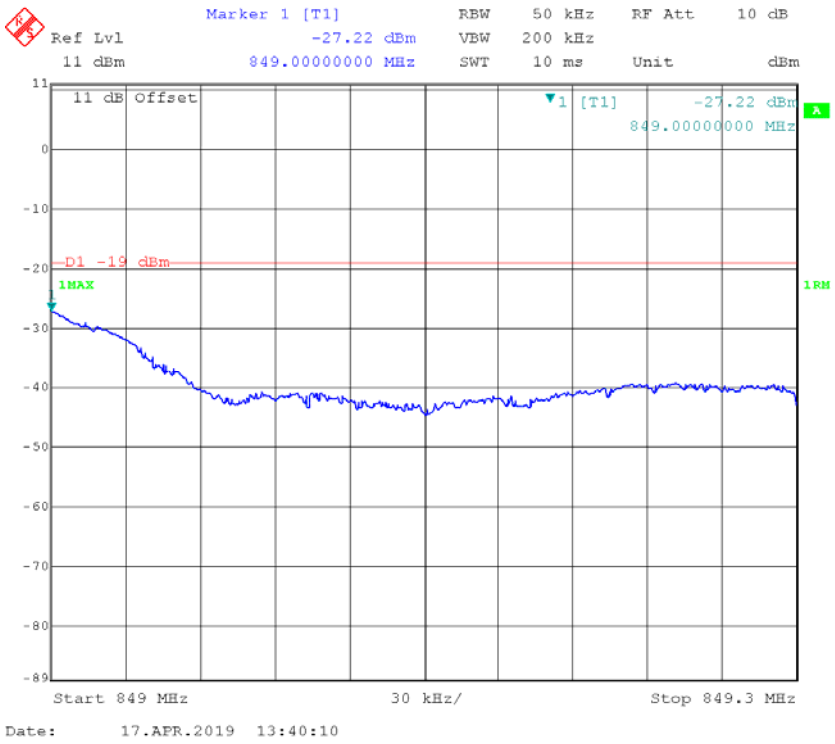


Cellular Band GSM Right Side 848.8MHz Pre-AGC

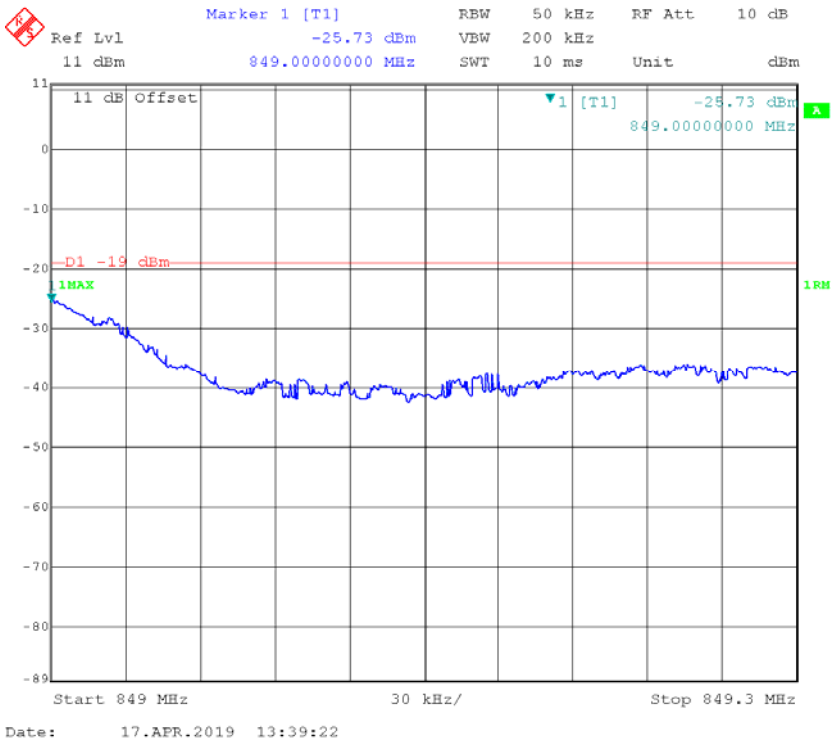


Cellular Band GSM Right Side 848.8MHz Above AGC

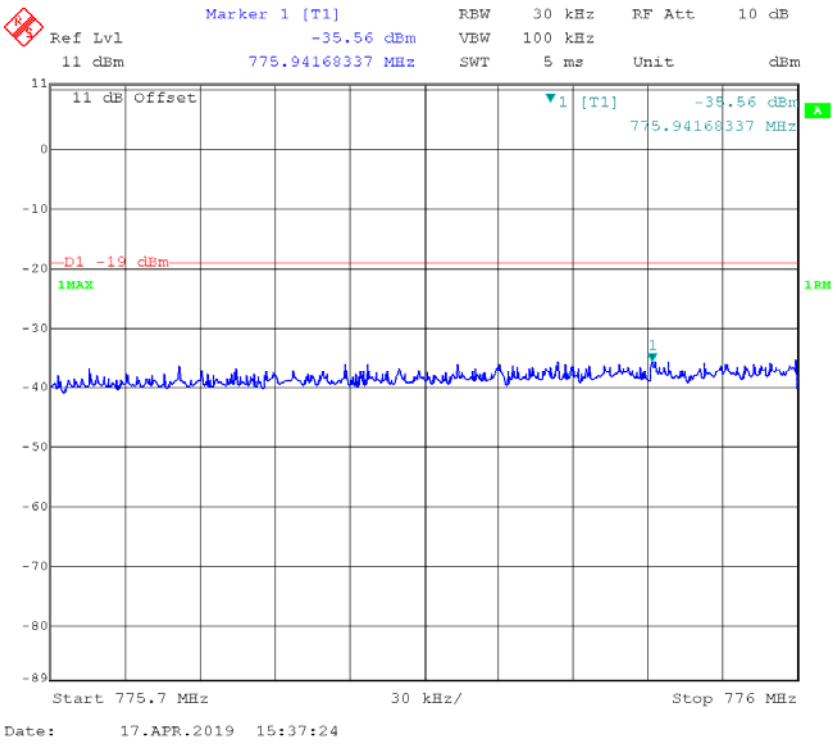
Cellular Band LTE Right Side 846.5MHz Pre-AGC



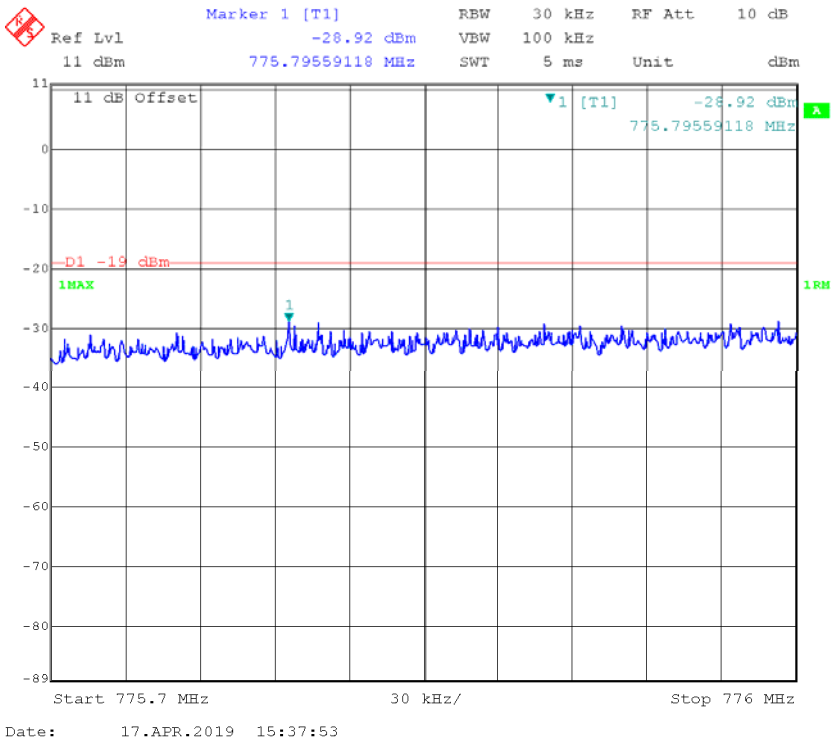
Cellular Band LTE Right Side 846.5MHz Above AGC



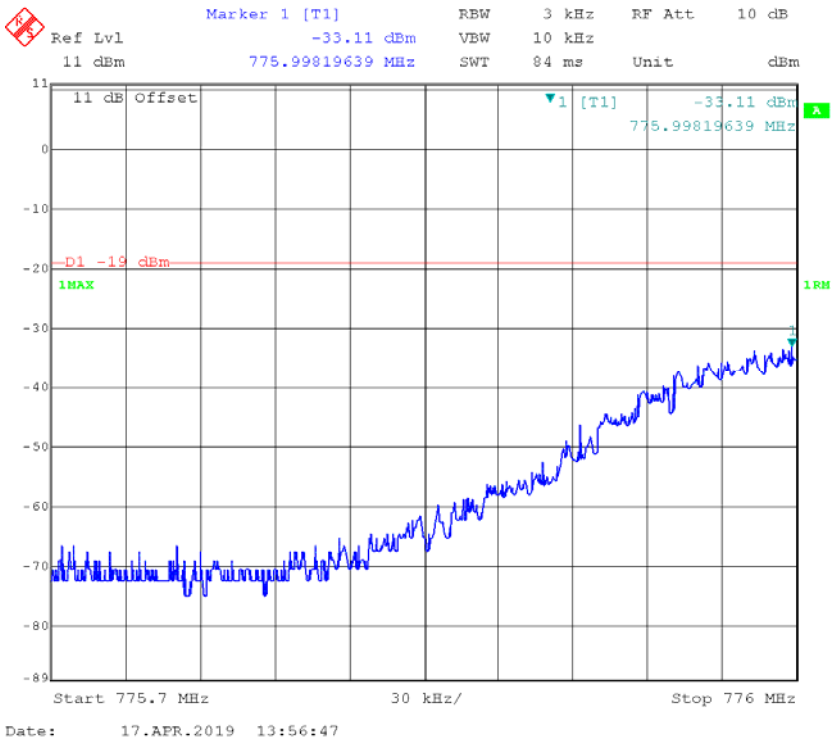
Upper 700MHz Band CDMA Left Side 777.25MHz Pre-AGC



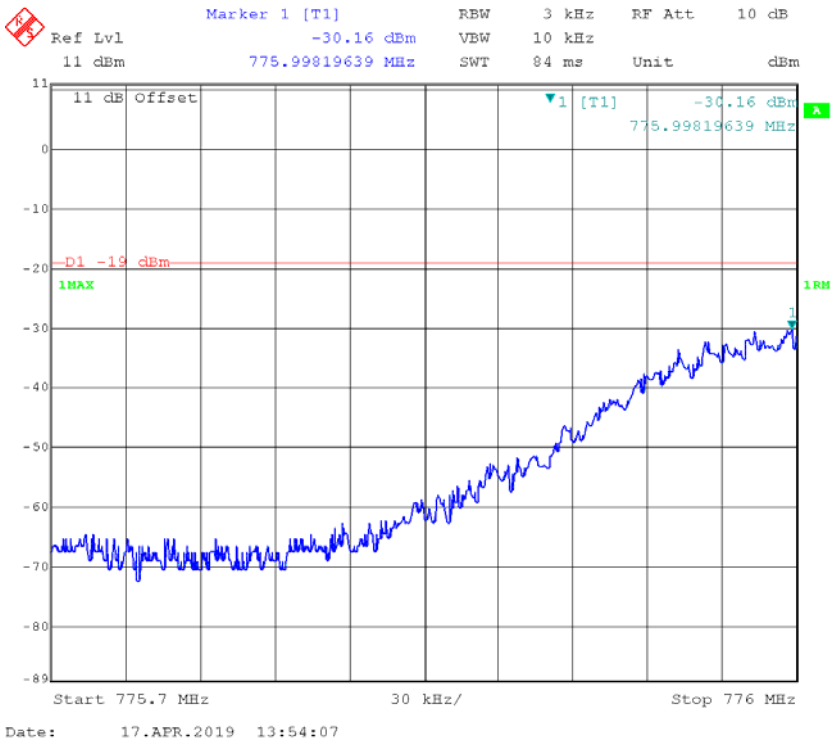
Upper 700MHz Band CDMA Left Side 777.25MHz Above AGC



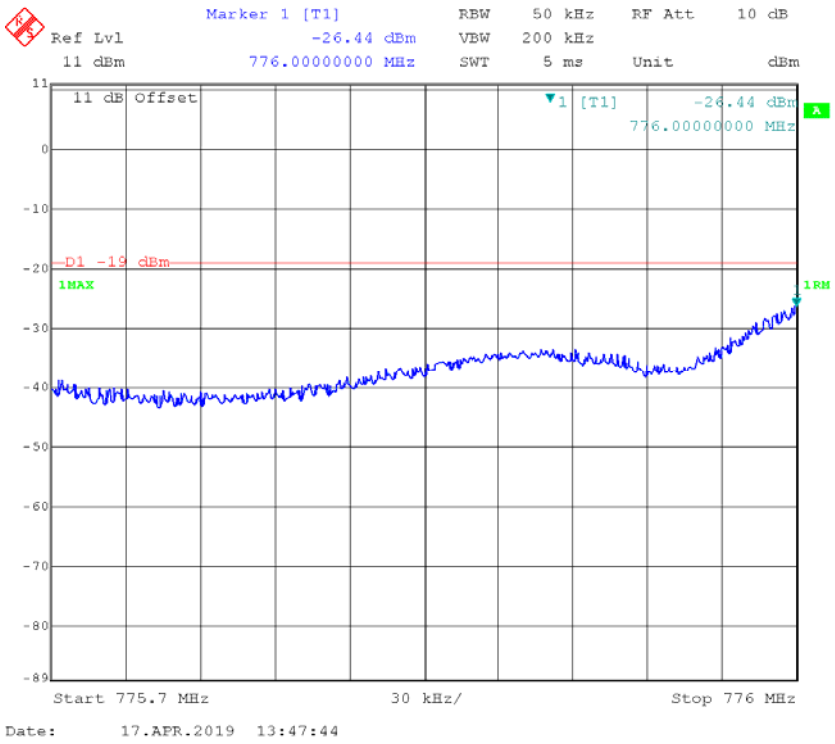
Upper 700MHz Band GSM Left Side 776.2MHz Pre-AGC



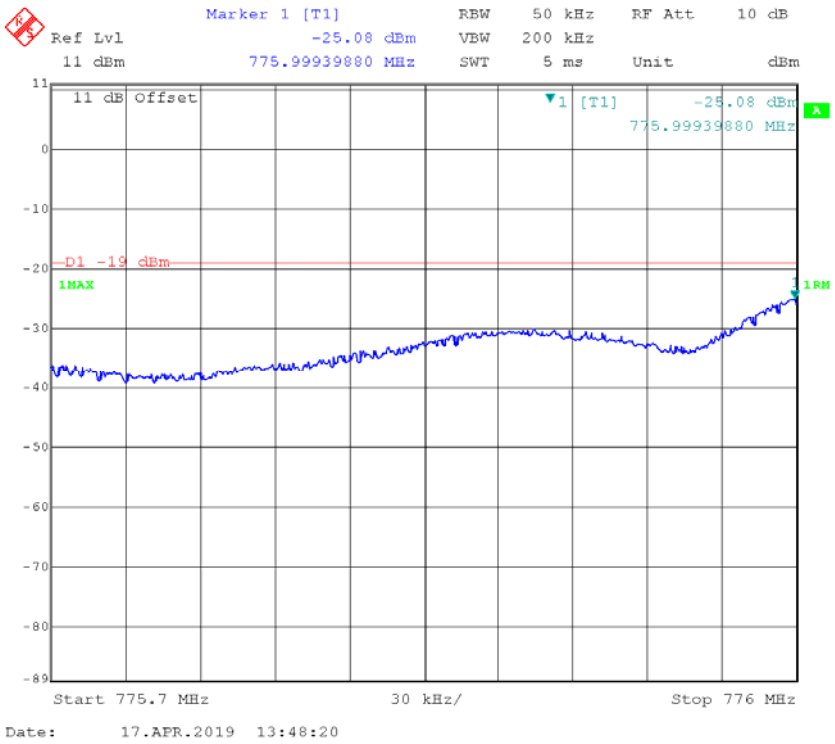
Upper 700MHz Band GSM Left Side 776.2MHz Above AGC



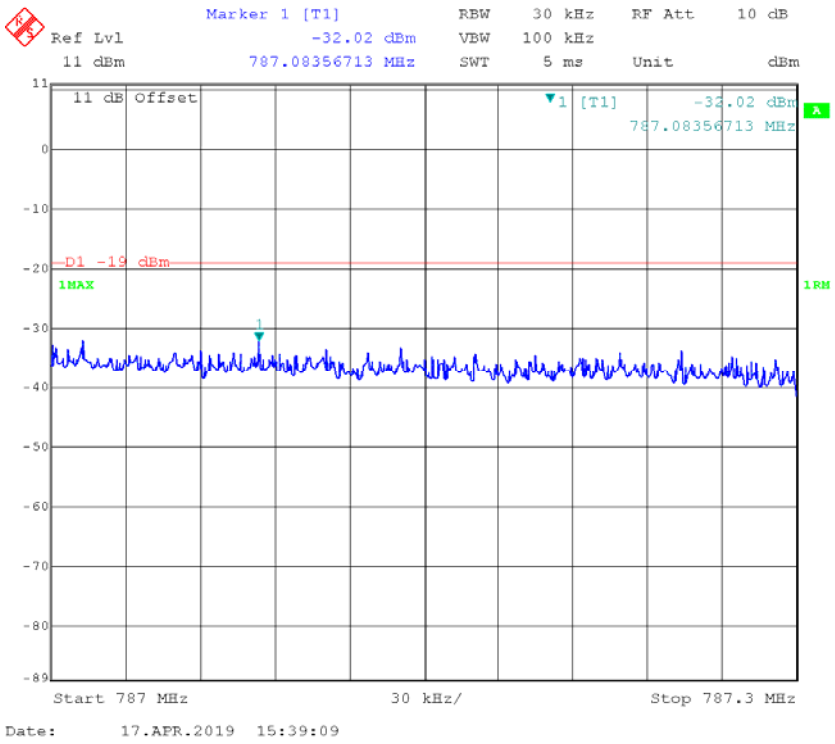
Upper 700MHz Band LTE Left Side 778.5MHz Pre-AGC



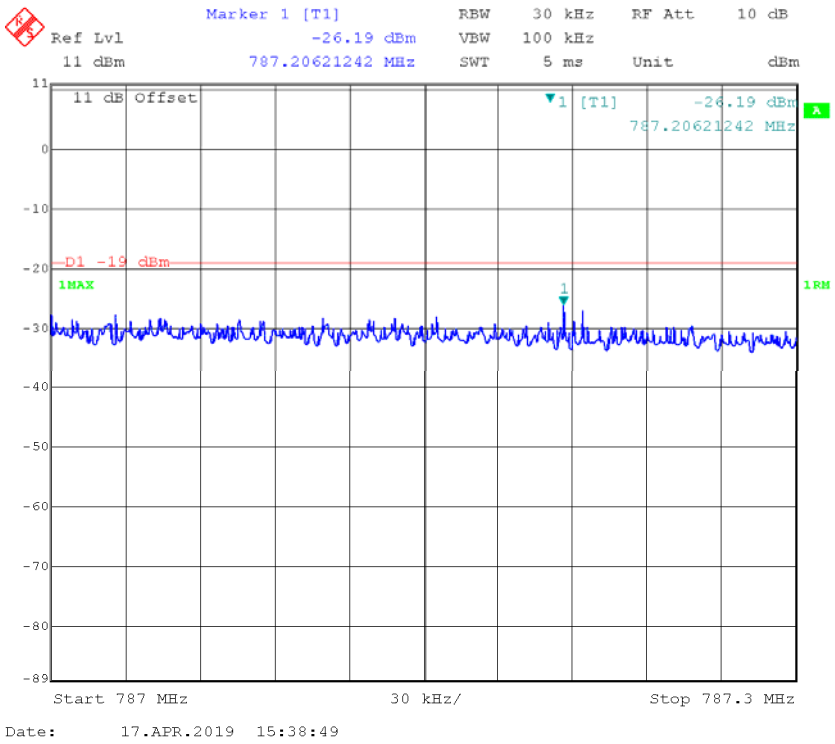
Upper 700MHz Band LTE Left Side 778.5MHz Above AGC



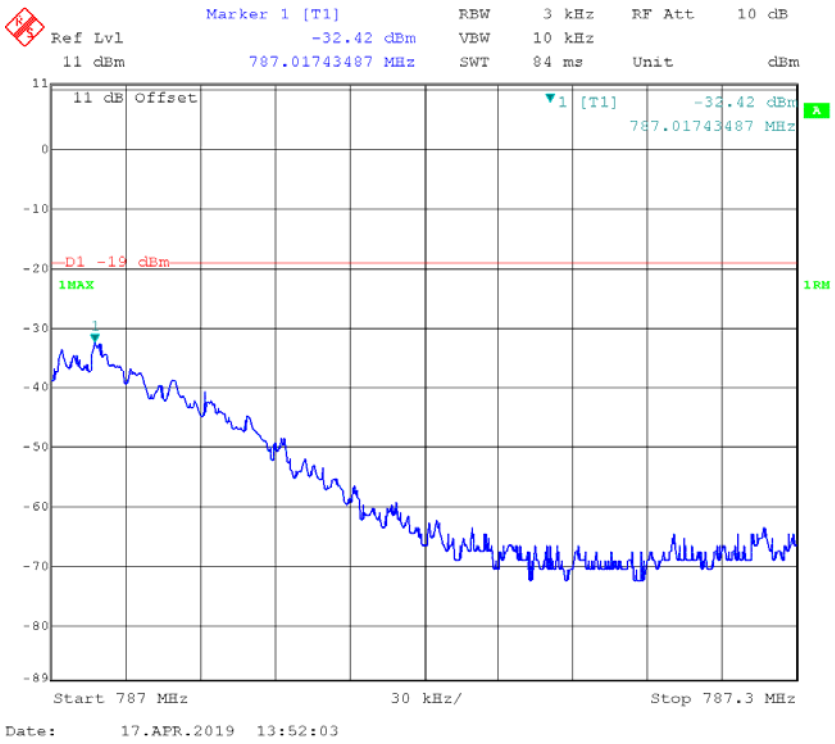
Upper 700MHz Band CDMA Right Side 785.75MHz Pre-AGC



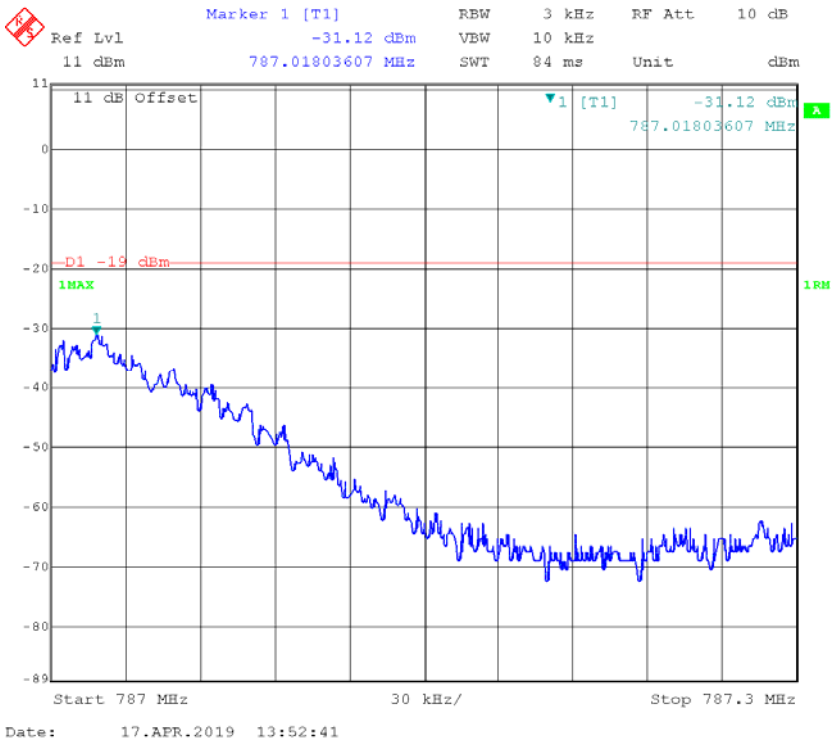
Upper 700MHz Band CDMA Right Side 785.75MHz Above AGC



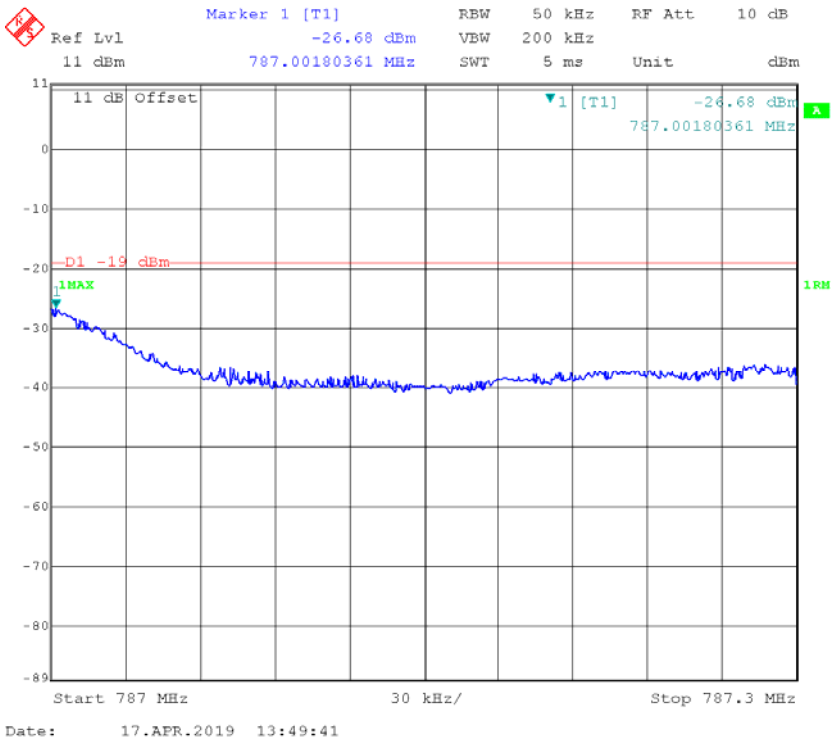
Upper 700MHz Band GSM Right Side 786.8MHz Pre-AGC



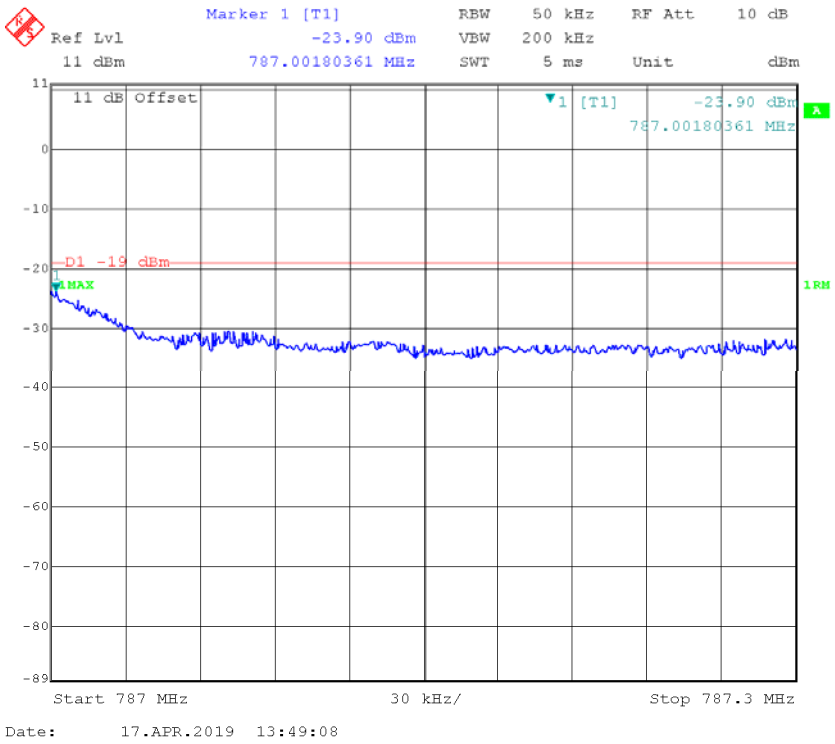
Upper 700MHz Band GSM Right Side 786.8MHz Above AGC



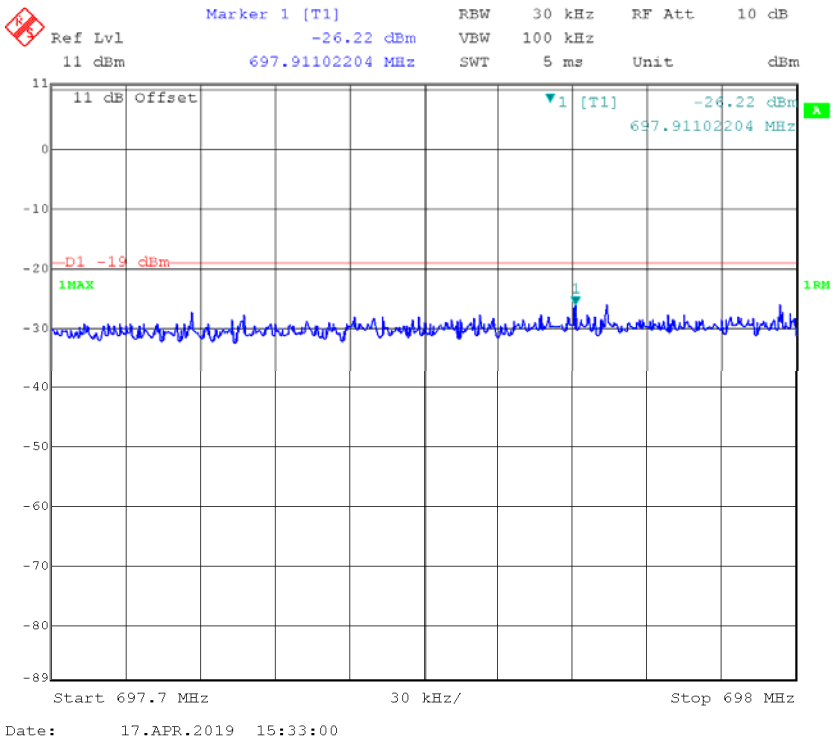
Upper 700MHz Band LTE Right Side 784.5MHz Pre-AGC



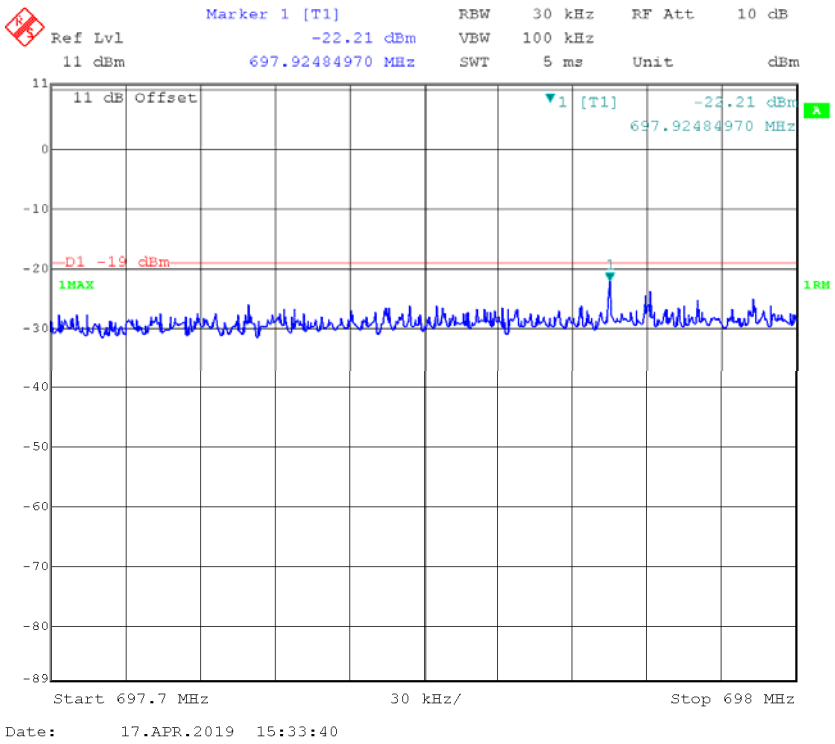
Upper 700MHz Band LTE Right Side 784.5MHz Above AGC



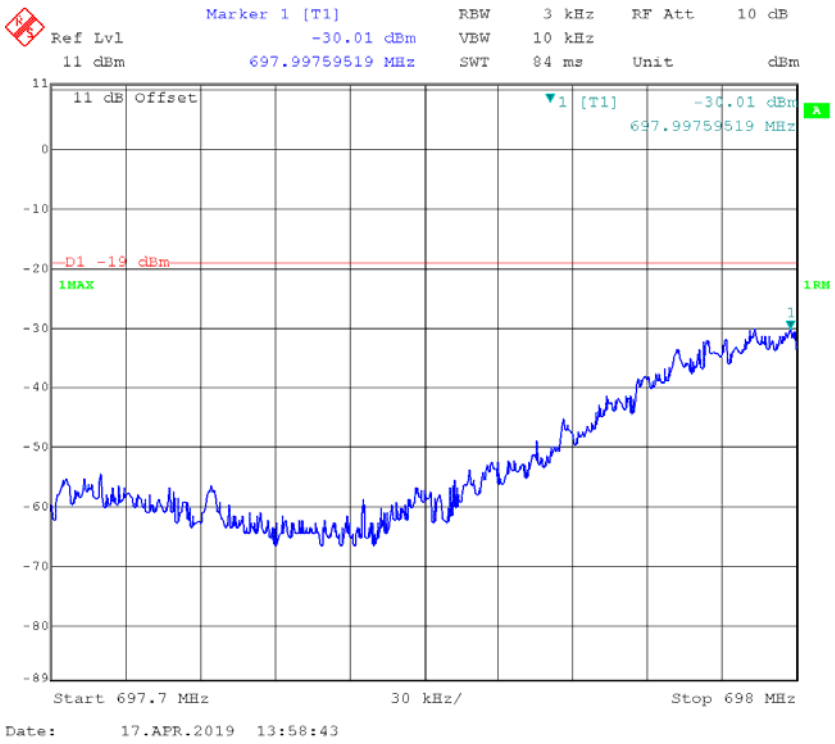
Lower700MHz Band CDMA Left Side 699.25MHz Pre-AGC



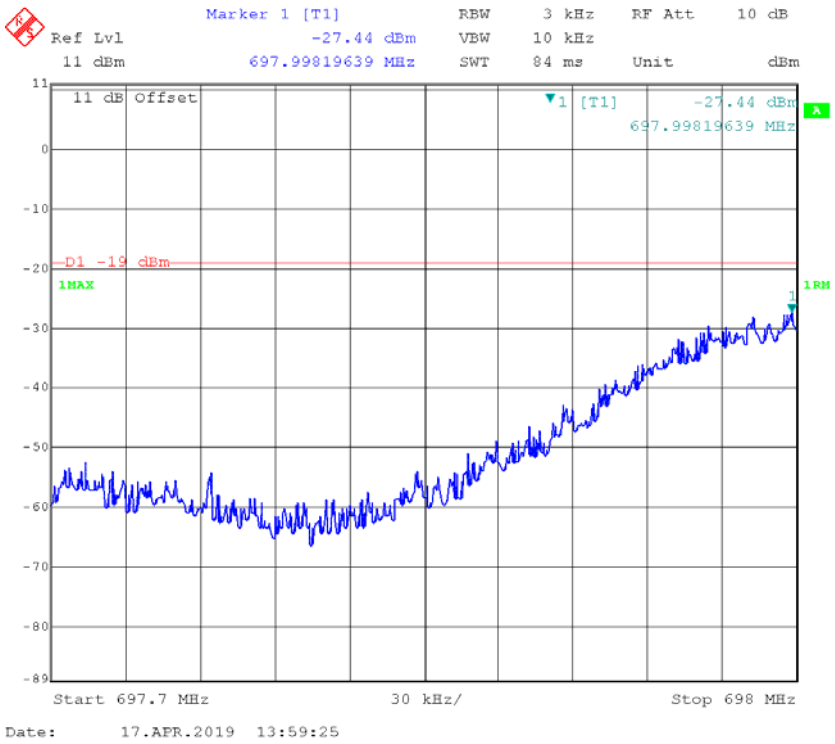
Lower 700MHz Band CDMA Left Side 699.25MHz Above AGC



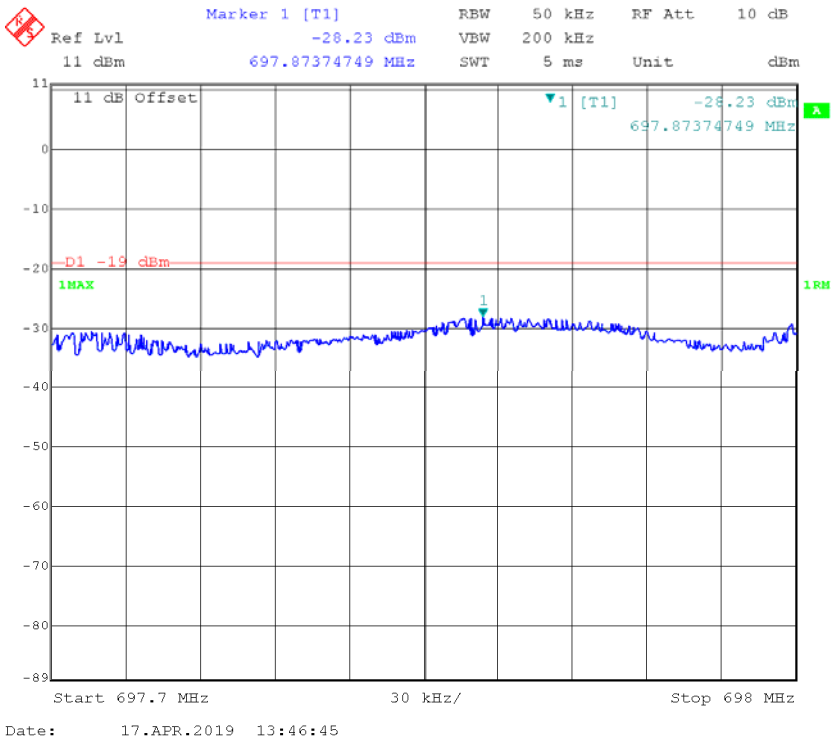
Lower 700MHz Band GSM Left Side 698.2MHz Pre-AGC



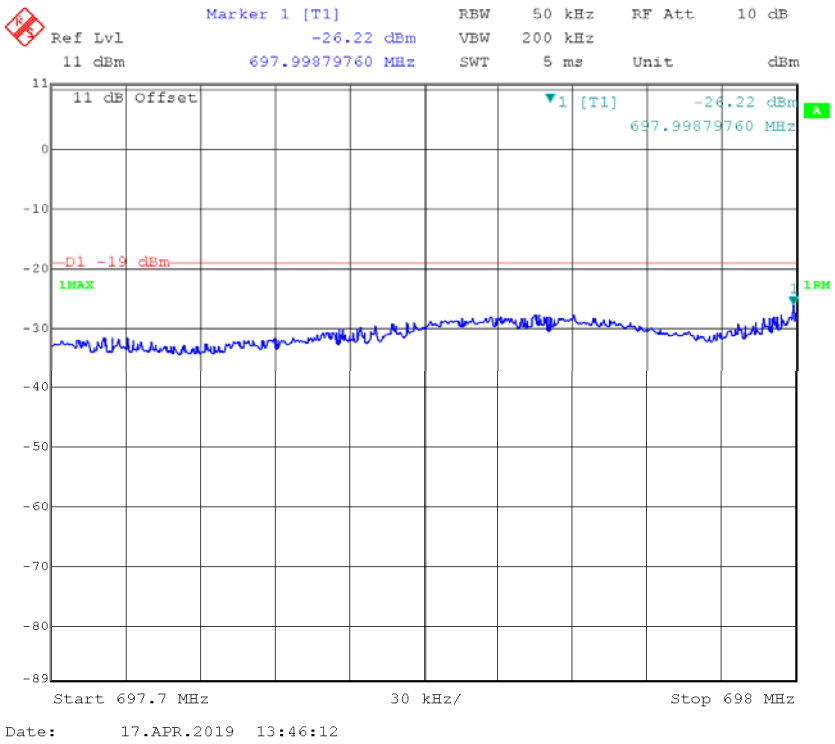
Lower 700MHz Band GSM Left Side 698.2MHz Above AGC



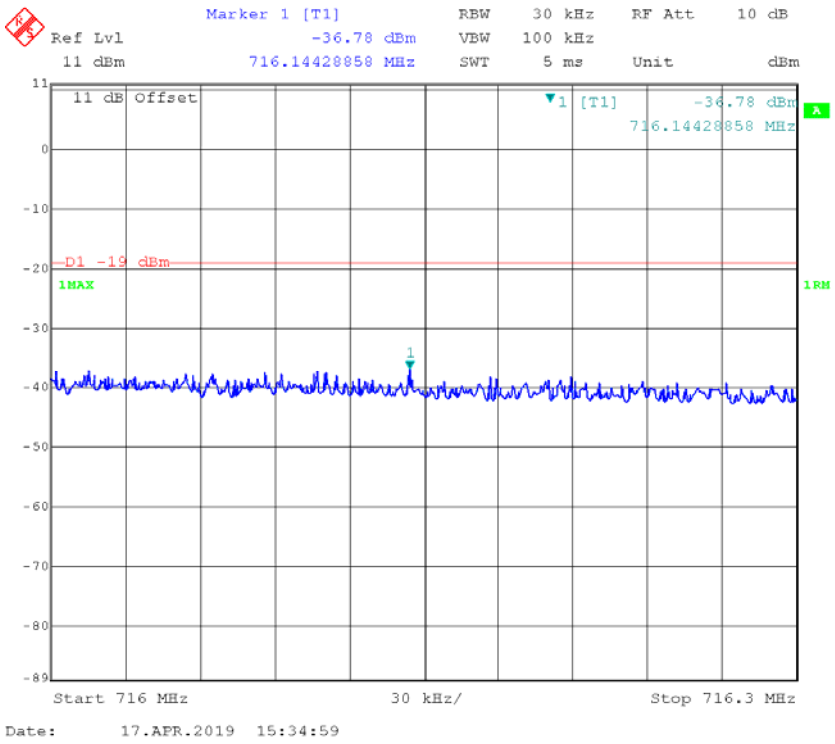
Lower 700MHz Band LTE Left Side 670.5MHz Pre-AGC



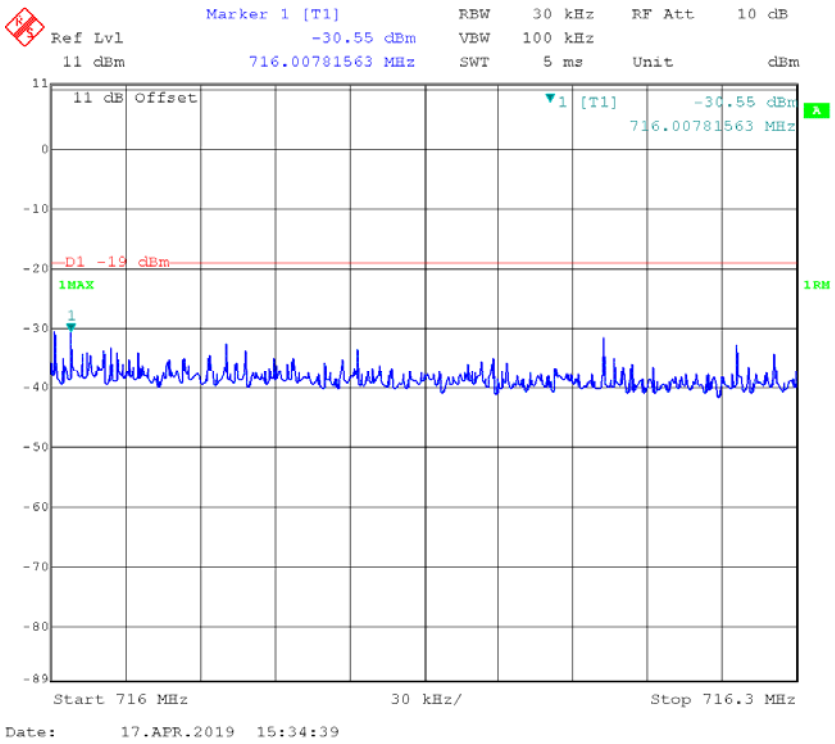
Lower 700MHz Band LTE Left Side 670.5MHz Above AGC



Lower 700MHz Band CDMA Right Side 714.75MHz Pre-AGC



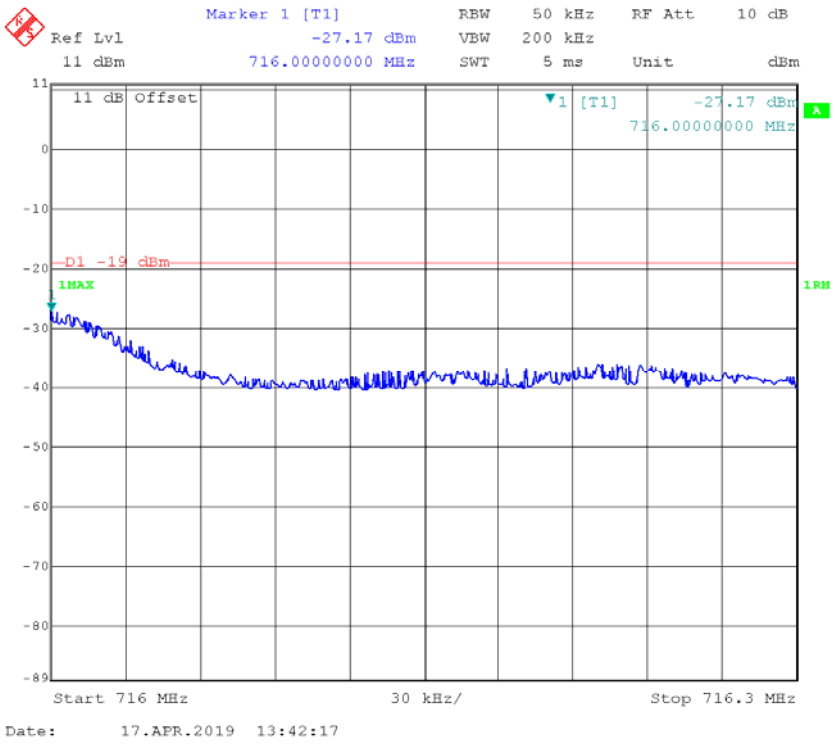
Lower 700MHz Band CDMA Right Side 714.75MHz Above AGC



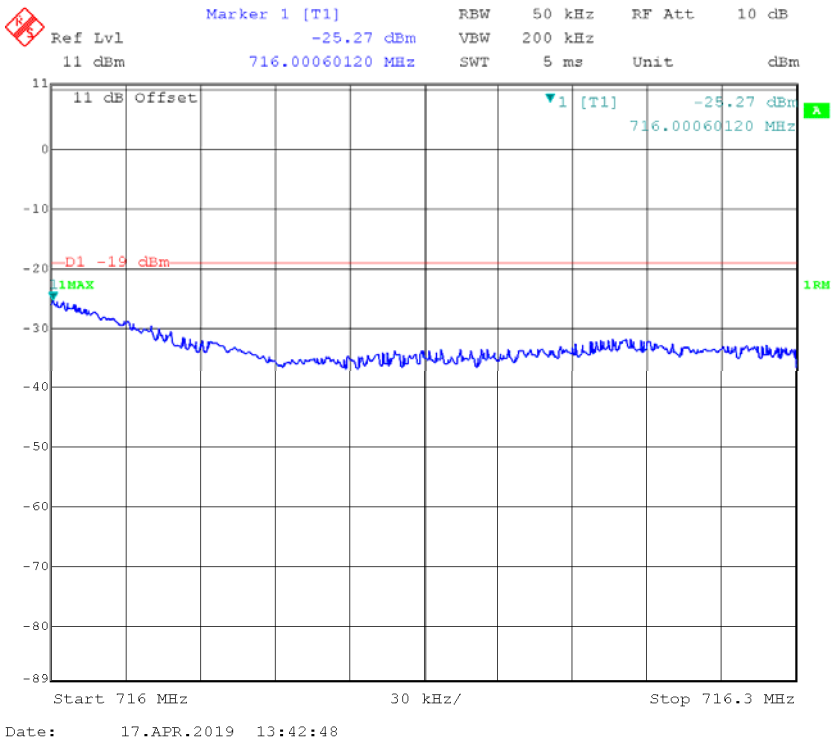
Lower 700MHz Band GSM Right Side 715.8MHz Pre-AGC

Lower 700MHz Band GSM Right Side 715.8MHz Above AGC

Lower 700MHz Band LTE Right Side 713.5MHz Pre-AGC



Lower 700MHz Band LTE Right Side 713.5MHz Above AGC



§ 20.21(e)(8)(i)(A), § 20.21(e)(8)(i)(H) &§20.21(e)(4) - NOISE LIMITS

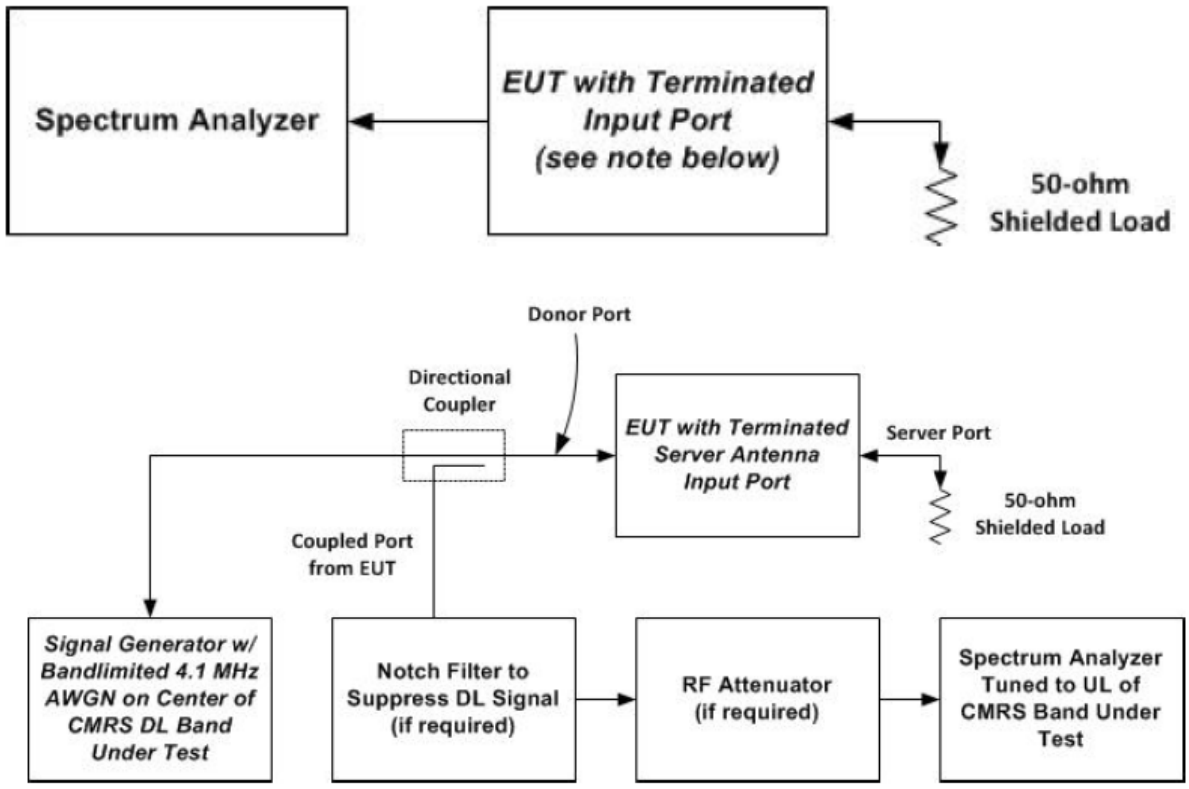
Applicable Standards

According to§ 20.21(e)(8)(i)(A) Noise Limits; § 20.21(e)(8)(i)(H) Transmit Power Off Mode (uplink and downlink noise power); §20.21(e)(4) Self-monitoring.

Test Procedure

Maximum transmitter noise power level
a) Connect the EUT to the test equipment as shown in **Figure 3**. Begin with the uplink output connected to the spectrum analyzer. When measuring downlink noise, connect the downlink output to the spectrum analyzer.
b) Set the spectrum analyzer RBW to 1 MHz with the VBW ≥ 3 × RBW.
c) Select the power averaging (RMS) detector and trace average over at least 100 traces.
d) Set the center frequency of the spectrum analyzer to the center of the CMRS band under test with the span ≥ 2 × the CMRS band.
e) Measure the maximum transmitter noise power level.
f) Save the spectrum analyzer plot as necessary for inclusion in the final test report.
g) Repeat 7.7b) to 7.7f) for all operational uplink and downlink bands.
h) Connect the EUT to the test equipment as shown in **Figure 4** for uplink. Affirm the coupled path of the RF coupler is connected to the spectrum analyzer.
i) Configure the signal generator for 4.1 MHz AWGN operation.
j) Set the spectrum analyzer RBW for 1 MHz with the 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 Annex 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 when varying the downlink signal generator output level from −90 dBm to −20 dBm, as measured at the input port, 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 noise limit in Annex D.
n) Repeat 7.7.1h) through 7.7.1m) for all operational uplink.

Variable uplink noise timing
Variable uplink noise timing is to be measured as follows.
a) Set the spectrum analyzer to the uplink frequency to be measured.
b) Set the span to 0 Hz with a sweep time of 10 seconds.
c) Set the power level of signal generator 1 to the lowest level of the RSSI-dependent noise.
d) Select MAX HOLD and increase the power level of signal generator 1 by 10 dB for mobile boosters and 20 dB for fixed boosters.
e) Confirm that the uplink noise decreases to the specified level within 1 second for mobile devices and 3 seconds for fixed devices
f) Repeat 7.7.2a) to 7.7.2e) for all operational uplink bands.
g) Include plots and summary table in test report.
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, connect a second signal generator and cycle the RF output to simulate this function.*



Test Data

Environmental Conditions

Temperature:	27.9 ℃
Relative Humidity:	64 %
ATM Pressure:	100.7 kPa

The testing was performed by Blake Yang from 2019-04-15 to 2019-04-23.

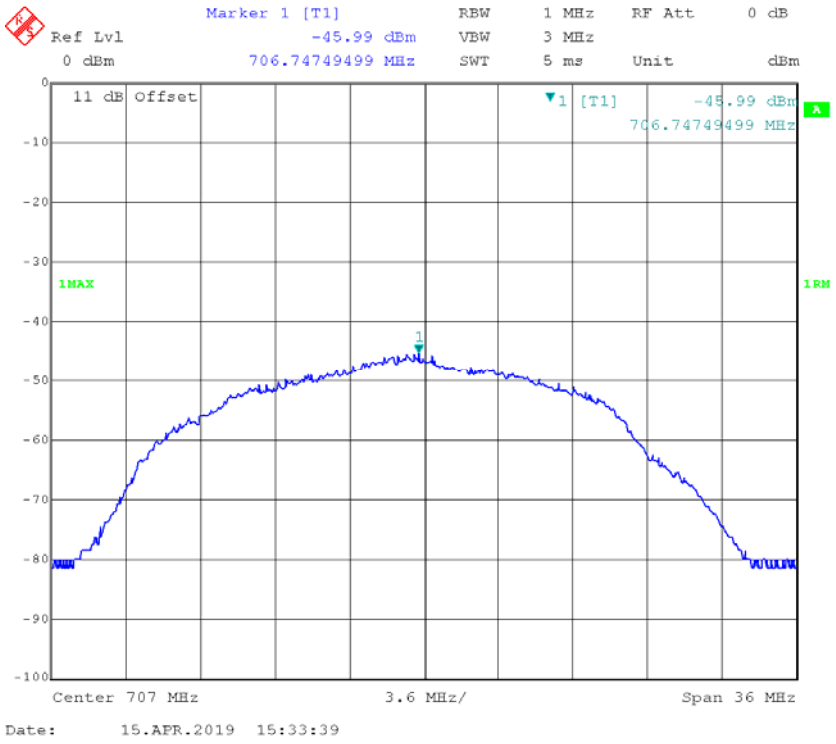
Test Result: Compliance. Please refer to following table.

Maximum Noise:

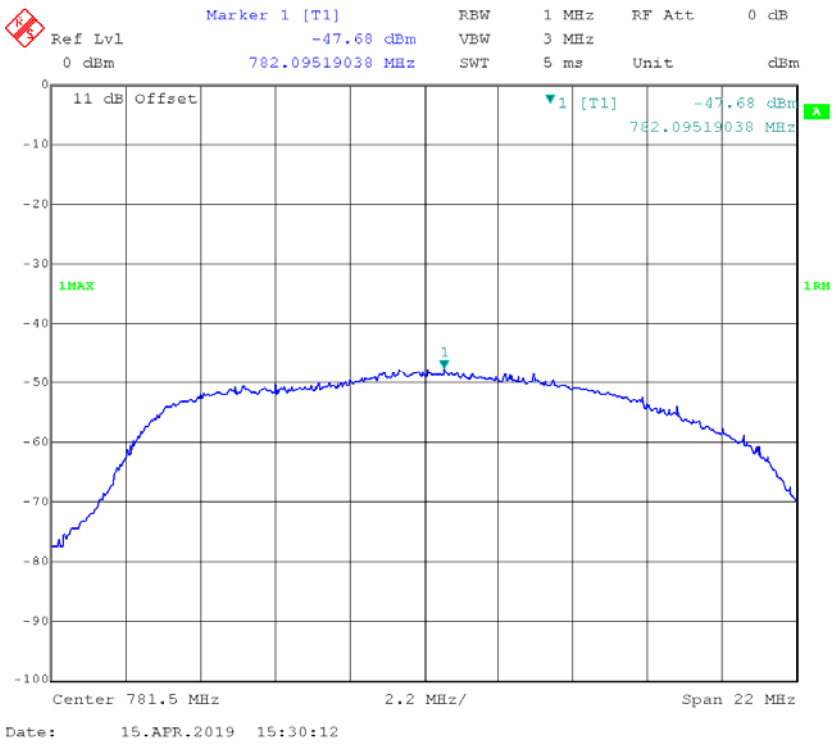
Mode	Operation Bands	Measured Value	Limit	Result
		dBm/MHz	dBm/MHz	
Uplink	PCS	-41.62	-37.01	Compliance
	AWS	-46.29	-37.73	Compliance
	Cellular	-47.93	-44.05	Compliance
	Lower 700	-45.99	-45.51	Compliance
	Upper 700	-47.68	-44.64	Compliance
Downlink	PCS	-43.72	-37.01	Compliance
	AWS	-38.97	-37.73	Compliance
	Cellular	-47.64	-44.05	Compliance
	Lower 700	-45.91	-45.51	Compliance
	Upper 700	-47.27	-44.64	Compliance

Note: Fixed booster maximum noise power shall not exceed −102.5 dBm/MHz + 20 Log10 (Frequency), where Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

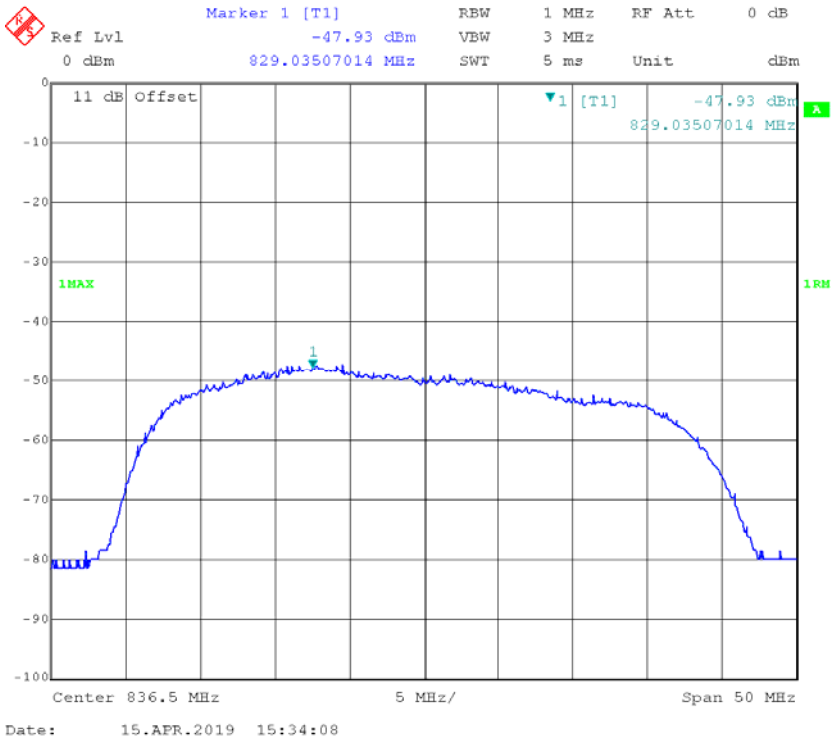
Uplink Lower 700MHz Band



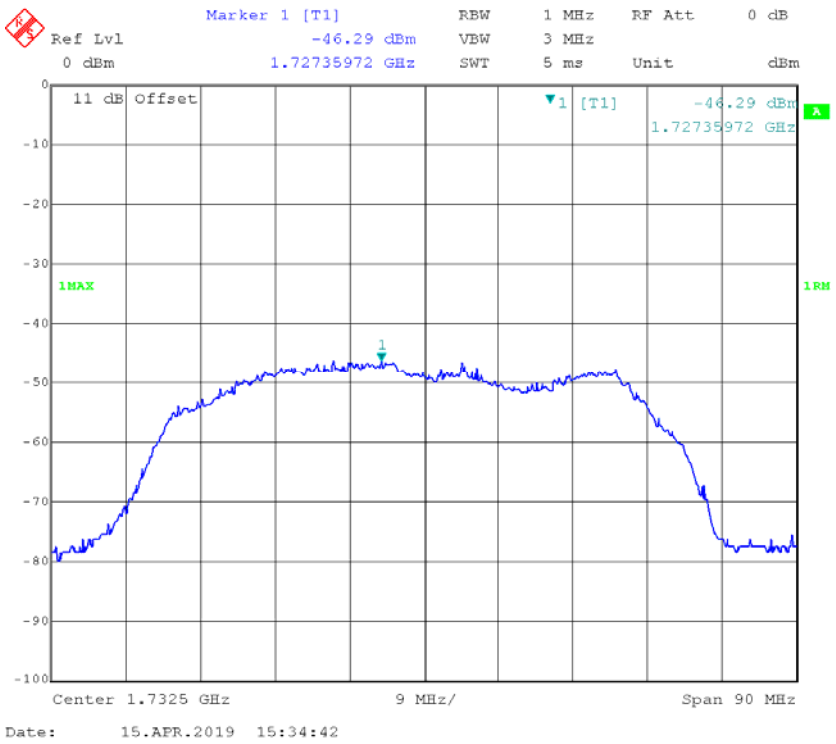
Uplink Upper 700MHz Band



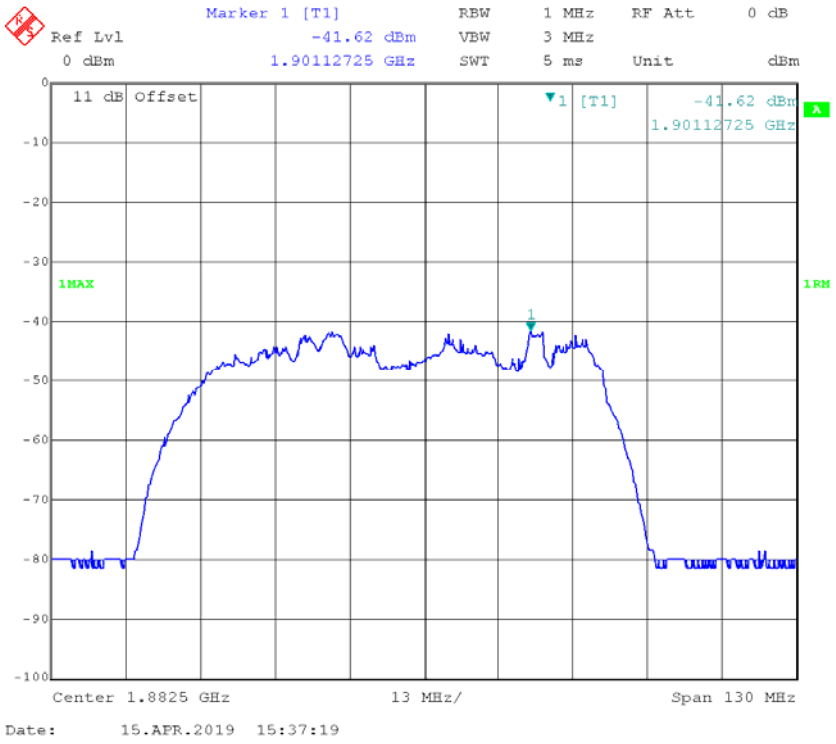
Uplink Cellular Band



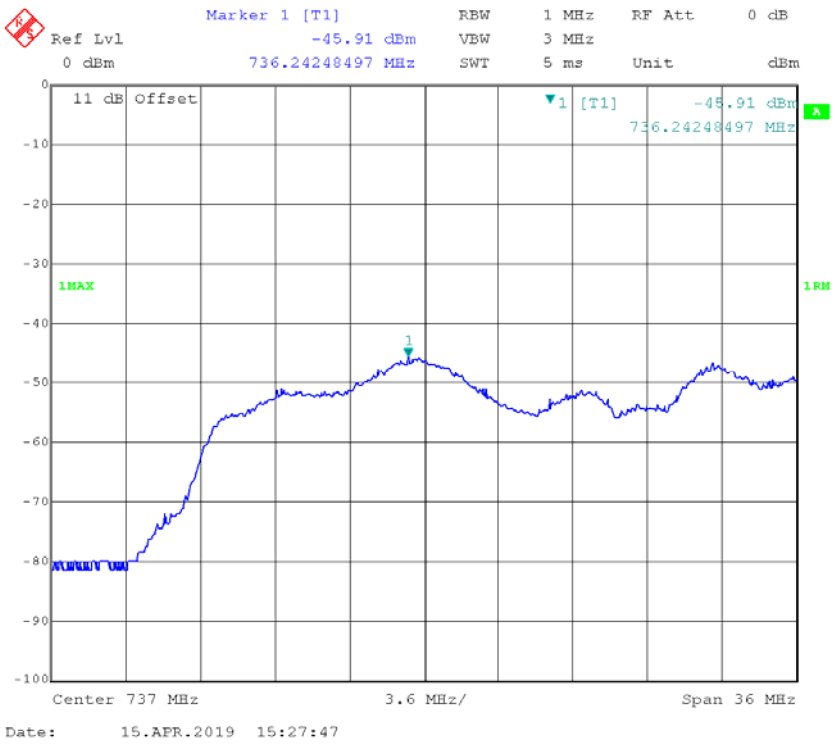
Uplink AWS Band



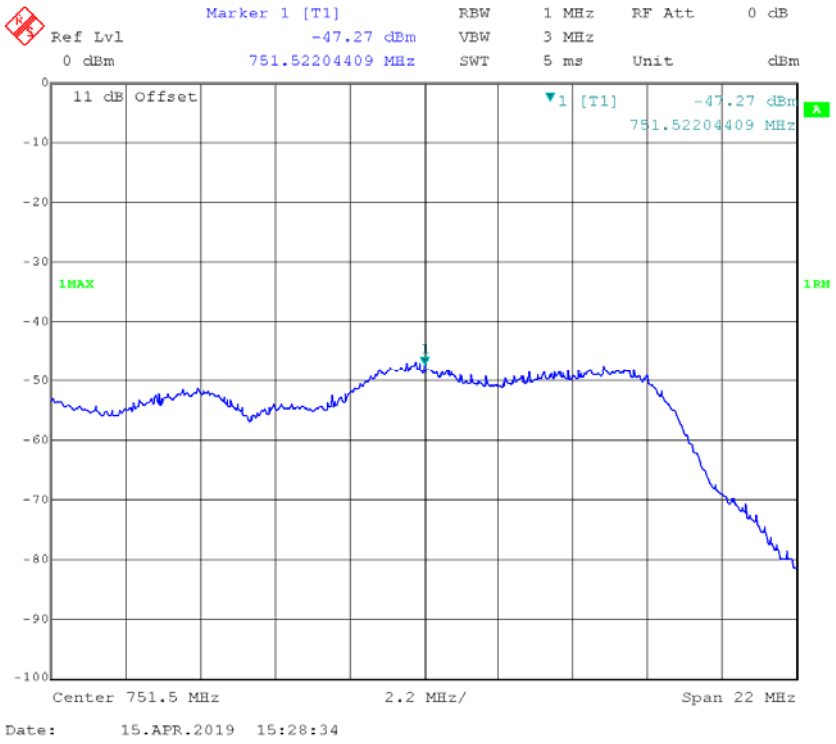
Uplink PCS Band



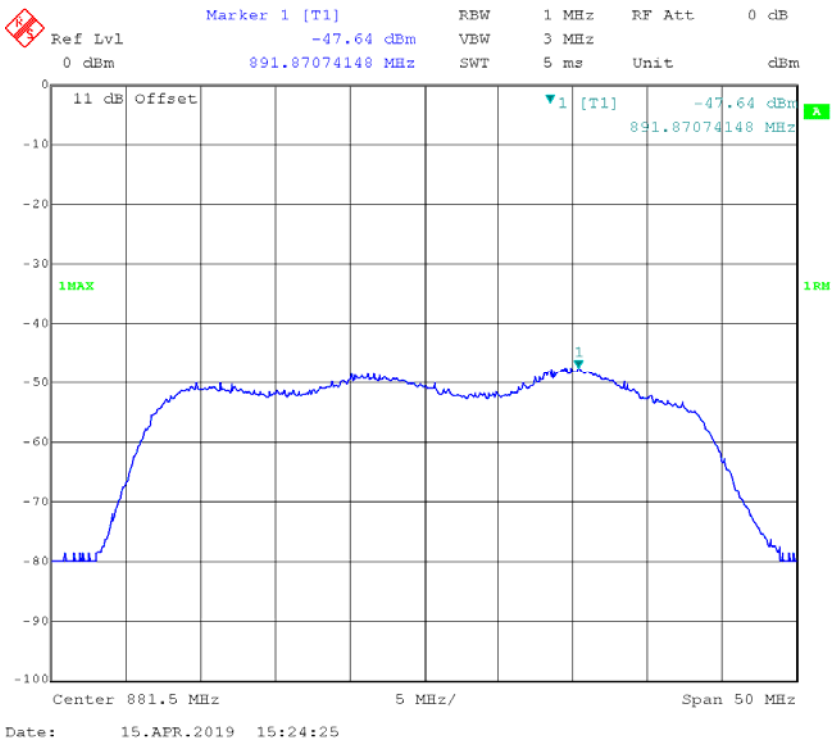
Downlink LTE Lower 700MHz Band



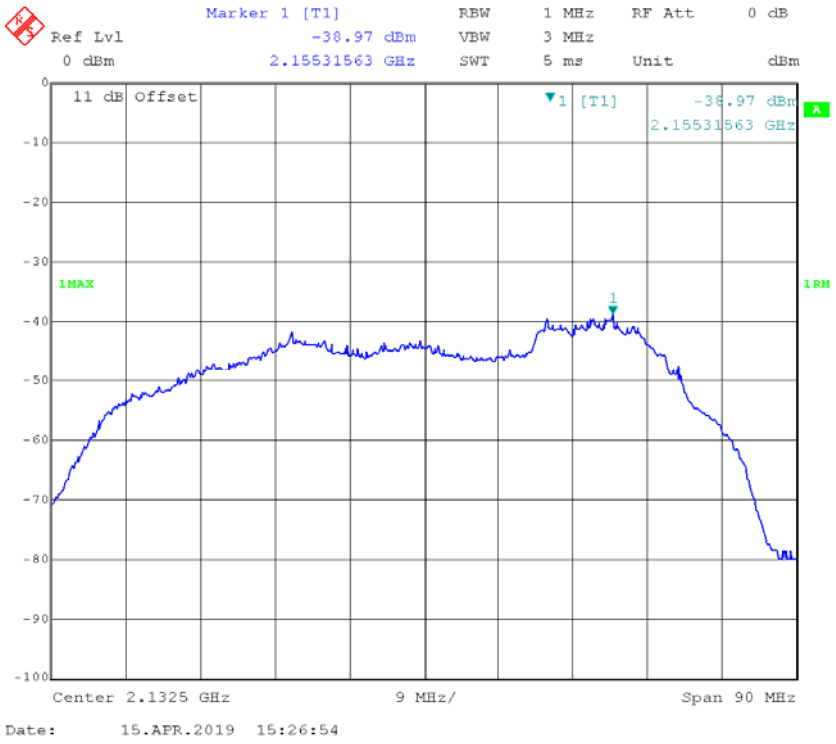
Downlink LTE Upper 700MHz Band



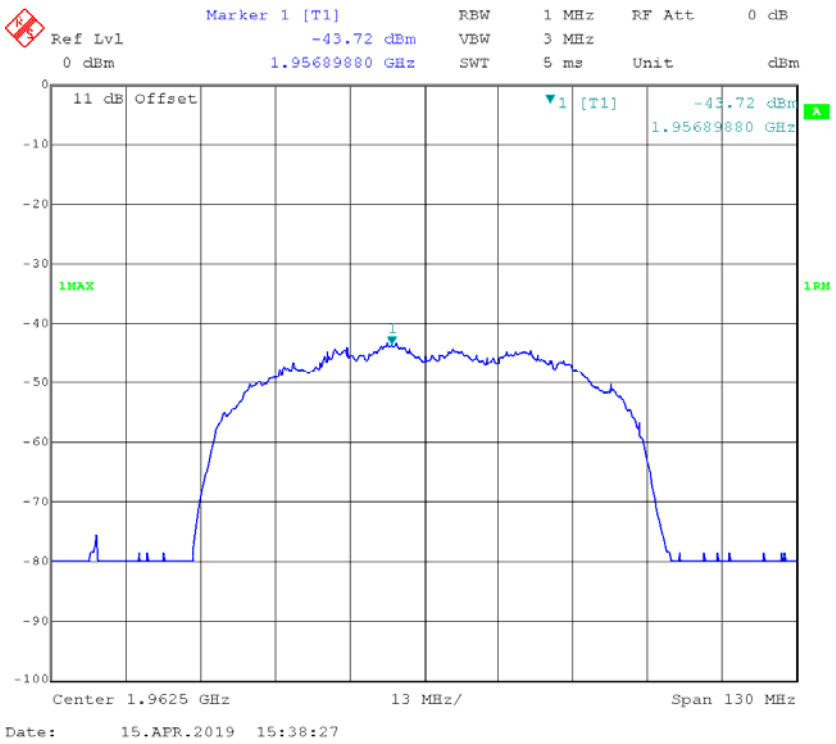
Downlink Cellular Band



Downlink AWS Band



Downlink PCS Band



Variable uplink Noise limit test result:

Operation Bands	RSSI	Measured Value	Limit	Results
	dBm	dBm/MHz	dBm/MHz	
PCS	-90	-45.57	-37.00	Compliance
	-80	-46.77	-37.00	Compliance
	-70	-46.38	-37.00	Compliance
	-55	-57.96	-48.00	Compliance
	-54	-58.72	-49.00	Compliance
	-53	-58.33	-50.00	Compliance
AWS	-90	-47.84	-37.73	Compliance
	-80	-47.98	-37.73	Compliance
	-60	-49.32	-43.00	Compliance
	-56	-51.08	-47.00	Compliance
	-54	-57.27	-49.00	Compliance
	-53	-57.61	-50.00	Compliance
Cellular	-90	-48.92	-44.05	Compliance
	-80	-49.44	-44.05	Compliance
	-70	-49.17	-44.05	Compliance
	-50	-54.76	-53.00	Compliance
	-49	-56.9	-54.00	Compliance
	-48	-58.72	-55.00	Compliance
Lower 700	-90	-47.61	-45.51	Compliance
	-80	-47.5	-45.51	Compliance
	-70	-47.18	-45.51	Compliance
	-56	-50.53	-47.00	Compliance
	-55	-59.54	-48.00	Compliance
	-54	-59.99	-49.00	Compliance
Upper 700	-90	-49.84	-44.64	Compliance
	-80	-49.31	-44.64	Compliance
	-70	-49.72	-44.64	Compliance
	-56	-52.7	-47.00	Compliance
	-55	-59.68	-48.00	Compliance
	-54	-60.46	-49.00	Compliance

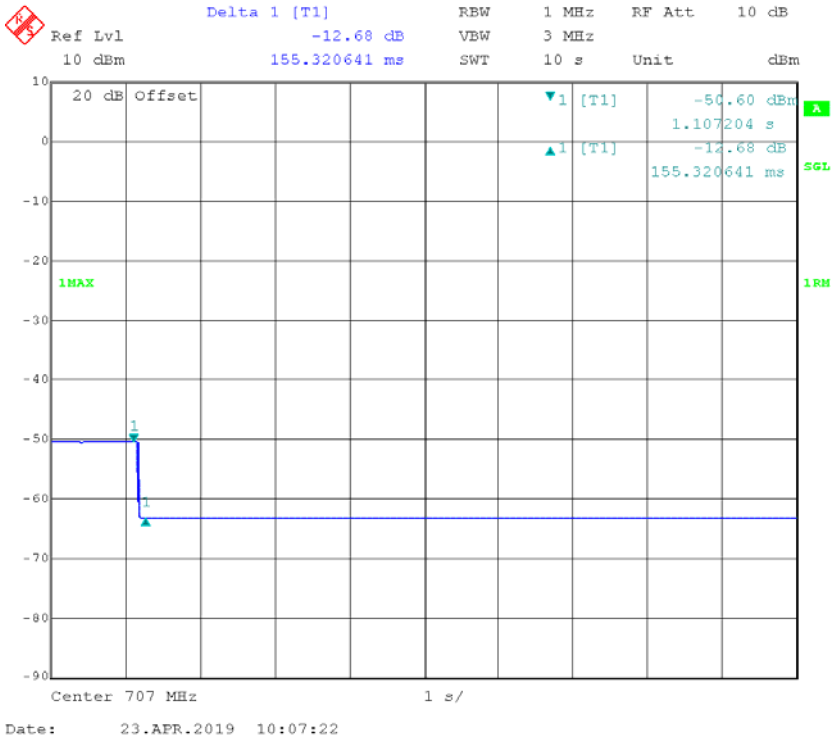
According to KDB 935210 D03 Signal Booster Measurements v04r03 Annex D, the Variable uplink Noise limit is −103 dBm – RSSI in RSSI-Dependent Region, out of RSSI-Dependent Region, it is −102.5 dBm/MHz + 20 Log10 (Frequency).

Variable Uplink Noise Timing:

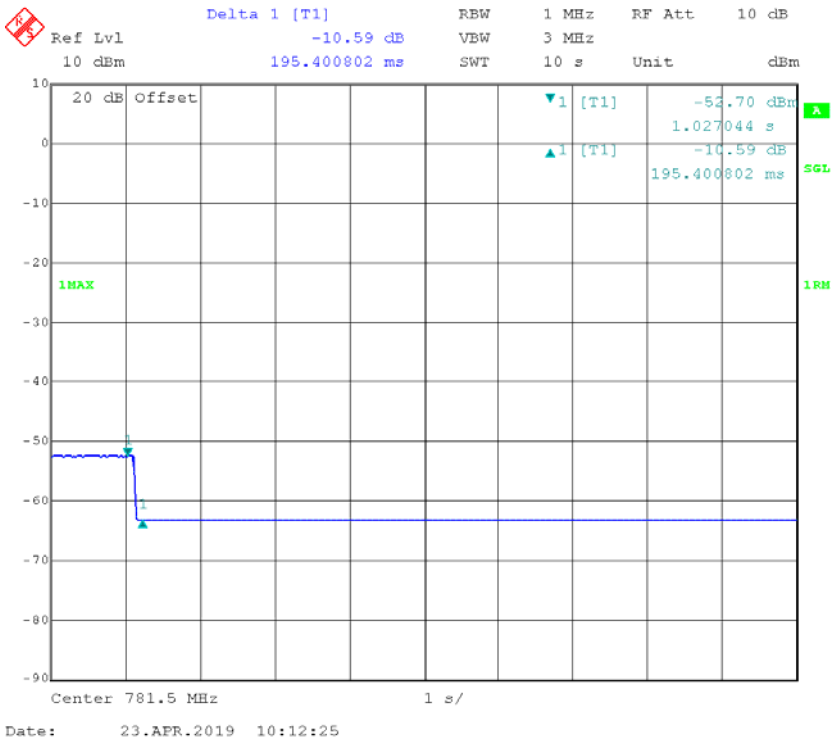
Operating Band	Measured Value	Limit	Results
	s	s	
PCS	0.155	3	Compliance
AWS	0.160	3	Compliance
Cellular	0.175	3	Compliance
LOWER 700	0.155	3	Compliance
UPPER 700	0.195	3	Compliance

Note: The uplink noise decreases to the specified level within 1 second for mobile devices and 3 seconds for fixed devices.

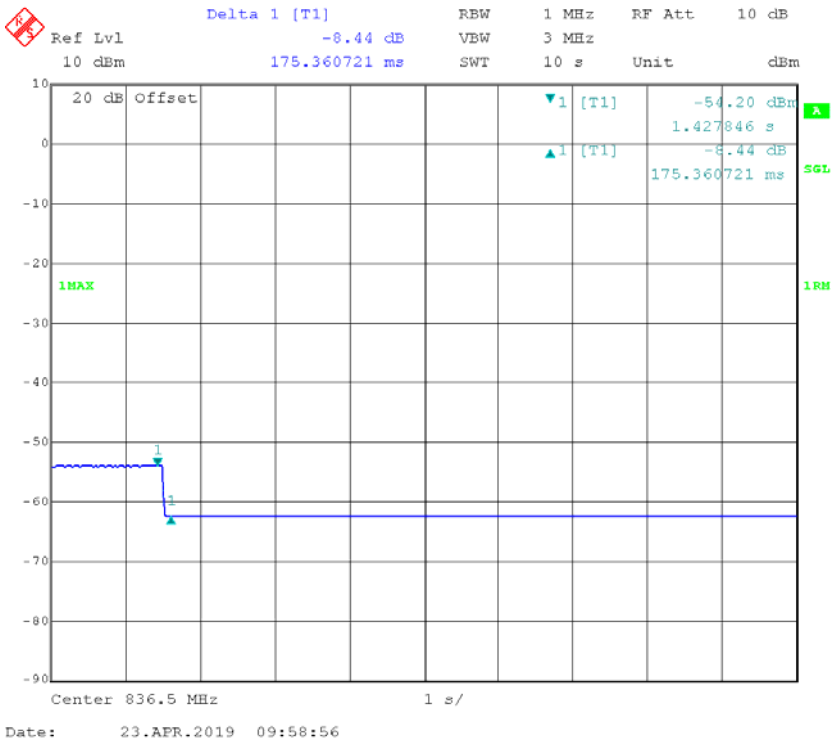
Lower 700MHz Band



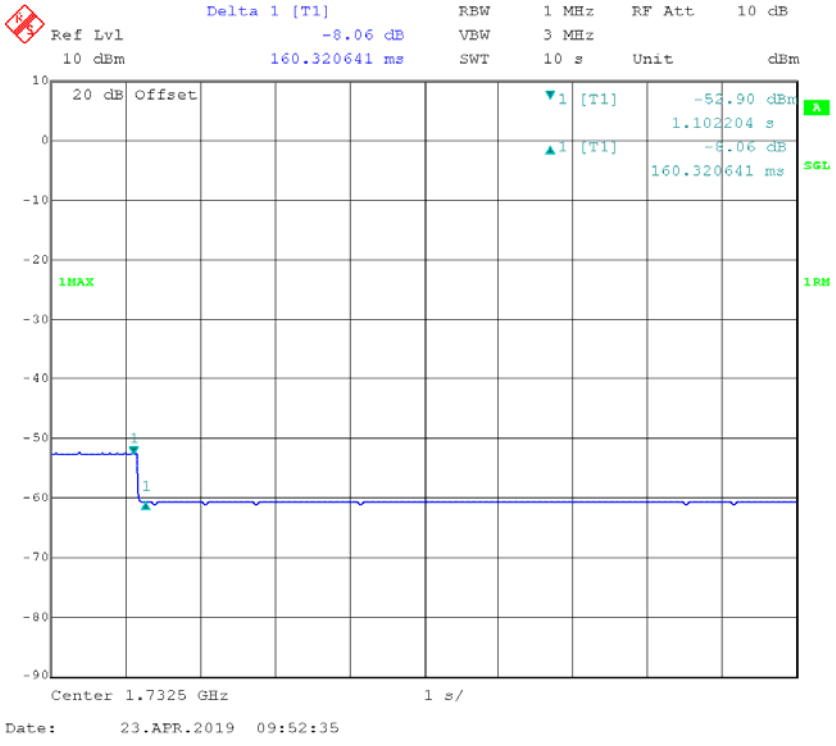
Upper 700MHz Band



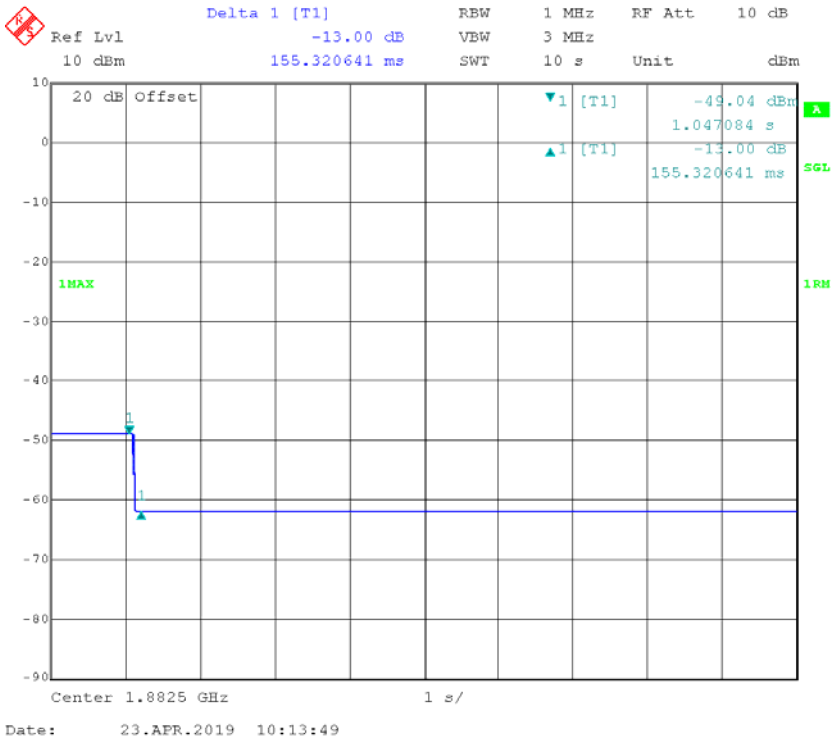
Cellular Band



AWS Band



PCS Band


Delta 1 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl
-13.00 dB
VBW 3 MHz
10 dBm
155.320641 ms
SWT 10 s
Unit dBm
20 dB Offset
1 [T1]
-49.04 dBm
1.047084 s
1 [T1]
-13.00 dB
155.320641 ms
SGL
1MAX
1RM
Center 1.8825 GHz
1 s/
Date: 23.APR.2019 10:13:49

§ 20.21(e)(8)(i)(I) &§20.21(e)(4) - UPLINK INACTIVITY

Applicable Standards

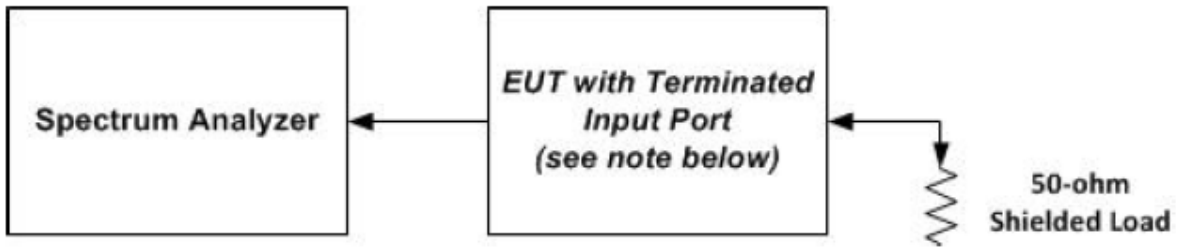
According to§ 20.21(e)(8)(i)(I) Uplink Inactivity&§20.21(e)(4); §20.21(e)(4) Self-monitoring.

Test Procedure

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).

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 ≥ 3 × 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 700 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 becomes inactive.
i) Affirm that 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 7.7.1a) to 7.7.1f).
l) Repeat 7.8d) through 7.8k) 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, connect a signal generator and cycle the RF output to simulate this function.*



Test Data

Environmental Conditions

Temperature:	26.6~27.2 ℃
Relative Humidity:	56~66 %
ATM Pressure:	101.1~101.5 kPa

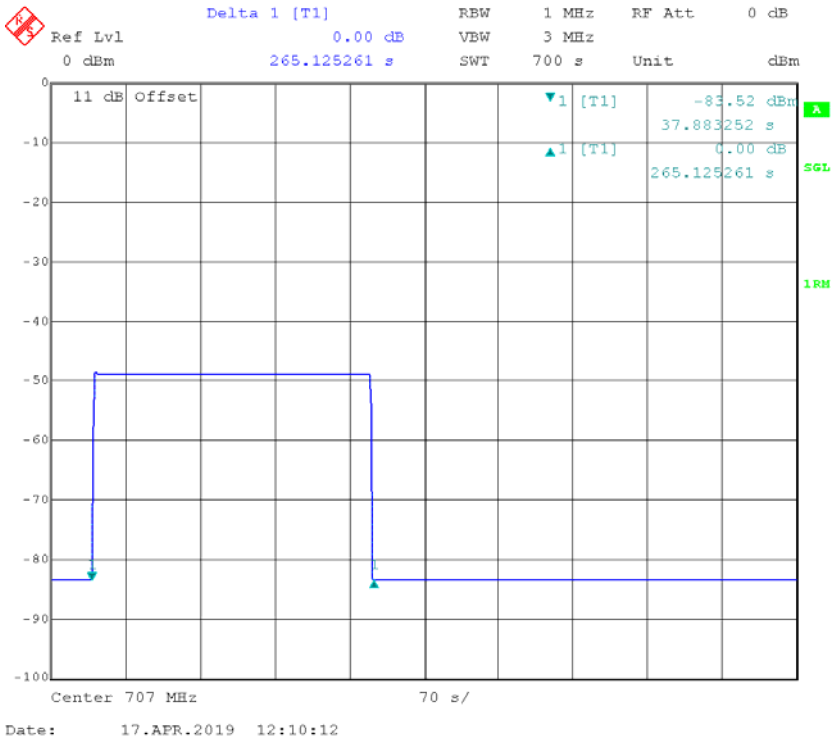
The testing was performed by Blake Yang on 2019-04-15 and 2019-04-19.

Test Result: Compliance. Please refer to following table.

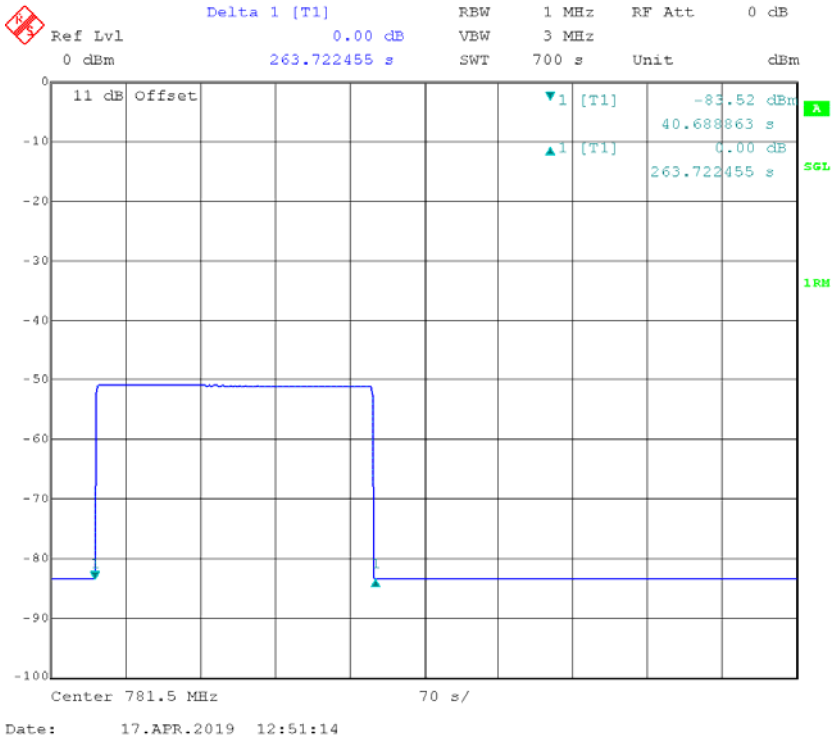
Operation Band	Measured value	Limit	Result
	s	s	
PCS	256.192	300	Compliance
AWS	265.130		Compliance
Cellular	265.125		Compliance
LOWER 700	265.125		Compliance
UPPER 700	263.722		Compliance

Note: When the consumer booster is not serving an active device connection after 5 minutes the uplink noise power not exceed −70 dBm/MHz.

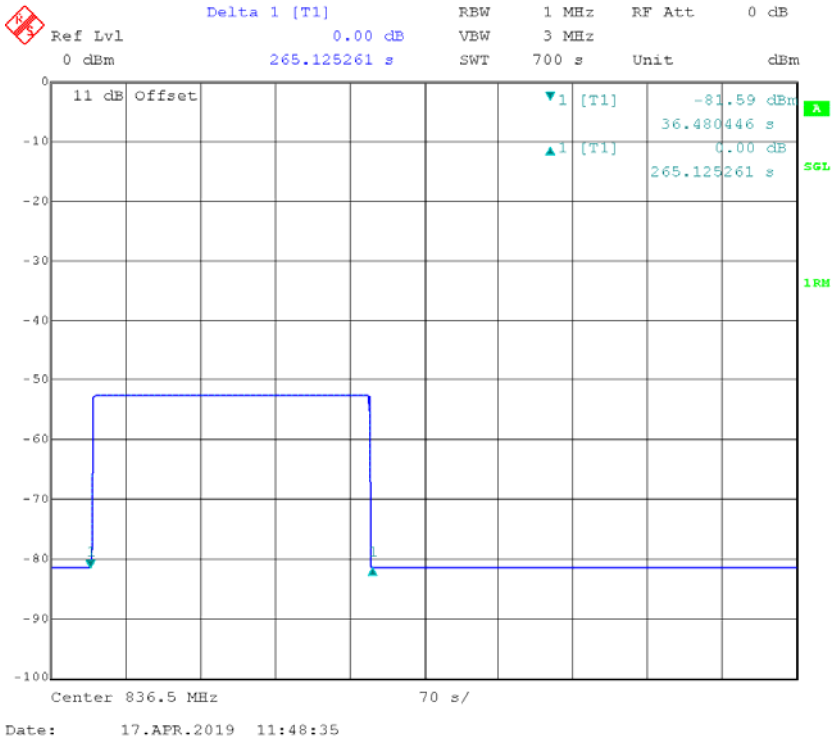
Lower 700MHz Band



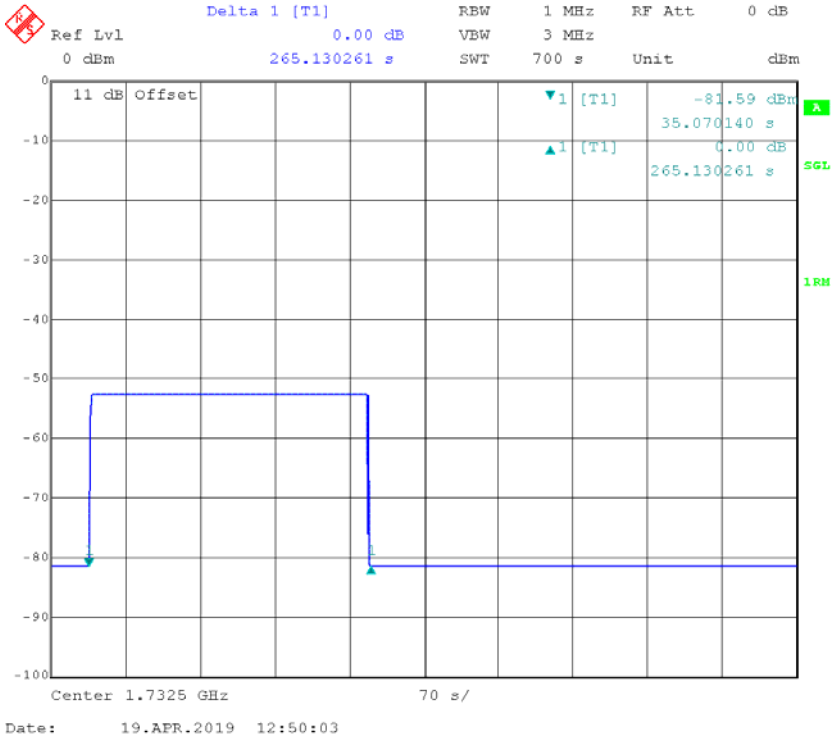
Upper 700MHz Band



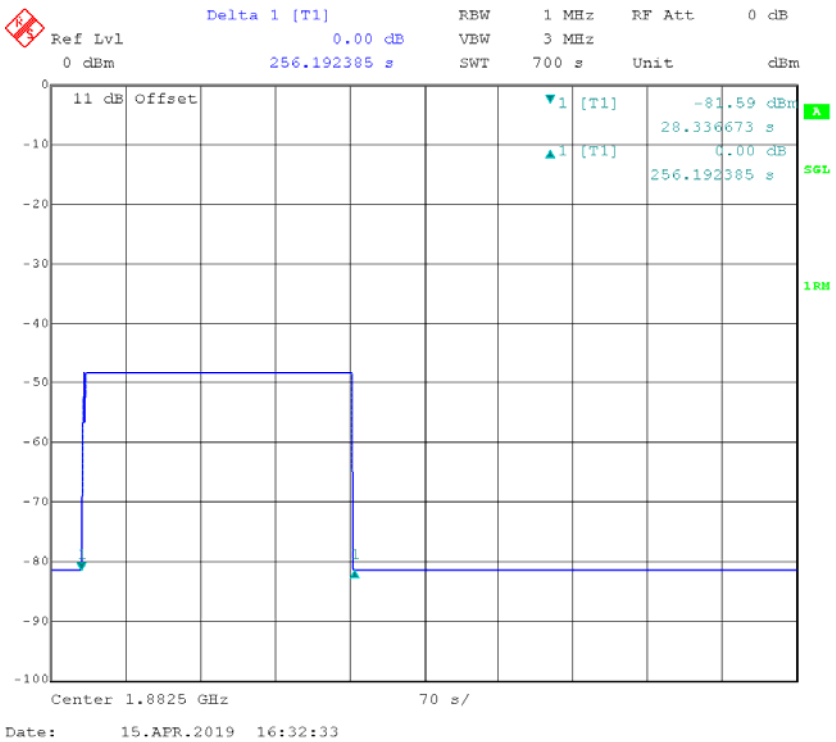
Cellular Band



AWS Band



PCS Band



§ 20.21(e)(8)(i)(C)(1) & § 20.21(e)(8)(i)(H) - VARIABLE BOOSTER GAIN

Applicable Standards

Rule paragraph(s): § 20.21(e)(8)(i)(C)(1) *Booster Gain Limits* (variable gain); § 20.21(e)(8)(i)(H) *Transmit Power Off Mode* (uplink gain).

Test Procedure

Maximum gain

This procedure shall be used to demonstrate compliance to the booster gain limits specified for wideband consumer signal boosters in § 20.21(e)(8)(i)(C) or § 20.21(e)(8)(i)(H). 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 on determining the applicable MSCL value.

a) Connect the EUT to the test equipment as shown in **Figure 5** with the uplink output connected to signal generator 1. Confirm 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% 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 determined from 7.2. The signal type is AWGN with a 99% OBW of 4.1 MHz.
d) Set RBW = 100 kHz.
e) Set VBW ≥ 300 kHz.
f) Select the CHANNEL POWER measurement mode.
g) Select the RMS (power averaging) detector.
h) Ensure that the number of measurement points per sweep ≥ (2 × span)/RBW.
i) Sweep time = auto couple or as necessary (but no less than auto couple value).
j) Trace average at least 10 traces in power averaging (i.e., RMS) mode.
k) Measure the maximum channel power and compute maximum gain when varying the signal generator 1 output to a level from −90 dBm to −20 dBm as measured at the input port 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. See gain limit in charts in Annex D for uplink gain requirements. Additionally, document that the EUT provides equivalent uplink and downlink gain, and when operating in shutoff mode the uplink and downlink gain is within the transmit power off mode gain limits.
l) Repeat 7.9.1b) to 7.9.1k) for all operational uplink bands.

Variable uplink gain timing

Variable uplink gain timing is to be measured as follows.

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

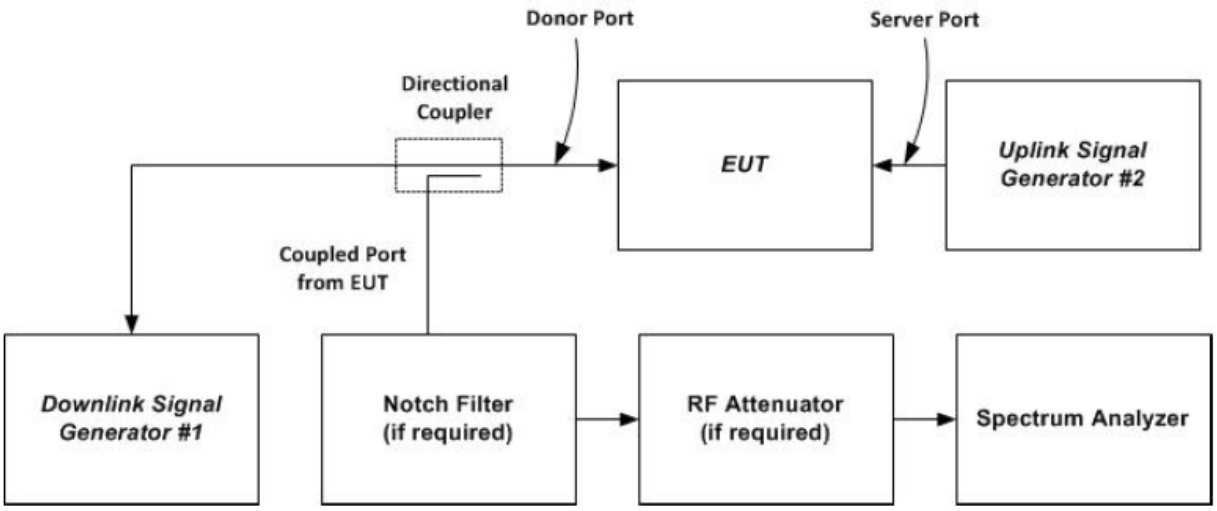


Figure 5 – Variable gain instrumentation test setup

Test Data

Environmental Conditions

Temperature:	26.6 ℃
Relative Humidity:	56 %
ATM Pressure:	101.5 kPa

The testing was performed by Blake Yang on 2019-04-24.

Test Result: Compliance. Please refer to following table.

MSCL calculation:

Operation Bands	Frequency	Distance	Path Loss	Indoor Antenna Gain	Indoor Cable Loss	Polarity Loss	MSCL
	MHz	m	dB	(dBi)	(dB)	(dB)	
PCS	1882.5	1	37.99	10	4.87	1.73	34.59
AWS	1732.5	1	37.27	10	4.87	1.73	33.87
Cellular	836.5	1	30.95	9	3.38	1.73	27.06
LOWER 700	707	1	29.49	9	2.90	1.73	25.12
UPPER 700	781.5	1	30.36	9	3.15	1.73	26.24

Note:
Path loss=20logf+20logd-27.5
Polarity loss=20log(1/sin(55))=1.73
d=1m, please refer to the user manual

Variable booster gain:

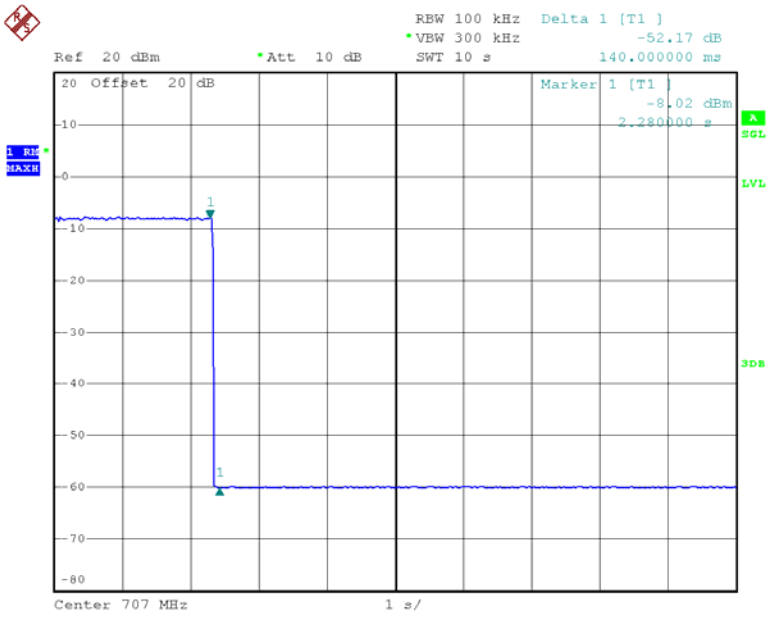
Operation Bands	RSSI	P_{in}	P_{out}	MSCL	Measured Value	Limit	Result
	dBm	dBm	dBm	dB	dB	dB	
PCS	-70	-40.23	8.85	34.59	49.08	70.59	Compliance
	-60	-40.23	6.24	34.59	46.47	60.59	Compliance
	-59	-40.23	4.51	34.59	44.74	59.59	Compliance
	-58	-40.23	3.32	34.59	43.55	58.59	Compliance
	-57	-40.23	2.18	34.59	42.41	57.59	Compliance
	-56	-40.23	1.29	34.59	41.52	56.59	Compliance
AWS	-70	-40.52	7.86	33.87	48.38	69.87	Compliance
	-60	-40.52	2.45	33.87	42.97	59.87	Compliance
	-59	-40.52	1.56	33.87	42.08	58.87	Compliance
	-58	-40.52	0.35	33.87	40.87	57.87	Compliance
	-57	-40.52	-0.45	33.87	40.07	56.87	Compliance
	-56	-40.52	-1.65	33.87	38.87	55.87	Compliance
Cellular	-80	-39.65	11.58	27.06	51.23	73.06	Compliance
	-70	-39.65	11.21	27.06	50.86	63.06	Compliance
	-60	-39.65	10.23	27.06	49.88	53.06	Compliance
	-55	-39.65	4.01	27.06	43.66	48.06	Compliance
	-54	-39.65	3.45	27.06	43.10	47.06	Compliance
	-53	-39.65	2.35	27.06	42.00	46.06	Compliance
LOWER 700	-80	-42.83	9.87	25.12	52.70	71.12	Compliance
	-70	-42.83	8.21	25.12	51.04	61.12	Compliance
	-60	-42.83	4.85	25.12	47.68	51.12	Compliance
	-58	-42.83	3.28	25.12	46.11	49.12	Compliance
	-57	-42.83	2.52	25.12	45.35	48.12	Compliance
	-56	-42.83	1.83	25.12	44.66	47.12	Compliance
UPPER 700	-70	-42.15	9.21	26.24	51.36	62.24	Compliance
	-60	-42.15	7.48	26.24	49.63	52.24	Compliance
	-58	-42.15	4.31	26.24	46.46	50.24	Compliance
	-57	-42.15	3.49	26.24	45.64	49.24	Compliance
	-56	-42.15	2.58	26.24	44.73	48.24	Compliance
	-55	-42.15	1.43	26.24	43.58	47.24	Compliance

Note: Variable booster gain Limit: −34 dB-RSSI + MSCL.

Variable gain timing:

Operation Bands	Measured value	Limit	Results
MHz	s	s	
PCS	0.14	3	Compliance
AWS	0.12		Compliance
Cellular	0.11		Compliance
LOWER 700	0.14		Compliance
UPPER 700	0.08		Compliance

Lower 700MHz Band



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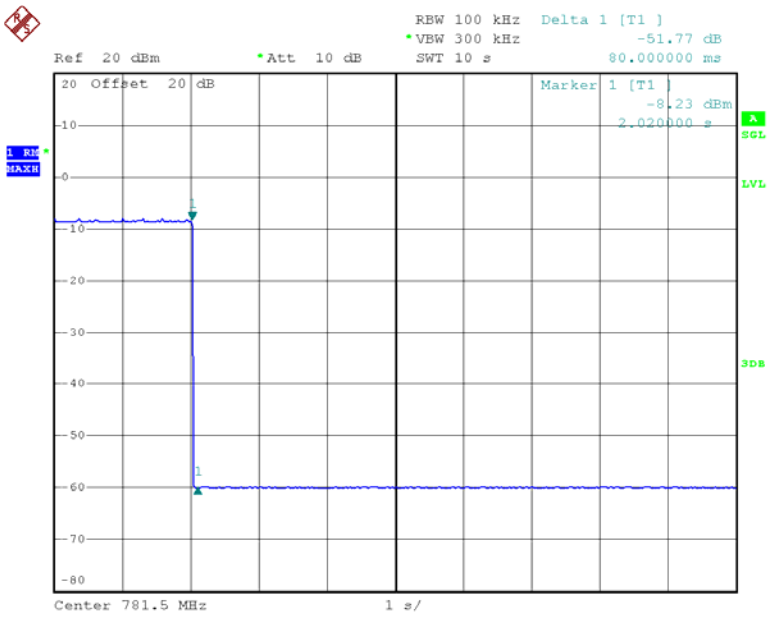
Upper 700MHz Band



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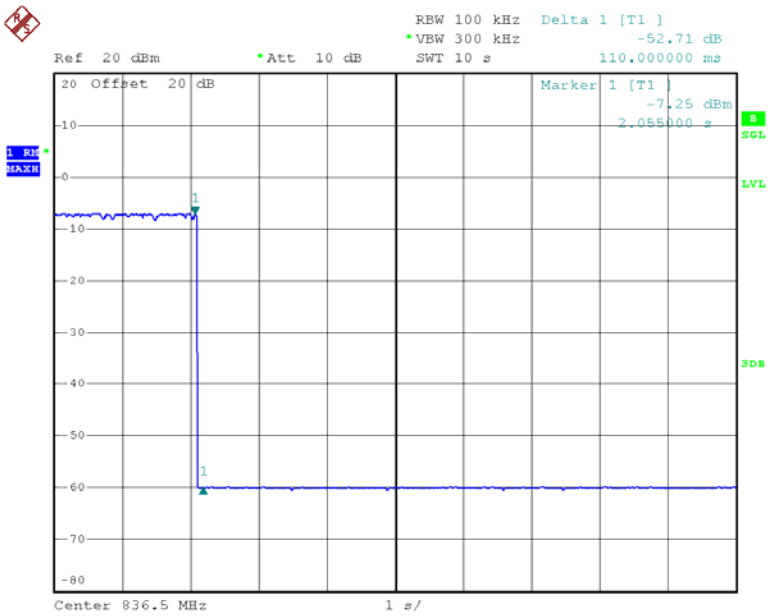
Cellular Band



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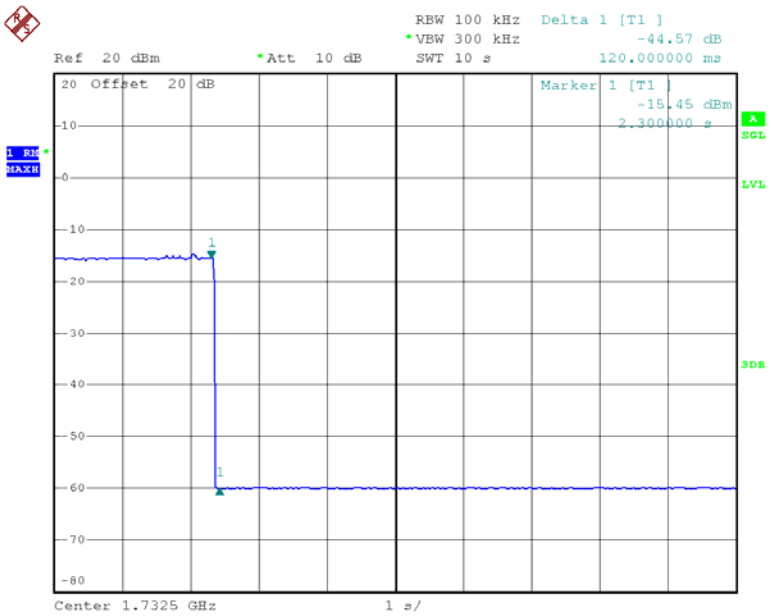
AWS Band



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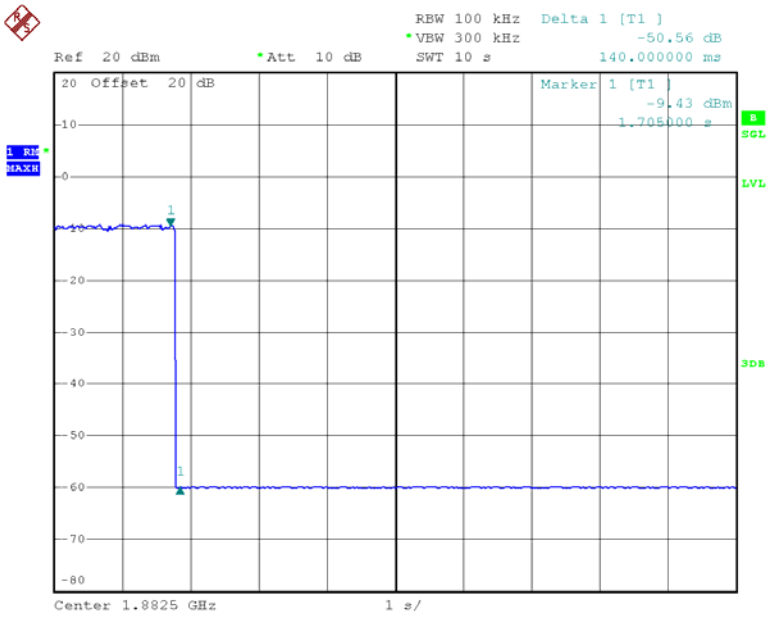
PCS Band



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§ 2.1049 - OCCUPIED BANDWIDTH

Applicable Standards

According to§ 2.1049 Measurements required: Occupied bandwidth.

Test Procedure

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.
a) Connect the test equipment as shown in **Figure 6** to measure the characteristics of the test signals produced by the signal generator.
b) Set VBW to ≥ 3 × RBW.
c) Set the center frequency of the spectrum analyzer to the center of the operational band. The span will be adjusted for each modulation type and occupied bandwidth as necessary for accurately viewing the signals.
d) Set the signal generator for power level to match the values obtained in 7.2.
e) Set the signal generator modulation type for GSM with a PRBS pattern and allow the trace on the signal generator to stabilize adjusting the span as necessary.
f) Set the spectrum analyzer RBW for 1% to 5% of the emissions bandwidth.
g) Capture the spectrum analyzer trace for inclusion in the test report.
h) Repeat 7.10c) to 7.10g) for CDMA and W-CDMA modulation adjusting the span as necessary for all uplink and downlink operational bands. AWGN or LTE may be used in place of W-CDMA, 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 7.10c) to 7.10h) in this new configuration.

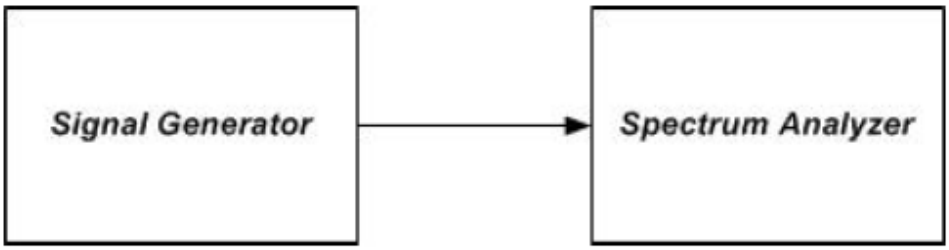


Figure 6 – Occupied bandwidth instrumentation test setup

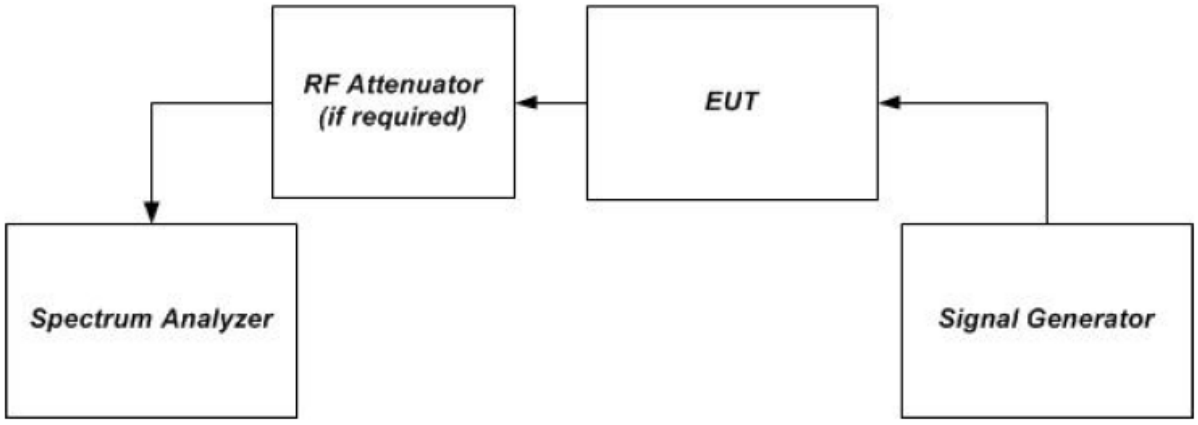


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

Temperature:	26.4 ℃
Relative Humidity:	56 %
ATM Pressure:	101.8 kPa

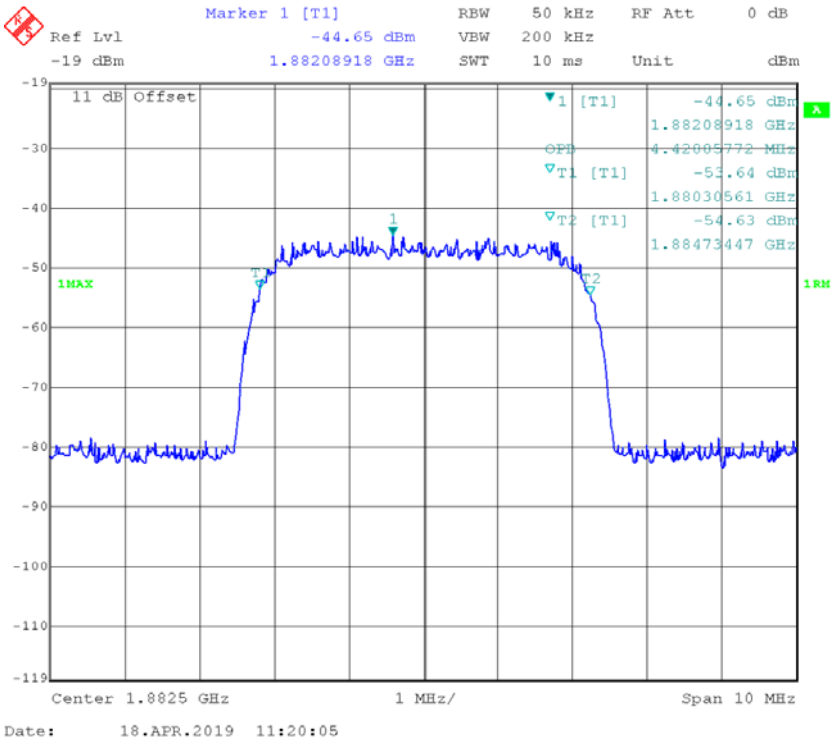
The testing was performed by Blake Yang on 2019-04-18.

Test Result: Compliance. Please refer to following table.

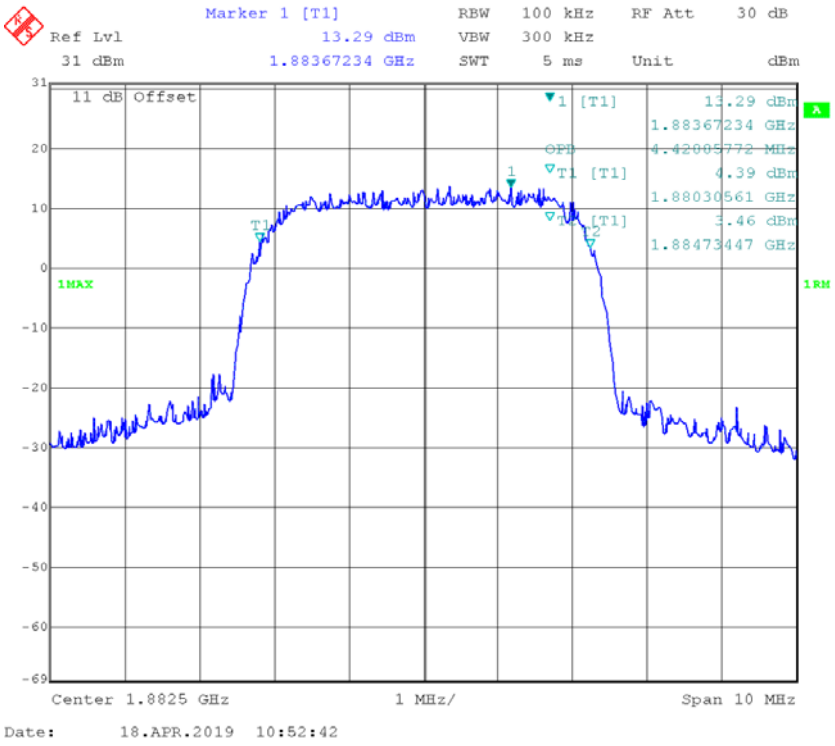
Input-versus-output signal comparison

Mode	Operation Band	Signal type	Input	Output	Results
			MHz	MHz	
Uplink	PCS	LTE	4.428	4.428	Compliance
		CDMA	1.275	1.281	Compliance
		GSM	0.244	0.246	Compliance
	AWS	LTE	4.449	4.449	Compliance
		CDMA	1.275	1.275	Compliance
		GSM	0.244	0.246	Compliance
	Cellular	LTE	4.429	4.449	Compliance
		CDMA	1.289	1.275	Compliance
		GSM	0.246	0.244	Compliance
	Lower 700	LTE	4.449	4.489	Compliance
		CDMA	1.281	1.275	Compliance
		GSM	0.248	0.248	Compliance
	Upper 700	LTE	4.449	4.369	Compliance
		CDMA	1.275	1.275	Compliance
		GSM	0.242	0.246	Compliance
Downlink	PCS	LTE	4.549	4.449	Compliance
		CDMA	1.287	1.287	Compliance
		GSM	0.248	0.246	Compliance
	AWS	LTE	4.569	4.420	Compliance
		CDMA	1.201	1.201	Compliance
		GSM	0.240	0.246	Compliance
	Cellular	LTE	4.489	4.429	Compliance
		CDMA	1.281	1.269	Compliance
		GSM	0.248	0.246	Compliance
	Lower 700	LTE	4.509	4.309	Compliance
		CDMA	1.275	1.263	Compliance
		GSM	0.244	0.248	Compliance
	Upper 700	LTE	4.489	4.168	Compliance
		CDMA	1.281	1.275	Compliance
		GSM	0.246	0.244	Compliance

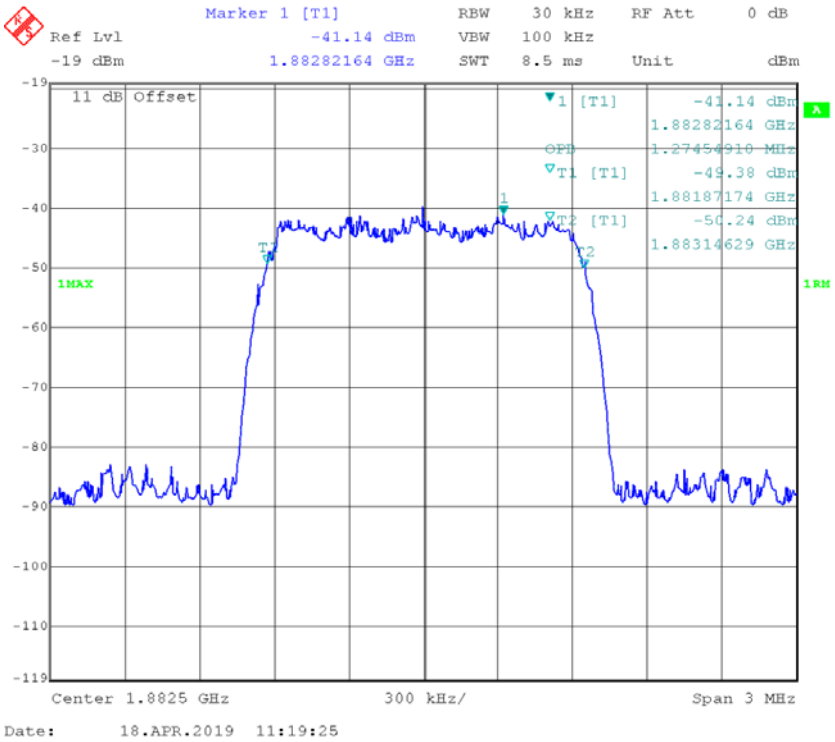
PCS UL-LTE-IN



PCS UL-LTE-OUT



PCS UL-CDMA-IN



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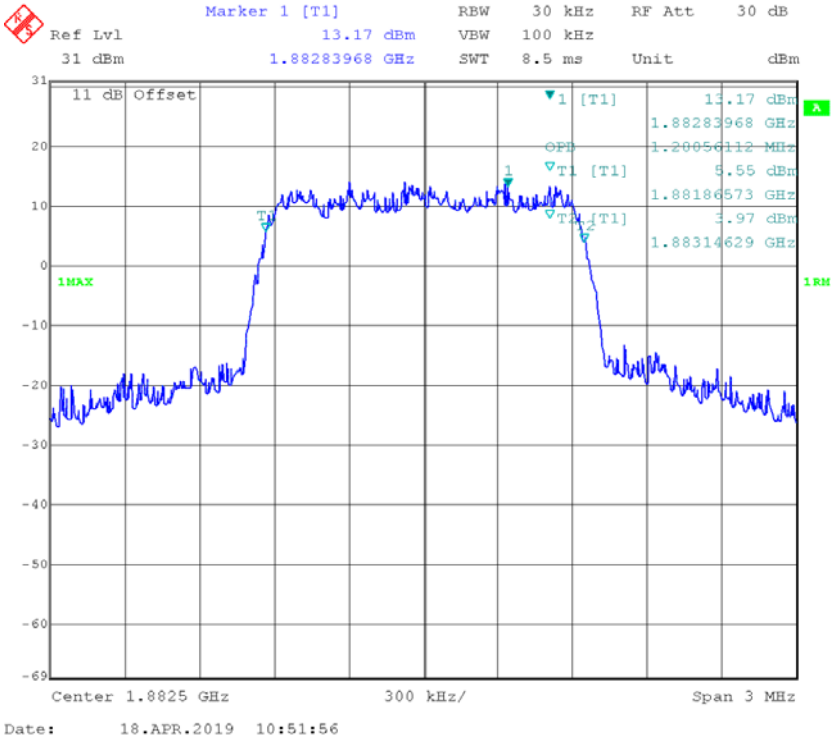

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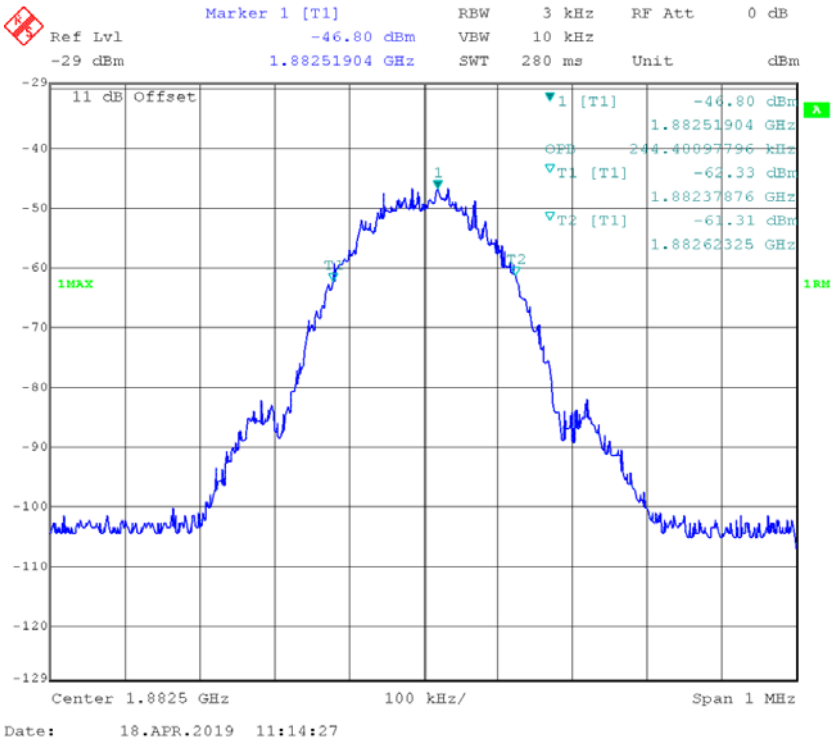

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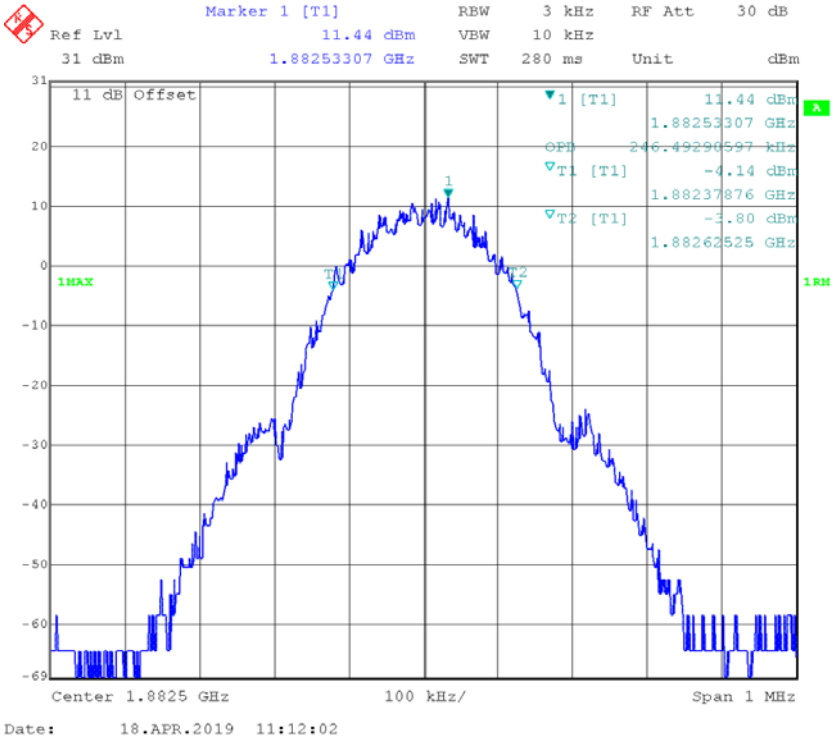

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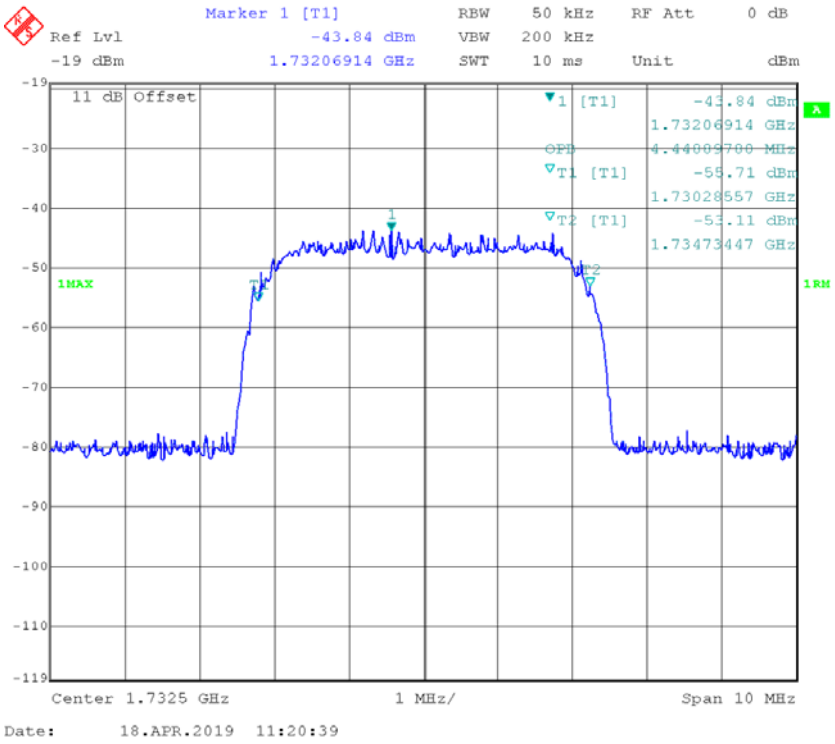

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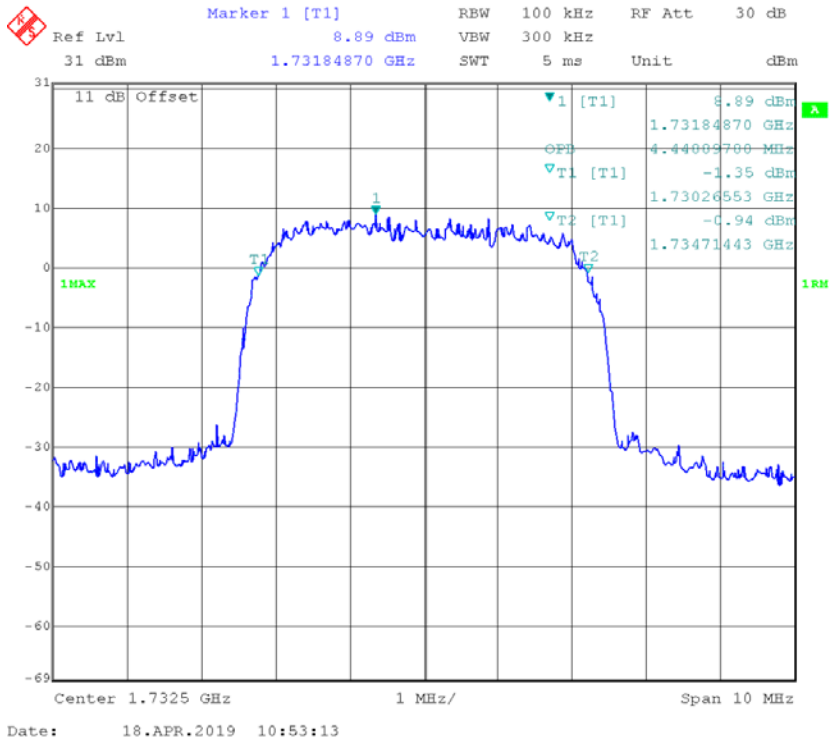

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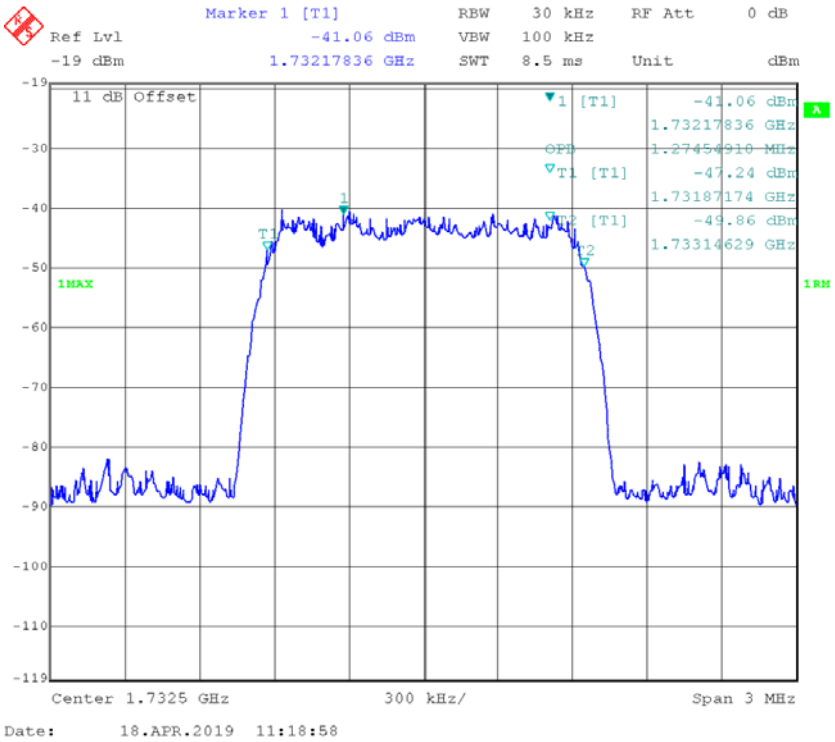

AWS UL-CDMA-OUT