TESTING LABORATORY
CERTIFICATE#4323.01

FCC PART 20.21

TEST REPORT

For

HONG KONG KONING INDUSTRIAL LIMITED

Unit 04,7/F Bright Way Tower No 33 Mong KOK RD KL Hong Kong

FCC ID: 2AT9LW1000

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

Project Engineer:	Stone Zhang
Report Number:	RKSA191030001-00B
Report Date:	2020-12-08
Reviewed By:	Oscar Ye EMC Manager
Prepared By:	Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road, Kunshan, Jiangsu province, China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant:	HONG KONG KONING INDUSTRIAL LIMITED
Tested Model:	W1000
Series Model:	W1001
Model Difference:	Model Names and Appearance
Product Type:	Consumer Cellular Signal booster
Power Supply:	DC 12V from adapter
RF Function:	Signal Booster
Operating Band/Frequency:	Lower 700MHz (A+B+C Block) Band: 698-716MHz(Uplink); 728-746MHz(Downlink) Upper 700MHz (C Block) Band: 776-787MHz(Uplink); 746-757MHz(Downlink) Cellular Band: 824-849MHz(Uplink); 869-894MHz(Downlink) PCS Band: 1850-1915MHz(Uplink); 1930-1995MHz(Downlink) AWS Band: 1710-1755MHz(Uplink); 2110-2155MHz(Downlink)

Adapter Information:
Model: GM50-120400-F
Input: AC100-240 V 50/60Hz 1.5A
Output:12V, 4.0A

**All measurement and test data in this report was gathered from production sample serial number: 20191030001. (Assigned by the BACL. The EUT supplied by the applicant was received on 2019-10-30)*

Objective

This test report is prepared on behalf of *HONG KONG KONING INDUSTRIAL LIMITED* in accordance with Part 2, Part 20.21 of the Federal Communication Commission's 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:

Test Method: ANSI C63.26-2015, KDB 935210 D03 Signal Booster Measurements v04r04.

All radiated and conducted emissions measurements were performed at Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19 dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0℃
Humidity		6%

Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01 and CAB identifier CN0004 under the ISED requirement. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Justification

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.

Equipment Modifications

No modifications were made to the EUT.

Support Equipment List and Details

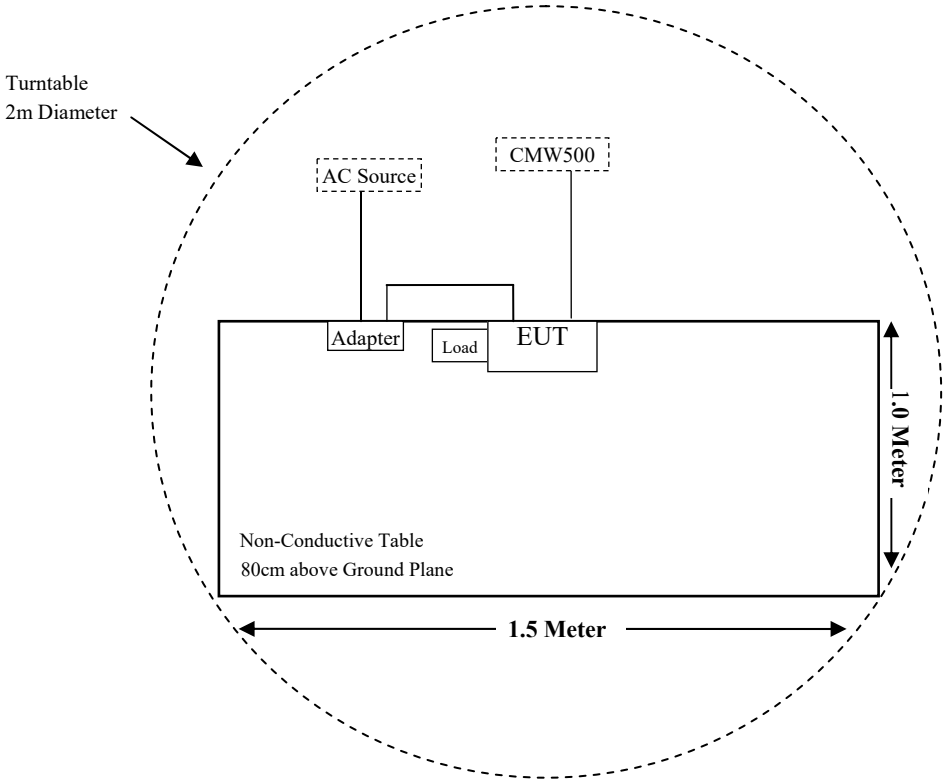
Manufacturer	Description	Model	Serial Number
Not applicable	Load	Not applicable	Not applicable
R & S	Wideband Radio Communication Tester	CMW500	104478

External I/O Cable

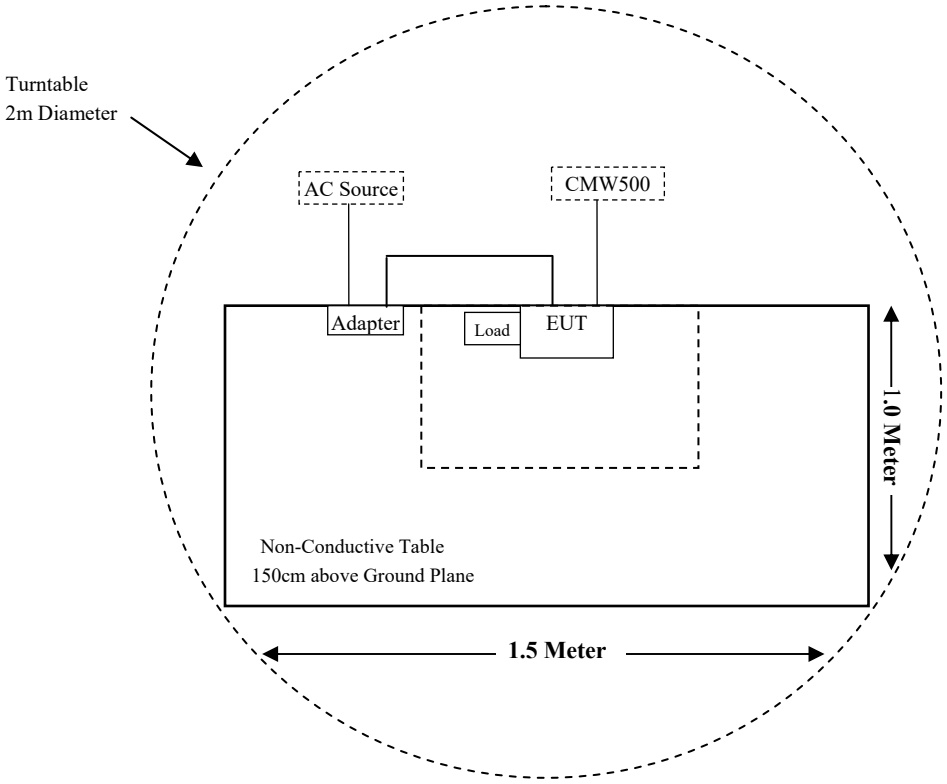
Cable Description	Length (m)	From Port	To
RF Cable	1.2	CMW500	EUT
Power Cable	1.0	EUT	Adapter

Block Diagram of Test Setup

For Radiated Emissions (Below 1GHz):



For Radiated Emissions (Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§20.21(e)(3)	7.1 Authorized Frequency Band Verification	Compliant
§20.21(e)(8)(i)(D) §20.21(e)(8)(i)(B) & §20.21(e)(4)	7.2 Maximum Power Measurement	Compliant
§20.21(e)(8)(i)(C)(2) §20.21(e)(8)(i)(B) & §20.21(e)(4)	7.9 Maximum Booster Gian Computation	Compliant
§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	Compliant
§20.21(e)(8)(i)(E)	7.5 Out Of Band Emissions	Compliant
§20.21(e)(8)(i)(A) §20.21(e)(8)(i)(H)&§20.21(e)(4)	7.7 Noise Limits	Compliant
§20.21(e)(8)(i)(I) &§20.21(e)(4)	7.8 Uplink Inactivity	Compliant
§20.21(e)(8)(i)(C)(1) & §20.21(e)(8)(i)(H)	7.9 Variable Booster Gain	Compliant
§2.1049	7.10 Occupied Bandwidth	Compliant
§20.21(e)(8)(ii)(A) &§20.21(e)(4)	7.11 Oscillation Detection	Compliant
§2.1051	7.6 Spurious Emissions At Antenna Terminals	Compliant
§2.1053	7.12 Radiated Spurious Emissions	Compliant

Note:
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（Chamber 1#）					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2019-11-12	2020-11-11
HP	Signal Generator	HP 8341B	2624A00116	2019-08-29	2020-08-28
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sunol Sciences	Broadband Antenna	JB3	A090314-2	2019-01-09	2022-01-08
Sonoma Instrunent	Pre-amplifier	310N	171205	2019-08-15	2020-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-8	008	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2019-08-15	2020-08-14
keysight	Vector signal source	N5182B	MY53051592	2018-11-30	2019-11-30
keysight	Vector signal source	N5182B	MY53051592	2019-11-30	2020-11-30
R & S	Wideband Radio Communication Tester	CMW500	104478	2019-07-21	2020-07-20
Radiated Emission Test（Chamber 2#）					
HP	Signal Generator	HP 8341B	2624A00116	2019-08-29	2020-08-28
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2019-08-27	2020-08-26
ETS-LINDGREN	Horn Antenna	3115	9311-4159	2019-01-11	2022-01-10
ETS-LINDGREN	Horn Antenna	3115	6229	2019-01-11	2022-01-10
ETS-LINDGREN	Horn Antenna	3116	00084159	2019-10-18	2022-10-17
ETS-LINDGREN	Horn Antenna	3116	2516	2016-12-12	2019-12-12
Mini-Circuits	Amplifier	ZVA-183W-S+	220701818	2019-05-20	2020-05-19
EM Electronics Corporation	Amplifier	EM18G40G	060726	2019-03-22	2020-03-21
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-16	016	2019-08-15	2020-08-14
keysight	Vector signal source	N5182B	MY53051592	2018-11-30	2019-11-30
keysight	Vector signal source	N5182B	MY53051592	2019-11-30	2020-11-30
R & S	Wideband Radio Communication Tester	CMW500	104478	2019-07-21	2020-07-20

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSV40	101116	2019-07-23	2020-07-22
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2018-11-30	2019-11-29
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2019-11-30	2020-11-29
Narda	Attenuator	6dB	006	2019-01-10	2020-01-09
Narda	Attenuator	10dB	010	2019-08-15	2020-08-14
HP	Attenuator/11dB	8494B	011	2019-01-10	2020-01-09
Agilent	Attenuator/110dB	8496B	110	2019-01-10	2020-01-09
keysight	Vector signal source	N5182B	MY53051592	2018-11-30	2019-11-30
keysight	Vector signal source	N5182B	MY53051592	2019-11-30	2020-11-30
R & S	Wideband Radio Communication Tester	CMW500	104478	2019-07-21	2020-07-20
Mini-Ciruits	Power splitter	ZFRSC-14-S+	SF019411452	2018-11-10	2019-11-09
Mini-Ciruits	Power splitter	ZFRSC-14-S+	SF019411452	2019-11-10	2020-11-09
HONG KONG KONING INDUSTRIAL LIMITED	RF Cable	HONG KONG KONING INDUSTRIAL LIMITED C01	C01	Each Time	/

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to NIST and CNAS requirements that traceable to National Primary Standards and International System of Units (SI).

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

Applicable Standards

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

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.

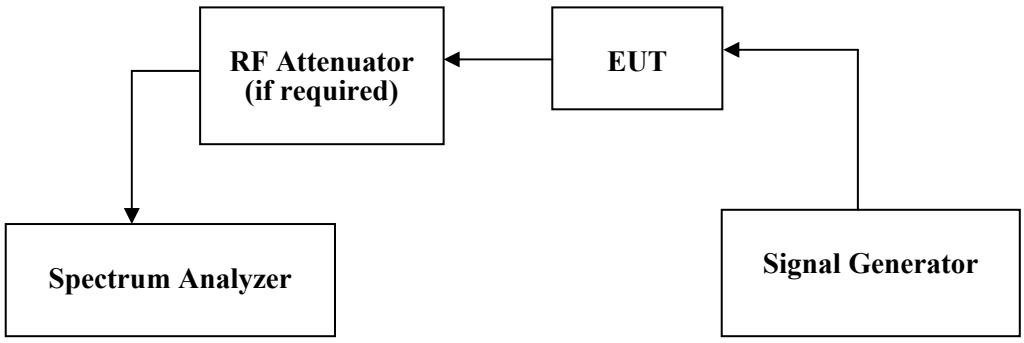


Figure 1-Band verification test instrumentation setup

Test Data

Environmental Conditions

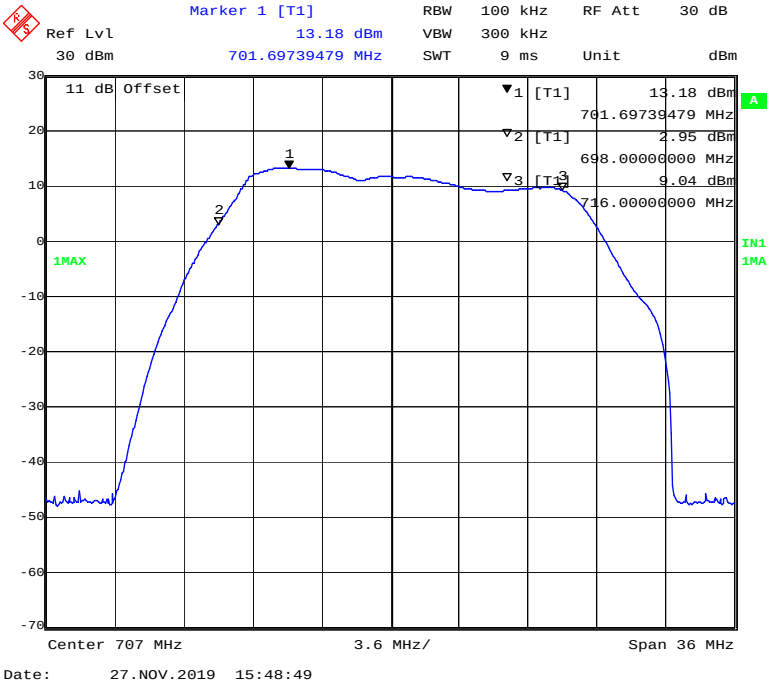
Temperature:	20.5 ℃
Relative Humidity:	52 %
ATM Pressure:	101.2 kPa

The testing was performed by Stone Zhang on 2019-11-27.

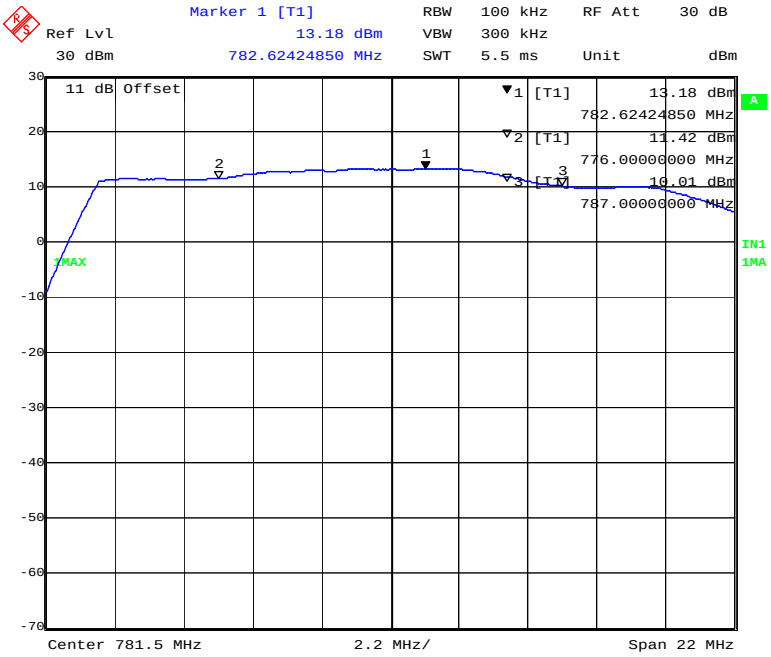
Test Result: Compliant. Please refer to following plots.

Uplink:

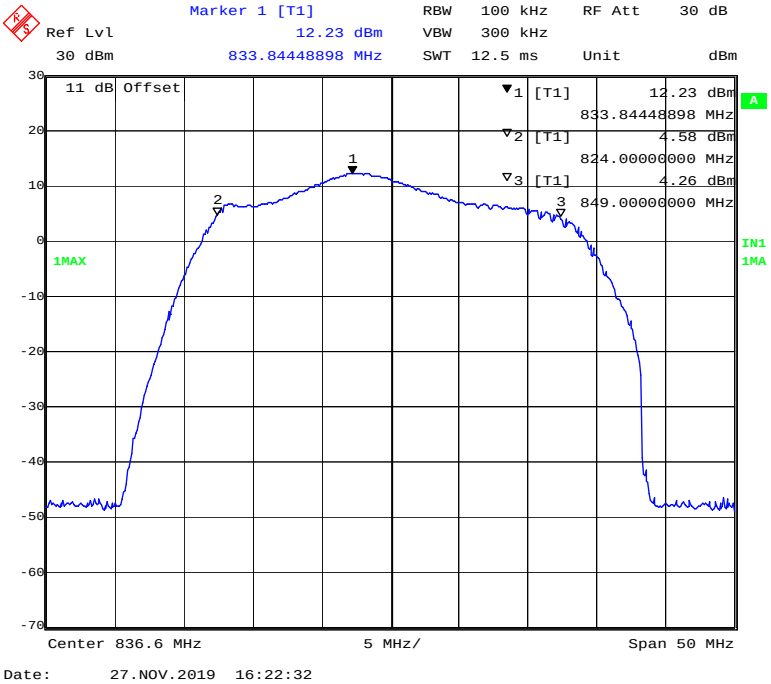
Lower 700MHz Band



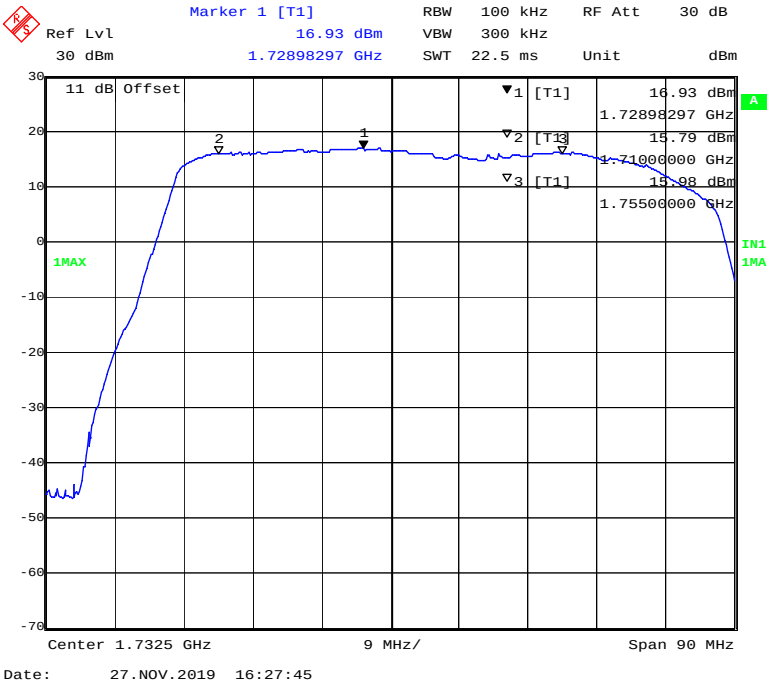
Upper 700MHz Band



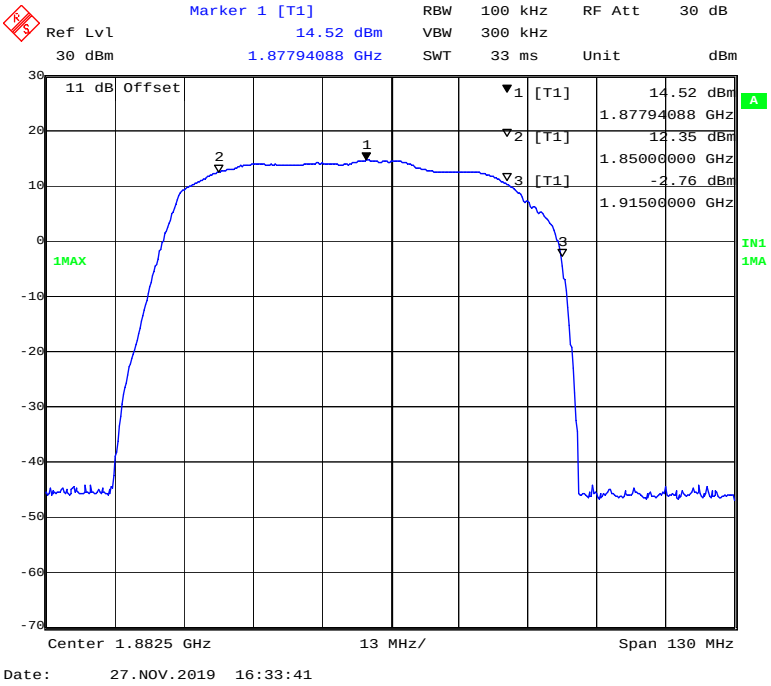
Cellular Band



AWS Band

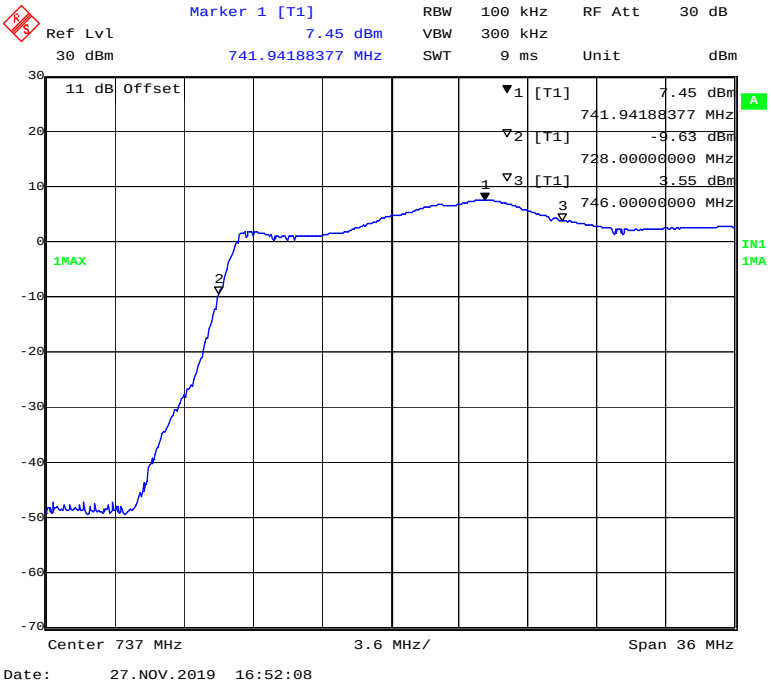


PCS Band



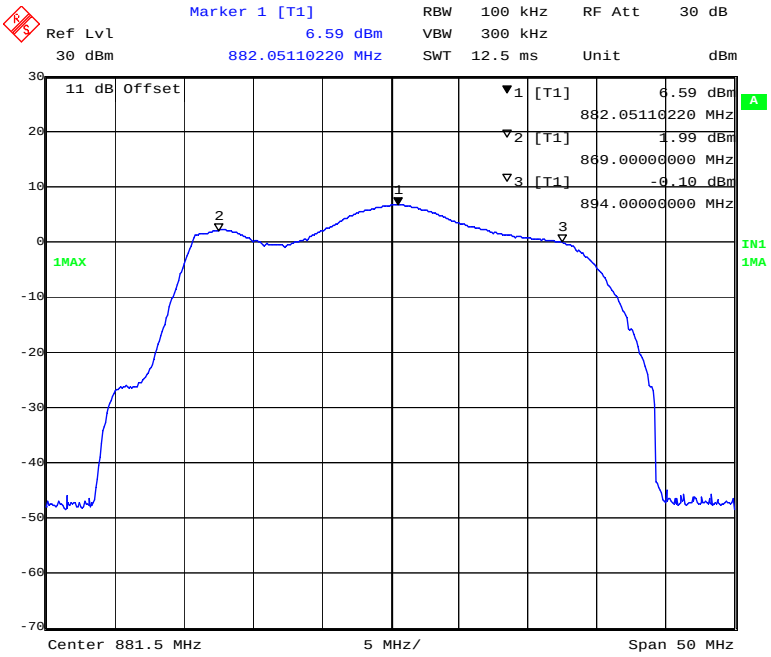
Downlink:

Lower 700MHz Band

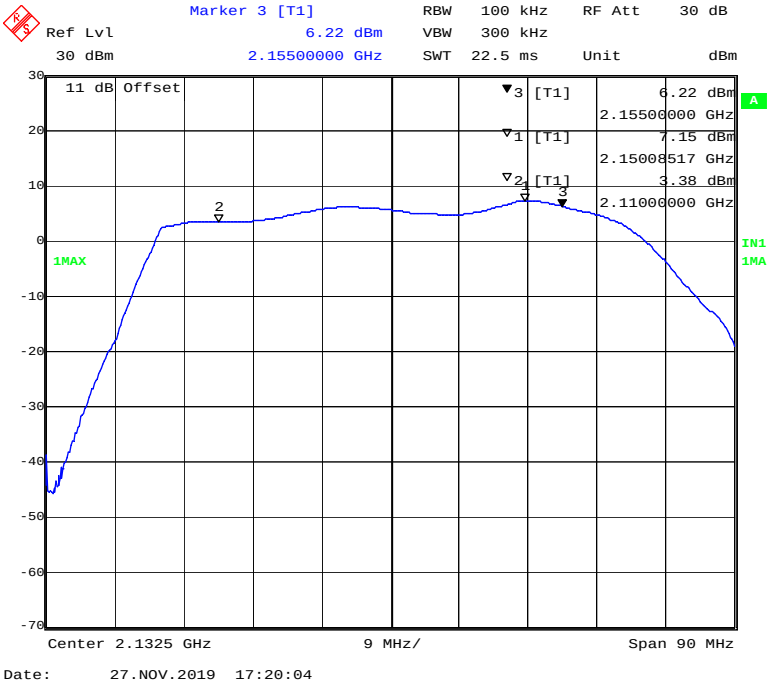


Upper 700MHz Band

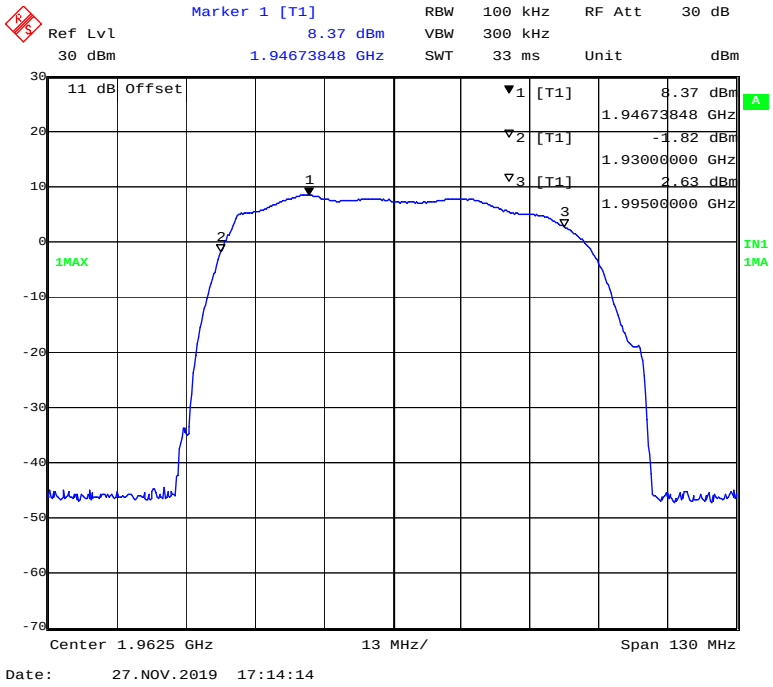
Cellular Band



AWS Band



PCS Band


Marker 1 [T1]
Ref Lvl
30 dBm
8.37 dBm
1.94673848 GHz
RBW 100 kHz
VBW 300 kHz
SWT 33 ms
RF Att 30 dB
Unit dBm
11 dB Offset
1 [T1] 8.37 dBm
1.94673848 GHz
2 [T1] -1.82 dBm
1.93000000 GHz
3 [T1] 2.63 dBm
1.99500000 GHz
1MAX
IN1
1MA
Center 1.9625 GHz
13 MHz/
Span 130 MHz
Date: 27.NOV.2019 17:14:14

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

Applicable Standards

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 $\geqslant$ 3 $\times$ 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 POUT 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:	20.5 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

The testing was performed by Stone Zhang on 2019-11-27.

Test Result: Compliant.

Output Power:

Modes	Operation Band	Signal Type	Pin	AGC level	Conducted Output Level	Antenna Gain	Cable Loss	Lightning Protector Loss	EIRP	Limit
			(dBm)	(dBm)	(dBm)	(dBi)	(dB)	(dB)	(dBm)	(dBm)
Uplink	PCS	AWGN	-42.6	-42.3	19.32	11	1.8	0.18	28.34	17-30
		GSM	-41.4	-41.2	18.22	11	1.8	0.18	27.24	
	AWS	AWGN	-45.0	-44.9	19.11	11	1.8	0.16	28.15	
		GSM	-44.8	-44.6	19.14	11	1.8	0.16	28.18	
	Cellular	AWGN	-36.8	-36.5	18.89	10	1.2	0.10	27.59	
		GSM	-36.1	-35.7	18.34	10	1.2	0.10	27.04	
	Lower 700	AWGN	-38.1	-37.8	17.31	10	1.2	0.10	26.01	
		GSM	-37.6	-37.4	17.25	10	1.2	0.10	25.95	
	Upper 700	AWGN	-37.8	-37.5	18.63	10	1.2	0.10	27.33	
		GSM	-37.5	-37.4	18.54	10	1.2	0.10	27.24	
Downlink	PCS	AWGN	-50.8	-50.5	10.46	1.5	1.8	/	10.16	≤17
		GSM	-51.1	-50.7	10.65	1.5	1.8	/	10.35	
	AWS	AWGN	-50.1	-49.9	10.02	1.5	1.8	/	9.72	
		GSM	-50.5	-50.3	9.90	1.5	1.8	/	9.6	
	Cellular	AWGN	-49.8	-49.6	10.25	1	1.2	/	10.05	
		GSM	-49.4	-49.2	10.65	1	1.2	/	10.45	
	Lower 700	AWGN	-50.0	-49.7	8.02	1	1.2	/	7.82	
		GSM	-48.5	-48.3	7.18	1	1.2	/	6.98	
	Upper 700	AWGN	-48.0	-47.6	8.82	1	1.2	/	8.62	
		GSM	-47.2	-47.0	8.14	1	1.2	/	7.94	

Note:
1) 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.
2) The Lightning Protector only installed for outside port.
3) Uplink: the worst antenna kit number:WD11-30400; Downlink: the worst antenna kit number:5-30400-50

Maximum Input Level:

Modes	Operation Band	Signal Type	Maximum Input Level (dBm)	Maximum Input Level Limits (dBm)	Conducted Output Level (dBm)
Uplink	PCS	AWGN	-33	27.0	19.50
		GSM	-31		18.45
	AWS	AWGN	-36		19.34
		GSM	-34		19.36
	Cellular	AWGN	-29		19.03
		GSM	-27		18.56
	Lower 700	AWGN	-32		17.52
		GSM	-30		17.68
	Upper 700	AWGN	-29		18.66
		GSM	-27		18.59
Downlink	PCS	AWGN	-42	-20.0	10.51
		GSM	-42		10.71
	AWS	AWGN	-41		10.02
		GSM	-40		9.98
	Cellular	AWGN	-39		10.26
		GSM	-39		10.69
	Lower 700	AWGN	-43		8.09
		GSM	-39		7.27
	Upper 700	AWGN	-38		8.89
		GSM	-37		8.21

§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:	21.2 ℃
Relative Humidity:	51 %
ATM Pressure:	101.1 kPa

The testing was performed by Stone Zhang on 2019-11-28.

EUT operation mode: Transmitting

Test Result: Compliant.

Maximum Gain:

Mode	Operation Band	Signal Type	Pre AGC Input Level	Conducted Output Level	Gain	Limit
			dBm	dBm	dB	dB
Uplink	PCS	AWGN	-42.30	19.32	61.62	71.99
		GSM	-41.20	18.22	59.42	
	AWS	AWGN	-44.90	19.11	64.01	71.27
		GSM	-44.60	19.14	63.74	
	Cellular	AWGN	-36.50	18.89	55.39	64.95
		GSM	-35.70	18.34	54.04	
	Lower 700	AWGN	-37.80	16.22	54.02	63.49
		GSM	-37.40	16.61	54.01	
	Upper 700	AWGN	-37.50	18.63	56.13	63.36
		GSM	-37.40	18.54	55.94	
Downlink	PCS	AWGN	-50.50	10.46	60.96	71.99
		GSM	-50.70	10.65	61.35	
	AWS	AWGN	-49.90	10.02	59.92	71.27
		GSM	-50.30	9.90	60.20	
	Cellular	AWGN	-49.60	10.25	59.85	64.95
		GSM	-49.20	10.65	59.85	
	Lower 700	AWGN	-49.70	8.02	57.72	63.49
		GSM	-48.30	7.18	55.48	
	Upper 700	AWGN	-47.60	8.82	56.42	63.36
		GSM	-47.00	8.14	55.14	

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:

Operation Band	Signal Type	Uplink Gain	Downlink Gain	Caculated Value	Limit
		dB	dB	dB	dB
PCS	AWGN	61.62	60.96	0.66	±9
	GSM	59.42	61.35	-1.93	
AWS	AWGN	64.01	59.92	4.09	
	GSM	63.74	60.20	3.54	
Cellular	AWGN	55.39	59.85	-4.46	
	GSM	54.04	59.85	-5.81	
Lower 700	AWGN	54.02	57.72	-3.70	
	GSM	54.01	55.48	-1.47	
Upper 700	AWGN	56.13	56.42	-0.29	
	GSM	55.94	55.14	0.80	

§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

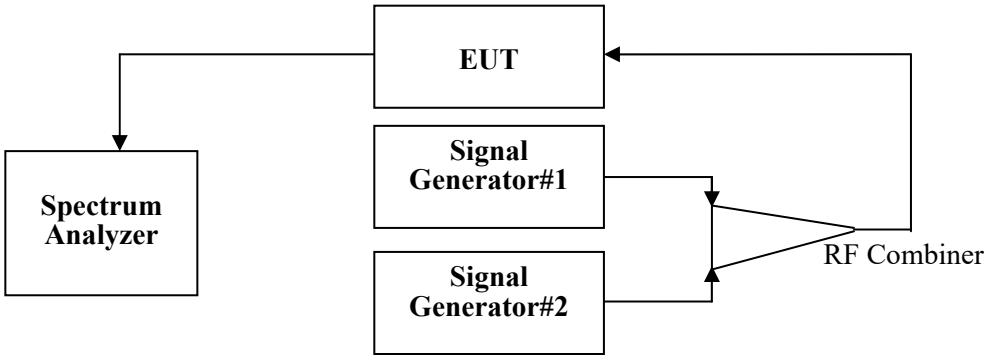


Figure 2 – Intermodulation Product Instrumentation Test Setup

Test Data

Environmental Conditions

Temperature:	22.5 ℃
Relative Humidity:	51 %
ATM Pressure:	101.2 kPa

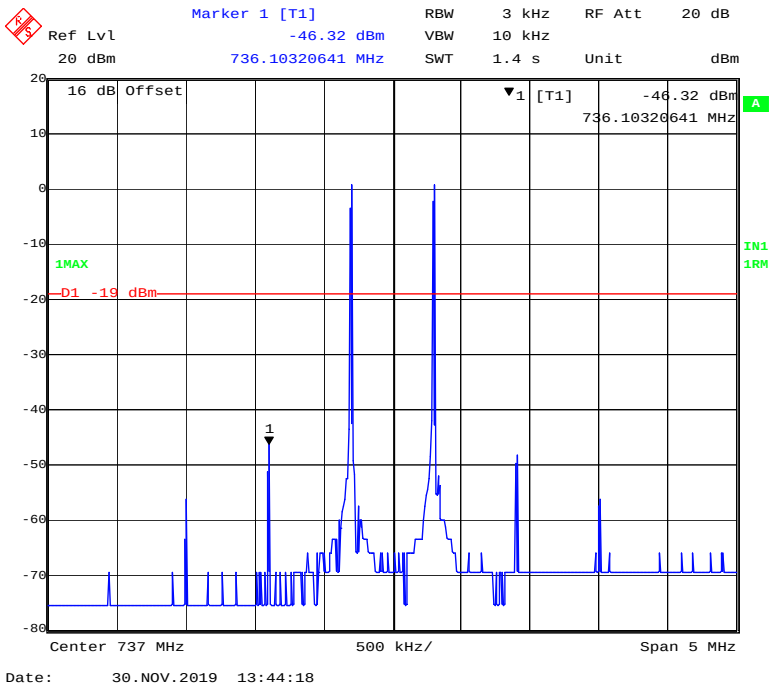
The testing was performed by Stone Zhang on 2019-11-30.

EUT operation mode: Transmitting

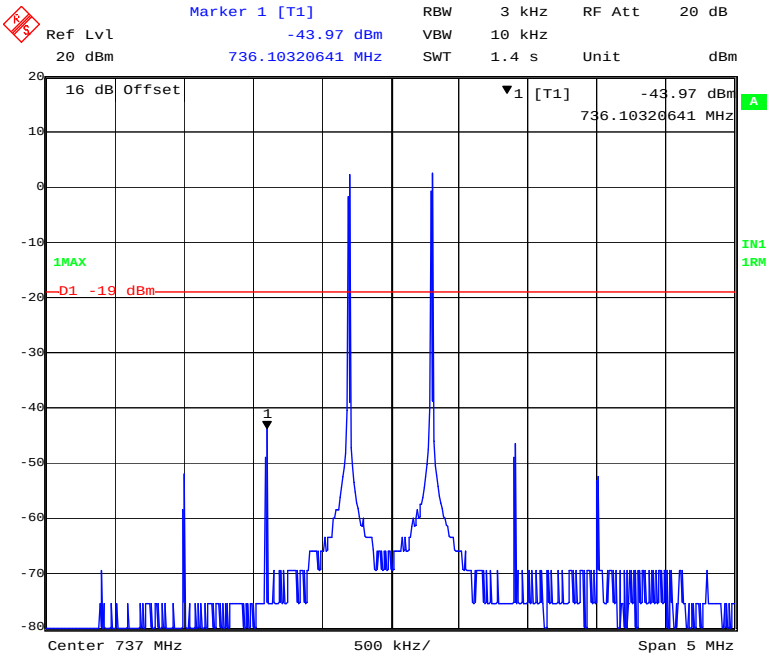
Test Result: Compliant.

Downlink:

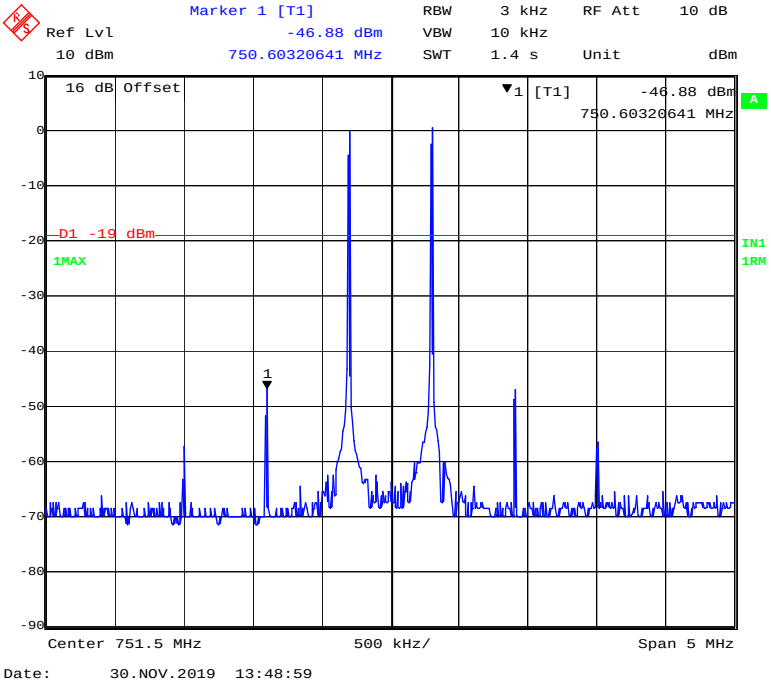
Lower 700MHz-Pre AGC



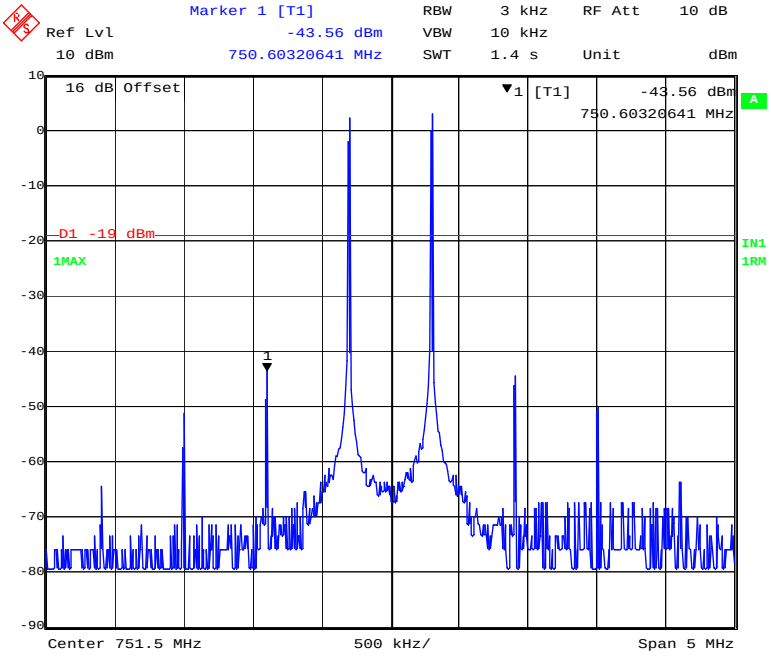
Lower 700MHz-Above AGC



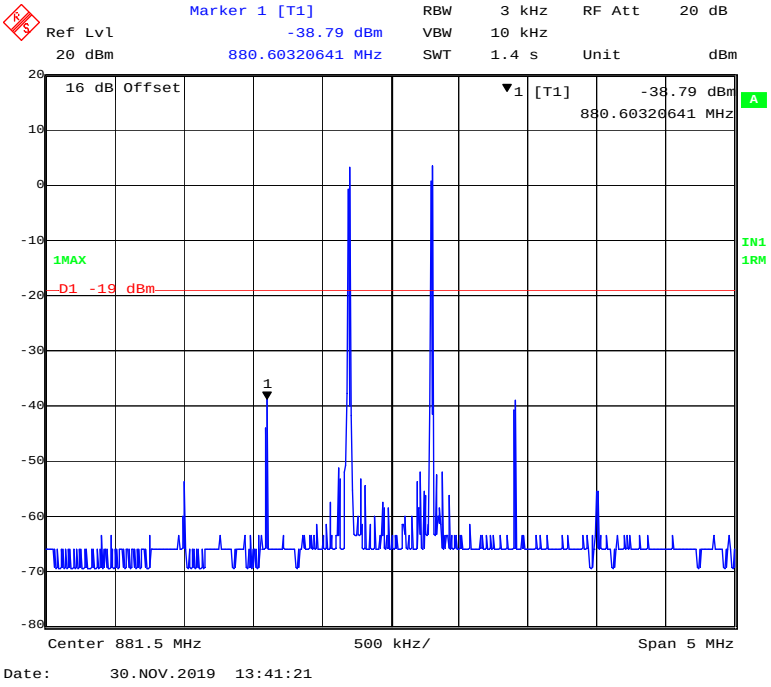
Upper 700MHz - Pre AGC



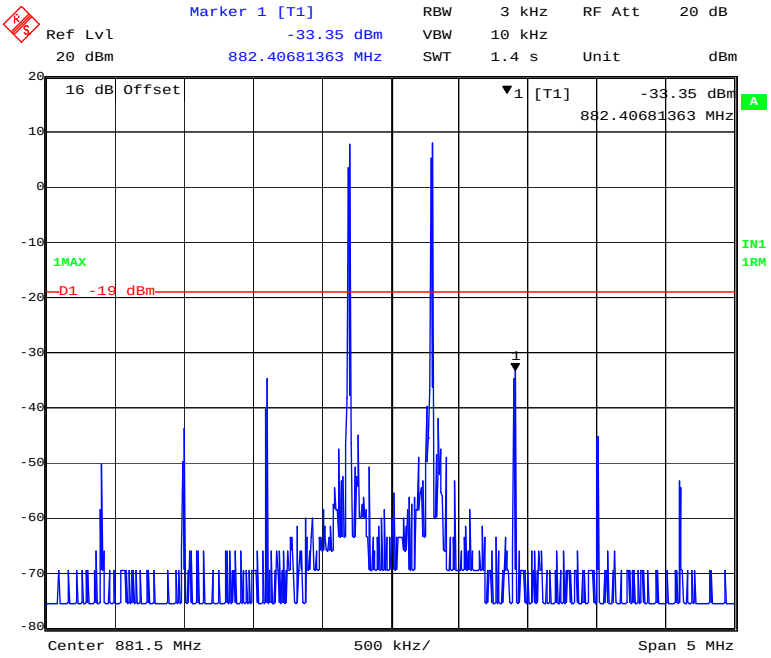
Upper 700MHz - Above AGC



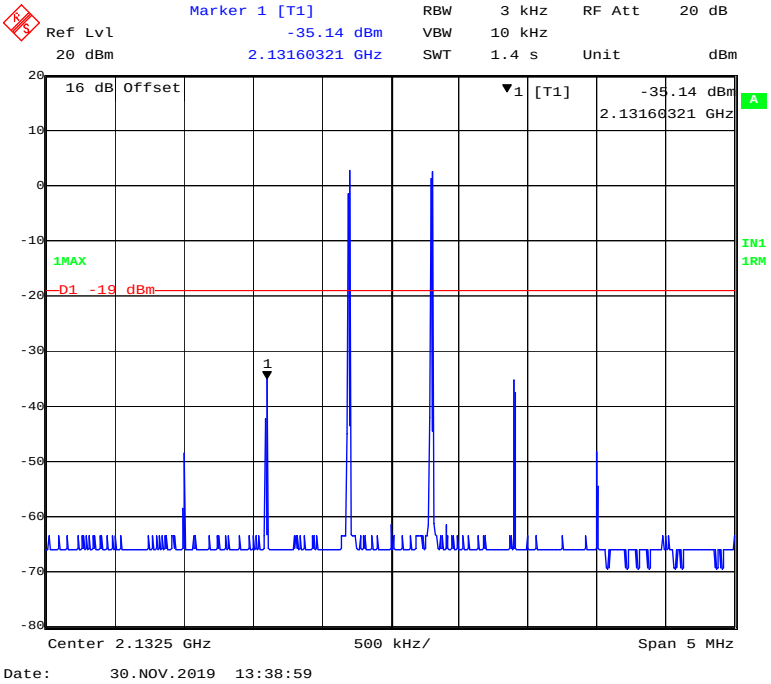
Cellular-Pre AGC



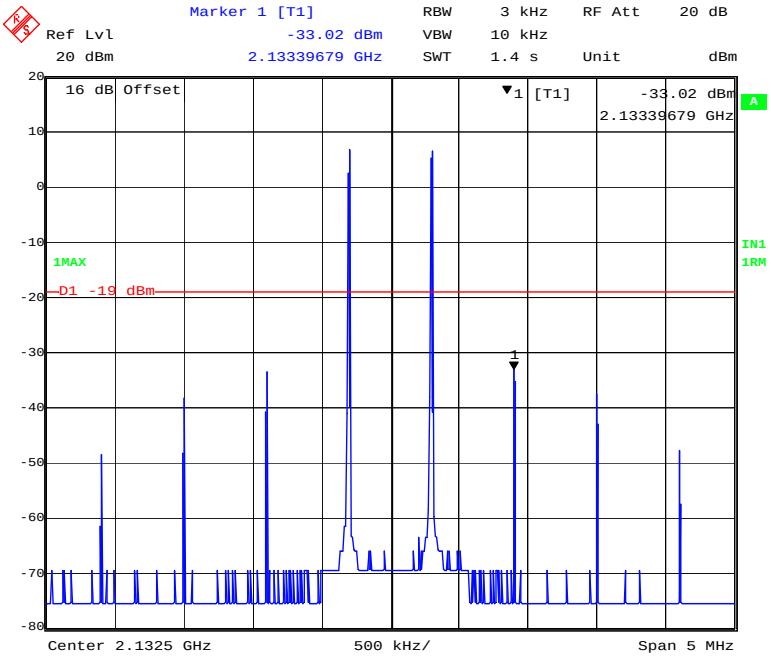
Cellular-Above AGC



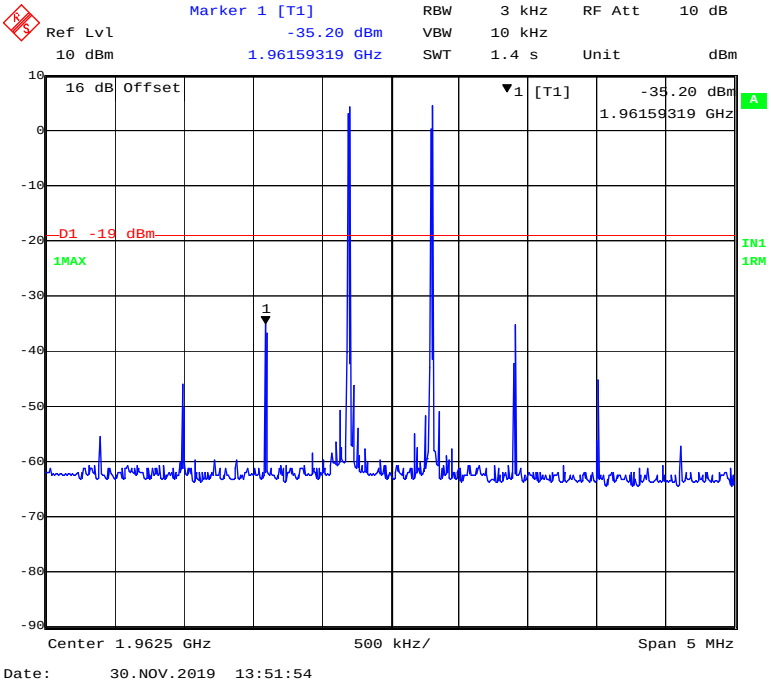
AWS-Pre AGC



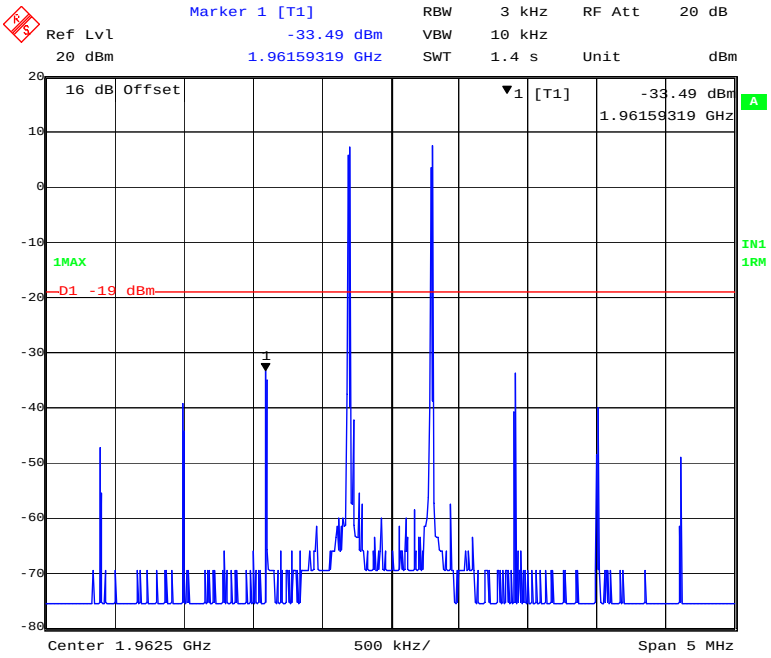
AWS-Above AGC



PCS-Pre AGC

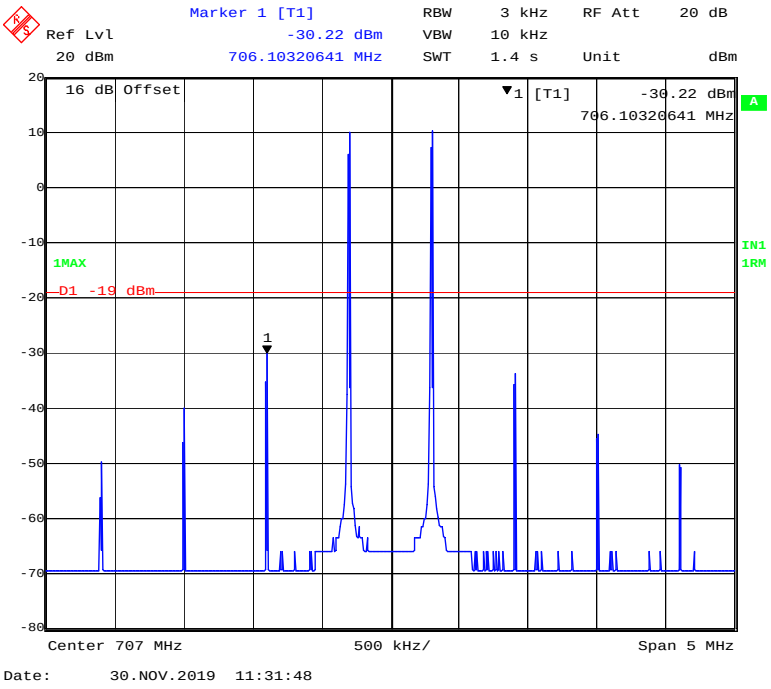


PCS-Above AGC

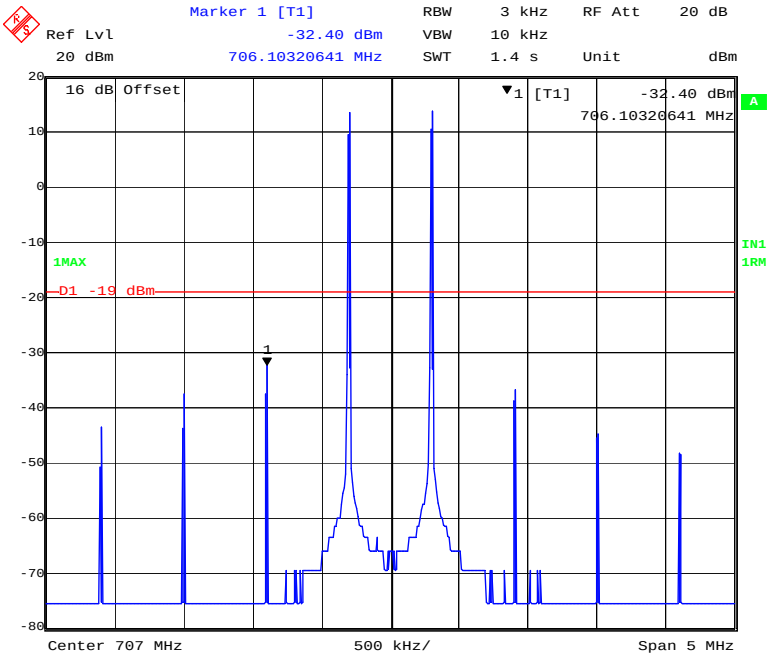


Uplink:

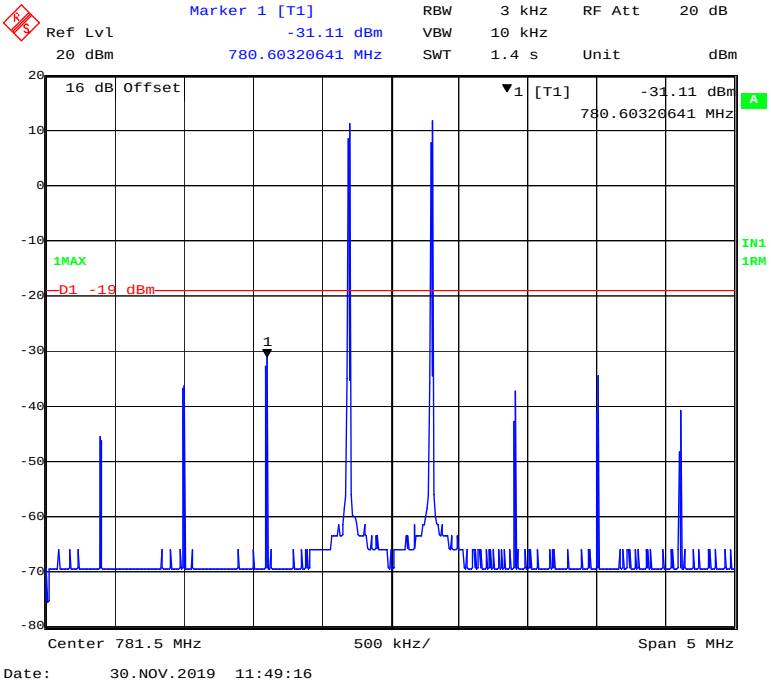
Lower 700MHz- Pre AGC



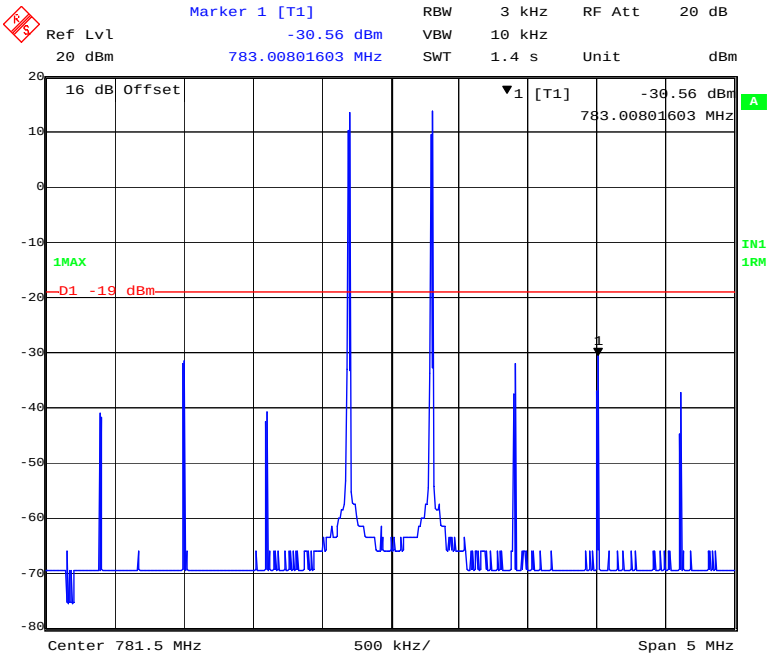
Lower 700MHz-Above AGC



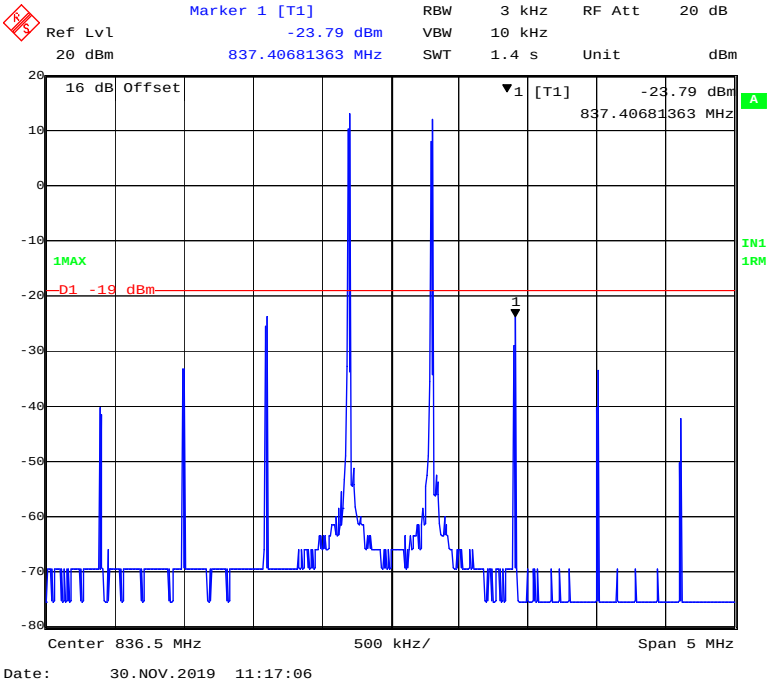
Upper 700MHz-Pre AGC



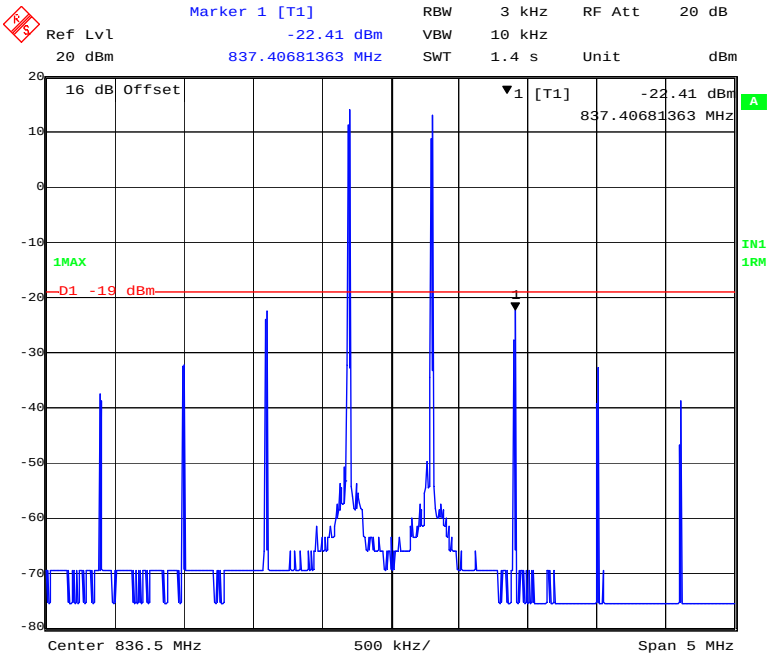
Upper 700MHz-Above AGC



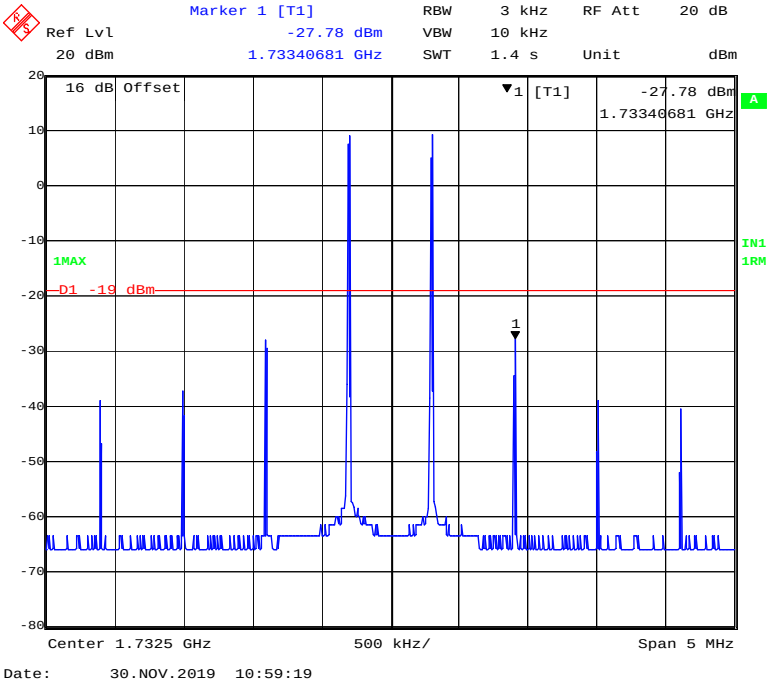
Cellular- Pre AGC



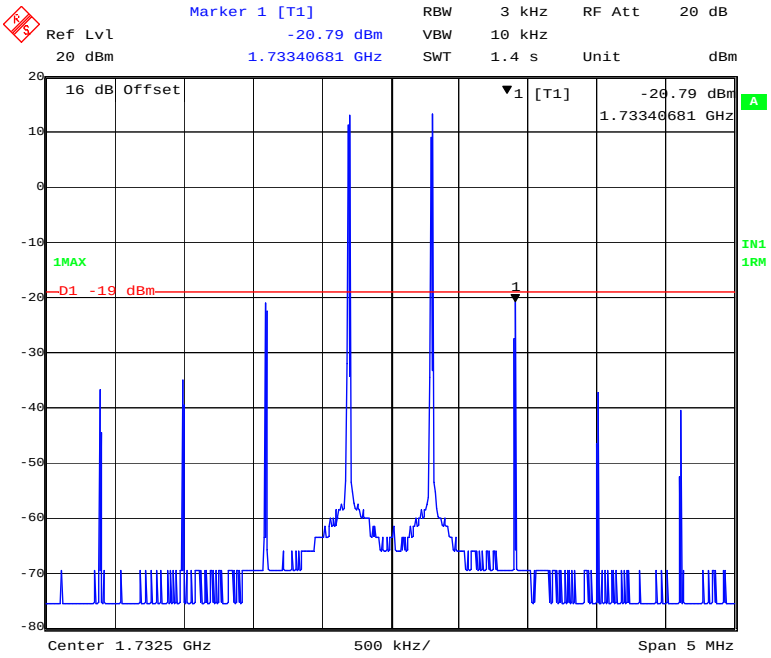
Cellular-Above AGC



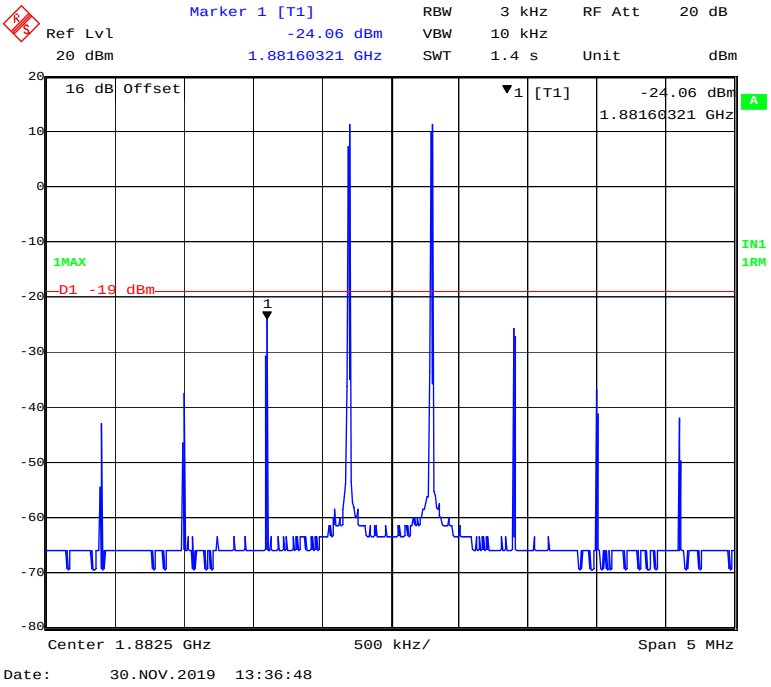
AWS-Pre AGC



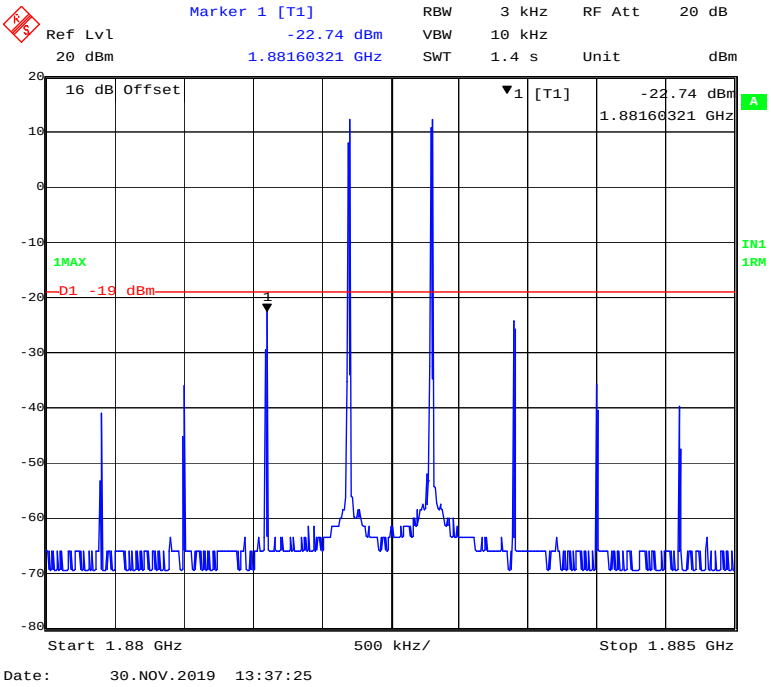
AWS-Above AGC



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.

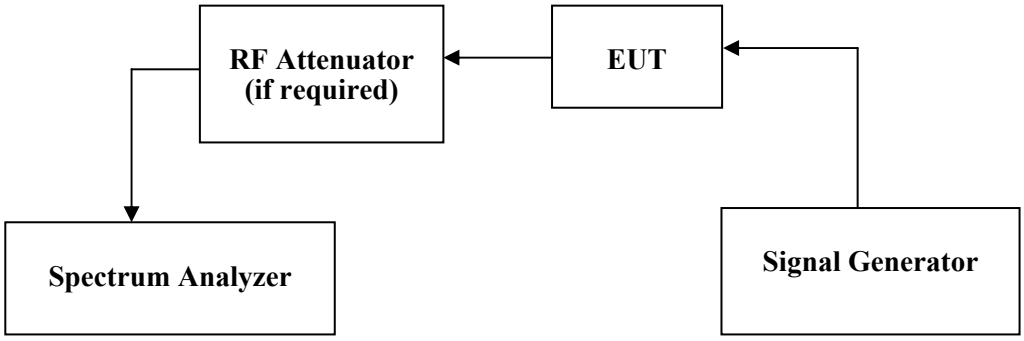


Figure 1-Band verification test instrumentation setup

Test Data

Environmental Conditions

Temperature:	21.2 ℃
Relative Humidity:	51 %
ATM Pressure:	101.2 kPa

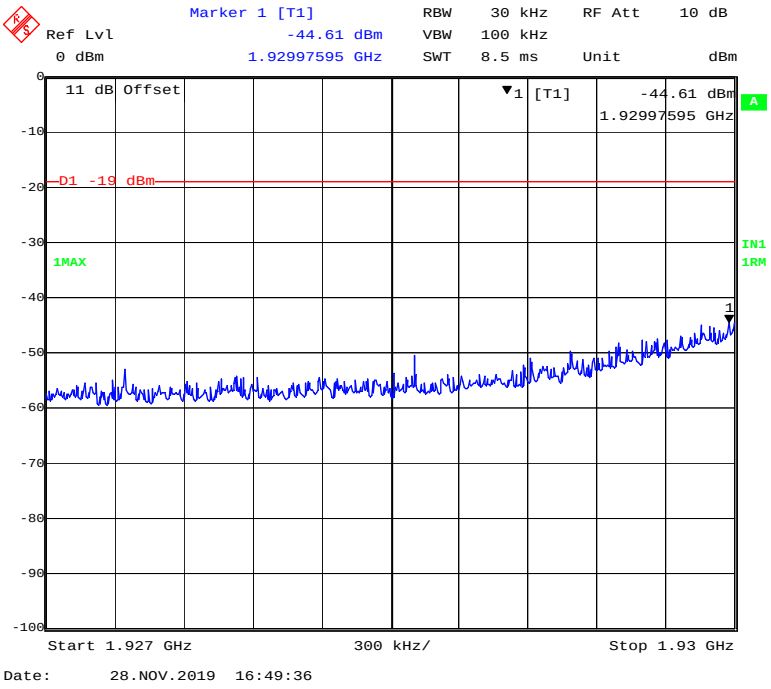
The testing was performed by Stone Zhang on 2019-11-28.

EUT operation mode: Transmitting

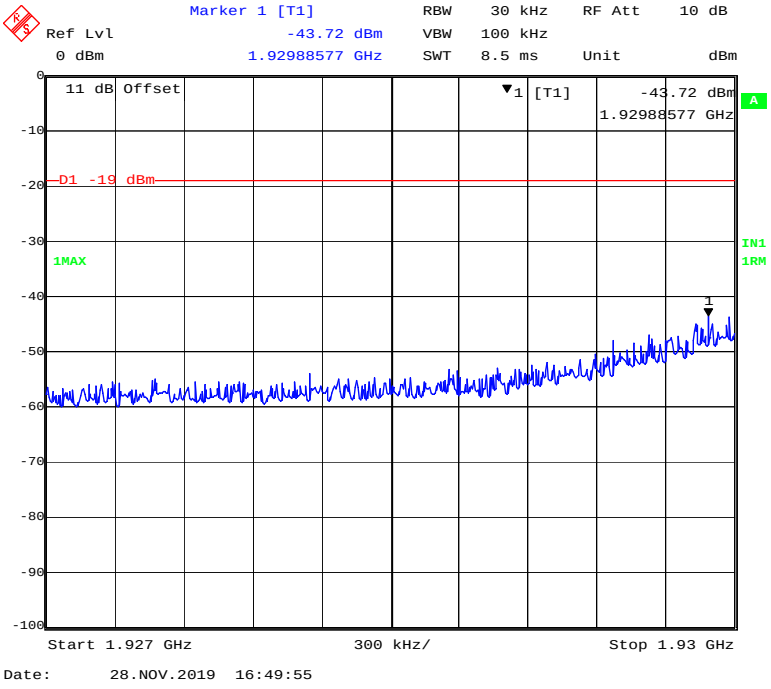
Test Result: Compliant. Please refer to following plots.

Downlink:

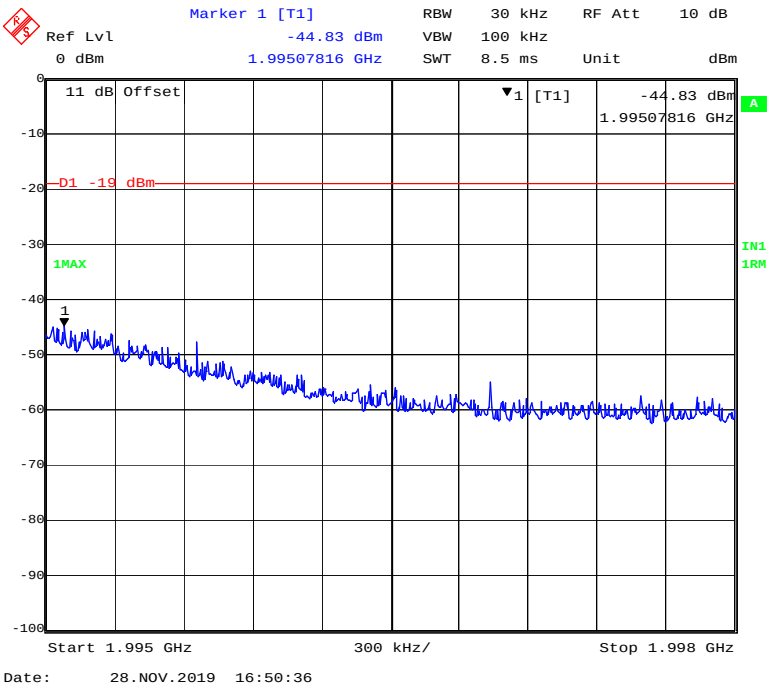
PCS Band CDMA Left Side 1931.25MHz Pre-AGC



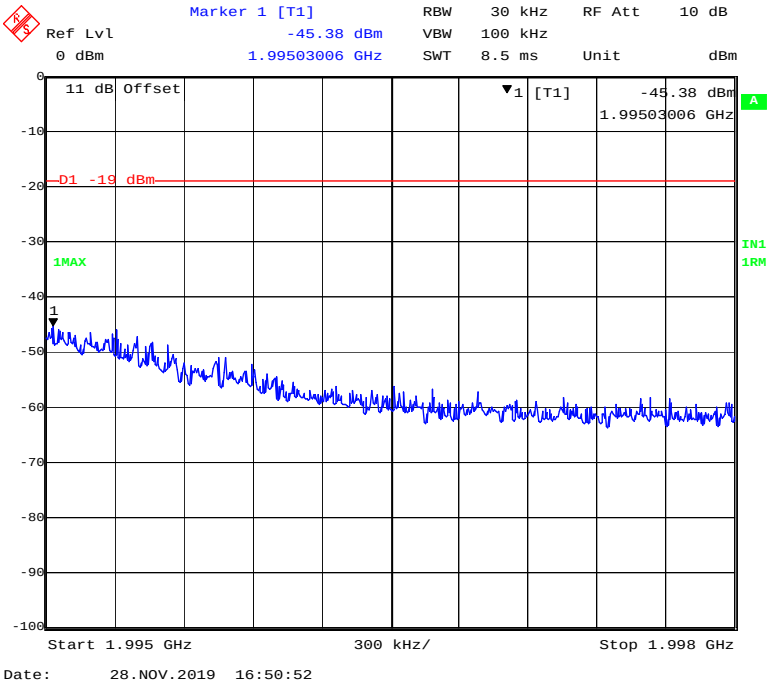
PCS Band CDMA Left Side 1931.25MHz Above AGC



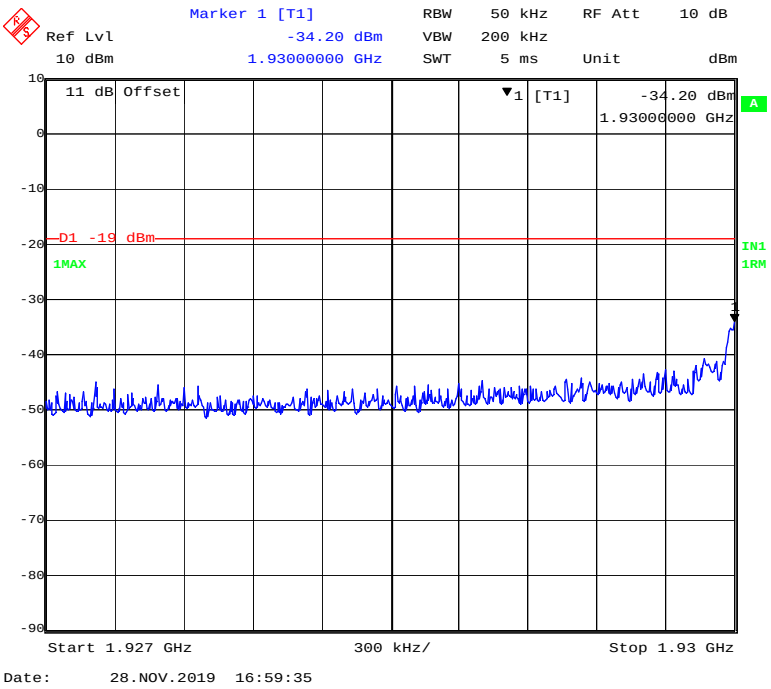
PCS Band CDMA Right Side 1993.75MHz Pre-AGC



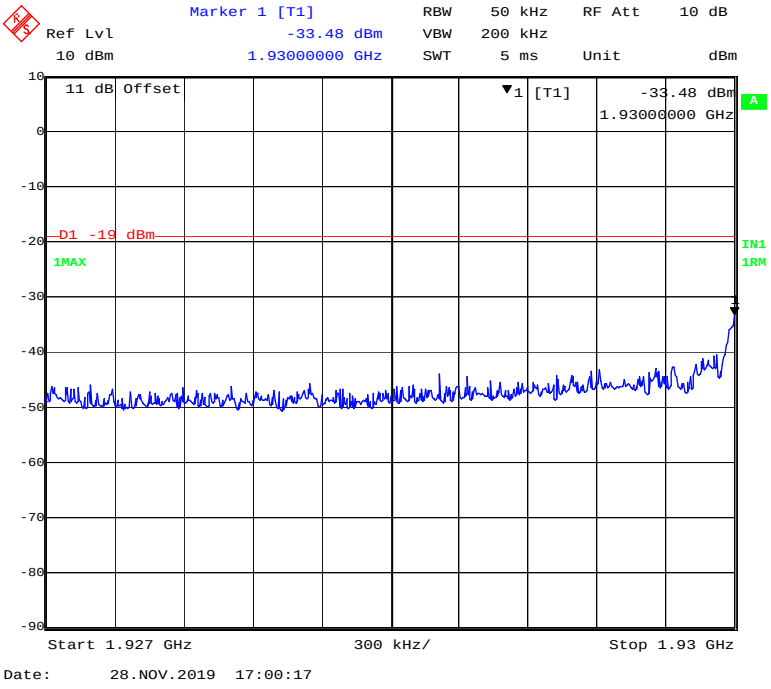
PCS Band CDMA Right Side 1993.75MHz Above AGC



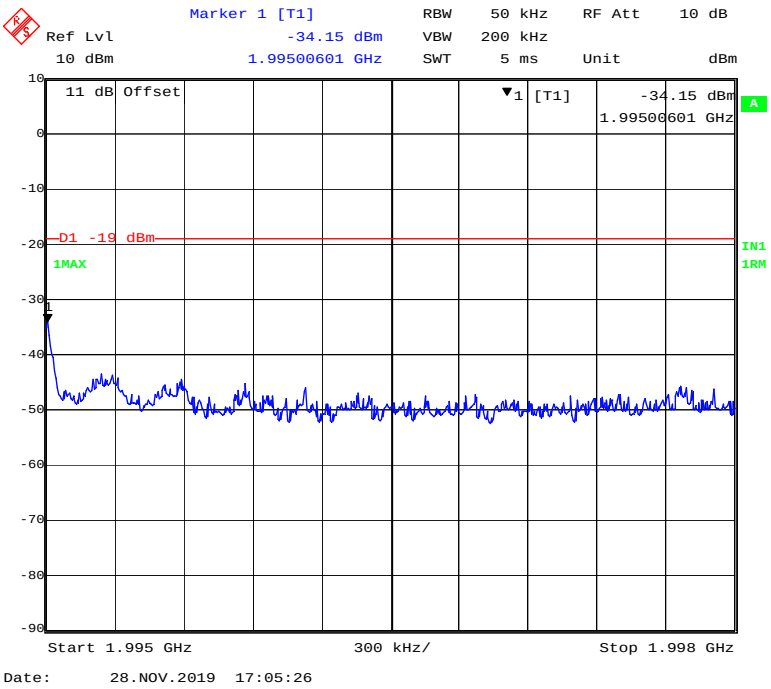
PCS Band LTE Left Side 1932.5MHz Pre-AGC



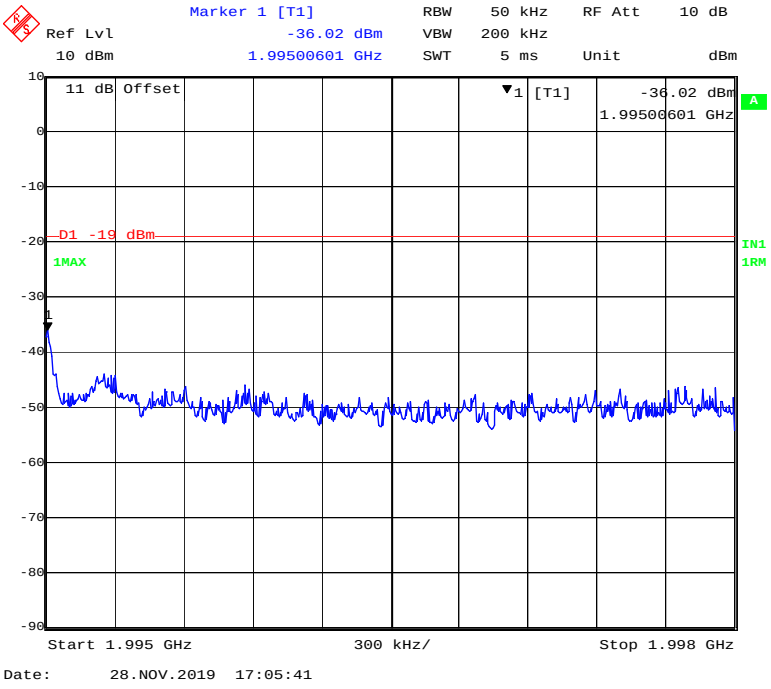
PCS Band LTE Left Side 1932.5MHz Above AGC



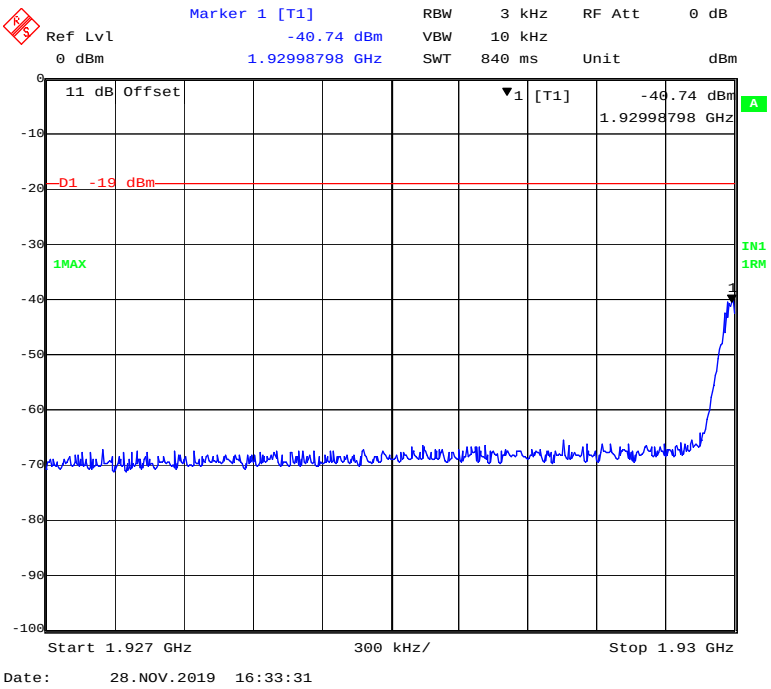
PCS Band LTE Right Side 1992.5MHz Pre-AGC



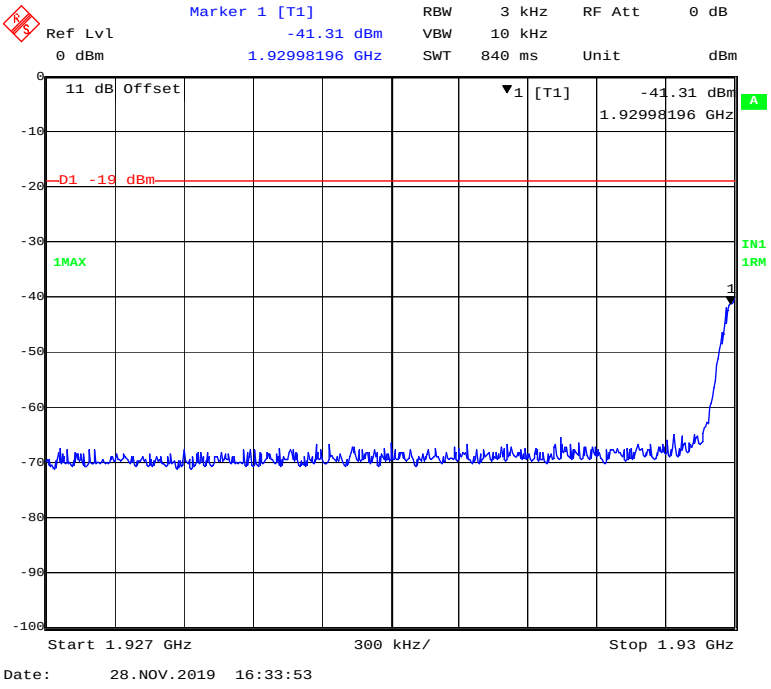
PCS Band LTE Right Side 1992.5MHz Above AGC



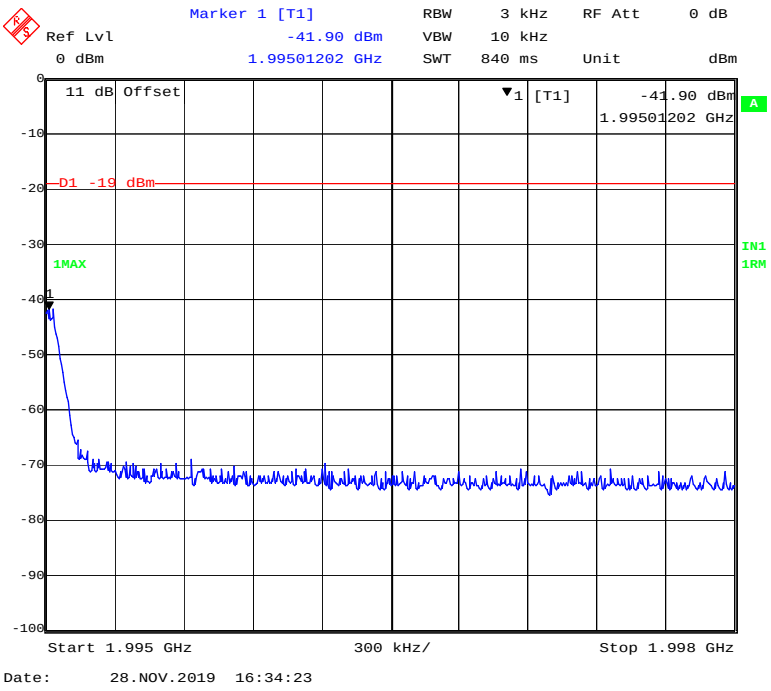
PCS Band GSM Left Side 1930.2MHz Pre-AGC



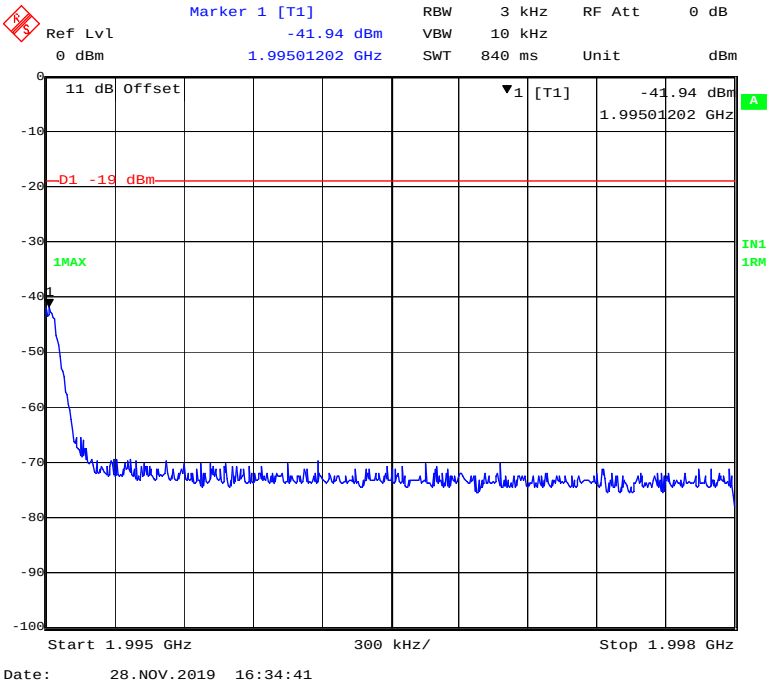
PCS Band GSM Left Side 1930.2MHz Above AGC



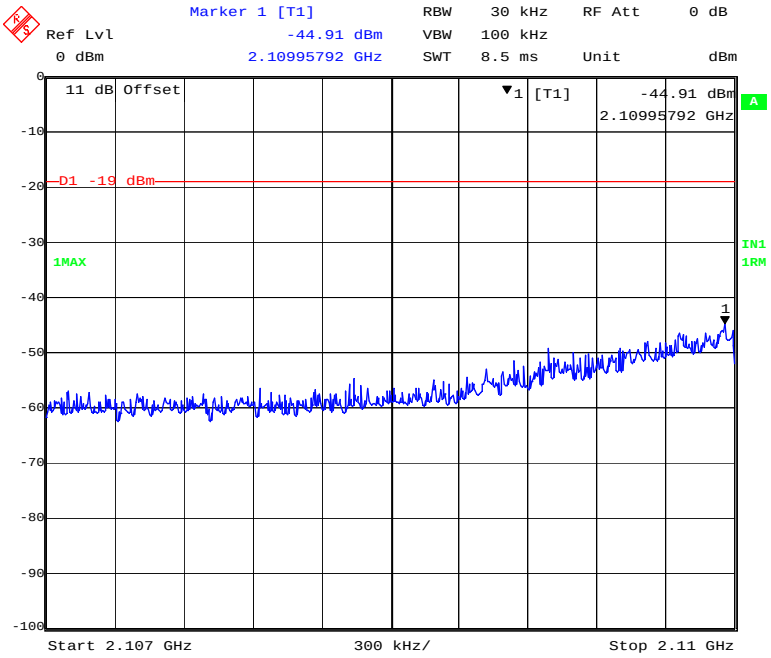
PCS Band GSM Right Side 1994.8MHz Pre-AGC



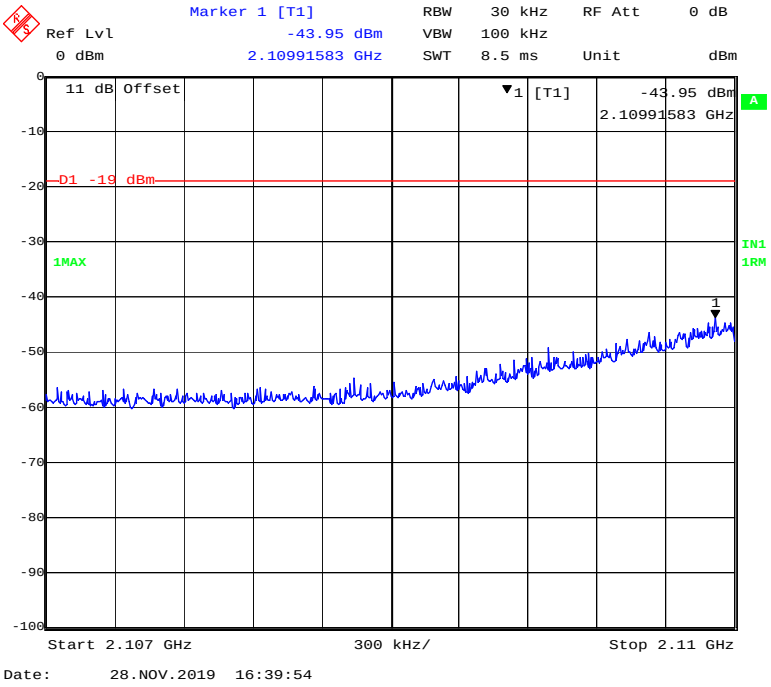
PCS Band GSM Right Side 1994.8MHz Above AGC



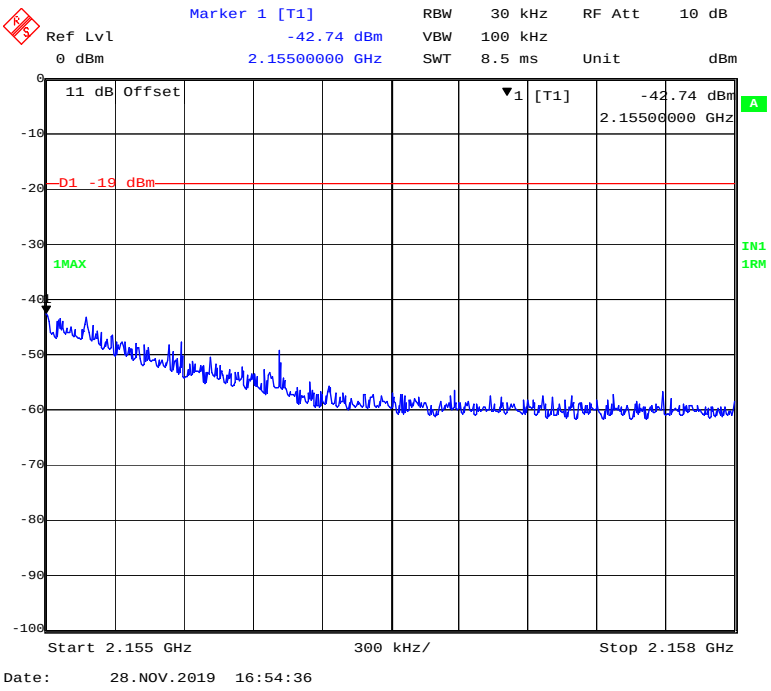
AWS Band CDMA Left Side 2111.25MHz Pre-AGC



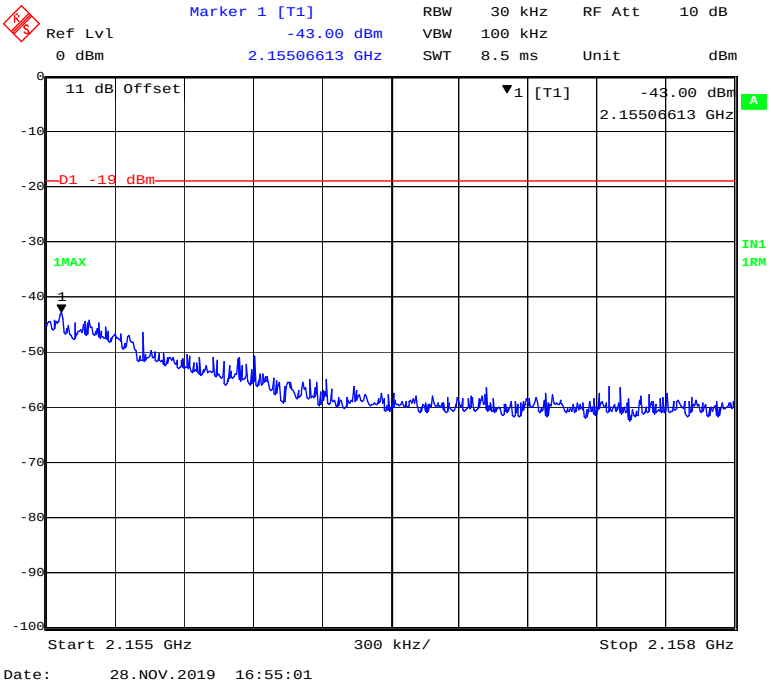
AWS Band CDMA Left Side 2111.25MHz Above AGC



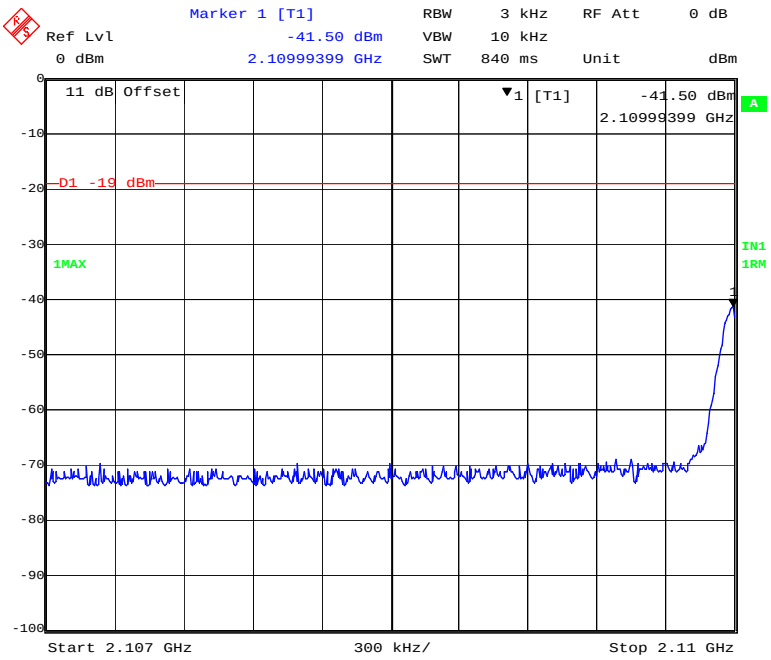
AWS Band CDMA Right Side 2153.75MHz Pre-AGC



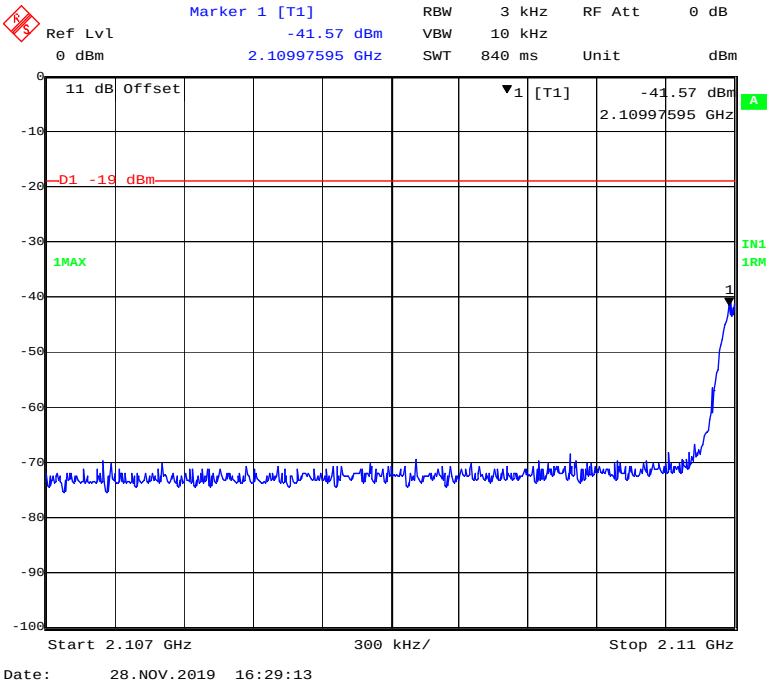
AWS Band CDMA Right Side 2153.75MHz Above AGC



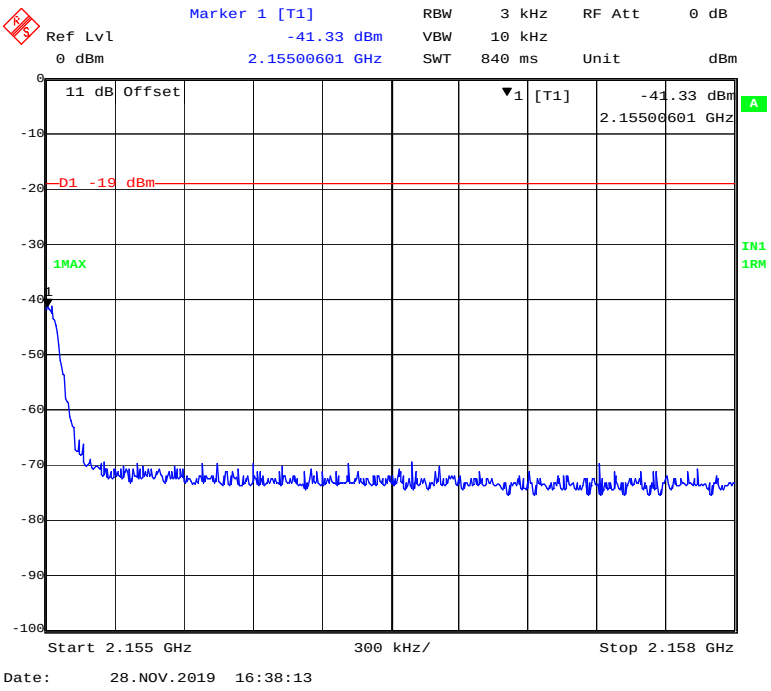
AWS Band GSM Left Side 2110.2MHz Pre-AGC



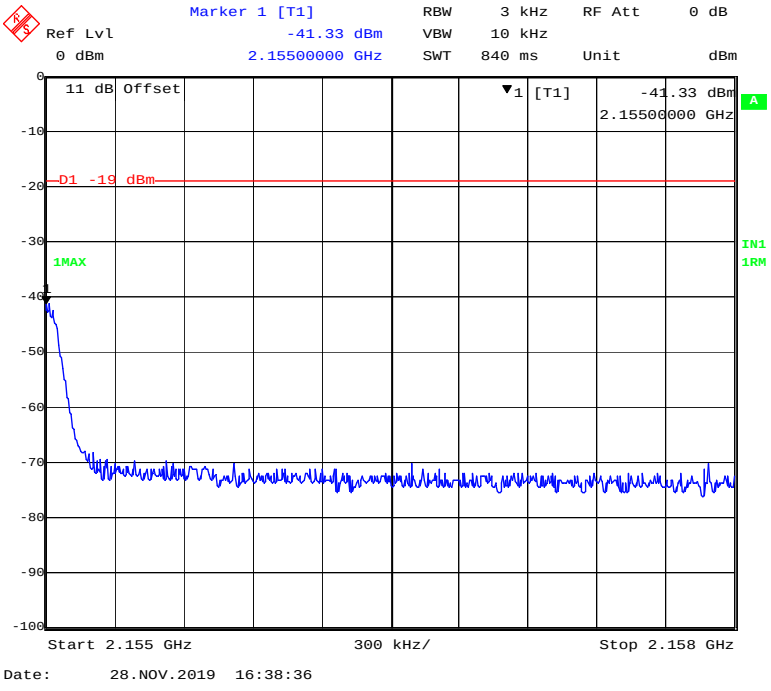
AWS Band GSM Left Side 2110.2MHz Above AGC



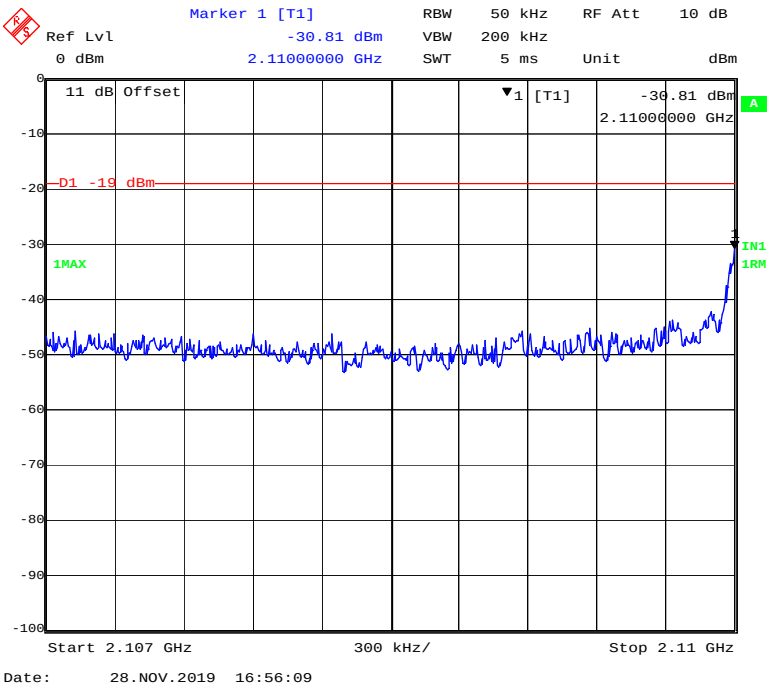
AWS Band GSM Right Side 2154.8MHz Pre-AGC



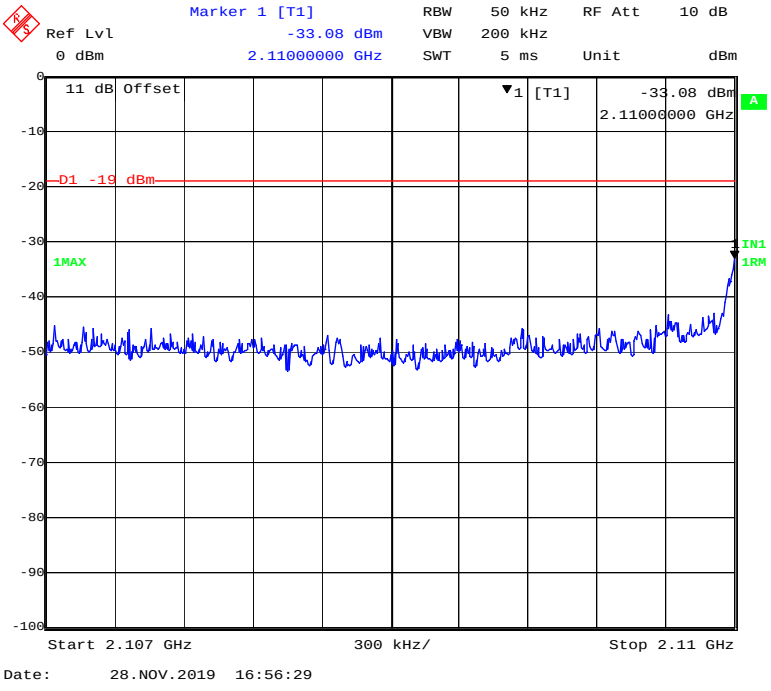
AWS Band GSM Right Side 2154.8MHz Above AGC



AWS Band LTE Left Side 2112.5MHz Pre-AGC



AWS Band LTE Left Side 2112.5MHz Above AGC



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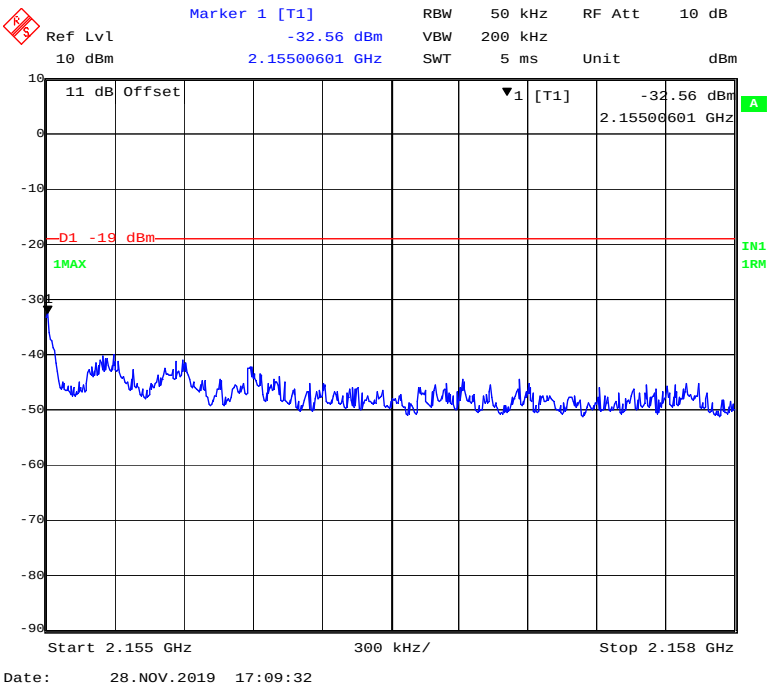

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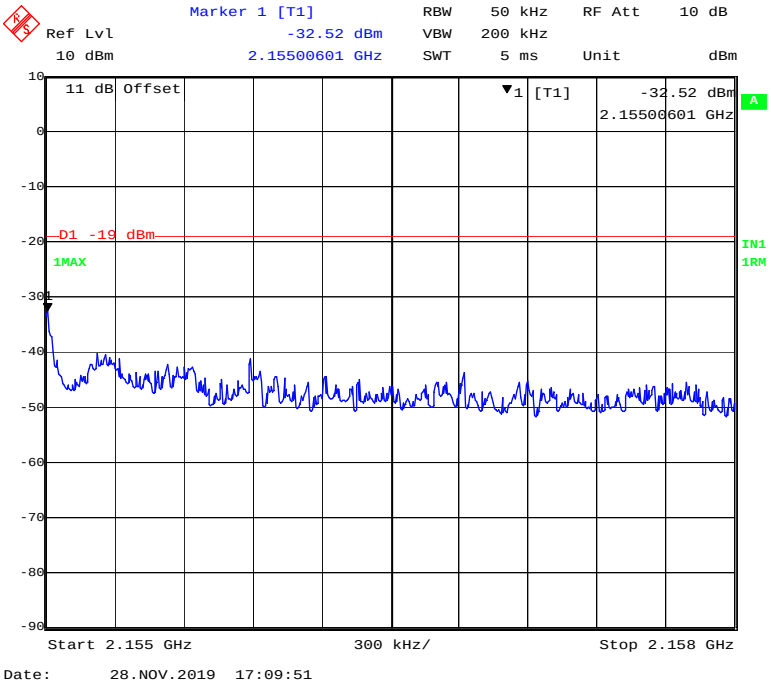
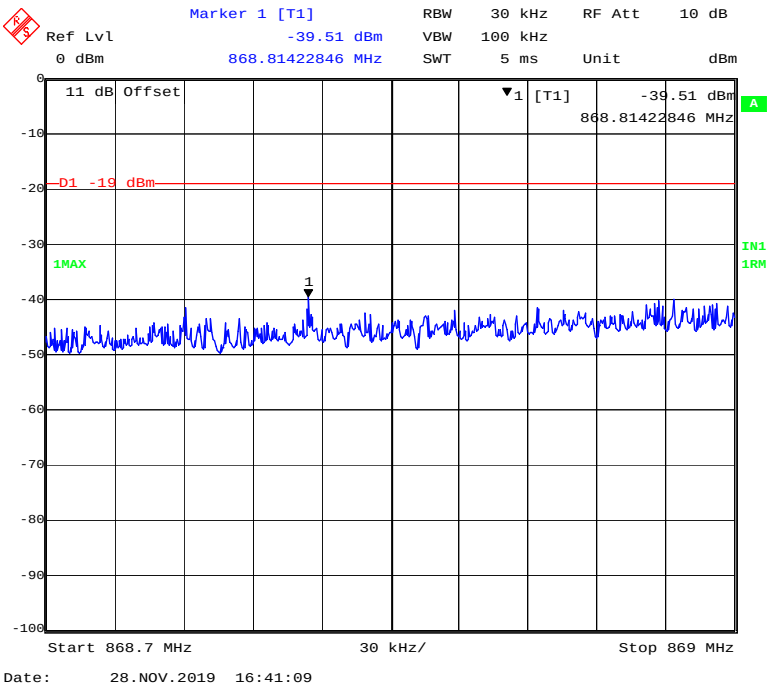
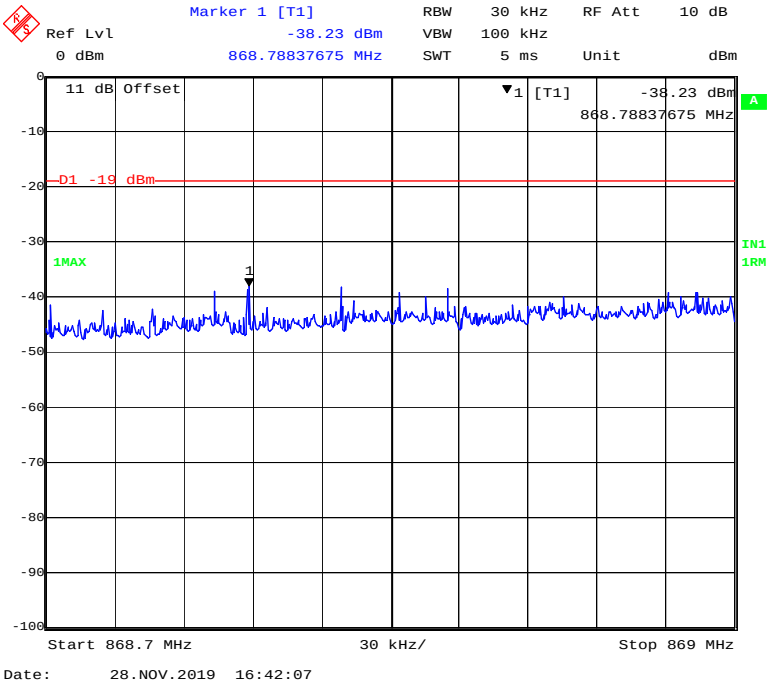


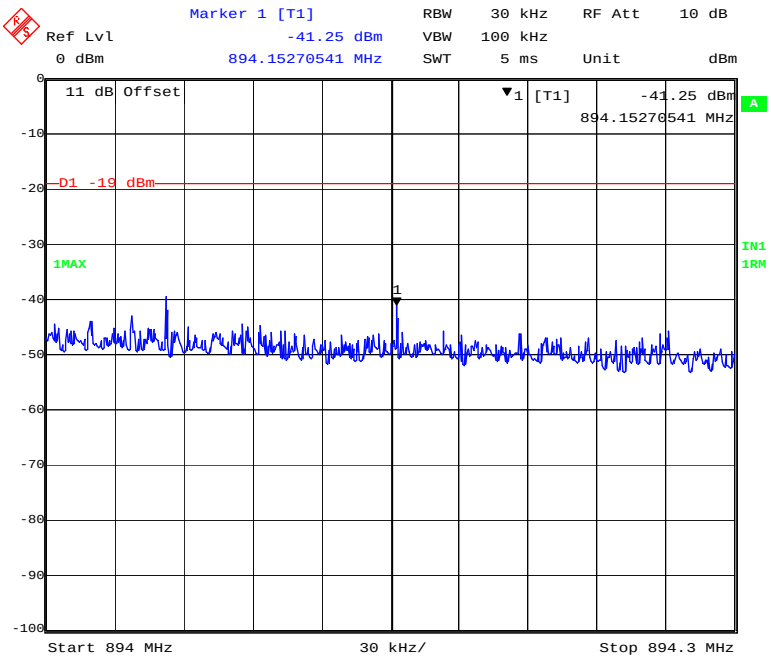
Cellular Band CDMA Left Side 869.88 MHz Pre-AGC



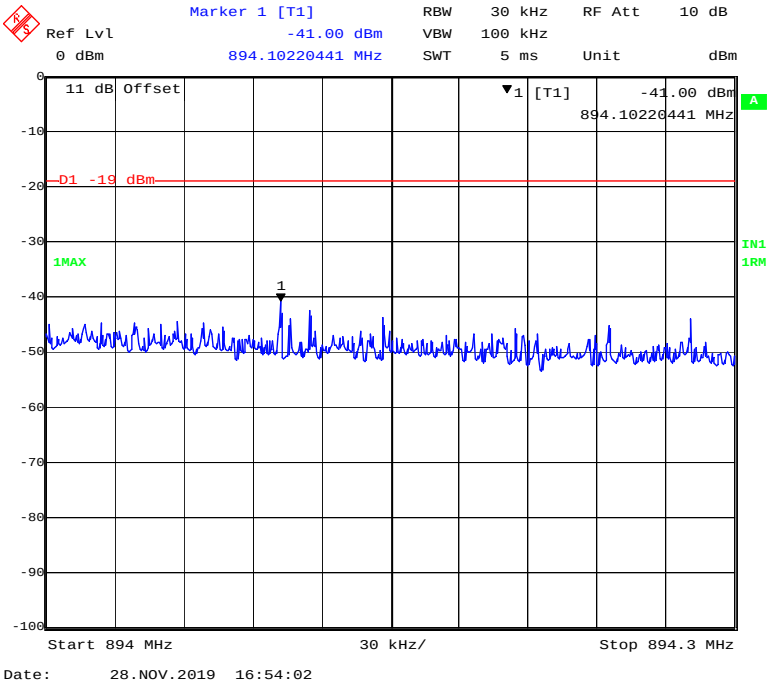
Cellular Band CDMA Left Side 869.88 MHz Above AGC



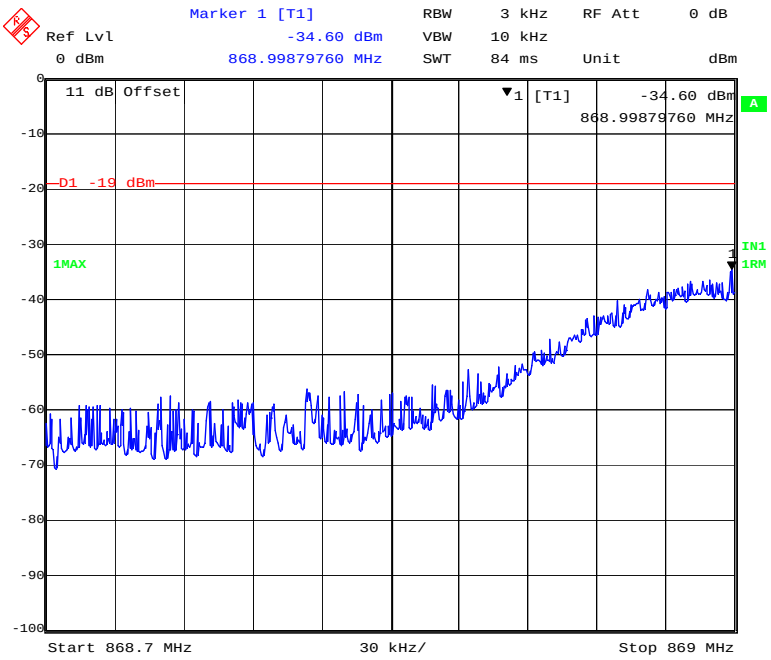
Cellular Band CDMA Right Side 893.1MHz Pre-AGC



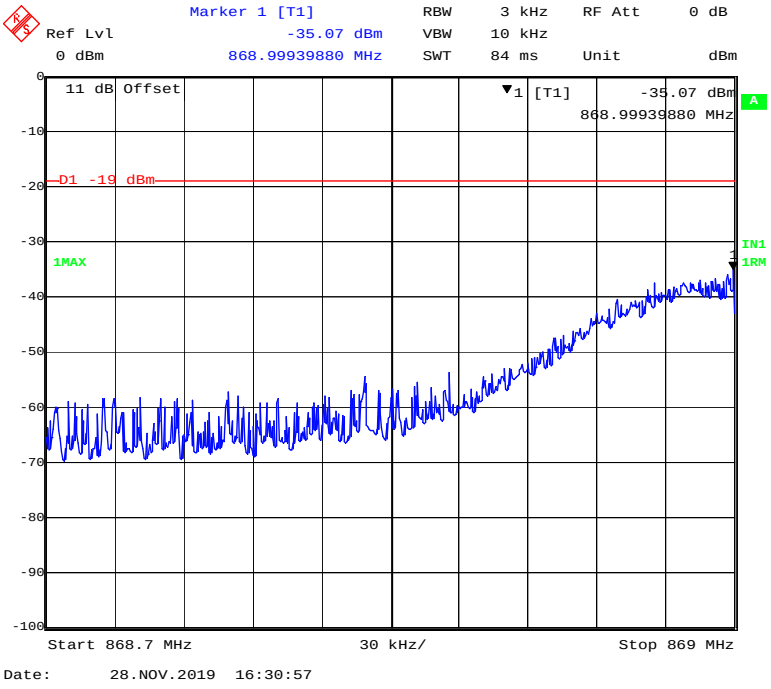
Cellular Band CDMA Right Side 893.1MHz Above AGC



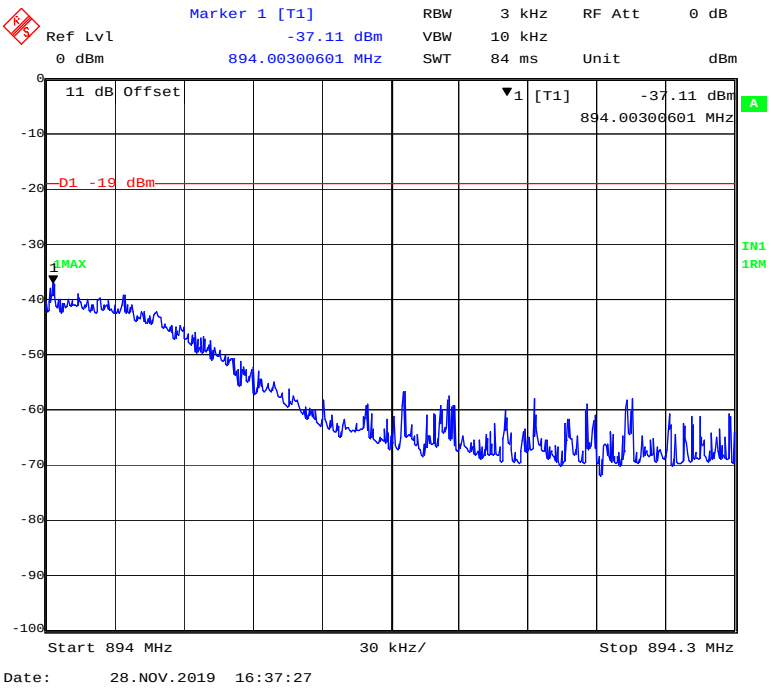
Cellular Band GSM Left Side 869.2MHz Pre-AGC



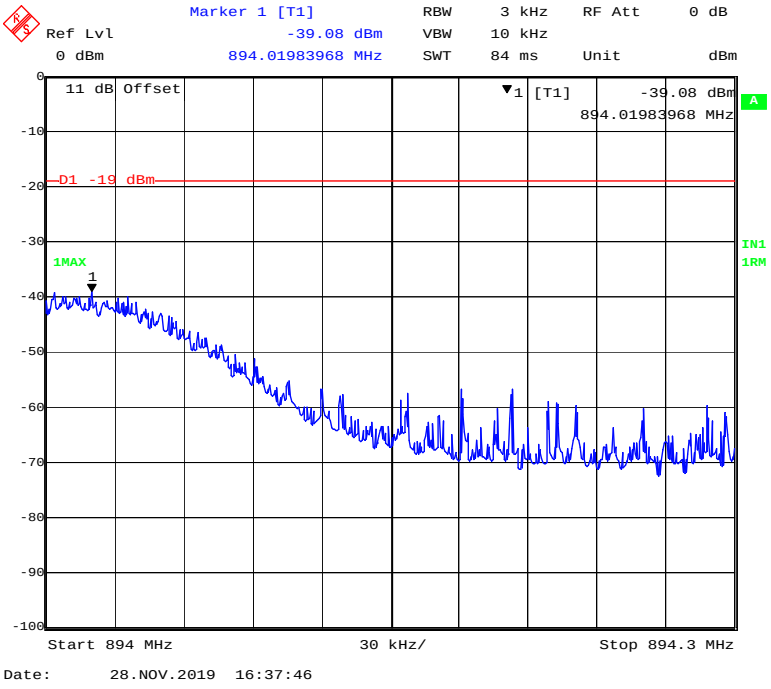
Cellular Band GSM Left Side 869.2MHz Above AGC



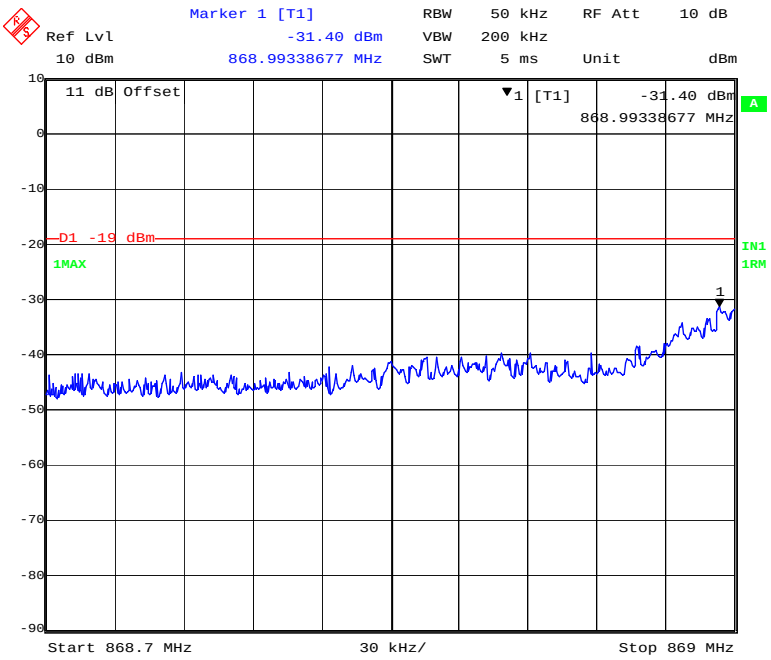
Cellular Band GSM Right Side 893.8MHz Pre-AGC



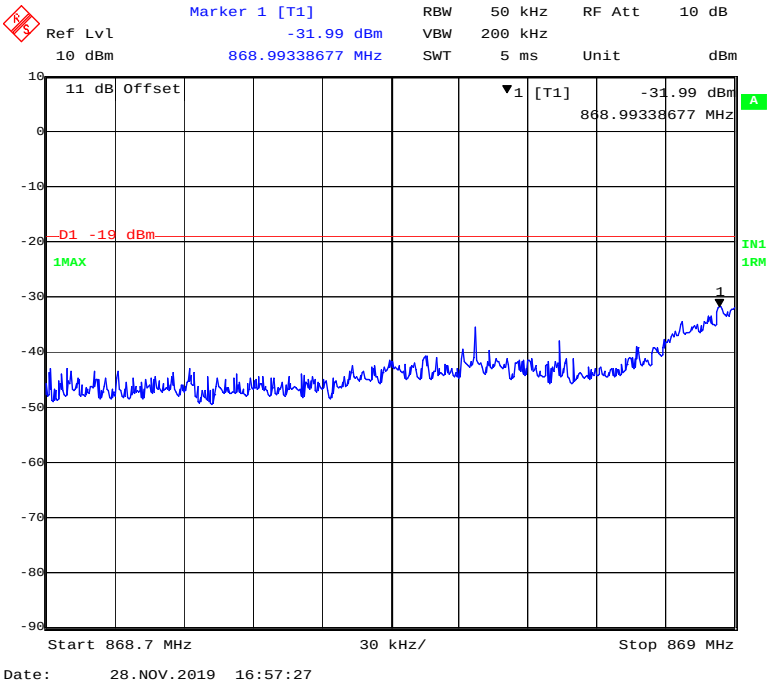
Cellular Band GSM Right Side 893.8MHz Above AGC



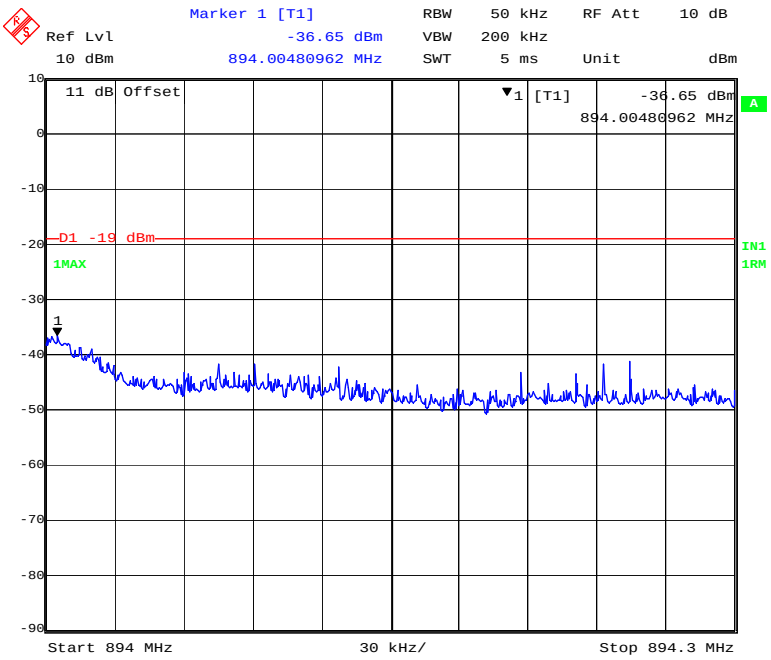
Cellular Band LTE Left Side 871.5MHz Pre-AGC



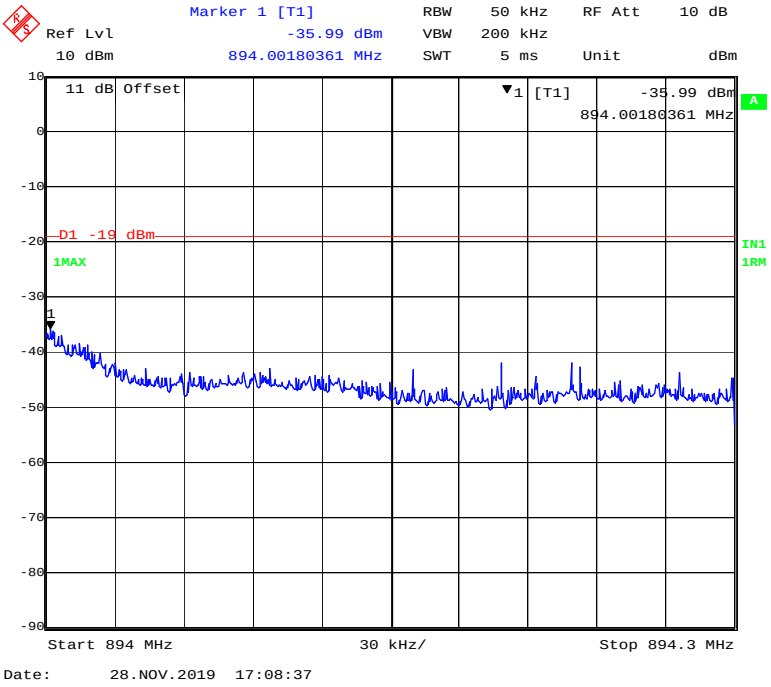
Cellular Band LTE Left Side 871.5MHz Above AGC



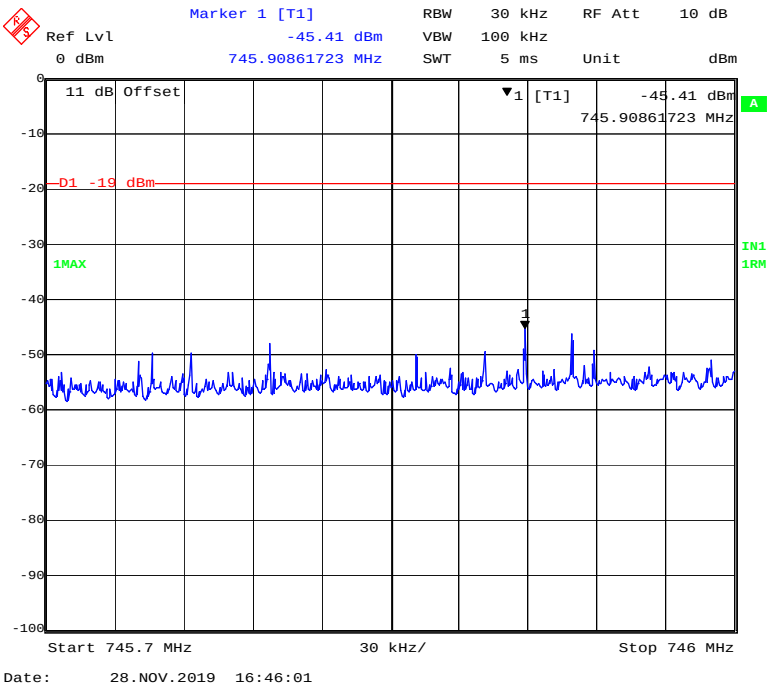
Cellular Band LTE Right Side 891.5MHz Pre-AGC



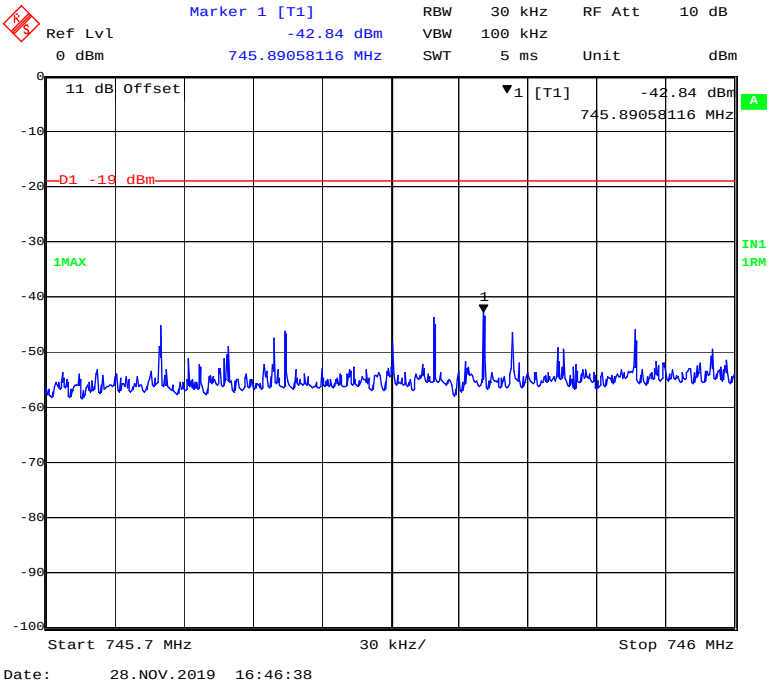
Cellular Band LTE Right Side 891.5MHz Above AGC



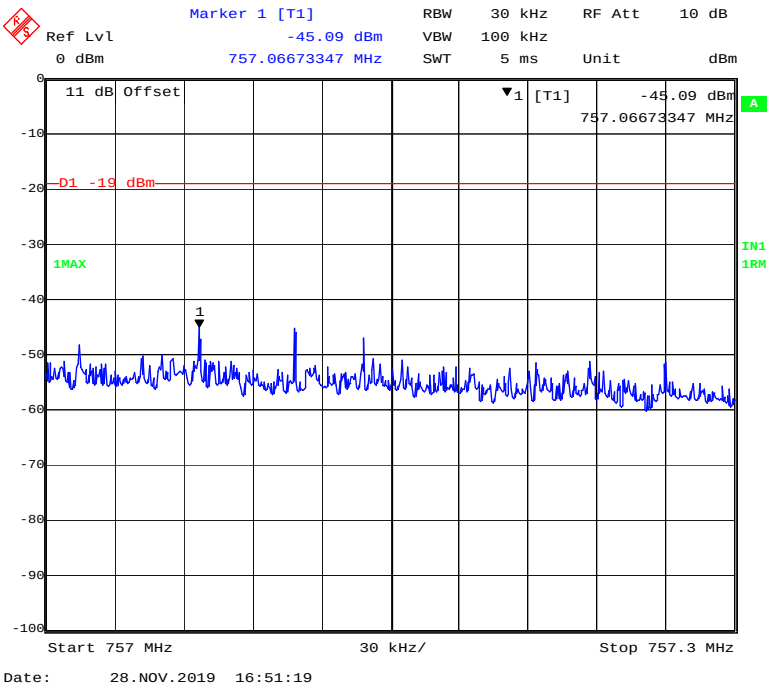
Upper 700MHz Band CDMA Left Side 747.25MHz Pre-AGC



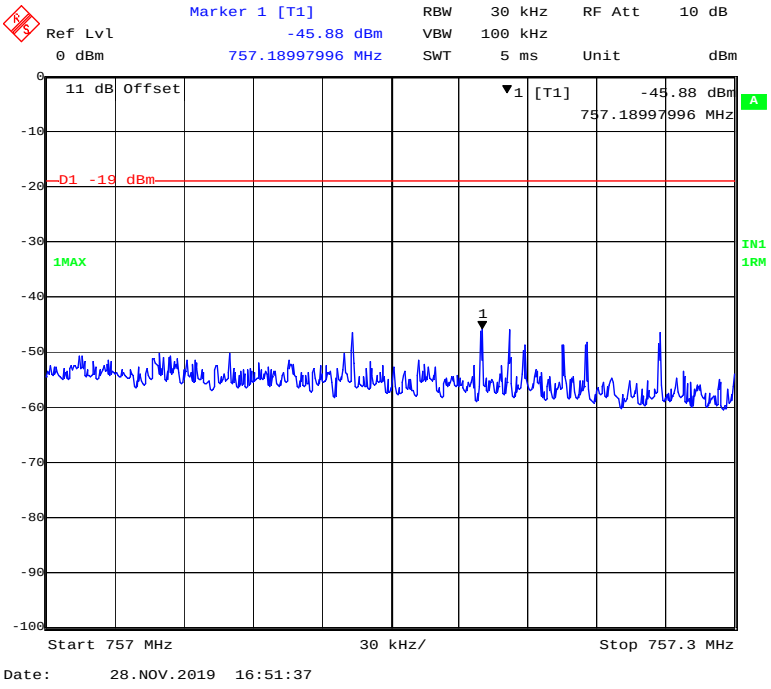
Upper 700MHz Band CDMA Left Side 747.25MHz Above AGC



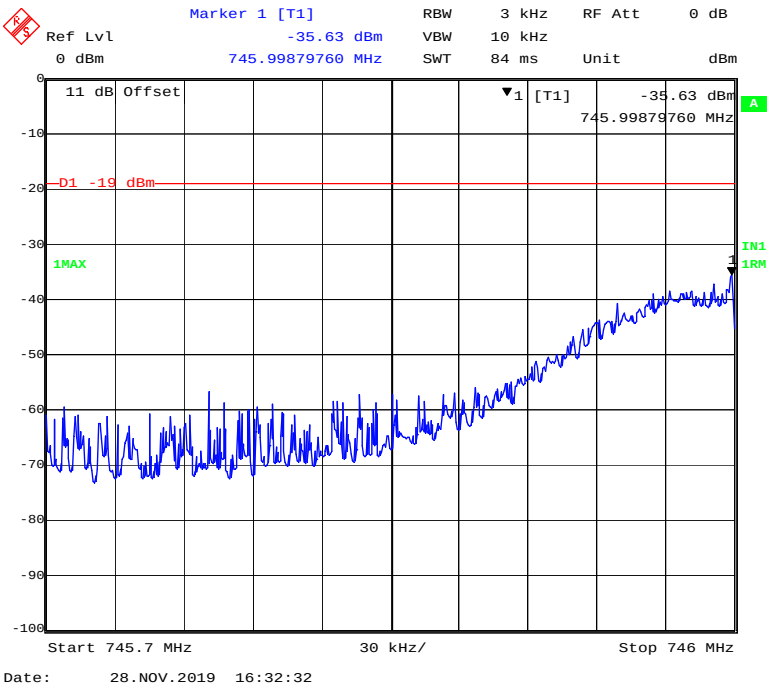
Upper 700MHz Band CDMA Right Side 755.75MHz Pre-AGC



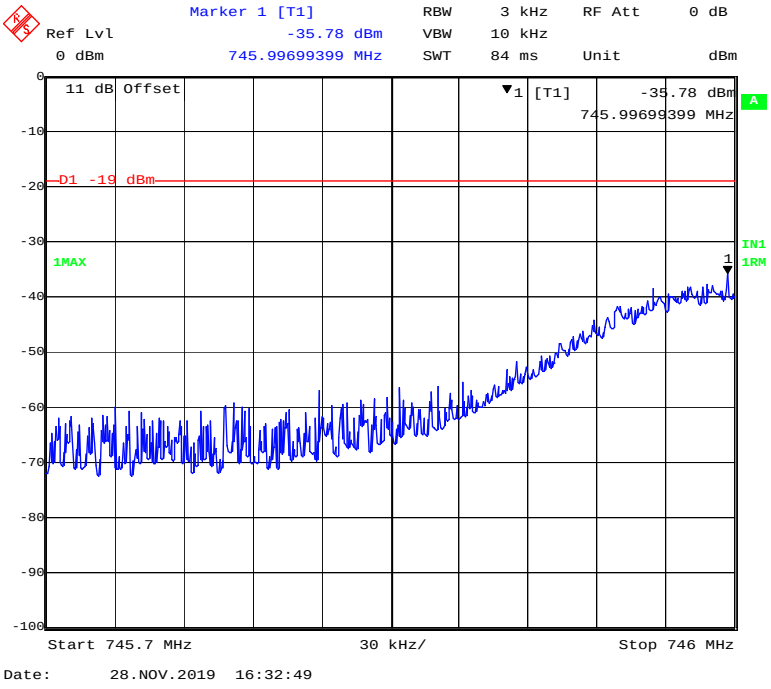
Upper 700MHz Band CDMA Right Side 755.75MHz Above AGC



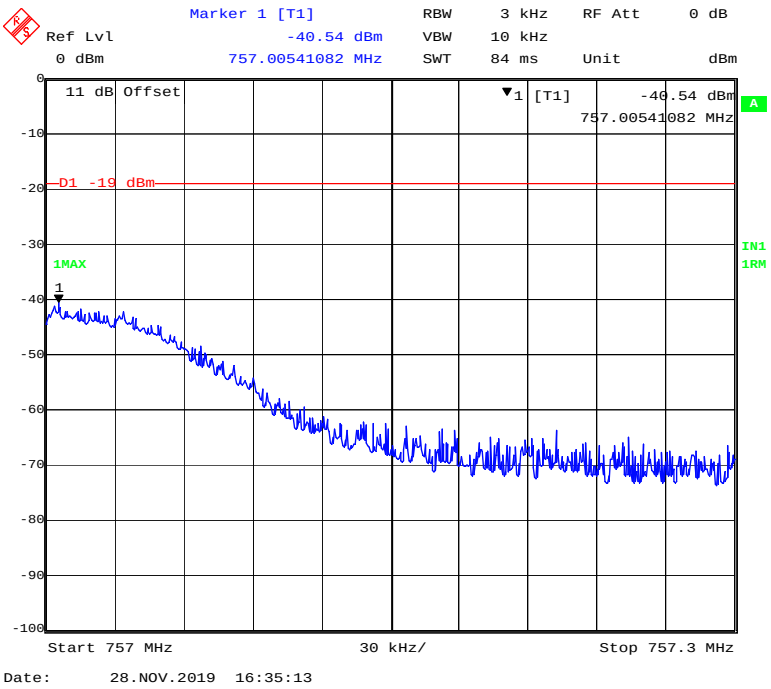
Upper 700MHz Band GSM Left Side 746.2MHz Pre-AGC



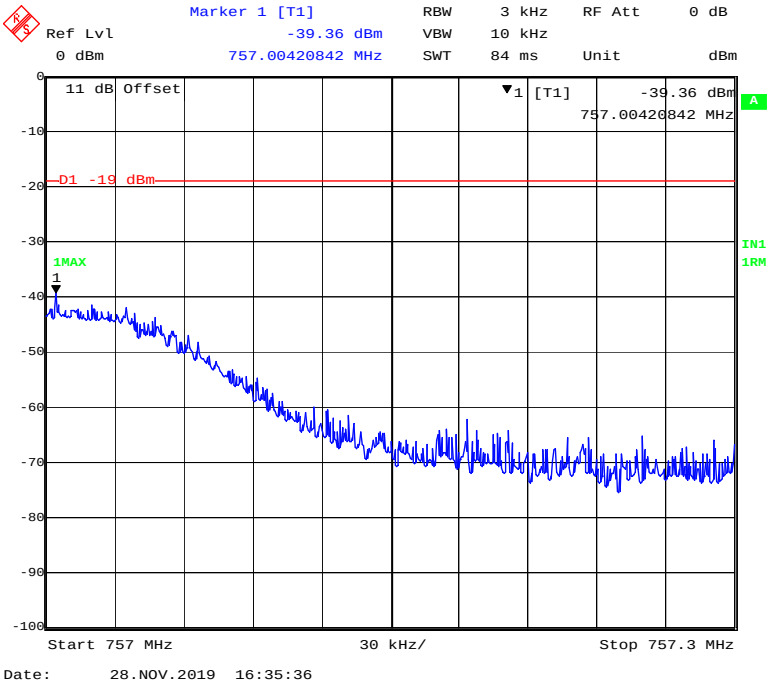
Upper 700MHz Band GSM Left Side 746.2MHz Above AGC



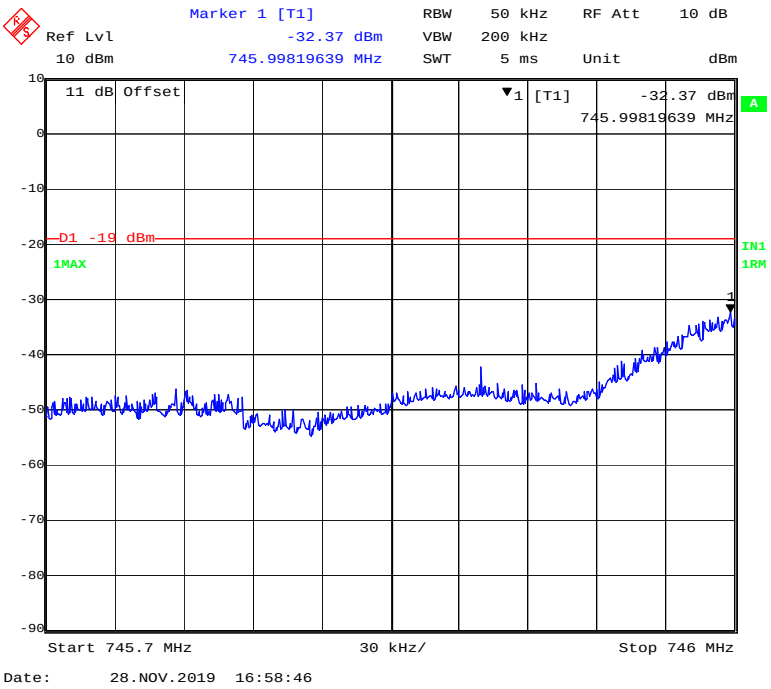
Upper 700MHz Band GSM Right Side 756.8MHz Pre-AGC



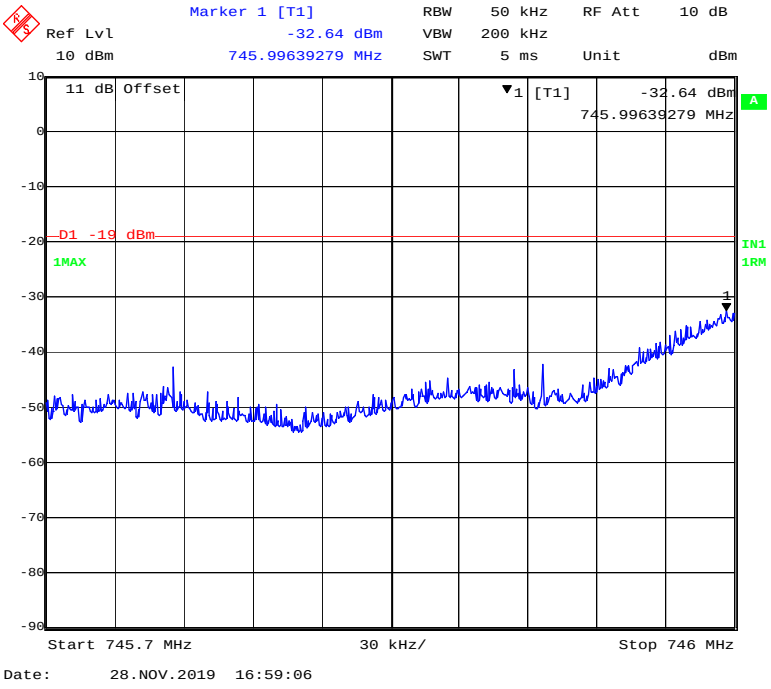
Upper 700MHz Band GSM Right Side 756.8MHz Above AGC



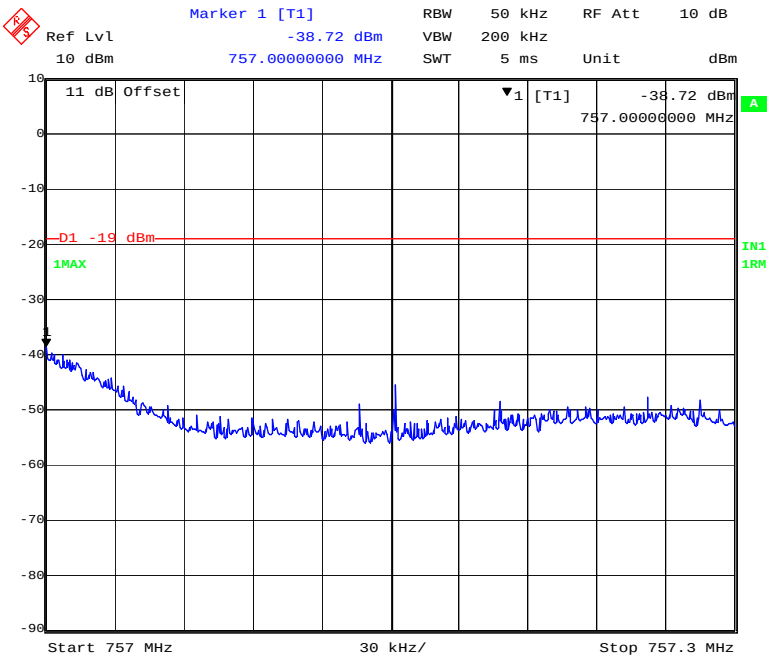
Upper 700MHz Band LTE Left Side 748.5MHz Pre-AGC



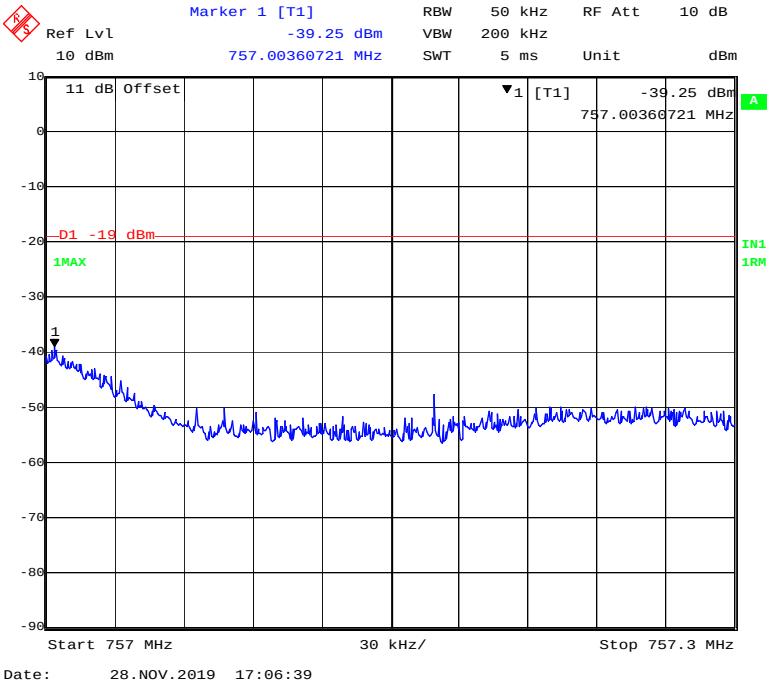
Upper 700MHz Band LTE Left Side 748.5MHz Above AGC



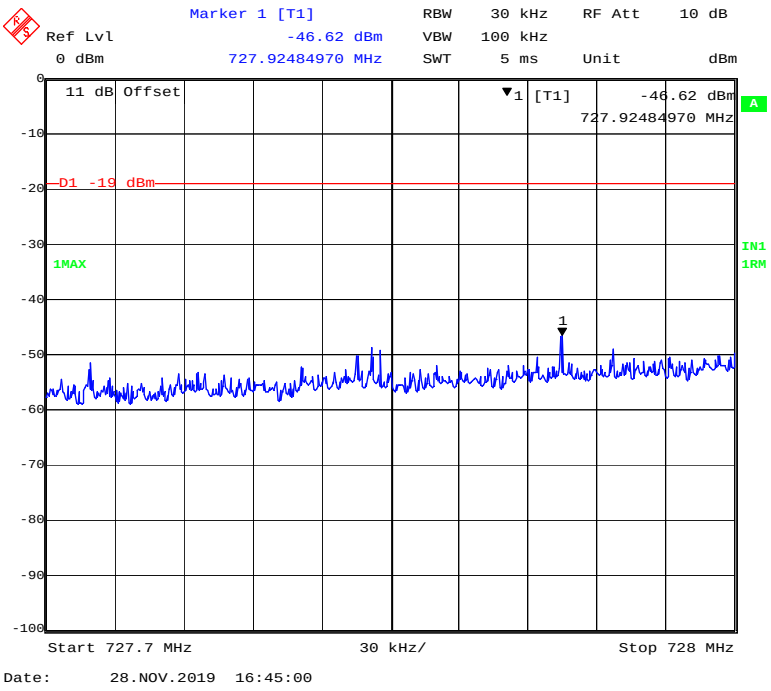
Upper 700MHz Band LTE Right Side 754.5MHz Pre-AGC



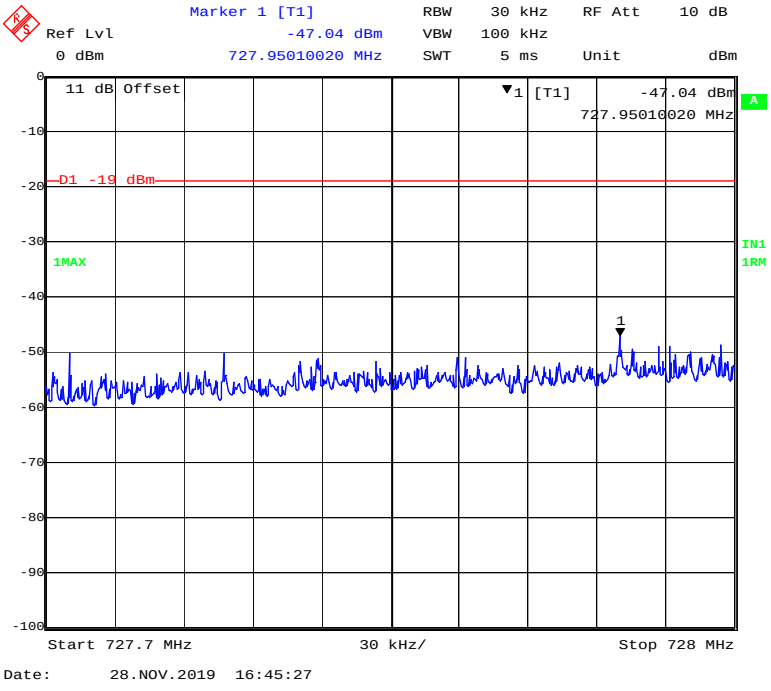
Upper 700MHz Band LTE Right Side 754.5MHz Above AGC



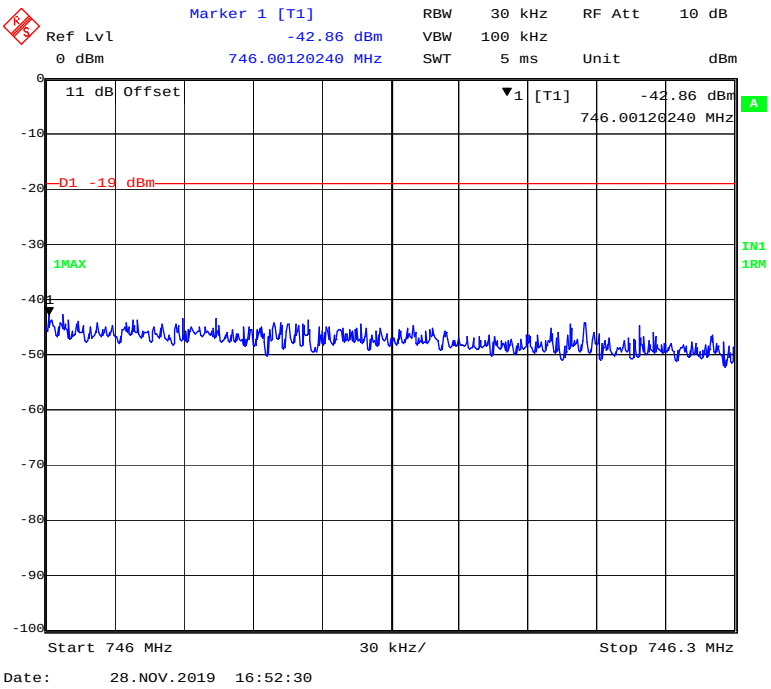
Lower 700MHz Band CDMA Left Side 729.25MHz Pre-AGC



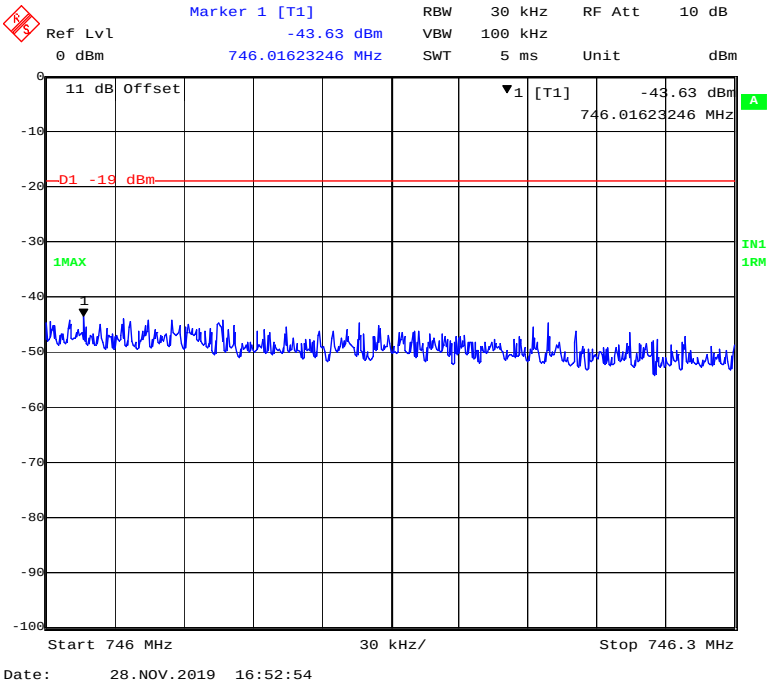
Lower 700MHz Band CDMA Left Side 729.25MHz Above AGC



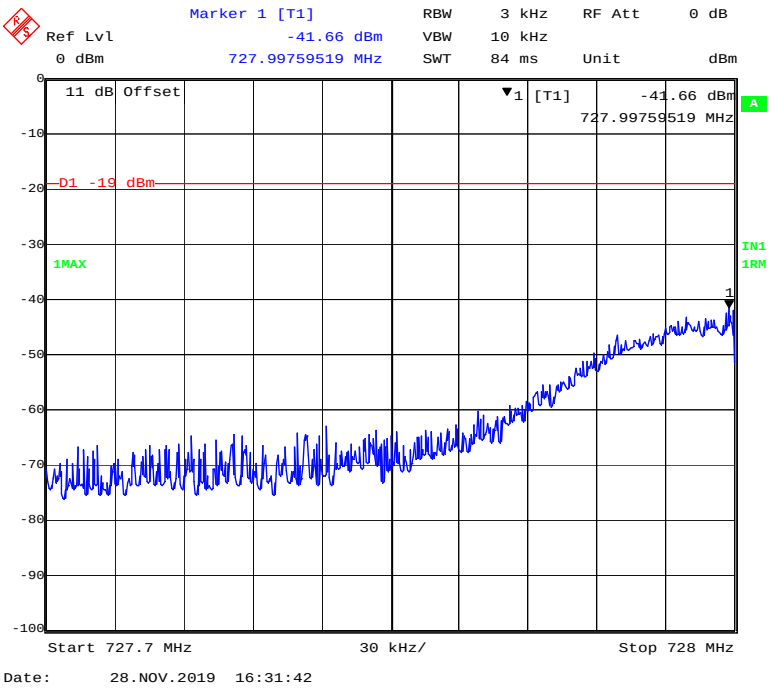
Lower 700MHz Band CDMA Right Side 744.75MHz Pre-AGC



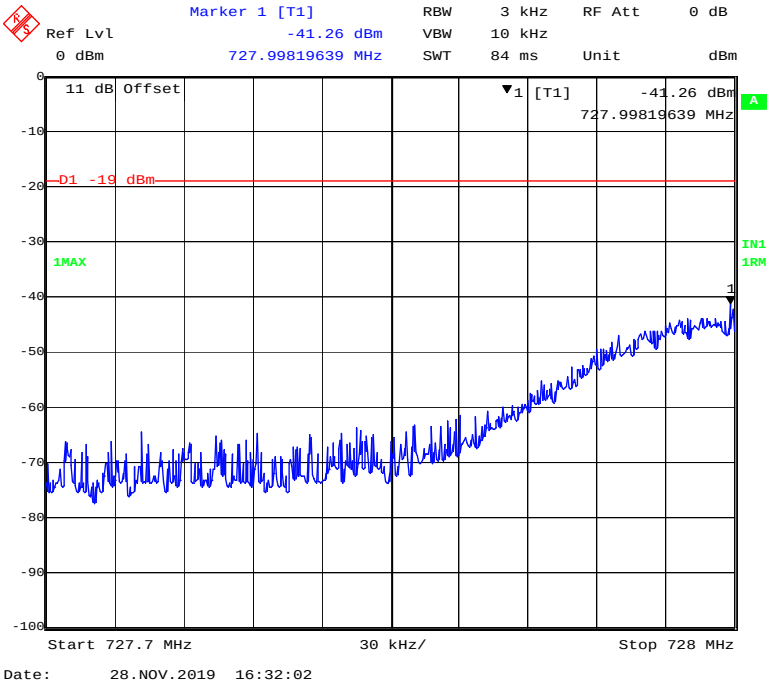
Lower 700MHz Band CDMA Right Side 744.75MHz Above AGC



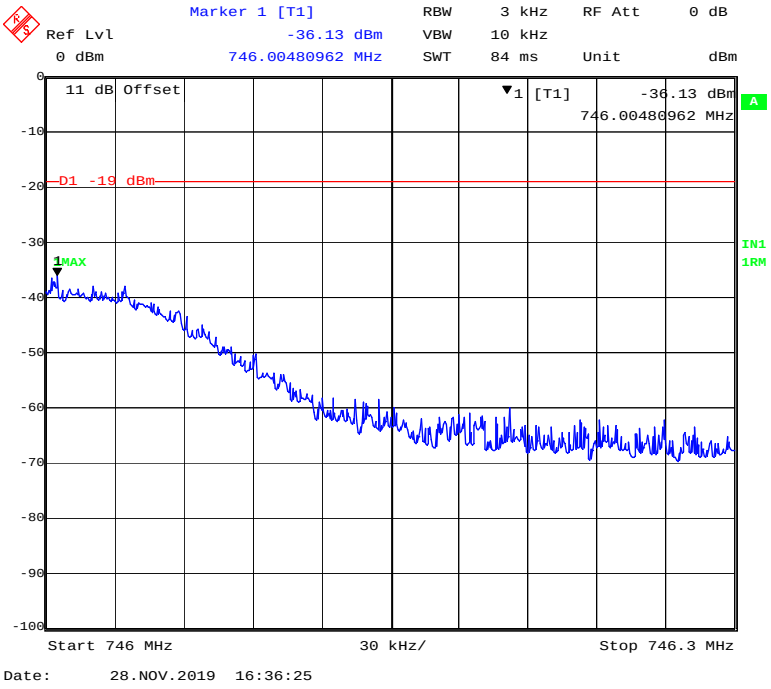
Lower 700MHz Band GSM Left Side 728.2MHz Pre-AGC



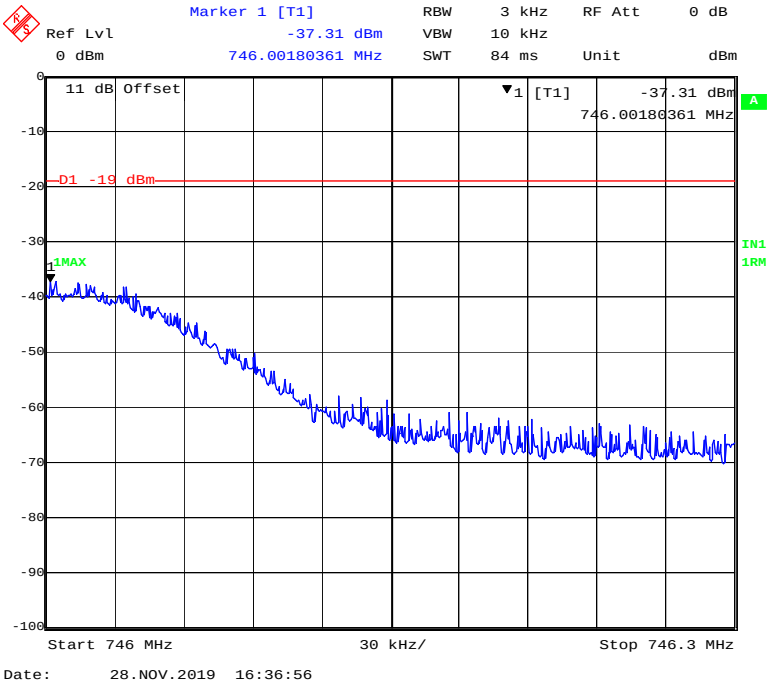
Lower 700MHz Band GSM Left Side 728.2MHz Above AGC



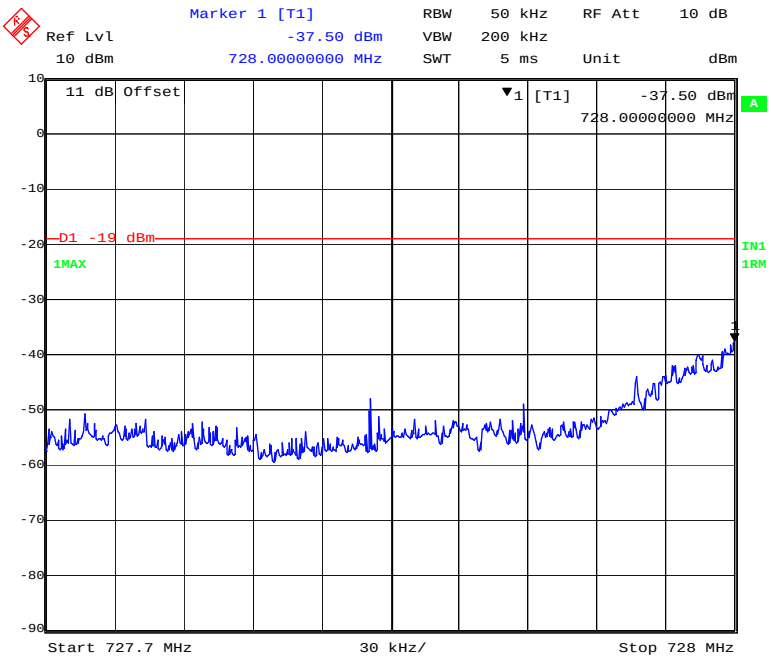
Lower 700MHz Band GSM Right Side 745.8MHz Pre-AGC



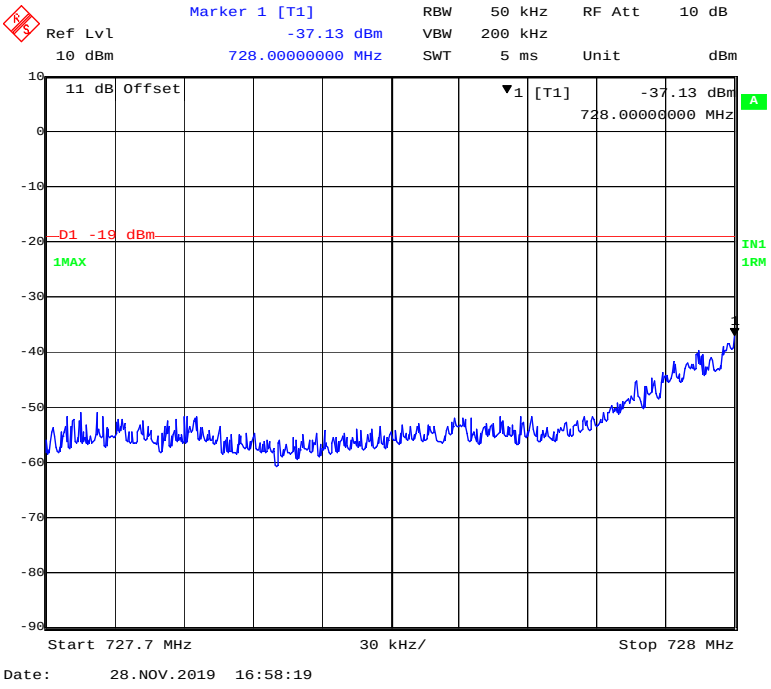
Lower 700MHz Band GSM Right Side 745.8MHz Above AGC



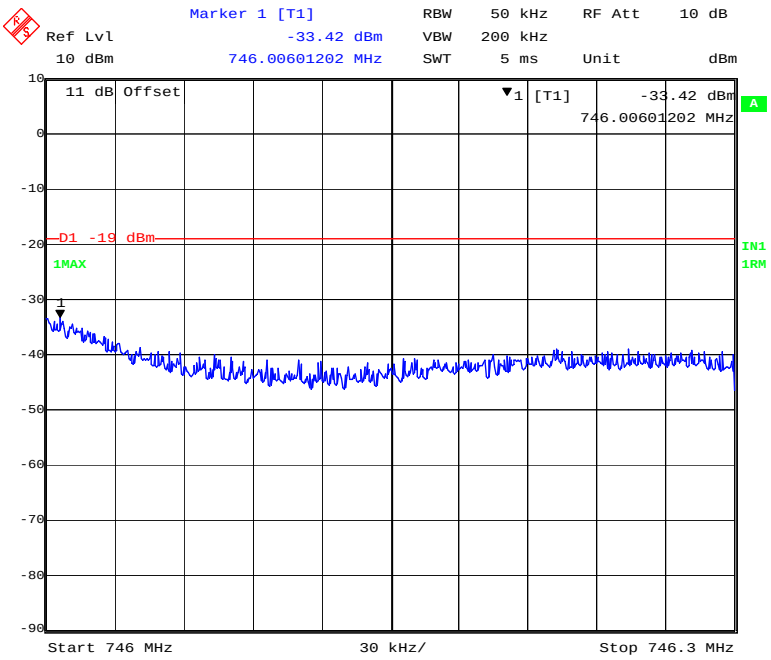
Lower 700MHz Band LTE Left Side 730.5MHz Pre-AGC



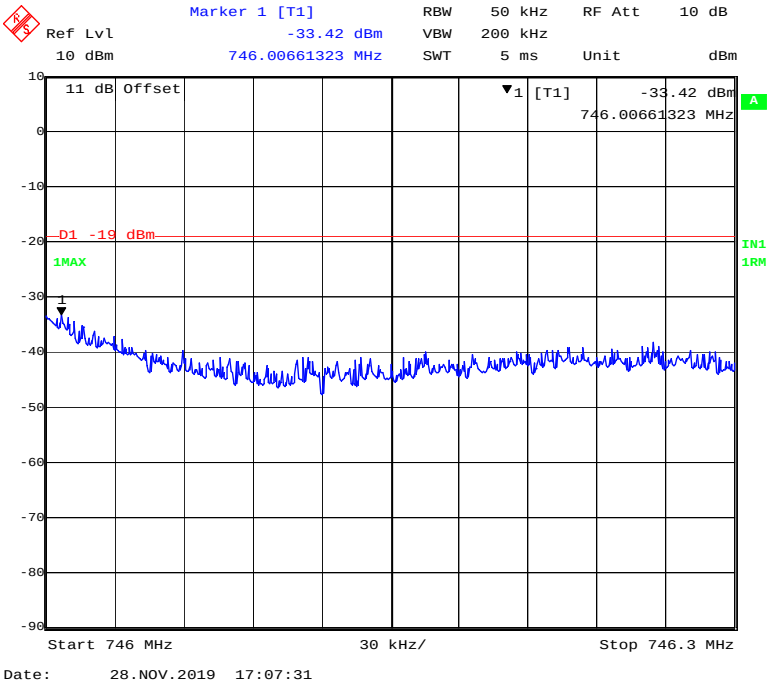
Lower 700MHz Band LTE Left Side 730.5MHz Above AGC



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

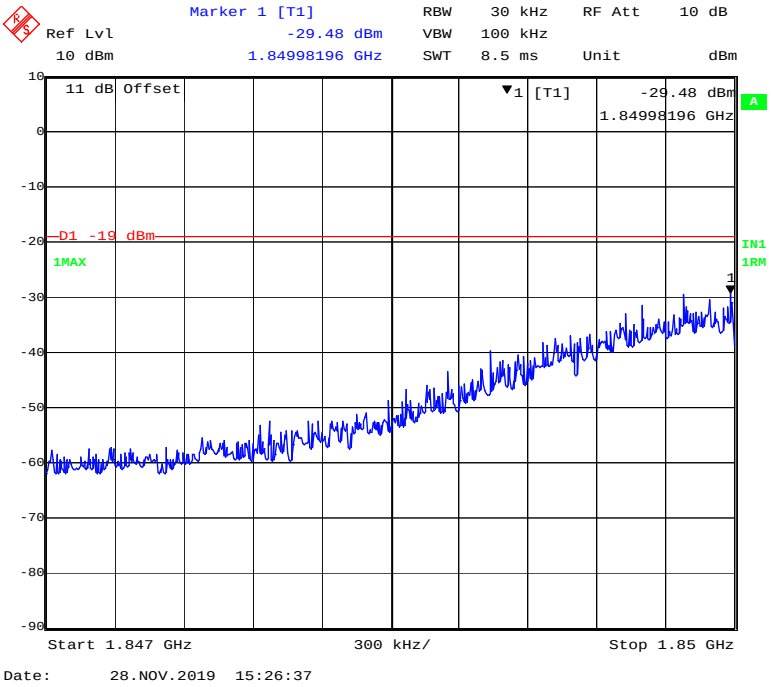


Lower 700MHz Band LTE Right Side 743.5MHz Above AGC

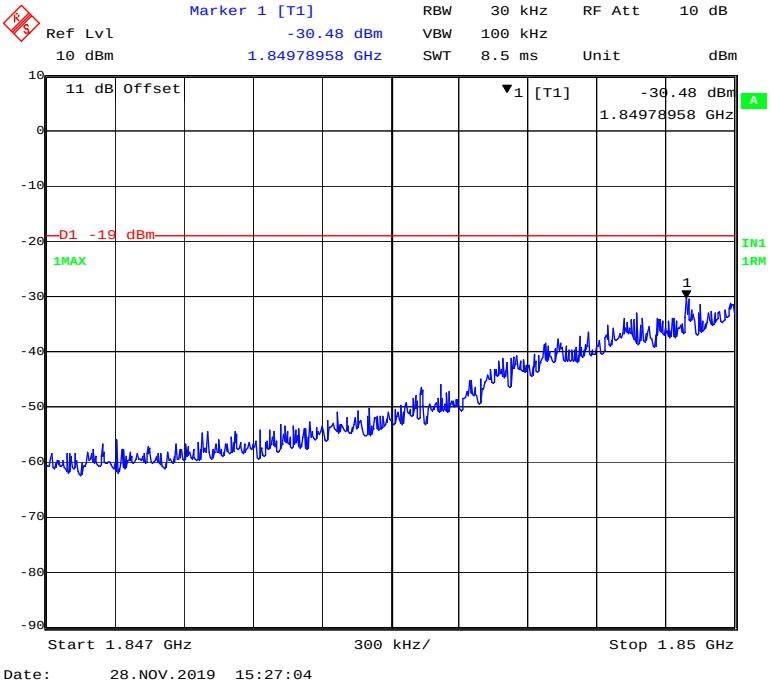


Uplink:

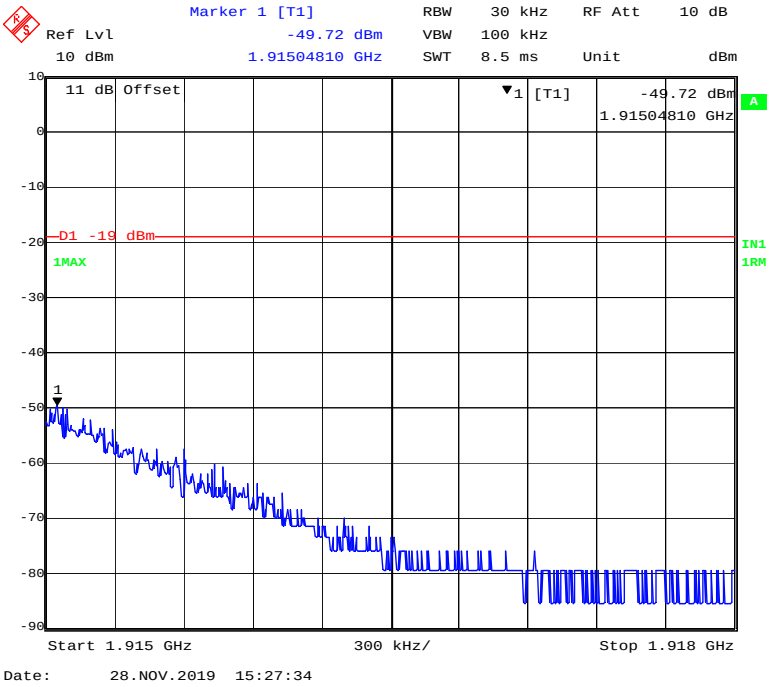
PCS Band CDMA Left Side 1851.25MHz Pre-AGC



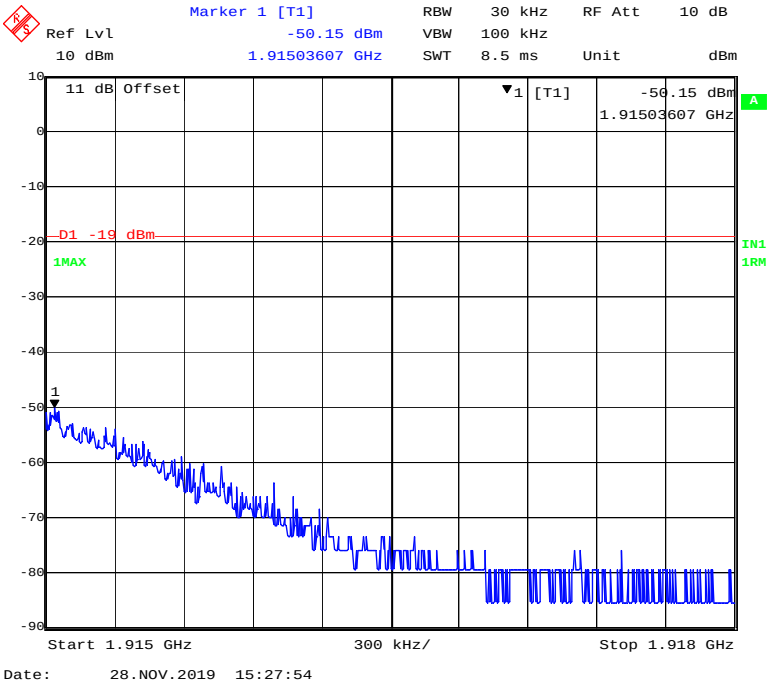
PCS Band CDMA Left Side 1851.25MHz Above AGC



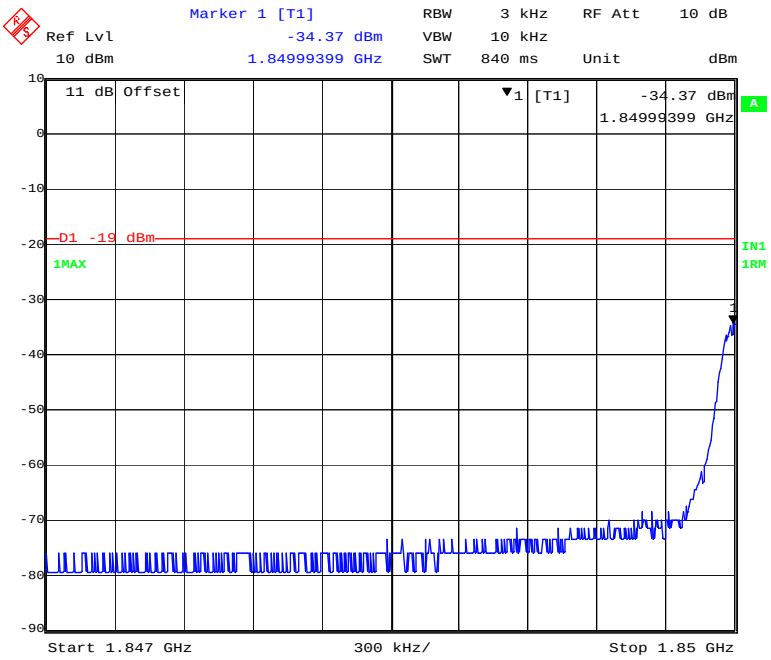
PCS Band CDMA Right Side 1913.75MHz Pre-AGC



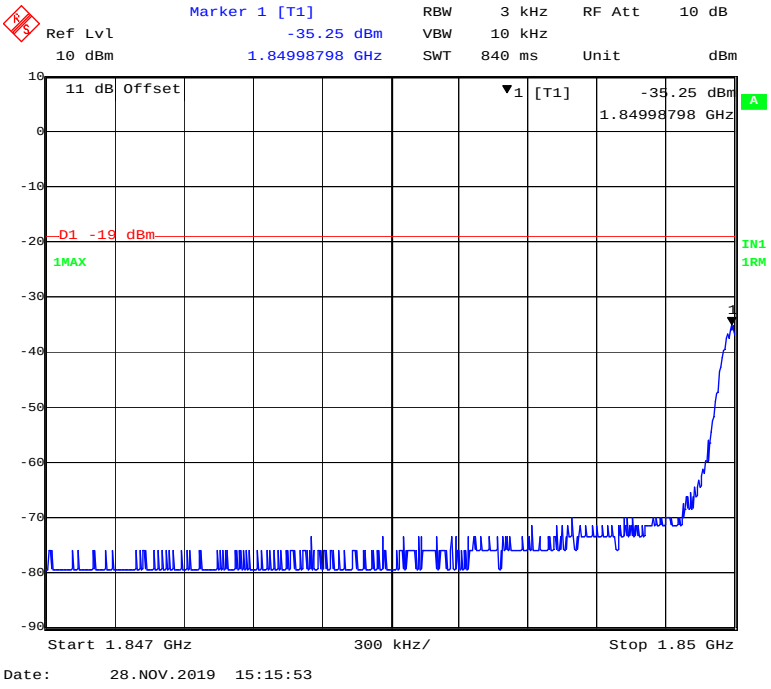
PCS Band CDMA Right Side 1913.75MHz Above AGC



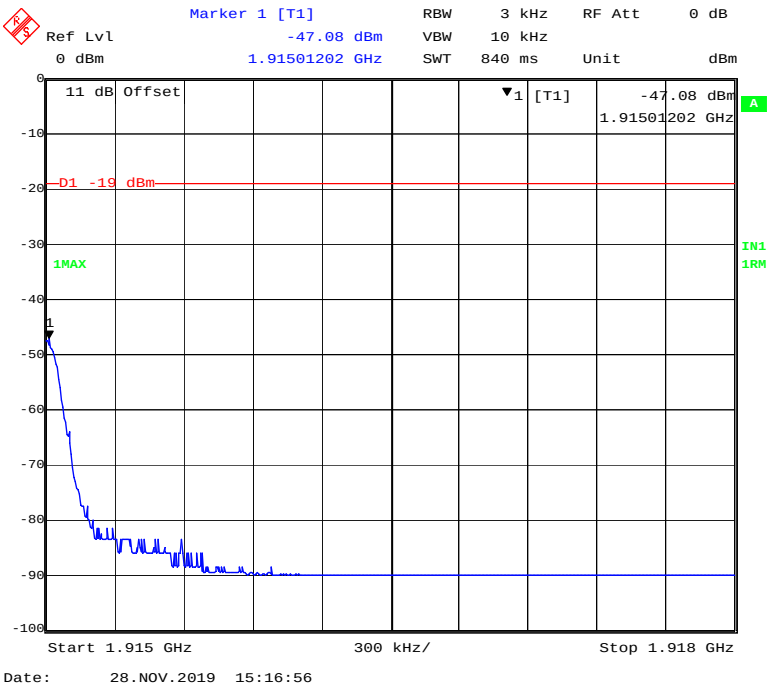
PCS Band GSM Left Side 1850.2MHz Pre-AGC



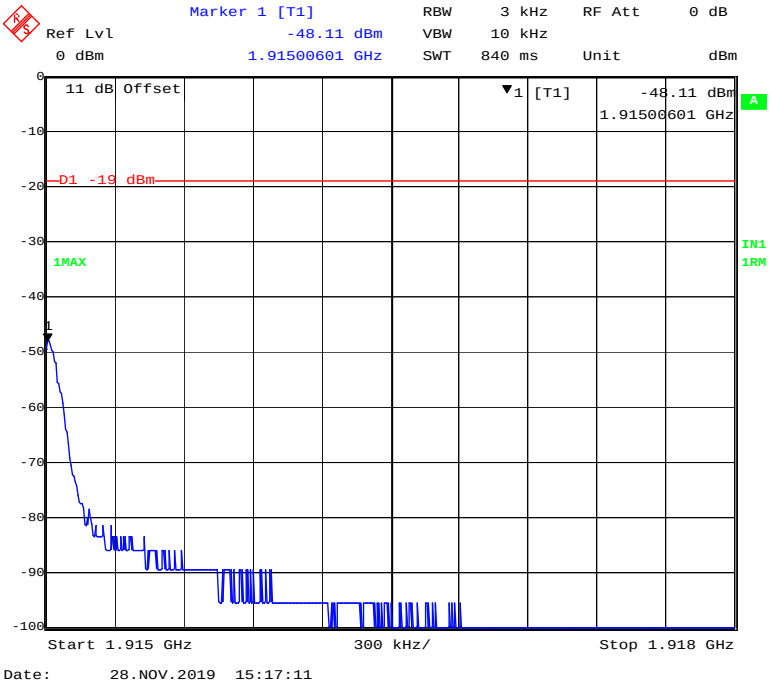
PCS Band GSM Left Side 1850.2MHz Above AGC



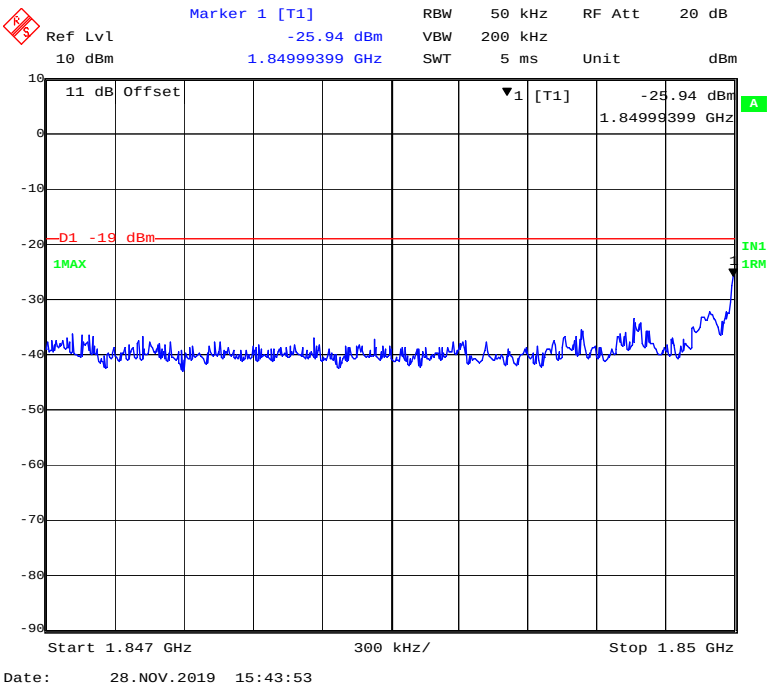
PCS Band GSM Right Side 1914.8MHz Pre-AGC



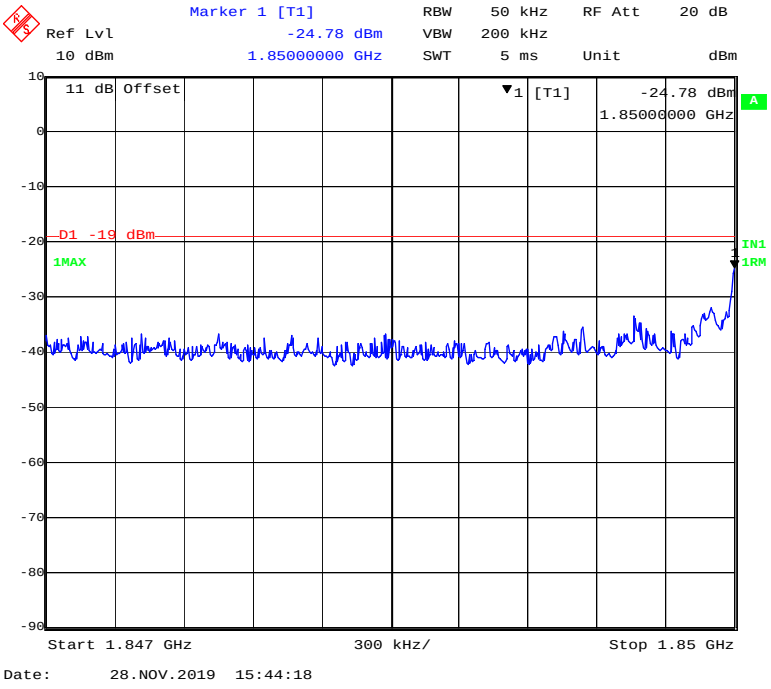
PCS Band GSM Right Side 1914.8MHz Above AGC



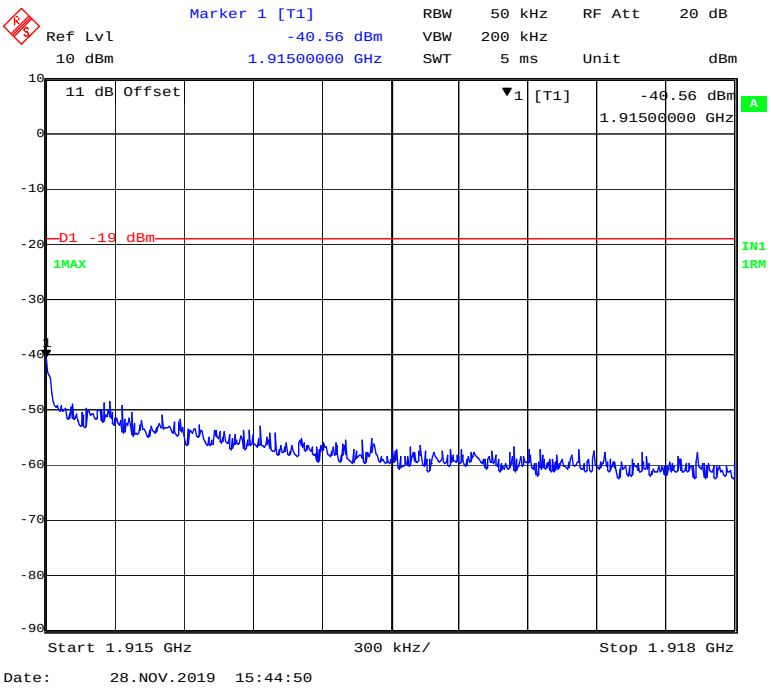
PCS Band LTE Left Side 1852.5MHz Pre-AGC



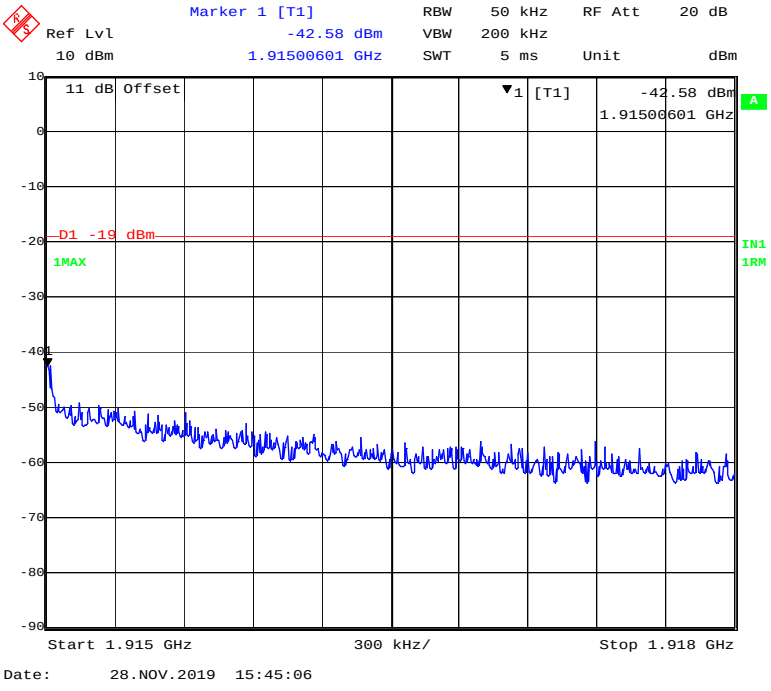
PCS Band LTE Left Side 1852.5MHz Above AGC



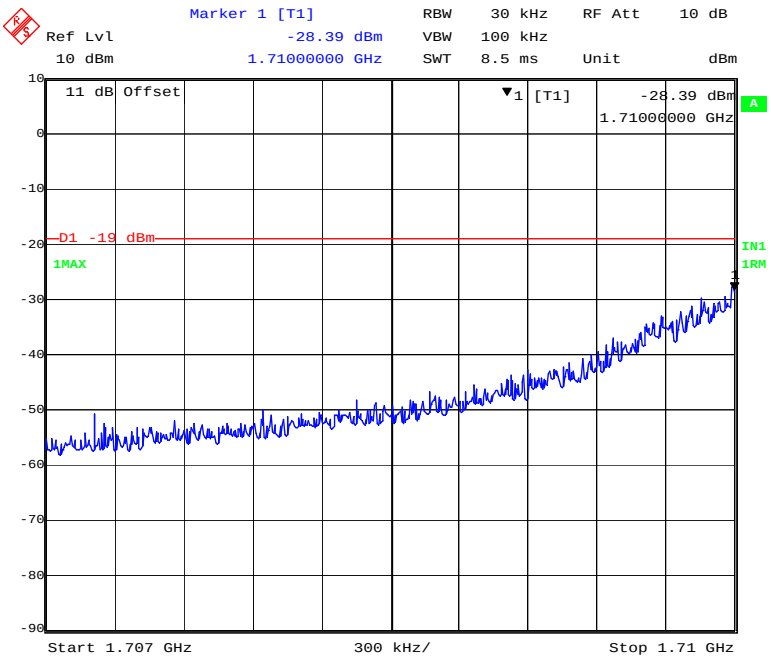
PCS Band LTE Right Side 1912.5MHz Pre-AGC



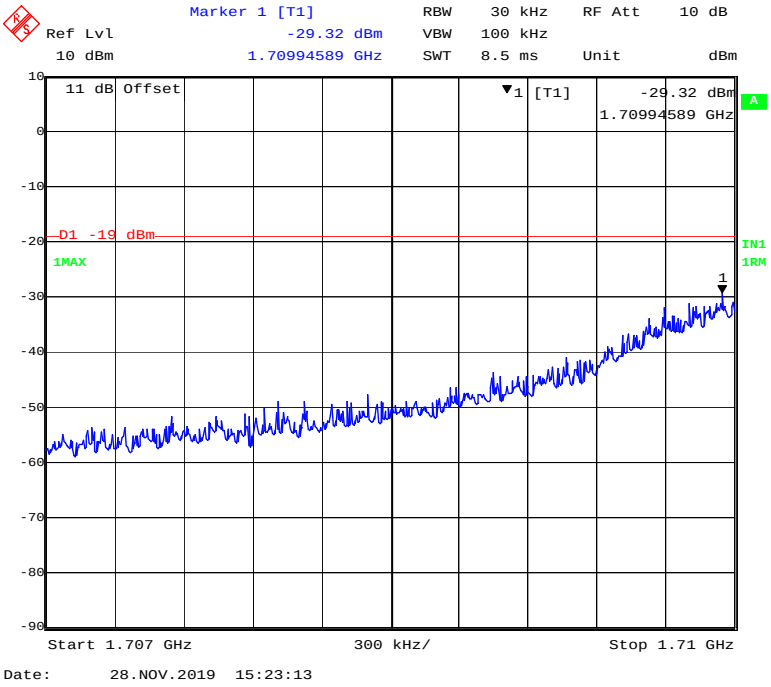
PCS Band LTE Right Side 1912.5MHz Above AGC



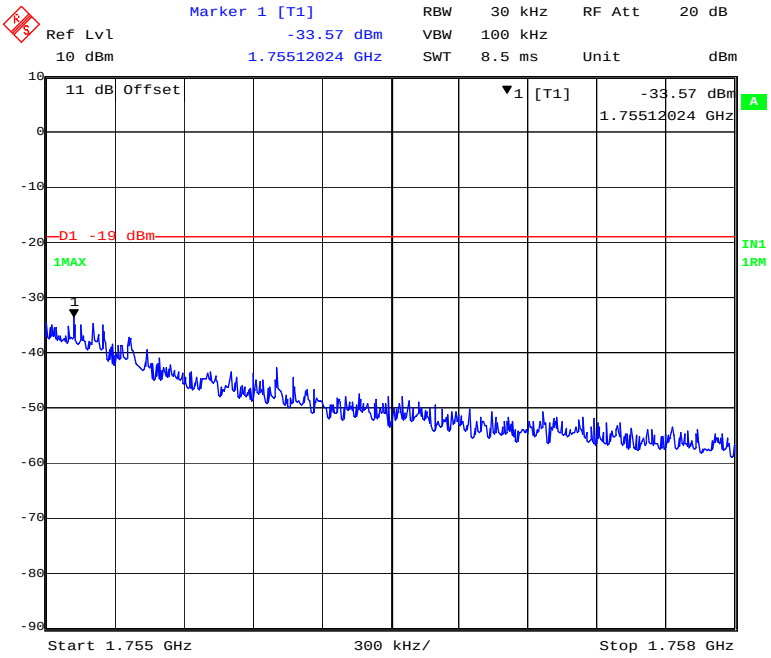
AWS Band CDMA Left Side 1711.25MHz Pre-AGC



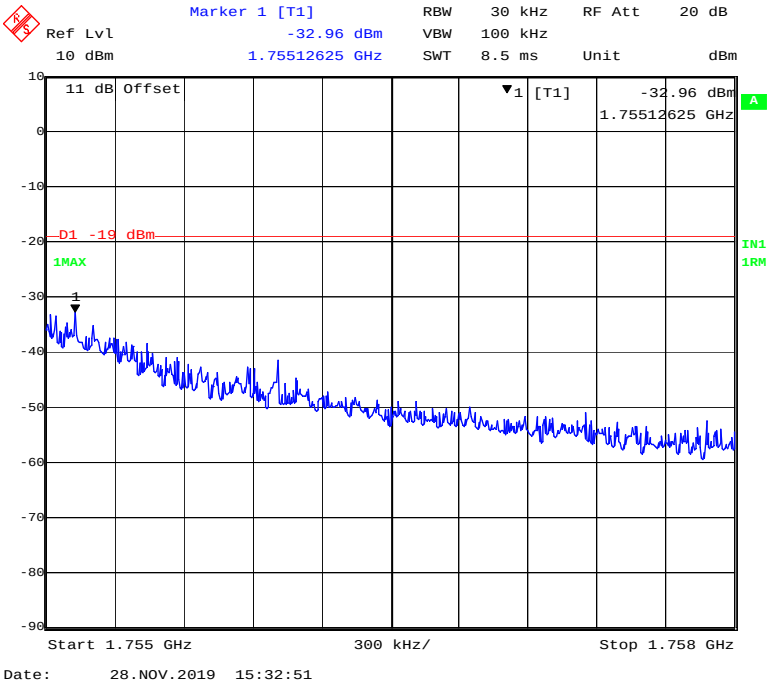
AWS Band CDMA Left Side 1711.25MHz Above AGC



AWS Band CDMA Right Side 1753.75MHz Pre-AGC

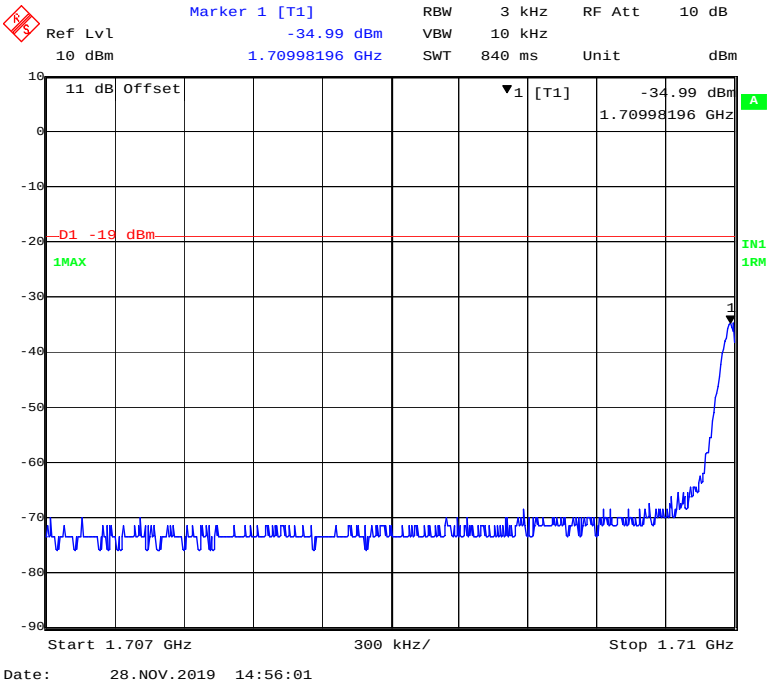


AWS Band CDMA Right Side 1753.75MHz Above AGC



AWS Band GSM Left Side 1710.2MHz Pre-AGC

AWS Band GSM Left Side 1710.2MHz Above AGC



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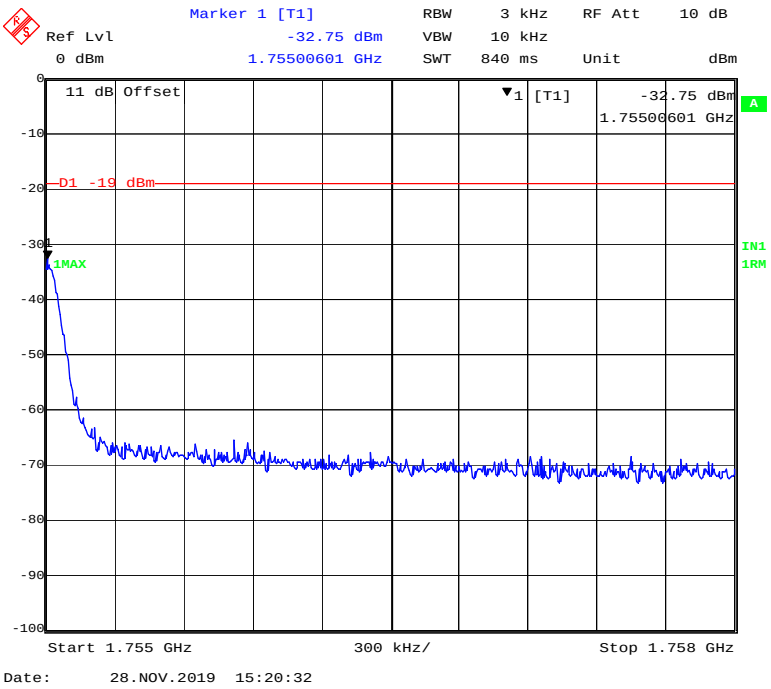
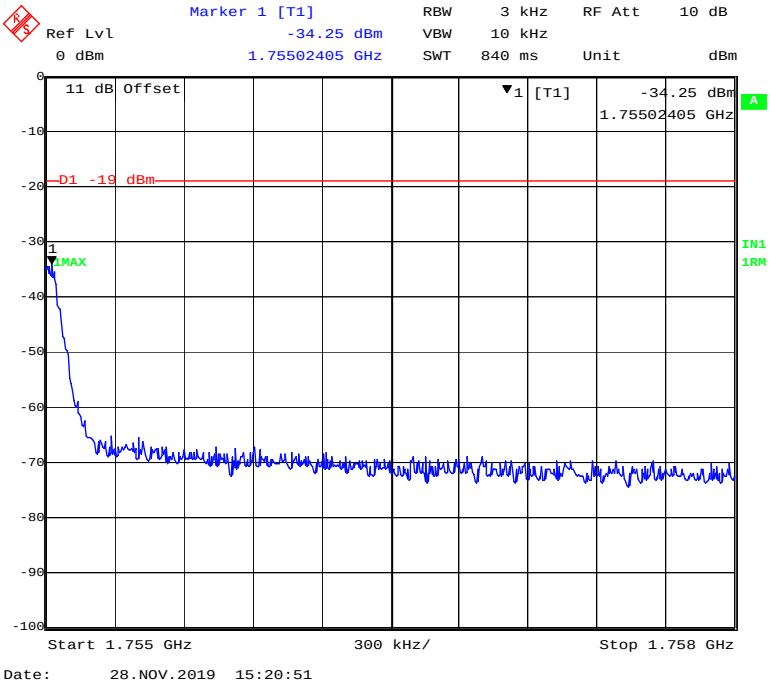
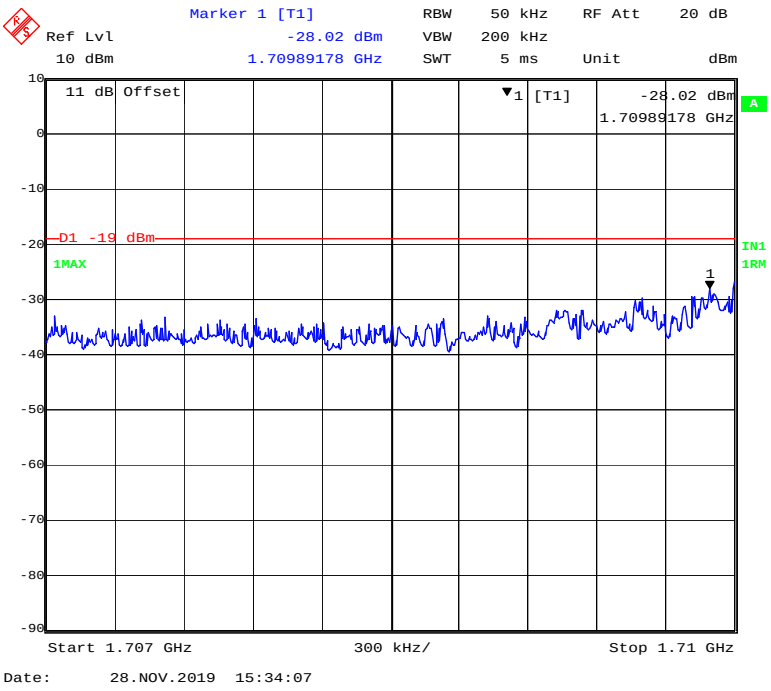


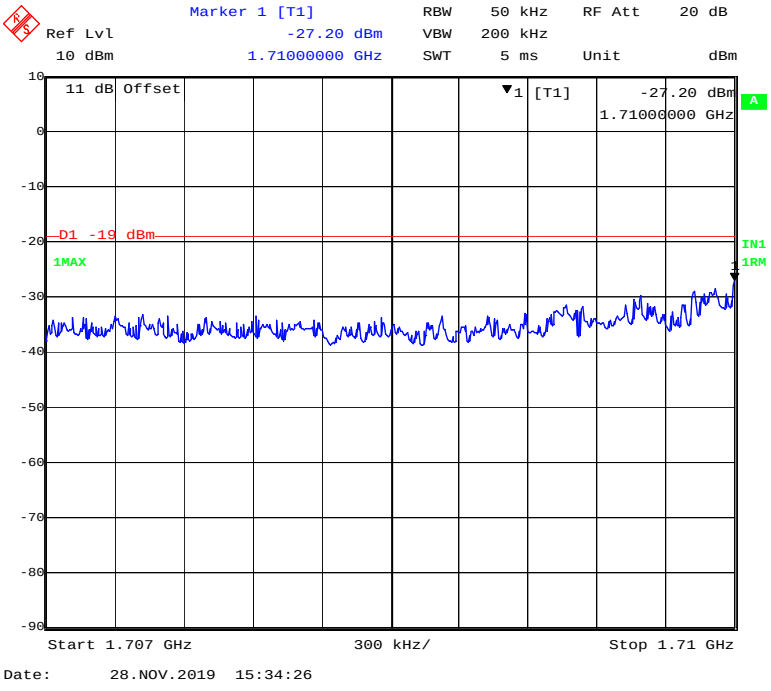
AWS Band GSM Right Side 1754.8MHz Above AGC



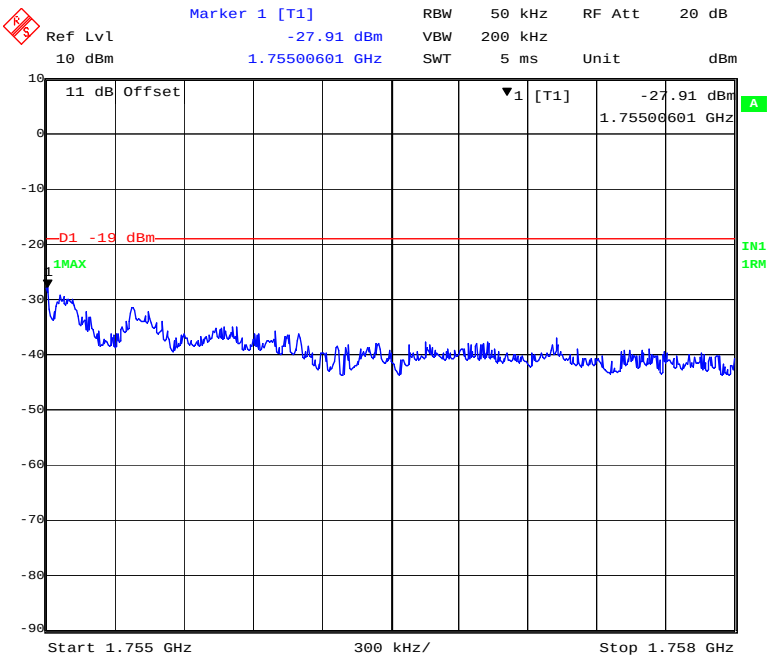
AWS Band LTE Left Side 1712.5MHz Pre-AGC



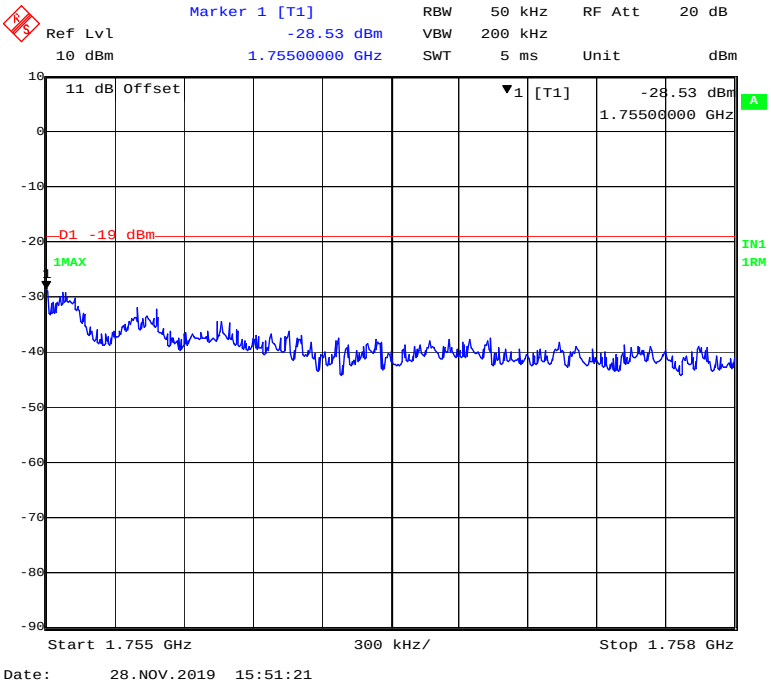
AWS Band LTE Left Side 1712.5MHz Above AGC



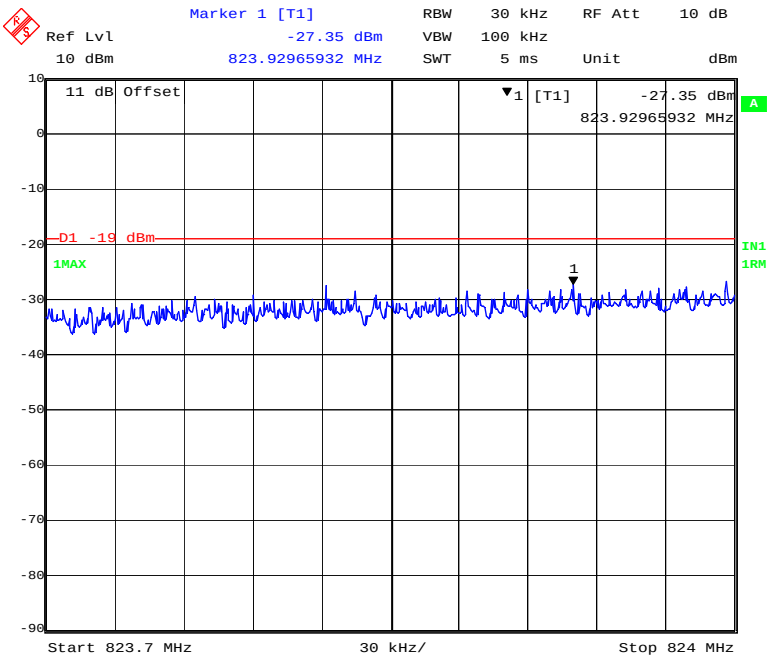
AWS Band LTE Right Side 1752.5MHz Pre-AGC



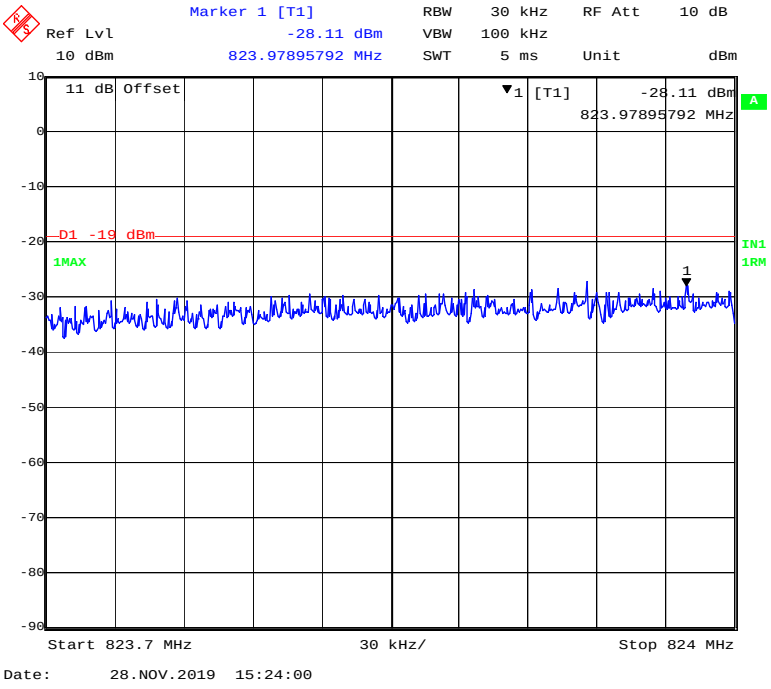
AWS Band LTE Right Side 1752.5MHz Above AGC



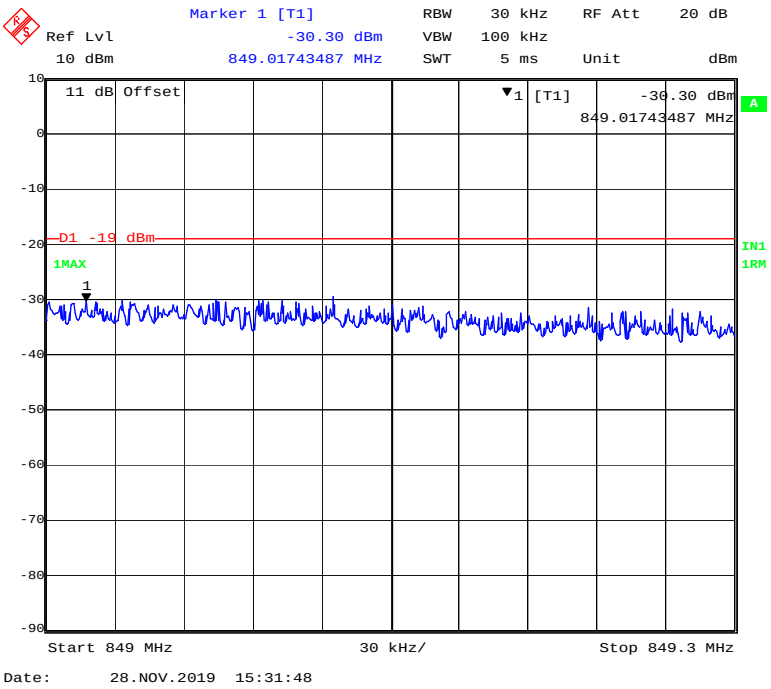
Cellular Band CDMA Left Side 824.88MHz Pre-AGC



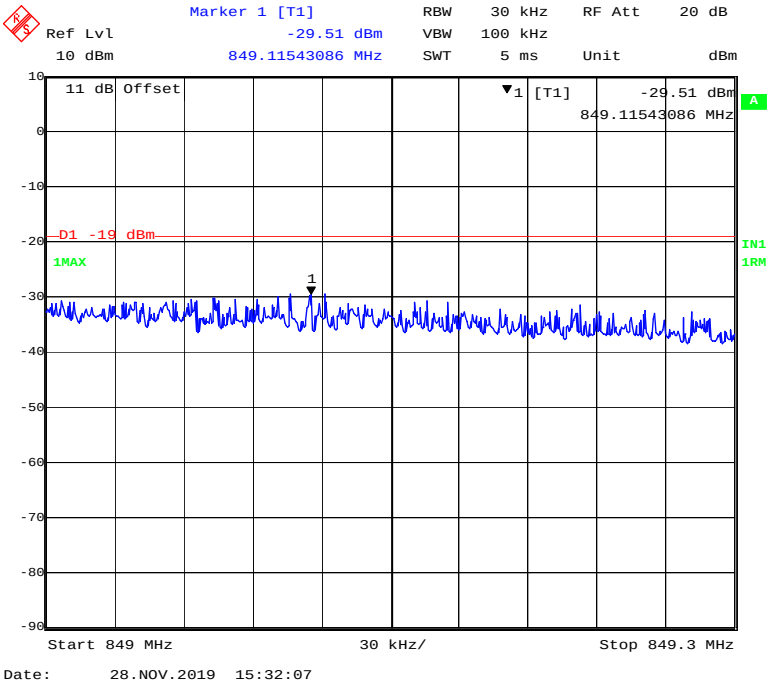
Cellular Band CDMA Left Side 824.88MHz Above AGC



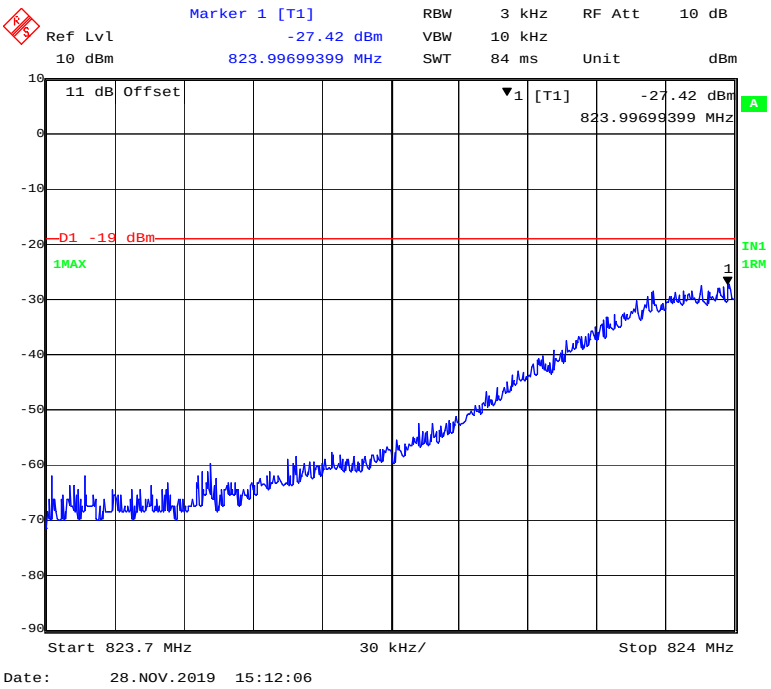
Cellular Band CDMA Right Side 848.10MHz Pre-AGC



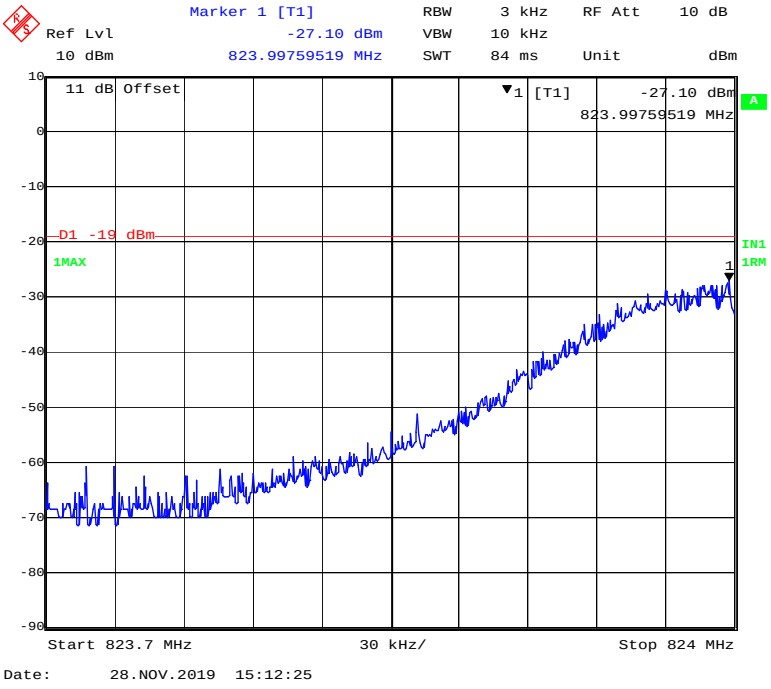
Cellular Band CDMA Right Side 848.10MHz Above AGC



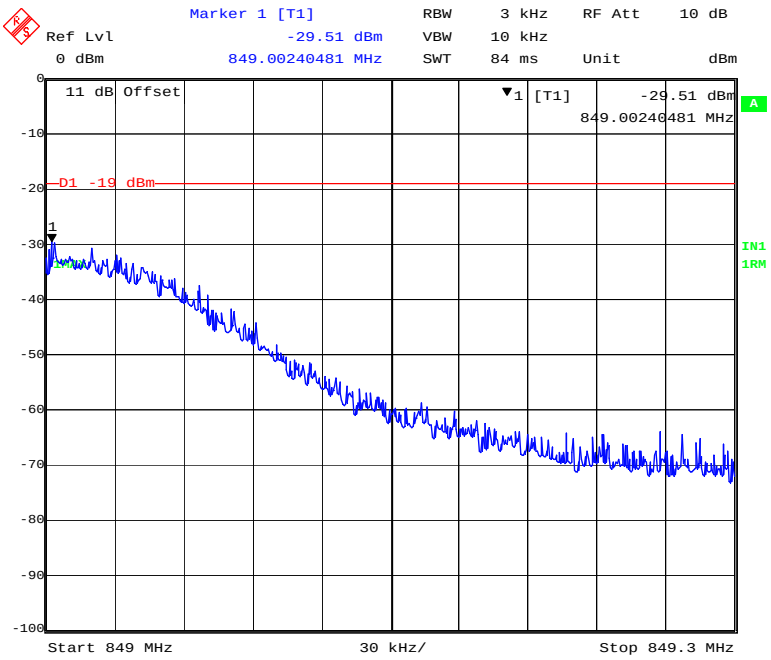
Cellular Band GSM Left Side 824.2MHz Pre-AGC



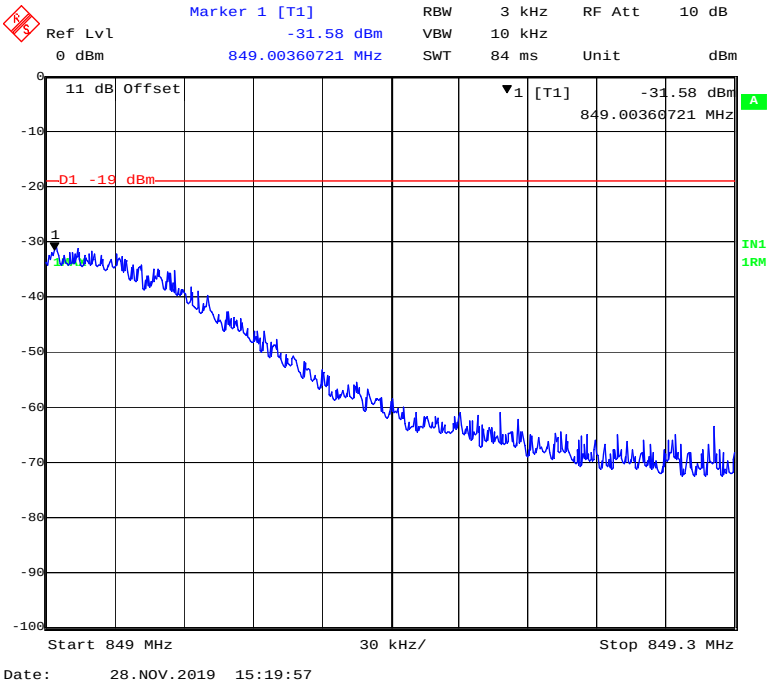
Cellular Band GSM Left Side 824.2MHz Above AGC



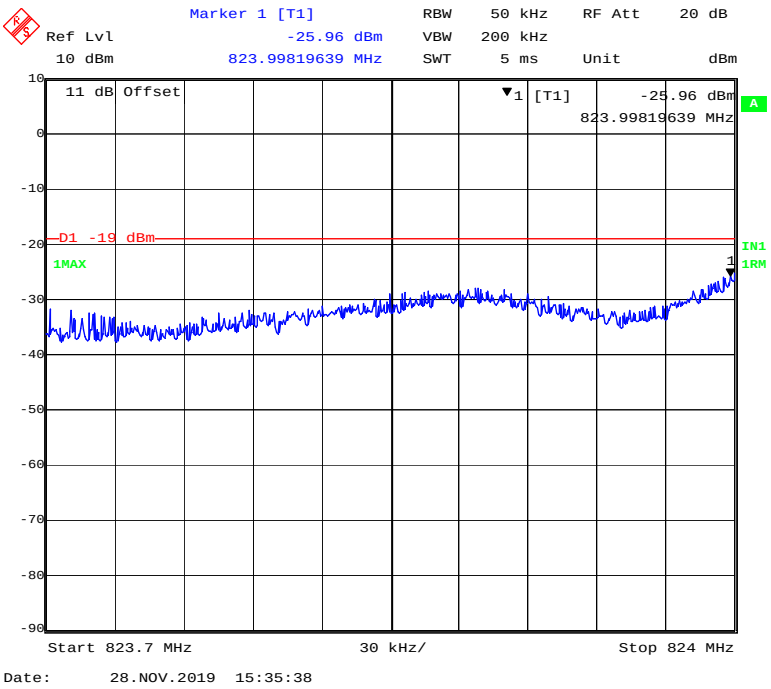
Cellular Band GSM Right Side 848.8MHz Pre-AGC



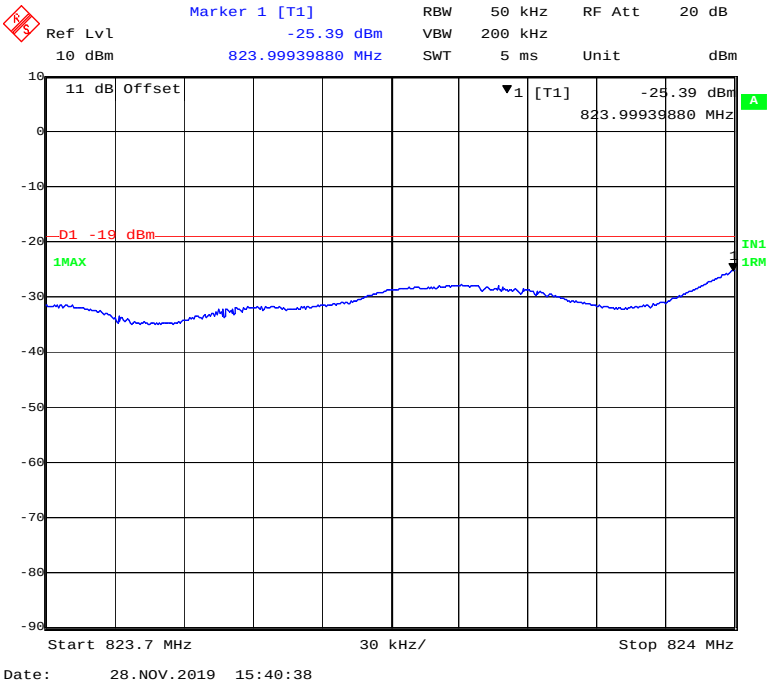
Cellular Band GSM Right Side 848.8MHz Above AGC



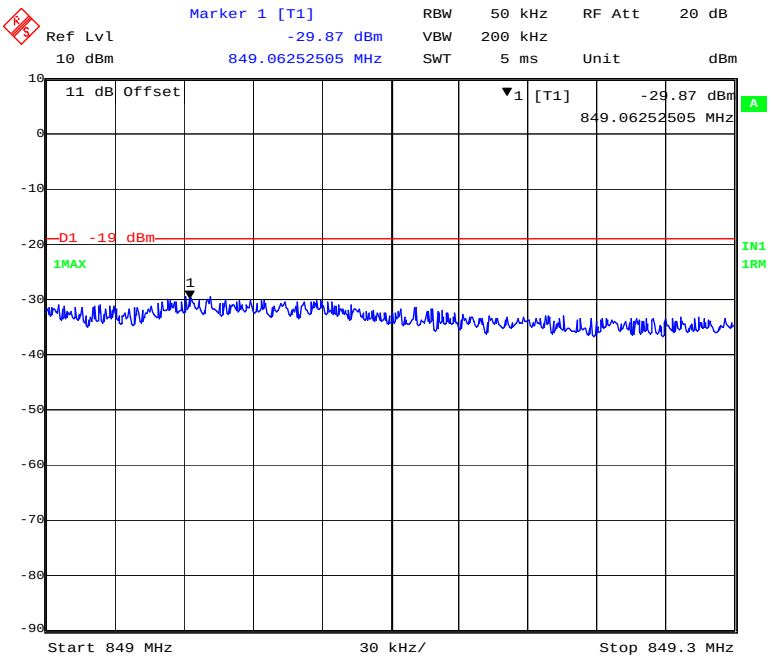
Cellular Band LTE Left Side 826.5MHz Pre-AGC



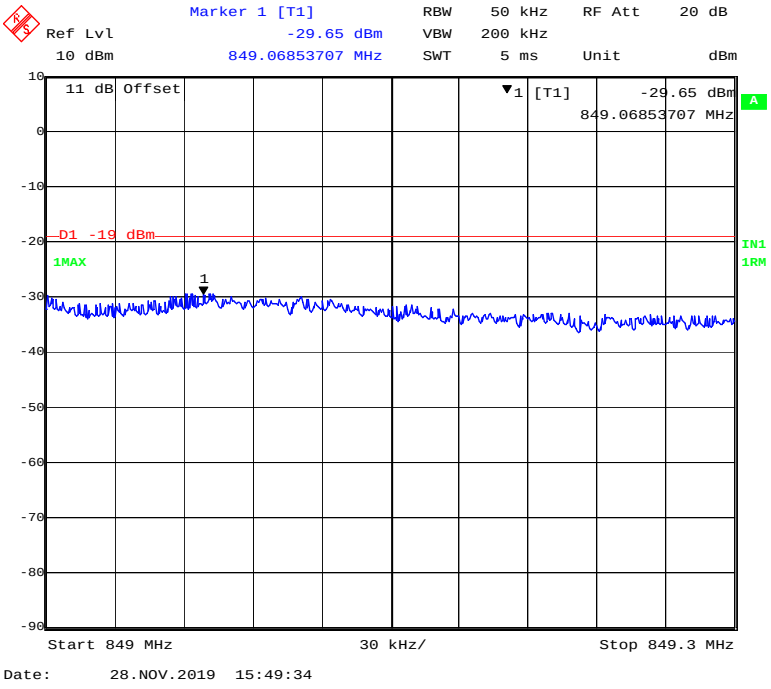
Cellular Band LTE Left Side 826.5MHz Above AGC



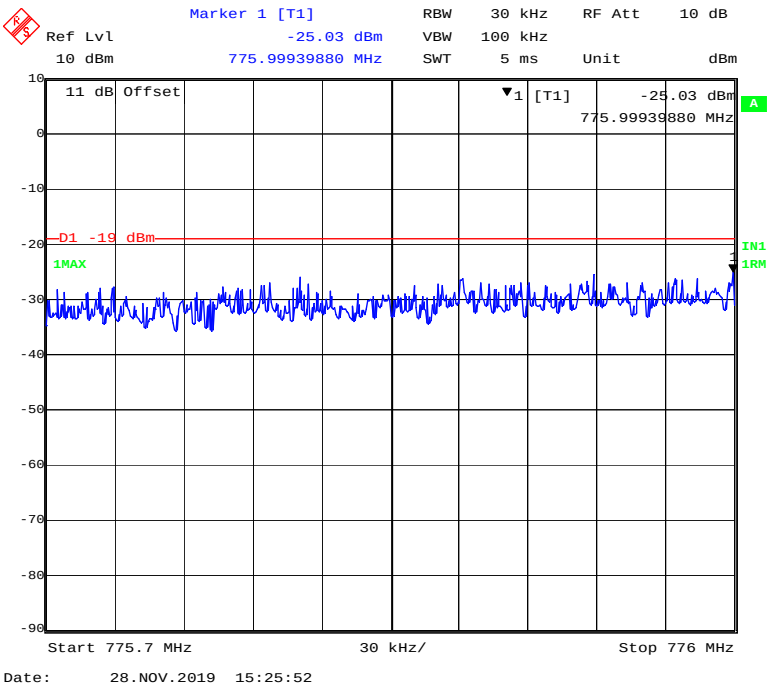
Cellular Band LTE Right Side 846.5MHz Pre-AGC



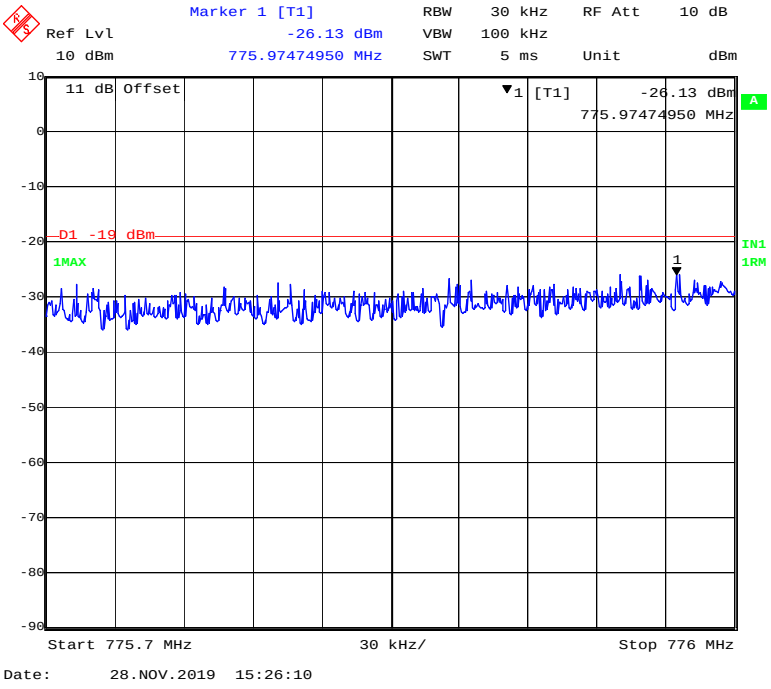
Cellular Band LTE Right Side 846.5MHz Above AGC



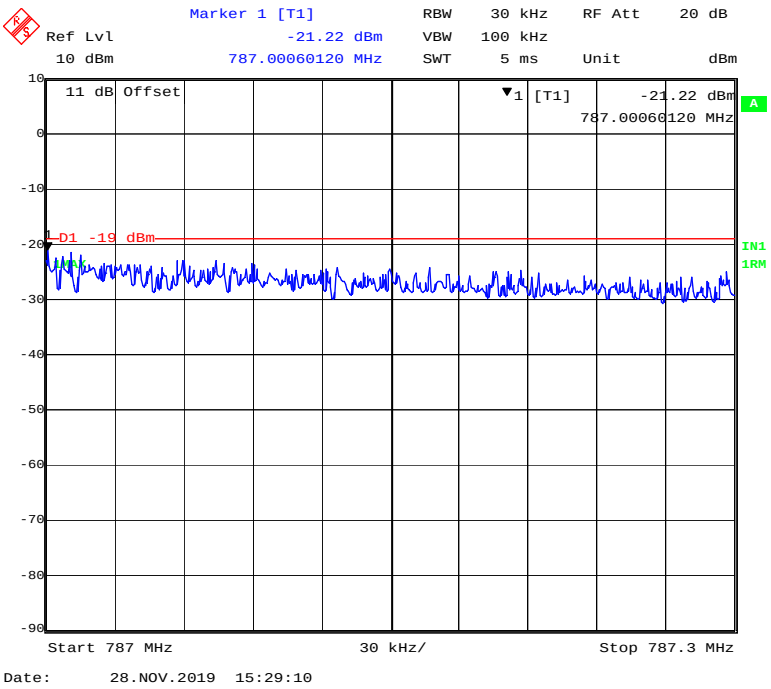
Upper 700MHz Band CDMA Left Side 777.25MHz Pre-AGC



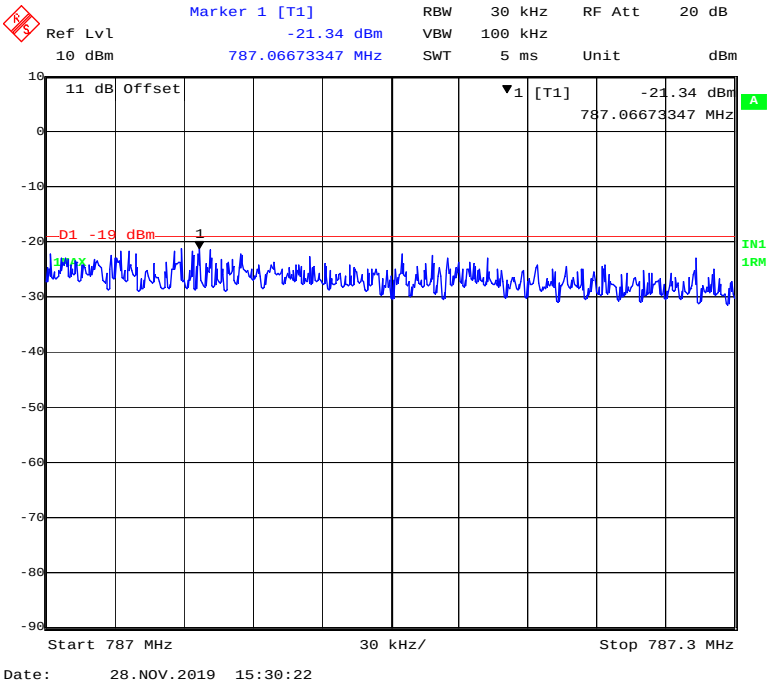
Upper 700MHz Band CDMA Left Side 777.25MHz Above AGC



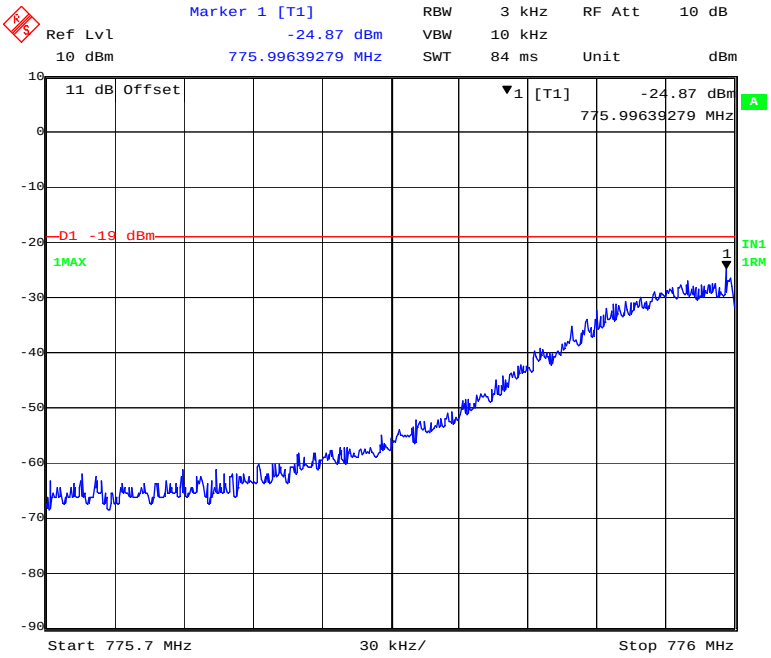
Upper 700MHz Band CDMA Right Side 785.75MHz Pre-AGC



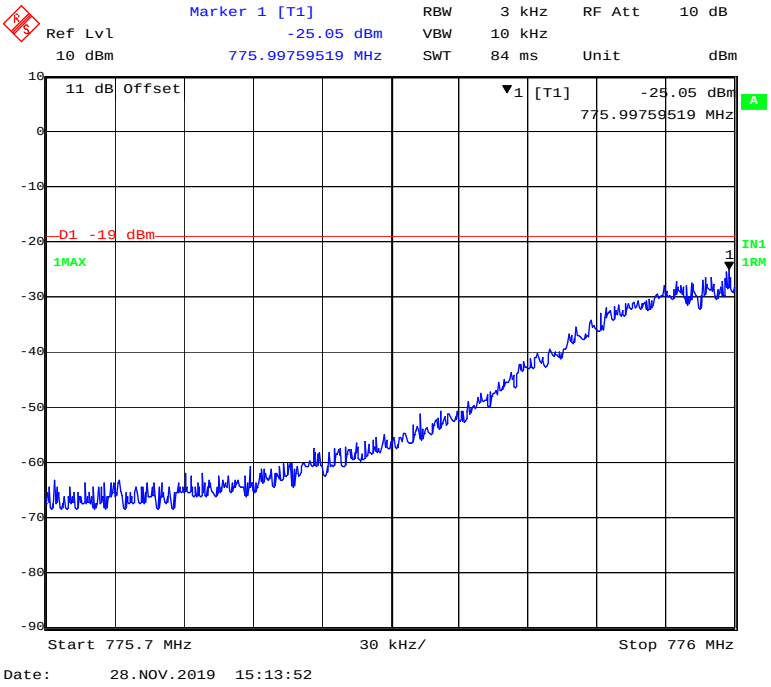
Upper 700MHz Band CDMA Right Side 785.75MHz Above AGC



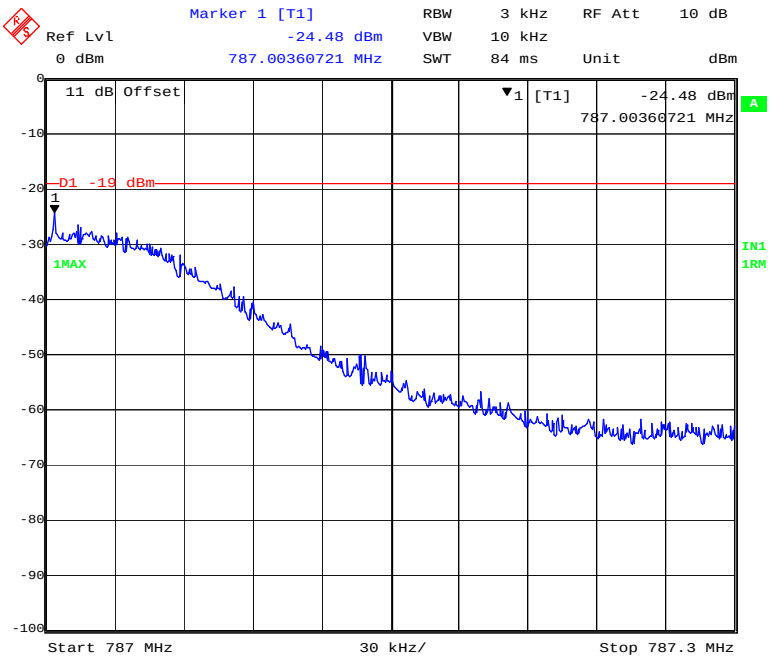
Upper 700MHz Band GSM Left Side 776.2MHz Pre-AGC



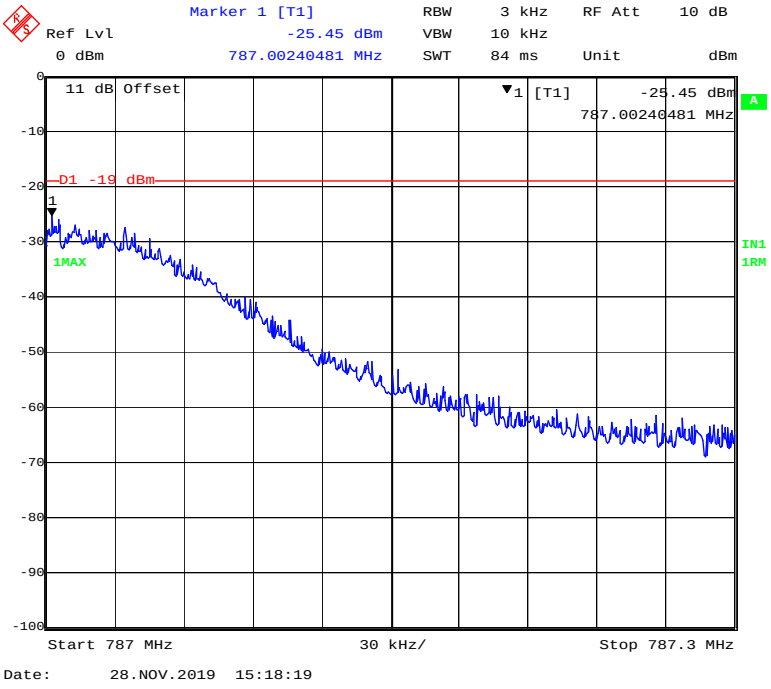
Upper 700MHz Band GSM Left Side 776.2MHz Above AGC



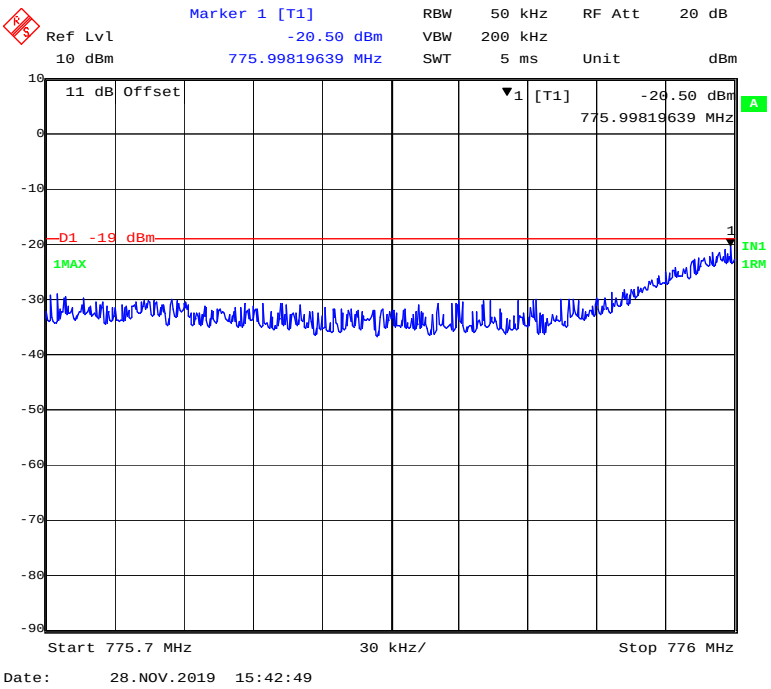
Upper 700MHz Band GSM Right Side 786.8MHz Pre-AGC



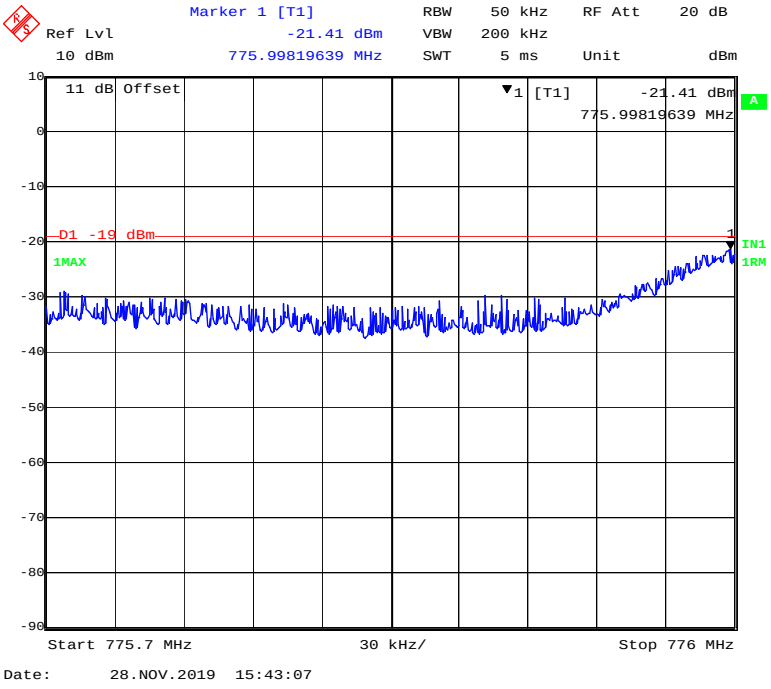
Upper 700MHz Band GSM Right Side 786.8MHz Above AGC



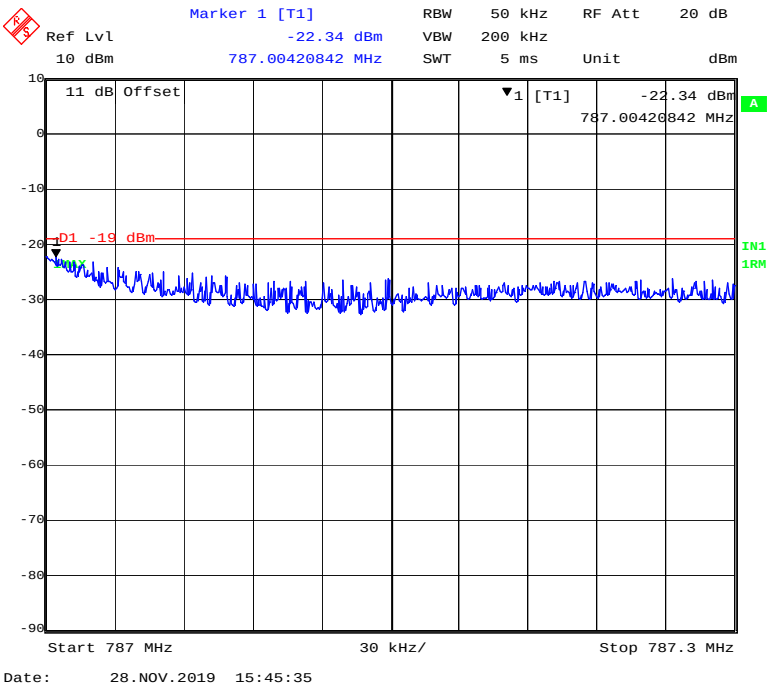
Upper 700MHz Band LTE Left Side 778.5MHz Pre-AGC



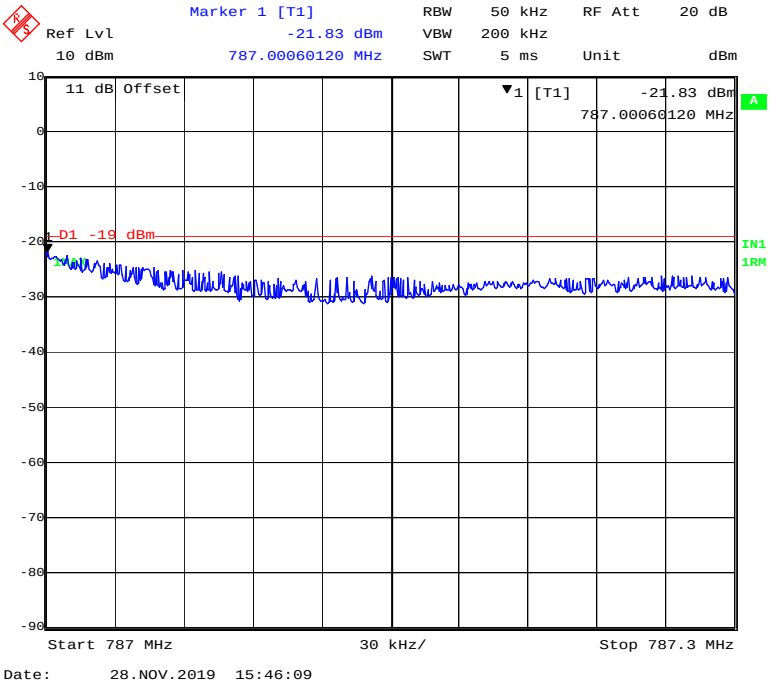
Upper 700MHz Band LTE Left Side 778.5MHz Above AGC



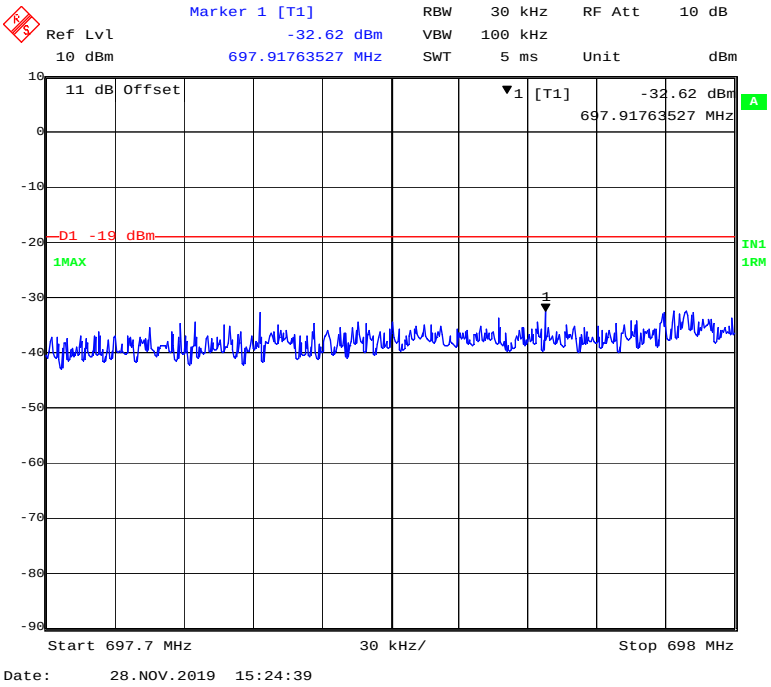
Upper 700MHz Band LTE Right Side 784.5MHz Pre-AGC



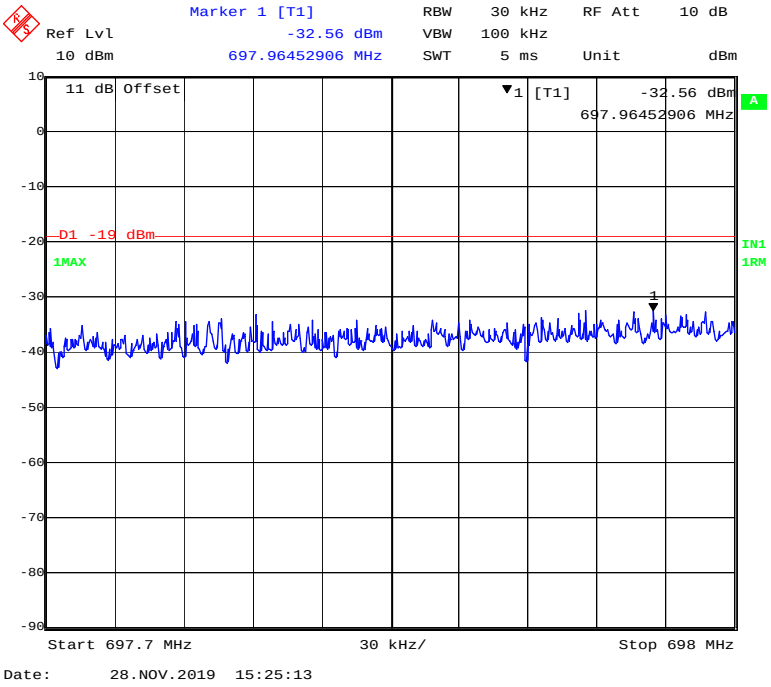
Upper 700MHz Band LTE Right Side 784.5MHz Above AGC



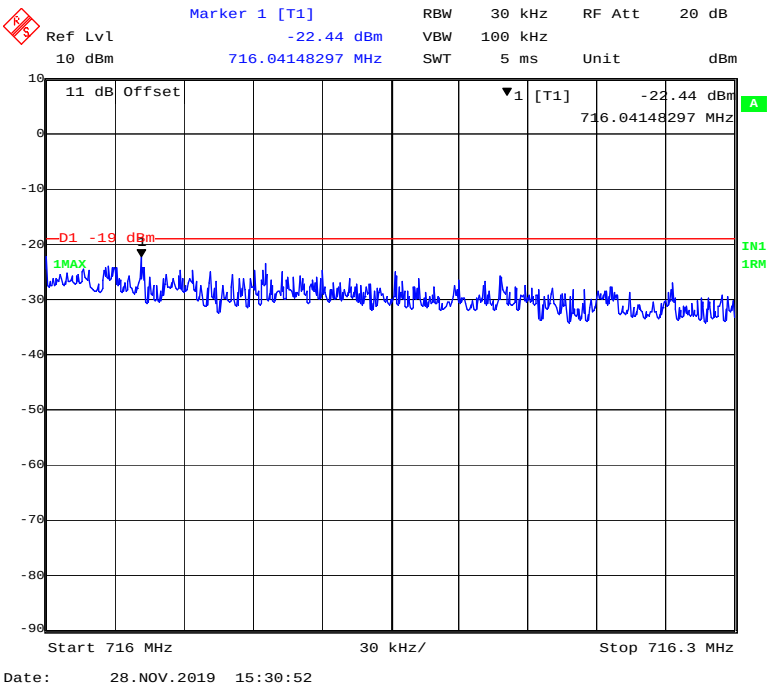
Lower700MHz Band CDMA Left Side 699.25MHz Pre-AGC



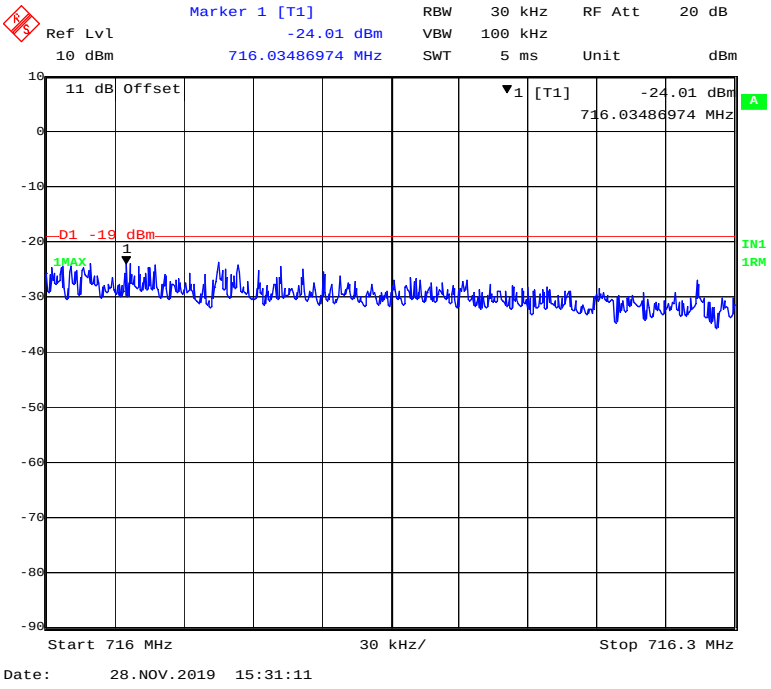
Lower 700MHz Band CDMA Left Side 699.25MHz Above AGC



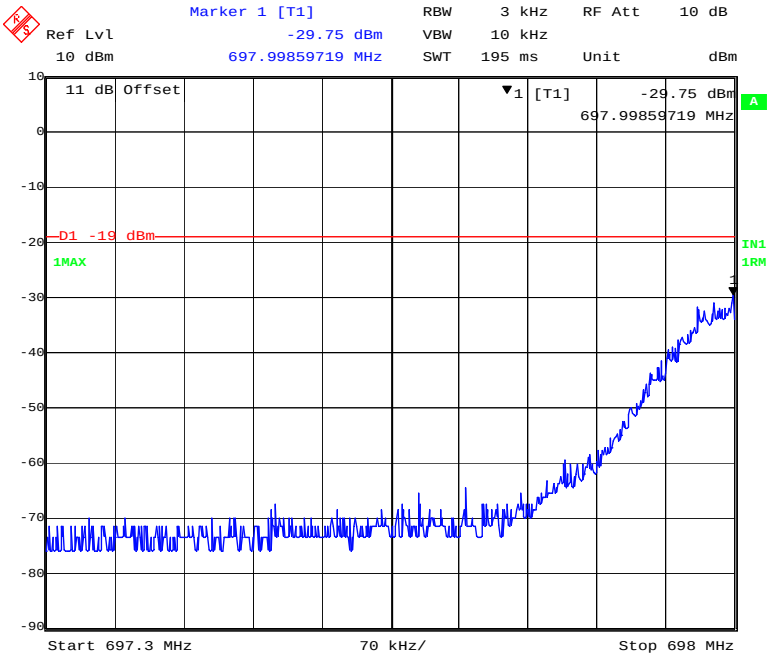
Lower 700MHz Band CDMA Right Side 714.75MHz Pre-AGC



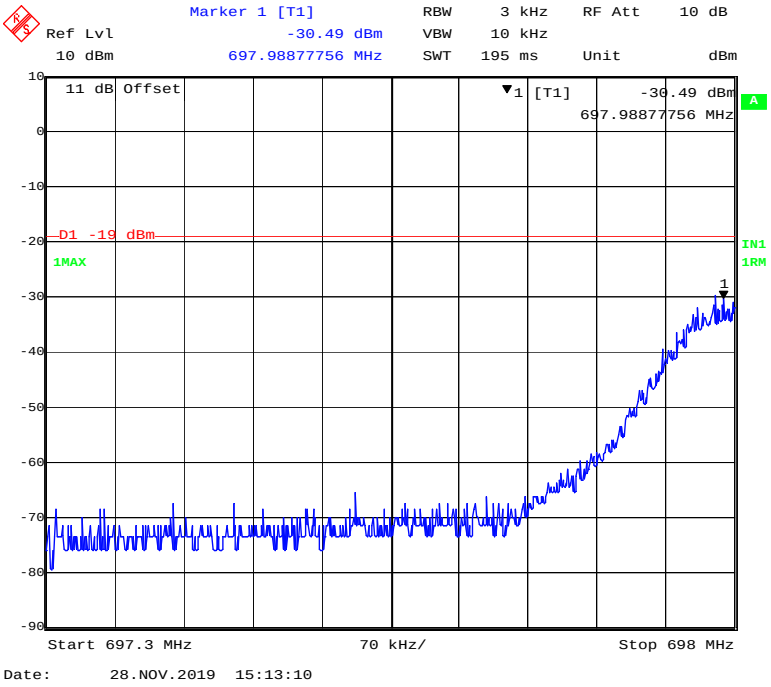
Lower 700MHz Band CDMA Right Side 714.75MHz Above AGC



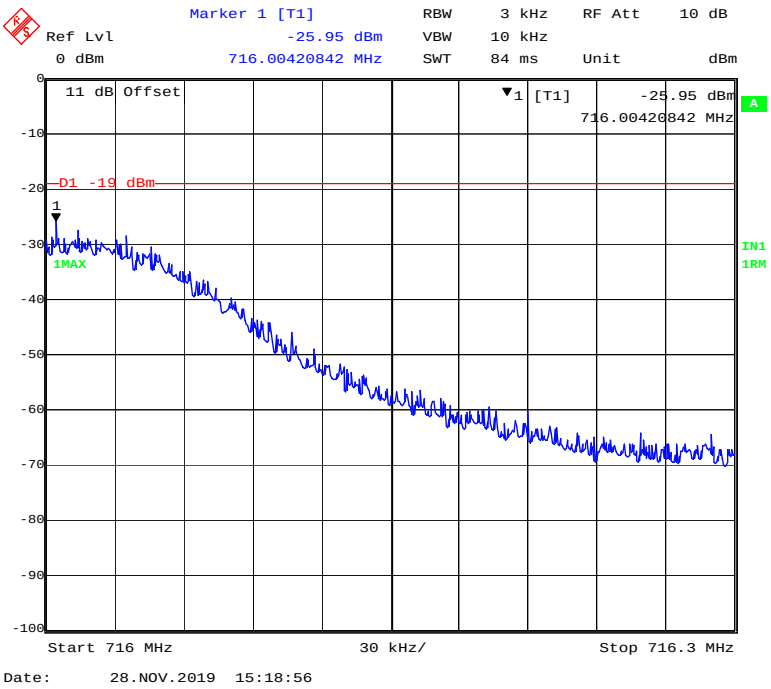
Lower 700MHz Band GSM Left Side 698.2MHz Pre-AGC



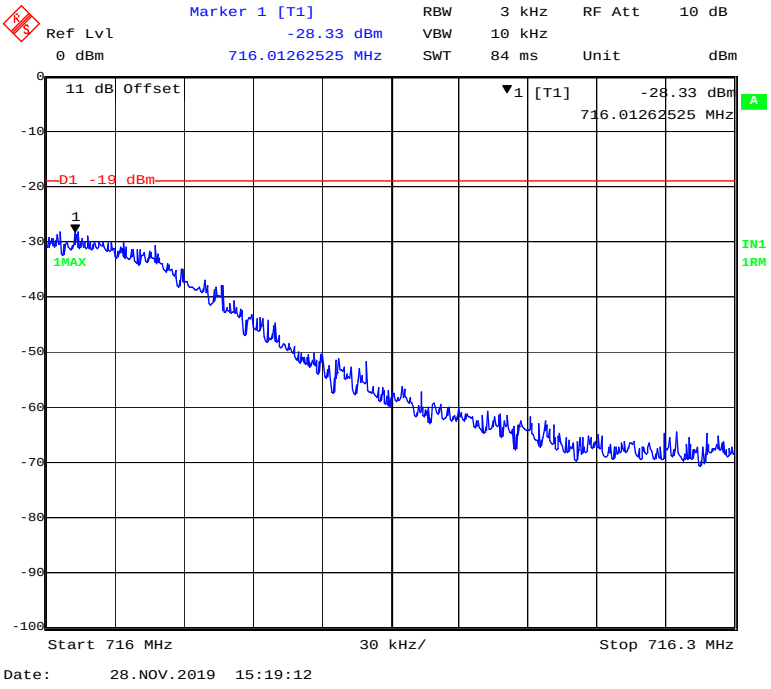
Lower 700MHz Band GSM Left Side 698.2MHz Above AGC



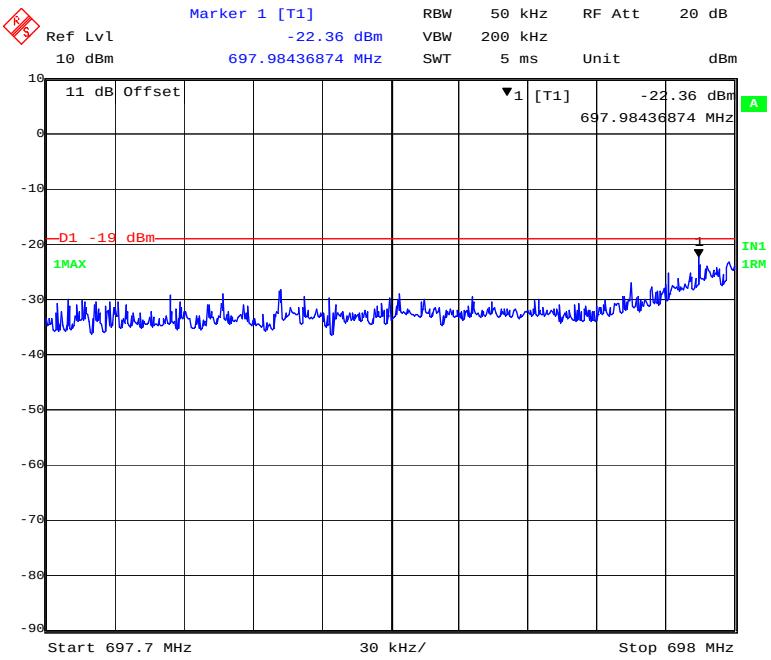
Lower 700MHz Band GSM Right Side 715.8MHz Pre-AGC



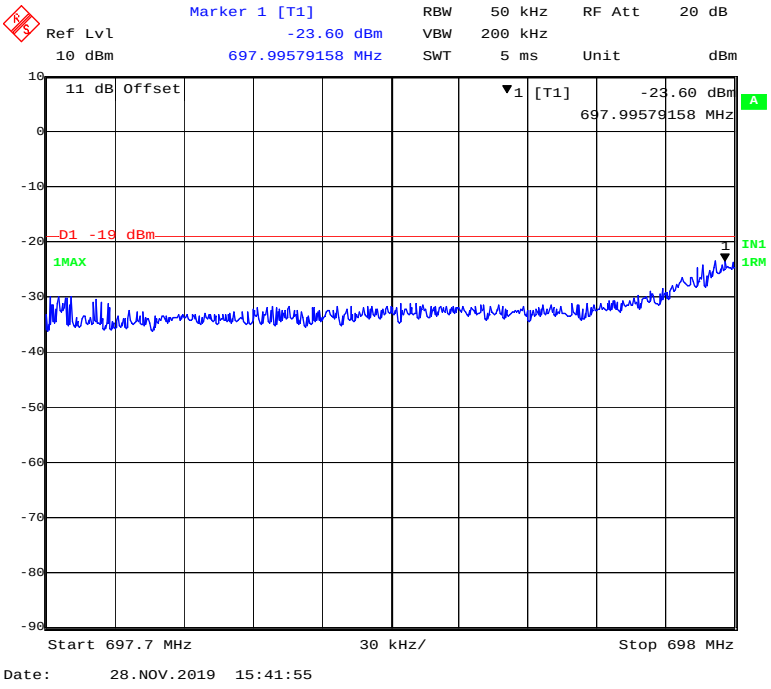
Lower 700MHz Band GSM Right Side 715.8MHz Above AGC



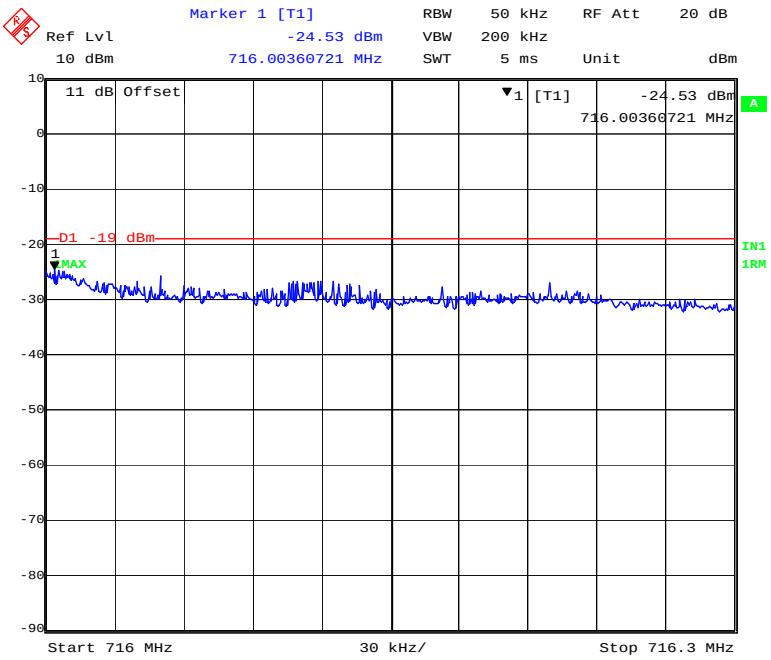
Lower 700MHz Band LTE Left Side 670.5MHz Pre-AGC



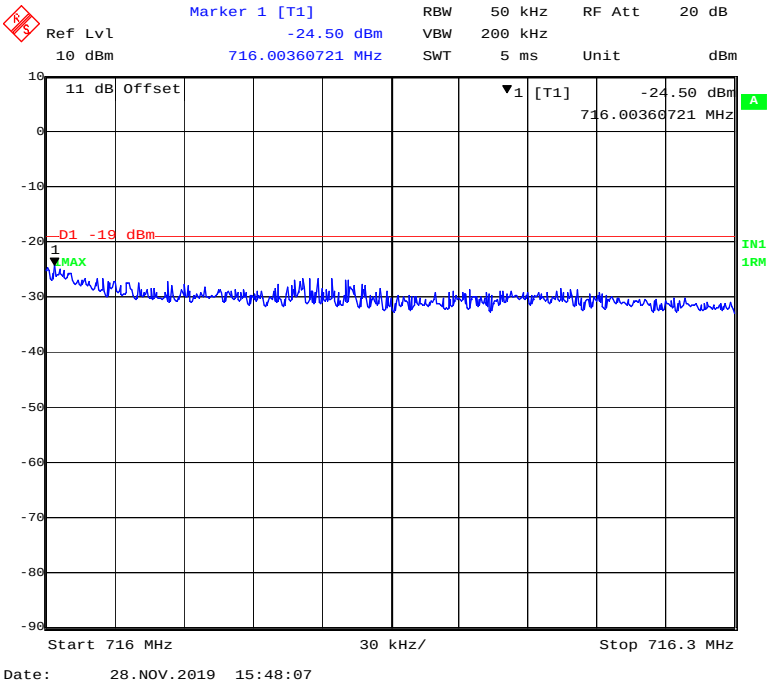
Lower 700MHz Band LTE Left Side 670.5MHz Above AGC



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



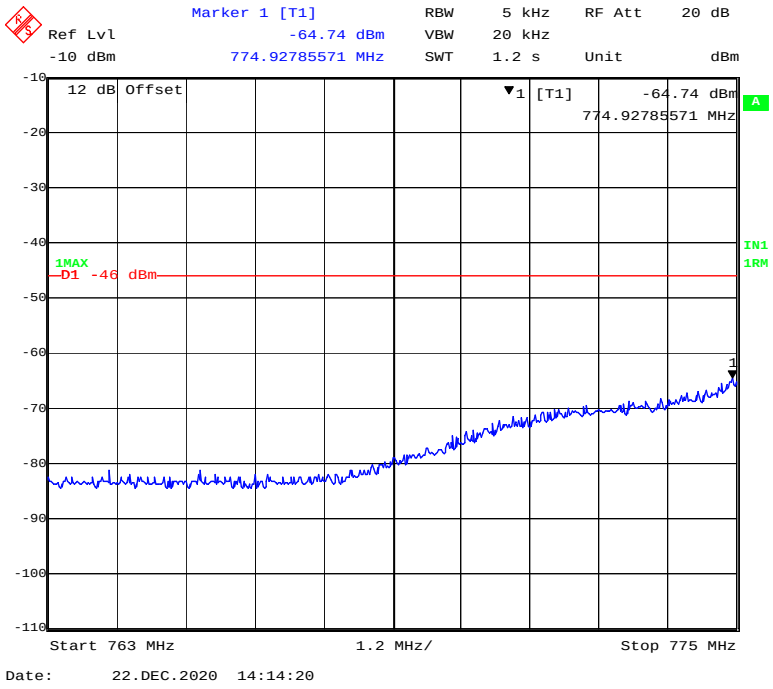
Lower 700MHz Band LTE Right Side 713.5MHz Above AGC



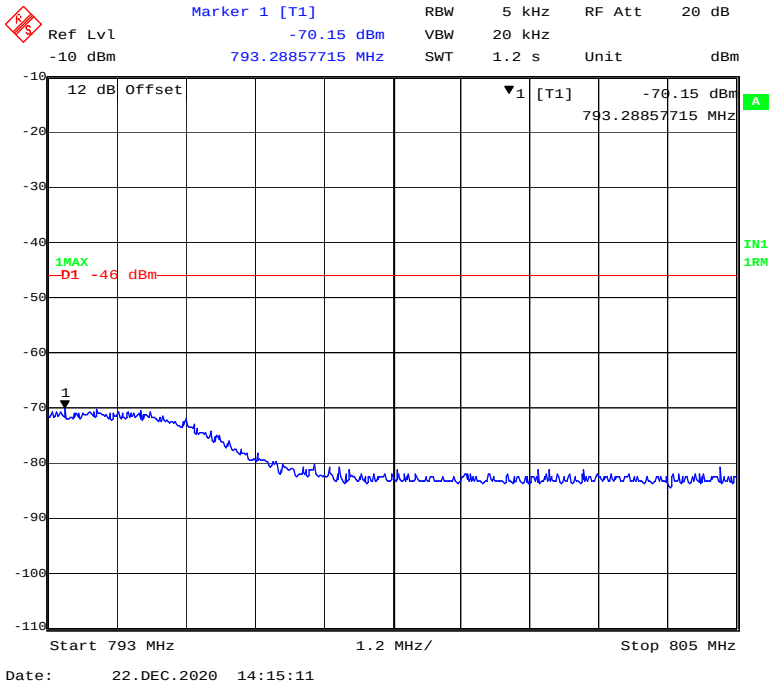
Additional Requirement for Upper 700MHz Band:

Uplink:

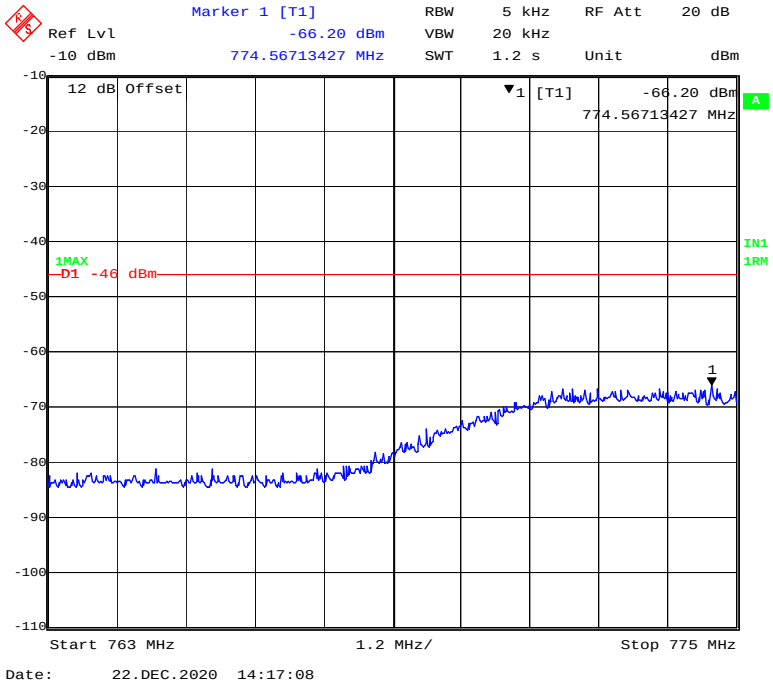
Upper 700MHz Band CDMA Left Side 777.25MHz（763-775MHz）



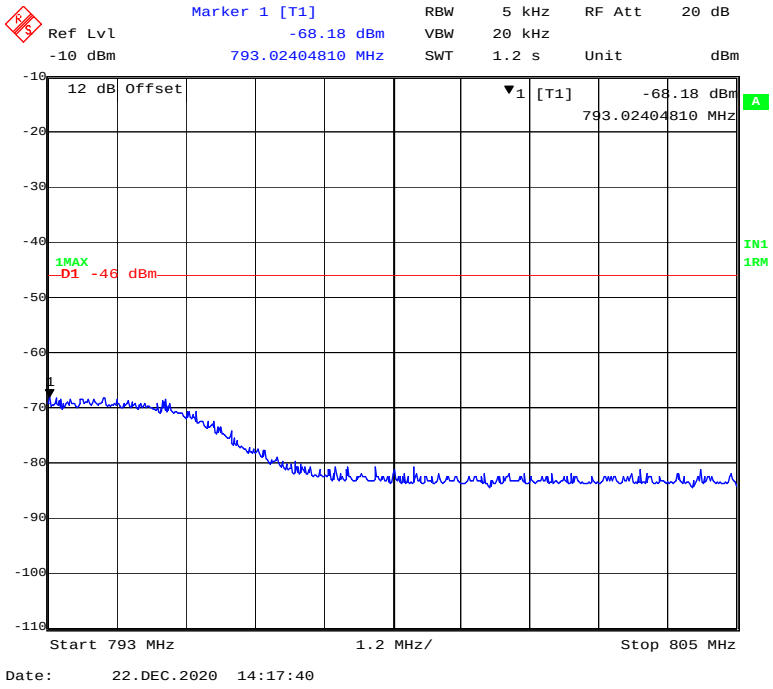
Upper 700MHz Band CDMA Left Side 777.25MHz（793-805MHz）



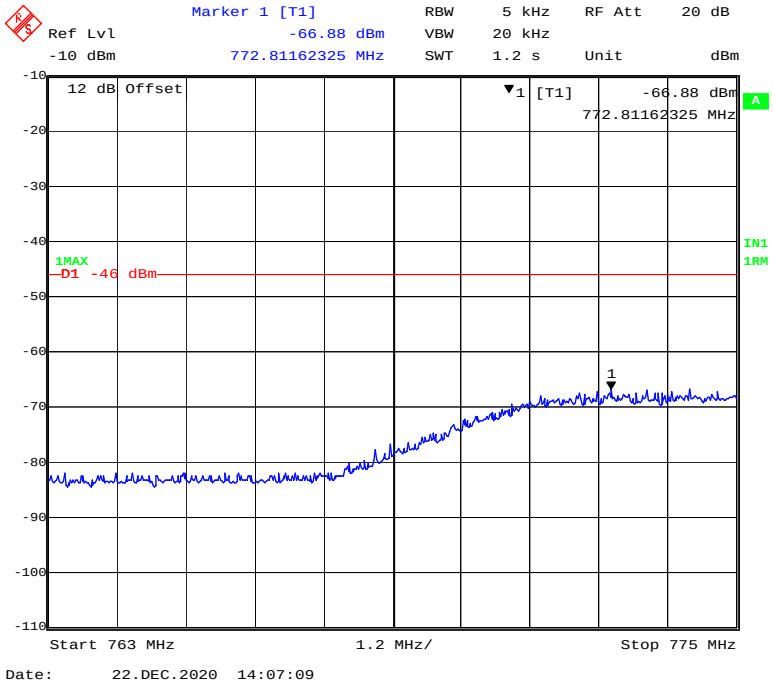
Upper 700MHz Band CDMA Right Side 785.75MHz（763-775MHz）



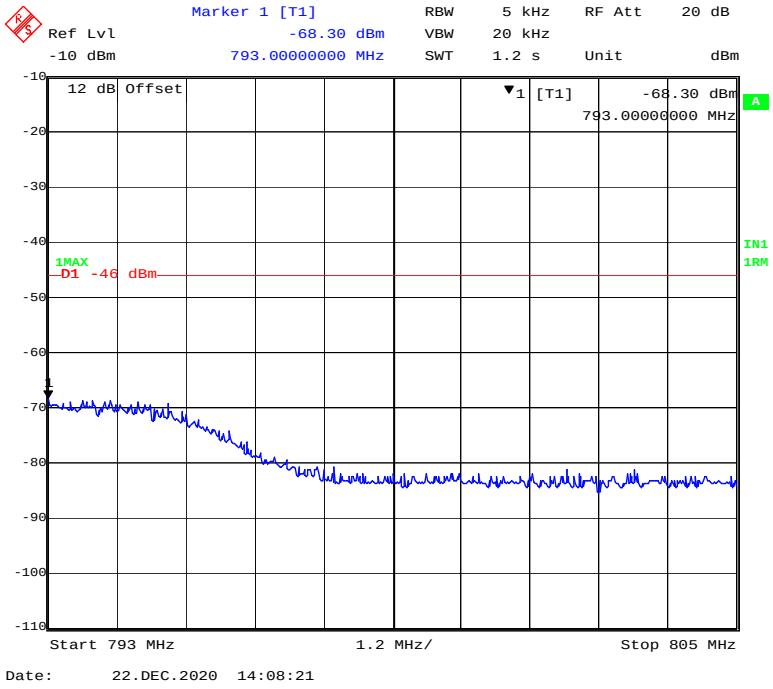
Upper 700MHz Band CDMA Right Side 785.75MHz（793-805MHz）



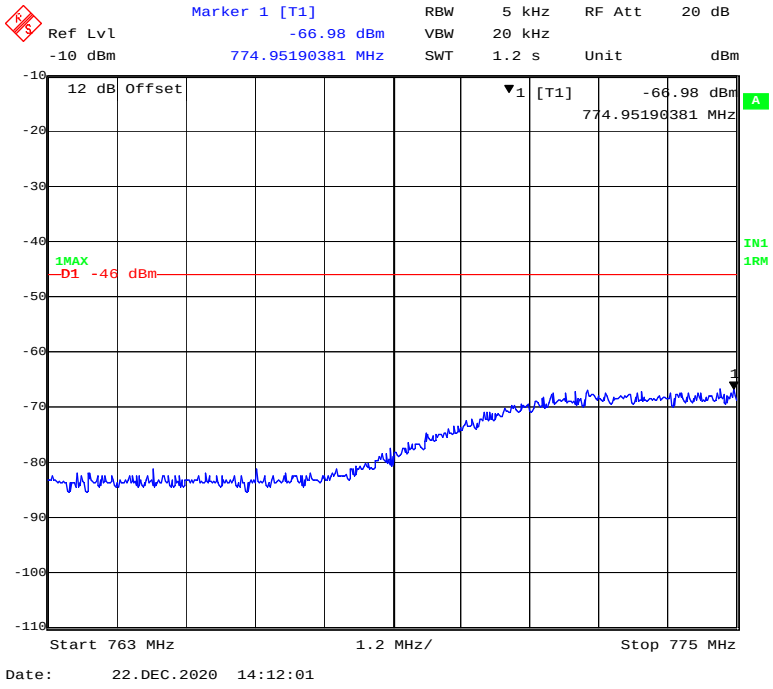
Upper 700MHz Band GSM Left Side 776.2MHz（763-775MHz）



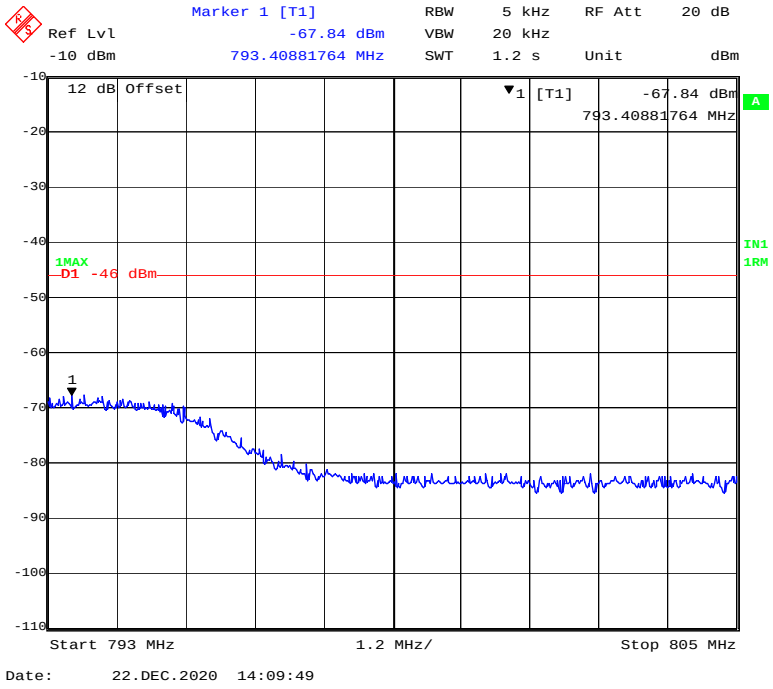
Upper 700MHz Band GSM Left Side 776.2MHz（793-805MHz）



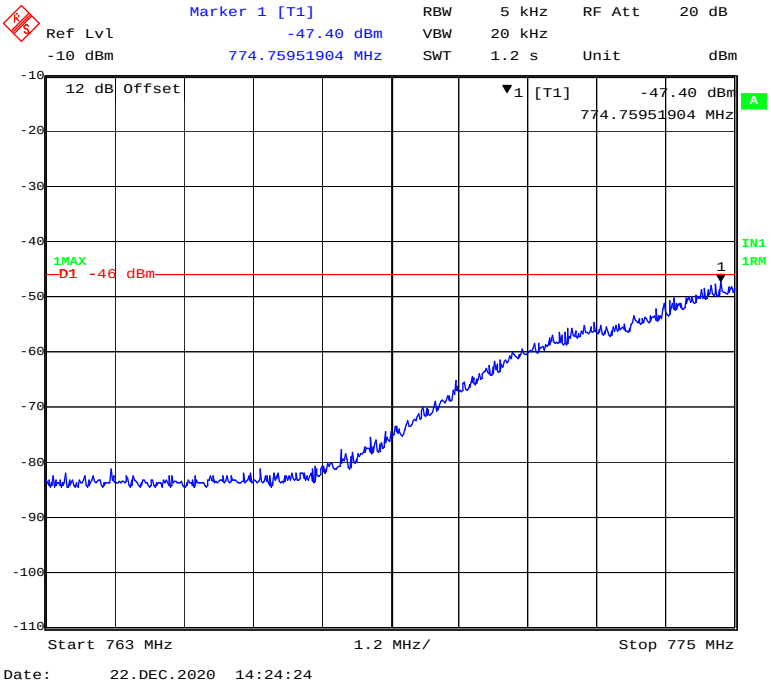
Upper 700MHz Band GSM Right Side 786.8MHz（763-775MHz）



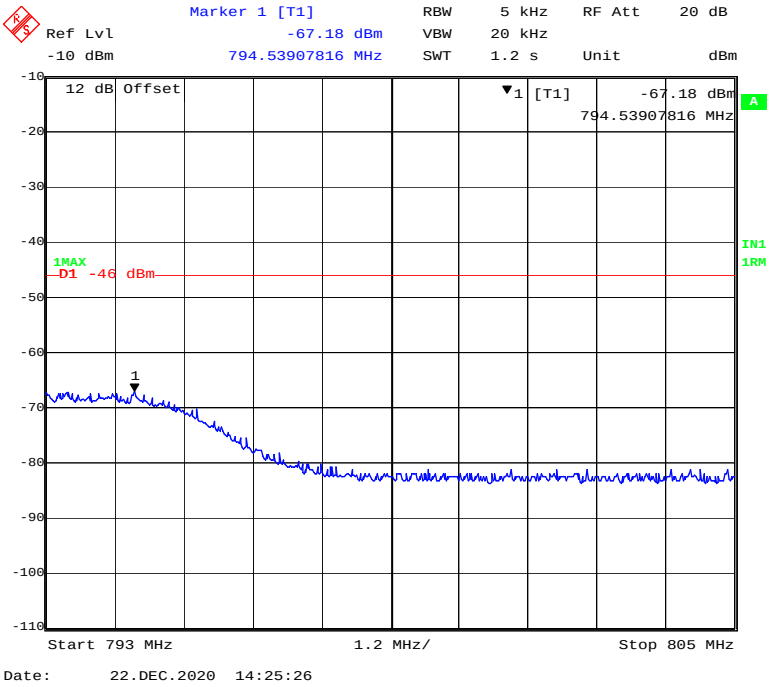
Upper 700MHz Band GSM Right Side 786.8MHz（793-805MHz）



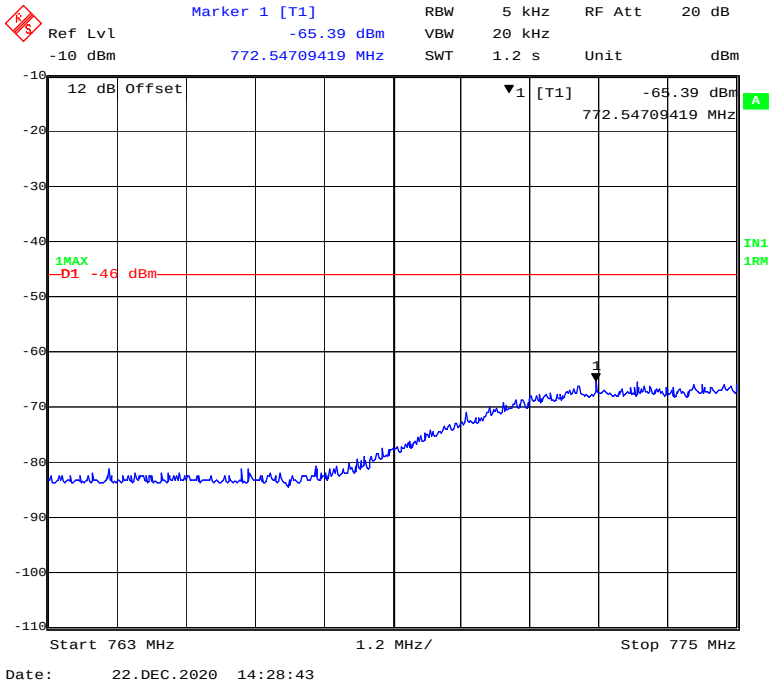
Upper 700MHz Band LTE Left Side 778.5MHz（763-775MHz）



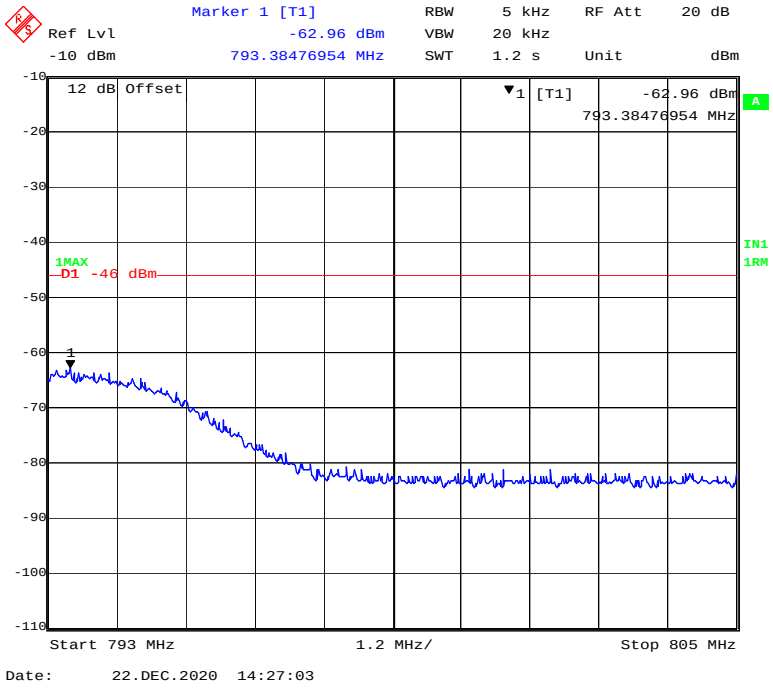
Upper 700MHz Band LTE Left Side 778.5MHz（793-805MHz）



Upper 700MHz Band LTE Right Side 784.5MHz（763-775MHz）

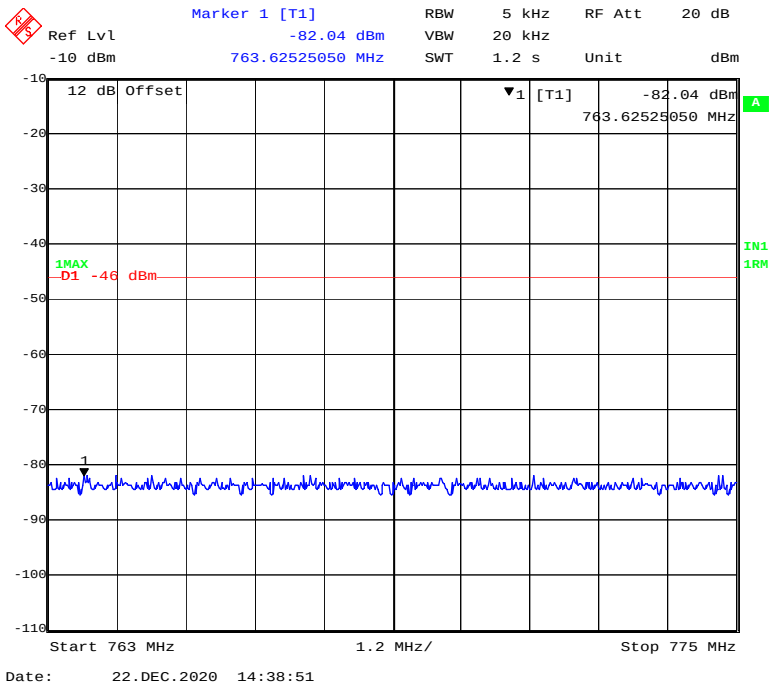


Upper 700MHz Band LTE Right Side 784.5MHz（793-805MHz）

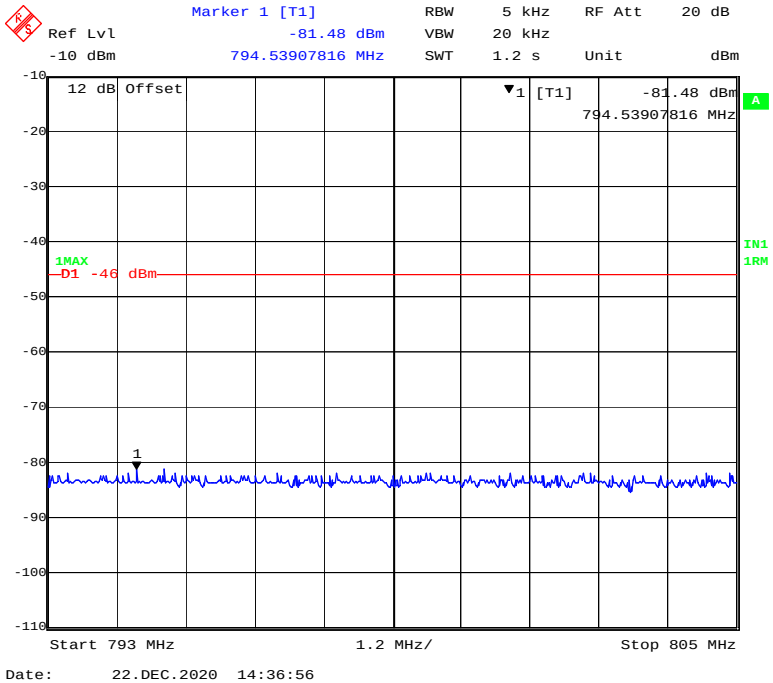


Downlink:

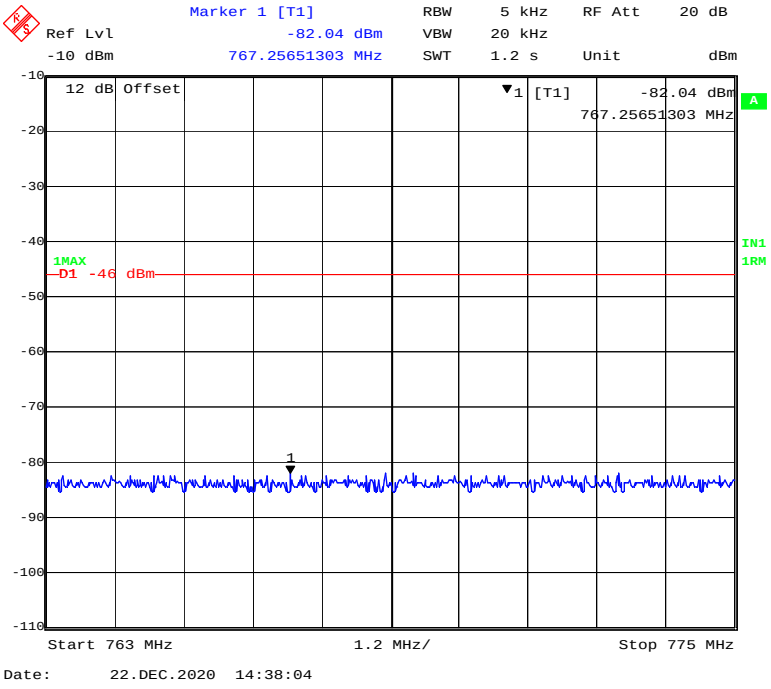
Upper 700MHz Band CDMA Left Side 747.25MHz（763-775MHz）



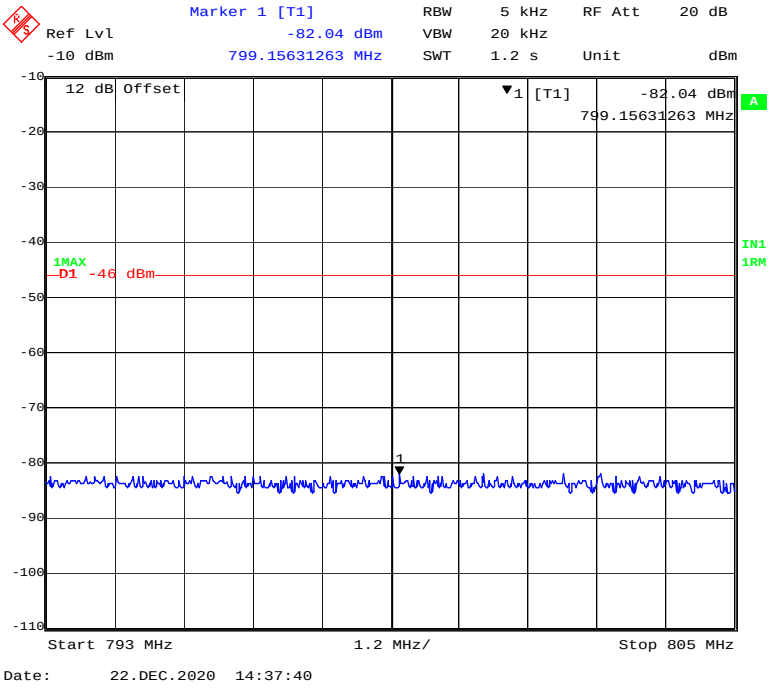
Upper 700MHz Band CDMA Left Side 747.25MHz（793-805MHz）



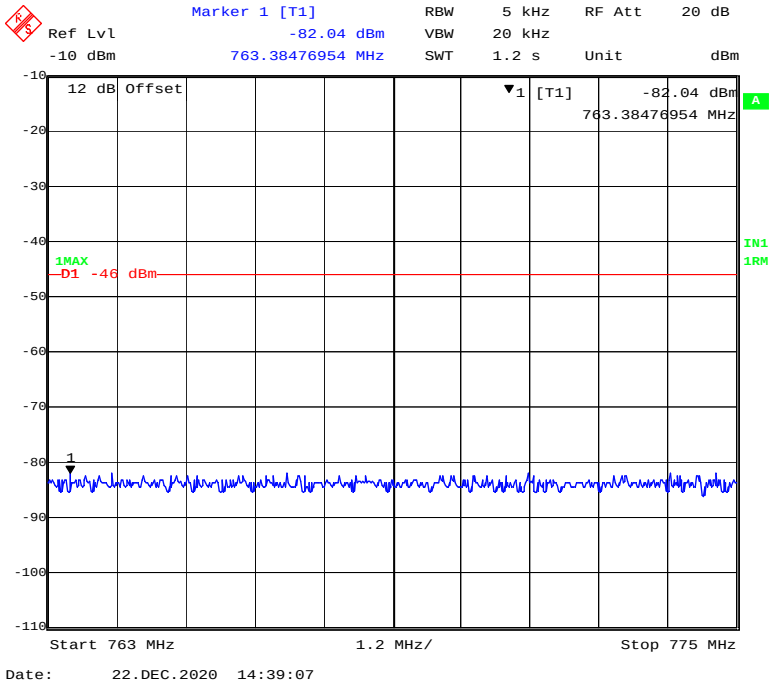
Upper 700MHz Band CDMA Right Side 755.75MHz（763-775MHz）



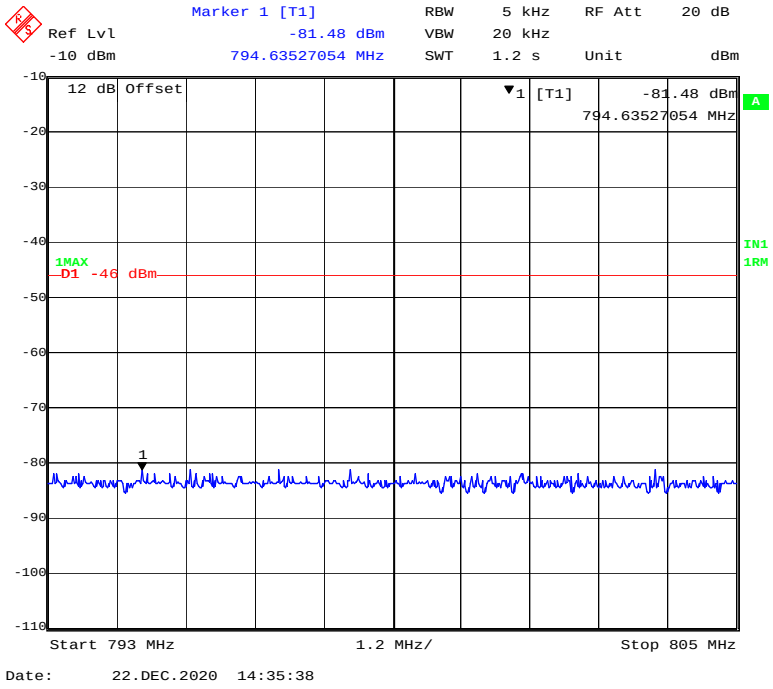
Upper 700MHz Band CDMA Right Side 755.75MHz（793-805MHz）



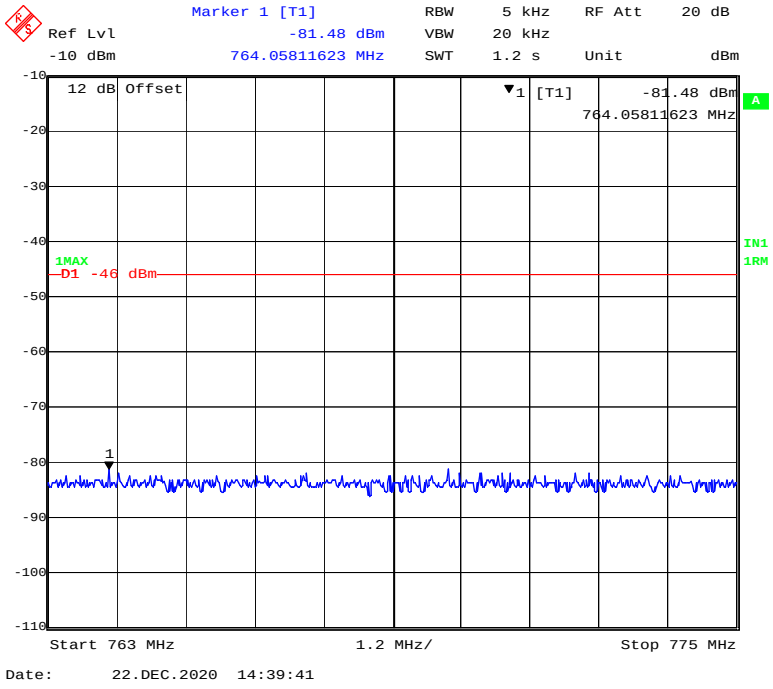
Upper 700MHz Band GSM Left Side 746.2MHz（763-775MHz）



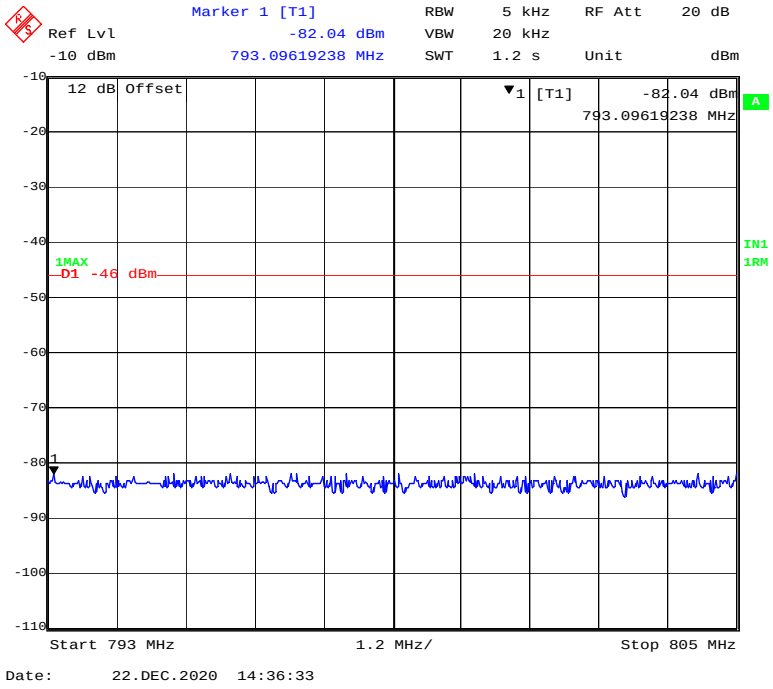
Upper 700MHz Band GSM Left Side 746.2MHz（793-805MHz）



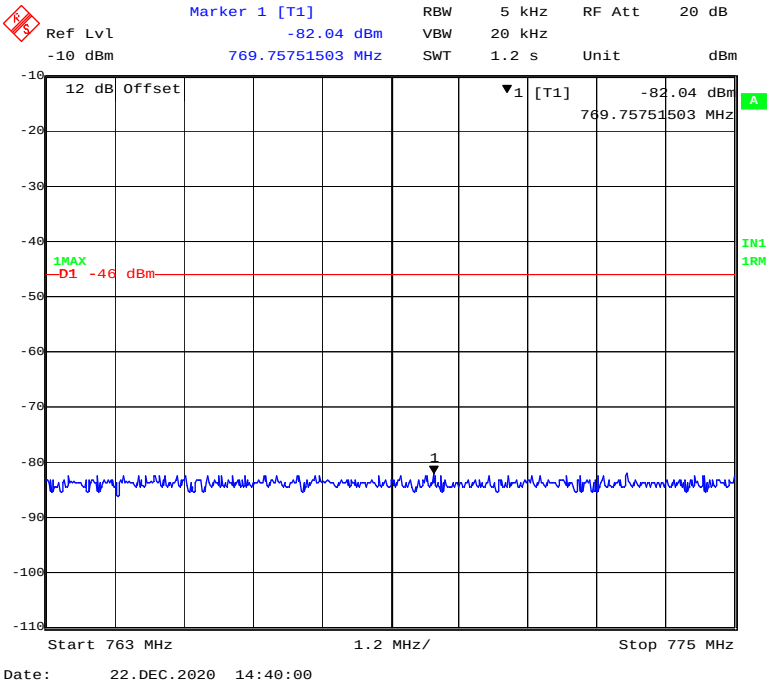
Upper 700MHz Band GSM Right Side 756.8MHz（763-775MHz）



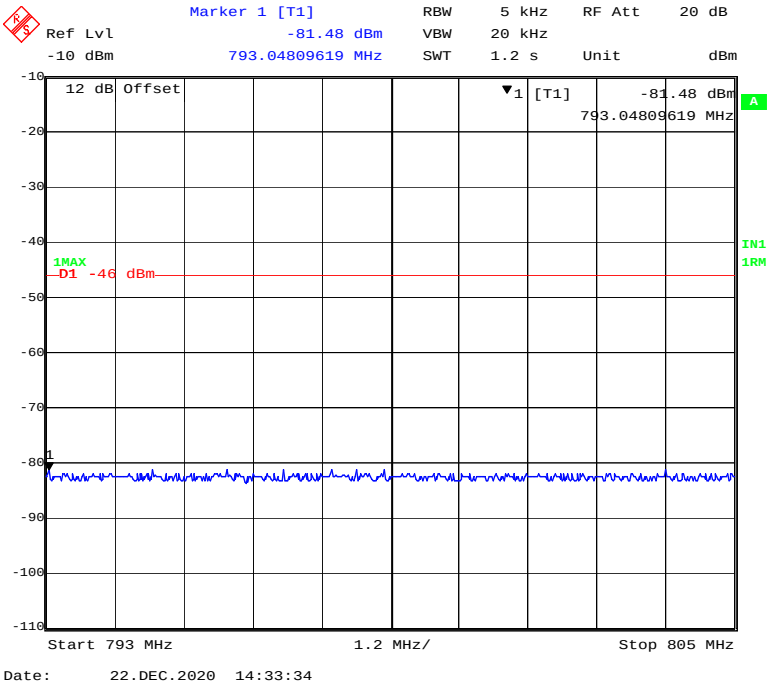
Upper 700MHz Band GSM Right Side 756.8MHz（793-805MHz）



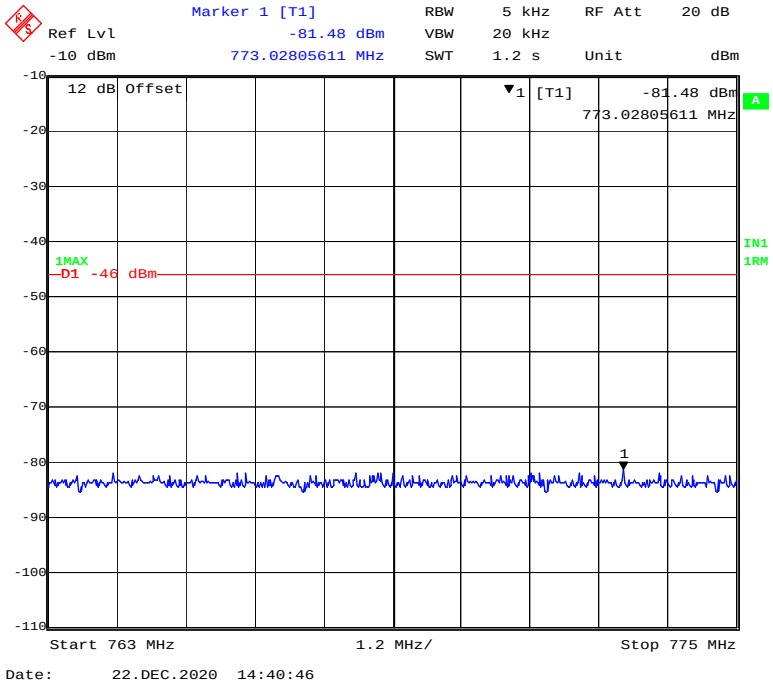
Upper 700MHz Band LTE Left Side 748.5MHz（763-775MHz）



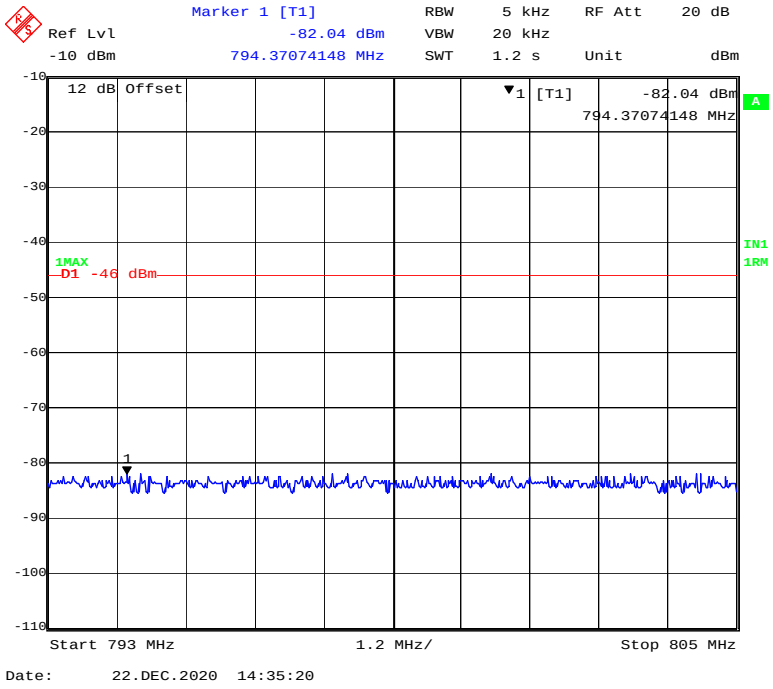
Upper 700MHz Band LTE Left Side 748.5MHz（793-805MHz）



Upper 700MHz Band LTE Right Side 754.5MHz（763-775MHz）



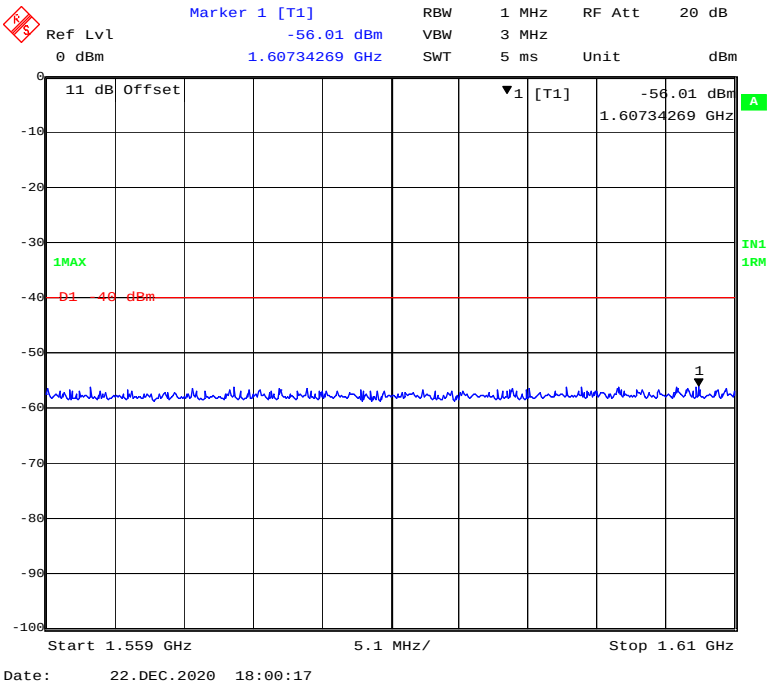
Upper 700MHz Band LTE Right Side 754.5MHz（793-805MHz）



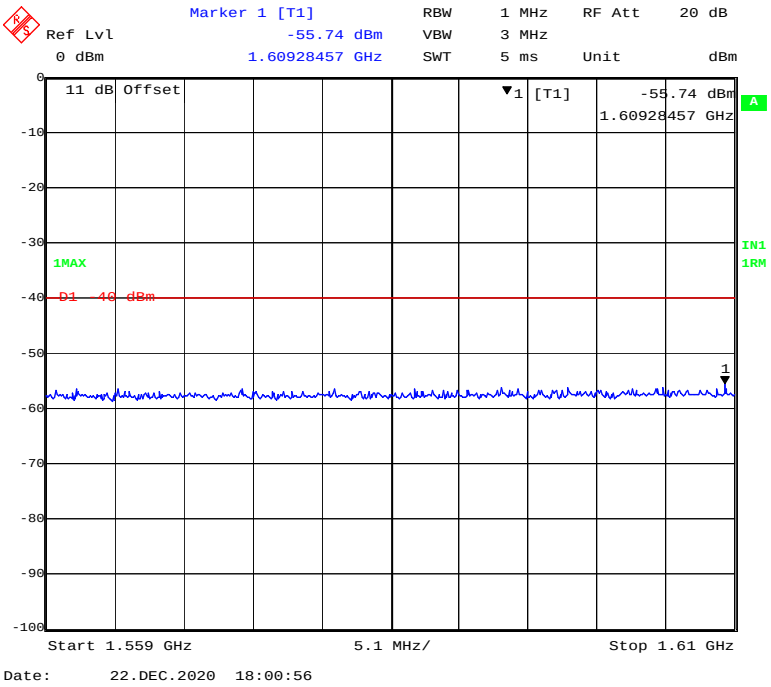
Co-existence with 1559-1610MHz:

Uplink:

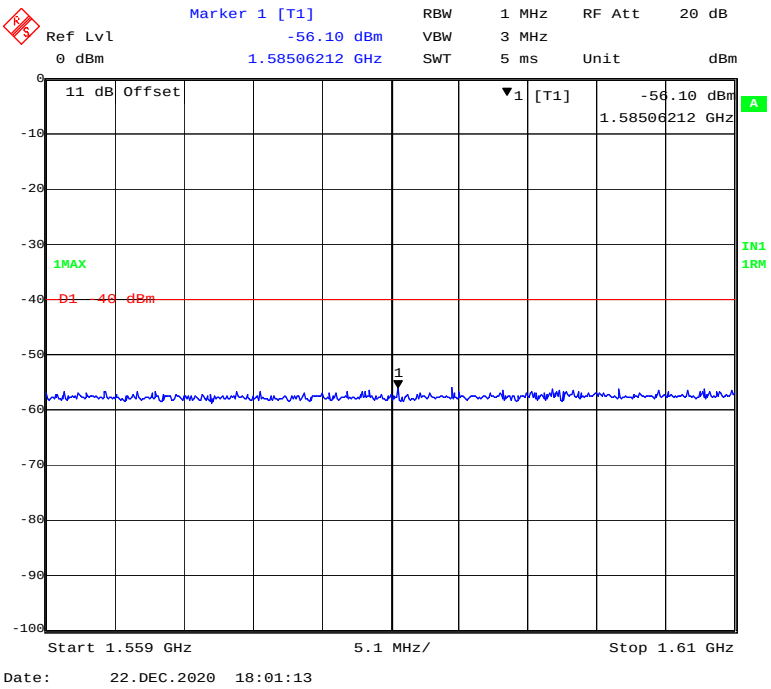
Upper 700MHz Band CDMA Left Side 777.25MHz



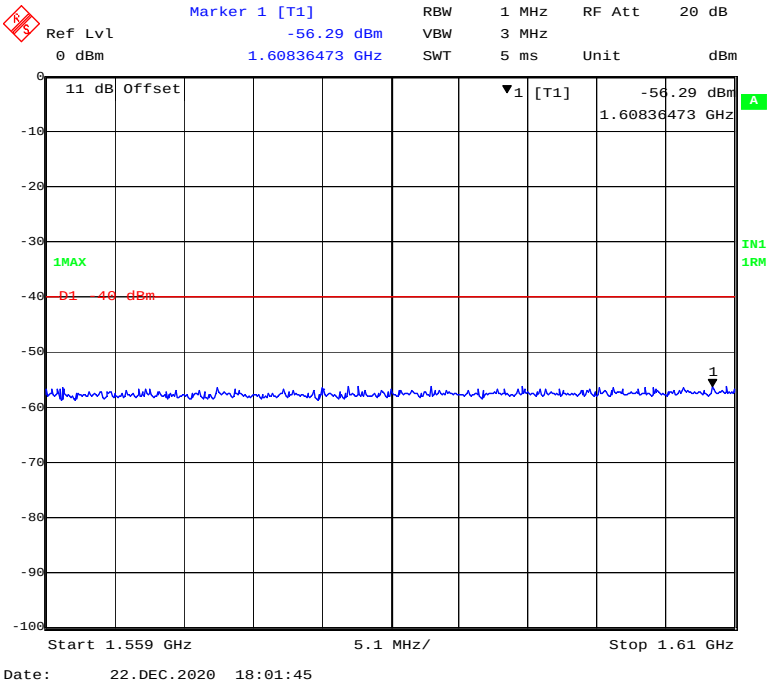
Upper 700MHz Band CDMA Right Side 785.75MHz



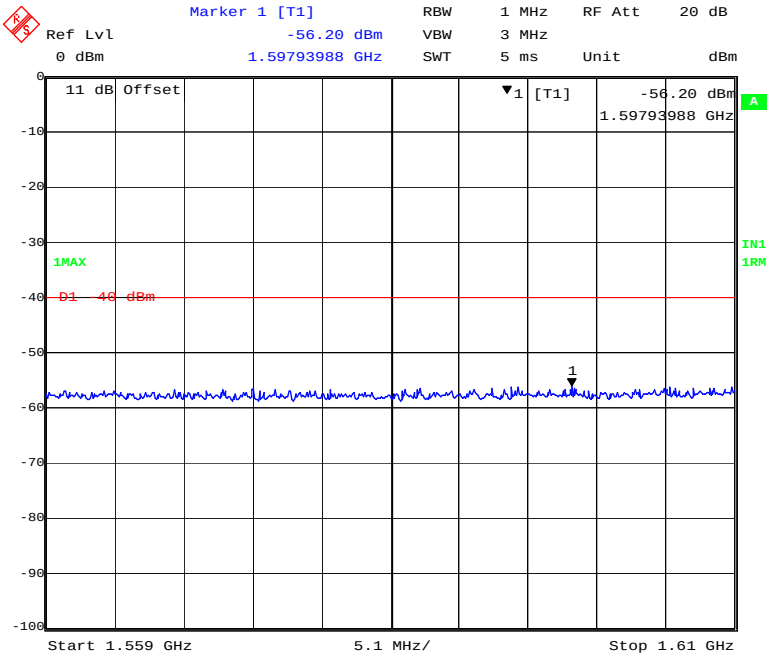
Upper 700MHz Band GSM Left Side 776.2MHz



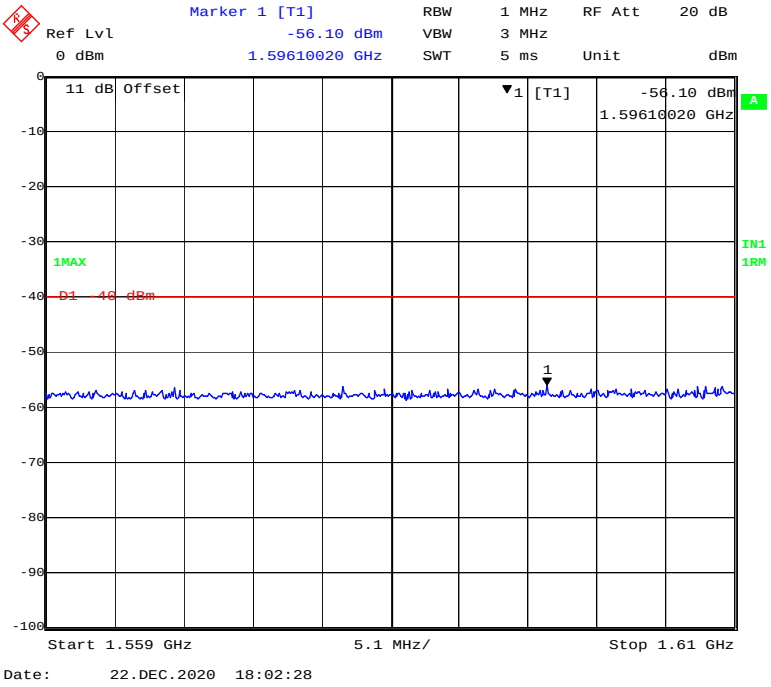
Upper 700MHz Band GSM Right Side 786.8MHz



Upper 700MHz Band LTE Left Side 778.5MHz

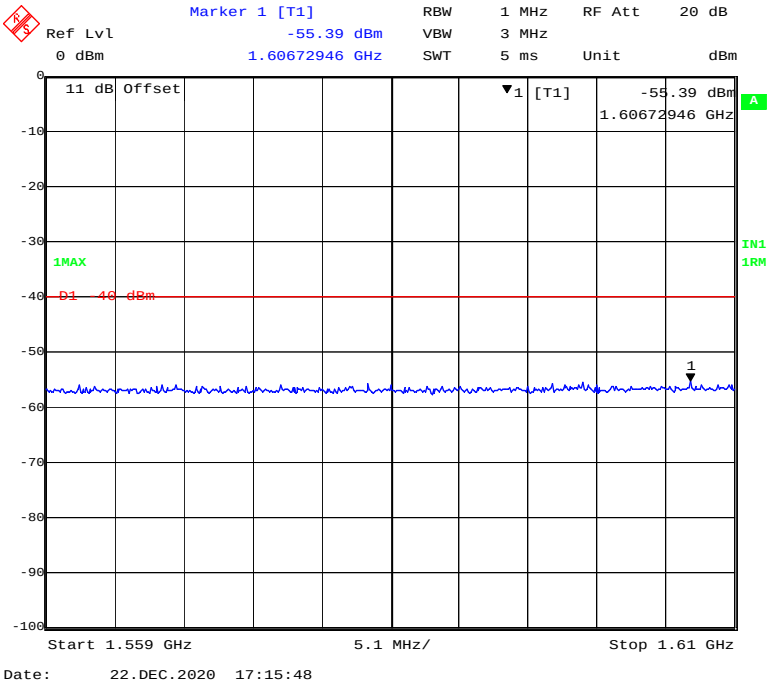


Upper 700MHz Band LTE Right Side 784.5MHz

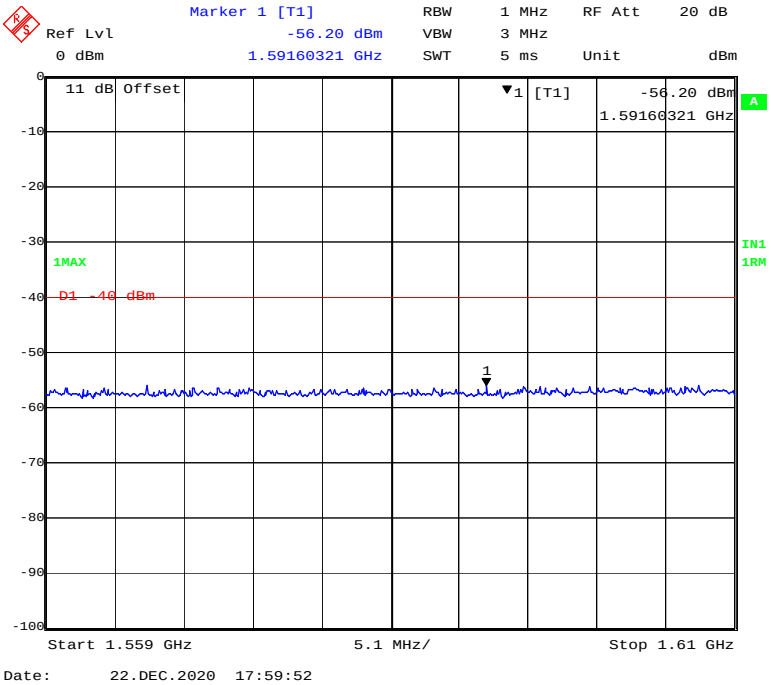


Downlink:

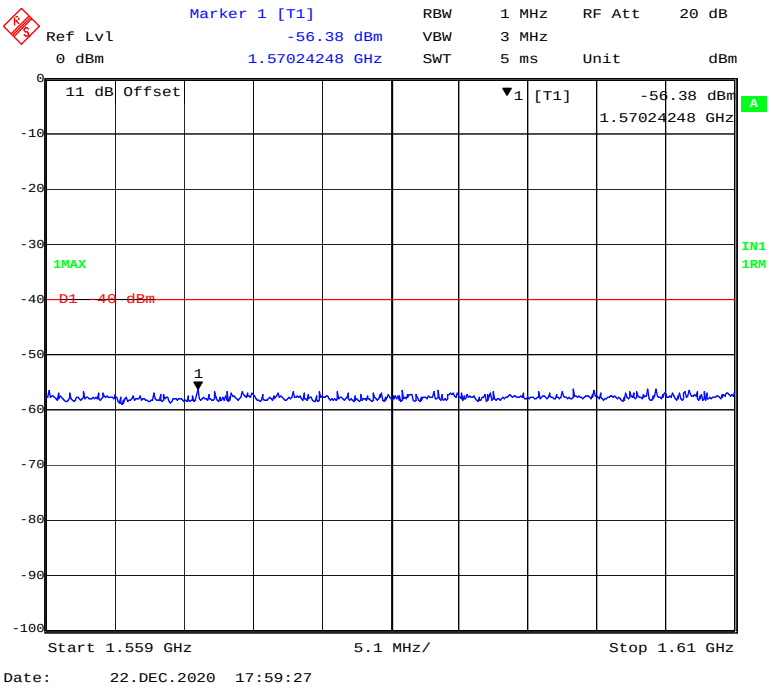
Upper 700MHz Band CDMA Left Side 747.25MHz



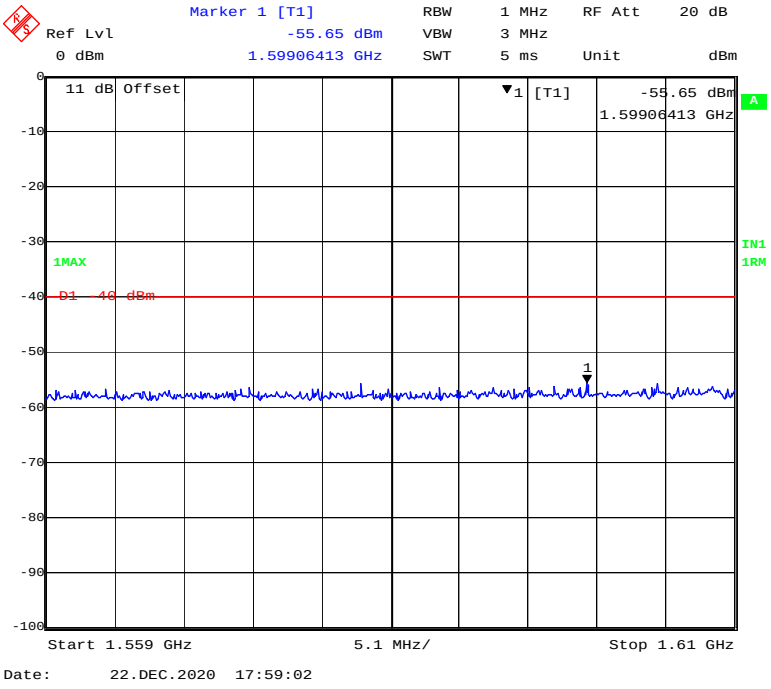
Upper 700MHz Band CDMA Right Side 755.75MHz



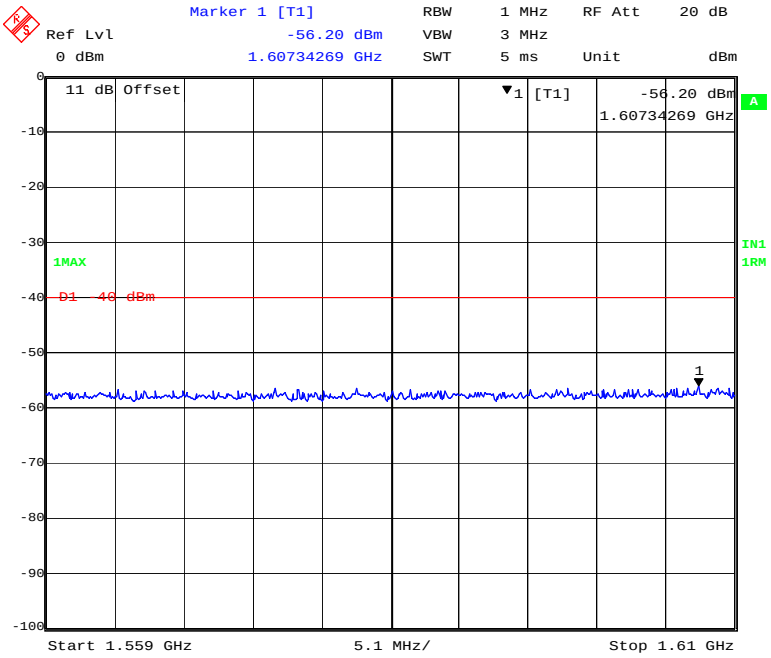
Upper 700MHz Band GSM Left Side 746.2MHz



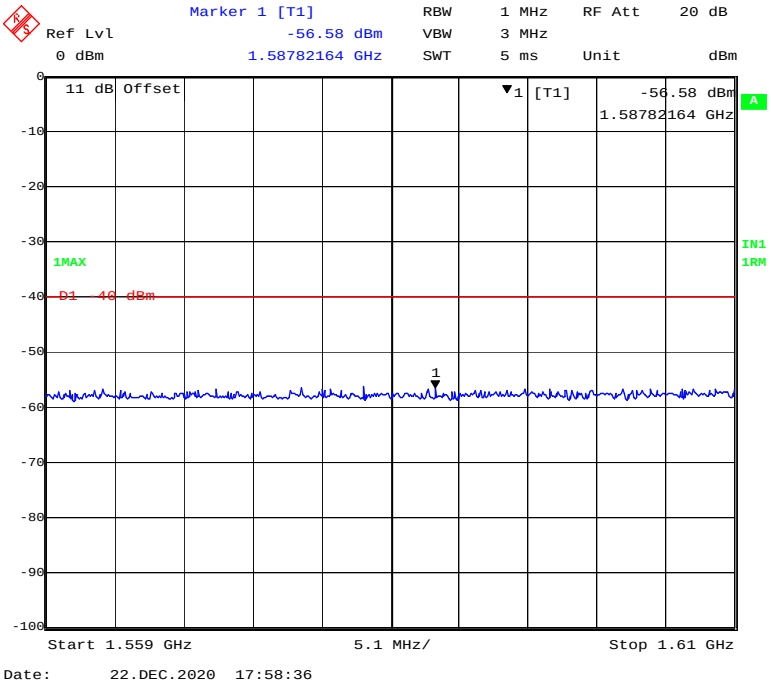
Upper 700MHz Band GSM Right Side 756.8MHz



Upper 700MHz Band LTE Left Side 748.5MHz



Upper 700MHz Band LTE Right Side 754.5MHz



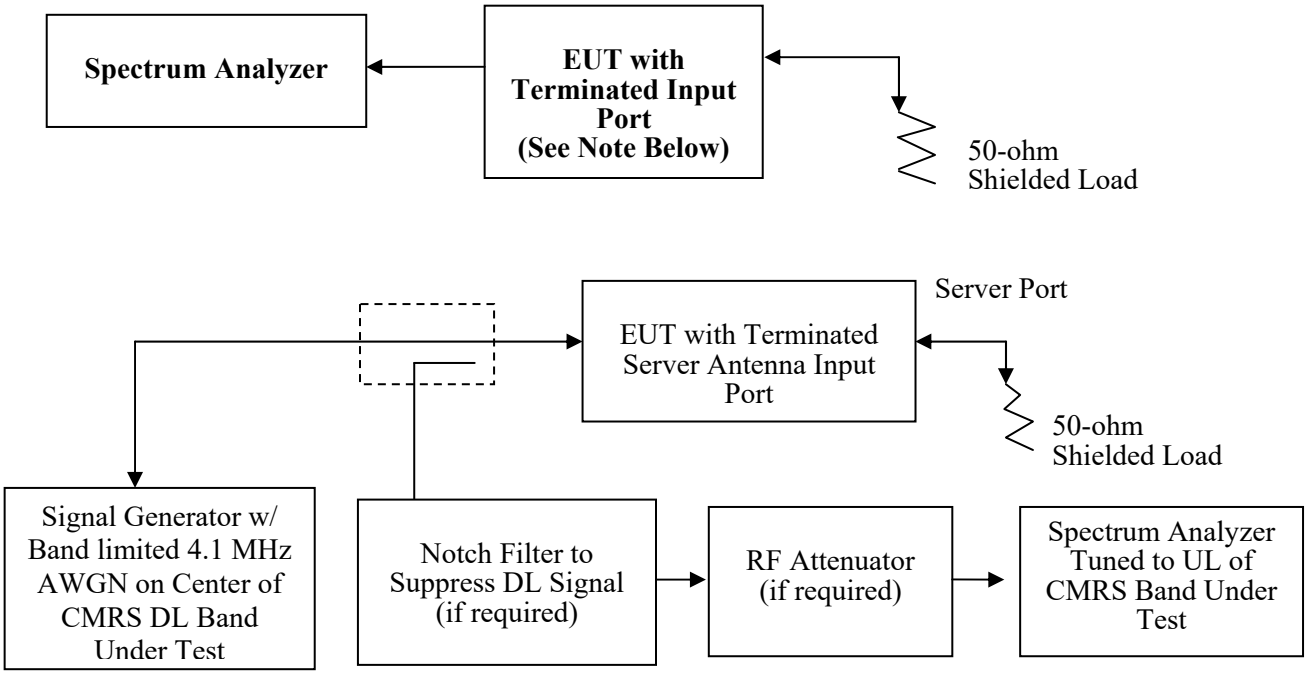
§20.21(e)(8)(i)(A), § 20.21(e)(8)(i)(H) &§20.21(e)(4) - NOISE LIMITS

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:	21.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

The testing was performed by Stone Zhang on 2019-12-03.

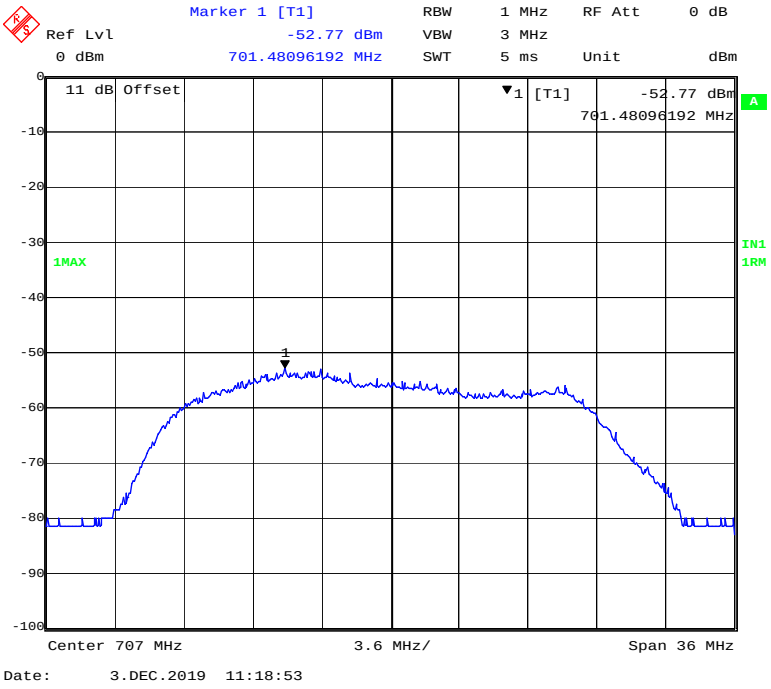
Test Result: Compliant. Please refer to following table.

Maximum Noise:

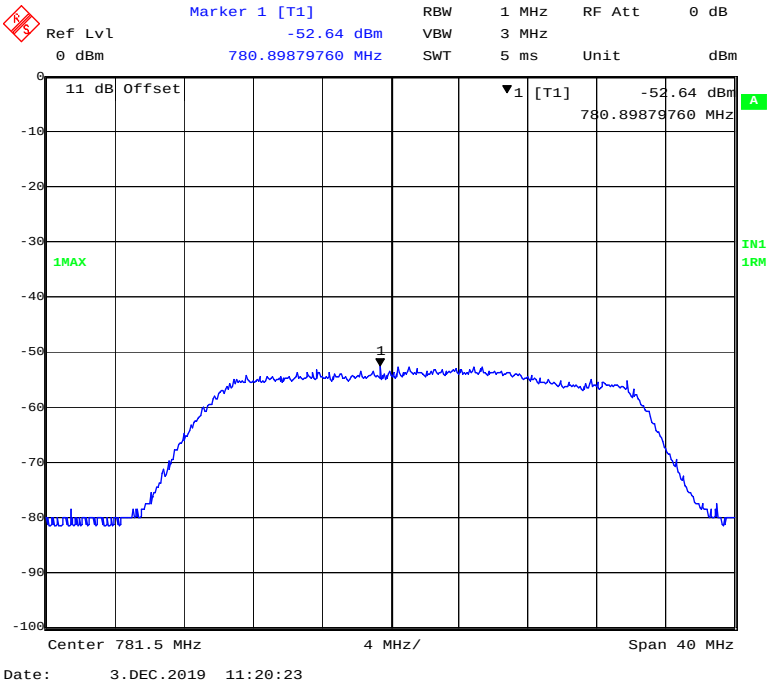
Mode	Operation Bands	Measured Value	Limit	Result
		dBm/MHz	dBm/MHz	
Uplink	PCS	-52.64	-37.01	Compliant
	AWS	-49.81	-37.73	Compliant
	Cellular	-53.70	-44.05	Compliant
	Lower 700MHz	-52.77	-45.51	Compliant
	Upper 700MHz	-52.64	-44.64	Compliant
Downlink	PCS	-62.70	-37.01	Compliant
	AWS	-64.44	-37.73	Compliant
	Cellular	-70.96	-44.05	Compliant
	Lower 700MHz	-72.64	-45.51	Compliant
	Upper 700MHz	-72.04	-44.64	Compliant

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.

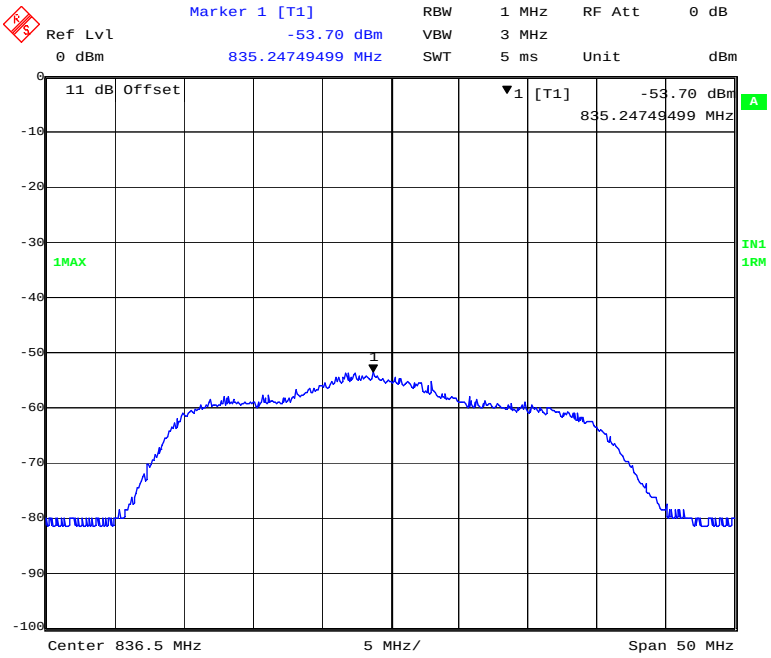
Uplink Lower 700MHz Band



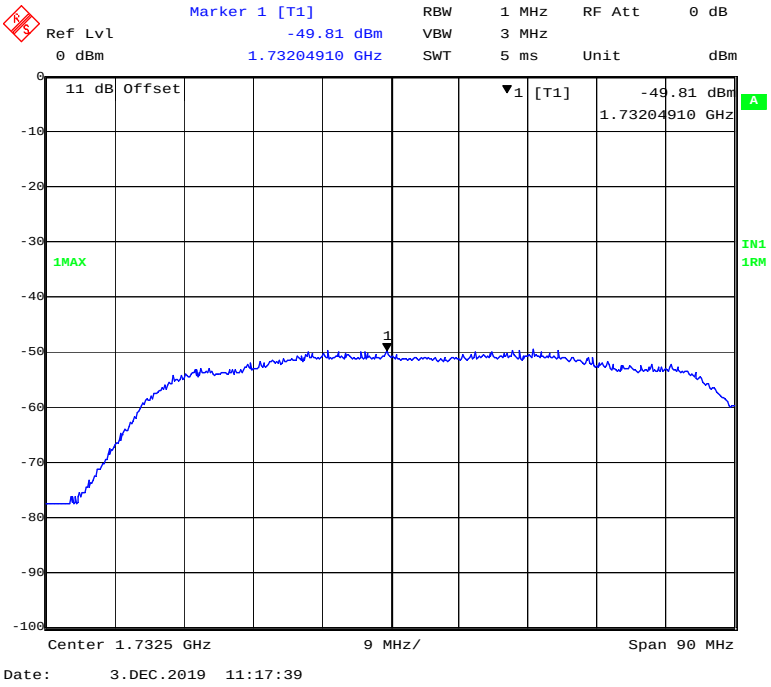
Uplink Upper 700MHz Band



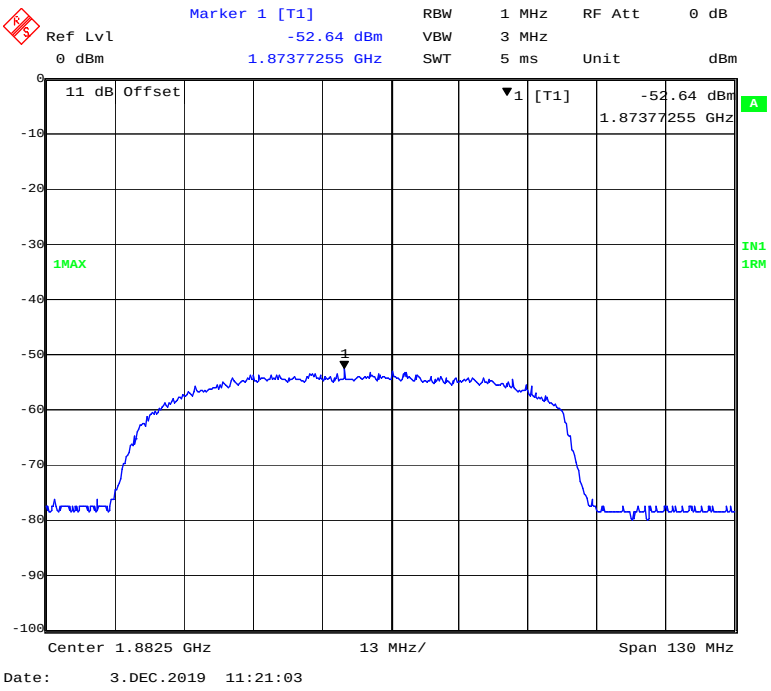
Uplink Cellular Band



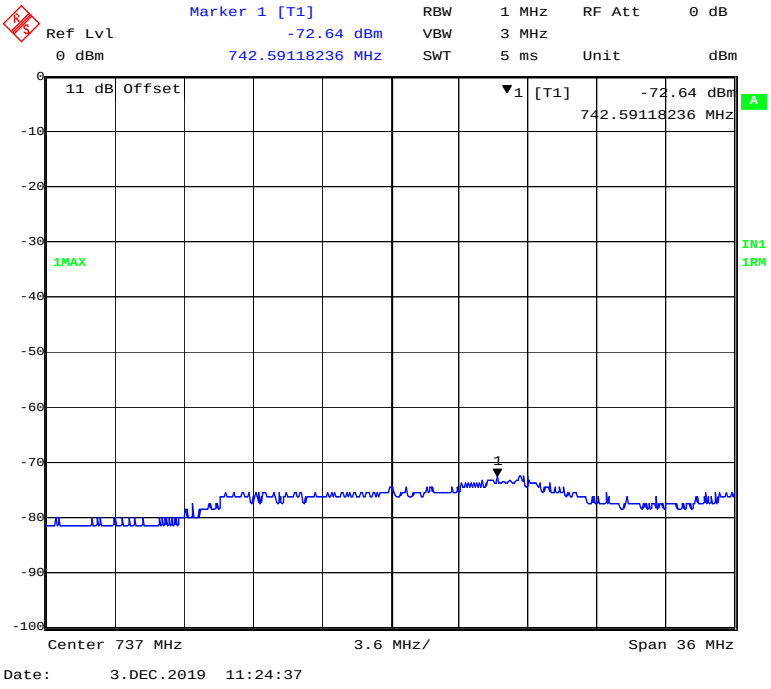
Uplink AWS Band



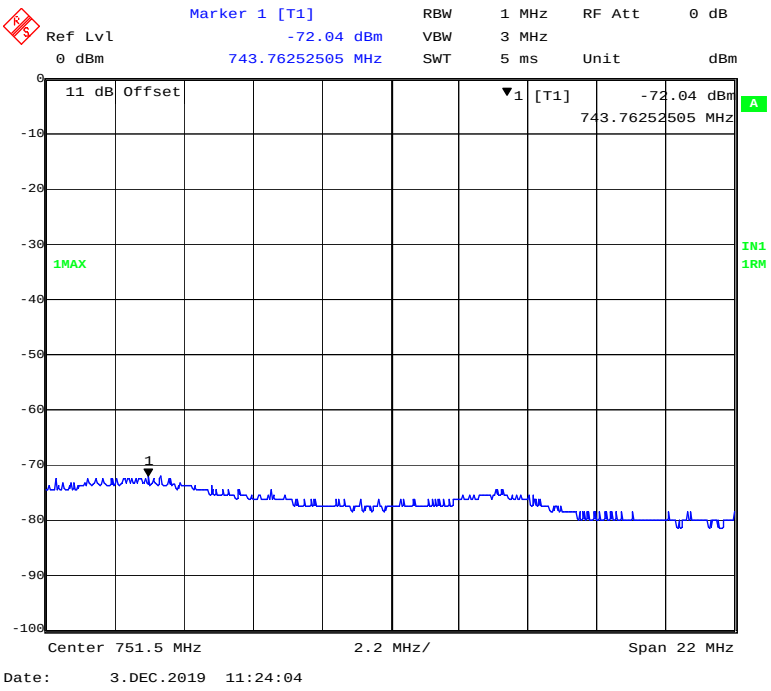
Uplink PCS Band



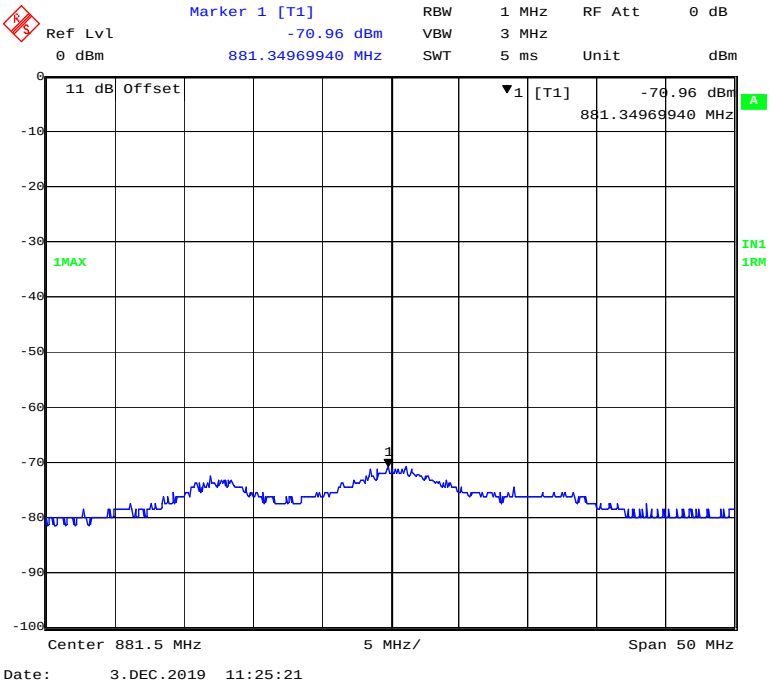
Downlink Lower 700MHz Band



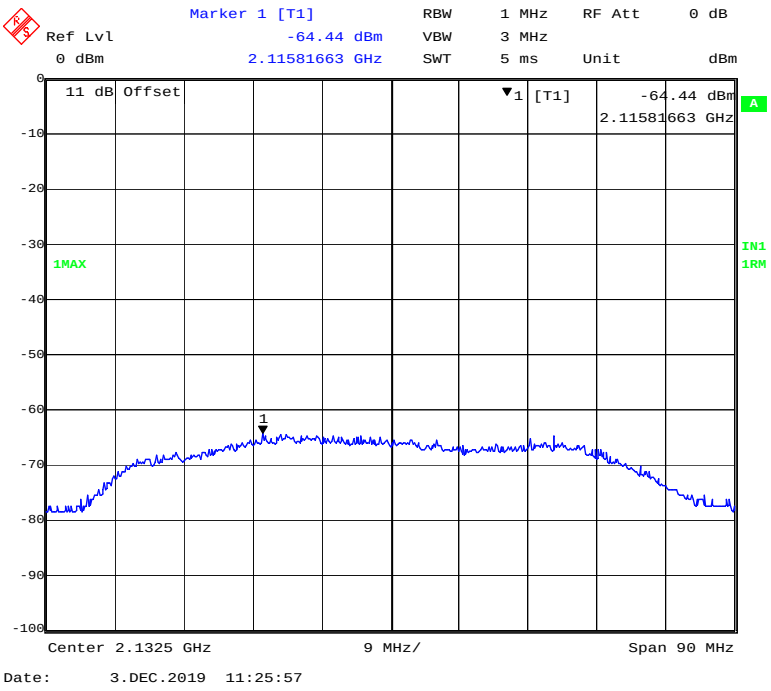
Downlink Upper 700MHz Band



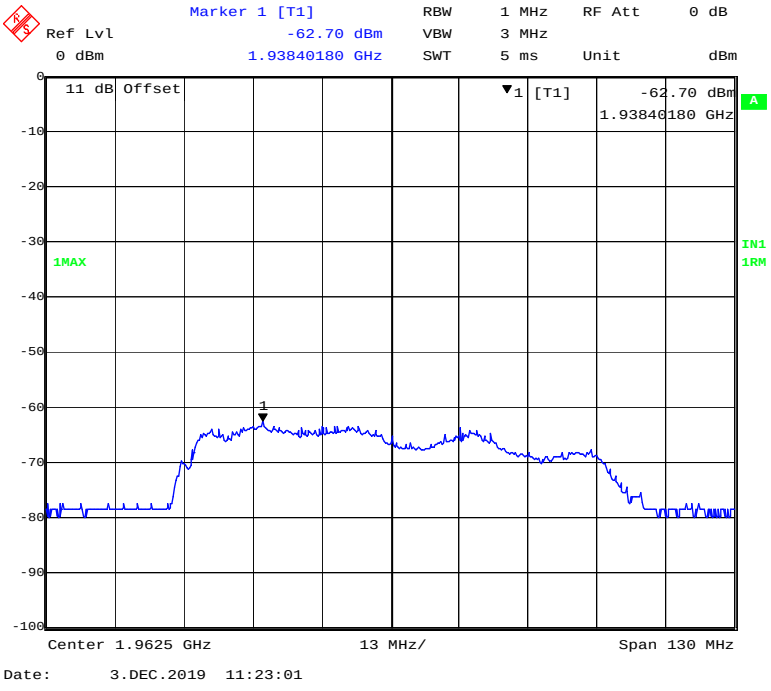
Downlink Cellular Band



Downlink AWS Band



Downlink PCS Band



Variable Uplink Noise Limit Test Result:

Operation Bands	RSSI	Measured Value	Limit	Result
	dBm	dBm/MHz	dBm/MHz	
PCS	-90	-53.56	-37.00	Compliant
	-80	-53.84	-37.00	Compliant
	-70	-53.49	-37.00	Compliant
	-49	-64.68	-54.00	Compliant
	-48	-64.94	-55.00	Compliant
	-47	-65.21	-56.00	Compliant
AWS	-90	-50.18	-37.73	Compliant
	-80	-50.70	-37.73	Compliant
	-70	-50.61	-37.73	Compliant
	-47	-64.44	-56.00	Compliant
	-46	-64.52	-57.00	Compliant
	-45	-64.18	-58.00	Compliant
Cellular	-90	-53.84	-44.05	Compliant
	-80	-54.13	-44.05	Compliant
	-70	-54.21	-44.05	Compliant
	-46	-67.27	-57.00	Compliant
	-45	-67.61	-58.00	Compliant
	-44	-67.58	-59.00	Compliant
Lower 700	-90	-53.49	-45.51	Compliant
	-80	-53.15	-45.51	Compliant
	-70	-53.63	-45.51	Compliant
	-45	-67.61	-58.00	Compliant
	-44	-67.56	-59.00	Compliant
	-43	-67.48	-60.00	Compliant
Upper 700	-90	-52.28	-44.64	Compliant
	-80	-52.77	-44.64	Compliant
	-70	-53.09	-44.64	Compliant
	-43	-67.27	-60.00	Compliant
	-42	-67.31	-61.00	Compliant
	-41	-67.45	-62.00	Compliant

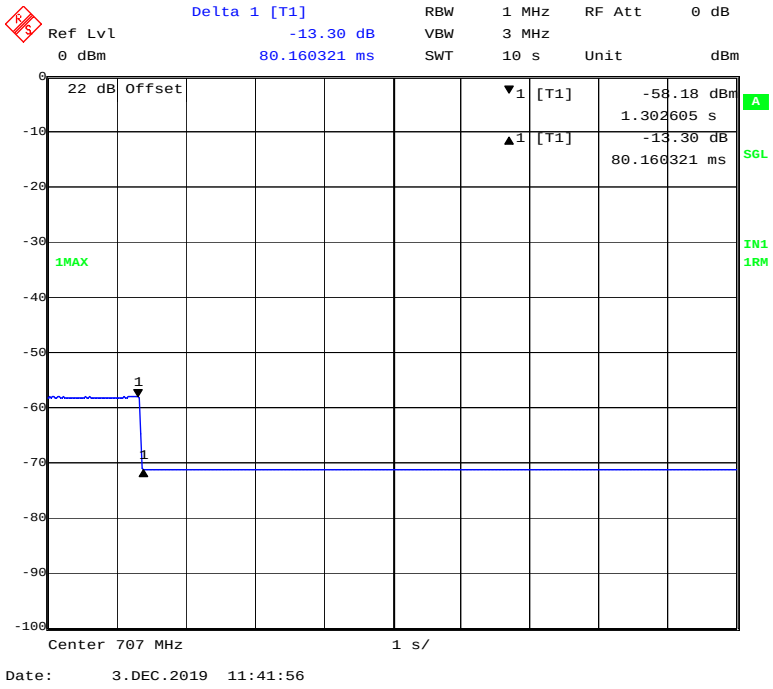
According to KDB 935210 D03 Signal Booster Measurements v04r03 Annex D, the Variable uplink Noise limit is −103 dBm – RSSI in RSSI-Dependent Region, out of RSSI-Dependent Region, it is −102.5 dBm/MHz + 20Log10 (Frequency).

Variable Uplink Noise Timing:

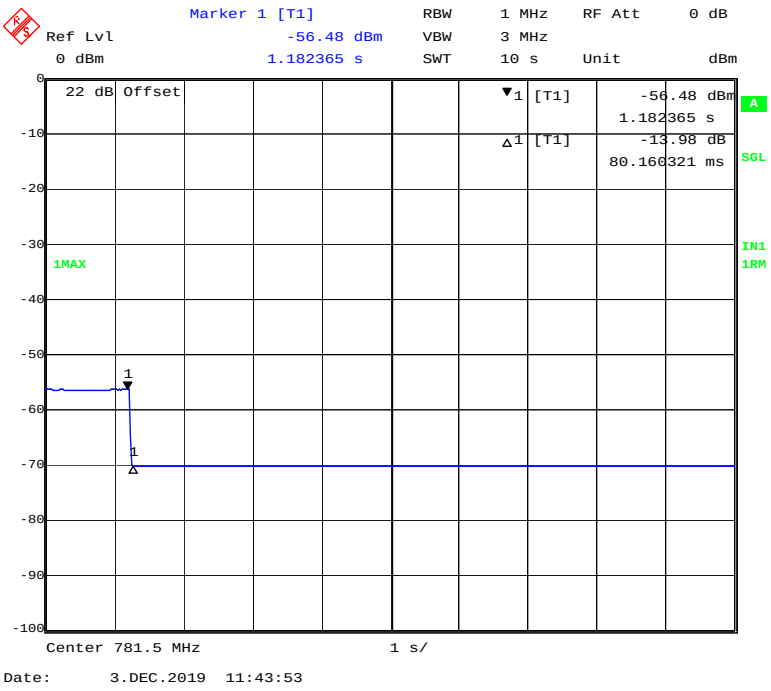
Operating Band	Measured Value	Limit	Result
	s	s	
PCS	0.08	3	Compliant
AWS	0.08	3	Compliant
Cellular	0.08	3	Compliant
Lower	0.08	3	Compliant
Upper	0.08	3	Compliant

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

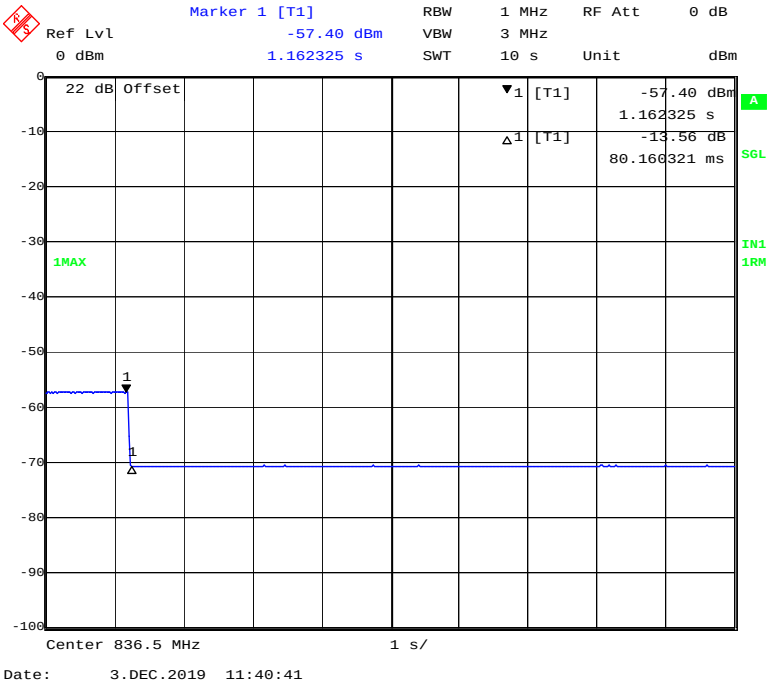
Lower 700MHz Band



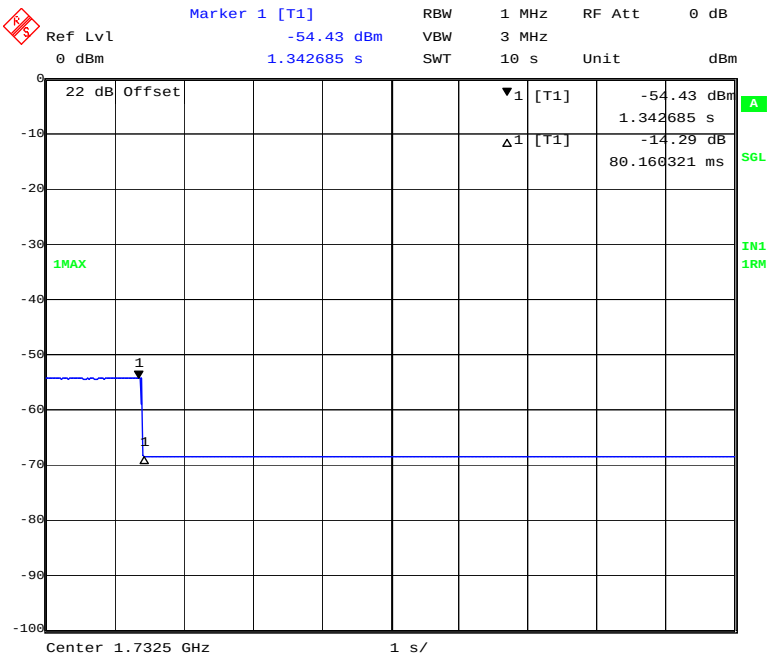
Upper 700MHz Band



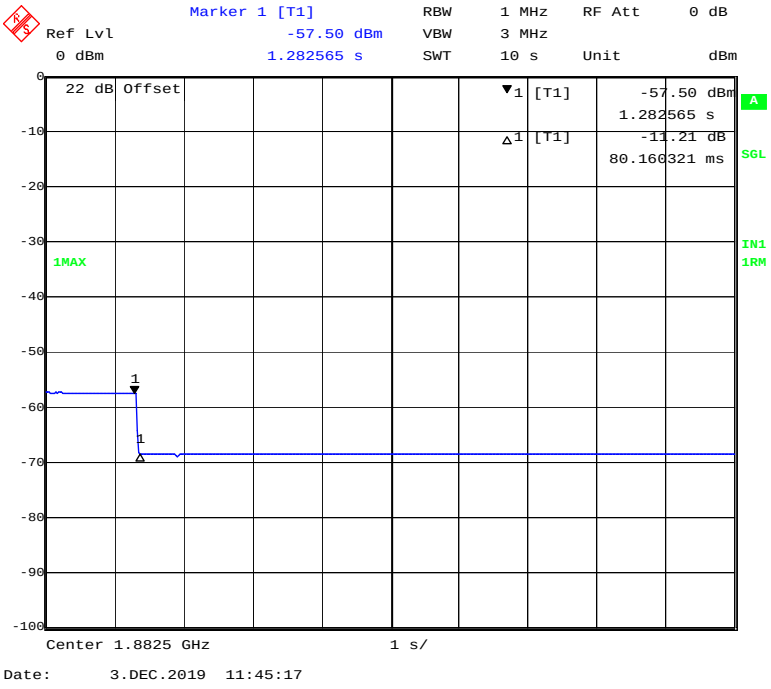
Cellular Band



AWS Band



PCS Band



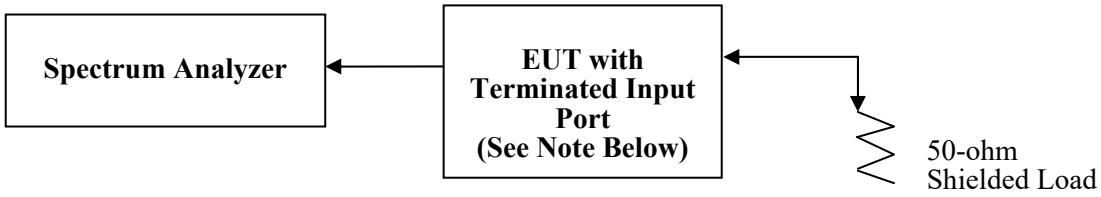
§20.21(e)(8)(i)(I) &§20.21(e)(4) - UPLINK INACTIVITY

Applicable Standards

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

Test Procedure

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:	23.5 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

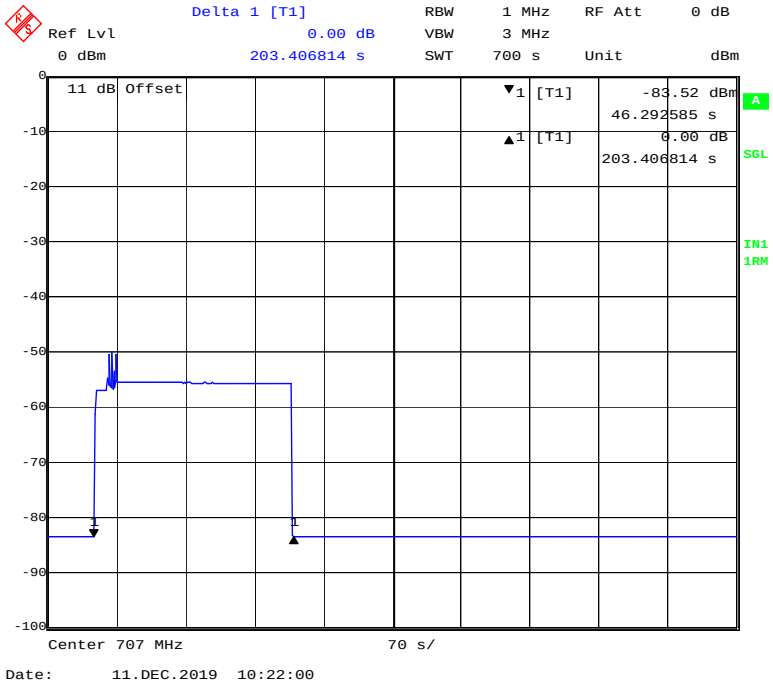
The testing was performed by Stone Zhang on 2019-12-11.

Test Result: Compliant. Please refer to following table.

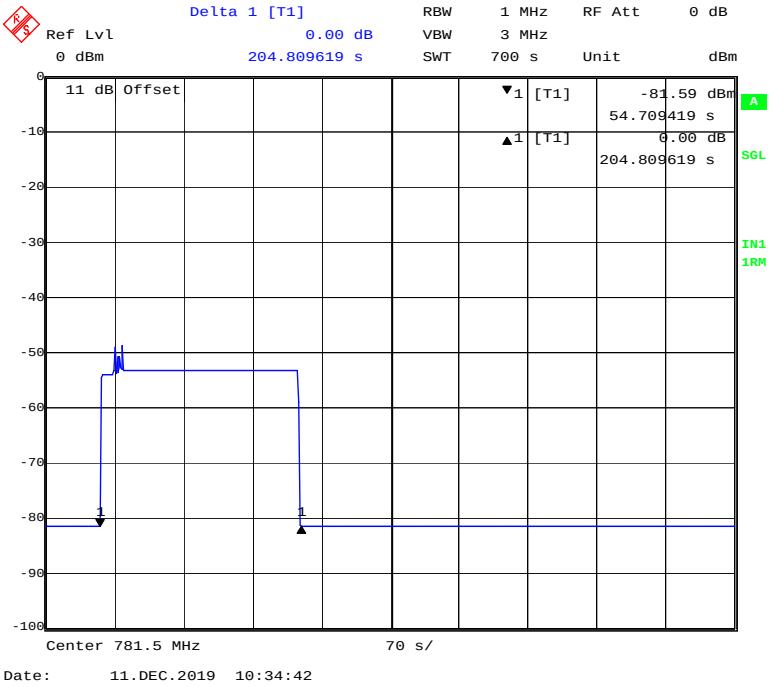
Operating Band	Measured Value	Limit	Result
	s	s	
PCS	204.81	300	Compliant
AWS	204.81		Compliant
Cellular	203.41		Compliant
Lower 700	230.41		Compliant
Upper 700	204.81		Compliant

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

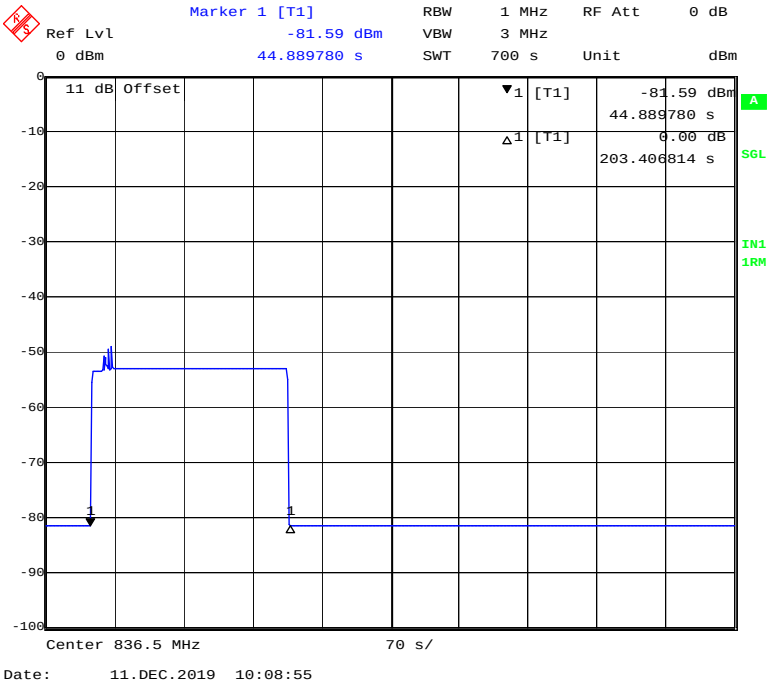
Lower 700MHz Band



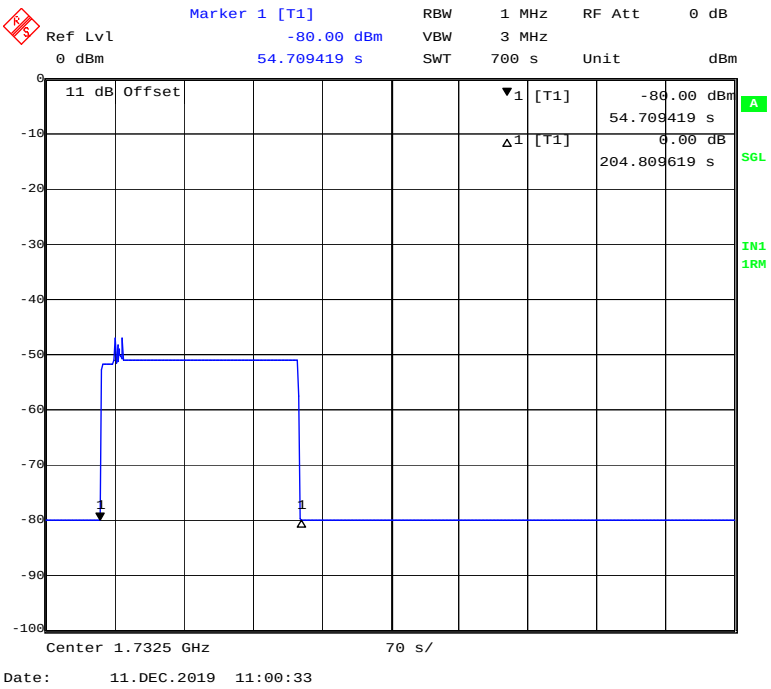
Upper 700MHz Band



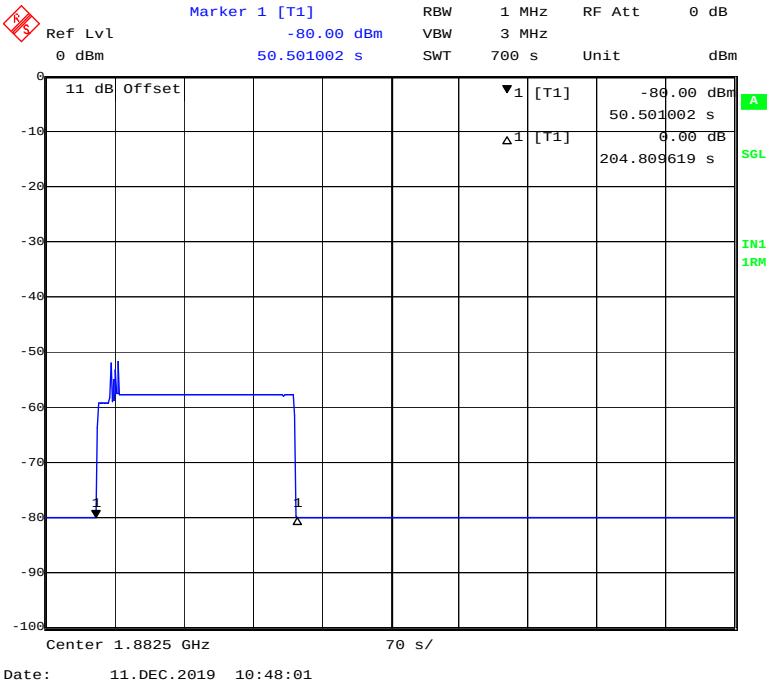
Cellular Band



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.

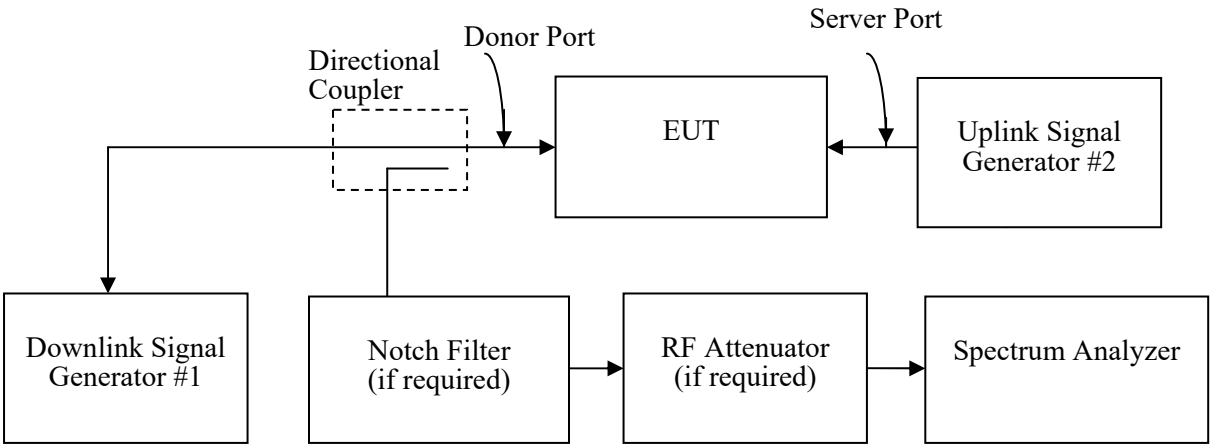


Figure 5 – Variable Gain Instrumentation Test Setup

Test Data

Environmental Conditions

Temperature:	21.1 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

The testing was performed by Stone Zhang on 2019-12-03.

Test Result: Compliant. 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	1.8288	43.24	11	1.8	3	44.44
AWS	1732.5	1.8288	42.52	11	1.8	3	43.72
Cellular	836.5	1.8288	36.19	10	1.2	3	37.99
Lower 700	707	1.8288	34.73	10	1.2	3	36.53
Upper 700	781.5	1.8288	35.60	10	1.2	3	37.40

Note:
Path loss=20logf+20logd-27.5
Polarity loss=20log (1/sin(45))=3
d=1.8288m (6feet), please refer to the user manual
The worst Antenna Kit numbers: WD11-30400
The indoor antenna will place different location, and the distance is not only 1.8288m for all condition.

Variable booster gain:

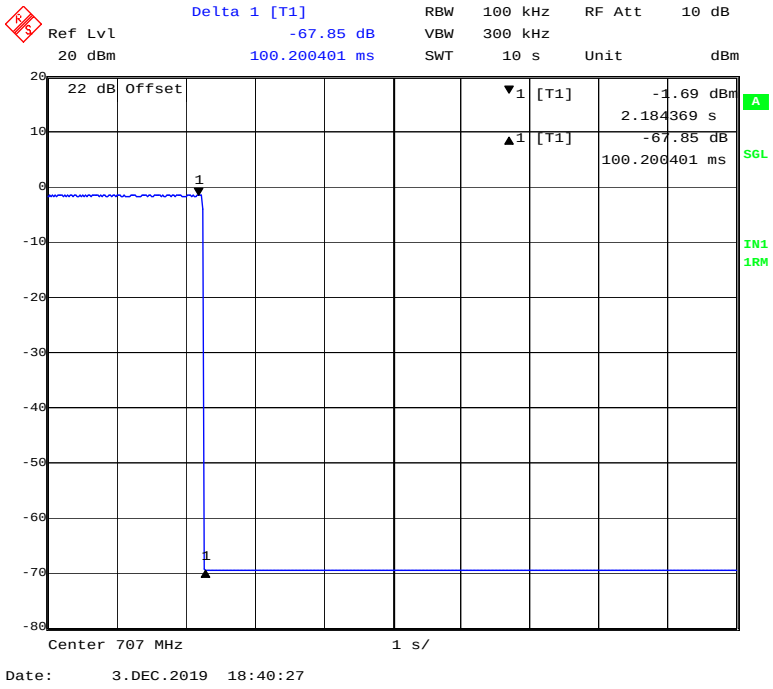
Operation Bands	RSSI	P_{in}	P_{out}	MSCL	Measured Value	Limit	Result
	dBm	dBm	dBm	dB	dB	dB	
PCS	-70	-47.3	4.97	44.44	52.27	80.44	Compliant
	-60	-47.3	4.23	44.44	51.53	70.44	Compliant
	-55	-47.3	3.71	44.44	51.01	65.44	Compliant
	-52	-47.3	3.42	44.44	50.72	62.44	Compliant
	-51	-47.3	2.46	44.44	49.76	61.44	Compliant
	-50	-47.3	1.04	44.44	48.34	60.44	Compliant
AWS	-70	-49.6	6.65	43.72	56.25	79.72	Compliant
	-60	-49.6	5.60	43.72	55.20	69.72	Compliant
	-50	-49.6	4.49	43.72	54.09	59.72	Compliant
	-49	-49.6	3.01	43.72	52.61	58.72	Compliant
	-48	-49.6	1.92	43.72	51.52	57.72	Compliant
	-47	-49.6	0.78	43.72	50.38	56.72	Compliant
Cellular	-70	-41.5	6.84	37.99	48.34	73.99	Compliant
	-60	-41.5	6.75	37.99	48.25	63.99	Compliant
	-50	-41.5	6.66	37.99	48.16	53.99	Compliant
	-45	-41.5	4.26	37.99	45.76	48.99	Compliant
	-44	-41.5	1.63	37.99	43.13	47.99	Compliant
	-43	-41.5	0.37	37.99	41.87	46.99	Compliant
Lower 700	-70	-42.8	5.49	36.53	48.29	72.53	Compliant
	-60	-42.8	5.32	36.53	48.12	62.53	Compliant
	-50	-42.8	5.26	36.53	48.06	52.53	Compliant
	-48	-42.8	3.05	36.53	45.85	50.53	Compliant
	-47	-42.8	1.85	36.53	44.65	49.53	Compliant
	-46	-42.8	1.41	36.53	44.21	48.53	Compliant
Upper 700	-80	-42.5	8.09	37.40	50.59	83.40	Compliant
	-60	-42.5	7.45	37.40	49.95	63.40	Compliant
	-45	-42.5	5.31	37.40	47.81	48.40	Compliant
	-42	-42.5	1.25	37.40	43.75	45.40	Compliant
	-40	-42.5	-0.54	37.40	41.96	43.40	Compliant
	-38	-42.5	-3.33	37.40	39.17	41.40	Compliant

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

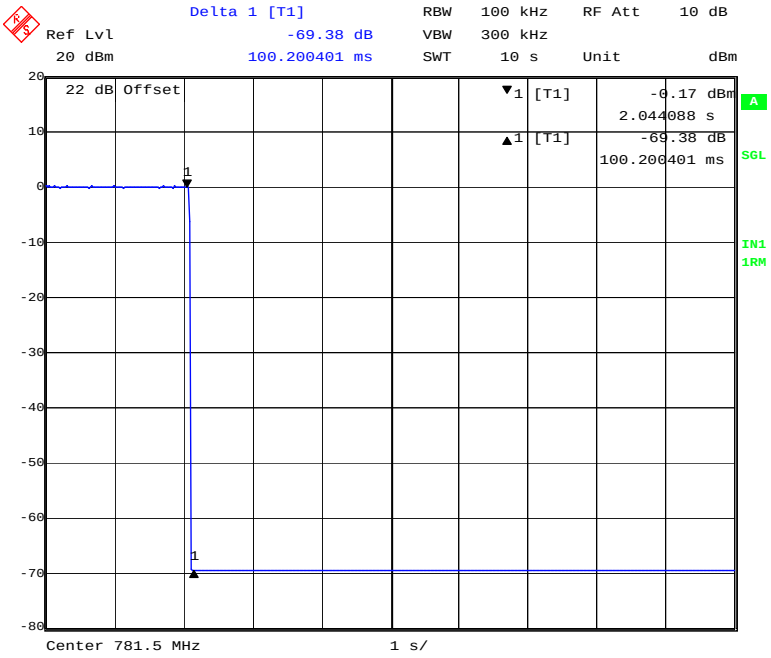
Variable gain timing:

Operating Band	Measured Value	Limit	Result
	s	s	
PCS	0.08	3	Compliant
AWS	0.08		Compliant
Cellular	0.08		Compliant
Lower 700	0.08		Compliant
Upper 700	0.08		Compliant

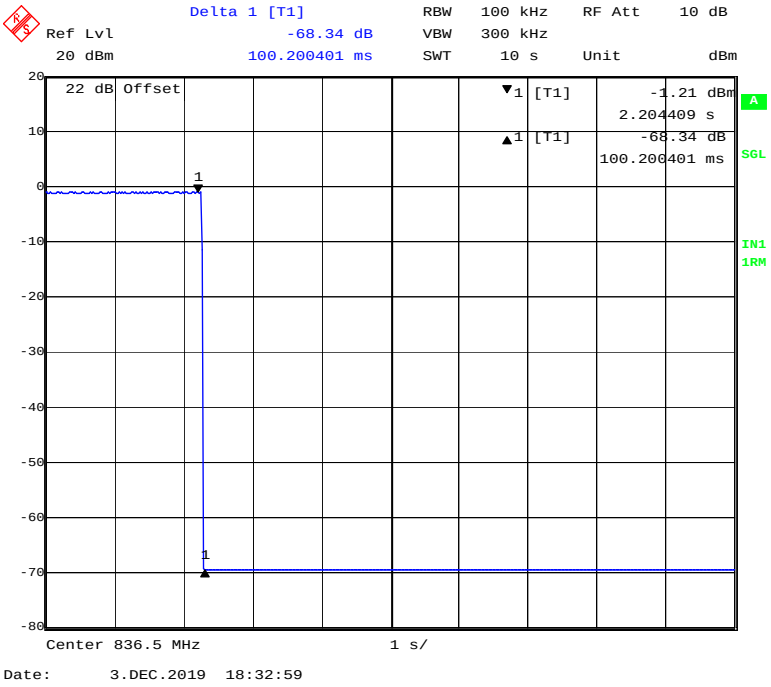
Lower 700MHz Band



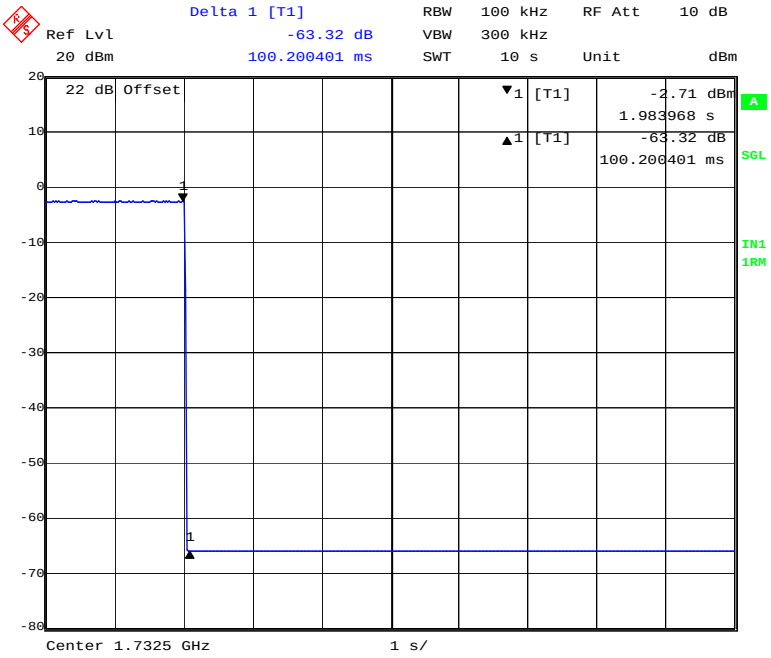
Upper 700MHz Band



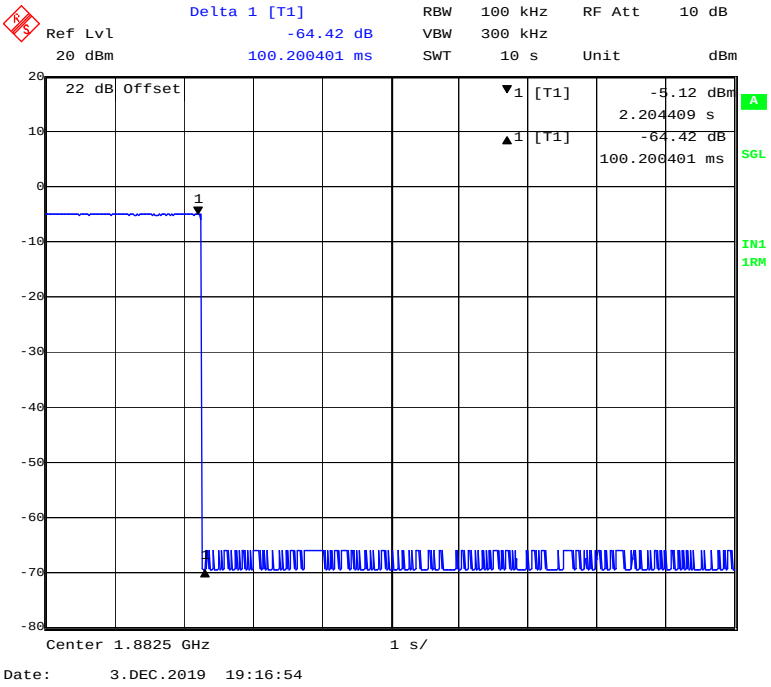
Cellular Band



AWS Band



PCS Band



§2.1049, §22.917, §24.238; §27.53- 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.

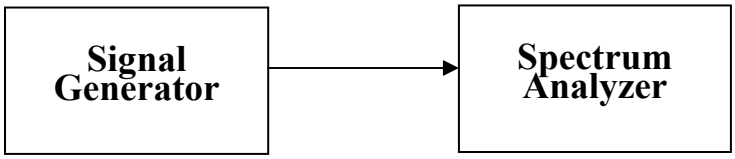


Figure 6 – Occupied Bandwidth Instrumentation Test Setup

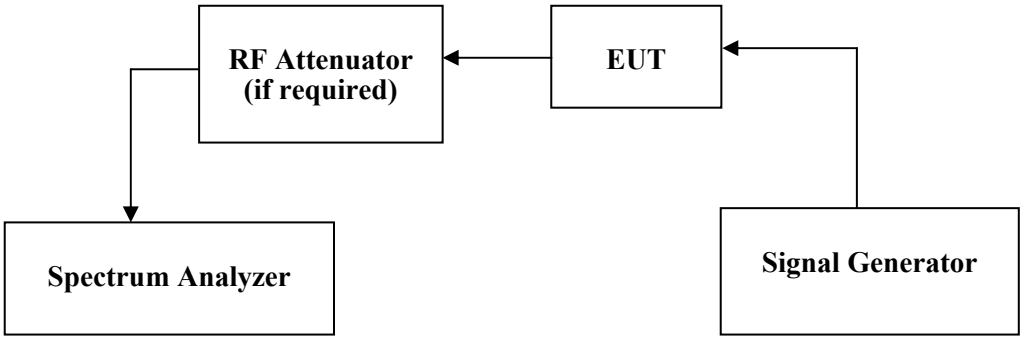


Figure 1 – Band Verification Test Instrumentation Setup

Test Data

Environmental Conditions

Temperature:	22.3 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

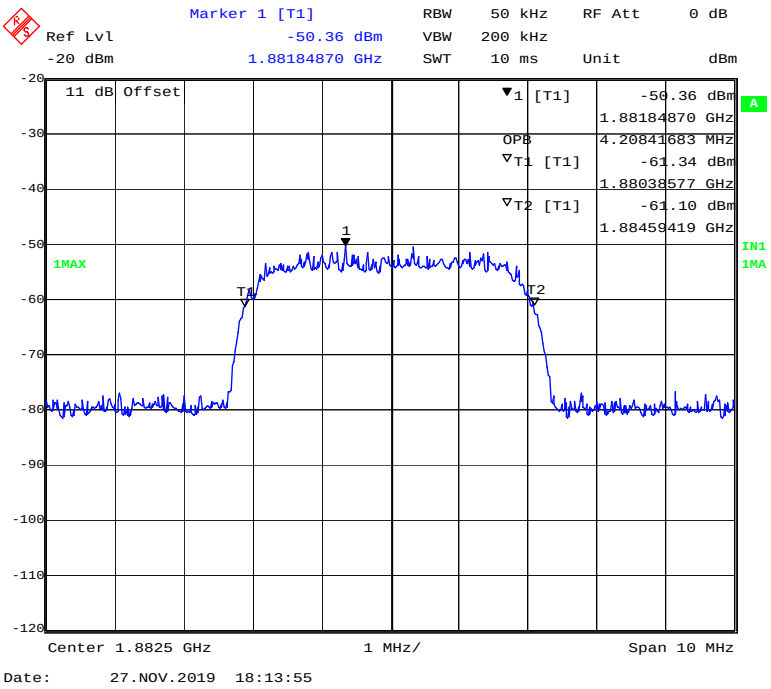
The testing was performed by Stone Zhang on 2019-11-27.

Test Result: Compliant. Please refer to following table.

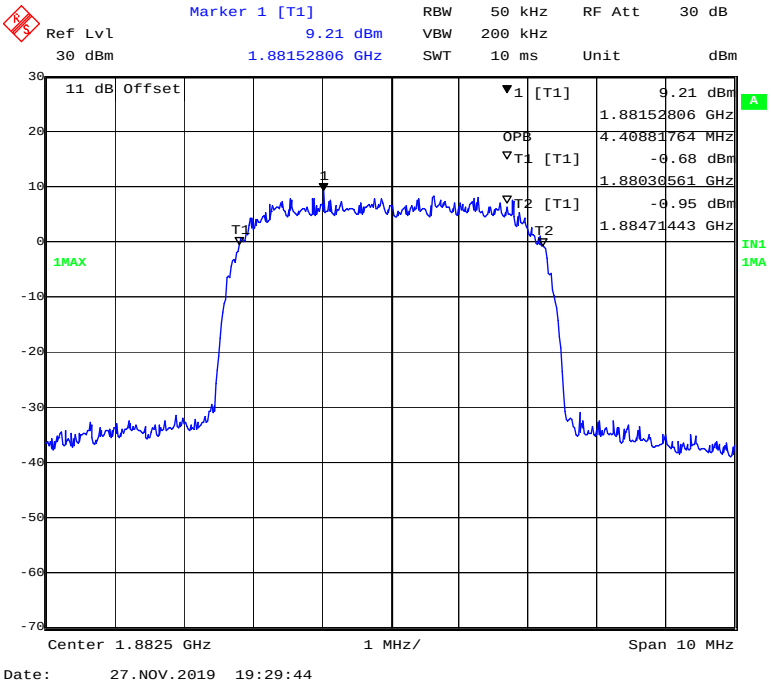
Modes	Operation Band	Signal Type	Input	Output	Result
			MHz	MHz	
Uplink	PCS	LTE	4.208	4.409	Compliant
		CDMA	1.251	1.251	Compliant
		GSM	0.244	0.244	Compliant
	AWS	LTE	4.349	4.429	Compliant
		CDMA	1.244	1.251	Compliant
		GSM	0.244	0.246	Compliant
	Cellular	LTE	4.148	4.409	Compliant
		CDMA	1.244	1.251	Compliant
		GSM	0.246	0.244	Compliant
	Lower 700	LTE	4.168	4.409	Compliant
		CDMA	1.238	1.251	Compliant
		GSM	0.246	0.246	Compliant
	Upper 700	LTE	4.148	4.429	Compliant
		CDMA	1.238	1.251	Compliant
		GSM	0.246	0.246	Compliant

Modes	Operation Band	Signal Type	Input	Output	Result
			MHz	MHz	
Downlink	PCS	LTE	4.168	4.168	Compliant
		CDMA	1.244	1.244	Compliant
		GSM	0.248	0.242	Compliant
	AWS	LTE	4.188	4.168	Compliant
		CDMA	1.244	1.238	Compliant
		GSM	0.246	0.242	Compliant
	Cellular	LTE	4.148	4.088	Compliant
		CDMA	1.238	1.244	Compliant
		GSM	0.248	0.244	Compliant
	Lower 700	LTE	4.148	4.128	Compliant
		CDMA	1.244	1.251	Compliant
		GSM	0.248	0.244	Compliant
	Upper 700	LTE	4.148	4.128	Compliant
		CDMA	1.238	1.238	Compliant
		GSM	0.244	0.244	Compliant

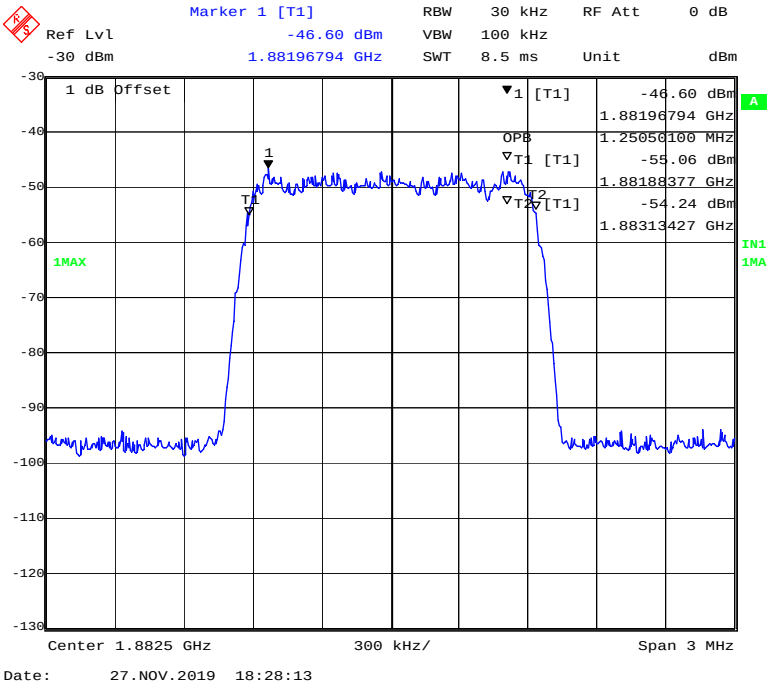
PCS UL-LTE-IN



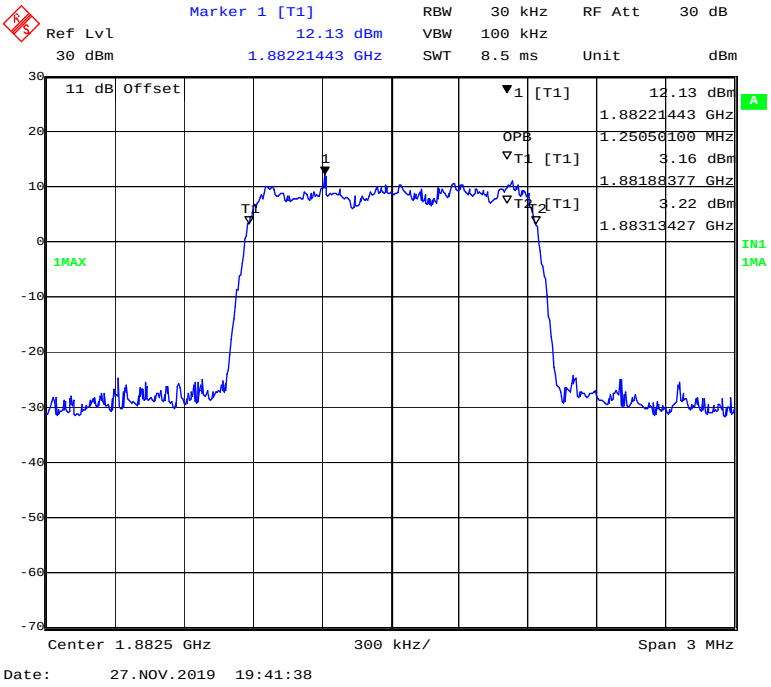
PCS UL-LTE-OUT



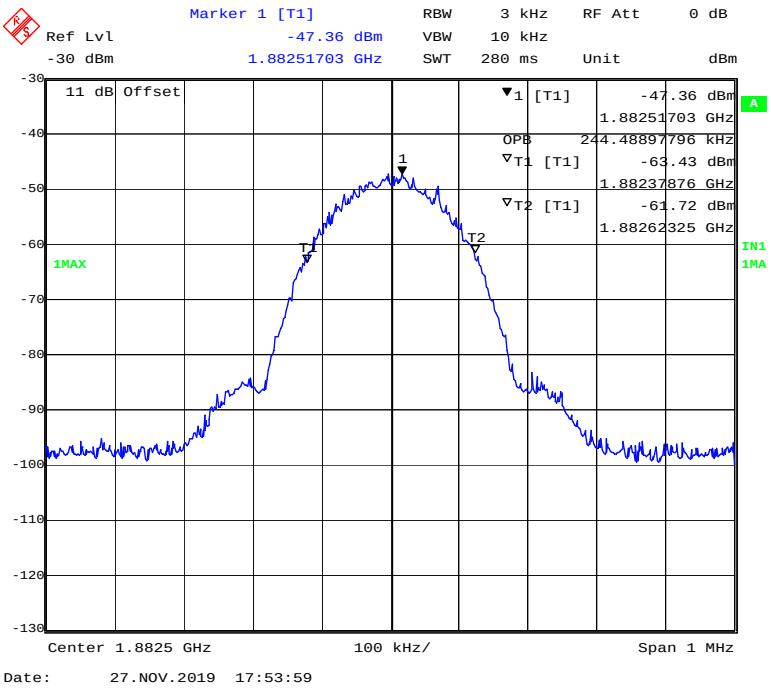
PCS UL-CDMA-IN



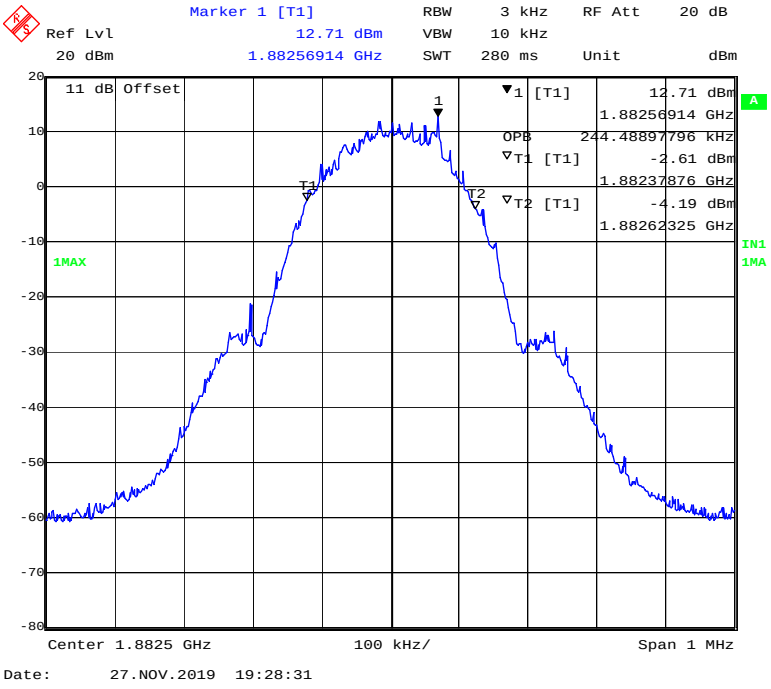
PCS UL-CDMA-OUT



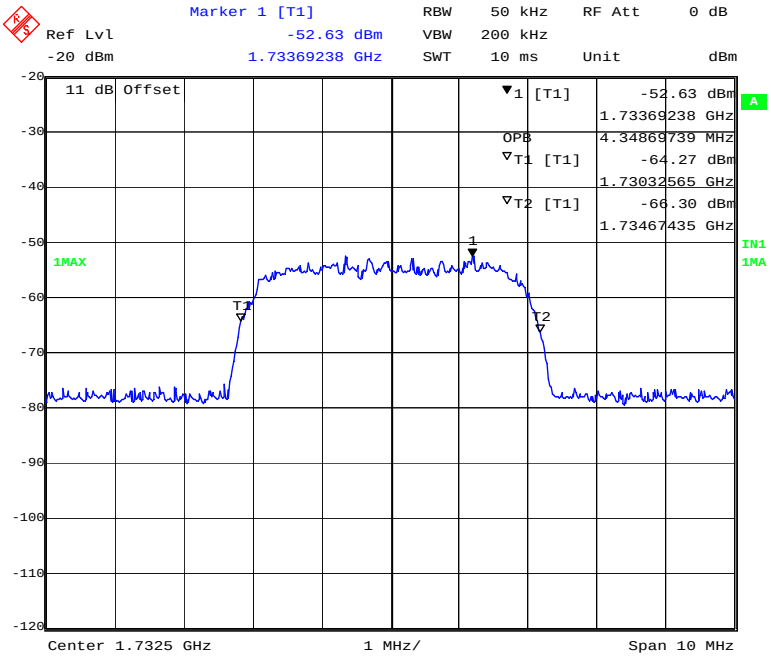
PCS UL-GSM-IN



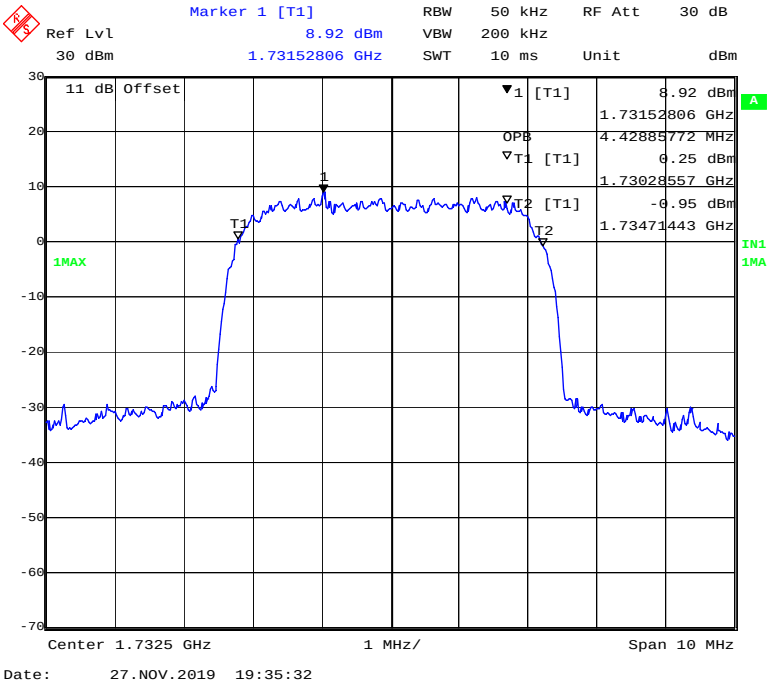
PCS UL-GSM-OUT



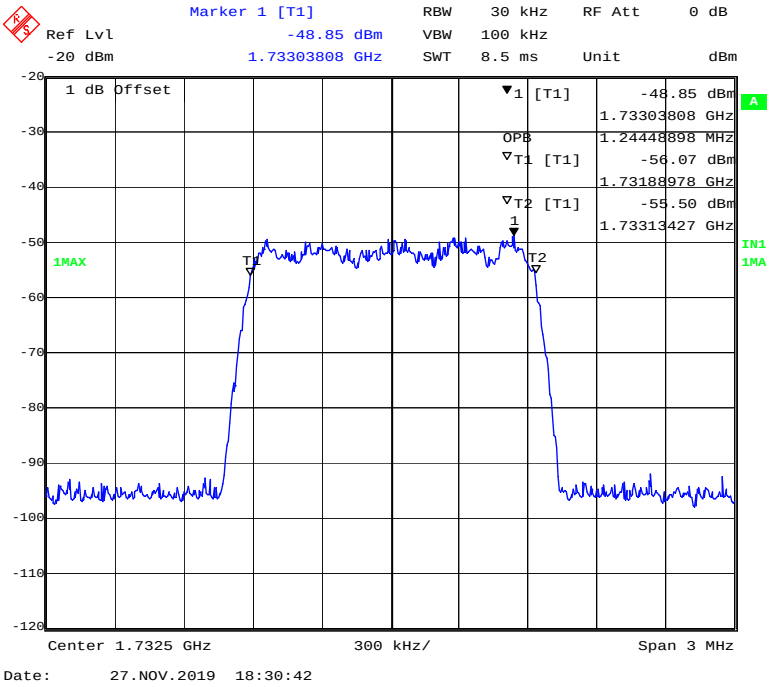
AWS UL-LTE-IN



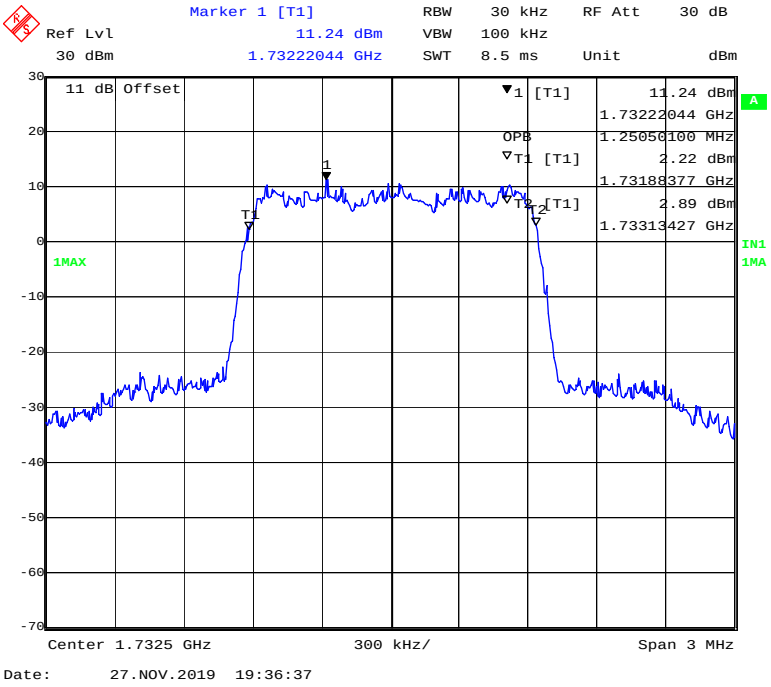
AWS UL-LTE-OUT



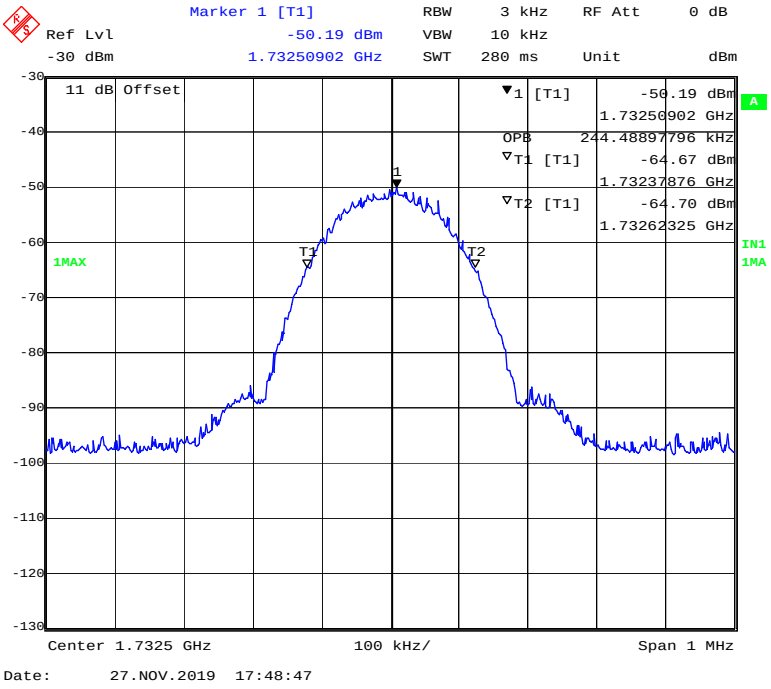
AWS UL-CDMA-IN



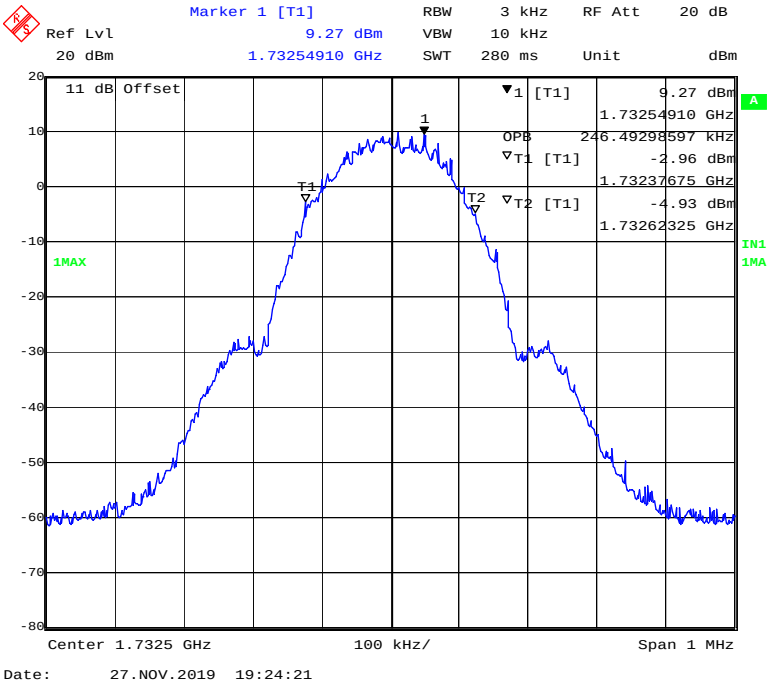
AWS UL-CDMA-OUT



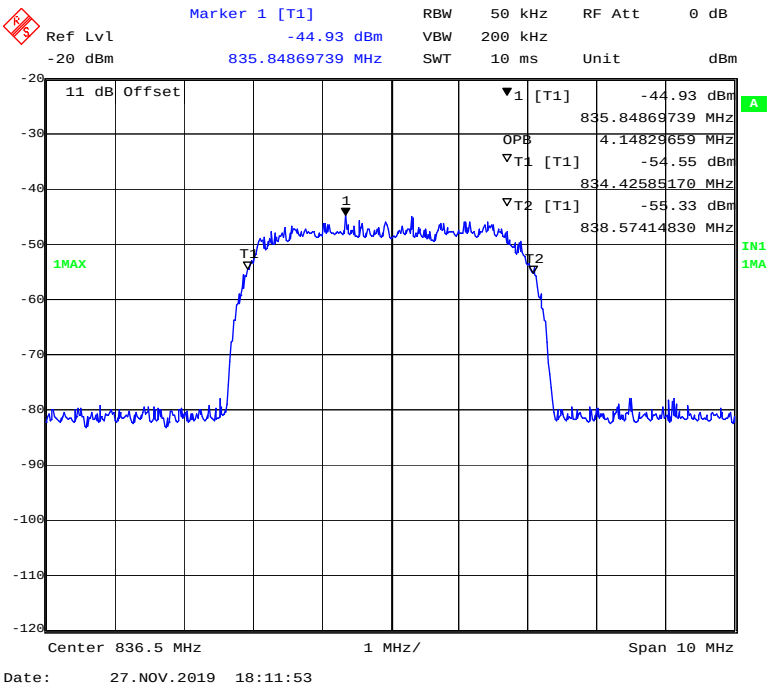
AWS UL-GSM-IN



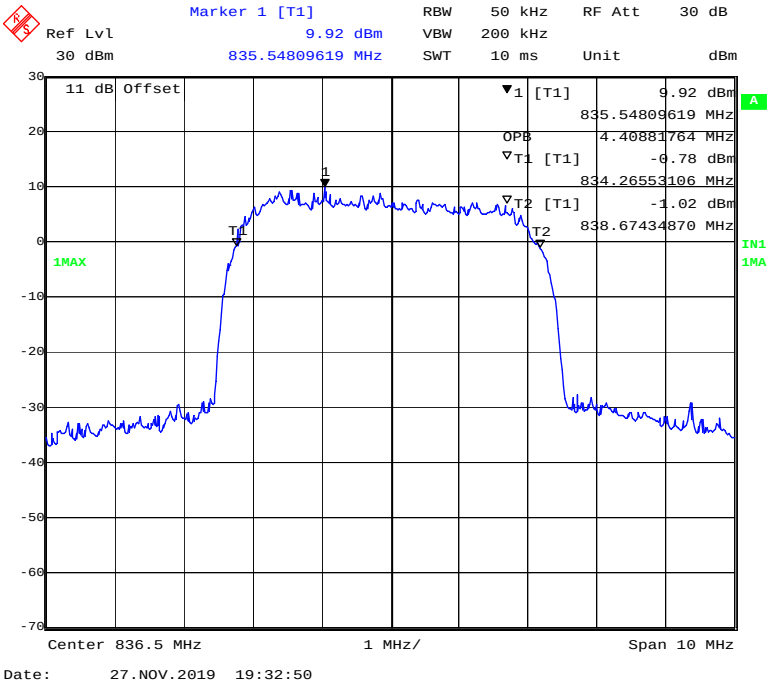
AWS UL-GSM-OUT



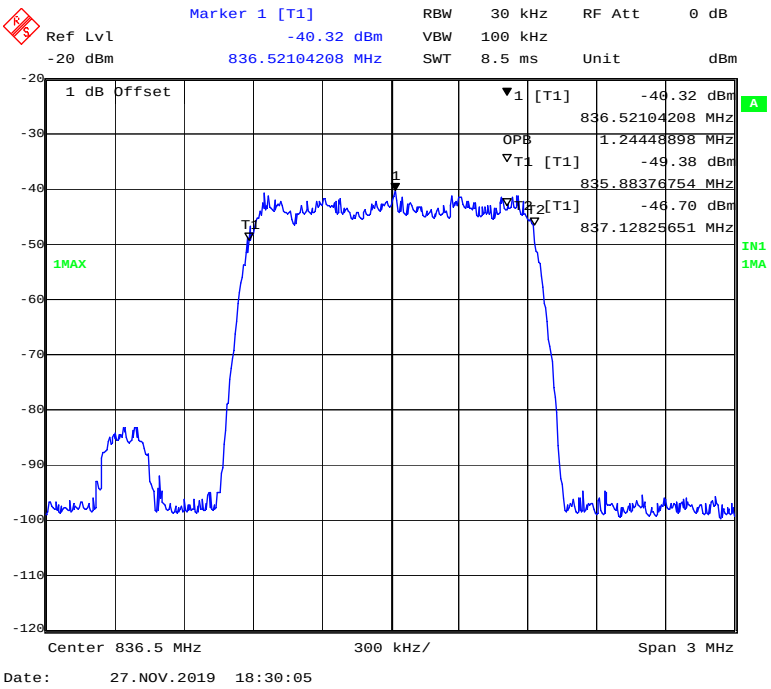
Cellular UL-LTE-IN



Cellular UL-LTE-OUT



Cellular UL-CDMA-IN



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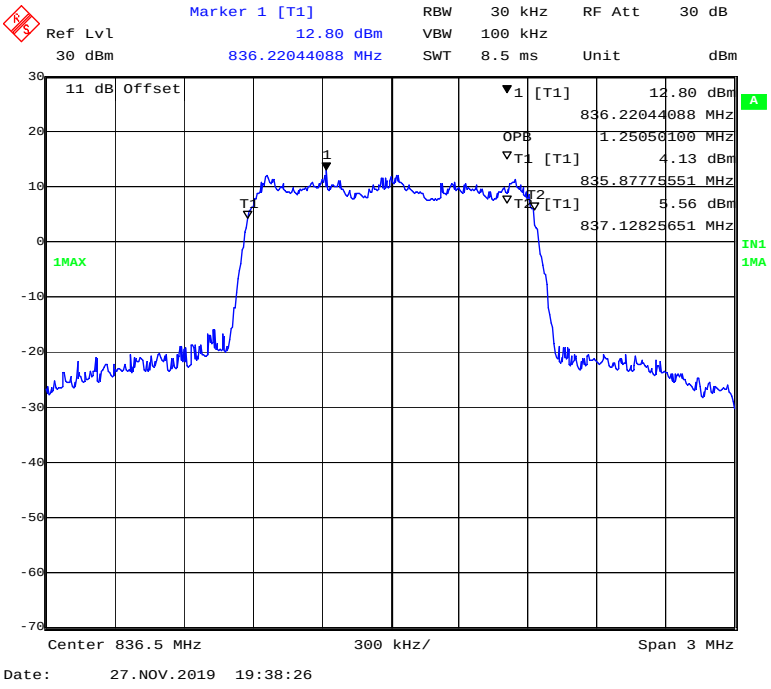

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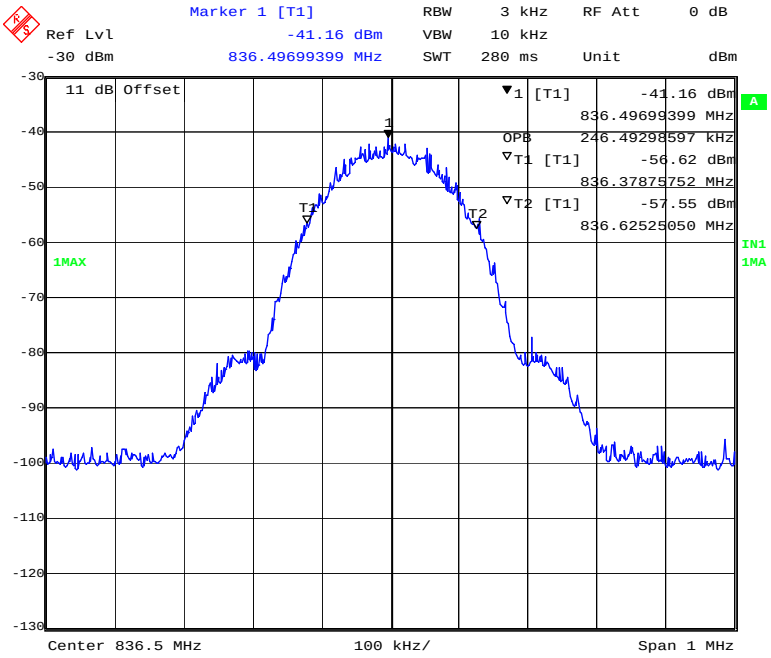

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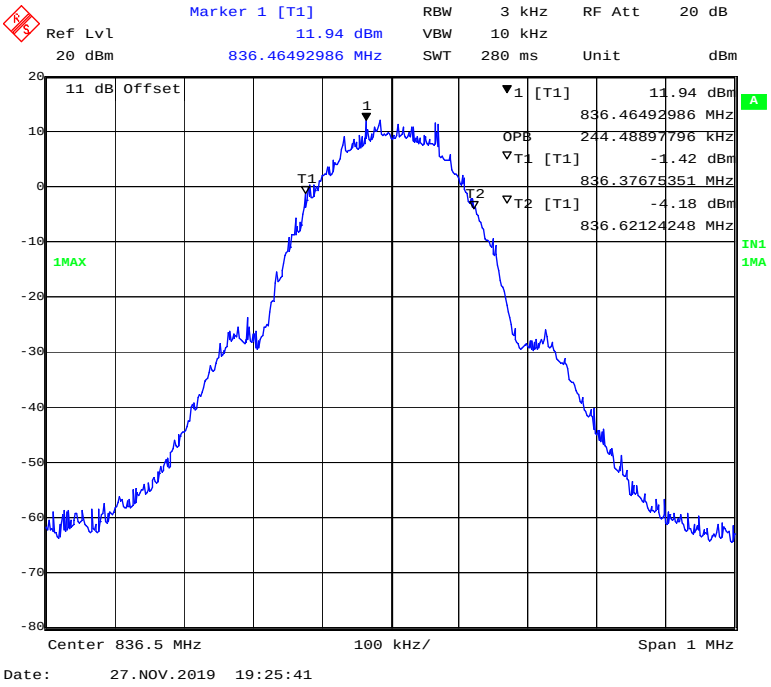

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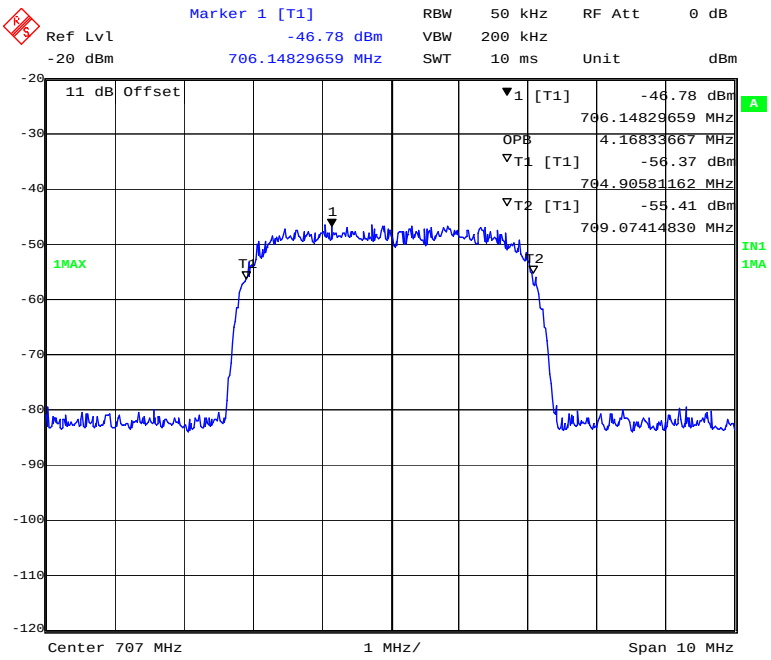

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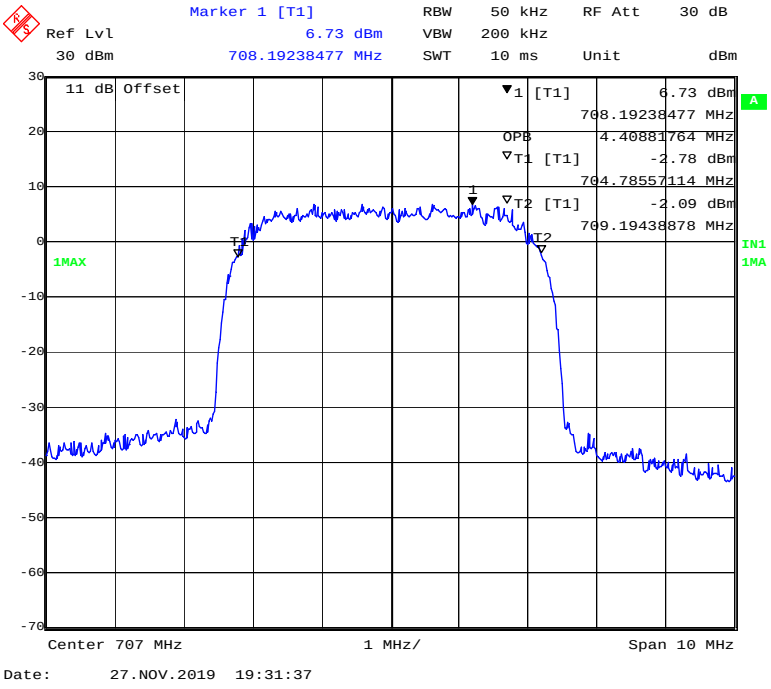

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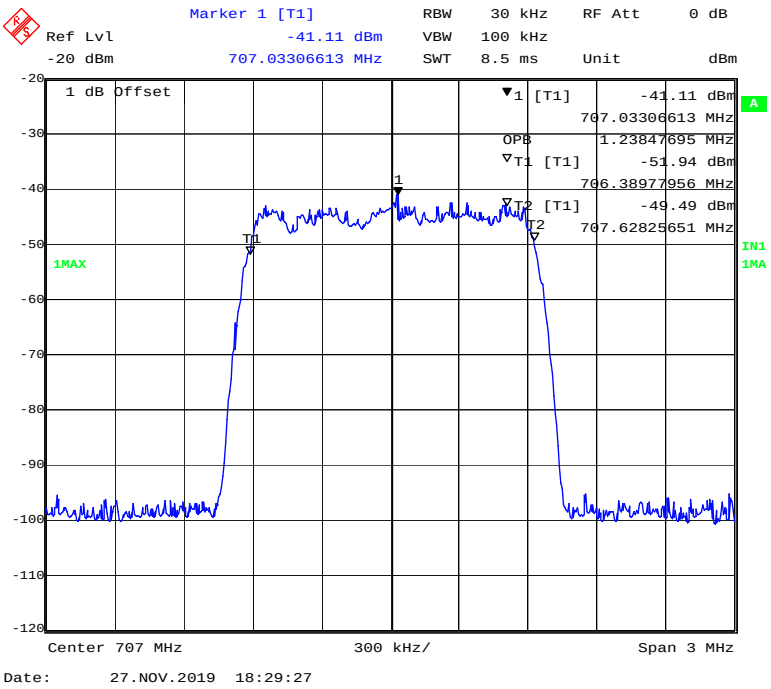

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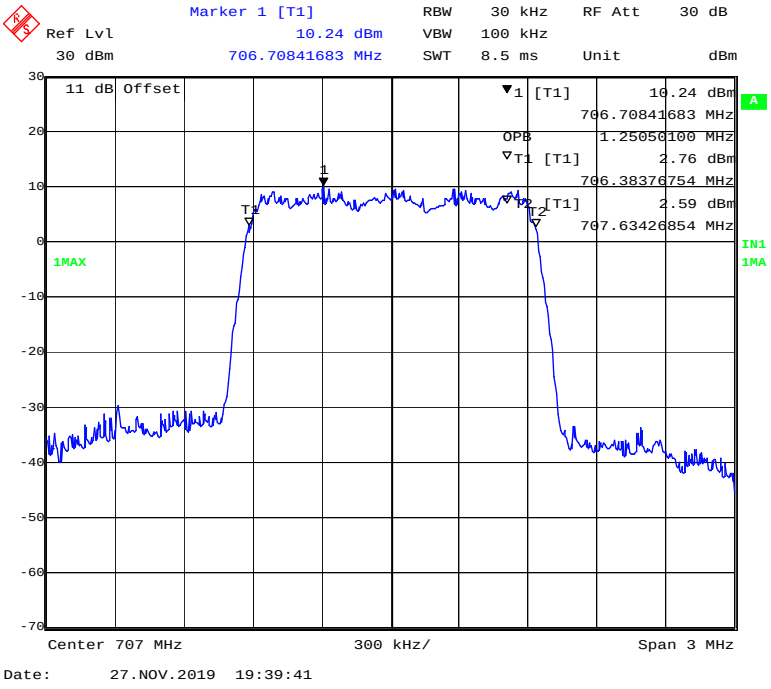

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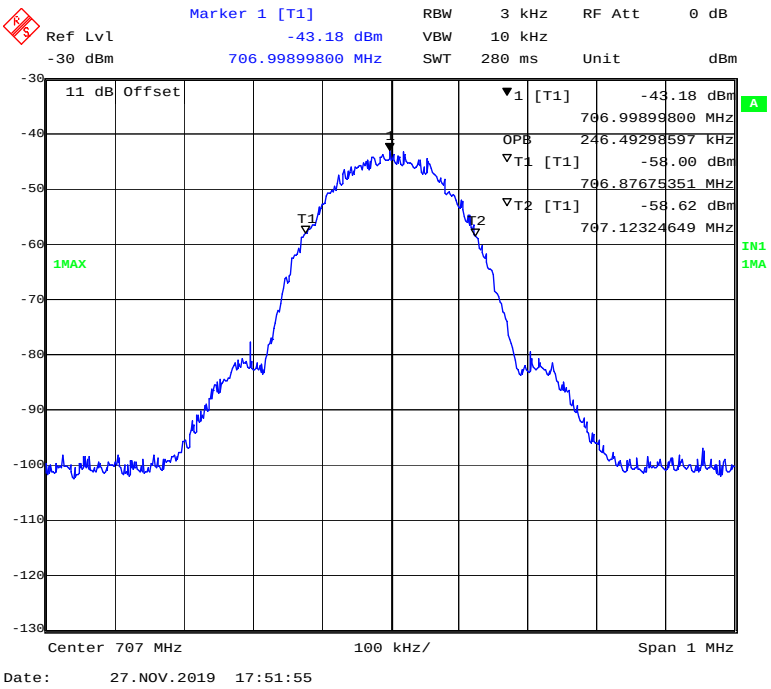

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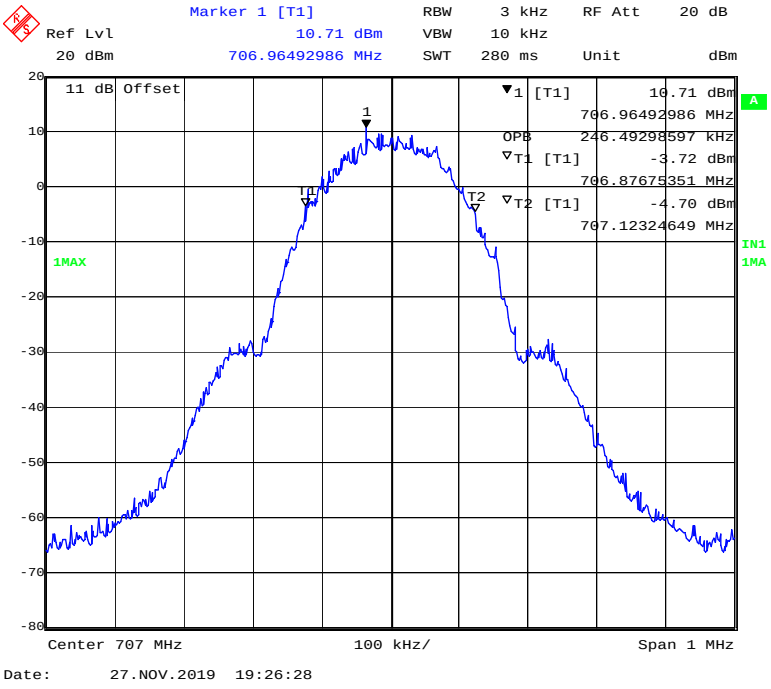

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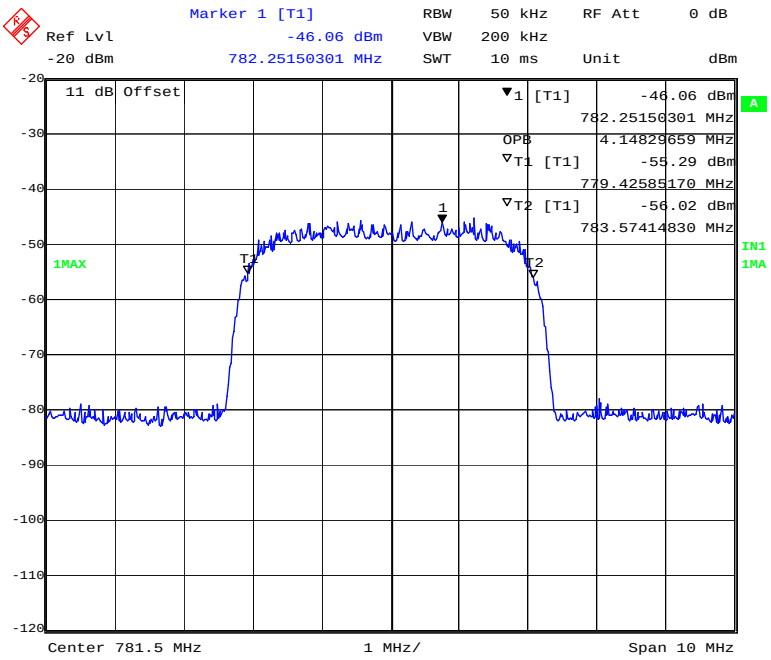

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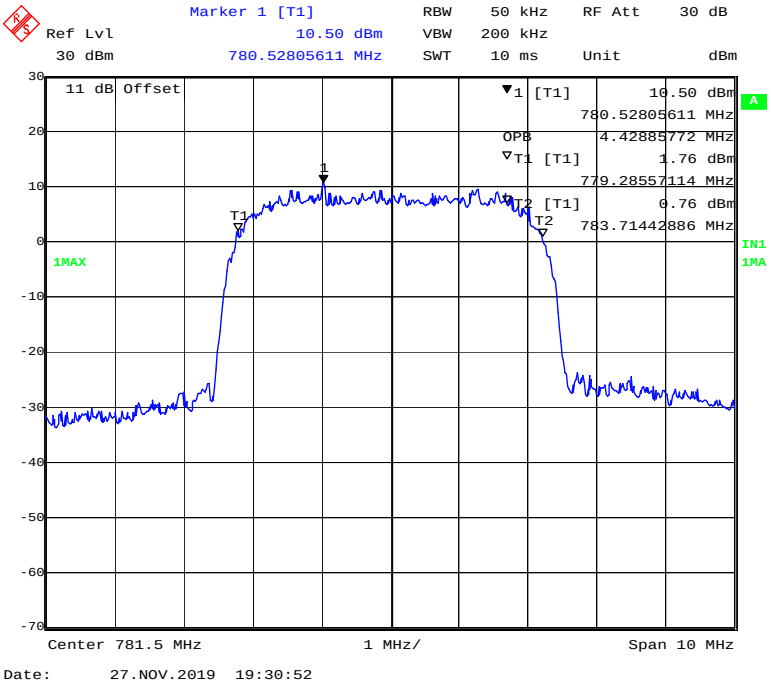

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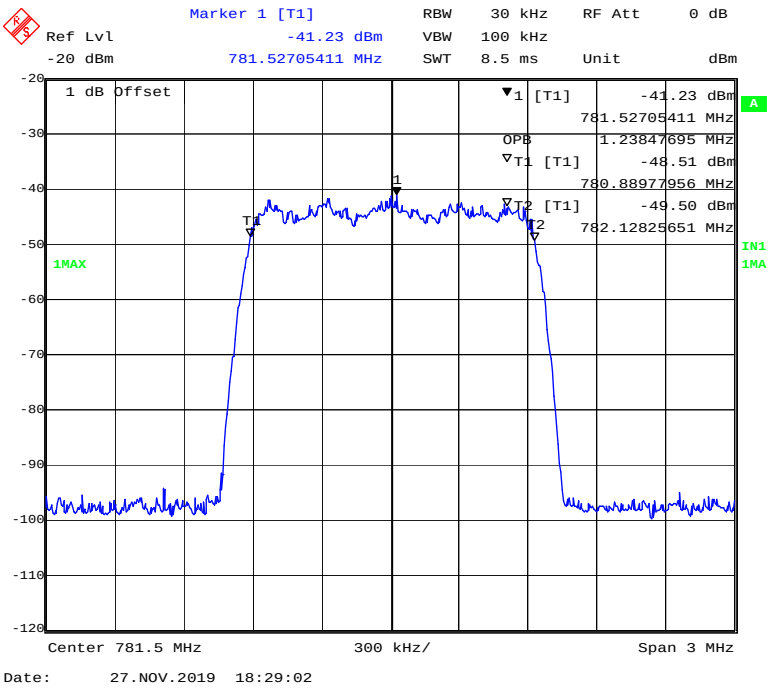

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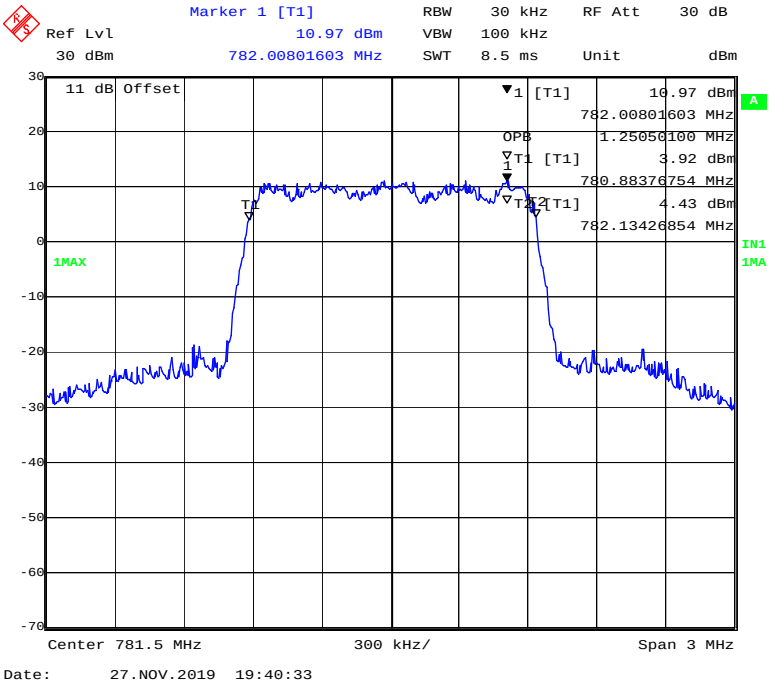

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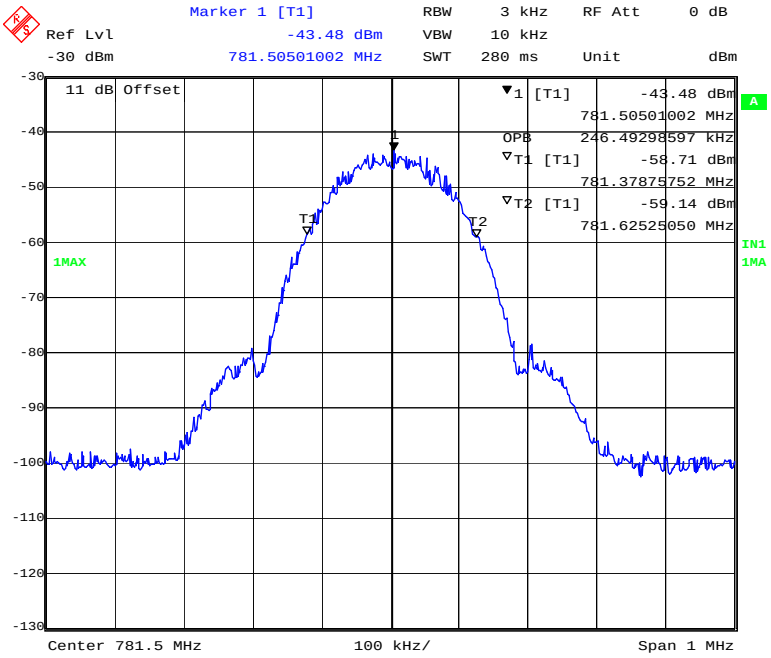
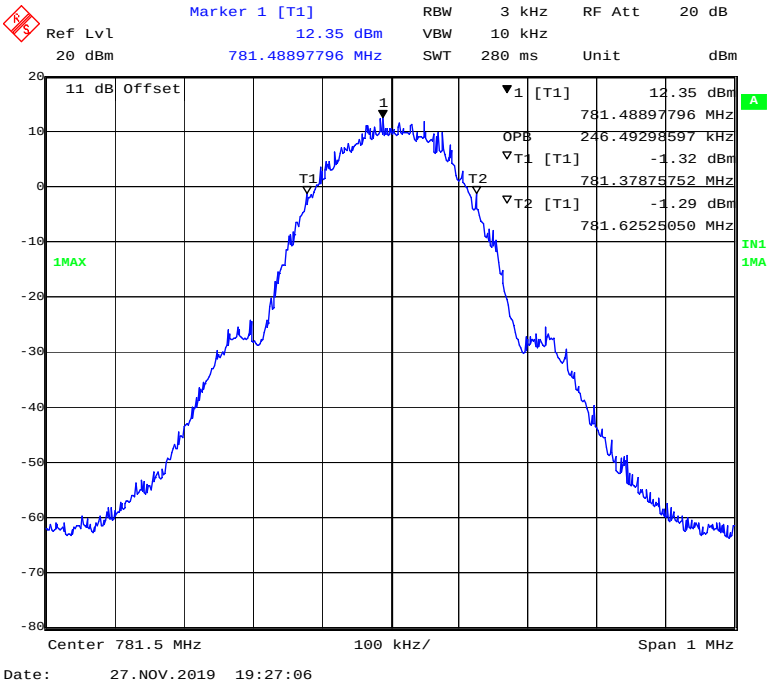
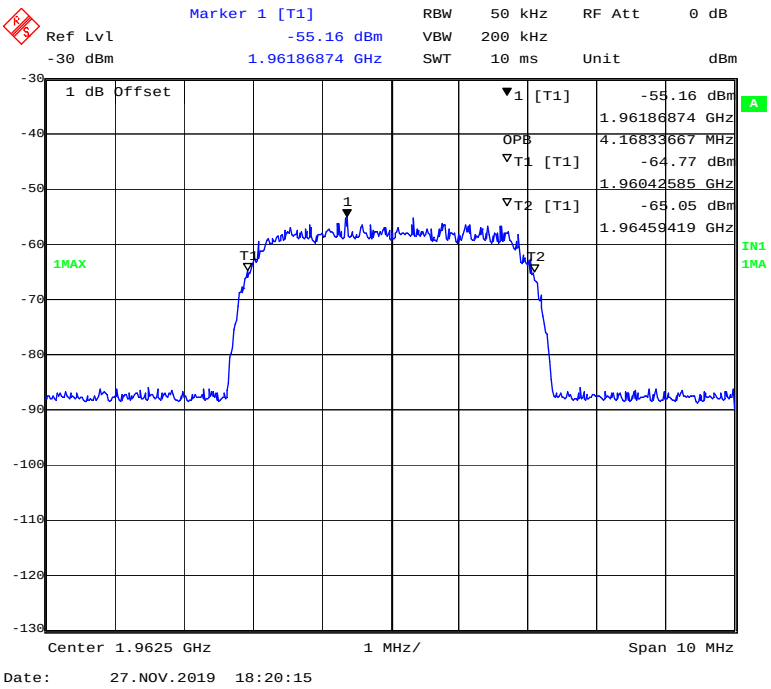


Upper 700MHz UL-GSM-OUT



PCS DL-LTE-IN



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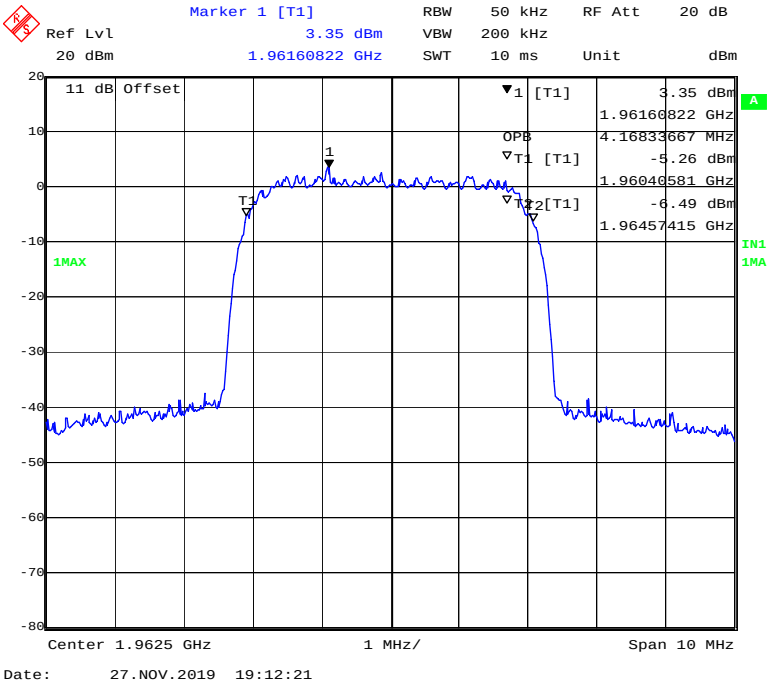

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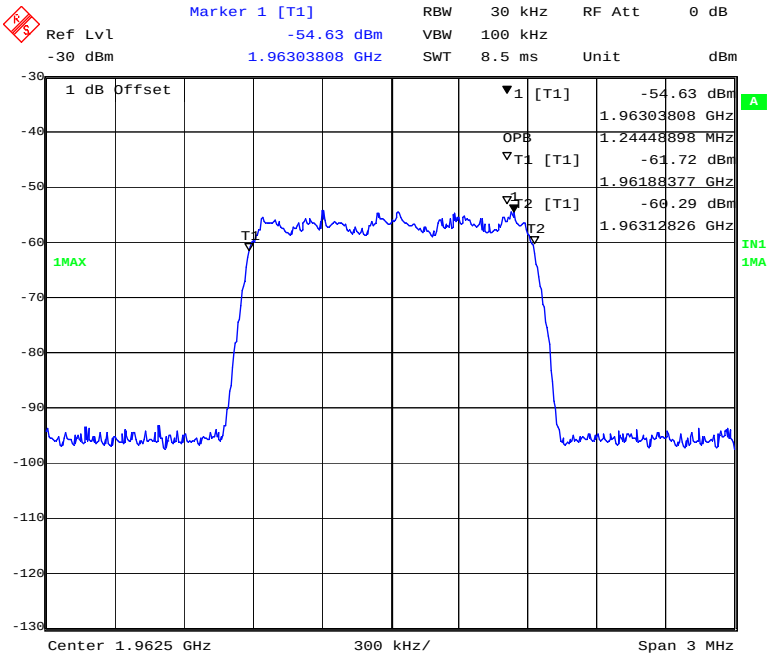

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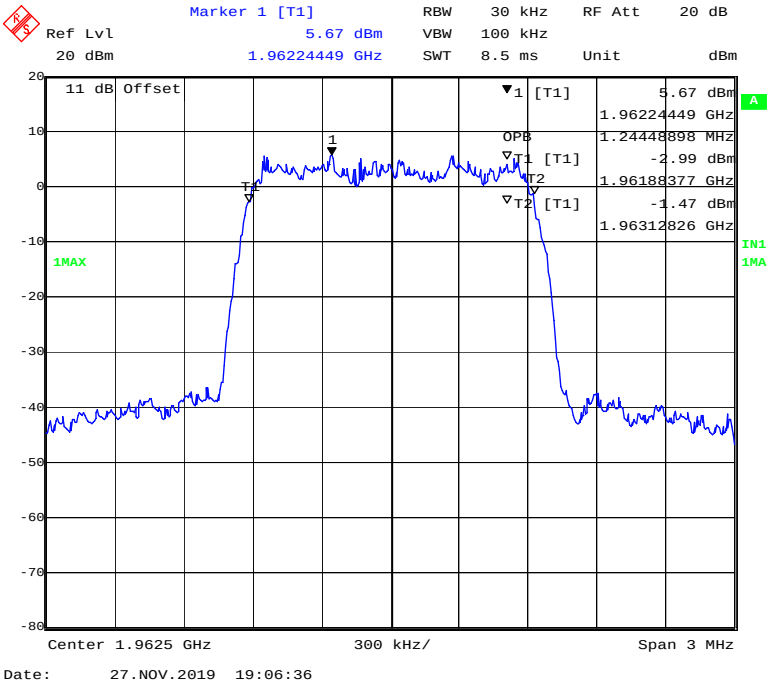

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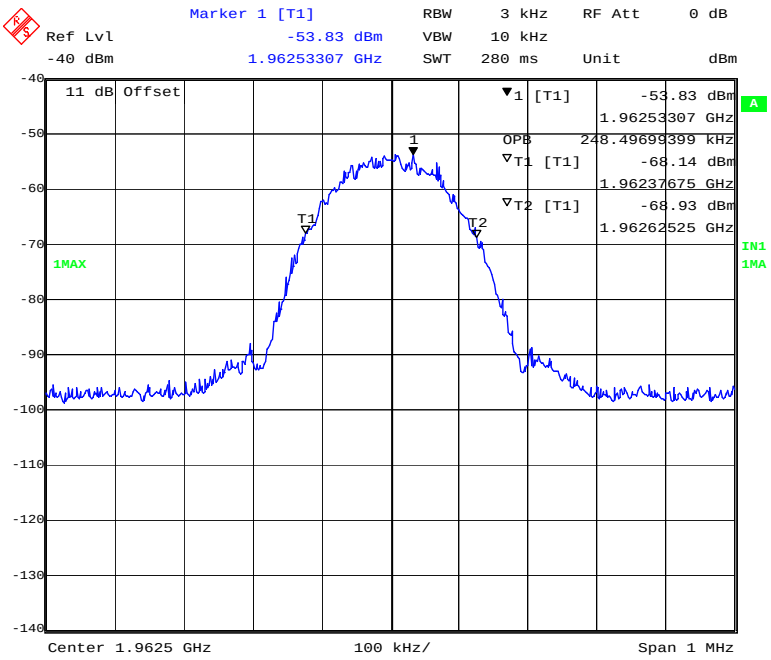

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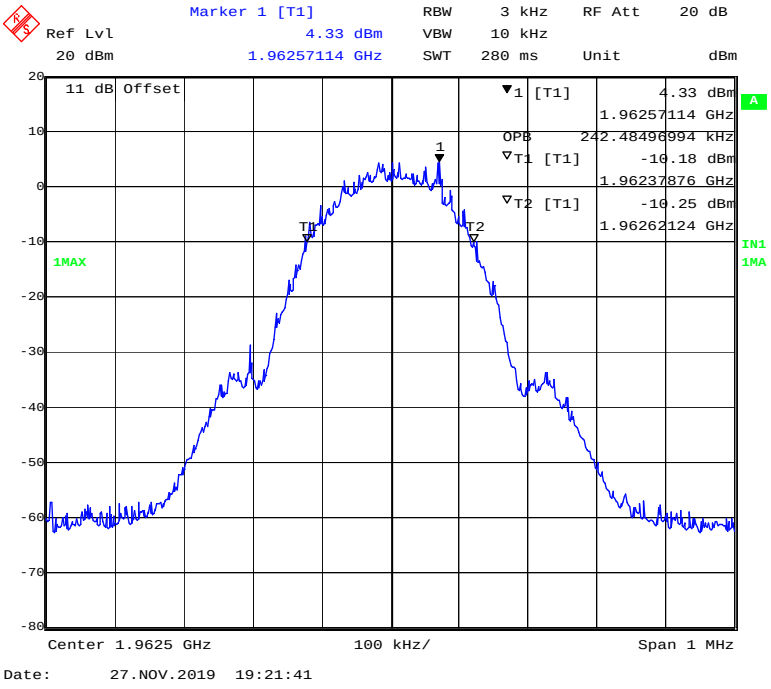

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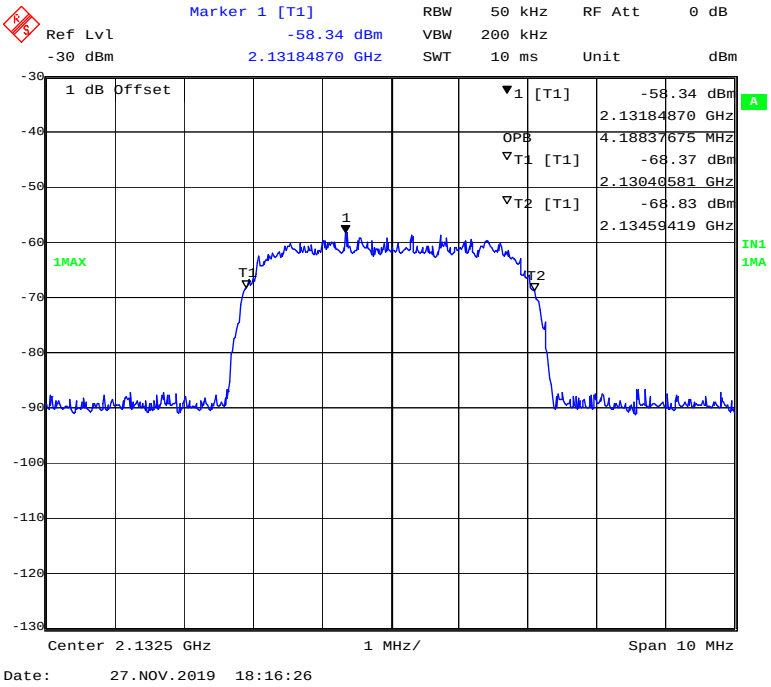

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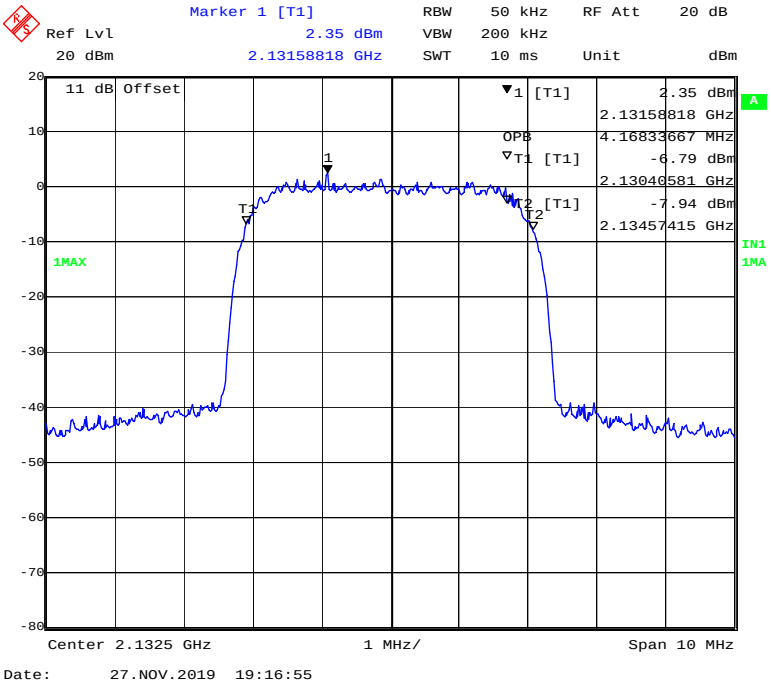

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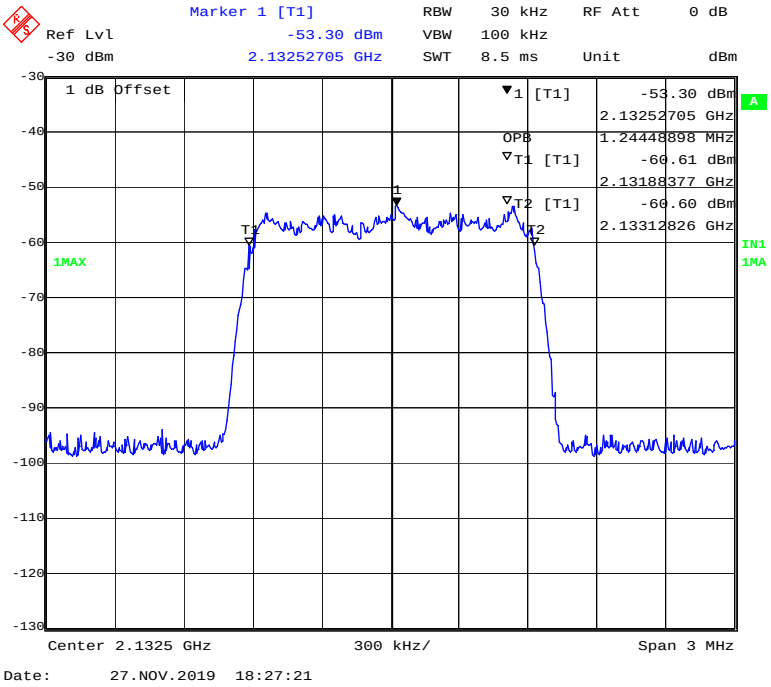

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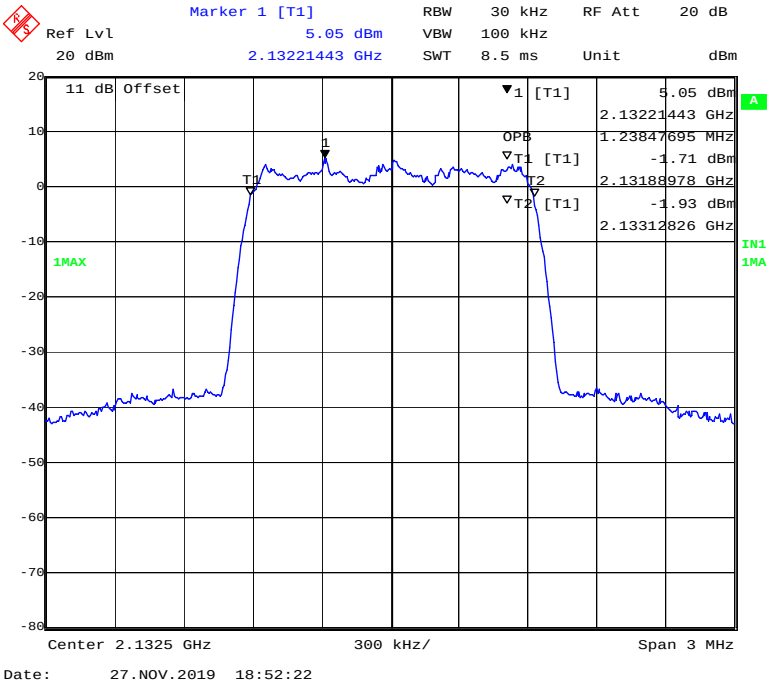

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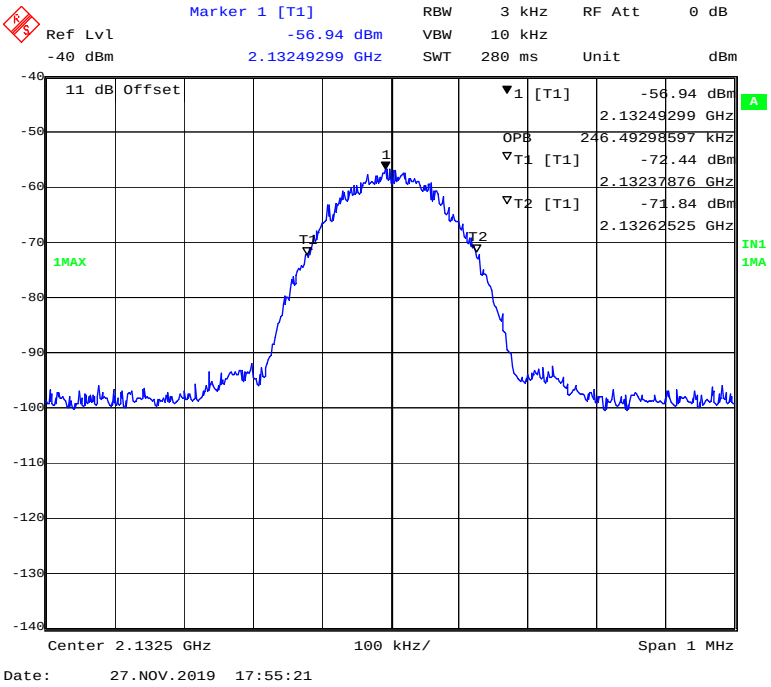

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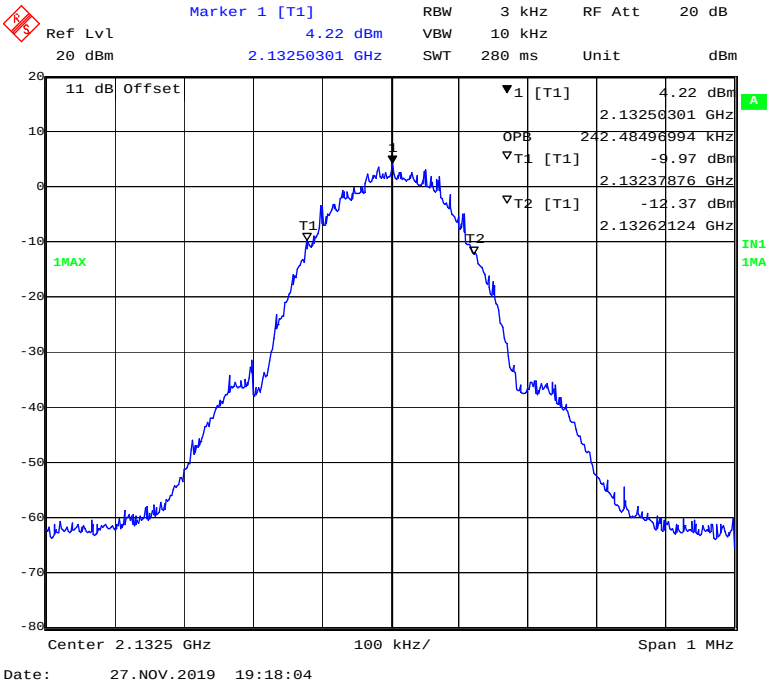
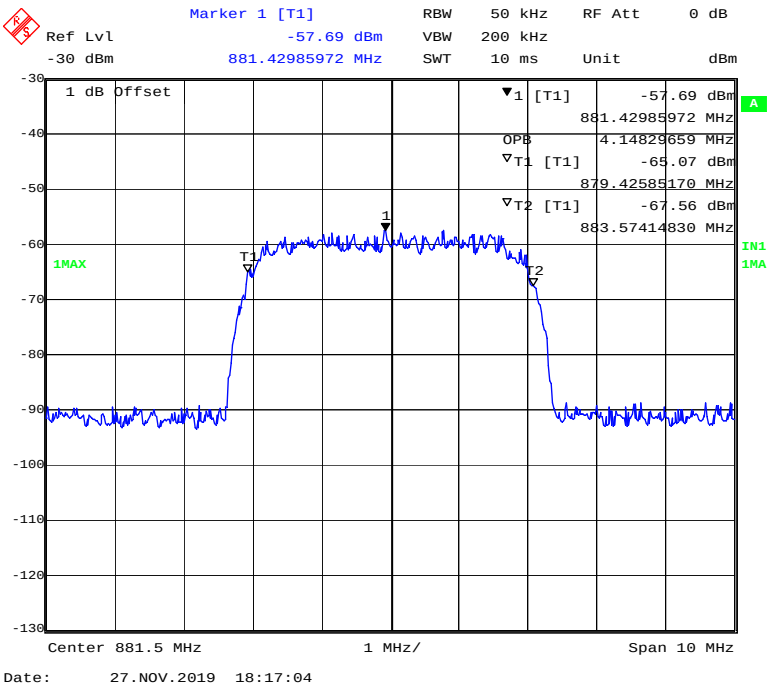


Cellular DL-LTE-IN



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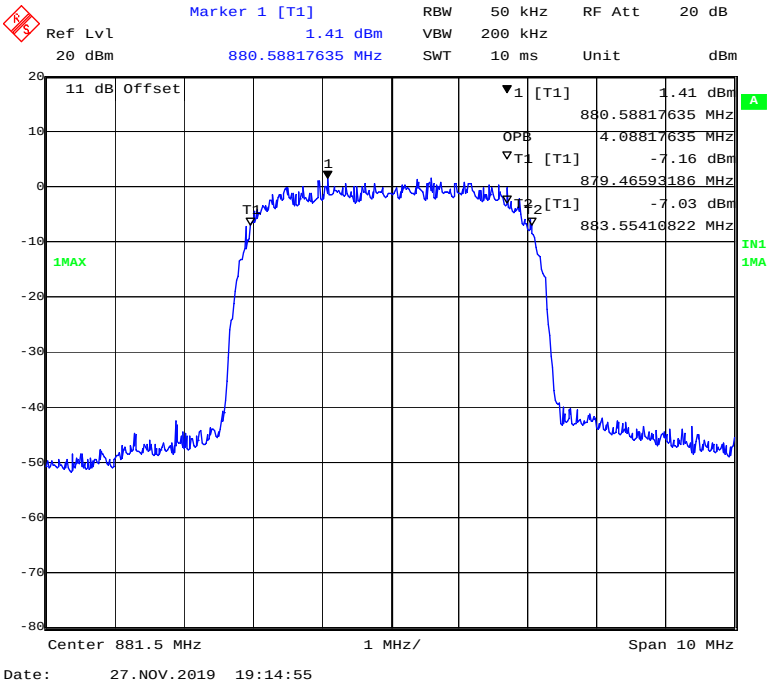

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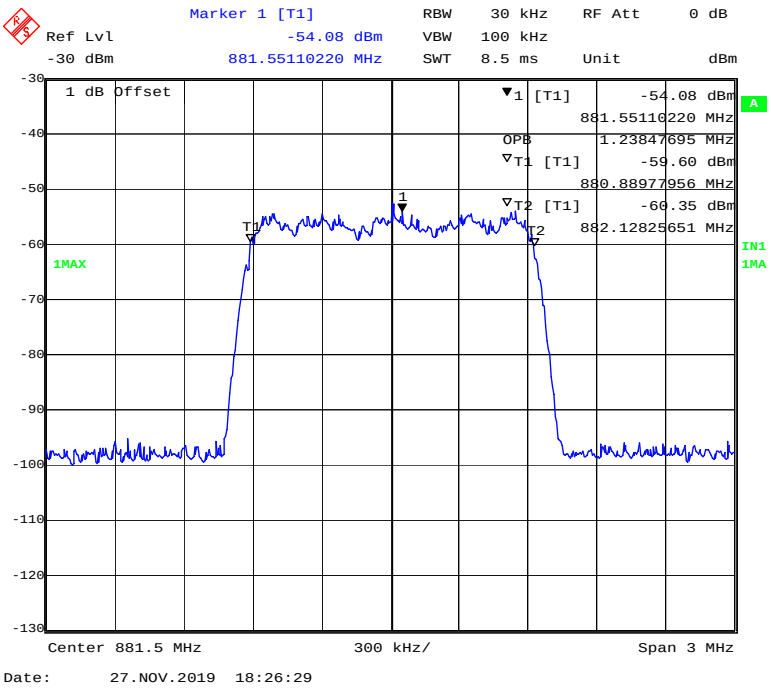

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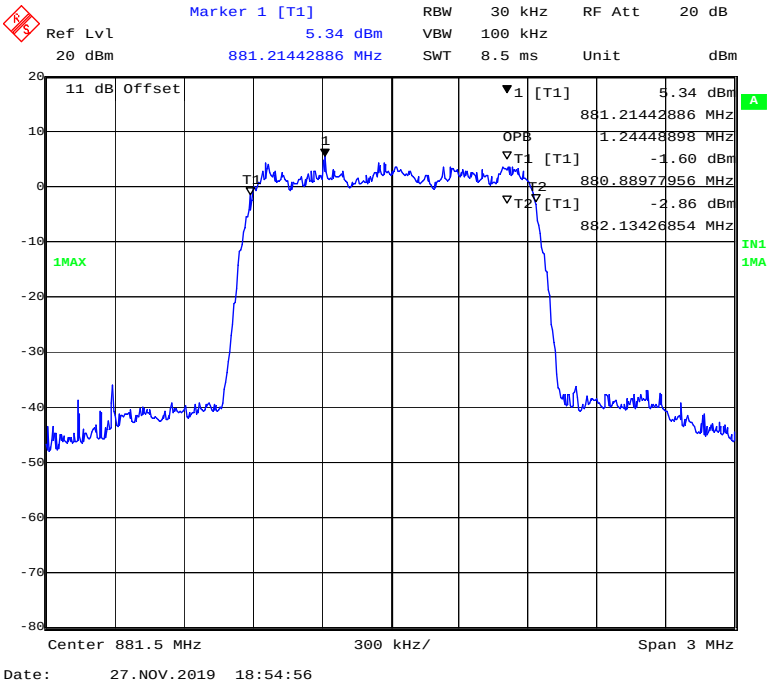

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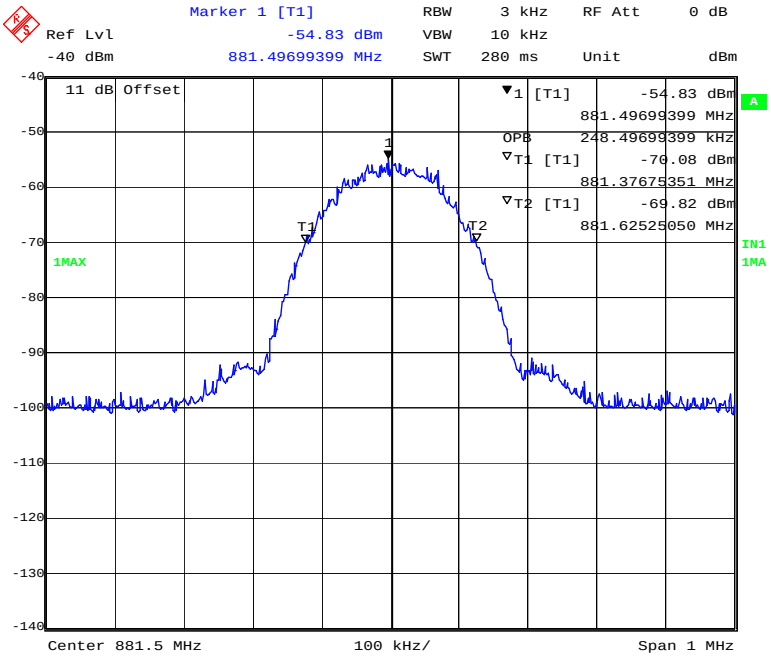

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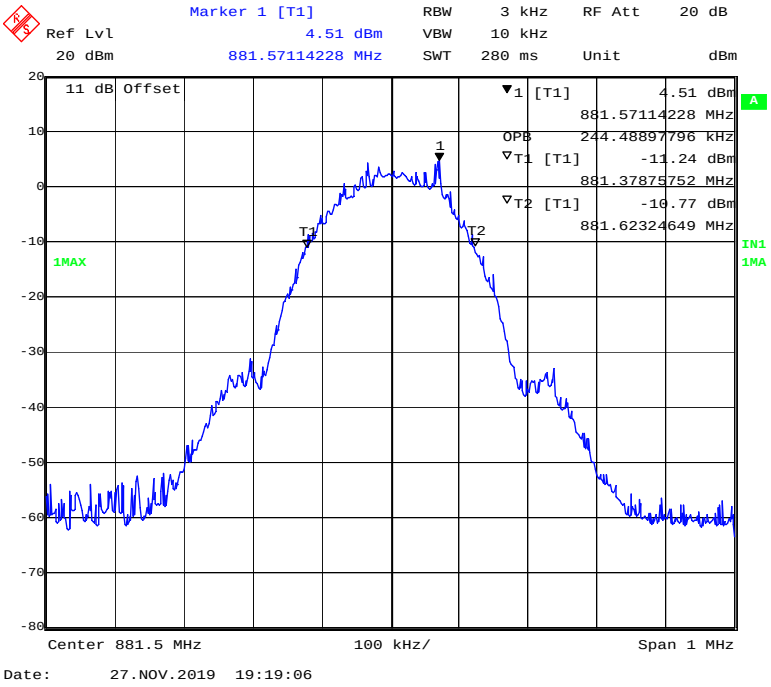
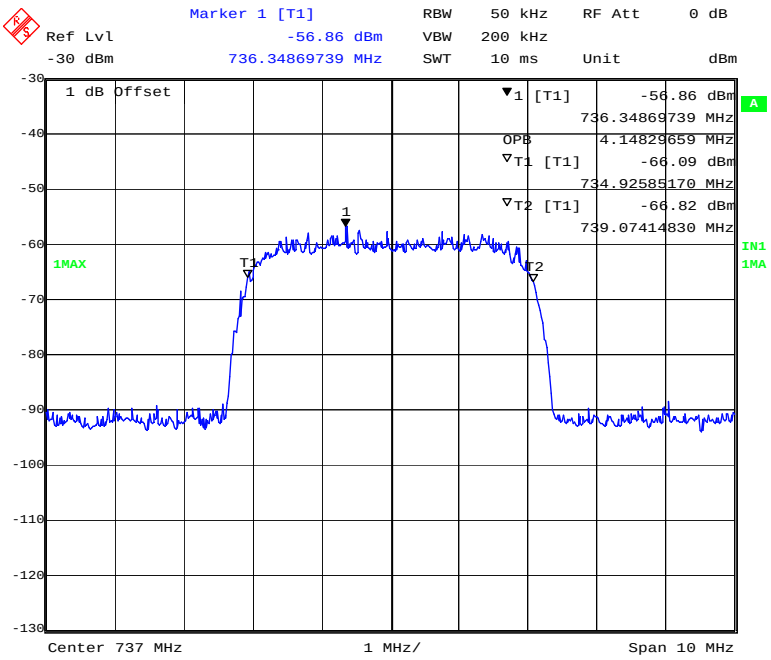
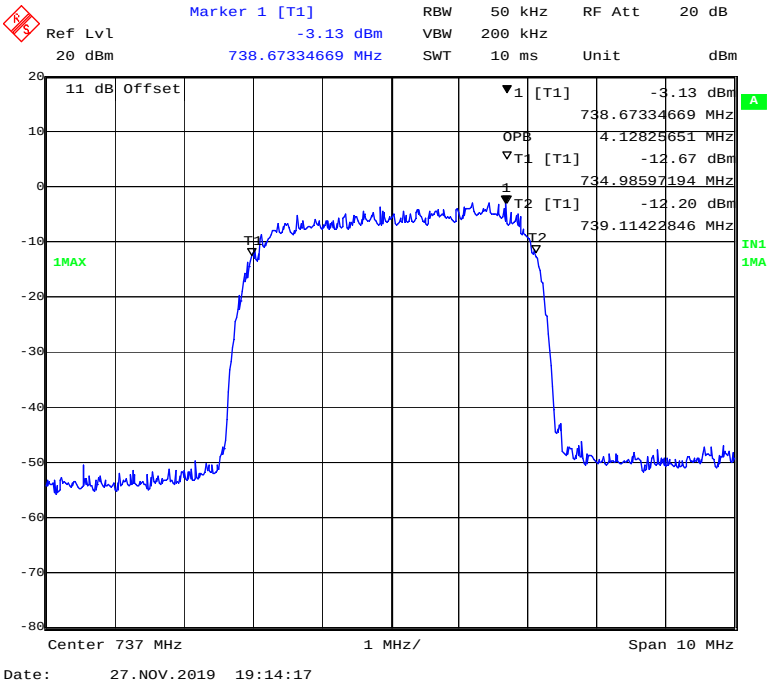


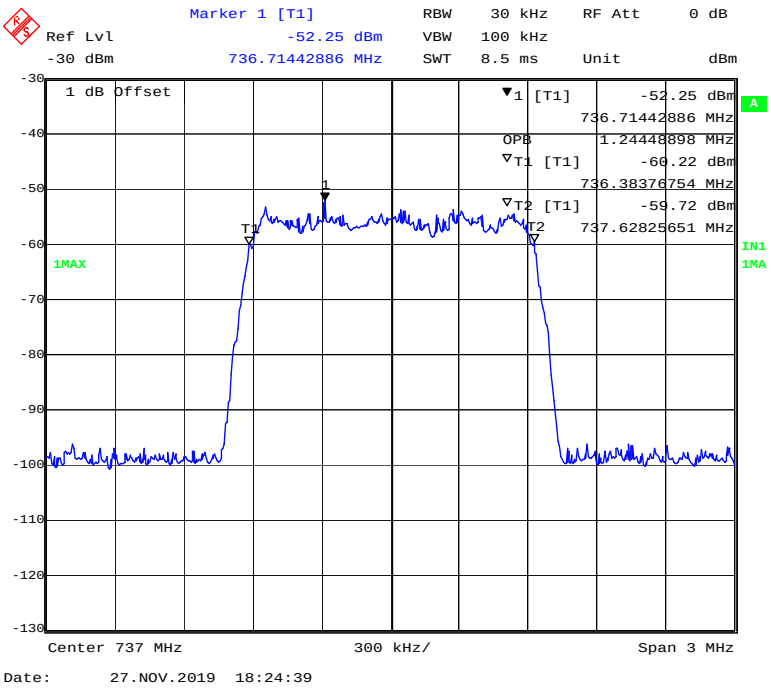
Lower 700MHz DL-LTE-IN



Lower 700MHz DL-LTE-OUT



Lower 700MHz DL-CDMA-IN



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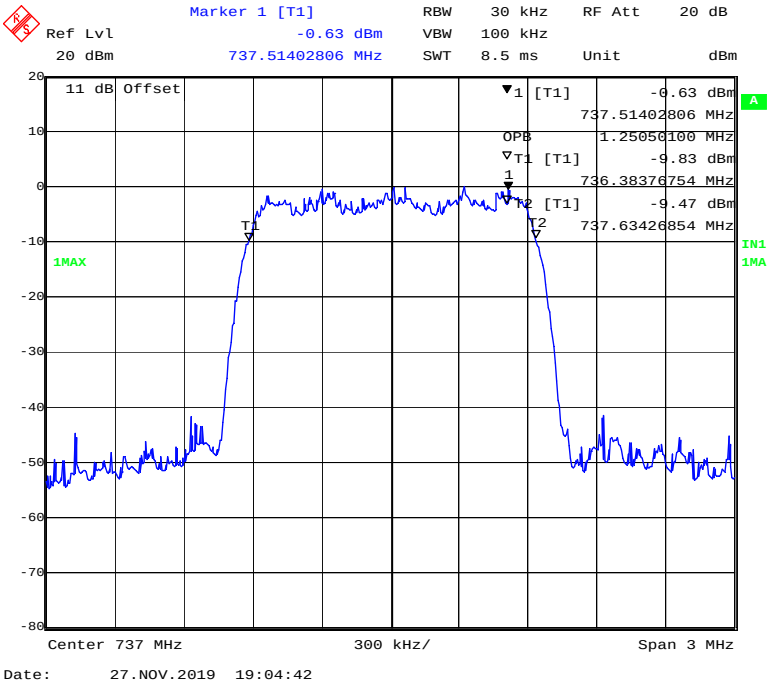
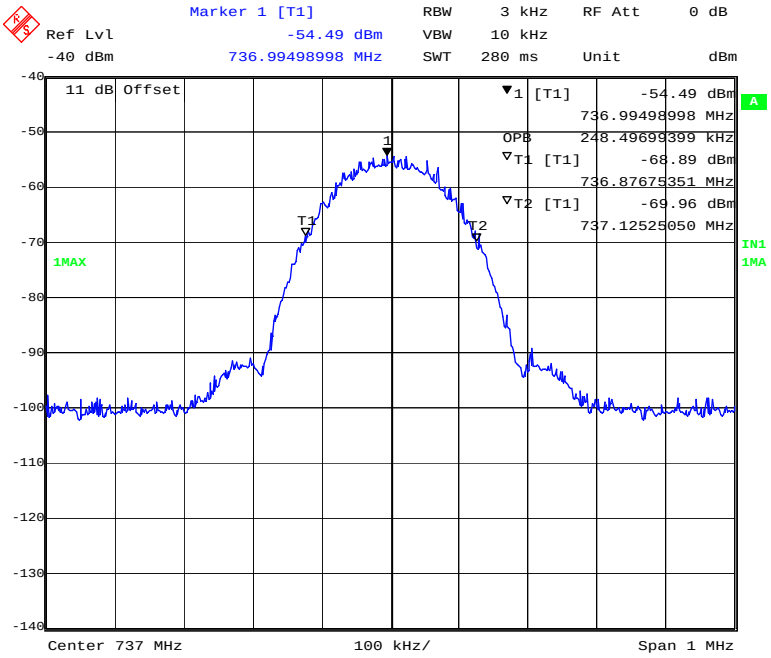
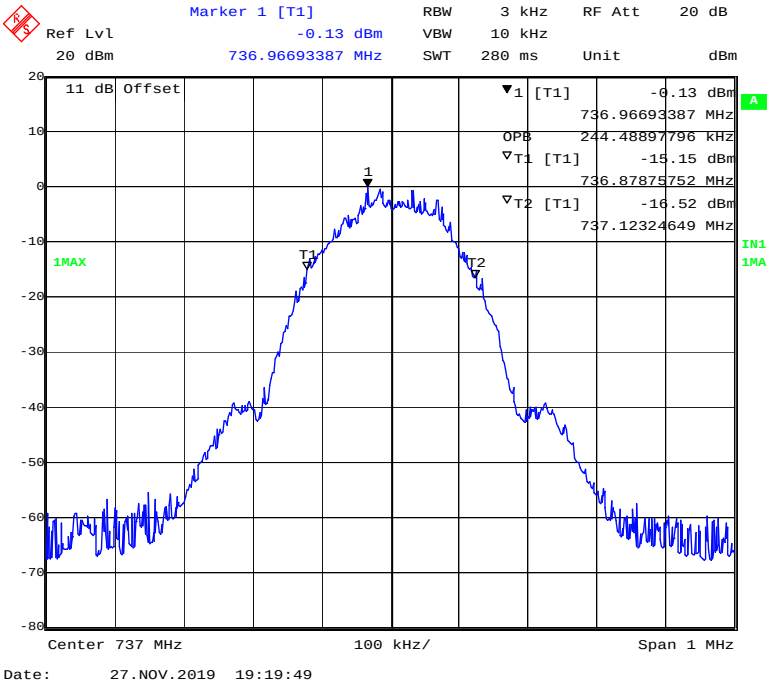


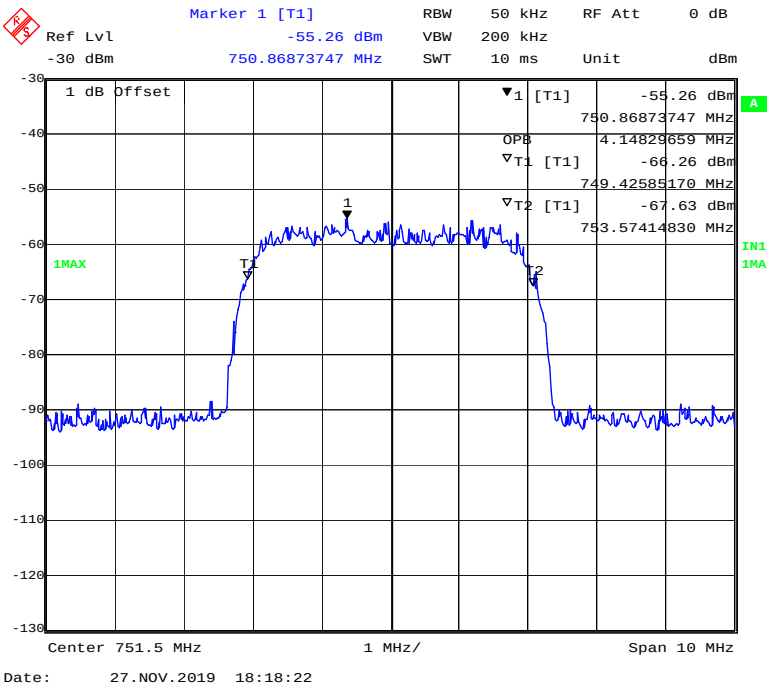
Lower 700MHz DL-GSM-IN



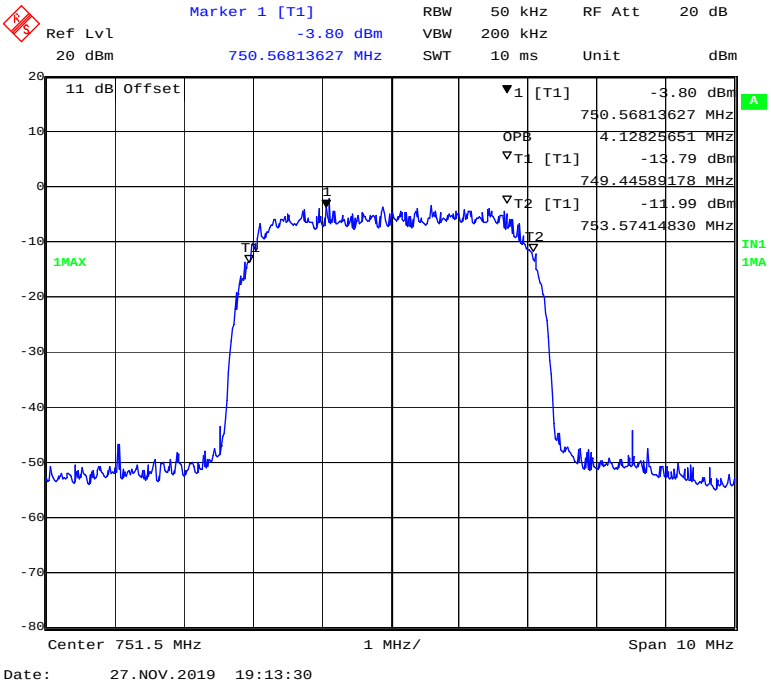
Lower 700MHz DL-GSM-OUT



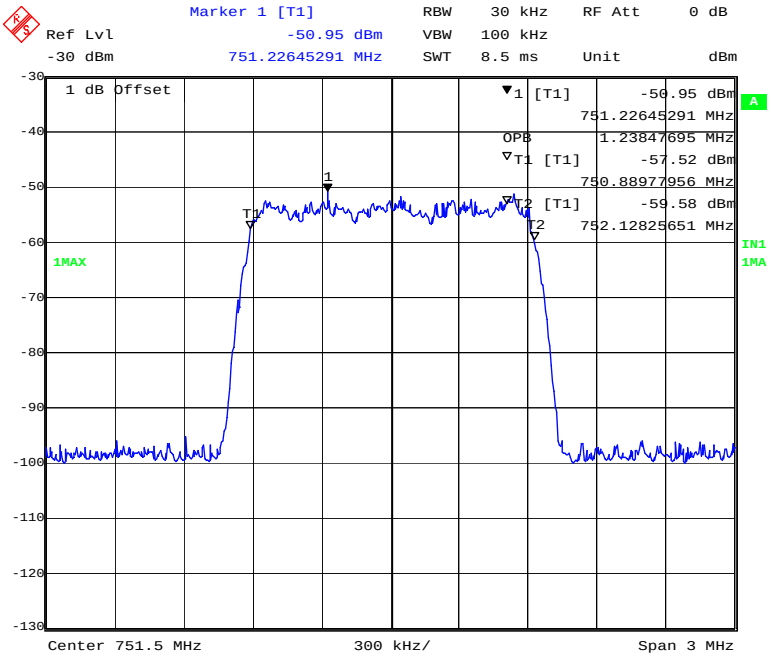
Upper 700MHz DL-LTE-IN



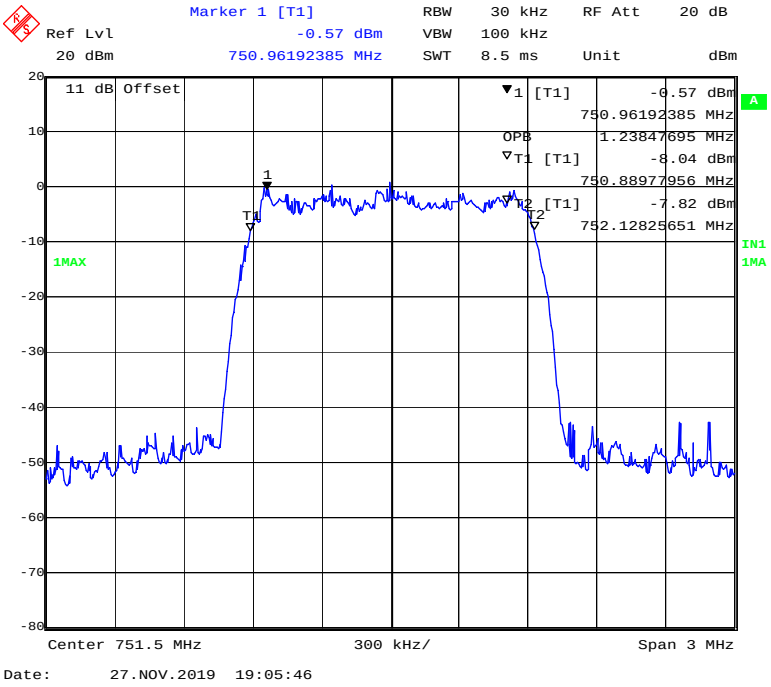
Upper 700MHz DL-LTE-OUT



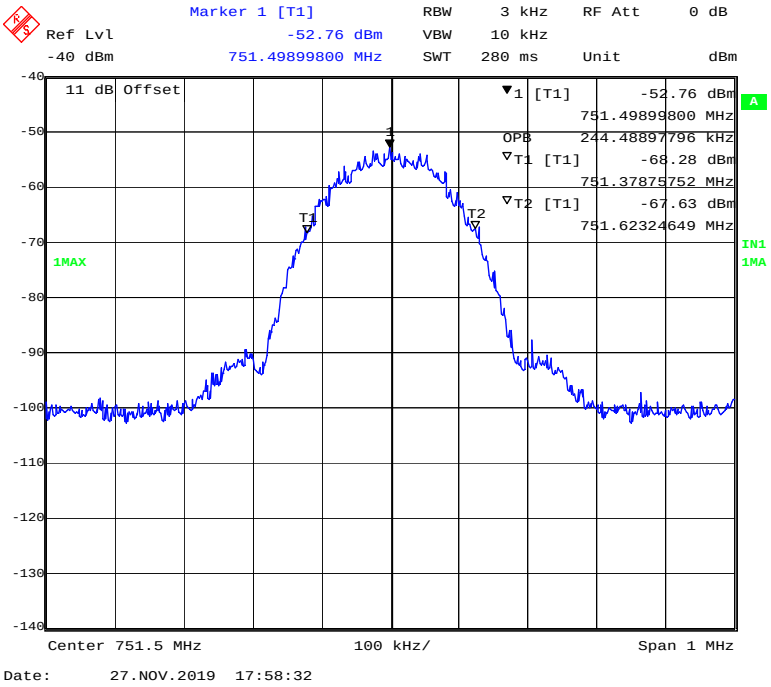
Upper 700MHz DL-CDMA-IN



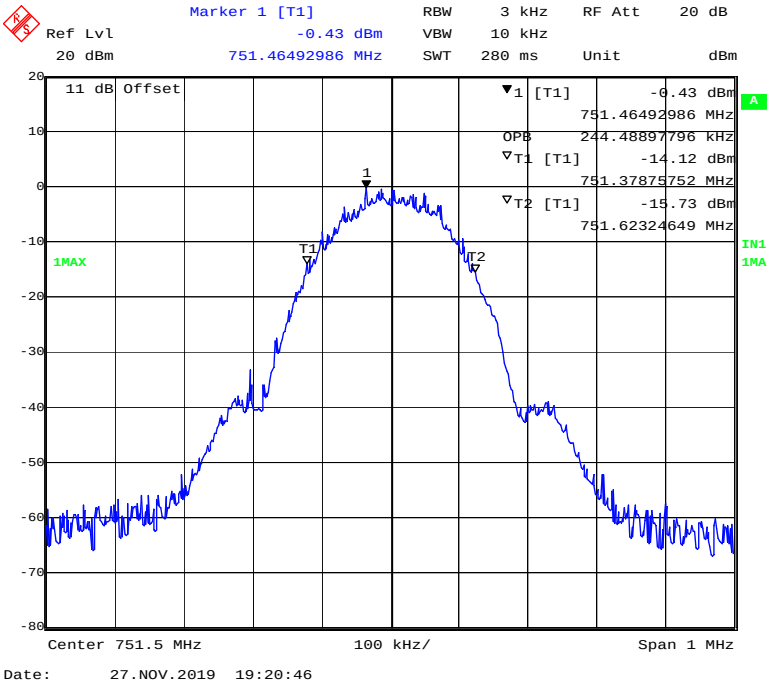
Upper 700MHz DL-CDMA-OUT



Upper 700MHz DL-GSM-IN



Upper 700MHz DL-GSM-OUT



§20.21(e)(8)(ii)(A) &§20.21(e)(4) - OSCILLATION DETECTION

Applicable Standards

Rule paragraph(s): § 20.21(e)(8)(ii)(A) Anti-Oscillation, §20.21(e)(4) Self-monitoring
For this measurement two EUTs will be permitted, one operating in a normal mode and the second operating in a test mode that is capable of disabling the uplink inactivity squelching and or a reduction of the time between restarts to 5 seconds. This will greatly decrease the test time required.
NOTE - Consumer boosters certified as direct connection mobile boosters having gain of less than or equal to 15 dB are exempt from compliance to testing procedures in 7.11.3 and 7.11.4.

Test Procedure

According to KDB 935210 D03 Signal Booster Measurements v04r03, §7.11.2 Oscillation restart tests and §7.11.3 Test procedure for measuring oscillation mitigation or shutdown

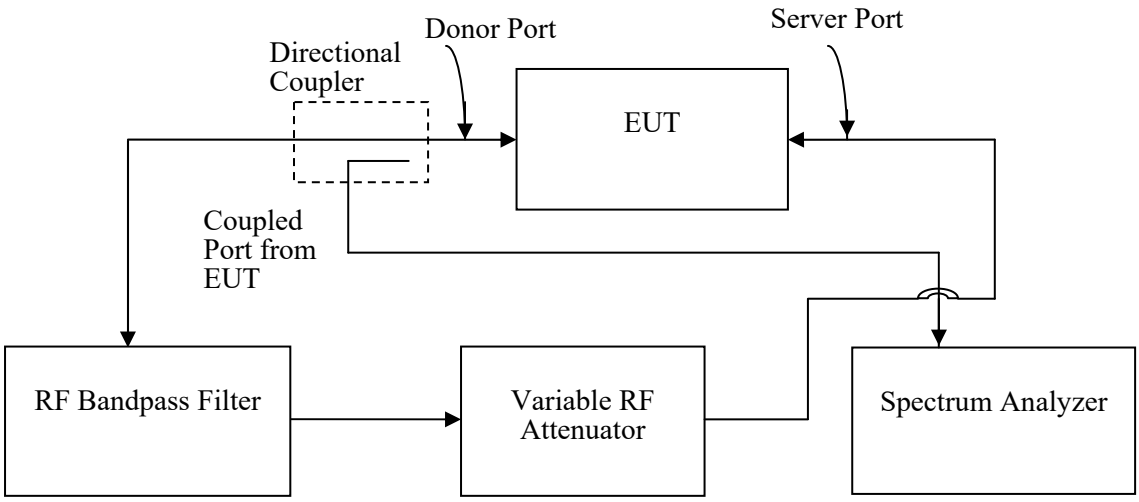


Figure 7 – Oscillation Detection Instrumentation Test Setup

Test Data

Environmental Conditions

Temperature:	22.2 ℃-23.5 ℃
Relative Humidity:	51 %-52 %
ATM Pressure:	101.3 kPa-102 kPa

The testing was performed by Stone Zhang from 2019-12-09 to 2019-12-16.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to following table.

Oscillation Restart Time:

Modes	Operation Bands	Detection Time (s)		Power level	Between restart time (s)		Number of restart		Result
		Reading	Limit	dBm	Reading	Limit	Reading	Limit	
Uplink	PCS	0.048	0.3	-36.26	62.099	>60	4	5	Compliant
	AWS	0.058		-34.22	62.157		4		Compliant
	Cellular	0.023		-33.16	62.110		4		Compliant
	Lower 700	0.064		-31.06	62.172		4		Compliant
	Upper 700	0.056		-32.58	62.212		4		Compliant
Downlink	PCS	0.035	1	-22.65	62.124		4		Compliant
	AWS	0.045		-24.38	62.127		4		Compliant
	Cellular	0.021		-21.06	62.037		4		Compliant
	Lower 700	0.104		-26.78	62.138		3		Compliant
	Upper 700	0.074		-25.38	62.140		3		Compliant

Oscillation Mitigation or Shutdown:

Mode	Operation Band	Max gain	Isolation	Difference	Limit	Result
		dB	dB	dB	dB	
Uplink	PCS	60	+5	5.96	12	Compliant
			+4	7.22	12	Compliant
			+3	8.65	12	Compliant
			+2	10.74	12	Compliant
			+1	10.86	12	Compliant
			+0	11.63	12	Compliant
			-1	/	12	Compliant*
			-2	/	12	Compliant*
			-3	/	12	Compliant*
			-4	/	12	Compliant*
			-5	/	12	Compliant*
	AWS	60	+5	5.34	12	Compliant
			+4	6.85	12	Compliant
			+3	7.27	12	Compliant
			+2	8.56	12	Compliant
			+1	9.89	12	Compliant
			+0	10.96	12	Compliant
			-1	/	12	Compliant*
			-2	/	12	Compliant*
			-3	/	12	Compliant*
			-4	/	12	Compliant*
			-5	/	12	Compliant*
	Cellular	60	+5	6.77	12	Compliant
			+4	7.69	12	Compliant
			+3	8.86	12	Compliant
			+2	9.61	12	Compliant
			+1	9.8	12	Compliant
			+0	11.56	12	Compliant
			-1	/	12	Compliant*
			-2	/	12	Compliant*
			-3	/	12	Compliant*
			-4	/	12	Compliant*
			-5	/	12	Compliant*
	Lower 700	60	+5	5.46	12	Compliant
			+4	6.17	12	Compliant
			+3	7.33	12	Compliant
			+2	8.96	12	Compliant
			+1	10.42	12	Compliant
			+0	11.56	12	Compliant
			-1	/	12	Compliant*
			-2	/	12	Compliant*
			-3	/	12	Compliant*
			-4	/	12	Compliant*
			-5	/	12	Compliant*

Note: Compliance*: The measured difference exceeds the limit (12dB) for a period of less than 300 seconds before device mitigate and shut down.

Mode	Operation Band	Max gain	Isolation	Difference	Limit	Result
		dB	dB	dB	dB	
Uplink	Upper 700	60	+5	4.86	12	Compliant
			+4	5.24	12	Compliant
			+3	6.36	12	Compliant
			+2	7.58	12	Compliant
			+1	7.42	12	Compliant
			+0	10.96	12	Compliant
			-1	/	12	Compliant*
			-2	/	12	Compliant*
			-3	/	12	Compliant*
			-4	/	12	Compliant*
			-5	/	12	Compliant*
Downlink	PCS	60	+5	5.11	12	Compliant
			+4	6.42	12	Compliant
			+3	7.69	12	Compliant
			+2	9.16	12	Compliant
			+1	10.24	12	Compliant
			+0	11.88	12	Compliant
			-1	/	12	Compliant*
			-2	/	12	Compliant*
			-3	/	12	Compliant*
			-4	/	12	Compliant*
			-5	/	12	Compliant*
	AWS	60	+5	5.98	12	Compliant
			+4	7.16	12	Compliant
			+3	8.6	12	Compliant
			+2	9.45	12	Compliant
			+1	10.22	12	Compliant
			+0	10.65	12	Compliant
			-1	/	12	Compliant*
			-2	/	12	Compliant*
			-3	/	12	Compliant*
			-4	/	12	Compliant*
			-5	/	12	Compliant*
	Cellular	60	+5	6.05	12	Compliant
			+4	7.12	12	Compliant
			+3	7.81	12	Compliant
			+2	8.27	12	Compliant
			+1	10.04	12	Compliant
			+0	11.36	12	Compliant
			-1	/	12	Compliant*
			-2	/	12	Compliant*
			-3	/	12	Compliant*
			-4	/	12	Compliant*
			-5	/	12	Compliant*

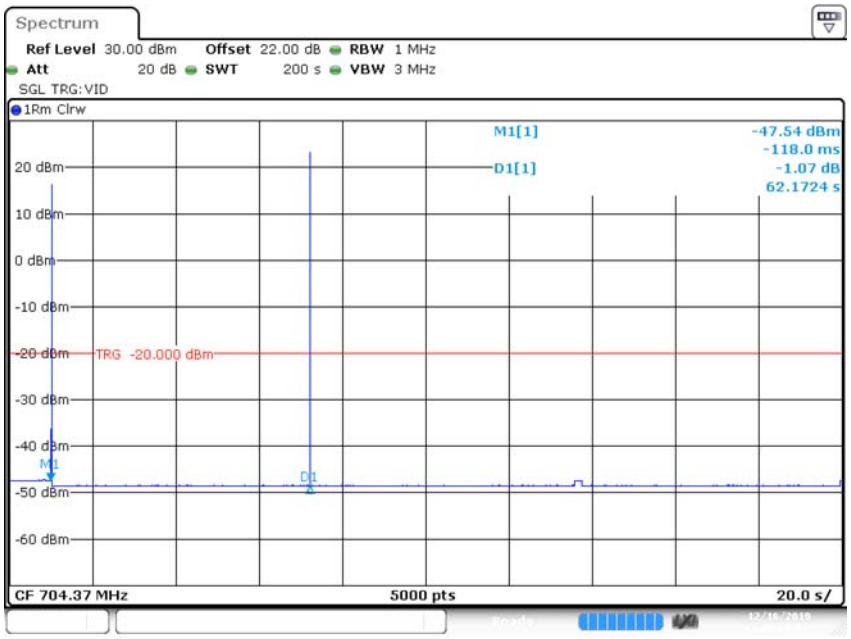
Mode	Operation Band	Max gain	Isolation	Difference	Limit	Result
		dB	dB	dB	dB	
Downlink	Lower 700	60	+5	5.75	12	Compliant
			+4	6.84	12	Compliant
			+3	7.85	12	Compliant
			+2	9.46	12	Compliant
			+1	10.12	12	Compliant
			+0	11.44	12	Compliant
			-1	/	12	Compliant*
			-2	/	12	Compliant*
			-3	/	12	Compliant*
			-4	/	12	Compliant*
			-5	/	12	Compliant*
	Upper 700	60	+5	6.58	12	Compliant
			+4	7.29	12	Compliant
			+3	8.31	12	Compliant
			+2	8.96	12	Compliant
			+1	9.71	12	Compliant
			+0	10.44	12	Compliant
			-1	/	12	Compliant*
			-2	/	12	Compliant*
			-3	/	12	Compliant*
			-4	/	12	Compliant*
			-5	/	12	Compliant*

Note: Compliance*: The measured difference exceeds the limit (12dB) for a period of less than 300 seconds before device mitigate and shut down.

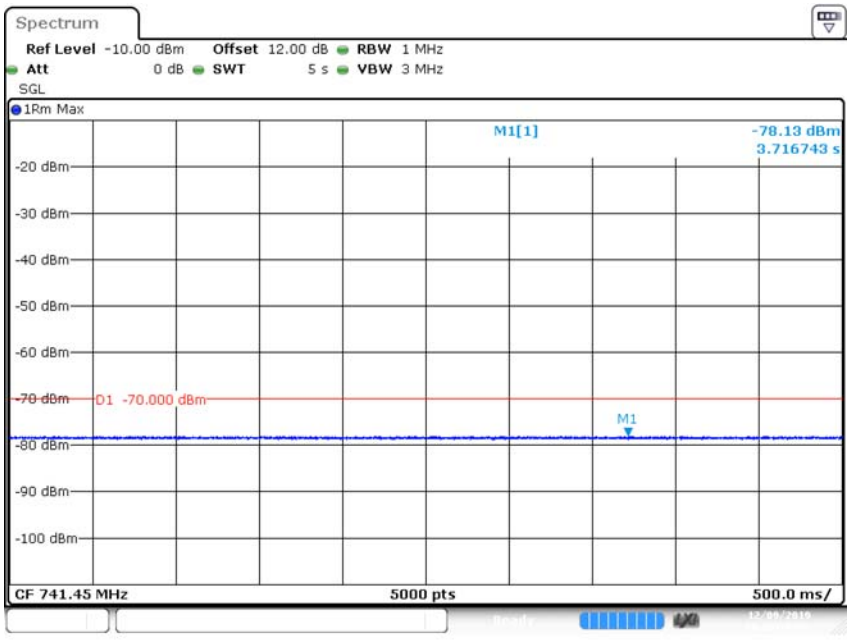
Oscillation Restart Tests:

Downlink:

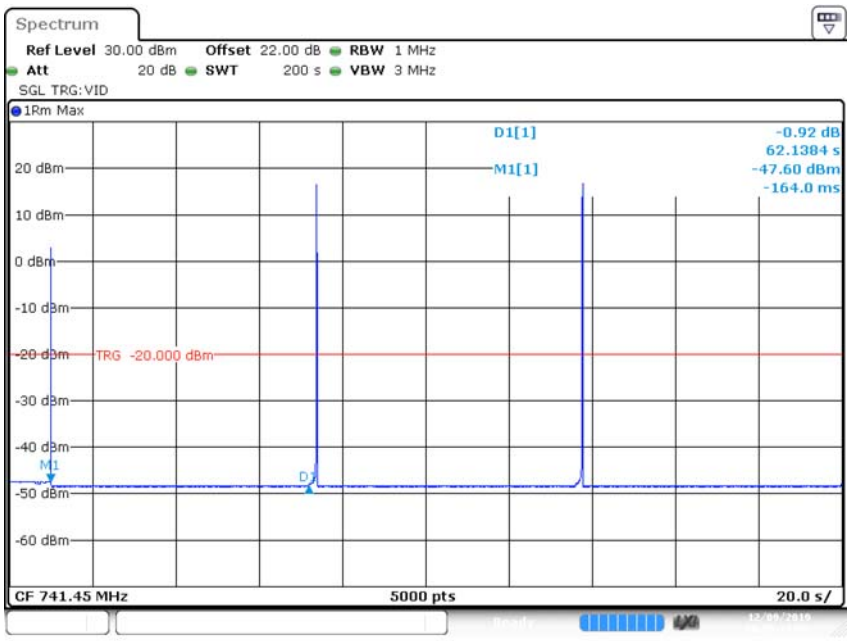
Lower 700MHz Band



Date: 16.DEC.2019 11:25:29

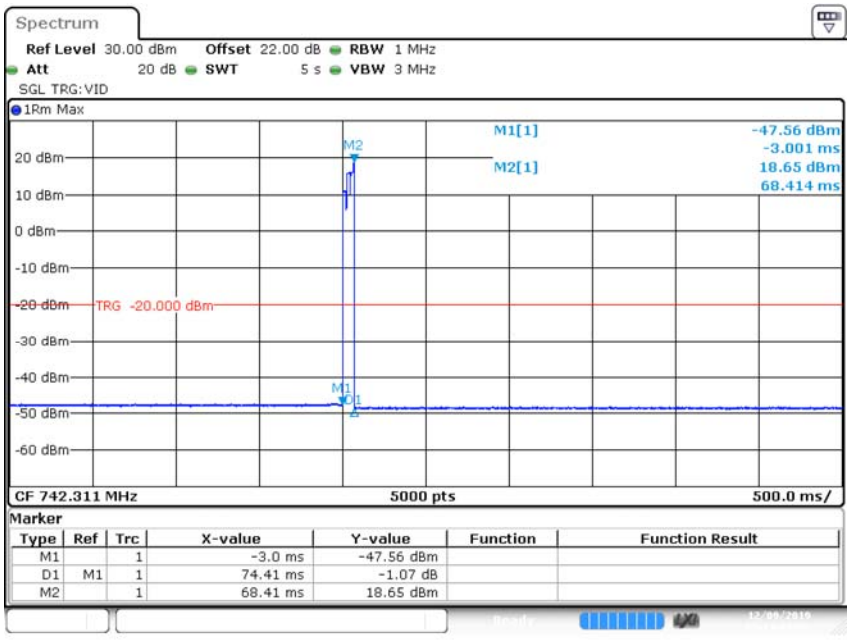


Date: 9.DEC.2019 18:29:58

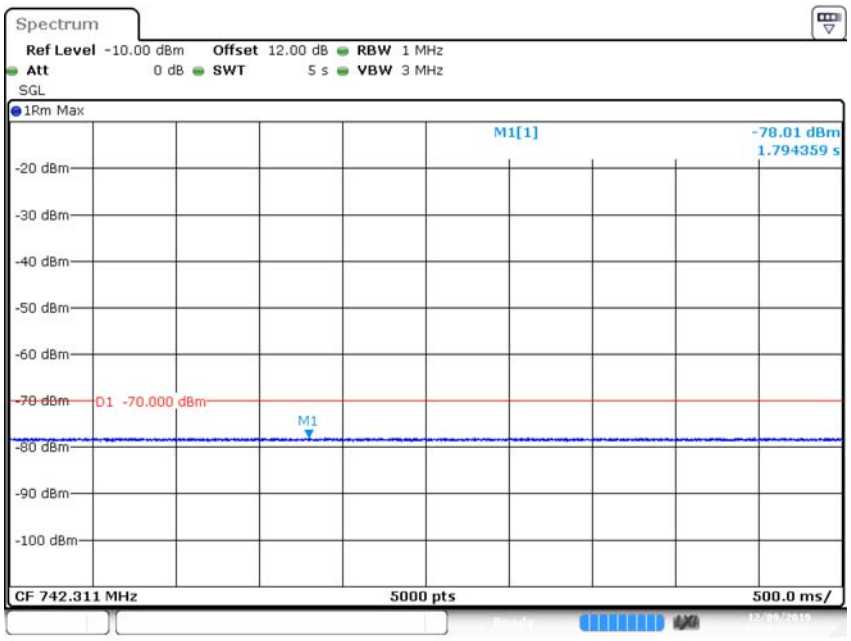


Date: 9.DEC.2019 18:35:13

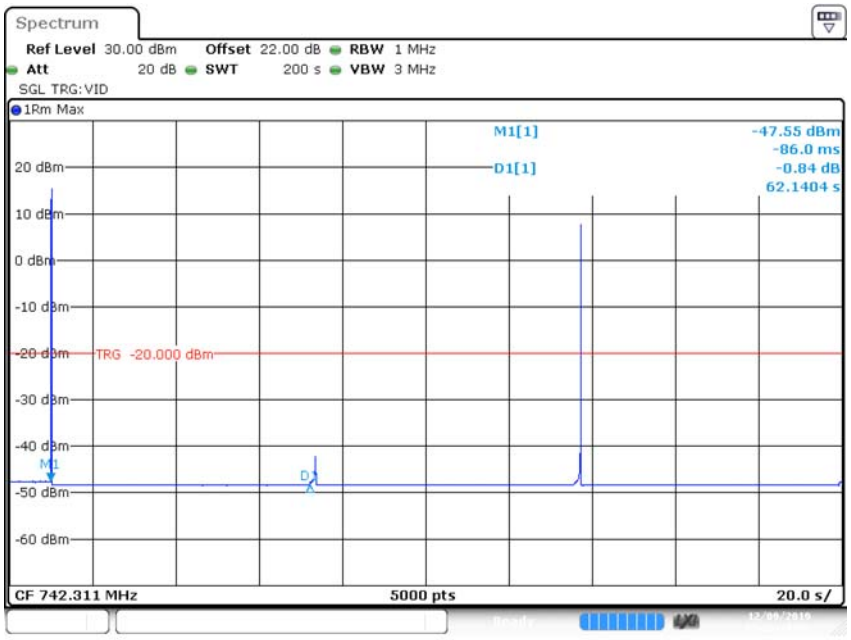
Upper 700MHz Band



Date: 9.DEC.2019 19:14:49

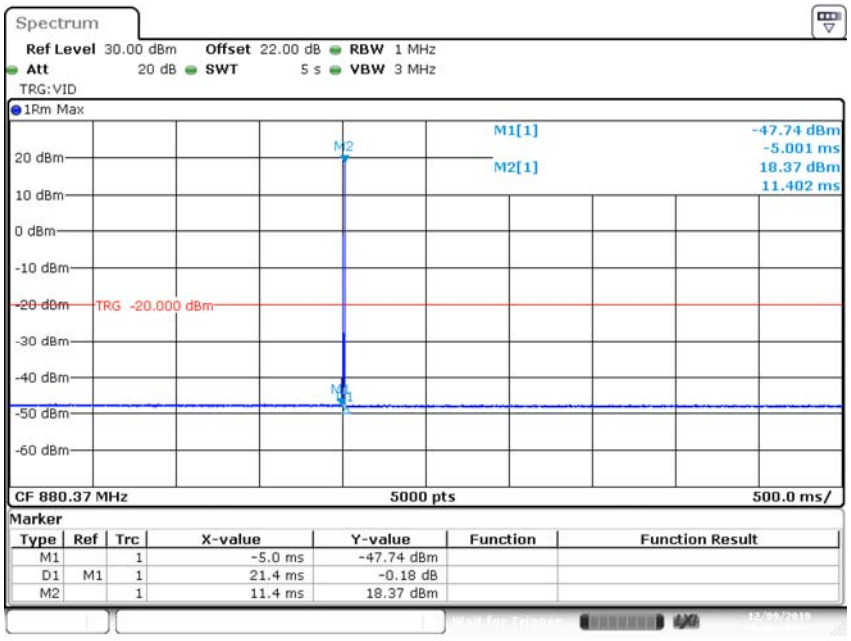


Date: 9.DEC.2019 19:16:07

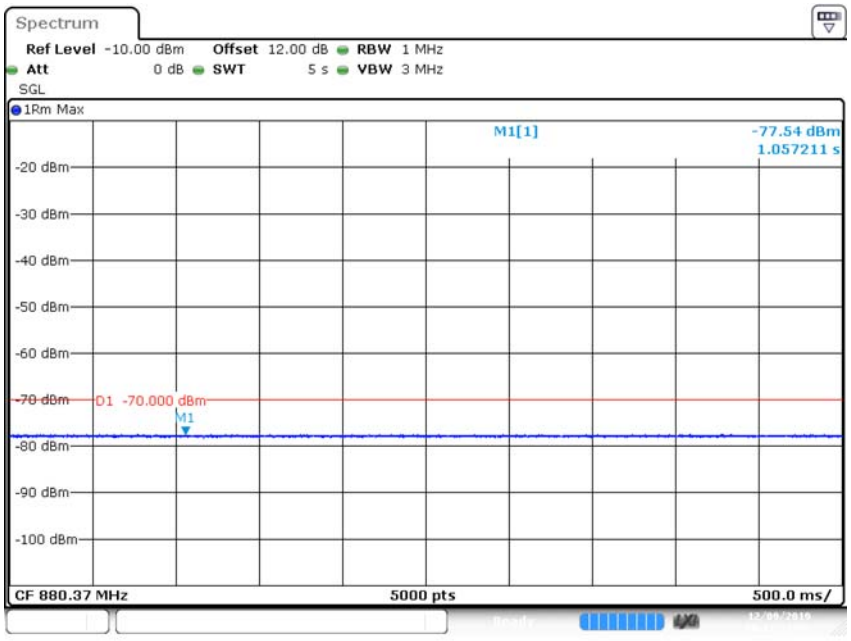


Date: 9.DEC.2019 19:23:39

Cellular Band



Date: 9.DEC.2019 18:09:38



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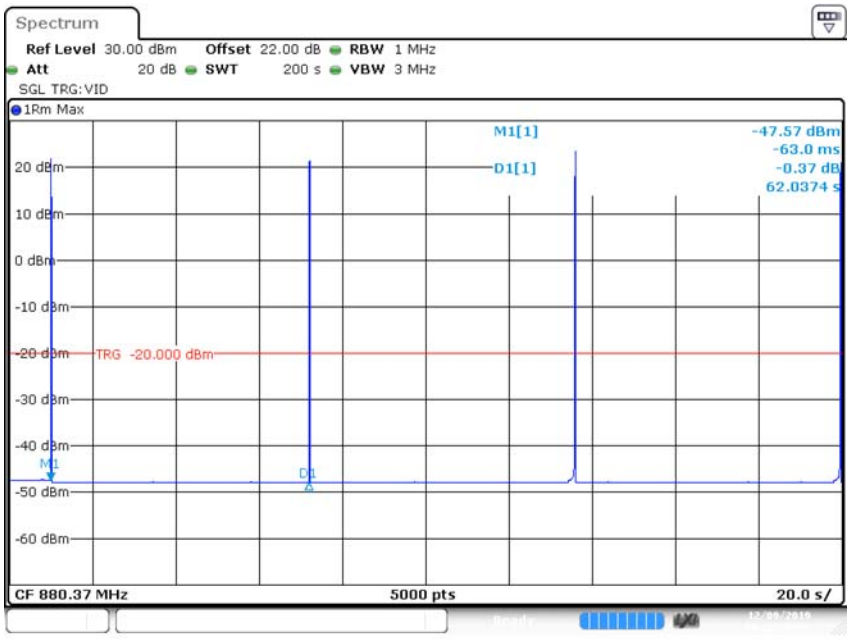
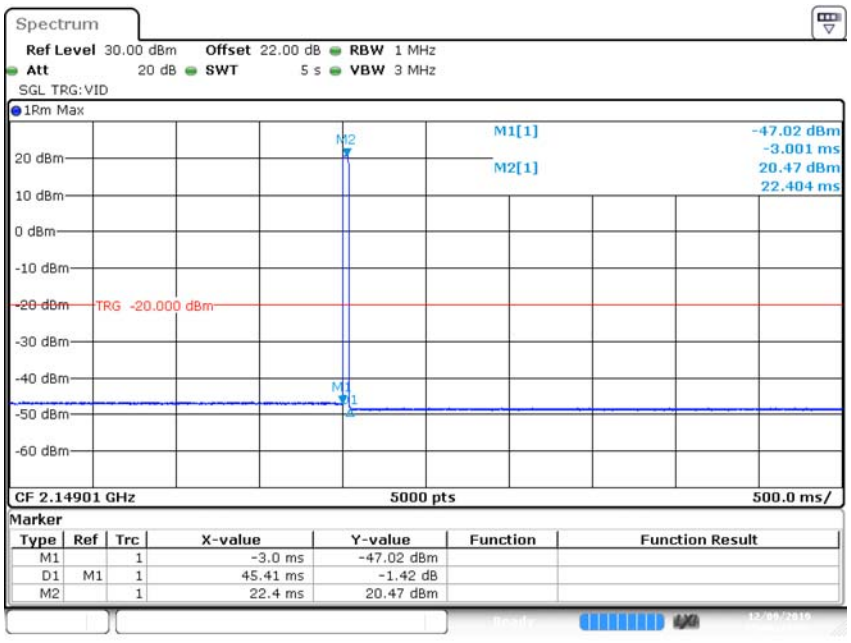


Date: 9.DEC.2019 18:22:26

AWS Band



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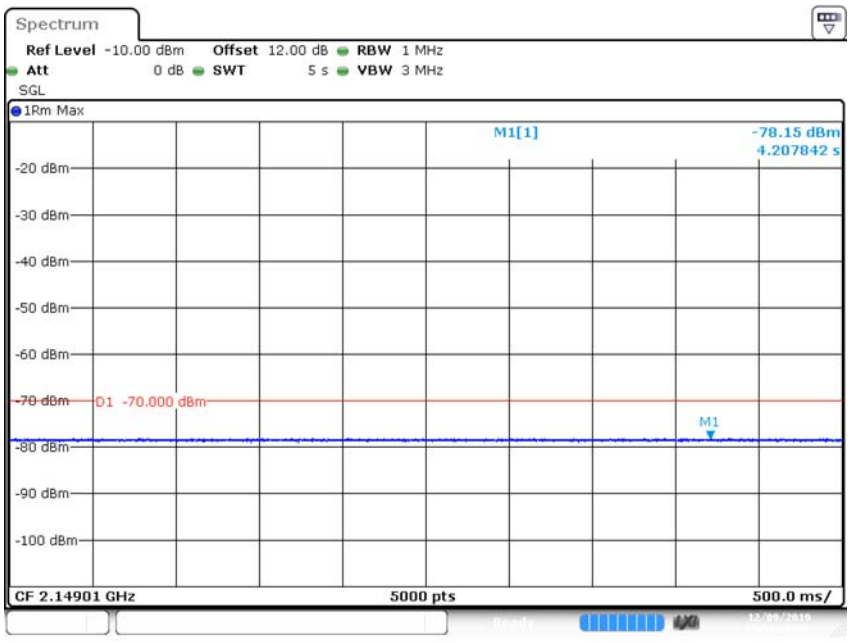

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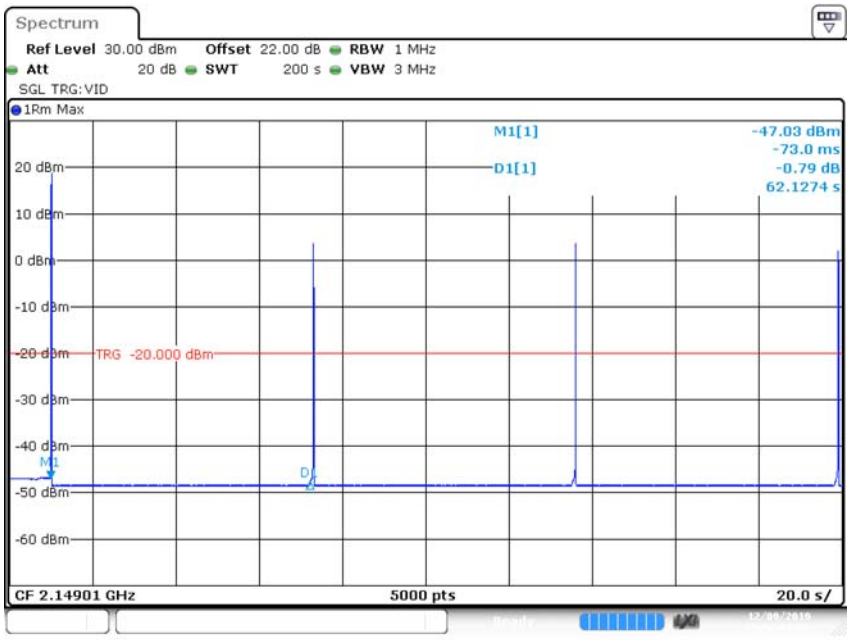
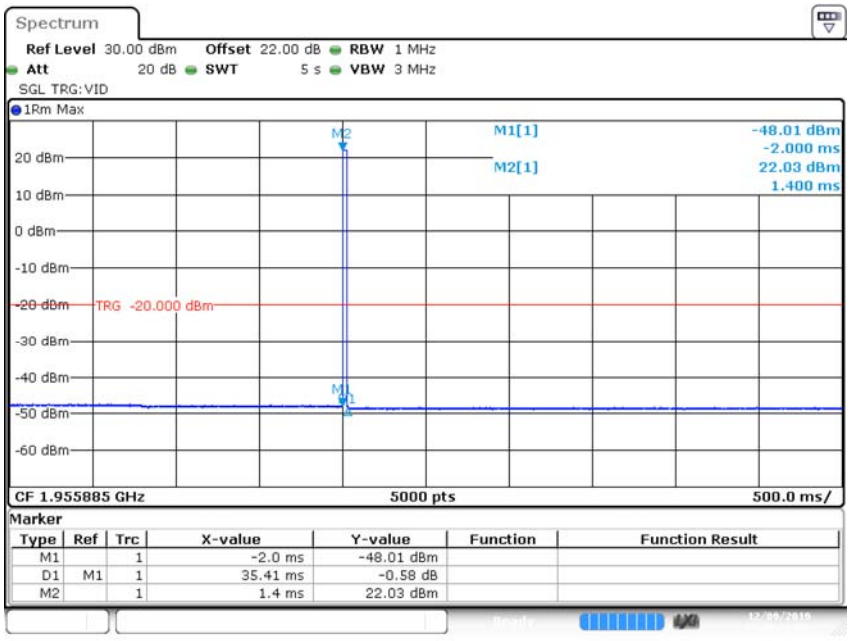
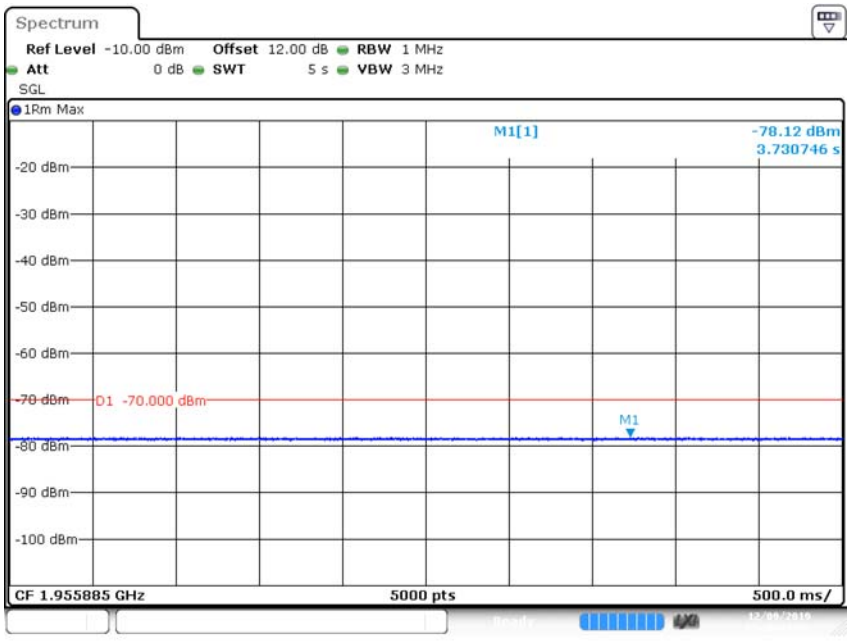


Date: 9.DEC.2019 17:57:04

PCS Band



Date: 9.DEC.2019 19:37:13



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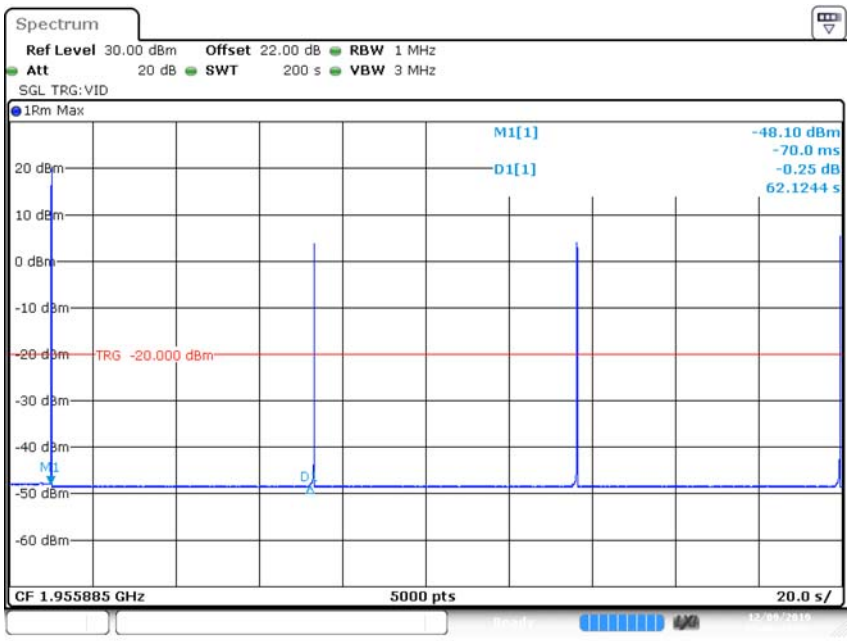
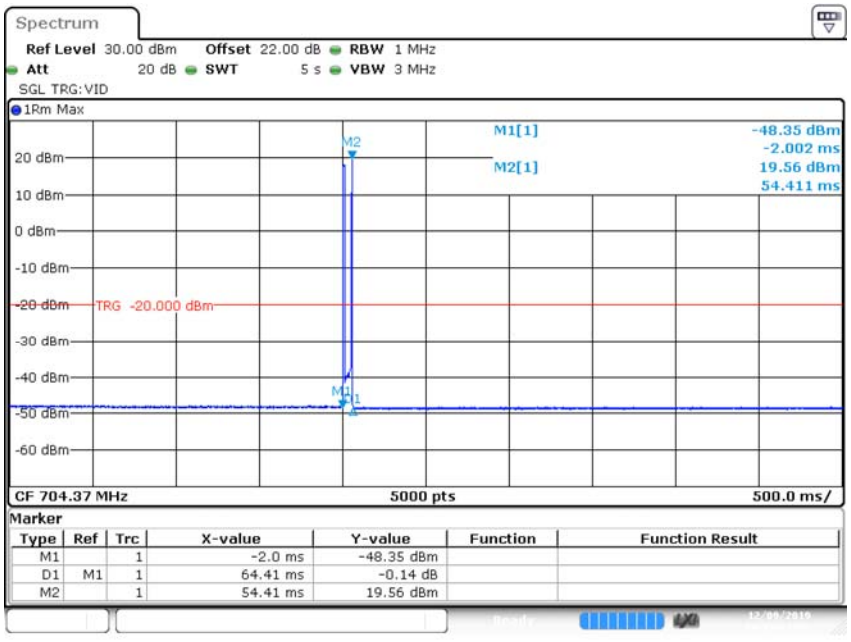


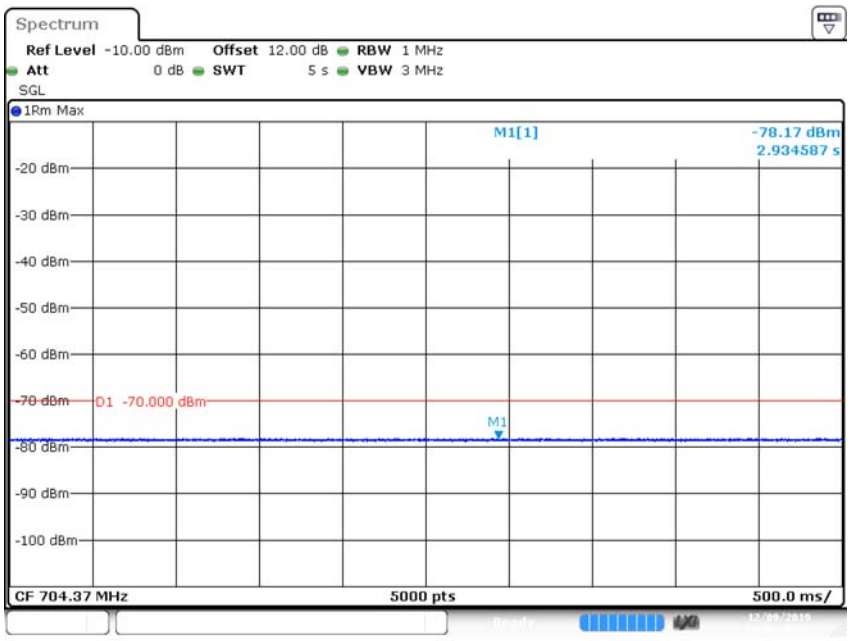
Date: 9.DEC.2019 19:43:44

Uplink:

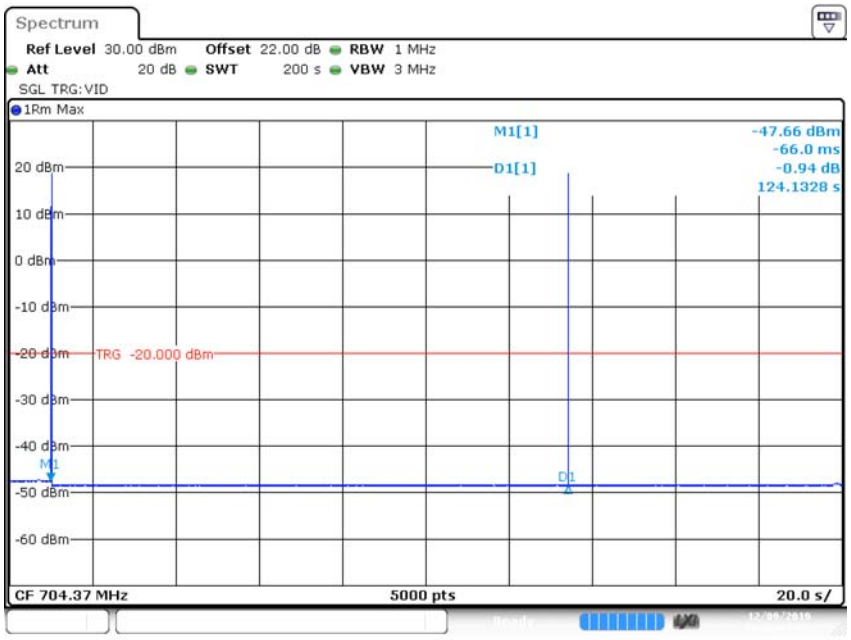
Lower 700MHz Band



Date: 9.DEC.2019 16:19:01

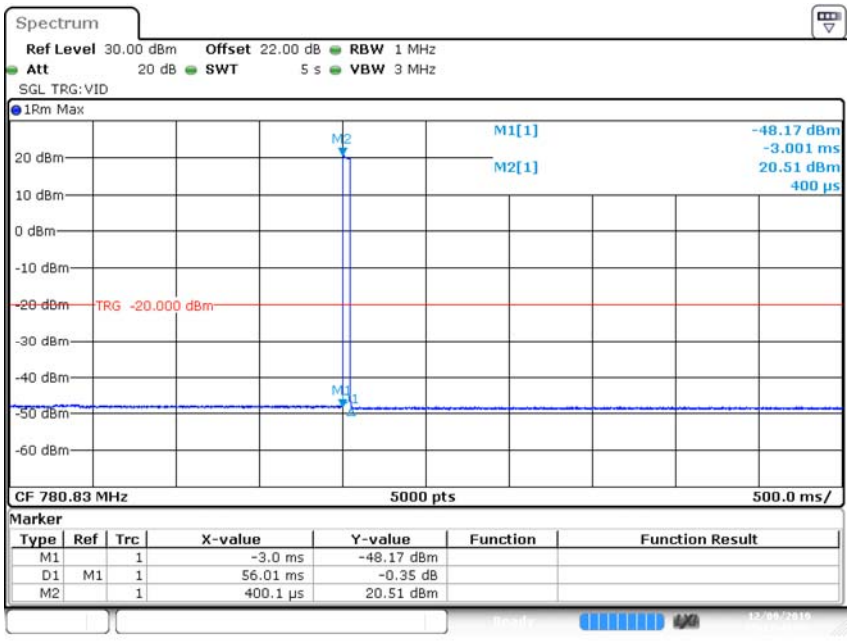


Date: 9.DEC.2019 16:20:37



Date: 9.DEC.2019 16:28:07

Upper 700MHz Band



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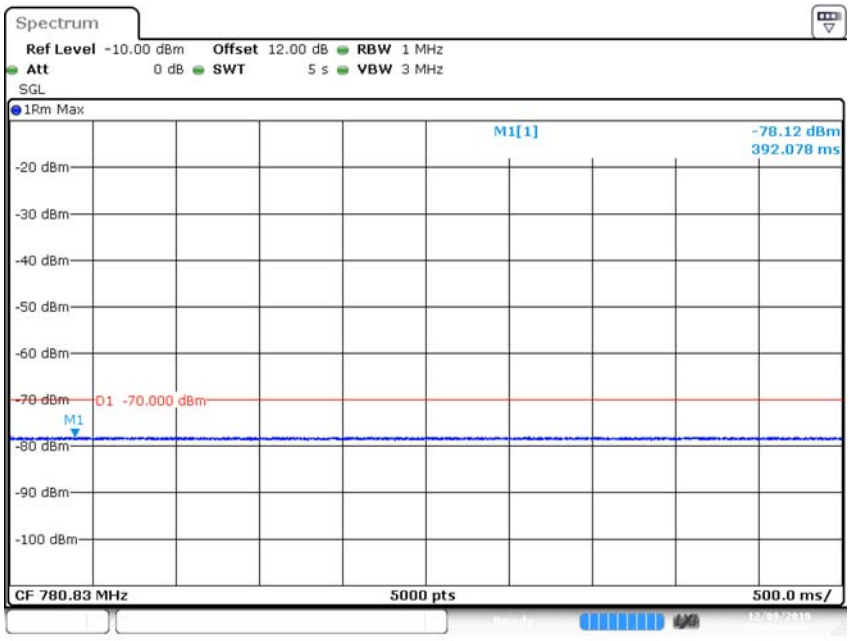
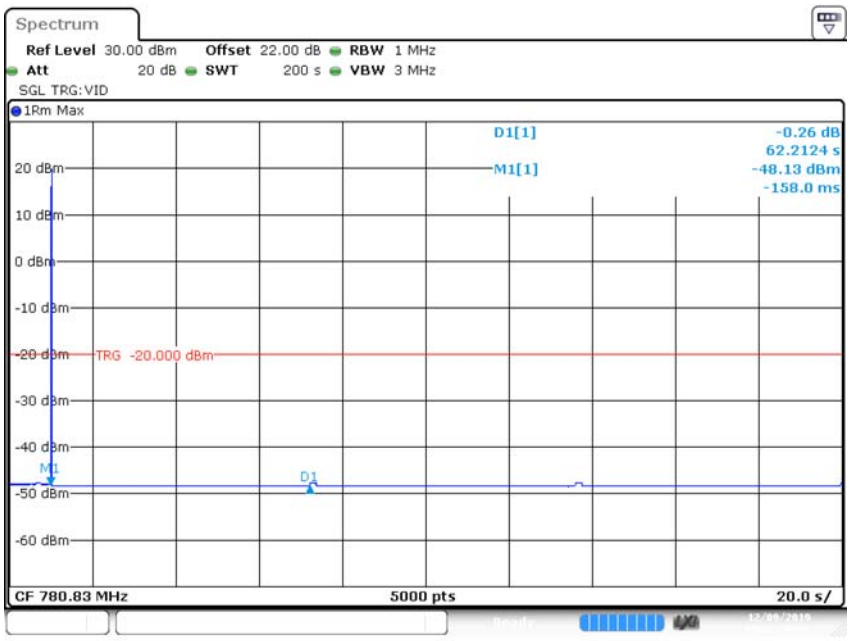
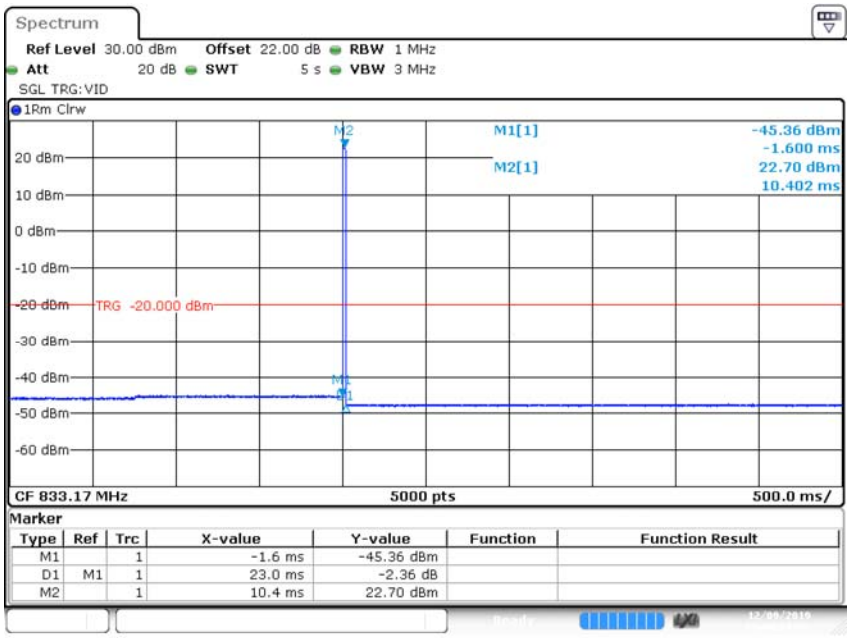


Date: 9.DEC.2019 17:19:00



Date: 9.DEC.2019 17:27:39

Cellular Band



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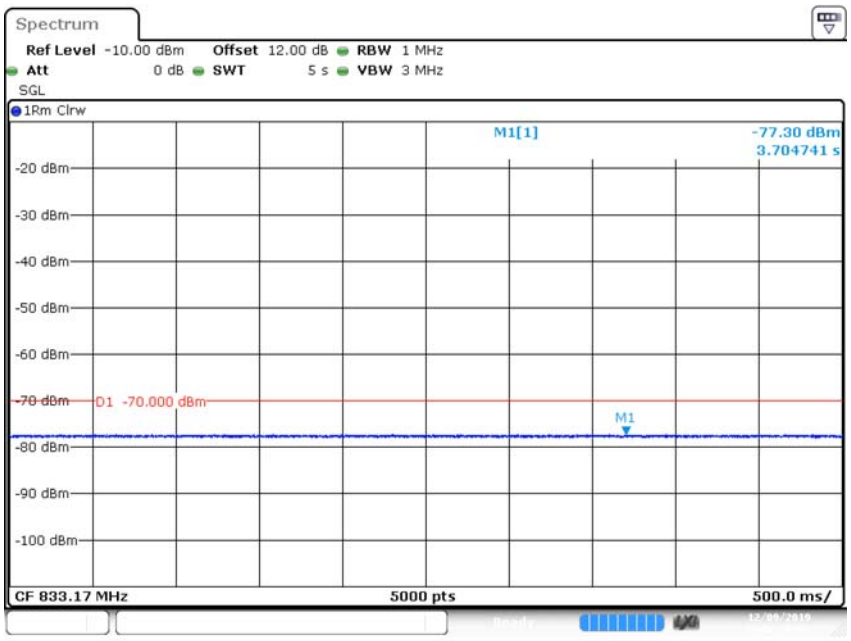

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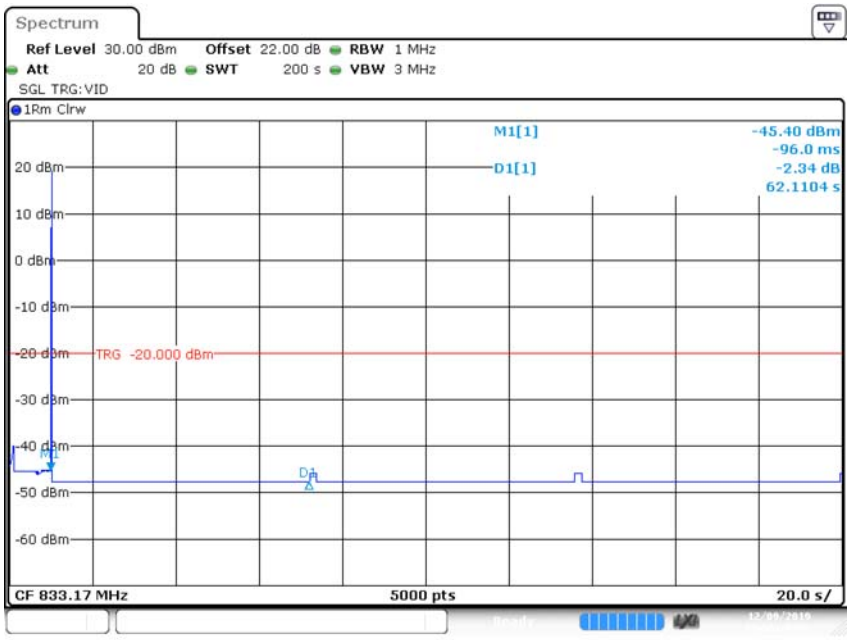
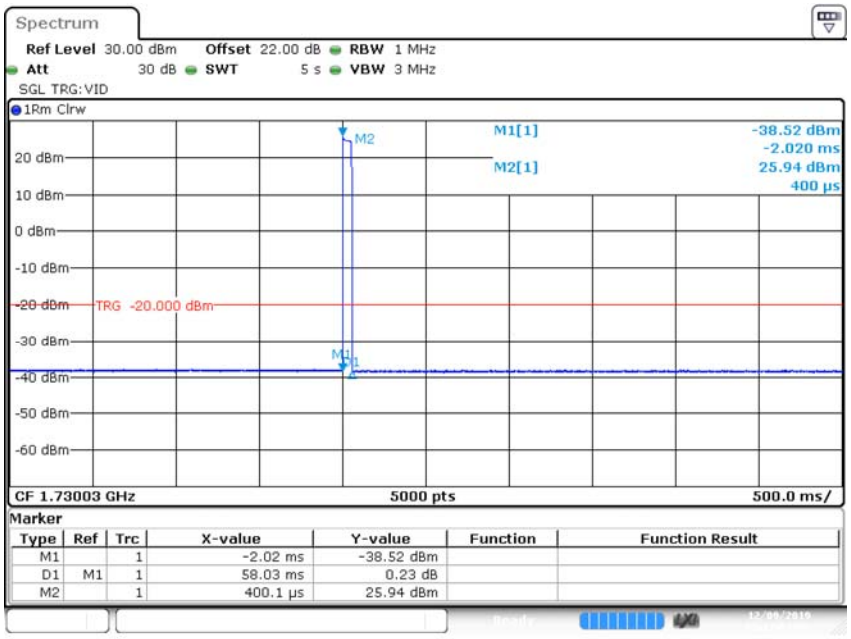


Date: 9.DEC.2019 15:58:26

AWS Band



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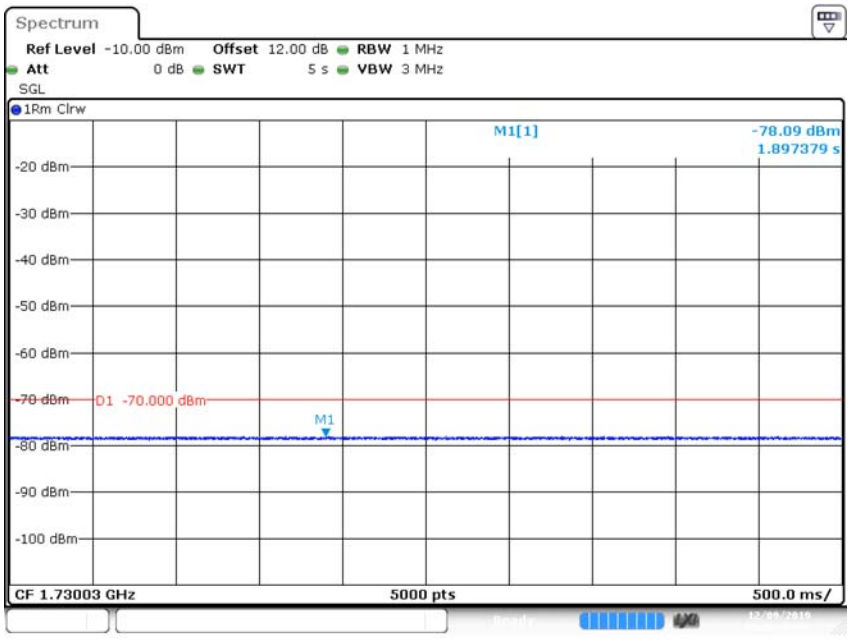
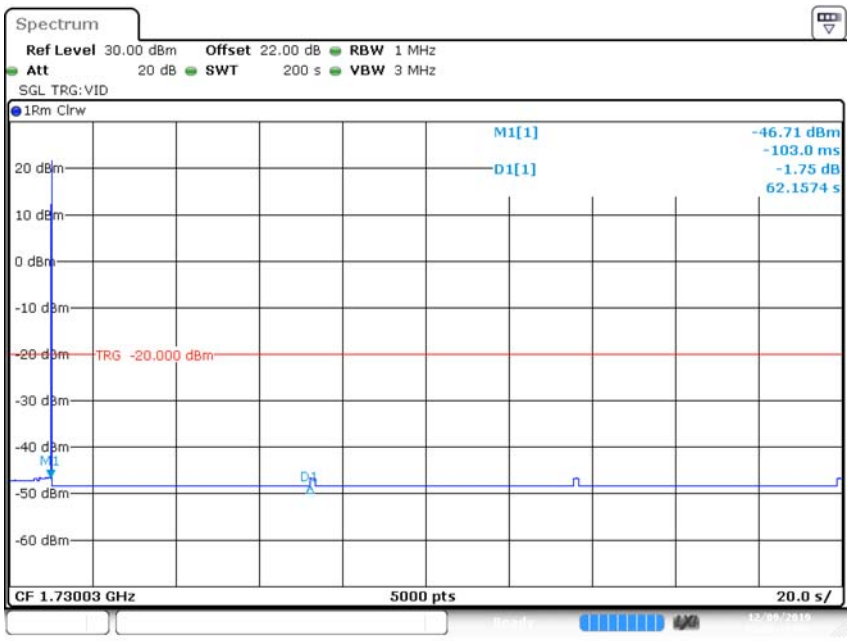
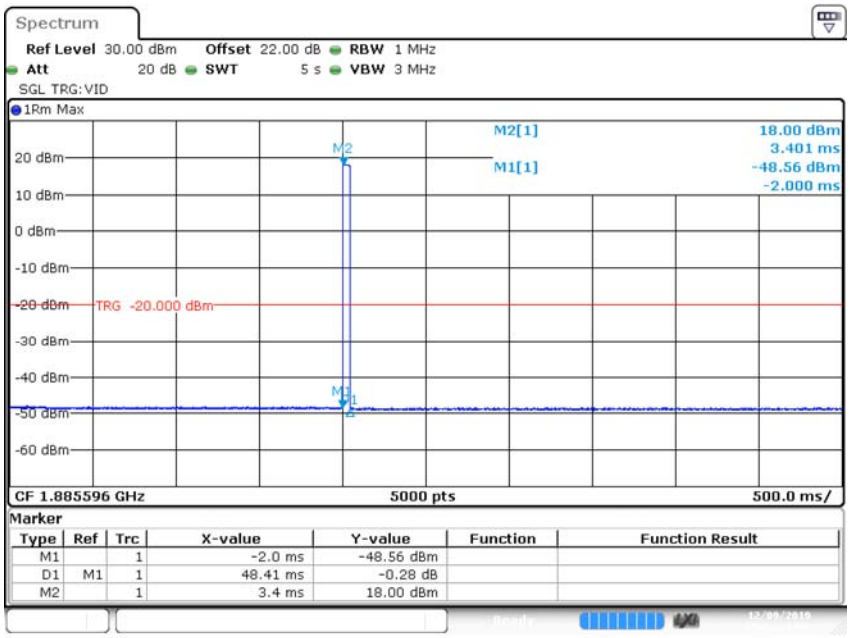


Date: 9.DEC.2019 14:18:47



Date: 9.DEC.2019 14:28:12

PCS Band



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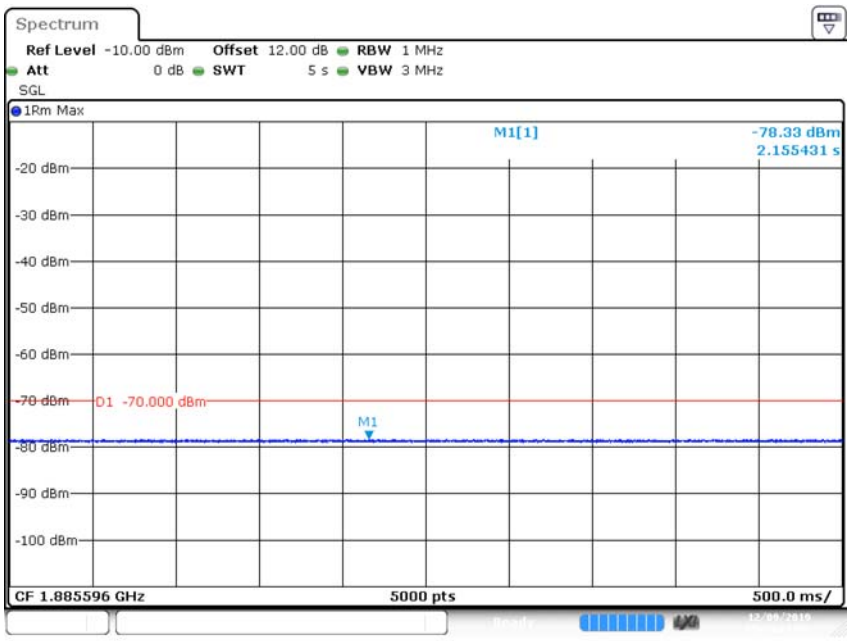

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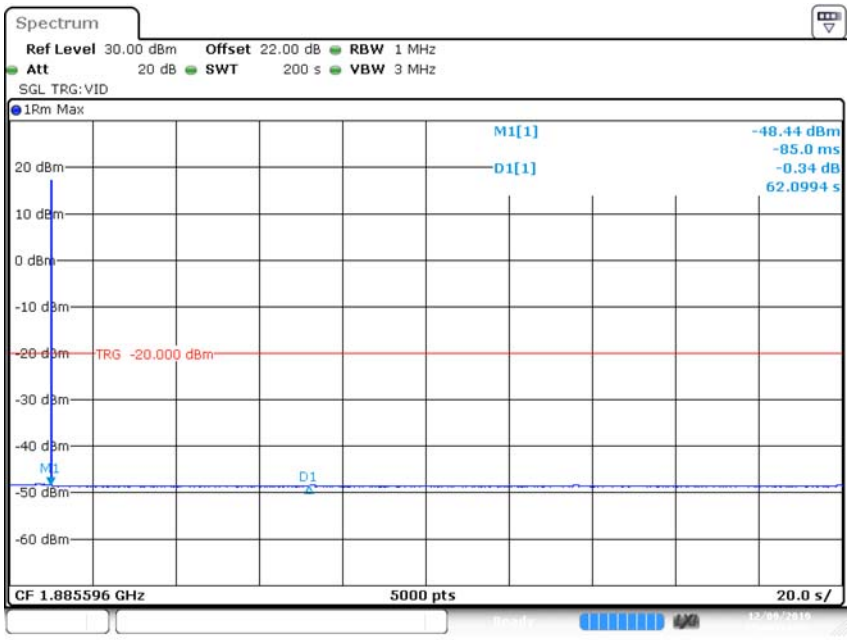


Date: 9.DEC.2019 17:40:55

§2.1051- SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Applicable Standards

FCC §2.1051 Measurements required: Spurious emissions at antenna terminals.

§20.21(e)(8)(i)(E): Booster out of band emissions (OOBE) shall be at least 6 dB below the FCC's mobile emission limits for the supported bands of operation. Compliance to OOBE limits will utilize high peak-to-average CMRS signal types.

§22.917 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

§24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

§27.53: the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

Test Procedure

The following procedures shall be used to demonstrate compliance to the applicable conducted spurious emissions limits as per § 2.1051.

Note: *For frequencies below 1 GHz, an RBW of 1 MHz may be used in a preliminary measurement. If non-compliant emissions are detected, a final measurement shall be made with a 100 kHz RBW. Additionally, a peak detector may also be used for the preliminary measurement. If non-compliant emissions are detected then a final measurement of these emissions shall be made with the power averaging (RMS) detector.*

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 AWGN with a 99% occupied bandwidth of 4.1 MHz with a center frequency corresponding to the center of the CMRS band under test.
c) Set the signal generator amplitude to the level determined in the power measurement procedure in 7.2.
d) Turn on the signal generator RF output and measure the spurious emission power levels with an appropriate measurement instrument as follows.
1) Set RBW = measurement bandwidth specified in the applicable rule section for the operational frequency band under consideration (see Annex A for relevant cross-references). Note that many of the individual rule sections permit the use of a narrower RBW (typically ≥ 1% of the emission bandwidth) to enhance measurement accuracy, but the result must then be integrated over the specified measurement bandwidth.
2) Set VBW = 3 × RBW.
3) Select the power averaging (RMS) detector. (See above note regarding the use of a peak detector for preliminary measurements.)
4) Sweep time = auto-couple.
Set the analyzer start frequency to the lowest radio frequency signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part. Note that the number of measurement points in each sweep

must be ≥ (2 × span/RBW) which may require that the measurement range defined by the start and stop frequencies above be subdivided, depending on the available number of measurement points provided by the spectrum analyzer. Trace average at least 10 traces in power averaging (i.e., RMS) mode.
5) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.
6) Reset the analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the analyzer stop frequency to 10 × the highest frequency of the fundamental emission. Note that the number of measurement points in each sweep must be ≥ (2 × span/RBW) which may require that the measurement range defined by the start and stop frequencies above be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.
7) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report.
e) Repeat 7.6b) through 7.6d) for each supported frequency band of operation.

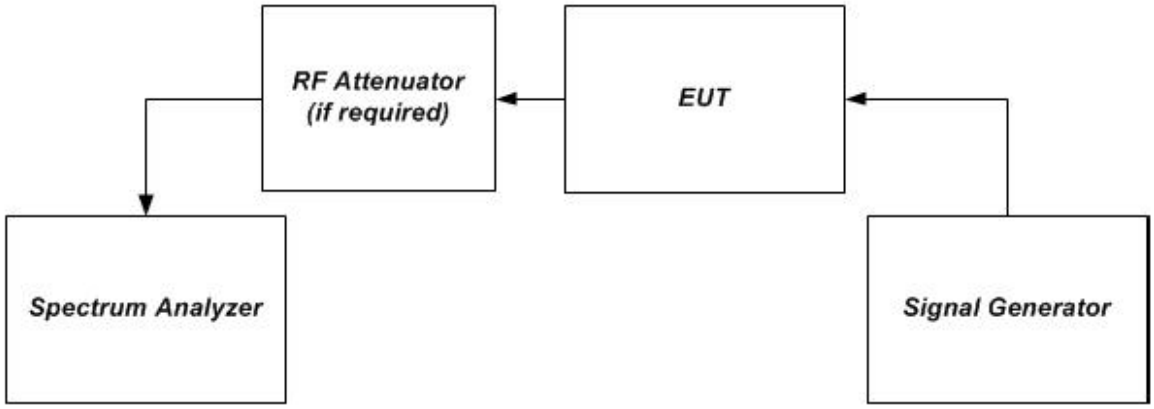


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

Temperature:	21.2 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

The testing was performed by Stone Zhang on 2019-11-30.

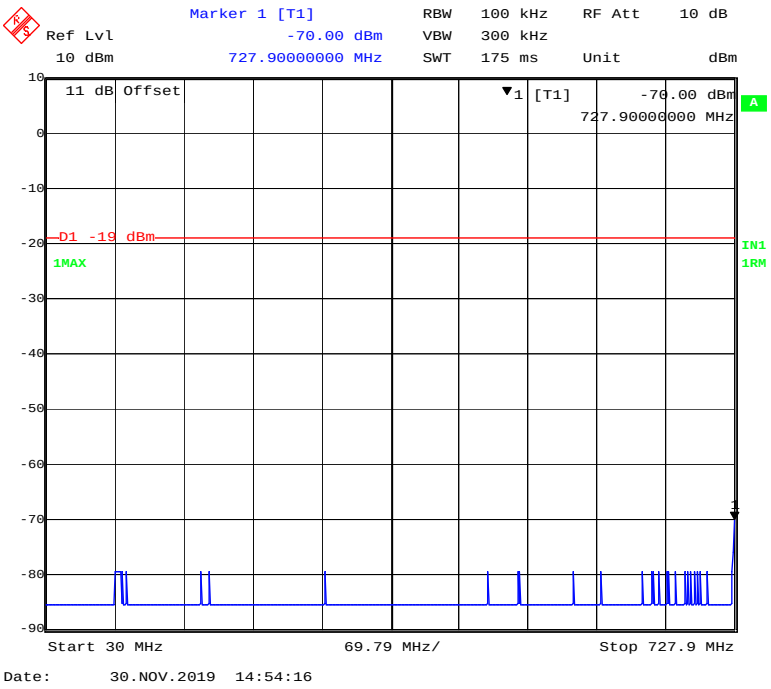
EUT operation mode: Transmitting

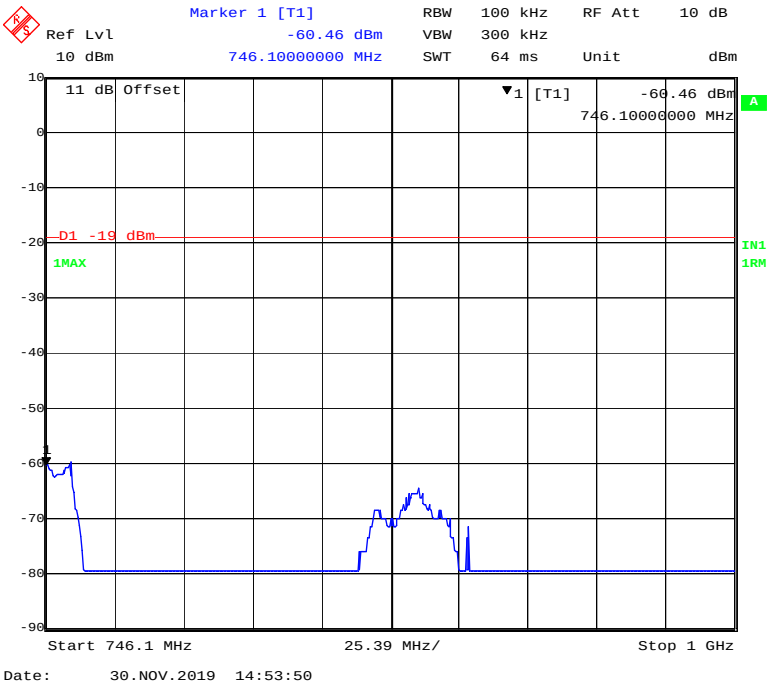
Test Result: Compliant.

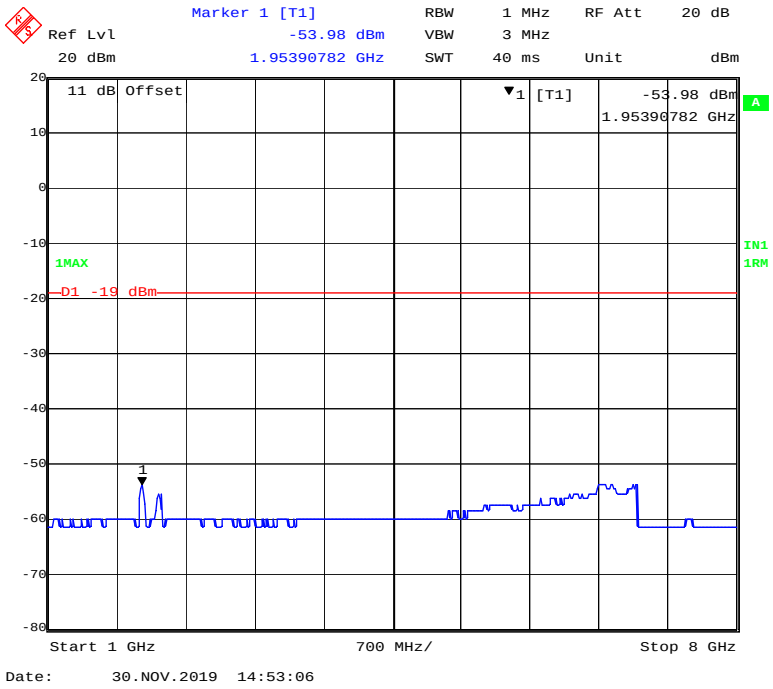
Note: mobile emission limits for the supported bands of operation is 43 + 10 log(P) dB=-13dBm, the out of band emissions (OOBE) shall be at least 6 dB below the FCC's mobile emission limits(-19dBm), the emissions compliance the emission limits ***-19dBm****, Please refer to the following plots*

Downlink:

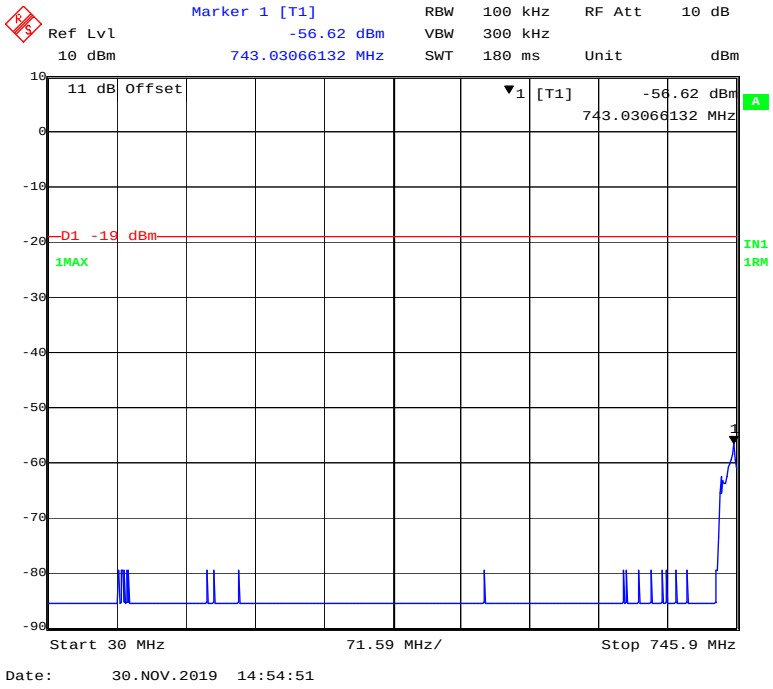
Lower 700MHz Band

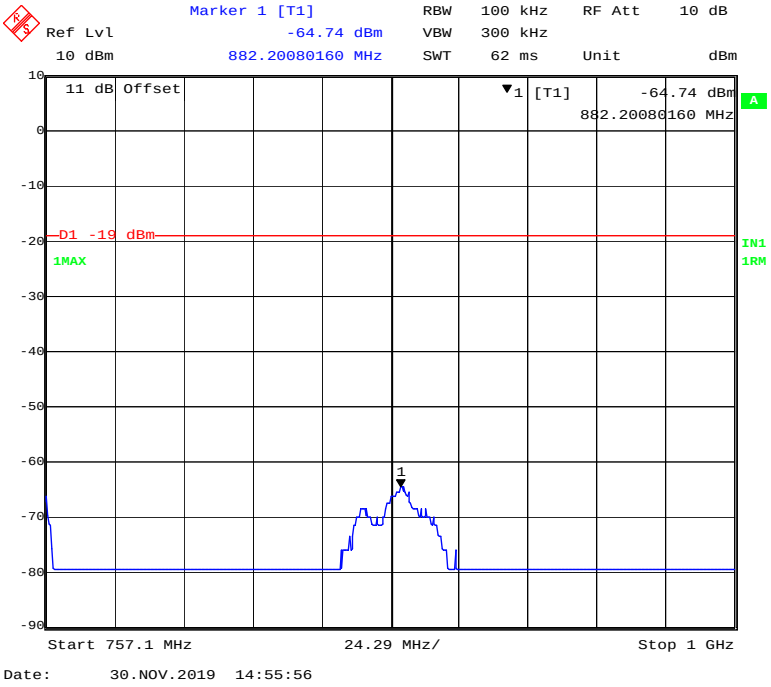






Upper 700MHz Band

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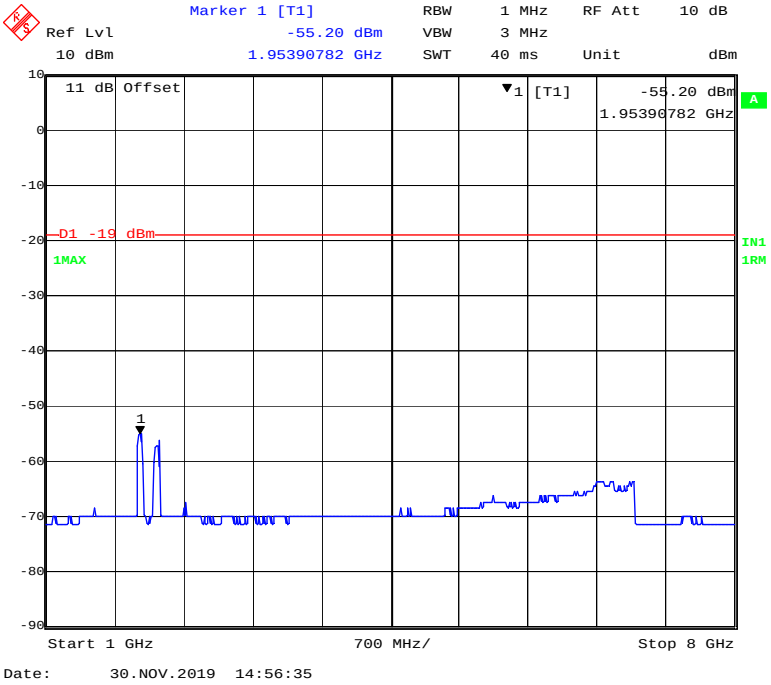
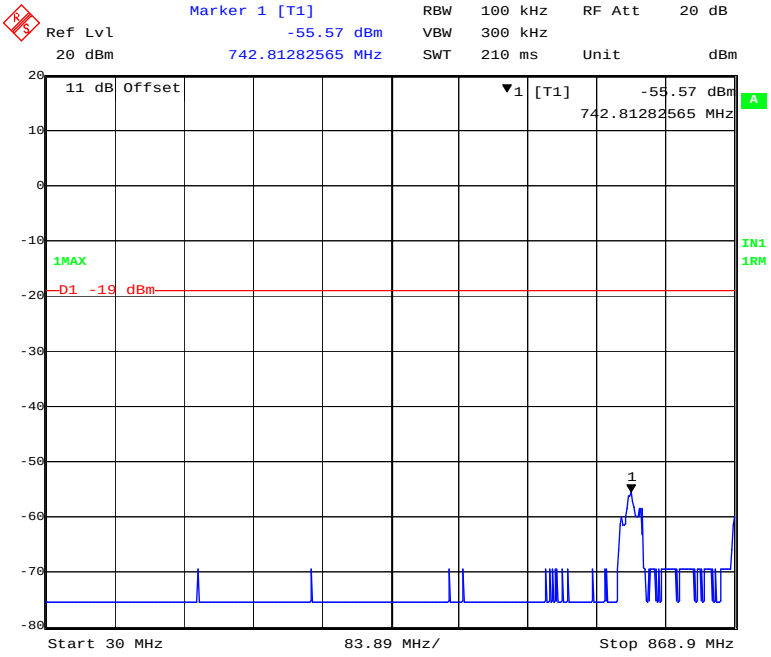
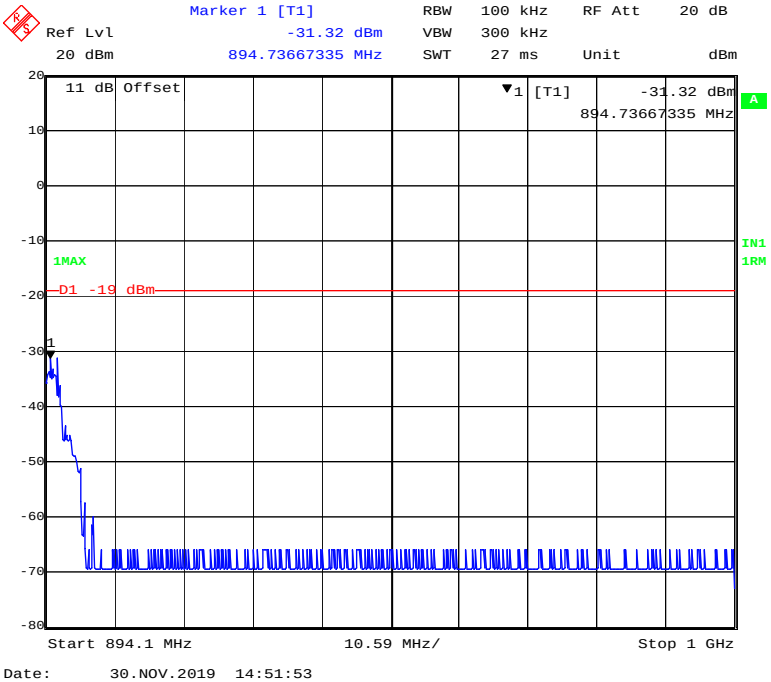
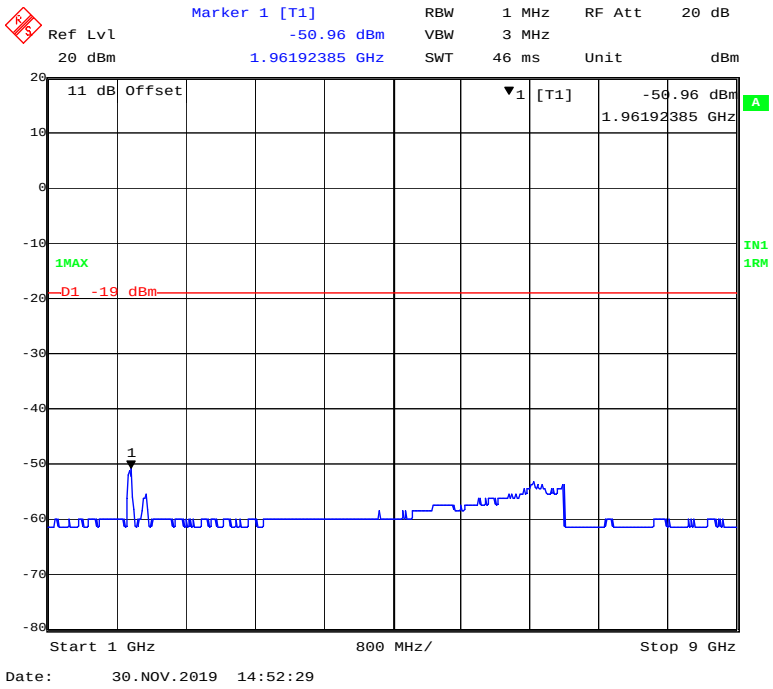
Ref Lvl
10 dBm
-64.74 dBm
882.20080160 MHz
RBW 100 kHz
VBW 300 kHz
SWT 62 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-64.74 dBm
882.20086160 MHz
D1 -19 dBm
1MAX
IN1
1RM
Start 757.1 MHz
24.29 MHz/
Stop 1 GHz
Date: 30.NOV.2019 14:55:56


Marker 1 [T1]
Ref Lvl
10 dBm
-55.20 dBm
1.95390782 GHz
RBW 1 MHz
VBW 3 MHz
SWT 40 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-55.20 dBm
1.95390782 GHz
D1 -19 dBm
1MAX
IN1
1RM
Start 1 GHz
700 MHz/
Stop 8 GHz
Date: 30.NOV.2019 14:56:35

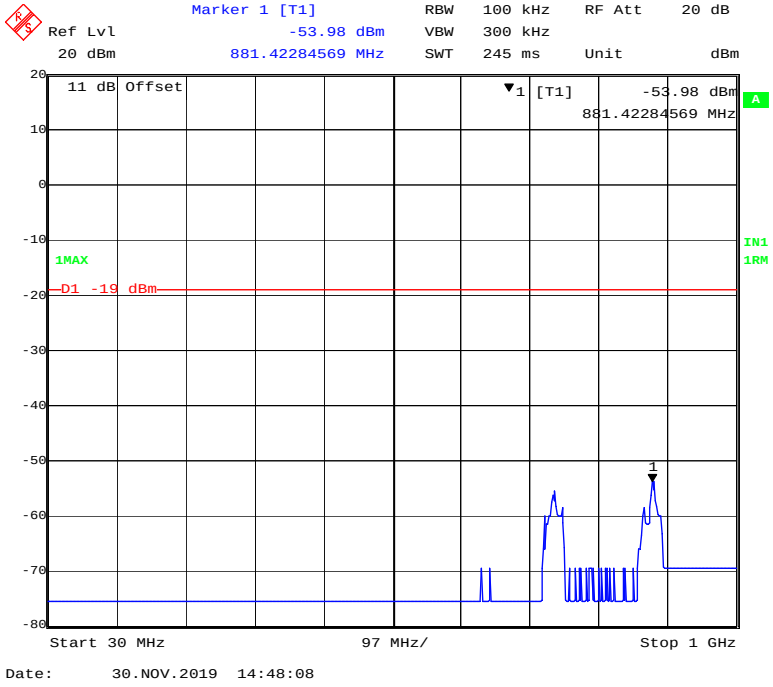
Cellular Band

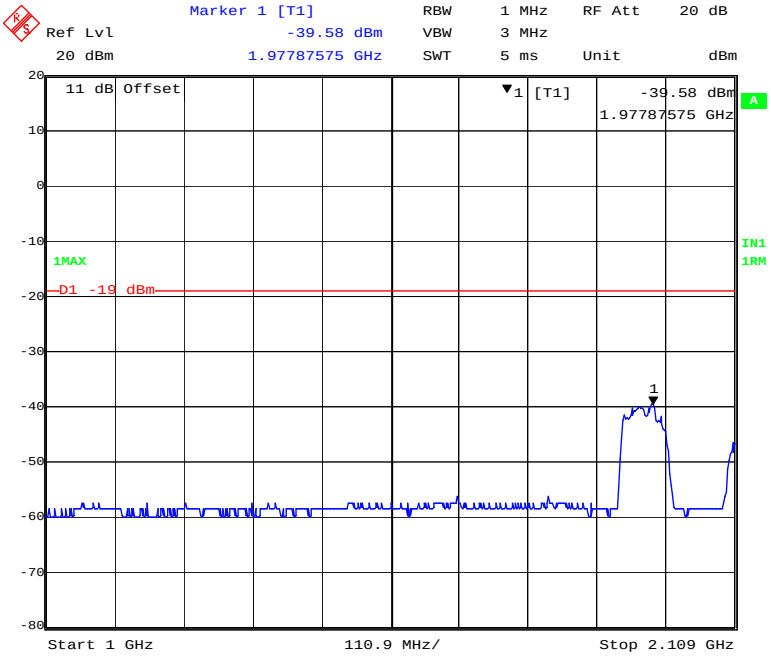


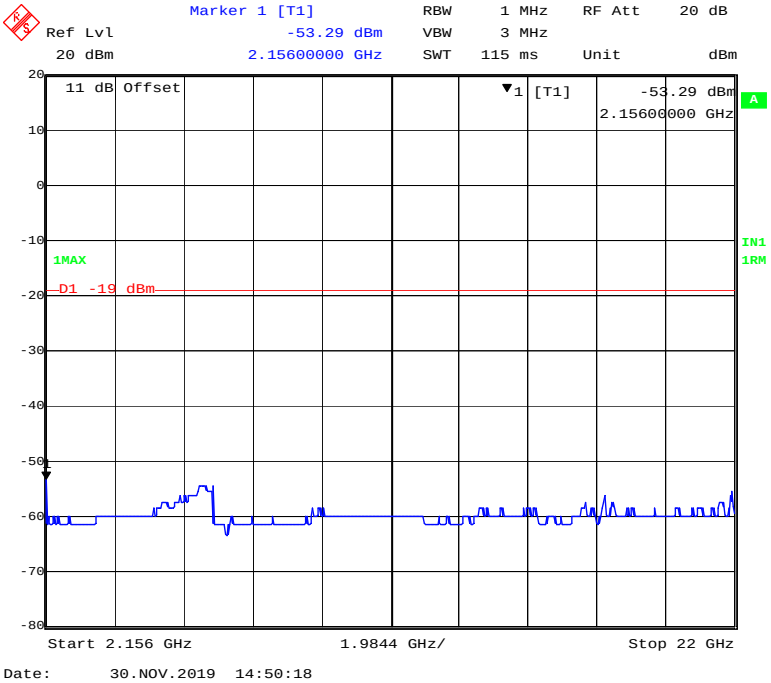



Marker 1 [T1]
Ref Lvl
20 dBm
-50.96 dBm
1.96192385 GHz
RBW 1 MHz
VBW 3 MHz
SWT 46 ms
RF Att 20 dB
Unit dBm
11 dB Offset
1 [T1]
-50.96 dBm
1.96192385 GHz
1MAX
D1 -19 dBm
IN1
1RM
Start 1 GHz
800 MHz/
Stop 9 GHz
Date: 30.NOV.2019 14:52:29

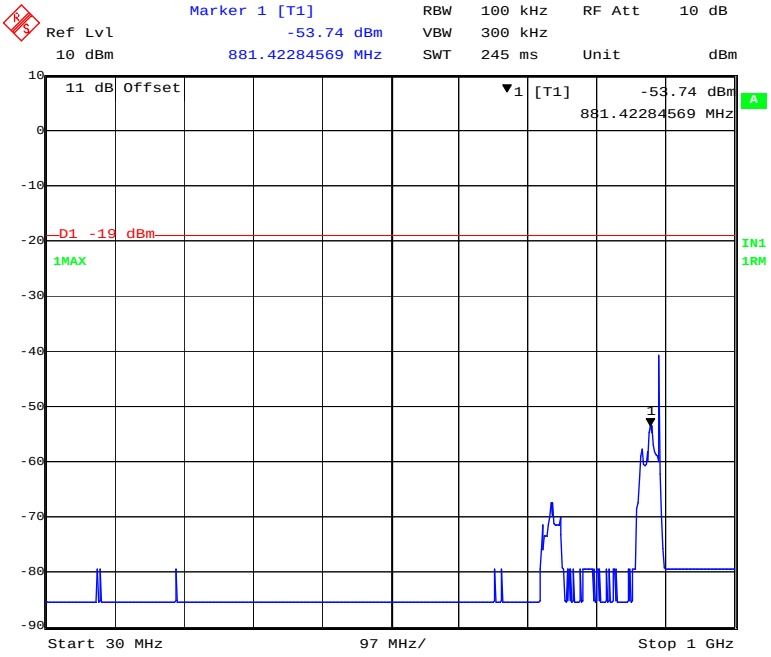
AWS Band

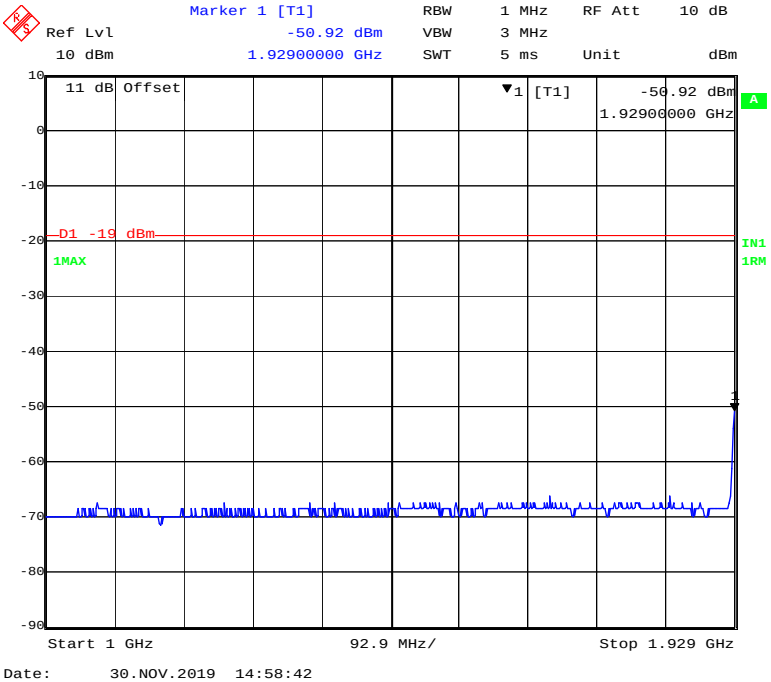

Marker 1 [T1]
Ref Lvl
20 dBm
-53.98 dBm
881.42284569 MHz
RBW 100 kHz
VBW 300 kHz
SWT 245 ms
RF Att 20 dB
Unit dBm
11 dB Offset
1 [T1]
-53.98 dBm
881.42284569 MHz
1MAX
D1 -19 dBm
IN1
1RM
Start 30 MHz
97 MHz/
Stop 1 GHz
Date: 30.NOV.2019 14:48:08

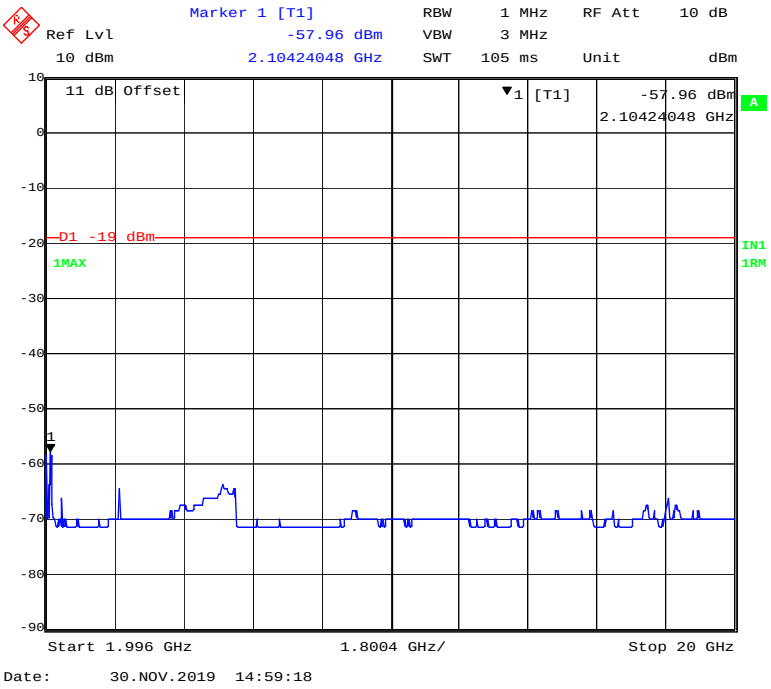

Marker 1 [T1]
Ref Lvl
20 dBm
-39.58 dBm
1.97787575 GHz
RBW 1 MHz
VBW 3 MHz
SWT 5 ms
RF Att 20 dB
Unit dBm
11 dB Offset
1 [T1]
-39.58 dBm
1.97787575 GHz
1MAX
D1 -19 dBm
IN1
1RM
Start 1 GHz
110.9 MHz/
Stop 2.109 GHz
Date: 30.NOV.2019 14:48:55


Marker 1 [T1]
Ref Lvl
20 dBm
-53.29 dBm
2.15600000 GHz
RBW 1 MHz
VBW 3 MHz
SWT 115 ms
RF Att 20 dB
Unit dBm
11 dB Offset
1 [T1]
-53.29 dBm
2.15600000 GHz
1MAX
D1 -19 dBm
IN1
1RM
Start 2.156 GHz
1.9844 GHz/
Stop 22 GHz
Date: 30.NOV.2019 14:50:18

PCS Band

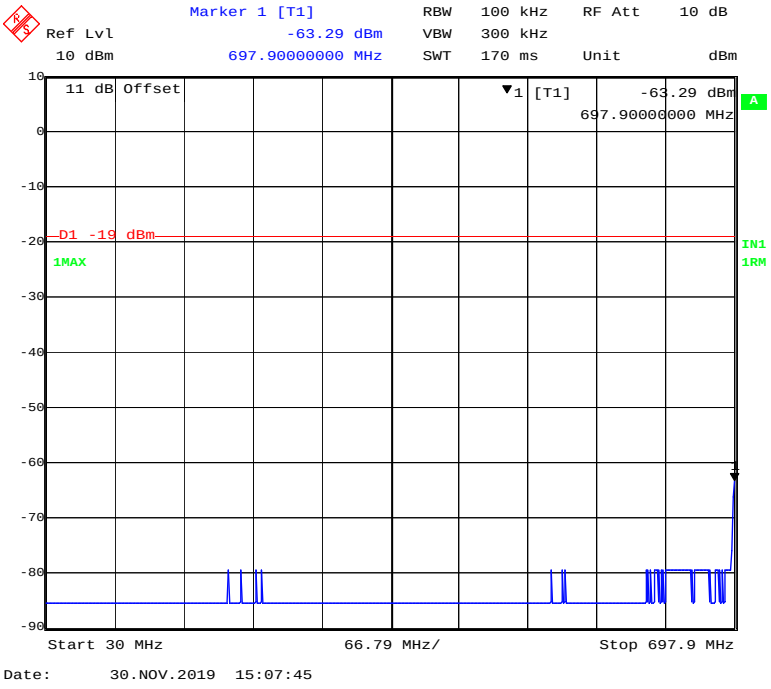

Marker 1 [T1]
Ref Lvl
10 dBm
-53.74 dBm
881.42284569 MHz
RBW 100 kHz
VBW 300 kHz
SWT 245 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-53.74 dBm
881.42284569 MHz
D1 -19 dBm
1MAX
IN1
1RM
Start 30 MHz
97 MHz/
Stop 1 GHz
Date: 30.NOV.2019 14:57:05

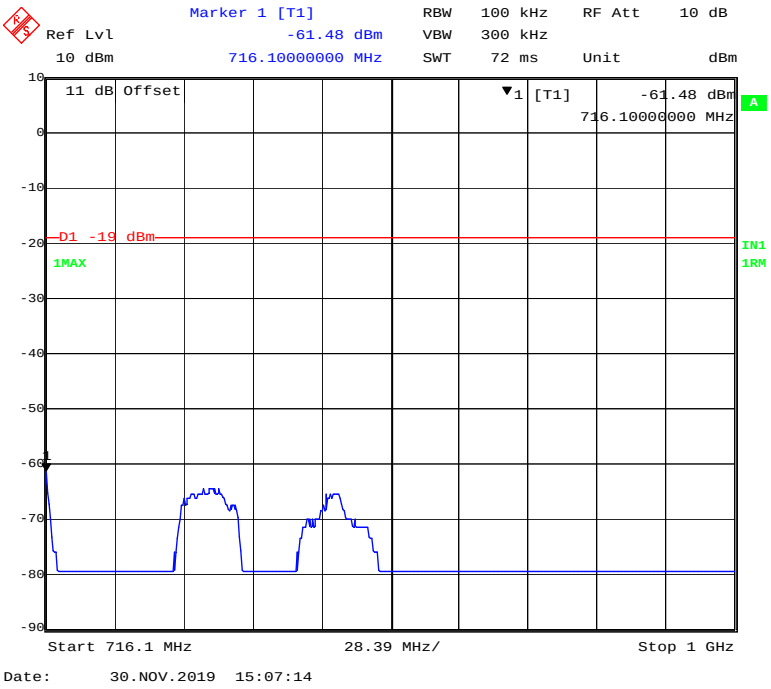

Marker 1 [T1]
Ref Lvl
10 dBm
-50.92 dBm
1.92900000 GHz
RBW 1 MHz
VBW 3 MHz
SWT 5 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-50.92 dBm
1.92900000 GHz
D1 -19 dBm
1MAX
IN1
1RM
Start 1 GHz
92.9 MHz/
Stop 1.929 GHz
Date: 30.NOV.2019 14:58:42

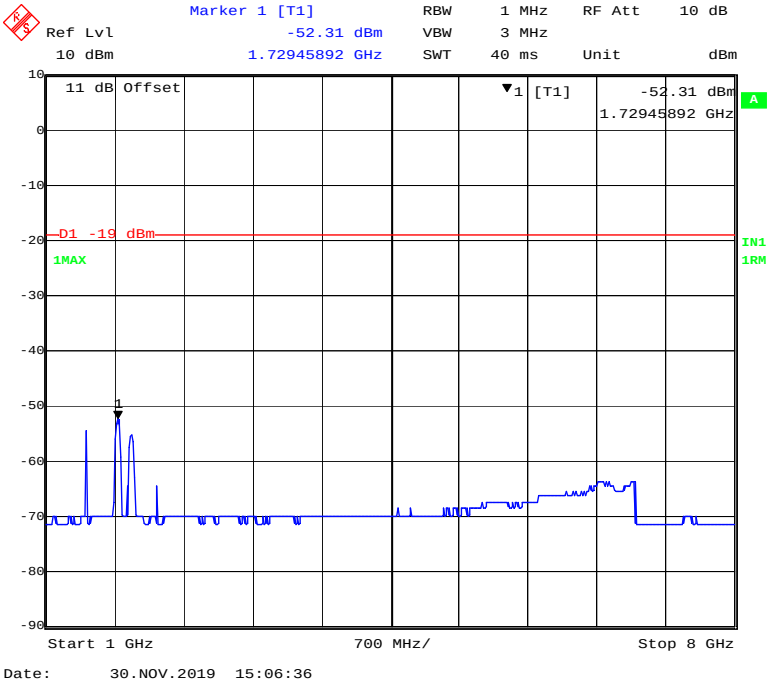


Uplink:

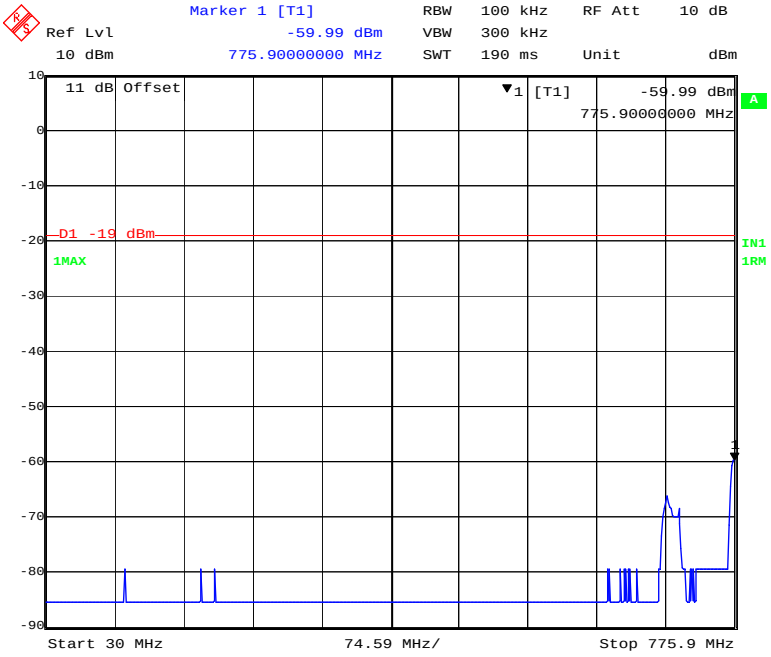
Lower 700MHz Band

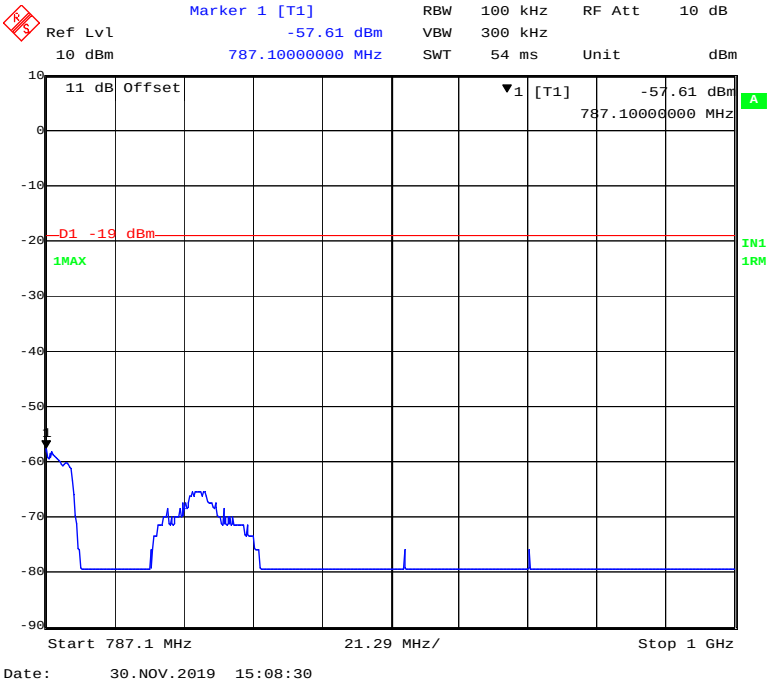


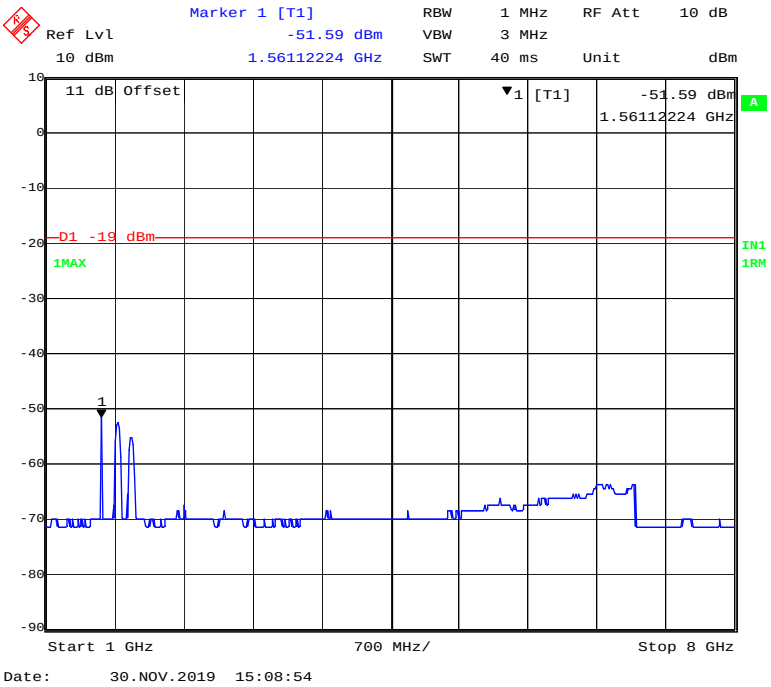

Marker 1 [T1]
Ref Lvl
10 dBm
-61.48 dBm
716.10000000 MHz
RBW 100 kHz
VBW 300 kHz
SWT 72 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-61.48 dBm
716.10000000 MHz
D1 -19 dBm
1MAX
IN1
1RM
Start 716.1 MHz
28.39 MHz/
Stop 1 GHz
Date: 30.NOV.2019 15:07:14


Marker 1 [T1]
Ref Lvl
10 dBm
-52.31 dBm
1.72945892 GHz
RBW 1 MHz
VBW 3 MHz
SWT 40 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-52.31 dBm
1.72945892 GHz
D1 -19 dBm
1MAX
IN1
1RM
Start 1 GHz
700 MHz/
Stop 8 GHz
Date: 30.NOV.2019 15:06:36

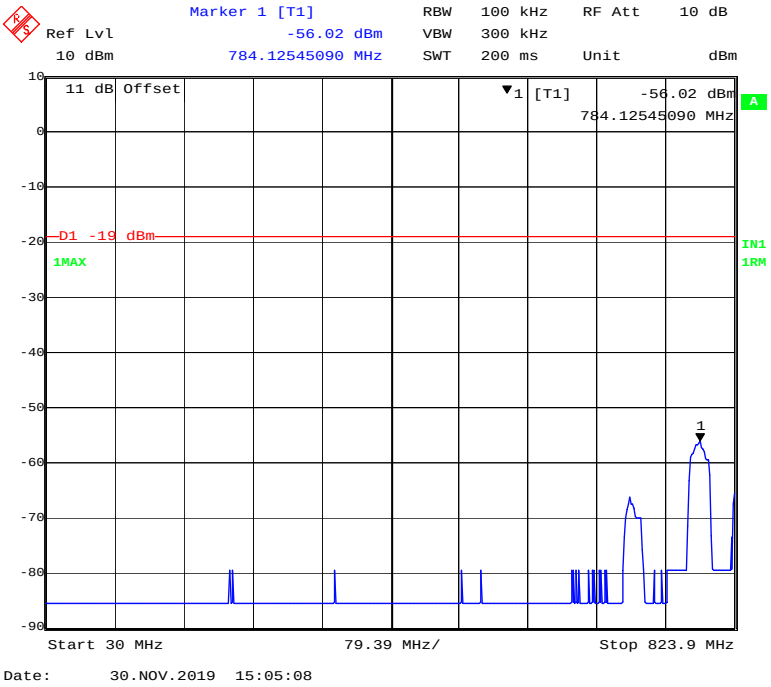
Upper 700MHz Band

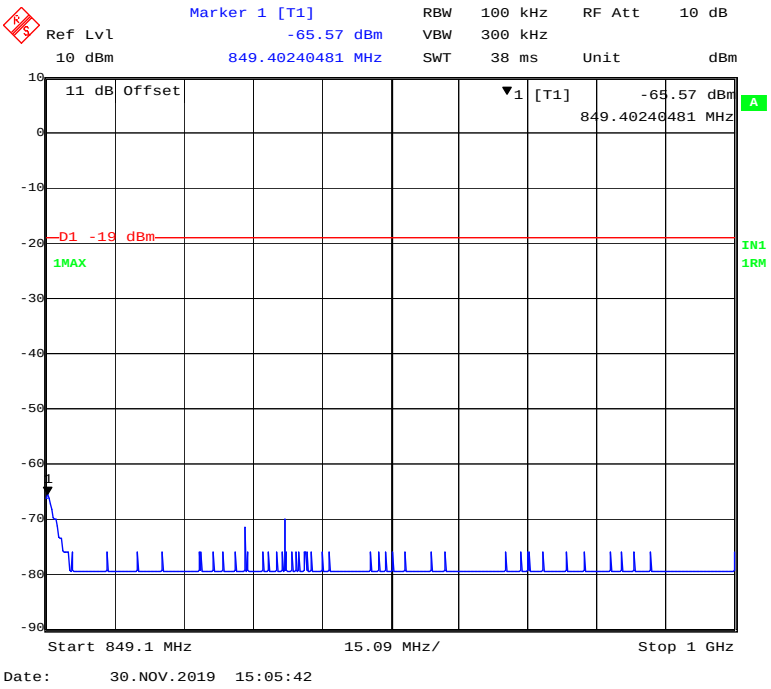


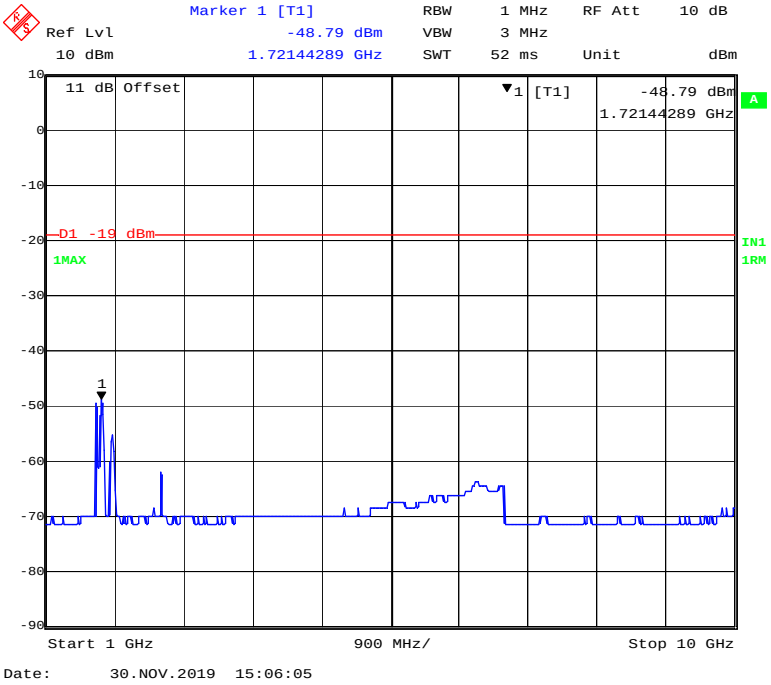




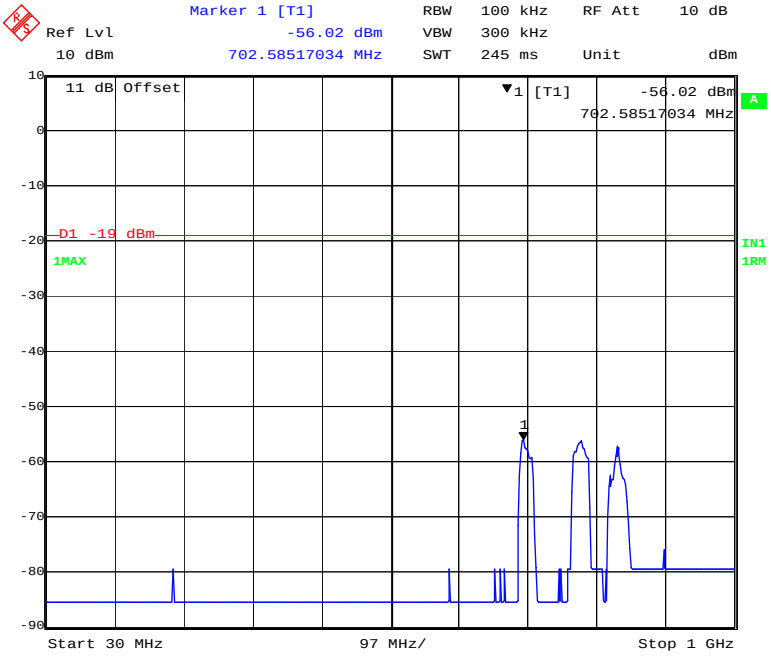
Cellular Band

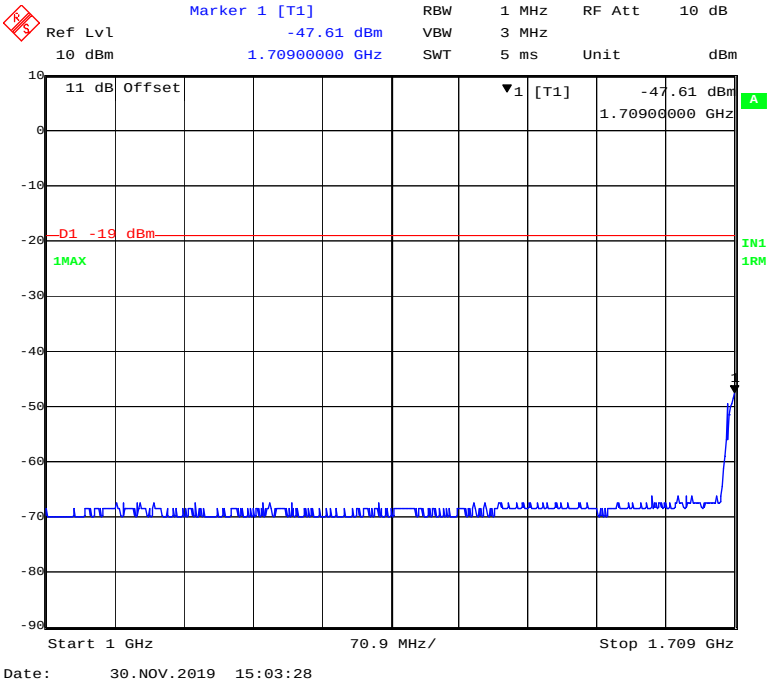


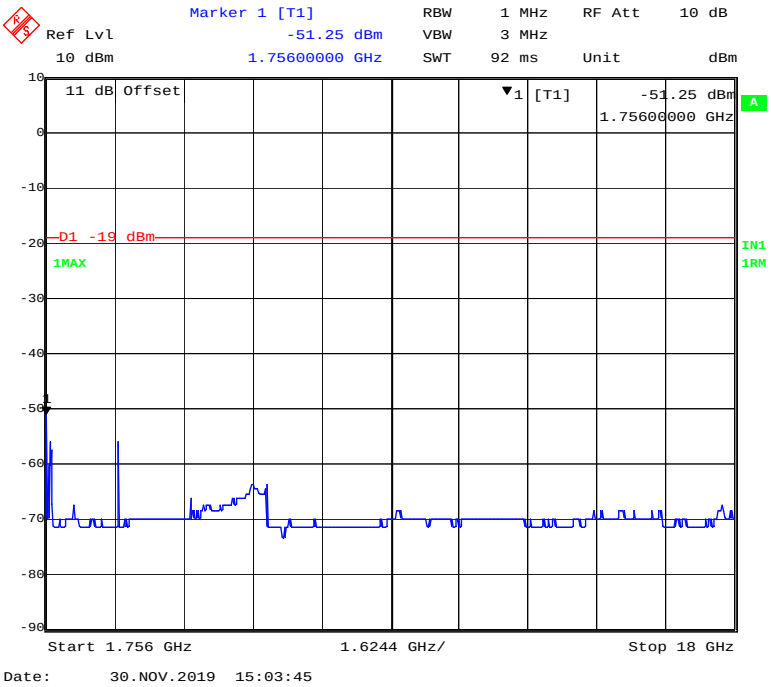

Marker 1 [T1]
Ref Lvl
10 dBm
-65.57 dBm
849.40240481 MHz
RBW 100 kHz
VBW 300 kHz
SWT 38 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-65.57 dBm
849.40240481 MHz
D1 -19 dBm
1MAX
IN1
1RM
Start 849.1 MHz
15.09 MHz/
Stop 1 GHz
Date: 30.NOV.2019 15:05:42


Marker 1 [T1]
Ref Lvl
10 dBm
-48.79 dBm
1.72144289 GHz
RBW 1 MHz
VBW 3 MHz
SWT 52 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-48.79 dBm
1.72144289 GHz
D1 -19 dBm
1MAX
IN1
1RM
Start 1 GHz
900 MHz/
Stop 10 GHz
Date: 30.NOV.2019 15:06:05

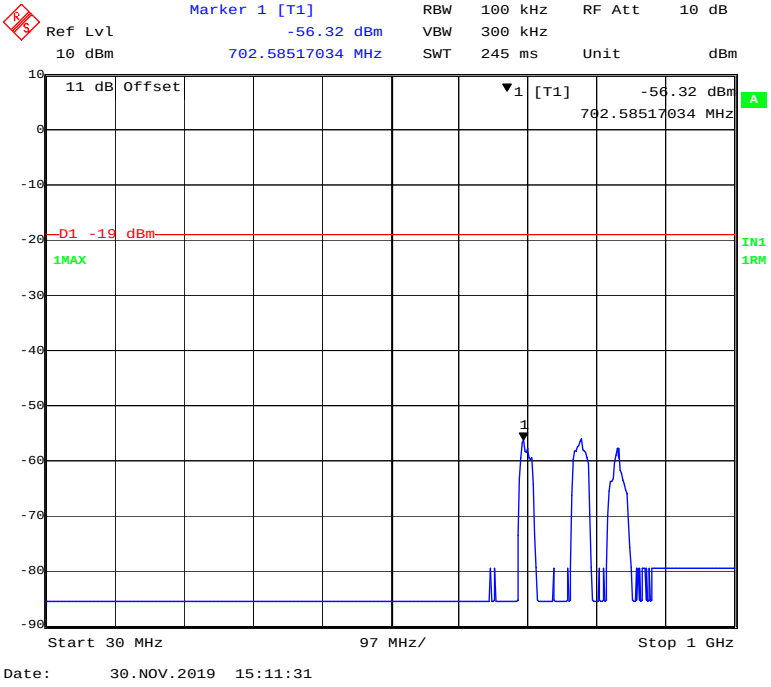
AWS Band

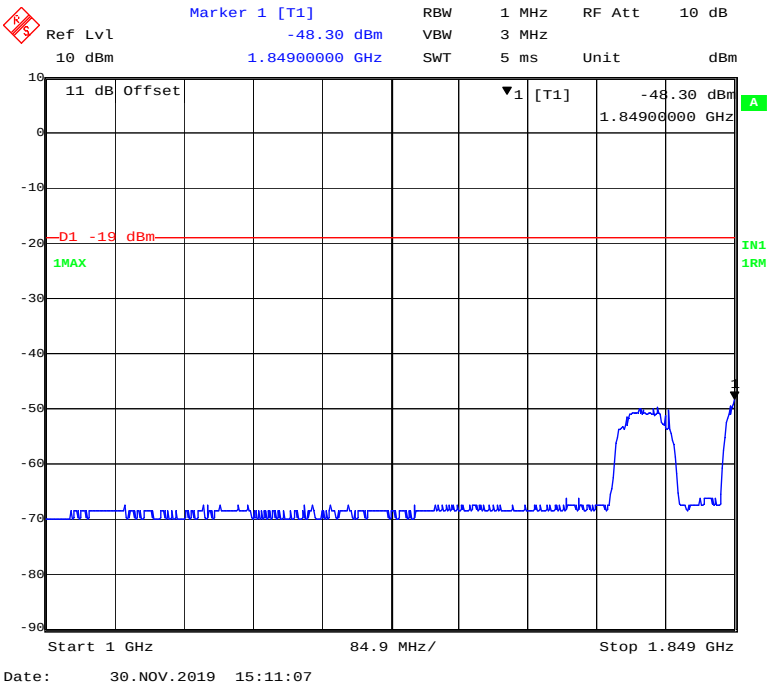

Marker 1 [T1]
Ref Lvl
10 dBm
-56.02 dBm
702.58517034 MHz
RBW 100 kHz
VBW 300 kHz
SWT 245 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-56.02 dBm
702.58517034 MHz
D1 -19 dBm
1MAX
IN1
1RM
Start 30 MHz
97 MHz/
Stop 1 GHz
Date: 30.NOV.2019 15:02:53

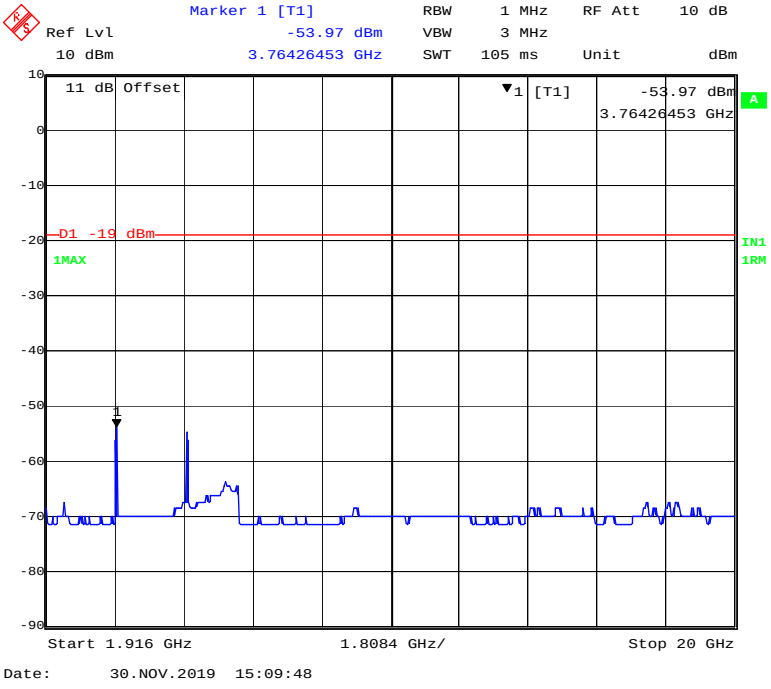

Marker 1 [T1]
Ref Lvl
10 dBm
-47.61 dBm
1.70900000 GHz
RBW 1 MHz
VBW 3 MHz
SWT 5 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-47.61 dBm
1.70900000 GHz
D1 -19 dBm
1MAX
IN1
1RM
Start 1 GHz
70.9 MHz/
Stop 1.709 GHz
Date: 30.NOV.2019 15:03:28


Marker 1 [T1]
RBW 1 MHz
RF Att 10 dB
Ref Lvl
-51.25 dBm
VBW 3 MHz
10 dBm
1.75600000 GHz
SWT 92 ms
Unit dBm
11 dB Offset
1 [T1]
-51.25 dBm
1.75600000 GHz
D1 -19 dBm
1MAX
IN1
1RM
Start 1.756 GHz
1.6244 GHz/
Stop 18 GHz
Date: 30.NOV.2019 15:03:45

PCS Band


Marker 1 [T1]
RBW 100 kHz
RF Att 10 dB
Ref Lvl
-56.32 dBm
VBW 300 kHz
10 dBm
702.58517034 MHz
SWT 245 ms
Unit dBm
11 dB Offset
1 [T1]
-56.32 dBm
702.58517034 MHz
D1 -19 dBm
1MAX
IN1
1RM
Start 30 MHz
97 MHz/
Stop 1 GHz
Date: 30.NOV.2019 15:11:31


Marker 1 [T1]
Ref Lvl
10 dBm
-48.30 dBm
1.84900000 GHz
RBW 1 MHz
VBW 3 MHz
SWT 5 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-48.30 dBm
1.84906000 GHz
D1 -19 dBm
1MAX
IN1
1RM
Start 1 GHz
84.9 MHz/
Stop 1.849 GHz
Date: 30.NOV.2019 15:11:07


Marker 1 [T1]
Ref Lvl
10 dBm
-53.97 dBm
3.76426453 GHz
RBW 1 MHz
VBW 3 MHz
SWT 105 ms
RF Att 10 dB
Unit dBm
11 dB Offset
1 [T1]
-53.97 dBm
3.76426453 GHz
D1 -19 dBm
1MAX
IN1
1RM
Start 1.916 GHz
1.8084 GHz/
Stop 20 GHz
Date: 30.NOV.2019 15:09:48

§ 2.1053 - RADIATED SPURIOUS EMISSIONS

Applicable Standards

§ 2.1053 Measurements required: Field strength of spurious radiation.

Test Procedure

This procedure is intended to satisfy the requirements specified in § 2.1053. The applicable limits are those specified for mobile emissions in the rule part appropriate to the band of operation (see Annex A).

a) Place the EUT on an OATS or semi-anechoic chamber turntable 3 m from the receiving antenna. 12
b) Connect the EUT to the test equipment as shown in **Figure 10** beginning with the uplink output.
c) Set the signal generator to produce a CW signal with the frequency set to the center of the operational band under test and the power level set at PIN as determined from 7.2.
d) Measure the radiated spurious emissions from the EUT from lowest to the highest frequencies as specified in § 2.1057. Maximize the radiated emissions by utilizing the procedures described in Clause 8 of ANSI C63.4-2014.
e) Capture the peak emissions plots using a peak detector with Max-Hold for inclusion in the test report. Tabular data is acceptable in lieu of spectrum analyzer plots.
f) Repeat 7.12c) through 7.12e) for all operational bands.

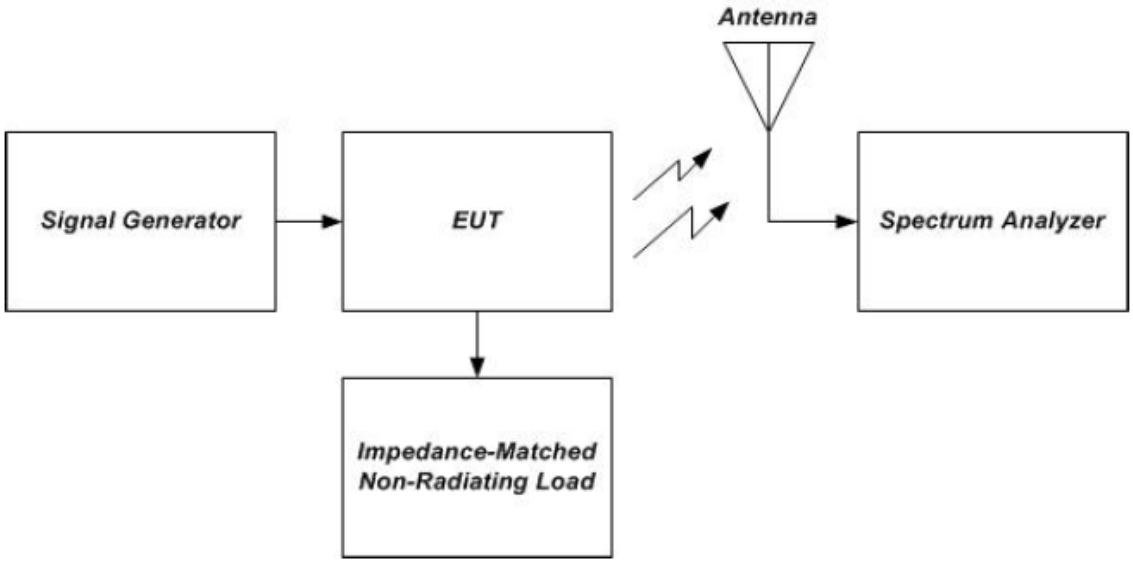


Figure 10 – Radiated spurious emissions test instrumentation setup

Test Data

Environmental Conditions

Temperature:	22.2 ℃
Relative Humidity:	50 %
ATM Pressure:	101.1 kPa

The testing was performed by Stone Zhang on 2019-11-26.

Test mode: Transmitting. Please refer to following table.

For Model: W1000

Frequency (MHz)	Receiver Reading (dBμV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	FCC Part 22H/24E/27	
			Height (cm)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
Uplink										
Lower 700MHz Band										
Test frequency range: 30MHz - 8 GHz										
193.70	54.43	276	200	H	-51.09	0.41	-4.23	-55.73	-19.00	36.73
193.70	52.36	187	200	V	-52.16	0.41	-4.23	-56.80	-19.00	37.80
1414.00	50.74	220	100	H	-55.01	0.79	7.19	-48.61	-19.00	29.61
1414.00	47.96	350	100	V	-57.86	0.79	7.19	-51.46	-19.00	32.46
Upper 700MHz Band										
Test frequency range: 30MHz - 8 GHz										
193.70	55.96	251	200	H	-49.56	0.41	-4.23	-54.20	-19.00	35.20
193.70	53.16	219	200	V	-51.36	0.41	-4.23	-56.00	-19.00	37.00
1563.00	48.19	52	200	H	-55.88	0.83	8.30	-48.41	-46.00	2.41
1563.00	46.15	56	200	V	-58.45	0.83	8.30	-50.98	-46.00	4.98
Cellular Band										
Test frequency range: 30MHz - 10 GHz										
193.70	54.21	324	100	H	-51.31	0.41	-4.23	-55.95	-19.00	36.95
193.70	51.17	36	100	V	-53.35	0.41	-4.23	-57.99	-19.00	38.99
1673.00	52.72	262	100	H	-51.17	0.84	8.48	-43.53	-19.00	24.53
1673.00	49.92	197	100	V	-53.47	0.84	8.48	-45.83	-19.00	26.83
PCS Band										
Test frequency range: 30MHz - 20 GHz										
193.70	55.25	295	200	H	-50.27	0.41	-4.23	-54.91	-19.00	35.91
193.70	53.13	287	200	V	-51.39	0.41	-4.23	-56.03	-19.00	37.03
3765.00	53.37	277	200	H	-43.33	0.95	9.74	-34.54	-19.00	15.54
3765.00	51.21	203	200	V	-45.65	0.95	9.74	-36.86	-19.00	17.86
AWS Band										
Test frequency range: 30MHz - 18 GHz										
193.70	53.09	134	200	H	-52.43	0.41	-4.23	-57.07	-19.00	38.07
193.70	50.27	222	200	V	-54.25	0.41	-4.23	-58.89	-19.00	39.89
3465.00	54.45	102	100	H	-43.16	0.93	9.87	-34.22	-19.00	15.22
3465.00	50.93	219	100	V	-47.22	0.93	9.87	-38.28	-19.00	19.28

Frequency (MHz)	Receiver Reading (dBμV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	FCC Part 22H/24E/27	
			Height (cm)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
Downlink										
Lower 700MHz Band										
Test frequency range: 30MHz - 8 GHz										
208.37	54.09	337	100	H	-50.84	0.42	-3.67	-54.93	-19.00	35.93
208.37	52.34	262	100	V	-53.51	0.42	-3.67	-57.60	-19.00	38.60
2875.10	56.78	280	200	H	-53.32	0.91	9.57	-44.66	-19.00	25.66
2875.10	54.85	85	200	V	-55.25	0.91	9.57	-46.59	-19.00	27.59
Upper 700MHz Band										
Test frequency range: 30MHz - 8 GHz										
208.37	55.47	12	100	H	-49.46	0.42	-3.67	-53.55	-19.00	34.55
208.37	52.85	333	100	V	-53.00	0.42	-3.67	-57.09	-19.00	38.09
2790.10	53.78	244	100	H	-56.57	0.91	9.69	-47.79	-19.00	28.79
2790.10	52.19	291	100	V	-58.16	0.91	9.69	-49.38	-19.00	30.38
Cellular Band										
Test frequency range: 30MHz - 10 GHz										
208.37	53.78	307	100	H	-51.15	0.42	-3.67	-55.24	-19.00	36.24
208.37	50.24	316	100	V	-55.61	0.42	-3.67	-59.70	-19.00	40.70
3199.80	52.37	332	200	H	-56.52	0.92	9.60	-47.84	-19.00	28.84
3199.80	50.91	8	200	V	-57.98	0.92	9.60	-49.30	-19.00	30.30
PCS Band										
Test frequency range: 30MHz - 20 GHz										
208.37	54.79	296	100	H	-50.14	0.42	-3.67	-54.23	-19.00	35.23
208.37	51.21	306	100	V	-54.64	0.42	-3.67	-58.73	-19.00	39.73
3009.40	54.92	328	100	H	-54.79	0.92	9.41	-46.30	-19.00	27.30
3009.40	53.12	198	100	V	-56.59	0.92	9.41	-48.10	-19.00	29.10
AWS Band										
Test frequency range: 30MHz -22 GHz										
208.37	55.70	171	100	H	-49.23	0.42	-3.67	-53.32	-19.00	34.32
208.37	51.34	320	100	V	-54.51	0.42	-3.67	-58.60	-19.00	39.60
4734.90	58.45	98	100	H	-48.19	1.05	10.09	-39.15	-19.00	20.15
4734.90	56.39	343	100	V	-50.25	1.05	10.09	-41.21	-19.00	22.21

Note:
1) Antenna gain is dBd for frequency below 1GHz and is dBi for frequency above 1GHz.
2) Absolute Level = SG Level - Cable loss + Antenna Gain
3) Margin = Limit- Absolute Level

For Model: W1001

Frequency (MHz)	Receiver Reading (dBμV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	FCC Part 22H/24E/27	
			Height (cm)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
Uplink										
Lower 700MHz Band										
Test frequency range: 30MHz - 8 GHz										
193.70	52.16	328	200	H	-53.36	0.41	-4.23	-58.00	-19.00	39.00
193.70	49.67	214	200	V	-54.85	0.41	-4.23	-59.49	-19.00	40.49
1414.00	48.75	18	100	H	-57.00	0.79	7.19	-50.60	-19.00	31.60
1414.00	45.36	279	100	V	-60.46	0.79	7.19	-54.06	-19.00	35.06
Upper 700MHz Band										
Test frequency range: 30MHz - 8 GHz										
193.70	54.38	78	150	H	-51.14	0.41	-4.23	-55.78	-19.00	36.78
193.70	52.16	100	150	V	-52.36	0.41	-4.23	-57.00	-19.00	38.00
1563.00	47.79	24	200	H	-56.28	0.83	8.30	-48.81	-46.00	2.81
1563.00	45.96	313	200	V	-58.64	0.83	8.30	-51.17	-46.00	5.17
Cellular Band										
Test frequency range: 30MHz - 10 GHz										
193.70	52.69	210	100	H	-52.83	0.41	-4.23	-57.47	-19.00	38.47
193.70	48.67	210	100	V	-55.85	0.41	-4.23	-60.49	-19.00	41.49
1673.00	50.37	56	200	H	-53.52	0.84	8.48	-45.88	-19.00	26.88
1673.00	46.55	343	200	V	-56.84	0.84	8.48	-49.20	-19.00	30.20
PCS Band										
Test frequency range: 30MHz - 20 GHz										
193.70	50.39	291	100	H	-55.13	0.41	-4.23	-59.77	-19.00	40.77
193.70	48.67	190	100	V	-55.85	0.41	-4.23	-60.49	-19.00	41.49
3765.00	50.29	299	200	H	-46.41	0.95	9.74	-37.62	-19.00	18.62
3765.00	48.37	283	200	V	-48.49	0.95	9.74	-39.70	-19.00	20.70
AWS Band										
Test frequency range: 30MHz - 18 GHz										
193.70	49.68	197	200	H	-55.84	0.41	-4.23	-60.48	-19.00	41.48
193.70	45.67	162	200	V	-58.85	0.41	-4.23	-63.49	-19.00	44.49
3465.00	51.23	169	150	H	-46.38	0.93	9.87	-37.44	-19.00	18.44
3465.00	48.62	117	150	V	-49.53	0.93	9.87	-40.59	-19.00	21.59

Frequency (MHz)	Receiver Reading (dBμV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	FCC Part 22H/24E/27	
			Height (cm)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
Downlink										
Lower 700MHz Band										
Test frequency range: 30MHz - 8 GHz										
208.37	52.67	213	100	H	-52.26	0.42	-3.67	-56.35	-19.00	37.35
208.37	46.37	236	150	V	-59.48	0.42	-3.67	-63.57	-19.00	44.57
2875.10	51.69	319	150	H	-58.41	0.91	9.57	-49.75	-19.00	30.75
2875.10	48.22	32	200	V	-61.88	0.91	9.57	-53.22	-19.00	34.22
Upper 700MHz Band										
Test frequency range: 30MHz - 8 GHz										
208.37	46.97	94	100	H	-57.96	0.42	-3.67	-62.05	-19.00	43.05
208.37	49.68	218	200	V	-56.17	0.42	-3.67	-60.26	-19.00	41.26
2790.10	50.16	101	200	H	-60.19	0.91	9.69	-51.41	-19.00	32.41
2790.10	47.23	139	100	V	-63.12	0.91	9.69	-54.34	-19.00	35.34
Cellular Band										
Test frequency range: 30MHz - 10 GHz										
208.37	50.16	74	100	H	-54.77	0.42	-3.67	-58.86	-19.00	39.86
208.37	48.26	284	100	V	-57.59	0.42	-3.67	-61.68	-19.00	42.68
3199.80	49.67	360	200	H	-59.22	0.92	9.60	-50.54	-19.00	31.54
3199.80	47.52	314	200	V	-61.37	0.92	9.60	-52.69	-19.00	33.69
PCS Band										
Test frequency range: 30MHz - 20 GHz										
208.37	51.26	2	100	H	-53.67	0.42	-3.67	-57.76	-19.00	38.76
208.37	47.63	48	150	V	-58.22	0.42	-3.67	-62.31	-19.00	43.31
3009.40	49.55	60	150	H	-60.16	0.92	9.41	-51.67	-19.00	32.67
3009.40	47.16	286	100	V	-62.55	0.92	9.41	-54.06	-19.00	35.06
AWS Band										
Test frequency range: 30MHz -22 GHz										
208.37	49.58	43	100	H	-55.35	0.42	-3.67	-59.44	-19.00	40.44
208.37	46.36	252	100	V	-59.49	0.42	-3.67	-63.58	-19.00	44.58
4734.90	50.31	337	200	H	-56.33	1.05	10.09	-47.29	-19.00	28.29
4734.90	48.29	130	200	V	-58.35	1.05	10.09	-49.31	-19.00	30.31

Note:
1) Antenna gain is dBd for frequency below 1GHz and is dBi for frequency above 1GHz.
2) Absolute Level = SG Level - Cable loss + Antenna Gain
3) Margin = Limit- Absolute Level

Declarations

1: BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.

2: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

3: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

4: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

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