ACCREDITED
TESTING LABORATORY
CERTIFICATE # 4821.01

BACL
Bay Area Compliance Labs Corp.

FCC PART 20.21

TEST REPORT

For

Romancell Technology Co.,Ltd.

4F-1,No.842,Ching-Guo Rd.,Taoyuan City, Taoyuan County, Taiwan 330

FCC ID: 2AHY2SCP5560

Report Type:	**Product Type:**
Original Report	Dual Band Cellphone Booster

Report Number:	RSZ160425020-00A
Report Date:	2018-08-07
Reviewed By:	Rocky Kang RF Engineer
Prepared By:	Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn

Note: This report must not be used by the customer to claim product certification, approval, or endorsement by A2LA* or any agency of the Federal Government. * This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*"

TABLE OF CONTENTS

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Romancell Technology Co.,Ltd.'s* product, model number: *SCP-5560 (FCC ID: 2AHY2SCP5560)* in this report is a *Dual Band Cellphone Booster,* which was measured approximately: 19.8cm (L) * 10.4 cm (W) * 4.1 cm (H), rated with input voltage: DC5.0V from adapter.

Operating frequency bands for Fixed wideband consumer signal booster:

Electrical specification	Uplink	Downlink
Frequency Range	824 ～ 849 MHz(B5) 1850 ～ 1910MHz(B2)	869 ～ 894 MHz(B5) 1930 ～ 1990MHz(B2)

Adapter Information:
Model: RH-050120US
Input: 100-240V ~ 50/60Hz, 0.4A
Output: 5V, 1.2A

Notes: This series products model: SCP-5055 and SCP-5560 are identical; they have the same or similar appearance, structure, PCB, Material and function to the testing products, Model SCP-5560 was selected for fully testing, the detailed information can be referred to the attached declaration which was stated and guaranteed by the applicant.

**All measurement and test data in this report was gathered from production sample serial number: 1602053. (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2016-04-25.*

Objective

This test report is prepared on behalf of *Romancell Technology Co.,Ltd.* in accordance with Part 2, Part 20.21 and Part 22, Part 24 of the Federal Communication Commissions rules.

Related Submittal(s)/Grant(s)

No related submittal(s).

Test Methodology

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

Applicable Standards: TIA 603-D. KDB 935210 D03 Signal Booster Measurements v04.

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

Measurement Uncertainty

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

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 342867, the FCC Designation No. : CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

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

Antenna kitting requirement: EUT has one set antenna kitting for marketing, the antenna gain and cable loss for varier band were listed below, fulfill the requirement of FCC Part 20.21(e)(8)(i)(G), more detail information please refer to the user manuals.

mode	Frequency band (MHz)	Antenna Gain (dBi)	Cable loss (dB)
uplink	824-849	6.8	2.98
	1850-1910	7.5	4.67
downlink	869-894	2.14	0
	1930-1990	2.14	0

EUT Exercise Software

No exercise software was used.

Special Accessories

No special accessory was used.

Equipment Modifications

No modification was made to the EUT tested.

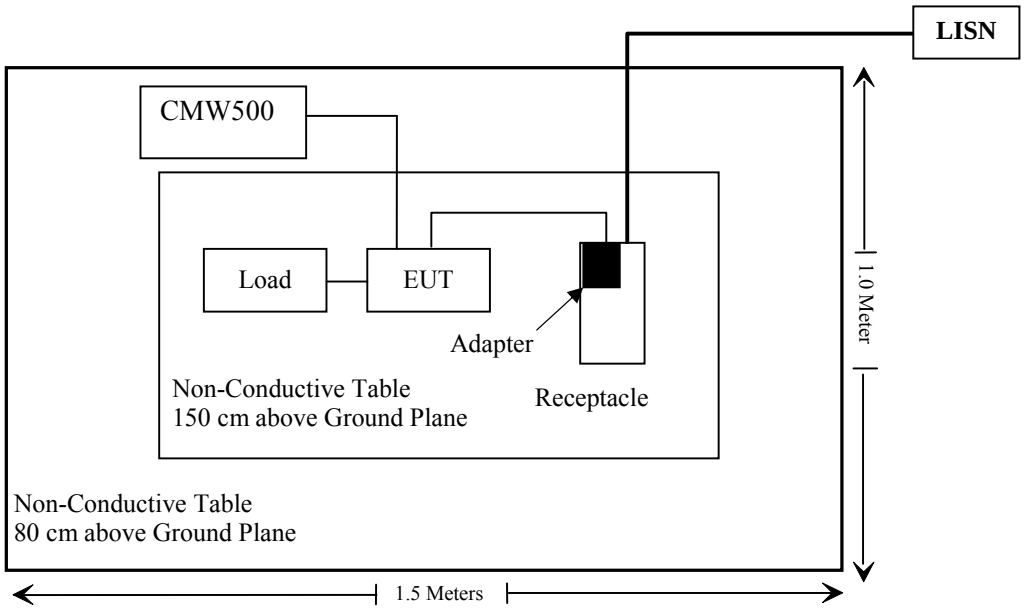
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
N/A	Load	N/A	N/A
Rohde & Schwarz	Wideband Radio Communication Tester	CMW500	1201.002K50-146520-wh

External I/O Cable

Cable Description	Length (m)	From Port	To
Shileding Detachable RF Cable	1.5	EUT	Load

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

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

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

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017-12-22	2020-12-21
Rohde & Schwarz	Signal Analyzer	FSEM	845987/005	2018-06-23	2019-06-23
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017-12-22	2020-12-21
COM-POWER	Pre-amplifier	PA-122	181919	2018-05-22	2018-11-22
Sonoma instrument	Amplifier	310N	186238	2018-05-12	2018-11-12
Anritsu	Signal Generator	68369B	004114	2017-12-24	2018-12-24
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2018-08-01	2019-02-01
COM POWER	Dipole Antenna	AD-100	041000	NCR	NCR
A.H. System	Horn Antenna	SAS-200/571	135	2018-08-18	2021-08-17
Ducommun technologies	RF Cable	UFA147A-2362-100100	MFR64639 231029-003	2018-08-01	2019-02-01
Ducommun technologies	RF Cable	104PEA	218124002	2018-05-21	2018-11-21
Ducommun technologies	RF Cable	RG-214	1	2018-05-21	2018-11-21
Ducommun technologies	RF Cable	RG-214	2	2018-05-22	2018-11-22
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-04	2017-12-29	2020-12-29
Ducommun technologies	Horn Antenna	ARH-4223-02	1007726-03	2017-12-29	2020-12-29
Ducommun technologies	Pre-amplifier	ALN-22093530-01	991373-01	2017-08-03	2018-08-03

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted test					
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2017-12-24	2018-12-24
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2017-08-19	2018-08-19
Long Wei	DC Power Supply	TPR-6420D	398363	NCR	NCR
Rohde & Schwarz	Wideband Radio Communication Tester	CMW500	1201.002K50-146520-wh	2018-04-24	2019-04-24
Ducommun technologies	RF Cable	104PEA	218124002	2018-05-21	2018-11-19
Ducommun technologies	RF Cable	RG-214	3	Each Time	
WEINSCHEL	10dB Attenuator	5324	AU 3842	Each Time	
HP	Adjustable attenuator	8496B	2827A12453	Each time	
Agilent	Vector signal source	N5182B	MY53051503	2018-06-23	2019-06-23
Un-known	Power Splitter	1620	129	2018-05-21	2019-05-21

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

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

Applicable Standard

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

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

Test Procedure

a) Connect the EUT to the test equipment as shown in Figure 1. Begin with the uplink output connected to the spectrum analyzer.
b) Set the spectrum analyzer RBW for 100 kHz with the VBW ≥ 3 × the RBW using a PEAK detector with the MAX HOLD function.
c) Set the center frequency of the spectrum analyzer to the center of the operational band under test with a span of 1 MHz.
d) Set the signal generator for CW mode and tune to the center frequency of the operational band under test.
e) Set the initial signal generator power to a level that is at least 6 dB below the AGC level specified by the manufacturer.
f) Slowly increase the signal generator power level until the output signal reaches the AGC operational level.
g) Reduce the signal generator power to a level that is 3 dB below the level noted above and manually reset the EUT.
h) Reset the spectrum analyzer span to 2 × the CMRS band under test. Adjust the tuned frequency of the signal generator to sweep 2 × the CMRS band using the sweep function. The AGC must not be activated throughout the entire sweep.
i) Using three markers, identify the CMRS band edges and the frequency with the highest power. Affirm that the values of all markers are visible on the display of the spectrum analyzer (e.g., marker table set to on).
j) Capture the spectrum analyzer trace for inclusion in the test report.
k) Repeat 7.1c) to 7.1j) for all operational uplink and downlink bands.

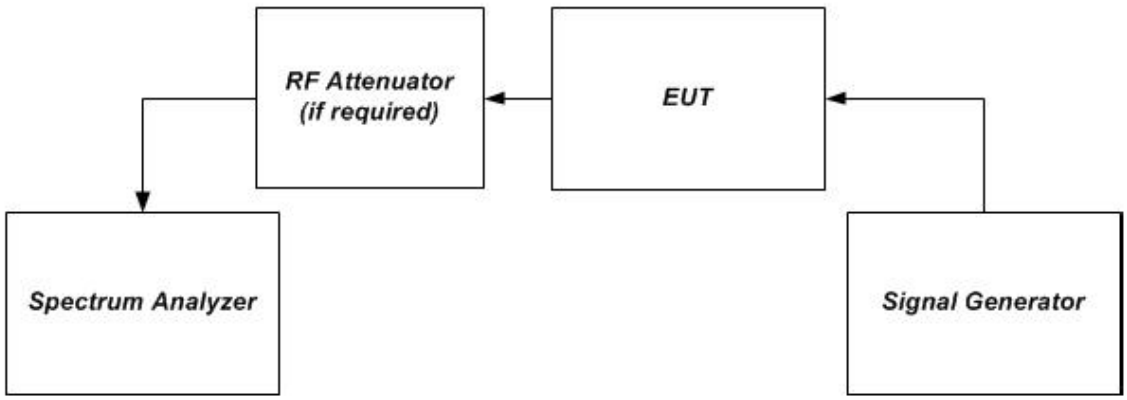


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

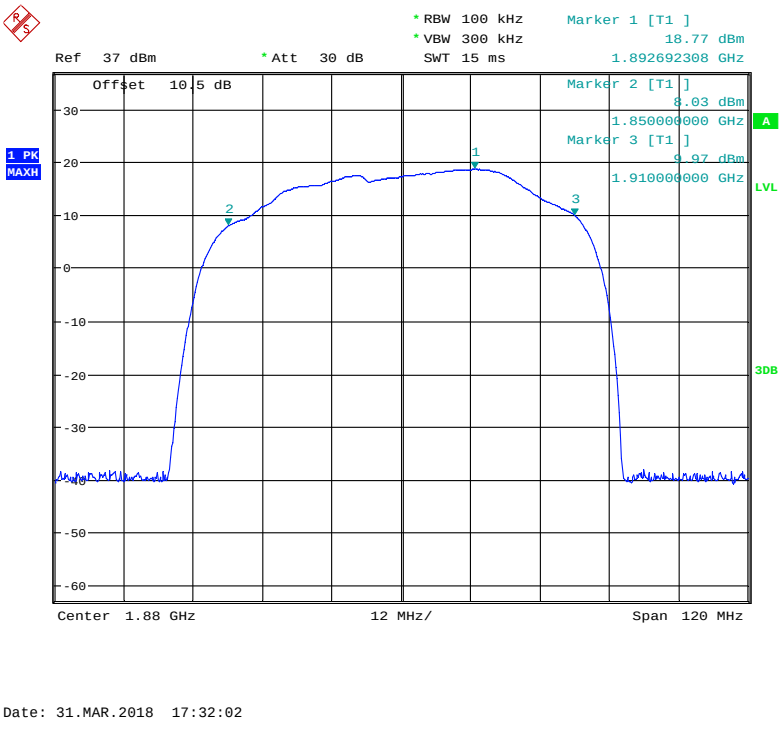
Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Kong on 2018-03-31.

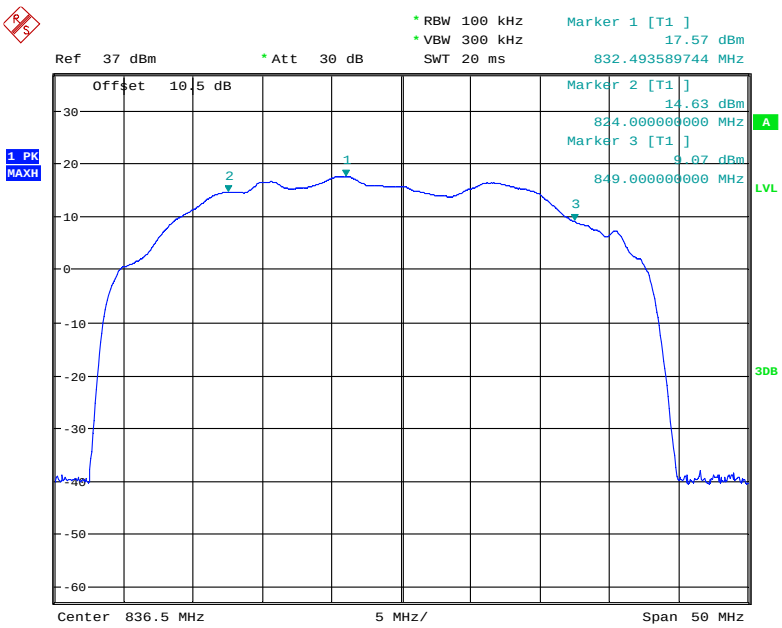
Test Result: Compliance. Please refer to following plots.

Uplink:

PCS Band



Cellular Band



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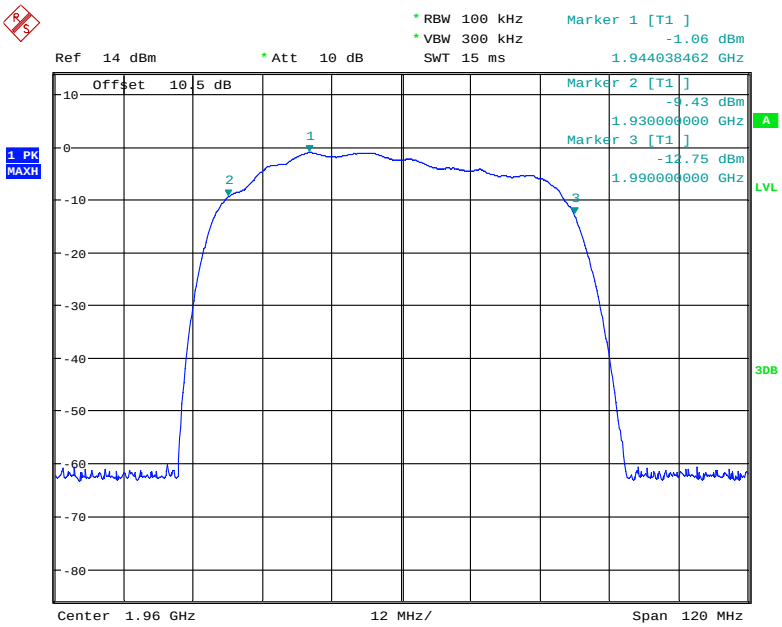
Downlink:

PCS Band



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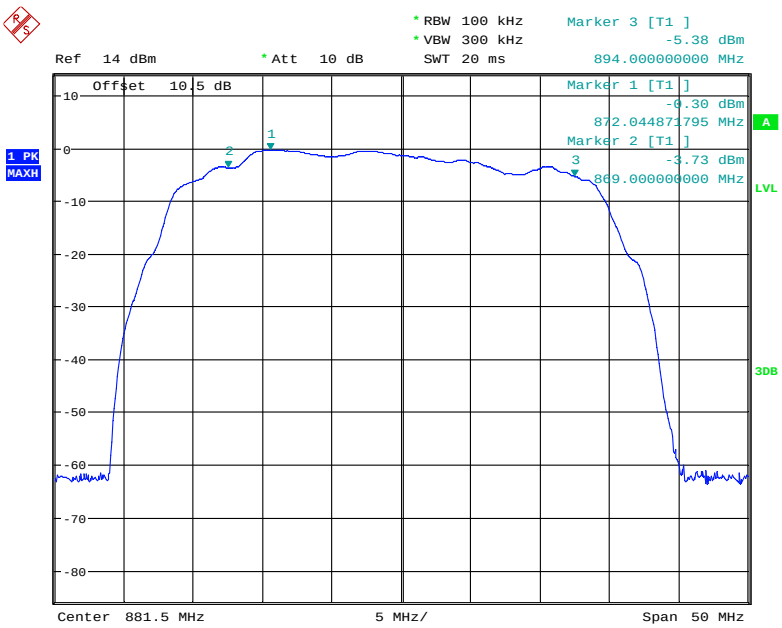
Cellular Band



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

Applicable Standard

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

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

a) Compliance to authorized EIRP limits must be shown using the highest gains from the list of antennas, cabling, and coupling devices declared by the manufacturer for use with the consumer booster.
b) In addition, the maximum power levels measured in this procedure will be utilized in calculating the maximum gain as described in the next subclause.
c) The frequency with the highest power level in each operational band as determined in 7.1 is to be measured discretely by applying the following procedure utilizing the stated emission and power detector types independently.
d) Use a signal generator to create a pulsed CW or GSM signal with a pulse width of 570 μs and a duty cycle of 12.5% (i.e., one GSM timeslot), then measure utilizing the burst power function of the measuring instrument.
e) Use a signal generator to create an AWGN signal with a 99% occupied bandwidth of 4.1 MHz, then measure utilizing the channel power or band power function of the measuring instrumentation.
f) All modes of operation must be verified to maintain operation within authorized limits at the maximum uplink and downlink test levels per device type as defined in 5.4, by increasing the power level in 2 dB steps from the AGC level to the maximum input level specified in 5.5.

Test Procedure

a) Connect the EUT to the test equipment as shown in Figure 1. Begin with the uplink output (donor port) connected to the spectrum analyzer.
b) Configure the signal generator and spectrum analyzer for operation on the frequency determined in 7.1 with the highest power level, but with the center frequency of the signal no closer than 2.5 MHz from the band edge. The spectrum analyzer span shall be set to at least 10 MHz.
c) Set the initial signal generator power to a level well below that which causes AGC control.
d) Slowly increase the signal generator power level until the output signal reaches the AGC operational limit (from observation of signal behavior on the spectrum analyzer; i.e., no further increase in output power as input power is increased).
e) Reduce power sufficiently on the signal generator to ensure that the AGC is not controlling the power output.
f) Slowly increase the signal generator power to a level just below (within 0.5 dB of) the AGC limit without triggering the AGC. Note the signal generator power level as Pin.
g) Measure the output power Pout with the spectrum analyzer as follows.

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

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

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Kong on 2018-04-02 and 2018-04-03.

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

Output Power:

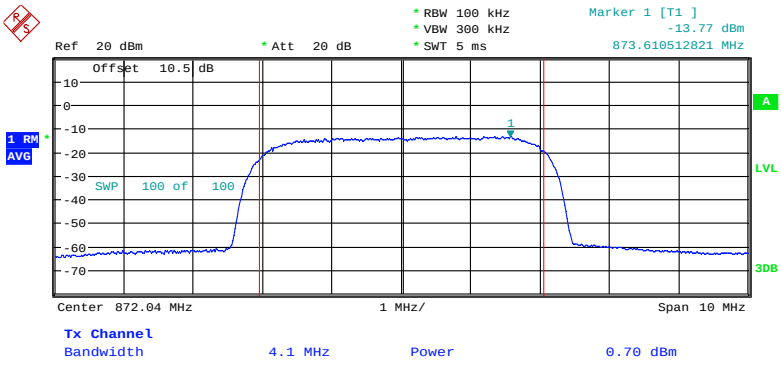
Mode	Operation Band	Signal type	Pre AGC Input level	Conducted Output level	Antenna Gain	Cable loss	EIRP	Limit
			dBm	dBm	dBi	dB	dBm	dBm
Uplink	Cellular	AWGN	-36.5	17.18	6.8	2.98	21.00	17-30
		CW	-37.5	19.65			23.47	
	PCS	AWGN	-34.7	17.15	7.5	4.67	19.98	
		CW	-34.5	19.9			22.73	
Downlink	Cellular	AWGN	-53.6	0.70	2.14	0	2.84	≤17
		CW	-53.4	1.09			3.23	
	PCS	AWGN	-52.8	-0.19	2.14	0	1.95	
		CW	-52.3	0.96			3.10	

Maximum Input level:

Mode	Operation Band	Signal type	Maximum Input level	Maximum Input level Limits	Conducted Output level
			dBm	dBm	dBm
Uplink	Cellular	AWGN	-11.3	27.0	17.45
		CW	-11.5		19.81
	PCS	AWGN	-13.1		16.92
		CW	-13.2		19.98
Downlink	Cellular	AWGN	-38.2	-20	0.83
		CW	-38.4		1.35
	PCS	AWGN	-37.1		-0.02
		CW	-37.5		1.03

AWGN:
Output Power

Cellular Downlink



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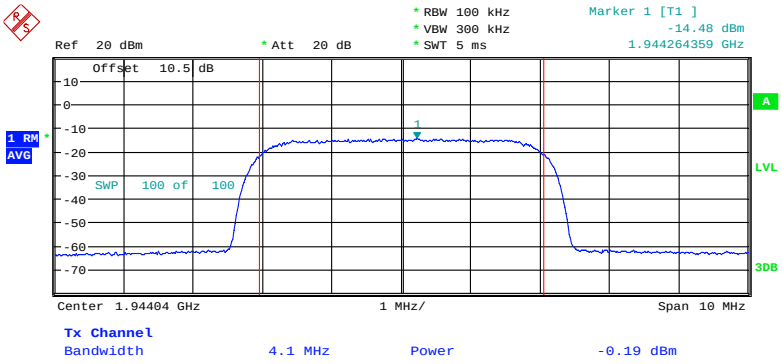
PCS Downlink



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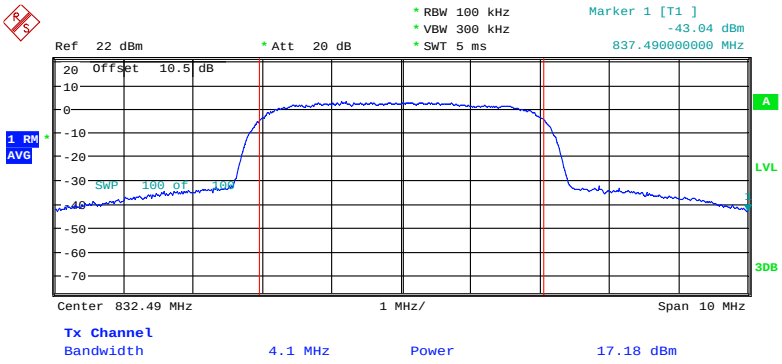
Cellular Uplink



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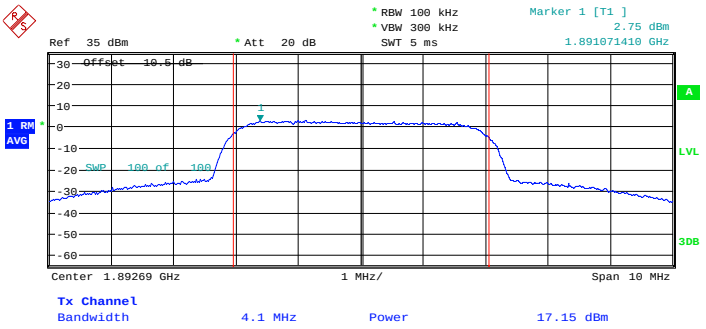
PCS Band Uplink



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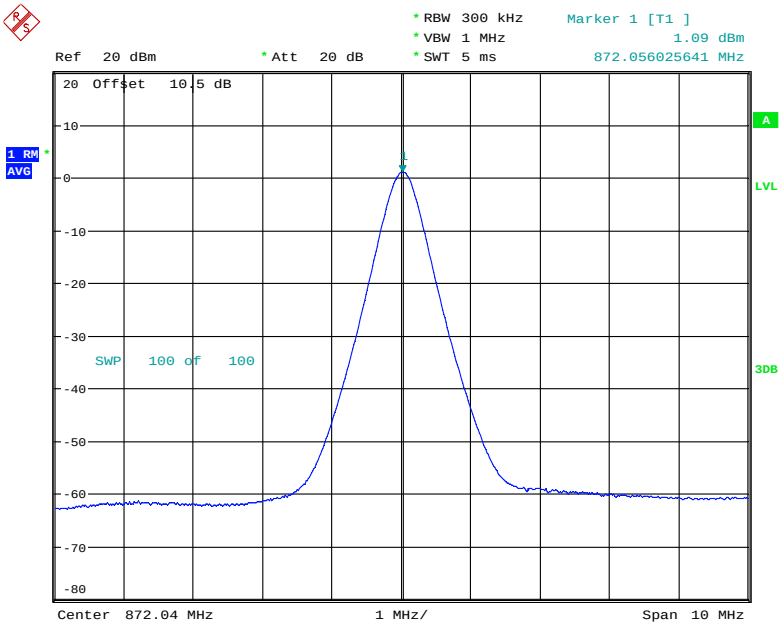
CW Output Power:

Cellular Downlink



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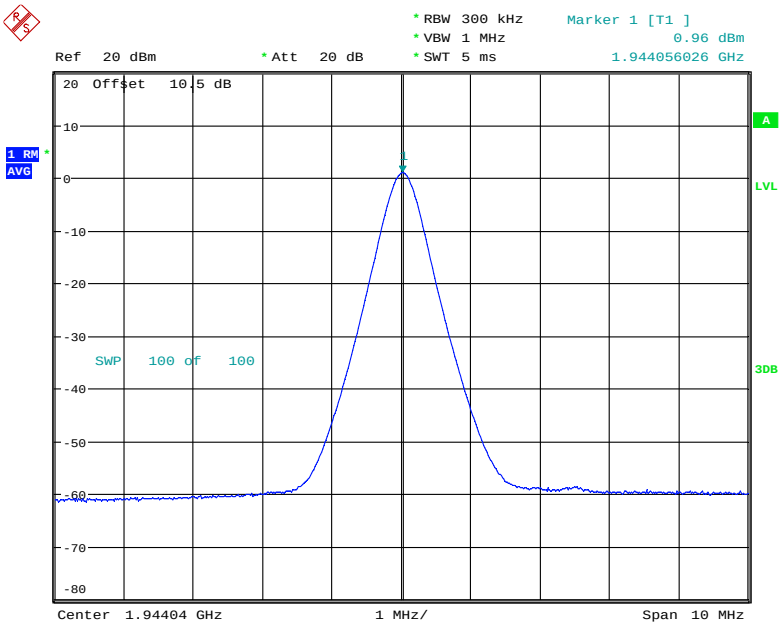
PCS Downlink



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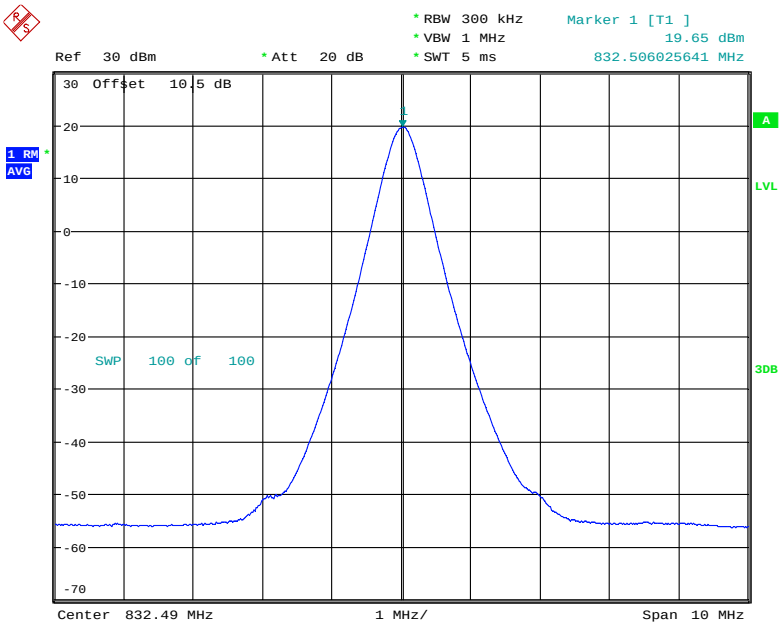
Cellular Uplink



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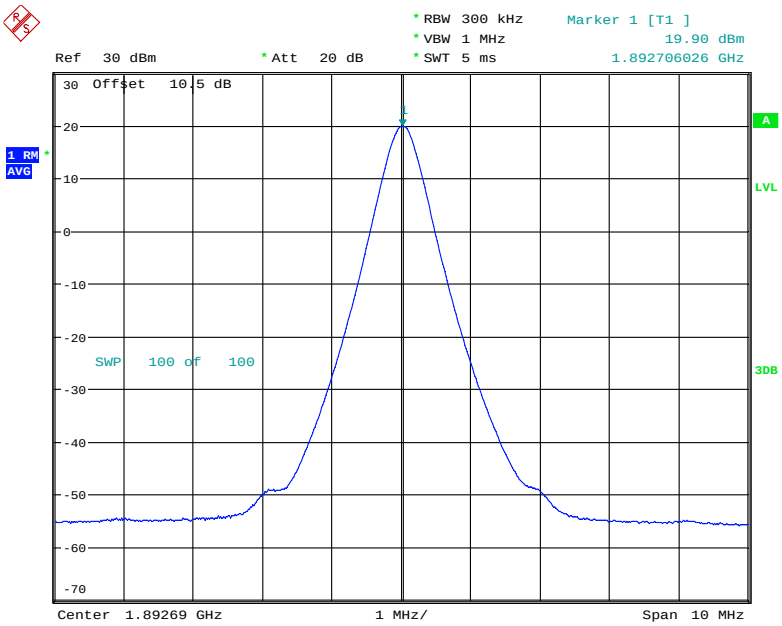
PCS band Uplink



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§ 20.21(e)(8)(i)(C)(2), § 20.21(e)(8)(i)(B)&§20.21(e)(4) – MAXIMUM BOOSTER GAIN 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:	24 ℃
Relative Humidity:	49 %
ATM Pressure:	100.0 kPa

The testing was performed by Jacob Kong on 2018-04-02.

Test Result: Compliance. Please refer to the following tables and the plots please refer to section 7.2.

Maximum gain:

Mode	Operation Band	Signal type	Pre AGC Input level	Conducted Output level	Gain	Limit
			dBm	dBm	dBm	dBm
Uplink	Cellular	AWGN	-36.5	17.18	53.68	64.95
		CW	-37.5	19.65	57.15	
	PCS	AWGN	-34.7	17.15	51.85	71.98
		CW	-34.5	19.9	54.40	
Downlink	Cellular	AWGN	-53.6	0.70	54.30	64.95
		CW	-53.4	1.09	54.49	
	PCS	AWGN	-52.8	-0.19	52.61	71.98
		CW	-52.3	0.96	53.26	

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

Equivalent Uplink and downlink gain:

Operating Band	Signal type	Uplink Gain	Downlink Gain	Caculated Value	Limit
MHz		dBi	dBi	dB	dB
Cellular	AWGN	53.68	54.30	0.62	+/-9
	CW	57.15	54.49	-2.66	
PCS	AWGN	51.85	52.61	0.76	
	CW	54.40	53.26	-1.14	

§ 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

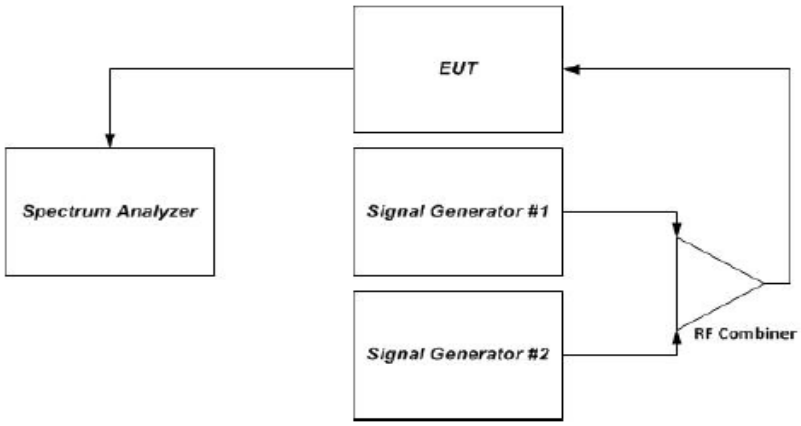


Figure 2 – Intermodulation product instrumentation test setup

Test Data

Environmental Conditions

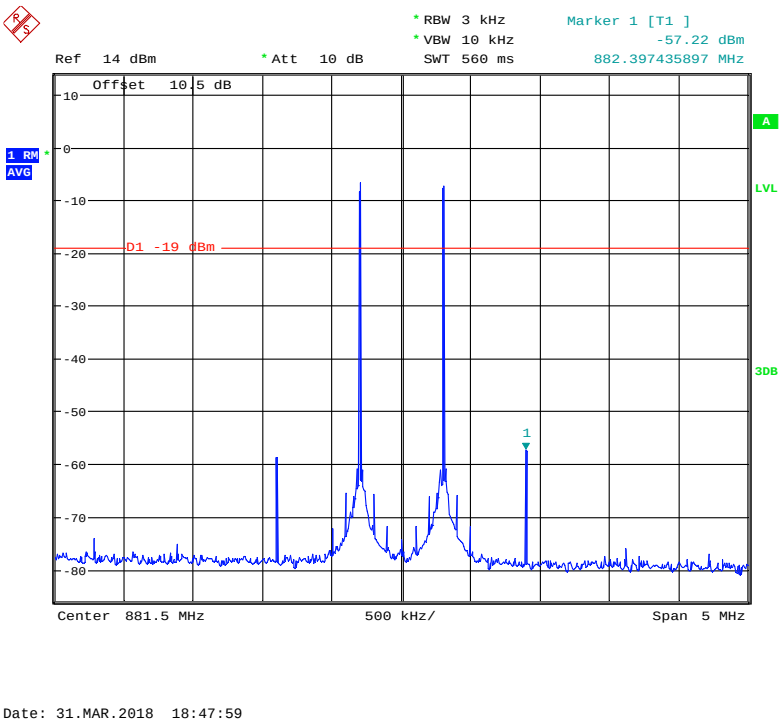
Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Kong on 2018-03-31.

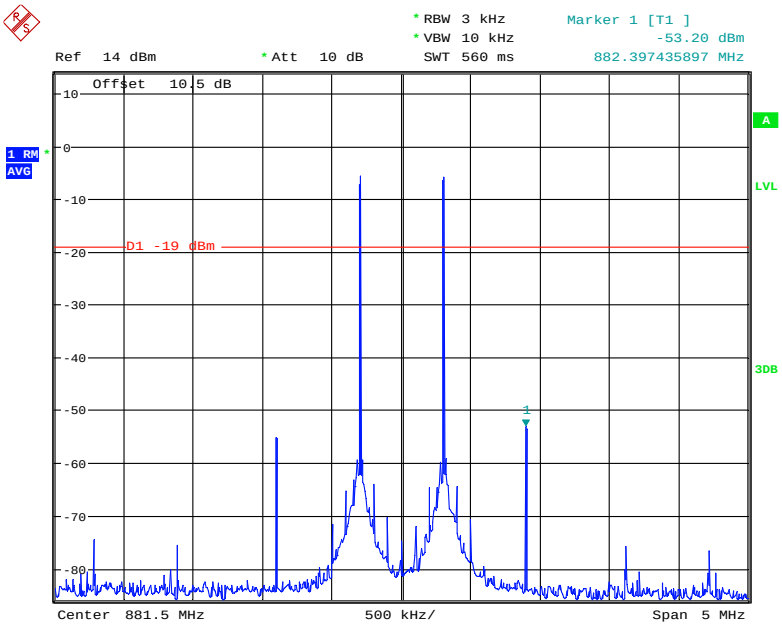
Test Result: Compliance. Please refer to following plots.

Downlink

Cellular Pre-AGC

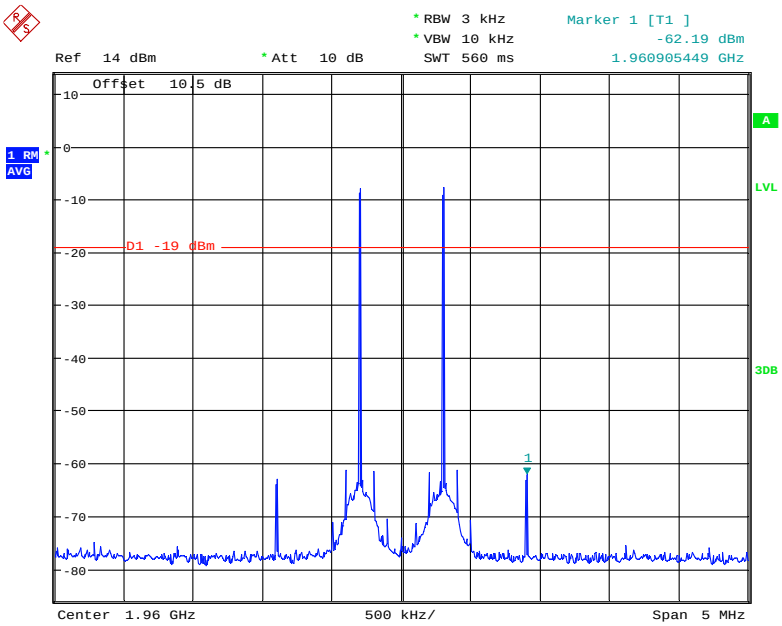


Cellular Above AGC



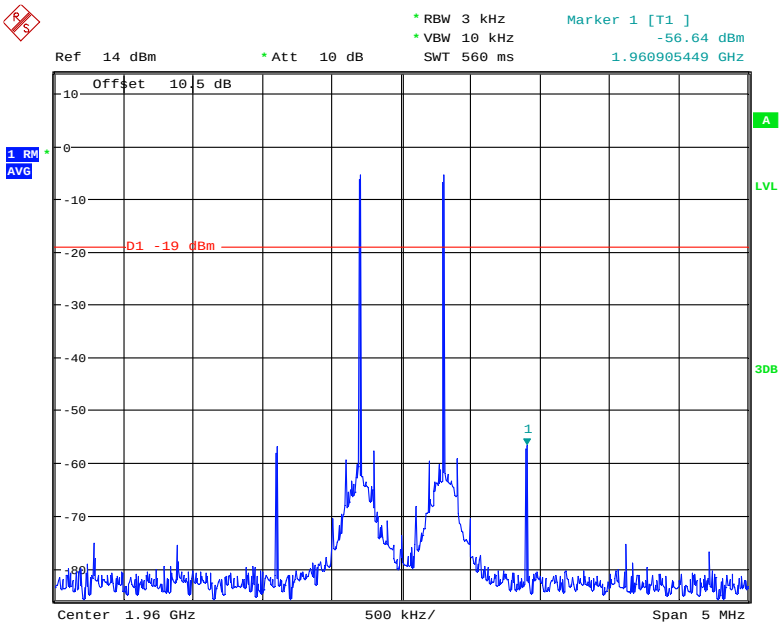
Date: 31.MAR.2018 18:48:46

PCS Pre-AGC



Date: 31.MAR.2018 18:50:14

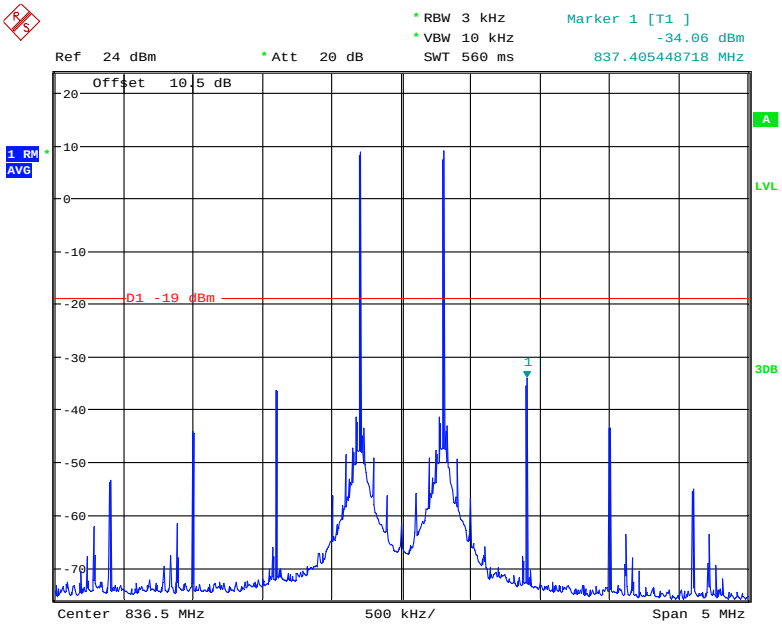
PCS Above AGC



Date: 31.MAR.2018 18:50:42

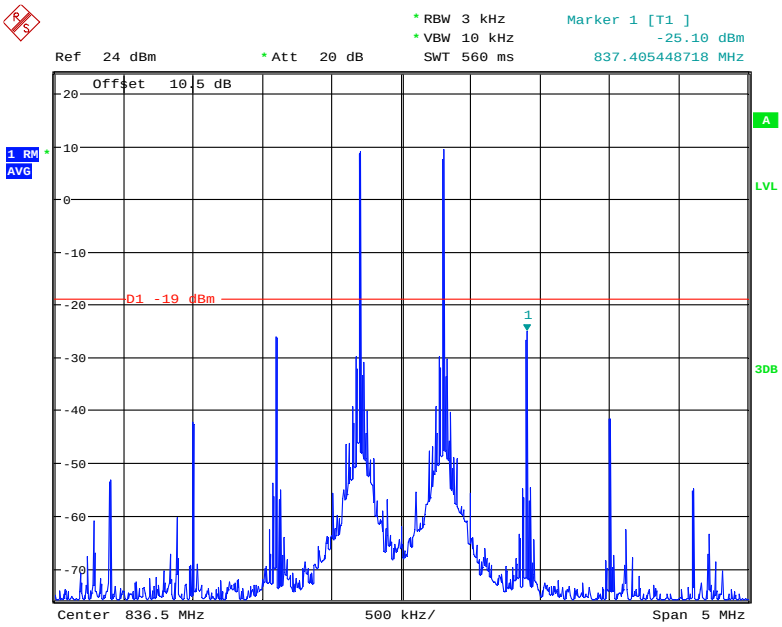
Uplink

Cellular Pre-AGC



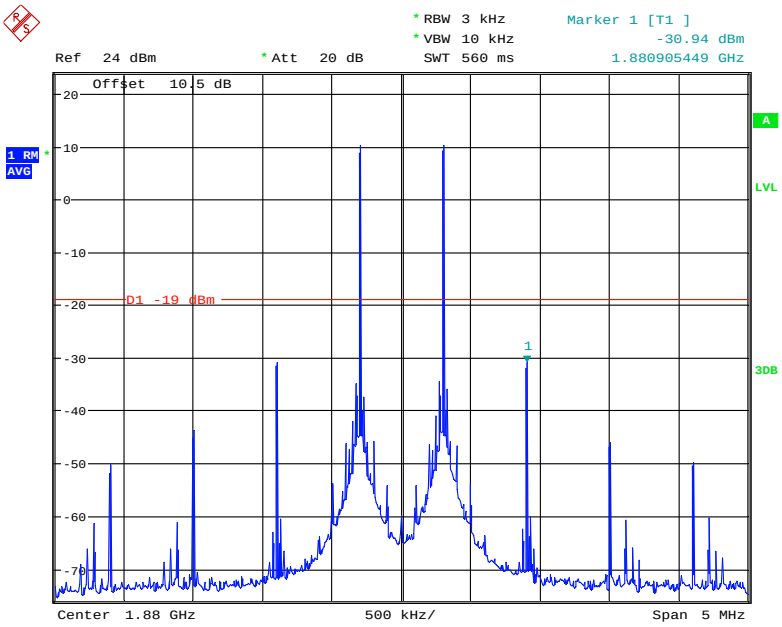
Date: 31.MAR.2018 18:53:34

Cellular Above AGC



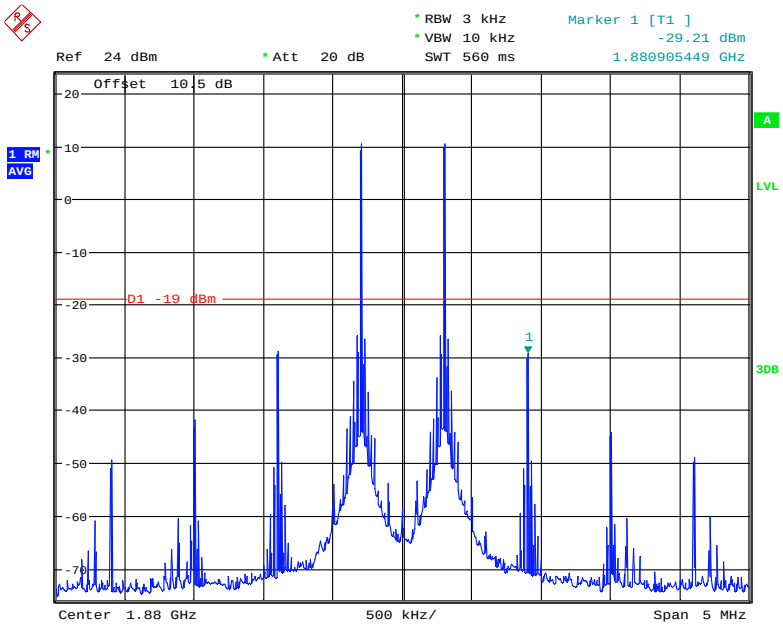
Date: 31.MAR.2018 18:53:59

PCS Pre-AGC



Date: 31.MAR.2018 18:54:51

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.

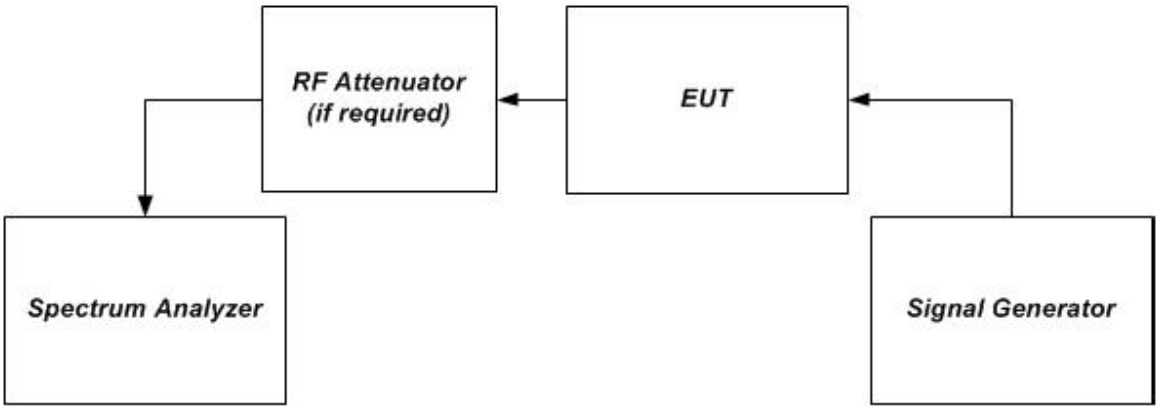


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

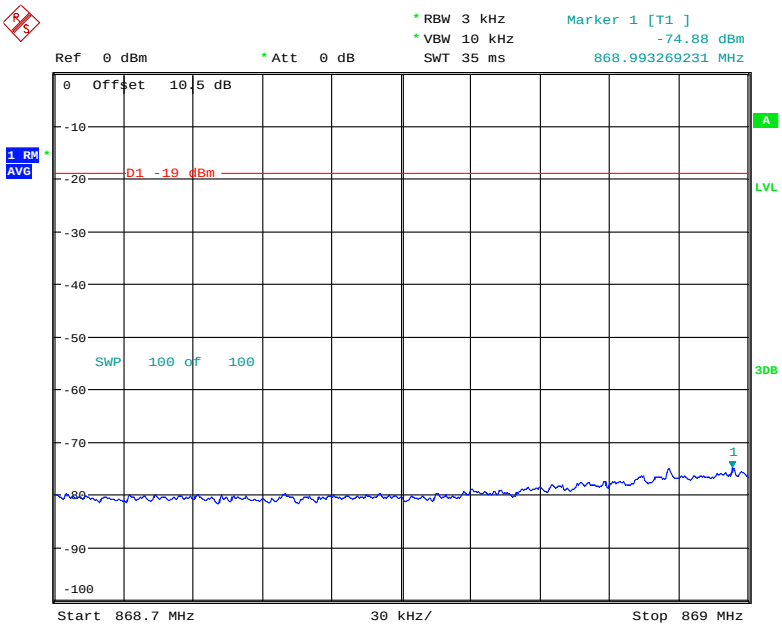
Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Kong on 2018-04-03.

Test Result: Compliance. Please refer to following plots.

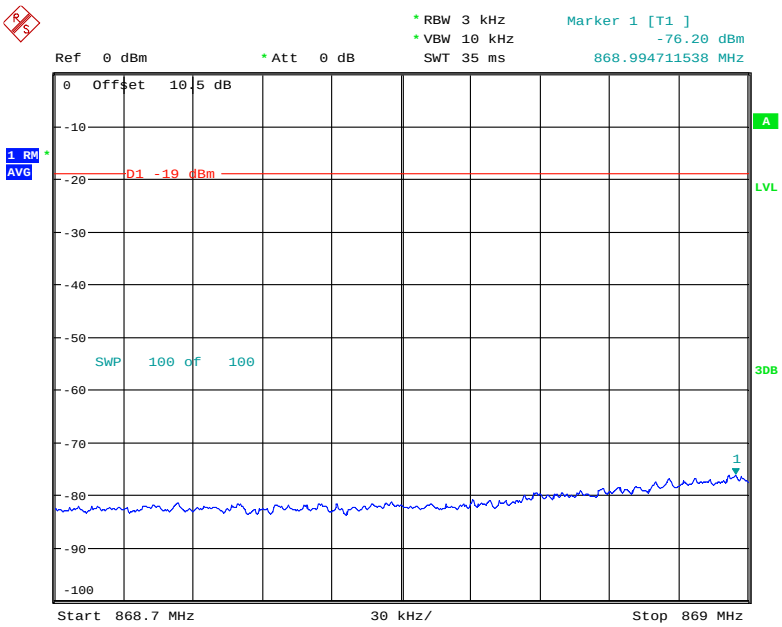
Downlink

Cellular Band GSM Left Side 869.2MHz Pre-AGC



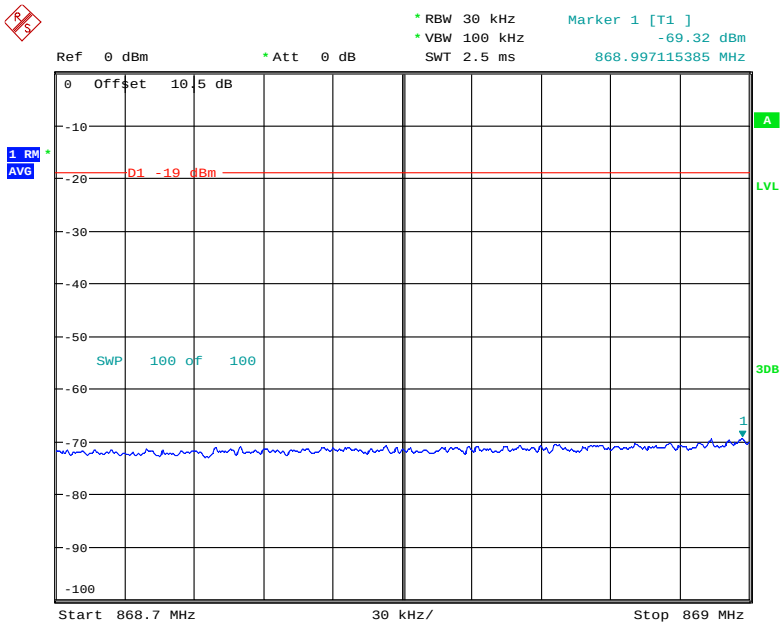
Date: 3.APR.2018 22:39:54

Cellular Band GSM Left Side 869.2MHz Above AGC



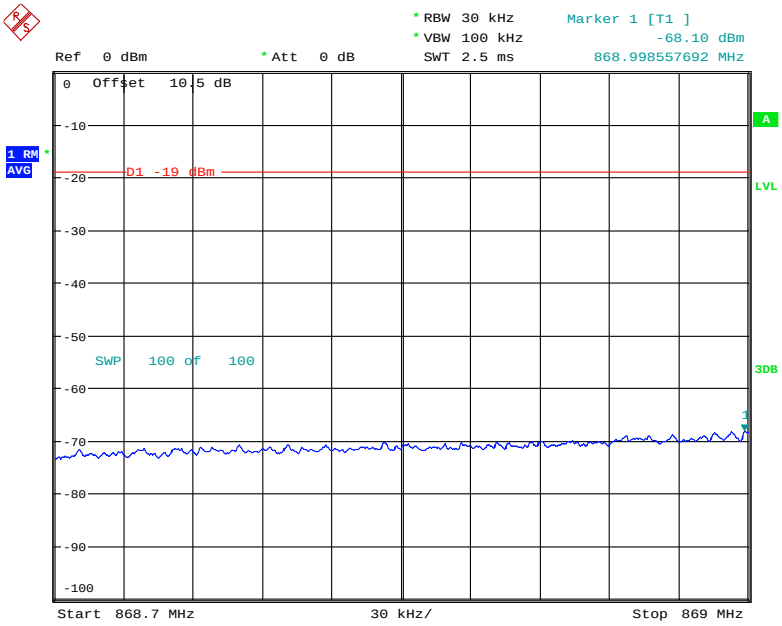
Date: 3.APR.2018 22:41:09

Cellular Band CDMA Left Side 869.88MHz Pre-AGC



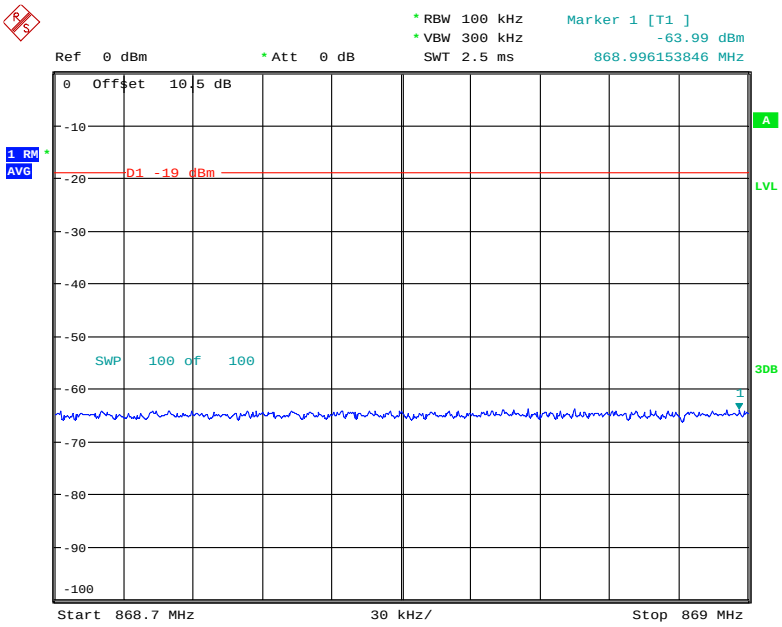
Date: 3.APR.2018 22:38:04

Cellular Band CDMA Left Side 869.88MHz Above AGC



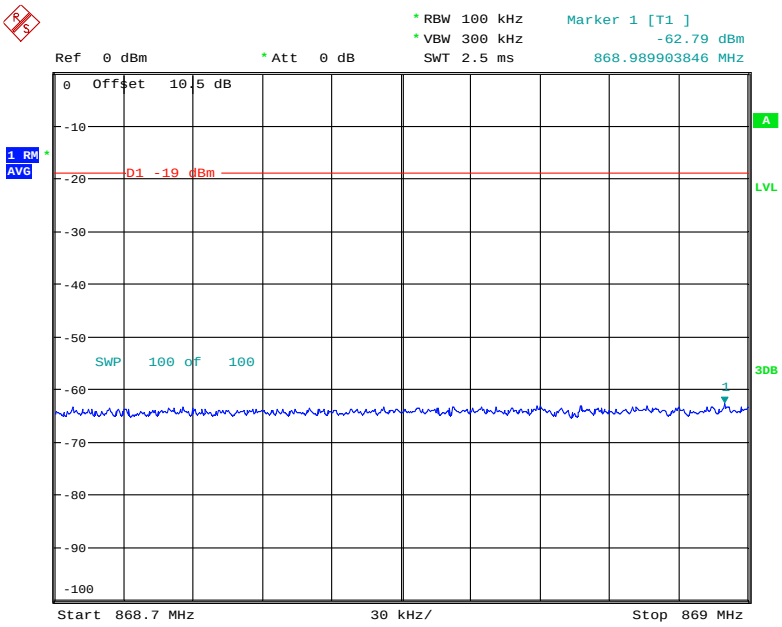
Date: 3.APR.2018 22:38:43

Cellular Band LTE Left Side 871.5MHz Pre-AGC



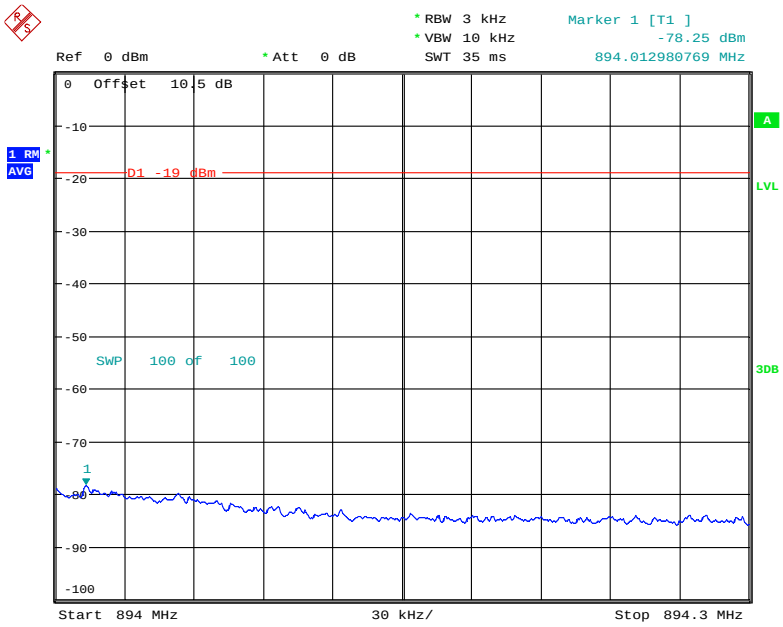
Date: 3.APR.2018 22:32:14

Cellular Band LTE Left Side 871.5MHz Above AGC



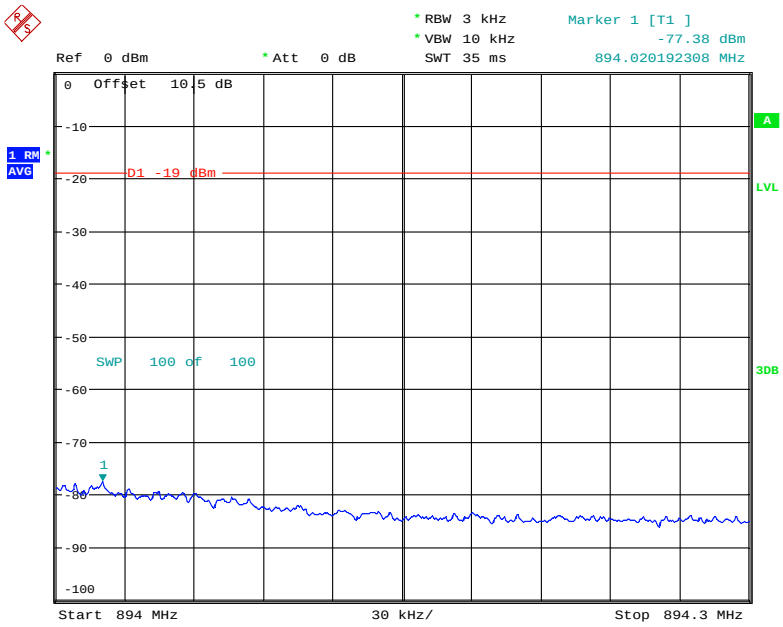
Date: 3.APR.2018 22:32:57

Cellular Band GSM Right Side 893.8MHz Pre-AGC



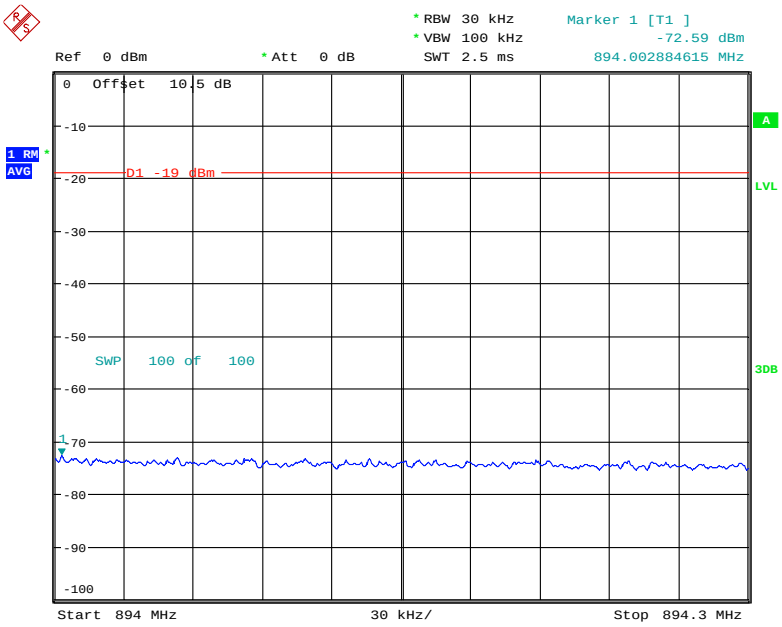
Date: 3.APR.2018 22:42:35

Cellular Band GSM Right Side 893.8MHz Above AGC



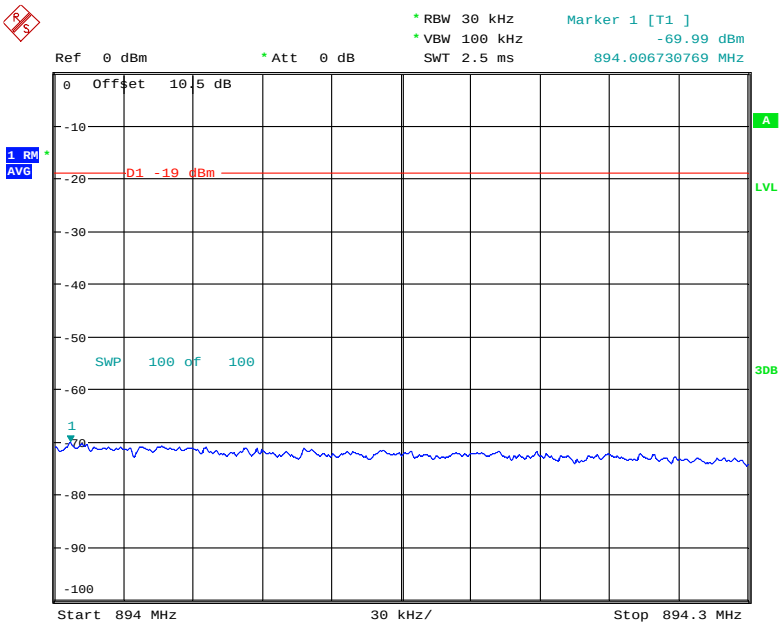
Date: 3.APR.2018 22:43:19

Cellular Band CDMA Right Side 893.10MHz Pre-AGC



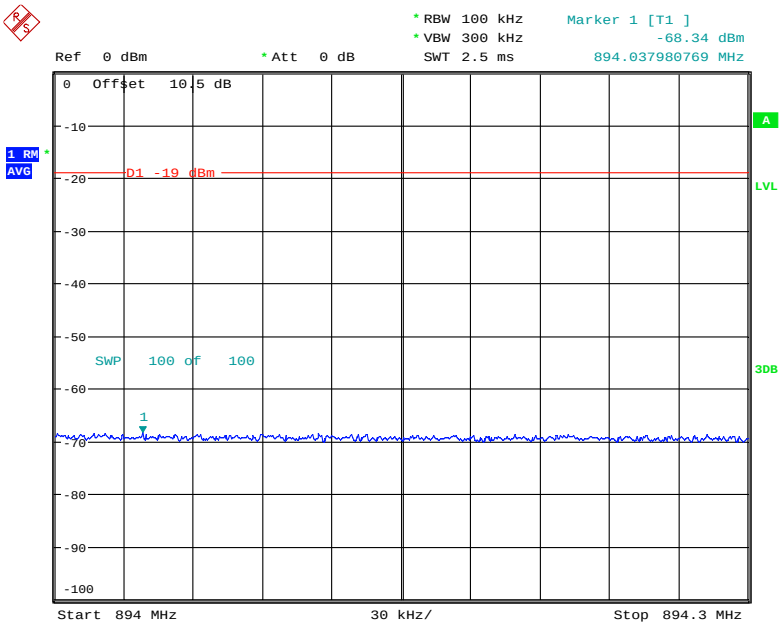
Date: 3.APR.2018 22:36:32

Cellular Band CDMA Right Side 893.10MHz Above AGC



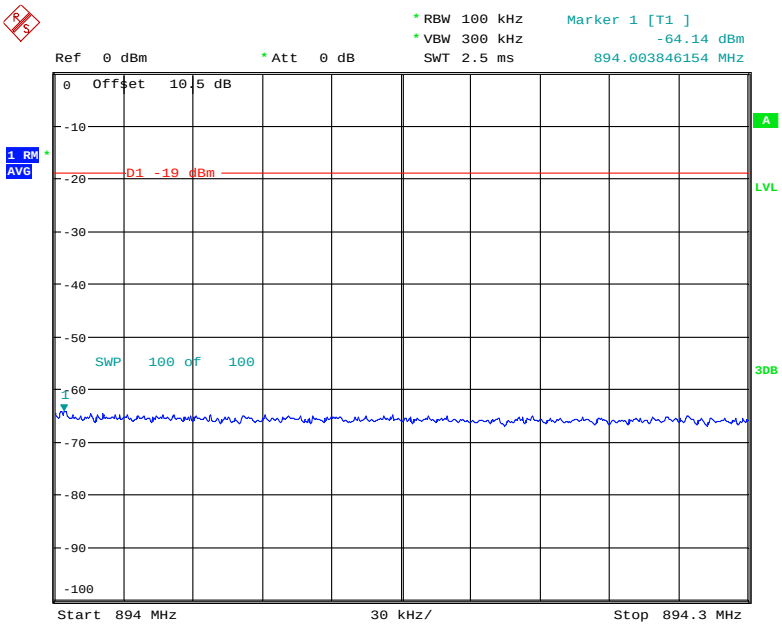
Date: 3.APR.2018 22:35:57

Cellular Band LTE Right Side 891.5MHz Pre-AGC



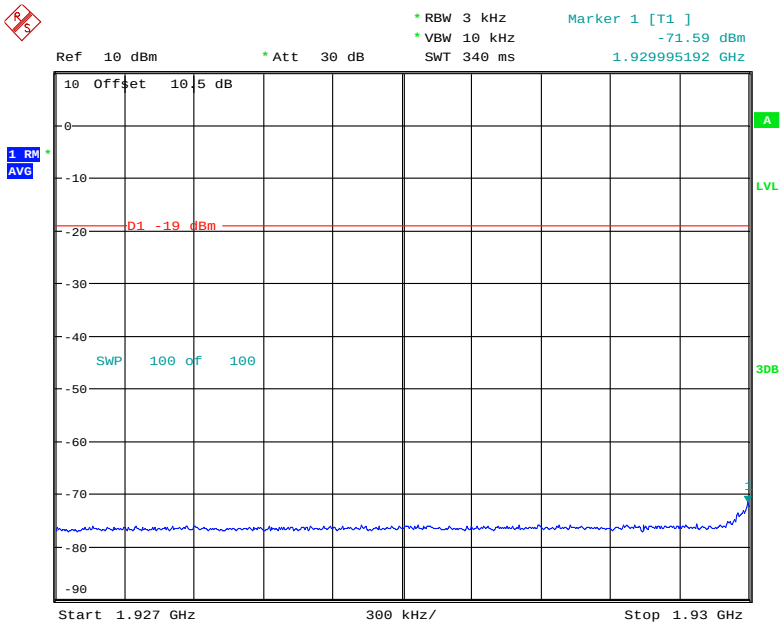
Date: 3.APR.2018 22:33:55

Cellular Band LTE Right Side 891.5MHz Above AGC



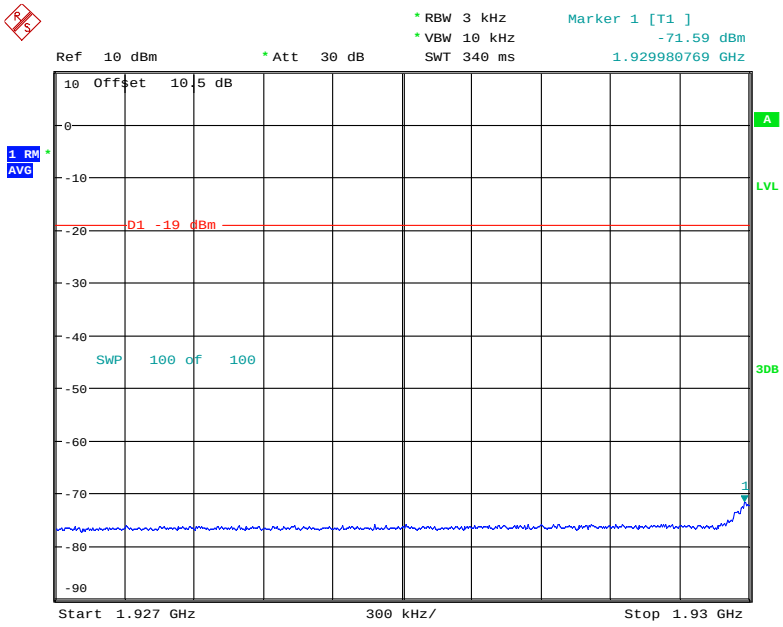
Date: 3.APR.2018 22:34:58

PCS Band GSM Left Side 1930.20MHz Pre-AGC



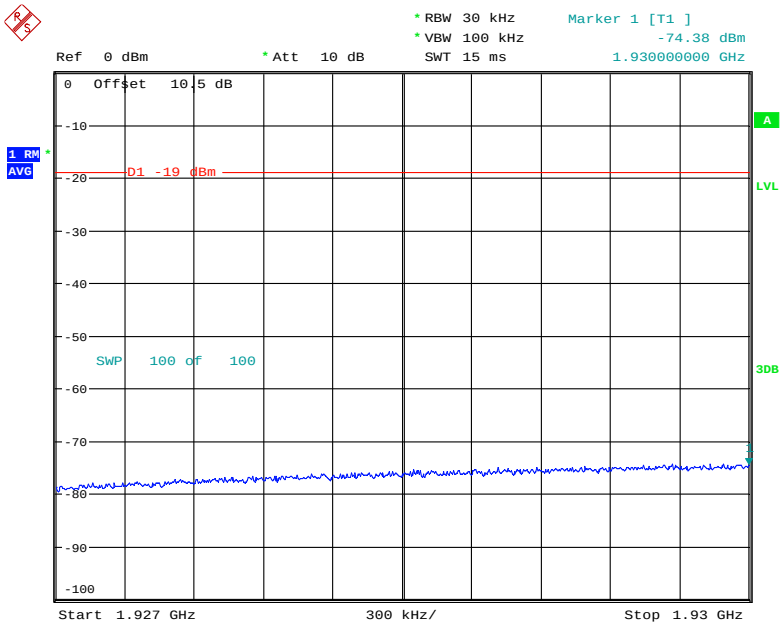
Date: 3.APR.2018 21:58:24

PCS Band GSM Left Side 1930.20MHz Above AGC



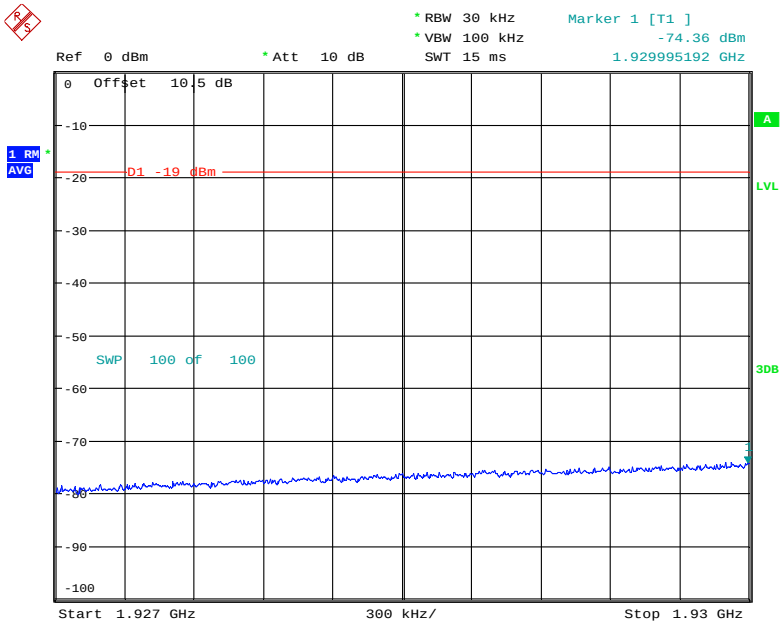
Date: 3.APR.2018 22:04:25

PCS Band CDMA Left Side 1931.25MHz Pre-AGC



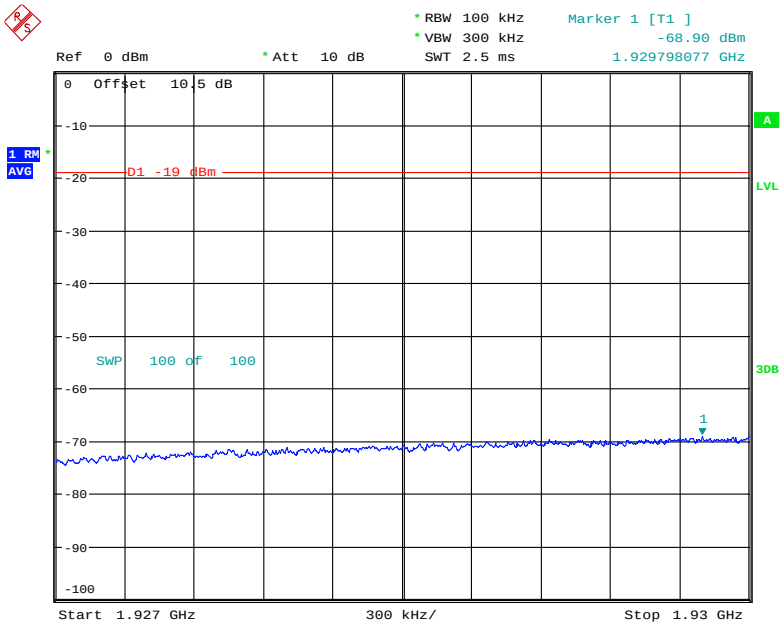
Date: 3.APR.2018 22:15:21

PCS Band CDMA Left Side 1931.25MHz Above AGC



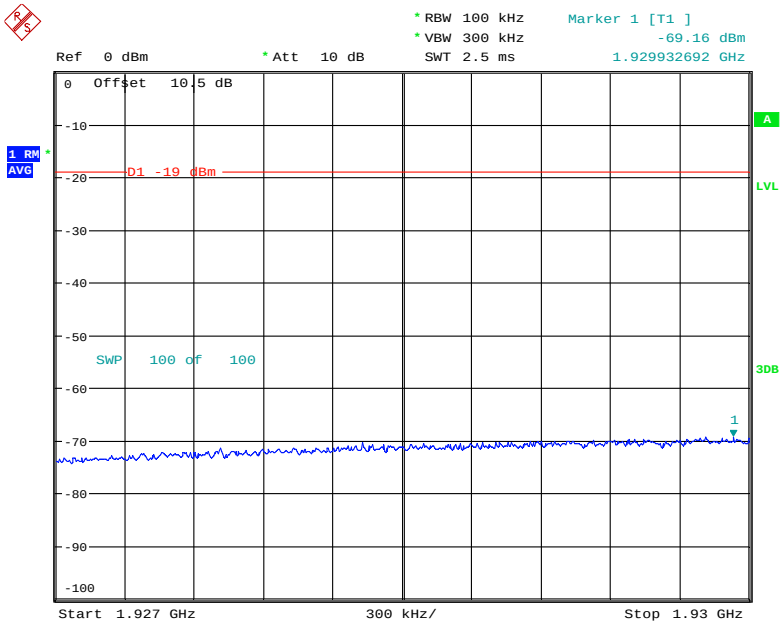
Date: 3.APR.2018 22:20:05

PCS Band LTE Left Side 1932.5MHz Pre-AGC



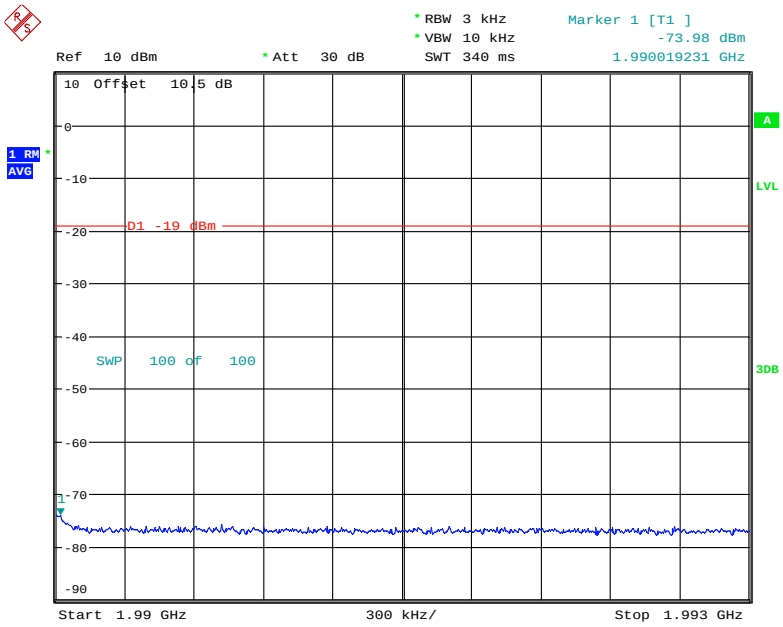
Date: 3.APR.2018 22:22:56

PCS Band LTE Left Side 1932.5MHz Above AGC



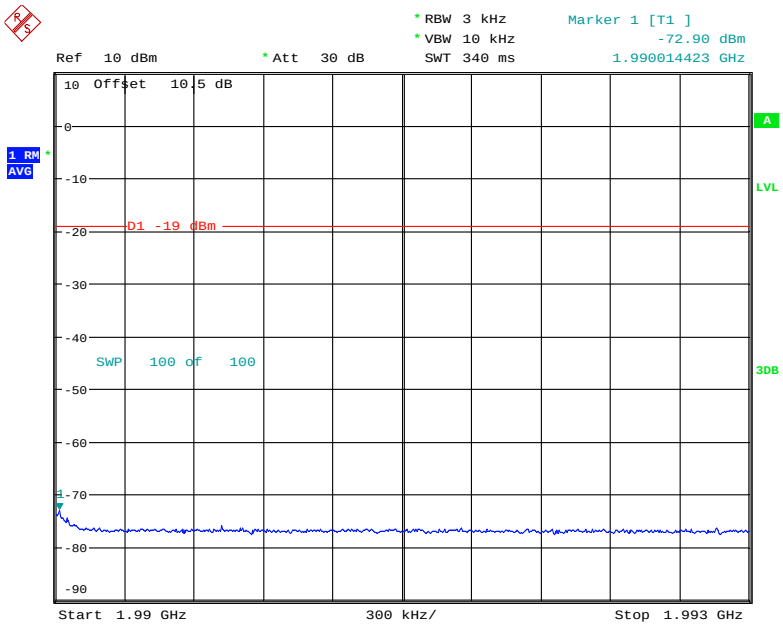
Date: 3.APR.2018 22:23:31

PCS Band GSM Right Side 1989.8MHz Pre-AGC



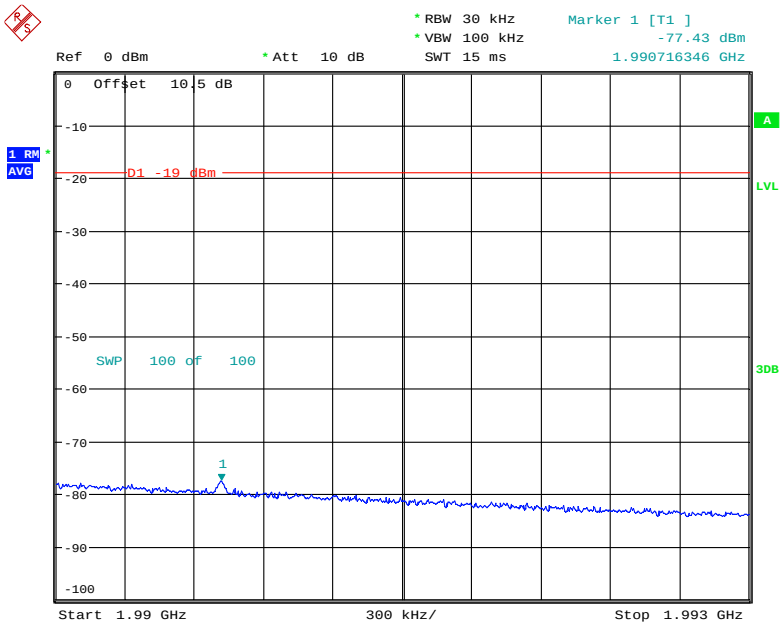
Date: 3.APR.2018 22:08:41

PCS Band GSM Right Side 1989.8MHz Above AGC



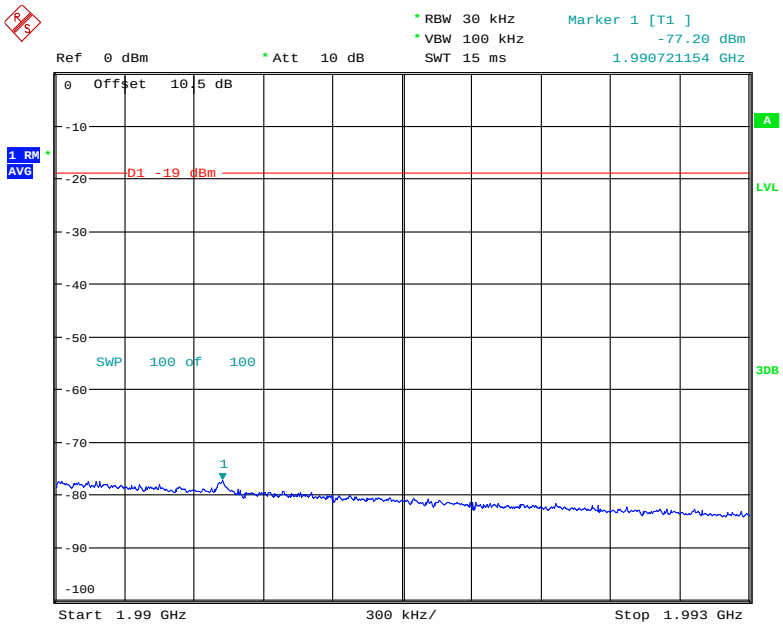
Date: 3.APR.2018 22:06:55

PCS Band CDMA Right Side 1988.75MHz Pre-AGC



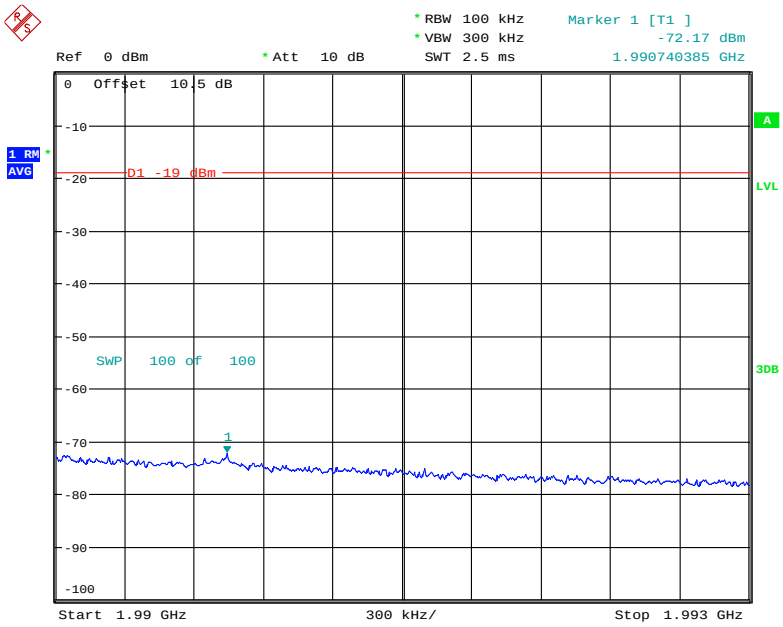
Date: 3.APR.2018 22:12:58

PCS Band CDMA Right Side 1988.75MHz Above AGC



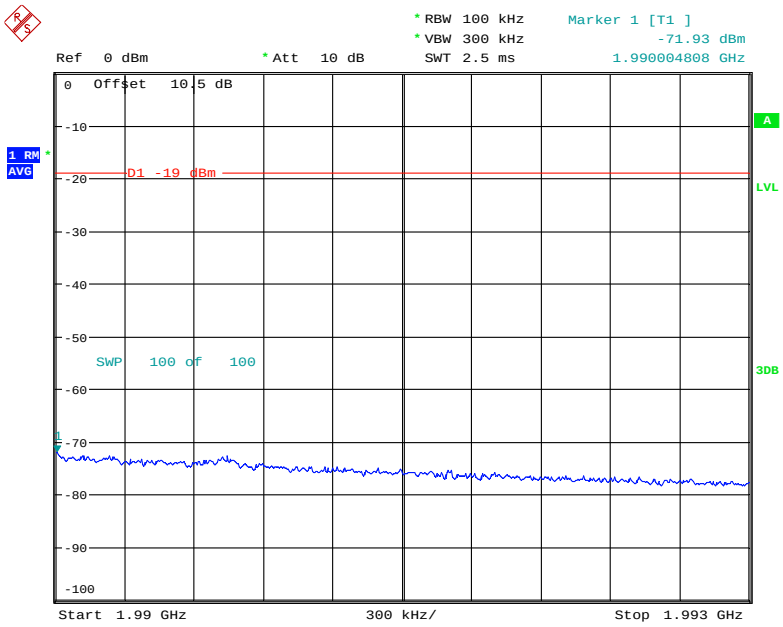
Date: 3.APR.2018 22:14:00

PCS Band LTE Right Side 1987.5MHz Pre-AGC



Date: 3.APR.2018 22:24:44

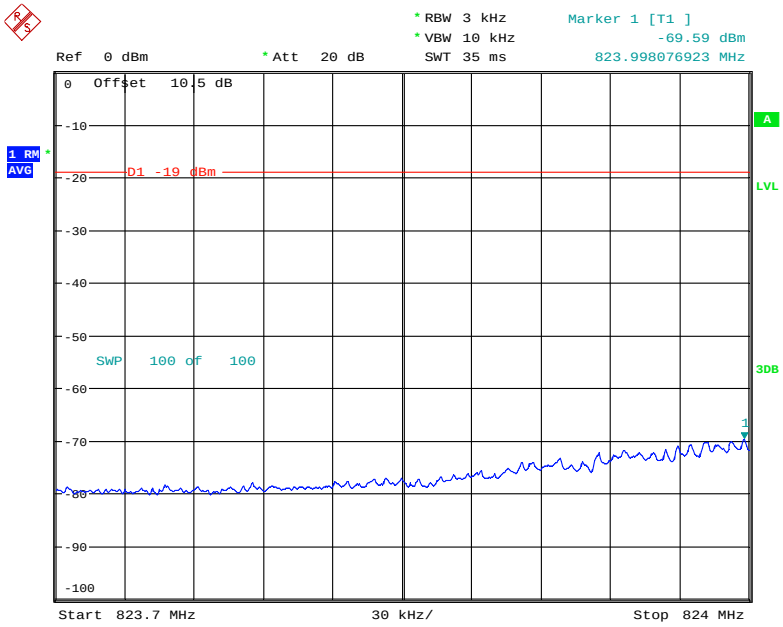
PCS Band LTE Right Side 1987.5MHz Above AGC



Date: 3.APR.2018 22:25:31

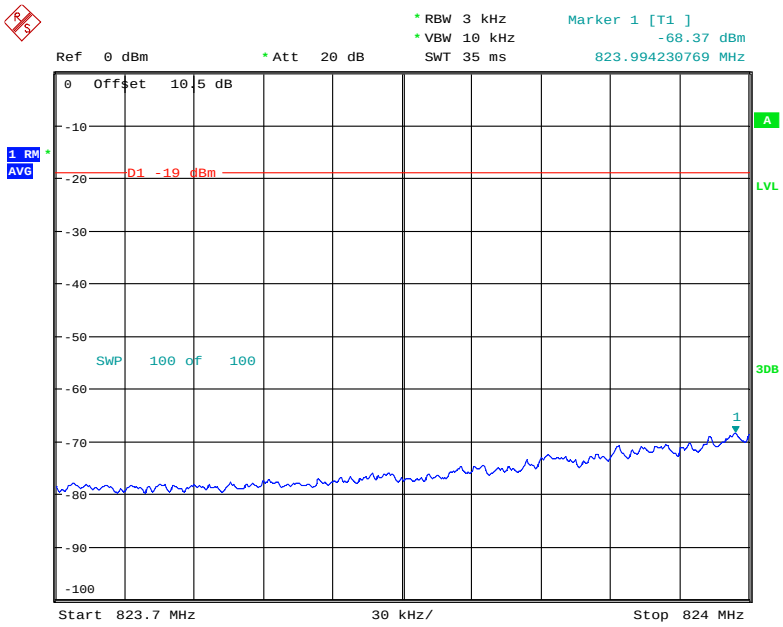
Uplink

Cellular Band GSM Left Side 824.2MHz Pre-AGC



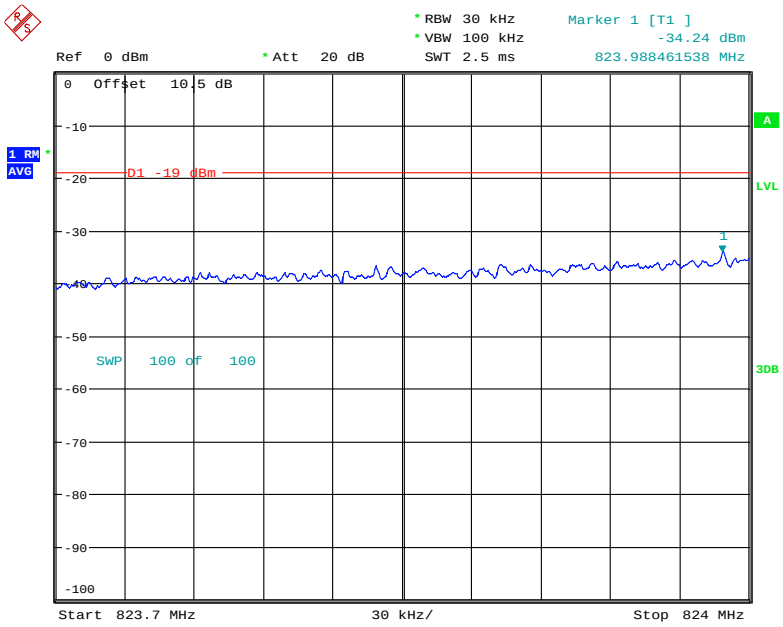
Date: 3.APR.2018 20:10:22

Cellular Band GSM Left Side 824.2MHz Above AGC



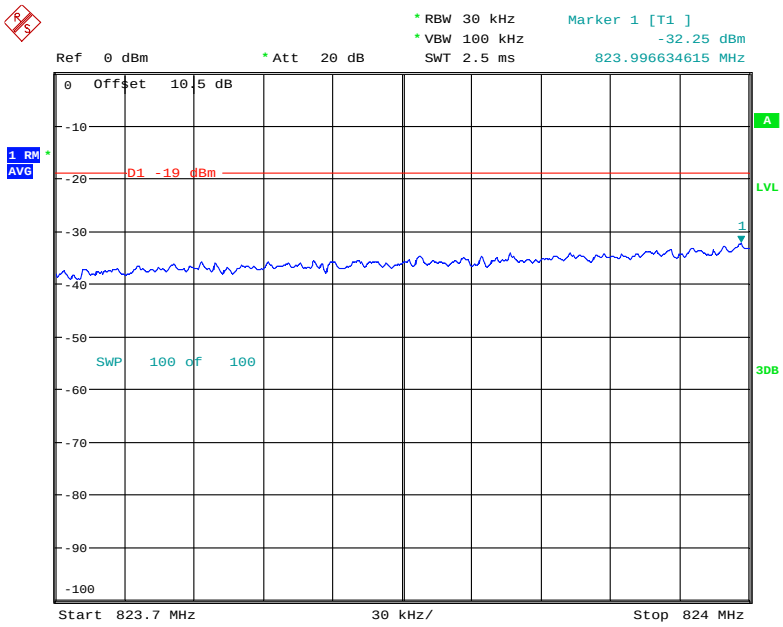
Date: 3.APR.2018 20:10:40

Cellular Band CDMA Left Side 824.88MHz Pre-AGC



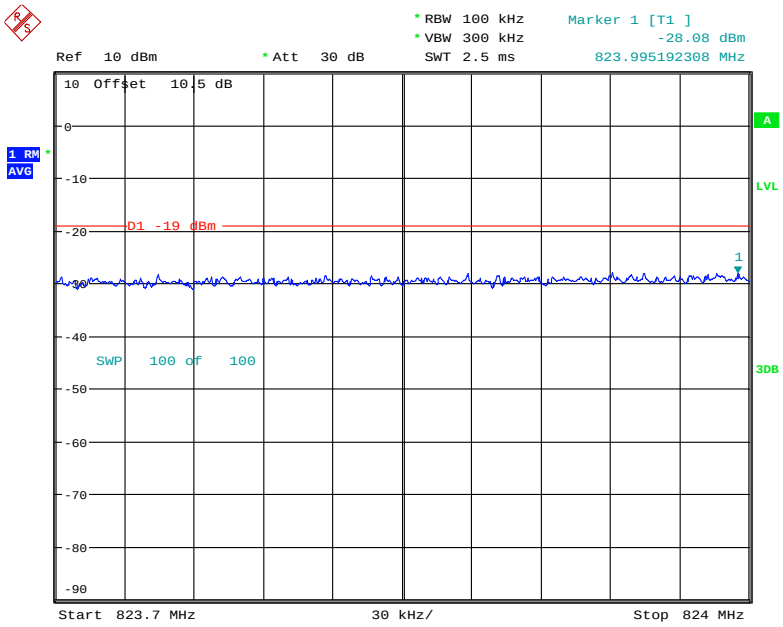
Date: 3.APR.2018 20:23:52

Cellular Band CDMA Left Side 824.88MHz Above AGC



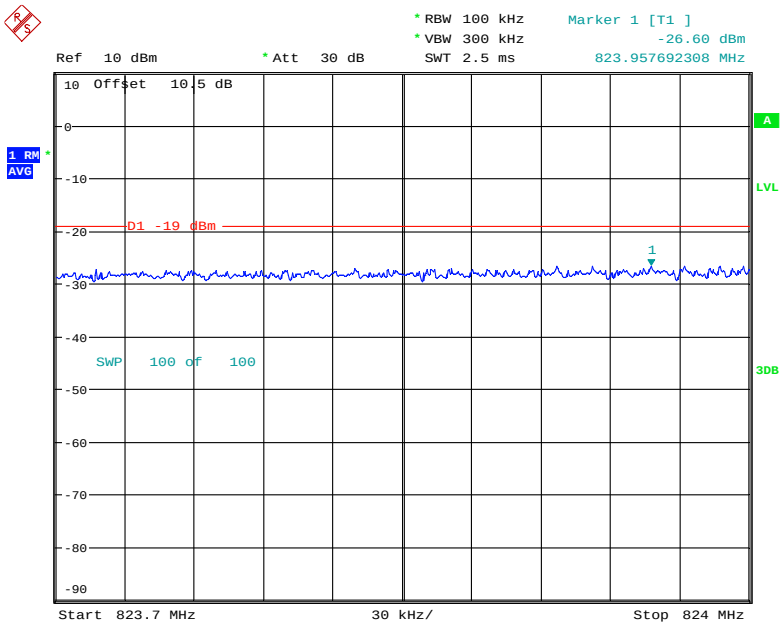
Date: 3.APR.2018 20:24:40

Cellular Band LTE Left Side 826.5MHz Pre-AGC



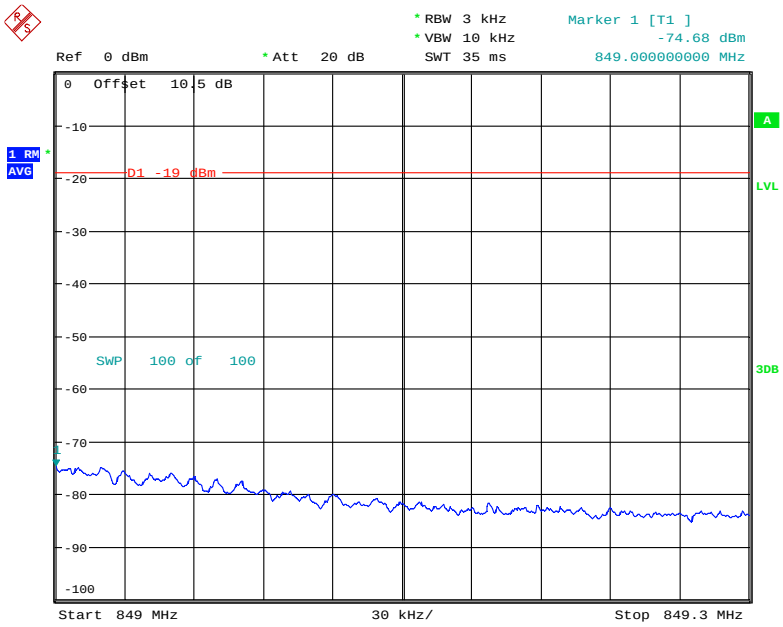
Date: 3.APR.2018 20:25:59

Cellular Band LTE Left Side 826.5MHz Above AGC



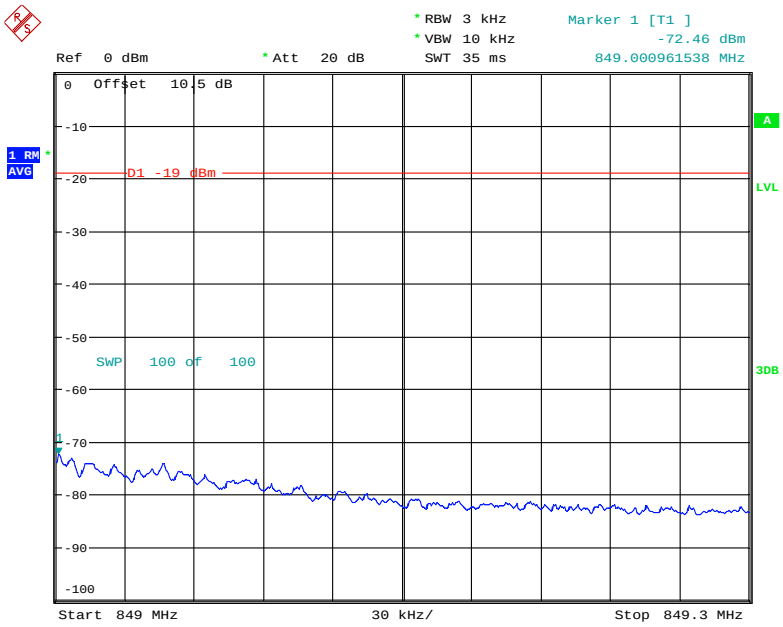
Date: 3.APR.2018 20:27:09

Cellular Band GSM Right Side 848.8MHz Pre-AGC



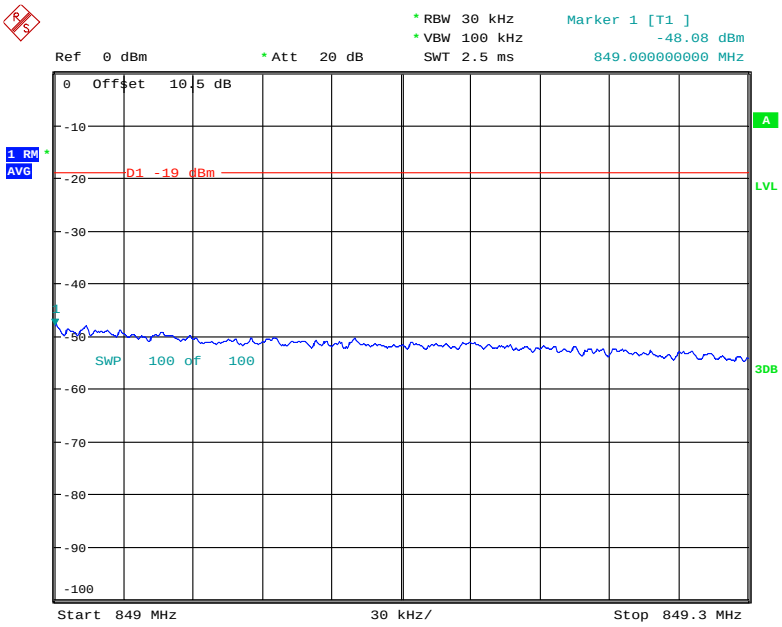
Date: 3.APR.2018 20:15:00

Cellular Band GSM Right Side 848.8MHz Above AGC



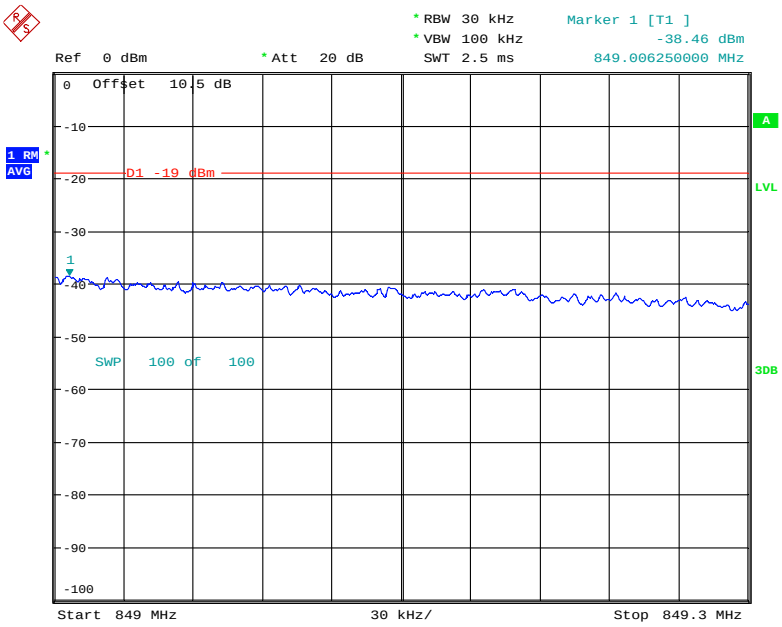
Date: 3.APR.2018 20:17:23

Cellular Band CDMA Right Side 848.10MHz Pre-AGC



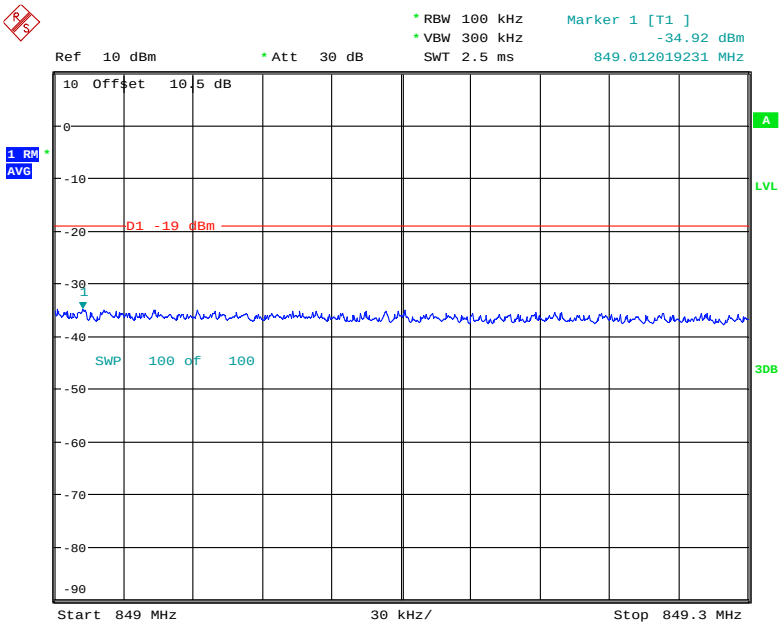
Date: 3.APR.2018 20:20:14

Cellular Band CDMA Right Side 848.10MHz Above AGC



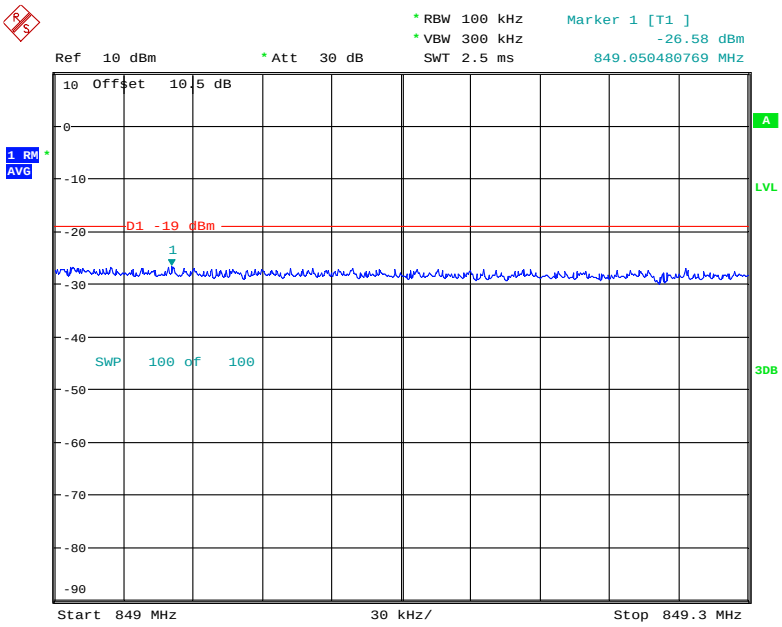
Date: 3.APR.2018 20:22:24

Cellular Band LTE Right Side 846.5MHz Pre-AGC



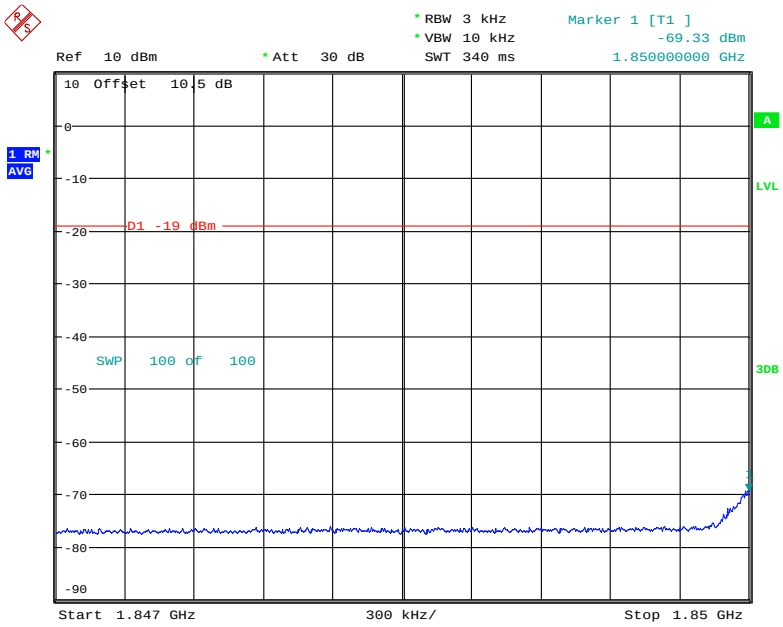
Date: 3.APR.2018 20:28:16

Cellular Band LTE Right Side 846.5MHz Above AGC



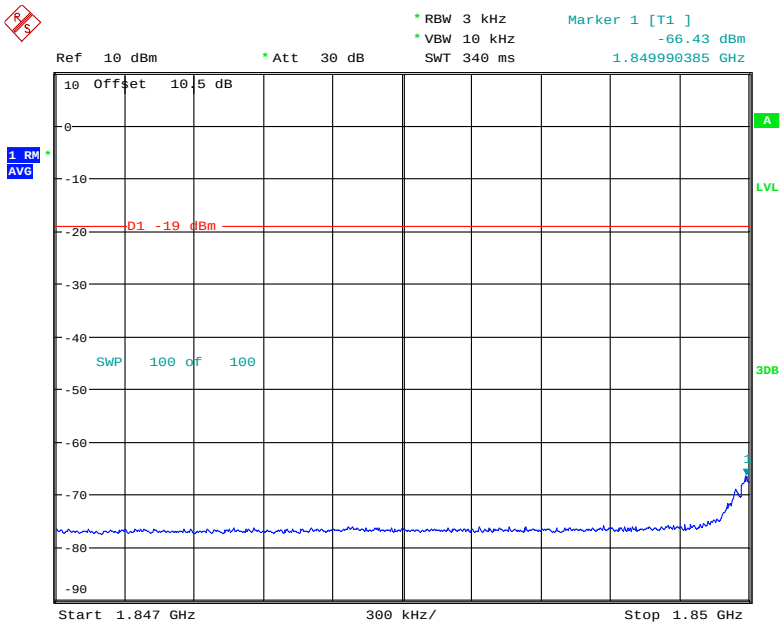
Date: 3.APR.2018 20:29:08

PCS Band GSM Left Side 1850.2MHz Pre-AGC



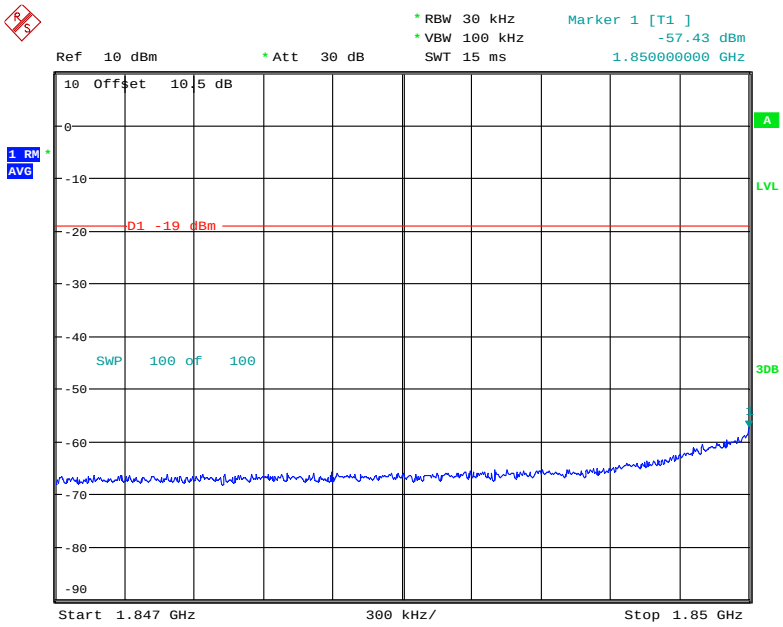
Date: 3.APR.2018 21:48:24

PCS Band GSM Left Side 1850.2MHz Above AGC



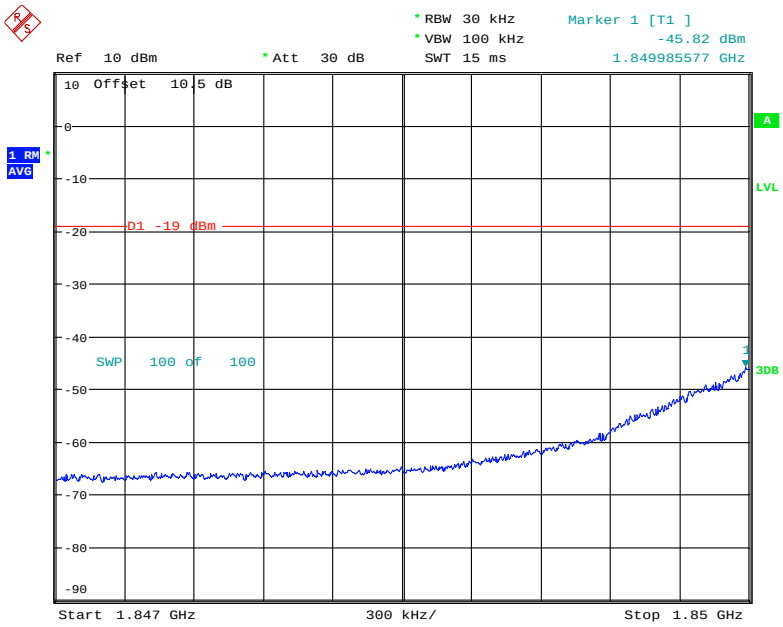
Date: 3.APR.2018 21:46:56

PCS Band CDMA Left Side 1851.25MHz Pre-AGC



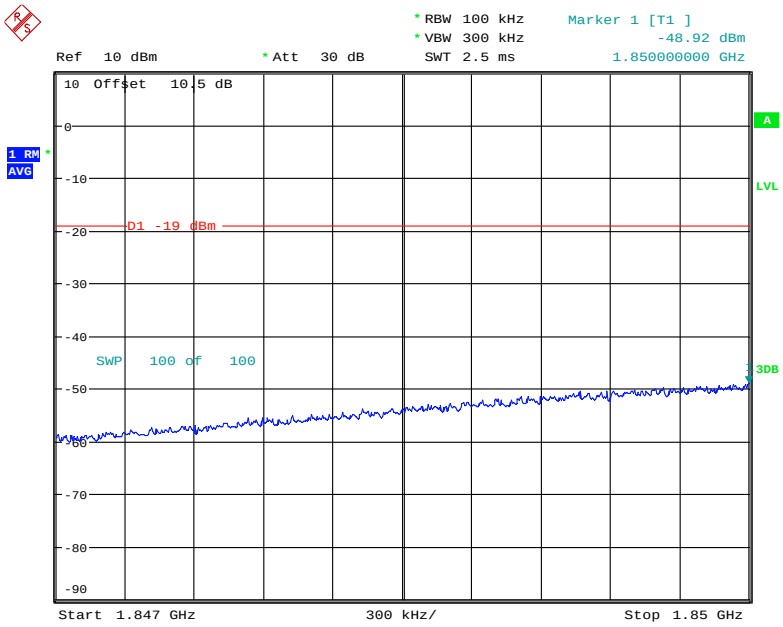
Date: 3.APR.2018 21:38:15

PCS Band CDMA Left Side 1851.25MHz Above AGC



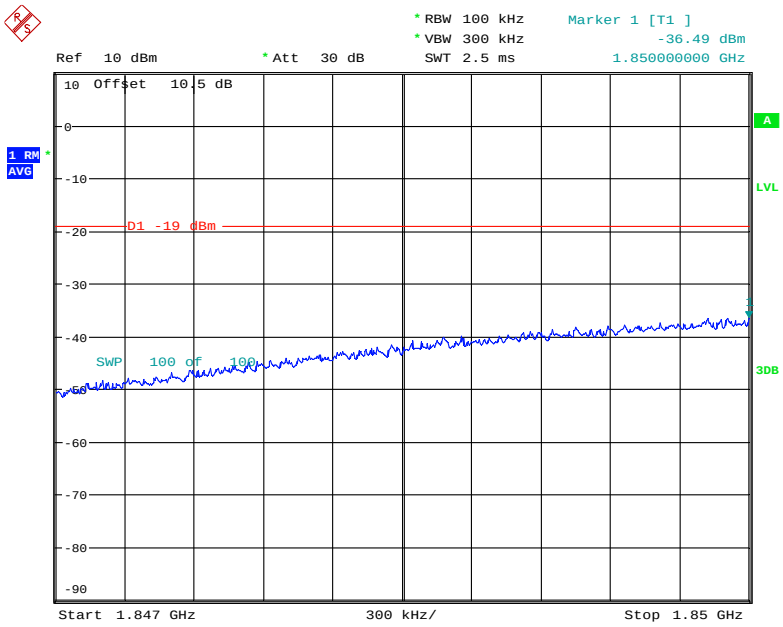
Date: 3.APR.2018 21:43:16

PCS Band LTE Left Side 1852.5MHz Pre-AGC



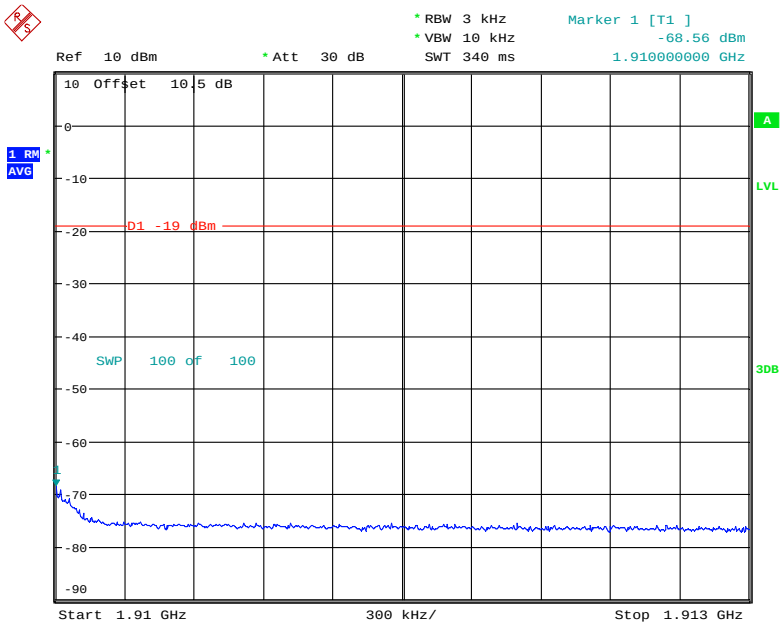
Date: 3.APR.2018 21:30:48

PCS Band LTE Left Side 18512.5MHz Above AGC



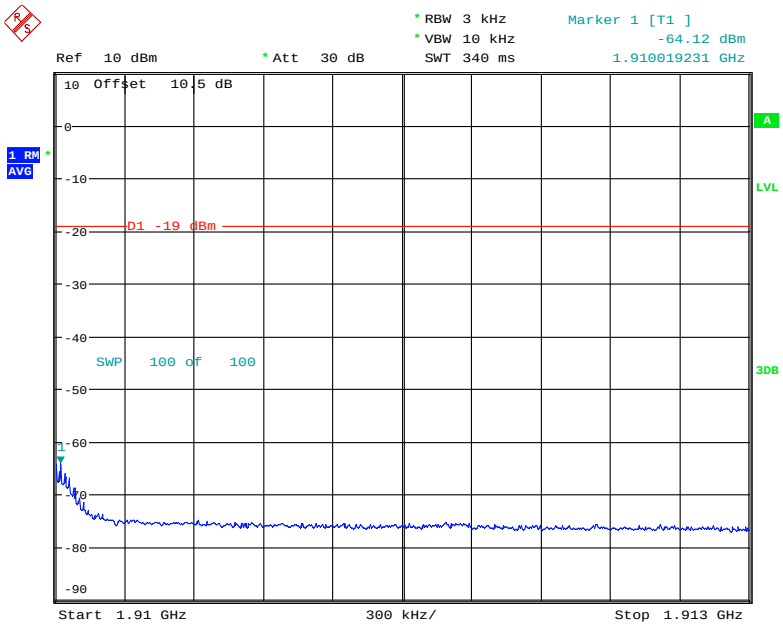
Date: 3.APR.2018 21:31:31

PCS Band GSM Right Side 1909.8MHz Pre-AGC



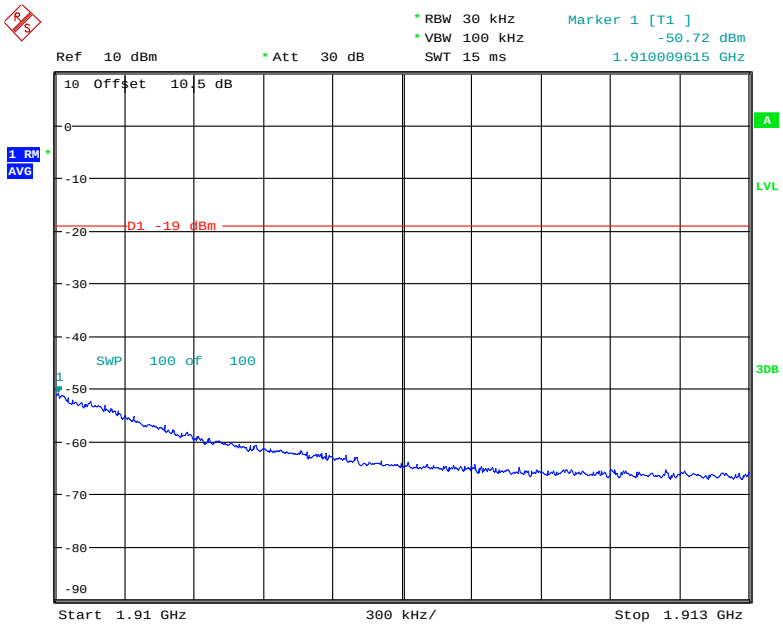
Date: 3.APR.2018 21:50:08

PCS Band GSM Right Side 1909.8MHz Above AGC



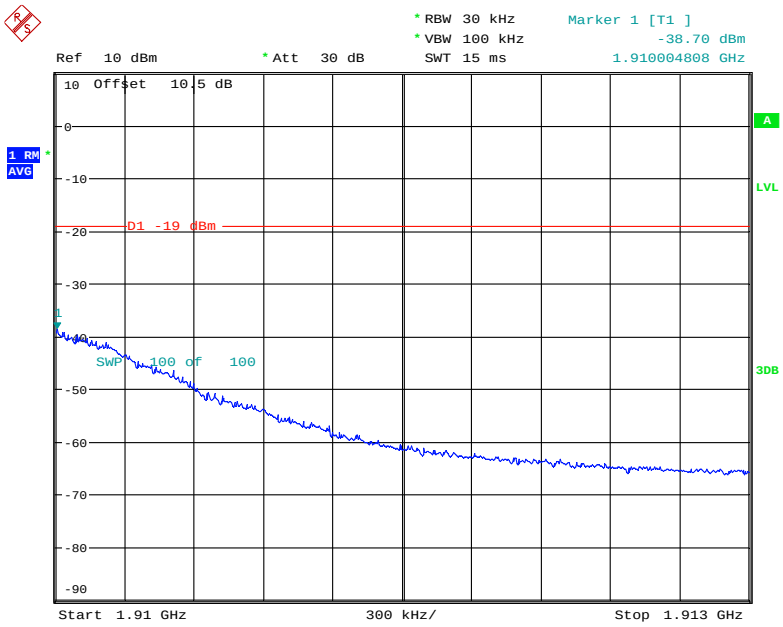
Date: 3.APR.2018 21:51:18

PCS Band CDMA Right Side 1908.75MHz Pre-AGC



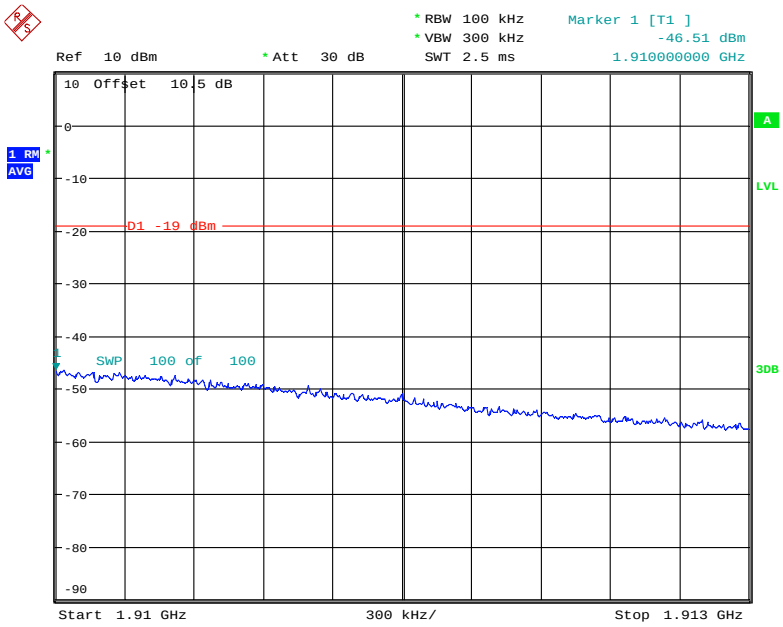
Date: 3.APR.2018 21:36:09

PCS Band CDMA Right Side 1908.75MHz Above AGC



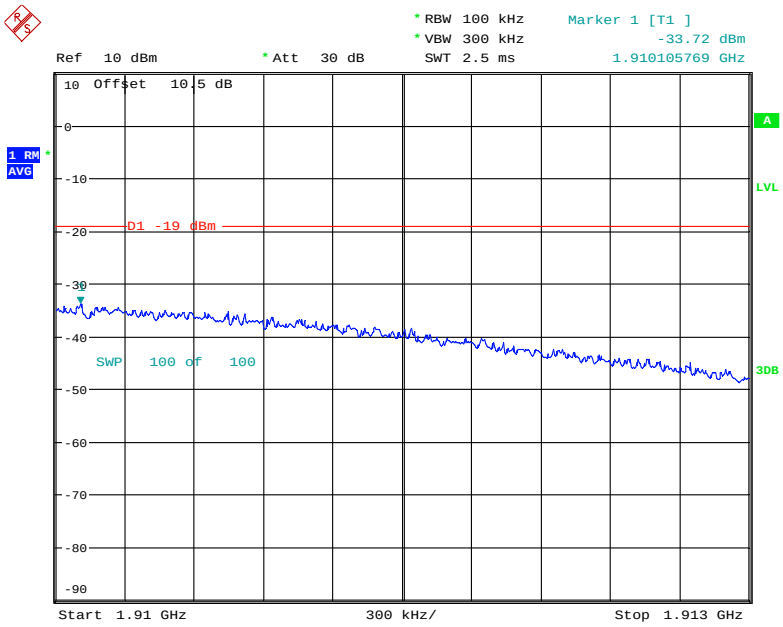
Date: 3.APR.2018 21:36:58

PCS Band LTE Right Side 1907.5MHz Pre-AGC



Date: 3.APR.2018 21:33:09

PCS Band LTE Right Side 1907.5MHz Above AGC



Date: 3.APR.2018 21:34:12

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

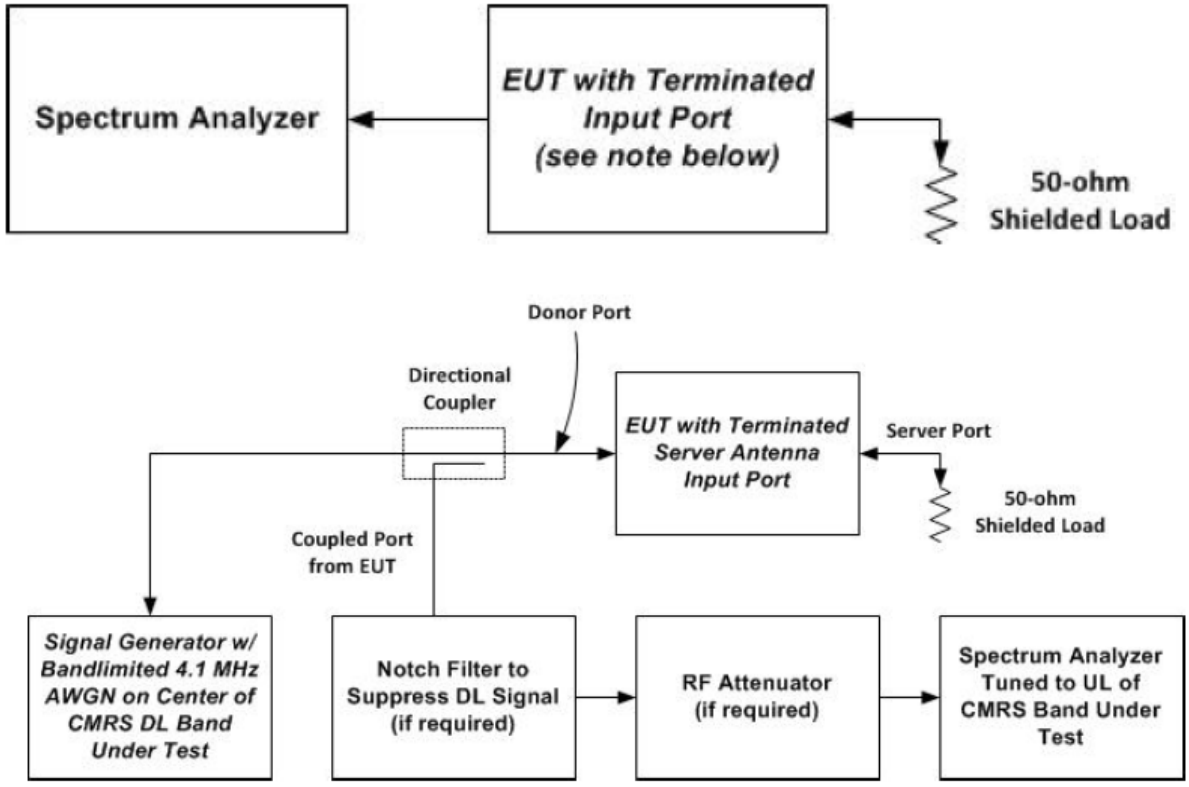
Applicable Standards

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:	24~25 ℃
Relative Humidity:	49~55 %
ATM Pressure:	100.0~101.0 kPa

The testing was performed by Jacob Kong from 2018-04-16 to 2018-08-06.

Test Result: Compliance. Please refer to following table.

Maximum Noise:

Mode	Operation Bands	Measured Value	Limit	Result
		dBm/MHz	dBm/MHz	
Uplink	PCS	-48.91	-37.01	Compliance
	cellular	-51.22	-44.05	Compliance
Downlink	PCS	-51.56	-37.01	Compliance
	cellular	-52.35	-44.05	Compliance

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

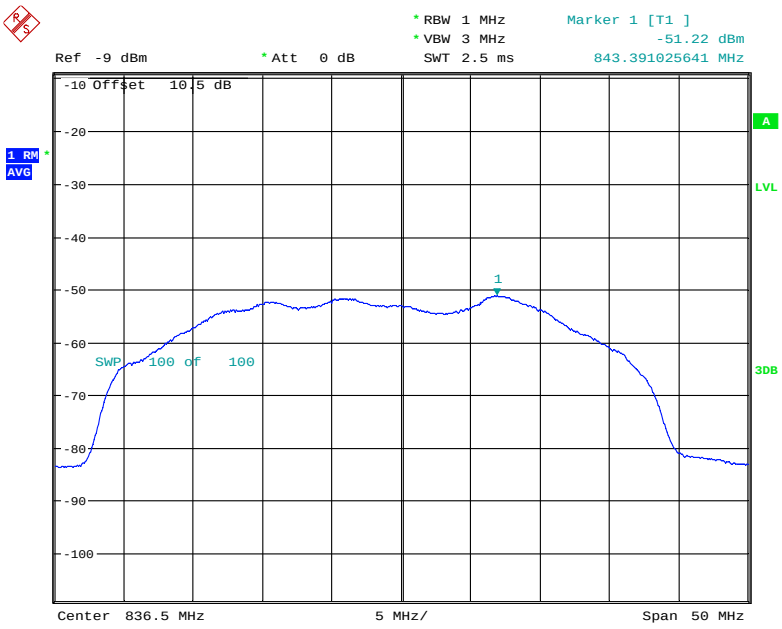
Variable uplink Noise limit test result:

Operation Bands	RSSI	Measured Value	Limit	Results
	dBm	dBm/MHz	dBm/MHz	
PCS	-80	-53.28	-37.01	Compliance
	-70	-54.06	-37.01	Compliance
	-43	-64.11	-60.00	Compliance
	-42	-64.72	-61.00	Compliance
	-41	-65.54	-62.00	Compliance
	-49	-65.91	-63.00	Compliance
cellular	-90	-50.75	-44.05	Compliance
	-70	-50.61	-44.05	Compliance
	-50	-55.76	-53.00	Compliance
	-44	-62.36	-59.00	Compliance
	-43	-64.15	-60.00	Compliance
	-42	-64.09	-61.00	Compliance

Note: The limit please refer to KDB 935210 D03 Signal Booster Measurements v04 Annex D

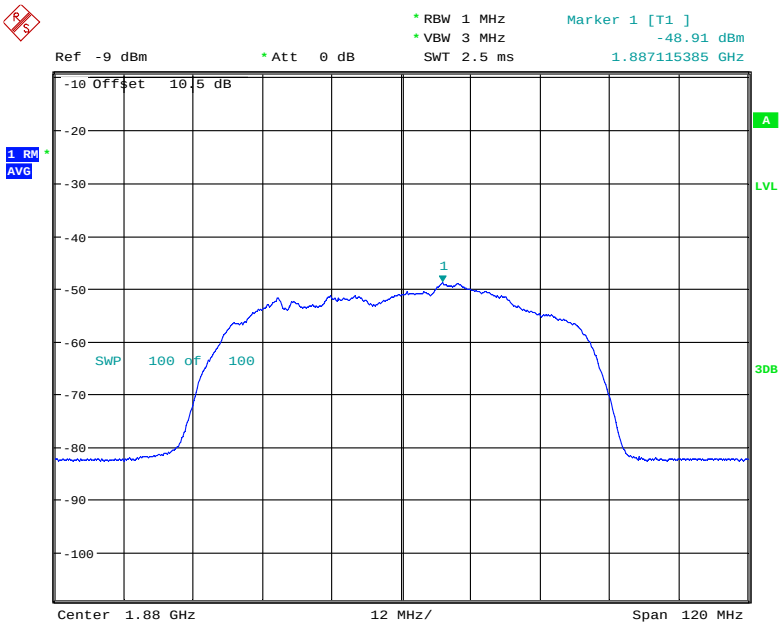
Maximum Noise:

Uplink Cellular Band



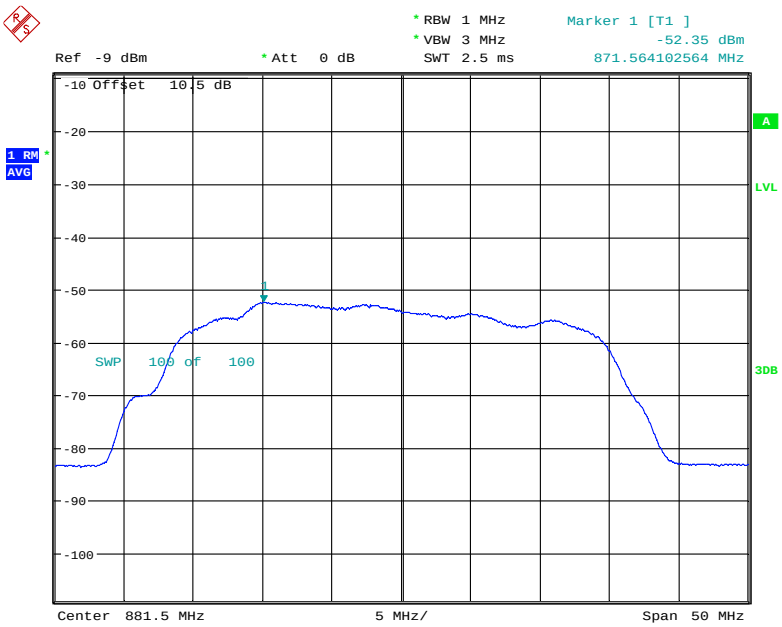
Date: 16.APR.2018 18:46:31

Uplink PCS Band



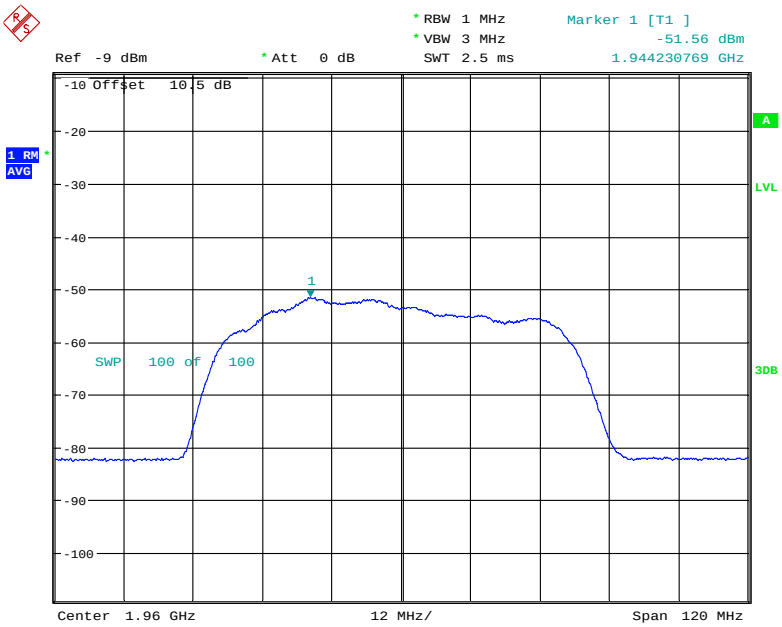
Date: 16.APR.2018 18:46:01

Downlink Cellular Band



Date: 16.APR.2018 18:39:21

Downlink PCS Band



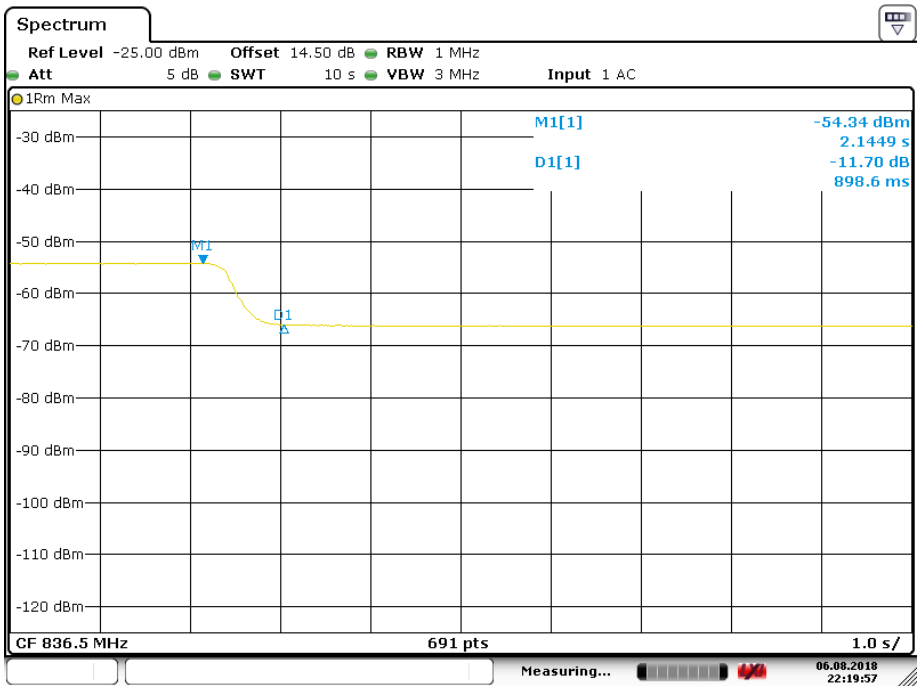
Date: 16.APR.2018 18:40:35

Variable Uplink Noise Timing:

Operating Band	Measured Value	Limit	Results
	s	s	
PCS	0.942	3	Compliance
cellular	0.899	3	Compliance

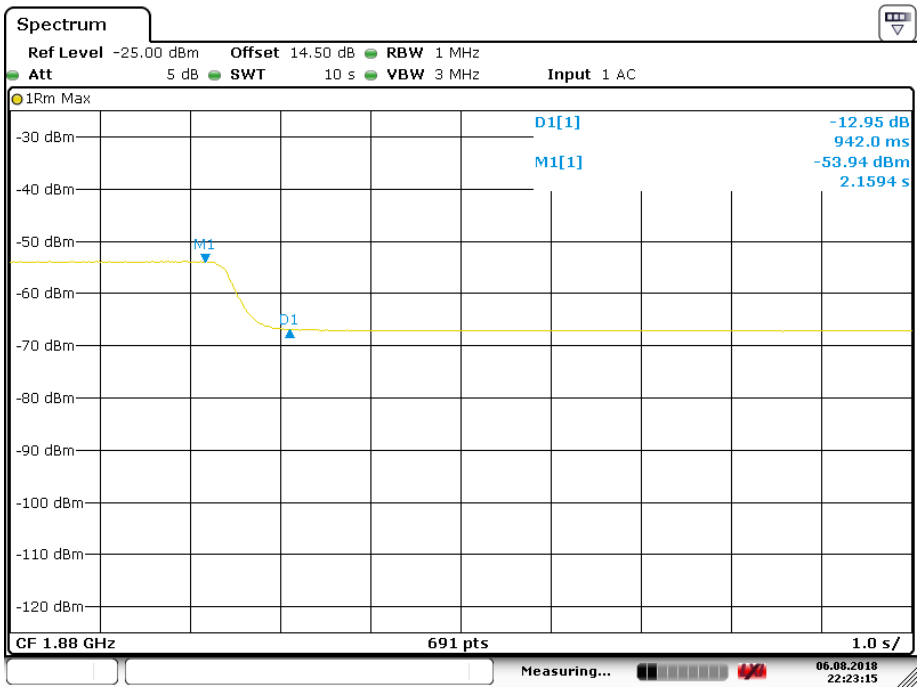
Note: The uplink noise decreases to the specified level within 1 second for mobile devices and 3 seconds for fixed devices.

Cellular Band



Date: 6.AUG.2018 22:19:57

PCS Band



Date: 6.AUG.2018 22:23:16

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

Applicable Standards

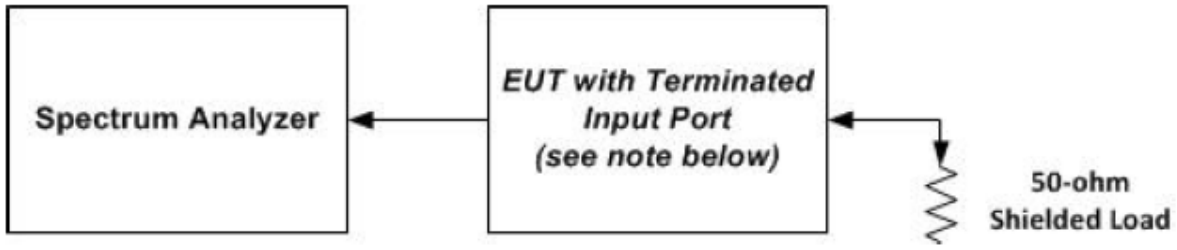
According to§ 20.21(e)(8)(i)(I) Uplink Inactivity&§20.21(e)(4); §20.21(e)(4) Self-monitoring.

Test Procedure

This measurement procedure is intended to demonstrate compliance to the uplink inactivity requirements specified for wideband consumer signal boosters in § 20.21(e)(8)(i)(I).

a) Connect the EUT to the test equipment as shown in **Figure 3** with the uplink output connected to the spectrum analyzer.
b) Select the RMS power averaging detector.
c) Set the spectrum analyzer RBW for 1 MHz with the VBW ≥ 3 × RBW.
d) Set the center frequency of the spectrum analyzer to the center of the uplink operational band.
e) Set the span for 0 Hz with a single sweep time for a minimum of 330 seconds.
f) Start to capture a new trace using MAX HOLD.
g) After approximately 15 seconds turn on the EUT power.
h) Once the full spectrum analyzer trace is complete place a MARKER on the leading edge of the pulse and use the DELTA MARKER METHOD to measure the time until the uplink 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:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

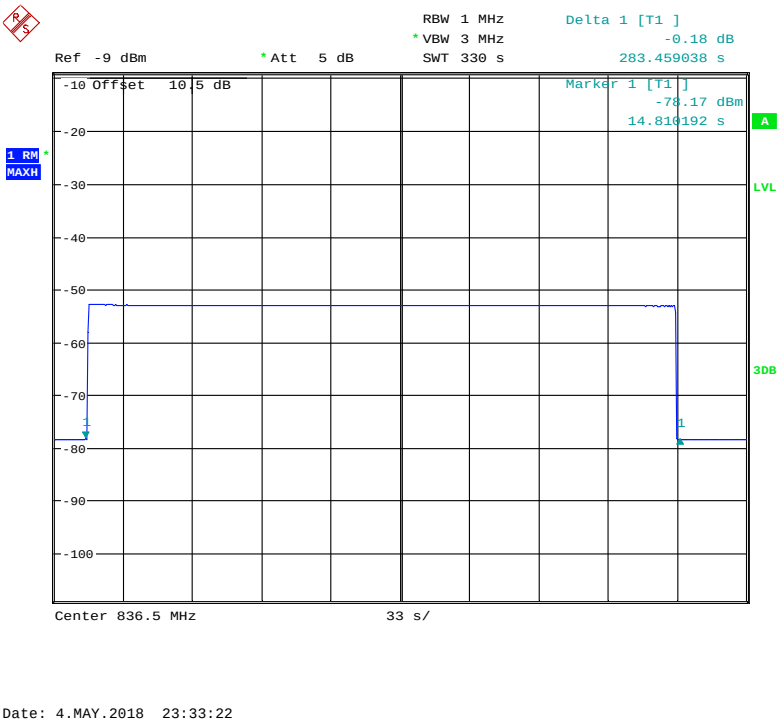
The testing was performed by Jacob Kong on 2018-05-04.

Test Result: Compliance. Please refer to following table.

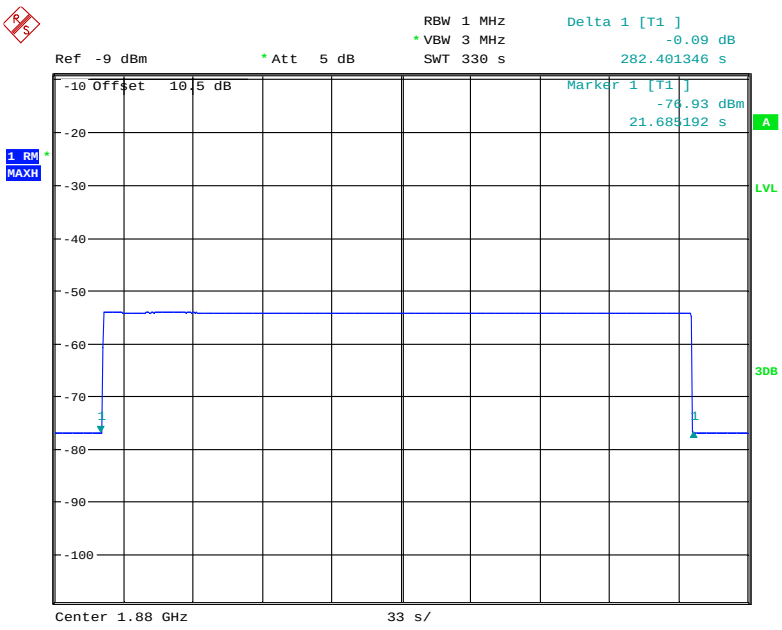
Operation Band	Measured value	Limit	Result
	s	s	
cellular	283.46	300	Compliance
PCS	282.40		Compliance

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

Cellular Band



PCS Band


RBW 1 MHz
VBW 3 MHz
SWT 330 s
Delta 1 [T1]
-0.09 dB
282.401346 s
Ref -9 dBm
Att 5 dB
Offset 10.5 dB
Marker 1 [T1]
-76.93 dBm
21.685192 s
1 RM
MAXH
A
LVL
3DB
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Center 1.88 GHz
33 s/
Date: 4.MAY.2018 23:45:32

§ 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.

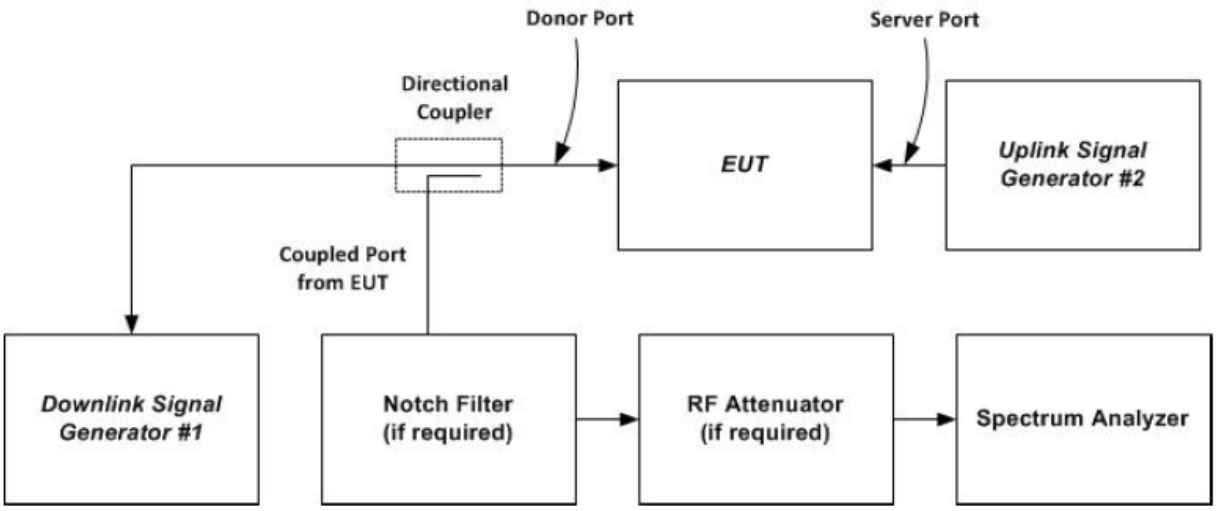


Figure 5 – Variable gain instrumentation test setup

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Kong on 2018-08-06.

Test Result: Compliance. Please refer to following table.

MSCL calculation:

Operation Bands	Frequency	Distance	Path Loss	Indoor Antenna Gain	Indoor Cable Loss	Polarity Loss	MSCL
	MHz	m	dB	(dBi)	(dB)	(dB)	
Cellur	836.5	2	36.97	2.14	0.00	3.01	37.84
PCS	1880	2	44.00	2.14	0.00	3.01	44.87

Note:
Path loss=20logf+20logd-27.5
Polarity loss=20log (1/ sin (45)) =3.01
MSCL= Path Loss-Indoor Antenna Gain + Indoor Cable Loss + Polarity Loss
All the parameters above was provided by manufacturer.

Variable booster gain:

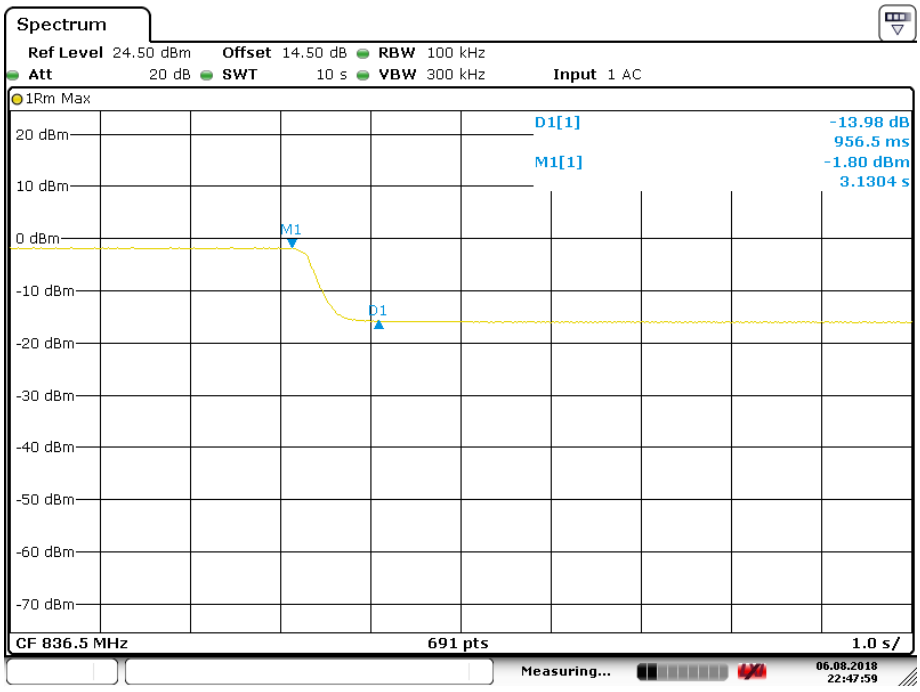
Operation Bands	RSSI	P_{in}	P_{out}	MSCL	Measured Value	Limit	Result
	dBm	dBm	dBm	dB	dB	dB	
Cellular	-90	-39.6	13.82	37.84	53.42	64.95	Compliance
	-50	-39.6	9.61	37.84	49.21	53.84	Compliance
	-45	-39.6	4.83	37.84	44.43	48.84	Compliance
	-42	-39.6	1.48	37.84	41.08	45.84	Compliance
	-41	-39.6	0.64	37.84	40.24	44.84	Compliance
	-40	-39.6	-0.38	37.84	39.22	43.84	Compliance
PCS	-70	-38.4	7.31	44.87	45.71	71.98	Compliance
	-50	-38.4	4.78	44.87	43.18	60.87	Compliance
	-45	-38.4	0.24	44.87	38.64	55.87	Compliance
	-43	-38.4	-0.58	44.87	37.82	53.87	Compliance
	-41	-38.4	-1.20	44.87	37.2	51.87	Compliance
	-40	-38.4	-1.59	44.87	36.81	50.87	Compliance

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

Variable gain timing:

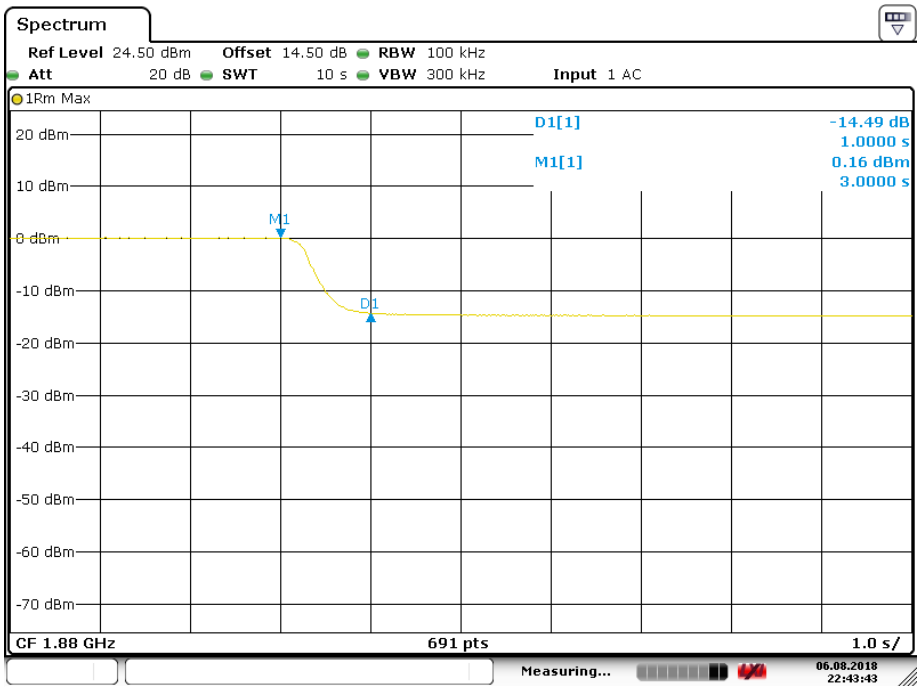
Operation Bands	Measured value	Limit	Results
MHz	s	s	
Cellular	0.96	3	Compliance
PCS	1.00		Compliance

Cellular Band



Date: 6.AUG.2018 22:48:00

PCS Band



Date: 6.AUG.2018 22:43:43

§ 2.1049 - OCCUPIED BANDWIDTH

Applicable Standards

According to§ 2.1049 Measurements required: Occupied bandwidth.

Test Procedure

This measurement is required to compare the uniformity of the output signal relative to the input signal and to satisfy the requirements of § 2.1049.
a) Connect the test equipment as shown in **Figure 6** to measure the characteristics of the test signals produced by the signal generator.
b) Set VBW to ≥ 3 × RBW.
c) Set the center frequency of the spectrum analyzer to the center of the operational band. The span will be adjusted for each modulation type and occupied bandwidth as necessary for accurately viewing the signals.
d) Set the signal generator for power level to match the values obtained in 7.2.
e) Set the signal generator modulation type for GSM with a PRBS pattern and allow the trace on the signal generator to stabilize adjusting the span as necessary.
f) Set the spectrum analyzer RBW for 1% to 5% of the emissions bandwidth.
g) Capture the spectrum analyzer trace for inclusion in the test report.
h) Repeat 7.10c) to 7.10g) for CDMA and W-CDMA modulation adjusting the span as necessary for all uplink and downlink operational bands. AWGN or LTE may be used in place of W-CDMA, as an option.
i) Connect the test equipment as shown in **Figure 1**. Begin with the uplink output connected to the spectrum analyzer.
j) Repeat 7.10c) to 7.10h) in this new configuration.

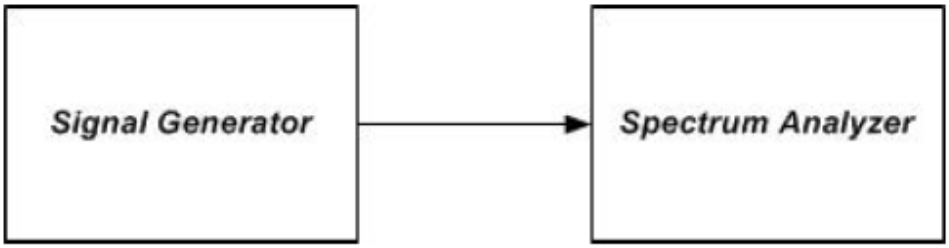


Figure 6 – Occupied bandwidth instrumentation test setup

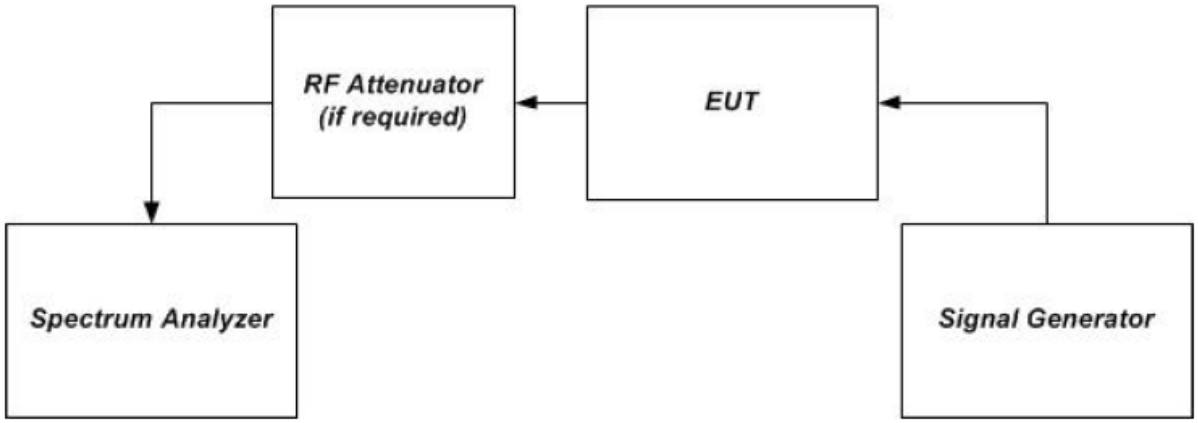


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

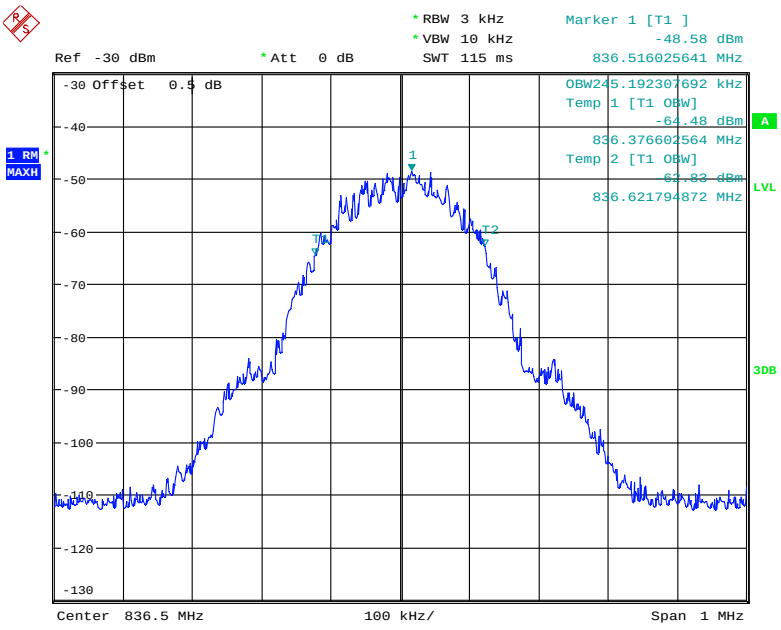
The testing was performed by Poboo Li on 2018-04-02.

Test Result: Compliance. Please refer to following table.

Input-versus-output signal comparison

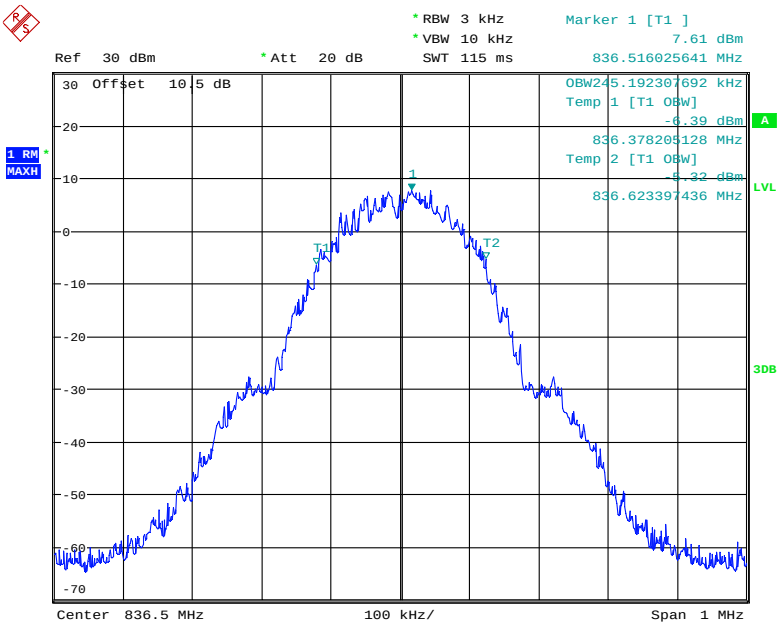
Mode	Operation Band	Signal type	Input	Output	Results
			MHz	MHz	
Uplink	PCS	GSM	0.245	0.245	Compliance
		CDMA	1.274	1.274	Compliance
		WCDMA	4.183	4.215	Compliance
	cellular	GSM	0.245	0.245	Compliance
		CDMA	1.274	1.269	Compliance
		WCDMA	4.183	4.183	Compliance
Downlink	PCS	GSM	0.245	0.247	Compliance
		CDMA	1.274	1.274	Compliance
		WCDMA	4.199	4.199	Compliance
	cellular	GSM	0.245	0.244	Compliance
		CDMA	1.274	1.269	Compliance
		WCDMA	4.199	4.199	Compliance

Uplink, 836.5MHz -GSM(Input)



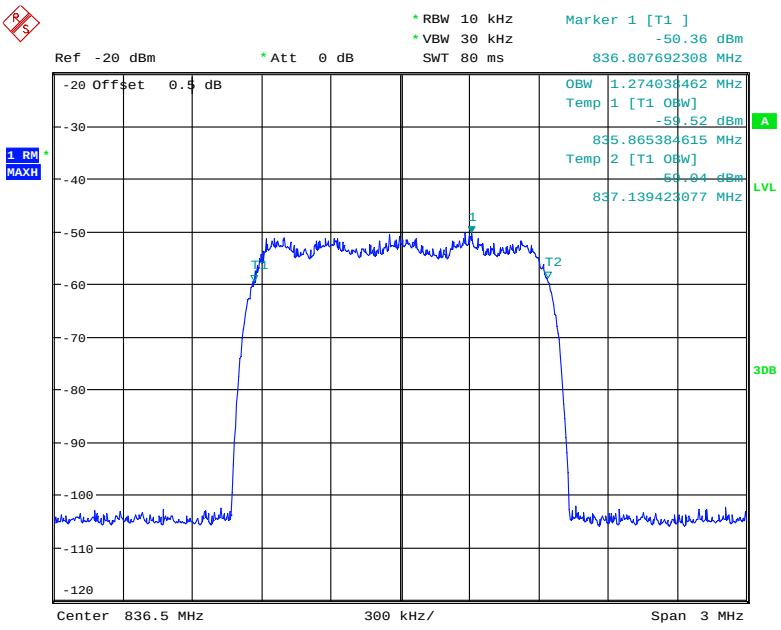
Date: 2.APR.2018 21:32:19

Uplink, 836.5MHz -GSM (Output)



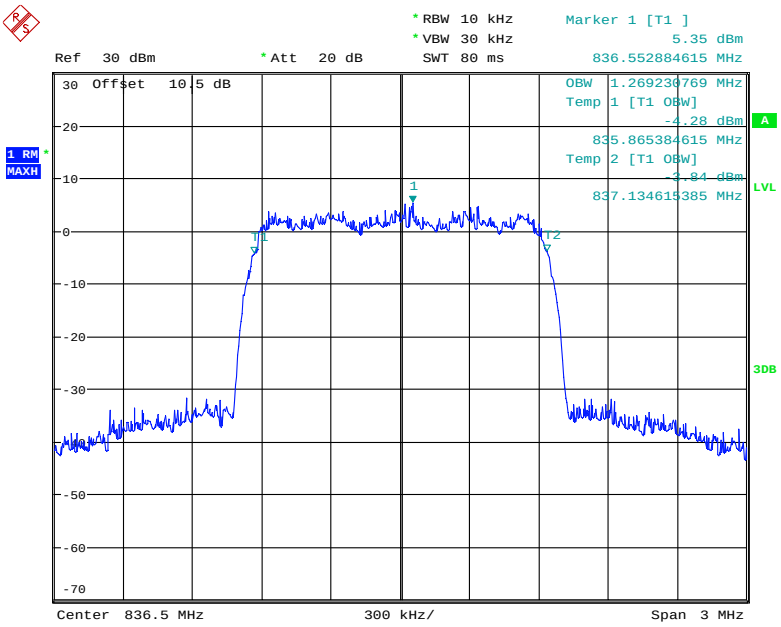
Date: 2.APR.2018 21:59:23

Uplink, 836.5MHz -CDMA (Input)



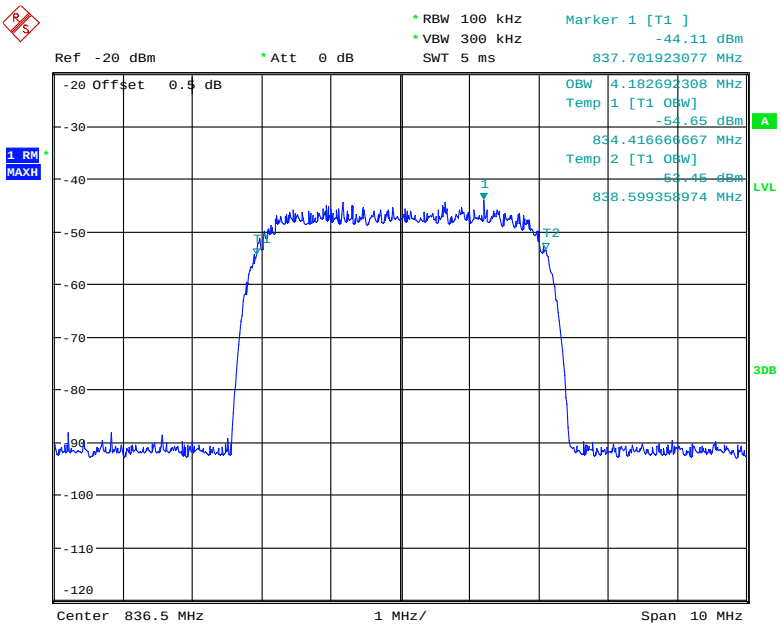
Date: 2.APR.2018 21:34:29

Uplink, 836.5MHz -CDMA (Output)



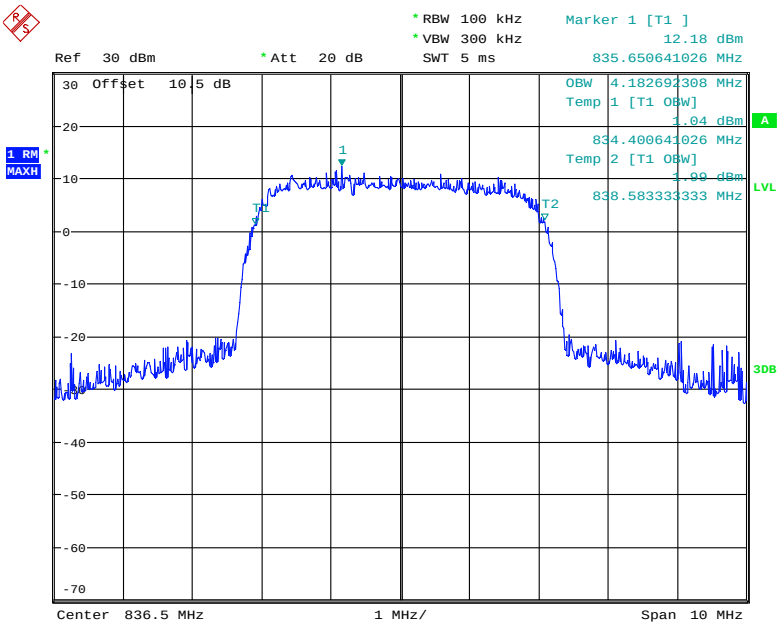
Date: 2.APR.2018 21:58:24

Uplink, 836.5MHz –WCDMA (Input)



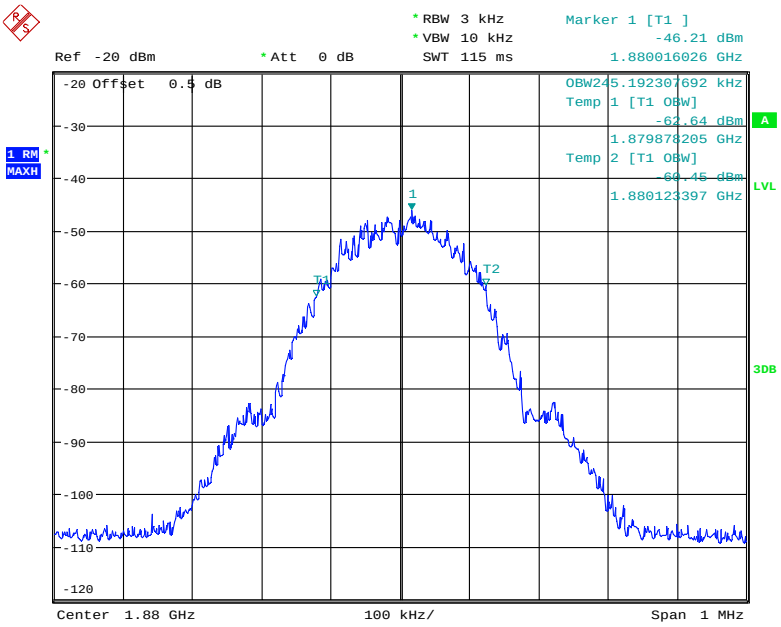
Date: 2.APR.2018 21:38:21

Uplink, 836.5MHz –WCDMA (Output)



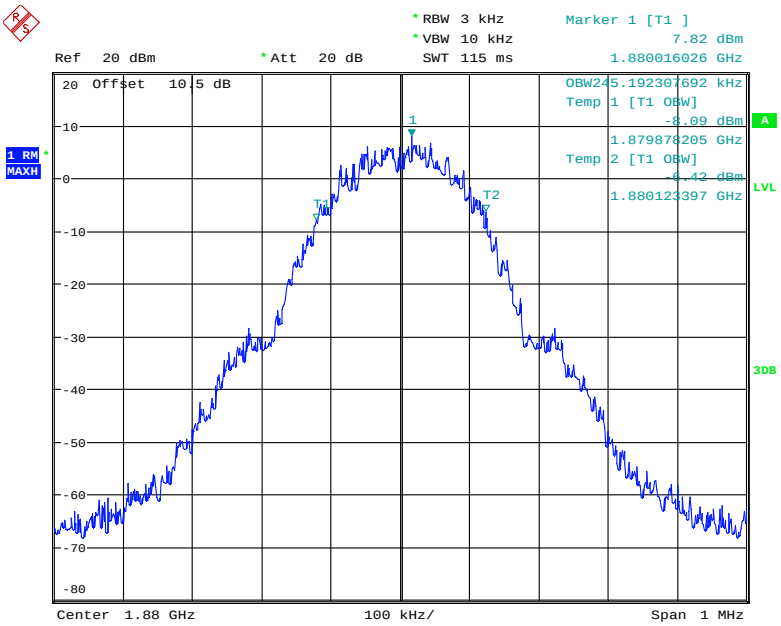
Date: 2.APR.2018 21:57:40

Uplink, 1880MHz-GSM(Input)



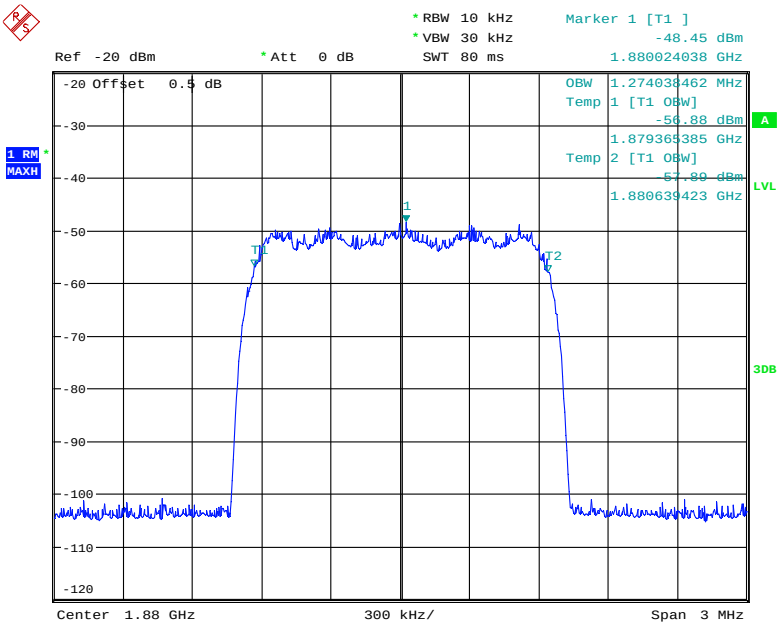
Date: 2.APR.2018 21:45:56

Uplink, 1880MHz-GSM (Output)



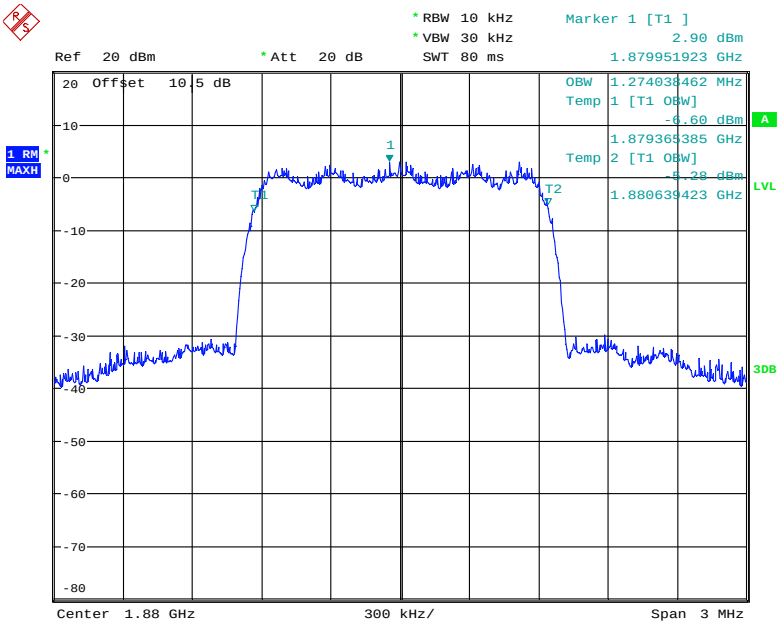
Date: 2.APR.2018 21:54:27

Uplink, 1880MHz-CDMA(Input)



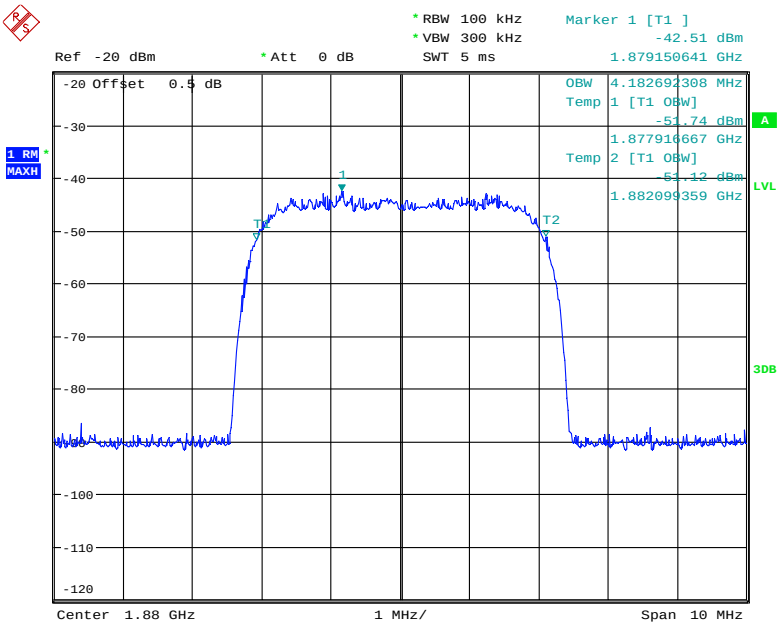
Date: 2.APR.2018 21:44:40

Uplink, 1880MHz-CDMA (Output)



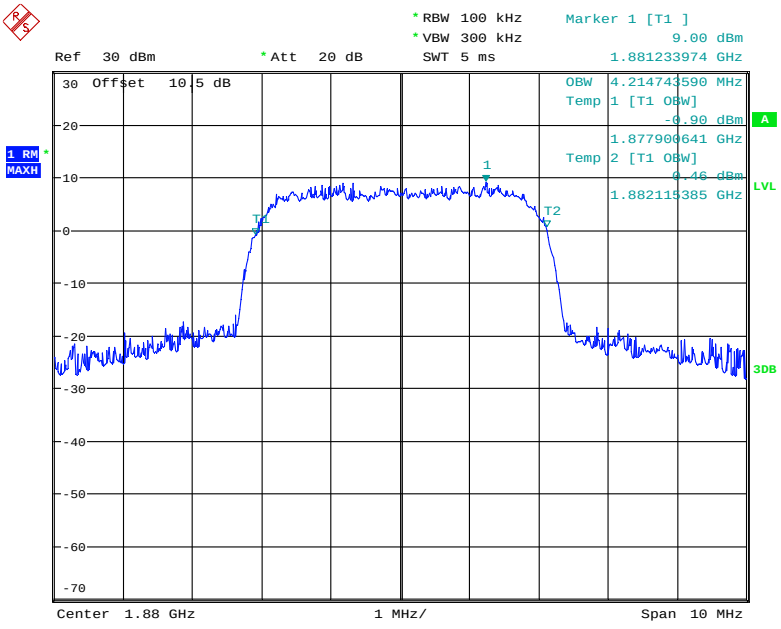
Date: 2.APR.2018 21:55:34

Uplink, 1880MHz-WCDMA (Input)



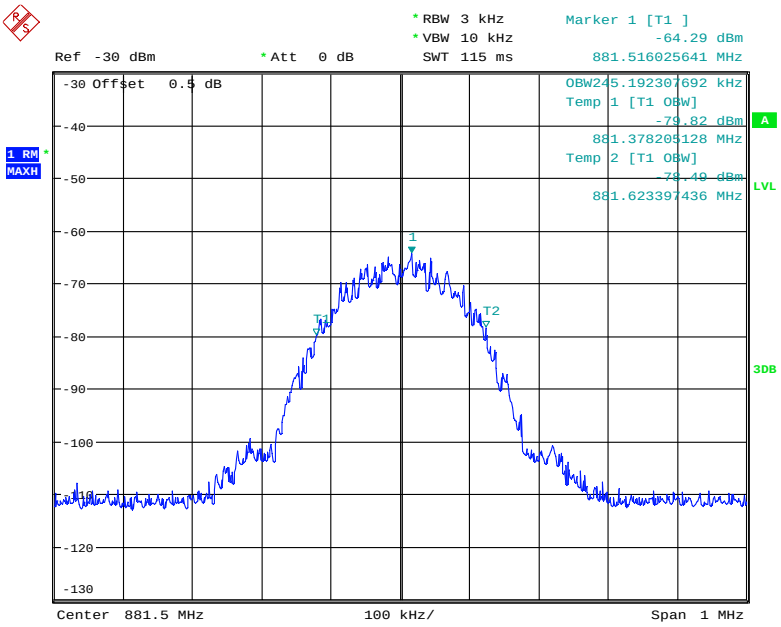
Date: 2.APR.2018 21:39:24

Uplink, 1880MHz- WCDMA (Output)



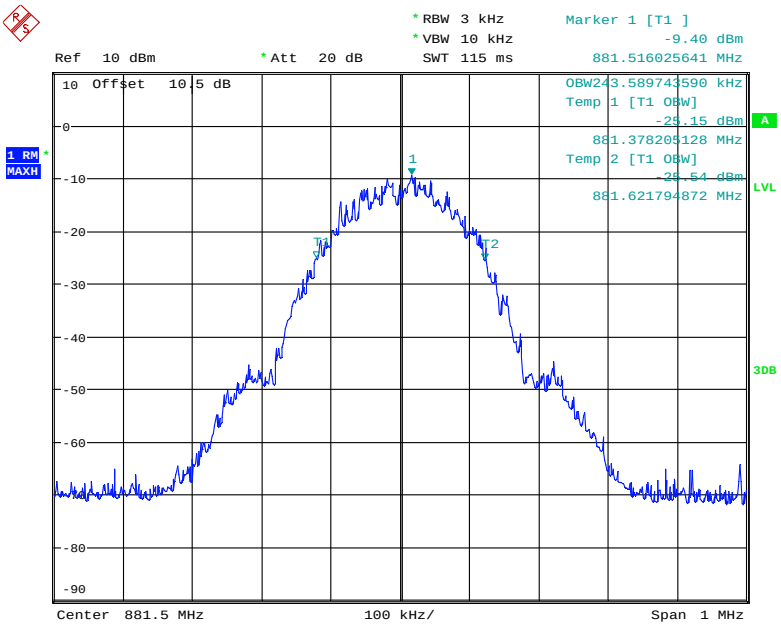
Date: 2.APR.2018 21:56:25

Downlink, 881.5MHz -GSM (Input)



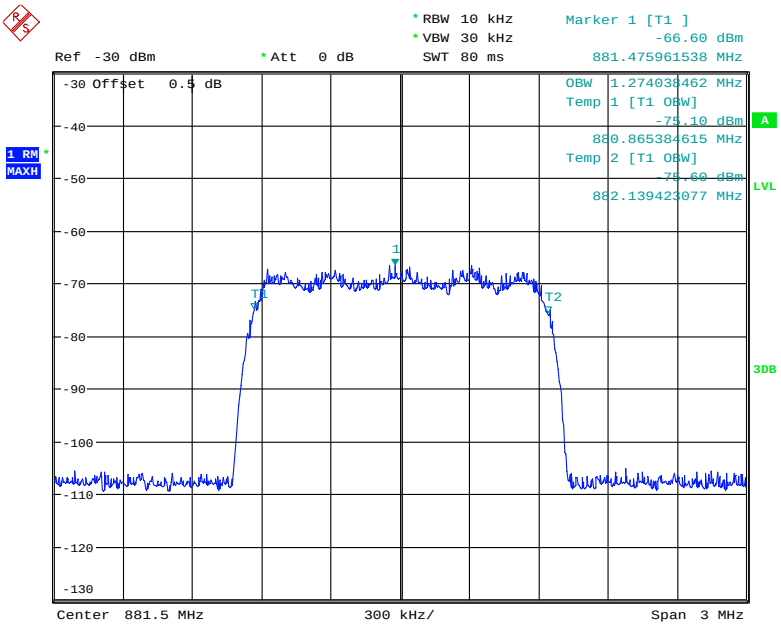
Date: 2.APR.2018 21:28:04

Downlink, 881.5MHz -GSM (Output)



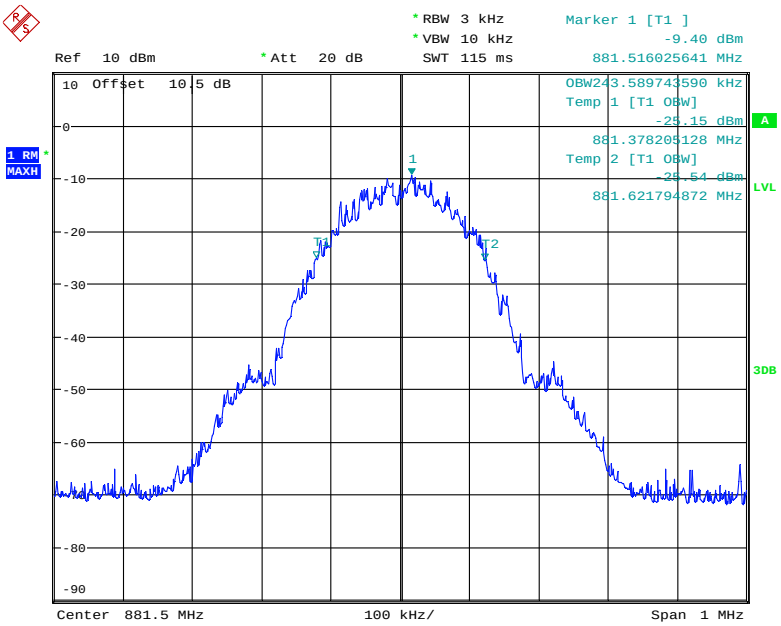
Date: 2.APR.2018 22:02:30

Downlink, 881.5MHz -CDMA(Input)



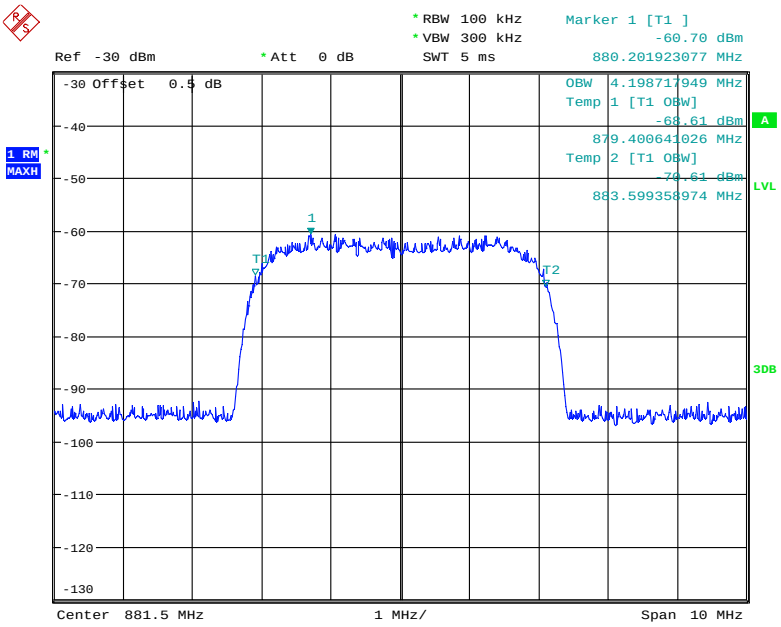
Date: 2.APR.2018 21:26:48

Downlink, 881.5MHz -CDMA (Output)



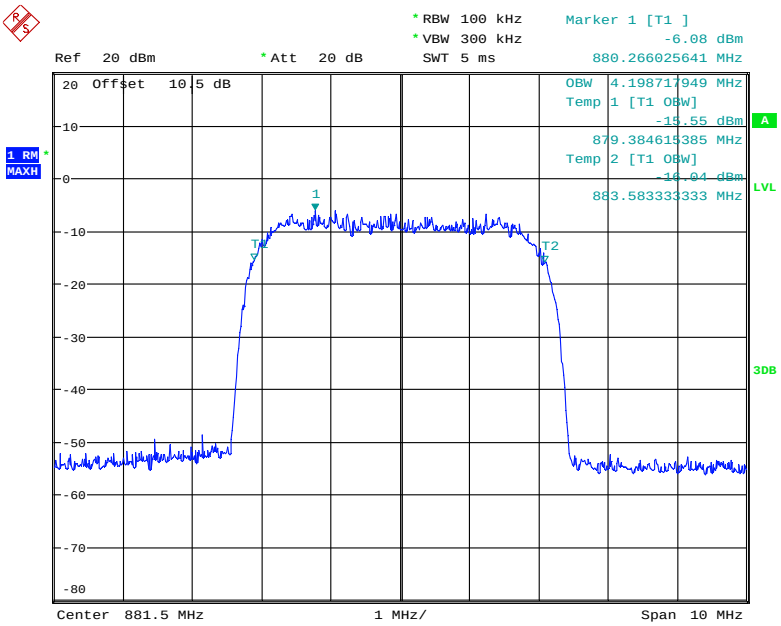
Date: 2.APR.2018 22:02:30

Downlink, 881.5MHz -WCDMA (Input)



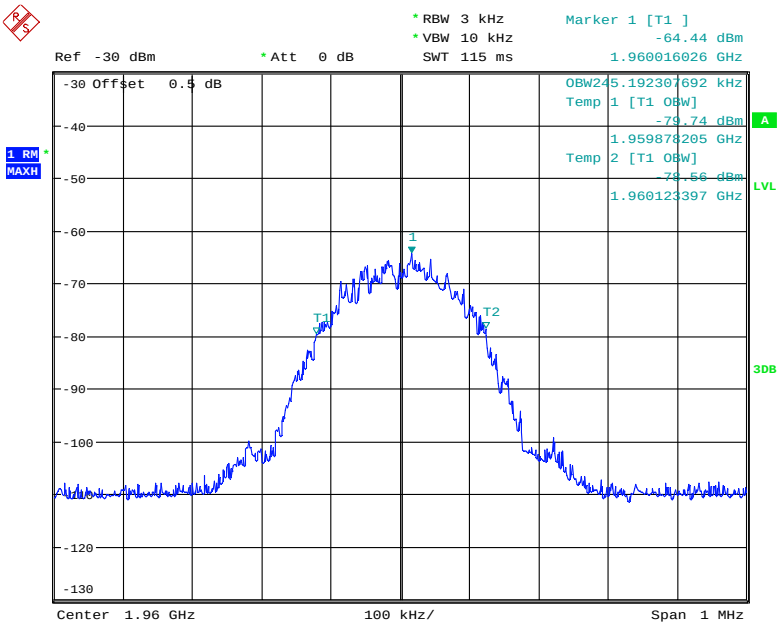
Date: 2.APR.2018 21:10:56

Downlink, 881.5MHz - WCDMA (Output)



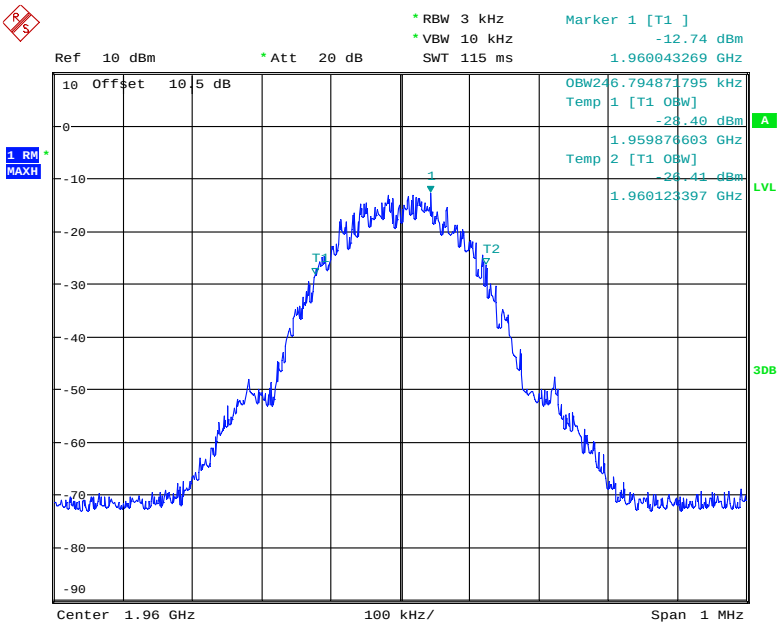
Date: 2.APR.2018 22:05:42

Downlink, 1960MHz -GSM(Input)



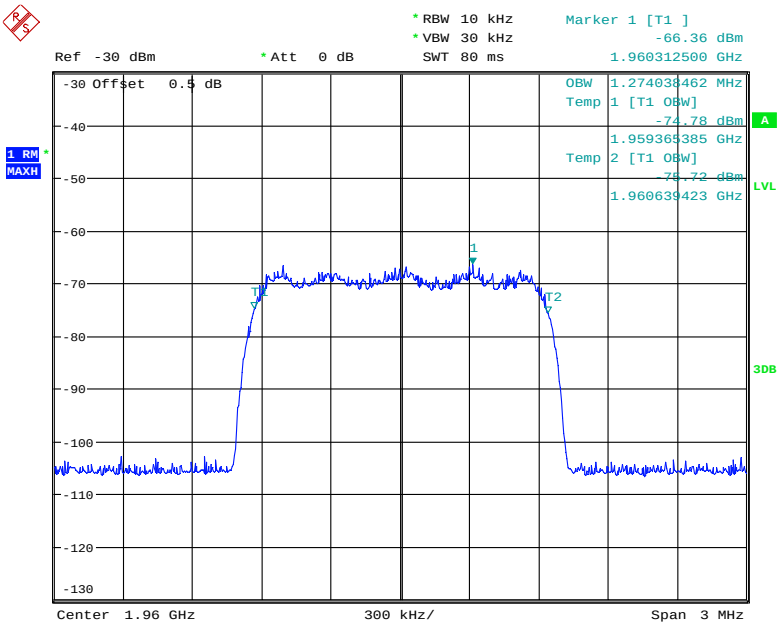
Date: 2.APR.2018 21:29:09

Downlink, 1960MHz -GSM (Output)



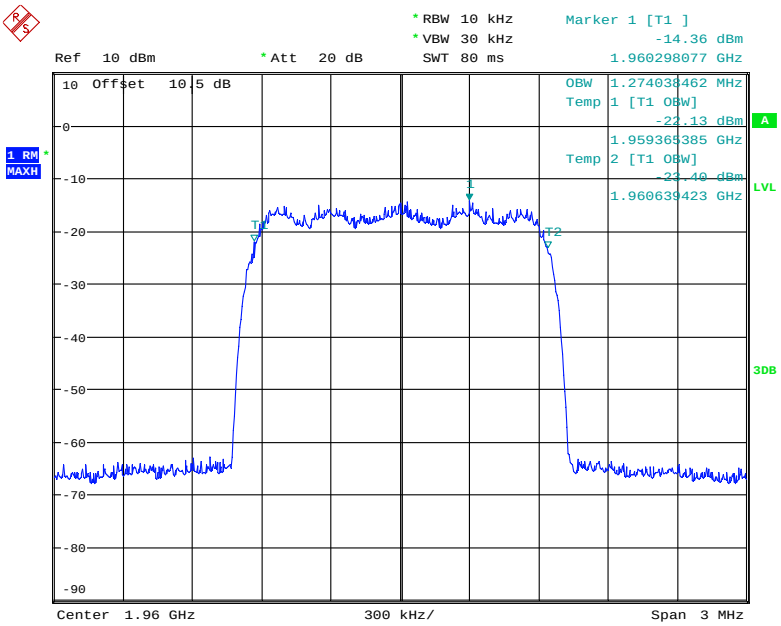
Date: 2.APR.2018 22:03:21

Downlink, 1960MHz -CDMA(Input)



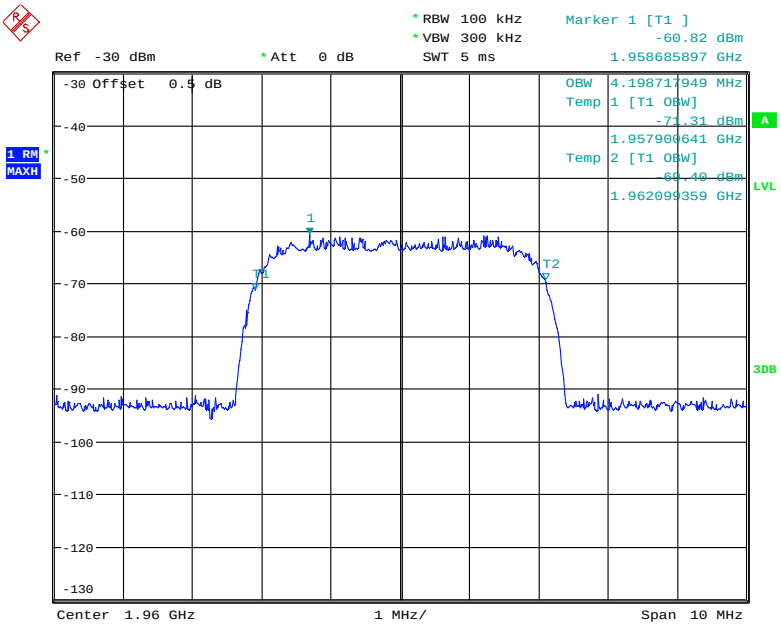
Date: 2.APR.2018 21:25:47

Downlink, 1960MHz -CDMA (Output)



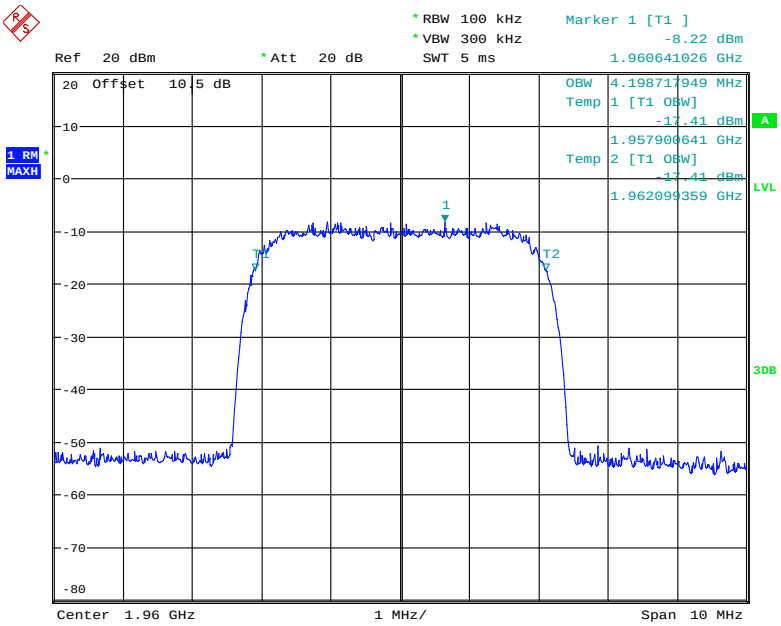
Date: 2.APR.2018 22:04:21

Downlink, 1960MHz -WCDMA (Input)



Date: 2.APR.2018 21:22:13

Downlink, 1960MHz -WCDMA (Output)



Date: 2.APR.2018 22:06:38

§ 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 v04, §7.11.2 Oscillation restart tests and §7.11.3 Test procedure for measuring oscillation mitigation or shutdown

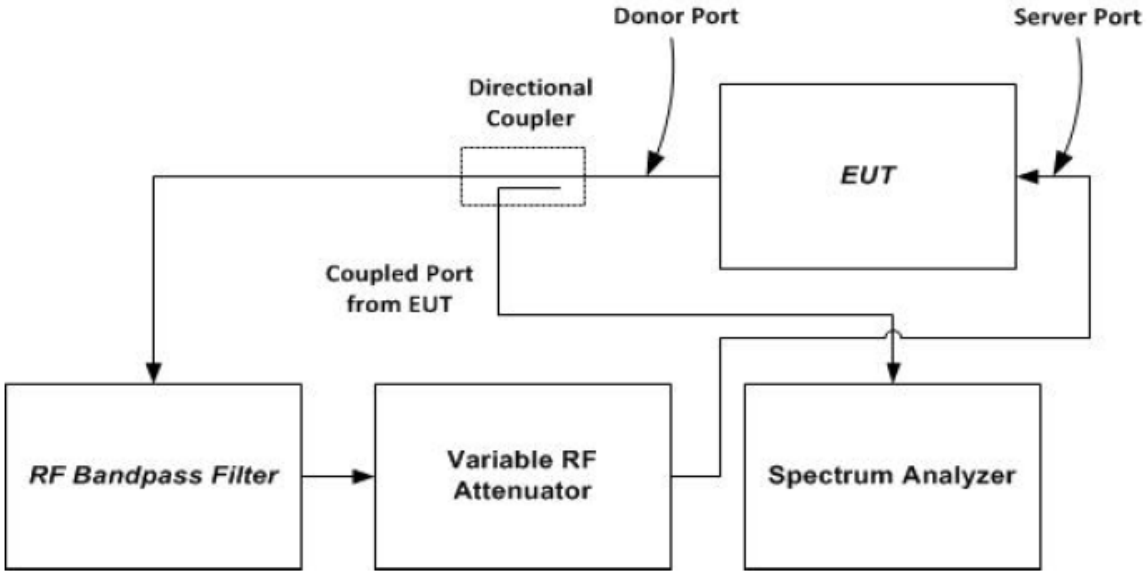


Figure 7 – Oscillation detection instrumentation test setup

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Jacob Kong on 2018-08-03.

Test Result: Compliance. Please refer to following table.

Oscillation Restart Time:

Mode	Operation Bands	Detection Time (s)		Power level	Between restart time (s)		Number of restart		Result
		Reading	Limit	dBm	Reading	Limit	Reading	Limit	
Uplink	PCS	0.203	0.3	17.86	60.74	60	4	5	Compliance
	Cellular	0.203		11.80	61.41		4		Compliance
Downlink	PCS	0.464	1	13.80	61.19		4		Compliance
	Cellular	0.455		10.19	61.19		4		Compliance

Oscillation Mitigation or Shutdown:

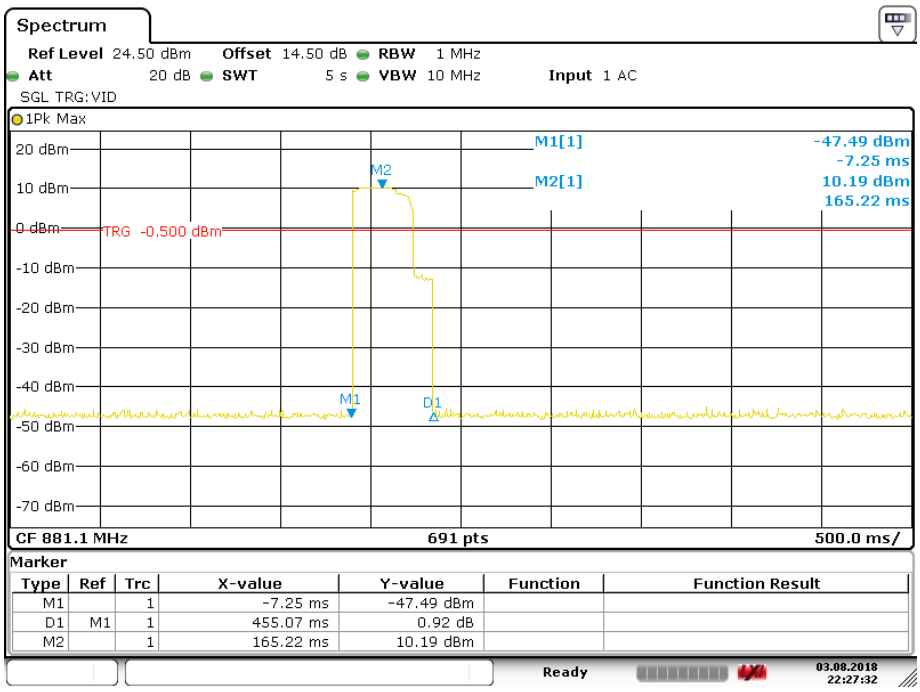
Mode	Operation Band	Max gain dB	Isolation dB	Difference dB	Limit dB	Result
Uplink	PCS	54.40	+5	9.74	12.00	Compliance
			+4	11.27	12.00	Compliance
			+3	12.60	12.00	Compliance
			+2	/	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
	Cellular	57.15	+5	6.92	12.00	Compliance
			+4	8.04	12.00	Compliance
			+3	9.03	12.00	Compliance
			+2	10.08	12.00	Compliance
			+1	11.44	12.00	Compliance
			+0	14.06	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
Downlink	PCS	53.26	+5	9.45	12.00	Compliance
			+4	10.37	12.00	Compliance
			+3	11.42	12.00	Compliance
			+2	13.15	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance
	Cellular	54.49	+5	9.96	12.00	Compliance
			+4	11.53	12.00	Compliance
			+3	13.93	12.00	Compliance
			+2	/	12.00	Compliance
			+1	/	12.00	Compliance
			+0	/	12.00	Compliance
			-1	/	12.00	Compliance
			-2	/	12.00	Compliance
			-3	/	12.00	Compliance
			-4	/	12.00	Compliance
			-5	/	12.00	Compliance

Note: The mesured difference exceeds the limit for a period of less than 300 seconds before device mitigrate and shut down. The maximum recorded time prior to mitigate or shutdown was 286s.

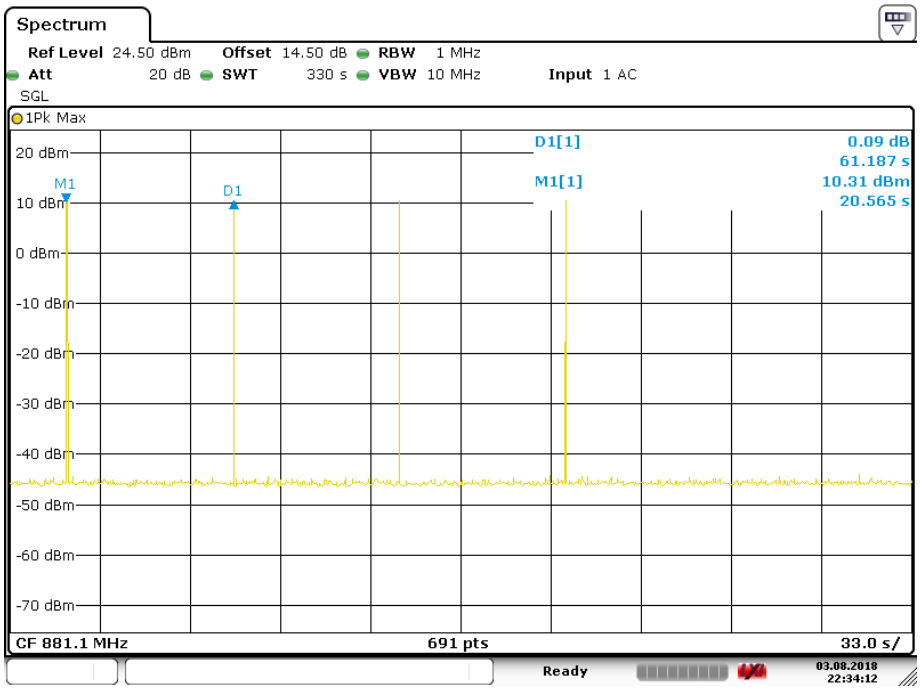
Oscillation restart tests:

Downlink:

Cellular Band

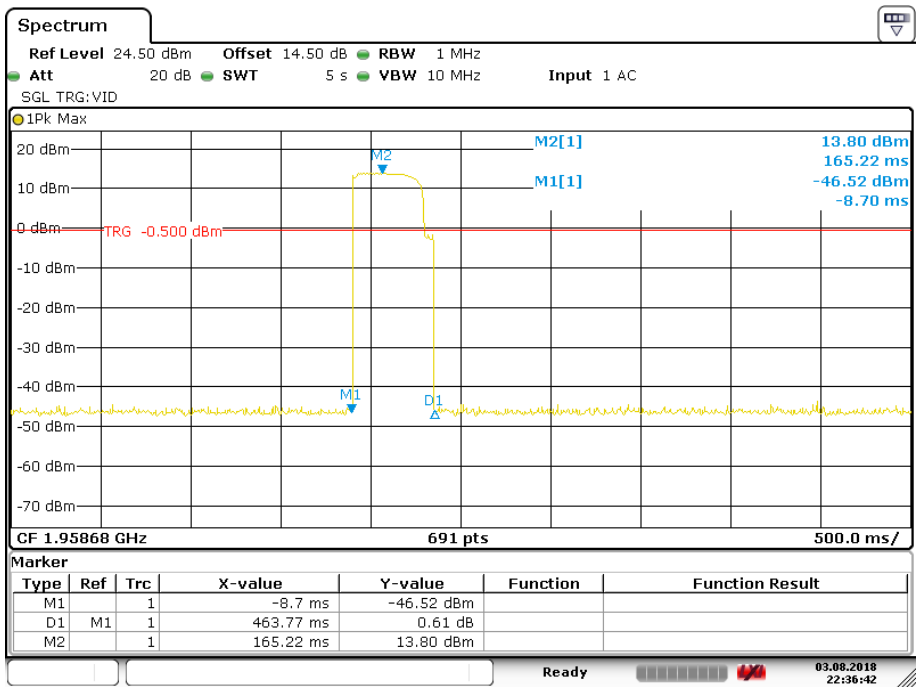


Date: 3.AUG.2018 22:27:31

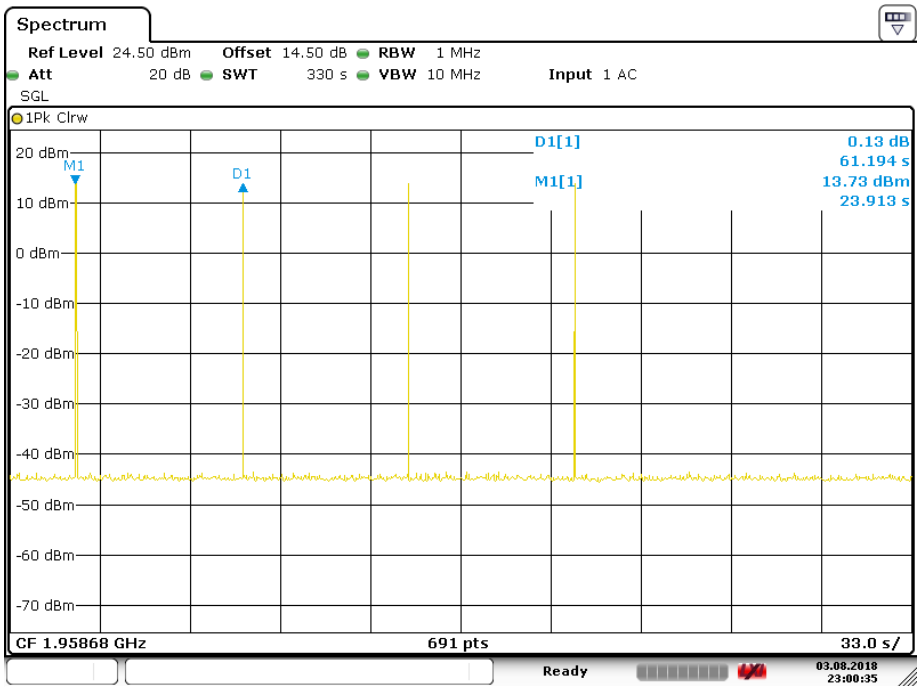


Date: 3.AUG.2018 22:34:12

PCS Band



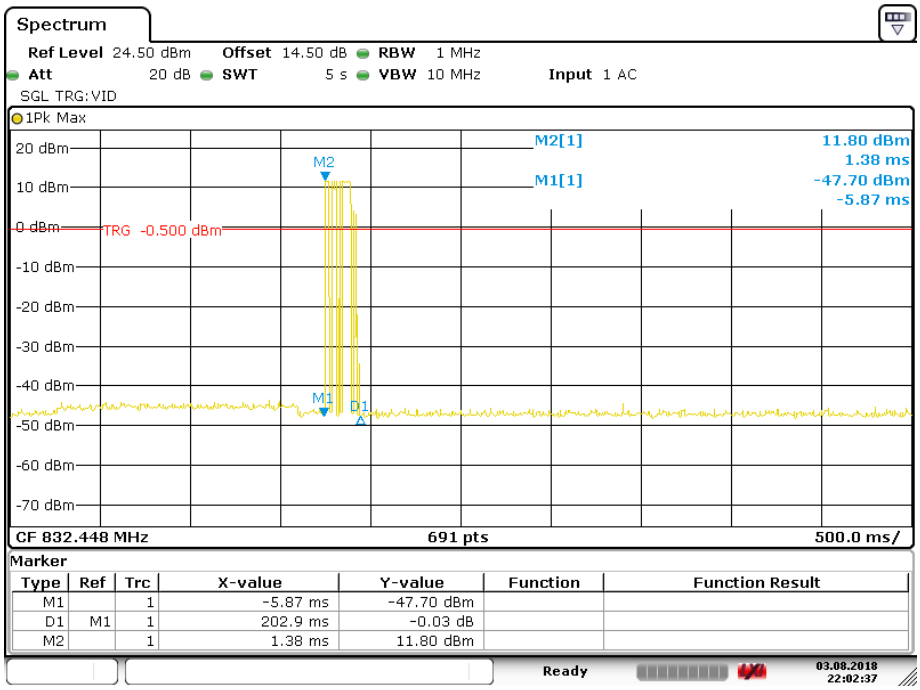
Date: 3.AUG.2018 22:36:42



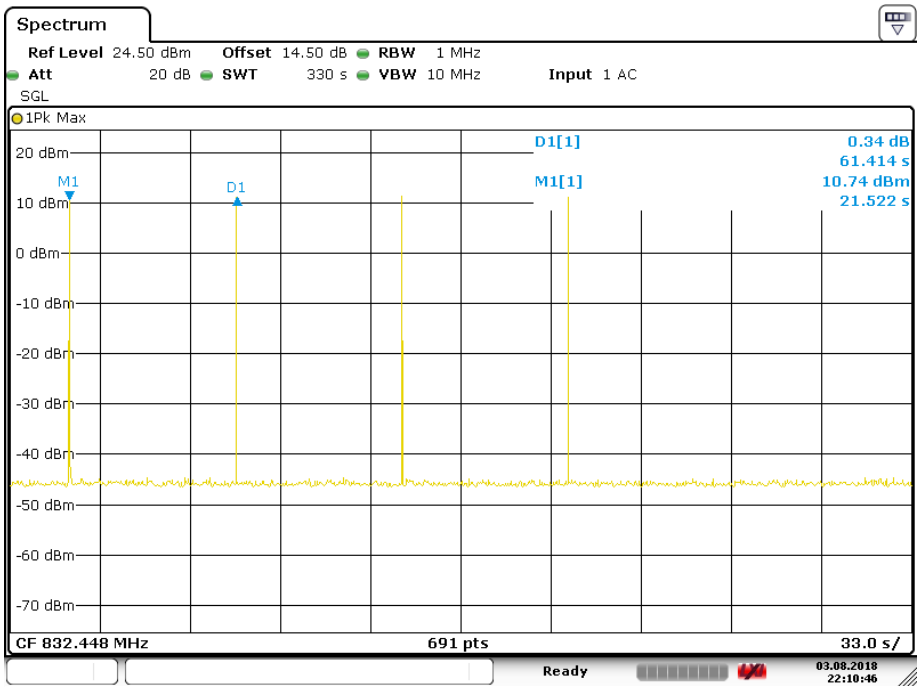
Date: 3.AUG.2018 23:00:35

Uplink:

Cellular Band

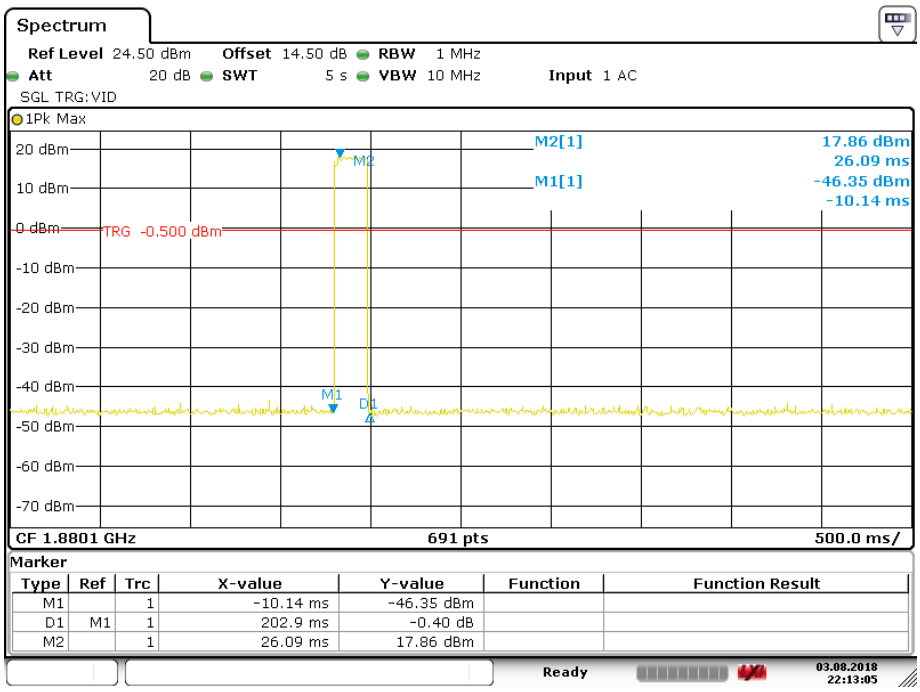


Date: 3.AUG.2018 22:02:37

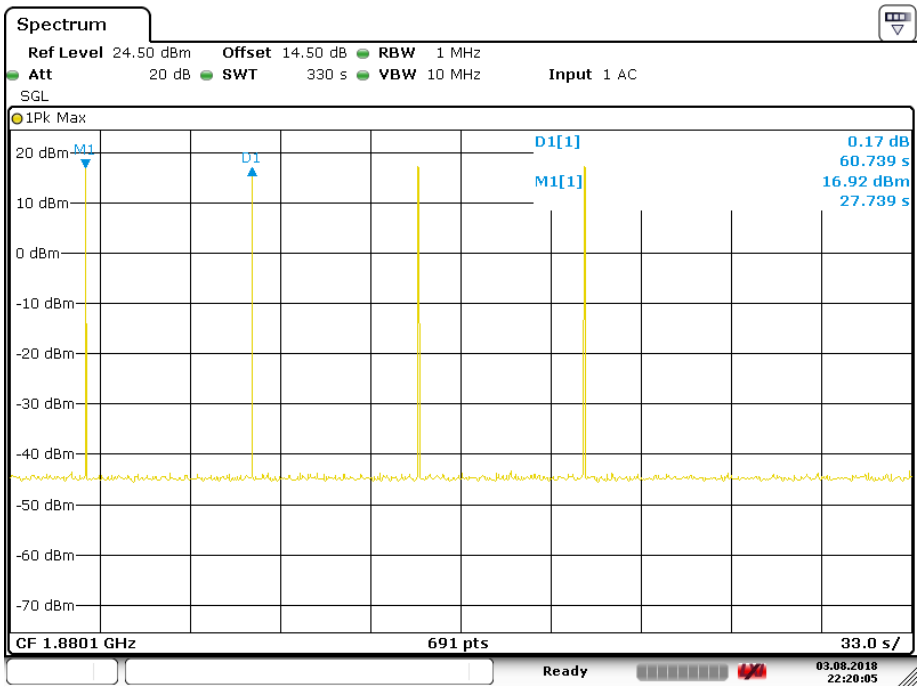


Date: 3.AUG.2018 22:10:46

PCS Band



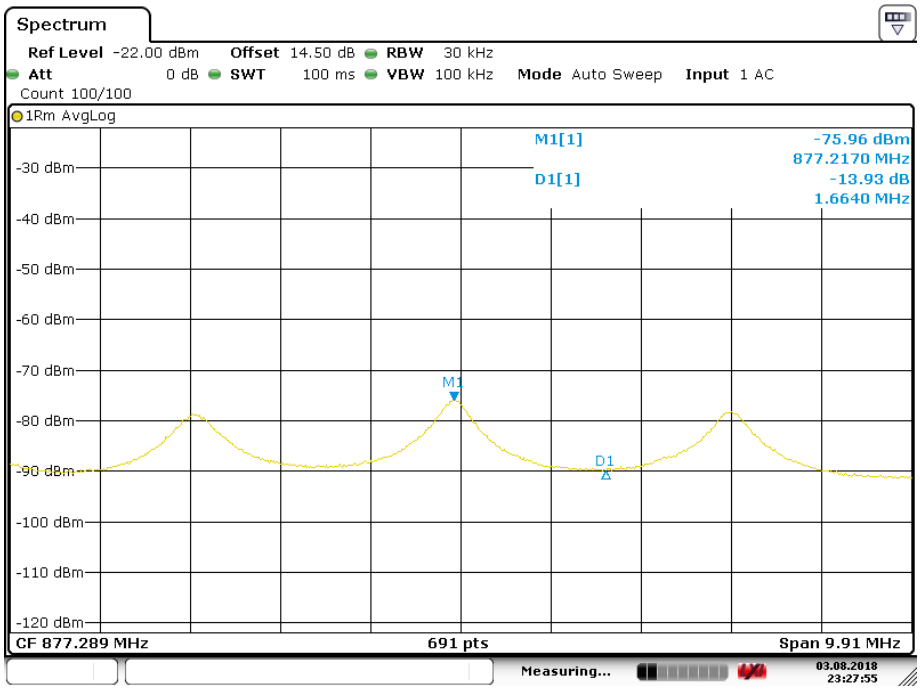
Date: 3.AUG.2018 22:13:05



Date: 3.AUG.2018 22:20:05

Oscillation mitigation or shutdown:
Downlink:

Cellular Band



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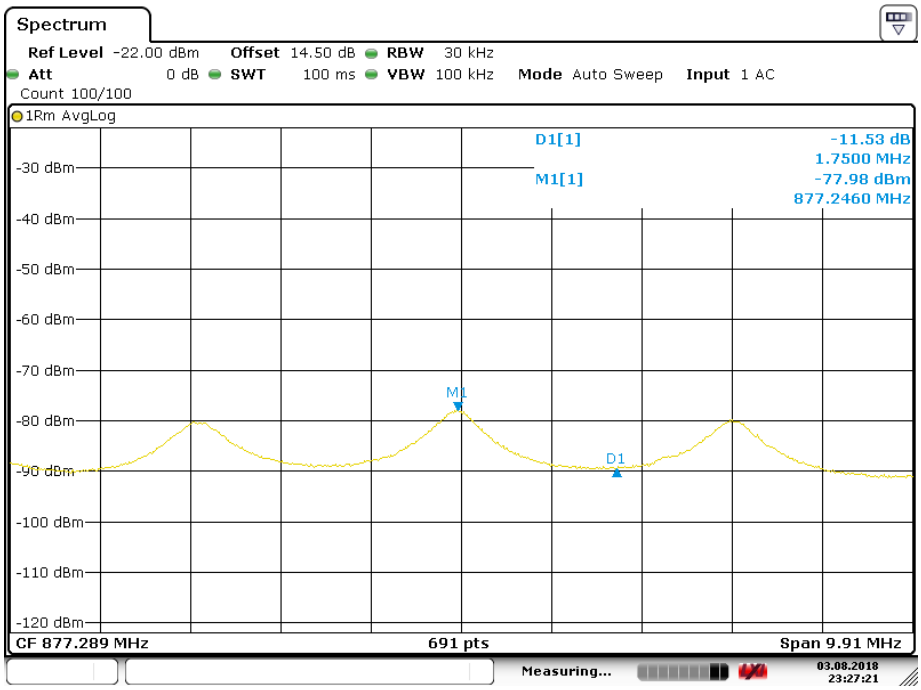

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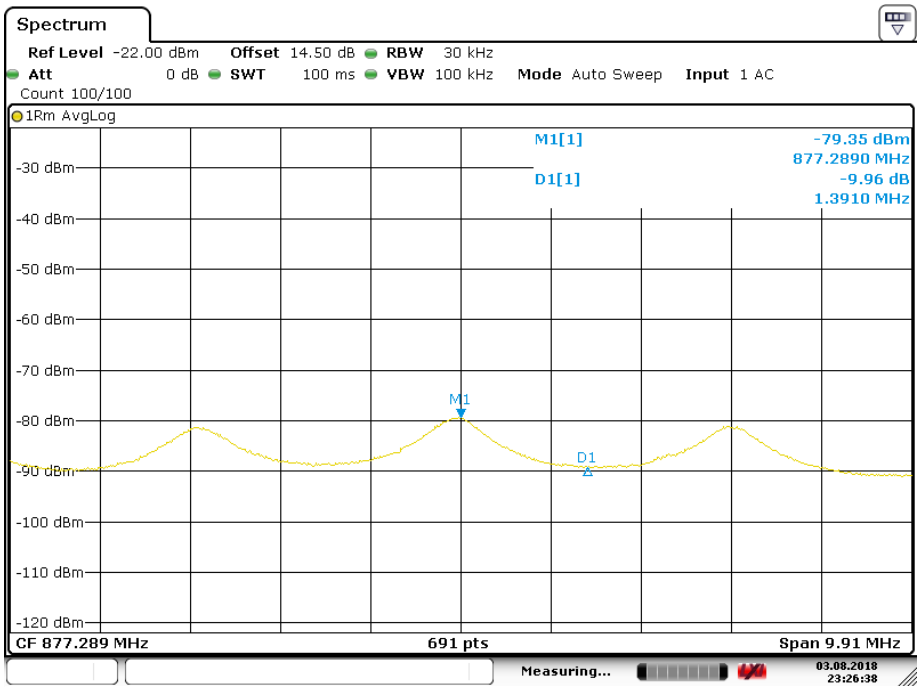
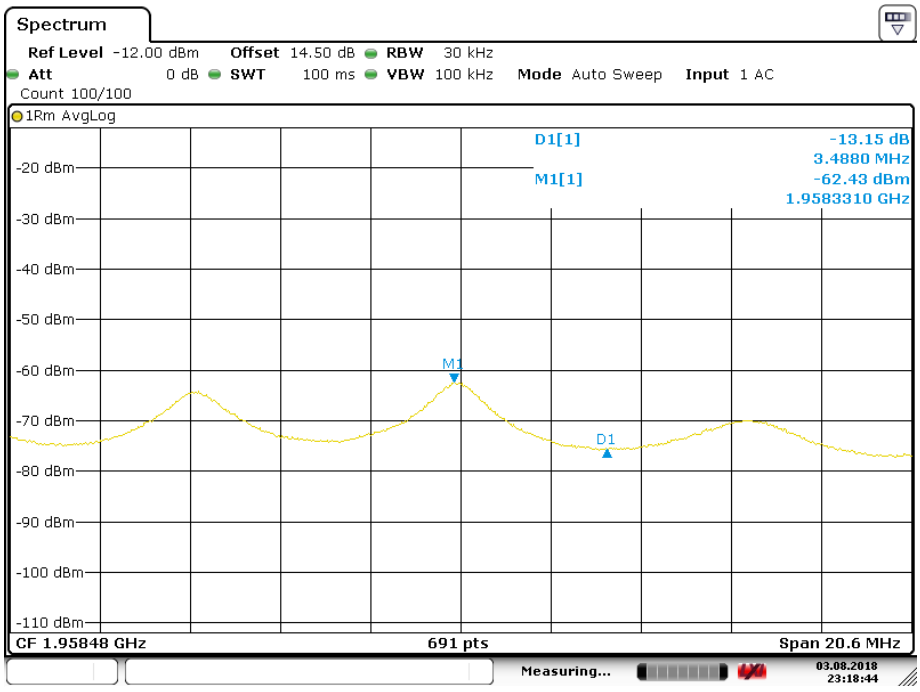


Date: 3.AUG.2018 23:26:38

PCS Band



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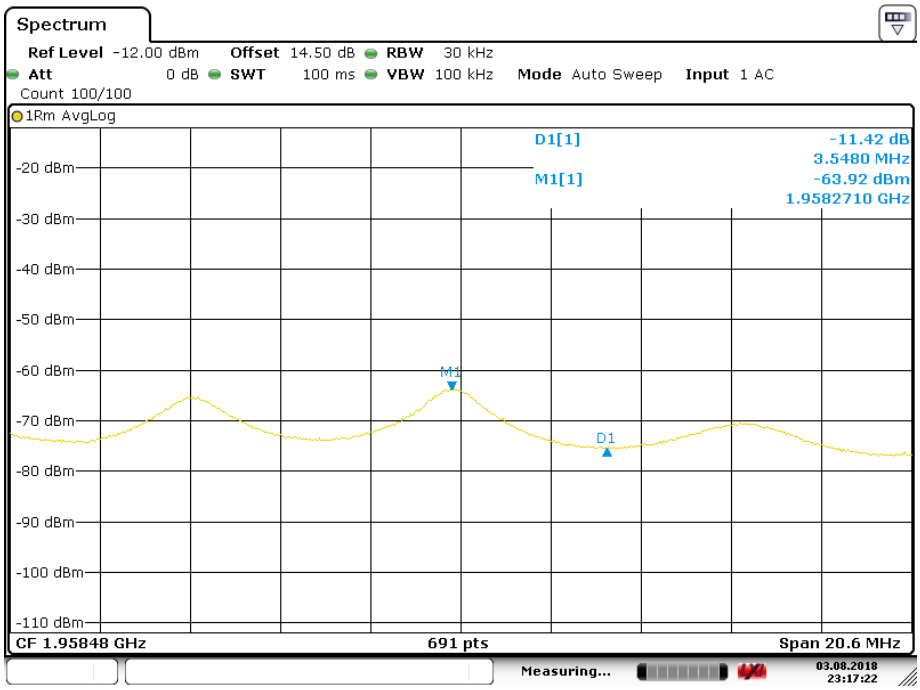

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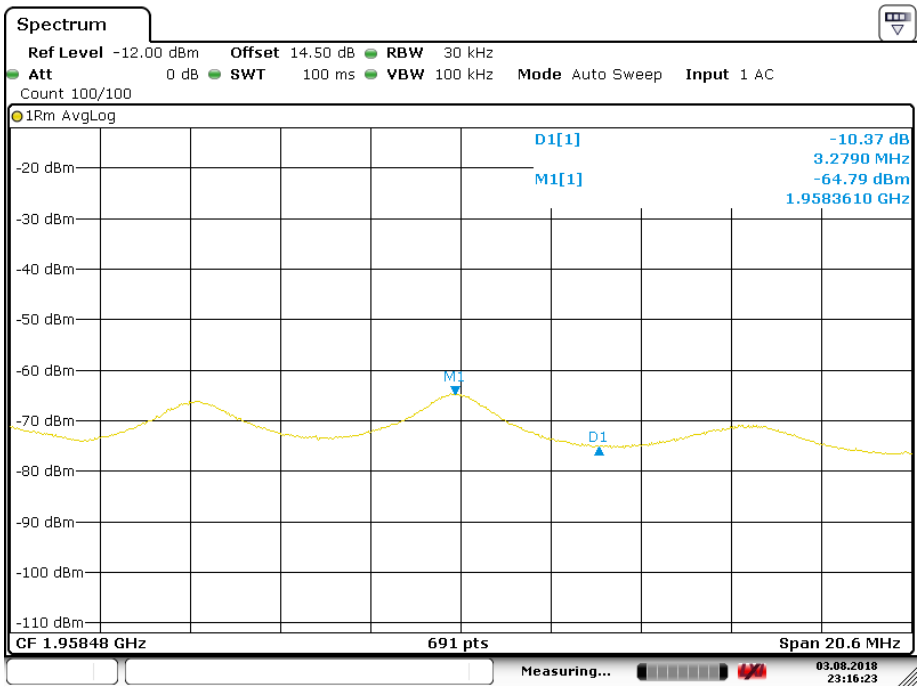
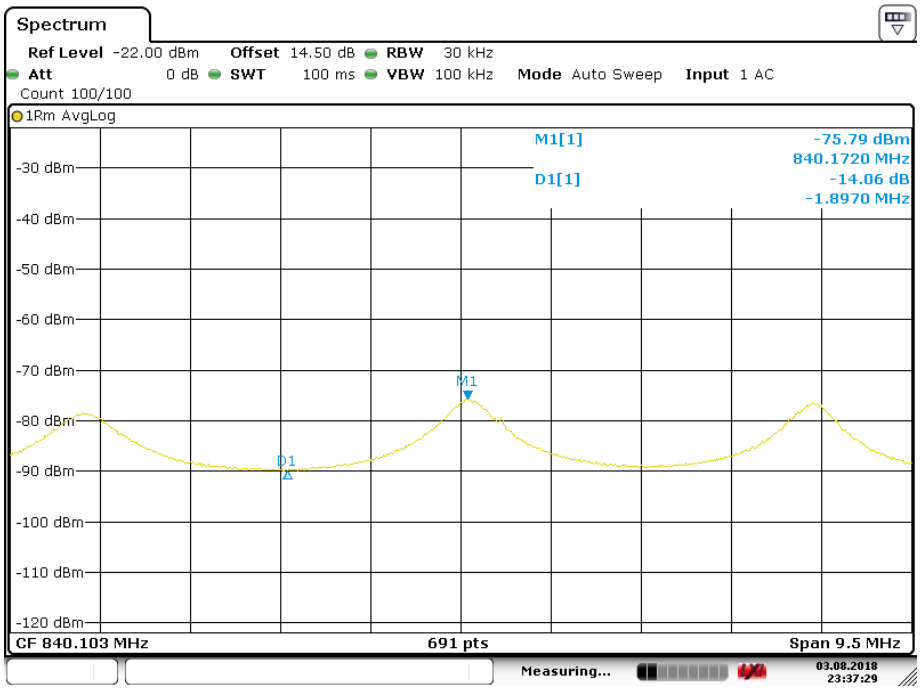


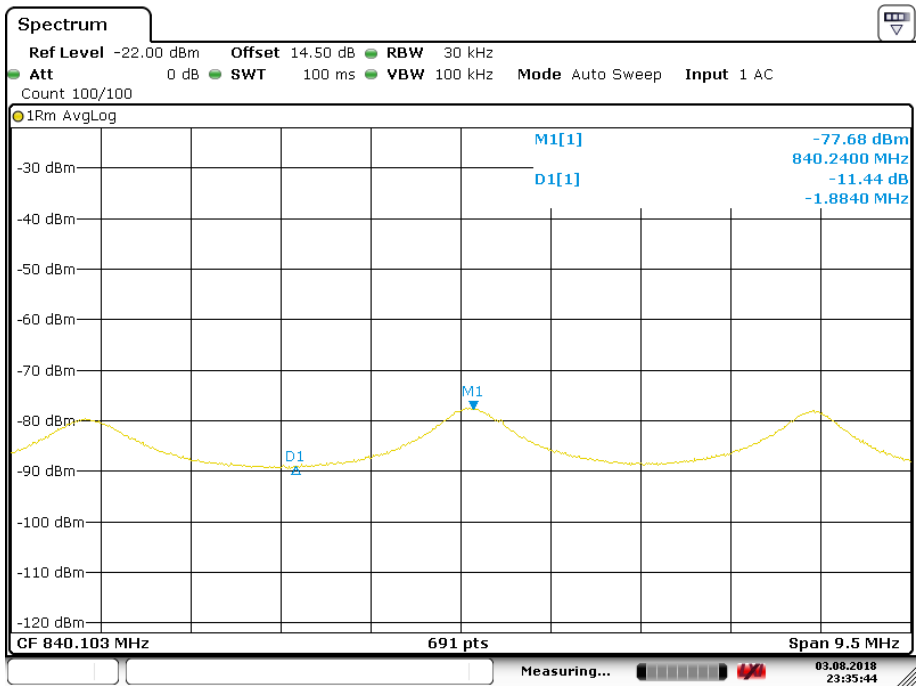
Date: 3.AUG.2018 23:16:22

Uplink:

Cellular Band



Date: 3.AUG.2018 23:37:29



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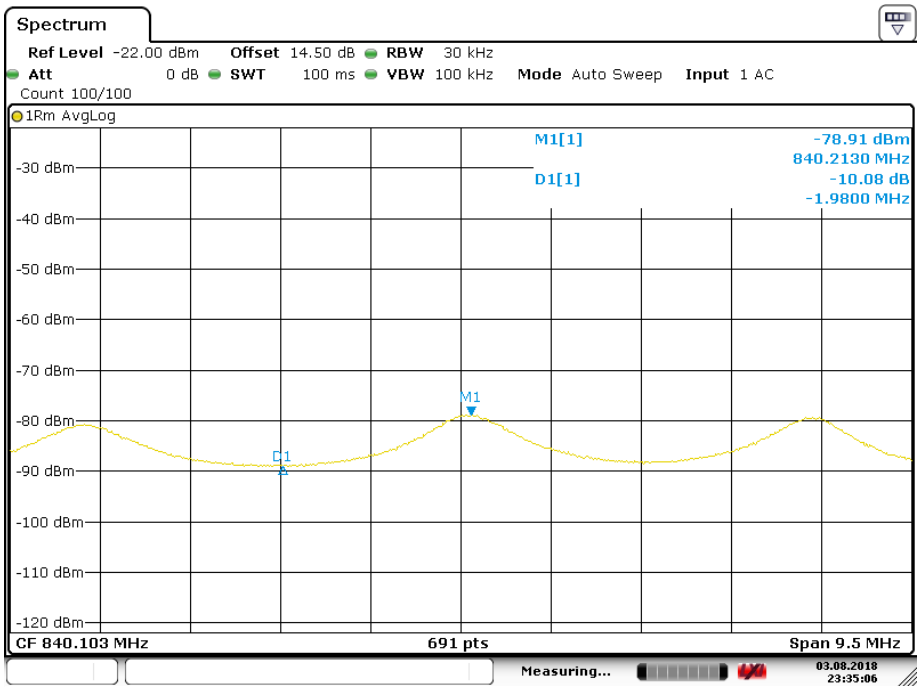

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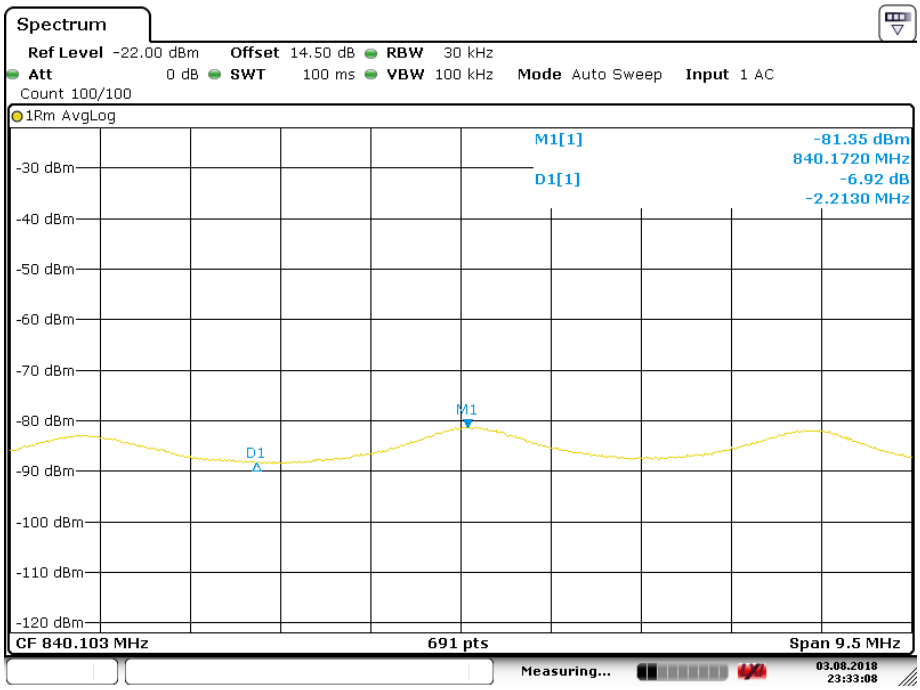
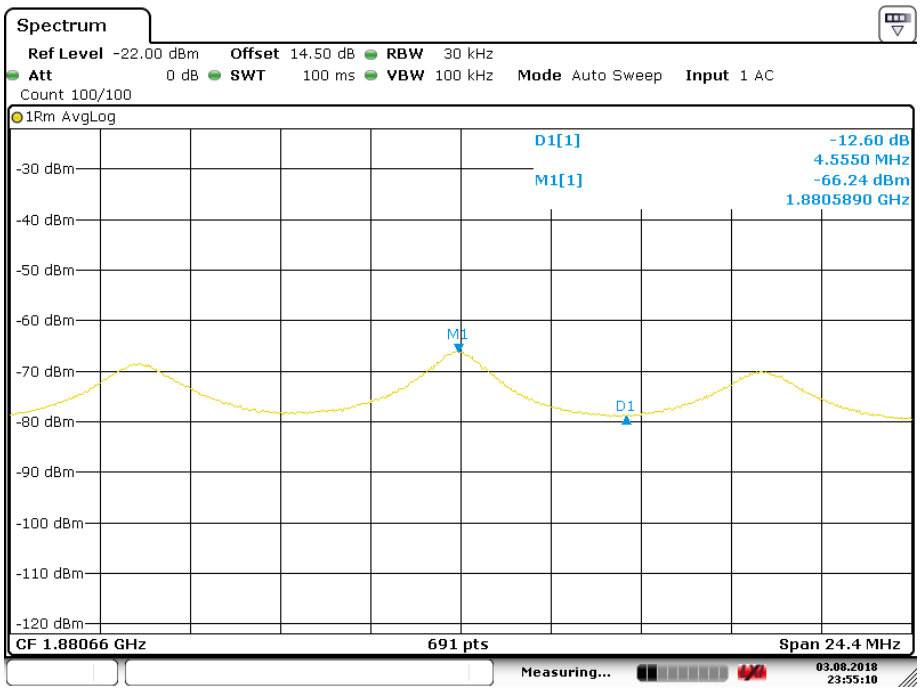


Date: 3.AUG.2018 23:33:08

PCS Band



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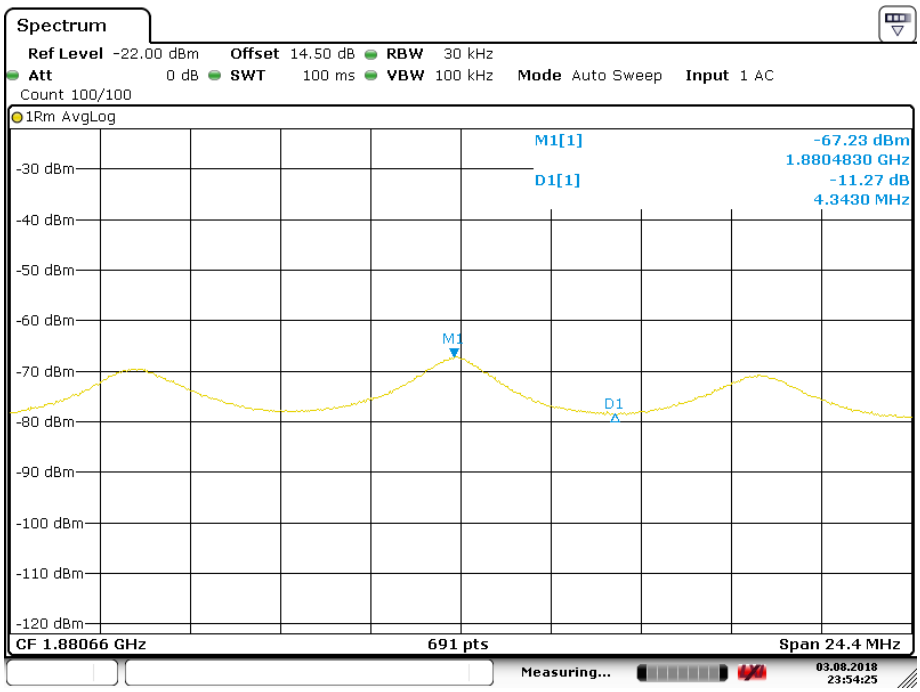
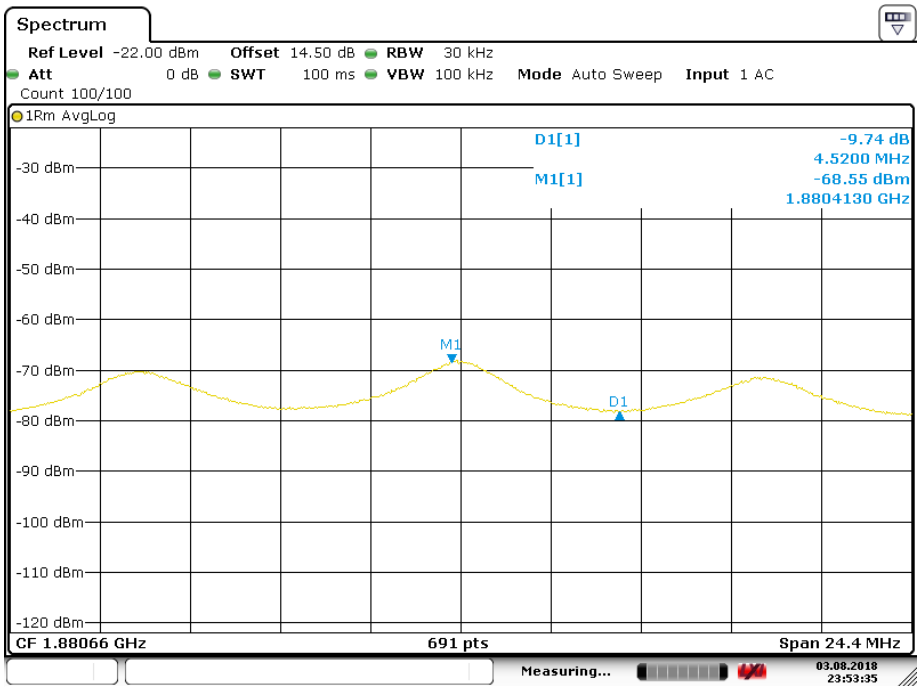


Date: 3.AUG.2018 23:54:25



Date: 3.AUG.2018 23:53:35

§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.
5) 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.
6) 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.
7) 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.
8) 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.

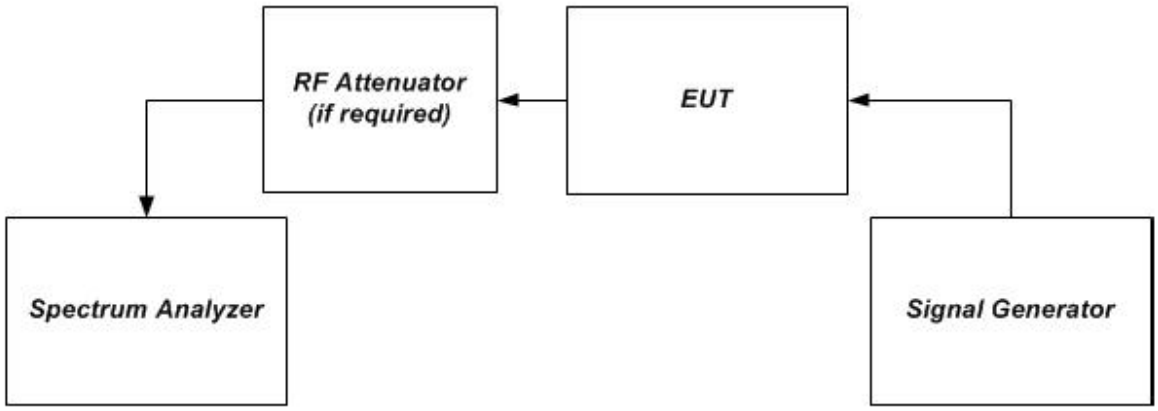


Figure 1 – Band verification test instrumentation setup

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

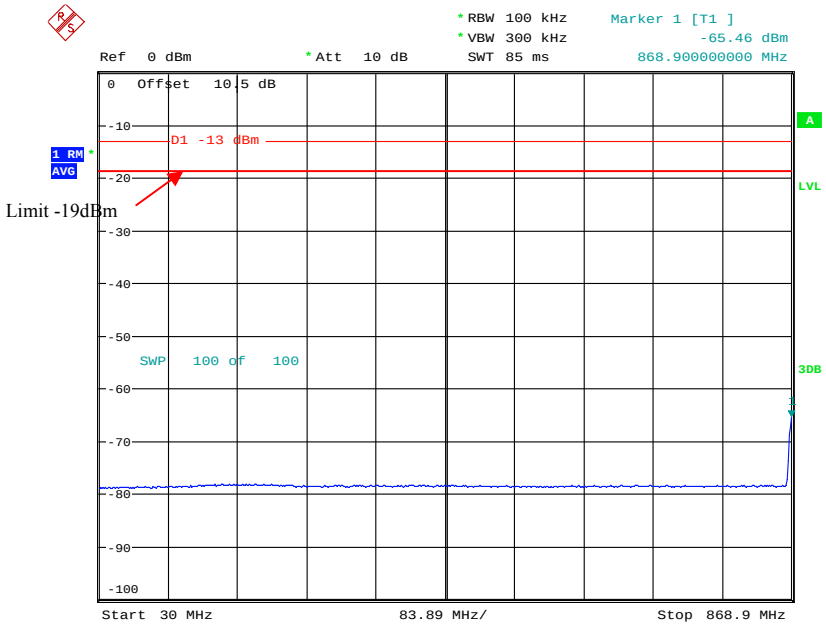
The testing was performed by Jacob Kong on 2018-04-03.

Test Mode: Transmitting, please refer to the following plots.

Test Result: Compliance.
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.*

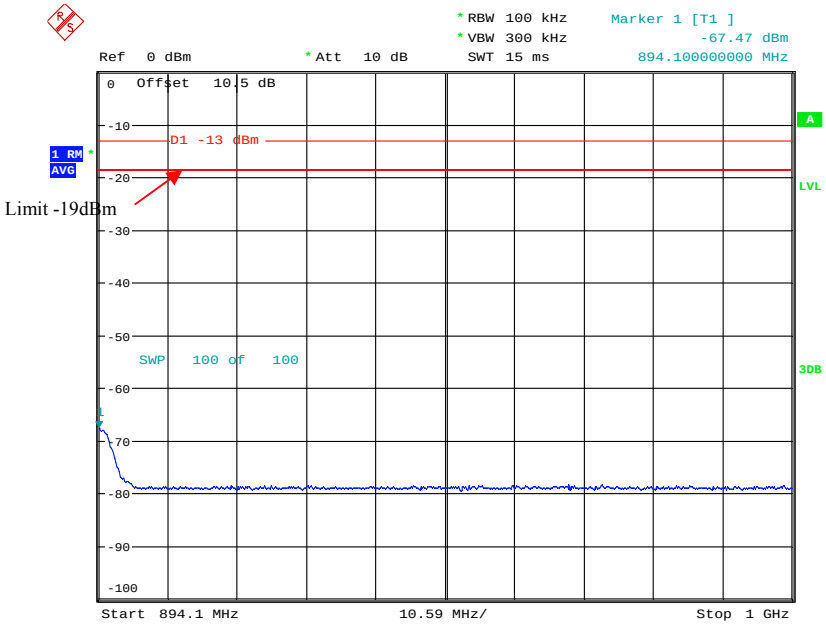
Downlink:

Cellular Band



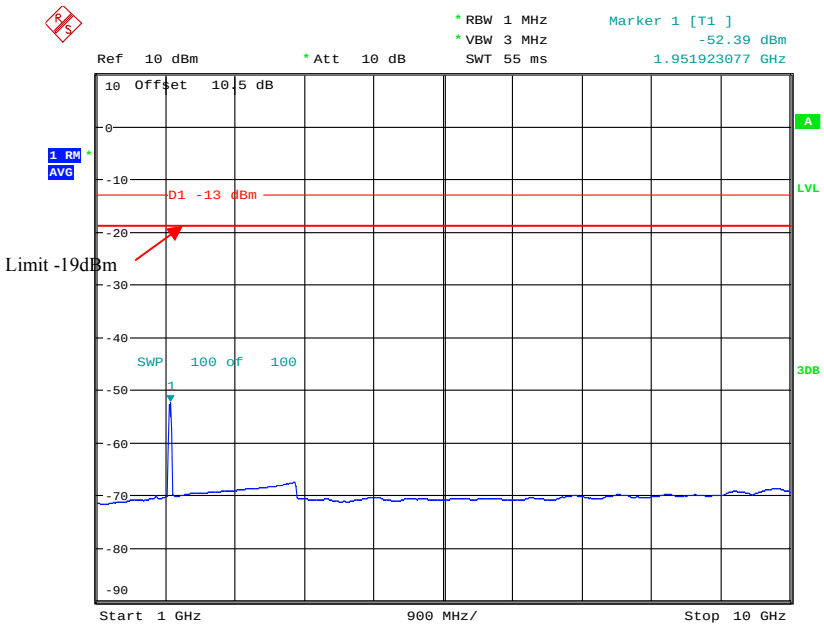
Limit -19dBm

Date: 3.APR.2018 23:15:34



Limit -19dBm

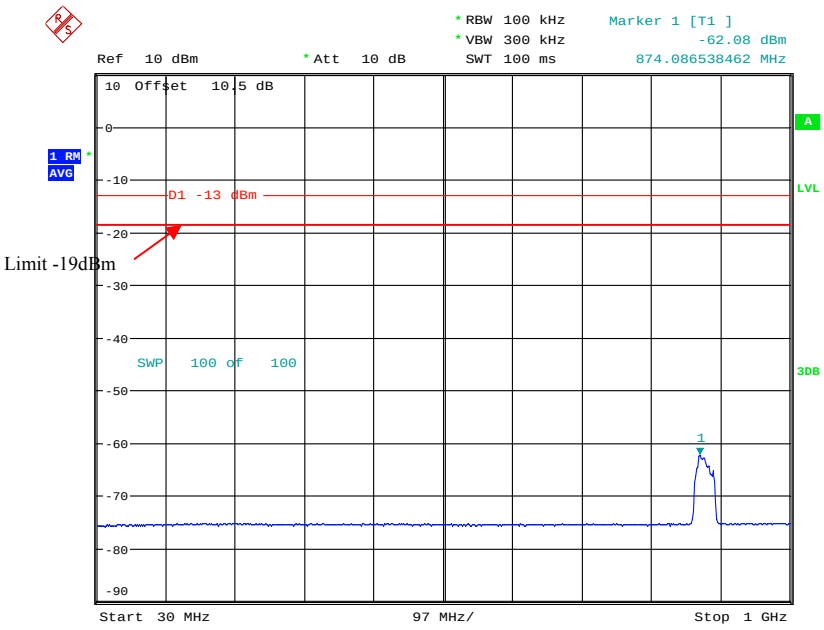
Date: 3.APR.2018 23:16:50



Limit -19dBm

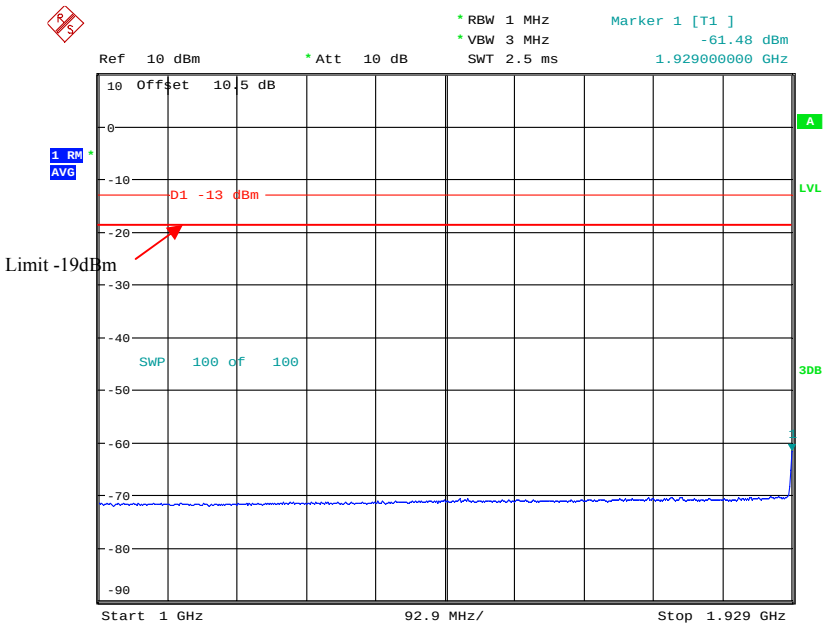
Date: 3.APR.2018 23:24:27

PCS Band



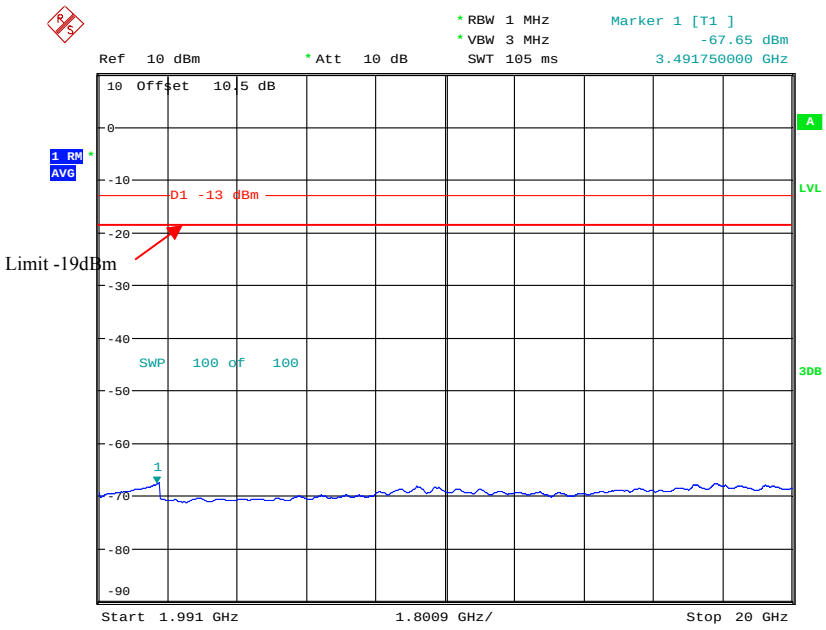
Limit -19dBm

Date: 3.APR.2018 23:47:00



Limit -19dBm

Date: 3.APR.2018 23:22:27

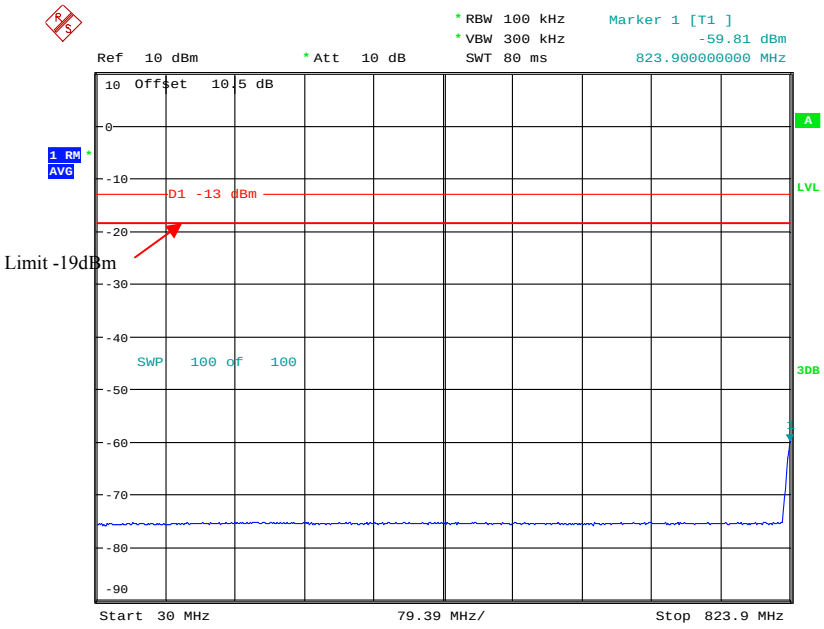


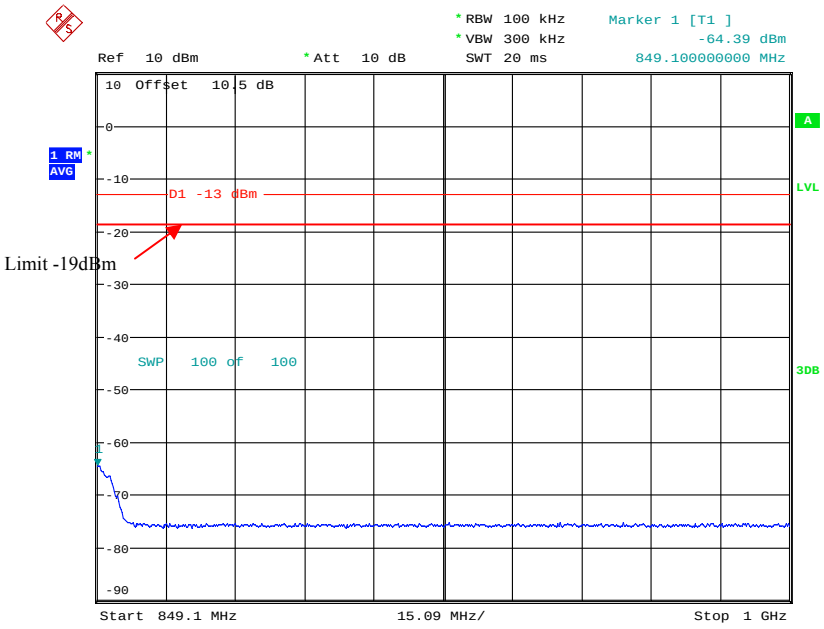
Limit -19dBm

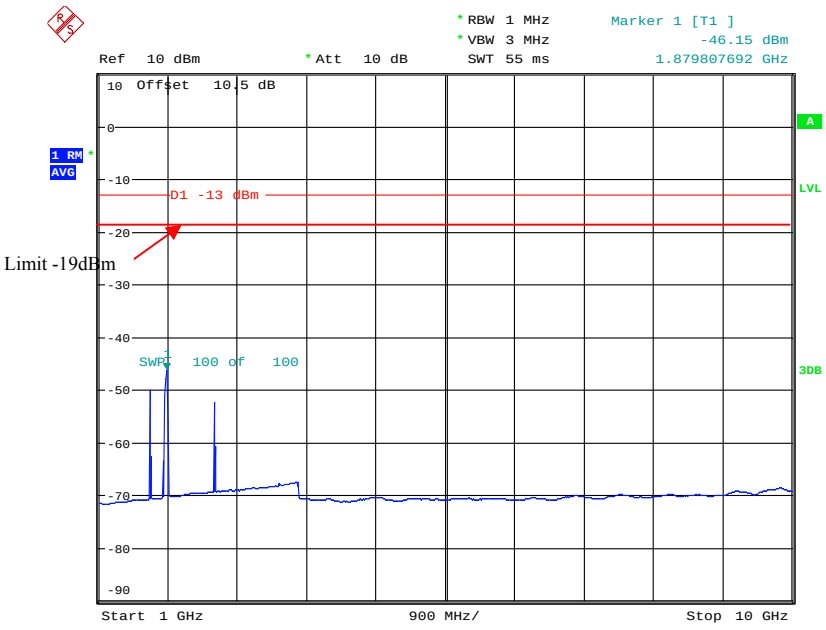
Date: 3.APR.2018 23:22:07

Uplink:

Cellular Band

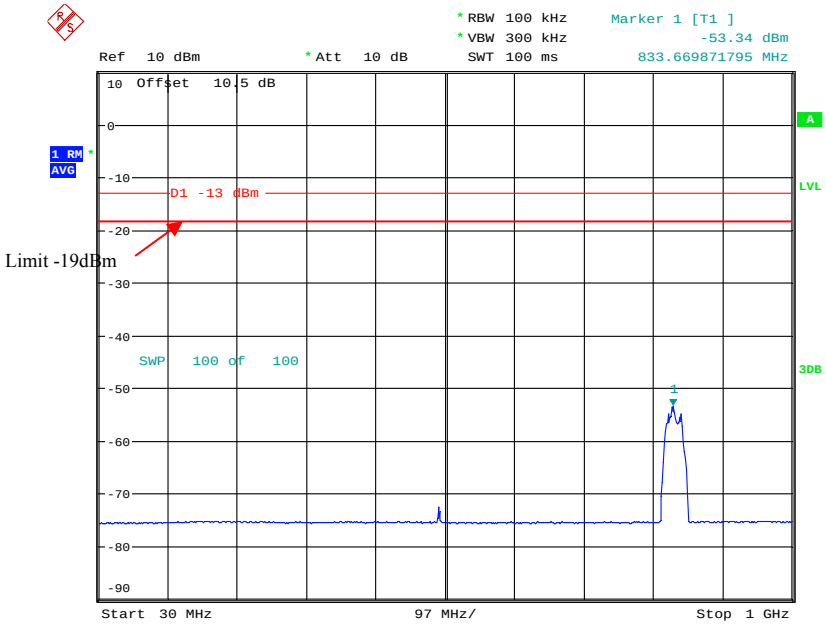




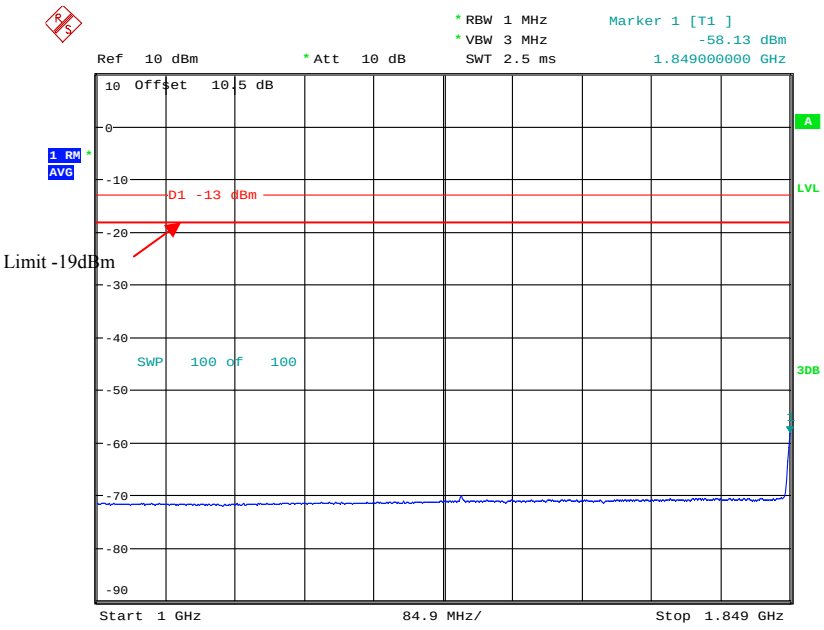


Date: 3.APR.2018 23:31:45

PCS Band

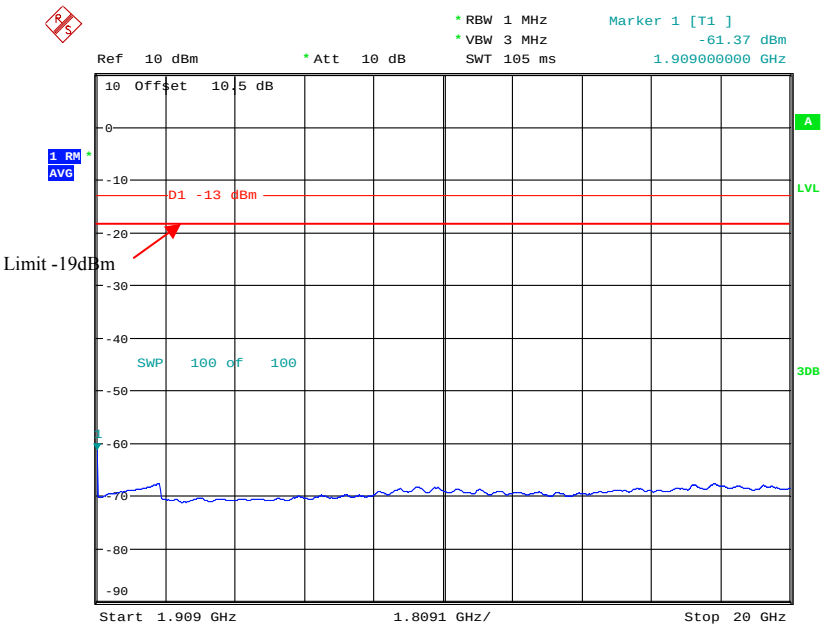


Date: 3.APR.2018 23:37:08



Limit -19dBm

Date: 3.APR.2018 23:33:03



Limit -19dBm

Date: 3.APR.2018 23:33:58

§ 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 P_{IN} 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.

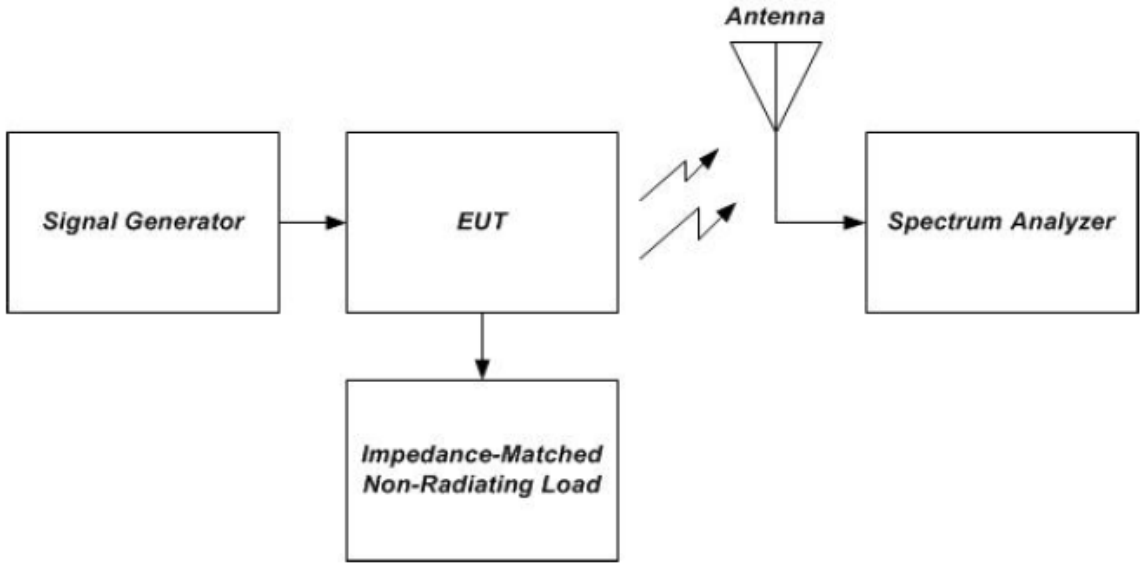


Figure 10 – Radiated spurious emissions test instrumentation setup

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Layne Li on 2018-06-29.

Test Result: Compliance. Please refer to following table.

Test Mode: Transmitting

Downlink:

Frequency (MHz)	Receiver Reading (dBμV)	Polar (H / V)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Level (dBm)	Cable loss(dB)	Antenna Gain(dB)			
Cellular Band, Test Frequency 881.5MHz								
163.26	37.75	H	-57.2	0.70	0	-57.90	-19	38.9
163.26	37.65	V	-57.3	0.70	0	-58.00	-19	39
1763.00	56.46	H	-50.0	1.30	8.50	-42.80	-19	23.8
1763.00	53.91	V	-52.1	1.30	8.50	-44.90	-19	25.9
2644.50	53.47	H	-51.0	2.20	9.40	-43.80	-19	24.8
2644.50	53.55	V	-50.6	2.20	9.40	-43.40	-19	24.4
PCS Band, Test Frequency 1960MHz								
163.26	36.08	H	-59.60	0.70	0	-59.60	-19	40.6
163.26	37.99	V	-57.70	0.70	0	-57.70	-19	38.7
3920.00	54.20	H	-39.30	1.60	9.70	-39.30	-19	20.3
3920.00	53.62	V	-39.70	1.60	9.70	-39.70	-19	20.7
5880.00	51.98	H	-36.80	1.70	11.40	-36.80	-19	17.8
5880.00	51.51	V	-36.70	1.70	11.40	-36.70	-19	17.7

Uplink:

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
Cellular Band, Test Frequency 836.5MHz								
163.26	36.66	H	-58.3	0	0.70	-59.00	-19	40
163.26	37.85	V	-57.1	0	0.70	-57.80	-19	38.8
1673.00	52.48	H	-55.0	9.10	1.30	-47.20	-19	28.2
1673.00	52.76	V	-54.1	9.10	1.30	-46.30	-19	27.3
2509.50	53.34	H	-50.9	9.30	2.60	-44.20	-19	25.2
2509.50	53.10	V	-50.5	9.30	2.60	-43.80	-19	24.8
PCS Band, Test Frequency 1880MHz								
163.26	37.85	H	-58.3	0	0.70	-57.80	-19	38.8
163.26	38.29	V	-57.1	0	0.70	-57.40	-19	38.4
3760.00	52.96	H	-55.0	9.70	1.50	-41.10	-19	22.1
3760.00	52.52	V	-54.1	9.70	1.50	-41.10	-19	22.1
5640.00	53.31	H	-50.9	11.20	1.70	-35.50	-19	16.5
5640.00	52.20	V	-50.5	11.20	1.70	-36.30	-19	17.3

Note:
1) Absolute Level = Substituted Level - Cable loss + Antenna Gain
2) Margin = Limit- Absolute Level

******* END OF REPORT *******