74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
TEL: +82-31-645-6300 FAX: +82-31-645-6401

FCC REPORT

Certification

Applicant Name:
GS Instech Co., Ltd.

Address:
70, Gilpa-ro 71beon-gil, Nam-gu, Inchen, Korea

Date of Issue:
May 28, 2018

Location of test lab:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Report No.: HCT-RF-1805-FC007-R3

FCC ID:	**U88-EZDASD-C23**
APPLICANT:	**GS Instech Co., Ltd.**

Model:	EZ-DASD-IC23
EUT Type:	Analog Optic DAS
Frequency Range:	817 MHz ~ 849 MHz (UL)
Tx Output Power:	23 dBm (0.2 W)
Date of Test:	April 10, 2018 ~ May 02, 2018
FCC Rule Part(s):	CFR 47 Part 2, Part 22, Part 90

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

Report prepared by : A Ram Han
Engineer of telecommunication testing center

Approved by : Jong Seok Lee
Manager of telecommunication testing center

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1805-FC007	May 03, 2018	- First Approval Report
HCT-RF-1805-FC007-R1	May 18, 2018	- Added a note to unwanted conducted emissions about the reason of omitting the test of part 90.210 / 90.691 (40 page)
HCT-RF-1805-FC007-R2	May 25, 2018	- Removed antenna gain information because manufacturer did not provide it. (4 page)
HCT-RF-1805-FC007-R3	May 28, 2018	- Added a note about the test equipment information for Occupied Bandwidths Test. (21 page)

Table of Contents

1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

Company Name	GS Instech Co., Ltd.
Company Address	70, Gilpa-ro 71beon-gil, Nam-gu, Inchen, Korea

1.2. PRODUCT INFORMATION

EUT Type	Analog Optic DAS
Power Supply	AC 110 V ~ 240 V
Frequency Range	817 MHz ~ 849 MHz (UL)
Tx Output Power	23 dBm (0.2 W)
Supporting Technologies	LTE 5 MHz, CDMA, 1xEVDO
Antenna Specification	Manufacturer does not provide an antenna.

1.3. TEST INFORMATION

FCC Rule Parts	CFR 47 Part 2, Part 22, Part 90
Measurement standards	ANSI C63.26-2015, KDB 971168 D01 v03r01, KDB 935210 D05 v01r02
Place of Test	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4 (Version: 2014) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated July 07, 2015 (Registration Number: 90661).

2.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

3. TEST SPECIFICATIONS

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 22, Part 90

Description	Reference	Results
RF Output Power	§2.1046, §22.913, §90.635	Compliant
Occupied Bandwidth	§2.1049	Compliant
Out of Band Rejection	KDB 935210 D05 v01r02	Compliant
Noise Figure	§90.219	Compliant
Unwanted Conducted Emissions	§2.1051, §22.917, §90.691	Compliant
Radiated Emissions	§2.1053, §22.917, §90.691	Compliant
Frequency Stability	§2.1055, §22.355, §90.213	Compliant

3.2. MODE OF OPERATION DURING THE TEST

The EUT was operated in a manner representative of the typical usage of the equipment.
During all testing, system components were manipulated within the confines of typical usage to maximize each emission.
The device does not supply antenna(s) with the system, so the dummy loads were connected to the RF output ports for radiated spurious emission testing.

* The test was carried out in conjunction with SU module (EZ-DASS-IC30/EZ-DASS-IC37) provided by applicant.
* The tests results in plots are already including the actual value of loss for the attenuator and cable combination. Please check correction factors below table.

▣ Correction Factor

Freq(MHz)	Factor(dB)
30	30.015
100	28.826
200	29.218
300	29.281
400	26.649
500	29.775
600	29.874
700	29.896
800	29.996
900	30.159
1000	30.272
2000	31.154
3000	31.848
4000	32.447
5000	33.234
6000	33.586
7000	34.840
8000	33.689
9000	34.850
10000	36.207
20000	44.683
26000	49.206

3.3. MAXIMUM MEASUREMENTUNCERTAINTY

The value of the measurement uncertainty for the measurement of each parameter.

Coverage factor *k* = 2, Confidence levels of 95 %

Description	Condition	Uncertainty
RF Output Power	-	± 0.72 dB
Occupied Bandwidth	OBW ≤ 20 MHz	± 52 kHz
Out of Band Rejection	Gain 20 dB bandwidth	± 0.89 dB ± 0.58 MHz
Noise Figure	-	± 0.89 dB
Unwanted Conducted Emissions	-	± 1.08 dB
Radiated Emissions	f ≤ 1 GHz f > 1 GHz	± 4.80 dB ± 6.07 dB
Frequency Stability	-	± 1.22 x 10^{-6}

3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature :	+15 ℃ to +35 ℃
Relative humidity:	30 % to 60 %
Air pressure	860 mbar to 1 060 mbar

4. TEST EQUIPMENTS

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	N9020A / Spectrum Analyzer	09/15/2017	Annual	MY46471250
Agilent	N5128A / Signal Generator	03/05/2018	Annual	MY50141649
Agilent	N5128A / Signal Generator	02/17/2018	Annual	MY46240523
Weinschel	WA67-30-33/ Fixed Attenuator	09/14/2017	Annual	WA67-30-33-2
Agilent	11636A / Power Divider	08/01/2018	Annual	09109
DEAYOUNG ENT	DFSS60 / AC Power Supply	04/05/2018	Annual	1003030-1
NANGYEUL CO., LTD.	NY-THR18750 / Temperature and Humidity Chamber	10/21/2017	Annual	NY-2009012201A
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
Innco system	MA4640/800-XP-EP / Antenna Position Tower	N/A	N/A	N/A
Emco	2090 / Controller	N/A	N/A	060520
Ets	Turn Table	N/A	N/A	N/A
Rohde & Schwarz	Loop Antenna	04/19/2017	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/06/2017	Biennial	760
Schwarzbeck	BBHA 9120D / Horn Antenna	06/30/2017	Biennial	9120D-1300
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	04/25/2017	Biennial	BBHA9170124
Rohde & Schwarz	FSP / Spectrum Analyzer	09/21/2017	Annual	836650/016
Wainwright Instruments	WHKX10-900-1000-15000-40SS	07/21/2017	Annual	5
Wainwright Instruments	WHKX10-2700-3000-18000-40SS / High Pass Filter	08/01/2017	Annual	4
CERNEX	CBLU1183540 / Power Amplifier	01/03/2018	Annual	24613
CERNEX	CBL06185030 / Power Amplifier	01/03/2018	Annual	24615
CERNEX	CBL18265035 / Power Amplifier	01/10/2018	Annual	22966

5. RF OUTPUT POWER

FCC Rules

Test Requirements:

§ 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

§22.913 Effective radiated power limits.

Licensees in the Cellular Radiotelephone Service are subject to the effective radiated power (ERP) limits and other requirements in this Section. See also §22.169.

(a) *Maximum ERP*. The ERP of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section.

(1) Except as described in paragraphs (a)(2), (3), and (4) of this section, the ERP of base stations and repeaters must not exceed—

(i) 500 watts per emission; or

(ii) 400 watts/MHz (PSD) per sector.

(d) Power measurement. Measurement of the ERP of Cellular base transmitters and repeaters must be made using an average power measurement technique. The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB. Power measurements for base transmitters and repeaters must be made in accordance with either of the following:

(1) A Commission-approved average power technique (see FCC Laboratory's Knowledge Database); or

(2) For purposes of this section, peak transmit power must be measured over an interval of

continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

§90.635 Limitations on power and antenna height

(a) The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values, and applicants will be required to justify power levels and antenna heights requested.

(b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

Table—Equivalent Power and Antenna Heights for Base Stations in the 851-869 MHz and 935-940 MHz Bands Which Have a Requirement for a 32 km (20 mi) Service Area Radius

Antenna height (ATT) meters (feet)	Effective radiated power (watts)
Above 1,372 (4,500)	65
Above 1,220 (4,000) to 1,372 (4,500)	70
Above 1,067 (3,500) to 1,220 (4,000)	75
Above 915 (3,000) to 1,067 (3,500)	100
Above 763 (2,500) to 915 (3,000)	140
Above 610 (2,000) to 763 (2,500)	200
Above 458 (1,500) to 610 (2,000)	350
Above 305 (1,000) to 458 (1,500)	600
Up to 305 (1,000)	1,000

Test Procedures:

Measurements were in accordance with the test methods section 3.5.2 of KDB 935210 D05 v01r02.

a) Connect a signal generator to the input of the EUT.

b) Configure to generate the AWGN (broadband) test signal.

c) The frequency of the signal generator shall be set to the frequency f_0 as determined from 3.3.

d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.

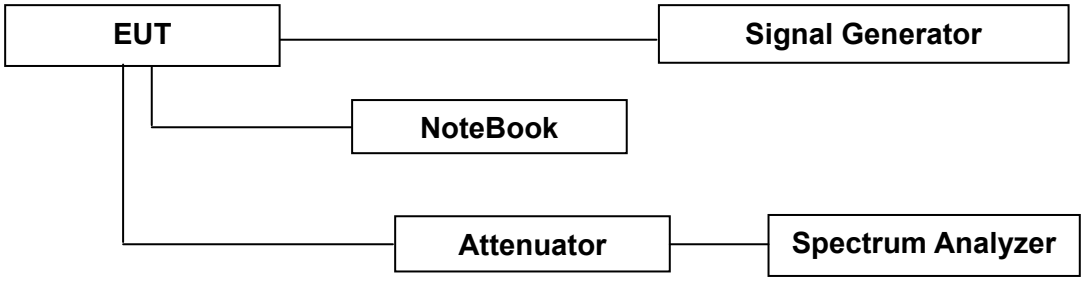
e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.

f) Measure and record the output power of the EUT; use 3.5.3 or 3.5.4 for power measurement.

g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.

h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.
i) Repeat steps e) to h) with the narrowband test signal.
j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.

Power measurement Method:
Guidance for performing input/output power measurements using a spectrum or signal analyzer is provided in 5.2 of KDB Publication 971168 D01 v03r01.



Block Diagram 1. RF Power Output Test Setup

Test Results:

Input Signal	Input Level (dBm)	Maximum Amp Gain (dB)
800	-74	97

* Due to EUT's ALC function (Auto Level Control), even if input signal is increased, the same output power is transmit.
* Amp gain is the result of combination with SU module EZ-DASS-IC37. This value is determined by SU module, so when combined with another SU module EZ-DASS-IC30, gain is changed to 90 dB.

Data of Output Power – FCC Part 90 Band

	Channel	Frequency (MHz)	Measured Output Power	
			(dBm)	(W)
LTE 5 MHz AGC threshold	Low	819.50	23.11	0.205
	High	821.50	23.24	0.211
LTE 5 MHz +3 dB above the AGC threshold	Low	819.50	23.05	0.202
	High	821.50	23.18	0.208
CDMA AGC threshold	Low	818.25	23.15	0.207
	High	822.75	23.24	0.211
CDMA +3 dB above the AGC threshold	Low	818.25	23.06	0.202
	High	822.75	23.13	0.206

Data of Output Power – FCC Part 22 Band

	Channel	Frequency (MHz)	Measured Output Power	
			(dBm)	(W)
LTE 5 MHz AGC threshold	Low	826.50	22.91	0.195
	Middle	836.50	23.03	0.201
	High	846.50	22.90	0.195
LTE 5 MHz +3 dB above the AGC threshold	Low	826.50	22.91	0.195
	Middle	836.50	23.14	0.206
	High	846.50	22.88	0.194
CDMA AGC threshold	Low	825.25	23.16	0.207
	Middle	836.50	23.16	0.207
	High	847.75	22.97	0.198
CDMA +3 dB above the AGC threshold	Low	825.25	23.22	0.210
	Middle	836.50	23.11	0.205
	High	847.75	23.04	0.201

*Note: We have done CDMA and 1xEVDO modulation test in technology. Test results are only attached worst cases.

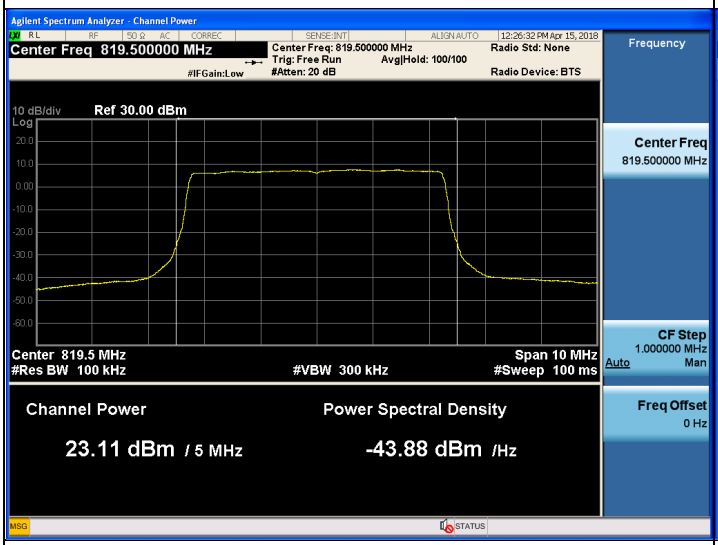
Data of Peak-to-Average Ratio (PAR) – FCC Part 22 Band

	Channel	Frequency (MHz)	Measured PAR (dB)
LTE 5 MHz AGC threshold	Middle	836.50	8.28
LTE 5 MHz +3 dB above the AGC threshold			8.25
CDMA AGC threshold			8.83
CDMA +3 dB above the AGC threshold			8.85

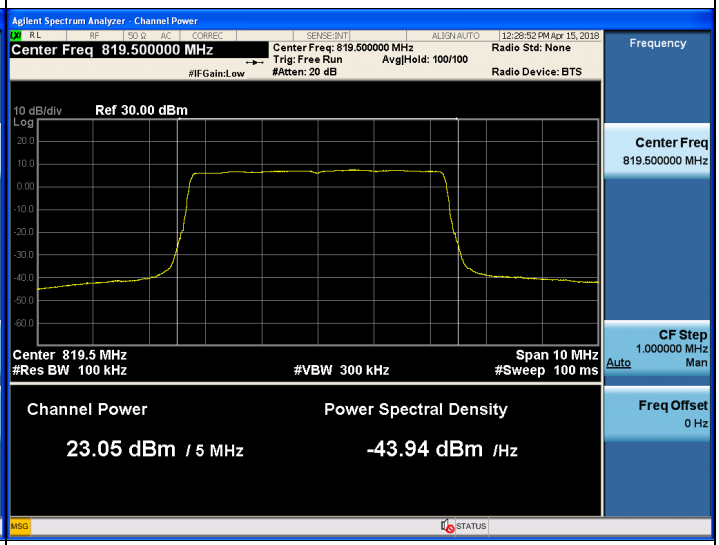
*Note: We have done CDMA and 1xEVDO modulation test in technology. Test results are only attached worst cases.

Plot of Output Power for LTE 5 MHz – FCC Part 90 Band

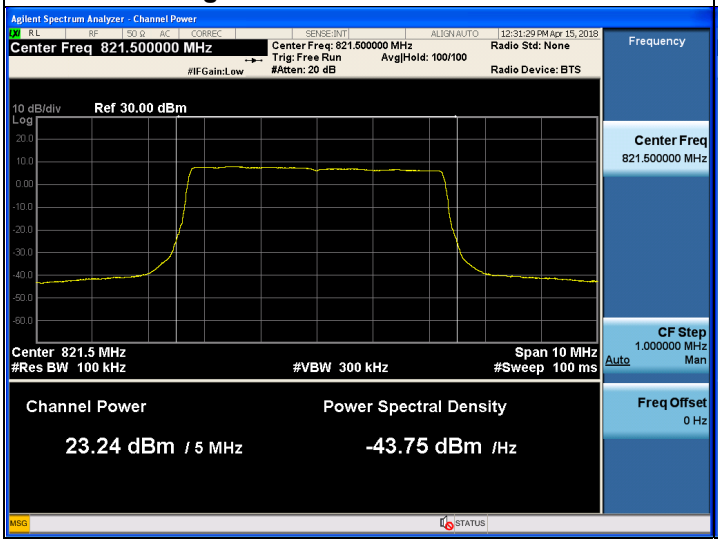
Low Channel AGC threshold



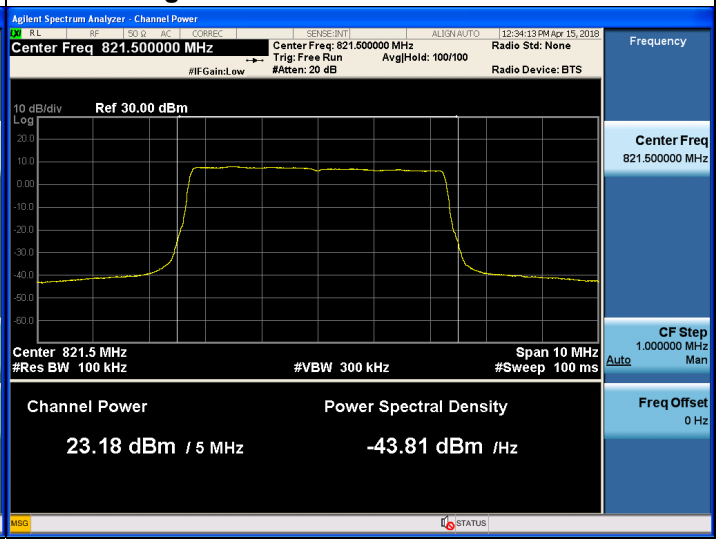
Low Channel +3 dB AGC threshold



High Channel AGC threshold

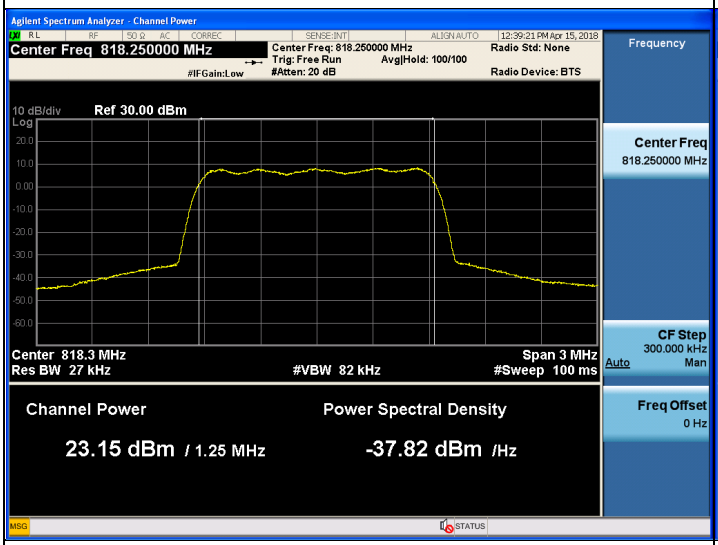


High Channel +3 dB AGC threshold

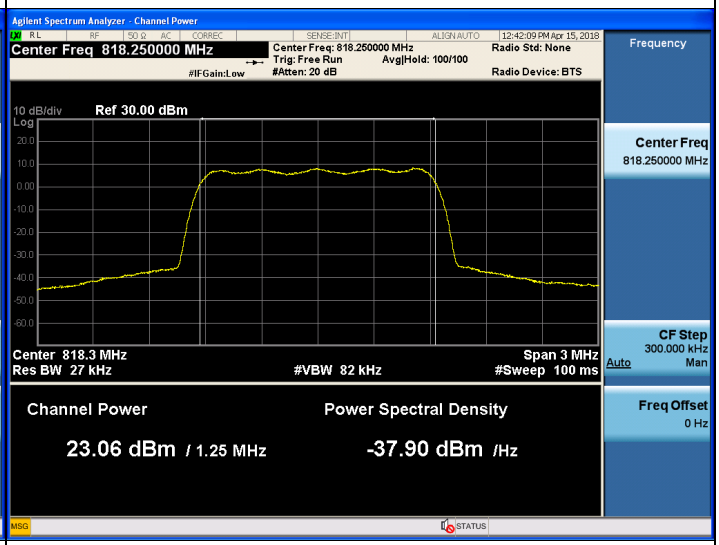


Plot of Output Power for CDMA – FCC Part 90 Band

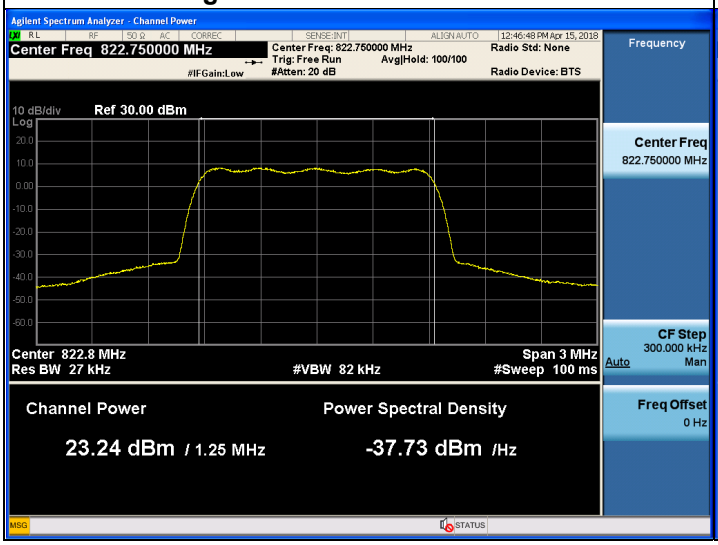
Low Channel AGC threshold



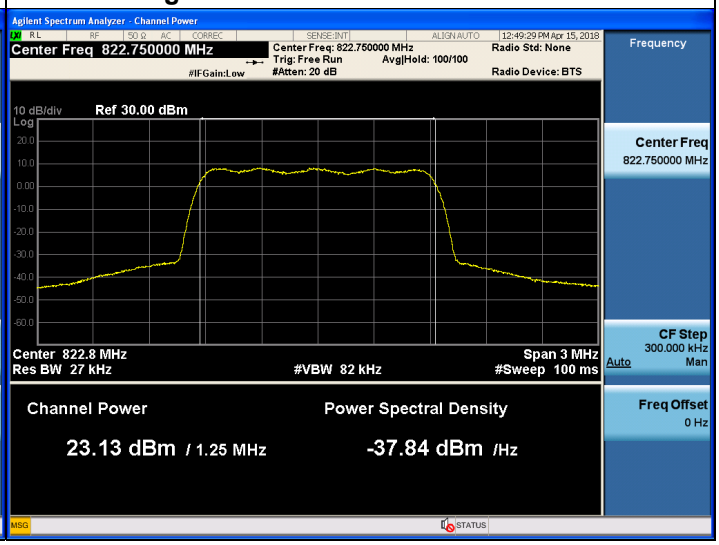
Low Channel +3 dB AGC threshold



High Channel AGC threshold

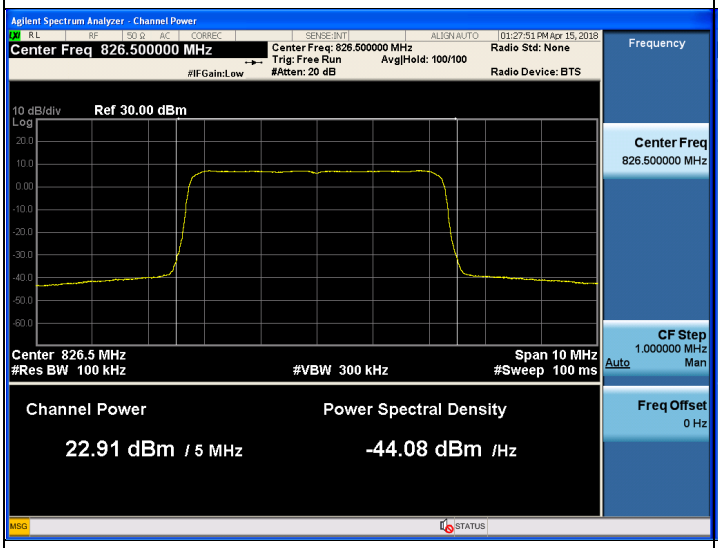


High Channel +3 dB AGC threshold

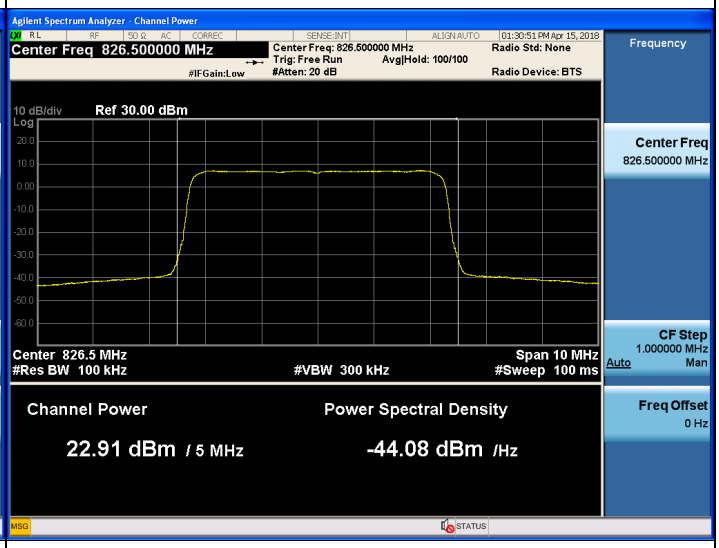


Plot of Output Power for LTE 5 MHz – FCC Part 22 Band

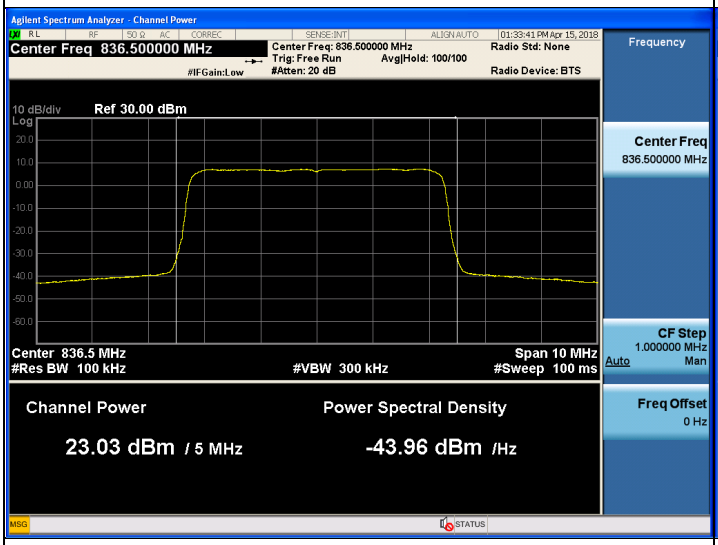
Low Channel AGC threshold



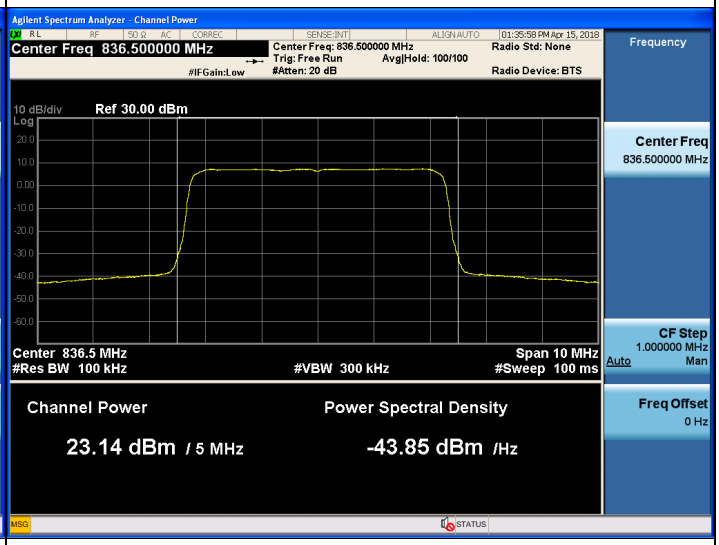
Low Channel +3 dB AGC threshold



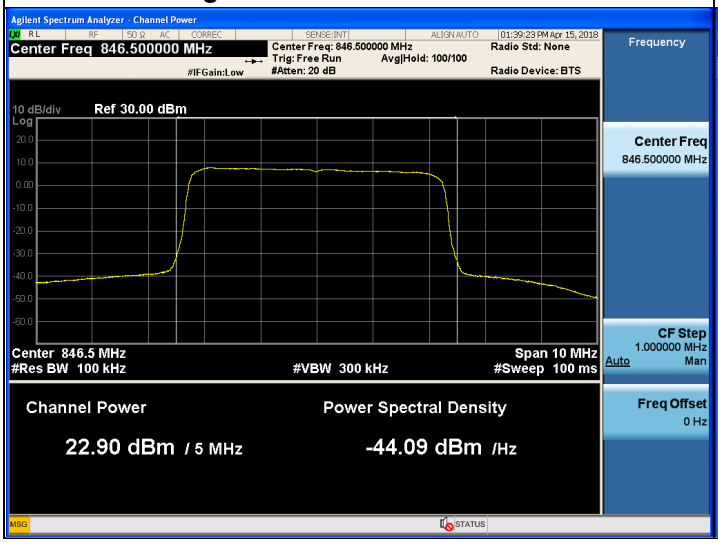
Middle Channel AGC threshold



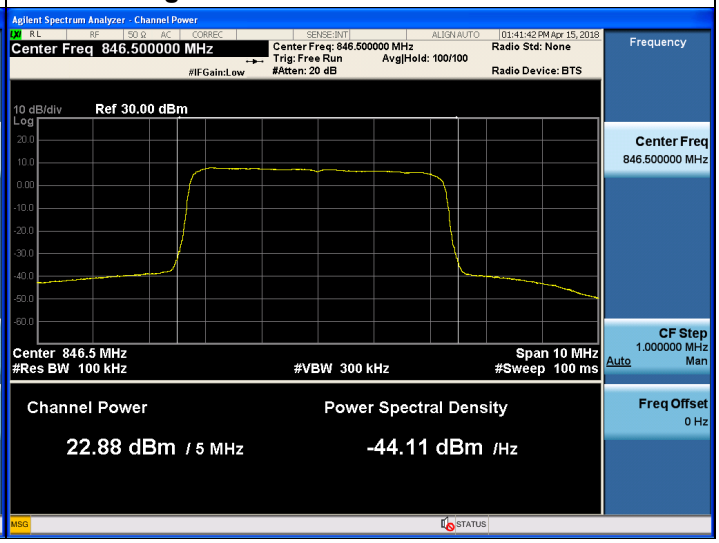
Middle Channel +3 dB AGC threshold



High Channel AGC threshold

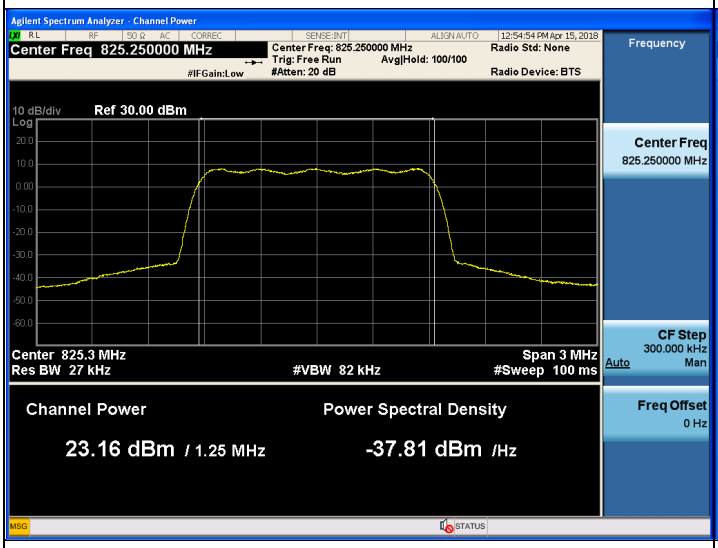


High Channel +3 dB AGC threshold

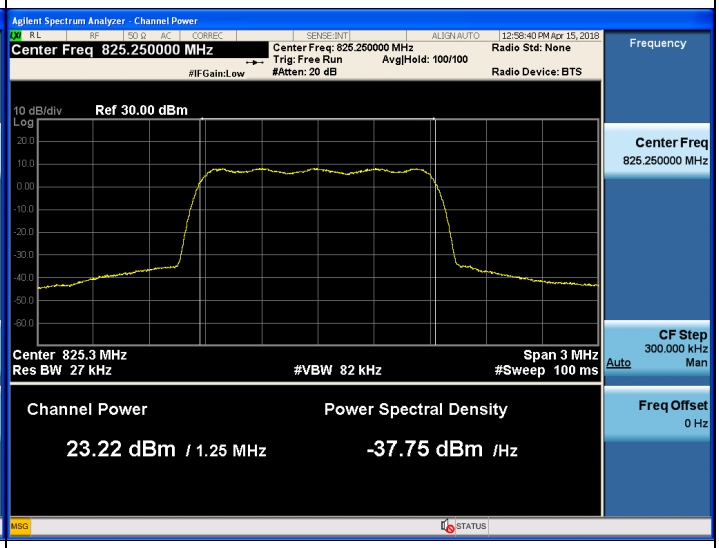


Plot of Output Power for CDMA – FCC Part 22 Band

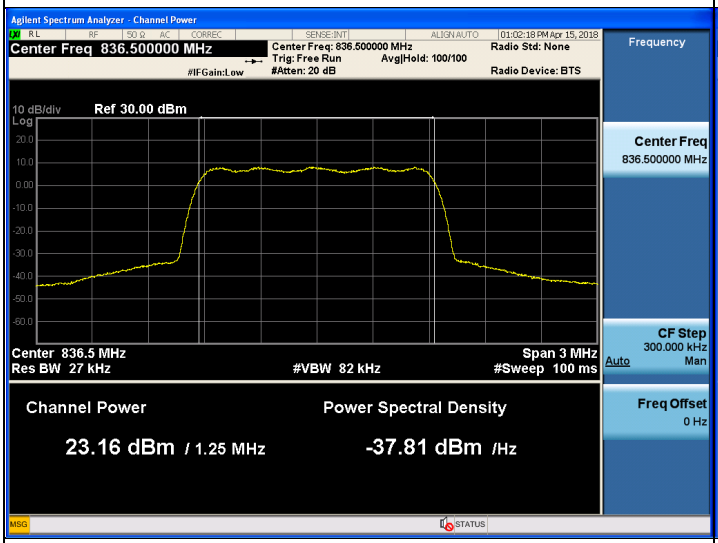
Low Channel AGC threshold



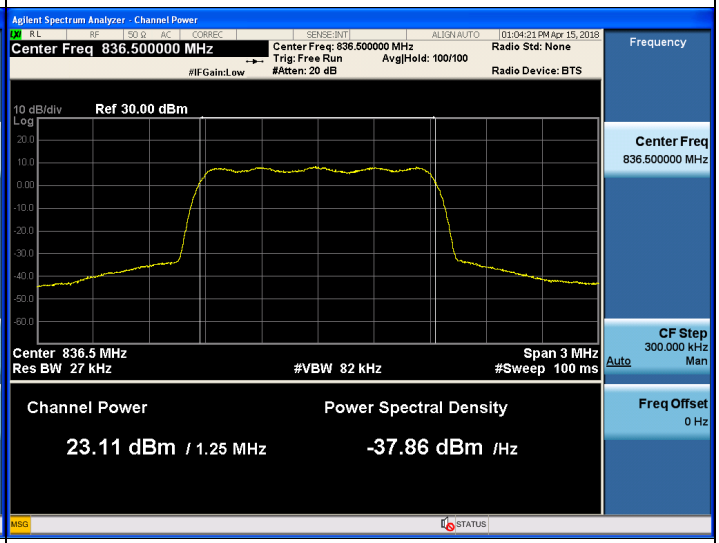
Low Channel +3 dB AGC threshold



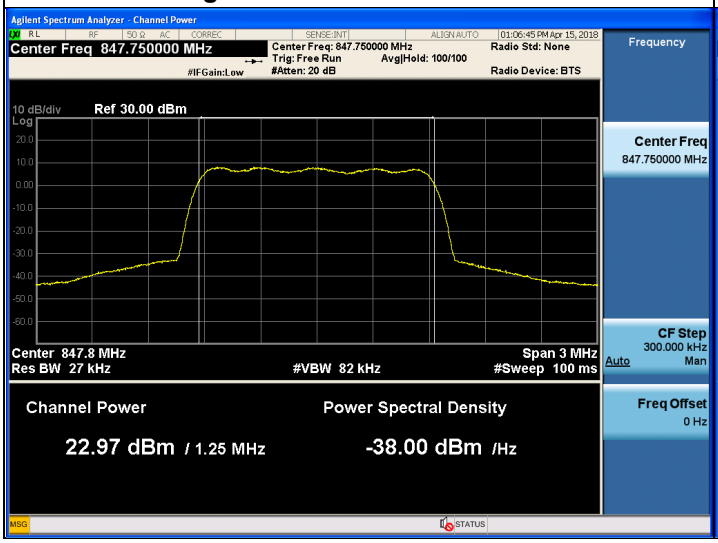
Middle Channel AGC threshold



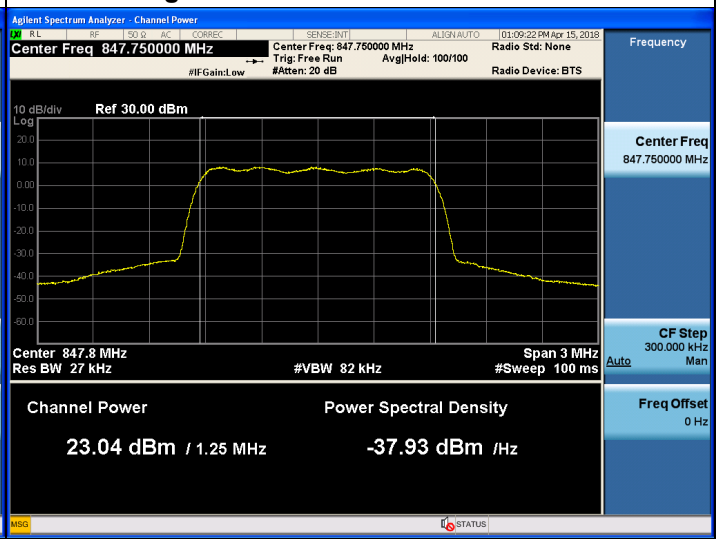
Middle Channel +3 dB AGC threshold



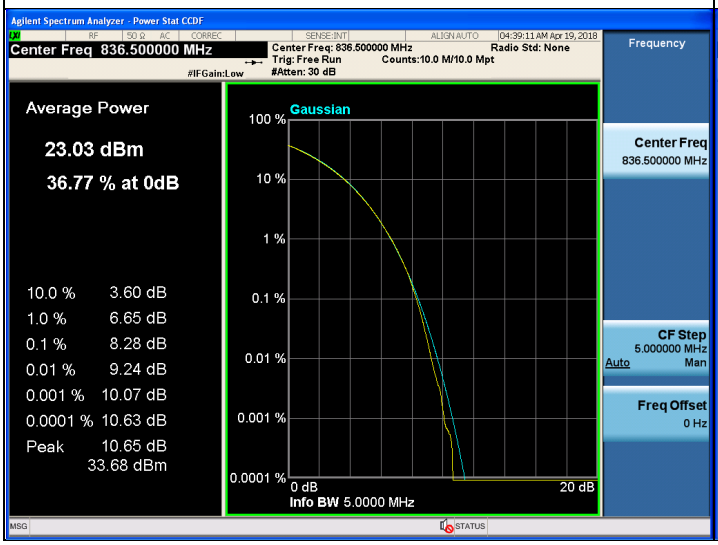
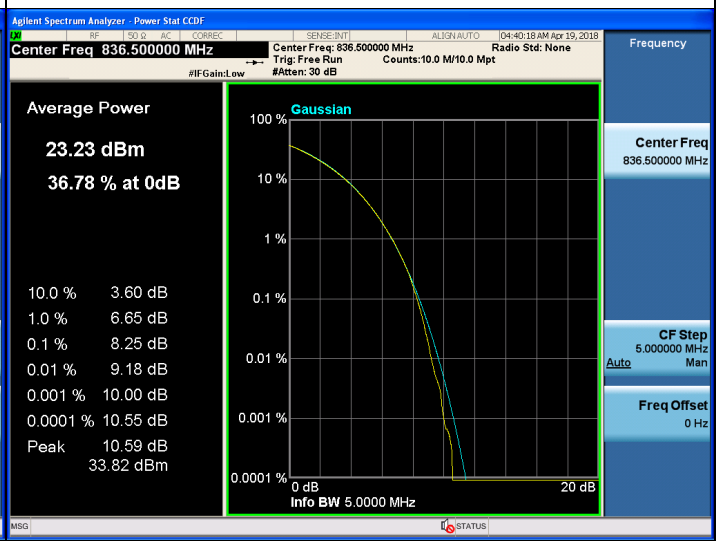
High Channel AGC threshold



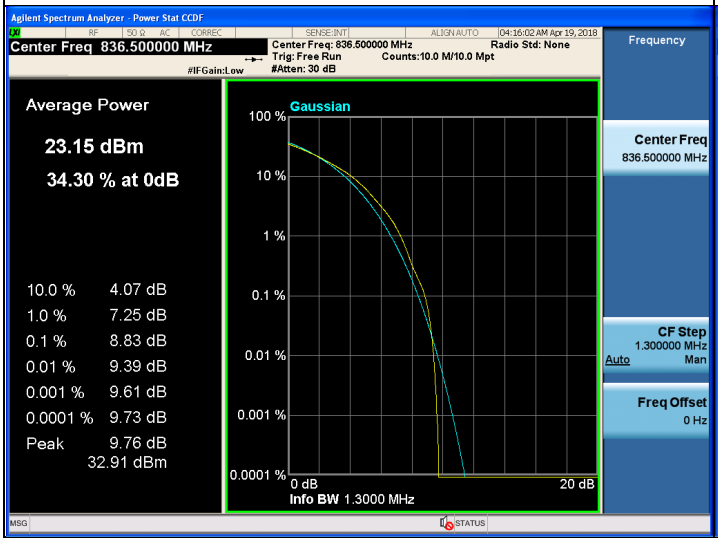
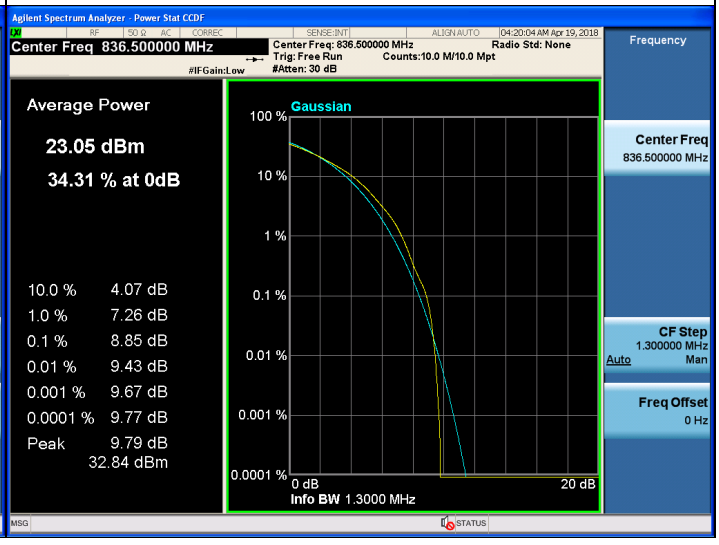
High Channel +3 dB AGC threshold



Plot of PAR for LTE 5 MHz – FCC Part 22 Band

Middle Channel AGC threshold	Middle Channel +3 dB AGC threshold
	

Plot of PAR for CDMA – FCC Part 22 Band

Middle Channel AGC threshold	Middle Channel +3 dB AGC threshold
	

6. OCCUPIED BANDWIDTH

FCC Rules

Test Requirements:

§ 2.1049 Measurements required: Occupied bandwidth.

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of § 2.1049 (a) through (i) as applicable.

Test Procedures:

Measurements were in accordance with the test methods section 3.4 of KDB 935210 D05 v01r02 and section 4.2 of KDB 971168 D01 v03r01.

Test is 99% OBW measured and used.

a) Connect a signal generator to the input of the EUT.

b) Configure the signal generator to transmit the AWGN signal.

c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.

d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between 2 times to 5 times the emission bandwidth (EBW) or alternatively, the OBW.

f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be $\geq 3 \times$ RBW.

g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than [10 log (OBW / RBW)] below the reference level.

Steps f) and g) may require iteration to enable adjustments within the specified tolerances.

h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below the reference level.

i) Set spectrum analyzer detection function to positive peak.

j) Set the trace mode to max hold.

k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency as f_0.

l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the −26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two

markers. If the spectral envelope crosses the −26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the −26 dB down amplitude point.

m) Repeat steps e) to l) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).

n) Compare the spectral plot of the input signal (determined from step m) to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.

o) Repeat the procedure [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.

p) Repeat steps e) to o) with the signal generator set to the narrowband signal.

q) Repeat steps e) to p) for all frequency bands authorized for use by the EUT.

Note:

1) Input and Output Occupied Bandwidth Test is performed using only the following equipment.

Manufacturer	Model / Equipment	Serial No.
Agilent	N9020A / Spectrum Analyzer	MY46471250
Agilent	N5128A / Signal Generator	MY50141649
Weinschel	WA67-30-33/ Fixed Attenuator	WA67-30-33-2
DEAYOUNG ENT	DFSS60 / AC Power Supply	1003030-1

Test Results:

Data of Output Occupied bandwidth – FCC Part 90 Band

	Channel	Frequency (MHz)	Measured OBW (MHz)
LTE 5 MHz AGC threshold	Low	819.50	4.4984
	High	821.50	4.5105
LTE 5 MHz +3 dB above the AGC threshold	Low	819.50	4.4994
	High	821.50	4.5083
CDMA AGC threshold	Low	818.25	1.2605
	High	822.75	1.2562
CDMA +3 dB above the AGC threshold	Low	818.25	1.2570
	High	822.75	1.2607

Data of Output Occupied bandwidth – FCC Part 22 Band

	Channel	Frequency (MHz)	Measured OBW (MHz)
LTE 5 MHz AGC threshold	Low	826.50	4.4468
	Middle	836.50	4.4403
	High	846.50	4.4274
LTE 5 MHz +3 dB above the AGC threshold	Low	826.50	4.4407
	Middle	836.50	4.4407
	High	846.50	4.4260
CDMA AGC threshold	Low	825.25	1.2638
	Middle	836.50	1.2586
	High	847.75	1.2562
CDMA +3 dB above the AGC threshold	Low	825.25	1.2585
	Middle	836.50	1.2580
	High	847.75	1.2547

*Note: We have done CDMA and 1xEVDO modulation test in technology. Test results are only attached worst cases.

Data of Input Occupied bandwidth – FCC Part 90 Band

	Channel	Frequency (MHz)	Measured OBW (MHz)
LTE 5 MHz AGC threshold	Low	819.50	4.5782
	High	821.50	4.5814
CDMA AGC threshold	Low	818.25	1.2651
	High	822.75	1.2670

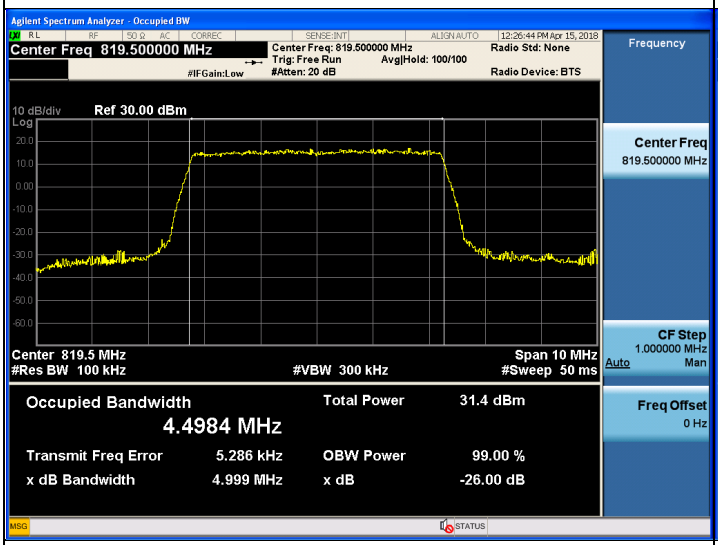
Data of Input Occupied bandwidth – FCC Part 22 Band

	Channel	Frequency (MHz)	Measured OBW (MHz)
LTE 5 MHz AGC threshold	Low	826.50	4.5846
	Middle	836.50	4.5869
	High	846.50	4.5858
CDMA AGC threshold	Low	825.25	1.2722
	Middle	836.50	1.2723
	High	847.75	1.2720

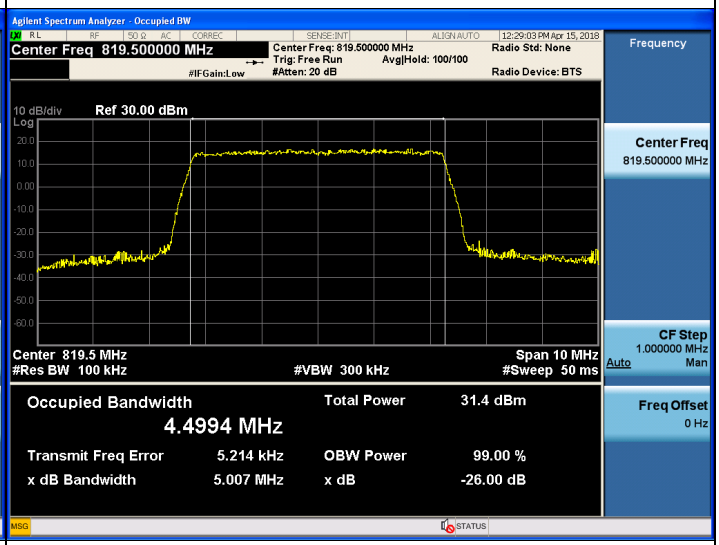
*Note: We have done CDMA and 1xEVDO modulation test in technology. Test results are only attached worst cases.

Plot of Output Occupied Bandwidth for LTE 5 MHz – FCC Part 90 Band

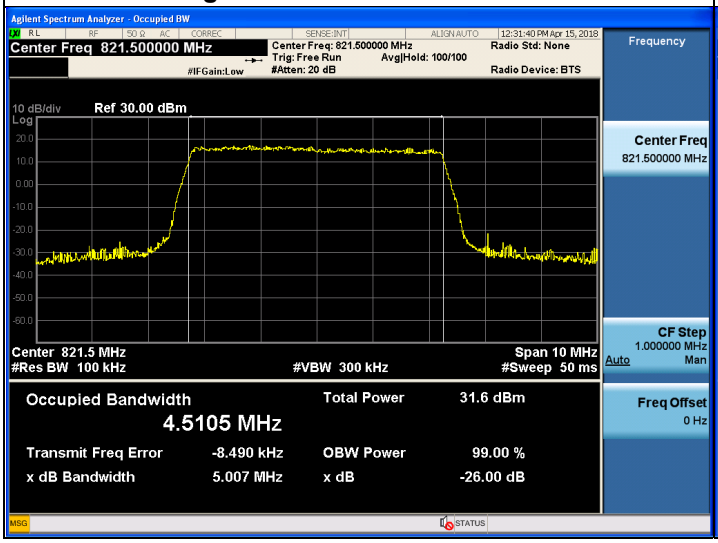
Low Channel AGC threshold



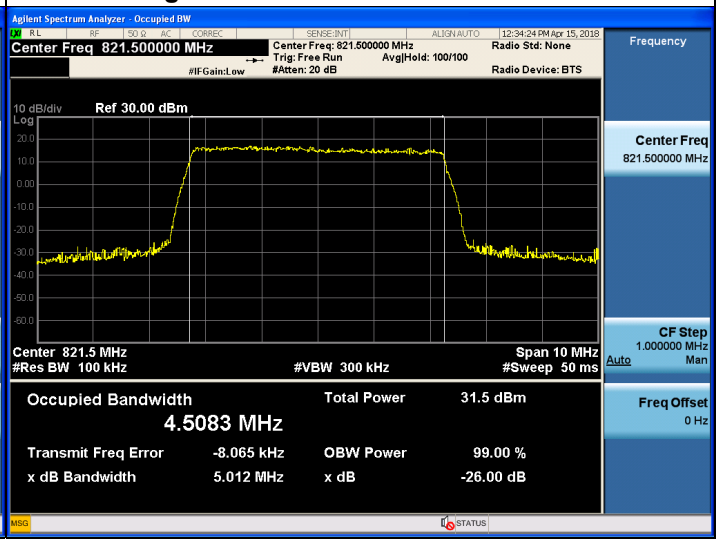
Low Channel +3 dB AGC threshold



High Channel AGC threshold

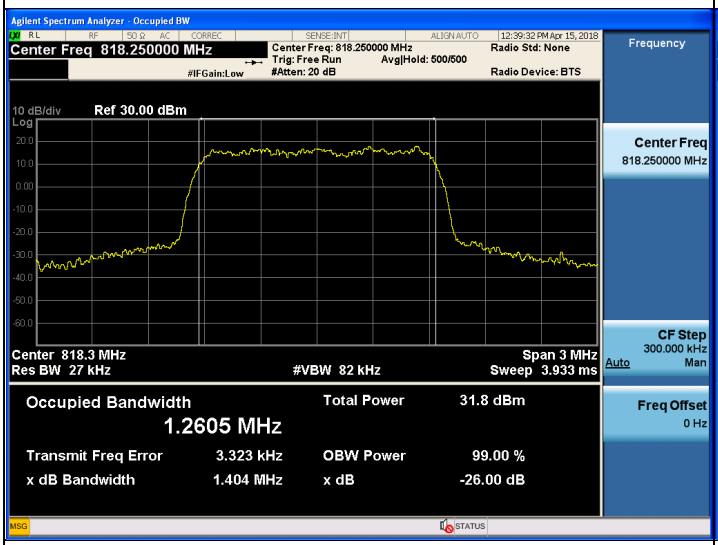


High Channel +3 dB AGC threshold

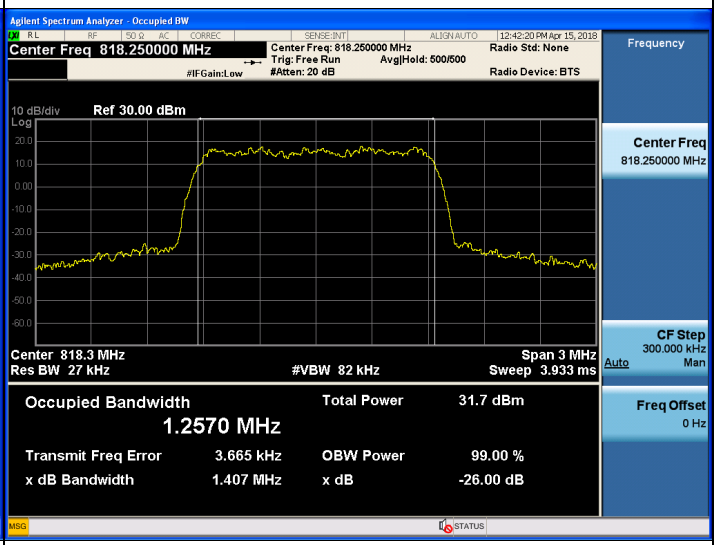


Plot of Output Occupied Bandwidth for CDMA – FCC Part 90 Band

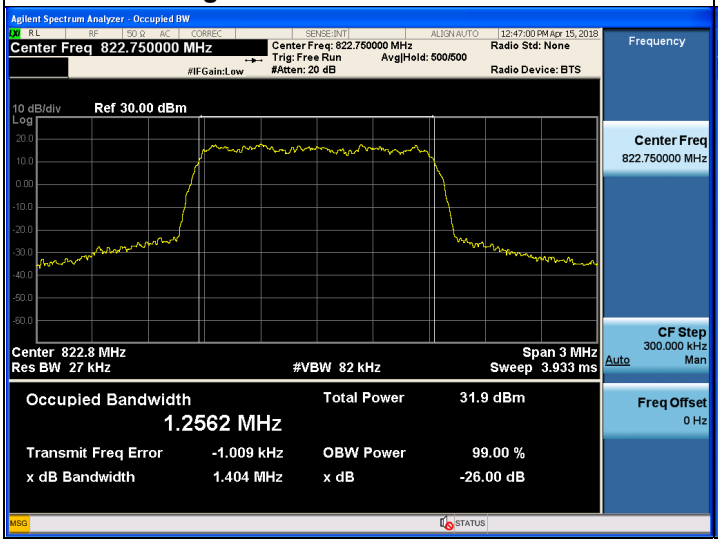
Low Channel AGC threshold



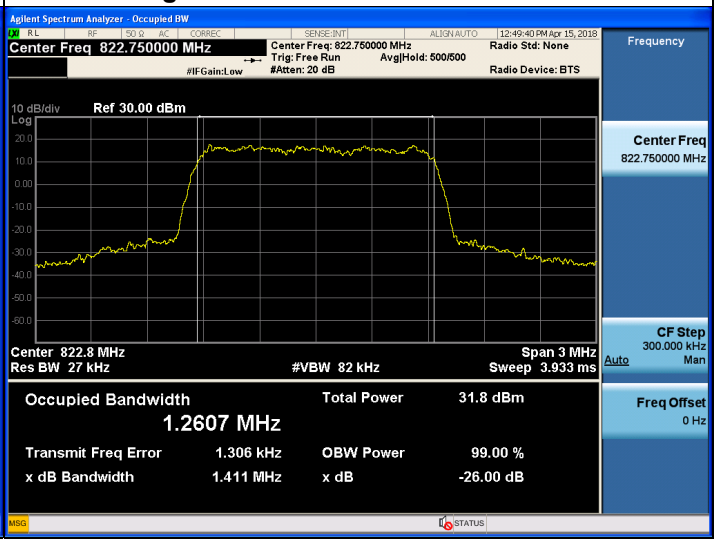
Low Channel +3 dB AGC threshold



High Channel AGC threshold

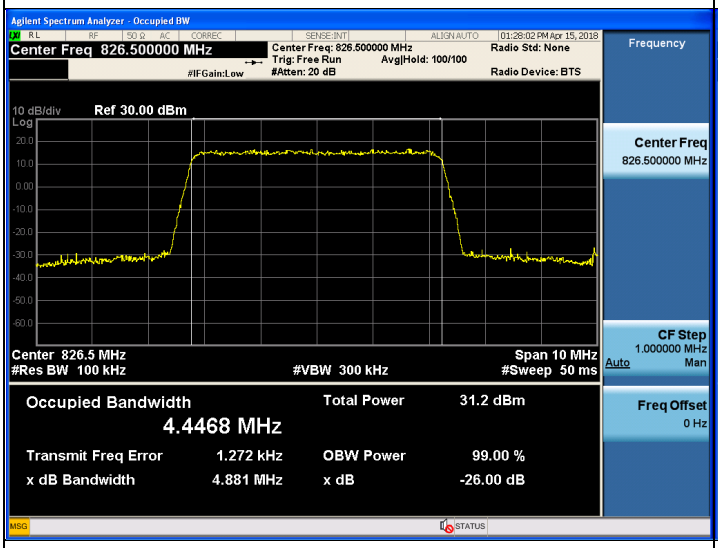


High Channel +3 dB AGC threshold

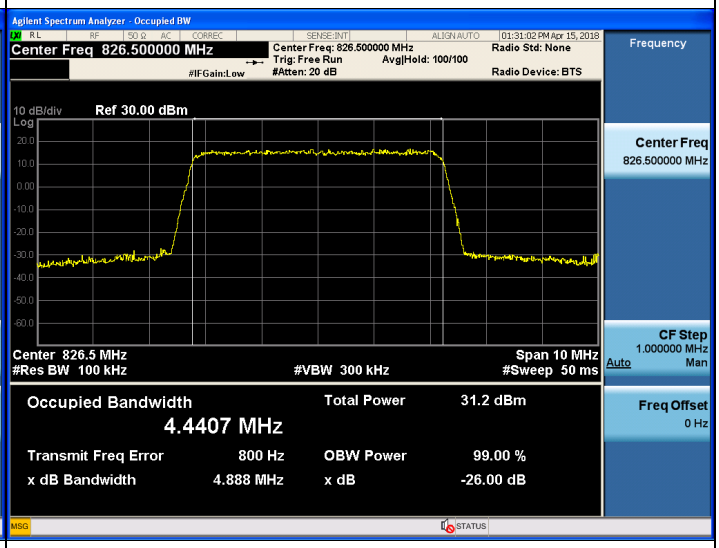


Plot of Output Occupied Bandwidth for LTE 5 MHz – FCC Part 22 Band

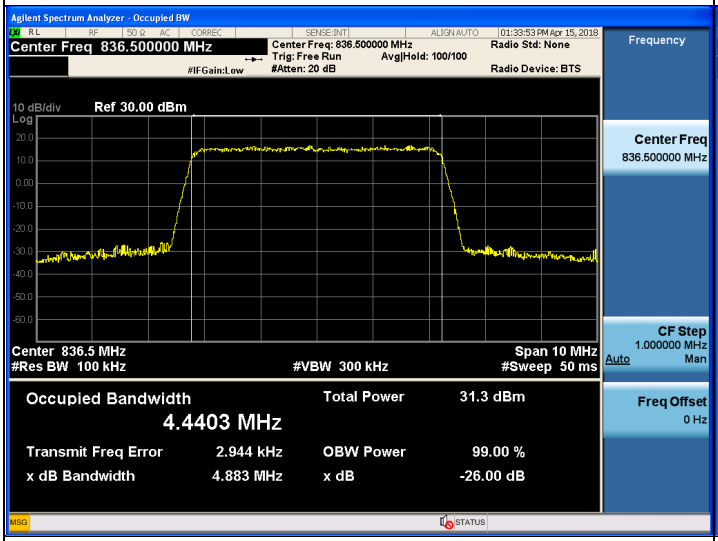
Low Channel AGC threshold



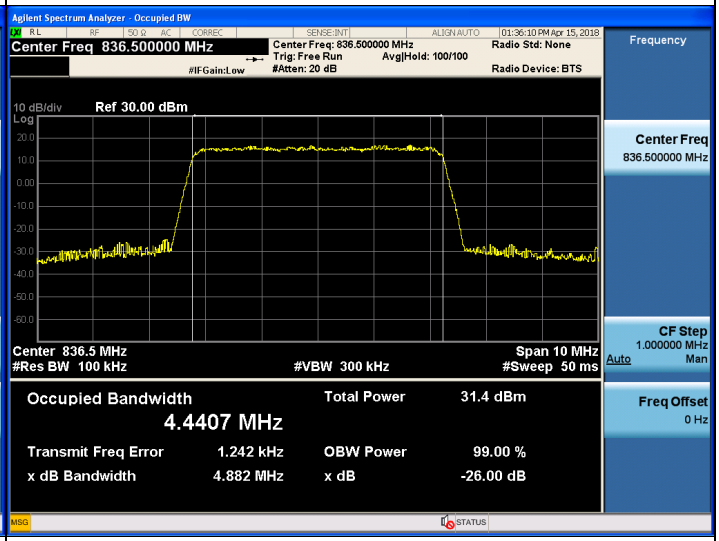
Low Channel +3 dB AGC threshold



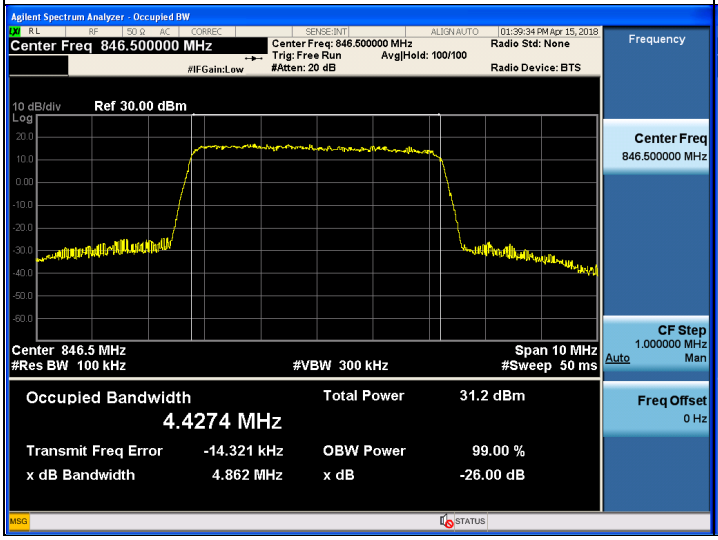
Middle Channel AGC threshold



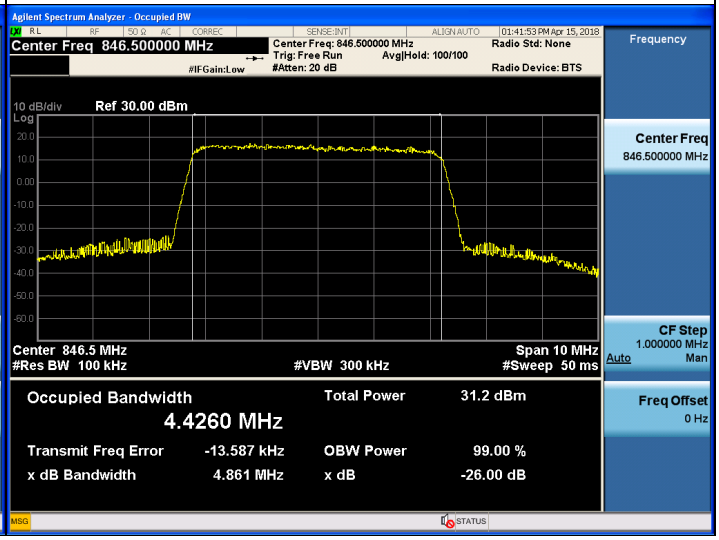
Middle Channel +3 dB AGC threshold



High Channel AGC threshold

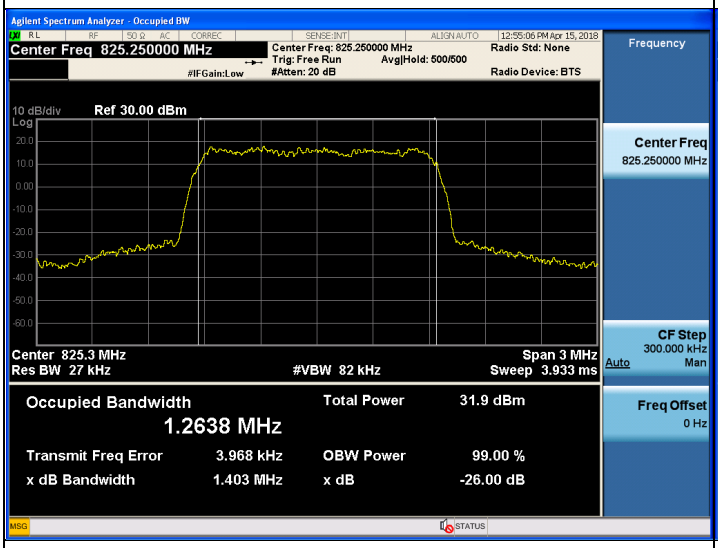


High Channel +3 dB AGC threshold

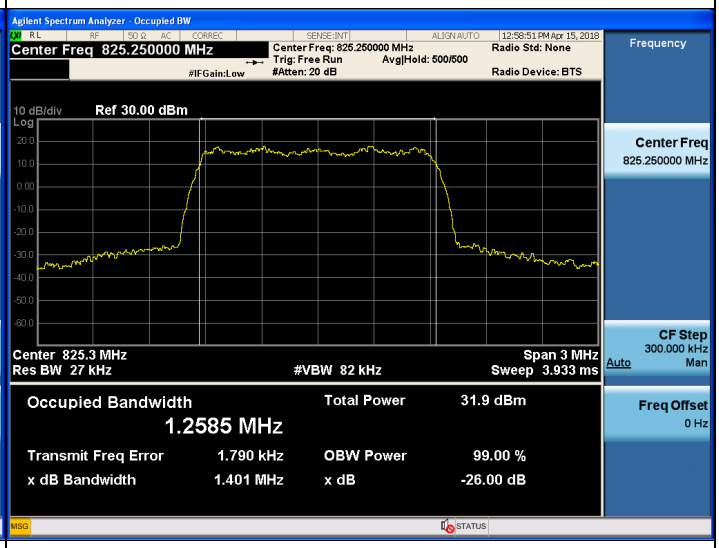


Plot of Output Occupied Bandwidth for CDMA – FCC Part 22 Band

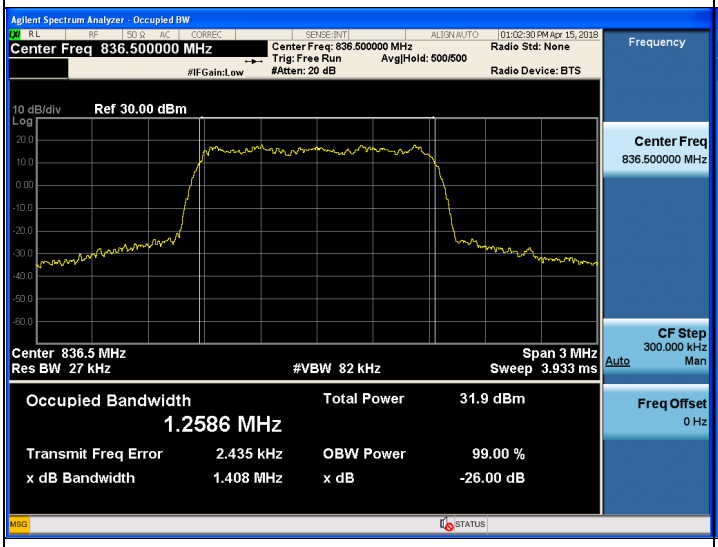
Low Channel AGC threshold



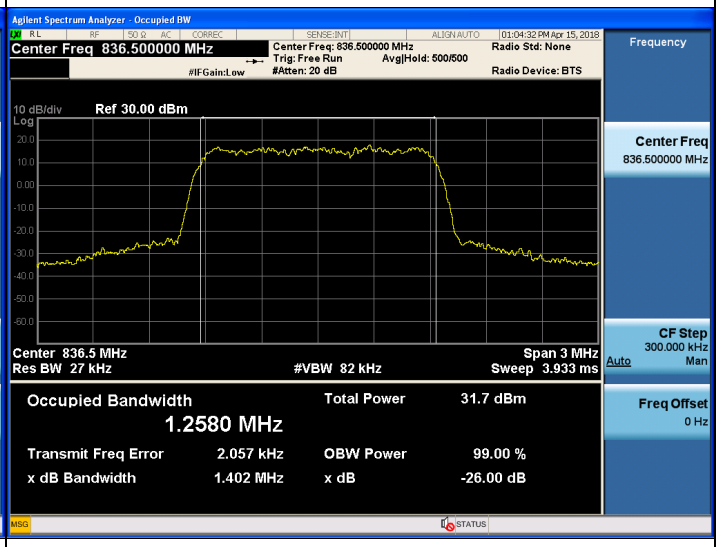
Low Channel +3 dB AGC threshold



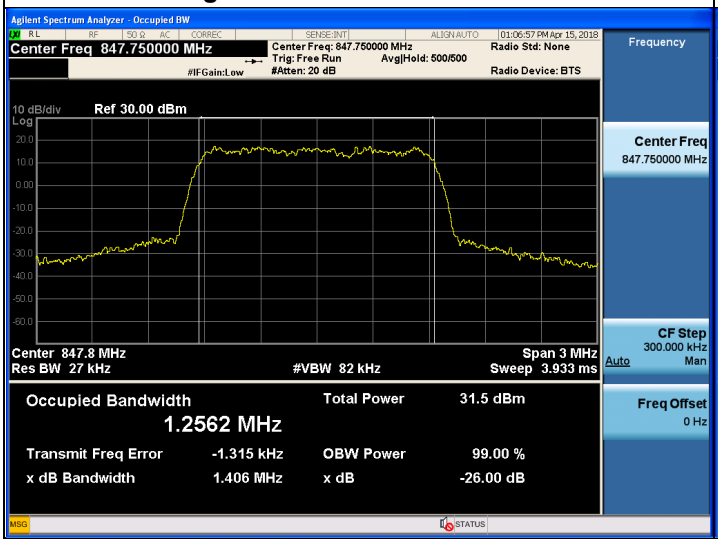
Middle Channel AGC threshold



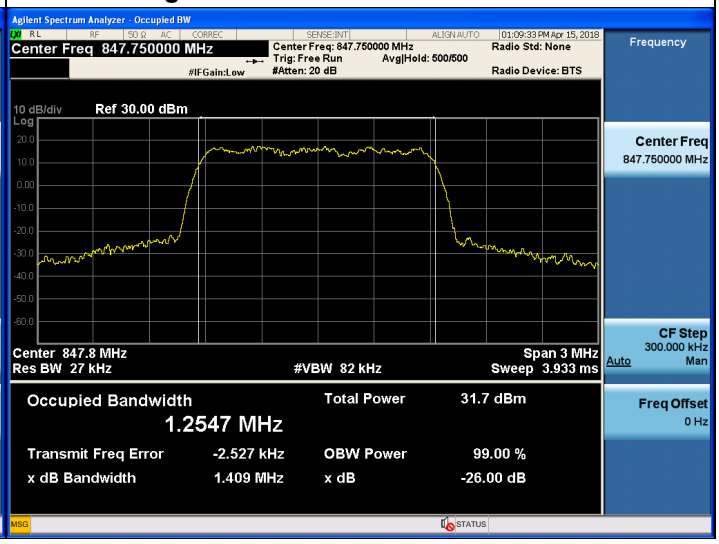
Middle Channel +3 dB AGC threshold



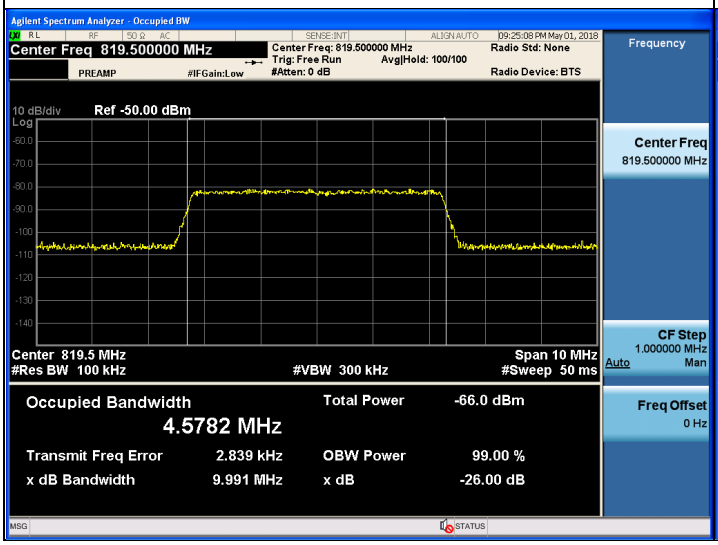
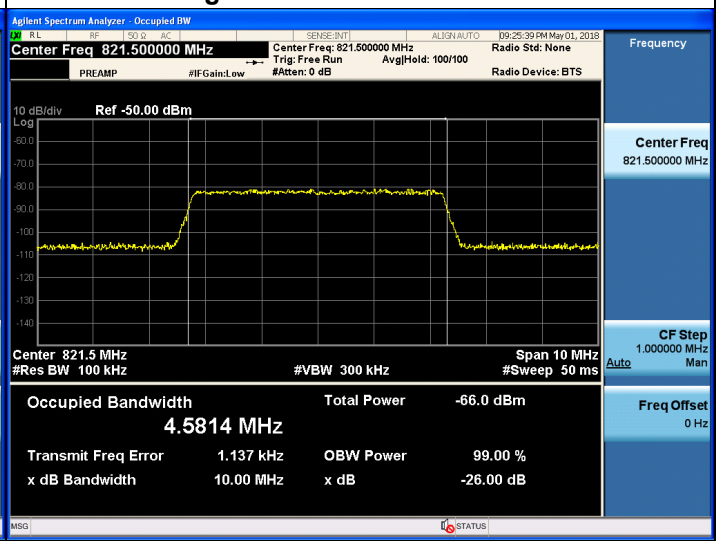
High Channel AGC threshold



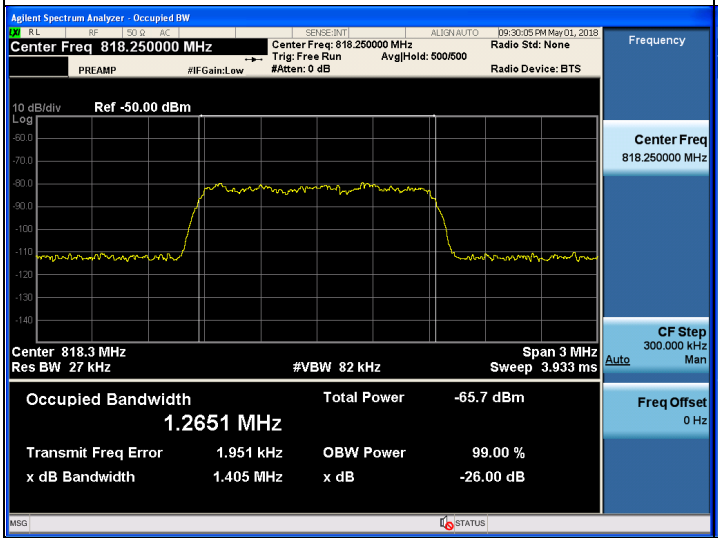
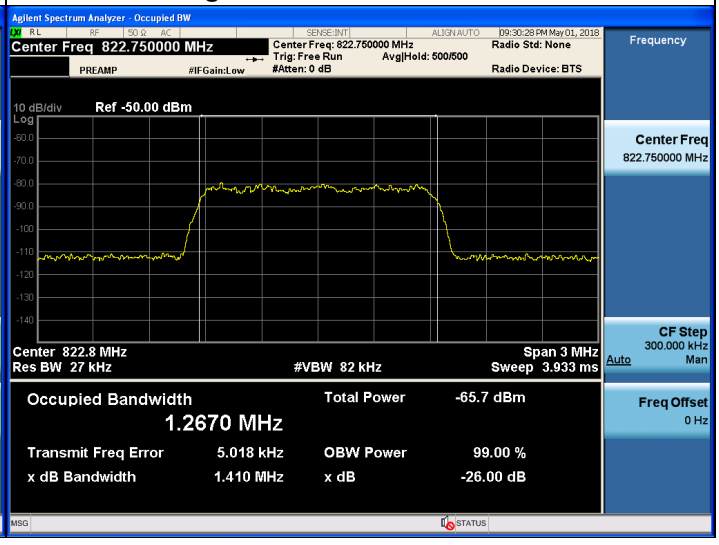
High Channel +3 dB AGC threshold



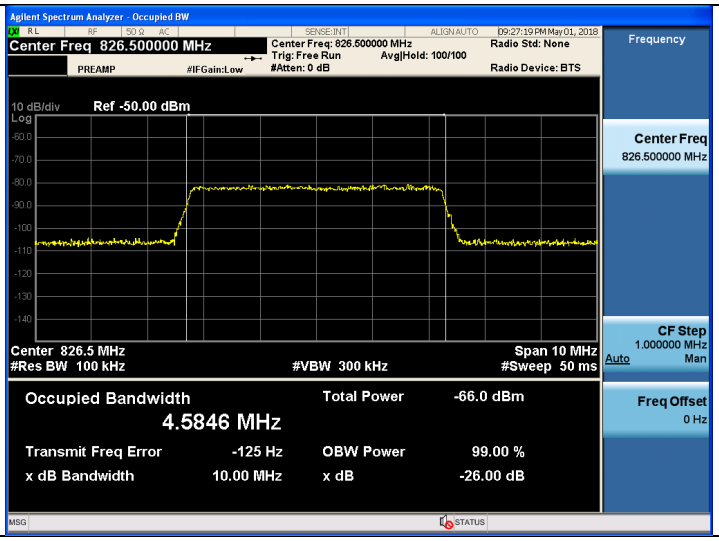
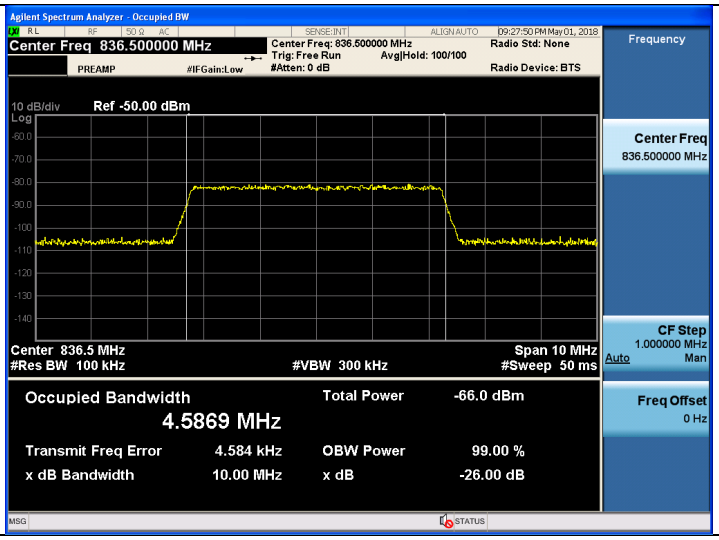
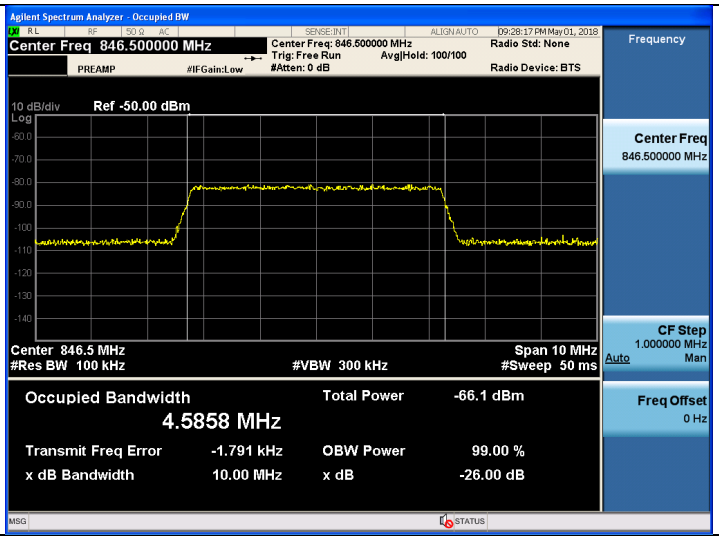
Plot of Input Occupied Bandwidth for LTE 5 MHz – FCC Part 90 Band

Low Channel AGC threshold	High Channel AGC threshold
	

Plot of Input Occupied Bandwidth for CDMA – FCC Part 90 Band

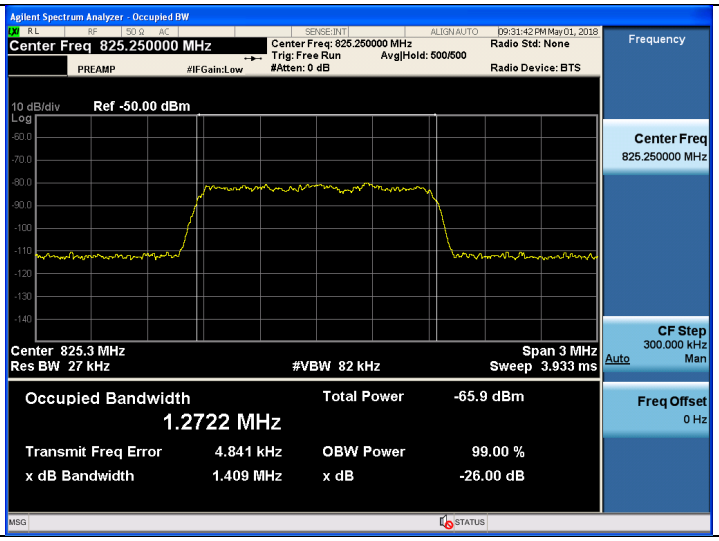
Low Channel AGC threshold	High Channel AGC threshold
	

Plot of Input Occupied Bandwidth for LTE 5MHz – FCC Part 22 Band

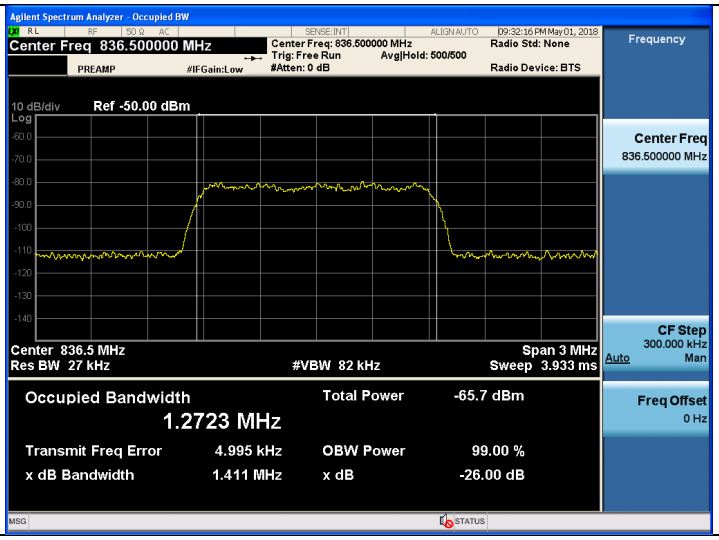
Low Channel AGC threshold

Middle Channel AGC threshold

High Channel AGC threshold


Plot of Input Occupied Bandwidth for CDMA – FCC Part 22 Band

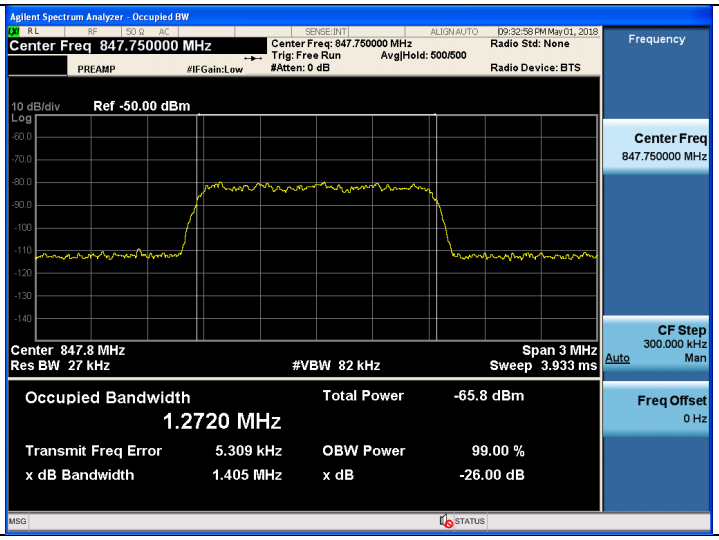
Low Channel AGC threshold



Middle Channel AGC threshold



High Channel AGC threshold



7. OUT OF BAND REJECTION

FCC Rules

Test Requirement(s):

KDB 935210 D05 v01r02

Out of Band Rejection – Test for rejection of out of band signals. Filter freq. response plots are acceptable.

Test Procedures:

Measurements were in accordance with the test methods section 3.3, 4.3 of KDB 935210 D05 v01r02.

3.3 EUT out-of-band rejection

a) Connect a signal generator to the input of the EUT.

b) Configure a swept CW signal with the following parameters:

1) Frequency range = ± 250 % of the passband from the center of the passband.

2) Level = a sufficient level to affirm that the out-of-band rejection is > 20 dB above the noise floor and will not engage the AGC during the entire sweep.

3) Dwell time = approx. 10 ms.

4) Number of points = SPAN/(RBW/2).

c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

d) Set the span of the spectrum analyzer to the same as the frequency range of the signal generator.

e) Set the resolution bandwidth of the spectrum analyzer to be 1 % to 5 % of the passband and the video bandwidth shall be set to ≥ 3 × RBW.

f) Set the detector to Peak Max-Hold and wait for the spectrum analyzer's spectral display to fill.

g) Place a marker to the peak of the frequency response and record this frequency as f0.

h) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the −20 dB down amplitude to determine the 20 dB bandwidth. Capture the frequency response of the EUT.

4.3 PLMRS device out-of-band rejection

Adjust the internal gain control of the equipment under test to the maximum gain for which equipment certification is sought.

a) Connect a signal generator to the input of the EUT.

b) Configure a swept CW signal with the following parameters:

c) Frequency range = ± 250 % of the manufacturer's pass band.

d) The CW amplitude will be 3 dB below the AGC threshold (see 4.2) and but not activate the AGC threshold throughout the test.

e) Dwell time = approx. 10 ms.

f) Frequency step = 50 kHz.

g) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

h) Set the resolution bandwidth of the spectrum analyzer between 1 % and 5 % of the manufacturer's pass band with the video bandwidth set to 3 × RBW.

i) Set the detector to Peak and the trace to Max-Hold.

j) After the trace is completely filled, place a marker at the peak amplitude, which is designated as f0, and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the gain has fallen by 20 dB).

k) Capture the frequency response plot and for inclusion in the test report.

Test Results:

Input Signal	Input Level (dBm)	Maximum Amp Gain (dB)
Sinusoidal	-74	97

* 800 MHz out of band rejection is measured in bands of part 22 and part 90, together.

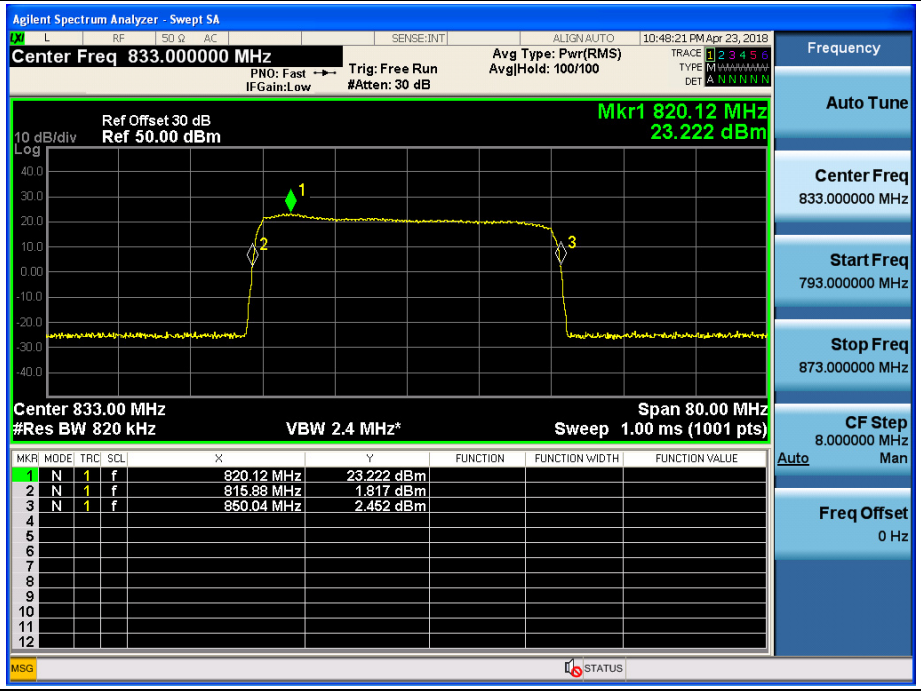
* Amp gain is the result of combination with SU module EZ-DASS-IC37. This value is determined by SU module, so when combined with another SU module EZ-DASS-IC30, gain is changed to 90 dB.

Data of Out of Band Rejection

	point of 20 dB below (MHz)		Output power (dBm)	Gain (dB)
800 Band	Left	815.88	23.222	97.222
	Right	850.04		

Plot of Out of Band Rejection

800 Band



8. NOISE FIGURE

FCC Rules

Test Requirements:

§ 90.219 Use of signal boosters:

(e) (2) The noise figure of a signal booster must not exceed 9 dB in either direction.

Test Procedures:

The EUT was tested using Agilent Application Note 57-1, 'The direct noise measurement method"

1. GAIN measurement
EUT in the maximum gain of the repeater state.
The signal generator was connected to RF input port at a maximum level as determined by the spectrum analyzer was connected to RF output port depending on the circuitry being measured.
EUT GAIN = Output signal level – Input signal level
2. Output Noise level measurement
EUT in the maximum gain of the repeater state.
Without input signal.
Spectrum analyzer was connected to RF output port
Measured to Noise power.

NF=NP-G-BCF-PNAD
NF=NP-G-60+174
NF=NP-G+114

NF=Noise Figure(dB)
NP=Noise power(dBm/MHz)
G=Maximum gain
BCF=Bandwidth Correction Factor=10log(1 MHz/1 Hz)=60
PNAD=Noise Power Density=-174 dBm/Hz

Test Results:

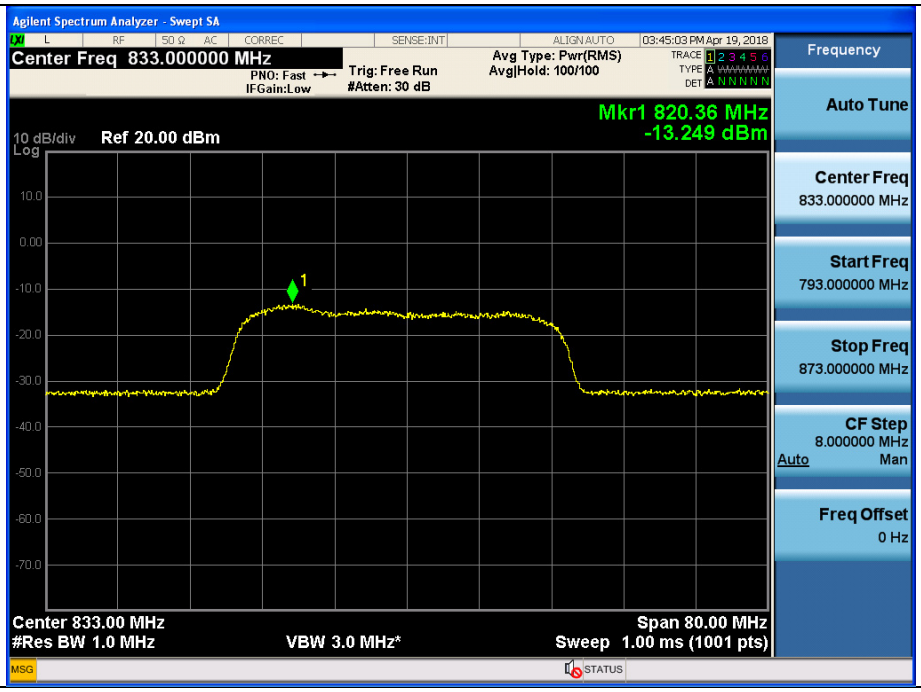
Input Signal	Input Level (dBm)	Maximum Amp Gain (dB)
Without input signal		97

* For reason of filter setting, noise figure is measured at all frequencies of par 22 and part 90 band.
* Amp gain is the result of combination with DU module (EZ-DASD-C02)

Noise Figure = -13.249 - 97 + 114 = 3.751 dB

Plot of Noise Figure

800 Band



9. UNWANTED CONDUCTED EMISSIONS

FCC Rules

Test Requirements:

§ 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 22.917 Emission limitations for cellular equipment.

The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

(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.

(b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:

(1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.

(c) Alternative out of band emission limit. Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.

(d) Interference caused by out of band emissions. If any emission from a transmitter operating in

this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

§ 90.691 Emission mask requirements for EA-based systems

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log_{10}(f/6.1) decibels or 50 + 10 Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log_{10}(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

Test Procedures:

Measurements were in accordance with the test methods section 3.6 and 4.7 of KDB 935210 D05 v01r02.

3.6.1 General

Refer to the applicable rule part(s) for specified limits on unwanted (out-of-band/out-of-block and spurious) emissions.

Spurious emissions shall be measured using a single test signal sequentially tuned to the low, middle, and high channels or frequencies within each authorized frequency band of operation.

Out-of-band/out-of-block emissions (including intermodulation products) shall be measured under each of the following two stimulus conditions:

a) two adjacent test signals sequentially tuned to the lower and upper frequency band/block edges;

b) a single test signal, sequentially tuned to the lowest and highest frequencies or channels within the frequency band/block under examination.

NOTE—Single-channel boosters that cannot accommodate two simultaneous signals within the passband may be excluded from the test stipulated in step a).

3.6.2 Out-of-band/out-of-block emissions conducted measurements

a) Connect a signal generator to the input of the EUT.

If the signal generator is not capable of generating two modulated carriers simultaneously, then two discrete signal generators can be connected with an appropriate combining network to support this two-signal test.

b) Set the signal generator to produce two AWGN signals as previously described (e.g., 4.1 MHz OBW).

c) Set the center frequencies such that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or 3GPP2, at the upper edge of the frequency band or block under test.

d) Set the composite power levels such that the input signal is just below the AGC threshold (see 3.2), but not more than 0.5 dB below. The composite power can be measured using the procedures provided in KDB Publication 971168, but it will be necessary to expand the power integration bandwidth so as to include both of the transmit channels. Alternatively, the composite power can be measured using an average power meter as described in KDB Publication 971168.

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band (typically 1 % of the EBW or 100 kHz or 1 MHz)

g) Set the VBW = 3 × RBW.

h) Set the detector to power averaging (rms) detector.

i) Set the Sweep time = auto-couple.

j) Set the spectrum analyzer start frequency to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.

k) Trace average at least 100 traces in power averaging (rms) mode.

l) Use the marker function to find the maximum power level.

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

n) Repeat steps k) to m) with the composite input power level set to 3 dB above the AGC threshold.

o) Reset the frequencies of the input signals to the lower edge of the frequency block or band under test.

p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.

q) Repeat steps k) to n).

r) Repeat steps a) to q) with the signal generator configured for a single test signal tuned as close as possible to the block edges.

s) Repeat steps a) to r) with the narrowband test signal.

t) Repeat steps a) to s) for all authorized frequency bands or blocks used by the EUT.

3.6.3 Spurious emissions conducted measurements

a) Connect a signal generator to the input of the EUT.

b) Set the signal generator to produce the broadband test signal as previously described (i.e., 4.1 MHz OBW AWGN).

c) Set the center frequency of the test signal to the lowest available channel within the frequency band or block.

d) Set the EUT input power to a level that is just below the AGC threshold (see 3.2), but not more than 0.5 dB below.

e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band of operation (e.g., reference bandwidth is typically 100 kHz or 1 MHz).

g) Set the VBW ≥ 3 × RBW.

h) Set the Sweep time = auto-couple.

i) Set the spectrum analyzer start frequency to the lowest RF 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.

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 be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.2

j) Select the power averaging (rms) detector function.

k) Trace average at least 10 traces in power averaging (rms) mode.

l) 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.

m) Reset the spectrum 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 spectrum analyzer stop frequency to 10 times the highest frequency of the fundamental emission (see § 2.1057). 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 be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.

n) Trace average at least 10 traces in power averaging (rms) mode.

o) 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; also provide tabular data, if required.

p) Repeat steps i) to o) with the input test signals firstly tuned to a middle band/block frequency/channel, and then tuned to a high band/block frequency/channel.

q) Repeat steps b) to p) with the narrowband test signal.

r) Repeat steps b) to q) for all authorized frequency bands/blocks used by the EUT.

Note:

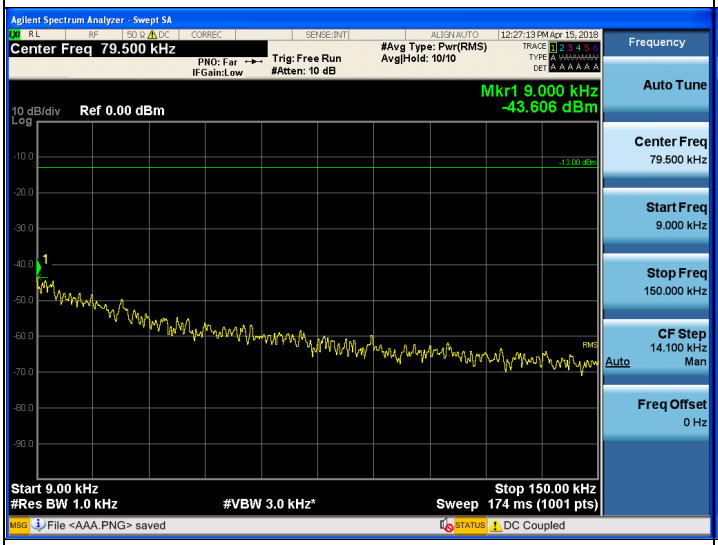
2) In 9 kHz to 150 kHz and 150 kHz to 30 MHz bands, RBW was reduced to 1 % and 10 % of the reference bandwidth for measuring unwanted emission level(typically, 100 kHz if the authorized frequency band is below 1 GHz) and power was integrated. (1 % = +20 dB, 10 % = +10 dB)
3) We have done CDMA and 1xEVDO modulation test in technology. Test results are only attached worst cases.
4) The test condition of §90.691 (2) can be applied because the EUT provides filters above 37.5 kHz such as LTE 5 MHz, CDMA and 1xEVDO. And its limit (43 + 10Log_{10}(P)) is included in spurious emissions and band edge.

Test Results:

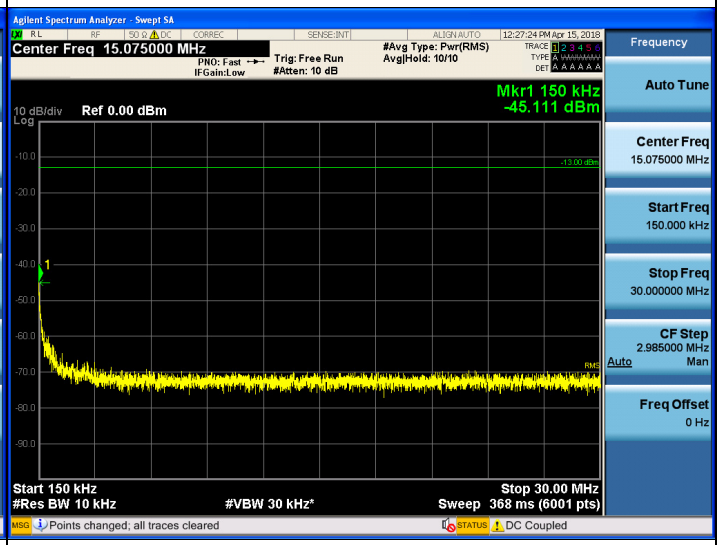
Plot of Unwanted Conducted Emissions for LTE 5 MHz – FCC Part 90 Band

Low Channel

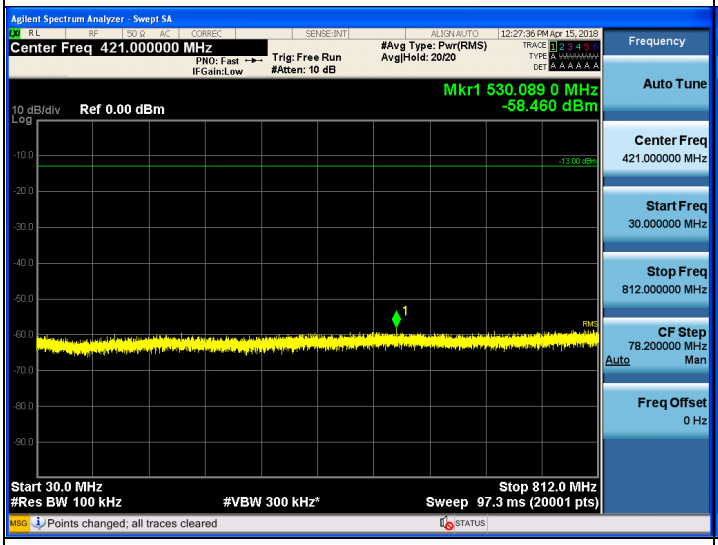
9 kHz ~ 150 kHz



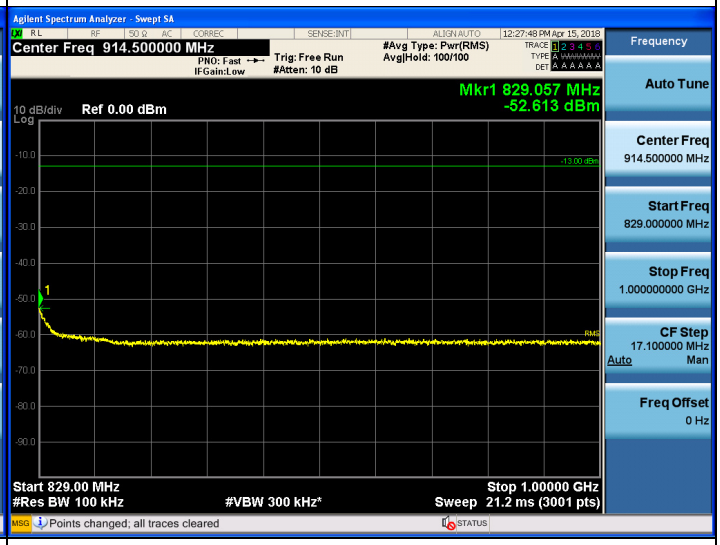
150 kHz ~ 30 MHz



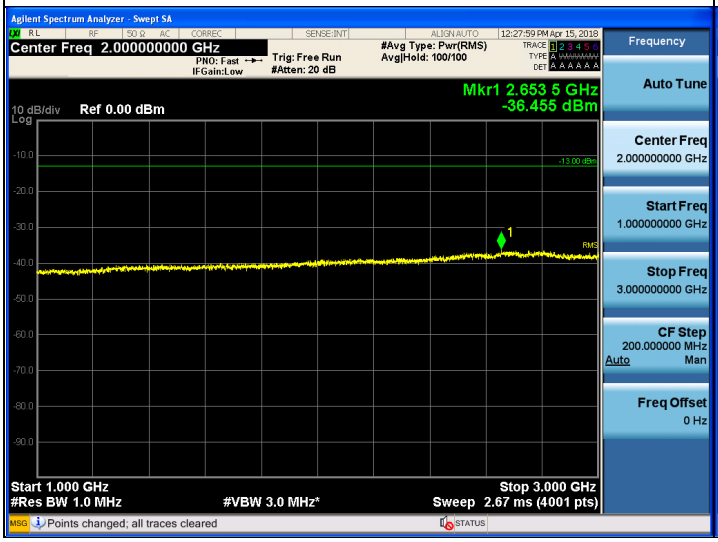
30 MHz ~ 812 MHz



829 MHz ~ 1 GHz



1 GHz ~ 3 GHz



3 GHz ~ 12.75 GHz