

FCC /ISED REPORT

Certification

Applicant Name:

SOLiD, Inc.

Date of Issue:

September 12, 2018

Address:10, 9th Floor, SOLiD Space, Pangyoyeok-ro
220, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-
400, South Korea**Location:**HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA**Report No.:** HCT-RF-1808-FI005-R1

FCC ID:	W6UL781921
IC:	9354A-L781921
APPLICANT:	SOLiD, Inc.

FCC/ ISED Model: N2RDU_781921
EUT Type: ALLIANCE_2W
Frequency Ranges: 729 ~ 768 MHz (Downlink), 862 ~ 894 MHz (Downlink),
1 930 ~ 1 995 MHz (Downlink), 2 110 ~ 2 180 MHz (Downlink)
Conducted Output Power: 2 W (33 dBm, Downlink)
Date of Test: July 16, 2018 ~ September 12, 2018
FCC Rule Part(s): CFR 47 Part 2, Part 22, Part 24, Part 27, Part 90
ISED Rules : RSS-Gen (Issue 5, April 2018), RSS-119 (Issue 12, May 2015)
RSS-130 (Issue 1, October 2013), RSS-131 (Issue 3, May 2017)
RSS-132 (Issue 3, January 2013), RSS-133 (Issue 6, January 2018)
RSS-139 (Issue 3, July 2015), RSS-140 (Issue 1, April 2018)

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 / ISED Rules under normal use and maintenance.



Report prepared by : Kyung Soo Kang
Engineer of Telecommunication testing center



Approved by : Jong Seok Lee
Manager of Telecommunication testing center

This report only responds to the tested sample and may not be reproduced, except in full, without written approval of the HCT Co., Ltd.

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1808-FI005	August 22, 2018	- First Approval Report
HCT-RF-1808-FI005-R1	September 12, 2018	- Added test results about 800 MHz PLMR band for IC - Change incorrect standard issuance date (RSS-133) - Removed the test result on page 181. (Plot of intermodulation for LTE 5 MHz in 800 IDEN band.) - Revised frequency range and test results for 700LTE band.

Table of Contents

1. GENERAL INFORMATION	4
1.1. APPLICANT INFORMATION	4
1.2. PRODUCT INFORMATION	4
1.3. TEST INFORMATION.....	4
2. FACILITIES AND ACCREDITATIONS.....	5
2.1. FACILITIES	5
2.2. EQUIPMENT.....	5
3. TEST SPECIFICATIONS	6
3.1. STANDARDS.....	6
3.2. MODE OF OPERATION DURING THE TEST	7
3.3. MAXIMUM MEASUREMENTUNCERTAINTY.....	8
3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS.....	8
4. TEST EQUIPMENT.....	9
5. RF OUTPUT POWER.....	10
6. OCCUPIED BANDWIDTH	62
7. INPUT VERSUS OUTPUT SPECTRUM.....	111
8. OUT OF BAND REJECTION & MEAN OUTPUT POWER AND ZONE ENHANCER GAIN	118
9. NOISE FIGURE	124
10. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL	126
11. RADIATED SPURIOUS EMISSIONS	229
12. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS	234
13. Annex A_EUT AND TEST SETUP PHOTO	244

1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

Company Name	SOLiD, Inc.
Company Address	10, 9th Floor, SOLiD Space, Pangyoyeok-ro 220, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-400, South Korea

1.2. PRODUCT INFORMATION

EUT Type	ALLIANCE_2W
FCC/ISED Model	N2RDU_781921
Power Supply	120 VAC, 50 Hz / DC -48 V
Frequency Range	729 ~ 768 MHz (Downlink), 862 ~ 894 MHz (Downlink), 1 930 MHz ~1 995 MHz (Downlink), 2 110 ~ 2 180 MHz (Downlink)
Conducted Output Power	2 W (33 dBm, Downlink)
Supporting Technologies	700LTE, FirstNet: LTE 5 MHz , LTE 10 MHz 800IDEN: CDMA, LTE 5 MHz 850CEL: CDMA, WCDMA, LTE 5 MHz, LTE 10 MHz 800 MHz PLMR for IC: P25 Phase 2 1900PCS: GSM, CDMA, WCDMA, LTE 5 MHz , LTE 10 MHz, LTE 20 MHz AWS13: CDMA, WCDMA, LTE 5 MHz , LTE 10 MHz, LTE 20 MHz
Antenna Specification	Manufacturer does not provide an antenna.

1.3. TEST INFORMATION

FCC Rule Parts	CFR 47 Part 2, Part 22, Part 24, Part 27, Part 90
ISED Rule Parts	RSS-Gen (Issue 5, April 2018), RSS-119 (Issue 12, May 2015) RSS-130 (Issue 1, October 2013), RSS-131 (Issue 3, May 2017) RSS-132 (Issue 3, January 2013), RSS-133 (Issue 6, January 2018) RSS-139 (Issue 3, July 2015), RSS-140 (Issue 1, April 2018)
Measurement standards	ANSI C63.26-2015, KDB 971168 D01 v03r01, KDB 935210 D05 v01r02, RSS-Gen, RSS-119, RSS-130, RSS-131, RSS-132, RSS-133, RSS-139 RSS-140
Place of Test	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA (ISED Registration Number : 5944A)

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 April 02, 2018 (Registration Number: KR0032).

For ISED, test facility was accepted dated October 19, 2015(Registration Number: 5944A-6)

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 24, Part 27, Part 90, RSS-Gen, RSS-119, RSS-130, RSS-131, RSS-132, RSS-133, RSS-139, RSS-140

Description	Reference (FCC)	Reference (ISED)	Results
Conducted RF Output Power	§2.1046, §22.913 §24.232, §27.50 §90.542, §90.635	RSS-119, Section 5.4 RSS-130, Section 4.4 RSS-131, Section 6.2 RSS-132, Section 5.4 RSS-133, Section 6.4 RSS-139, Section 6.5 RSS-140, Section 4.3	Compliant
Occupied Bandwidth	§2.1049	RSS-Gen, Section 6.7	Compliant
Input-versus-output Spectrum	-	RSS-131 Section 5.2.2	Compliant
Out of Band Rejection & Mean Output Power and Zone Enhancer Gain	KDB 935210 D05 v01r01	RSS-131, Section 5.2.1 RSS-131, Section 5.2.3	Compliant
Noise Figure	§90.219	RSS-131, Section 6.4	Compliant
Spurious Emissions at Antenna Terminals	§2.1051, §22.917 §24.238, §27.53 §90.219(e)(3), §90.543, §90.691	RSS-Gen, Section 6.13 RSS-130, Section 4.6 RSS-131, Section 6.3 RSS-131, Section 6.5 RSS-132, Section 5.5 RSS-133, Section 6.5 RSS-139, Section 6.6 RSS-140, Section 4.4	Compliant
Radiated Spurious Emissions	§2.1053, §22.917 §24.238, §27.53 §90.691	RSS-Gen, Section 7.3 RSS-133, Section 6.6	Compliant
Frequency Stability	§2.1055, §22.355 §24.235, §27.54 §90.213	RSS-119, Section 5.3 RSS-130, Section 4.3 RSS-131, Section 5.2.4 RSS-132, Section 5.3 RSS-133, Section 6.3 RSS-139, Section 6.4 RSS-140, Section 4.2	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.
- * This EUT is supported power supply both of AC and DC. Test results are only attached worst cases.
- * The PLMR band from 862 MHz to 869 MHz was further tested with narrowband signal suitable for RSS-119.
- * 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	30.566
100	30.388
200	30.728
300	30.899
400	30.975
500	30.789
600	30.952
700	31.156
800	31.105
900	31.153
1000	31.324
2000	31.874
3000	31.834
4000	31.583
5000	31.963
6000	32.065
7000	32.513
8000	32.585
9000	32.294
10000	32.623
20000	36.428
26000	36.623

3.3. MAXIMUM MEASUREMENT UNCERTAINTY

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

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

Description	Condition	Uncertainty
Conducted RF Output Power	-	± 0.72 dB
Occupied Bandwidth & Input-versus-output Spectrum	OBW ≤ 25 kHz	± 0.16 kHz
	OBW ≤ 20 MHz	± 52 kHz
Out of Band Rejection & Mean Output Power and Zone Enhancer Gain	Gain 20 dB bandwidth	± 0.89 dB ± 0.58 MHz
Noise Figure	-	± 0.89 dB
Transmitter unwanted emissions	-	± 1.08 dB
Radiated Spurious Emissions	$f \leq 1$ GHz	± 4.80 dB
	$f > 1$ GHz	± 6.07 dB
Frequency Stability	-	$\pm 1.22 \times 10^{-6}$

3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

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

4. TEST EQUIPMENT

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	N9020A / Spectrum Analyzer	09/15/2017	Annual	MY46471250
Agilent	E4438C / Signal Generator	12/22/2017	Annual	MY42082646
Agilent	N5128A / Signal Generator	03/05/2018	Annual	MY50141649
Agilent	N5128A / Signal Generator	02/17/2018	Annual	MY46240523
AGILENT	8498A / Coaxial Attenuator	02/19/2018	Annual	51162
Agilent	11636A / Power Divider	07/26/2018	Annual	09109
KIKUSUI	CBL06185030 / DC Power Supply	02/27/2018	Annual	RE001149
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
Audix	EM1000 / Controller	N/A	N/A	060520
Audix	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	05/02/2017	Biennial	9120D-937
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	12/04/2017	Biennial	BBHA9170541
Rohde & Schwarz	FSP / Spectrum Analyzer	09/03/2018	Annual	100688
Wainwright Instruments	WHKX10-900-1000-15000-40SS	07/20/2018	Annual	5
Wainwright Instruments	WHK3.0/18G-10EF / High Pass Filter	06/07/2018	Annual	8
CERNEK	CBLU1183540 / Power Amplifier	07/10/2018	Annual	22964
CERNEK	CBL06185030 / Power Amplifier	07/10/2018	Annual	22965
CERNEK	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 radio telephone 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 as 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.

§ 24.232 Power and antenna height limits.

- (a)(1) Base stations with an emission bandwidth of 1 MHz or less are limited to 1640 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.
- (2) Base stations with an emission bandwidth greater than 1 MHz are limited to 1640 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.
- (3) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; see Tables 1 and 2 of this section.
- (4) The service area boundary limit and microwave protection criteria specified in §§24.236 and 24.237 apply.

Table 1—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth of 1 MHz or Less

HAAT in meters	Maximum EIRP watts
≤300	1640
≤500	1070
≤1000	490
≤1500	270
≤2000	160

Table 2—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth Greater Than 1 MHz

HAAT in meters	Maximum EIRP watts/MHz
≤300	1640
≤500	1070
≤1000	490
≤1500	270
≤2000	160

- (b)(1) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of

the Census, with an emission bandwidth of 1 MHz or less are limited to 3280 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.

(2) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census, with an emission bandwidth greater than 1 MHz are limited to 3280 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.

(3) Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; see Tables 3 and 4 of this section.

(4) The service area boundary limit and microwave protection criteria specified in §§24.236 and 24.237 apply.

(5) Operation under this paragraph (b) at power limits greater than permitted under paragraph (a) of this section must be coordinated in advance with all broadband PCS licensees authorized to operate on adjacent frequency blocks within 120 kilometers (75 miles) of the base station and is limited to base stations located more than 120 kilometers (75 miles) from the Canadian border and more than 75 kilometers (45 miles) from the Mexican border.

Table 3—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth of 1 MHz or Less

HAAT in meters	Maximum EIRP watts
≤300	3280
≤500	2140
≤1000	980
≤1500	540
≤2000	320

Table 4—Reduced Power for Base Station Antenna Heights Over 300 Meters, With Emission Bandwidth Greater Than 1 MHz

HAAT in meters	Maximum EIRP watts/MHz
≤300	3280
≤500	2140
≤1000	980
≤1500	540
≤2000	320

(c) Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

(d) Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(e) Peak transmit power must be measured over any 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.

§ 27.50 Power limits and duty cycle.

(b) The following power and antenna height limits apply to transmitters operating in the 746-758 MHz, 775-788 MHz and 805-806 MHz bands:

(4) Fixed and base stations transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section.

(5) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section.

(c) The following power and antenna height requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band:

(4) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section;

(5) Licensees, except for licensees operating in the 600 MHz downlink band, seeking to operate a fixed or base station located in a county with population density of 100 or fewer

persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal at an ERP greater than 1000 watts must:

- (i) Coordinate in advance with all licensees authorized to operate in the 698-758 MHz, 775-788, and 805-806 MHz bands within 120 kilometers (75 miles) of the base or fixed station;
 - (ii) coordinate in advance with all regional planning committees, as identified in §90.527 of this chapter, with jurisdiction within 120 kilometers (75 miles) of the base or fixed station.
- (d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:
- (1) The power of each fixed or base station transmitting in the 1995-2000 MHz, 2110-2155 MHz, 2155-2180 MHz or 2180-2200 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to:
 - (i) An equivalent isotropically radiated power (EIRP) of 3280 watts when transmitting with an emission bandwidth of 1 MHz or less;
 - (ii) An EIRP of 3280 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.
 - (2) The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:
 - (i) An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less;
 - (ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.
 - (3) A licensee operating a base or fixed station in the 2110-2155 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must coordinate such operations in advance with all Government and non-Government satellite entities in the 2025-2110 MHz band. A licensee operating a base or fixed station in the 2110-2180 MHz band utilizing power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with the following licensees authorized to operate within 120 kilometers (75 miles) of the base or fixed station operating in this band: All Broadband Radio Service (BRS) licensees authorized under this part in the 2155-2160 MHz band and all advanced wireless services (AWS) licensees authorized to operate on adjacent frequency blocks in the 2110-2180 MHz band.
 - (4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating

in these bands must employ a means for limiting power to the minimum necessary for successful communications.

(5) Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(6) Peak transmit power must be measured over any 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.

(7) Fixed, mobile, and portable (hand-held) stations operating in the 2000-2020 MHz band are limited to 2 watts EIRP, except that the total power of any portion of an emission that falls within the 2000-2005 MHz band may not exceed 5 milliwatts. A licensee of AWS-4 authority may enter into private operator-to-operator agreements with all 1995-2000 MHz licensees to operate in 2000-2005 MHz at power levels above 5 milliwatts EIRP; except the total power of the AWS-4 mobile emissions may not exceed 2 watts EIRP.

(8) A licensee operating a base or fixed station in the 2180-2200 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with all AWS licensees authorized to operate on adjacent frequency blocks in the 2180-2200 MHz band.

(9) Fixed, mobile and portable (hand-held) stations operating in the 1915-1920 MHz band are limited to 300 milliwatts EIRP.

(10) A licensee operating a base or fixed station in the 1995-2000 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with all PCS G Block licensees authorized to operate on adjacent frequency blocks in the 1990-1995 MHz band within 120 kilometers of the base or fixed station operating in this band.

§ 90.542 Broadband transmitting power limits.

(a) The following power limits apply to the 758-768/788-798 MHz band:

(1) Fixed and base stations transmitting a signal in the 758-768 MHz band with an emission bandwidth of 1 MHz or less must not exceed an ERP of 1000 watts and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts ERP in accordance with Table 1 of this section.

(2) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 758-768 MHz band with an emission bandwidth of 1 MHz or less must not exceed an ERP of 2000 watts and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts ERP in accordance with Table 2 of this section.

(3) Fixed and base stations transmitting a signal in the 758-768 MHz band with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP accordance with Table 3 of this section.

(4) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 758-768 MHz band with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section.

(5) Licensees of fixed or base stations transmitting a signal in the 758-768 MHz band at an ERP greater than 1000 watts must comply with the provisions set forth in paragraph (b) of this section.

(6) Control stations and mobile stations transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 30 watts ERP.

(7) Portable stations (hand-held devices) transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 3 watts ERP.

(8) For transmissions in the 758-768 MHz and 788-798 MHz bands, licensees may employ equipment operating in compliance with either of the following measurement techniques:

(i) The maximum composite transmit power shall be measured over any interval of continuous transmission using instrumentation calibrated in terms of 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, etc., so as to obtain a true maximum composite measurement for the emission in question over the full bandwidth of the channel.

(ii) A Commission-approved average power technique.

Table 1 to §90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth of 1 MHz or Less

Antenna height (AAT) in meters (feet)	Effective radiated power (ERP) (watts)
Above 1372 (4500)	65
Above 1220 (4000) To 1372 (4500)	70
Above 1067 (3500) To 1220 (4000)	75
Above 915 (3000) To 1067 (3500)	100
Above 763 (2500) To 915 (3000)	140
Above 610 (2000) To 763 (2500)	200
Above 458 (1500) To 610 (2000)	350
Above 305 (1000) To 458 (1500)	600
Up to 305 (1000)	1000

Table 2 to §90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth of 1 MHz or Less

Antenna height (AAT) in meters (feet)	Effective radiated power (ERP) (watts)
Above 1372 (4500)	130
Above 1220 (4000) To 1372 (4500)	140
Above 1067 (3500) To 1220 (4000)	150
Above 915 (3000) To 1067 (3500)	200
Above 763 (2500) To 915 (3000)	280
Above 610 (2000) To 763 (2500)	400
Above 458 (1500) To 610 (2000)	700
Above 305 (1000) To 458 (1500)	1200
Up to 305 (1000)	2000

Table 3 to §90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth Greater Than 1 MHz

Antenna height (AAT) in meters (feet)	Effective radiated power (ERP) per MHz (watts/MHz)
Above 1372 (4500)	65
Above 1220 (4000) To 1372 (4500)	70
Above 1067 (3500) To 1220 (4000)	75
Above 915 (3000) To 1067 (3500)	100
Above 763 (2500) To 915 (3000)	140
Above 610 (2000) To 763 (2500)	200
Above 458 (1500) To 610 (2000)	350
Above 305 (1000) To 458 (1500)	600
Up to 305 (1000)	1000

Table 4 to §90.542(a)—Permissible Power and Antenna Heights for Base and Fixed Stations in the 758-768 MHz Band Transmitting a Signal With an Emission Bandwidth Greater Than 1 MHz

Antenna height (AAT) in meters (feet)	Effective radiated power (ERP) per MHz (watts/MHz)
Above 1372 (4500)	130
Above 1220 (4000) To 1372 (4500)	140
Above 1067 (3500) To 1220 (4000)	150
Above 915 (3000) To 1067 (3500)	200
Above 763 (2500) To 915 (3000)	280
Above 610 (2000) To 763 (2500)	400
Above 458 (1500) To 610 (2000)	700
Above 305 (1000) To 458 (1500)	1200
Up to 305 (1000)	2000

(b) For base and fixed stations operating in the 758-768 MHz band in accordance with the provisions of paragraph (a)(5) of this section, the power flux density that would be produced by such stations through a combination of antenna height and vertical gain pattern must not exceed 3000 microwatts per square meter on the ground over the area extending to 1 km from the base of the antenna mounting structure.

§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

ISED Rules

Test Requirements:

RSS-119

5. Transmitter and Receiver Specifications

5.4 Transmitter Output Power

The output power shall be within ± 1 dB of the manufacturer's rated power listed in the equipment specifications.

The transmitter output power limits set forth in Table 2 will come into force upon the publication of Issue 12 of this standard and will apply to newly certified equipment.

Frequency Bands (MHz)	Transmitter Output Power (W)	
	Base/Fixed Equipment	Mobile Equipment
27.41-28 and 29.7-50	300	30
72-76	No limit	1
138-174	110	60
217-218 and 219-220	110	30
220-222	See SRSP-512 for ERP limit	50
406.1-430 and 450-470	110	60
768-776 and 798-806	See SRSP-511 for ERP limit	30 3 W ERP for portable equipment
806-821/851-866 and 821-824/866-869	110	30
896-901/935-940	110	60
929-930/931-932	110	30
928-929/952-953 and 932-932.5/941-941.5	110	30
932.5-935/941.5-944	110	30

RSS-130

4. Transmitter and Receiver Standard Specifications

4.4 Transmitter Output Power and Equivalent Isotropic Radiated Power (e.i.r.p.)

The transmitter output power shall be measured in terms of average power.

For base and fixed equipment, refer to SRSP-518 for power limits.

The e.i.r.p. shall not exceed 50 watts for mobile equipment or for outdoor fixed subscriber equipment, nor shall it exceed 5 watts for portable equipment or for indoor fixed subscriber equipment.

In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

RSS-131

6. Equipment standard specifications for zone enhancers working with equipment certified under RSS-119

6.2 Output power

The output power of the zone enhancer shall comply with the transmitter output power of the equipment with which it is to be used (as specified in RSS-119) and shall be within ± 1.0 dB of the zone enhancer manufacturer's rated output power.

RSS-132

5. Transmitter Standard Specifications

5.4 Transmitter Output Power and Equivalent Isotropically Radiated Power

The transmitter output power shall be measured in terms of average power. The equivalent isotropically radiated power (e.i.r.p.) for mobile equipment shall not exceed 11.5 watts. Refer to SRSP-503 for base station e.i.r.p. limits.

In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

RSS-133

6. Transmitter and Receiver Standard Specifications

6.4 Transmitter Output Power and Equivalent Isotropically Radiated Power

The equivalent isotropically radiated power (e.i.r.p.) for transmitters shall not exceed the limits given in SRSP-510.

In addition, the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

RSS-139

6. Transmitter Standard Specifications

6.5 Transmitter Output Power

The equivalent isotropically radiated power (e.i.r.p.) for mobile and portable transmitters shall not exceed one watt. The e.i.r.p. for fixed and base stations in the band 1710-1780 MHz shall not exceed one watt.

Consult SRSP-513 for e.i.r.p. limits on fixed and base stations operating in the band 2110-2180 MHz.

In addition, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

RSS-140

4. Transmitter Specifications

4.3 Transmitter Output Power

The equivalent radiated power (e.r.p.) for control and mobile equipment shall not exceed 30 W.

The e.r.p. for portable equipment including handheld devices shall not exceed 3 W.

Fixed and base station equipment shall comply with the e.r.p. limits in SRSP-540.

In addition, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

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.

EUT

Signal Generator

NoteBook

Attenuator

Spectrum Analyzer

Block Diagram 1. RF Power Output Test Setup

Test Results:

Input Signal	Input Level	Maximum Amp Gain
700LTE, FirstNet 800IDEN, 850CEL 800 MHz PLMR 1900PCS AWS13	-20 dBm	53 dB

*Note: Due to EUT's ALC function (Auto Level Control), even if input signal is increased, the same output power is transmit.

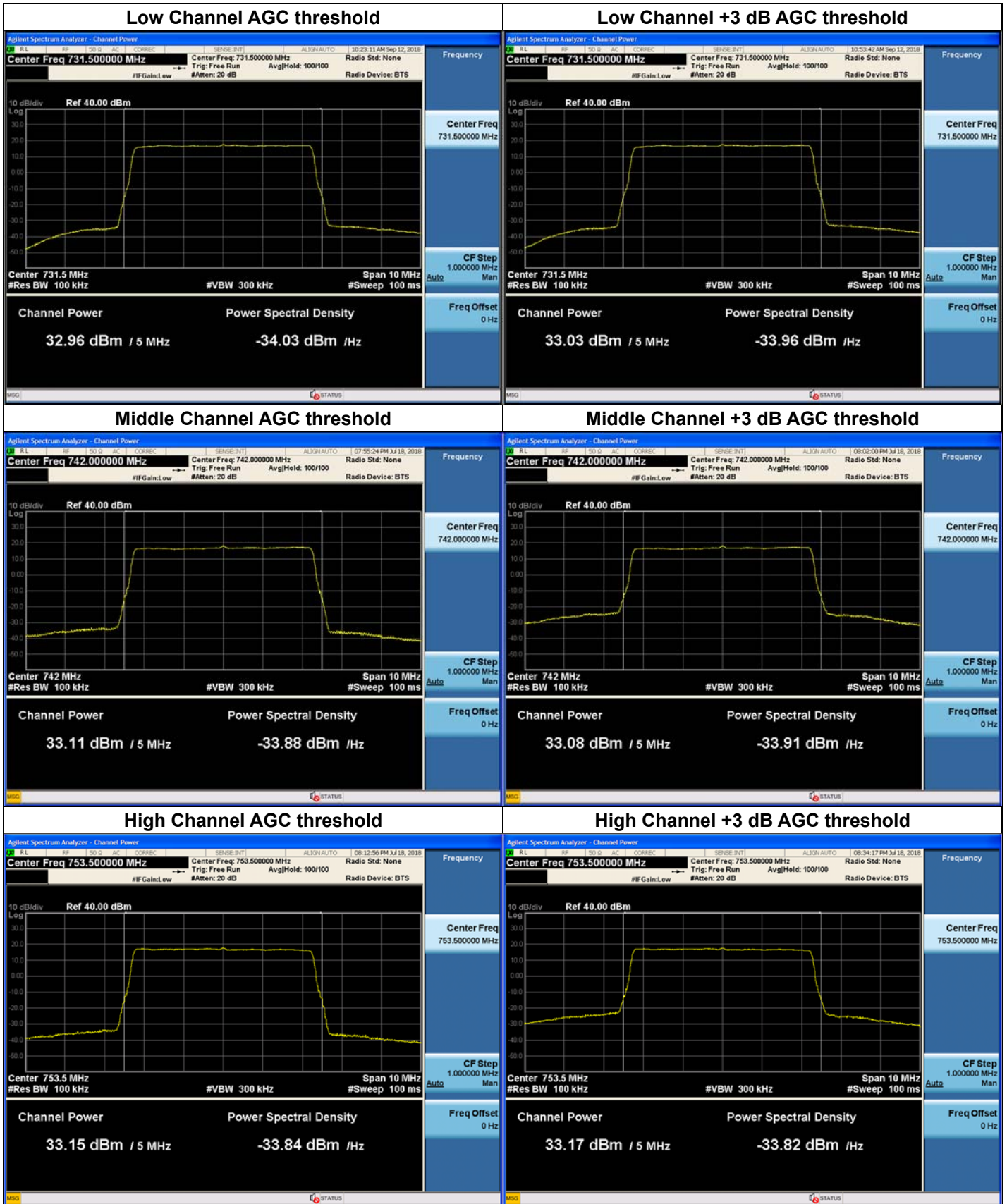
[Downlink_700 LTE]

700 LTE Band	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
LTE 5 MHz AGC threshold	Low	731.50	32.96	1.976
	Middle	742.00	33.11	2.046
	High	753.50	33.15	2.065
LTE 5 MHz +3dBm above the AGC threshold	Low	731.50	33.03	2.010
	Middle	742.00	33.08	2.032
	High	753.50	33.17	2.075
LTE 10 MHz AGC threshold	Low	734.00	32.93	1.961
	Middle	741.00	33.20	2.089
	High	751.00	32.99	1.991
LTE 10 MHz +3dBm above the AGC threshold	Low	734.00	33.13	2.058
	Middle	741.00	33.13	2.056
	High	751.00	33.21	2.094

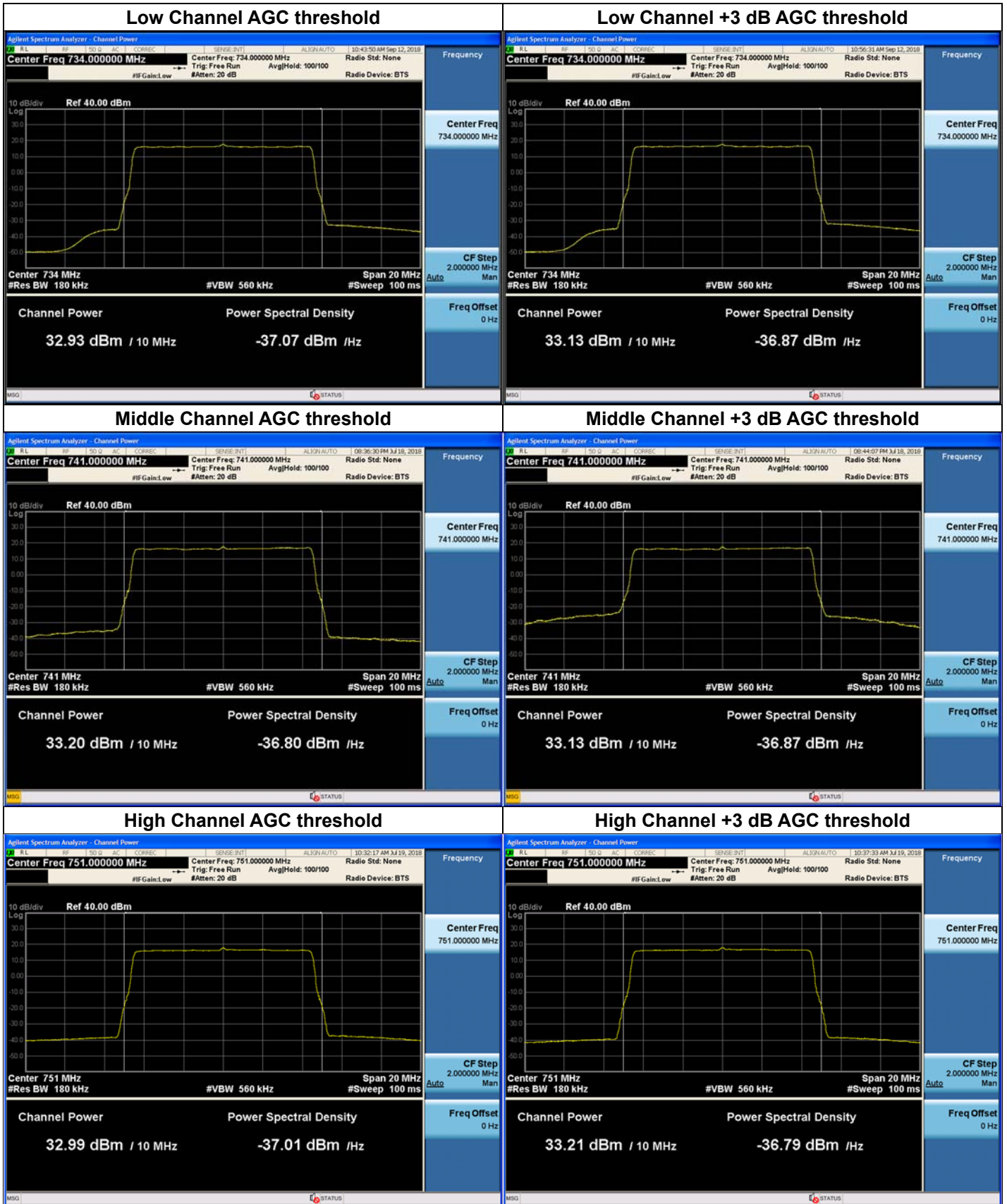
[Downlink_FirstNet]

FirstNet Band	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
LTE 5 MHz AGC threshold	Low	760.50	32.89	1.945
	High	765.50	32.81	1.910
LTE 5 MHz +3dBm above the AGC threshold	Low	760.50	32.90	1.950
	High	765.50	32.79	1.901
LTE 10 MHz AGC threshold	Middle	763.00	32.96	1.977
LTE 10 MHz +3dBm above the AGC threshold	Middle	763.00	32.88	1.941

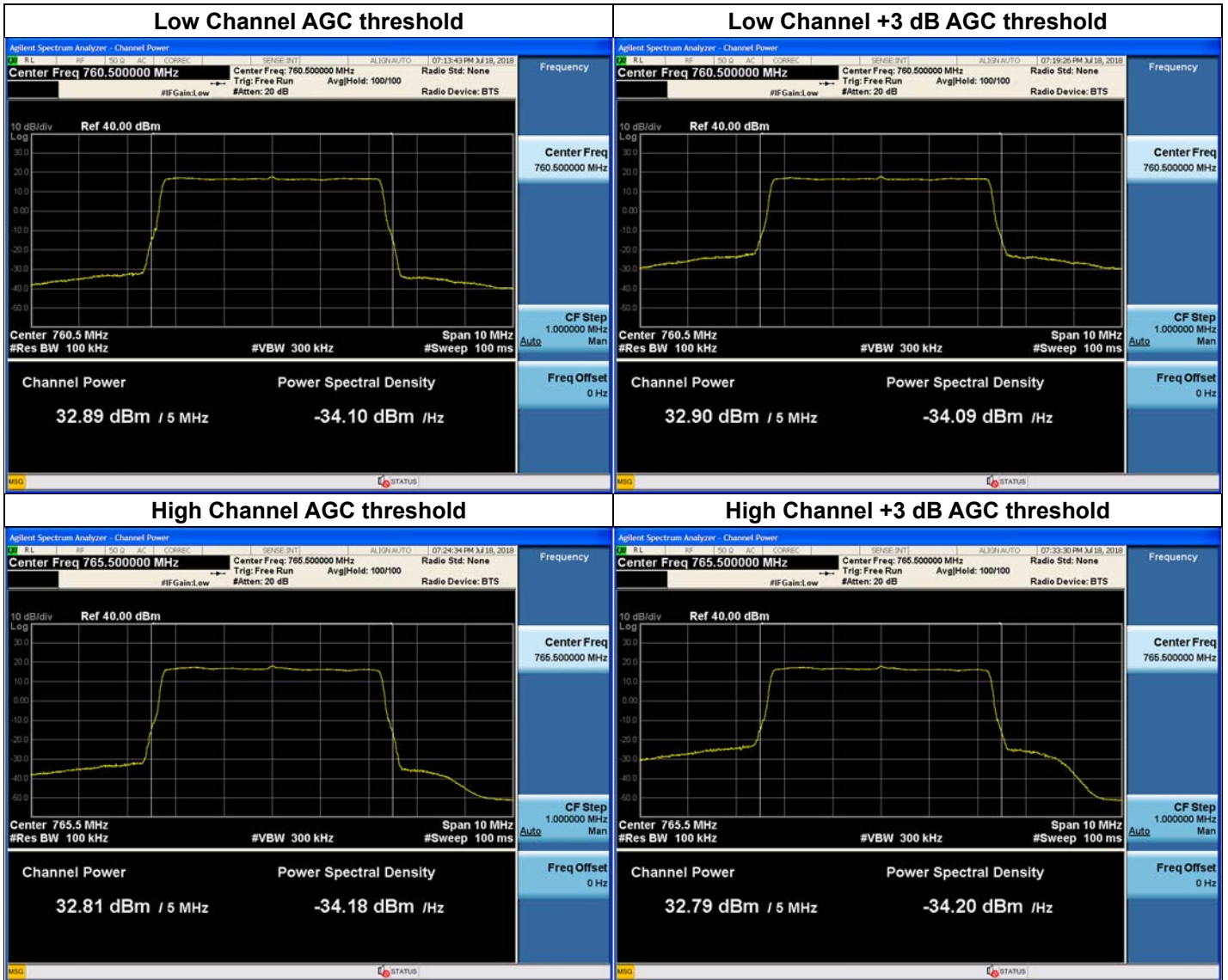
Plots of RF Output Power for LTE 5 MHz_700 LTE Band



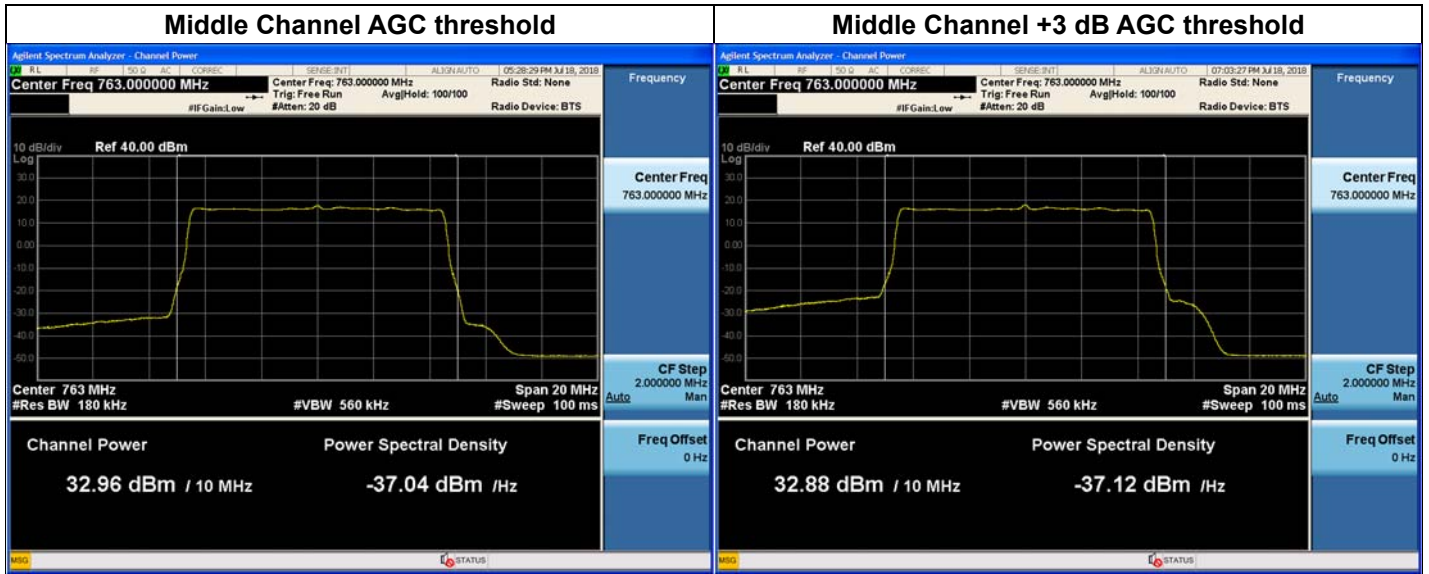
Plots of RF Output Power for LTE 10 MHz_700 LTE Band



Plots of RF Output Power for LTE 5 MHz_FirstNet Band



Plots of RF Output Power for LTE 10 MHz_FirstNet Band



Peak-to-Average Ratio (PAR)_700 LTE

700 LTE Band	Channel	Frequency (MHz)	PAR (dB)
LTE 5 MHz AGC threshold	Middle	742.00	8.30
LTE 10 MHz AGC threshold	Middle	741.00	8.33

Peak-to-Average Ratio (PAR)_FirstNet

FirstNet Band	Channel	Frequency (MHz)	PAR (dB)
LTE 5 MHz AGC threshold	Middle	763.00	8.25
LTE 10 MHz AGC threshold	Middle	763.00	8.22

Plots of Peak-to-Average Ratio for 700 LTE Band



Plots of Peak-to-Average Ratio for FirstNet Band



[Downlink_800 IDEN]

800 IDEN Band	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
LTE 5 MHz AGC threshold	Low	864.50	33.00	1.995
	High	866.50	33.39	2.183
LTE 5 MHz +3dBm above the AGC threshold	Low	864.50	33.11	2.046
	High	866.50	33.35	2.163
CDMA AGC threshold	Low	863.25	33.10	2.042
	Middle	865.50	32.95	1.972
	High	867.75	32.96	1.977
CDMA +3dBm above the AGC threshold	Low	863.25	33.13	2.056
	Middle	865.50	32.94	1.968
	High	867.75	33.00	1.995

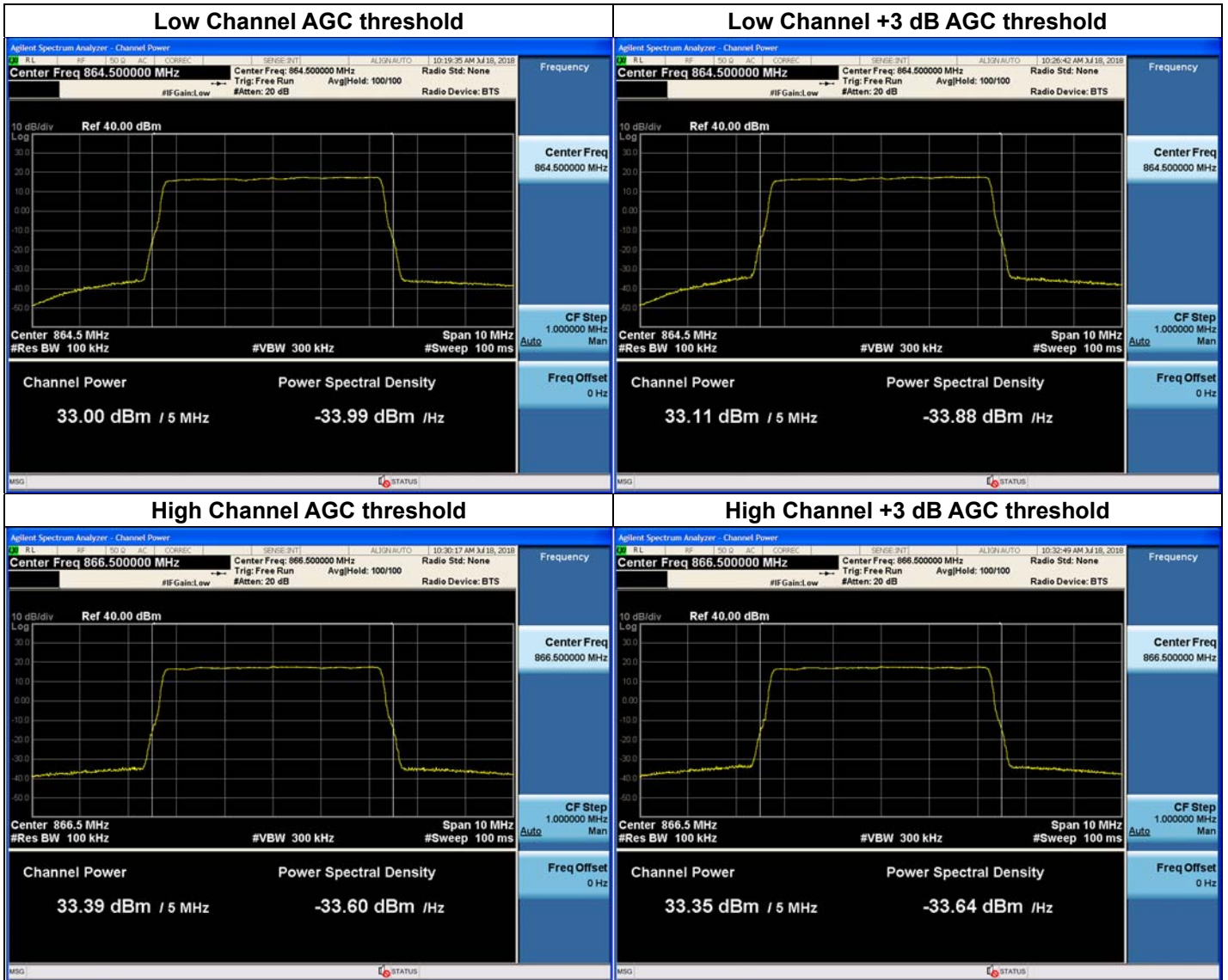
[Downlink_850 CEL]

850 CEL Band	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
LTE 5 MHz AGC threshold	Low	871.50	33.31	2.143
	Middle	881.50	32.89	1.945
	High	891.50	32.99	1.991
LTE 5 MHz +3dBm above the AGC threshold	Low	871.50	33.29	2.133
	Middle	881.50	33.02	2.004
	High	891.50	32.94	1.969
LTE 10 MHz AGC threshold	Low	874.00	33.19	2.084
	Middle	881.50	32.79	1.901
	High	889.00	33.20	2.089
LTE 10 MHz +3dBm above the AGC threshold	Low	874.00	33.17	2.075
	Middle	881.50	32.85	1.928
	High	889.00	33.17	2.075
WCDMA AGC threshold	Low	871.50	33.23	2.104
	Middle	881.50	32.78	1.897
	High	891.50	32.91	1.954
WCDMA +3dBm above the AGC threshold	Low	871.50	33.21	2.094
	Middle	881.50	32.91	1.954
	High	891.50	32.89	1.945
CDMA AGC threshold	Low	870.25	33.19	2.084
	Middle	881.50	33.28	2.128
	High	892.75	32.98	1.986
CDMA +3dBm above the AGC threshold	Low	870.25	33.20	2.089
	Middle	881.50	33.27	2.123
	High	892.75	32.96	1.977

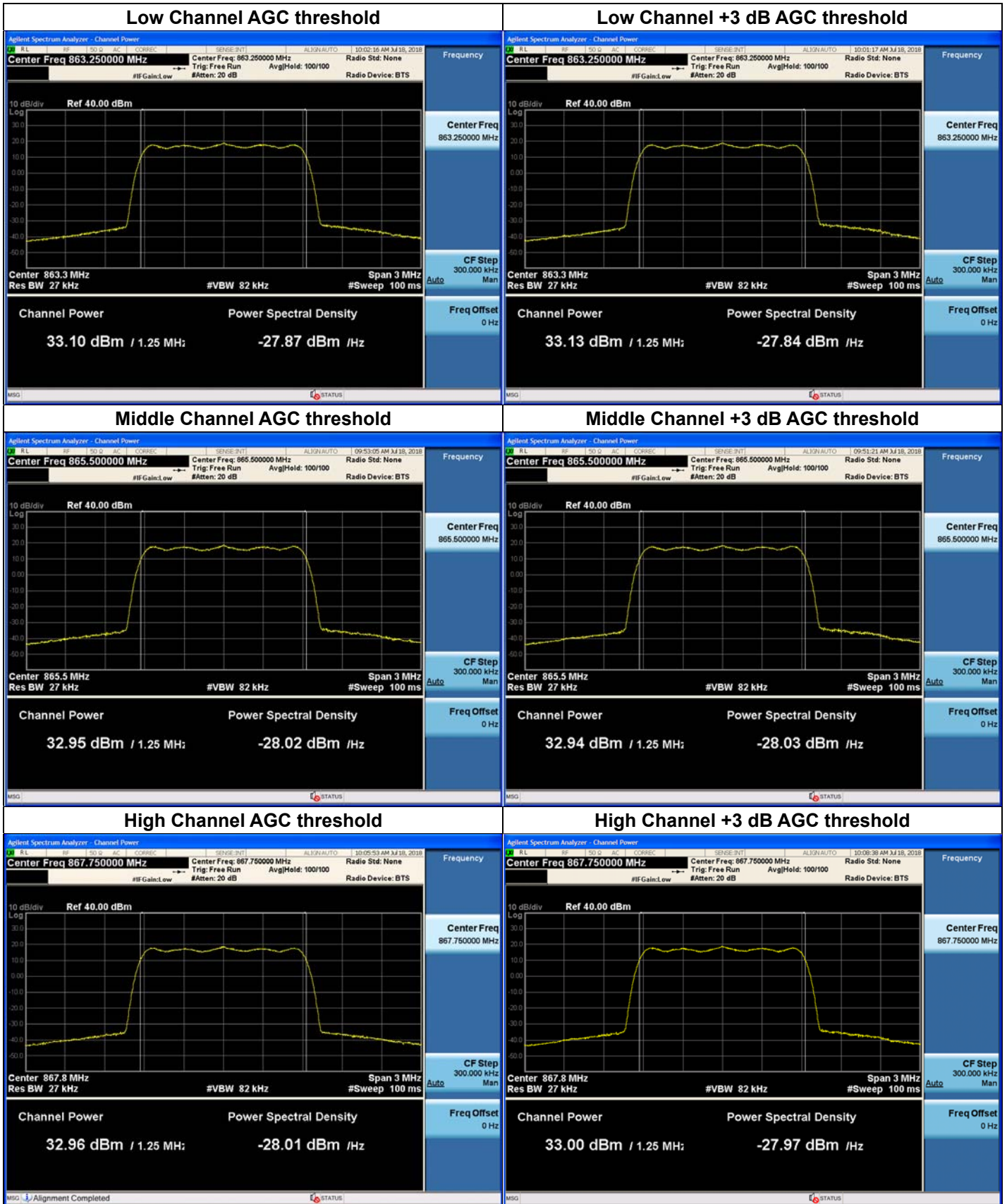
[Downlink_800 MHz PLMR]

800 MHz PLMR Band	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
P25 Phase 2	Low	862.003125	32.80	1.905
	Middle	865.500000	32.96	1.977
	High	868.996875	32.68	1.854
P25 Phase 2 +3dB above the AGC threshold	Low	862.003125	32.86	1.932
	Middle	865.500000	33.27	2.123
	High	868.996875	33.01	2.000

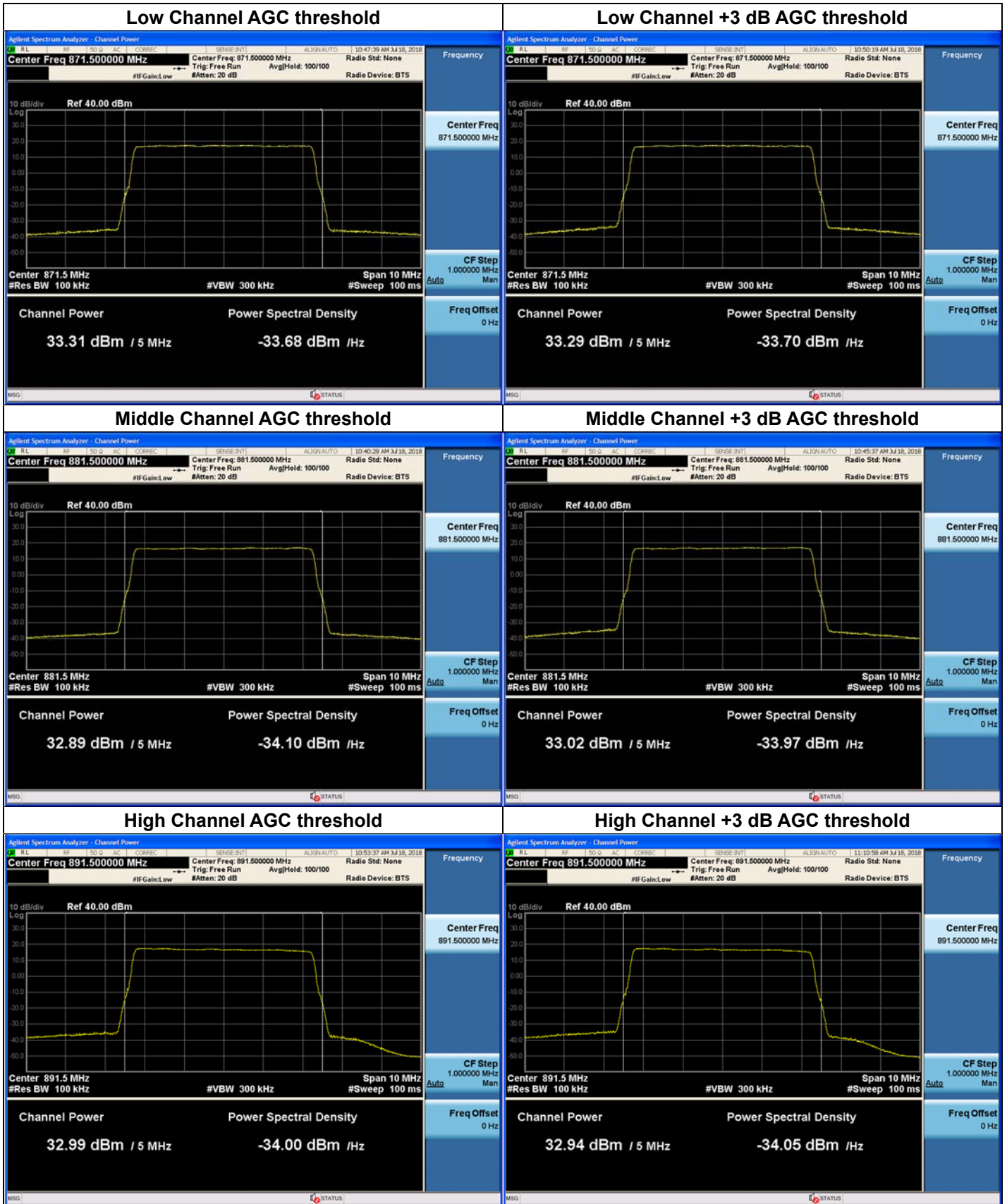
Plots of RF Output Power for LTE 5 MHz_800 IDEN Band



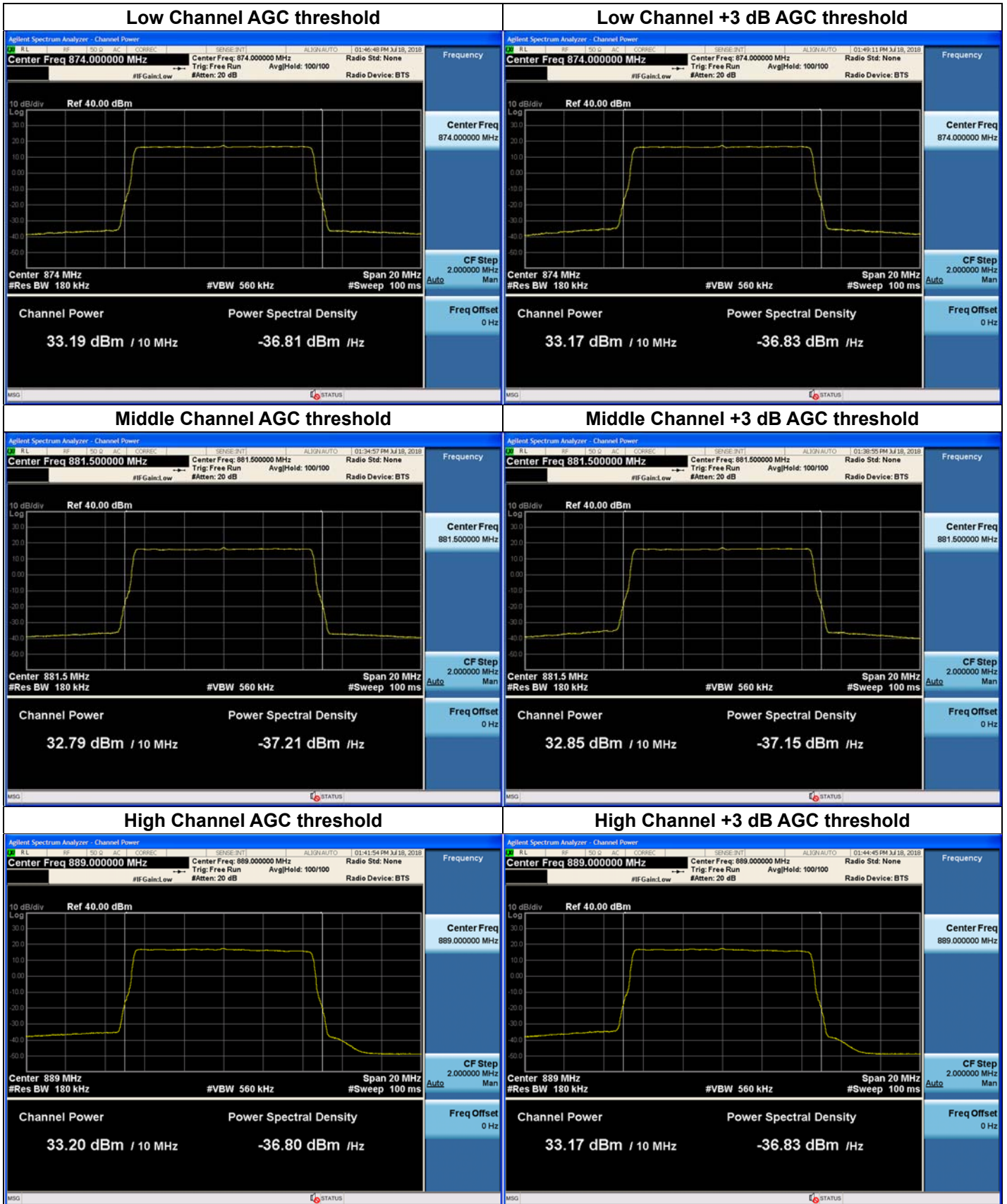
Plots of RF Output Power for CDMA_800 IDEN Band



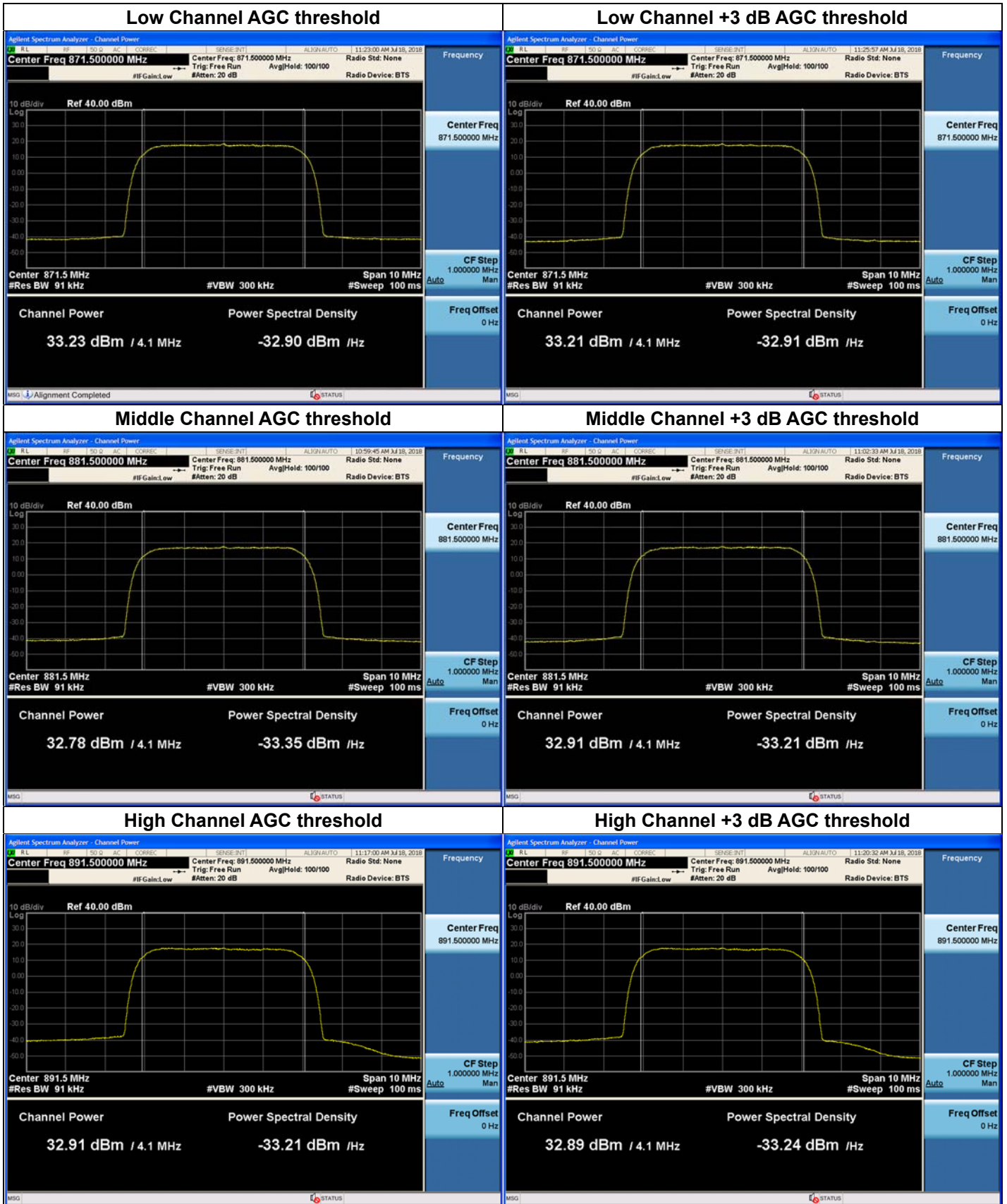
Plots of RF Output Power for LTE 5 MHz_850 CEL Band



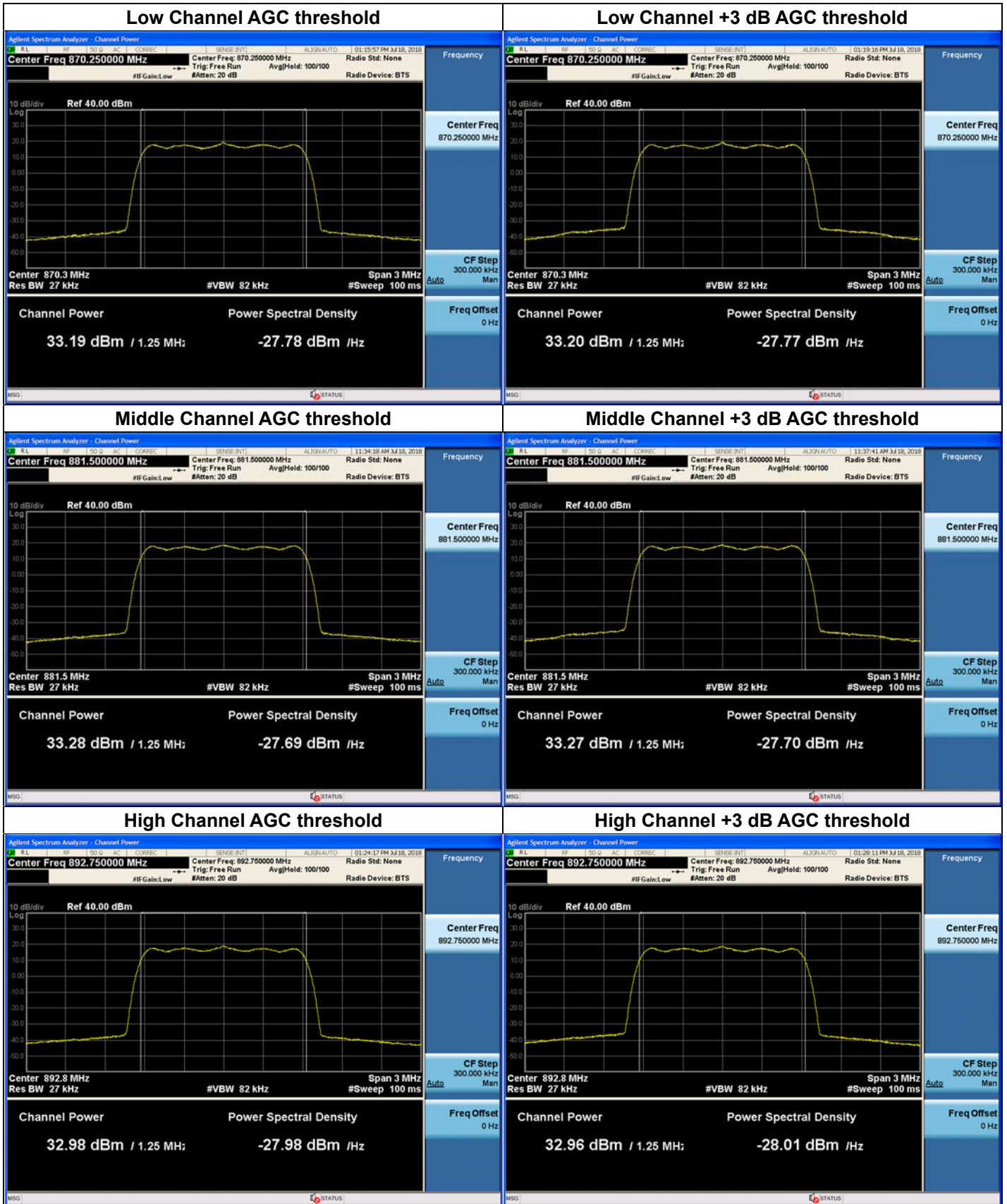
Plots of RF Output Power for LTE 10 MHz_850 CEL Band



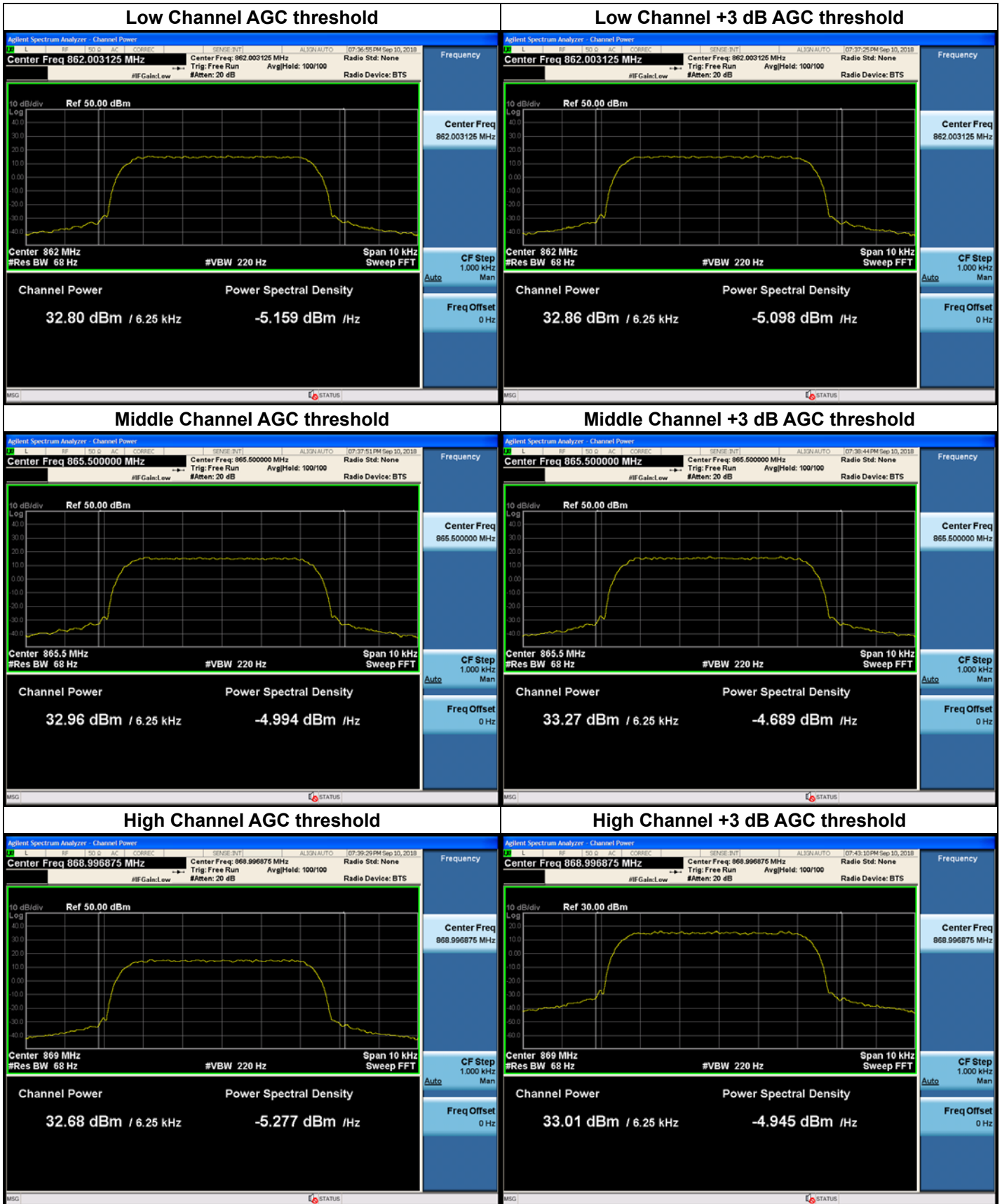
Plots of RF Output Power for WCDMA_850 CEL Band



Plots of RF Output Power for CDMA_850 CEL Band



Plots of RF Output Power for P25 Phase2_800 MHz PLMR Band



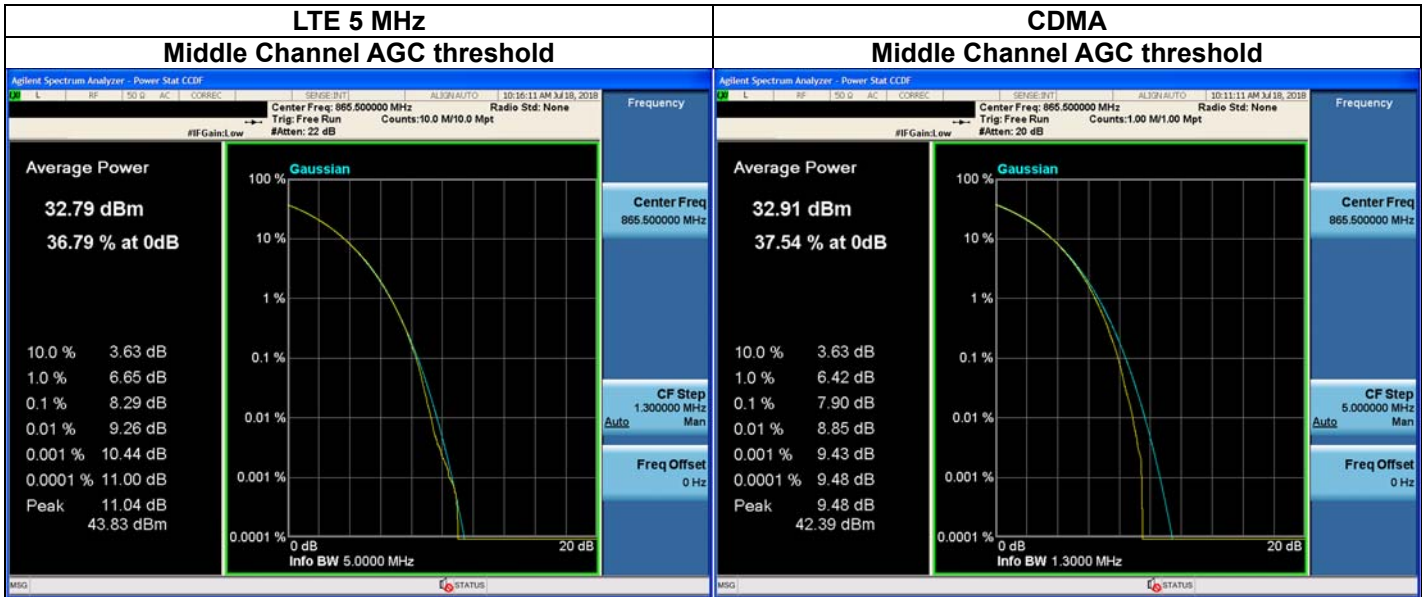
Peak-to-Average Ratio (PAR)_800 IDEN Band

800 IDEN Band	Channel	Frequency (MHz)	PAR (dB)
LTE 5 MHz AGC threshold	Middle	865.50	8.29
CDMA AGC threshold	Middle	865.50	7.90

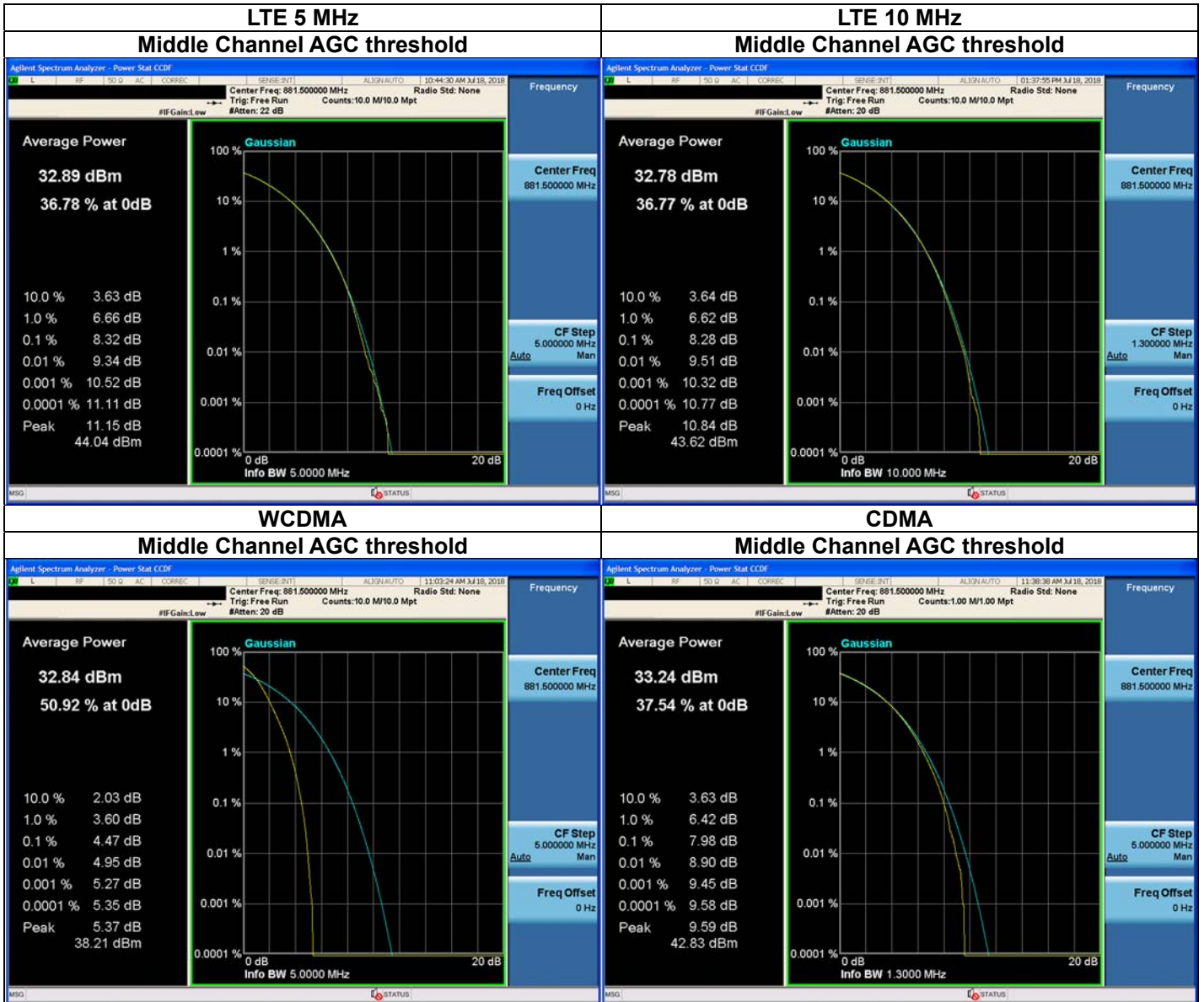
Peak-to-Average Ratio (PAR)_850 CEL

850 CEL Band	Channel	Frequency (MHz)	PAR (dB)
LTE 5 MHz AGC threshold	Middle	881.50	8.32
LTE 10 MHz AGC threshold	Middle	881.50	8.28
WCDMA AGC threshold	Middle	881.50	4.47
CDMA AGC threshold	Middle	881.50	7.98

Plots of Peak-to-Average Ratio for 800 IDEN Band



Plots of Peak-to-Average Ratio for 850 CEL Band



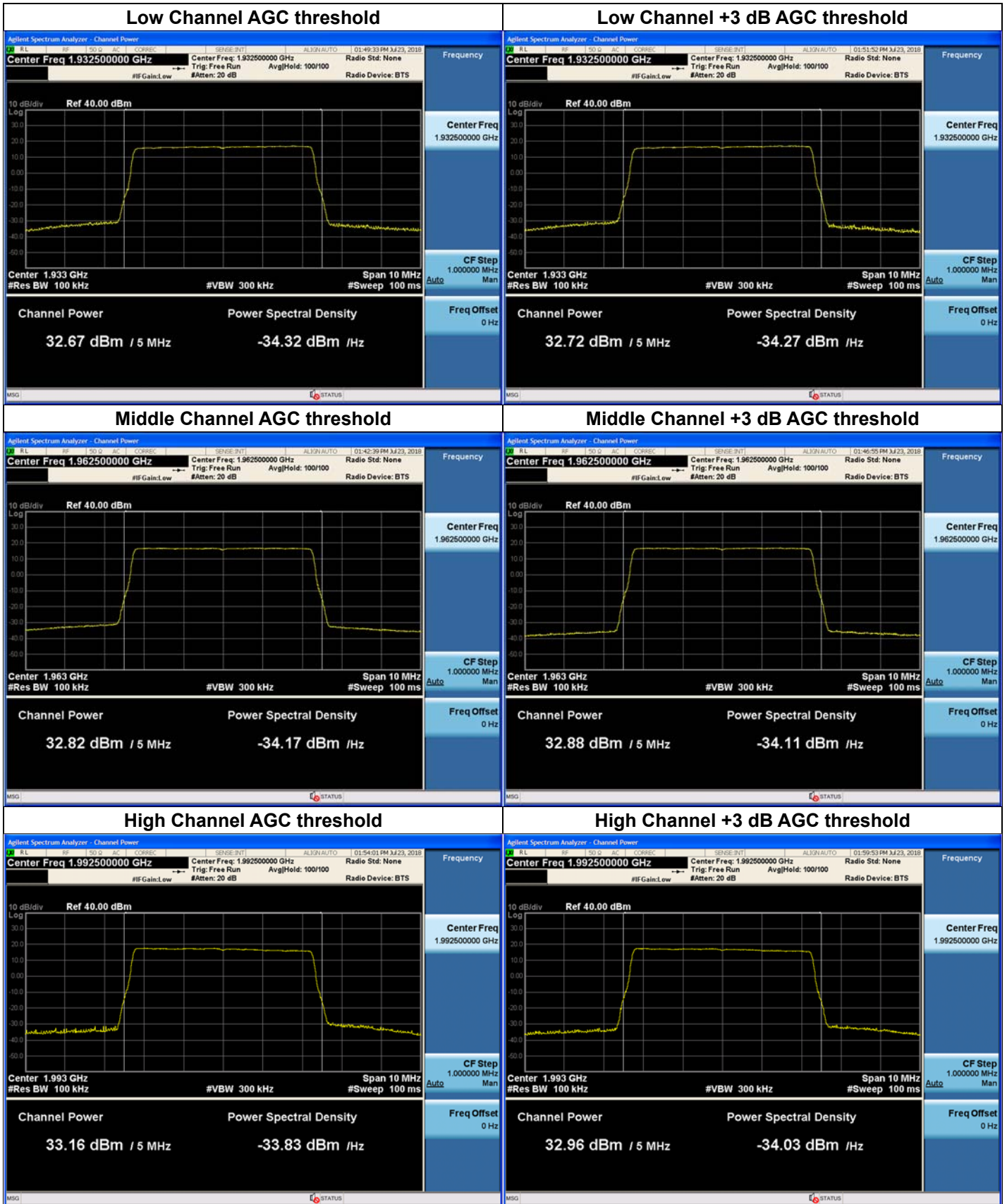
[Downlink_1900 PCS Band]

1900 PCS Band	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
LTE 5 MHz AGC threshold	Low	1932.50	32.67	1.849
	Middle	1962.50	32.82	1.914
	High	1992.50	33.16	2.070
LTE 5 MHz +3 dB above the AGC threshold	Low	1932.50	32.72	1.871
	Middle	1962.50	32.88	1.941
	High	1992.50	32.96	1.977
LTE 10 MHz AGC threshold	Low	1935.00	32.88	1.941
	Middle	1962.50	32.82	1.914
	High	1990.00	32.82	1.914
LTE 10 MHz +3 dB above the AGC threshold	Low	1935.00	32.82	1.914
	Middle	1962.50	33.05	2.018
	High	1990.00	33.04	2.014
LTE 20 MHz AGC threshold	Low	1940.00	32.90	1.950
	Middle	1962.50	32.78	1.897
	High	1985.00	33.12	2.051
LTE 20 MHz +3 dB above the AGC threshold	Low	1940.00	33.07	2.028
	Middle	1962.50	32.99	1.991
	High	1985.00	33.27	2.123
WCDMA AGC threshold	Low	1932.50	32.96	1.977
	Middle	1962.50	33.05	2.018
	High	1992.50	32.93	1.963
WCDMA +3 dB above the AGC threshold	Low	1932.50	32.88	1.941
	Middle	1962.50	33.34	2.158
	High	1992.50	32.79	1.901

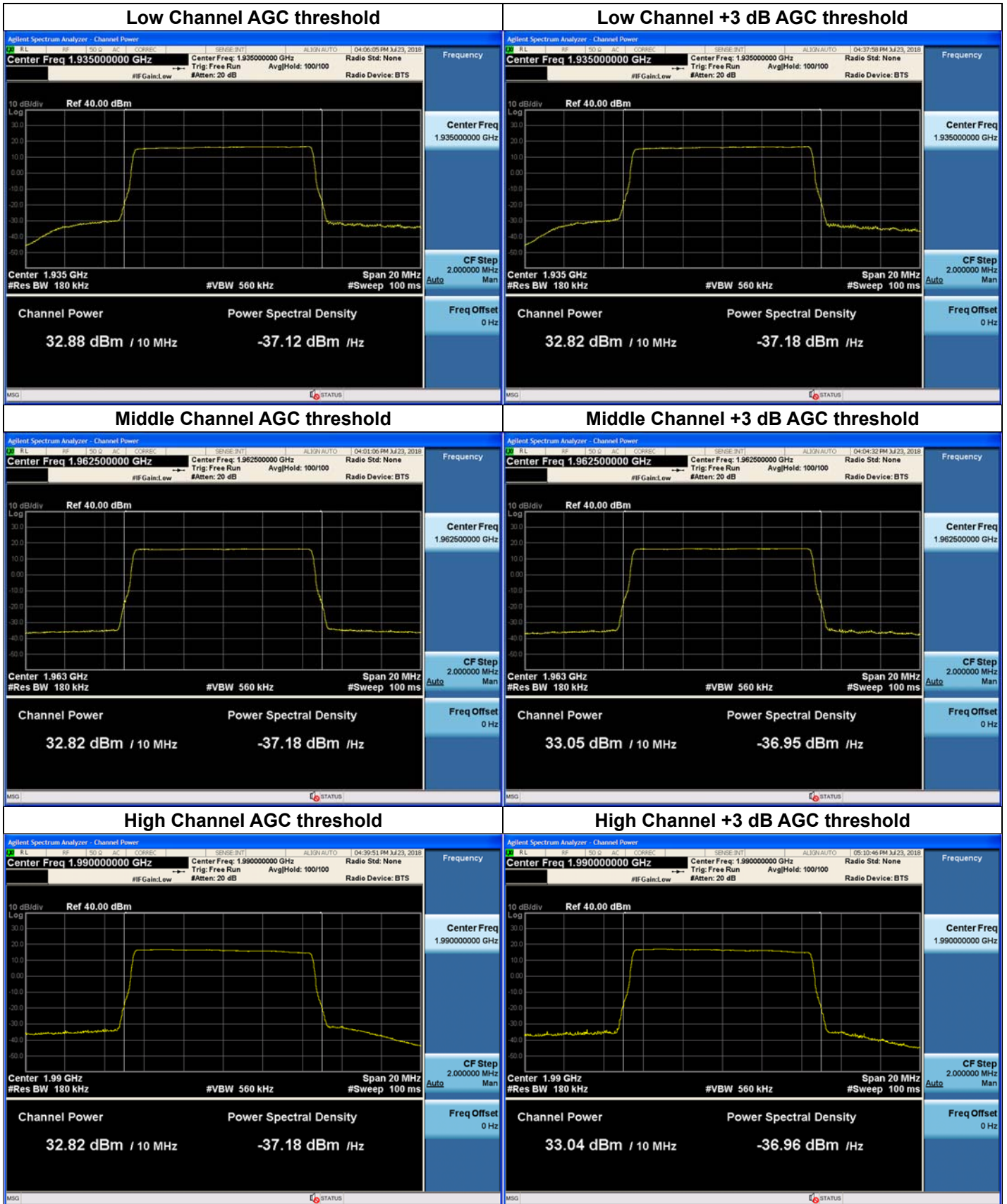
1900 PCS Band	Channel	Frequency (MHz)	Output Power	
			(dBm)	(W)
CDMA AGC threshold	Low	1931.25	32.79	1.901
	Middle	1962.50	33.20	2.089
	High	1993.75	33.17	2.075
CDMA +3 dB above the AGC threshold	Low	1931.25	33.08	2.032
	Middle	1962.50	33.29	2.133
	High	1993.75	33.00	1.995
GSM AGC threshold	Low	1930.20	32.79	1.901
	Middle	1962.50	32.94	1.968
	High	1994.80	32.92	1.959
GSM +3 dB above the AGC threshold	Low	1930.20	32.68	1.854
	Middle	1962.50	33.14	2.061
	High	1994.80	32.97	1.982

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

Plots of RF Output Power for 1900 PCS Band LTE 5 MHz



Plots of RF Output Power for 1900 PCS Band LTE 10 MHz



Plots of RF Output Power for 1900 PCS Band LTE 20 MHz

