

# FCC /IC REPORT

## Certification

Applicant Name: SOLiD, Inc.		Date of Issue: July 15, 2016 Location:
Address:		HCT CO., LTD.,
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220, Bundang-gu, Seo 463-400, South Korea	ngnam-si, Gyeonggi-do,	Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA <b>Report No.:</b> HCT-R-1607-F005-1 <b>HCT FRN:</b> 0005866421 <b>IC Recognition No.:</b> 5944A-5
FCC ID:	W6UHMAWS13	
IC:	9354A-HMAWS13	3
APPLICANT:	SOLiD, Inc	
FCC/ IC Model(s):	MRDU_AWS13	

EUT Type:	RDU(Remote Drive Unit)
Frequency Ranges:	1 710 MHz ~1 780 MHz (Uplink) / 2 110 MHz ~2 180 MHz (Downlink)
Conducted Output Power:	6.607 W (38.2 dBm)
Date of Test:	June 20, 2016 ~ July 6, 2016
FCC Rule Part(s):	CFR 47 Part 27
IC Rules :	RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 2, July 2003)

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 / IC Rules under normal use and maintenance.

Report prepared by : Kyung Soo Kang Test Engineer of RF Team

Approved by : Jong Seok Lee Manager of RF Team

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# <u>Version</u>

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1607-F005	July 7, 2016	- First Approval Report
HCT-R-1607-F005-1	July 15, 2016	- Revise the KDB 935210 D02 version.



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# 1. CLIENT INFORMATION

#### The EUT has been tested by request of

	SOLiD, Inc.							
Company	10, Seo	9th ngna	Floor, m-si, Gy	SOLiD /eonggi-o	Space, do, 463-4	Pangyoyeok-ro 00, South Korea	220,	Bundang-gu,

FCC ID:	W6UHMAWS13
IC:	9354A-HMAWS13
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Frequency Ranges:	1 710 MHz ~1 780 MHz (Uplink) / 2 110 MHz ~2 180 MHz (Downlink)
Conducted Output Power:	6.607 W (38.2 dBm)
Antenna Gain(s):	Manufacturer does not provide an antenna.
Measurement standard(s):	ANSI/TIA-603-C-2004, KDB 971168 D01 v02r02 KDB 935210 D02 v03r02, KDB 935210 D05 v01r01, RSS-GEN, RSS-131
FCC Rule Part(s):	CFR 47 Part 27
IC Rules Part(s):	RSS-Gen (Issue 4, November 2014), RSS-131 (Issue 2, July 2003)
Place of Tests:	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi- do, 17383, Rep. of KOREA(IC Recognition No. : 5944A-5)

# 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 27, RSS-GEN, RSS-131.

Description	Reference (FCC)	Reference (IC)	Results
Conducted RF Output Power	§2.1046; §27.50	RSS-131, Section 4.3 RSS-131, Section 6.2 SRSP-513	Compliant
Occupied Bandwidth	§2.1049	RSS-GEN, Section 4.6.1	Compliant
Passband Gain and Bandwidth & Out of Band Rejection	KDB 935210 D02 v03r02	RSS-131, Section 4.2 RSS-131, Section 6.1	Compliant
Spurious Emissions at Antenna Terminals	§2.1051, §27.53	RSS-131, Section 4.4 RSS-131, Section 6.3 RSS-131, Section 6.4	Compliant
Radiated Spurious Emissions	§2.1053, §27.53	-	Compliant
Frequency Stability	§2.1055, §27.54	RSS-131, Section 4.5 RSS-131, Section 6.5	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.



## **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
Conducted RF Output Power	-	± 0.72 dB
Occupied Bandwidth	OBW ≤ 20 MHz	± 52 kHz
Passband Gain and Bandwidth & Out of Band Rejection	Gain 20 dB bandwidth	± 0.89 dB ± 0.58 MHz
Spurious Emissions at Antenna Terminals	-	± 1.08 dB
Radiated Spurious Emissions	f ≤ 1 GHz f > 1 GHz	± 4.80 dB ± 6.07 dB
Frequency Stability	-	± 1.22 x 10 <sup>-6</sup>

# 4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

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



# **5. TEST EQUIPMENT**

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	E4438C /Signal Generator	09/02/2015	Annual	MY42082646
Agilent	N5182A /Signal Generator	03/29/2016	Annual	MY50141649
Agilent	N5182A /Signal Generator	05/13/2016	Annual	MY47070230
Agilent	N9030A / Signal Analyzer	11/24/2015	Annual	MY49431210
Weinschel	67-30-33 / Fixed Attenuator	10/29/2015	Annual	BR5347
Weinschel	1506A / Power Divider	02/15/2016	Annual	MD793
DEAYOUNG ENT	DFSS60 / AC Power Supply	04/06/2016	Annual	1003030-1
НР	6674A / DC Power Supply	07/27/2015	Annual	3501A00901
Audix	AM4000 / Antenna Position Tower	N/A	N/A	N/A
Audix	Turn Table	N/A	N/A	N/A
Audix	EM1000 / Controller	N/A	N/A	060520
Rohde & Schwarz	Loop Antenna	02/23/2016	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/15/2015	Biennial	255
Schwarzbeck	BBHA 9120D / Horn Antenna	05/07/2015	Biennial	937
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	09/03/2015	Biennial	BBHA9170541
Rohde & Schwarz	FSP / Spectrum Analyzer	09/24/2015	Annual	100688
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/23/2015	Annual	101068-SZ
Wainwright Instruments	WHK3.0/18G-10EF / High Pass Filter	06/24/2016	Annual	8
CERNEX	CBLU1183540 / Power Amplifier	07/21/2015	Annual	22964
CERNEX	CBL06185030 / Power Amplifier	07/21/2015	Annual	22965
CERNEX	CBL18265035 / Power Amplifier	07/27/2015	Annual	22966



# **6. RF OUTPUT POWER**

#### FCC Rules

#### **Test Requirements:**

#### § 2.1046 Measurements required: RF power output:

**§ 2.1046 (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.

§ 2.1046 (b) For single sideband, independent sideband, and single channel, controlled carrier Radio telephone transmitters, the procedure specified in paragraph (a) of this section shall beemployed 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.

**§ 2.1046 (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.

#### § 27.50 Power limits and duty cycle.

(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.

#### **Test Procedures:**

Measurements were in accordance with the test methods section 3.5.2 of KDB 935210 D05 v01r01. 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 f0 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.



Block Diagram 1. RF Power Output Test Setup



#### **IC Rules**

#### Test Requirements:

#### **SRSP-513**

#### 5. Technical Criteria

#### 5.1 Radiated Power and Antenna Height Limits

#### 5.1.1 Fixed and Base Stations

5.1.1.2 For fixed and base stations operating within the frequency range 2110-2180 MHz with a channel bandwidth greater than 1 MHz, the maximum permissible e.i.r.p. is 1640 watts/MHz e.i.r.p. (i.e. no more than 1640 watts e.i.r.p. in any 1 MHz band segment) with an antenna height above average terrain (HAAT) up to 300 metres.

5.1.1.3 Fixed and base stations located in geographic areas at a distance greater than 26 km from large or medium population centres and transmitting within the frequency range 2110-2180 MHz, may increase their e.i.r.p. up to a maximum of 3280 watts/MHz (i.e. no more than 3280 watts e.i.r.p. in any 1 MHz band segment), with an antenna HAAT up to 300 metres. Within 26 km of any large or medium population centre, fixed and base stations may operate at increased e.i.r.p. if more than 50% of the population within a particular sector's coverage 6 is located outside these large and medium population centres.

Fixed and base stations with increased e.i.r.p. must not be used to provide coverage to large and medium population centres. However, some incidental coverage of these large and medium population centres by stations with increased e.i.r.p. is permitted.

This provision also applies for fixed and base stations with a channel bandwidth equal to or less than 1 MHz (i.e. the e.i.r.p. may be increased up to a maximum of 3280 watts).



## RSS-131 6.2

The manufacturer's output power rating Prated MUST NOT be greater than Pmean for all types of enhancers.

#### Additional Power Back-off Condition for Multiple Carrier Operations:

An example of a single carrier operation is a band translator that incorporates an (IF) filter of apassband equal to one channel bandwidth. Another example of a single carrier operation is the useof an enhancer, before the connection to the antenna, to boost a low power transmitter (singlecarrier) to a higher power.

An example of a multiple carrier operation is the use of an enhancer to amplify off-air signals thatcontain the wanted carrier and two (or more) adjacent band carriers. If the enhancer passband iswide enough to pass more than the wanted channel bandwidth, the enhancer output stage will beloaded by the multiple carriers.

Examination: with 3 carrier signals (of assumed equal level), the peak voltage will be 3 times thesingle carrier voltage. The corresponding Peak Envelope Power (PEP) will be 3<sup>2</sup>times greater than a single carrier or 9/4 = 2.25 times greater than 2 tones PEP. Therefore the permissible wanted signal operating point has to be backed off by 3.5 dB (i.e. **Ppermissible = Prated - 3.5 dB**). **Note 1:** All enhancers will be classified in the Radio Equipment List (REL) for a single carrieroperation.

Note 2: For a multiple carrier operation, the rating must be reduced by 3.5 dB or more.

**Note 3:** If there are more than 3 carriers present at the amplifier input point, greater powerback-off may be required. This can be examined on a case-by-case basis.

#### Test Procedures: RSS-131 4.3

#### 4.3.1 Multi-channel Enhancer

The following subscript "o" denotes a parameter at the enhancer output point.

Connect two signal generators to the input of the Device Under Test (DUT), via a proper impedance matching network (and preferably via a variable attenuator) so that the two input signals are equal sinusoids (and can be raised equally).

Connect a dummy load of suitable load rating to the enhancer output point. Connect also a spectrum analyser to this output point via a coupling network and attenuator, so that only a portion of the output signal is coupled to the spectrum analyser. The coupling attenuation shall be stated in the test report.

Set the two generator frequencies f1 and f2 such that they and their third-order intermodulation product frequencies, f3= 2f1-f2 and f4 = 2f2 - f1, are all within the passband of the DUT.

Raise the input level to the DUT while observing the output tone levels, Po1 and Po2, and theintermodulation product levels, Po3 and Po4.

**For enhancers rated 500 watts or less:** Raise the input level to the DUT until the greater level of the intermodulation products at the enhancer output terminals, Po3 or Po4, equals -43 dBW.

**For enhancers rated over 500 watts:** Raise the input level to the DUT until the greater level of the intermodulation products at the enhancer output terminals, Po3 or Po4, is 67 dB below the level of either output tone level, Po1 or Po2.

Record all signal levels and their frequencies. Calculate the mean output power (Pmean) under this testing condition using Pmean = Po1 + 3 dB.

#### 4.3.2 Single Channel Enhancer

A suitably modulated signal, representative of the technology for which certification is sought, isapplied to the input of the amplifier. The input power level is increased until the manufacturer'srated input power level is achieved or until a 2 dB increase in input level results in a 1 dB increase

in output level (i.e. compression begins). Record the output power in the 99% emission bandwidthusing any suitable means.



#### **Test Results:**

Input Signal	Input Level (dBm)	Maximum Amp Gain
AWS	-14 dBm	52.2 dB

## Single channel Enhancer

\* Due to EUT's ALC function (Auto Level Control), even if input signal is increased,

The same output power is transmit.



# [Downlink]

	Observat	Frequency	Output Power		
	Channel	(MHz)	(dBm)	(W)	
AWS Band	Low	2112.50	38.22	6.637	
LTE 5 MHz	Middle	2145.00	38.23	6.653	
AGC threshold	High	2177.50	38.21	6.622	
AWS Band_	Low	2112.50	38.15	6.531	
+3dBm	Middle	2145.00	38.22	6.637	
above the AGC threshold	High	2177.50	38.25	6.683	
	Low	2115.00	38.31	6.776	
LTE 10 MHz	Middle	2145.00	38.26	6.699	
AGC threshold	High	2175.00	38.23	6.653	
AWS Band_	Low	2115.00	38.32	6.792	
+3dBm	Middle	2145.00	38.34	6.823	
above the AGC threshold	High	2175.00	38.21	6.622	
AWS Bond	Low	2120.00	38.31	6.776	
LTE 20 MHz	Middle	2145.00	38.20	6.607	
AGC threshold	High	2170.00	38.54	7.145	
AWS Band_	Low	2120.00	38.35	6.839	
LTE 20 MHz +3dBm above the	Middle	2145.00	38.34	6.823	
AGC threshold	High	2170.00	38.61	7.261	



	Observat	Frequency	Output Power	
	Channel	(MHz)	(dBm)	(W)
AWS Band_ CDMA	Low	2111.25	38.30	6.761
	Middle	2145.00	38.43	6.966
AGC threshold	GC threshold High 2178.75	38.40	6.918	
AWS Band_ CDMA +3dBm above the AGC threshold	Low	2111.25	38.36	6.855
	Middle	2145.00	38.54	7.145
	High	2178.75	38.47	7.031
AWS Band_ WCDMA AGC threshold	Low	2112.50	38.23	6.653
	Middle	2145.00	38.44	6.982
	High	2177.50	38.26	6.699
AWS Band_ WCDMA +3dBm above the AGC threshold	Low	2112.50	38.28	6.730
	Middle	2145.00	38.48	7.047
	High	2177.50	38.21	6.622



#### Multi-channel Enhancer for IC

\* Due to EUT's ALC function (Auto Level Control), even if input signal is increased,

The same output power is transmit.

## [Downlink]

	Channel	Frequency (MHz)	Output Power		
			Po1(dBm)	Pmean(dBm)	
AWS Band	Low	2110.40	35.272	38.272	
	Middle	2145.00	35.291	38.291	
	High	2179.60	35.232	38.232	

## Additional Power Back-off Condition for Multiple Carrier Operations for IC

#### [Downlink]

	1 Carrier	3 Carrier	Power Back-off
	(dBm)	(dBm)	(dB)
AWS Band	38.23	33.43	4.80

## Plots of RF Output Power for AWS Band LTE 5MHz [AGC threshold Downlink Low]



## [AGC threshold Downlink Middle]





Model: MRDU\_AWS13



## [AGC threshold Downlink High]

## [+3dBm above AGC threshold Downlink Low]







## [+3dBm above AGC threshold Downlink Middle]

## [+3dBm above AGC threshold Downlink High]





# Plots of RF Output Power for AWS Band LTE 10MHz [AGC threshold Downlink Low]



## [AGC threshold Downlink Middle]





Model: MRDU\_AWS13



## [AGC threshold Downlink High]

## [+3dBm above AGC threshold Downlink Low]







## [+3dBm above AGC threshold Downlink Middle]

## [+3dBm above AGC threshold Downlink High]





# Plots of RF Output Power for AWS Band LTE 20MHz [AGC threshold Downlink Low]



## [AGC threshold Downlink Middle]





Model: MRDU\_AWS13



## [AGC threshold Downlink High]

## [+3dBm above AGC threshold Downlink Low]







## [+3dBm above AGC threshold Downlink Middle]

## [+3dBm above AGC threshold Downlink High]



# Plots of RF Output Power for AWS Band CDMA [AGC threshold Downlink Low]



## [AGC threshold Downlink Middle]





Model: MRDU\_AWS13



## [AGC threshold Downlink High]

## [+3dBm above AGC threshold Downlink Low]







## [+3dBm above AGC threshold Downlink Middle]

## [+3dBm above AGC threshold Downlink High]





# Plots of RF Output Power for AWS Band WCDMA [AGC threshold Downlink Low]



## [AGC threshold Downlink Middle]





Model: MRDU\_AWS13



## [AGC threshold Downlink High]

## [+3dBm above AGC threshold Downlink Low]







## [+3dBm above AGC threshold Downlink Middle]

## [+3dBm above AGC threshold Downlink High]





#### Multi-channel Enhancer for IC\_AWS BAND



## [Downlink Low]

## [Downlink Middle]





3:21 PM Jun 30, 2016 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET A N N N N N SENSE:INT Frequency Avg Type: RMS Avg|Hold: 10/10 Ext Gain: -20.00 dB Trig: Free Run #Atten: 20 dB PNO: Wide ↔ IFGain:Low Auto Tune Mkr1 2.179 80 GHz 35.232 dBm Ref Offset 30.9 dB Ref 50.00 dBm 10 dB/div Log **Center Freq** 2.180000000 GHz Start Freq 2.170000000 GHz Stop Freq 2.19000000 GHz CF Step 2.000000 MHz Man <u>Auto</u> Freq Offset 0 Hz Center 2.18000 GHz #Res BW 100 kHz Span 20.00 MHz #Sweep 100.0 ms (1001 pts) #VBW 300 kHz\* STATUS

## [Downlink High]



## \* Power Back-off for IC\_ AWS BAND



#### [Downlink 3 Carrier Middle]


# 7. OCCUPIED BANDWIDTH

#### FCC Rules

#### Test Requirement(s): § 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 v01r01 and section 4.2 of KDB 971168 D01 v02r02.

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 OBW.
f) The nominal resolution bandwidth (RBW) shall be in the range of 1% to 5 % of the anticipated OBW, and the VBW shall be ≥ 3 × 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.

NOTE—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) Use the 99 % power bandwidth function of the spectrum analyzer (if available) and report the measured bandwidth.

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

m) Compare the spectral plot of the input signal (determined from step I) to the output signal (determined from step k) 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.

n) Repeat for all frequency bands authorized for use by the EUT.



#### **IC Rules**

#### Test Requirements: RSS-GEN 6.6

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99 % emission bandwidth, as calculated or measured.

#### **Test Procedures: RSS-GEN 6.6**

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW. Video averaging is not permitted. A peak,or peak hold, maybe used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of peak hold maybenecessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered amplitude data points, beginningat the lowest frequency, are placed in arunningsum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right sideof the span, and going down in frequency). This frequency is the necorded.

The difference between thetwo recorded frequencies is the 99% occupied bandwidth.



#### **Test Results:**The EUT complies with the requirements of this section.

Input Signal	Input Level (dBm)	Maximum Amp Gain
AWS	-14 dBm	52.2 dB

#### [Downlink Output\_AWS BAND ]

	Channel	Frequency (MHz)	OBW (MHz)
AW/S Band	Low	2112.50	4.5124
LTE 5 MHz	Middle	2145.00	4.5133
AGC threshold	High	2177.50	4.5107
AWS Band_ LTE 5 MHz	Low	2112.50	4.5068
+3dBm above the	Middle	2145.00	4.5125
AGC threshold	High	2177.50	4.5117
AWS Band	Low	2115.00	8.9943
LTE 10 MHz	Middle	2145.00	8.9975
AGC threshold	High	2175.00	8.9924
AWS Band_	Low	2115.00	8.9923
+3dBm	Middle	2145.00	9.0012
above the AGC threshold	High	2175.00	8.9844



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	Channel	Frequency (MHz)	OBW (MHz)
AW/S Band	Low	2120.00	17.962
LTE 20 MHz	Middle	2145.00	17.990
AGC threshold	High	2170.00	17.905
AWS Band_ LTE 20 MHz	Low	2120.00	17.986
+3dBm	Middle	2145.00	17.957
AGC threshold	High	2170.00	17.945
AVA/S Bond	Low	2111.25	1.2758
CDMA AGC threshold	Middle	2145.00	1.2734
	High	2178.75	1.2707
AWS Band_	Low	2111.25	1.2725
+3dBm	Middle	2145.00	1.2753
above the AGC threshold	High	2178.75	1.2755
AW/S Band	Low	2112.50	4.1795
WCDMA	Middle	2145.00	4.1802
AGC threshold	High	2177.50	4.1737
AWS Band_	Low	2112.50	4.1799
+3dBm	Middle	2145.00	4.1850
above the AGC threshold	High	2177.50	4.1782



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# [Downlink Input\_AWS BAND ]

	Channel	Frequency (MHz)	OBW (MHz)
AW/S Band	Low	2112.50	4.5770
LTE 5 MHz	Middle	2145.00	4.5639
AGC threshold	High	2177.50	4.5638
AWS Band	Low	2115.00	9.3272
LTE 10 MHz	Middle	2145.00	9.3196
	High	2175.00	9.2985
AWS Band	Low	2120.00	18.021
LTE 20 MHz AGC threshold	Middle	2145.00	18.032
	High	2170.00	18.032
AWS Band	Low	2111.25	1.2818
CDMA AGC threshold	Middle	2145.00	1.2804
	High	2178.75	1.2776
AWS Band	Low	2111.25	4.3066
WCDMA	Middle	2145.00	4.2905
AGC Inreshold	High	2178.75	4.2789



# Plots of Occupied Bandwidth\_AWS BAND LTE 5MHz

#### [AGC threshold Output Downlink Low]



#### [AGC threshold Output Downlink Middle]





Model: MRDU\_AWS13



#### [AGC threshold Output Downlink High]

#### [+3dBmabove AGC threshold Output Downlink Low]







#### [+3dBm above AGC threshold Output Downlink Middle]

#### [+3dBm above AGC threshold Output Downlink High]

Agilent Spectrum Analyzer - Oc	cupied BV	N								
<mark>LX/</mark> L RF 50 ผ	AC	CORREC	SE Center F	NSE:INT	0000 GHz	ALIGN AU	JTO 11:10:13 P Padio Std:	M Jun 20, 2016	Frequency	
		+	Trig: Free	e Run	Avg Hold:	100/100	)	None		
		#IFGain:Low	#Atten: 30	DdB	Ext Gain: -	20.00 d	IB Radio Dev	ice: BTS		
10 dB/div Ref 40.0	0 dBm	۱ <u>.                                    </u>								
30.0		manna	a Concentration of the						Comton Fra	
30.0		1				1			CenterFre	p
20.0	1					ľ			2.177500000 GF	1Z
10.0						1				
0.00	1					1				
IN IT WHILE WALL AND	YAAW						Hall Ball mar wind	ale break a desan		
10.0										
-20.0										
-30.0										
-40.0										
-50.0										
00.0									CF Ste	р
Center 2.178 GHz							Spa	n 10 MHz	1.000000 MH	Ηz
#Res BW 100 kHz			#VE	SW 300 k	Hz		#Swee	ep 50 ms	Auto Ma	IU
Occupied Band	widt	h		Total P	ower	4	l6.7 dBm		Frea Offs	et
	4.	5117 M	Hz						0 +	łz
Transmit Freq Er	ror	-6.504	kHz	OBW P	ower		99.00 %			
x dB Bandwidth		5.0391	MH7	x dB			26.00 dB			
		0.000								
MSG						ST	ATUS			



# Plots of Occupied Bandwidth\_ AWS BAND LTE 10MHz



#### [AGC threshold Output Downlink Middle]







#### [AGC threshold Output Downlink High]

#### [+3dBmabove AGC threshold Output Downlink Low]







#### [+3dBm above AGC threshold Output Downlink Middle]

#### [+3dBm above AGC threshold Output Downlink High]





# Plots of Occupied Bandwidth\_AWS BAND LTE 20MHz

19.96 MHz



# [AGC threshold Output Downlink Middle]

x dB

-26.00 dB

STATUS



x dB Bandwidth





#### [AGC threshold Output Downlink High]

#### [+3dBmabove AGC threshold Output Downlink Low]







#### [+3dBm above AGC threshold Output Downlink Middle]

#### [+3dBm above AGC threshold Output Downlink High]





# Plots of Occupied Bandwidth\_AWS BAND CDMA

#### [AGC threshold Output Downlink Low]



#### [AGC threshold Output Downlink Middle]





Model: MRDU\_AWS13



#### [AGC threshold Output Downlink High]

#### [+3dBmabove AGC threshold Output Downlink Low]







#### [+3dBm above AGC threshold Output Downlink Middle]

#### [+3dBm above AGC threshold Output Downlink High]





# Plots of Occupied Bandwidth\_AWS BAND WCDMA

#### [AGC threshold Output Downlink Low]



#### [AGC threshold Output Downlink Middle]









#### [AGC threshold Output Downlink High]

#### [+3dBmabove AGC threshold Output Downlink Low]







#### [+3dBm above AGC threshold Output Downlink Middle]

#### [+3dBm above AGC threshold Output Downlink High]





# Plots of Occupied Bandwidth\_AWS BAND LTE 5MHz [AGC threshold Input Downlink Low]

Agilent Spectrum Analyzer - Occupied	BW					
XX         T         RF         50 Q         Ac           Center Freq 2.112500001	CORREC 0 GHz #IFGain:Low	SENSE:INT Center Freq: 2.1125 Trig: Free Run #Atten: 30 dB	ALIGN 00000 GHz Avg Hold: 100/ Ext Gain: -20.0	10:21:14 P Radio Std (100 00 dB Radio Dev	MJun 21, 2016 : None vice: BTS	Frequency
10 dB/div Ref 10.00 dB	m					
-10.0						Center Freq 2.112500000 GHz
-20.0		Mayoy—C <sup>en</sup> terlein <sub>ini</sub> s <sub>ini</sub> sinisin ayb				
-50.0				**************************************	*******	
-70.0						
Center 2.113 GHz #Res BW 100 kHz		#VBW 300	kHz	Spa #Swee	n 10 MHz ep 50 ms	CF Step 1.000000 MHz
Occupied Bandwid	th	Total F	ower	-3.73 dBm		<u>Auto</u> Man
4 Transmit Freq Error	57 7 U IVIF. + 1.409	1Z (Hz OBW F	ower	99.00 %		Freq Offset 0 Hz
x dB Bandwidth	9.953 M	lHz xdB		-26.00 dB		
MSG				STATUS		

#### [AGC threshold Input Downlink Middle]





Agilent Spectrum Analyzer - Occupied BW	
(X) T RF 50 Ω AC CORREC SENSE:INT ALIGN AUTO 10:27:05 PM Jun 21, 2016	Erequency
Center Freq 2.177500000 GHz Center Freq: 2.177500000 GHz Radio Std: None	Trequency
#IFGain:Low #Atten: 30 dB Ext Gain: -20.00 dB Radio Device: BTS	
10 dB/div Ref 10.00 dBm	
	Contor From
	Center Freq
-10.0	2.177500000 GHz
-20.0	
-30.0	
terrely and the second se	
-60.0	
-70.0	
-80.0	
Center 2.178 GHz Span 10 MHz	CE Sten
#Res BW 100 kHz #VBW 300 kHz #Sweep 50 ms	1 000000 MHz
	Auto Man
Occupied Bandwidth Total Power -3.25 dBm	
4 5638 MHz	
	FreqOffset
Transmit Freg Error 4.565 kHz OBW Power 99.00 %	0 Hz
X dB Bandwidth 9.964 WHZ X dB -20.00 dB	

# [AGC threshold Input Downlink High]



# Plots of Occupied Bandwidth\_AWS BAND LTE 10MHz [AGC threshold Input Downlink Low]

Image: Conter Freq 2.115000000 GHz     Center Freq: 2.115000000 GHz     AligNAUTO     10:29:24 PM Jun 21, 2016       Center Freq 2.115000000 GHz     Center Freq: 2.115000000 GHz     Radio Std: None       #IFGain:Low     #IFGain:Low     Avg  Hold: 100/100       Ext Gain: -20.00 dB     Radio Device: BTS	ency
Trig: Free Run Avg Hold: 100/100 #/FGain:Low #Atten: 30 dB Ext Gain: -20.00 dB Radio Device: BTS	
#IFGain:Low #Atten: 30 db Ext Gain: -20.00 db Radio Device: B15	
10.0 Cent	er Frea
0.00 2.1150004	000 GHz
-10.0	
20.0	
30.0	
-40.0 ported a construction of the constructio	
50.0	
60.0	
70.0	
Center 2.115 GHz Span 20 MHz S50 kHz Span 20 MHz S50 kHz Sweep 50 ms	F Step
WRCS BW 180 KHZ #VBW 500 KHZ #SWEEP 50 HIS 2.000	000 MHz
Occupied Bandwidth Total Power -3.08 dBm	Man
9 3272 MHz	
Free	Offset
Transmit Freq Error -11.501 kHz OBW Power 99.00 %	0 Hz
x dB Bandwidth 20.00 MHz x dB -26.00 dB	
MSG STATUS	

#### [AGC threshold Input Downlink Middle]





Model: MRDU\_AWS13

UP       T       RF       508       AC       CORREC       SENSE:INT       ALIZINAUTO       Total Power       Padio Std: None       Radio Std: None       Frequency         Center Freq 2.1750000000 GHz       Center Freq: 2.17500000 GHz       Center Freq: 2.17500000 GHz       Radio Device: BTS       Radio Device: BTS       Center Freq         10 dB/div       Ref 20.00 dBm       Center Freq       Center       Center Freq       <	Agilent Spectrum Analyzer - Occupied	BW				
Image: Construction of the second	X T RF 50 Ω AC Center Freg 2.17500000	CORREC	SENSE:INT Center Freq: 2.17500	ALIGN AUTO	10:33:03 PM Jun 21, 2016 Radio Std: None	Frequency
10 dB/div       Ref 20.00 dBm         100       100         100<		+++ #IFGain:Low	Trig: Free Run #Atten: 30 dB	Avg Hold: 100/100 Ext Gain: -20.00 dB	Radio Device: BTS	
10 dB/div       Ref 20.00 dBm       Center Freq         10 dB/div       I </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>						
Log       Image: Construction of the second se	10 dB/div Ref 20.00 dB	m				
000       0000       0000       000       000 <td< td=""><td>10.0</td><td></td><td></td><td></td><td></td><td>Center Freg</td></td<>	10.0					Center Freg
100       1	0.00					2.175000000 GHz
200 200 200 200 200 200 200 200	-10.0					
S00       Image: Supervision of the supervision o	-20.0		Mary Contract Contract Align	and the state of t		
4000       Internet of the second of the secon	-30.0					
60.0       60.0	-40.0 March 1994 - 40.0 March 1994 - 40.0 March 1994 - 40.0				₽₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩	a la
YOU       Span 20 MHz       CF Step 2.00000 MHz         Center 2.175 GHz #Res BW 180 kHz       #VBW 560 kHz       Span 20 MHz 2.00000 MHz 2.00000 MHz         Occupied Bandwidth       Total Power       -2.78 dBm         9.2985 MHz       Freq Offset 0 Hz       Man         Transmit Freq Error       6.119 kHz       OBW Power       99.00 %         x dB Bandwidth       20.00 MHz       x dB       -26.00 dB	-60.0					
Center 2.175 GHz #Res BW 180 kHz       #VBW 560 kHz       Span 20 MHz #Sweep 50 ms       CF Step 2.000000 MHz 2.000000 MHz         Occupied Bandwidth       Total Power       -2.78 dBm       Auto       Man         9.2985 MHz       Freq Offset 0 Hz       Hz       Freq Offset       0 Hz         x dB Bandwidth       20.00 MHz       x dB       -26.00 dB       Hz	-70.0					
Both 2     #VBW 560 kHz     #Sweep 50 ms     CC 5tep 2.00000 MHz       Occupied Bandwidth     Total Power     -2.78 dBm       9.2985 MHz     Freq Offset     0 Hz       Transmit Freq Error     6.119 kHz     OBW Power     99.00 %       x dB Bandwidth     20.00 MHz     x dB     -26.00 dB	Center 2 175 GHz				Span 20 MH	
Occupied Bandwidth     Total Power     -2.78 dBm     Auto     Man       9.2985 MHz     Freq Offset       Transmit Freq Error     6.119 kHz     OBW Power     99.00 %     0 Hz       x dB Bandwidth     20.00 MHz     x dB     -26.00 dB     0 Hz	#Res BW 180 kHz		#VBW 560 k	Hz	#Sweep 50 ms	CF Step 2 000000 MHz
Scoupled Bandwidth     Freq Offset       9.2985 MHz     Freq Offset       Transmit Freq Error     6.119 kHz     OBW Power     99.00 %       x dB Bandwidth     20.00 MHz     x dB     -26.00 dB	Occupied Bandwid	th	Total P	ower _2.78	RdBm	Auto Man
J.2900 IVITIZ     Freq Offset       Transmit Freq Error     6.119 kHz     OBW Power     99.00 %     0 Hz       x dB Bandwidth     20.00 MHz     x dB     -26.00 dB			-	2.10	3 abin	
Transmit Freq Error       6.119 kHz       OBW Power       99.00 %       0 Hz         x dB Bandwidth       20.00 MHz       x dB       -26.00 dB	3	.2985 1016	Z			Freq Offset
x dB Bandwidth 20.00 MHz x dB -26.00 dB	Transmit Freq Error	6.119 kl	Iz OBW P	ower 9	9.00 %	0 Hz
	x dB Bandwidth	20.00 MI	Hz xdB	-26.	.00 dB	
MSG STATUS	MSG			STATU	s	

# [AGC threshold Input Downlink High]



# Plots of Occupied Bandwidth\_AWS BAND LTE 20MHz [AGC threshold Input Downlink Low]



#### [AGC threshold Input Downlink Middle]





Model: MRDU\_AWS13



#### [AGC threshold Input Downlink High]



# Plots of Occupied Bandwidth\_AWS BAND CDMA

#### [AGC threshold Input Downlink Low]



#### [AGC threshold Input Downlink Middle]





Model: MRDU\_AWS13



# [AGC threshold Input Downlink High]



# Plots of Occupied Bandwidth\_AWS BAND WCDMA [AGC threshold Input Downlink Low]



#### [AGC threshold Input Downlink Middle]





Agilent Spectrum Analyzer - Occupied	BW						
LXI T RF 50 Q AC	CORREC	SENSE:INT	ALIGN AUT	0 10:18:48 PM	4 Jun 21, 2016		
Center Freg 2,17750000	0 GHz	Center Freq: 2.17750	00000 GHz	Radio Std:	None	Freque	ency
		Trig: Free Run	Avg Hold: 100/100				
	#IFGain:Low	#Atten: 30 dB	Ext Gain: -20.00 dF	3 Radio Dev	ice: BTS		
10 dB/div Ref 10.00 dB	m						
Log	رصوالک		وي المحد ال			Cont	er Erog
0.00	<b>A 13 3 7</b>		هي روايين			Cen	erreq
-10.0						2.177500	000 GHz
20.0	A Contraction	wetware of the more	Change Barry Com				
-2010		ويعدين الكم					
-30.0							
-40.0							
works when the work when the second she	41227			And the second second second	Nedwork		
-50.0	<b>Ais</b> - 7		هي روسيد ا				
-60.0	<u> معالم الم</u>		<u>م الکام ال</u>				
70.0							
-70.0	<u>م معالمًا الم</u>						
-80.0	Albert						
Center 2.178 GHz				Spai	n 10 MHz		
#Res BW 100 kHz		#VBW 300 k	(Hz	#Swee	n 50 ms	(	CF Step
WINGS BATTING HTTE						1.000	000 MHz
		Total B		10 dBm		Auto	Man
Occupied Bandwid	th		ower -ə.	43 abm			
	2799 MH						
	2103 11172	<b>4</b>				Free	q Offset
Transmit Freg Error	-1.088 kH	Z OBW P	ower	99.00 %			0 Hz
x dB Bandwidth	8.493 MH	z xdB	-2	6.00 dB			
MSG			STA	TUS			

# [AGC threshold Input Downlink High]

# 8. PASSBAND GAIN AND BANDWIDTH & OUT OF BAND REJECTION

#### FCC Rules

#### Test Requirement(s): KDB 935210 D02 v03r02

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 of KDB 935210 D05 v01r01.

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, for each applicable CMRS band (see also KDB

Publication 935210 D02 [R7] and KDB Publication 634817 [R5] about selection of frequencies for testing and for grant listings).

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 = approximately 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 (RBW) of the spectrum analyzer to be 1 % to 5 % of the EUT passband, and the video bandwidth (VBW) shall be set to  $\geq$  3  $\times$  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.

i) Capture the frequency response of the EUT.

j) Repeat for all frequency bands applicable for use by the EUT.

#### **IC Rules**

#### Test Requirements: RSS-131 6.1

The passband gain shall not exceed the nominal gain by more than 1.0 dB. The 20 dB bandwidth shall not exceed the nominal bandwidth that is stated by the manufacturer. Outside of the 20 dB bandwidth, the gain shall not exceed the gain at the 20 dB point.



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#### Test Procedures: RSS-131 4.2

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

With the aid of a signal generator and spectrum analyzer, measure the 20 dB bandwidth of the amplifier (i.e. at the point where the gain has fallen by 20 dB). Measure the gain-versus-frequency response of the amplifier from the midband frequency f0 of the passband up to at least f0 + 250% of the 20 dB bandwidth.

Signal generator sweep from the frequency more lower than the low frequency -250% to the frequency more higher than high frequency +250%.

Input Signal	Input Level (dBm)	Maximum Amp Gain	
input Signal	Input Signal : Sinusoidal		
AWS	-14 dBm	52.2 dB	

#### **Test Results:** The EUT complies with the requirements of this section.



# [Downlink\_AWS BAND]

	20 dB point frequency (MHz)	Output power (dBm)	Gain (dB)
	2101.680 MHz	00.050	50.050
AWS Band	~ 2188.440 MHz	38.652	52.652

# Plots of Passband Gain and Bandwidth & Out of Band Rejection

[AWS BAND]

L       RF       50.2       AC       Serve: INT       ALIGNATIO       12:3:4:49M 30:02,2016       Frequency         MAY       Trig: Free Run (FGain:Low)       Trig: Free Run #Atten: 20 dB       MAY Type: Pwr(RMS) Avg Hold: 100/100       Trace: Descent Ref 0ffset 30.9 dB       ALICA 49.2       CH         0.00       B       38.652 dBm       38.652 dBm       38.652 dBm       Center Freq 2.14500000 GHz       ALICA 49.2       CH         0.00       B       MK1 2.164 92 GHz       38.652 dBm       38.652 dBm       Center Freq 2.14500000 GHz       Start Freq 1.99500000 GHz         0.00       Center 2.1450 GHz       YEW 3.0 MHz       Sweep 1.00 ms (5001 pts)       Stop Freq 30.000000 MHz         MKR       MOHZ       1       f       2.164 92 GHz       38.652 dBm       Stop Freq 30.000000 GHz         N       1       f       2.164 92 GHz       38.652 dBm       Span 300.0 MHz       Frequency         N       1       f       2.164 92 GHz       38.652 dBm       Span 300.0 MHz       Frequency         N       1       f       2.164 92 GHz       38.652 dBm       Span 300.0 MHz       Frequency         N       1       f       2.164 92 GHz       38.652 dBm       Stop Freq 30.000000 MHz       Stop Freq 30.000000 MHz       Stop Freq 30.00	Agilent Spectrum Analyzer - Sw	vept SA	22				
PHO: Fast	<mark>χα</mark> L RF 50 Ω	2 AC	SENSE:INT	#Avg Type	ALIGNAUTO : Pwr(RMS)	12:34:49 AM Jun 21, 2 TRACE 1 2 3.4	Frequency
Ref Offset 30.9 dB         Mkr1 2.164 92 GHz 38.652 dBm         Center Free 2.14500000 GHz           00         0		PNO: Fast • IFGain:Low	Trig: Free Run #Atten: 20 dB	Avg Hold: Ext Gain:	100/100 -20.00 dB	TYPE MWWW DET PAAA	
Conter 2,1450 GHz       Y       Function       <	Ref Offset 30	Ref Offset 30.9 dB         Mkr1 2.164 92 GHz           dB/div         Ref 60.00 dBm         38.652 dBm					
400       4	50.0			1			Center F
200       2	40.0 30.0	^2	A 2				2.145000000
000       1.99500000 GHz         100       FEA         11       FEA         12       FEA         11       FEA         10       FEA         11       F         11       F         12       FEA         13       F         14       F         15       FEA         16       FEA         17       FEA         18       FEA         11       F         11       F         12       FEA	20.0						Start F
100       1	0.00					P	1.995000000 ( PEAK
300       3	-20.0	الورد اليرينين بيا تواد ومعتري بالمراجع اليري التورد اليرينين بيا تواد ومعتري بالمراجع			ang ang sang sang sang sang sang sang sa	and a specific the specific the specific test and the specific test and the specific test and the specific test	Stop F
Center 2.1450 GHz         Span 300.0 MHz         CF Step 30.00000 MHz           #Res BW 1.0 MHz         #VBW 3.0 MHz         Sweep 1.00 ms (5001 pts)         30.00000 MHz           MKR MODE         TRC SCL         X         Y         FUNCTION         FUNCTION VALUE         Auto           1         N         1         f         2.168 92 GHz         38.652 dBm         Auto         Man           3         N         1         f         2.101 68 GHz         18.103 dBm         Freq Offset           4	-30.0				<u> </u>	<u></u>	2.295000000
MKR     MODE     TRC     SCL     X     Y     FUNCTION     FUNCTION WIDTH     FUNCTION VALUE       1     N     1     f     2.164.92.GHz     38.652.dBm     -       2     N     1     f     2.101.68.GHz     18.103.dBm     -       3     N     1     f     2.188.44.GHz     18.457.dBm     -       4     -     -     -     -     -       5     -     -     -     -     -       6     -     -     -     -     -       7     -     -     -     -     -       9     -     -     -     -     -       10     -     -     -     -     -       11     -     -     -     -     -	Center 2.1450 GHz #Res BW 1.0 MHz	#VB	W 3.0 MHz		Sweep 1	Span 300.0 M .00 ms (5001 pi	Hz (ts) CF S 30,000000 I
2       N       1       f       2.101 68 GHz       18.103 dBm         3       N       1       f       2.138 44 GHz       18.457 dBm       Freq Offset         4       -       -       -       -       -       OHz         6       -       -       -       -       -       OHz         7       -       -       -       -       -       OHz         9       -       -       -       -       -       -       -       0Hz         10       -       -       -       -       -       -       -       -       -       0Hz         11       -       -       -       -       -       -       -       -       -       -       0Hz       -       -       0Hz       0Hz       -       0Hz       0Hz       -       -       0Hz       0Hz       -       0Hz       0Hz       0Hz       -       -       0Hz       0Hz       -       0Hz       0Hz       0Hz       -       0Hz       0Hz       -       0Hz       0Hz       0Hz       0Hz       0Hz       0Hz       0Hz       -       0Hz       0Hz       0Hz <t< td=""><td>MKR MODE TRC SCL</td><td>× 2.164 92 GHz</td><td>ץ 38.652 dBm</td><td>FUNCTION FUI</td><td>NCTION WIDTH</td><td>FUNCTION VALUE</td><td>Auto</td></t<>	MKR MODE TRC SCL	× 2.164 92 GHz	ץ 38.652 dBm	FUNCTION FUI	NCTION WIDTH	FUNCTION VALUE	Auto
6     7 <td>2 N 1 f 3 N 1 f 4 5</td> <td>2.101 68 GHz 2.188 44 GHz</td> <td>18.103 dBm 18.457 dBm</td> <td></td> <td></td> <td></td> <td>Freq Off</td>	2 N 1 f 3 N 1 f 4 5	2.101 68 GHz 2.188 44 GHz	18.103 dBm 18.457 dBm				Freq Off
9     9 <td>6 7 8</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	6 7 8						
	9						
					STATUS		



# 9. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

#### **FCC Rules**

# Test Requirement(s): § 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.

#### § 27.53 Emission limits

(h) *AWS emission limits*—(1) *General protection levels.* Except as otherwise specified below, for operations 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 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10  $\log_{10}$  (P) dB.

(3) *Measurement procedure.* (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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.

**Test Procedures:** Measurements were in accordance with the test methods section 3.6 and 4.7 of KDB 935210 D05 v01r01.

#### 3.6.1. General

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/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, can be excluded from the test stipulated in step a).

3.6.2. EUT out-of-band/block emissions conducted measurement

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

NOTE—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 the two-tone 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 of interest.

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 emission bandwidth, 100 kHz, or 1 MHz)

g) Set the VBW =  $3 \times RBW$ .

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

i) Set the Sweep time = auto-couple.

j) Set the 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 (i.e., rms) mode.

I) 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 the procedure with the composite input power level set to 3 dB above the AGC threshold.

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

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.

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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. EUT spurious emissions conducted measurement

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 (e.g., 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  $\geq$  3 × RBW.

h) Set the Sweep time = auto-couple.

i) Set the analyzer start frequency to the lowest radio frequency signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part.

NOTE—The number of measurement points in each sweep must be  $\geq$  (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.

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

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

I) 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 analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the analyzer stop frequency to 10 times the highest frequency of the fundamental emission (see §2.1057). Note that the number of measurement points in each sweep must be  $\geq$  (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 (i.e., 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 and provide tabular data, if required.
p) Repeat the procedure with the input test signals tuned to a middle band/block frequency/channel and then a high band/block frequency/channel.

q) Repeat entire procedure with the narrowband test signal.

r) Repeat for all authorized frequency bands/blocks used by the EUT.

#### **IC Rules**

### Test Requirement(s): RSS-131 6.4

Spurious emissions of zone enhancers and translators shall be suppressed as much as possible. Spurious emissions shall be attenuated below the rated power of the enhancer by at least:

43 + 10 Log10(Prated in watts), or 70 dB, whichever is less stringent.

**Note:** If the minimum standard is not met, check to see if the input signal generators have a high harmonic content.

### Test Procedures: RSS-131 4.4

## 4.4.1 Multi-channel Enhancer

The spurious emissions of the equipment under test shall be measured using the two-tone method in section 4.3.1, with the two tones Po1 and Po2 set to the required levels.

Using a spectrum analyser with a resolution bandwidth set at 100 kHz, search for spurious emissions from 30 MHz to at least 5 times the highest RF passband frequency. The search may omit the band that contains the test tones and intermodulation products.

#### 4.4.2 Single channel Enhancer

The enhancer shall be operated as described in section 4.3.2 during the search for spurious emissions.

Using a spectrum analyser with a resolution bandwidth set at 100 kHz, search for spurious emissions from 30 MHz to at least 5 times the highest RF passband frequency. The search may omit the band that contains the input signal.

**Test Results:** The EUT complies with the requirements of this section. There were no Detectable Spurious emissions for this EUT.



# Single channel Enhancer Plots of Spurious Emission for AWS BAND LTE 5MHz Conducted Spurious Emissions (9 kHz – 150 kHz)



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-90.0				Freq Offset 0 Hz
Start 9.00 kHz #Res BW 1.0 kHz	#VBW 3.0 kHz*	Sweep	Stop 150.00 kHz 174 ms (1001 pts)	
MSG		STATUS	L DC Coupled	



## Conducted Spurious Emissions (150 kHz – 30 MHz)

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Agilent Spectr	rum Analyze	er - Swept SA								
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Conducted Spurious Emissions (30 MHz – 1 GHz)

### [Downlink Low]



## [Downlink Middle]





## [Downlink High]

Agilent Spect	rum Analyzer - Swept SA					
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Conducted Spurious Emissions (1 GHz – 26.5 GHz)

## [Downlink Low]-1



## [Downlink Low]-2

