HCT CO.,LTD
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
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FCC REPORT

Certification

Applicant Name:
GS Instech Co., Ltd.

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

Date of Issue:
September 06, 2018

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

Report No.: HCT-RF-1809-FC018

FCC ID:	**U88CC-L13**
APPLICANT:	**GS Instech Co., Ltd.**

Model: CC-L13

EUT Type: Industrial RF Repeater

Frequency Range:

Band	Downlink	Uplink
12	728 MHz ~ 746 MHz	698 MHz ~ 716 MHz
13	746 MHz ~ 757 MHz	776 MHz ~ 787 MHz

Output Power: DL : 13 dBm (0.02 W) / UL : 18 dBm (0.06 W)

Date of Test: July 23, 2018 ~ August 17, 2018

FCC Rule Part(s): CFR 47 Part 2, Part 27

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

Report prepared by : Kwang Il Yoon
Engineer of telecommunication testing center

Approved by : Jong Seok Lee
Manager of telecommunication testing center

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1809-FC018	September 06, 2018	- First Approval Report

Table of Contents

1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

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

1.2. PRODUCT INFORMATION

EUT Type	Industrial RF Repeater
Power Supply	AC-DC Adapter (Input : AC 90 ~ 264 V, Output : DC 12 V)
Frequency Range	Band 12: Downlink 728 MHz ~ 746 MHz, Uplink 698 MHz ~ 716 MHz Band 13: Downlink 746 MHz ~ 757 MHz, Uplink 776 MHz ~ 787 MHz
Output Power	DL : 13 dBm (0.02 W) UL : 18 dBm (0.06 W)
Supporting Technologies	LTE 10 MHz
Antenna Specification	Manufacturer does not provide an antenna.

1.3. TEST INFORMATION

FCC Rule Parts	CFR 47 Part 2, Part 27
Measurement standards	ANSI C63.26-2015, KDB 971168 D01 v03r01, KDB 935210 D05 v01r02
Place of Test	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version: 2014) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

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 27

Description	Reference	Results
RF Output Power	§2.1046, §27.50	Compliant
Occupied Bandwidth	§2.1049	Compliant
Out of Band Rejection	KDB 935210 D05 v01r02	Compliant
Unwanted Conducted Emissions	§2.1051, §27.53	Compliant
Radiated Emissions	§2.1053, §27.53	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.
* Because band 12 and band 13 are adjacent to downlink, we performed test both bands together only once.
* Since EUT does not alter the input signal, frequency stability test did not proceed according to section 4.8 of KDB935210 D05 v01r02.
* 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)
50	20.014
100	19.929
200	20.130
300	20.199
400	20.327
500	20.119
600	20.254
700	20.373
800	20.397
900	20.397
1000	20.414
2000	20.836
3000	20.743
4000	21.265
5000	21.408
6000	21.558
7000	21.863
8000	22.118
9000	21.590
10000	21.884
20000	23.124
26000	24.212

3.3. MAXIMUM MEASUREMENTUNCERTAINTY

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

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

Description	Condition	Uncertainty
RF Output Power	-	± 0.72 dB
Occupied Bandwidth	OBW ≤ 20 MHz	± 52 kHz
Out of Band Rejection	Gain 20 dB bandwidth	± 0.89 dB ± 0.58 MHz
Unwanted Conducted Emissions	-	± 1.08 dB
Radiated Emissions	f ≤ 1 GHz f > 1 GHz	± 4.80 dB ± 6.07 dB

3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

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

4. TEST EQUIPMENTS

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	N9020A / Spectrum Analyzer	09/15/2017	Annual	MY46471250
Agilent	N5128A / Signal Generator	03/05/2018	Annual	MY50141649
Agilent	N5128A / Signal Generator	02/17/2018	Annual	MY46240523
Agilent	11636A / Power Divider	07/26/2018	Annual	09109
Changwoo	18N-20dB / Attenuator	02/22/2018	Annual	4
DEAYOUNG ENT	DFSS60 / AC Power Supply	04/05/2018	Annual	1003030-1
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
Innco system	MA4640/800-XP-EP / Antenna Position Tower	N/A	N/A	N/A
Emco	2090 / Controller	N/A	N/A	060520
Ets	Turn Table	N/A	N/A	N/A
Rohde & Schwarz	Loop Antenna	04/19/2017	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/06/2017	Biennial	760
Schwarzbeck	BBHA 9120D / Horn Antenna	06/30/2017	Biennial	9120D-1300
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	04/25/2017	Biennial	BBHA9170124
Rohde & Schwarz	FSP30 / Spectrum Analyzer	09/06/2017	Annual	100688
Wainwright Instruments	WHKX10-900-1000-15000-40SS	07/20/2018	Annual	5
Wainwright Instruments	WHKX10-2700-3000-18000-40SS / High Pass Filter	07/16/2018	Annual	4
CERNEX	CBLU1183540 / Power Amplifier	01/03/2018	Annual	24613
CERNEX	CBL06185030 / Power Amplifier	01/03/2018	Annual	24615
CERNEX	CBL18265035 / Power Amplifier	01/10/2018	Annual	22966

5. RF OUTPUT POWER

FCC Rules

Test Requirements:

§ 2.1046 Measurements required: RF power output.

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

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

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

§ 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.

Test Procedures:

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

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

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

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

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

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

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

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

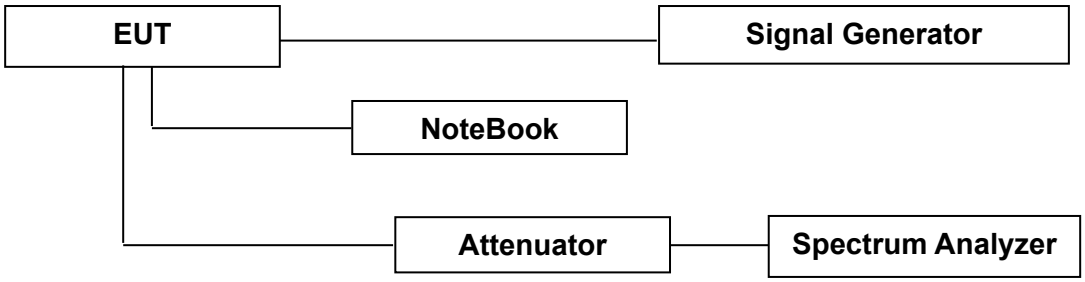
h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.

i) Repeat steps e) to h) with the narrowband test signal.

j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.

Power measurement Method:

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



Block Diagram 1. RF Power Output Test Setup

Test Results:

Input Signal	Link	Input Level (dBm)	Maximum Amp Gain (dB)
700LTE	Downlink	-62	75
	Uplink	-57	

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

Data of Output Power

Downlink (Band 12 & Band 13)

	Channel	Frequency (MHz)	Measured Output Power	
			(dBm)	(W)
LTE 10 MHz AGC threshold	Low	733.00	13.16	0.021
	Middle	742.50	13.27	0.021
	High	751.00	12.90	0.019
LTE 10 MHz +3 dB above the AGC threshold	Low	733.00	13.06	0.020
	Middle	742.50	13.23	0.021
	High	751.00	12.88	0.019

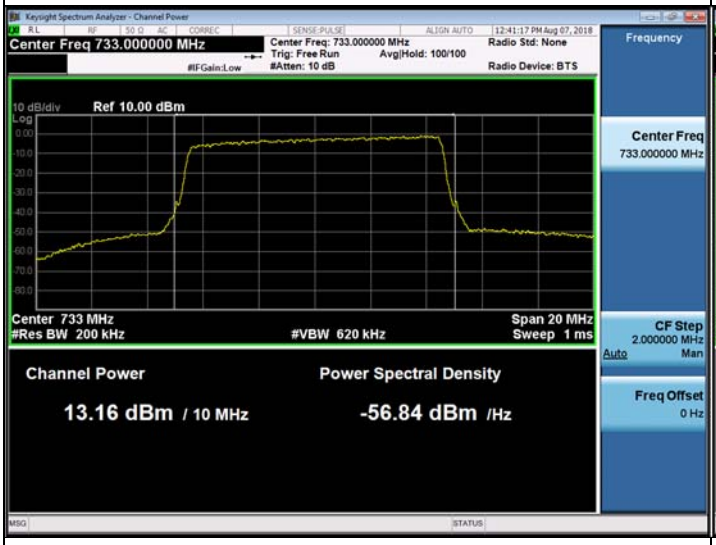
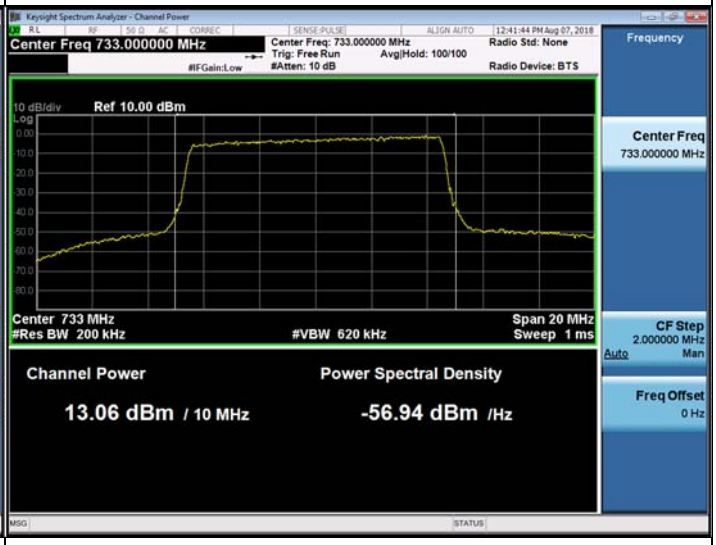
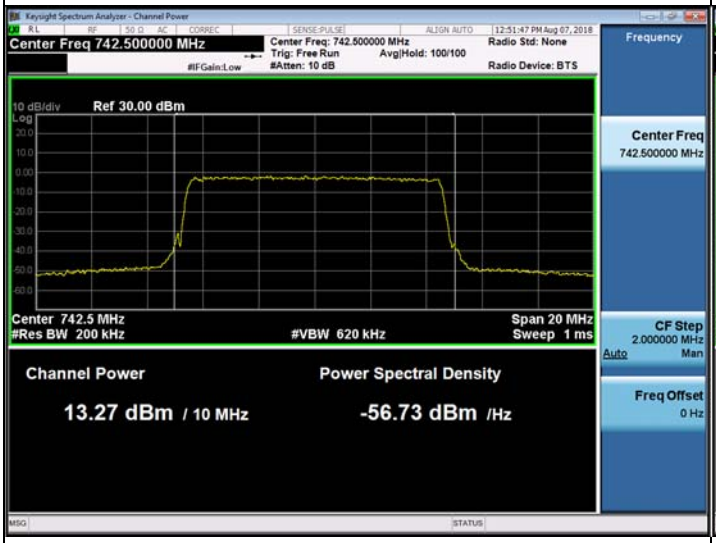
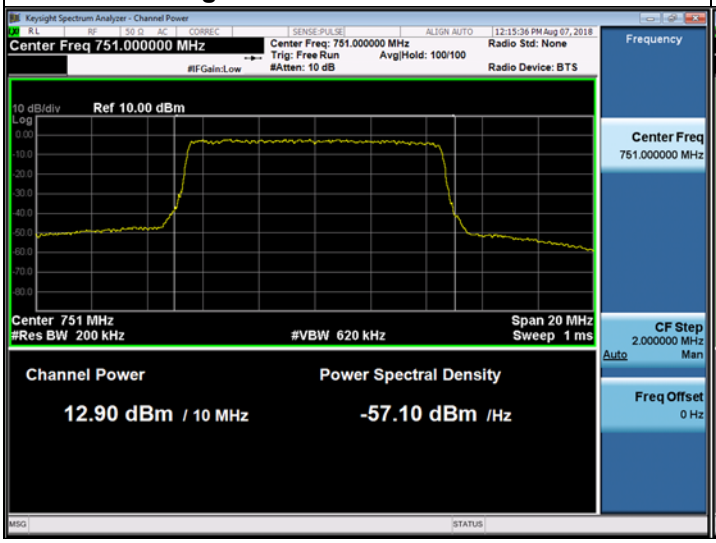
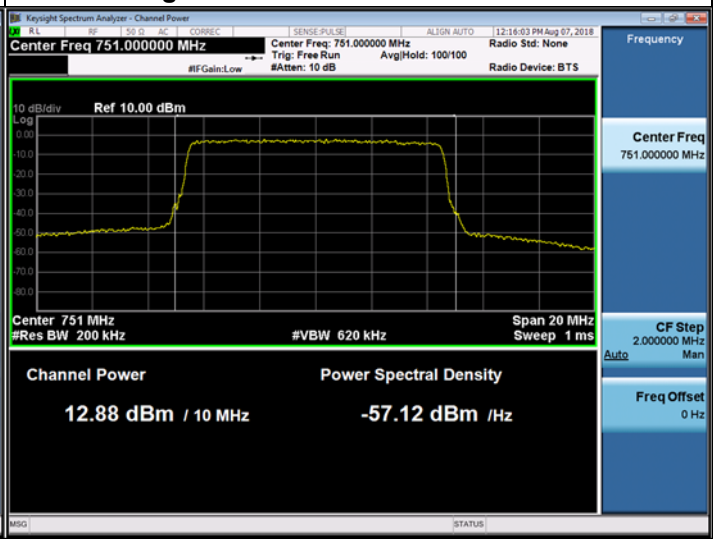
Uplink (Band 12)

	Channel	Frequency (MHz)	Measured Output Power	
			(dBm)	(W)
LTE 10 MHz AGC threshold	Low	703.00	18.05	0.064
	Middle	707.00	18.04	0.064
	High	711.00	18.08	0.064
LTE 10 MHz +3 dB above the AGC threshold	Low	703.00	18.11	0.065
	Middle	707.00	18.13	0.065
	High	711.00	18.12	0.065

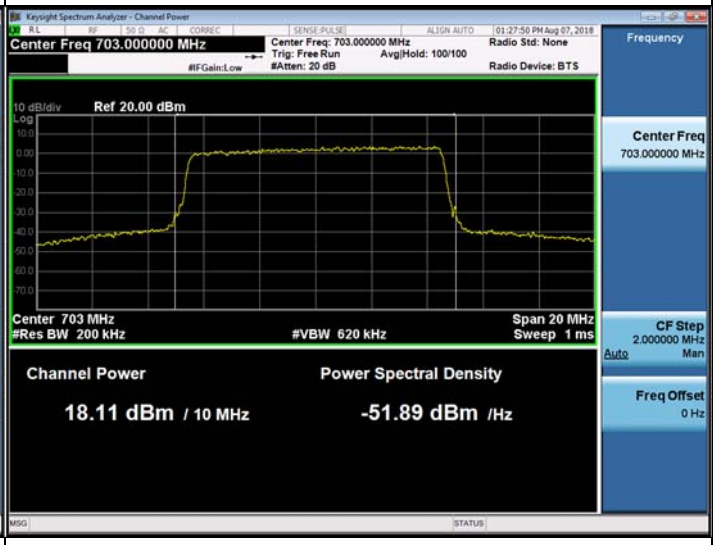
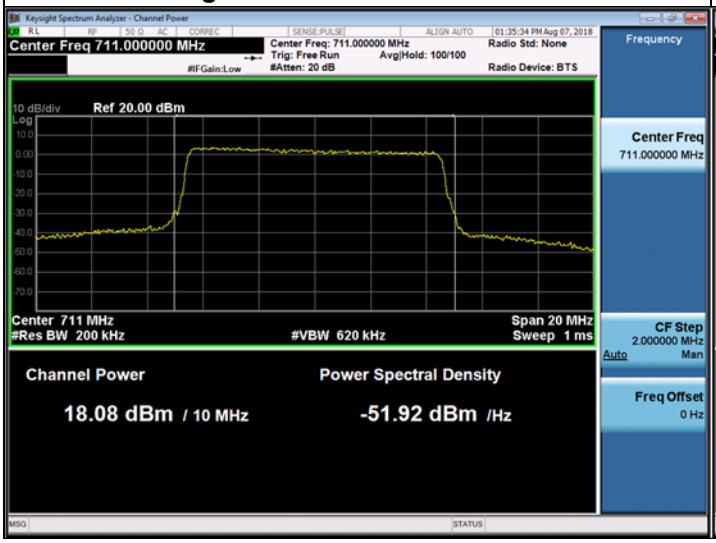
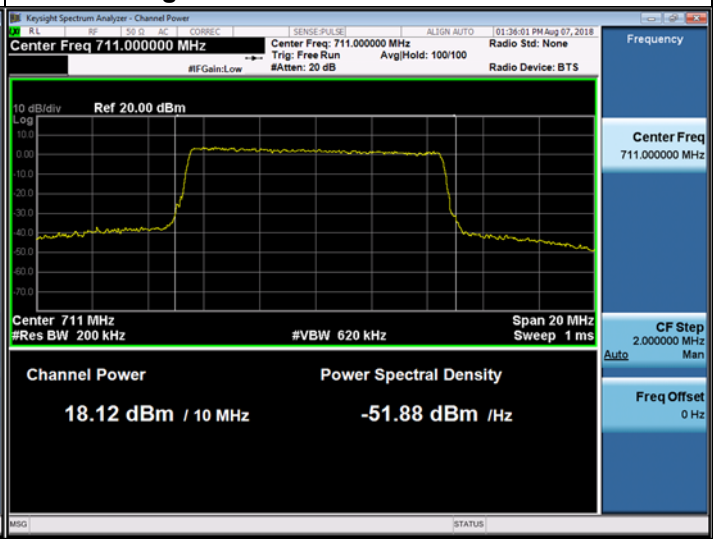
Uplink (Band 13)

	Channel	Frequency (MHz)	Measured Output Power	
			(dBm)	(W)
LTE 10 MHz AGC threshold	Low	781.00	17.74	0.059
	Middle	781.50	18.06	0.064
	High	782.00	17.98	0.063
LTE 10 MHz +3 dB above the AGC threshold	Low	781.00	18.10	0.065
	Middle	781.50	18.30	0.068
	High	782.00	18.28	0.067

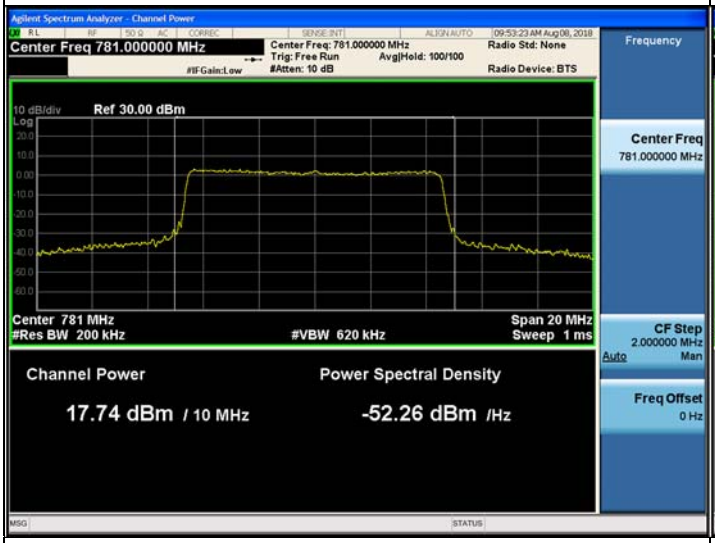
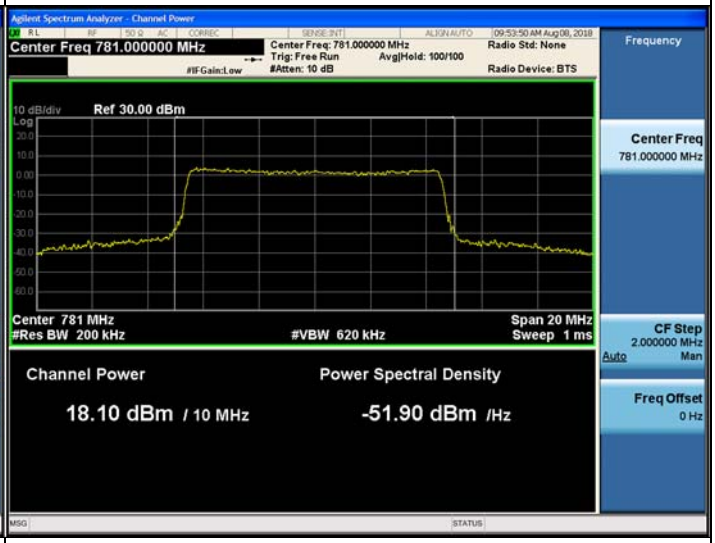
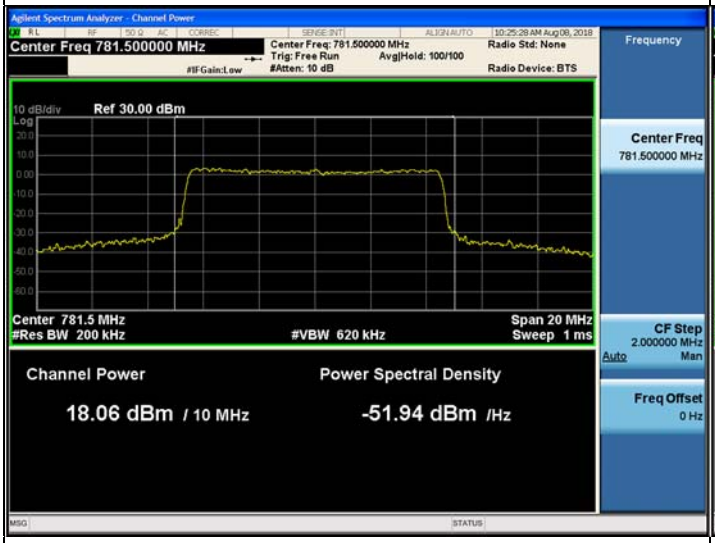
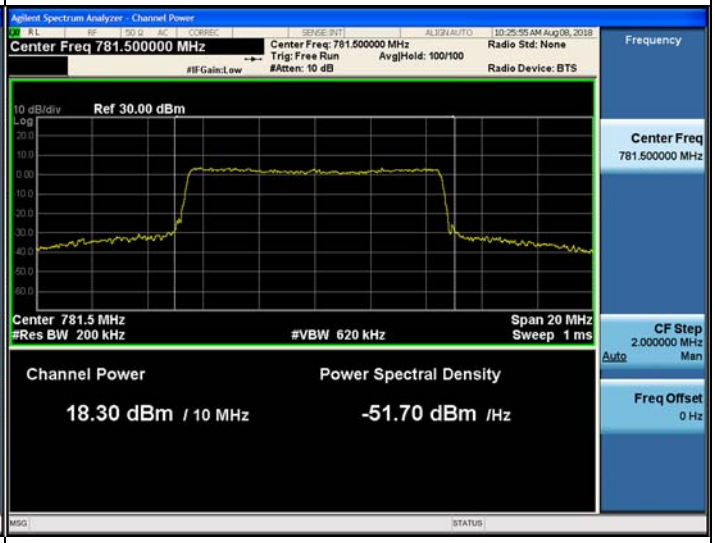
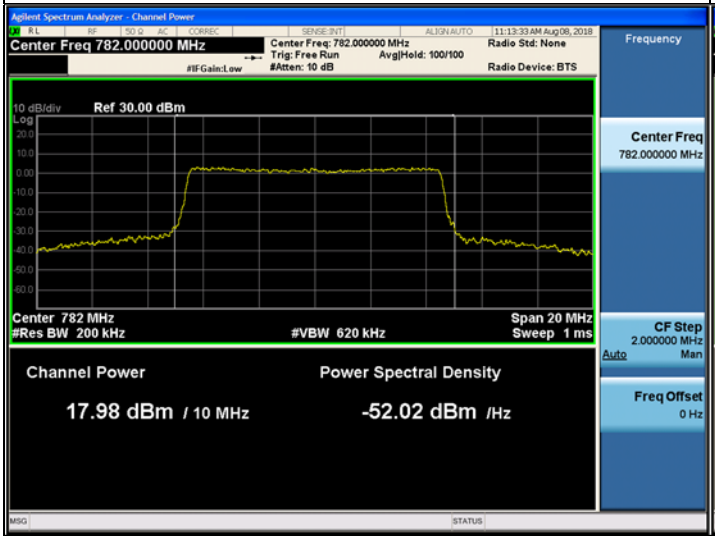
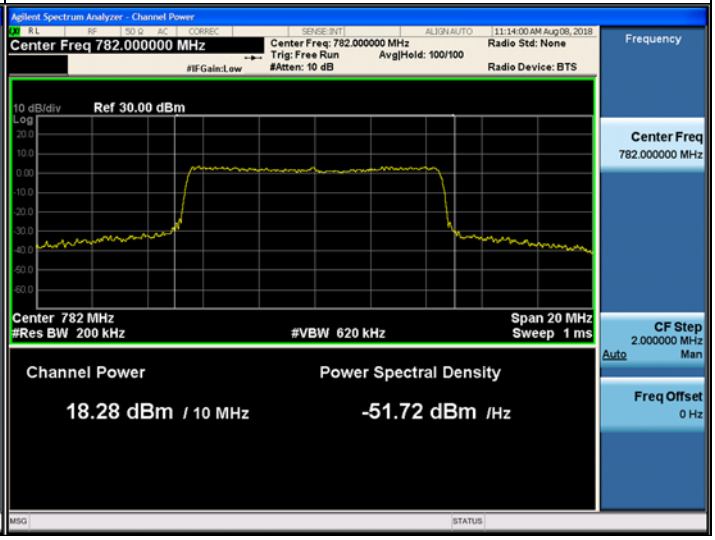
Plot of Output Power for LTE 10 MHz Downlink (Band 12 & Band 13)

Low Channel AGC threshold	Low Channel +3 dB AGC threshold
	
Middle Channel AGC threshold	**Middle Channel +3 dB AGC threshold**
	
High Channel AGC threshold	**High Channel +3 dB AGC threshold**
	

Plot of Output Power for LTE 10 MHz Uplink (Band 12)

Low Channel AGC threshold	Low Channel +3 dB AGC threshold
	
Middle Channel AGC threshold	**Middle Channel +3 dB AGC threshold**
	
High Channel AGC threshold	**High Channel +3 dB AGC threshold**
	

Plot of Output Power for LTE 10 MHz Uplink (Band 13)

Low Channel AGC threshold	Low Channel +3 dB AGC threshold
	
Middle Channel AGC threshold	**Middle Channel +3 dB AGC threshold**
	
High Channel AGC threshold	**High Channel +3 dB AGC threshold**
	

6. OCCUPIED BANDWIDTH

FCC Rules

Test Requirements:

§ 2.1049 Measurements required: Occupied bandwidth.

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

Test Procedures:

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

Test is 99% OBW measured and used.

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

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

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

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

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

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

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

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

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

i) Set spectrum analyzer detection function to positive peak.

j) Set the trace mode to max hold.

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

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

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

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

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

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

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

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

Test Results:

Data of Output Occupied bandwidth

Downlink (Band 12 & Band 13)

	Channel	Frequency (MHz)	Measured OBW (MHz)
LTE 10 MHz AGC threshold	Low	733.00	8.9649
	Middle	742.50	8.9758
	High	751.00	8.9811
LTE 10 MHz +3 dB above the AGC threshold	Low	733.00	8.9826
	Middle	742.50	8.9854
	High	751.00	8.9892

Uplink (Band 12)

	Channel	Frequency (MHz)	Measured OBW (MHz)
LTE 10 MHz AGC threshold	Low	703.00	8.9785
	Middle	707.00	9.0029
	High	711.00	9.0118
LTE 10 MHz +3 dB above the AGC threshold	Low	703.00	8.9850
	Middle	707.00	8.9953
	High	711.00	9.0172

Uplink (Band 13)

	Channel	Frequency (MHz)	Measured OBW (MHz)
LTE 10 MHz AGC threshold	Low	781.00	9.0380
	Middle	781.50	9.0419
	High	782.00	9.0539
LTE 10 MHz +3 dB above the AGC threshold	Low	781.00	9.0588
	Middle	781.50	9.0296
	High	782.00	9.0535

Data of Input Occupied bandwidth

Downlink (Band 12 & Band 13)

	Channel	Frequency (MHz)	Measured OBW (MHz)
LTE 10 MHz AGC threshold	Low	733.00	8.9984
	Middle	742.00	9.0033
	High	751.00	9.0260

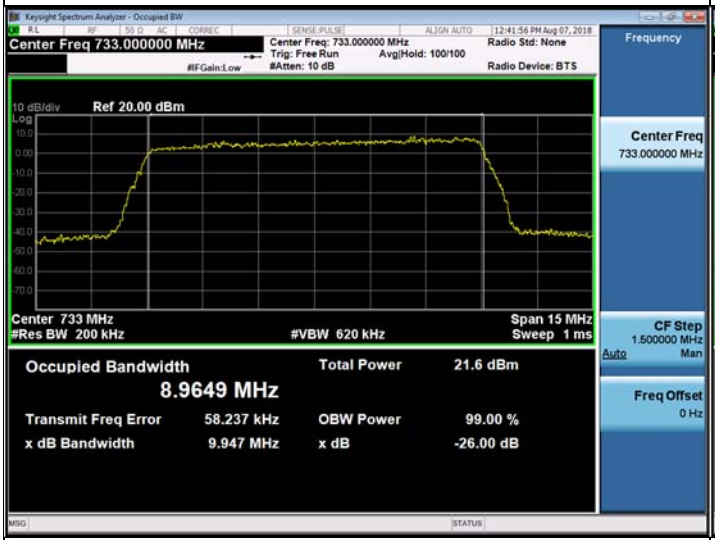
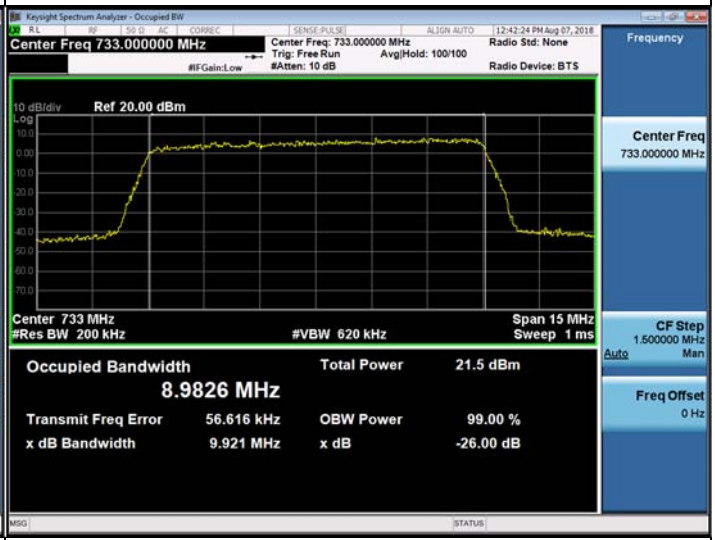
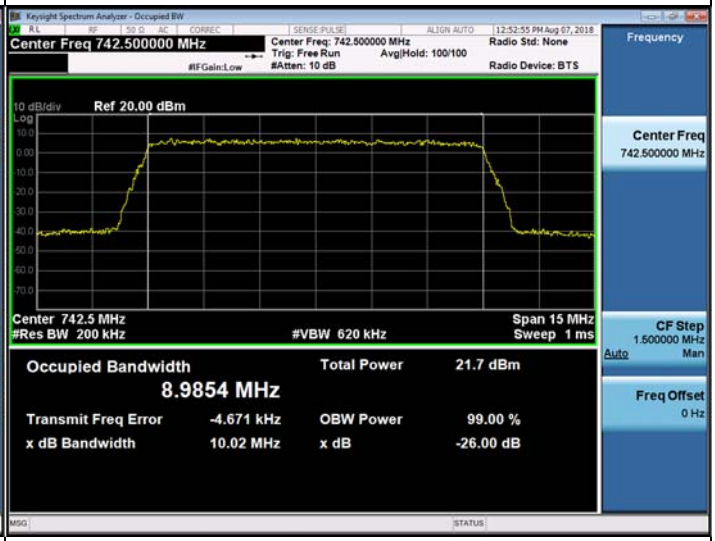
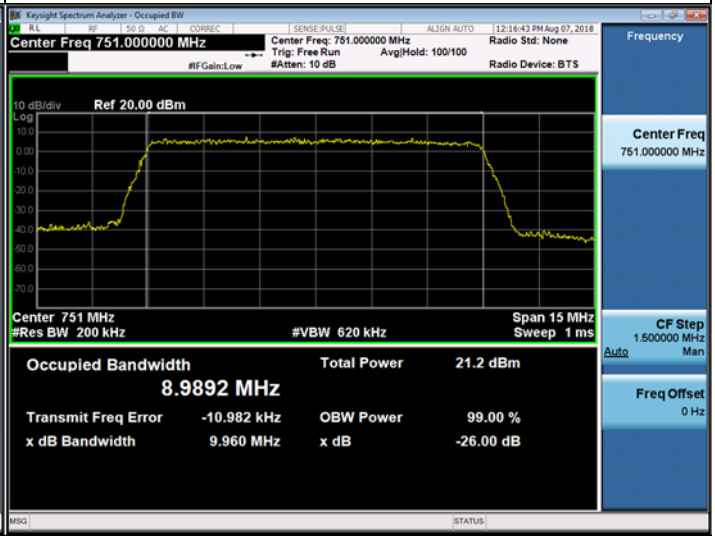
Uplink (Band 12)

	Channel	Frequency (MHz)	Measured OBW (MHz)
LTE 10 MHz AGC threshold	Low	703.00	8.9968
	Middle	707.00	9.0259
	High	711.00	9.0183

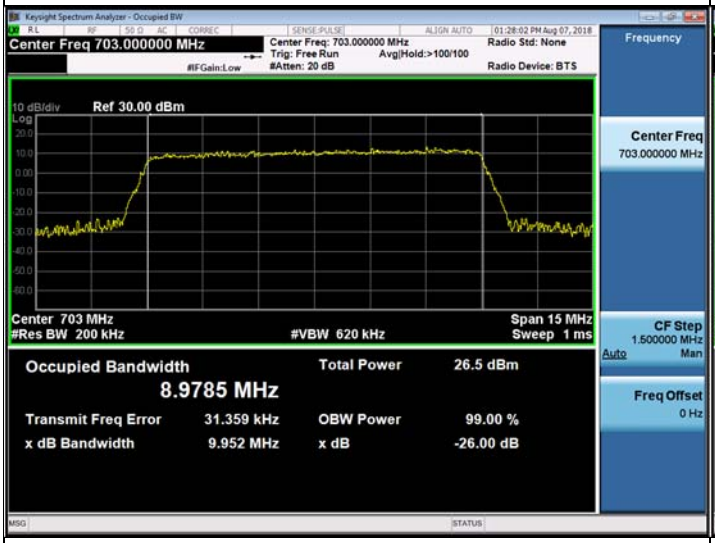
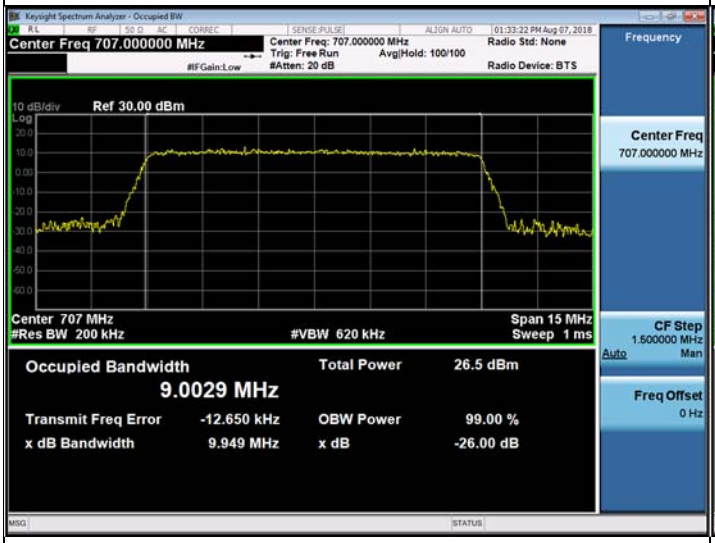
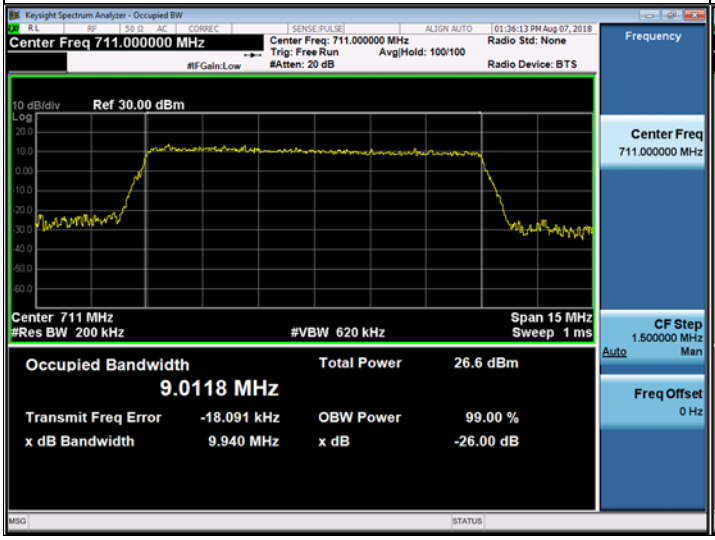
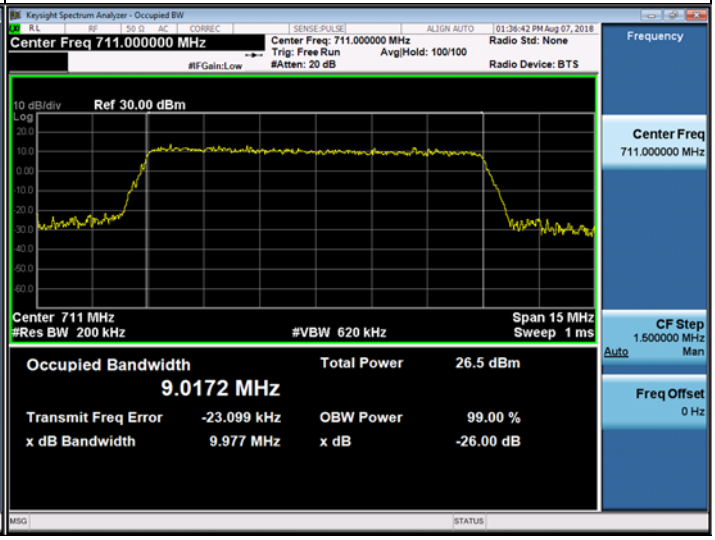
Uplink (Band 13)

	Channel	Frequency (MHz)	Measured OBW (MHz)
LTE 10 MHz AGC threshold	Low	781.00	9.0139
	Middle	781.50	9.0241
	High	782.00	9.0236

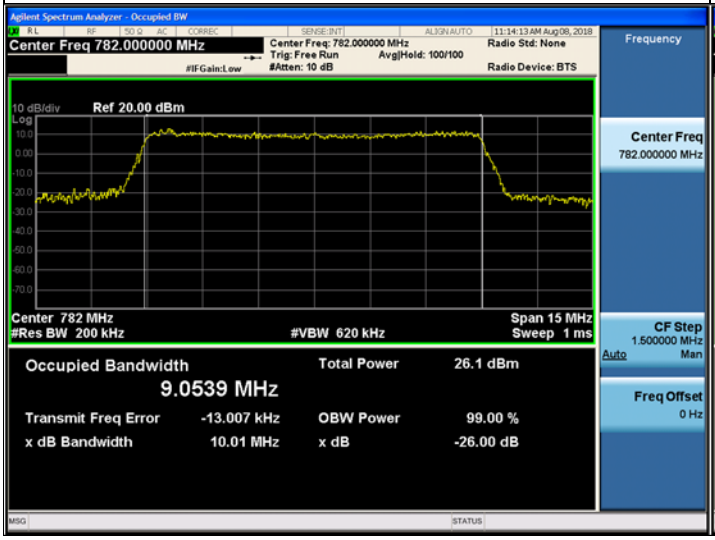
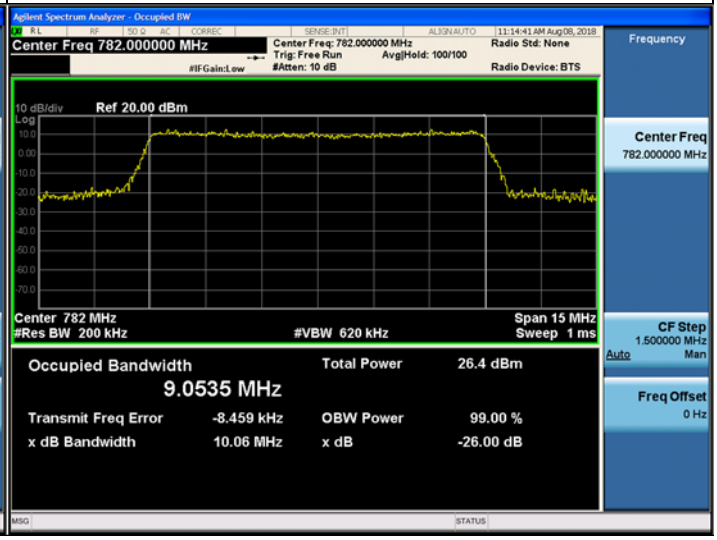
Plot of Output Occupied Bandwidth for LTE 10 MHz Downlink (Band 12 & Band 13)

Low Channel AGC threshold	Low Channel +3 dB AGC threshold
	
Middle Channel AGC threshold	**Middle Channel +3 dB AGC threshold**
	
High Channel AGC threshold	**High Channel +3 dB AGC threshold**
	

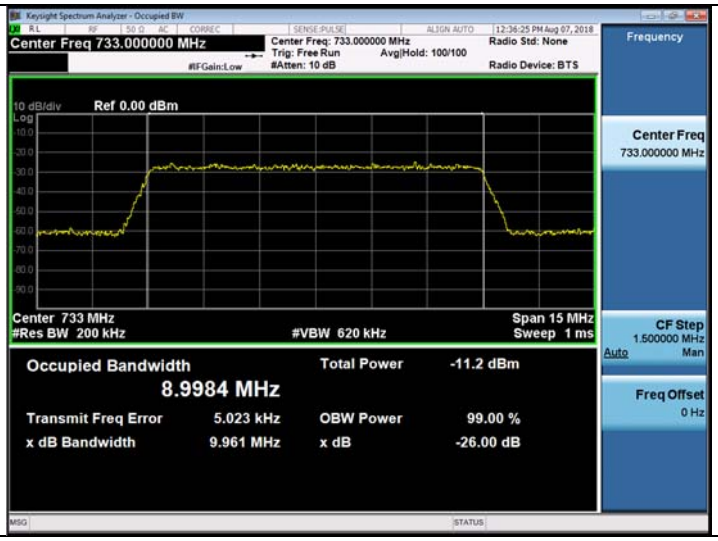
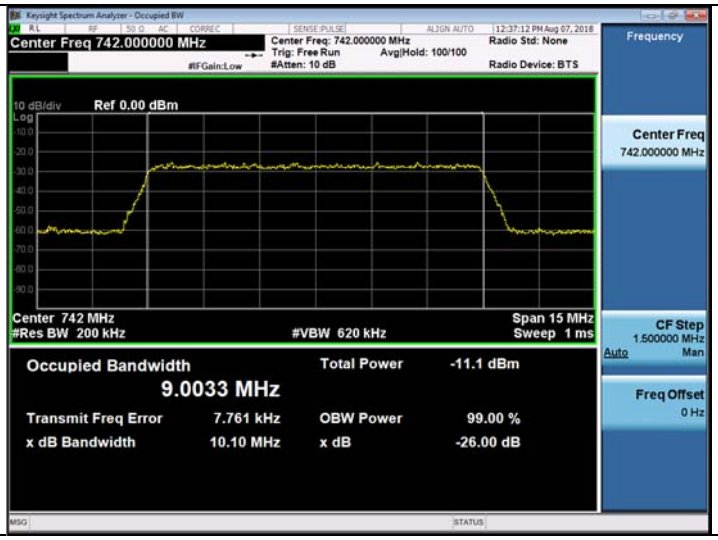
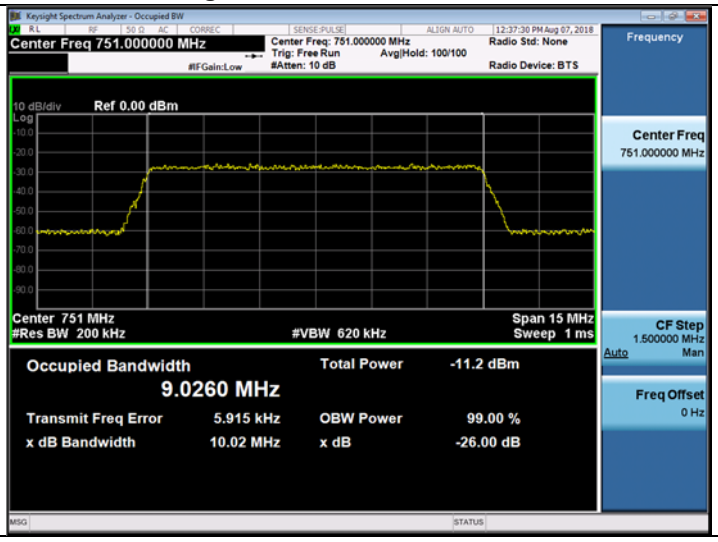
Plot of Output Occupied Bandwidth for LTE 10 MHz Uplink (Band 12)

Low Channel AGC threshold	Low Channel +3 dB AGC threshold
	
Middle Channel AGC threshold	**Middle Channel +3 dB AGC threshold**
	
High Channel AGC threshold	**High Channel +3 dB AGC threshold**
	

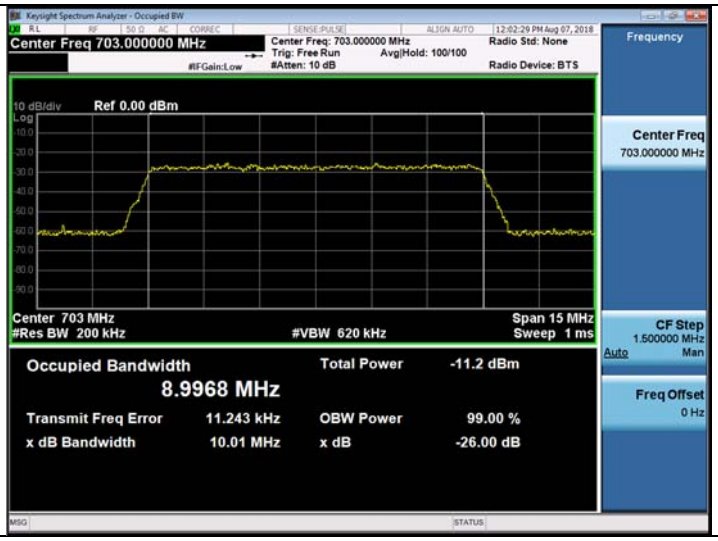
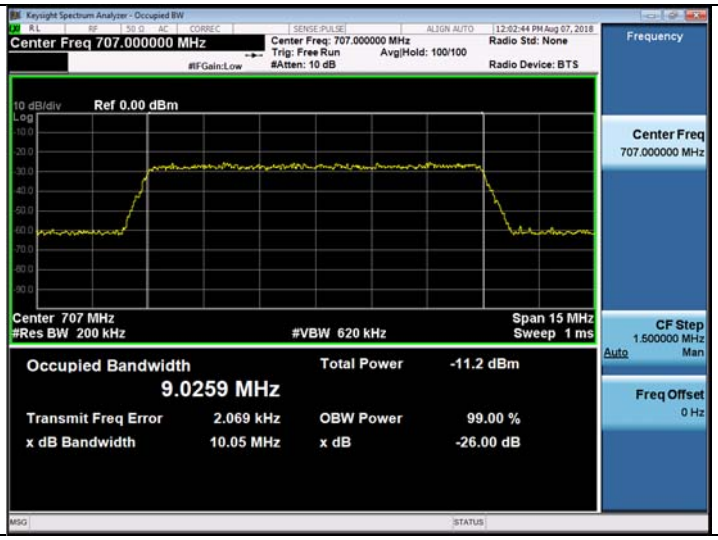
Plot of Output Occupied Bandwidth for LTE 10 MHz Uplink (Band 13)

Low Channel AGC threshold	Low Channel +3 dB AGC threshold
	
Middle Channel AGC threshold	**Middle Channel +3 dB AGC threshold**
	
High Channel AGC threshold	**High Channel +3 dB AGC threshold**
	

Plot of Input Occupied Bandwidth for LTE 10 MHz Downlink (Band 12 & Band 13)

Low Channel AGC threshold

Middle Channel AGC threshold

High Channel AGC threshold


Plot of Input Occupied Bandwidth for LTE 10 MHz Uplink (Band 12)

Low Channel AGC threshold

Middle Channel AGC threshold

High Channel AGC threshold