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FCC PARTS 2, 20, 22, 24, 27 TEST REPORT

Applicant	Dali Wireless, Inc.
Address	535 Middlefield Road, Suite 280, Menlo Park, CA 94025, USA
FCC ID	HCOHD304NACEHIO1A
Model Number	HD30-4-NA-CEHI-O1H
Product Description	700, 850, 1900, AWS Indoor Remote Unit, Quad-Band
Date Sample Received	October 18th, 2016
Date Sample Tested	October 18th to October 21st, 2016
Tested by	Sophie Piao
Approved by	Andrew Leung
Report No.	HD30-4-NA-CEHI-O1H
Test Results	Compliant

Revision History

Revision	Date	Reason For Change	Reviewed By	Author(s)
0.1	October 21st, 2016	Initial release		S. Piao
0.2	Nov 23rd, 2016	Edit		S. Piao
2.0	Dec 06th, 2016	Modification in response to TIMCO-TCB's comments		S. Piao
3.0	Dec 20th, 2016	Approver's signature added	A. Leung	S. Piao

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ACRONYMS AND ABBREVIATIONS

BTS	Base Transceiver Station
CW	Continuous Wave
dB	deciBel (logarithmic ratio)
dBm	deciBels related to 1 Mw
DL	Downlink
EIRP	Effective Isotropic Radiated Power
GSM	Groupe Spéciale Mobile, Global System for Mobile communications
IF	Intermediate Frequency
IM	Inter-Modulation
kHz	kilo Hertz
LTE	Long Term Evolution
MHz	Mega Hertz
NF	Noise Figure
PCS	Personal Communications Service
RF	Radio Frequency
RX	Receiver
TX	Transmit
UL	Uplink
WCDMA	Wideband Code Division Multiple Access

1 Overview

1.1 Scope

The purpose of this document is to present test results in the context of a full qualification test report for FCC Part 2, 22, 24, 27 as applicable to the equipment under test. The scope of this document is limited to the tests listed below in the downlink mode.

1.2 Attestation Statement

The device under test does fulfill the general approval requirements as identified in this test report.

This equipment has been tested in accordance with the standards identified in this test report. To the best of our knowledge and belief, these tests were performed using the measurement procedures described in this report. All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025:2005 requirements.

We attest that the necessary measurements were made, under my supervision, at DALI WIRELESS, INC. located at 8618 Commerce Court, Burnaby, British Columbia, V5A 4N6, Canada.

Authorized Signatories:

Written by Sophie Piao
Test Engineer
Date: October 23rd, 2016

Approved by Andrew Leung
VP Operations
Date: December 20th, 2016

1.3 Report Summary

Disclaimer	The test results relate only to the items tested.
Report Purpose	To demonstrate the DUT compliance with FCC Parts 2, 22, 24 and 27 requirements for a quad-band digital repeater.

Applicable Rule Parts	FCC CFR 47 Parts 2 Lower and Upper 700 MHz Band: 27.5(c), 27.50(c), 27.53(c, g) Cellular Band: 22.905, 22.913, 22.917 AWS-1 Band: 27.5(h), 27.50(d), 27.53(h) Broadband PCS Band: 24.229, 24.232, 24.238
Test Procedures	ANSI/TIA-603-C: 2004; FCC KDB 935210 D05 v01r01, Feb 12, 2016; FCC KDB 971168 D01 v02r02, Oct 17, 2014; FCC KDB 971168 D03 v01, Jan 06, 2016

1.4 Test Environment

Test Facilities	Tests were performed by Dali Wireless Inc. located at 8618 Commerce Court, Burnaby, BC, V5A 4N6, Canada.
Test Conditions	Temperature: 25° C Relative Humidity: 60% Atmospheric Pressure: 98.1 kPa

1.5 Test Setup

Deviation to the rules	There was no deviation from the test standards.
Modification to the DUT	No modification was made to the DUT.
Test Exercise	The DUT was placed in continuous transmit mode of operation.

1.6 Device Under Test Information

Manufactured by	Dali Wireless Inc.
DUT Description	700, 850, PCS, AWS Remote Unit, Quad-Band Bi-directional Distributed System

FCC ID	HCOHD304NACEHIO1A
Model Name	HD30-4-NA-CEHI-O1H
Operating Frequency	Downlink 728 – 757 MHz, Downlink 869 – 894 MHz, Downlink 1930 – 1995 MHz, Downlink 2110 – 2155 MHz.
Emission Designators	3K00GXW, 5M00D7W, 5M00G7D, 5M00G7W, 5M00W7D
Test Signals	Broadband: representative AWGN test signal with 4.1 MHz 99% occupied bandwidth; Narrowband: representative MSK modulation signal with a Gaussian Filter of 0.3 and a data rate of 270 kbps
User Power Range and Control	There are NO user power controls
Test Item	Production
DC Voltage and Current into final amplifier	48V DC
Type of Equipment	Fixed

1.7 Measurement Uncertainty

Radio Frequency	±1 ppm
Total RF Power: Conducted	±1 dB
RF Power Density: Conducted	±2.75 dB
Spurious Emissions: Conducted	±3 dB

Temperature	±1ºC
Humidity	±5 %
DC and Low Frequency Voltages	±3 %

1.8 Equipment List

Description	Manufacturer	Model	Serial Number	Cal Interval	Cal Due Date
Spectrum Analyzer	Agilent	EXA-N9010A	MY49061160	3 years	Mar-09-2018
Signal Generator	Agilent	MXG-N5182B	MY53051862	2 years	Jun-27-2018

1.9 Test Procedure

General

The *hd*30 remote – EUT hereafter, is connected to the *hd*Host in a manner consistent with a typical installation. A digital modulation signal generator is connected to the TX_IN port of the appropriate band of the *hd*Host and spectrum analyzer is connected to the EUT downlink antenna port through an attenuator, nominally 40 dB for the band under consideration.

The 700 MHz (728 – 757 MHz), 850 MHz (869 – 894 MHz), PCS (1930-1995 MHz) and AWS (2110-2155 MHz) band was investigated. Measurements were performed with two types of test signals recommended by FCC KDB 935210 D05 v01r01. A quote is shown below:

> **3.0 Test Methods for CMRS Non-Consumer Repeater/Amplifier and Industrial Booster Devices**
> **3.1 General**
> Commercial Mobile Radio Services (CMRS) non-consumer RF repeaters, amplifiers, and industrial boosters shall be tested for compliance with the applicable regulatory technical requirements. Input and output power and emissions measurements must be performed using test signals that are intended to bound the typical signal space encountered within the CMRS bands. Broadband amplifiers/boosters shall be tested using a representative band-limited AWGN signal. The AWGN test signal must have a 4.1 MHz 99 % occupied bandwidth (OBW) (representative of a 5 MHz LTE channel). Narrowband test signals shall use a representative MSK modulated signal, with a Gaussian Filter of 0.3 and a data rate of 270 kbps (representative of a GSM-TDMA signal).

In the tests reported here the LTE and GSM signals were used as the two test signal representatives:

- LTE (5MHz channel bandwidth representing wide band signal) and
- GSM (GMSK modulation with a Gaussian Filter of 0.3 and a data rate o 270kbs representing narrow band signal of about 200kHz bandwidth)

for the mid, lowest and highest frequency for declared bandwidths. The modulation types are described in detail in Table 1- Table 5.

Figure 1-1 Conducted Emission Test Setup Diagram

AGC Threshold Level

The measurement procedure used was KDB 935210 D05. AGC threshold level is measured by connecting a Spectrum Analyzer to the RF antenna port via an attenuator and a Signal Generator to the supporting device – *hd*Host RF source port.

A GSM signal was generated on the center frequency of the operating band under test. Channel power was measured using 1% of the emission bandwidth. AGC threshold level was determined when increasing the input signal amplitude 0.5dB will no longer cause 0.5dB increase in the output signal amplitude.

Out of Band Rejection

The measurement procedure used was KDB 935210 D05. The Signal Generator sent CW signal sweep in the range of ±250% of the passband. So is the Spectrum Analyzer span was set to. The RBW was set to 5% of the passband. An input signal level 5dB below the AGC threshold was injected. Two traces were obtained, via Max-Hold and Clear-Write. The peak frequency in the Max-Hold trace was recorded and would be allocated for the system gain and output power measurement.

Occupied Bandwidth – Input versus Output Signal Comparison

The measurement procedure used was KDB 935210 D05. Occupied Bandwidth is measured by connecting a Spectrum Analyzer to the RF output connector.

The required measurement resolution bandwidth (RBW) is 1% of the emission bandwidth. 99% energy rule was applied to measure the occupied channel bandwidth. The emission bandwidth is measured as the width of the signal between two frequency points on the channel edge, outside of which the transmission power is attenuated at least 26dB below the transmitter output power. The carrier allocated on the center frequency of the passband was investigated with input amplitude 0.5dB below the AGC threshold, for both input and output signal occupied band width. The output was then measured again with input amplitude 3dB above the AGC threshold.

RF Power Output

The measurement procedure used was KDB 971168 D01 Section 5.2.1. The EUT was configured to transmit continuously. RF power is measured by connecting a spectrum analyzer to the RF output connector. With an input power 0.5dB below and 3dB above the AGC threshold, respectively, the RF output is measured via Spectrum Analyzer's channel power function. The carrier was located at the peak frequency obtained in the out of band rejection measurement.

Out of Block Emissions

The measurement procedure used was KDB 935210 D05. The out of block emission was measured under two stimulus conditions. 1). Two adjacent test signal sequentially tuned to the lower and upper band edges; 2). A single test signal, sequentially tuned to the lowest and highest channels within the operating band. The intermodulation emission out of block was produced by the two carrier test signal as well. The peak emission was measured in 100kHz or 1MHz integrated bandwidth within 300kHz or 3MHz span immediate out of band, for carriers below or above 1GHz, respectively. The input power was set with two amplitude levels, i.e. 0.5dB below and 3dB above the AGC threshold level.

Spurious Emissions
The procedure used was ANSI/TIA-603-C: 2004. The spectrum was scanned from 9 kHz to at least the tenth harmonic of the fundamental using a spectrum analyzer. For digital modulation, the carrier is modulated to its maximum extent. The measurements were made in accordance with standard ANSI/TIA-603-C: 2004. The input power was set 0.5dB below the AGC threshold level. Simultaneous three carriers were allocated on the lowest, center and highest channels. The spurious emissions were then measured in the above range exclude the operating band ± 300kHz or ± 3MHz, in a reference bandwidth of 100kHz or 1MHz, for carriers below or above 1GHz, respectively.

Intermodulation Product Spurious Emissions
The procedure used was ANSI/TIA-603-C: 2004 and KDB 971168 D03. Three tones (modulated) method was used. Two tones are close to each other on the one edge and the third one is alone on the other edge of the passband. The input power to the amplifier was set to 0.5dB below the AGC threshold level by combining the three tones. The intermodulation product emissions were measured in band and spurious emissions were measured out of band.

1.10 Operational Description

Dali Matrix™ is a modular, end-to-end digital RF distribution system.
Matrix is implemented in two tiers:
Modular Universal Base Station Interface Tray (UBiT) functioning as a headend

Modular digital remote units are for indoor and outdoor deployments. A single optical fiber interface, based on the CPRI protocol, is used to connect the *UBiT digital Host module* with a number of *hd30/37/43 remote* units, in a star, daisy-chain, or hybrid star/daisy-chain configuration. The *digital* remote units can be installed up to 20km away from the *UBiT headend*. Both *headend and remote units* contain a digital processing section and an RF processing section.
The UBit integrated headend typically interface RF signals with Base Stations via coaxial RF cables or digital baseband signal via optical fibers.
The remote unit hd30, which is the EUT in this test report is a quad band unit with 1 W average output power per band. Bands supported and scope of the requested license is as follows:

- Lower and Upper 700 MHz Band: 27.5(c), 27.50(c), 27.53(c,g)

- Cellular Band: 22.905, 22.913, 22.917
- AWS-1 Band: 27.5(h), 27.50(d), 27.53(h)
- Broadband PCS Band: 24.229, 24.232, 24.238

The band set that particular remote unit support is determined by the type of module that is installed in the unit, each containing frequency of operation limiting RF band-pass filters and band set specific multiplexer (please refer to Spectral management section).
It is marketed for commercial cellular applications. All band support broadband 2G, 3G, and 4G waveforms.
To maintain declared output power, and to prevent Power Amplifier (PA) to go into saturation condition, Automated Level Control (ALC) circuitry is implemented inside power amplifier section. The ALC circuitry monitors PA output power via built in average power detector, and if detected output power level is above threshold (set during manufacturing process), introduces attenuation in a PA lineup (PA gain reduction) that is equivalent to power difference between detected power and threshold power, hence maintains output power at level equal to ALC threshold level. The ALC attenuation range is from 0 dB to 30 dB. The ALC threshold level is set 1 dB above the declared maximum average output power, thus to +31 dBm in a case of the *hd30* remote unit.

1.11 Measurement Configuration

Table 1 Test Signal Applied

Modulation	# Carriers	BW/Carrier	Notation	Apply to Test
GSM	1	200kHz	GSM-1C	OBW, Pout, Out of Block Emission
GSM	2	200kHz	GSM-2C	Out of Block Emission
GSM	3	200kHz	GSM-3C	Spurious Emission
GSM	3	200kHz	GSM-3TIM	Intermodulation
LTE	1	5MHz	LTE-1C	OBW, Pout, Out of Block Emission
LTE	2	5MHz	LTE-2C	Out of Block Emission
LTE	3	5MHz	LTE-3C	Spurious Emission
LTE	3	5MHz	LTE-3TIM	Intermodulation

Table 2 700 MHz DL Measurement Matrix

Notation	Frequency (MHz)
GSM-1C	728.2, 742.5, 756.8
GSM-2C	728.2 and 728.4, or 756.6 and 756.8 [a]
GSM-3C	728.2, 742.5, 756.8
GSM-3TIM	728.2, 728.8, 756.8 [b]
LTE-1C	730.5, 742.5, 754.5
LTE-2C	730.5 and 735.5, or 749.5 and 754.5 [a]
LTE-3C	730.5, 742.5, 754.5

LTE-3TIM	730.5, 735.5, 754.5 [b]
	a. 2 carriers on band edges b. 2 carriers on the one edge 600kHz apart, the third on the other edge

Table 3 850 MHz DL Measurement Matrix

Notation	Frequency (MHz)
GSM-1C	869.2, 881.5, 893.8
GSM-2C	869.2 and 869.4, or 893.6 and 893.8 [a]
GSM-3C	869.2, 881.5, 893.8
GSM-3TIM	869.2, 869.8, 893.8 [b]
LTE-1C	871.5, 881.5, 891.5
LTE-2C	871.5 and 876.5, or 886.5 and 891.5 [a]
LTE-3C	871.5, 881.5, 891.5
LTE-3TIM	871.5, 876.5, 891.5 [b]
	a. 2 carriers on band edges b. 2 carriers on the one edge 600kHz apart, the third on the other edge

Table 4 PCS DL Measurement Matrix

Notation	Frequency (MHz)
GSM-1C	1930.2, 1962.5, 1994.8
GSM-2C	1930.2 and 1930.4, or 1994.6 and 1994.8 [a]
GSM-3C	1930.2, 1962.5, 1994.8
GSM-3TIM	1930.2, 1931.4, 1991.6 [b]
LTE-1C	1932.5, 1962.5, 1992.5
LTE-2C	1932.5 and 1937.5, or 1987.5 1992.5 [a]
LTE-3C	1932.5, 1962.5, 1992.5
LTE-3TIM	1932.5, 1937.5, 1992.5 [b]
	a. 2 carriers on band edges b. 2 carriers on the one edge 1.2MHz apart, the third on the other edge

Table 5 AWS DL Measurement Matrix

Notation	Frequency (MHz)
GSM-1C	2110.2, 2132.5, 2154.8
GSM-2C	2110.2 and 2110.4, or 2154.6 and 2154.8 [a]
GSM-3C	2110.2, 2132.5, 2154.8
GSM-3TIM	2110.2, 2111.4, 2154.8 [b]
LTE-1C	2112.5, 2132.5, 2152.5
LTE-2C	2112.5 and 2117.5, or 2147.5 and 2152.5 [a]
LTE-3C	2112.5, 2132.5, 2152.5

LTE-3TIM	2112.5, 2117.5, 2152.5 [b]
	a. 2 carriers on band edges b. 2 carriers on the one edge 1.2MHz apart, the third on the other edge

2 AGC Threshold Level

2.1 Methodology

Measurements were performed at narrow band single carrier for the center frequency within the 700 MHz (728 – 757 MHz), 850 MHz (869 – 894 MHz), PCS (1930-1995 MHz) and AWS (2110-2155 MHz) band.

Tabular data is shown in section 2.3 for the all bands. The AGC threshold level is to provide the instruction of input signal amplitude for the emission in conducted measurement address in this report.

The AGC threshold was determined following test method defined in FCC KDB 935210 D05 (Feb 2016) Section 3.2.

2.2 Interpretation

The equipment under test (EUT) is featured automatic level control (ALC), which electronically adjusts the output power not exceed a certain maximum level. In order to align with the measurement guidance, the AGC threshold is used throughout the report, representing the ALC trip point (input power).
At amplitude above the AGC threshold, an increase of 1dB in the input power will no longer cause a 1dB increase in the output signal power.

2.3 Results

Table 6 AGC Threshold Levels

Band	Frequency (MHz)	Modulation	AGC Threshold (dBm)	Max Output Power (dBm)
700	742.5	GSM	-8.5	30.2
850	881.5	GSM	-6.0	30.4
PCS	1962.5	GSM	-7	29.9
AWS	2132.5	GSM	-7	30.4

3 Out-of-band Rejection

3.1 Methodology

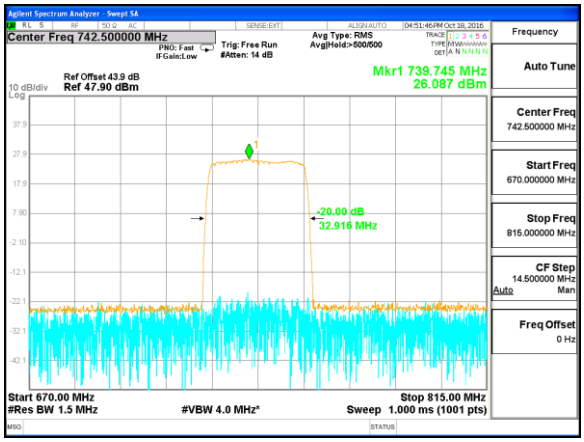
Measurements were performed at CW signal sweep in a frequency range of 5 times the operating bandwidth centered at the operating band. The operating bands are 700 MHz (728 – 757 sMHz), 850 MHz (869 – 894 MHz), PCS (1930-1995 MHz) and AWS (2110-2155 MHz) on the downlink – transmitting direction - where the air interface exists.

The measurement procedure follows the KDB 935210 D05 Section 3.3. The input power level was set 5dB lower than the AGC threshold level, so that no output suppression occurred in any of the EUT bands. 20dB down bandwidth was measured compared to the peak power in-band. The peak power frequency was recorded and would be used to check the EUT output power.

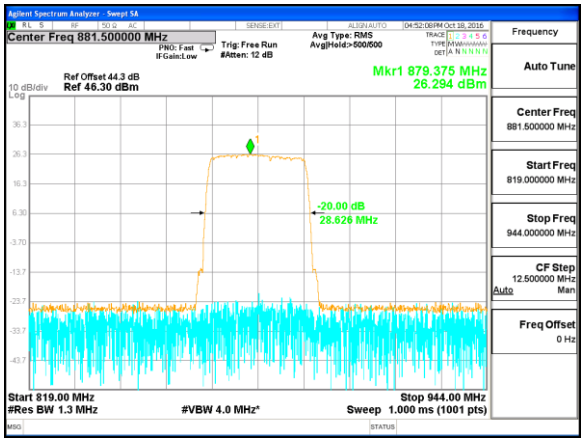
3.2 Results – Frequency Responses

Figure 3-1 Frequency Response of EUT

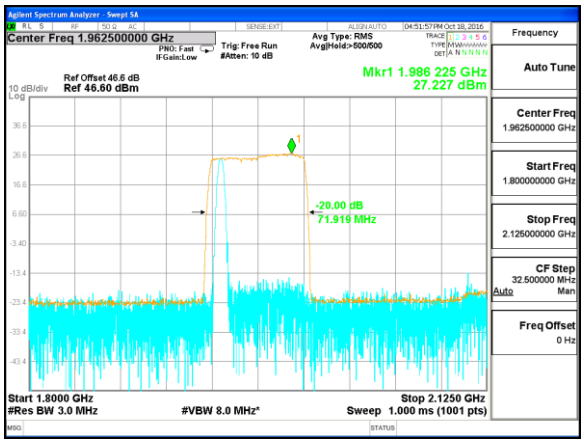
Band 700



Band 850



Band PCS



Band AWS

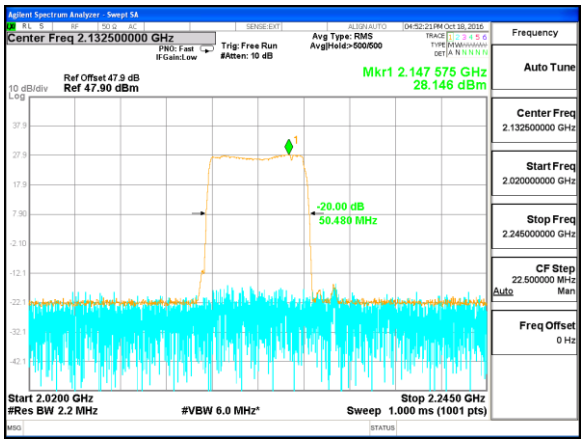


Table 7 AGC Threshold Levels

Band	Operating Bandwidth (MHz)	Modulation	20dB Passband (MHz)	Peak Frequency (MHz)
700	29	CW	32.916	739.745
850	25	CW	28.625	879.375
PCS	65	CW	71.919	1986.225
AWS	45	CW	50.48	2147.575

4 Input-versus-output Signal Comparison

4.1 Methodology

Measurements were performed at narrow band and wide band signal for the mid frequency within the 700 MHz (730 – 755 MHz), 850 MHz (871 – 892 MHz), PCS (1930-1995 MHz) and AWS (2100-2155 MHz) band. Measurement method was following KDB 935210 D05 Section 3.4.

Occupied bandwidth (OBW) of input and output signal is shown in Figure 4-1 and Figure 4-2 side by side for the four operating bands. The output OBW was tested under two input conditions:

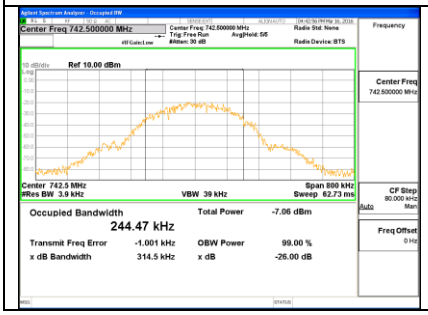
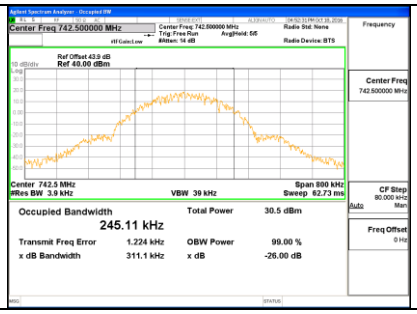
- Nominal: with input 0.5dB below AGC threshold
- AGC: with input 3dB above AGC threshold

A brief summary of applicable FCC specifications is listed in the table below.

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

4.2 Results – Occupied Bandwidth

Figure 4-1 Screen Captures of OBW Measurement – Input and Output Narrow Band Signal

Input Signal	Output Signal – Nominal	Output Signal - AGC
Band 700		
		

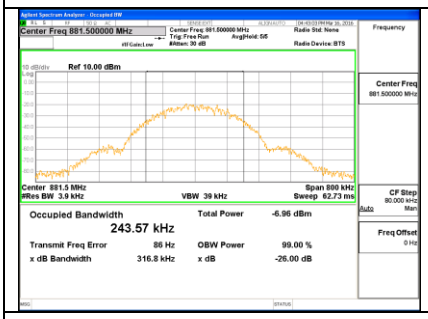
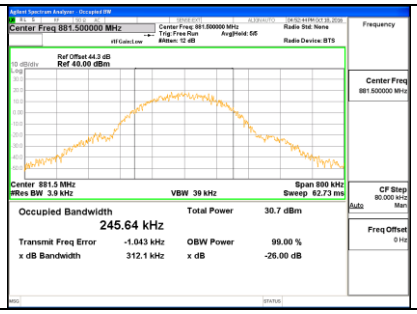
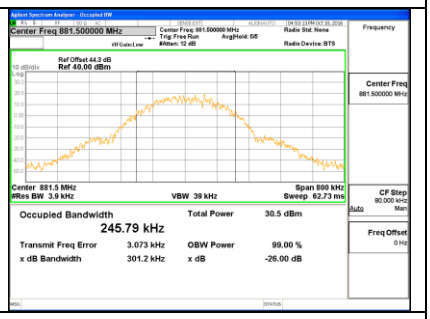
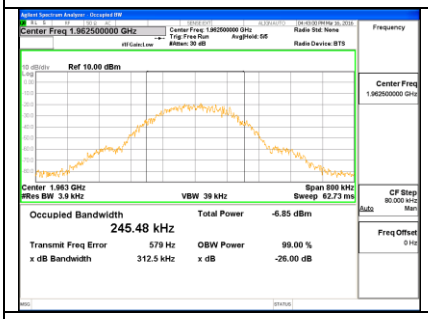
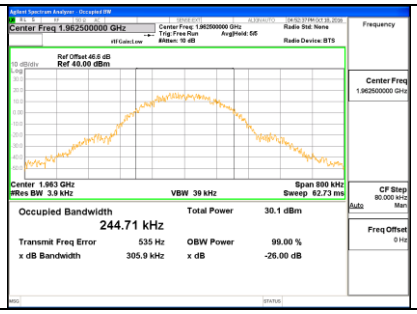
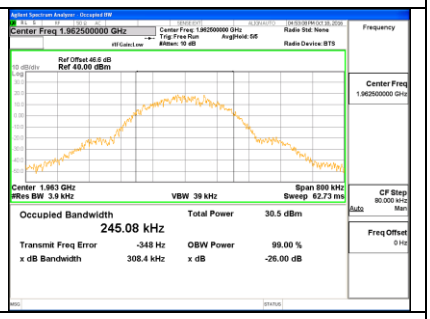
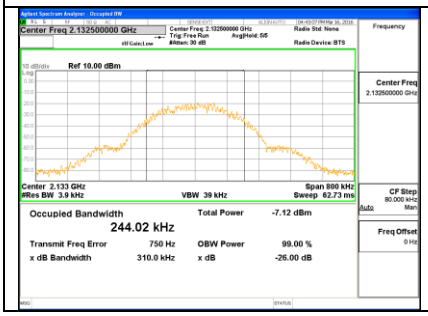
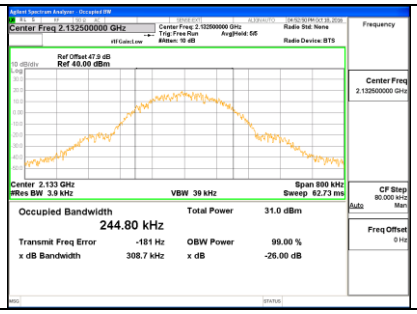
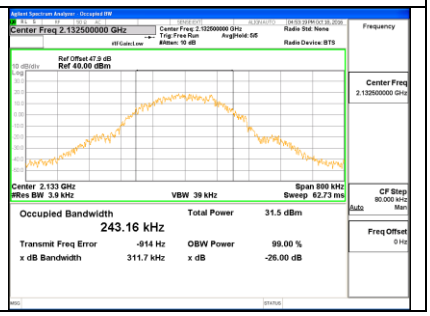
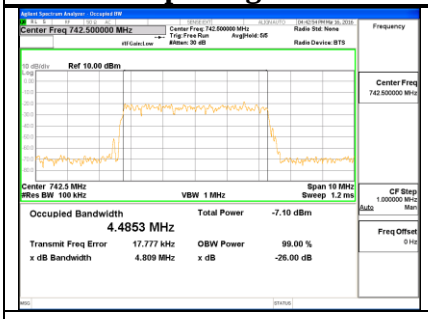
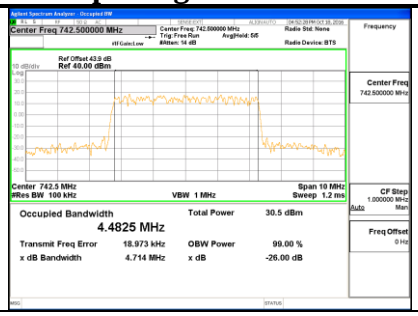
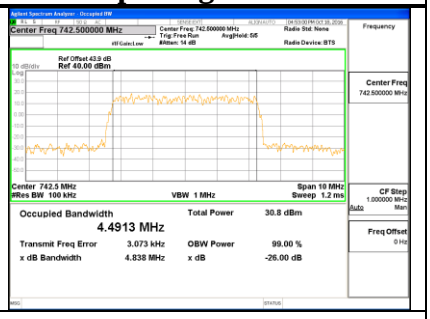
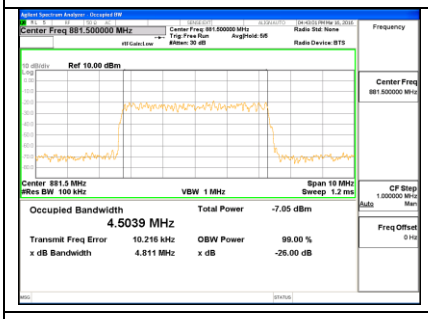
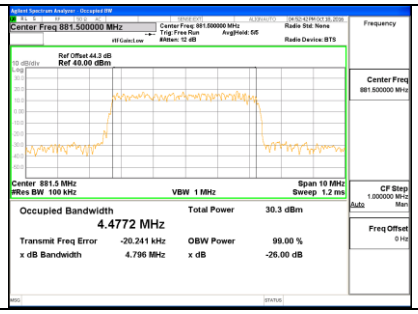
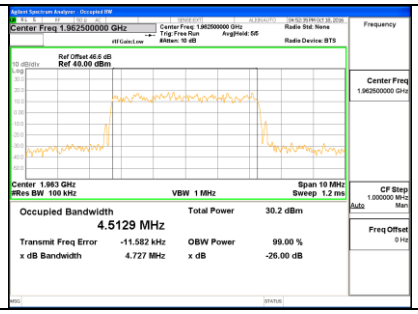
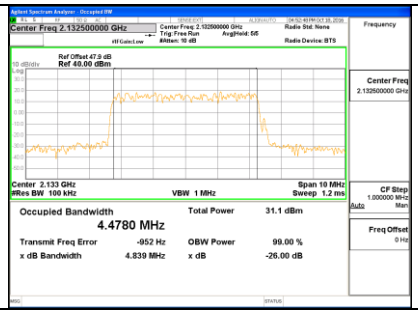
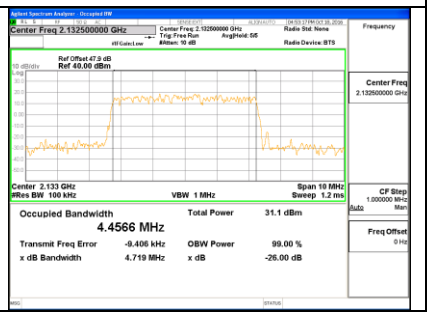
Input Signal	Output Signal – Nominal	Output Signal - AGC
Band 850		
		
Band PCS		
		
Band AWS		
		

Figure 4-2 Screen Captures of OBW Measurement – Input and Output Wide Band Signal

Input Signal	Output Signal – Nominal	Output Signal - AGC
Band 700		

Input Signal	Output Signal – Nominal	Output Signal - AGC
		
Band 850		
		
Band PCS		
		
Band AWS		
		

Conclusion**:**

There is no change of the OBW comparing input and output signal. There is also no change of the OBW in the output signal when the EUT is working under AGC active or inactive status.

The maximum deterioration observed is less than 1% of the input signal.

5 Output Power

5.1 Methodology

Measurements were performed at narrow band and wide band signal for the peak output power within the 700 MHz (728 – 757 MHz), 850 MHz (869 – 894 MHz), PCS (1930-1995 MHz) and AWS (2110-2155 MHz) band. Measurement method was following KDB 935210 D05 Section 3.4 and KDB 971168 D01 Section 5.2.1.

Average output power is shown in the Figure 5-1and Figure 5-2 for the four operating bands. The output power was tested under two input conditions:

- Nominal: with input 0.5dB below AGC threshold
- AGC: with input 3dB above AGC threshold

A brief summary of applicable FCC specifications is listed in the table below.

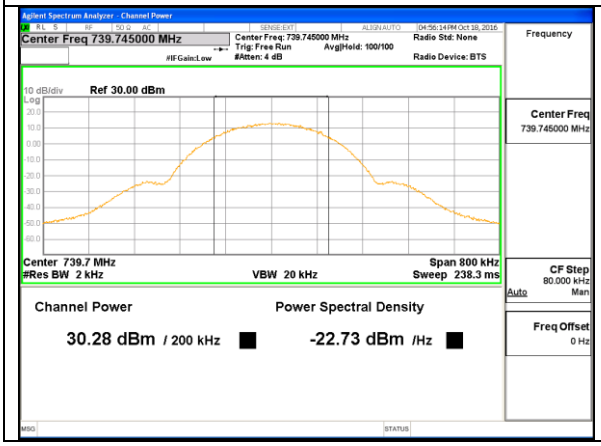
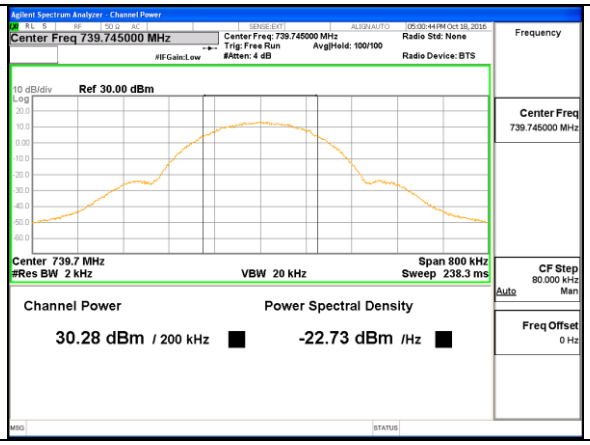
2.1046 Measurements required: RF power output. (a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values 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.

5.2 Interpretation

The peak output power was allocated in the previous out-of-band rejection test. In the case that a full channel cannot accommodate in-band by setting the carrier frequency to the exact peak frequency, the test carrier location was moved inward to the first applicable channel.

5.3 Results

Figure 5-1 Screen Captures of Power Measurement – Narrow Band Signal

Output Signal – Nominal	Output Signal - AGC
Band 700	
	

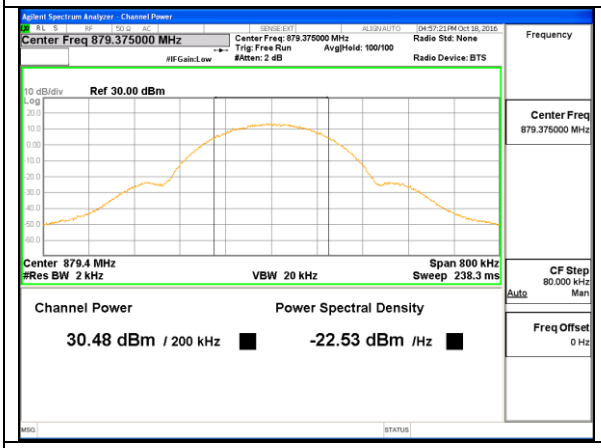
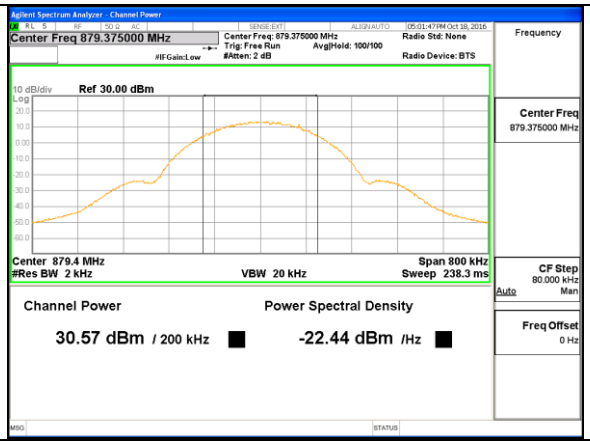
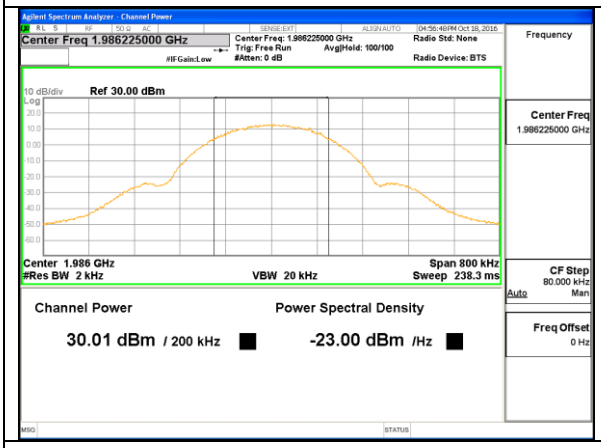
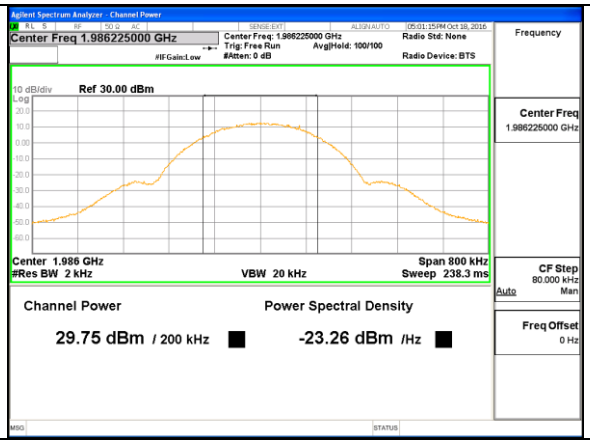
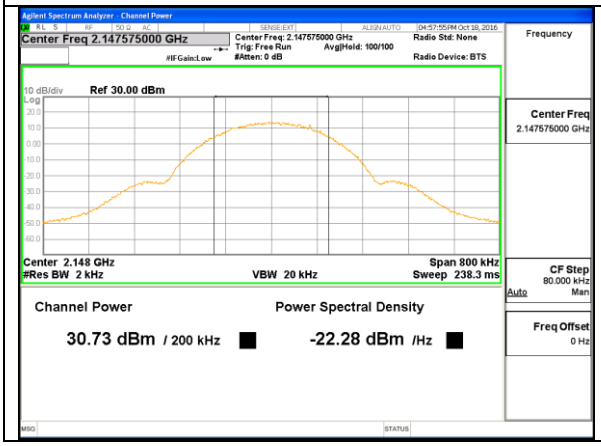
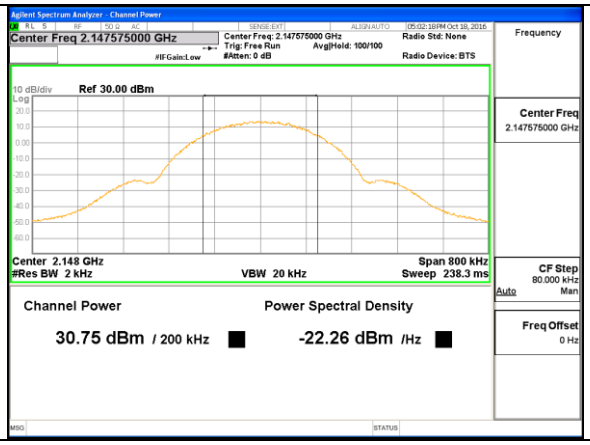
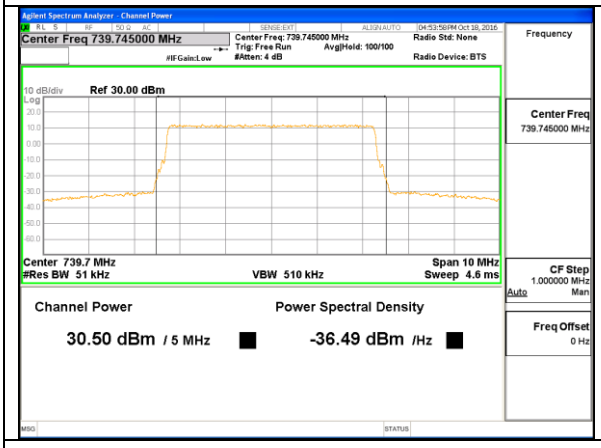
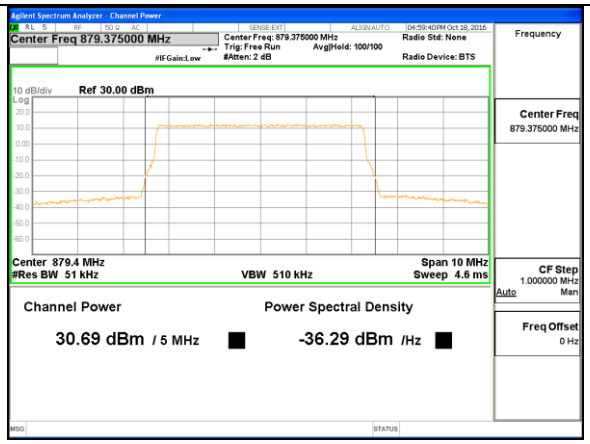
Output Signal – Nominal	Output Signal - AGC
Band 850	
	
Band PCS	
	
Band AWS	
	

Figure 5-2 Screen Captures of Power Measurement – Wide Band Signal

Output Signal - Nominal	Output Signal - AGC
Band 700	
	
Band 850	
	
Band PCS	

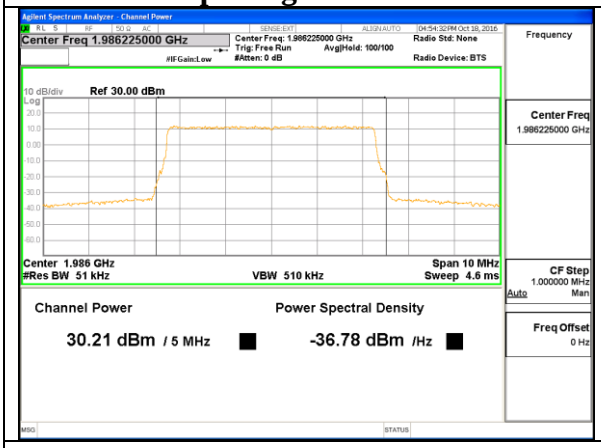
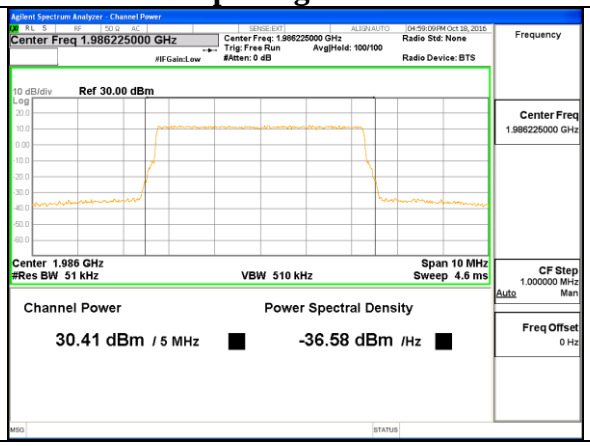
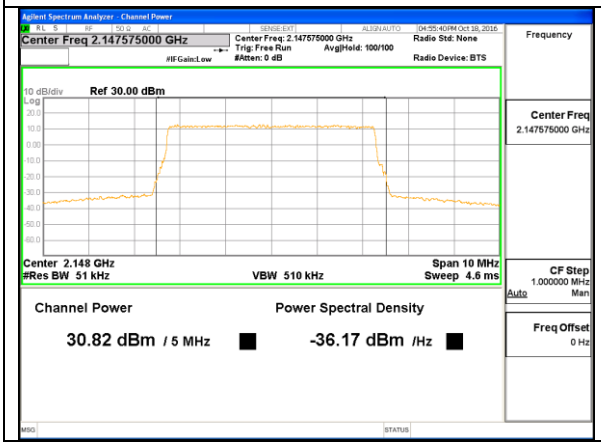
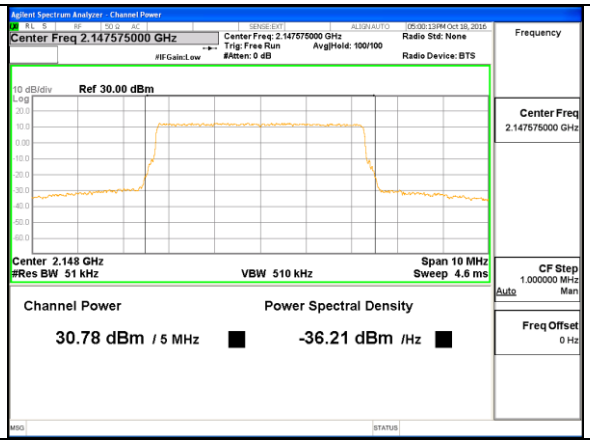
Output Signal - Nominal	Output Signal - AGC
	
Band AWS	
	

Table 8 EUT Maximum Output Power

	Narrow Band Signal Pout (dBm)		Wide Band Signal Pout (dBm)	
	Nominal	**AGC**	**Nominal**	**AGC**
Band 700	30.28	30.28	30.5	30.52
Band 850	30.48	30.57	30.7	30.69
Band PCS	30.01	29.75	30.21	30.41
Band AWS	30.73	30.75	30.82	30.78

Conclusion:

The maximum output power occurred on band AWS. The maximum output level was 30.8 dBm.

Due to the AGC feature, the output power with input 0.5 dB below and 3 dB above AGC threshold produced output power differencing less than 0.5dB, with narrow band or wide band signal.

6 Emission at Antenna Terminal

6.1 Methodology

All test conditions and measurement procedures were performed in accordance with FCC CFR47 part 2 subpart J Clause 2.1051. Detailed measurement method was following KDB 935210 D05 Section 3.6.

A brief summary of the applicable FCC specifications are listed in the table below.

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.

2.1057 Frequency spectrum to be investigated.
(a) In all of the measurements set forth in §§ 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:
(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

27.53 Emission limits.
(c) (1) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:
On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB
(g)For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.
(h) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 $\log_{10}$ (P) dB.
(1) 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.

22.917 Emission limits.
(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

24.238 Emission limitations for Broadband PCS equipment.
(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

The limit is = -13 dBm.

6.2 Out-of-band Emission

6.2.1 Measurement Configuration

Measurements were performed at narrow band and wide band signal at the lower and upper edge within the 700 MHz (728 – 757 MHz), 850 MHz (869 – 894 MHz), PCS (1930-1995 MHz) and AWS (2110-2155 MHz) band.

Tests were repeated for single carrier and adjacent dual carriers, as defined in 3GPP, on first and last channel in the operating bands.

For each type of signal applied, tests were again repeated under two input conditions:

- Nominal: with input 0.5dB below AGC threshold
- AGC: with input 3dB above AGC threshold

The out-of-band emission was measured within specified frequency range at the edge of the authorized frequency band, 300kHz range for the frequency band below 1GHz and 3MHz range for the one above 1GHz. Normally the reference band width (RBW) in spurious emission measurement was specified to 100kHz for the frequency range below 1GHz and 1MHz for the frequency range above 1GHz. A relaxation of RBW is allowed to be applied to out-of-band emission measurement.

KDB 971168 D01 page14:
This is often implemented by permitting the use of a narrower RBW (typically limited to a minimum RBW of 1% of the OBW) for measuring the out-of-band emissions without a requirement to integrate the result over the full reference bandwidth. Beyond the specified frequency range in which this relaxation is permitted, it is also typically acceptable to use a narrower RBW (again limited to a minimum of 1% of OBW) in order to increase accuracy, but the measurement result must subsequently be integrated over the full reference bandwidth.

6.2.2 Results

The immediate out-of-band emission measurement is shown in the Figure 6-1, Figure 6-2, Figure 6-3 and Figure 6-4 for the four operating bands.

Conclusion:
The peak out-of-band emission caused by any of the following combination – narrow band signal vs wide band signal, single carrier vs dual carriers, and nominal input vs input above AGC threshold - is below -13dBm limit.

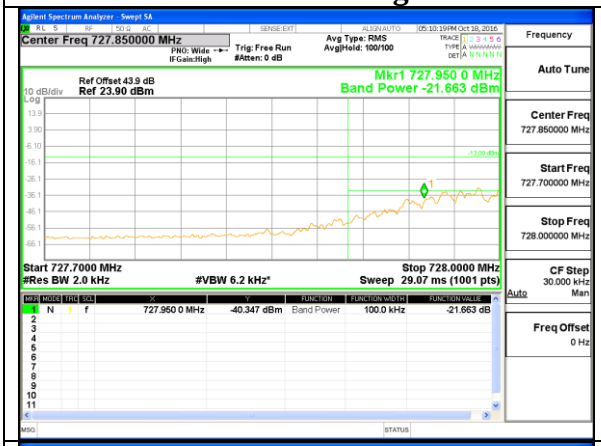
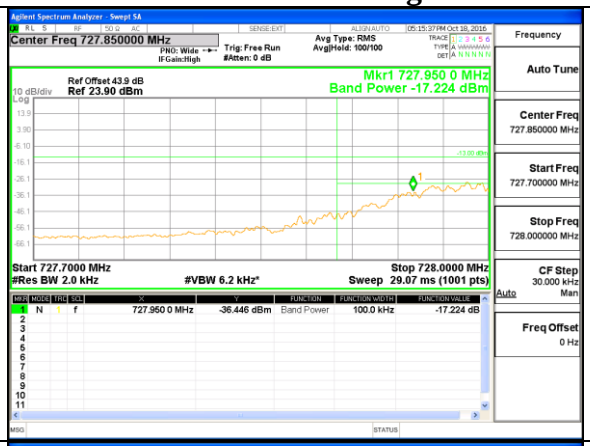
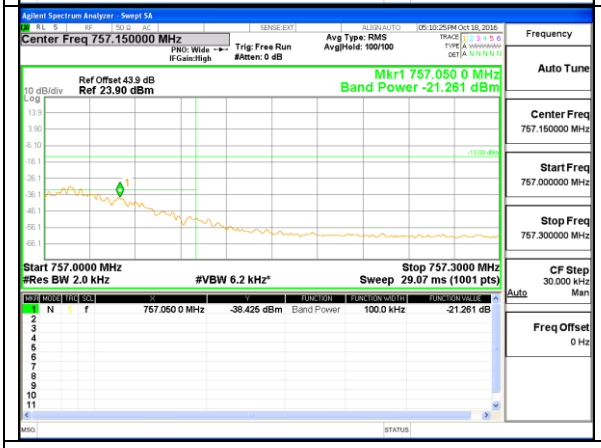
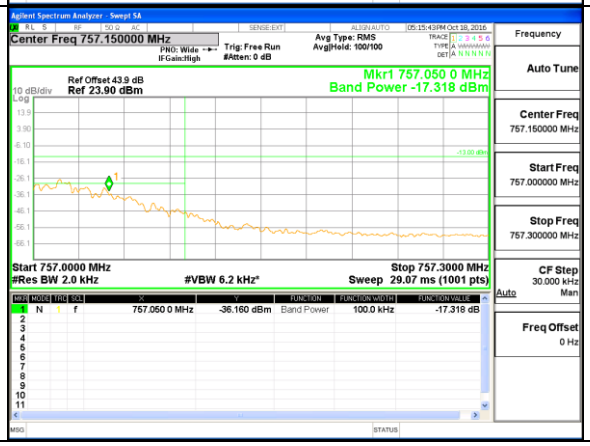
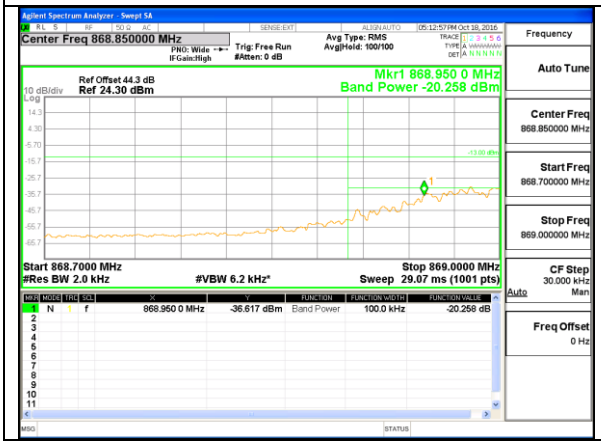
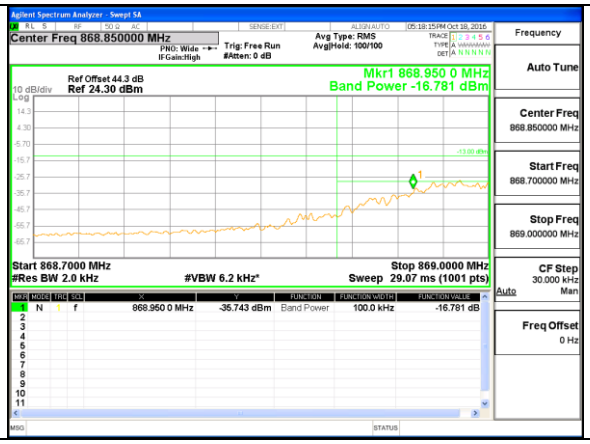
The narrow band signal is allocated more close to the band edge than the wide band signal, in terms of absolute guard band due to OBW is less than the 3GPP authorized channel bandwidth. Hence the emission caused by narrow band signal is higher than wide band signal.

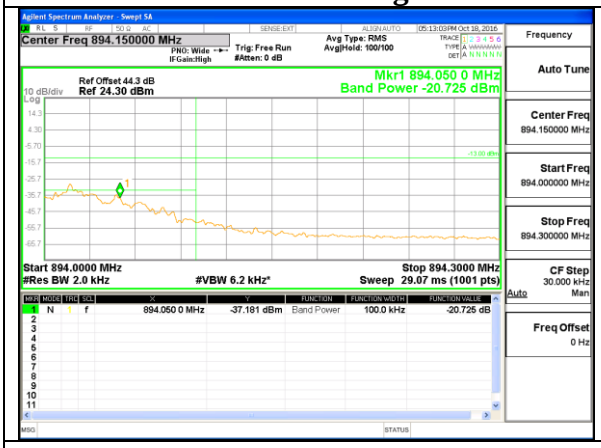
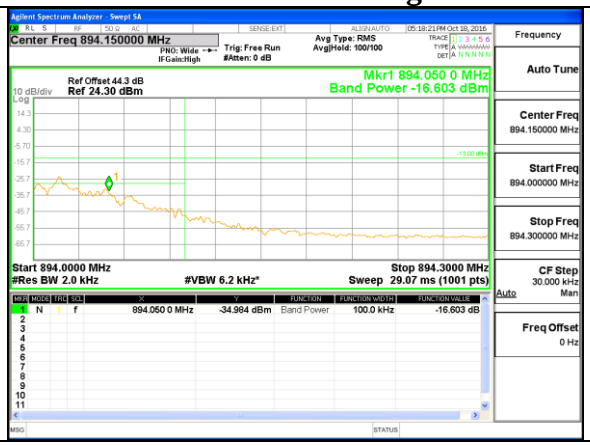
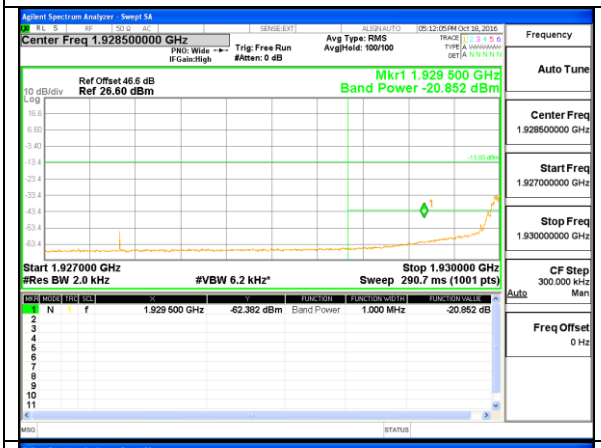
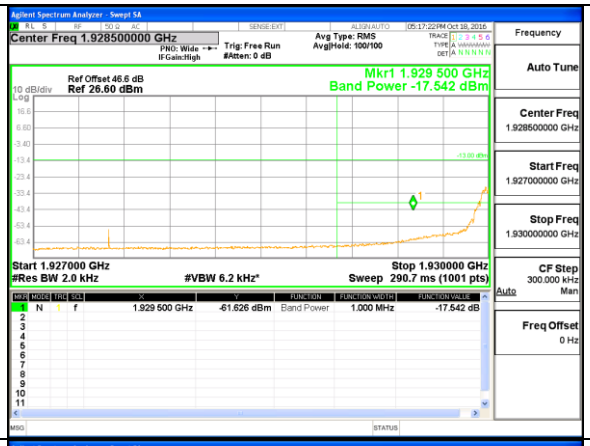
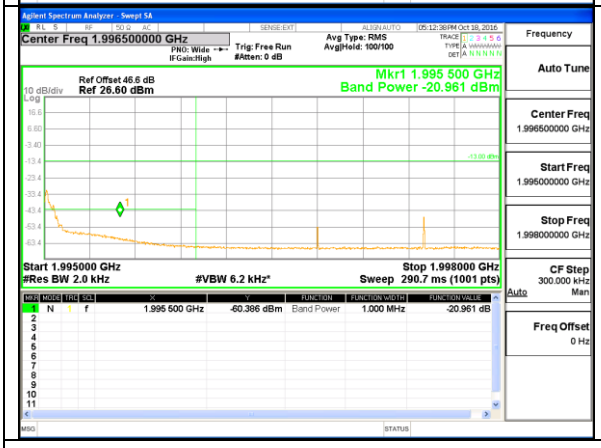
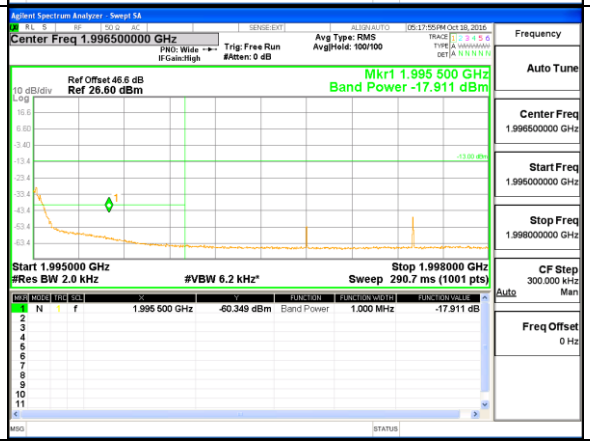
The band isolation of EUT in the frequency range farther than 1MHz from the band edge plays the main role of suppressing the emission. Hence the intermodulation product of dual-carrier wide band signal shows the lowest emission.

With the input power level above the AGC threshold, higher level emission was observed on narrow band signal compared to no AGC triggered. It worsened the emission by less than 4dB, but still lower than -13dBm limit.

Figure 6-1 Out-of-band Emission in 300kHz or 3GHz Range – 1 Carrier Narrow Band Signal Applied on First or Last Channel in the Appropriate Operating Band

1 Carrier Narrow Band Signal - Nominal	1 Carrier Narrow Band Signal - AGC
Band 700	

1 Carrier Narrow Band Signal - Nominal	1 Carrier Narrow Band Signal - AGC
	
	
Band 850	
	

1 Carrier Narrow Band Signal - Nominal	1 Carrier Narrow Band Signal - AGC
	
Band PCS	
	
	
Band AWS	

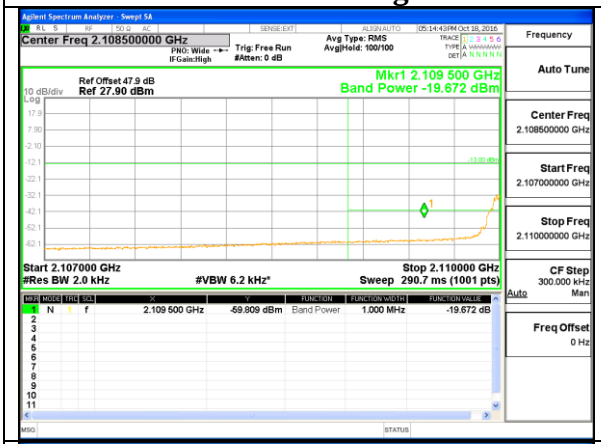
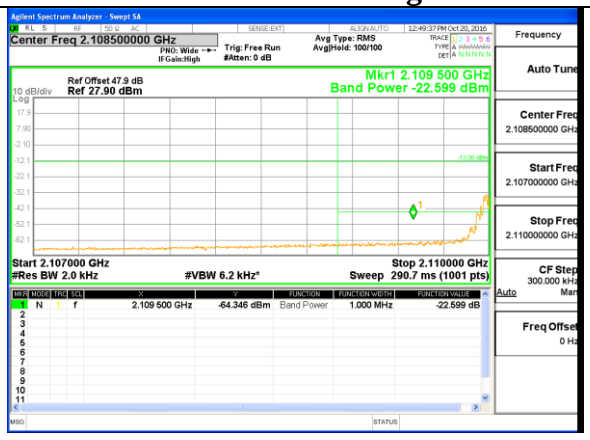
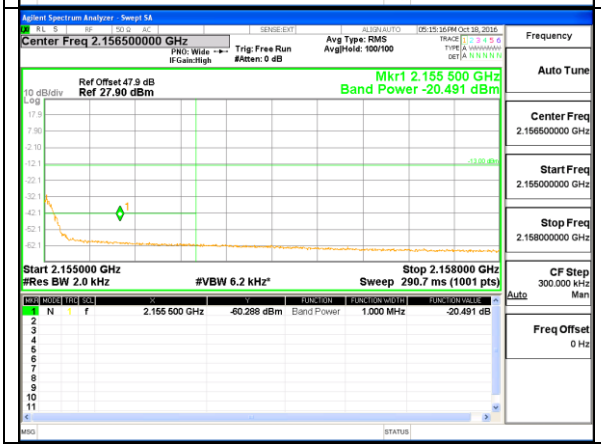
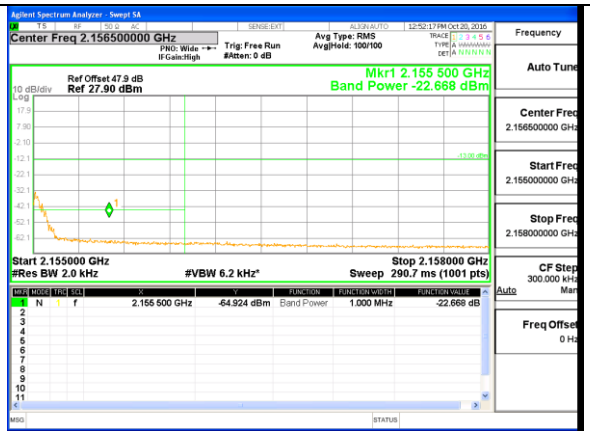
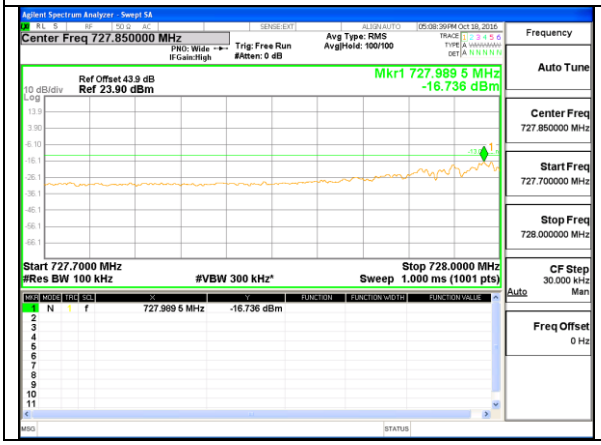
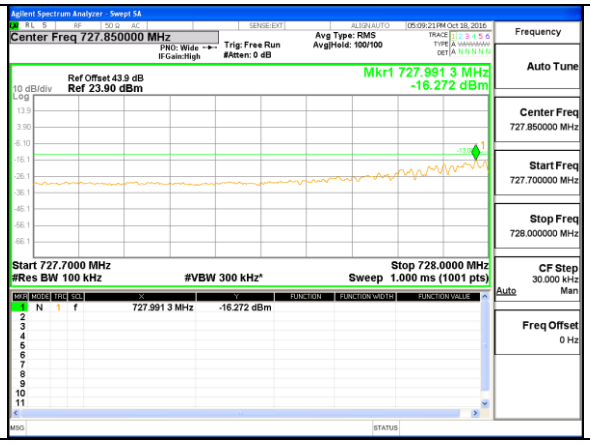
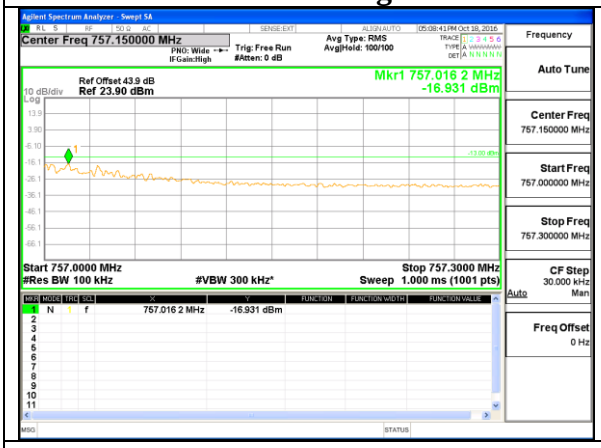
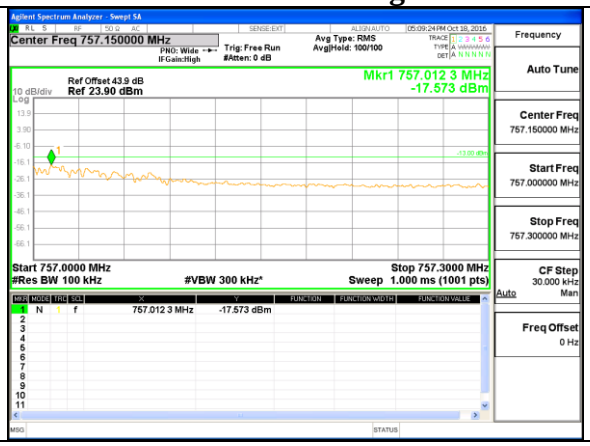
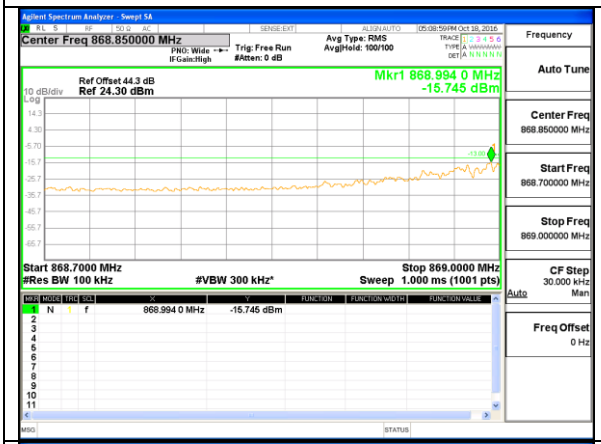
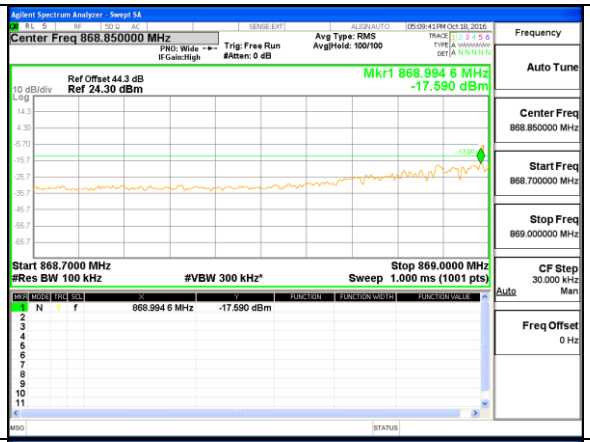
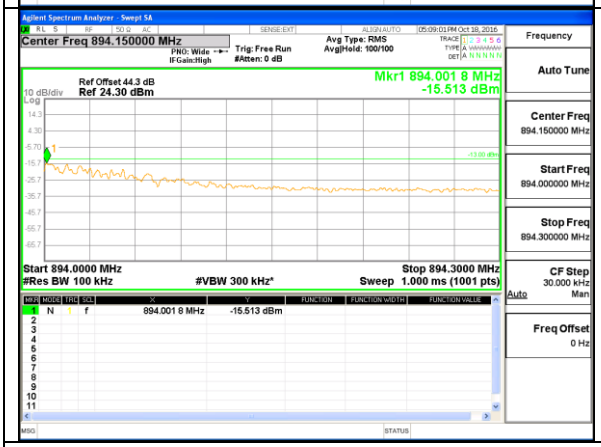
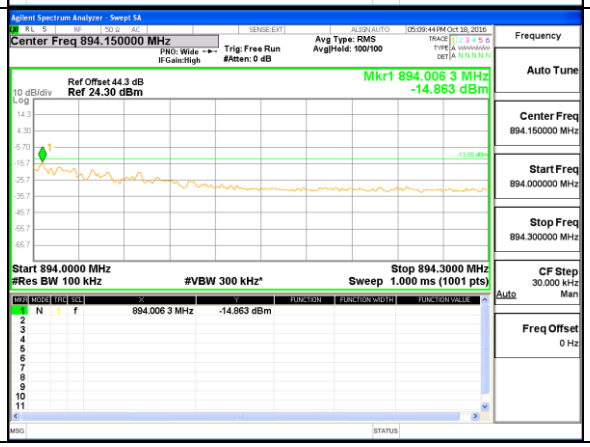
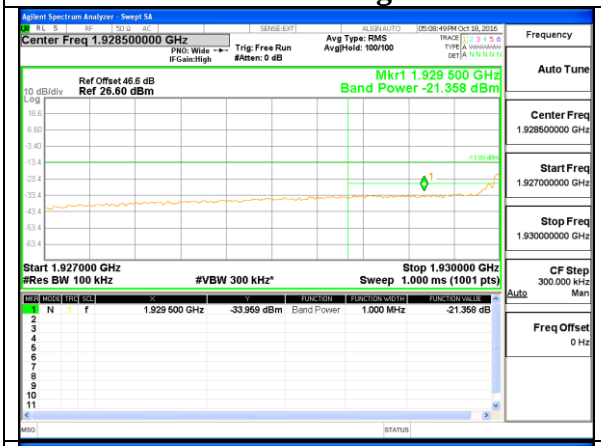
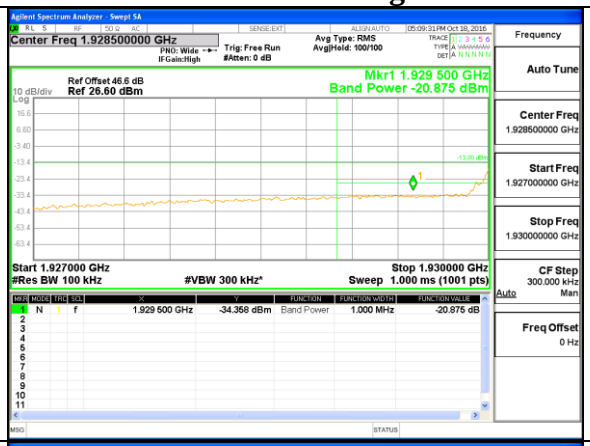
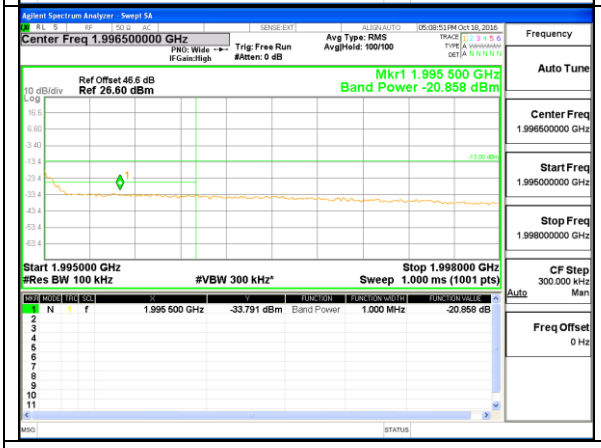
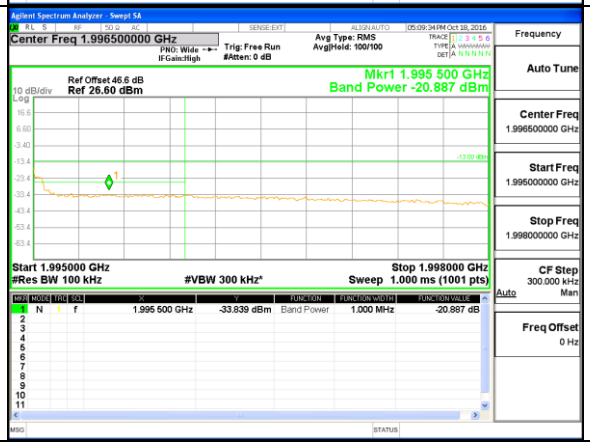
1 Carrier Narrow Band Signal - Nominal	1 Carrier Narrow Band Signal - AGC
	
	

Figure 6-2 Out-of-band Emission in 300kHz or 3GHz Range – 1 Carrier Wide Band Signal Applied on First or Last Channel in the Appropriate Operating Band

1 Carrier Wide Band Signal - Nominal	1 Carrier Wide Band Signal - AGC
Band 700	
	

1 Carrier Wide Band Signal - Nominal	1 Carrier Wide Band Signal - AGC
	
Band 850	
	
	
Band PCS	

1 Carrier Wide Band Signal - Nominal	1 Carrier Wide Band Signal - AGC
	
	
Band AWS