

PCTEST ENGINEERING LABORATORY, INC.

7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. 410.290.6652 / Fax 410.290.6654 http://www.pctest.com



#### MEASUREMENT REPORT FCC Part 30 5G mmWave

#### **Applicant Name:**

Pivotal Commware 10801 120th Ave NE #200, Kirkland, WA 98033 United States

#### Date of Testing: 10/7/2019-11/27/2019 Test Site/Location: PCTEST Lab. Columbia, MD, USA Test Report Serial No.: 1M1909170154-01-R1.2AUVU

# FCC ID:

APPLICANT:

## 2AUVU-OES3

**Pivotal Commware** 

Application Type:CertificationModel:OES3EUT Type:5G mmWave RepeaterFCC Classification:Part 30 Transportable Transmitter (5GT)FCC Rule Part(s):2, 30Test Procedure(s):ANSI C63.26-2015, KDB 842590 D01 v01, KDB 662911 D01 v02r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

This revised Test Report (S/N: 1M1909170154-01-R1.2AUVU) supersedes and replaces the previously issued test report (S/N: 1M1909170154-01-R1.2AUVU) on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.





FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	PIVOTAL"	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 1 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Fage 1 01 94
© 2010 PCTEST Engineering Labora	ton/ Inc			V/1.0



## TABLE OF CONTENTS

1.0	INTR	RODUCTION	4				
	1.1	Scope	4				
	1.2	PCTEST Test Location	4				
	1.3	Test Facility / Accreditations	4				
2.0	PRO	DUCT INFORMATION	5				
	2.1	Equipment Description	5				
	2.2	Device Capabilities	5				
	2.3	Test Configuration	5				
	2.4	EMI Suppression Device(s)/Modifications	5				
3.0	DESC	CRIPTION OF TESTS					
	3.1	Measurement Procedure	6				
	3.2	Radiated Power and Radiated Spurious Emissions	6				
4.0	MEAS	SUREMENT UNCERTAINTY	8				
5.0	TEST	T FOLIIPMENT CALIBRATION DATA	9				
6.0	CVW		10				
0.0			10				
7.0	1551	I RESULIS					
	7.1	Summary					
	7.2						
		7.2.1 HBF ANTENNA OCCUPIED BANDWIDTH					
	73						
	7.5		20				
		7.3.2 PATCH CONDUCTED POWER					
	7.4	Equivalent Isotropic Radiated Power					
		7.4.1 HBF EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)	35				
		7.4.2 PATCH EQUIVALENT ISOTROPIC RADIATED POWER (EIRP)	37				
	7.5	Radiated Spurious and Harmonic Emissions					
		7.5.1 HBF ANTENNA RADIATED SPURIOUS EMISSIONS	40				
		7.5.2 PATCH ANTENNA RADIATED SPURIOUS EMISSIONS	62				
	7.6	Band Edge Emissions					
		7.6.1 HBF ANTENNA BAND EDGE	85				
		7.6.2 PATCH ANTENNA BAND EDGE	87				
	7.7	Frequency Stability / Temperature Variation					
8.0	CON	ICLUSION	92				
9.0	APPE	ENDIX A	93				
	9.1	VDI Mixer Verification Certificate					

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 2 01 94
© 2019 PCTEST Engineering Laboratory, Inc. V1.0				





## MEASUREMENT REPORT FCC Part 30



**HBF** Antenna Overview (MIMO)

Band	FCC Rule Part	Bandwidth (MHz)	Frequency [MHz]	Antenna Pol	Modulation	SISO EIRP [dBm]	SISO EIRP [W]	MIMO EIRP [dBm]	MIMO EIRP [W]	Emission Designator
n261	30	100	27500-28350	Н	ODCK	29.48	0.89	32.46	1 76	
11201	30	100	27500-28350	V	QFSK	29.47	0.89	52.40	1.70	941014070
n261	30	100	27500-28350	Н	0014	29.46	0.88	22.22	1 67	
11201	30	100	27500-28350	V	QAIVI	29.43	0.88	52.22	1.07	941013 00 7 D
<b>n</b> 261	30	400	27500-28350	Н	ODEK	28.31	0.68	20 72	1 10	27714670
11201	30	400	27500-28350	V	QPSK	27.54	0.57	50.72	1.10	377101070
n261	30	400	27500-28350	Н	OAM	28.03	0.64	20.94	1 21	
11201	30	400	27500-28350	V	QAIVI	28.02	0.63	30.84	1.21	3771VIV7D

Patch Antenna Overview (MIMO)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	COMMWARE	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 2 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 3 01 94
© 2019 PCTEST Engineering Laboration	tory. Inc.			V1.0



## **1.0 INTRODUCTION**

#### 1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

## 1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

#### 1.3 Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).
- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 4 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 4 01 94
© 2010 PCTEST Engineering Laborat	tory Inc		V/1.0



## 2.0 PRODUCT INFORMATION

#### 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Pivotal Commware 5G mmWave Repeater FCC ID: 2AUVU-OES3**. The test data contained in this report pertains only to the emissions due to the EUT's 5G mmWave function.

The EUT has 2 antenna configurations. Both antenna configurations are comprised to two separate antenna fees – one for horizontal and one fore the vertical polarization. Of the two antennas, one is a patch antenna, and the other a Holographic Beam Forming (HBF) antenna.

The EUT supports any combination of bandwidths, number of carriers, and modulations as input signals. It will transmit all signals within the 5G n261 band that are received.

Test Device Serial No.: 00013, 00015, 0010

#### 2.2 Device Capabilities

This device contains the following capabilities:

5G FR2 (mmWave), WIFI, BT, BTLE, LTE

#### 2.3 Test Configuration

The EUT was tested per the guidance of ANSI C63.26-2015. See Section 7.0 of this test report for a description of the radiated tests.

EIRP Simulation data for all Beam IDs was used to determine the worst case Beam ID for SISO operation and Beam ID pair for MIMO operation. These Beam ID's were used for final measurements.

All testing was performed using a signal generator connected to the input port of the EUT via waveguide adapters. The signal generator was set to transmit a simulated a 5G mmWave NR signal in various sized bandwidth and modulations.

#### 2.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage E of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 5 01 94
© 2010 PCTEST Engineering Laboratory Inc.				\/1.0



## 3.0 DESCRIPTION OF TESTS

#### 3.1 Measurement Procedure

The measurement procedures described in the document titled "American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services" (ANSI C63.26-2015) was used in the measurement of the EUT. KDB 842590 D01 v01 was referenced for testing the EUT as well.

#### 3.2 Radiated Power and Radiated Spurious Emissions §30.202, §30.203

The radiated test facilities consisted of an indoor 3 meter anechoic chamber used for final measurements and exploratory measurements, when necessary for radiated emissions measurements in the spurious domain. The test site conforms to the site validation requirements of CISPR 16-1-4. The measurement area is contained within the anechoic chamber which is shielded from any ambient interference. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane.

A positioner was used to manipulate the EUT through several positions in space by rotating about the roll axis as shown in the figure below. The positioner was mounted on top of a turntable bringing the total EUT height to 1.5m.



Figure 3-1. Rotation of the EUT Through Three Orthogonal Planes

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Daga 6 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 6 01 94
© 2019 PCTEST Engineering Laboration	tory, Inc.		V1.0



The equipment under test was transmitting while connected to its patch or HBF antenna and is placed on a positioner. The measurement antenna is in the far field of the EUT per formula  $2D^2/\lambda$  where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT. For radiated power and radiated spurious emission measurements, "D" is the largest dimension of the measurement antenna per KDB 842590 D01. The EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

Radiated power levels are investigated while the receive antenna was rotated through all angles to determine the worst case polarization/positioning. It was determined that H=0 degree and V=90 degree are the worst case positions when the EUT was transmitting horizontally and vertically polarized beams, respectively.

The maximized power level is recorded using the spectrum analyzer's "Channel Power" function with the integration bandwidth set to the emissions' occupied bandwidth. The EIRP is calculated from the raw power level measured with the spectrum analyzer using the formulas shown below.

#### Effective Isotropic Radiated Power Sample Calculation

The measured e.i.r.p is converted to E-field in V/m. Then, the distance correction is applied before converting back to calculated e.i.r.p, as explained in KDB 971168 D01.

	= 17.24 dBm e.i.r.p.
	= 10*log((1.26V/m * 1.00m)^2/30) + 30dB
e.i.r.p. [dBm]	= 10 * log((E-Field*D <sub>m</sub> )^2/30) + 30dB
	= 10^(122.03/20)/1000000 = 1.26 V/m
	= - 34.06 dBm + (40.6dB/m + 8.49dB) + 107 = 122.03dBuV/m
Field Strength [dBµV/m]	= Measured Value [dBm] + AFCL [dB/m] + 107

#### Sample MIMO e.i.r.p. Calculation:

The e.i.r.p of the H Beam and V Beam were first measured individually. The measured values were then summed in linear power units then converted back to dBm per the guidance of KDB 662911 D01.

Conversion to linear value	= 10^(e.i.r.p/10) = 10^(17.24/10) = 52.97mW
MIMO e.i.r.p.	= e.i.r.p.H + e.i.r.p.V
	= 52.97mW + 43.15mW
	=10*log(96.12mW)
	= 19.83dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Daga Z of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 7 01 94	
© 2019 PCTEST Engineering Laboratory, Inc. V1.0				.0	



## 4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the  $U_{\text{CISPR}}$  measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 9 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 8 01 94
© 2019 PCTEST Engineering Laboration	V1.0			



## 5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to an accredited ISO/IEC 17025 calibration facility. Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Com-Power	PAM-103	Pre-Amplifier (1-1000MHz)	5/10/2019	Annual	5/10/2020	441112
Emco	3115	Horn Antenna (1-18GHz)	3/28/2018	Biennial	3/28/2020	9704-5182
Agilent	N9030A	PXA Signal Analyzer (44GHz)	6/12/2019	Annual	6/12/2020	MY52350166
OML, Inc.	M19RH	Horn Antenna (40 - 60GHz)	7/30/2019	Annual	7/30/2020	17111701
OML, Inc.	M12RH	Horn Antenna (60 - 90GHz)	7/30/2019	Annual	7/30/2020	17111701
OML, Inc.	M08RH	Horn Antenna (90 - 140GHz)	7/30/2019	Annual	7/30/2020	17111701
OML, Inc.	M05RH	Horn Antenna (140 - 220GHz)	7/30/2019	Annual	7/30/2020	18073001
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	5/6/2019	Annual	5/6/2020	103200
Rohde & Schwarz	SMW200A	Vector Signal Generator		N/A		100976
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	6/5/2019	Annual	6/5/2020	100342
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	7/11/2019	Annual	7/11/2020	102134
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	4/19/2018	Biennial	4/19/2020	A051107
Virginia Diodes Inc	SAX252	SAX Module (60 - 90GHz)	9/30/2019	Annual	9/30/2020	SAX252
Virginia Diodes Inc	SAX253	SAX Module (90 - 140GHz)	9/30/2019	Annual	9/30/2020	SAX253
Virginia Diodes Inc	SAX411	SAX Module (40 - 60GHz)	10/2/2019	Annual	10/2/2020	SAX411

Table 5-1. Test Equipment

#### Notes:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	 Dage 0 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 9 01 94
© 2019 PCTEST Engineering Laboration	tory. Inc.		V1.0



## 6.0 SAMPLE CALCULATIONS

### **Emission Designator**

#### **QPSK Modulation**

#### Emission Designator = 800MG7D

BW = 800 MHz G = Phase Modulation 7 = Quantized/Digital Info D = Data transmission, telemetry, telecommand

#### **QAM Modulation**

#### Emission Designator = 802MW7D

BW = 802 MHz W = Amplitude/Angle Modulated 7 = Quantized/Digital Info D = Data transmission, telemetry, telecommand

FCC ID: 2AUVU-OES3		CERTIFICATION		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 10 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 10 01 94
© 2019 PCTEST Engineering Laboration	V1.0			



## 7.0 TEST RESULTS

#### 7.1 Summary

Company Name:	Pivotal Commware
FCC ID:	2AUVU-OES3
FCC Classification:	Part 30 Transportable Transmitter (5GT)

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049	Occupied Bandwidth	N/A		PASS	Section 7.2
2.1046	Conducted Power	N/A	CONDUCTED	PASS	Section 7.3
2.1051, 30.203	Out-of-Band Emissions at the Band Edge	-13dBm/MHz for all out-of- band emissions, -5dBm/MHz from the band edge up to 10% of the channel BW		PASS	Section 7.6
2.1046, 30.202(c)	Equivalent Isotropic Radiated Power	55dBm		PASS	Section 7.4
2.1051, 30.203	Spurious Emissions	-13dBm/MHz for all out-of-band emissions	RADIATED	PASS	Section 7.5
2.1055	Frequency Stability	Fundamental emissions stay within authorized frequency block		PASS	Section 7.7

Table 7-1. Summary of Radiated Test Results

#### Notes:

- 1) Per 2.1057(a)(2), spurious emissions were investigated up to 100GHz.
- 2) Testing was completed with a signal generator creating a representative mmWave 5G NR signal, using DFTs-OFDM scheme, various modulations including QPSK, BPSK, and QAM, 120kHz subcarrier spacing, with 100MHz and 400MHz bandwidths, single carrier, full and single resource block allocations.
- 3) HBF refers to Holographic Beam Forming
- 4) The input signal to the EUT was set in order to produce the max power of the AGC range.
- 5) Based upon investigations of all possible modulations, testing was mainly performed with QPSK modulation.

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dogo 11 of 01	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 11 01 94	
© 2019 PCTEST Engineering Laboratory, Inc.					



# 7.2 Occupied Bandwidth §2.1049

#### **Test Overview**

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. All modes of operation were investigated and the worst case configuration results are reported in this section.

#### **Test Procedure Used**

ANSI C63.26-2015 Section 5.4.3

#### **Test Settings**

- 1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
- 2. RBW = 1 5% of the expected OBW
- 3. VBW  $\geq$  3 x RBW
- 4. Detector = Peak
- 5. Trace mode = max hold
- 6. Sweep = auto couple
- 7. The trace was allowed to stabilize
- 8. If necessary, steps 2 7 were repeated after changing the RBW such that it would be within

1-5% of the 99% occupied bandwidth observed in Step 7

#### **Test Notes**

None.

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	PIVOTAL"	Approved by: Quality Manager		
Test Report S/N:	Test Dates:	EUT Type:		Dogo 12 of 04		
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 12 01 94		
© 2019 PCTEST Engineering Laboratory, Inc.						



### 7.2.1 HBF Antenna Occupied Bandwidth

Channel	Bandwidth	Modulation	OBW [MHz]
Mid	100	π/2 BPSK	94.08
Mid	100	QPSK	94.14
Mid	100	16QAM	94.03
Mid	100	64QAM	94.33
Mid	100	256QAM	94.10
Mid	400	π/2 BPSK	375.82
Mid	400	QPSK	375.84
Mid	400	16QAM	376.20
Mid	400	64QAM	375.81
Mid	400	256QAM	376.04

Table 7-2. Summary of HBF Antenna Occupied Bandwidths



Plot 7-1. Occupied Bandwidth Plot - HBF Antenna (100MHz – π/2 BPSK - Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 12 of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 13 01 94	
© 2019 PCTEST Engineering Laboratory, Inc.					



Keysight Spectrum Analyzer - Occupied BW							[	
IXI RL RF 50Ω DC	CORREC	SENSE:INT	AL	LIGN AUTO	04:45:03 PI	4 Sep 27, 2019	Trace	/Detector
		Trig: Free Run	Avg Hold: 1	100/100	caulo Stu:	None		
	#IFGain:Low	#Atten: 10 dB		F	Radio Dev	ice: BTS		
10 dB/div Ref 27.00 dBm								
Log								
17.0								lear Write
7.00	an allow and an an	All and a second and		and the second of the second second				acai winte
-3.00					<b>\</b>			
-13.0					\			
-23.0								Average
33.0 kus ala ust. welWUM					alstern	م ب الديموري		Ŭ
					11.141.44	alfu afa sabatu		
-43.0								
-53.0								Max Hold
-63.0								
Cepter 27 02352 CHz					Snan 1	50.0 MHz		
#Res BW 2 MHz		VBW 50 M	17		Swe	en 1ms		
			12					Min Hold
Occupied Bandwidth		Total	Power	22.4 (	dBm			
04	4 4 2 MIL	<b>J</b>						Detector
94.143 MHZ						Detector		
Transmit Freg Error	83.594	Hz % of O	BW Power	r 99.0	00 %		Auto	Man
	00.47			00-0				
X dB Bandwidth	99.47 N	IHZ X dB		-26.00	Jab			
MSG				STATUS				

Plot 7-2. Occupied Bandwidth Plot - HBF Antenna (100MHz - QPSK - Mid Channel)



Plot 7-3. Occupied Bandwidth Plot - HBF Antenna (100MHz - 16QAM - Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dogo 14 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 14 01 94
© 2019 PCTEST Engineering Laboration	V1.0			



Keysight Spectrum Analyzer - Occupied BV	V				
ίχα RL   RF   50 Ω DC	CORREC Cente +→→ Trig: #IFGain:Low #Atter	SENSE:INT Pr Freq: 27.923520000 GHz Free Run Avg Hol n: 10 dB	ALIGN AUTO 04:53:36 z Radio Si Id: 100/100 Radio Do	PM Sep 27, 2019 d: None evice: BTS	Trace/Detector
10 dB/div Ref 27.00 dBn	n				
7.00	WINAL PANALANDAR CANA	and and the state of the second se	Jp-mannana		Clear Write
-13.0 -23.0 -33.0 aringstantantantantantantantantantantantantant				Sigerender Mandmere	Average
-43.0 -53.0 -63.0					Max Hold
Center 27.92352 GHz #Res BW 2 MHz	V	/BW 50 MHz	Span Sv	150.0 MHz /eep 1 ms	Min Hold
Occupied Bandwidt 94	<sup>th</sup> 4.331 MHz	Total Power	21.8 dBm		Detector
Transmit Freq Error x dB Bandwidth	91.211 kHz 99.07 MHz	% of OBW Pov x dB	ver 99.00 % -26.00 dB		Auto <u>Man</u>
MSG			STATUS		

Plot 7-4. Occupied Bandwidth Plot - HBF Antenna (100MHz - 64QAM Mid Channel)



Plot 7-5. Occupied Bandwidth Plot - HBF Antenna (100MHz - 256QAM Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dogo 15 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 15 01 94
© 2019 PCTEST Engineering Laboration	V1.0			



Keysight Spectrum Analyzer - Occupied B	W				
LX RL RF 50Ω DC		SENSE:INT Center Freq: 27.92652 Frig: Free Run	ALIGN AUTO 0000 GHz Avg Hold: 100/100	05:08:26 PM Sep 27, 2019 Radio Std: None	Trace/Detector
	#IFGain:Low #	Atten: 16 dB		Radio Device: BTS	_
10 dB/div Ref 40.00 dB	m				
30.0 20.0					Clear Write
10.0	monally she planeter when	and	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	ump	
-10.0					Average
-20.0 Hender Marsheller Miller					
-40.0					Max Hold
Center 27.9265 GHz #Res BW 8 MHz		VBW 50 MHz	2	Span 600.0 MHz Sweep 1 ms	Min Hold
Occupied Bandwid	th	Total Po	ower 23	.6 dBm	
3	75.82 MHz	2			Detector Peak▶
Transmit Freq Error	1.1117 MH	z % of OB	W Power 9	9.00 %	Auto <u>Man</u>
x dB Bandwidth	392.8 MH:	z x dB	-26	5.00 dB	
MSG			STAT	US	

Plot 7-6. Occupied Bandwidth Plot - HBF Antenna (400MHz – π/2 BPSK - Mid Channel)



Plot 7-7. Occupied Bandwidth - HBF Antenna Plot (400MHz - QPSK - Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 16 of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 16 of 94	
© 2019 PCTEST Engineering Laboration	V1.0				



🔤 Keysight Spectrum Analyzer - Occupied BV	V				
LX/ RL RF 50Ω DC	CORREC	SENSE:INT	ALIGN AUTO	05:14:51 PM Sep 27, 2019	Trace/Detector
		Trig: Free Run	Avg Hold: 100/100	Radio Sta: None	
	#IFGain:Low	#Atten: 16 dB		Radio Device: BTS	
10 dB/div Ref 40.00 dBr	n				
Log					
30.0					Clear Write
20.0					Clear write
10.0		و الأور بر بر بر المراجع ( مراجع الرواية	testino del anciente de la decimiente de		
0.00	entertainen Philippieren Antonio	an de se de la contra de la contr			
10.0					Average
					riverage
-20.0 Land be bereing bereitigt				maponolounder	
-30.0					
-40.0					Max Hold
-50.0					
Center 27.9265 GHz				Span 600.0 MHz	
#Res BW 8 WIHZ		VBW OUMHZ		Sweep 1 ms	Min Hold
Occupied Bandwidt	h	Total Po	wer 23.7	dBm	
Occupied Bandwidt		-	20.1	abiii	
37	6.20 MI	IZ			Detector
Tronomit From Freez	4 4054 1			00.0/	Peak≯ Auto Man
Fransmit Freq Error	1.1251 1		v Fower 99.	00-%	Man Man
x dB Bandwidth	391.8 M	Hz xdB	-26.0	0 dB	
			0.71.71.0		
MSG			STATUS		

Plot 7-8. Occupied Bandwidth Plot - HBF Antenna (400MHz - 16QAM - Mid Channel)



Plot 7-9. Occupied Bandwidth Plot - HBF Antenna (400MHz - 64QAM Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 17 of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 17 of 94	
© 2019 PCTEST Engineering Laboration	V1.0				



Keysight Spectrum Analyzer - Occupied BW	/							
XX RL RF 50Ω DC	CORREC	SENSE:INT	A	LIGN AUTO	05:23:13 P	M Sep 27, 2019	Trace	e/Detector
		Trig: Free Run	Avg Hold:	100/100	Radio Stu	None		
	#IFGain:Low	#Atten: 16 dB			Radio Dev	ice: BTS		
10 dB/div Ref 40.00 dBm	า							
Log								
30.0								Noar Write
20.0								JEal Wille
10.0	made a selatable	And and all the state of the second street and	interior and server	Mannan Mer				
0.00					<b>`</b>			
-10.0					1			Average
20.0								Ŭ
20.0 marchardenter all the other					Lowburger	roundouter		
-30.0								
-40.0								Max Hold
-50.0								
Contor 27 0265 CHz					Enon 6			
#Res BM 8 MHz		VBM 50 MH	17		Swe	en 1 ms		
WICC3 Day O WITZ		4044 30 Mil	12		OWC	ср т шэ		Min Hold
Occupied Bandwidt	h	Total F	Power	23.7	dBm			
27		1-					_	Detector
31	6.04 IVI							Detector Peak >
Transmit Freg Error	1.1542 M	IHz % of O	BW Powe	r 99.0	00 %		Auto	Man
	004 0			00-0				
X dB Bandwidth	391.6 N	IHZ X dB		-26.0	dB			
MSG				STATUS				

Plot 7-10. Occupied Bandwidth Plot - HBF Antenna (400MHz - 256QAM Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	PIVOTAL"	Approved by:		
Test Report S/N:	Test Dates:	EUT Type:	COMMITTEE			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 18 of 94		
© 2019 PCTEST Engineering Laboratory, Inc.						



### 7.2.2 Patch Antenna Occupied Bandwidth

Channel	Bandwidth	Modulation	OBW [MHz]
Mid	100	π/2 BPSK	94.46
Mid	100	QPSK	94.39
Mid	100	16QAM	94.48
Mid	100	64QAM	94.40
Mid	100	256QAM	94.44
Mid	400	π/2 BPSK	376.47
Mid	400	QPSK	376.93
Mid	400	16QAM	377.16
Mid	400	64QAM	376.70
Mid	400	256QAM	376.69

Table 7-3. Summary of Patch Antenna Occupied Bandwidths



Plot 7-11. Occupied Bandwidth Plot - Patch Antenna (100MHz – π/2 BPSK - Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager		
Test Report S/N:	Test Dates:	EUT Type:		Dage 10 of 04		
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 19 01 94		
© 2019 PCTEST Engineering Laboratory, Inc.						



🤤 Keysight Spectrum Analyzer - Occupied B	W				- ē <del>x</del>
LX RL RF 50Ω DC		SENSE:INT nter Freq: 27.923520 g: Free Run	ALIGN AUTO 000 GHz Avg Hold: 100/100	03:34:11 PM Oct 07 Radio Std: None	, 2019 Trace/Detector
	IFGain:Low #A	tten: 18 dB		Radio Device: B1	rs
10 dB/div Ref 21.00 dBr	m			_	
1.00	www.enersen	ware with the second	www.www.whilewarelev.alis	- <b>.</b>	Clear Write
1.00				<b>\</b>	
-9.00					
-19.0					
-29.0 Montemperature of the second state				human	Average
-39.0					
-49.0					
-59.0					Max Hold
-69.0					
Center 27.92352 GHZ		VRW 50 MHz		Span 150.0	WIHZ
Thes Dov 2 IVII IZ		8 D 8 0 0 1 1 1 2		Sweep	Min Hold
Occupied Bandwid	th	Total Pov	ver 22.0	dBm	
9					Detector
9					Detector Peak▶
Transmit Freq Error	-194.56 kHz	% of OBV	V Power 99	.00 %	Auto <u>Man</u>
x dB Bandwidth	99 83 MHz	x dB	-26	00 dB	
	33.03 MITZ	A UD	-20.		
MSG			STATUS	5	

Plot 7-12. Occupied Bandwidth Plot - Patch Antenna (100MHz - QPSK - Mid Channel)



Plot 7-13. Occupied Bandwidth Plot - Patch Antenna (100MHz - 16QAM - Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager		
Test Report S/N:	Test Dates:	EUT Type:		Dage 20 of 04		
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 20 of 94		
© 2019 PCTEST Engineering Laboratory, Inc.						



🔤 Keysight Spectrum Analyzer - Occupied BW					- 6 -
LXV RL RF 50Ω DC	CORREC	SENSE:INT	ALIGN AUTO	03:28:34 PM Oct 07, 201 Radio Std: None	Trace/Detector
		Trig: Free Run	Avg Hold: 100/100	Radio Std. None	
	IFGain:Low	#Atten: 18 dB		Radio Device: BTS	_
10 dB/div Ref 21.00 dBm	1				
4.00	we have the the	Marghan Horse Margan	the second of the second of the second	****	Clear Write
1.00					
-9.00					
-19.0					
-29.0 with mark of the second second				Annon an anno an anno an an anno an an anno an	Average
-39.0					
-49.0					
-59.0					Max Hold
-69.0					
				0	
Center 27.92352 GHZ #Pas BMC 2 MHz		VRM 50 MH	7	Sween 1 m	2
#Res DVV Z WIIIZ		4044 30 Mill	2	Sweep 111	Min Hold
Occupied Bandwidt	h	Total P	ower 21.	.8 dBm	
0/	401 ML	7			Detector
95		12			Peak►
Transmit Freq Error	-197.6 <u>0</u> k	Hz % of OE	BW Power 9	9.00 %	Auto <u>Man</u>
x dB Bandwidth	99 68 M	Hz ydB	-26	00 dB	
	33.00 M		-20		
· · · · · · · · · · · · · · · · · · ·					
MSG			STATU	US	

Plot 7-14. Occupied Bandwidth Plot - Patch Antenna (100MHz - 64QAM Mid Channel)



Plot 7-15. Occupied Bandwidth Plot - Patch Antenna (100MHz - 256QAM Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 21 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 21 01 94
© 2019 PCTEST Engineering Laboration	tory, Inc.		V1.0



Keysight Spectrum Analyzer - Occupied BV	V				
LX/RL RF 50Ω DC	CORREC	SENSE:INT	ALIGN AUTO	05:10:59 PM Oct 07, 20 Radio Std: None	Trace/Detector
		rig: Free Run	Avg Hold: 100/100	Rualo ota. Hone	
	IFGain:Low #	Atten: 18 dB		Radio Device: BTS	_
10 dB/div Ref 21.00 dBr	n			_	
1.00	way mary marker with	manuthant	wild manufacture and and	1	Clear Write
-9.00					
-19 0					
29 D water mar to a mar a far for the same				a south of the shear and and	Average
39.0					
49.0					
50.0					
					Max Hold
-09.0					
Center 27.9265 GHz				Span 600.0 MI	Hz
#Res BW 8 MHz		VBW 50 MH:	Z	Sweep 1 n	ns Min Hold
Occupied Rendwidt	h	Total P	ower 22	2 dBm	
Occupied Ballowid		Total I v			
37	6.4/ MHz				Detector
Transmit Freq Error	-237.68 kH	z % of OE	W Power 99	9.00 %	Auto <u>Man</u>
v dB Bandwidth	302.5 MH	v dB	-26	00 dB	
	552.5 With		-20	.00 00	
				-	
MSG			STATU	5	

Plot 7-16. Occupied Bandwidth Plot - Patch Antenna (400MHz – π/2 BPSK - Mid Channel)



Plot 7-17. Occupied Bandwidth - Patch Antenna Plot (400MHz - QPSK - Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 22 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 22 01 94
© 2019 PCTEST Engineering Laboration	tory, Inc.		V1.0



Keysight Spectrum Analyzer - Occupied BW						
LXU RL RF 50Ω DC	CORREC SE	ENSE:INT	ALIGN AUTO 04:56:12 Radio Sto	PM Oct 07, 2019	Trace/De	tector
	Trig: Fre	e Run Avg Hold	: 100/100			
	IFGain:Low #Atten: "	18 dB	Radio De	vice: BTS		
10 dB/div Ref 21.00 dBm						
11.0						
1.00	wetter water and the second	here was a strate of the second s	Menurlan that will be		Clea	ar Write
-9 00						
.19 0						
29.0 Washington the way of			Unimon	water was and the	4	verage
20.0						
-39.0						
-49.0						
-59.0					м	ax Hold
-69.0					-	_
Center 27.9265 GHz			Span	600.0 MHz		
#Res BW 8 MHz	VB	W 50 MHz	Sw	eep 1ms	M	lin Hold
		Tetel Dever	22.2 dB			
Occupied Bandwidth		Total Power	22.2 dBm			
37	7.16 MHz				D	etector
Transmit Fred Error	-376 23 kHz	% of OBW Powe	or 00.00 %		Auto	Peak▶ Man
	-570.25 KHZ		55.00 %		rato	mari
x dB Bandwidth	392.5 MHz	x dB	-26.00 dB			
MSG			STATUS			

Plot 7-18. Occupied Bandwidth Plot - Patch Antenna (400MHz - 16QAM - Mid Channel)



Plot 7-19. Occupied Bandwidth Plot - Patch Antenna (400MHz - 64QAM Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 23 01 94
© 2019 PCTEST Engineering Laboration	tory, Inc.		V1.0



Keysight Spectrum Analyzer - Occupied BW	1				
💢 RL RF 50Ω DC	CORREC	SENSE:INT	ALIGN AUTO	04:53:10 PM Oct 07, 2019	Trace/Detector
		rig: Free Run	Avg Hold: 100/100	Radio Std: None	
	IFGain:Low #/	Atten: 18 dB		Radio Device: BTS	
10 dB/div Ref 21.00 dBm	n				
Log					
11.0	Marthanka and Announced	المراجعة المرور والمحمل المروقة والمحمل	the unlike the second second		Clear Write
1.00					Clear write
-9.00					
-19.0					
29 0 Watthe Works Makes Markes				an mininter shipping make	Average
20.0					
-39.0					
-49.0					
-59.0					Max Hold
-69.0					
				0	
Center 27.9265 GHZ				Span 600.0 MHz	
#Res BW 8 MHZ				Sweep This	Min Hold
Occupied Bandwidt	h	Total Pov	ver 22.2	dBm	
					_
37	6.69 MHZ				Detector
Transmit Freq Error	-298.51 kHz	% of OBV	V Power 99	.00 %	Auto <u>Man</u>
x dB Bandwidth	391.8 MHz	x dB	-26.0	00 dB	
			2010		
MSG			STATUS		

Plot 7-20. Occupied Bandwidth Plot - Patch Antenna (400MHz - 256QAM Mid Channel)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Da
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 24 01 94
© 2019 PCTEST Engineering Laboration	tory. Inc.		V1.0



#### 7.3 Conducted Power §2.1046 Test Overview

A transmitter port of the EUT is connected to the input of a signal analyzer. A signal generator supples a 5G NR signal directly into the input port of the device. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

#### **Test Procedures Used**

ANSI C63.26-2015 Section 5.2.4.4.1

#### Test Settings

- 1. Conducted power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
- 2. RBW = 1 5% of the expected OBW, not to exceed 1MHz
- 3. VBW  $\geq$  3 x RBW
- 4. Span = 2x to 3x the OBW
- 5. No. of sweep points  $\geq$  2 x span / RBW
- 6. Detector = RMS
- 7. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with

continuous operation.

- 8. Trace mode = trace averaging (RMS) over 100 sweeps
- 9. The trace was allowed to stabilize

#### Test Notes

The EUT was tested in all possible test configurations. The worst case emissions are reported with the modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 25 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 25 01 94
© 2019 PCTEST Engineering Laboration	tory Inc.		V1.0



#### **HBF Conducted Power** 7.3.1

Polarity	Direction	Multiple Access Scheme	Modulation	Bandwidth (MHz)	No. RBs	RB Offset	Center Frequency (MHz)	Conducted Power (dBm)
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27559.32	9.93
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27923.52	9.98
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	28292.16	9.90
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27701.88	9.94
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27926.52	9.92
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	28140.96	9.96
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	27559.32	9.96
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	27923.52	9.99
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	28292.16	9.92
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	27701.88	9.91
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	27926.52	9.91
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	28140.96	9.91
Vertical	Uplink	DFT-s-OFDM	QPSK	100	Full	0	27559.32	9.92
Vertical	Uplink	DFT-s-OFDM	QPSK	100	Full	0	27923.52	9.88
Vertical	Uplink	DFT-s-OFDM	QPSK	100	Full	0	28292.16	9.96
Vertical	Uplink	DFT-s-OFDM	QPSK	400	Full	0	27701.88	9.97
Vertical	Uplink	DFT-s-OFDM	QPSK	400	Full	0	27926.52	9.96
Vertical	Uplink	DFT-s-OFDM	QPSK	400	Full	0	28140.96	9.96
Vertical	Uplink	DFT-s-OFDM	QPSK	100	1	0	27559.32	9.98
Vertical	Uplink	DFT-s-OFDM	QPSK	100	1	0	27923.52	9.98
Vertical	Uplink	DFT-s-OFDM	QPSK	100	1	0	28292.16	9.90
Vertical	Uplink	DFT-s-OFDM	QPSK	400	1	0	27701.88	9.94
Vertical	Uplink	DFT-s-OFDM	QPSK	400	1	0	27926.52	9.91
Vertical	Uplink	DFT-s-OFDM	QPSK	400	1	0	28140.96	9.92
Vertical	Uplink	DFT-s-OFDM	16QAM	100	Full	0	27559.32	9.96
Vertical	Uplink	DFT-s-OFDM	16QAM	100	Full	0	27923.52	9.95
Vertical	Uplink	DFT-S-OFDM	16QAM	100	Full	0	28292.16	9.95
Vertical	Uplink	DFT-S-OFDM	16QAM	400	Full	0	27701.88	9.91
Vertical	Uplink	DFT-S-OFDM	16QAM	400	Full	0	27926.52	9.91
Vertical	Uplink	DFT-S-OFDIM	16QAM	400	Full 1	0	28140.96	9.93
Vertical	Uplink	DFT-S-OFDIM	16QAM	100	1	0	27559.32	9.97
Vertical	Uplink		16QAM	100	1	0	27923.32	9.90
Vertical	Uplink		16QAM	400	1	0	20292.10	9.94
Vertical	Uplink	DET-S-OEDM	160AM	400	1	0	27701.88	9.91
Vertical	Unlink	DET-S-OEDM	160AM	400	1	0	27920.32	9.90
Vertical	Unlink	DET-S-OEDM	640AM	100	Full	0	27559 32	9.95
Vertical	Unlink	DET-S-OEDM	640AM	100	Full	0	27923 52	9.99
Vertical	Unlink	DET-S-OEDM	640AM	100	Full	0	28292.16	9.99
Vertical	Unlink	DFT-s-OFDM	640AM	400	Full	0	27701 88	9.92
Vertical	Unlink	DFT-s-OFDM	640AM	400	Full	0	27926 52	10.00
Vertical	Unlink	DFT-s-OFDM	640AM	400	Full	0	28140.96	9.97
Vertical	Uplink	DFT-s-OFDM	640AM	100	1	0	27559.32	9,93
Vertical	Uplink	DFT-s-OFDM	64QAM	100	1	0	27923.52	9.95
Vertical	Uplink	DFT-s-OFDM	64QAM	100	1	0	28292.16	9.97
Vertical	Uplink	DFT-s-OFDM	64QAM	400	1	0	27701.88	9.92
Vertical	Uplink	DFT-s-OFDM	64QAM	400	1	0	27926.52	9.98
Vertical	Uplink	DFT-s-OFDM	64QAM	400	1	0	28140.96	9.97
Vertical	Uplink	DFT-s-OFDM	256QAM	100	Full	0	27559.32	9.96
Vertical	Uplink	DFT-s-OFDM	256QAM	100	Full	0	27923.52	9.99
Vertical	Uplink	DFT-s-OFDM	256QAM	100	Full	0	28292.16	9.91
Vertical	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27701.88	9.92
Vertical	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27926.52	9.91
Vertical	Uplink	DFT-s-OFDM	256QAM	400	Full	0	28140.96	9.98
Vertical	Uplink	DFT-s-OFDM	256QAM	100	1	0	27559.32	9.92
Vertical	Uplink	DFT-s-OFDM	256QAM	100	1	0	27923.52	9.93
Vertical	Uplink	DFT-s-OFDM	256QAM	100	1	0	28292.16	9.97
Vertical	Uplink	DFT-s-OFDM	256QAM	400	1	0	27701.88	9.95
Vertical	Uplink	DFT-s-OFDM	256QAM	400	1	0	27926.52	9.96
Vertical	Uplink	DFT-s-OFDM	256QAM	400	1	0	28140.96	9.92

#### Table 7-4. HBF Conducted Power Vertical Polarization (SISO)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	PIVOTAL"	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 26 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 26 01 94
© 0040 DOTEOT Ex size s size 1 shares	tani lan			1/4.0



Polarity	Direction	Multiple Access Scheme	Modulation	Bandwidth (MHz)	No. RBs	RB Offset	Center Frequency (MHz)	Conducted Power (dBm)
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27559.32	9.95
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27923.52	9.93
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	28292.16	9.97
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27701.88	9.94
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27926.52	9.95
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	28140.96	9.98
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	27559.32	9.92
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	27923.52	9.94
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	28292.16	9.99
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	27701.88	9.92
Horizontal	Uplink	DFT-S-OFDM	π/2 BPSK	400	1	0	27926.52	9.96
Horizontal	Uplink	DFT-S-OFDM		400	1	0	28140.96	9.97
Horizontal	Uplink		QPSK	100	Full	0	27559.32	9.98
Horizontal	Uplink	DFT-S-OFDIVI	QPSK	100	Full	0	27923.52	9.92
Horizontal	Uplink		OPSK	400	Full	0	28292.10	9.95
Horizontal	Unlink		ODZK	400	Full	0	27926 52	9.91
Horizontal	Unlink		Obek	400	Full	0	281/0 96	9.90
Horizontal	Unlink	DFT-s-OFDM	OPSK	100	1	0	27559 32	9.97
Horizontal	Unlink	DFT-S-OFDM	OPSK	100	1	0	27923.52	9.97
Horizontal	Unlink	DFT-s-OFDM	OPSK	100	1	0	28292.16	9.92
Horizontal	Uplink	DFT-s-OFDM	OPSK	400	1	0	27701.88	9.98
Horizontal	Uplink	DFT-s-OFDM	QPSK	400	1	0	27926.52	9.95
Horizontal	Uplink	DFT-s-OFDM	QPSK	400	1	0	28140.96	9.95
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	Full	0	27559.32	9.92
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	Full	0	27923.52	9.91
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	Full	0	28292.16	9.93
Horizontal	Uplink	DFT-s-OFDM	16QAM	400	Full	0	27701.88	9.95
Horizontal	Uplink	DFT-s-OFDM	16QAM	400	Full	0	27926.52	9.94
Horizontal	Uplink	DFT-s-OFDM	16QAM	400	Full	0	28140.96	9.99
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	1	0	27559.32	9.98
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	1	0	27923.52	9.97
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	1	0	28292.16	9.93
Horizontal	Uplink	DFT-s-OFDM	16QAM	400	1	0	27701.88	9.98
Horizontal	Uplink	DFT-s-OFDM	16QAM	400	1	0	27926.52	9.99
Horizontal	Uplink	DFT-s-OFDM	16QAM	400	1	0	28140.96	9.92
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27559.32	9.97
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27923.52	9.96
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	Full	0	28292.16	9.94
Horizontal	Uplink	DFT-s-OFDM	64QAM	400	Full	0	27701.88	9.98
Horizontal	Uplink	DFT-S-OFDM	64QAM	400	Full	0	27926.52	9.97
Horizontal	Uplink			400	1 FUII	0	20140.90	9.94
Horizontal	Uplink			100	1	0	27559.32	9.92
Horizontal	Unlink		640AM	100	1	0	2/323.32	9.99
Horizontal	Unlink		640AM	400	1	0	20292.10	9.91
Horizontal	Unlink	DFT-s-OFDM	640AM	400	1	0	27926 52	9.95
Horizontal	Uplink	DFT-s-OFDM	640AM	400	1	0	28140.96	9,94
Horizontal	Uplink	DFT-s-OFDM	2560AM	100	Full	0	27559 32	9,95
Horizontal	Uplink	DFT-s-OFDM	2560AM	100	Full	0	27923.52	9,96
Horizontal	Uplink	DFT-s-OFDM	256QAM	100	Full	0	28292.16	9.95
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27701.88	9.90
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27926.52	9.92
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	Full	0	28140.96	9.97
Horizontal	Uplink	DFT-s-OFDM	256QAM	100	1	0	27559.32	9.92
Horizontal	Uplink	DFT-s-OFDM	256QAM	100	1	0	27923.52	9.96
Horizontal	Uplink	DFT-s-OFDM	256QAM	100	1	0	28292.16	9.89
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	1	0	27701.88	9.94
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	1	0	27926.52	9.98
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	1	0	28140.96	9.99
Tab	le 7-5	HBE Cond	lucted Po	ower Ho	rizonta	I Pola	rization (S	

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dogo 27 of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 27 01 94	
© 2019 PCTEST Engineering Laboratory, Inc.					



Antenna Configuration	Direction	Multiple Access Scheme	Modulation	Bandwidth (MHz)	No. RBs	RB Offset	Center Frequency (MHz)	Horizontal Outut power (dBm)	Vertical Output power (dBm)	MIMO Conducted Power (dBm)
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27559.32	9.95	9.93	12.95
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27923.52	9.93	9.98	12.97
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	28292.16	9.97	9.90	12.95
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27701.88	9.94	9.94	12.95
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27926.52	9.95	9.92	12.95
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	28140.96	9.98	9.96	12.98
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	27559.32	9.92	9.96	12.95
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	27923.52	9.94	9.99	12.98
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	28292.16	9.99	9.92	12.97
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	27701.88	9.92	9.91	12.93
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	27926.52	9.96	9.91	12.95
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	28140.96	9.97	9.91	12.95
MIMO	Uplink	DFT-s-OFDM	QPSK	100	Full	0	27559.32	9.98	9.92	12.96
MIMO	Uplink	DFT-S-OFDM	QPSK	100	Full	0	27923.52	9.92	9.88	12.91
MIMO	Uplink	DFT-s-OFDM	QPSK	100	Full	0	28292.16	9.95	9.96	12.97
MIMO	Uplink	DFT-S-OFDM	QPSK	400	Full	0	27/01.88	9.91	9.97	12.95
MINO	Uplink	DFT-S-OFDIM	QPSK	400	Full	0	27926.52	9.98	9.96	12.98
	Uplink	DFT-S-OFDIVI	QPSK	400	1 Full	0	28140.90	9.97	9.90	12.98
MIMO	Uplink	DFT-S-OFDIM	QF3K OPSK	100	1	0	27339.32	9.99	9.90	12.00
MIMO	Unlink	DFT-S-OFDIM	OPSK	100	1	0	27923.32	9.97	9.90	12.99
MIMO	Unlink	DFT-s-OFDM	OPSK	400	1	0	27701 88	9.92	9.90	12.92
MIMO	Unlink	DFT-s-OFDM	OPSK	400	1	0	27926 52	9.95	9.91	12.94
MIMO	Unlink	DFT-s-OFDM	OPSK	400	1	0	28140.96	9.95	9.92	12.95
MIMO	Uplink	DFT-s-OFDM	160AM	100	Full	0	27559.32	9.92	9.96	12.95
MIMO	Uplink	DFT-s-OFDM	16QAM	100	Full	0	27923.52	9.91	9.95	12.94
MIMO	Uplink	DFT-s-OFDM	16QAM	100	Full	0	28292.16	9.93	9.95	12.95
MIMO	Uplink	DFT-s-OFDM	16QAM	400	Full	0	27701.88	9.95	9.91	12.94
MIMO	Uplink	DFT-s-OFDM	16QAM	400	Full	0	27926.52	9.94	9.91	12.94
MIMO	Uplink	DFT-s-OFDM	16QAM	400	Full	0	28140.96	9.99	9.93	12.97
MIMO	Uplink	DFT-s-OFDM	16QAM	100	1	0	27559.32	9.98	9.97	12.99
MIMO	Uplink	DFT-s-OFDM	16QAM	100	1	0	27923.52	9.97	9.90	12.95
MIMO	Uplink	DFT-s-OFDM	16QAM	100	1	0	28292.16	9.93	9.94	12.95
MIMO	Uplink	DFT-s-OFDM	16QAM	400	1	0	27701.88	9.98	9.91	12.96
MIMO	Uplink	DFT-s-OFDM	16QAM	400	1	0	27926.52	9.99	9.96	12.99
MIMO	Uplink	DFT-s-OFDM	16QAM	400	1	0	28140.96	9.92	9.95	12.95
MIMO	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27559.32	9.97	9.95	12.97
MIMO	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27923.52	9.96	9.99	12.99
MIMO	Uplink	DFT-s-OFDM	64QAM	100	Full	0	28292.16	9.94	9.99	12.98
MIMO	Uplink	DFT-s-OFDM	64QAM	400	Full	0	27701.88	9.98	9.92	12.96
MIMO	Uplink	DFT-s-OFDM	64QAM	400	Full	0	27926.52	9.97	10.00	13.00
MIMO	Uplink	DFT-S-OFDM	64QAM	400	Full	0	28140.96	9.94	9.97	12.97
MIMO	Uplink	UFI-S-OFDM	64QAM	100	1	0	27559.32	9.92	9.93	12.94
MINO	Uplink	DET & OFDIA	64QAM	100	1	U	2/923.52	9.99	9.95	12.98
	Uplink		64QAM	100	1	0	28292.16	9.91	9.97	12.95
	Uplink	DET & OFDIA	64QAM	400	1	0	27/01.88	9.95	9.92	12.95
MIMO	Uplink		640AM	400	1	0	21320.52	9.97	9.98 9.97	12.99
MINO	Uplink		2560 AM	400		0	20140.90	9.94 0.0E	9.97	12.97
MIMO	Uplink	DFT-S-OFDIM	2560AM	100	Full	0	27559.52	9.95	9.90	12.97
MIMO	Unlink		2560AM	100	Full	0	27923.52	9.90	9.99 Q Q1	12.99
MIMO	Unlink	DFT-s-OFDM	2560AM	400	Full	0	27701 88	9.90	9.92	12.54
MIMO	Unlink	DFT-s-OFDM	2560AM	400	Full	0	27926 52	9.92	9.91	12.92
MIMO	Uplink	DFT-s-OFDM	2560AM	400	Full	0	28140.96	9,97	9,98	12.99
MIMO	Uplink	DFT-s-OFDM	2560AM	100	1	0	27559.32	9.92	9.92	12.93
MIMO	Unlink	DFT-s-OFDM	2560AM	100	1	0	27923 52	9.96	9.93	12.96
MIMO	Uplink	DFT-s-OFDM	256QAM	100	1	0	28292.16	9.89	9.97	12.94
MIMO	Uplink	DFT-s-OFDM	256QAM	400	1	0	27701.88	9.94	9.95	12.96
MIMO	Uplink	DFT-s-OFDM	256QAM	400	1	0	27926.52	9.98	9.96	12.98
MIMO	Uplink	DFT-s-OFDM	256QAM	400	1	0	28140.96	9.99	9.92	12.97
	Т	able 7-6.	HBF Cor	nducted	Power	Summ	ary Data	a (MIMO	)	

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	COMMWARE	Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 20 of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 28 01 94	
© 2019 PCTEST Engineering Laboratory, Inc.					



#### 7.3.2 **Patch Conducted Power**

Polarity	Direction	Multiple Access Scheme	Modulation	Bandwidth (MHz)	No. RBs	RB Offset	Center Frequency (MHz)	Conducted Power (dBm)
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27559.32	19.95
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27923.52	19.96
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	28292.16	19.96
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27701.88	19.97
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27926.52	19.93
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	28140.96	19.95
Vertical	Uplink	DFT-S-OFDM	π/2 BPSK	100	1	0	27559.32	19.92
Vertical	Uplink	DFT-S-OFDM	π/2 BPSK	100	1	0	27923.52	19.95
Vertical	Uplink	DFT-S-OFDM	π/2 BPSK	100	1	0	28292.16	19.93
Vertical	Unlink	DFT-s-OFDM	π/2 BPSK	400	1	0	27926 52	19.90
Vertical	Unlink	DET-S-OEDM	π/2 BPSK	400	1	0	28140.96	19.99
Vertical	Uplink	DFT-s-OFDM	OPSK	100	Full	0	27559.32	19.94
Vertical	Uplink	DFT-s-OFDM	QPSK	100	Full	0	27923.52	19.99
Vertical	Uplink	DFT-s-OFDM	QPSK	100	Full	0	28292.16	19.96
Vertical	Uplink	DFT-s-OFDM	QPSK	400	Full	0	27701.88	19.96
Vertical	Uplink	DFT-s-OFDM	QPSK	400	Full	0	27926.52	19.92
Vertical	Uplink	DFT-s-OFDM	QPSK	400	Full	0	28140.96	19.90
Vertical	Uplink	DFT-s-OFDM	QPSK	100	1	0	27559.32	19.99
Vertical	Uplink	DFT-s-OFDM	QPSK	100	1	0	27923.52	19.97
Vertical	Uplink	DFT-s-OFDM	QPSK	100	1	0	28292.16	19.94
Vertical	Uplink	DFT-s-OFDM	QPSK	400	1	0	27701.88	19.94
Vertical	Uplink	DFT-s-OFDM	QPSK	400	1	0	27926.52	19.98
Vertical	Uplink	DFT-s-OFDM	QPSK	400	1	0	28140.96	19.93
Vertical	Uplink	DFT-s-OFDM	16QAM	100	Full	0	27559.32	19.96
Vertical	Uplink	DFT-s-OFDM	16QAM	100	Full	0	27923.52	19.99
Vertical	Uplink	DFT-S-OFDM	16QAM	100	Full	0	28292.16	19.95
Vertical	Uplink	DFT-S-OFDM	16QAM	400	Full	0	27701.88	19.96
Vertical	Uplink	DFT-S-OFDM	16QAM	400	Full	0	27926.52	19.91
Vertical	Uplink	DFT-S-OFDM	160AM	100	1 1	0	28140.90	19.69
Vertical	Unlink	DFT-s-OFDM	160AM	100	1	0	27923 52	19.95
Vertical	Uplink	DFT-s-OFDM	160AM	100	1	0	28292.16	19.93
Vertical	Uplink	DFT-s-OFDM	16QAM	400	1	0	27701.88	19.94
Vertical	Uplink	DFT-s-OFDM	16QAM	400	1	0	27926.52	19.99
Vertical	Uplink	DFT-s-OFDM	16QAM	400	1	0	28140.96	19.94
Vertical	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27559.32	19.96
Vertical	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27923.52	19.99
Vertical	Uplink	DFT-s-OFDM	64QAM	100	Full	0	28292.16	19.95
Vertical	Uplink	DFT-s-OFDM	64QAM	400	Full	0	27701.88	19.97
Vertical	Uplink	DFT-s-OFDM	64QAM	400	Full	0	27926.52	19.91
Vertical	Uplink	DFT-s-OFDM	64QAM	400	Full	0	28140.96	19.94
Vertical	Uplink	DF1-S-OFDM	64QAM	100	1	0	27559.32	19.98
Vertical	Uplink		64QAM	100	1	0	2/923.52	19.98
Vertical	Uplink	DFT-S-OFDIVI	64QAIVI	100	1	0	28292.10	19.93
Vertical	Unlink		640AM	400	1	0	27701.00	19.95
Vertical	Unlink	DFT-s-OFDM	640AM	400	1	0	27920.32	19.90
Vertical	Uplink	DFT-s-OFDM	2560AM	100	Full	0	27559 32	19.97
Vertical	Uplink	DFT-s-OFDM	2560AM	100	Full	0	27923.52	19.99
Vertical	Uplink	DFT-s-OFDM	256QAM	100	Full	0	28292.16	19.96
Vertical	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27701.88	19.97
Vertical	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27926.52	19.90
Vertical	Uplink	DFT-s-OFDM	256QAM	400	Full	0	28140.96	19.98
Vertical	Uplink	DFT-s-OFDM	256QAM	100	1	0	27559.32	19.97
Vertical	Uplink	DFT-s-OFDM	256QAM	100	1	0	27923.52	19.97
Vertical	Uplink	DFT-s-OFDM	256QAM	100	1	0	28292.16	19.92
Vertical	Uplink	DFT-s-OFDM	256QAM	400	1	0	27701.88	19.94
Vertical	Uplink	DFT-s-OFDM	256QAM	400	1	0	27926.52	19.96
Vertical	Uplink	DFT-s-OFDM	256QAM	400	1	0	28140.96	19.98

Table 7-7. Patch Conducted Power Vertical Polarization (SISO)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 20 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 29 01 94
© 2010 DOTECT Engineering Labora	ton ( loo		1/4.0



Polarity	Direction	Multiple Access Scheme	Modulation	Bandwidth (MHz)	No. RBs	RB Offset	Center Frequency (MHz)	Conducted Power (dBm)
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27559.32	19.99
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27923.52	19.98
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	28292.16	19.95
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27701.88	19.97
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27926.52	19.99
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	28140.96	19.97
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	27559.32	19.95
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	27923.52	19.97
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	28292.16	19.95
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	27701.88	19.96
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	27926.52	19.97
Horizontal	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	28140.96	19.96
Horizontal	Uplink	DFT-s-OFDM	QPSK	100	Full	0	27559.32	19.95
Horizontal	Uplink	DFT-s-OFDM	QPSK	100	Full	0	27923.52	19.93
Horizontal	Uplink	DFT-S-OFDM	QPSK	100	Full	0	28292.16	19.97
Horizontal	Uplink	DFT-S-OFDM	QPSK	400	Full	0	27/01.88	19.97
Horizontal	Uplink	DFT-S-OFDM	QPSK	400	Full	0	27926.52	19.98
Horizontal	Uplink	DFT-S-OFDM	QPSK	400	Full	0	28140.96	19.97
Horizontal	Uplink	DFT-S-OFDM	QPSK	100	1	0	27559.32	19.93
Horizontal	Uplink	DFT-S-OFDM	QPSK	100	1	0	2/923.52	19.96
Horizontal	Uplink	DFT-S-OFDM	QPSK	100	1	0	28292.16	19.94
Horizontal	Uplink	DFT-S-OFDM	QPSK	400	1	0	27701.88	19.97
Horizontal	Uplink	DFT-S-OFDM	OPSK	400	1	0	27920.52	19.97
Horizontal	Uplink		160AM	400	L Eull	0	28140.90	19.99
Horizontal	Uplink		160AM	100	Full	0	27559.52	19.97
Horizontal	Unlink	DET-S-OEDM	160AM	100	Full	0	27923.32	19.95
Horizontal	Unlink	DFT-s-OEDM	160AM	400	Full	0	27701 88	19.95
Horizontal	Unlink	DFT-s-OFDM	160AM	400	Full	0	27926 52	19.99
Horizontal	Uplink	DFT-s-OFDM	160AM	400	Full	0	28140.96	19.99
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	1	0	27559.32	19.94
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	1	0	27923.52	19.99
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	1	0	28292.16	19.96
Horizontal	Uplink	DFT-s-OFDM	16QAM	400	1	0	27701.88	19.97
Horizontal	Uplink	DFT-s-OFDM	16QAM	400	1	0	27926.52	19.94
Horizontal	Uplink	DFT-s-OFDM	16QAM	400	1	0	28140.96	19.94
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27559.32	19.94
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27923.52	19.97
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	Full	0	28292.16	19.98
Horizontal	Uplink	DFT-s-OFDM	64QAM	400	Full	0	27701.88	19.90
Horizontal	Uplink	DFT-s-OFDM	64QAM	400	Full	0	27926.52	19.95
Horizontal	Uplink	DFT-s-OFDM	64QAM	400	Full	0	28140.96	19.93
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	1	0	27559.32	19.98
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	1	0	27923.52	19.96
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	1	0	28292.16	19.96
Horizontal	Uplink	DFT-s-OFDM	64QAM	400	1	0	27701.88	19.98
Horizontal	Uplink	DFT-s-OFDM	64QAM	400	1	0	27926.52	19.91
Horizontal	Uplink	DFT-s-OFDM	64QAM	400	1	0	28140.96	19.93
Horizontal	Uplink	DFT-s-OFDM	256QAM	100	Full	0	27559.32	19.93
Horizontal	Uplink	DFT-s-OFDM	256QAM	100	Full	0	27923.52	19.99
Horizontal	Uplink	DFT-s-OFDM	256QAM	100	Full	0	28292.16	19.97
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27701.88	19.92
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27926.52	19.92
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	Full	0	28140.96	19.93
Horizontal	Uplink	DFT-S-OFDM	256QAM	100	1	0	27559.32	19.97
Horizontal	Uplink	DFT-s-OFDM	256QAM	100	1	0	27923.52	19.97
Horizontal	Uplink	DF1-S-OFDM	256QAM	100	1	U	28292.16	19.99
Horizontal	Uplink	DFT & OFDM	256QAM	400	1	0	27/01.88	19.92
Horizontal	Uplink		256QAM	400	1	U	2/926.52	19.98
Horizontal	Uplink	DEL-S-OFDIM	256QAIVI	400	1	U	28140.96	19.96

#### Table 7-8. Patch Conducted Power Horizontal Polarization (SISO)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 20 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 30 01 94
© 2019 PCTEST Engineering Labora	V1.0			



Antenna Configuration	Direction	Multiple Access Scheme	Modulation	Bandwidth (MHz)	No. RBs	RB Offset	Center Frequency (MHz)	Horizontal Output power (dBm)	Vertical Output power (dBm)	MIMO Conducted Power (dBm)
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27559.32	19.99	19.95	22.98
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	27923.52	19.98	19.96	22.98
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	100	Full	0	28292.16	19.95	19.96	22.97
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27701.88	19.97	19.97	22.98
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	27926.52	19.99	19.93	22.97
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	Full	0	28140.96	19.97	19.95	22.97
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	27559.32	19.95	19.92	22.95
MIMO	Uplink	DFT-S-OFDM	π/2 BPSK	100	1	0	2/923.52	19.97	19.95	22.97
MIMO	Uplink		π/2 BPSK	400	1	0	28292.10	19.95	19.93	22.95
MIMO	Unlink	DET-S-OEDM	π/2 BPSK	400	1	0	27926 52	19.90	19.90	22.37
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	28140.96	19.96	19.99	22.99
MIMO	Uplink	DFT-s-OFDM	QPSK	100	Full	0	27559.32	19.95	19.94	22.96
MIMO	Uplink	DFT-s-OFDM	QPSK	100	Full	0	27923.52	19.93	19.99	22.97
MIMO	Uplink	DFT-s-OFDM	QPSK	100	Full	0	28292.16	19.97	19.96	22.98
MIMO	Uplink	DFT-s-OFDM	QPSK	400	Full	0	27701.88	19.97	19.96	22.98
MIMO	Uplink	DFT-s-OFDM	QPSK	400	Full	0	27926.52	19.98	19.92	22.96
MIMO	Uplink	DFT-s-OFDM	QPSK	400	Full	0	28140.96	19.97	19.90	22.95
MIMO	Uplink	DFT-s-OFDM	QPSK	100	1	0	27559.32	19.93	19.99	22.97
MIMO	Uplink	DFT-s-OFDM	QPSK	100	1	0	27923.52	19.96	19.97	22.98
MIMO	Uplink	DFT-s-OFDM	QPSK	100	1	0	28292.16	19.94	19.94	22.95
MINO	Uplink	DFT-S-OFDM	QPSK	400	1	0	27/01.88	19.97	19.94	22.97
MIMO	Unlink	DFT-S-OFDM	OPSK	400	1	0	27920.52	19.97	19.90	22.99
MIMO	Uplink	DFT-s-OFDM	160AM	100	Full	0	27559.32	19.97	19.96	22.98
MIMO	Uplink	DFT-s-OFDM	16QAM	100	Full	0	27923.52	19.95	19.99	22.98
MIMO	Uplink	DFT-s-OFDM	16QAM	100	Full	0	28292.16	19.98	19.95	22.98
MIMO	Uplink	DFT-s-OFDM	16QAM	400	Full	0	27701.88	19.95	19.96	22.97
MIMO	Uplink	DFT-s-OFDM	16QAM	400	Full	0	27926.52	19.99	19.91	22.96
MIMO	Uplink	DFT-s-OFDM	16QAM	400	Full	0	28140.96	19.99	19.89	22.95
MIMO	Uplink	DFT-s-OFDM	16QAM	100	1	0	27559.32	19.94	19.93	22.95
MIMO	Uplink	DFT-s-OFDM	16QAM	100	1	0	27923.52	19.99	19.95	22.98
MIMO	Uplink	DFT-S-OFDM	16QAM	100	1	0	28292.16	19.96	19.93	22.96
MIMO	Unlink	DFT-S-OFDM	160AM	400	1	0	27701.88	19.97	19.94	22.97
MIMO	Unlink	DFT-S-OFDM	160AM	400	1	0	27320.32	19.94	19.95	22.50
MIMO	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27559.32	19.94	19.96	22.96
MIMO	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27923.52	19.97	19.99	22.99
MIMO	Uplink	DFT-s-OFDM	64QAM	100	Full	0	28292.16	19.98	19.95	22.98
MIMO	Uplink	DFT-s-OFDM	64QAM	400	Full	0	27701.88	19.90	19.97	22.95
MIMO	Uplink	DFT-s-OFDM	64QAM	400	Full	0	27926.52	19.95	19.91	22.94
MIMO	Uplink	DFT-s-OFDM	64QAM	400	Full	0	28140.96	19.93	19.94	22.95
MIMO	Uplink	DFT-s-OFDM	64QAM	100	1	0	27559.32	19.98	19.98	22.99
MIMO	Uplink	DFT-s-OFDM	64QAM	100	1	0	27923.52	19.96	19.98	22.98
MIMO	Uplink	DFT-s-OFDM	64QAM	100	1	0	28292.16	19.96	19.93	22.96
	Uplink	DFT-S-OFDM	64QAIVI	400	1	0	27/01.88	19.98	19.93	22.97
MIMO	Unlink	DFT-S-OFDM	640AM	400	1	0	27320.32	19.91	19.90	22.95
MIMO	Uplink	DFT-s-OFDM	256QAM	100	Full	0	27559.32	19.93	19.97	22.96
MIMO	Uplink	DFT-s-OFDM	256QAM	100	Full	0	27923.52	19.99	19.99	23.00
MIMO	Uplink	DFT-s-OFDM	256QAM	100	Full	0	28292.16	19.97	19.96	22.98
MIMO	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27701.88	19.92	19.97	22.96
MIMO	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27926.52	19.92	19.90	22.92
MIMO	Uplink	DFT-s-OFDM	256QAM	400	Full	0	28140.96	19.93	19.98	22.97
MIMO	Uplink	DFT-s-OFDM	256QAM	100	1	0	27559.32	19.97	19.97	22.98
MIMO	Uplink	DFT-s-OFDM	256QAM	100	1	0	27923.52	19.97	19.97	22.98
MIMO	Uplink	DFT-s-OFDM	256QAM	100	1	0	28292.16	19.99	19.92	22.97
MIMO	Uplink	DFT & OFDIA	256QAM	400	1	0	27/01.88	19.92	19.94	22.94
	Uplink	DET & OFDIA	256QAM	400	1	0	2/926.52	19.98	19.96	22.98
UNIN	орилк	DE1-S-OFDIM	ZOBUAIVI	400	1	U	20140.96	та.ар	19.98	22.98

#### Table 7-9. Patch Conducted Power Summary Data (MIMO)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	COMMWARE COMMWARE	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 21 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 31 01 94
© 2010 DOTEST Engineering Labora	ton/ Inc			\/1.0



#### Note:

Per KDB 662911 D01 v02r01 Section E)2), the power at horizontal and vertical were first measured separately as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

#### Sample MIMO Calculation:

At 27559.32MHz in  $\pi/2$  BPSK with full resource blocks allocated the conducted power was measured to be 19.99dBm for the horizontal Antenna and 19.95 dBm for the vertical Antenna.

Antenna 1 + Antenna 2 = MIMO

(19.99 dBm + 19.95 dBm) = (99.77mW + 98.86mW) = 198.63 mW = 22.98dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 22 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 32 01 94
© 2019 PCTEST Engineering Laborat	V1.0			



# 7.4 Equivalent Isotropic Radiated Power §2.1046, §30.202(c)

#### **Test Overview**

Equivalent Isotropic Radiated Power (EIRP) measurements are performed using broadband horn antennas. All measurements are performed as RMS average measurements while the EUT is operating at the appropriate frequencies with the max power conditions found in the Conducted Power section of this report.

#### The average power of the sum of all antenna elements is limited to a maximum EIRP of +55 dBm.

#### **Test Procedures Used**

ANSI C63.26-2015 Section 5.2.4.4.1

#### Test Settings

- 1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
- 2. RBW = 1 5% of the expected OBW, not to exceed 1MHz
- 3. VBW  $\geq$  3 x RBW
- 4. Span = 2x to 3x the OBW
- 5. No. of sweep points  $\geq 2 \times \text{span} / \text{RBW}$
- 6. Detector = RMS
- 7. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
- 8. Trace mode = trace averaging (RMS) over 100 sweeps
- 9. The trace was allowed to stabilize

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager		
Test Report S/N:	Test Dates:	EUT Type:		Dage 22 of 04		
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 33 01 94		
© 2019 PCTEST Engineering Laboratory. Inc.						



- 1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.
- 2) The input signal to the EUT was set in order to produce the max power of the AGC range.
- 3) EIRP measurements were taken in the far field.
- 4) A signal generator fed a 5G nr mmWave signal into the EUT.
- 5) The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: EIRP (dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance (in the far field region) in m. The field strength E is calculated E (dBµV/m) = Spectrum Analyzer Channel Power Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + 107.

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 24 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 34 01 94
© 2019 PCTEST Engineering Laboration	V1.0			



#### HBF Equivalent Isotropic Radiated Power (EIRP) 7.4.1

Bandwidth [MHz]	Frequency [MHz]	Channel	Beam Pol	Modulation	Ant. Pol. [H/V]	Turntable Azimuth [degrees]	Azimuth Roll [degrees]	RB Size/Offset	EIRP [dBm]	MIMO EIRP [dBm]	Limit [dBm]	Margin [dB]
	27559.32	Low	н	QPSK	Н	0	0	Full RB	28.16	21 52	55.00	-26.84
-	27559.32	Low	v	QPSK	V	2	4	Full RB	28.83	51.52	55.00	-26.17
	27923.52	Mid	Н	QPSK	Н	1	0	Full RB	27.66	20 02	55.00	-27.34
	27923.52	Mid	V	QPSK	V	1	0	Full RB	27.96	30.82	55.00	-27.04
	28292.16	High	Н	QPSK	Н	2	2	Full RB	26.25	30 33	55.00	-28.75
100	28292.16	High	V	QPSK	V	1	6	Full RB	28.18	50.55	55.00	-26.82
100	27559.32	Low	н	16QAM	Н	0	0	Full RB	28.76	21 56	55.00	-26.24
	27559.32	Low	V	16QAM	V	2	4	Full RB	28.33	51.50	55.00	-26.67
	27923.52	Mid	Н	16QAM	Н	1	0	Full RB	26.90	30.61	55.00	-28.10
	27923.52	Mid	V	16QAM	V	1	0	Full RB	28.20	50.61	55.00	-26.80
	28292.16	High	Н	16QAM	Н	2	2	Full RB	27.60	20 50	55.00	-27.40
	28292.16	High	V	16QAM	V	1	6	Full RB	27.56	30.59	55.00	-27.44

Table 7-10. HBF EIRP -- 100MHz Bandwidth Full RB

Bandwidth [MHz]	Frequency [MHz]	Channel	Beam Pol	Modulation	Ant. Pol. [H/V]	Turntable Azimuth [degrees]	Azimuth Roll [degrees]	RB Size/Offset	EIRP [dBm]	MIMO EIRP [dBm]	Limit [dBm]	Margin [dB]
	27559.32	Low	н	QPSK	Н	0	0	1 RB	29.11	21 72	55.00	-25.89
	27559.32	Low	v	QPSK	v	2	3	1 RB	28.30	51.75	55.00	-26.70
	27923.52	Mid	Н	QPSK	Н	1	0	1 RB	28.17	21 11	55.00	-26.83
	27923.52	Mid	V	QPSK	V	1	0	1 RB	28.02	51.11	55.00	-26.98
	28292.16	High	Н	QPSK	Н	2	1	1 RB	26.14	29.84	55.00	-28.86
100	28292.16	High	V	QPSK	V	2	3	1 RB	27.42	23.04	55.00	-27.58
100	27559.32	Low	н	16QAM	н	0	0	1 RB	28.86	31 42	55.00	-26.14
	27559.32	Low	v	16QAM	v	2	3	1 RB	27.91	51.42	55.00	-27.09
	27923.52	Mid	Н	16QAM	Н	1	0	1 RB	28.00	20.81	55.00	-27.00
	27923.52	Mid	V	16QAM	V	1	0	1 RB	27.59	50.81	55.00	-27.41
	28292.16	High	н	16QAM	Н	2	1	1 RB	27.70	30.96	55.00	-27.30
	28292.16	High	V	16QAM	V	2	3	1 RB	28.19	30.90	55.00	-26.81

Table 7-11. HBF EIRP -- 100MHz Bandwidth 1 RB

Bandwidth [MHz]	Frequency [MHz]	Channel	Beam Pol	Modulation	Ant. Pol. [H/V]	Turntable Azimuth [degrees]	Azimuth Roll [degrees]	RB Size/Offset	EIRP [dBm]	MIMO EIRP [dBm]	Limit [dBm]	Margin [dB]
	27701.88	Low	н	QPSK	Н	2	1	Full RB	28.29	21 11	55.00	-26.71
	27701.88	Low	v	QPSK	v	7	3	Full RB	27.89	51.11	55.00	-27.11
	27926.52	Mid	Н	QPSK	Н	6	2	Full RB	27.83	20.54	55.00	-27.17
400	27926.52	Mid	V	QPSK	V	1	4	Full RB	27.20	30.34	55.00	-27.80
	28140.96	High	Н	QPSK	Н	8	4	Full RB	27.03	30.28	55.00	-27.97
	28140.96	High	V	QPSK	V	2	2	Full RB	27.50		55.00	-27.50
400	27701.88	Low	н	16QAM	H	2	1	Full RB	28.19	21 01	55.00	-26.81
	27701.88	Low	v	16QAM	v	7	3	Full RB	27.79	51.01	55.00	-27.21
	27926.52	Mid	Н	16QAM	Н	6	2	Full RB	28.03	20.02	55.00	-26.97
	27926.52	Mid	V	16QAM	V	1	4	Full RB	27.60	30.83	55.00	-27.40
	28140.96	High	Н	16QAM	Н	8	4	Full RB	27.23	30.65	55.00	-27.77
	28140.96	High	V	16QAM	V	2	2	Full RB	28.01	50.05	55.00	-26.99

Table 7-12. HBF EIRP -- 400MHz Bandwidth Full RB

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager					
Test Report S/N:	Test Dates:	EUT Type:		Dage 25 of 04					
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 35 01 94					
© 2019 PCTEST Engineering Laboratory, Inc.									



Bandwidth [MHz]	Frequency [MHz]	Channel	Beam Pol	Modulation	Ant. Pol. [H/V]	Turntable Azimuth [degrees]	Azimuth Roll [degrees]	RB Size/Offset	EIRP [dBm]	MIMO EIRP [dBm]	Limit [dBm]	Margin [dB]
	27701.88	Low	Н	QPSK	н	1	3	1 RB	27.67	20.06	55.00	-27.33
	27701.88	Low	v	QPSK	v	2	5	1 RB	28.21	30.90	55.00	-26.79
	27926.52	Mid	Н	QPSK	Н	5	3	1 RB	27.97	30.96	55.00	-27.03
	27926.52	Mid	V	QPSK	V	2	1	1 RB	27.92	30.90	55.00	-27.08
	28140.96	High	Н	QPSK	Н	4	1	1 RB	27.33	30.34	55.00	-27.67
400	28140.96	High	V	QPSK	V	1	3	1 RB	27.33	50.54	55.00	-27.67
400	27701.88	Low	Н	16QAM	Н	1	3	1 RB	27.98	20.69	55.00	-27.02
	27701.88	Low	V	16QAM	V	2	5	1 RB	27.33	30.08	55.00	-27.67
	27926.52	Mid	н	16QAM	н	5	3	1 RB	28.05	20.00	55.00	-26.95
	27926.52	Mid	v	16QAM	V	2	1	1 RB	27.91	30.99	55.00	-27.09
	28140.96	High	Н	16QAM	Н	4	1	1 RB	27.33	20.49	55.00	-27.67
	28140.96	High	V	16QAM	V	1	3	1 RB	27.60	30.46	55.00	-27.40

Table 7-13. HBF EIRP -- 400MHz Bandwidth 1 RB

#### Note:

Per KDB 662911 D01 v02r01 Section E)2), the power at horizontal and vertical were first measured separately as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

#### Sample MIMO Calculation:

At 27559.32MHz in QPSK with full resource blocks allocated the conducted power was measured to be 30.61dBm for the horizontal Antenna and 29.80dBm for the vertical Antenna.

Antenna 1 + Antenna 2 = MIMO

(29.11 dBm + 28.30dBm) = (814.7mW + 676.08mW) = 1490.78mW = 31.73dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager					
Test Report S/N:	Test Dates:	EUT Type:		Dage 26 of 04					
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Fage 30 01 94					
© 2019 PCTEST Engineering Laboratory, Inc.									


#### Patch Equivalent Isotropic Radiated Power (EIRP) 7.4.2

Bandwidth [MHz]	Frequency [MHz]	Channel	Beam Pol	Modulation	Ant. Pol. [H/V]	Turntable Azimuth [degrees]	Azimuth Roll [degrees]	RB Size/Offset	EIRP [dBm]	MIMO EIRP [dBm]	Limit [dBm]	Margin [dB]
	27559.32	Low	Н	QPSK	Н	357	3	Full RB	29.48	21 / 2	55.00	-25.52
	27559.32	Low	V	QPSK	V	4	12	Full RB	27.01	51.45	55.00	-27.99
	27923.52	Mid	Н	QPSK	Н	350	0	Full RB	29.42	22.46	55.00	-25.58
	27923.52	Mid	v	QPSK	V	5	358	Full RB	29.47	52.40	55.00	-25.53
	28292.16	High	Н	QPSK	Н	350	359	Full RB	27.70	21 56	55.00	-27.30
100	28292.16	High	V	QPSK	V	7	352	Full RB	29.25	51.50	55.00	-25.75
100	27559.32	Low	Н	16QAM	Н	357	3	Full RB	29.46	21 /0	55.00	-25.54
	27559.32	Low	V	16QAM	V	4	12	Full RB	27.21	51.45	55.00	-27.79
	27923.52	Mid	н	16QAM	Н	350	0	Full RB	29.03	22.22	55.00	-25.97
	27923.52	Mid	v	16QAM	V	5	358	Full RB	29.38	52.22	55.00	-25.62
	28292.16	High	Н	16QAM	Н	350	359	Full RB	26.78	21.21 55.00	55.00	-28.22
	28292.16	High	V	16QAM	V	7	352	Full RB	29.43	51.51	55.00	-25.57

Table 7-14. Patch EIRP -- 100MHz Bandwidth Full RB

Bandwidth [MHz]	Frequency [MHz]	Channel	Beam Pol	Modulation	Ant. Pol. [H/V]	Turntable Azimuth [degrees]	Azimuth Roll [degrees]	RB Size/Offset	EIRP [dBm]	MIMO EIRP [dBm]	Limit [dBm]	Margin [dB]
	27559.32	Low	Н	QPSK	Н	357	3	1 RB	27.16	20 12	55.00	-27.84
	27559.32	Low	V	QPSK	V	4	12	1 RB	25.51	29.42	55.00	-29.49
	27923.52	Mid	Н	QPSK	Н	350	0	1 RB	26.14	20.00	55.00	-28.86
	27923.52	Mid	V	QPSK	V	5	358	1 RB	26.02	29.09	55.00	-28.98
	28292.16	High	Н	QPSK	н	350	359	1 RB	27.66	20.92	55.00	-27.34
100	28292.16	High	v	QPSK	V	7	352	1 RB	25.75	25.02	55.00	-29.25
100	27559.32	Low	Н	16QAM	Н	357	3	1 RB	26.20	28 64	55.00	-28.80
	27559.32	Low	V	16QAM	V	4	12	1 RB	24.96	20.04	55.00	-30.04
	27923.52	Mid	Н	16QAM	H	350	0	1 RB	26.45	20.46	55.00	-28.55
	27923.52	Mid	v	16QAM	V	5	358	1 RB	26.45	23.40	55.00	-28.55
	28292.16	High	Н	16QAM	Н	350	359	1 RB	26.11	29.01	55.00	-28.89
	28292.16	High	V	16QAM	V	7	352	1 RB	25.88	29.01	55.00	-29.12

Table 7-15. Patch EIRP -- 100MHz Bandwidth 1 RB

Bandwidth [MHz]	Frequency [MHz]	Channel	Beam Pol	Modulation	Ant. Pol. [H/V]	Turntable Azimuth [degrees]	Azimuth Roll [degrees]	RB Size/Offset	EIRP [dBm]	MIMO EIRP [dBm]	Limit [dBm]	Margin [dB]
	27701.88	Low	Н	QPSK	H	355	359	Full RB	28.31	20 72	55.00	-26.69
	27701.88	Low	v	QPSK	v	5	5	Full RB	27.02	50.72	55.00	-27.98
	27926.52	Mid	Н	QPSK	Н	353	11	Full RB	28.13	20.60	55.00	-26.87
	27926.52	Mid	V	QPSK	V	349	358	Full RB	27.18	30.09	55.00	-27.82
	28140.96	High	Н	QPSK	Н	348	4	Full RB	26.49	20.06	55.00	-28.51
400	28140.96	High	V	QPSK	V	355	2	Full RB	27.54	50.00	55.00	-27.46
400	27701.88	Low	Н	16QAM	Н	355	359	Full RB	27.91	20.22	55.00	-27.09
	27701.88	Low	V	16QAM	V	5	5	Full RB	26.63	50.55	55.00	-28.37
	27926.52	Mid	н	16QAM	Н	353	11	Full RB	27.70	20.94	55.00	-27.30
	27926.52	Mid	v	16QAM	v	349	358	Full RB	27.95	50.04	55.00	-27.05
	28140.96	High	Н	16QAM	Н	348	4	Full RB	26.09	20.17	55.00	-28.91
	28140.96	High	V	16QAM	V	355	2	Full RB	28.02	50.17	55.00	-26.98

Table 7-16. Patch EIRP -- 400MHz Bandwidth Full RB

FCC ID: 2AUVU-OES3	PCTEST	MEASUREMENT REPORT	PIVOTAL"	Approved by:			
	A SHERRER PRESS	(CERTIFICATION)	COMMWARE	Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:		Dogo 27 of 04			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Fage 37 01 94			
© 2019 PCTEST Engineering Laboratory, Inc. V1							

© 2019 PCTEST Engineering Laboratory, Inc.



Bandwidth [MHz]	Frequency [MHz]	Channel	Beam Pol	Modulation	Ant. Pol. [H/V]	Turntable Azimuth [degrees]	Azimuth Roll [degrees]	RB Size/Offset	EIRP [dBm]	MIMO EIRP [dBm]	Limit [dBm]	Margin [dB]
	27701.88	Low	н	QPSK	Н	355	359	1 RB	28.20	20.11	55.00	-26.80
	27701.88	Low	v	QPSK	v	5	5	1 RB	25.62	50.11	55.00	-29.38
	27926.52	Mid	Н	QPSK	Н	353	11	1 RB	27.59	20.91	55.00	-27.41
	27926.52	Mid	V	QPSK	V	349	358	1 RB	25.82	29.01	55.00	-29.18
	28140.96	High	Н	QPSK	Н	348	4	1 RB	26.25	20.74	55.00	-28.75
400	28140.96	High	V	QPSK	V	2	4	1 RB	27.16	29.74	55.00	-27.84
400	27701.88	Low	н	16QAM	н	355	359	1 RB	28.03	20.02	55.00	-26.97
	27701.88	Low	v	16QAM	V	5	5	1 RB	25.42	29.93	55.00	-29.58
	27926.52	Mid	Н	16QAM	Н	353	11	1 RB	27.67	20.60	55.00	-27.33
	27926.52	Mid	V	16QAM	V	349	358	1 RB	25.40	29.09	55.00	-29.60
	28140.96	High	Н	16QAM	Н	348	4	1 RB	26.85	20.66 55.00	55.00	-28.15
	28140.96	High	V	16QAM	V	355	2	1 RB	26.43	29.00	55.00	-28.57

Table 7-17. Patch EIRP -- 400MHz Bandwidth 1 RB

#### Note:

Per KDB 662911 D01 v02r01 Section E)2), the power at horizontal and vertical were first measured separately as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

### Sample MIMO Calculation:

At 27559.32MHz in QPSK with full resource blocks allocated the conducted power was measured to be 29.48dBm for the horizontal Antenna and 27.01dBm for the vertical Antenna.

Antenna 1 + Antenna 2 = MIMO

(29.48 dBm + 27.01 dBm) = (887.16mW + 502.34mW) = 1389.50mW = 31.43dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager		
Test Report S/N:	Test Dates:	EUT Type:		Dogo 29 of 04		
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Fage 30 01 94		
© 2019 PCTEST Engineering Laboratory, Inc.						



# 7.5 Radiated Spurious and Harmonic Emissions §2.1051, §30.203

#### Test Overview

The spectrum is scanned from 30MHz to 100GHz. All out of band emissions are measured in a radiated test setup while the EUT is operating at the appropriate frequencies with the max power conditions found in the Conducted Power section of this report. All modulations were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

## The conductive power or total radiated power of any emissions outside a licensee's frequency block shall be -13dBm/1MHz.

#### Test Procedure Used

ANSI C63.26-2015 Section 5.7.4

#### Test Settings

- 1. Start frequency was set to 30MHz and stop frequency was set to 100 GHz. Several plots are used to show investigations in this entire span.
- 2. Detector = RMS
- 3. Trace mode = trace average
- 4. Sweep time = auto couple
- 5. Number of sweep points  $\ge 2 \times \text{Span/RBW}$
- 6. The trace was allowed to stabilize
- 7. RBW = 1MHz, VBW = 3MHz

#### Test Notes

- The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below. The worst case found was QPSK, 1RB and was tested as such.
- 2) All radiated spurious emissions were measured as EIRP to compare with the §30.203 TRP limits.
- 3) The plots from 1-100GHz show corrected average EIRP levels. Plots below 1GHz are corrected field strength levels. The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: EIRP (dBm) = E (dBµV/m) + 20log(D) 104.8; where D is the measurement distance (in the far field region) in m. The field strength E is calculated E (dBµV/m) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + Harmonic Mixer Conversion Loss (dB) + 107. All appropriate Antenna Factor and Cable Loss have been applied in the spectrum analyzer for each measurement. For measurements > 40GHz, Harmonic Mixer Conversion Loss was also applied to the spectrum analyzer.
- 4) Emissions below 18GHz were measured at a 3 meter test distance, while emissions above 18GHz were measured at the appropriate far field distance. The far field of the mmWave signal is based on formula: R > 2D^2/wavelength, where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT.
- 5) All emissions from 30MHz 40GHz were measured using a spectrum analyzer with an internal preamplifier. Emissions >40GHz were measured using a harmonic mixer with the spectrum analyzer.
- 6) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:					
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 39 01 94			
© 2019 PCTEST Engineering Laboratory Inc.							



## 7.5.1 HBF Antenna Radiated Spurious Emissions



## 30MHz – 1GHz

Plot 7-21. HBF Antenna Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Mid Channel H Beam)



Plot 7-22. HBF Antenna Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Mid Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:		Dage 40 of 04			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 40 01 94			
© 2019 PCTEST Engineering Laboratory, Inc.							





Plot 7-23. HBF Antenna Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel H Beam)



Plot 7-24. HBF Antenna Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	PIVOTAL"	Approved by: Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:		Dage 41 of 04			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 41 01 94			
© 2019 PCTEST Engineering Laboratory, Inc.							





Plot 7-25. HBF Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Low Channel H Beam)



Plot 7-26. HBF Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Mid Channel H Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	COMMWARE COMMWARE	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dogo 42 of 04
1M1909170154-01-R1.2AUVU	54-01-R1.2AUVU 10/7/2019-11/27/2019 5G mmWave Repeater		Page 42 01 94	
© 2010 DCTEST Engineering Labora	1/1.0			





Plot 7-27. HBF Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK High Channel H Beam)



Plot 7-28. HBF Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Low Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:		Page 43 of 04			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Faye 43 01 94			
© 2019 PCTEST Engineering Laboratory. Inc.							





Plot 7-29. HBF Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Mid Channel V Beam)



Plot 7-30. HBF Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK High Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager				
Test Report S/N:	Test Dates:	EUT Type:						
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 44 01 94				
© 2019 PCTEST Engineering Laboratory, Inc. V								



## **Spurious Emissions EIRP Sample Calculation**

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

Margin [dB] -22.08 -21.62 -23.24 -29.11 -22.40

-22.16

Frequency [MHz]	Detector/Trace	Chan.	Bandwidth (MHz)	Mod.	EUT Beam Polarization	Ant. Pos [H/V]	Positioner Azimuth roll [degree]	Turn Table Azimuth [degree]	RSE EIRP [dBm]	Limit [dBm]
27210.00	RMS/MaxH	Low	100	QPSK	Н	Н	0	359	-35.08	-13.00
27270.90	RMS/MaxH	Mid	100	QPSK	Н	Н	2	3	-34.62	-13.00
27230.60	RMS/MaxH	High	100	QPSK	Н	Н	3	4	-36.24	-13.00
26781.60	RMS/MaxH	Low	100	QPSK	V	V	5	6	-42.11	-13.00
27336.10	RMS/MaxH	Mid	100	QPSK	V	V	355	7	-35.40	-13.00
27297.70	RMS/MaxH	High	100	QPSK	V	V	2	4	-35.16	-13.00

RSE EIRP [dBm] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) - 104.8

Table 7-18. HBF Antenna Spurious Emissions Table (18-27.375GHz)

#### <u>Notes</u>

- 1. Plots 7-25 through 7-30 show spurious emission measurements from 18 27.375GHz. The portion of spectrum from 27.375 27.5GHz is shown Section 7.6 which covers band edge emissions.
- 2. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.
- 3. To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

(-35.08 dBm + -42.11 dBm) = (310.46 nW + 61.52 nW) = (372.39nW) = -34.429 dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager		
Test Report S/N:	Report S/N: Test Dates: EUT Type:		Dage 45 of 04			
1M1909170154-01-R1.2AUVU 10/7/2019-11/27/2019		5G mmWave Repeater	Page 45 of 94			
© 2019 PCTEST Engineering Laboratory. Inc. V1.						





Plot 7-31. HBF Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Low Channel H Beam)



Plot 7-32. HBF Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Mid Channel H Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 46 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Fage 40 01 94
© 2010 DCTEST Engineering Labora	1/1.0			





Plot 7-33. HBF Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK High Channel H Beam)



Plot 7-34. HBF Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Low Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:		Dogo 47 of 04			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Fage 47 01 94			
© 2019 PCTEST Engineering Laboratory, Inc. V1.0							





Plot 7-35. HBF Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Mid Channel V Beam)



Plot 7-36. HBF Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK High Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager			
Test Report S/N:	Report S/N: Test Dates: EUT Type:						
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 46 01 94			
© 2019 PCTEST Engineering Laboratory, Inc. V1							



## **Spurious Emissions EIRP Sample Calculation**

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

Frequency [MHz]	Detector/Trace	Chan.	Bandwidth (MHz)	Mod.	EUT Beam Polarization	Ant. Pos [H/V]	Positioner Azimuth roll [degree]	Turn Table Azimuth [degree]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
28631.10	RMS/MaxH	Low	100	QPSK	Н	Н	3	358	-39.08	-13.00	-26.08
28537.40	RMS/MaxH	Mid	100	QPSK	Н	Н	355	4	-37.93	-13.00	-24.93
28644.20	RMS/MaxH	High	100	QPSK	Н	Н	0	3	-38.49	-13.00	-25.49
28670.40	RMS/MaxH	Low	100	QPSK	V	V	6	357	-36.47	-13.00	-23.47
29868.60	RMS/MaxH	Mid	100	QPSK	V	V	5	3	-43.29	-13.00	-30.29
28579.20	RMS/MaxH	High	100	QPSK	V	V	0	7	-36.48	-13.00	-23.48

RSE EIRP [dBm] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) - 104.8

 Table 7-19. HBF Antenna Spurious Emissions Table (28.475-40 GHz)

#### <u>Notes</u>

- 1. Plots 7-31 through 7-36 show spurious emission measurements from 28.475 40GHz. The portion of spectrum from 28.35 28.475GHz is shown Section 7.6 which covers band edge emissions.
- 2. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.
- 3. To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

(-39.08 dBm + -36.47 dBm) = (123.59 nW + 225.42 nW) = (349.14 nW) = -34.57 dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager		
Test Report S/N: Test Dates: EUT Type:			Dogo 40 of 04			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 49 01 94		
© 2019 PCTEST Engineering Laboratory, Inc.						





Plot 7-37. HBF Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK Low Channel H Beam)



Plot 7-38. HBF Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK Mid Channel H Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Daga E0 of 04
1M1909170154-01-R1.2AUVU 10/7/2019-11/27/2019		5G mmWave Repeater	Fage 50 01 94	
© 2010 DOTECT Engineering Labors	ton loo			1/4.0





Plot 7-39. HBF Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK High Channel H Beam)



Plot 7-40. HBF Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK Low Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager		
Test Report S/N:	Test Dates:	EUT Type:		Daga E1 of 01		
1M1909170154-01-R1.2AUVU	909170154-01-R1.2AUVU 10/7/2019-11/27/2019 5G mmWave Repeater		Page 51 01 94			
© 2019 PCTEST Engineering Laboratory Inc						





Plot 7-41. HBF Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK Mid Channel V Beam)



Plot 7-42. HBF Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK High Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:		Dogo 52 of 04			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 52 01 94			
© 2019 PCTEST Engineering Laboratory. Inc. V1.0							



## **Spurious Emissions EIRP Sample Calculation**

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1.5 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) + Harmonic Mixer Loss (dB) - 104.8

Frequency [MHz]	Detector/Trace	Chan.	Bandwidth (MHz)	Mod.	EUT Beam Polarization	Ant. Pos [H/V]	Positioner Azimuth roll [degree]	Turn Table Azimuth [degree]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
59523.00	RMS/MaxH	Low	100	QPSK	Н	Н	-	-	-30.30	-13.00	-17.30
59547.50	RMS/MaxH	Mid	100	QPSK	Н	Н	-	-	-29.83	-13.00	-16.83
59510.00	RMS/MaxH	High	100	QPSK	Н	Н	-	-	-29.69	-13.00	-16.69
59578.50	RMS/MaxH	Low	100	QPSK	V	V	-	-	-29.14	-13.00	-16.14
59573.00	RMS/MaxH	Mid	100	QPSK	V	V	-	-	-29.84	-13.00	-16.84
58839.00	RMS/MaxH	High	100	OPSK	V	V	-	-	-30 49	-13.00	-17.49

Table 7-20. HBF Antenna Spurious Emissions Table (40 - 60GHz)

#### <u>Notes</u>

- 1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1.5 meter.
- To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

(-30.30 dBm + -29.14 dBm) = (933.25 nW + 1218.99 nW) = (2152.78 nW) = -26.67 dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	PIVOTAL"	Approved by: Quality Manager		
Test Report S/N:	Test Dates:	EUT Type:		Dage 52 of 04		
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 53 01 94		
© 2019 PCTEST Engineering Laboratory, Inc.						





Plot 7-43. HBF Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK Low Channel H Beam)

Keysight S	pectrum Analyzer - Sw	rept SA									
LXI RL	EXT MIXER	C	DRREC	SE	NSE:INT	#Avg Typ	e: RMS	12:07:33 AM TRAC	1 Oct 24, 2019 E 1 2 3 4 5 6	Fre	equency
PASS			PNO:Fast 🕞 EGain:Low	Trig: Fre #Atten: 0	e Run dB	Avg Hold:	>100/100	TYP DE			
			Junizon				Mkr	1 89.396	0 GHz		Auto Tune
10 dB/div	Ref -10.00	dBm						-27.2	88 dBm		
Tra	ce 1 Pass				Ĭ					0	enter Freg
-20.0										75.000	0000000 GHz
-30.0					मुर्ग्धाः स्वयन् भित्रस्य			Jula de tetra te			Start Freq
-40.0										60.000	0000000 GHz
-40.0											
-50.0											Stop Freg
										90.000	000000 GHz
-60.0											
-70.0											CF Step
										3.000 Auto	Man
-80.0											
										F	Freq Offset
-90.0											0 Hz
-100											
										:	Scale Type
Start 60.	00 GHz							Stop 9	0.00 GHz	Log	Lin
#Res BW	/ 1.0 MHz		#VBV	V 3.0 MHz	*	s	weep 40	.00 ms (6	0001 pts)		
MSG							STATUS				

Plot 7-44. HBF Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK Mid Channel H Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	PIVOTAL"	Approved by: Quality Manager				
Test Report S/N:	Test Dates:	EUT Type:		Dogo E4 of 04				
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 54 01 94					
© 2019 PCTEST Engineering Laboratory, Inc.								

© 2019 PCTEST Engineering Laboratory, Inc.





Plot 7-45. HBF Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK High Channel H Beam)



Plot 7-46. HBF Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK Low Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage EE of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 55 01 94
© 2019 PCTEST Engineering Laboration	tory Inc		V1.0



🔤 Keysight	Spectrum Analyzer - Sv	vept SA								
L <mark>XI</mark> RL	EXT MIXER	C	ORREC	SEN	ISE:INT	#Avg Typ	e: RMS	11:43:58 PI TRAC	M Oct 23, 2019 E 1 2 3 4 5 6	Frequency
PASS	Ref -10.00	dBm	PNO: Fast FGain:Low	#Atten: 0	dB	Avginoid	Mkr	1 89.60 -27.1	0 5 GHz 22 dBm	Auto Tune
-20.0	ace 1 Pass									Center Freq 75.00000000 GHz
-30.0 ( <del>1997)</del> -40.0				i sedişdir. Başırtışı Alasıda Tarkan başını Ayanan Ala						<b>Start Freq</b> 60.000000000 GHz
-50.0										<b>Stop Freq</b> 90.000000000 GHz
-70.0										CF Step 3.000000000 GHz <u>Auto</u> Man
-90.0										<b>Freq Offset</b> 0 Hz
-100										Scale Type
Start 60 #Res B	).00 GHz W 1.0 MHz		#VBW	3.0 MHz*	*	s	weep 40	Stop 9 .00 ms <u>(6</u>	0.00 GHz 0001 pts)	Log <u>Lin</u>
MSG							STATUS			

Plot 7-47. HBF Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK Mid Channel V Beam)



Plot 7-48. HBF Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK High Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager					
Test Report S/N:	Test Dates:	EUT Type:		Daga FC of 04					
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 56 01 94					
© 2019 PCTEST Engineering Laboratory. Inc.									



## **Spurious Emissions EIRP Sample Calculation**

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) + Harmonic Mixer Loss (dB) - 104.8

Frequency [MHz]	Detector/Trace	Chan.	Bandwidth (MHz)	Mod.	EUT Beam Polarization	Ant. Pos [H/V]	Positioner Azimuth roll [degree]	Turn Table Azimuth [degree]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
89152.00	RMS/MaxH	Low	100	QPSK	Н	Н	-	-	-27.24	-13.00	-14.24
89396.00	RMS/MaxH	Mid	100	QPSK	Н	Н	-	-	-27.29	-13.00	-14.29
88847.00	RMS/MaxH	High	100	QPSK	Н	Н	-	-	-26.64	-13.00	-13.64
89412.00	RMS/MaxH	Low	100	QPSK	V	V	-	-	-27.11	-13.00	-14.11
89600.50	RMS/MaxH	Mid	100	QPSK	V	V	-	-	-27.12	-13.00	-14.12
89361 50	RMS/MaxH	High	100	OPSK	V	V	-	-	-26.02	-13.00	-13.02

Table 7-21. HBF Antenna Spurious Emissions Table (60-90GHz)

#### <u>Notes</u>

- 1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.
- To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

 $(-27.24 \text{ dBm} + -27.11 \text{ dBm}) = (1.89 \mu\text{W} + 1.95 \mu\text{W}) = (3.84 \mu\text{W}) = -24.16 \text{ dBm}$ 

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager				
Test Report S/N:	Test Dates:	EUT Type:		Daga FZ of 04				
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 57 01 94				
© 2019 PCTEST Engineering Laboratory, Inc.								





Plot 7-49. HBF Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Low Channel H Beam)



Plot 7-50. HBF Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Mid Channel H Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage EQ of 04
1M1909170154-01-R1.2AUVU	170154-01-R1.2AUVU 10/7/2019-11/27/2019 5G mmWave Repeater		Fage 50 01 94	
@ 2010 DOTECT Engineering Labore	ton loo			1/4.0





Plot 7-51. HBF Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK High Channel H Beam)



Plot 7-52. HBF Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Low Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager					
Test Report S/N:	Test Dates:	EUT Type:		Dage E0 of 04					
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 59 01 94					
© 2019 PCTEST Engineering Laboratory. Inc.									





Plot 7-53. HBF Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Mid Channel V Beam)



Plot 7-54. HBF Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK High Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager					
Test Report S/N:	Test Dates:	EUT Type:		Dage 60 of 04					
1M1909170154-01-R1.2AUVU	09170154-01-R1.2AUVU 10/7/2019-11/27/2019 5G mmWave Repeater			Page 60 01 94					
© 2019 PCTEST Engineering Laboratory. Inc.									



## **Spurious Emissions EIRP Sample Calculation**

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL[dB/m] + 20Log(Dm) + Harmonic Mixer Loss (dB) – 104.8

Frequency [MHz]	Detector/Trace	Chan.	Bandwidth (MHz)	Mod.	EUT Beam Polarization	Ant. Pos [H/V]	Positioner Azimuth roll [degree]	Turn Table Azimuth [degree]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
96165.00	RMS/MaxH	Low	100	QPSK	Н	Н	-	-	-24.39	-13.00	-11.39
96036.00	RMS/MaxH	Mid	100	QPSK	Н	Н	-	-	-23.62	-13.00	-10.62
96168.50	RMS/MaxH	High	100	QPSK	Н	Н	-	-	-23.85	-13.00	-10.85
96414.50	RMS/MaxH	Low	100	QPSK	V	V	-	-	-24.11	-13.00	-11.11
96527.50	RMS/MaxH	Mid	100	QPSK	V	V	-	-	-23.85	-13.00	-10.85
90049.50	RMS/MaxH	High	100	QPSK	V	V	-	-	-23.97	-13.00	-10.97

Table 7-22. HBF Antenna Spurious Emissions Table (90-100GHz)

#### Notes

- 1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.
- To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

 $(-24.39 \text{ dBm} + -24.11 \text{ dBm}) = (3.64 \mu\text{W} + 3.88 \mu\text{W}) = (7.52 \mu\text{W}) = -21.24 \text{ dBm}$ 

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager				
Test Report S/N:	Test Dates:	EUT Type:		Dage 61 of 04				
1M1909170154-01-R1.2AUVU 10/7/2019-11/27/2019 5G		5G mmWave Repeater	Page 61 01 94					
© 2019 PCTEST Engineering Laboratory. Inc.								







Plot 7-55. Patch Antenna Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Mid Channel H Beam)



Plot 7-56. Patch Antenna Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Mid Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	COMMWARE COMMWARE	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 62 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 62 01 94
© 2019 PCTEST Engineering Laboration	V1.0			





RBW: 1 MHz VBW: 3 MHz SWT: 68.0ms

Plot 7-57. Patch Antenna Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel H Beam)



Plot 7-58. Patch Antenna Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:		Dage 62 of 04			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 63 01 94			
© 2019 PCTEST Engineering Laboratory. Inc.							



### 18 – 27.375<u>GHz</u>



Plot 7-59. Patch Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Low Channel H Beam)



Plot 7-60. Patch Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Mid Channel H Beam)

				Approved by:			
FCC ID: 2AUVU-OES3	C ID: 2AUVU-OES3		COMMWARE	Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:					
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 64 01 94			
© 2019 PCTEST Engineering Laboratory. Inc.							





Plot 7-61. Patch Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK High Channel H Beam)



Plot 7-62. Patch Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Low Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:		Dage CE of 04			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 65 01 94			
© 2019 PCTEST Engineering Laboratory, Inc.							





Plot 7-63. Patch Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Mid Channel V Beam)



Plot 7-64. Patch Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK High Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:					
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 66 01 94			
© 2019 PCTEST Engineering Laboratory. Inc.							



## **Spurious Emissions EIRP Sample Calculation**

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

RSE EIRP [dBm] = Analyzer Level [dBm]	+ 107 + AFCL [dB/m] + 20Log(Dm) – 104.8
---------------------------------------	---

Frequency [MHz]	Detector/Trace	Chan.	Bandwidth (MHz)	Mod.	EUT Beam Polarization	Ant. Pos [H/V]	Positioner Azimuth roll [degree]	Turn Table Azimuth [degree]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
27361.90	RMS/MaxH	Low	100	QPSK	Н	Н	0	5	-27.98	-13.00	-14.98
26789.10	RMS/MaxH	Mid	100	QPSK	Н	Н	2	1	-38.44	-13.00	-25.44
27368.00	RMS/MaxH	High	100	QPSK	Н	Н	4	0	-39.36	-13.00	-26.36
27357.70	RMS/MaxH	Low	100	QPSK	V	V	356	3	-42.53	-13.00	-29.53
27267.70	RMS/MaxH	Mid	100	QPSK	V	V	3	1	-42.07	-13.00	-29.07
27322.50	RMS/MaxH	High	100	QPSK	V	V	2	359	-42.61	-13.00	-29.61

#### Notes

- 1. Plots 7-59 through 7-64 show spurious emission measurements from 18 27.375GHz. The portion of spectrum from 27.375 27.5GHz is shown Section 7.6 which covers band edge emissions.
- 2. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.
- To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

(-27.98 dBm + -42.53 dBm) = (1.59 uW + 55.85 nW) = (1.65 uW) = -27.83 dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:		Dage 67 of 04			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 67 01 94			
© 2019 PCTEST Engineering Laboratory. Inc.							





Plot 7-65. Patch Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Low Channel H Beam)



Plot 7-66. Patch Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Mid Channel H Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager			
Test Report S/N:	Test Dates:	EUT Type:		Dogo 69 of 04			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 66 01 94			





Plot 7-67. Patch Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK High Channel H Beam)



Plot 7-68. Patch Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Low Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	PIVOTAL"	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 60 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 69 01 94
© 2019 PCTEST Engineering Labora	tory. Inc.			V1.0



🔤 Keysight Spec	trum Analyzer - Swep	ot SA								
LXI RL	RF 50 Ω	DC CORREC	Tria	SENSE:INT	Avg Type	: RMS	10:54:16 PM TRAC	E 1 2 3 4 5 6	Frequ	ency
	LNP	PNO: Fa IFGain:H	ast ⊂⊃ ing: igh #Atte	en: 0 dB	Avginoid	>100/100	DE	ANNNN		
10 dB/div	Ref -30.00 d	IBm				Mk	r1 28.50 -37.2	5 3 GHz 29 dBm	Au	to Tune
-40.0								DL1 -13.00 dBm	Cent 34.237500	t <b>er Freq</b> 1000 GHz
-60.0			en Diffing <mark>Halas</mark> Ann Na Starge Lander for t	n an an an an an an an an Anna an Anna an Anna an Anna A Anna Anna		de la de la grada de la seconda de la se Seconda de la seconda de la Seconda de la seconda de la	in de lange (norder de la de lange) nord de lange (nord de la de lange (nord de la de l nord de la de l	ang dina pang dina dina dina dina dina dina dina dina	Sta 28.475000	a <b>rt Freq</b> 1000 GHz
-70.0									St 40.000000	<b>op Freq</b> 1000 GHz
-90.0									( 1.152500 <u>Auto</u>	C <b>F Step</b> 1000 GHz Man
-110									Fre	q <b>Offset</b> 0 Hz
-120									Sca	le Type
Start 28.47 #Res BW	75 GHz 1.0 MHz	#	VBW 3.0 N	IHz*	s	weep_2	Stop 40 0.80 ms (2	.000 GHz 4001 pts)	Log	Lin
MSG						STATU	IS			

Plot 7-69. Patch Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Mid Channel V Beam)



Plot 7-70. Patch Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK High Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager		
Test Report S/N:	Test Dates:	EUT Type:		Dage 70 of 04		
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 70 01 94		
© 2019 PCTEST Engineering Laboratory, Inc.						



## **Spurious Emissions EIRP Sample Calculation**

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

Frequency [MHz]	Detector/Trace	Chan.	Bandwidth (MHz)	Mod.	EUT Beam Polarization	Ant. Pos [H/V]	Positioner Azimuth roll [degree]	Turn Table Azimuth [degree]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
29684.60	RMS/MaxH	Low	100	QPSK	Н	Н	6	4	-37.75	-13.00	-24.75
29285.60	RMS/MaxH	Mid	100	QPSK	Н	Н	7	1	-39.64	-13.00	-26.64
29504.10	RMS/MaxH	High	100	QPSK	Н	Н	359	0	-37.30	-13.00	-24.30
28632.50	RMS/MaxH	Low	100	QPSK	V	V	0	357	-43.28	-13.00	-30.28
28505.30	RMS/MaxH	Mid	100	QPSK	V	V	3	5	-37.23	-13.00	-24.23
28599.40	RMS/MaxH	High	100	QPSK	V	V	358	2	-37.83	-13.00	-24.83

RSE EIRP [dBm] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) - 104.8

 Table 7-24. Patch Antenna Spurious Emissions Table (28.475-40 GHz)

#### <u>Notes</u>

- 1. Plots 7-65 through 7-70 show spurious emission measurements from 28.475 40GHz. The portion of spectrum from 28.35 28.475GHz is shown Section 7.6 which covers band edge emissions.
- 2. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.
- 3. To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

(-37.75 dBm + -37.30 dBm) = (167.88 nW + 186.21 nW) = (354.09 nW) = -34.51 dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 71 of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page / 1 01 94	
© 2019 PCTEST Engineering Laboratory. Inc.					





Plot 7-71. Patch Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK Low Channel H Beam)



Plot 7-72. Patch Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK Mid Channel H Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager		
Test Report S/N:	Test Dates:	EUT Type:		Dogo 70 of 04		
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 72 01 94		
© 2019 PCTEST Engineering Laboratory, Inc.						




Plot 7-73. Patch Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK High Channel H Beam)



Plot 7-74. Patch Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK Low Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Daga 72 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 73 01 94
© 2019 PCTEST Engineering Laboration	tory Inc		V1.0





Plot 7-75. Patch Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK Mid Channel V Beam)



Plot 7-76. Patch Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK High Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager					
Test Report S/N:	Test Dates:	EUT Type:		Dage 74 of 04					
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 74 01 94					
© 2019 PCTEST Engineering Laboratory, Inc.									



#### **Spurious Emissions EIRP Sample Calculation**

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1.5 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) - 104.8 + Harmonic Mixer Loss [dB]

Frequency [MHz]	Detector/Trace	Chan.	Bandwidth (MHz)	Mod.	EUT Beam Polarization	Ant. Pos [H/V]	Positioner Azimuth roll [degree]	Turn Table Azimuth [degree]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
59691.50	RMS/MaxH	Low	100	QPSK	Н	Н	-	-	-30.19	-13.00	-17.19
54628.00	RMS/MaxH	Mid	100	QPSK	Н	Н	-	-	-30.18	-13.00	-17.18
59997.50	RMS/MaxH	High	100	QPSK	Н	Н	-	-	-30.27	-13.00	-17.27
59475.00	RMS/MaxH	Low	100	QPSK	V	V	-	-	-30.56	-13.00	-17.56
55716.00	RMS/MaxH	Mid	100	QPSK	V	V	-	-	-30.69	-13.00	-17.69
59600.50	RMS/MaxH	High	100	QPSK	V	V	-	-	-30.14	-13.00	-17.14

Table 7-25. Patch Antenna Spurious Emissions Table (40 - 60GHz)

#### Notes

- 1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1.5 meter.
- To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

(-30.19 dBm + -30.56 dBm) = (957.19 nW + 879.02 nW) = (1.836 uW) = -27.36 dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 75 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 75 01 94
© 2019 PCTEST Engineering Laboration	tory. Inc.		V1.0





Plot 7-77. Patch Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK Low Channel H Beam)



FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	PIVOTAL"	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 76 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 76 01 94
© 2019 PCTEST Engineering Laboration	tory, Inc.			V1.0





Plot 7-79. Patch Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK High Channel H Beam)



Plot 7-80. Patch Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK Low Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 77 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 77 01 94
© 2019 PCTEST Engineering Laboration	tory Inc		V1.0



🔤 Key	sight Spec	trum Analyzer -	Swept SA									
<b>lxi</b> Rl	- E	XT MIXER		CORREC	SE	NSE:INT	#Avg Typ	e: RMS	11:13:13 PI TRAC	1 Oct 26, 2019 E 1 2 3 4 5 6	Fr	equency
<b>PAS</b>	S 3/div	Ref -10.0	0 dBm	PNO: Fast G	#Atten: 0	e Run ) dB	AvgiHold	:>100/100 Mki	1 89.29 <sup>°</sup> -27.8	1 5 GHz 45 dBm		Auto Tune
Log -20.0	Trace	1 Pass								1	<b>C</b> 75.000	e <b>nter Freq</b> 0000000 GHz
-30.0											60.000	Start Freq
-50.0 -60.0											90.000	Stop Freq 0000000 GHz
-70.0 - -80.0 -											3.000 <u>Auto</u>	<b>CF Step</b> 0000000 GHz Man
-90.0											-	F <b>req Offset</b> 0 Hz
-100											:	Scale Type
Start #Res	t 60.00 s BW 1	GHz .0 MHz		#VBN	V 3.0 MHz	*	s	weep 40	Stop 9 0.00 ms (6	0.00 GHz 0001 pts)	Log	Lin
MSG								STATU	s			

Plot 7-81. Patch Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK Mid Channel V Beam)



Plot 7-82. Patch Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK High Channel V Beam)

FCC ID: 2AUVU-OES3	Test Dates: E   10/7/2019-11/27/2019 5   rv, Inc. 5	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager		
Test Report S/N:	Test Dates:	EUT Type:		Dage 79 of 04		
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 78 01 94		
© 2019 PCTEST Engineering Laboratory, Inc.						



#### **Spurious Emissions EIRP Sample Calculation**

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) + Harmonic Mixer Loss (dB) - 104.8

Frequency [MHz]	Detector/Trace	Chan.	Bandwidth (MHz)	Mod.	EUT Beam Polarization	Ant. Pos [H/V]	Positioner Azimuth roll [degree]	Turn Table Azimuth [degree]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
89459.50	RMS/MaxH	Low	100	QPSK	Н	Н	-	-	-26.39	-13.00	-13.39
89311.00	RMS/MaxH	Mid	100	QPSK	Н	Н	-	-	-27.52	-13.00	-14.52
89411.00	RMS/MaxH	High	100	QPSK	Н	Н	-	-	-28.03	-13.00	-15.03
89314.50	RMS/MaxH	Low	100	QPSK	V	V	-	-	-28.10	-13.00	-15.10
89291.50	RMS/MaxH	Mid	100	QPSK	V	V	-	-	-27.85	-13.00	-14.85
89951.00	RMS/MaxH	High	100	QPSK	V	V	-	-	-27.12	-13.00	-14.12

Table 7-26. Patch Antenna Spurious Emissions Table (60-90GHz)

#### Notes

- 1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.
- To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

(-26.39 dBm + -28.10 dBm) = (2.296 uW + 1.549 uW) = (3.845 uW) = -24.15 dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	COMMWARE Quality Ma		
Test Report S/N:	Test Dates:	EUT Type:		Dage 70 of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Fage 79 01 94	
© 2019 PCTEST Engineering Laboration	tory, Inc.			V1.0	





Plot 7-83. Patch Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Low Channel H Beam)



Plot 7-84. Patch Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Mid Channel H Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)	Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:	Dage 90 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater	Page 80 01 94
© 2019 PCTEST Engineering Laboration	tory, Inc.		V1.0





Plot 7-85. Patch Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK High Channel H Beam)

К	eysight Sp	ectrum Analy	zer - Swept SA	Ą									
<mark>LXI</mark> I	RL	EXT MIXER		CORF	EC	SE	NSE:INT	#Ava Tvp	e: RMS	12:14:17 A	4 Oct 25, 2019	F	requency
PA	SS			PN	0:Fast 🕞	Trig: Fre	Run	Avg Hold	>100/100	D TYF			
				IFGi	ain:Low				M	kr1 00 32			Auto Tune
10 c	B/div	Ref 0.	00 dBm							-23.8	10 dBm		
LUg	Trac	e 1 Pass					Ĭ						Center Fred
	,											95.00	00000000 GHz
	P <b>⊢</b> ♦¹												Otort From
		the Lotter		the states	destroit de de ma	. in the	at halos dable	n la misischiele laise			han Hitter and A	90.00	Start Freq
-30.0	"			مرينات ويستنظ فالكان								00.00	
-40 (													
												100 0	Stop Freq
	·											100.0	0000000 0112
													CE Sten
-60.0												1.00	00000000 GHz
	,											<u>Auto</u>	Man
	ĺ												
	, <b> </b>												
													Seele Tumo
													Scale Type
Sta	rt 90.0	00 GHz								Stop 100	.000 GHz	Log	Lin
#Re	es BW	1.0 MH	z		#VBW	/ 3.0 MHz	*	s	weep	13.33 ms (2	0001 pts)		
MSG									ST/	ATUS			

Plot 7-86. Patch Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Low Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 81 of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 61 01 94	
© 2019 PCTEST Engineering Laboratory Inc					





Plot 7-87. Patch Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Mid Channel V Beam)



Plot 7-88. Patch Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK High Channel V Beam)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 62 01 94	
© 2019 PCTEST Engineering Laboratory, Inc.					



#### **Spurious Emissions EIRP Sample Calculation**

The raw radiated spurious level is converted to field strength in dBµV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

**RSE EIRP [dBm]** = Analyzer Level [dBm] + 107 + AFCL [dB/m] + 20Log(Dm) + Harmonic Mixer Loss (dB) - 104.8

Frequency [MHz]	Detector/Trace	Chan.	Bandwidth (MHz)	Mod.	EUT Beam Polarization	Ant. Pos [H/V]	Positioner Azimuth roll [degree]	Turn Table Azimuth [degree]	RSE EIRP [dBm]	Limit [dBm]	Margin [dB]
96519.50	RMS/MaxH	Low	100	QPSK	Н	Н	-	-	-24.88	-13.00	-11.88
96586.50	RMS/MaxH	Mid	100	QPSK	Н	Н	-	-	-23.94	-13.00	-10.94
96055.50	RMS/MaxH	High	100	QPSK	Н	Н	-	-	-23.72	-13.00	-10.72
90320.50	RMS/MaxH	Low	100	QPSK	V	V	-	-	-23.81	-13.00	-10.81
96544.50	RMS/MaxH	Mid	100	QPSK	V	V	-	-	-24.10	-13.00	-11.10
96234.00	RMS/MaxH	High	100	OPSK	V	V	-	-	-23 75	-13 00	-10 75

Table 7-27. Patch Antenna Spurious Emissions Table (90-100GHz)

#### <u>Notes</u>

- 1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.
- To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

(-23.72 dBm + -23.75 dBm) = (4.246 uW + 4.217 uW) = (8.463 uW) = -20.72 dBm

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 82 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 63 01 94
© 2019 PCTEST Engineering Laboratory, Inc.				



#### 7.6 Band Edge Emissions §2.1051, §30.203

#### Test Overview

The EUT was fed a 5G NR mmWave reperesentative signal via waveguide adapter. All out of band emissions are measured in a conducted setup while the EUT is operating at its maximum AGC level, at maximum power, and at the appropriate frequencies. All modulations were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible attenuation level of any spurious emission is -13dBm/1MHz. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be -5 dBm/MHz or lower.

#### Test Procedure Used

ANSI C63.26-2015 Section 5 and ANSI C63.26-2015 Section 6.4

#### Test Settings

- 1. Start and stop frequency were set such that both upper and lower band edges are measured.
- 2. Span was set large enough so as to capture all out of band emissions near the band edge
- 3. RBW = 1MHz
- 4. VBW <u>></u> 3 x RBW
- 5. Detector = RMS
- 6. Number of sweep points  $\geq 2 \times \text{Span/RBW}$
- 7. Trace mode = trace average
- 8. Sweep time = auto couple
- 9. The trace was allowed to stabilize

#### Test Notes

- Band Edge measurements in this section are shown as conductive powers for direct comparison to the 30.203 limit. Band Edge measurements were performed using waveguide adapters to the input and output ports of the EUT which allowed for direct RF connection to the spectrum analyzer
- 2) The spectrum plots in this section show measurement of some emissions that may be considered as part of the spurious domain, extending beyond the band edges by more than 10% of the occupied bandwidth of the test signal. These measurements were made with a WR28 waveguide-to-RF adapter where the operating range of the WR28 waveguide is in the 26.5 – 40GHz range. Thus, all spurious emission measurements shown in the following plots remain valid.
- 3) The MIMO Band Edges were calculated by using the "*measure and add 10 log (N<sub>ANT</sub>) dB*" technique specified in Section 6.4.3.2.2 of ANSI C63.26-2015. An offset of 10log(N<sub>ANT</sub>) was added to the worst case polarization band edge, where N<sub>ANT</sub> = 2.

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dago 84 of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 64 01 94	
© 2019 PCTEST Engineering Laboratory Inc.					



## 7.6.1 HBF Antenna Band Edge MIMO







Plot 7-90. Lower Band Edge Plot (400MHz QPSK Full RB)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 05 of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 85 OF 94	
© 2019 PCTEST Engineering Laboratory, Inc.					









Plot 7-92. Upper Band Edge Plot (400MHz QPSK Full RB)

FCC ID: 2AUVU-OES3	PCTEST	MEASUREMENT REPORT		Approved by:
	···· V SHELMERSTER LABORATION DEC	(CERTIFICATION)	COMMWARE	Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 96 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 66 01 94
© 2019 PCTEST Engineering Laboratory, Inc.				



### 7.6.2 Patch Antenna Band Edge MIMO



Plot 7-93. Lower Band Edge Plot (100MHz QPSK Full RB)



Plot 7-94. Lower Band Edge Plot (400MHz QPSK Full RB)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:			
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 67 01 94	
© 2019 PCTEST Engineering Laboratory, Inc.					









Plot 7-96. Upper Band Edge Plot (400MHz QPSK Full RB)

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 80 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 66 01 94
© 2019 PCTEST Engineering Laboration	V1.0			



### 7.7 Frequency Stability / Temperature Variation §2.1055

#### Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015. The frequency stability of the transmitter is measured by:

- a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.
- b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

#### Test Procedure Used

ANSI C63.5-2015 Section 5.6

#### **Test Settings**

- 1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
- 2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
- 3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

#### Test Setup

The EUT was measured using horn antenna connected to a spectrum analyzer. The EUT was placed inside an environmental chamber. Using a foam plug, the horn antenna measured the frequency of the fundamental signal.

#### Test Notes

The Frequency Deviation column in the table below is the amount of deviation measured from the center frequency of the Reference measurement (first row).

			Second and the second se	A management la sur	
FCC ID: 2AUVU-OES3	A PCTEST	MEASUREMENT REPORT		Approved by:	
	AND AND ALL AND TARBUTAR TAR	(CERTIFICATION)	COMMWARE	Quality Manager	
Test Report S/N:	Test Dates:	EUT Type:		Dage 80 of 04	
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 69 01 94	
© 2019 PCTEST Engineering Laboratory Inc					



### Frequency Stability Measurements §2.1055

OPERATING FREQUENCY:	27,923,520,000	Hz
REFERENCE VOLTAGE:	14.00	VDC

VOLTAGE (%)	POWER (VDC)	<b>ТЕМР</b> ( <sup>°</sup> С)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %		- 30	27,923,430,000	90,000	0.0003223
100 %		- 20	27,923,440,000	80,000	0.0002865
100 %		- 10	27,923,490,000	30,000	0.0001074
100 %		0	27,923,630,000	-110,000	-0.0003939
100 %		+ 10	27,923,625,000	-105,000	-0.0003760
100 %	14.00	+ 20	27,923,630,000	-110,000	-0.0003939
100 %		+ 30	27,923,560,000	-40,000	-0.0001432
100 %		+ 40	27,923,455,000	65,000	0.0002328
100 %		+ 50	27,923,440,000	80,000	0.0002865
85 %		+ 20	27,923,510,000	10,000	0.0000358
115 %		+20	27,923,520,000	46,000	0.0001647

Table 7-28. Frequency Stability Data

#### Note:

Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
		()		scally manager
Test Report S/N:	Test Dates:	EUT Type:		Page 90 of 94
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		
© 2019 PCTEST Engineering Laborat	V1.0			



# Frequency Stability Measurements §2.1055



Figure 7-1. Frequency Stability Graph

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 91 of 94
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		
© 2019 PCTEST Engineering Laboratory, Inc.				



### 8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Pivotal Commware 5G mmWave Repeater FCC ID: 2AUVU-OES3** complies with all the requirements of Part 30.

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 92 of 94
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		
© 2019 PCTEST Engineering Laboratory. Inc.				



#### 9.0 APPENDIX A

#### 9.1 VDI Mixer Verification Certificate



#### Virginia Diodes, Inc

979 2nd St. SE Suite 309 Charlottesville, VA 22902 Phone: 434-297-3257 Fax: 434-297-3258

#### Certificate of Conformance

To: PCTEST Engineering Laboratory 7185 Oakland Mills Road Columbia, MD 21046 United States From: Virginia Diodes, Inc 979 2nd St. SE Suite 309 Charlottesville, VA 22902

Packing List No: 193065 Shipping Date: 10/02/19 Today's Date: 10/02/19 -

Quantity

Shipped Unit 1 EA

Description VDIWR19.0SAX WR19SAX / SN: SAX 411

The VDI product(s) in this shipment meet(s) the guidelines for performance specifications established in accordance with the corresponding Purchase Order. Data presented in the User Guide, where applicable, has been obtained in accordance with VDI's Quality Management System. All instruments, used to obtain data, which require calibration have been calibrated with equipment traceable to the National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI).

vin Authorized Signature Virginia Diodes, Inc

Page 1 of 1

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Page 93 of 94
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		
© 2019 PCTEST Engineering Laboratory, Inc.				V1.0





#### Virginia Diodes, Inc 979 2nd St. SE Suite 309 Charlottesville, VA 22902 Phone: 434-297-3257 Fax: 434-297-3258

#### Certificate of Conformance

To: PCTEST Engineering Laboratory 7185 Oakland Mills Road Columbia, MD 21046 United States

From: Virginia Diodes, inc 🖌 979 2nd St. SE Suite 309 Charlottesville, VA 22902

Packing List No: 193037 Shipping Date: 09/30/19 Today's Date: 09/30/19 -

Quantity

- <u>Unit</u> Shipped
- Description SAX RETEST-WR12SAX EA 1 WR12SAX / SN: SAX 252
  - SAX RETEST-WR8.0SAX / WR8.0SAX / SN: SAX 253 ΕA 1
  - SAX RETEST-WR5.1SAX / 1 EΑ WR5.1SAX / SN: SAX 254

The VDI product(s) in this shipment meet(s) the guidelines for performance specifications established in accordance with the corresponding Purchase Order. Data presented in the User Guide, where applicable, has been obtained in accordance with VDI's Quality Management System. All instruments, used to obtain data, which require calibration have been calibrated with equipment traceable to the National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI).

Authorized Signature Virginia Diodes, Inc

Page 1 of 1

FCC ID: 2AUVU-OES3		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Quality Manager
Test Report S/N:	Test Dates:	EUT Type:		Dage 04 of 04
1M1909170154-01-R1.2AUVU	10/7/2019-11/27/2019	5G mmWave Repeater		Page 94 01 94
				1/1.0