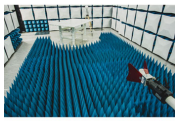
PCTEST ENGINEERING LABORATORY, INC.
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctest.com



MEASUREMENT REPORT
FCC Part 20 Industrial Signal Booster (CMRS)

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.:
1M1909170154-02-R1.2AUVU

FCC ID:	**2AUVU-OES3**
APPLICANT:	**Pivotal Commware**

Application Type:	Certification
Model:	OES3
EUT Type:	5G mmWave Repeater
FCC Classification:	Part 20 Industrial Booster (CMRS) (B2I)
FCC Rule Part(s):	2, 20, 30
Test Procedure(s):	ANSI C63.26-2015, KDB 935210 D02 v04r02, KDB 935210 D05 v01r03, KDB 971168 D01 v03r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and has been 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: 1M1909170154-02-R1.2AUVU) supersedes and replaces the previously issued test report (S/N: 1M1909170154-02.2AUVU) 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.

Randy Ortanez
President

ACCREDITED
TESTING CERT#2041.01

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

TABLE OF CONTENTS

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

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 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.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

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 covers the requirements for the operation of an industrial booster per FCC Part 20.21, KDB 935210 D02, and KDB 935210 D05.

The EUT has 2 antenna configurations. Both antenna configurations are comprised of two separate antenna feeds – one for horizontal polarization and one for the vertical polarization. Of the two antennas, one is a patch antenna, and the other a Holographic Beam Forming (HBF) antenna. The device is a booster/repeater designed to provide 5G coverage inside of a building.

The EUT supports any combination of bandwidths, number of carriers, and modulations as input signals in the n261 (28GHz) band.

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 and KDB 935210 D05 in a conducted setup. The EUT was fitted with waveguide adapters that allowed direct injection of an input signal into one of the two antennas for measurement from the other antenna. See Section 6.0 of this test report for a description of the tests.

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 representative 5G mmWave NR signal in various sized bandwidths and modulations.

2.4 EMI Suppression Device(s)/Modifications

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

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

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) and KDB 935210 D05 were used in the measurement of the EUT. KDB 842590 D01 v01 was referenced for testing the EUT as well.

3.2 Industrial Booster Test Cases

Per the requirements of KDB 935210 D05, the following test cases shall be investigated for Industrial Boosters under FCC Part 20.21:

1. AGC Threshold Level
2. Out-of-Band Rejection
3. Input-versus-Output Signal Comparison
4. Mean Output Power and Amplifier/Booster Gain
5. Out-of-Band/Out-of-Block Emissions and Spurious Emissions
6. Frequency Stability
7. Radiated Spurious Emissions

3.3 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

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_{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 Disturbance	3.09
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). 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
Agilent	N9030A	PXA Signal Analyzer (44GHz)	6/12/2019	Annual	6/12/2020	MY52350166
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	5/6/2019	Annual	5/6/2020	103200
Rohde & Schwarz	SMW200A	Vector Signal Generator	N/A			100976

Table 5-1. Annual Test Equipment Calibration Schedule

Note:

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.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

6.0 TEST RESULTS

6.1 Summary

Company Name: Pivotal Commware

FCC ID: 2AUVU-OES3

FCC Classification: Part 20 Industrial Booster (CMRS) (B2I)

FCC Part Section(s)	KDB 935210 D05 Section(s)	Test Description	Test Limit	Test Result	Reference
2.1049, 20.21	3.4	Occupied Bandwidth / Input-Versus-Output Signal Comparison	N/A	PASS	Section 6.2
2.1051, 30.203, 20.21	3.8	Radiated Spurious Emissions	-13dBm/MHz for all out-of-band emissions	PASS	See Part 30 Report
2.1051, 30.203, 20.21	3.6	Out-of-Band/Out of Block Emissions	-13dBm/MHz for all out-of-band emissions, -5dBm/MHz from the band edge up to 10% of the channel BW	PASS	See Part 30 Report
2.1055, 20.21	3.7	Frequency Stability	Fundamental emissions stay within authorized frequency block	PASS	See part 30 Report
20.21	3.3	Out-of-Band Rejection	N/A	PASS	Section 6.4
2.1046, 30.202, 20.21	3.2, 3.5	Measuring AGC Threshold Level / Mean Output Power and Amplifier/Booster Gain	N/A	PASS	Section 6.5

Table 6-1. Summary of Radiated Test Results

Notes:

1) Since the EUT can only operate as a Booster, some of the test requirements specified in KDB 935210 D05 are already addressed in the Part 30 report in this filing.
2) The EUT was fitted with waveguide-to-RF adapters that allowed direct conducted measurements. All measurements, except for those referencing the Part 30 report in this filing, were performed in a conducted test setup.
3) Due to the design of the device with waveguides, conducted spurious emission measurements were not applicable.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

6.2 Input-Versus-Output Signal Comparison

§2.1049, §20.21

Test Overview

The Input-versus-Output Signal Comparison checks for the change in occupied bandwidth of the output signal from the booster at 3dB above the AGC threshold level and just below the AGC threshold level while not more than 0.5dB below the threshold level. All modes of operation were investigated and the worst case configuration results are reported in this section. Per KDB 935210 D05 clause 3.4, this is to be measured on both the input signal and the output signal.

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.3, KDB 935210 D05 – Section 3.4

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 ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize

Test Notes

Per FCC guidance, a 100MHz 5G NR mmWave signal was used as the input signal as opposed to the 4.1MHz AWGN required in KDB 935210 D05.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

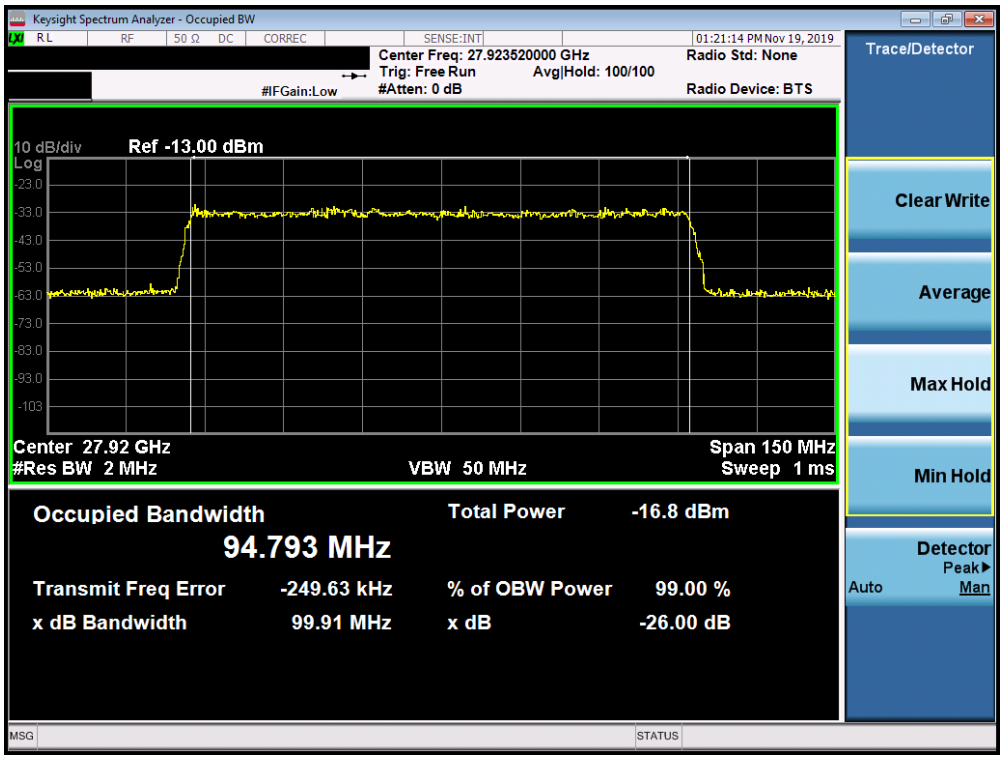
AGC Threshold Level	Channel	Bandwidth	Output Power OBW [MHz]	Input Power OBW [MHz]
0.5dB below Threshold	Mid	100	94.67	94.79
3dB above Threshold	Mid	100	94.90	94.97

Table 6-2. HBF Antenna Occupied Bandwidth by AGC Threshold Level

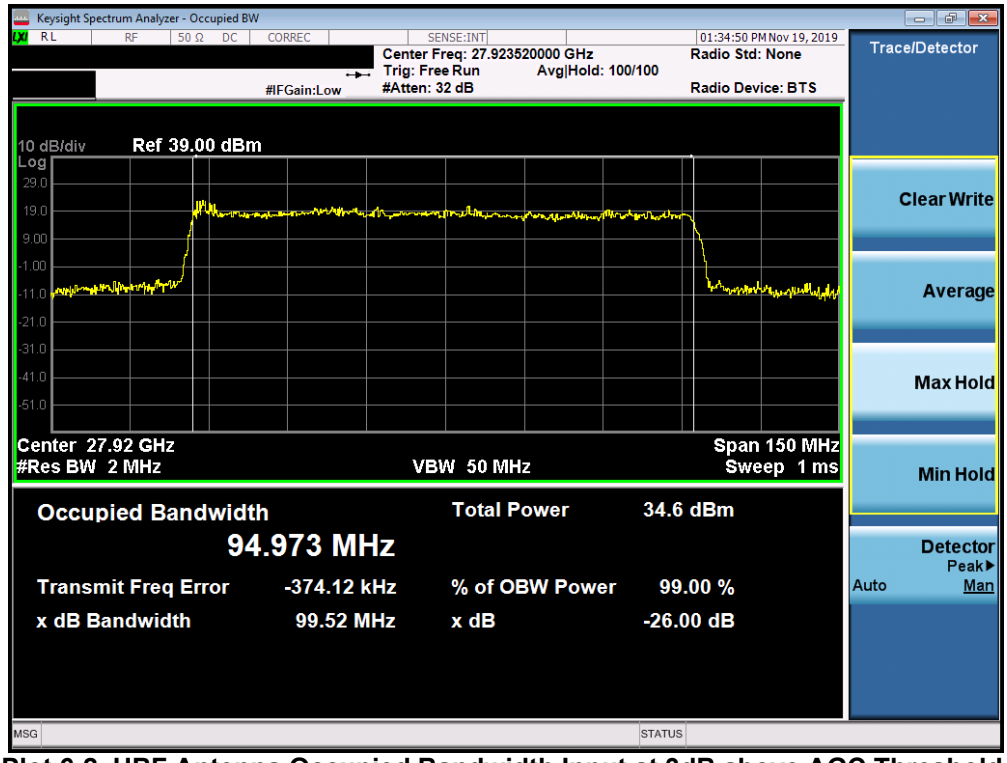
AGC Threshold Level	Channel	Bandwidth	Output Power OBW [MHz]	Input Power OBW [MHz]
0.5dB below Threshold	Mid	100	92.11	93.91
3dB above Threshold	Mid	100	92.17	92.38

Table 6-3. Patch Antenna Occupied Bandwidth by AGC Threshold Level

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

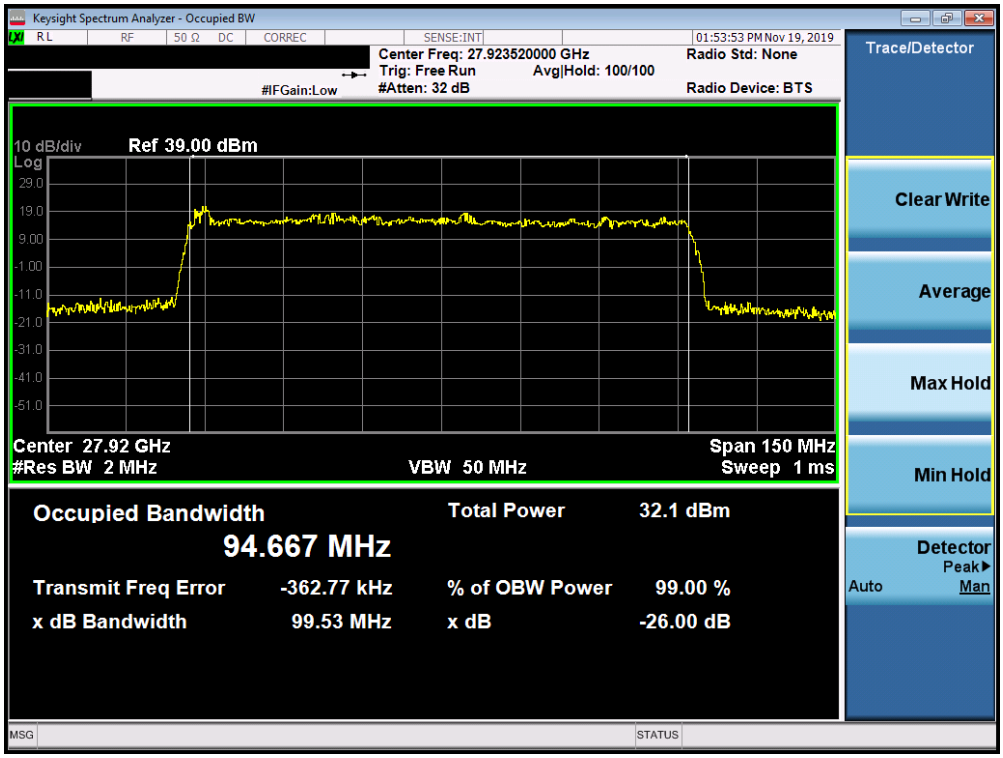


Plot 6-1. HBF Antenna Occupied Bandwidth Input at 0.5dB below AGC Threshold.

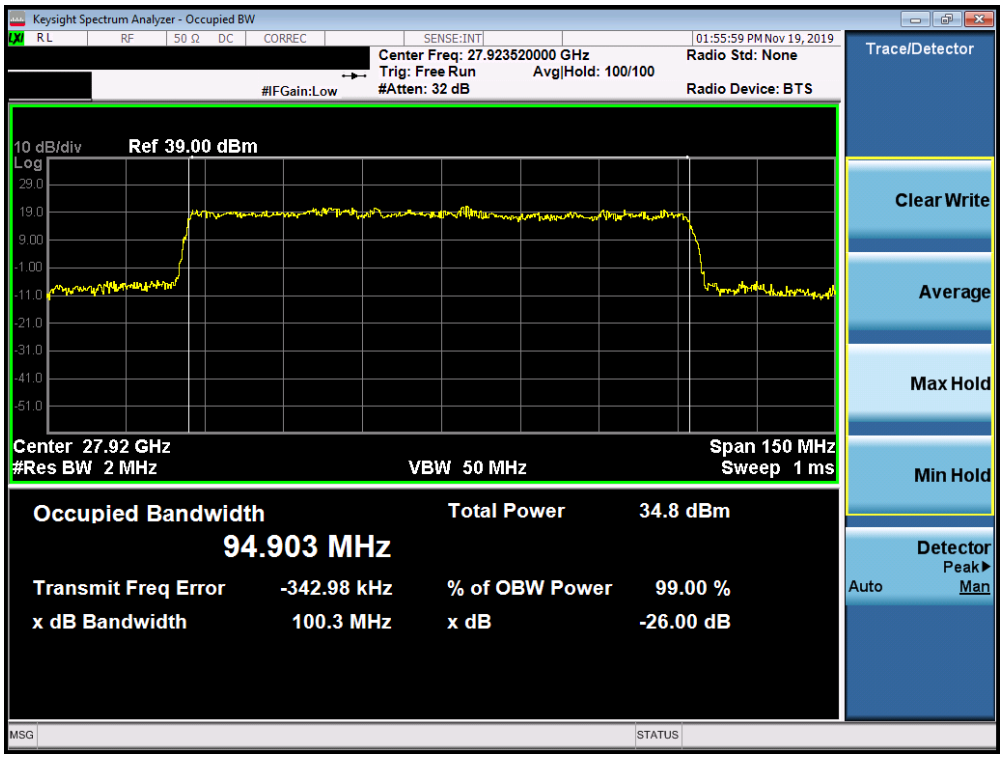


Plot 6-2. HBF Antenna Occupied Bandwidth Input at 3dB above AGC Threshold.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

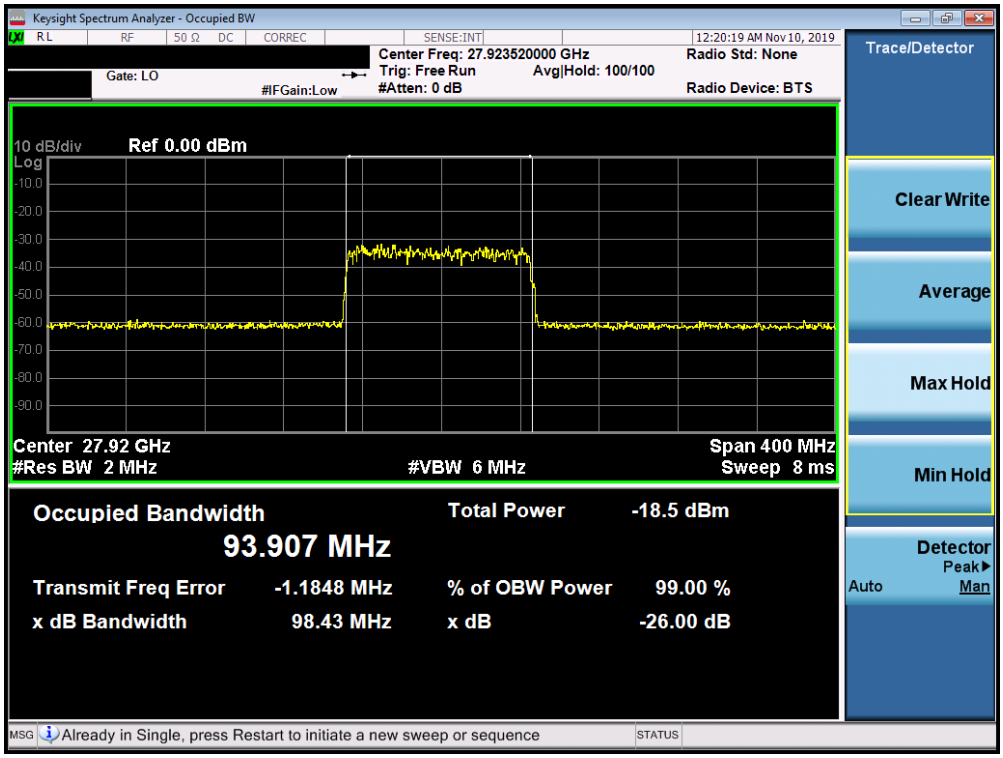


Plot 6-3. HBF Antenna Occupied Bandwidth Output at 0.5dB below AGC Threshold.

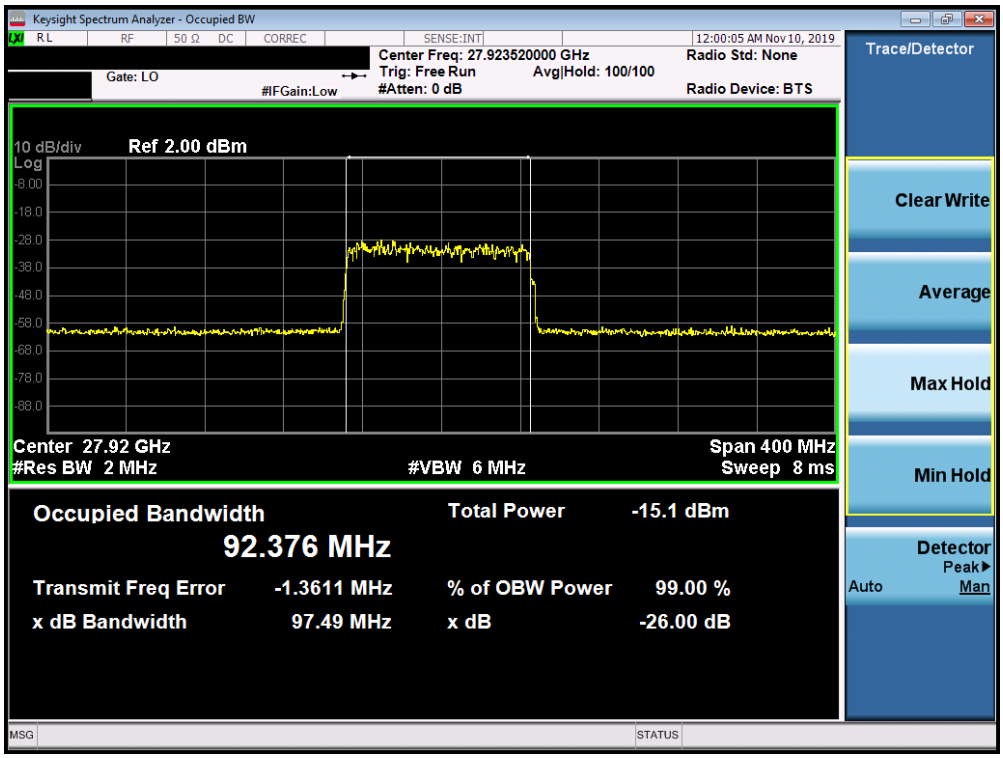


Plot 6-4. HBF Antenna Occupied Bandwidth Output at 3dB above AGC Threshold.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

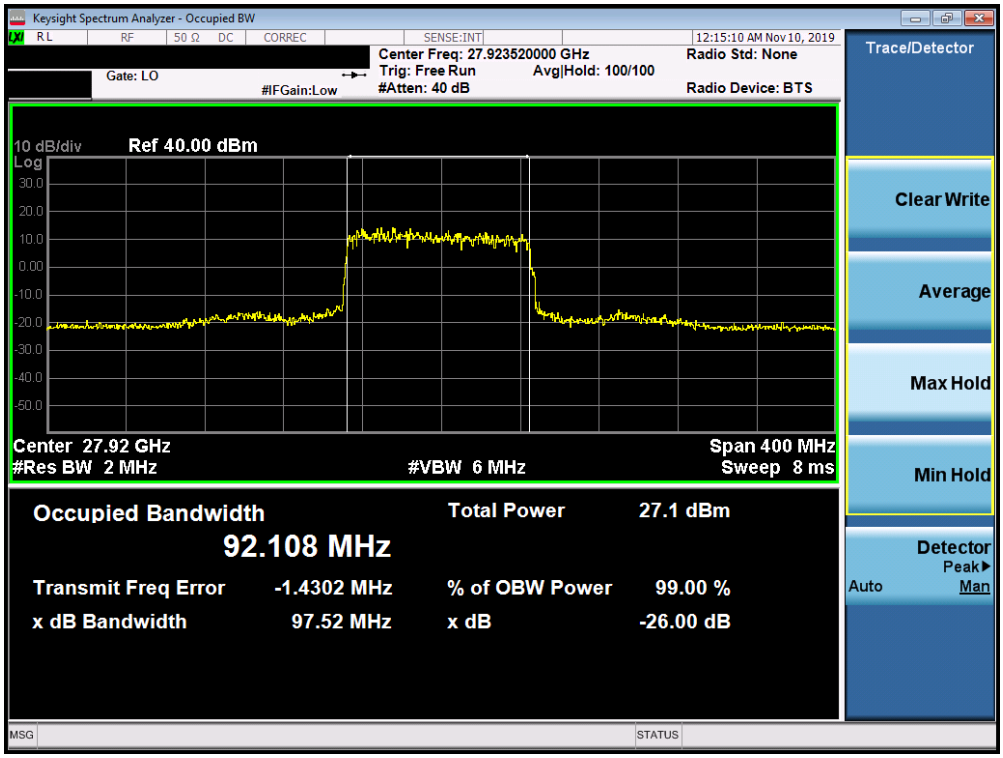


Plot 6-5. Patch Antenna Occupied Bandwidth Input at 0.5dB below AGC Threshold.

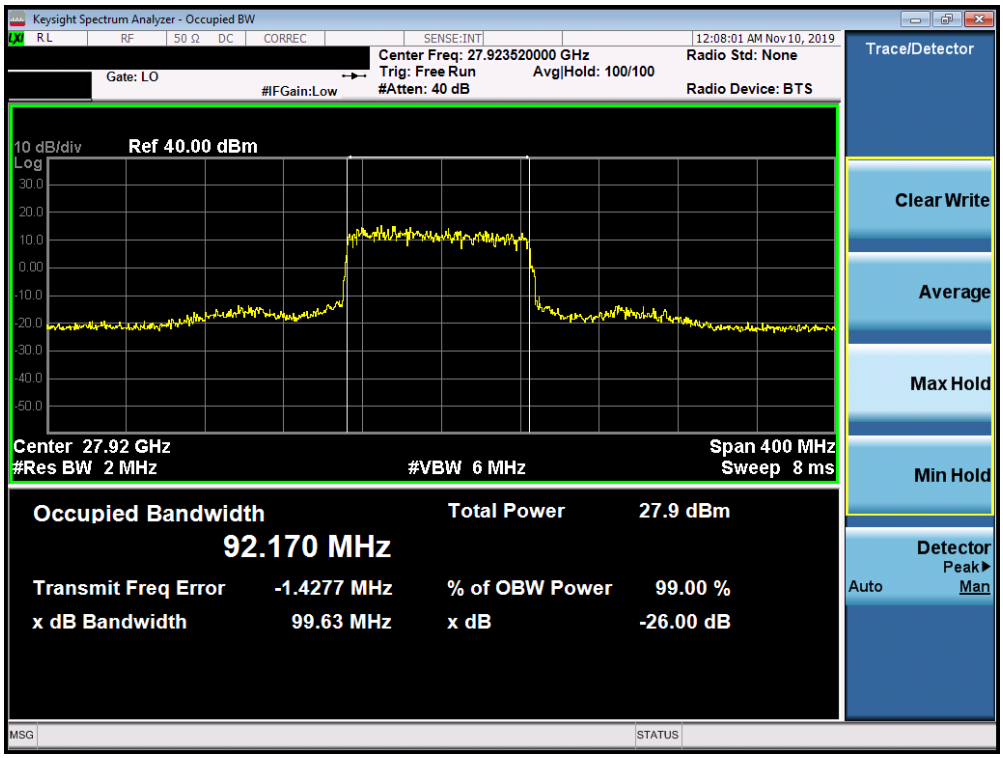


Plot 6-6. Patch Antenna Occupied Bandwidth Input at 3dB above AGC Threshold.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.



Plot 6-7. Patch Antenna Occupied Bandwidth Output at 0.5dB below AGC Threshold.



Plot 6-8. Patch Antenna Occupied Bandwidth Output at 3dB above AGC Threshold.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

6.3 Out-of-band Emissions Conducted Measurements

Test Overview

All out-of-band emissions are measured with a spectrum analyzer connected to the RF port of EUT while the EUT is operating at maximum power (within its AGC threshold) at the appropriate frequencies. All modes of operation were investigated and the worst case configuration results are reported in this section. Per KDB 935210 D05, there are two stimulus conditions – one with a single test signal tuned to the lower and upper band edges, the data for which may be found in the Part 30 report and another with two adjacent signals tuned to the lowest and highest frequencies of the block under examination. The data representing two adjacent signals is found 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

KDB 971168 D01 v03r01 – Section 6.0, KDB 935210 D05 – Section 3.6

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW ≥ 1% of the emission bandwidth
4. VBW ≥ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average for continuous emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

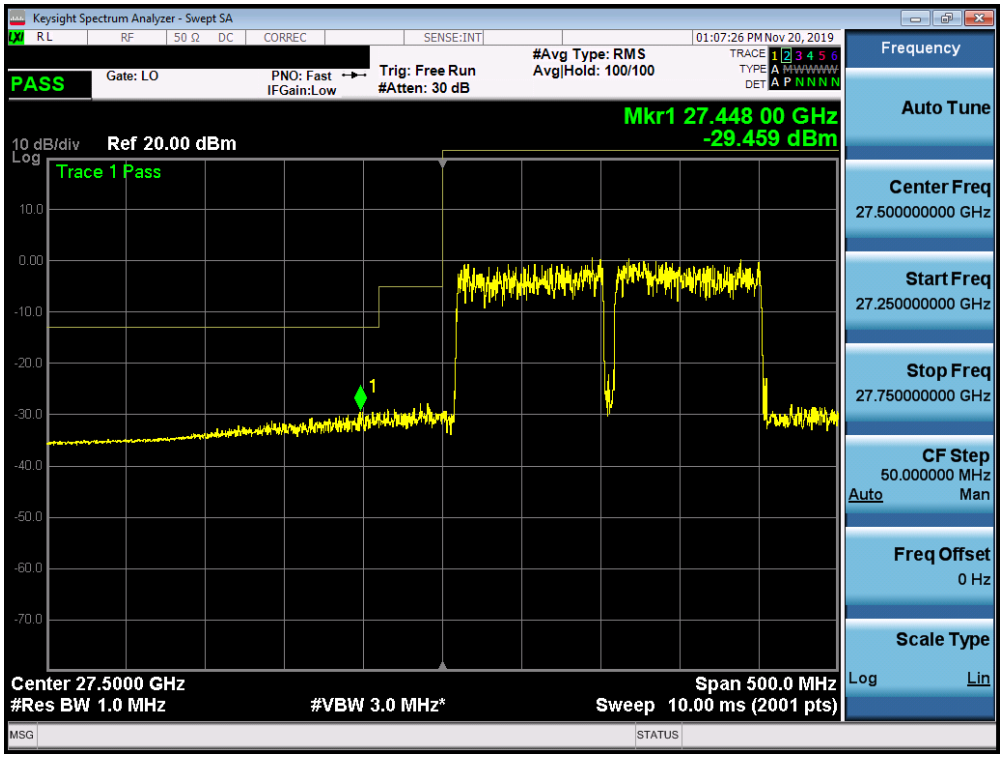
The EUT and measurement equipment were set up as shown in the diagram below.

Figure 6-1. Test Instrument & Measurement Setup

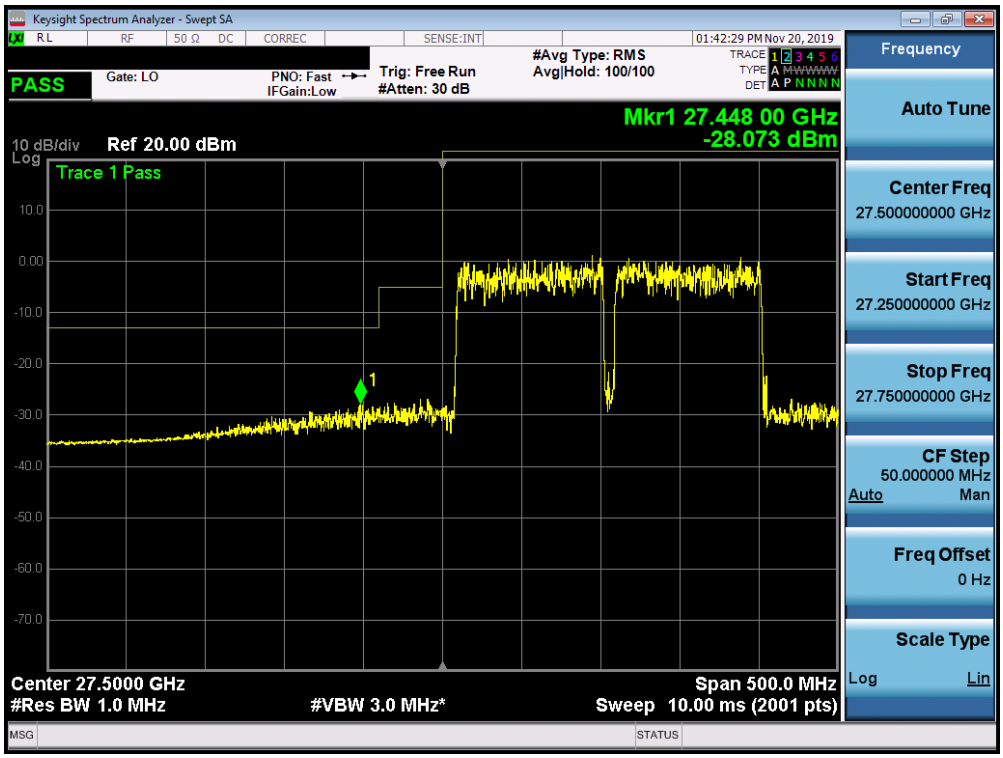
Test Notes

Per FCC guidance, a 100MHz 5G NR mmWave signal was used as the input signal as opposed to the 4.1MHz AWGN required in KDB 935210 D05.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

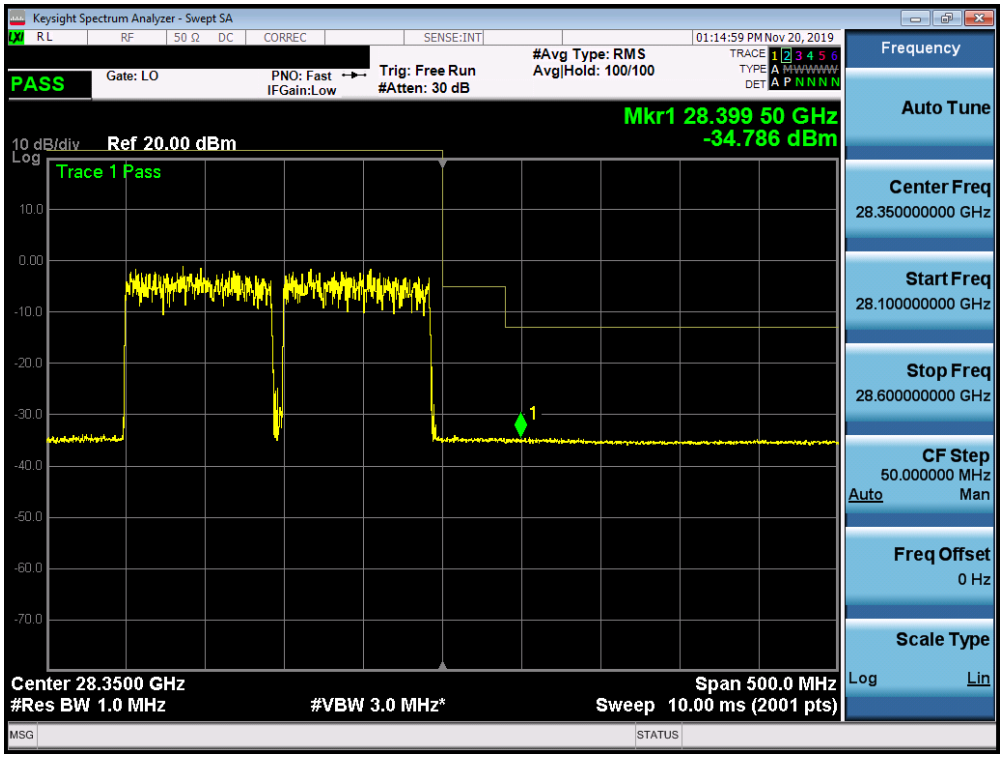


Plot 6-9. HBF Horizontal Antenna Lower Band Edge Plot with 2 Carriers.

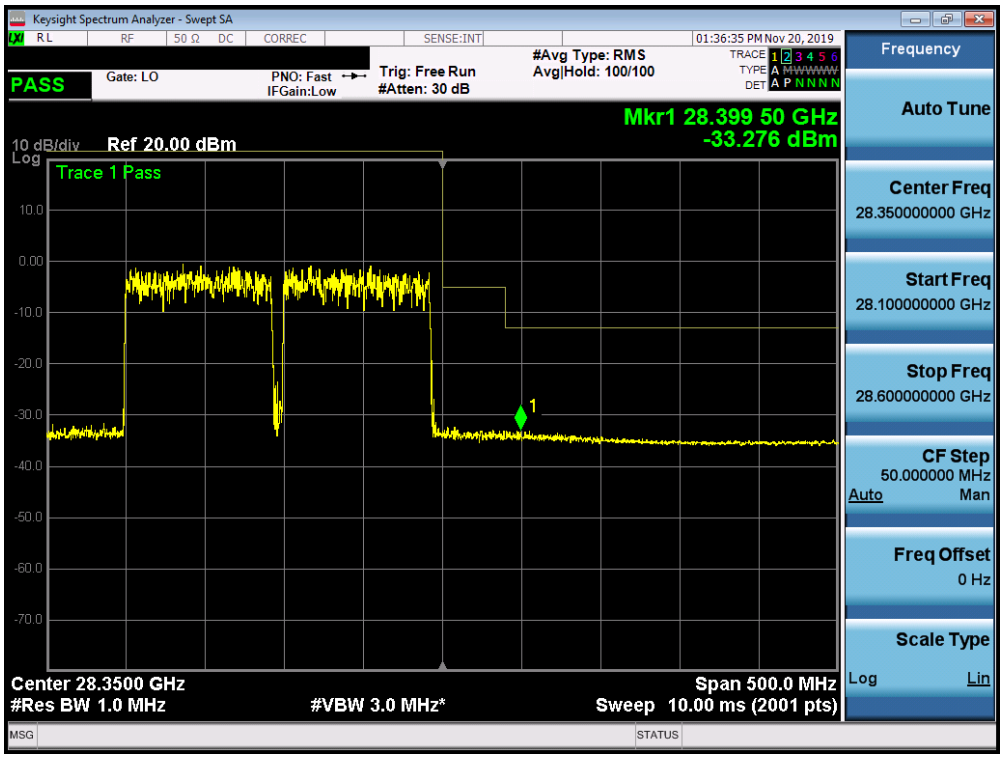


Plot 6-10. HBF Vertical Antenna Lower Band Edge Plot with 2 Carriers.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.



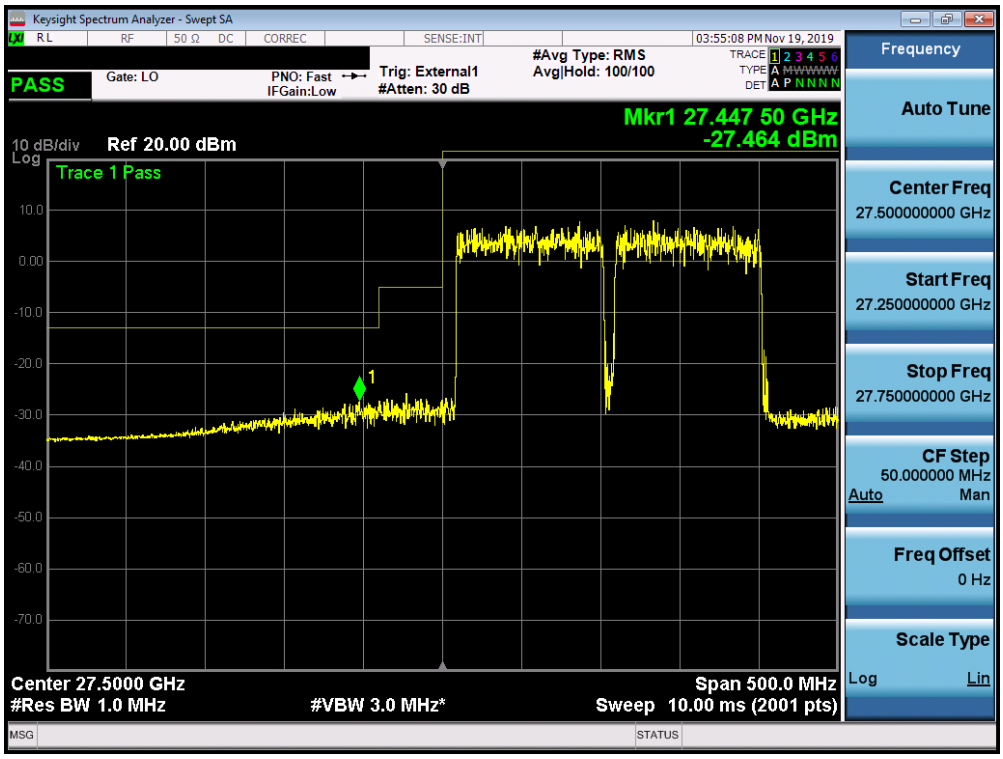
Plot 6-11. HBF Horizontal Antenna Upper Band Edge Plot with 2 Carriers.



Plot 6-12. HBF Vertical Antenna Upper Band Edge Plot with 2 Carriers.

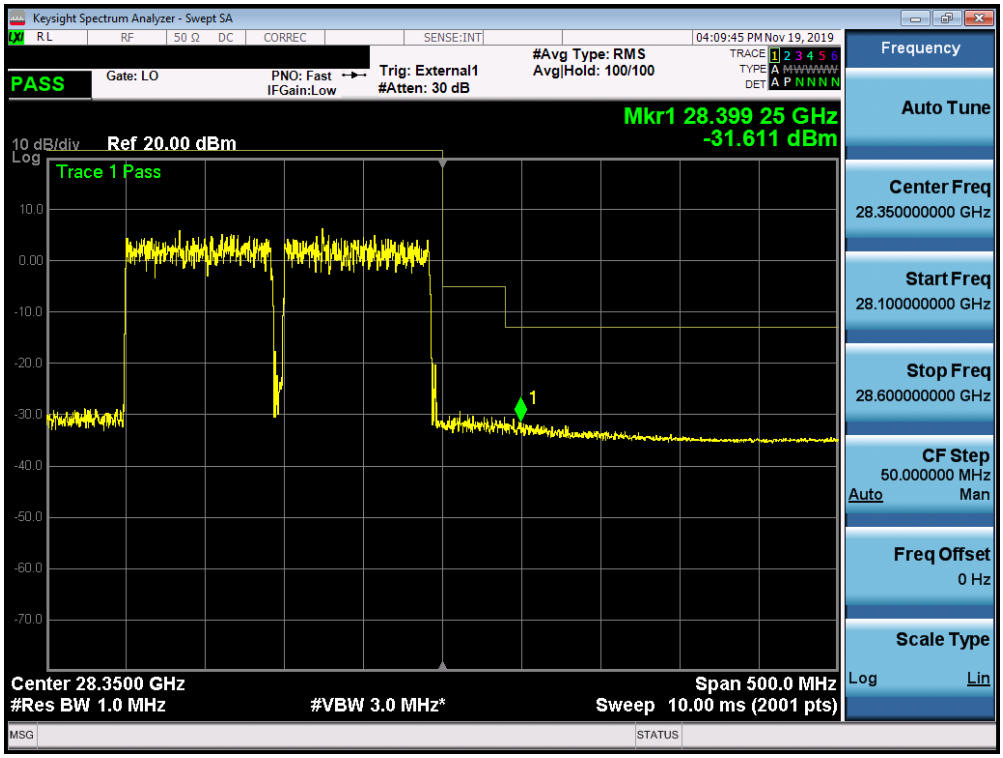
© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

Plot 6-13. Patch Horizontal Antenna Lower Band Edge Plot with 2 Carriers.

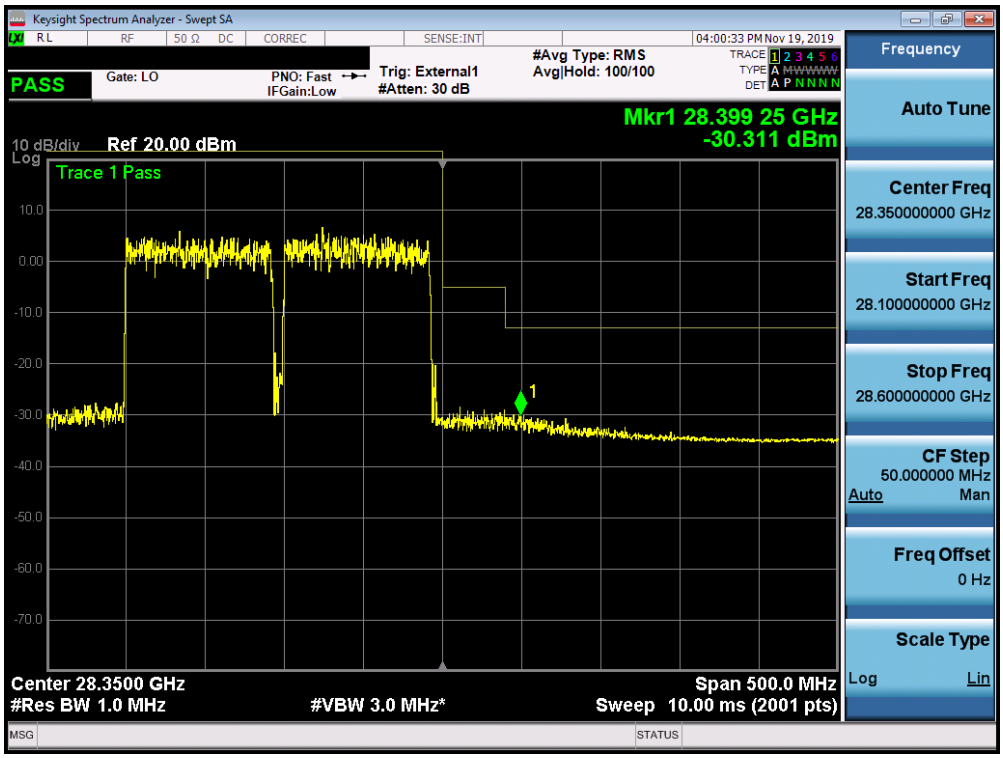


Plot 6-14. Patch Vertical Antenna Lower Band Edge Plot with 2 Carriers.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.



Plot 6-15. Patch Horizontal Antenna Upper Band Edge Plot with 2 Carriers.



Plot 6-16. Patch Vertical Antenna Upper Band Edge Plot with 2 Carriers.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

6.4 Out-of-band Rejection

Test Overview

A signal generator is set to the input port of the EUT, and the output of the EUT shall be connected to a spectrum analyzer. Per KDB 935210 D05 Section 3.3, the signal generator will sweep a CW signal to ± 250 % of the passband. Per FCC Part 20, an industrial booster shall have its 20dB bandwidth analyzed in order to assess the pass band of the booster.

Test Procedure Used

KDB 935210 D05 v01r03 – Section 3.3

Test Settings

1. Start and stop frequency of the signal generator shall be ± 250 % of the passband, for each applicable CMRS band
2. Span same as the frequency range of the signal generator
3. RBW ≥ 1 % to 5 % of the EUT passband
4. VBW ≥ 3 x RBW
5. Detector = Peak/Max Hold
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

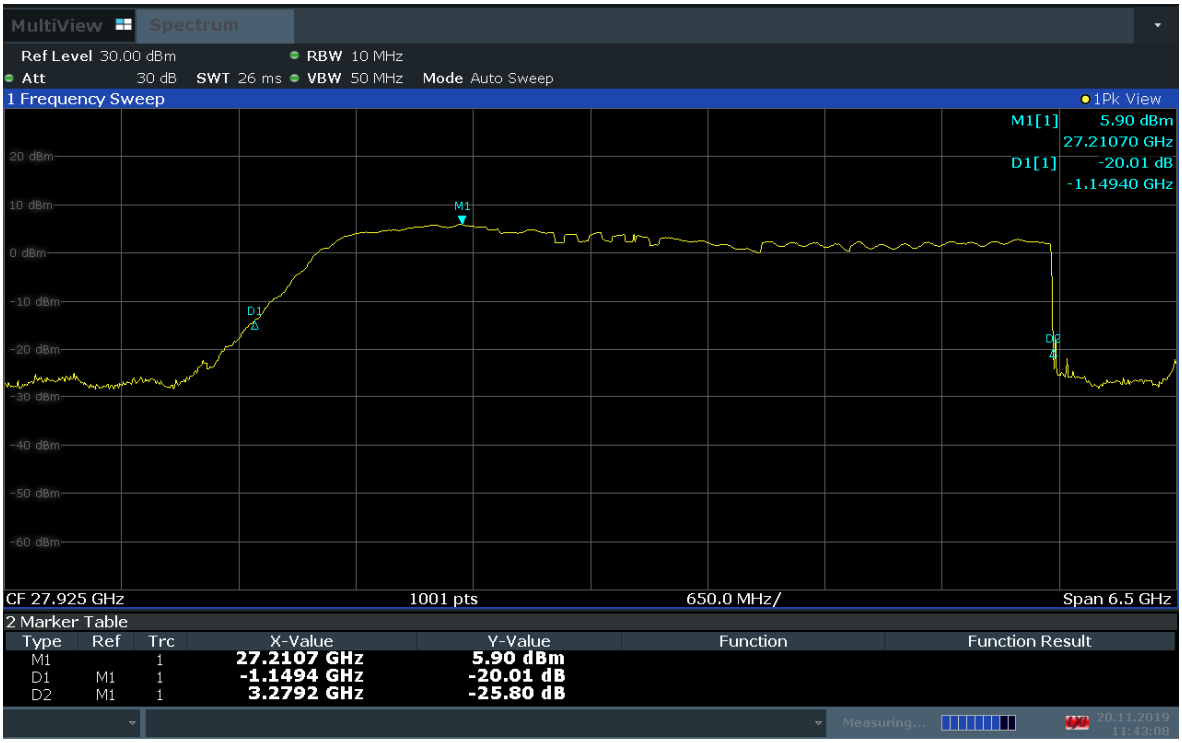
Figure 6-2. Test Instrument & Measurement Setup

Test Notes

In the plots on the following page, a spectrum plot is shown with a CW signal sweeping across the input of the EUT for both antennas. The sweep is set based on ±250% of the passband which is equal to ±2.5 x (28.35GHz – 27.5GHz) = ±2.125GHz. Therefore, the following plots demonstrate the frequency response of the EUT when a CW signal is sweeping from 25.375GHz to 30.475GHz.

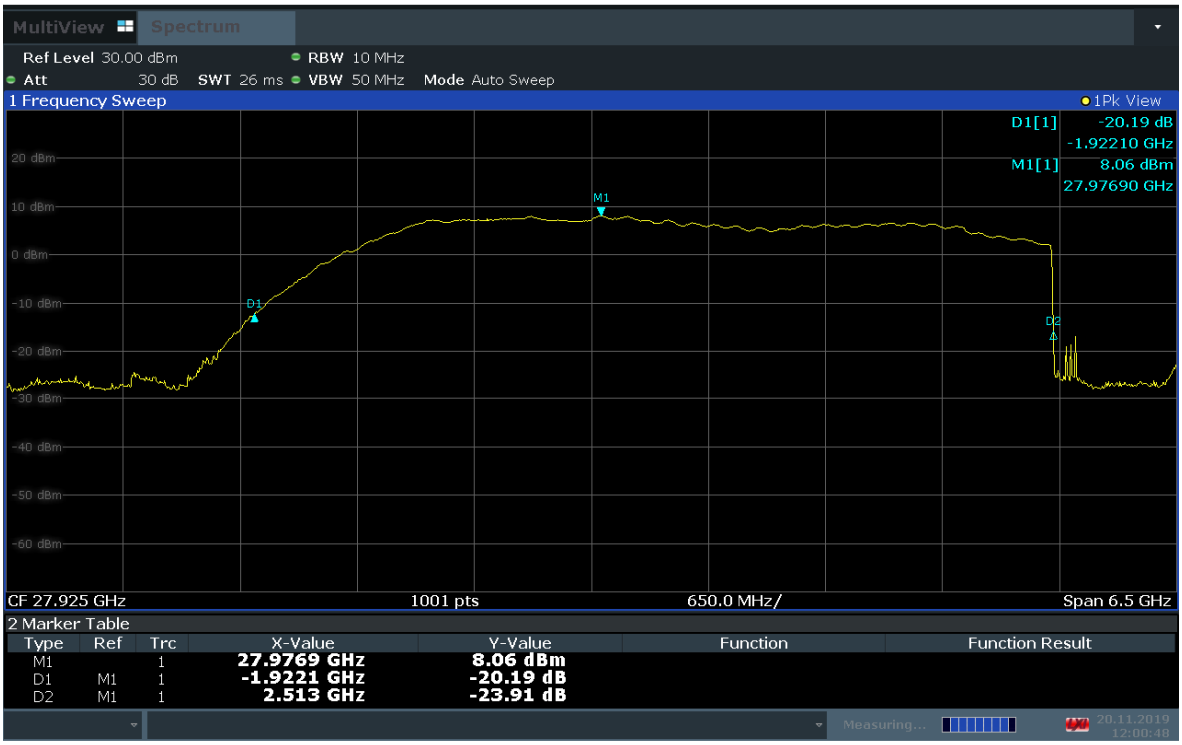
The “D1” and “D2” markers in the plots are provided to demonstrate the approximate OBW of the output frequency response.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.



11:43:09 20.11.2019

Plot 6-17. HBF Antenna Out-Of-Band Rejection



12:00:49 20.11.2019

Plot 6-18. Patch Antenna Out-Of-Band Rejection

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

6.5 Measuring AGC Threshold Level, Mean Output Power and Amplifier/Booster Gain §2.1046, §30.202

Test Overview

A signal generator supplies a 5G NR mmWave signal directly into the input port of the device. The output port of the EUT is connected to the input of a signal analyzer. The AGC threshold level is measured by output power of the EUT until a 1dB increase in the input signal power no longer causes a 1dB increase in the output signal power. The Booster Gain is measured by calculating the gain between the input and the output power of the EUT at the signal generator level just below the AGC threshold level, but not more than 0.5dB below.

Test Procedures Used

KDB 935210 D05 V01R03 – Section 3.2 - Measuring AGC threshold level
KDB 935210 D05 V01R03 – Section 3.5 - Mean output power and amplifier/booster gain

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 ≥ 3 x RBW
4. Span = 2x to 3x the OBW
5. No. of sweep points ≥ 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

Per FCC guidance, a 100MHz 5G NR mmWave signal was used as the input signal as opposed to the 4.1MHz AWGN required in KDB 935210 D05.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

Bandwidth (MHz)	Frequency [MHz]	Channel	Modulation	RB Size	Signal Generator Level [dBm]	EUT Input Power Level (dBm)	Conducted Power [dBm]	Calculated Change in Output Power	Calculated gain (dB)
100	27923.52	Mid	QPSK	Full RB	-39.0	-47.85	4.78	-	52.63
100	27923.52	Mid	QPSK	Full RB	-38.0	-46.86	5.75	0.97	52.61
100	27923.52	Mid	QPSK	Full RB	-37.0	-45.87	6.77	1.02	52.64
100	27923.52	Mid	QPSK	Full RB	-36.0	-44.81	7.73	0.96	52.54
100	27923.52	Mid	QPSK	Full RB	-35.0	-43.84	8.74	1.01	52.58
100	27923.52	Mid	QPSK	Full RB	-34	-43.00	9.36	0.62	52.36
100	27923.52	Mid	QPSK	Full RB	-33.0	-41.99	9.72	0.36	51.71
100	27923.52	Mid	QPSK	Full RB	-32.0	-40.94	9.98	0.26	50.92
100	27923.52	Mid	QPSK	Full RB	-31.0	-39.92	9.99	0.01	49.91

Table 6-4. HBF Antenna Full RB AGC Threshold and Booster Gain – Full RB.

Note: AGC Level is found at **-43.00dBm** EUT Input Power Level.

Bandwidth (MHz)	Frequency [MHz]	Channel	Modulation	RB Size	Signal Generator Level [dBm]	EUT Input Power Level (dBm)	Conducted Power [dBm]	Calculated Change in Output Power	Calculated gain (dB)
100	27923.52	Mid	QPSK	1RB	-49.0	-48.19	3.69	-	51.88
100	27923.52	Mid	QPSK	1RB	-48.0	-47.09	4.80	1.11	51.89
100	27923.52	Mid	QPSK	1RB	-47.0	-46.02	5.73	0.93	51.75
100	27923.52	Mid	QPSK	1RB	-46.0	-45.12	6.68	0.95	51.80
100	27923.52	Mid	QPSK	1RB	-45.0	-44.21	7.45	0.77	51.66
100	27923.52	Mid	QPSK	1RB	-44.0	-43.25	6.71	-0.74	49.96
100	27923.52	Mid	QPSK	1RB	-43.0	-42.13	7.45	0.74	49.58
100	27923.52	Mid	QPSK	1RB	-42.0	-41.28	7.27	-0.18	48.55
100	27923.52	Mid	QPSK	1RB	-41.0	-40.21	7.30	0.03	47.51

Table 6-5. HBF Antenna Full RB AGC Threshold and Booster Gain – 1 RB.

Note: AGC Level is found at **-46.02dBm** EUT Input Power Level.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

Bandwidth (MHz)	Frequency [MHz]	Channel	Modulation	RB Size	Signal Generator Level [dBm]	EUT Input Power Level (dBm)	Conducted Power [dBm]	Calculated Change in Output Power	Calculated gain (dB)
100	27923.52	Mid	QPSK	Full RB	-39.0	-33.77	14.79	-	48.56
100	27923.52	Mid	QPSK	Full RB	-38.0	-32.76	15.74	0.95	48.50
100	27923.52	Mid	QPSK	Full RB	-37.0	-31.77	16.74	1.00	48.51
100	27923.52	Mid	QPSK	Full RB	-36.0	-30.91	17.56	0.82	48.47
100	27923.52	Mid	QPSK	Full RB	-35.0	-29.88	18.52	0.96	48.40
100	27923.52	Mid	QPSK	Full RB	-34.0	-28.83	19.29	0.77	48.12
100	27923.52	Mid	QPSK	Full RB	-33.0	-27.88	19.27	-0.02	47.15
100	27923.52	Mid	QPSK	Full RB	-32.0	-26.83	19.99	0.72	46.82
100	27923.52	Mid	QPSK	Full RB	-31.0	-25.89	19.47	-0.52	45.36

Table 6-6. Patch Antenna Full RB AGC Threshold and Booster Gain – Full RB.

Note: AGC Level is found at **-30.91dBm** EUT Input Power Level.

Bandwidth (MHz)	Frequency [MHz]	Channel	Modulation	RB Size	Signal Generator Level [dBm]	EUT Input Power Level (dBm)	Conducted Power [dBm]	Calculated Change in Output Power	Calculated gain (dB)
100	27923.52	Mid	QPSK	1RB	-40.0	-34.88	11.85	-	46.73
100	27923.52	Mid	QPSK	1RB	-39.0	-33.84	12.66	0.81	46.50
100	27923.52	Mid	QPSK	1RB	-38.0	-32.93	13.84	1.18	46.77
100	27923.52	Mid	QPSK	1RB	-37.0	-31.95	14.85	1.01	46.80
100	27923.52	Mid	QPSK	1RB	-36.0	-30.93	15.70	0.85	46.63
100	27923.52	Mid	QPSK	1RB	-35.0	-30.12	15.96	0.26	46.08
100	27923.52	Mid	QPSK	1RB	-34.0	-28.94	15.72	-0.24	44.66
100	27923.52	Mid	QPSK	1RB	-33.0	-27.81	16.39	0.67	44.20
100	27923.52	Mid	QPSK	1RB	-32.0	-26.90	17.12	0.73	44.02

Table 6-7. Patch Antenna Full RB AGC Threshold and Booster Gain – 1 RB.

Note: AGC Level is found at **-30.93dBm** EUT Input Power Level.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.

7.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Pivotal Commware 5G mmWave Repeater FCC ID: 2AUVU-OES3** has been tested to comply with the requirements specified in §20.21 and KDB 935210 D05 for Industrial Booster operation.

© 2019 PCTEST Engineering Laboratory, Inc. V 9.0 02/01/2019
All rights reserved. Unless otherwise specified, no part of this report may be reproduced or utilized in any part, form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from PCTEST Engineering Laboratory, Inc. If you have any questions about this international copyright or have an enquiry about obtaining additional rights to this report or assembly of contents thereof, please contact INFO@PCTEST.COM.