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

Application Type:	Certification
Model:	OES3
EUT Type:	5G mmWave Repeater
FCC Classification:	Part 30 Transportable Transmitter (5GT)
FCC Rule Part(s):	2, 30
Test 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.

Randy Ortanez
President

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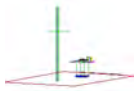


Band	FCC Rule Part	Bandwidth (MHz)	Frequency [MHz]	Antenna Pol	Modulation	SISO EIRP [dBm]	SISO EIRP [W]	MIMO EIRP [dBm]	MIMO EIRP [W]	Emission Designator
n261	30	100	27500-28350	H	QPSK	29.11	0.81	31.73	1.49	94M1G7D
	30		27500-28350	V		28.83	0.76			
n261	30	100	27500-28350	H	QAM	28.86	0.77	31.56	1.43	94M3W7D
	30		27500-28350	V		28.33	0.68			
n261	30	400	27500-28350	H	QPSK	28.29	0.67	31.11	1.29	376MG7D
	30		27500-28350	V		28.21	0.66			
n261	30	400	27500-28350	H	QAM	28.19	0.66	31.01	1.26	376MW7D
	30		27500-28350	V		28.01	0.63			

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	H	QPSK	29.48	0.89	32.46	1.76	94M4G7D
	30		27500-28350	V		29.47	0.89			
n261	30	100	27500-28350	H	QAM	29.46	0.88	32.22	1.67	94M5W7D
	30		27500-28350	V		29.43	0.88			
n261	30	400	27500-28350	H	QPSK	28.31	0.68	30.72	1.18	377MG7D
	30		27500-28350	V		27.54	0.57			
n261	30	400	27500-28350	H	QAM	28.03	0.64	30.84	1.21	377MW7D
	30		27500-28350	V		28.02	0.63			

Patch Antenna Overview (MIMO)

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.

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.

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.

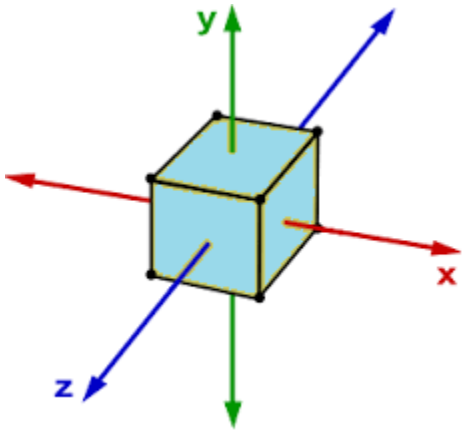


Figure 3-1. Rotation of the EUT Through Three Orthogonal Planes

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.

Field Strength [dBμV/m] = Measured Value [dBm] + AFCL [dB/m] + 107

= - 34.06 dBm + (40.6dB/m + 8.49dB) + 107 = 122.03dBuV/m

= 10^(122.03/20)/1000000 = 1.26 V/m

e.i.r.p. [dBm] = 10 * log((E-Field*D_m)^2/30) + 30dB

= 10*log((1.26V/m * 1.00m)^2/30) + 30dB

= **17.24 dBm e.i.r.p.**

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

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 Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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.

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

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	CONDUCTED	PASS	Section 7.2
2.1046	Conducted Power	N/A		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	RADIATED	PASS	Section 7.4
2.1051, 30.203	Spurious Emissions	-13dBm/MHz for all out-of-band emissions		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 DFT-s-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.

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 ≥ 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

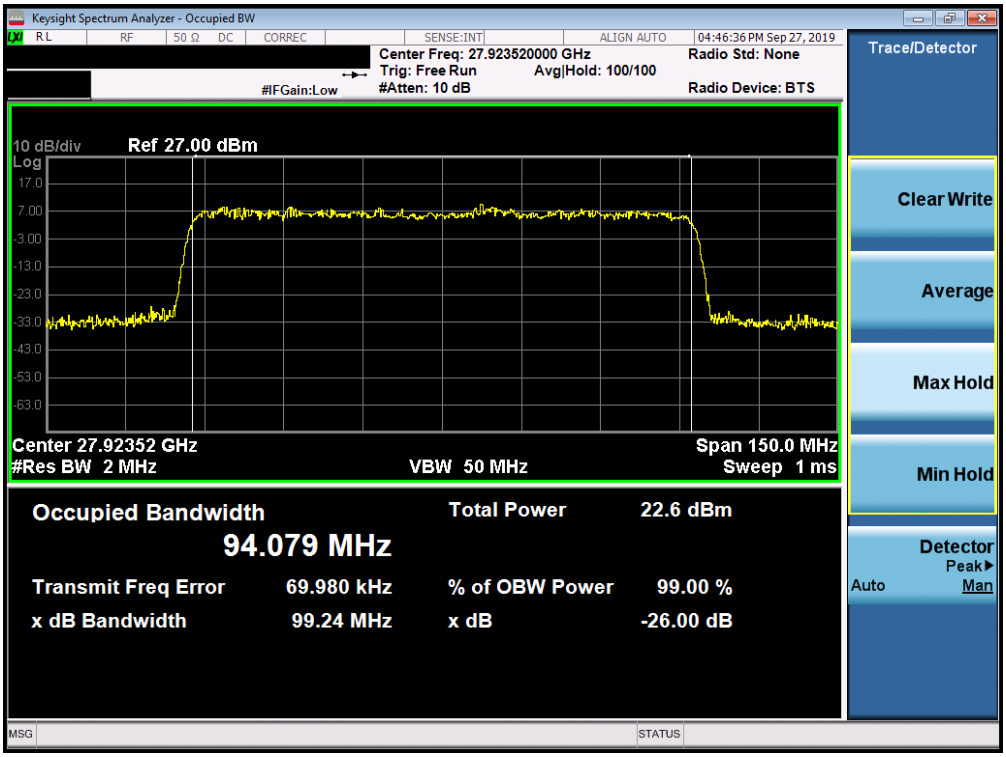
Test Notes

None.

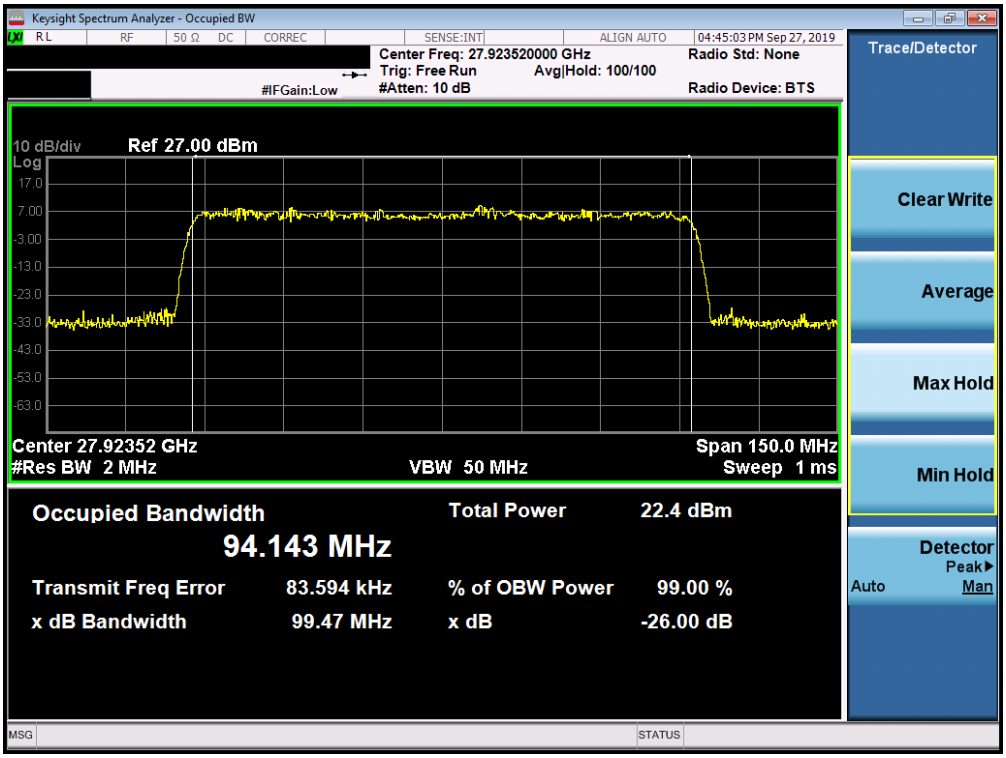
7.2.1 HBF Antenna Occupied Bandwidth

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

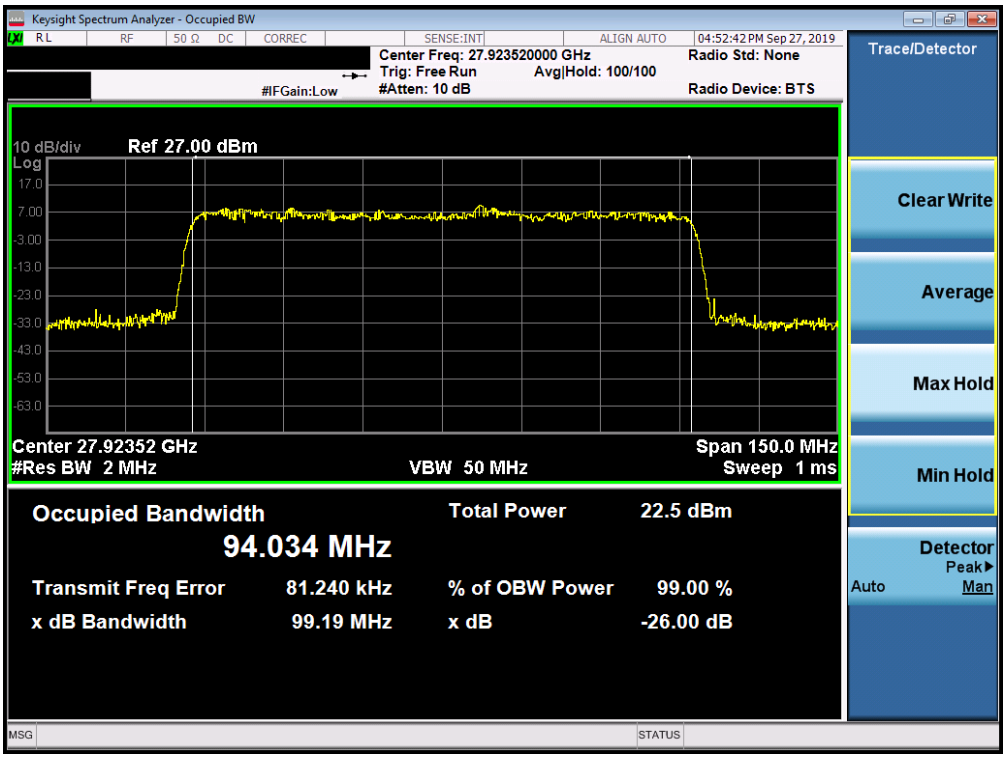
Table 7-2. Summary of HBF Antenna Occupied Bandwidths



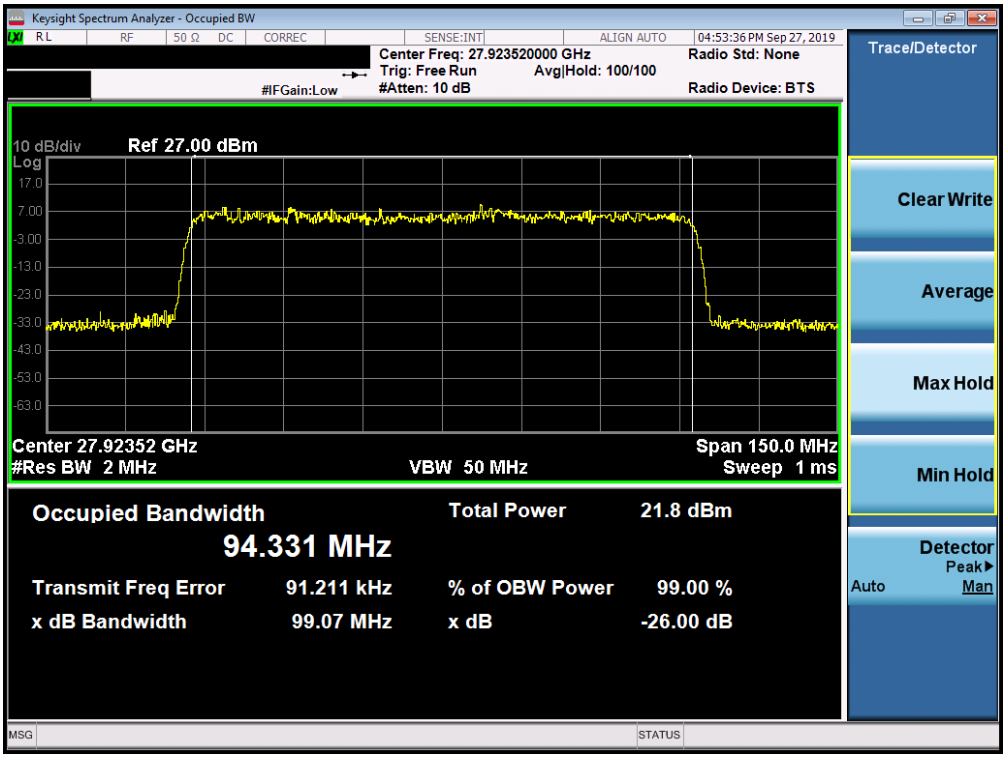
Plot 7-1. Occupied Bandwidth Plot - HBF Antenna (100MHz – π/2 BPSK - Mid Channel)



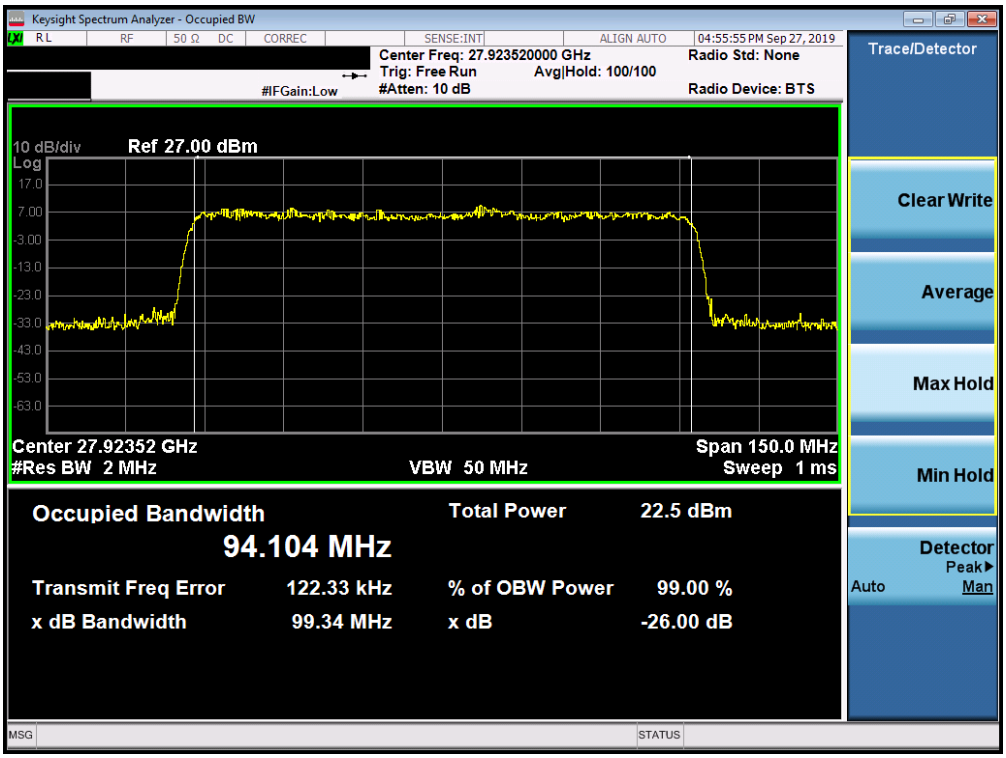
Plot 7-2. Occupied Bandwidth Plot - HBF Antenna (100MHz - QPSK - Mid Channel)



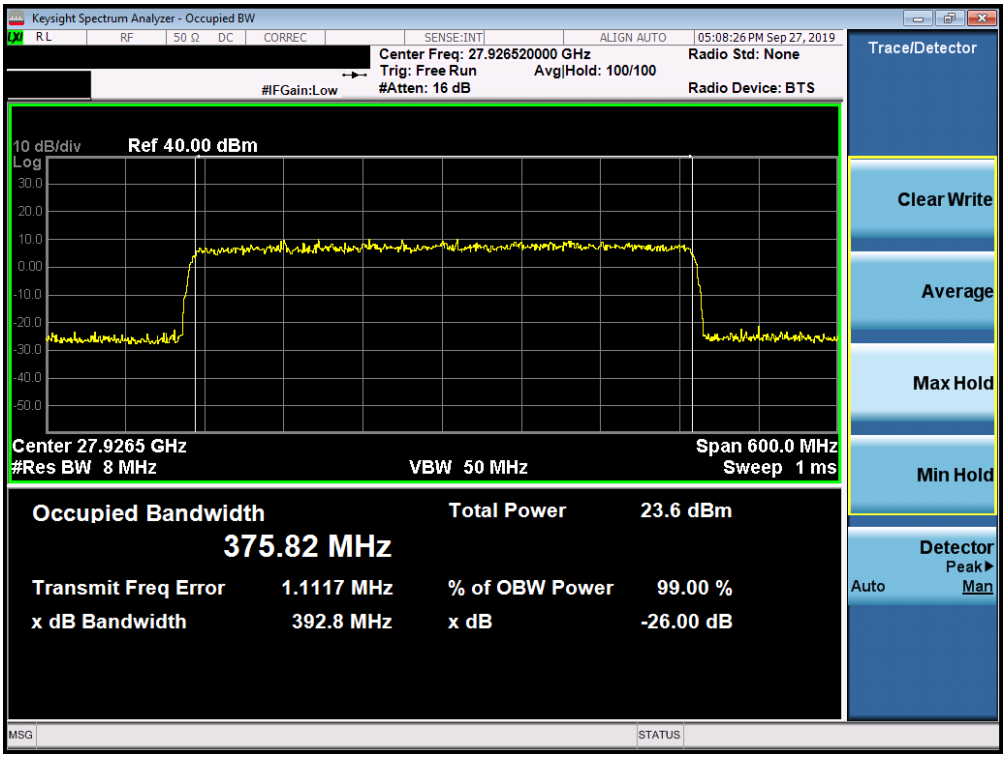
Plot 7-3. Occupied Bandwidth Plot - HBF Antenna (100MHz - 16QAM - Mid Channel)



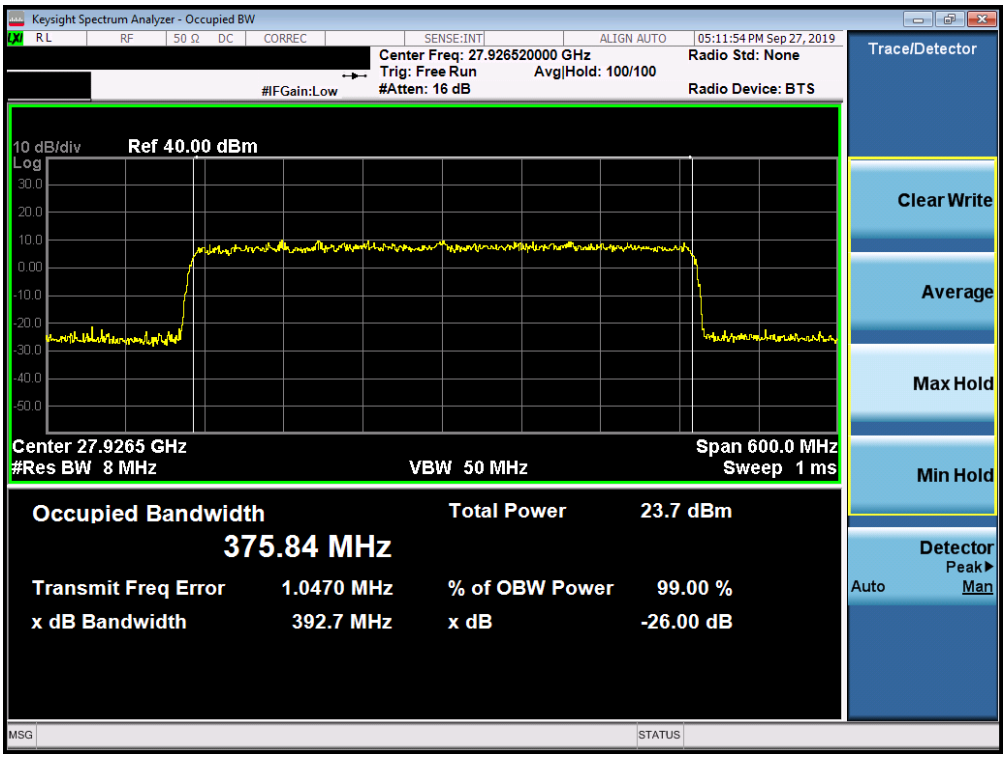
Plot 7-4. Occupied Bandwidth Plot - HBF Antenna (100MHz - 64QAM Mid Channel)



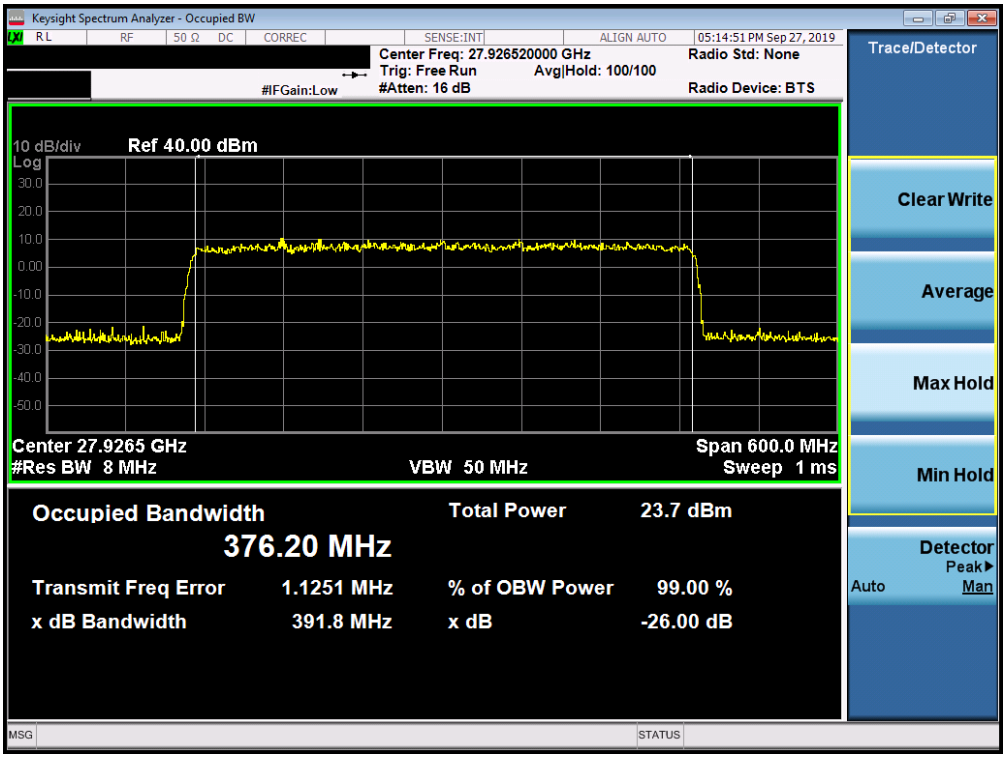
Plot 7-5. Occupied Bandwidth Plot - HBF Antenna (100MHz - 256QAM Mid Channel)



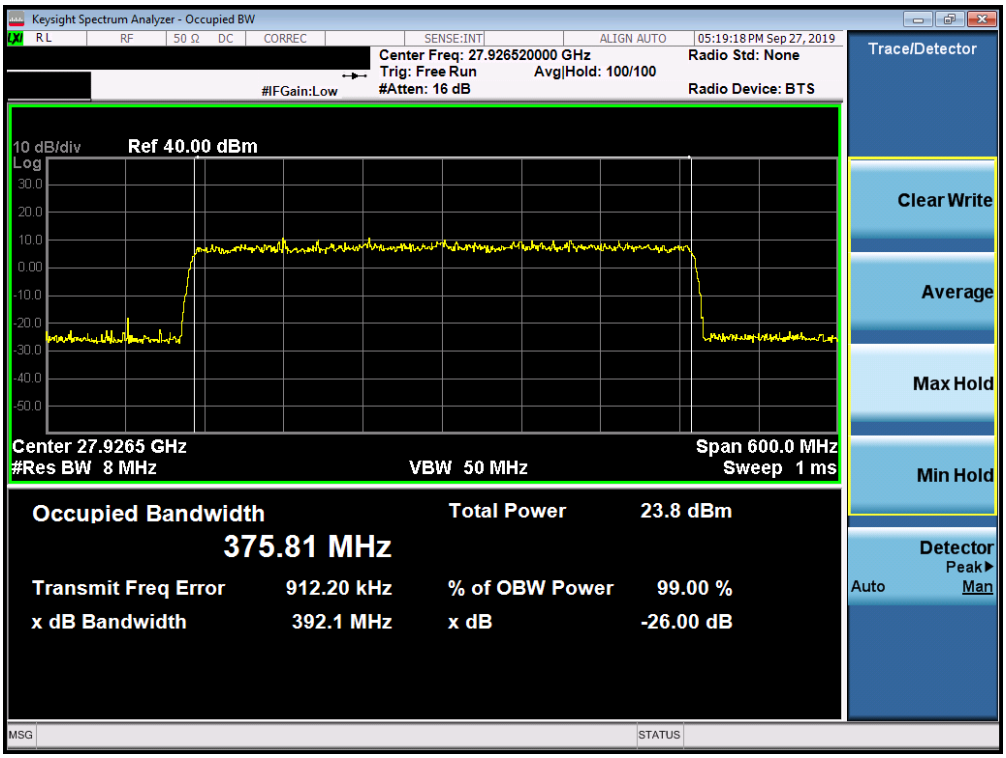
Plot 7-6. Occupied Bandwidth Plot - HBF Antenna (400MHz – π/2 BPSK - Mid Channel)



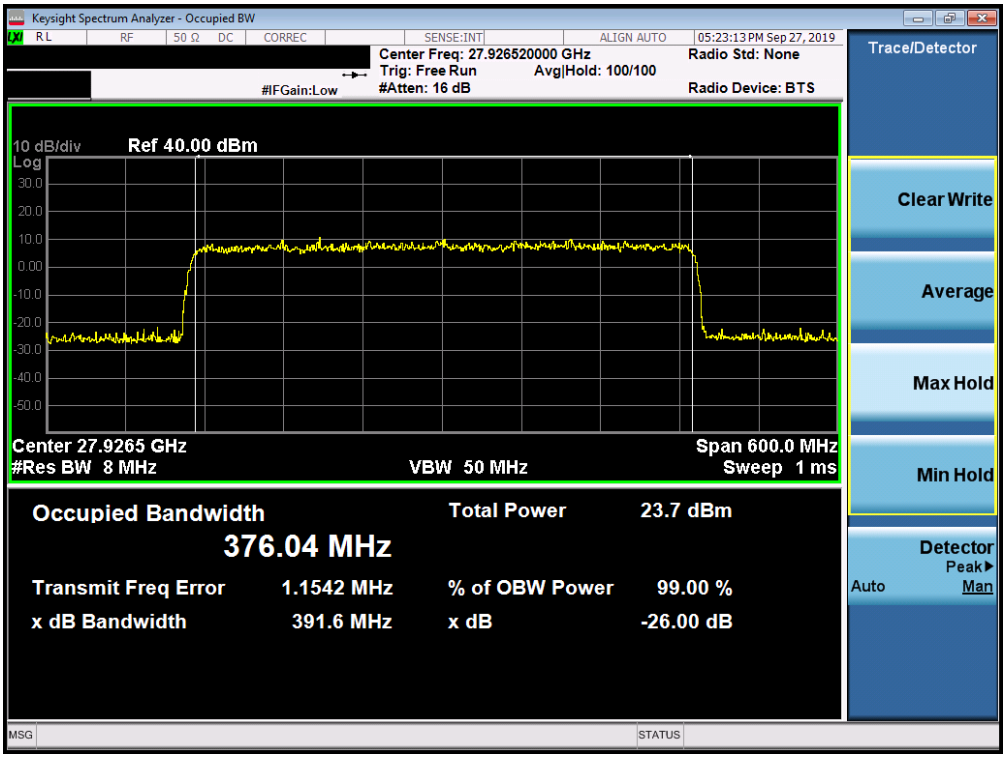
Plot 7-7. Occupied Bandwidth - HBF Antenna Plot (400MHz - QPSK - Mid Channel)



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



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

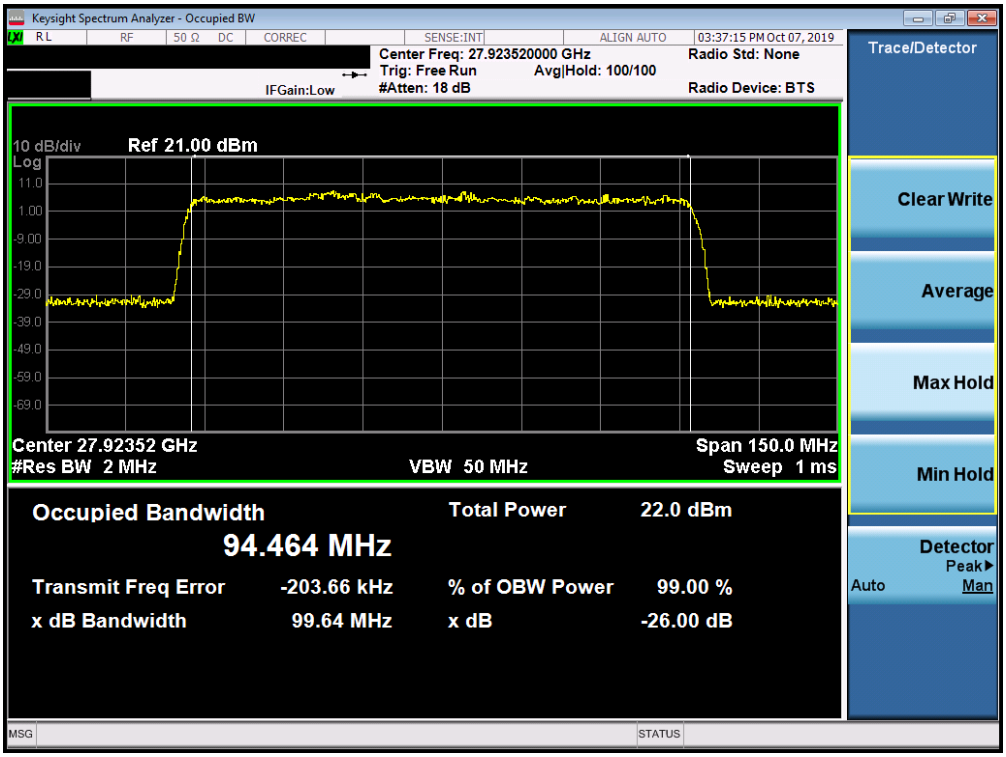


Plot 7-10. Occupied Bandwidth Plot - HBF Antenna (400MHz - 256QAM Mid Channel)

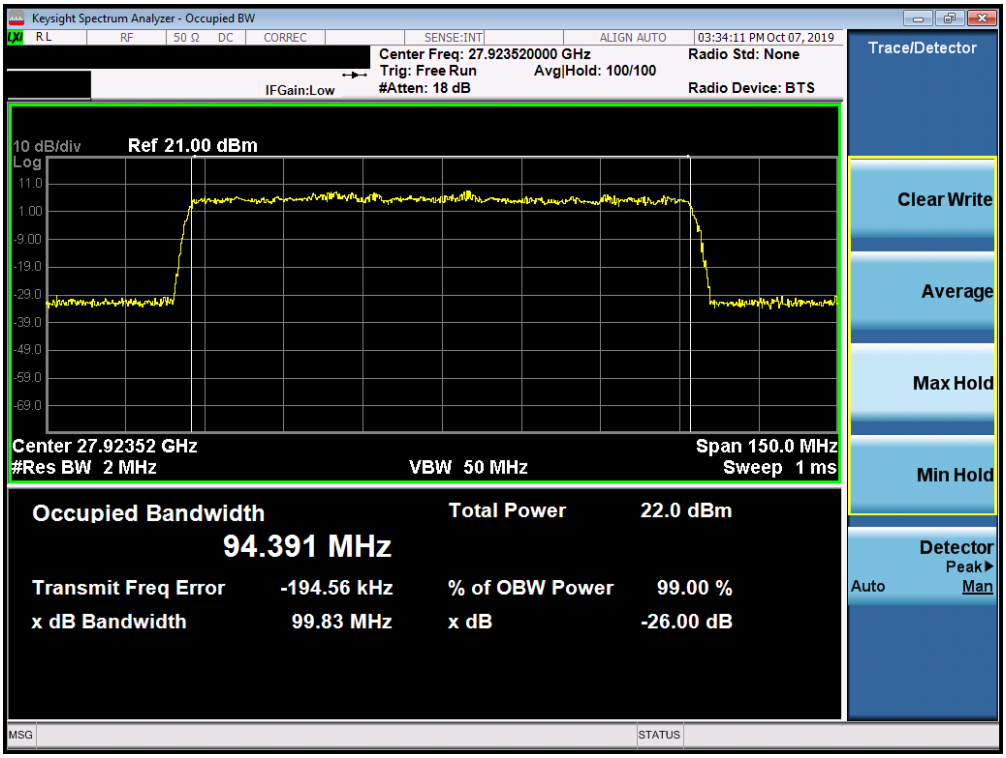
7.2.2 Patch Antenna Occupied Bandwidth

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

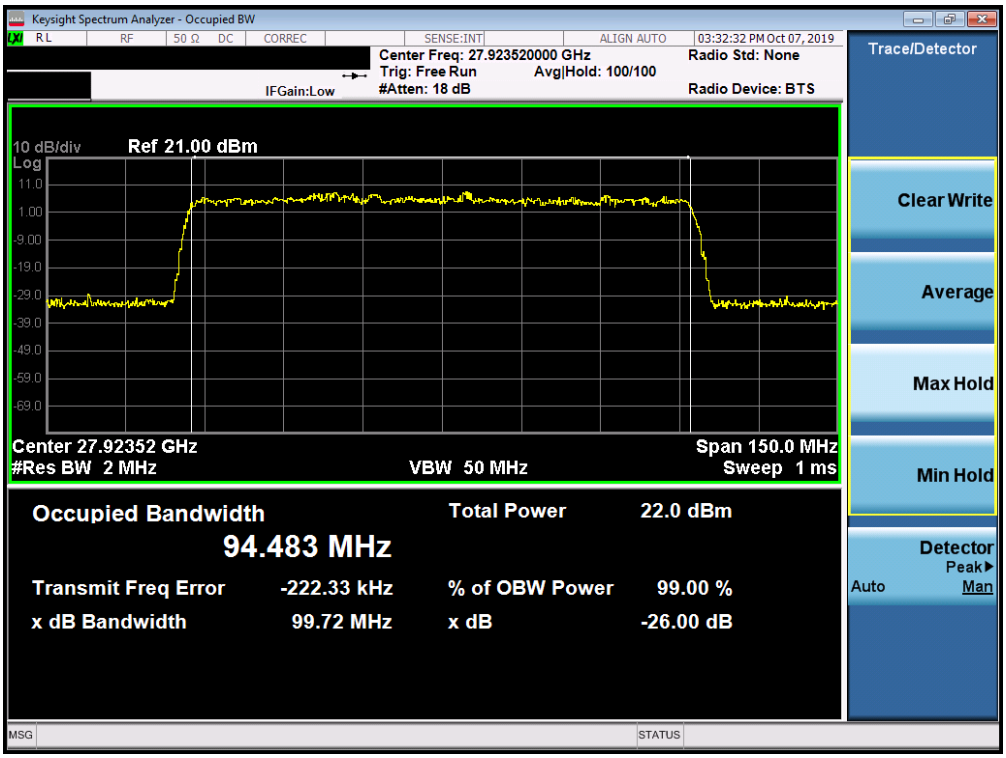
Table 7-3. Summary of Patch Antenna Occupied Bandwidths



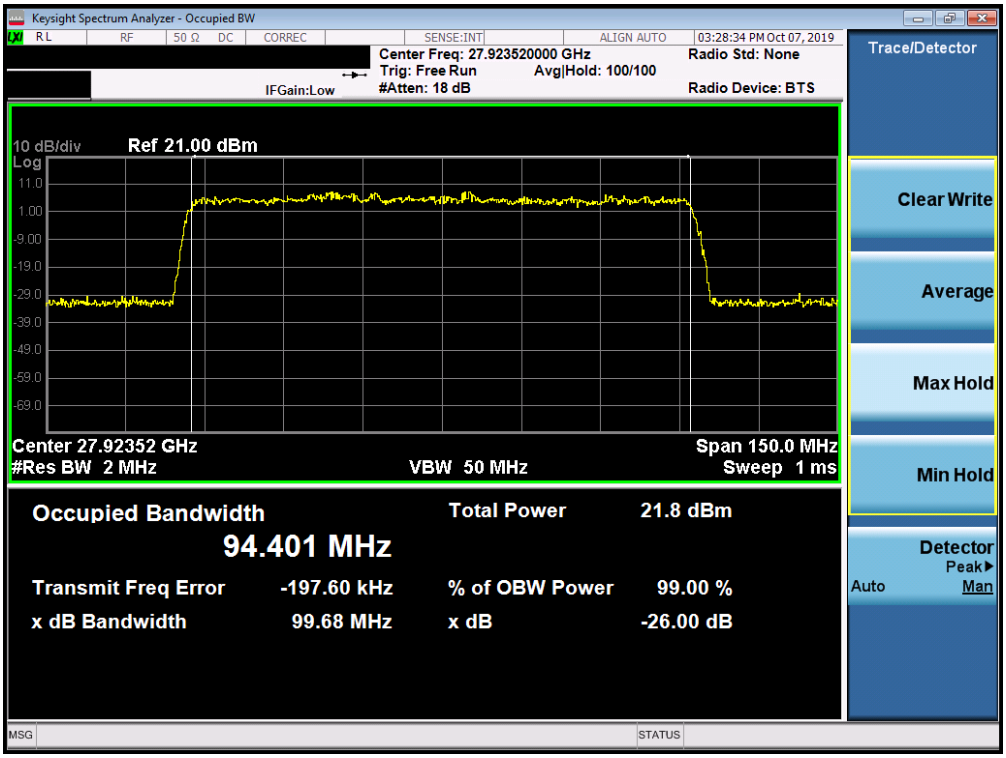
Plot 7-11. Occupied Bandwidth Plot - Patch Antenna (100MHz – π/2 BPSK - Mid Channel)



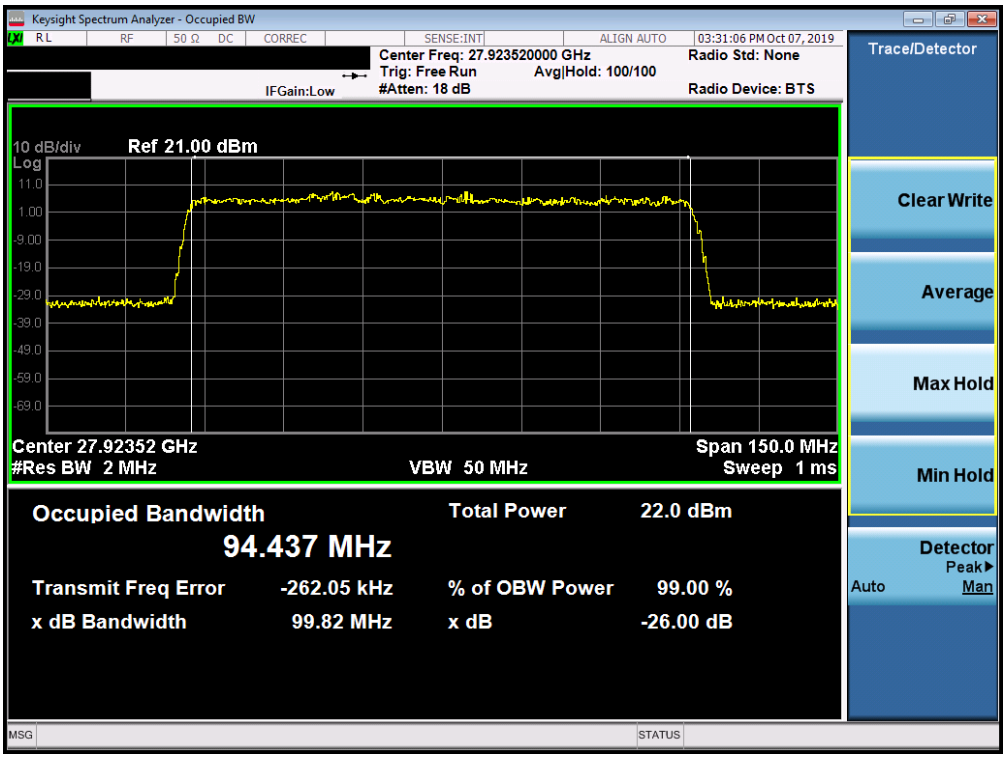
Plot 7-12. Occupied Bandwidth Plot - Patch Antenna (100MHz - QPSK - Mid Channel)



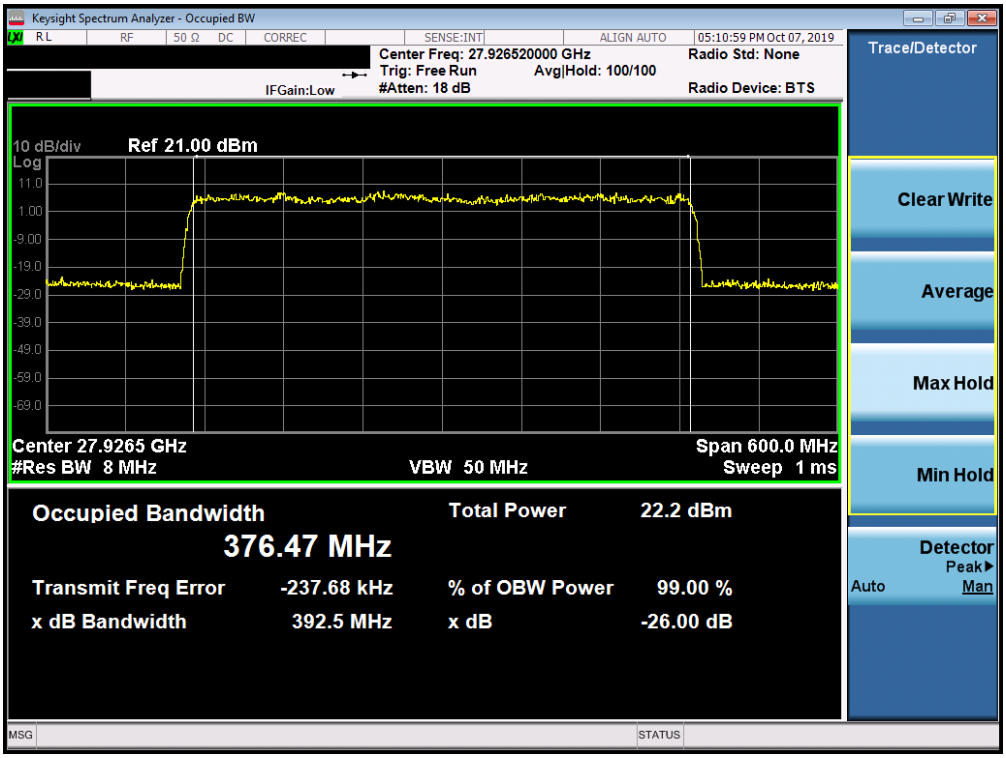
Plot 7-13. Occupied Bandwidth Plot - Patch Antenna (100MHz - 16QAM - Mid Channel)



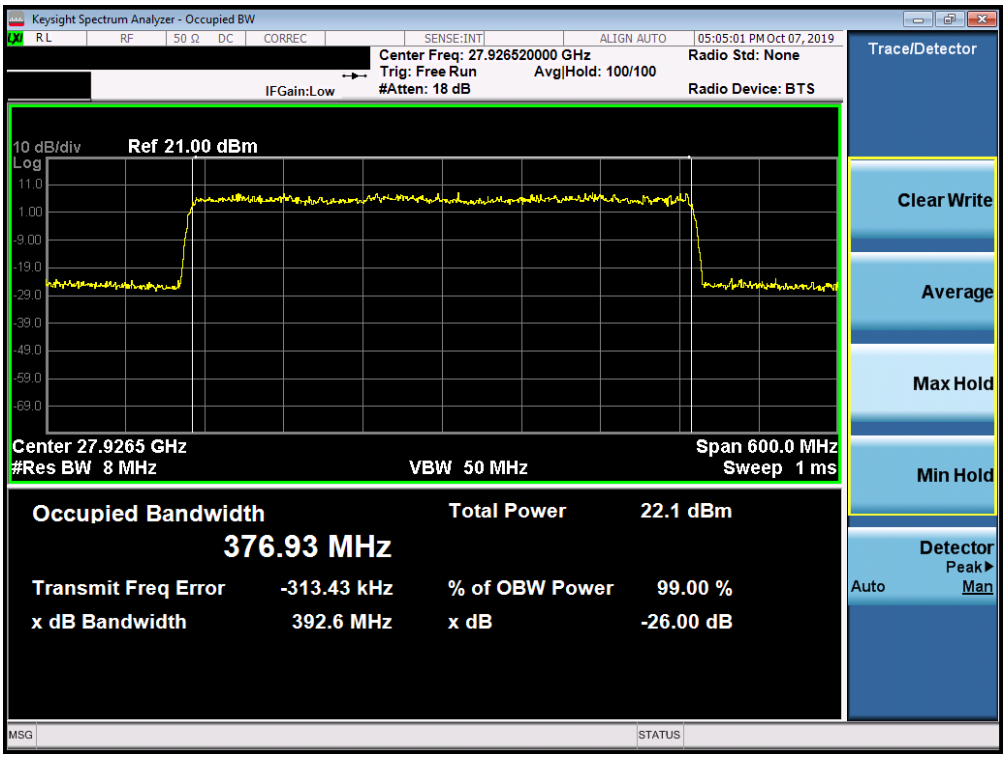
Plot 7-14. Occupied Bandwidth Plot - Patch Antenna (100MHz - 64QAM Mid Channel)



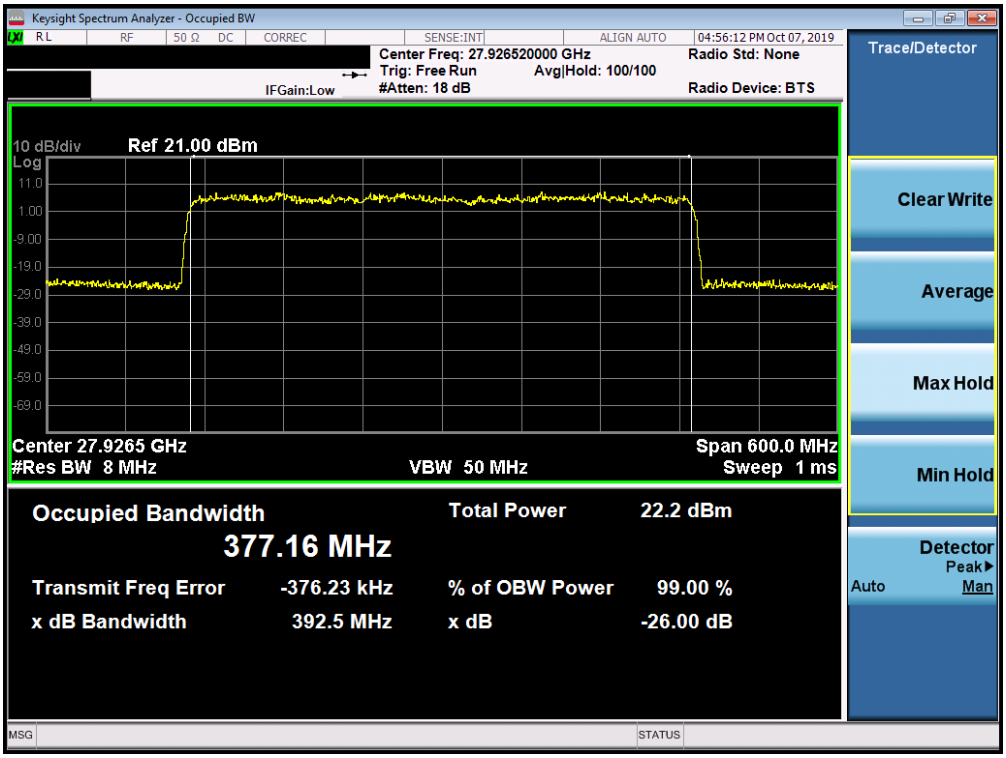
Plot 7-15. Occupied Bandwidth Plot - Patch Antenna (100MHz - 256QAM Mid Channel)



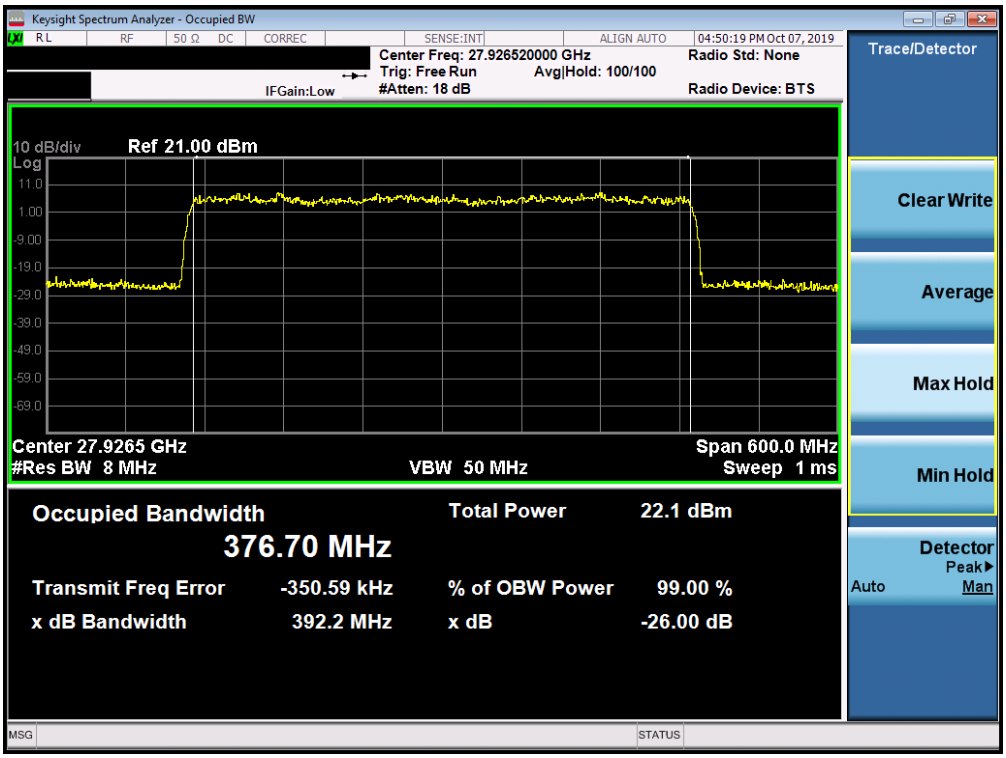
Plot 7-16. Occupied Bandwidth Plot - Patch Antenna (400MHz – π/2 BPSK - Mid Channel)



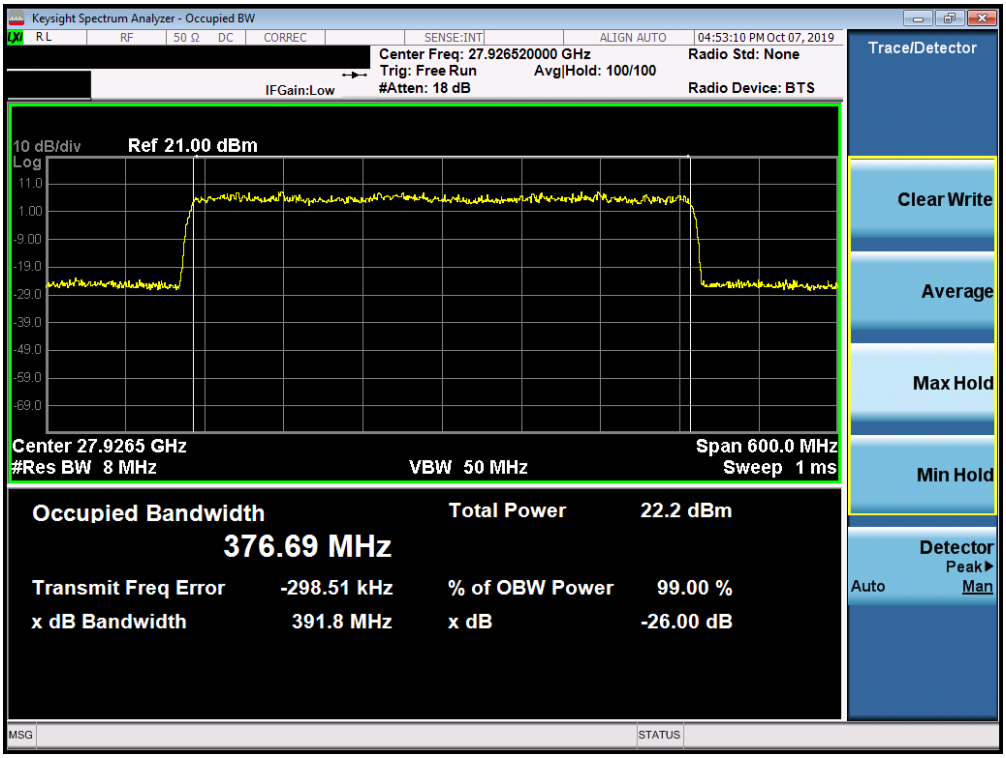
Plot 7-17. Occupied Bandwidth - Patch Antenna Plot (400MHz - QPSK - Mid Channel)



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



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



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

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 ≥ 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

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.

7.3.1 HBF 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	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-OFDM	16QAM	400	Full	0	28140.96	9.93
Vertical	Uplink	DFT-s-OFDM	16QAM	100	1	0	27559.32	9.97
Vertical	Uplink	DFT-s-OFDM	16QAM	100	1	0	27923.52	9.90
Vertical	Uplink	DFT-s-OFDM	16QAM	100	1	0	28292.16	9.94
Vertical	Uplink	DFT-s-OFDM	16QAM	400	1	0	27701.88	9.91
Vertical	Uplink	DFT-s-OFDM	16QAM	400	1	0	27926.52	9.96
Vertical	Uplink	DFT-s-OFDM	16QAM	400	1	0	28140.96	9.95
Vertical	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27559.32	9.95
Vertical	Uplink	DFT-s-OFDM	64QAM	100	Full	0	27923.52	9.99
Vertical	Uplink	DFT-s-OFDM	64QAM	100	Full	0	28292.16	9.99
Vertical	Uplink	DFT-s-OFDM	64QAM	400	Full	0	27701.88	9.92
Vertical	Uplink	DFT-s-OFDM	64QAM	400	Full	0	27926.52	10.00
Vertical	Uplink	DFT-s-OFDM	64QAM	400	Full	0	28140.96	9.97
Vertical	Uplink	DFT-s-OFDM	64QAM	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)

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	π/2 BPSK	400	1	0	28140.96	9.97
Horizontal	Uplink	DFT-s-OFDM	QPSK	100	Full	0	27559.32	9.98
Horizontal	Uplink	DFT-s-OFDM	QPSK	100	Full	0	27923.52	9.92
Horizontal	Uplink	DFT-s-OFDM	QPSK	100	Full	0	28292.16	9.95
Horizontal	Uplink	DFT-s-OFDM	QPSK	400	Full	0	27701.88	9.91
Horizontal	Uplink	DFT-s-OFDM	QPSK	400	Full	0	27926.52	9.98
Horizontal	Uplink	DFT-s-OFDM	QPSK	400	Full	0	28140.96	9.97
Horizontal	Uplink	DFT-s-OFDM	QPSK	100	1	0	27559.32	9.99
Horizontal	Uplink	DFT-s-OFDM	QPSK	100	1	0	27923.52	9.97
Horizontal	Uplink	DFT-s-OFDM	QPSK	100	1	0	28292.16	9.92
Horizontal	Uplink	DFT-s-OFDM	QPSK	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	DFT-s-OFDM	64QAM	400	Full	0	28140.96	9.94
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	1	0	27559.32	9.92
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	1	0	27923.52	9.99
Horizontal	Uplink	DFT-s-OFDM	64QAM	100	1	0	28292.16	9.91
Horizontal	Uplink	DFT-s-OFDM	64QAM	400	1	0	27701.88	9.95
Horizontal	Uplink	DFT-s-OFDM	64QAM	400	1	0	27926.52	9.97
Horizontal	Uplink	DFT-s-OFDM	64QAM	400	1	0	28140.96	9.94
Horizontal	Uplink	DFT-s-OFDM	256QAM	100	Full	0	27559.32	9.95
Horizontal	Uplink	DFT-s-OFDM	256QAM	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

Table 7-5. HBF Conducted Power Horizontal Polarization (SISO)

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	27701.88	9.91	9.97	12.95
MIMO	Uplink	DFT-s-OFDM	QPSK	400	Full	0	27926.52	9.98	9.96	12.98
MIMO	Uplink	DFT-s-OFDM	QPSK	400	Full	0	28140.96	9.97	9.96	12.98
MIMO	Uplink	DFT-s-OFDM	QPSK	100	1	0	27559.32	9.99	9.98	13.00
MIMO	Uplink	DFT-s-OFDM	QPSK	100	1	0	27923.52	9.97	9.98	12.99
MIMO	Uplink	DFT-s-OFDM	QPSK	100	1	0	28292.16	9.92	9.90	12.92
MIMO	Uplink	DFT-s-OFDM	QPSK	400	1	0	27701.88	9.98	9.94	12.97
MIMO	Uplink	DFT-s-OFDM	QPSK	400	1	0	27926.52	9.95	9.91	12.94
MIMO	Uplink	DFT-s-OFDM	QPSK	400	1	0	28140.96	9.95	9.92	12.95
MIMO	Uplink	DFT-s-OFDM	16QAM	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	DFT-s-OFDM	64QAM	100	1	0	27559.32	9.92	9.93	12.94
MIMO	Uplink	DFT-s-OFDM	64QAM	100	1	0	27923.52	9.99	9.95	12.98
MIMO	Uplink	DFT-s-OFDM	64QAM	100	1	0	28292.16	9.91	9.97	12.95
MIMO	Uplink	DFT-s-OFDM	64QAM	400	1	0	27701.88	9.95	9.92	12.95
MIMO	Uplink	DFT-s-OFDM	64QAM	400	1	0	27926.52	9.97	9.98	12.99
MIMO	Uplink	DFT-s-OFDM	64QAM	400	1	0	28140.96	9.94	9.97	12.97
MIMO	Uplink	DFT-s-OFDM	256QAM	100	Full	0	27559.32	9.95	9.96	12.97
MIMO	Uplink	DFT-s-OFDM	256QAM	100	Full	0	27923.52	9.96	9.99	12.99
MIMO	Uplink	DFT-s-OFDM	256QAM	100	Full	0	28292.16	9.95	9.91	12.94
MIMO	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27701.88	9.90	9.92	12.92
MIMO	Uplink	DFT-s-OFDM	256QAM	400	Full	0	27926.52	9.92	9.91	12.93
MIMO	Uplink	DFT-s-OFDM	256QAM	400	Full	0	28140.96	9.97	9.98	12.99
MIMO	Uplink	DFT-s-OFDM	256QAM	100	1	0	27559.32	9.92	9.92	12.93
MIMO	Uplink	DFT-s-OFDM	256QAM	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

Table 7-6. HBF Conducted Power Summary Data (MIMO)

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	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	27701.88	19.96
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	27926.52	19.93
Vertical	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	28140.96	19.99
Vertical	Uplink	DFT-s-OFDM	QPSK	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	16QAM	400	Full	0	28140.96	19.89
Vertical	Uplink	DFT-s-OFDM	16QAM	100	1	0	27559.32	19.93
Vertical	Uplink	DFT-s-OFDM	16QAM	100	1	0	27923.52	19.95
Vertical	Uplink	DFT-s-OFDM	16QAM	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	DFT-s-OFDM	64QAM	100	1	0	27559.32	19.98
Vertical	Uplink	DFT-s-OFDM	64QAM	100	1	0	27923.52	19.98
Vertical	Uplink	DFT-s-OFDM	64QAM	100	1	0	28292.16	19.93
Vertical	Uplink	DFT-s-OFDM	64QAM	400	1	0	27701.88	19.93
Vertical	Uplink	DFT-s-OFDM	64QAM	400	1	0	27926.52	19.96
Vertical	Uplink	DFT-s-OFDM	64QAM	400	1	0	28140.96	19.98
Vertical	Uplink	DFT-s-OFDM	256QAM	100	Full	0	27559.32	19.97
Vertical	Uplink	DFT-s-OFDM	256QAM	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)

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	27701.88	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	27923.52	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	QPSK	400	1	0	27926.52	19.97
Horizontal	Uplink	DFT-s-OFDM	QPSK	400	1	0	28140.96	19.99
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	Full	0	27559.32	19.97
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	Full	0	27923.52	19.95
Horizontal	Uplink	DFT-s-OFDM	16QAM	100	Full	0	28292.16	19.98
Horizontal	Uplink	DFT-s-OFDM	16QAM	400	Full	0	27701.88	19.95
Horizontal	Uplink	DFT-s-OFDM	16QAM	400	Full	0	27926.52	19.99
Horizontal	Uplink	DFT-s-OFDM	16QAM	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	DFT-s-OFDM	256QAM	100	1	0	28292.16	19.99
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	1	0	27701.88	19.92
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	1	0	27926.52	19.98
Horizontal	Uplink	DFT-s-OFDM	256QAM	400	1	0	28140.96	19.96

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

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	27923.52	19.97	19.95	22.97
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	100	1	0	28292.16	19.95	19.93	22.95
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	27701.88	19.96	19.96	22.97
MIMO	Uplink	DFT-s-OFDM	π/2 BPSK	400	1	0	27926.52	19.97	19.93	22.96
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
MIMO	Uplink	DFT-s-OFDM	QPSK	400	1	0	27701.88	19.97	19.94	22.97
MIMO	Uplink	DFT-s-OFDM	QPSK	400	1	0	27926.52	19.97	19.98	22.99
MIMO	Uplink	DFT-s-OFDM	QPSK	400	1	0	28140.96	19.99	19.93	22.97
MIMO	Uplink	DFT-s-OFDM	16QAM	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	Uplink	DFT-s-OFDM	16QAM	400	1	0	27701.88	19.97	19.94	22.97
MIMO	Uplink	DFT-s-OFDM	16QAM	400	1	0	27926.52	19.94	19.99	22.98
MIMO	Uplink	DFT-s-OFDM	16QAM	400	1	0	28140.96	19.94	19.94	22.95
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
MIMO	Uplink	DFT-s-OFDM	64QAM	400	1	0	27701.88	19.98	19.93	22.97
MIMO	Uplink	DFT-s-OFDM	64QAM	400	1	0	27926.52	19.91	19.96	22.95
MIMO	Uplink	DFT-s-OFDM	64QAM	400	1	0	28140.96	19.93	19.98	22.97
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-s-OFDM	256QAM	400	1	0	27701.88	19.92	19.94	22.94
MIMO	Uplink	DFT-s-OFDM	256QAM	400	1	0	27926.52	19.98	19.96	22.98
MIMO	Uplink	DFT-s-OFDM	256QAM	400	1	0	28140.96	19.96	19.98	22.98

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

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 π/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

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 ≥ 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

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.

7.4.1 HBF Equivalent Isotropic Radiated Power (EIRP)

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]
100	**27559.32**	**Low**	**H**	**QPSK**	**H**	**0**	**0**	**Full RB**	**28.16**	**31.52**	**55.00**	**-26.84**
	27559.32	**Low**	**V**	**QPSK**	**V**	**2**	**4**	**Full RB**	**28.83**		**55.00**	**-26.17**
	27923.52	Mid	H	QPSK	H	1	0	Full RB	27.66	30.82	55.00	-27.34
	27923.52	Mid	V	QPSK	V	1	0	Full RB	27.96		55.00	-27.04
	28292.16	High	H	QPSK	H	2	2	Full RB	26.25	30.33	55.00	-28.75
	28292.16	High	V	QPSK	V	1	6	Full RB	28.18		55.00	-26.82
	27559.32	**Low**	**H**	**16QAM**	**H**	**0**	**0**	**Full RB**	**28.76**	**31.56**	**55.00**	**-26.24**
	27559.32	**Low**	**V**	**16QAM**	**V**	**2**	**4**	**Full RB**	**28.33**		**55.00**	**-26.67**
	27923.52	Mid	H	16QAM	H	1	0	Full RB	26.90	30.61	55.00	-28.10
	27923.52	Mid	V	16QAM	V	1	0	Full RB	28.20		55.00	-26.80
	28292.16	High	H	16QAM	H	2	2	Full RB	27.60	30.59	55.00	-27.40
	28292.16	High	V	16QAM	V	1	6	Full RB	27.56		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]
100	**27559.32**	**Low**	**H**	**QPSK**	**H**	**0**	**0**	**1 RB**	**29.11**	**31.73**	**55.00**	**-25.89**
	27559.32	**Low**	**V**	**QPSK**	**V**	**2**	**3**	**1 RB**	**28.30**		**55.00**	**-26.70**
	27923.52	Mid	H	QPSK	H	1	0	1 RB	28.17	31.11	55.00	-26.83
	27923.52	Mid	V	QPSK	V	1	0	1 RB	28.02		55.00	-26.98
	28292.16	High	H	QPSK	H	2	1	1 RB	26.14	29.84	55.00	-28.86
	28292.16	High	V	QPSK	V	2	3	1 RB	27.42		55.00	-27.58
	27559.32	**Low**	**H**	**16QAM**	**H**	**0**	**0**	**1 RB**	**28.86**	**31.42**	**55.00**	**-26.14**
	27559.32	**Low**	**V**	**16QAM**	**V**	**2**	**3**	**1 RB**	**27.91**		**55.00**	**-27.09**
	27923.52	Mid	H	16QAM	H	1	0	1 RB	28.00	30.81	55.00	-27.00
	27923.52	Mid	V	16QAM	V	1	0	1 RB	27.59		55.00	-27.41
	28292.16	High	H	16QAM	H	2	1	1 RB	27.70	30.96	55.00	-27.30
	28292.16	High	V	16QAM	V	2	3	1 RB	28.19		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]
400	**27701.88**	**Low**	**H**	**QPSK**	**H**	**2**	**1**	**Full RB**	**28.29**	**31.11**	**55.00**	**-26.71**
	27701.88	**Low**	**V**	**QPSK**	**V**	**7**	**3**	**Full RB**	**27.89**		**55.00**	**-27.11**
	27926.52	Mid	H	QPSK	H	6	2	Full RB	27.83	30.54	55.00	-27.17
	27926.52	Mid	V	QPSK	V	1	4	Full RB	27.20		55.00	-27.80
	28140.96	High	H	QPSK	H	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
	27701.88	**Low**	**H**	**16QAM**	**H**	**2**	**1**	**Full RB**	**28.19**	**31.01**	**55.00**	**-26.81**
	27701.88	**Low**	**V**	**16QAM**	**V**	**7**	**3**	**Full RB**	**27.79**		**55.00**	**-27.21**
	27926.52	Mid	H	16QAM	H	6	2	Full RB	28.03	30.83	55.00	-26.97
	27926.52	Mid	V	16QAM	V	1	4	Full RB	27.60		55.00	-27.40
	28140.96	High	H	16QAM	H	8	4	Full RB	27.23	30.65	55.00	-27.77
	28140.96	High	V	16QAM	V	2	2	Full RB	28.01		55.00	-26.99

Table 7-12. HBF EIRP -- 400MHz 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]
400	**27701.88**	**Low**	**H**	**QPSK**	**H**	**1**	**3**	**1 RB**	**27.67**	**30.96**	**55.00**	**-27.33**
	27701.88	**Low**	**V**	**QPSK**	**V**	**2**	**5**	**1 RB**	**28.21**		**55.00**	**-26.79**
	27926.52	Mid	H	QPSK	H	5	3	1 RB	27.97	30.96	55.00	-27.03
	27926.52	Mid	V	QPSK	V	2	1	1 RB	27.92		55.00	-27.08
	28140.96	High	H	QPSK	H	4	1	1 RB	27.33	30.34	55.00	-27.67
	28140.96	High	V	QPSK	V	1	3	1 RB	27.33		55.00	-27.67
	27701.88	Low	H	16QAM	H	1	3	1 RB	27.98	30.68	55.00	-27.02
	27701.88	Low	V	16QAM	V	2	5	1 RB	27.33		55.00	-27.67
	27926.52	**Mid**	**H**	**16QAM**	**H**	**5**	**3**	**1 RB**	**28.05**	**30.99**	**55.00**	**-26.95**
	27926.52	**Mid**	**V**	**16QAM**	**V**	**2**	**1**	**1 RB**	**27.91**		**55.00**	**-27.09**
	28140.96	High	H	16QAM	H	4	1	1 RB	27.33	30.48	55.00	-27.67
	28140.96	High	V	16QAM	V	1	3	1 RB	27.60		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

7.4.2 Patch Equivalent Isotropic Radiated Power (EIRP)

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]
100	27559.32	Low	H	QPSK	H	357	3	Full RB	29.48	31.43	55.00	-25.52
	27559.32	Low	V	QPSK	V	4	12	Full RB	27.01		55.00	-27.99
	27923.52	**Mid**	**H**	**QPSK**	**H**	**350**	**0**	**Full RB**	**29.42**	**32.46**	**55.00**	**-25.58**
	27923.52	**Mid**	**V**	**QPSK**	**V**	**5**	**358**	**Full RB**	**29.47**		**55.00**	**-25.53**
	28292.16	High	H	QPSK	H	350	359	Full RB	27.70	31.56	55.00	-27.30
	28292.16	High	V	QPSK	V	7	352	Full RB	29.25		55.00	-25.75
	27559.32	Low	H	16QAM	H	357	3	Full RB	29.46	31.49	55.00	-25.54
	27559.32	Low	V	16QAM	V	4	12	Full RB	27.21		55.00	-27.79
	27923.52	**Mid**	**H**	**16QAM**	**H**	**350**	**0**	**Full RB**	**29.03**	**32.22**	**55.00**	**-25.97**
	27923.52	**Mid**	**V**	**16QAM**	**V**	**5**	**358**	**Full RB**	**29.38**		**55.00**	**-25.62**
	28292.16	High	H	16QAM	H	350	359	Full RB	26.78	31.31	55.00	-28.22
	28292.16	High	V	16QAM	V	7	352	Full RB	29.43		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]
100	27559.32	Low	H	QPSK	H	357	3	1 RB	27.16	29.42	55.00	-27.84
	27559.32	Low	V	QPSK	V	4	12	1 RB	25.51		55.00	-29.49
	27923.52	Mid	H	QPSK	H	350	0	1 RB	26.14	29.09	55.00	-28.86
	27923.52	Mid	V	QPSK	V	5	358	1 RB	26.02		55.00	-28.98
	28292.16	**High**	**H**	**QPSK**	**H**	**350**	**359**	**1 RB**	**27.66**	**29.82**	**55.00**	**-27.34**
	28292.16	**High**	**V**	**QPSK**	**V**	**7**	**352**	**1 RB**	**25.75**		**55.00**	**-29.25**
	27559.32	Low	H	16QAM	H	357	3	1 RB	26.20	28.64	55.00	-28.80
	27559.32	Low	V	16QAM	V	4	12	1 RB	24.96		55.00	-30.04
	27923.52	**Mid**	**H**	**16QAM**	**H**	**350**	**0**	**1 RB**	**26.45**	**29.46**	**55.00**	**-28.55**
	27923.52	**Mid**	**V**	**16QAM**	**V**	**5**	**358**	**1 RB**	**26.45**		**55.00**	**-28.55**
	28292.16	High	H	16QAM	H	350	359	1 RB	26.11	29.01	55.00	-28.89
	28292.16	High	V	16QAM	V	7	352	1 RB	25.88		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]
400	**27701.88**	**Low**	**H**	**QPSK**	**H**	**355**	**359**	**Full RB**	**28.31**	**30.72**	**55.00**	**-26.69**
	27701.88	**Low**	**V**	**QPSK**	**V**	**5**	**5**	**Full RB**	**27.02**		**55.00**	**-27.98**
	27926.52	Mid	H	QPSK	H	353	11	Full RB	28.13	30.69	55.00	-26.87
	27926.52	Mid	V	QPSK	V	349	358	Full RB	27.18		55.00	-27.82
	28140.96	High	H	QPSK	H	348	4	Full RB	26.49	30.06	55.00	-28.51
	28140.96	High	V	QPSK	V	355	2	Full RB	27.54		55.00	-27.46
	27701.88	Low	H	16QAM	H	355	359	Full RB	27.91	30.33	55.00	-27.09
	27701.88	Low	V	16QAM	V	5	5	Full RB	26.63		55.00	-28.37
	27926.52	**Mid**	**H**	**16QAM**	**H**	**353**	**11**	**Full RB**	**27.70**	**30.84**	**55.00**	**-27.30**
	27926.52	**Mid**	**V**	**16QAM**	**V**	**349**	**358**	**Full RB**	**27.95**		**55.00**	**-27.05**
	28140.96	High	H	16QAM	H	348	4	Full RB	26.09	30.17	55.00	-28.91
	28140.96	High	V	16QAM	V	355	2	Full RB	28.02		55.00	-26.98

Table 7-16. Patch EIRP -- 400MHz 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]
400	**27701.88**	**Low**	**H**	**QPSK**	**H**	**355**	**359**	**1 RB**	**28.20**	**30.11**	**55.00**	**-26.80**
	27701.88	**Low**	**V**	**QPSK**	**V**	**5**	**5**	**1 RB**	**25.62**		**55.00**	**-29.38**
	27926.52	Mid	H	QPSK	H	353	11	1 RB	27.59	29.81	55.00	-27.41
	27926.52	Mid	V	QPSK	V	349	358	1 RB	25.82		55.00	-29.18
	28140.96	High	H	QPSK	H	348	4	1 RB	26.25	29.74	55.00	-28.75
	28140.96	High	V	QPSK	V	2	4	1 RB	27.16		55.00	-27.84
	27701.88	**Low**	**H**	**16QAM**	**H**	**355**	**359**	**1 RB**	**28.03**	**29.93**	**55.00**	**-26.97**
	27701.88	**Low**	**V**	**16QAM**	**V**	**5**	**5**	**1 RB**	**25.42**		**55.00**	**-29.58**
	27926.52	Mid	H	16QAM	H	353	11	1 RB	27.67	29.69	55.00	-27.33
	27926.52	Mid	V	16QAM	V	349	358	1 RB	25.40		55.00	-29.60
	28140.96	High	H	16QAM	H	348	4	1 RB	26.85	29.66	55.00	-28.15
	28140.96	High	V	16QAM	V	355	2	1 RB	26.43		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

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 ≥ 2 x Span/RBW
6. The trace was allowed to stabilize
7. RBW = 1MHz, VBW = 3MHz

Test Notes

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. 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.

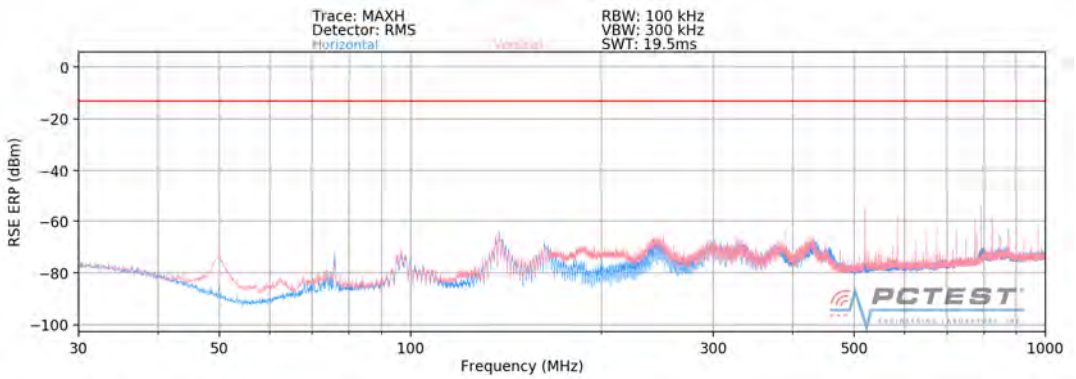
4) Emissions below 18GHz were measured at a 3 meter test distance, while emissions above 18GHz were measured at the appropriate far field distance. The far field of the mmWave signal is based on formula: R > 2D^2/wavelength, where D is the larger between the dimension of the measurement antenna and the 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.

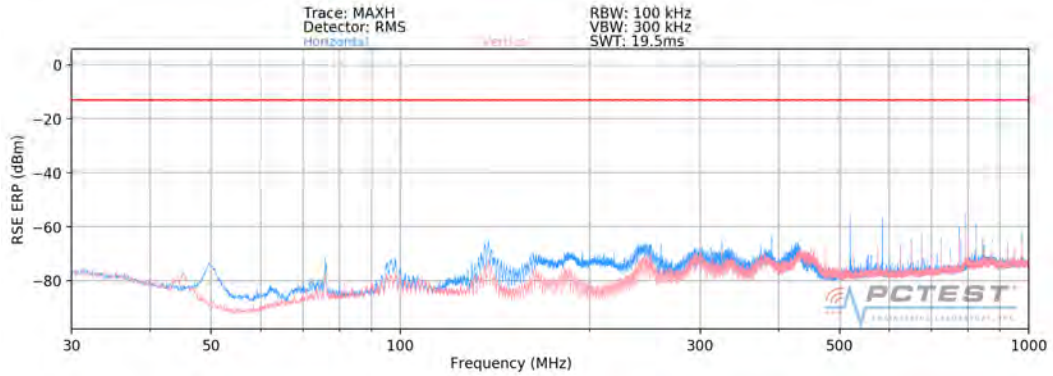
6) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

7.5.1 HBF Antenna Radiated Spurious Emissions

30MHz – 1GHz

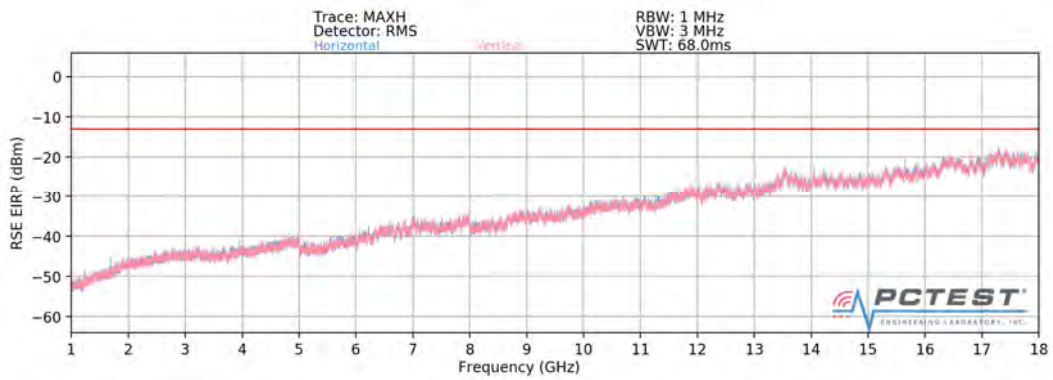


Plot 7-21. HBF Antenna Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Mid Channel H Beam)

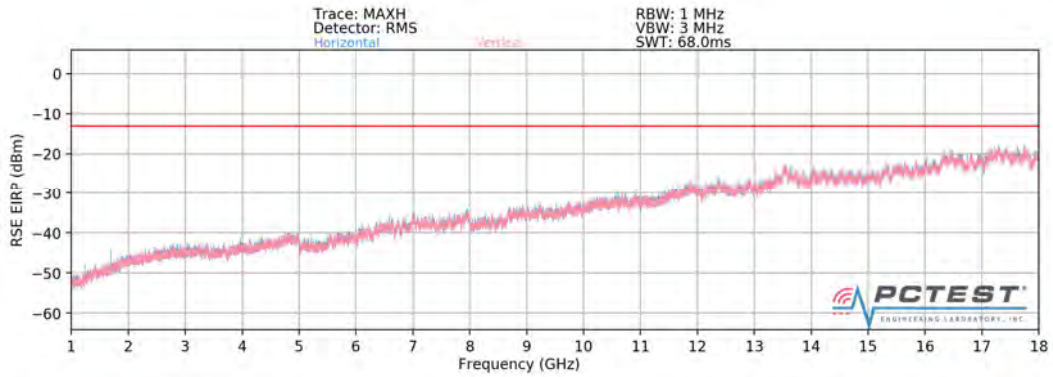


Plot 7-22. HBF Antenna Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Mid Channel V Beam)

1 – 18GHz

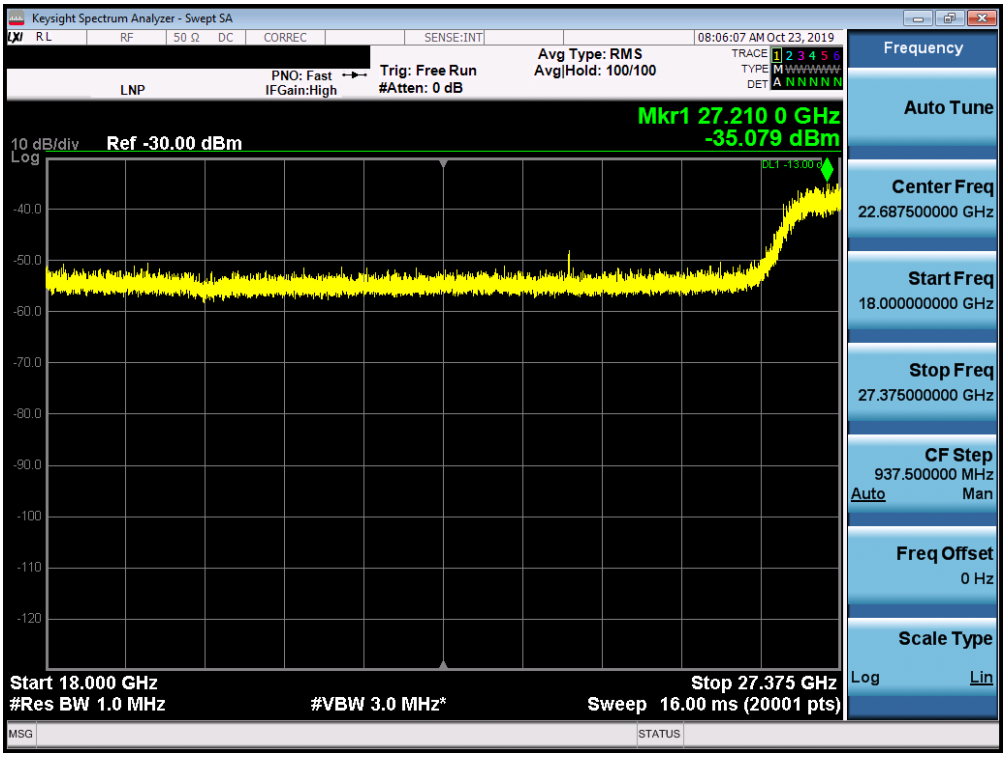


Plot 7-23. HBF Antenna Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel H Beam)

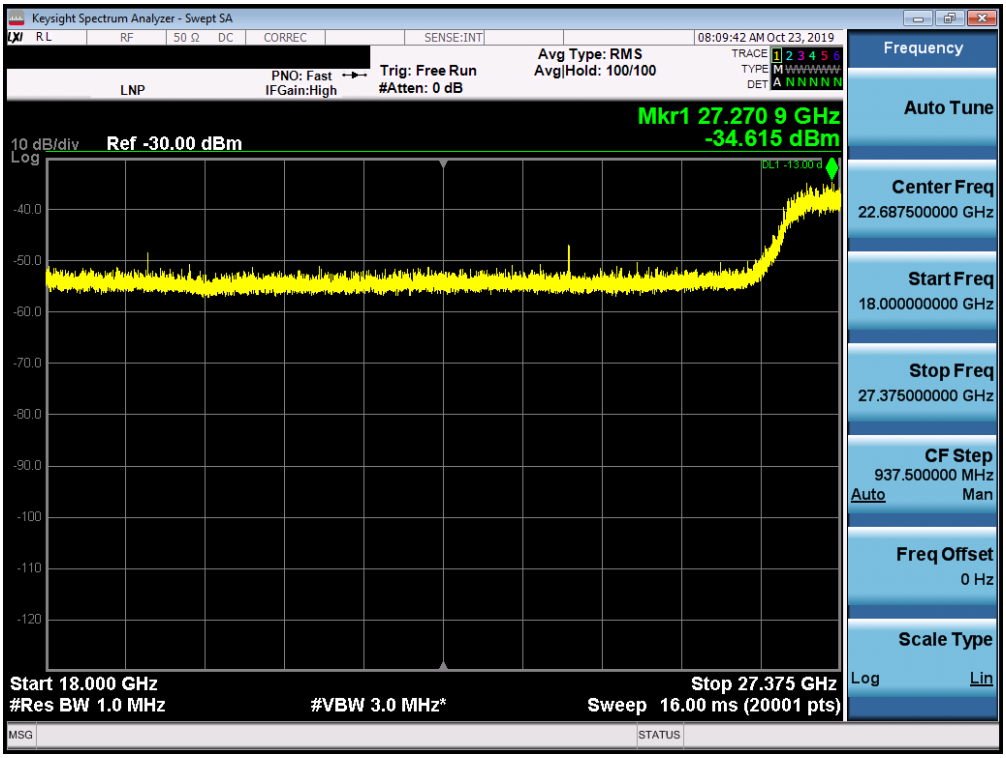


Plot 7-24. HBF Antenna Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel V Beam)

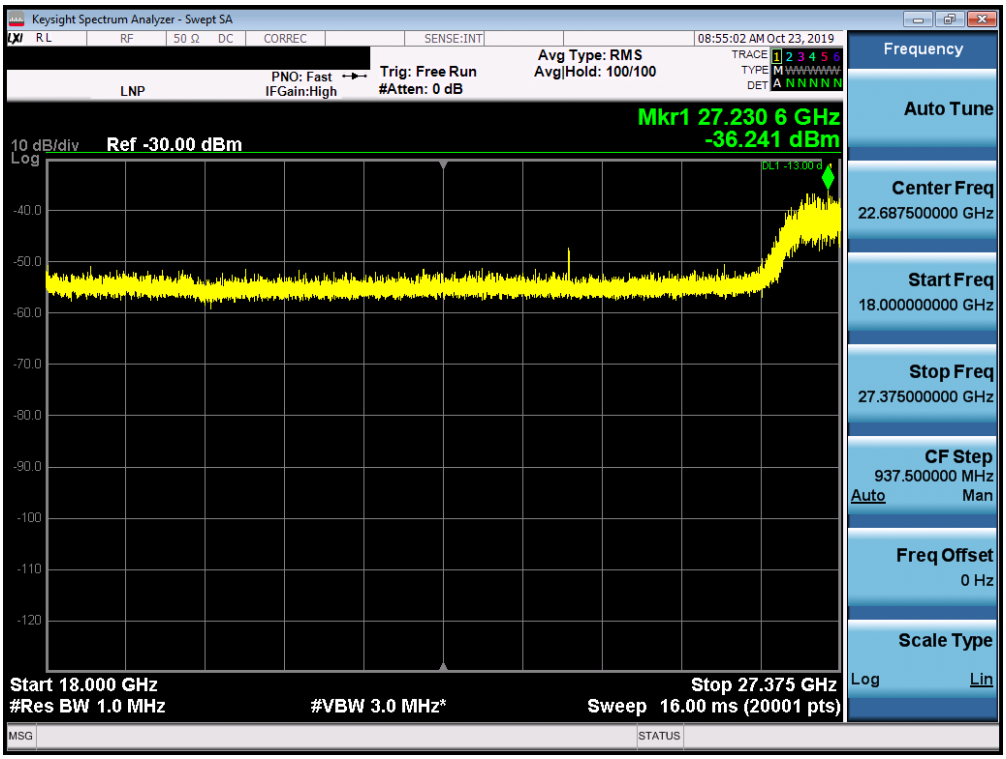
18 – 27.375GHz



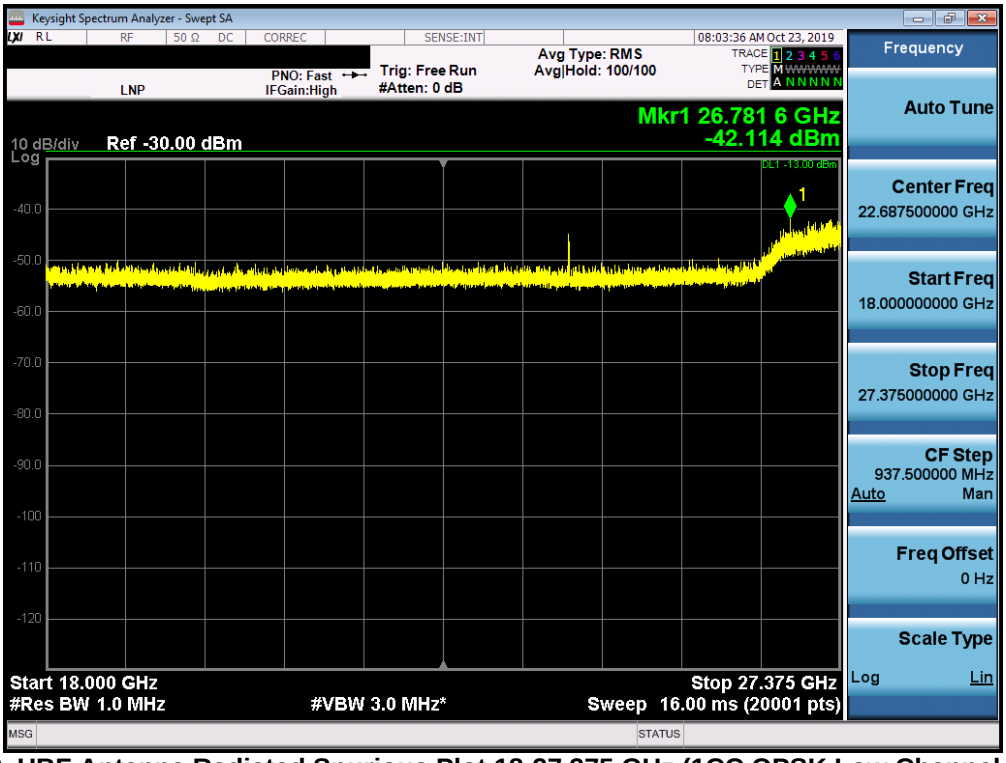
Plot 7-25. HBF Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Low Channel H Beam)



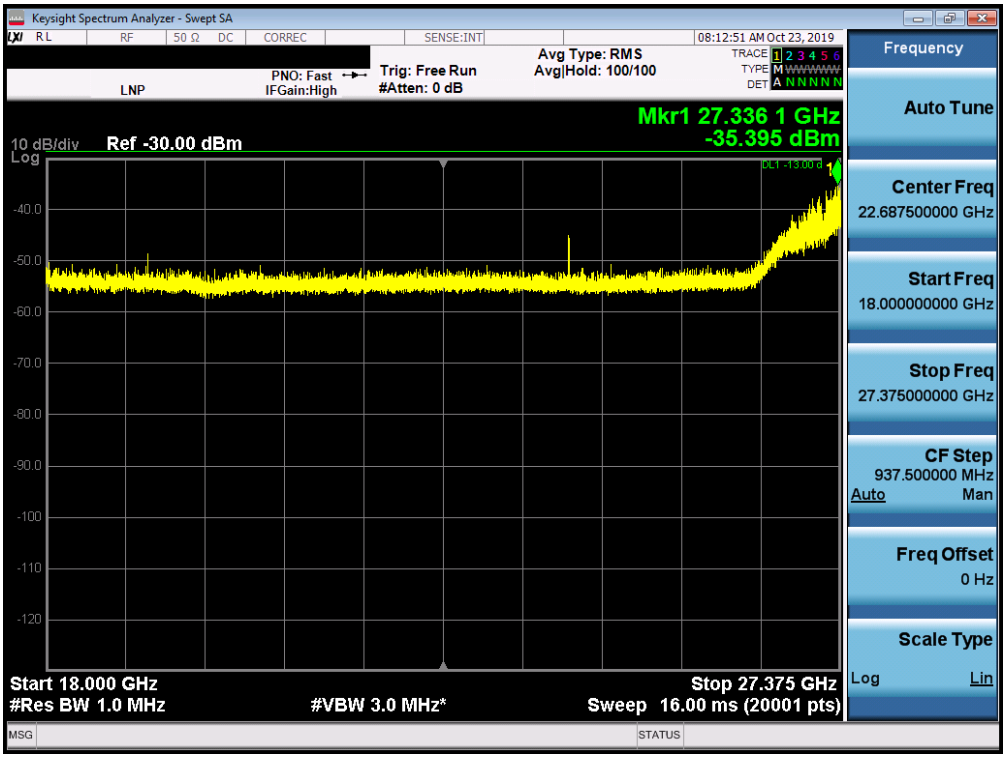
Plot 7-26. HBF Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Mid Channel H Beam)



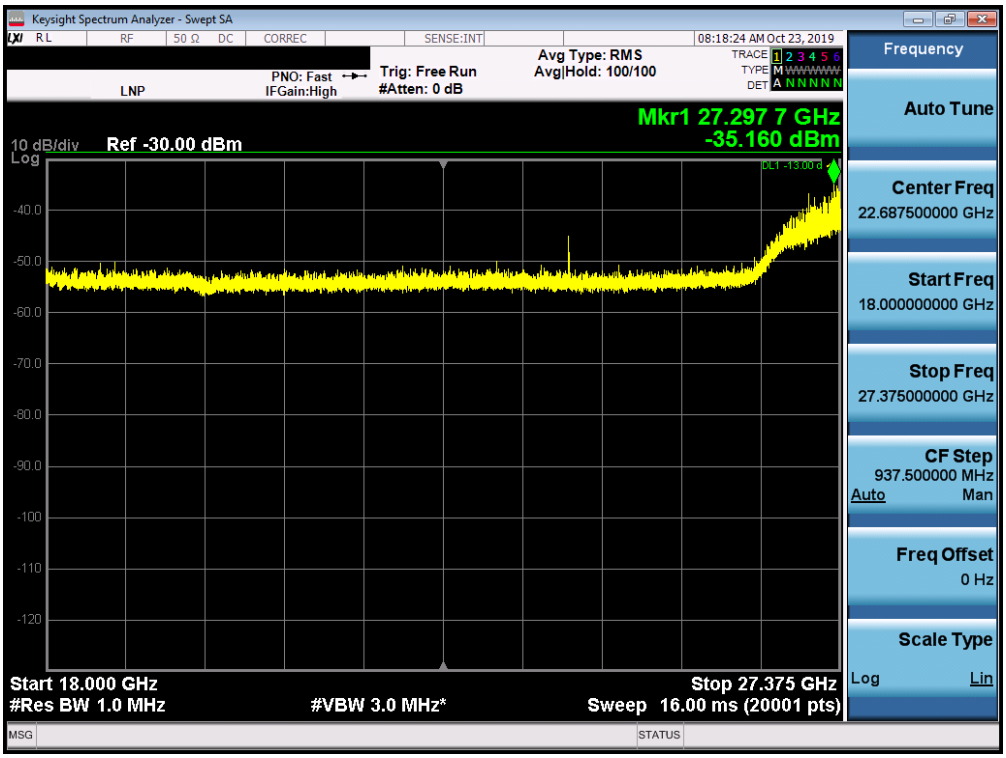
Plot 7-27. HBF Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK High Channel H Beam)



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



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)

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]
27210.00	RMS/MaxH	Low	100	QPSK	H	H	0	359	-35.08	-13.00	-22.08
27270.90	RMS/MaxH	Mid	100	QPSK	H	H	2	3	-34.62	-13.00	-21.62
27230.60	RMS/MaxH	High	100	QPSK	H	H	3	4	-36.24	-13.00	-23.24
26781.60	RMS/MaxH	Low	100	QPSK	V	V	5	6	-42.11	-13.00	-29.11
27336.10	RMS/MaxH	Mid	100	QPSK	V	V	355	7	-35.40	-13.00	-22.40
27297.70	RMS/MaxH	High	100	QPSK	V	V	2	4	-35.16	-13.00	-22.16

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

Notes

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.

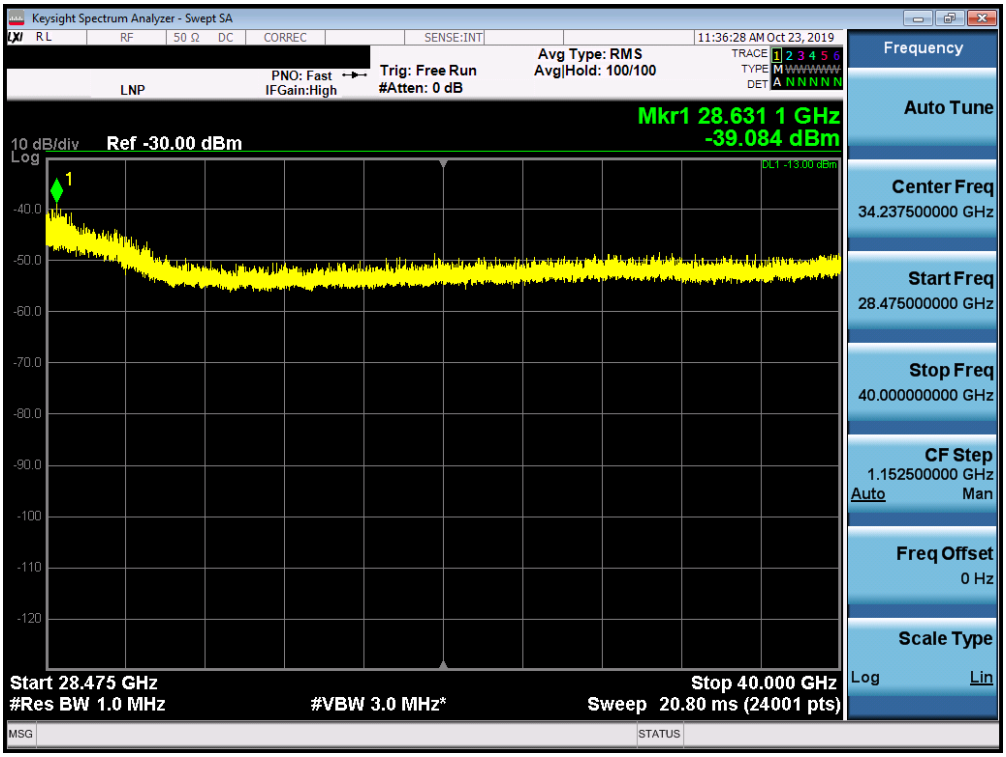
2. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

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:

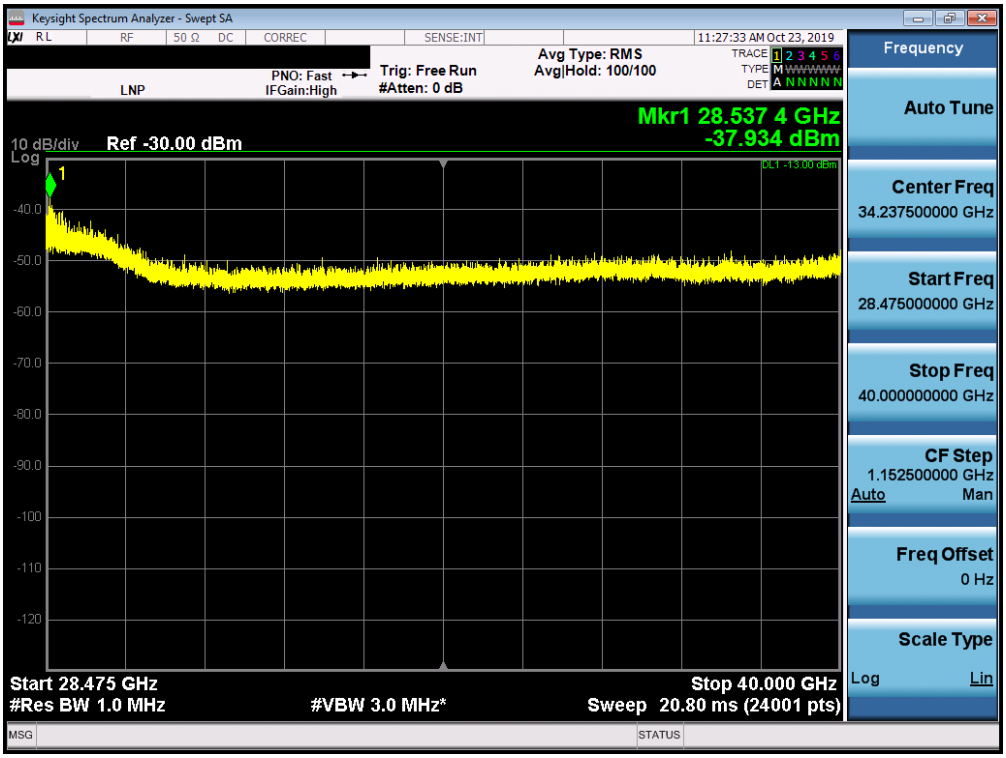
EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

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

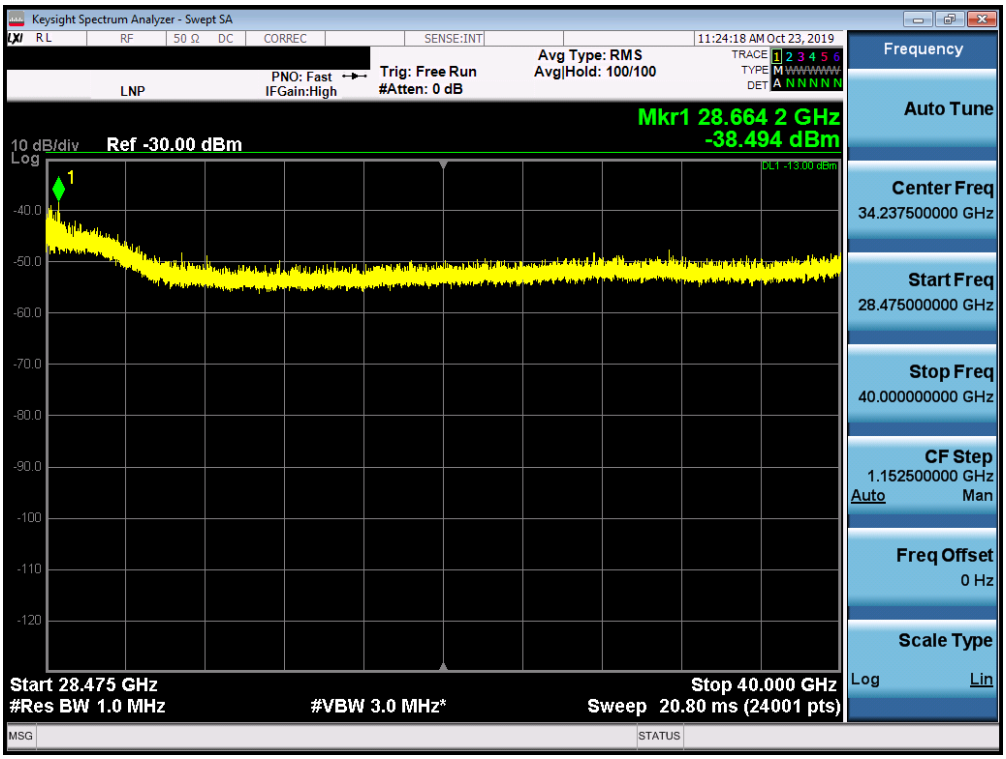
28.475 – 40GHz



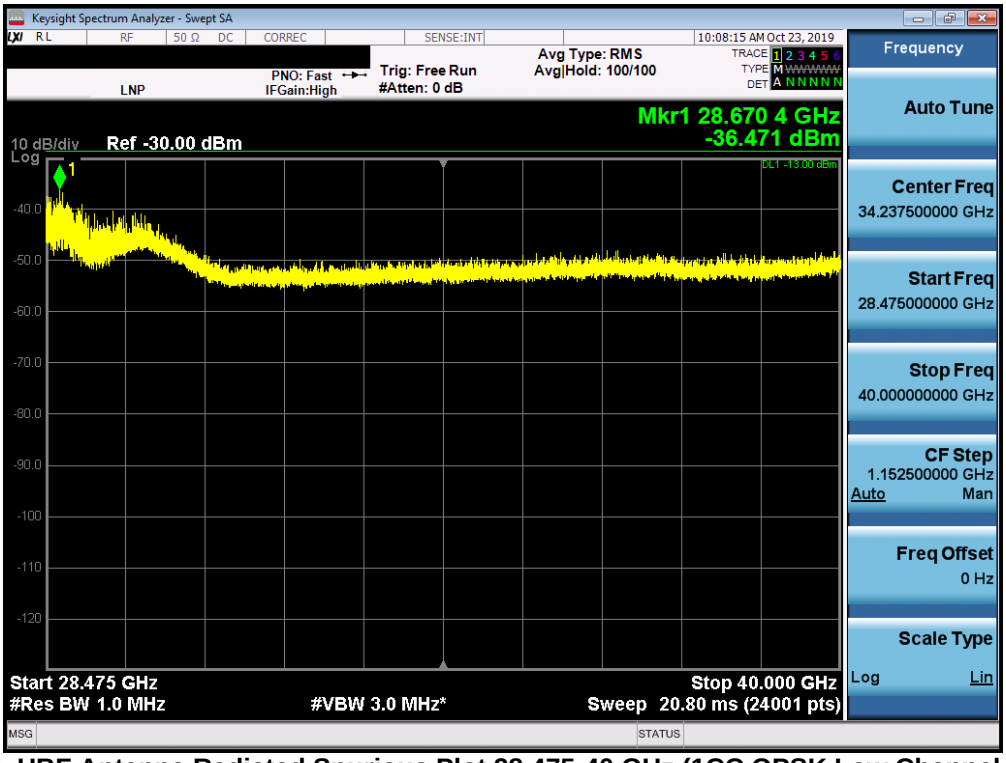
Plot 7-31. HBF Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Low Channel H Beam)



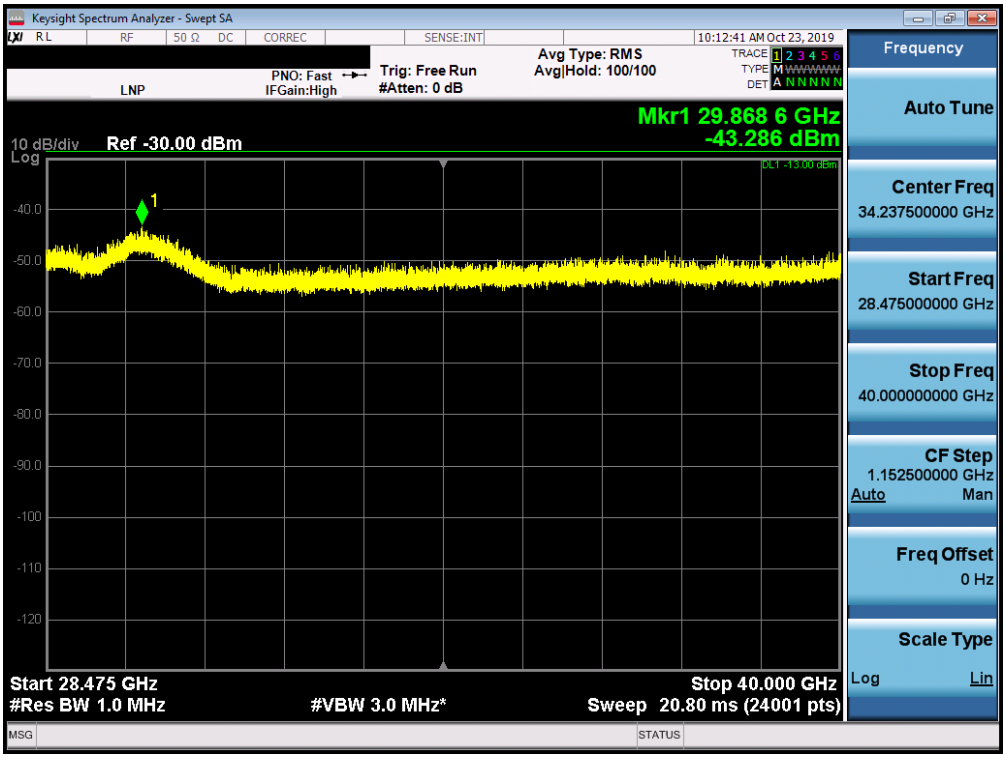
Plot 7-32. HBF Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Mid Channel H Beam)



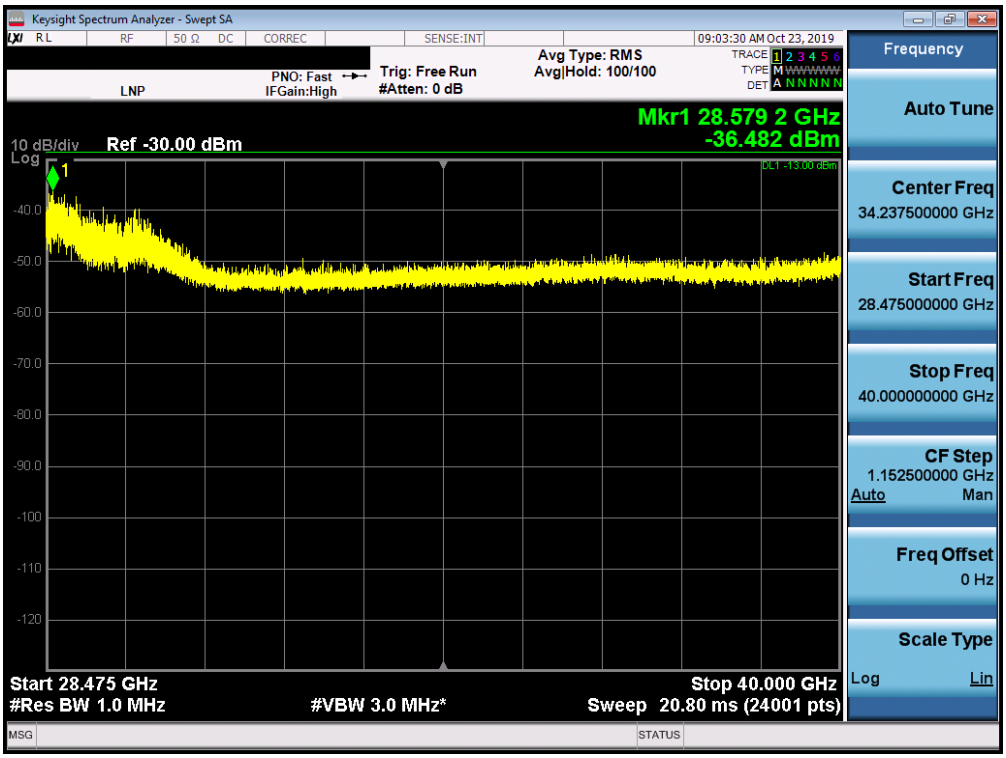
Plot 7-33. HBF Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK High Channel H Beam)



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



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)

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]
28631.10	RMS/MaxH	Low	100	QPSK	H	H	3	358	-39.08	-13.00	-26.08
28537.40	RMS/MaxH	Mid	100	QPSK	H	H	355	4	-37.93	-13.00	-24.93
28644.20	RMS/MaxH	High	100	QPSK	H	H	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

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

Notes

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.

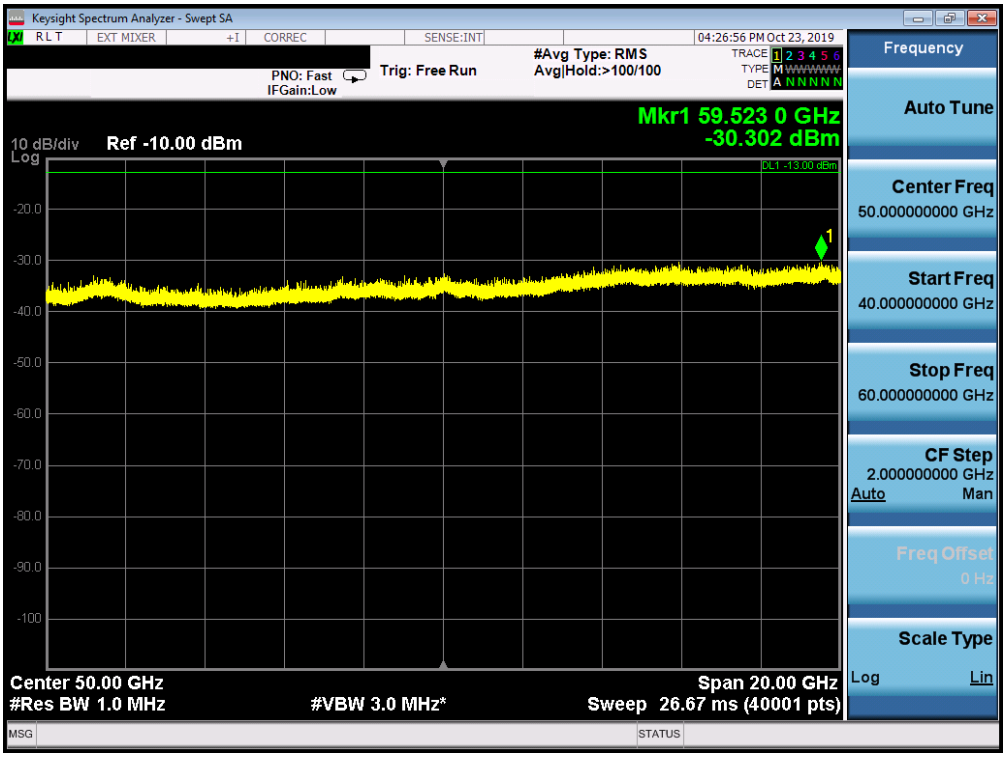
2. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

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)

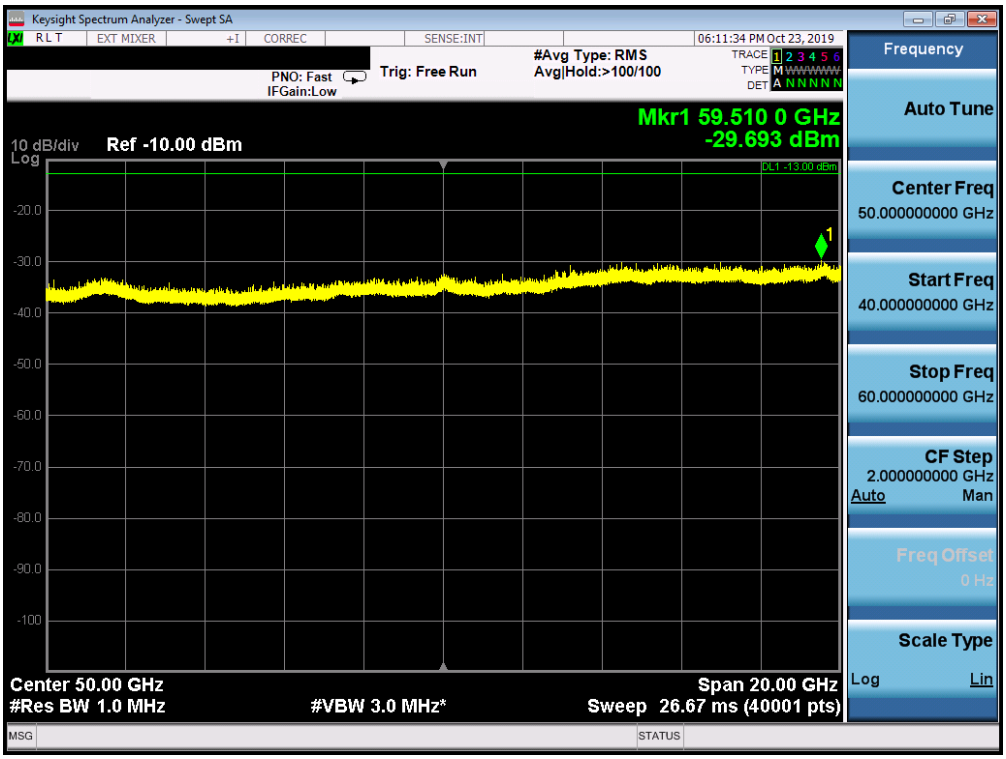
(-39.08 dBm + -36.47 dBm) = (123.59 nW + 225.42 nW) = (349.14 nW) = -34.57 dBm

40 – 60GHz



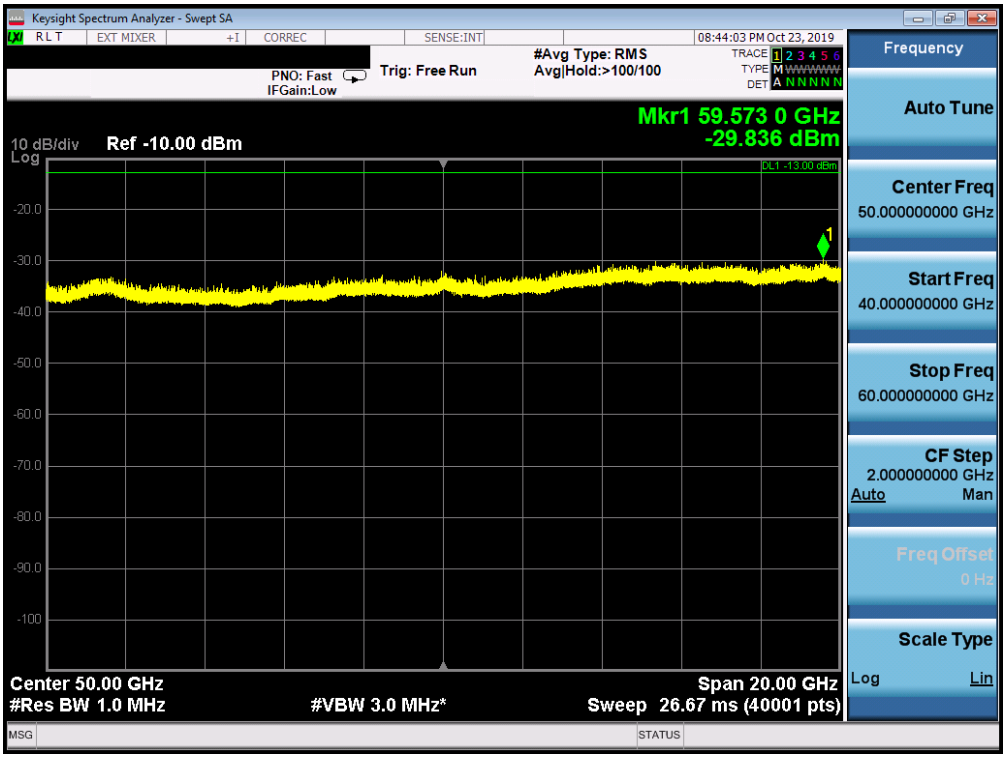
Plot 7-37. HBF Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK Low Channel H Beam)

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

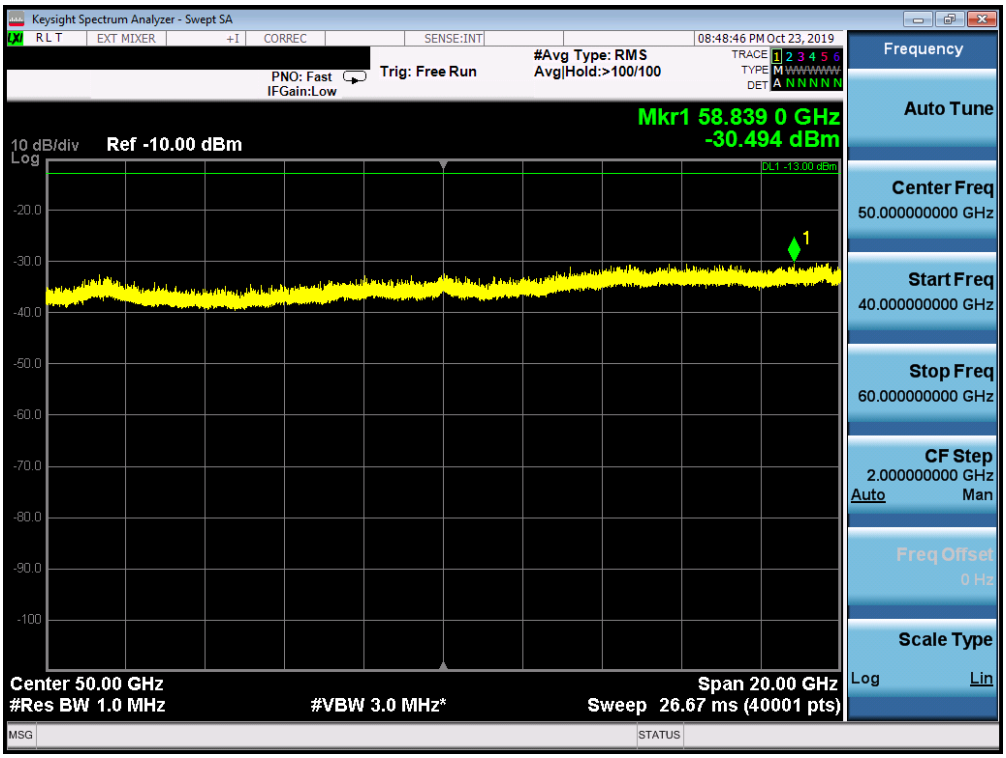


Plot 7-39. HBF Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK High Channel H Beam)

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



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)

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	H	H	-	-	-30.30	-13.00	-17.30
59547.50	RMS/MaxH	Mid	100	QPSK	H	H	-	-	-29.83	-13.00	-16.83
59510.00	RMS/MaxH	High	100	QPSK	H	H	-	-	-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	QPSK	V	V	-	-	-30.49	-13.00	-17.49

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

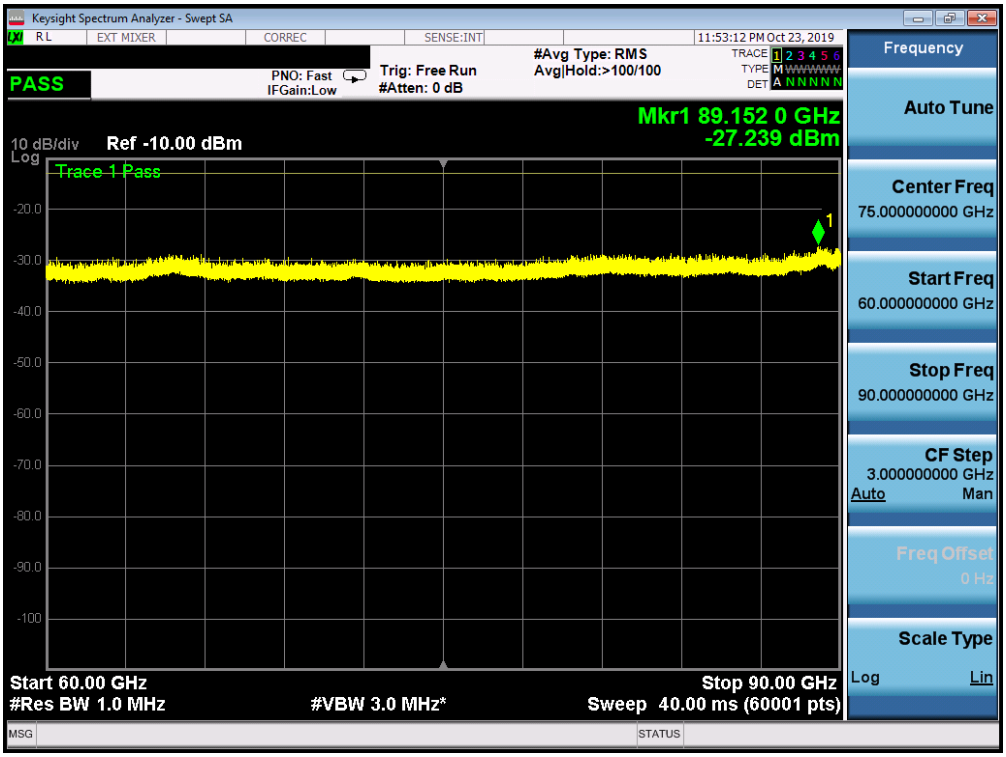
Notes

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.

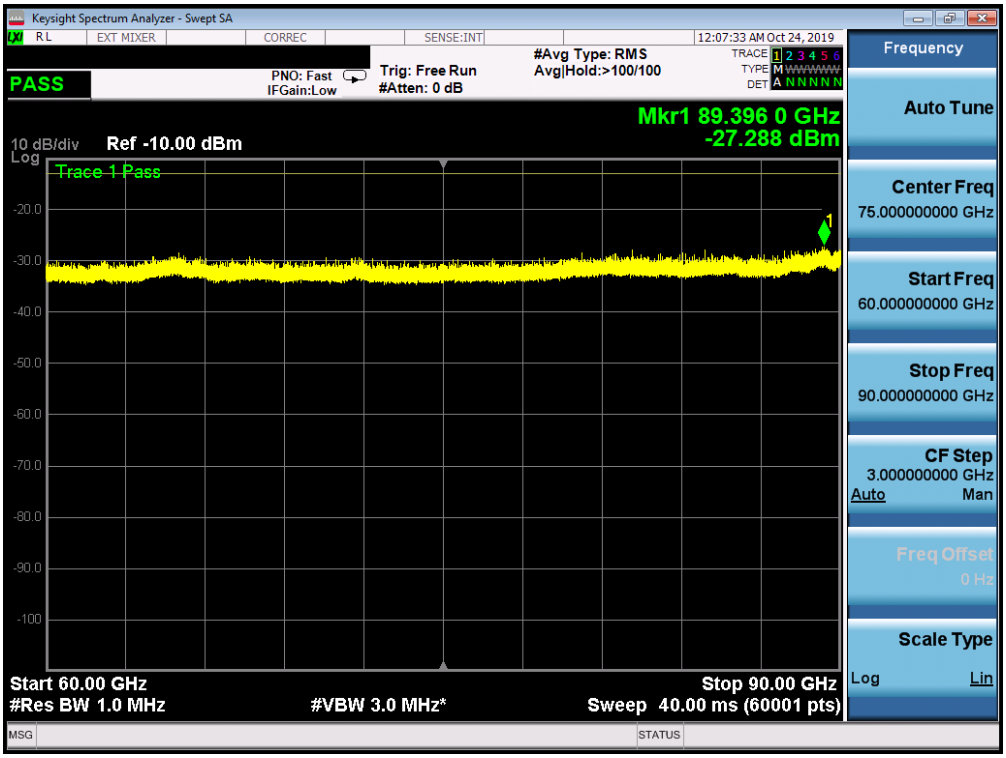
2. To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

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

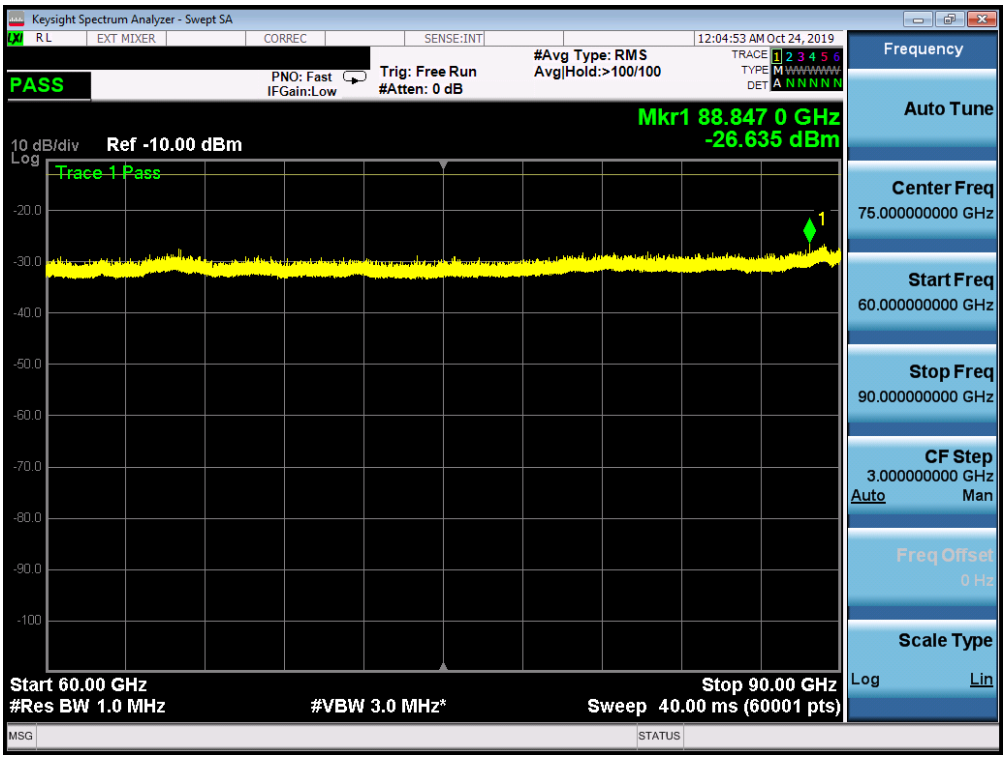
(-30.30 dBm + -29.14 dBm) = (933.25 nW + 1218.99 nW) = (2152.78 nW) = -26.67 dBm



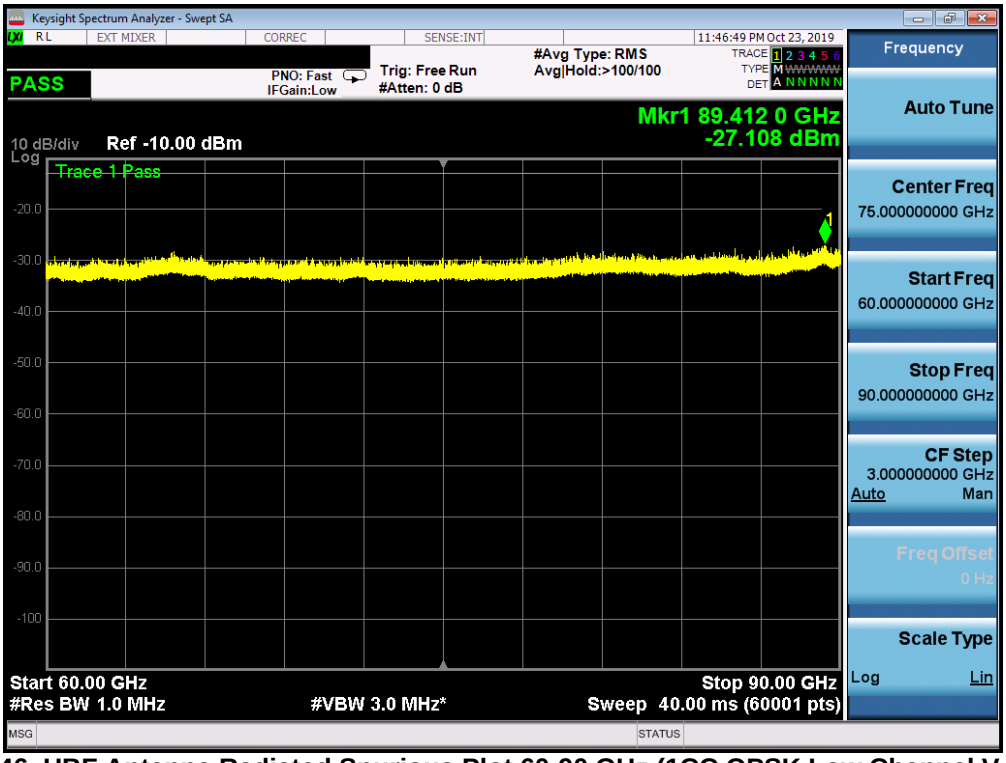
Plot 7-43. HBF Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK Low Channel H Beam)



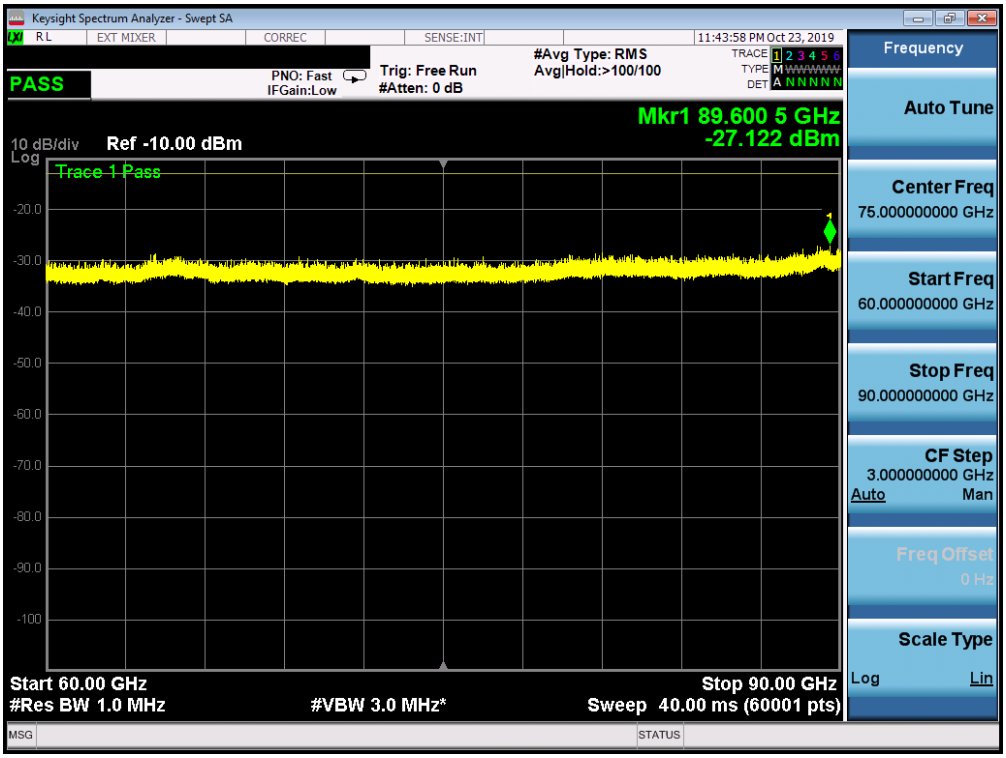
Plot 7-44. HBF Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK Mid Channel H Beam)



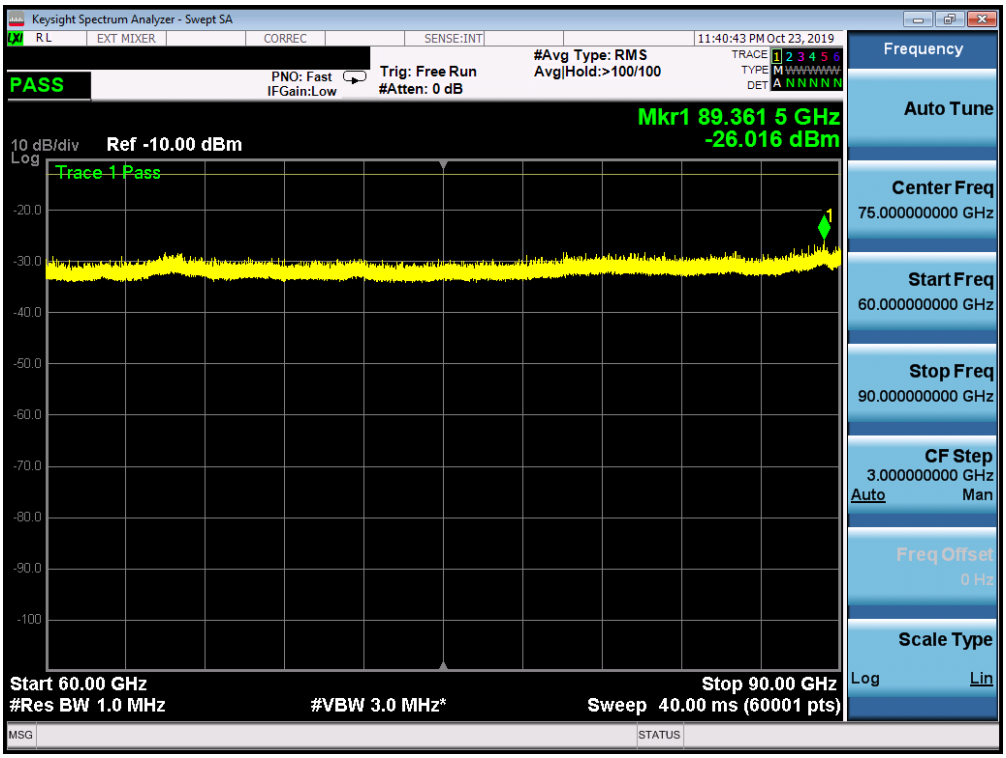
Plot 7-45. HBF Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK High Channel H Beam)



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



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)

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	H	H	-	-	-27.24	-13.00	-14.24
89396.00	RMS/MaxH	Mid	100	QPSK	H	H	-	-	-27.29	-13.00	-14.29
88847.00	RMS/MaxH	High	100	QPSK	H	H	-	-	-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	QPSK	V	V	-	-	-26.02	-13.00	-13.02

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

Notes

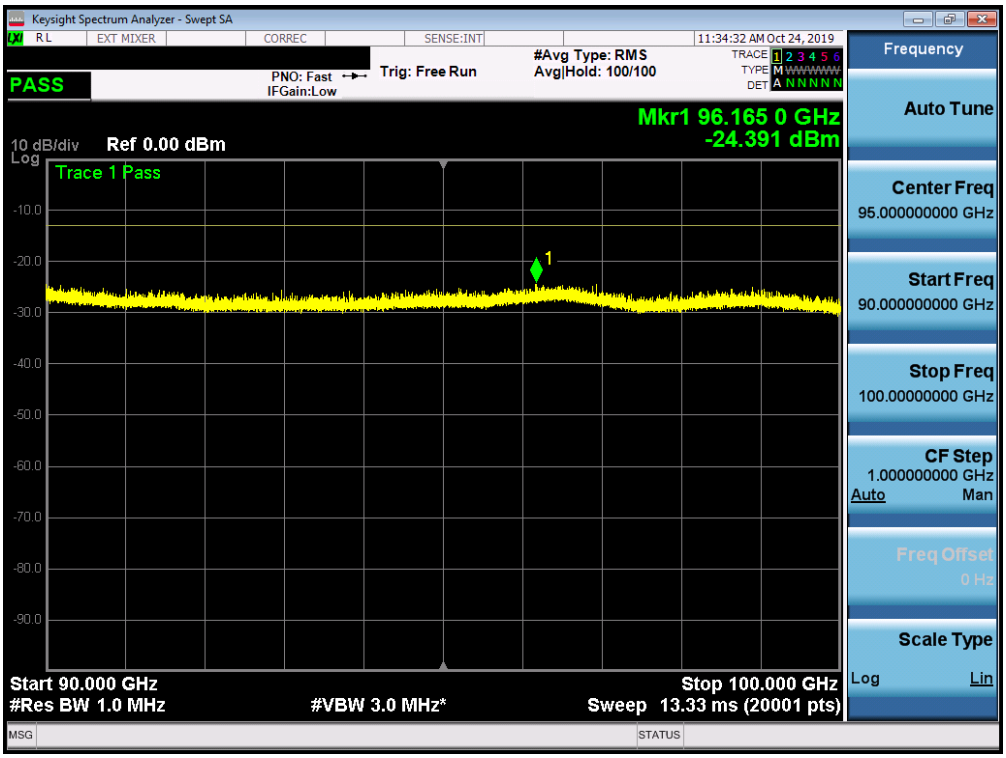
1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

2. 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:

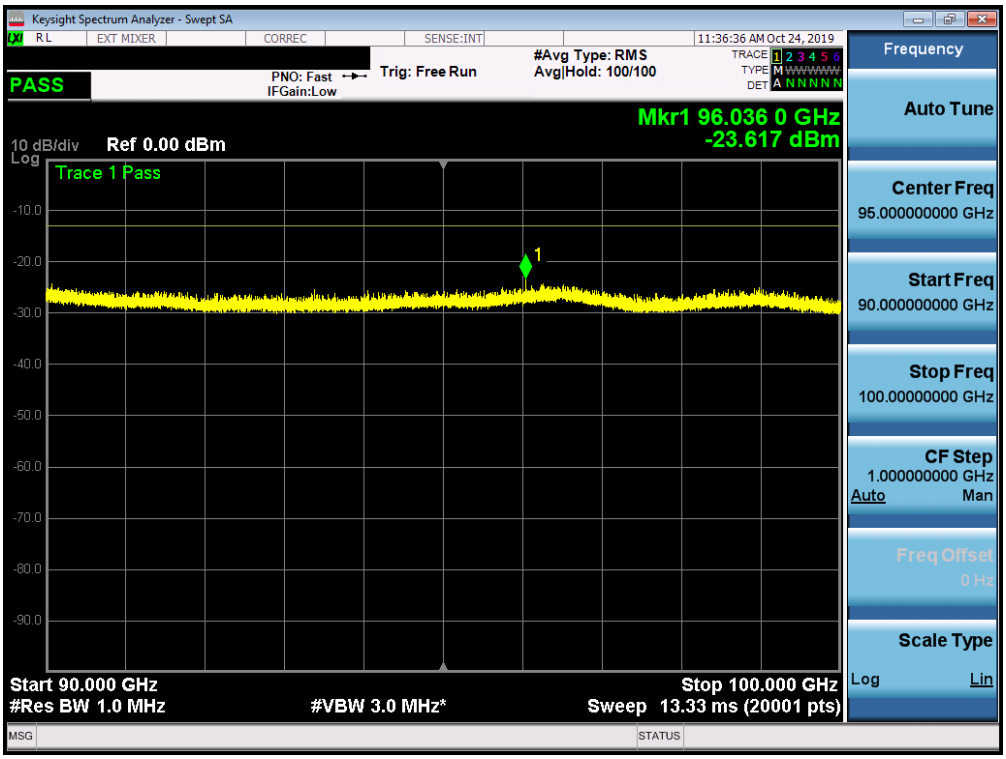
EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

(-27.24 dBm + -27.11 dBm) = (1.89 µW + 1.95 µW) = (3.84 µW) = -24.16 dBm

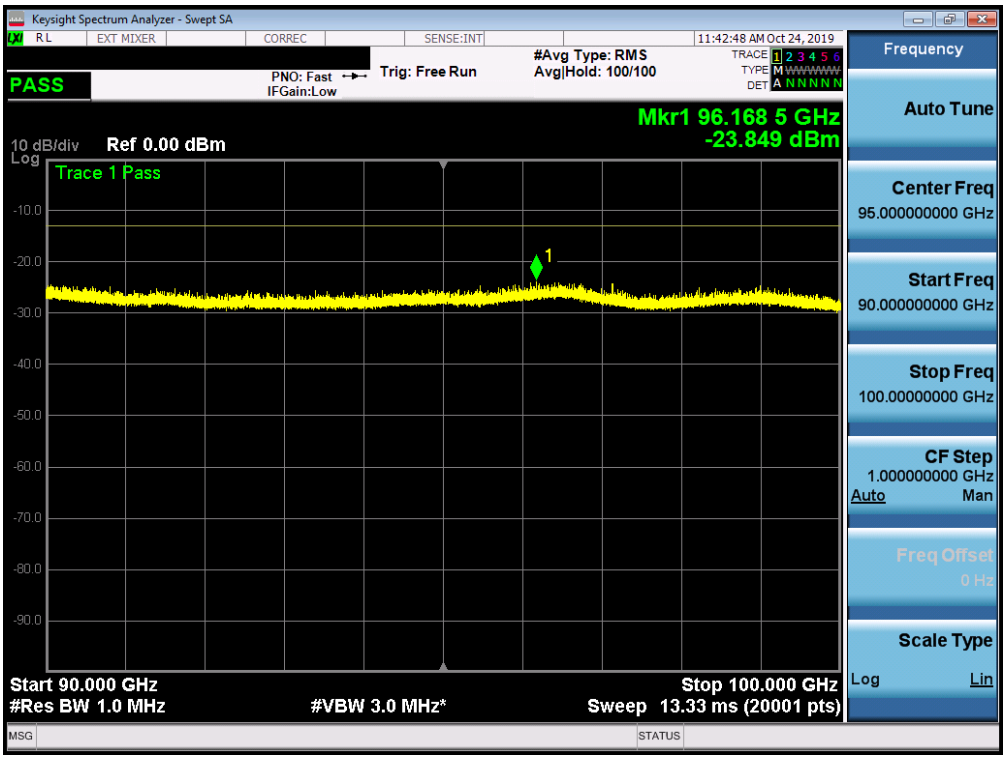
90 – 100GHz



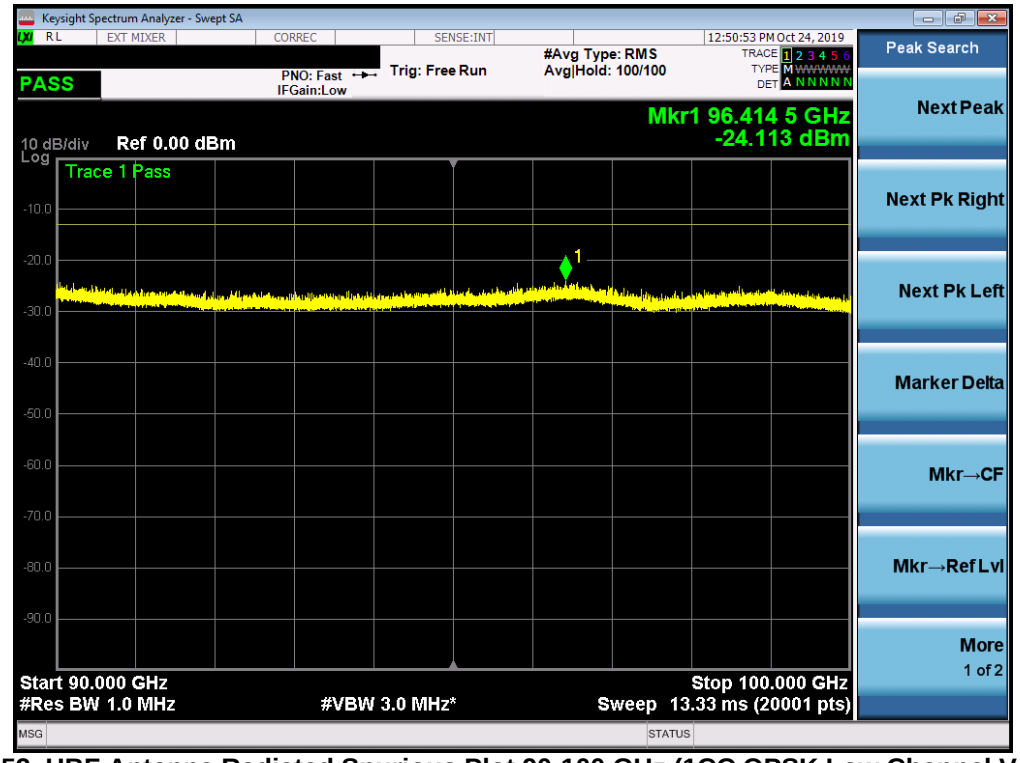
Plot 7-49. HBF Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Low Channel H Beam)



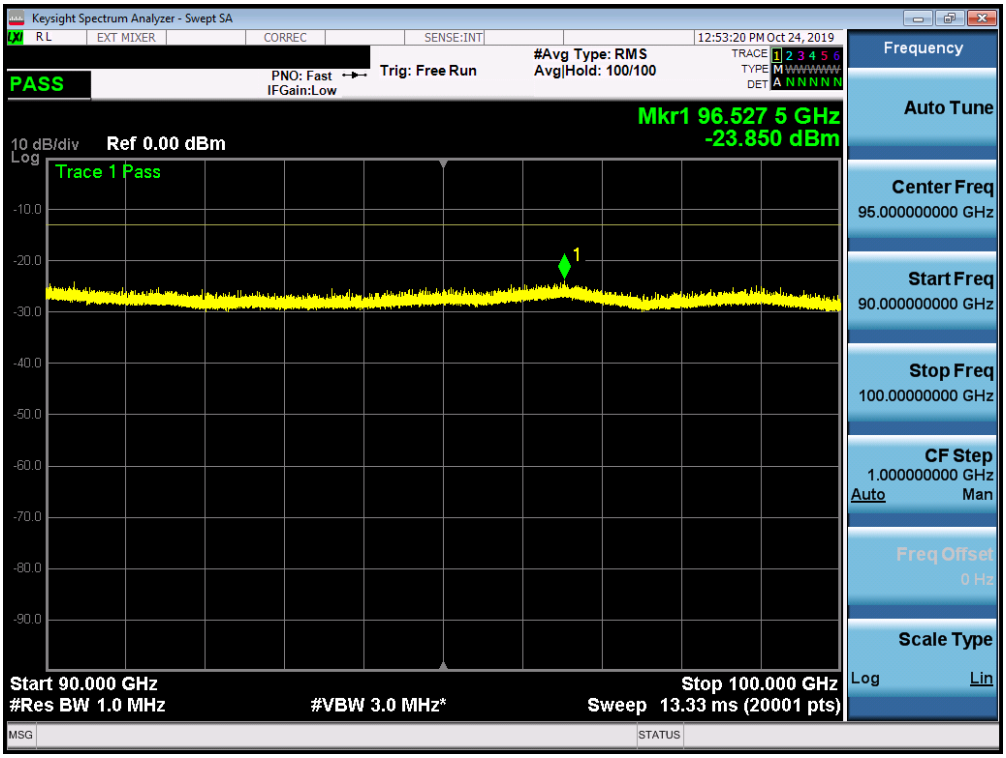
Plot 7-50. HBF Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Mid Channel H Beam)



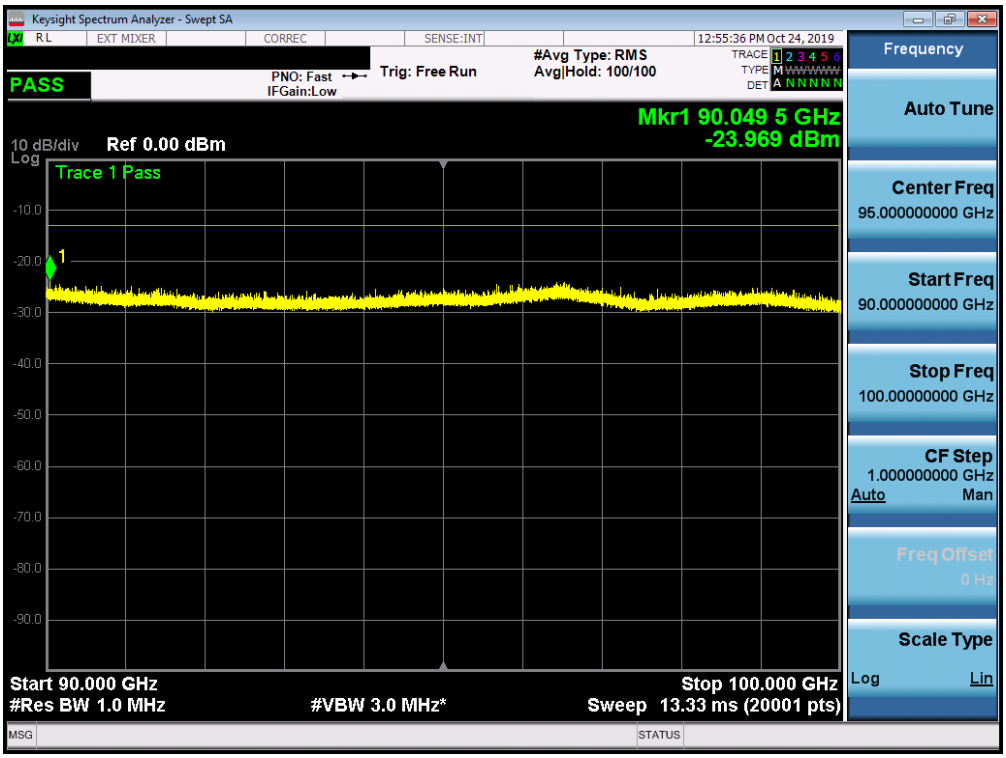
Plot 7-51. HBF Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK High Channel H Beam)



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



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)

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	H	H	-	-	-24.39	-13.00	-11.39
96036.00	RMS/MaxH	Mid	100	QPSK	H	H	-	-	-23.62	-13.00	-10.62
96168.50	RMS/MaxH	High	100	QPSK	H	H	-	-	-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

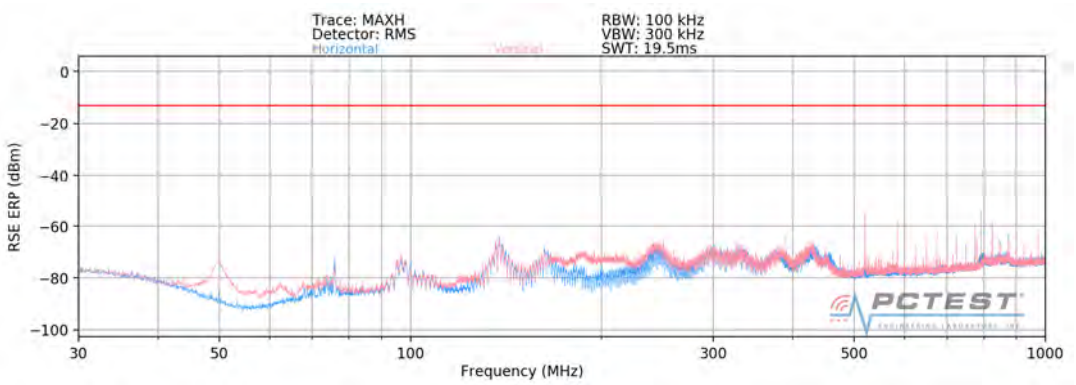
1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

2. 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:

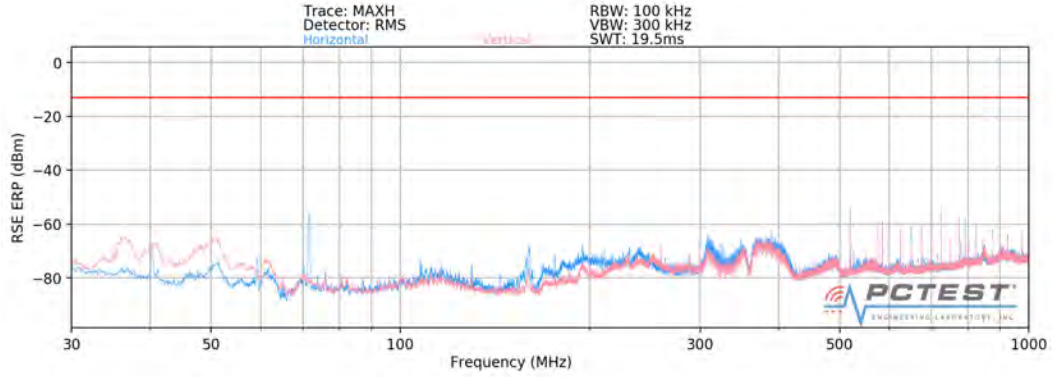
EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

(-24.39 dBm + -24.11 dBm) = (3.64 µW + 3.88 µW) = (7.52 µW) = -21.24 dBm

7.5.2 Patch Antenna Radiated Spurious Emissions
30MHz – 1GHz

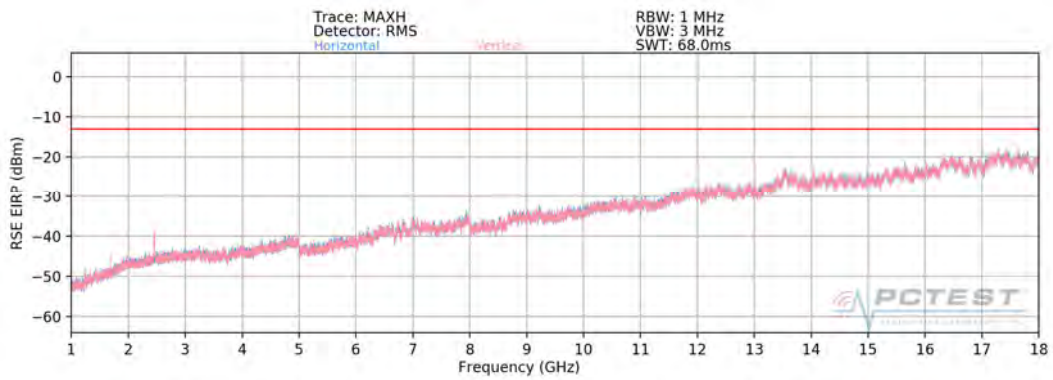


Plot 7-55. Patch Antenna Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Mid Channel H Beam)

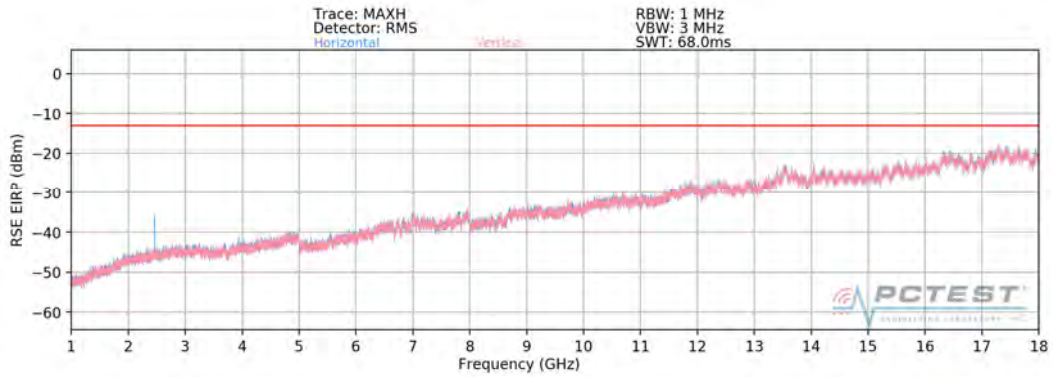


Plot 7-56. Patch Antenna Radiated Spurious Plot 30 MHz - 1 GHz (1CC QPSK Mid Channel V Beam)

1 – 18GHz

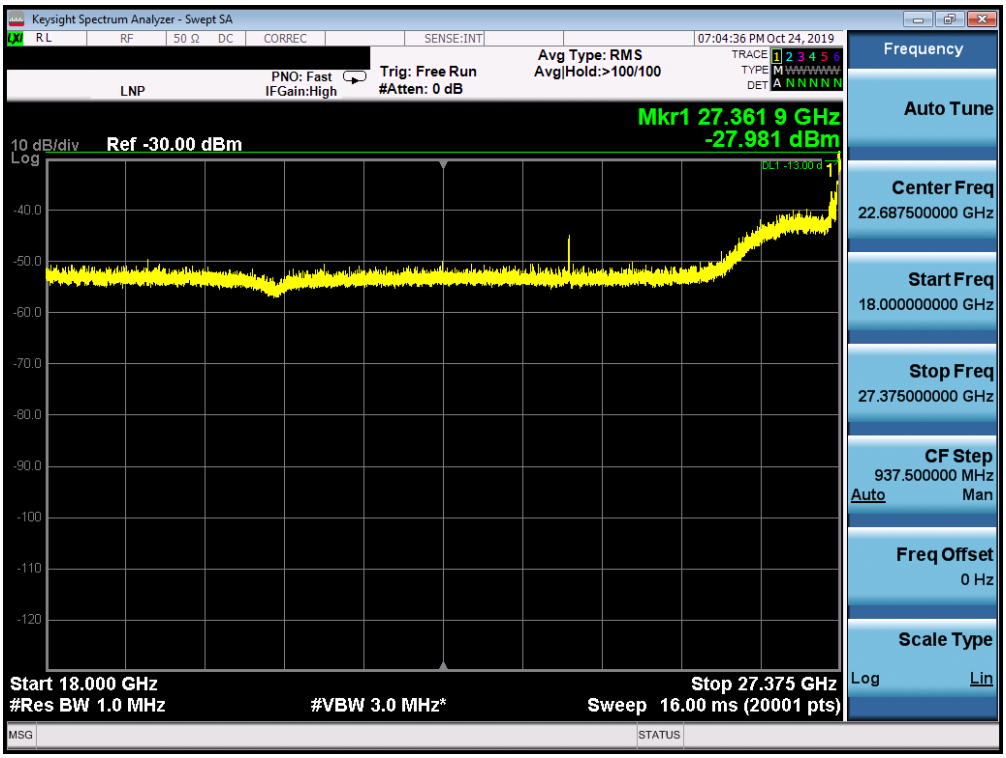


Plot 7-57. Patch Antenna Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel H Beam)

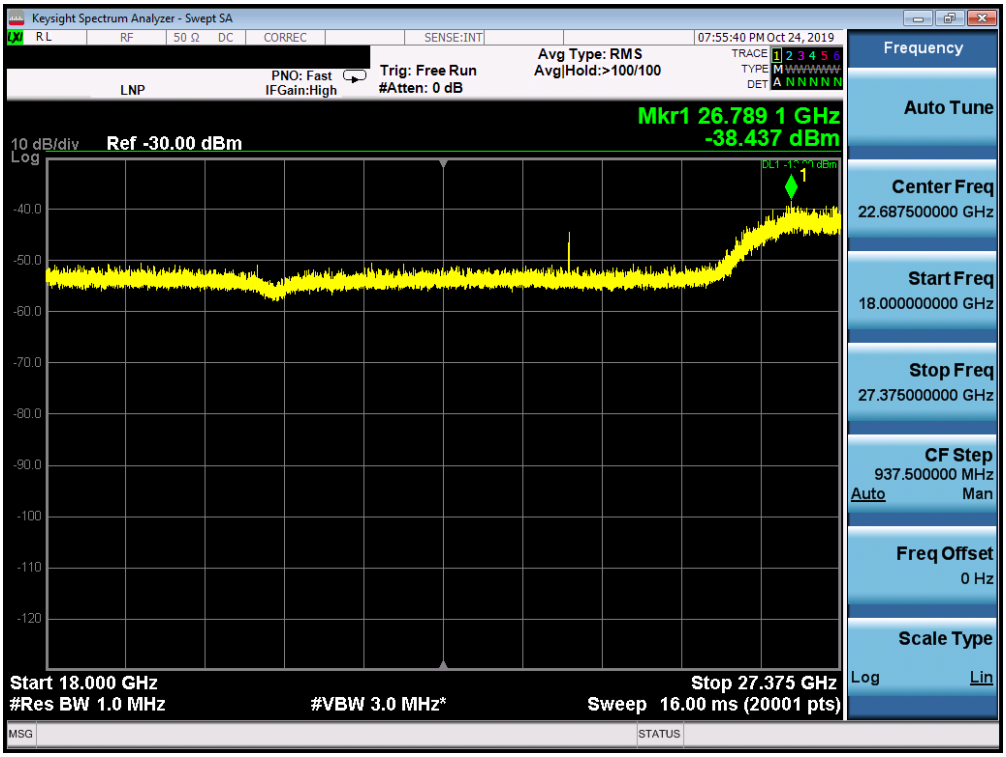


Plot 7-58. Patch Antenna Radiated Spurious Plot 1-18 GHz (1CC QPSK Mid Channel V Beam)

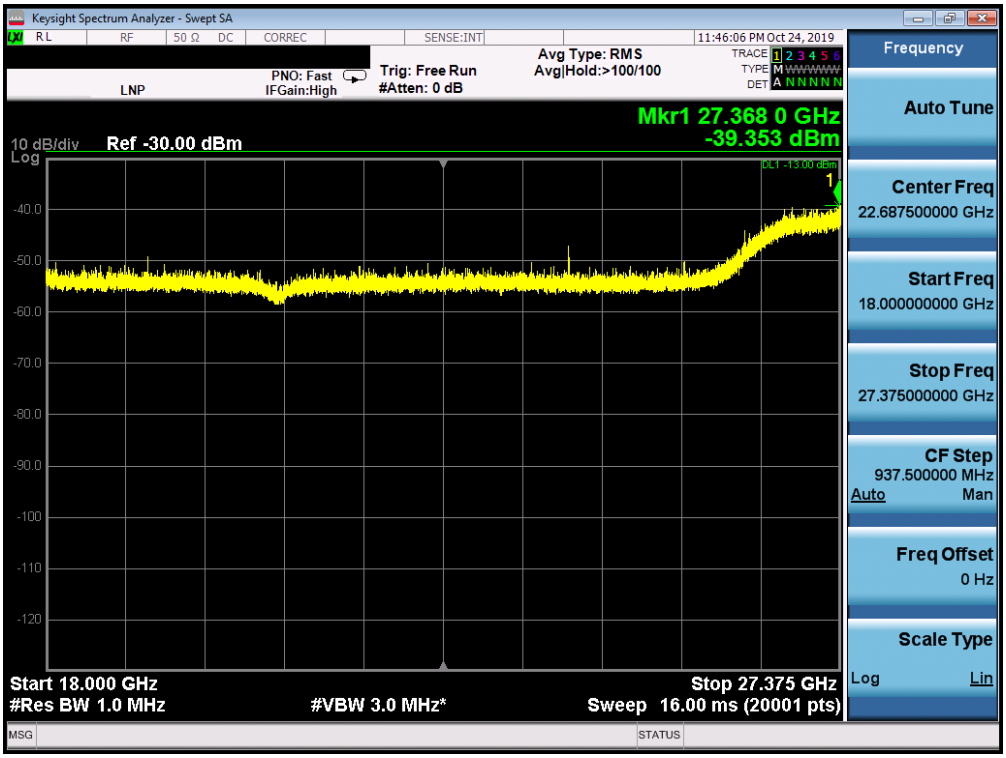
18 – 27.375GHz



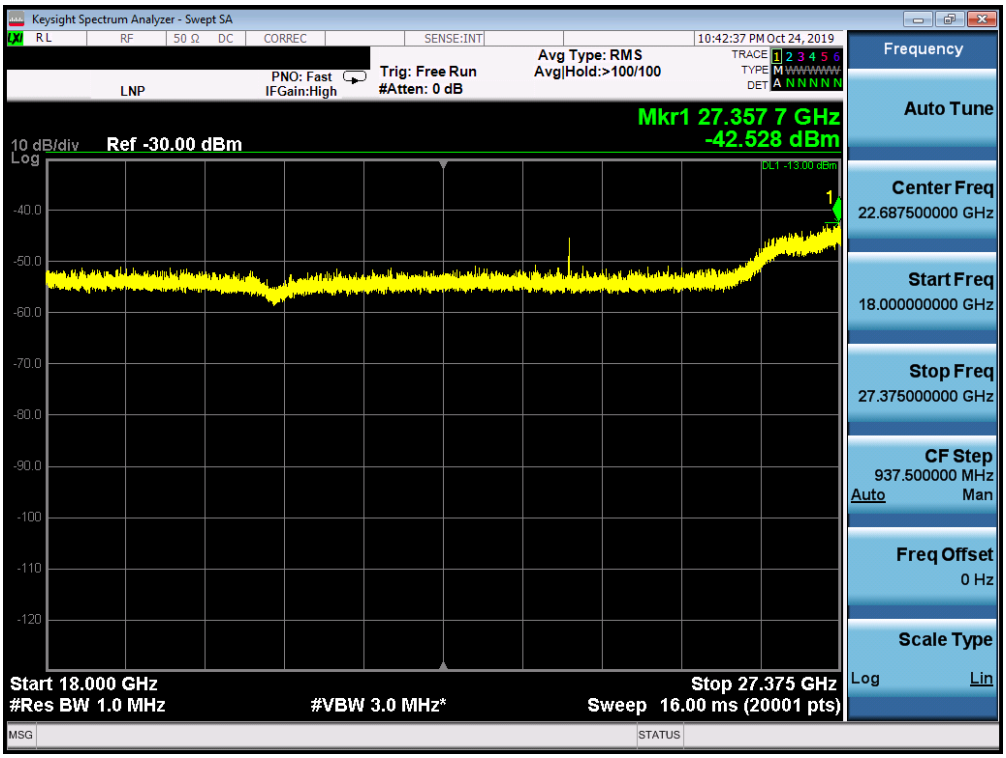
Plot 7-59. Patch Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Low Channel H Beam)



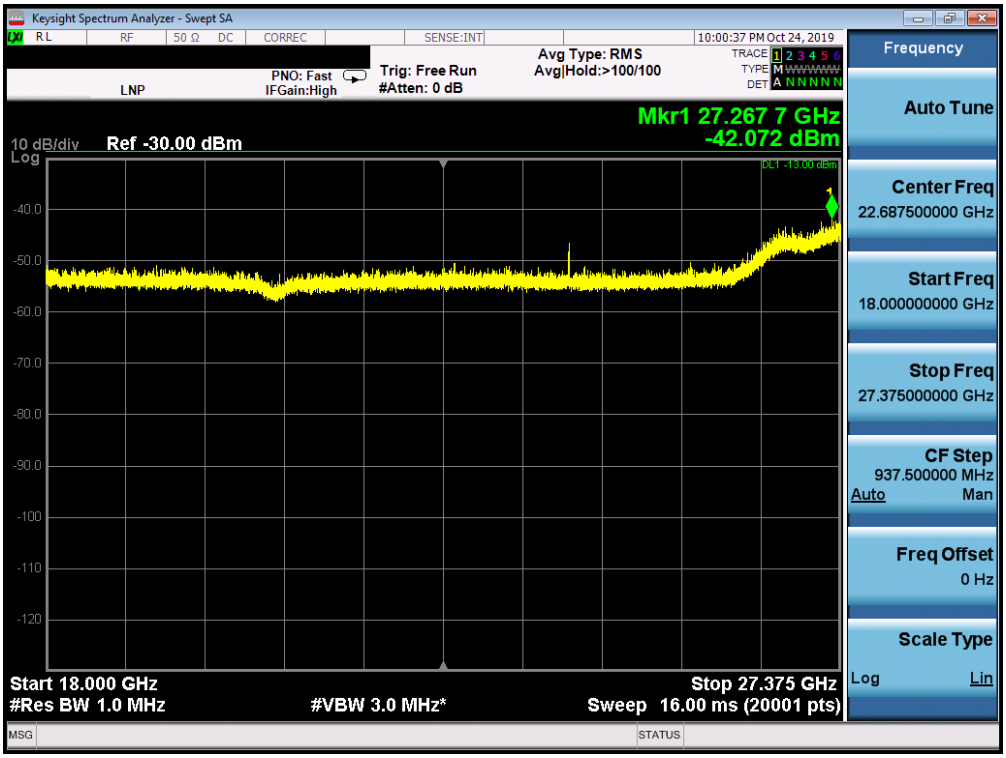
Plot 7-60. Patch Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK Mid Channel H Beam)



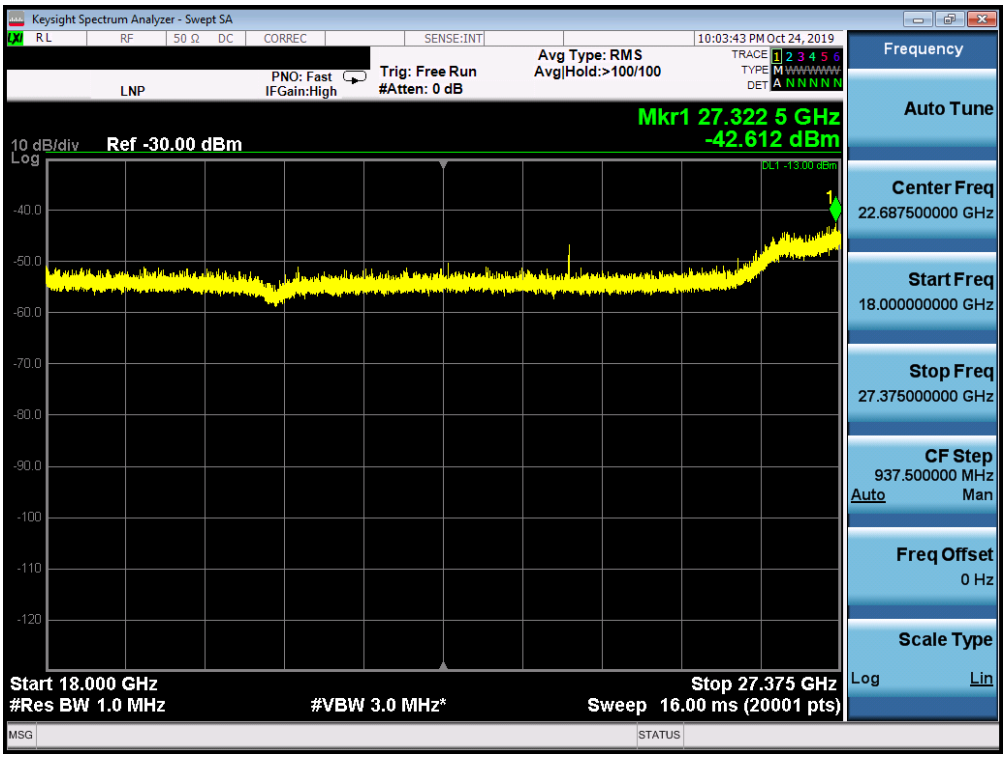
Plot 7-61. Patch Antenna Radiated Spurious Plot 18-27.375 GHz (1CC QPSK High Channel H Beam)



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



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)

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	H	H	0	5	-27.98	-13.00	-14.98
26789.10	RMS/MaxH	Mid	100	QPSK	H	H	2	1	-38.44	-13.00	-25.44
27368.00	RMS/MaxH	High	100	QPSK	H	H	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

Table 7-23. Patch Antenna Spurious Emissions Table (18-27.375GHz)

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.

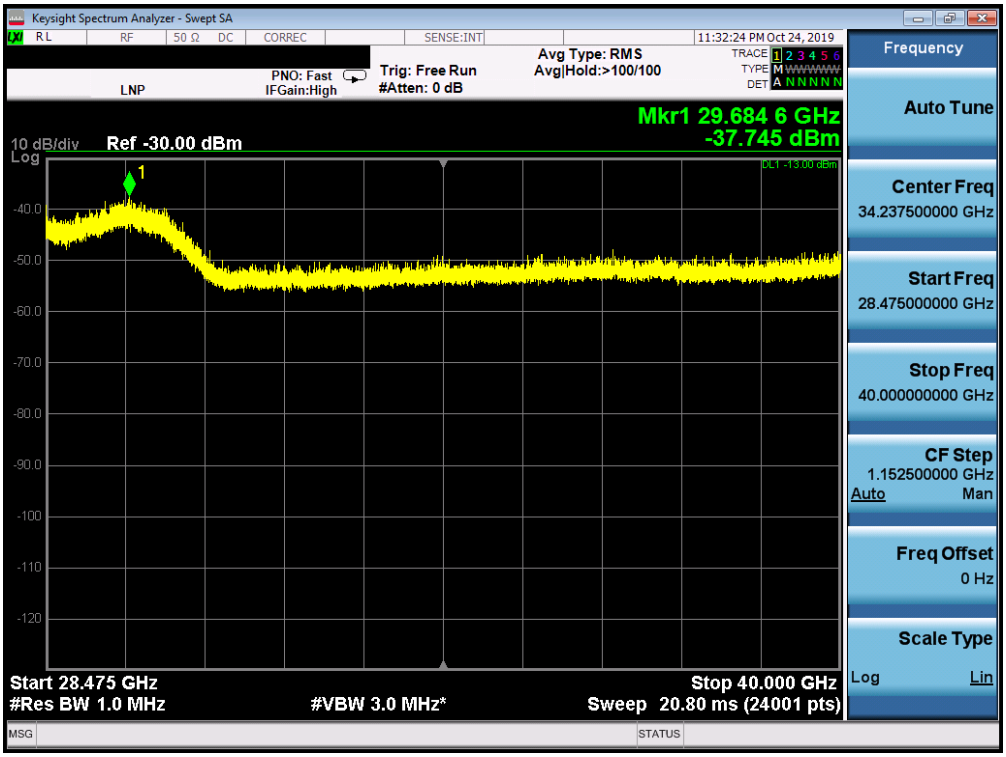
2. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

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:

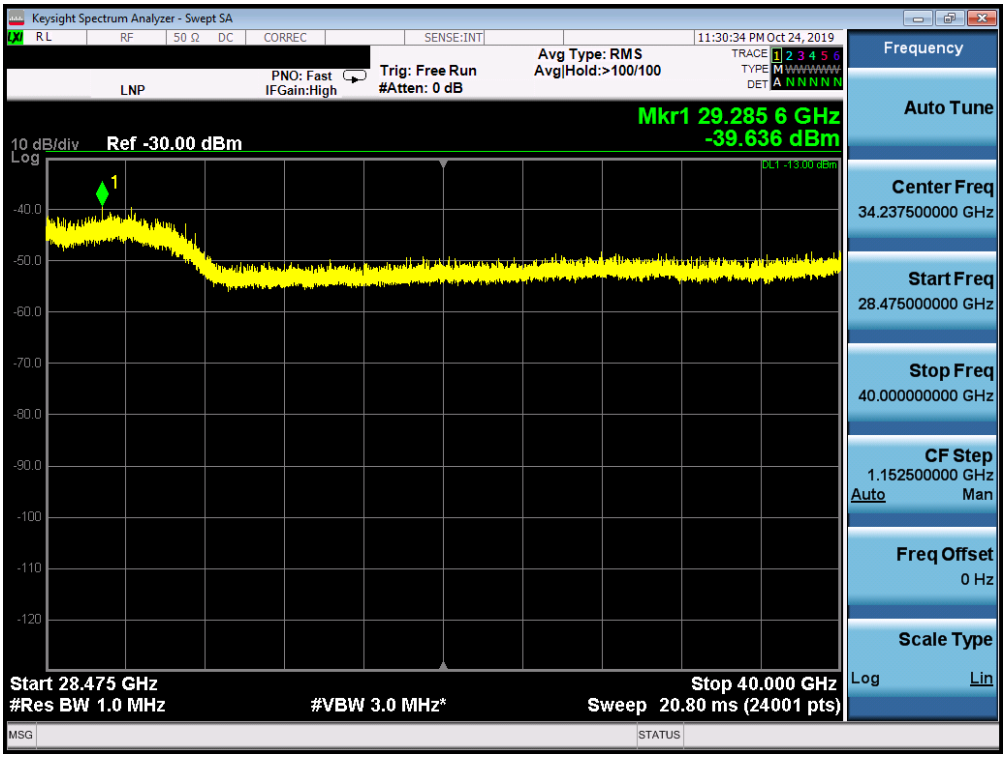
EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

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

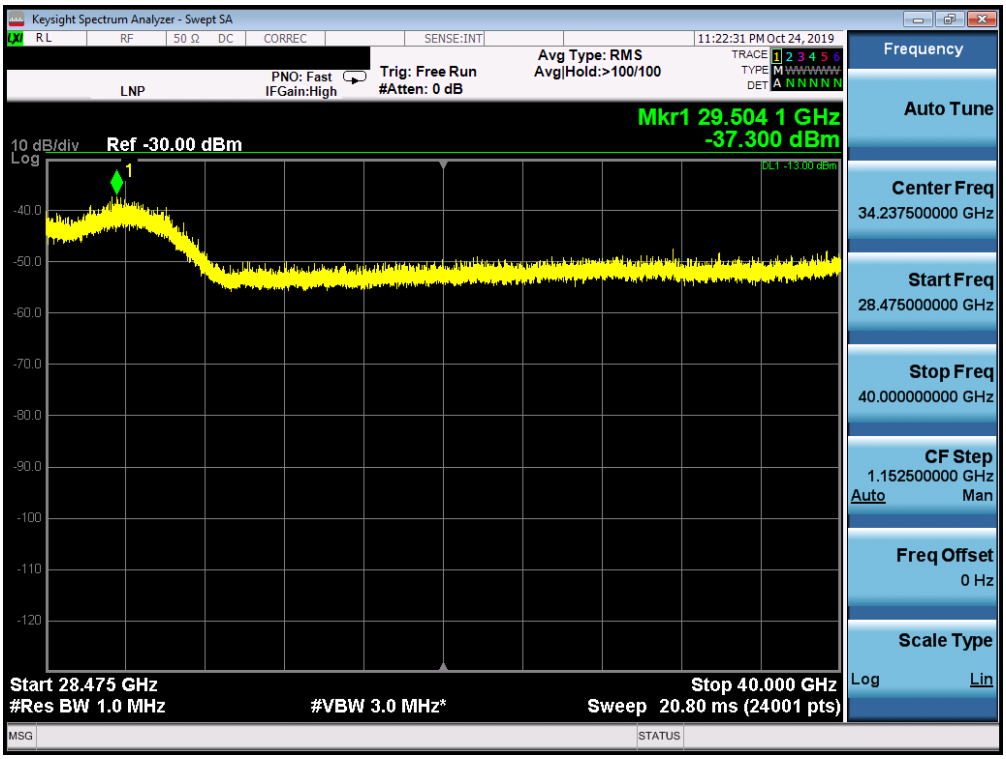
28.475 – 40GHz



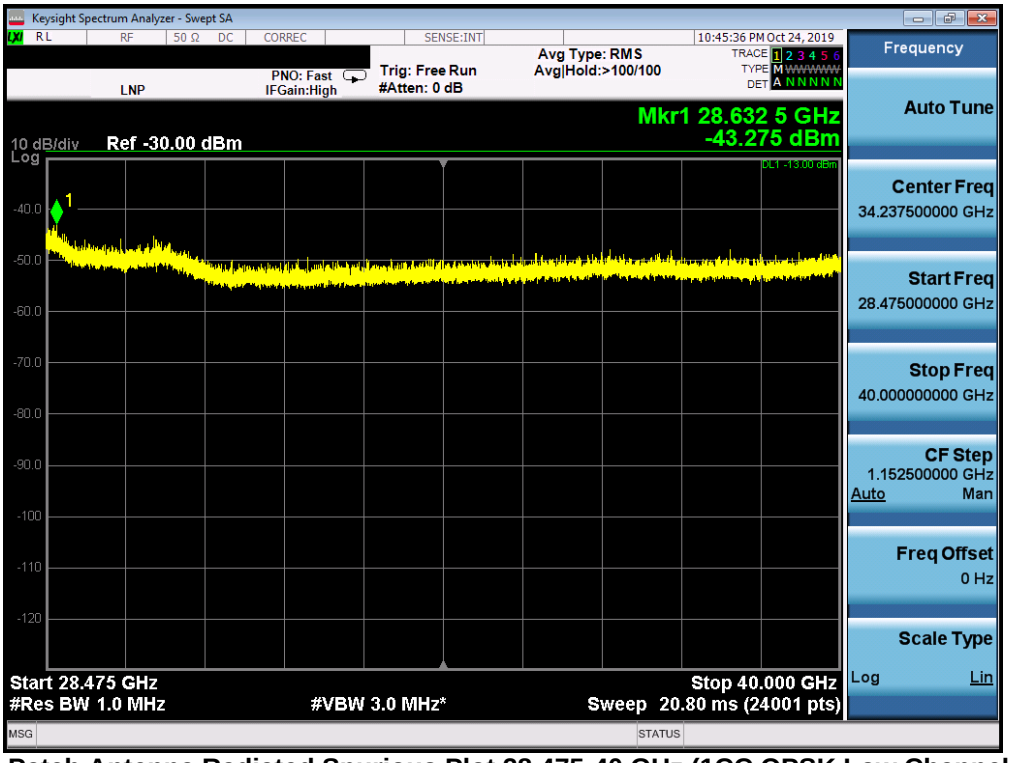
Plot 7-65. Patch Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Low Channel H Beam)



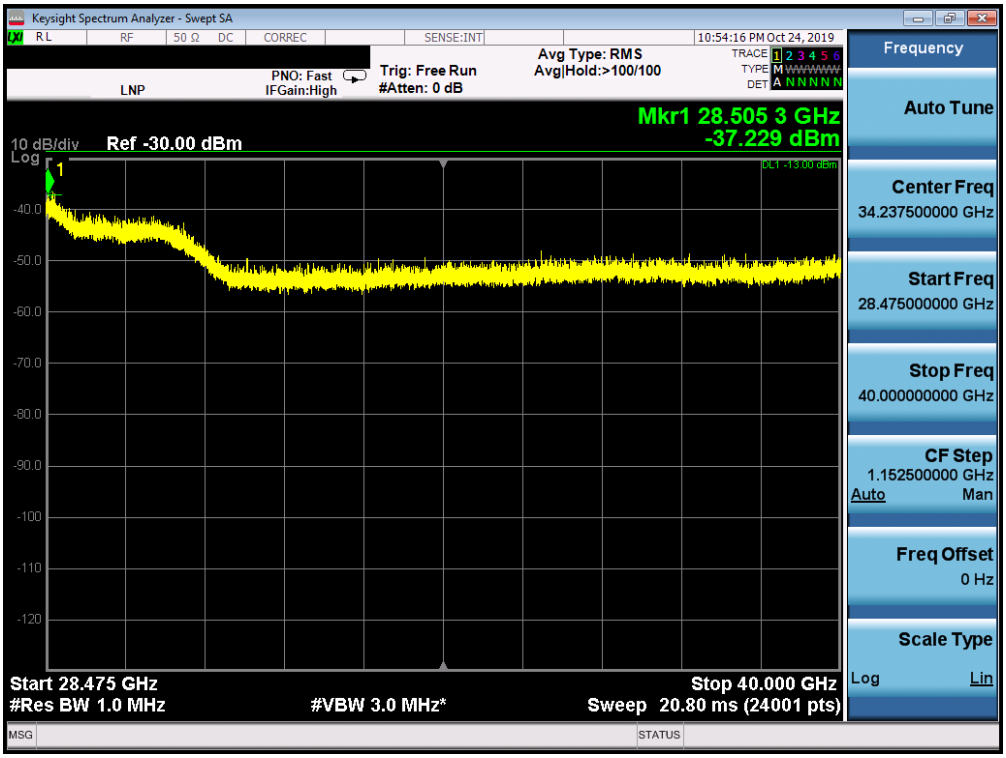
Plot 7-66. Patch Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK Mid Channel H Beam)



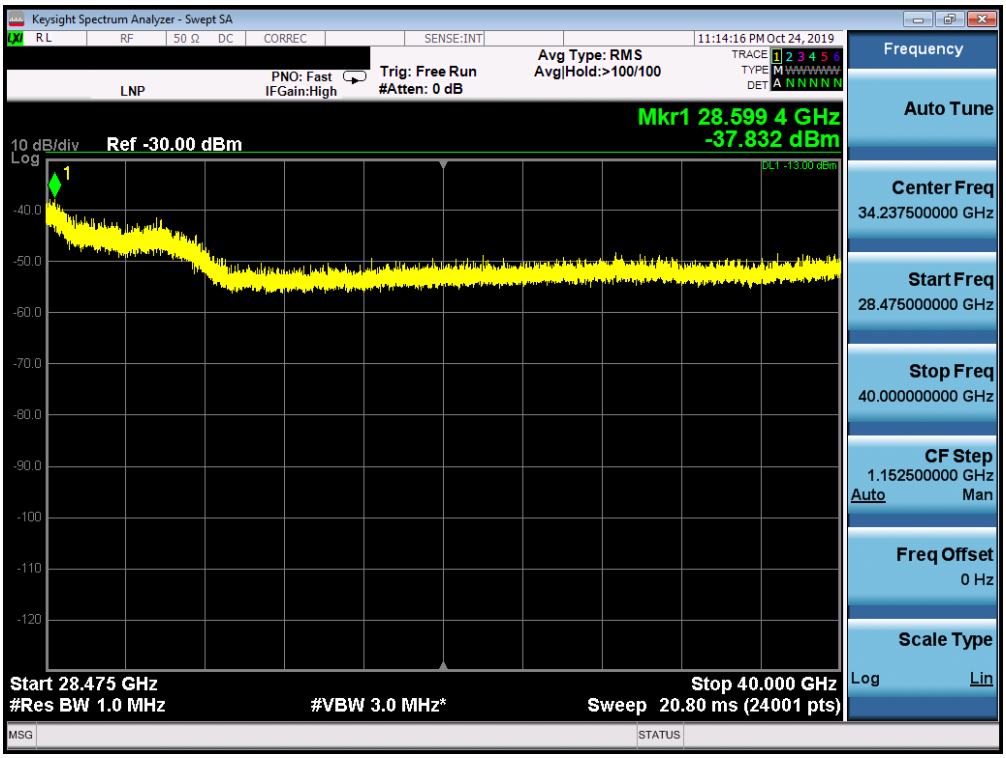
Plot 7-67. Patch Antenna Radiated Spurious Plot 28.475-40 GHz (1CC QPSK High Channel H Beam)



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



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)

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]
29684.60	RMS/MaxH	Low	100	QPSK	H	H	6	4	-37.75	-13.00	-24.75
29285.60	RMS/MaxH	Mid	100	QPSK	H	H	7	1	-39.64	-13.00	-26.64
29504.10	RMS/MaxH	High	100	QPSK	H	H	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

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

Notes

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.

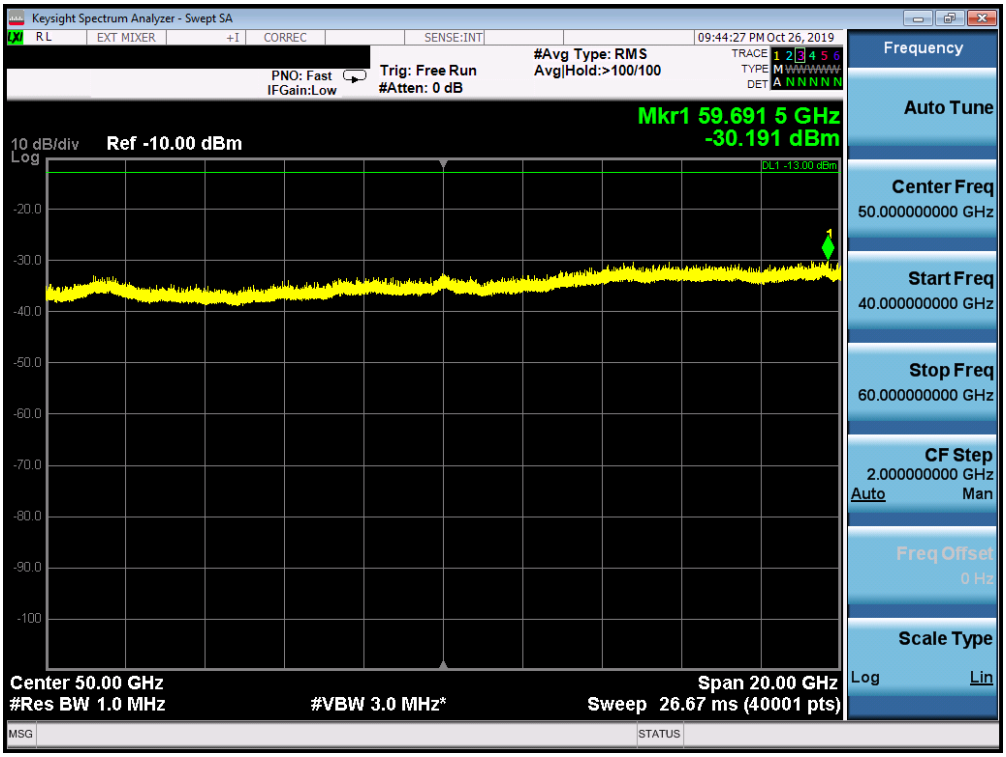
2. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

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:

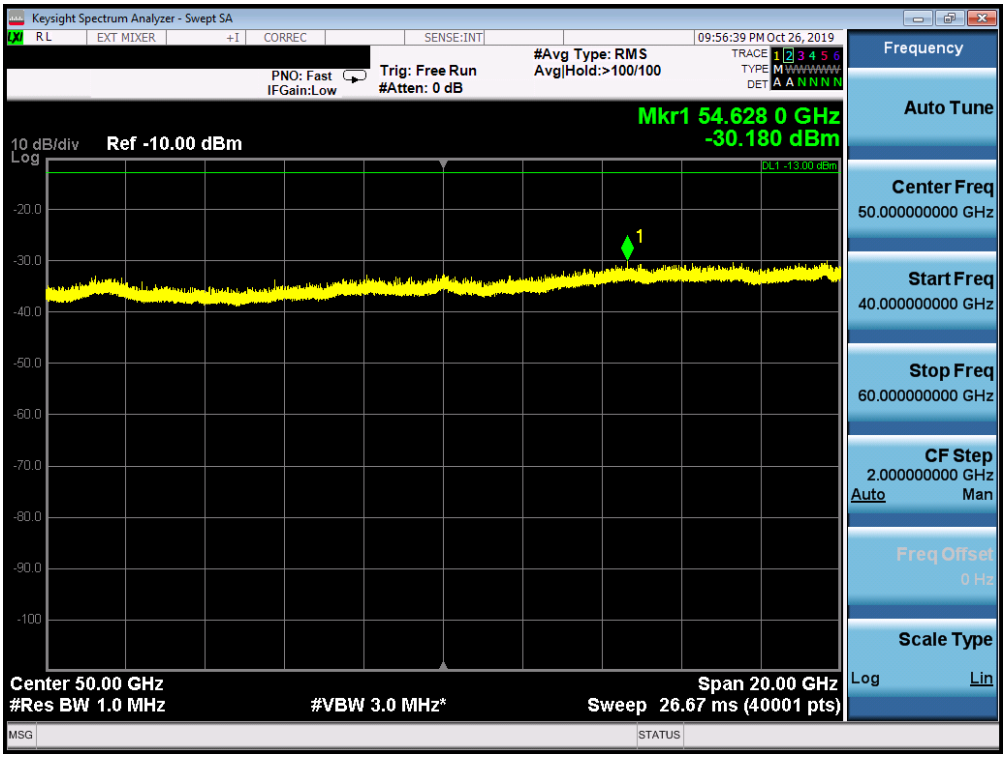
EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

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

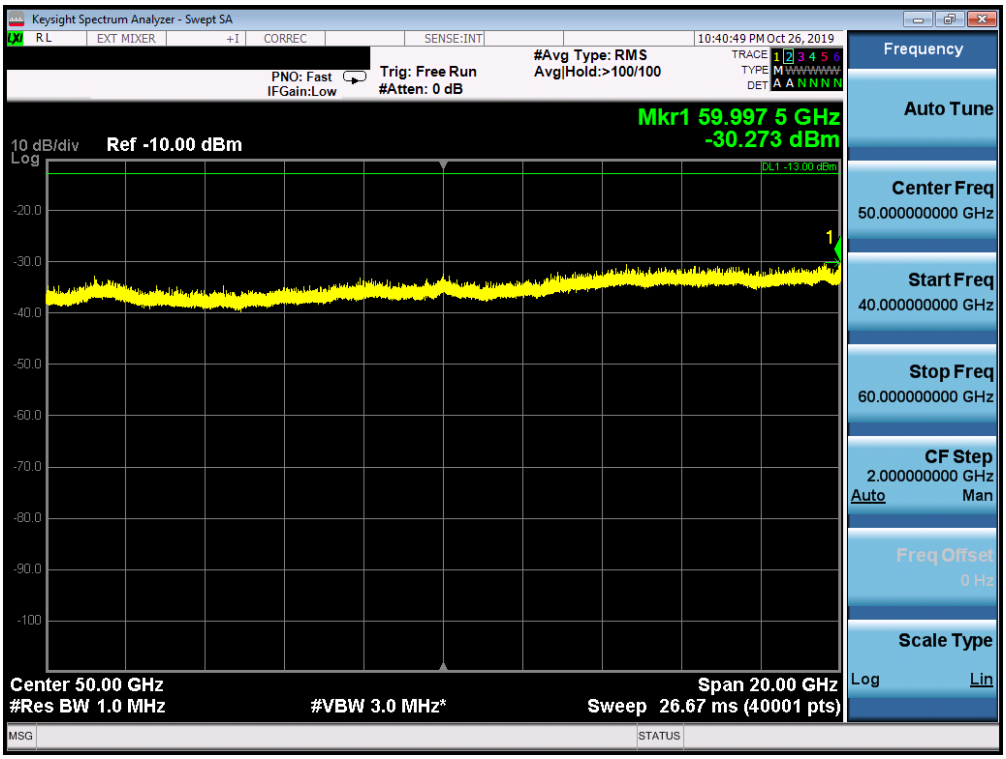
40 – 60GHz



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

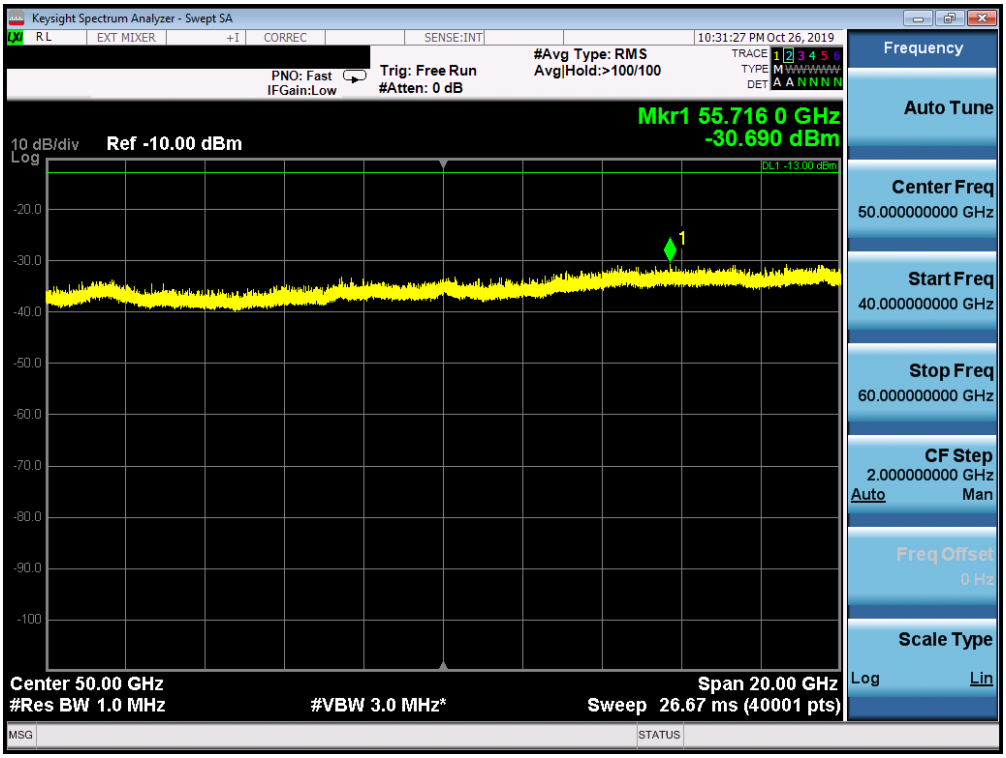


Plot 7-72. Patch Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK Mid Channel H Beam)

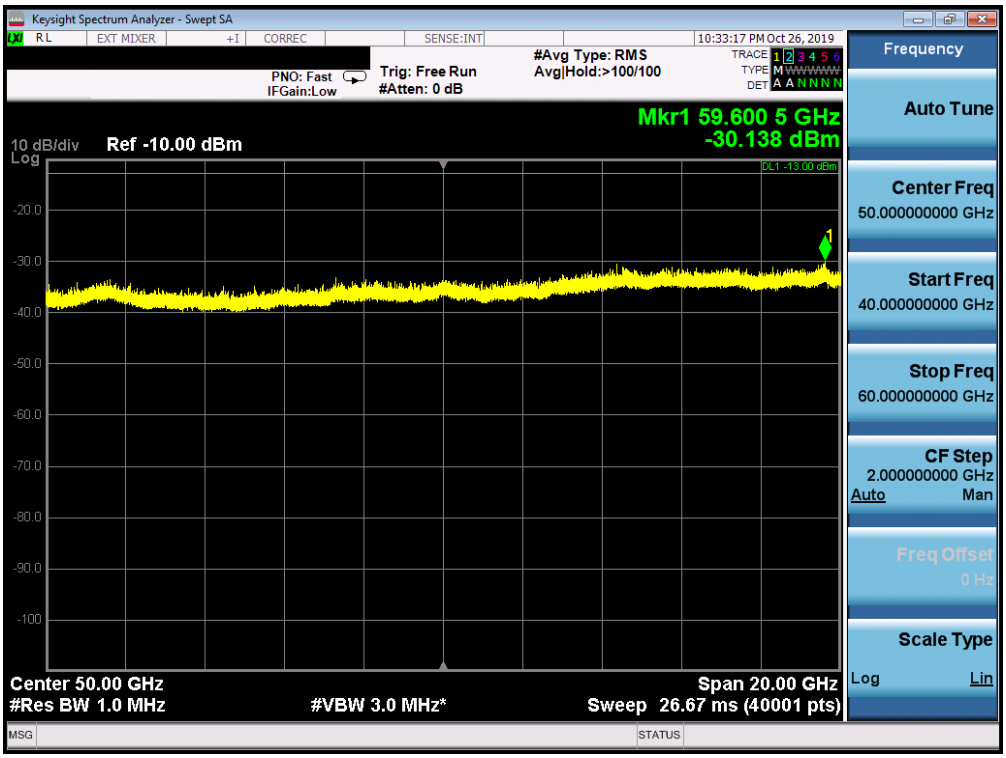


Plot 7-73. Patch Antenna Radiated Spurious Plot 40-60 GHz (1CC QPSK High Channel H Beam)

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



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)

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	H	H	-	-	-30.19	-13.00	-17.19
54628.00	RMS/MaxH	Mid	100	QPSK	H	H	-	-	-30.18	-13.00	-17.18
59997.50	RMS/MaxH	High	100	QPSK	H	H	-	-	-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)

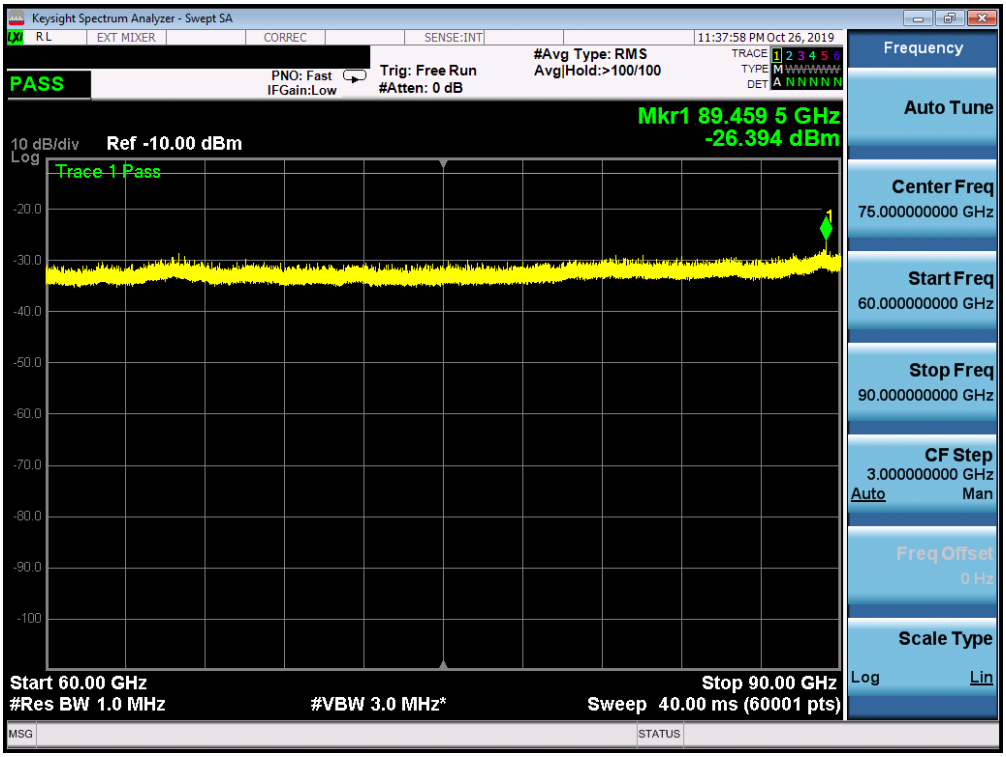
Notes

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.

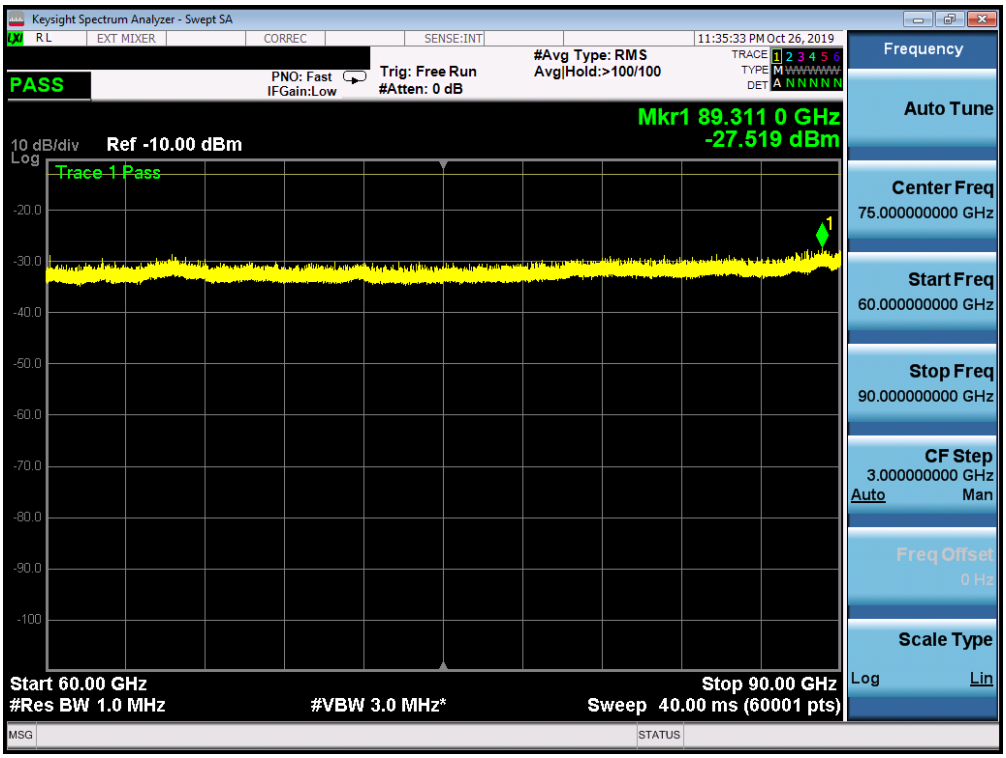
2. To address compliance of MIMO RSE per KDB 662911 D01, the MIMO RSE EIRP is calculated by summing the worst case H Beam EIRP and V Beam EIRP in linear powers units then converted back to dBm:

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

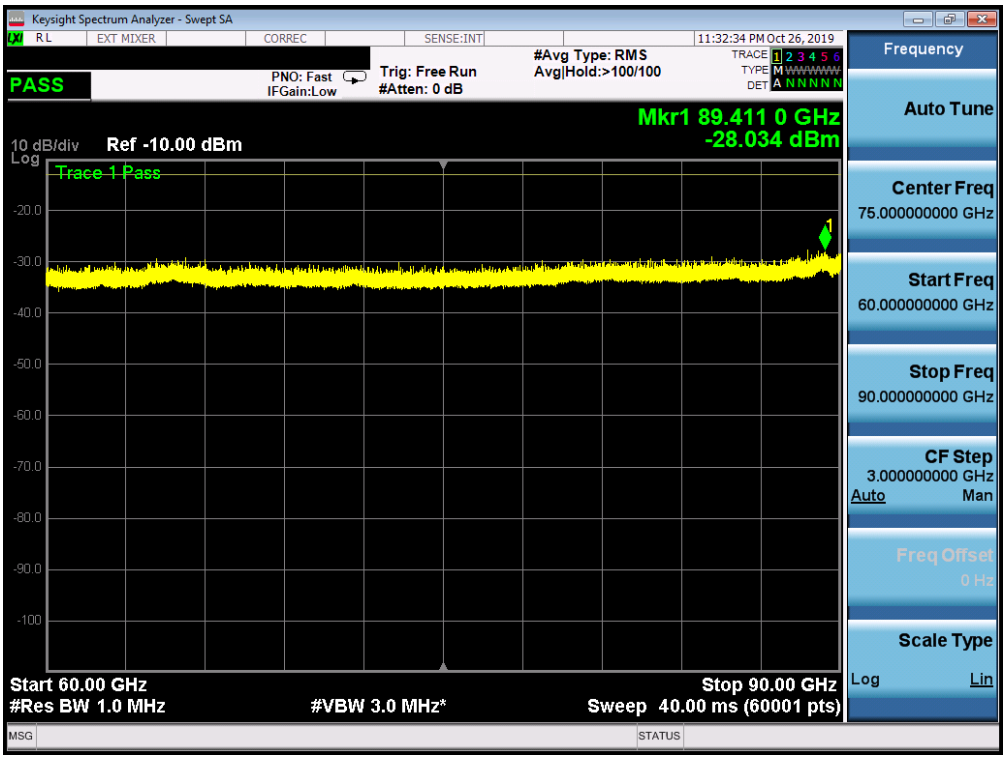
(-30.19 dBm + -30.56 dBm) = (957.19 nW + 879.02 nW) = (1.836 uW) = -27.36 dBm



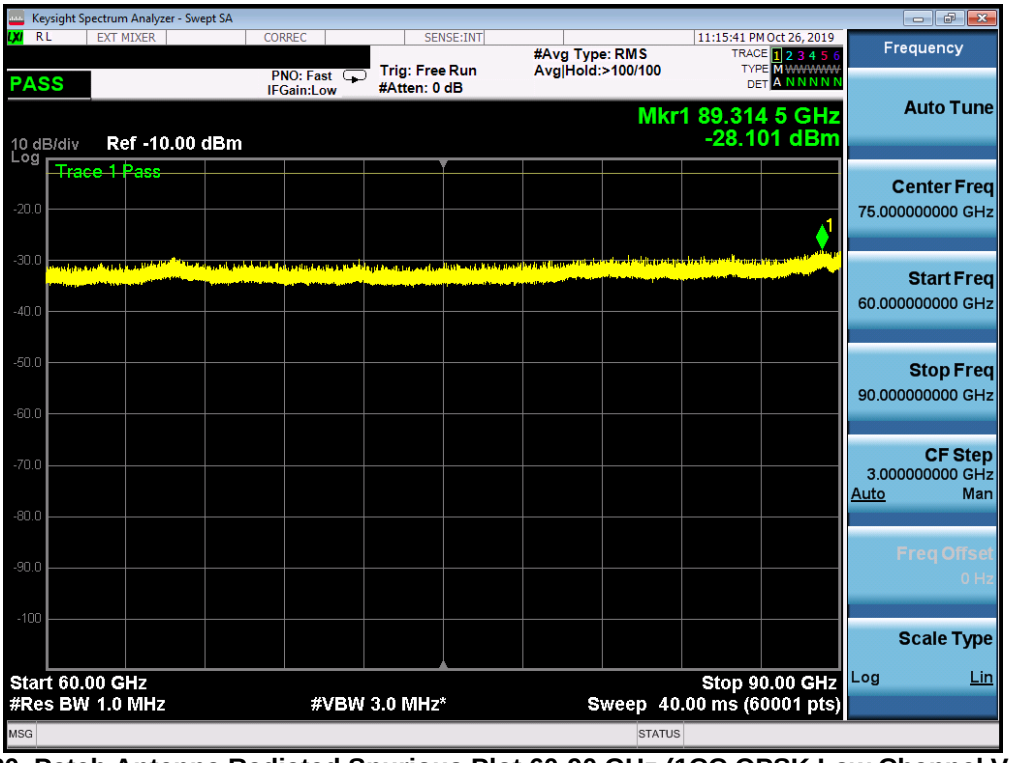
Plot 7-77. Patch Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK Low Channel H Beam)



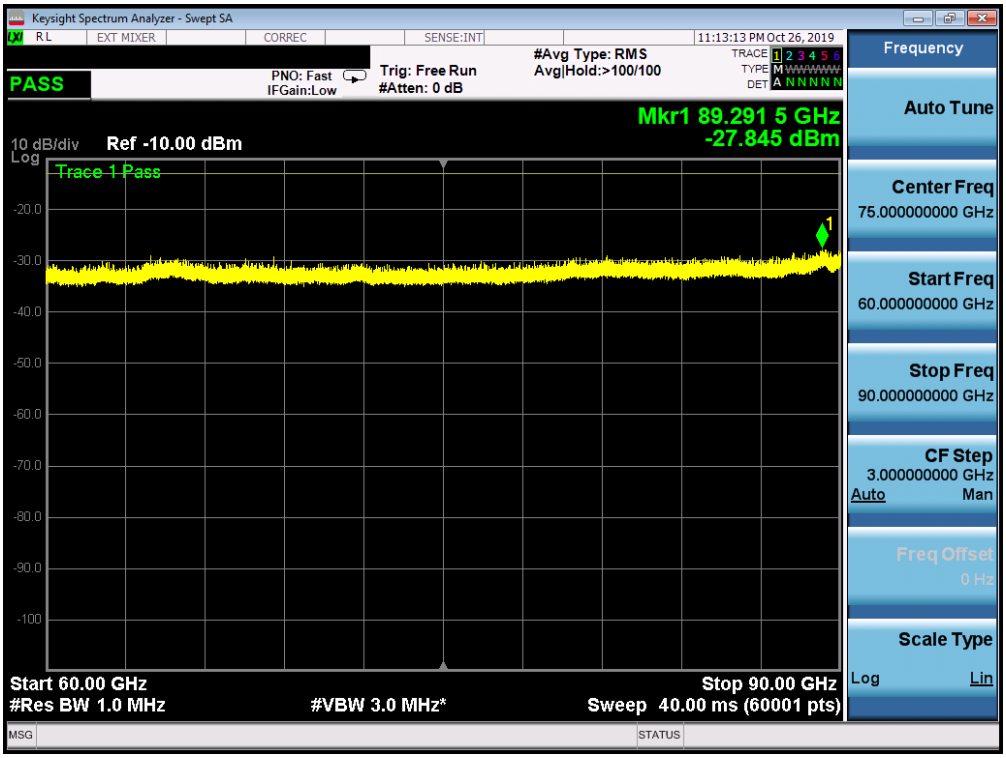
Plot 7-78. Patch Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK Mid Channel H Beam)



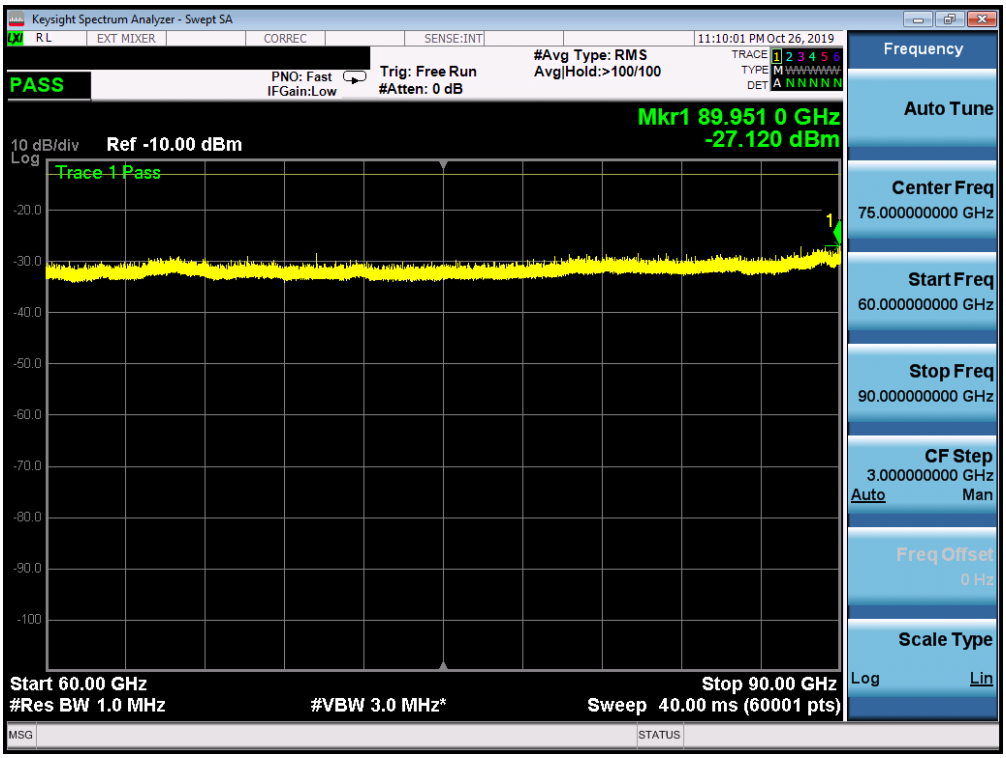
Plot 7-79. Patch Antenna Radiated Spurious Plot 60-90 GHz (1CC QPSK High Channel H Beam)



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



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)

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	H	H	-	-	-26.39	-13.00	-13.39
89311.00	RMS/MaxH	Mid	100	QPSK	H	H	-	-	-27.52	-13.00	-14.52
89411.00	RMS/MaxH	High	100	QPSK	H	H	-	-	-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

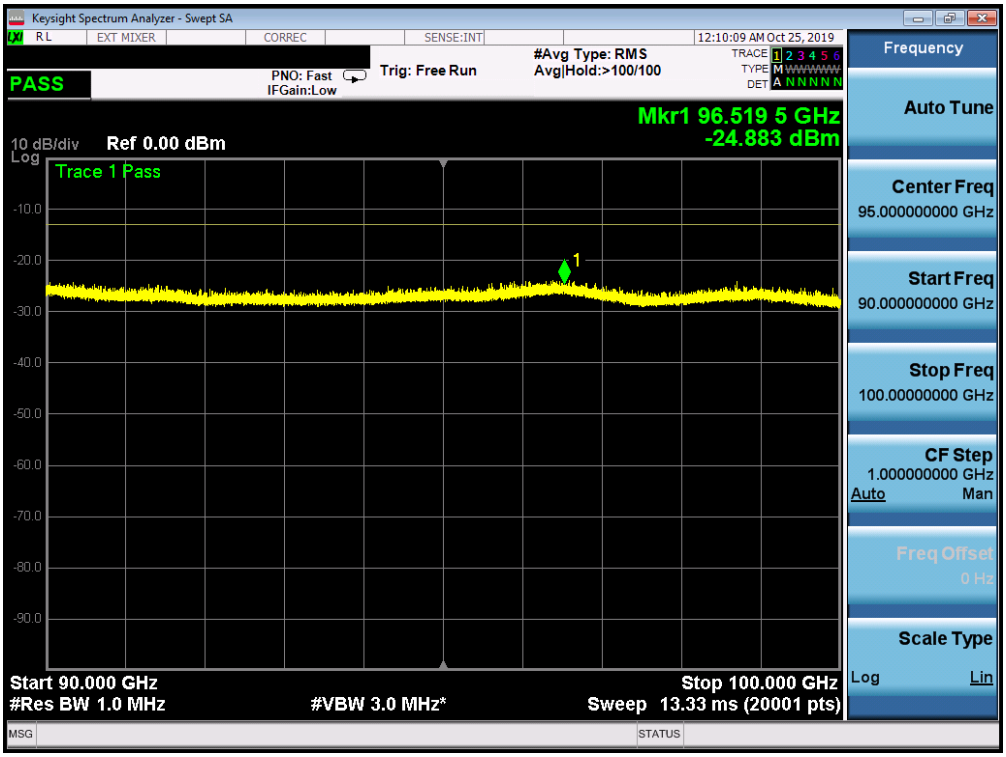
1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses, and harmonic mixer conversion losses. Measurements were performed at a distance of 1 meter.

2. 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:

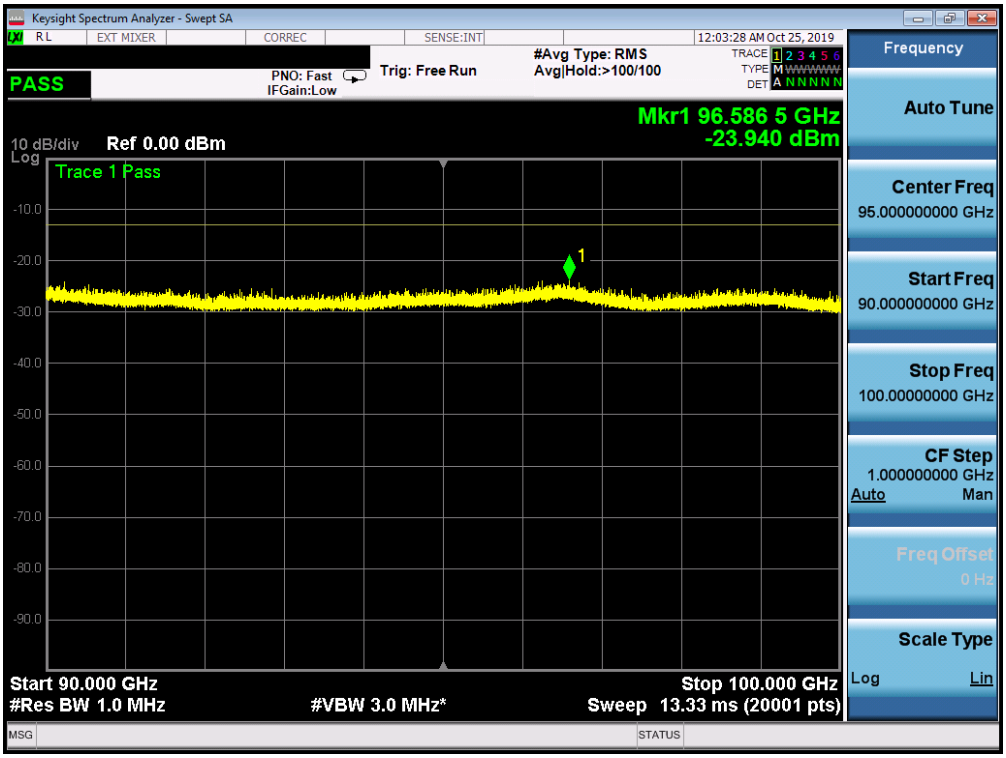
EIRP(H Beam) + EIRP(V Beam) = EIRP(MIMO)

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

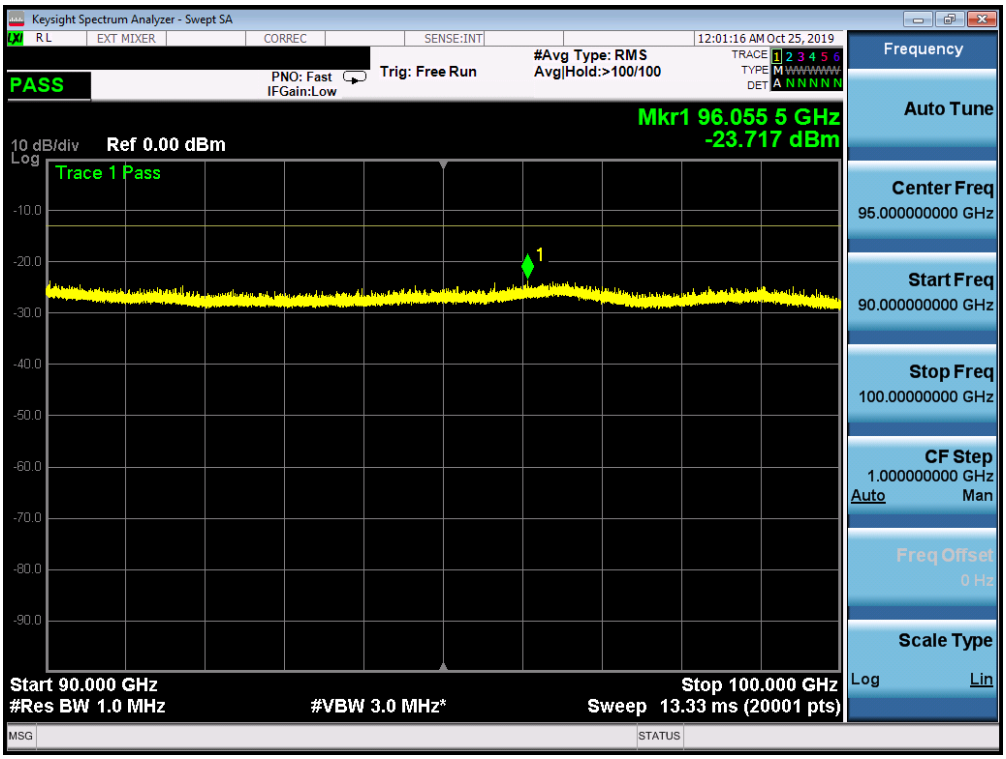
90 – 100GHz



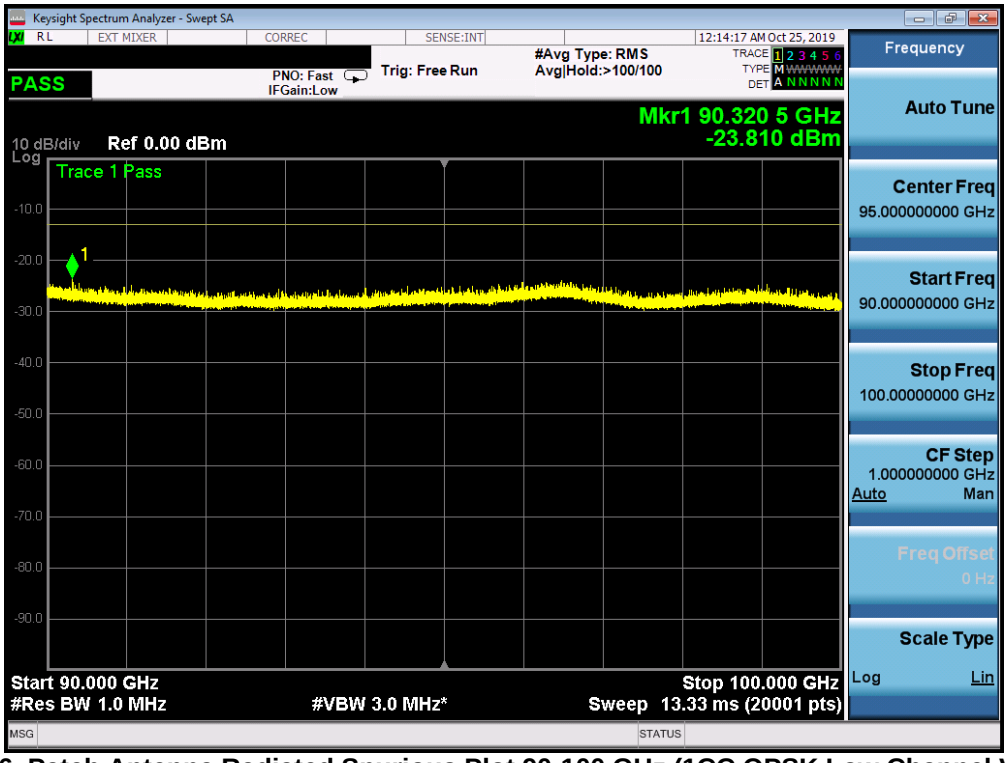
Plot 7-83. Patch Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Low Channel H Beam)



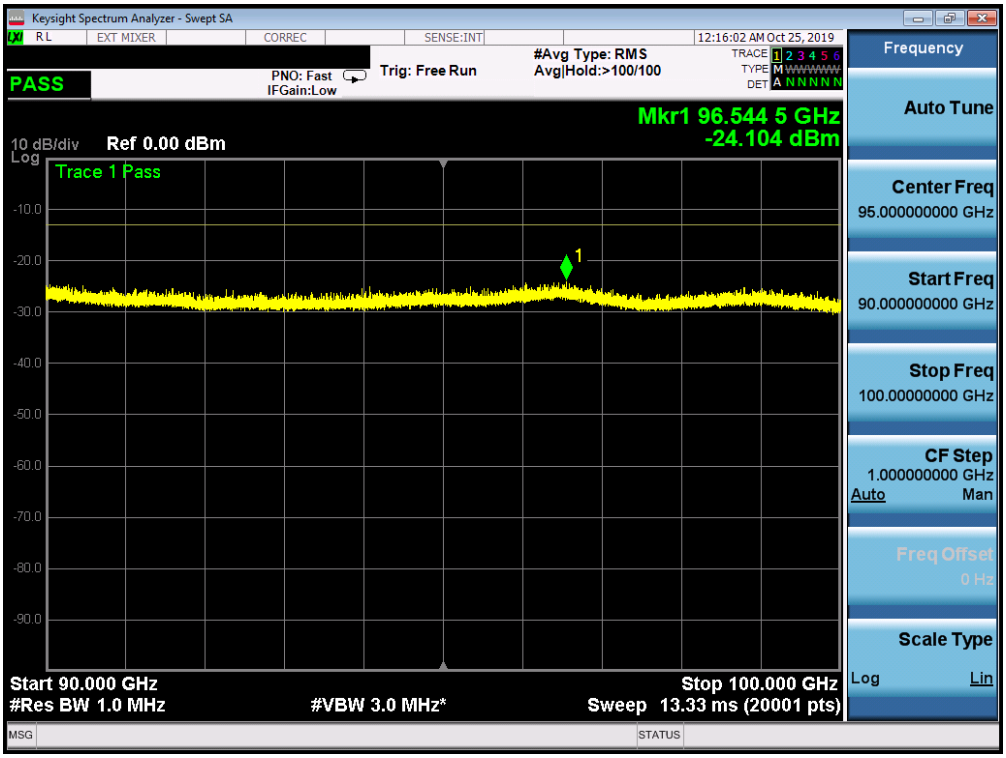
Plot 7-84. Patch Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK Mid Channel H Beam)



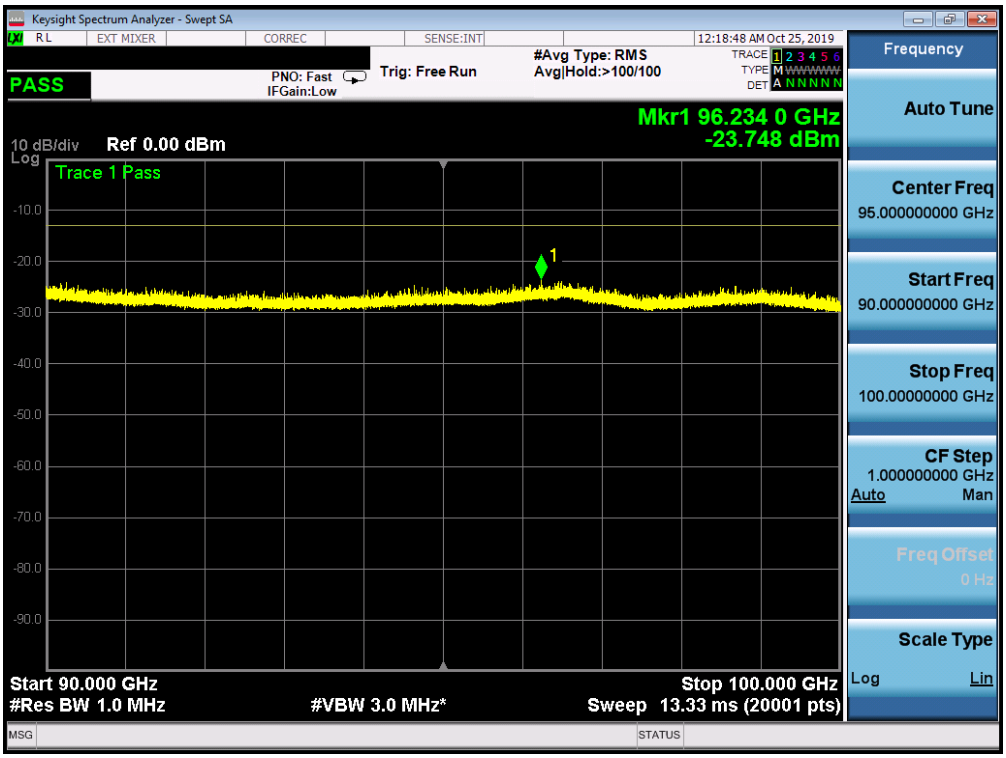
Plot 7-85. Patch Antenna Radiated Spurious Plot 90-100 GHz (1CC QPSK High Channel H Beam)



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



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)

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	H	H	-	-	-24.88	-13.00	-11.88
96586.50	RMS/MaxH	Mid	100	QPSK	H	H	-	-	-23.94	-13.00	-10.94
96055.50	RMS/MaxH	High	100	QPSK	H	H	-	-	-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	QPSK	V	V	-	-	-23.75	-13.00	-10.75

Table 7-27. Patch 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.

2. 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

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 ≥ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

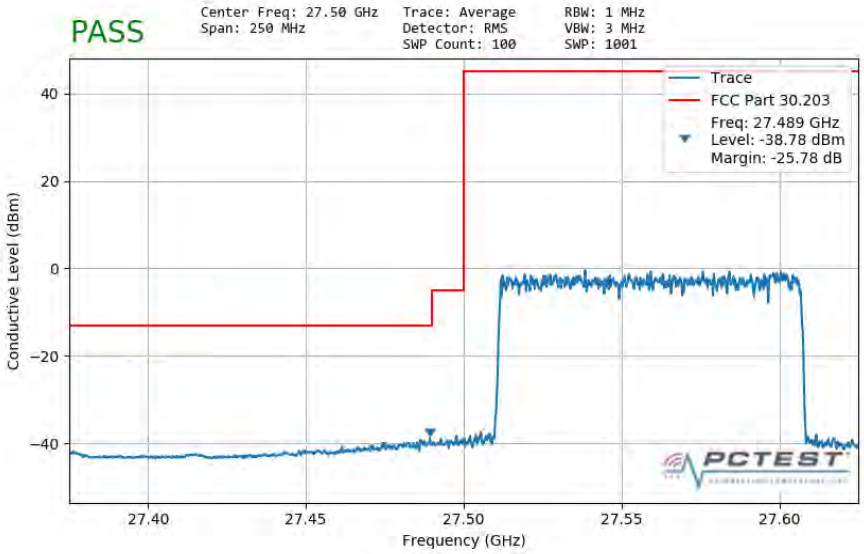
Test Notes

1) 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

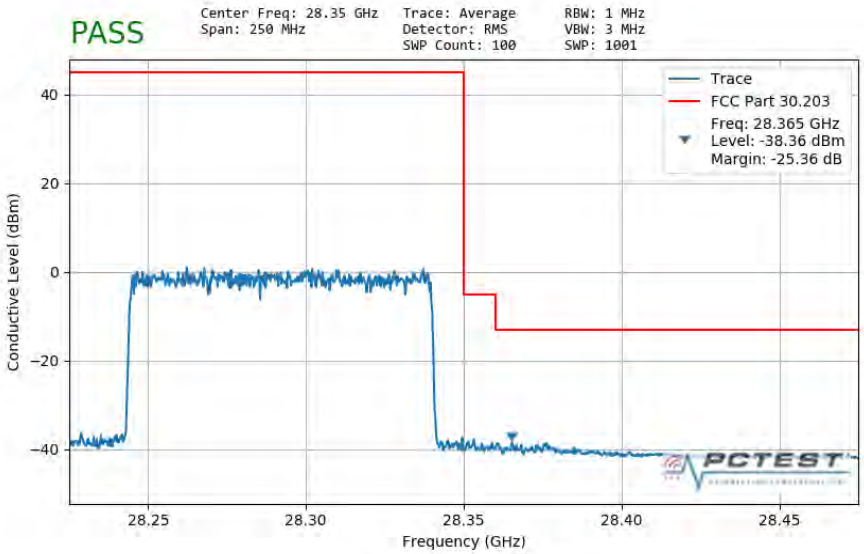
2) The spectrum plots in this section show measurement of some emissions that may be considered as part of the spurious domain, extending beyond the band edges by more than 10% of the occupied bandwidth of the test signal. These measurements were made with a WR28 waveguide-to-RF adapter where the operating 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_{ANT}) dB*" technique specified in Section 6.4.3.2.2 of ANSI C63.26-2015. An offset of 10log(N_{ANT}) was added to the worst case polarization band edge, where N_{ANT} = 2.

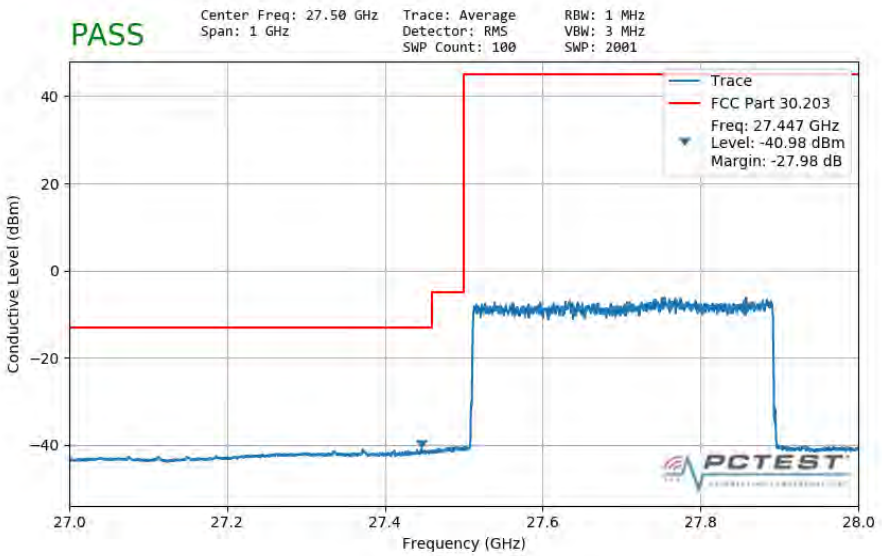
7.6.1 HBF Antenna Band Edge MIMO



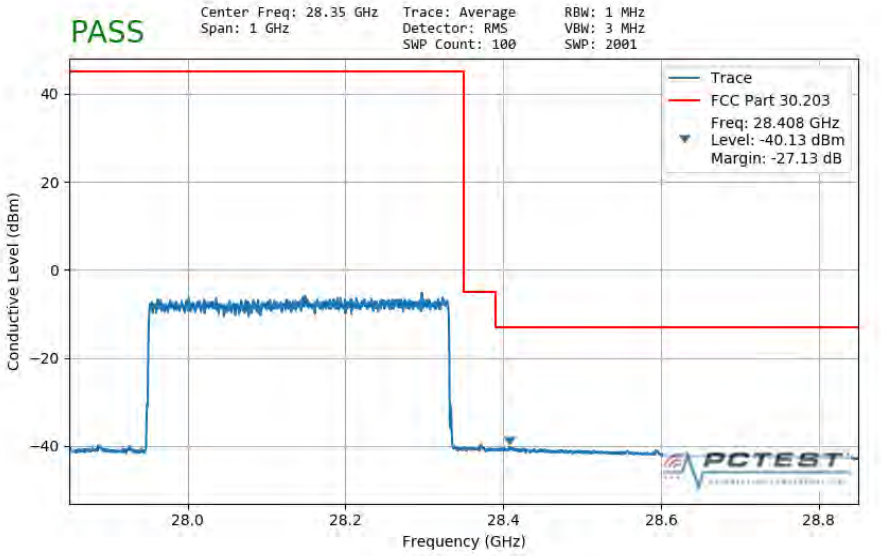
Plot 7-89. Lower Band Edge Plot (100MHz QPSK Full RB)



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

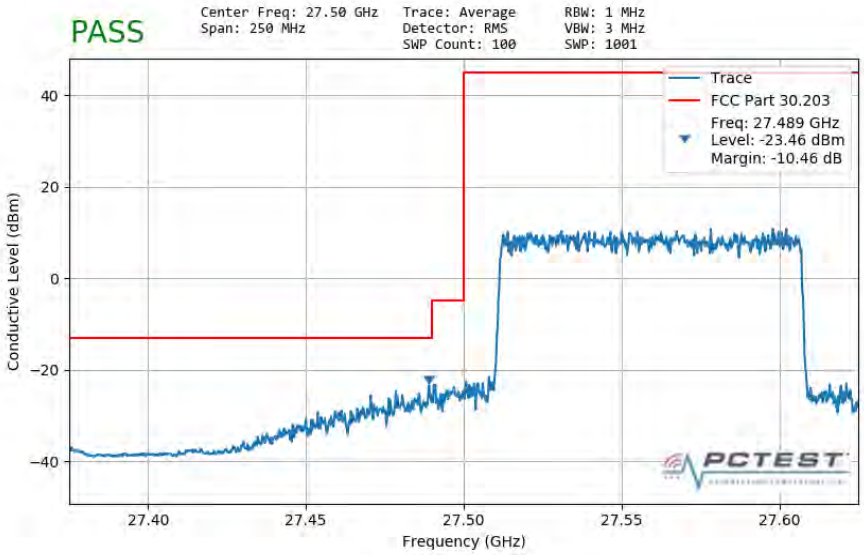


Plot 7-91. Upper Band Edge Plot (100MHz QPSK Full RB)

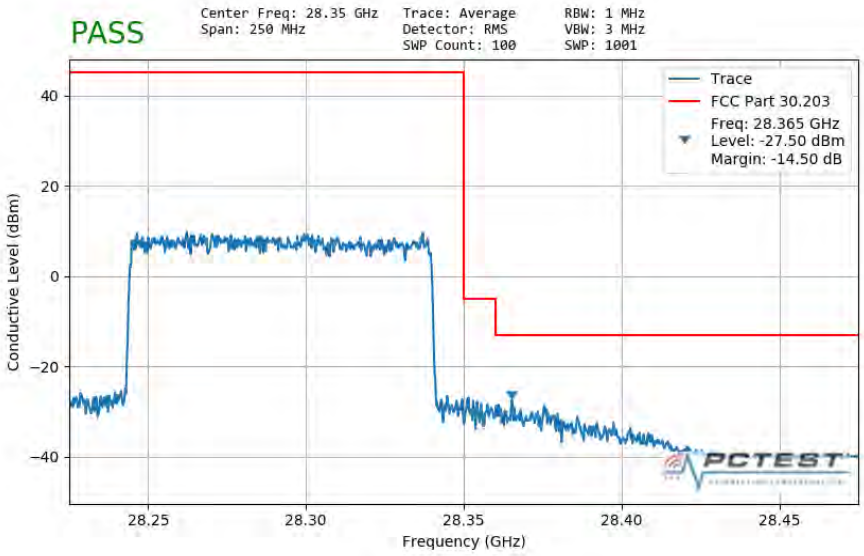


Plot 7-92. Upper Band Edge Plot (400MHz QPSK Full RB)

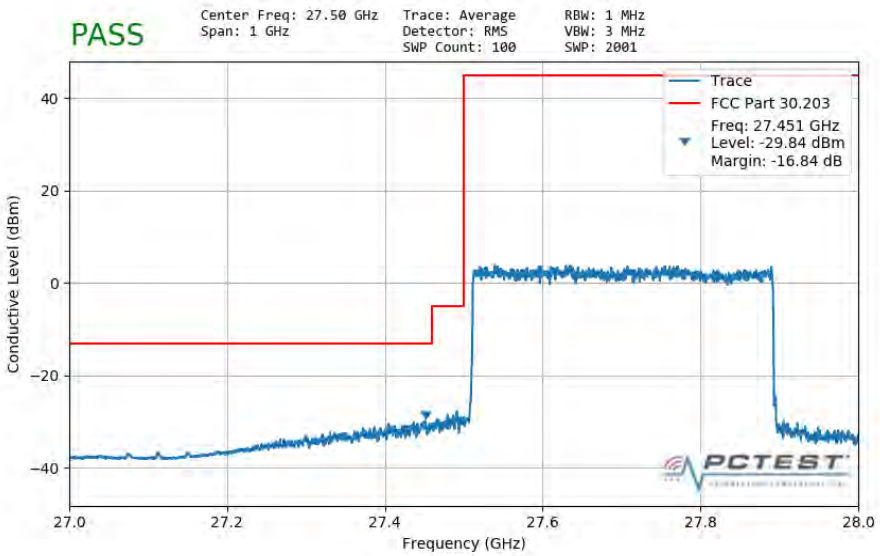
7.6.2 Patch Antenna Band Edge MIMO



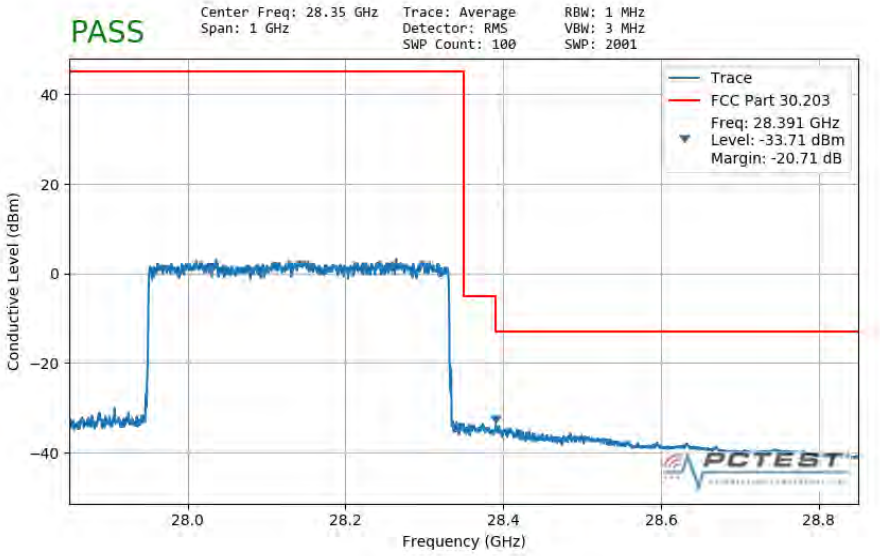
Plot 7-93. Lower Band Edge Plot (100MHz QPSK Full RB)



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



Plot 7-95. Upper Band Edge Plot (100MHz QPSK Full RB)



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

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).

Frequency Stability Measurements

§2.1055

OPERATING FREQUENCY: 27,923,520,000 Hz

REFERENCE VOLTAGE: 14.00 VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	14.00	- 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 %		+ 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.

Frequency Stability Measurements

§2.1055

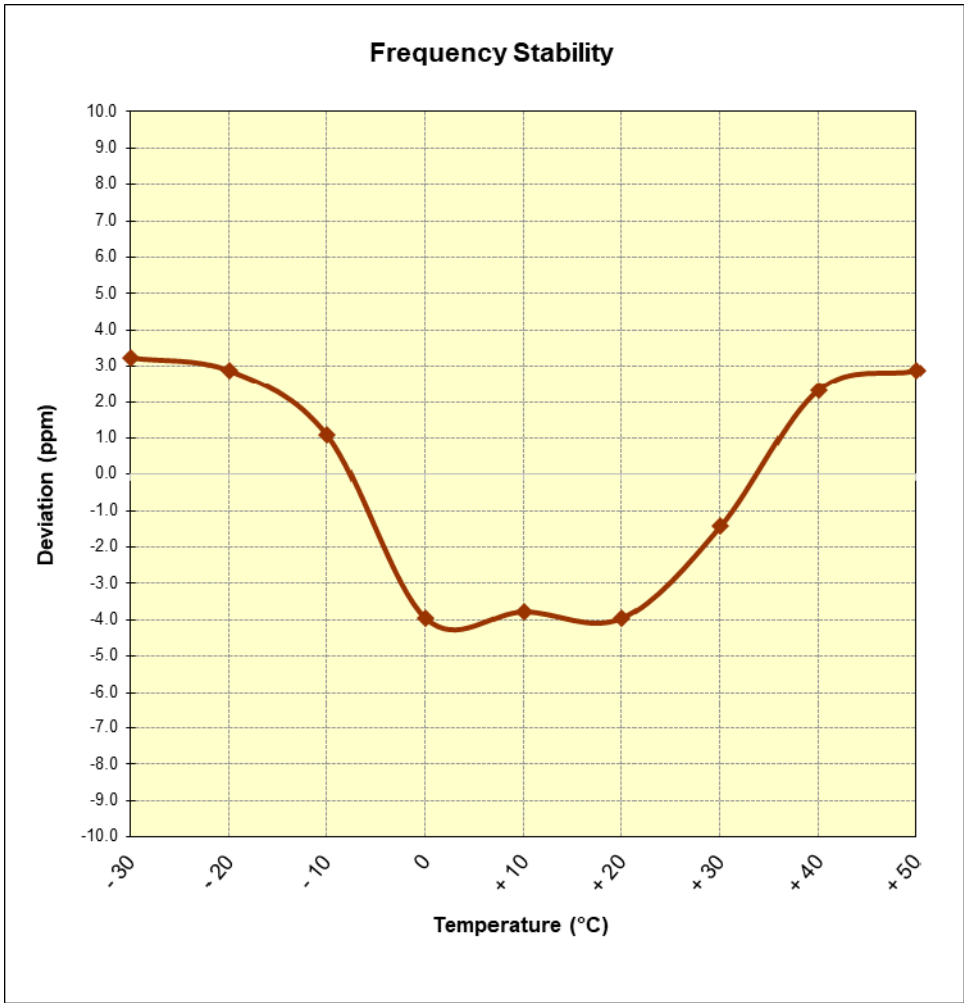


Figure 7-1. Frequency Stability Graph

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.

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	Description
1	EA	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).

Authorized Signature
Virginia Diodes, Inc

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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 Shipped	Unit	Description
1	EA	SAX RETEST-WR12SAX WR12SAX / SN: SAX 252
1	EA	SAX RETEST-WR8.0SAX WR8.0SAX / SN: SAX 253
1	EA	SAX RETEST-WR5.1SAX 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

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