

Test Report

Prepared for: ED2 Corporation

Model: Roadrunner

Description: Band n261 5G mmWave Repeater

FCC ID: 2AYVPRR001ODR

To

FCC Part 30

Date of Issue: February 12, 2021

On the behalf of the applicant:

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Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	February 12, 2021	Greg Corbin	Original Document

Table of Contents

<u>Description</u>	<u>Page</u>
Table of Contents	3
Table of Annexes	4
Standard Test Conditions and Engineering Practices	6
Test Result Summary	8
AGC Threshold	9
Out-Of-Band Rejection	10
Input-Versus-Output Signal Comparison	11
Mean Output and Amplifier Gain	12
Out-Of-Band/Block Emission (Dual Carrier)	15
Out-Of-Band/Block Emission (Single Carrier)	16
Conducted Spurious Emissions	17
Radiated Spurious Emissions	24
Measurement Uncertainty	38
Calibration Data	38
Test Equipment Utilized	39

Table of Annexes

<u>Description</u>	<u>Page</u>
Annex A – Out of Band Rejection	10
Annex B – Input vs Output	11
Annex C – Out of Band/Block Emission (Dual Carrier)	15
Annex D – Out of Band/Block Emission (Single Carrier)	16
Annex E – Conducted Spurious Emission	23
Annex F – Radiated Spurious Emission	37
Annex G – Test Equipment Calibration Certificates	38
Annex H – Scope of Accreditation	38

ANAB

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to <http://www.compliancetesting.com/labscope.html> for current scope of accreditation.



FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

Test and Measurement Data

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, KDB 935210 D05 v01r04 Industrial Booster Basic Measurements, KDB 586862, KDB 842590 D01 Upper Microwave Flexible Use Service v01r01, ANSI C63-26-2015, and FCC Part 2, Part 30 where appropriate.

Standard Test Conditions and Engineering Practices

In accordance with ANSI/C63.4-2014, and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F), unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Environmental Conditions		
Temp (°C)	Humidity (%)	Pressure (mbar)
23.6 – 25.8	24.3 – 38.1	964.2 – 966.5

Measurement results, unless otherwise noted, are worst-case measurements.

EUT Description

Model: Roadrunner

Description: Band n261 5G mmWave Repeater

Additional Information:

The EUT is a 5G mmWave Repeater.

The frequency range for both the Donor and Server ports is 27.50 – 28.35 GHz.

The EUT has separate horizontal and vertical inputs and outputs.

For Output Power and Conducted Spurious Emissions, the horizontal and vertical outputs for each signal path are summed together per KDB 662911 D01 Emissions Testing of Transmitters with Multiple Outputs in the Same Band.

Modulation used is according to the 5G NR (New Radio Standard) 3GPP 38 (Downlink: CP-OFDM, Uplink: CP-OFDM or DFT-S-OFDM – up to 256QAM).

EUT Operation during Tests

EUT was set up for normal operating conditions.

5G test signals with either 100 MHz or 400 MHz bandwidths were used as required.

The antennas were removed to provide access to the antenna ports.

Test signals were injected into the antenna ports.

The EUT Antenna ports and signal paths are listed below.

From	To
Donor Vertical RX Input	Server Vertical TX Output
Donor Horizontal RX Input	Server Horizontal TX output
Server Vertical RX Output	Donor Vertical TX Input
Server Horizontal RX output	Donor Horizontal TX Input

Antenna Gain

Antenna	Frequency (GHz)	Gain (dBi)
TX	27.50 – 28.35	18
RX	27.50 – 28.35	18

Accessories: None

Cables: manufacturer supplied interconnect cable set

Modifications: None

Test Result Summary

Specification	Test Name	Pass, Fail, N/A	Comments
KDB 935210 D05 (3.2)	AGC Threshold	Pass	
KDB 935210 D05 (3.3)	Out-of-Band Rejection	Pass	
KDB 935210 D05 (3.4)	Input-Versus-Output Signal Comparison	Pass	
2.1046 Part 30.202 KDB 935210 D05 (3.5)	Mean Output Power and Amplifier gain	Pass	
Part 30.203(a) KDB 935210 D05 (3.6.2)	Out-Of-Band/Block Emissions Conducted	Pass	
2.1051 Part 30.203(a) KDB 935210 D05 (3.6.3)	Spurious Emissions Conducted	Pass	
KDB 935210 D05 (3.7)	Frequency Stability	N/A	Does not have Frequency translation
2.1053 KDB 935210 D05 (3.8)	Spurious Emissions Radiated	Pass	

Statements of conformity are reported as:

- Pass - the measured value is below the acceptance limit, *acceptance limit = test limit*.
- Fail - the measured value is above the acceptance limit, *acceptance limit = test limit*.

AGC Threshold

Engineer: Greg Corbin

Test Date: 1/27/2021

Test Procedure

The EUT was connected as shown in the test set-up block diagram.

The Signal Generator was configured to produce 5G signals with 100 MHz and 400 MHz bandwidth.

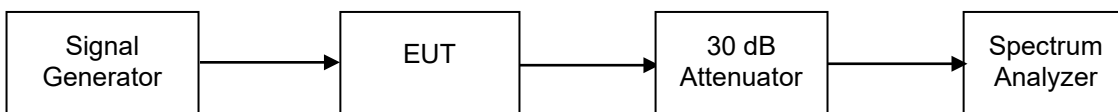
The peak frequency from the Out of Band Rejection was used unless the frequency was too close to the band edge in which case the next highest peak was selected that allowed bandwidth of the signal to remain within the passband. This same signal was used for the Mean Output Power test.

The input power level was increased in 1 dB increments until the power no longer increased.

The input levels were recorded in the table below.

The spectrum analyzer channel power tool was used to monitor the output power level.

Test Setup



AGC Threshold Test Results

Repeater Output	Tuned Frequency (MHz)	AGC Threshold (dBm)
		100 MHz BW
Server Vert TX Output	27549	-42
Server Horz TX Output	27550	-38
Donor Vert TX Output	27744	-38
Donor Horz TX Output	27550	-41

Repeater Output	Tuned Frequency (MHz)	AGC Threshold (dBm)
		400 MHz BW
Server Vert TX Output	27729	-46
Server Horz TX Output	27745	-42
Donor Vert TX Output	27744	-42
Donor Horz TX Output	27740	-43

Out-Of-Band Rejection

Engineer: Greg Corbin

Test Date: 1/26/2021

Test Procedure

The EUT was connected as shown in the test set-up block diagram.

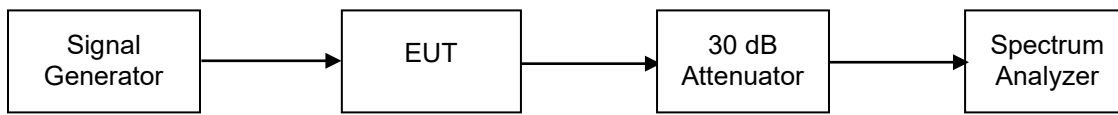
A signal generator was utilized to produce a swept CW signal with the RF input level set to 3 dB below the AGC Threshold level.

The Uplink and Downlink filter response and the -20 dB bandwidth were measured.

RBW = 1 kHz

Video BW = 3 kHz

Test Setup



-20 dB Bandwidth Test Results

Repeater Output	-20 dB Bandwidth (MHz)
Server Vert TX Output	2037
Server Horz TX Output	1992
Donor Vert TX Output	2021
Donor Horz TX Output	2222

Annex A Out of Band Rejection

Refer to Annex A for Out of Band Rejection and -20 dB BW plots

Input-Versus-Output Signal Comparison

Engineer: Greg Corbin

Test Date: 1/28/2021

Test Procedure

The EUT was connected as shown in the test set-up block diagram.

The amplitude was set to be just below the AGC threshold level but not more than 0.5 dB.

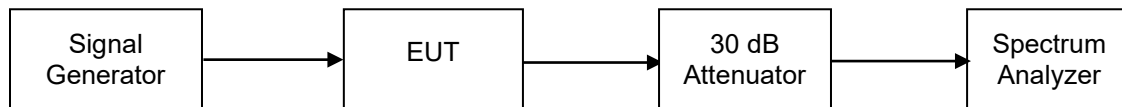
The Occupied BW tool on the spectrum analyzer was used to measure the -26 dB BW and the 99% BW for both the input and output signals.

The 99% bandwidth was compared between the input and the output of the EUT.

The input level was then increased by 3 dB above and the comparison repeated.

The Input and Output signal comparison was performed with 100 MHz and 400 MHz BW signals.

Test Setup



Annex B – Input vs Output

Refer to Annex B for Input vs Output plots.

Mean Output and Amplifier Gain

Engineer: Greg Corbin

Test Date: 1/27/2021

Test Procedure

The EUT was connected as shown in the test set-up block diagram.

The peak frequency from the Out of Band Rejection was used unless the frequency was too close to the band edge in which case the next highest peak was selected that allowed bandwidth of the signal to remain within the passband.

The output power test was performed with 100 MHz and 400 MHz test signals.

The channel power tool on the spectrum analyzer was used to measure output power.

The input power level was increased in 1 dB increments until the power no longer increased.

The input and output levels were recorded in the table below.

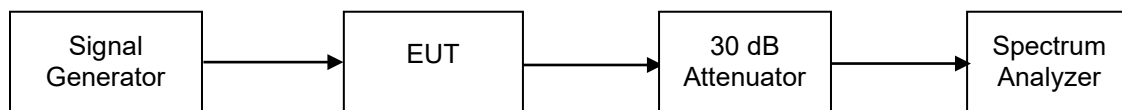
The amplifier gain was determined from the delta between the input and output levels.

The input level was increased 3 dB and the output power was recorded.

The antenna gain for both the Donor and Server port is 18 dBi.

The horizontal and vertical outputs were measured individually and then summed together per KDB 662911 D01 Emissions Testing of Transmitters with Multiple Outputs in the Same Band.

Test Setup



Composite Output Power (dBm) = $10 \cdot \text{LOG}(P1+P2)$

P1 = Horizontal TX Output Power (mw)

P2 = Vertical TX Output Power (mw)

EIRP = Composite Output Power + Antenna Gain

Gain = Output Power – Input Power

Output Power and Gain Test Results

Composite Output Power at the AGC Threshold

Donor RX Input to Server TX Output										
Test Signal BW	Test Frequency (Horz, Vert)	Output Power		Output Power		Composite Output power	Antenna Gain	EIRP	Limit	Result
		Server Horz TX Output	Server Vert TX Output	Server Horz TX Output	Server Vert TX Output					
(MHz)	(GHz)	(dBm)	(dBm)	(mw)	(mw)	(dBm)	(dBi)	(dBm)	(dBm)	Pass / Fail
100	27.255, 27.549	27.28	27.25	534.56	530.88	30.28	18	48.28	75	Pass
400	27.745, 27.729	26.71	26.8	468.81	478.63	29.77	18	47.77	75	Pass

Server TX Input to Donor TX Output										
Test Signal BW	Test Frequency (Horz, Vert)	Output Power		Output Power		Composite Output power	Antenna Gain	EIRP	Limit	Result
		Donor Horz TX Output	Donor Vert TX Output	Donor Horz TX Output	Donor Vert TX Output					
(MHz)	(GHz)	(dBm)	(dBm)	(mw)	(mw)	(dBm)	(dBi)	(dBm)	(dBm)	Pass / Fail
100	27.550, 27.744	25.11	26.07	324.34	404.58	28.63	18	46.63	75	Pass
400	27.740, 27.744	26.85	26.2	484.17	416.87	29.55	18	47.55	75	Pass

Composite Output Power at the AGC Threshold + 3 dB

Donor RX Input to Server TX Output										
Test Signal BW	Test Frequency (Horz, Vert)	Output Power		Output Power		Composite Output power	Antenna Gain	EIRP	Limit	Result
		Server Horz TX Output	Server Vert TX Output	Server Horz TX Output	Server Vert TX Output					
(MHz)	(GHz)	(dBm)	(dBm)	(mw)	(mw)	(dBm)	(dBi)	(dBm)	(dBm)	Pass / Fail
100	27.255, 27.549	28.8	28.82	758.58	762.08	31.82	18	49.82	75	Pass
400	27.745, 27.729	28.65	28.6	732.82	724.44	31.64	18	49.64	75	Pass

Server TX Input of Donor TX Output										
Test Signal BW	Test Frequency (Horz, Vert)	Output Power		Output Power		Composite Output power	Antenna Gain	EIRP	Limit	Result
		Donor Horz TX Output	Donor Vert TX Output	Donor Horz TX Output	Donor Vert TX Output					
(MHz)	(GHz)	(dBm)	(dBm)	(mw)	(mw)	(dBm)	(dBi)	(dBm)	(dBm)	Pass / Fail
100	27.550, 27.744	26.8	27.42	478.63	552.08	30.13	18	48.13	75	Pass
400	27.740, 27.744	28.64	28.22	731.14	663.74	31.45	18	49.45	75	Pass

Out-Of-Band/Block Emission (Dual Carrier)

Engineer: Greg Corbin

Test Date: 1/28/2021

Test Procedure

This test was performed using test signals with 100 MHz bandwidth.

For Band edge OOBE, the measurement is performed for 10% of the emission BW, for 100 MHz BW signal, the OOBE is measured for 10 MHz from the band edge.

The Lower Band Edge is 27490 - 27500MHz

The Upper Band Edge = 28350 - 28360 MHz

The limit is -5 dBm/MHz in the OOBE region

Part 30 section 203_Emission Limits_

(a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be -13 dBm/MHz or lower. 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

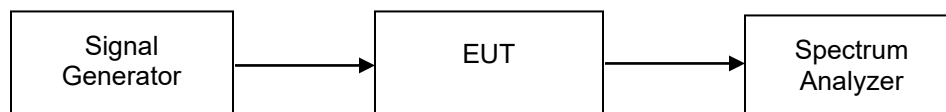
The test was performed at the lower and upper band edge.

RBW = 1 MHz

VBW = 3 MHz

The test was performed with the input level 0.2 dB below the AGC level and at 3 dB above the AGC level.

Test Setup



Annex C – Out of Band/Block Emission (Dual Carrier)

Refer to Annex C for Out of Band/Block emission plots (Dual Carrier)

Out-Of-Band/Block Emission (Single Carrier)

Engineer: Greg Corbin

Test Date: 1/28/2021

Test Procedure

This test was performed using a test signal with 100 MHz and 400 MHz bandwidth.

For Band edge OOBE, the measurement is performed for 10% of the emission BW.

The limit is -5 dBm/MHz in the OOBE region

Part 30 section 203_Emission Limits_

(a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be -13 dBm/MHz or lower. 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

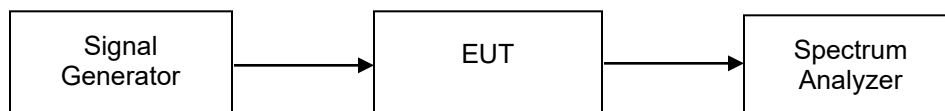
The test was performed at the lower and upper band edge.

RBW = 1 MHz

VBW = 3 MHz

The test was performed with the input level 0.2 dB below the AGC level and at 3 dB above the AGC level.

Test Setup



Annex D – Out of Band/Block Emission (Single Carrier)

Refer to Annex D for Out of Band/Block emission plots (Single Carrier)

Conducted Spurious Emissions

Engineer: Greg Corbin

Test Date: 2/1/2021

Test Procedure

This test was performed using 5GNR test signals with 100 MHz bandwidth.

Raw data was recorded, with no correction factors were input to the spectrum analyzer.

The peak emission was recorded and the final value was calculated in the table below.

Conducted spurious emissions were measured from 30 MHz to 110 GHz.

From 30 MHz to 40 GHz the EUT output was connected directly to the spectrum analyzer and raw data was recorded.

From 30 MHz to 40 GHz the only correction factor was the cable loss from the EUT output to the spectrum analyzer input.

From 40 – 110 GHz, external mixers were used and raw data was recorded with all correction factors applied manually in the table below.

1. for 30 MHz - 40 GHz, used direct measurement, cable insertion loss from the EUT output to the spectrum analyzer input (3 ft cable, C557-086-36B, EUT output to SA input) not included in spectrum analyzer plots. Insertion loss accounted for in the tables below.
2. For 40 - 50 GHz, plots are raw data, connection from EUT output to SA input: EUT output to SMP (f) - 2.92 (f) adapter to (2.92 mm _20 dB attn, weinschel) to (2.92 M - 2.4 M adapter) to (Q281D 2.4 F - WR 22) to Mixer input (HP 11970Q)
3. For 50 - 75GHz, plots are raw data, connection from EUT output to SA input: EUT output to SMP (f) - 2.92 (f) adapter to 2.92 (m) – 2.4 (m) adapter to 2.4 (f) to 1.85 (m) adapter to 1.85 (f) to WR15 waveguide to WR15 Mixer(11970V) waveguide input
4. For 75 - 110 GHz, plots are raw data, connection from EUT output to SA input: EUT output to SMP (f) - 2.92 (f) adapter to 2.92 (m) to 1.85 (m) adapter to 1.85 (f) to 1.0 (m) adapter to 1.0 (f) to WR10 waveguide to WR10 Mixer(11970V) waveguide input

RBW = 100 kHz for measurements below 1 GHz.

RBW = 1 MHz for measurements above 1 GHz.

VBW = 3 X RBW.

The tests were performed with the test signal set to the low, mid, and high channels of the band, with the output power level set to just below the AGC point.

Part 30 section 203_Emission Limits_

- (a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be -13 dBm/MHz or lower.

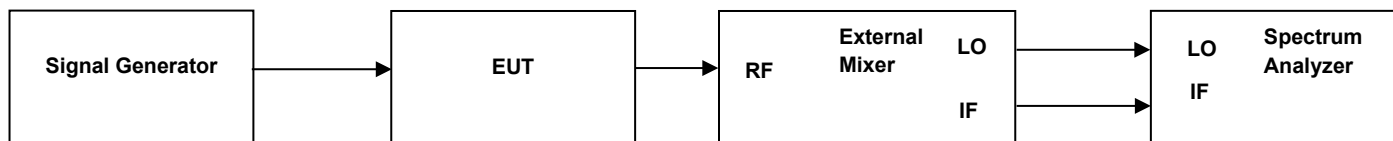
The horizontal and vertical outputs were measured individually and then summed together per KDB 662911 D01 Emissions Testing of Transmitters with Multiple Outputs in the Same Band.

A table with the Composite Conducted Spurious Emissions is provided at the end of this section per KDB 662911 D01 Emissions Testing of Transmitters with Multiple Outputs in the Same Band.

Test Setup_30 MHz to 40 GHz



Test Setup_40 GHz to 110 GHz



Calculations:

30 MHz – 40 GHz_ Direct connection to spectrum analyzer

Final Data = Raw Data + Cable Insertion Loss

44 GHz – 110 GHz_ EUT output connected to external mixer with the IF/LO ports going to a diplexer then connected to spectrum analyzer

Final Data = Raw Data + Diplexer Insertion Loss + Cable/Conn Insertion Loss + Mixer Conversion Loss

Conducted Spurious Test Data

Test Frequency	Spectrum Analyzer span	Conducted Spurious (raw data)		RBW	Diplexer Insertion Loss @ 311 MHz	Cable/Conn Insertion Loss_ EUT output to Mixer input	Receive Mixer Conversion Loss	Conducted Spurious Emissions_ Final Data	Limit	Margin
		Frequency	Amplitude							
GHz	GHz	GHz	dBm	kHz	dB	dB	dB	dBm	dBm	dB
Donor Vert RX In - Server Vert TX Out										
27.550	0.03 - 1	0.0408	-62.40	100	0	-6.38	0.00	-56.02	-13	-43.02
27.550	1 - 27.45	27.448	-29.10	1000	0	-10.48	0.00	-18.62	-13	-5.62
27.550	28.40 - 40	28.45	-46.80	1000	0	-10.62	0.00	-36.18	-13	-23.18
27.550	40 - 50	45.856	-84.50	1000	-1	-20.5	-22.70	-40.30	-13	-27.30
27.550	50 - 75	55.12	-57.50	1000	-1	-2.05	-33.90	-20.55	-13	-7.55
27.550	75 - 110	82.679	-72.90	1000	-1	-2.05	-40.60	-29.25	-13	-16.25
Donor Horz RX In - Server Horz TX Out										
27.550	0.03 - 1	0.0822	-73.30	100	0	-6.61	0.00	-66.69	-13	-53.69
27.550	1 - 27.45	27.442	-31.00	1000	0	-10.48	0.00	-20.52	-13	-7.52
27.550	28.40 - 40	38.648	-40.60	1000	0	-12.06	0.00	-28.54	-13	-15.54
27.550	40 - 50	45.863	-89.40	1000	-1	-20.5	-22.70	-45.20	-13	-32.20
27.550	50 - 75	55.082	-59.80	1000	-1	-2.05	-33.90	-22.85	-13	-9.85
27.550	75 - 110	76.814	-93.50	1000	-1	-2.05	-40.80	-49.65	-13	-36.65
Donor Vert RX In - Server Vert TX Out										
27.925	0.03 - 1	0.0821	-70.50	100	0	-6.61	0.00	-63.89	-13	-50.89
27.925	1 - 27.45	27.258	-35.60	1000	0	-10.46	0.00	-25.14	-13	-12.14
27.925	28.40 - 40	28.458	-46.80	1000	0	-10.62	0.00	-36.18	-13	-23.18
27.925	40 - 50	46.491	-91.10	1000	-1	-19.9	-22.40	-47.80	-13	-34.80
27.925	50 - 75	55.822	-68.30	1000	-1	-2.05	-33.50	-31.75	-13	-18.75
27.925	75 - 110	83.761	-94.60	1000	-1	-2.05	-40.70	-50.85	-13	-37.85
Donor Horz RX In - Server Horz TX Out										
27.925	0.03 - 1	0.3894	-78.20	100	0	-6.37	0.00	-71.83	-13	-58.83
27.925	1 - 27.45	27.275	-37.00	1000	0	-10.46	0.00	-26.54	-13	-13.54
27.925	28.40 - 40	38.651	-40.30	1000	0	-12.06	0.00	-28.24	-13	-15.24
27.925	40 - 50	46.368	-91.40	1000	-1	-20	-22.50	-47.90	-13	-34.90
27.925	50 - 75	55.844	-67.90	1000	-1	-2.05	-33.50	-31.35	-13	-18.35
27.925	75 - 110	91.649	-94.90	1000	-1	-2.05	-41.10	-50.75	-13	-37.75
Donor Vert RX In - Server Vert TX Out										
28.300	0.03 - 1	0.0658	-71.10	100	0	-6.54	0.00	-64.56	-13	-51.56
28.300	1 - 27.45	27.273	-35.90	1000	0	-10.47	0.00	-25.43	-13	-12.43
28.300	28.40 - 40	28.404	-31.60	1000	0	-10.61	0.00	-20.99	-13	-7.99
28.300	40 - 50	47.143	-90.80	1000	-1	-19.2	-22.40	-48.20	-13	-35.20
28.300	50 - 75	56.605	-56.60	1000	-1	-2.05	-33.30	-20.25	-13	-7.25
28.300	75 - 110	108.42	-95.10	1000	-1	-2.05	-42.90	-49.15	-13	-36.15
Donor Horz RX In - Server Horz TX Out										
28.300	0.03 - 1	0.4491	-66.40	100	0	-6.41	0.00	-59.99	-13	-46.99
28.300	1 - 27.45	27.210	-36.30	1000	0	-10.46	0.00	-25.84	-13	-12.84
28.300	28.40 - 40	28.789	-32.85	1000	0	-10.64	0.00	-22.21	-13	-9.21
28.300	40 - 50	47.175	-91.10	1000	-1	-19.2	-22.40	-48.50	-13	-35.50
28.300	50 - 75	56.603	-68.90	1000	-1	-2.05	33.30	-99.15	-13	-86.15
28.300	75 - 110	87.129	-94.00	1000	-1	-2.05	-40.60	-50.35	-13	-37.35

Test Frequency	Spectrum Analyzer span	Conducted Spurious (raw data)		RBW	Diplexer Insertion Loss @ 311 MHz	Cable/Conn Insertion Loss_ EUT output to Mixer input	Receive Mixer Conversion Loss	Conducted Spurious Emissions_ Final Data	Limit	Margin
		Frequency	Amplitude							
GHz	GHz	GHz	dBm	kHz	dB	dB	dB	dBm	dBm	dB
Server Vert RX In - Donor Vert TX Out										
27.550	0.03 - 1	0.0725	-69.30	100	0	-6.18	0.00	-63.12	-13	-50.12
27.550	1 - 27.45	27.445	-29.40	1000	0	-10.48	0.00	-18.92	-13	-5.92
27.550	28.40 - 40	38.942	-40.50	1000	0	-12.09	0.00	-28.41	-13	-15.41
27.550	40 - 50	45.859	-91.30	1000	-1	-19.9	-22.70	-47.70	-13	-34.70
27.550	50 - 75	55.106	-58.90	1000	-1	-2.05	-33.90	-21.95	-13	-8.95
27.550	75 - 110	96.452	-84.00	1000	-1	-2.05	-41.50	-39.45	-13	-26.45
Server Horz RX In - Donor Horz TX Out										
27.550	0.03 - 1	0.0773	-64.00	100	0	-6.18	0.00	-57.82	-13	-44.82
27.550	1 - 27.45	27.446	-25.30	1000	0	-10.48	0.00	-14.82	-13	-1.82
27.550	28.40 - 40	38.636	-40.90	1000	0	-12.07	0.00	-28.83	-13	-15.83
27.550	40 - 50	45.857	-83.80	1000	-1	-19.9	-22.70	-40.20	-13	-27.20
27.550	50 - 75	55.096	-58.00	1000	-1	-2.05	-33.90	-21.05	-13	-8.05
27.550	75 - 110	82.678	-78.50	1000	-1	-2.05	-40.60	-34.85	-13	-21.85
Server Vert RX In - Donor Vert TX Out										
27.925	0.03 - 1	0.082	-68.80	100	0	-6.18	0.00	-62.62	-13	-49.62
27.925	1 - 27.45	27.201	-31.60	1000	0	-10.46	0.00	-21.14	-13	-8.14
27.925	28.40 - 40	38.06	-40.90	1000	0	-11.99	0.00	-28.91	-13	-15.91
27.925	40 - 50	46.467	-91.00	1000	-1	-19.2	-22.60	-48.20	-13	-35.20
27.925	50 - 75	55.809	-67.20	1000	-1	-2.05	-33.60	-30.55	-13	-17.55
27.925	75 - 110	96.981	-84.20	1000	-1	-2.05	-41.60	-39.55	-13	-26.55
Server Horz RX In - Donor Horz TX Out										
27.925	0.03 - 1	0.0716	-71.90	100	0	-6.18	0.00	-65.72	-13	-52.72
27.925	1 - 27.45	27.329	-34.70	1000	0	-10.48	0.00	-24.22	-13	-11.22
27.925	28.40 - 40	38.66	-42.00	1000	0	-12.06	0.00	-29.94	-13	-16.94
27.925	40 - 50	46.552	-91.00	1000	-1	-19.2	-22.40	-48.40	-13	-35.40
27.925	50 - 75	55.844	-66.60	1000	-1	-2.05	-33.50	-30.05	-13	-17.05
27.925	75 - 110	87.126	-91.30	1000	-1	-2.05	-40.60	-47.65	-13	-34.65
Server Vert RX In - Donor Vert TX Out										
28.300	0.03 - 1	0.4159	-68.50	100	0	-6.39	0.00	-62.11	-13	-49.11
28.300	1 - 27.45	26.9	-29.30	1000	0	-10.42	0.00	-18.88	-13	-5.88
28.300	28.40 - 40	28.414	-33.20	1000	0	-10.62	0.00	-22.58	-13	-9.58
28.300	40 - 50	47.255	-87.70	1000	-1	-18.5	-22.40	-45.80	-13	-32.80
28.300	50 - 75	56.604	-69.20	1000	-1	-2.05	-33.30	-32.85	-13	-19.85
28.300	75 - 110	93.685	-85.20	1000	-1	-2.05	-41.50	-40.65	-13	-27.65
Server Horz RX In - Donor Horz TX Out										
28.300	0.03 - 1	0.4683	-67.30	100	0	-6.42	0.00	-60.88	-13	-47.88
28.300	1 - 27.45	27.329	-35.40	1000	0	-10.48	0.00	-24.92	-13	-11.92
28.300	28.40 - 40	28.04	-29.90	1000	0	-10.56	0.00	-19.34	-13	-6.34
28.300	40 - 50	47.149	-89.40	1000	-1	-18.5	-22.40	-47.50	-13	-34.50
28.300	50 - 75	56.605	-64.90	1000	-1	-2.05	-33.30	-28.55	-13	-15.55
28.300	75 - 110	96.207	-91.80	1000	-1	-2.05	-41.50	-47.25	-13	-34.25

Composite Conducted Spurious Emission at the AGC Threshold

Donor RX Input to Server TX Output								
Test Frequency = 27.550 GHz	Conducted Spurious Emission				Composite Spurious Emission	Limit	Margin	Result
Spectrum Analyzer Span	Server Horz TX Output	Server Vert TX Output	Server Horz TX Output	Server Vert TX Output				
	(dBm)	(dBm)	(mw)	(mw)	(dBm)	(dBm)	(dB)	Pass / Fail
30 - 1000 MHz	-66.69	-56.02	0.0000002	0.0000025	-55.66	-13	-42.66	Pass
1 - 27.45 GHz	-20.52	-18.62	0.0088716	0.0137404	-16.46	-13	-3.46	Pass
28.40 - 40 GHz	-28.54	-36.18	0.0013996	0.0002410	-27.85	-13	-14.85	Pass
40 - 50 GHz	-45.2	-40.3	0.0000302	0.0000933	-39.08	-13	-26.08	Pass
50 - 75 GHz	-22.85	-20.55	0.0051880	0.0088105	-18.54	-13	-5.54	Pass
75 - 110 GHz	-49.65	-29.25	0.0000108	0.0011885	-29.21	-13	-16.21	Pass

Donor RX Input to Server TX Output								
Test Frequency = 27.925 GHz	Conducted Spurious Emission				Composite Spurious Emission	Limit	Margin	Result
Spectrum Analyzer Span	Server Horz TX Output	Server Vert TX Output	Server Horz TX Output	Server Vert TX Output				
	(dBm)	(dBm)	(mw)	(mw)	(dBm)	(dBm)	(dB)	Pass / Fail
30 - 1000 MHz	-71.83	-63.89	0.0000001	0.0000004	-63.24	-13	-50.24	Pass
1 - 27.45 GHz	-26.54	-25.14	0.0022182	0.0030620	-22.77	-13	-9.77	Pass
28.40 - 40 GHz	-28.24	-36.18	0.0014997	0.0002410	-27.59	-13	-14.59	Pass
40 - 50 GHz	-47.9	-47.8	0.0000162	0.0000166	-44.84	-13	-31.84	Pass
50 - 75 GHz	-31.35	-31.75	0.0007328	0.0006683	-28.54	-13	-15.54	Pass
75 - 110 GHz	-50.75	-50.85	0.0000084	0.0000082	-47.79	-13	-34.79	Pass

Donor RX Input to Server TX Output								
Test Frequency = 28.300 GHz	Conducted Spurious Emission				Composite Spurious Emission	Limit	Margin	Result
Spectrum Analyzer Span	Server Horz TX Output	Server Vert TX Output	Server Horz TX Output	Server Vert TX Output				
	(dBm)	(dBm)	(mw)	(mw)				
30 - 1000 MHz	-59.99	-64.56	0.0000010	0.0000003	-58.69	-13	-45.69	Pass
1 - 27.45 GHz	-25.84	-25.43	0.0026062	0.0028642	-22.62	-13	-9.62	Pass
28.40 - 40 GHz	-22.21	-20.99	0.0060117	0.0079616	-18.55	-13	-5.55	Pass
40 - 50 GHz	-48.5	-48.2	0.0000141	0.0000151	-45.34	-13	-32.34	Pass
50 - 75 GHz	-99.15	-20.25	0.0000000	0.0094406	-20.25	-13	-7.25	Pass
75 - 110 GHz	-50.35	-49.15	0.0000092	0.0000122	-46.70	-13	-33.70	Pass

Server RX Input to Donor TX Output								
Test Frequency = 27.550 GHz	Conducted Spurious Emission				Composite Spurious Emission	Limit	Margin	Result
Spectrum Analyzer Span	Server Horz TX Output	Server Vert TX Output	Server Horz TX Output	Server Vert TX Output				
	(dBm)	(dBm)	(mw)	(mw)				
30 - 1000 MHz	-57.82	-63.12	0.0000017	0.0000005	-56.70	-13	-43.70	Pass
1 - 27.45 GHz	-14.82	-18.92	0.0329610	0.0128233	-13.39	-13	-0.39	Pass
28.40 - 40 GHz	-28.83	-28.41	0.0013092	0.0014421	-25.60	-13	-12.60	Pass
40 - 50 GHz	-40.2	-47.7	0.0000955	0.0000170	-39.49	-13	-26.49	Pass
50 - 75 GHz	-21.05	-21.95	0.0078524	0.0063826	-18.47	-13	-5.47	Pass
75 - 110 GHz	-34.85	-39.45	0.0003273	0.0001135	-33.56	-13	-20.56	Pass

Server RX Input to Donor TX Output								
Test Frequency = 27.925 GHz	Conducted Spurious Emission				Composite Spurious Emission	Limit	Margin	Result
Spectrum Analyzer Span	Server Horz TX Output	Server Vert TX Output	Server Horz TX Output	Server Vert TX Output				
	(dBm)	(dBm)	(mw)	(mw)	(dBm)	(dBm)	(dB)	Pass / Fail
30 - 1000 MHz	-65.72	-62.62	0.0000003	0.0000005	-60.89	-13	-47.89	Pass
1 - 27.45 GHz	-24.22	-21.14	0.0037844	0.0076913	-19.40	-13	-6.40	Pass
28.40 - 40 GHz	-29.94	-28.91	0.0010139	0.0012853	-26.38	-13	-13.38	Pass
40 - 50 GHz	-48.4	-48.2	0.0000145	0.0000151	-45.29	-13	-32.29	Pass
50 - 75 GHz	-30.05	-30.55	0.0009886	0.0008810	-27.28	-13	-14.28	Pass
75 - 110 GHz	-47.65	-39.55	0.0000172	0.0001109	-38.92	-13	-25.92	Pass

Server RX Input to Donor TX Output								
Test Frequency = 28.300 GHz	Conducted Spurious Emission				Composite Spurious Emission	Limit	Margin	Result
Spectrum Analyzer Span	Server Horz TX Output	Server Vert TX Output	Server Horz TX Output	Server Vert TX Output				
	(dBm)	(dBm)	(mw)	(mw)	(dBm)	(dBm)	(dB)	Pass / Fail
30 - 1000 MHz	-60.88	-62.11	0.0000008	0.0000006	-58.44	-13	-45.44	Pass
1 - 27.45 GHz	-24.92	-18.88	0.0032211	0.0129420	-17.91	-13	-4.91	Pass
28.40 - 40 GHz	-19.34	-22.58	0.0116413	0.0055208	-17.65	-13	-4.65	Pass
40 - 50 GHz	-47.5	-45.8	0.0000178	0.0000263	-43.56	-13	-30.56	Pass
50 - 75 GHz	-28.55	-32.85	0.0013964	0.0005188	-27.18	-13	-14.18	Pass
75 - 110 GHz	-47.25	-40.65	0.0000188	0.0000861	-39.79	-13	-26.79	Pass

Annex E – Conducted Spurious Emission

Refer to Annex E for Conducted Spurious Emission plots.

Radiated Spurious Emissions

Engineer: Greg Corbin

Test Date: 2/7/2021

Test Procedure

Radiated spurious emissions were measured from 30 MHz to 110 GHz.

This test was performed using 5GNR test signals with 100 MHz bandwidth.

For 30 - 1000 MHz, all correction factors were input to the spectrum analyzer before recording final measurement.

For 1 – 110 GHz, raw data was recorded, no correction factors were input to the spectrum analyzer.

The peak emission was recorded and the final value was calculated in the table below.

The tests were performed with the test signal set to the low, mid, and high channels of the band, with the output power level set to just below the AGC point.

All measurements are field strength at 1 meter, except for 30 - 1000 MHz and 1 - 18 GHz, which were measured at 3 meters.

For 30 - 1000 MHz and 1 - 18 GHz, a distance correction factor was used to convert the measurement to 1 meter.

Distance Correction Factor: $DCF (dB) = 20 * LOG(D1/D2)$

Field Strength (calculated) = Measured Data + Distance Corr Factor + Cable Insertion Loss + Rcv Mixer Corr Factor + Rcv Ant Corr Factor - Ext Amp Gain

Convert field strength (dBuV/m) to EIRP (dBm).

$EIRP(dBm) = \text{Field strength (dBuV/m)} - 104.77$

Compare result to -13 dBm EIRP limit.

For the Horn antennas used with the external mixers above 40 GHz , the data supplied from manufacturer is transmit gain data. The TX gain data needs to be converted to Antenna factor data with the following formula:

Antenna Gain to Antenna Factor, _____ $ACF(dB) = 20 * LOG(\text{freq, MHz}) - \text{Antenna gain (dBi)} - 29.79$

All measurements were made with a peak detector set to max hold.

For any signals close to the limit, the measurement was repeated with an average detector.

From 30 - 1000 MHz, RBW = 100 kHz, VBW = 300 kHz

From 1 - 110 GHz, RBW = 1 MHz, VBW = 3 MHz

For 1 - 40 GHz, Amplifier Asset # i00555 was used.

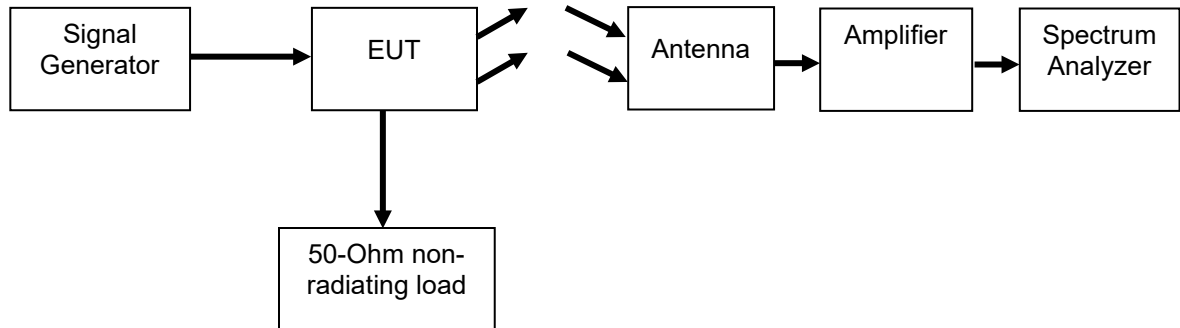
For 50 – 75 GHz, Amplifier Asset # i00588 was used.

For 75 - 110 GHz, Amplifier Asset # i00589 was used.

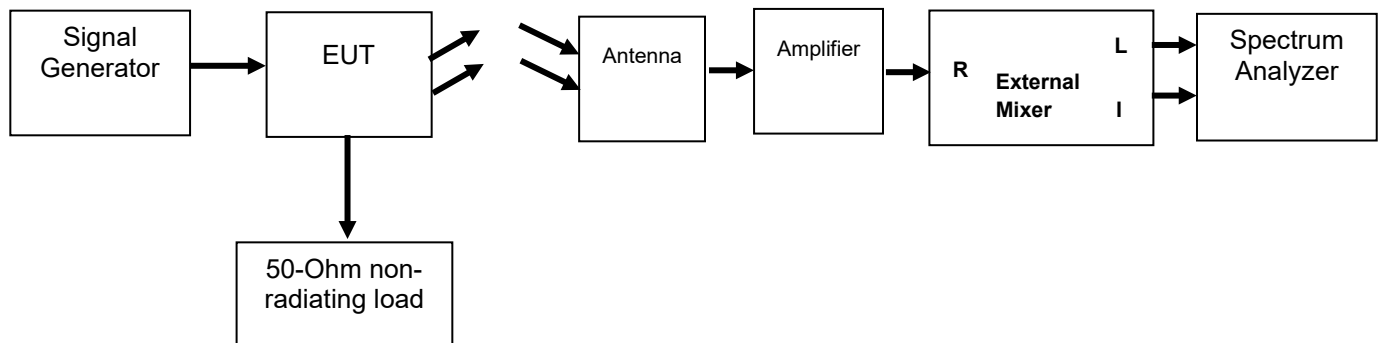
Part 30 section 203_Emission Limits_

(a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be -13 dBm/MHz or lower.

Test Setup_30 MHz to 40 GHz



Test Setup_40 to 110 GHz



Radiated Spurious Test Data

**Server Vert RX In - Donor Vert TX Out
Test Frequency = 27.550 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
GHz	GHz	dBuV	meter	meter	dB	dB
0.030 - 1	0.9903	64.53	1	3	9.54	0.0
1 - 18	1.2	69.47	1	3	9.54	4.1
18 - 38.6	24.4	54.34	1	1	0.00	18.7
40 - 50	40.586	17.34	1	1	0.00	2.0
50 - 75	60.274	36.69	1	1	0.00	2.0
75 - 110	78.52	20.59	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	74.07	-30.70	-13	-17.70
1 - 18	43.75	0.00	24.91	64.27	-40.50	-13	-27.50
18 - 38.6	33.13	0.00	45.91	85.82	-18.95	-13	-5.95
40 - 50	0	23.70	39.30	82.34	-22.43	-13	-9.43
50 - 75	38.42	34.30	33.60	68.17	-36.60	-13	-23.60
75 - 110	47.04	40.40	37.10	53.05	-51.72	-13	-38.72

**Server Horz RX In - Donor Horz TX Out
Test Frequency = 27.550 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
GHz	GHz	dBuV	meter	meter	dB	dB
0.030 - 1	0.9782	64.35	1	3	9.54	0.0
1 - 18	1.4999	68.97	1	3	9.54	4.5
18 - 38.6	24.4	54.45	1	1	0.00	18.7
40 - 50	45.024	15.52	1	1	0.00	2.0
50 - 75	60.274	36.57	1	1	0.00	2.0
75 - 110	87.002	21.31	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	73.89	-30.88	-13	-17.88
1 - 18	43.83	0.00	25.14	64.31	-40.46	-13	-27.46
18 - 38.6	33.13	0.00	45.91	85.93	-18.84	-13	-5.84
40 - 50	0	22.90	40.20	80.62	-24.15	-13	-11.15
50 - 75	38.42	34.30	33.60	68.05	-36.72	-13	-23.72
75 - 110	44.72	40.60	38.39	57.58	-47.19	-13	-34.19

**Server Vert RX In - Donor Vert TX Out
Test Frequency = 27.925 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
GHz	GHz	dBuV	meter	meter	dB	dB
0.030 - 1	0.9806	64.28	1	3	9.54	0.0
1 - 18	1.4999	69.43	1	3	9.54	4.5
18 - 38.6	24.4	52.54	1	1	0.00	18.7
40 - 50	48.653	15.61	1	1	0.00	2.0
50 - 75	60.274	43.38	1	1	0.00	2.0
75 - 110	91.731	20.41	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	73.82	-30.95	-13	-17.95
1 - 18	43.83	0.00	25.14	64.78	-39.99	-13	-26.99
18 - 38.6	33.13	0.00	45.91	84.02	-20.75	-13	-7.75
40 - 50	0	22.70	40.55	80.86	-23.91	-13	-10.91
50 - 75	38.42	34.30	33.60	74.86	-29.91	-13	-16.91
75 - 110	45.06	41.10	39.05	57.50	-47.27	-13	-34.27

**Server Horz RX In - Donor Horz TX Out
Test Frequency = 27.925 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
GHz	GHz	dBuV	meter	meter	dB	dB
0.030 - 1	0.9976	64.32	1	3	9.54	0.0
1 - 18	1.4999	70.58	1	3	9.54	4.5
18 - 38.6	24.4	54.26	1	1	0.00	18.7
40 - 50	47.004	16.58	1	1	0.00	2.0
50 - 75	60.274	37.74	1	1	0.00	2.0
75 - 110	91.037	20.35	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	73.86	-30.91	-13	-17.91
1 - 18	43.83	0.00	25.14	65.93	-38.84	-13	-25.84
18 - 38.6	33.13	0.00	45.91	85.74	-19.03	-13	-6.03
40 - 50	0	22.40	40.30	81.28	-23.49	-13	-10.49
50 - 75	38.42	34.30	33.60	69.22	-35.55	-13	-22.55
75 - 110	44.8	40.80	38.97	57.32	-47.45	-13	-34.45

**Server Vert RX In - Donor Vert TX Out
Test Frequency = 28.300 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
GHz	GHz	dBuV	meter	meter	dB	dB
0.030 - 1	0.9855	64.62	1	3	9.54	0.0
1 - 18	1.4999	70.00	1	3	9.54	4.5
18 - 38.6	24.4	53.71	1	1	0.00	18.7
40 - 50	41.512	15.56	1	1	0.00	2.0
50 - 75	60.274	43.34	1	1	0.00	2.0
75 - 110	91.708	20.04	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	74.16	-30.61	-13	-17.61
1 - 18	43.83	0.00	25.14	65.35	-39.42	-13	-26.42
18 - 38.6	33.13	0.00	45.91	85.19	-19.58	-13	-6.58
40 - 50	0	23.20	39.45	80.21	-24.56	-13	-11.56
50 - 75	38.42	34.30	33.60	74.82	-29.95	-13	-16.95
75 - 110	45.06	41.10	39.05	57.13	-47.64	-13	-34.64

**Server Horz RX In - Donor Horz TX Out
Test Frequency = 28.300 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
GHz	GHz	dBuV	meter	meter	dB	dB
0.030 - 1	0.7958	64.80	1	3	9.54	0.0
1 - 18	1.4999	70.89	1	3	9.54	4.5
18 - 38.6	24.4	53.30	1	1	0.00	18.7
40 - 50	44.362	15.64	1	1	0.00	2.0
50 - 75	60.274	37.95	1	1	0.00	2.0
75 - 110	92.291	21.48	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	74.34	-30.43	-13	-17.43
1 - 18	43.83	0.00	25.14	66.24	-38.53	-13	-25.53
18 - 38.6	33.13	0.00	45.91	84.78	-19.99	-13	-6.99
40 - 50	0	23.40	39.90	80.94	-23.83	-13	-10.83
50 - 75	38.42	34.30	33.60	69.43	-35.34	-13	-22.34
75 - 110	44.36	41.30	39.20	59.62	-45.15	-13	-32.15

**Donor Vert RX In - Server Vert TX Out
Test Frequency = 27.550 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
	GHz	dBuV				
0.030 - 1	0.9442	65.18	1	3	9.54	0.0
1 - 18	1.4999	70.89	1	3	9.54	4.5
18 - 38.6	24.4	53.88	1	1	0.00	18.7
40 - 50	41.038	15.73	1	1	0.00	2.0
50 - 75	55.095	31.20	1	1	0.00	2.0
75 - 110	91.549	20.61	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	74.72	-30.05	-13	-17.05
1 - 18	43.83	0.00	25.14	66.24	-38.53	-13	-25.53
18 - 38.6	33.13	0.00	45.91	85.36	-19.41	-13	-6.41
40 - 50	0	23.40	39.38	80.51	-24.26	-13	-11.26
50 - 75	40.58	33.80	32.41	58.83	-45.94	-13	-32.94
75 - 110	45.32	41.10	39.05	57.44	-47.33	-13	-34.33

**Donor Horz RX In - Server Horz TX Out
Test Frequency = 27.550 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
GHz	GHz	dBuV	meter	meter	dB	dB
0.030 - 1	0.9952	64.47	1	3	9.54	0.0
1 – 18	1.4999	72.37	1	3	9.54	4.5
18 – 38.6	24.4001	54.89	1	1	0.00	18.7
40 – 50	41.296	15.18	1	1	0.00	2.0
50 - 75	60.274	43.22	1	1	0.00	2.0
75 - 110	86.349	21.18	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	74.01	-30.76	-13	-17.76
1 – 18	43.83	0.00	25.14	67.72	-37.05	-13	-24.05
18 – 38.6	33.13	0.00	45.91	86.37	-18.40	-13	-5.40
40 – 50	0	23.30	39.45	79.93	-24.84	-13	-11.84
50 - 75	38.42	34.30	33.60	74.70	-30.07	-13	-17.07
75 - 110	44.84	40.50	38.30	57.14	-47.63	-13	-34.63

**Donor Vert RX In - Server Vert TX Out
Test Frequency = 27.925 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
GHz	GHz	dBuV	meter	meter	dB	dB
0.030 - 1	0.9345	64.97	1	3	9.54	0.0
1 - 18	1.4999	71.44	1	3	9.54	4.5
18 - 38.6	24.4	54.26	1	1	0.00	18.7
40 - 50	44.166	15.90	1	1	0.00	2.0
50 - 75	60.163	31.00	1	1	0.00	2.0
75 - 110	91.005	20.62	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	74.51	-30.26	-13	-17.26
1 - 18	43.83	0.00	25.14	66.79	-37.98	-13	-24.98
18 - 38.6	33.13	0.00	45.91	85.74	-19.03	-13	-6.03
40 - 50	0	23.40	39.40	80.70	-24.07	-13	-11.07
50 - 75	38.61	34.20	33.60	62.19	-42.58	-13	-29.58
75 - 110	44.8	40.90	38.97	57.69	-47.08	-13	-34.08

**Donor Horz RX In - Server Horz TX Out
Test Frequency = 27.925 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
GHz	GHz	dBuV	meter	meter	dB	dB
0.030 - 1	0.9806	64.44	1	3	9.54	0.0
1 - 18	1.4999	71.14	1	3	9.54	4.5
18 - 38.6	24.4	53.37	1	1	0.00	18.7
40 - 50	40.465	15.16	1	1	0.00	2.0
50 - 75	60.274	37.02	1	1	0.00	2.0
75 - 110	92.251	21.07	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	73.98	-30.79	-13	-17.79
1 - 18	43.83	0.00	25.14	66.49	-38.28	-13	-25.28
18 - 38.6	33.13	0.00	45.91	84.85	-19.92	-13	-6.92
40 - 50	0	23.70	39.30	80.16	-24.61	-13	-11.61
50 - 75	38.42	34.30	33.60	68.50	-36.27	-13	-23.27
75 - 110	44.36	41.25	39.15	59.11	-45.66	-13	-32.66

**Donor Vert RX In - Server Vert TX Out
Test Frequency = 28.300 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
GHz	GHz	dBuV	meter	meter	dB	dB
0.030 - 1	0.9782	64.60	1	3	9.54	0.0
1 - 18	1.4999	70.96	1	3	9.54	4.5
18 - 38.6	24.4	53.94	1	1	0.00	18.7
40 - 50	41.708	15.34	1	1	0.00	2.0
50 - 75	60.274	44.48	1	1	0.00	2.0
75 - 110	77.44	20.32	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	74.14	-30.63	-13	-17.63
1 - 18	43.83	0.00	25.14	66.31	-38.46	-13	-25.46
18 - 38.6	33.13	0.00	45.91	85.42	-19.35	-13	-6.35
40 - 50	0	23.10	39.50	79.94	-24.83	-13	-11.83
50 - 75	38.42	34.30	33.60	75.96	-28.81	-13	-15.81
75 - 110	46.46	40.60	36.85	53.31	-51.46	-13	-38.46

**Donor Horz RX In - Server Horz TX Out
Test Frequency = 28.300 GHz**

Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	3 meter Chamber Cable Insertion Loss
	Frequency	Amplitude				
GHz	GHz	dBuV	meter	meter	dB	dB
0.030 - 1	0.9927	64.27	1	3	9.54	0.0
1 – 18	1.4999	71.21	1	3	9.54	4.5
18 – 38.6	24.4	53.96	1	1	0.00	18.7
40 – 50	46.382	16.18	1	1	0.00	2.0
50 - 75	60.274	43.76	1	1	0.00	2.0
75 - 110	91.037	20.57	1	1	0.00	2.0

Spectrum Analyzer span	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
GHz	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.030 - 1	0	0.00	0.00	73.81	-30.96	-13	-17.96
1 – 18	43.83	0.00	25.14	66.56	-38.21	-13	-25.21
18 – 38.6	33.13	0.00	45.91	85.44	-19.33	-13	-6.33
40 – 50	0	22.40	40.20	80.78	-23.99	-13	-10.99
50 - 75	38.42	34.30	33.60	75.24	-29.53	-13	-16.53
75 - 110	44.8	40.90	38.97	57.64	-47.13	-13	-34.13

Annex F – Radiated Spurious Emission

Refer to Annex F for Radiated Spurious Emission plots.

Measurement Uncertainty

Measurement Uncertainty for Compliance Testing is listed in the table below.

The reported expanded uncertainty has been estimated at a 95% confidence level (k=2)

Measurement Type	Expanded Uncertainty
Conducted Emissions, AC Powerline	± 3.28 dB
Radiated Emissions_30 MHz – 18 GHz	± 4.8 dB
Radiated Emissions_18 – 40 GHz	± 5.9 dB
Frequency Error	± 22 Hz
Conducted RF Power	± 0.98 dB
Conducted Spurious Emission	± 2.49 dB
AC Voltage	± 2.3 %
DC Voltage	± 0.12 %
Temperature	± 1.0 deg C
Humidity	± 4.32 %

Calibration Data

Annex G – Test Equipment Calibration Certificates

Refer to Annex G for test equipment calibration certificates

Scope of Accreditation for Part 30

Annex H – Scope of Accreditation

Refer to Annex H for Part 30 Scope of Accreditation

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
EMI Receiver	Keysight	N9038A	i00552	1/12/2021	2/12/2022
Vector Signal Generator (rental equipment)	Rohde and Schwarz	SMW200A	S/N: 105019	1/11/2019	1/11/22
Harmonic Mixer, 33 – 50 GHz	Hewlett Packard	11970Q	i00465	6/29/18	6/29/21
Harmonic Mixer, 50 – 75 GHz	Agilent	11970V	i00463	6/29/18	6/29/21
Harmonic Mixer, 75 - 110 GHz	Hewlett Packard	11970W	i00464	6/29/18	6/29/21
Horn Antenna, 1 – 18 GHz	ARA	DRG-118/A	i00271	8/3/20	8/3/22
Horn Antenna, 18 – 40 GHz	EMCO	3116	i00085	2/28/19	2/28/21
Horn Antenna, 33 – 50 GHz	Custom Microwave	HO22R	i00484	Verify when used	
Horn Antenna, 50 – 75 GHz	Custom Microwave	HO15R	i00477	Verify when used	
Horn Antenna, 75 – 110 GHz	Custom Microwave	HO10R	i00476	Verify when used	
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	1/17/19	1/17/21
Attenuator, 20 dB	Weinschel Corp	54-20	i00538.8	Verify when used	
Pre-Amplifier, 50 – 75 GHz	Eravant	SBL-5037533550-1515-E1	i00588	Verify when used	
Pre-Amplifier, 75 – 110 GHz	Eravant	SBL-7531143550-1010-E1	i00589	Verify when used	
Pre-amplifier, 10 MHz – 50 GHz	Eravant	SBB-0115034018-2F2F-E3	i00591	Verify when used	
Millimeter Wave Source Module, 50 – 75 GHz (rental equipment)	OML	S15MS-AG KT-E8257DS15	Electrorent Asset 1608082A	NCR	NCR
Millimeter Wave Source Module, 75 - 110 GHz (rental equipment)	OML	S10MS-AG KT-E8257DS10	Electrorent Asset 1320457C	NCR	NCR

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT