



Test Report

Prepared for: FRTek

Model: FRM-DU39D / FRM-MRU39D

Description: 5G 39 GHz Optical DAS

FCC ID: 2AFEG-FRM-39

To

FCC Part 30

Date of Issue: September 23, 2020

On the behalf of the applicant:

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Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	July 9, 2020	Greg Corbin	Original Document



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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

FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

None

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)
25.9 – 30.8	18.6 – 32.1	962.2 – 965.6

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

EUT Description

Model: FRM-DU39D / FRM-MRU39D

Description: 5G 39 GHz Optical DAS

Additional Information:

The EUT is a 5G 39 GHz Optical DAS (Distributed Amplifier System).

The frequency range for both the uplink and downlink is 38.6 – 40.0 GHz.

The EUT has separate SISO and MIMO input / outputs.

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).

Channel Capacity is:

100MHz X 8FA (Continuous & Non-Continuous) or 200MHz X 4FA (Continuous & Non-Continuous) or 400MHz X 2FA (Continuous & Non-Continuous)

EUT Operation during Tests

EUT was set up for normal operating conditions.

The EUT was controlled by a GUI, Control: *i-storm*, version:40.01

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

The DU and mHU antennas were removed to provide access to the antenna ports.

Test signals were injected into the antenna ports.

The 5G 39 GHz Optical DAS contains the following individual units.

Product Name	Model Name
39 GHz 5G mRU	FRM-mRU39D
39 GHz 5G DU	FRM-DU39D
39 GHz 5G DRU	FRM-DRU39
39 GHz 5G MDU	FRM-MDU39
39 GHz 5G MHU	FRM-MHU39
39 GHz 5G MPSU	FRM-MSPU

The EUT Antenna ports are listed below.

DU	mRU
SISO Downlink Input	SISO Downlink Output
SISO Uplink Output	SISO Uplink Input
MIMO Downlink Input	MIMO Downlink Output
MIMO Uplink Output	MIMO Uplink Input

Antenna Gain

Antenna	Frequency (GHz)	Bandwidth (GHz)	Gain (dBi)
DU	38.6 – 40	1.4	10 ±1 dB
mRU	38.6 – 40	1.4	8 ±1 dB

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 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: 8/26/2020

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

Downlink

Tuned Frequency (MHz)	Channel Configuration	AGC Threshold (dBm)	
		100 MHz BW	400 MHz BW
39653	SISO	-55	-55
38700	MIMO	-55	-55

Uplink

Tuned Frequency (MHz)	Channel Configuration	AGC Threshold (dBm)	
		100 MHz BW	400 MHz BW
38938	SISO	-55	-50
38700	MIMO	-55	-55

Out-Of-Band Rejection

Engineer: Greg Corbin

Test Date: 8/25/2020

Test Procedure

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

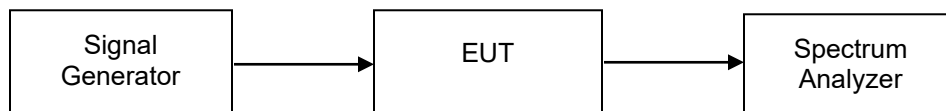
A signal generator was utilized to produce a swept CW signal with the RF input level set to 3 dB below the AGC Threshold level.

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

RBW = 1 MHz

Video BW = 3 MHz

Test Setup



-20 dB Bandwidth Test Results

Channel Configuration	-20 dB Bandwidth (MHz)
SISO Downlink	1585
SISO Uplink	1647.5
MIMO Downlink	1612.5
MIMO Uplink	1605.5

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: 8/30/2020

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 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: 8/26/2020

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.

Antenna gains are 10 dBi \pm 1 dB for the uplink and 8 dBi \pm 1 dB for the downlink. Worst case was used for EIRP calculations.

Test Setup



Output Power and Gain Test Results

Channel Configuration	Bandwidth (MHz)	Tuned Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Gain (dB)	(Input Power +3 dB) Output Power (dBm)
SISO Downlink	100	39653	-55	20.1	9	29.1	75.1	20.1
SISO Uplink	100	38938	-55	20.0	11	31.0	75.0	20.2
MIMO Downlink	100	38700	-55	20.2	9	29.2	75.2	20.2
MIMO Uplink	100	38700	-55	20.2	11	31.2	75.2	20.3
SISO Downlink	400	39653	-55	20.2	9	29.2	75.2	20.4
SISO Uplink	400	38938	-55	20.2	11	31.2	75.2	20.2
MIMO Downlink	400	38800	-55	20.1	9	29.1	75.1	20.3
MIMO Uplink	400	38800	-55	20.2	11	31.2	75.2	20.1

EIRP = Output Power + Antenna Gain

Gain = Output Power – Input Power

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

Engineer: Greg Corbin

Test Date: 8/27/2020

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 38590 - 38600 MHz

The Upper Band Edge = 40000 - 40010 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: 8/27/2020

Test Procedure

This test was performed using a test signal 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 38590 - 38600 MHz

The Upper Band Edge = 40000 - 40010 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 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: 8/30/2020

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 44 GHz the EUT output was connected directly to the spectrum analyzer and raw data was recorded.

From 30 MHz to 44 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 - 44 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 44 - 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 the 44 - 50 GHz plots the test signal is in the Mixer passband and overdriving the mixer RF input. A 20 dB attenuator was used to lower the fundamental signal so the mixer input was not being over-loaded. This 20 dB attn was accounted for in the spreadsheet
4. 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 - m) adapter to 2.92 (f) to 1.85 (f) adapter to 1.85 (m - m, 12 inch cable assy C546-086-12) to 1.85 (f) to WR15 waveguide to WR15 Mixer(11970V) waveguide input
5. 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.

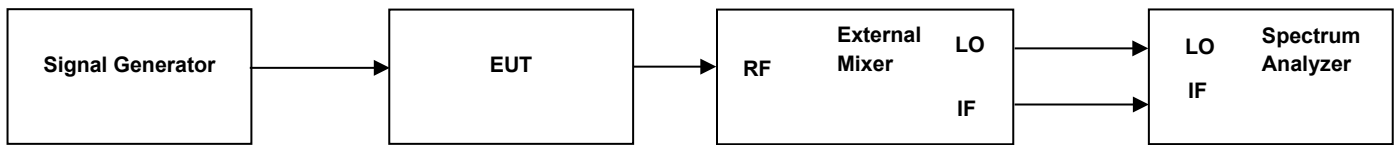
Part 30 section 203_Emission Limits_

(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.

Test Setup_30 MHz to 40 GHz



Test Setup_40 GHz to 110 GHz



Calculations:

30 MHz – 44 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

SISO Downlink 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
38.650	0.03 - 1	0.441	-75.30	120	0	-0.7	0.00	-74.60	-13	-61.60
38.650	1 - 36	33.981	-50.70	1000	0	-4.51	0.00	-46.19	-13	-33.19
38.650	36 - 38.6	36.3	-31.40	1000	0	-4.63	0.00	-26.77	-13	-13.77
38.650	40 - 44	40.011	-48.10	1000	0	-4.93	0.00	-43.17	-13	-30.17
38.650	44 - 50	48.314	-64.80	1000	-1	-17.98	-22.70	-23.02	-13	-10.02
38.650	50 - 75	72.226	-103.50	1000	-1	-1.7	-35.60	-65.10	-13	-52.10
38.650	75 - 110	78.045	-103.50	1000	-1	-2.05	-40.60	-59.75	-13	-46.75
39.300	0.03 - 1	0.228	-72.70	120	0	-0.7	0.00	-72.00	-13	-59.00
39.300	1 - 36	35.807	-57.00	1000	0	-4.61	0.00	-52.39	-13	-39.39
39.300	36 - 38.6	36.3	-31.69	1000	0	-4.63	0.00	-27.06	-13	-14.06
39.300	40 - 44	40.029	-50.70	1000	0	-4.93	0.00	-45.77	-13	-32.77
39.300	44 - 50	49.141	-65.10	1000	-1	-18.6	-22.20	-23.30	-13	-10.30
39.300	50 - 75	51.443	-103.30	1000	-1	-1.7	-34.70	-65.90	-13	-52.90
39.300	75 - 110	77.3	-102.80	1000	-1	-2.05	-40.60	-59.15	-13	-46.15
39.950	0.03 - 1	0.799	-75.40	120	0	-0.7	0.00	-74.70	-13	-61.70
39.950	1 - 36	35.631	-58.10	1000	0	-4.61	0.00	-53.49	-13	-40.49
39.950	36 - 38.6	38.579	-31.50	1000	0	-4.84	0.00	-26.66	-13	-13.66
39.950	40 - 44	40.01	-38.70	1000	0	-4.93	0.00	-33.77	-13	-20.77
39.950	44 - 50	48.437	-60.30	1000	-1	-18.1	-22.60	-18.60	-13	-5.60
39.950	50 - 75	66.116	-102.90	1000	-1	-1.7	-34.20	-66.00	-13	-53.00
39.950	75 - 110	79.261	-103.30	1000	-1	-2.05	-40.40	-59.85	-13	-46.85

SISO Uplink 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
38.650	0.03 - 1	0.339	-69.70	120	0	-0.7	0.00	-69.00	-13	-56.00
38.650	1 - 36	33.916	-53.60	1000	0	-4.52	0.00	-49.08	-13	-36.08
38.650	36 - 38.6	38.58	-31.90	1000	0	-4.84	0.00	-27.06	-13	-14.06
38.650	40 - 44	40.017	-47.30	1000	0	-4.93	0.00	-42.37	-13	-29.37
38.650	44 - 50	48.296	-64.50	1000	-1	-17.98	-22.60	-22.92	-13	-9.92
38.650	50 - 75	64.631	-102.40	1000	-1	-1.7	-34.10	-65.60	-13	-52.60
38.650	75 - 110	92.726	-103.30	1000	-1	-2.05	-41.30	-58.95	-13	-45.95
39.300	0.03 - 1	0.33	-68.40	120	0	-0.7	0.00	-67.70	-13	-54.70
39.300	1 - 36	3	-56.30	1000	0	-1.24	0.00	-55.06	-13	-42.06
39.300	36 - 38.6	38.585	-31.40	1000	0	-4.84	0.00	-26.56	-13	-13.56
39.300	40 - 44	40.038	-44.10	1000	0	-4.93	0.00	-39.17	-13	-26.17
39.300	44 - 50	47.948	-73.20	1000	-1	-17.78	-22.70	-31.72	-13	-18.72
39.300	50 - 75	65.405	-102.60	1000	-1	-1.7	-34.10	-65.80	-13	-52.80
39.300	75 - 110	88.686	-102.80	1000	-1	-2.05	-40.70	-59.05	-13	-46.05
39.950	0.03 - 1	0.337	-76.70	120	0	-0.7	0.00	-76.00	-13	-63.00
39.950	1 - 36	35.076	-58.50	1000	0	-4.57	0.00	-53.93	-13	-40.93
39.950	36 - 38.6	36300	-31.20	1000	0	-4.63	0.00	-26.57	-13	-13.57
39.950	40 - 44	40.021	-42.50	1000	0	-4.93	0.00	-37.57	-13	-24.57
39.950	44 - 50	48.384	-65.80	1000	-1	-17.98	-22.70	-24.12	-13	-11.12
39.950	50 - 75	65.405	-103.40	1000	-1	-1.7	-34.10	-66.60	-13	-53.60
39.950	75 - 110	85.099	-103.30	1000	-1	-2.05	-40.30	-59.95	-13	-46.95

MIMO Downlink 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
38.650	0.03 - 1	0.356	-66.40	120	0	-0.7	0.00	-65.70	-13	-52.70
38.650	1 - 36	33.912	-49.20	1000	0	-4.52	0.00	-44.68	-13	-31.68
38.650	36 - 38.6	38.588	-31.30	1000	0	-4.85	0.00	-26.45	-13	-13.45
38.650	40 - 44	40.015	-36.70	1000	0	-4.93	0.00	-31.77	-13	-18.77
38.650	44 - 50	48.304	-61.90	1000	-1	-17.98	-22.70	-20.22	-13	-7.22
38.650	50 - 75	65.405	-102.30	1000	-1	-1.7	-39.90	-59.70	-13	-46.70
38.650	75 - 110	79.93	-103.00	1000	-1	-2.05	-41.00	-58.95	-13	-45.95
39.300	0.03 - 1	0.318	-61.90	120	0	-0.7	0.00	-61.20	-13	-48.20
39.300	1 - 36	33.344	-56.30	1000	0	-4.48	0.00	-51.82	-13	-38.82
39.300	36 - 38.6	38.587	-32.40	1000	0	-4.85	0.00	-27.55	-13	-14.55
39.300	40 - 44	40.013	-35.50	1000	0	-4.93	0.00	-30.57	-13	-17.57
39.300	44 - 50	47.706	-70.40	1000	-1	-19.1	-22.50	-27.80	-13	-14.80
39.300	50 - 75	64.631	-102.70	1000	-1	-1.7	-33.50	-66.50	-13	-53.50
39.300	75 - 110	94.592	-102.60	1000	-1	-2.05	-40.60	-58.95	-13	-45.95
39.950	0.03 - 1	0.329	-62.20	120	0	-0.7	0.00	-61.50	-13	-48.50
39.950	1 - 36	35.02	-57.00	1000	0	-4.58	0.00	-52.42	-13	-39.42
39.950	36 - 38.6	35.588	-31.20	1000	0	-4.85	0.00	-26.35	-13	-13.35
39.950	40 - 44	40.011	-33.30	1000	0	-4.93	0.00	-28.37	-13	-15.37
39.950	44 - 50	44.374	-60.40	1000	-1	-20.3	-23.30	-15.80	-13	-2.80
39.950	50 - 75	64.631	-102.30	1000	-1	-1.7	-34.10	-65.50	-13	-52.50
39.950	75 - 110	102.673	-102.80	1000	-1	-2.05	-42.00	-57.75	-13	-44.75

MIMO Uplink 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
38.650	0.03 - 1	0.075	-77.00	120	0	-0.7	0.00	-76.30	-13	-63.30
38.650	1 - 36	33.924	-45.70	1000	0	-4.52	0.00	-41.18	-13	-28.18
38.650	36 - 38.6	38.589	-29.90	1000	0	-4.84	0.00	-25.06	-13	-12.06
38.650	40 - 44	40.013	-38.80	1000	0	-4.93	0.00	-33.87	-13	-20.87
38.650	44 - 50	48.906	-69.70	1000	-1	-18.3	-22.30	-28.10	-13	-15.10
38.650	50 - 75	71.433	-102.80	1000	-1	-1.7	-35.30	-64.80	-13	-51.80
38.650	75 - 110	78.998	-103.30	1000	-1	-2.05	-40.30	-59.95	-13	-46.95
39.300	0.03 - 1	0.31	-76.50	120	0	-0.7	0.00	-75.80	-13	-62.80
39.300	1 - 36	33.339	-53.20	1000	0	-4.46	0.00	-48.74	-13	-35.74
39.300	36 - 38.6	38.558	-28.60	1000	0	-5.65	0.00	-22.95	-13	-9.95
39.300	40 - 44	40.011	-34.60	1000	0	-4.93	0.00	-29.67	-13	-16.67
39.300	44 - 50	47.663	-69.90	1000	-1	-18.1	-22.40	-28.40	-13	-15.40
39.300	50 - 75	52.31	-102.60	1000	-1	-1.7	-34.60	-65.30	-13	-52.30
39.300	75 - 110	108.37	-103.00	1000	-1	-2.05	-43.10	-56.85	-13	-43.85
39.950	0.03 - 1	0.326	-78.10	120	0	-0.7	0.00	-77.40	-13	-64.40
39.950	1 - 36	32.678	-58.10	1000	0	-4.41	0.00	-53.69	-13	-40.69
39.950	36 - 38.6	38.556	-28.50	1000	0	-5.65	0.00	-22.85	-13	-9.85
39.950	40 - 44	40.015	-34.70	1000	0	-4.93	0.00	-29.77	-13	-16.77
39.950	44 - 50	48.327	-66.80	1000	-1	-17.98	-22.60	-25.22	-13	-12.22
39.950	50 - 75	59.378	92.30	1000	-1	-1.7	-34.00	129.00	-13	142.00
39.950	75 - 110	102	-102.50	1000	-1	-2.05	-41.80	-57.65	-13	-44.65

Annex E – Conducted Spurious Emission

Refer to Annex E for Conducted Spurious Emission plots.

Radiated Spurious Emissions

Engineer: Greg Corbin

Test Date: 7/7/2020

Test Procedure

Radiated spurious emissions were measured from 30 MHz to 200 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 – 200 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: $DCF (dB) = 20 \cdot \log(D1/D2)$

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, _____ $ACF(dB) = 20 \cdot \log(\text{freq, MHz}) - \text{Antenna gain (dBi)} - 29.79$

For measurements above 110 GHz, preliminary scans were performed from 0.1 – 1 meter, no spurious signals were observed. Then the RX antenna was moved to 0.1 meter and a distance correction factor was used to convert the measurement to 1 meter distance.

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 - 200 GHz, RBW = 1 MHz, VBW = 3 MHz

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

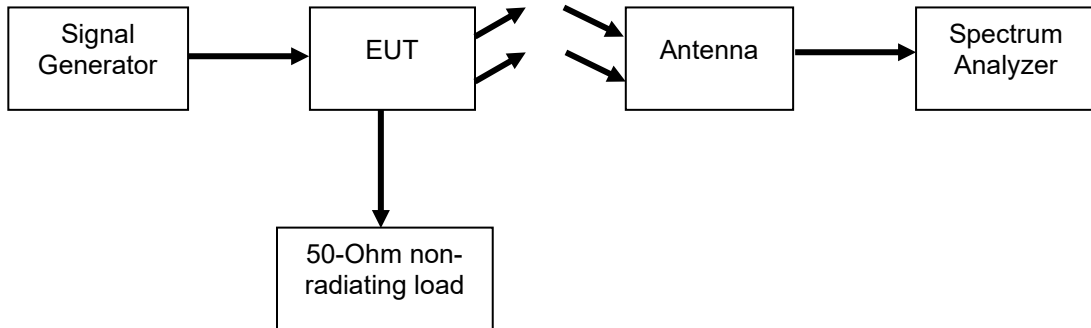
For 50 – 75 GHz, Amplifier Asset # i00588 was used.

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

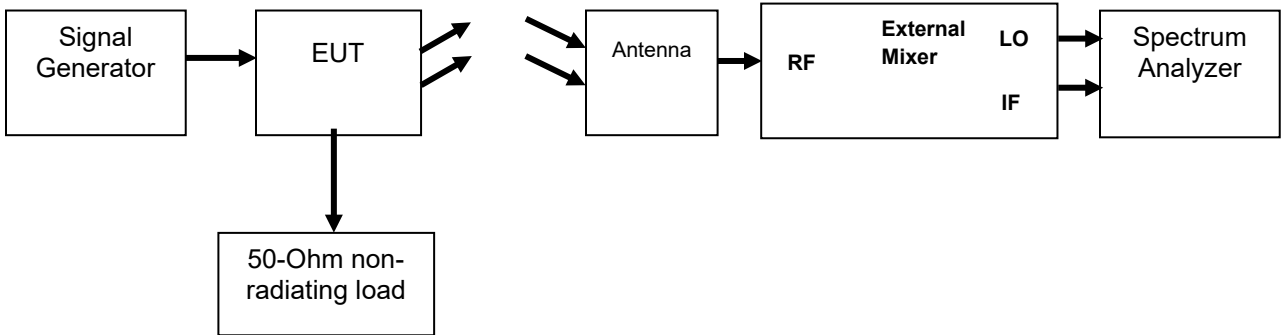
Part 30 section 203_Emission Limits_

(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 200 GHz



Radiated Spurious Test Data

MIMO Downlink

Test Frequency GHz	Spectrum Analyzer span GHz	Radiated Spurious (raw data)		Measurement distance per standard meter	Measurement distance meter	Distance Correction Factor dB	RBW MHz
		Frequency GHz	Amplitude dBuV				
38.650	0.030 - 1	175.03	62.10	1	3	9.54	120
38.650	1 - 18	2.333	64.05	1	3	9.54	1000
38.650	18 - 38.6	36.3	54.09	1	1	0.00	1000
38.650	40 - 50	40.724	15.76	1	1	0.00	1000
38.650	50 - 75	54.451	51.98	1	1	0.00	1000
38.650	75 - 110	101.268	26.63	1	1	0.00	1000
38.650	110 - 170	115.698	9.29	1	0.1	-20.00	1000
38.650	170 - 200	179.247	11.55	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss dB	Ext Amplifier Gain dB	Receive Mixer Correction Factor dB	Receive Antenna Correction Factor dB	Field Strength (calculated) dBuV/m	Convert Field Strength (dBuV/m) to EIRP (dBm) dBm	Limit dBm	Margin dB
0.00	0	0.00	0.00	71.64	-33.13	-13	-20.13
5.30	42.15	0.00	27.75	64.49	-40.28	-13	-27.28
21.22	32.66	0.00	46.63	89.28	-15.49	-13	-2.49
2.00	0	23.50	39.30	80.56	-24.21	-13	-11.21
2.00	41.92	34.10	32.30	78.46	-26.31	-13	-13.31
2.00	37.45	41.90	40.37	73.45	-31.32	-13	-18.32
0.50	0	51.05	48.98	89.82	-14.95	-13	-1.95
0.50	0	44.12	52.57	88.74	-16.03	-13	-3.03

MIMO Downlink

Test Frequency	Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	RBW
		Frequency	Amplitude				
GHz	GHz	GHz	dBuV	meter	meter	dB	MHz
39.300	0.030 - 1	175.03	61.80	1	3	9.54	120
39.300	1 – 18	2.975	67.82	1	3	9.54	1000
39.300	18 – 38.6	36.3	53.77	1	1	0.00	1000
39.300	40 – 50	43.113	11.38	1	1	0.00	1000
39.300	50 - 75	54.45	51.73	1	1	0.00	1000
39.300	75 - 110	101.409	26.59	1	1	0.00	1000
39.300	110 - 170	115.743	9.14	1	0.1	-20.00	1000
39.300	170 - 200	180.268	11.79	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
dB	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.00	0	0.00	0.00	71.34	-33.43	-13	-20.43
5.97	41.8	0.00	29.91	71.44	-33.33	-13	-20.33
21.22	32.66	0.00	46.63	88.96	-15.81	-13	-2.81
2.00	0	22.80	39.70	75.88	-28.89	-13	-15.89
2.00	41.92	34.10	32.30	78.21	-26.56	-13	-13.56
2.00	37.05	41.90	40.40	73.84	-30.93	-13	-17.93
0.50	0	51.07	48.98	89.69	-15.08	-13	-2.08
0.50	0	41.51	52.82	86.62	-18.15	-13	-5.15

MIMO Downlink

Test Frequency	Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	RBW
		Frequency	Amplitude				
GHz	GHz	GHz	dBuV	meter	meter	dB	MHz
39.950	0.030 - 1	173.03	62.20	1	3	9.54	120
39.950	1 - 18	2.5	60.77	1	3	9.54	1000
39.950	18 - 38.6	36.3	53.92	1	1	0.00	1000
39.950	40 - 50	46.715	15.60	1	1	0.00	1000
39.950	50 - 75	54.45	51.69	1	1	0.00	1000
39.950	75 - 110	102.135	26.94	1	1	0.00	1000
39.950	110 - 170	115.741	9.65	1	0.1	-20.00	1000
39.950	170 - 200	180.256	10.85	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
dB	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.00	0	0.00	0.00	71.74	-33.03	-13	-20.03
5.48	42.1	0.00	28.58	62.27	-42.50	-13	-29.50
21.22	32.66	0.00	46.63	89.11	-15.66	-13	-2.66
2.00	0	22.40	40.25	80.25	-24.52	-13	-11.52
2.00	41.92	34.10	32.30	78.17	-26.60	-13	-13.60
2.00	36	41.80	40.48	75.22	-29.55	-13	-16.55
0.50	0	51.07	48.48	89.70	-15.07	-13	-2.07
0.50	0	41.51	52.82	85.68	-19.09	-13	-6.09

**Radiated Spurious Test Data
MIMO Uplink**

Test Frequency GHz	Spectrum Analyzer span GHz	Radiated Spurious (raw data)		Measurement distance per standard meter	Measurement distance meter	Distance Correction Factor dB	RBW MHz
		Frequency GHz	Amplitude dBuV				
38.650	0.030 - 1	36.91	63.10	1	3	9.54	120
38.650	1 – 18	2.308	61.80	1	3	9.54	1000
38.650	18 – 38.6	36.3	55.72	1	1	0.00	1000
38.650	40 – 50	40.303	19.90	1	1	0.00	1000
38.650	50 - 75	54.45	40.77	1	1	0.00	1000
38.650	75 - 110	99.607	19.68	1	1	0.00	1000
38.650	110 - 170	115.687	9.03	1	0.1	-20.00	1000
38.650	170 - 200	180.234	11.83	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss dB	Ext Amplifier Gain dB	Receive Mixer Correction Factor dB	Receive Antenna Correction Factor dB	Field Strength (calculated) dBuV/m	Convert Field Strength (dBuV/m) to EIRP (dBm) dBm	Limit dBm	Margin dB
0.00	0	0.00	0.00	72.64	-32.13	-13	-19.13
5.25	42.15	0.00	27.71	62.15	-42.62	-13	-29.62
21.20	32.66	0.00	46.63	90.89	-13.88	-13	-0.88
2.00	0	23.65	39.25	84.80	-19.97	-13	-6.97
2.00	41.92	34.10	32.30	67.25	-37.52	-13	-24.52
2.00	38.48	41.95	40.15	65.30	-39.47	-13	-26.47
0.50	0	51.05	48.98	89.56	-15.21	-13	-2.21
0.50	0	41.51	52.82	86.66	-18.11	-13	-5.11

MIMO Uplink

Test Frequency	Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	RBW
		Frequency	Amplitude				
GHz	GHz	GHz	dBuV	meter	meter	dB	MHz
39.300	0.030 - 1	37.4	63.50	1	3	9.54	120
39.300	1 - 18	2.967	60.92	1	3	9.54	1000
39.300	18 - 38.6	36.3	54.57	1	1	0.00	1000
39.300	40 - 50	42.025	22.46	1	1	0.00	1000
39.300	50 - 75	54.45	40.33	1	1	0.00	1000
39.300	75 - 110	98.293	19.68	1	1	0.00	1000
39.300	110 - 170	115.743	9.19	1	0.1	-20.00	1000
39.300	170 - 200	180.247	11.94	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
dB	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.00	0	0.00	0.00	73.04	-31.73	-13	-18.73
5.97	41.85	0.00	29.90	64.48	-40.29	-13	-27.29
21.20	32.66	0.00	46.63	89.74	-15.03	-13	-2.03
2.00	0	23.00	39.20	86.66	-18.11	-13	-5.11
2.00	41.92	34.10	32.30	66.81	-37.96	-13	-24.96
2.00	36.97	41.85	39.98	66.54	-38.23	-13	-25.23
0.50	0	51.05	48.98	89.72	-15.05	-13	-2.05
0.50	0	41.51	52.82	86.77	-18.00	-13	-5.00



MIMO Uplink

Test Frequency GHz	Spectrum Analyzer span GHz	Radiated Spurious (raw data)		Measurement distance per standard meter	Measurement distance meter	Distance Correction Factor dB	RBW MHz
		Frequency GHz	Amplitude dBuV				
39.950	0.030 - 1	37.28	62.30	1	3	9.54	120
39.950	1 - 18	3.618	66.27	1	3	9.54	1000
39.950	18 - 38.6	36.3	54.95	1	1	0.00	1000
39.950	40 - 50	40.363	15.68	1	1	0.00	1000
39.950	50 - 75	54.45	40.72	1	1	0.00	1000
39.950	75 - 110	79.087	17.30	1	1	0.00	1000
39.950	110 - 170	115.732	10.13	1	0.1	-20.00	1000
39.950	170 - 200	180.212	12.01	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss dB	Ext Amplifier Gain dB	Receive Mixer Correction Factor dB	Receive Antenna Correction Factor dB	Field Strength (calculated) dBuV/m	Convert Field Strength (dBuV/m) to EIRP (dBm) dBm	Limit dBm	Margin dB
0.00	0	0.00	0.00	71.84	-32.93	-13	-19.93
6.60	41.54	0.00	30.94	71.81	-32.96	-13	-19.96
21.20	32.66	0.00	46.63	90.12	-14.65	-13	-1.65
2.00	0	23.65	39.25	80.58	-24.19	-13	-11.19
2.00	41.92	34.10	32.30	67.20	-37.57	-13	-24.57
2.00	46.72	40.30	37.15	48.03	-56.74	-13	-43.74
0.50	0	51.05	48.98	90.16	-14.61	-13	-1.61
0.50	0	41.51	52.82	86.34	-18.43	-13	-5.43

Radiated Spurious Test Data

SISO Downlink

Test Frequency	Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	RBW
		Frequency	Amplitude				
GHz	GHz	GHz	dBuV	meter	meter	dB	MHz
38.650	0.030 - 1	0.175	61.40	1	3	9.54	120
38.650	1 - 18	2.3	65.10	1	3	9.54	1000
38.650	18 - 38.6	36.3	55.44	1	1	0.00	1000
38.650	40 - 50	40.34	20.90	1	1	0.00	1000
38.650	50 - 75	54.45	46.41	1	1	0.00	1000
38.650	75 - 110	102.134	26.29	1	1	0.00	1000
38.650	110 - 170	115.739	9.21	1	0.1	-20.00	1000
38.650	170 - 200	180.223	11.66	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
dB	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.0	0	0.00	0.00	70.94	-33.83	-13	-20.83
5.3	42.13	0.00	27.69	65.45	-39.32	-13	-26.32
21.2	32.66	0.00	46.63	90.63	-14.14	-13	-1.14
2.0	0	23.65	39.25	85.80	-18.97	-13	-5.97
2.0	41.92	34.10	32.30	72.89	-31.88	-13	-18.88
2.0	36.08	41.85	40.48	74.54	-30.23	-13	-17.23
0.5	0	51.05	48.98	89.74	-15.03	-13	-2.03
0.5	0	41.51	52.82	86.49	-18.28	-13	-5.28

SISO Downlink

Test Frequency GHz	Spectrum Analyzer span GHz	Radiated Spurious (raw data)		Measurement distance per standard meter	Measurement distance meter	Distance Correction Factor dB	RBW MHz
		Frequency GHz	Amplitude dBuV				
39.300	0.030 - 1	0.175	61.60	1	3	9.54	120
39.300	1 - 18	3.045	-66.80	1	3	9.54	1000
39.300	18 - 38.6	36.3	55.34	1	1	0.00	1000
39.300	40 - 50	42.865	21.47	1	1	0.00	1000
39.300	50 - 75	54.45	46.27	1	1	0.00	1000
39.300	75 - 110	102.134	28.08	1	1	0.00	1000
39.300	110 - 170	115.716	9.19	1	0.1	-20.00	1000
39.300	170 - 200	180.253	10.99	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss dB	Ext Amplifier Gain dB	Receive Mixer Correction Factor dB	Receive Antenna Correction Factor dB	Field Strength (calculated) dBuV/m	Convert Field Strength (dBuV/m) to EIRP (dBm) dBm	Limit dBm	Margin dB
0.0	0	0.00	0.00	71.14	-33.63	-13	-20.63
6.0	41.78	0.00	30.10	-62.91	-167.68	-13	-154.68
21.2	32.66	0.00	46.63	90.53	-14.24	-13	-1.24
2.0	0	22.78	39.60	85.85	-18.92	-13	-5.92
2.0	41.92	34.10	32.30	72.75	-32.02	-13	-19.02
2.0	36.08	41.85	40.48	76.33	-28.44	-13	-15.44
0.5	0	51.05	48.98	89.72	-15.05	-13	-2.05
0.5	0	41.51	52.82	85.82	-18.95	-13	-5.95

SISO Downlink

Test Frequency	Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	RBW
		Frequency	Amplitude				
GHz	GHz	GHz	dBuV	meter	meter	dB	MHz
39.950	0.030 - 1	0.175	61.40	1	3	9.54	120
39.950	1 - 18	3.633	76.02	1	3	9.54	1000
39.950	18 - 38.6	36.3	55.37	1	1	0.00	1000
39.950	40 - 50	47.602	21.88	1	1	0.00	1000
39.950	50 - 75	54.45	46.40	1	1	0.00	1000
39.950	75 - 110	102.134	28.81	1	1	0.00	1000
39.950	110 - 170	115.742	9.48	1	0.1	-20.00	1000
39.950	170 - 200	180.216	11.75	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
dB	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.0	0	0.00	0.00	70.94	-33.83	-13	-20.83
6.6	41.54	0.00	30.95	81.57	-23.20	-13	-10.20
21.2	32.66	0.00	46.63	90.56	-14.21	-13	-1.21
2.0	0	22.40	40.42	86.70	-18.07	-13	-5.07
2.0	41.92	34.10	32.30	72.88	-31.89	-13	-18.89
2.0	36.08	41.85	40.48	77.06	-27.71	-13	-14.71
0.5	0	51.05	48.98	90.01	-14.76	-13	-1.76
0.5	0	41.51	52.82	86.58	-18.19	-13	-5.19



**Radiated Spurious Test Data
SISO Uplink**

Test Frequency	Spectrum Analyzer span	Radiated Spurious (raw data)		Measurement distance per standard	Measurement distance	Distance Correction Factor	RBW
		Frequency	Amplitude				
GHz	GHz	GHz	dBuV	meter	meter	dB	MHz
38.650	0.030 - 1	37.4	62.30	1	3	9.54	120
38.650	1 - 18	2.356	63.52	1	3	9.54	1000
38.650	18 - 38.6	36.3	54.12	1	1	0.00	1000
38.650	40 - 50	40.563	22.29	1	1	0.00	1000
38.650	50 - 75	54.45	42.44	1	1	0.00	1000
38.650	75 - 110	97.756	18.45	1	1	0.00	1000
38.650	110 - 170	115.722	10.10	1	0.1	-20.00	1000
38.650	170 - 200	180.28	11.84	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss	Ext Amplifier Gain	Receive Mixer Correction Factor	Receive Antenna Correction Factor	Field Strength (calculated)	Convert Field Strength (dBuV/m) to EIRP (dBm)	Limit	Margin
dB	dB	dB	dB	dBuV/m	dBm	dBm	dB
0.0	0	0.00	0.00	71.84	-32.93	-13	-19.93
5.3	42.1	0.00	27.81	64.10	-40.67	-13	-27.67
21.2	32.66	0.00	46.63	89.31	-15.46	-13	-2.46
2.0	0	23.70	39.30	87.29	-17.48	-13	-4.48
2.0	41.92	34.10	32.30	68.92	-35.85	-13	-22.85
2.0	36.87	41.75	39.90	65.23	-39.54	-13	-26.54
0.5	0	51.05	48.98	90.63	-14.14	-13	-1.14
0.5	0	41.51	52.82	86.67	-18.10	-13	-5.10

SISO Uplink

Test Frequency GHz	Spectrum Analyzer span GHz	Radiated Spurious (raw data)		Measurement distance per standard meter	Measurement distance meter	Distance Correction Factor dB	RBW MHz
		Frequency GHz	Amplitude dBuV				
39.300	0.030 - 1	37.03	62.60	1	3	9.54	120
39.300	1 - 18	3.042	61.92	1	3	9.54	1000
39.300	18 - 38.6	36.3	53.92	1	1	0.00	1000
39.300	40 - 50	46.305	20.88	1	1	0.00	1000
39.300	50 - 75	54.45	42.59	1	1	0.00	1000
39.300	75 - 110	97.812	19.33	1	1	0.00	1000
39.300	110 - 170	115.693	9.35	1	0.1	-20.00	1000
39.300	170 - 200	180.272	12.38	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss dB	Ext Amplifier Gain dB	Receive Mixer Correction Factor dB	Receive Antenna Correction Factor dB	Field Strength (calculated) dBuV/m	Convert Field Strength (dBuV/m) to EIRP (dBm) dBm	Limit dBm	Margin dB
0.0	0	0.00	0.00	72.14	-32.63	-13	-19.63
6.0	41.78	0.00	30.10	65.81	-38.96	-13	-25.96
21.2	32.66	0.00	46.63	89.09	-15.68	-13	-2.68
2.0	0	22.50	40.20	85.58	-19.19	-13	-6.19
2.0	41.92	34.10	32.30	69.07	-35.70	-13	-22.70
2.0	36.88	41.75	39.90	66.10	-38.67	-13	-25.67
0.5	0	51.05	48.98	89.88	-14.89	-13	-1.89
0.5	0	41.51	52.82	87.21	-17.56	-13	-4.56

SISO Uplink

Test Frequency GHz	Spectrum Analyzer span GHz	Radiated Spurious (raw data)		Measurement distance per standard meter	Measurement distance meter	Distance Correction Factor dB	RBW MHz
		Frequency GHz	Amplitude dBuV				
39.950	0.030 - 1	37.15	62.60	1	3	9.54	120
39.950	1 – 18	3.609	63.19	1	3	9.54	1000
39.950	18 – 38.6	36.3	24.12	1	1	0.00	1000
39.950	40 – 50	42.981	20.35	1	1	0.00	1000
39.950	50 - 75	54.45	42.70	1	1	0.00	1000
39.950	75 - 110	101.409	19.34	1	1	0.00	1000
39.950	110 - 170	115.703	9.63	1	0.1	-20.00	1000
39.950	170 - 200	180.237	11.73	1	0.1	-20.00	1000

3 meter Chamber Cable Insertion Loss dB	Ext Amplifier Gain dB	Receive Mixer Correction Factor dB	Receive Antenna Correction Factor dB	Field Strength (calculated) dBuV/m	Convert Field Strength (dBuV/m) to EIRP (dBm) dBm	Limit dBm	Margin dB
0.0	0	0.00	0.00	72.14	-32.63	-13	-19.63
6.6	41.52	0.00	30.94	68.73	-36.04	-13	-23.04
21.2	32.66	0.00	46.63	59.29	-45.48	-13	-32.48
2.0	0	22.70	39.68	84.73	-20.04	-13	-7.04
2.0	41.92	34.10	32.30	69.18	-35.59	-13	-22.59
2.0	37.05	41.90	40.40	66.59	-38.18	-13	-25.18
0.5	0	51.05	48.98	90.16	-14.61	-13	-1.61
0.5	0	41.51	52.82	86.56	-18.21	-13	-5.21

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	9/9/2019	9/9/20 **
Vector Signal Generator (rental equipment)	Rohde and Schwarz	SMW200A	Electrorent Asset 1778667D	7/22/2019	7/22/22
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
Harmonic Mixer, 110 – 170 GHz	OML	M06HWD	i00480	8-24-2020	8-24-2023
Harmonic Mixer, 170 – 260 GHz	OML	M04HWD	i00481	8-24-2020	8-24-2023
Horn Antenna, 1 – 18 GHz	EMCO	3115	i00103	2/28/19	2/28/21
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	
Horn Antenna, 110 - 170 GHz	Custom Microwave	H06R	i00475	Verify when used	
Horn Antenna, 170 – 260 GHz	Custom Microwave	HO4R	i00473	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, 10 MHz – 45 GHz	RF-Lambda	RLNA00M45GA	i00555	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	
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

** 30 day calibration extension per quality manager

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