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TEST REPORT

FCC Test for AT1H01-A10
Class II Permissive Change

APPLICANT
SAMSUNG Electronics Co., Ltd.

REPORT NO.
HCT-RF-2111-FC011-R1

DATE OF ISSUE
December 16, 2021

Tested by
Kwang Il Yoon

Technical Manager
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Additional Model
-

Applicant	**SAMSUNG Electronics Co., Ltd.** 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
Product Name	AU(AT1H01)
Model Name	AT1H01-A10
FCC ID	A3LAT1H01-A10
Date of Test	October 20, 2021 ~ November 9, 2021
Test Standard Used	CFR 47 Part 2, Part 30

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test results were applied only to the test methods required by the standard.

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	November 10, 2021	Initial Release
1	December 16, 2021	We added test plots and notes on Section 5.5.

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

If this report is required to confirmation of authenticity, please contact to www.hct.co.kr

CONTENTS

1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

Company Name	Samsung Electronics Co., Ltd.
Company Address	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea

1.2. PRODUCT INFORMATION

EUT Type	AU(AT1H01)
EUT Serial Number	S616621223
Equipment Class	5GB-Part 30 Fixed Transmitter
Power Supply	-48 V DC

Output Power

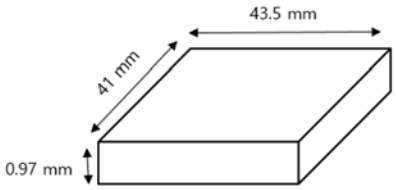
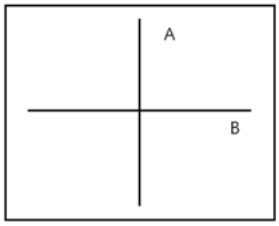
Installation	Wall and Pole		Ceiling	
Mode	EIRP (dBm/CC/path)	Total (2 path) (dBm)	EIRP (dBm/CC/path)	Total (2 path) (dBm)
1CC	40.0	43.0	36.0	39.0
2CC	37.0	43.0	33.0	39.0
3CC	35.2	43.0	31.2	39.0
4CC	34.0	43.0	30.0	39.0

Frequency Range	27 500 MHz ~ 28 350 MHz

Emission Designator

Mode	QPSK (G7D)	QPSK Max EIRP Density [W/100 MHz]	16/64 QAM (W7D)	QAM Max EIRP Density [W/100 MHz]
1CC Contiguous	94M2G7D	18.707	94M3W7D	18.621
4CC Contiguous	392MG7D	5.875	392MW7D	5.715
1CC+ 3CC Non-Contiguous	386MG7D	4.831	387MW7D	4.887
3CC+ 1CC Non-Contiguous	387MG7D	4.508	387MW7D	4.624

Channel Bandwidths	1CC: 100 MHz ~ 4CC: 400 MHz
Modulation Type	QPSK, 16QAM, 64QAM

Antenna Specification	Maximum Gain: 21 dBi (Wall/Pole) / 17 dBi (Ceiling) Size: Array:  

1.3. TEST INFORMATION

FCC Rule Parts	CFR 47 Part 2, Part 30
Measurement standards	ANSI C63.26-2015, KDB 971168 D01 v03r01, KDB 662911 D01 v02r01, KDB 662911 D02 v01, KDB 842590 D01 v01r02
Place of Test	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4 (Version: 2014) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

2.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

3. TEST SPECIFICATIONS

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 30

Description	Reference	Results
Occupied Bandwidth	§ 2.1049	Compliant
EIRP Density	§ 30.202	Compliant
Equivalent Isotropic Radiated Power	§ 2.1046	Compliant
Band Edge	§ 2.1051, § 30.203	Compliant
Radiated Spurious Emissions	§ 2.1051, § 30.203	Compliant
Frequency Stability	§ 2.1055	Compliant

3.2. ADDITIONAL DESCRIPTIONS ABOUT TEST

- All tests is performed by radiated measurement and applied below conditions.

: Used measurement distance with far field of test such as EIRP, OBW and Band edge are as follow.

Wavelength = Speed of light / Measurement frequency = 30 / 2 835 = 0.01058

(2 X (EUT Antenna dimension)^2) / Wavelength = (2 X (0.05978)^2)/ 0.01058 = 0.68 ***m***

So, measurement distance is 3 m.

: Spurious emissions measurement distance is shown in table below(Reference : Measurement Antenna Dimension).

Frequency Rage (GHz)	Wavelength (cm)	Far Field Distance (m)	Measurement Distance(m)
18 ~ 40	0.75	2.46	3.00
40 ~ 60	0.50	1.354	3.00
60 ~90	0.33	0.856	3.00
90 ~ 100	0.30	0.409	3.00

- CC means component carriers and EUT support 1CC ~ 4CC.

- Test was performed the carrier 1 and 4 case having maximum output power and maximum PSD(It means the worst case.).

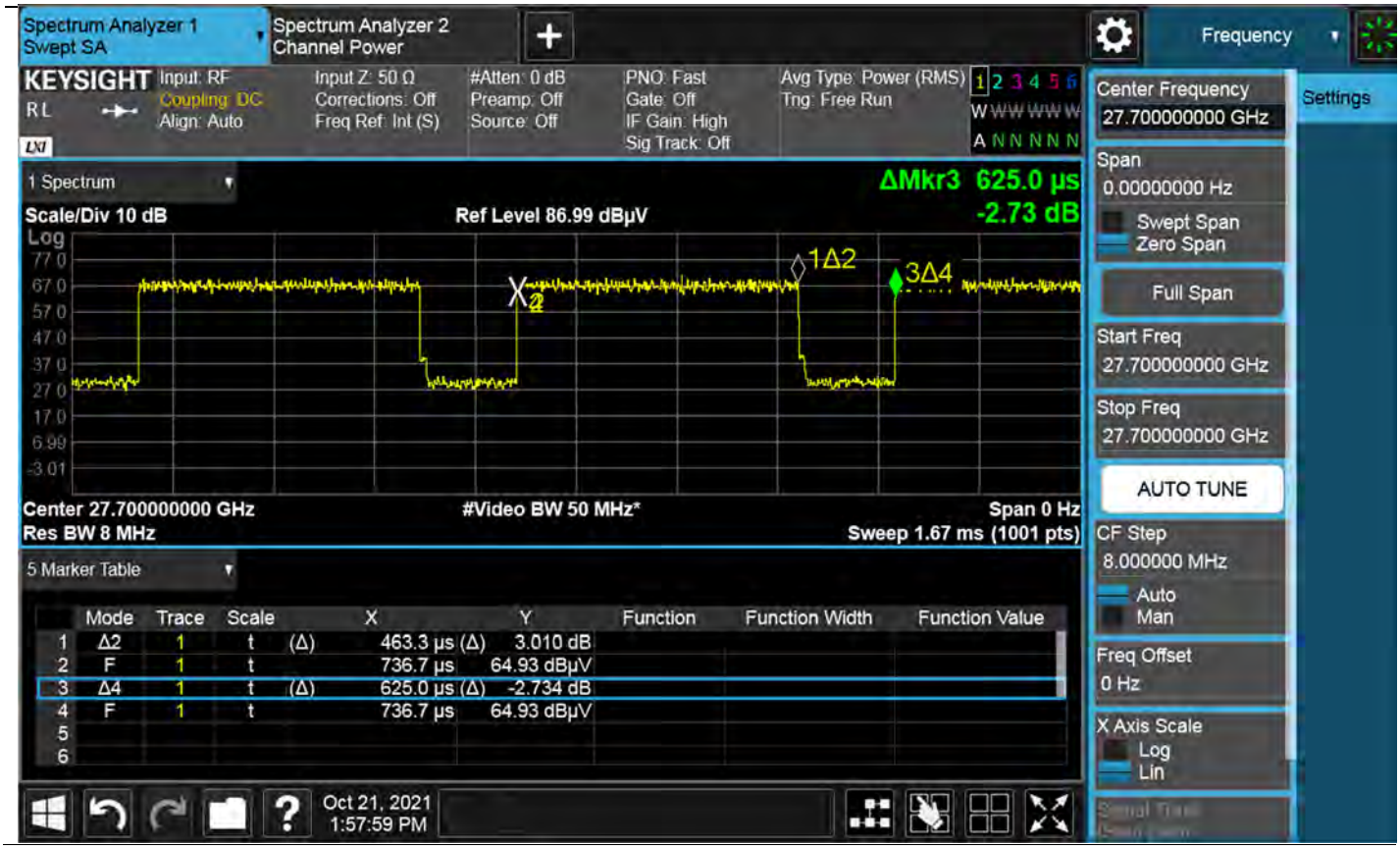
- Unwanted radiated emissions test was performed on state of all EUT antenna path is operated with a maximum output power level.

- Transmitter output signals are correlated.

- In case of far-filed distance for fundamental emission, we applied the EUT antenna dimension because the EUT antenna dimension is bigger than the measurement antenna dimension.

- Because of the EUT using TDD technology, it cannot be configured to transmit continuously and measurement instrument cannot be configured to measure only during active transmissions. So we perform the measurement using duty cycle method.

Measurement Result of AT1H01-A10 Transmit On/Off Timing



- The EUT duty cycle is calculated according to ANSI C63.26 - 5.2.4.3.4.

Duty Cycle = On-time / Transmitter period = 0.4633 ms / 0.625 ms = 0.74128
Duty Correction = 10 log (1/duty cycle) = 10 log (1/0.74128) = 1.30 dB

- After full testing in higher EIRP(Wall/Pole installation), and worst case spot checking in lower EIRP(Ceiling installation), full testing data are reported.

3.3. MAXIMUM MEASUREMENTUNCERTAINTY

The value of the measurement uncertainty for the measurement of each parameter.

Coverage factor k= 2, Confidence levels of 95 %

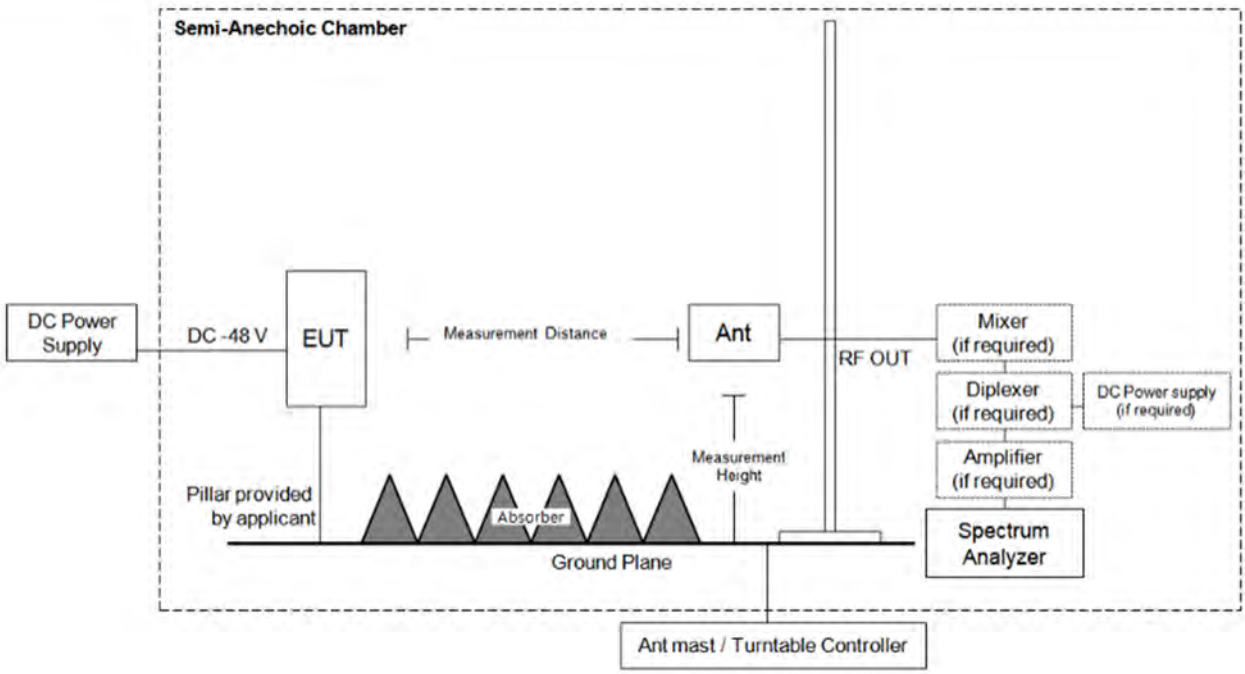
Description	Frequency	Uncertainty
Occupied Bandwidth	28 GHz	± 0.31 MHz
Equivalent Isotropic Radiated Power		± 5.05 dB
EIRP Density		
Band Edge		
Radiated Spurious Emissions	9 kHz ~ 30 MHz	± 3.40 dB
	30 MHz ~ 1 GHz	± 4.80 dB
	1 GHz ~ 18 GHz	± 5.70 dB
	18 GHz ~ 40 GHz	± 5.05 dB
	40 GHz ~ 100 GHz	± 4.59 dB
Frequency Stability	28 GHz	69.61 kHz

3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

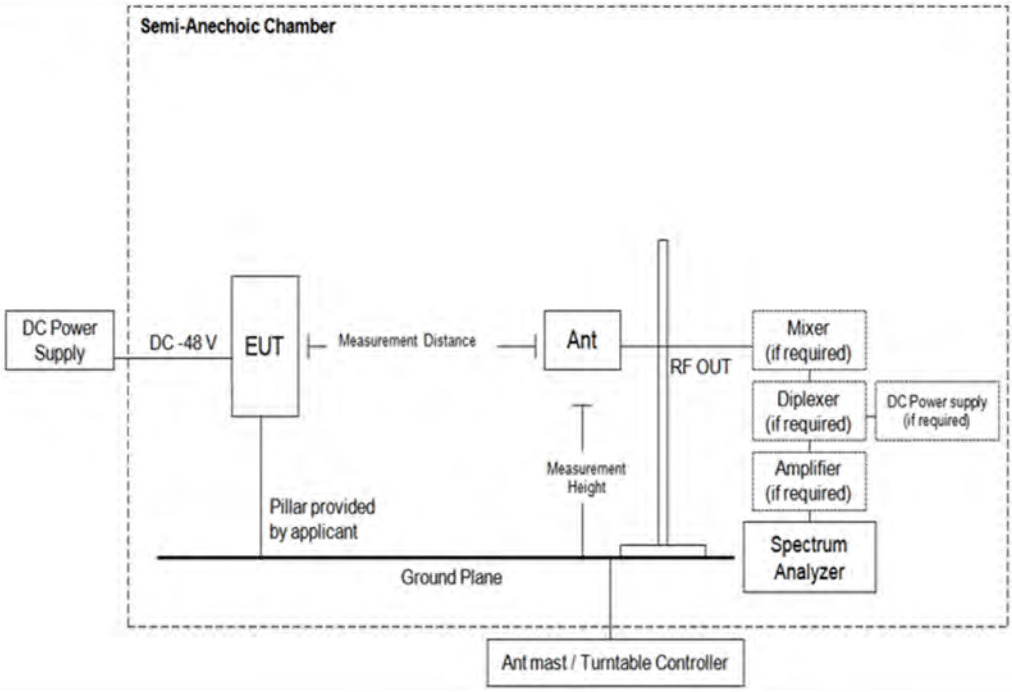
Temperature :	+15 °C to +35 °C
Relative humidity:	30 % to 60 %
Air pressure	860 mbar to 1 060 mbar

3.5. TEST DIAGRAMS

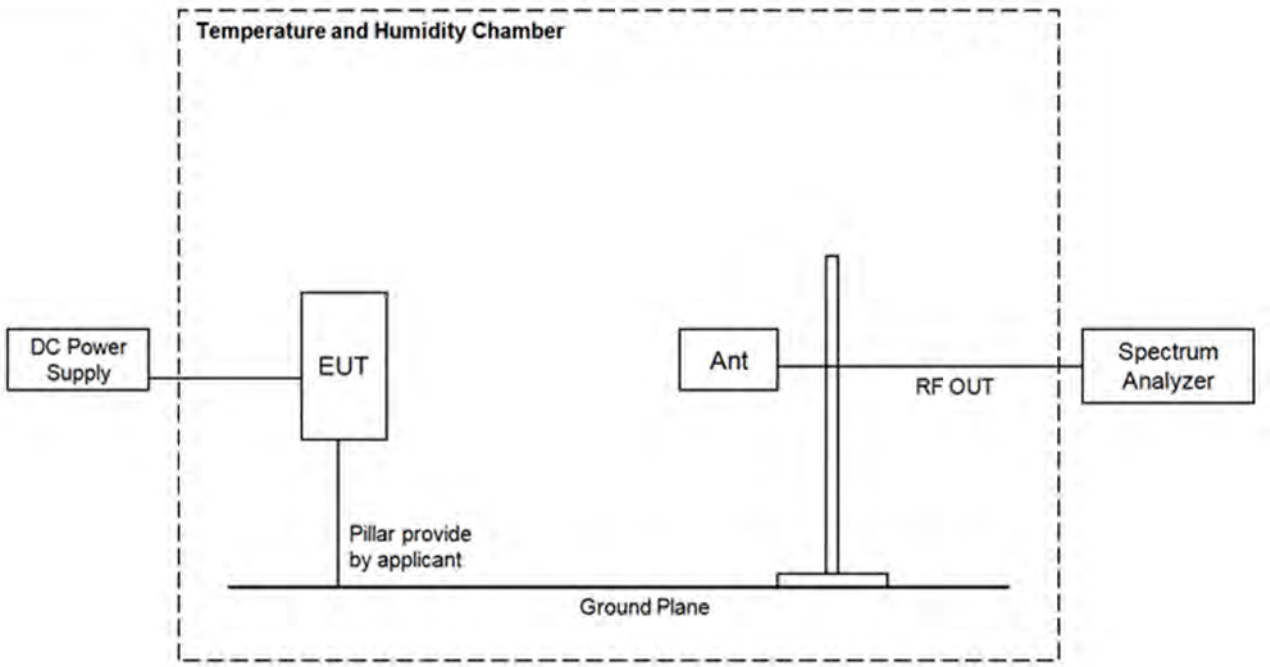
Occupied Bandwidth / EIRP / Band Edge / Radiated Spurious Emissions in 1 GHz to 40 GHz



Radiated Spurious Emissions in other bands



Frequency stability



4. TEST EQUIPMENTS

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
PXA Signal Analyzer	N9030B	Agilent	MY55480167	06/02/2022	Annual
Horn Antenna	BBHA 9170	Schwarzbeck	BBHA9170541	11/29/2021	Biennial
DC Power Supply	PWR800L	KIKUSUI	RE002047	07/13/2022	Annual
Controller(Antenna mast)	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	N/A	N/A	N/A
Spectrum Analyzer	FSP	Rohde&Schwarz	836650/016	09/13/2022	Annual
Loop Antenna	Loop Antenna	Rohde & Schwarz	1513-175	05/18/2022	Biennial
Controller	2090	Emco	060520	N/A	N/A
Turn Table	Turn Table	Ets	N/A	N/A	N/A
Hybrid Antenna	VULB 9168	Schwarzbeck	00895	07/14/2023	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1300	06/23/2022	Biennial
Horn Antenna	WR-19 Horn Antenna	OML INC.	18042301	04/23/2022	Biennial
Horn Antenna	WR-19 Horn Antenna	OML INC.	18042302	04/23/2022	Biennial
Horn Antenna	WR-12 Horn Antenna	OML INC.	18042301	04/23/2022	Biennial
Horn Antenna	WR-12 Horn Antenna	OML INC.	18042302	04/23/2022	Biennial
Horn Antenna	WR-08 Horn Antenna	OML INC.	18050101	04/23/2022	Biennial
Horn Antenna	WR-08 Horn Antenna	OML INC.	18050102	04/23/2022	Biennial
Horn Antenna	WR-05 Horn Antenna	OML INC.	18050101	04/23/2022	Biennial
Horn Antenna	WR-05 Horn Antenna	OML INC.	18050102	04/23/2022	Biennial
Harmonic Mixer	WR-5	VDI	SAX774	04/02/2022	Annual
Harmonic Mixer	WR-8	VDI	SAX779	04/02/2022	Annual
Harmonic Mixer	WR-12	VDI	SAX773	04/02/2022	Annual
Harmonic Mixer	WR-19	VDI	SAX771	03/17/2022	Annual
Source Module	WR-19	OML INC.	S19MS-A-160516-1	09/02/2022	Annual
Source Module	WR-12	OML INC.	S12MS-A-160419-1	09/02/2022	Annual
Source Module	WR-08	OML INC.	S08MS-A-160419-1	09/02/2022	Annual
Source Module	WR-05	OML INC.	S05MS-A-160419-1	09/02/2022	Annual
Temperature and Humidity Chamber	NY-THR18750	NANGYEUL CO., LTD.	NY-2009012201A	01/14/2022	Annual
Signal Generator	SMV100A	Rohde & Schwarz	177633	07/05/2022	Annual

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

5. TEST RESULT

5.1. OCCUPIED BANDWIDTH

FCC Rules

Test Requirements:

§ 2.1049 Measurements required: Occupied bandwidth.

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 under the specified conditions of § 2.1049 (a) through (i) as applicable.

Test Procedures:

The measurement is performed in accordance with Section 5.4.3 and 5.4.4 of ANSI C63.26.

5.4.3 Occupied bandwidth—Relative measurement procedure

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.

b) The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.

NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

d) The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target "−X dB" requirement, i.e., if the requirement calls for measuring the −26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.

e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.

f) Determine the reference value by either of the following:

1) Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

2) Set the EUT to transmit an unmodulated carrier. Set the spectrum analyzer marker to the level of the carrier.

g) Determine the "−X dB amplitude" as equal to (Reference Value − X). Alternatively, this calculation can be performed on the spectrum analyzer using the delta-marker measurement function.

h) If the reference value was determined using an unmodulated carrier, turn the EUT modulation on, then either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise the trace from step f) shall be used for step i).

i) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the "−X dB amplitude" determined in step f). If a marker is below this "−X dB amplitude" value it should be as close as possible to this value. The OBW is the positive frequency difference between the two markers. The spectral envelope can cross the "−X dB amplitude" at multiple points. The lowest or highest frequency shall be selected as the frequencies that are the farthest away from the center frequency at which the spectral envelope crosses the "−X dB amplitude."

j) The OBW shall be reported by providing plot(s) of the measuring instrument display, to include markers depicting the relevant frequency and amplitude information (e.g., marker table). The frequency and amplitude axis and scale shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

5.4.4 Occupied bandwidth—Power bandwidth (99%) measurement procedure

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of 1.5 × OBW is sufficient).

b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.

e) If the instrument does not have a 99% OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.

f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

Test Results:

Tabular Data of Occupied Bandwidth

1. Contiguous

Ant.	Ant. Angle	CC	Channel	Mod.	Freq. (GHz)	Measured OBW (MHz)
A	0°	1	Low	QPSK	27.55008	94.104
				16QAM		94.069
				64QAM		94.244
		4		QPSK	27.70002	391.35
				16QAM		391.06
				64QAM		390.19
B	90°	1		QPSK	27.55008	94.173
				16QAM		94.146
				64QAM		94.286
		4		QPSK	27.70002	389.86
				16QAM		389.20
				64QAM		390.27
A	0°	1	Middle	QPSK	27.92496	93.994
				16QAM		94.158
				64QAM		93.870
		4		QPSK	27.92490	390.18
				16QAM		391.29
				64QAM		390.57
B	90°	1		QPSK	27.92496	94.104
				16QAM		94.064
				64QAM		94.186
		4		QPSK	27.92490	390.99
				16QAM		389.97
				64QAM		390.44

Ant.	Ant. Angle	CC	Channel	Mod.	Freq. (GHz)	Measured OBW (MHz)
A	0°	1	High	QPSK	28.29996	94.198
				16QAM		94.147
				64QAM		94.130
		4		QPSK	28.15002	392.21
				16QAM		391.87
				64QAM		391.29
B	90°	1		QPSK	28.29996	94.126
				16QAM		94.142
				64QAM		94.174
		4		QPSK	28.15002	392.33
				16QAM		391.69
				64QAM		391.89

2. Non-Contiguous

1+3_Low

Ant.	Ant. Angle	CC	Channel	Mod.	Measured OBW (MHz)_Left	Measured OBW (MHz)_Right	SUM OBW (MHz)
A	0°	1+3	Low	QPSK	94.211	292.05	386.26
				16QAM	94.032	292.50	386.53
				64QAM	94.134	292.32	386.46
B	90°	1+3		QPSK	94.153	292.26	386.42
				16QAM	94.189	292.33	386.52
				64QAM	94.120	292.68	386.80

1+3_High

Ant.	Ant. Angle	CC	Channel	Mod.	Measured OBW (MHz)_Left	Measured OBW (MHz)_Right	SUM OBW (MHz)
A	0°	1+3	High	QPSK	94.191	292.61	386.80
				16QAM	94.313	292.43	386.75
				64QAM	94.405	291.84	386.24
B	90°	1+3		QPSK	94.217	292.66	386.87
				16QAM	94.135	292.46	386.60
				64QAM	94.151	292.33	386.48

3+1_Low

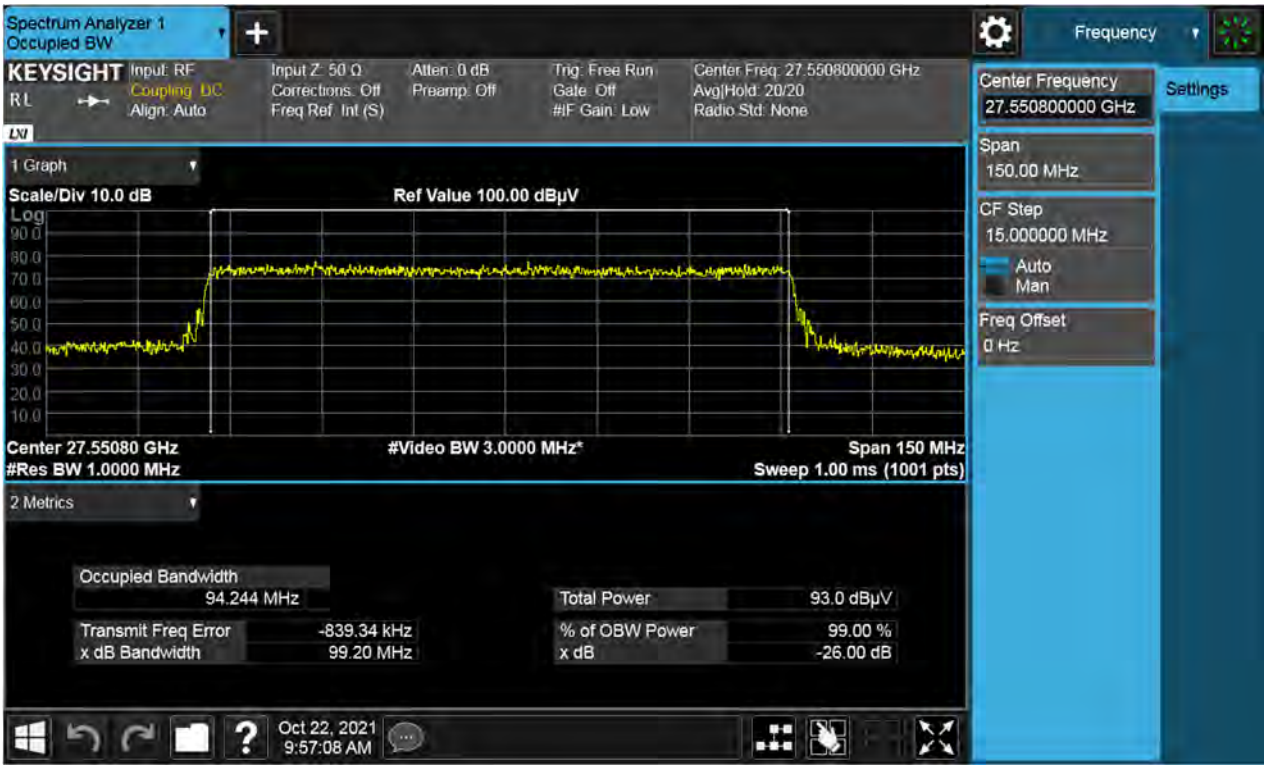
Ant.	Ant. Angle	CC	Channel	Mod.	Measured OBW (MHz)_Left	Measured OBW (MHz)_Right	SUM OBW (MHz)
A	0°	3+1	Low	QPSK	291.83	94.219	386.05
				16QAM	292.03	94.166	386.19
				64QAM	291.28	94.178	385.46
B	90°	3+1		QPSK	291.65	94.134	385.79
				16QAM	291.94	94.178	386.12
				64QAM	292.24	94.334	386.57

3+1_High

Ant.	Ant. Angle	CC	Channel	Mod.	Measured OBW (MHz)_Left	Measured OBW (MHz)_Right	SUM OBW (MHz)
A	0°	3+1	High	QPSK	291.64	94.071	385.71
				16QAM	291.49	94.254	385.74
				64QAM	291.88	94.208	386.08
B	90°	3+1		QPSK	291.56	94.179	385.74
				16QAM	292.27	94.237	386.50
				64QAM	291.83	93.992	385.83

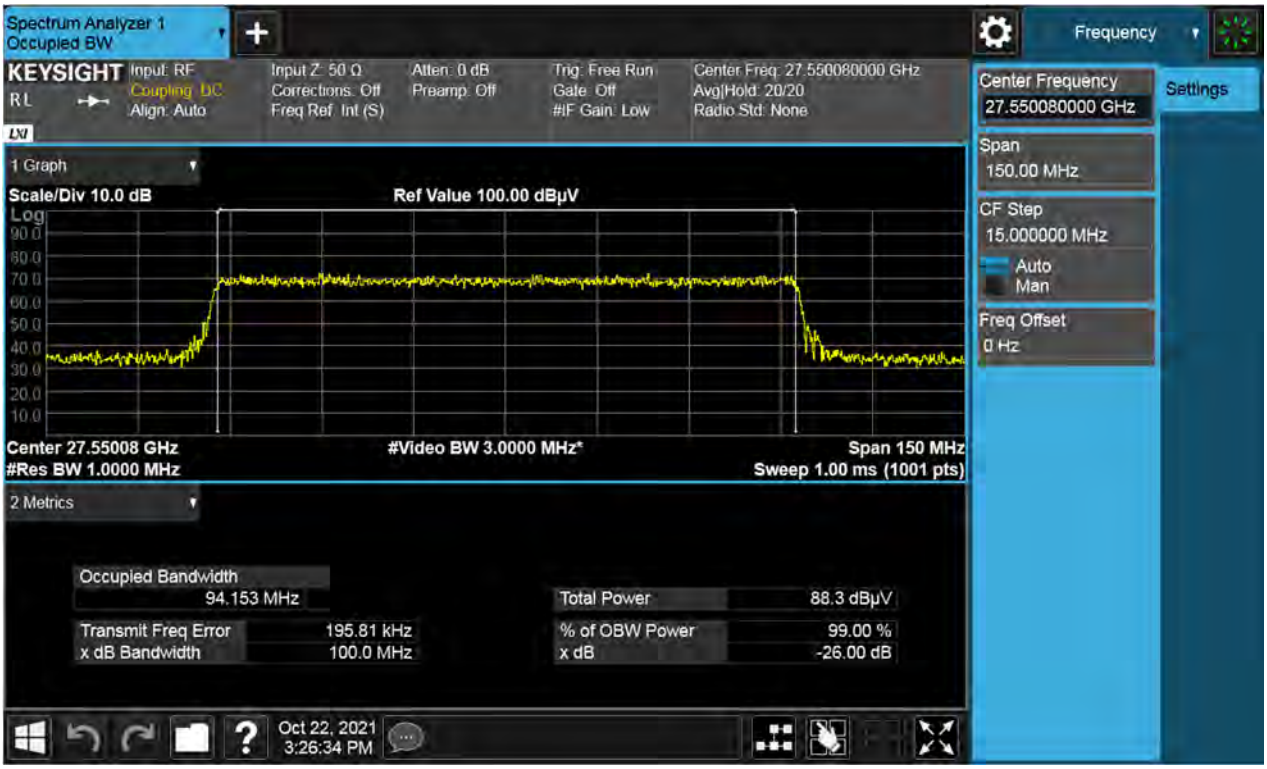
Plot Data of RF Occupied Bandwidth

Antenna A / 1cc / 64QAM / Low



Antenna A / 4cc / QPSK / Middle

Antenna B / 1+3 cc / QPSK / Low_ Left



Antenna B / 1+3 cc / QPSK / Low_Right

Antenna B / 3+1 cc / 16QAM / High_Left

Antenna B / 3+1 cc / 16QAM / High_Right

5.2. EIRP DENSITY

FCC Rules

Test Requirements:

§ 30.202 Power limits.

(a) For fixed and base stations operating in connection with mobile systems, the average power of the sum of all antenna elements is limited to an equivalent isotopically radiated power (EIRP) density of +75dBm/100 MHz. For channel bandwidths less than 100 megahertz the EIRP must be reduced proportionally and linearly based on the bandwidth relative to 100 megahertz.

Test Procedures:

The measurement is performed in accordance with Section 5.2.4.4.2 of ANSI C63.26.

a) Set span to 2 × to 3 × the OBW.

b) Set RBW = 1% to 5% of the OBW.

c) Set VBW ≥ 3 × RBW.

d) Set number of measurement points in sweep ≥ 2 × span / RBW.

e) Sweep time:

1) Set = auto-couple, or

2) Set ≥ [10 × (number of points in sweep) × (transmission symbol period)] for single sweep (automation-compatible) measurement.

f) Detector = power averaging (rms).

g) Set sweep trigger to “free run.”

h) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.

i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band or channel power measurement function with band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

j) Add 10 log (1/duty cycle) to the measured power level to compute the average power during continuous transmission.

Note:

1) Test distance is determined to 3.0 m by far field condition; see test descriptions on section 3.2.
2) In this test, EUT is operated only measurement path is turned on and path has straight beamforming.
3) For 4 cc measurement, test is performed for all carriers of 100 MHz bandwidth, but recorded only maximum output level.
4) The angle of antenna is set as maximum radiated power conditions.
5) EIRP is calculated from measured value according to section 5.2.7 of ANSI C63.26-2015, and the formula is as follows.

$$EIRP\ (dBm) = E\ (dB\mu V/m) + 20\log(3m) - 104.77$$

$$= E\ (dB\mu V/m) - 95.23$$

6) E (dBμV/m) value is considered AFCL and Duty cycle factor and it as follow.

E (dBμV/m) = measurement value (dBμV) + AFCL (27.95 GHz) + Duty cycle correction (74 %)

= measurement value (dBμV) + 45.695 + 1.300

7) The output tolerance of the EUT in the specification is ±5 dB and test result satisfies this condition.

8) Sample calculation:

86.56 dBμV (measured Value) + 9.54(distance) - 104.77 + 47.12 (AFCL) + 1.300 (Duty)

= 39.75 dBm (Final EIRP)

Test Results:

Tabular Data of EIRP Density per path

1. Contiguous

Ant.	Ant. Angle	CC	Channel	Frequency (GHz)	Mod.	Measured Level (dBuV)	Calculated EIRP (dBm/100 MHz)
A	Hor.	1	Low	27.55008	QPSK	86.50	39.69
					16QAM	86.43	39.63
					64QAM	86.22	39.41
			Middle	27.92496	QPSK	86.71	39.42
					16QAM	86.58	39.30
					64QAM	86.75	39.46
			High	28.29996	QPSK	86.13	39.26
					16QAM	86.05	39.19
					64QAM	85.84	38.97
		4	Low	27.70002	QPSK	81.75	34.67
					16QAM	81.73	34.65
					64QAM	81.74	34.66
			Middle	27.92490	QPSK	81.63	34.35
					16QAM	81.23	33.94
					64QAM	81.33	34.04
			High	28.15002	QPSK	80.94	34.56
					16QAM	80.92	34.54
					64QAM	80.86	34.47

Ant.	Ant. Angle	CC	Channel	Frequency (GHz)	Mod.	Measured Level (dBuV)	Calculated EIRP (dBm/100 MHz)
B	Ver.	1	Low	27.55008	QPSK	86.55	39.74
					16QAM	86.56	39.75
					64QAM	86.55	39.74
			Middle	27.92496	QPSK	86.73	39.45
					16QAM	86.69	39.40
					64QAM	86.70	39.42
			High	28.29996	QPSK	84.78	37.92
					16QAM	84.53	37.66
					64QAM	84.71	37.85
		4	Low	27.70002	QPSK	81.75	34.68
					16QAM	81.55	34.47
					64QAM	81.48	34.40
			Middle	27.92490	QPSK	81.25	33.97
					16QAM	81.09	33.80
					64QAM	81.37	34.08
			High	28.15002	QPSK	80.63	34.24
					16QAM	80.39	34.01
					64QAM	80.40	34.02

Tabular Data of SUM EIRP Density

Ant.	CC	Channel	Modulation	Ant A EIRP (dBm/100 MHz)	Ant B EIRP (dBm/100 MHz)	Calculated EIRP (dBm/100 MHz)
A+B	1	Low	QPSK	39.69	39.74	42.72
			16QAM	39.63	39.75	42.70
			64QAM	39.41	39.74	42.59
		Middle	QPSK	39.42	39.45	42.44
			16QAM	39.30	39.40	42.36
			64QAM	39.46	39.42	42.45
		High	QPSK	39.26	37.92	41.65
			16QAM	39.19	37.66	41.50
			64QAM	38.97	37.85	41.46
	4	Low	QPSK	34.67	34.68	37.69
			16QAM	34.65	34.47	37.57
			64QAM	34.66	34.40	37.54
		Middle	QPSK	34.35	33.97	37.17
			16QAM	33.94	33.80	36.88
			64QAM	34.04	34.08	37.07
		High	QPSK	34.56	34.24	37.41
			16QAM	34.55	34.01	37.30
			64QAM	34.47	34.02	37.26

2. Non-Contiguous

Tabular Data of EIRP Density per path

1+3

Ant.	Ant. Angle	CC	Channel	Frequency (GHz)	Mod.	Measured Level (dBuV)	Calculated EIRP (dBm/100 MHz)
A	0°	1+3	Low	28.05012	QPSK	80.64	33.83
				27.55008	16QAM	80.69	33.88
				28.05012	64QAM	80.64	33.83
			High	28.20000	QPSK	80.76	33.90
				28.10004	16QAM	80.67	33.81
				27.60000	64QAM	80.70	33.84
B	90°		Low	27.55008	QPSK	80.69	33.62
				27.55008	16QAM	80.18	33.10
				27.55008	64QAM	80.02	32.94
			High	28.10004	QPSK	79.80	33.41
				27.60000	16QAM	80.06	33.68
				27.60000	64QAM	80.23	33.85

3+1

Ant.	Ant. Angle	CC	Channel	Frequency (GHz)	Mod.	Measured Level (dBuV)	Calculated EIRP (dBm/100 MHz)
A	0°	3+1	Low	27.64998	QPSK	80.63	33.83
				27.64998	16QAM	80.68	33.87
				27.74994	64QAM	80.69	33.88
			High	27.79986	QPSK	80.75	33.55
				27.79986	16QAM	80.68	33.48
				27.79986	64QAM	80.72	33.53
B	90°		Low	27.74994	QPSK	80.53	33.45
				27.74994	16QAM	80.63	33.56
				27.74994	64QAM	80.65	33.57
			High	27.79986	QPSK	80.62	33.43
				27.79986	16QAM	80.51	33.31
				27.79986	64QAM	80.62	33.42

Tabular Data of SUM EIRP Density

Ant.	CC	Channel	Modulation	Ant A EIRP (dBm/100 MHz)	Ant B EIRP (dBm/100 MHz)	Calculated EIRP (dBm/100 MHz)
A+B	1+3	Low	QPSK	33.83	33.83	36.84
			16QAM	33.88	33.87	36.89
			64QAM	33.83	33.88	36.87
		High	QPSK	33.90	33.55	36.74
			16QAM	33.81	33.48	36.66
			64QAM	33.84	33.53	36.69
	3+1	Low	QPSK	33.62	33.45	36.54
			16QAM	33.10	33.56	36.35
			64QAM	32.94	33.57	36.28
		High	QPSK	33.41	33.43	36.43
			16QAM	33.68	33.31	36.51
			64QAM	33.85	33.42	36.65

Plot Data of EIRP Density Tabular per path

Antenna A / 1cc / 64QAM / Low

Antenna A / 4cc / QPSK / Middle

Antenna B / 1+3 cc / QPSK / Low

Antenna B / 3+1 cc / 16QAM / High

5.3. EQUIVALENT ISOTROPIC RADIATED POWER

FCC Rules

Test Requirements:

§ 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

Test Procedures:

The measurement is performed in accordance with Section 5.2.4.4.2 of ANSI C63.26.

a) Set span to 2 × to 3 × the OBW.

b) Set RBW = 1% to 5% of the OBW.

c) Set VBW ≥ 3 × RBW.

d) Set number of measurement points in sweep ≥ 2 × span / RBW.

e) Sweep time:

1) Set = auto-couple, or

2) Set ≥ [10 × (number of points in sweep) × (transmission symbol period)] for single sweep (automation-compatible) measurement.

f) Detector = power averaging (rms).

g) Set sweep trigger to “free run.”

h) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.

i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band or channel power measurement function with band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

j) Add 10 log (1/duty cycle) to the measured power level to compute the average power during continuous transmission.

Note:

1) Basic test conditions are same as EIRP density test on section 5.2.
2) Same 400 MHz bandwidth applies for 1cc and 4 cc.
3) Antenna Gain of the above formula was applied from actual measurement data of the radiation pattern document.
4) Sample calculation

Path A, 1cc, Low, QPSK:

86.90 dBμV (measured) + 9.54(distance) - 104.77 +47.120(AFCL) + 1.300 (Duty)

= 40.09 dBm (Final conducted output power)

Test Results:

Tabular Data of Equivalent Isotropic Radiated Power

1. Contiguous

Ant.	Ant. Angle	CC	Channel	Freq. (GHz)	Mod.	Measured Level (dBuV)	EIRP (dBm)
A	0°	1	Low	27.55008	QPSK	86.90	40.09
					16QAM	86.99	40.18
					64QAM	87.04	40.23
			Middle	27.92496	QPSK	87.38	40.10
					16QAM	86.87	39.59
					64QAM	86.95	39.67
			High	28.29996	QPSK	86.79	40.15
					16QAM	86.39	39.76
					64QAM	86.36	39.73
		4	Low	27.70002	QPSK	86.94	39.96
					16QAM	87.02	40.04
					64QAM	87.17	40.19
			Middle	27.92490	QPSK	87.69	40.41
					16QAM	87.58	40.30
					64QAM	87.63	40.35
			High	28.15002	QPSK	86.48	40.09
					16QAM	86.37	39.98
					64QAM	86.37	39.99

Ant.	Ant. Angle	CC	Channel	Freq. (GHz)	Mod.	Measured Level (dBuV)	EIRP (dBm)
B	90°	1	Low	27.55008	QPSK	86.80	39.99
					16QAM	86.70	39.89
					64QAM	86.78	39.97
			Middle	27.92496	QPSK	86.68	39.39
					16QAM	86.40	39.12
					64QAM	86.30	39.02
			High	28.29996	QPSK	84.78	38.14
					16QAM	84.96	38.32
					64QAM	84.80	38.17
		4	Low	27.70002	QPSK	87.09	40.11
					16QAM	86.44	39.47
					64QAM	86.59	39.61
			Middle	27.92490	QPSK	87.09	39.81
					16QAM	86.98	39.70
					64QAM	86.63	39.34
			High	28.15002	QPSK	85.45	39.06
					16QAM	85.27	38.89
					64QAM	85.25	38.86

Tabular Data of Conducted SUM Output Power

Antenna	CC	Channel	Mod.	Ant. A (dBm)	Ant. B (dBm)	Result (dBm)
A+B	1	Low	QPSK	40.09	39.99	43.05
			16QAM	40.18	39.89	43.05
			64QAM	40.23	39.97	43.11
		Middle	QPSK	40.10	39.39	42.77
			16QAM	39.59	39.12	42.37
			64QAM	39.67	39.02	42.37
		High	QPSK	40.15	38.14	42.27
			16QAM	39.76	38.32	42.11
			64QAM	39.73	38.17	42.03
	4	Low	QPSK	39.96	40.11	43.05
			16QAM	40.04	39.47	42.77
			64QAM	40.19	39.61	42.92
		Middle	QPSK	40.41	39.81	43.13
			16QAM	40.30	39.70	43.02
			64QAM	40.35	39.34	42.88
		High	QPSK	40.09	39.06	42.62
			16QAM	39.98	38.89	42.48
			64QAM	39.99	38.86	42.47

2. Non-Contiguous

1+3

Ant.	Ant. Angle	CC	Channel	Freq. (GHz)	Mod.	Measured Level (dBuV)	EIRP (dBm)
A	0°	1+3	Low	27.90006	QPSK	85.67	38.32
					16QAM	85.73	38.37
					64QAM	85.63	38.27
			High	27.94998	QPSK	85.40	38.14
					16QAM	85.51	38.25
					64QAM	85.52	38.25
B	90°		Low	27.90006	QPSK	85.78	38.42
					16QAM	84.58	37.22
					64QAM	84.73	37.37
			High	27.94998	QPSK	84.98	37.72
					16QAM	84.71	37.44
					64QAM	84.72	37.46

3+1

Ant.	Ant. Angle	CC	Channel	Freq. (GHz)	Mod.	Measured Level (dBuV)	EIRP (dBm)
A	0°	3+1	Low	27.90006	QPSK	86.40	39.05
					16QAM	86.45	39.10
					64QAM	86.55	39.19
			High	27.94998	QPSK	86.40	39.14
					16QAM	86.48	39.22
					64QAM	86.46	39.20
B	90°		Low	27.90006	QPSK	86.29	38.93
					16QAM	86.32	38.97
					64QAM	86.41	39.05
			High	27.94998	QPSK	86.52	39.26
					16QAM	86.55	39.29
					64QAM	86.52	39.25

Tabular Data of Conducted Output Power for MIMO

Antenna	CC	Channel	Mod.	Ant. A (dBm)	Ant. B (dBm)	Result (dBm)
A+B	1+3	Low	QPSK	38.32	39.05	41.71
			16QAM	38.37	39.10	41.76
			64QAM	38.27	39.19	41.76
		High	QPSK	38.14	39.14	41.68
			16QAM	38.25	39.22	41.77
			64QAM	38.25	39.20	41.76
	3+1	Low	QPSK	38.42	38.92	41.69
			16QAM	37.22	38.97	41.19
			64QAM	37.37	39.05	41.30
		High	QPSK	37.72	39.26	41.57
			16QAM	37.44	39.29	41.47
			64QAM	37.46	39.25	41.46

Plot Data of Equivalent Isotropic Radiated Power

Antenna A / 1cc / 64QAM / Low

Antenna A / 4cc / QPSK / Middle

Antenna B / 1+3 cc / QPSK / Low

Antenna B / 3+1 cc / 16QAM / High

5.4. BAND EDGE

FCC Rules

Test Requirements:

§ 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 30.203 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.

(b)(1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater.

(2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges as the design permits.

(3) The measurements of emission power can be expressed in peak or average values.

Test Procedures:

The measurement is performed in accordance with Section 5.7.3 of ANSI C63.26.

5.7.3 Out-of-band unwanted emissions measurements

a) Set the spectrum analyzer center frequency to the block, band, or channel edge frequency.

b) Set the span wide enough to capture the fundamental emission closest to the authorized block or band edge, and to include all modulation products that spill into the immediately adjacent frequency band. In some cases, it may be possible to set the center frequency and span so as to encompass the fundamental emission and the unwanted out-of-band (band-edge) emissions on either side of the authorized block, band, or channel. This can be accomplished with a single (slow) sweep, if adequate overload protection and sufficient dynamic range can be maintained.

c) Set the number of points in sweep ≥ 2 × span / RBW.

d) Sweep time should be auto for peak detection. For rms detection the sweep time should be set as follows:

1), 2) Omitted

3) If the device cannot be configured to transmit continuously (duty cycle < 98%) and a free running sweep must be used, set the sweep time so that the averaging is performed over multiple on/off cycles by setting the sweep time > (number of points in sweep) × (transmitter period) (i.e., the transmit on-time + the off-time). The spectrum analyzer readings shall subsequently be corrected by [10 log (1/duty cycle)]. This assumes that the transmission period and duty cycle is relatively constant (duty cycle variation ≤ ±2%).

4) Omitted

e) The test report shall include the plots of the measuring instrument display and the measured data.

f) See Annex I for example emission mask plots.

TRP Test Procedures:

The measurement is performed in accordance with Section 4.4.3.3.2 of KDB 842590 v01 (2019-04).

a) Align the EUT with a chosen xy-plane and the xz-plane of the antenna measurement coordinate system.

NOTE 1 For harmonics and spurious emission frequencies which are beamforming as identified in exploratory scan, it may be required to align the orthogonal cuts to include the peak based on exploratory scans.

b) Measure the EUT dimensions, i.e., depth (d), width (w), and height (h); see Figure A.1 in Appendix A.

c) Calculate the spherical and cylindrical diameters (D and Dcyl) using Equations (A.1) and (A.2) (see Appendix A).

d) For the highest frequency (smallest wavelength) of the frequency band measured, calculate the reference angular steps $\Delta\theta$ref and $\Delta\phi$ref using Equations (A.3) and (A.4).

e) Set the grid spatial sampling step $\Delta\theta \leq \Delta\theta$ref for the vertical angle and $\Delta\phi \leq \Delta\phi$ref for the horizontal cut.

f) For each emission frequency, measure the EIRP (as a sum of two orthogonal polarizations) at each spatial sampling step on the selected grid.

g) For each emission frequency, calculate the average EIRP for both the cuts separately, and then take the average of these two average values.

h) Add 2 dB as a correction factor to the averaged value computed in step g).

i) If the TRP limit is exceeded, a third orthogonal cut in the yz-plane and using the $\Delta\theta$ angular step, can be added. Now, calculate the average values in all three cuts separately, and then take the average value of these three average values.

j) Add 1.5 dB as a correction factor to the averaged value computed in step i).

k) Evaluate the pass/fail decision by comparing TRP from step h) or step j) against the applicable TRP limit.

Note:

1) Basic test conditions are same as EIRP test on section 5.2.
2) In the band edge test of path A, B are individually operated and measured at the maximum emission position of path A, and the respective measurement results are summed.
3) For measurement of path B repeat 2) at the maximum emission position of path B.
4) Band edge value is calculated as follows.

Band Edge = Measured Value + 20log(D) – 104.77 + AFCL + Duty

5) Sample calculation

Path B, 1cc, Low, 64QAM:

41.344 dBμV (measured) + 9.54(distance) - 104.77 +46.969(AFCL) + 1.300 (Duty)

= -5.617 dBm (Path B Edge)

Test Results:

Tabular Data of Band Edge

1. Contiguous

Pos.	Ant. Angle	Distance (m)	cc	Edge	Mod.	Ant	Measured Level (dBuV)	EIRP (dBm)	Limit (dBm)	TRP (dBm)
MAX Ant. A	0°	3	1	Low	QPSK	A	38.942	-8.019	-8	-11.795
						B	27.515	-19.446	-8	-
					16QAM	A	38.154	-8.807	-8	-12.410
						B	24.290	-22.671	-8	-
					64QAM	A	38.624	-8.337	-8	-11.808
						B	26.710	-20.251	-8	-
				High	QPSK	A	36.596	-10.462	-8	-
						B	22.219	-24.674	-16	-
					16QAM	A	36.173	-10.885	-8	-
						B	22.687	-24.206	-16	-
					64QAM	A	35.250	-11.808	-8	-
						B	22.373	-24.685	-16	-
			4	Low	QPSK	A	32.633	-14.328	-8	-
						B	24.506	-23.102	-16	-
					16QAM	A	31.565	-15.396	-8	-
						B	24.524	-23.084	-16	-
					64QAM	A	31.230	-15.731	-8	-
						B	24.678	-22.724	-16	-
				High	QPSK	A	32.184	-14.874	-8	-
						B	22.230	-23.988	-16	-
					16QAM	A	35.297	-11.761	-8	-
						B	22.330	-24.728	-8	-
					64QAM	A	33.987	-13.071	-8	-
						B	22.342	-24.503	-16	-

Pos.	Ant. Angle	Distance (m)	cc	Edge	Mod.	Ant	Measured Level (dBuV)	EIRP (dBm)	Limit (dBm)	TRP (dBm)
MAX Ant. B	90°	3	1	Low	QPSK	A	32.688	-14.273	-8	-
						B	38.917	-8.044	-8	-11.500
					16QAM	A	28.585	-18.100	-8	-
						B	41.279	-5.682*	-8	-9.506
					64QAM	A	35.268	-11.417	-8	-
						B	41.344	-5.617*	-8	-9.756
				High	QPSK	A	22.493	-24.636	-16	-
						B	34.671	-12.387	-8	-
					16QAM	A	22.459	-24.487	-16	-
						B	32.277	-14.781	-8	-
					64QAM	A	22.627	-24.502	-16	-
						B	34.514	-12.544	-8	-
			4	Low	QPSK	A	29.122	-17.980	-16	-
						B	31.089	-16.383	-16	-18.989
					16QAM	A	29.060	-18.042	-16	-
						B	30.300	-16.687	-16	-18.998
					64QAM	A	29.788	-16.484	-16	-18.383
						B	30.497	-16.490	-8	-
				High	QPSK	A	28.094	-18.228	-16	-
						B	28.736	-18.393	-8	-
					16QAM	A	27.818	-19.504	-16	-
						B	30.652	-16.477	-8	-
					64QAM	A	27.916	-18.406	-16	-
						B	31.110	-16.019	-8	-

2. Non-Contiguous

1+3

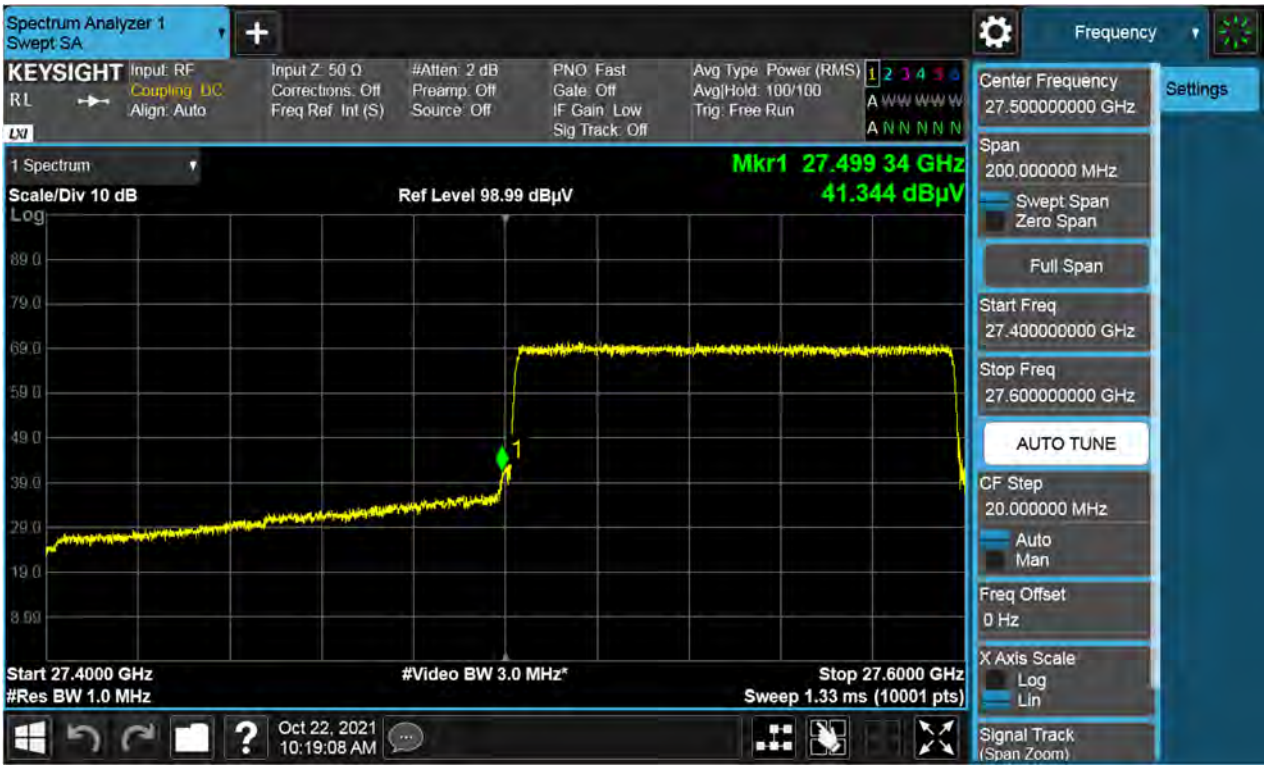
Pos.	Ant. Angle	Distance (m)	cc	Edge	Mod.	Ant	Measured Level (dBuV)	EIRP (dBm)	Limit (dBm)	TRP (dBm)
MAX Ant. A	0°	3	1+3	Low	QPSK	A	31.118	-15.787	-8	
						B	27.685	-19.294	-16	
					16QAM	A	29.521	-17.458	-16	
						B	28.168	-18.811	-16	
					64QAM	A	28.961	-18.018	-16	
						B	28.352	-18.627	-16	
				High	QPSK	A	33.922	-13.136	-8	
						B	30.062	-16.673	-16	-18.398
					16QAM	A	33.630	-13.428	-8	
						B	29.358	-17.377	-16	
					64QAM	A	32.159	-14.899	-8	
						B	29.872	-16.863	-16	-18.697
MAX Ant. B	90°			Low	QPSK	A	24.462	-23.006	-16	
						B	31.093	-15.812	-8	
					16QAM	A	24.494	-22.974	-16	
						B	27.747	-19.721	-16	
					64QAM	A	24.570	-23.155	-16	
						B	28.309	-18.406	-16	
				High	QPSK	A	23.125	-23.291	-16	
						B	31.353	-15.705	-8	
					16QAM	A	22.837	-23.579	-16	
						B	33.215	-13.843	-8	
					64QAM	A	22.955	-23.461	-16	
						B	29.727	-17.331	-8	

3+1

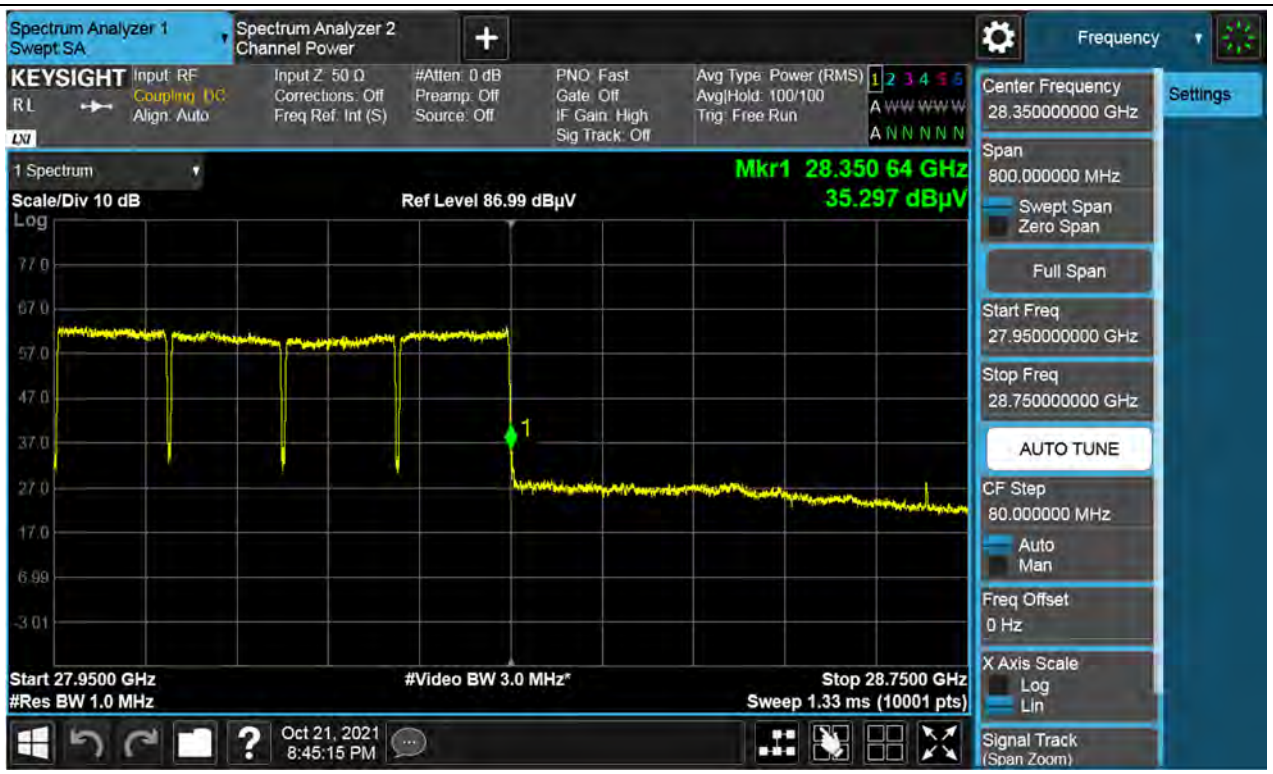
Pos.	Ant. Angle	Distance (m)	cc	Edge	Mod.	Ant	Measured Level (dBuV)	EIRP (dBm)	Limit (dBm)	TRP (dBm)
MAX Ant. A	0°	3	3+1	Low	QPSK	A	30.242	-16.663	-8	-
						B	29.458	-17.521	-16	-
					16QAM	A	30.746	-16.159	-8	-
						B	29.144	-17.835	-16	-
					64QAM	A	30.428	-16.177	-16	-18.191
						B	29.397	-17.582	-16	-
				High	QPSK	A	29.186	-17.872	-8	-
						B	28.333	-18.402	-16	-
					16QAM	A	29.713	-17.022	-16	-
						B	28.045	-18.690	-16	-
					64QAM	A	30.045	-16.690	-16	-18.603
						B	28.709	-18.026	-16	-
MAX Ant. B	90°			Low	QPSK	A	24.808	-22.800	-16	-
						B	30.346	-16.369	-16	-18.303
					16QAM	A	24.393	-23.332	-16	-
						B	29.723	-17.479	-16	-
					64QAM	A	24.313	-23.373	-16	-
						B	30.704	-16.201	-8	-
				High	QPSK	A	22.883	-23.711	-16	-
						B	28.232	-18.826	-8	-
					16QAM	A	22.740	-23.854	-16	-
						B	30.091	-16.967	-8	-
					64QAM	A	22.654	-23.940	-16	-
						B	28.972	-18.086	-8	-

Plot data of Band Edge

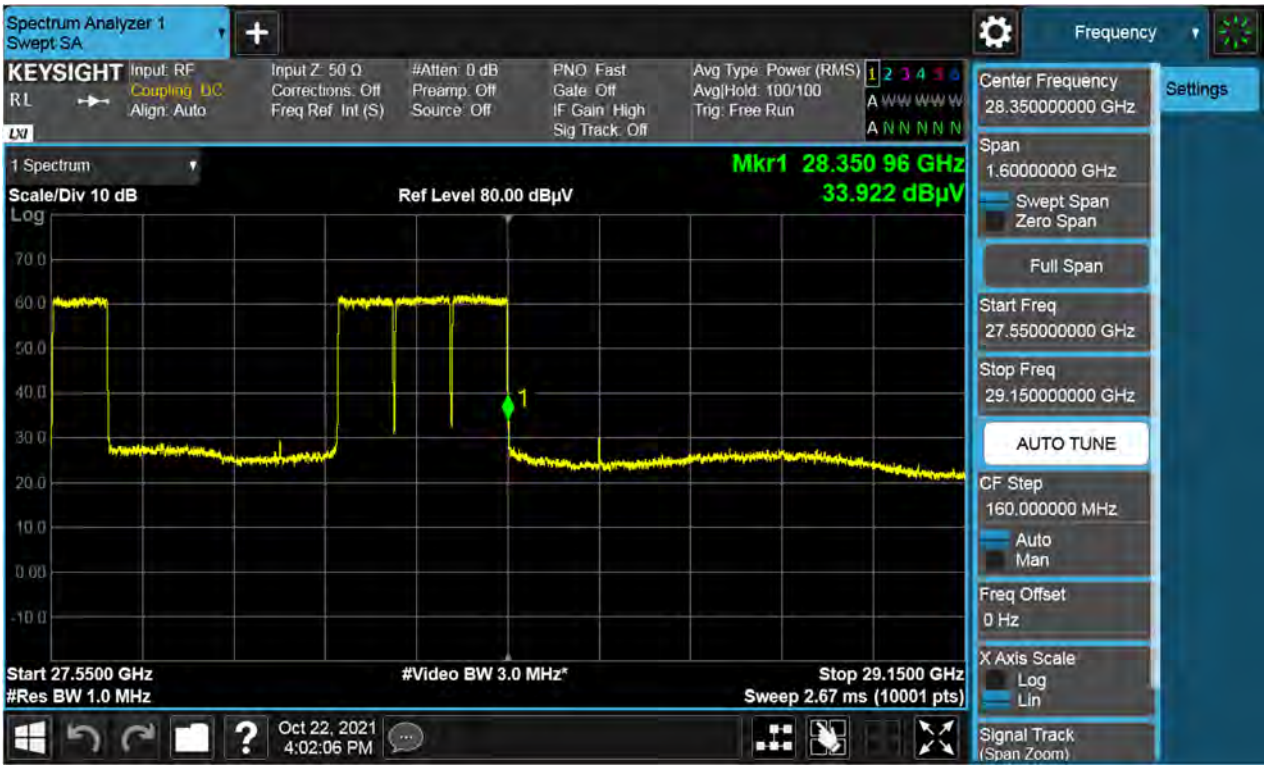
MAX Ant. B Position / 1cc / Low / 64QAM / Ant. B



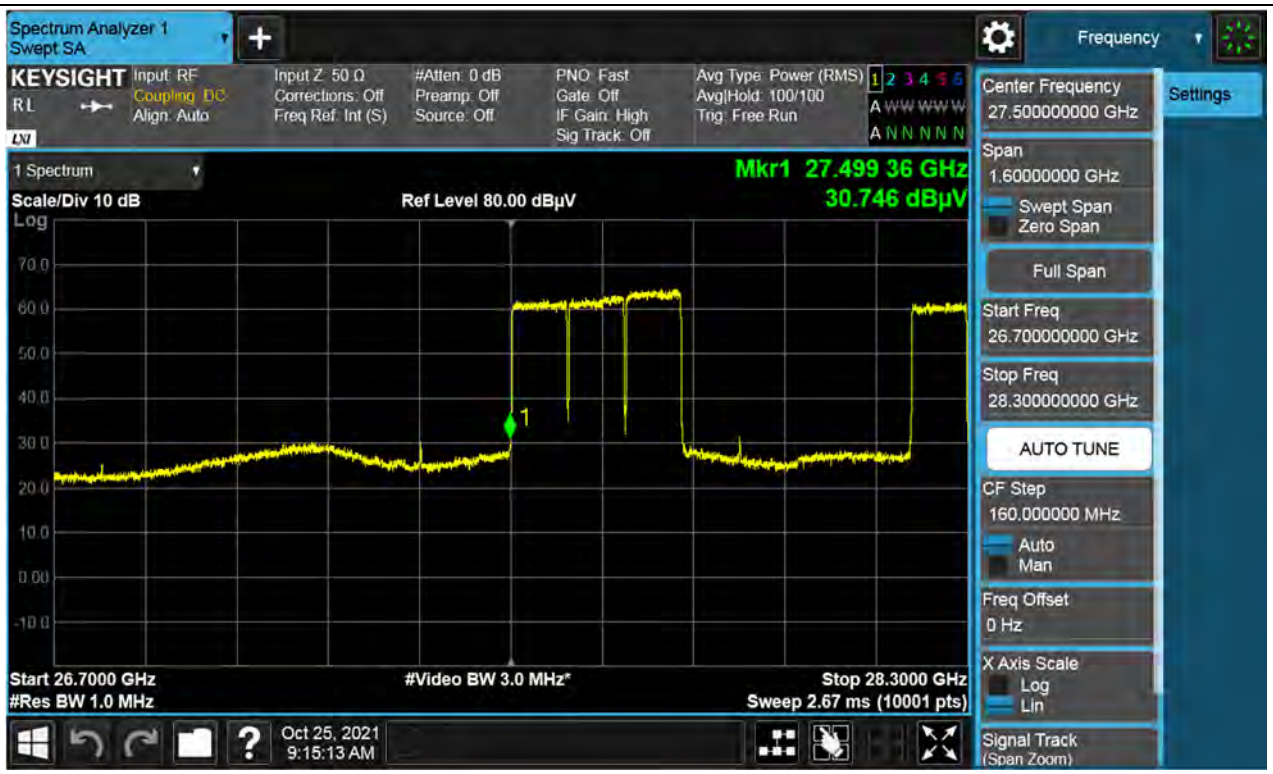
MAX Ant. A Position / 4cc / High / 16QAM / Ant. A



MAX Ant. A Position / 1+3cc / High / QPSK / Ant. A



MAX Ant. A Position / 3+1cc / Low / 16QAM / Ant. A



5.5. RADIATED SPURIOUS EMISSIONS

FCC Rules

Test Requirements:

§ 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 30.203 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.

(b)(1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater.

(2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges as the design permits.

(3) The measurements of emission power can be expressed in peak or average values.

EIRP Test Procedures:

The measurement is performed in accordance with Section 5.7.4 of ANSI C63.26.

5.7.4 Spurious unwanted emission measurements

a) Set the spectrum analyzer start frequency to the lowest frequency generated by the EUT, without going below 9 kHz, and the stop frequency to the lower frequency covered by the measurements previously performed in 5.7.3. As an alternative, the stop frequency can be set to the value specified in 5.1.1, depending on the EUT operating range, if the resulting plot can clearly demonstrate compliance for all frequencies not addressed by the out-of-band emissions measurements performed as per 5.7.3.

b) When using an average power (rms) detector, ensure that the number of points in the sweep ≥ 2 × (span / RBW). This may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the spectrum analyzer capabilities. This requirement does not apply to peak-detected power measurements.

When average power is specified by the applicable regulation, a peak-detector can be utilized for preliminary measurements to accommodate wider frequency spans.

Any emissions found in the preliminary measurement to exceed the applicable limit(s) shall be further examined using a power averaging (rms) detector with the minimum number of measurement points as defined above.

c) The sweep time should be set to auto-couple for performing peak-detector measurements. For measurements that use a power averaging (rms) detector, the sweep time shall be set as described for out-of-band emissions measurements in item d) of 5.7.3.

d) Identify and measure the highest spurious emission levels in each frequency range. It is not necessary to re-measure the out-of-band emissions as a part of this test. Record the frequencies and amplitudes corresponding to the measured emissions and capture the data plots.

e) Repeat step b) through step d) for the upper spurious emission frequency range if not already captured by a wide span measurement performed as per the alternative provided in step a). The upper frequency for this measurement is defined in 5.1.1 as a function of the EUT operating range.

f) Compare the results with the corresponding limit in the applicable regulation.

g) The test report shall include the data plots of the measuring instrument display and the measured data.

Note:

1) Spurious emission test is performed up to 100 GHz frequency according to section 5.1.1 of ANSI C63.26 -2015.
2) Measurement distance is applied far field condition on page 8.
3) In case of 9 kHz to 30 MHz and 30 MHz to 1 GHz, the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
4) Test plot(1 GHz ~ 100 GHz) doesn't include any factors and all factors such as AFCL is calculated in tabular data.
5) In this test, AFCL factor consists of antenna factor, cable loss, mixer loss, amplifier gain and duty correction.
6) Emissions value is first converted by distance factor as follow.

   Converted value (dBm) = Measured Value (dBuV) + 20 LOG(D) - 104.77 + Duty Cycle correction

7) Final spurious emissions result is calculated as follows.

   Spurious Emissions = Converted Value (dBm) + AFCL + Duty

8) Sample calculations

1 GHz ~ 18 GHz

22.261 dBμV (measured) + 9.54 (distance) - 104.77 + 33.183 (AFCL) + 1.300 (Duty) = -38.48 dBm

18 GHz ~ 40 GHz

29.033 dBμV (measured) + 9.54 (distance) - 104.77 + 46.517 (AFCL) + 1.300 (Duty) = -18.38dBm

40 GHz ~ 100 GHz

4.987 dBμV (measured) + 9.54 (distance) - 104.77 + 65.282 (AFCL) +1.300 (Duty) = -23.66 dBm

Test Results:

Tabular Data of Radiated Spurious Emissions

1. Contiguous

1cc

Ant.	Freq.	Mod	Distance (m)	Frequency (GHz)	Measured (dBuV)	Limit (dBm)	Result (dBm)
H	1 GHz ~ 18 GHz	QPSK	3	3.831	22.261	-13	-38.48
	18 GHz ~ 40 GHz			38.695	28.786		-19.58
	40 GHz ~ 60 GHz			40.246	5.495		-31.30
	60 GHz ~ 90 GHz			72.663	5.009		-27.29
	90 GHz ~ 100 GHz			94.404	5.506		-25.98
V	1 GHz ~ 18 GHz	QPSK	3	3.867	21.882		-38.82
	18 GHz ~ 40 GHz			39.127	29.033		-18.38
	40 GHz ~ 60 GHz			40.247	7.053		-29.74
	60 GHz ~ 90 GHz			77.736	4.987		-23.66
	90 GHz ~ 100 GHz			99.496	5.100		-26.24

4cc

Ant.	Freq.	Mod	Distance (m)	Frequency (GHz)	Measured (dBuV)	Limit (dBm)	Result (dBm)
H	1 GHz ~ 18 GHz	QPSK	3	3.828	21.939	-13	-38.81
	18 GHz ~ 40 GHz			38.639	29.285		-19.19
	40 GHz ~ 60 GHz			40.246	5.605		-31.19
	60 GHz ~ 90 GHz			70.433	4.886		-27.34
	90 GHz ~ 100 GHz			98.903	5.008		-26.41
V	1 GHz ~ 18 GHz	QPSK	3	3.871	21.383		-39.32
	18 GHz ~ 40 GHz			38.710	29.140		-19.23
	40 GHz ~ 60 GHz			40.242	7.175		-29.62
	60 GHz ~ 90 GHz			87.892	5.120		-28.65
	90 GHz ~ 100 GHz			98.895	5.241		-26.23

Note:

1. Because of no critical emissions are detected in the test, only peak value is recorded in this report.

2. Non-Contiguous

1cc+3cc

Ant.	Freq.	Mod	Distance (m)	Frequency (GHz)	Measured (dBuV)	Limit (dBm)	Result (dBm)
H	1 GHz ~ 18 GHz	QPSK	3	3.833	21.780	-13	-39.06
	18 GHz ~ 40 GHz			38.719	28.890		-19.48
	40 GHz ~ 60 GHz			40.284	4.346		-32.44
	60 GHz ~ 90 GHz			71.715	5.015		-28.55
	90 GHz ~ 100 GHz			98.854	4.857		-26.61
V	1 GHz ~ 18 GHz	QPSK	3	3.912	22.200		-38.37
	18 GHz ~ 40 GHz			38.737	28.726		-19.64
	40 GHz ~ 60 GHz			40.279	4.368		-32.42
	60 GHz ~ 90 GHz			69.056	4.911		-27.84
	90 GHz ~ 100 GHz			93.791	4.629		-26.89

3cc+1cc

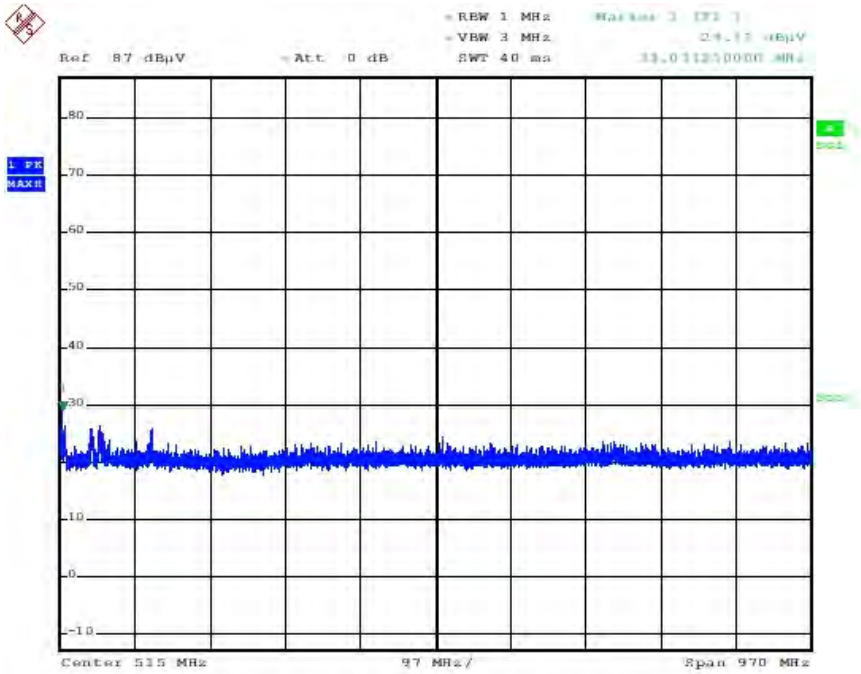
Ant.	Freq.	Mod	Distance (m)	Frequency (GHz)	Measured (dBuV)	Limit (dBm)	Result (dBm)
H	1 GHz ~ 18 GHz	QPSK	3	3.823	21.778	-13	-39.07
	18 GHz ~ 40 GHz			38.701	28.773		-19.60
	40 GHz ~ 60 GHz			40.269	4.704		-32.09
	60 GHz ~ 90 GHz			62.364	5.013		-29.98
	90 GHz ~ 100 GHz			98.863	4.663		-26.81
V	1 GHz ~ 18 GHz	QPSK	3	3.809	21.638		-39.11
	18 GHz ~ 40 GHz			38.653	29.085		-19.39
	40 GHz ~ 60 GHz			40.281	4.176		-32.61
	60 GHz ~ 90 GHz			72.841	5.005		-27.12
	90 GHz ~ 100 GHz			99.482	4.565		-26.77

Note:

1. Because of no critical emissions are detected in the test, only peak value is recorded in this report.

Plot data of Radiated Spurious Emissions

30 MHz ~ 1 GHz / 1cc / H



1 GHz ~ 18 GHz / 1cc / H

18 GHz ~ 40 GHz / 1cc / H

40 GHz ~ 60 GHz / 1cc / H

60 GHz ~ 90 GHz / 1cc / H

90 GHz ~ 100 GHz / 1cc / H

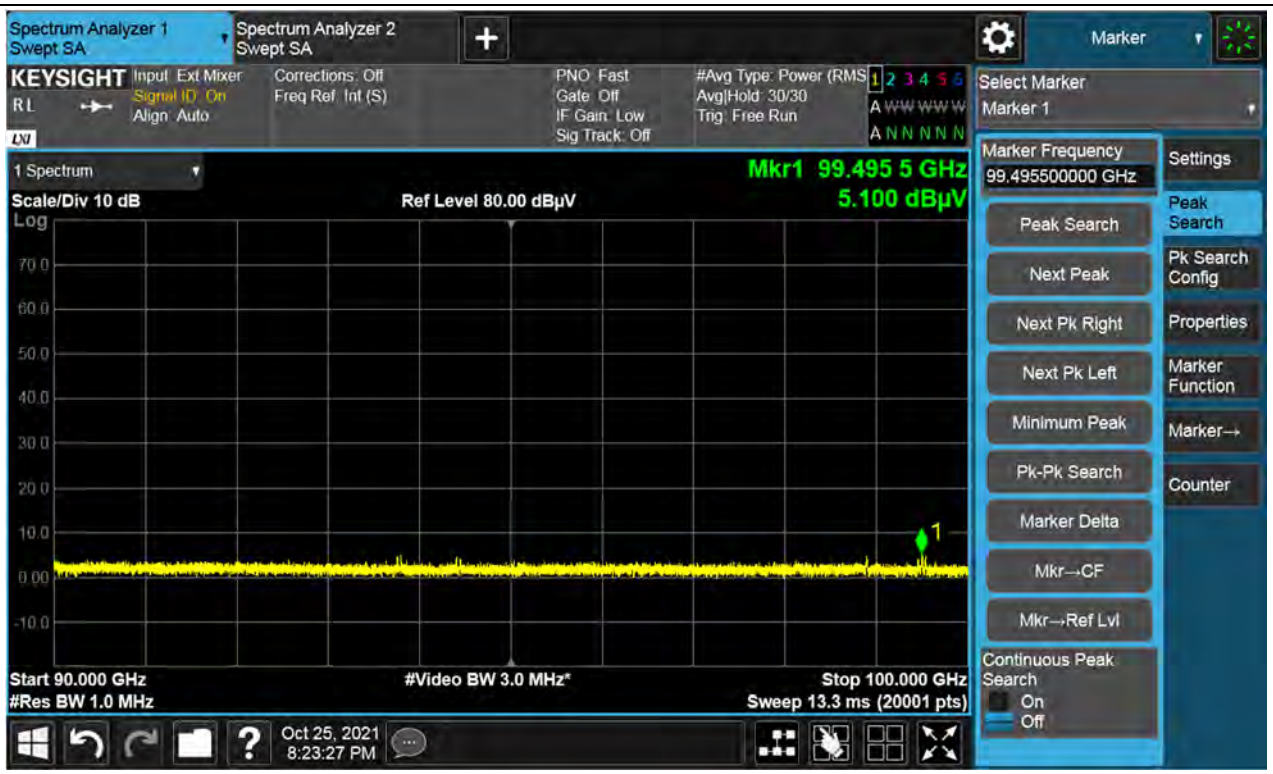
1 GHz ~ 18 GHz / 1cc / V

18 GHz ~ 40 GHz / 1cc / V

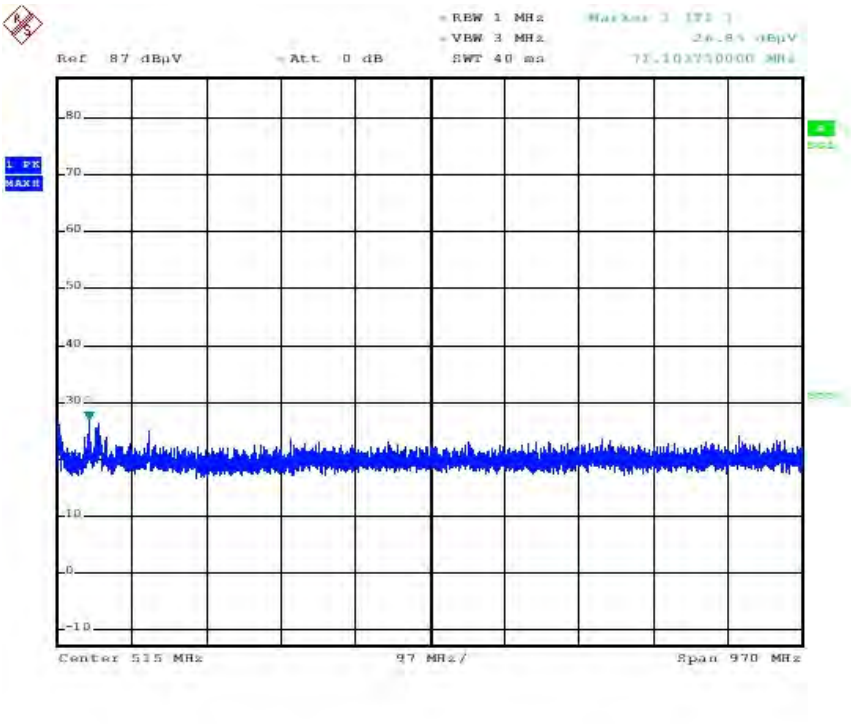
40 GHz ~ 60 GHz / 1cc / V

60 GHz ~ 90 GHz / 1cc / V

90 GHz ~ 100 GHz / 1cc / V



30 MHz ~ 1 GHz / 4cc / H



1 GHz ~ 18 GHz / 4cc / H

18 GHz ~ 40 GHz / 4cc / H

40 GHz ~ 60 GHz / 4cc / H

60 GHz ~ 90 GHz / 4cc / H

90 GHz ~ 100 GHz / 4cc / H

1 GHz ~ 18 GHz / 4cc / V

18 GHz ~ 40 GHz / 4cc / V

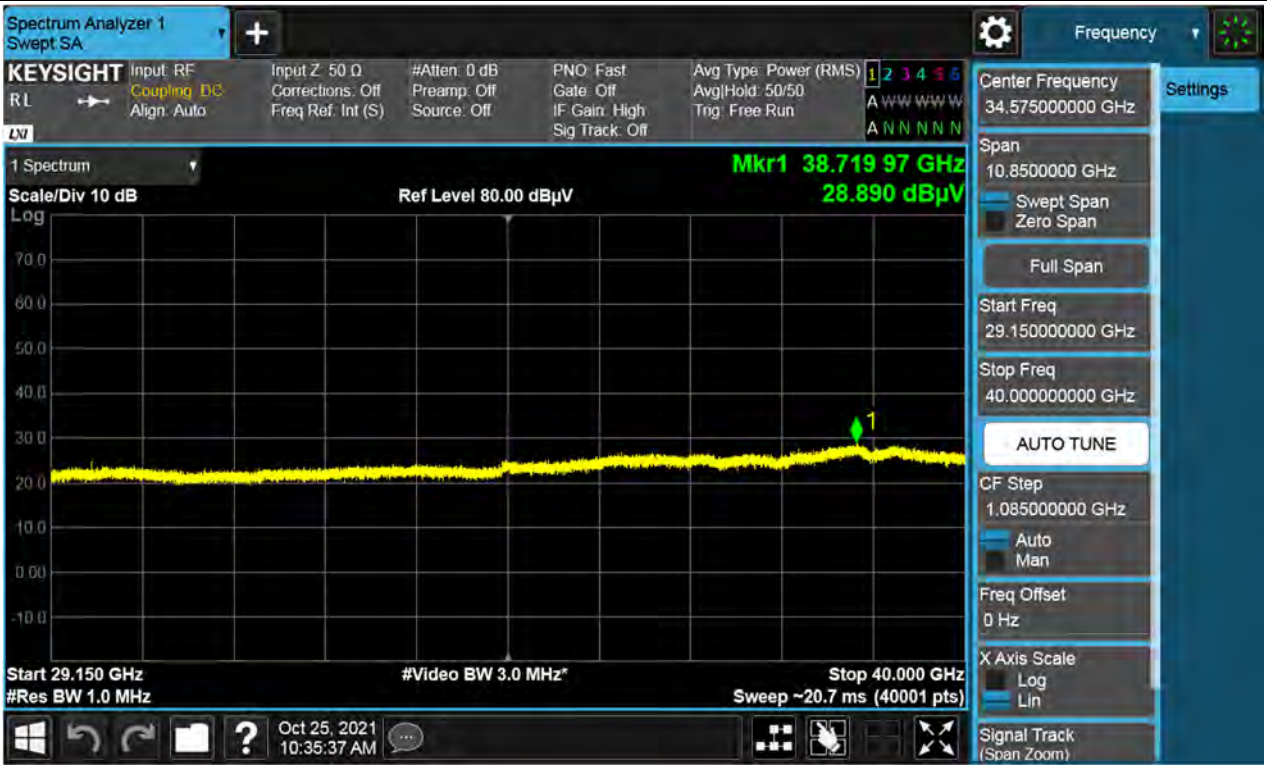
40 GHz ~ 60 GHz / 4cc / V

60 GHz ~ 90 GHz / 4cc / V

90 GHz ~ 100 GHz / 4cc / V

1 GHz ~ 18 GHz / 1cc + 3cc / H

18 GHz ~ 40 GHz / 1cc + 3cc / H

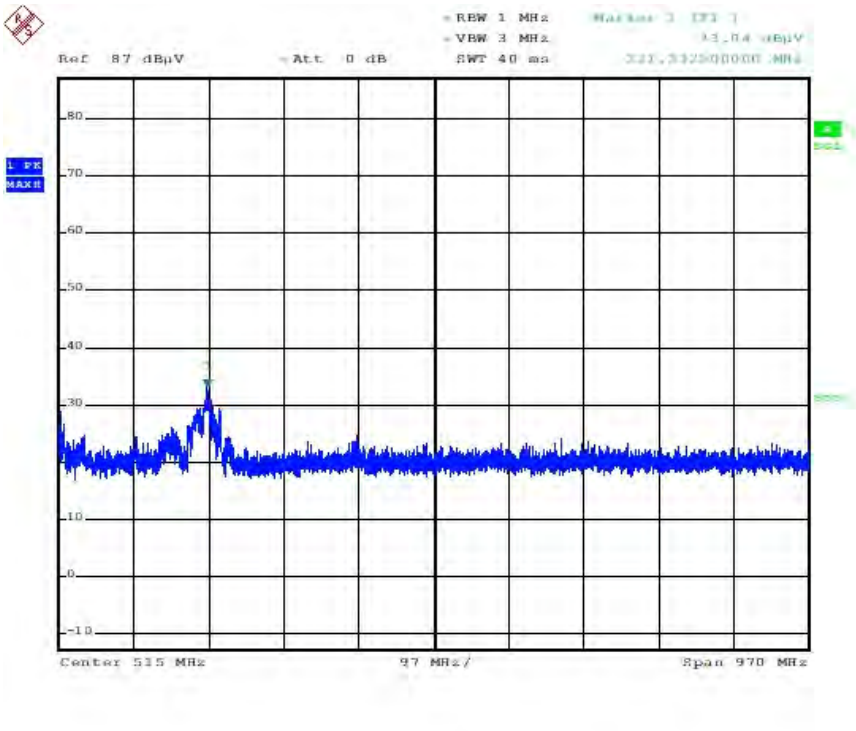


40 GHz ~ 60 GHz / 1cc + 3cc / H

60 GHz ~ 90 GHz / 1cc + 3cc / H

90 GHz ~ 100 GHz / 1cc + 3cc / H

30 MHz ~ 1 GHz / 1cc + 3cc / V



1 GHz ~ 18 GHz / 1cc + 3cc / V

18 GHz ~ 40 GHz / 1cc + 3cc / V

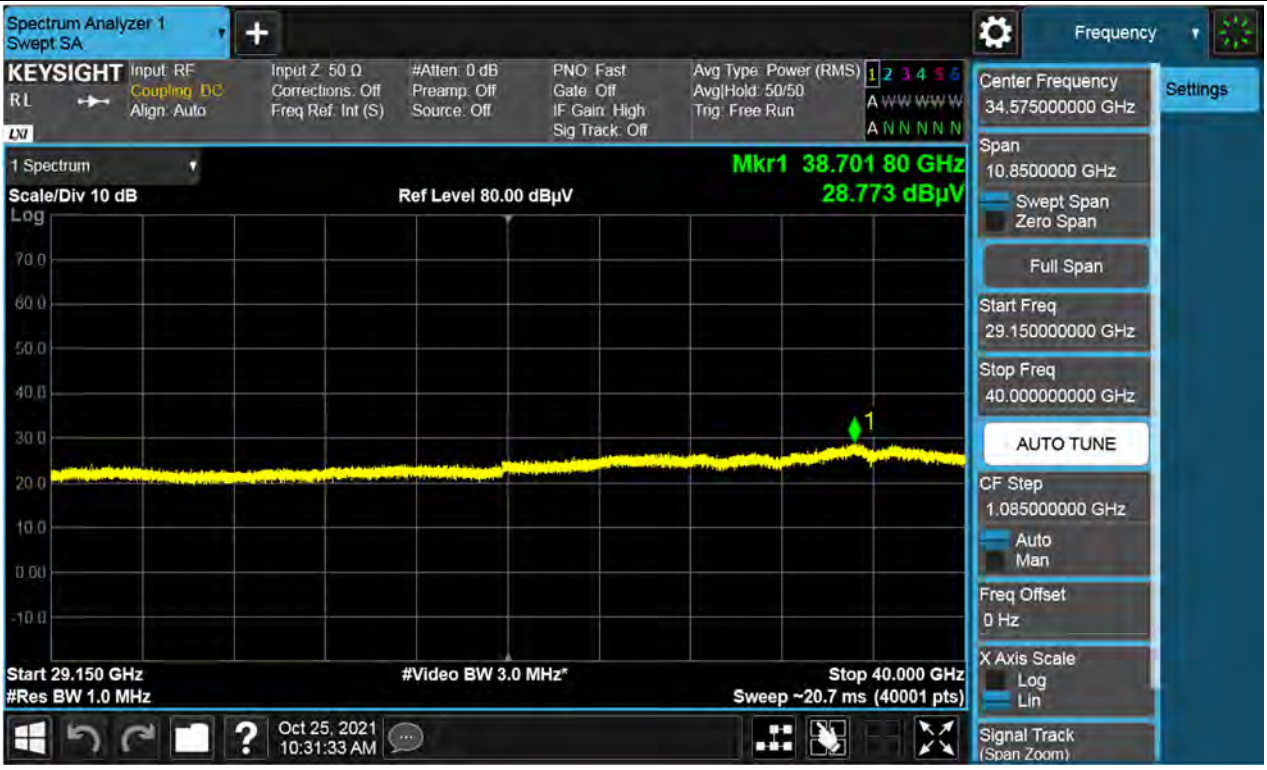
40 GHz ~ 60 GHz / 1cc + 3cc / V

60 GHz ~ 90 GHz / 1cc + 3cc / V

90 GHz ~ 100 GHz / 1cc + 3cc / V

1 GHz ~ 18 GHz / 3cc + 1cc / H

18 GHz ~ 40 GHz / 3cc + 1cc / H

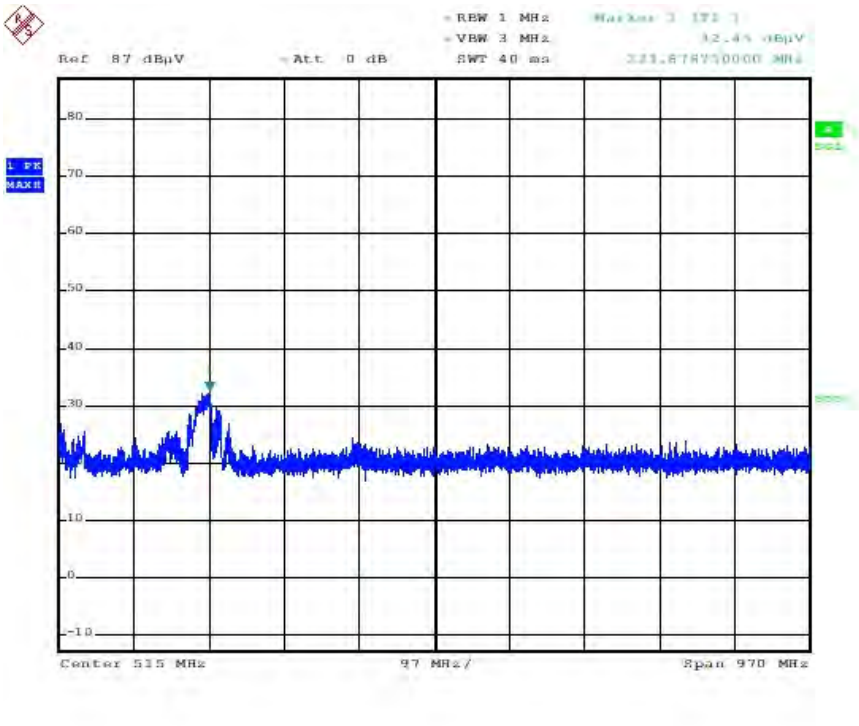


40 GHz ~ 60 GHz / 3cc + 1cc / H

60 GHz ~ 90 GHz / 3cc + 1cc / H

90 GHz ~ 100 GHz / 3cc + 1cc / H

30 MHz ~ 1 GHz / 3cc + 1cc / V



1 GHz ~ 18 GHz / 3cc + 1cc / V

18 GHz ~ 40 GHz / 3cc + 1cc / V

40 GHz ~ 60 GHz / 3cc + 1cc / V

60 GHz ~ 90 GHz / 3cc + 1cc / V

90 GHz ~ 100 GHz / 3cc + 1cc / V

5.6. FREQUENCY STABILITY

FCC Rules

Test Requirements:

§ 2.1055 Measurements required: Frequency stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

Test Procedures:

The measurement is performed in accordance with Section 5.6.4 and 5.6.5 of ANSI C63.26.

5.6.4 Frequency stability over variations in temperature

a) Supply the EUT with a nominal 60 Hz ac voltage, dc voltage, or install a new or fully charged battery in the EUT.

b) If possible a dummy load should be connected to the EUT because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, the EUT should be placed in the center of the chamber with the antenna adjusted to the shortest length possible.

c) Turn on the EUT, and tune it to the center frequency of the operating band.

d) Couple the transmitter output to the measuring instrument through a suitable attenuator and coaxial cable. If connection to the EUT output is not possible, make the measurement by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away).

NOTE—An instrument that has an adequate level of accuracy as specified by the procuring or regulatory authority is the recommended measuring instrument.

e) Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument, but is strong enough to allow measurement of the operating or fundamental frequency of the EUT). Adjust the detector bandwidth and span settings to achieve a resolution capable of accurate frequency measurements over the applicable frequency stability limits.

f) Turn the EUT off, and place it inside the environmental temperature chamber. For devices that have oscillator heaters, energize only the heater circuit.

g) Set the temperature control on the chamber to the highest temperature specified in the regulatory requirements for the type of device, and allow the oscillator heater and the chamber temperature to stabilize. Unless otherwise instructed by the regulatory authority, this temperature should be 50 °C.

h) While maintaining a constant temperature inside the environmental chamber, turn on the EUT and allow sufficient time for the EUT temperature to stabilize.

i) Measure the frequency.

j) Switch off the EUT, but do not switch off the oscillator heater.

k) Lower the chamber temperature to the next level that is required by the standard and allow the temperature inside the chamber to stabilize. Unless otherwise instructed by the regulators, this temperature step should be 10 °C.

l) Repeat step h) through step k) down to the lowest specified temperature. Unless otherwise instructed by the regulators, this temperature should be −30 °C. When the frequency stability limit is stated as being sufficient such that the fundamental

emissions stay within the authorized bands of operation, a reference point shall be established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation shall be identified as f_L and f_H respectively. The worst-case frequency offset determined in the above methods shall be added or subtracted from the values of f_L and f_H and the resulting frequencies must remain within the band.

m) Omitted

5.6.5 Frequency stability when varying supply voltage

a) Couple the transmitter output to the measuring instrument through a suitable attenuator and coaxial cable. If connection to the EUT output is not possible make the measurement by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away)

b) Supply the EUT with nominal ac or dc voltage. The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

c) Turn on the EUT, and couple its output to a frequency counter or other frequency-measuring instrument.

d) Tune the EUT to the center frequency of the operating band. Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument, but is strong enough to allow measurement of the operating or fundamental frequency of the EUT). Adjust the detector bandwidth and span settings to achieve a resolution capable of accurate frequency measurements over the applicable frequency stability limits.

NOTE—An instrument that has an adequate level of accuracy as specified by the procuring or regulatory authority is the recommended measuring instrument.

e) Measure the frequency.

f) Unless otherwise specified, vary primary supply voltage from 85% to 115% of the nominal value for other than hand carried battery equipment.

g) For hand carried, battery powered equipment, reduce the primary ac or dc supply voltage to the battery operating end point, which shall be specified by the manufacturer.

h) Repeat the frequency measurement.

NOTE—For band-edge compliance, it can be required to make these measurements at the low and high channel of the operating band.

Note:

1) The results of the frequency stability test shown above the frequency deviation measured values are very small and similar trend for each path, so we are attached only the worst case data.
2) Test signal is CW signal for frequency stability.

Test Results:

Reference: Voltage = (100 ~ 240) VAC at 20°C, Frequency = 38.50 GHz

Voltage	Temp.	Frequency	Frequency Error	Deviation	ppm
(%)	(°C)	(Hz)	(Hz)	(Hz)	
100%	+20(Ref)	27924 960 013	13.422	0.000	0.00000
	-30	27924 960 006	5.874	-7.548	-0.00027
	-20	27924 960 010	9.763	-3.659	-0.00013
	-10	27924 960 008	8.340	-5.082	-0.00018
	0	27924 960 002	1.693	-11.729	-0.00042
	+10	27924 960 000	0.077	-13.345	-0.00048
	+30	27924 960 001	0.812	-12.610	-0.00045
	+40	27924 960 006	5.776	-7.646	-0.00027
	+50	27924 960 010	9.819	-3.603	-0.00013
115%	+20	27924 960 001	1.418	-12.004	-0.00043
85%	+20	27924 960 006	5.998	-7.424	-0.00027

6. Annex A_Test Equipment CERTIFIED DOCUMENTS

Please refer to test equipment certified documents.

7. Annex B_EUT AND TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2111-FC011-P