

RF Test Report

Applicant : Framery Oy
Product Name : Radar Unit
Trade Name : Framery
Model Number : 9007966
Applicable Standard : FCC 47 CFR PART 15 SUBPART C
ANSI C63.10:2013
Received Date : Nov. 02, 2023
Test Period : Dec. 19, 2023 ~ Apr. 15, 2024
Issued Date : May 29, 2024

Issued by

Eurofins E&E Wireless Taiwan Co., Ltd.
No. 140-1, Changan Street, Bade District,
Taoyuan City 334025, Taiwan (R.O.C.)
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Taiwan Accreditation Foundation accreditation number: 1330

Frequency Range: 9 kHz to 325 GHz

Bade test site :

Test Firm Registration Number: 226252

Test Firm Designation Number: TW0010

Wugu test site :

Test Firm Registration Number: 191812

Test Firm Designation Number: TW0034

Note:

1. The test results are valid only for samples provided by customers and under the test conditions described in this report.
2. This report shall not be reproduced except in full, without the written approval of Eurofins E&E Wireless Taiwan Co., Ltd.
3. The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.

Revision History

Rev.	Issued Date	Description	Revised by
00	May 29, 2024	Initial Issue	Snow Wang

Verification of Compliance

Applicant : Framery Oy

Product Name : Radar Unit

Trade Name : Framery

Model Number : 9007966

FCC ID : 2AX4J9007966

Applicable Standard : FCC 47 CFR PART 15 SUBPART C
ANSI C63.10:2013

Test Result : Complied

Performing Lab. : Eurofins E&E Wireless Taiwan Co., Ltd.
No. 140-1, Changan Street, Bade District,
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Taiwan Accreditation Foundation accreditation number: 1330



Eurofins E&E Wireless Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Eurofins E&E Wireless Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By : _____

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1 General Information

1.1. Summary of Test Result

FCC Standard	Item	Result	Remark
15.207	AC Power Conducted Emission	PASS	-----
15.205, 15.209	Transmitter Radiated Emissions (Below 40 GHz)	PASS	-----
15.255(d)	Transmitter Radiated Emissions (Above 40 GHz)	PASS	-----
Part 15.255(c)(2)(iii)(A)	EIRP (Peak & Avg)	PASS	-----
15.255(e)	Peak Conducted Output Power	PASS	-----
15.255(e)(2)	6 dB Emission Bandwidth	Reference only	-----
2.1049	99% Occupied Bandwidth	Reference only	-----
15.255(f)	Frequency Stability	PASS	-----
15.203	Antenna Requirement	PASS	-----

Standard	Description
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63. 10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
TCB Workshop	2023-10-25-3.1 Part 15.255 Rules Amendment General Measurement Guidance

Decision Rule

- Uncertainty is not included.
- Uncertainty is included.

1.2. Testing Location

Lab Name: Eurofins E&E Wireless Taiwan Co., Ltd.
 Site Address: No. 140-1, Changan Street, Bade District, Taoyuan City 334025, Taiwan (R.O.C.)
 Site Address: No. 2, Wuquan 5th Rd. Wugu Dist., New Taipei City, Taiwan (R.O.C.)

1.3. Measurement Uncertainty

Test Item	Frequency	Uncertainty			
		BD		WG	
Conducted Emission	150 kHz ~ 30 MHz	2.7 dB		2.6 dB	
Test Item	Frequency	Uncertainty			
		96601-BD	96603-BD	96602-WG	96603-WG
Radiated Emission	9 kHz ~ 30 MHz	1.9 dB	1.9 dB	1.6 dB	1.6 dB
	30 MHz ~ 1000 MHz	4.9 dB	4.9 dB	4.8 dB	4.8 dB
	1000 MHz ~ 18000 MHz	4.9 dB	5.0 dB	5.0 dB	5.2 dB
	18000 MHz ~ 26500 MHz	4.3 dB	4.4 dB	4.4 dB	4.5 dB
	26500 MHz ~ 40000 MHz	4.5 dB	4.5 dB	4.6 dB	4.5 dB
	40000 MHz ~ 325000 MHz	3.1 dB	3.1 dB	3.1 dB	3.1 dB

1.4. Test Site Environment

Items	Required (IEC 60068-1)	Interval(*)
Temperature (°C)	15-35	20-30
Humidity (%RH)	25-75	45-75

(*)The measurement ambient temperature is within this range.

2 EUT Description

The product specifications of the EUT presented in the report are declared by the manufacturer who shall take full responsibility for the authenticity(except Max. RF Output Power, Max. EIRP).

Applicant	Framery Oy Patamaenkatu 7, Tampere 33900, Finland
Product Name	Radar Unit
Trade Name	Framery
Model Number	9007966
FCC ID	2AX4J9007966
Frequency Range	60-64 GHz
Modulation Type	FMCW
Number of Channel	1 CH
Antenna Type	Patch antenna
Antenna Gain	5.2 dBi
Operate Temp. Range	-15 ~ +35 °C
EUT Power Rating	Input - 24 Vdc, 2.2 A
Max. EIRP	10.93 dBm (Peak)
Max. RF Output Power	5.73 dBm (Peak Conducted)

3 Test Methodology

3.1. Mode of Operation

Decision of Test Eurofins has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

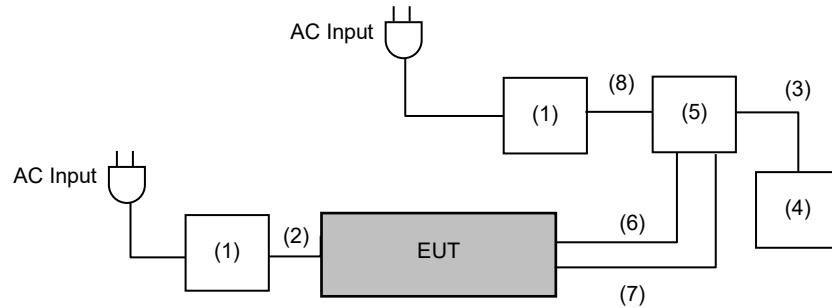
Pre-Test Mode	Final-Test Mode
Transmit Mode (60-64GHz)	✓

By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that "X axis" position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

3.2. EUT Test Step

1	Setup the EUT shown on "Configuration of Test System Details".
2	Turn on the power of EUT.

3.3. Configuration of Test System Details



Product		Manufacturer	Model Number	Serial Number	Note
(1)	Power Unit	Framery	9004252	---	---
(2)	Power cable (2pin to 2pin)	Mekoprint	9007640	---	---
(3)	HDMI Cable	Mekoprint	9007146	---	---
(4)	Touch Screen	Framery	9007015	---	---
(5)	Core unit	Framery	9005682	---	---
(6)	Molex cable (4pin to 4pin)	Framery	9000590_A	---	---
(7)	Molex cable (6pin to 6pin)	Mekoprint	9007177	---	---
(8)	Power cable (2pin to 2pin)	Mekoprint	9007640	---	---

3.4. Test Instruments

For Conducted Emission

Test Period: Jan. 18, 2024

Testing Engineer: Jayson Hsieh

Test Site		Conduction01-BD				
Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESCI	100367	May 22, 2023	1 year
<input checked="" type="checkbox"/>	LISN	R&S	ENV216	101040	Mar. 21, 2024	1 year
<input checked="" type="checkbox"/>	LISN	R&S	ENV216	101140	Jan. 15, 2024	1 year
<input checked="" type="checkbox"/>	RF Cable	Woken	00100D1380194M	TE-02-03	Jun. 01, 2023	1 year
<input checked="" type="checkbox"/>	Software	EZ EMC	1.1.4.3	N/A	N.C.R.	---

Note: N.C.R. = No Calibration Request.

For Conducted

Test Period: Dec. 28, 2023

Testing Engineer: John Chen

Test Site		RF01-BD				
Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
<input checked="" type="checkbox"/>	Spectrum Analyzer (3 Hz~50 GHz)	Agilent	N9030A	MY53120541	Dec. 29, 2022	1 year
<input checked="" type="checkbox"/>	Temperature & Humidity Chamber	TAICHY	MHU-225LA	980729	Mar. 29, 2023	1 year
<input checked="" type="checkbox"/>	True RMS Multimeter	FLIKE	87V	15530240	Jun. 16, 2023	1 year
<input checked="" type="checkbox"/>	Millimeter-Wave Signal Analyzer Frequency Extension Module (50-75GHz)	VDI	N9029AV15 (SAX 410)	US54250165	Aug. 23, 2023	2 years
<input checked="" type="checkbox"/>	Std Gain Horn Antenna Std Gain (50-75GHz)	VDI	N9029AH15 (WR15)	WR15-01	Aug. 23, 2023	2 years

Note: N.C.R. = No Calibration Request.

For Radiated Emissions

Test Period: Dec. 21, 2023 ~ Apr. 15, 2024

Testing Engineer: Hung Chou

Test Site		96603-BD				
Radiation test sites		Semi Anechoic Room				
Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
<input checked="" type="checkbox"/>	Spectrum Analyzer (3 Hz~50 GHz)	Agilent	N9030A	MY53120541	Dec. 29, 2022 Dec. 27, 2023	1 year
<input type="checkbox"/>	Spectrum Analyzer (2 Hz~50 GHz)	Keysight	N9030B	MY57143537	Apr. 18, 2023	1 year
<input checked="" type="checkbox"/>	Spectrum Analyzer (10 Hz~44 GHz)	Keysight	N9020B	MY60112363	Jan. 13, 2023 Jan. 10, 2024	1 year
<input checked="" type="checkbox"/>	Amplifier (100 kHz~1.3 GHz)	Agilent	8447D	2944A11119	Jan. 07, 2023 Jan. 10, 2024	1 year
<input type="checkbox"/>	Amplifier (100 kHz~1.3 GHz)	Agilent	8447D	2944A10961	Jul. 10, 2023	1 year
<input type="checkbox"/>	Broadband Amplifier (100 kHz~1 GHz)	Titan	T0910E00014330 A1F	001	Jul. 24, 2023	1 year
<input type="checkbox"/>	Amplifier (1 GHz~26.5 GHz)	Agilent	8449B	3008A02237	Oct. 31, 2023	1 year
<input checked="" type="checkbox"/>	Broadband Amplifier (1 GHz~26.5 GHz)	Titan	T0912E01263025 A1F	002	Jul. 24, 2023	1 year
<input checked="" type="checkbox"/>	Preamplifier (26.5 GHz~40 GHz)	EMCI	EMC2654045	980028	Sep. 01, 2023	1 year
<input checked="" type="checkbox"/>	Loop Antenna (9 kHz~30 MHz)	COM-POWER CORPORATION	AL-130	121014	Mar. 23, 2023 Mar. 27, 2024	1 year
<input type="checkbox"/>	Active Loop Antenna (9 kHz~30 MHz)	Schwarzbeck Mess-Elektronik	FMZB 1513-60	1513-60-031	Feb. 21, 2023	1 year
<input checked="" type="checkbox"/>	Trilog Broadband Antenna (30 kHz~1 GHz)	Schwarzbeck Mess-Elektronik	VULB9168	01146	Jun. 27, 2023	1 year
<input type="checkbox"/>	Trilog Broadband Antenna (30 kHz~1 GHz)	Schwarzbeck Mess-Elektronik	VULB9168	416	Jun. 13, 2023	1 year
<input checked="" type="checkbox"/>	Broadband Horn Antenna (1 GHz~18 GHz)	Schwarzbeck Mess-Elektronik	9120D	02207	Jul. 07, 2023	1 year
<input type="checkbox"/>	Broadband Horn Antenna (1 GHz~18 GHz)	Schwarzbeck Mess-Elektronik	9120D	9120D-550	Jul. 21, 2023	1 year
<input checked="" type="checkbox"/>	Broadband Horn Antenna (18 GHz~40 GHz)	Schwarzbeck Mess-Elektronik	9170	9170-320	Jul. 21, 2023	1 year

 means with testing used ; means without testing used

Note: N.C.R. = No Calibration Request.

For Radiated Emissions

Test Period: Dec. 21 ~ Dec. 22, 2023

Testing Engineer: Hung Chou

Test Site		96603-BD				
Radiation test sites		Semi Anechoic Room				
Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
<input checked="" type="checkbox"/>	Coaxial Cable	Titan	T0710AT327A10A 100	J11005	Aug. 10, 2023	1 year
<input checked="" type="checkbox"/>	Coaxial Cable	Titan	T0710AT327A10A 900	J11004	Aug. 10, 2023	1 year
<input checked="" type="checkbox"/>	Coaxial Cable	Titan	CFD400NL-LW	001	Aug. 10, 2023	1 year
<input checked="" type="checkbox"/>	Millimeter-Wave Signal Analyzer Frequency Extension Module (50-75GHz)	VDI	N9029AV15 (SAX 410)	US54250165	Aug. 23, 2023	2 years
<input checked="" type="checkbox"/>	Millimeter-Wave Signal Analyzer Frequency Extension Module (60-90GHz)	VDI	N9029AV12 (SAX 409)	US54250171	Aug. 23, 2023	2 years
<input checked="" type="checkbox"/>	Millimeter-Wave Signal Analyzer Frequency Extension Module (90-140GHz)	VDI	N9029AV08 (SAX 406)	US53250013	Aug. 24, 2023	2 years
<input checked="" type="checkbox"/>	Millimeter-Wave Signal Analyzer Frequency Extension Module (140- 220GHz)	VDI	N9029AV05 (SAX 407)	US53250020	Aug. 28, 2023	2 years
<input checked="" type="checkbox"/>	Horn Antenna (33-50GHz)	QuinStar	QWH-QPDR00	1231900027	Aug. 23, 2023	2 years
<input checked="" type="checkbox"/>	Std Gain Horn Antenna Std Gain (50-75GHz)	VDI	N9029AH15 (WR15)	WR15-01	Aug. 23, 2023	2 years
<input checked="" type="checkbox"/>	Std Gain Horn Antenna Std Gain (60-90GHz)	VDI	N9029AH12 (WR12)	WR12-01	Aug. 24, 2023	2 years
<input checked="" type="checkbox"/>	Std Gain Horn Antenna Std Gain (90-140GHz)	VDI	N9029AH08 (WR8.0)	WR08-01	Aug. 23, 2023	2 years
<input checked="" type="checkbox"/>	Std Gain Horn Antenna Std Gain (140-220GHz)	VDI	N9029AH05 (WR5.0)	WR05-01	Aug. 28, 2023	2 years
<input type="checkbox"/>	Power Supply	KEITHLEY	2303	4045290	Jan. 06, 2023	1 year
<input checked="" type="checkbox"/>	Software	EZ EMC	1.1.4.4	N/A	N.C.R.	---

means with testing used ;

means without testing used

Note: N.C.R. = No Calibration Request.

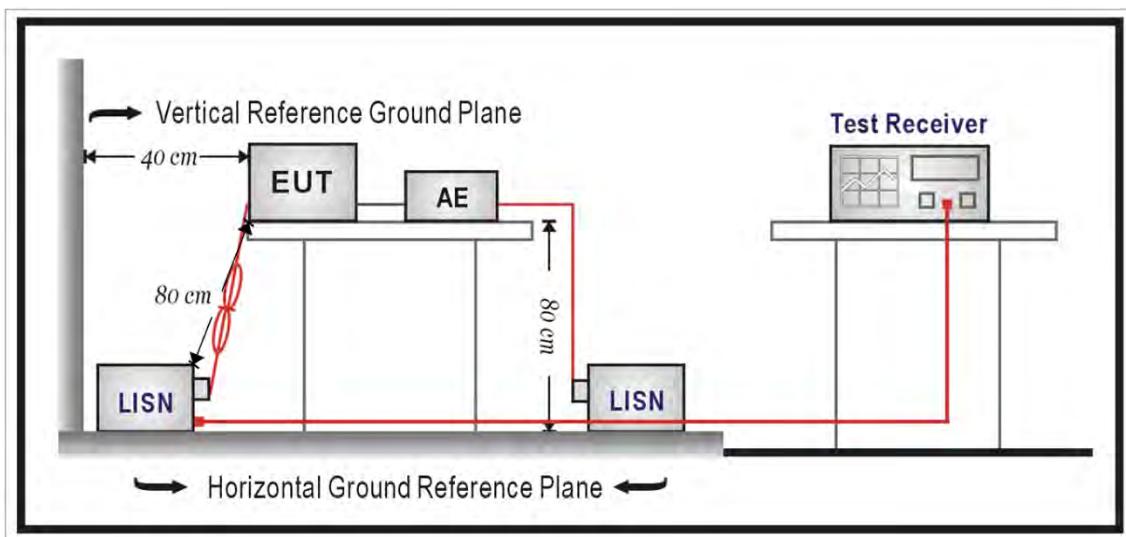
4 Measurement Procedure

4.1. AC Power Line Conducted Emission Measurement

■ Limit

Frequency (MHz)	Quasi-peak	Average
0.15 - 0.5	66 to 56	56 to 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

■ Test Setup



■ Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a $50 \Omega // 50 \mu\text{H}$ coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a $50 \Omega // 50 \mu\text{H}$ coupling impedance with 50 ohm termination.

Tabletop device shall be placed on a non-conducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The wall of screened room shall be located 40 cm to the rear of the EUT. Other surfaces of tabletop or floor standing EUT shall be at least 80 cm from any other ground conducting surface including one or more LISNs. For floor-standing device shall be placed under the EUT with a 12 mm insulating material.

Conducted emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a resolution bandwidth of 9 kHz. The equipment under test (EUT) shall be meet the limits in section 4.1, as applicable, including the average limit and the quasi-peak limit when using respectively, an average detector and quasi-peak detector measured in accordance with the methods described of related standard. When all of peak value were complied with quasi-peak and average limit from 150 kHz to 30 MHz then quasi-peak and average measurement was unnecessary.

The AMN shall be placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for AMNs mounted on top of the ground reference plane. This distance is between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8 m from the AMN. If the mains power cable is longer than 1 m then the cable shall be folded back and forth at the centre of the lead to form a bundle no longer than 0.4 m. All of interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long. All of EUT and AE shall be separate place more than 0.1 m. All 50Ω ports of the LISN shall be resistively terminated into 50Ω loads when not connected to the measuring instrument.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

4.2. Radiated Emission Measurement

■ Limit

- (1) The power density of any emissions outside the 57–71 GHz band shall consist solely of spurious emissions.
- (2) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209
- (3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm² at a distance of 3 meters.
- (4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

Limits of Radiated Emission Measurement (FCC 15.209):

Frequency (MHz)	Field Strength (μV/m at meter)	Measurement Distance (meter)
0.009 – 0.490	2400 / F (kHz)	300
0.490 – 1.705	24000 / F (kHz)	30
1.705 – 30.0	30	30
30 - 88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note: (1) The tighter limit applies at the band edges.

(2) Emission level (dBuV/m)=20 log Emission level (uV/m).

Radiated emissions above 40 GHz:

Frequency Range (GHz)	Limit (pW/cm ²) @ 3 m	Equivalent to EIRP limit (dBm)
40-200	90	-9.92

Note: (1) $PD = EIRP_{Linear} / (4 * \pi * d^2)$

Where:

PD is the power density at the distance specified by the limit, in W/m²

$EIRP_{Linear}$ is the equivalent isotropically radiated power, in watts

d is the distance at which the power density limit is specified, in m

Within the 57–71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

Standard	Limit
<input checked="" type="checkbox"/> Part 15.255(c)(2)(iii)(A)	The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds, except as specific in paragraph (c)(2)(iii)(B) of this section;

Peak transmitter conducted output power:

Except as specified paragraph (e)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (b) of this section.

Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

Calculate the conducted output power (in watts) from the EIRP (in watts) using Equation:

$$P_{\text{cond}} = \text{EIRP}_{\text{Linear}} / G_{\text{EUT}}$$

Where:

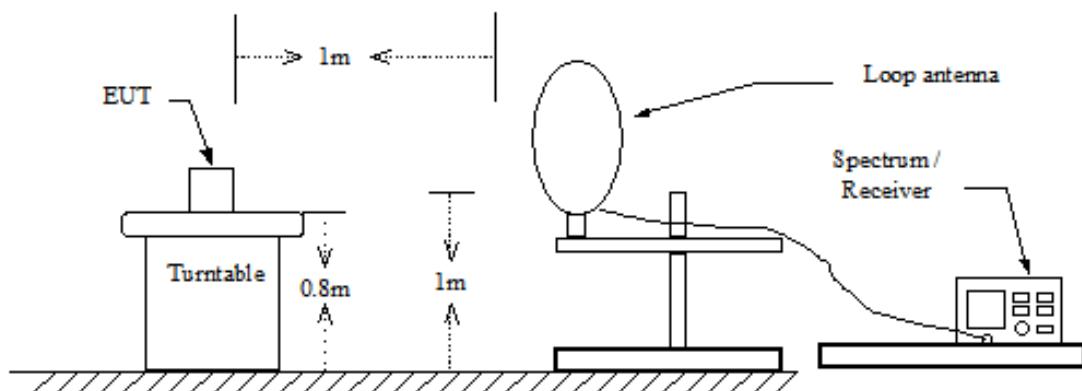
P_{cond} is the conducted output power, in W

$\text{EIRP}_{\text{Linear}}$ is the equivalent isotropically radiated power, in W

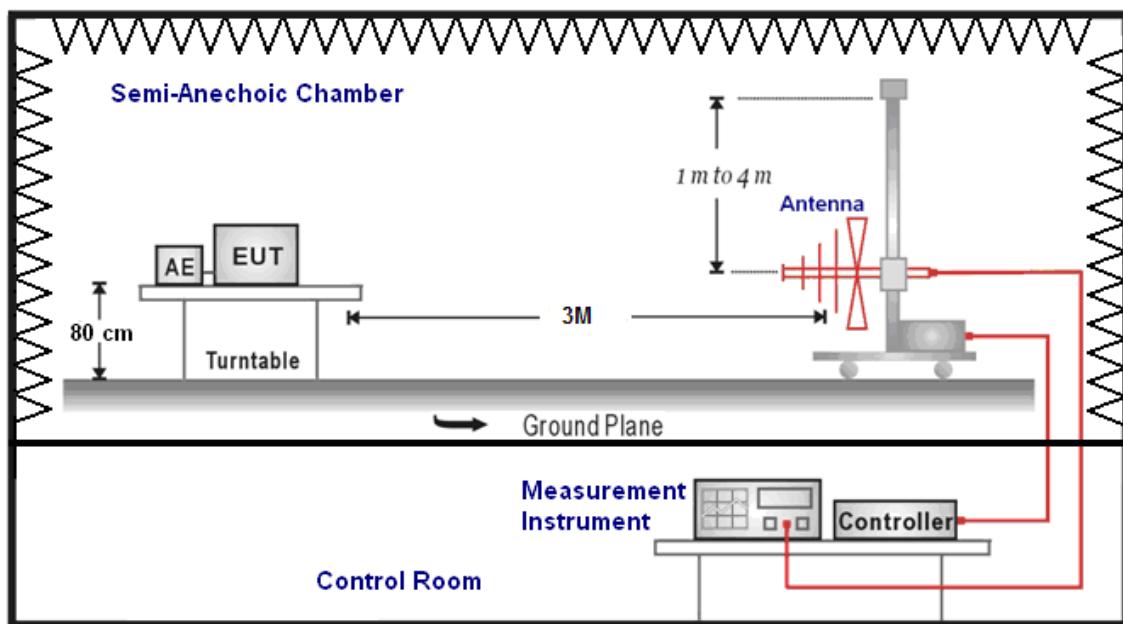
G_{EUT} is numeric gain of the EUT radiating element (antenna)

■ Setup

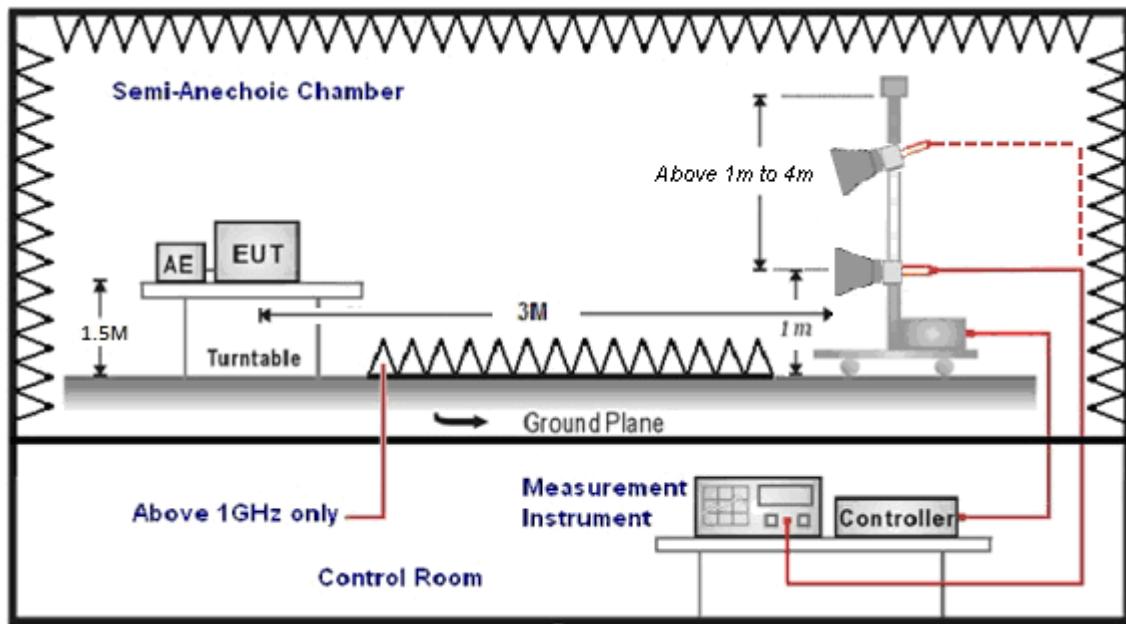
Below 30 MHz



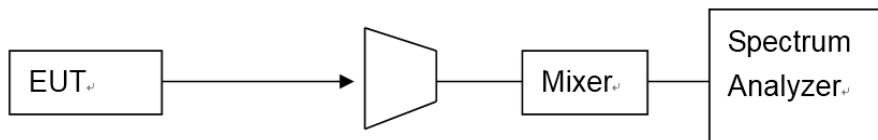
30 MHz ~ 1 GHz



Above 1 GHz



Above 50 GHz



■ Test Procedure

Final radiation measurements were made on a three-meter, Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 meters height, top surface 1.0 x 1.5 meter. The EUT was set to transmit continuously & Measurements range from 9 kHz to 10th harmonic is investigated.

For measurements below 30 MHz the resolution bandwidth is set to 10 kHz for peak detection measurements or 9 kHz for quasi-peak detection measurements. The video bandwidth is 3 times of the resolution bandwidth.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 3 MHz for peak (detector for peak) measurements and average (detector for peak) measurements.

A nonconductive material surrounded the EUT to supporting the EUT for standing on tree orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

Biconilog Antenna at 3 Meter and the Horn Antenna was used in frequencies 18 – 40 GHz at a distance of 1 meter. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20 dB/decade).

For testing above 1 GHz, the emission level of the EUT in peak mode was 20 dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dB_{uV}) into field intensity in micro volts pre meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in micro colts per meter (dB_{uV/m}).

The actual field intensity in dBuV/m is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

(1) Amplitude (dBuV/m) = FI (dBuV) + AF (dBuV) + CL (dBuV) - Gain (dB)

FI= Reading of the field intensity.

AF= Antenna factor.

CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

(2) Actual Amplitude (dBuV/m) = Amplitude (dBuV) - Dis(dB)

The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:

(a) For fundamental frequency : Transmitter Output < +30 dBm

(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

Above 40GHz: $E = 126.8 - 20\log(\lambda) + P - G$

E is the field strength of the emission at the measurement distance, in dBuV/m

P is the power measured at the output of the test antenna, in dBm

λ is the wavelength of the emission under investigation [300/fMHz], in m

G is the gain of the test antenna, in dBi

Note: The measured power P includes all applicable instrument correction factors up to the connection to the test antenna.

Measurement distance conversion calculation formula:

$$E_{Space\ Limit} = E_{Meas} + 20\log(D_{Meas} / D_{Space\ Limit})$$

$E_{Space\ Limit}$ is the field strength of the emission at the distance specified by the limit, in dBuV/m

E_{Meas} is the field strength of the emission at the distance specified by the limit, in dBuV/m

D_{Meas} is the measurement distance, in m

$D_{Space\ Limit}$ is the distance specified by the limit, in m

Field strength to EIRP calculation formula:

$$EIRP = E + 20\log(d) - 104.7$$

EIRP is the equivalent isotropically radiated power, in dBm

E is the field strength of the emission at the measurement distance, in dBuV/m

d is the measurement distance, in m

Far Field Distance Evaluation:

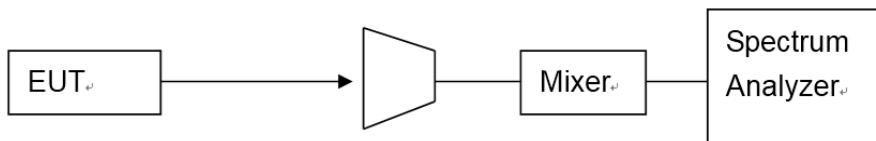
Rx Antenna	Frequency (GHz)	Wavelength λ (m)	Measurement Antenna D (m)	Far field Rm (m) $\geq 2*D^2/\lambda$	Measurement Distance d_1 (m)	Distance specified by the limit d_2 (m)	Distance Factor = $20 * \log(d_1/d_2)$ (dB)
9170	18	0.0167	0.06	0.43	1	3	-9.54
	40	0.0075	0.06	0.96	1	3	-9.54
QWH-QPDR00	40	0.0075	0.0389	0.40	1	3	-9.54
	50	0.0060	0.0389	0.50	1	3	-9.54
N9029AH15	50	0.0060	0.0241	0.19	1	3	-9.54
	75	0.0040	0.0241	0.29	1	3	-9.54
N9029AH12	60	0.0050	0.0199	0.16	1	3	-9.54
	90	0.0033	0.0199	0.24	1	3	-9.54
N9029AH08	90	0.0033	0.0136	0.11	1	3	-9.54
	140	0.0021	0.0136	0.17	1	3	-9.54
N9029AH05	140	0.0021	0.0084	0.07	1	3	-9.54
	220	0.0014	0.0084	0.10	1	3	-9.54
N9029AH03	220	0.0014	0.0056	0.05	1	3	-9.54
	325	0.0009	0.0056	0.07	1	3	-9.54

4.3. 6 dB Emission Bandwidth and 99% Occupied Bandwidth Measurement

■ **Limit**

NA

■ **Test Setup**



■ **Test Procedure**

6 dB Emission Bandwidth:

The testing follows ANSI C63.10-2013 Section 9.3.

99% Occupied Bandwidth:

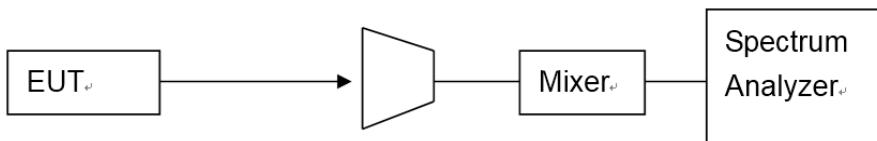
The testing follows ANSI C63.10-2020 Section 6.9.3 and RSS-Gen Section 6.7.

4.4. 20 dB Emission Bandwidth Measurement

- **Limit**

61 to 61.5GHz.

- **Test Setup**



- **Test Procedure**

20 dB Emission Bandwidth:

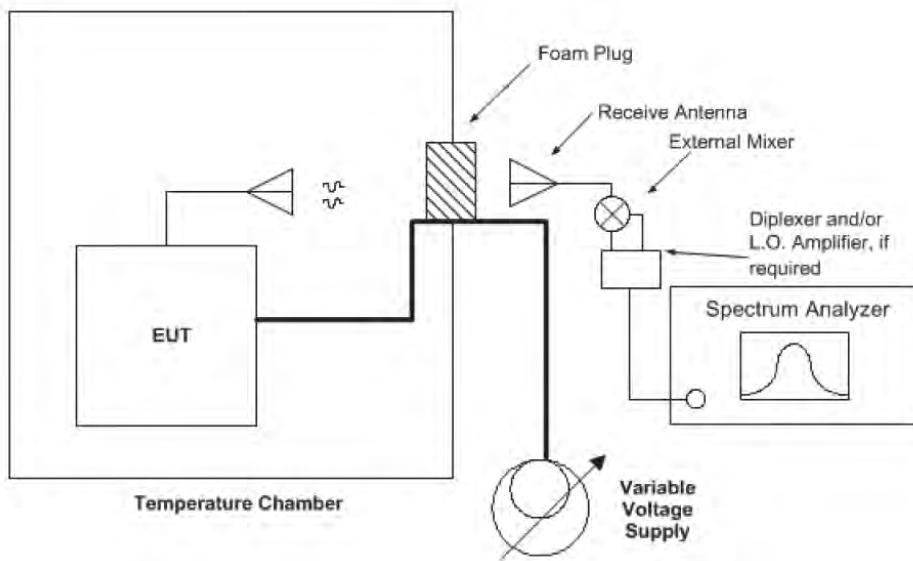
The testing follows ANSI C63.10-2013 Section 9.3.

4.5. Frequency Stability Measurement

■ Limit

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

■ Test Setup



■ Test Procedure

The testing follows ANSI C63.10-2020 Section 9.5.

4.6. Antenna Measurement

■ Limit

FCC Part 15.203:

For intentional device, according to 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

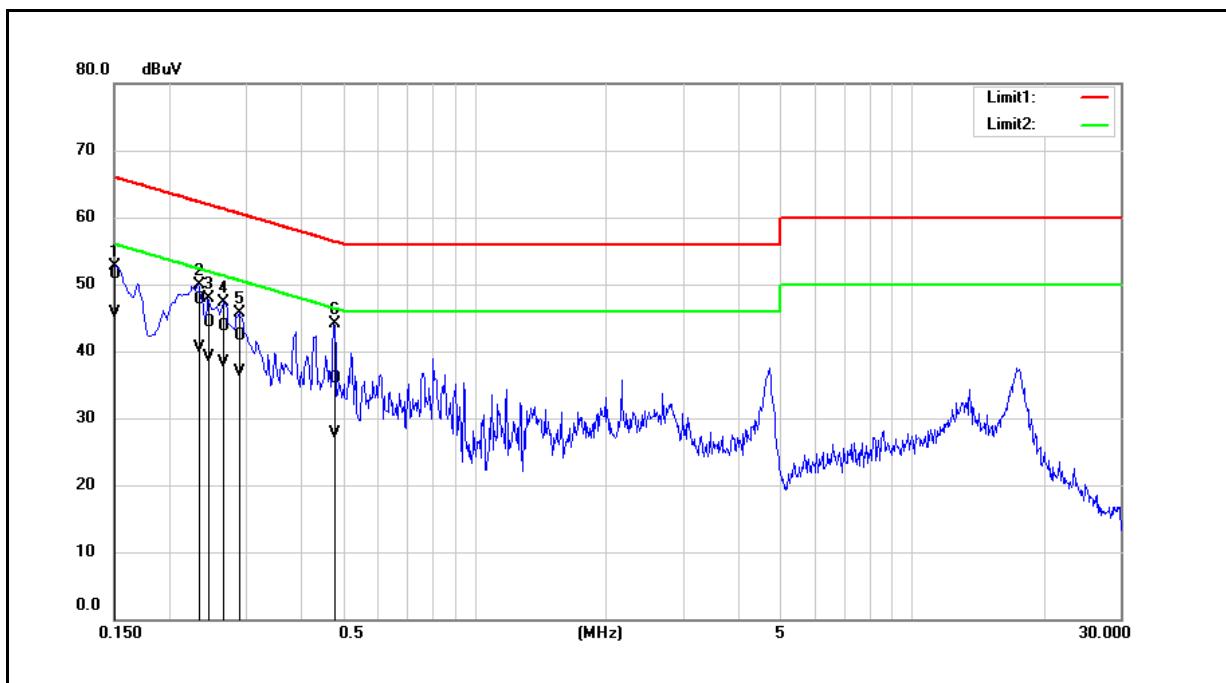
■ Antenna Connector Construction

See section 2 – antenna information.

5 Test Results

5.1. Conducted Emission

Standard:	FCC Part 15.255	Line:	L1
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Mode:	Transmit Mode		
Description:			

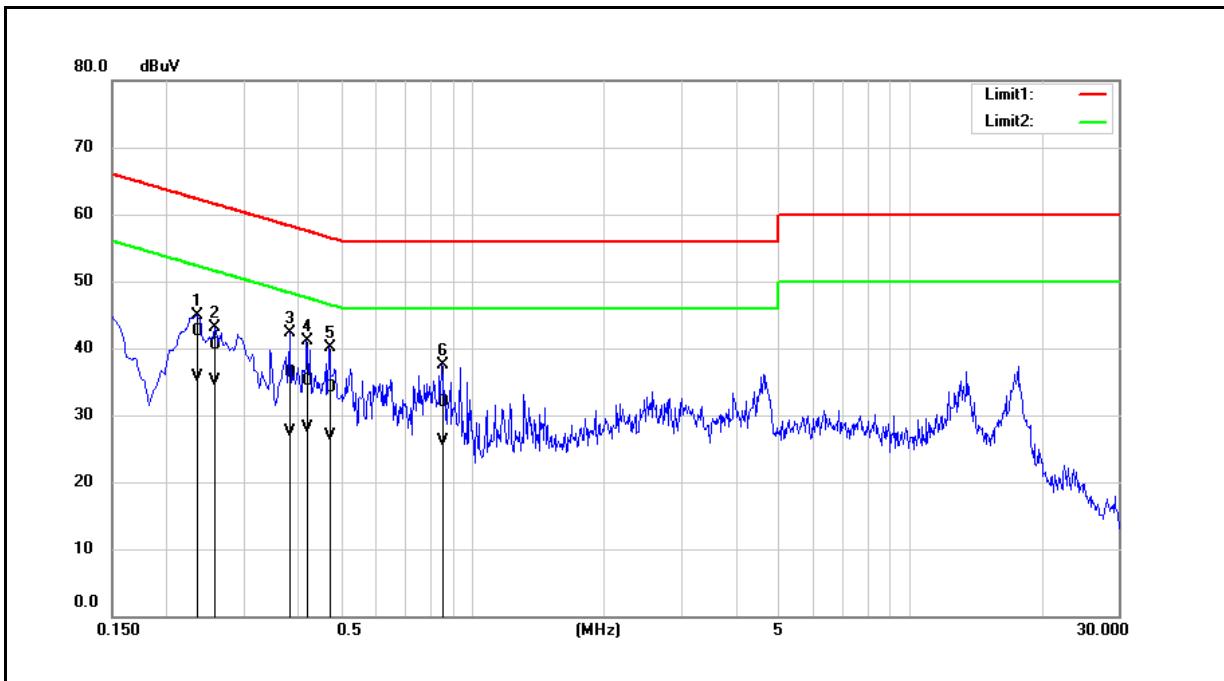


No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	Avg result (dBuV)	QP limit (dBuV)	Avg limit (dBuV)	QP margin (dB)	Avg margin (dB)	Remark
1	0.1500	41.91	35.94	9.68	51.59	45.62	66.00	56.00	-14.41	-10.38	Pass
2	0.2340	38.07	30.78	9.69	47.76	40.47	62.31	52.31	-14.55	-11.84	Pass
3	0.2460	34.60	29.51	9.69	44.29	39.20	61.89	51.89	-17.60	-12.69	Pass
4	0.2660	34.08	28.69	9.69	43.77	38.38	61.24	51.24	-17.47	-12.86	Pass
5	0.2900	32.57	27.17	9.69	42.26	36.86	60.52	50.52	-18.26	-13.66	Pass
6	0.4780	26.26	18.09	9.70	35.96	27.79	56.37	46.37	-20.41	-18.58	Pass

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

Standard:	FCC Part 15.255	Line:	N
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Mode:	Transmit Mode		
Description:			



No.	Frequency (MHz)	QP reading (dBuV)	AVG reading (dBuV)	Correction factor (dB)	QP result (dBuV)	AVG result (dBuV)	QP limit (dBuV)	AVG limit (dBuV)	QP margin (dB)	AVG margin (dB)	Remark
1	0.2340	32.92	25.97	9.68	42.60	35.65	62.31	52.31	-19.71	-16.66	Pass
2	0.2580	30.86	25.52	9.68	40.54	35.20	61.50	51.50	-20.96	-16.30	Pass
3	0.3820	26.70	17.77	9.68	36.38	27.45	58.24	48.24	-21.86	-20.79	Pass
4	0.4180	25.46	18.51	9.68	35.14	28.19	57.49	47.49	-22.35	-19.30	Pass
5	0.4700	24.52	17.25	9.68	34.20	26.93	56.51	46.51	-22.31	-19.58	Pass
6	0.8500	22.20	16.35	9.70	31.90	26.05	56.00	46.00	-24.10	-19.95	Pass

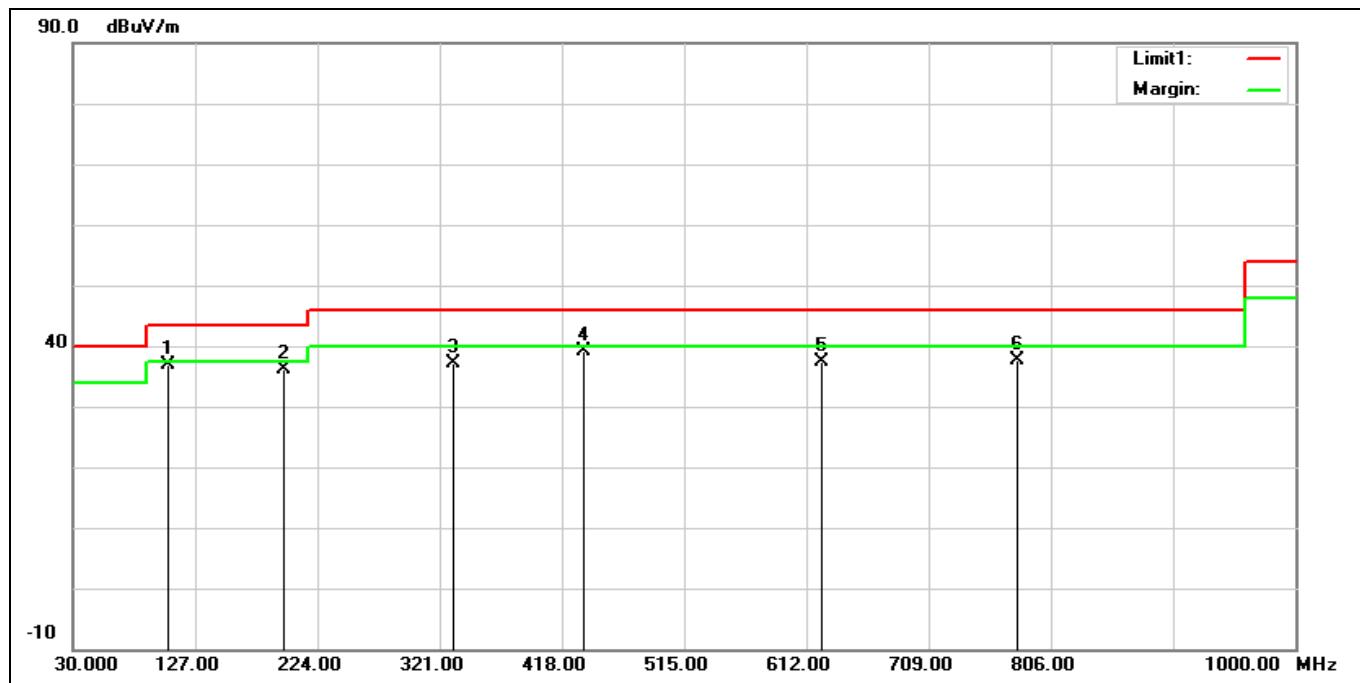
Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

5.2. Radiated Emission Test Results

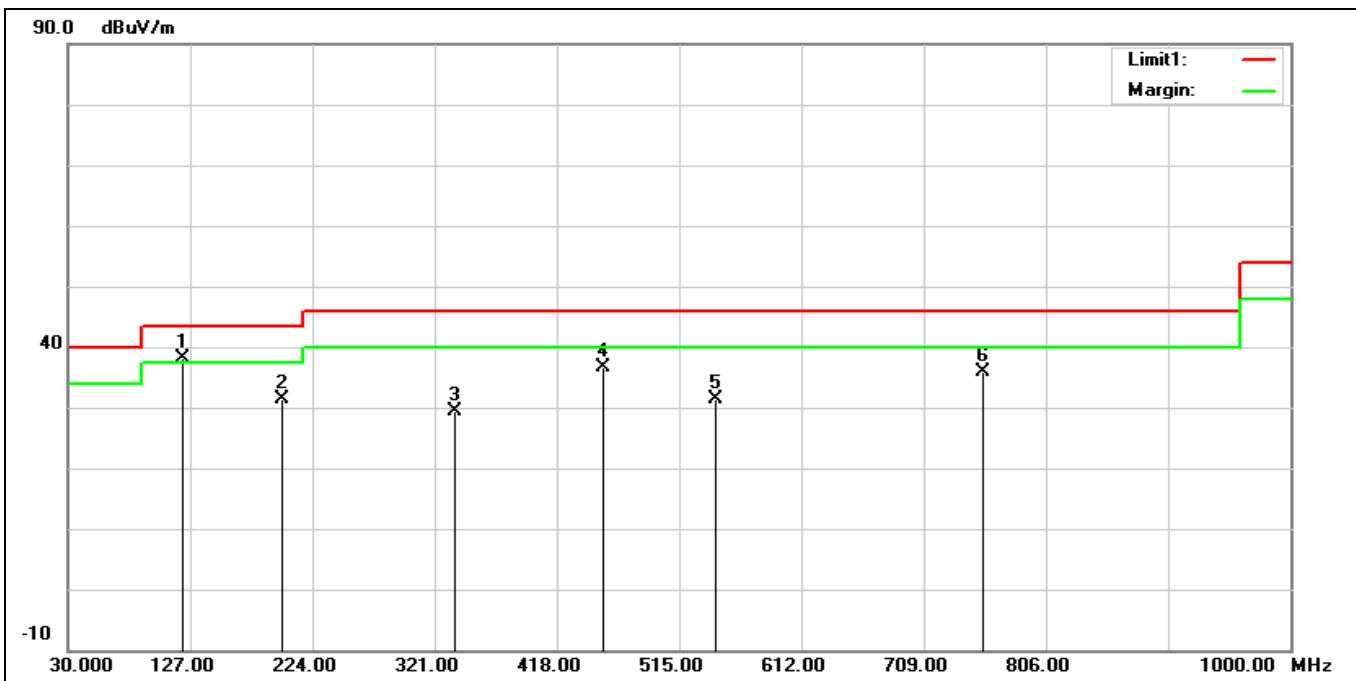
Radiated Emissions (below 1 GHz)

Standard:	Part 15C	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	Transmit Mode		
Remark:			



No.	Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	105.6600	47.86	-10.99	36.87	43.50	-6.63	QP
2	197.8100	44.92	-8.84	36.08	43.50	-7.42	QP
3	331.6700	41.97	-4.74	37.23	46.00	-8.77	QP
4	435.4600	41.22	-2.08	39.14	46.00	-6.86	QP
5	623.6400	36.23	1.20	37.43	46.00	-8.57	QP
6	778.8400	33.63	3.99	37.62	46.00	-8.38	QP

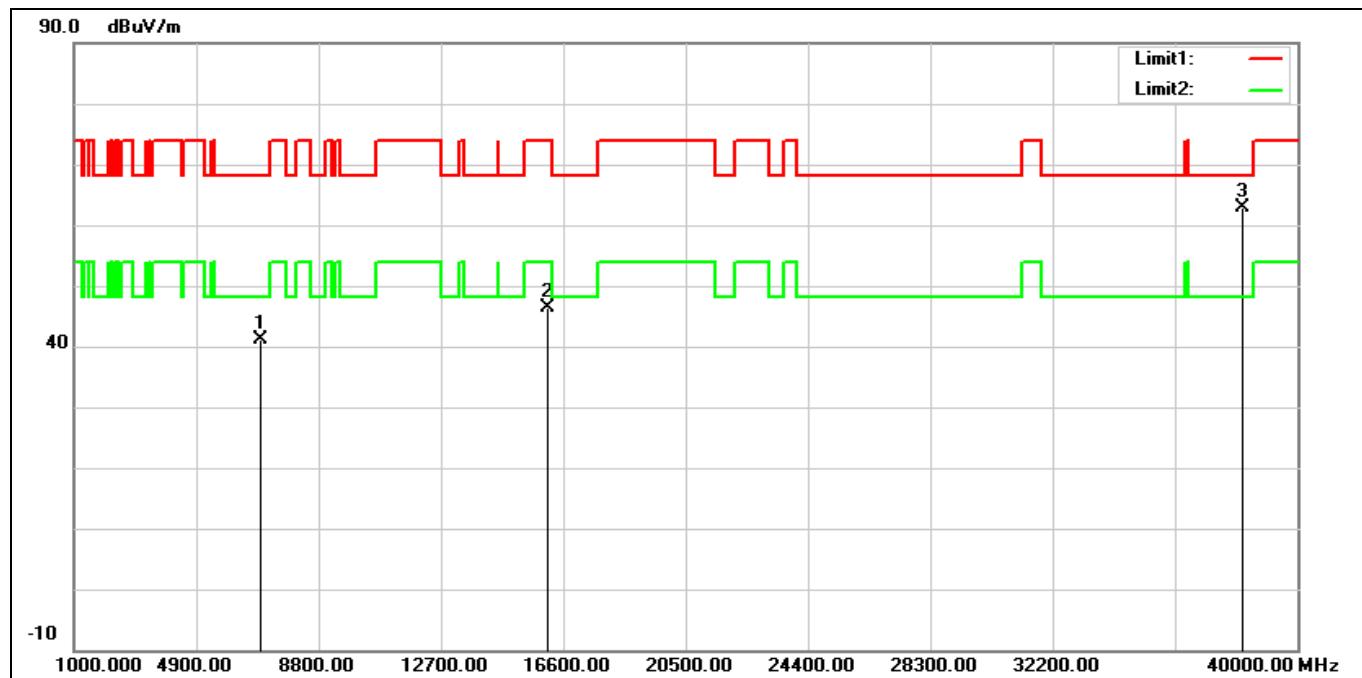
Standard:	Part 15C	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	Transmit Mode		
Remark:			



No.	Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	121.1800	47.43	-9.19	38.24	43.50	-5.26	QP
2	199.7500	40.33	-8.93	31.40	43.50	-12.10	QP
3	336.5200	34.02	-4.63	29.39	46.00	-16.61	QP
4	454.8600	38.27	-1.74	36.53	46.00	-9.47	QP
5	544.1000	32.06	-0.76	31.30	46.00	-14.70	QP
6	755.5600	32.08	3.72	35.80	46.00	-10.20	QP

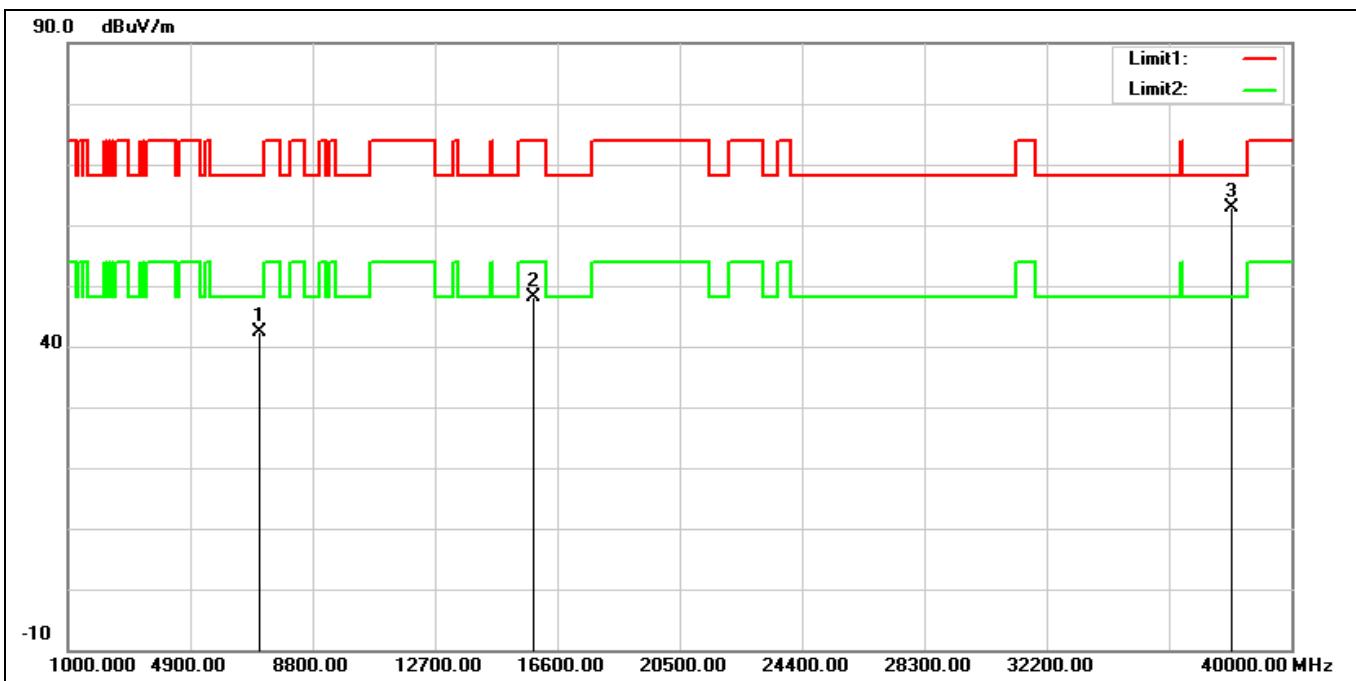
Radiated Emissions (Above 1 GHz)

Standard:	Part 15C	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	62 GHz		



No.	Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	6950.000	35.49	5.53	41.02	68.20	-27.18	peak
2	16062.000	30.69	15.79	46.48	74.00	-27.52	peak
3*	38240.000	41.86	21.08	62.94	68.20	-5.26	peak

Standard:	Part 15C	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	62 GHz		

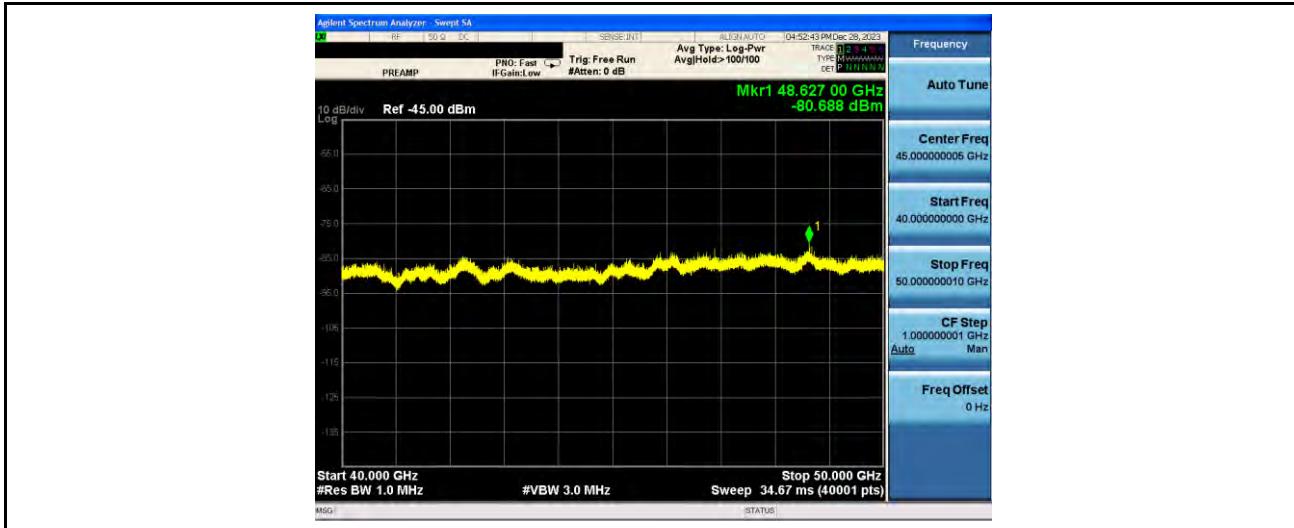


No.	Frequency (MHz)	Reading (dB _{uV})	Correction (dB/m)	Result (dB _{uV/m})	Limit (dB _{uV/m})	Margin (dB)	Remark
1	7069.000	36.30	6.07	42.37	68.20	-25.83	peak
2	15841.000	31.89	16.18	48.07	74.00	-25.93	peak
3*	38086.000	40.87	21.98	62.85	68.20	-5.35	peak

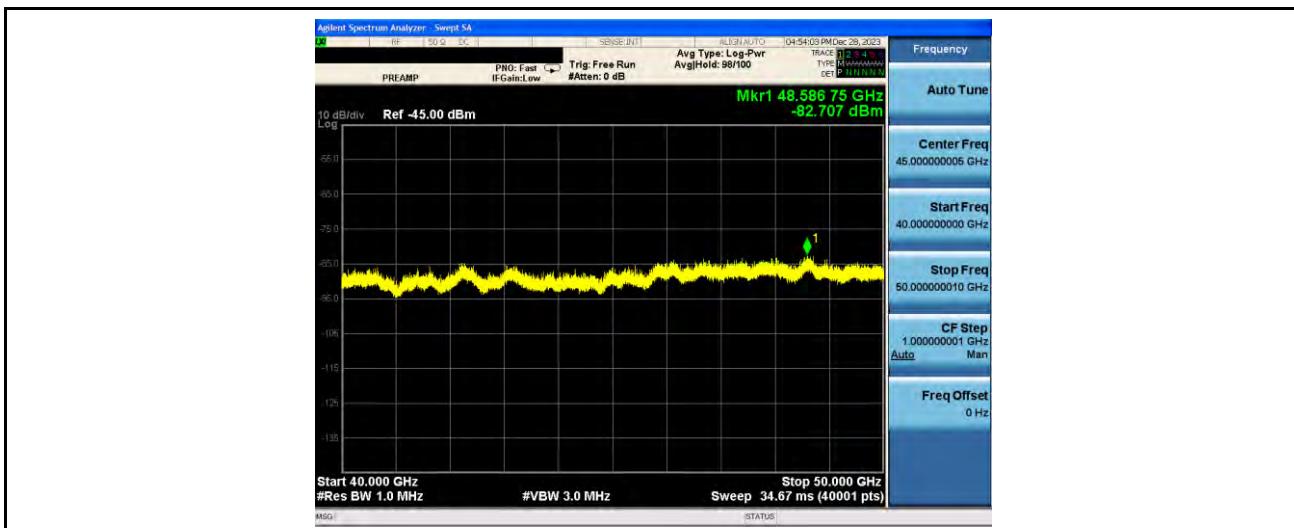
5.3. Power density Test Results

Transmit Mode (60-64GHz)								
Frequency (GHz)	Reading (dBm)	Distance Factor = 20*log(1m/3m) (dB)	Ant. Pol.	AF (dB/m)	CL+ML (dB)	Result (dBm)	Power Density (pW/cm ²)	Limit (pW/cm ²)
48.627	-80.688	-9.54	H	41.20	6.12	-42.91	0.0452	90
48.586	-82.707	-9.54	V	41.20	6.12	-44.93	0.0284	
74.583	-93.147	-9.54	H	44.90	13.70	-44.09	0.0345	
54.776	-93.115	-9.54	V	44.30	13.71	-44.65	0.0303	
77.948	-93.226	-9.54	H	46.20	12.81	-43.76	0.0372	
83.824	-93.062	-9.54	V	46.70	14.23	-41.67	0.0601	
113.567	-93.208	-9.54	H	49.80	12.62	-40.33	0.0819	
134.896	-91.981	-9.54	V	50.70	14.21	-36.61	0.1928	
145.914	-92.973	-9.54	H	53.20	15.30	-34.02	0.3508	
149.651	-92.01	-9.54	V	53.50	13.77	-34.28	0.3298	

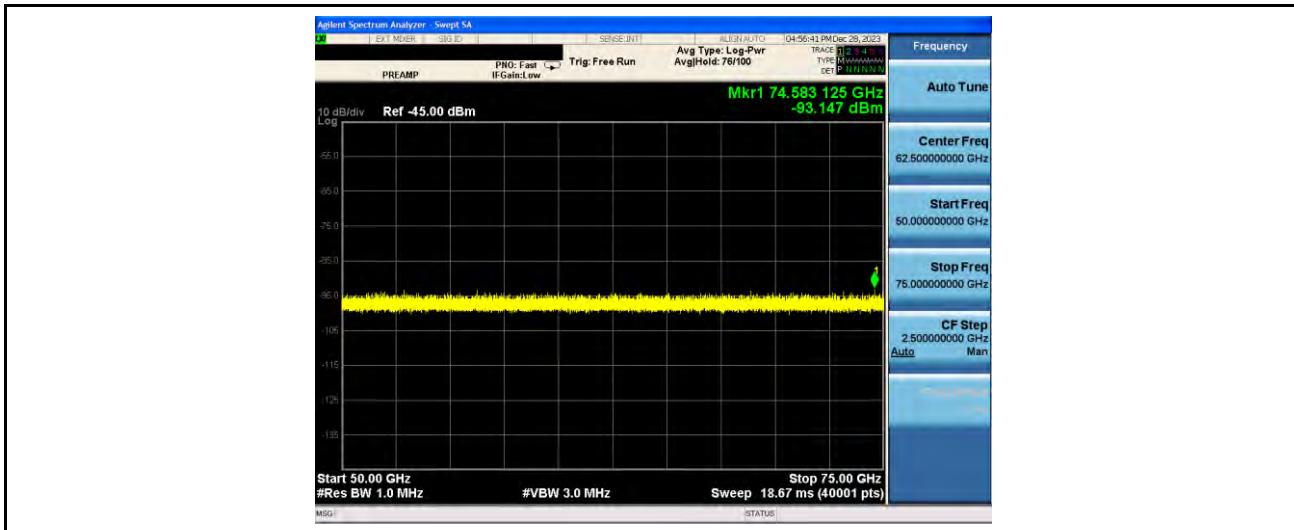
Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	40-50 G		



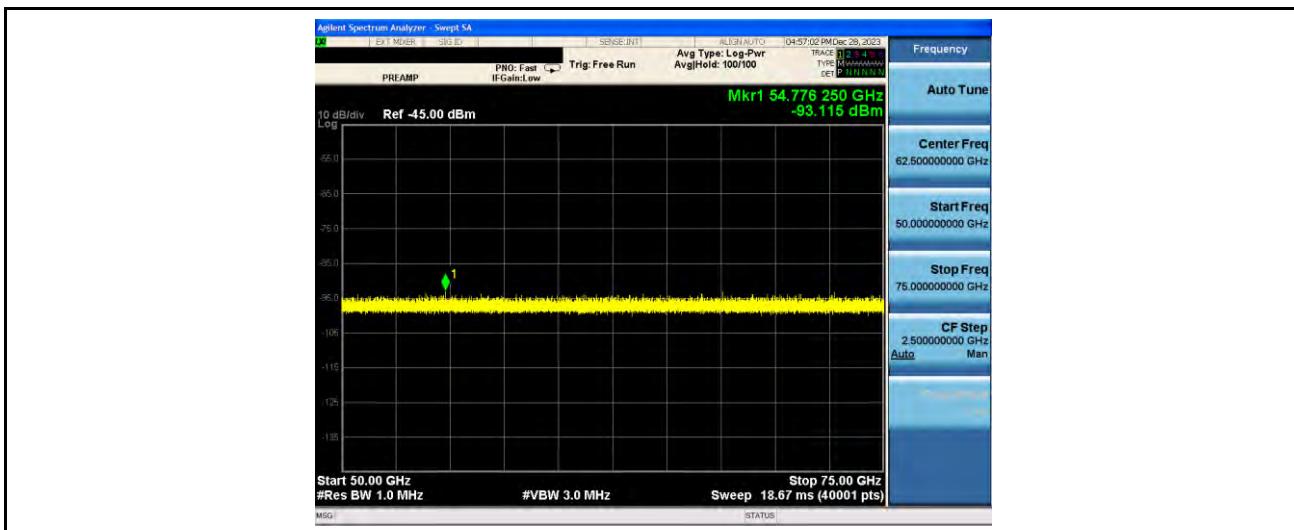
Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	40-50 G		



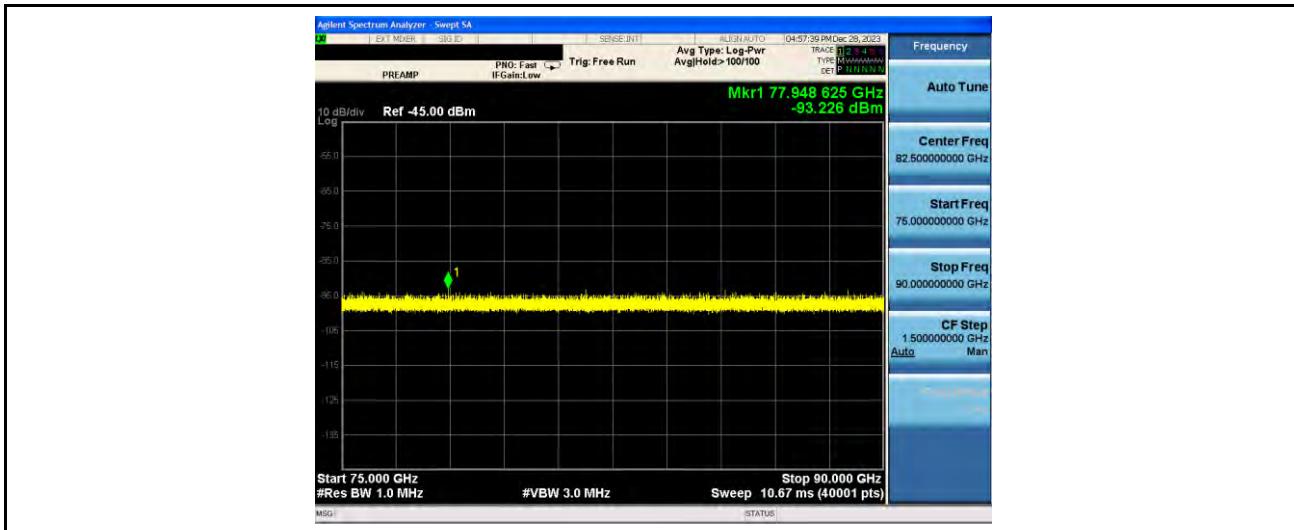
Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	50-75 G		



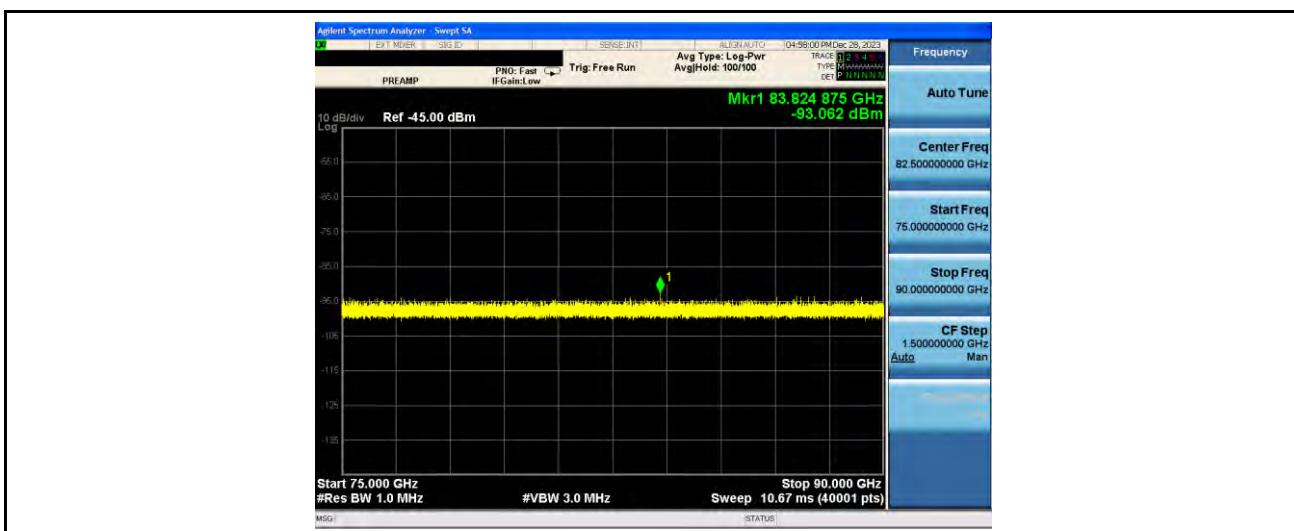
Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	50-75 G		



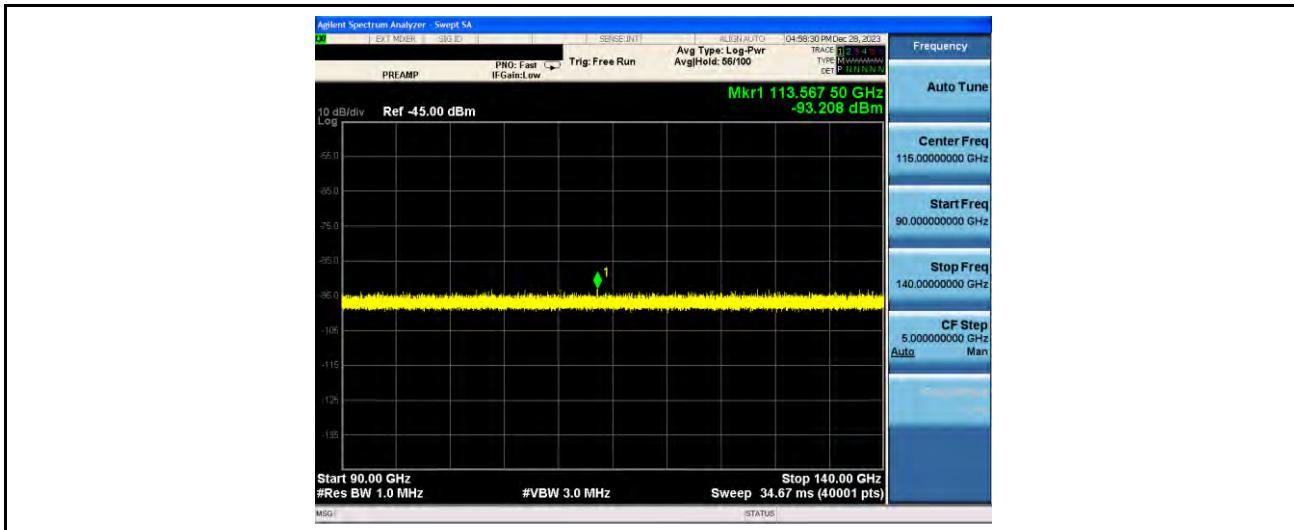
Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	75-90 G		



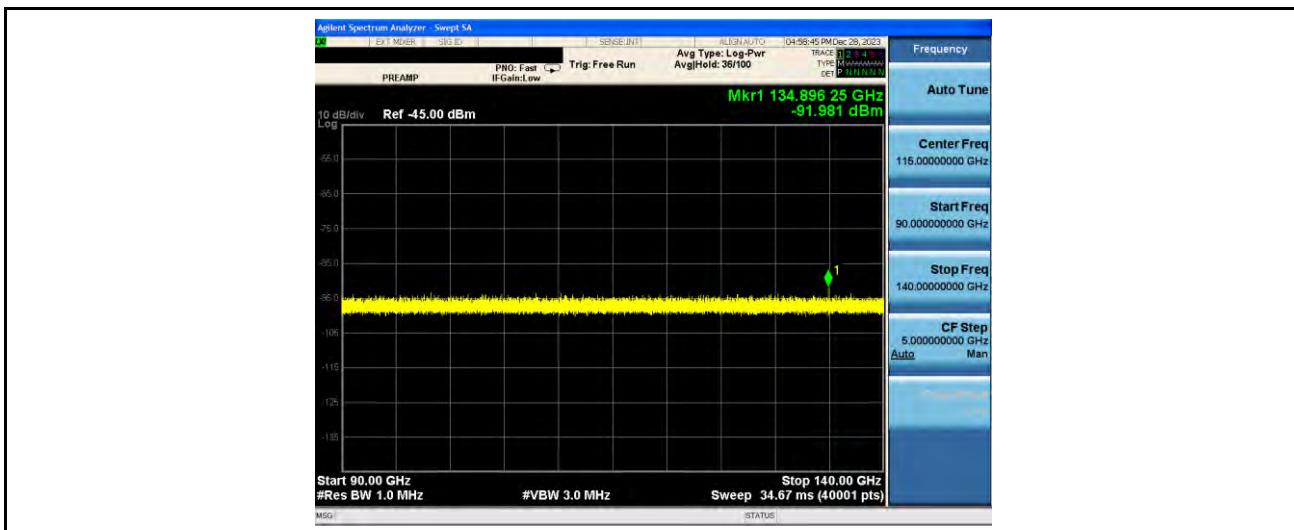
Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	75-90 G		



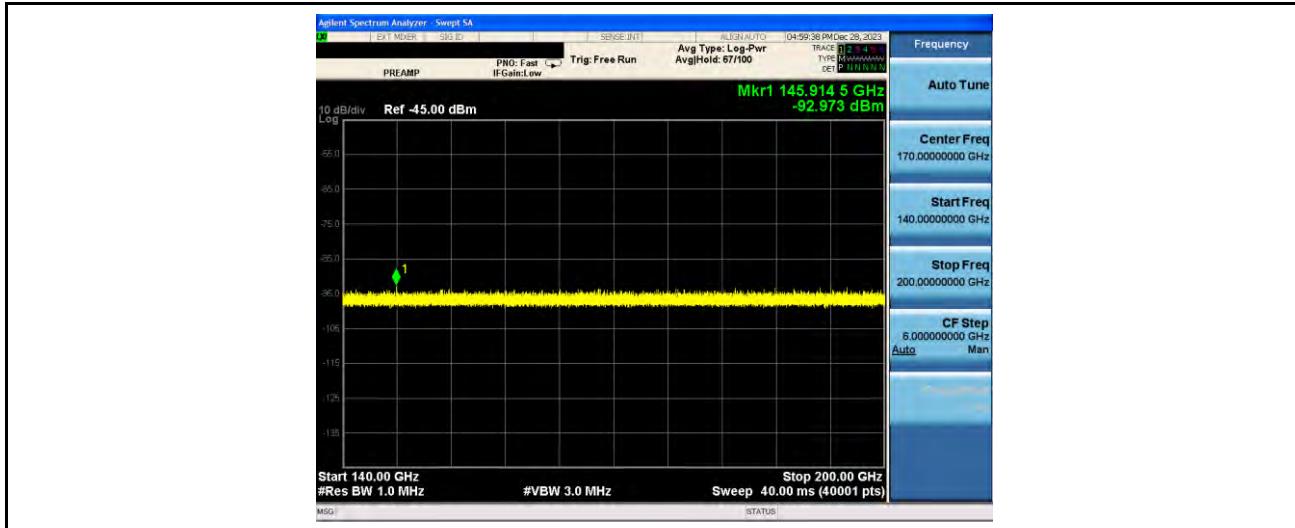
Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	90-140 G		



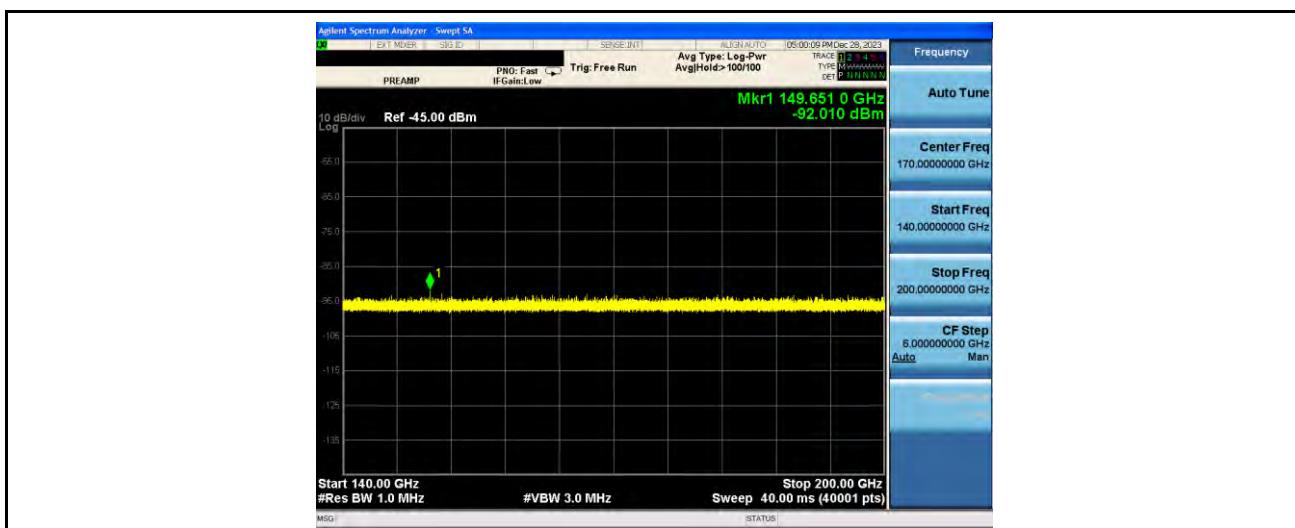
Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	90-140 G		



Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	140-200 G		



Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	Transmit Mode (60-64GHz)		
Remark:	140-200 G		



5.4. Output Power Test Results

For Peak Power (E.I.R.P)

Mode	Measurement Distance (m)	Frequency (GHz)	Readin (dBm)	Antenna Gain (dBi)	E (dBuV/m)	E.I.R.P (dBm)	Limit (dBm)	Result
Transmit Mode (60-64GHz)	1	62	-36.0761	21.4	115.63	10.93	14	PASS

Note: The EIRP was evaluated on vertical and horizontal polarization, the worst case is Horizontal polarization.

For Peak Output Power

Mode	Frequency (GHz)	Peak E.I.R.P (dBm)	Antenna Gain (dBi)	Peak Conduced output Power (dBm)	Limit (dBm)	Result
Transmit Mode (60-64GHz)	62	10.93	5.2	5.73	27	PASS

Note: Peak power = Peak EIRP power – Antenna Gain.

For Duty cycle

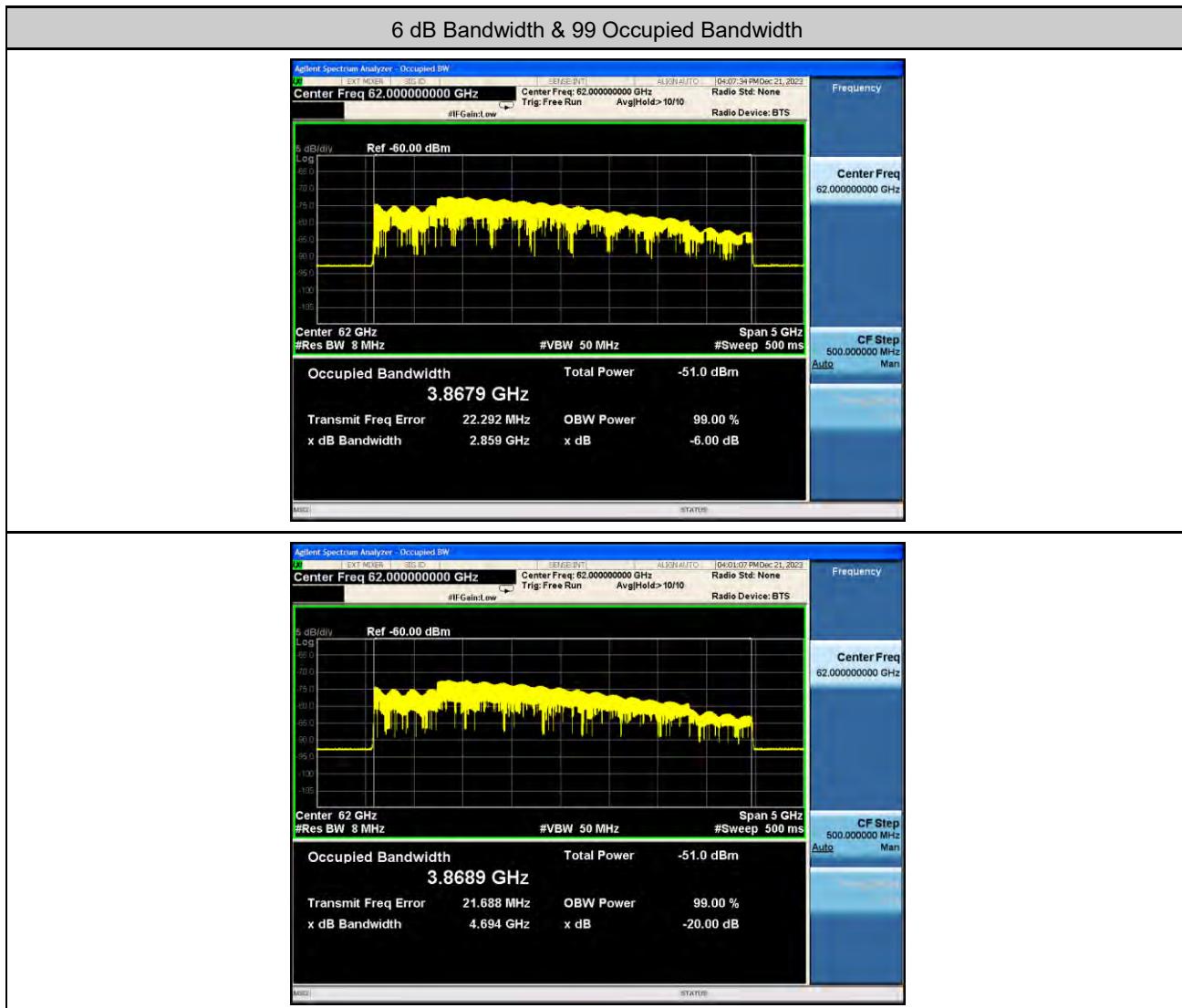
Mode	Frequency (GHz)	On time (us)	On+off time (us)	Duty cycle (%)	Duty Factor (dB)
Transmit Mode (60-64GHz)	62	4500	40000	11.25	9.49

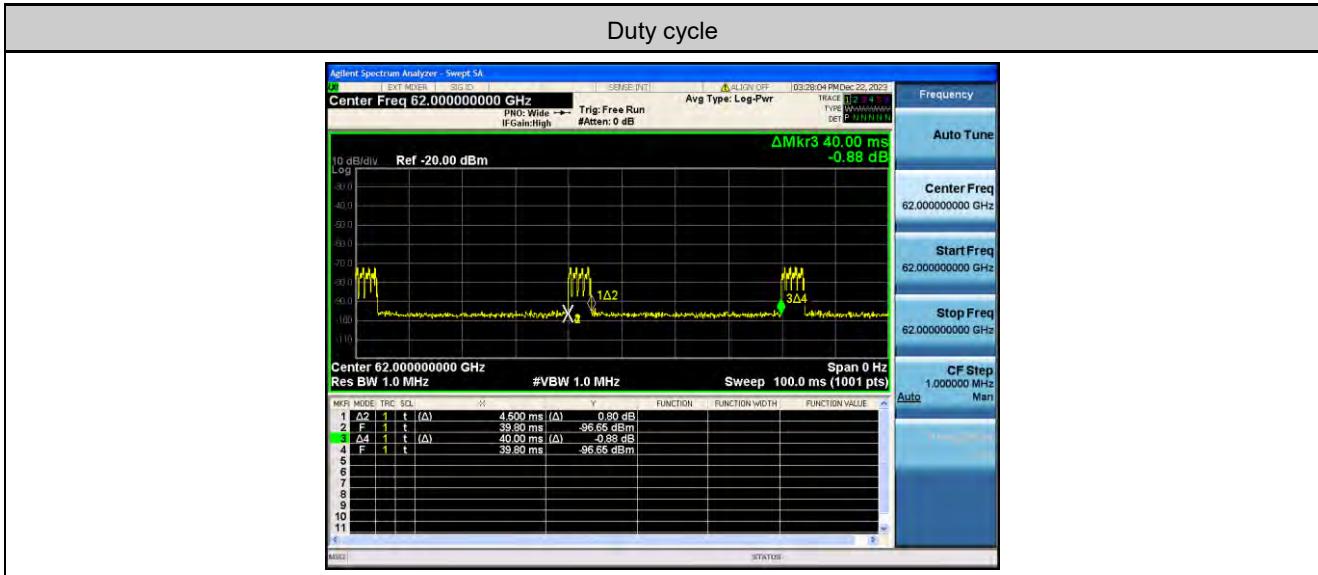
For Continuous Transmitter off-times

Mode	Frequency (GHz)	On time (ms)	Specify period (ms)	Off time (ms)	Limit (ms)	Result
Transmit Mode (60-64GHz)	62	4.5	33	28.50	25.50	PASS

5.5. 6dB & 99 Occupied Bandwidth Test Results

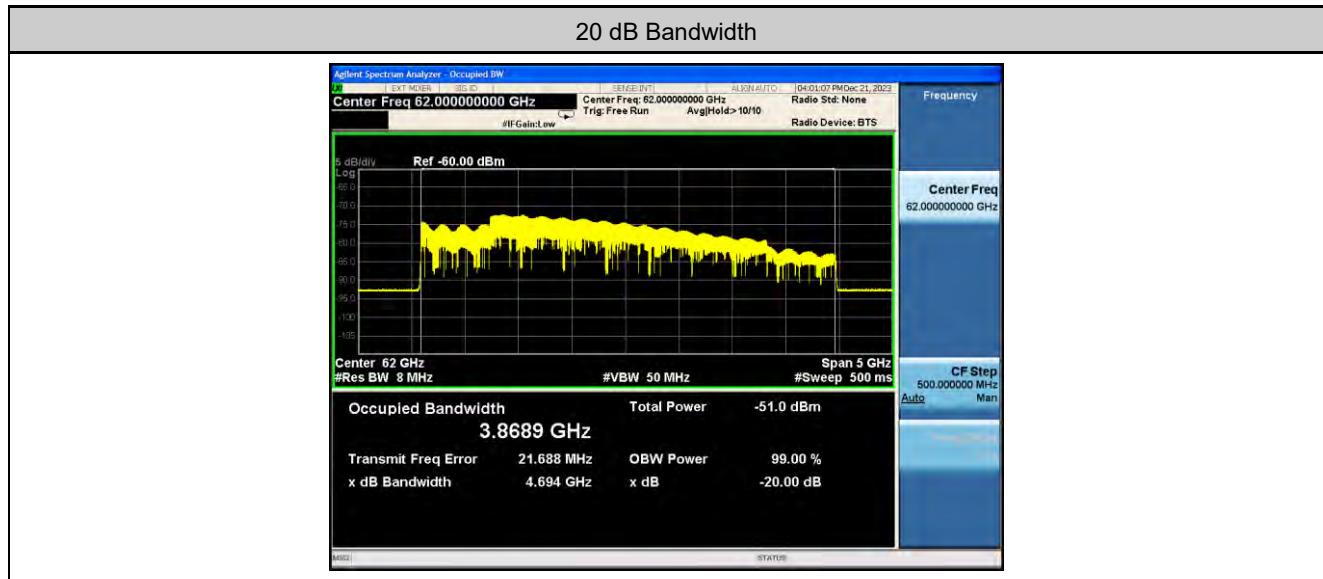
Mode	Frequency (GHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
Transmit Mode (60-64GHz)	62	2859	3.8689





5.6. 20dB Bandwidth Test Results

Mode	Frequency (GHz)	20 dB Bandwidth (MHz)	Low Frequency (GHz)	High Frequency (GHz)	Result
Transmit Mode (60-64GHz)	62	4694.00	59.653	64.347	PASS



5.7. Frequency Stability Test Results

Test Mode	: Transmit Mode (60-64GHz)
Frequency	: 62 GHz
V _{Nom}	: 24 Vdc

Environment Temperature (°C)	Power Supplied (Vdc)	Measured Frequency (GHz)				Result
		0 min	2 min	5 min	10 min	
-20	V _{Nom}	61.9905	61.9930	61.9960	61.9920	PASS
-10	V _{Nom}	60.7935	61.0130	60.8330	60.8690	PASS
0	V _{Nom}	60.8820	60.8640	60.7540	60.7730	PASS
10	V _{Nom}	60.8320	60.8430	60.8220	60.7920	PASS
20(Normal)	V _{Nom}	60.7890	60.7830	60.6620	60.6220	PASS
30	V _{Nom}	60.8220	60.7760	60.9830	60.8860	PASS
40	V _{Nom}	61.0280	61.0150	60.9760	60.8810	PASS
50	V _{Nom}	61.9950	61.9905	61.9930	61.9910	PASS

Environment Temperature (°C)	Power Supplied (Vdc)	Measured Frequency (GHz)				Result
		0 min	2 min	5 min	10 min	
20	V _{Low}	60.6420	60.7640	60.7120	60.6480	PASS
	V _{Nom}	60.7890	60.7830	60.6620	60.6220	PASS
	V _{High}	60.7220	60.7430	60.6730	60.6780	PASS

Note 1: V_{Low}= 20.4 V ; V_{High}= 27.6 V

---END---