



TEST REPORT

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Product Name: Presence Sensor S1

FCC ID: 2BHY888888888

IC: 32945-88888

HVIN: PS-SP1

47 CFR Part 15, Subpart C(15.255)

Standard(s):
ANSI C63.10-2020
RSS-210 Issue 11, June 25, 2024
RSS-Gen, Issue 5, February 2021 Amendment 2

Report Number: 2402W88632E-RF-00AM1

Report Date: 2024/11/13

The above device has been tested and found compliant with the requirement of the relative standards by Bay Area Compliance Laboratories Corp. (Dongguan).

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1.0	2402W88632E-RF-00A	Original Report	2024/9/18
2.0	2402W88632E-RF-00AM1	Change the HVIN to PS-SP1	2024/11/13

1. GENERAL INFORMATION

1.1 General Description of Equipment under Test

EUT Name:	Presence Sensor S1
EUT Model:	PS-SP1
Operation Frequency Range:	59.16-61.56 GHz
Modulation Type:	FMCW
Chirp Time ▲:	64 μs
Emission Designator:	NON
Operational Temperature Range ▲: (°C)	-10~+40
Rated Input Voltage:	DC 5V
Serial Number:	2PE4-1
EUT Received Date:	2024/8/2
EUT Received Status:	Good

1.2 Accessory Information

Accessory Description	Manufacturer	Model	Parameters
/	/	/	/

1.3 Antenna Information Detail▲

Antenna Type	input impedance (Ohm)	Antenna Gain	Frequency Range
Microstrip Antenna	Unknown	0 dBi	59.16-61.56 GHz

The Method of §15.203 Compliance:

Antenna must be permanently attached to the unit.
 Antenna must use a unique type of connector to attach to the EUT.
 Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

1.4 Equipment Modifications

No modifications are made to the EUT during all test items.

2. SUMMARY OF TEST RESULTS

Standard(s)/Rule(s)	Description of Test	Result
§15.207(a) RSS-Gen Clause 8.8	AC Line Conducted Emissions	Compliant
§15.255(c)(2)(ii) RSS-210 Annex J	Peak EIRP and Transmitter Off-times	Compliant
§15.215, §15.255 (e) RSS-Gen Clause 6.7	Occupied Bandwidth	Compliant
§15.205, §15.209, §15.255(d) RSS-Gen Clause 8.10 RSS-210, Annex J	Radiated Spurious Emissions	Compliant
§15.255 (f) RSS-210 Annex J	Frequency Stability	Compliant
§15.255 (h) RSS-210 Annex J	Group Installation	Compliant
§15.203 RSS-GEN Clause 6.8	Antenna Requirement	Compliant

3. DESCRIPTION OF TEST CONFIGURATION

3.1 EUT Operation Condition

The system was configured for testing in production version with highest transmitter activity (on time), which was provided by the manufacturer. According to 15.31(c) and KDB 364244 Meas 15.255 Radars DR01-45264, the device tested at Swept mode for FMCW modulation.

3.2 EUT Exercise Software

Software "Data association intelligence" was used in test. The EUT transmit when EUT was power up.

3.3 Support Equipment List and Details

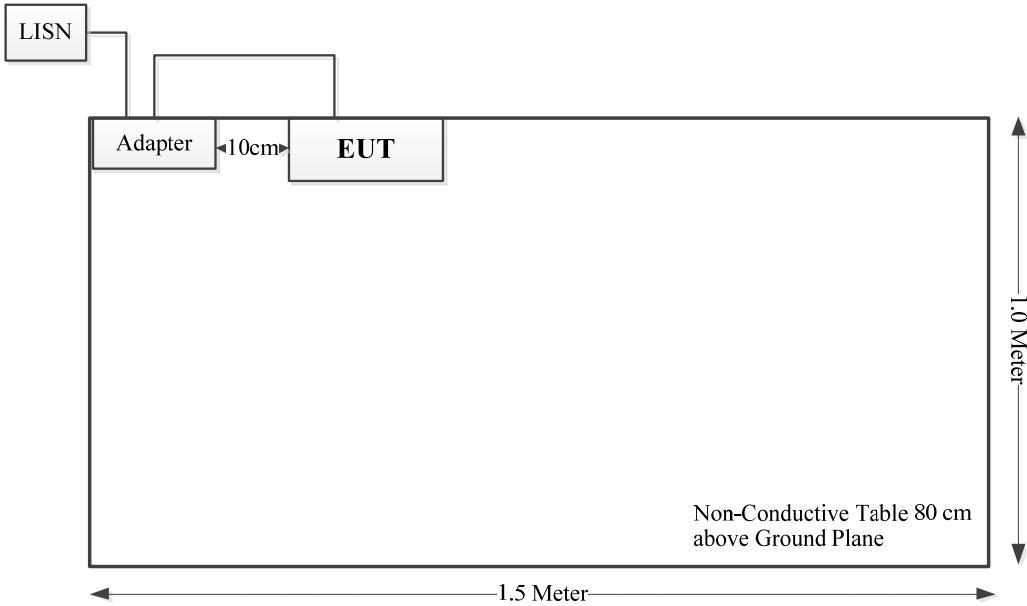
Manufacturer	Description	Model	Serial Number
Aohal	Adapter	A70-050200U-EU1	A70-050200U-EU1

3.4 Support Cable List and Details

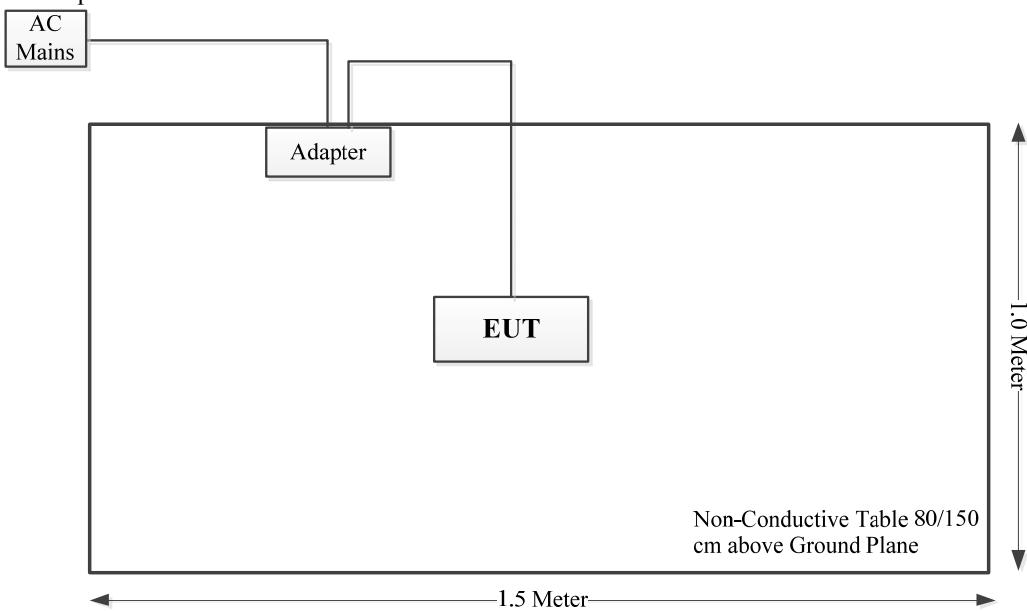
Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
DC Cable	No	No	3	Adapter	EUT

3.5 Block Diagram of Test Setup

AC Line Conducted emissions:



Radiated Spurious emissions:



3.6 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.12, Pulong East 1st Road, Tangxia Town, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 829273, the FCC Designation No. : CN5044.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

3.7 Measurement Uncertainty

Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
Unwanted Emissions, radiated	9kHz~30MHz: 3.3dB, 30MHz~200MHz: 4.55 dB, 200MHz~1GHz: 5.92 dB, 1GHz~6GHz: 4.98 dB, 6GHz~18GHz: 5.89 dB, 18GHz~26.5GHz: 5.47 dB, 26.5GHz~40GHz: 5.63 dB 40~60G: 4.83dB, 60G~90G: 4.94dB, 90G~140G: 5.46dB, 140G~220G: 6.00dB, 220G~325G: 7.35dB
EIRP	4.94dB
Temperature	±1°C
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.11 dB (150 kHz to 30 MHz)

4. REQUIREMENTS TEST RESULTS

4.1 AC Line Conducted Emissions

4.1.1 Applicable Standard

FCC§15.207(a).

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 μ V within the frequency band 535-1705 kHz, as measured using a 50 μ H/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtainig their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

RSS-Gen Clause 8.8

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 μ H / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Table 4 – AC power-line conducted emissions limits

Frequency (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 ¹	56 to 46 ¹
0.5 – 5	56	46
5 – 30	60	50

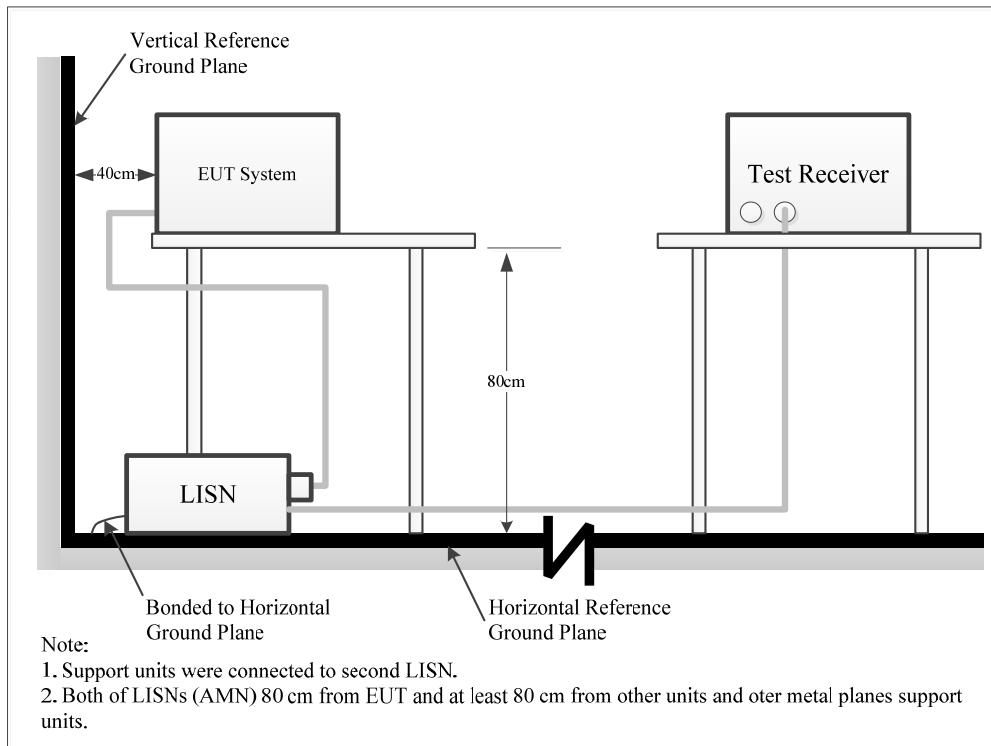
Note 1: The level decreases linearly with the logarithm of the frequency.

For an EUT with a permanent or detachable antenna operating between 150 kHz and 30 MHz, the AC power-line conducted emissions must be measured using the following configurations:

(a) Perform the AC power-line conducted emissions test with the antenna connected to determine compliance with the limits of table 4 outside the transmitter's fundamental emission band.

(b) Retest with a dummy load instead of the antenna to determine compliance with the limits of table 4 within the transmitter's fundamental emission band. For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network that simulates the antenna in the fundamental frequency band.

4.1.2 EUT Setup



The setup of EUT is according with per ANSI C63.10-2020 measurement procedure. The specification used was with the FCC Part 15.207, RSS-Gen limits.

The spacing between the peripherals was 10 cm.

3.1.3 EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

4.1.4 Test Procedure

During the conducted emission test, the EUT was connected to the outlet of the first LISN.

The frequency and amplitude of the six highest ac power-line conducted emissions relative to the limit, measured over all the current-carrying conductors of the EUT power cords, and the operating frequency or frequency to which the EUT is tuned (if appropriate), should be reported, unless such emissions are more than 20 dB below the limit. AC power-line conducted emissions measurements are to be separately carried out only on each of the phase ("hot") line(s) and (if used) on the neutral line(s), but not on the ground [protective earth] line(s). If less than six emission frequencies are within 20 dB of the limit, then the noise level of the measuring instrument at representative frequencies should be reported. The specific conductor of the power-line cord for each of the reported emissions should be identified. Measure the six highest emissions with respect to the limit on each current-carrying conductor of each power cord associated with the EUT (but not the power cords of associated or peripheral equipment that are part of the test configuration). Then, report the six highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current-carrying conductor identified with the emission. The six highest emissions should be reported for each of the current-carrying conductors, or the six highest emissions may be reported over all the current-carrying conductors.

4.1.5 Corrected Amplitude & Margin Calculation

The basic equation is as follows:

Result = Reading + Factor

Factor = attenuation caused by cable loss + voltage division factor of AMN

The "Margin" column of the following data tables indicates the degree of compliance within the applicable limit. The equation for margin calculation is as follows:

Margin = Limit – Result

4.1.6 Test Data

Serial Number:	2PE4-1	Test Date:	2024/8/15
Test Site:	CE	Test Mode:	Transmitting
Tester:	Yukin Qiu	Test Result:	Pass

Environmental Conditions:

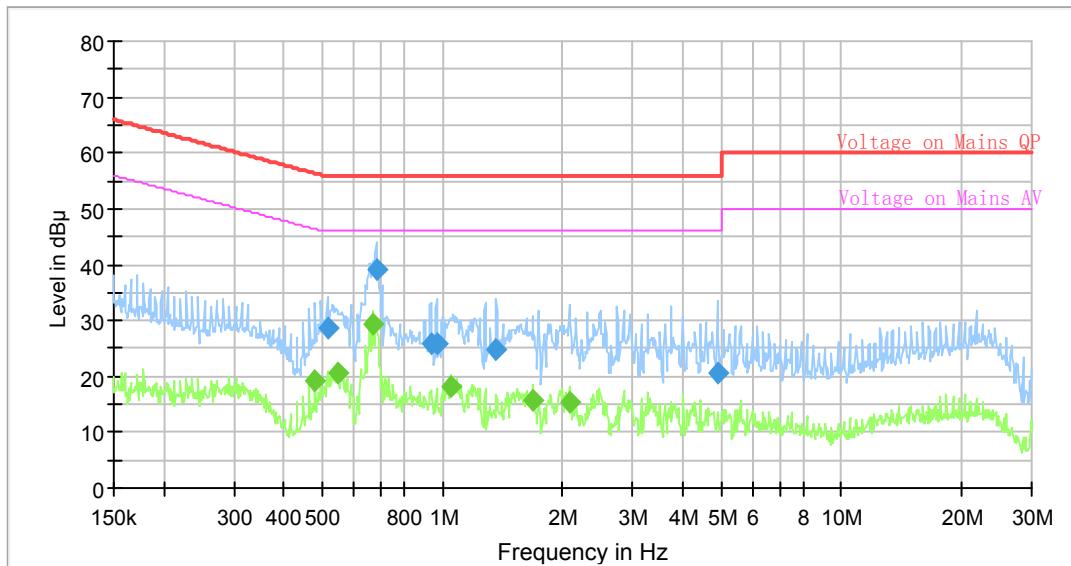
Temperature: (°C)	26.3	Relative Humidity: (%)	66	ATM Pressure: (kPa)	100.4
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	LISN	ENV216	101614	2023/10/18	2024/10/17
MICRO-COAX	Coaxial Cable	C-NJNJ-50	C-0200-01	2023/9/7	2024/9/6
R&S	EMI Test Receiver	ESCI	100035	2023/8/18	2024/8/17
R&S	Test Software	EMC32	V9.10.00	N/A	N/A

** Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

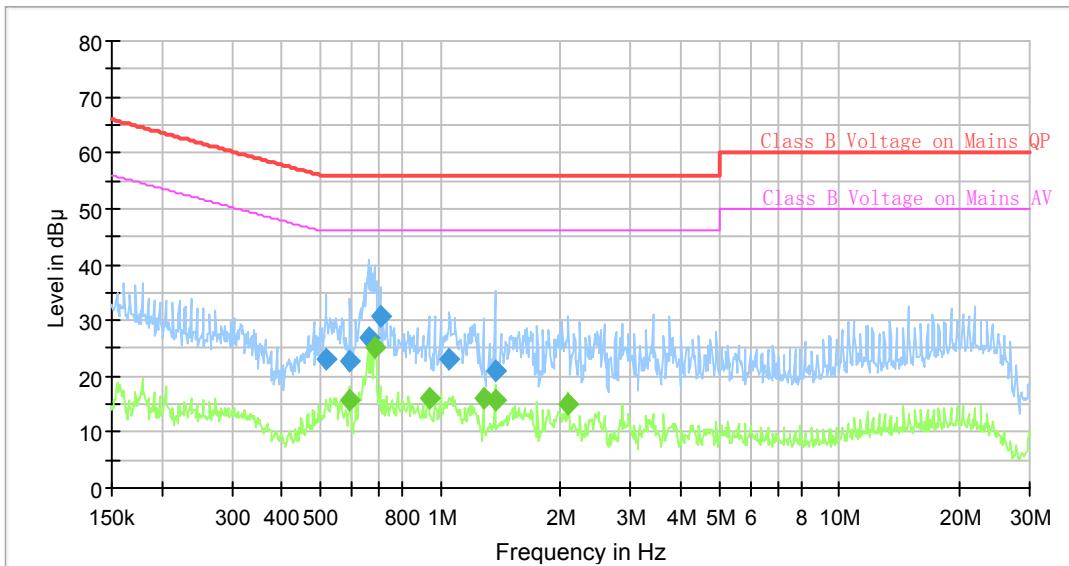
Project No: 2402W88632E-RF
 Test Engineer: Yukin Qiu
 Test Date: 2024-8-15
 Port: L
 Test Mode: Transmitting
 Power Source: AC 120V/60Hz
 Note: 2PE4-1



Final_Result

Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.479495	---	19.18	46.35	26.17	9.000	L1	10.8
0.514172	28.72	---	56.00	27.28	9.000	L1	10.8
0.545885	---	20.51	46.00	25.49	9.000	L1	10.8
0.673094	---	29.42	46.00	16.58	9.000	L1	10.8
0.683241	39.23	---	56.00	16.77	9.000	L1	10.9
0.935483	25.72	---	56.00	30.28	9.000	L1	10.9
0.968720	26.01	---	56.00	29.99	9.000	L1	10.9
1.054439	---	18.06	46.00	27.94	9.000	L1	10.8
1.366648	24.66	---	56.00	31.34	9.000	L1	10.8
1.685121	---	15.73	46.00	30.27	9.000	L1	10.8
2.077810	---	15.35	46.00	30.65	9.000	L1	10.8
4.899688	20.75	---	56.00	35.25	9.000	L1	10.8

Project No: 2402W88632E-RF
Test Engineer: Yukin Qiu
Test Date: 2024-8-15
Port: N
Test Mode: Transmitting
Power Source: AC 120V/60Hz
Note: 2PE4-1



Final_Result

Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.516743	23.14	---	56.00	32.86	9.000	N	10.7
0.594189	---	15.88	46.00	30.12	9.000	N	10.7
0.594189	22.69	---	56.00	33.31	9.000	N	10.7
0.659799	27.03	---	56.00	28.97	9.000	N	10.7
0.683241	---	25.31	46.00	19.69	9.000	N	10.8
0.707516	30.85	---	56.00	25.15	9.000	N	10.8
0.935483	---	16.23	46.00	29.77	9.000	N	10.8
1.054439	23.15	---	56.00	32.85	9.000	N	10.9
1.280849	---	15.98	46.00	30.02	9.000	N	10.9
1.373481	---	15.73	46.00	30.27	9.000	N	10.9
1.373481	20.96	---	56.00	35.04	9.000	N	10.9
2.088199	---	15.04	46.00	30.96	9.000	N	10.9

4.2 Peak EIRP And Transmitter Off-times

4.2.1 Applicable Standard

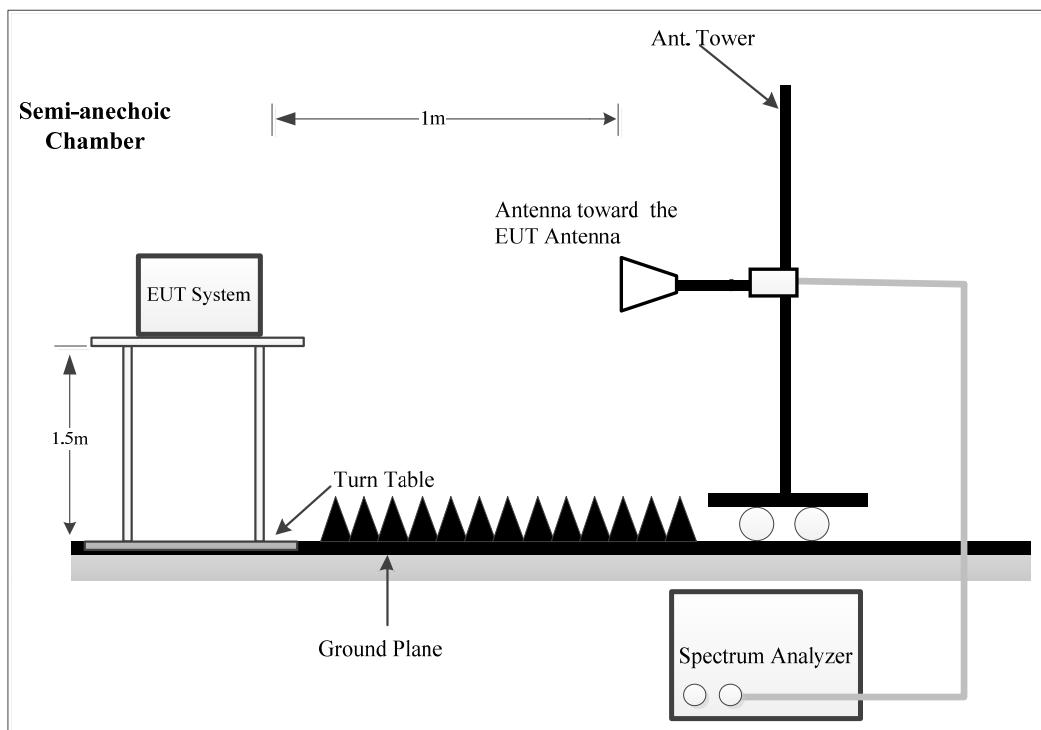
FCC §15.255(c)(2)(ii)

57.0 – 61.56 GHz: the peak EIRP shall not exceed 3 dBm except that the peak EIRP shall not exceed 20 dBm if the sum of continuous transmitter off-times of at least two milliseconds equals at least 16.5 milliseconds within any contiguous interval of 33 milliseconds.

RSS-210, Annex J.3.2 (ii)

FDS devices operating in the 57.0-61.56 GHz band shall have the peak e.i.r.p. not exceeding 3 dBm or, if the sum of continuous transmitter off-times of at least 2 ms equals at least 16.5 ms within any contiguous interval of 33 ms, the peak e.i.r.p. shall not exceed 20 dBm.

4.2.2 EUT Setup



Place the measurement antenna at a measurement distance that is in the far-field of the measurement antenna, in the far-field of the EUT antenna. The EIRP test was performed at 1m distance, which was larger than the minimum test distance, please refer to section 4.4.4 for more detail.

4.2.3 Test Procedure

Refer to ANSI C63.10-2020 Clause 9.8

For radiated measurements:

- 1) Place the measurement antenna at a measurement distance that is in the far-field of the measurement antenna, in the far-field of the EUT antenna, and meets the measurement distance requirements for final radiated measurements as specified in 9.1.4.
- 2) Place the measurement antenna in the main beam of the EUT then maximize the fundamental emission using the procedures of 9.7, noting that multiple peaks can be found at different beam orientations and/or polarizations.
- 3) Correct the power reading from the spectrum analyzer for any external gain and/or attenuation between the measurement antenna and the spectrum analyzer. This is the power at the output of the measurement antenna
- 4) Calculate the EIRP from the power at the output of the measurement antenna using Equation (22), and then convert to linear form using Equation (24).

$$EIRP = 21.98 - 20\log(\lambda) + 20\log(d_{\text{Meas}}) + P - G \quad (22)$$

where

$EIRP$ is the equivalent isotropic radiated power, in dBm
 λ is the wavelength of the emission under investigation [300/f(MHz)], in m
 d_{Meas} is the measurement distance, in m
 P is the power measured at the output of the measurement antenna, in dBm
 G is the gain of the measurement antenna, in dBi

NOTE—The measured power P includes all applicable instrument correction factors up to the connection to the measurement antenna.

- 5) Where applicable, calculate conducted output power from the EIRP using Equation (27).

For FMCW emissions, the procedures in 4.1.5.2.8 and Annex L shall be used.

4.2.4 Test Result

Serial Number:	2PE4-1	Test Date:	2024/9/3
Test Site:	Chamber B	Test Mode:	Transmitting
Tester:	Bill Yang	Test Result:	Pass

Environmental Conditions:					
Temperature: (°C)	26.5	Relative Humidity: (%)	37	ATM Pressure: (kPa)	100.8

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	Waveguide Mixer	11970V	2521A011767	2023/2/16	2026/2/15
Flann Micowave	Horn Antenna	861V/385	736	2023/2/27	2026/2/26
Resenberger	Coaxial Cable	LU7-022-1000	0031	2024/3/1	2025/2/28
Resenberger	Coaxial Cable	LU7-022-1000	0032	2024/3/1	2025/2/28
Agilent	Spectrum Analyzer	E4440A	MY44303352	2023/10/18	2024/10/17

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:**Peak EIRP:**

Frequency (GHz)	Receiver		Polar (H/V)	Factor (dB/m)	E-Field@1m (dB μ V/m)	Chirps Correction Factor (dB)	EIRP (dBm)	Limit (dBm)
	Reading (dB μ V)	Detector						
60.42	63.12	PK	V	41.98	105.10	5.99	6.29	20.00

Factor = Antenna Factor

EIRP = Reading + Factor + 20log(Measurement distance) - 104.8

Measurement distance = 1m

Chirps Time (μs)	Span (MHz)	RBW (MHz)	Chirps Correction Factor (dB)
64	2281.20	1	5.99

Refer to ANSI C63.10-2020/cor 1-2023 Annex L.1. The chirps correction factor was calculated using the formula:

$$\alpha = \frac{1}{\left(1 + \left[\left(\frac{2 \times \ln(2)}{\pi}\right)^2 \times \left(\frac{BW_{Chirp}}{T_{Chirp} \times RBW^2}\right)^2\right]\right)^{0.25}}$$

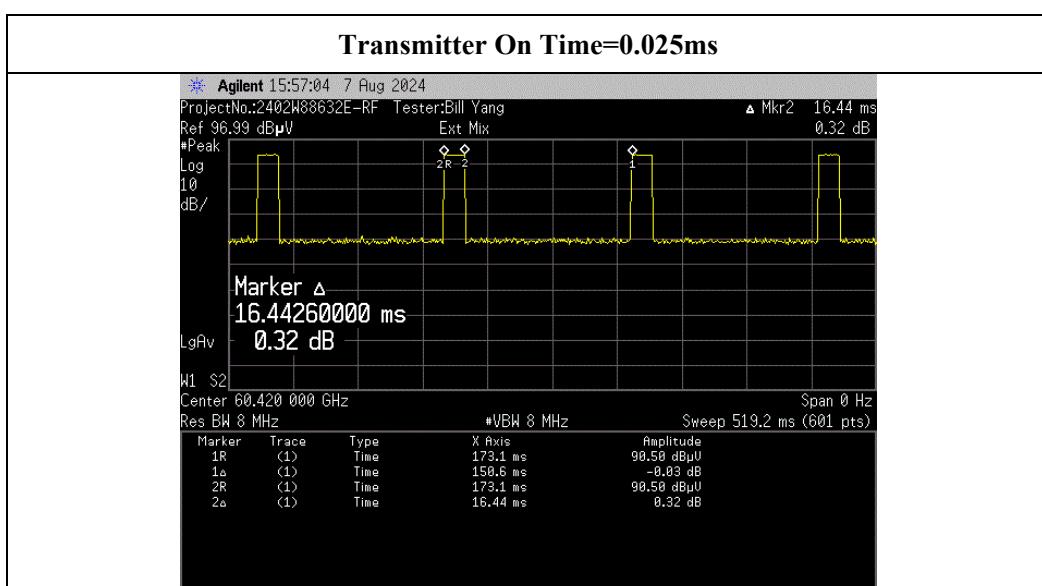
where

α is the reduction in amplitude
 BW_{Chirp} is the FMCW Chirp Bandwidth
 T_{Chirp} is the FMCW Chirp Time

Transmitter Off-times

Transmitter On (ms)	Observation Time (ms)	sum of continuous transmitter off-times (ms)	Limit (dBm)
16.44	33	16.56	≥16.5

Note: Sum of Continuous Transmitter Off-times= Observation Time(33ms) - Ton



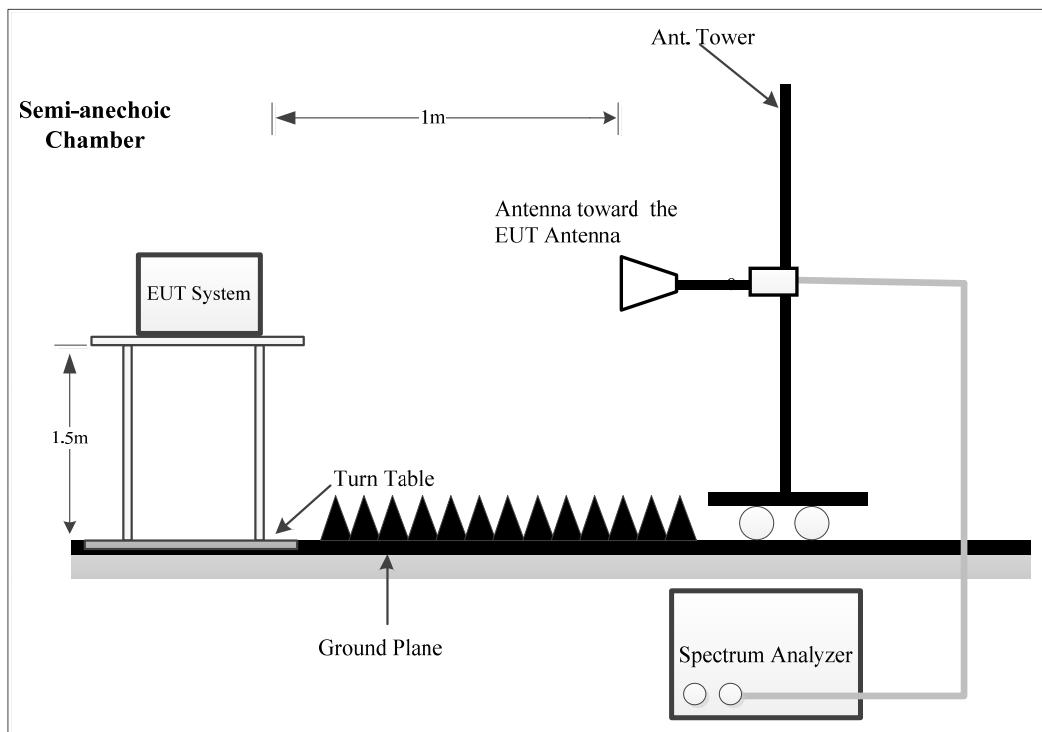
4.3 Emission Bandwidth:

4.3.1 Applicable Standard

KDB 364244 Meas 15.255 Radars DR01-45264

For other than pulsed radar transmitters, the fundamental emission bandwidth is presumed to be "...the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage $\beta/2$ of the total mean power of a given emission. Unless otherwise specified in an ITU-R Recommendation for the appropriate class of emission, the value of $\beta/2$ should be taken as 0.5%," as defined in §2.1(c) of the FCC rules. This is also known as the 99% occupied bandwidth (OBW).

4.3.2 EUT Setup



Place the measurement antenna in the main beam of the EUT then maximize the fundamental emission, noting that multiple peaks can be found at different beam orientations and/or polarizations.

4.3.3 Test Procedure

KDB 364244 Meas 15.255 Radars DR01-45264

Clauses 9.3 and 9.4 of C63.10-2020 provide standardized procedures recognized by the FCC for measuring both the relative (-10 dB) bandwidth and the 99% OBW.

The occupied bandwidth (OBW) is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

a) The following procedure shall be used for measuring 99% power bandwidth: Use the following spectrum analyzer settings:

- 1) Span equal to approximately 1.5 times the OBW, centered on the carrier frequency
- 2) RBW, prefer 1% to 5% of OBW, or a minimum of 1 MHz if this is not possible due to a large OBW
- 3) VBW approximately $3 \times$ RBW
- 4) Set the reference level of the instrument as required to reduce the chance of the signal amplitude exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.1.6.
- 5) Sweep = No faster than coupled (auto) time.
- 6) Detector function = peak.
- 7) Trace = max-hold.

b) The EUT shall be transmitting at its maximum data rate. Allow the trace to stabilize.

c) 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.

d) 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).

e) Repeat this test for each modulation scheme using the guidance of 5.6.2.1.

4.3.4 Test Data

Serial Number:	2PE4-1	Test Date:	2024/9/3
Test Site:	Chamber B	Test Mode:	Transmitting
Tester:	Bill Yang	Test Result:	Pass

Environmental Conditions:					
Temperature: (°C)	25.1	Relative Humidity: (%)	48	ATM Pressure: (kPa)	100.3

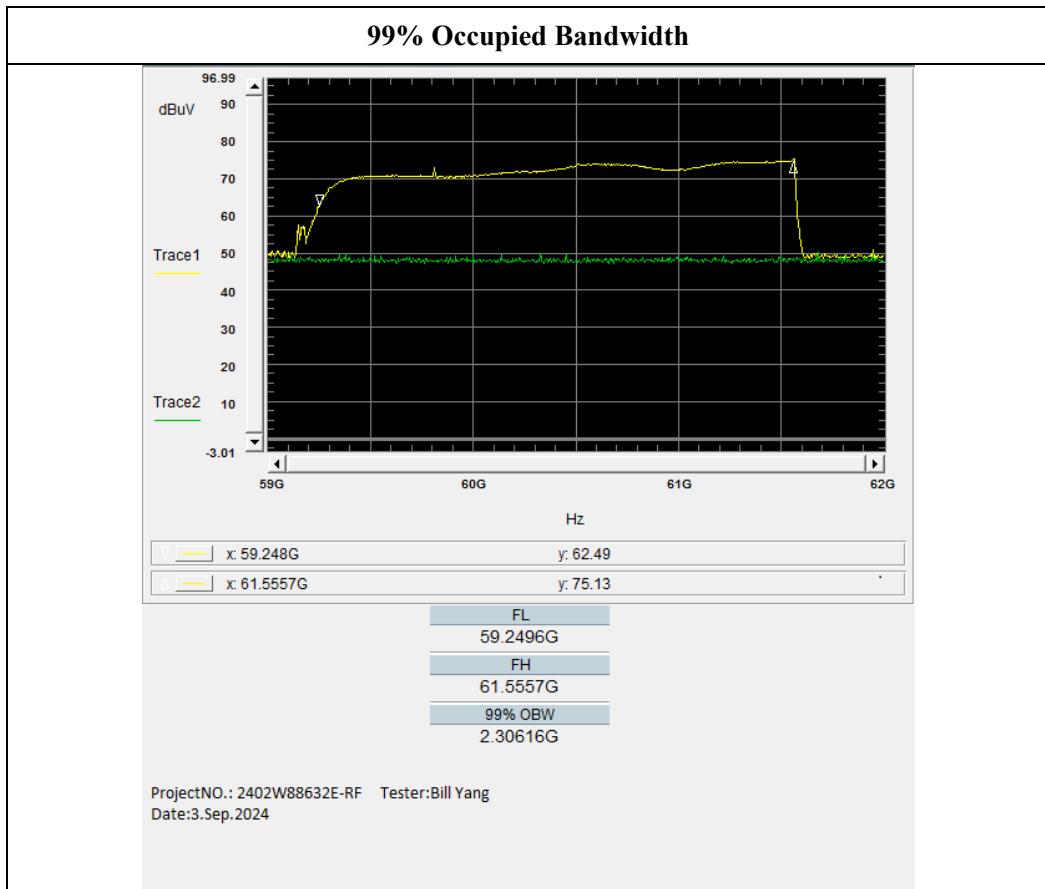
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	Waveguide Mixer	11970V	2521A011767	2023/2/16	2026/2/15
Flann Microwave	Horn Antenna	861V/385	736	2023/2/27	2026/2/26
Agilent	Spectrum Analyzer	E4440A	MY44303352	2023/10/18	2024/10/17
Resenberger	Coaxial Cable	LU7-022-1000	0031	2024/3/1	2025/2/28
Resenberger	Coaxial Cable	LU7-022-1000	0032	2024/3/1	2025/2/28

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

Test Mode	99% Occupied Bandwidth (MHz)	F _L (GHz)	Limit F _L (GHz)	F _H (GHz)	Limit F _H (GHz)
Sweep	2306.16	59.2496	59.16	61.5557	61.56



4.4 Radiated Emissions

4.4.1 Applicable Standard

FCC §15.255(d)

Limits on spurious emissions:

- (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.

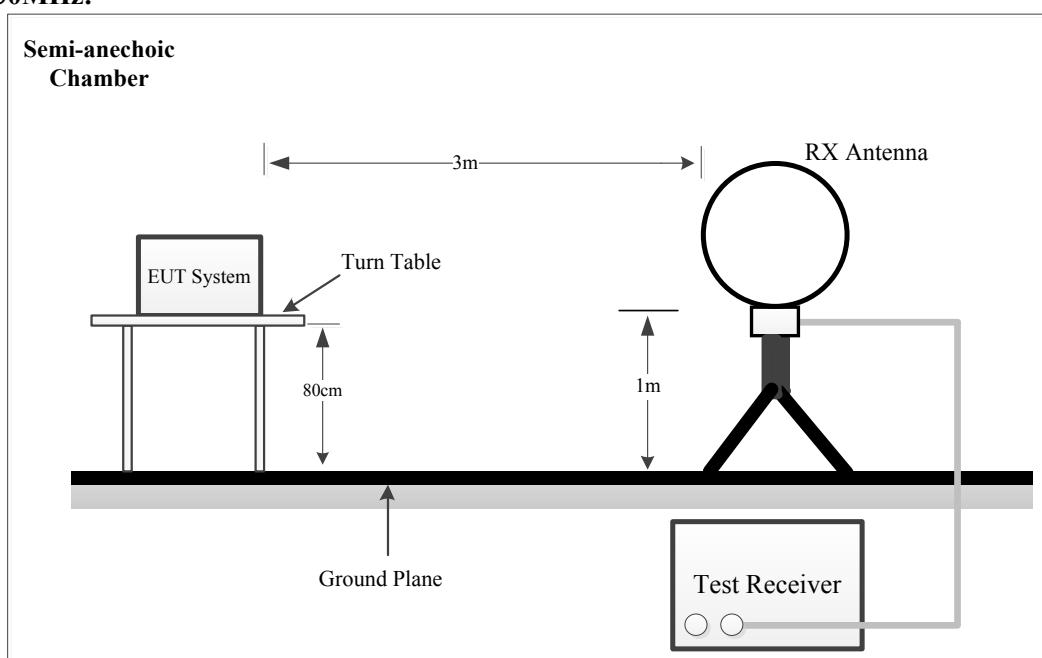
RSS-210, Annex J.4

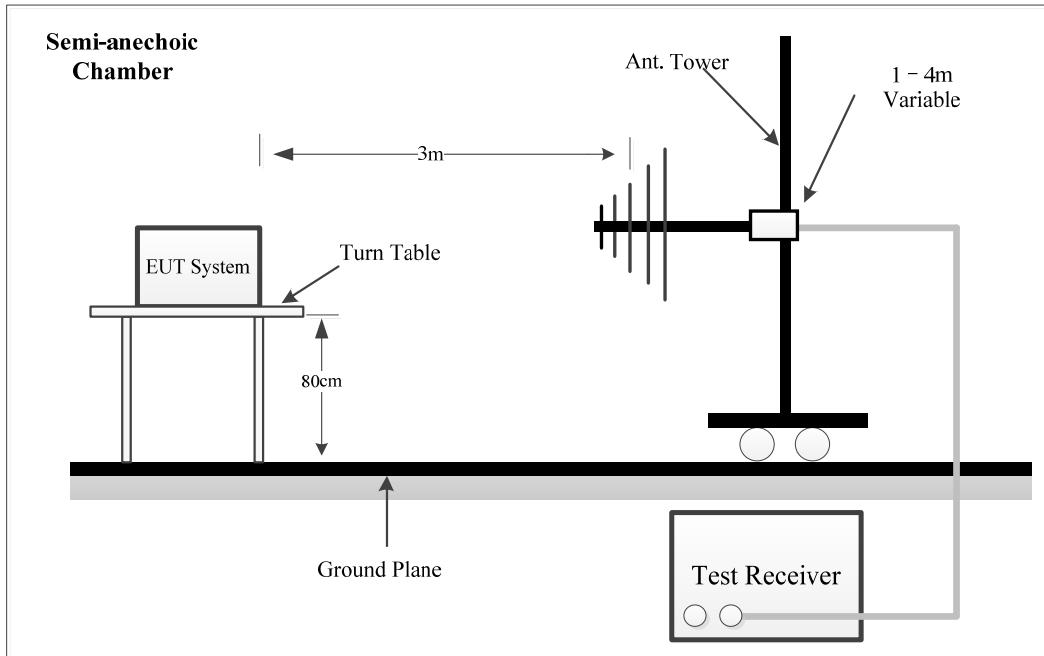
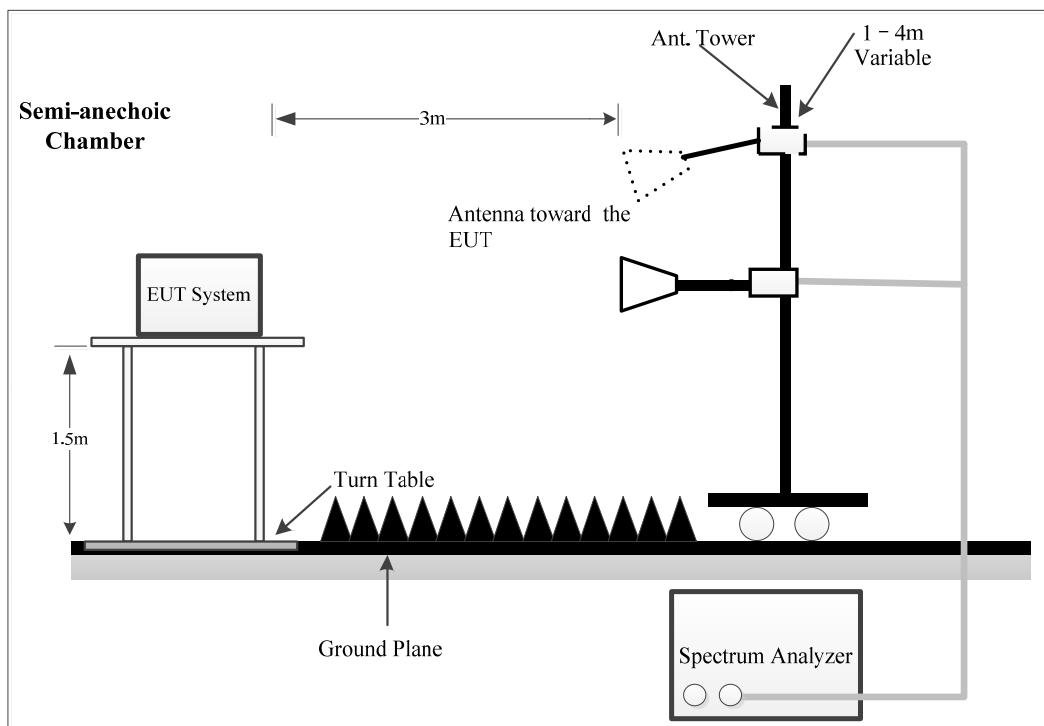
Any emissions outside the band 57-71 GHz shall consist solely of spurious emissions and shall not exceed:

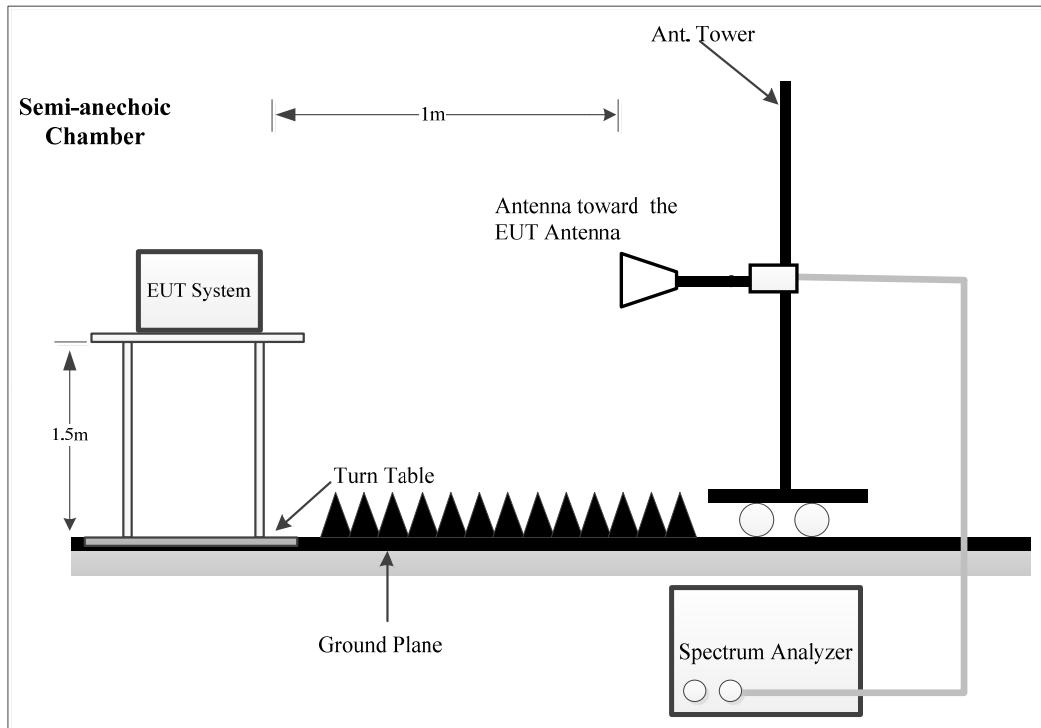
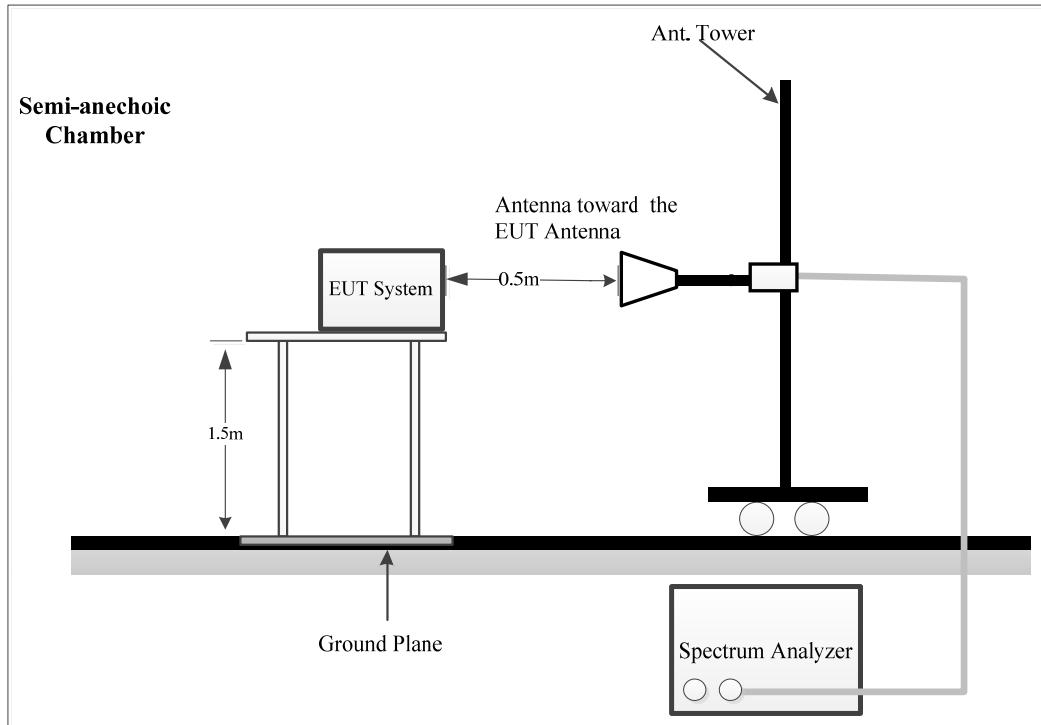
- (a) the fundamental emission levels
- (b) the general field strength limits specified in RSS-Gen, General Requirements for Compliance of Radio Apparatus, for emissions below 40 GHz
- (c) 90 pW/cm² peak at a distance of 3 m for emissions between 40 GHz and 200 GHz

4.4.2 EUT Setup

9kHz-30MHz:



30MHz~1GHz:**1~40 GHz:**

40~90 GHz:**90~200 GHz:**

Above 40GHz:

The antenna is scanned around the entire perimeter surface of the EUT, in both horizontal and vertical polarizations, at the distance of 1.0 m from 40 GHz to 90 GHz, and 0.5 m from 90 GHz to 200 GHz.

The radiated emission and out of band emission tests were performed in the 3 meters chamber, using the setup accordance with the ANSI C63.10-2020 The specification used was the FCC 15.209/15.205/15.255, RSS-210 and RSS-Gen limits.

4.4.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 200 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
9 kHz – 150 kHz	200 Hz	1 kHz	200 Hz	QP/Average
150 kHz – 30 MHz	9 kHz	30 kHz	9 kHz	QP/Average
30 MHz – 1000 MHz	/	/	120 kHz	QP
1-40 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Average
Above 40 GHz	1MHz	3 MHz	/	Average

Note: Data was recorded in Quasi-peak detection mode for frequency range of 9 kHz-30MHz except 9 – 90 kHz, 110 – 490 kHz, employing an average detector.

4.4.4 Test Procedure

Refer to ANSI C63.10-2020 Clauses 9.10, and 9.11.

A Maximizing procedure was performed to ensure that the highest emissions from the EUT were actually measured in all of the Test Arrangements of the EUT and Local Support Equipment.

All emissions under the average limit and under the noise floor have not recorded in the report.

For above 40GHz:

External harmonic mixers are utilized. The antenna is scanned around the entire perimeter surface of the EUT, in both horizontal and vertical polarizations. The Mixers and it's RF cables is compose a system for calibration, the conversion factor was added into the test Spectrum Analyzer in testing.

The far-field boundary is given in ANSI C63.10-2020:

$$R_m = 2D^2 / \lambda$$

Where:

D is the largest dimension of the antenna aperture in m and

λ is the free-space wavelength in m at the frequency of measurement.

The minimum test distance for the frequency range 40GHz-200GHz determine as below:

Model	Frequency Range (GHz)	Largest Dimension of the Horn Antenna (mm)	Minimum Test Distance R_m (m)
M19RH	40-60	46.3	0.57
M12RH	60-90	30.02	0.36
M08RH	90-140	19.7	0.23
M05RH	140-220	12.5	0.15

Note: the test distances used were 1.0 m from 40 GHz to 90 GHz, and 0.5 m from 90 GHz to 231GHz, it can be seen that the EUT was always in the Far-field of the Receive Antenna during all Radiated Emissions Tests.

4.4.5 Corrected Amplitude & Margin Calculation

The basic equation is as follows:

For 9kHz~40GHz:

The basic equation is as follows:

Result = Reading + Factor

Factor = Antenna Factor + Cable Loss- Amplifier Gain

Note: the antenna JB3 was calibrated with 6dB Attenuator, the antenna factor includes the insertion loss of the Attenuator.

The “Margin” column of the following data tables indicates the degree of compliance within the applicable limit. The equation for margin calculation is as follows:

Margin = Limit – Result

4.4.6 Test Data

Serial Number:	2PE4-1	Test Date:	2024/8/10~2024/8/12
Test Site:	Chamber A, Chamber B	Test Mode:	Transmitting
Tester:	Zoo Zou, Leo Xiao	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	27.7~30.6	Relative Humidity: (%)	46~58	ATM Pressure: (kPa)	99.5~100.5
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
9kHz~1000MHz					
EMCO	Passive Loop Antenna	6512	9706-1206	2023/10/21	2026/10/20
Sunol Sciences	Hybrid Antenna	JB3	A060611-1	2023/9/6	2026/9/5
Narda	Coaxial Attenuator	779-6dB	04269	2023/9/6	2026/9/5
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2024/8/1	2025/7/31
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-04	2024/8/1	2025/7/31
Unknown	Coaxial Cable	C-NJNJ-50	C-0530-01	2024/8/1	2025/7/31
Sonoma	Amplifier	310N	185914	2024/8/1	2025/7/31
R&S	EMI Test Receiver	ESCI	100224	2023/8/18	2024/8/17
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Above 1GHz					
ETS-Lindgren	Horn Antenna	3115	000 527 35	2023/9/7	2026/9/6
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-02 1304	2023/2/22	2026/2/21
Ducommun Technologies	Horn Antenna	ARH-2823-02	1007726-01 1302	2023/2/22	2026/2/21
Xinhang Macrowave	Coaxial Cable	XH750A-N/J-SMA/J-10M	20231117004 #0001	2023/11/17	2024/11/16
Xinhang Macrowave	Coaxial Cable	XH360A-2.92/J-2.92/J-6M-A	20231208001 #0001	2023/12/11	2024/12/10
AH	Preamplifier	PAM-0118P	469	2023/8/19	2024/8/18
AH	Preamplifier	PAM-1840VH	191	2023/9/7	2024/9/6
R&S	Spectrum Analyzer	FSV40	101944	2023/10/18	2024/10/17
Audix	Test Software	E3	191218 (V9)	N/A	N/A
OML	Waveguide Mixer	WR19/M19HWD	U60313-1	2023/2/16	2026/2/15
OML	Horn Antenna	M19RH	11648-01	2023/2/27	2026/2/26
OML	Waveguide Mixer	WR12/M12HWD	E60120-1	2023/2/16	2026/2/15
OML	Horn Antenna	M12RH	E60120-2	2023/2/27	2026/2/26
OML	Waveguide Mixer	WR08/M08HWD	F60313-1	2023/2/16	2026/2/15
OML	Horn Antenna	M08RH	F60313-2	2023/2/27	2026/2/26
OML	Waveguide Mixer	WR05/M05HWD	G60106-1	2023/2/16	2026/2/15
OML	Horn Antenna	M05RH	G60106-2	2023/2/27	2026/2/26

Resenberger	Coaxial Cable	LU7-022-1000	0031	2024/3/1	2025/2/28
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** Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

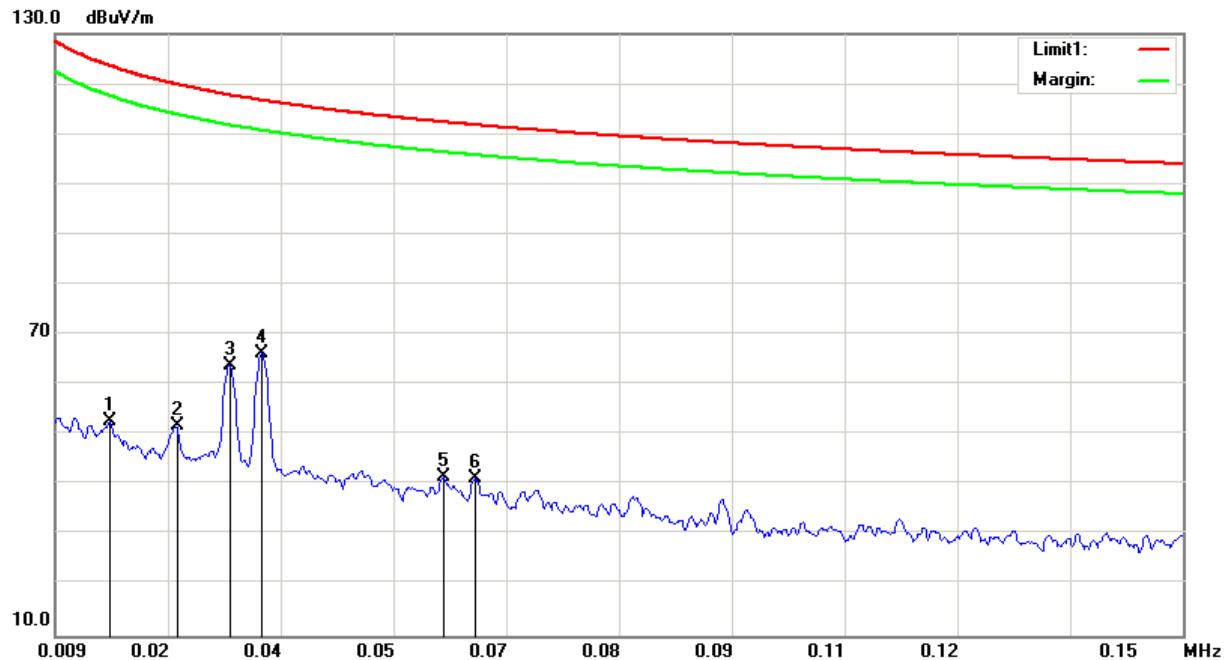
Test Data:

Please refer to the below table and plots.

After pre-scan in the X, Y and Z axes of orientation, the worst case is below:

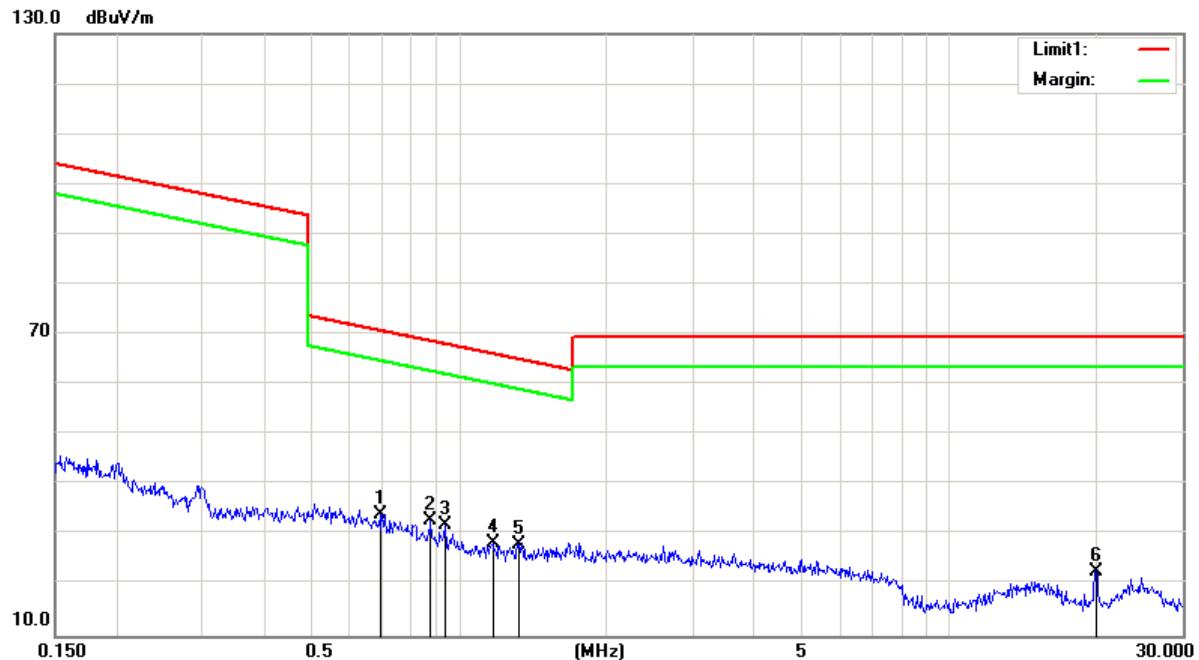
1) 9kHz~30MHz

Project No: 2402W88632E-RF
Test Engineer: Zoo Zou
Test Date: 2024-8-12
Polarization: Parallel
Test Mode: Transmitting
Power Source: AC 120V/60Hz



No.	Frequency (MHz)	Reading (dB μ V)	Detector	Corrected dB/m	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1	0.0158	1.44	peak	51.22	52.66	123.63	70.97
2	0.0241	2.68	peak	49.02	51.70	119.96	68.26
3	0.0310	16.45	peak	47.37	63.82	117.78	53.96
4	0.0348	19.54	peak	46.69	66.23	116.77	50.54
5	0.0575	-1.20	peak	42.77	41.57	112.41	70.84
6	0.0616	-0.87	peak	42.07	41.20	111.81	70.61

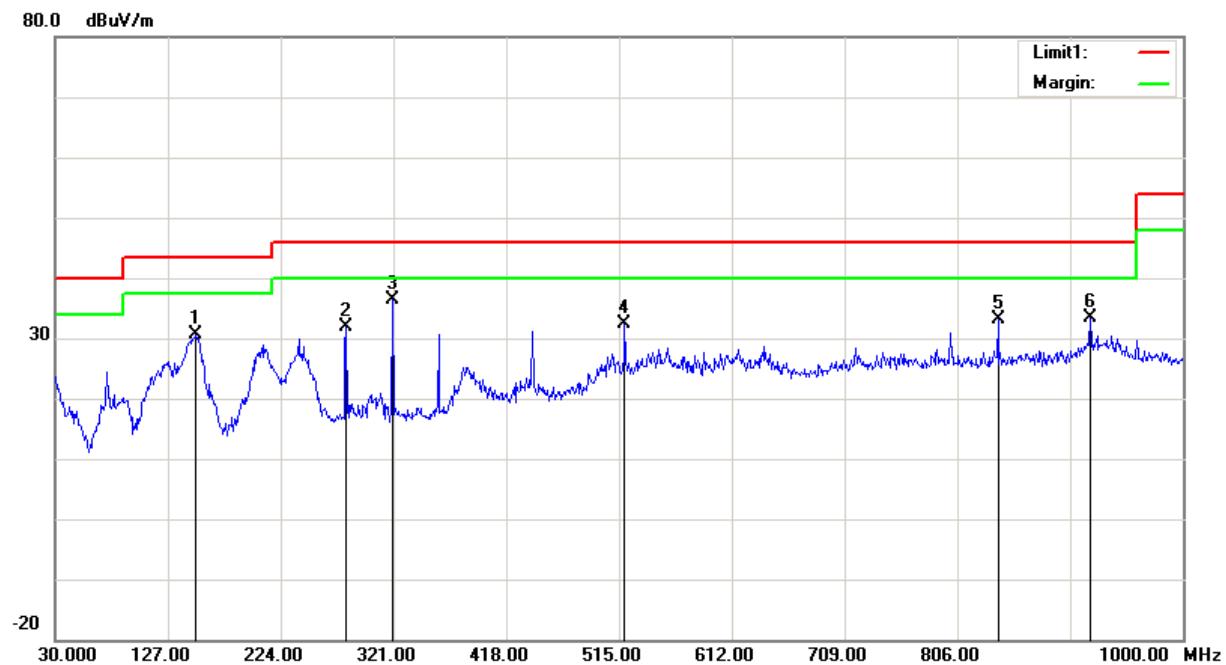
Project No: 2402W88632E-RF
Test Engineer: Zoo Zou
Test Date: 2024-8-12
Polarization: Parallel
Test Mode: Transmitting
Power Source: AC 120V/60Hz



No.	Frequency (MHz)	Reading (dB μ V)	Detector	Corrected dB/m	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1	0.6900	12.65	peak	21.57	34.22	70.81	36.59
2	0.8757	14.04	peak	19.05	33.09	68.73	35.64
3	0.9381	14.11	peak	17.80	31.91	68.13	36.22
4	1.1720	12.58	peak	15.80	28.38	66.19	37.81
5	1.3238	13.10	peak	15.12	28.22	65.13	36.91
6	19.9500	18.72	peak	4.16	22.88	69.54	46.66

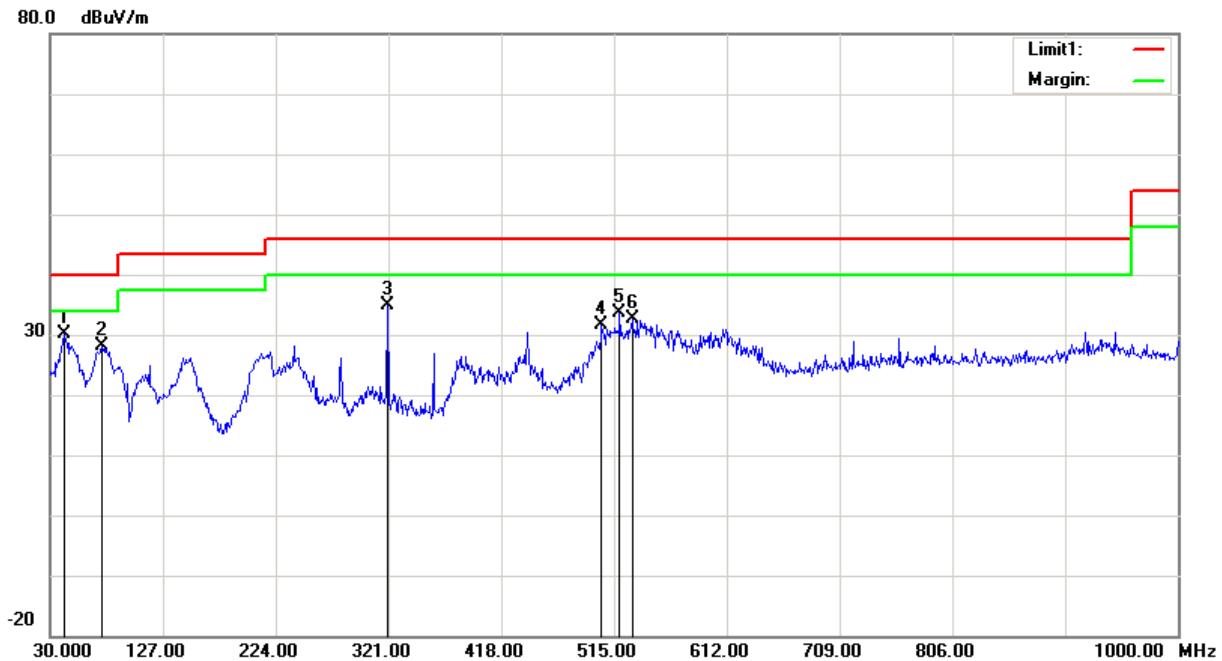
2) 30MHz-1GHz

Project No: 2402W88632E-RF
Test Engineer: Zoo Zou
Test Date: 2024-8-12
Polarization: Horizontal
Test Mode: Transmitting
Power Source: AC 120V/60Hz



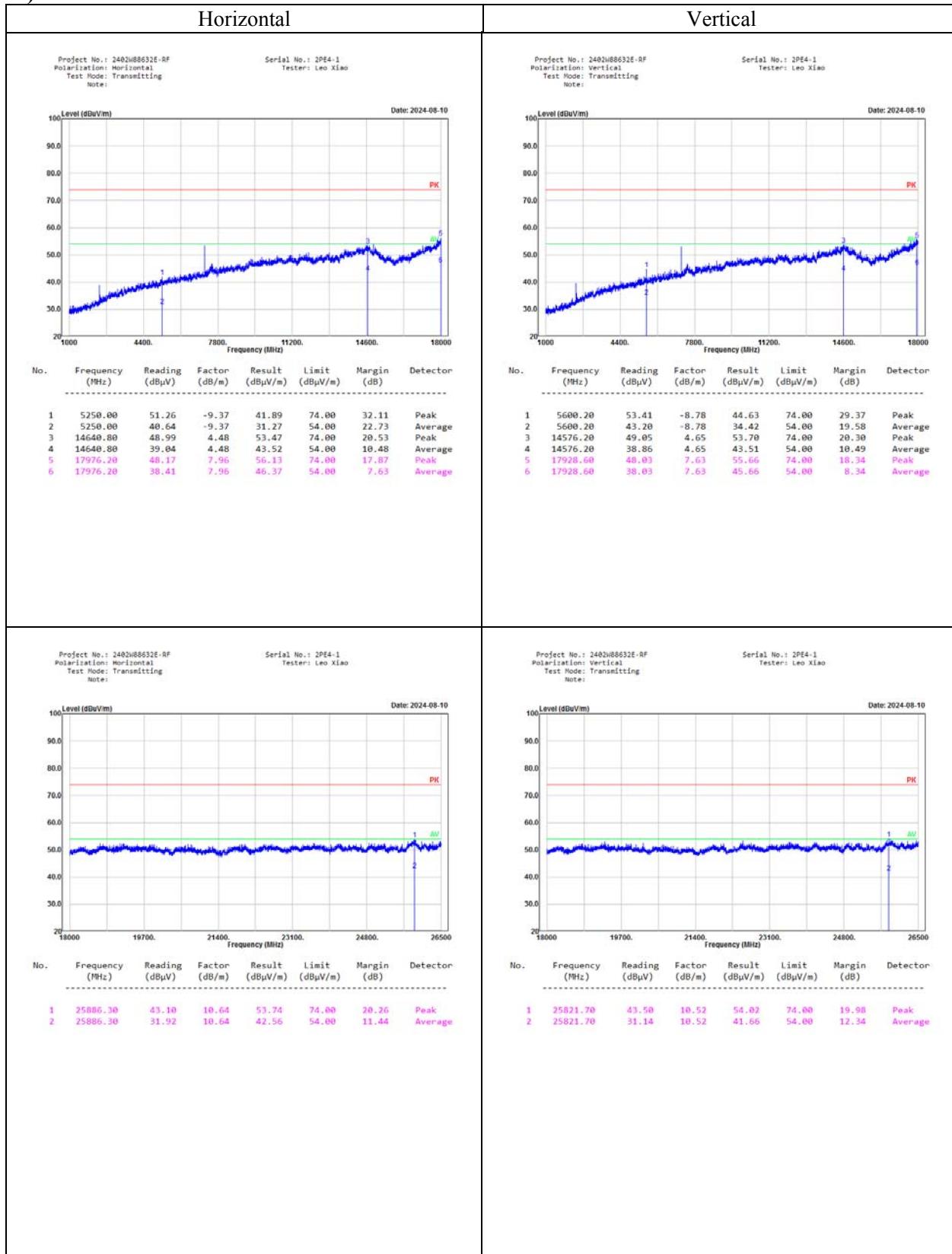
No.	Frequency (MHz)	Reading (dB μ V)	Detector	Corrected dB/m	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1	151.2500	41.59	peak	-11.07	30.52	43.50	12.98
2	280.2600	41.59	peak	-9.73	31.86	46.00	14.14
3	320.0300	45.38	peak	-9.07	36.31	46.00	9.69
4	519.8500	36.43	peak	-3.94	32.49	46.00	13.51
5	840.9200	32.42	peak	0.81	33.23	46.00	12.77
6	920.4600	31.72	peak	1.66	33.38	46.00	12.62

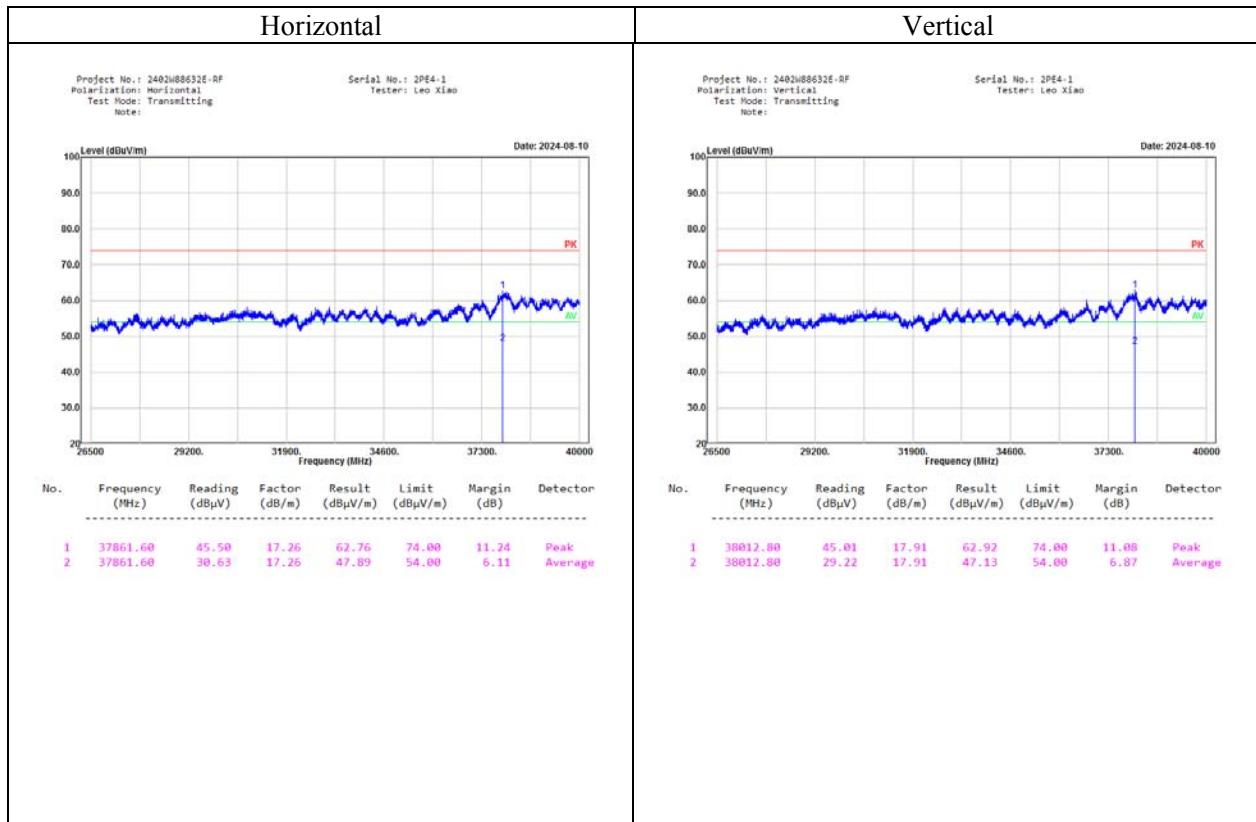
Project No: 2402W88632E-RF
Test Engineer: Zoo Zou
Test Date: 2024-8-12
Polarization: Vertical
Test Mode: Transmitting
Power Source: AC 120V/60Hz
Note:



No.	Frequency (MHz)	Reading (dB μ V)	Detector	Corrected dB/m	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1	42.6100	42.46	peak	-12.35	30.11	40.00	9.89
2	74.6200	44.32	peak	-16.14	28.18	40.00	11.82
3	320.0300	44.01	peak	-9.07	34.94	46.00	11.06
4	504.3300	35.84	peak	-4.21	31.63	46.00	14.37
5	519.8500	37.65	peak	-3.94	33.71	46.00	12.29
6	530.5200	36.40	peak	-3.77	32.63	46.00	13.37

2) 1GHz-40GHz:





3) 40GHz-200GHz:

Frequency (GHz)	Reading (dB μ V)	Detector	Polar (H/V)	Factor (dB/m)	Field Strength@3m (dB μ V/m)	Power Density (pW/cm ²)	Limit (pW/cm ²)
42.200	49.65	PK	H	39.13	79.24	22.27	90.00
41.260	50.74	PK	V	38.99	80.19	27.71	90.00
91.200	50.33	PK	H	45.25	80.02	26.65	90.00
92.050	50.26	PK	V	45.36	80.06	26.89	90.00
142.320	49.62	PK	H	48.99	83.05	53.56	90.00
140.400	50.08	PK	V	48.91	83.43	58.43	90.00

Note:

Factor = Antenna Factor

Field Strength = Reading + Factor + 20log(d_{Meas}/d_{SpecLimit})

d_{Meas} is the measurement distance, in m

d_{SpecLimit} is the distance specified by the limit, in m

$$PD = \frac{E_{SpecLimit}^2}{377}$$

where

PD is the power density at the distance specified by the limit, in W/m²
 $E_{SpecLimit}$ is the field strength at the distance specified by the limit, in V/m

The Specified distance is 3m.

4.5 Frequency Stability

4.5.1 Applicable Standard

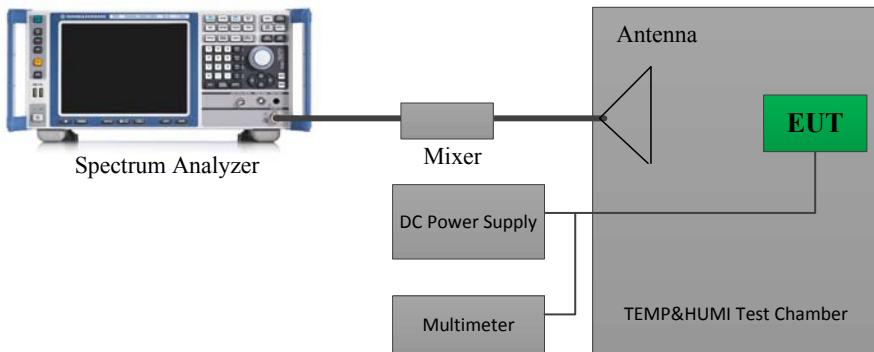
FCC §15.255(f)

(f) Frequency stability. 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.

RSS-210, Annex J.6

Fundamental emissions shall be contained within the frequency bands specified in this annex during all conditions of operation when tested at the temperature and voltage variations specified for the frequency stability measurement in RSS-Gen.

4.5.2 EUT Setup Block Diagram



4.5.3 Test Procedure

Refer to ANSI C63.10-2020 Clauses 9.5.

The following procedure shall be used for determining frequency stability of millimeter-wave systems:

- a) Arrange EUT and test equipment as shown in Figure 21. Some temperature chambers have a window or other opening that permits locating the receive antenna outside the chamber.
- b) With the EUT at ambient temperature (approximately 25 °C) and voltage source set to the EUT nominal operating voltage (100%), record the spectrum mask of the EUT emission on the spectrum analyzer.
- c) Vary EUT power supply between 85% and 115% of nominal, and record the frequency excursion of the EUT emission mask.
- d) Set the power supply to 100% nominal setting, and raise EUT operating temperature to 50 °C. Record the frequency excursion of the EUT emission mask.
- e) Repeat step d) at each 10 °C increment down to -20 °C.

4.5.3 Test Result

Serial Number:	2PE4-1	Test Date:	2024/9/3
Test Site:	RF	Test Mode:	Transmitting
Tester:	Bill Yang	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	25.1	Relative Humidity: (%)	48	ATM Pressure: (kPa)	100.3
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	Waveguide Mixer	11970V	2521A011767	2023/2/16	2026/2/15
Flann Microwave	Horn Antenna	861V/385	736	2023/2/27	2026/2/26
Agilent	Spectrum Analyzer	E4440A	MY44303352	2023/10/18	2024/10/17
Resenberger	Coaxial Cable	LU7-022-1000	0031	2024/3/1	2025/2/28
Resenberger	Coaxial Cable	LU7-022-1000	0032	2024/3/1	2025/2/28
BACL	TEMP&HUMI Test Chamber	BTH-150-40	30173	2023/10/18	2024/10/17
All-sun	Clamp Meter	EM305A	8348897	2024/8/16	2025/8/15
TDK-Lambda	DC Power Supply	Z+60-14	F-08-EM038-1	N/A	N/A

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

Temperature	Voltage	Frequency (GHz)			
		$^{\circ}\text{C}$	V_{AC}	f_{L}	f_{H}
-10	5			59.2494	61.5550
0	5			59.2492	61.5554
10	5			59.2493	61.5553
20	5			59.2496	61.5557
30	5			59.2490	61.5550
40	5			59.2495	61.5551
20	4.5			59.2498	61.5553
20	5.5			59.2497	61.5557

4.6 Group Installation

4.6.1 Applicable Standard

§15.255 (h)

Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

RSS-210, Annex J.7

Any transmitter that is certified under this annex may be mounted in a group installation for simultaneous operation with one or more certified transmitters, without any additional equipment authorization. However, no transmitter operating under the provisions of this annex shall be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

4.6.2 Judgment

The frequency, amplitude and phase of the transmit signal are set within the EUT. There are no external phase-locking inputs or any other means of combining two or more units together to realize a beam-forming array.

4.7 Antenna Requirement

4.7.1 Applicable Standard

FCC §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.
- c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

RSS-Gen Clause 6.8

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dB_i) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dB_i) and the required impedance for each antenna type.

4.7.2 Judgment

Please refer to the Antenna Information detail in Section 1.3.

EXHIBIT A - TEST SETUP PHOTOGRAPHS

Please refer to the attachment 2402W88632E-RF-00AM1-TSP test setup photographs.

EXHIBIT B - RF EXPOSURE EVALUATION

MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

FCC §15.255(g) & §1.1310 & §2.1091

Regardless of the power density levels permitted under this subpart, devices operating under the provisions of this subpart are subject to the radiofrequency radiation exposure requirements specified in §§ 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See §1.1307(b)(1) of this chapter.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Procedure

Prediction of power density at the distance of the applicable MPE limit

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Measurement Result

Frequency (GHz)	EIRP including Tune-up Tolerance		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
	(dBm)	(mW)			
59.16-61.56	13	20.0	20.00	0.004	1

Note:

The Value of EIRP including Tune-up Tolerance was declared by the customer.

Result: The device meet FCC MPE at 20 cm distance.

EXEMPTION LIMITS FOR ROUTINE EVALUATION – RF EXPOSURE EVALUATION

Applicable Standard

RSS-102 issue 5 Clause 2.5.2:

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

Calculated Result

E.I.R.P = 13dBm(20mW) << 5W

Result: Compliance. The device is compliance exemption from Routine Evaluation Limits –RF exposure Evaluation.

***** END OF REPORT *****