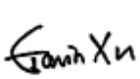
NVLAP TESTING
NVLAP LAB CODE 600341-0

BACL Bay Area Compliance Labs Corp.

TEST REPORT

Applicant:	**Lumi United Technology Co., Ltd**
Address:	**B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District, Nanshan District, Shenzhen, China**
Product Name:	**Presence Sensor FP1E**
FCC ID:	**2AKIT-PSS03**
Standard(s):	**47 CFR Part 15, Subpart C(15.255) ANSI C63.10-2013**
Report Number:	**2402S47547-RF-00B**
Report Date:	**2024/5/11**

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



Reviewed By: Gavin Xu
Title: RF Engineer

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1.0	2402S47547-RF-00B	Original Report	2024/5/11

1. GENERAL INFORMATION

1.1 General Description of Equipment under Test

EUT Name:	Presence Sensor FP1E
EUT Model:	PS-S03D
Multiple Models:	PS-S03E
Operation Frequency Range:	60-61 GHz
Modulation Type:	FMCW
Rated Input Voltage:	DC 5V from Adapter
Serial Number:	2JP1-1
EUT Received Date:	2024/4/11
EUT Received Status:	Good
Note: The multiple models are electrically identical with the test model. Please refer to the declaration letter for more detail, which was provided by manufacturer.	

1.2 Accessory Information

Accessory Description	Manufacturer	Model	Parameters
Adapter	Jiangsu Chenyang Electronics Co., LTD	MDY-08-ET	Input: 100-240Vac ~50-60Hz 0.2A Output: DC5V 1A

1.3 Antenna Information Detail▲

Antenna Type	input impedance (Ohm)	Antenna Gain	Frequency Range
Integrated in chip	Unknown	5 dBi	60-61 GHz
The design of compliance with §15.203:			
☒ Unit uses a permanently attached antenna.			
☐ Unit uses a unique coupling to the intentional radiator.			
☐ Unit was 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)	AC Line Conducted Emissions	Compliant
§15.255(c)(2)(ii)	Peak EIRP and Transmitter Off-times	Compliant
§15.215, §15.255 (e)	Occupied Bandwidth	Compliant
§15.205, §15.209, §15.255(d)	Radiated Spurious Emissions	Compliant
§15.255 (f)	Frequency Stability	Compliant
§15.255 (h)	Group Installation	Compliant
§15.203	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

No software was used in test. The EUT transmit when EUT was power up.

3.3 Support Equipment List and Details

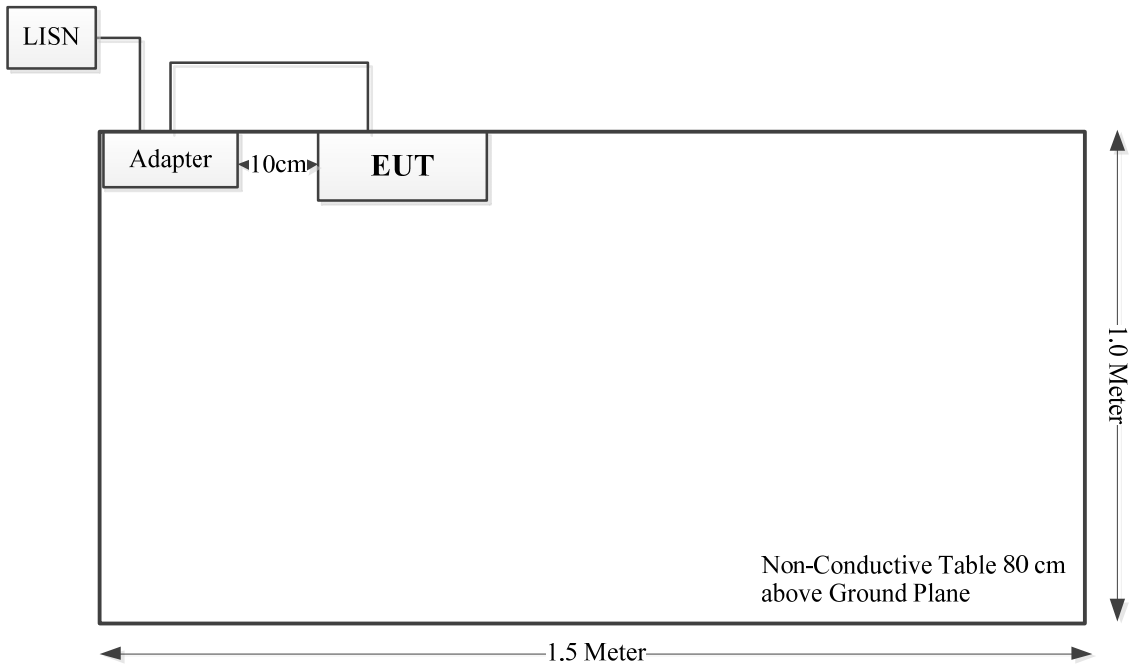
Manufacturer	Description	Model	Serial Number
Gushi	Adapter	GS-0500200	GS-0500200

3.4 Support Cable List and Details

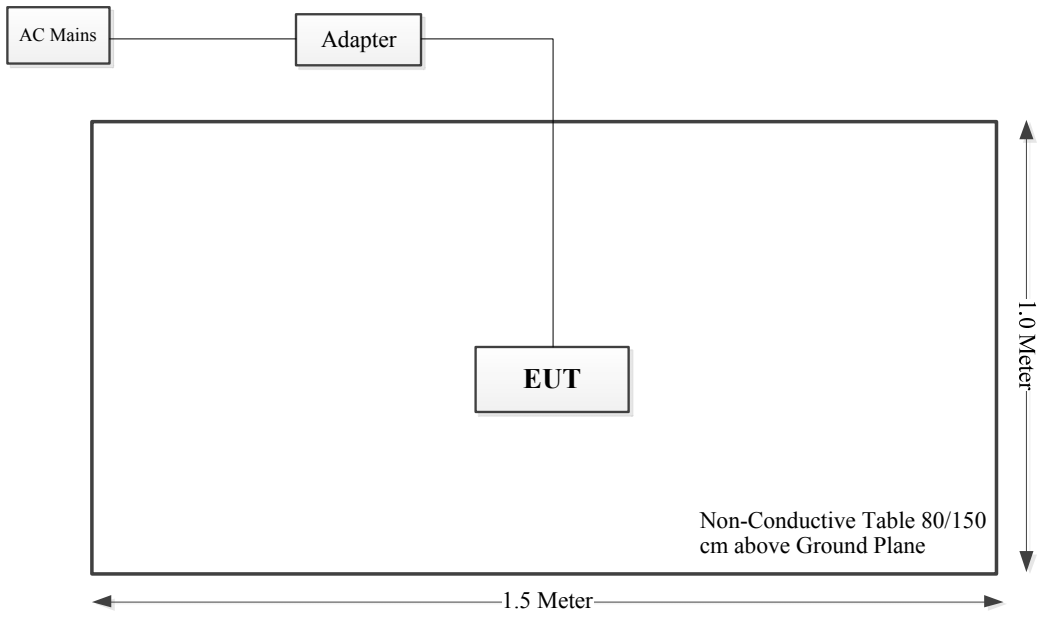
Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
USB Cable	No	No	1.2	Adapter	EUT

3.5 Block Diagram of Test Setup

AC line conducted emissions:



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℃
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 μH/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.

	Conducted limit (dBμV)	
Frequency of emission (MHz)	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:

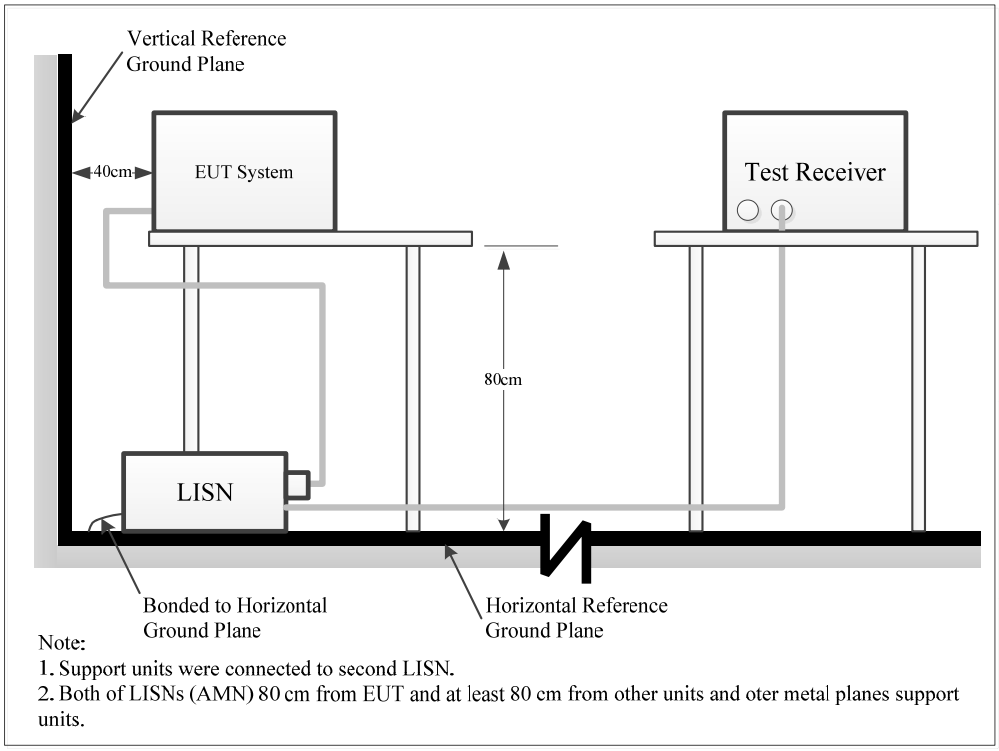
(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 μV within the frequency band 535-1705 kHz, as measured using a 50 μH/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.

4.1.2 EUT Setup



Note:
1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at least 80 cm from other units and oter metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 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:	2JP1-1	Test Date:	2024/4/20
Test Site:	CE	Test Mode:	Swept
Tester:	Lane Sun	Test Result:	Pass

Environmental Conditions:

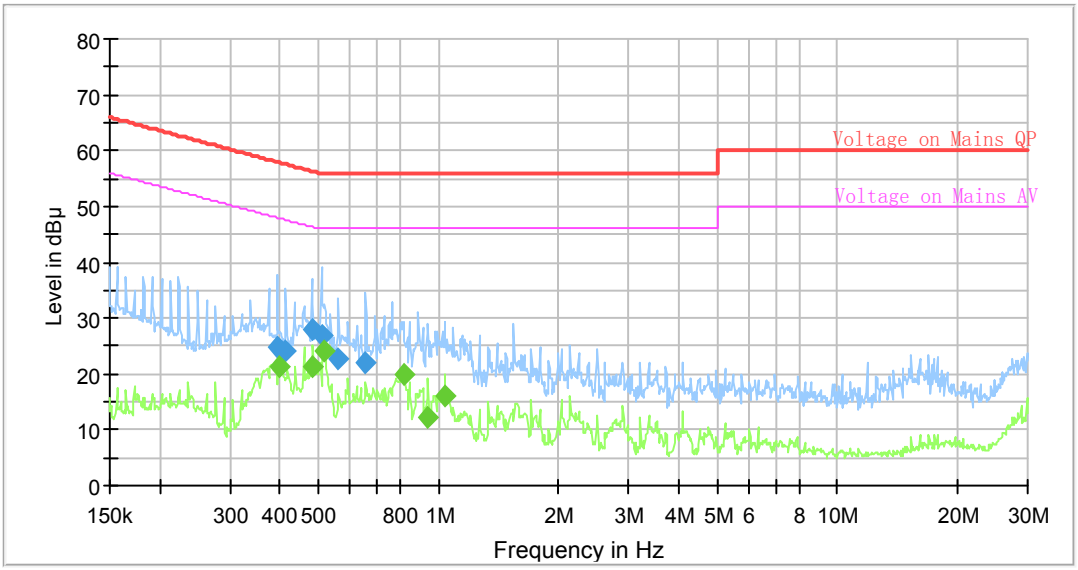
Temperature: (℃)	25.3	Relative Humidity: (%)	62	ATM Pressure: (kPa)	100.1

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	2023/9/5	2024/9/4
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).*

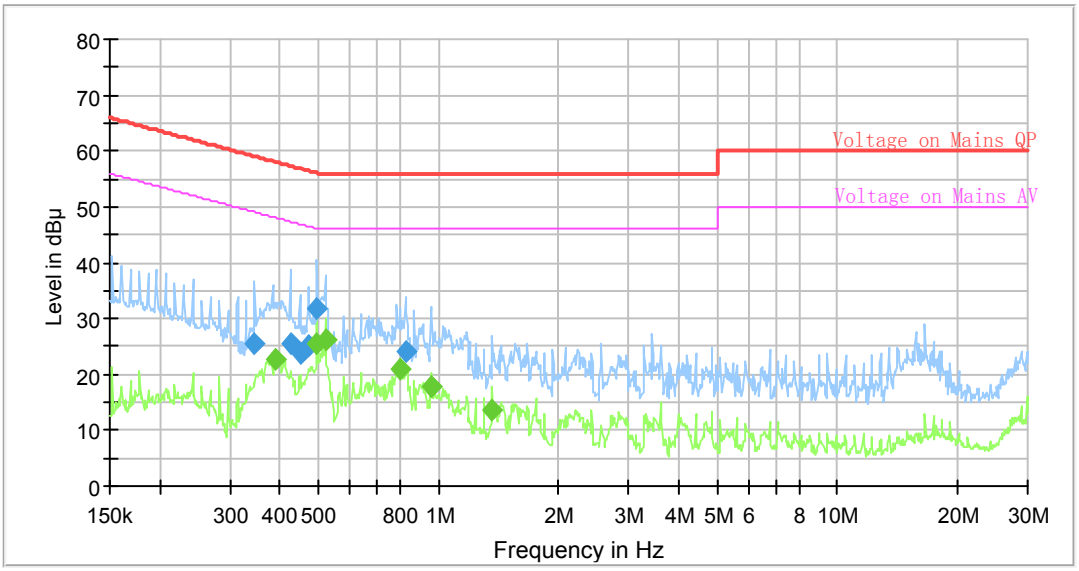
Project No:	2402S47547-RF
Test Engineer:	Lane Sun
Test Date:	2024-4-20
Port:	L
Test Mode:	Swept
Power Source:	AC 120V/60Hz



Final_Result

Frequency (MHz)	QuasiPeak (dB µ V)	Average (dB µ V)	Limit (dB µ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.394736	24.63	---	57.96	33.33	9.000	L1	10.8
0.400687	---	21.16	47.84	26.68	9.000	L1	10.8
0.414923	23.94	---	57.55	33.61	9.000	L1	10.8
0.481892	27.86	---	56.31	28.45	9.000	L1	10.8
0.484301	---	21.35	46.26	24.91	9.000	L1	10.8
0.509069	26.83	---	56.00	29.17	9.000	L1	10.8
0.514172	---	24.17	46.00	21.83	9.000	L1	10.8
0.562468	22.57	---	56.00	33.43	9.000	L1	10.8
0.656516	21.99	---	56.00	34.01	9.000	L1	10.8
0.817621	---	20.03	46.00	25.97	9.000	L1	10.9
0.940160	---	12.22	46.00	33.78	9.000	L1	10.9
1.038779	---	16.20	46.00	29.80	9.000	L1	10.8

Project No:	2402S47547-RF
Test Engineer:	Lane Sun
Test Date:	2024-4-20
Port:	N
Test Mode:	Swept
Power Source:	AC 120V/60Hz



Final_Result

Frequency (MHz)	QuasiPeak (dB µ V)	Average (dB µ V)	Limit (dB µ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.346729	25.33	---	59.04	33.71	9.000	N	10.8
0.390819	---	22.72	48.05	25.33	9.000	N	10.8
0.425401	25.55	---	57.34	31.79	9.000	N	10.8
0.449391	23.71	---	56.89	33.18	9.000	N	10.8
0.472373	25.22	---	56.47	31.25	9.000	N	10.7
0.496531	---	25.54	46.06	20.52	9.000	N	10.7
0.496531	31.95	---	56.06	24.11	9.000	N	10.7
0.521923	---	26.28	46.00	19.72	9.000	N	10.7
0.801471	---	20.97	46.00	25.03	9.000	N	10.8
0.825818	24.04	---	56.00	31.96	9.000	N	10.8
0.959105	---	17.79	46.00	28.21	9.000	N	10.8
1.366648	---	13.49	46.00	32.51	9.000	N	10.9

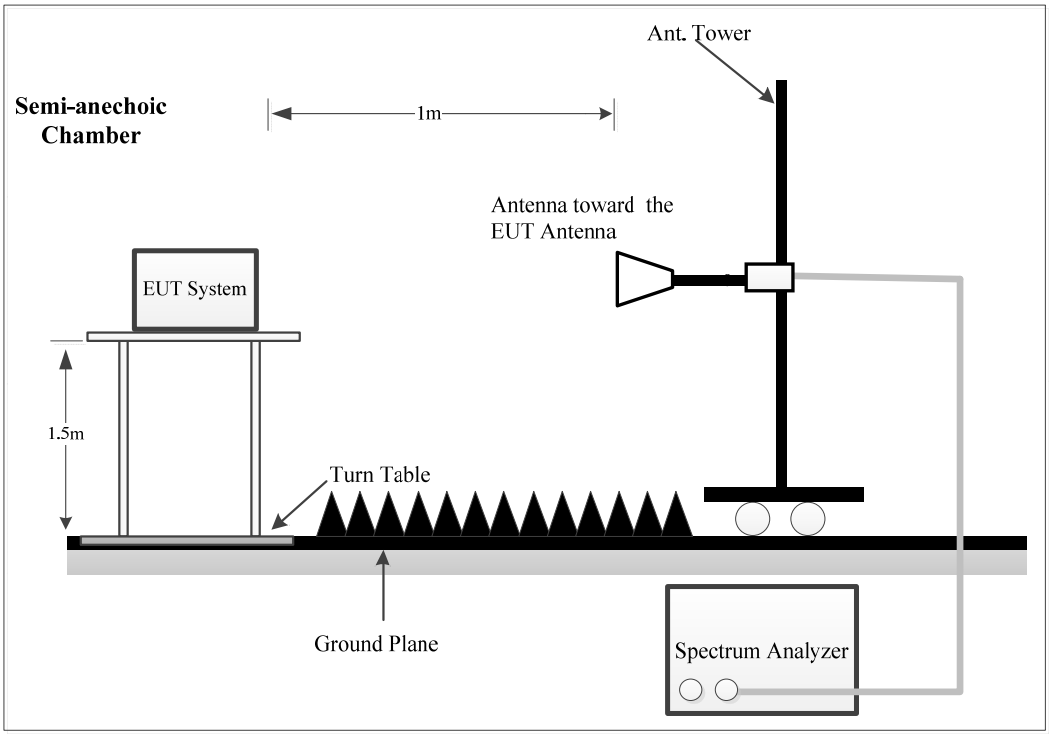
4.2 Peak EIRP And Transmitter Off-times

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.

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 C63.10-2013 Clause 9.11

For radiated emissions measurements, connect the test antenna for the fundamental frequency band to the mm-wave RF detector or the downconverter. Place the test horn in the main beam of the EUT at a distance that will provide a signal within the operating range of the RF detector or downconverter

Connect the video output of the detector to the 50 Ω input of a DSO. The video bandwidth of the combination of the detector and DSO must be greater than 10 MHz. When connected to the 50 Ω input of the DSO, the video bandwidth will typically be greater than 10 MHz, in which case a low-pass filter (LPF) with a cutoff frequency of at least 10 MHz may be inserted between the output of the detector and the input of the DSO. Due to the input capacitance of the DSO, the video bandwidth will normally be less than 10 MHz when the output of the detector is connected to the high impedance (e.g., 1 MΩ) input of the DSO.

Set the sampling rate of the DSO to at least twice the cutoff frequency of any LPF used or to at least twice the signal bandwidth without a LPF. Adjust the memory depth, the triggering, and the sweep speed to obtain a display that is representative of the signal considering the type of modulation. If the signal is noncontinuous, then identify the segment of the signal that has the highest amplitude, and then adjust the triggering and the sweep speed to capture that segment. If the emission consists of RF bursts, then identify the highest level burst and adjust the triggering and sweep rate of the DSO to display the entire burst without blanking intervals.

Determine the maximum measurement distance using 9.8.

If it is impractical to make measurements due to inadequate instrument sensitivity, then connect a low-noise amplifier between the test antenna and the mm-wave RF detector or downconverter to provide an adequate signal-to-noise ratio to permit accurate amplitude measurements. Recalculate the maximum measurement distance if needed.

Maximize the fundamental emission using 9.9, noting that multiple peaks may be found at different beam orientations and/or polarizations.

Measure the level of the emission using substitution as follows

1) Record the average and peak voltages from the DSO.
2) Disconnect the test antenna or EUT (as applicable for radiated or conducted tests) from the RF input port of the instrumentation system.

3) Connect a mm-wave source to the RF input port of the instrumentation system via a waveguide variable attenuator.

4) The mm-wave source shall be unmodulated.

5) Adjust the frequency of the mm-wave source to the center of the frequency range occupied by the transmitter.

Calculate the maximum peak and average field strength of the emission at the measurement distance, using Equation (19) and the peak and average (respectively) substitution power at the output of the test antenna (input to the instrumentation system) as recorded in step e).

Calculate the peak and average EIRP from the measured peak and average (respectively) field strength using Equation (22), and then convert to linear form using Equation (24).

For peak measurements, calculate the peak conducted output power from the peak EIRP using Equation (27).

4) If measurements were made at any distance other than the distance specified by the limit, then extrapolate the maximum measured peak and average field strength to the peak and average (respectively) field strength at the distance specified by the limit using Equation (20) and convert to the linear form using Equation (21).

5) Calculate the peak and average power density at the distance specified by the limit from the peak and average (respectively) field strength at the distance specified by the limit using Equation (26).

4.2.4 Test Result

Serial Number:	2JP1-1	Test Date:	2024/4/14~2024/5/10
Test Site:	Chamber B	Test Mode:	Swept
Tester:	Bill Yang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	23.5~26	Relative Humidity: (%)	45~51	ATM Pressure: (kPa)	101.2~101.4

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
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:

Peak EIRP:

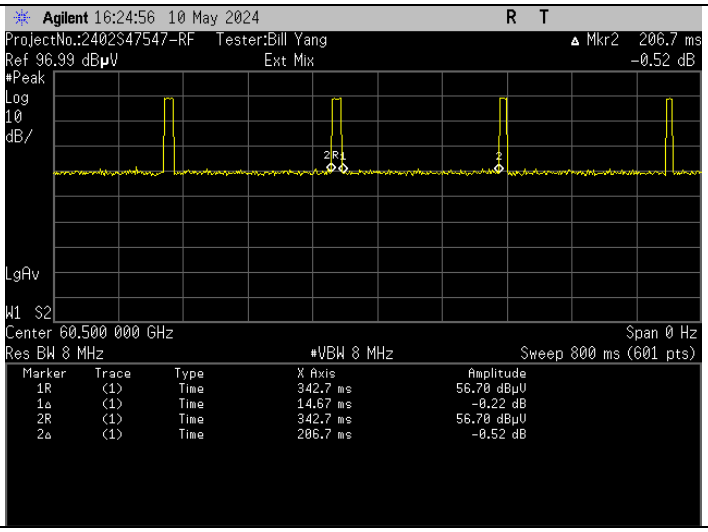
Frequency (GHz)	DSO		Polar (H/V)	Substituted Level (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)
	Reading (mV)	Detector					
60.500	1.79	PK	V	-29.57	24.00	14.62	20

E_{meas} = 126.8 - 20log(λ) + Substituted level - Antenna Gain
EIRP = E_{meas} + 20log(Measurement distance) - 104.7
Measurement distance = 1m
The Mixers and it`s RF cables is compose a system for calibration.
The test data recorded was the maximum polarization.

Transmitter Off-times

Transmitter On (ms)	Observation Time (ms)	sum of continuous transmitter off-times (ms)	Limit (dBm)
14.67	33	18.33	≥16.5
Note: Sum of Continuous Transmitter Off-times= Observation Time(33ms) - Ton			

Transmitter On Time=0.025ms



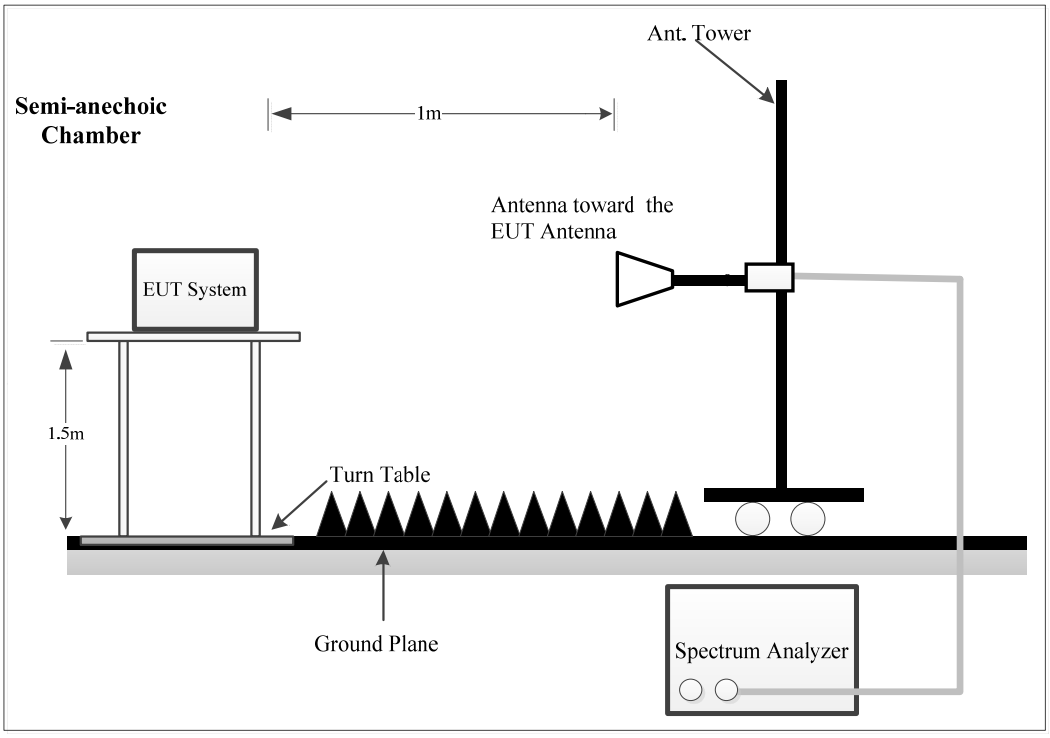
4.3 Emission Bandwidth:

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 β/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 β/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 × 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:	2JP1-1	Test Date:	2024/4/14
Test Site:	Chamber B	Test Mode:	Swept
Tester:	Bill Yang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	26	Relative Humidity: (%)	51	ATM Pressure: (kPa)	101.2

Test Equipment List and Details:

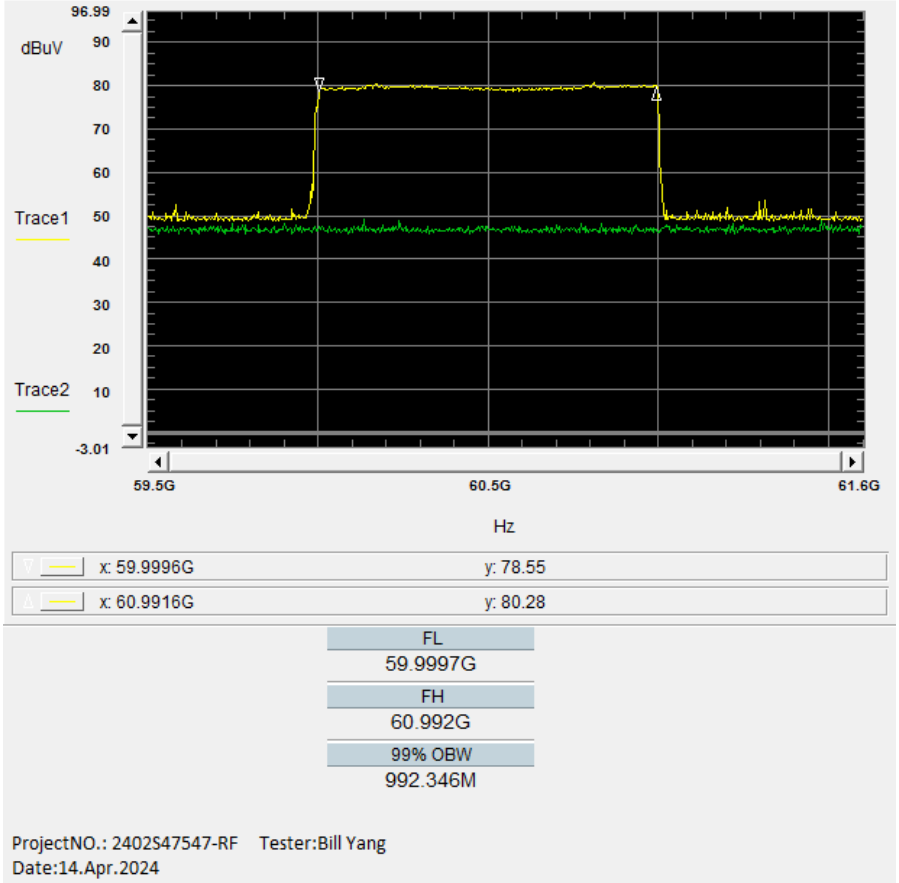
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	Waveguide Mixer	11970V	2521A011767	2023/2/16	2026/2/15
Flann Micowave	Horn Antenna	861V/385	736	2023/2/27	2026/2/26
R&S	Spectrum Analyzer	FSV40	101944	2023/10/18	2024/10/17

** 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:

Test Mode	99% Occupied Bandwidth (MHz)	F_L (GHz)	Limit F_L(GHz)	F_H (GHz)	Limit F_H(GHz)
Swept	992.346	60.000	57	60.992	61.56

99% Occupied Bandwidth



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.

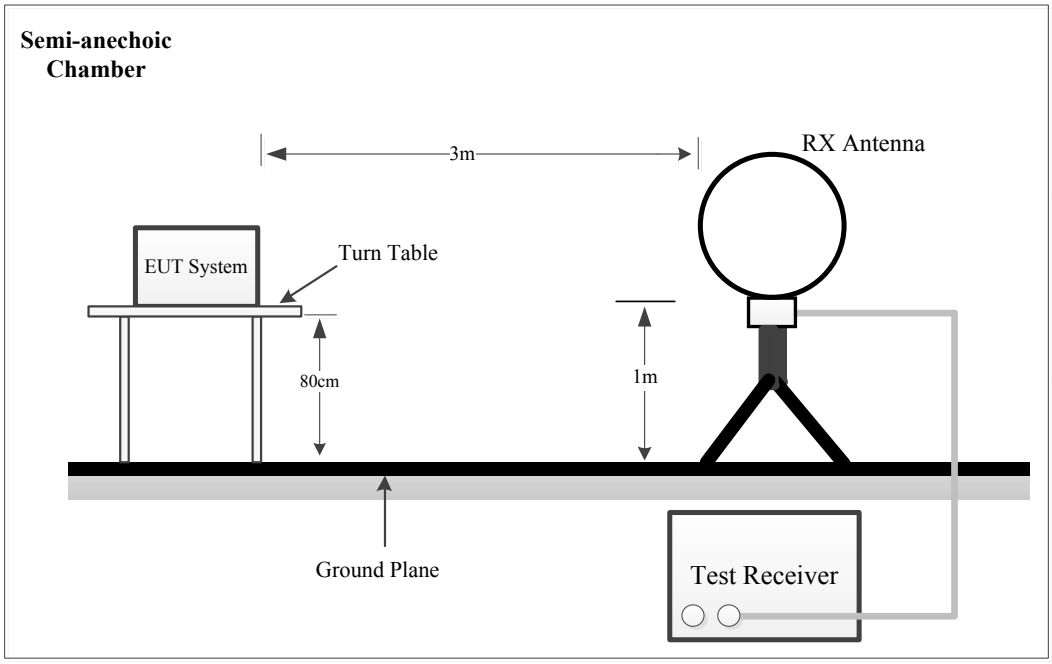
(2) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters.

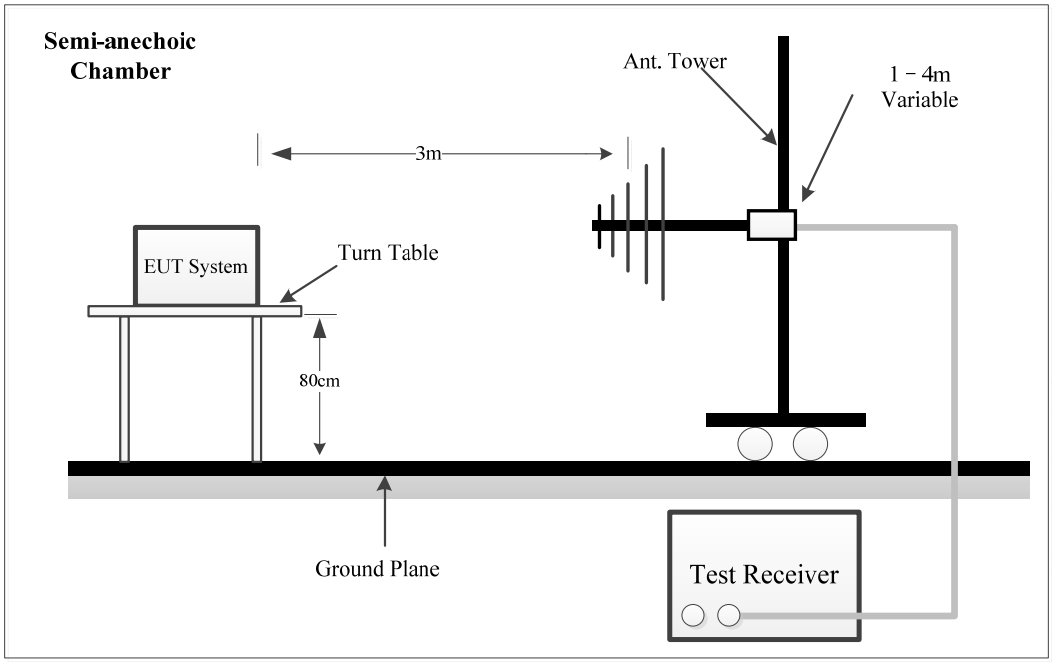
(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

4.4.2 EUT Setup

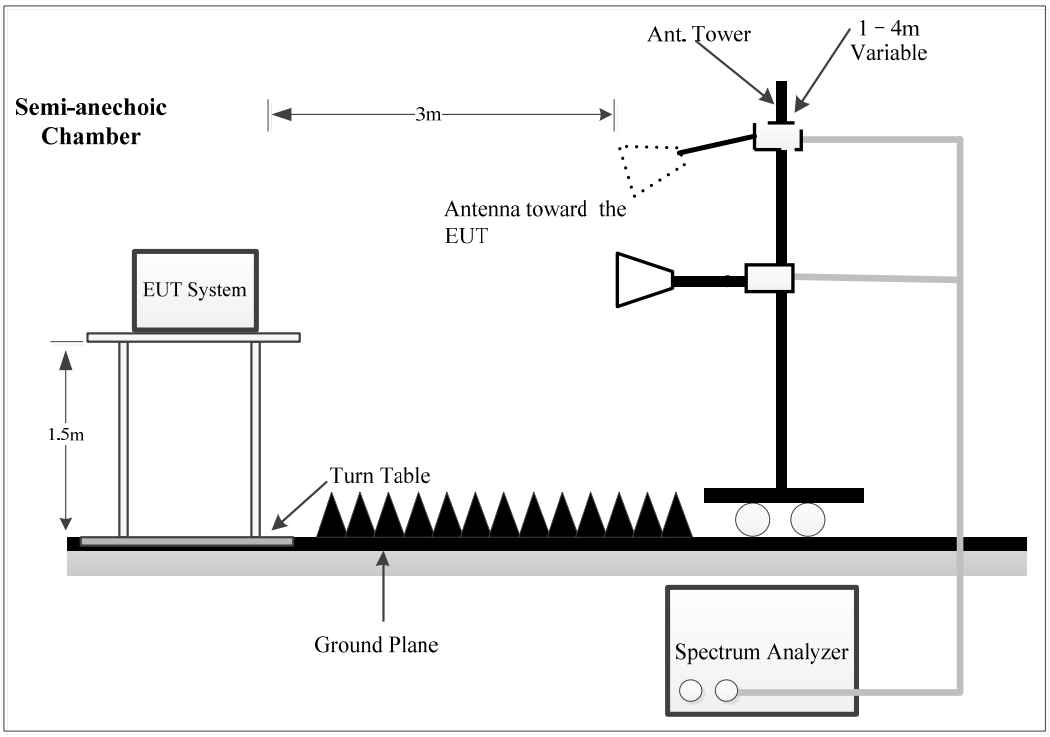
9kHz-30MHz:



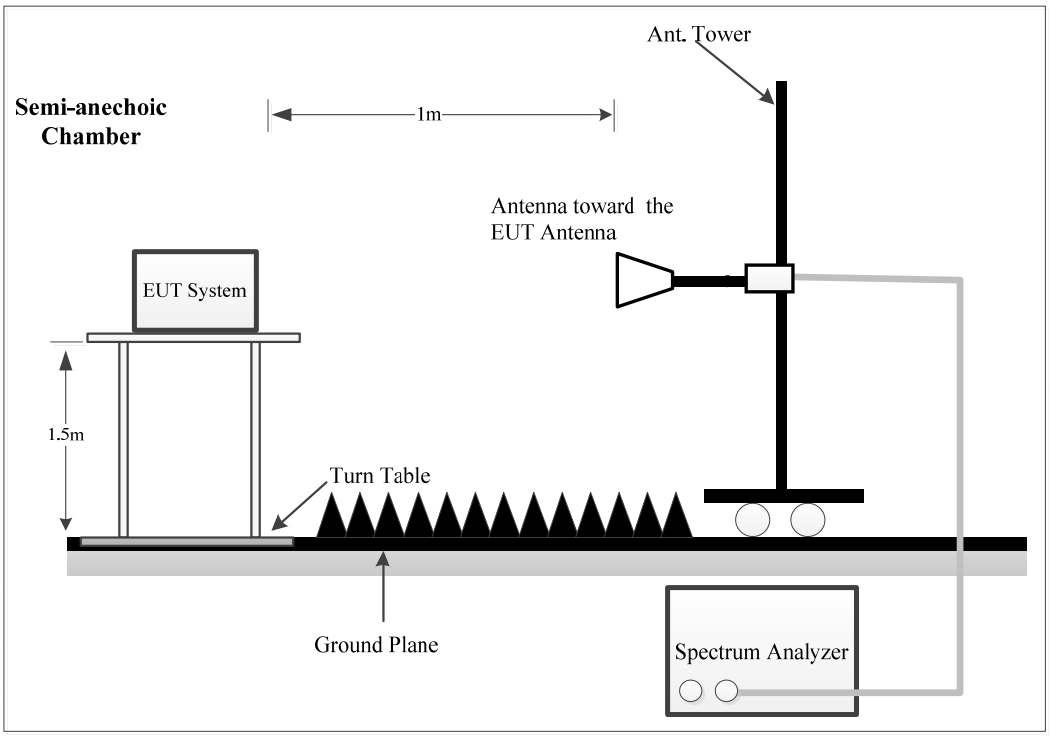
30MHz~1GHz:


Semi-anechoic
Chamber
Ant. Tower
1 – 4m
Variable
3m
EUT System
Turn Table
80cm
Ground Plane
Test Receiver

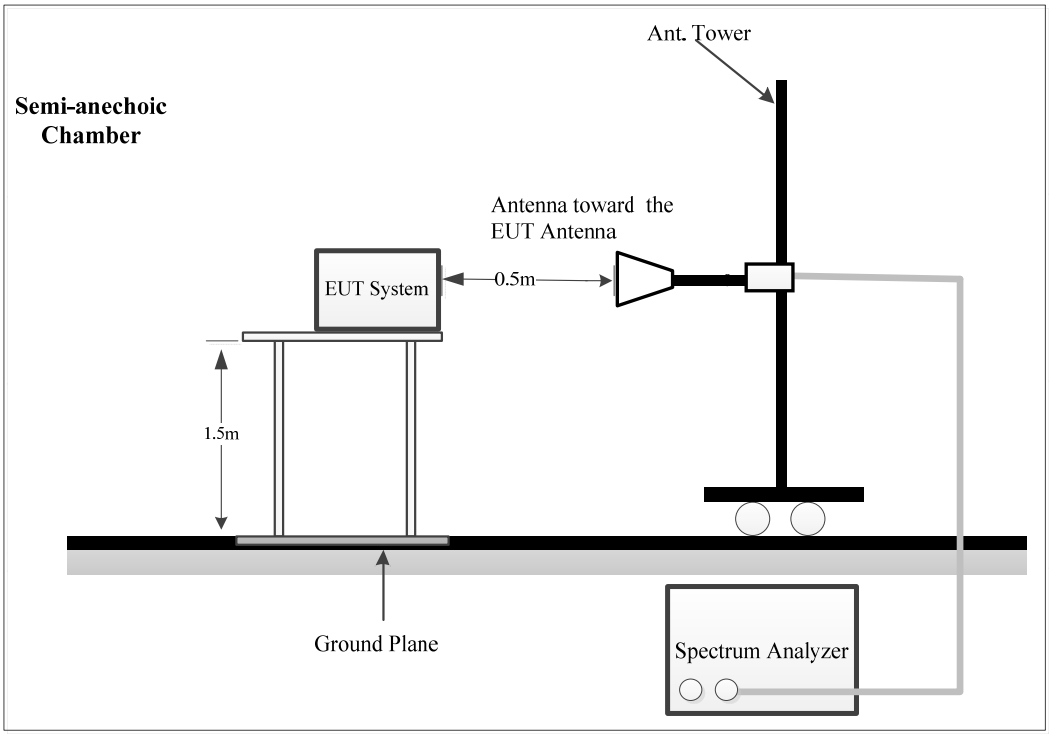
1~40 GHz:


Ant. Tower
1 – 4m
Variable
Semi-anechoic
Chamber
3m
Antenna toward the
EUT
EUT System
1.5m
Turn Table
Ground Plane
Spectrum Analyzer

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 C63.10-2013 The specification used was the FCC 15.209, 15.205, 15.255 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
	100 kHz	300 kHz	/	PK
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 C63.10-2013 Clauses 9.9, 9.12, and 9.13.

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 C63.10-2013:

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

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-231GHz 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
M03RH	220-325	8.36	0.10

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:	2JP1-1	Test Date:	2024/4/3~2024/4/7
Test Site:	Chamber A, Chamber B	Test Mode:	Swept
Tester:	Alan Xie, Bill Yang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	24.2~25.1	Relative Humidity: (%)	52	ATM Pressure: (kPa)	100.4

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	2024/10/20
Sunol Sciences	Hybrid Antenna	JB3	A060611-3	2021/1/12	2024/1/11
Wilson	Attenuator	859936	F-08-EM014	2023/7/1	2024/6/30
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2023/7/1	2024/6/30
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2023/7/1	2024/6/30
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2023/7/1	2024/6/30
Sonoma	Amplifier	310N	372193	2023/7/1	2024/6/30
R&S	EMI Test Receiver	ESR3	102453	2023/8/18	2024/8/17
Audix	Test Software	E3	191218 (V9)	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

** 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).*

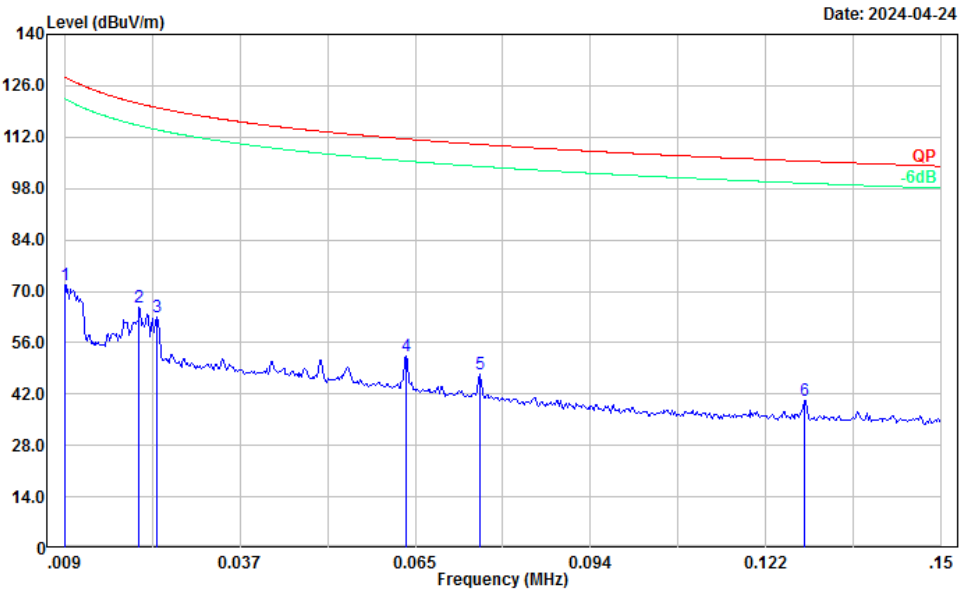
Test Data:

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:

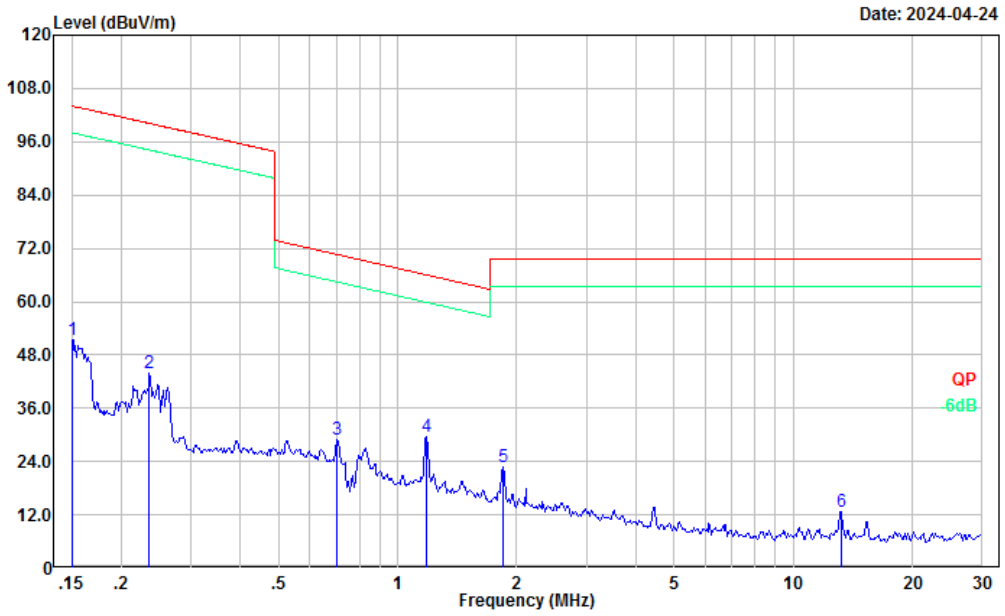
1) 9kHz~30MHz

Project No.: 2402S47547-RF Serial No.: 2JP1-1
Polarization: Parallel Tester: Bill Yang
Test Mode: Normal Working
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.01	602.63	-530.76	71.87	128.52	56.65	Peak
2	0.02	597.16	-531.55	65.61	121.14	55.53	Peak
3	0.02	594.76	-531.59	63.17	120.03	56.86	Peak
4	0.06	584.17	-531.79	52.38	111.48	59.10	Peak
5	0.08	579.04	-531.78	47.26	110.01	62.75	Peak
6	0.13	571.99	-531.74	40.25	105.46	65.21	Peak

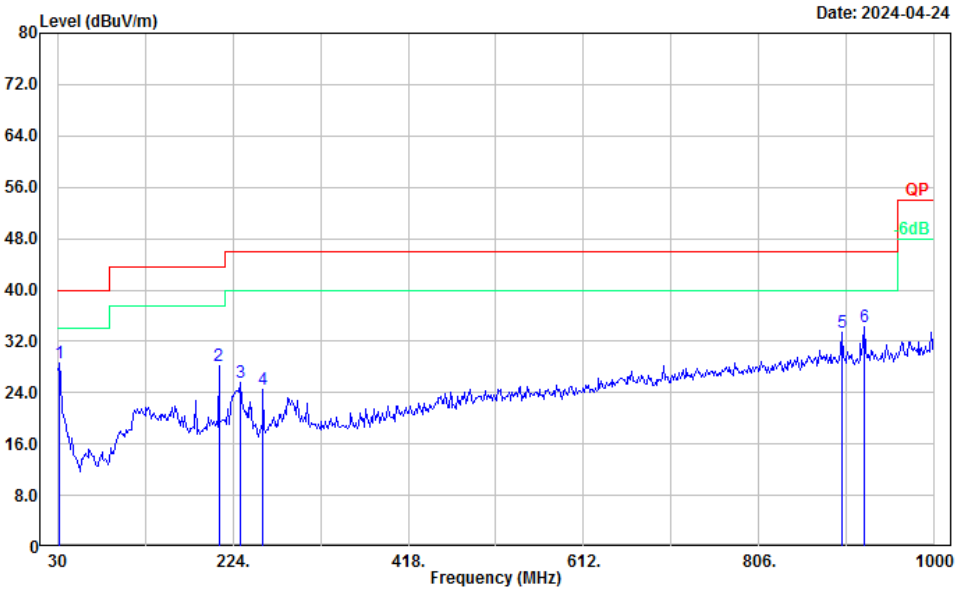
Project No.: 2402S47547-RF Serial No.: 2JP1-1
Polarization: Parallel Tester: Bill Yang
Test Mode: Normal Working
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.15	582.97	-531.69	51.28	104.08	52.80	Peak
2	0.24	575.35	-531.60	43.75	100.15	56.40	Peak
3	0.70	560.43	-531.58	28.85	70.61	41.76	Peak
4	1.18	561.16	-531.53	29.63	65.98	36.35	Peak
5	1.85	554.23	-531.49	22.74	69.54	46.80	Peak
6	13.19	543.94	-531.14	12.80	69.54	56.74	Peak

2) 30MHz-1GHz

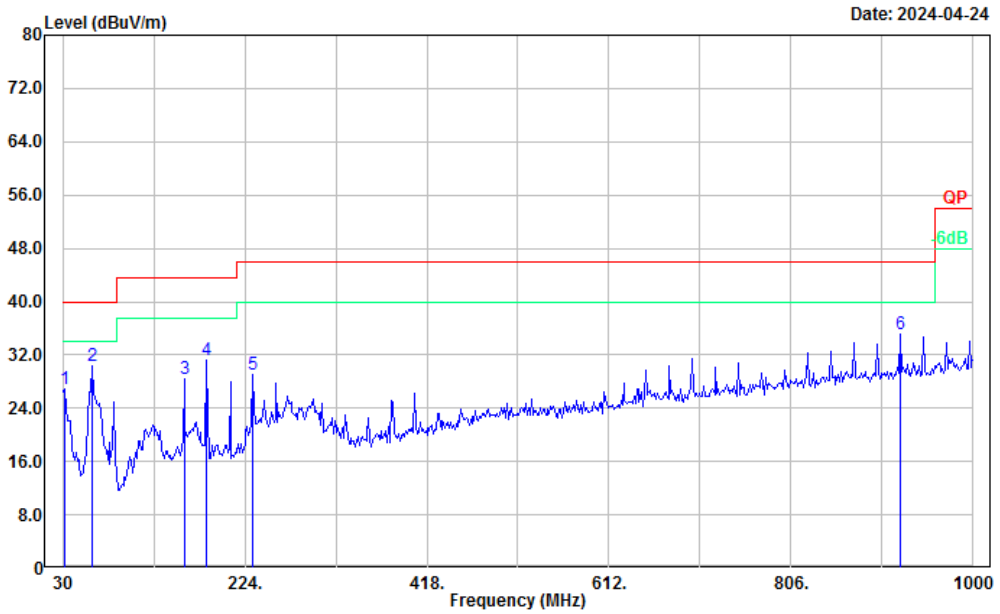
Project No.: 2402S47547-RF Serial No.: 2JP1-1
Polarization: Horizontal Tester: Bill Yang
Test Mode: Normal Working
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	32.81	33.55	-4.95	28.60	40.00	11.40	Peak
2	208.54	38.96	-10.79	28.17	43.50	15.33	Peak
3	232.43	36.55	-10.89	25.66	46.00	20.34	Peak
4	257.74	35.26	-10.67	24.59	46.00	21.41	Peak
5	897.38	30.08	3.23	33.31	46.00	12.69	Peak
6	922.68	30.57	3.75	34.32	46.00	11.68	Peak

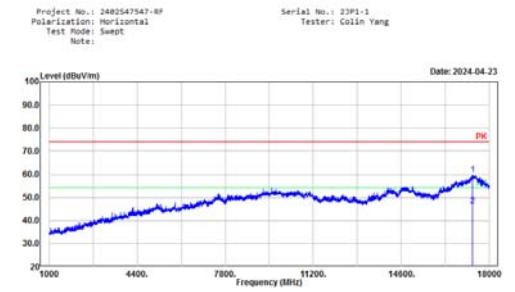
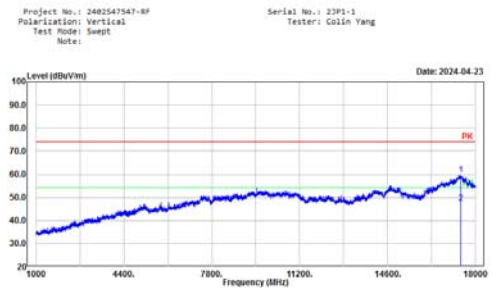
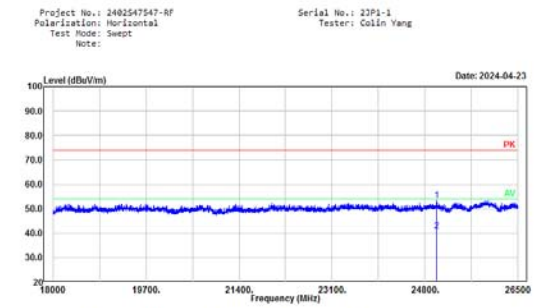
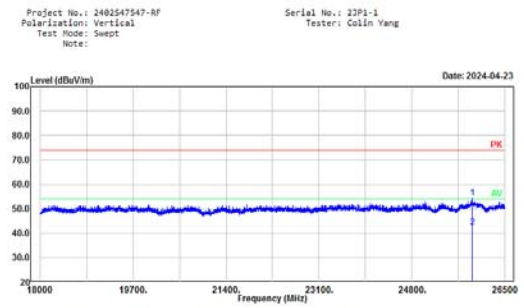
Project No.: 2402S47547-RF
Polarization: Vertical
Test Mode: Normal Working
Note:

Serial No.: 2JP1-1
Tester: Bill Yang



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	32.81	31.74	-4.95	26.79	40.00	13.21	Peak
2	60.93	46.74	-16.48	30.26	40.00	9.74	Peak
3	159.33	39.43	-11.03	28.40	43.50	15.10	Peak
4	183.23	43.24	-12.02	31.22	43.50	12.28	Peak
5	232.43	40.00	-10.89	29.11	46.00	16.89	Peak
6	922.68	31.29	3.75	35.04	46.00	10.96	Peak

2) 1GHz-40GHz:

Horizontal	Vertical
	
	

Project No.: 2402S47547-RF
Polarization: Horizontal
Test Mode: Swept
Note:
Serial No.: 23P1-1
Tester: Colin Yang
Date: 2024-04-23
Level (dBuV/m)
Frequency (MHz)

No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	17354.00	45.13	14.71	59.84	74.00	14.16	Peak
2	17354.00	31.68	14.71	46.39	54.00	7.61	Average

Project No.: 2402S47547-RF
Polarization: Vertical
Test Mode: Swept
Note:
Serial No.: 23P1-1
Tester: Colin Yang
Date: 2024-04-23
Level (dBuV/m)
Frequency (MHz)

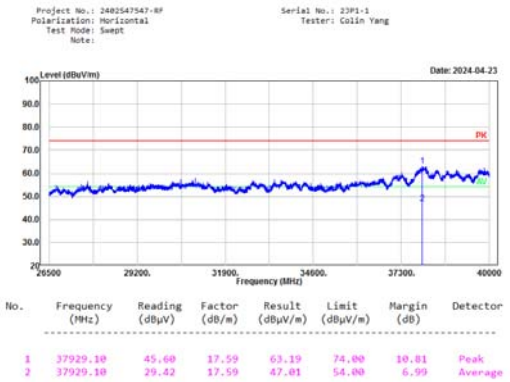
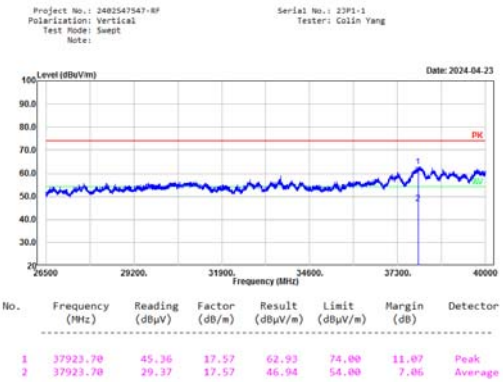
No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	17422.00	44.60	15.25	59.85	74.00	14.15	Peak
2	17422.00	32.16	15.25	47.41	54.00	6.59	Average

Project No.: 2402S47547-RF
Polarization: Horizontal
Test Mode: Swept
Note:
Serial No.: 23P1-1
Tester: Colin Yang
Date: 2024-04-23
Level (dBuV/m)
Frequency (MHz)

No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	25005.70	43.97	9.60	53.57	74.00	20.43	Peak
2	25005.70	31.29	9.60	40.89	54.00	13.11	Average

Project No.: 2402S47547-RF
Polarization: Vertical
Test Mode: Swept
Note:
Serial No.: 23P1-1
Tester: Colin Yang
Date: 2024-04-23
Level (dBuV/m)
Frequency (MHz)

No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	25894.80	43.78	10.65	54.43	74.00	19.57	Peak
2	25894.80	31.57	10.65	42.22	54.00	11.78	Average

Horizontal	Vertical
	

No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	37929.10	45.60	17.59	63.19	74.00	10.81	Peak
2	37929.10	29.42	17.59	47.01	54.00	6.99	Average

No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	37923.70	45.36	17.57	62.93	74.00	11.07	Peak
2	37923.70	29.37	17.57	46.94	54.00	7.06	Average

3) 40GHz-200GHz:

Frequency (GHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)	Field Strength@3m (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
40.520	54.62	PK	H	38.87	83.95	65.87	90.00
41.260	53.62	PK	V	38.99	83.07	53.78	90.00
90.650	54.65	PK	H	45.19	84.28	71.07	90.00
90.560	54.19	PK	V	45.18	83.81	63.78	90.00
141.230	51.26	PK	H	48.95	84.65	77.39	90.00
142.060	51.09	PK	V	48.98	84.51	74.93	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/m^2
$E_{SpecLimit}$ is the field strength at the distance specified by the limit, in V/m

The Specified distance is 3m.

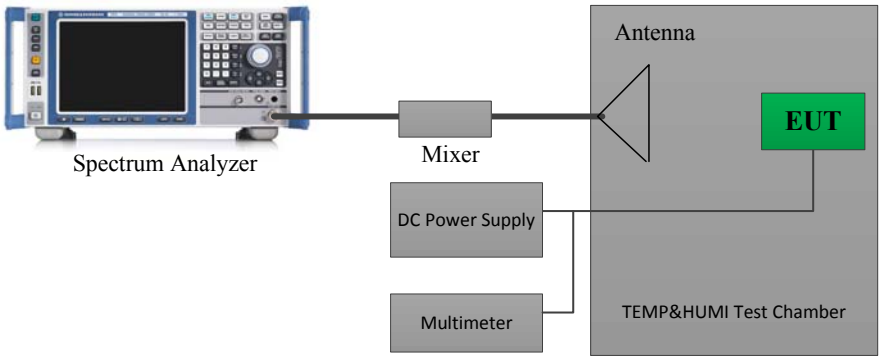
4.5 Frequency Stability

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.

4.5.2 EUT Setup Block Diagram



4.5.3 Test Procedure

Refer to ANSI C63.10-2013 Clauses 9.14.

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:	2JP1-1	Test Date:	2024/4/14
Test Site:	RF	Test Mode:	Transmitting
Tester:	Bill Yang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	26.1	Relative Humidity: (%)	52	ATM Pressure: (kPa)	101.2

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
R&S	Spectrum Analyzer	FSV40	101944	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	2023/8/3	2024/8/2
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)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	5.0	59.9998	60.9929	57	61.56
-10	5	59.9998	60.9926	57	61.56
0	5	59.9998	60.9929	57	61.56
10	5	59.9999	60.9927	57	61.56
20	5	59.9997	60.9920	57	61.56
30	5	59.9992	60.9923	57	61.56
40	5	59.9991	60.9924	57	61.56
20	4.5	59.9991	60.9923	57	61.56
20	5.5	4.0000	60.9921	57	61.56

Note: The Voltage range was declared by manufacturer.

4.6 Group Installtion

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.

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.

4.7.2 Judgment

Please refer to the Antenna Information detail in Section 1.3.

APPENDIX A - EUT PHOTOGRAPHS

Please refer to the attachment 2402S47547-RF-EXP EUT external photographs and 2402S47547-RF-INP EUT internal photographs.

APPENDIX B - TEST SETUP PHOTOGRAPHS

Please refer to the attachment 2402S47547-RF-00B-TSP test setup photographs.

APPENDIX C - 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/f²)	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/cm^2);
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)			
60-61.5	15	31.62	20.00	0.006	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.

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