NVLAP TESTING
NVLAP LAB CODE 600341-0

BACL Bay Area Compliance Labs Corp.

TEST REPORT

Applicant: **Ketsen Networks, Inc.**

Address: **3301 N Thanksgiving Pkwy #100 Lehi, Utah United States**

Product Name: **PTP-PV2-58**

FCC ID: **2BHPU-PTP-PV2-58**

IC: **32811-PTPPV258**

HVIN: **PTP-PV2-58**

Standard(s): **47 CFR Part 15, Subpart C(15.255)**
ANSI C63.10-2020
RSS-210 Issue 11, June 25, 2024
RSS-Gen, Issue 5, February 2021 Amendment 2

Report Number: **2402W89616E-RF-00A**

Report Date: **2024/12/31**

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	2402W89616E-RF-00A	Original Report	2024/12/31

1. GENERAL INFORMATION

1.1 General Description of Equipment under Test

EUT Name:	PTP-PV2-58
EUT Model:	PTP-PV2-58
Equipment Type:	fixed point-to-point Outdoor equipment
Operation Frequency Range:	58.32-69.12 GHz
Modulation Type:	π/2-BPSK, π/2-QPSK, π/2-16QAM
Maximum Peak Output Power:	42.67dBm
Emission Designator:	G1D
Rated Input Voltage:	DC 48V From PoE
Serial Number:	2PRO-2
EUT Received Date:	2024/8/13
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
Array+Parabolic Antenna	Unknown	38dBi	56-71 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	Emission 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
Note 1: For AC line conducted emissions, the maximum output power mode and channel was tested. Note 2: For Radiated Spurious Emissions 9kHz~ 40GHz, the maximum output power mode and channel was tested.		

3. DESCRIPTION OF TEST CONFIGURATION

3.1 EUT Operation Condition

The system was configured for testing in Engineering Mode, which was provided by the manufacturer.

Channel	Frequency (GHz)	Channel	Frequency (GHz)
1	**58.32**	4	**64.80**
2	60.48	5	66.96
3	62.64	6	**69.12**

Note:
The device supports π/2-BPSK, π/2-QPSK, π/2-16QAM modulation, test was performed with all the module on the frequencies in bold.

3.2 EUT Exercise Software

Software "Data association intelligence" was used in test. The EUT is transmitting in default power level.

3.3 Support Equipment List and Details

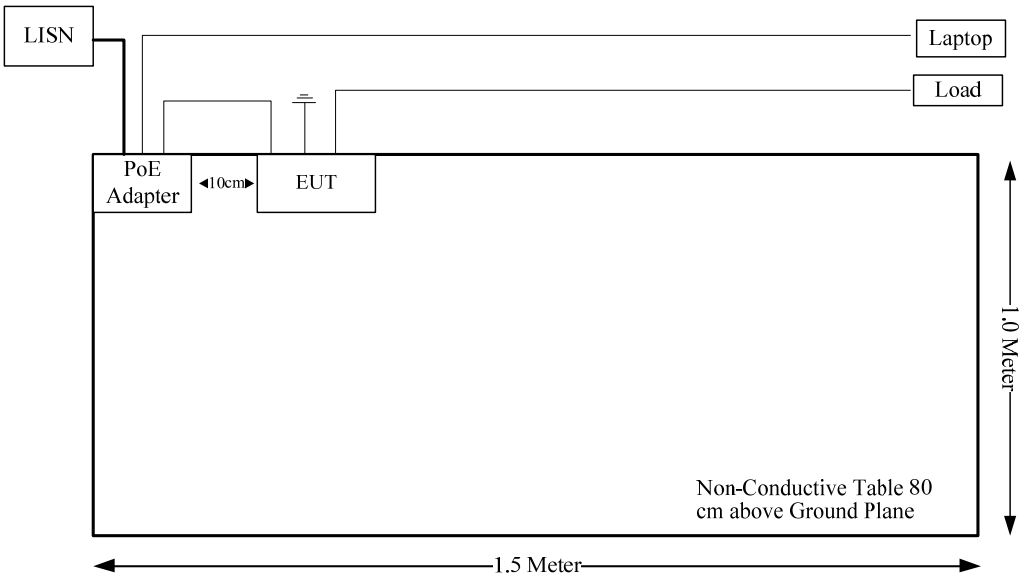
Manufacturer	Description	Model	Serial Number
I.T.E	PoE	GME241DA-480050G	GME241DA-480050G
Lenovo	Laptop	E450	PF-OMRADG
Unknown	Load	RJ45 Load	RJ45 Load

3.4 Support Cable List and Details

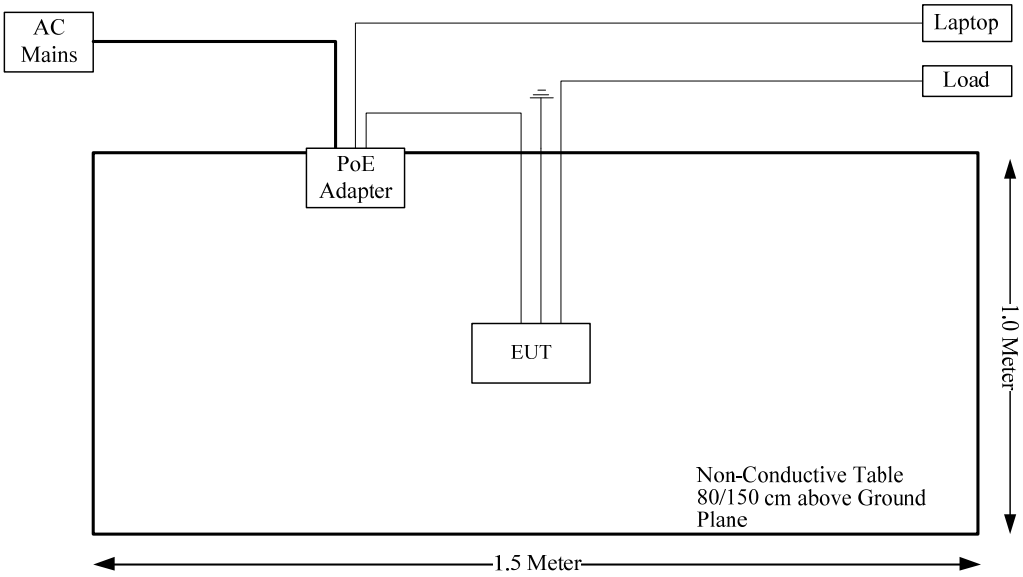
Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
RJ45 Cable	No	No	10	EUT	POE
RJ45 Cable	No	No	1.2	POE	Laptop
RJ45 Cable*3	No	No	1.5	EUT	RJ45 Load
Earth Cable	No	No	1.5	EUT	Reference ground

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℃
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.

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 µH / 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

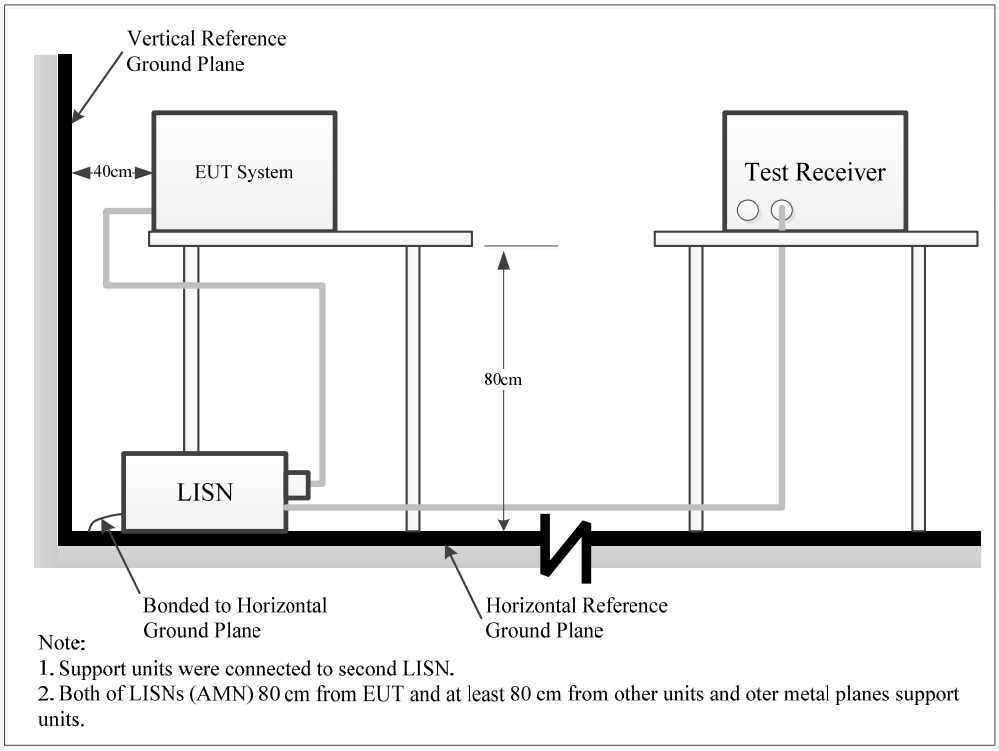
Frequency (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56[1]	56 to 46[1]
0.5 – 5	56	46
5 – 30	60	50

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:	2PRO-2	Test Date:	2024/10/30
Test Site:	CE	Test Mode:	Transmitting
Tester:	Yukin Qiu	Test Result:	Pass

Environmental Conditions:

Temperature: (℃)	27.7	Relative Humidity: (%)	47	ATM Pressure: (kPa)	101.3

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	LISN	ENV216	101614	2024/9/5	2025/9/4
MICRO-COAX	Coaxial Cable	C-NJNJ-50	C-0200-01	2024/9/5	2025/9/4
R&S	EMI Test Receiver	ESCI	100035	2024/8/26	2025/8/25
Audix	Test Software	E3	191218 V9	N/A	N/A

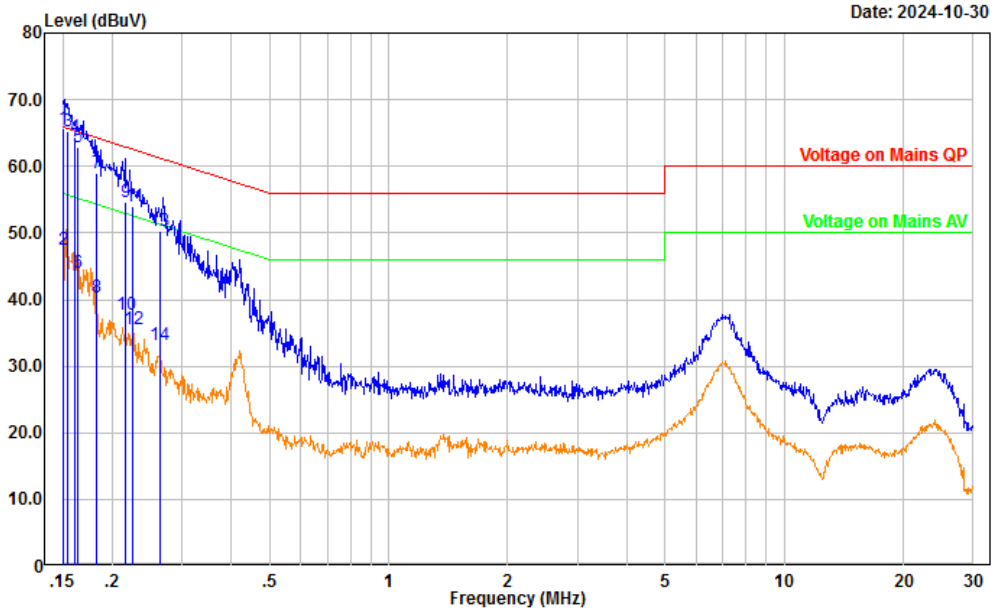
** Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Note: π/2-QPSK, 64.8GHz was tested.

Project No.: 2402W89616E-RF
Port: Line
Test Mode: Transmitting
Note:

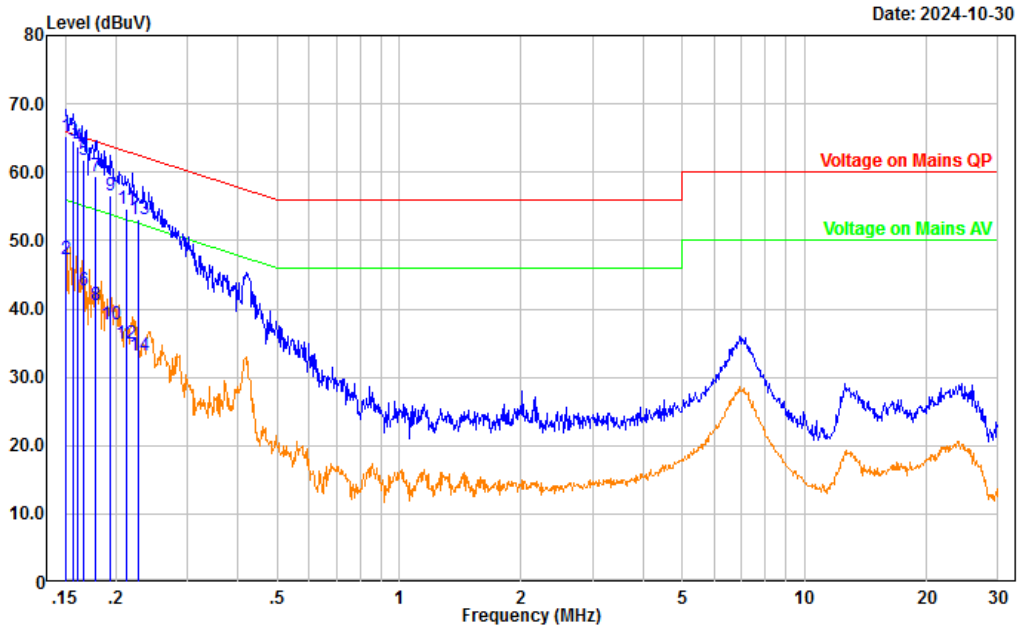
Serial No.: 2PRO-2
Tester: Yukin Qiu



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.150	54.95	10.75	65.70	65.98	0.28	QP
2	0.150	36.83	10.75	47.58	55.98	8.40	Average
3	0.155	54.47	10.76	65.23	65.75	0.52	QP
4	0.161	53.55	10.77	64.32	65.42	1.10	QP
5	0.164	52.14	10.78	62.92	65.25	2.33	QP
6	0.164	33.18	10.78	43.96	55.25	11.29	Average
7	0.183	48.13	10.82	58.95	64.35	5.40	QP
8	0.183	29.61	10.82	40.43	54.35	13.92	Average
9	0.216	43.88	10.85	54.73	62.97	8.24	QP
10	0.216	26.82	10.85	37.67	52.97	15.30	Average
11	0.226	43.04	10.84	53.88	62.59	8.71	QP
12	0.226	24.79	10.84	35.63	52.59	16.96	Average
13	0.263	39.53	10.83	50.36	61.32	10.96	QP
14	0.263	22.27	10.83	33.10	51.32	18.22	Average

Project No.: 2402W89616E-RF
Port: neutral
Test Mode: Transmitting
Note:

Serial No.: 2PRO-2
Tester: Yukin Qiu



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB)	Result (dBµV)	Limit (dBµV)	Margin (dB)	Detector
1	0.150	54.49	10.85	65.34	66.00	0.66	QP
2	0.150	36.37	10.85	47.22	56.00	8.78	Average
3	0.157	53.69	10.85	64.54	65.63	1.09	QP
4	0.161	52.81	10.85	63.66	65.42	1.76	QP
5	0.166	51.03	10.85	61.88	65.14	3.26	QP
6	0.166	31.86	10.85	42.71	55.14	12.43	Average
7	0.179	48.57	10.85	59.42	64.54	5.12	QP
8	0.179	29.68	10.85	40.53	54.54	14.01	Average
9	0.194	45.80	10.85	56.65	63.86	7.21	QP
10	0.194	26.88	10.85	37.73	53.86	16.13	Average
11	0.212	43.83	10.85	54.68	63.14	8.46	QP
12	0.212	23.96	10.85	34.81	53.14	18.33	Average
13	0.228	42.24	10.83	53.07	62.53	9.46	QP
14	0.228	22.32	10.83	33.15	52.53	19.38	Average

4.2 EIRP and Peak Conducted Output power

4.2.1 Applicable Standard

FCC §15.255(c) Radiated power limits.

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

(1) Devices other than field disturbance sensors shall comply with one of the following power limits, as measured during the transmit interval:

(i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or

(ii) For fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.

(A) The provisions in this paragraph (c) for reducing transmit power based on antenna gain shall not require that the power levels be reduced below the limits specified in paragraph(c)(1)(i) of this section.

(B) The provisions of § 15.204(c)(2) and (4) that permit the use of different antennas of the same type and of equal or less directional gain do not apply to intentional radiator systems operating under this provision. In lieu thereof, intentional radiator systems shall be certified using the specific antenna(s) with which the system will be marketed and operated. Compliance testing shall be performed using the highest gain and the lowest gain antennas for which certification is sought and with the intentional radiator operated at its maximum available output power level. The responsible party, as defined in § 2.909 of this chapter, shall supply a list of acceptable antennas with the application for certification.

FCC §15.255(e) Limits on transmitter conducted output power

(1) Except as specified in paragraph (e)(2) of this section, the peak transmitter conducted output power of devices other than field disturbance sensors/radars shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (c) of this section.

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

RSS-210, Annex J.3.3 Emission limits for devices other than FDS

Following are the conditions for devices other than FDS:

a) Except when J.3.3(b) applies, the average e.i.r.p. of any emission shall not exceed 40 dBm and the peak e.i.r.p. of any emission shall not exceed 43 dBm.

b) For fixed point-to-point equipment located outdoors:

(i) The average e.i.r.p. of any emission shall not exceed 82 dBm minus 2 dB for every dB the antenna gain is less than 51 dBi. The peak e.i.r.p. of any emission shall not exceed 85 dBm minus 2 dB for every dB the antenna gain is less than 51 dBi.

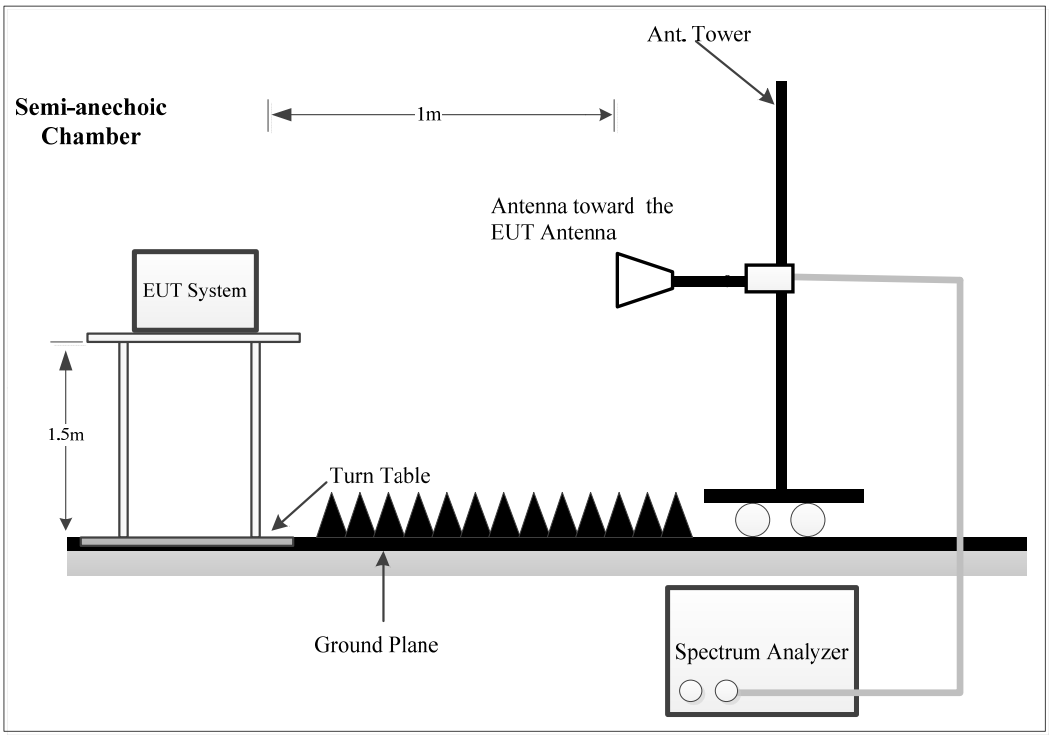
(ii) The provisions for reducing the transmit power based on the antenna gain, as per J.3.3(b)(i), shall not require that the power levels be reduced below the limits specified in J.3.3(a).

(iii) Compliance testing shall be performed using the highest gain and the lowest gain antennas with which the equipment is certified. Further, this equipment shall not be marketed and operated with antennas other than those listed in the certification application with which the equipment is certified.

c) Except as specified in J.3.3(d), the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the e.i.r.p. limits specified in J.3.3(a) and J.3.3(b).

d) For devices with an emission bandwidth less than 100 MHz, the peak transmitter conducted output power (PTCOP) shall be less than or equal to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purpose of J.3.3(d), emission bandwidth is the instantaneous frequency range occupied by a steady radiated signal with modulation, outside which the radiated power spectral density is 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth. The centre frequency shall be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

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 9.9

Step c) For radiated measurements:

1) Connect the measurement antenna for the fundamental frequency band to the mm-wave RF detector or the downconverter. Place the measurement antenna at a test 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 maximizing procedures 9.7, noting that multiple peaks can be found at different beam orientations and/or polarizations.

Step d)

1) Record the peak voltage from the DSO and record the average voltage during the ON time of the EUT from the DSO.

2) Disconnect the measurement antenna or EUT (as applicable for radiated or conducted tests, respectively) 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.

6) Adjust the amplitude of the mm-wave source and/or the variable attenuator such that the DSO indicates a voltage equal to the peak voltage recorded in step d)1)

7) Disconnect the waveguide variable attenuator from the RF input port of the instrumentation system.

8) Without changing any settings, connect the waveguide variable attenuator to a wideband mm-wave power meter with a thermocouple detector or equivalent.

9) Measure and note the power.

10) Repeat steps d)3) through d)9) for the average voltage recorded in step d)1) .

Step e)

1) Correct the peak and average substitution power at the input to the measurement instrument, as recorded in step d), for any external gain and/or attenuation between the measurement antenna and the measurement instrument that was not included in the substitution power measurement. This is the peak and average (respectively) substitution power at the output of the measurement antenna.

2) Calculate the peak and average EIRP from the peak and average (respectively) substitution power at the output of the measurement antenna using Equation (22), and then convert to linear form using Equation (24)

3) Calculate the peak conducted output power from the peak EIRP using Equation (27).

4) Where applicable, calculate the peak and average power density at the distance at which the limit is specified from the peak and average (respectively) EIRP using Equation (25).

4.2.4 Test Result

Serial Number:	2PRO-2	Test Date:	2024/11/29
Test Site:	Chamber B	Test Mode:	Transmitting
Tester:	Colin Yang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	21.1	Relative Humidity: (%)	26	ATM Pressure: (kPa)	102.3

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Tektronix	Digital Phosphor Oscilloscope	TDS 3054	B015264	2024/9/5	2025/9/4
Millitech	RF Detector	DET-15-RPFW0	A18521	2023/2/16	2026/2/15
Resenberger	Coaxial Cable	LU7-022-1000	1900/2/1	2024/3/1	2025/2/28
Flann Micowave	Horn Antenna	861V/385	736	2023/2/27	2026/2/26
NSI	Horn Antenna	NSI-RF-SG15	F-08-EM195-3	2023/2/27	2026/2/26
Agilent	mm-Wave Source Modules	83557A	3942A00699	2023/2/16	2026/2/15
Agilent	Coaxial Cable	5061-5458	1301	2024/3/1	2025/2/28
Agilent	Signal Generator	E8247C	MY43321350	2024/9/5	2025/9/4

** 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:

Note: The device is fixed Point-to-Point equipment.

EIRP:

Frequency (GHz)	DSO		Polar (H/V)	Substituted Level (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)
	Reading (mV)	Detector					
π/2-BPSK							
58.320	994.60	PK	V	-1.97	24.00	41.90	59
58.320	878.60	AV	V	-2.51	24.00	41.36	56
64.800	690.30	PK	V	-4.07	24.00	40.72	59
64.800	564.00	AV	V	-4.95	24.00	39.84	56
69.120	630.40	PK	V	-5.55	24.00	39.80	59
69.120	525.10	AV	V	-6.34	24.00	39.01	56
π/2-QPSK							
58.320	750.00	PK	V	-3.20	24.00	40.67	59
58.320	620.10	AV	V	-4.02	24.00	39.85	56
64.800	1082.00	PK	V	-2.12	24.00	42.67	59
64.800	831.00	AV	V	-3.26	24.00	41.53	56
69.120	720.00	PK	V	-4.97	24.00	40.38	59
69.120	510.20	AV	V	-6.47	24.00	38.88	56
π/2-16-QAM							
58.320	236.00	PK	V	-8.22	24.00	35.65	59
58.320	168.00	AV	V	-9.69	24.00	34.18	56
64.800	84.00	PK	V	-13.22	24.00	31.57	59
64.800	55.40	AV	V	-15.02	24.00	29.77	56
69.120	86.00	PK	V	-14.20	24.00	31.15	59
69.120	53.90	AV	V	-16.23	24.00	29.12	56

EIRP = E_{meas}+ 20log(Measurement distance) - 104.8

E_{meas} = 126.8 - 20log(λ) + Substitued level - Antenna Gain

Measurement distance = 1m

Conducted Peak Output Power:

Frequency (GHz)	Peak EIRP (dBm)	Antenna Gain (dBi)	Peak Conducted Power (dBm)	Limit (dBm)	Margin (dB)
π/2-BPSK					
58.32	41.9	38	3.9	27	23.1
64.8	40.72	38	2.72	27	24.28
69.12	39.8	38	1.8	27	25.2
π/2-QPSK					
58.32	40.67	38	2.67	27	24.33
64.8	42.67	38	4.67	27	22.33
69.12	40.38	38	2.38	27	24.62
π/2-16-QAM					
58.32	35.65	38	-2.35	27	29.35
64.8	31.57	38	-6.43	27	33.43
69.12	31.15	38	-6.85	27	33.85

Note:
For radiated emissions measurements, calculated transmitter conducted output power P(con)
P(con)=EIRP-Antenna gain(dBi)

4.3 Emission Bandwidth

4.3.1 Applicable Standard

FCC §15.255(e)(2)

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

RSS-210, Annex J.3.3

d) For devices with an emission bandwidth less than 100 MHz, the peak transmitter conducted output power (PTCOP) shall be less than or equal to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purpose of J.3.3(d), emission bandwidth is the instantaneous frequency range occupied by a steady radiated signal with modulation, outside which the radiated power spectral density is 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth. The centre frequency shall be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

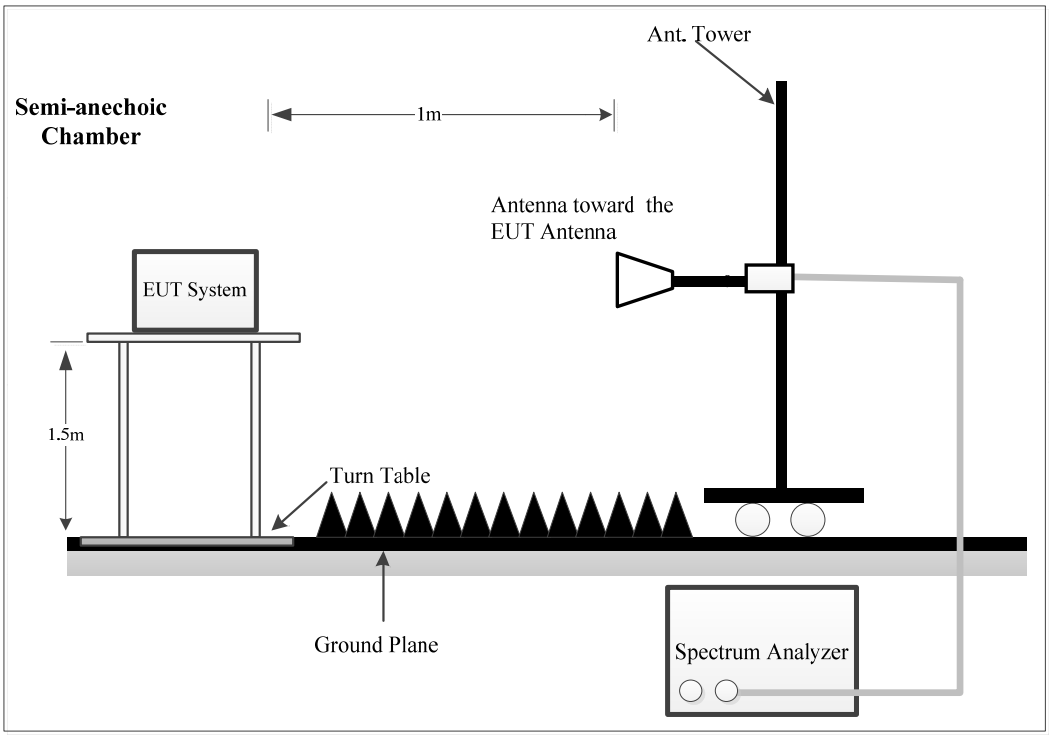
RSS-Gen Clause 6.7

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.
In some cases, the "x dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.
The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:
The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

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

ANSI C63.10-2020 Clause 9.3 Emission bandwidth - relative measurement procedure

The emission bandwidth (EBW) is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least the specified amount below the maximum level of the modulated carrier.

The following procedure shall be used for measurement of the bandwidth for millimeter-wave devices. (See Figure 21):

a) Use the following spectrum analyzer settings:
1) Span equal to approximately 1.5 times the EBW, centered on the carrier frequency
2) RBW, prefer 1% to 5% of EBW, or a minimum of 1 MHz if this is not possible due to a large EBW, unless otherwise specified by the applicable rule
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) Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure the specified dB down one side of the emission.
d) Reset the marker-delta function, and move the marker to the other side of the emission, until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth. The spectral envelope can cross the "−X dB amplitude" at multiple points. The lowest or highest frequency shall be selected as the frequencies that are the farthest away from the center frequency at which the spectral envelope crosses the "−X dB amplitude."

e) The EBW shall be reported by providing plot(s) of the measuring instrument display, to include markers depicting the relevant frequency and amplitude information (e.g., marker table). The frequency and amplitude axis and scale shall be clearly labeled. Tabular data may be reported in addition to the plot(s).
f) Repeat this test for each modulation scheme using the guidance of 5.6.2.1.

ANSI C63.10-2020 Clause 9.4 Occupied bandwidth—Power bandwidth (99%) measurement procedure

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:	2PRO-2	Test Date:	2024/8/26
Test Site:	Chamber B	Test Mode:	Transmitting
Tester:	Bill Yang	Test Result:	N/A

Environmental Conditions:					
Temperature: (℃)	28.2	Relative Humidity: (%)	44	ATM Pressure: (kPa)	100.1

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).*

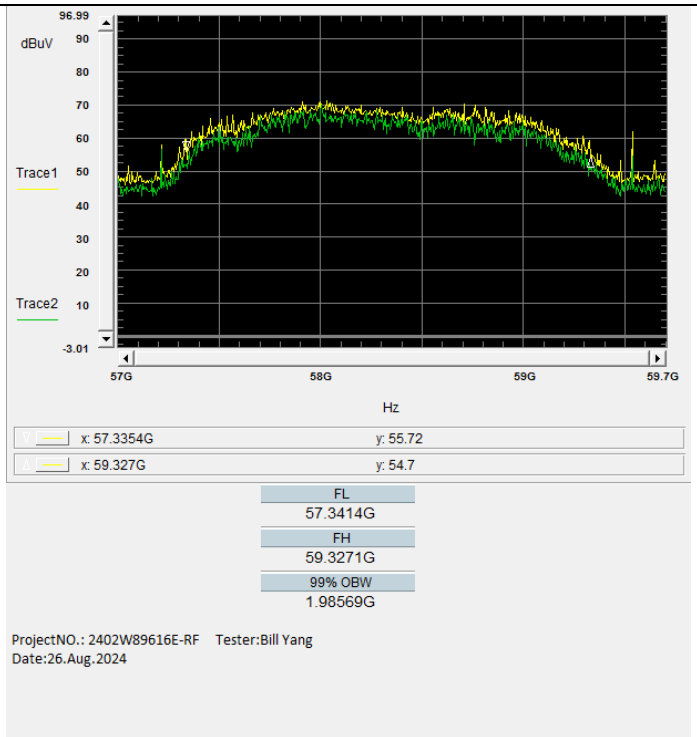
Test Data:

Test Frequency (GHz)	99% Occupied Bandwidth (GHz)	F_L of 99% Occupied Bandwidth (GHz)		F_H of 99% Occupied Bandwidth (GHz)	
		Result	Limit	Result	Limit
π/2-BPSK					
58.32	1.9857	57.3414	57	59.3271	71
64.8	1.8516	63.8418	57	65.6933	71
69.12	1.8464	68.1564	57	70.0028	71
π/2-QPSK					
58.32	2.0396	57.3414	57	59.3810	71
64.8	1.8732	63.8374	57	65.7106	71
69.12	1.9183	68.1339	57	70.0522	71
π/2-16-QAM					
58.32	1.9632	57.3549	57	59.3181	71
64.8	1.8992	63.8374	57	65.7366	71
69.12	1.9363	68.1249	57	70.0612	71

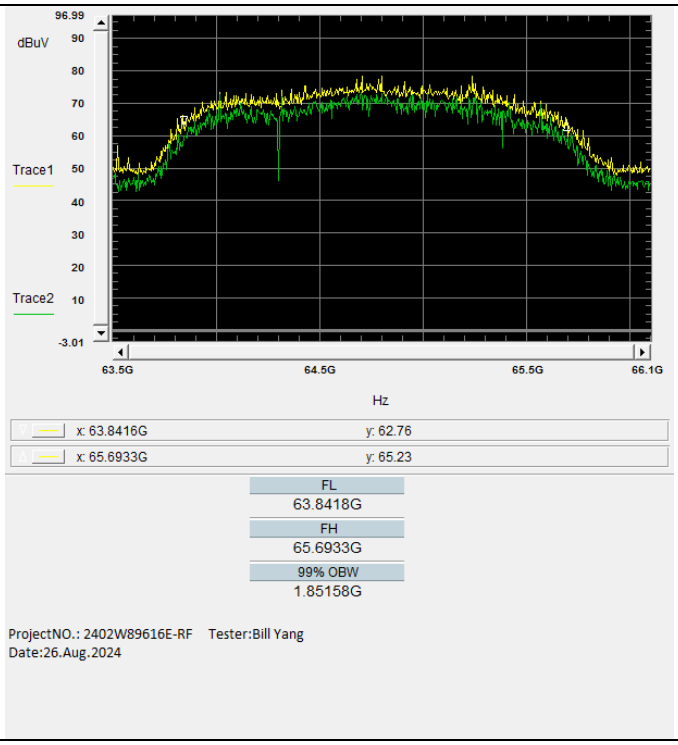
Test Frequency（GHz）	6dB Emission Bandwidth (GHz)	F_L of 6dB Emission Bandwidth (GHz)		F_H of 6dB Emission Bandwidth (GHz)	
		Result	Limit	Result	Limit
π/2-BPSK					
58.32	1.3281	57.7122	57	59.0402	71
64.8	1.1581	64.1576	57	65.3256	71
69.12	1.0333	68.4424	57	69.4707	71
π/2-QPSK					
58.32	1.3238	57.7291	57	59.0533	71
64.8	1.1161	64.071	57	65.1872	71
69.12	1.1681	68.339	57	69.5086	71
π/2-16-QAM					
58.32	1.2676	57.6473	57	58.9148	71
64.8	1.4017	63.9931	57	65.3948	71
69.12	1.2220	68.3945	57	69.6164	71

99% Occupied Bandwidth
π/2-BPSK:

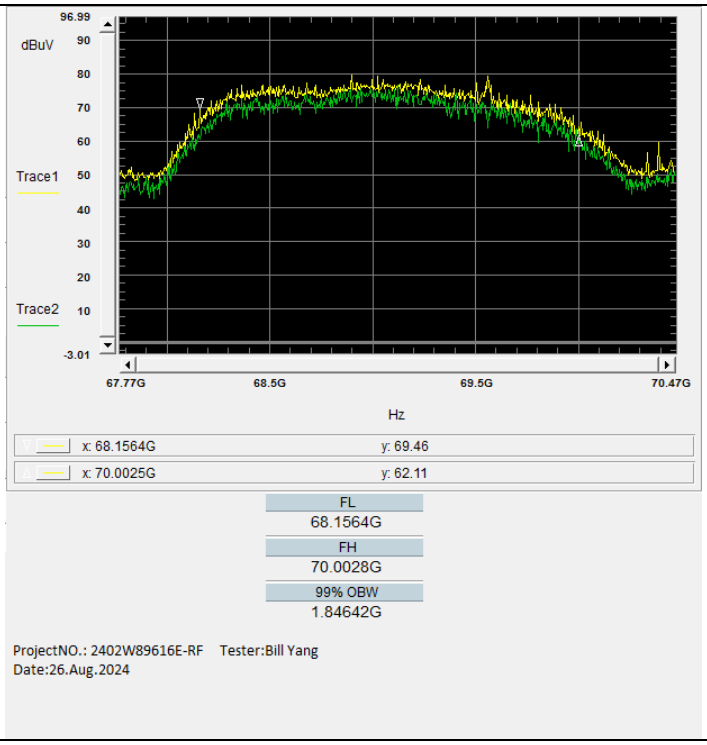
58.32GHz



64.8GHz

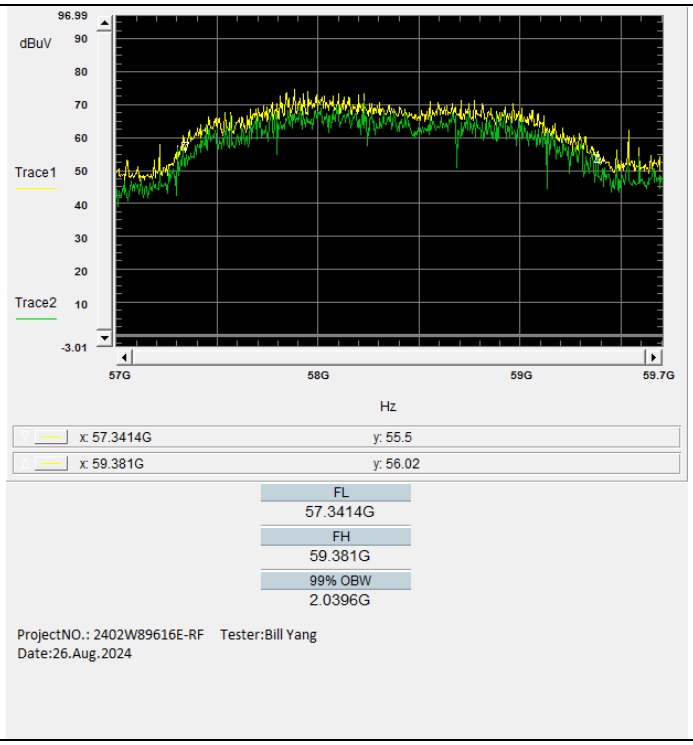


69.12GHz

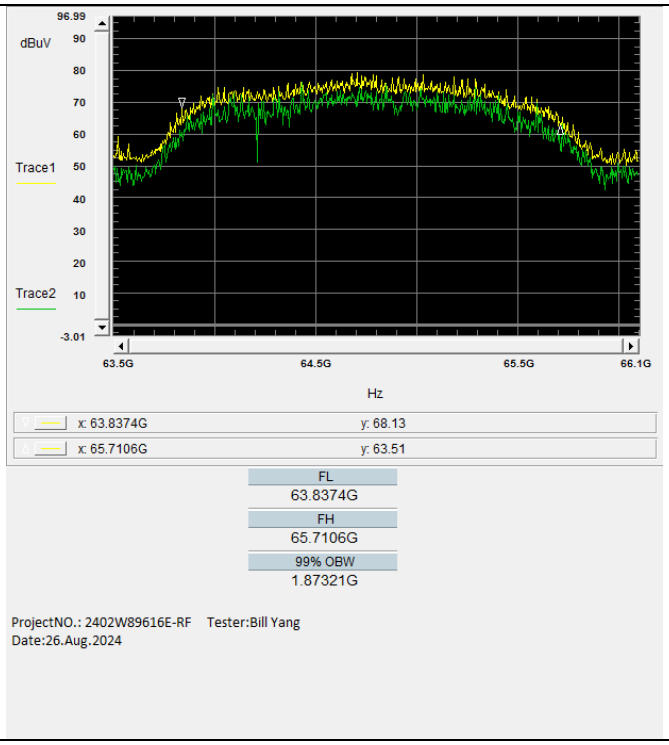


π/2-QPSK:

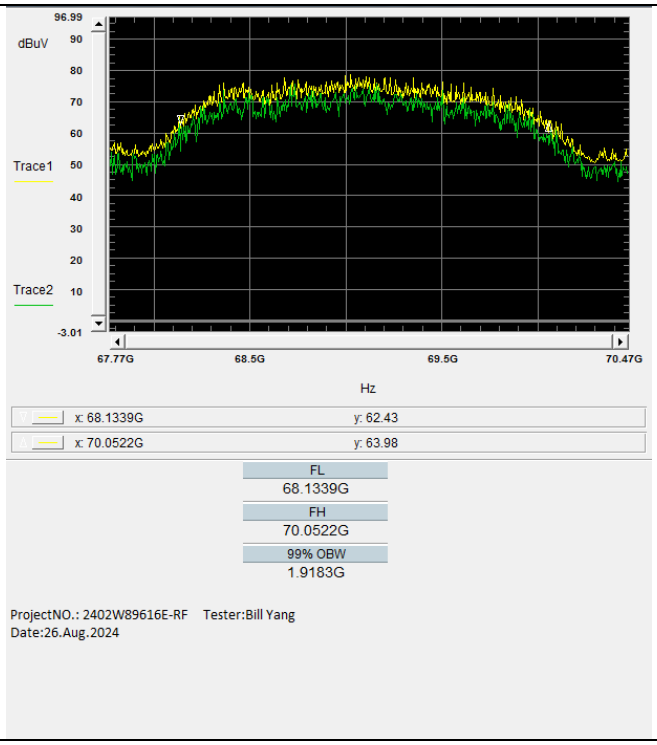
58.32GHz



64.8GHz

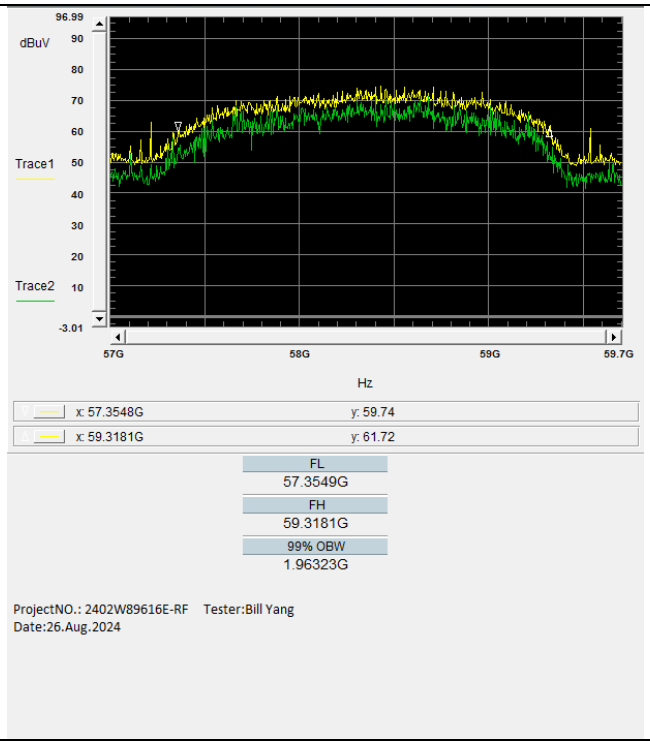


69.12GHz

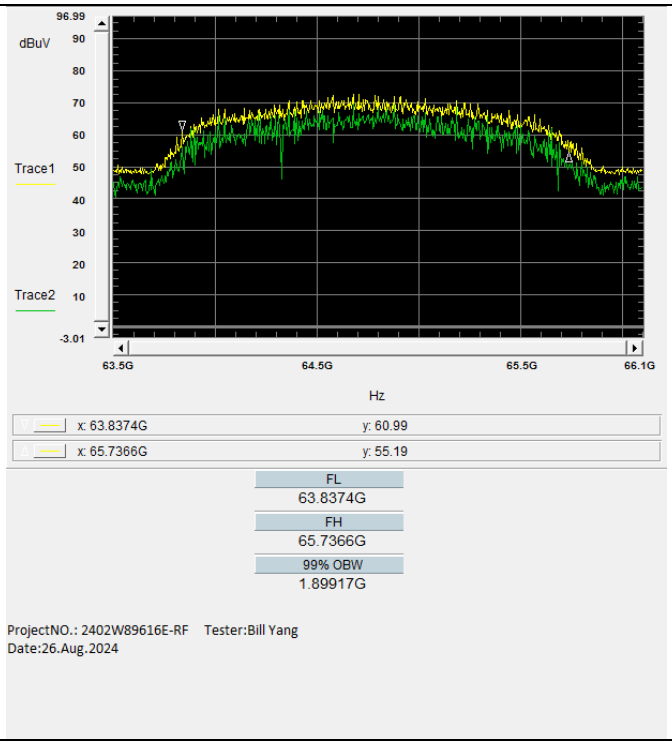


π/2-16-QAM

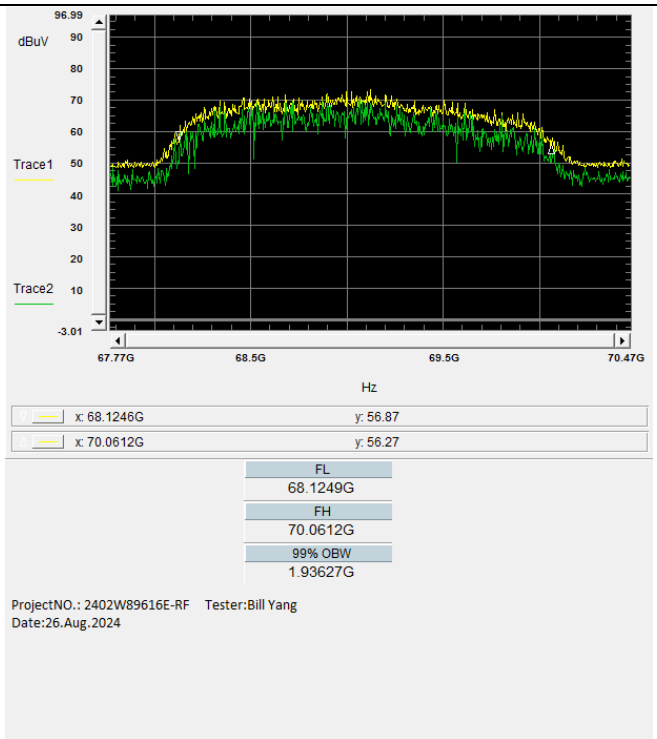
58.32GHz



64.8GHz

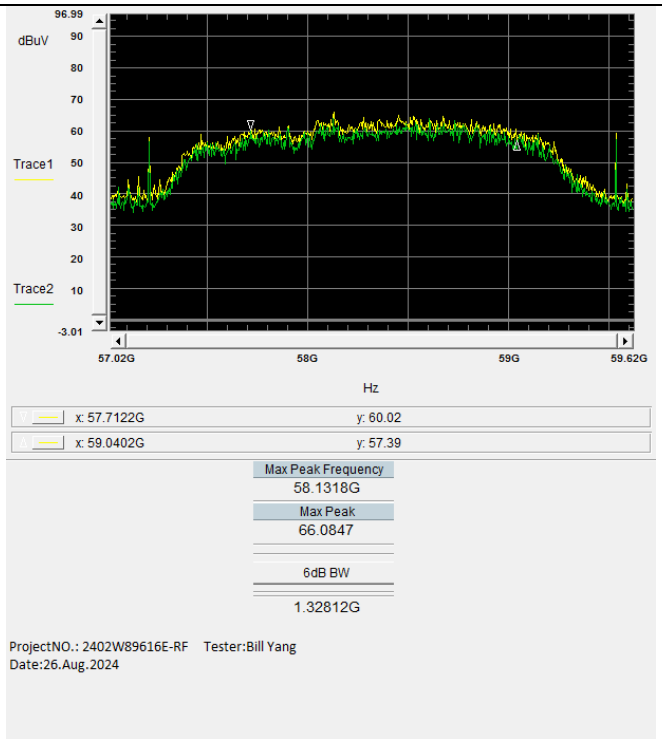


69.12GHz

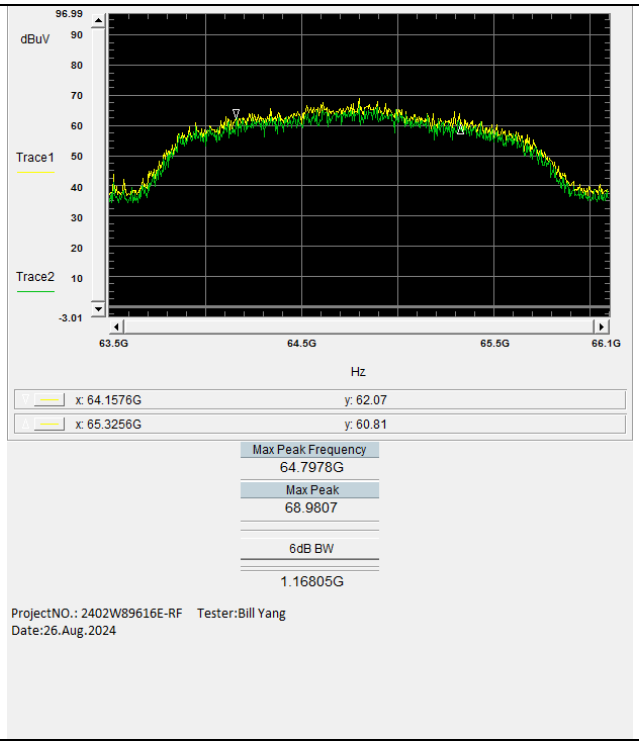

96.99
dBuV
90
80
70
60
Trace1
50
40
30
20
Trace2
10
-3.01
67.77G
68.5G
69.5G
70.47G
Hz
x: 68.1246G
y: 56.87
x: 70.0612G
y: 56.27
FL
68.1249G
FH
70.0612G
99% OBW
1.93627G
ProjectNO.: 2402W89616E-RF Tester:Bill Yang
Date:26.Aug.2024

6dB Emission Bandwidth
π/2-BPSK:

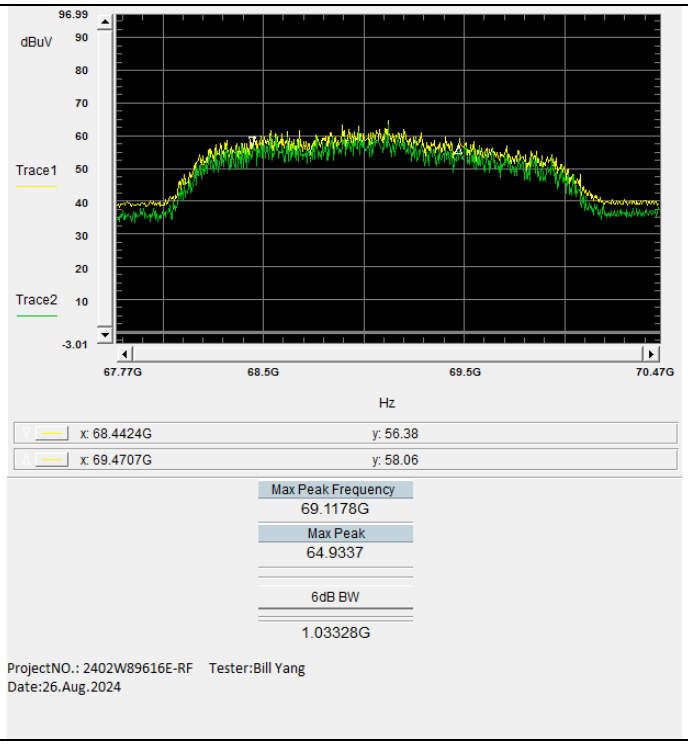
58.32GHz



64.8GHz

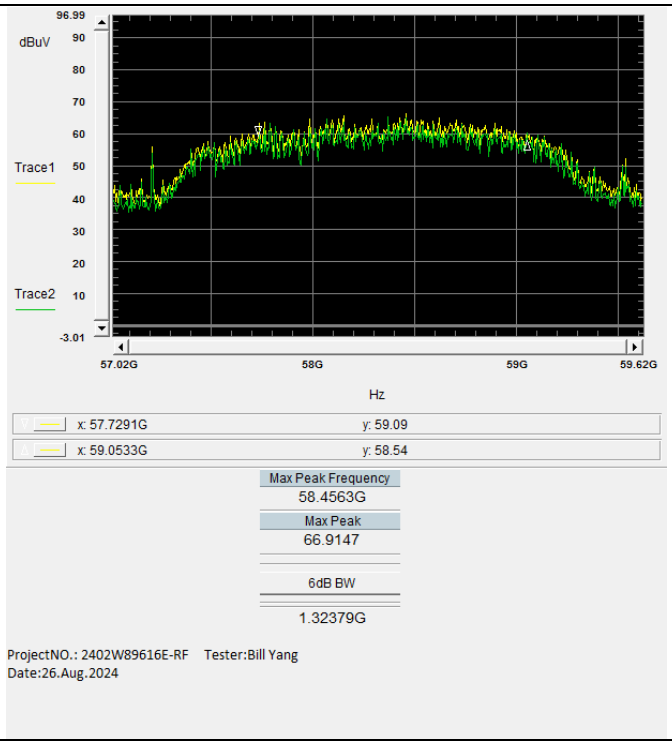


69.12GHz

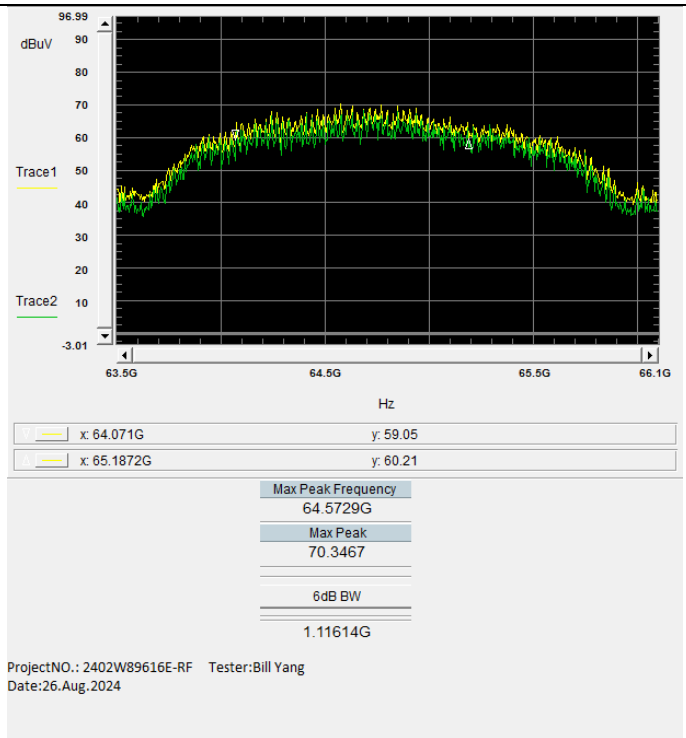


π/2-QPSK:

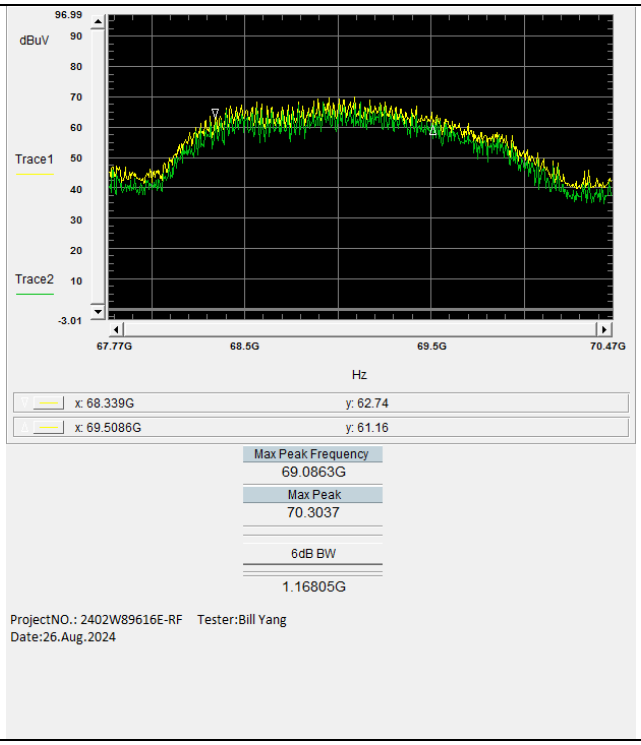
58.32GHz



64.8GHz

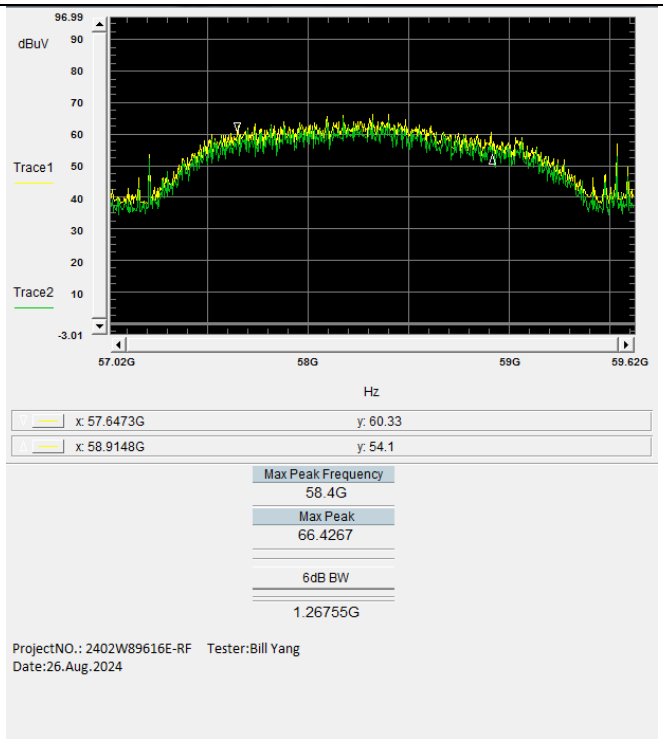


69.12GHz

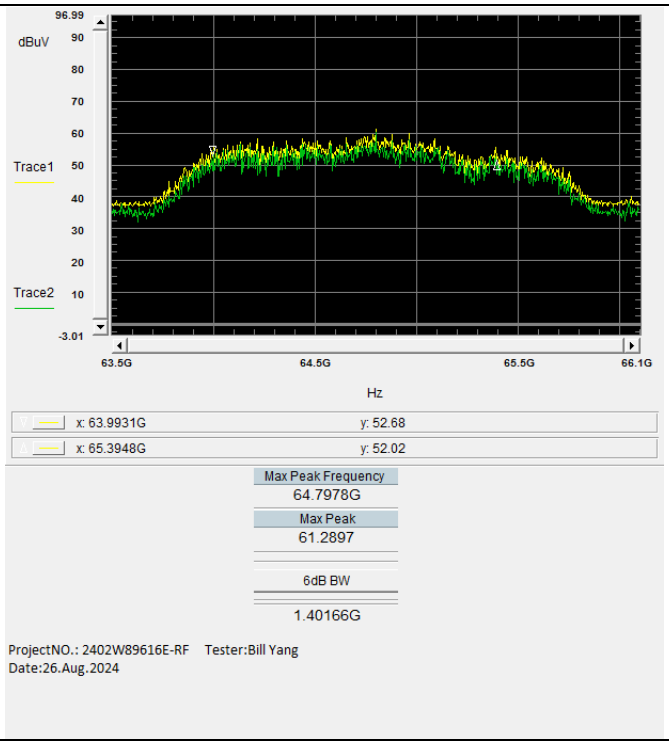


π/2-16-QAM

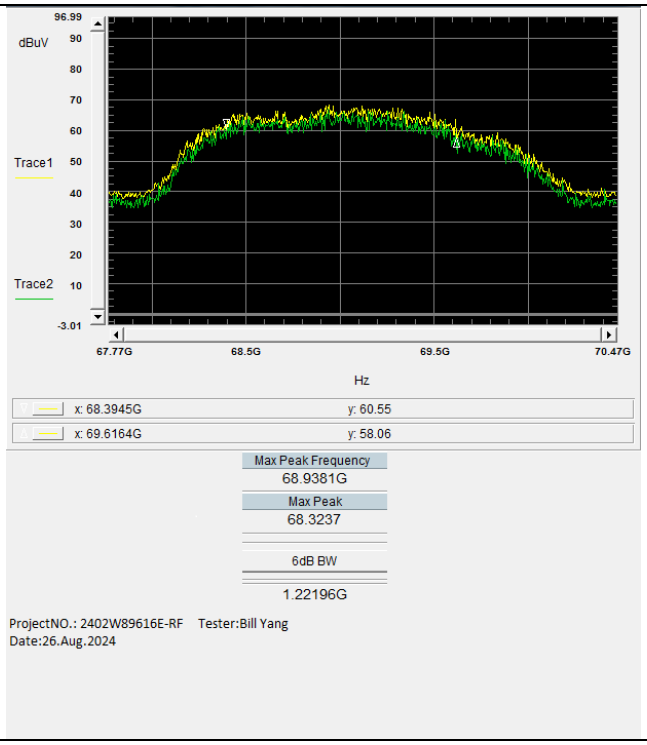
58.32GHz



64.8GHz



69.12GHz


96.99
dBuV
90
80
70
60
Trace1
50
40
30
20
Trace2
10
-3.01
67.77G
68.5G
69.5G
70.47G
Hz
x: 68.3945G
y: 60.55
x: 69.6164G
y: 58.06
Max Peak Frequency
68.9381G
Max Peak
68.3237
6dB BW
1.22196G
ProjectNO.: 2402W89616E-RF Tester:Bill Yang
Date:26.Aug.2024

4.4 Radiated Spurious 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.

RSS-210, Annex J.4

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

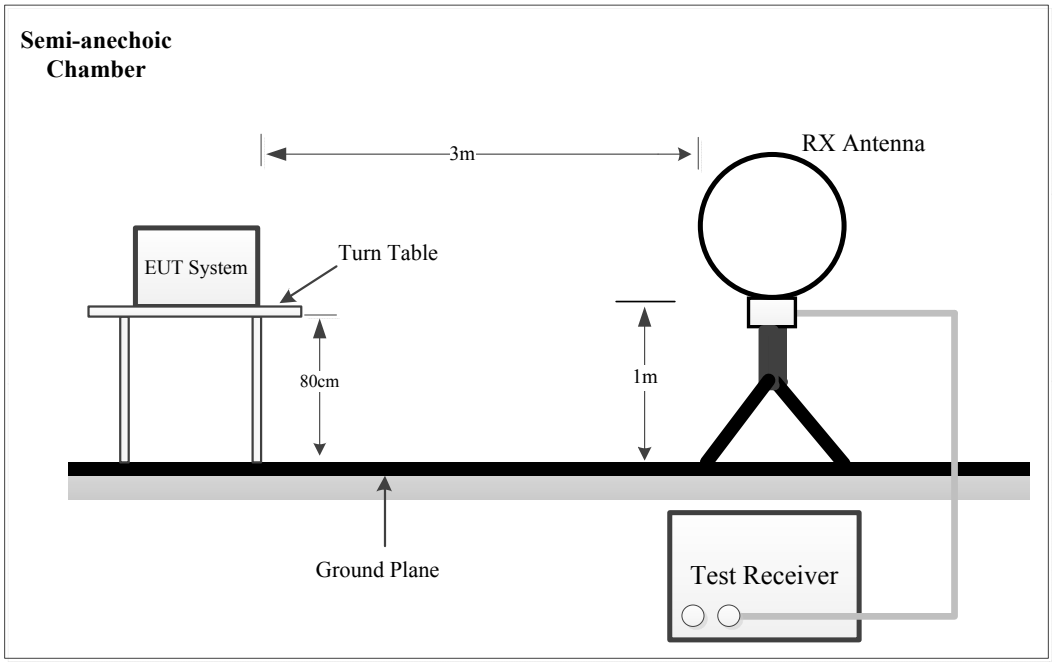
(a) the fundamental emission levels

(b) the general field strength limits specified in RSS-Gen, General Requirements for Compliance of Radio Apparatus, for emissions below 40 GHz

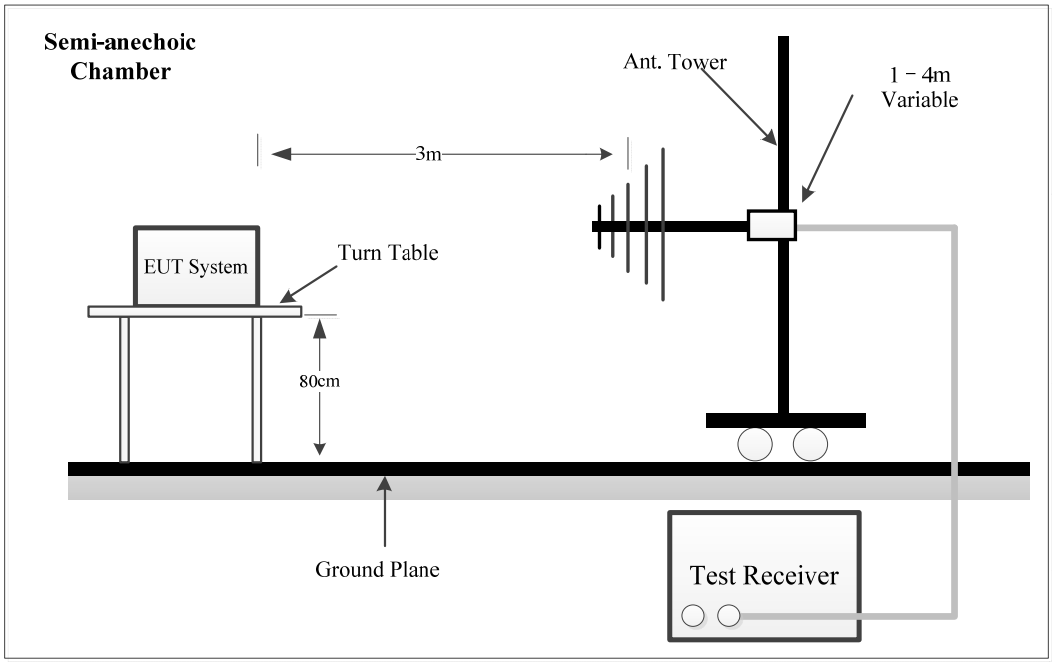
(c) 90 pW/cm^2 peak at a distance of 3 m for emissions between 40 GHz and 200 GHz

4.4.2 EUT Setup

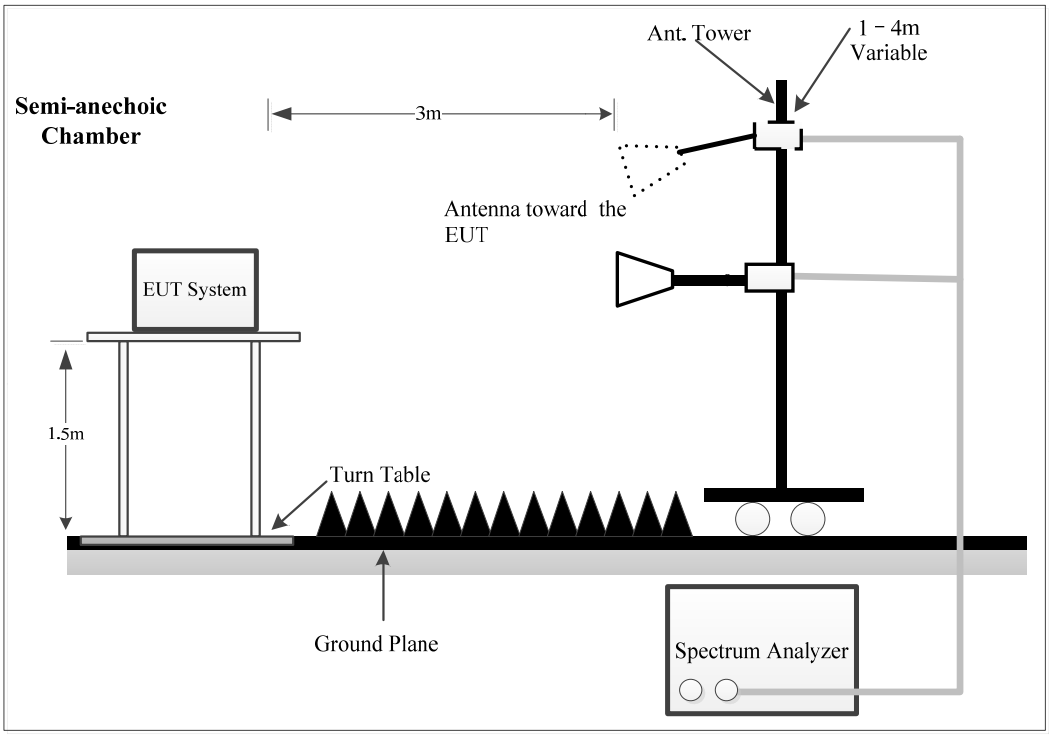
9kHz-30MHz:



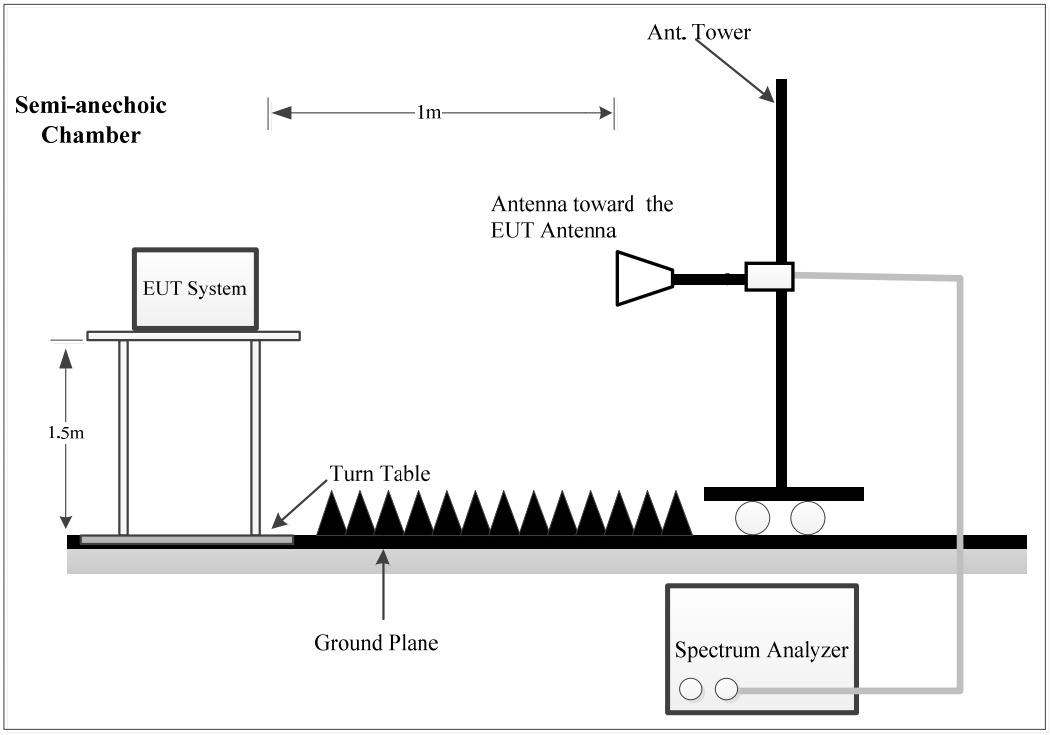
30MHz~1GHz:



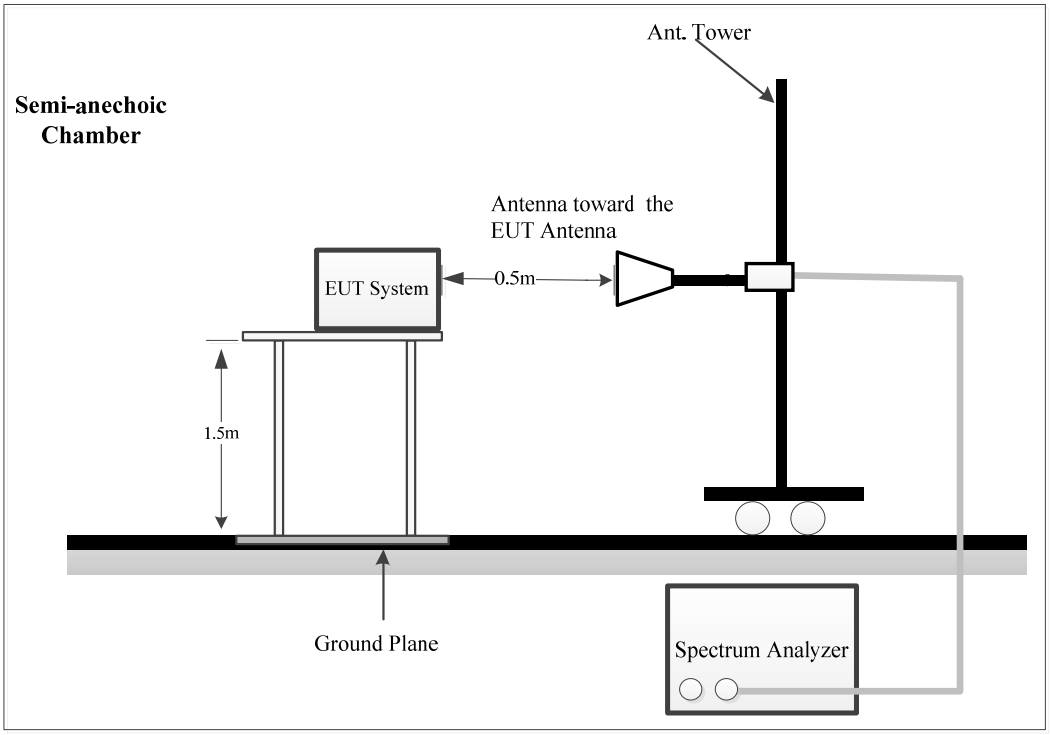
1~40 GHz:



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	Detector
9 kHz – 150 kHz	200 Hz	1 kHz	200 Hz	QP/Average	QP/Average
150 kHz – 30 MHz	9 kHz	30 kHz	9 kHz	QP/Average	QP/Average
30 MHz – 1000 MHz	/	/	120 kHz	QP	QP
	100 kHz	300 kHz	/	PK	PK

1- 40GHz:
Pre-scan:

Frequency Range	Measurement	RBW	Video B/W	Detector
1-40GHz	Peak	1MHz	3 MHz	PK
	AV	1MHz	5kHz	PK

Final measurement for emission identified during the pre-scan:

Frequency Range	Measurement	RBW	Video B/W	Detector
1-40GHz	Peak	1MHz	3 MHz	PK
	AV	1MHz	10 Hz	PK

40-200GHz:

Frequency Range	Measurement	RBW	Video B/W	Detector
40-200GHz	Peak	1MHz	3 MHz	PK

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
861/385	50-75	43.7	0.64
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 200 GHz, 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:	2PRO-2	Test Date:	Below 1GHz:2024/10/25 Above 1GHz: 2024/11/1
Test Site:	Chamber10m, Chamber B	Test Mode:	Transmitting
Tester:	Leesin Xiang, Colin Yang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.5~28.2	Relative Humidity: (%)	44~50	ATM Pressure: (kPa)	100.1~100.9

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
9kHz~1000MHz					
EMCO	Passive Loop Antenna	6512	9706-1206	2023/10/25	2026/10/24
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	2024/7/1	2025/6/30
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-04	2024/7/1	2025/6/30
Unknown	Coaxial Cable	C-NJNJ-50	C-0530-01	2024/7/1	2025/6/30
Sonoma	Amplifier	310N	185914	2024/8/26	2025/8/25
R&S	EMI Test Receiver	ESCI	100224	2024/8/26	2025/8/25
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
Xinhang Macrowave	Coaxial Cable	XH750A-N/J-SMA/J-10M	20231117004 #0001	2023/11/17	2024/11/16
AH	Preamplifier	PAM-0118P	469	2024/4/15	2025/4/15
R&S	Spectrum Analyzer	FSV40	101944	2023/10/18	2024/10/17
Audix	Test Software	E3	191218 V9	N/A	N/A
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	XH360A-2.92/J-2.92/J-6M-A	20231208001 #0001	2023/12/11	2024/12/10
AH	Preamplifier	PAM-1840VH	191	2023/9/7	2024/9/6
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:

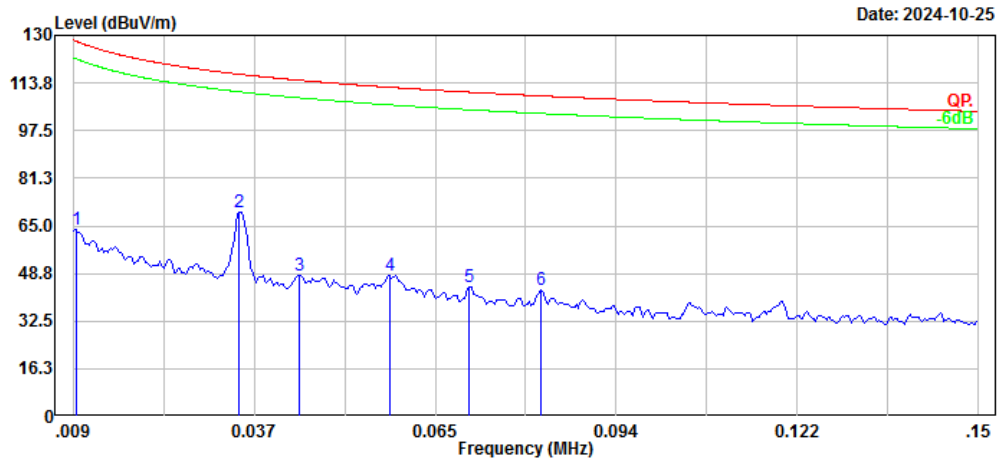
Please refer to the below table and plots.

1) 9kHz~30MHz

π/2-QPSK, 64.8GHz was tested.

Project No.: 2402W89616E-RF
Polarization: Parallel
Test Mode: Transmitting
Note:

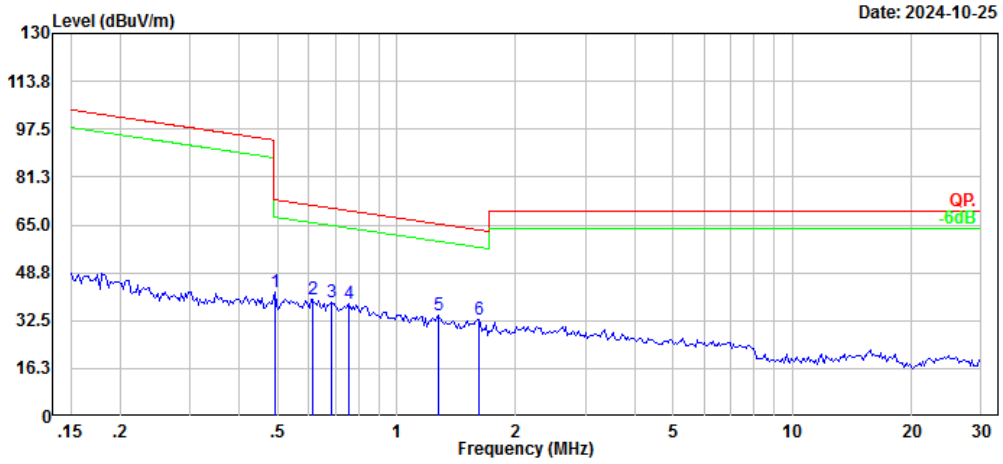
Serial No.: 2PRO-2
Tester: Leesin Xiang



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	0.010	10.69	53.02	63.71	128.00	64.29	Peak
2	0.035	22.93	46.67	69.60	116.74	47.14	Peak
3	0.044	2.92	45.04	47.96	114.69	66.73	Peak
4	0.058	5.34	42.62	47.96	112.28	64.32	Peak
5	0.071	3.85	40.46	44.31	110.61	66.30	Peak
6	0.082	4.34	38.61	42.95	109.35	66.40	Peak

Project No.: 2402W89616E-RF
Polarization: Parallel
Test Mode: Transmitting
Note:

Serial No.: 2PRO-2
Tester: Leesin Xiang



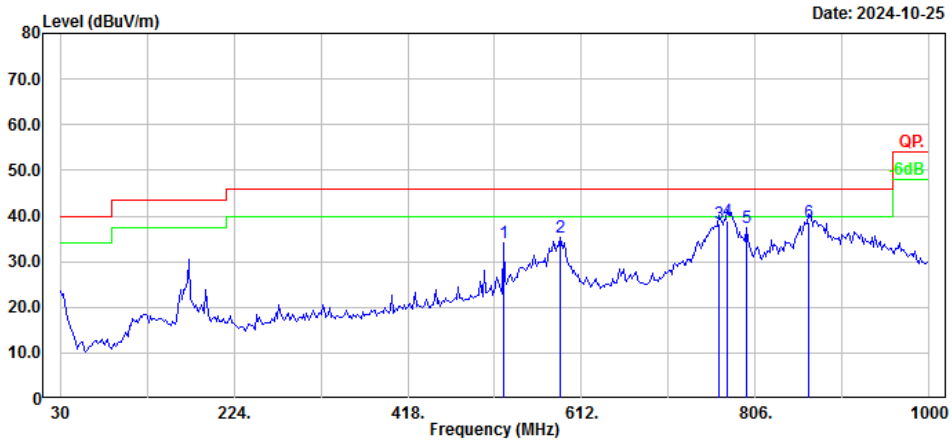
No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.491	18.42	23.55	41.97	73.77	31.80	Peak
2	0.614	17.46	22.32	39.78	71.80	32.02	Peak
3	0.683	17.07	21.64	38.71	70.86	32.15	Peak
4	0.759	17.11	20.93	38.04	69.92	31.88	Peak
5	1.276	18.89	15.34	34.23	65.31	31.08	Peak
6	1.610	18.98	13.85	32.83	63.25	30.42	Peak

2) 30MHz-1GHz

π/2-QPSK, 64.8GHz was tested.

Project No.: 2402W89616E-RF
Polarization: Horizontal
Test Mode: Transmitting
Note:

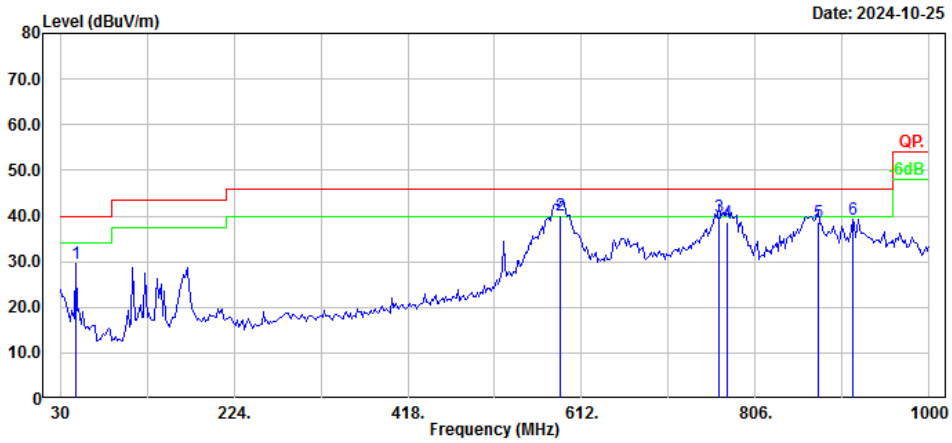
Serial No.: 2PRO-2
Tester: Leesin Xiang



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	524.70	37.91	-3.86	34.05	46.00	11.95	Peak
2	588.72	38.34	-3.03	35.31	46.00	10.69	Peak
3	765.26	38.31	-0.08	38.23	46.00	7.77	QP
4	774.96	38.80	0.07	38.87	46.00	7.13	QP
5	796.30	37.10	0.40	37.50	46.00	8.50	Peak
6	866.14	37.70	1.06	38.76	46.00	7.24	QP

Project No.: 2402W89616E-RF
Polarization: Vertical
Test Mode: Transmitting
Note:

Serial No.: 2PRO-2
Tester: Leesin Xiang

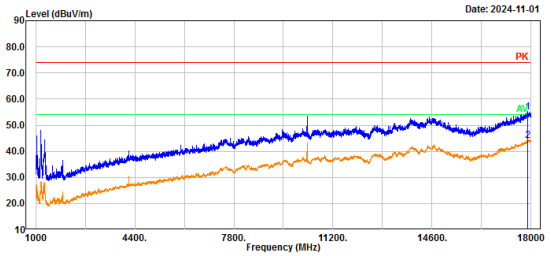


No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	47.46	44.62	-15.04	29.58	40.00	10.42	Peak
2	588.72	43.09	-3.03	40.06	46.00	5.94	QP
3	765.26	39.81	-0.08	39.73	46.00	6.27	QP
4	774.96	38.50	0.07	38.57	46.00	7.43	QP
5	875.84	37.60	1.16	38.76	46.00	7.24	QP
6	914.64	37.68	1.60	39.28	46.00	6.72	Peak

2) 1GHz-40GHz(π/2-QPSK, 64.8GHz was tested)

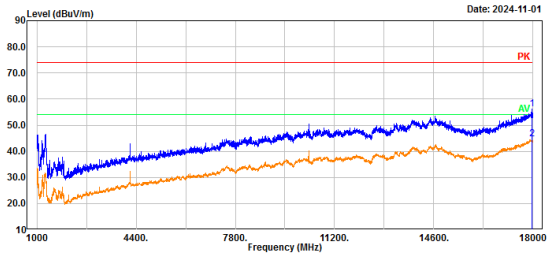
Horizontal	Vertical

Project No.: 2402W89616E-RF
Polarization: Horizontal
Test Mode: Transmitting
Note:
Serial No.: 2PRO-2
Tester: Colin Yang



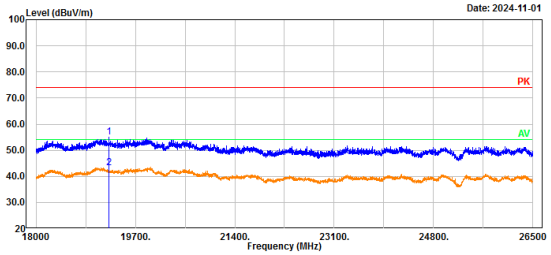
No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	17884.40	47.82	7.31	55.13	74.00	18.87	Peak
2	17884.40	36.68	7.31	43.99	54.00	10.01	Average

Project No.: 2402W89616E-RF
Polarization: Vertical
Test Mode: Transmitting
Note:
Serial No.: 2PRO-2
Tester: Colin Yang



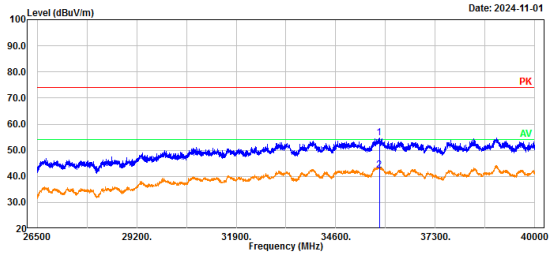
No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	17966.00	48.19	7.89	56.08	74.00	17.92	Peak
2	17966.00	36.86	7.89	44.75	54.00	9.25	Average

Project No.: 2402W89616E-RF
Polarization: Horizontal
Test Mode: Transmitting
Note:
Serial No.: 2PRO-2
Tester: Colin Yang



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	19249.50	47.33	7.68	55.01	74.00	18.99	Peak
2	19249.50	35.70	7.68	43.38	54.00	10.62	Average

Project No.: 2402W89616E-RF
Polarization: Vertical
Test Mode: Transmitting
Note:
Serial No.: 2PRO-2
Tester: Colin Yang

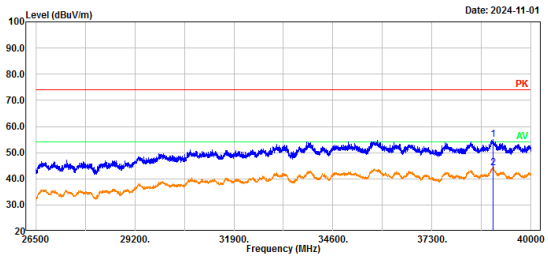


No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	35779.90	46.84	7.97	54.81	74.00	19.19	Peak
2	35779.90	34.38	7.97	42.35	54.00	11.65	Average

Horizontal	Vertical

Project No.: 2402W89616E-RF
Polarization: Horizontal
Test Mode: Transmitting
Note:

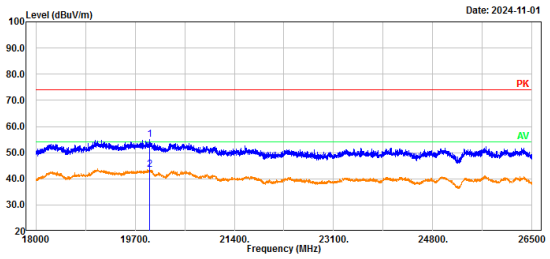
Serial No.: 2PRO-2
Tester: Colin Yang



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	38965.90	45.17	9.89	55.06	74.00	18.94	Peak
2	38965.90	34.26	9.89	44.15	54.00	9.85	Average

Project No.: 2402W89616E-RF
Polarization: Vertical
Test Mode: Transmitting
Note:

Serial No.: 2PRO-2
Tester: Colin Yang



No.	Frequency (MHz)	Reading (dBμV)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	19948.20	47.45	7.72	55.17	74.00	18.83	Peak
2	19948.20	35.68	7.72	43.40	54.00	10.60	Average

3) 40GHz-200GHz:
π/2-BPSK

Frequency (GHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)	Field Strength (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
Test Frequency: 58.32 GHz							
40.620	50.32	PK	H	38.89	79.67	24.58	90.00
40.190	52.32	PK	V	38.82	81.60	38.34	90.00
90.850	51.74	PK	H	45.21	81.39	36.53	90.00
90.180	52.31	PK	V	45.13	81.88	40.89	90.00

Frequency (GHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)	Field Strength (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
Test Frequency: 64.8 GHz							
40.320	50.30	PK	H	38.84	79.60	24.19	90.00
41.090	50.48	PK	V	38.96	79.90	25.92	90.00
90.100	52.05	PK	H	45.12	81.61	38.43	90.00
91.320	51.49	PK	V	45.27	81.20	34.97	90.00

Frequency (GHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)	Field Strength (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
Test Frequency: 69.12 GHz							
40.780	50.26	PK	H	38.91	79.63	24.36	90.00
40.650	51.33	PK	V	38.89	80.68	31.02	90.00
90.220	51.87	PK	H	45.13	81.44	36.95	90.00
90.310	51.69	PK	V	45.14	81.27	35.54	90.00

π/2-QPSK

Frequency (GHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)	Field Strength (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
Test Frequency: 58.32 GHz							
41.784	51.41	PK	H	39.07	80.94	32.94	90.00
40.560	51.30	PK	V	38.88	80.64	30.74	90.00
90.660	52.08	PK	H	45.19	81.71	39.32	90.00
90.380	52.79	PK	V	45.15	82.38	45.88	90.00

Frequency (GHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)	Field Strength (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
Test Frequency: 64.8 GHz							
41.260	51.66	PK	H	38.99	81.11	34.25	90.00
40.870	52.05	PK	V	38.93	81.44	36.95	90.00
90.590	53.21	PK	H	45.18	82.83	50.89	90.00
91.370	52.98	PK	V	45.28	82.70	49.39	90.00

Frequency (GHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)	Field Strength (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
Test Frequency: 69.12 GHz							
41.870	51.32	PK	H	39.08	80.86	32.33	90.00
40.290	51.28	PK	V	38.84	80.58	30.32	90.00
90.550	53.26	PK	H	45.17	82.87	51.36	90.00
90.310	52.79	PK	V	45.14	82.37	45.78	90.00

π/2-16-QAM

Frequency (GHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)	Field Strength (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
Test Frequency: 58.32 GHz							
40.350	50.74	PK	H	38.84	80.04	26.77	90.00
41.590	51.32	PK	V	39.04	80.82	32.04	90.00
90.580	53.29	PK	H	45.18	82.91	51.84	90.00
90.620	53.87	PK	V	45.18	83.49	59.25	90.00

Frequency (GHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)	Field Strength (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
Test Frequency: 64.8 GHz							
40.870	50.32	PK	H	38.93	79.71	24.81	90.00
40.300	50.87	PK	V	38.84	80.17	27.58	90.00
90.770	52.35	PK	H	45.20	81.99	41.94	90.00
90.360	53.74	PK	V	45.15	83.33	57.10	90.00

Frequency (GHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)	Field Strength (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
Test Frequency: 69.12 GHz							
40.230	50.32	PK	H	38.83	79.61	24.25	90.00
40.590	51.84	PK	V	38.88	81.18	34.81	90.00
90.740	52.33	PK	H	45.20	81.97	41.75	90.00
90.310	52.18	PK	V	45.14	81.76	39.78	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

$$PD = \frac{E^2_{SpecLimit}}{377}$$

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

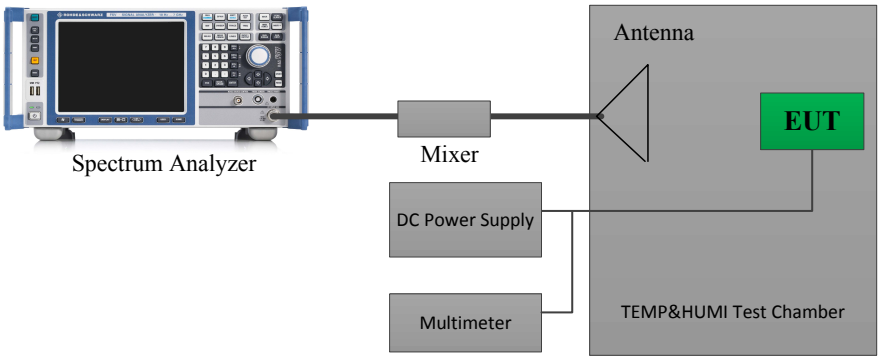
FCC §15.255(f)

(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.

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.

4.5.4 Test Result

Serial Number:	2PRO-2	Test Date:	2024/8/26
Test Site:	RF	Test Mode:	Transmitting
Tester:	Bill Yang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	26.4	Relative Humidity: (%)	65	ATM Pressure: (kPa)	100.1

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
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:
π/2-BPSK:
(Low channel for F_L, High channel for F_H)

Low channel

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	48	57.3414	59.3275	57	71
-10	48	57.3415	59.3274	57	71
0	48	57.3416	59.3273	57	71
10	48	57.3412	59.3277	57	71
20	48	57.3414	59.3271	57	71
30	48	57.3413	59.3274	57	71
40	48	57.3411	59.3271	57	71
50	48	57.3413	59.3272	57	71
20	40.8	57.3411	59.3278	57	71
20	55.2	57.3412	59.3277	57	71

π/2-BPSK:
(Low channel for F_L, High channel for F_H)

Middle channel

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	48	63.8414	65.6934	57	71
-10	48	63.8413	65.6936	57	71
0	48	63.8417	65.6933	57	71
10	48	63.8415	65.6931	57	71
20	48	63.8418	65.6933	57	71
30	48	63.8417	65.6932	57	71
40	48	63.8412	65.6937	57	71
50	48	63.8411	65.6935	57	71
20	40.8	63.8413	65.6931	57	71
20	55.2	63.8417	65.6933	57	71

π/2-BPSK:
(Low channel for F_L, High channel for F_H)

High channel

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	48	68.1561	70.0025	57	71
-10	48	68.1564	70.0027	57	71
0	48	68.1562	70.0023	57	71
10	48	68.1563	70.0027	57	71
20	48	68.1564	70.0028	57	71
30	48	68.1568	70.0022	57	71
40	48	68.1567	70.0025	57	71
50	48	68.1563	70.0023	57	71
20	40.8	68.1565	70.0024	57	71
20	55.2	68.1567	70.0021	57	71

π/2-QPSK:
(Low channel for F_L, High channel for F_H)

Low channel

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	48	57.3411	59.3813	57	71
-10	48	57.3413	59.3812	57	71
0	48	57.3417	59.3814	57	71
10	48	57.3412	59.3818	57	71
20	48	57.3414	59.3810	57	71
30	48	57.3417	59.3812	57	71
40	48	57.3416	59.3811	57	71
50	48	57.3411	59.3818	57	71
20	40.8	57.3417	59.3813	57	71
20	55.2	57.3413	59.3817	57	71

π/2-QPSK:
(Low channel for F_L, High channel for F_H)

Middle channel

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	48	63.8379	65.7100	57	71
-10	48	63.8375	65.7104	57	71
0	48	63.8377	65.7107	57	71
10	48	63.8373	65.7103	57	71
20	48	63.8374	65.7106	57	71
30	48	63.8378	65.7101	57	71
40	48	63.8371	65.7104	57	71
50	48	63.8373	65.7107	57	71
20	40.8	63.8379	65.7103	57	71
20	55.2	63.8378	65.7105	57	71

π/2-QPSK:
(Low channel for F_L, High channel for F_H)

High channel

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	48	68.1332	70.0521	57	71
-10	48	68.1335	70.0524	57	71
0	48	68.1330	70.0526	57	71
10	48	68.1336	70.0529	57	71
20	48	68.1339	70.0522	57	71
30	48	68.1335	70.0526	57	71
40	48	68.1337	70.0521	57	71
50	48	68.1335	70.0527	57	71
20	40.8	68.1338	70.0523	57	71
20	55.2	68.1336	70.0526	57	71

π/2-16QAM:
(Low channel for F_L, High channel for F_H)

Low channel

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	48	57.3547	59.3183	57	71
-10	48	57.3548	59.3187	57	71
0	48	57.3543	59.3182	57	71
10	48	57.3541	59.3185	57	71
20	48	57.3549	59.3181	57	71
30	48	57.3547	59.3183	57	71
40	48	57.3545	59.3187	57	71
50	48	57.3547	59.3186	57	71
20	40.8	57.3543	59.3183	57	71
20	55.2	57.3542	59.3187	57	71

π/2-16QAM:
(Low channel for F_L, High channel for F_H)

Middle channel

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	48	63.8372	65.7363	57	71
-10	48	63.8375	65.7361	57	71
0	48	63.8377	65.7367	57	71
10	48	63.8371	65.7369	57	71
20	48	63.8374	65.7366	57	71
30	48	63.8374	65.7363	57	71
40	48	63.8375	65.7363	57	71
50	48	63.8377	65.7361	57	71
20	40.8	63.8372	65.7369	57	71
20	55.2	63.8371	65.7364	57	71

π/2-16QAM:
(Low channel for F_L, High channel for F_H)

High channel

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	48	68.1246	70.0613	57	71
-10	48	68.1247	70.0617	57	71
0	48	68.1244	70.0616	57	71
10	48	68.1243	70.0613	57	71
20	48	68.1249	70.0612	57	71
30	48	68.1244	70.0612	57	71
40	48	68.1247	70.0613	57	71
50	48	68.1243	70.0615	57	71
20	40.8	68.1247	70.0617	57	71
20	55.2	68.1245	70.0616	57	71

Note: the operation voltage is 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.

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 dBi) 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 dBi) 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 - EUT PHOTOGRAPHS

Please refer to the attachment 2402W89616E-RF-EXP EUT EXTERNAL PHOTOGRAPHS and 2402W89616E-RF-INP EUT INTERNAL PHOTOGRAPHS.

EXHIBIT B - TEST SETUP PHOTOGRAPHS

Please refer to the attachment 2402W89616E-RF-00A-TSP SETUP PHOTOGRAPHS.

EXHIBIT 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);

Calculated Result

Frequency (GHz)	EIRP including Tune-up Tolerance		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
	(dBm)	(mW)			
58.32-69.12	43	19952.62	40.00	0.9929	1.0

Note: The EIRP Tune-up power was declared by the manufacturer.
Result: The device meet FCC MPE at 40 cm distance.

Electric field strength levels, magnetic field strength levels and power density levels (10 MHz to 300 GHz)

Applicable Standard

RSS-102 issue 6 Clause 5.3.2,

The electric and magnetic field strength reference levels, power density reference levels, and associated reference period for devices employed by the general public (uncontrolled environment) and controlled-use devices (controlled environment) are specified in table 7 and table 8. Note that the power density limits specified in these tables apply to whole body exposure conditions.

Table 7: RF field strength and power density limits for devices used by the general public (uncontrolled environment)

Frequency range (MHz)	Electric field (V_{RMS}/m)	Magnetic field (A_{RMS}/m)	Power density (W/m^2)	Reference period (minutes)
10-20	27.46	0.0728	2	6
20-48	$58.07 / f^{0.25}$	$0.1540 / f^{0.25}$	$8.944 / f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142\ f^{0.3417}$	$0.008335\ f^{0.3417}$	$0.02619\ f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158\ f^{0.5}$	$4.21 \times 10^{-4}\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000/f^{1.2}$

Note: f is frequency in MHz.

Procedure

Prediction of power density at the distance of the applicable MPE limit
S = PG/4πR² = power density (in appropriate units, e.g. W/m^2);
P = power input to the antenna (in appropriate units, e.g., W);
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);

Calculated Result

Frequency (GHz)	EIRP including Tune-up Tolerance		Evaluation Distance (cm)	Power Density (W/m^2)	MPE Limit (W/m^2)
	(dBm)	(mW)			
58.32-69.12	43	19952.62	40.00	9.929	10

Note: The EIRP Tune-up power was declared by the manufacturer.
Result: The device meet IESD MPE at 40 cm distance.

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