

Test results (In band)

Ground-parallel

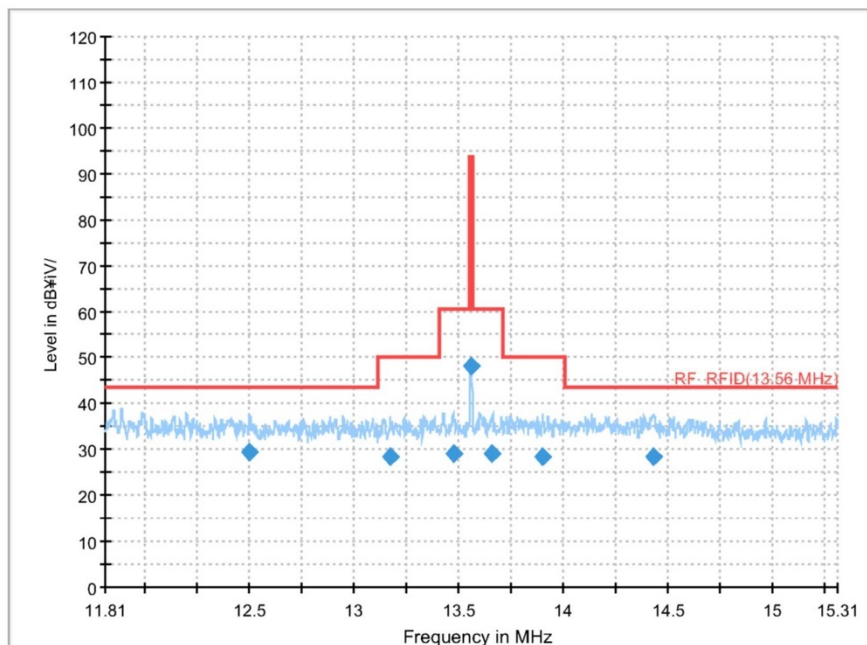
9 kHz to 30 MHz

4/4/2024

Test Report

Common Information

Test Description: A2023-14190
 Test Mode: Operating Mode
 Environment Conditions: Input AC 220 V / Temp 21.8 Humi 54.6
 Operator Name: YURA OH
 Comment: Ground, Inband



Final Result

Frequency (MHz)	Quasi Peak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Po l	Azimuth (deg)	Corr. (dB/m)	Comment
12.4999	29.29	43.50	14.21	1000.0	9.000	H	232.0	19.9	4:20:39 PM - 4/4/2024
13.1726	28.44	50.00	21.56	1000.0	9.000	H	218.0	19.7	4:20:49 PM - 4/4/2024
13.4746	29.19	60.50	31.31	1000.0	9.000	H	36.0	19.9	4:21:21 PM - 4/4/2024
13.5584	48.08	93.50	45.42	1000.0	9.000	H	262.0	20.0	4:21:59 PM - 4/4/2024
13.6560	29.05	60.50	31.45	1000.0	9.000	H	225.0	20.1	4:22:12 PM - 4/4/2024
13.9005	28.48	50.00	21.52	1000.0	9.000	H	357.0	20.3	4:22:37 PM - 4/4/2024
14.4286	28.41	43.50	15.09	1000.0	9.000	H	76.0	20.4	4:23:22 PM - 4/4/2024

Test results (Below 1 000 MHz)

Horizontal // Vertical

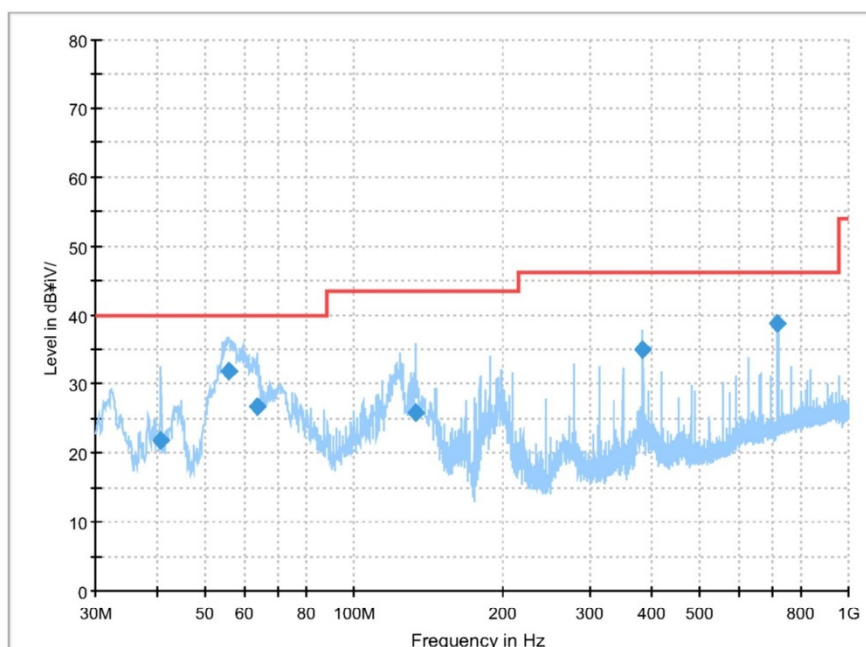
30-1 GHz

4/4/2024

Test Report

Common Information

Test Description: A2023-14190
 Test Mode: Operating Mode
 Environment Conditions: Input AC 220 V / Temp 21.8 Humi 54.6
 Operator Name: YURA OH
 Comment:



Final Result

Frequency (MHz)	Quasi Peak (dBμV/ m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Comment
40.573000	21.85	18.15	2000.0	120.000	100.0	V	344.0	5:52:18 PM - 4/4/2024
55.802000	31.91	8.09	2000.0	120.000	100.0	V	170.0	5:51:38 PM - 4/4/2024
63.659000	26.70	13.30	2000.0	120.000	100.0	V	244.0	5:51:56 PM - 4/4/2024
133.402000	25.90	17.62	2000.0	120.000	100.0	V	51.0	5:51:15 PM - 4/4/2024
383.953000	34.89	11.13	2000.0	120.000	100.0	H	333.0	5:49:25 PM - 4/4/2024
719.961000	38.83	7.20	2000.0	120.000	200.0	H	154.0	5:50:21 PM - 4/4/2024

Test results (Above 1 GHz ~ 18 GHz)

Ground-parallel

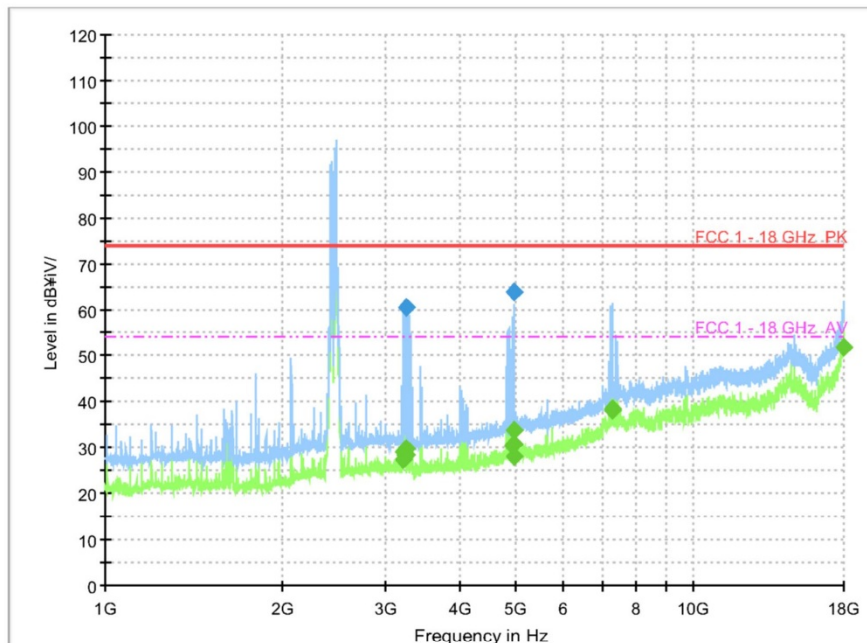
1-18

4/25/2024

Test Report

Common Information

Test Description: A2023-14190
 Test Mode: Operating Mode
 Test Standard:
 Environment Conditions: Input AC 220 V / Temp 21.4 Humi 54.8
 Operator Name: YURA OH
 Comment:



Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Comment
3215.666667	---	26.74	1000.0	1000.000	300.0	V	135.0	8:57:54 PM - 4/25/2024
3218.500000	---	24.82	1000.0	1000.000	200.0	V	0.0	8:56:40 PM - 4/25/2024
3224.166667	---	24.71	1000.0	1000.000	200.0	V	353.0	8:59:05 PM - 4/25/2024
3231.722222	---	25.55	1000.0	1000.000	100.0	H	253.0	8:55:36 PM - 4/25/2024
3240.222222	---	24.33	1000.0	1000.000	100.0	V	0.0	8:56:18 PM - 4/25/2024
3240.222222	60.41	13.59	1000.0	1000.000	100.0	V	0.0	9:00:57 PM - 4/25/2024
3242.111111	---	25.66	1000.0	1000.000	200.0	V	10.0	8:56:54 PM - 4/25/2024
4929.833333	---	23.64	1000.0	1000.000	200.0	V	0.0	8:56:45 PM - 4/25/2024
4942.111111	---	20.14	1000.0	1000.000	100.0	V	274.0	8:58:36 PM - 4/25/2024
4942.111111	63.97	10.03	1000.0	1000.000	100.0	V	274.0	9:01:33 PM - 4/25/2024
4945.888889	---	23.38	1000.0	1000.000	100.0	V	0.0	8:56:23 PM - 4/25/2024
4949.666667	---	25.94	1000.0	1000.000	200.0	V	74.0	8:57:27 PM - 4/25/2024
7284.333333	---	16.03	1000.0	1000.000	200.0	V	48.0	8:57:15 PM - 4/25/2024
7290.000000	---	15.55	1000.0	1000.000	200.0	V	10.0	8:57:00 PM - 4/25/2024
17998.111111	---	2.12	1000.0	1000.000	100.0	H	81.0	9:02:10 PM - 4/25/2024

Test results (Above 18 GHz ~ 26.5 GHz)

Ground-parallel

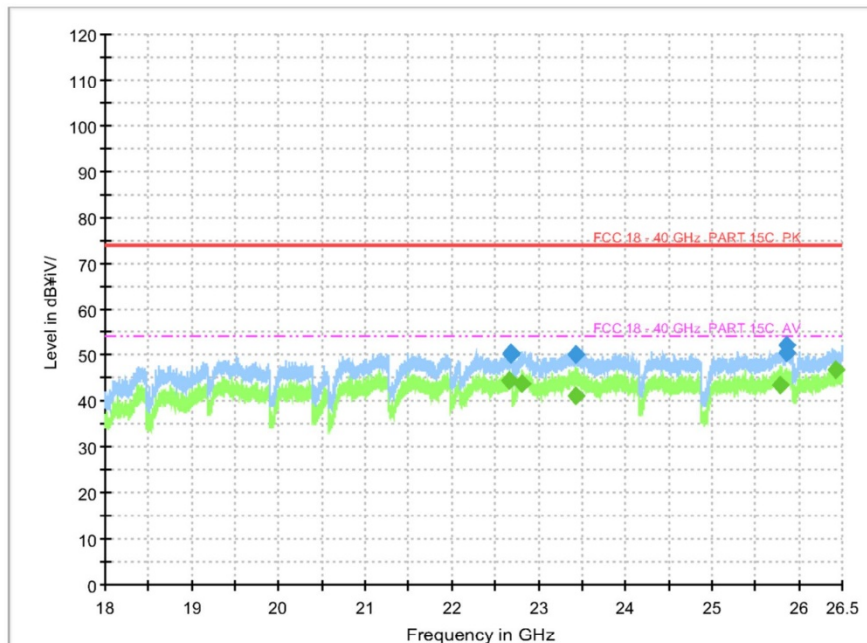
9 kHz to 30 MHz

4/25/2024

Test Report

Common Information

Test Description: A2023-14190
 Test Mode: Operating Mode
 Test Standard:
 Environment Conditions: Input AC 220 V / Temp 21.4 Humi 54.8
 Operator Name: YURA OH
 Comment:



Final Result

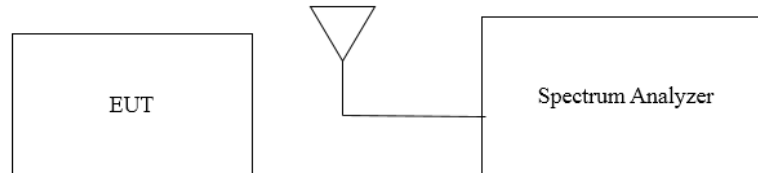
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Comment
25863.917	50.51	---	74.00	23.49	100.0	H	64.0	9:21:20 PM - 4/25/2024
22652.806	---	44.29	54.00	9.71	100.0	H	356.0	9:13:51 PM - 4/25/2024
22674.528	50.37	---	74.00	23.63	200.0	H	98.0	9:22:30 PM - 4/25/2024
22674.528	50.11	---	74.00	23.89	200.0	H	98.0	9:18:45 PM - 4/25/2024
22816.194	---	43.84	54.00	10.16	300.0	V	0.0	9:19:51 PM - 4/25/2024
23437.639	50.16	---	74.00	23.84	300.0	V	334.0	9:21:50 PM - 4/25/2024
23437.639	---	41.18	54.00	12.82	300.0	V	334.0	9:20:27 PM - 4/25/2024
25787.417	---	43.54	54.00	10.46	400.0	H	126.0	9:21:14 PM - 4/25/2024
25863.917	51.98	---	74.00	22.02	100.0	H	64.0	9:10:38 PM - 4/25/2024
26433.889	---	46.71	54.00	7.29	200.0	V	66.0	9:18:51 PM - 4/25/2024

Note.

1. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector for emissions below 960 MHz.
2. Both Vertical and Horizontal polarities of the receive antenna were evaluated with the worst case emissions being reported. Below 30 MHz the loop antenna was positioned in 3 orthogonal planes (X front, Y side, Z top) to determine the orientation resulting in the worst case emissions.
3. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
4. The spectrum is measured from 9 kHz to the 10th harmonic and the worst-case emissions are reported.
5. No spurious emissions levels were found to be greater than the level of the fundamental.

2.2 20 dB bandwidth

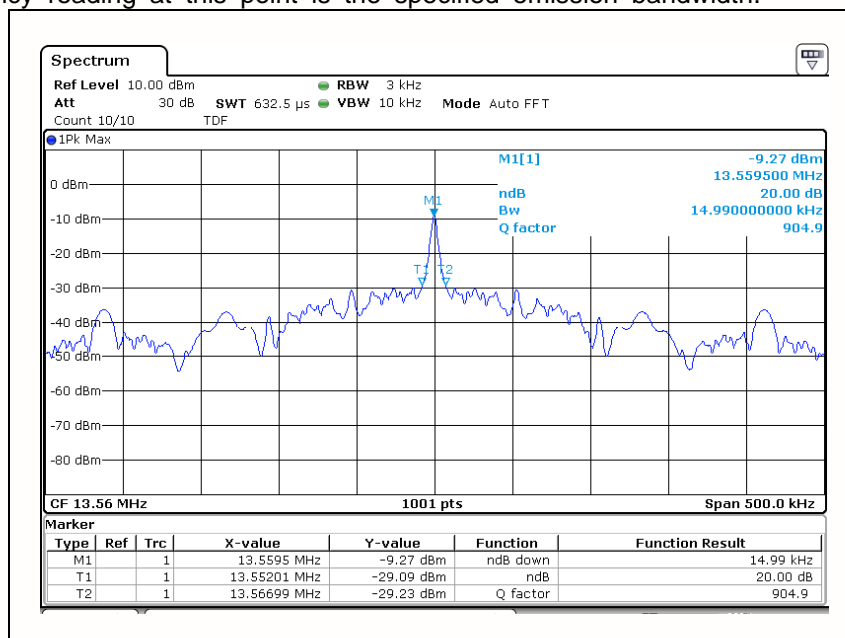
Test setup



Test procedure

ANSI C63.10-2013 – Section 6.9.2

1. Spectrum analyzer frequency is set to the nominal EUT channel center frequency.
2. RBW = 1~5% OBW
3. VBW $\geq 3 \times$ RBW
4. Reference level set to keep signal from exceeding maximum input mixer for linear operation.
5. Detector = Peak
6. Trace mode = Max hold
7. Sweep = Auto couple
8. The trace was allowed to stabilize
9. Using the marker-delta function, determine the “-20 dB down amplitude” using [(highest in band spectral density) – 20 dB]
10. Set a marker at the lowest frequency of the envelope of the spectral density, such that the marker is at or slightly below the “-20 dB down amplitude” determined in Step 9.
11. Reset Marker-delta function and move the marker to other side of the emission until the delta marker amplitude is the same level as reference amplitude. The marker delta frequency reading at this point is the specified emission bandwidth.



Note.

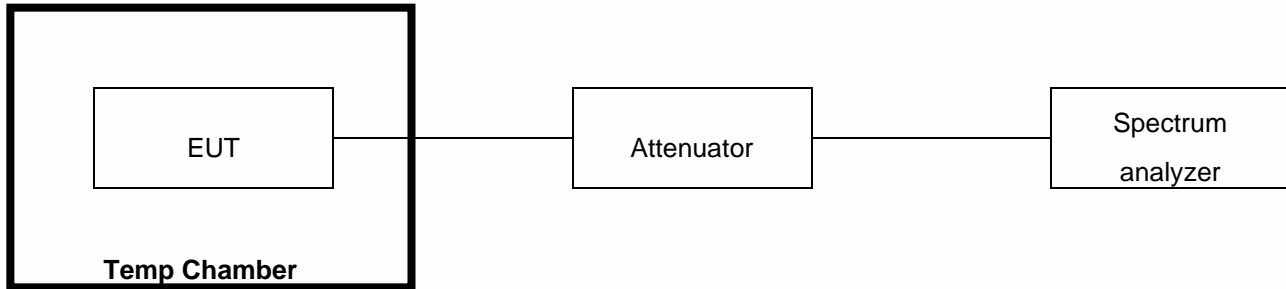
Because the measured signal is CW/CW-like, adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW.

2.3 Frequency stability

Test procedure

ANSI C63.10-2013, clause 6.8.1

Test setup



1. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
2. Turn the EUT on and couple its output to a spectrum analyzer.
3. Turn the EUT off and set the chamber to the highest temperature specified.
4. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency.
5. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
6. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency recorded.
7. While maintaining a constant temperature inside the environmental chamber, turn the EUT on and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

Limit

According to §15.225 (e), the frequency tolerance of the carrier signal shall be maintained within +/- 0.01 % of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Test results

Test voltage (%)	Test voltage (V)	Temperature (℃)	Maintaining time	Measure frequency (MHz)	Frequency deviation (Hz)	Deviation (%)
100 %	AC 220 V	-20	Startup	13.559 5	-500	-0.003 687
			2 minutes	13.559 5	-500	-0.003 687
			5 minutes	13.559 5	-500	-0.003 687
			10 minutes	13.559 5	-500	-0.003 687
		-10	Startup	13.559 5	-500	-0.003 687
			2 minutes	13.559 5	-500	-0.003 687
			5 minutes	13.559 5	-500	-0.003 687
			10 minutes	13.559 5	-500	-0.003 687
		0	Startup	13.559 5	-500	-0.003 687
			2 minutes	13.559 5	-500	-0.003 687
			5 minutes	13.559 5	-500	-0.003 687
			10 minutes	13.559 5	-500	-0.003 687
		10	Startup	13.559 5	-500	-0.003 687
			2 minutes	13.559 5	-500	-0.003 687
			5 minutes	13.559 5	-500	-0.003 687
			10 minutes	13.559 5	-500	-0.003 687
		20	Startup	13.559 5	-500	-0.003 687
			2 minutes	13.559 5	-500	-0.003 687
			5 minutes	13.559 5	-500	-0.003 687
			10 minutes	13.559 5	-500	-0.003 687
		30	Startup	13.559 5	-500	-0.003 687
			2 minutes	13.559 5	-500	-0.003 687
			5 minutes	13.559 5	-500	-0.003 687
			10 minutes	13.559 5	-500	-0.003 687
		10	Startup	13.559 5	-500	-0.003 687
			2 minutes	13.559 5	-500	-0.003 687
			5 minutes	13.559 5	-500	-0.003 687
			10 minutes	13.559 5	-500	-0.003 687
		50	Startup	13.559 5	-500	-0.003 687
			2 minutes	13.559 5	-500	-0.003 687
			5 minutes	13.559 5	-500	-0.003 687
			10 minutes	13.559 5	-500	-0.003 687

Test voltage (%)	Test voltage (V)	Temperature (℃)	Maintaining time	Measure frequency (MHz)	Frequency deviation (Hz)	Deviation (%)
85 %	AC 85 V	23	Startup	13.559 5	-500	-0.003 687
			2 minutes	13.559 5	-500	-0.003 687
			5 minutes	13.559 5	-500	-0.003 687
			10 minutes	13.559 5	-500	-0.003 687
115 %	AC 276 V	23	Startup	13.559 5	-500	-0.003 687
			2 minutes	13.559 5	-500	-0.003 687
			5 minutes	13.559 5	-500	-0.003 687
			10 minutes	13.559 5	-500	-0.003 687

2.4 AC Power Line Conducted Emission

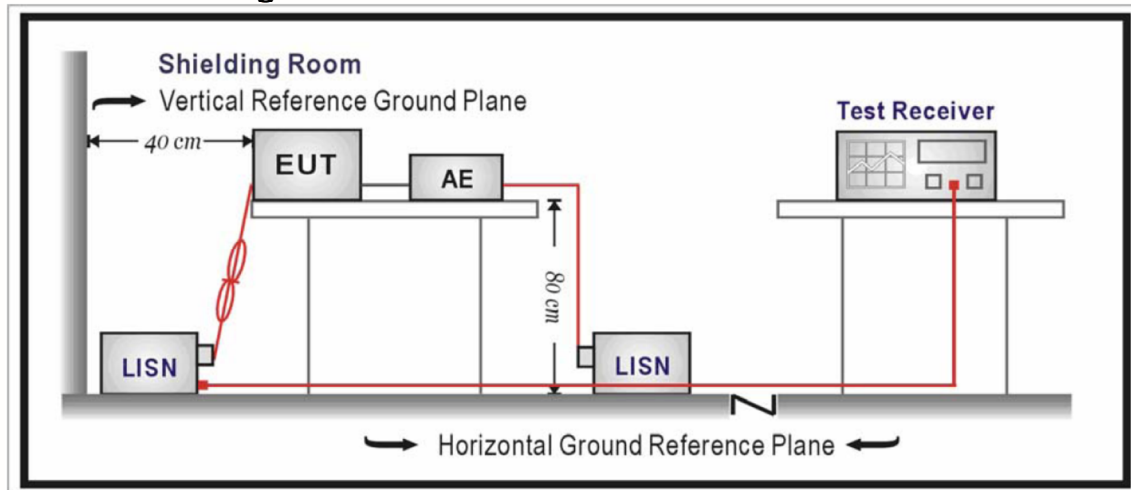
2.4.1 Limit

Test Specification: According to FCC CFR Title 47 Part 15 Subpart C Section 15.207

Frequency (MHz)	Limit (dBuV)	
	Quasi-Peak	Average
0.15 to 0.5	66 to 56 *	56 to 46 *
0.5 to 5	56	46
5 to 30	60	50

Note : * Decrease with the logarithm of the frequency

2.4.2 Test Configuration



2.4.3 Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50 uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50 ohm/50 uH coupling impedance with 50ohm termination. (Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed on conducted measurement.

Conducted emissions were measured over the frequency range from 0.15 MHz to 30 MHz using a receiver bandwidth of 9kHz.

2.4.4 Test Result

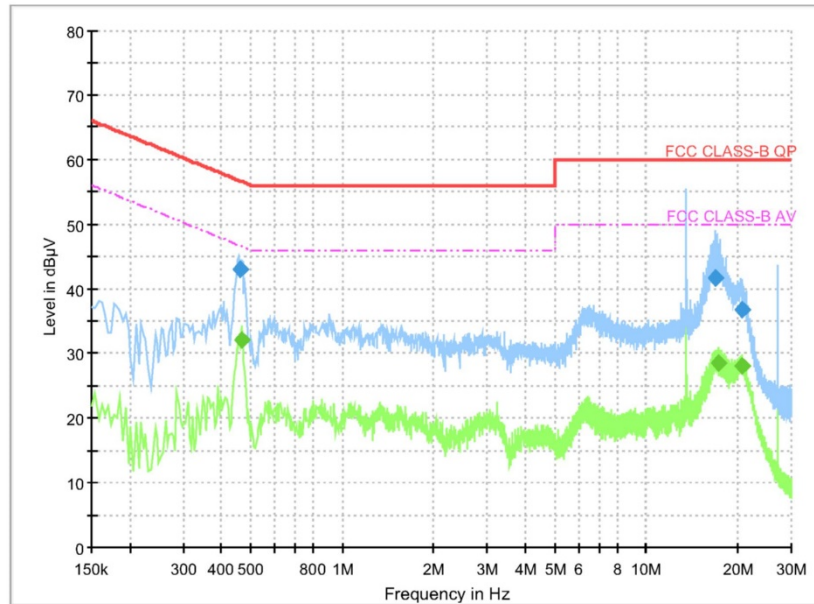
RF CE_L

2024-04-15

Test Report

Common Information

Test Description: A2023-14190
 Test Mode: Operating Mode
 Test Standard: FCC PART18
 Environment Conditions: AC 220 V
 Operator Name: YURA OH
 Comment: -



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.462500	42.91	---	56.65	13.74	1000.0	9.000	L1	10.0
0.465500	---	32.18	46.59	14.42	1000.0	9.000	L1	10.0
16.855640	41.60	---	60.00	18.40	1000.0	9.000	L1	10.6
17.281620	---	28.47	50.00	21.53	1000.0	9.000	L1	10.6
20.612660	36.85	---	60.00	23.15	1000.0	9.000	L1	10.7
20.724680	---	28.01	50.00	21.99	1000.0	9.000	L1	10.7

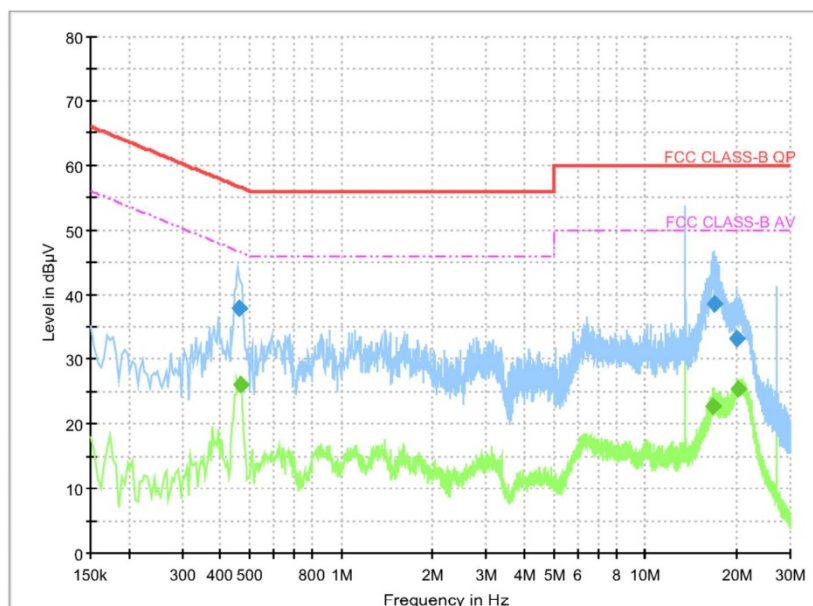
RF CE_N

2024-04-15

Test Report

Common Information

Test Description: A2023-14190
 Test Mode: Operating Mode
 Test Standard: FCC PART18
 Environment Conditions: AC 220 Vz
 Operator Name: YURA OH
 Comment: -



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.462500	37.92	---	56.65	18.73	1000.0	9.000	N	10.0
0.466500	---	26.09	46.58	20.49	1000.0	9.000	N	10.0
16.728720	---	22.76	50.00	27.24	1000.0	9.000	N	10.5
16.879580	38.49	---	60.00	21.51	1000.0	9.000	N	10.5
16.899260	38.60	---	60.00	21.40	1000.0	9.000	N	10.5
19.936440	33.15	---	60.00	26.85	1000.0	9.000	N	10.6
20.166680	---	25.51	50.00	24.49	1000.0	9.000	N	10.6

- End of Test Report -