

Compliance Certification Services (Kunshan) Inc.

CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240300043401

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TEST REPORT

Application No.: KSCR2403000434AU
FCC ID: 2BB3401010101
Applicant: Freetech Intelligent Systems Co., Ltd.
Address of Applicant: 16 Xingfa Road, Tongxiang City, Jiaxing City, Zhejiang Province, China
Manufacturer: Freetech Intelligent Systems Co., Ltd.
Address of Manufacturer: 16 Xingfa Road, Tongxiang City, Jiaxing City, Zhejiang Province, China
Factory: Freetech Intelligent Systems Co., Ltd.
Address of Factory: 16 Xingfa Road, Tongxiang City, Jiaxing City, Zhejiang Province, China
Equipment Under Test (EUT):
EUT Name: Side Rear Millimeter Wave Radar
Model No.: CVR10
Trade Mark: 
Standard(s) : 47 CFR Part 95, Subpart M
Date of Receipt: 2024-03-15
Date of Test: 2024-03-25 to 2024-04-03
Date of Issue: 2024-04-11

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards specified above.

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<i>Revision Record</i>			
<i>Version</i>	<i>Description</i>	<i>Date</i>	<i>Remark</i>
00	Original	2024-04-11	

Authorized for issue by:			
Tested By		<i>Maker Qi</i>	
		Maker_Qi/Project Engineer	
Approved By		<i>Terry Hou</i>	
		Terry Hou /Reviewer	

2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 95, Subpart M	N/A	N/A	Customer Declaration

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Equivalent Isotropically Radiated Power (EIRP)	47 CFR Part 95, Subpart M	ANSI C63.26 (2015) Section 5.2	Peak EIRP<55dBm/MHz Average EIRP<50dBm/MHz	Pass
Occupied bandwidth	47 CFR Part 95, Subpart M	ANSI C63.26 (2015) Section 5.4	≥76GHz, ≤81GHz	Pass
Modulation characteristics	47 CFR Part 95, Subpart M	ANSI C63.26 (2015) Section 5.3	N/A	Customer Declaration
Unwanted Emissions	47 CFR Part 95, Subpart M	ANSI C63.26 (2015) Section 5.5	Refer to 47 CFR Part 95, Subpart M § 95.3379	Pass
Frequency stability	47 CFR Part 95, Subpart M	ANSI C63.26 (2015) Section 5.6	76-81GHz	Pass



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4 General Information

4.1 Details of E.U.T.

Power supply:	DC 12V
Test voltage:	DC 12V
Operation Frequency Range:	76GHz to 81GHz
Modulation:	FMCW
Antenna type:	Integrated Patch Antenna

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
DC power supply	Agilent	E3632A	/

4.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	8.4 x 10 ⁻⁸
2	Timeout	2s
3	Duty Cycle	0.37%
4	Occupied Bandwidth	3%
5	RF Conducted Power	0.6dB
6	RF Power Density	2.9dB
7	Conducted Spurious Emissions	0.75dB
8	RF Radiated Power	5.2dB (Below 1GHz)
		5.9dB (Above 1GHz)
9	Radiated Spurious Emission Test	4.2dB (Below 30MHz)
		4.5dB (30MHz-1GHz)
		5.1dB (1GHz-18GHz)
		5.4dB (Above 18GHz)
10	Temperature Test	1°C
11	Humidity Test	3%
12	Supply Voltages	1.5%
13	Time	3%

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4.4 Test Location

All tests were performed at:

Compliance Certification Services (Kunshan) Inc.

No.10 Weiye Rd, Innovation park, Eco&Tec, Development Zone, Kunshan City, Jiangsu, China.

Tel: +86 512 5735 5888 Fax: +86 512 5737 0818

No tests were sub-contracted.

Note:

1.SGS is not responsible for wrong test results due to incorrect information (e.g. max. clock frequency, highest internal frequency, antenna gain, cable loss, etc) is provided by the applicant. (if applicable).

2.SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (if applicable).

3. Sample source: sent by customer.

4.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA**

Compliance Certification Services (Kunshan) Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 2541.01.

- **FCC**

Compliance Certification Services Inc. has been recognized as an accredited testing laboratory.

Designation Number: CN1172.

- **ISED**

Compliance Certification Services (Kunshan) Inc. has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory. Company Number: 2324E

- **VCCI**

The 3m and 10m Semi-anechoic chamber and Shielded Room of Compliance Certification Services (Kunshan) Inc. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-20134, R-11600, C-11707, T-11499, G-10216 respectively.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None



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5 Equipment List

Item	Equipment	Manufacturer	Model	Serial Number	Cal Date	Cal. Due Date
RF Radiated Test						
1	Spectrum Analyzer	R&S	FSV40	KUS1806E003	08/24/2023	08/23/2024
2	PXA Spectrum Analyzer	KEYSIGHT	N9030B	KSEM021-1	01/15/2024	01/14/2025
3	Signal Generator	Agilent	E8257C	KS301066	08/24/2023	08/23/2024
4	Loop Antenna	COM-POWER	AL-130R	KUS1806E001	03/18/2023	03/17/2025
5	Bilog Antenna	TESEQ	CBL 6112D	KUS1806E005	06/29/2023	06/28/2025
6	Bilog Antenna	SCHWARZBECK	VULB9160	CZ301016	04/13/2021	04/12/2024
7	Amplifier(30MHz~18GHz)	PANSHAN TECHNOLOGY	LNA:1~18G	KSEM010-1	01/15/2024	01/14/2025
8	Horn-antenna(1-18GHz)	ETS-LINDGREN	3117	KS301186	04/07/2023	04/06/2025
9	Amplifier(18~40GHz)	PANSHAN TECHNOLOGY	LNA180400G40	KSEM038	08/24/2023	08/23/2024
10	Horn Antenna(18-40GHz)	Schwarzbeck	BBHA9170	CZ301058	02/25/2024*	02/24/2025
11	Horn-antenna(40-60GHz)	ERAVENT	SAZ-2410-19-S1	KSEM003-1	02/02/2021*	02/01/2031**
12	Horn-antenna(50-75GHz)	ERAVENT	SAZ-2410-15-S1	KSEM003-2	02/02/2021*	02/01/2031**
13	Horn-antenna(75-110GHz)	ERAVENT	SAZ-2410-10-S1	KSEM003-3	02/02/2021*	02/01/2031**
14	Horn-antenna(110-170GHz)	ERAVENT	SAZ-2410-06-S1	KSEM003-4	02/02/2021*	02/01/2031**
15	Horn-antenna(140-220GHz)	ERAVENT	SAZ-2410-05-S1	KSEM003-5	02/02/2021*	02/01/2031**
16	Horn-antenna(220-325GHz)	ERAVENT	SAR-2309-03-S2	KSEM003-6	02/02/2021*	02/01/2031**
17	Extended waveguide(40-60GHz)	ERAVENT	SWG-19025-FB	KSEM004-1	02/02/2021*	02/01/2031**
18	Extended waveguide(50-75GHz)	ERAVENT	SWG-15025-FB	KSEM004-2	02/02/2021*	02/01/2031**
19	Extended waveguide(75-110GHz)	ERAVENT	SWG-10025-FB	KSEM004-3	02/02/2021*	02/01/2031**
20	Extended waveguide(110-170GHz)	ERAVENT	SWG-06025-FB	KSEM004-4	02/02/2021*	02/01/2031**
21	Extended waveguide(140-220GHz)	ERAVENT	SWG-05025-FB	KSEM004-5	02/02/2021*	02/01/2031**
22	Extended waveguide(220-325GHz)	ERAVENT	SWG-03025-FB	KSEM004-6	02/02/2021*	02/01/2031**
23	Harmonic mixer(40-60GHz)	ERAVENT	STH-19SF-S1	KSEM005-2	10/01/2020*	09/30/2030**
24	Harmonic Mixer(50-75GHz)	VDI	SAX WR15	KSEM007-1	08/23/2023*	08/23/2033**
25	Harmonic Mixer(60-90GHz)	VDI	SAX WR12	KSEM007-2	08/23/2023*	08/23/2033**
26	Harmonic mixer(90-140GHz)	VDI	SAX WR8.0	KSEM007-3	08/23/2023*	08/23/2033**
27	Harmonic mixer(140-220GHz)	VDI	SAX WR5.1	KSEM007-4	08/23/2023*	08/23/2033**
28	Harmonic mixer(220-325GHz)	ERAVENT	HM 220-325	KSEM005-4	04/20/2021*	04/19/2031**
29	RE Test Cable	ERAVENT MICROWAVE	/	CZ301097	11/11/2023	11/10/2024
30	Temperature & Humidity Recorder	Renke Control	RS-WS-N01-6J	KSEM024-4	03/21/2024	03/20/2025
31	Software	Faratronic	EZ EMC-v 3A1	/	N/A	N/A
32	Software	ESE	E3_V 6.111221a	/	N/A	N/A

*Calibration date provided by the equipment manufacturer.

**Calibration every ten years. During this period, there will be daily check files for the equipment and the requirements for operators will be clearly defined through SOP.

6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

FCC 47 CFR Part 95M

6.1.2 Conclusion

Standard Requirement:

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 an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit permanently attached antenna or of an so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

EUT Antenna:

The antenna is Integrated Patch Antenna and no consideration of replacement.

Antenna location: Refer to EUT Photos.

7 Radio Spectrum Matter Test Results

7.1 Modulation characteristics

7.1.1 Test Requirement:

47 CFR Part 95, Subpart M;

7.1.2 Conclusion

According to § 2.1047, A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed

Comments from manufacturer on modulation characteristics according to KDB:

Parameter	
Duty Cycle %:	28.16%
Time RF on(ms):	14.08 ms
Time RF off (ms):	35.92 ms
Power:	Constant during RF on
Steepness of Ramps(GHz/s):	7.324 MHz/us
Calibration:	N/A
Characteristics	
Sweep Bandwidth:	1.0228GHz
Sweep Rate(KHz):	72.44MHz/ms
Sweep Time(us):	14.08ms

7.2 EIRP

Test Requirement: 47 CFR Part 95, Subpart M;
Test Method: ANSI C63.26 (2015) Section 5.2
Limit:
Peak EIRP <55dBm/MHz
Average EIRP <50dBm

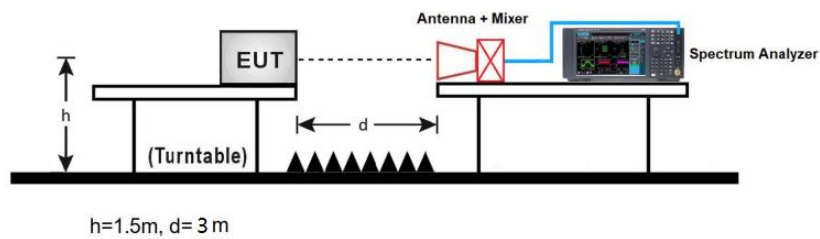
7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 24 °C Humidity: 48 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode_Make EUT continuously emit radar signals

7.2.2 Test Setup Diagram



7.2.3 Measurement Data

Please Refer to Appendix for Details

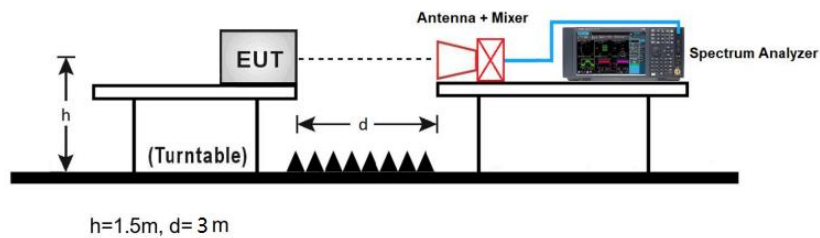
7.3 Occupied Bandwidth

Test Requirement: 47 CFR Part 95, Subpart M;
 Test Method: ANSI C63.26 (2015)Section 5.4;
 Limit: $\geq 76\text{GHz}, \leq 81\text{GHz}$

7.3.1 E.U.T. Operation

Operating Environment:
 Temperature: 24 °C Humidity: 48 % RH Atmospheric Pressure: 1010 mbar
 Test mode a:TX mode_Make EUT continuously emit radar signals

7.3.2 Test Setup Diagram



7.3.3 Measurement Data

Please Refer to Appendix for Details

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7.4 Unwanted Emissions

Test Requirement: 47 CFR Part 95, Subpart M
 Test Method: ANSI C63.26 (2015) Section 5.5
 Limit:

The power density of any emissions outside the 76-81 GHz band shall consist solely of spurious emissions and shall not exceed the following:

(1) Radiated emissions below 40 GHz shall not exceed the field strength as shown in the following emissions table.

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

(i) The tighter limit applies at the band edges.

(ii) The limits in the table are based on the frequency of the unwanted emissions and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(iii) The emissions limits shown in the table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9.0-90.0 kHz, 110.0-490.0 kHz, and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector with a 1 MHz RBW.

(2) The power density of radiated emissions outside the 76-81 GHz band above 40.0 GHz shall not exceed the following, based on measurements employing an average detector with a 1 MHz

(i) For radiated emissions between 40 GHz and 200 GHz: 600 pW/cm² at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For radiated emissions above 200 GHz: 1000 pW/cm² at a distance of 3 meters from the exterior surface of the radiating structure.

(3) For field disturbance sensors and radar systems operating in the 76-81 GHz band, the spectrum shall be investigated up to 231.0 GHz

Frequency (GHz)	Power density at 3 m distance (pW/cm ²)	Distance (m)	Field strength (dBuV/m)*, peak	Field strength (dBuV/m)*, average
40 - 200	600	3.0	113.54	93.54
200-231	1000	3.0	115.76	95.76

* - Field strength was calculated per equation (26) of ANSI C63.10-2013 section 9 as follows: $E = \sqrt{PD \times 377}$, where PD is the power density at the distance specified by the limit in W/m², E- field strength in V/m.

** - The limit for other test distance was calculated using the inverse distance extrapolation factor as follows: $LimS2 = LimS1 + 20 \log (S1/S2)$, where S1 and S2 - standard defined and test distance respectively in meters.

7.4.1 E.U.T. Operation

Operating Environment:

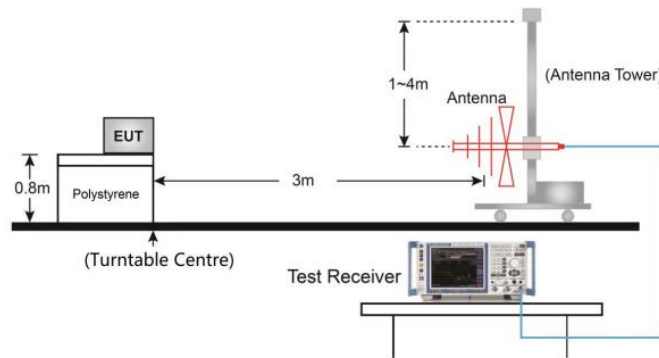
Temperature: 24 °C Humidity: 48 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode_Make EUT continuously emit radar signals

7.4.2 Test Setup Diagram

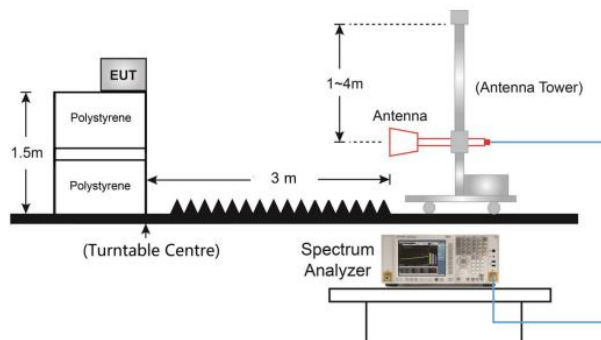
Below 1GHz

Below 1GHz Test Setup:

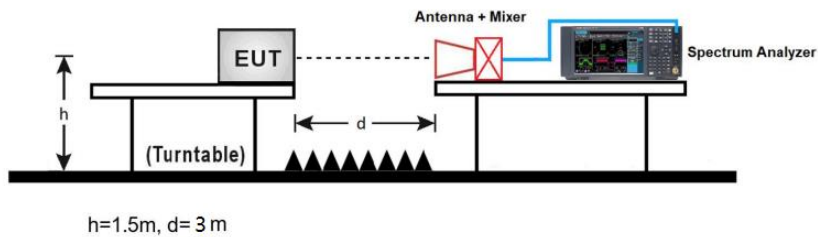


1GHz-40GHz

1GHz ~ 40GHz Test Setup:



Above 40GHz



7.4.3 Test Procedure and Measurement Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For 1-18GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. For 18-40GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

d. For above 40GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation

e. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

f. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

g. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

h. If the emission level of the EUT in Peak mode was 10dB lower than the limit specified, then testing could be stopped and the Peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using Peak, quasi-Peak or average method as specified and then reported in a data sheet.

i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark 1: $Level = Read\ Level + Cable\ Loss + Antenna\ Factor - Preamp\ Factor$

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the Peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose Peak level is lower than the average limit, only the Peak measurement is shown in the report.

Remark 3: Scan from 9kHz to 40GHz, the disturbance below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

The detailed test data see: Appendix

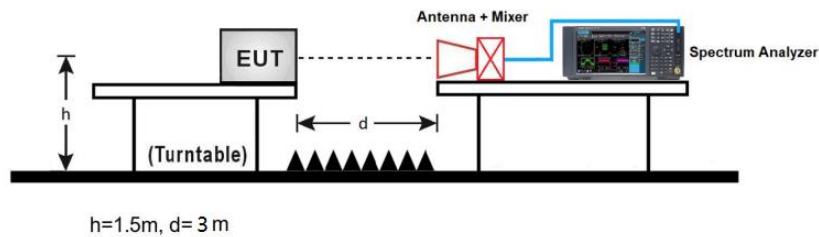
7.5 Frequency Stability

Test Requirement: 47 CFR Part 95, Subpart M
Test Method: ANSI C63.26 (2015) Section 5.6;
Limit: 76-81GHz

7.5.1 E.U.T. Operation

Operating Environment:
Temperature: 20 °C Humidity: 48 % RH Atmospheric Pressure: 1010 mbar
Test mode a:TX mode_Make EUT continuously emit radar signals

7.5.2 Test Setup Diagram



7.5.3 Measurement Data

Please Refer to Appendix for Details



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8 Test Setup Photo

Refer to Appendix - Test Setup Photo for KSCR2403000434AU

9 EUT Constructional Details (EUT Photos)

Refer to Appendix - Photographs of EUT Constructional Details for KSCR2403000434AU

10 Appendix

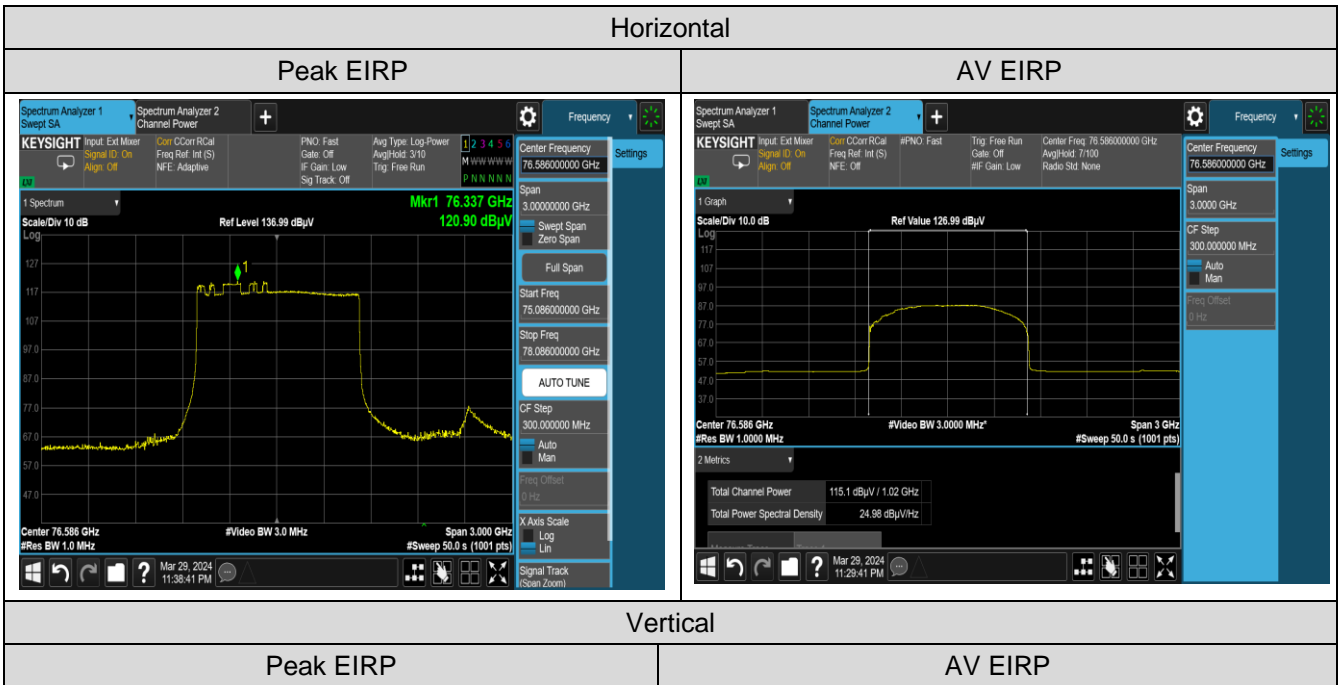
10.1 Quivalent Isotropically Radiated Power (EIRP)

Frequency (GHz)	Distance (m)	Polarity	dBuV/m @ 3m	E.I.R.P. Power (dBm)	E.I.R.P. Limit (dBm)	Result	Remark
76.586	3	Horizontal	120.90	25.67	55.0	Pass	Peak
	3	Horizontal	115.10	19.87	50.0	Pass	AVG
	3	Vertical	102.33	7.10	55.0	Pass	Peak
	3	Vertical	96.82	1.59	50.0	Pass	AVG

Remark:

$E[\text{dB}\mu\text{V}/\text{m}] = \text{EIRP}[\text{dBm}] - 20 \log(d[\text{meters}]) + 104.77$, where E = field strength and d = distance at which field strength limit is specified in the rules

$\text{EIRP}[\text{dBm}] = E[\text{dB}\mu\text{V}/\text{m}] + 20 \log(d[\text{meters}]) - 104.77$

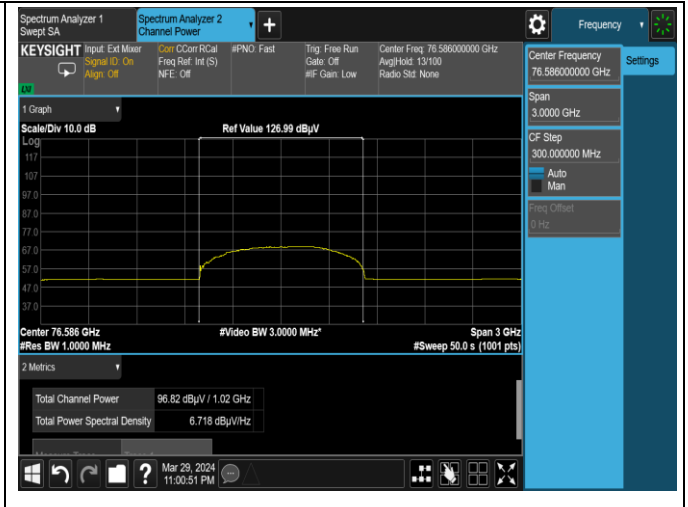
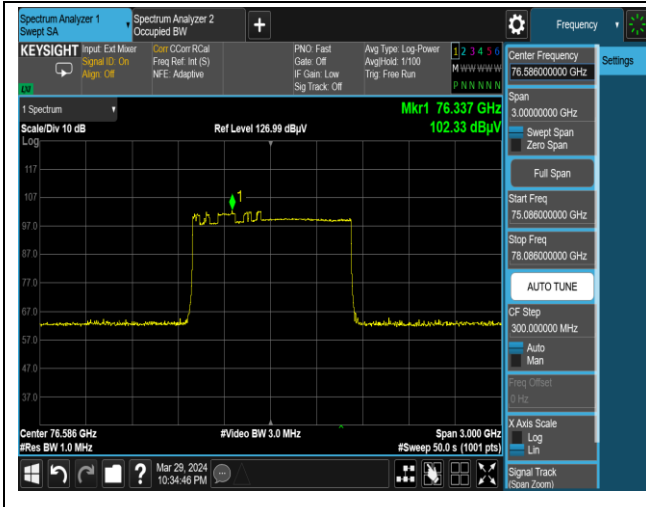


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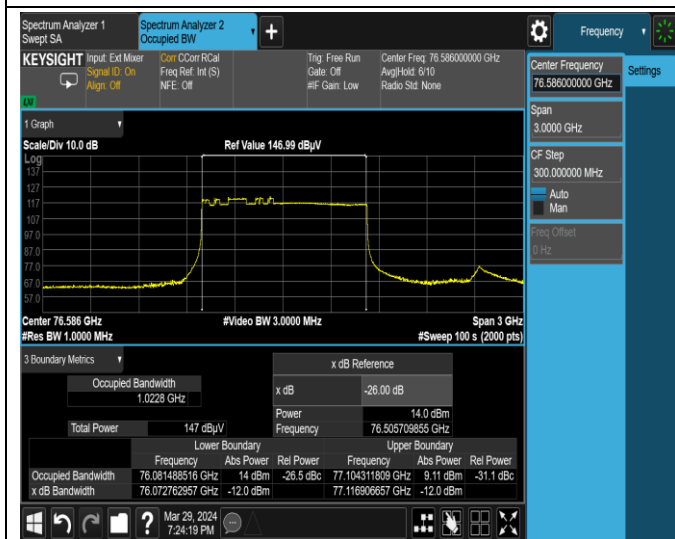
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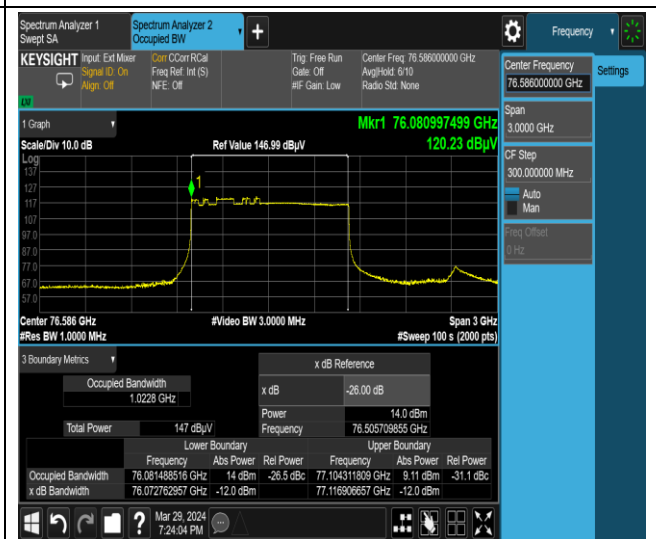
10.2 Occupied Bandwidth

99% Bandwidth (GHz)	Lowest Frequency (GHz)	Highest Frequency (GHz)	Limit	Result
1.0228	76.080997499	77.108000000	76-81GHz	Pass

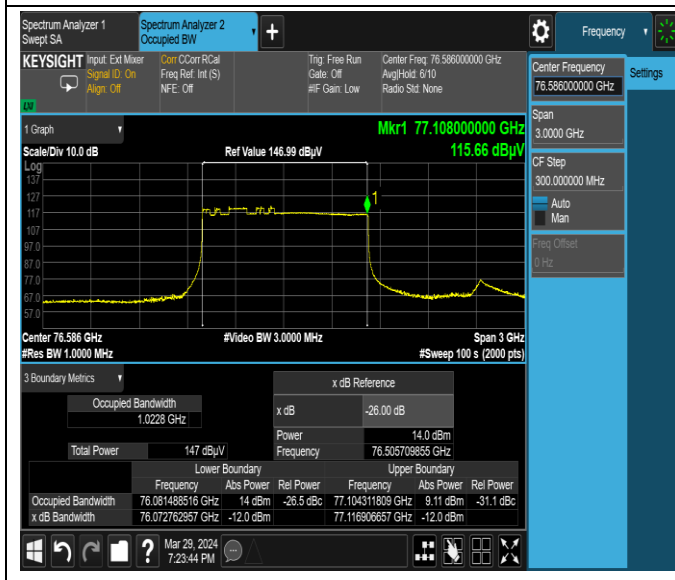
99%OBW



99%OBW-Left



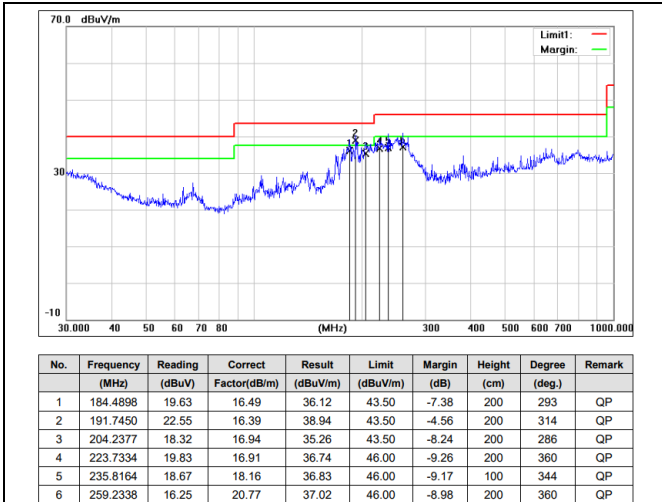
99%OBW-Right



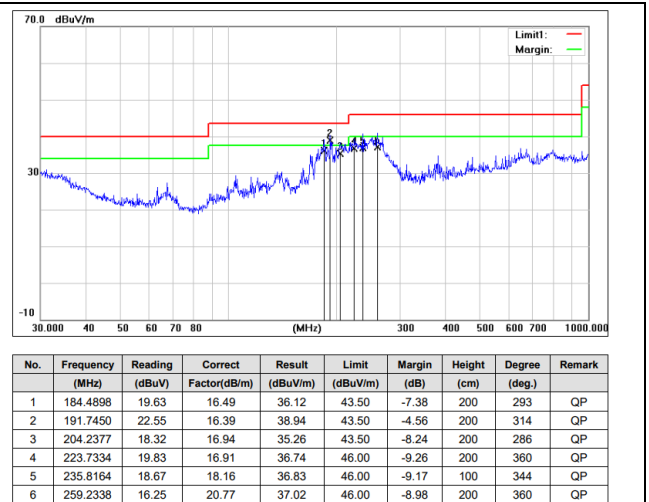
20dB OBW



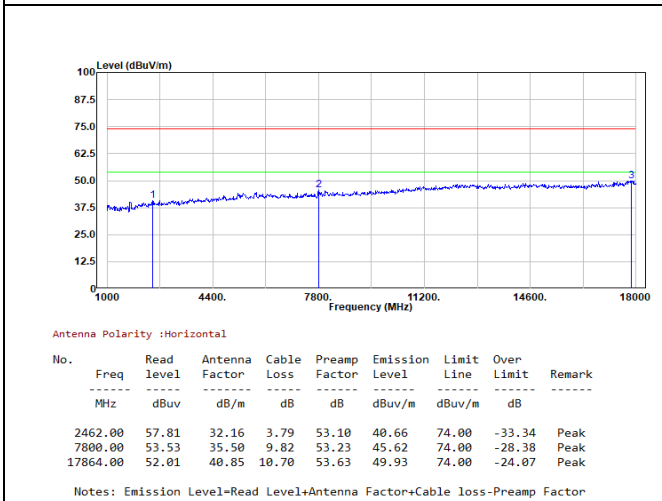
10.3 Unwanted Emissions



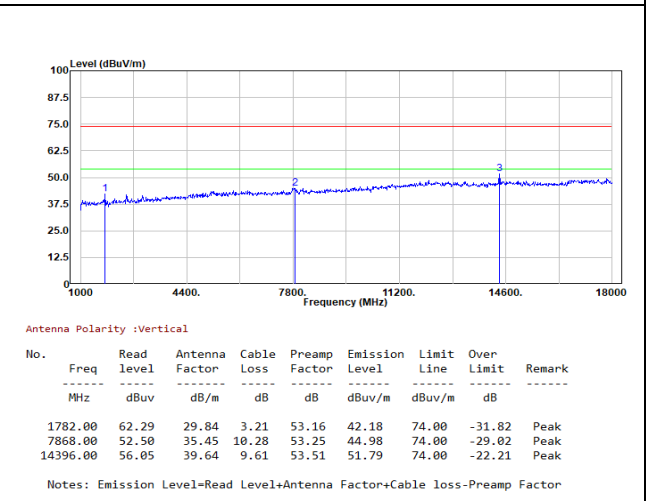
30MHz-1GHz-Horizontal



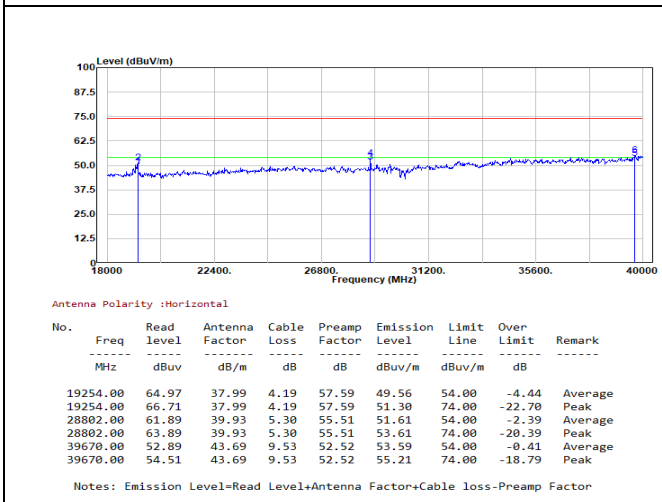
30MHz-1GHz-Vertical



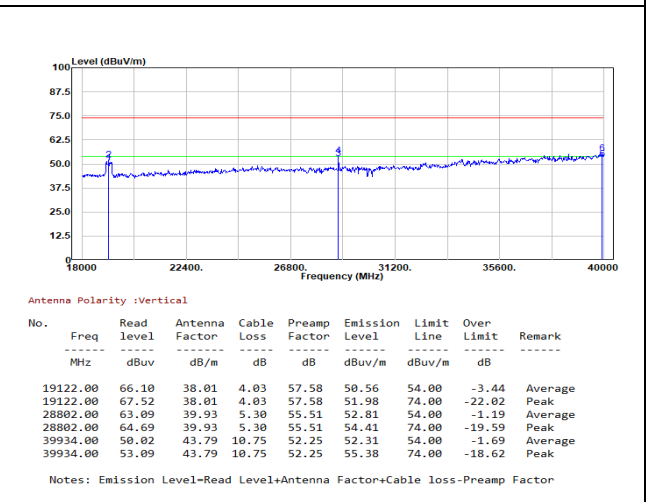
1GHz-18GHz-Horizontal



1GHz-18GHz-Vertical



18GHz-40GHz-Horizontal



18GHz-40GHz-Vertical

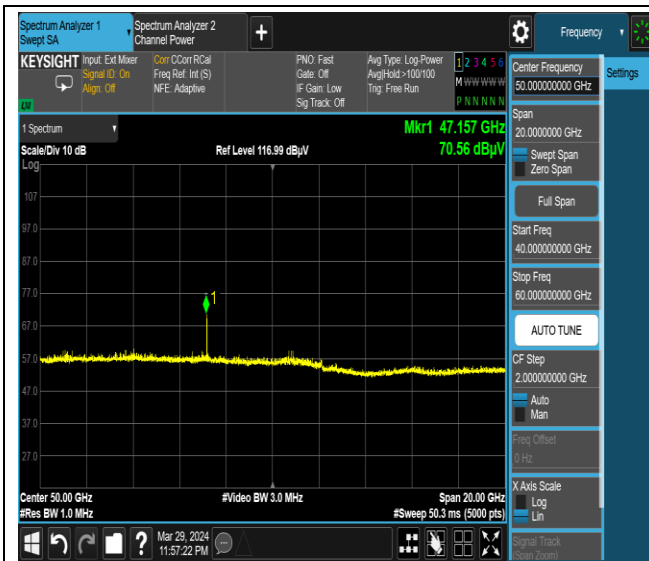
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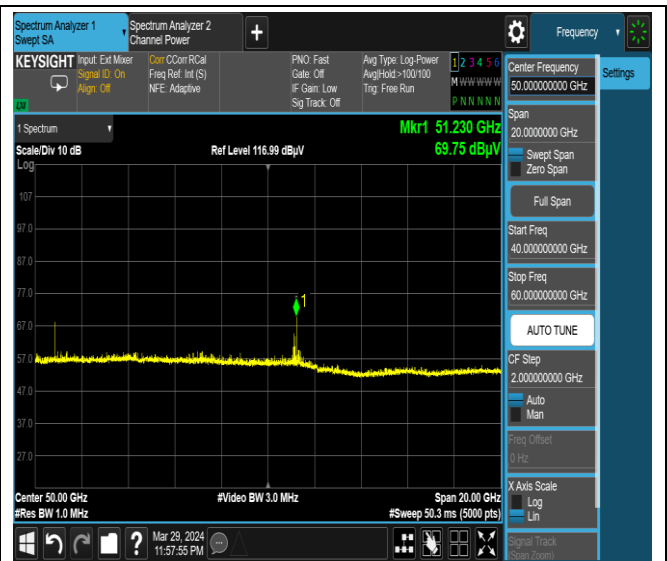
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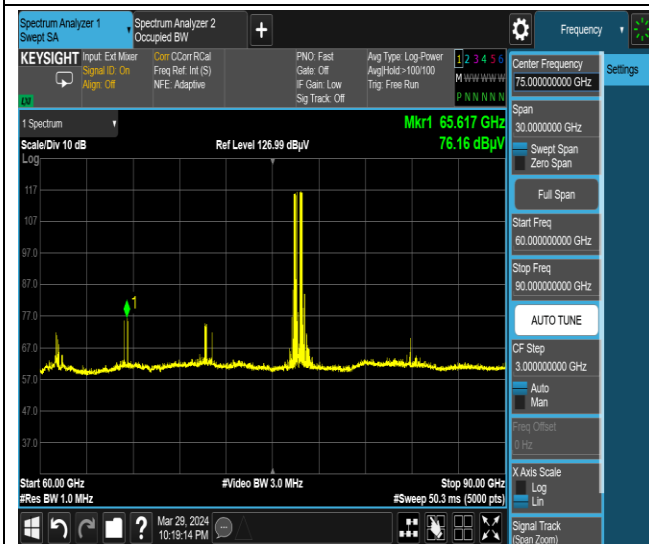
Frequency Range (GHz)	Frequency (GHz)	Distance (M)	Peak Value (dBuV/m)	FCC AV Limit (dBuV/m)	Polarization	Result
40-60	47.157	3	70.56	93.54	Horizontal	PASS
	51.230	3	69.75	93.54	Vertical	PASS
60-90	65.617	3	76.16	93.54	Horizontal	PASS
	70.292	3	64.58	93.54	Vertical	PASS



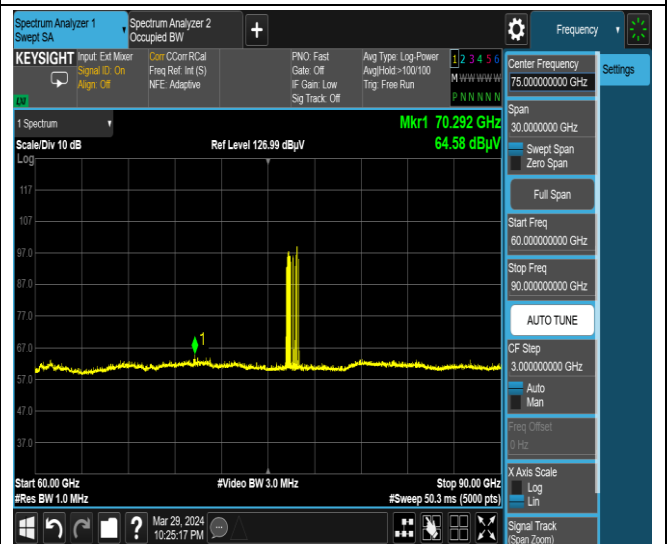
40GHz-60GHz-Horizontal



40GHz-60GHz-Vertical



60GHz-90GHz-Horizontal



60GHz-90GHz-Vertical



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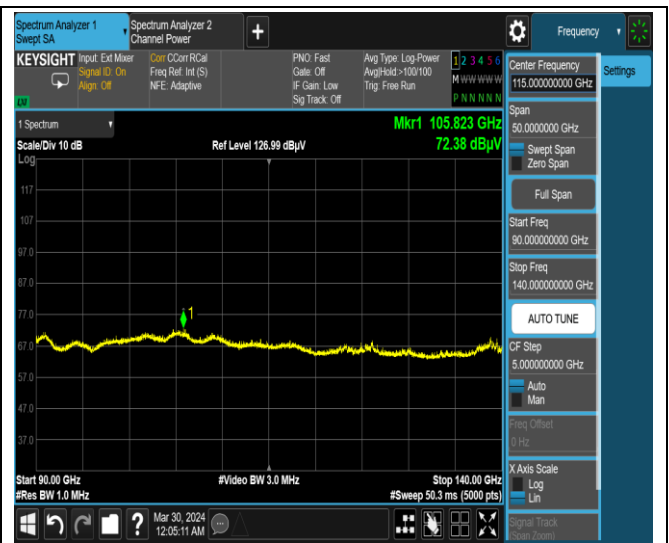
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Frequency Range (GHz)	Frequency (GHz)	Distance (M)	Peak Value (dBuV/m)	FCC AV Limit (dBuV/m)	Polarization	Result
90-140	139.630	3	78.28	93.54	Horizontal	PASS
	105.823	3	72.38	93.54	Vertical	PASS
140-220	187.786	3	82.38	93.54	Horizontal	PASS
	187.097	3	82.40	93.54	Vertical	PASS



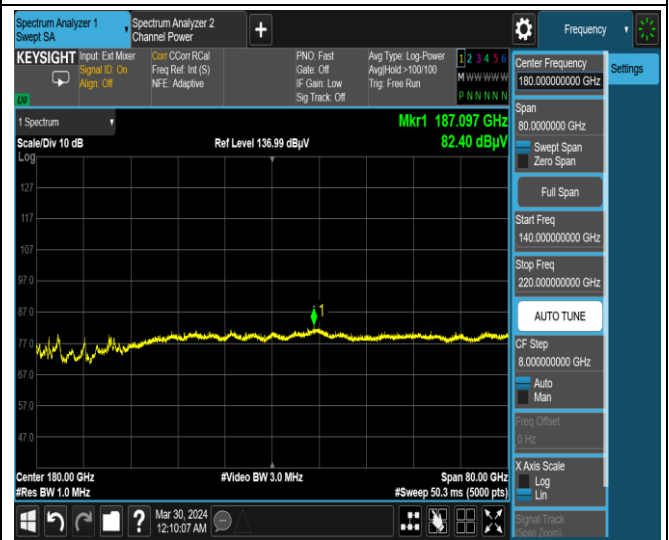
90GHz-140GHz-Horizontal



90GHz-140GHz-Vertical



140GHz-220GHz-Horizontal



140GHz-220GHz-Vertical

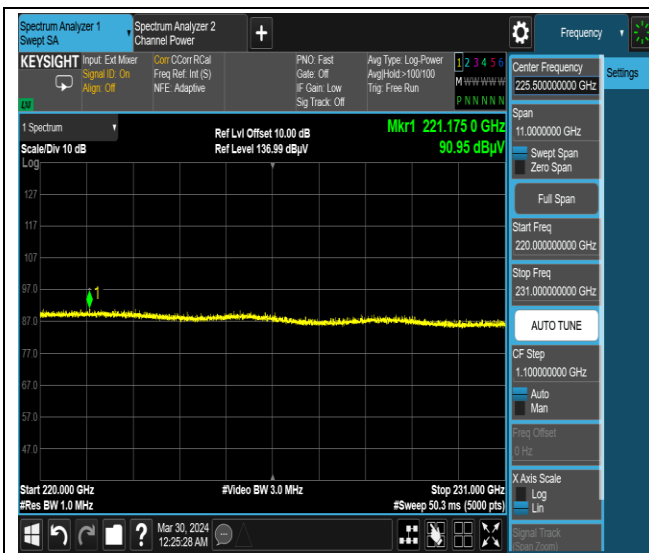
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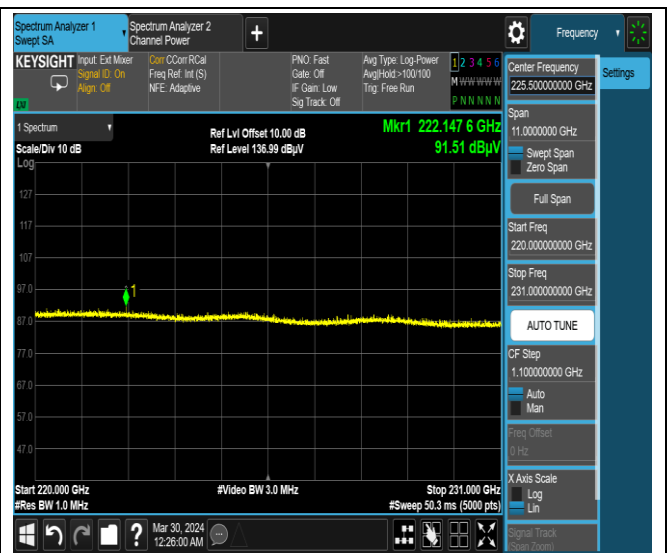
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Frequency Range (GHz)	Frequency (GHz)	Distance (M)	Peak Value (dBuV/m)	FCC AV Limit (dBuV/m)	Polarization	Result
220-230	221.175	3	90.95	95.76	Horizontal	PASS
	222.147	3	91.51	95.76	Vertical	PASS



220GHz-230GHz-Horizontal



220GHz-230GHz-Vertical

10.4 Frequency Stability

Voltage (%)	Power (VDC)	Temp (°C)	FL (GHz)	FH (GHz)	Limit (GHz)	Result
100%	12V	-30	76.080997	77.108000	76-81GHz	Pass
		-20	76.080999	77.108001	76-81GHz	Pass
		-10	76.080999	77.108005	76-81GHz	Pass
		0	76.080995	77.108003	76-81GHz	Pass
		+10	76.080996	77.108007	76-81GHz	Pass
		+20	76.080998	77.108005	76-81GHz	Pass
		+30	76.080994	77.108006	76-81GHz	Pass
		+40	76.080997	77.108010	76-81GHz	Pass
		+50	76.080997	77.108009	76-81GHz	Pass
		+60	76.080994	77.108002	76-81GHz	Pass
115%	13.8V	+20	76.080999	77.108005	76-81GHz	Pass



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85%	10.2V	+20	76.080997	77.108007	76-81GHz	Pass
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- End of the Report -