中认信通
CHINA CERTIFICATION ICT CO., LTD (DONGGUAN)

ACCREDITED
TESTING LABORATORY
CERTIFICATE # 6356.01

TEST REPORT

Applicant: **Beijing Jingwei Hirain Technologies Co., Inc**

Address: 4/F, building 1,14 Jiuxianqiao Road, Chaoyang District, Beijing, P.R.China ,100015

FCC ID: **2A7MKMRR510**

Product Name: **Millimeter Wave Radar**

Model Number: **MRR510**

Standard(s): **47 CFR Part 95, Subpart M**
ANSI C63.26-2015
KDB 653005 D01 76-81 GHz Radars v01r02

The above equipment has been tested and found compliant with the requirement of the relative standards by China Certification ICT Co., Ltd (Dongguan)

Report Number: **CR22050022-00**

Date Of Issue: **2022-07-11**

Reviewed By: **Sun Zhong** Sun Zhong

Title: Manager

Test Laboratory: **China Certification ICT Co., Ltd (Dongguan)**
No. 113, Pingkang Road, Dalang Town, Dongguan,
Guangdong, China
Tel: +86-769-82016888

Test Facility

The Test site used by China Certification ICT Co., Ltd (Dongguan) to collect test data is located on the No. 113, Pingkang Road, Dalang 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. : 442868, the FCC Designation No. : CN1314.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0123.

Declarations

China Certification ICT Co., Ltd (Dongguan) is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol "▲". Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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CONTENTS

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

1.1.1 General:

EUT Name:	Millimeter Wave Radar
EUT Model:	MRR510
Operation Frequency:	76.5GHz
Maximum Average Output Power (Radiated):	44.24 dBm
Modulation Type:	FMCW
Sweep Period:	50ms
Sweep Bandwidth▲:	840MHz(76.06-76.9GHz)
Chirp Time▲:	50μs
Antenna Number:	3TX4RX
Rated Input Voltage:	DC 12V
Serial Number:	CR22050022-RF-S1
EUT Received Date:	2022.05.19
EUT Received Status:	Good

1.1.2 Antenna Information Detail▲:

Antenna Manufacturer	Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range
Beijing Jingwei Hirain Technologies Co., Inc	Microstrip Array	Unknow	17.5dBi/76~77GHz

1.1.3 Accessory Information:

No.

1.2 Description of Test Configuration

1.2.1 EUT Operation Condition:

EUT Operation Mode:	The system was configured for testing in Engineering Mode, which was provided by the manufacturer.
Equipment Modifications:	No
EUT Exercise Software:	No
Engineering Mode was provided by manufacturer▲. The maximum power was configured default setting.	

1.2.2 Support Equipment List and Details

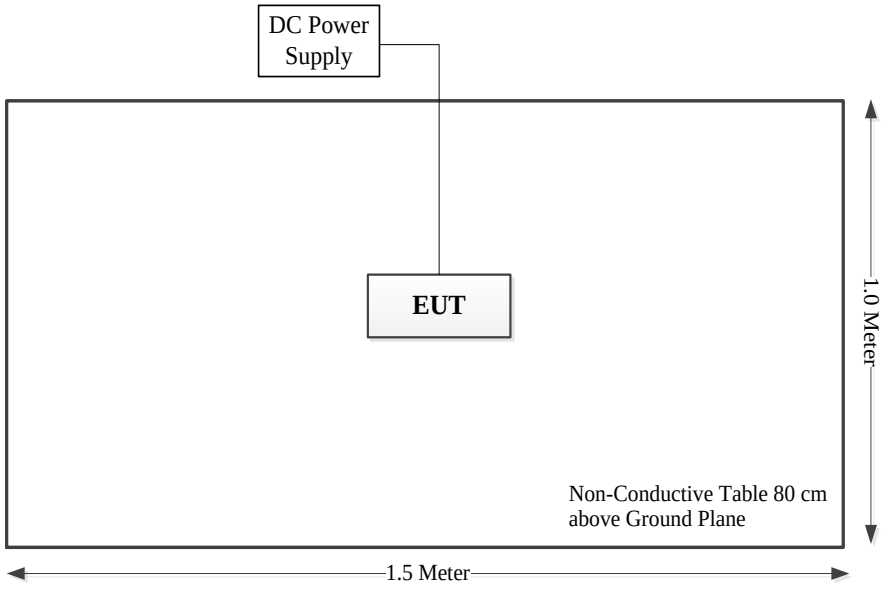
Manufacturer	Description	Model	Serial Number
ZHAOXIN	DC Power Supply	RXN-6010D	21R6010D0912386

1.2.3 Support Cable List and Details

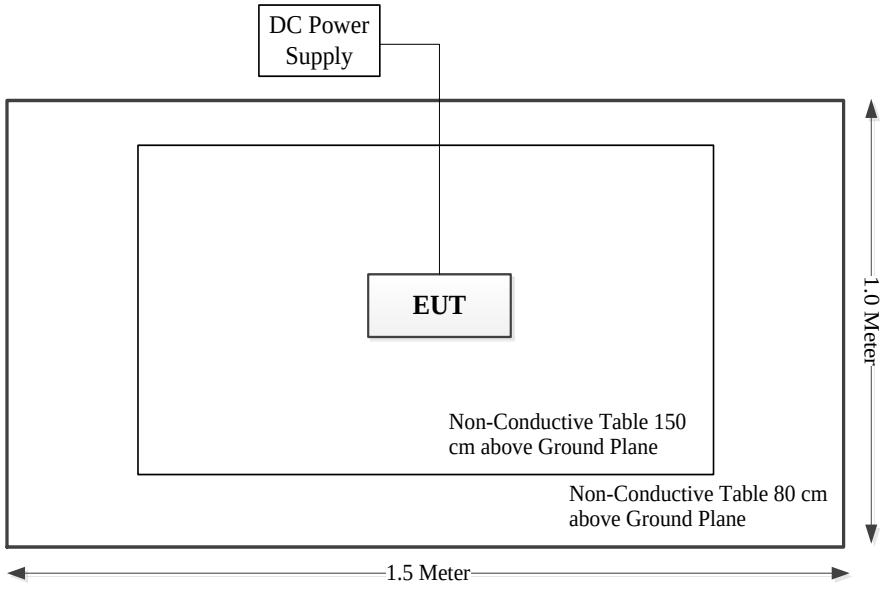
Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
Power Cable	No	No	2	EUT	DC Power Supply

1.2.4 Block Diagram of Test Setup

Unwanted Emissions:
Below 1GHz:



Above 1GHz:



1.3 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 %
Radiated Emissions	9kHz~30MHz: 4.12dB 30M~200MHz: 4.15 dB,200M~1GHz: 5.61 dB,1G~6GHz: 5.14 dB, 6G~18GHz: 5.93 dB,18G~26.5G: 5.47 dB, 26.5G~40G:5.63 dB, 40~60G: 4.83dB, 60G~90G: 4.94dB, 90G-140G: 5.46dB, 140G-220G: 6.00dB, 220G-325G: 7.35dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
AC Power Lines Conducted Emission	2.8 dB (150 kHz to 30 MHz)

2. SUMMARY OF TEST RESULTS

Standard(s) Section	Test Items	Result
FCC §2.1046, §95.3367	Radiated Power	Compliant
FCC §2.1053, §95.3379	Unwanted Emissions	Compliant
FCC §2.1055(d), §95.3379	Frequency Stability	Compliant
FCC §2.1049	Occupied Bandwidth	Compliant
FCC §1.1310, §2.1091, §95.3385	Maximum Permissible Exposure (MPE)	Compliant

3. REQUIREMENTS AND TEST PROCEDURES

3.1 Radiated Power

3.1.1 Applicable Standard

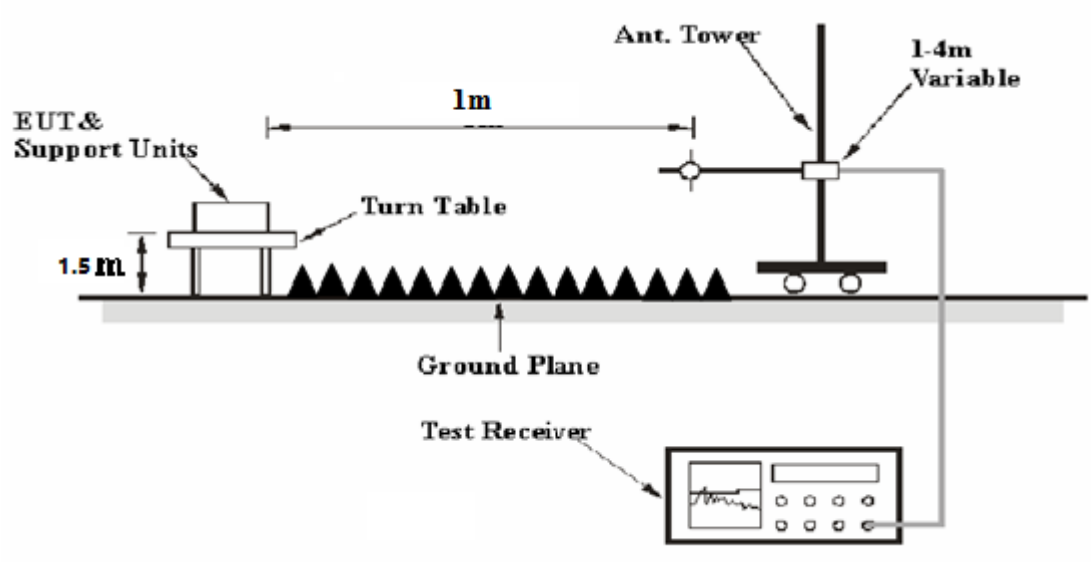
FCC §2.1046, §95.3367;

The fundamental radiated emission limits within the 76-81 GHz band are expressed in terms of Equivalent Isotropically Radiated Power (EIRP) and are as follows:

(a) The maximum power (EIRP) within the 76-81 GHz band shall not exceed 50 dBm based on measurements employing a power averaging detector with a 1 MHz Resolution Bandwidth (RBW).

(b) The maximum peak power (EIRP) within the 76-81 GHz band shall not exceed 55 dBm based on measurements employing a peak detector with a 1 MHz RBW.

3.2.2 EUT Setup



3.2.3 Test Procedure

Refer to ANSI C63.26-2015 Clause 5.2.7

Connect the test antenna for the fundamental frequency band to a spectrum analyzer via an external mixer.

Set spectrum analyzer RBW, VBW, detector, span, and so on, to the proper values.

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

Calculate the EIRP from the measured field strength using equation as follows:

EIRP (dBm) = E (dBμV/m) + 20log(D) − 104.8

EIRP is the equivalent isotropically radiated power
E is the field strength of the emission at the measurement distance
D is the measurement distance

3.2 Unwanted Emissions

3.2.1 Applicable Standard

FCC §2.1053 and §95.3379;

(a) 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 (microvolts/meter)	Measurement distance (meters)
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) In the emissions table in paragraph (a)(1) of this section, the tighter limit applies at the band edges.

(ii) The limits in the table in paragraph (a)(1) of this section 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 in paragraph (a)(1) of this section 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 RBW:

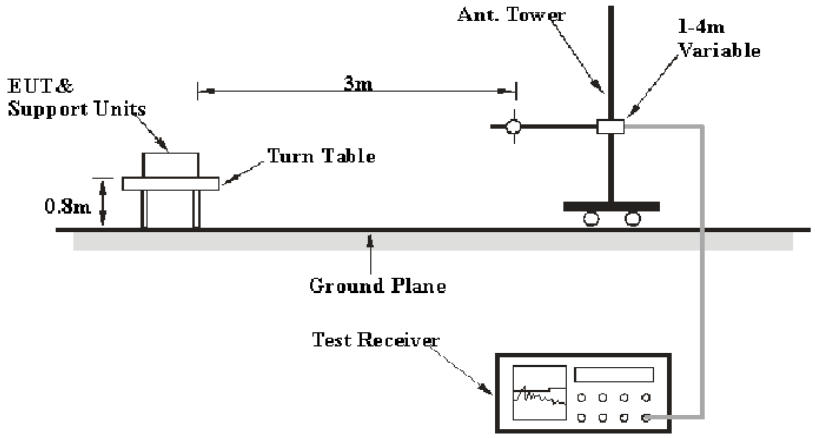
(i) For radiated emissions outside the 76-81 GHz band between 40 GHz and 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 600 pW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For radiated emissions above 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 1000 pW/cm2 at a distance of 3 meters from the exterior surface of the radiating structure.

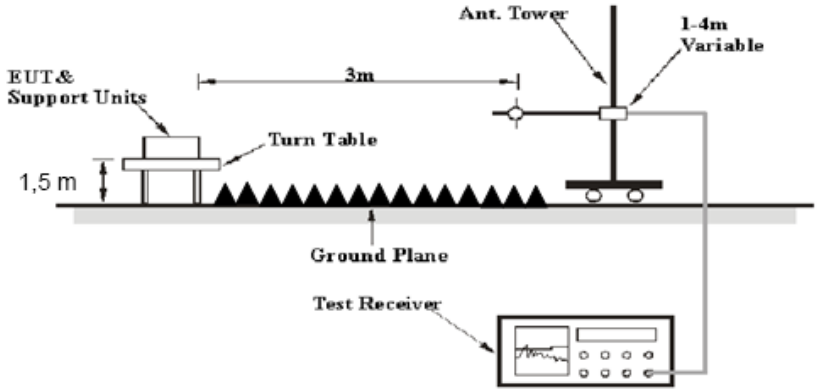
(3) For field disturbance sensors and radar systems operating in the 76-81 GHz band, the spectrum shall be investigated up to 231.0 GHz.

3.2.2 EUT Setup

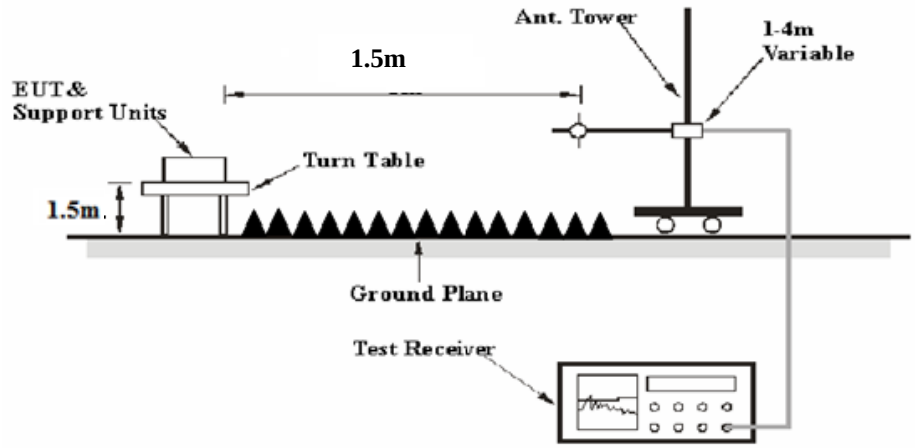
Below 1GHz:



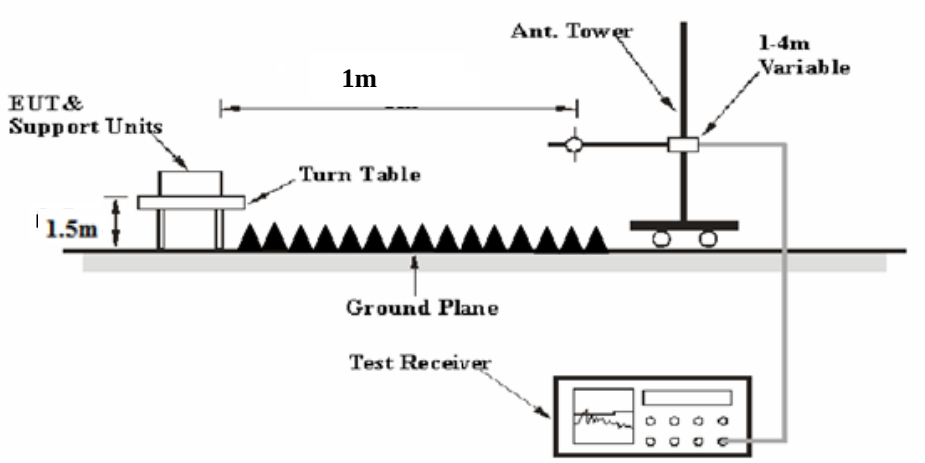
1-26.5 GHz:



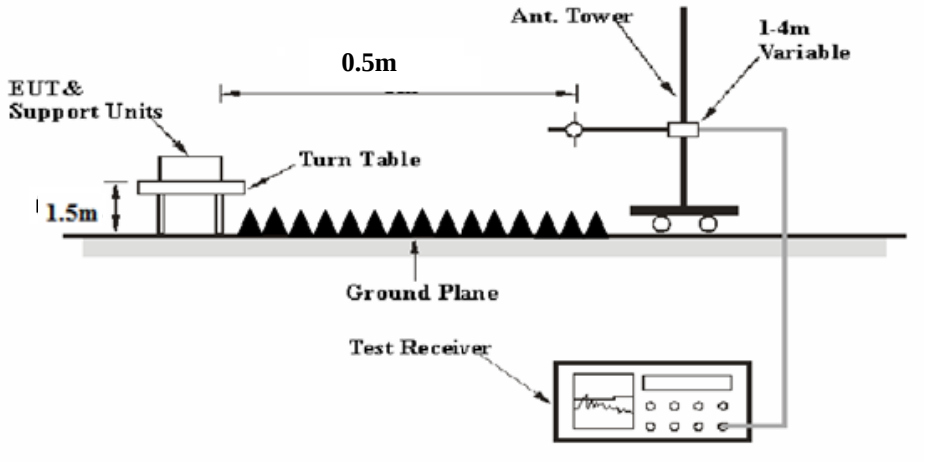
26.5-40 GHz:



40-90 GHz:



90-231 GHz:



The radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.26-2015. The specification used was the FCC 95.3379 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

3.2.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 231 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Measurement
9 kHz – 150 kHz	200 Hz	1 kHz	200 Hz	QP/Average
150 kHz – 30 MHz	9 kHz	30 kHz	9 kHz	QP/Average
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
1-40 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Average
Above 40 GHz	1MHz	3 MHz	/	Average

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

3.2.4 Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

According to C63.26, the 26.5- 40GHz test result shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade from 3m to 1.5m

For 26.5-40GHz
Distance extrapolation factor =20 log (specific distance [3m]/test distance [1.5m]) dB=6.02dB

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 C63.26-2015:

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

Where:

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

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

The minimum test distance for the frequency range 40GHz-231GHz determine as below:

Model	Frequency Range (GHz)	Largest Dimension of the Horn Antenna (mm)	Minimum Test Distance R_m (m)
M19RH	40-60	46.3	0.57
M12RH	60-90	30.02	0.36
M08RH	90-140	19.7	0.23
M05RH	140-220	12.5	0.15
M03RH	220-325	8.36	0.10

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

3.2.5 Corrected Amplitude & Margin Calculation

The basic equation is as follows:

Factor = Antenna Factor + Cable Loss- Amplifier Gain

For 30MHz-26.5GHz:
Result = Reading + Factor

For 26.5GHz-40GHz
Result = Reading + Factor-Distance extrapolation Factor

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

3.3 Frequency Stability:

3.3.1 Applicable Standard

FCC §95.3379 (b)

(b) 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.

3.3.3 Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external power supply and the RF output was connected to Test equipment via feed-through attenuators. The EUT was placed inside the temperature chamber. The power leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the Frequency Counter.

Frequency Stability vs. Voltage:

1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

The output frequency was recorded for each voltage.

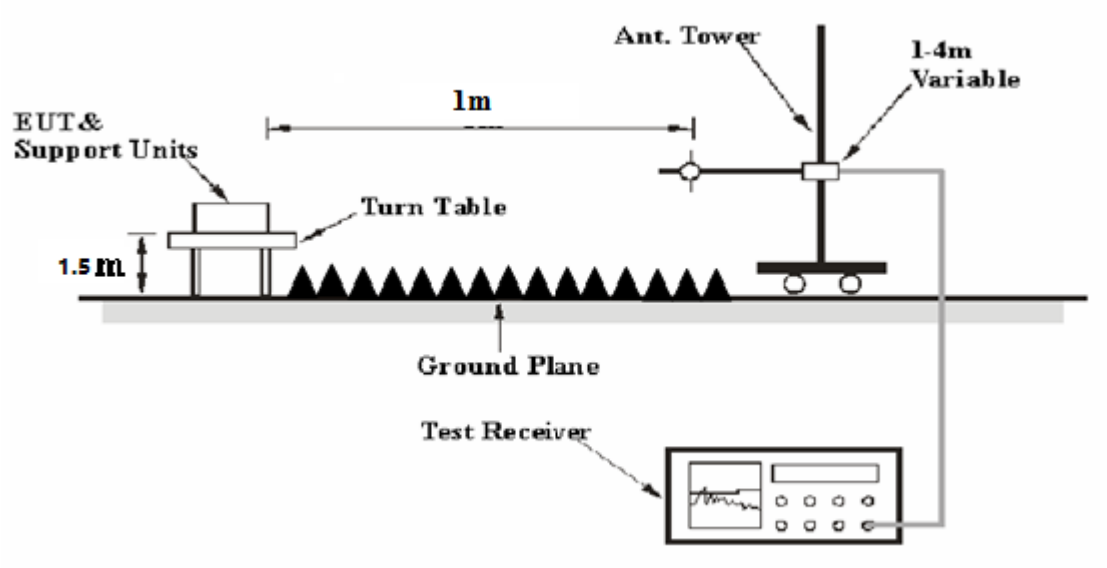
3.4 Occupied Bandwidth:

3.4.1 Applicable Standard

FCC §2.1049

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

3.4.2 EUT Setup



3.4.3Test Procedure

The following procedure shall be used for measuring (99%) power bandwidth:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of 1.5 × OBW is sufficient).

b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.

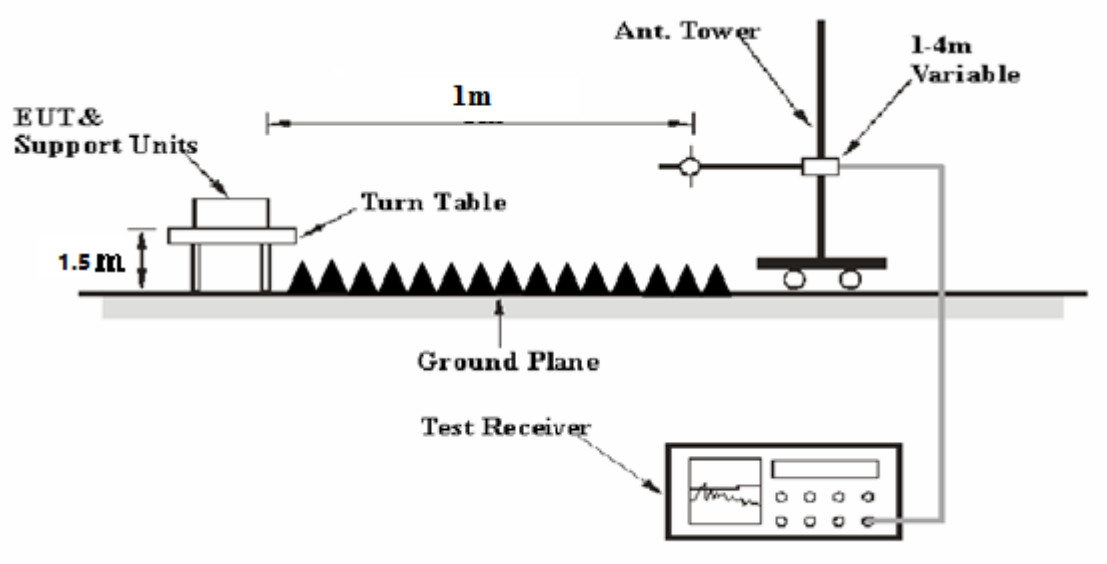
NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.

e) 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).

3.5 Duty Cycle:

3.5.1 EUT Setup



3.5.2 Test Procedure

According to ANSI C63.26-2015 Section 5.2.4.3.4

An oscilloscope with a diode detector that combined have sufficiently short response time to permit accurate measurements of the on and off times. A fundamental condition for all average power compliance measurements are that they be performed with the EUT transmitting continuously (duty cycle ⩾ 98%) at maximum output power level. However, in those cases where this condition cannot be realized, then one of the alternative procedures must be selected based on whether the EUT transmitter exhibits a constant or a non-constant duty cycle. The measurement of transmitter duty cycle shall be performed using one of the following techniques:
a) Off times of the transmitted signal.
b) The zero-span mode on a spectrum analyzer if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

4. Test DATA AND RESULTS

4.1 Radiated Power

Serial Number:	CR22050022-RF-S1	Test Date:	2022.6.17
Test Site:	966-1	Test Mode:	Transmitting
Tester:	Mack Huang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	24.1	Relative Humidity: (%)	62	ATM Pressure: (kPa)	100.2

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
OML	Harmonic Mixer	WR12/M12HWD	E60119-1	2020-10-17	2023-10-16
OML	Horn Antenna	M12RH	E60119-2	2020-10-18	2023-10-17
R&S	Spectrum Analyzer	FSV40	101943	2021-10-10	2022-10-09

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Frequency (GHz)	Receiver		Polar (H/V)	Factor (dB/m)	EIRP (dBm)
	Reading (dBμV)	Detector			
76.50	101.09	PK	H	43.44	39.73
76.50	105.60	AV	H	43.44	44.24

Factor = Antenna Factor
EIRP = Reading + Factor + 20log(Measurement distance) - 104.8
Measurement distance = 1m

Detector	EIRP (dBm)	Chirps Correction Factor (dB)	Result (dBm)	Limit (dBm)	Margin (dBm)
Peak	39.73	8.74	48.47	55	6.53
Average	44.24	/	44.24	50	5.66

Result = EIRP + Chirps Correction Factor
Refer to Application Note 1EF107-1E Rohde &Schwarz Peak and Mean Power measurements on wideband FMCW radar signals.The chirps correction factor was calculated using the formula:

$$CF_{chirp} = 5 * \log\left(1 + K * \left(\frac{Span}{t * RBW^2}\right)^2\right)$$

K = a correction factor for the settling process of the gaussian shaped filter (0.1947)
t = the length of the chirp
$CF_{chirp} = 5 * log(1 + 0.1947 * (840/(50*1^2))^2 = 8.74dB$

4.2 Radiation Spurious Emissions

Serial Number:	CR22050022-RF-S1	Test Date:	2022-06-16~2022.7.7
Test Site:	966-1, 966-2	Test Mode:	Transmitting
Tester:	Gary Ling, Mack Huang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	24.1~25.9	Relative Humidity: (%)	50~62	ATM Pressure: (kPa)	100.2~100.3

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
ETS-Lindgren	Horn Antenna	3115	9912-5985	2020-10-13	2023-10-12
R&S	Spectrum Analyzer	FSV40	101591	2021-07-22	2022-07-21
MICRO-COAX	Coaxial Cable	UFA210A-1-1200-70U300	217423-008	2021-08-08	2022-08-07
MICRO-COAX	Coaxial Cable	UFA210A-1-2362-300300	235780-001	2021-08-08	2022-08-07
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2021-11-10	2022-11-09
Audix	Test Software	E3	201021 (V9)	N/A	N/A
PASTERNACK	Horn Antenna	PE9852/2F-20	112002	2021-02-05	2024-02-04
AH	Preamplifier	PAM-1840VH	190	2021-11-19	2022-11-18
MICRO-COAX	Coaxial Cable	UFB142A-1-2362-200200	235772-001	2021-08-08	2022-08-07
PASTERNACK	Horn Antenna	PE9850/2F-20	072001	2021-02-05	2024-02-04
OML	Harmonic Mixer	WR19/M19HWD	U60314-1	2020-10-16	2023-10-15
OML	Horn Antenna	M19RH	11648-03	2020-10-16	2023-10-15
OML	Harmonic Mixer	WR12/M12HWD	E60119-1	2020-10-17	2023-10-16
OML	Horn Antenna	M12RH	E60119-2	2020-10-18	2023-10-17
OML	Harmonic Mixer	WR08/M08HWD	F60315-1	2020-10-22	2023-10-21
OML	Horn Antenna	M08RH	F60315-2	2020-10-24	2023-10-23
OML	Harmonic Mixer	WR05/M05HWD	G60107-1	2020-10-25	2023-10-24
OML	Horn Antenna	M05RH	G60107-2	2020-10-26	2023-10-25
OML	Harmonic Mixer	WR03/M03HWD	H60122-1	2020-11-10	2023-11-09
OML	Horn Antenna	M03RH	H60122-2	2020-11-06	2023-11-05
R&S	Spectrum Analyzer	FSV40	101943	2021-10-10	2022-10-09
TESEQ	HF Loop Antenna	HLA6120	33561	2021-02-03	2024-02-02
Sunol Sciences	Antenna	JB6	A082520-5	2020-10-19	2023-10-18
R&S	EMI Test Receiver	ESR3	102724	2021-07-22	2022-07-21
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0470-02	2021-07-18	2022-07-17

TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0780-01	2021-07-18	2022-07-17
Sonoma	Amplifier	310N	186165	2021-07-18	2022-07-17

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

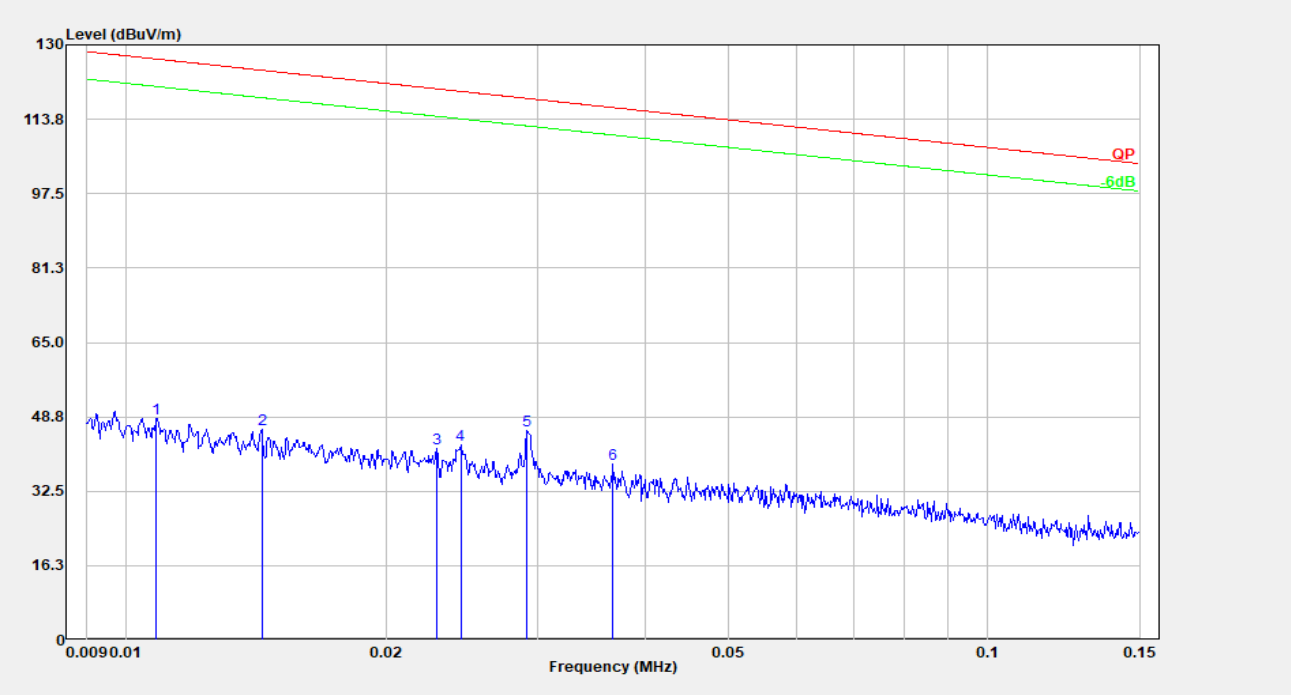
Test Data:

Please refer to the below table and plots.

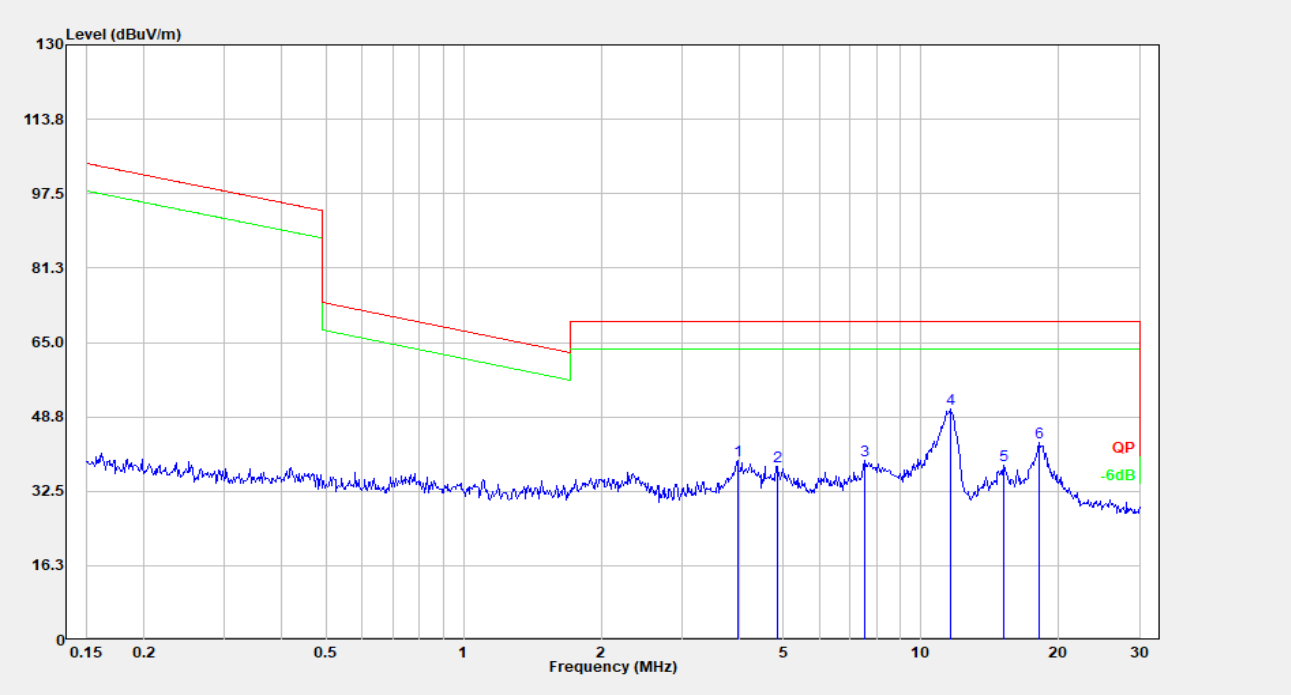
Note: The device can be mounted in multiple orientations, test was performed with X,Y, Z Axis, the worst orientation was photographed and it`s data was recorded.

1) 9kHz-30MHz

Parallel:

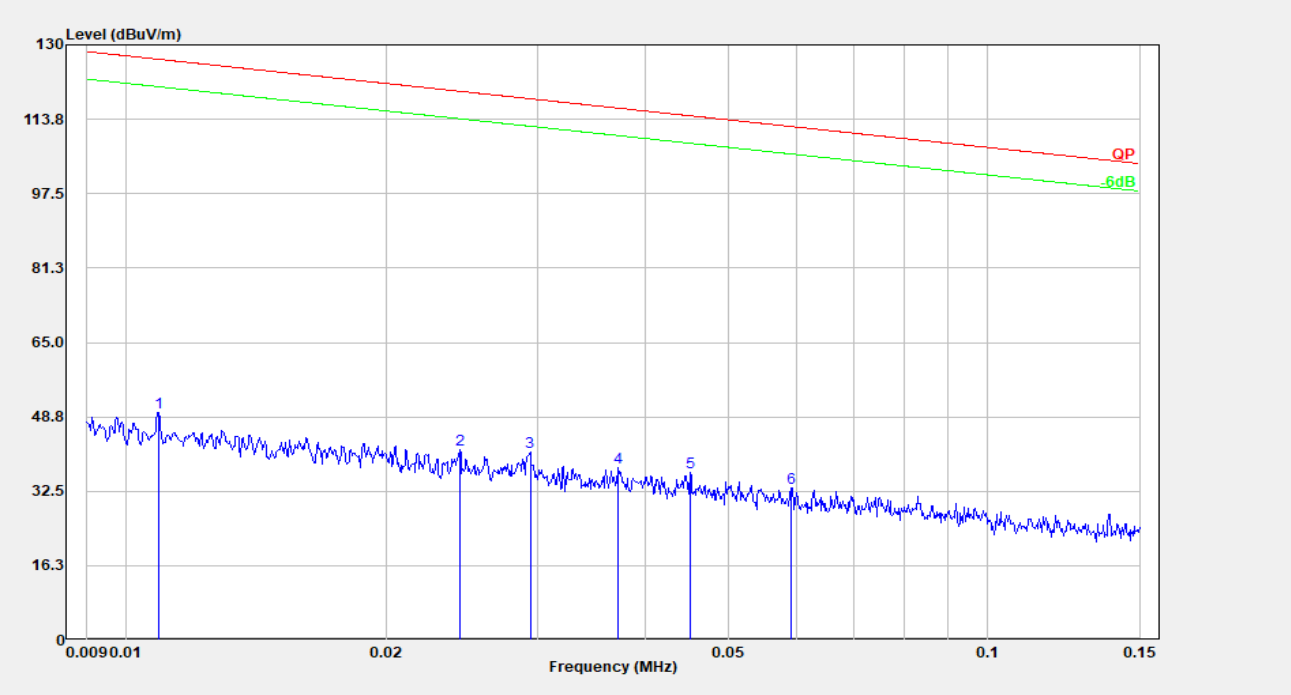


No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.011	28.01	20.51	48.52	126.91	78.39	Peak
2	0.014	25.47	20.51	45.98	124.46	78.49	Peak
3	0.023	21.42	20.45	41.87	120.41	78.54	Peak
4	0.024	22.12	20.42	42.54	119.84	77.31	Peak
5	0.029	25.45	20.41	45.86	118.31	72.44	Peak
6	0.037	17.94	20.41	38.35	116.30	77.96	Peak

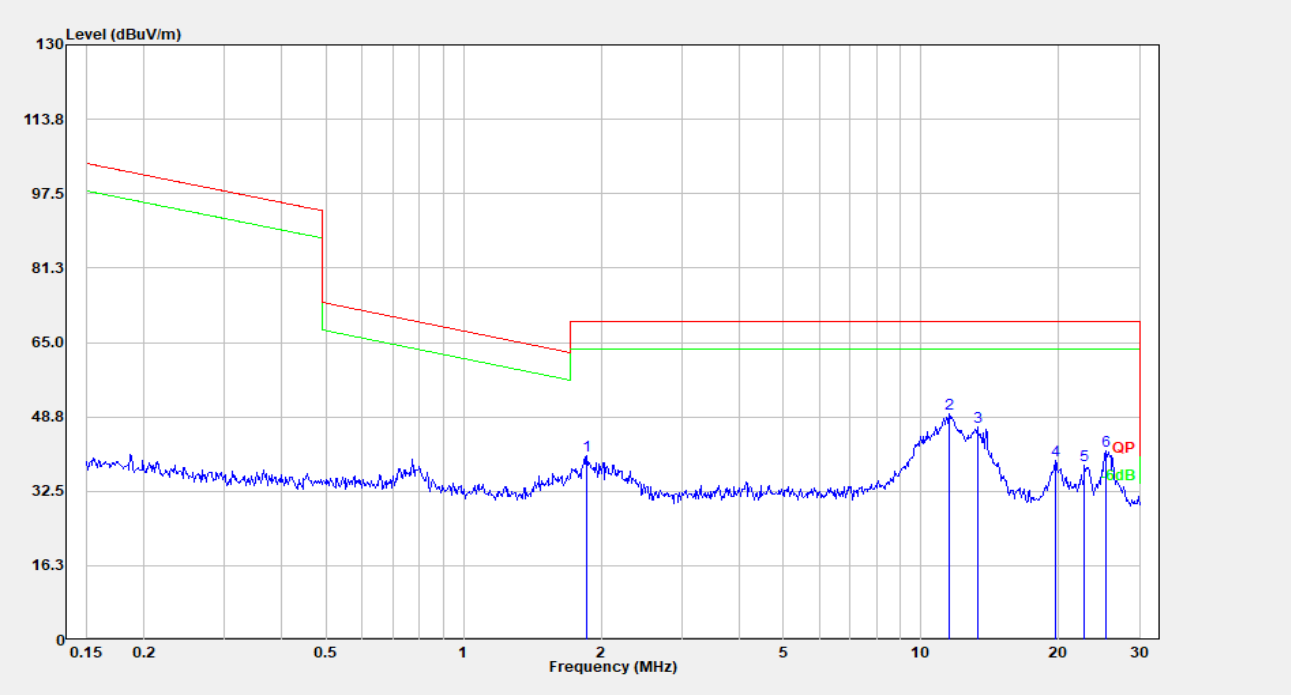


No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	3.964	19.14	20.00	39.14	69.54	30.40	Peak
2	4.848	17.79	20.03	37.81	69.54	31.73	Peak
3	7.526	19.13	20.10	39.23	69.54	30.31	Peak
4	11.559	30.14	20.34	50.48	69.54	19.06	Peak
5	15.146	17.74	20.42	38.16	69.54	31.38	Peak
6	18.135	22.81	20.42	43.23	69.54	26.31	Peak

Perpendicular:

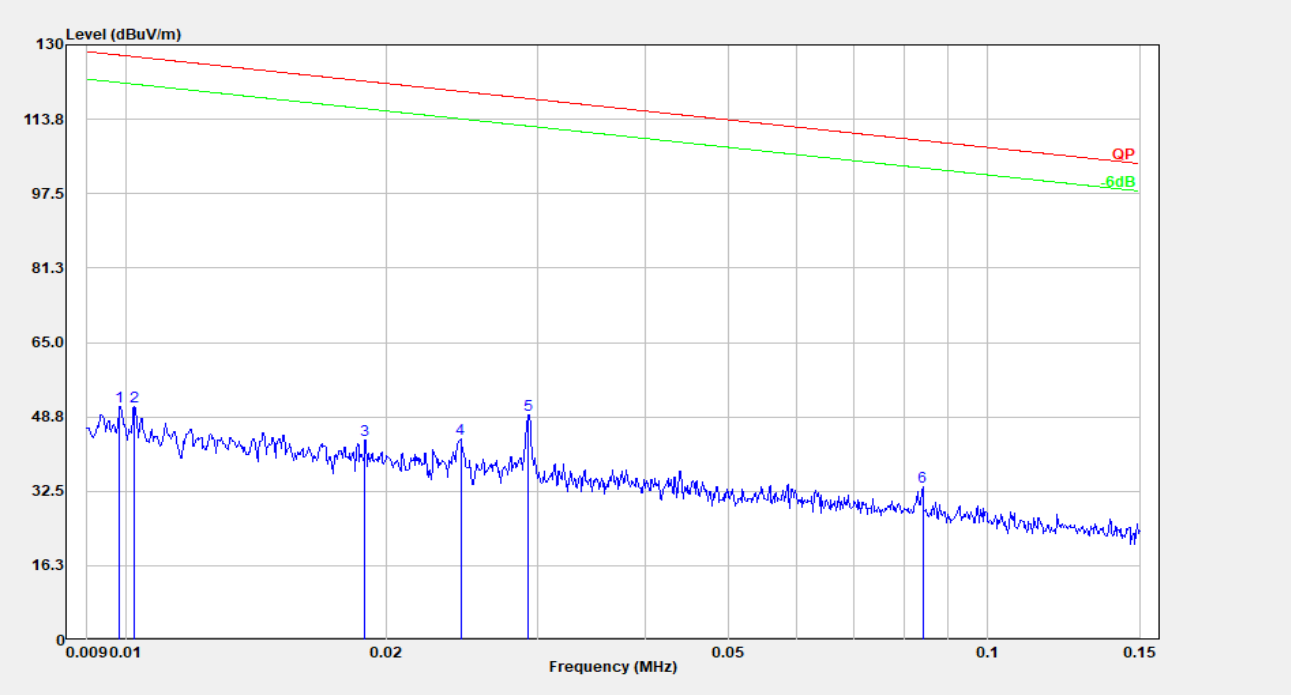


No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.011	29.27	20.51	49.78	126.86	77.08	Peak
2	0.024	21.15	20.42	41.57	119.87	78.30	Peak
3	0.029	20.76	20.41	41.17	118.23	77.06	Peak
4	0.037	17.30	20.41	37.71	116.20	78.49	Peak
5	0.045	16.17	20.41	36.58	114.52	77.94	Peak
6	0.059	12.92	20.41	33.33	112.17	78.85	Peak

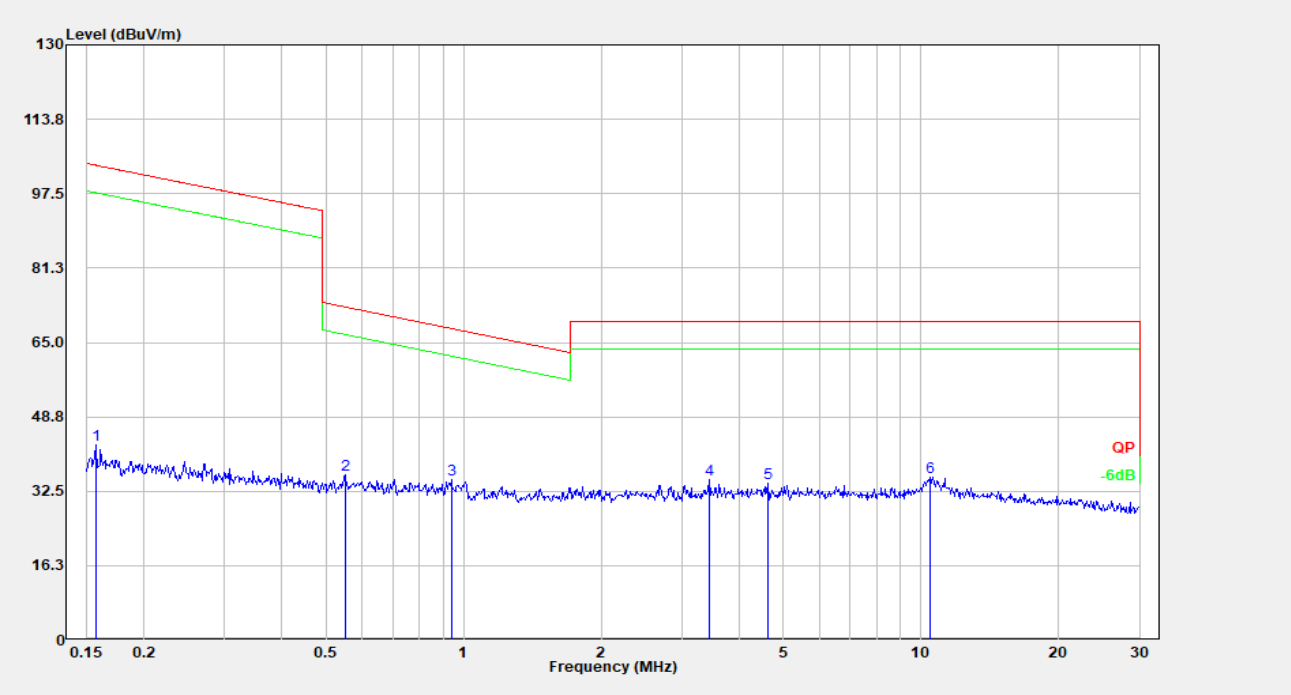


No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	1.858	20.26	19.96	40.21	69.54	29.33	Peak
2	11.498	29.03	20.33	49.36	69.54	20.18	Peak
3	13.267	26.16	20.38	46.54	69.54	23.00	Peak
4	19.635	18.79	20.42	39.21	69.54	30.33	Peak
5	22.775	17.85	20.31	38.16	69.54	31.38	Peak
6	25.321	21.14	20.21	41.35	69.54	28.19	Peak

Ground-Parallel:



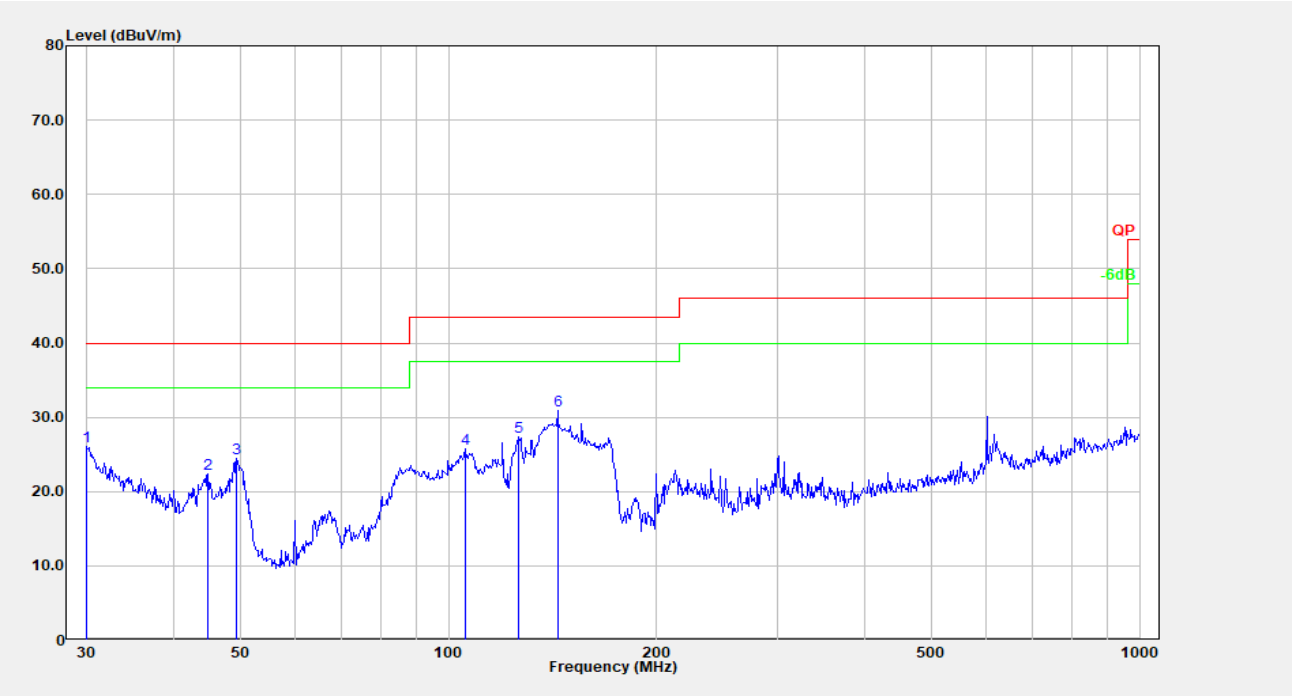
No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.010	30.39	20.51	50.90	127.76	76.86	Peak
2	0.010	30.55	20.51	51.06	127.42	76.36	Peak
3	0.019	23.08	20.51	43.59	122.07	78.48	Peak
4	0.024	23.39	20.42	43.81	119.84	76.03	Peak
5	0.029	28.78	20.41	49.19	118.28	69.09	Peak
6	0.084	13.13	20.33	33.46	109.12	75.66	Peak



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.156	22.35	20.22	42.57	103.71	61.14	Peak
2	0.549	16.00	20.02	36.02	72.79	36.76	Peak
3	0.938	14.93	20.03	34.96	68.04	33.08	Peak
4	3.436	15.03	19.99	35.02	69.54	34.52	Peak
5	4.622	14.14	20.02	34.16	69.54	35.38	Peak
6	10.452	15.38	20.31	35.69	69.54	33.85	Peak

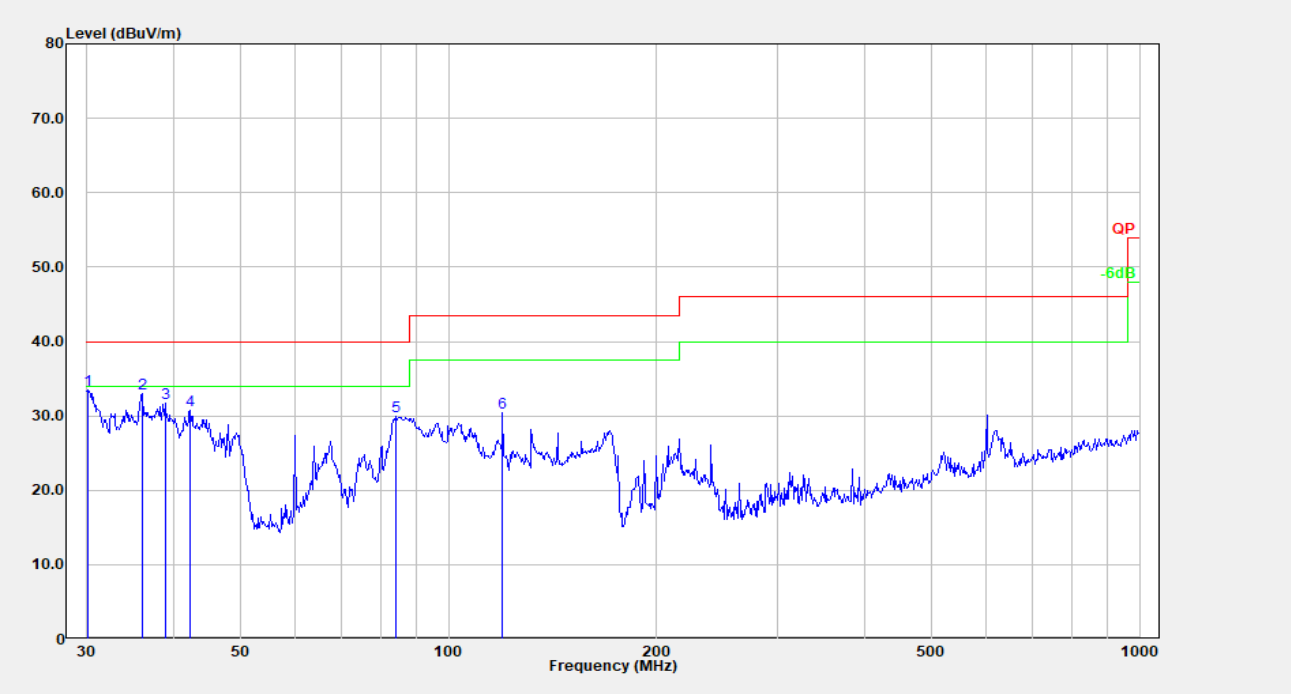
2) 30MHz-1GHz

Horizontal:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	30.000	29.79	-3.79	26.00	40.00	14.00	Peak
2	44.901	36.77	-14.39	22.38	40.00	17.62	Peak
3	49.359	41.45	-17.01	24.43	40.00	15.57	Peak
4	105.642	39.27	-13.49	25.78	43.50	17.72	Peak
5	126.329	38.91	-11.57	27.34	43.50	16.16	Peak
6	143.830	43.16	-12.20	30.96	43.50	12.54	Peak

Vertical:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	30.105	37.33	-3.87	33.46	40.00	6.54	Peak
2	36.001	41.38	-8.42	32.96	40.00	7.04	Peak
3	38.888	42.29	-10.63	31.66	40.00	8.34	Peak
4	42.302	43.60	-12.86	30.74	40.00	9.26	Peak
5	83.816	47.44	-17.49	29.95	40.00	10.05	Peak
6	119.856	42.23	-11.75	30.48	43.50	13.02	Peak

3) 1GHz-40GHz:

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector					
13970.19	35.18	PK	H	24.08	59.26	74.00	14.74
13970.19	23.09	AV	H	24.08	47.17	54.00	6.83
15741.95	37.35	PK	V	22.27	59.62	74.00	14.38
15741.95	25.12	AV	V	22.27	47.39	54.00	6.61
25051.31	39.94	PK	H	12.82	52.76	74.00	21.24
25051.31	27.42	AV	H	12.82	40.24	54.00	13.76
25092.12	39.99	PK	V	12.76	52.75	74.00	21.25
25092.12	27.44	AV	V	12.76	40.20	54.00	13.80
37990.80	43.35	PK	H	20.69	58.02	74.00	15.98
37990.80	31.12	AV	H	20.69	45.79	54.00	8.21
39484.20	42.40	PK	V	21.58	57.96	74.00	16.04
39484.20	30.20	AV	V	21.58	45.76	54.00	8.24

Note:
For 26.5-40GHz:
Result = Reading + Factor- Distance extrapolation Factor
Distance extrapolation Factor =20 log (specific distance [3m]/test distance [1.5m]) dB= 6.02 dB

3) 40GHz-231GHz:

Frequency (GHz)	Receiver Reading (dBμV)	Polar (H/V)	Factor (dB/m)	Field Strength (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
48.466	51.74	H	40.11	91.85	44.83	600.00
48.466	51.91	V	40.11	92.02	46.62	600.00
72.538	58.33	H	43.87	102.20	485.90	600.00
72.538	58.55	V	43.87	102.42	511.15	600.00
84.510	58.17	H	44.43	102.60	532.78	600.00
84.510	58.14	V	44.43	102.57	529.11	600.00
91.049	61.22	H	45.24	100.44	324.00	600.00
91.049	61.56	V	45.24	100.78	350.39	600.00
191.690	56.56	H	51.16	101.70	433.06	600.00
191.690	56.69	V	51.16	101.83	446.22	600.00
230.562	46.86	H	52.86	93.70	68.64	1000.00
230.339	46.87	V	52.85	93.70	68.64	1000.00

Factor = Antenna Factor
Field Strength = Reading + Factor
EIRP (dBm) = Field Strength (dBμV/m) + 20log(D) − 104.8

D is the measurement distance

$$EIRP_{Linear} = 10^{\left[(EIRP_{Log} - 30)/10\right]}$$

where

$EIRP_{Linear}$ is the equivalent isotropically radiated power, in watts
$EIRP_{Log}$ is the equivalent isotropically radiated power, in dBm

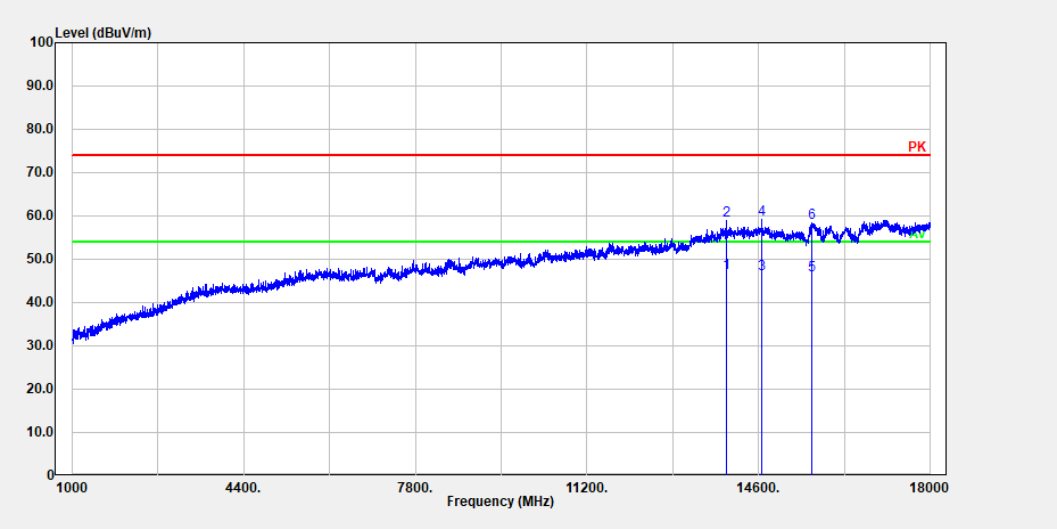
$$PD = \frac{EIRP_{Linear}}{4\pi d^2}$$

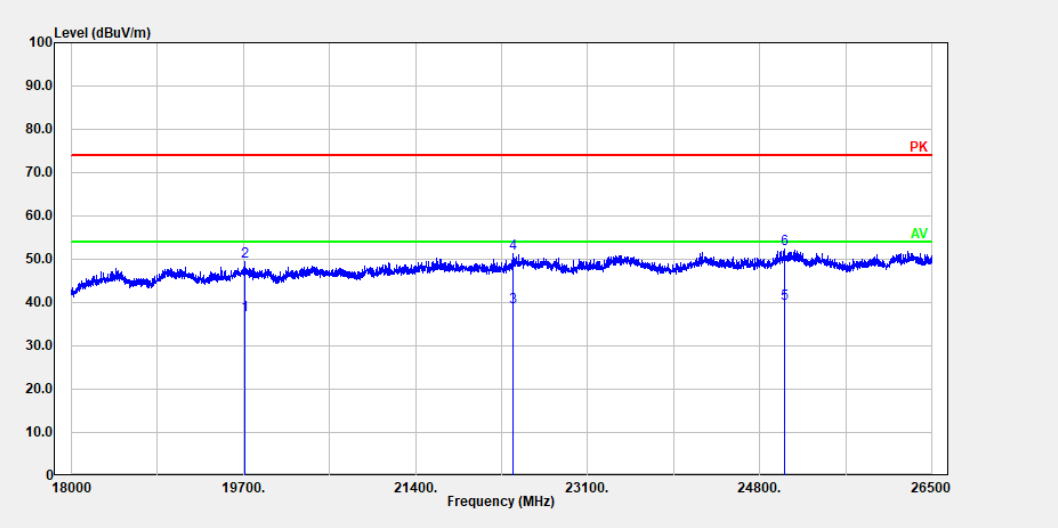
where

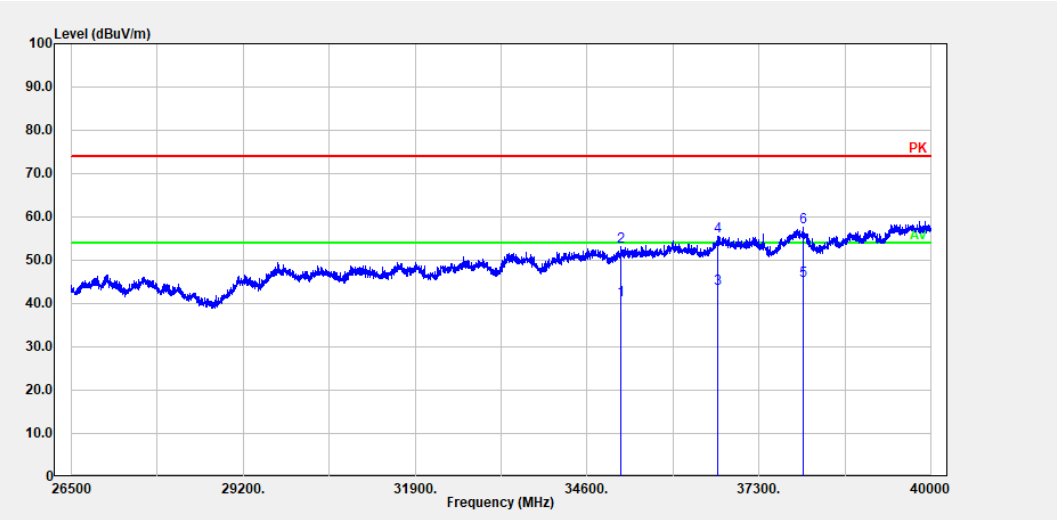
PD is the power density at the distance specified by the limit, in W/m^2
$EIRP_{Linear}$ is the equivalent isotropically radiated power, in watts
d is the distance at which the power density limit is specified, in m

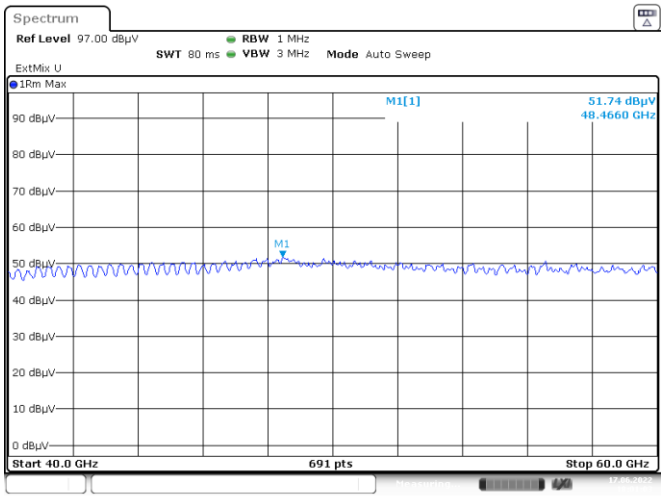
The Specified distance is 3m.

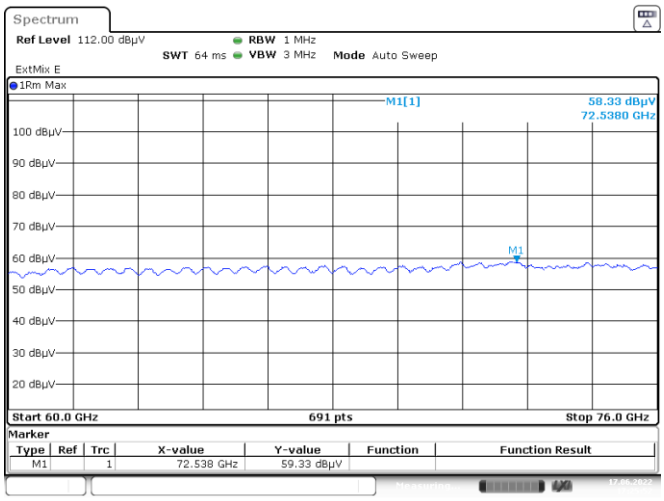
Test plots
Horizontal:

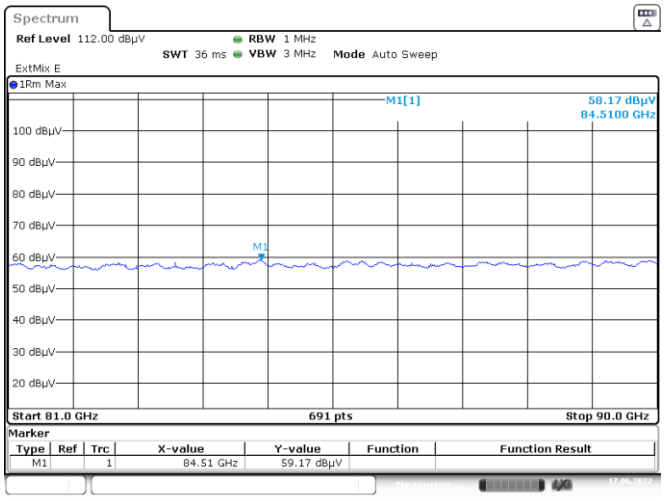


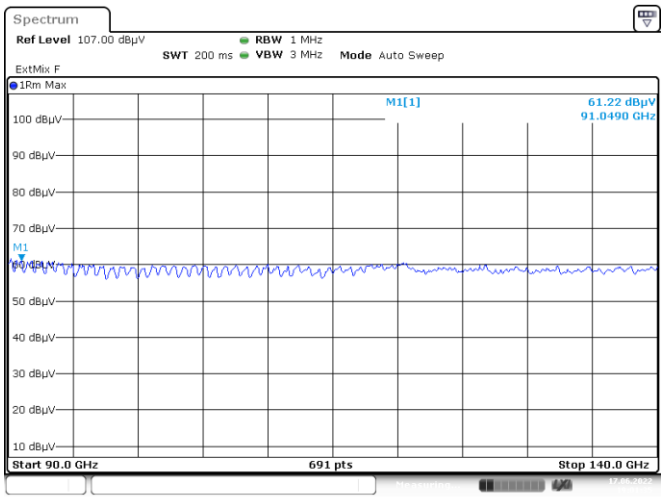




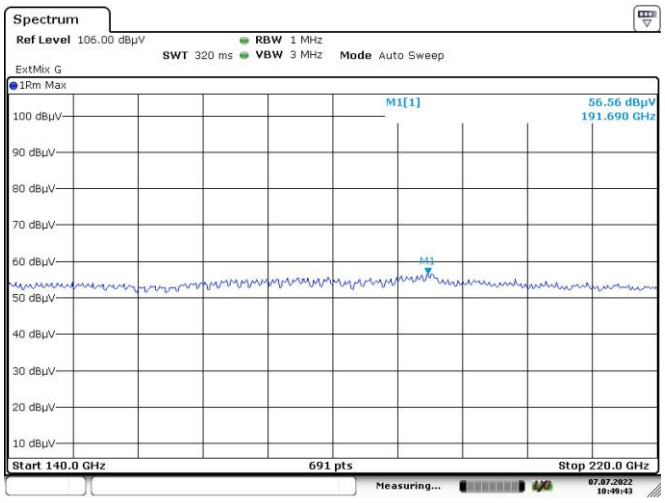

Spectrum
Ref Level 97.00 dBµV
RBW 1 MHz
SWT 80 ms VBW 3 MHz Mode Auto Sweep
ExtMix U
1Rm Max
M1[1] 51.74 dBµV
48.4660 GHz
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
0 dBµV
Start 40.0 GHz
691 pts
Stop 60.0 GHz
Date: 17.JUN.2022 18:01:03


Spectrum
Ref Level 112.00 dBµV
RBW 1 MHz
SWT 64 ms VBW 3 MHz Mode Auto Sweep
ExtMix E
1Rm Max
M1[1] 58.33 dBµV
72.5380 GHz
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
Start 60.0 GHz
691 pts
Stop 76.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 72.538 GHz 59.33 dBµV
Date: 17.JUN.2022 17:25:52

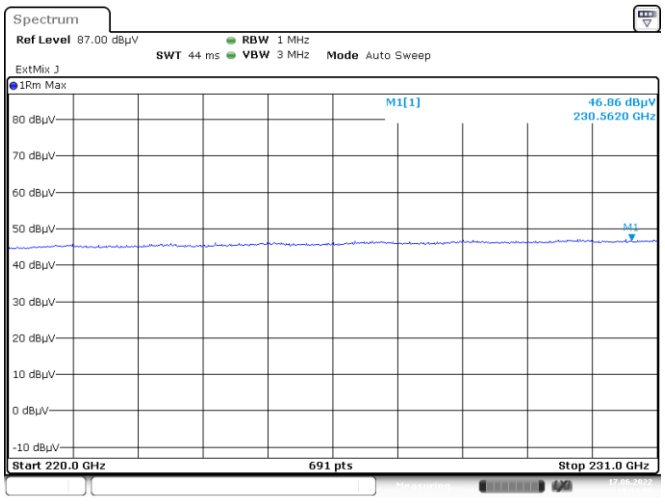

Spectrum
Ref Level 112.00 dBµV
RBW 1 MHz
SWT 36 ms VBW 3 MHz Mode Auto Sweep
ExtMix E
1Rm Max
M1[1] 58.17 dBµV
84.5100 GHz
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
Start 81.0 GHz
691 pts
Stop 90.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 84.51 GHz 59.17 dBµV
Date: 17.JUN.2022 17:31:05



Date: 17.JUN.2022 19:01:36

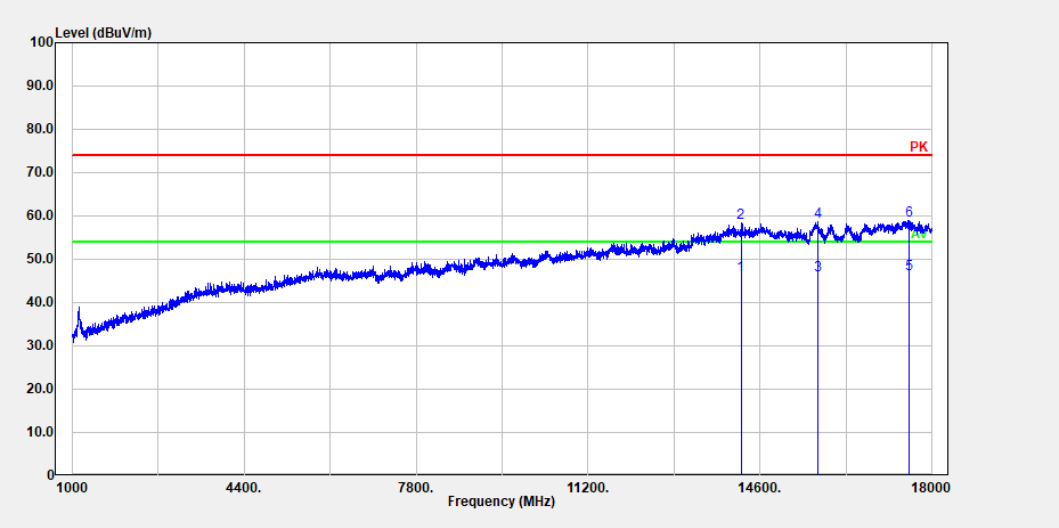


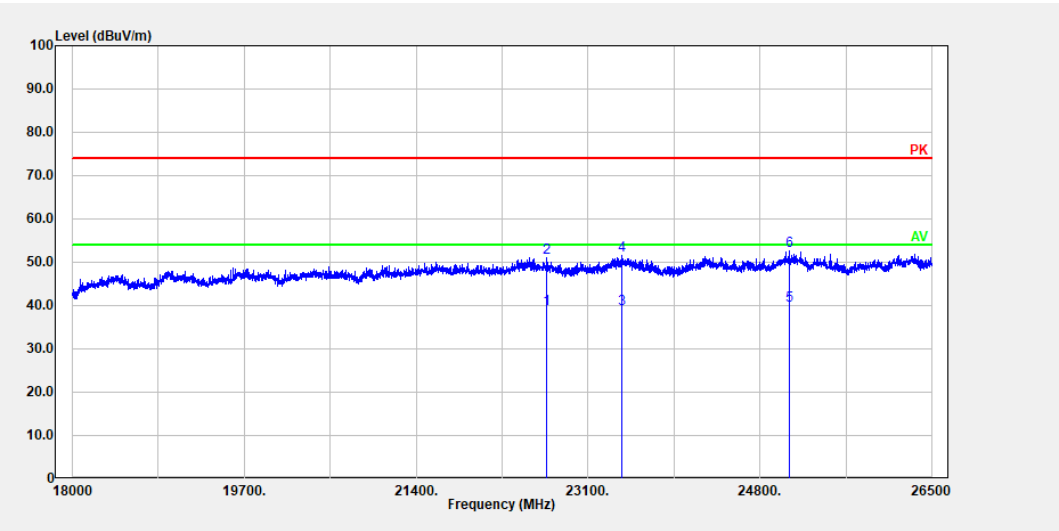
Date: 7.JUL.2022 10:49:42

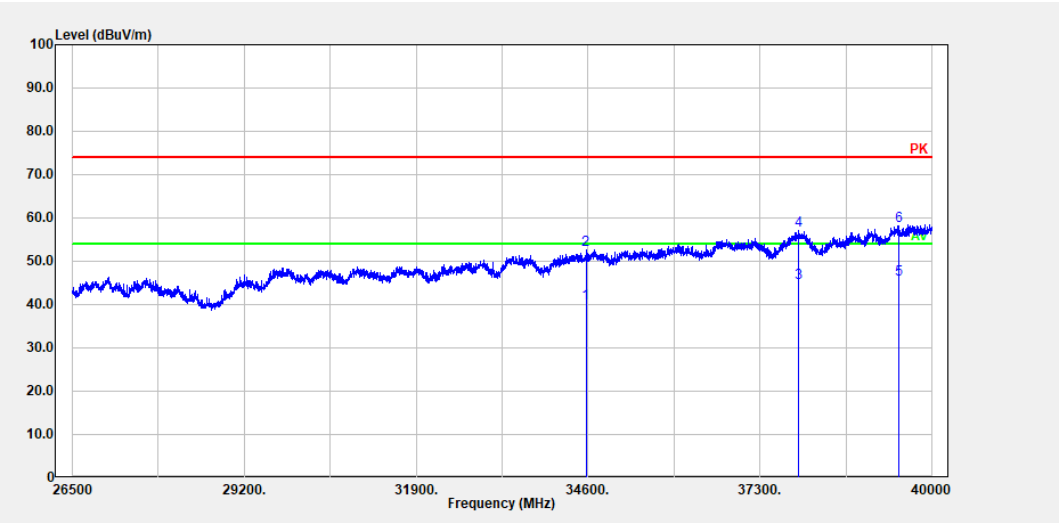


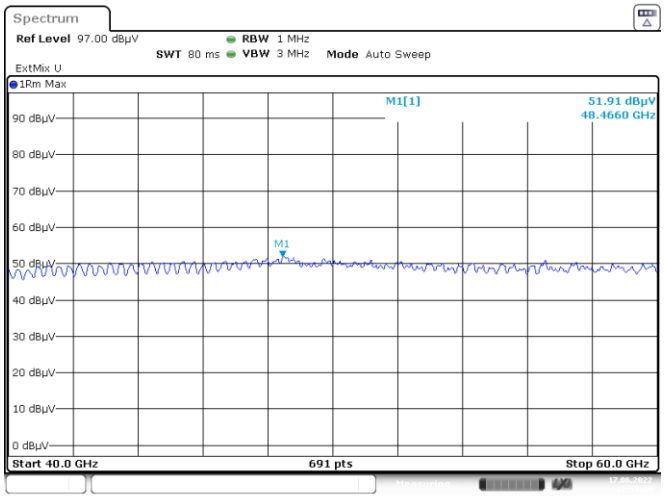
Date: 17.JUN.2022 19:34:03

Vertical:


Level (dBuV/m)
100
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
PK
AV
1
2
3
4
5
6
1000
4400.
7800.
11200.
14600.
18000
Frequency (MHz)


Level (dBuV/m)
100
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
PK
AV
1
2
3
4
5
6
18000
19700.
21400.
23100.
24800.
26500
Frequency (MHz)


Level (dBuV/m)
100
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0
PK
AV
1
2
3
4
5
6
26500
29200.
31900.
34600.
37300.
40000
Frequency (MHz)



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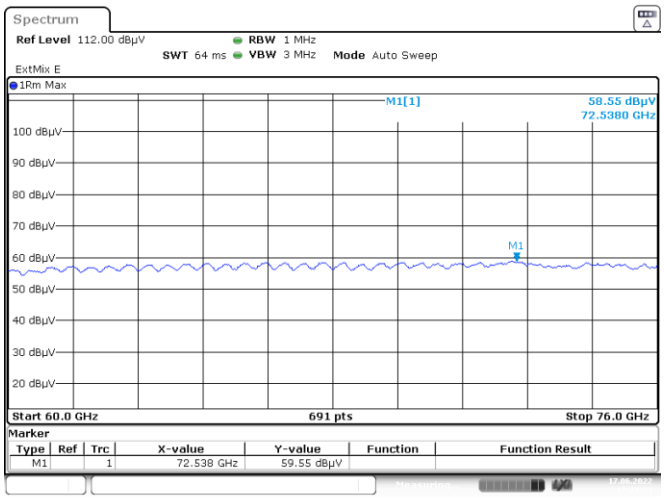

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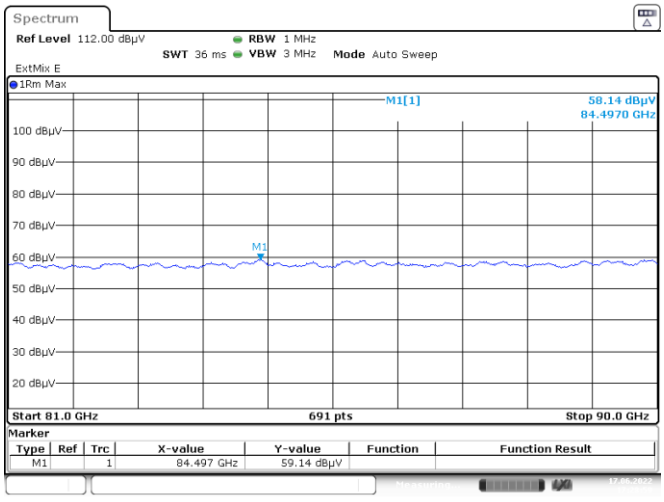

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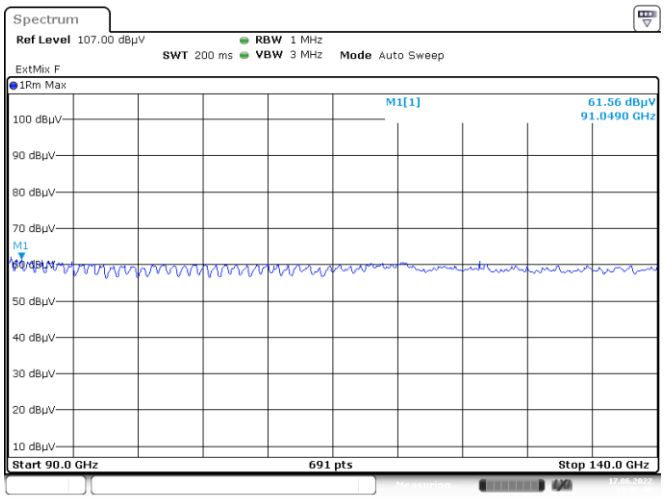

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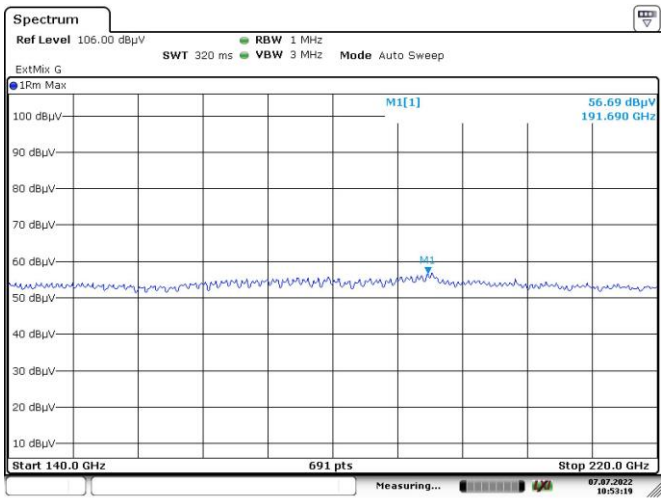
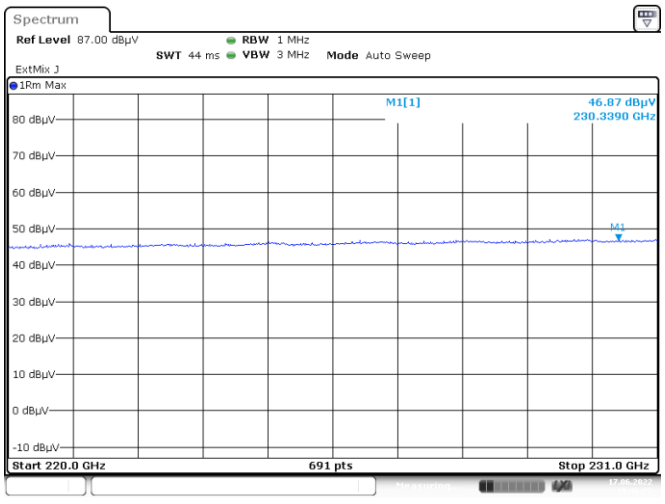


Date: 7.JUL.2022 10:53:19



Date: 17.JUN.2022 19:36:23

4.3 Frequency Stability:

Serial Number:	CR22050022-RF-S1	Test Date:	2022.6.17
Test Site:	RF	Test Mode:	Transmitting
Tester:	Mack Huang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	24.1	Relative Humidity: (%)	62	ATM Pressure: (kPa)	100.2

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2021-10-10	2022-10-09
OML	Harmonic Mixer	WR12/M12HWD	E60119-1	2020-10-17	2023-10-16
OML	Horn Antenna	M12RH	E60119-2	2020-10-18	2023-10-17
BACL	TEMP&HUMI Test Chamber	BTH-150	30026	2021-07-22	2022-07-21
UNI-T	Multimeter	UT39A+	C210582554	2021-09-30	2022-09-29

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Temperature	**Voltage**	**Frequency (GHz)**			
℃	**V_{DC}**	**f_L**	**f_H**	**f_L Limit**	**f_H Limit**
-20	12	76.02571	76.94475	76	81
-10	12	76.02577	76.94479	76	81
0	12	76.02588	76.94486	76	81
10	12	76.02584	76.94481	76	81
20	12	76.02595	76.94492	76	81
30	12	76.02599	76.94495	76	81
40	12	76.02611	76.94499	76	81
50	12	76.02614	76.94503	76	81
20	10.2	76.02618	76.94507	76	81
20	13.8	76.02622	76.94510	76	81

4.4 Occupied Bandwidth:

Serial Number:	CR22050022-RF-S1	Test Date:	2022.6.17
Test Site:	966-1	Test Mode:	Transmitting
Tester:	Mack Huang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	24.1	Relative Humidity: (%)	62	ATM Pressure: (kPa)	100.2

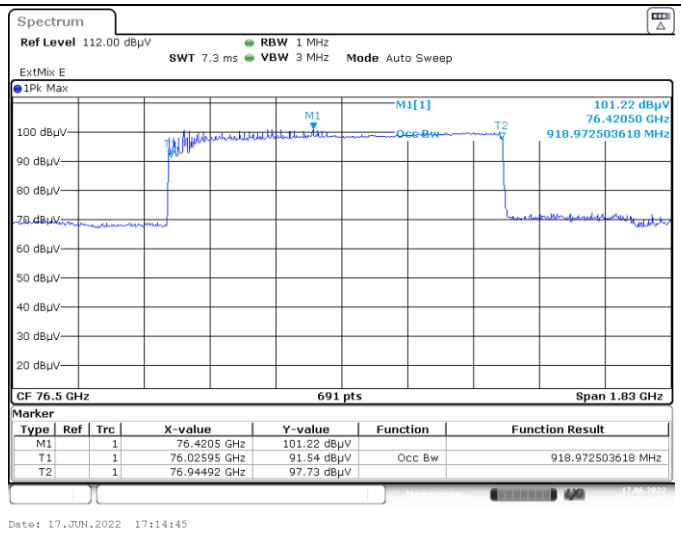
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2021-10-10	2022-10-09
OML	Harmonic Mixer	WR12/M12HWD	E60119-1	2020-10-17	2023-10-16
OML	Horn Antenna	M12RH	E60119-2	2020-10-18	2023-10-17

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Test Frequency (MHz)	99% Occupied Bandwidth (MHz)
76.5	918.973

99% Emission Bandwidth	
	

4.5 Duty Cycle:

Serial Number:	CR22050022-RF-S1	Test Date:	2022.7.7
Test Site:	966-1	Test Mode:	Transmitting
Tester:	Mack Huang	Test Result:	N/A

Environmental Conditions:					
Temperature: (℃)	24.4	Relative Humidity: (%)	51	ATM Pressure: (kPa)	100.2

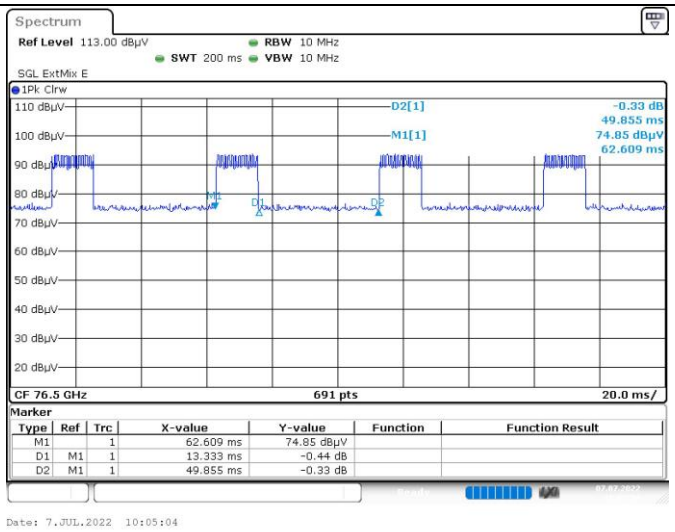
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2021-10-10	2022-10-09
OML	Harmonic Mixer	WR12/M12HWD	E60119-1	2020-10-17	2023-10-16
OML	Horn Antenna	M12RH	E60119-2	2020-10-18	2023-10-17

** Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Test Frequency (GHz)	Ton (ms)	Ton+off (ms)	Duty cycle (%)
76.5	13.333	49.855	26.74

Duty Cycle	
	

Spectrum
Ref Level 113.00 dBµV
RBW 10 MHz
SWT 200 ms
VBW 10 MHz
SGL ExtMix E
1Pk Clrw
D2[1]
-0.33 dB
49.855 ms
M1[1]
74.85 dBµV
62.609 ms
110 dBµV
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
CF 76.5 GHz
691 pts
20.0 ms/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 62.609 ms 74.85 dBµV
D1 M1 1 13.333 ms -0.44 dB
D2 M1 1 49.855 ms -0.33 dB
Date: 7.JUL.2022 10:05:04

5. RF EXPOSURE EVALUATION

5.1 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

5.1.1 Applicable Standard

FCC §95.3385 & §1.1310 & §2.1091

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

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

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

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

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

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

5.1.2 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);

5.2 Measurement Result

Frequency (GHz)	Antenna Gain		Conducted output power including Tune-up Tolerance		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
	(dBi)	(numeric)	(dBm)	(mW)			
76-77	17.50	56.23	27	501.19	50	0.8971	1

Result: The device meet FCC MPE at 50 cm distance.

===== END OF REPORT =====