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

ACCREDITED
TESTING LABORATORY
CERTIFICATE # 6356.01

TEST REPORT

Applicant: **Q Global Solutions Electronics Corp.**

Address: 195 Si-Ming Yuan,Tong-An Collective Industrial Park,Tong-An District,Xiamen, Fujian,China

FCC ID: **2BDTH-QRM150SST**

Product Name: **Medium range radar**

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

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

Report Number: **CR231168258-00B**

Date Of Issue: **2023/12/23**

Reviewed By: **Julie Tan** Julie Tan

Title: RF Engineer

Approved 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

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1.0	CR231168258-00B	Original Report	2023/12/23

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

1.1.1 General:

EUT Name:	Medium range radar
EUT Model:	QRM150SST
Operation Frequency Range:	77.50-78.70 GHz
Maximum Average Output Power (EIRP):	26.96 dBm
Modulation Type:	FMCW
Chirp Time▲:	30μs
Rated Input Voltage:	DC 12-24V
Serial Number:	2DW5-1
EUT Received Date:	2023/11/18
EUT Received Status:	Good

1.1.2 Antenna Information Detail▲:

Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range
Patch Antenna	Unknown	17.5 dBi/77~79GHz

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. The device has 4T4R, 4TX only simultaneously transmit.
Equipment Modifications:	No
EUT Exercise Software:	No
Engineering Mode was provided by manufacturer▲. The maximum power was configured default setting.	

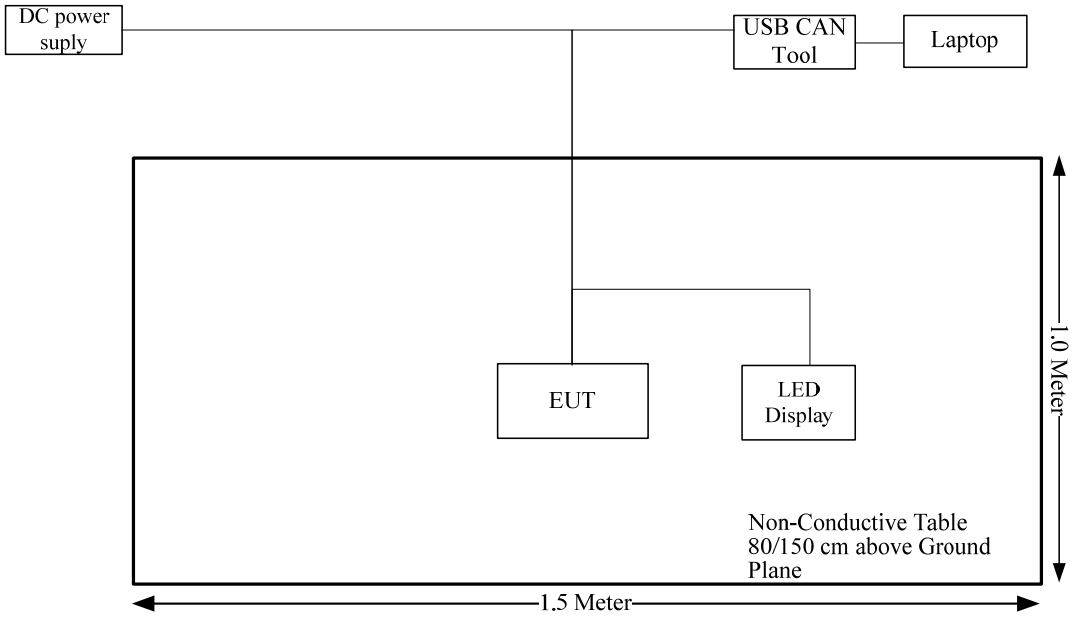
1.2.2 Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Q Global Solutions Electronics Corp.	USB CAN Tool	CANalyst-II	31F0001C04B
DK	DC power supply	DK-60V50A	T-08-EE140
DELL	Laptop	E6410ATG	EMZBPC21103005

1.2.3 Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
DC Cable	No	No	0.4	DC power supply	CAN Cable
CAN Cable	No	No	1.53	EUT	USB CAN Tool
USB Cable	No	No	1	USB CAN Tool	Laptop
LED Cable	No	No	0.2	CAN Cable	LED Display

1.2.4 Block Diagram of Test Setup



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

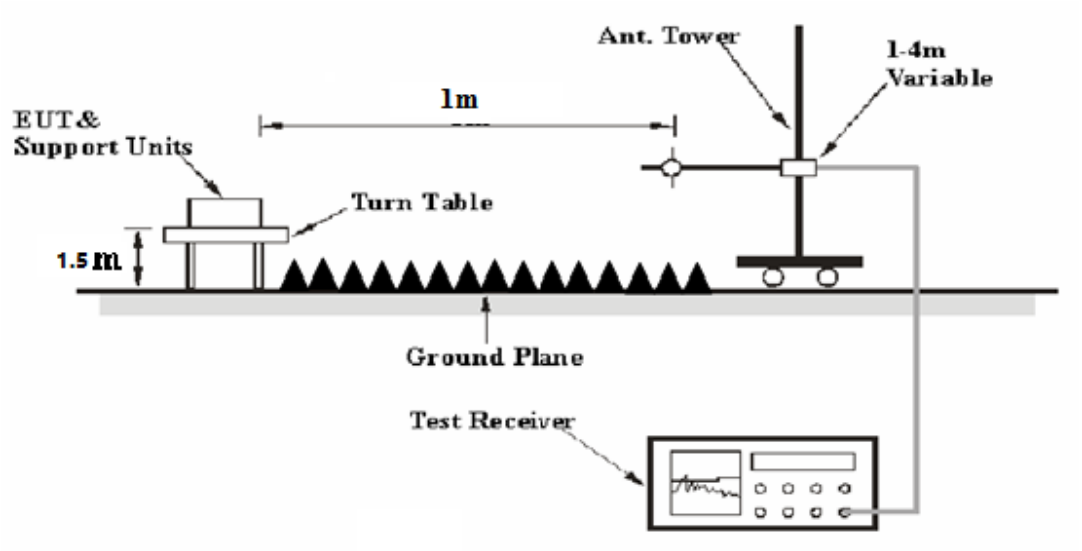
FCC §2.1046, §95.3367;

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:

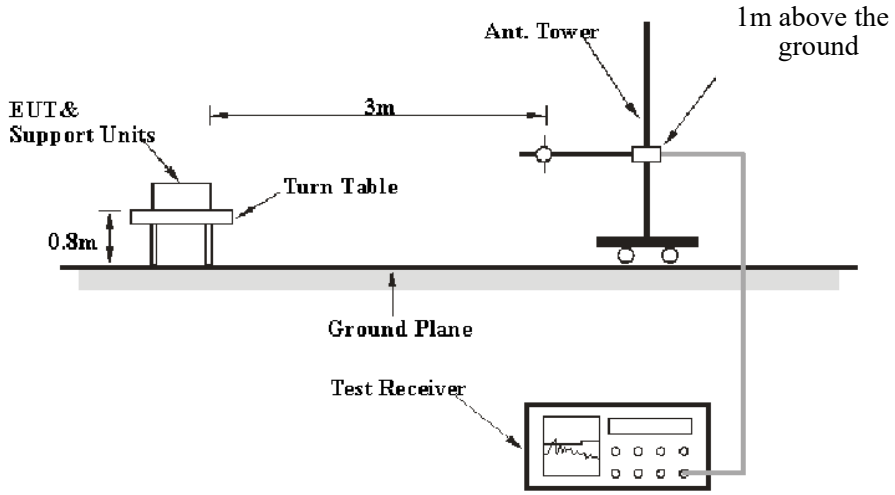
(i) For radiated emissions outside the 76-81 GHz band between 40 GHz and 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 600 pW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For radiated emissions above 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 1000 pW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure.

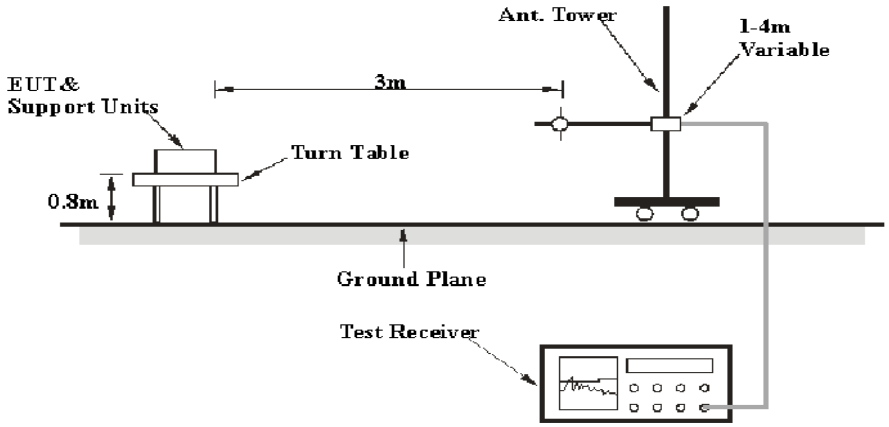
(3) For field disturbance sensors and radar systems operating in the 76-81 GHz band, the spectrum shall be investigated up to 231.0 GHz.

3.2.2 EUT Setup

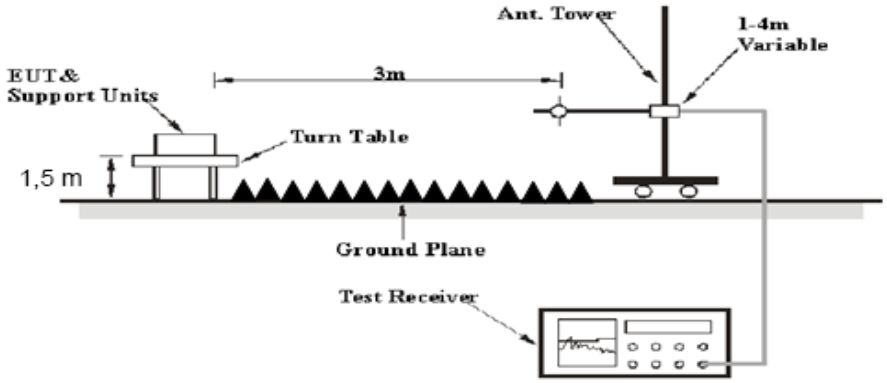
9kHz~30MHz:



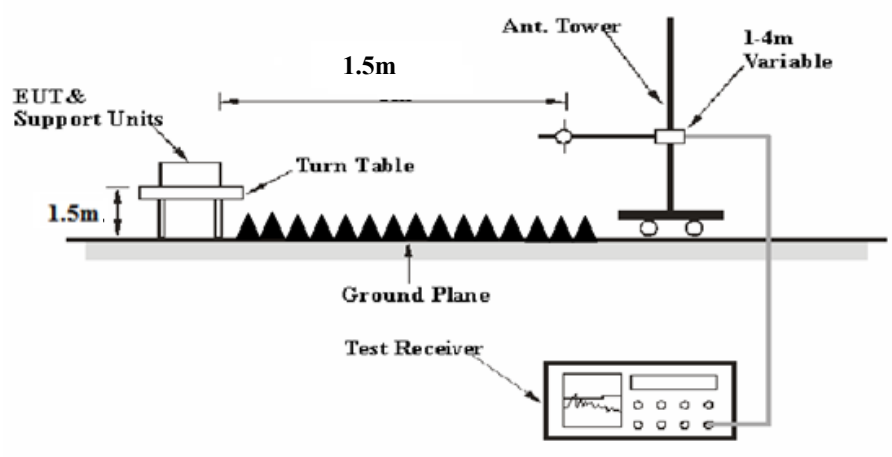
30MHz- 1GHz:



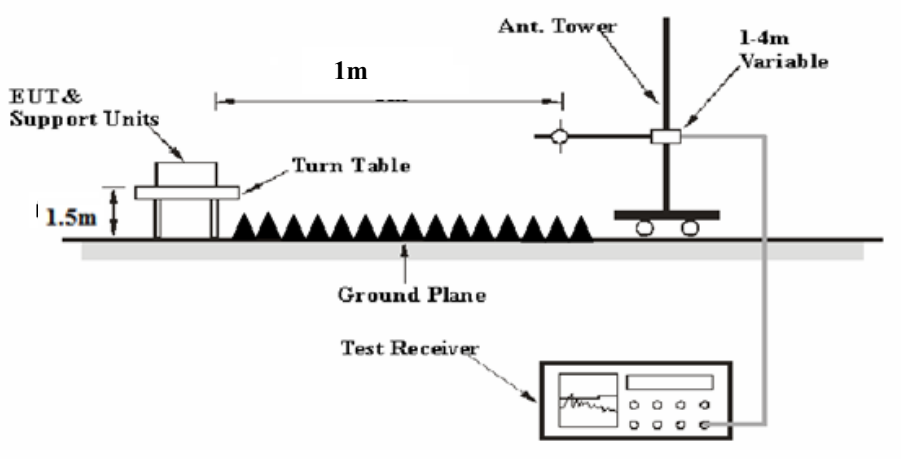
1-26.5 GHz:



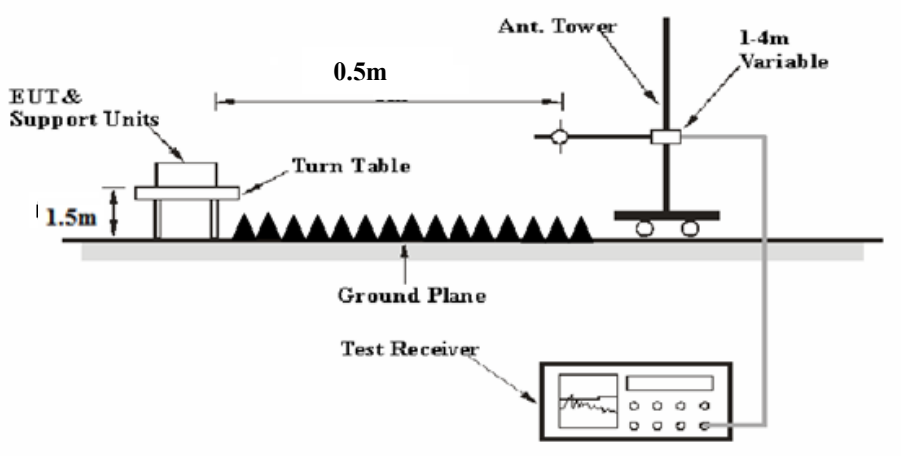
26.5-40 GHz:



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.

For 9kHz-30MHz test, the lowest height of the magnetic antenna shall be 1 m above the ground and three antenna orientations (parallel, perpendicular, and ground-parallel) shall be measured.

3.2.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 9kHz 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	QP
	100 kHz	300 kHz	/	PK
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.

Data was recorded in Quasi-peak detection mode for frequency range of 9 kHz-1 GHz except 9 – 90 kHz, 110 – 490 kHz, employing an average detector, peak and Average detection modes for frequencies above 1 GHz.

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:

Result = Reading + Factor

For 30MHz-26.5GHz:
Factor = Antenna Factor + Cable Loss- Amplifier Gain

For 26.5GHz-40GHz
Factor = Antenna Factor + Cable Loss-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.

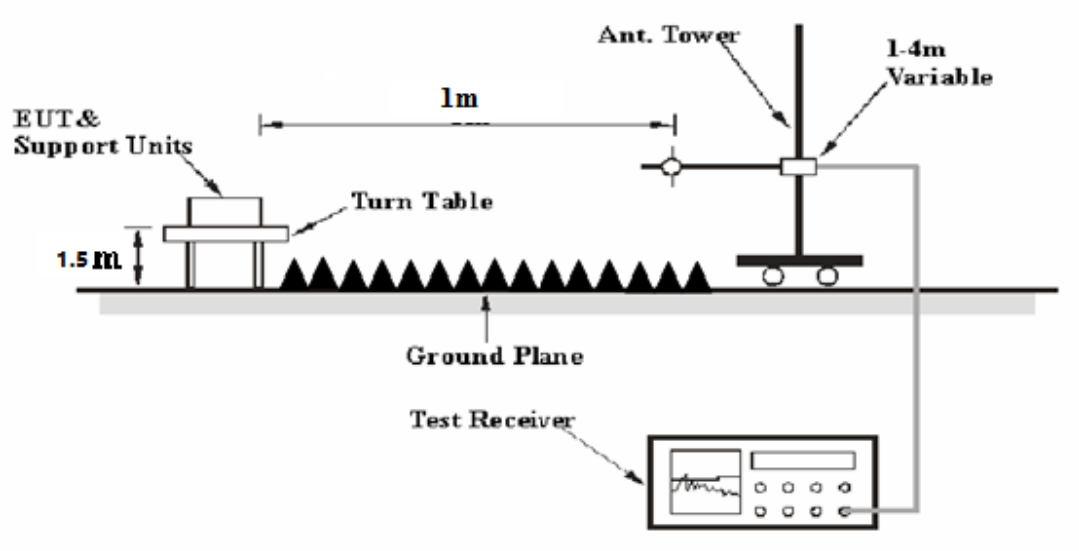
3.4 Occupied Bandwidth:

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



3.4.3 Test 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.

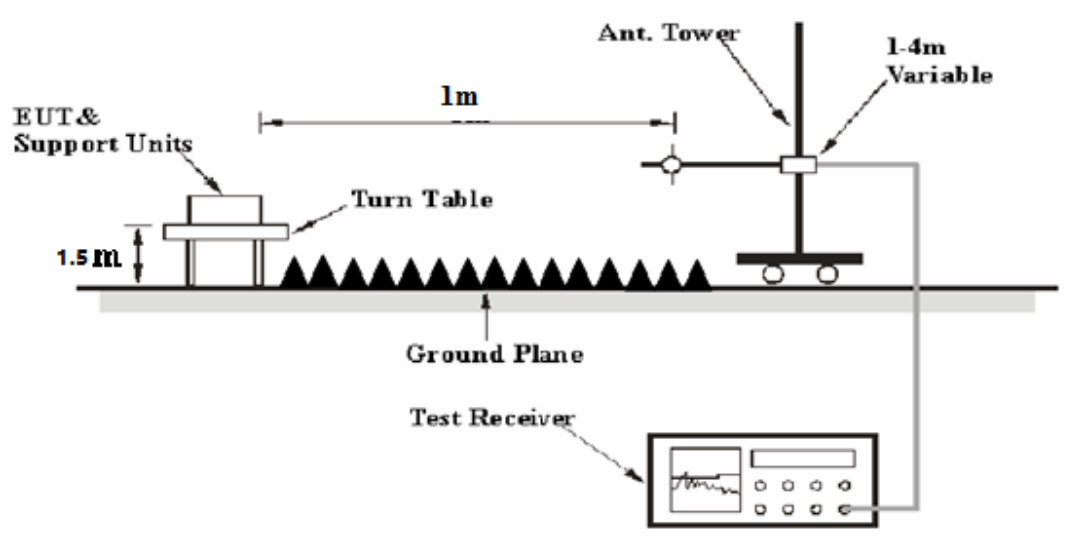
NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

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:	2DW5-1	Test Date:	2023/12/20
Test Site:	966-1	Test Mode:	Transmitting
Tester:	coco Tian	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.9	Relative Humidity: (%)	52	ATM Pressure: (kPa)	101.8

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
OML	Harmonic Mixer	WR12/M12HWD	E60119-1	2023/2/16	2026/2/15
OML	Horn Antenna	M12RH	E60119-2	2023/2/27	2026/2/26
R&S	Spectrum Analyzer	FSV40	101943	2023/3/31	2024/3/30

**** 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:

Average Power:

Operation Frequency (GHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)	EIRP (dBm)	Limit (dBm)
78.1	88.13	AV	V	43.63	26.96	50

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

Peak EIRP PSD:

Operation Frequency (GHz)	Reading (dBμV/MHz)	Detector	Polar (H/V)	Factor (dB/m)	Chirps Correction Factor (dB)	EIRP (dBm/MHz)	Limit (dBm/MHz)
78.1	86.62	PK	V	43.63	12.44	37.89	55

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

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

Span=1190MHz, t=30us
chirps correction factor=12.44dB

4.2 Radiation Spurious Emissions

Serial Number:	2DW5-1	Test Date:	2023/12/15-2023/12/21
Test Site:	966-2, 966-1	Test Mode:	Transmitting
Tester:	Vic Du, coco Tian	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	24-26.4	Relative Humidity: (%)	35-52	ATM Pressure: (kPa)	101.2-102.1

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
BACL	Loop Antenna	1313-1P	3092721	2023/10/20	2026/10/19
Sunol Sciences	Antenna	JB6	A082520-6	2023/9/18	2026/9/17
R&S	EMI Test Receiver	ESR3	102724	2023/3/31	2024/3/30
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0470-02	2023/7/16	2024/7/15
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0780-01	2023/7/16	2024/7/15
Sonoma	Amplifier	310N	186165	2023/7/16	2024/7/15
Audix	Test Software	E3	201021 (V9)	N/A	N/A
AH	Double Ridge Guide Horn Antenna	SAS-571	1394	2023/2/22	2026/2/21
R&S	Spectrum Analyzer	FSV40	101591	2023/3/31	2024/3/30
MICRO-COAX	Coaxial Cable	UFA210A-1-1200-70U300	217423-008	2023/8/6	2024/8/5
MICRO-COAX	Coaxial Cable	UFA210A-1-2362-300300	235780-001	2023/8/6	2024/8/5
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2023/11/8	2024/11/7
PASTERNACK	Horn Antenna	PE9852/2F-20	112002	2021/2/5	2024/2/4
Quinstar	Preamplifier	QLW-18405536-JO	15964001005	2023/9/15	2024/9/14
MICRO-COAX	Coaxial Cable	UFB142A-1-2362-200200	235772-001	2023/8/6	2024/8/5
PASTERNACK	Horn Antenna	PE9850/2F-20	072001	2021/2/5	2024/2/4
OML	Harmonic Mixer	WR19/M19HWD	U60314-1	2023/2/16	2026/2/15
OML	Horn Antenna	M19RH	11648-03	2023/2/27	2026/2/26
OML	Harmonic Mixer	WR12/M12HWD	E60119-1	2023/2/16	2026/2/15
OML	Horn Antenna	M12RH	E60119-2	2023/2/27	2026/2/26
OML	Harmonic Mixer	WR08/M08HWD	F60315-1	2023/2/16	2026/2/15
OML	Horn Antenna	M08RH	F60315-2	2023/2/27	2026/2/26
OML	Harmonic Mixer	WR05/M05HWD	G60107-1	2023/2/16	2026/2/15
OML	Horn Antenna	M05RH	G60107-2	2023/2/27	2026/2/26

OML	Harmonic Mixer	WR03/M03HWD	H60122-1	2023/2/16	2026/2/15
OML	Horn Antenna	M03RH	H60122-2	2023/2/27	2026/2/26

** 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).*

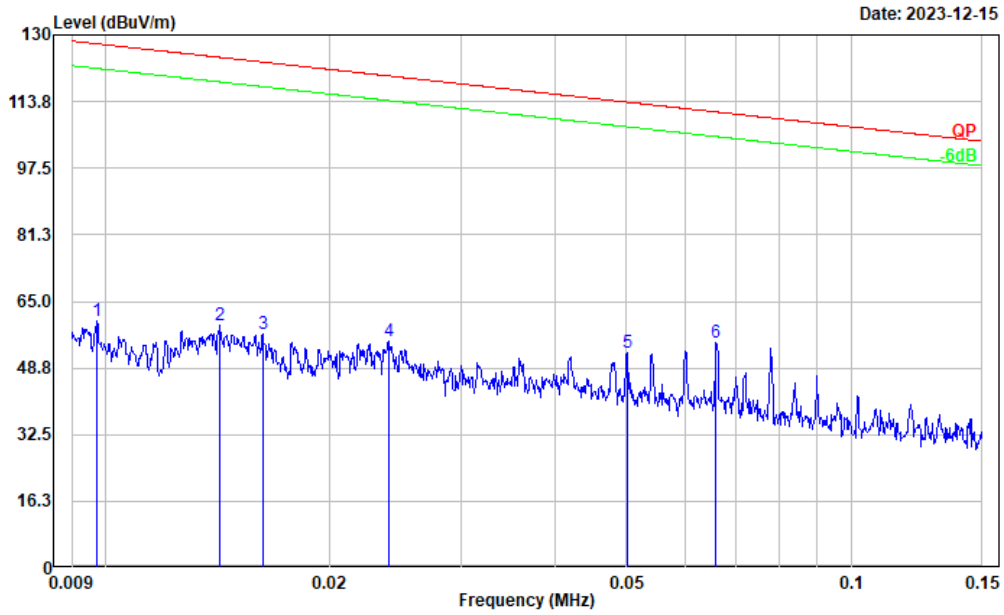
Test Data:

Please refer to the below table and plots.

After pre-scan in the X, Y and Z axes of orientation, the worst case is below:

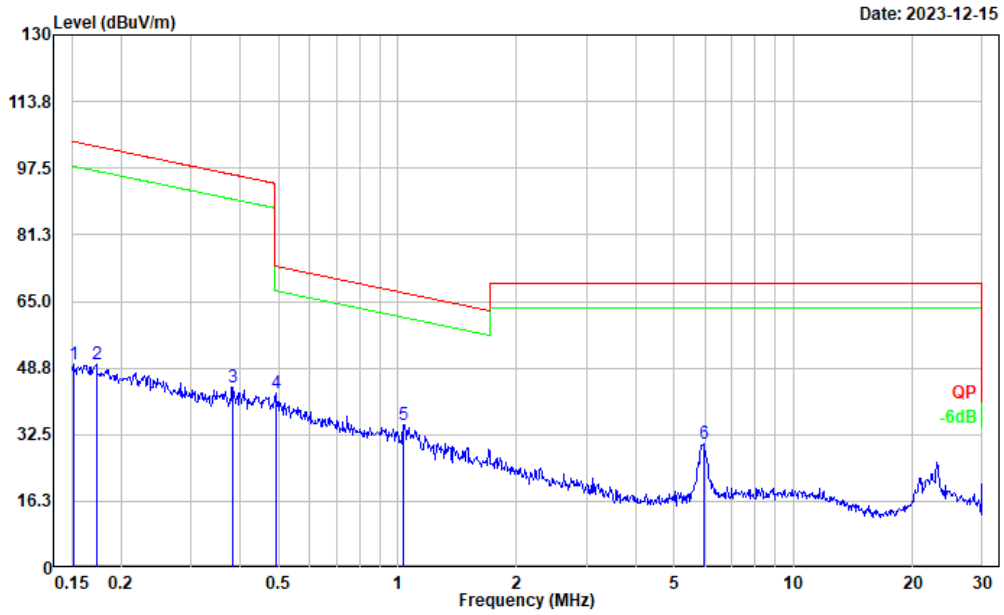
1) 9kHz-30MHz: Parallel

Project No.: CR231168258-RF
Tester: Vic Du
Polarization: Parallel
Note: Transmitting



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.010	2.16	58.16	60.32	127.84	67.52	Peak
2	0.014	3.65	55.38	59.03	124.54	65.51	Peak
3	0.016	2.71	54.21	56.92	123.39	66.47	Peak
4	0.024	5.43	50.02	55.45	120.02	64.57	Peak
5	0.050	10.15	42.44	52.59	113.61	61.02	Peak
6	0.066	14.54	40.27	54.81	111.22	56.41	Peak

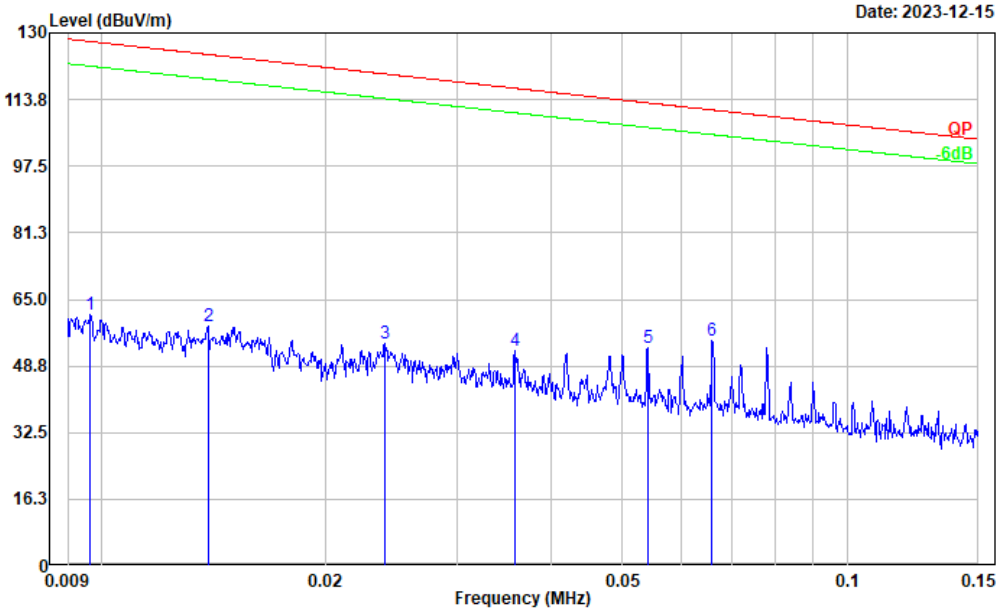
Project No.: CR231168258-RF
Tester: Vic Du
Polarization: Parallel
Note: Transmitting



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.152	15.80	33.89	49.69	103.99	54.30	Peak
2	0.173	16.81	32.87	49.68	102.84	53.16	Peak
3	0.383	19.11	25.03	44.14	95.94	51.80	Peak
4	0.491	19.89	22.67	42.56	73.77	31.21	Peak
5	1.037	18.64	16.40	35.04	67.15	32.11	Peak
6	5.929	25.96	4.32	30.28	69.54	39.26	Peak

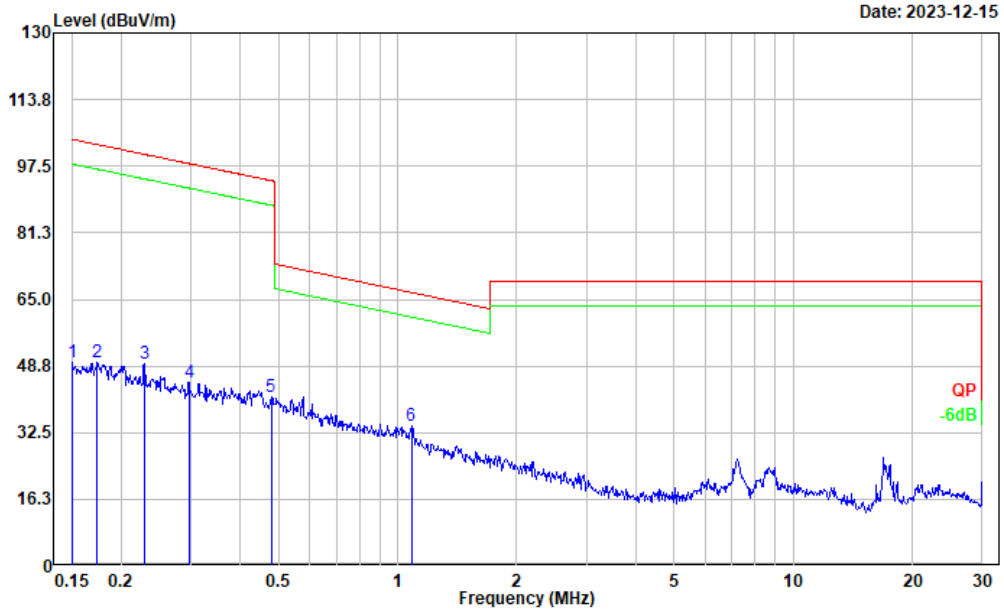
Perpendicular

Project No.: CR231168258-RF
Tester: Vic Du
Polarization: Perpendicular
Note: Transmitting



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.010	3.03	58.25	61.28	127.91	66.63	Peak
2	0.014	2.82	55.59	58.41	124.76	66.35	Peak
3	0.024	4.42	49.99	54.41	119.99	65.58	Peak
4	0.036	6.73	45.64	52.37	116.52	64.15	Peak
5	0.054	11.43	41.91	53.34	112.95	59.61	Peak
6	0.066	14.58	40.27	54.85	111.22	56.37	Peak

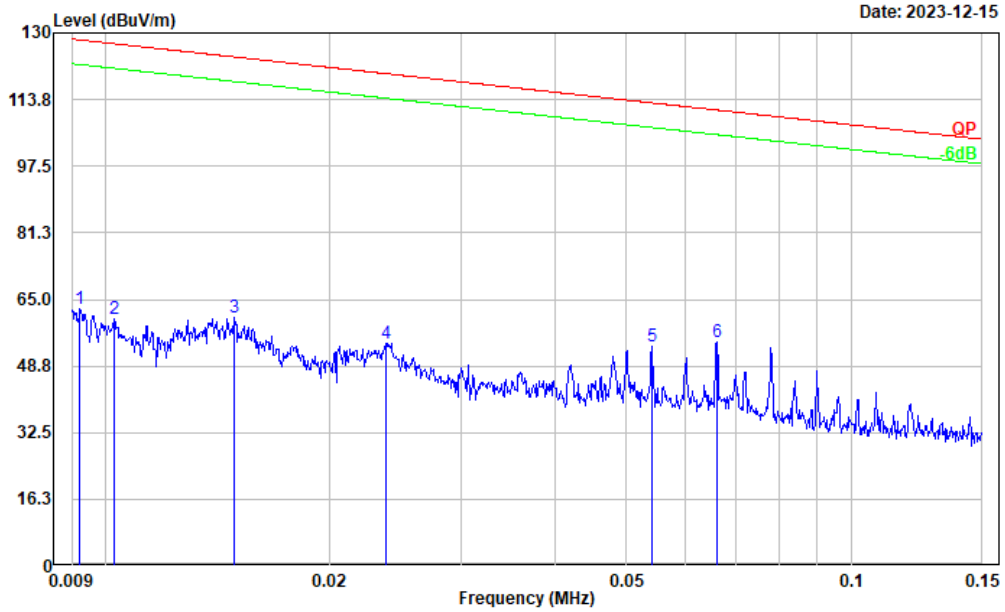
Project No.: CR231168258-RF
Tester: Vic Du
Polarization: Perpendicular
Note: Transmitting



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.150	15.65	33.96	49.61	104.08	54.47	Peak
2	0.174	16.91	32.83	49.74	102.79	53.05	Peak
3	0.229	19.07	30.21	49.28	100.40	51.12	Peak
4	0.297	17.69	27.00	44.69	98.15	53.46	Peak
5	0.479	18.19	22.95	41.14	94.00	52.86	Peak
6	1.082	18.19	16.15	34.34	66.77	32.43	Peak

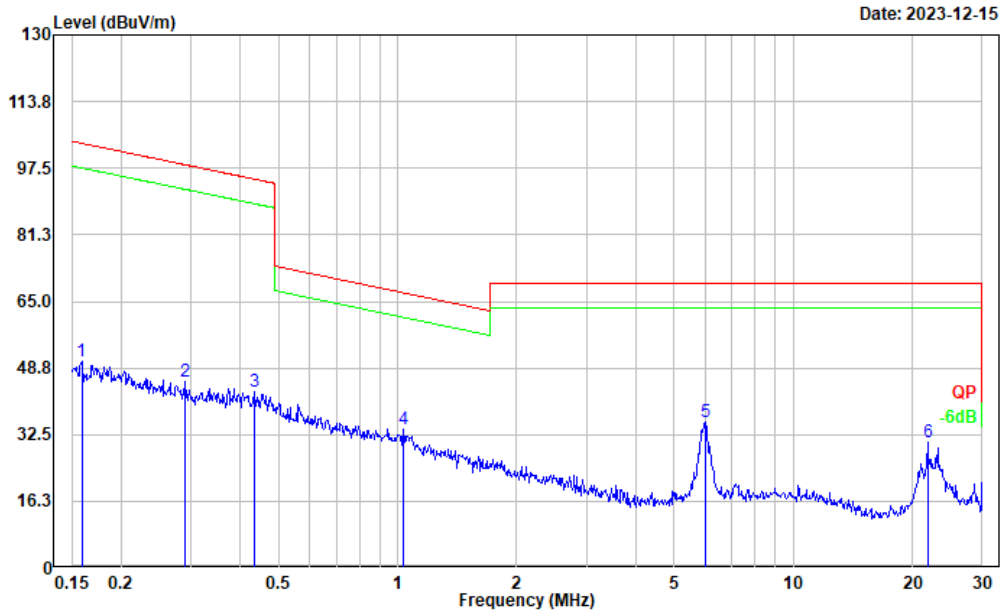
Ground-parallel

Project No.: CR231168258-RF
Tester: Vic Du
Polarization: Ground-parallel
Note: Transmitting



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.009	3.84	58.74	62.58	128.30	65.72	Peak
2	0.010	2.63	57.69	60.32	127.37	67.05	Peak
3	0.015	5.74	55.00	60.74	124.15	63.41	Peak
4	0.024	4.08	50.12	54.20	120.09	65.89	Peak
5	0.054	11.47	41.91	53.38	112.95	59.57	Peak
6	0.066	14.36	40.24	54.60	111.19	56.59	Peak

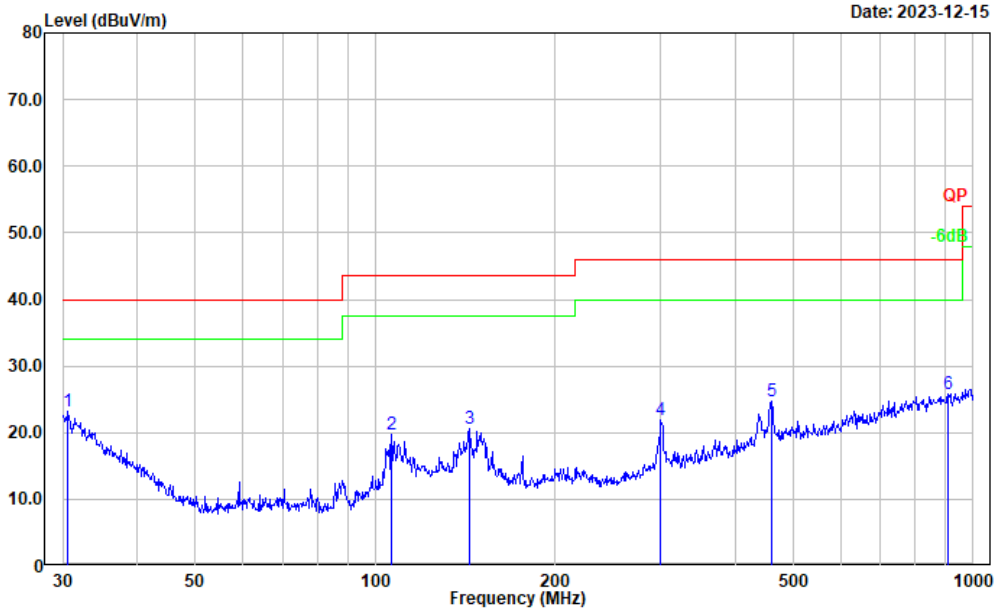
Project No.: CR231168258-RF
Tester: Vic Du
Polarization: Ground-parallel
Note: Transmitting



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	0.159	16.78	33.54	50.32	103.58	53.26	Peak
2	0.289	18.07	27.37	45.44	98.38	52.94	Peak
3	0.433	19.12	23.94	43.06	94.88	51.82	Peak
4	1.037	17.58	16.40	33.98	67.15	33.17	Peak
5	5.993	31.39	4.26	35.65	69.54	33.89	Peak
6	21.830	29.01	1.68	30.69	69.54	38.85	Peak

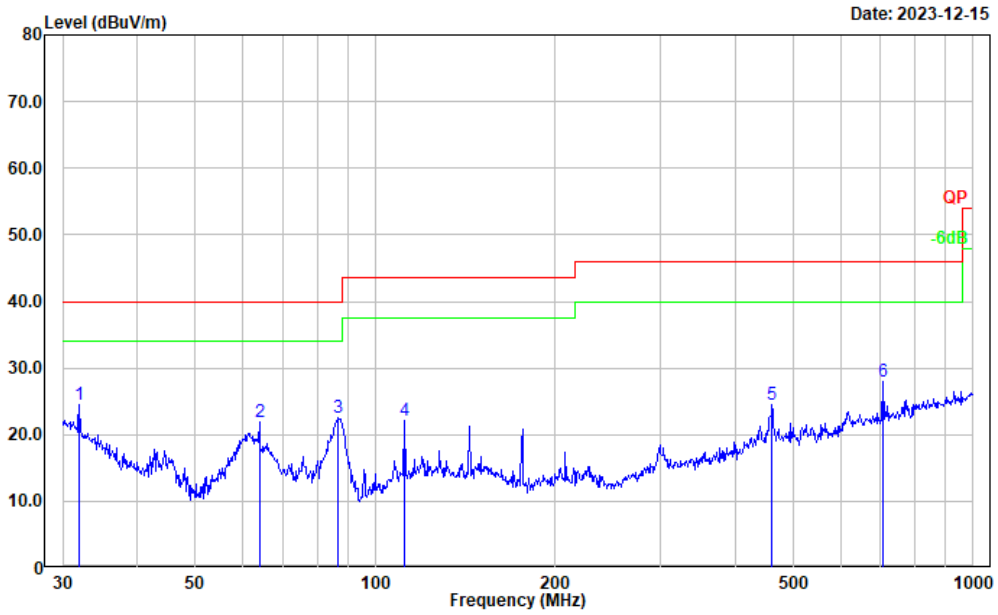
30M-1GHz

Project No.: CR231168258-RF
Tester: Vic Du
Polarization: horizontal
Note: Transmitting



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	30.638	27.71	-4.61	23.10	40.00	16.90	Peak
2	106.385	33.05	-13.39	19.66	43.50	23.84	Peak
3	143.830	32.63	-12.13	20.50	43.50	23.00	Peak
4	300.367	32.88	-11.05	21.83	46.00	24.17	Peak
5	460.727	31.75	-7.08	24.67	46.00	21.33	Peak
6	909.667	26.72	-0.86	25.86	46.00	20.14	Peak

Project No.: CR231168258-RF
Tester: Vic Du
Polarization: vertical
Note: Transmitting



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	31.955	30.12	-5.60	24.52	40.00	15.48	Peak
2	63.983	39.36	-17.36	22.00	40.00	18.00	Peak
3	86.807	39.98	-17.43	22.55	40.00	17.45	Peak
4	112.131	34.71	-12.50	22.21	43.50	21.29	Peak
5	460.727	31.51	-7.08	24.43	46.00	21.57	Peak
6	706.700	31.70	-3.81	27.89	46.00	18.11	Peak

3) 1GHz-40GHz:

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector					
17908.18	28.16	PK	H	32.21	60.37	74.00	13.63
17908.18	15.32	AV	H	32.21	47.53	54.00	6.47
7199.44	42.07	PK	V	14.99	57.06	74.00	16.94
7199.44	29.12	AV	V	14.99	44.11	54.00	9.89
19373.88	55.26	PK	H	4.78	60.04	74.00	13.96
19373.88	42.76	AV	H	4.78	47.54	54.00	6.46
19373.88	56.73	PK	V	4.78	61.51	74.00	12.49
19373.88	43.69	AV	V	4.78	48.47	54.00	5.53
39354.57	50.91	PK	H	16.19	61.08	74.00	12.92
39354.57	37.75	AV	H	16.19	47.92	54.00	6.08
39616.12	51.62	PK	V	15.71	61.31	74.00	12.69
39616.12	38.17	AV	V	15.71	47.86	54.00	6.14

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)
55.150	47.35	H	41.15	88.50	20.73	600.00
53.914	46.59	V	40.96	87.55	16.66	600.00
88.041	53.75	H	44.86	98.61	212.59	600.00
89.230	53.21	V	45.01	98.22	194.33	600.00
135.260	59.62	H	48.69	108.31	496.01	600.00
136.170	58.36	V	48.73	107.09	374.53	600.00

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

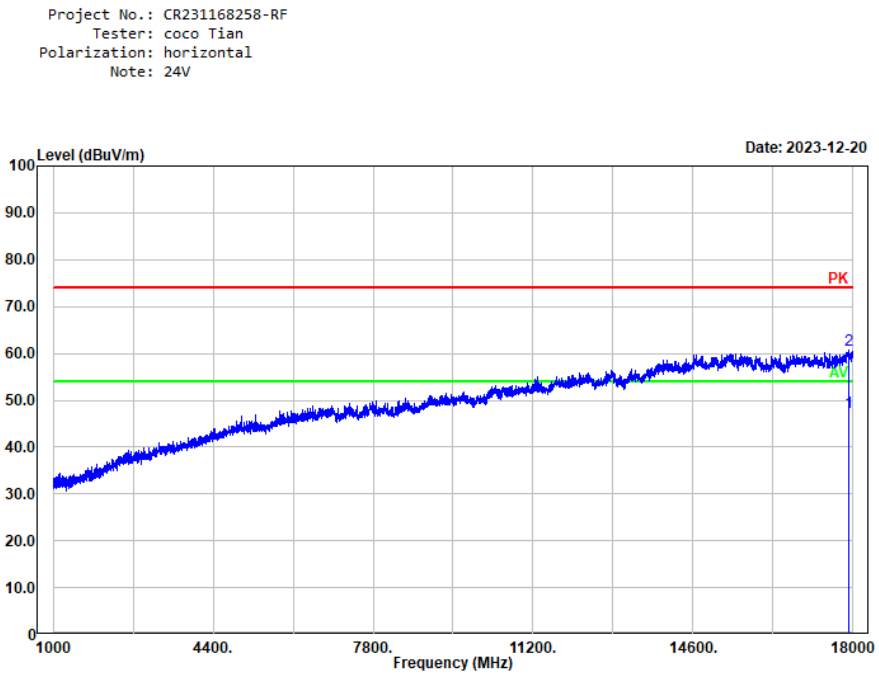
$$PD = \frac{EIRP_{Linear}}{4\pi d^2}$$

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.

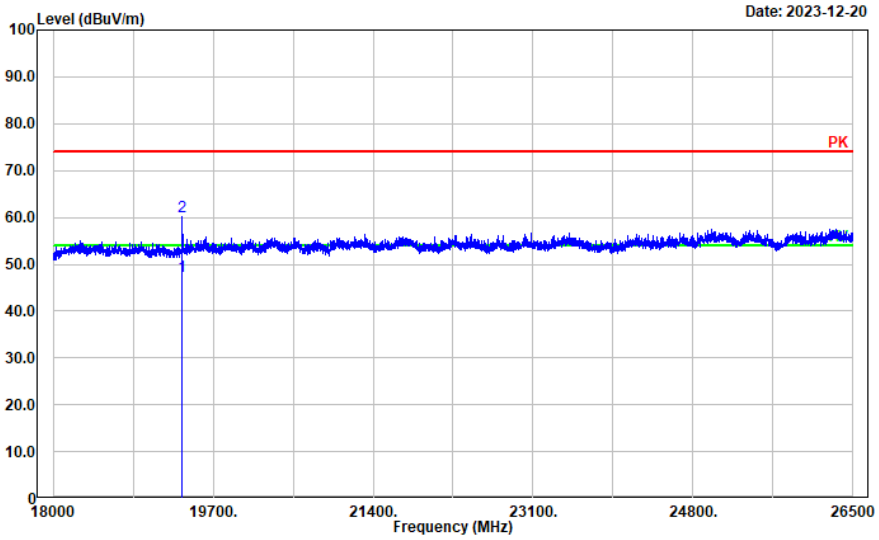
Test plots

Horizontal	
1-18GHz	

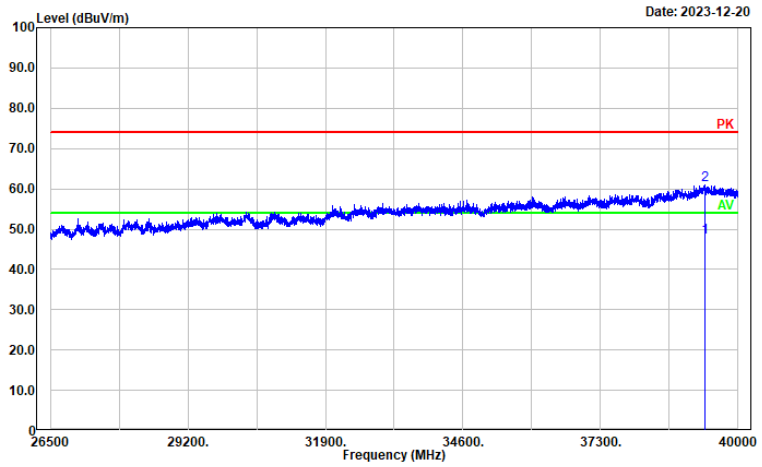
No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	17908.180	15.32	32.21	47.53	54.00	6.47	Average
2	17908.180	28.36	32.21	60.57	74.00	13.43	Peak

Horizontal	
18-26.5GHz	

Project No.: CR231168258-RF
Tester: coco Tian
Polarization: horizontal
Note: 24V

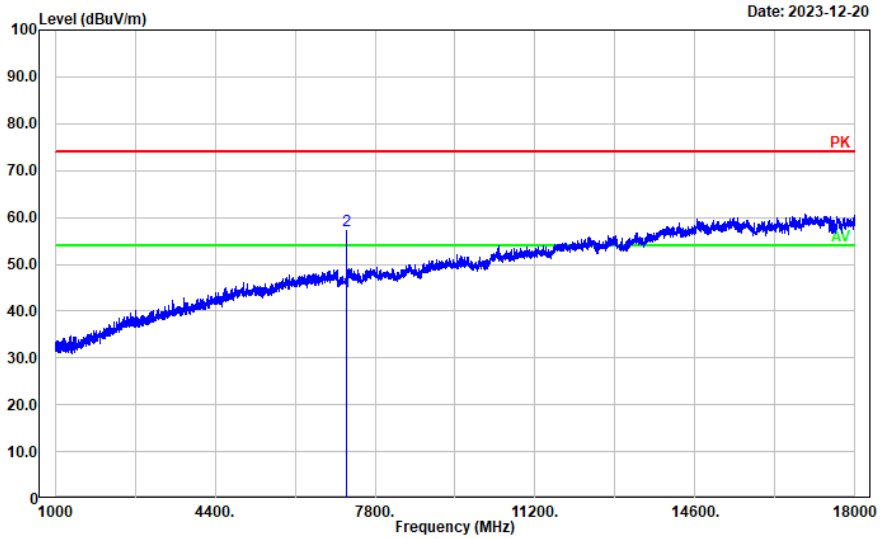


No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	19373.880	42.76	4.78	47.54	54.00	6.46	Average
2	19373.880	55.26	4.78	60.04	74.00	13.96	Peak

26.5-40GHz	Project No.: CR231168258-RF Tester: coco Tian Polarization: horizontal Note: 24V  No. Frequency (MHz) Reading (dBµV) Factor (dB/m) Result (dBµV/m) Limit (dBµV/m) Margin (dB) Detector 1 39354.570 37.75 10.17 47.92 54.00 6.08 Average 2 39354.570 50.91 10.17 61.08 74.00 12.92 Peak

Vertical	
1-18GHz	

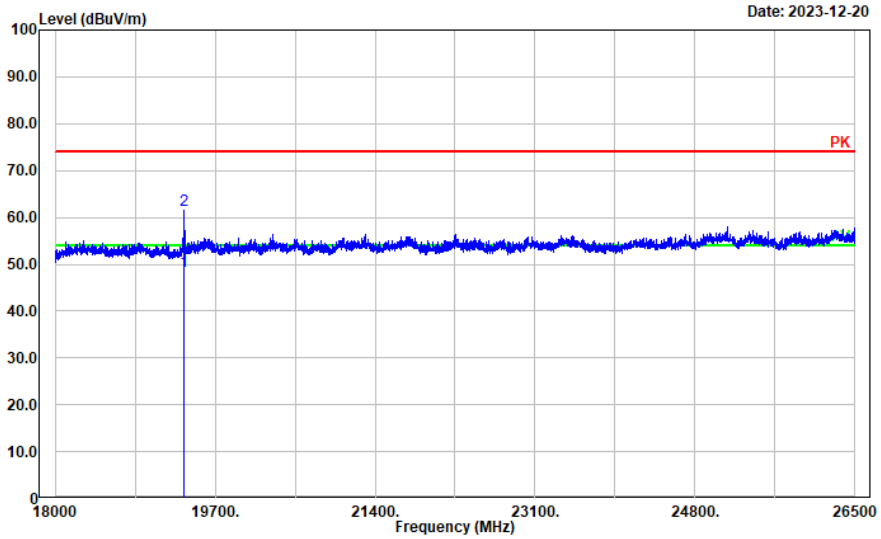
Project No.: CR231168258-RF
Tester: coco Tian
Polarization: vertical
Note: 24V



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	7199.440	29.12	14.99	44.11	54.00	9.89	Average
2	7199.440	42.07	14.99	57.06	74.00	16.94	Peak

Vertical	
18-26.5GHz	

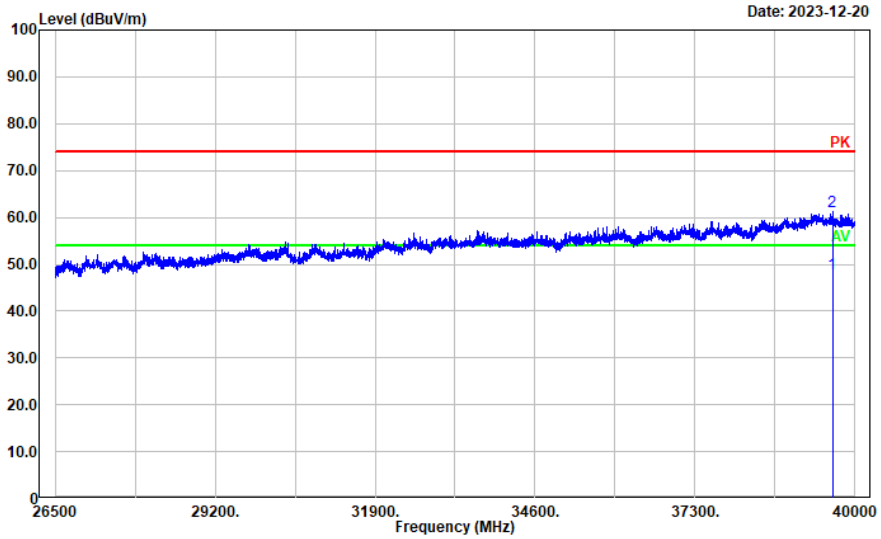
Project No.: CR231168258-RF
Tester: coco Tian
Polarization: vertical
Note: 24V



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	19373.880	43.69	4.78	48.47	54.00	5.53	Average
2	19373.880	56.73	4.78	61.51	74.00	12.49	Peak

26.5-40GHz

Project No.: CR231168258-RF
Tester: coco Tian
Polarization: vertical
Note: 24V



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	39616.520	38.17	9.69	47.86	54.00	6.14	Average
2	39616.520	51.62	9.69	61.31	74.00	12.69	Peak

4.3 Frequency Stability:

Serial Number:	2DW5-1	Test Date:	2023/12/20
Test Site:	RF	Test Mode:	Transmitting
Tester:	coco Tian	Test Result:	

Environmental Conditions:					
Temperature: (℃)	25.9	Relative Humidity: (%)	52	ATM Pressure: (kPa)	101.8

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2023/3/31	2024/3/30
OML	Harmonic Mixer	WR12/M12HWD	E60119-1	2023/2/16	2026/2/15
OML	Horn Antenna	M12RH	E60119-2	2023/2/27	2026/2/26
BACL	TEMP&HUMI Test Chamber	BTH-150-40	30174	2023/3/31	2024/3/30
UNI-T	Multimeter	UT39A+	C210582554	2023/9/28	2024/9/27
ZHAOXIN	DC Power Supply	RXN-6010D	21R6010D0912386	N/A	N/A

**** 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	24	77.5058	78.6961	76	81
	12	77.5054	78.6957	76	81
-10	24	77.5055	78.6958	76	81
	12	77.5052	78.6953	76	81
0	24	77.5048	78.6943	76	81
	12	77.5045	78.6941	76	81
10	24	77.5043	78.6937	76	81
	12	77.5040	78.6933	76	81
20	24	77.5039	78.6939	76	81
	12	77.5035	78.6931	76	81
30	24	77.5077	78.6929	76	81
	12	77.5053	78.6915	76	81
40	24	77.5059	78.6932	76	81
	12	77.5061	78.6935	76	81
50	24	77.5029	78.6931	76	81
	12	77.5024	78.6926	76	81
20	10	77.5050	78.6951	76	81
20	32	77.5017	78.6976	76	81

4.4 Occupied Bandwidth:

Serial Number:	2DW5-1	Test Date:	2023/12/20
Test Site:	966-1	Test Mode:	Transmitting
Tester:	coco Tian	Test Result:	N/A

Environmental Conditions:					
Temperature: (℃)	25.9	Relative Humidity: (%)	52	ATM Pressure: (kPa)	101.8

Test Equipment List and Details:

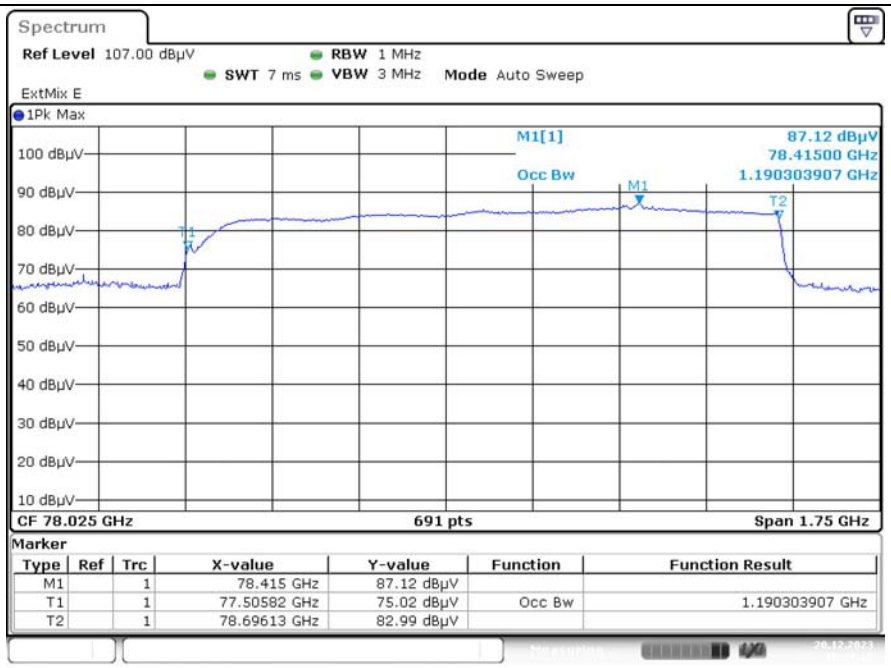
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2023/3/31	2024/3/30
OML	Harmonic Mixer	WR12/M12HWD	E60119-1	2023/2/16	2026/2/15
OML	Horn Antenna	M12RH	E60119-2	2023/2/27	2026/2/26

**** 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)	99% Occupied Bandwidth (MHz)
77.50-78.70 GHz	1190.304

99% Emission Bandwidth



4.5 Duty Cycle:

Serial Number:	2DW5-1	Test Date:	2023/12/20
Test Site:	RF	Test Mode:	Transmitting
Tester:	coco Tian	Test Result:	N/A

Environmental Conditions:					
Temperature: (℃)	25.9	Relative Humidity: (%)	52	ATM Pressure: (kPa)	101.8

Test Equipment List and Details:

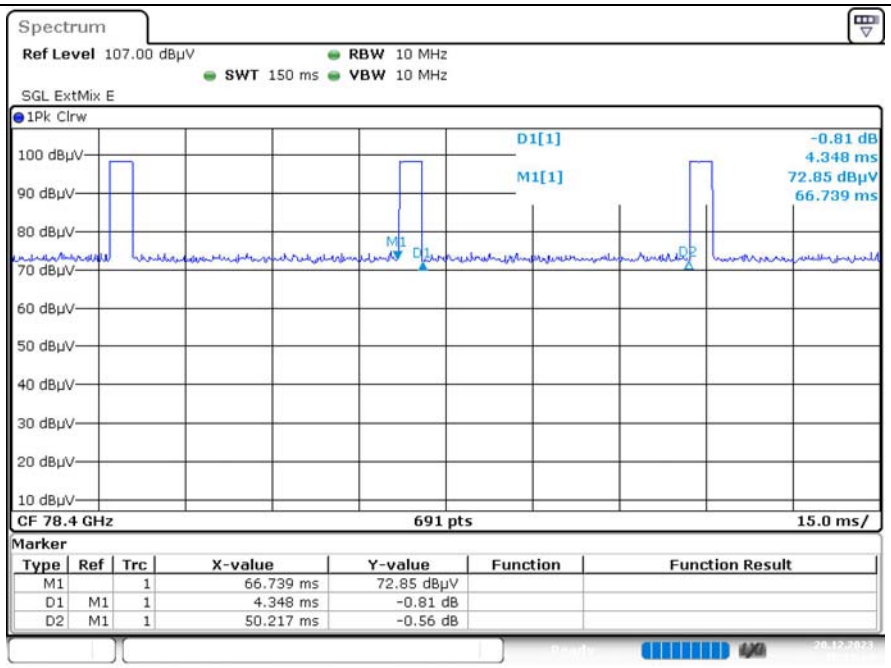
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101943	2023/3/31	2024/3/30
OML	Harmonic Mixer	WR12/M12HWD	E60119-1	2023/2/16	2026/2/15
OML	Horn Antenna	M12RH	E60119-2	2023/2/27	2026/2/26

**** 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 (%)
77.50-78.70 GHz	4.35	50.22	8.66%

Duty Cycle


Spectrum
Ref Level 107.00 dBµV
RBW 10 MHz
SWT 150 ms VBW 10 MHz
SGL ExtMix E
1Pk Clrw
D1[1] -0.81 dB
4.348 ms
M1[1] 72.85 dBµV
66.739 ms
100 dBµV
90 dBµV
80 dBµV
70 dBµV
60 dBµV
50 dBµV
40 dBµV
30 dBµV
20 dBµV
10 dBµV
CF 78.4 GHz
691 pts
15.0 ms/
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 66.739 ms 72.85 dBµV
D1 M1 1 4.348 ms -0.81 dB
D2 M1 1 50.217 ms -0.56 dB
ProjectNo.:CR231168258-RF Tester:coco Tian
Date: 20.DEC.2023 18:13:14

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)	**EIRP Average Output power including Tune-up Tolerance**		**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**MPE Limit (mW/cm^2)**
	(dBm)	**(mW)**			
77.50-78.70	27	501	20	0.1	1

Result: The device meet FCC MPE at 20 cm distance.

6. EUT PHOTOGRAPHS

Please refer to the attachment CR231168258-EXP EUT EXTERNAL PHOTOGRAPHS and CR231168258-INP EUT INTERNAL PHOTOGRAPHS

7. TEST SETUP PHOTOGRAPHS

Please refer to the attachment CR231168258-00B-TSP TEST SETUP PHOTOGRAPHS.

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