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

ACCREDITED
TESTING LABORATORY
CERTIFICATE # 6356.01

TEST REPORT

Applicant: **Autel Robotics Co., Ltd.**

Address: 601, 701, 801, 901, Block B1, Nanshan iPark, No. 1001 Xueyuan Avenue, Nanshan District, Shenzhen, Guangdong, 518055, China

FCC ID: **2AGNTMDH240958A**

Product Name: **Autel Alpha**

Standard(s): **47 CFR Part 15, Subpart C(15.255)**
ANSI C63.10-2013

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: **CR230636130-00F**

Date Of Issue: **2023/11/29**

Reviewed By: **Julie Tan** Julie Tan

Title: RF Engineer

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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	CR230636130-00F	Original Report	2023/11/29

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Name:	Autel Alpha
EUT Model:	MDH
Operation Frequency Range:	Low Band:60-62 GHz High Band:62-64 GHz
Maximum EIRP:	Low Band:19.43 dBm High Band:19.60 dBm
Modulation Type:	FMCW
Rated Input Voltage:	DC 23.7V from battery
Serial Number:	278G-2
EUT Received Date:	2023/6/26
EUT Received Status:	Good

Antenna Information Detail▲:

Antenna Type	input impedance (Ohm)	Antenna Gain	Frequency Range
Microstrip Array	50	10 dBi	60~64GHz

The Method of §15.203 Compliance:

☒Antenna was permanently attached to the unit.

☐Antenna use a unique type of connector to attach to the EUT.

☐Unit was professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

Accessory Information:

Accessory Description	Manufacturer	Model
Adapter	Shenzhen Esun Power Technology Co.,Ltd	DF_CHARGER

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 have 6 Radar Module, operates in the below frequency range: Front Radar: 62-64GHz(High Band) Back Radar: 60-62GHz(Low Band) Top Radar: 60-62GHz(Low Band) Bottom Radar: 62-64GHz(High Band) Left Radar: 62-64GHz(High Band) Right Radar: 60-62GHz(Low Band) Each module was tested separately, except radiation emissions test simultaneously.
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

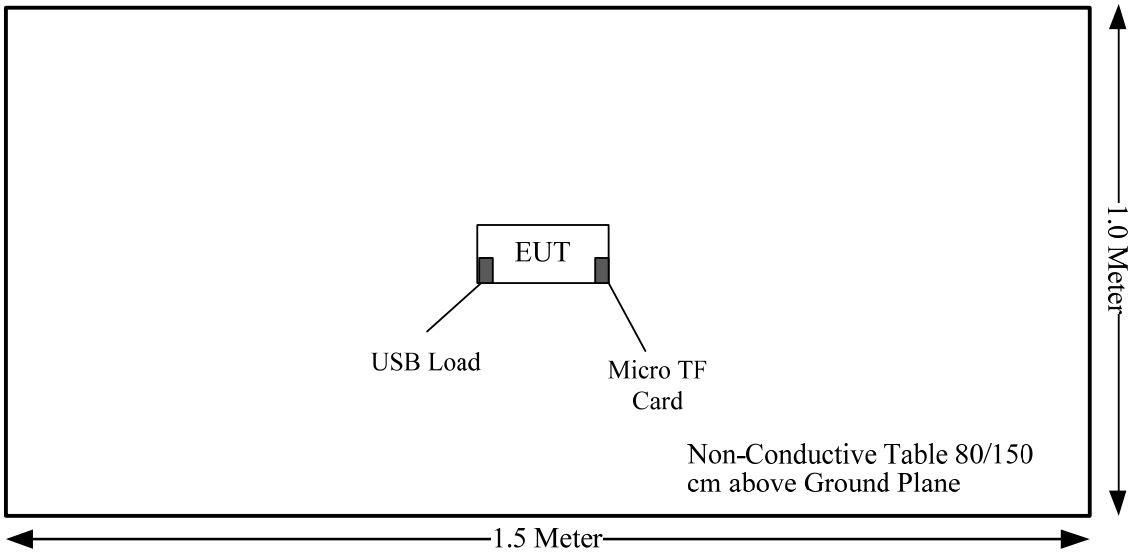
Manufacturer	Description	Model	Serial Number
Unknown	USB Load	Unknown	Unknown
SanDisk	Micro TF Card	UHS-I-16G	9292DVDSV0XZ

1.2.3 Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
/	/	/	/	/	/

1.2.4 Block Diagram of Test Setup

Spurious emissions



1.3 FAR Field Boundary Calculations

The far-field boundary is given in ANSI C63.10-2013:

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

Where:

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

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

The minimum test distance for the frequency range 40GHz-200GHz determine as below:

Model	Frequency Range (GHz)	Largest Dimension of the Horn Antenna (mm)	Minimum Test Distance R_m (m)
M19RH	40-60	46.3	0.57
861V/385	50-75	43.7	0.64
M12RH	60-90	30.02	0.36
M08RH	90-140	19.7	0.23
M05RH	140-220	12.5	0.30

Note: The test distances used were 1.0 m from 40 GHz to 90 GHz, and 0.5 m from 90 GHz to 200 GHz, it can be seen that the EUT was always in the Far-field of the Receive Antenna during all Radiated Emissions Tests.

1.4 Measurement Uncertainty

Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
Unwanted Emissions, radiated	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
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	2.8 dB (150 kHz to 30 MHz)

2. SUMMARY OF TEST RESULTS

Standard(s)/Rule(s)	Description of Test	Result
§15.207(a)	Conduction Emissions	Not Applicable
§15.205, §15.209, §15.255(d)	Radiated Emissions	Compliant
§15.215	20dB Emission Bandwidth	Compliant
§15.255(b)(3)	Equivalent Isotropically Radiated Power (EIRP)	Compliant
§15.255 (f)	Frequency Stability	Compliant
§15.255(b)(3)	Duty Cycle	Compliant
§15.255 (a),(b),(h)	Operation Restriction And Group Installation	Compliant
§15.203	Antenna Requirement	Compliant

3. REQUIREMENTS AND TEST PROCEDURES

3.1 AC Line Conducted Emissions

3.1.1 Applicable Standard

FCC§15.207(a).

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

	Conducted limit (dBμV)	
Frequency of emission (MHz)	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

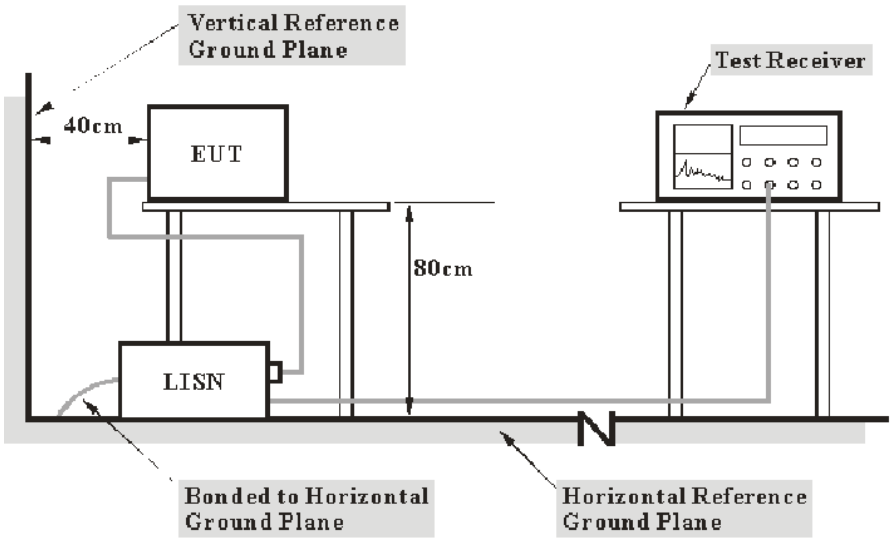
(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 μV within the frequency band 535-1705 kHz, as measured using a 50 μH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtainig their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

3.1.2 EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

3.1.3 EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

3.1.4 Test Procedure

During the conducted emission test, the EUT was connected to the outlet of the first LISN.

The frequency and amplitude of the six highest ac power-line conducted emissions relative to the limit, measured over all the current-carrying conductors of the EUT power cords, and the operating frequency or frequency to which the EUT is tuned (if appropriate), should be reported, unless such emissions are more than 20 dB below the limit. AC power-line conducted emissions measurements are to be separately carried out only on each of the phase ("hot") line(s) and (if used) on the neutral line(s), but not on the ground [protective earth] line(s). If less than six emission frequencies are within 20 dB of the limit, then the noise level of the measuring instrument at representative frequencies should be reported. The specific conductor of the power-line cord for each of the reported emissions should be identified. Measure the six highest emissions with respect to the limit on each current-carrying conductor of each power cord associated with the EUT (but not the power cords of associated or peripheral equipment that are part of the test configuration). Then, report the six highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current-carrying conductor identified with the emission. The six highest emissions should be reported for each of the current-carrying conductors, or the six highest emissions may be reported over all the current-carrying conductors.

3.1.5 Corrected Amplitude & Margin Calculation

The basic equation is as follows:

Result = Reading + Factor
Factor = attenuation caused by cable loss + voltage division factor of AMN

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. The equation for margin calculation is as follows:

Margin = Limit – Result

3.2 Radiated Emissions

3.2.1 Applicable Standard

FCC §15.255(d) Limits on spurious emissions:

(1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

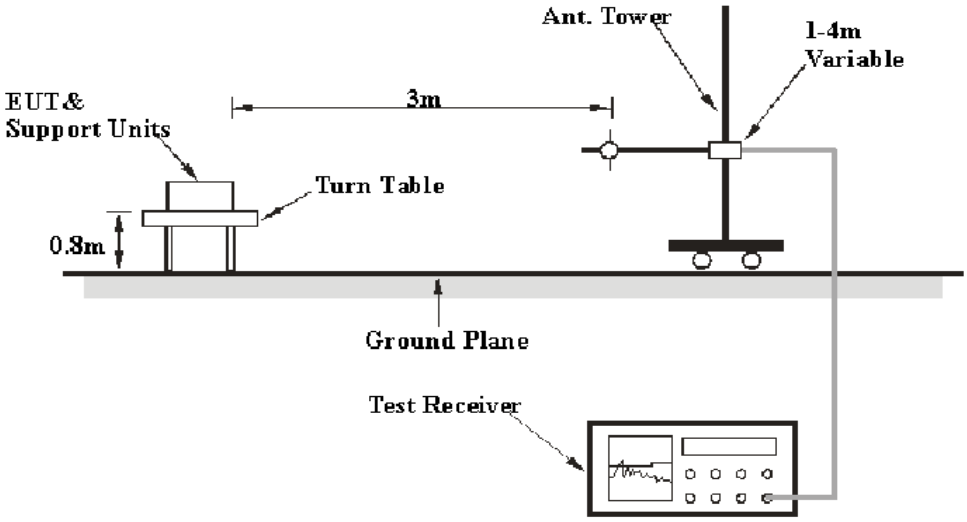
(2) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters.

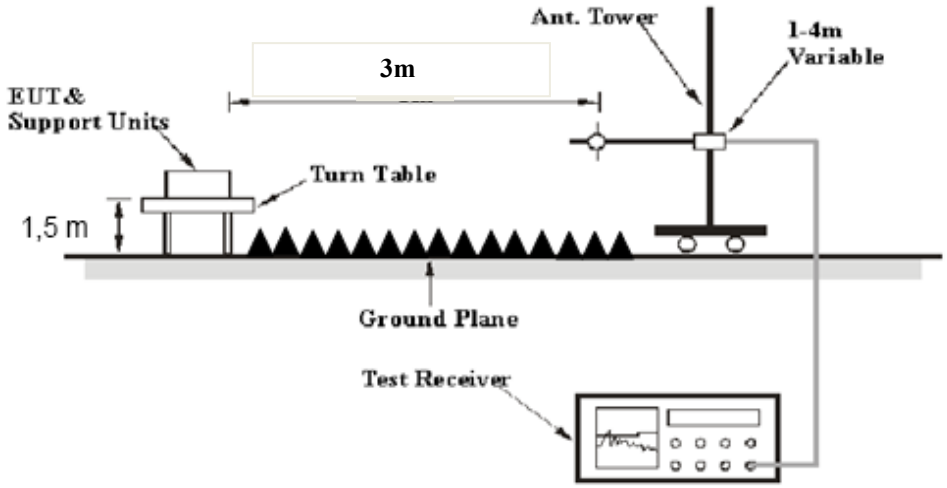
(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

3.2.2 EUT Setup

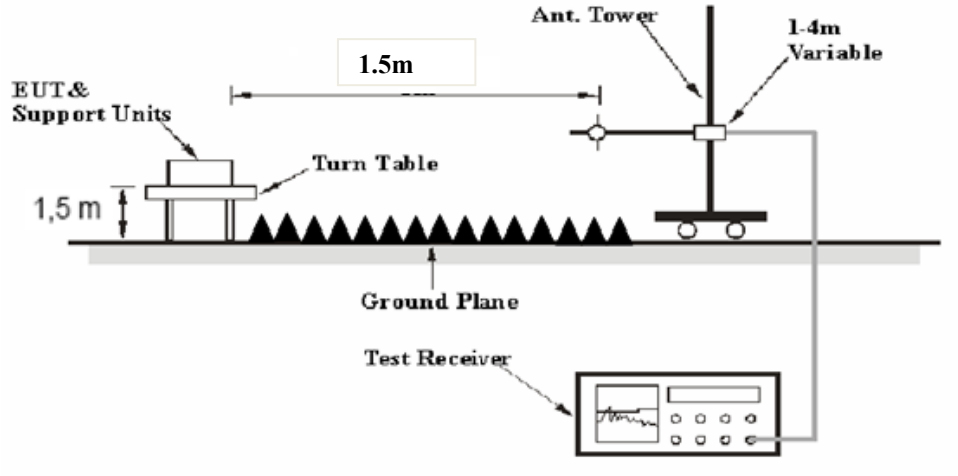
Below 1GHz:



1-26.5 GHz:



26.5-40 GHz:



Above 40GHz:

The antenna is scanned around the entire perimeter surface of the EUT, in both horizontal and vertical polarizations, at the distance of 1.0 m from 40 GHz to 90 GHz, and 0.5 m from 90 GHz to 200 GHz.

The radiated emission and out of band emission tests were performed in the 3 meters chamber test site A, using the setup accordance with the ANSI C63.10-2013 The specification used was the FCC 15.209/15.205 and FCC 15.255 limits.

3.2.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 200 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
1-40 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Ave
40 GHz – 200 GHz	1MHz	3 MHz	/	PK

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

Refer to ANSI C63.10-2013 Clauses 9.9, 9.12, and 9.13.

A Maximizing procedure was performed to ensure that the highest emissions from the EUT were actually measured in all of the Test Arrangements of the EUT and Local Support Equipment.

In accordance with FCC Rules Part 15 Subpart A Section 15.35, from 30 MHz to 1 GHz all radiated emissions measurements were made using a Quasi-peak Detector, and from 1 GHz to 40 GHz, all radiated emissions measurements were made using a Peak Detector and CISPR Average Detector. In accordance with FCC Rules Part 15 Subpart C Section 15.255, from 40 GHz to 200 GHz, all radiated emissions measurements were made using a Peak Detector.

According to C63.10, 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

Distance extrapolation factor =20 log (specific distance [3m]/test distance [1.5m]) dB= 6.02 dB

All emissions under the average limit and under the noise floor have not recorded in the report.

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

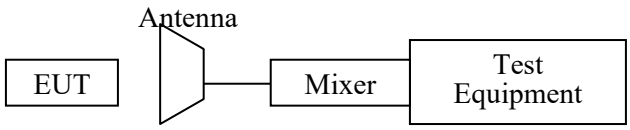
3.3 20dB Emission Bandwidth:

3.3.1 Applicable Standard

FCC §15.215

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

3.3.2 EUT Setup

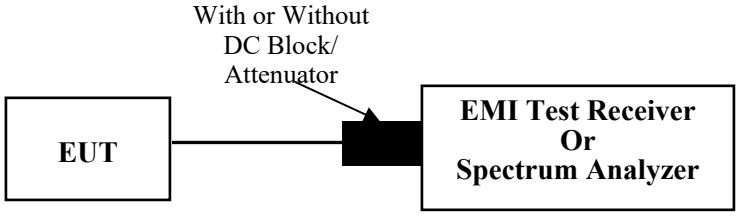


3.3.3 Test Procedure

According to ANSI C63.10-2013 Section 9.3.

3.4 99% Occupied Bandwidth

3.4.1 EUT Setup



3.4.2 Test Procedure

According to ANSI C63.10-2013 Section 6.9.3

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.
The following procedure shall be used for measuring 99% power bandwidth:
a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
d) Step a) through step c) might require iteration to adjust within the specified range.
e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

3.5 Equivalent Isotropically Radiated Power (EIRP)

3.5.1 Applicable Standard

FCC §15.255(b)(3)

Field disturbance sensors/radar devices deployed on unmanned aircraft may operate within the frequency band 60 – 64 GHz, provided that the transmitter not exceed 20 dBm peak EIRP. The sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds. Operation shall be limited to a maximum of 121.92 meters (400 feet) above ground level.

3.5.2 Test Procedure

Refer to ANSI C63.10-2013 Clause 9.11

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

3.6 Frequency Stability

3.6.1 Applicable Standard

FCC§15.255 (f)

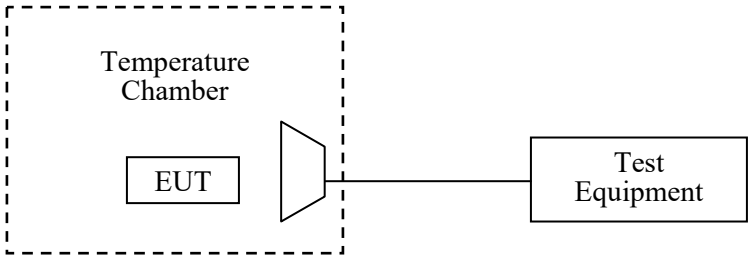
Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

3.6.2 Test Procedure

Frequency Stability vs. Temperature: The adapter of the equipment under test was connected to an power source. The EUT was placed inside the temperature chamber. Place the Horn antenna outside the temperature chamber. Place the EUT antenna toward the Horn antenna.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the communication test set.

Frequency Stability vs. Voltage: An external variable DC power supply was connected to the equipment under test. The voltage was set from 85% to 115% of the nominal value. The output frequency was recorded for each voltage.



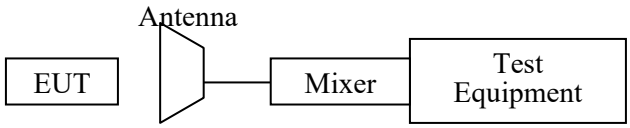
3.7 Duty Cycle:

3.7.1 Applicable Standard

FCC §15.255(b)(3)

Field disturbance sensors/radar devices deployed on unmanned aircraft may operate within the frequency band 60 – 64 GHz, provided that the transmitter not exceed 20 dBm peak EIRP. The sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds. Operation shall be limited to a maximum of 121.92 meters (400 feet) above ground level.

3.7.2 EUT Setup



3.7.3 Test Procedure

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:
1) Set the center frequency of the instrument to the center frequency of the transmission.
2) Set RBW ⩾ OBW if possible; Otherwise, set RBW to the largest available value.
3) Set VBW ⩾ RBW. Set detector = peak or average.

3.8 Operation Restriction and Group Installation

3.8.1 Applicable Standard

§15.255 (a) General. Operation under the provisions of this section is not permitted for equipment used on satellites.

§15.255 (b) Operation on aircraft. Operation on aircraft is permitted under the following conditions:

(1) When the aircraft is on the ground.

(2) While airborne, only in closed exclusive on-board communication networks within the aircraft, with the following exceptions:

(i) Equipment shall not be used in wireless avionics intra-communication (WAIC) applications where external structural sensors or external cameras are mounted on the outside of the aircraft structure.

(ii) Except as permitted in paragraph (b)(3) of this section, equipment shall not be used on aircraft where there is little attenuation of RF signals by the body/fuselage of the aircraft.

(iii) Field disturbance sensor/radar devices may only operate in the frequency band 59.3–71.0 GHz while installed in passengers' personal portable electronic equipment (e.g., smartphones, tablets) and shall comply with paragraph (b)(2)(i) of this section, and relevant requirements of paragraphs (c)(2) through (c)(4) of this section.

(3) Field disturbance sensors/radar devices deployed on unmanned aircraft may operate within the frequency band 60–64 GHz, provided that the transmitter not exceed 20 dBm peak EIRP. The sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds. Operation shall be limited to a maximum of 121.92 meters (400 feet) above ground level.

§15.255 (h) Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

3.8.2 Result

15.255(a), the device is a unmanned aircraft. Not used on satellites.

15.255(b)(1), the Radar Operation on aircraft when the aircraft is on the ground.

15.255(b)(2), not applicable, the device is a unmanned aircraft.

15.255(b)(3), Operation be limited to a maximum of 121.92 meters (400 feet) above ground level. Please refer to the user manual.

§15.255 (h), No equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

3.9 Antenna Requirement

3.9.1 Applicable Standard

FCC §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.
c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

3.9.2 Judgment

Result: Compliant. Please refer to the Antenna Information detail in Section 1.

4. TEST DATA AND RESULTS

4.1 AC Line Conducted Emissions

Not Applicable, the device was powered by battery when operating.

4.2 Radiated Emissions

Serial Number:	278G-2	Test Date:	2023/10/9~2023/11/28
Test Site:	966-2/966-1	Test Mode:	Transmitting
Tester:	Vic Du, Mack Huang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.3~26.3	Relative Humidity: (%)	56~62	ATM Pressure: (kPa)	100.7~101.3

Test Equipment List and Details:

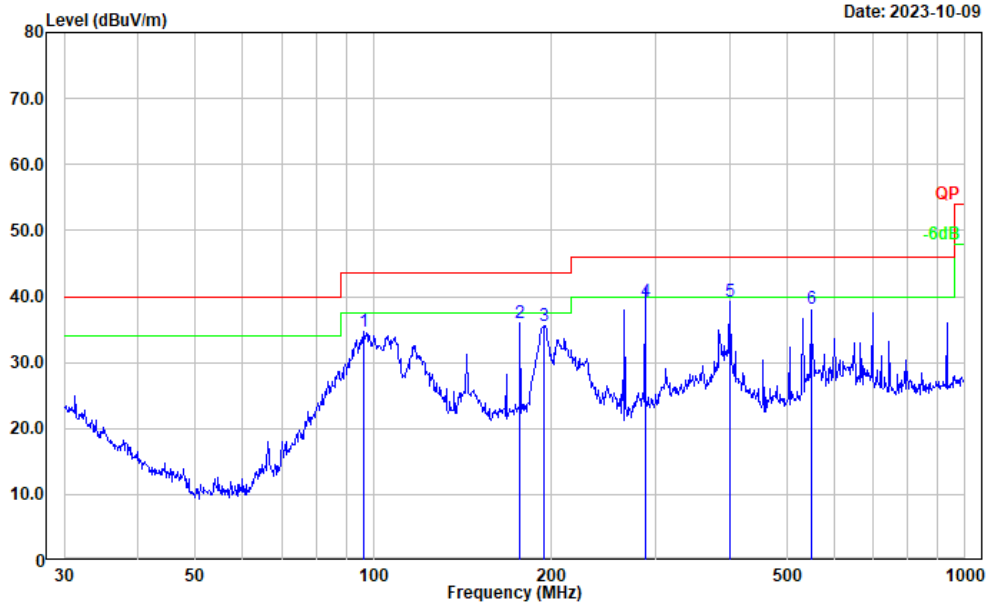
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sunol Sciences	Antenna	JB6	A082520-5	2020/10/19	2023/10/18
R&S	EMI Test Receiver	ESR3	102724	2023/3/31	2024/3/30
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0470-02	2023/7/16	2024/7/15
TIMES MICROWAVE	Coaxial Cable	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	2025/2/23
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	2022/11/9	2023/11/8
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2023/11/8	2024/11/9
Audix	Test Software	E3	201021 (V9)	N/A	N/A
PASTERNACK	Horn Antenna	PE9852/2F-20	112002	2021/2/5	2024/2/4
AH	Preamplifier	PAM-1840VH	190	2022/11/9	2023/11/8
AH	Preamplifier	PAM-1840VH	190	2023/11/8	2024/11/9
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	2021/10/15	2024/10/16
OML	Horn Antenna	M19RH	11648-03	2021/10/15	2024/10/16
OML	Harmonic Mixer	WR12/M12HWD	E60119-1	2021/10/16	2024/10/17
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	Horn Antenna	M12RH	E60119-2	2021/10/17	2024/10/18
OML	Harmonic Mixer	WR08/M08HWD	F60315-1	2021/10/21	2024/10/22
OML	Horn Antenna	M08RH	F60315-2	2021/10/23	2024/10/24

OML	Harmonic Mixer	WR05/M05HWD	G60107-1	2021/10/24	2024/10/25
OML	Horn Antenna	M05RH	G60107-2	2021/10/25	2024/10/26

** 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).*

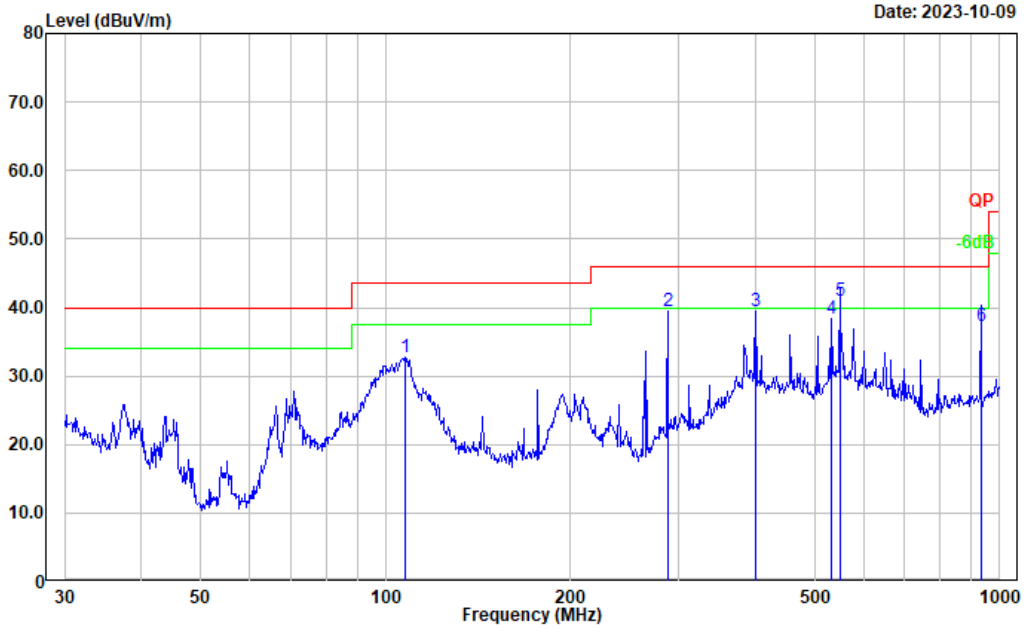
1) 30MHz-1GHz(radar modules transmitting simultaneously):

Project No.: CR230636130-RF
Tester: Vic Du
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	96.436	49.98	-15.23	34.75	43.50	8.75	Peak
2	176.888	49.39	-13.41	35.98	43.50	7.52	Peak
3	193.773	48.62	-12.96	35.66	43.50	7.84	Peak
4	287.990	50.34	-11.16	39.18	46.00	6.82	QP
5	400.432	48.01	-8.74	39.27	46.00	6.73	Peak
6	549.020	43.82	-5.77	38.05	46.00	7.95	Peak

Project No.: CR230636130-RF
Tester: Vic Du
Polarization: vertical
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	107.510	45.57	-12.80	32.77	43.50	10.73	Peak
2	287.990	50.57	-11.16	39.41	46.00	6.59	Peak
3	400.432	48.23	-8.74	39.49	46.00	6.51	Peak
4	531.964	44.27	-5.99	38.28	46.00	7.72	Peak
5	549.020	46.79	-5.77	41.02	46.00	4.98	QP
6	932.272	37.93	-0.55	37.38	46.00	8.62	QP

2) 40GHz-200GHz:

Frequency (GHz)	Receiver		Polar (H/V)	Factor (dB/m)	Field Strength (dBμV/m)	Power Density (pW/cm^2)	Limit (pW/cm^2)
	Reading (dBμV)	Detector					
47.130	46.89	PK	H	39.90	77.25	14.08	90.00
48.050	47.75	PK	V	40.05	78.26	17.77	90.00
74.260	44.68	PK	H	44.13	79.27	22.42	90.00
77.140	46.14	PK	V	43.51	80.11	27.21	90.00
120.350	48.26	PK	H	48.03	80.73	31.38	90.00
122.830	48.63	PK	V	48.14	81.21	35.05	90.00
181.860	48.66	PK	H	50.73	83.83	64.07	90.00
182.630	48.95	PK	V	50.76	84.15	68.97	90.00
46.620	46.57	PK	H	39.82	76.85	12.84	90.00
48.530	47.28	PK	V	40.12	77.86	16.21	90.00
75.260	44.85	PK	H	43.28	78.59	19.17	90.00
76.680	46.24	PK	V	43.46	80.16	27.52	90.00
122.360	48.76	PK	H	48.12	81.32	35.95	90.00
123.450	48.93	PK	V	48.17	81.54	37.81	90.00
183.630	48.85	PK	H	50.80	84.09	68.02	90.00
185.270	48.18	PK	V	50.87	83.49	59.25	90.00

Note:
Factor = Antenna Factor
Field Strength = Reading + Factor + 20log($d_{Meas}/d_{SpecLimit}$)
d_{Meas} is the measurement distance, in m
$d_{SpecLimit}$ is the distance specified by the limit, in m

$$PD = \frac{E_{SpecLimit}^2}{377}$$

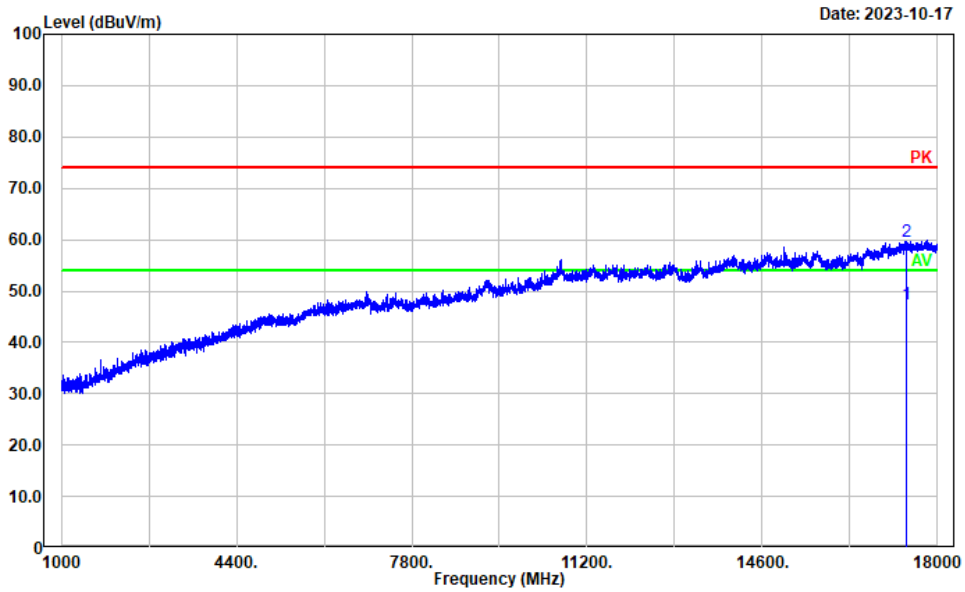
where

PD is the power density at the distance specified by the limit, in W/m^2
$E_{SpecLimit}$ is the field strength at the distance specified by the limit, in V/m

The Specified distance is 3m.

Test Plots

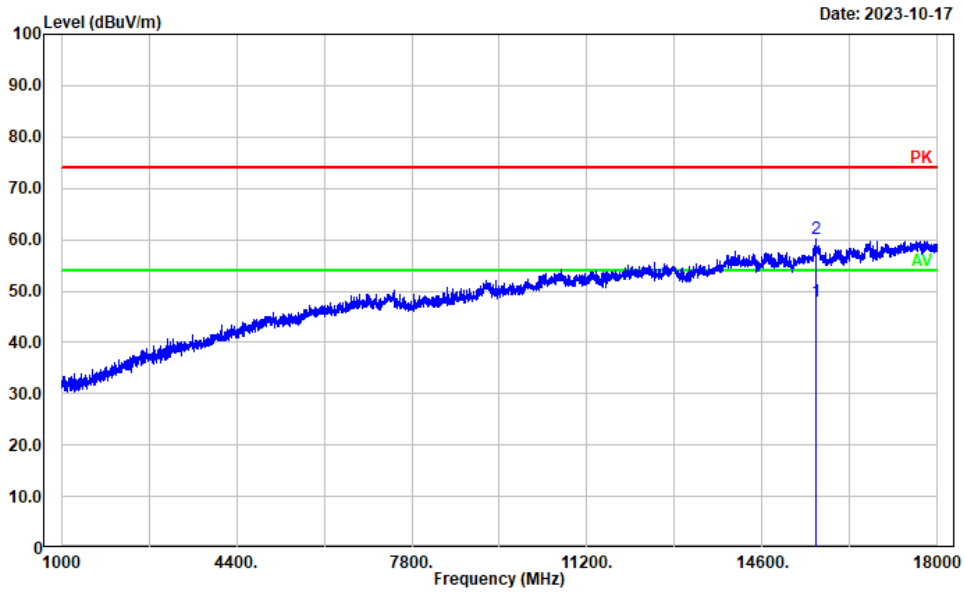
Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	17408.280	17.59	29.74	47.33	54.00	6.67	Average
2	17408.280	29.90	29.74	59.64	74.00	14.36	Peak

Test Plots

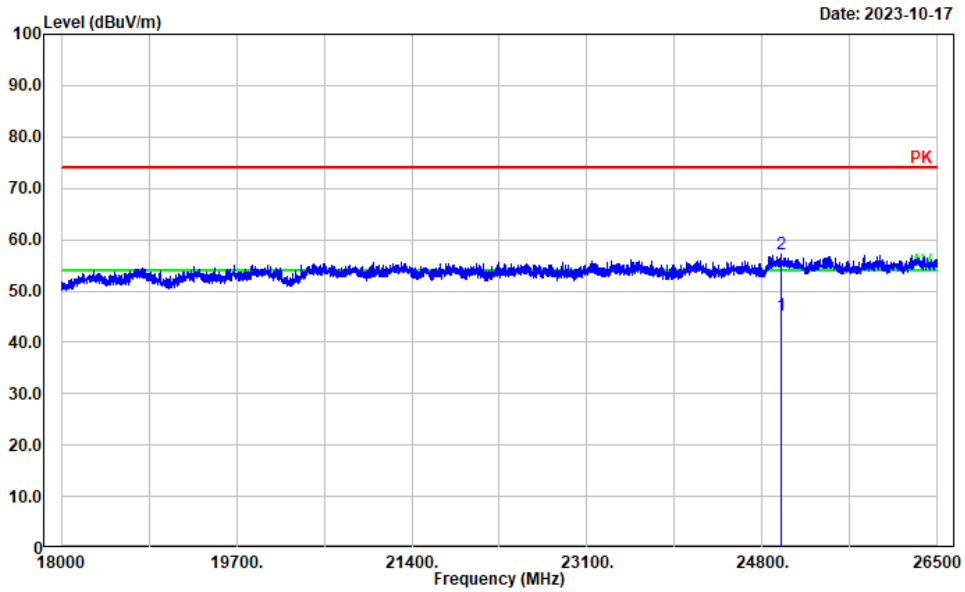
Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: vertical
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	15629.730	23.16	24.73	47.89	54.00	6.11	Average
2	15629.730	35.34	24.73	60.07	74.00	13.93	Peak

Test Plots

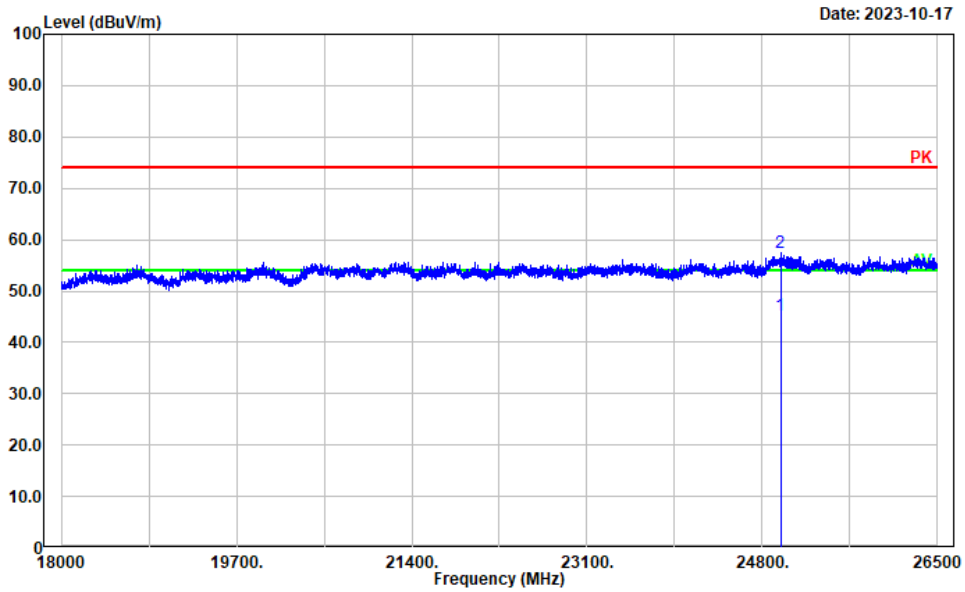
Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	24985.000	38.47	6.73	45.20	54.00	8.80	Average
2	24985.000	50.41	6.73	57.14	74.00	16.86	Peak

Test Plots

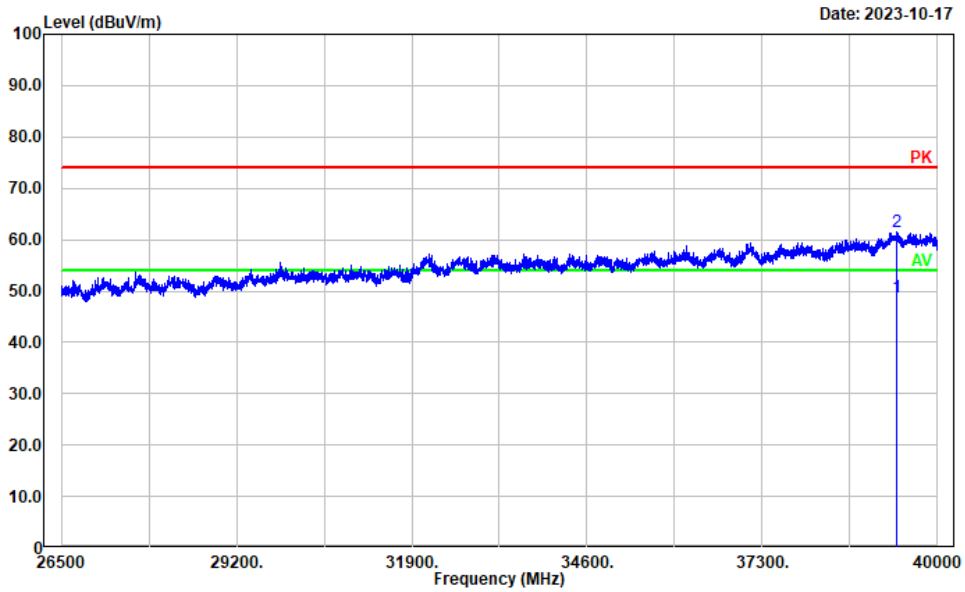
Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: vertical
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	24976.500	38.55	6.68	45.23	54.00	8.77	Average
2	24976.500	50.66	6.68	57.34	74.00	16.66	Peak

Test Plots

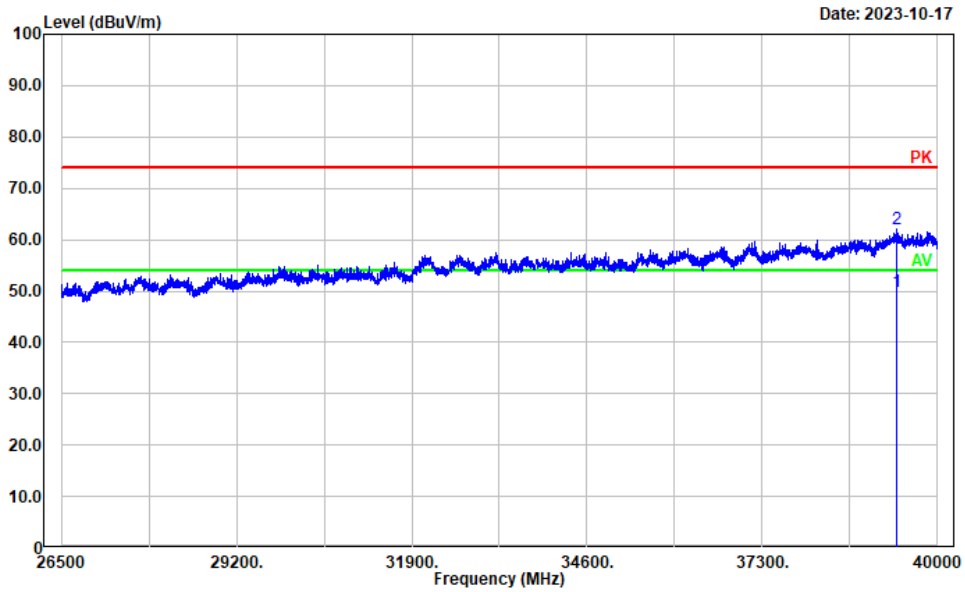
Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	39370.770	38.51	10.18	48.69	54.00	5.31	Average
2	39370.770	51.27	10.18	61.45	74.00	12.55	Peak

Test Plots

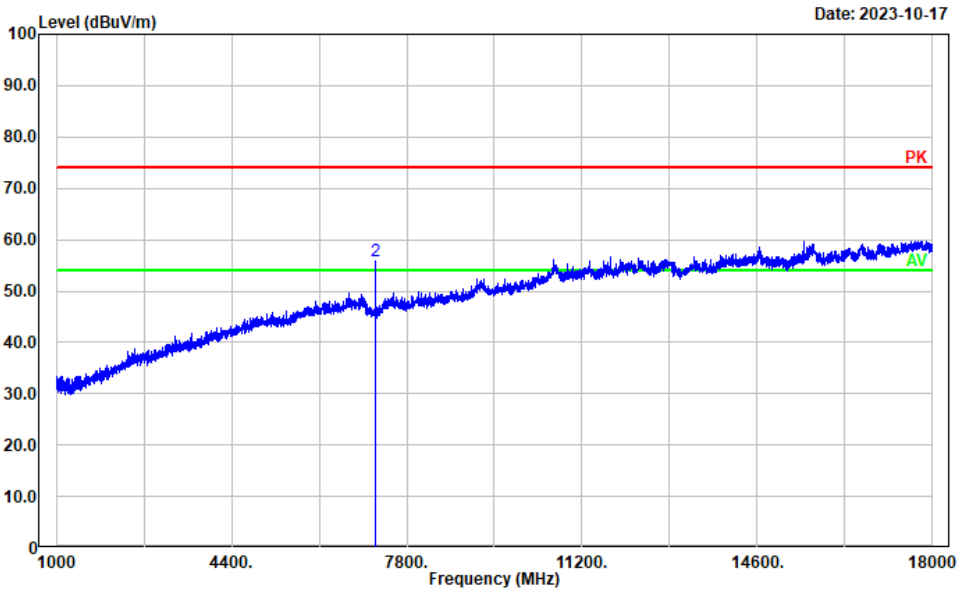
Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: vertical
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	39359.970	39.60	10.18	49.78	54.00	4.22	Average
2	39359.970	51.91	10.18	62.09	74.00	11.91	Peak

Test Plots

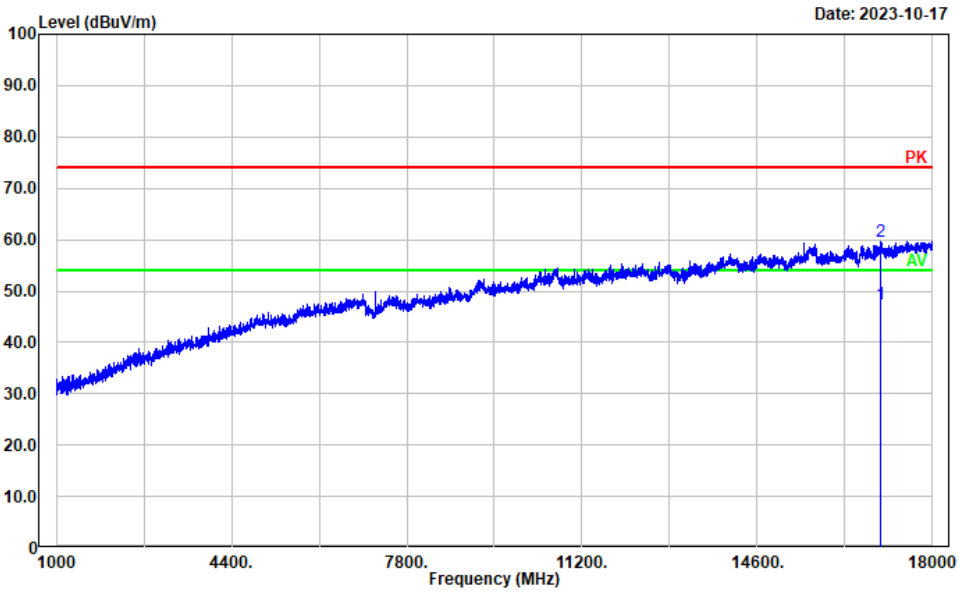
Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	7199.440	28.57	14.99	43.56	54.00	10.44	Average
2	7199.440	40.91	14.99	55.90	74.00	18.10	Peak

Test Plots

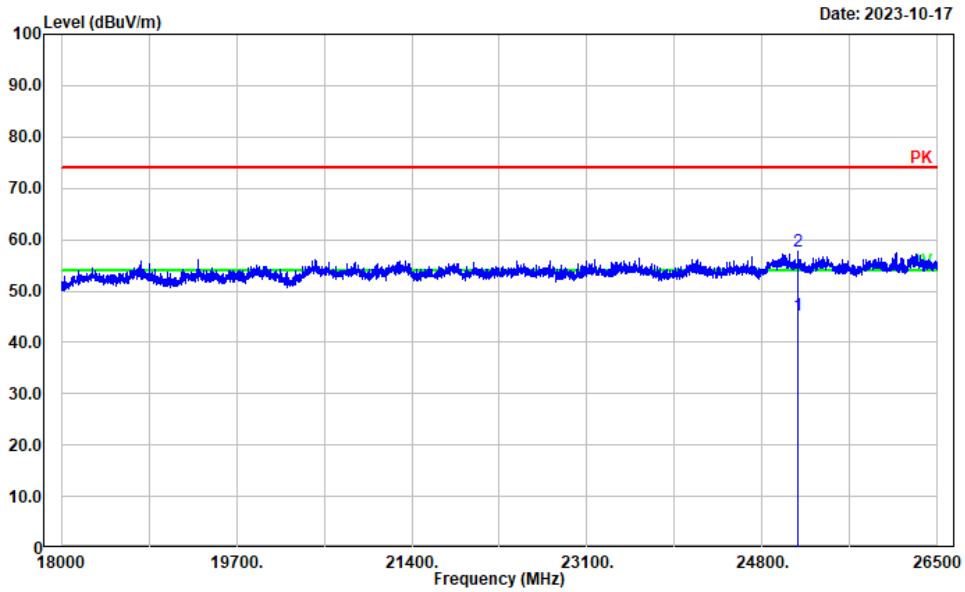
Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: vertical
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	17000.200	19.33	28.09	47.42	54.00	6.58	Average
2	17000.200	31.57	28.09	59.66	74.00	14.34	Peak

Test Plots

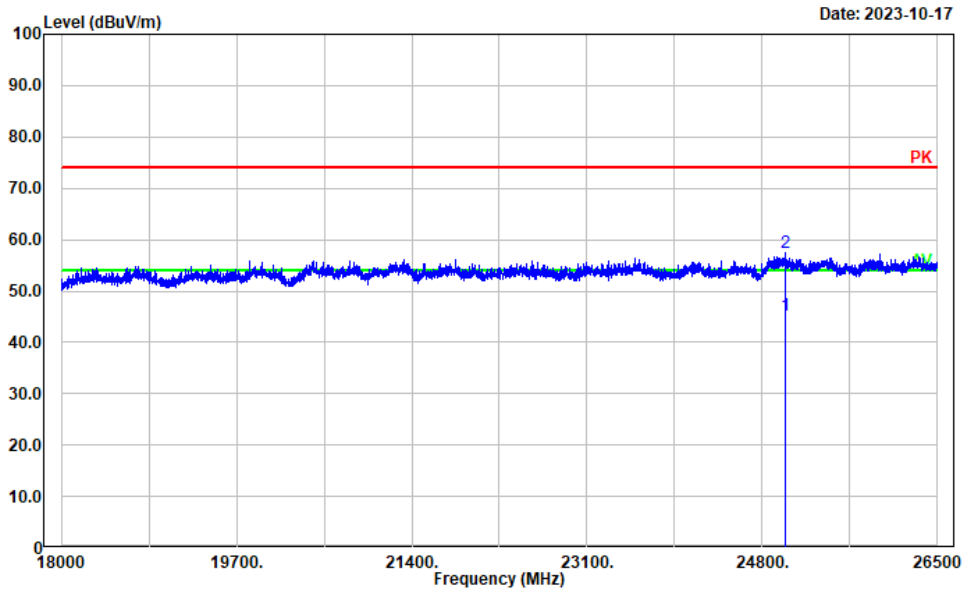
Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	25144.830	38.49	6.84	45.33	54.00	8.67	Average
2	25144.830	50.80	6.84	57.64	74.00	16.36	Peak

Test Plots

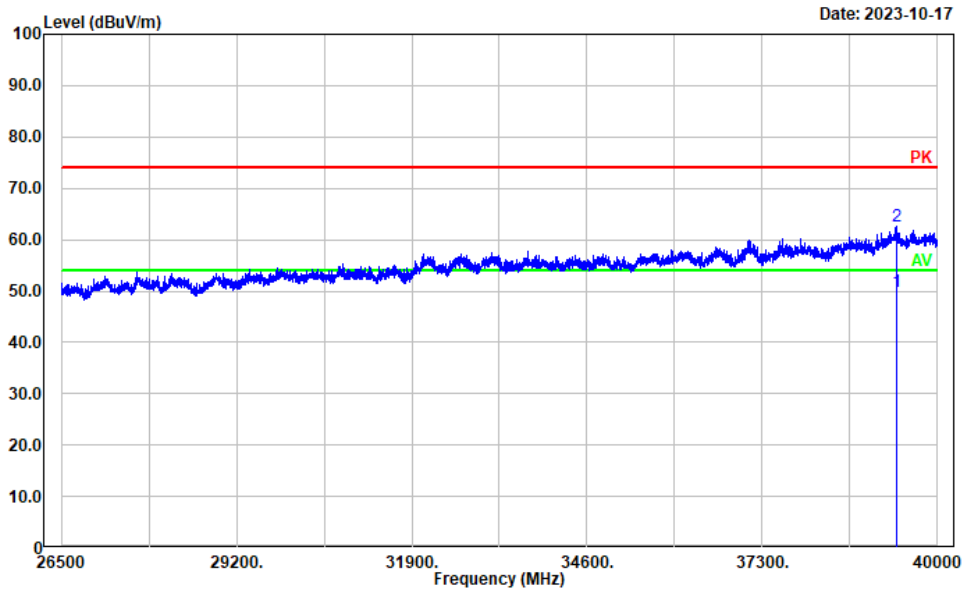
Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: vertical
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	25019.000	38.38	6.82	45.20	54.00	8.80	Average
2	25019.000	50.62	6.82	57.44	74.00	16.56	Peak

Test Plots

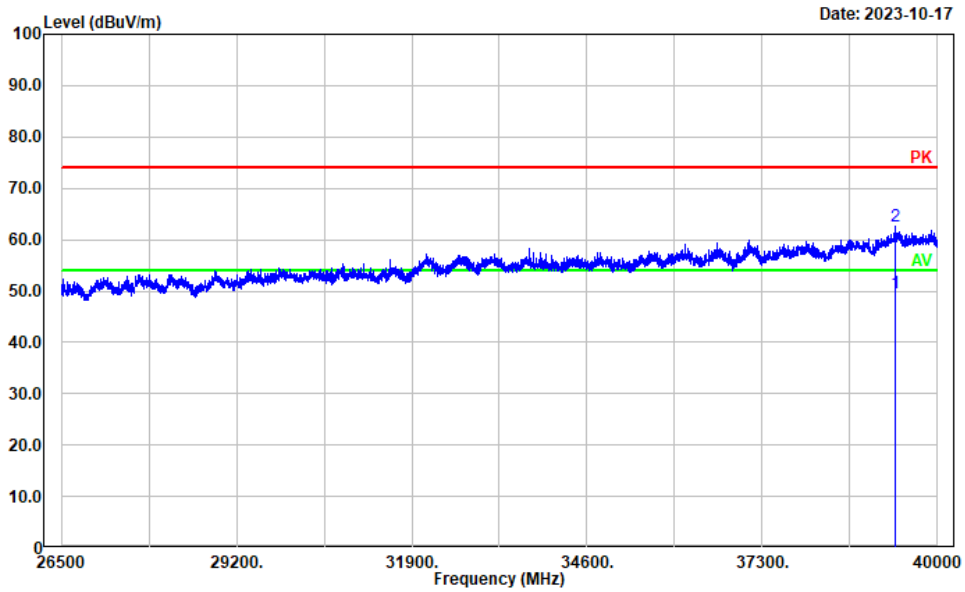
Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: horizontal
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	39359.970	39.69	10.18	49.87	54.00	4.13	Average
2	39359.970	52.39	10.18	62.57	74.00	11.43	Peak

Test Plots

Project No.: CR230636130-RF
Tester: Mack Huang
Polarization: vertical
Note:



No.	Frequency (MHz)	Reading (dBµV)	Factor (dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
1	39349.170	39.49	10.18	49.67	54.00	4.33	Average
2	39349.170	52.35	10.18	62.53	74.00	11.47	Peak

4.3 20 dB Emission Bandwidth&99% Emission Bandwidth

Serial Number:	278G-2	Test Date:	2023/10/17~2023/11/28
Test Site:	966-1	Test Mode:	Transmitting
Tester:	Mack Huang, Coco Tian	Test Result:	N/A

Environmental Conditions:					
Temperature: (℃)	25.3~25.8	Relative Humidity: (%)	56~62	ATM Pressure: (kPa)	100.9~101.3

Test Equipment List and Details:

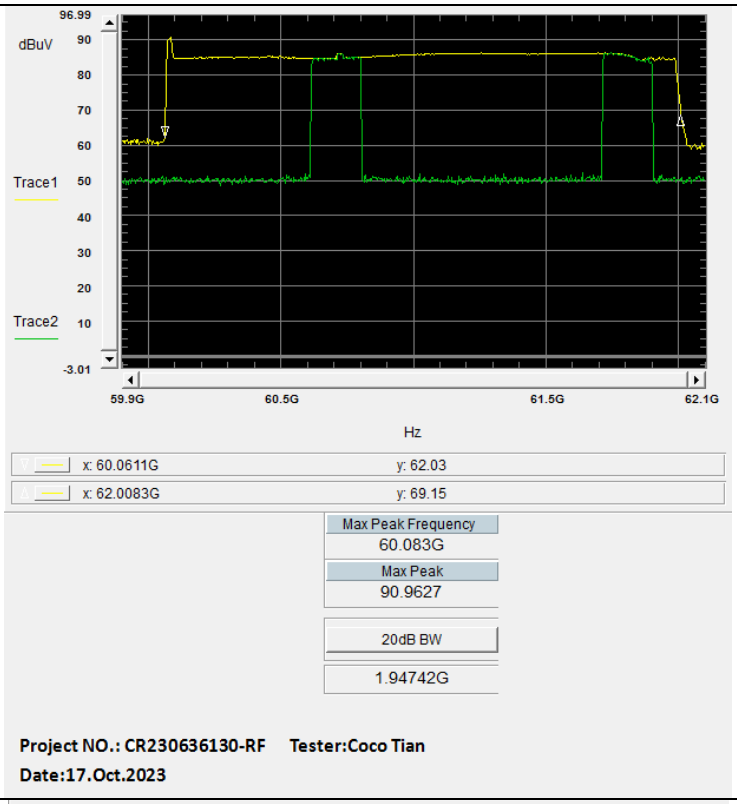
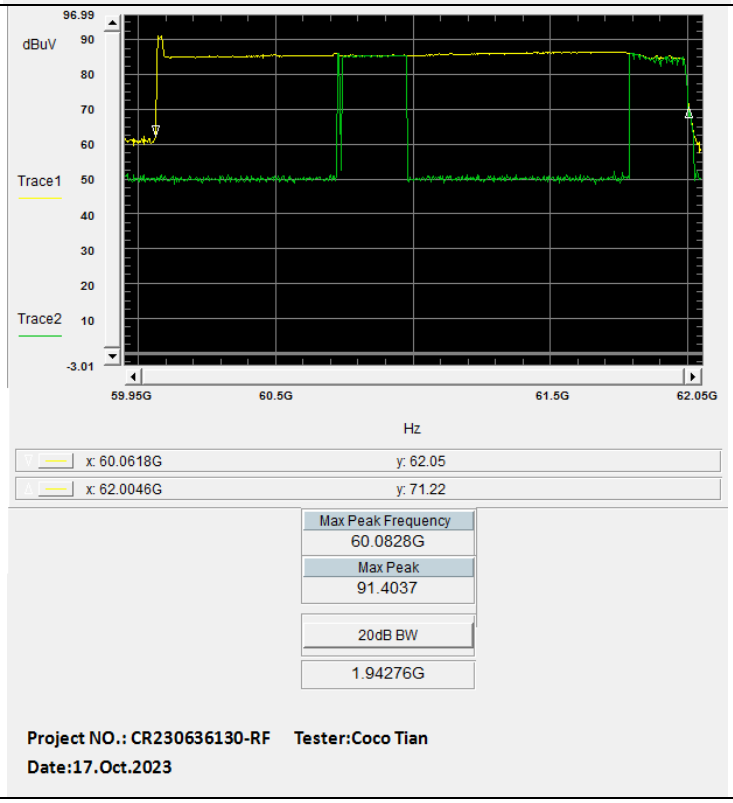
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	Spectrum Analyzer	E4440A	MY44303354	2023/3/31	2024/3/30
Agilent	Harmonic Mixer	Agilent 11970V	2521A01768	2021/11/7	2024/11/8
Flann Micowave	Horn Antenna	861V/385	738	2021/11/7	2024/11/8

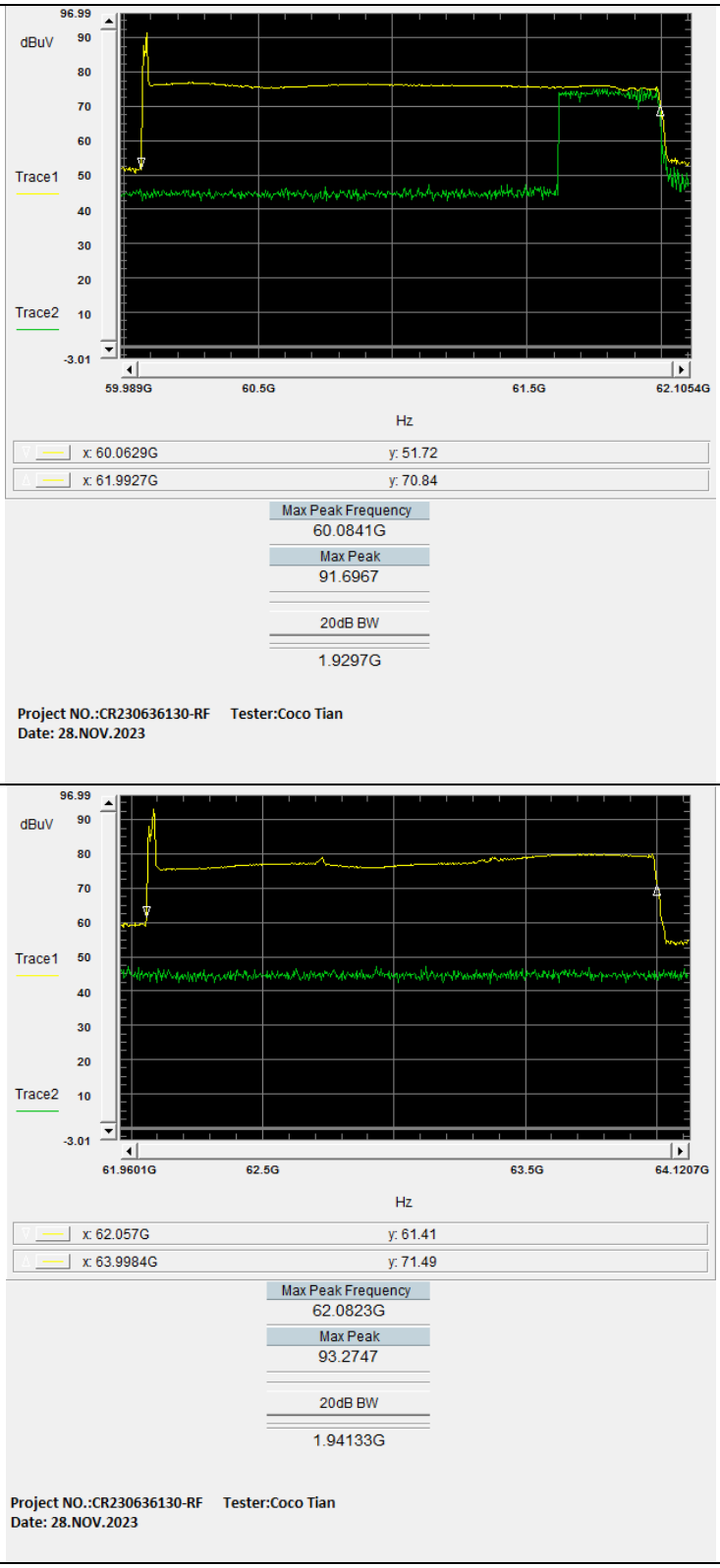
**** Statement of Traceability:*** *China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

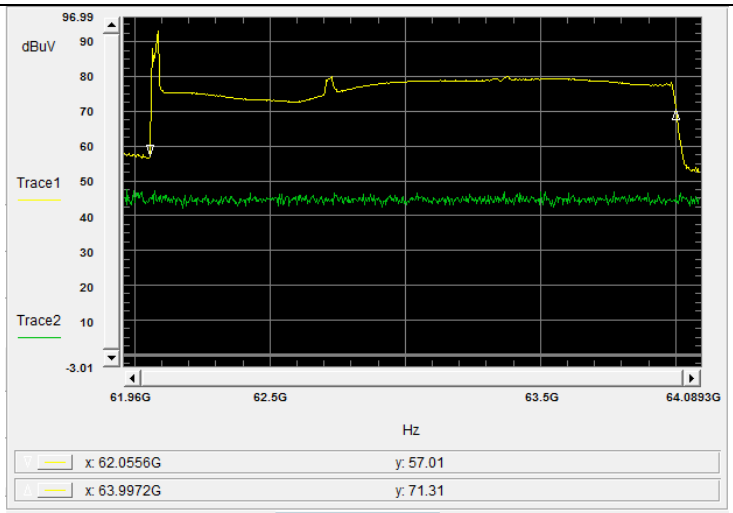
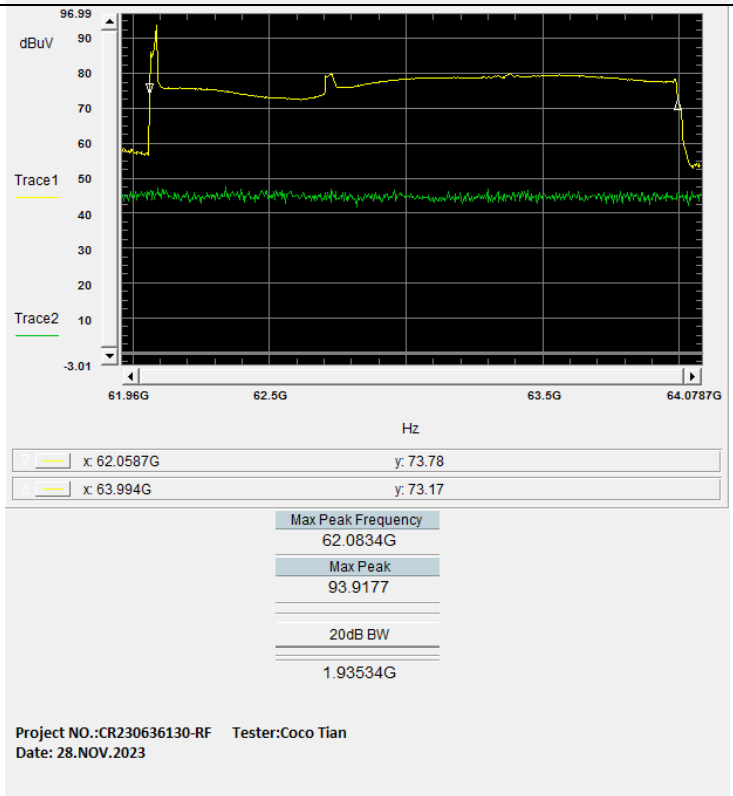
Test Data:

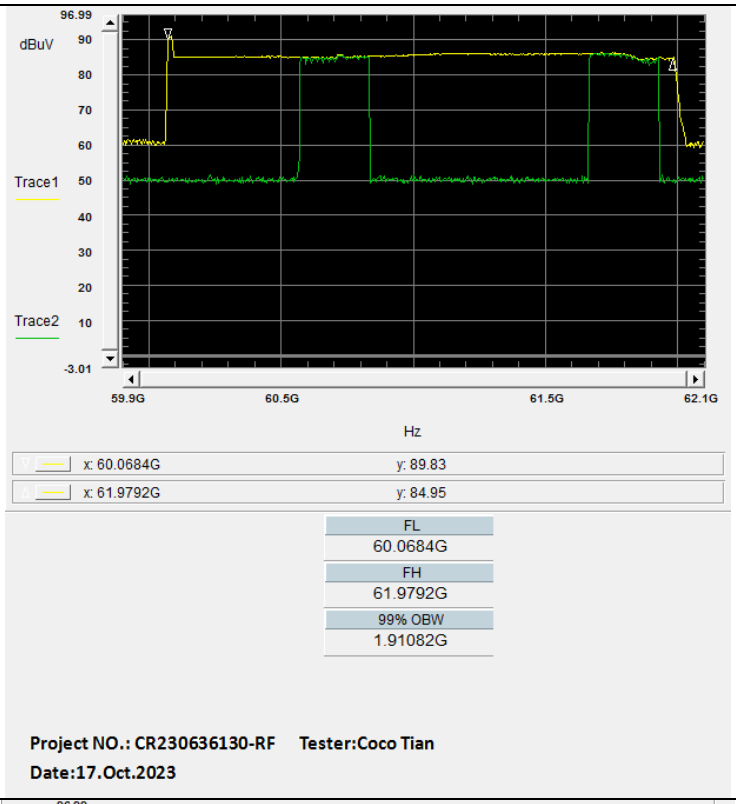
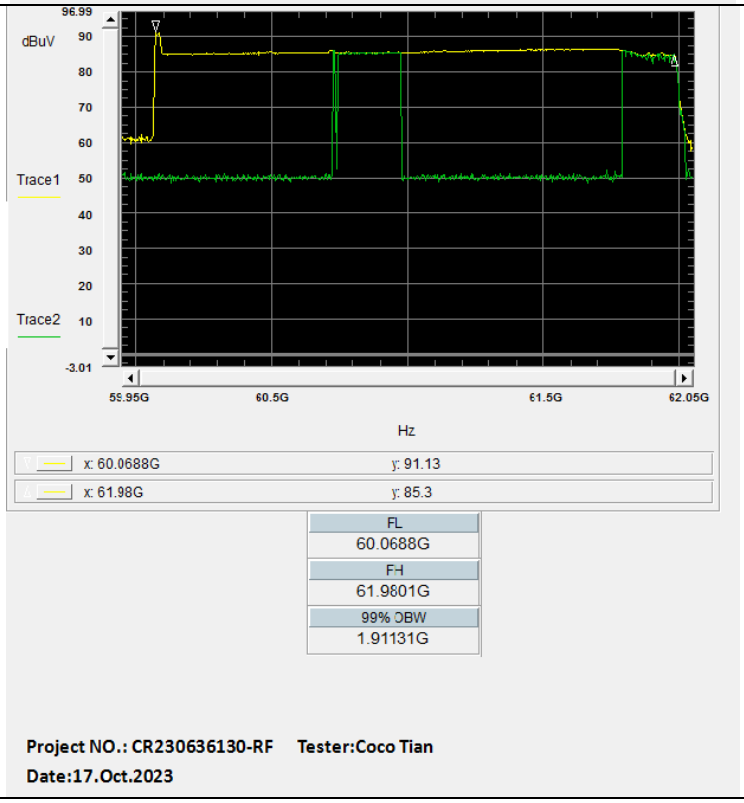
Radar Module	Test Mode	20dB Emission Bandwidth (GHz)	F_L (GHz)	F_H (GHz)
Back Radar	Sweep	1.947	60.0611	62.0083
Top Radar	Sweep	1.943	60.0618	62.0046
Right Radar	Sweep	1.930	60.0629	61.9927
Front Radar	Sweep	1.941	62.057	63.9984
Bottom Radar	Sweep	1.942	62.0556	63.9972
Left Radar	Sweep	1.935	62.0587	63.994

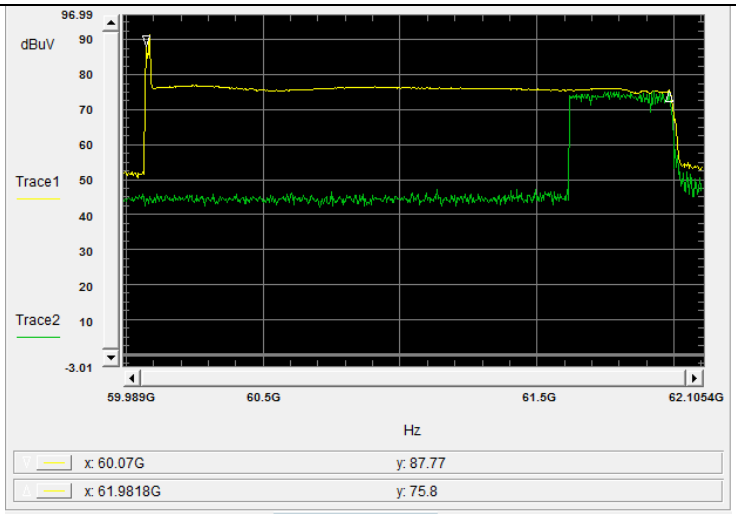
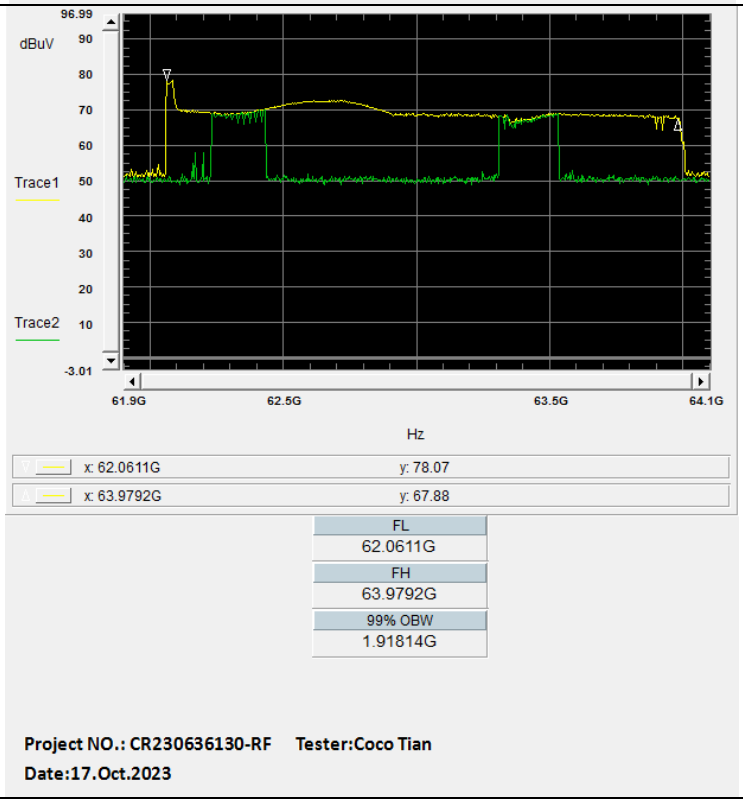
Radar Module	Test Mode	99% Occupied Bandwidth (GHz)	F_L (GHz)	F_H (GHz)
Back Radar	Sweep	1.911	60.068	61.979
Top Radar	Sweep	1.911	60.069	61.980
Right Radar	Sweep	1.912	60.070	61.982
Front Radar	Sweep	1.918	62.061	63.979
Bottom Radar	Sweep	1.923	62.064	63.987
Left Radar	Sweep	1.921	62.062	63.984

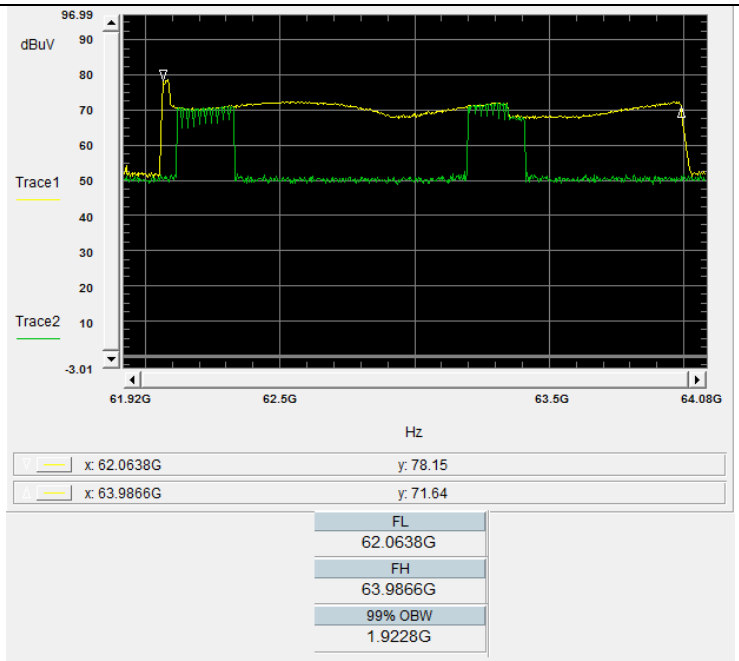
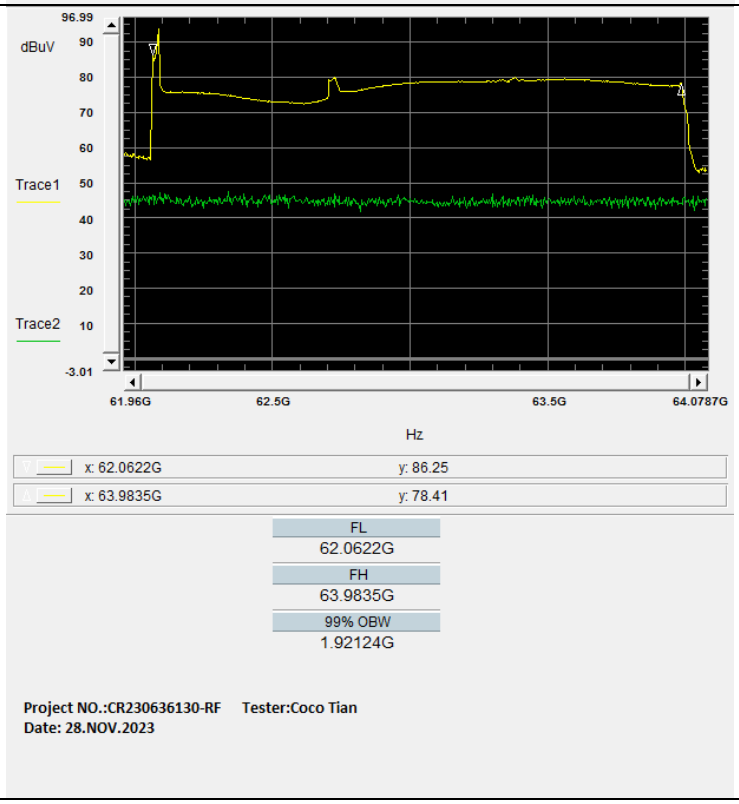
20 dB Emission Bandwidth	
Back Radar	
Top Radar	

20 dB Emission Bandwidth	
Right Radar	
Front Radar	

20 dB Emission Bandwidth	
Bottom Radar	
Left Radar	

99% OBW Emission Bandwidth	
Back Radar	
Top Radar	

99% OBW Emission Bandwidth	
Right Radar	
Front Radar	

99% OBW Emission Bandwidth	
Bottom Radar	
Left Radar	

4.4 Equivalent Isotropically Radiated Power (EIRP)

Serial Number:	278G-2	Test Date:	2023/10/17
Test Site:	966-1	Test Mode:	Transmitting
Tester:	Mack Huang, Coco Tian	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.3	Relative Humidity: (%)	56	ATM Pressure: (kPa)	100.9

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Flann Micowave	Horn Antenna	861V/385	738	2020/11/8	2023/11/7
millitech	RF Detector	DET-15-RPFW0	A18521	2022/12/14	2023/12/13
Tektronix	Digital Phosphor Oscilloscope	TDS 3054	B015264	2022/11/18	2023/11/17
Agilent	Signal Generator	E8247C	MY43321352	2022/11/18	2023/11/17
Agilent	mm-Wave Source Modules	83557A	3942A00697	2022/11/18	2023/11/17

**** 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:

Back Radar:

Frequency (GHz)	DSO		Polar (H/V)	Substituted Level (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)
	Reading (mV)	Detector					
61.00	5.23	PK	V	-24.83	24.00	19.43	20

Top Radar:

Frequency (GHz)	DSO		Polar (H/V)	Substituted Level (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)
	Reading (mV)	Detector					
61.00	5.04	PK	V	-24.99	24.00	19.27	20

Right Radar:

Frequency (GHz)	DSO		Polar (H/V)	Substituted Level (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)
	Reading (mV)	Detector					
61.00	4.78	PK	V	-25.22	24.00	19.04	20

Front Radar:

Frequency (GHz)	DSO		Polar (H/V)	Substituted Level (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)
	Reading (mV)	Detector					
63.00	5.16	PK	V	-24.94	24.00	19.60	20

Bottom Radar:

Frequency (GHz)	DSO		Polar (H/V)	Substituted Level (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)
	Reading (mV)	Detector					
63.00	4.98	PK	V	-25.10	24.00	19.44	20

Left Radar:

Frequency (GHz)	DSO		Polar (H/V)	Substituted Level (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)
	Reading (mV)	Detector					
63.00	5.04	PK	V	-25.04	24.00	19.50	20

EIRP = E_{meas}+ 20log(Measurement distance) - 104.7
E_{meas} = 126.8 - 20log(λ) + Substituted level - Antenna Gain
Measurement distance = 1m
The test data recorded was the maximum polarization.

4.5 Frequency Stability

Serial Number:	278G-2	Test Date:	2023/10/17
Test Site:	RF	Test Mode:	Transmitting
Tester:	Mack Huang, Coco Tian	Test Result:	

Environmental Conditions:					
Temperature: (℃)	25.3	Relative Humidity: (%)	56	ATM Pressure: (kPa)	100.9

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	Spectrum Analyzer	E4440A	MY44303354	2023/3/31	2024/3/30
Agilent	Harmonic Mixer	Agilent 11970V	2521A01768	2021/11/7	2024/11/8
Flann Micowave	Horn Antenna	861V/385	738	2021/11/7	2024/11/8
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:

Back Radar:

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	26.4	60.0684	61.9791	60	64
-10	26.4	60.0683	61.9792	60	64
0	26.4	60.0682	61.9793	60	64
10	26.4	60.0683	61.9794	60	64
20	26.4	60.0684	61.9792	60	64
30	26.4	60.0681	61.9793	60	64
40	26.4	60.0685	61.9791	60	64
50	26.4	60.0682	61.9794	60	64
20	22.44	60.0685	61.9791	60	64
20	30.36	60.0684	61.9793	60	64

Top Radar:

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	26.4	60.0688	61.9801	60	64
-10	26.4	60.0685	61.9802	60	64
0	26.4	60.0684	61.9803	60	64
10	26.4	60.0683	61.9804	60	64
20	26.4	60.0688	61.9801	60	64
30	26.4	60.0685	61.9802	60	64
40	26.4	60.0687	61.9805	60	64
50	26.4	60.0683	61.9804	60	64
20	22.44	60.0684	61.9802	60	64
20	30.36	60.0686	61.9801	60	64

Right Radar:

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	26.4	60.0701	61.9825	60	64
-10	26.4	60.0708	61.9827	60	64
0	26.4	60.0706	61.9826	60	64
10	26.4	60.0701	61.9827	60	64
20	26.4	60.0700	61.9821	60	64
30	26.4	60.0705	61.9822	60	64
40	26.4	60.0707	61.9827	60	64
50	26.4	60.0709	61.9825	60	64
20	22.44	60.0705	61.9823	60	64
20	30.36	60.0704	61.9821	60	64

Front Radar:

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	26.4	62.0611	63.9792	60	64
-10	26.4	62.0612	63.9791	60	64
0	26.4	62.0614	63.9794	60	64
10	26.4	62.0613	63.9793	60	64
20	26.4	62.0611	63.9792	60	64
30	26.4	62.0610	63.9793	60	64
40	26.4	62.0612	63.9791	60	64
50	26.4	62.0614	63.9792	60	64
20	22.44	62.0610	63.9794	60	64
20	30.36	62.0613	63.9793	60	64

Bottom Radar:

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	26.4	62.0638	63.9866	60	64
-10	26.4	62.0634	63.9864	60	64
0	26.4	62.0636	63.9862	60	64
10	26.4	62.0635	63.9863	60	64
20	26.4	62.0638	63.9866	60	64
30	26.4	62.0635	63.9865	60	64
40	26.4	62.0632	63.9863	60	64
50	26.4	62.0637	63.9864	60	64
20	22.44	62.0635	63.9867	60	64
20	30.36	62.0634	63.9868	60	64

Left Radar:

Temperature	Voltage	Frequency (GHz)			
℃	V_{DC}	f_L	f_H	f_L Limit	f_H Limit
-20	26.4	62.0623	63.9831	60	64
-10	26.4	62.0624	63.9834	60	64
0	26.4	62.0626	63.9836	60	64
10	26.4	62.0628	63.9837	60	64
20	26.4	62.0622	63.9835	60	64
30	26.4	62.0625	63.9832	60	64
40	26.4	62.0621	63.9833	60	64
50	26.4	62.0620	63.9838	60	64
20	22.44	62.0627	63.9835	60	64
20	30.36	62.0623	63.9831	60	64

4.6 Duty Cycle

Serial Number:	2BJM-1	Test Date:	2023/11/9~2023/11/10
Test Site:	966-1	Test Mode:	Transmitting
Tester:	coco Tian	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.6~26.7	Relative Humidity: (%)	54~55	ATM Pressure: (kPa)	100.9~101.1

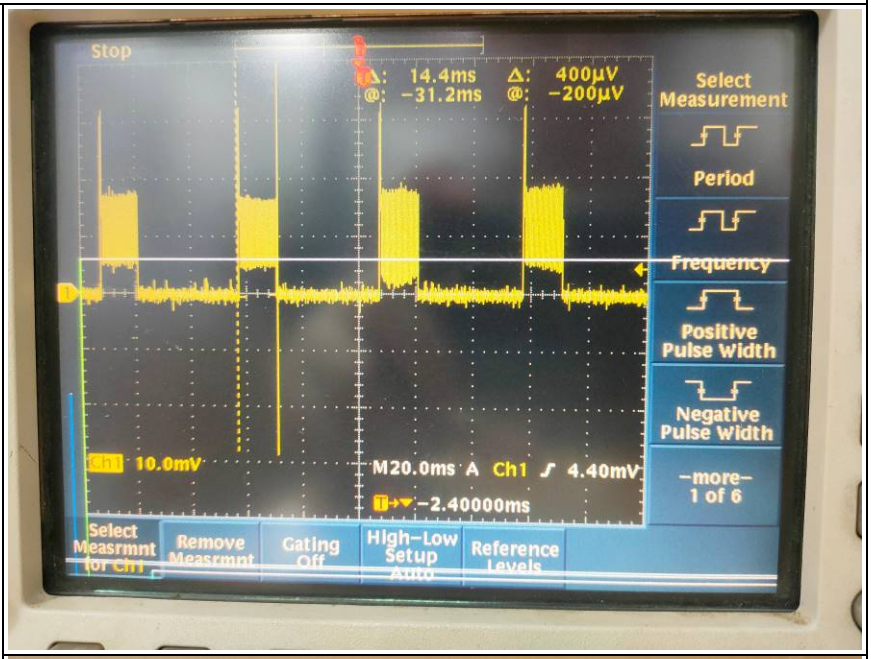
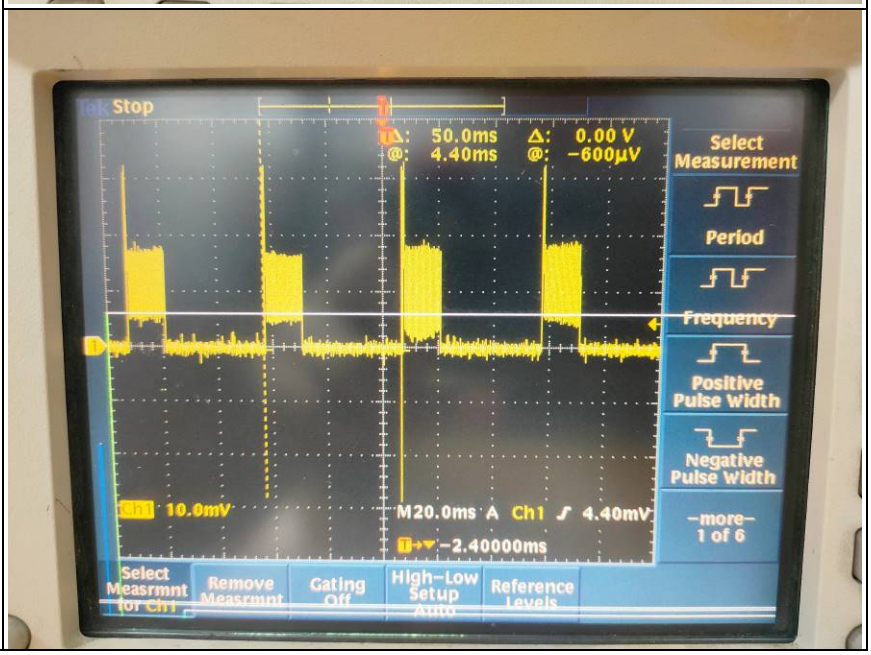
Test Equipment List and Details:

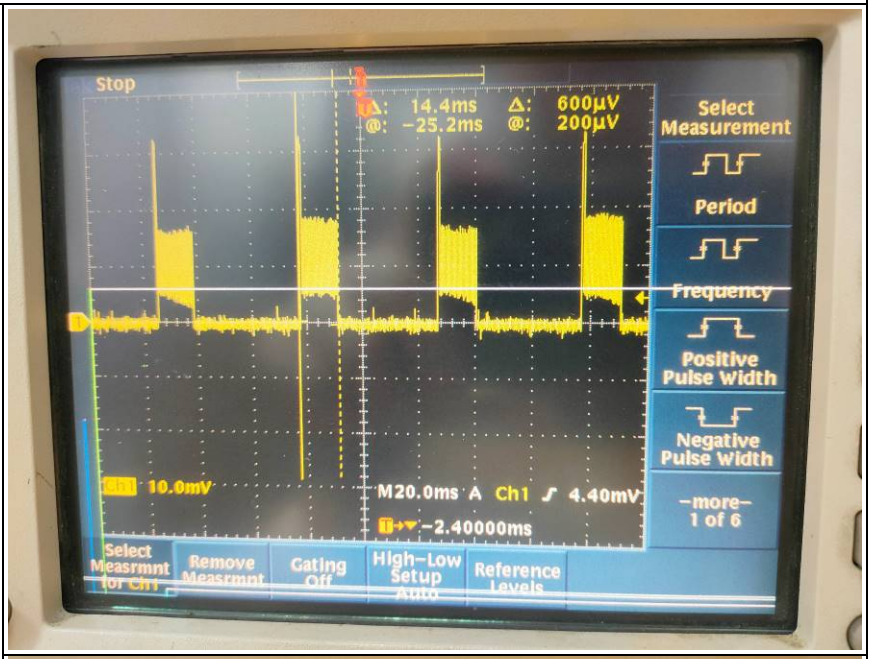
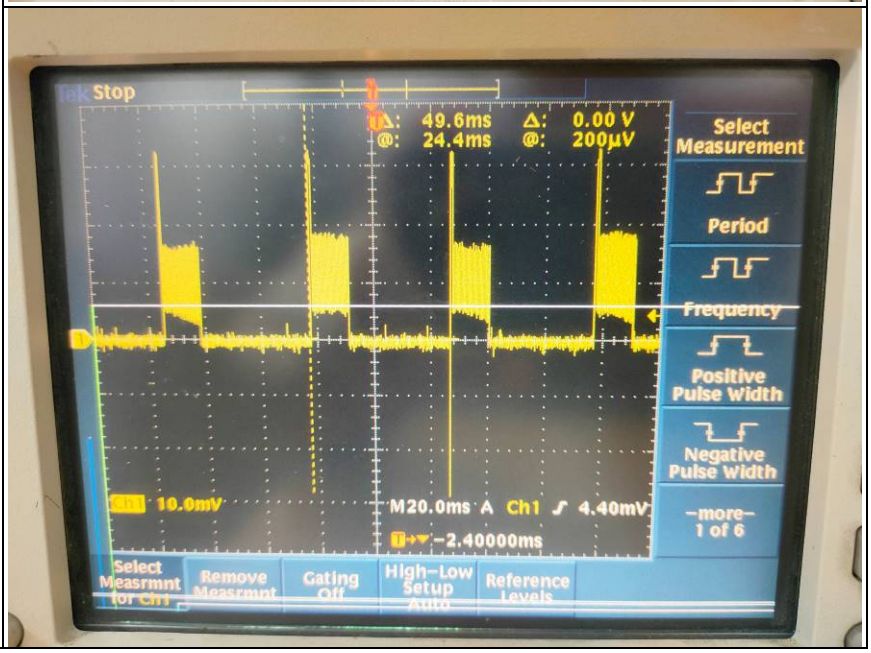
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Flann Micowave	Horn Antenna	861V/385	738	2023/2/27	2026/2/26
millitech	RF Detector	DET-15-RPFW0	A18521	2022/12/14	2023/12/13
Tektronix	Digital Phosphor Oscilloscope	TDS 3054	B015264	2022/11/18	2023/11/17

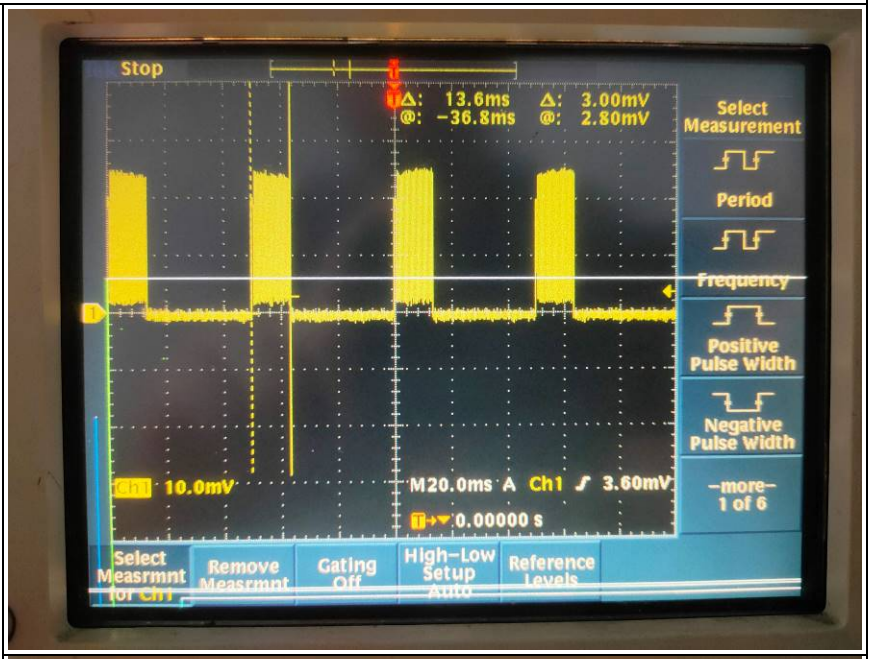
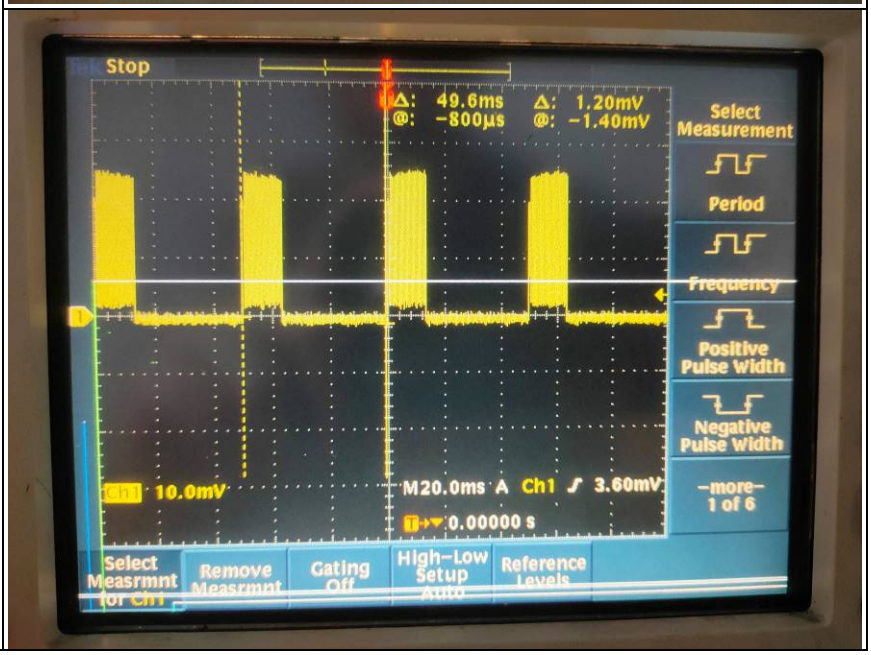
**** Statement of Traceability:*** *China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

Test Data:

Radar Module	Observation Time (ms)	Ton (ms)	Sum of Continuous Transmitter Off-times (ms)	Limit (ms)
Back Radar	33	14.4	18.6	≥16.5
Top Radar	33	14.4	18.6	≥16.5
Right Radar	33	13.6	19.4	≥16.5
Front Radar	33	14.0	19	≥16.5
Bottom Radar	33	13.2	19.8	≥16.5
Left Radar	33	13.6	19.4	≥16.5
Note: Sum of Continuous Transmitter Off-times= Observation Time- Ton				

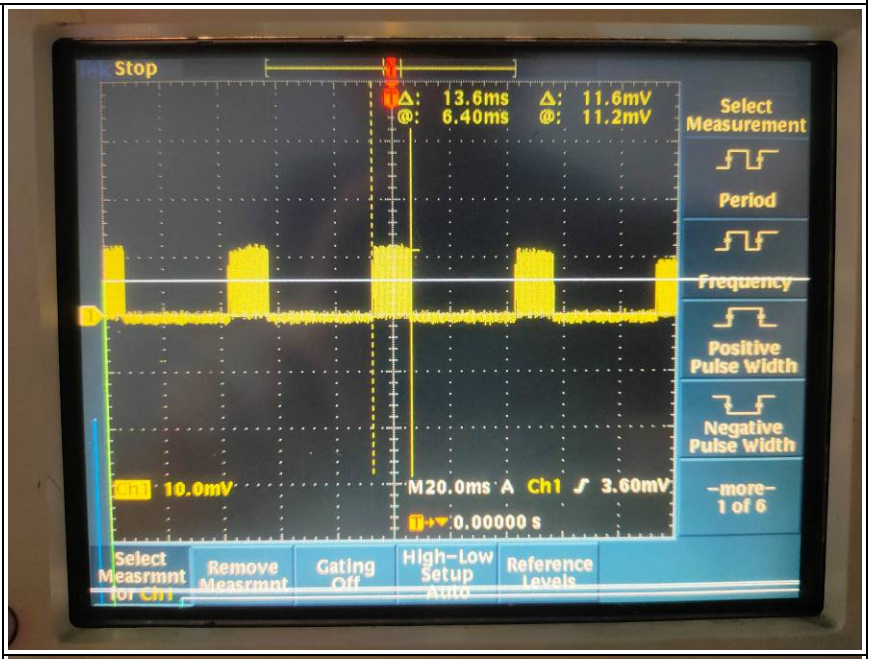
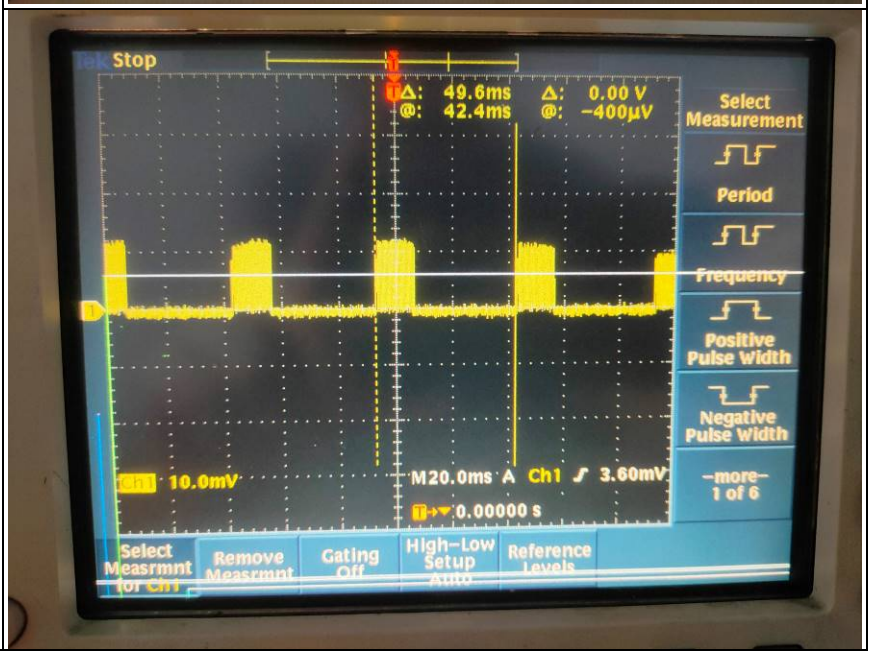
Duty Cycle	
Back Radar	 

Duty Cycle	
Top Radar	 

Duty Cycle	
Right Radar	 

Duty Cycle	
Front Radar	
	

Duty Cycle	
Bottom Radar	 

Duty Cycle	
Left Radar	 

6. EUT PHOTOGRAPHS

Please refer to the attachment CR230636130-EXP EUT EXTERNAL PHOTOGRAPHS and CR230636130-INP EUT INTERNAL PHOTOGRAPHS

7. TEST SETUP PHOTOGRAPHS

Please refer to the attachment CR230636130-00F-TSP TEST SETUP PHOTOGRAPHS.

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