Test Report

Test Report No.: CQC-IVTS-2024-0385-E1

Product Name Millimeter wave radar module

Model Number YQF-6012-00

Applicant Shenzhen Yiqifei Technology Co., Ltd

Approval Types FCC ID: 2BOAI-YQF-6012-00

CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.

National Quality Inspection and Testing Center for Internet of Vehicles Products

TEST REPORT DECLARATION

Equipment under Test	:	**Millimeter wave radar module**
Model /Type	:	YQF-6012-00
Listed Models	:	N/A
Applicant	:	**Shenzhen Yiqifei Technology Co., Ltd**
Address	:	Room 419, Building 2, Fiber Optic Community, Bagua 3rd Road, Futian District, Shenzhen, China
Manufacturer	:	**Shenzhen Yiqifei Technology Co., Ltd**
Address	:	Room 419, Building 2, Fiber Optic Community, Bagua 3rd Road, Futian District, Shenzhen, China

The EUT described above is tested by CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd. to determine the maximum emissions from the EUT. CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd. is assumed full responsibility for the accuracy of the test results.

Project Engineer:	 Yankun Wang	Date: 2025-03-21
Checked by:	 Haohao Li	Date: 2025-03-21
Approved by:	 (Wenliang Li 李文亮)	Date: 2025-03-21

Contents

1. TEST STANDARDS

The tests were performed according to following standards: The equipment under test (EUT) has been tested at CQC-IVTS's (own or subcontracted) laboratories according to the leading reference documents giving table below:

No	Identify	Document Title	Version/Date
1	FCC Part 15.255	Operation within the band 57-71 GHz	04/23/2025
2	ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	2014
3	ANSI C63.10	American National Standard for Testing Unlicensed Wireless Devices	2020

2. SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	March 10, 2025
Testing commenced on	:	March 11, 2025
Testing concluded on	:	March 20, 2025

2.2. Product Description*

Product Name:	Millimeter wave radar module
Trade Mark	
Model/Type reference:	YQF-6012-00
FCC ID:	2BOAI-YQF-6012-00
Hardware Version:	N/A
Software Version:	N/A
Frequency Range:	59.00 – 63.00 GHz
Technology:	Radar
Modulation Type:	FMCW
Channel Bandwidth:	< 4 GHz
Channel Spacing:	N/A
Receiver Category:	N/A
Receiver Bandwidth:	N/A
Antenna:	Patch Antenna
Antenna Gain:	6.00 dBi
Specified Rated Output Power E.R.I.P.):	≤ -4.12 dBm
Power Supply:	DC 5.00V from USB
Temperature Range:	-40℃ to +125℃
Difference Declaration	N/A

*: declared by the applicant. CQC-IVTS not responsible for accuary.

2.3. EUT Operation Mode*

EUT operating mode no	Description of operating modes	Additional information
op. 1	Continuously transmitting and receiving mode	Carrier modulation (normal mode). 59 – 63 GHz, a continuous wave with 100% duty cycle

*: declared by the applicant

2.4. Modifications

No modifications were implemented to meet testing criteria

2.5. Test Item (Equipment Under Test) Description*

Short designation	EUT Name	EUT Description	Serial number	Hardware status	Software status
EUT A	YQF-6012-00	Millimeter wave radar module	-/-	-/-	-/-

*: declared by the applicant.

2.6. Auxiliary Equipment (AE) Description*

AE short designation	EUT Name (if available)	EUT Description	Serial number (if available)	Software (if used)
AE 1	**-/-**	Power Adapeter	-/-	-/-
AE 2	USB Cable	Length: 1m	-/-	-/-
			-/-	-/-

*: declared by the applicant.

2.7. Test Item Set-ups Description

set. 1	EUT A + AE 1 + AE2	EUT operating mode 1

2.8. Test Conditions*

Temperature, [°C]		Voltage, [V]	
T_{nom}	+25.0	V_{nom}	DC 5.0 V
T_{min}	-40.0	V_{min}	DC 4.5 V
T_{max}	+125.0	V_{max}	DC 5.5 V

*: declared by the applicant

2.9. Additional Information

Test items differences	None
Additional application considerations to test a component or sub-assembly	Laptop with test software

2.10. Test Location

Location 1

Company:	CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.
Address:	Building G5, TCL International E City, Xili Street, Nanshan District, Shenzhen, China
Post code:	518112
Contact Person:	Wenliang Li
Telephone:	+86-755-8618 9654
e-Mail:	liwenliang@cqc.com.cn

2.11. Abnormalities from Standard Conditions

None

2.12. Possible verdicts of the results

Test sample meets the requirements	P (PASS) ± the measured value is below the acceptance limit, AL = TL
Test sample does not meet the requirements	F (FAIL) ± the measured value is above the acceptance limit, AL = TL
Test case does not apply to the test sample	N/A (Not applicable)
Test case not performed	N/P (Not performed)

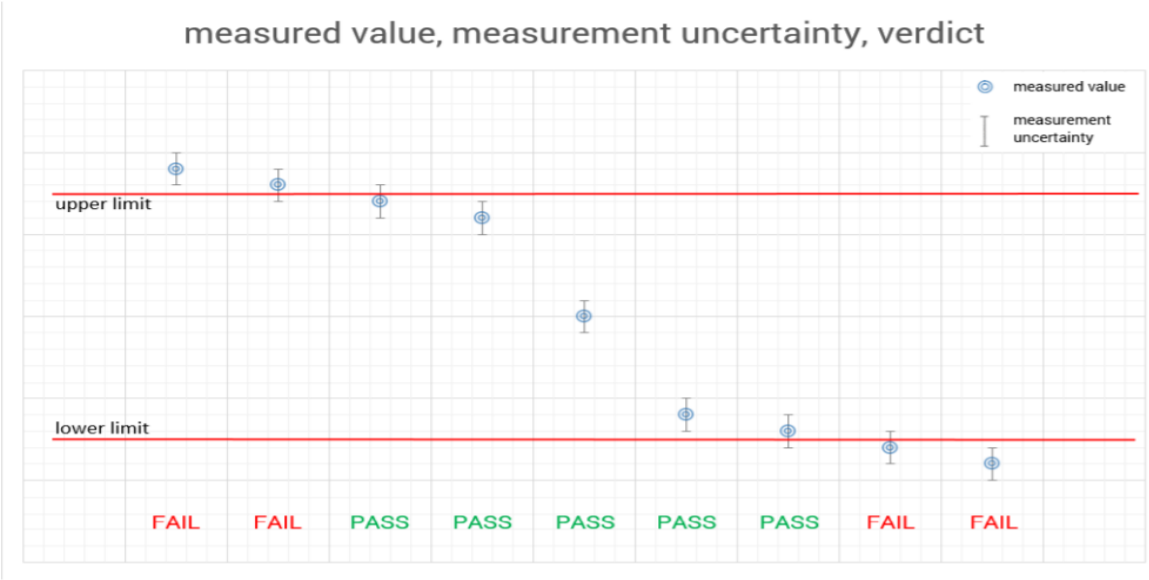
2.13. Formula for Determination of Correction Values (E_C)

$E_C = E_R + AF + C_L + D_F - G_A$ (1)
$M = L_T - E_C$ (2)

E_C = Electrical field ± corrected value
E_R = Receiver reading
M = Margin
L_T = Limit
AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
G_A = Gain of pre-amplifier (if used)
All units are dB-units, positive margin means value is below limit.

2.14. Reporting Statements of Conformity – Decision Rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed. The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



2.15. Radiated Emission Measurement Distance

The measurement antenna is in the far field of the EUT per formula $2D^2/\lambda$, where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT. In this case, “D” is the largest dimension of the measurement antenna. The EUT is manipulated through all orthogonal planes representative of its typical use and for both polarities of the measurement antenna in order to achieve the highest signal level. The worst-case position found was used for all radiated testing.

Frequency Range [GHz]	Wavelength [centimetres]	Far Field Distance [meters]	Measurement Distance [meters]
18 – 40	0.750	0.65	1.00
40 – 60	0.522	0.97	1.00
60 – 90	0.322	0.69	1.00
90 – 140	0.210	0.52	1.00
140 – 220	0.148	0.37	1.00
220 – 325	0.101	0.24	1.00

2.16. Antenna Characteristics

Following information is derived from documents “Antenna Specification” provided by applicant.

2.17. Basic information of the DUT & selection of applicable rule parts

Basic information of the DUT:

Modes:

◆ Normal operation mode:

▼ FMCW modulation is (sequentially) active.

The FMCW signals are emitted one after the other within a single cycle time. This mode is used in normal operation.

▼ Test mode (not used in normal operation):

FMCW signal emission is activated.

Operation condition:

☐ Operation on aircraft (47 CFR 15.255(b))

☐ Unmanned aircraft (47 CFR 15.255(b)(3))

☐ Not unmanned aircraft

☒ No operation on aircraft

Note: Operation under the provisions of this section is not permitted for equipment used on satellites (47 CFR 15.255(a)).

Kind of DUT:

☒ Devices other than field disturbance sensors and other than fixed point-to-point transmitters located outdoors

Note: FMCW signal

☐ Fixed point-to-point transmitters located outdoors

☒ Field disturbance sensors/radars

☐ Pulsed field disturbance sensors/radars

☒ Other than pulsed field disturbance sensors/radars

Note: FMCW signal

Frequency band:

☐ Operating within band 57-71 GHz (47 CFR 15.255/47 CFR 15.255(c))

☐ Operating within band 59.3-71.0 GHz (47 CFR 15.255(b)(2)(ii))

☐ Operating within band 60-64 GHz (47 CFR 15.255(b)(3))

☐ Operating within band 57-64 GHz (47 CFR15.255(c)(3)/47 CFR 15.255(c)(2)(ii))

☒ Operating within band 57-71 GHz (47 CFR 15.255(c)(2))

Note: FMCW signal

☐ Operating within band 57.0- 59.4 GHz (47 CFR 15.255(c)(2)(i))

☐ Operating within band 57.0-61.56 GHz (47 CFR 15.255(c)(2)(i))

☐ Operating within band 61.0- 61.5 GHz (47 CFR 15.255(c)(2)(v))

Selection of applicable rule parts:

Applicable rule parts and limits depend on the basic information of the DUT.

The comparison of the basic information of the DUT with the rule parts lead to the following conclusions.

Rule Part	Applicable?	
	Yes	No
47 CFR 15.255		
(a) General: Operation under the provisions of this section is not permitted for equipment used on satellites.	☒	
(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) (if this section, and relevant requirements of paragraphs (c)(2) throughout 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		☒
(c) Radiated power limits: Within the 57-71 GHz band, emission levels shall not exceed the following equivalent isotopically radiated power (EIRP):		☒
(1) Devices other than field disturbance sensors shall comply with one of the following power limits, as measured during the transmit interval:		☒
(i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or		☒
(ii) For fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.		☒
(A) The provisions in this paragraph (c) for reducing transmit power based on antenna gain shall not require that the power levels be reduced below the limits specified in paragraph (c)(1)(i) of this section.		☒
(B) The provisions of § 15.204(c)(2) and (4) that permit the use of different antennas of the same type and of equal or less directional gain do not apply to intentional radiator systems operating under this provision. In lieu thereof, intentional radiator systems shall be certified using the specific antenna(s) with which the system will be marketed and operated. Compliance testing shall be performed using the highest gain and the lowest gain antennas for which certification is sought and with the intentional radiator operated at its maximum available output power level. The responsible party, as defined in § 2.909 of this chapter, shall supply a list of acceptable antennas with the application for certification.		☒
(2) Field disturbance sensors/radars shall not exceed −10 dBm peak conducted output power and 10 dBm peak EIRP except that field disturbance sensors/radars that limit their operation to all or part of the specified frequency band may operate without being subject to a transmitter conducted output power limit if they operate in compliance with paragraph (b)(3) of this section or with one or more of the provisions below:	☒	
(i) ***57.0-59.4 GHz:*** the peak EIRP level shall not exceed 20 dBm for indoor operation or 30 dBm for outdoor operation;		☒
(ii) ***57.0-61.56 GHz:*** the peak EIRP shall not exceed 3 dBm except that the peak EIRP shall not exceed 20 dBm if the sum of continuous transmitter off-times of at least two milliseconds equals at least 16.5 milliseconds within any contiguous interval of 33 milliseconds;		☒
(iii) 57.0-64.0 GHz:		☒
(A) The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds, except as specific in paragraph (c)(2)(iii)(B) of this section;		☒
(B) The peak EIRP shall not exceed 20 dBm, and 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 when operated outdoors:		☒
(1) As part of a temporary or permanently fixed application; or		☒
(2) When being used in vehicular applications to perform specific tasks of moving something or someone, except for in-cabin applications;		☒
(iv) A field disturbance sensor may operate in any of the modes in the above sub-sections so long as the device operates in only one mode at any time and does so for at least 33 milliseconds before switching to another mode.		☒
(v) ***61.0-61.5 GHz:*** For field disturbance sensors/radars that occupy 500 MHz bandwidth or less that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0-61.5 GHz band, measured during the transmit interval, but still within the 57-71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.		☒

(3) For pulsed field disturbance sensors/radars operating in the 57-64 GHz band that have a maximum pulse duration of 6 ns, the average EIRP shall not exceed 13 dBm and the transmit duty cycle shall not exceed 10% during any 0.3 µs time window. In addition, the average integrated EIRP within the frequency band 61.5-64.0 GHz shall not exceed 5 dBm in any 0.3 µs time window. Peak emissions shall not exceed 20 dB above the maximum permitted average emission limit applicable to the equipment under test. The radar bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna.		☒
(4) The provisions in § 15.35(b) and (c) that require emissions to be averaged over a 100 millisecond period and that limits the peak power to 20 dB above the average limit do not apply to devices operating under paragraphs (c)(2) and (3) of this section.	☒	
(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.	☒	
(e) Limits on transmitter conducted output power.		
(1) Except as specified in paragraph (e)(2) of this section, the peak transmitter conducted output power of devices other than field disturbance sensors/radars shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (c) of this section.		☒
(2) Devices other than field disturbance sensors/radars with an emission bandwidth of less than 100 megahertz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 megahertz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kilohertz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (*e.g.,* for frequency hopping devices).		☒
(f) ***Frequency stability.*** 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.	☒	
(g) ***Radio frequency radiation exposure.*** Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.	☒	
(h) ***Group installation.*** 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.	☒	
(i) ***Compliance measurement.*** Measurement procedures that have been found to be acceptable to the Commission in accordance with § 2.947 of this chapter may be used to demonstrate compliance.	☒	
(1) For purposes of demonstrating compliance with this section, corrections to the transmitter conducted output power may be made due to the antenna and circuit loss.	☒	
(2) Compliance measurements of frequency-agile field disturbance sensors/radars shall be performed with any related frequency sweep, step, or hop function activated.	☒	
47 CFR 15.255		
(c) Click to open paragraph tools 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.		
47 CFR 15.209	☒	
47 CFR 15.207		
(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.	☒	
(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. TEST ENVIRONMENT

3.1. Address of the test laboratory

CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.
Building G5, TCL International E City, Xili Street, Nanshan District, Shenzhen, China
CQC-IVTS A2LA Certification Number: 6645.01;
FCC Designation Number: CN1329

3.2. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	25°C
Lative Humidity	55 %
Air Pressure	989 hPa

3.3. Test Description

Test Specification Clause	Test Case	Temperature Condition	Power Supply	PASS	FAIL	NA	NP	Results
§ 15.225(c)	Radiated Power (EIRP)	Nominal	Nominal	☒	☐	☐	☐	
§ 15.225(c)	Peak Transmitter Conducted Output Power	Nominal	Nominal	☒	☐	☐	☐	
§ 15.225(b)(c)	Time domain requirements: Continuous transmitter off-times & transmit duty cycle	Nominal	Nominal	☐	☐	☒	☐	
§ 15.215(c)	Occupied bandwidth (20dB)	Nominal	Nominal	☒	☐	☐	☐	
§ 15.225(d) § 15.225(i) § 15.33(a) § 15.209	Spurious Emissions Radiated	Nominal	Nominal	☒	☐	☐	☐	
§15.207	AC Power-Line Conducted Emissions Limits	Nominal	Nominal	☒	☐	☐	☐	
§2.1055 § 15.255 (f)	Frequency Stability	Nominal Extreme	Nominal Extreme	☒	☐	☐	☐	
§15.203	Antenna Requirement	Nominal	Nominal	☒	☐	☐	☐	

Note 1: NA means “not applicable”; NP means Not Performed;
Note 2: The measurement uncertainty is not included in the test result.
Note 3: FCC’s Millimeter Wave Test Procedures: I. A radiated method of measurements in order to demonstrate compliance with the various regulatory requirements has been choose in consideration of test equipment availability and the limitations of many external harmonic mixers and lower-power amplifier. A conducted method of measurement could be employed if EUT and mixer waveguides both are accessible and of the same type (WG number) and if waveguide sections and transitions cab be found. Another potential problem is that the peak power output may exceed the +20 dBm input power limit of many commercially available mixers. For these reasons a radiated method is preferred.

3.4. Statement of The Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd..quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.90 dB	(1)
Radiated Emission	1~6GHz	4.20 dB	(1)
Radiated Emission	6~18GHz	4.50 dB	(1)
Radiated Emission	18-40GHz	5.42 dB	(1)
Radiated Emission	Above 40 GHz	5.50 dB	(1)
Conducted Disturbance	0.15~30MHz	3.30 dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3.5. Equipments Used during the Test

Radiated Emission						
Item	Test Equipment	Manufacturer	Model No.	Equipment No.	Last Cal.	Cal.Due
1	EMI Test Receiver	R&S	ESW26	103003	2024/06/18	2025/06/17
2	Spectrum Analyzer	R&S	FSW43	10182	2024/05/14	2025/05/13
3	Ultra-Broadband Antenna	Schwarzbeck	VULB9168	1291	2024/08/01	2027/07/31
4	Horn Antenna	ETS-Lindgren	3117	102732	2024/08/01	2027/07/31
5	Amplifier	R&S	SCU01F	100369	2024/05/14	2025/05/13
6	Amplifier	R&S	SCU18F	100868	2024/05/14	2025/05/13
7	Receive Unit	Tonscond	RIRU(QWO1)-18-40G	24D806RTRU0842	2024/07/02	2025/07/01
8	EMI Test Software	R&S	EMC32	N/A	N/A	N/A
8	TC-RX60	Tonscond	Receive Unit	1551	N/A	N/A
9	TC-RX75	Tonscond	Receive Unit	1545	N/A	N/A
10	TC-RX90	Tonscond	Receive Unit	1552	N/A	N/A
11	TC-RX140	Tonscond	Receive Unit	1553	N/A	N/A
12	TC-RX220	Tonscond	Receive Unit	1554	N/A	N/A
13	TC-RX40	Tonscond	Receive Unit	1543	N/A	N/A
14	Antenna Mast	Maturo	BAM4.0	N/A	N/A	N/A
15	Turntable	Maturo	TT3.5	N/A	N/A	N/A
16	Loop Antenna	R&S	HFH2-Z2E	101066	2024/05/14	2025/05/13
17	Thermal chamber	ESPEC	GFS-800-15	0050-001161	2024/06/18	2025/06/17

Note:

1. Receive Unit including the antenna, pre-amplifier and mixer.
2. RIRU(QWO1)-18-40G Receive Unit inclduing antenna and pre-amplifier.

4. TEST CONDITIONS AND RESULTS

4.1. Radiated Power EIRP [§15.225(c)]

4.1.1. LIMITS

Measurement of the maximum radiated ElRP of the wanted signal
Limits as bellows table

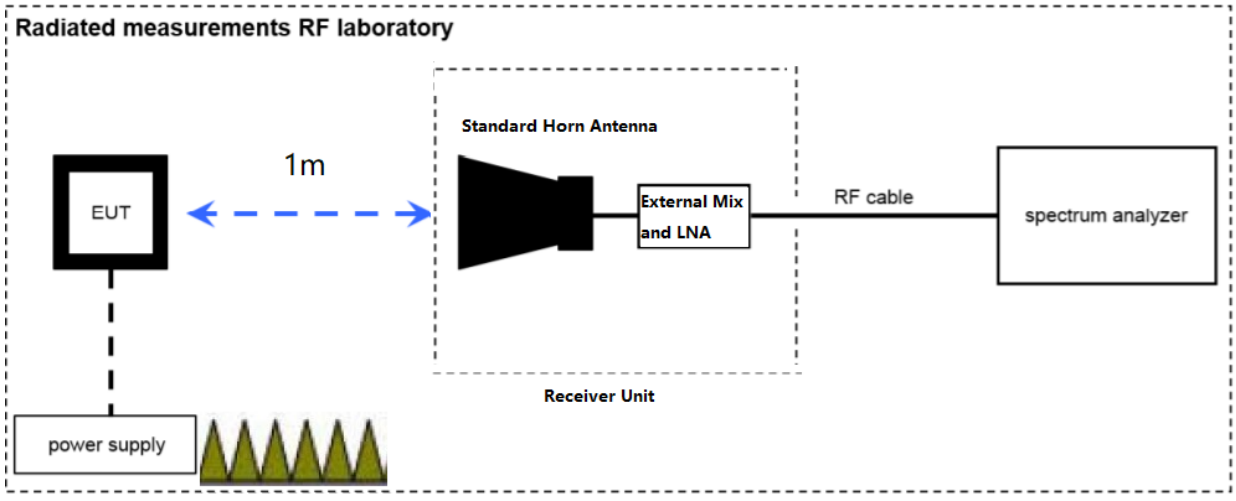
Applicable limits for radiated power (EIRP)			
Applicable	**Rule part**	**Limit average ElRP**	**Limit peak EIRP**
☐	15.255(c)(1)(i)	40 dBm (see note 1)	43 dBm
☐	15.255(c)(1)(ii)	(see note 1 & 2.1)	(see note 1 & 2.2)
☒	15.255(c)(2)	none	10 dBm
☐	15.255(c)(2)(i)	none	20 dBm(indoor) 30 dBm (outdoor)
☐	15.255(c)(2)(i)	none	3 dBm (general)
			20 dBm (+ off-time requirement)
☐	15.255(c)(2)(iii)(A)	none	14 dBm (+ off-time requirement)
☐	15.255(c)(2)(ii)(B)	none	20 dBm (+ off-time requirement)
☐	15.255(c)(2)(v)	40 dBm (within 61-61.5 GHz) (see note 1)	43 dBm (within 61.0-61.5 GHz)
		10 dBm (outside 61-61.5 GHz) (see note 1)	13 dBm (outside 61-61.5 GHz)
☐	15.255(c)(3)	13 dBm (+ time domain requirement)	applicable average limit + 20 dB
		5 dBm (average integrated ElRP within61.5-64.0 GHz in any 0.3 us time window)	

Note:

3. Measured during the transmit interval
4. Calculation:

2.1 The average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dBthat the antenna gain is less than 51 dBi.
2.2 The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.

4.1.2. TEST CONFIGURATION



4.1.3. TEST PROCEDURE

Mean Power
Method with spectrum analyser with external mixer

A spectrum analyser with the following settings is used as measuring receiver in the test setup:

- Start frequency: lower than the lower edge of the operating frequency range.
- Stop frequency: higher than the upper edge of the operating frequency range.
- Resolution bandwidth: 1 MHz
- Video bandwidfh: 3 MHz

- Detector mode: RMS
- Display mode: clear write
- Averaging time: averaging time x number of sweep points

Channel Power Function needs to be used to calculate the average power. Boundaries for the calculation needs to be defined. This is typically the operating frequency range.

Method with Power Meter

The power meter shall be connected to the measurement antenna. The frequency correction factor shall be taken into account. The power meter shall be a true RMS power meter. The measurement time shall be equal or longer than the EUT cycle time.

Peak Power

Method with spectrum analyser with external mixer

- Start frequency: lower than the lower edge of the operating frequency range.
- Stop frequency: higher than the upper edge of the operating frequency range.
- Resolution bandwidth: 1 MHz
- Video bandwidfh: 3 MHz
- Detector mode: Peak detector
- Display mode: Maxhold
- Sweep time: EUT cycle time x number of sweep points
- Measurement is done until trace us stabilised.

The peak power to be considered us the maximum value recorded.

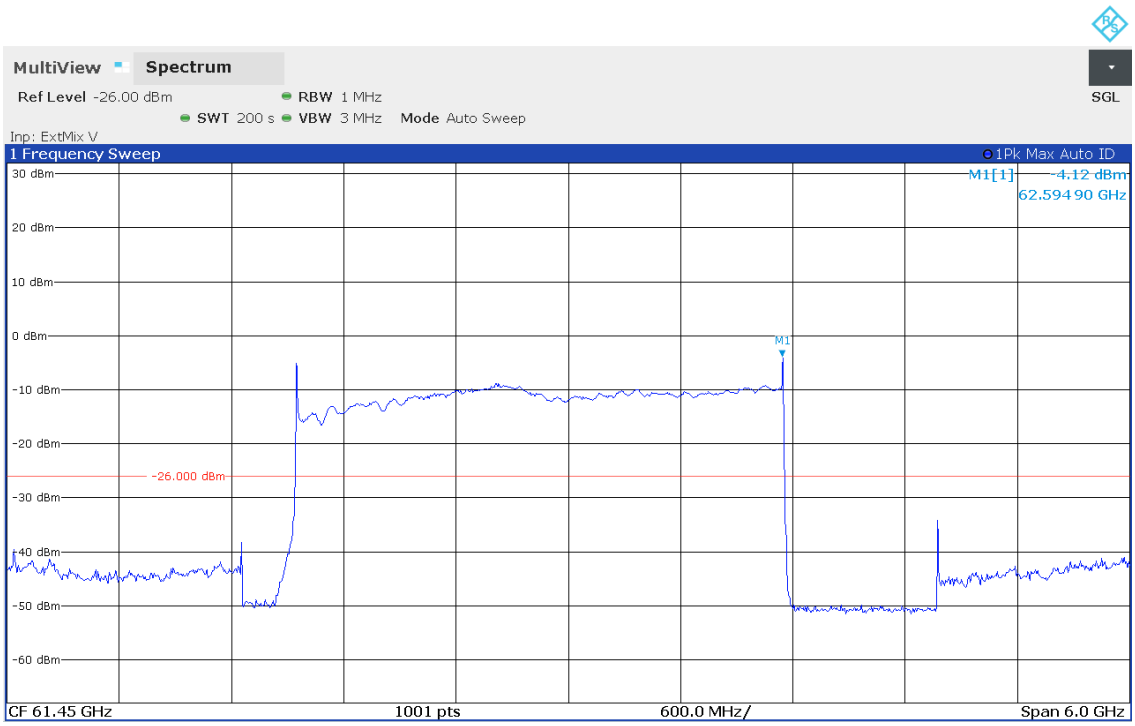
The test report used test procedure: Method with spectrum analyser with external mixer.

4.1.4. TEST RESULTS

EIRP measurements were ensured to be taken in the Far-Field test distance are shown in Section 2.15.

EUT Mode	Test Distance [m]	Radiated Peak Power (EIRP) [dBm]	Radiated Peak Power Limit (EIRP) [dBm]	Verdict
op. 1	1	-4.12	10	PASS

Plots No. 1: Peak Power EIRP, Peak detector, Horizontal / Vertical Polarization



4.2. Peak Transmitter Conducted Output Power [§15.225(c)]

4.2.1. LIMITS

Measurement or calculation of the transmitter conducted output power.
Limits as bellows table

Applicable limits for peak transmitter conducted output power		
Applicable	**Rule part**	**Limit peak transmitter conducted output power**
☒	15.255(c)(2)	-10 dBm
☐	15.255(e)(1)	500 mw
☐	15.255(e)(2)	500 mW*(emission bandwidth/100 MHz)

4.2.2. TEST RESULT

EUT Mode	Test Distance [m]	Peak EIRP [dBm]	Antenna Gain [dBi]	Peak Transmitter Conducted Output Power [dBm]	Peak Transmitter Conducted Output Power Limit [dBm]	Verdict
Op1	1	-4.12	6.00	-10.12	-10.00	PASS

Note:

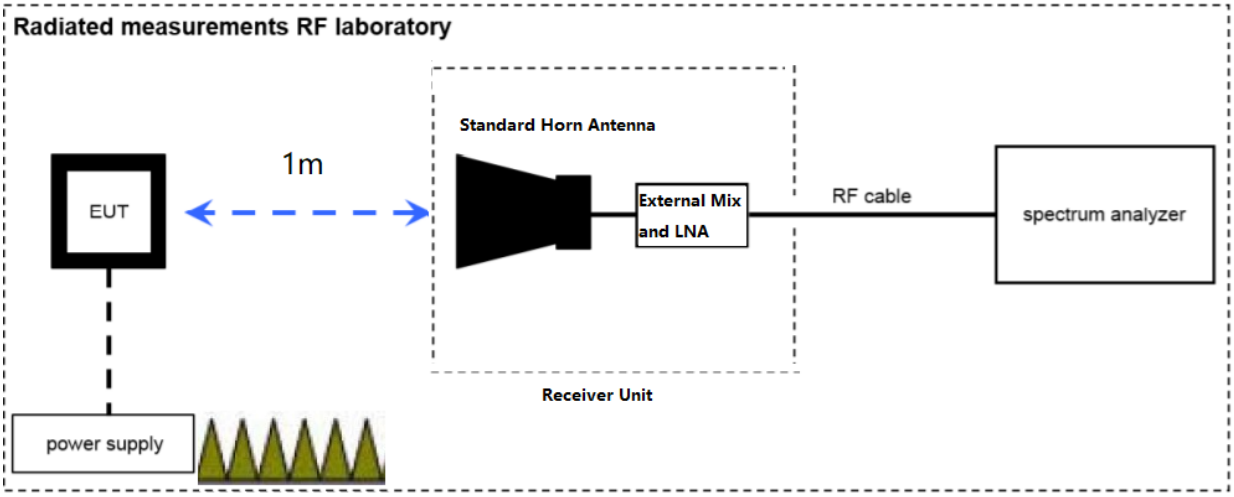
- Peak transmitter conducted output power [dBm] = Peak E.I.R.P [dBm] – Antenna Gain [dBi]
- Peak EIRP: see chapter 4.1
- Antenna Gain:
  - External Antenna specifications provided by customer:
  - Maximum Antenna Gain is 6.00dBi
- Limit Peak transmitter conducted output power.
  - Peak Transmitter Conducted Output Power [dBm] = Peak EIRP [dBm] - Antenna Gain [dBi] = -4.12 – 6.00 = -10.12 dBm

4.3. Occupied Bandwidth [§15.215]

4.3.1. LIMITS

According to § 15.215 (c) - 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.

4.3.2. TEST CONFIGURATION



4.3.3. TEST PROCEDURE

According to ANSI C63.10:2020 section 9.3: The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwdith:

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 (3dB 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 [$10\log_{10}$(OBW/RBW] below the reference level. Specific guidance is given in 4.1.6.

d) Set the detection mode to peak, and the trace mode to maxhold.

e) If the instrument does not have 99% OBW function, recover the trace data points and sum directly in linear power terms. Placce the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Recorded that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.

f) The OBW shall be reported and plots of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labelled. Tabular data can be reported in addition to the plots.

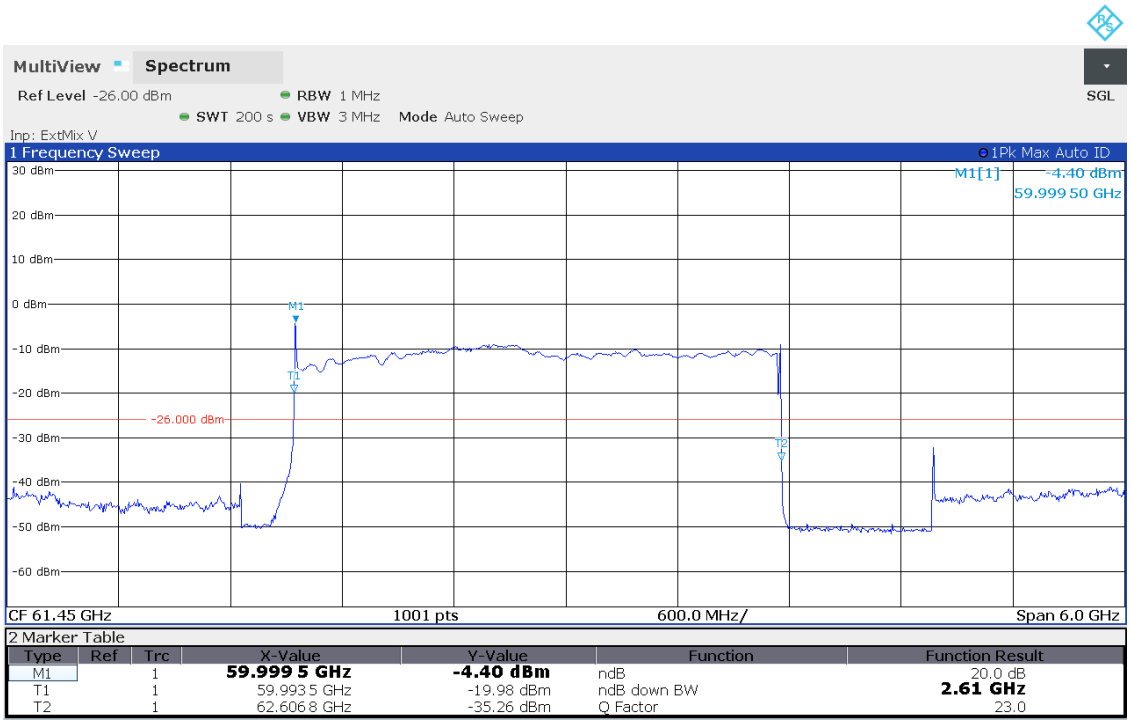
Measurement with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results.

4.3.4. TEST RESULTS

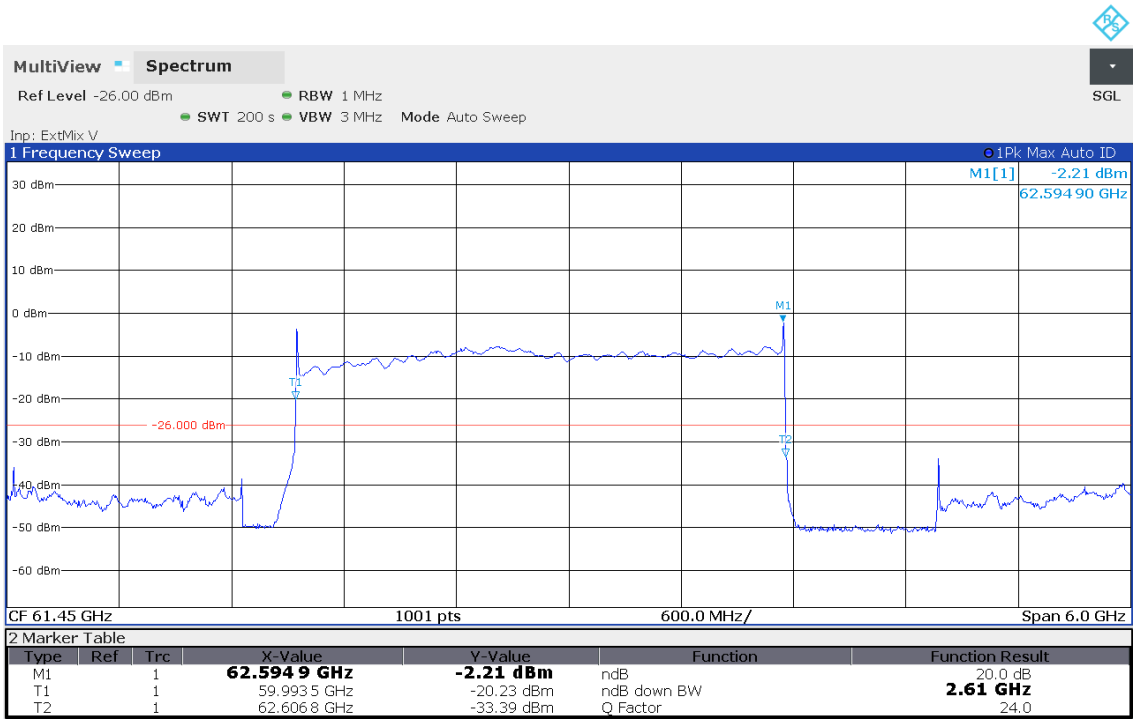
EUT Mode	Test Conditions	f_L [GHz]	f_H [GHz]	20dB OBW [GHz]
op. 1	50℃	59.9935	62.6068	2.61
op. 1	40℃	59.9935	62.6068	2.61
op. 1	30℃	59.9935	62.6068	2.61
op. 1	20℃ (V_{nor})	59.9935	62.6068	2.61
op. 1	20℃ (V_{max})	59.9935	62.6068	2.61
op. 1	20℃ (V_{min})	59.9935	62.6068	2.61
op. 1	10℃	59.9935	62.6008	2.61
op. 1	0℃	59.9935	62.6068	2.61
op. 1	-10℃	59.9935	62.6068	2.61
op. 1	-20℃	59.9935	62.6008	2.61
op. 1	-30℃	59.9935	62.6068	2.61

Note 1: With voltage variation, Input voltage variation does not affect the transmitted signal (see plots for ambient /normal temperature).

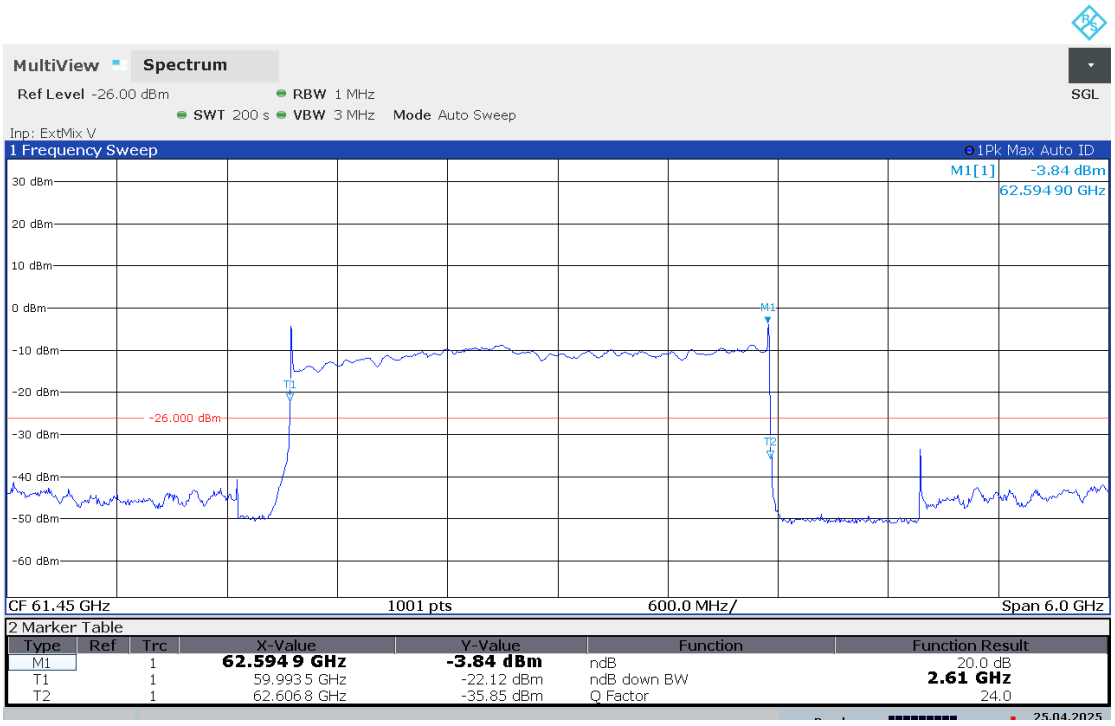
Plots No. 2: 20dB OBW, Peak detector, Horizontal / Vertical Polarization, 50℃/V_{nor}



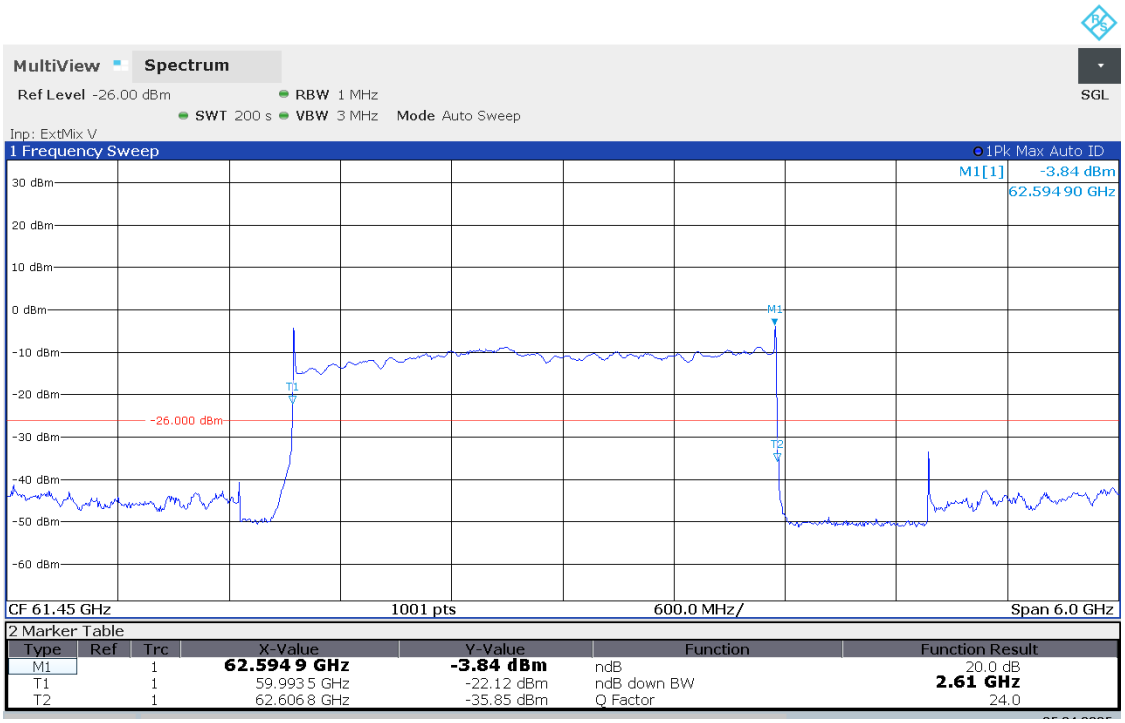
Plots No. 3: 20dB OBW, Peak detector, Horizontal / Vertical Polarization, 40℃/V_{nor}



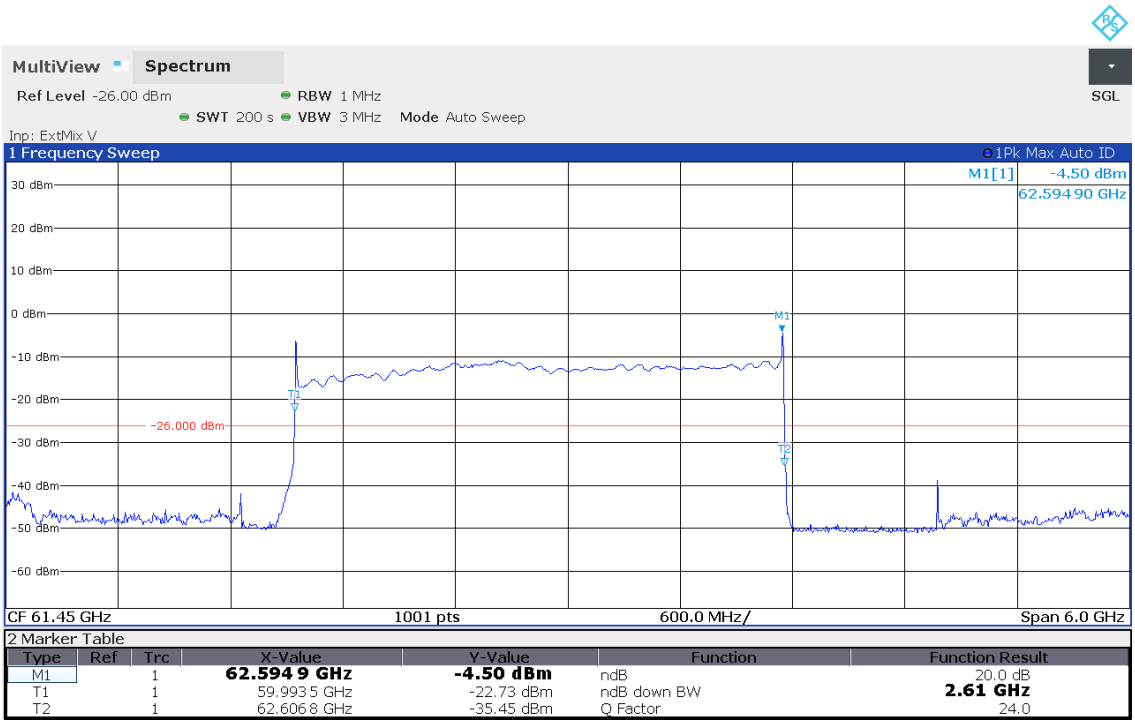
Plots No. 4: 20dB OBW, Peak detector, Horizontal / Vertical Polarization, 30℃/V_{nor}



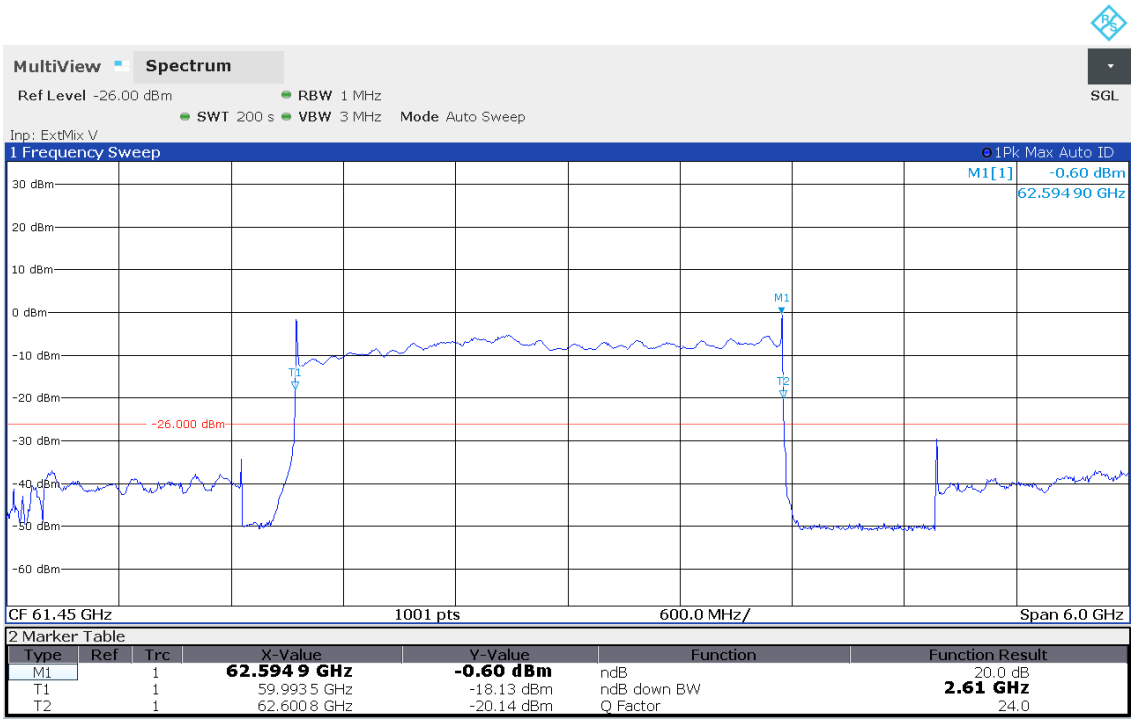
Plots No. 5: 20dB OBW, Peak detector, Horizontal / Vertical Polarization, 25℃/V_{nor}



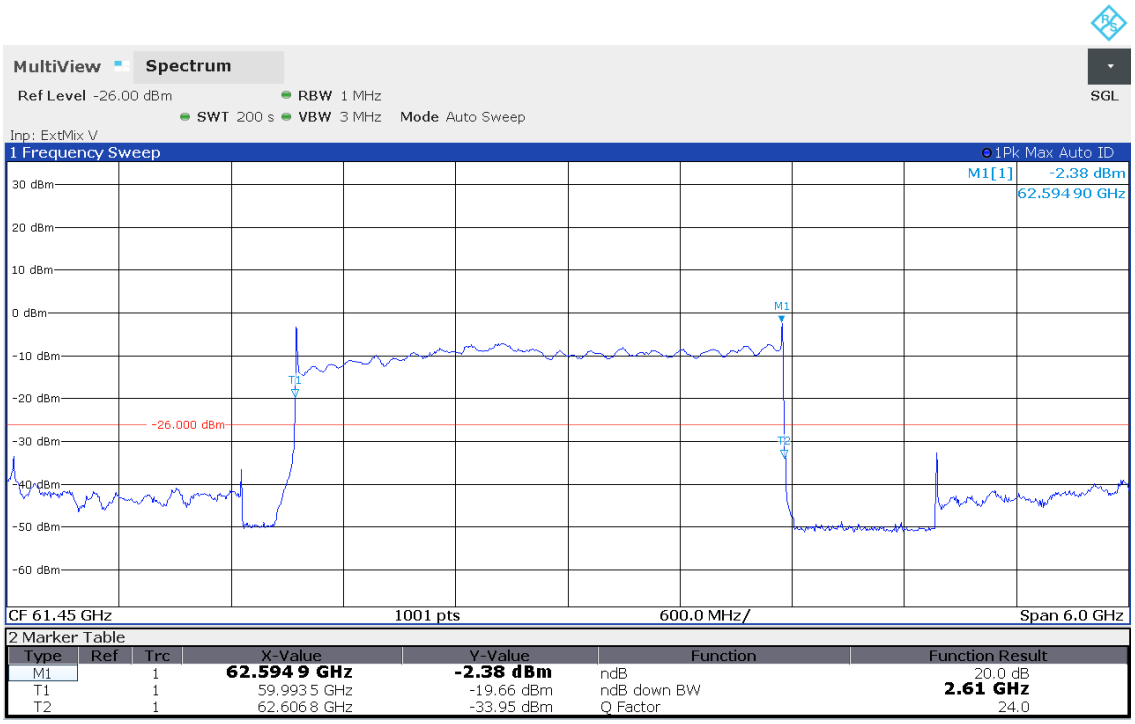
Plots No. 6: 20dB OBW, Peak detector, Horizontal / Vertical Polarization, 25℃/V_{max}



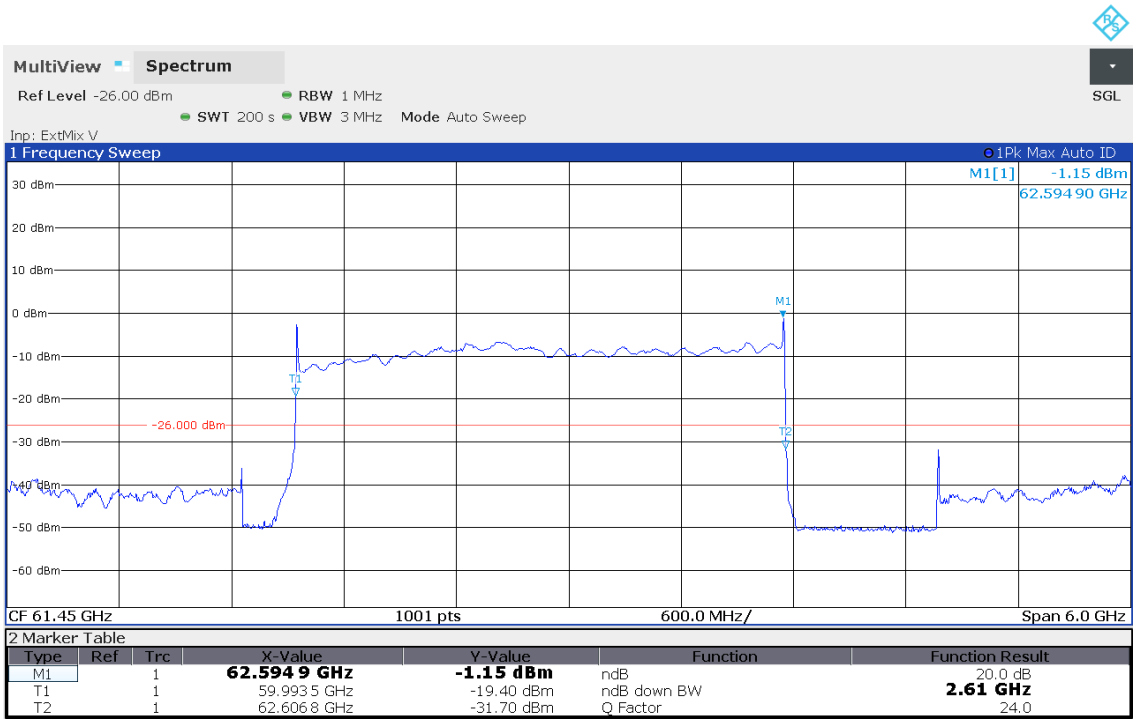
Plots No. 7: 20dB OBW, Peak detector, Horizontal / Vertical Polarization, 10℃/V_{nor}



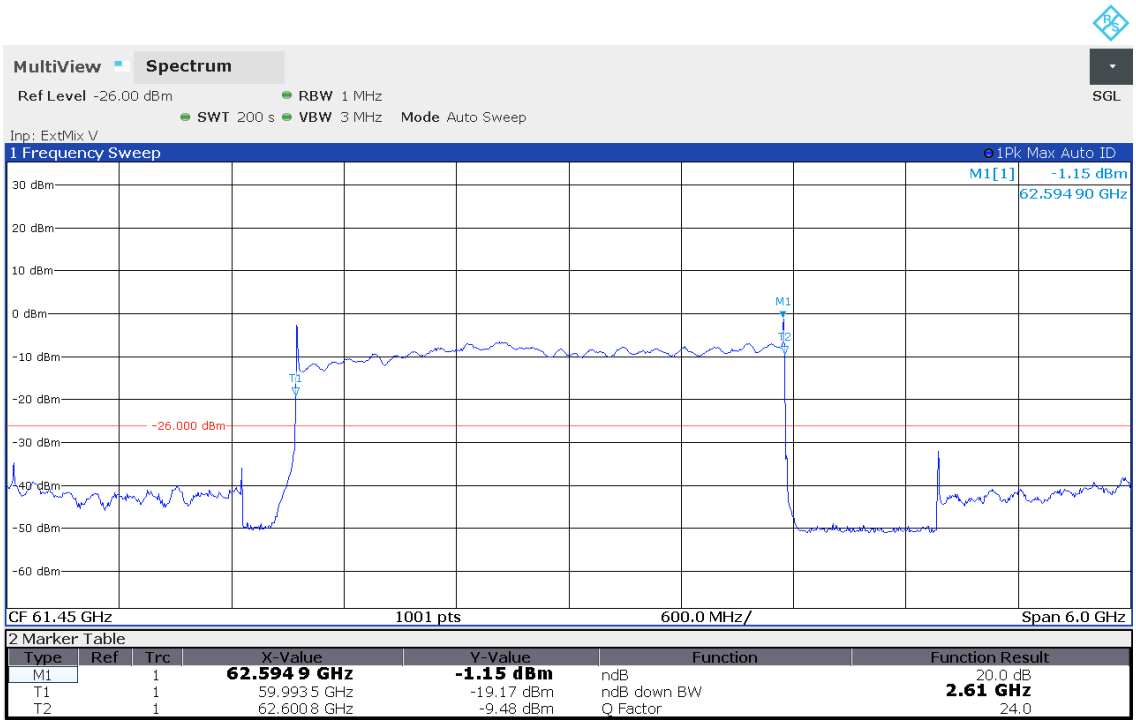
Plots No. 8: 20dB OBW, Peak detector, Horizontal / Vertical Polarization, 0℃/V_{nor}



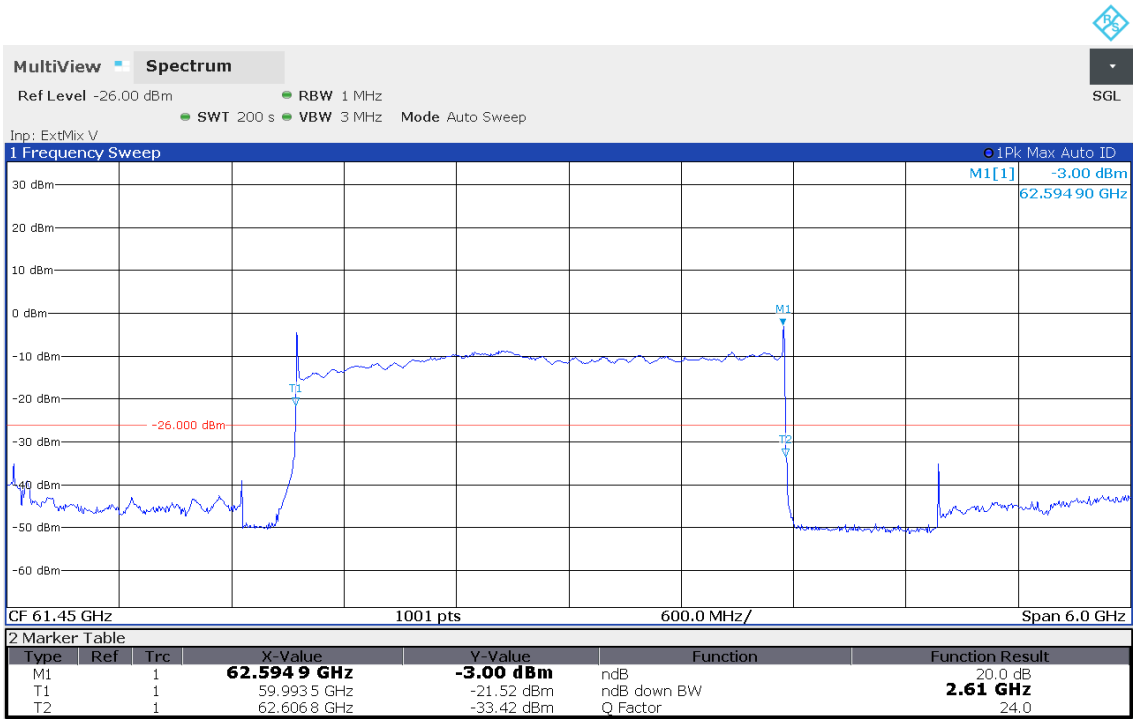
Plots No. 9: 20dB OBW, Peak detector, Horizontal / Vertical Polarization, -10℃/V_{nor}



Plots No. 10: 20dB OBW, Peak detector, Horizontal / Vertical Polarization, -20℃/V_{nor}



Plots No. 11: 20dB OBW, Peak detector, Horizontal / Vertical Polarization, -30℃/V_{nor}



4.4. Time Domain Requirements: Continuous Transmitter off-times & Transmit Duty Cycle [§15.255]

4.4.1. LIMITS

Measurement of the time domain parameter.
Limits for Selection of applicable rule parts as bellows;

Applicable Time Domain Requirements		
Applicable	**Rule part**	**Time domain requirement**
☐	15.255(b)(3)	sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any continuous interval of 33milliseconds
☐	15.255(c)(2)(i)	Peak EIRP ≤ 3 dBm: none
		Peak EIRP ≤ 20 dBm: sum of continuous transmitter off-times of at least two milliseconds equals at least 16.5 milliseconds within any contiguous interval of 33 milliseconds
☐	15.255(c)(2)(ii)(A)	sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33milliseconds
☐	15.255(c)(2)(iii)(B)	sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33milliseconds
☐	15.255(c)(3)	maximum pulse duration of 6 ns; transmit duty cycle shall not exceed 10% during any 0.3 us time window

Note:

- Continuous transmitter off-times:
  Off-times are only taken into account if they are larger than the specified minimum value (e.g. 2 ms).
  Off-times smaller than the specified minimum value are not considered when checking the specified limit (e.g. at least 25.5 ms within any continuous interval of 33 ms").

4.4.2. TEST RESULTS

Not Applicable

4.5. Spurious Emissions Radiation [§15.255]

4.5.1. LIMITS

According to § 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.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

(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.

Frequency Range [GHz]	Power Density / EIRP at Measurement Distance 3 [m]	Power Density / EIRP at Measurement Distance 1 [m]
40 – 200	90 pW/cm^2 / -10 dBm	90 pW/cm^2 / -19.47 dBm

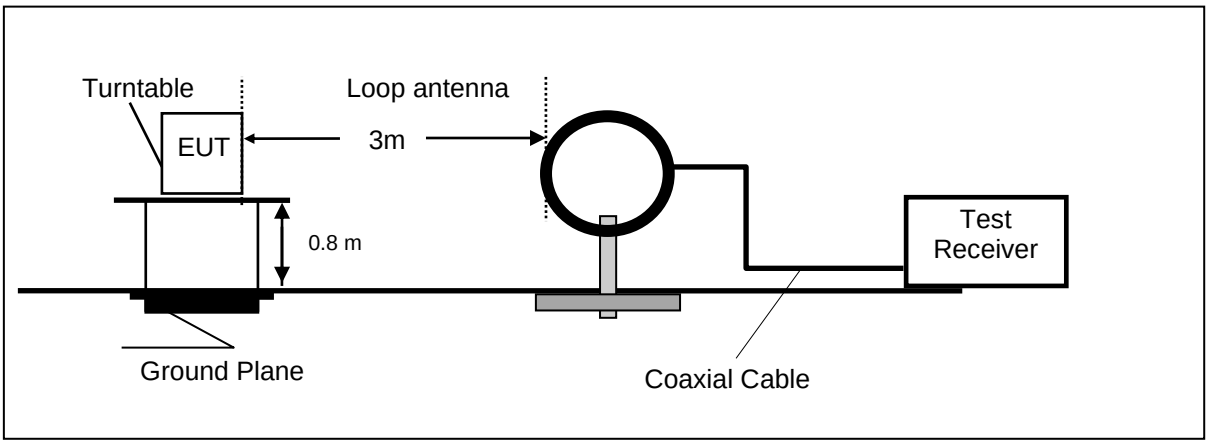
Limit conversion (ANSI C63.10-2013 9.6):
EIRP[dBm] = 10 x log (4 x π x d^2 x PD [W/m^2])
Power density at the distance specified by the limit: PD [W/m^2] Equivalent isotopically radiated power: EIRP [dBm]
Distance at which the power density limit is specified: d [m]According to this formula, an emission limit of PD = 90 pW/cm^2 at a distance of d = 3 m corresponds to an equivalent isotopically radiated power of EIRP = -10 dBm, PD = 90 pW/cm^2 at a distance of d = 1 m corresponds to an equivalent isotopically radiated power of EIRP = -19.47 dBm

(4) Compliance measurements of frequency-agile field disturbance sensors/radars shall be performed with any related frequency sweep, step, or hop function activated.

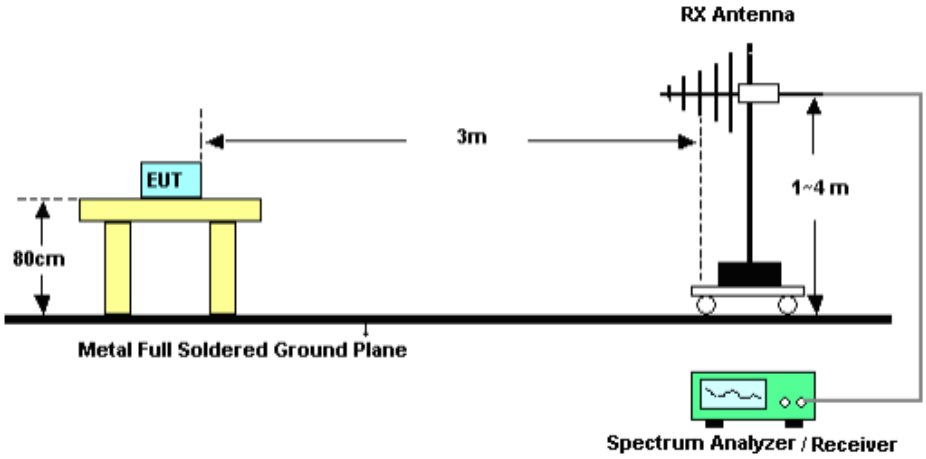
(5) If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

4.5.2. TEST RESULTS

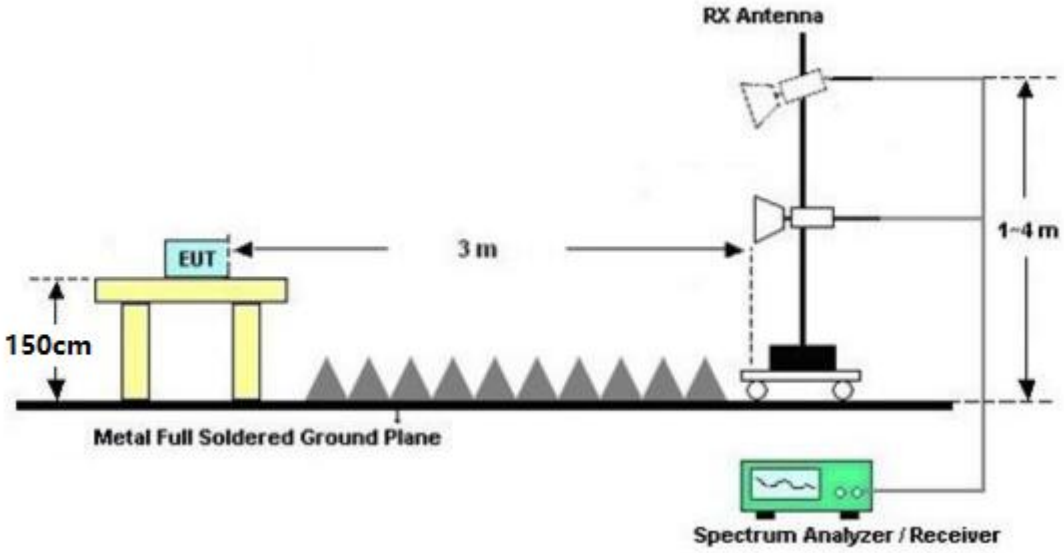
(a) Frequency range 9 KHz – 30MHz



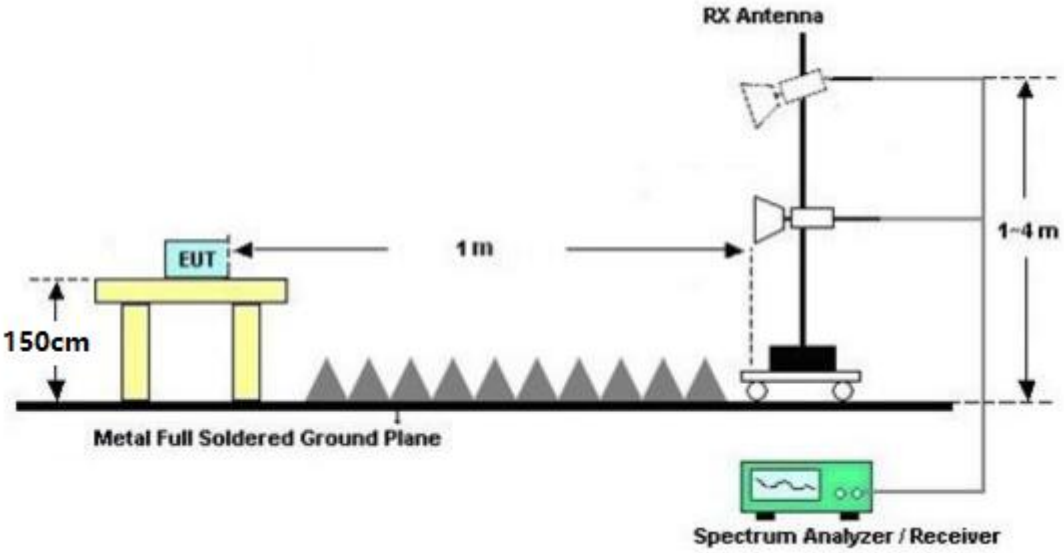
(b) Radiated emission test set-up, frequency range: 30 - 1000MHz



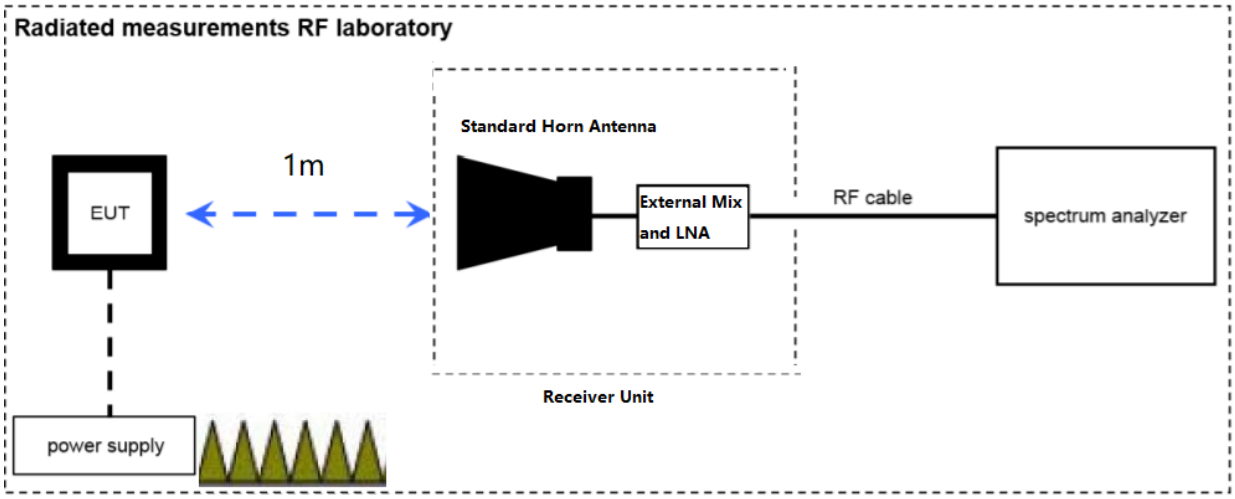
(c) Radiated emission test set-up, frequency range 1GHz – 18 GHz



(d) Radiated emission test set-up, frequency range 18GHz – 40 GHz



(e) Radiated emission test set-up, frequency range 40GHz – 240 GHz



4.5.3. TEST PROCEDURE

4.1.3.1 Sequence of testing radiated spurious 9 KHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measuremet distance is 3m (see ANSI C63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0 degree to 360 degree.
- The antenna height is 1m.
- Set RBW = 200 Hz / VBW = 1 KHz, sweep time: Auto
- At each turntable position the anzlyer sweeps with position-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the premeaurement are maximized by the software by rotating the turntable from 0 degree to 360 degree.
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, conrrection factor, margin to the limit and limit will be recorded. A plot with the graph of the measurement and the limit is stored.

4.1.3.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 0.8 m height is used, which is placed on the ground plance.
- If the EUT is a floor standing device, it is placed directly on the ground plane.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measuremet distance is 3m (see ANSI C63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0 degree to 360 degree.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1m to 4m.
- Set RBW = 120 KHz / VBW = 1 MHz, sweep time: Auto
- At each turntable position the anzlyer sweeps with position-peak detector to find the maximum of all emissions.

Final measurement
- The final neasurement is perormed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, conrrection factor, margin to the limit and limit will be recorded. A plot with the graph of the measurement and the limit is stored.

4.1.3.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup
- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turntable.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measuremet distance is 3m (see ANSI C63.4) – see test details.
- EUT is set into operation.

Premeasurement
- The turntable rotates from 0 degree to 360 degree.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1m to 4m.
- Set RBW = 1 MHz / VBW = 3 MHz, sweep time: Auto, detector: Peak for Peak, RBW = 1 MHz / VBW = 3 MHz, sweep time: Auto, detector: Average for Average.
- At each turntable position the anzlyer sweeps with position-peak detector to find the maximum of all emissions.

Final measurement
- The final neasurement us perormed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable and antenna height between 1 and 4 m.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the height emissions with Peak and Average detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, conrrection factor, margin to the limit and limit will be recorded. A plot with the graph of the measurement and the limit is stored.

4.1.3.4 Sequence of testing radiated spurious 18 GHz – 42 GHz

Setup
- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turntable.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measuremet distance is 1m (see ANSI C63.4) – see test details.
- EUT is set into operation.

Premeasurement
- The turntable rotates from 0 degree to 360 degree.

- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1m to 4m.
- Set RBW = 1 MHz / VBW = 3 MHz, sweep time: Auto, detector: Peak for Peak, RBW = 1 MHz / VBW = 3 MHz, sweep time: Auto, detector: Average for Average.
- At each turntable position the anzlyer sweeps with position-peak detector to find the maximum of all emissions.

Final measurement

- The final neasurement is perormed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable and antenna height between 1 and 4 m.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the height emissions with Peak and RMS detector (as described in ANSI C 63.4).
- All final levels should consider distance conversion factor as format: Final values (3 m) = Measurement values (1 m) + Distance conversion factor
  Distance conversion factor = 20 x Log_{10} (d/3), where d = measurement distance in m
  - Distance conversion factor = 20 x Log_{10} (1/3) = -9.54 [dB]
- Final levels, frequency, measuring time, bandwidth, turntable position, conrrection factor, margin to the limit and limit will be recorded. A plot with the graph of the measurement and the limit is stored.

4.1.3.5 Sequence of testing radiated spurious above 42 GHz with external mixers

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turntable.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measuremet distance is 1m (see ANSI C63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0 degree to 360 degree.
- The antenna with external mixer is polarized vertical and horizontal.
- The antenna height changes from 1m to 4m.
- Set RBW = 1 MHz / VBW = 3 MHz, sweep time: Auto, detector: Peak for Peak, RBW = 1 MHz / VBW = 3 MHz, sweep time: Auto, detector: Average for Average.
- At each turntable position the anzlyer sweeps with position-peak detector to find the maximum of all emissions.

Final measurement

- The final neasurement is perormed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable and antenna height between 1 and 4 m.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the height emissions with Peak and RMS detector (as described in ANSI C 63.4).
- All final levels should consider distance conversion factor as format: Final values (3 m) = Measurement values (1 m) + Distance conversion factor
  Distance conversion factor = 20 x Log_{10} (d/3), where d = measurement distance in m
  - Distance conversion factor = 20 x Log_{10} (1/3) = -9.54 [dB]
- Final levels, frequency, measuring time, bandwidth, turntable position, conrrection factor, margin to the limit and limit will be recorded. A plot with the graph of the measurement and the limit is stored.

4.5.4. FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS (dBuV/m) = RA (dBuV) + AF (dB/m) + CL (dB) – AG (dB)

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

4.5.5. TEST RESULTS

EIRP measurements were ensured to be taken in the Far-Field test distance are shown in Section 2.15.

Sample Calculations

Calculating Field Strength from substitution power:

$$\mathbf{E(dBuV/m) = 126.8 - 20log(\lambda) + P - G}$$

Where;
E is the field strength of the emission at the measurement distance, in dBuV/m
P is the power measured at the output of the test antenna, in dBm; where P includes all applicable instrument correction factors up to the connections to the test antenna.
λ is the wavelength of the emission under investigation [300 / f_{MHz}], in m.
G is the gain of the test antenna, in dBi.

Calculating EIRP from Field Strength;

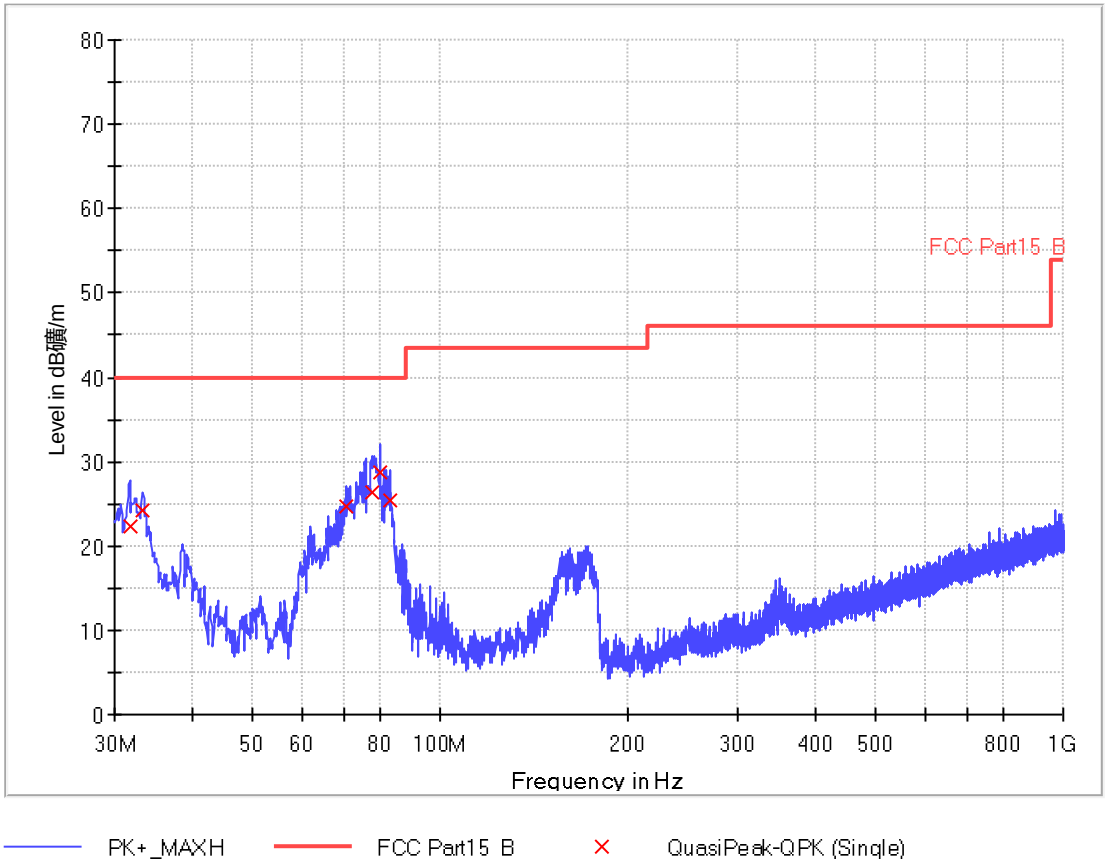
$$\mathbf{EIRP_{[dBm]} = E_{measurement} + 20log\ (D_{measured}) - 104.7}$$

Where;
EIRP is the equivalent isotropic radiated power in dBm
$E_{measured}$ is the field strength of the emission at the measurement distance, in dBuV/m
$D_{measure}$d is the measurement distance in meters.

PASS

Note 1: Not recorded values after pre-test below 30 MHz (9 KHz – 30 MHz), values at least 20 dB below limit.

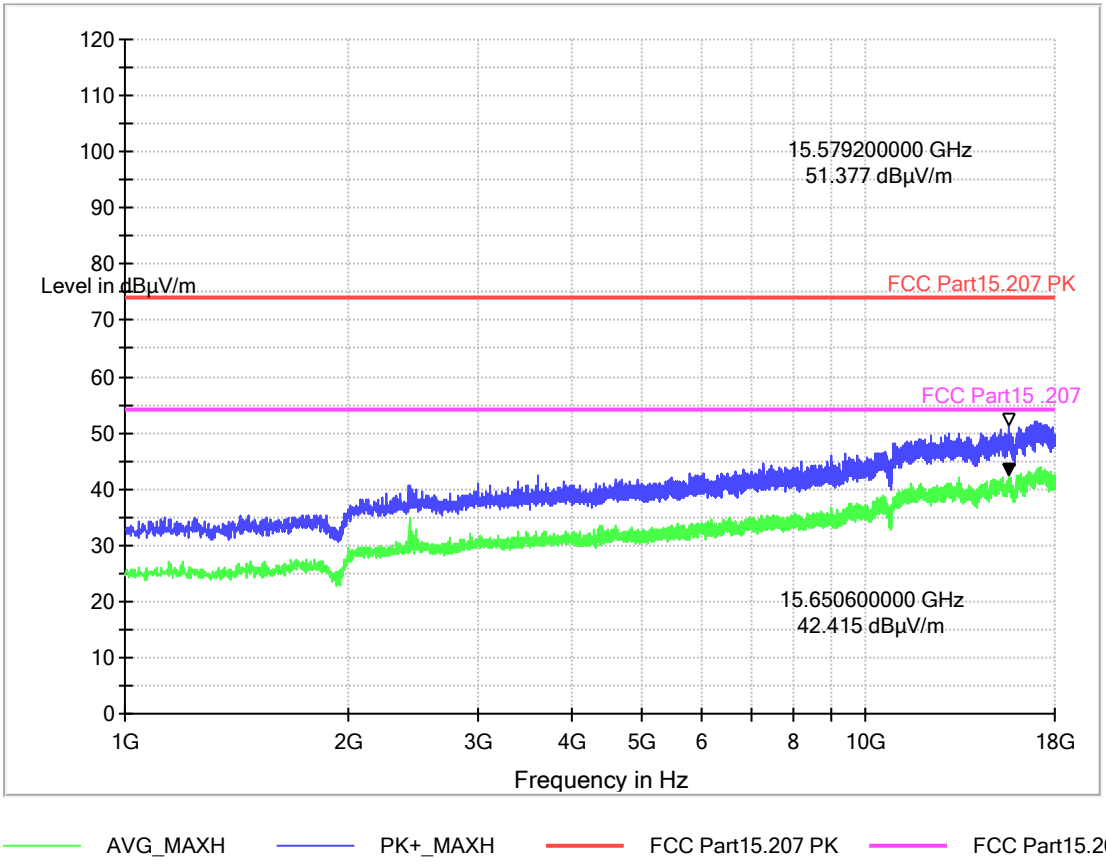
Plots No. 12: Radiated Emission, 30 MHz to 1 GHz, Horizontal / Vertical Polarization



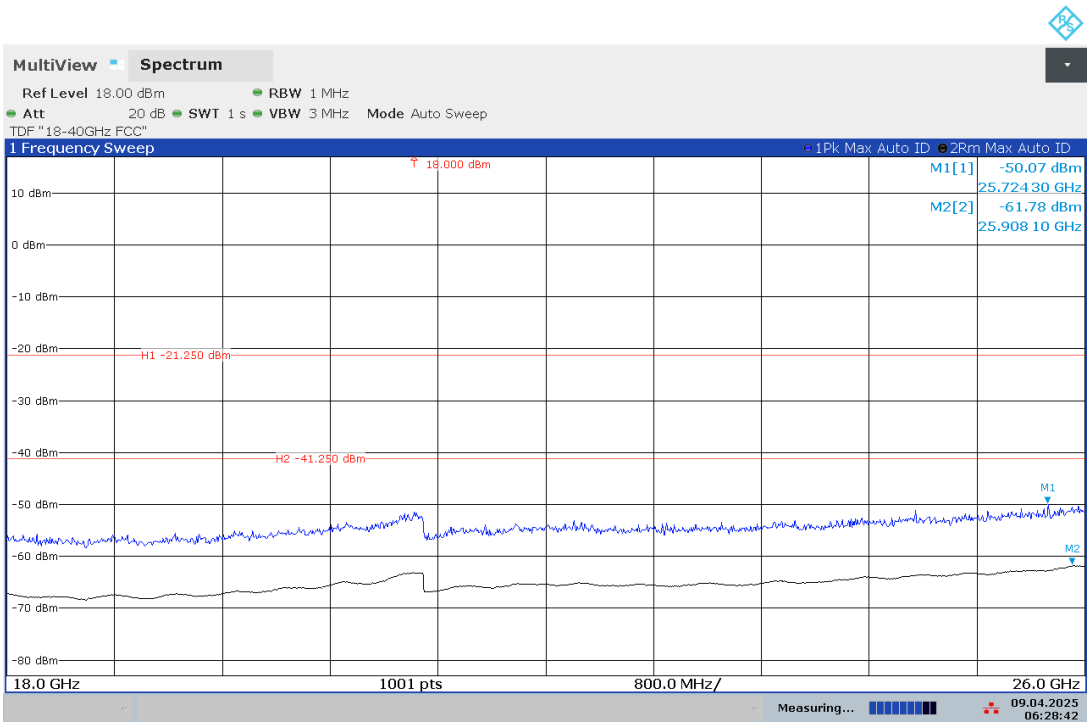
Limit and Margin

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)
31.760	22.3	1000.0	120.000	400.0	V	-1.0	-25.3	17.7
33.200	24.3	1000.0	120.000	400.0	V	-1.0	-25.3	15.7
70.720	24.8	1000.0	120.000	400.0	V	-1.0	-27.4	15.2
77.720	26.3	1000.0	120.000	400.0	V	-1.0	-28.1	13.7
80.240	28.6	1000.0	120.000	400.0	V	-1.0	-28.5	11.4
83.160	25.4	1000.0	120.000	400.0	V	-1.0	-28.5	14.6

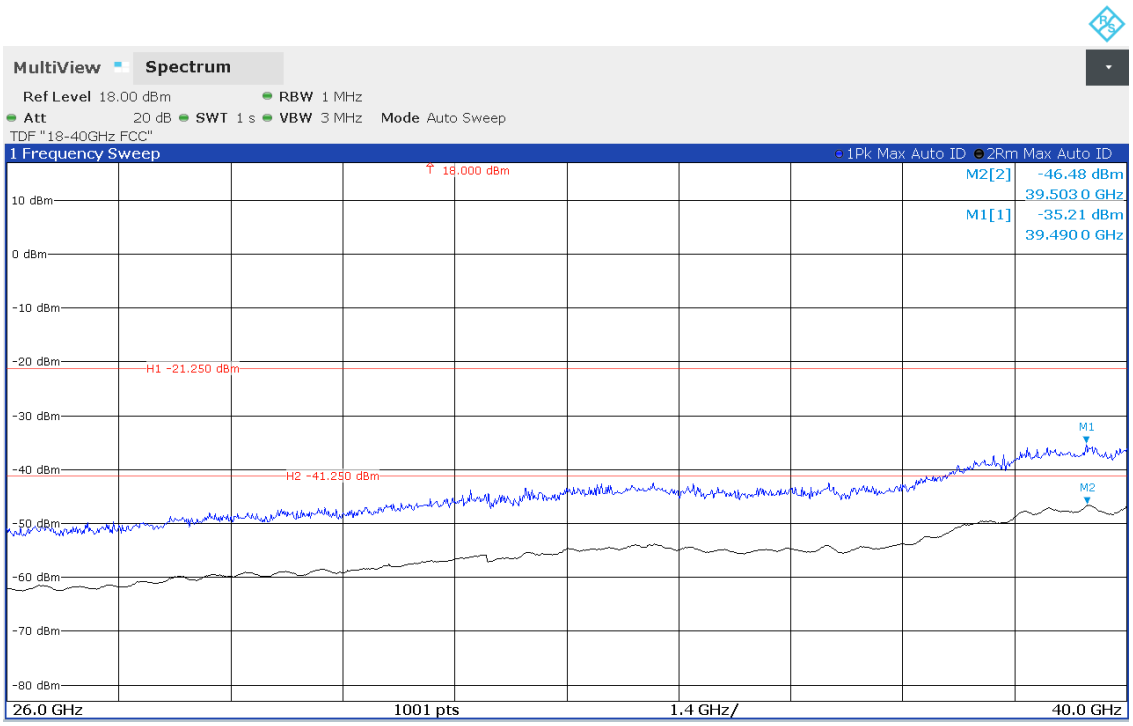
Plots No. 13: Radiated Emission, 1 GHz to 18 GHz, Horizontal / Vertical Polarization



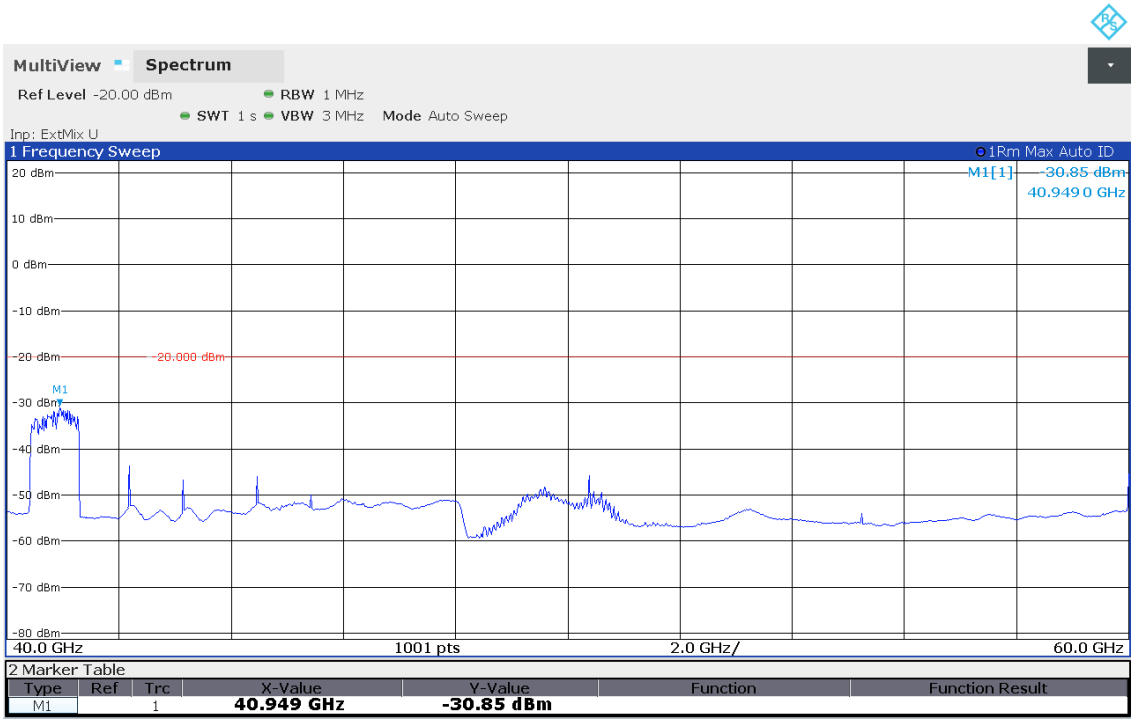
Plots No. 14: Radiated Emission, 18 GHz – 26.5 GHz, Horizontal / Vertical Polarization



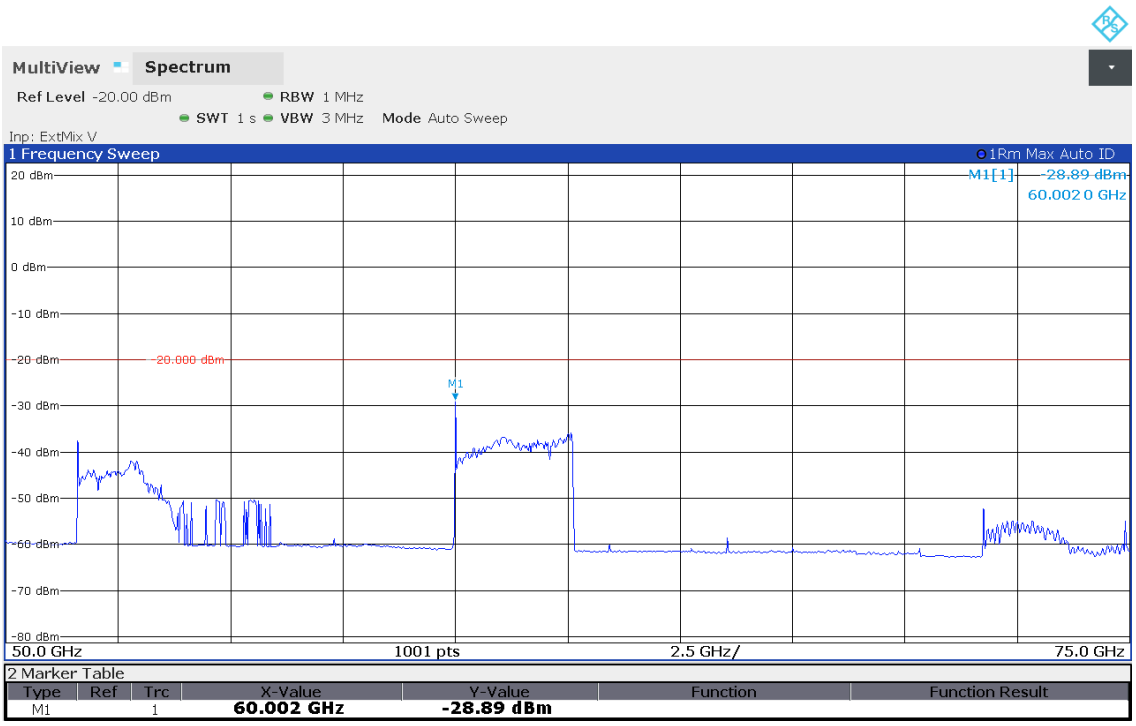
Plots No. 15: Radiated Emission, 26.5 GHz – 40 GHz, Horizontal / Vertical Polarization



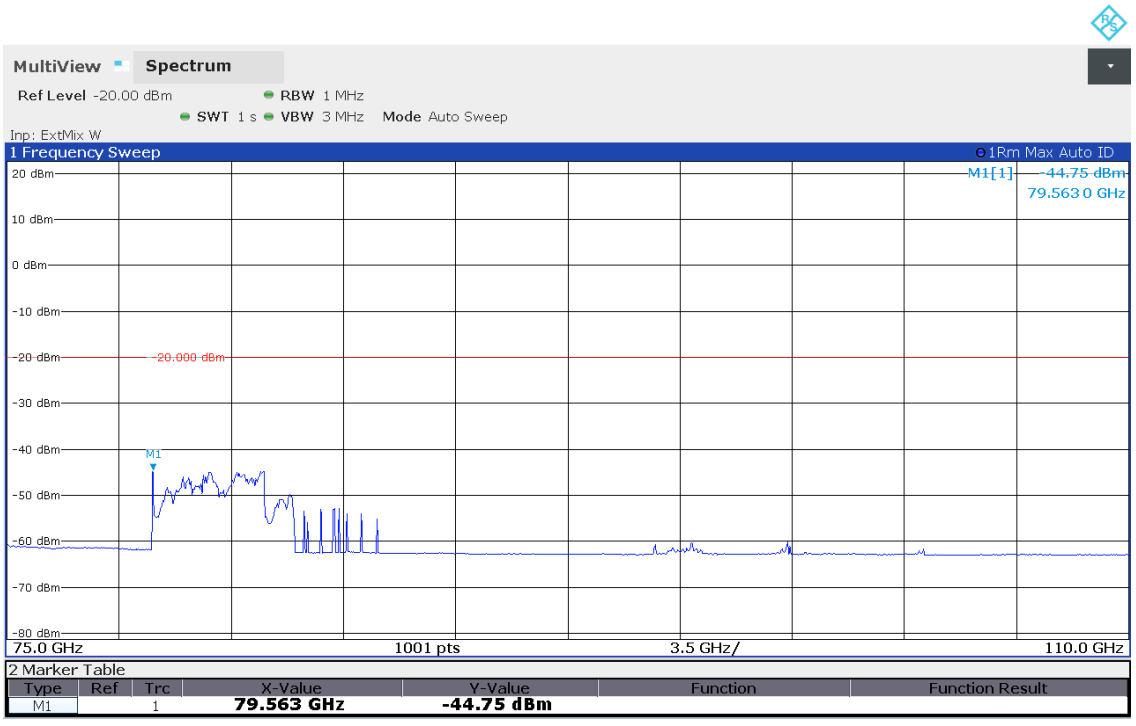
Plots No. 16: Radiated Emission, 40 GHz – 60 GHz, Horizontal / Vertical Polarization



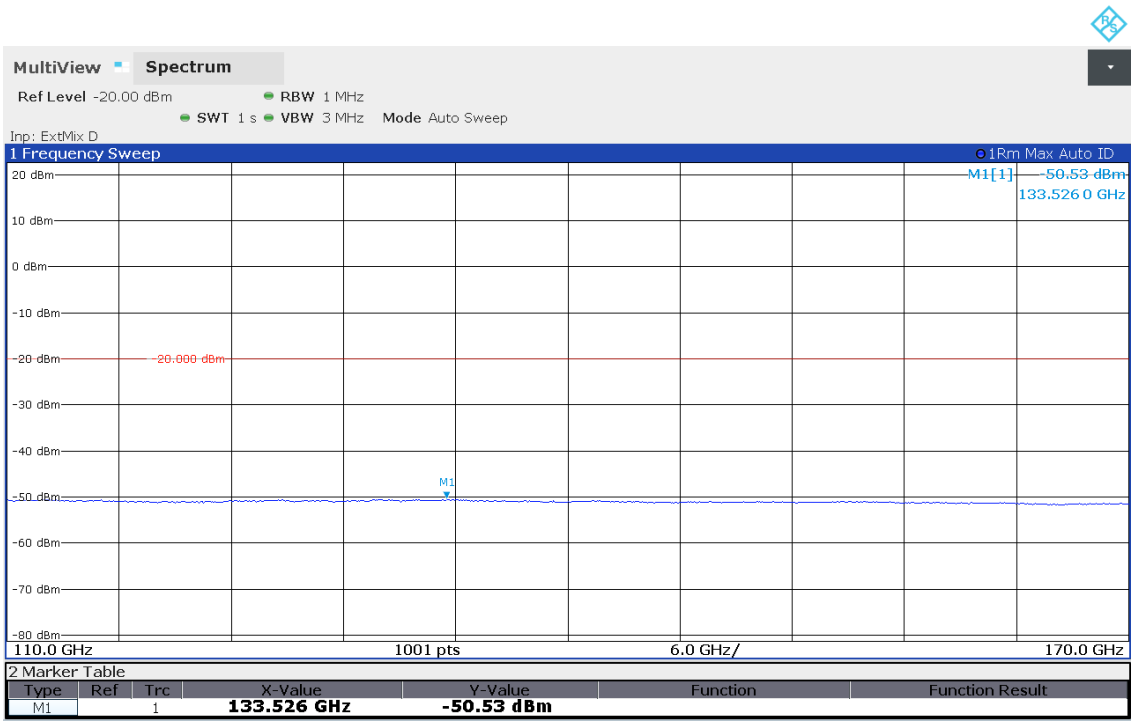
Plots No. 17: Radiated Emission, 50 GHz to 75 GHz, Horizontal / Vertical Polarization



Plots No. 18: Radiated Emission, 75 GHz to 110 GHz, Horizontal / Vertical Polarization



Plots No. 19: Radiated Emission, 110 GHz to 170 GHz, Horizontal / Vertical Polarization



Plots No. 20: Radiated Emission, 170 GHz to 220 GHz, Horizontal / Vertical Polarization

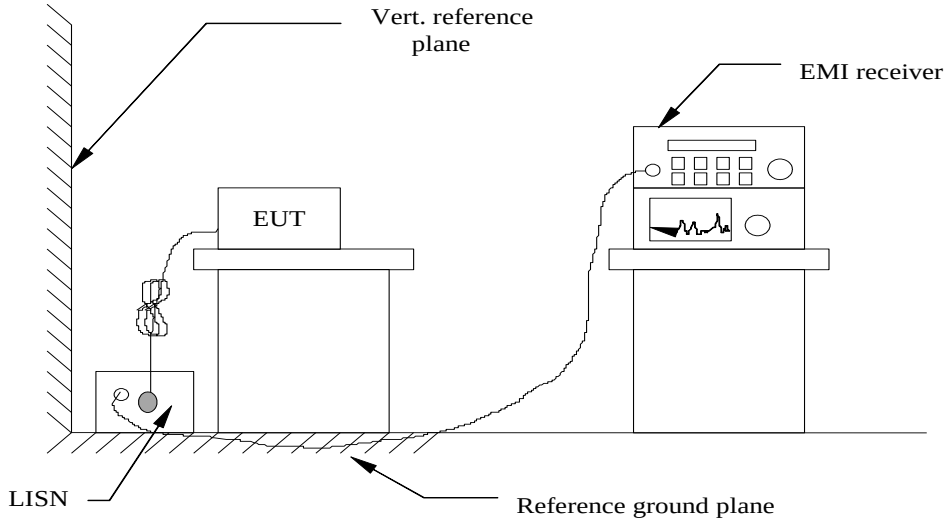
4.6. AC Conducted Emission [§15.209]

4.6.1. LIMITS OF DISTURBANCE

According to RSS Gen 8.8 and § 15.207(a) Line Conducted Emission Limits is as following:

Frequency range (MHz)	Limit (dBuV)	
	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.		

4.6.2. TEST CONFIGURATION



4.6.3. TEST PROCEDURE

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2. Support equipment, if needed, was placed as per ANSI C63.10-2013
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
4. The EUT received DC 12V power from adapter, the adapter received AC120V/60Hz and AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipment received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50-ohm load; the second scan had Line 1 connected to a 50-ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

4.6.4. DISTURBANCE CALCULATION

The AC mains conducted disturbance is calculated by adding the 10dB Pulse Limiter and Cable Factor and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

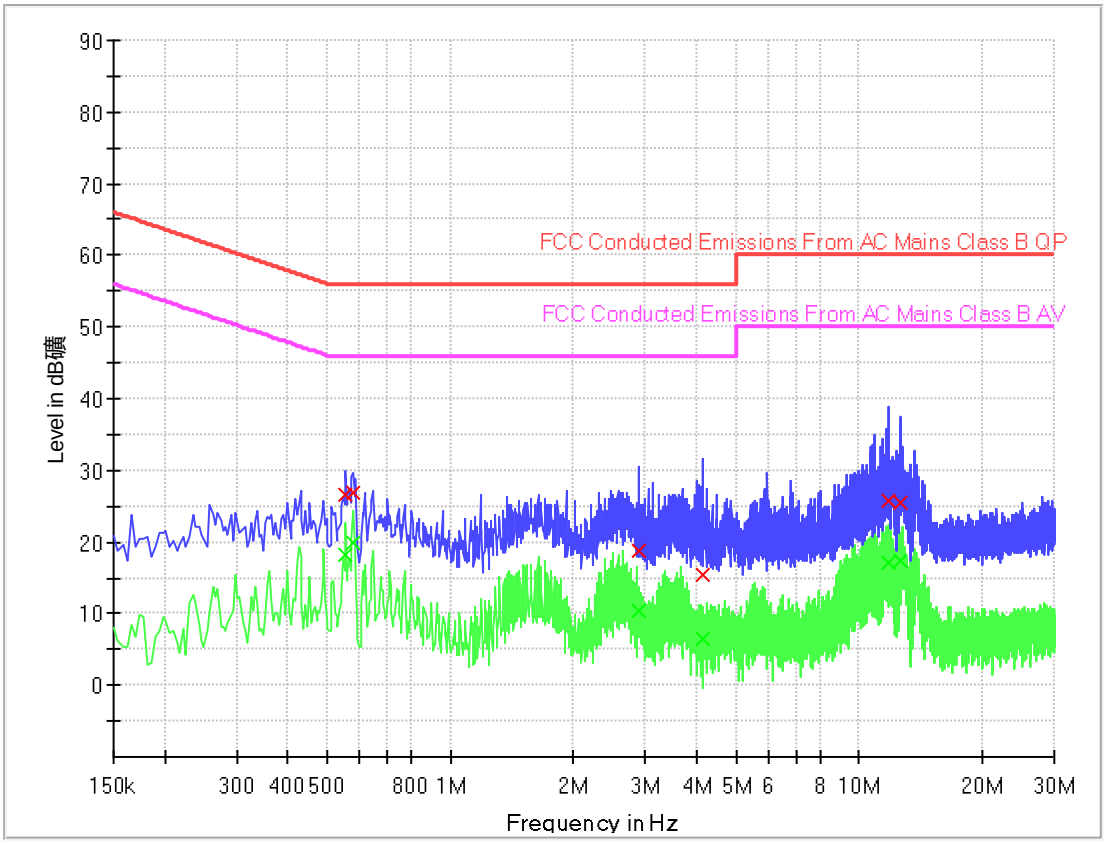
CD (dBuV) = RA (dBuV) + PL (dB) + CL (dB)

Where CD = Conducted Disturbance	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	PL = 10 dB Pulse Limiter Factor

4.6.5. TEST RESULTS

Note 1: Pre-test AC conducted emission at charge from 3Mbps-Middle Channel mode, recorded worst case. Pre-test AC conducted emission at both voltage AC 120V/60Hz and AC 240V/50Hz, recorded worst case at AC 120V/60Hz.

N



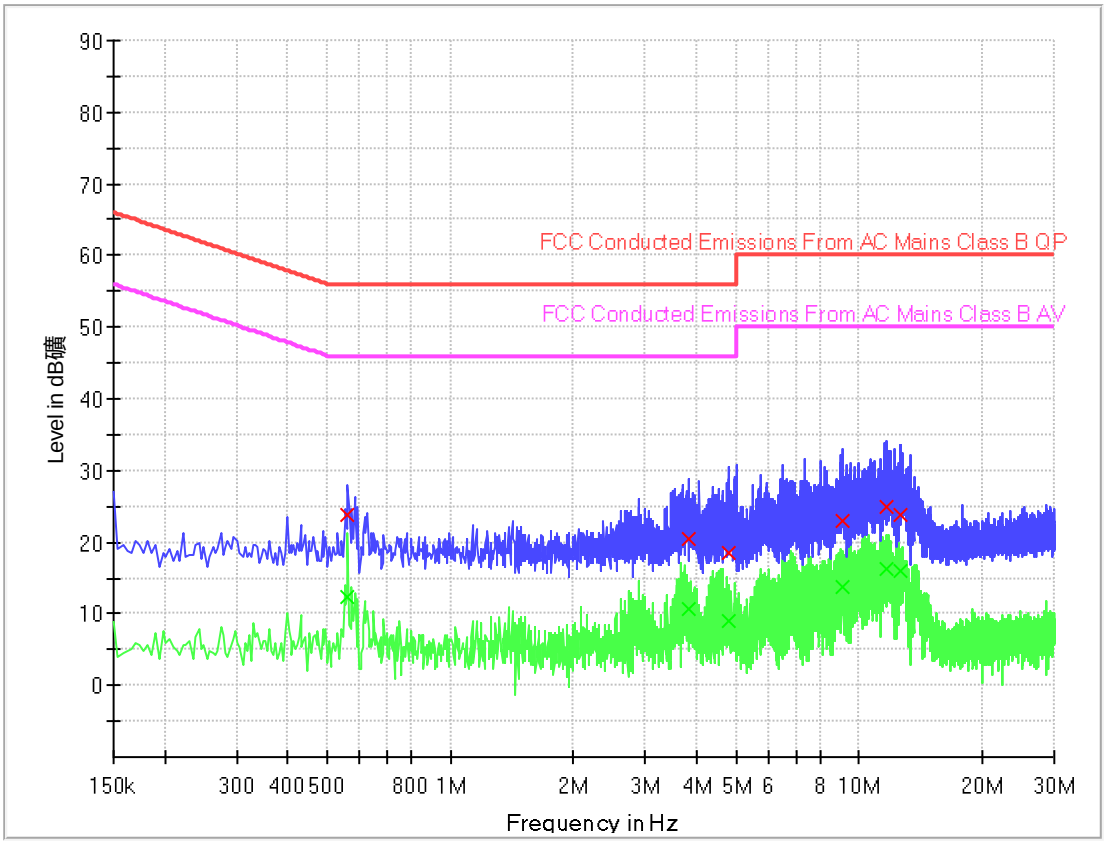
Limit and Margin

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.554	26.5	18.2	---	1000.0	9.000	N	OFF	9.8
0.578	26.9	19.9	---	1000.0	9.000	N	OFF	9.8
2.882	18.8	10.3	---	1000.0	9.000	N	OFF	10.0
4.134	15.5	6.5	---	1000.0	9.000	N	OFF	10.1
11.826	25.8	17.0	---	1000.0	9.000	N	OFF	10.4
12.670	25.6	17.4	---	1000.0	9.000	N	OFF	10.5

(continuation of the "Limit and Margin" table from column 14 ...)

Frequency (MHz)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - AVG (dB)	Limit - AVG (dBµV)	Comment
0.554	29.5	56.0	27.8	46.0	
0.578	29.2	56.0	26.1	46.0	
2.882	37.2	56.0	35.7	46.0	
4.134	40.5	56.0	39.5	46.0	
11.826	34.2	60.0	33.0	50.0	

L



Limit and Margin

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.562	23.9	12.4	---	1000.0	9.000	N	OFF	9.8
3.846	20.4	10.6	---	1000.0	9.000	N	OFF	10.1
4.778	18.6	9.1	---	1000.0	9.000	N	OFF	10.1
9.102	22.9	13.8	---	1000.0	9.000	N	OFF	10.3
11.698	24.9	16.3	---	1000.0	9.000	N	OFF	10.4
12.638	23.7	15.9	---	1000.0	9.000	N	OFF	10.5

(continuation of the "Limit and Margin" table from column 14 ...)

Frequency (MHz)	Margin - QPK (dB)	Limit - QPK (dBµV)	Margin - AVG (dB)	Limit - AVG (dBµV)	Comment
0.562	32.1	56.0	33.6	46.0	
3.846	35.6	56.0	35.4	46.0	
4.778	37.4	56.0	36.9	46.0	
9.102	37.1	60.0	36.2	50.0	
11.698	35.1	60.0	33.7	50.0	
12.638	36.3	60.0	34.1	50.0	

4.7. Frequency Stability [§15.255 (f)]

4.7.1. LIMITS

According to §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.

(a) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

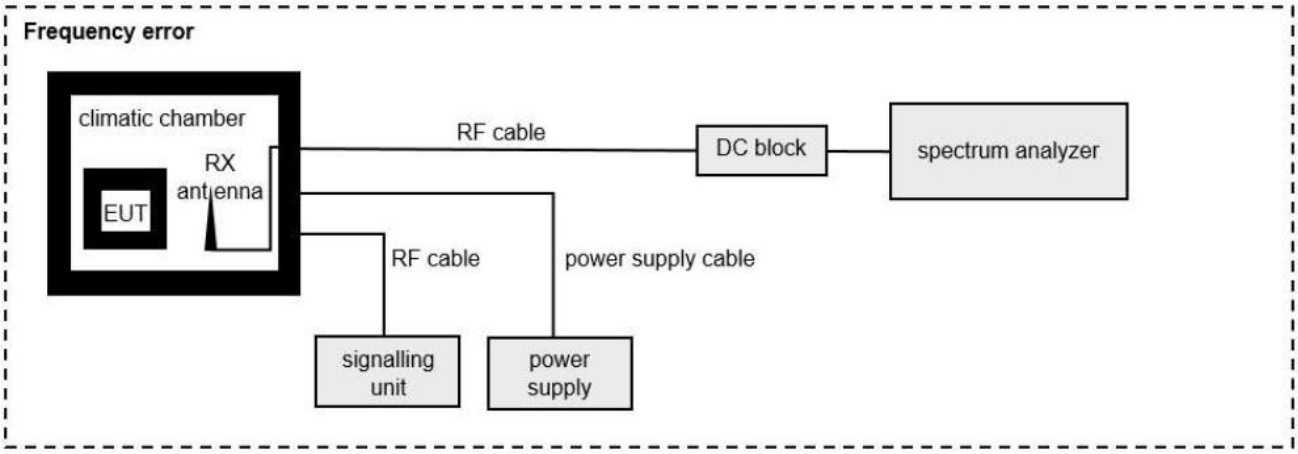
(b) The frequency stability shall be measured with variation of primary supply voltage as follows:

(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.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

4.7.2. TEST CONFIGURATION



4.7.3. TEST PROCEDURE

According to ANSI C63.10:2020 section 9.5: The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwdith:

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 (3dB 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 [$10\log_{10}$(OBW/RBW] below the reference level. Specific guidance is given in 4.1.5.2.

d) Set the detection mode to peak, and the trace mode to maxhold.

e) If the instrument does not have 99% OBW function, recover the trace data points and sum directly in linear power terms. Placce the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Recorded that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.

f) The OBW shall be reported and plots of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labelled. Tabular data can be reported in addition to the plots.

Measurement with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results.

4.7.4. TEST RESULTS

PASS

Please refer to measurement results for Occupied Bandwidth.

4.8. Antenna Requirement [§15.203]

4.8.1. REQUIREMENT

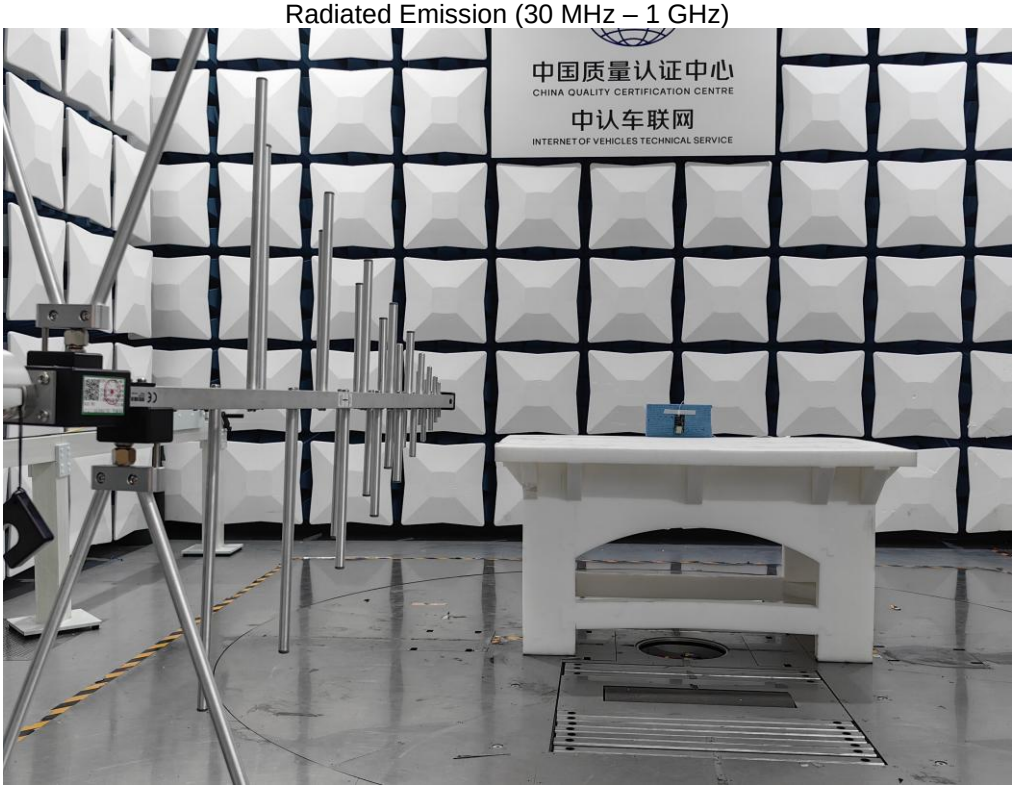
According to § 15.203 and RSS-Gen: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited

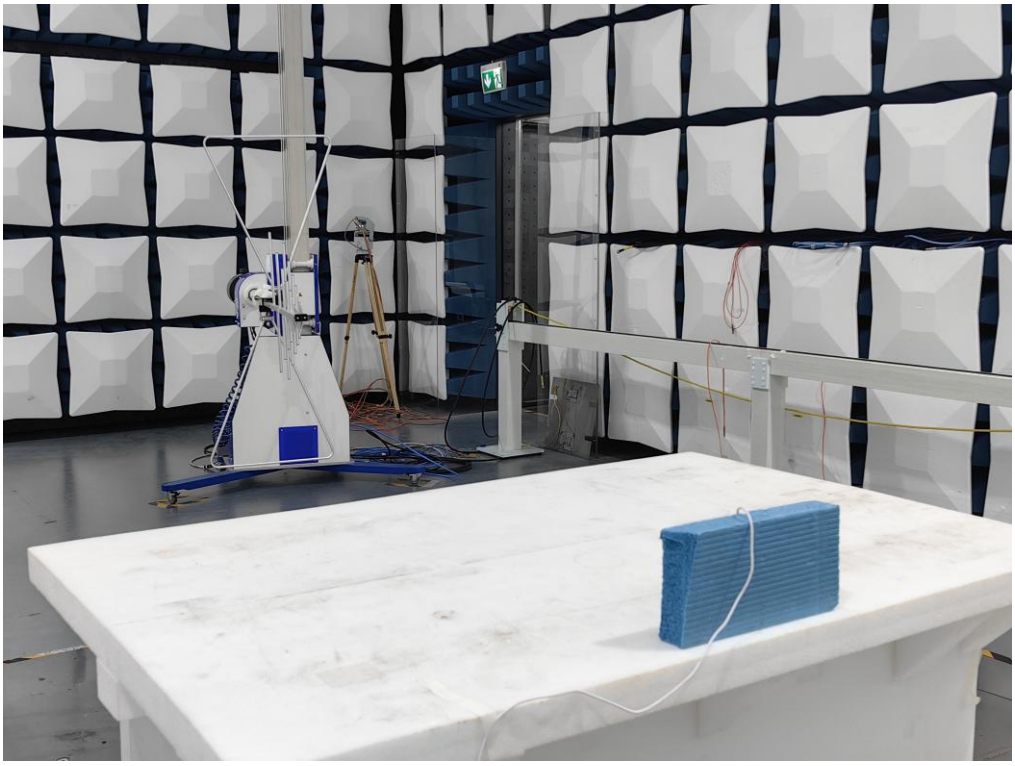
4.8.2. VERDICT

The EUT has an patch antenna which is not user accessible. Hence it compliances with the antenna requirements.

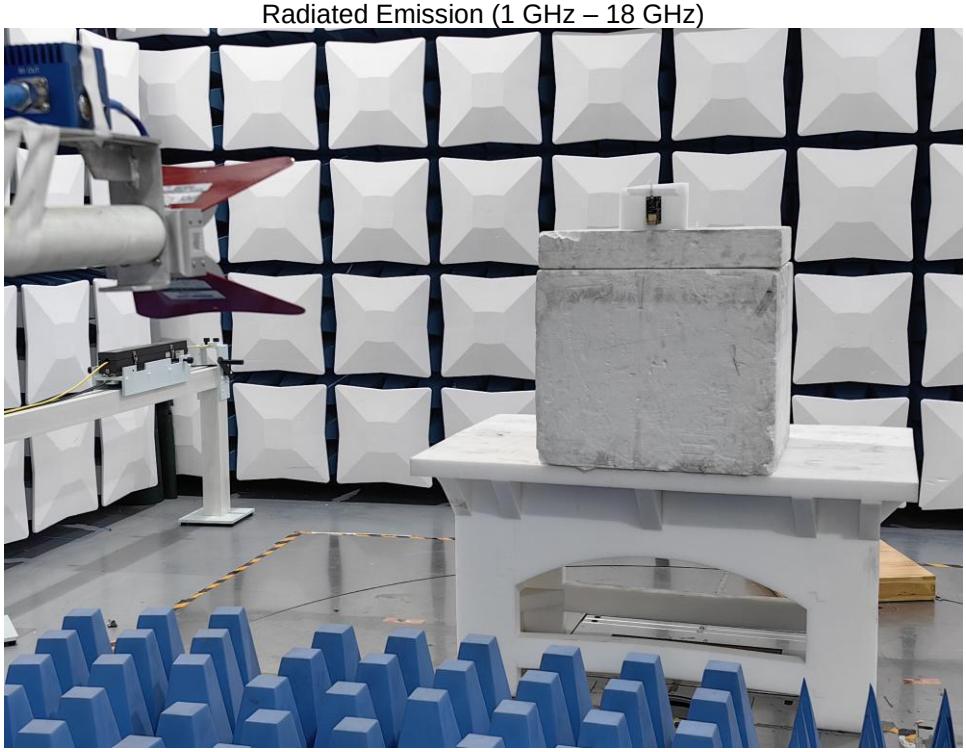
5. Test Set-up Photos of the EUT

Radiated Emission (30 MHz – 1 GHz)

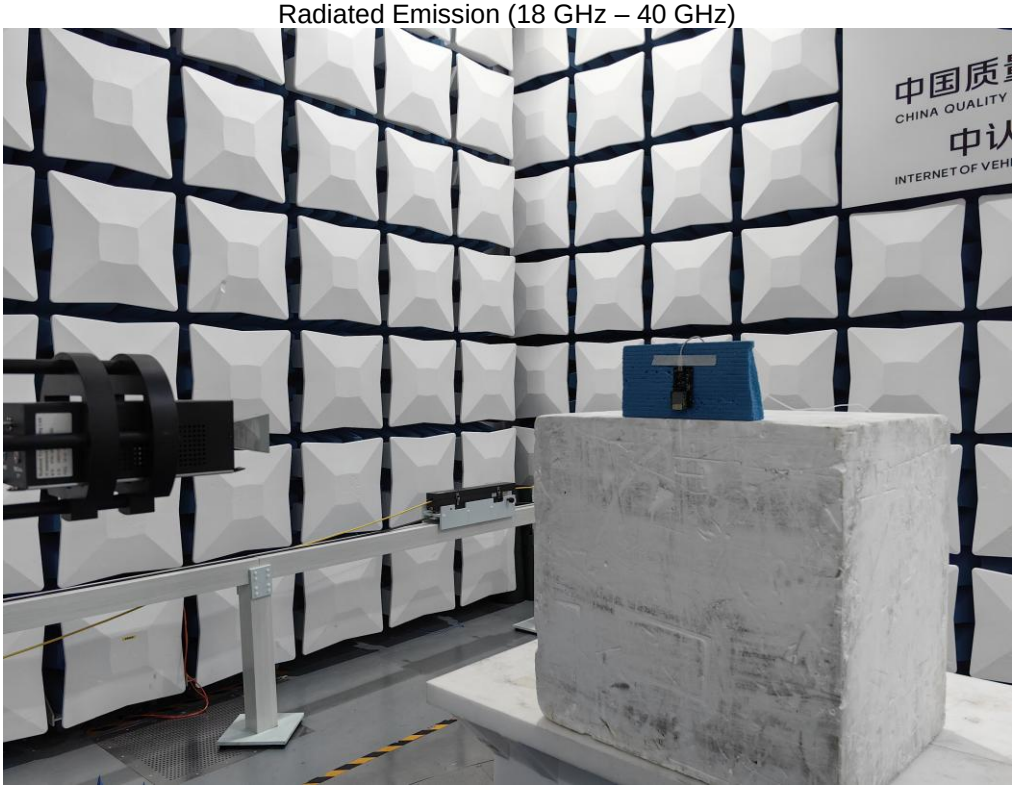




Radiated Emission (1 GHz – 18 GHz)

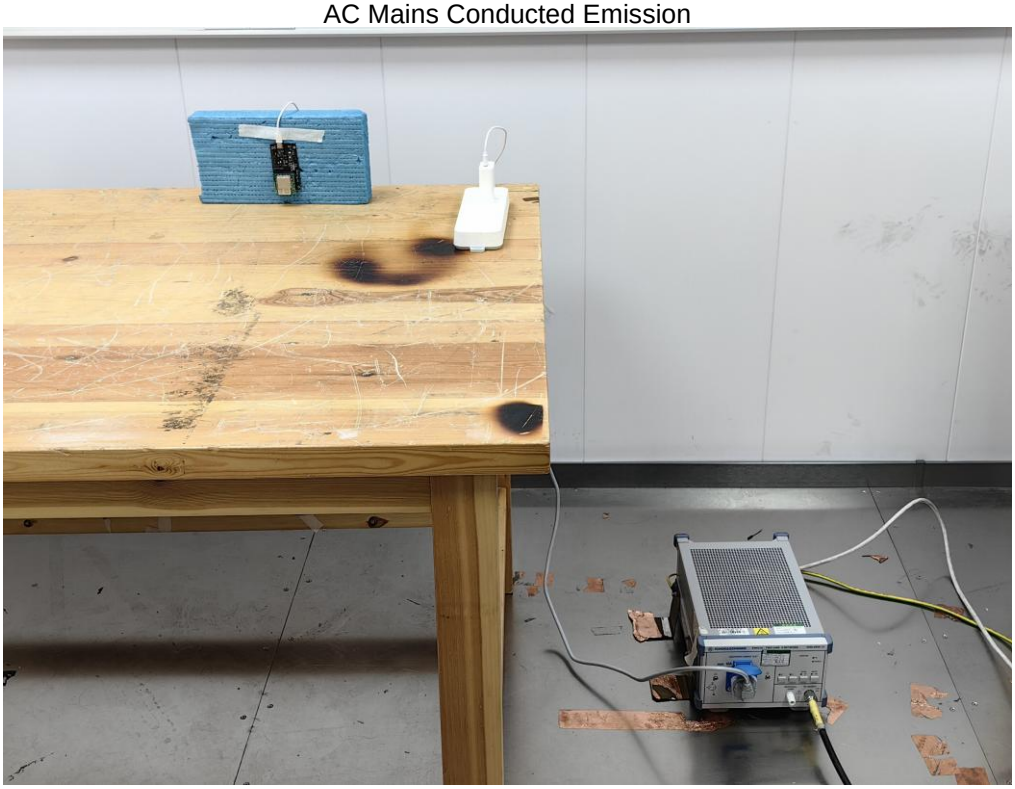


Radiated Emission (18 GHz – 40 GHz)



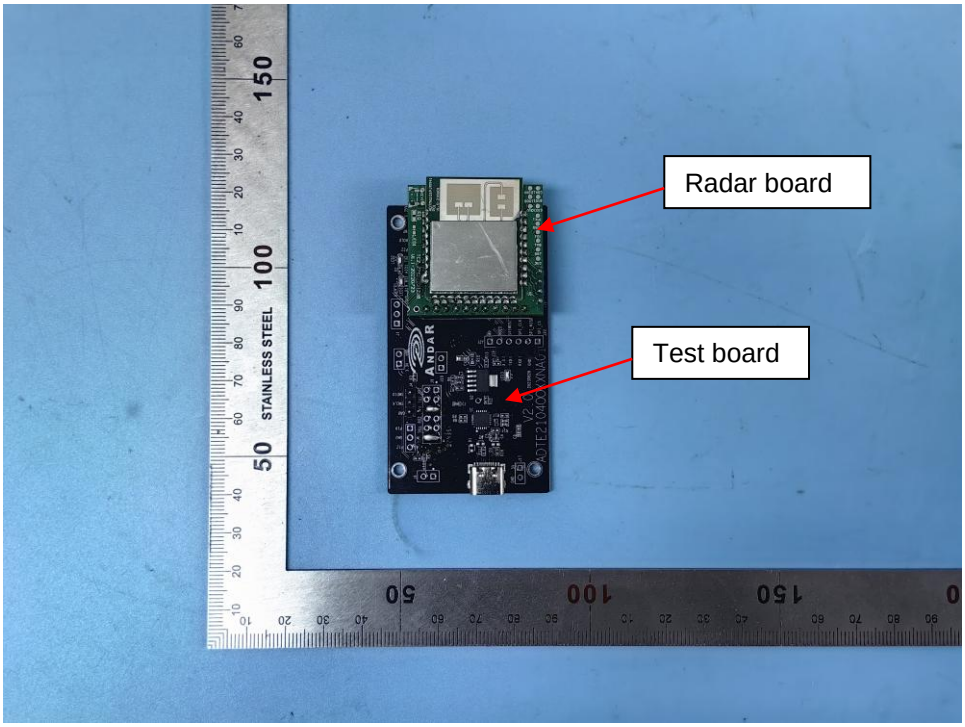
Radiated Emission (Above 40 GHz)

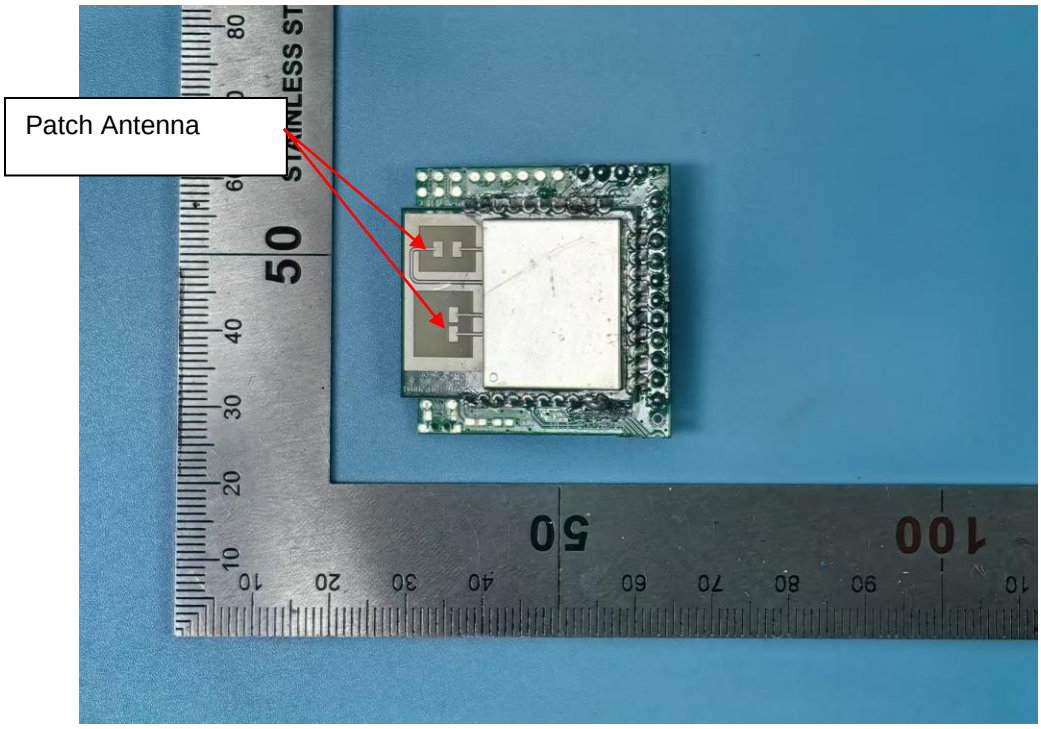
AC Mains Conducted Emission

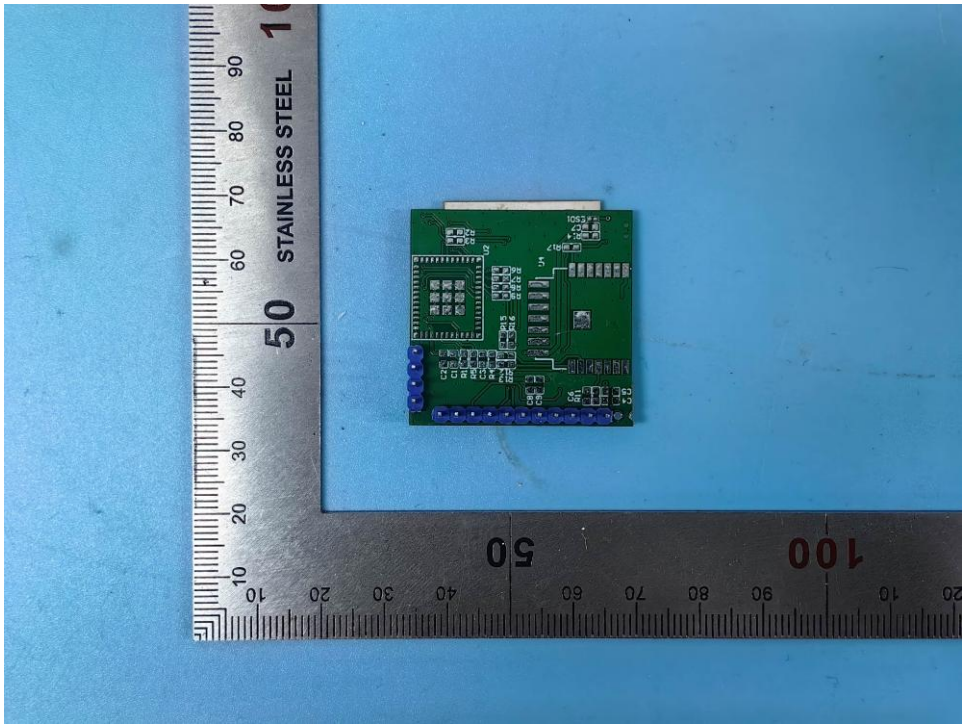


6. Photos of the EUT

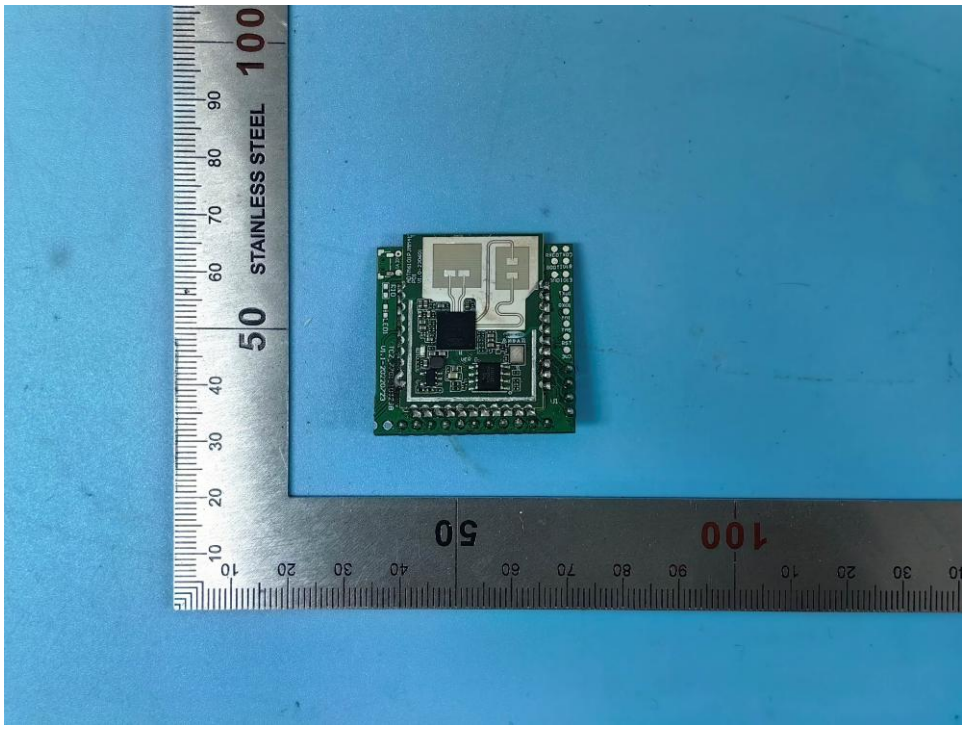
External Photos

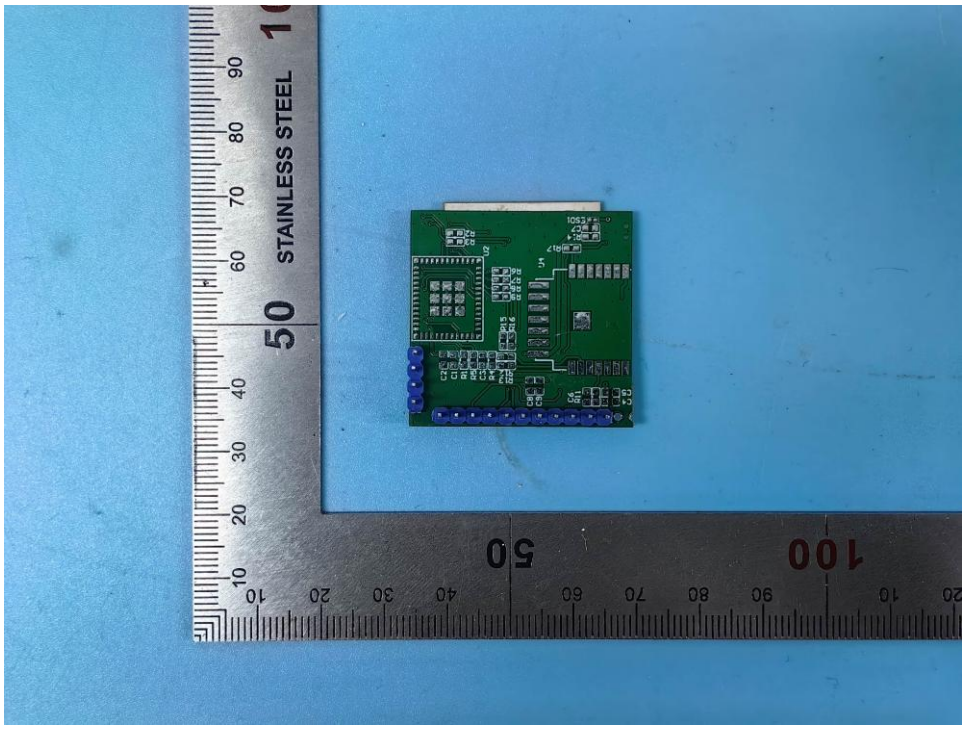





STAINLESS STEEL
50
100

Internal Photos





Revision History

Revision	Issue Date	Revisions	Revised By
1.0	2025-03-21	Orignal Issue	Wenliang Li

********** End of Report **********

DECLARATION

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.
If you have any questions on this report, please contact us within 15 days after issue this report.

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