Testing Laboratory 3787

RADIO TEST REPORT

FCC ID	:	RCC-RAR720000
Equipment	:	79G Millimeter Wave Radar
Brand Name	:	RoyalTek
Model Name	:	RAR-7200, RAR-7203
Applicant	:	RoyalTek Company Ltd. 8th Floor, No. 40 Wenhwa 2nd Rd., Guishan Dist., Tao Yuan City, 333010, Taiwan
Manufacturer	:	RoyalTek Company Ltd. 8th Floor, No. 40 Wenhwa 2nd Rd., Guishan Dist., Tao Yuan City, 333010, Taiwan
Standard	:	47 CFR FCC Part 95M

The product was received on Apr. 25, 2024, and testing was started from Apr. 25, 2024 and completed on Jul. 19, 2024. We, Sporton International Inc. Hsinchu Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Hsinchu Laboratory, the test report shall not be reproduced except in full.

Approved by: Sam Chen

Sporton International Inc. Hsinchu Laboratory
No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issued Date
FR430117-01	01	Initial issue of report	Oct. 14, 2024

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	95.303	Occupied Bandwidth	PASS	-
3.2	95.3367	Radiated E.I.R.P Power	PASS	-
3.3	95.3379	Transmitter Radiated Unwanted Emissions	PASS	-
3.4	95.3379	Frequency Stability	PASS	-

Conformity Assessment Condition:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the chapter "Measurement Uncertainty".

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Sam Chen
Report Producer: Sandy Chuang

1 General Description

1.1 Information

1.1.1 RF General Information

For EUT 1:

RF General Information			
Frequency Range (GHz)	**Operating Frequency Range (GHz)**	**Test Frequency (GHz)**	**Modulation**
77-81	78.8~79.3	79.058	FMCW

For EUT 2~3:

RF General Information			
Frequency Range (GHz)	**Operating Frequency Range (GHz)**	**Test Frequency (GHz)**	**Modulation**
77-81	77~81	79.000	FMCW

1.1.2 Antenna Information

Ant.	TX/RX	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	Remark
1~2	TX	RoyalTek	RAR-7200	Patch Array	N/A	12.2877	2TX/4RX
3~6	RX						

Note: The above information was declared by manufacturer.

1.1.3 EUT Operational Condition

EUT Power Type	From DC power supply (24Vdc)			
Supply Voltage	☐	AC	State AC voltage	-
Supply Voltage	☒	DC	State DC voltage	24

1.1.4 Test Signal Duty Cycle

Test Signal Duty Cycle
☒ Continuous transmission - 100%
☐ Transmissions occur regularly in time - …%

1.1.5 Table for Multiple Listing

Model Name	Operation Mode		
	EUT 1	EUT 2	EUT 3
	BSD-RCTA (Bandwidth: 500MHz)	PAS (Bandwidth: 4GHz)	RPAS (Bandwidth: 4GHz)
	78.8~79.3GHz	77~81GHz	77~81GHz
RAR-7200	V	V	-
RAR-7203	-	-	V

Description
The power setting is the same for RPAS/PAS mode.
The power setting is the same for BSD/RCTA mode.

Model Name	Accessories Description							
	ECU		ECU to radar cable			ECU to signal cable		
	Brand	Model	Brand	Model	Remark	Brand	Model	Remark
RAR-7200	RoyalTek	RAR-7200 ECU	RoyalTek	CABLE RAR-7200	Non-Shielded, 3.7m	RoyalTek	Y CABLE RAR-7200	Non-Shielded, 6.5m
RAR-7203	RoyalTek	RAR-8200 ECU	RoyalTek	CABLE RAR-7200	Non-Shielded, 12.4m	RoyalTek	CABLE RAR-8200	Non-Shielded, 5m

Model Name	LED		Indicator			Radar bracket	
	Brand	Model	Brand	Model	Remark	Brand	Model
RAR-7200	RoyalTek	CABLE LED RAR-7200	-	-	-	RoyalTek	RAR-7200 car bracket
RAR-7203	-	-	RoyalTek	RAR-8200 Indicator	Non-Shielded, 1m	RoyalTek	RAR-7200 car bracket

Model Name	Buzzer			DC adaptor		
	Brand	Model	Remark	Brand	Model	Remark
RAR-7200	RoyalTek	CABLE BUZZER RAR-7000	Non-Shielded, 0.08m	-	-	-
RAR-7203	-	-	-	RoyalTek	DC ADAPTOR	Non-Shielded, 1.2m

Note 1: From the above EUTs, EUT 1 and EUT 2 were selected to test all the test items, and EUT 3 were selected to test Transmitter Radiated Unwanted Emissions (Below 1GHz) test only.

Note 2: The above information was declared by manufacturer.

1.2 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR FCC Part 95M
- ANSI C63.10 - Testing Unlicensed Wireless Devices
- KDB653005 D01 76-81 GHz Radars v01r02

The following reference test guidance is not within the scope of accreditation of TAF.

- FCC KDB 414788 D01 v01r01

1.3 Testing Location Information

Testing Location Information	
Test Lab.：Sporton International Inc. Hsinchu Laboratory	
Hsinchu (TAF: 3787)	ADD: No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.) TEL: 886-3-656-9065 FAX: 886-3-656-9085 Test site Designation No. TW3787 with FCC. Conformity Assessment Body Identifier (CABID) TW3787 with ISED.

Test Condition	Test Site No.	Test Engineer	Test Environment (°C / %)	Test Date
Radiated (Frequency Stability)	TH03-CB	Gino Huang	23~24 / 64~66	Apr. 25, 2024~ May 07, 2024
Radiated (For other test items)	03CH05-CB	Paul Hu	21.6-22.7 / 56-59	Jul. 18, 2024~ Jul. 19, 2024

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Test Date: Before May 28, 2024

Test Items	Uncertainty	Remark
Radiated Emission (9kHz ~ 30MHz)	3.7 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	5.1 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	4.1 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	4.2 dB	Confidence levels of 95%
Radiated Emission (40GHz ~ 60GHz)	3.0 dB	Confidence levels of 95%
Radiated Emission (60GHz ~ 90GHz)	3.0 dB	Confidence levels of 95%
Radiated Emission (90GHz ~ 200GHz)	4.3 dB	Confidence levels of 95%
Radiated Emission (200GHz ~ 280GHz)	5.0 dB	Confidence levels of 95%
Temperature	1.3°C	Confidence levels of 95%

Test Date: After May 27, 2024

Test Items	Uncertainty	Remark
Radiated Emission (9kHz ~ 30MHz)	4.1 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	4.2 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	4.2 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	4.0 dB	Confidence levels of 95%
Radiated Emission (40GHz ~ 60GHz)	3.0 dB	Confidence levels of 95%
Radiated Emission (60GHz ~ 90GHz)	3.2 dB	Confidence levels of 95%
Radiated Emission (90GHz ~ 200GHz)	2.5 dB	Confidence levels of 95%
Radiated Emission (200GHz ~ 280GHz)	5.0 dB	Confidence levels of 95%
Temperature	1.2°C	Confidence levels of 95%

2 Test Configuration of EUT

2.1 Test Channel Frequencies Configuration

Test Software Version	For EUT 1: 4475_4260 (BSD-RCTA) For EUT 2: 4475_4260 (PAS) For EUT 3: 5601_5249 (RPAS)	
Test Frequencies (GHz)	**EUT 1**	**EUT 2**
	79.058	79.000
Software Setting	Default	Default

2.2 Conformance Tests and Related Test Frequencies

For EUT 1

Test Item	Test Frequencies (GHz)
Occupied Bandwidth	79.058
Radiated E.I.R.P Power / E.I.R.P Power Density	79.058
Transmitter Spurious Emissions (below 1 GHz)	79.058
Transmitter Spurious Emissions (1 GHz-40 GHz)	79.058
Transmitter Spurious Emissions (above 40 GHz)	79.058
Frequency Stability	79.058

For EUT 2

Test Item	Test Frequencies (GHz)
Occupied Bandwidth	79.000
Radiated E.I.R.P Power / E.I.R.P Power Density	79.000
Transmitter Spurious Emissions (1 GHz-40 GHz)	79.000
Transmitter Spurious Emissions (above 40 GHz)	79.000
Frequency Stability	79.000

2.3 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	Occupied Bandwidth Radiated E.I.R.P Power Frequency Stability
Test Condition	Radiated measurement
Operating Mode	CTX
1	EUT 1 in Z axis
2	EUT 2 in Z axis

The Worst Case Mode for Following Conformance Tests	
Tests Item	Transmitter Radiated Unwanted Emissions
Test Condition	Radiated measurement
Operating Mode < 1GHz	CTX
After evaluating, the worst case was found at Z axis, thus the measurement will follow this same test configuration.	
1	EUT 1 in Z axis
2	EUT 2 in Z axis
3	EUT 3 in Z axis
For operating mode 1 is the worst case and it was record in this test report.	
Operating Mode > 1GHz	CTX
After evaluating, the worst case was found at Z axis, thus the measurement will follow this same test configuration.	
1	EUT 1 in Z axis
2	EUT 2 in Z axis

2.4 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

2.5 Accessories

Accessories	
ECU*1	
Radar bracket*1	
For EUT 1~2 use	**For EUT 3 use**
ECU to radar cable 1*1: Non-Shielding, 3.7m	ECU to radar cable 2*1: Non-Shielding, 12.4m
ECU to signal cable 1*1: Non-Shielding, 6.5m	ECU to signal cable 2*1: Non-Shielding, 5.0m
LED*2	Indicator*1
Buzzer*1: Non-Shielding, 0.08m	DC Adapter*1: Non-Shielding, 1.2m

2.6 Support Equipment

Support Equipment				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
A	Battery	YUASA	38B19L-MF	N/A

2.7 Far Field Boundary Calculations

The far-field boundary is given as:

far field = (2 * L^2) /λ

where:

L = Largest Antenna Dimension, including the reflector, in meters

λ= wavelength in meters

Test Mode: Mode 1

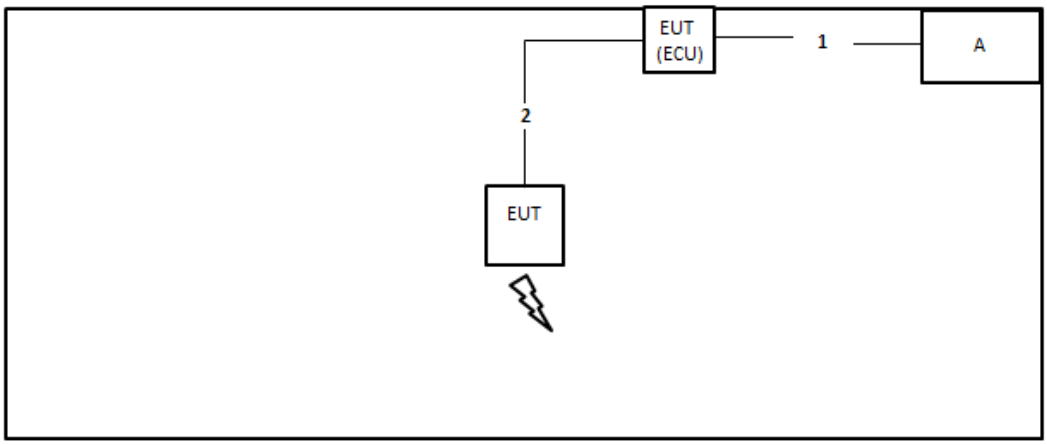
Far Field (m)				
Frequency (GHz)	**L (m)**	**Lambda (m)**	**d(Far Field) (m)**	**d(Far Field) (cm)**
79.058	0.01953	0.0037947	0.201	20.10

Test Mode: Mode 2

Far Field (m)				
Frequency (GHz)	**L (m)**	**Lambda (m)**	**d(Far Field) (m)**	**d(Far Field) (cm)**
79.000	0.01953	0.0037975	0.201	20.09

2.8 Test Setup Diagram

Test Setup Diagram - Radiated Test



Item	Connection	Shielded	Length
1	ECU to radar cable	No	3.7m
2	ECU to signal cable	No	6.5m

3 Transmitter Test Result

3.1 Occupied Bandwidth

3.1.1 Occupied Bandwidth (OBW) Limit

Occupied Bandwidth (EBW) Limit
Information only

3.1.2 Measuring Instruments

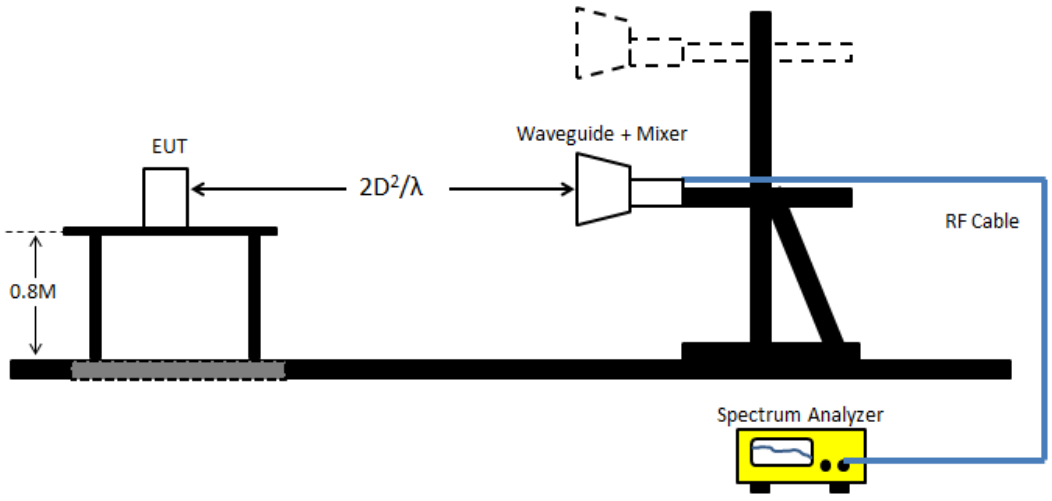
Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

Test Method	
☒	For the Occupied bandwidth shall be measured using one of the options below:
☒	Refer as ANSI C63.10, clause 7.8.7 for EBW measurement.
☐	Refer as ANSI C63.10, clause 6.9.2 for occupied bandwidth testing.
☒	Refer as ANSI C63.10, clause 9 for radiated measurement.
☒	Radiated test was conducted at far-field distance. the distance from the radiating element of the EUT to the edge of the far field may be calculated from [$r \geq 2D^2/\lambda$] r is the distance from the radiating element of the EUT to the edge of the far field, in m D is the largest dimension of both the radiating element and the test antenna (horn), in m λ is the wavelength of the emission under investigation [300/f (MHz)], in m

3.1.4 Test Setup

Occupied Bandwidth



3.1.5 Test Result of Occupied Bandwidth

Test Mode: Mode 1

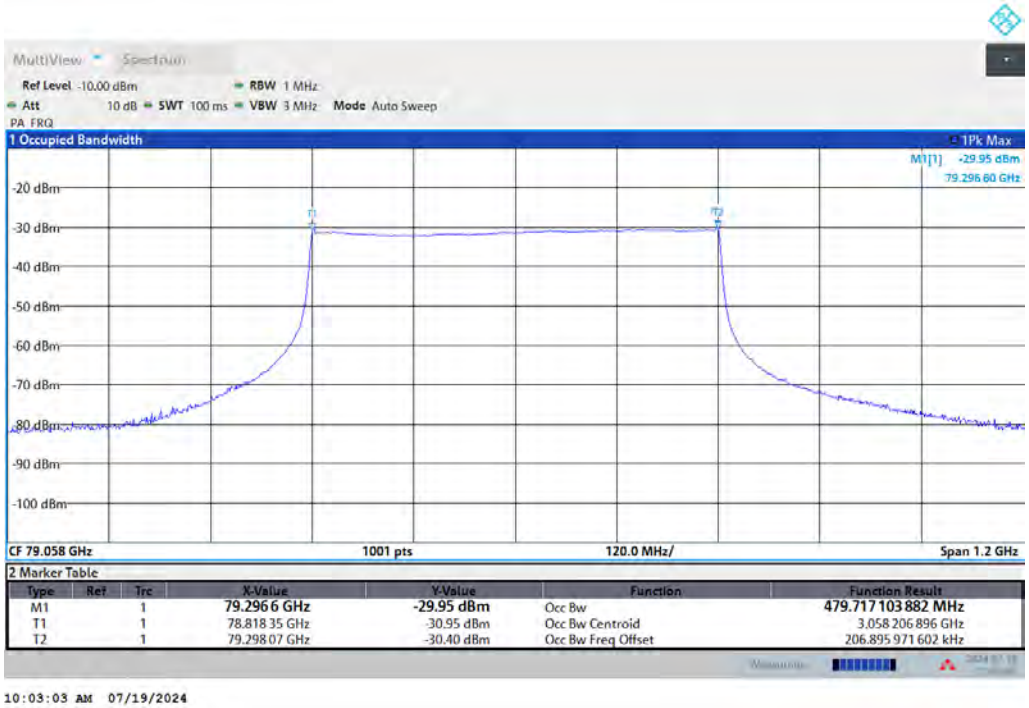
Test Results		
Test Freq. (GHz)	**99% Occupied Bandwidth (MHz)**	**Limit (MHz)**
79.058	479.72	N/A

Test Mode: Mode 2

Test Results		
Test Freq. (GHz)	**99% Occupied Bandwidth (MHz)**	**Limit (MHz)**
79.000	3898.85	N/A

Test Mode: Mode 1

Occupied Bandwidth Plots
Test Frequency: 79.058 GHz



Test Mode: Mode 2

Test Frequency: 79.000 GHz

3.2 Radiated E.I.R.P Power

3.2.1 Radiated E.I.R.P Power Limit

Radiated E.I.R.P Power	
☒	76-81 GHz Band:
	☒ Peak: EIRP 55 dBm [279uW/cm^2 at 3m] Average: EIRP 50 dBm [88uW/cm^2 at 3m]

3.2.2 Measuring Instruments

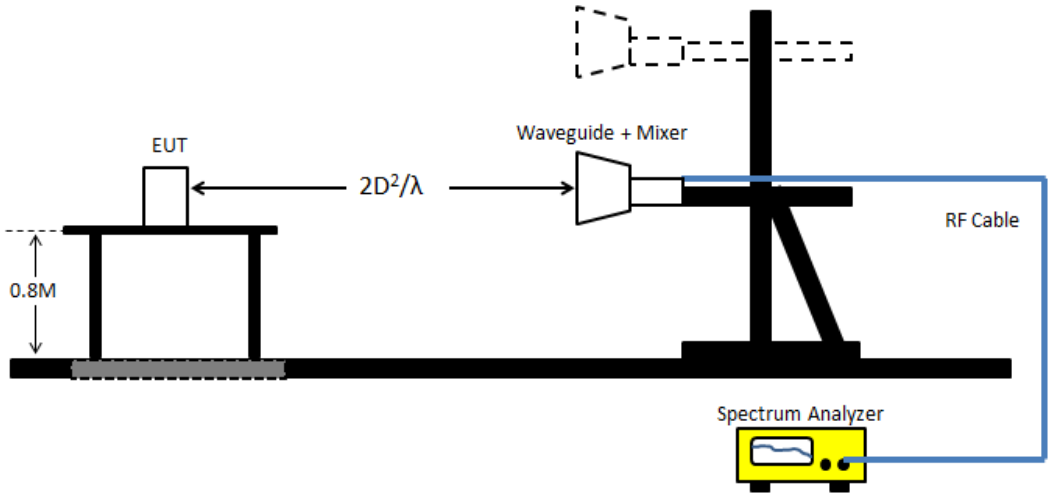
Refer a test equipment and calibration data table in this test report.

3.2.3 Test Procedures

Test Method	
☒	For the Occupied bandwidth shall be measured using one of the options below:
☒	Refer as ANSI C63.10, clause 9 for radiated measurement.
	☒ Radiated test was conducted at far-field distance. the distance from the radiating element of the EUT to the edge of the far field may be calculated from [$r \geq 2D^2/\lambda$] r is the distance from the radiating element of the EUT to the edge of the far field, in m D is the largest dimension of both the radiating element and the test antenna (horn), in m λ is the wavelength of the emission under investigation [300/f (MHz)], in m
	☒ The measured power level is converted to EIRP using the Friis equation: E Meas = 126.8 - 20log(λ) + P – G where E is the field strength of the emission at the measurement distance, in dBμV/m P is the power measured at the output of the test antenna, in dBm λ is the wavelength of the emission under investigation [300/fMHz], in m G is the gain of the test antenna, in dBi EIRP = E Meas + 20 log(d Meas) – 104.7 where EIRP : is the equivalent isotropically radiated power, in dBm. E Meas : is the field strength of the emission at the measurement distance, in dBμV/m. d Meas : is the measurement distance, in m.

3.2.4 Test Setup

Radiated E.I.R.P Power



3.2.5 Measurement Results Calculation

The measured Level is calculated using:

EIRP = Read Level - Rx Gain +20*LOG(4*3.14159* Distance / (300/(Test Freq.*1000))).

Power Density = ((10^(EIRP/10)/1000)/(4*3.14159*(Specification Distance *100)^2))*1000000000000.

3.2.6 Test Result of Radiated E.I.R.P Power

Test Mode: Mode 1

Freq. (GHz)	Rx Gain (dBi)	P-Peak (dBm)	P-Average (dBm)	E-Meas-Peak (dBuV/m)	E-Meas-Average (dBuV/m)	Distance (m)	EIRP-Peak (dBm)	EIRP-Average (dBm)
79.058	23.9	-6.13	-33.13	145.19	118.19	0.50	34.37	7.37
EIRP Limit							**55**	**50**

Test Mode: Mode 2

Freq. (GHz)	Rx Gain (dBi)	P-Peak (dBm)	P-Average (dBm)	E-Meas-Peak (dBuV/m)	E-Meas-Average (dBuV/m)	Distance (m)	EIRP-Peak (dBm)	EIRP-Average (dBm)
79.000	23.9	-27.04	-54.39	124.27	96.92	0.50	13.45	-13.90
EIRP Limit							**55**	**50**

3.3 Transmitter Radiated Unwanted Emissions

3.3.1 Transmitter Radiated Unwanted Emissions Limit

Transmitter Radiated Unwanted Emissions Limit (Below 40 GHz)			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960 - 40000	500	54	3

Frequency Range (GHz)	EIRP (dBm)	Power Density (pW/cm^2 @ 3m)
40 - 200	-1.7	600
200 - 231	0.5	1000

3.3.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.3.3 Test Procedures

Test Method – General Information			
☒	For the transmitter unwanted emissions shall be measured using following options below:		
	☒	Refer as ANSI C63.10, clause 6.3 for unwanted emissions into non-restricted bands.	
	☒	For unwanted emissions below 40GHz bands.	
		☒	Radiated emissions below 40 GHz shall not exceed the general limits in LP0002 Section 2.8
		☒	Refer as ANSI C63.10, clause 4.1.4.2.3 (Video Averaging) average measurements using spectrum reduced video bandwidth (VBW≥10Hz) - [duty cycle ≥ 98 or external power trigger].
		☐	Refer as ANSI C63.10, clause 4.1.4.2.4 average value of pulsed emissions.
		☐	Refer as ANSI C63.10, clause 4.1.4.2.2 measurement procedure peak limit.

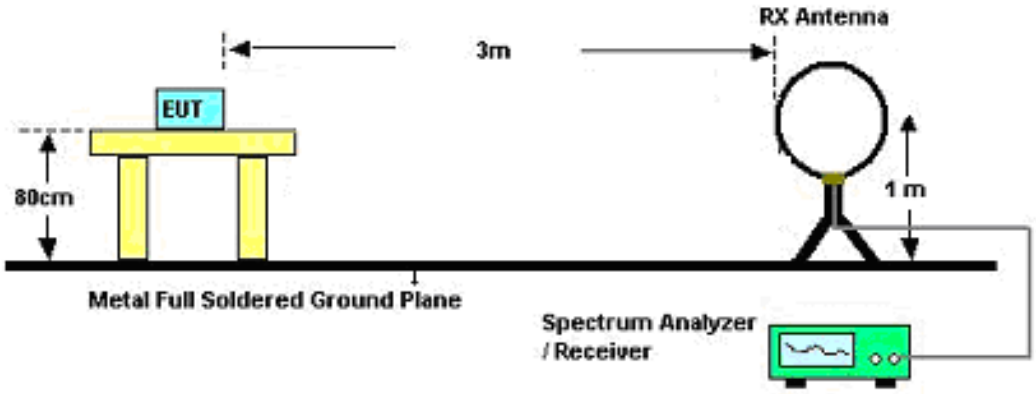
Test Method		
☒	For radiated measurement below 40GHz.	
	☒	Refer as ANSI C63.10, clause 6.3 through 6.6 for radiated emissions from below 40 GHz.
☒	For radiated measurement above 40GHz. Refer as ANSI C63.10, clause 9.12 for radiated measurement.	
	☒	Radiated test was conducted at far-field distance. the distance from the radiating element of the

Test Method		
		EUT to the edge of the far field may be calculated from [$r \geq 2D^2/\lambda$] r is the distance from the radiating element of the EUT to the edge of the far field, in m D is the largest dimension of both the radiating element and the test antenna (horn), in m λ is the wavelength of the emission under investigation [300/f (MHz)], in m
	☒	The measured power level is converted to EIRP using the Friis equation: E Meas = 126.8 - 20log(λ) + P – G where E is the field strength of the emission at the measurement distance, in dBμV/m P is the power measured at the output of the test antenna, in dBm λ is the wavelength of the emission under investigation [300/fMHz], in m G is the gain of the test antenna, in dBi EIRP = E Meas + 20 log(d Meas) – 104.7 where EIRP : is the equivalent isotropically radiated power, in dBm. E Meas : is the field strength of the emission at the measurement distance, in dBμV/m. d Meas : is the measurement distance, in m. Equations to calculate power density Calculate the power density at the distance specified by the limit from the EIRP in watts using Equation: $PD = \frac{EIRP_{Linear}}{4\pi d^2}$ where PD is the power density at the distance specified by the limit, in W/m2 EIRPLinear is the equivalent isotropically radiated power, in watts d is the distance at which the power density limit is specified, in m.

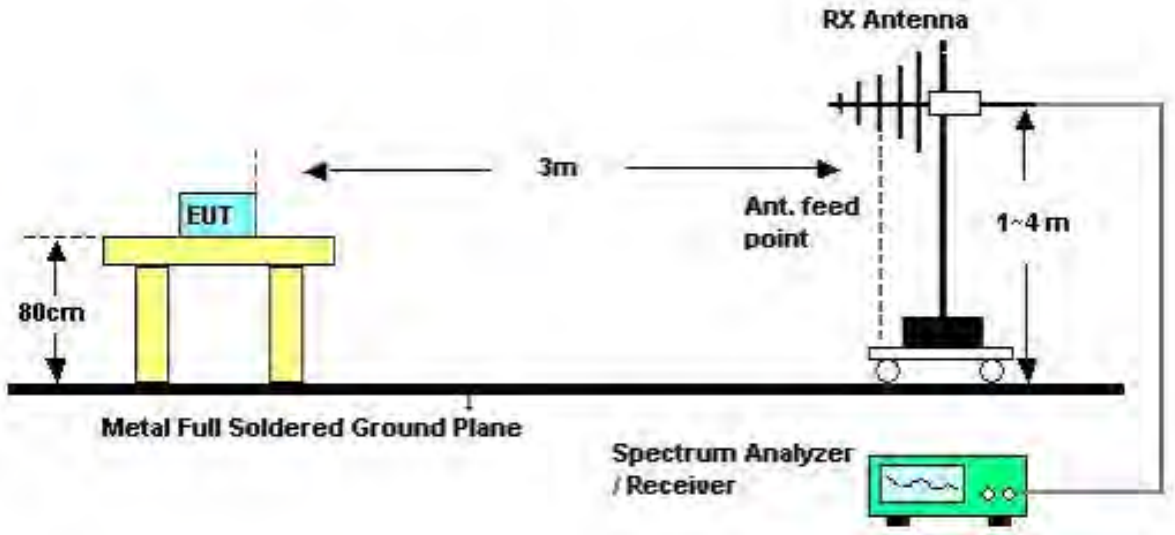
3.3.4 Test Setup

Transmitter Radiated Unwanted Emissions

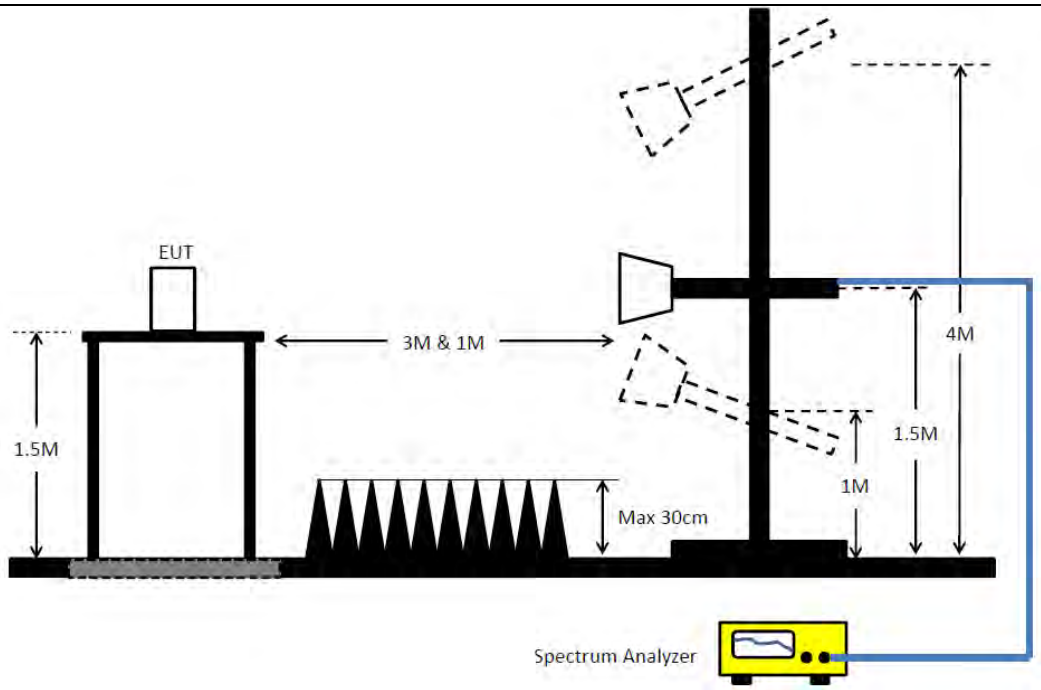
9kHz ~30MHz



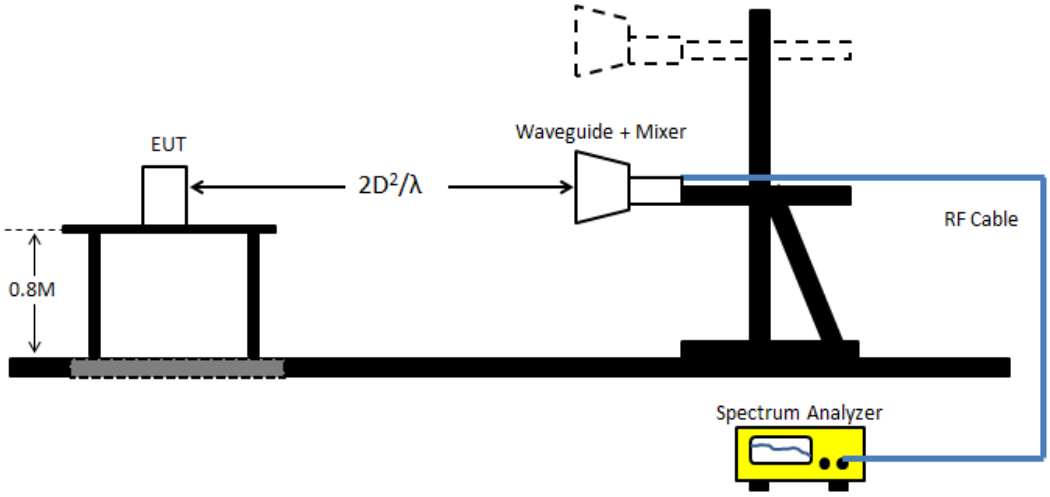
30MHz~1GHz



1GHz ~40GHz



Above 40GHz



3.3.5 Measurement Results Calculation

The measured Level is calculated using:
For below 40GHz
Corrected Reading: Antenna factor (AF) + Cable loss (CL) + Read level (Raw) - Preamp factor (PA)(if applicable) = Level.
For above 40GHz
EIRP = Read Level - Rx Gain +20*LOG(4*3.14159* Distance / (300/(Test Freq.*1000))).
Power Density = ((10^(EIRP/10)/1000)/(4*3.14159*(Specification Distance *100)^2))*1000000000000.

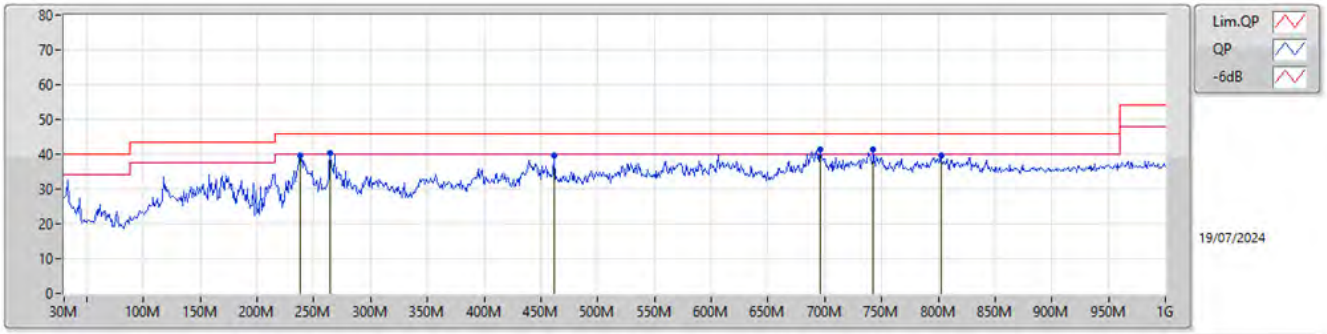
3.3.6 Test Result of Transmitter Radiated Unwanted Emissions (Below 30MHz)

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to KDB414788 Radiated Test Site, and the result came out very similar.
All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.
The radiated emissions were investigated from 9 kHz or the lowest frequency generated within the device, up to the 10 harmonic or 40 GHz, whichever is appropriate.

3.3.7 Test Result of Transmitter Radiated Unwanted Emissions (30MHz ~ 1GHz)

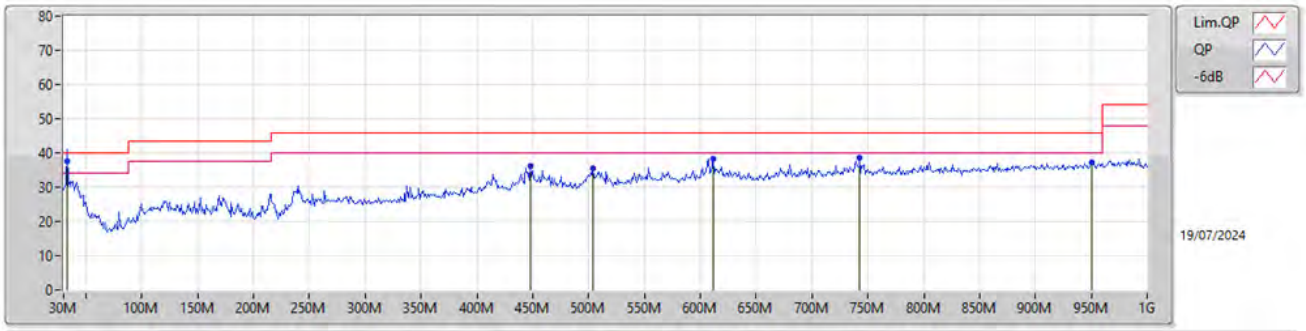
est Range	30 MHz – 1000 MHz	Test Freq. (GHz)	79.058
Test Distance	3 m	Test Mode	Mode 1

Horizontal



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
PK	237.58M	39.70	46.00	-6.30	-12.16	3	Horizontal	223	1.25	-	51.86	16.90	2.75	31.81
PK	264.74M	40.18	46.00	-5.82	-9.73	3	Horizontal	297	1.25	-	49.91	19.18	2.92	31.83
PK	461.65M	39.50	46.00	-6.50	-5.29	3	Horizontal	298	1.25	-	44.79	22.77	3.99	32.05
PK	696.39M	41.23	46.00	-4.77	-2.54	3	Horizontal	142	1.25	-	43.77	24.78	5.01	32.33
PK	742.95M	41.43	46.00	-4.57	-1.69	3	Horizontal	155	1.25	"Worst"	43.12	25.47	5.20	32.36
PK	802.12M	39.65	46.00	-6.35	-1.06	3	Horizontal	146	1.00	-	40.71	25.84	5.44	32.34

Vertical



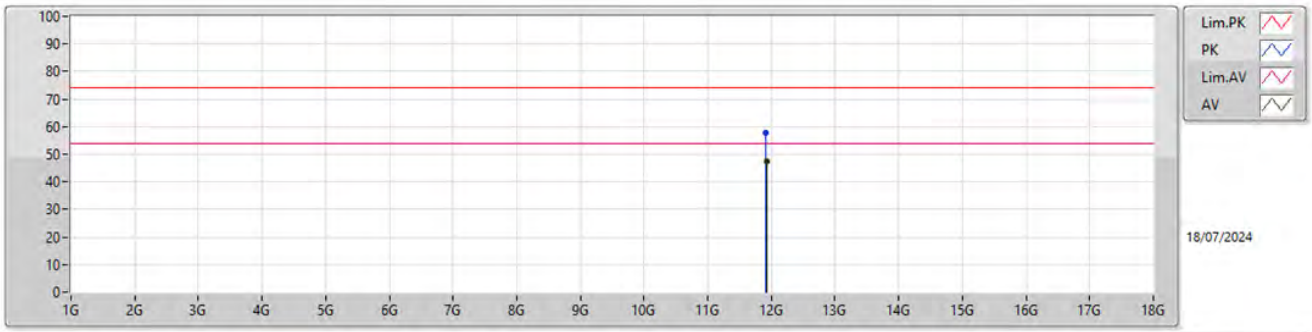
Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
QP	32.91M	37.69	40.00	-2.31	-7.57	3	Vertical	262	1.00	"Worst"	45.26	22.92	0.95	31.44
PK	448.07M	36.29	46.00	-9.71	-5.64	3	Vertical	193	2.00	-	41.93	22.47	3.93	32.04
PK	504.33M	35.57	46.00	-10.43	-4.66	3	Vertical	173	1.50	-	40.23	23.26	4.19	32.11
PK	612M	38.33	46.00	-7.67	-3.15	3	Vertical	206	1.50	-	41.48	24.44	4.66	32.25
PK	742.95M	38.79	46.00	-7.21	-1.69	3	Vertical	194	1.00	-	40.48	25.47	5.20	32.36
PK	950.53M	37.09	46.00	-8.91	0.30	3	Vertical	347	1.50	-	36.79	26.62	5.98	32.30

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)

3.3.8 Test Result of Transmitter Radiated Unwanted Emissions (1GHz – 40GHz)

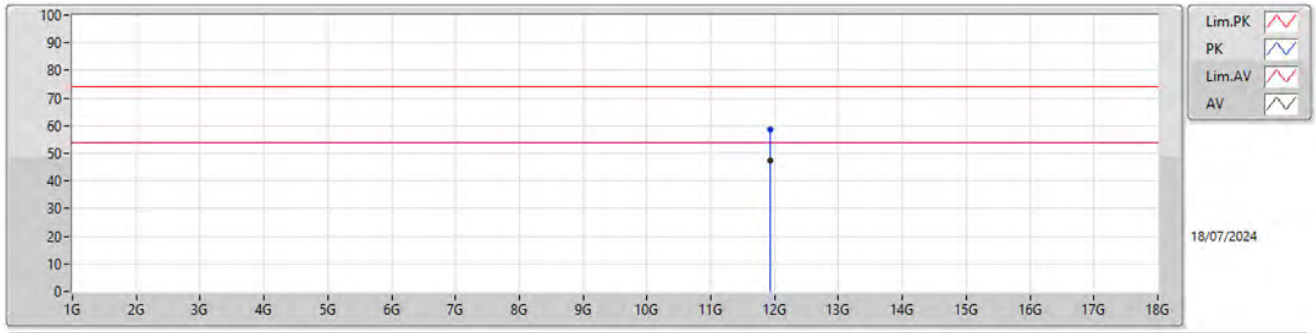
Test Range	1GHz – 18GHz	Test Freq. (GHz)	79.058
Test Distance	3 m	Test Mode	Mode 1

Horizontal



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
PK	11.91742G	57.83	74.00	-16.17	16.28	3	Horizontal	28	1.50	-	41.55	38.63	11.03	33.38
AV	11.92335G	47.32	54.00	-6.68	16.31	3	Horizontal	28	1.50	"Worst"	31.01	38.65	11.04	33.38

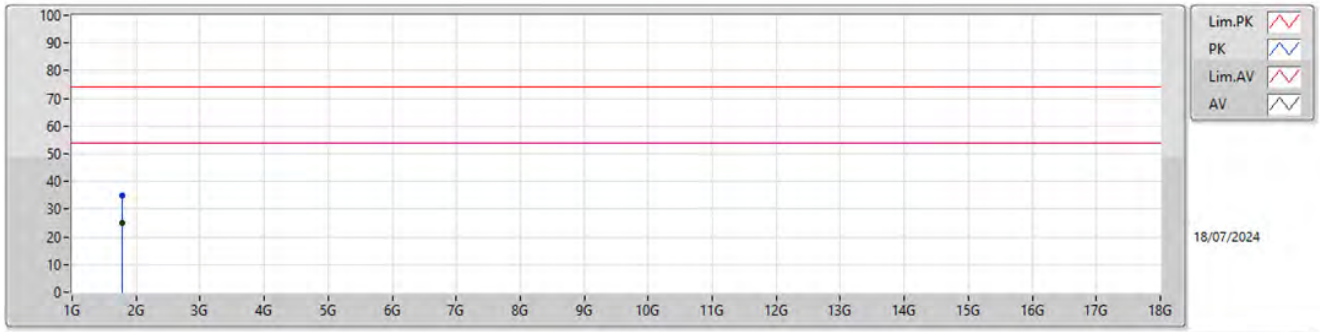
Vertical



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
PK	11.92321G	58.43	74.00	-15.57	16.31	3	Vertical	0	2.22	-	42.12	38.65	11.04	33.38
AV	11.92342G	47.44	54.00	-6.56	16.31	3	Vertical	0	2.22	"Worst"	31.13	38.65	11.04	33.38

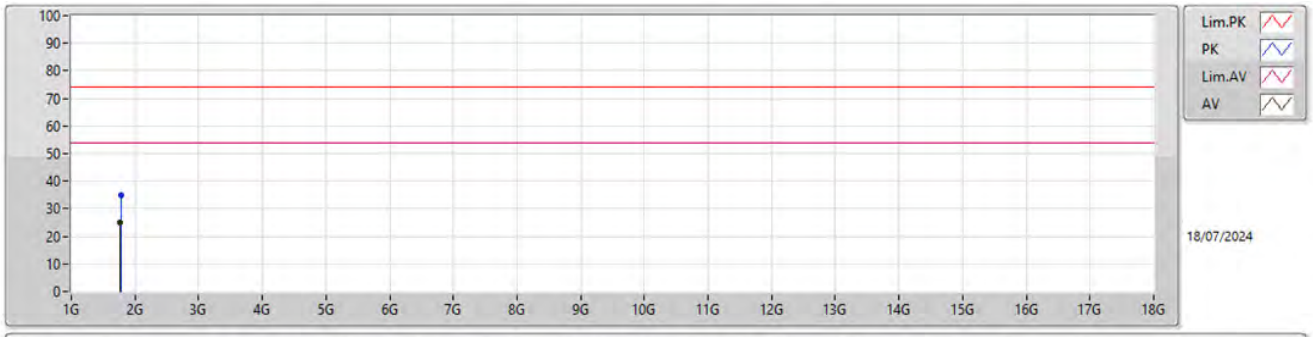
Test Range	1GHz – 18GHz	Test Freq. (GHz)	79.000
Test Distance	3 m	Test Mode	Mode 2

Horizontal



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
PK	1.77712G	35.08	74.00	-38.92	-7.16	3	Horizontal	142	1.61	-	42.24	25.03	4.53	36.72
AV	1.77831G	24.98	54.00	-29.02	-7.16	3	Horizontal	254	1.61	"Worst"	32.14	25.02	4.54	36.72

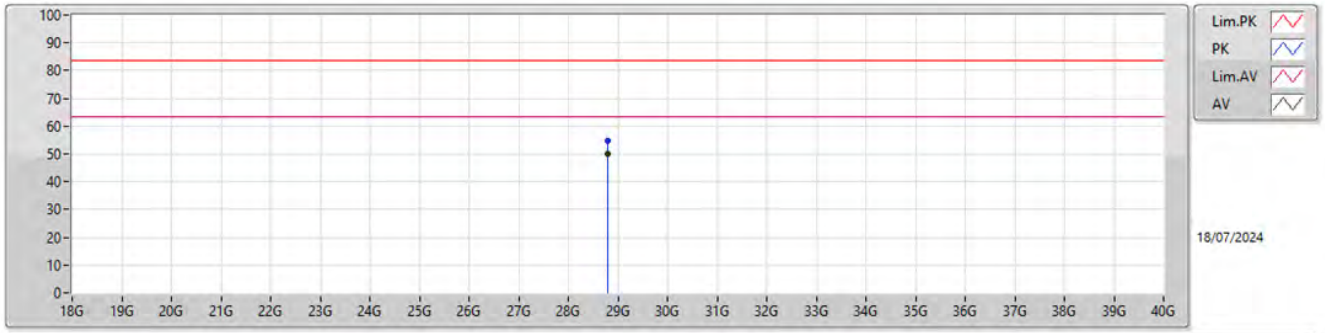
Vertical



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
PK	1.77456G	35.00	74.00	-39.00	-7.14	3	Vertical	65	1.74	-	42.14	25.05	4.53	36.72
AV	1.77143G	25.02	54.00	-28.98	-7.10	3	Vertical	65	1.74	"Worst"	32.12	25.09	4.53	36.72

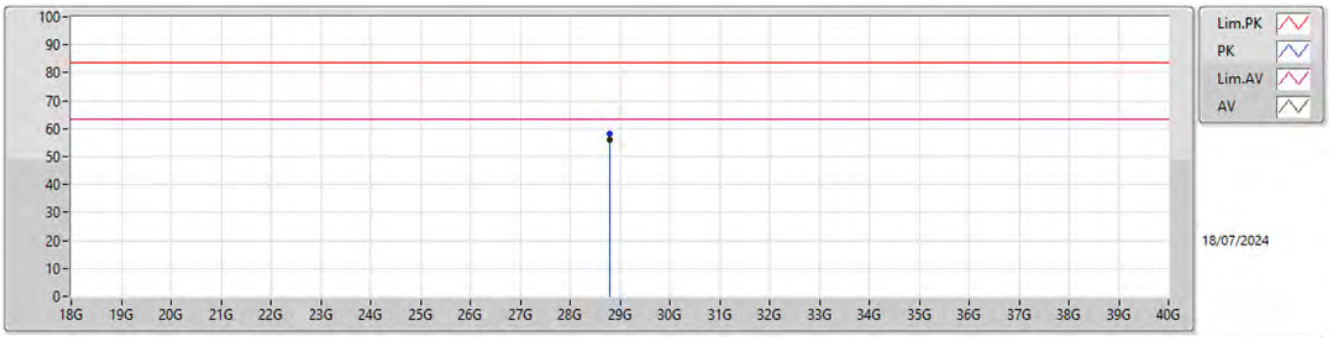
Test Range	18GHz – 40GHz	Test Freq. (GHz)	79.058
Test Distance	1 m	Test Mode	Mode 1

Horizontal



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
PK	28.79921G	54.94	83.54	-28.60	13.80	1	Horizontal	5	1.50	-	41.14	40.00	19.26	45.46
AV	28.79945G	50.14	63.54	-13.40	13.80	1	Horizontal	5	1.50	"Worst"	36.34	40.00	19.26	45.46

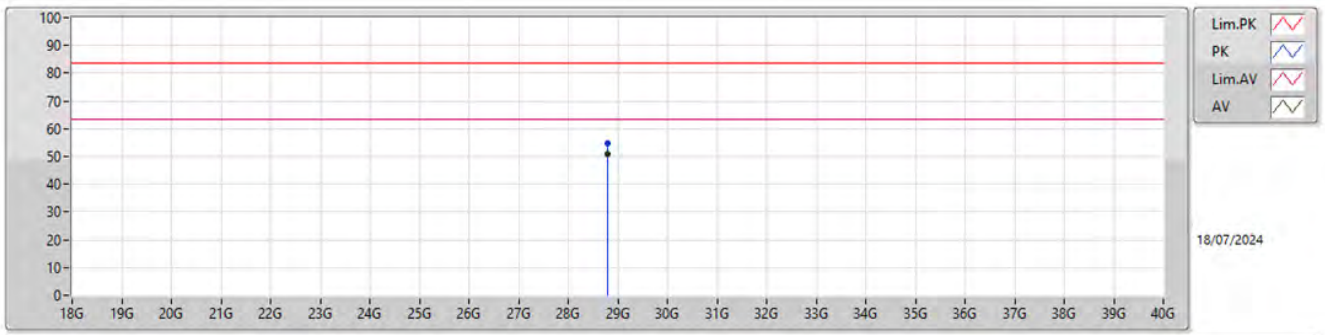
Vertical



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
PK	28.79943G	58.21	83.54	-25.33	13.80	1	Vertical	185	1.50	-	44.41	40.00	19.26	45.46
AV	28.79923G	55.82	63.54	-7.72	13.80	1	Vertical	185	1.50	"Worst"	42.02	40.00	19.26	45.46

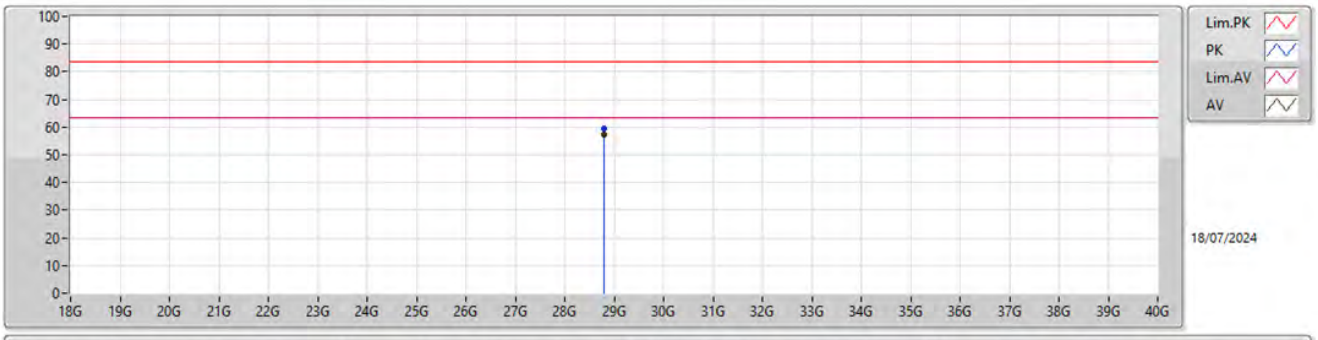
Test Range	18GHz – 40GHz	Test Freq. (GHz)	79.000
Test Distance	1 m	Test Mode	Mode 2

Horizontal



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
PK	28.79903G	54.67	83.54	-28.87	13.80	1	Horizontal	168	1.50	-	40.87	40.00	19.26	45.46
AV	28.79908G	50.77	63.54	-12.77	13.80	1	Horizontal	168	1.50	"Worst"	36.97	40.00	19.26	45.46

Vertical



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB/m)	(m)		(°)	(m)		(dBuV)	(dB/m)	(dB)	(dB)
PK	28.79915G	59.55	83.54	-23.99	13.80	1	Vertical	178	1.50	-	45.75	40.00	19.26	45.46
AV	28.79967G	57.21	63.54	-6.33	13.80	1	Vertical	178	1.50	"Worst"	43.41	40.00	19.26	45.46

3.3.9 Test Result of Transmitter Radiated Unwanted Emissions (40GHz – 200GHz)

Test Mode: Mode 1

Test Freq. (GHz)	Rx Gain (dBi)	Distance (m)	Read Worse Frequency (GHz)	Read Level (dBm)	EIRP (dBm)	Specification Distance (m)	Power Density (pW/cm^2)	Test Result
79.058	23.2	0.50	40.58	-84.71	-49.32	3	0.0103	PASS
Limit							**600**	-

Test Mode: Mode 2

Test Freq. (GHz)	Rx Gain (dBi)	Distance (m)	Read Worse Frequency (GHz)	Read Level (dBm)	EIRP (dBm)	Specification Distance (m)	Power Density (pW/cm^2)	Test Result
79.000	23.2	0.50	40.53	-79.92	-44.54	3	0.0311	PASS
Limit							**600**	-

3.3.10 Test Result of Transmitter Radiated Unwanted Emissions (200GHz – 231GHz)

Test Mode: Mode 1

Test Freq. (GHz)	Rx Gain (dBi)	Distance (m)	Read Worse Frequency (GHz)	Read Level (dBm)	EIRP (dBm)	Specification Distance (m)	Power Density (pW/cm^2)	Test Result
79.058	24.2	0.50	203.69	-76.33	-27.93	3	1.4243	PASS
Limit							**1000**	-

Test Mode: Mode 2

Test Freq. (GHz)	Rx Gain (dBi)	Distance (m)	Read Worse Frequency (GHz)	Read Level (dBm)	EIRP (dBm)	Specification Distance (m)	Power Density (pW/cm^2)	Test Result
79.000	24.2	0.50	203.54	-74.38	-25.99	3	2.2283	PASS
Limit							**1000**	-

3.4 Frequency Stability

3.4.1 Frequency Stability Limit

Frequency Stability Limit
Fundamental emissions must be contained within the frequency bands specified in this 76-81GHz band 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.

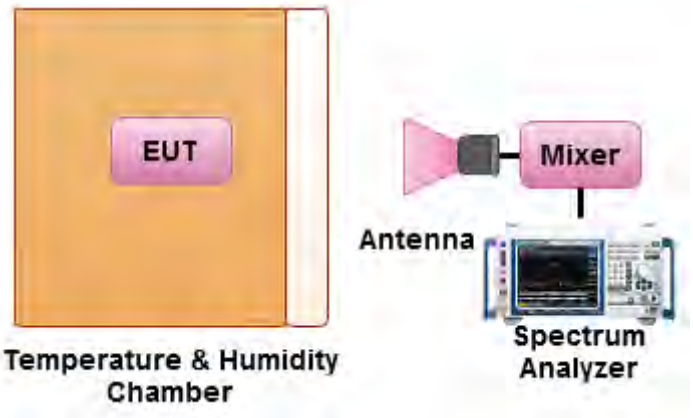
3.4.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.4.3 Test Procedures

Test Method	
☒	For the frequency stability shall be measured using one of the options below:
	☒ Refer as ANSI C63.10, clause 9.14 for frequency stability measurement.
☒	Refer as ANSI C63.10, clause 9 for radiated measurement.
	☒ Radiated test was conducted at far-field distance. the distance from the radiating element of the EUT to the edge of the far field may be calculated from [$r \geq 2D^2/\lambda$] r is the distance from the radiating element of the EUT to the edge of the far field, in m D is the largest dimension of both the radiating element and the test antenna (horn), in m λ is the wavelength of the emission under investigation [300/f (MHz)], in m
	☒ The mixer may be placed outside the chamber in front of the temperature chamber door, and the chamber door opened for each reading.

3.4.4 Test Setup

Frequency Stability


3.4.5 Test Result of Frequency Stability

Test Mode: Mode 1
Test Freq. (GHz): 79.058

Test Temperature: (°C)	Measured Frequency (MHz)	Delta Frequency (kHz)	Limit (±kHz)
-40	79058.615	1085	Within band
-30	79058.615	1085	Within band
-20	79058.615	1085	Within band
-10	79058.615	1085	Within band
0	79057.530	0	Within band
10	79057.530	0	Within band
20	79057.530	Reference	Within band
30	79057.530	0	Within band
40	79057.530	0	Within band
50	79057.530	0	Within band
60	79056.440	-1090	Within band
70	79056.440	-1090	Within band
80	79056.440	-1090	Within band
85	79056.440	-1090	Within band
Test Voltage: (Vdc)	**Measured Frequency (MHz)**	**Delta Frequency (kHz)**	**Limit (±kHz)**
20.4	79057.53	0	Within band
24	79057.53	Reference	Within band
27.6	79057.53	0	Within band

Test Mode: Mode 2
Test Freq. (GHz): 79.000

Test Temperature: (°C)	Measured Frequency (MHz)	Delta Frequency (kHz)	Limit (±kHz)
-40	79019.690	3290	Within band
-30	79018.485	2085	Within band
-20	79018.095	1695	Within band
-10	79017.715	1315	Within band
0	79017.555	1155	Within band
10	79016.445	45	Within band
20	79016.400	Reference	Within band
30	79015.405	-995	Within band
40	79015.345	-1055	Within band
50	79014.555	-1845	Within band
60	79014.195	-2205	Within band
70	79014.010	-2390	Within band
80	79013.440	-2960	Within band
85	79013.435	-2965	Within band
Test Voltage: (Vdc)	**Measured Frequency (MHz)**	**Delta Frequency (kHz)**	**Limit (±kHz)**
20.4	79016.445	45	Within band
24	79016.400	Reference	Within band
27.6	79015.405	-995	Within band

4 Test Equipment and Calibration Data

Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
Loop Antenna	Teseq	HLA 6121	65417	9kHz - 30 MHz	Oct. 13, 2023	Oct. 12, 2024	Radiation (03CH05-CB)
3m Semi Anechoic Chamber NSA	TDK	SAC-3M	03CH05-CB	30 MHz ~ 1 GHz	Aug. 02, 2023	Aug. 01, 2024	Radiation (03CH05-CB)
3m Semi Anechoic Chamber VSWR	TDK	SAC-3M	03CH05-CB	1GHz ~18GHz 3m	Sep. 29, 2023	Sep. 28, 2024	Radiation (03CH05-CB)
Bilog Antenna with 6dB Attenuator	TESEQ & EMCI	CBL 6112D & N-6-06	35236 & AT-N0610	30MHz ~ 2GHz	Mar. 23, 2024	Mar. 22, 2025	Radiation (03CH05-CB)
Horn Antenna	SCHWARZBECK	BBHA9120D	BBHA 9120 D-1291	1GHz~18GHz	Jun. 20, 2024	Jun. 19, 2025	Radiation (03CH05-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Sep. 04, 2023	Sep. 03, 2024	Radiation (03CH05-CB)
Amplifier	EMCI	EMC330N	980331	20MHz ~ 3GHz	May 02, 2024	May 01, 2025	Radiation (03CH05-CB)
Pre-Amplifier	EMCI	EMC12630SE	980287	1GHz – 26.5GHz	Jun. 29, 2024	Jun. 28, 2025	Radiation (03CH05-CB)
Pre-Amplifier	SGH	SGH184	20221107-3	18GHz ~ 40GHz	Nov. 24, 2023	Nov. 23, 2024	Radiation (03CH05-CB)
Spectrum Analyzer	R&S	FSP40	100304	9kHz ~ 40GHz	Apr. 17, 2024	Apr. 16, 2025	Radiation (03CH05-CB)
EMI Test Receiver	R&S	ESR7	102172	9kHz ~ 7GHz	Oct. 20, 2023	Oct. 19, 2024	Radiation (03CH05-CB)
RF Cable-low	Woken	RG402	Low Cable-04+23	30MHz~1GHz	Dec. 06, 2023	Dec. 05, 2024	Radiation (03CH05-CB)
RF Cable-high	Woken	RG402	High Cable-28	1GHz~18GHz	Oct. 02, 2023	Oct. 01, 2024	Radiation (03CH05-CB)
RF Cable-high	Woken	RG402	High Cable-04+28	1GHz~18GHz	Oct. 02, 2023	Oct. 01, 2024	Radiation (03CH05-CB)
High Cable	Woken	WCA0929M	40G#5+6	1GHz ~ 40 GHz	Jan. 11, 2024	Jan. 10, 2025	Radiation (03CH05-CB)
Test Software	SPORTON	SENSE	V5.10	-	N.C.R.	N.C.R.	Radiation (03CH05-CB)
Mixer	OML	M19HWA	U91113-1	40 GHz ~ 60 GHz	Apr. 23, 2024	Apr. 22, 2025	Radiation (03CH05-CB)
*Harmonic Mixer	R&S	FS-Z90	102135	60GHz~90GHz	Jul. 28, 2022	Jul. 27, 2024	Radiation (03CH05-CB)
*Harmonic Mixer	R&S	FS-Z140	101160	90GHz~140GHz	Feb. 22, 2023	Feb. 21, 2025	Radiation (03CH05-CB)
*Harmonic Mixer	R&S	FS-Z220	101065	140GHz~220GHz	Feb. 22, 2023	Feb. 21, 2025	Radiation (03CH05-CB)
*Harmonic Mixer	R&S	FS-Z325	101026	220GHz~325GHz	Feb. 22, 2023	Feb. 21, 2025	Radiation (03CH05-CB)

Instrument	Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
Standard Horn Antenna	Custom Microwave	M19RH	U91113-A	40 ~ 60 GHz	N.C.R	N.C.R	Radiation (03CH05-CB)
Standard Horn Antenna	Custom Microwave	M12RH	E91113-A	60 ~ 90 GHz	N.C.R	N.C.R	Radiation (03CH05-CB)
Standard Horn Antenna	Custom Microwave	M08RH	F91113-A	90 ~ 140 GHz	N.C.R	N.C.R	Radiation (03CH05-CB)
Standard Horn Antenna	Custom Microwave	M05RH	G91113-A	140 ~ 220 GHz	N.C.R	N.C.R	Radiation (03CH05-CB)
Standard Horn Antenna	Custom Microwave	M03RH	120320-A	220 ~ 325 GHz	N.C.R	N.C.R	Radiation (03CH05-CB)
Spectrum analyzer	R&S	FSV40	101028	9kHz~40GHz	Dec. 22, 2023	Dec. 21, 2024	Radiation (TH03-CB)
Temp. and Humidity Chamber	Gaint Force	GTH-408-40-C P-AR	MAA1410-011	-40~100 degree	Sep. 01, 2023	Aug. 31, 2024	Radiation (TH03-CB)
RF Cable	Woken	RG402	High Cable-11	30MHz –18 GHz	Oct. 02, 2023	Oct. 01, 2024	Conducted (TH03-CB)
RF Cable	Woken	RG402	High Cable-12	30MHz –18 GHz	Oct. 02, 2023	Oct. 01, 2024	Conducted (TH03-CB)
RF Cable	Woken	RG402	High Cable-13	30MHz –18 GHz	Oct. 02, 2023	Oct. 01, 2024	Conducted (TH03-CB)

Note: Calibration Interval of instruments listed above is one year.
"*" Calibration Interval of instruments listed above is two years.
N.C.R. means Non-Calibration required.