

TEST REPORT

Applicant: arad technologies LTD.

Address of Applicant: 4 Hamada Street Yokneam 2066718 Israel

Manufacturer: arad technologies LTD.

Address of Manufacturer: 4 Hamada Street Yokneam 2066718 Israel

Equipment Under Test (EUT)

Product Name: Allegro Cellular

Model No.: CAT-M Pit Module

FCC ID: 2A7AA-CM5PIT4G

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.247

Date of sample receipt: July 26, 2024

Date of Test: July 26, 2024-August 06, 2024

Date of report issued: August 06, 2024

Test Result : PASS *

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:



Robinson Luo

Laboratory Manager

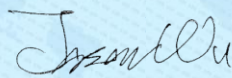
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2 Version

Report No.	Version No.	Date	Description
GTS2024010115F01	00	March 28, 2024	Original
GTS2024070384F01	01	August 06, 2024	Components replacement (Class II permissive change)

Prepared By:

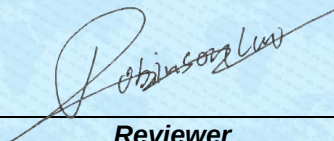


Project Engineer

Date:

August 06, 2024

Check By:



Reviewer

Date:

August 06, 2024

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4 Test Summary

Test Item	Section in CFR 47	Result
Antenna requirement	15.203/15.247 (c)	Pass
AC Power Line Conducted Emission	15.207	N/A
Conducted Output Power	15.247 (b)(3)	Pass*
Channel Bandwidth	15.247 (a)(2)	Pass*
Power Spectral Density	15.247 (e)	Pass*
Band Edge	15.247(d)	Pass
Spurious Emission	15.205/15.209	Pass

Remarks:

1. Pass: The EUT complies with the essential requirements in the standard.
2. Pass*: This's Class II permissive change report, all of the changes are not effect to the RF performance, function and power. So the RF conducted test data directly reference the original report number GTS2024010115F01.
3. N/A: Not applicable.
4. Test according to ANSI C63.10:2013

Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	9kHz-30MHz	3.1dB	(1)
Radiated Emission	30MHz-200MHz	3.8039dB	(1)
Radiated Emission	200MHz-1GHz	3.9679dB	(1)
Radiated Emission	1GHz-18GHz	4.29dB	(1)
Radiated Emission	18GHz-40GHz	3.30dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	3.44dB	(1)

Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.

5 General Information

5.1 General Description of EUT

Product Name:	Allegro Cellular
Model No.:	CAT-M Pit Module
HW:	V.6
Test sample(s) ID:	GTS2024070384-1
Sample(s) Status:	Engineer sample
S/N:	N/A
Operation Frequency:	2402MHz~2480MHz
Channel Numbers:	40
Channel Separation:	2MHz
Modulation Type:	GFSK
Data Rate:	LE 1M PHY: 1 Mb/s
Antenna Type:	Integral Antenna
Antenna Gain:	2.67dBi
Power Supply:	DC 3.6V

Remark:

1. Antenna gain information provided by the customer
2. The relevant information of the sample is provided by the entrusting company, and the laboratory is not responsible for its authenticity.

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402 MHz	11	2422 MHz	21	2442 MHz	31	2462 MHz
2	2404 MHz	12	2424 MHz	22	2444 MHz	32	2464 MHz
3	2406 MHz	13	2426 MHz	23	2446 MHz	33	2466 MHz
4	2408 MHz	14	2428 MHz	24	2448 MHz	34	2468 MHz
5	2410 MHz	15	2430 MHz	25	2450 MHz	35	2470 MHz
6	2412 MHz	16	2432 MHz	26	2452 MHz	36	2472 MHz
7	2414 MHz	17	2434 MHz	27	2454 MHz	37	2474 MHz
8	2416 MHz	18	2436 MHz	28	2456 MHz	38	2476 MHz
9	2418 MHz	19	2438 MHz	29	2458 MHz	39	2478 MHz
10	2420 MHz	20	2440 MHz	30	2460 MHz	40	2480 MHz

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The lowest channel	2402MHz
The middle channel	2440MHz
The Highest channel	2480MHz

5.2 Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode.
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5.3 Description of Support Units

Manufacturer	Description	Model	Serial Number
MEILI	DC POWER SUPPLY	MCH-305A	011121168

5.4 Deviation from Standards

None.

5.5 Abnormalities from Standard Conditions

None.

5.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations: • FCC—Registration No.: 381383 Designation Number: CN5029 Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. • ISED—Registration No.: 9079A CAB identifier: CN0091 The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of ISED for radio equipment testing • NVLAP (LAB CODE:600179-0) Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).
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5.7 Test Location

All tests were performed at:
Global United Technology Services Co., Ltd. Address: No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102 Tel: 0755-27798480 Fax: 0755-27798960

5.8 Additional Instructions

Test Software	Special test software provided by manufacturer
Power level setup	Default

6 Test Instruments list

Radiated Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	June 22, 2024	June 21, 2027
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	April 11, 2024	April 10, 2025
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9168	GTS640	March 19, 2023	March 18, 2025
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	April 17, 2023	April 16, 2025
6	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
7	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	April 11, 2024	April 10, 2025
8	Loop Antenna	ZHINAN	ZN30900A	GTS534	Nov. 13, 2023	Nov.12, 2024
9	Broadband Preamplifier	SCHWARZBECK	BBV9718	GTS535	April 11, 2024	April 10, 2025
10	Amplifier(1GHz-26.5GHz)	HP	8449B	GTS601	April 11, 2024	April 10, 2025
11	Horn Antenna (18-26.5GHz)	/	UG-598A/U	GTS664	Oct. 29, 2023	Oct. 28, 2024
12	Horn Antenna (26.5-40GHz)	A.H Systems	SAS-573	GTS665	Oct. 29, 2023	Oct. 28, 2024
13	FSV·Signal Analyzer (10Hz-40GHz)	Keysight	FSV-40-N	GTS666	March 12, 2024	March 11, 2025
14	Amplifier	/	LNA-1000-30S	GTS650	April 11, 2024	April 10, 2025
15	CDNE M2+M3-16A	HCT	30MHz-300MHz	GTS692	Nov. 08, 2023	Nov.07, 2024
16	Wideband Amplifier	/	WDA-01004000-15P35	GTS602	April 11, 2024	April 10, 2025
17	Thermo meter	JINCHUANG	GSP-8A	GTS643	April 18, 2024	April 17, 2025
18	RE cable 1	GTS	N/A	GTS675	July 02. 2024	July 01. 2025
19	RE cable 2	GTS	N/A	GTS676	July 02. 2024	July 01. 2025
20	RE cable 3	GTS	N/A	GTS677	July 02. 2024	July 01. 2025
21	RE cable 4	GTS	N/A	GTS678	July 02. 2024	July 01. 2025
22	RE cable 5	GTS	N/A	GTS679	July 02. 2024	July 01. 2025
23	RE cable 6	GTS	N/A	GTS680	July 02. 2024	July 01. 2025
24	RE cable 7	GTS	N/A	GTS681	July 05. 2024	July 04. 2025
25	RE cable 8	GTS	N/A	GTS682	July 05. 2024	July 04. 2025

General used equipment:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Barometer	KUMAO	SF132	GTS647	April 18, 2024	April 17, 2025

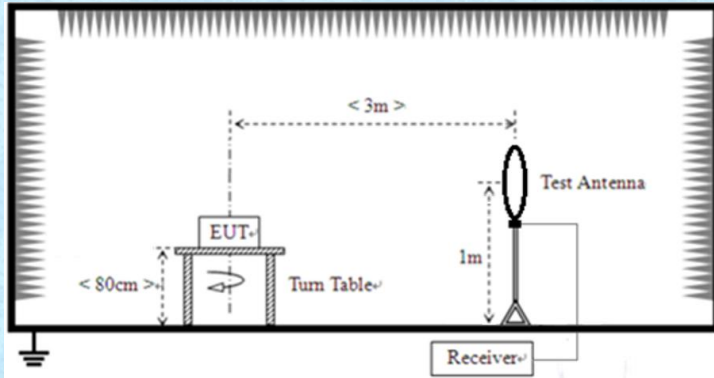
7 Test results and Measurement Data

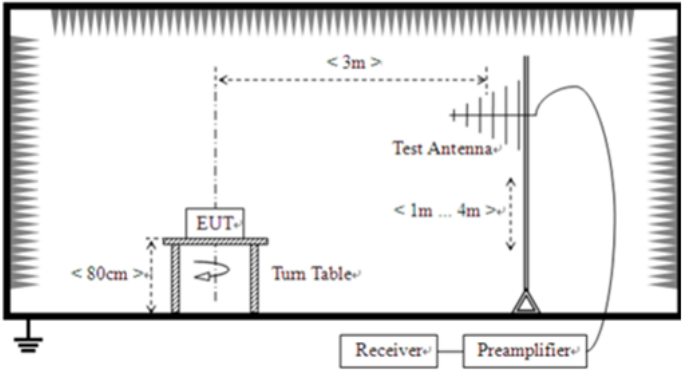
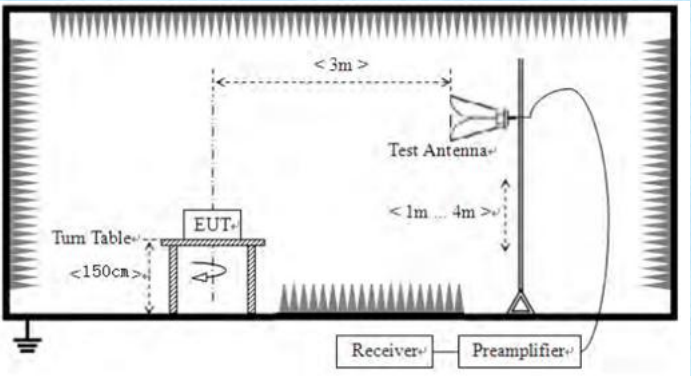
7.1 Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)
15.203 requirement: 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.	
15.247(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.	
E.U.T Antenna:	
The antenna is Integral antenna, reference to the appendix II for details	

7.2 Spurious Emission in Non-restricted & restricted Bands

7.2.1 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	9kHz to 25GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak
	150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz	Average
	Note: For Duty cycle $\geq 98\%$, average detector set as above For Duty cycle $< 98\%$, average detector set as below: $VBW \geq 1 / T$				
Limit:	Frequency	Limit (uV/m)	Value	Measurement Distance	
	0.009MHz-0.490MHz	2400/F(KHz)	QP/PK/AV	300m	
	0.490MHz-1.705MHz	24000/F(KHz)	QP	30m	
	1.705MHz-30MHz	30	QP	30m	
	30MHz-88MHz	100	QP	3m	
	88MHz-216MHz	150	QP		
	216MHz-960MHz	200	QP		
	960MHz-1GHz	500	QP		
	Above 1GHz	500	Average		
		5000	Peak		
Test setup:	For radiated emissions from 9kHz to 30MHz				
					

	For radiated emissions from 30MHz to 1GHz  For radiated emissions above 1GHz 
Test Procedure:	1. The EUT was placed on the top of a rotating table (0.8m for below 1G and 1.5m for above 1G) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details

Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar
Test voltage:	AC 120V, 60Hz					
Test results:	Pass					

Measurement data:

Remark:

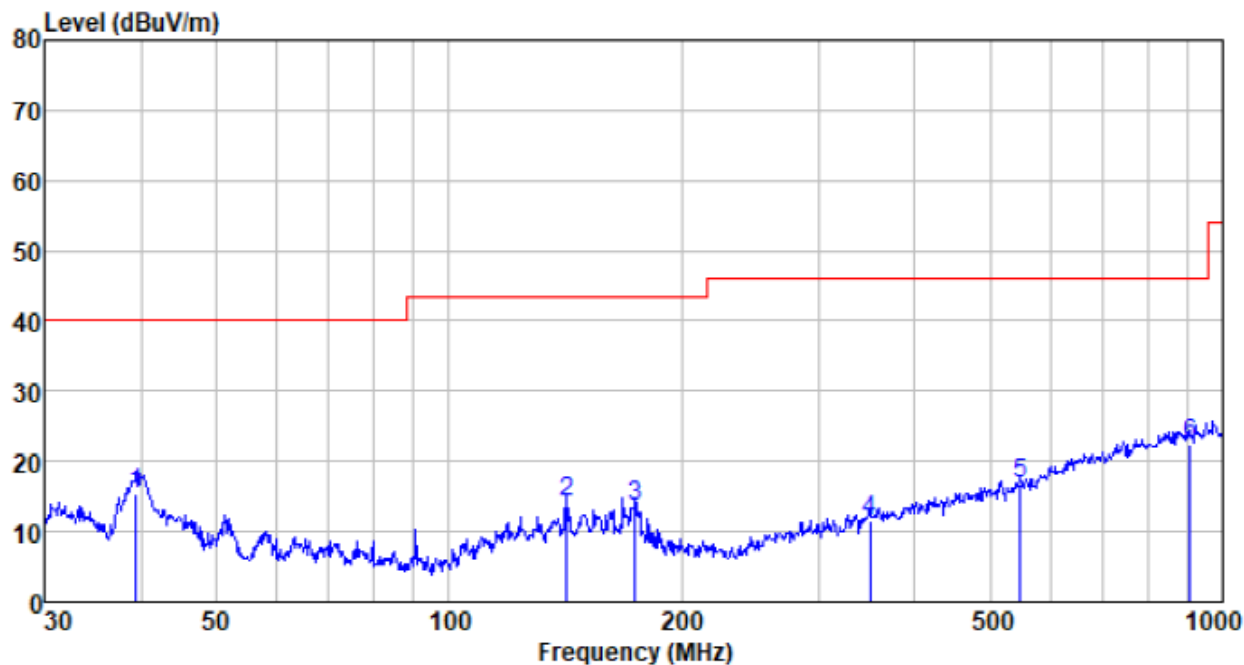
Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.

■ 9kHz~30MHz

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

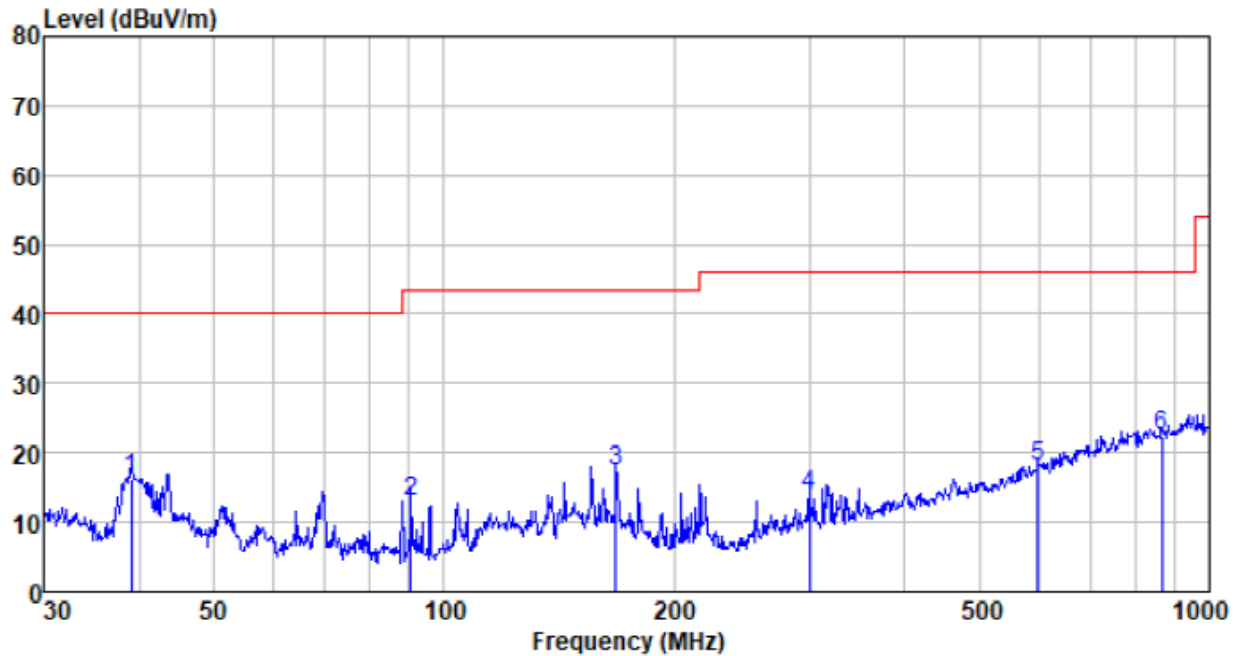
■ Below 1GHz

Pre-scan all test modes, found worst case at 2480MHz, and so only show the test result of 2480MHz,
Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
39.437	32.24	14.29	1.25	32.30	15.48	40.00	-24.52	QP
141.826	30.39	13.88	2.39	32.46	14.20	43.50	-29.30	QP
173.814	30.36	13.04	2.66	32.43	13.63	43.50	-29.87	QP
350.477	26.42	13.61	3.67	32.27	11.43	46.00	-34.57	QP
547.098	26.69	17.64	4.41	32.03	16.71	46.00	-29.29	QP
906.482	24.67	23.13	5.75	31.10	22.45	46.00	-23.55	QP

Vertical:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV/m	Limit level dBuV/m	Over limit dB	Remark
39.024	33.20	14.20	1.25	32.30	16.35	40.00	-23.65	QP
90.537	35.10	8.65	1.78	32.46	13.07	43.50	-30.43	QP
167.824	33.69	13.62	2.62	32.43	17.50	43.50	-26.00	QP
300.367	30.46	12.41	3.42	32.30	13.99	46.00	-32.01	QP
597.223	26.19	18.89	4.62	31.84	17.86	46.00	-28.14	QP
866.088	25.17	22.72	5.65	31.10	22.44	46.00	-23.56	QP

■ Above 1GHz

■ Unwanted Emissions in Non-restricted Frequency Bands

Test channel:	Lowest channel
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Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4804.00	36.85	31.06	16.91	38.36	46.46	74.00	-27.54	Vertical
7206.00	31.19	35.91	23.33	38.96	51.47	74.00	-22.53	Vertical
9608.00	31.46	37.91	30.16	39.68	59.85	74.00	-14.15	Vertical
4804.00	41.24	31.06	16.91	38.36	50.85	74.00	-23.15	Horizontal
7206.00	33.21	35.91	23.33	38.96	53.49	74.00	-20.51	Horizontal
9608.00	30.21	37.91	30.16	39.68	58.60	74.00	-15.40	Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4804.00	25.32	31.06	16.91	38.36	34.93	54.00	-19.07	Vertical
7206.00	20.02	35.91	23.33	38.96	40.30	54.00	-13.70	Vertical
9608.00	19.39	37.91	30.16	39.68	47.78	54.00	-6.22	Vertical
4804.00	29.73	31.06	16.91	38.36	39.34	54.00	-14.66	Horizontal
7206.00	22.22	35.91	23.33	38.96	42.50	54.00	-11.50	Horizontal
9608.00	19.35	37.91	30.16	39.68	47.74	54.00	-6.26	Horizontal

Test channel:	Middle channel
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Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4880.00	36.94	31.28	17.16	38.38	47.00	74.00	-27.00	Vertical
7320.00	31.25	36.16	24.06	39.00	52.47	74.00	-21.53	Vertical
9760.00	31.52	38.06	30.51	39.72	60.37	74.00	-13.63	Vertical
4880.00	41.35	31.28	17.16	38.38	51.41	74.00	-22.59	Horizontal
7320.00	33.28	36.16	24.06	39.00	54.50	74.00	-19.50	Horizontal
9760.00	30.27	38.06	30.51	39.72	59.12	74.00	-14.88	Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4880.00	25.40	31.28	17.16	38.38	35.46	54.00	-18.54	Vertical
7320.00	20.08	36.16	24.06	39.00	41.30	54.00	-12.70	Vertical
9760.00	19.44	38.06	30.51	39.72	48.29	54.00	-5.71	Vertical
4880.00	29.83	31.28	17.16	38.38	39.89	54.00	-14.11	Horizontal
7320.00	22.28	36.16	24.06	39.00	43.50	54.00	-10.50	Horizontal
9760.00	19.41	38.06	30.51	39.72	48.26	54.00	-5.74	Horizontal

Test channel:	Highest channel
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Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4960.00	36.93	31.52	17.43	38.54	47.34	74.00	-26.66	Vertical
7440.00	31.24	36.34	24.43	39.23	52.78	74.00	-21.22	Vertical
9920.00	31.51	38.32	30.75	39.96	60.62	74.00	-13.38	Vertical
4960.00	41.34	31.52	17.43	38.54	51.75	74.00	-22.25	Horizontal
7440.00	33.28	36.34	24.43	39.23	54.82	74.00	-19.18	Horizontal
9920.00	30.27	38.32	30.75	39.96	59.38	74.00	-14.62	Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4960.00	25.43	31.52	17.43	38.54	35.84	54.00	-18.16	Vertical
7440.00	20.10	36.34	24.43	39.23	41.64	54.00	-12.36	Vertical
9920.00	19.46	38.32	30.75	39.96	48.57	54.00	-5.43	Vertical
4960.00	29.87	31.52	17.43	38.54	40.28	54.00	-13.72	Horizontal
7440.00	22.31	36.34	24.43	39.23	43.85	54.00	-10.15	Horizontal
9920.00	19.44	38.32	30.75	39.96	48.55	54.00	-5.45	Horizontal

Remarks:

1. *Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *The emission levels of other frequencies are very lower than the limit and not show in test report.*

■ Unwanted Emissions in Restricted Frequency Bands

Test channel:	Lowest channel
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Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2310.00	48.29	27.17	4.60	38.52	41.54	74.00	-32.46	Horizontal
2390.00	52.08	27.27	4.65	38.56	45.44	74.00	-28.56	Horizontal
2310.00	48.67	27.17	4.60	38.52	41.92	74.00	-32.08	Vertical
2390.00	53.79	27.27	4.65	38.56	47.15	74.00	-26.85	Vertical

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2310.00	37.31	27.17	4.60	38.52	30.56	54.00	-23.44	Horizontal
2390.00	39.00	27.27	4.65	38.56	32.36	54.00	-21.64	Horizontal
2310.00	37.61	27.17	4.60	38.52	30.86	54.00	-23.14	Vertical
2390.00	39.81	27.27	4.65	38.56	33.17	54.00	-20.83	Vertical

Test channel:	Highest channel
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Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.50	50.64	27.38	4.52	38.59	43.95	74.00	-30.05	Horizontal
2500.00	48.94	27.40	4.49	38.60	42.23	74.00	-31.77	Horizontal
2483.50	52.26	27.38	4.52	38.59	45.57	74.00	-28.43	Vertical
2500.00	50.37	27.40	4.49	38.60	43.66	74.00	-30.34	Vertical

Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.50	38.31	27.38	4.52	38.59	31.62	54.00	-22.38	Horizontal
2500.00	37.79	27.40	4.49	38.60	31.08	54.00	-22.92	Horizontal
2483.50	38.23	27.38	4.52	38.59	31.54	54.00	-22.46	Vertical
2500.00	38.15	27.40	4.49	38.60	31.44	54.00	-22.56	Vertical

Remarks:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Pre-amplifier Factor
2. The emission levels of other frequencies are very lower than the limit and not show in test report.

8 Test Setup Photo

Reference to the **appendix I** for details.

9 EUT Constructional Details

Reference to the **appendix II** for details.

-----End-----