

TEST REPORT

Applicant: arad technologies LTD

Address of Applicant: 4 Hamada Street, Yokneam, Israel

Manufacturer/Factory: arad technologies LTD

Address of Manufacturer/Factory: 4 Hamada Street, Yokneam, Israel

Equipment Under Test (EUT)

Product Name: Allegro Cellular

Model No.: Wall mount CAT-M

FCC ID: 2A7AA-CTMWM4G

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

Date of sample receipt: September 19, 2024

Date of Test: September 20, 2024-October 31, 2024

Date of report issued: November 01, 2024

Test Result : PASS *

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

Authorized Signature:



Robinson Luo

Laboratory Manager

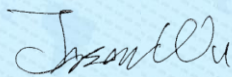
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2 Version

Report No.	Version No.	Date	Description
GTS202203000188F01	00	March 28, 2023	Original
GTS2024090211F01	01	November 01, 2024	Change product name and model number, Components replacement (Class II permissive change)

Prepared By:

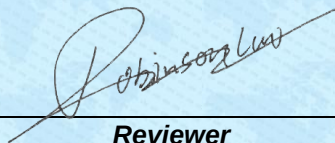


Date:

November 01, 2024

Project Engineer

Check By:



Date:

November 01, 2024

Reviewer

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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 GTS202200030188F01.
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.:	Wall mount CAT-M
Hardware Version:	Rev.6
Software Version:	5.2.15.9
Test sample(s) ID:	GTS2024090211-1
Sample(s) Status:	Engineer sample
S/N:	N/A
Operation Frequency:	2402MHz~2480MHz
Channel Numbers:	40
Channel Separation:	2MHz
Modulation Type:	GFSK
Antenna Type:	Integral Antenna
Antenna Gain:	0dBi(Declare by applicant)
Power Supply:	DC 3.6V

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.
Remark: New battery is used during all test.	

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. ● IC —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 Industry Canada 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	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	Jun. 22, 2024	Jun. 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	Apr. 11, 2024	Apr. 10, 2025
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	Mar. 19, 2023	Mar. 18, 2025
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	Apr. 17, 2023	Apr. 16, 2025
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	N/A	N/A
7	EMI Test Software	AUDIX	E3	N/A	Apr. 11, 2024	Apr. 10, 2025
8	Coaxial Cable	GTS	N/A	GTS213	Nov. 13, 2023	Nov.12, 2024
9	Coaxial Cable	GTS	N/A	GTS211	Apr. 11, 2024	Apr. 10, 2025
10	Coaxial cable	GTS	N/A	GTS210	Apr. 11, 2024	Apr. 10, 2025
11	Coaxial Cable	GTS	N/A	GTS212	Mar. 07, 2024	Mar. 06, 2025
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	Mar. 12, 2024	Mar. 11, 2025
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	Apr. 11, 2024	Apr. 10, 2025
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	Nov. 08, 2023	Nov. 07, 2024
15	Band filter	Amindeon	82346	GTS219	Apr. 11, 2024	Apr. 10, 2025
16	Power Meter	Anritsu	ML2495A	GTS540	Apr. 18, 2024	Apr. 17, 2025
17	Power Sensor	Anritsu	MA2411B	GTS541	Jul. 02, 2024	Jul. 01, 2025
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	Jul. 02, 2024	Jul. 01, 2025
19	Splitter	Agilent	11636B	GTS237	Jul. 02, 2024	Jul. 01, 2025
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	Jul. 02, 2024	Jul. 01, 2025
21	Breitband hornantenne	SCHWARZBECK	BBHA 9170	GTS579	Jul. 02, 2024	Jul. 01, 2025
22	Amplifier	TDK	PA-02-02	GTS574	Jul. 02, 2024	Jul. 01, 2025
23	Amplifier	TDK	PA-02-03	GTS576	Jul. 05, 2024	Jul. 04, 2025
24	PSA Series Spectrum Analyzer	Rohde & Schwarz	FSP	GTS578	Jul. 05, 2024	Jul. 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	Apr. 18, 2024	Apr. 17, 2025

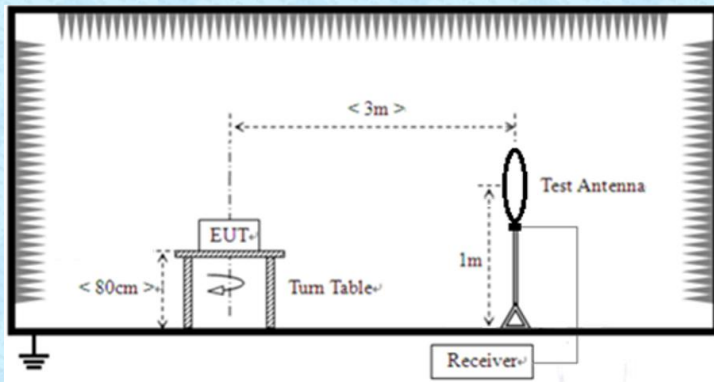
7 Test results and Measurement Data

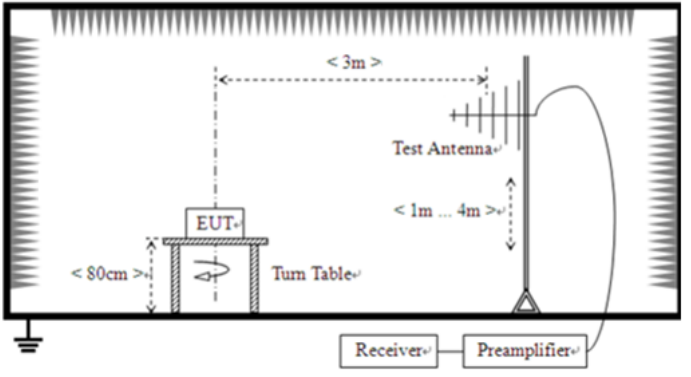
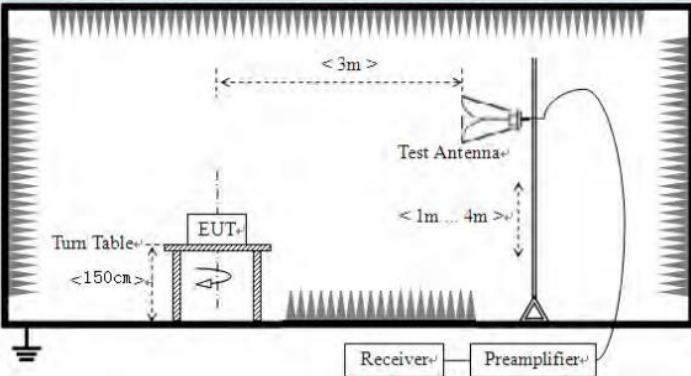
7.1 Antenna requirement

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:	
<i>The antenna is integral antenna, reference to the appendix II for details</i>	

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
Limit:	Frequency	Limit (uV/m)		Value	Measurement Distance
	0.009MHz-0.490MHz	2400/F(KHz)		QP	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 results:	Pass					

Measurement data:

Remark:

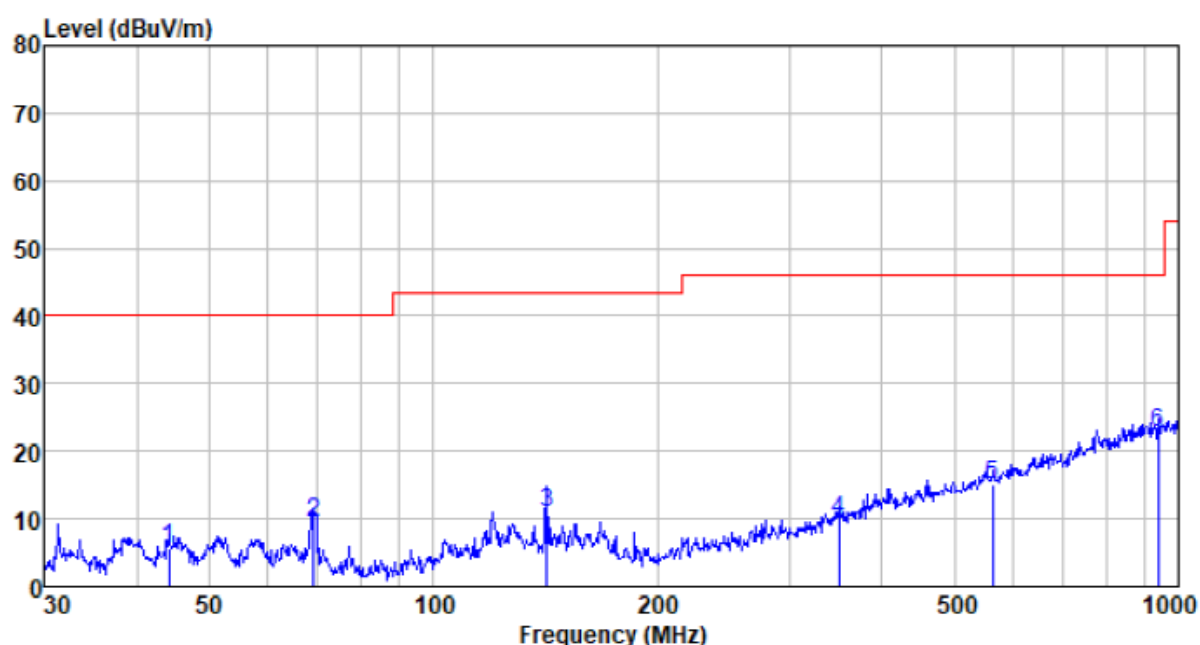
Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.

■ 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.

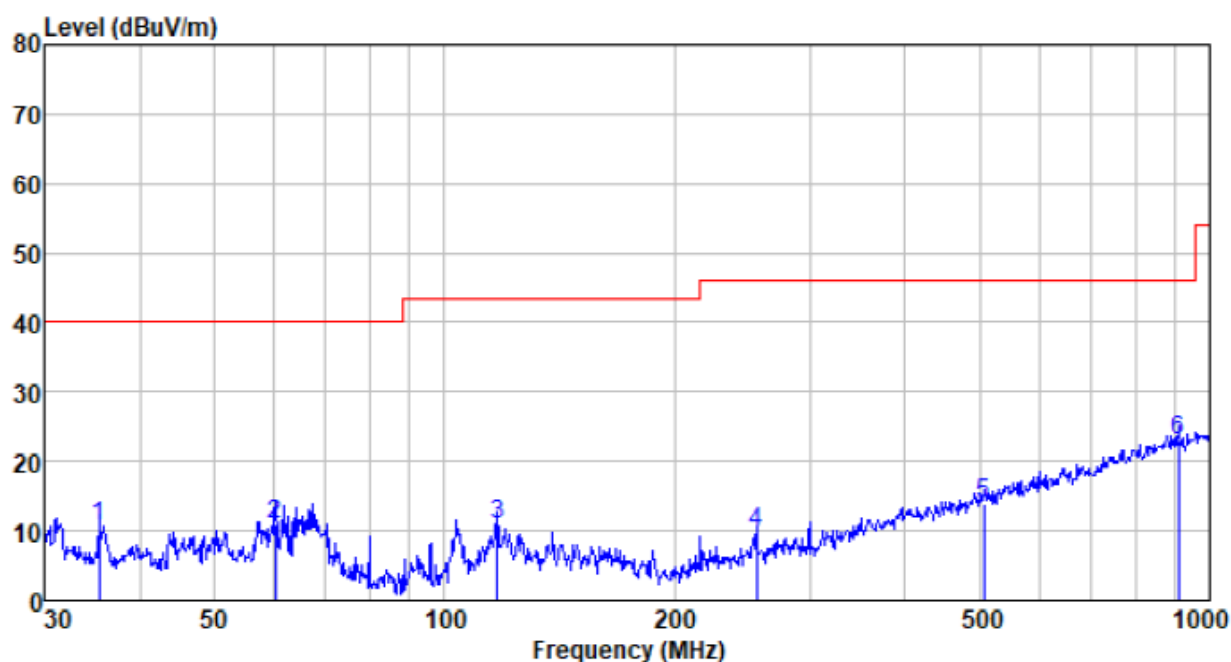
■ Below 1GHz

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
44.120	25.36	13.37	0.71	33.71	5.73	40.00	-34.27	QP
69.114	31.46	10.67	0.93	33.60	9.46	40.00	-30.54	QP
141.826	30.10	12.42	1.52	33.20	10.84	43.50	-32.66	QP
350.477	25.38	14.18	2.62	32.49	9.69	46.00	-36.31	QP
562.662	24.79	18.70	3.57	31.86	15.20	46.00	-30.80	QP
938.833	24.51	24.22	4.99	30.86	22.86	46.00	-23.14	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
35.375	30.92	12.76	0.61	33.76	10.53	40.00	-29.47	QP
60.069	31.23	12.58	0.86	33.64	11.03	40.00	-28.97	QP
117.360	31.84	11.02	1.34	33.42	10.78	40.00	-29.22	QP
255.623	28.99	11.36	2.15	32.74	9.76	47.00	-37.24	QP
506.479	24.90	17.72	3.33	31.98	13.97	47.00	-33.03	QP
909.667	25.23	23.98	4.88	30.94	23.15	47.00	-23.85	QP

- Above 1GHz
- 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
4804.00	37.33	31.06	16.91	38.36	46.94	74.00	-27.06	Vertical
7206.00	31.51	35.91	23.33	38.96	51.79	74.00	-22.21	Vertical
9608.00	31.75	37.91	30.16	39.68	60.14	74.00	-13.86	Vertical
4804.00	41.82	31.06	16.91	38.36	51.43	74.00	-22.57	Horizontal
7206.00	33.58	35.91	23.33	38.96	53.86	74.00	-20.14	Horizontal
9608.00	30.54	37.91	30.16	39.68	58.93	74.00	-15.07	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	25.71	31.06	16.91	38.36	35.32	54.00	-18.68	Vertical
7206.00	20.29	35.91	23.33	38.96	40.57	54.00	-13.43	Vertical
9608.00	19.62	37.91	30.16	39.68	48.01	54.00	-5.99	Vertical
4804.00	30.18	31.06	16.91	38.36	39.79	54.00	-14.21	Horizontal
7206.00	22.52	35.91	23.33	38.96	42.80	54.00	-11.20	Horizontal
9608.00	19.63	37.91	30.16	39.68	48.02	54.00	-5.98	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	37.16	31.28	17.16	38.38	47.22	74.00	-26.78	Vertical
7320.00	31.39	36.16	24.06	39.00	52.61	74.00	-21.39	Vertical
9760.00	31.65	38.06	30.51	39.72	60.50	74.00	-13.50	Vertical
4880.00	41.61	31.28	17.16	38.38	51.67	74.00	-22.33	Horizontal
7320.00	33.45	36.16	24.06	39.00	54.67	74.00	-19.33	Horizontal
9760.00	30.42	38.06	30.51	39.72	59.27	74.00	-14.73	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	25.58	31.28	17.16	38.38	35.64	54.00	-18.36	Vertical
7320.00	20.20	36.16	24.06	39.00	41.42	54.00	-12.58	Vertical
9760.00	19.54	38.06	30.51	39.72	48.39	54.00	-5.61	Vertical
4880.00	30.03	31.28	17.16	38.38	40.09	54.00	-13.91	Horizontal
7320.00	22.42	36.16	24.06	39.00	43.64	54.00	-10.36	Horizontal
9760.00	19.54	38.06	30.51	39.72	48.39	54.00	-5.61	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	36.73	31.52	17.43	38.54	47.14	74.00	-26.86	Vertical
7440.00	31.11	36.34	24.43	39.23	52.65	74.00	-21.35	Vertical
9920.00	31.40	38.32	30.75	39.96	60.51	74.00	-13.49	Vertical
4960.00	41.10	31.52	17.43	38.54	51.51	74.00	-22.49	Horizontal
7440.00	33.13	36.34	24.43	39.23	54.67	74.00	-19.33	Horizontal
9920.00	30.13	38.32	30.75	39.96	59.24	74.00	-14.76	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	25.27	31.52	17.43	38.54	35.68	54.00	-18.32	Vertical
7440.00	19.99	36.34	24.43	39.23	41.53	54.00	-12.47	Vertical
9920.00	19.36	38.32	30.75	39.96	48.47	54.00	-5.53	Vertical
4960.00	29.68	31.52	17.43	38.54	40.09	54.00	-13.91	Horizontal
7440.00	22.18	36.34	24.43	39.23	43.72	54.00	-10.28	Horizontal
9920.00	19.32	38.32	30.75	39.96	48.43	54.00	-5.57	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 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)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2310.00	48.81	27.17	4.60	38.52	42.06	74.00	-31.94	Horizontal
2390.00	52.68	27.27	4.65	38.56	46.04	74.00	-27.96	Horizontal
2310.00	49.25	27.17	4.60	38.52	42.50	74.00	-31.50	Vertical
2390.00	54.45	27.27	4.65	38.56	47.81	74.00	-26.19	Vertical

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
2310.00	37.71	27.17	4.60	38.52	30.96	54.00	-23.04	Horizontal
2390.00	39.44	27.27	4.65	38.56	32.80	54.00	-21.20	Horizontal
2310.00	38.05	27.17	4.60	38.52	31.30	54.00	-22.70	Vertical
2390.00	40.29	27.27	4.65	38.56	33.65	54.00	-20.35	Vertical

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
2483.50	51.22	27.38	4.52	38.59	44.53	74.00	-29.47	Horizontal
2500.00	49.42	27.40	4.49	38.60	42.71	74.00	-31.29	Horizontal
2483.50	52.92	27.38	4.52	38.59	46.23	74.00	-27.77	Vertical
2500.00	50.91	27.40	4.49	38.60	44.20	74.00	-29.80	Vertical

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
2483.50	38.71	27.38	4.52	38.59	32.02	54.00	-21.98	Horizontal
2500.00	38.13	27.40	4.49	38.60	31.42	54.00	-22.58	Horizontal
2483.50	38.49	27.38	4.52	38.59	31.80	54.00	-22.20	Vertical
2500.00	38.53	27.40	4.49	38.60	31.82	54.00	-22.18	Vertical

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.

8 Test Setup Photo

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

9 EUT Constructional Details

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

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