

Prüfbericht-Nr.: <i>Test report no.:</i>	CN24104U 002	Auftrags-Nr.: <i>Order no.:</i>	168472504	Seite 1 von 21 Page 1 of 21
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2024-03-05	
Auftraggeber: <i>Client:</i>	ECARX (Hubei) Tech Co., Ltd B1336, Taizi Lake Industry Park, No 18 ShenLong AVE, WH, China			
Prüfgegenstand: <i>Test item:</i>	LOTUS-Lambda-DHU			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	ECMC3			
Auftrags-Inhalt: <i>Order content:</i>	Test Report			
Prüfgrundlage: <i>Test specification:</i>	CFR47 FCC Part 15: Subpart C Section 15.247 RSS-247 Issue 3 August 2023 RSS-Gen Issue 5 February 2021			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2024-02-29	Please refer to Photo Document		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003664372-003~004 A003664372-007			
Prüfzeitraum: <i>Testing period:</i>	2024-03-11 - 2024-03-21			
Ort der Prüfung: <i>Place of testing:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>	Hardy X <i>Hardy</i> <i>Suo</i>		genehmigt von: <i>authorized by:</i>	Lin Lin X <i>Lin Lin</i>
Datum: <i>Date:</i>	2024-03-29		Ausstellungsdatum: <i>Issue date:</i>	2024-03-29
Stellung / Position:	Sachverständige(r)/Expert		Stellung / Position:	Sachverständige(r)/Expert
Sonstiges / <i>Other:</i>	FCC ID: 2BD49-ECMC3 IC: 31788-ECMC3, HVIN: ECMC3 This report is for 2.4GHz Wi-Fi. Applicant & Manufacturer: ECARX (Hubei) Tech Co., Ltd., B1336, Taizi Lake Industry Park, No 18 ShenLong AVE, WH, China			
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>			
* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet			
* Legend:	P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested			
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Anmerkungen
Remarks

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4	Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019. <i>The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</i>

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Test Summary

5.1.1 ANTENNA REQUIREMENT

RESULT: Pass

5.1.2 MAXIMUM PEAK CONDUCTED OUTPUT POWER

RESULT: Pass

5.1.3 CONDUCTED POWER SPECTRAL DENSITY

RESULT: Pass

5.1.4 99%dB BANDWIDTH

RESULT: Pass

5.1.5 6dB BANDWIDTH

RESULT: Pass

5.1.6 CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 KHz BANDWIDTH

RESULT: Pass

5.1.7 RADIATED SPURIOUS EMISSION

RESULT: Pass

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1 General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A: Test Results of 2.4GHz Wi-Fi.

Appendix B: Photographs of the Test Set-up.

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Shenzhen) Co., Ltd.

No. 362 Huanguan Road Middle, Longhua District, 518110, Shenzhen, P. R. China.

FCC Registration No.: 694916

ISED wireless device testing laboratory: 25069

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Radio Spectrum Testing (TS8997)					
Equipment	Manufacturer	Model	Serial No.	Cal. Date	Cal. until
Signal Analyzer	R&S	FSV 40	101441	2023-07-26	2024-07-25
OSP	R&S	OSP 150	101017	2023-11-14	2024-11-13
Control PC	DELL	OptiPlex 7050	FTJZ9P2	N/A	N/A
Test Software	R&S	WMS32 (V11.00.00)	N/A	N/A	N/A
Power Meter	R&S	NRP2	107105	2023-11-14	2024-11-13
Wideband Power Sensor	R&S	NRP-Z81	105677	2023-07-26	2024-07-25
Shielding Room 8#	Albatross	SR8	APC17151-SR8	2021-06-22	2024-06-22
Unwanted Emission Testing (TS9975)					
Equipment	Manufacturer	Model	Serial No.	Cal. Date	Cal. until
EMI Test Receiver	R&S	ESR 7	102021	2023-07-26	2024-07-25
Signal Analyzer	R&S	FSV 40	101439	2023-07-26	2024-07-25
System Controller Interface	R&S	SCI-100	S10010038	N/A	N/A
Filterbank	R&S	Wlan	100759	2023-07-26	2024-07-25
OSP	R&S	OSP 120	102040	N/A	N/A
Pre-amplifier	R&S	SCU08F1	08320031	2023-07-26	2024-07-25
Amplifier	R&S	SCU-18F	180070	2023-07-26	2024-07-25
Amplifier	R&S	SCU40A	100475	2023-07-26	2024-07-25
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	2022-08-07	2024-08-06
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	2022-08-07	2024-08-06
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	2022-08-28	2024-08-27

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Active Loop Antenna	Schwarzbeck	FMZB 1513	302	2022-08-07	2024-08-06
Test software	R&S	EMC32 (V10.60.10)	N/A	N/A	N/A
Control PC	Dell	OptiPlex 7050	36NV9P2	N/A	N/A
3m Semi-Anechoic Chamber	Albatross	SAC-3m	APC17151-SAC	2021-06-22	2024-06-22

2.3 Traceability

All measurement equipment calibrations are traceable to NIM (National Institute of Metrology) or where calibration is performed in other countries, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements as below table.

Table 2: Measurement Uncertainty

Parameter	Uncertainty (k=2)
RF output power, conducted	± 0.99 dB
Occupied Channel Bandwidth	± 2.08 %
RF power density, conducted	± 0.99 dB
Unwanted Emissions, conducted	± 0.89 dB
All emissions, radiated	±4.17 dB

2.6 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendix A & B of this report and delivered to the applicant. A copy has been retained in the TÜV Rheinland (Shenzhen) file for certification follow-up purposes.

2.7 Status of Facility Used for Testing

The TÜV Rheinland (Shenzhen) Co., Ltd. Test facility located at No. 362 Huanguan Road Middle, Longhua District, 518110, Shenzhen, P. R. China. is listed on the US Federal Communications Commission list of facilities approved to perform measurements.

3 General Product Information

3.1 Product Function and Intended Use

The EUT is a LOTUS-Lambda-DHU intended to be assembled into automotive environment, which supports Bluetooth (dual mode), 2.4G Wi-Fi and 5.2G/5.8G Wi-Fi technologies.

For details refer to the User Manual, Technical Description and Circuit Diagram.

3.2 Ratings and System Details

Table 3: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment:	LOTUS-Lambda-DHU
Type Designation:	ECMC3
FCC ID:	2BD49-ECMC3
IC:	31788-ECMC3
HVIN:	ECMC3
Operating Voltage:	DC 12V
Testing Voltage:	DC 12V
Operating Temperature Range:	-40 °C ~ 85 °C
Operating Frequency Mode:	Bluetooth: Classic BR, EDR + BLE (1Mbps only) 2.4G Wi-Fi: 802.11 b/g/n20/n40/ax20/ax40 5.2G/5.8G Wi-Fi: 802.11 a/n20/n40/ac20/ac40/ac80/ax20/ax40/ax80
Technical Specification of Bluetooth (dual mode)	
Operating Frequency:	2402 MHz to 2480 MHz
Type of Modulation:	GFSK, $\pi/4$ -DQPSK, 8DPSK
Channel Number:	BR & EDR mode:79 channels, Low Energy mode:40 channels
Channel Separation:	BR & EDR mode:1MHz, Low Energy mode:2MHz
Data Rate:	BR & EDR mode:(1Mbps, 2Mbps, 3Mbps) Low Energy mode: (1Mbps)
Antenna Type:	Integral Antenna
Antenna Gain:	3.50 dBi (Provided by the Client)
Technical Specification of 2.4GHz Wi-Fi	
Operating Frequency:	2412 - 2462MHz for 802.11b/g/n20/ax20 2422 - 2452MHz for 802.11n40/ax40
Type of Modulation:	DSSS(DBPSK/DQPSK/CCK) OFDM(BPSK/QPSK/16QAM/64QAM/256QAM)
Data Rate:	1/2/5.5/11 Mbps for 802.11b 6/9/12/18/24/36/48/54 Mbps for 802.11g MCS0 ~ MCS7 for 802.11n MCS0~MCS9 for 802.11ac MCS0~MCS11 for 802.11ax
Channel Number:	11 channels for 802.11b/g/n20/ax20 7 channels for 802.11n40/ax40

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Channel Separation:	5 MHz
Antenna Type:	Integral Antenna
Antenna Number:	1Tx1Rx for SISO mode, 2Tx2Rx for MIMO mode
Antenna Gain:	3.05 dBi for ANT1, 4.44 dBi for ANT2 (Provided by the Client)
Technical Specification of 5.2GHz Wi-Fi	
Operating Frequency:	5180 - 5240MHz
Type of Modulation:	OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
Data Rate:	6/9/12/18/24/36/48/54 Mbps for 802.11a MCS0~MCS7 for 802.11n MCS0~MCS9 for 802.11ac MCS0~MCS11 for 802.11ax
Channel Number:	7 channels for 802.11 a/n20/n40/ac20/ac40/ac80/ax20/ax40/ax80
Channel Separation:	20MHz, 40MHz, 80MHz
Antenna Type:	Integral Antenna
Antenna Number:	1Tx1Rx for SISO mode, 2Tx2Rx for MIMO mode
Antenna Gain:	4.06 dBi for ANT1, 3.75 dBi for ANT2 (Provided by the Client)
Technical Specification of 5.8GHz Wi-Fi	
Operating Frequency:	5745 - 5825MHz
Type of Modulation:	OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
Data Rate:	6/9/12/18/24/36/48/54 Mbps for 802.11a MCS0~MCS7 for 802.11n MCS0~MCS9 for 802.11ac MCS0~MCS11 for 802.11ax
Channel Number:	8 channels for 802.11 a/n20/n40/ac20/ac40/ac80/ax20/ax40/ax80
Channel Separation:	20MHz, 40MHz, 80MHz
Antenna Type:	Integral Antenna
Antenna Number:	1Tx1Rx for SISO mode, 2Tx2Rx for MIMO mode
Antenna Gain:	3.98 dBi for ANT1, 3.82 dBi for ANT2 (Provided by the Client)

Table 4: RF Channel and Frequency of 2.4GHz Wi-Fi

RF Channel	802.11 b/g/n(HT20)/ax(HE20)	802.11 n(HT40)/ax(HE40)
	Frequency (MHz)	Frequency (MHz)
01	2412	/
02	2417	/
03	2422	2422
04	2427	2427
05	2432	2432
06	2437	2437
07	2442	2442
08	2447	2447
09	2452	2452
10	2457	/
11	2462	/

Test frequencies are lowest channel: 2412 MHz, middle channel: 2437 MHz and highest channel: 2462 MHz for 802.11b/g/n(HT20)/ax(HE20)

Test frequencies are lowest channel: 2422 MHz, middle channel: 2437 MHz and highest channel: 2452 MHz for 802.11n(HT40)/ax(HE40)

3.3 Independent Operation Modes

The basic operation modes are:

A. On, 2.4GHz Wi-Fi transmitting mode

- 1) Low Channel
- 2) Middle Channel
- 3) High Channel

B. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- Application Form
- User Manual
- ID Label and Location Info
- Operation Description

4 Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

Radio Spectrum: The equipment under test (EUT) was configured at its highest power output in order to measure its highest possible radiation and conducted level. The test modes were adapted accordingly in reference to the instructions for use.

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All testing were performed according to the procedures in ANSI C63.10: 2013.

According to clause 3.1, all tests were performed on model ECMC3 in this report.

Remark: This testing was carried out on SISO mode and MIMO mode, but only the worst case was presented in this report.

4.3 Special Accessories and Auxiliary Equipment

Table 5: List of Accessories and Auxiliary Equipment

Description	Manufacturer	Model	S/N	Rating
Laptop	Lenovo	T480	PF-16A6N8	N/A
DC power Supply	Topward	3303D	809332	0-30 Volts, 0-3 Amps

4.4 Countermeasures to Achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Technical Construction File (TCF).

No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

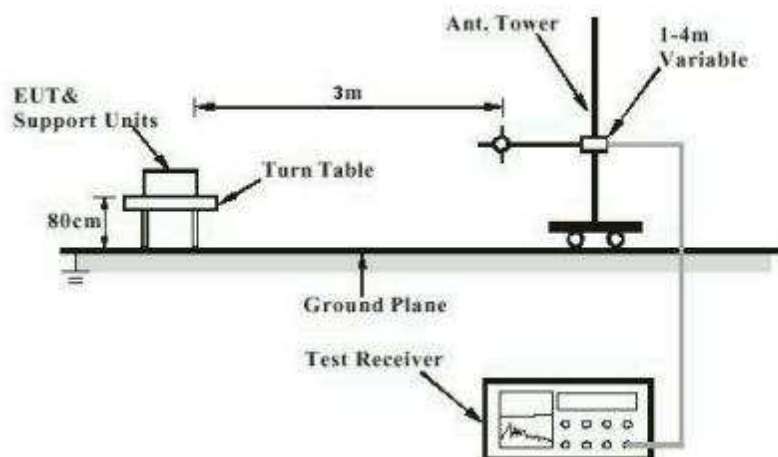


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

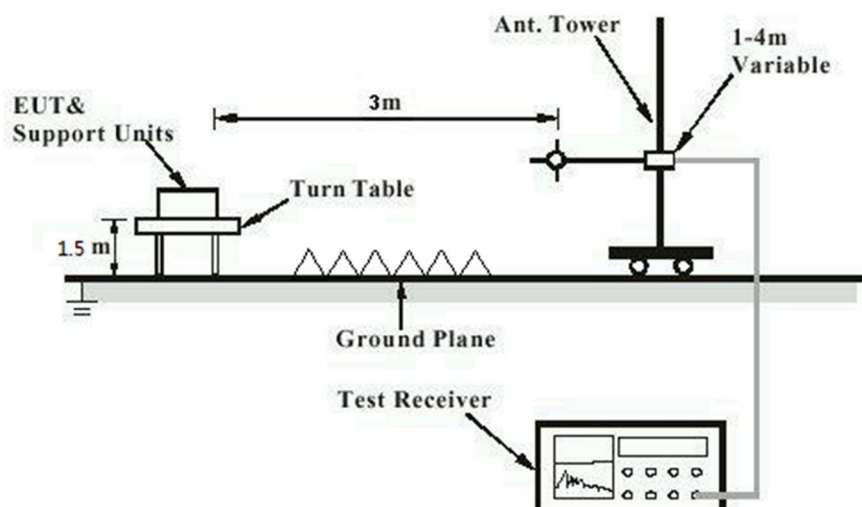
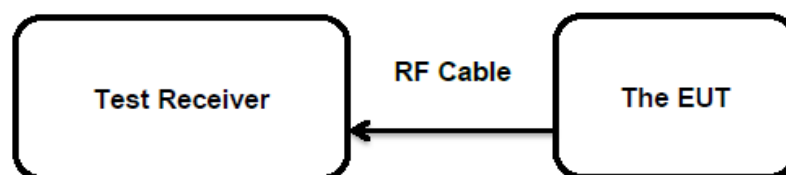


Diagram of Measurement Configuration for Conducted Transmitter Measurement



5 Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Pass****Test Specification**

Test standard	:	FCC Part 15.247(b)(4) and Part 15.203 RSS-Gen Clause 6.8
Limit	:	the use of antennas with directional gains that do not exceed 6 dBi

According to the manufacturer declared, the EUT have two Integral Antennas, the max. uncorrelated antenna gain is 4.44dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement.

Therefore, the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

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5.1.2 Maximum Peak Conducted Output Power

RESULT:

Pass

Test Specification

Test standard	: FCC Part 15.247(b)(3) RSS-247 Clause 5.4(d)
Basic standard	: ANSI C63.10: 2013
Limits	: < 1 W (Maximum Conducted Peak Power) e.i.r.p. <4W
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2024-03-11 to 2024-03-14
Input voltage	: DC 12V
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 22.7 °C
Relative humidity	: 46 %
Atmospheric pressure	: 101 kPa

For details refer to following test result.

Table 6: Test Result of Maximum Peak Conducted Output Power

SISO mode_ANT2

Test Mode	Data Rate	Test Channel (MHz)	Measured Peak Power		Limit (W)
			(dBm)	(W)	
802.11b	1 Mbps	2412	16.11	0.0408	< 1.0
		2437	16.04	0.0402	
		2462	15.65	0.0367	
802.11g	6 Mbps	2412	19.66	0.0925	
		2437	19.40	0.0871	
		2462	18.91	0.0778	
802.11n (HT20)	MCS0	2412	19.04	0.0802	
		2437	19.24	0.0839	
		2462	18.59	0.0723	
802.11n (HT40)	MCS0	2422	20.40	0.1096	
		2437	20.27	0.1064	
		2452	19.83	0.0962	
802.11ax (HE20)	MCS0	2412	18.18	0.0658	
		2437	17.84	0.0608	
		2462	17.58	0.0573	
802.11ax (HE40)	MCS0	2422	17.80	0.0603	
		2437	17.82	0.0605	
		2452	17.75	0.0596	

MIMO mode

Test Mode	Data Rate	Test Channel (MHz)	Measured Peak Power		Limit (W)
			(dBm)	(W)	
802.11n (HT20)	MCS0	2412	22.07	0.1611	< 1.0
		2437	22.04	0.1600	
		2462	21.71	0.1483	
802.11n (HT40)	MCS0	2422	23.08	0.2032	
		2437	23.16	0.2070	
		2452	22.86	0.1932	
802.11ax (HE20)	MCS0	2412	20.96	0.1247	
		2437	21.01	0.1262	
		2462	20.76	0.1191	
802.11ax (HE40)	MCS0	2422	20.69	0.1172	
		2437	20.63	0.1156	
		2452	20.72	0.1180	

Max. e.i.r.p.=23.16dBm+3.8dBi=26.96dBm, which is less than 36dBm=4W.

Note:

- 1) The cable loss is taken into account in results.
- 2) Antenna gain(G) of 2.4GHz Wi-Fi: 3.8dBi (uncorrelated antenna gain)
e.i.r.p.=P_(Peak power)+ G, which is far below the 4 W

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5.1.3 Conducted Power Spectral Density

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.247(e) RSS-247 Clause 5.2(b)
Basic standard	: ANSI C63.10: 2013
Limits	: 8 dBm / 3kHz
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2024-03-11
Input voltage	: DC 12V
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 22.7 °C
Relative humidity	: 46 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix A.

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5.1.4 99%dB Bandwidth

RESULT:

Pass

Test Specification

Test standard : RSS-Gen clause 6.7
Basic standard : ANSI C63.10: 2013
Kind of test site : Shielded Room

Test Setup

Date of testing : 2024-03-14
Input voltage : DC 12V
Operation mode : A
Test channel : Low / Middle / High
Ambient temperature : 22.7 °C
Relative humidity : 46 %
Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix A.

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5.1.5 6dB Bandwidth

RESULT:**Pass****Test Specification**

Test standard	:	FCC Part 15.247(a)(2) RSS-247 Clause 5.2(a)
Basic standard	:	ANSI C63.10: 2013
Limits	:	> 500 KHz
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2024-03-14
Input voltage	:	DC 12V
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	22.7 °C
Relative humidity	:	46 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix A.

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5.1.6 Conducted Spurious Emissions Measured in 100 kHz Bandwidth

RESULT:

Pass

Test Specification

Test standard	: FCC Part 15.247(d) RSS-247 Clause 5.5
Basic standard	: ANSI C63.10: 2013
Limits	: 20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power); In addition, radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified in 15.209(a)
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2024-03-11
Input voltage	: DC 12V
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 22.7 °C
Relative humidity	: 46 %
Atmospheric pressure	: 101 kPa

Test results of 100kHz Bandwidth of Frequency Band Edge by Conducted method refer to test plots, and compliance is achieved as well.

For the measurement records, refer to the appendix A.

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5.1.7 Radiated Spurious Emission

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.247(d) & FCC Part 15.205 RSS-247 Clause 3.3 & 5.5
Basic standard	: ANSI C63.10: 2013
Limits	: Refer to 15.209(a) of FCC part 15.247(d) RSS-Gen Table 5
Kind of test site	: 3m Semi-anechoic Chamber

Test Setup

Date of testing	: 2024-03-18 to 2024-03-21
Input voltage	: DC 12V
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: Refer to test result
Relative humidity	: Refer to test result
Atmospheric pressure	: 101 kPa

Remark:

Testing was carried out within frequency range 9kHz to the tenth harmonics. Only the worst case spurious emissions configuration of the each mode were reported.

For the measurement records, refer to the appendix A.

6 Photographs of the Test Set-Up

For photographs of the test set-up, refer to the appendix B.

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