

Prüfbericht-Nr.: Test report no.:	CN25615P 005	Auftrags-Nr.: Order no.:	168516757	Seite 1 von 9 Page 1 of 9
Kunden-Referenz-Nr.: Client reference no.:	N/A	Auftragsdatum: Order date:	2024-12-03	
Auftraggeber: Client:	Aptiv Electronics (Suzhou) Co., Ltd. No. 123, Changyang Street, Suzhou Industrial Park, Suzhou, China			
Prüfgegenstand: Test item:	DHU2.5_A (Digital Cockpit Head Unit)			
Bezeichnung / Typ-Nr.: Identification / Type no.:	DHU2.5_A			
Auftrags-Inhalt: Order content:	Test Report			
Prüfgrundlage: Test specification:	CFR Title 47 FCC Part 2: Section 2.1091 CFR Title 47 FCC Part 1: Section 1.1310			
Wareneingangsdatum: Date of sample receipt:	2024-12-20	Please refer to Photo Document		
Prüfmuster-Nr.: Test sample no:	A003881754-001~018			
Prüfzeitraum: Testing period:	2025-01-14 - 2025-01-20			
Ort der Prüfung: Place of testing:	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: Test result*:	Pass			
geprüft von: tested by:	<u>X Jonathan Li</u>		genehmigt von: authorized by:	<u>X Bell Hu</u>
Datum: Date: 2025-02-10	Signed by: Jonathan Li		Ausstellungsdatum: Issue date: 2025-02-10	Signed by: Bell Hu
Stellung / Position:	Sachverständige(r)/Expert		Stellung / Position:	Sachverständige(r)/Expert
Sonstiges / Other:	FCC ID: 2AX7A-DHU2-5-A			
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:	Prüfmuster vollständig und unbeschädigt Test item complete and undamaged			
* 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
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report only relates to the above mentioned test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.				

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Anmerkungen
Remarks

1	Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben. Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden. <i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i>
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3	Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt. <i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i> <i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i>
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

3.1.1 RF EXPOSURE COMPLIANCE
RESULT: Pass

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1. Test Sites

1.1 Test Facilities

TÜV Rheinland (Shenzhen) Co., Ltd.

2-3F, 101 & 102, No.2, Nuclear Power Industrial Park, Fuming Community, Fucheng Street,
Longhua District, Shenzhen 518000, People's Republic of China

FCC Accreditation Designation No.: CN1260

1.2 Traceability

All measurement equipment calibrations are traceable to NIST or where calibration is performed outside the United States, to equivalent nationally recognized standards organizations.

1.3 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.

1.4 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendixes 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. General Product Information

2.1 General Description

The EUT is an Intelligent cockpit domain controller which supports Bluetooth dual mode, 2.4GHz Wi-Fi, 5GHz Wi-Fi and FM/DAB wireless technologies.

The EUT has a BT module AH20C and a BT/WIFI module AF66T.

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

2.2 Rating and System details

Table 1: Technical Specification of EUT

Kind of Equipment:	DHU2.5_A (Digital Cockpit Head Unit)
Type Designation:	DHU2.5_A
FCC ID:	2AX7A-DHU2-5-A
Operating Voltage:	DC 9~16V
Testing Voltage:	DC 12V
Operating Temperature Range:	-40 °C ~ +85 °C

Table 2: Technical Specification of Module "Module AH20C"

Technical Specification of Bluetooth dual mode (Module AH20C)	
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:	0.79 dBi Max. (Provided by the Client)

Table 3: Technical Specification of Module "AF66T"

Technical Specification of Bluetooth dual mode (Module AF66T)	
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:	1.41 dBi Max. (Provided by the Client)
Technical Specification of 2.4GHz Wi-Fi (Module AF66T)	
Operating Frequency:	2412 - 2462 MHz for 802.11b/g/n(HT20)/ax(HE20)

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	2422 - 2452 MHz for 802.11n(HT40)/ax(HE40)
Type of Modulation:	DSSS(DBPSK/DQPSK/CCK) OFDM(BPSK/QPSK/16QAM/64QAM/256QAM/1024QAM)
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 ~ MCS11 for 802.11ax
Channel Number:	11 channels for 802.11b/g/n(HT20)/ax(HE)20 7 channels for 802.11n(HT40)/ax(HE40)
Channel Separation:	5 MHz
Antenna Type:	Integral Antenna
Antenna Number:	1Tx1Rx for SISO mode, 2Tx2Rx for MIMO mode
Antenna Gain:	1.41 dBi Max. for ANT1 /0.58 dBi for ANT2 (Provided by the Client)
Technical Specification of 5GHz Wi-Fi (Module AF66T)	
Operating Frequency:	5180-5240MHz, 5260-5320MHz, 5500-5700MHz, 5745-5825MHz
Protocol:	802.11 a/n20/n40/ac20/ac40/ac80/ax/20/ax40/ax80
Channel Number:	5180-5240MHz: 7CHs, 5260-5320MHz: 7CHs 5500-5700MHz: 18CHs, 5745-5825MHz: 8CHs
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 Separation:	20MHz, 40MHz, 80MHz
Antenna Type:	Integral Antenna
Antenna Number:	1Tx1Rx for SISO mode, 2Tx2Rx for MIMO mode
Antenna Gain:	6.65 dBi Max. for ANT1 5.84 dBi Max for ANT2 (5180-5320MHz & 5500-5700MHz) 6.61 dBi Max. for ANT1 5.52 dBi Max for ANT2 (5745-5825MHz) (Provided by the Client)

3. Test Results

3.1 RF Exposure Evaluation

3.1.1 RF Exposure Compliance

RESULT:
Pass

Test standard : CFR Title 47 FCC Part 2.1091
Limit : Table 1 of 47 CFR FCC Part 1.1310

This device is mobile device, and the applicant declares that the minimum separation distance is greater than 20cm. Therefore, MPE measurement or computational modelling should be used to determine compliance.

3.1.1.1 RF Exposure Compliance Requirement for FCC

a) Radio Frequency Exposure Limit

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

b) Radio Frequency Exposure Calculation Formula

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density (in appropriate units, e.g. mW/cm²)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

or:

$$S = \frac{EIRP}{4\pi R^2}$$

where: EIRP = equivalent (or effective) isotropically radiated power

c) RF Exposure Calculations for FCC, stand-alone mode
Table 4: Test Results of RF Exposure Calculations, Stand-alone mode (Module AF66T)

Operating Mode	Measured RF Output Power (dBm)	Max. EIRP (dBm)	Distance (cm)	MPE P _d (mW/cm ²)	Limit (mW/cm ²)	Verdict
Bluetooth	9.30	10.71	20	0.0023	1.0	Pass
2.4GHz Wi-Fi	23.38	24.79	20	0.0600	1.0	Pass
5GHz Wi-Fi	18.17	24.82	20	0.0604	1.0	Pass

Note: The max antenna gain were considered for ANT1/ANT2.

Table 5: Test Results of RF Exposure Calculations, Stand-alone mode (Module AH20C)

Operating Mode	Measured RF Output Power (dBm)	Max. EIRP (dBm)	Distance (cm)	MPE P _d (mW/cm ²)	Limit (mW/cm ²)	Verdict
Bluetooth	7.51	8.30	20	0.0013	1.0	Pass

Table 6: Test Results of RF Exposure Calculations, Simultaneous mode

Co-location Mode	Sum of the MPE ratios	Limit	Verdict
Bluetooth (Module AH20C) + 2.4G Wi-Fi (Module AF66T)	0.0013/1+0.0600/1<1.0	1.0	Pass
Bluetooth (Module AH20C) + 5G Wi-Fi (Module AF66T)	0.0013/1+0.0604/1<1.0	1.0	Pass

d) Conclusion

Therefore the maximum calculations result of above are meet the requirement of Radio Frequency Exposure (MPE) limit.