Report on the FCC and IC Testing of the APTIV Services US, LLC Vehicle Radar. Model: FLR4PS In accordance with CFR 47, Part 1 §1.1310 and Part 2, § 2.1093 and RSS-210

Prepared for: APTIV Services US, LLC
5725 Innovation Drive
Troy, Michigan 48098
USA

FCC ID: L2CQFLR4PS
IC 3432A-FLR4PS

Product Service

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COMMERCIAL-IN-CONFIDENCE

Date: 2024-09-04
Document Number: TR-713312045-05 | Revision 0

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Martin Steindl	2024-09-04	Steindl Martin *SIGN-ID 958438*
Authorised Signatory	Alex Fink	2024-09-04	Fink *SIGN-ID 958660*

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

ENGINEERING STATEMENT
The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Parts 1 and 2 and RSS-102. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Martin Steindl	2024-09-04	Steindl Martin *SIGN-ID 958439*

Laboratory Accreditation	Laboratory recognition	ISED Canada test site registration
DAkkS Reg. No. D-PL-11321-11-03 DAkkS Reg. No. D-PL-11321-11-04	Registration No. BNetzA-CAB-16/21-15	3050A-2

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with FCC 47 CFR Parts 1 and 2 and ISED RSS-102, Issue 6 (2023-12)

Trade Register Munich
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VAT ID No. DE129484267
Information pursuant to Section 2(1)
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Product Service

Summary

Prüfergebnisse / *Test Results*	Auftragsnummer / *Order No.* **NA**
Die Prüfungen wurden nach folgenden Vorschriften durchgeführt: *Tests were performed according to:* **CFR 47, Parts 1 and 2** **RSS-210**	

Durchgeführte Prüfung ***Test performed***	**Prüfergebnis** ***Test result***
Radiated Power	Pass

Bemerkungen / *Remarks:*

Die Prüfergebnisse beziehen sich ausschließlich auf das zur Prüfung vorgestellte Prüfmuster. Ohne schriftliche Genehmigung des Prüflabors darf der Prüfbericht auszugsweise nicht vervielfältigt werden. *The test results relate only to the individual item which has been tested. Without the written approval of the test laboratory this report may not be reproduced in extracts.*

Table of Contents

1 Administrative Data

Application details	
Applicant:	APTIV Services US, LLC 5725 Innovation Drive Troy, Michigan 48098 USA
Contact person:	Mr. Dean Farouki
Intercompany contact:	TÜV SÜD Product Service GmbH GMA Straubing Mr. Thomas Ring
Order number:	NA
Receipt of EUT:	2024-06-04
Return of EUT:	---
Date(s) of test:	2024-06-04 to 2024-06-06
Note(s):	---
Responsible for testing:	Mr. Martin Steindl
Responsible for test report:	Mr. Martin Steindl
Test report checked by:	Mr. Alex Fink

Report details	
Report number:	TR-713312045-05
Revision:	0
Issue date:	2024-09-04

2 Details about the Test Laboratory

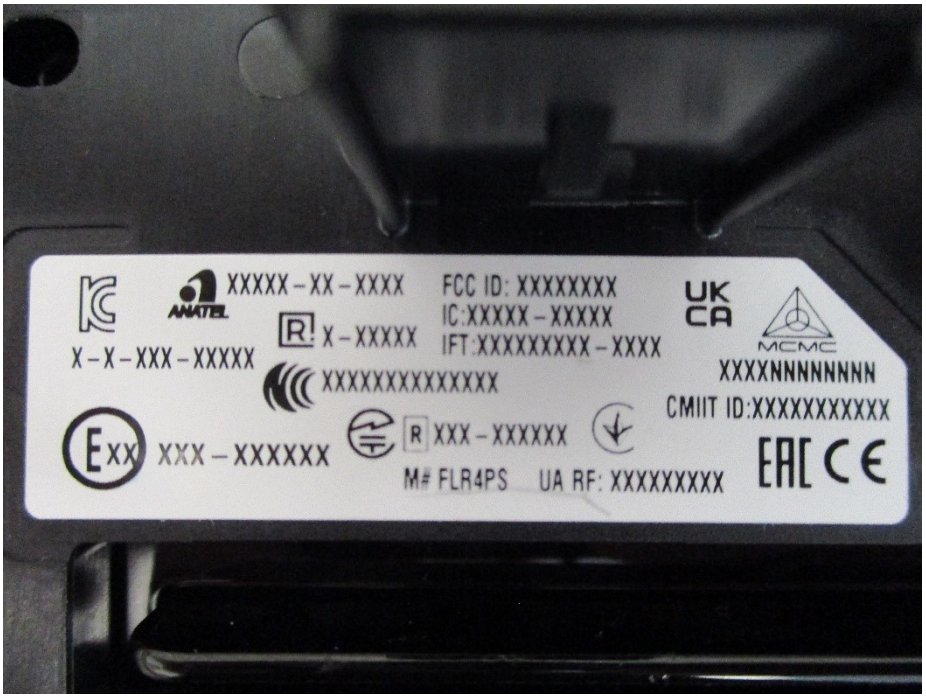
Details about the Test Laboratory	
Company name:	TÜV SÜD Product Service GmbH
Address:	Äußere Frühlingstraße 45 D-94315 Straubing Germany
Laboratory accreditation:	DAkkS Registration No. D-PL-11321-11-03 DAkkS Registration No. D-PL-11321-11-04
Laboratory recognition:	Registration No. BNetzA-CAB-16/21-15
Industry Canada test site registration:	3050A-2
Contact:	Mr. Markus Biberger Phone: +49 9421 5522-0 Fax: +49 9421 5522-99

3 Description of the Equipment Under Test

Equipment characteristics	
Type designation:	FLR4PS
Parts of the system:	Radar ECU
Options and accessories:	---
Type of equipment:	Vehicle Radar
Serial number:	NA
Manufacturer:	APTIV Services US, LLC
Hardware version:	N/A
Software version:	N/A
Drawing number:	---
Build status:	---
Power supply:	Battery supply (regulated lead-acid) Nominal: 12.0 V DC Minimum: 9 V DC Maximum: 16.0 V DC Nominal frequency: N/A - DC
Highest internal frequency:	

Technical Description
The Device Under Test (DUT) is a 76 – 77 GHz vehicular radar. The device employs a dynamic chirp modulated transmit array. Multiple receive antennas are used to determine target angular resolution through digital beam forming. When installed on a vehicle, the device will operate when the vehicle is running. The nominal operating voltage is DC 12.0 V. **Modulation characteristics:** Non-pulsed radar The radar is a FMCW radar; modulation type is sawtooth.

Marking Plate(s)



4 Operation Mode and Configuration of EUT

Operation Mode(s)
The operating modes were tested with a single modulation, as provided by the manufacturer.

List of ports and cables					
No.	*Description*	*Classification*[1]	*Cable type*	*Cable length used*	*maximum*[2]
D1	DC 12 V supply	dc power	Unshielded	2 m	< 3 m
S1	Wiring harness (CAN, Ethernet)	signal/control port	Unshielded	2 m	< 3 m

List of devices connected to EUT				
No.	*Description*	*Type designation*	*Serial no. or ID*	*Manufacturer*
	---	---	---	---

List of support devices				
No.	*Description*	*Type designation*	*Serial no. or ID*	*Manufacturer*
1	CAN/LIN-Interface	VN1640A		Vector
2	Notebook	Latitude 5480	---	Dell

[1] Ports shall be classified as ac power, dc power or signal/control port.
[2] As specified by applicant

5 Referenced Regulations

Publication	*Title*
CFR 47, Part 1	Code of Federal Regulations Part 1 (Practice and Procedure) of the Federal Communications Comission (FCC)
CFR 47, Part 2	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communications Comission (FCC)
CFR 47, Part 95, Subpart M	Code of Federal Regulations Part 95 (Personal Radio Services), Subpart M (76 – 77 GHz Band Radar Service) of the Federal Communications Comission (FCC)
RSS-102, Issue 5 (March 2015) + Amendment 1 (February 2021)	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
RSS-251, Issue 2 (July 2018)	Vehicular Radar and Airport Fixed or Mobile Radar in the 76 – 81 GHz Frequency band
RSS-Gen, Isse 5 (April 2018) + Amendment 1 (March 2019) + Amendment 2 (February 2021)	General Requirements for Compliance of Radio Apparatus
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

6 Test Results

CFR 47, Part 1			
Section(s)	*Test performed*	*Page*	*Test Result*
§ 1.1310	RF Exposure Value	11	Test passed

KDB 447498 D04 V01

RSS-210			
Section(s)	*Test performed*	*Page*	*Test Result*
5.3.2	Reference levels – Feld strength and power density levles	11	Test passed

6.1 Radiated Power

Date of Test	2024-06-04
Operator	M. Steindl
Test Site	Fully anechoic room, cabin no. 2

Test Result

☒ **Passed**

☐ **Not Passed**

Barometric pressure:	976 hPa
Relative humidity:	50 %
Ambient temperature:	24 °C

Specifications:	Part 1, § 1.1310 RSS-102, section 5.3.2
Description:	The test was performed in accordance with KDB 447498 D04 V01. Average RF power test was performed according to ANSI C63.10, section 10.3.5.
Operation mode:	Transmitting continuously on frequency with modulation bandwidth as stated in table below
Comment :	Test was performed as radiated test. The test distance was 3 m. A correction factor of -58 dB and mixer conversion loss table were used to account for the test antenna gain, free-space loss and external mixer loss. The evaluation distance for power density of 20 cm was declared by the applicant. For details on tests refer to test reports TR-713312045-01 and TR-713312045-02.

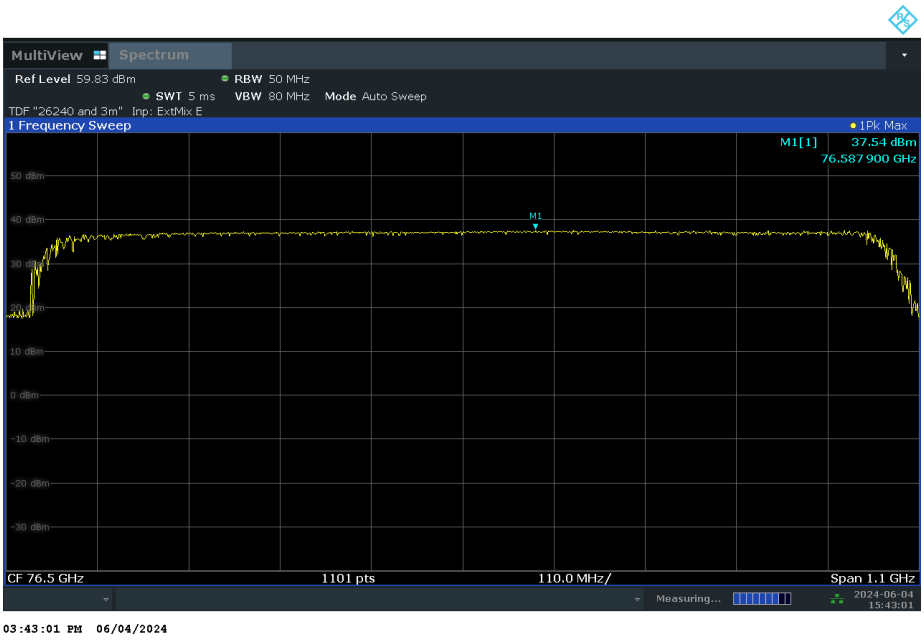
Detector	*E.I.R.P.*		*Power Density (20 cm)*	*Limit*	*Note*
Average	28.11 dBm	647.14 mW	0.003 mW/cm²	1.0 mW/cm²	1, 2
Peak	37.54 dBm	5675.45 mW	0.133 mW/cm²	1.0 mW/cm²	1

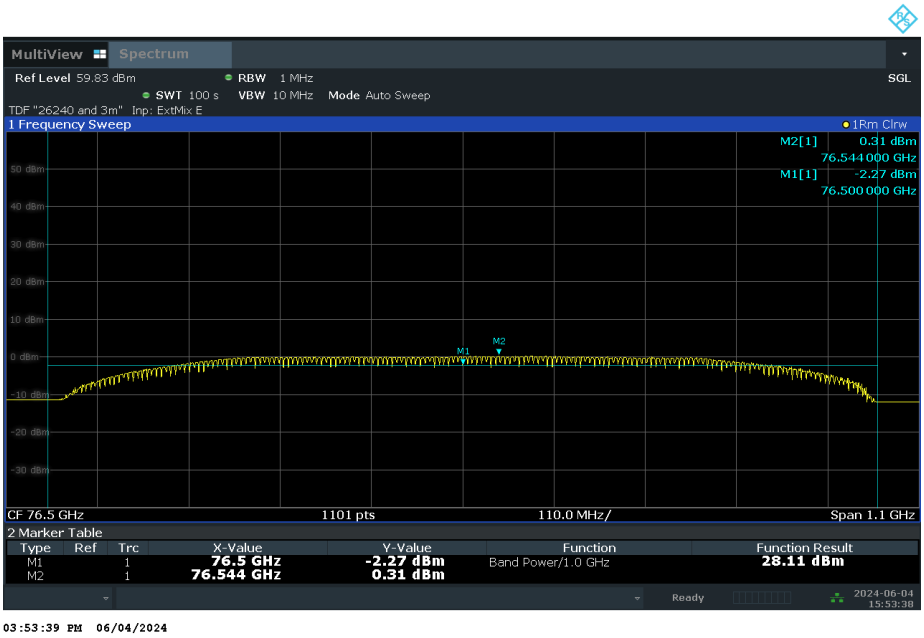
Note(s):

1 Limit for uncontrolled environment: 10 W/m² = 1 mW/cm²

2 Integrated value within 1 GHz

Plots taken during test





Operating mode – Continuously Transmitting - 12.0 V DC power supply

7 Test Equipment used

T-ID	*Designation*	*Type*	*Last Cal.*	*Next Cal.*
18874	Horn antenna	3160-07	Verified	
18875	Horn antenna	3160-08	Verified	
19125	Horn antenna	3160-09	Verified	
40089	Double ridged horn antenna	HF907	2022-10	2024-10
19442	Horn antenna	3160-10	Verified	
19946	Horn antenna	24240-20	Verified	
39897	EMI test receiver	ESW44	2024-04	2025-04
22553	Waveguide mixer	FS-Z170	2023-06	2026-06
25849	Waveguide mixer	FS-Z60	2023-05	2026-05
25850	Waveguide mixer	FS-Z90	2023-05	2026-05
25851	Waveguide mixer	FS-Z110	2023-06	2026-06
27898	Horn antenna	26240-20	Verified	
27899	Horn antenna	27240-20	Verified	
36954	Harmonic Mixer	FS-Z220	2023-05	2026-05
36955	Harmonic Mixer	FS-Z325	2023-05	2026-05
37863	Horn antenna	30240-20 WG30	Verified	
37864	Horn antenna	32240-20 WG32	Verified	
19918	TRILOG Broadband antenna	VULP 9163	2022-10	2025-10

Test software for: EMC32 V10.

8 Measurement Uncertainty Values

The measurement uncertainty in the laboratory is less than or equal to the maximum measurement uncertainty according to EN 55016-4-2: 2011 + A1 + A2 + AC and CISPR16-4-2: 2011 + A1 + A2 + Cor1 (UCISPR). This normative regulation means that the measured value is also the value to be assessed in relation to the limit value.

For a 95% confidence level, the measurement uncertainties for defined systems are:

Radio Testing			
Test Name	kp	Expanded Uncertainty	Note
Occupied Bandwidth	2.0	±1.14 %	2
RF-Frequency error	1.96	±1 · 10-7	7
RF-Power, conducted carrier	2	±0.079 dB	2
RF-Power uncertainty for given BER	1.96	+0.94 dB / -1.05	7
RF power, conducted, spurious emissions	1.96	+1.4 dB / -1.6 dB	7
RF power, radiated			
25 MHz – 4 GHz	1.96	+3.6 dB / -5.2 dB	8
1 GHz – 18 GHz	1.96	+3.8 dB / -5.6 dB	8
18 GHz – 26.5 GHz	1.96	+3.4 dB / -4.5 dB	8
40 GHz – 170 GHz	1.96	+4.2 dB / -7.1 dB	8
Spectral Power Density, conducted	2.0	±0.53 dB	2
Maximum frequency deviation			
300 Hz – 6 kHz	2	±2,89 %	2
6 kHz – 25 kHz	2	±0.2 dB	2
Maximum frequency deviation for FM	2	±2,89 %	2
Adjacent channel power 25 MHz – 1 GHz	2	±2.31 %	2
Temperature	2	±0.39 K	4
(Relative) Humidity	2	±2.28 %	2
DC- and low frequency AC voltage			
DC voltage	2	±0.01 %	2
AC voltage up to 1 kHz	2	±1.2 %	2
Time	2	±0.6 %	2

Radio Interference Emission Testing			
Test Name	kp	Expanded Uncertainty	Note
Conducted Voltage Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
100 kHz to 200 MHz (50Ω/5µH AMN)	2	± 3.6 dB	1
Discontinuous Conducted Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
Conducted Current Emission			
9 kHz to 200 MHz	2	± 3.5 dB	1
Magnetic Fieldstrength			
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB	1
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB	1
Radiated Emission			
Test distance 1 m (ALSE)			
9 kHz to 150 kHz	2	± 4.6 dB	1
150 kHz to 30 MHz	2	± 4.1 dB	1
30 MHz to 200 MHz	2	± 5.2 dB	1
200 MHz to 2 GHz	2	± 4.4 dB	1
2 GHz to 3 GHz	2	± 4.6 dB	1
Test distance 3 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 5.0 dB	1
1 GHz to 6 GHz	2	± 4.6 dB	1
Test distance 10 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 4.9 dB	1
Radio Interference Power			
30 MHz to 300 MHz	2	± 3.5 dB	1
Harmonic Current Emissions			4
Voltage Changes, Voltage Fluctuations and Flicker			4

Immunity Testing			
Test Name	kp	Expanded Uncertainty	Note
Electrostatic Discharges			4
Radiated RF-Field			
Pre-calibrated field level	2	+32.2 / -24.3 %	5
Dynamic feedback field level	2.05	+21.2 / -17.5 %	3
Electrical Fast Transients (EFT) / Bursts			4
Surges			4
Conducted Disturbances, induced by RF-Fields			
via CDN	2	+15.1 / -13.1 %	6
via EM clamp	2	+42.6 / -29.9 %	6
via current clamp	2	+43.9 / -30.5 %	6
Power Frequency Magnetic Field	2	+20.7 / -17.1 %	2
Pulse Magnetic Field			4
Voltage Dips, Short Interruptions and Voltage Variations			4
Oscillatory Waves			4
Conducted Low Frequency Disturbances			
Voltage setting	2	± 0.9 %	2
Frequency setting	2	± 0.1 %	2
Electrical Transient Transmission in Road Vehicles			4

Note 1:
The expanded uncertainty reported according to CISPR 16-4-2:2003-11 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 2:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 3:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2.05, providing a level of confidence of p = 95.45%
Note 4:
It has been demonstrated that the used test equipment meets the specified requirements in the standard with at least a 95%confidence.
Note 5:
The expanded uncertainty reported according to IEC 61000-4-3 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 6:
The expanded uncertainty reported according to IEC 61000-4-6 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 7:
The expanded uncertainty reported according ETSI TR 100 028 V1.4.1 (all parts) to is based on a standard uncertainty multiplied by a coverage factor of kp = 1.96, providing a level of confidence of p = 95.45%
Note 8:
The expanded uncertainty reported according to ETSI TR 102 273 V1.2.1 (all parts) is based on a standard uncertainty multiplied by a coverage factor of kp = 1.96, providing a level of confidence of p = 95.45%

9 Revision History

Revision History			
Revision	*Date*	*Issued by*	*Modifications*
0	2024-09-04	M. Steindl	First Edition