Report

on the

Certificate

Z10 088989 0023 Rev. 04

of the

Safety Component
RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432

Applicant

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Report No.: TD98072C

Version 1.5 of 2024-10-04

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Modification History

Rev.	Status	Date	Author	Modification / Description
1.0	Replaced	2022-01-18	Axel Köhnen	Initial
1.1	Replaced	2022-07-21	Axel Köhnen	AWR1843AoP and AWR6843AoP devices added
1.2	Replaced	2022-11-29	Axel Köhnen	AWR6243 devices added
1.3	Replaced	2023-03-29	Axel Köhnen	Update to DFP2.2.4
1.4	Replaced	2023-12-13	Daniel Girón	AWR294x devices added
1.5	Active	2024-10-04	Daniel Girón	AWRL6432 devices added

Table 1: Modification history

1 Target of Evaluation (ToE)

In August 2018 Texas Instruments Incorporated requested TÜV SÜD Rail GmbH to test and certify the RADAR ASIC AWR1243, AWR1642, AWR1843, AWR2243, AWR6443, AWR6843 up to ASIL B according to ISO 26262:2018. Additionally, the systematic capability for ASIL D according to ISO 26262:2018 is requested to be tested. The project number related to this Technical Report is 717518286. It covers the ASIC hardware as well as the software. The ToE is a product used in safety related applications. The following devices are covered:

- AWR1243
- AWR1642
- AWR1843
- AWR2243
- AWR6443
- AWR6843

In February 2022 Texas Instruments Incorporated requested TÜV SÜD Rail GmbH to test and certify the AoP variants of AWR1843 and AWR6843 up to ASIL B according to ISO 26262:2018. Additionally, the systematic capability for ASIL D according to ISO 26262:2018 was requested to be tested. The project number related to this Technical Report is 717524791. The following devices are additionally covered in this report:

- AWR1843AoP
- AWR6843AoP

In March 2022 Texas Instruments Incorporated requested TÜV SÜD Rail GmbH to test and certify the AWR6243 up to ASIL B according to ISO 26262:2018. Additionally, the systematic capability for ASIL D according to ISO 26262:2018 was requested to be tested. The project number related to this Technical Report is 717524911. The following devices are additionally covered in this report:

- AWR6243

In January 2023 Texas Instruments Incorporated requested TÜV SÜD Rail GmbH to test and certify the updated DFP2.2.4 for AWR2243. The project number related to this Technical Report is 717527064.

In November 2022 Texas Instruments Incorporated requested TÜV SÜD Rail GmbH to test and certify the AWR2943 and AWR2944 up to ASIL B according to ISO 26262:2018. Additionally, the systematic capability for ASIL D according to ISO 26262:2018 was requested to be tested. The project number related to this Technical Report is 717526750. The following devices are additionally covered in this report:

- AWR2943

- AWR2944

In October 2023 Texas Instruments Incorporated requested TÜV SÜD Rail GmbH to test and certify the AWRL6432 up to ASIL B according to ISO 26262:2018. Additionally, the systematic capability for ASIL D according to ISO 26262:2018 was requested to be tested. The project number related to this Technical Report is 717528833. The following devices are additionally covered in this report:

- AWRL6432

The resulting version of this Report on the Certificate is v1.5.

2 Scope of Testing

2.1 Test Specimen

The mission of the RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432 based application is to identify an object in a specified range. When used in conjunction with MCU/Processor that implements radar signal processing algorithms, Radar front end sensors are used to measure the object's

1. Range
2. Velocity (Relative)
3. Angle of Arrival

The above three information about the object open up scope for many automotive applications.

2.2 Nomenclature and Identification of RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432

The RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432 tested is identified by hardware and software version as follows:

2.2.1 Nomenclature and Identification of Front End SensorAWR1243

Name	Silicon Rev.	Package	Datasheet
AWR1243FBIGABLQ1	2	FCBGA-161	SWRS188
AWR1243FBIGABLRQ1			

Table 2: HW Identification of AWR1243

Name	Date	SW	Remarks
RadarSS Firmware	2020-06-11	ROM: 2.0.0.1 PATCH: 1.2.6.11	Binary delivered as part of the Device Firmware Package, version 01.02.06.03 MD5 for DFP 01.02.06.03: ace1d018571487691e8bfbb255df4beb *mmwave_dfp_01_02_06_03_win32.exe
MSS Firmware (ES3.0 only)	2020-06-11	ROM: 1.10.0.20 PATCH: 1.2.6.12	

Table 3: SW Identification of AWR1243

2.2.2 Nomenclature and Identification of Single Chip Sensor AWR1642

Name	Silicon Rev.	Package	Datasheet
AWR1642ABIGABLQ1	2	FCBGA-161	SWRS203
AWR1642ABIGABLRQ1			
AWR1642ABISABLQ1			
AWR1642ABISABLRQ1			

Table 4: HW Identification of AWR1642

Name	Date	SW	Remarks
RadarSS Firmware	2020-06-11	ROM: 2.0.0.1 PATCH: 1.2.6.11	Binary delivered as part of the Device Firmware Package, version 01.02.06.03 MD5 for DFP 01.02.06.03: ace1d018571487691e8bfbb255df4beb *mmwave_dfp_01_02_06_03_win32.exe
MSS Firmware	2020-06-11	ROM: 1.10.0.20 PATCH: 1.2.6.12	

Table 5: SW Identification of AWR1642

2.2.3 Nomenclature and Identification of Single Chip Sensor AWR1843

Name	Silicon Rev.	Package	Datasheet
AWR1843ABGABLQ1	2	FCBGA-161	SWRS222
AWR1843ABGABLRQ1			
AWR1843ABSABLQ1			
AWR1843ABSABLRQ1			

Table 6: HW Identification of AWR1843

Name	Date	SW	Remarks
RadarSS Firmware	2020-06-11	ROM: 2.0.0.1 PATCH: 1.2.6.11	Binary delivered as part of the Device Firmware Package, version 01.02.06.03 MD5 for DFP 01.02.06.03: ace1d018571487691e8bfbb255df4beb *mmwave_dfp_01_02_06_03_win32.exe
MSS Firmware	2020-06-11	ROM: 1.10.0.20 PATCH: 1.2.6.12	

Table 7: SW Identification of AWR1843

2.2.4 Nomenclature and Identification of Single Chip Sensor AWR1843AoP

Name	Silicon Rev.	Package	Datasheet
AWR1843ARBGALPQ1	2	FCBGA-180	SWRS236B
AWR1843ARBGALPRQ1			
AWR1843ARBSALPQ1			
AWR1843ARBSALPRQ1			

Table 8: HW Identification of AWR1843AoP

Name	Date	SW	Remarks
RadarSS Firmware	2020-06-11	ROM: 2.0.0.1 PATCH: 1.2.6.11	Binary delivered as part of the Device Firmware Package, version 01.02.06.03 MD5 for DFP 01.02.06.03: ace1d018571487691e8bfbb255df4beb *mmwave_dfp_01_02_06_03_win32.exe
MSS Firmware	2020-06-11	ROM: 1.10.0.20 PATCH: 1.2.6.12	

Table 9: SW Identification of AWR1843AoP

Note: The software was not changed for AWR1843AoP and is identical to AWR1843.

2.2.5 Nomenclature and Identification of Front End Sensor AWR2243

Name	Silicon Rev.	Package	Datasheet
AWR2243ABGABLQ1	2	FCBGA-161	SWRS223
AWR2243ABGABLRQ1			
AWR2243APBGABLQ1			
AWR2243APBGABLRQ1			

Table 10: HW identification of AWR2243

Name	Date	SW	Remarks
RadarSS Firmware	2021-05-21	ROM: 2.2.0.13 PATCH: 2.2.3.3	Binary delivered as part of the Device Firmware Package, version 02.02.03.01 MD5 for DFP 02.02.03.01: 4085eed2f300ad8e1e33577985d64767 *mmwave_dfp_02_02_03_01_win32.exe 31cedf3ec7b3f0a2e79978925ae1f52d *mmwave_dfp_02_02_03_01.zip
MSS Firmware	2021-05-21	ROM: 2.2.1.7 PATCH: 2.2.2.0	
RadarSS Firmware	2022-09-02	ROM: 2.2.0.13 PATCH: 2.2.4.0	Binary delivered as part of the Device Firmware Package, version 02.02.04.00 MD5 for DFP 02.02.04.00: 07b0184fb649fd192ed2083430c396de *mmwave_dfp_02_02_04_00_win32.exe 3cc12fac74bb271e32c48a322ae665e0 *mmwave_dfp_02_02_04_00.zip
MSS Firmware	2022-09-02	ROM: 2.2.1.7 PATCH: 2.2.2.0	

Table 11: SW identification of AWR2243 BSS and MSS FW of DFP 02.02.03.01 and 02.02.04.00

2.2.6 Nomenclature and Identification of Single Chip Sensor AWR6x43

Name	Silicon Rev.	Package	Datasheet
AWR6443ABGABLQ1	2	FCBGA-161	SWRS248
AWR6443ABGABLRQ1			
AWR6843ABGABLQ1			
AWR6843ABGABLRQ1			
AWR6843ABSABLQ1			
AWR6843ABSABLRQ1			

Table 12: HW Identification of AWR6x43

Name	Date	SW	Remarks
RadarSS Firmware	2020-09-02	RAM 6.3.2.6	Binary delivered as part of the Device Firmware Package, version 06.03.02.01 MD5 for DFP 06.03.02.01: 2a094955e9b96e516fb3e3aeb53d274d (Windows) 4761f2e4e44c65feed58b7b0a8766e03 (Linux)
Bootloader	See device identification in Table 12		

Table 13: SW identification of AWR6x43

2.2.7 Nomenclature and Identification of Single Chip Sensor AWR6843AoP

Name	Silicon Rev.	Package	Datasheet
AWR6843ARBGALPQ1	2	FCBGA-180	SWRS246C
AWR6843ARBGALPRQ1			
AWR6843ARBSALPQ1			
AWR6843ARBSALPRQ1			

Table 14: HW Identification of AWR6843AoP

Name	Date	SW	Remarks
RadarSS Firmware	2020-09-02	RAM 6.3.2.6	Binary delivered as part of the Device Firmware Package, version 06.03.02.01 MD5 for DFP 06.03.02.01: 2a094955e9b96e516fb3e3aeb53d274d (Windows) 4761f2e4e44c65feed58b7b0a8766e03 (Linux)
Bootloader	See device identification in Table 14		

Table 15: SW identification of AWR6843AoP

Note: The software was not changed for AWR6843AoP and is identical to AWR6843.

2.2.8 Nomenclature and Identification of Front End Sensor AWR6243

Name	Silicon Rev.	Package	Datasheet
AWR6243ABGABLQ1	2	FCBGA-161	SWRS281B
AWR6243ABGABLRQ1			

Table 16: HW identification of AWR6243

Name	Date	SW	Remarks
RadarSS Firmware	2022-08-11	RAM: 6.4.1.13	Binary delivered as part of the Device Firmware Package, version 06.04.01.00 MD5 for DFP 06.04.01.00 173ab61bb75d85095306f12cdc58f265 *mmwave_dfp_06_04_01_00_win32.exe
MSS Firmware	2022-08-11	ROM: 2.2.1.7 PATCH: 2.6.0.3	

Table 17: SW identification of AWR6243

2.2.9 Nomenclature and Identification of Front End Sensor AWR2943, AWR2944

Name	Silicon Rev	Package	Datasheet
AWR2943ABGALTQ1	2.0	FCBGA-266	SWRS273
AWR2943ABGALTRQ1			
AWR2943ABSALTRQ1			
AWR2944ABGALTQ1			
AWR2944ABGALTRQ1			
AWR2944ABSALTQ1			
AWR2944ABSALTRQ1			

Table 18: HW Identification of Front End Sensor AWR2943, AWR2944

Name	Date	SW	Remarks
RadarSS Firmware	2023-07-12	ROM 2.4.5.3 PATCH: 2.4.9.5	MD5 Checksum for the DFP executable file f0d1183b1bf7d19cc495d491a9a47270 *mmwave_dfp_02_04_09_01_win32.exe

Table 19: SW Identification of Front End Sensor AWR2943, AWR2944

2.2.10 Nomenclature and Identification of Low Power Sensor AWRL6432

Name	Silicon Rev	Package	Datasheet
AWRL6432BDBGAMFRQ1	2.0	FCCSP-102	SWRS295A
AWRL6432BDBGAMFQ1			
AWRL6432BDBAAMFRQ1			
AWRL6432BDBAAMFQ1			

Table 20: HW Identification of Low Power Sensor AWRL6432

Name	Date	SW	Remarks
xWRL6432 (60GHz) RFS Patch Firmware	2023-12-17	RAM: 7.2.0.0	9f5064f88cd39507c6c42a3000844e3b
FECSSLib Library and Source code	2023-10-29	RAM: 3.1.8.1	07868b8a4920043d4148a55d79dfcf27
mmWaveLink Library and Source code	2023-01-10	RAM: 3.2.0.3	80878bd71a914a3049d823c9283c7acb
xWRL6432 ROM	2023-05-10	RBL 03.02.02.04	Binary delivered as part of the xWRL6432 device

Table 21: SW Identification of Low Power Sensor AWRL6432

3 Certification Requirements

The certification of the RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432 is according to the regulations and standards listed in clause 4 of this document. This certifies the successful completion of the following test segments.

I. Functional Safety including

- Functional safety management (FSM) and safety lifecycle
- Avoidance of systematic faults / Systematic capability
- Hardware safety requirements (including assumptions of use)
- Analysis of the device structure (IP/Element FMAs)
- Software Safety Requirements
- Analysis of the device structure (IP FMAs)
- Dependent Failure Analysis (DFA)
- Criteria for coexistence of elements
- Quantitative analysis of the hardware (FMEDA)
- Fault injection and simulation
- Hardware functional test and design verification
- Hardware qualification
- Software functional test and design verification
- Development tool qualification

II. Safety information in the product documentation (safety manual, user manual, installation and operating instructions).

III. Product-Related Quality Assurance in Manufacture and Product Development

Certification is dependent on successful completion of all above listed test segments. The testing follows the basic certification scheme for Safety Components of TÜV SÜD Rail GmbH.

3.1 Certification Documentation

The detailed technical evaluation is documented in the most recent version of the Technical Report:

Document No.	Description	Project No.
TD97730T	Technical Report AWR1243 Hardware	717518286
TD97859T	Technical Report AWR1642/1843 Hardware	717518286
TD95756T	Technical Report DFP 01.02.06.03 Software	717518286
TD97175T	Technical Report AWR2243 Hardware	717518286 717527064
TD97177T	Technical Report DFP 02.02.03.01 and 02.02.04.00 Software	717518286 717527064
TD96309T	Technical Report AWR6x43 Hardware	717518286
TD96416T	Technical Report DFP 06.03.02.01 Software	717518286
TD99097T	Technical Report AWR1843AoP/6843AoP Hardware	717524791
TD99824T	Technical Report AWR6243 Hardware	717524911
TD99840T	Technical Report DFP 06.04.01.00 Software	717524911
TD101946T	Technical Report AWR2943/AWR2944 Hardware	717526750
TD101947T	Technical Report DFP 02.04.09.01 Software	717526750
TD103558T	Technical Report AWRL6432 Hardware	717528833
TD103711T	Technical Report DFP Software	717528833
TD103712T	Technical Report RBL Software	717528833
Safety related requirements, conditions and restrictions can be found in the following user documentation		
-	xWR_Front_End_Sensor_Safety_Manual.pdf, v1.10	717527064
-	xWR_Single_Chip_Sensor_Safety_Manual.pdf, v1.99	717524791
-	SFFS262_AWR294xETS_FSM.pdf	717526750
-	xWRLx432_FSM(SFFS613)_v1.0	717528833

Table 22: Technical Reports and User Documents

Based on the specified purpose of use of the RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432 in safety critical applications, the certification is based on the set of standards listed in clause 4 of this document. The issuance of the certificate states compliance with these references unless specifically noted otherwise.

4 Standards and Guidelines

The regulations and guidelines which form the basis of the type testing are listed below.

4.1 Functional Safety

No.	Reference	Description
/N1/	ISO 26262-2:2018 (ASIL B, Systematic Capability ASIL D)	Road vehicles — Functional safety — Part 2: Management of functional safety
/N2/	ISO 26262-5:2018 (ASIL B, Systematic Capability ASIL D)	Road vehicles — Functional safety — Part 5: Product development at the hardware level
/N3/	ISO 26262-6:2018 (ASIL D)	Road vehicles — Functional safety — Part 6: Product development at the software level
/N4/	ISO 26262-7:2018 (ASIL B, Systematic Capability ASIL D)	Road vehicles — Functional safety — Part 7: Production and operation
/N5/	ISO 26262-8:2018 (ASIL B, Systematic Capability ASIL D)	Road vehicles — Functional safety — Part 8: Supporting processes
/N6/	ISO 26262-9:2018 (ASIL B, Systematic Capability ASIL D)	Road vehicles — Functional safety — Part 9: Automotive Safety Integrity Level (ASIL)-oriented and safety-oriented analyses

Table 24: Functional safety standards

4.2 Quality Management System

No.	Reference	Description
[M1]	QMS	Quality Management System TÜV SÜD Rail GmbH
	TR_RA_P_04.50	Test Program Functional Safety TR_RA_P_04.51 Definition Scope of testing TR_RA_P_04.07 Product Modification TR_RA_P_04.52 Concept Phase & Safety Lifecycle TR_RA_P_04.53 Detail Phase Hardware TR_RA_P_04.54 Detail Phase Software TR_RA_P_04.55 Safety Manual TR_RA_P_04.56 Result of Testing
[M2]	D-PL-11190-08-00	DAkkS accreditation according to DIN EN ISO 17025:2018 / EN ISO/IEC 17025:2017

Table 25: Quality Management System

5 Results

5.1 Functional Safety

The tests performed and quality assurance measures implemented by the Texas Instruments Incorporated have shown that the RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432 complies with the tailored testing criteria specified in clause 4 subject to the conditions defined in clause 6.

The RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432 was proven to meet the systematic capability for ASIL D according to ISO 26262:2018. The RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432 provides safety mechanisms implemented on-chip and safety mechanisms to be implemented by the system integrator. By using the different safety mechanisms, the Safety MCUs can be used to support safety functions up to ASIL B in accordance with ISO 26262:2018.

6 Implementation Conditions and Restrictions

The use of the RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432 in a safety related application shall comply with the safety manual, and the following implementation and installation requirements have to be followed if the RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432 is used in safety-related systems:

- The guidelines and requirements specified in the user documentation shall be followed. Especially the requirements of the system integration section of the safety manual have to be regarded.
- The impact on the overall safety concept and the safety function has to be well understood and analyzed if a safety mechanism described in the safety manual is not used.
- All safety mechanisms implemented by the system integrator have to be developed and verified according to the targeted safety standards.
- All specific characteristics and behaviors of the RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432 required by the final safety function have to be developed and verified according to the targeted safety standards. This includes also timing aspects like reaction times, test intervals or test execution times.
- The system integrator has to understand the conditions and restrictions defined in the documentation of the RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432.

7 Certificate Number

This report specifies technical details and implementation conditions required for the application of RADAR ASIC AWR1243, AWR1642, AWR1843, AWR1843AoP, AWR2243, AWR6243, AWR6443, AWR6843, AWR6843AoP, AWR2943, AWR2944, AWRL6432 to the certificate:

Z10 088989 0023 Rev. 04

Technical Certifier

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