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1 Scope of Document

This document specifies requirements on the module DIO Driver.

Constraints

First scope for specification of requirements on basic software modules are systems which are not safety relevant. For this reason safety requirements are assigned to medium priority.

2 Conventions to be used

2.1 Document Conventions

The representation of requirements in AUTOSAR documents follows the table specified in [TPS_STDT_00078], see [1, Standardization Template].

The verbal forms for the expression of obligation specified in [TPS_STDT_00053] shall be used to indicate requirements, see [1, Standardization Template].

2.2 Requirements Guidelines

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as follows.

Note that the requirement level of the document in which they are used modifies the force of these words.

- MUST: This word, or the adjective “LEGALLY REQUIRED”, means that the definition is an absolute requirement of the specification due to legal issues.
- MUST NOT: This phrase, or the phrase “MUST NOT”, means that the definition is an absolute prohibition of the specification due to legal issues.
- SHALL: This phrase, or the adjective “REQUIRED”, means that the definition is an absolute requirement of the specification.
- SHALL NOT: This phrase means that the definition is an absolute prohibition of the specification.
- SHOULD: This word, or the adjective “RECOMMENDED”, means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- SHOULD NOT: This phrase, or the phrase “NOT RECOMMENDED”, means that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
- MAY: This word, or the adjective “OPTIONAL”, means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item.

An implementation, which does not include a particular option, SHALL be prepared to interoperate with another implementation, which does include the option, though

perhaps with reduced functionality. In the same vein an implementation, which does include a particular option, SHALL be prepared to interoperate with another implementation, which does not include the option (except, of course, for the feature the option provides).

2.3 Requirement structure

Each module specific chapter contains a short functional description of the Basic Software Module. Requirements of the same kind within each chapter are grouped under the following headlines (where applicable):

Functional Requirements

- Configuration (which elements of the module need to be configurable)
- Initialisation
- Normal Operation
- Shutdown Operation
- Fault Operation
- ...

Non-Functional Requirements

- Timing Requirements
- Resource Usage
- Usability
- Output for other WPs (e.g. Description Templates, Tooling,...)
- ...

3 Acronyms and abbreviations

The glossary below includes acronyms and abbreviations relevant to DIO Driver that are not included in the AUTOSAR Glossary [2].

Abbreviation / Acronym:	Description:
CS	Chip select
EOL	End Of Line Often used in the term 'EOL Programming' or 'EOL Configuration'
MAL	Old name of Microcontroller Abstraction Layer (replaced by MCAL because 'MAL' is a french term meaning 'bad')
Master	A device controlling other devices (slaves, see below)
Slave	A device being completely controlled by a master device
NMI	Non maskable interrupt
PLL	Phase Locked Loop
RX	Reception (in the context of bus communication)
SPAL	The name of this working group
SFR	Special Function Register
WP	Work Package
STD	Standard
REQ	Requirement
UNINIT	Uninitialized (= not initialized)

Table 3.1: Acronyms and abbreviations used in the scope of this Document

4 Requirements Specification

This chapter describes all requirements driving the work to define the DIO Driver.

4.1 Functional Overview

The DIO driver provides port and channel based read and write access to the internal general purpose I/O ports. The read and write behavior is unbuffered. The basic behavior of this driver is synchronous.

The following expressions are used within the DIO driver:

Expression	*Explanation*
DIO channel	Represents a single general-purpose digital input/output pin
DIO port	Represents multiple DIO channels that are grouped by hardware and accessible synchronously (typically controlled by one hardware register). Example: Port A (8 bit) of Freescale HC08
DIO channel group	Represents multiple adjoining DIO channels represented by a logical group. A DIO channel group is a subset of one DIO port, accessible synchronously. Example: Port pins 2..6 of an 8 bit port

4.2 Functional Requirements

4.2.1 Configuration and Initialization

The configuration and initialization of the port structure is not part of the DIO driver. This is done by the Port driver (see [SRS_Port_12001] Configuration of port pin properties in [3]).

[SRS_Dio_12355] Symbolic names shall be configured ⌈

Description:	The DIO driver shall allow the static configuration of the following symbolic names: • DIO channel names • DIO channel group names • DIO port names
Rationale:	Provide human readable symbolic names for DIO channels
Use Case:	–
Dependencies:	–
Supporting Material:	–

⌋

4.2.2 Normal Operation

[SRS_Dio_12003] The DIO Driver shall provide a service that writes a data word to the assigned DIO port ⌈

Description:	The DIO Driver shall provide a service that writes a data word to the assigned DIO port. The operation shall be unbuffered. There shall be no influence to the input functionality of the port.
Rationale:	Basic functionality
Use Case:	Write access to an entire DIO port.
Dependencies:	[SRS_Dio_12352] General read/write behavior
Supporting Material:	–

⌋

[SRS_Dio_12004] The DIO Driver shall provide a service that writes a selectable number of adjoining bits to an assigned part of a DIO port ⌈

Description:	The DIO Driver shall provide a service that writes a selectable number of adjoining bits to an assigned part of a DIO port. The operation shall be unbuffered.
Rationale:	Allow for simultaneous setting of a group of DIO channels of a DIO port that has multiple external assignments.
Use Case:	Write access to DIO ports with multiple assignments.
Dependencies:	[SRS_Dio_12352] General read/write behavior
Supporting Material:	–

⌋

[SRS_Dio_12005] The DIO Driver shall provide a service for write access to single DIO channels ⌈

Description:	The DIO Driver shall provide a service for write access to single DIO channels (specific port pins).
Rationale:	Efficient handling of single DIO channels.
Use Case:	Write access to a particular DIO channel (port pin).
Dependencies:	[SRS_Dio_12352] General read/write behavior
Supporting Material:	–

⌋

[SRS_Dio_12006] The DIO Driver shall provide a service for reading a data word from the assigned DIO port ⌈

Description:	The DIO Driver shall provide a service for reading a data word from the assigned DIO port. The operation shall be unbuffered. There shall be no influence to the output functionality of the port.
Rationale:	Basic functionality
Use Case:	Read access to an entire DIO port.
Dependencies:	[SRS_Dio_12352] General read/write behavior
Supporting Material:	–

⌋

[SRS_Dio_12007] The DIO Driver shall provide a service for reading a selectable number of adjoining bits from an assigned part of a DIO port ⌈

Description:	The DIO Driver shall provide a service for reading a selectable number of adjoining bits from an assigned part of a DIO port. The operation shall be unbuffered.
Rationale:	Basic functionality
Use Case:	Read access to DIO ports with multiple assignments.
Dependencies:	[SRS_Dio_12352] General read/write behavior
Supporting Material:	–

⌋

[SRS_Dio_12008] The DIO Driver shall provide a service for reading one bit of an assigned DIO channel ⌈

Description:	The DIO Driver shall provide a service for reading one bit of an assigned DIO channel (specific port pin). The operation shall be unbuffered.
Rationale:	Efficient handling of single DIO channels.
Use Case:	Read access to a particular DIO channel.
Dependencies:	[SRS_Dio_12352] General read/write behavior
Supporting Material:	–

⌋

[SRS_Dio_12900] The DIO Driver shall provide a service to flip ⌈

Description:	The DIO Driver shall provide a service to flip (change from 1 to 0 or from 0 to 1) one bit of an assigned DIO channel (specific port pin) and return the level of the channel after flip. The operation shall be unbuffered.
Rationale:	Efficient handling of single DIO channels.
Use Case:	Read & write access to a particular DIO channel to flip the level.

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Dependencies:	[SRS_Dio_12352] General read/write behavior
Supporting Material:	–

⌋

[SRS_Dio_12352] The DIO driver shall allow reading from and writing to DIO ports, channel groups and channels ⌈

Description:	The DIO driver shall allow reading from and writing to DIO ports, channel groups and channels regardless of the configuration of their direction. If a channel configured as input is written to, the value shall be written to the output register, but does not appear on the physical port pin. If a channel configured as output is read, the value of the real pin level is read, if supported by hardware. Otherwise, the value of the port output register is read.
Rationale:	Simplify implementation of all DIO read and write services. Allow readback of output pins. Allow presetting of output values before switching the port pin to output direction.
Use Case:	See rationale.
Dependencies:	–
Supporting Material:	–

⌋

4.3 Non-Functional Requirements (Qualities)

[SRS_Dio_12424] Provide atomicity of DIO access ⌈

Description:	All re-entrant functions of the DIO Driver shall perform the following access actions in an atomic way: • DIO ports • DIO channels • DIO channel groups
Rationale:	Avoid data integrity problems within concurrent access of DIO Driver API functions.
Use Case:	A specific microcontroller (or a specific compiler) does not provide atomic access to single port pins. For that reason, the implementation has to use read-modify-write operations on the whole port. Concurrent access to pins of the same port will lead to data integrity problems if concurrent access is not blocked.
Dependencies:	–
Supporting Material:	–

⌋

5 References

[1] Standardization Template
AUTOSAR_FO_TPS_StandardizationTemplate

[2] Glossary
AUTOSAR_FO_TR_Glossary

[3] Requirements on Port Driver
AUTOSAR_CP_RS_PortDriver

A Change history of AUTOSAR traceable items

Please note that the lists in this chapter also include traceable items that have been removed from the specification in a later version. These items do not appear as hyperlinks in the document.

A.1 Traceable item history of this document according to AUTOSAR Release R24-11

A.1.1 Added Requirements in R24-11

none

A.1.2 Changed Requirements in R24-11

none

A.1.3 Deleted Requirements in R24-11

none

A.2 Traceable item history of this document according to AUTOSAR Release R25-11

A.2.1 Added Requirements in R25-11

none

A.2.2 Changed Requirements in R25-11

none

A.2.3 Deleted Requirements in R25-11

none

A.3 Traceable item history of this document according to AUTOSAR Release R26-11

A.3.1 Added Requirements in R26-11

none

A.3.2 Changed Requirements in R26-11

none

A.3.3 Deleted Requirements in R26-11

none