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Table of Contents

1	Introduction and functional overview	6
2	Acronyms and abbreviations	7
3	Related documentation.....	8
3.1	Input documents.....	8
4	Constraints and assumptions	9
4.1	Limitations	9
4.2	Applicability to car domains.....	9
5	Dependencies to other modules.....	10
5.1	File structure	10
5.1.1	Code file structure.....	10
5.1.2	Header file structure.....	10
6	Requirements traceability	12
7	Functional specification	19
7.1	General behavior.....	19
7.2	Time Unit Ticks.....	19
7.2.1	Background & Rationale	19
7.2.2	Requirements.....	19
7.3	Error classification	20
7.4	Error Detection	20
7.5	Error Notification.....	20
7.6	Duty Cycle Resolution and scaling	21
7.7	Version check.....	21
8	API specification.....	22
8.1	Imported types.....	22
8.2	Type definitions	22
8.2.1	Pwm_ChannelType.....	22
8.2.2	Pwm_PeriodType.....	22
8.2.3	Pwm_OutputStateType	22
8.2.4	Pwm_EdgeNotificationType	23
8.2.5	Pwm_ChannelClassType	23
8.2.6	Pwm_ConfigType.....	23
8.3	Function definitions	24
8.3.1	Pwm_Init	24
8.3.2	Pwm_DelInit.....	25
8.3.3	Pwm_SetDutyCycle	26
8.3.4	Pwm_SetPeriodAndDuty.....	27
8.3.5	Pwm_SetOutputTogle	28
8.3.6	Pwm_GetOutputState	29
8.3.7	Pwm_DisableNotification	30
8.3.8	Pwm_EnableNotification	30

8.3.9	Pwm_GetVersionInfo	31
8.4	Callback notifications.....	31
8.5	Scheduled functions	32
8.6	Expected Interfaces.....	32
8.6.1	Mandatory Interfaces	32
8.6.2	Optional Interfaces	32
8.6.3	Configurable interfaces	32
8.7	API parameter checking	33
9	Sequence diagrams	34
9.1	Initialization	34
9.2	De-initialization.....	35
9.3	Setting the duty cycle	36
9.4	Setting the period and the duty	37
9.5	Setting the PWM output to idle.....	38
9.6	Getting the PWM Output state	39
9.7	Using the PWM notifications	40
10	Configuration specification.....	41
10.1	How to read this chapter	41
10.1.1	Configuration and configuration parameters	41
10.1.2	Containers.....	41
10.1.3	Specification template for configuration parameters	42
10.2	Containers and configuration parameters	42
10.2.1	Variants.....	42
10.2.2	Pwm	43
10.2.3	PwmGeneral	43
10.2.4	PwmChannel.....	44
10.2.5	PwmChannelConfigSet	46
10.2.6	PwmConfigurationOfOptApiServices	46
10.3	Published Information.....	49
11	Changes	50
11.1	Deleted SWS Items	50
11.2	Replaced SWS Items	50
11.3	Changed SWS Items.....	50
11.4	Added SWS Items	50
12	Changes during SWS Improvements by Technical Office	52
12.1	Deleted SWS Items	52
12.2	Replaced SWS Items	52
12.3	Changed SWS Items.....	52
12.4	Added SWS Items	52

1 Introduction and functional overview

This specification specifies the functionality, API and the configuration of the AUTOSAR Basic Software module PWM driver.

Each PWM channel is linked to a hardware PWM which belongs to the microcontroller. The type of the PWM signal (for example center Align, left Align, Etc..) is not defined within this specification and is left up to the implementation.

The driver provides functions for initialization and control of the microcontroller internal PWM stage (pulse width modulation). The PWM module generates pulses with variable pulse width. It allows the selection of the duty cycle and the signal period time.

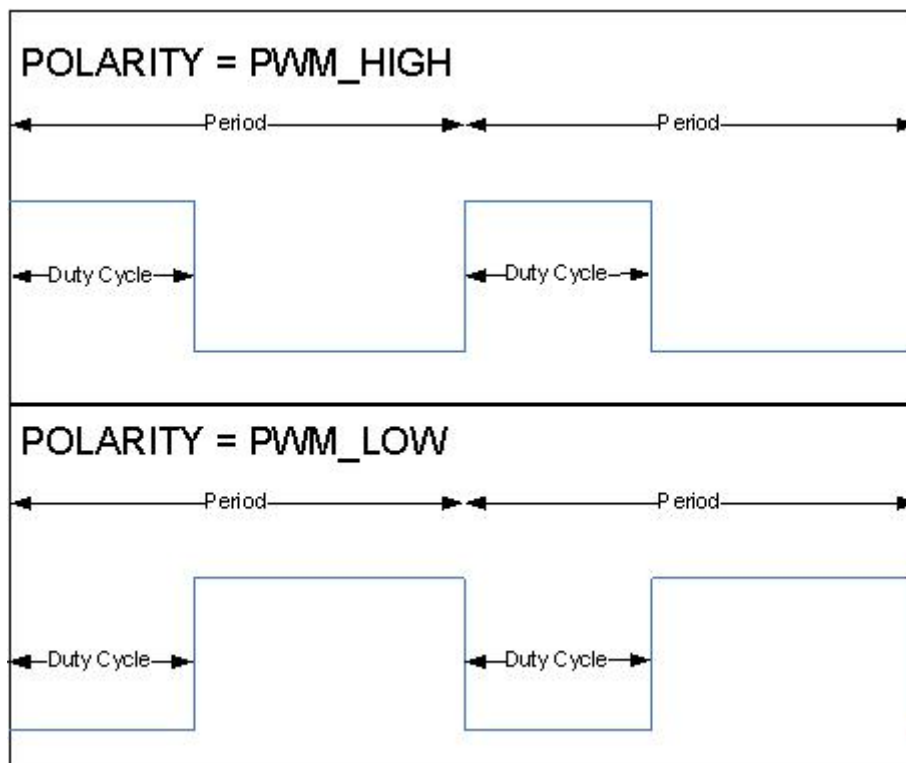


Figure 1: PWM signal description

2 Acronyms and abbreviations

Acronyms and abbreviations that have a local scope are not contained in the AUTOSAR glossary. These must appear in a local glossary.

Acronym:	Description:
PWM Channel	Numeric identifier linked to a hardware PWM.
PWM Output State	Defines the output state for a PWM signal. It could be: <ul style="list-style-type: none"> ▪ High. ▪ Low.
PWM Idle State	The idle state represents the output state of the PWM channel after the call of Pwm_SetOutputToidle or Pwm_Delnit
PWM Polarity	Defines the starting output state of each PWM channel
PWM Duty cycle	Defines a percentage of the starting level (could be high or low) related to the period.
PWM period	Defines the period of the PWM signal.

Abbreviation:	Description:
PWM	Pulse Width Modulation.
DEM	Diagnostic Event Manager.
DET	Development Error Tracer.
MCU	Microcontroller Unit.
PLL	Phase Locked Loop.
ISR	Interrupt Service Routine.

3 Related documentation

3.1 Input documents

- [1] Layered Software Architecture
https://svn2.autosar.org/repos2/22_Releases
AUTOSAR_LayeredSoftwareArchitecture.pdf
- [2] General Requirements on SPAL
https://svn2.autosar.org/repos2/22_Releases
AUTOSAR_SRS_SPAL_General.pdf
- [3] General Requirements on Basic Software Modules
https://svn2.autosar.org/repos2/22_Releases
AUTOSAR_SRS_General.pdf
- [4] Specification of Development Error Tracer
https://svn2.autosar.org/repos2/22_Releases
AUTOSAR_SWS_DevelopmentErrorTracer.pdf
- [5] Specification of MCU Driver
https://svn2.autosar.org/repos2/22_Releases
AUTOSAR_SWS_MCU_Driver.pdf
- [6] Specification of ECU Configuration,
https://svn2.autosar.org/repos2/22_Releases
AUTOSAR_ECU_Configuration.pdf
- [7] AUTOSAR Basic Software Module Description Template,
https://svn2.autosar.org/repos2/22_Releases/
AUTOSAR_BSW_Module_Description.pdf

4 Constraints and assumptions

4.1 Limitations

PWM001 The Pwm SWS does not cover PWM emulation on general purpose I/O.

4.2 Applicability to car domains

No restrictions.

5 Dependencies to other modules

The PWM depends on the system clock. Thus, changes of the system clock (e.g. PLL on → PLL off) also affect the clock settings of the PWM hardware.

The PWM Driver depends on the following modules:

- PORT Driver: To set the port pin functionality.
- MCU Driver: To set prescaler, system clock and PLL.
- DET: Development Error Tracer in Development mode.

5.1 File structure

5.1.1 Code file structure

PWM065: The Pwm SWS shall not define the code file structure.

5.1.2 Header file structure

PWM075: The Pwm module shall adhere to the following include file structure:

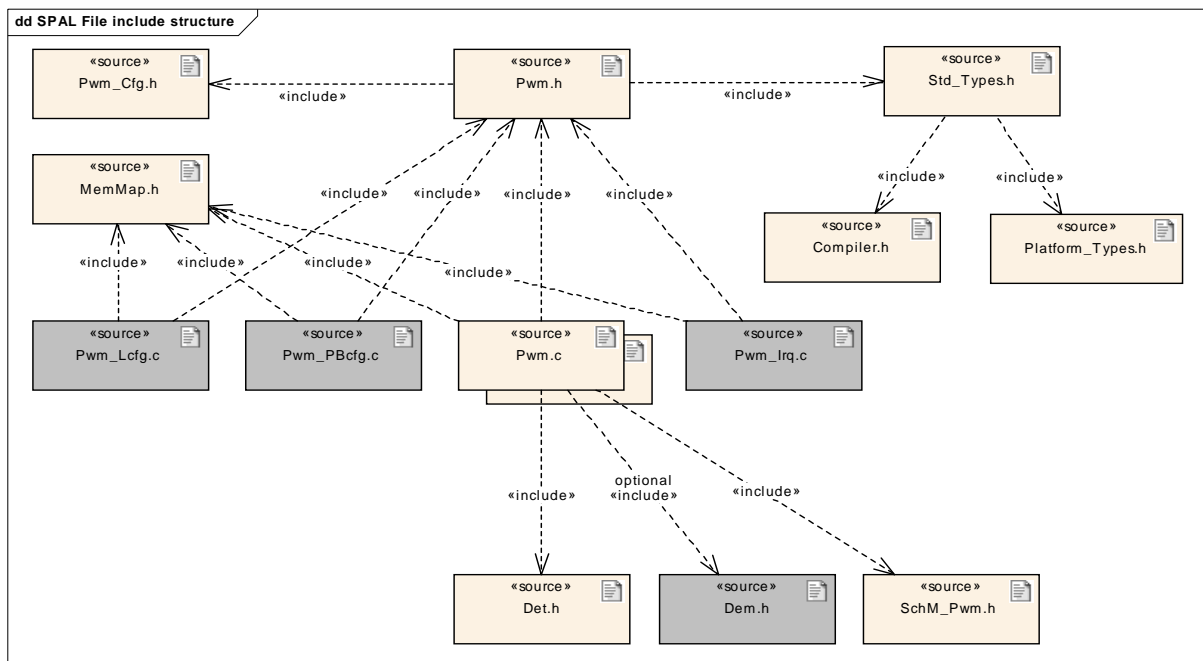


Figure 2: Header file structure

PWM066: The Pwm module shall optionally include the Dem.h file if any production error will be issued by the implementation.

By this inclusion the APIs to report errors as well as the required Event Id symbols are included. This specification defines the name of the Event Id symbols which are provided by XML to the DEM configuration tool. The DEM configuration tool assigns

ECU dependent values to the Event Id symbols and publishes the symbols in Dem_IntErrId.h.

6 Requirements traceability

Document: General Requirements on Basic Software Modules.

Requirement	Satisfied by
[BSW00344] Reference to link-time configuration	PWM027
[BSW00404] Reference to post build time configuration	PWM027
[BSW00405] Reference to multiple configuration sets	PWM027
[BSW00345] Configuration at Compile time	PWM004
[BSW159] Tool-based configuration	Not applicable (Both static and runtime configuration parameters are located outside the source code of the module. This is the prerequisite for automatic configuration.)
[BSW167] Static configuration checking	Not Applicable (requirement on configuration tool)
[BSW171] Configurability of optional functionality	PWM004 PWM080 PWM082 PWM083 PWM084 PWM085
[BSW170] Data for reconfiguration of AUTOSAR SW-Components	Not applicable (no reconfiguration and not a SWC)
[BSW00380] Separate C-File for configuration parameters	PWM065
[BSW00419] Separate C-Files for pre-compile time configuration parameters	Not applicable (Implementation specific, the code file structure is not defined within this specification and is left up to the implementer)
[BSW00381] Separate configuration header file for pre-compile time parameters	PWM075
[BSW00412] Separate H-File for configuration parameters	PWM075
[BSW00383] List dependencies of configuration files	Not applicable (Requirement to be taken into account during implementation)
[BSW00384] List dependencies to other modules	CHECK WITH OTHER SWS!
[BSW00387] Specify the configuration class of callback function	PWM027 parameter PwmNotification
[BSW00388] Introduce containers	PWM004 PWM027
[BSW00389] Containers shall have names	PWM004 PWM027
[BSW00390] Parameter content shall be unique within the module	PWM004 PWM027
[BSW00391] Parameter shall have unique names	PWM004 PWM027
[BSW00392] Parameters shall have a type	PWM004 PWM027
[BSW00393] Parameters shall have a range	PWM004 PWM027
[BSW00394] Specify the scope of the parameters	PWM004 PWM027
[BSW00395] List the required parameters (per parameter)	PWM004 PWM027
[BSW00396] Configuration classes	PWM004 PWM027
[BSW00397] Pre-compile-time parameters	PWM004 PWM027
[BSW00398] Link-time parameters	PWM004 PWM027
[BSW00399] Loadable Post-build time parameters	PWM004 PWM027
[BSW00400] Selectable Post-build time parameters	PWM004 PWM027
[BSW00402] Published information	PWM054
[BSW00375] Notification of wake-up reason	Not applicable (No wakeup functionality in this BSW)
[BSW101] Initialization interface	PWM007
[BSW00416] Sequence of Initialization	Not Applicable

Requirement	Satisfied by
	(SW Integration requirement)
[BSW00406] Check module initialization	PWM117
[BSW168] Diagnostic Interface of SW components	Not applicable (Not a SWC)
[BSW00407] Function to read out published parameters	PWM068 PWM069
[BSW00423] Usage of SW-C template to describe BSW modules with AUTOSAR Interfaces	Not applicable (Module is part of MCAL)
[BSW00424] BSW main processing function task allocation	Not applicable (No Main function in this module and requirement for software integration)
[BSW00425] Trigger conditions for schedulable objects	Not applicable (Requirement to be taken into account during implementation and integration)
[BSW00426] Exclusive areas in BSW modules	Not applicable (Requirement to be taken into account during implementation and integration)
[BSW00427] ISR description for BSW modules	Not applicable (Requirement to be taken into account during implementation and integration)
[BSW00428] Execution order dependencies of main processing functions	Not applicable (Requirement to be taken into account during implementation and integration)
[BSW00429] Restricted BSW OS functionality access	Not applicable (Requirement to be taken into account during implementation and integration)
[BSW00431] The BSW Scheduler module implements task bodies	Not applicable (Requirement to be taken into account during implementation and integration)
[BSW00432] Modules should have separate main processing functions for read/receive and write/transmit data path	Not applicable (Requirement to be taken into account during implementation and integration)
[BSW00433] Calling of main processing functions	Not applicable (Requirement to be taken into account during implementation and integration)
[BSW00434] The Schedule Module shall provide an API for exclusive areas	Not applicable (Requirement to be taken into account during implementation and integration)
[BSW00435] Module Header File Structure for the Basic Software Scheduler	PWM075
[BSW00436] Module Header File Structure for the Memory Mapping	PWM075
[BSW00336] Shutdown interface	PWM010
[BSW00337] Classification of errors	PWM002
[BSW00338] Detection and Reporting of development errors	PWM003
[BSW00369] Do not return development error codes via API	PWM003
[BSW00339] Reporting of production relevant error status	PWM005 PWM006 PWM066
[BSW00421] Reporting of production relevant error events	PWM005 PWM006 PWM066
[BSW00422] Debouncing of production relevant error status	PWM005 PWM006
[BSW00420] Production relevant error event rate detection	PWM005 PWM006

Requirement	Satisfied by
[BSW00417] Reporting of Error Events by Non-Basic Software	Not Applicable (Module is a BSW)
[BSW00323] API parameter checking	PWM117 PWM045 PWM046 PWM047 PWM051
[BSW004] Version check	PWM029
[BSW00409] Header files for production code error IDs	PWM066
[BSW00385] List possible error notifications	PWM002
[BSW00386] Configuration for detecting an error	PWM051 PWM117 PWM045 PWM046 PWM047 PWM003 PWM005 PWM006 PWM064 PWM002
[BSW161] Microcontroller abstraction	Not Applicable (Requirement on software architecture, not for a single module)
[BSW162] ECU layout abstraction	Not Applicable (Requirement on software architecture, not for a single module)
[BSW005] No hard coded horizontal interfaces within MCAL	Not applicable (Requirement to be taken into account during implementation)
[BSW00415] User dependent include files	Not applicable (Requirement to be taken into account during implementation)
[BSW164] Implementation of interrupt service routines	Not applicable (Requirement to be taken into account during implementation)
[BSW00325] Runtime of interrupt service routines	Not applicable (Requirement to be taken into account during implementation)
[BSW00326] Transition from ISRs to OS tasks	Not applicable (Requirement to be taken into account during implementation/Integration)
[BSW00342] Usage of source code and object code	Not applicable (Requirement to be taken into account during implementation)
[BSW00343] Specification and configuration of time	PWM070
[BSW160] Human-readable configuration data	Not applicable (Requirement to be taken into account during implementation)
[BSW007] HIS MISRA C	Not applicable (Requirement to be taken into account during implementation)
[BSW00300] Module naming convention	Not applicable (Requirement to be taken into account during implementation)
[BSW00413] Accessing instances of BSW modules	Not applicable (Requirement to be taken into account during implementation)
[BSW00347] Naming separation of different instances of BSW drivers	Not applicable (Requirement to be taken into account during implementation)
[BSW00305] Self-defined data types naming convention	Not applicable (Requirement to be taken into account during implementation)
[BSW00307] Global variables naming convention	Not applicable (Requirement to be taken into account during implementation)

Requirement	Satisfied by
[BSW00310] API naming convention	Not applicable (Requirement to be taken into account during implementation)
[BSW00373] Main processing function naming convention	Not applicable (Requirement to be taken into account during implementation)
[BSW00327] Error values naming convention	Not applicable (Requirement to be taken into account during implementation)
[BSW00335] Status values naming convention	Not applicable (Requirement to be taken into account during implementation)
[BSW00350] Development error detection keyword	Not applicable (Requirement to be taken into account during implementation)
[BSW00408] Configuration parameter naming convention	Not applicable (Requirement to be taken into account during implementation)
[BSW00410] Compiler switches shall have defined values	Not applicable (Requirement to be taken into account during implementation)
[BSW00411] Get version info keyword	PWM004
[BSW00346] Basic set of module files	PWM065
[BSW158] Separation of configuration from implementation	PWM065
[BSW00314] Separation of interrupt frames and service routines	PWM065
[BSW00370] Separation of callback interface from API	PWM065
[BSW00348] Standard type header	Not applicable (Requirement to be taken into account during implementation)
[BSW00353] Platform specific type header	Not applicable (Requirement to be taken into account during implementation)
[BSW00361] Compiler specific language extension header	Not applicable (Requirement to be taken into account during implementation)
[BSW00301] Limit imported information	Not applicable (Requirement to be taken into account during implementation)
[BSW00302] Limit exported information	Not applicable (Requirement to be taken into account during implementation)
[BSW00328] Avoid duplication of code	Not applicable (Requirement to be taken into account during implementation)
[BSW00312] Shared code shall be reentrant	Not applicable (Requirement to be taken into account during implementation)
[BSW006] Platform independency	Not applicable (Requirement to be taken into account during implementation)
[BSW00357] Standard API return type	Not applicable (Requirement to be taken into account during implementation)
[BSW00377] Module specific API return types	Not applicable (Requirement to be taken into account during implementation)
[BSW00304] AUTOSAR integer data types	Not applicable

Requirement	Satisfied by
	(Requirement to be taken into account during implementation)
[BSW00355] Do not redefine AUTOSAR integer data types	Not applicable (Requirement to be taken into account during implementation)
[BSW00378] AUTOSAR boolean type	Not applicable (Requirement to be taken into account during implementation)
[BSW00306] Avoid direct use of compiler and platform specific keywords	Not applicable (Requirement to be taken into account during implementation)
[BSW00308] Definition of global data	Not applicable (Requirement to be taken into account during implementation)
[BSW00309] Global data with read-only constraint	Not applicable (Requirement to be taken into account during implementation)
[BSW00371] Do not pass function pointers via API	Not applicable (Requirement to be taken into account during implementation)
[BSW00358] Return type of <code>init()</code> functions	Not applicable (Requirement to be taken into account during implementation)
[BSW00414] Parameter of <code>init</code> function	Not applicable (Requirement to be taken into account during implementation)
[BSW00376] Return type and parameters of main processing functions	Not Applicable: (No Main Function)
[BSW00359] Return type of callback functions	Not applicable (Requirement to be taken into account during implementation)
[BSW00360] Parameters of callback functions	Not applicable (Requirement to be taken into account during implementation)
[BSW00329] Avoidance of generic interfaces	Not Applicable (Requirement on software architecture, not for a single module)
[BSW00330] Usage of macros / inline functions instead of functions	Not applicable (Requirement to be taken into account during implementation)
[BSW00331] Separation of error and status values	Not applicable (Requirement to be taken into account during implementation)
[BSW009] Module User Documentation	Not applicable (Requirement to be taken into account during implementation)
[BSW00401] Documentation of multiple instances of configuration parameters	Not applicable (Requirement to be taken into account during implementation)
[BSW172] Compatibility and documentation of scheduling strategy	Not applicable (Requirement to be taken into account during implementation)
[BSW010] Memory resource documentation	Not applicable (Requirement to be taken into account during implementation)
[BSW00333] Documentation of callback function context	Not applicable (Requirement to be taken into account during implementation)

Requirement	Satisfied by
[BSW00374] Module vendor identification	PWM054
[BSW00379] Module identification	PWM054
[BSW003] Version identification	Not applicable (Requirement to be taken into account during implementation)
[BSW00318] Format of module version numbers	PWM054
[BSW00321] Enumeration of module version numbers	PWM054
[BSW00341] Microcontroller compatibility documentation	Not applicable (Requirement to be taken into account during implementation)
[BSW00334] Provision of XML file	Not applicable (Requirement to be taken into account during implementation)

Document: General Requirements on SPAL.

Requirements	Satisfied by
[BSW12263] Object code compatible configuration concept	PWM027
[BSW12056] Configuration of notification mechanisms	PWM027
[BSW12267] Configuration of wake-up sources	Not applicable (No wakeup functionality in this BSW)
[BSW12057] Driver module initialization	PWM007 PWM062 PWM009 PWM052
[BSW12125] Initialization of hardware resources	PWM062
[BSW12163] Driver module deinitialization	PWM010 PWM011 PWM012
[BSW12461] Responsibility for register initialization	Not applicable (Requirement to be taken into account during implementation)
[BSW12462] Provide settings for register initialization	Not applicable (Requirement to be taken into account during implementation)
[BSW12463] Combine and forward settings for register initialization	Not Applicable (Requirement on configuration tool)
[BSW12068] MCAL initialization sequence	Not applicable (this is a general software integration requirement)
[BSW12069] Wake-up notification of ECU State Manager	Not Applicable (No wakeup functionality in this BSW)
[BSW157] Notification mechanisms of drivers and handlers	PWM025 PWM025
[BSW12169] Control of operation mode	Not Applicable (No mode used)
[BSW12063] Raw value mode	Conflicts with BSW12459
[BSW12075] Use of application buffers	Not Applicable (No buffers used)
[BSW12129] Resetting of interrupt flags	PWM026 PWM026
[BSW12064] Change of operation mode during running operation	Not Applicable (No mode used)
[BSW12448] Behavior after development error detection	PWM051
[BSW12067] Setting of wake-up conditions	Not Applicable (No wakeup functionality)
[BSW12077] Non-blocking implementation	Not applicable (Requirement to be taken into account during implementation)
[BSW12078] Runtime and memory efficiency	Not applicable (Requirement to be taken into

Requirements	Satisfied by
	account during implementation)
[BSW12092] Access to drivers	Not applicable (this is a driver)
[BSW12265] Configuration data shall be kept constant	Not applicable (Requirement to be taken into account during implementation)
[BSW12264] Specification of configuration items	PWM004 PWM027
Requirements (module specific)	Satisfied by
[BSW12459] PWM duty cycle scaling	PWM059
[BSW12383] Resolution of duty cycle	PWM058
[BSW12375] PWM global configuration	PWM004
[BSW12293] Configuration of PWM channel properties	PWM061
[BSW12378] Assign notification to edges	PWM023 PWM024 PWM061
[BSW12379] Frequency of PWM channel groups	Not applicable (Requirement to be taken into account during implementation)
[BSW12389] Frequency of PWM channels	PWM041
[BSW12380] Initialization of PWM driver	PWM009
[BSW12381] De-Initialization of PWM driver	PWM010
[BSW12295] Set PWM duty cycle	PWM013
[BSW12382] Update of PWM duty cycle	PWM017
[BSW12358] Set PWM output to idle level	PWM021
[BSW12385] Get current state of PWM Channel	PWM022
[BSW12297] Set PWM period	PWM019 Pwm_SetPeriodAndDuty
[BSW12299] Activation of PWM edge notification	PWM023 PWM024 PWM025
[BSW12386] No PWM emulation	PWM001

7 Functional specification

7.1 General behavior

PWM088: All functions from the PWM module except `Pwm_Init`, `Pwm_DeInit` and `Pwm_GetVersionInfo` shall be re-entrant for different PWM channel numbers.

In order to keep a simple module implementation, no check of PWM088 must be performed by the module.

PWM089: The Pwm module's user shall ensure the integrity if several function calls are made during run time in different tasks or ISRs for the same PWM channel.

7.2 Time Unit Ticks

7.2.1 Background & Rationale

To get times out of register values it is necessary to know the oscillator frequency, prescalers and so on. Since these settings are made in MCU and/or in other modules it is not possible to calculate such times.

Hence the conversions between time and ticks shall be part of an upper layer.

7.2.2 Requirements

PWM070: All time units used within the API services of the PWM module shall be of the unit ticks.

7.3 Error classification

PWM002: Development error values are of type uint8.

<i>Type or error</i>	<i>Relevance</i>	<i>Related error code</i>	<i>Value [hex]</i>
API Pwm_Init service called with wrong parameter	Development	PWM_E_PARAM_CONFIG	0x10
API service used without module initialization	Development	PWM_E_UNINIT	0x11
API service used with an invalid channel Identifier	Development	PWM_E_PARAM_CHANNEL	0x12
Usage of unauthorized PWM service on PWM channel configured a fixed period	Development	PWM_E_PERIOD_UNCHANGEABLE	0x13
API Pwm_Init service called while the PWM driver has already been initialised	Development	PWM_E_ALREADY_INITIALIZED	0x14
--	Production	--	Assigned externally

To get more details concerning error detection, refer to chapter [API parameter checking](#).

7.4 Error Detection

PWM003: The detection of development errors is configurable (*ON / OFF*) at pre-compile time. The switch `PwmDevErrorDetect` shall activate or deactivate the detection of all development errors.

PWM064: If the `PwmDevErrorDetect` switch is enabled, API parameter checking is enabled. The detailed description of the detected errors can be found in chapter [Error classification](#) and chapter [API specification](#).

PWM067: The detection of production code errors cannot be switched off.

PWM006: Additional errors that are detected because of specific implementation and/or specific hardware properties shall be added in the PWM device specific implementation specification. The classification and enumeration shall be compatible to the errors listed above (refer to [PWM002](#)).

7.5 Error Notification

PWM078: Detected development errors shall be reported to the `Det_ReportError` service of the Development Error Tracer (DET) if the pre-processor switch `PwmDevErrorDetect` is set.

PWM005: Production errors shall be reported to Diagnostic Event Manager.

7.6 Duty Cycle Resolution and scaling

PWM058: The width of the duty cycle parameter is 16 Bits.

PWM059: The Pwm module shall comply with the following scaling scheme for the duty cycle:

- 0x0000 means 0%.
- 0x8000 means 100%. 0x8000 gives the highest resolution while allowing 100% duty cycle to be represented with a 16 bit value.

As an implementation guide, the following source code example is given:

```
AbsoluteDutyCycle =  
((uint32)AbsolutePeriodTime * RelativeDutyCycle) >> 15;
```

7.7 Version check

PWM029: The PWM C-files shall perform a preprocessor check of the versions of its header files to ensure the files are consistent and compatible between themselves.

8 API specification

8.1 Imported types

This chapter lists all types included from other modules.

PWM094:

Header file	Imported Type
Dem_Types.h	Dem_EventIdType
Std_Types.h	Std_VersionInfoType

8.2 Type definitions

8.2.1 Pwm_ChannelType

PWM106:

Name:	Pwm_ChannelType	
Type:	uint8, uint16, uint32	
Range:	8..32 bit	This is implementation specific but not all values may be valid within the type. This type shall be chosen in order to have the most efficient implementation on a specific microcontroller platform.
Description:	Numeric identifier of a PWM channel.	

8.2.2 Pwm_PeriodType

PWM107:

Name:	Pwm_PeriodType	
Type:	uint8, uint16, uint32	
Range:	8..32 bit	Implementation specific. This type shall be chosen in order to have the most efficient implementation on a specific microcontroller platform.
Description:	Definition of the period of a PWM channel.	

8.2.3 Pwm_OutputStateType

PWM108:

Name:	Pwm_OutputStateType	
Type:	Enumeration	
Range:	PWM_HIGH	The PWM channel is in high state.
	PWM_LOW	The PWM channel is in low state.
Description:	Output state of a PWM channel.	

8.2.4 Pwm_EdgeNotificationType

PWM109:

Name:	Pwm_EdgeNotificationType	
Type:	Enumeration	
Range:	PWM_RISING_EDGE	Notification will be called when a rising edge occurs on the PWM output signal.
	PWM_FALLING_EDGE	Notification will be called when a falling edge occurs on the PWM output signal.
	PWM_BOTH_EDGES	Notification will be called when either a rising edge or falling edge occur on the PWM output signal.
Description:	Definition of the type of edge notification of a PWM channel.	

8.2.5 Pwm_ChannelClassType

PWM110:

Name:	Pwm_ChannelClassType	
Type:	Enumeration	
Range:	PWM_VARIABLE_PERIOD	The PWM channel has a variable period. The duty cycle and the period can be changed.
	PWM_FIXED_PERIOD	The PWM channel has a fixed period. Only the duty cycle can be changed.
	PWM_FIXED_PERIOD_SHIFTED	The PWM channel has a fixed shifted period. Impossible to change it (only if supported by hardware)
Description:	Defines the class of a PWM channel	

8.2.6 Pwm_ConfigType

PWM111:

Name:	Pwm_ConfigType	
Type:	Structure	
Range:	Hardware dependent structure.	The contents of the initialization data structure are hardware specific.
Description:	This is the type of data structure containing the initialization data for the PWM driver.	

PWM061: Pwm_ConfigType is a type of data structure containing the initialization data for the PWM driver.

Mandatory parameters:

- Assigned HW channel
- Default value for period
- Default value for duty cycle
- Polarity (high or low)
- Idle state high or low
- Channel class:
 - Fixed period
 - Fixed period, shifted (if supported by hardware)
 - Variable period

Optional parameters (if supported by hardware):

- Channel phase shift
- Reference channel for phase shift
- Microcontroller specific channel properties

8.3 Function definitions

8.3.1 Pwm_Init

PWM095:

Service name:	Pwm_Init	
Syntax:	<pre>void Pwm_Init(const Pwm_ConfigType* ConfigPtr)</pre>	
Service ID[hex]:	0x00	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	ConfigPtr	Pointer to configuration set
Parameters (inout):	None	
Parameters (out):	None	
Return value:	None	
Description:	Service for PWM initialization.	

PWM007: The function Pwm_Init shall initialize all internal variables and the used PWM structure of the microcontroller according to the parameters specified in ConfigPtr.

PWM062: The function Pwm_Init shall only initialize the configured resources and shall not touch resources that are not configured in the configuration file.

PWM009: The function Pwm_Init shall start all PWM channels with the configured default values. If the duty cycle parameter equals:

- 0% or 100% : Then the PWM output signal shall be in the state according to the configured polarity parameter
- >0% and <100%: Then the PWM output signal shall be modulated according to parameters period, duty cycle and configured polarity.

PWM052: The function Pwm_Init shall disable all notifications.

The reason is that the users of these notifications may not be ready. They can call Pwm_EnableNotification to start notifications.

PWM093: The users of the Pwm module shall not call the function Pwm_Init during a running operation.

PWM046: If development error detection is enabled for the Pwm module, the function Pwm_Init shall raise development error PWM_E_PARAM_CONFIG if ConfigPtr is a null pointer.

Regarding error detection, the requirement PWM051 is applicable to the function Pwm_Init.

PWM116: The Pwm module's environment shall not call any function of the Pwm module before having called Pwm_Init.

PWM118: If development error detection is enabled, calling the routine Pwm_Init while the PWM driver and hardware are already initialized will cause a development error PWM_E_ALREADY_INITIALIZED. The desired functionality shall be left without any action.

PWM120: For pre-compile and link time configuration variants, a NULL pointer shall be passed to the initialization routine. In this case the check for this NULL pointer has to be omitted.

PWM121: A re-initialization of the Pwm driver by executing the Pwm_Init() function requires a de-initialization before by executing a Pwm_DeInit().

8.3.2 Pwm_DeInit

PWM096:

Service name:	Pwm_DeInit
Syntax:	void Pwm_DeInit()
Service ID[hex]:	0x01
Sync/Async:	Synchronous
Reentrancy:	Non Reentrant
Parameters (in):	None
Parameters (inout):	None
Parameters (out):	None
Return value:	None
Description:	Service for PWM De-Initialization.

PWM010: The function Pwm_Delnit shall de-initialize the PWM module.

PWM011: The function Pwm_Delnit shall set the state of the PWM output signals to the idle state.

PWM012: The function Pwm_Delnit shall disable PWM interrupts and PWM signal edge notifications.

PWM080: The function Pwm_Delnit shall be pre compile time configurable On/Off by the configuration parameter: PwmDelnitApi.

Regarding error detection, the requirements PWM117 and PWM051 are applicable to the function Pwm_Delnit.

8.3.3 Pwm_SetDutyCycle

PWM097:

Service name:	Pwm_SetDutyCycle	
Syntax:	<pre>void Pwm_SetDutyCycle(Pwm_ChannelType ChannelNumber, uint16 DutyCycle)</pre>	
Service ID[hex]:	0x02	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant for different channel numbers	
Parameters (in):	ChannelNumber	Numeric identifier of the PWM
	DutyCycle	Min=0x0000 Max=0x8000
Parameters (inout):	None	
Parameters (out):	None	
Return value:	None	
Description:	Service sets the duty cycle of the PWM channel.	

PWM013: The function Pwm_SetDutyCycle shall set the duty cycle of the PWM channel.

PWM014: The function Pwm_SetDutyCycle shall set the PWM output state according to the configured polarity parameter, when the duty cycle = 0% or 100%.

PWM016: The function Pwm_SetDutyCycle shall modulate the PWM output signal according to parameters period, duty cycle and configured polarity, when the duty cycle > 0 % and < 100%.

PWM017: The function Pwm_SetDutyCycle shall update the duty cycle always at the end of the period if supported by the implementation and configured with PwmDutyCycleUpdatedEndperiod.

Regarding format definition of duty cycle parameter, the requirement PWM058 is applicable to the function Pwm_SetDutyCycle.

Regarding scaling definition of duty cycle parameter, the requirement PWM059 is applicable to the function Pwm_SetDutyCycle.

PWM018: The driver shall forbid the spike on the PWM output signal.

Regarding error detection, the requirements PWM117, PWM047 and PWM051 are applicable to the function Pwm_SetDutyCycle.

PWM082: The function Pwm_SetDutyCycle shall be pre compile time configurable On/Off by the configuration parameter: PwmSetDutyCycle.

8.3.4 Pwm_SetPeriodAndDuty

PWM098:

Service name:	Pwm_SetPeriodAndDuty	
Syntax:	<pre>void Pwm_SetPeriodAndDuty(Pwm_ChannelType ChannelNumber, Pwm_PeriodType Period, uint16 DutyCycle)</pre>	
Service ID[hex]:	0x03	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant for different channel numbers	
Parameters (in):	ChannelNumber	Numeric identifier of the PWM
	Period	Period of the PWM signal
	DutyCycle	Min=0x0000 Max=0x8000
Parameters (inout):	None	
Parameters (out):	None	
Return value:	None	
Description:	Service sets the period and the duty cycle of a PWM channel	

PWM019: The function Pwm_SetPeriodAndDuty shall set the period and the duty cycle of a PWM channel.

PWM076: The function Pwm_SetPeriodAndDuty shall update the period always at the end of the current period if supported by the implementation and configured with PwmPeriodUpdatedEndperiod.

PWM020: The driver shall avoid spikes on the PWM output signal when updating the PWM period and duty.

The PWM duty cycle parameter is necessary to maintain the consistency between frequency and duty cycle. Refer to PWM058: and PWM059 : to know the scaling and format definition of duty cycle parameter

Regarding error detection, the requirements PWM117, PWM045, PWM047 and PWM051 are applicable to the function Pwm_SetPeriodAndDuty.

PWM041: The function `Pwm_SetPeriodAndDuty` shall allow changing the period only for the PWM channel declared as variable period type.

PWM083: The function `Pwm_SetPeriodAndDuty` shall be pre compile time configurable On/Off by the configuration parameter: `PwmSetPeriodAndDuty`.

8.3.5 Pwm_SetOutputToldle

PWM099:

Service name:	Pwm_SetOutputToldle	
Syntax:	<pre>void Pwm_SetOutputToIdle(Pwm_ChannelType ChannelNumber)</pre>	
Service ID[hex]:	0x04	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant for different channel numbers	
Parameters (in):	ChannelNumber	Numeric identifier of the PWM
Parameters (inout):	None	
Parameters (out):	None	
Return value:	None	
Description:	Service sets the PWM output to the configured Idle state.	

PWM021: The function `Pwm_SetOutputToldle` shall set immediately the PWM output to the configured Idle state.

Regarding error detection, the requirements [PWM117](#), [PWM047](#) and [PWM051](#) are applicable to the function `Pwm_SetOutputToldle`.

PWM084: The function `Pwm_SetOutputToldle` shall be pre compile time configurable On/Off by the configuration parameter: `PwmSetOutputToldle`.

PWM086: After the call of the function `Pwm_SetOutputToldle`, variable period type channels shall be reactivated either using the Api `Pwm_SetPeriodAndDuty()` to activate the PWM channel with the new passed period or Api `Pwm_SetDutyCycle()` to activate the PWM channel with the old period.

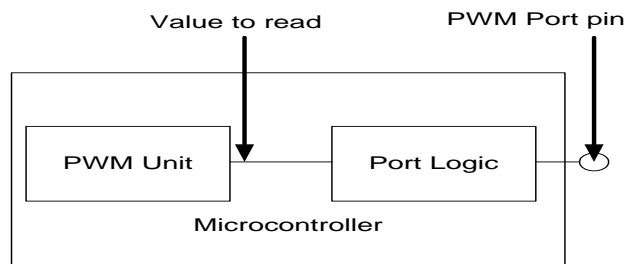
PWM119: After the call of the function `Pwm_SetOutputToldle`, fixed period type channels shall be reactivated using only the API `Pwm_SetDutyCycle()` to activate the PWM channel with the old period.

8.3.6 Pwm_GetOutputState

PWM100:

Service name:	Pwm_GetOutputState	
Syntax:	Pwm_OutputStateType Pwm_GetOutputState(Pwm_ChannelType ChannelNumber)	
Service ID[hex]:	0x05	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant for different channel numbers	
Parameters (in):	ChannelNumber	Numeric identifier of the PWM
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Pwm_OutputStateType	PWM_HIGH The PWM output state is high PWM_LOW The PWM output state is low
Description:	Service to read the internal state of the PWM output signal.	

PWM022: The function Pwm_GetOutputState shall read the internal state of the PWM output signal and return it as defined in the diagram below



Regarding error detection, the requirements [PWM117](#), [PWM047](#) and [PWM051](#) are applicable to the function Pwm_GetOutputState.

PWM085: The function Pwm_GetOutputState shall be pre compile time configurable On/Off by the configuration parameter: PwmGetOutputState.

Due to real time constraint and setting of the PWM channel (project dependant), the output state can be modified just after the call of the service Pwm_GetOutputState.

8.3.7 Pwm_DisableNotification

PWM101:

Service name:	Pwm_DisableNotification	
Syntax:	<pre>void Pwm_DisableNotification(Pwm_ChannelType ChannelNumber)</pre>	
Service ID[hex]:	0x06	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant for different channel numbers	
Parameters (in):	ChannelNumber	Numeric identifier of the PWM
Parameters (inout):	None	
Parameters (out):	None	
Return value:	None	
Description:	Service to disable the PWM signal edge notification.	

PWM023: The function Pwm_DisableNotification shall disable the PWM signal edge notification.

PWM112: The function Pwm_DisableNotification shall be pre compile time configurable On/Off by the configuration parameter: PwmNotificationSupported.

Regarding error detection, the requirements [PWM117](#), [PWM047](#) and [PWM051](#) are applicable to the function Pwm_DisableNotification.

8.3.8 Pwm_EnableNotification

PWM102:

Service name:	Pwm_EnableNotification	
Syntax:	<pre>void Pwm_EnableNotification(Pwm_ChannelType ChannelNumber, Pwm_EdgeNotificationType Notification)</pre>	
Service ID[hex]:	0x07	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant for different channel numbers	
Parameters (in):	ChannelNumber	Numeric identifier of the PWM
	Notification	Type of notification PWM_RISING_EDGE or PWM_FALLING_EDGE or PWM_BOTH_EDGES
Parameters (inout):	None	
Parameters (out):	None	
Return value:	None	
Description:	Service to enable the PWM signal edge notification according to notification parameter.	

PWM024: The function `Pwm_EnableNotification` shall enable the PWM signal edge notification according to notification parameter.

PWM081: The function `Pwm_EnableNotification` shall cancel pending interrupts.

PWM113: The function `Pwm_EnableNotification` shall be pre compile time configurable On/Off by the configuration parameter: `PwmNotificationSupported`.

Regarding error detection, the requirements [PWM117](#), [PWM047](#) and [PWM051](#) are applicable to the function `Pwm_EnableNotification`.

8.3.9 Pwm_GetVersionInfo

PWM103:

Service name:	<code>Pwm_GetVersionInfo</code>
Syntax:	<pre>void Pwm_GetVersionInfo(Std_VersionInfoType* versioninfo)</pre>
Service ID[hex]:	0x08
Sync/Async:	Synchronous
Reentrancy:	Non Reentrant
Parameters (in):	None
Parameters (inout):	None
Parameters (out):	<code>versioninfo</code> Pointer to where to store the version information of this module.
Return value:	None
Description:	Service returns the version information of this module.

PWM068: The function `Pwm_GetVersionInfo` shall return the version information of this module. The version information includes:

- Module Id
- Vendor Id
- Vendor specific version numbers (BSW00407).

PWM069: The function `Pwm_GetVersionInfo` shall be pre compile time configurable On/Off by the configuration parameter: `PwmVersionInfoApi`.

PWM114: If source code for caller and callee of `Pwm_GetVersionInfo` is available, the Pwm module should realize `Pwm_GetVersionInfo` as a macro, defined in the module's header file.

8.4 Callback notifications

Since the PWM Driver is a module on the lowest architectural layer it doesn't provide any call-back functions for lower layer modules.

8.5 Scheduled functions

The PWM driver offers only synchronous services and therefore doesn't need any scheduled functions.

8.6 Expected Interfaces

In this chapter all interfaces required from other modules are listed.

8.6.1 Mandatory Interfaces

This chapter defines all interfaces which are required to fulfill the core functionality of the module.

As this module is part of the MCAL layer, it access directly to the microcontroller registers and therefore doesn't need any lower interfaces.

8.6.2 Optional Interfaces

This chapter defines all interfaces which are required to fulfill an optional functionality of the module.

PWM104:

<i>API function</i>	<i>Description</i>
Dem_ReportErrorStatus	Reports errors to the DEM.
Det_ReportError	Service to report development errors.

8.6.3 Configurable interfaces

In this chapter all interfaces are listed where the target function could be configured. The target function is usually a call-back function. The names of these kinds of interfaces are not fixed because they are configurable.

PWM105:

Service name:	Pwm_Notification_<#Channel>
Syntax:	void Pwm_Notification_<#Channel>()
Sync/Async:	Synchronous
Reentrancy:	PWM user implementation dependant
Parameters (in):	None
Parameters (inout):	None
Parameters (out):	None
Return value:	None
Description:	The Pwm module shall call the function Pwm_Notification_<#Channel> accordingly to the last call of Pwm_EnableNotification for channel <#Channel>.

PWM025: The Pwm module shall call the function `Pwm_Notification_<#Channel>` accordingly to the last call of `Pwm_EnableNotification` and `Pwm_DisableNotification` for channel `<#Channel>`.

PWM026: The Pwm module shall reset the interrupt flag associated to the notification `Pwm_Notification_<#Channel>`

PWM115: The Pwm module shall only provide the functionality of PWM025 and PWM026 if the configuration parameter `PwmNotificationSupported` is ON.

8.7 API parameter checking

PWM051: If development error detection for the Pwm module is enabled: when a development error occurs, the corresponding PWM function shall:

- Report the error to the Development Error Tracer.
- Skip the desired functionality in order to avoid any corruptions of data or hardware registers: This means leave the function without any actions.
- Return `PWM_LOW` for the function `Pwm_GetOutputState`.

PWM117: If development error detection for the Pwm module is enabled: if any function (except `Pwm_Init`) is called before `Pwm_Init` has been called, the called function shall raise development error `PWM_E_UNINIT`.

PWM045: If development error detection for the Pwm module is enabled: the PWM functions shall check the channel class type and raise development error `PWM_E_PERIOD_UNCHANGEABLE` if the PWM channel is not declared as a variable period type.

PWM047: If development error detection for the Pwm module is enabled: the PWM functions shall check the parameter `ChannelNumber` and raise development error `PWM_E_PARAM_CHANNEL` if the parameter `ChannelNumber` is invalid.

9 Sequence diagrams

9.1 Initialization

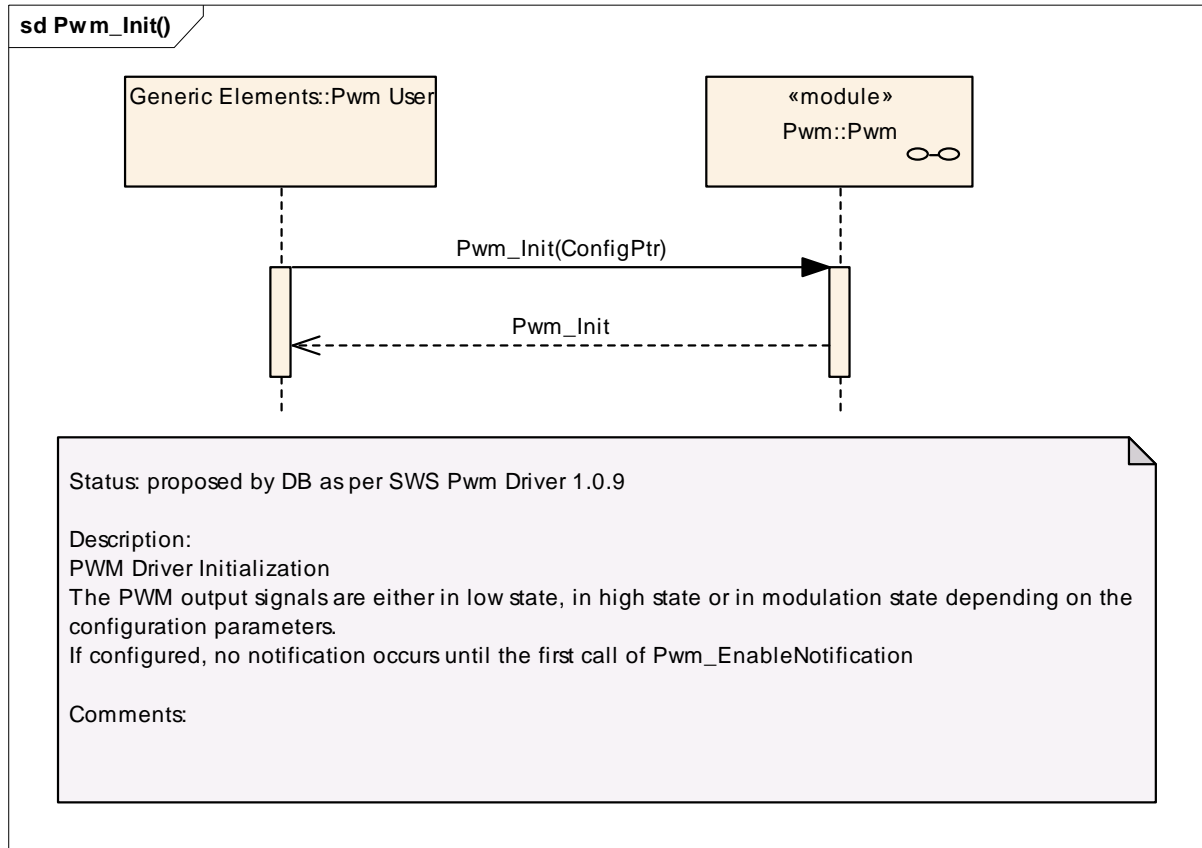


Figure 3: Pwm initialization

9.2 De-initialization

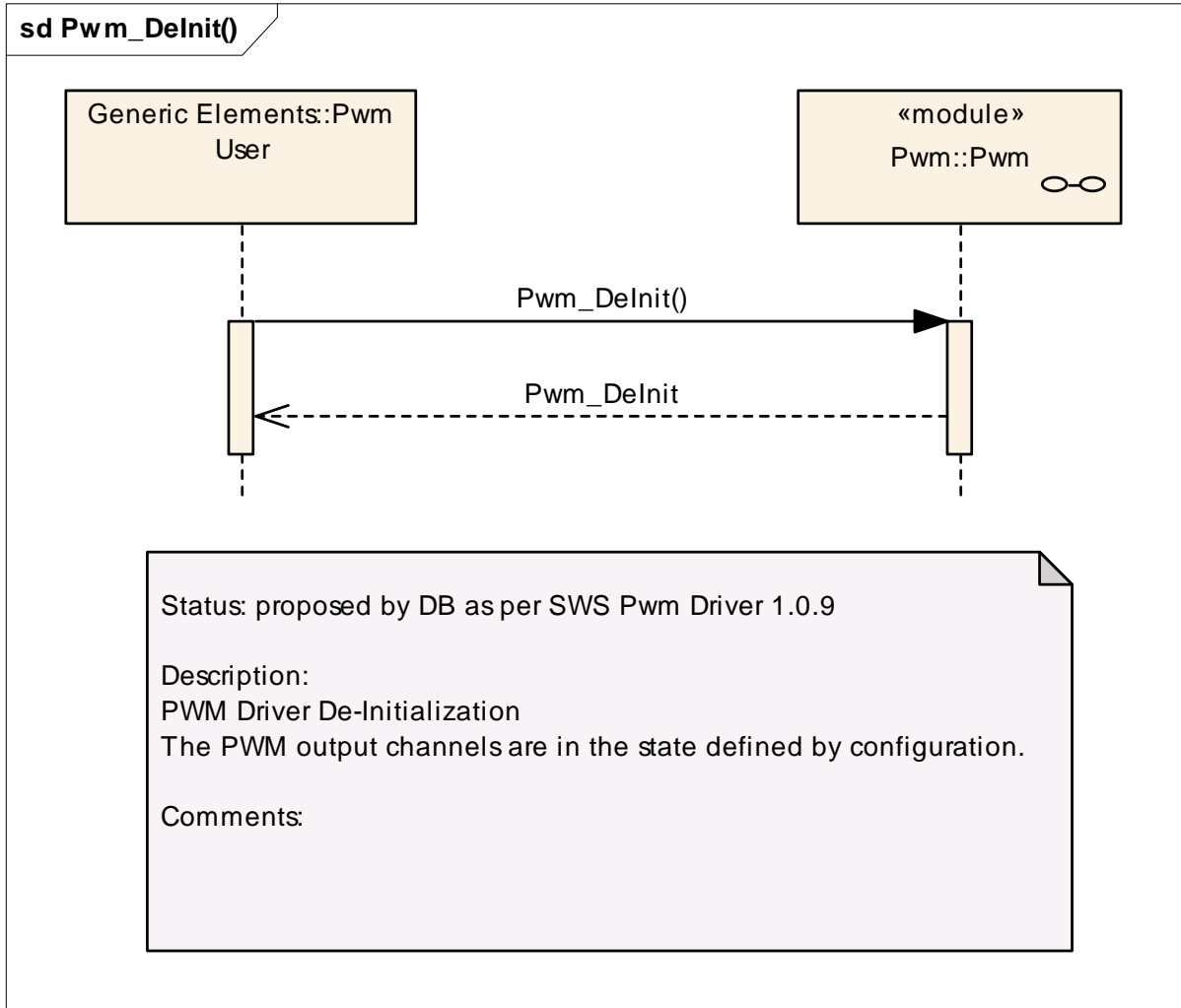


Figure 4: Pwm de-initialization

9.3 Setting the duty cycle

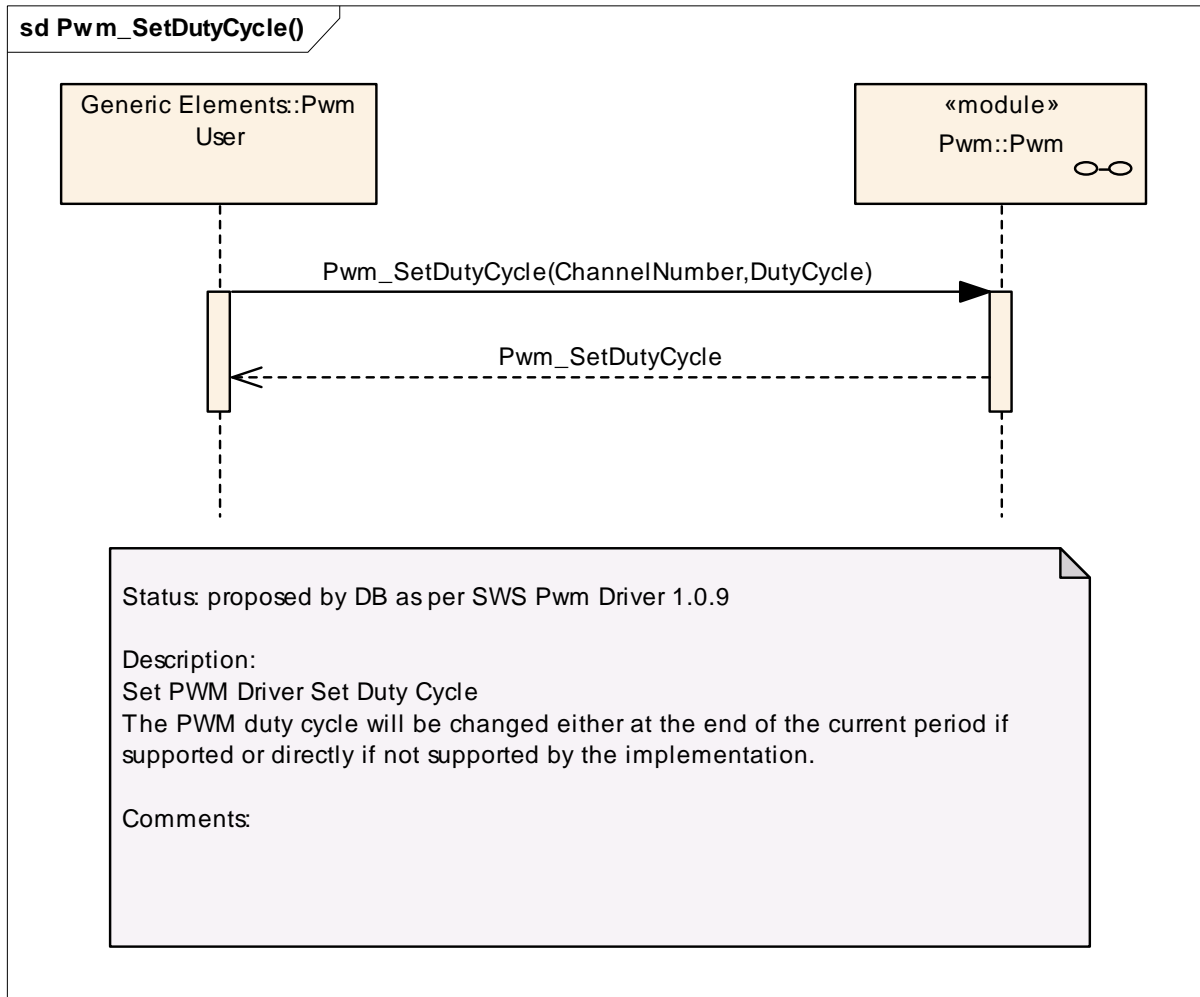


Figure 5: Setting the duty cycle

9.4 Setting the period and the duty

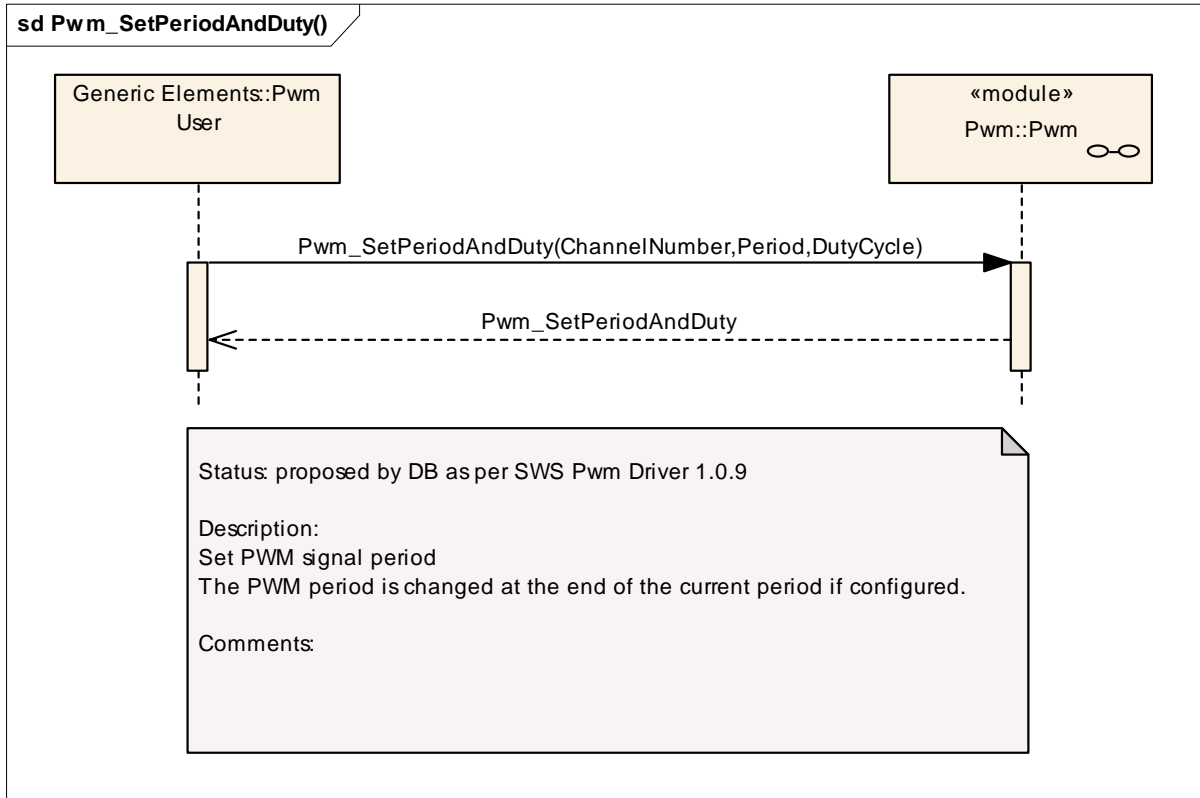


Figure 6: Setting period and duty cycle

9.5 Setting the PWM output to idle

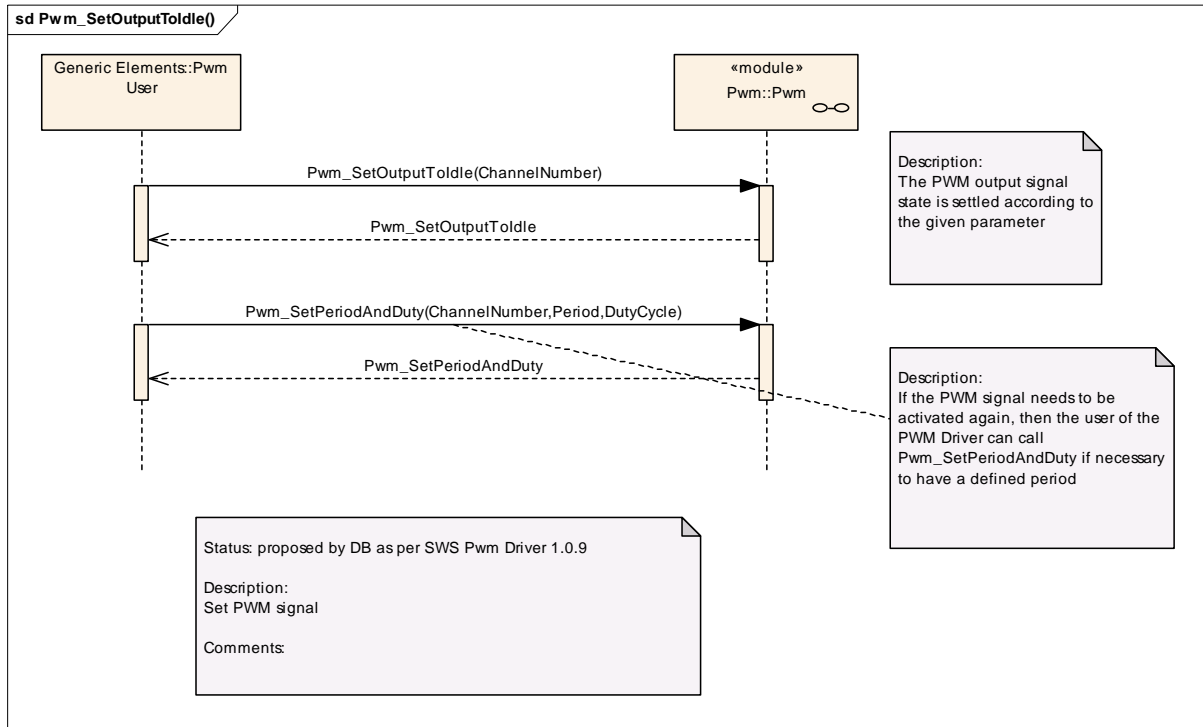


Figure 7: Setting Pwm output to idle

9.6 Getting the PWM Output state

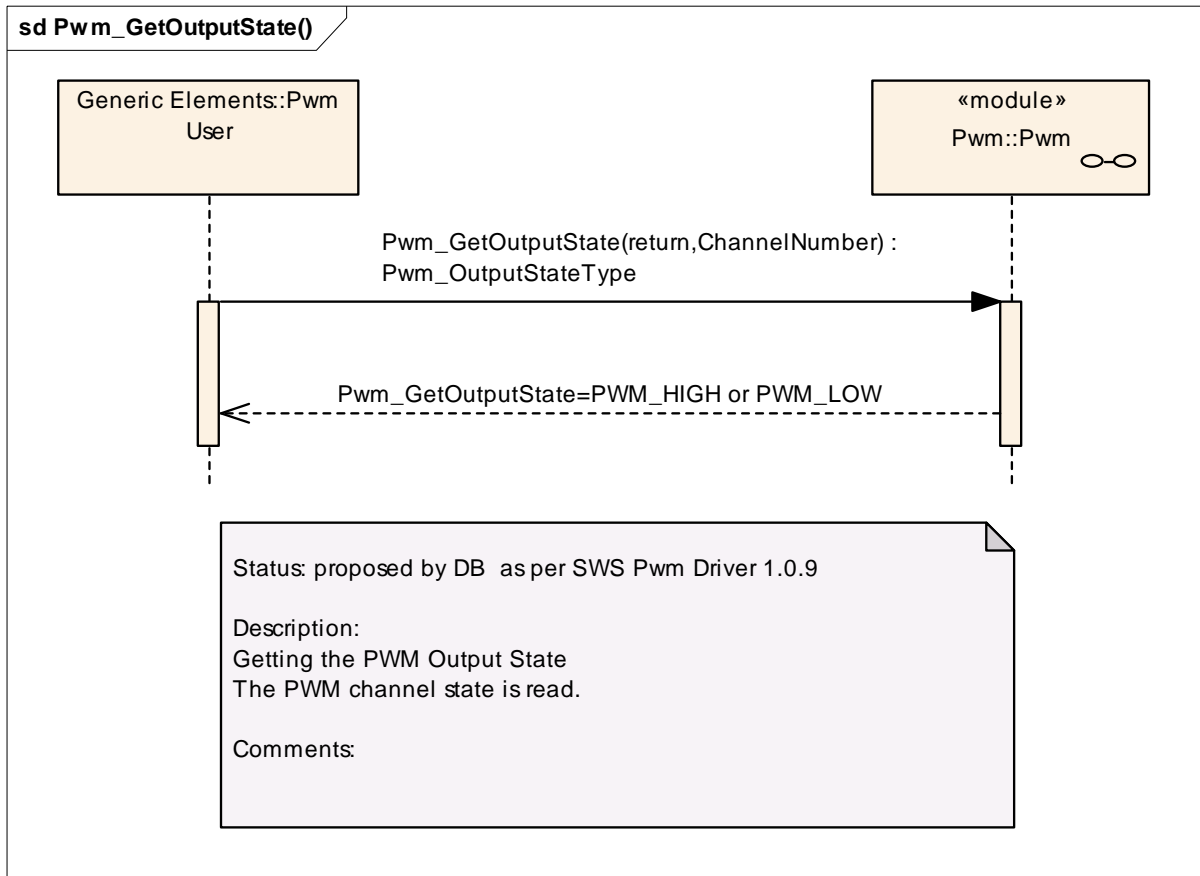


Figure 8: Getting Pwm output state

9.7 Using the PWM notifications

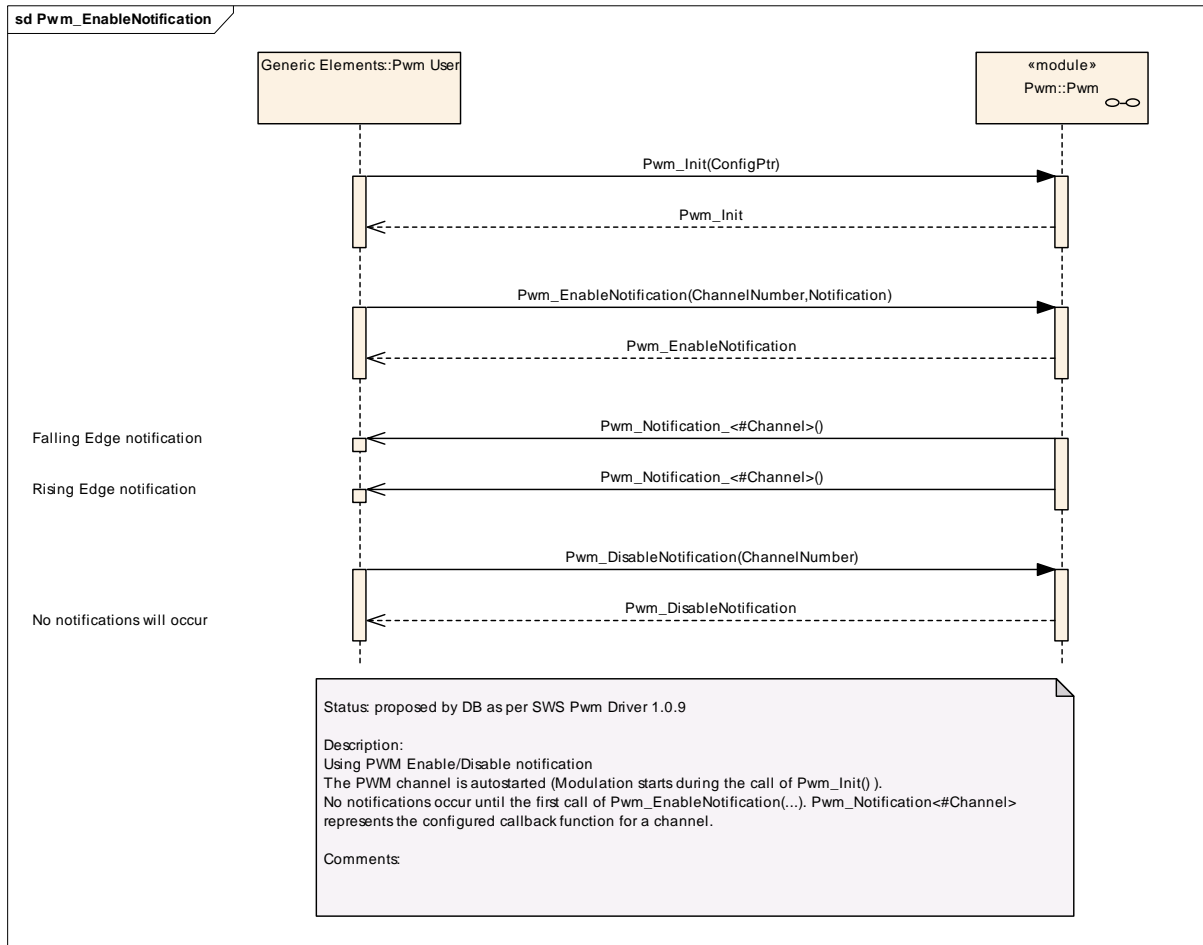


Figure 9: Using Pwm notifications

10 Configuration specification

In general, this chapter defines configuration parameters and their clustering into containers. In order to support the specification Chapter 10.1 describes fundamentals. It also specifies a template (table) you shall use for the parameter specification. We intend to leave Chapter 10.1 in the specification to guarantee comprehension.

Chapter 10.2 specifies the structure (containers) and the parameters of the module PWM Driver.

Chapter 10.3 specifies published information of the module PWM Driver.

10.1 How to read this chapter

In addition to this section, it is highly recommended to read the documents:

- AUTOSAR Layered Software Architecture [1]
- AUTOSAR ECU Configuration Specification [6]
This document describes the AUTOSAR configuration methodology and the AUTOSAR configuration metamodel in detail.

The following is only a short survey of the topic and it will not replace the ECU Configuration Specification document.

10.1.1 Configuration and configuration parameters

Configuration parameters define the variability of the generic part(s) of an implementation of a module. This means that only generic or configurable module implementation can be adapted to the environment (software/hardware) in use during system and/or ECU configuration.

The configuration of parameters can be achieved at different times during the software process: before compile time, before link time or after build time. In the following, the term “configuration class” (of a parameter) shall be used in order to refer to a specific configuration point in time.

10.1.2 Containers

Containers structure the set of configuration parameters. This means:

- *all* configuration parameters are kept in containers.
- (sub-) containers can reference (sub-) containers. It is possible to assign a multiplicity to these references. The multiplicity then defines the possible number of instances of the contained parameters.

10.1.3 Specification template for configuration parameters

The following tables consist of three sections:

- the general section
- the configuration parameter section
- the section of included/referenced containers

Pre-compile time - specifies whether the configuration parameter shall be of configuration class *Pre-compile time* or not

Label	Description
x	The configuration parameter shall be of configuration class <i>Pre-compile time</i> .
--	The configuration parameter shall never be of configuration class <i>Pre-compile time</i> .

Link time - specifies whether the configuration parameter shall be of configuration class *Link time* or not

Label	Description
x	The configuration parameter shall be of configuration class <i>Link time</i> .
--	The configuration parameter shall never be of configuration class <i>Link time</i> .

Post Build - specifies whether the configuration parameter shall be of configuration class *Post Build* or not

Label	Description
x	The configuration parameter shall be of configuration class <i>Post Build</i> and no specific implementation is required.
L	<i>Loadable</i> - the configuration parameter shall be of configuration class <i>Post Build</i> and only one configuration parameter set resides in the ECU.
M	<i>Multiple</i> - the configuration parameter shall be of configuration class <i>Post Build</i> and is selected out of a set of multiple parameters by passing a dedicated pointer to the init function of the module.
--	The configuration parameter shall never be of configuration class <i>Post Build</i> .

10.2 Containers and configuration parameters

The following chapters summarize all configuration parameters. The detailed meanings of the parameters describe Chapters [Functional specification](#) and Chapter [API specification](#).

10.2.1 Variants

PWM079: Variant **PC** is limited to pre-compile configuration parameters only.

PWM077: Variant **PB**: has been defined for this module and allows Mix of precompile and Post Build multiple selectable configurable configurations.

10.2.2 Pwm

Module Name	Pwm
Module Description	Configuration of Pwm (Pulse Width Modulation) module.

Included Containers		
Container Name	Multiplicity	Scope / Dependency
PwmChannelConfigSet	1	Multiple Configuration Set Container
PwmConfigurationOfOptApiServices	1	--
PwmGeneral	1	--

10.2.3 PwmGeneral

SWS Item	PWM004 :
Container Name	PwmGeneral{PwmModuleConfiguration}
Description	--
Configuration Parameters	

SWS Item	PWM131 :		
Name	PwmDevErrorDetect {PWM_DEV_ERROR_DETECT}		
Description	Switch for enabling the development error detection.		
Multiplicity	1		
Type	BooleanParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	PWM132 :		
Name	PwmDutycycleUpdatedEndperiod {PWM_DUTYCYCLE_UPDATED_ENDPERIOD}		
Description	Switch for enabling the update of the duty cycle parameter at the end of the current period		
Multiplicity	1		
Type	BooleanParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	PWM122 :		
Name	PwmIndex		
Description	Specifies the InstanceId of this module instance. If only one instance is present it shall have the Id 0.		
Multiplicity	1		
Type	IntegerParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	PWM133 :		
Name	PwmNotificationSupported {PWM_NOTIFICATION_SUPPORTED}		
Description	Switch to indicate that the notifications are supported		
Multiplicity	1		
Type	BooleanParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	PWM134 :		
Name	PwmPeriodUpdatedEndperiod {PWM_DUTY_PERIOD_UPDATED_ENDPERIOD }		
Description	Switch for enabling the update of the period parameter at the end of the current period		
Multiplicity	1		
Type	BooleanParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

No Included Containers

10.2.4 PwmChannel

SWS Item	PWM027 :		
Container Name	PwmChannel{PwmChannelConfiguration}		
Description	Configuration of an individual PWM channel.		
Configuration Parameters			

SWS Item	PWM119 :		
Name	PwmChannelClass {PWM_CHANNEL_CLASS}		
Description	Class of PWM Channel. ImplementationType: Pwm_ChannelClassType		
Multiplicity	1		
Type	EnumerationParamDef		
Range	PWM_FIXED_PERIOD	Only the duty cycle can be changed.	
	PWM_FIXED_PERIOD_SHIFTED	Only the duty cycle can be changed. The period is shifted (only if supported by hardware)	
	PWM_VARIABLE_PERIOD	Duty Cycle and period can be changed.	
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	--	
	Post-build time	M	VARIANT-POST-BUILD
Scope / Dependency	scope: ECU		

SWS Item	PWM120 :		
Name	PwmChannelId		
Description	Channel Id of the PWM channel. This value will be assigned to the symbolic name derived of the PwmChannel container short name.		

Multiplicity	1		
Type	IntegerParamDef (Symbolic Name generated for this parameter)		
Default value	--		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	PWM121 :		
Name	PwmDutyCycleDefault {PWM_DUTYCYCLE_DEFAULT}		
Description	Value of duty cycle used for Initialization 0, represents 0% 0x8000 represents 100%		
Multiplicity	1		
Type	IntegerParamDef		
Range	0 .. 32768		
Default value	--		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	--	
	Post-build time	M	VARIANT-POST-BUILD
Scope / Dependency	scope: ECU		

SWS Item	PWM122 :		
Name	PwmIdleState {PWM_IDLE_STATE}		
Description	The parameter PWM_IDLE_STATE represents the output state of the PWM after the signal is stopped (e.g. call of Pwm_SetOutputTIdle).		
Multiplicity	1		
Type	EnumerationParamDef		
Range	PWM_HIGH	The PWM channel output will be set to high (3 or 5 V) in idle state.	
	PWM_LOW	The PWM channel output will be set to low (0 V) in idle state.	
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	--	
	Post-build time	M	VARIANT-POST-BUILD
Scope / Dependency	scope: ECU		

SWS Item	PWM123 :		
Name	PwmNotification {Pwm_Notification}		
Description	Definition of the Callback function.		
Multiplicity	1		
Type	FunctionNameDef		
Default value	"NULL"		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	--	
	Post-build time	M	VARIANT-POST-BUILD
Scope / Dependency	scope: ECU		

SWS Item	PWM124 :		
Name	PwmPeriodDefault {PWM_PERIOD_DEFAULT}		
Description	Value of period used for Initialization.(in seconds).		
Multiplicity	1		
Type	FloatParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE

	Link time	--	
	Post-build time	M	VARIANT-POST-BUILD
Scope / Dependency	scope: ECU		

SWS Item	PWM125 :		
Name	PwmPolarity {PWM_POLARITY}		
Description	Defines the starting polarity of each PWM channel.		
Multiplicity	1		
Type	EnumerationParamDef		
Range	PWM_HIGH	The PWM channel output is high at the beginning of the cycle and then goes low when the duty count is reached.	
	PWM_LOW	The PWM channel output is low at the beginning of the cycle and then goes high when the duty count is reached.	
ConfigurationClass	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	--	
	Post-build time	M	VARIANT-POST-BUILD
Scope / Dependency	scope: ECU		

No Included Containers

10.2.5 PwmChannelConfigSet

SWS Item	PWM118 :		
Container Name	PwmChannelConfigSet [Multi Config Container]		
Description	Multiple Configuration Set Container		
Configuration Parameters			

Included Containers		
Container Name	Multiplicity	Scope / Dependency
PwmChannel	1..*	Configuration of an individual PWM channel.

10.2.6 PwmConfigurationOfOptApiServices

SWS Item	PWM126 :		
Container Name	PwmConfigurationOfOptApiServices		
Description	--		
Configuration Parameters			

SWS Item	--		
Name	PwmDelInitApi {PWM_DE_INIT_API}		
Description	Adds / removes the service Pwm_DelInit() from the code.		
Multiplicity	1		
Type	BooleanParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	PWM127 :		
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Name	PwmGetOutputState {PWM_GET_OUTPUT_STATE_API}		
Description	--		
Multiplicity	1		
Type	BooleanParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	PWM128 :		
Name	PwmSetDutyCycle {PWM_SET_DUTY_CYCLE_API}		
Description	--		
Multiplicity	1		
Type	BooleanParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	PWM129 :		
Name	PwmSetOutputToIdle {PWM_SET_OUTPUT_TO_IDLE_API}		
Description	--		
Multiplicity	1		
Type	BooleanParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	PWM130 :		
Name	PwmSetPeriodAndDuty {PWM_SET_PERIOD_AND_DUTY_API}		
Description	--		
Multiplicity	1		
Type	BooleanParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	PWM135 :		
Name	PwmVersionInfoApi {PWM_VERSION_INFO_API}		
Description	Switch to indicate that the Pwm_GetVersionInfo is supported		
Multiplicity	1		
Type	BooleanParamDef		
Default value	--		
ConfigurationClass	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

No Included Containers

10.3 Published Information

Published information contains data defined by the implementer of the SW module that does not change when the module is adapted (i.e. configured) to the actual HW/SW environment. It thus contains version and manufacturer information.

The standard common published information like

vendorId (<Module>_VENDOR_ID),
moduleId (<Module>_MODULE_ID),
arMajorVersion (<Module>_AR_MAJOR_VERSION),
arMinorVersion (<Module>_AR_MINOR_VERSION),
arPatchVersion (<Module>_AR_PATCH_VERSION),
swMajorVersion (<Module>_SW_MAJOR_VERSION),
swMinorVersion (<Module>_SW_MINOR_VERSION),
swPatchVersion (<Module>_SW_PATCH_VERSION),
vendorApiInfix (<Module>_VENDOR_API_INFIX)

is provided in the BSW Module Description Template (see [7] Figure 4.1 and Figure 7.1).

Additional published parameters are listed below if applicable for this module.

11 Changes

11.1 Deleted SWS Items

SWS Item	Rationale
PWM028	Take in account the new template for configuration
PWM030	Take in account the new template for configuration and bug #5523
PWM042	Correction of bug #4007
PWM036	Remove time resolution from the published parameter
PWM055	Remove (due to SRS publication)
PWM056	Remove (due to SRS publication)
PWM057	Remove (due to SRS publication)
PWM015	Review comments of SVDO
PWM048	Correction of Bug #11802 and RFC #13823
PWM031	RFC #19937: Removal of Callback requirements
PWM032	RFC #19937: Removal of Callback requirements
PWM033	RFC #19937: Removal of Callback requirements
PWM040	RfC#17621: Implementation is HW dependent

11.2 Replaced SWS Items

SWS Item of Release 1	replaced by SWS Item	Rationale

11.3 Changed SWS Items

SWS Item	Rationale
PWM002	Take in account the new template sentence to describe requirement
PWM003	Take in account the new template sentence to describe requirement
PWM004	Take in account the new template for configuration
PWM015	Correct bugzilla #4171
PWM027	Take in account the new template for configuration and bug #4055
PWM029	Take in account the new template
PWM054	Implementation of Rfc 4060
PWM022	Correction of bug #4052
PWM021	Remove abstraction level #4962 and correct # 9607
PWM009	Remove abstraction level #4962
PWM025	Clarify the name of the notification
PWM011	Remove abstraction level #4962
PWM014	Remove abstraction level #4962
PWM015	Remove abstraction level #4962
PWM016	Remove abstraction level #4962
PWM051	Remove abstraction level #4962
PWM009	Review comments of SVDO
PWM014	Review comments of SVDO
PWM086	Adapted reactivation concept for variable period type PWM channels

11.4 Added SWS Items

SWS Item	Rationale
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PWM064	Take in account the new template sentence to describe requirement
PWM065	Take in account the new template sentence to describe requirement
PWM066	Take in account the new template sentence to describe requirement
PWM067	Take in account the new template sentence to describe requirement
PWM068	Implementation of Pwm_GetVersionInfo
PWM069	Implementation of Pwm_GetVersionInfo
PWM070	Take in account configuration of time
PWM073	Take in account new SRS of Autosar Srs_General BSW00384
PWM074	Take in account new SRS of Autosar_Srs_General BSW00384
PWM075	Take in account new SRS of Autosar_Srs_General BSW00381, BSW00412, BSW00435, BSW00436
PWM076	Bugzilla 8485
PWM077	Variant definition
PWM078	Add this requirement to comply with chapter Error notification of the SWS template
PWM079	Add PC variant
PWM080	Bug #11767 RFC #13627: Configuration of optional API service "Pwm_DeInit()"
PWM081	Bug #11800 RFC #13633: Cancel pending interrupts
PWM082	Bug #14468 RFC #15495: Configuration of optional API service "Pwm_SetDutyCycle()"
PWM083	Bug #14468 RFC #15495: Configuration of optional API service "Pwm_SetPeriodAndDuty()"
PWM084	Bug #14468 RFC #15495: Configuration of optional API service "Pwm_SetOutputTolde()"
PWM085	Bug #14468 RFC #15495: Configuration of optional API service "Pwm_GetOutputState()"
PWM118	Bug #19185: [RfC#17500]: Added DET error PWM_E_ALREADY_INITIALIZED
PWM119	RFC #19235: Extend reactivation concept for fixed period type PWM channels
PWM120	Bug #18756 [RFC #18344]: NULL pointer check of configuration structure in initialization function
PWM121	Bug 20365 [RFC 19605] : Re-initialization of MCAL modules

12 Changes during SWS Improvements by Technical Office

12.1 Deleted SWS Items

SWS Item	Rationale
PWM060	No requirement, just information; ID removed but text left in
PWM073	No requirement, just information; ID removed but text left in
PWM074	No requirement, just information; ID removed but text left in
PWM035	Requirement and text removed as this is covered by the API definition in the table PWM105

12.2 Replaced SWS Items

SWS Item of Release 1	replaced by SWS Item	Rationale
PWM034	PWM088 , PWM089	Made requirement atomic
PWM044	PWM116 , PWM117	Made requirement atomic

12.3 Changed SWS Items

Many requirements have been changed to improve understandability without changing the technical contents.

12.4 Added SWS Items

SWS Item	Rationale
PWM086	Caveat for Pwm_SetOutputToldle.
PWM093	Caveat for Pwm_Init
PWM094	UML Model linking of imported types
PWM095	UML Model linking of Pwm_Init
PWM096	UML Model linking of Pwm_DeInit
PWM097	UML Model linking of Pwm_SetDutyCycle
PWM098	UML Model linking of Pwm_SetPeriodAndDuty
PWM099	UML Model linking of Pwm_SetOutputToldle
PWM100	UML Model linking of Pwm_GetOutputState
PWM101	UML Model linking of Pwm_DisableNotification
PWM102	UML Model linking of Pwm_EnableNotification
PWM103	UML Model linking of Pwm_GetversionInfo
PWM104	UML Model linking of the optional interfaces
PWM105	UML Model linking of Pwm_Notification_<#Channel>
PWM106	UML Model linking of Pwm_ChannelType
PWM107	UML Model linking of Pwm_PeriodType
PWM108	UML Model linking of Pwm_OutputStateType
PWM109	UML Model linking of Pwm_EdgeNotificationType
PWM110	UML Model linking of Pwm_ChannelClassType
PWM111	UML Model linking of Pwm_ConfigType
PWM112	Gave explicit ID to note out of Pwm_DisableNotification
PWM113	Gave explicit ID to note out of Pwm_EnableNotificaiton
PWM114	Gave an ID to a suggestion out of Pwm_GetVersionInfo

PWM115	Gave an ID to the dependency of the callbacks on the config parameter PwmNotificationSupported
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