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Document Change History

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07.12.2007	2.2.0	AUTOSAR Administration	• Section 5.1.2 the file include structure has been changed. • Section 8.6.2 Dem_ReportErrorStatus added as optional interfaces. • Rephrased the requirementsWDG019, SWS_Wdg_00031, SWS_Wdg_00034. • Modified sequence diagrams in chapter 9. • Document meta information extended • Small layout adaptations made
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20.03.2006	2.0.0	AUTOSAR Administration	Document structure adapted to common Release 2.0 SWS Template
31.05.2005	1.0.0	AUTOSAR Administration	Initial Release

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1 Introduction and functional overview

This document specifies the functionality, API and the configuration of the AUTOSAR Basic Software module watchdog driver (Wdg).

This module provides services for initialization, changing the operation mode and setting the trigger condition (timeout).

The functional requirements and the functional scope are the same for both internal and external watchdog drivers. Hence the API is semantically identical.

An internal watchdog driver belongs to the Microcontroller Abstraction Layer (MCAL), whereas an external watchdog driver belongs to the Onboard Device Abstraction Layer. Therefore, an external watchdog driver needs other drivers (in MCAL) in order to access the microcontroller hardware.

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.

Abbreviation / Acronym:	Description:
DIP	Digital Input/Output
DET	Development Error Tracer – module to catch development errors.
DEM	Diagnostic Event Manager – module to handle diagnostic relevant events.
SPI	Serial Peripheral Interface
WDG	Watchdog (module specific prefix)

Definitions needed for understanding of the concepts

Definition:	Description:
Off-Mode	The watchdog hardware is disabled / shut down. This might be necessary in order to shut down the complete ECU and not get cyclic resets from a still running external watchdog. This mode might not be allowed for safety critical systems. In this case, the Wdg module has to be configured to prevent switching to this mode.
Slow-Mode	Triggering the watchdog hardware can be done with a long timeout period. This mode can e.g. be used during system startup / initialization phase. E.g. the watchdog hardware is configured for toggle mode (no constraints on the point in time at which the triggering is done) and a timeout period of 20 milliseconds.
Fast-Mode	Triggering the watchdog hardware has to be done with a short timeout period. This mode can e.g. be used during normal operations of the ECU. E.g. the watchdog hardware is configured for window mode (triggering the watchdog has to occur within certain minimum / maximum boundaries within the timeout period) and a timeout period of 5 milliseconds.

3 Related documentation

3.1 Input documents

[1] Layered Software Architecture
AUTOSAR_EXP_LayeredSoftwareArchitecture.pdf

[2] General Requirements on Basic Software Modules
AUTOSAR_SRS_BSWGeneral.pdf

[3] General Requirements on SPAL
AUTOSAR_SRS_SPALGeneral.pdf

[4] Requirements on Watchdog Driver
AUTOSAR_SRS_WatchdogDriver.pdf

[5] Specification of Watchdog Interface
AUTOSAR_SWS_WatchdogInterface.pdf

[6] Basic Software Module Description Template
AUTOSAR_TPS_BSWModuleDescriptionTemplate.pdf

[7] Specification of RTE Software Specification of Watchdog Driver
AUTOSAR_SWS_RTE.pdf

[8] List of Basic Software Modules
AUTOSAR_TR_BSWModuleList

[9] General Specification of Basic Software Modules
AUTOSAR_SWS_BSWGeneral.pdf

3.2 Related standards and norms

None

3.3 Related specification

AUTOSAR provides a General Specification on Basic Software modules [9] (SWS BSW General), which is also valid for Watchdog Driver.

Thus, the specification SWS BSW General shall be considered as additional and required specification for Watchdog Driver.

4 Constraints and assumptions

4.1 Limitations

No limitations.

4.2 Applicability to car domains

No restrictions.

5 Dependencies to other modules

A Wdg module for an internal (on-chip) watchdog accesses the microcontroller hardware directly and is located in the Microcontroller Abstraction layer.

A Wdg module for an external watchdog uses other modules (e.g. SPI) to access the external watchdog device. Such a Wdg module is located in the Onboard Device Abstraction Layer (see [1]).

[SWS_Wdg_00055] ⌈The Wdg module for an external watchdog driver shall have source code that is independent of the microcontroller platform.⌋ ()

5.1 File structure

5.1.1 Code file structure

[SWS_Wdg_00079] ⌈The code file structure shall not be defined within this specification completely. At this point it shall be pointed out that the code-file structure shall include the following files (as far as required; for name expansion see SWS_Wdg_00169):

- Wdg_Lcfg.c – for link time configurable parameters
- Wdg_PBcfg.c – for post build time configurable parameters
- Wdg_Irq.c – for holding the interrupt frames in case an internal watchdog servicing is implemented as interrupt routine (and not via timer callback)

These files shall contain all link time and post-build time configurable parameters.⌋ (SRS_BSW_00380, SRS_BSW_00346, SRS_BSW_00158, SRS_BSW_00314, SRS_SPAL_12263)

Note: These names are required by SRS_BSW_00314 and SRS_BSW_00346

[SWS_Wdg_00169] ⌈If more than one watchdog driver instance exists on an ECU (namely an external and an internal one) the implementer shall provide unique code file names by expanding the names according to SRS_BSW_00347.⌋ (SRS_BSW_00347)

5.1.2 Header file structure

[SWS_Wdg_00061] ⌈The Wdg module shall adhere to the following file structure:

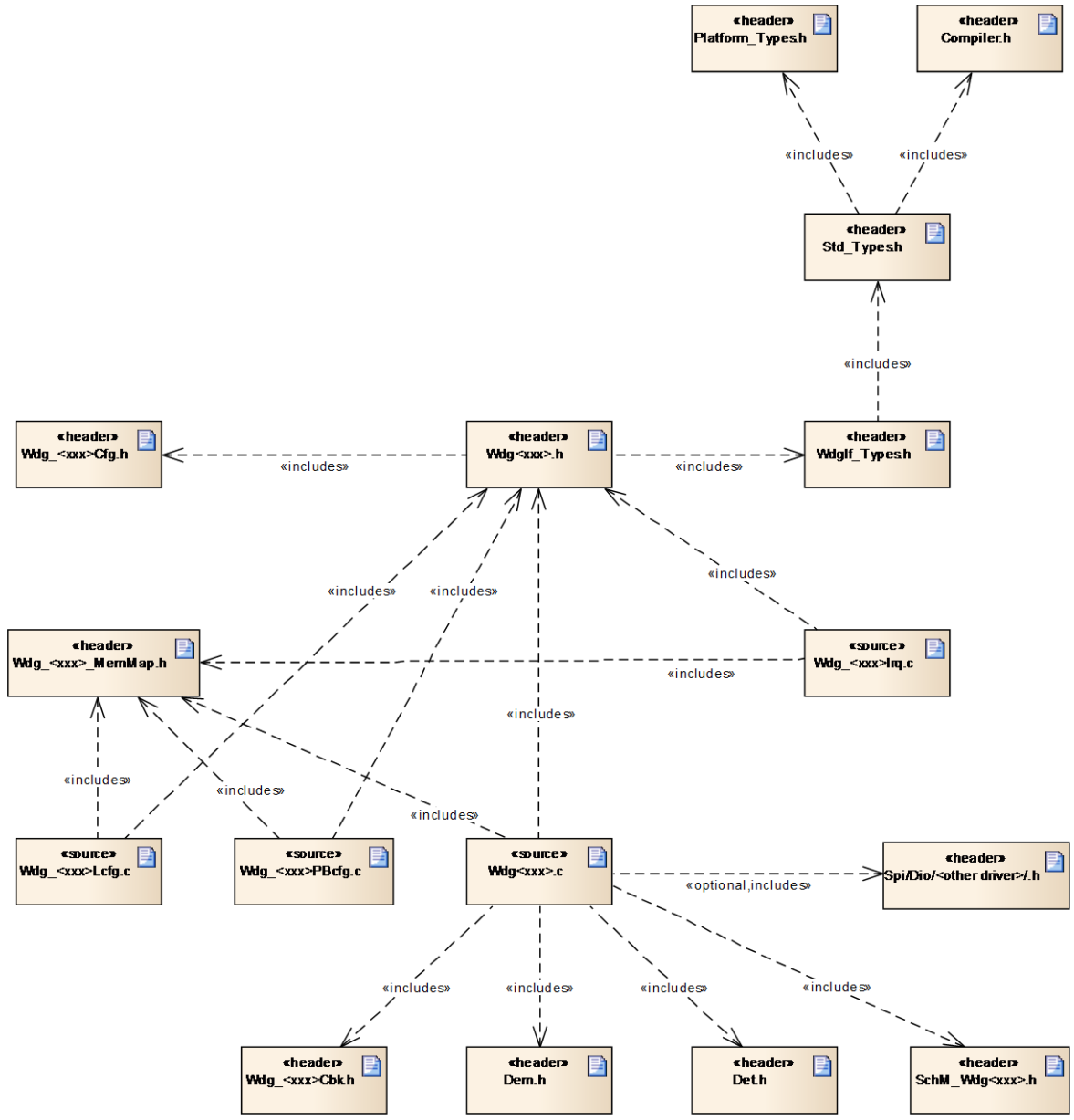

Figure 1: File include structure

⌋(SRS_BSW_00345, SRS_BSW_00159, SRS_BSW_00381, SRS_BSW_00412, SRS_BSW_00346, SRS_BSW_00158, SRS_BSW_00370, SRS_BSW_00435, SRS_BSW_00436, SRS_BSW_00301)

Notes to the figure:

- The possible name expansion for multiple driver modules are indicated as <xxx> in Figure 1.
- Since the API names are also to be expanded, the header Wdg<xxx>.h will become instance specific.

- Wdg<xxx>.h contains the pre-compile configuration macros. It is not expected that, source code is required to implement the pre-compile configuration for the watchdog driver module. This file also contains – if required – references to the c-data for link-time and/or post-build configuration.
- Wdg_<xxx>Cbk.h contains the declaration of callback functions from other modules implemented by the Wdg module (see SRS_BSW_00370). This file is mandatory, even if there are no callback functions required.
- SchM_Wdg<xxx>.h is a mandatory include file (see SRS_BSW_00335) provided by the RTE generator. Though the Watchdog Driver has no scheduled function, this header is e.g. needed, if the Wdg module defines critical section.
- The need to include headers from SPI-, DIO- or other drivers depends on how the watchdog is serviced and the watchdog hardware is accessed, see chapters 7.7 and 7.8.

[SWS_Wdg_00170] ⌈If more than one watchdog driver instance exists on an ECU (namely an external and an internal one) the implementer shall provide unique header file names by expanding the names according to SRS_BSW_00347.⌋ (SRS_BSW_00347)

Note:
In case of multiple watchdog driver instances, the Event Id symbols for production errors defined in this specification (see SWS_Wdg_00010 and ECUC_Wdg_00148) might be expanded in the configuration of the DEM in order to make them unique.

5.1.3 Version check

For details refer to the chapter 5.1.8 “Version Check” in *SWS_BSWGeneral.*

5.2 System clock

If the hardware of the internal watchdog depends on the system clock, changes to the system clock (e.g. PLL on → PLL off) may also affect the clock settings of the watchdog hardware.

5.3 Onboard communication handlers

A Wdg module for an external watchdog device depends on the API and capabilities of the used onboard communication handlers or drivers (e.g. SPI handler).

6 Requirements traceability

Requirement	Description	Satisfied by
-	-	SWS_Wdg_00034
-	-	SWS_Wdg_00055
-	-	SWS_Wdg_00103
-	-	SWS_Wdg_00105
-	-	SWS_Wdg_00107
-	-	SWS_Wdg_00109
-	-	SWS_Wdg_00111
-	-	SWS_Wdg_00136
-	-	SWS_Wdg_00138
-	-	SWS_Wdg_00139
-	-	SWS_Wdg_00140
-	-	SWS_Wdg_00145
-	-	SWS_Wdg_00146
-	-	SWS_Wdg_00152
-	-	SWS_Wdg_00153
-	-	SWS_Wdg_00154
-	-	SWS_Wdg_00157
-	-	SWS_Wdg_00158
-	-	SWS_Wdg_00159
-	-	SWS_Wdg_00161
-	-	SWS_Wdg_00168
-	-	SWS_Wdg_00173
-	-	SWS_Wdg_00174
BSW00434	-	SWS_Wdg_00175
BSW00443	-	SWS_Wdg_00175
BSW00444	-	SWS_Wdg_00175
BSW00445	-	SWS_Wdg_00175
BSW00446	-	SWS_Wdg_00175
BSW12155	-	SWS_Wdg_00175
see[1]	-	SWS_Wdg_00162
SRS_BSW_00004	All Basic SW Modules shall perform a pre-processor check of the versions of all imported include files	SWS_Wdg_00086
SRS_BSW_00005	Modules of the æC Abstraction Layer (MCAL) may not have hard coded horizontal interfaces	SWS_Wdg_00175
SRS_BSW_00006	The source code of software	SWS_Wdg_00175

	modules above the æC Abstraction Layer (MCAL) shall not be processor and compiler dependent.	
SRS_BSW_00007	All Basic SW Modules written in C language shall conform to the MISRA C 2004 Standard.	SWS_Wdg_00175
SRS_BSW_00009	All Basic SW Modules shall be documented according to a common standard.	SWS_Wdg_00175
SRS_BSW_00010	The memory consumption of all Basic SW Modules shall be documented for a defined configuration for all supported platforms.	SWS_Wdg_00175
SRS_BSW_00101	The Basic Software Module shall be able to initialize variables and hardware in a separate initialization function	SWS_Wdg_00001
SRS_BSW_00158	All modules of the AUTOSAR Basic Software shall strictly separate configuration from implementation	SWS_Wdg_00061, SWS_Wdg_00079
SRS_BSW_00159	All modules of the AUTOSAR Basic Software shall support a tool based configuration	SWS_Wdg_00061
SRS_BSW_00161	The AUTOSAR Basic Software shall provide a microcontroller abstraction layer which provides a standardized interface to higher software layers	SWS_Wdg_00175
SRS_BSW_00162	The AUTOSAR Basic Software shall provide a hardware abstraction layer	SWS_Wdg_00175
SRS_BSW_00164	The Implementation of interrupt service routines shall be done by the Operating System, complex drivers or modules	SWS_Wdg_00166
SRS_BSW_00167	All AUTOSAR Basic Software Modules shall provide configuration rules and constraints to enable plausibility checks	SWS_Wdg_00086
SRS_BSW_00168	SW components shall be tested by a function defined in a common API in the Basis-SW	SWS_Wdg_00175
SRS_BSW_00170	The AUTOSAR SW Components shall provide information about their dependency from faults, signal qualities, driver demands	SWS_Wdg_00175
SRS_BSW_00172	The scheduling strategy that is built inside the Basic Software Modules shall be compatible with the strategy used in the system	SWS_Wdg_00175

SRS_BSW_00301	All AUTOSAR Basic Software Modules shall only import the necessary information	SWS_Wdg_00061
SRS_BSW_00302	All AUTOSAR Basic Software Modules shall only export information needed by other modules	SWS_Wdg_00175
SRS_BSW_00304	-	SWS_Wdg_00175
SRS_BSW_00306	AUTOSAR Basic Software Modules shall be compiler and platform independent	SWS_Wdg_00175
SRS_BSW_00307	Global variables naming convention	SWS_Wdg_00175
SRS_BSW_00308	AUTOSAR Basic Software Modules shall not define global data in their header files, but in the C file	SWS_Wdg_00175
SRS_BSW_00309	All AUTOSAR Basic Software Modules shall indicate all global data with read-only purposes by explicitly assigning the const keyword	SWS_Wdg_00175
SRS_BSW_00312	Shared code shall be reentrant	SWS_Wdg_00175
SRS_BSW_00314	All internal driver modules shall separate the interrupt frame definition from the service routine	SWS_Wdg_00079
SRS_BSW_00321	The version numbers of AUTOSAR Basic Software Modules shall be enumerated according specific rules	SWS_Wdg_00175
SRS_BSW_00323	All AUTOSAR Basic Software Modules shall check passed API parameters for validity	SWS_Wdg_00025, SWS_Wdg_00026, SWS_Wdg_00089, SWS_Wdg_00090, SWS_Wdg_00091, SWS_Wdg_00092
SRS_BSW_00325	The runtime of interrupt service routines and functions that are running in interrupt context shall be kept short	SWS_Wdg_00166
SRS_BSW_00326	-	SWS_Wdg_00166
SRS_BSW_00327	Error values naming convention	SWS_Wdg_00010
SRS_BSW_00328	All AUTOSAR Basic Software Modules shall avoid the duplication of code	SWS_Wdg_00175
SRS_BSW_00330	It shall be allowed to use macros instead of functions where source code is used and runtime is critical	SWS_Wdg_00175
SRS_BSW_00331	All Basic Software Modules shall strictly separate error and status information	SWS_Wdg_00010
SRS_BSW_00333	For each callback function it shall be specified if it is called from interrupt context or not	SWS_Wdg_00175

SRS_BSW_00334	All Basic Software Modules shall provide an XML file that contains the meta data	SWS_Wdg_00175
SRS_BSW_00335	Status values naming convention	SWS_Wdg_00017, SWS_Wdg_00018, SWS_Wdg_00019
SRS_BSW_00336	Basic SW module shall be able to shutdown	SWS_Wdg_00031
SRS_BSW_00337	Classification of development errors	SWS_Wdg_00010
SRS_BSW_00338	-	SWS_Wdg_00017, SWS_Wdg_00018, SWS_Wdg_00025, SWS_Wdg_00026, SWS_Wdg_00035, SWS_Wdg_00052, SWS_Wdg_00089, SWS_Wdg_00090, SWS_Wdg_00091, SWS_Wdg_00092
SRS_BSW_00339	Reporting of production relevant error status	SWS_Wdg_00175
SRS_BSW_00341	Module documentation shall contains all needed informations	SWS_Wdg_00175
SRS_BSW_00343	The unit of time for specification and configuration of Basic SW modules shall be preferably in physical time unit	SWS_Wdg_00155
SRS_BSW_00344	BSW Modules shall support link-time configuration	SWS_Wdg_00175
SRS_BSW_00345	BSW Modules shall support pre-compile configuration	SWS_Wdg_00061
SRS_BSW_00346	All AUTOSAR Basic Software Modules shall provide at least a basic set of module files	SWS_Wdg_00061, SWS_Wdg_00079
SRS_BSW_00347	A Naming seperation of different instances of BSW drivers shall be in place	SWS_Wdg_00169, SWS_Wdg_00170, SWS_Wdg_00172
SRS_BSW_00348	All AUTOSAR standard types and constants shall be placed and organized in a standard type header file	SWS_Wdg_00175
SRS_BSW_00353	All integer type definitions of target and compiler specific scope shall be placed and organized in a single type header	SWS_Wdg_00175
SRS_BSW_00355	-	SWS_Wdg_00175
SRS_BSW_00358	The return type of init() functions implemented by AUTOSAR Basic Software Modules shall be void	SWS_Wdg_00106
SRS_BSW_00359	All AUTOSAR Basic Software Modules callback functions shall avoid return types other than void if possible	SWS_Wdg_00175
SRS_BSW_00360	AUTOSAR Basic Software Modules callback functions are allowed to have parameters	SWS_Wdg_00175

SRS_BSW_00361	All mappings of not standardized keywords of compiler specific scope shall be placed and organized in a compiler specific type and keyword header	SWS_Wdg_00175
SRS_BSW_00370	-	SWS_Wdg_00061
SRS_BSW_00371	The passing of function pointers as API parameter is forbidden for all AUTOSAR Basic Software Modules	SWS_Wdg_00175
SRS_BSW_00373	The main processing function of each AUTOSAR Basic Software Module shall be named according the defined convention	SWS_Wdg_00175
SRS_BSW_00375	Basic Software Modules shall report wake-up reasons	SWS_Wdg_00175
SRS_BSW_00376	-	SWS_Wdg_00175
SRS_BSW_00377	A Basic Software Module can return a module specific types	SWS_Wdg_00175
SRS_BSW_00378	AUTOSAR shall provide a boolean type	SWS_Wdg_00175
SRS_BSW_00380	Configuration parameters being stored in memory shall be placed into separate c-files	SWS_Wdg_00079
SRS_BSW_00381	The pre-compile time parameters shall be placed into a separate configuration header file	SWS_Wdg_00061
SRS_BSW_00383	The Basic Software Module specifications shall specify which other configuration files from other modules they use at least in the description	SWS_Wdg_00175
SRS_BSW_00385	List possible error notifications	SWS_Wdg_00010
SRS_BSW_00400	Parameter shall be selected from multiple sets of parameters after code has been loaded and started	SWS_Wdg_00001
SRS_BSW_00401	Documentation of multiple instances of configuration parameters shall be available	SWS_Wdg_00175
SRS_BSW_00404	BSW Modules shall support post-build configuration	SWS_Wdg_00175
SRS_BSW_00405	BSW Modules shall support multiple configuration sets	SWS_Wdg_00175
SRS_BSW_00406	A static status variable denoting if a BSW module is initialized shall be initialized with value 0 before any APIs of the BSW module is called	SWS_Wdg_00019
SRS_BSW_00410	Compiler switches shall have defined values	SWS_Wdg_00175

SRS_BSW_00412	References to c-configuration parameters shall be placed into a separate h-file	SWS_Wdg_00061
SRS_BSW_00413	An index-based accessing of the instances of BSW modules shall be done	SWS_Wdg_00175
SRS_BSW_00414	The init function may have parameters	SWS_Wdg_00106, SWS_Wdg_00171
SRS_BSW_00415	Interfaces which are provided exclusively for one module shall be separated into a dedicated header file	SWS_Wdg_00175
SRS_BSW_00416	The sequence of modules to be initialized shall be configurable	SWS_Wdg_00175
SRS_BSW_00417	Software which is not part of the SW-C shall report error events only after the DEM is fully operational.	SWS_Wdg_00175
SRS_BSW_00419	If a pre-compile time configuration parameter is implemented as "const" it should be placed into a separate c-file	SWS_Wdg_00175
SRS_BSW_00422	Pre-de-bouncing of error status information is done within the DEM	SWS_Wdg_00175
SRS_BSW_00423	BSW modules with AUTOSAR interfaces shall be describable with the means of the SW-C Template	SWS_Wdg_00175
SRS_BSW_00424	BSW module main processing functions shall not be allowed to enter a wait state	SWS_Wdg_00175
SRS_BSW_00425	The BSW module description template shall provide means to model the defined trigger conditions of schedulable objects	SWS_Wdg_00175
SRS_BSW_00426	BSW Modules shall ensure data consistency of data which is shared between BSW modules	SWS_Wdg_00040
SRS_BSW_00427	ISR functions shall be defined and documented in the BSW module description template	SWS_Wdg_00166
SRS_BSW_00428	A BSW module shall state if its main processing function(s) has to be executed in a specific order or sequence	SWS_Wdg_00175
SRS_BSW_00429	BSW modules shall be only allowed to use OS objects and/or related OS services	SWS_Wdg_00040
SRS_BSW_00432	Modules should have separate main processing functions for read/receive and write/transmit data path	SWS_Wdg_00175
SRS_BSW_00433	Main processing functions are only	SWS_Wdg_00175

	allowed to be called from task bodies provided by the BSW Scheduler	
SRS_BSW_00435	-	SWS_Wdg_00061
SRS_BSW_00436	-	SWS_Wdg_00061
SRS_BSW_00437	Memory mapping shall provide the possibility to define RAM segments which are not to be initialized during startup	SWS_Wdg_00175
SRS_BSW_00439	Enable BSW modules to handle interrupts	SWS_Wdg_00166
SRS_BSW_00440	The callback function invocation by the BSW module shall follow the signature provided by RTE to invoke servers via Rte_Call API	SWS_Wdg_00175
SRS_BSW_00441	Naming convention for type, macro and function	SWS_Wdg_00175
SRS_BSW_00447	Standardizing Include file structure of BSW Modules Implementing Autosar Service	SWS_Wdg_00175
SRS_BSW_00449	BSW Service APIs used by Autosar Application Software shall return a Std_ReturnType	SWS_Wdg_00175
SRS_BSW_00450	A Main function of a un-initialized module shall return immediately	SWS_Wdg_00175
SRS_SPAL_00157	All drivers and handlers of the AUTOSAR Basic Software shall implement notification mechanisms of drivers and handlers	SWS_Wdg_00175
SRS_SPAL_12056	All driver modules shall allow the static configuration of notification mechanism	SWS_Wdg_00175
SRS_SPAL_12057	All driver modules shall implement an interface for initialization	SWS_Wdg_00100, SWS_Wdg_00101
SRS_SPAL_12063	All driver modules shall only support raw value mode	SWS_Wdg_00175
SRS_SPAL_12064	All driver modules shall raise an error if the change of the operation mode leads to degradation of running operations	SWS_Wdg_00016, SWS_Wdg_00017
SRS_SPAL_12067	All driver modules shall set their wake-up conditions depending on the selected operation mode	SWS_Wdg_00175
SRS_SPAL_12068	The modules of the MCAL shall be initialized in a defined sequence	SWS_Wdg_00175
SRS_SPAL_12069	All drivers of the SPAL that wake up from a wake-up interrupt shall report the wake-up reason	SWS_Wdg_00175
SRS_SPAL_12075	All drivers with random streaming capabilities shall use application	SWS_Wdg_00175

	buffers	
SRS_SPAL_12077	All drivers shall provide a non blocking implementation	SWS_Wdg_00175
SRS_SPAL_12078	The drivers shall be coded in a way that is most efficient in terms of memory and runtime resources	SWS_Wdg_00175
SRS_SPAL_12092	The driver's API shall be accessed by its handler or manager	SWS_Wdg_00076
SRS_SPAL_12125	All driver modules shall only initialize the configured resources	SWS_Wdg_00100, SWS_Wdg_00101
SRS_SPAL_12129	The ISRs shall be responsible for resetting the interrupt flags and calling the according notification function	SWS_Wdg_00166
SRS_SPAL_12163	All driver modules shall implement an interface for de-initialization	SWS_Wdg_00025, SWS_Wdg_00026, SWS_Wdg_00031
SRS_SPAL_12263	The implementation of all driver modules shall allow the configuration of specific module parameter types at link time	SWS_Wdg_00079
SRS_SPAL_12265	Configuration data shall be kept constant	SWS_Wdg_00175
SRS_SPAL_12267	Wakeup sources shall be initialized by MCAL drivers and/or the MCU driver	SWS_Wdg_00175
SRS_SPAL_12448	All driver modules shall have a specific behavior after a development error detection	SWS_Wdg_00017, SWS_Wdg_00089, SWS_Wdg_00090, SWS_Wdg_00091, SWS_Wdg_00092
SRS_SPAL_12461	Specific rules regarding initialization of controller registers shall apply to all driver implementations	SWS_Wdg_00100, SWS_Wdg_00101
SRS_SPAL_12462	The register initialization settings shall be published	SWS_Wdg_00175
SRS_SPAL_12463	The register initialization settings shall be combined and forwarded	SWS_Wdg_00175
SRS_Wdg_12015	The watchdog driver shall allow the static configuration of watchdog modes	SWS_Wdg_00051, SWS_Wdg_00160
SRS_Wdg_12018	The watchdog driver shall provide a service for selecting the watchdog mode	SWS_Wdg_00160
SRS_Wdg_12019	The watchdog driver shall provide a watchdog trigger routine.	SWS_Wdg_00093, SWS_Wdg_00094, SWS_Wdg_00095, SWS_Wdg_00134, SWS_Wdg_00135, SWS_Wdg_00144, SWS_Wdg_00166
SRS_Wdg_12105	The watchdog driver shall provide an initialization service that allows the selection of one of the statically configured watchdog modes	SWS_Wdg_00001, SWS_Wdg_00100, SWS_Wdg_00101

SRS_Wdg_12106	The disabling of the watchdog shall not be possible	SWS_Wdg_00025, SWS_Wdg_00026
SRS_Wdg_12165	For an external watchdog driver the same requirements shall apply like for an internal watchdog driver	SWS_Wdg_00077
SRS_Wdg_12166	A driver for an external SPI watchdog shall allow the static configuration of the required SPI parameters	SWS_Wdg_00078
SRS_Wdg_12167	The external watchdog driver shall have a semantically identical API as an internal watchdog driver	SWS_Wdg_00175
SRS_Wdg_12168	The source code of the external watchdog driver shall be independent from the underlying microcontroller	SWS_Wdg_00175

7 Functional specification

7.1 General design rules

[SWS_Wdg_00086] ⌈The Wdg module shall statically check the configuration parameters (at the latest during compile time) for correctness.⌋ (SRS_BSW_00167, SRS_BSW_00004)

[SWS_Wdg_00031] ⌈The Wdg module shall not implement an interface for de-initialization/shutdown. If the watchdog supports a de-initialization/shutdown and the environment allows the usage of this feature, the de-initialization/shutdown shall be achieved by calling the `Wdg_SetMode` routine with OFF mode parameter.⌋ (SRS_BSW_00336, SRS_SPAL_12163)

Rationale: Some watchdogs do not support the de-initialization/shutdown functionality and in some environments this feature must not be used (e.g. in safety critical systems).

[SWS_Wdg_00034] ⌈The start address of the watchdog trigger routine shall be statically configurable to a fixed memory location by the user. The user needs to take care that
Configured memory location is valid for the platform on which driver is being implemented on.This configuration parameter shall only be given if supported/needed by the hardware.⌋ ()

Rationale: This allows the watchdog device to identify the correct trigger input if supported by the hardware.

[SWS_Wdg_00040] ⌈If interrupts have to be disabled in order to ensure data consistency or correct functionality of this module (e.g. while switching the watchdog mode or during the watchdog trigger routine), this shall be done by using the corresponding BSW Scheduler functionality if possible (this means definition of an exclusive area). The internal watchdog driver (because it belongs to MCAL) may also directly disable interrupts – see SRS_BSW_00429.⌋ (SRS_BSW_00426, SRS_BSW_00429)

[SWS_Wdg_00168] ⌈Depending on a static configuration (see ECUC_Wdg_00147), the code of the Wdg module is executed either from ROM or from RAM.⌋ ()

Motivation: For certain use cases, e.g. for flash programming in bootloader mode, the watchdog module has to be part of an executable which runs in RAM.

Hint: This is more a requirement for the build environment than for the watchdog module itself. However, since it might also influence the implementation of the code, it is stated here and a corresponding configuration parameter is given.

7.2 Error classification

[SWS_Wdg_00010] ⌈The Wdg module shall detect the following errors and exceptions depending on its configuration (development/production mode):

Type or error	*Related error code*	*Value [hex]*
API service used in wrong context (e.g. module not initialized).	WDG_E_DRIVER_STATE	0x10
API service called with wrong / inconsistent parameter(s)	WDG_E_PARAM_MODE WDG_E_PARAM_CONFIG	0x11 0x12
The passed timeout value is higher than the maximum timeout value	WDG_E_PARAM_TIMEOUT	0x13
API is called with wrong pointer value (e.g. NULL pointer)	WDG_E_PARAM_POINTER	0x14

⌋(SRS_BSW_00337, SRS_BSW_00385, SRS_BSW_00327, SRS_BSW_00331)

7.3 Production errors

There exist no Production Errors for the WatchdogDriver.

7.4 Extended production errors

Type or error	*Related error code*	*Value [hex]*
Setting a watchdog mode failed (during initialization or mode switch).	WDG_E_MODE_FAILED	Assigned by DEM
Initialization or watchdog mode switch failed because it would disable the watchdog though this is not allowed in this configuration	WDG_E_DISABLE_REJECTED	Assigned by DEM

7.5 Error detection

For details refer to the chapter 7.3 “Error Detection” in *SWS_BSWGeneral.*

7.6 Error notification

For details refer to the chapter 7.4 “Error notification” in *SWS_BSWGeneral.*

7.7 External watchdog driver

[SWS_Wdg_00076] ⌈To access the external watchdog hardware, the corresponding Wdg module instance shall use the functionality and API of the corresponding handler or driver, e.g. the SPI handler or DIO driver.⌋ (SRS_SPAL_12092)

[SWS_Wdg_00162] ⌈The routine servicing an external watchdog shall be implemented by usage of an own internal hardware timer to be independent from other peripherals or by using a GPT driver callback ⌋

Hint: An external watchdog driver is part of the Onboard Device Abstraction Layer (see [1]), which excludes direct hardware access.
This architectural discrepancy will be resolved in an upcoming release.

[SWS_Wdg_00077] ⌈A Wdg module for an external watchdog shall satisfy the same functional requirements and offer the same functional scope as a Wdg module for an internal watchdog. Hence their respective APIs are semantically identical.⌋ (SRS_Wdg_12165)

[SWS_Wdg_00078] ⌈The Wdg module shall add all parameters required for accessing the external watchdog hardware, e.g. the used SPI channel or DIO port, to the module's published parameters and to the module's configuration parameters.⌋ (SRS_Wdg_12166)

7.8 Internal watchdog driver

[SWS_Wdg_00161] ⌈To access the internal watchdog hardware, the corresponding Wdg module instance shall access the hardware for watchdog servicing directly.⌋ ()

Hint: An internal watchdog driver is part of the Microcontroller Abstraction Layer (see [1]), which allows direct hardware access.

[SWS_Wdg_00166] ⌈The routine servicing an internal watchdog shall be implemented as an interrupt routine driven by a hardware timer⌋ (SRS_BSW_00427, SRS_BSW_00164, SRS_BSW_00325, SRS_BSW_00326, SRS_BSW_00439, SRS_SPAL_12129, SRS_Wdg_12019)

Notes:
In both cases, the watchdog servicing routine runs in interrupt context.

If the watchdog servicing routine is implemented as an interrupt routine (i.e. as a cat1 or cat2 interrupt routine and not via the GPT), it shall be described in the Basic Software Module Description and the implementation shall follow the requirements for interrupt handling as given by [2] and [2] [3] (SRS_BSW_00427, SRS_BSW_00325, SRS_BSW_00326, SRS_BSW_00439, SRS_BSW_00314, SRS_BSW_00429, SRS_SPAL_12129).

7.9 Triggering concept to support windowed watchdogs

In former versions of this specification, the watchdog servicing routine was called from an upper layer of the software which made it difficult to guarantee timing constraints namely for windowed watchdog conditions. This concept has been changed leading to the requirements explained in this chapter.

The basic idea of this concept is to decouple the timing for servicing the watchdog hardware from the logical control.

As already stated by SWS_Wdg_00162 and SWS_Wdg_00166, the time base for triggering the watchdog shall be provided by means of a hardware. This ensures minimum timing jitter.

These two requirements SWS_Wdg_00162 and SWS_Wdg_00166 also imply that servicing of the watchdog hardware is done directly from a timer ISR. This ensures minimum latencies.

These two conditions – minimum jitter and latencies - ensure that the time window of a windowed watchdog can be met.

The Wdg Driver expects, that the logical control of the watchdog (whether the watchdog shall be triggered or not) shall be the responsibility of the environment, e.g. the Wdg Manager, so that the basic concepts of the Wdg Manager (alive supervision) shall remain unchanged.

[SWS_Wdg_00144] ⌈The Wdg Manager (or other entities) shall control the watchdog driver via a so called trigger condition: as long as the trigger condition is valid the Wdg Driver services the watchdog hardware, if the trigger condition becomes invalid the Wdg Driver stops triggering and the watchdog expires.
The semantics of the trigger condition can be interpreted as a “permission to service the watchdog for the next n milliseconds”. Within this time frame the trigger condition has to be updated by the controlling entity else the watchdog will expire.
Handover of the watchdog control logic is simply done by shared usage of the trigger condition (e.g. during startup / shutdown).⌋ (SRS_Wdg_12019)

[SWS_Wdg_00134] ⌈If the trigger counter is greater than zero, the watchdog servicing routine shall decrement the trigger counter and trigger the hardware watchdog.⌋ (SRS_Wdg_12019)

[SWS_Wdg_00135] ⌈If the trigger counter has reached zero, the watchdog servicing routine shall do nothing (i.e. the watchdog is not triggered and will therefore expire).⌋ (SRS_Wdg_12019)

[SWS_Wdg_00093] ⌈If the watchdog hardware requires an activation code which can be configured or changed, the Wdg Driver shall handle the activation code internally. In this case, the Wdg Driver shall pass the correct activation code to the watchdog hardware and the watchdog hardware in turn shall update the Wdg

module's internal variable where the next expected access code is stored.⌋ (SRS_Wdg_12019)

[SWS_Wdg_00094] ⌈If the watchdog hardware requires an activation code which can be configured or changed, the trigger cycle of the Wdg Driver shall be defined with a value so that updating the activation code by the watchdog hardware can be guaranteed (see **Figure 3**).
⌋ (SRS_Wdg_12019)

[SWS_Wdg_00095] ⌈If the watchdog hardware requires an activation code which can be configured or changed and the initial activation code can be configured, the activation code shall be provided in the Wdg Driver's configuration set. If the activation code is fixed for a particular hardware the above requirement can be ignored.⌋ (SRS_Wdg_12019)

[SWS_Wdg_00035] ⌈When development error detection is enabled for the Wdg Driver module: the watchdog servicing routine shall check whether the Wdg module's state is `WDG_IDLE` (meaning the watchdog driver and hardware are initialized and the watchdog is currently not being triggered or switched). If this is not the case, the function shall not trigger the watchdog hardware but raise the development error `WDG_E_DRIVER_STATE`.⌋ (SRS_BSW_00338)

[SWS_Wdg_00052] ⌈When development error detection or debugging support is enabled for the Wdg Driver module: the watchdog servicing routine shall set the Wdg module's state to `WDG_BUSY` during its execution (indicating, that the module is busy) and shall reset the module's state to `WDG_IDLE` (indicating, that the module is initialized and not busy) as last operation before it returns.⌋ (SRS_BSW_00338)

Note: This specification prescribes the symbols `WDG_IDLE` and `WDG_BUSY` only, if they are externally visible, e.g. for debugging (see SRS_BSW_00335). Choosing the data type for the status variable is up to the implementation.

Hint for the integration: The Wdg module's environment shall make sure that the Wdg Driver module has been initialized before watchdog servicing routine is called.

7.10 Debugging

[SWS_Wdg_00152] ⌈The internal state of the module (which indicates whether it is not initialized, idle or busy) shall be available for debugging.⌋ ()

[SWS_Wdg_00153] ⌈The internal variable for the watchdog timeout counter shall be available for debugging.⌋ ()

[SWS_Wdg_00154] ⌈The internal variable for the watchdog mode shall be available for debugging.⌋ ()

8 API specification

[SWS_Wdg_00172] ⌈If more than one watchdog driver instance exits on an ECU (namely an external and an internal one) the API names and instance specific type names specified in this chapter shall be made unique by expansion according to SRS_BSW_00347. ⌋(SRS_BSW_00347)

8.1 Imported types

In this chapter all types included from the following files are listed:

[SWS_Wdg_00105] ⌈

Module	*Imported Type*
Dem	Dem_EventIdType
	Dem_EventStatusType
Std_Types	Std_ReturnType
	Std_VersionInfoType
WdgIf	WdgIf_ModeType

⌋()

8.2 Type definitions

8.2.1 Wdg_ConfigType

[SWS_Wdg_00171] ⌈

Name:	`Wdg_ConfigType`	
Type:	`Structure`	
Range:	`Hardware dependent structure`	Structure to hold the watchdog driver configuration set.
Description:	Used for pointers to structures holding configuration data provided to the Wdg module initialization routine for configuration of the module and watchdog hardware.	

⌋(SRS_BSW_00414)

8.3 Function definitions

8.3.1 Wdg_Init

[SWS_Wdg_00106] ⌈

Service name:	Wdg_Init
Syntax:	`void Wdg_Init(` `  const Wdg_ConfigType* ConfigPtr`

	)	
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:	Initializes the module.	

⌋ (SRS_BSW_00358, SRS_BSW_00414)

[SWS_Wdg_00001] ⌈The `Wdg_Init` function shall initialize the Wdg module and the watchdog hardware, i.e. it shall set the default watchdog mode and timeout period as provided in the configuration set.⌋ (SRS_BSW_00400, SRS_BSW_00101, SRS_Wdg_12105)

Note:
Via post-build configuration, the user can choose the configuration set to be used with the `Wdg_Init` function from a limited number of statically configured sets (see also SRS_BSW_00314).

[SWS_Wdg_00100] ⌈The `Wdg_Init` function shall initialize all global variables of the Wdg module and set the default watchdog mode and initial timeout period⌋ (SRS_SPAL_12057, SRS_SPAL_12125, SRS_SPAL_12461, SRS_Wdg_12105)

[SWS_Wdg_00101] ⌈The `Wdg_Init` function shall initialize those controller registers that are needed for controlling the watchdog hardware and that do not influence/depend on other (hardware) modules.

Registers that can influence or depend on other modules are initialized by a common system module.⌋ (SRS_SPAL_12057, SRS_SPAL_12125, SRS_SPAL_12461, SRS_Wdg_12105)

[SWS_Wdg_00025] ⌈If disabling the watchdog is not allowed (because pre-compile configuration parameter `WdgDisableAllowed==OFF`) and if the default mode given in the provided configuration set disables the watchdog, the `Wdg_Init` function shall not execute the initialization but raise the extended production error `WDG_E_DISABLE_REJECTED`.⌋ (SRS_BSW_00338, SRS_BSW_00323, SRS_SPAL_12163, SRS_Wdg_12106)

[SWS_Wdg_00173] ⌈If switching the Wdg module and the watchdog hardware into the default mode is not possible, e.g. because of inconsistent mode settings or because some timing constraints have not been met, the `Wdg_Init` function shall raise the extended production error `WDG_E_MODE_FAILED`.⌋ ()

[SWS_Wdg_00089] ⌈When development error detection is enabled for the Wdg module: The function `Wdg_Init` shall check that the parameter `ConfigPtr` is not NULL (except for the Pre-Compiled variant). If this error is detected, the function Wdg_Init shall not execute the initialization but raise the development error `WDG_E_PARAM_POINTER.`⌋ (SRS_BSW_00338, SRS_BSW_00323, SRS_SPAL_12448)

[SWS_Wdg_00090] ⌈When development error detection is enabled for the Wdg module: The `Wdg_Init` function shall check that the (hardware specific) contents of the given configuration set is within the allowed boundaries. If this error is detected, the function `Wdg_Init` shall not execute the initialization but raise the extended error `WDG_E_PARAM_CONFIG`.⌋ (SRS_BSW_00338, SRS_BSW_00323, SRS_SPAL_12448)

[SWS_Wdg_00019] ⌈When development error detection or debugging support is enabled for the Wdg module: The `Wdg_Init` function shall set the Wdg module's internal state from `WDG_UNINIT` (the default state indicating a non-initialized module) to `WDG_IDLE` if the initialization was successful.⌋ (SRS_BSW_00406, SRS_BSW_00335)

Note: This specification prescribes the symbols `WDG_IDLE` and `WDG_UNINIT` only, if they are externally visible, e.g. for debugging (see SRS_BSW_00335). Choosing the data type for the status variable is up to the implementation.

8.3.2 Wdg_SetMode

[SWS_Wdg_00107] ⌈

Service name:	Wdg_SetMode	
Syntax:	`Std_ReturnType Wdg_SetMode( WdgIf_ModeType Mode )`	
Service ID[hex]:	0x01	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	Mode	One of the following statically configured modes: 1. WDGIF_OFF_MODE 2. WDGIF_SLOW_MODE 3. WDGIF_FAST_MODE
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	Std_ReturnType.
Description:	Switches the watchdog into the mode Mode.	

⌋ ()

[SWS_Wdg_00160] ⌈The function `Wdg_SetMode` shall switch the watchdog driver from the current watchdog mode into the mode given by the argument `Mode`. This means: By choosing one of a limited number of statically configured settings (e.g. toggle or window watchdog, different timeout periods) the Wdg module and the watchdog hardware are switched to one of the following three different modes:

- WDGIF_OFF_MODE
- WDGIF_SLOW_MODE
- WDGIF_FAST_MODE ⌋ (SRS_Wdg_12015, SRS_Wdg_12018)

[SWS_Wdg_00051] ⌈The configuration set provided to the Wdg module's initialization routine shall contain the hardware / driver specific parameters to be used in the different watchdog modes.⌋ (SRS_Wdg_12015)

[SWS_Wdg_00145] ⌈The `Wdg_SetMode` function shall reset the watchdog timeout counter based on the new watchdog mode i.e. the timeout frame remaining shall be recalculated based on a changed trigger period.⌋ ()

[SWS_Wdg_00103] ⌈The `Wdg_SetMode` function shall return `E_OK` if the mode switch has been executed completely and successfully, i.e. all parameters of the Wdg module and the watchdog hardware have been set to the new values⌋ ()

[SWS_Wdg_00016] ⌈If switching the Wdg module and the watchdog hardware into the requested mode is not possible, e.g. because of inconsistent mode settings or because some timing constraints have not been met, the `Wdg_SetMode` function shall return the value `E_NOT_OK` and raise the extended production error `WDG_E_MODE_FAILED`.⌋ (SRS_SPAL_12064)

[SWS_Wdg_00026] ⌈If disabling the watchdog is not allowed (e.g. in safety relevant systems, seeECUC_Wdg_00115) the `Wdg_SetMode` function shall check whether the settings for the requested mode would disable the watchdog. In this case, the function shall not execute the mode switch but raise the extended production error `WDG_E_DISABLE_REJECTED` and return with the value `E_NOT_OK`.⌋ (SRS_BSW_00338, SRS_BSW_00323, SRS_SPAL_12163, SRS_Wdg_12106)

[SWS_Wdg_00091] ⌈When development error detection is enabled for the Wdg module: The `Wdg_SetMode` function shall check that the parameter Mode is within the allowed range. If this is not the case, the function shall not execute the mode switch but raise development error `WDG_E_PARAM_MODE` and return with the value `E_NOT_OK`⌋ (SRS_BSW_00338, SRS_BSW_00323, SRS_SPAL_12448)

[SWS_Wdg_00092] ⌈When development error detection is enabled for the Wdg module: The `Wdg_SetMode` function shall check that the (hardware specific) settings for the requested mode are within the allowed boundaries. If this is not the case, the function shall not execute the mode switch but raise the development error `WDG_E_PARAM_MODE` and return with the value `E_NOT_OK`. ⌋ (SRS_BSW_00338, SRS_BSW_00323, SRS_SPAL_12448)

[SWS_Wdg_00017] ⌈When development error detection is enabled for the Wdg module: The `Wdg_SetMode` function shall check that the Wdg module's state is `WDG_IDLE` (meaning the Wdg module and the watchdog hardware are initialized and the watchdog is currently not being triggered or switched). If this is not the case, the function shall not execute the mode switch but raise the development error `WDG_E_DRIVER_STATE` and return with the value `E_NOT_OK`. ⌋ (SRS_BSW_00338, SRS_BSW_00335, SRS_SPAL_12064, SRS_SPAL_12448)

[SWS_Wdg_00018] ⌈When development error detection or debugging support is enabled for the Wdg module: The function `Wdg_SetMode` shall set the Wdg module's state to `WDG_BUSY` during its execution (indicating, that the module is busy) and shall reset the Wdg module's state to `WDG_IDLE` as last operation before it returns to the caller.⌋ (SRS_BSW_00338, SRS_BSW_00335)

Note: This specification prescribes the symbols `WDG_IDLE` and `WDG_BUSY` only, if they are externally visible, e.g. for debugging (see SRS_BSW_00335). Choosing the data type for the status variable is up to the implementation.

8.3.3 Wdg_SetTriggerCondition

[SWS_Wdg_00155] ⌈

Service name:	Wdg_SetTriggerCondition

Syntax:	`void Wdg_SetTriggerCondition(`
	`  uint16 timeout`
	`)`

Service ID[hex]:	0x03
Sync/Async:	Synchronous
Reentrancy:	Non Reentrant
Parameters (in):	timeout — Timeout value (milliseconds) for setting the trigger counter.
Parameters (inout):	None
Parameters (out):	None
Return value:	None
Description:	Sets the timeout value for the trigger counter.

⌋ (SRS_BSW_00343)

[SWS_Wdg_00136] ⌈The function `Wdg_SetTriggerCondition` shall reset the watchdog timeout counter according to the timeout value passed.⌋ ()

[SWS_Wdg_00138] ⌈The timeout value passed shall be interpreted as 'milliseconds'. The conversion from milliseconds to the corresponding counter value shall be done internally by the Wdg module.⌋ ()

[SWS_Wdg_00139] ⌈The current watchdog mode shall be taken into account when calculating the counter value from the timeout parameter.⌋ ()

[SWS_Wdg_00140] ⌈This function shall also allow to set "0" as the time frame for triggering which will result in an (almost) immediate stop of the watchdog triggering and an (almost) instantaneous watchdog reset of the ECU.⌋ ()

[SWS_Wdg_00146] ⌈When development error detection is enabled for the module: The function `Wdg_SetTriggerCondition` shall check that the timeout parameter given is less or equal to the maximum timeout value (`WdgMaxTimeout`). If this is not

the case the function shall not reload the timeout counter but raise the development error `WDG_E_PARAM_TIMEOUT` and return to the caller.⌋ ()

8.3.4 Wdg_GetVersionInfo

[SWS_Wdg_00109] ⌈

Service name:	Wdg_GetVersionInfo
Syntax:	`void Wdg_GetVersionInfo( Std_VersionInfoType* versioninfo )`
Service ID[hex]:	0x04
Sync/Async:	Synchronous
Reentrancy:	Reentrant
Parameters (in):	None
Parameters (inout):	None
Parameters (out):	versioninfo | Pointer to where to store the version information of this module.
Return value:	None
Description:	Returns the version information of the module.

⌋ ()

[SWS_Wdg_00174] ⌈If DET is enabled for the Wdg Driver module, the function `Wdg_GetVersionInfo` shall raise `WDG_E_PARAM_POINTER`, if the argument is a NULL pointer and return without any action.⌋ ()

8.4 Call-back Notifications

This chapter lists all functions provided by the Wdg module to lower layer modules.

The Wdg module has no call back notifications

8.5 Scheduled functions

This chapter lists all functions provided by the Wdg module and called directly by the Basic Software Module Scheduler.

The Wdg module has no scheduled functions.

8.6 Expected interfaces

This chapter lists all functions that the Wdg module requires from other modules.

8.6.1 Mandatory interfaces

This module does not require any mandatory interfaces.

8.6.2 Optional interfaces

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

[SWS_Wdg_00111] ⌈

API function	*Description*
Dem_ReportErrorStatus	Queues the reported events from the BSW modules (API is only used by BSW modules). The interface has an asynchronous behavior, because the processing of the event is done within the Dem main function. OBD Events Suppression shall be ignored for this computation.
Det_ReportError	Service to report development errors.

In addition to the functions listed above, further functions might be used to access the external watchdog over Dio or Spi. ⌋ ()

8.6.3 Configurable interfaces

This module does not require any configurable interfaces.

9 Sequence diagrams

9.1 Watchdog initialization, setting trigger condition and mode.

The diagram shows the sequence to initialize the Wdg module, to set the trigger condition and to change the watchdog mode. Note that this is only an example. Especially, another “client” module than the Watchdog Manager (WdgM) could set the trigger condition.

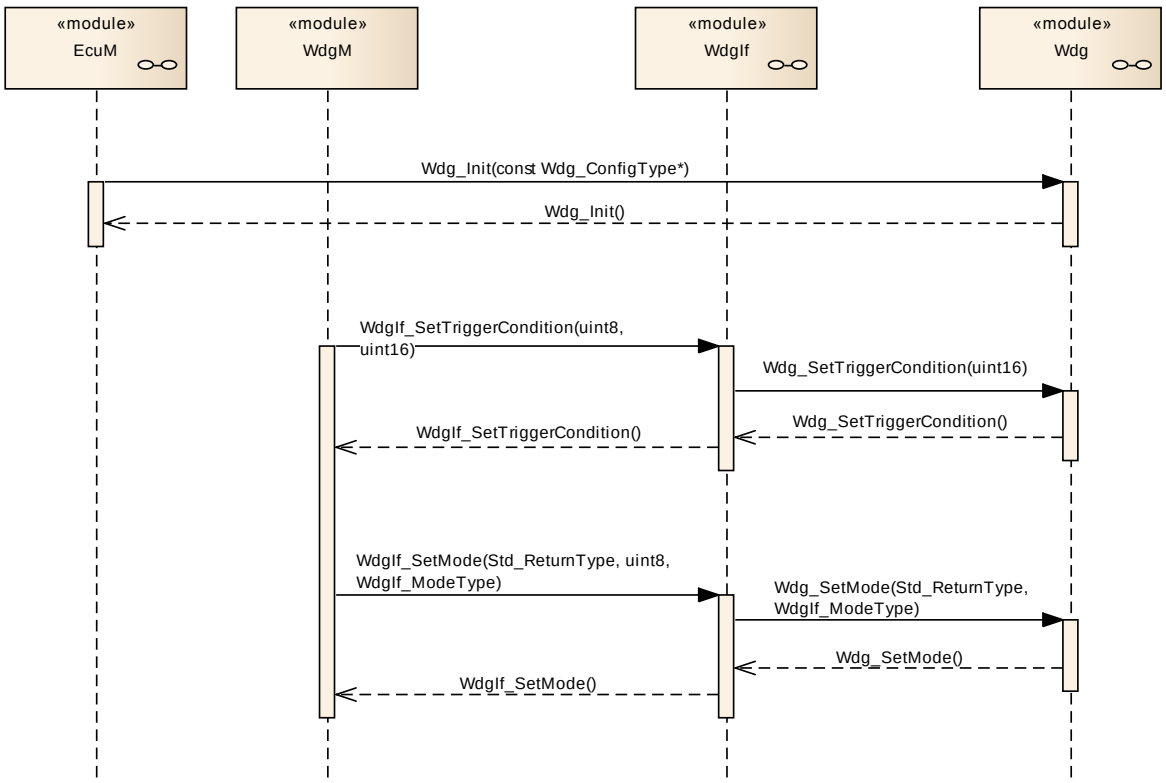

Figure 2: Sequence of watchdog initialization, setting trigger condition and mode switching.

9.2 Data exchange between watchdog driver and hardware

The diagram shows the sequence to trigger the watchdog hardware. Note that this is only an example. For an external watchdog, the watchdog hardware cannot be accessed directly, but only via drivers of the MCAL layer, like SPI or DIO.

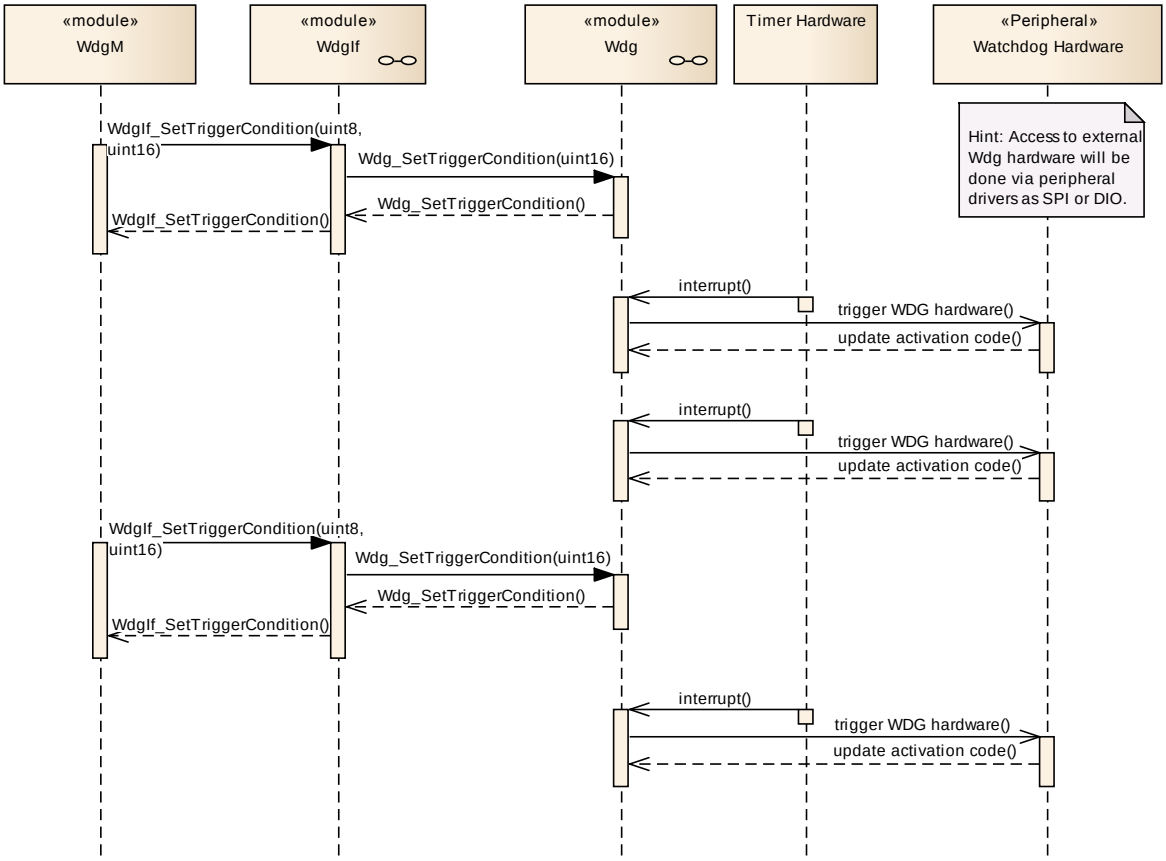

Figure 3: Data exchange between watchdog driver and hardware

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 Wdg.

Chapter 10.3 specifies published information of the module Wdg.

10.1 How to read this chapter

For details refer to the chapter 10.1 “Introduction to configuration specification” in *SWS_BSWGeneral.*

10.2 Containers and configuration parameters

The following chapters summarize all configuration parameters. The detailed meanings of the parameters describe Chapters 7 and Chapter 8.

10.2.1 Variants

[SWS_Wdg_00157] ⌈This module shall support the configuration variant VARIANT-PRE-COMPILE. Only parameters with "Pre-compile time" configuration are allowed in this variant.⌋ ()

[SWS_Wdg_00158] ⌈This module shall support the configuration variant VARIANT-LINK-TIME.
Parameters with "Pre-compile time" and "Link time" are allowed in this variant.⌋ ()

[SWS_Wdg_00159] ⌈This module shall support the configuration variant VARIANT-POST-BUILD. Parameters with "Pre-compile time", "Link time" and "Post-build time" are allowed in this variant.⌋ ()

10.2.2 Wdg

SWS Item	**ECUC_Wdg_00073 :**
Module Name	*Wdg*
Module Description	Configuration of the Wdg (Watchdog driver) module.

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
WdgDemEventParameterRefs	0..1	Container for the references to DemEventParameter elements which shall be invoked using the API Dem_ReportErrorStatus in case the corresponding error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId value. The standardized errors are provided in the container and can be extended by vendor-specific error references.
WdgGeneral	1	All general parameters of the watchdog driver are collected here.
WdgPublishedInformation	1	Container holding all Wdg specific published information parameters
WdgSettingsConfig	1	Configuration items for the different watchdog settings, including those for external watchdog hardware. Note: All postbuild parameters are handled via this container.

10.2.3 WdgDemEventParameterRefs

SWS Item	**ECUC_Wdg_00148 :**
Container Name	WdgDemEventParameterRefs
Description	Container for the references to DemEventParameter elements which shall be invoked using the API Dem_ReportErrorStatus in case the corresponding error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId value.

	The standardized errors are provided in the container and can be extended by vendor-specific error references.
Configuration Parameters	

SWS Item	**ECUC_Wdg_00150 :**		
Name	WDG_E_DISABLE_REJECTED		
Description	Reference to the DemEventParameter which shall be issued when the error "Initialization or mode switch failed because it would disable the watchdog" has occurred.		
Multiplicity	0..1		
Type	Symbolic name reference to [DemEventParameter]		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Wdg_00149 :**		
Name	WDG_E_MODE_FAILED		
Description	Reference to the DemEventParameter which shall be issued when the error "Setting a watchdog mode failed (during initialization or mode switch)" has occurred.		
Multiplicity	0..1		
Type	Symbolic name reference to [DemEventParameter]		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

No Included Containers

10.2.4 WdgGeneral

SWS Item	**ECUC_Wdg_00114 :**
Container Name	WdgGeneral
Description	All general parameters of the watchdog driver are collected here.
Configuration Parameters	

SWS Item	**ECUC_Wdg_00115 :**		
Name	WdgDevErrorDetect {WDG_DEV_ERROR_DETECT}		
Description	Compile switch to enable / disable development error detection for this module. True: Development error detection enabled False: Development error detection disabled		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Wdg_00116 :**
Name	WdgDisableAllowed {WDG_DISABLE_ALLOWED}
Description	Compile switch to allow / forbid disabling the watchdog driver during runtime. True: Disabling the watchdog driver at runtime is allowed. False: Disabling

	the watchdog driver at runtime is not allowed.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local dependency: Safety relevant compile switch, this has to be in accordance with the corresponding settings for the watchdog manager.		

SWS Item	**ECUC_Wdg_00117 :**		
Name	WdgIndex		
Description	Represents the watchdog driver's ID so that it can be referenced by the watchdog interface.		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 255		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Wdg_00130 :**		
Name	WdgInitialTimeout		
Description	The initial timeout (sec) for the trigger condition to be initialized during Init function. It shall be not larger than WdgMaxTimeout.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	0 .. 65.535		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Wdg_00131 :**		
Name	WdgMaxTimeout		
Description	The maximum timeout (sec) to which the watchdog trigger condition can be initialized.		
Multiplicity	1		
Type	EcucFloatParamDef		
Range	0 .. 65.535		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Wdg_00147 :**
Name	WdgRunArea
Description	Represents the watchdog driver execution area is either from ROM(Flash) or RAM as required with the particular microcontroller.
Multiplicity	1
Type	EcucEnumerationParamDef

Range	RAM	Watchdog driver to be executed out of RAM area	
	ROM	Watchdog driver to be executed out of ROM area	
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Wdg_00118 :**		
Name	WdgTriggerLocation {WDG_TRIGGER_LOCATION}		
Description	Location (memory address) of the watchdog trigger routine.		
Multiplicity	1		
Type	EcucFunctionNameDef		
Default value	--		
maxLength	--		
minLength	--		
regularExpression	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local dependency: Only relevant if provided by hardware and needed by the system.		

SWS Item	**ECUC_Wdg_00119 :**		
Name	WdgVersionInfoApi		
Description	Compile switch to enable / disable the version information API • True: API enabled • False: API disabled		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

No Included Containers

10.2.5 WdgSettingsConfig

SWS Item	**ECUC_Wdg_00082 :**
Container Name	WdgSettingsConfig [Multi Config Container]
Description	Configuration items for the different watchdog settings, including those for external watchdog hardware. Note: All postbuild parameters are handled via this container.
Configuration Parameters	

SWS Item	**ECUC_Wdg_00120 :**
Name	WdgDefaultMode {WDG_DEFAULT_MODE}
Description	Default mode for watchdog driver initialization. ImplementationType: WdgIf_ModeType
Multiplicity	1

Type	EcucEnumerationParamDef		
Range	WDGIF_FAST_MODE	Default watchdog mode is "fast"	
	WDGIF_OFF_MODE	Default watchdog mode is "off"	
	WDGIF_SLOW_MODE	Default watchdog mode is "slow"	
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local dependency: "Off" mode only possible if disabling the watchdog driver is allowed.		

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
WdgExternalConfiguration	0..1	Configuration items for an external watchdog hardware
WdgSettingsFast	1	Hardware dependent settings for the watchdog driver's "fast" mode.
WdgSettingsOff	1	Hardware dependent settings for the watchdog driver's "off" mode.
WdgSettingsSlow	1	Hardware dependent settings for the watchdog driver's "slow" mode.

Note:
The three modes are provided as containers for the reason that they might be referred by other modules and hence no parameters are needed. However those containers might be extended by the vendor (resp. hardware) specific configuration parameters, but these could not be standardized.

10.2.6 WdgSettingsFast

SWS Item	**ECUC_Wdg_00121 :**
Container Name	WdgSettingsFast{WDG_SETTINGS_FAST}
Description	Hardware dependent settings for the watchdog driver's "fast" mode.
Configuration Parameters	

No Included Containers

10.2.7 WdgSettingsSlow

SWS Item	**ECUC_Wdg_00123 :**
Container Name	WdgSettingsSlow{WDG_SETTINGS_SLOW}
Description	Hardware dependent settings for the watchdog driver's "slow" mode.
Configuration Parameters	

No Included Containers

10.2.8 WdgSettingsOff

SWS Item	**ECUC_Wdg_00122 :**
Container Name	WdgSettingsOff{WDG_SETTINGS_OFF}
Description	Hardware dependent settings for the watchdog driver's "off" mode.
Configuration Parameters	

No Included Containers

10.2.9 WdgExternalConfiguration

SWS Item	**ECUC_Wdg_00112 :**
Container Name	WdgExternalConfiguration{Wdg_ExternalConfiguration}
Description	Configuration items for an external watchdog hardware
Configuration Parameters	

SWS Item	**ECUC_Wdg_00113 :**		
Name	WdgExternalContainerRef {WDG_EXTERNAL_CONTAINER_REF}		
Description	Reference to either - a DioChannelGroup container in case the hardware watchdog is connected via DIO pins - an SpiSequenceConfiguration container in case the watchdog hardware is accessed via SPI		
Multiplicity	0..1		
Type	Choice reference to [DioChannelGroup , SpiSequence]		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	X	VARIANT-POST-BUILD
Scope / Dependency	scope: local dependency: See DIO resp. SPI SWS		

No Included Containers

10.3 Published information

For details refer to the chapter 10.3 “Published Information” in *SWS_BSWGeneral.*

10.3.1 WdgPublishedInformation

SWS Item	**ECUC_Wdg_00074 :**
Container Name	WdgPublishedInformation
Description	Container holding all Wdg specific published information parameters
Configuration Parameters	

SWS Item	**ECUC_Wdg_00127 :**		
Name	WdgTriggerMode {WDG_TRIGGER_MODE}		
Description	Watchdog trigger mode (toggle/window/both)		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	WDG_BOTH	--	
	WDG_TOGGLE	--	
	WDG_WINDOW	--	
ConfigurationClass	***Published Information***	X	All Variants
Scope / Dependency	scope: local		

No Included Containers

Note:
`WdgTriggerMode` is only published for information purposes; this parameter is not used to configure the Watchdog Driver or the modules using the Watchdog Driver.

11 Not applicable requirements

[SWS_Wdg_00175] ⌈ These requirements are not applicable to this specification.⌋ (SRS_BSW_00344, SRS_BSW_00404, SRS_BSW_00405, SRS_BSW_00170, SRS_BSW_00419, SRS_BSW_00383, SRS_BSW_00375, SRS_BSW_00416, SRS_BSW_00437, SRS_BSW_00168, SRS_BSW_00423, SRS_BSW_00424, SRS_BSW_00425, SRS_BSW_00428, SRS_BSW_00432, SRS_BSW_00433, SRS_BSW_00450, BSW00434, SRS_BSW_00339, SRS_BSW_00422, SRS_BSW_00417, SRS_BSW_00161, SRS_BSW_00162, SRS_BSW_00005, SRS_BSW_00415, SRS_BSW_00007, SRS_BSW_00413, SRS_BSW_00441, SRS_BSW_00307, SRS_BSW_00373, SRS_BSW_00410, SRS_BSW_00447, SRS_BSW_00348, SRS_BSW_00353, SRS_BSW_00361, SRS_BSW_00302, SRS_BSW_00328, SRS_BSW_00312, SRS_BSW_00006, SRS_BSW_00449, SRS_BSW_00377, SRS_BSW_00304, SRS_BSW_00355, SRS_BSW_00378, SRS_BSW_00306, SRS_BSW_00308, SRS_BSW_00309, SRS_BSW_00371, SRS_BSW_00376, SRS_BSW_00359, SRS_BSW_00360, SRS_BSW_00440, SRS_BSW_00330, BSW00443, BSW00444, BSW00445, BSW00446, SRS_BSW_00009, SRS_BSW_00401, SRS_BSW_00172, SRS_BSW_00010, SRS_BSW_00333, SRS_BSW_00321, SRS_BSW_00341, SRS_BSW_00334, SRS_SPAL_12056, SRS_SPAL_12267, SRS_SPAL_12462, SRS_SPAL_12463, SRS_SPAL_12068, SRS_SPAL_12069, SRS_SPAL_00157, BSW12155, SRS_SPAL_12063, SRS_SPAL_12075, SRS_SPAL_12067, SRS_SPAL_12077, SRS_SPAL_12078, SRS_SPAL_12265, SRS_Wdg_12167, SRS_Wdg_12168)