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Contents

1 Scope of document

This document specifies the additional TTCAN requirements for the CAN BSW stack.

2 Conventions to be used

2.1 Document Conventions

The representation of requirements in AUTOSAR documents follows the table specified in [TPS_STDT_00078], see Standardization Template, chapter Support for Traceability ([1]).

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

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

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

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

An implementation, which does not include a particular option, SHALL be prepared to interoperate with another implementation, which does include the option, though perhaps with reduced functionality. In the same vein an implementation, which does include a particular option, SHALL be prepared to interoperate with another implemen-

tation, which does not include the option (except, of course, for the feature the option provides.)

3 Acronyms and abbreviations

There are no additional acronyms and abbreviations that are not included in the AUTOSAR Glossary [2].

4 Requirements Specification

This chapter describes all requirements driving the work to define the TTCAN. Only requirements are listed that are additional with respect to the CAN requirements [3].

4.1 Functional Requirements

4.1.1 TTCAN support

4.1.1.1 [SRS_TtCan_41001] The CAN stack shall support TTCAN according to ISO11898.

[SRS_TtCan_41001] The CAN stack shall support TTCAN according to ISO11898. ⌈

Description:	The CAN stack shall additionally support part 4 of ISO11898 Time-triggered communication [4]. TTCAN level 1 and level 2 shall be supported.
Rationale:	–
Use Case:	Time triggered communication, Event synchronized time triggered communication
Dependencies:	–
Supporting Material:	ISO11898-4:2004 [4], RS Features: RS_BRF_00312 [5]

⌋*(RS_BRF_01744)*

4.1.2 CAN Driver with TTCAN functionality

4.1.2.1 Configuration

4.1.2.1.1 [SRS_TtCan_41003] The Hardware Object Handles shall be mappable to all types of time windows defined in ISO 11898 by configuration.

[SRS_TtCan_41003] The Hardware Object Handles shall be mappable to all types of time windows defined in ISO 11898 by configuration. ⌈

Description:	The hardware objects (SRS_Can_01039 CAN SRS) shall be mappable to the specific time windows defined in ISO 11898-4:2004. The configuration parameters shall be allowed to be of types Pre-Compile-Time, Link-Time or Post-Build-Time.
Rationale:	A Hardware object shall be configurable to transmit or receive messages in a specific time window.

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Use Case:	See Rationale.
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋(*RS_BRF_01560*)

4.1.2.1.2 [SRS_TtCan_41014] Configuration interfaces defined in ISO 11898-4:2004 shall be configurable.

[SRS_TtCan_41014] Configuration interfaces defined in ISO 11898-4:2004 shall be configurable. ⌈

Description:	The "configuration interfaces" of chapter 10 of ISO 11898-4:2004 shall be configurable. The configuration parameters shall be allowed to be of types Pre-Compile-Time.
Rationale:	Parameters like e.g. "operation mode" , "master/slave", "trigger" etc. need to be configured.
Use Case:	See Rationale.
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋(*RS_BRF_01744*)

4.1.2.1.3 [SRS_TtCan_41004] The "Appl_Watchdog_Limit" (see chapter 10.1.2.7 of ISO 11898-4:2004) shall be configurable.

[SRS_TtCan_41004] The "Appl_Watchdog_Limit" (see chapter 10.1.2.7 of ISO 11898-4:2004) shall be configurable. ⌈

Description:	Activation of "Application_Watchdog" needs to be configured. The configuration parameter shall be allowed to be of type Pre-Compile-Time, Link-Time or Post-Build-Time.
Rationale:	See description
Use Case:	–
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋(*RS_BRF_01464*)

4.1.2.2 Normal Operation

4.1.2.2.1 [SRS_TtCan_41005] The CAN Driver with TTCAN functionality shall provide means for influencing timing parameters and providing information from the TTCAN controller for synchronization purposes.

[SRS_TtCan_41005] The CAN Driver with TTCAN functionality shall provide means for influencing timing parameters and providing information from the TTCAN controller for synchronization purposes. ⌈

Description:	Timing parameters, synchronization state and master state (see ISO 11898-4:2004 for details) shall be provided by the CAN Driver with TTCAN functionality. If a TTCAN controller is timing master, it shall be possible to adjust the timing parameters during runtime (see ISO 11898-4:2004 for details).
Rationale:	Synchronizing application with communication if required
Use Case:	See Rationale.
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋*(RS_BRF_01432)*

4.1.2.2.2 [SRS_TtCan_41006] The CAN Driver with TTCAN functionality shall support the event synchronized time-triggered communication.

[SRS_TtCan_41006] The CAN Driver with TTCAN functionality shall support the event synchronized time-triggered communication. ⌈

Description:	Event-Synchronized communication (see chapter 5.2.3 of ISO 11898-4:2004) shall be supported.
Rationale:	Synchronizing communication with external events.
Use Case:	See Rationale.
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋*(RS_BRF_01432)*

4.1.2.2.3 [SRS_TtCan_41007] The CAN Driver with TTCAN functionality shall indicate occurred events according to chapter 10.2.2 "Interrupt_Status_Vector" of ISO 11898-4:2004.

[SRS_TtCan_41007] The CAN Driver with TTCAN functionality shall indicate occurred events according to chapter 10.2.2 "Interrupt_Status_Vector" of ISO 11898-4:2004. ⌈

Description:	The events which will be supported by ISO 11898-4 shall be available to application if needed.
Rationale:	See description
Use Case:	Application can react on occurred events.
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋*(RS_BRF_01328)*

4.1.2.3 Fault Operation

4.1.2.3.1 [SRS_TtCan_41008] The CAN Driver with enabled TTCAN functionality shall provide a notification for severe error (S3).

[SRS_TtCan_41008] The CAN Driver with enabled TTCAN functionality shall provide a notification for severe error (S3). ⌈

Description:	The CAN Driver with TTCAN functionality shall notify the CAN Interface with TTCAN functionality if the TTCAN Controller enters error level S3 (Severe Error, see ISO 11898-4:2004 [4]). The notification is done by call of static (non-configurable) callback function implemented inside the CAN Interface with TTCAN functionality.
Rationale:	see ISO 11898-4:2004 [4]
Use Case:	Any state transition is notified to the CAN Interface with TTCAN functionality which forwards this notification to the responsible upper layer.
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋*(RS_BRF_02168)*

4.1.2.3.2 [SRS_TtCan_41009] The CAN Driver with TTCAN functionality shall not recover from severe error (S3) automatically.

[SRS_TtCan_41009] The CAN Driver with TTCAN functionality shall not recover from severe error (S3) automatically. ⌈

Description:	The severe error (S3, see ISO 11898-4:2004 [4]) recovery shall be software driven.
Rationale:	see ISO 11898-4:2004 chapter 9 Failure handling [4]
Use Case:	See Rationale
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋*(RS_BRF_02168)*

4.1.3 CAN Interface with TTCAN functionality

4.1.3.1 [SRS_TtCan_41010] A Job List shall be configurable.

[SRS_TtCan_41010] A Job List shall be configurable. ⌈

Description:	It shall be configurable Pre-Compile-Time and per controller, whether a Job List shall be available.
Rationale:	Handling of BasicCAN hardware objects
Use Case:	–
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋*(RS_BRF_01592)*

4.1.3.2 [SRS_TtCan_41011] If a Job List is available (see SRS_TtCan_41010) it shall be executed by a separate Job List Execution Function.

[SRS_TtCan_41011] If a Job List is available (see SRS_TtCan_41010) it shall be executed by a separate Job List Execution Function. ⌈

Description:	The Job List Execution Function shall be called in task or interrupt context.
Rationale:	Handling of BasicCAN hardware objects
Use Case:	–
Dependencies:	–

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Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋(*RS_BRF_01592*)

4.1.3.3 [SRS_TtCan_41012] "Time Marks" (see ISO 11898-4:2004 [7]) shall be configurable Pre-Compile-Time.

[SRS_TtCan_41012] "Time Marks" (see ISO 11898-4:2004) shall be configurable Pre-Compile-Time. ⌈

Description:	The "Time Marks" of ISO 11898-4:2004 shall be configurable.
Rationale:	–
Use Case:	–
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋(*RS_BRF_01744*)

4.1.3.4 [SRS_TtCan_41013] An occurred severe error (S3) shall be processed as a BusOff (see SRS_Can_01029 of CAN SRS)

[SRS_TtCan_41013] An occurred severe error (S3) shall be processed as a Bus Off (see SRS_Can_01029 of CAN SRS) ⌈

Description:	Severe Error (see ISO 11898-4:2004 [4]), Handling and recovery is the same as for BusOff events.
Rationale:	The required behaviour for an occured severe error (see ISO 11898-4_2004 [4]) is the same as the AUTOSAR BSW behaviour of a detected BusOff.
Use Case:	–
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋(*RS_BRF_01640*)

4.2 Non-Functional Requirements

4.2.1 CAN dependence

4.2.1.1 [SRS_TtCan_41002] The additional TTCAN components shall be integrated into the CAN stack.

[SRS_TtCan_41002] The additional TTCAN components shall be integrated into the CAN stack. ⌈

Description:	TheCAN stack shall be extended by additional APIs, type definitions and functionality to support TTCAN.
Rationale:	TTCAN completely uses the CAN stack. The CAN stack shall not be available twice (code optimization).
Use Case:	–
Dependencies:	–
Supporting Material:	RS Features: RS_BRF_00312 [5]

⌋*(RS_BRF_01744)*

5 Requirements Tracing

The following table references the requirements specified in [6] and links to the fulfillments of these.

Feature	Description	Satisfied by
[RS_BRF_01328]	AUTOSAR RTE shall support scheduling of executable entities on defined events	[SRS_TtCan_41007]
[RS_BRF_01432]	AUTOSAR services shall support system time services	[SRS_TtCan_41005] [SRS_TtCan_41006]
[RS_BRF_01464]	AUTOSAR services shall support standardized handling of watchdogs	[SRS_TtCan_41004]
[RS_BRF_01560]	AUTOSAR communication shall support mapping of signals into transferrable protocol data units	[SRS_TtCan_41003]
[RS_BRF_01592]	AUTOSAR communication shall offer data transfer on user request, time based, and requested via the underlying bus	[SRS_TtCan_41010] [SRS_TtCan_41011]
[RS_BRF_01640]	AUTOSAR communication shall support transmit and receive cancelation	[SRS_TtCan_41013]
[RS_BRF_01744]	AUTOSAR communication shall support TTCAN	[SRS_TtCan_41001] [SRS_TtCan_41002] [SRS_TtCan_41012] [SRS_TtCan_41014]
[RS_BRF_02168]	AUTOSAR diagnostics shall provide a central classification and handling of abnormal operative conditions	[SRS_TtCan_41008] [SRS_TtCan_41009]

6 References

[1] Standardization Template
AUTOSAR_TPS_StandardizationTemplate

[2] Glossary
AUTOSAR_TR_Glossary

[3] Requirements on CAN
AUTOSAR_SRS_CAN

[4] ISO 11898-4:2004 - Road vehicles - Controller area network (CAN) - Part 4: Time-triggered communication

[5] Requirements on AUTOSAR Features
AUTOSAR_RS_Features

[6] Main Requirements
AUTOSAR_RS_Main

[7] Specification of TTCAN Driver
AUTOSAR_SWS_TTCANDriver

[8] Specification of TTCAN Interface
AUTOSAR_SWS_TTCANInterface

[9] General Requirements on Basic Software Modules
AUTOSAR_SRS_BSWGeneral