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# 1 Introduction and functional overview

This specification specifies the functionality, API and the configuration of the AUTOSAR Basic Software module TTCAN Driver (called "Ttcan module" in this document).

The base for this document is ISO 11898-4 [1]. It is assumed that the reader is familiar with this specification. This document will not describe TTCAN functionality again.

The `Ttcan module` is part of the lowest layer, performs the hardware access and offers a hardware independent API to the upper layer.

The only upper layer that has access to the `Ttcan module` is the `TtcanIf` module (see also SRS\_SPAL\_12092).

The `Ttcan` module is an extension of the Can module so this document shall only provide information and specifications which differ from the CAN stack. Some general information is given for a better understanding.

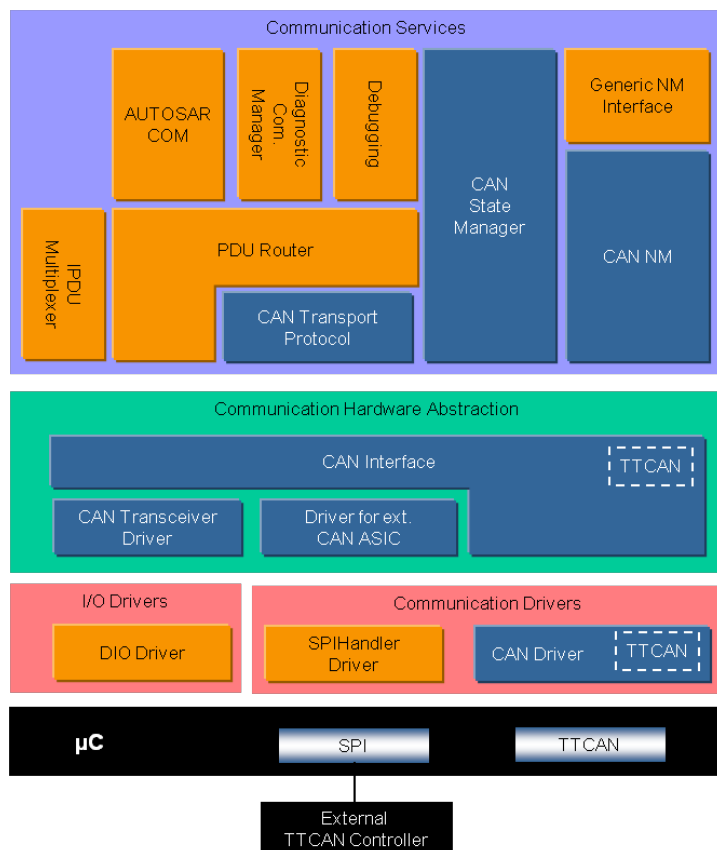


Figure 1.1: AUTOSAR TTCAN Layer Model (see [2])

The `Ttcan module` provides services for initiating transmissions and calls the call-back functions of the `TtcanIf module` for notifying events, independently from the hardware.

Furthermore, it provides services to control the behavior and state of the `TTCAN Controllers` that are belonging to the same TTCAN Hardware Unit.

Several **TTCAN Controllers** can be controlled by a single **Ttcan module** as long as they belong to the same TTCAN Hardware Unit.

Messages, which are configured for **Exclusive Time Windows**, will be transmitted periodically with every **Tx\_Trigger** configured for this message (**Continuous Transmission**).

Messages, which are configured for **Arbitrating Time Windows**, will be transmitted only once per transmit request (**Single Shot**).

## 2 Acronyms and Abbreviations

The glossary below includes acronyms and abbreviations relevant to the TTCAN Driver module that are not included in the [3, AUTOSAR glossary].

Abbreviation / Acronym:	Description:
Arbitrating Time Window	See ISO 11898-4 [1]
Basic Cycle	See ISO 11898-4 [1]
BSW	Basic Software
CanIf	CAN Interface
Continuous Transmission	Contrary to <a href="#">Single Shot</a> a message will be transmitted cyclically even without a new transmit request.
Current Time Master	See ISO 11898-4 [1]
DLC	Data Length Code (part of <a href="#">L-PDU</a> that describes the SDU length)
Cycle Time	See ISO 11898-4 [1]
Exclusive Time Window	See ISO 11898-4 [1]
Global Time	See ISO 11898-4 [1]
Hardware Receive Handle (HRH)	The Hardware Receive Handle (HRH) is defined and provided by the TTCAN driver. Typically each HRH represents exactly one hardware object. The HRH can be used to optimize software filtering.
Inner Priority Inversion	Transmission of a high-priority <a href="#">L-PDU</a> is prevented by the presence of a pending low-priority <a href="#">L-PDU</a> in the same transmit hardware object.
ISR	Interrupt Service Routine
L-PDU	Protocol Data Unit for the data link layer (DLL)
Local Time	See ISO 11898-4 [1]
Matrix Cycle	See ISO 11898-4 [1]
MCAL	Microcontroller Abstraction Layer
NTU	See ISO 11898-4 [1]
Reference Message	See ISO 11898-4 [1]
Single Shot	A message will be transmitted only once contrary to <a href="#">Continuous Transmission</a> .
System Matrix	See ISO 11898-4 [1]
Time Gap	See ISO 11898-4 [1]
Time Master	See ISO 11898-4 [1]
Time Window	See ISO 11898-4 [1]
Transmission Column	See ISO 11898-4 [1]
Transmit Trigger Event	See ISO 11898-4 [1]
TTCAN Controller	A TTCAN Controller serves exactly one physical channel.
TtcanDrv	CAN Driver module with enabled TTCAN functionality
TtcanIf	CAN Interface module with enabled TTCAN functionality
Tx_Trigger	See ISO 11898-4 [1]



### 3 Related documentation

All documents of the referenced CAN Driver document [4] are also valid for this document.

#### 3.1 Input documents & related standards and norms

##### Bibliography

- [1] ISO 11898-4:2004 - Road vehicles - Controller area network (CAN) - Part 4: Time-triggered communication
- [2] Layered Software Architecture  
AUTOSAR\_EXP\_LayeredSoftwareArchitecture
- [3] Glossary  
AUTOSAR\_TR\_Glossary
- [4] Specification of CAN Driver  
AUTOSAR\_SWS\_CANDriver
- [5] General Specification of Basic Software Modules  
AUTOSAR\_SWS\_BSWGeneral
- [6] Specification of CAN Transceiver Driver  
AUTOSAR\_SWS\_CANTransceiverDriver
- [7] Specification of TTCAN Interface  
AUTOSAR\_SWS\_TTCANInterface
- [8] Specification of Watchdog Driver  
AUTOSAR\_SWS\_WatchdogDriver
- [9] Specification of CAN Interface  
AUTOSAR\_SWS\_CANInterface
- [10] Specification of ECU State Manager  
AUTOSAR\_SWS\_ECUSTateManager

#### 3.2 Related specification

AUTOSAR provides a General Specification on Basic Software modules [5, SWS BSW General], which is also valid for TTCAN Driver.

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

## 4 Constraints and assumptions

The constraints and assumptions of the `Ttcan module` are the same as for the CAN Driver module [6].

## 5 Dependencies to other modules

This chapter contains brief descriptions of configuration information and services, which are additionally required by the [TTCAN Driver module](#) from other modules.

The dependencies described in the referenced CAN Driver module [6] also apply for the [TTCAN Driver module](#).

### 5.1 TTCAN Interface

The [TTCAN Driver](#) needs additional callback functions provided by the [TTCAN Interface](#) (refer to [Table 8.5.1](#)).

## 6 Requirements Tracing

Requirement	Description	Satisfied by
[SRS_BSW_00337]	Classification of development errors	[SWS_TtCan_00010]
[SRS_TtCan_41003]	The Hardware Object Handles shall be mappable to all types of time windows defined in ISO 11898 by configuration.	[SWS_TtCan_00156]
[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.	[SWS_TtCan_00004] [SWS_TtCan_00005] [SWS_TtCan_00006] [SWS_TtCan_00091] [SWS_TtCan_00092] [SWS_TtCan_00093] [SWS_TtCan_00094] [SWS_TtCan_00095] [SWS_TtCan_00096] [SWS_TtCan_00097] [SWS_TtCan_00098] [SWS_TtCan_00099] [SWS_TtCan_00101] [SWS_TtCan_00102] [SWS_TtCan_00103] [SWS_TtCan_00104] [SWS_TtCan_00105] [SWS_TtCan_00106] [SWS_TtCan_00107]
[SRS_TtCan_41006]	The CAN Driver with TTCAN functionality shall support the event synchronized time-triggered communication.	[SWS_TtCan_00007] [SWS_TtCan_00094] [SWS_TtCan_00095]
[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.	[SWS_TtCan_00009] [SWS_TtCan_00124] [SWS_TtCan_00126]
[SRS_TtCan_41008]	The CAN Driver with enabled TTCAN functionality shall provide a notification for severe error (S3).	[SWS_TtCan_00082] [SWS_TtCan_00120] [SWS_TtCan_00126]
[SRS_TtCan_41009]	The CAN Driver with TTCAN functionality shall not recover from severe error (S3) automatically.	[SWS_TtCan_00121] [SWS_TtCan_00122] [SWS_TtCan_00123]

## 7 Functional specification

The following section only describes additional TTCAN specific 'Functional specifications'. The Specification of CAN Driver [4] is the base of this `TtcanDrv` 'extension'.

For a description of the specific functional behaviour of TTCAN refer to the Specification of the `TTCAN Interface` [7] and the TTCAN ISO Specification [1].

### 7.1 TTCAN Controller State Machine

An additional state `SYNCHRONIZING` has to be incorporated between the CAN Controller states `STOPPED` and `STARTED`.

#### 7.1.1 TTCAN Controller specific State Description

This chapter corresponds to the chapter "Can Controller State Machine" of the CAN Driver SWS [4].

`TTCAN Controller` state `SYNCHRONIZING`: The controller has left the state `STOPPED` and is ready for normal operation. However, in order to participate on the bus, the controller needs to be synchronized to the global bus timing. As long as the controller is not synchronized to the bus, the controller stays in the state `SYNCHRONIZING` and error frames and acknowledges must not be sent. As soon as the controller is synchronized to the bus, the state of the controller changes from `SYNCHRONIZING` to `STARTED`.

For description of the procedure for a controller to become synchronized to the bus refer to [1, ISO 11898-4].

`TTCAN Controller` states `IN_GAP` and `IN_SCHEDULE`: During normal operation the controller may switch between `IN_SCHEDULE` (normal time-triggered operation) and `IN_GAP` (as soon as a gap at the end of the current `Basic Cycle` is signaled until next `Reference Message` is sent on the bus to indicate the end of the gap). These state changes do not affect the `Ttcan module`.

#### 7.1.2 TTCAN Controller specific State Transitions

State transition caused by function `Can_SetControllerMode(CAN_CS_STARTED)`:

**[SWS\_TtCan\_00155]** [ Replaces `SWS_Can_00262`: The function `Can_SetControllerMode(CAN_CS_STARTED)` shall wait for a limited time until the `TTCAN Controller` has changed to the state `SYNCHRONIZING` (Compare to `SWS_Can_00371`). ]()

Rational for [SWS\_TtCan\_00155]: The controller will switch to the state `SYNCHRONIZING` and will try to become synchronized to the bus. The procedure of synchronizing the controller to the bus might be significantly longer than `CanTimeoutTime`. Therefore, only the change to the state `SYNCHRONIZING` shall be observed by the function `Can_SetControllerMode` (compare to *SWS\_Can\_00371*) and the function `Can_Mainfunction_Timeout` (compare to *SWS\_Can\_00372*).

State Transition caused by Severe Error (triggered by state change of `TTCAN Controller`)

[SWS\_TtCan\_00120] [

- `STARTED` -> `STOPPED`
- Triggered by hardware if the `TTCAN Controller` reaches error level `S3` (see *TTCAN ISO Specification [1]*)
- The `CanIf` module is notified with the function `CanIf_TTSevereError` after `STOPPED` state is reached.

](*SRS\_TtCan\_41008*)

[SWS\_TtCan\_00121] [ After severe error detection, the `TTCAN Controller` shall transition to the state `STOPPED` and the `Ttcan Driver module` shall ensure that the CAN Controller doesn't participate on the network anymore. ](*SRS\_TtCan\_41009*)

[SWS\_TtCan\_00122] [ After severe error detection, `TtcanDrv` shall cancel still pending messages without raising a cancellation notification. ](*SRS\_TtCan\_41009*)

[SWS\_TtCan\_00123] [ `TtcanDrv` shall disable or suppress automatic severe error recovery. ](*SRS\_TtCan\_41009*)

## 7.2 L-PDU Transmission

Due to the time-triggered schedule, the `L-PDU` transmission is scheduled according to the `Matrix Cycle` configured during initialization, i.e. a call of the function `Can_Write()` does not directly trigger an immediate transmission but rather stores the `L-PDU` in the corresponding HW object, which is scheduled for transmission in a specific `Time Window`.

[SWS\_TtCan\_00156] [ It shall be possible to map all transmit message objects to specific `Time Windows` (see *TTCAN ISO Specification [1]*) by configuration (see *TTCANIF145\_Conf*, *TTCANIF146\_Conf*, *TTCANIF147\_Conf*, *TTCANIF148\_Conf*). ](*SRS\_TtCan\_41003*)

### 7.2.1 Priority Inversion

**[SWS\_TtCan\_00154]** [ Multiplexed transmission and transmit cancellation described in the Specification of CAN Driver [4] shall only be used in [Arbitrating Time Windows](#). ]()

Note: In TTCAN communication priority inversion can only happen in [Arbitration Time Windows](#), because the L-PDU with its corresponding CAN ID, which has to be available in a HW object is fixed for [Exclusive Time Windows](#).

### 7.3 L-PDU Reception

The verification of the message reception is controlled by the HW using the configured trigger for reception `CAN_TT_RX_TRIGGER` (see [ECUC\\_Can\\_00145](#)).

A detailed description of reception triggering and the verification of message reception can be found in [1, ISO 11898-4].

Configuration hint: To suppress regular notifications of consecutive received messages, which maybe needed not that frequently as they arrive, the notifications can be switched-off. In this case the polling via "Read received data" and API `CanIf_ReadRxPduData()`, can be used to get the data from `CanIf`, when it is needed.

### 7.4 Synchronization

Since TTCAN supports time-triggered communication, `TtcanDrv` needs to support maintaining the timing parameters and the master-controlled synchronization mechanisms.

**[SWS\_TtCan\_00004]** [ `TtcanDrv` shall provide information from the `TTCAN Controller` about the timing parameters (see [\[SWS\\_TtCan\\_00090\]](#)), the synchronization state and the master state (see [\[SWS\\_TtCan\\_00091\]](#)). ]([SRS\\_TtCan\\_41005](#))

**[SWS\_TtCan\_00005]** [ `TtcanDrv` shall provide means to influence the timing parameters of a `TTCAN Controller` (see [\[SWS\\_TtCan\\_00096\]](#), [\[SWS\\_TtCan\\_00097\]](#), [\[SWS\\_TtCan\\_00098\]](#), [\[SWS\\_TtCan\\_00099\]](#)) during runtime, if the `TTCAN Controller` acts as `Time Master`. ]([SRS\\_TtCan\\_41005](#))

**[SWS\_TtCan\_00006]** [ `TtcanDrv` shall provide the functionality of a timer, which is based on the time marks of the communication system, provided by the `TTCAN Controller`. ]([SRS\\_TtCan\\_41005](#))

### 7.4.1 Event Synchronization

[SWS\_TtCan\_00007] [ *TtcanDrv* shall support event-synchronized communication (see [SWS\_TtCan\_00094], [SWS\_TtCan\_00095]) (refer to [1, ISO 11898-4]). ]  
(*SRS\_TtCan\_41006*)

## 7.5 Time-Triggered Operation

The events listed below are related to the time-triggered operation of a TTCAN system.

[SWS\_TtCan\_00009] [ The events according to Table 7.1 shall be indicated to the application via *TtcanIf*. ](*SRS\_TtCan\_41007*)

Event	Description	TtcanIf Function*
Application Watchdog	The application has not served the application watchdog in time.	<i>TtcanIf_ApplWatchdogError</i>
Change of error level	The error level of the <i>TTCAN Controller</i> changes between the states <i>S0 - S3</i>	<i>TtcanIf_TimingError</i>
Tx overflow	More Tx triggers than expected	<i>TtcanIf_TimingError</i>
Tx underflow	Less Tx triggers than expected	<i>TtcanIf_TimingError</i>
Global time error	Synchronization failed	<i>TtcanIf_TimingError</i>
Watch trigger	Watch trigger occurs	<i>TtcanIf_TimingError</i>
Initialization watch trigger	<i>Init_watch_trigger</i> is reached	<i>TtcanIf_TimingError</i>
Gap	""Next is Gap"" bit is set	<i>TtcanIf_Gap</i>
Start of Cycle	Start of a <i>Basic Cycle</i> (including the cycle count value).	<i>TtcanIf_StartOfCycle</i>
Time discontinuity	""Disc Bit"" is set	<i>TtcanIf_TimeDisc</i>
Master state change	Change of the master state between potential and current <i>Time Master</i>	<i>TtcanIf_MasterStateChange</i>

**Table 7.1: Events indicated to application via *TtcanIf***

\* to be called in interrupt context (refer to [section 8.6](#))

## 7.6 Application Watchdog

Note: The TTCAN Application Watchdog shall be served by using a Watchdog Driver instance (see [8, Watchdog Driver SWS]). The Watchdog Driver instance shall serve the TTCAN Application Watchdog regularly before the timeout is reached.

Note: The timeout is the maximum time period between two consecutive calls to serve the TTCAN Application Watchdog.

Note: The Application Watchdog timeout limit shall be configured by *CanTTControllerApplWatchdogLimit* (see *ECUC\_Can\_00139*).



## 7.7 TTCAN error handling

This chapter corresponds to the chapter "Error handling" of the CAN Driver SWS [4].

**[SWS\_TtCan\_00124]** [ Either the function `Can_TTMainFunction_IRQ()` or an interrupt shall call the function `CanIf_TTTimingError()` with the corresponding event type, when error levels `S1` or `S2` (see TTCAN ISO Specification [1]) are reached. ]  
([SRS\\_TtCan\\_41007](#))

**[SWS\_TtCan\_00126]** [ Either the function `Can_TTMainFunction_IRQ()` or an interrupt shall call the function `CanIf_TTSevereError()` with the corresponding event type, when error level `S3` (see TTCAN ISO Specification [1]) is reached. ]  
([SRS\\_TtCan\\_41007](#), [SRS\\_TtCan\\_41008](#))

## 7.8 Error Classification

### 7.8.1 Development Errors

**[SWS\_TtCan\_00010]** [ The errors and exceptions according to Table 7.2 are specific to `Ttcan`. ]([SRS\\_BSW\\_00337](#))

Type of error	Relevance	Related error code	Value [hex]
TTCAN Controller is not a potential time master	Development	CAN_TT_E_NOT_MASTER	0x08
TTCAN Controller is not a current time master	Development	CAN_TT_E_NOT_CURRENT_MASTER	0x09
TTCAN Controller transmits two consecutive reference messages which both have the "Disc_bit" set	Development	CAN_TT_E_CONSEQUITIVE_DISC	0x0a
Adjustment of global time fails, because external synchronization has been disabled during configuration	Development	CAN_TT_E_SYNC_DISABLED	0x0b

**Table 7.2: Errors and exceptions specific to `Ttcan`**

### 7.8.2 Runtime Errors

There are no runtime errors.

### **7.8.3 Transient Faults**

There are no transient faults.

### **7.8.4 Production Errors**

There are no production errors.

### **7.8.5 Extended Production Errors**

There are no extended production errors.

## 8 API specification

Since the `Ttcan module` is an extension of the CAN Driver module [4], only specifications which differ from the CAN stack and which are TTCAN specific shall be provided within this chapter.

### 8.1 Imported types

Additional TTCAN specific imported types

[SWS\_TtCan\_00125] [

<i>Module</i>	<i>Header File</i>	<i>Imported Type</i>
CanIf	TtcanIf.h TtcanIf.h TtcanIf.h	CanIf_TTMasterStateType CanIf_TTSevereErrorEnumType CanIf_TTTimingErrorIRQType
Can_GeneralTypes	Can_GeneralTypes.h	Can_IdType
Std_Types	StandardTypes.h	Std_ReturnType

**Table 8.1: Ttcan\_ImportedTypes**

]0

### 8.2 Type definitions

Additional TTCAN specific type definitions

#### 8.2.1 Can\_TTTimeType

[SWS\_TtCan\_00084] [

<b>Name:</b>	Can_TTTimeType
<b>Type:</b>	uint16
<b>Description:</b>	16 bit value representing time values of TTCAN, e.g. cycle, local or global time
<b>Available via:</b>	Ttcan.h

**Table 8.2: Can\_TTTimeType**

]0

### 8.2.2 Can\_TTMasterSlaveModeType

[SWS\_TtCan\_00115] [

<b>Name:</b>	Can_TTMasterSlaveModeType		
<b>Type:</b>	Enumeration		
<b>Range:</b>	CAN_TT_BACKUP_MASTER	–	Master-Slave Mode: Backup master
	CAN_TT_CURRENT_MASTER	–	Master-Slave Mode: Current master
	CAN_TT_MASTER_OFF	–	Master-Slave Mode: Master off
	CAN_TT_SLAVE	–	Master-Slave Mode: Slave
<b>Description:</b>	Master-Slave Mode		
<b>Available via:</b>	Ttcan.h		

**Table 8.3: Can\_TTMasterSlaveModeType**

]()

### 8.2.3 Can\_TTSyncModeEnumType

[SWS\_TtCan\_00116] [

<b>Name:</b>	Can_TTSyncModeEnumType		
<b>Type:</b>	Enumeration		
<b>Range:</b>	CAN_TT_IN_GAP	–	Sync mode: In_Gap
	CAN_TT_IN_SCHEDULE	–	Sync mode: In_Schedule
	CAN_TT_SYNC_OFF	–	Sync mode: Sync_Off
	CAN_TT_SYNCHRONIZING	–	Sync mode: Synchronizing
<b>Description:</b>	Sync mode		
<b>Available via:</b>	Ttcan.h		

**Table 8.4: Can\_TTSyncModeEnumType**

]()

### 8.2.4 Can\_TTMasterStateType

[SWS\_TtCan\_00085] [

<b>Name:</b>	Can_TTMasterStateType		
<b>Type:</b>	Structure		
<b>Element:</b>	Can_TTMasterSlave ModeType uint8	masterSlaveMode  refTriggerOffset	–  current value of ref trigger offset

	Can_TTSyncModeEnum Type	syncMode	-
<b>Description:</b>	Master state type including sync mode, master-slave mode and current ref trigger offset		
<b>Available via:</b>	Ttcan.h		

**Table 8.5: Can\_TTMasterStateType**

}]()

### 8.2.5 Can\_TTErrorLevelEnumType

[SWS\_TtCan\_00117] [

<b>Name:</b>	Can_TTErrorLevelEnumType		
<b>Type:</b>	Enumeration		
<b>Range:</b>	CAN_TT_ERROR_S0	-	Error level S0: No Error
	CAN_TT_ERROR_S1	-	Error level S1: Warning
	CAN_TT_ERROR_S2	-	Error level S2: Error
	CAN_TT_ERROR_S3	-	Error level S3: Fatal Error
<b>Description:</b>	Error level (S0-S3)		
<b>Available via:</b>	Ttcan.h		

**Table 8.6: Can\_TTErrorLevelEnumType**

}]()

### 8.2.6 Can\_TTErrorLevelType

[SWS\_TtCan\_00086] [

<b>Name:</b>	Can_TTErrorLevelType		
<b>Type:</b>	Structure		
<b>Element:</b>	Can_TTErrorLevel EnumType uint8	errorLevel	Error Level (S0-S3)
	uint8	maxMessageStatus Count	Max value of message status count (0-7)
		minMessageStatus Count	Min value of message status count (0-7)
<b>Description:</b>	TTCAN error level including min and max values of message status count		
<b>Available via:</b>	Ttcan.h		

**Table 8.7: Can\_TTErrorLevelType**

}]()

## 8.2.7 Can\_TTTimeSourceType

[SWS\_TtCan\_00088] [

<b>Name:</b>	Can_TTTimeSourceType		
<b>Type:</b>	Enumeration		
<b>Range:</b>	CAN_TT_CYCLE_TIME	–	Time source: Cycle Time
	CAN_TT_GLOBAL_TIME	–	Time source: Global Time
	CAN_TT_LOCAL_TIME	–	Time source: Local Time
	CAN_TT_UNDEFINED	–	Time source: Undefined
<b>Description:</b>	Time source		
<b>Available via:</b>	Ttcan.h		

**Table 8.8: Can\_TTTimeSourceType**

]()

## 8.3 Function definitions

Additional TTCAN specific function definitions

### 8.3.1 Can\_TTGetControllerTime

[SWS\_TtCan\_00090] [

<b>Service name:</b>	Can_TTGetControllerTime	
<b>Syntax:</b>	<pre>void Can_TTGetControllerTime( uint8 Controller, Can_TTTimeType* Can_TTGlobalTime, Can_TTTimeType* Can_TTLocalTime, Can_TTTimeType* Can_TTCycleTime, uint8* Can_TTCycleCount )</pre>	
<b>Service ID[hex]:</b>	0x33	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller from which the time information shall be retrieved
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	Can_TTGlobalTime Can_TTLocalTime Can_TTCycleTime Can_TTCycleCount	Address to store return value: Global time Address to store return value: Local time Address to store return value: Cycle time Address to store return value: Cycle count value
<b>Return value:</b>	None	
<b>Description:</b>	Gets the current values for the global, local and cycle time and the cycle count of the controller	
<b>Available via:</b>	Ttcan.h	

**Table 8.9: Can\_TTGetControllerTime**

]()

**[SWS\_TtCan\_00012]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTGetControllerTime()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00013]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTGetControllerTime()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

**[SWS\_TtCan\_00014]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTGetControllerTime()` shall raise the error `CAN_E_PARAM_POINTER` and shall return `E_NOT_OK` if the parameter `Can_TTGlobalTime` or the parameter `Can_TTLocalTime` or the parameter `Can_TTCycleTime` or the parameter `Can_TTCycleCount` is a `NULL` pointer. ]()

### 8.3.2 Can\_TTGetMasterState

**[SWS\_TtCan\_00091]** [

<b>Service name:</b>	Can_TTGetMasterState	
<b>Syntax:</b>	<pre>void Can_TTGetMasterState(     uint8 Controller,     Can_TTMasterStateType* Can_TTMasterState )</pre>	
<b>Service ID[hex]:</b>	0x34	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller from which the master state shall be retrieved
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	Can_TTMasterState	Address to store return value: Master state
<b>Return value:</b>	None	
<b>Description:</b>	Gets the master state. The master state includes the sync mode (sync_off, synchronizing, in_gap, in_schedule) the master-slave mode (master_off, slave, backup_master, current_master) and the current value for ref trigger offset.	
<b>Available via:</b>	Ttcan.h	

**Table 8.10: Can\_TTGetMasterState**

]([SRS\\_TtCan\\_41005](#))

**[SWS\_TtCan\_00016]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTGetMasterState()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00017]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTGetMasterState()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

[SWS\_TtCan\_00018] [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTGetMasterState()` shall raise the error `CAN_E_PARAM_POINTER` and shall return `E_NOT_OK` if the parameter `Can_TTMasterState` is a NULL pointer. ]()

### 8.3.3 Can\_TTGetNTUActual

[SWS\_TtCan\_00092] [

<b>Service name:</b>	Can_TTGetNTUActual	
<b>Syntax:</b>	<pre>void Can_TTGetNTUActual ( uint8 Controller, Can_TTTURType* Can_TTTURAct )</pre>	
<b>Service ID[hex]:</b>	0x35	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller from which the NTU vale shall be retrieved
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	Can_TTTURAct	Address to store return value: Actual value of NTU. Value is given in microseconds.
<b>Return value:</b>	None	
<b>Description:</b>	Gets the actual value of NTU (network time unit). Together with the local oscillator period, the actual value of NTU can be derived from the actual value of TUR.	
<b>Available via:</b>	Ttcan.h	

**Table 8.11: Can\_TTGetNTUActual**

] ([SRS\\_TtCan\\_41005](#))

[SWS\_TtCan\_00020] [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTGetNTUActual()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

[SWS\_TtCan\_00021] [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTGetNTUActual()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

[SWS\_TtCan\_00022] [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTGetNTUActual()` shall raise the error `CAN_E_PARAM_POINTER` and shall return `E_NOT_OK` if the parameter `Can_TTNTUAct` is a NULL pointer. ]()

### 8.3.4 Can\_TTGetErrorLevel

[SWS\_TtCan\_00093] [



<b>Service name:</b>	Can_TTGetErrorLevel	
<b>Syntax:</b>	<pre>void Can_TTGetErrorLevel ( uint8 Controller, Can_TTErrorLevelType* Can_TTErrorLevel )</pre>	
<b>Service ID[hex]:</b>	0x36	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller from which the error level shall be retrieved
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	Can_TTErrorLevel	Address to store return value: Error level
<b>Return value:</b>	None	
<b>Description:</b>	Gets the error level. This includes the severity of the error level (S0-S3) and the minimum and maximum value of the message status count.	
<b>Available via:</b>	Ttcan.h	

**Table 8.12: Can\_TTGetErrorLevel**

]([SRS\\_TtCan\\_41005](#))

**[SWS\_TtCan\_00024]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTGetErrorLevel()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00025]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTGetErrorLevel()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

**[SWS\_TtCan\_00026]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTGetErrorLevel()` shall raise the error `CAN_E_PARAM_POINTER` and shall return `E_NOT_OK` if the parameter `Can_TTErrorLevel` is a `NULL` pointer. ]()

### 8.3.5 Can\_TTSetNextIsGap

**[SWS\_TtCan\_00094]** [

<b>Service name:</b>	Can_TTSetNextIsGap	
<b>Syntax:</b>	<pre>void Can_TTSetNextIsGap ( uint8 Controller )</pre>	
<b>Service ID[hex]:</b>	0x37	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller for which the "next is gap" indication shall be set.
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	None	
<b>Return value:</b>	None	

<b>Description:</b>	Sets the "Next_is_Gap" bit.
<b>Available via:</b>	Ttcan.h

**Table 8.13: Can\_TTSetNextIsGap**

]([SRS\\_TtCan\\_41005](#), [SRS\\_TtCan\\_41006](#))

**[SWS\_TtCan\_00028]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTSetNextIsGap()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00029]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTSetNextIsGap()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

### 8.3.6 Can\_TTSetEndOfGap

**[SWS\_TtCan\_00095]** [

<b>Service name:</b>	Can_TTSetEndOfGap	
<b>Syntax:</b>	<pre>void Can_TTSetEndOfGap(     uint8 Controller )</pre>	
<b>Service ID[hex]:</b>	0x38	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller for which the "set end of gap" indication shall be set
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	None	
<b>Return value:</b>	None	
<b>Description:</b>	Signals the end of a gap.	
<b>Available via:</b>	Ttcan.h	

**Table 8.14: Can\_TTSetEndOfGap**

]([SRS\\_TtCan\\_41005](#), [SRS\\_TtCan\\_41006](#))

**[SWS\_TtCan\_00031]** [ The function `Can_TTSetEndOfGap()` shall only take effect if the [TTCAN Controller](#) is a potential [Time Master](#). ]()

**[SWS\_TtCan\_00032]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTSetEndOfGap()` shall raise the error `CAN_TT_E_NOT_MASTER` if the [TTCAN Controller](#) is not a potential [Time Master](#). ]()

**[SWS\_TtCan\_00033]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTSetEndOfGap()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

[SWS\_TtCan\_00034] [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTSetEndOfGap()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

### 8.3.7 Can\_TTSetTimeCommand

[SWS\_TtCan\_00096] [

<b>Service name:</b>	Can_TTSetTimeCommand	
<b>Syntax:</b>	void Can_TTSetTimeCommand( uint8 Controller )	
<b>Service ID[hex]:</b>	0x39	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller for which the global time shall be adjusted
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	None	
<b>Return value:</b>	None	
<b>Description:</b>	Adjusts the global time at the beginning of the next basic cycle by the amount of "global time preset"	
<b>Available via:</b>	Ttcan.h	

Table 8.15: Can\_TTSetTimeCommand

] ([SRS\\_TtCan\\_41005](#))

[SWS\_TtCan\_00036] [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTSetTimeCommand()` shall raise the error `CAN_TT_E_CONSECUTIVE_DISC` if two consecutive reference messages are transmitted with both have the "Disc\_bit" set. ]()

[SWS\_TtCan\_00037] [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTSetTimeCommand()` shall raise the error `CAN_TT_E_SYNC_DISABLED` if the adjustment of the `Global Time` fails, because the external synchronization has been disabled during configuration. ]()

[SWS\_TtCan\_00038] [ The function `Can_TTSetTimeCommand()` shall only take effect if the `TTCAN Controller` is the current `Time Master`. ]()

[SWS\_TtCan\_00039] [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTSetTimeCommand()` shall raise the error `CAN_TT_E_NOT_CURRENT_MASTER` if the `TTCAN Controller` is not the current `Time Master`. ]()

[SWS\_TtCan\_00040] [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTSetTimeCommand()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

[SWS\_TtCan\_00041] [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTSetTimeCommand()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

### 8.3.8 Can\_TTGlobalTimePreset

[SWS\_TtCan\_00097] [

<b>Service name:</b>	Can_TTGlobalTimePreset	
<b>Syntax:</b>	<pre>void Can_TTGlobalTimePreset ( uint8 Controller, Can_TTTimeType Can_TTGlobalTimePreset )</pre>	
<b>Service ID[hex]:</b>	0x3a	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller  Can_TTGlobalTimePreset	Controller for which the "global time preset" shall be set  New value for "global time preset"
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	None	
<b>Return value:</b>	None	
<b>Description:</b>	Sets the value of "global time preset".	
<b>Available via:</b>	Ttcan.h	

**Table 8.16: Can\_TTGlobalTimePreset**

] ([SRS\\_TtCan\\_41005](#))

[SWS\_TtCan\_00043] [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTGlobalTimePreset()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

[SWS\_TtCan\_00044] [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTGlobalTimePreset()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

### 8.3.9 Can\_TTSetExtClockSyncCommand

[SWS\_TtCan\_00098] [

<b>Service name:</b>	Can_TTSetExtClockSyncCommand	
<b>Syntax:</b>	<pre>void Can_TTSetExtClockSyncCommand ( uint8 Controller )</pre>	
<b>Service ID[hex]:</b>	0x3b	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	

<b>Parameters (in):</b>	Controller	Controller for which the NTU shall be adjusted.
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	None	
<b>Return value:</b>	None	
<b>Description:</b>	Adjusts the NTU (network time unit) according to the value given by "NTU adjust". Together with the local oscillator period, "TUR adjust" can be derived from "NTU adjust".	
<b>Available via:</b>	Ttcan.h	

**Table 8.17: Can\_TTSetExtClockSyncCommand**

]([SRS\\_TtCan\\_41005](#))

**[SWS\_TtCan\_00046]** [ The function `Can_TTSetExtClockSyncCommand()` shall only take effect if the [TTCAN Controller](#) is the current [Time Master](#). ]()

**[SWS\_TtCan\_00047]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTSetExtClockSyncCommand()` shall raise the error `CAN_TT_E_NOT_CURRENT_MASTER` if the [TTCAN Controller](#) is not the current [Time Master](#). ]()

**[SWS\_TtCan\_00048]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTSetExtClockSyncCommand()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00049]** [ If development error detection for the [Ttcan module](#) is enabled: The function `Can_TTSetExtClockSyncCommand()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

### 8.3.10 Can\_TTSetNTUAdjust

**[SWS\_TtCan\_00099]** [

<b>Service name:</b>	Can_TTSetNTUAdjust	
<b>Syntax:</b>	<pre>void Can_TTSetNTUAdjust (     uint8 Controller,     Can_TTTURType Can_TTTURAdjust )</pre>	
<b>Service ID[hex]:</b>	0x3c	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller Can_TTTURAdjust	Controller for which the "NTU adjust" shall be set New value for "NTU adjust" Value is given in microseconds.
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	None	
<b>Return value:</b>	None	
<b>Description:</b>	Sets the value of "NTU adjust". Together with the local oscillator period, "TUR adjust" can be derived from "NTU adjust".	

<b>Available via:</b>	Ttcan.h
-----------------------	---------

**Table 8.18: Can\_TTSetNTUAdjust**

](SRS\_TtCan\_41005)

**[SWS\_TtCan\_00051]** [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTSetNTUAdjust()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00052]** [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTSetNTUAdjust()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

## 8.4 Optional Function definitions

Additional optional TTCAN specific function definitions

### 8.4.1 Can\_TTGetSyncQuality

**[SWS\_TtCan\_00101]** [

<b>Service name:</b>	Can_TTGetSyncQuality	
<b>Syntax:</b>	<pre>void Can_TTGetSyncQuality( uint8 Controller, boolean* Can_TTClockSpeed, boolean* Can_TTGlobalTimePhase )</pre>	
<b>Service ID[hex]:</b>	0x47	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller from which the sync quality shall be retrieved
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	Can_TTClockSpeed	Address to store return value: True if the synchronization deviation is smaller than the "Synchronization deviation limit"
	Can_TTGlobalTimePhase	Address to store return value: True if the global time is in phase with the time master.
<b>Return value:</b>	None	
<b>Description:</b>	Gets the synchronization quality.	
<b>Available via:</b>	Ttcan.h	

**Table 8.19: Can\_TTGetSyncQuality**

](SRS\_TtCan\_41005)

**[SWS\_TtCan\_00057]** [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTGetSyncQuality()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00058]** [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTGetSyncQuality()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

**[SWS\_TtCan\_00059]** [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTGetSyncQuality()` shall raise the error `CAN_E_PARAM_POINTER` and shall return `E_NOT_OK` if the parameter `Can_TTClockSpeed` or the parameter `Can_TTGlobalTimePhase` is a `NULL` pointer. ]()

## 8.4.2 Can\_TTSetTimeMark

**[SWS\_TtCan\_00102]** [

<b>Service name:</b>	Can_TTSetTimeMark	
<b>Syntax:</b>	<pre>void Can_TTSetTimeMark ( uint8 Controller, Can_TTTimeType Can_TTTimeMark, Can_TTTimeSourceType Can_TTTimeSource )</pre>	
<b>Service ID[hex]:</b>	0x48	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller Can_TTTimeMark Can_TTTimeSource	Controller for which the time mark shall be set Gives the value of the time mark to be set. Defines the time source for the time mark to be set.
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	None	
<b>Return value:</b>	None	
<b>Description:</b>	Sets a new value for the time mark for the given time source.	
<b>Available via:</b>	Ttcan.h	

**Table 8.20: Can\_TTSetTimeMark**

] ([SRS\\_TtCan\\_41005](#))

**[SWS\_TtCan\_00061]** [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTSetTimeMark()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00062]** [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTSetTimeMark()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

### 8.4.3 Can\_TTCancelTimeMark

[SWS\_TtCan\_00103] [

<b>Service name:</b>	Can_TTCancelTimeMark	
<b>Syntax:</b>	void Can_TTCancelTimeMark (uint8 Controller)	
<b>Service ID[hex]:</b>	0x49	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller for which the time mark shall be cancelled.
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	None	
<b>Return value:</b>	None	
<b>Description:</b>	Cancels the time mark.	
<b>Available via:</b>	Ttcan.h	

**Table 8.21: Can\_TTCancelTimeMark**

]([SRS\\_TtCan\\_41005](#))

[SWS\_TtCan\_00064] [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTCancelTimeMark()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

[SWS\_TtCan\_00065] [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTCancelTimeMark()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

### 8.4.4 Can\_TTAckTimeMark

[SWS\_TtCan\_00104] [

<b>Service name:</b>	Can_TTAckTimeMark	
<b>Syntax:</b>	void Can_TTAckTimeMark (uint8 Controller)	
<b>Service ID[hex]:</b>	0x4a	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller for which the time mark shall be acknowledged.
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	None	
<b>Return value:</b>	None	
<b>Description:</b>	Acknowledges the time mark interrupt by resetting the flag in the interrupt vector register.	
<b>Available via:</b>	Ttcan.h	

**Table 8.22: Can\_TTAckTimeMark**



](SRS\_TtCan\_41005)

**[SWS\_TtCan\_00067]** [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTAckTimeMark()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00068]** [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTAckTimeMark()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

### 8.4.5 Can\_TTEnableTimeMarkIRQ

**[SWS\_TtCan\_00105]** [

<b>Service name:</b>	Can_TTEnableTimeMarkIRQ	
<b>Syntax:</b>	void Can_TTEnableTimeMarkIRQ( uint8 Controller )	
<b>Service ID[hex]:</b>	0x4b	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller for which the time mark interrupt shall be enabled.
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	None	
<b>Return value:</b>	None	
<b>Description:</b>	Enables the time mark interrupt.	
<b>Available via:</b>	Ttcan.h	

**Table 8.23: Can\_TTEnableTimeMarkIRQ**

](SRS\_TtCan\_41005)

**[SWS\_TtCan\_00070]** [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTEnableTimeMarkIRQ()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00071]** [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTEnableTimeMarkIRQ()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

### 8.4.6 Can\_TTDisableTimeMarkIRQ

**[SWS\_TtCan\_00106]** [

<b>Service name:</b>	Can_TTDisableTimeMarkIRQ	
<b>Syntax:</b>	void Can_TTDisableTimeMarkIRQ( uint8 Controller )	

<b>Service ID[hex]:</b>	0x4c	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller for which the time mark interrupt shall be disabled.
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	None	
<b>Return value:</b>	None	
<b>Description:</b>	Disables the time mark interrupt.	
<b>Available via:</b>	Ttcan.h	

**Table 8.24: Can\_TTDisableTimeMarkIRQ**

](SRS\_TtCan\_41005)

**[SWS\_TtCan\_00073]** [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTDisableTimeMarkIRQ()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00074]** [ If development error detection for the `Ttcan` module is enabled: The function `Can_TTDisableTimeMarkIRQ()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

#### 8.4.7 Can\_TTGetTimeMarkIRQStatus

**[SWS\_TtCan\_00107]** [

<b>Service name:</b>	Can_TTGetTimeMarkIRQStatus	
<b>Syntax:</b>	<pre>void Can_TTGetTimeMarkIRQStatus(     uint8 Controller,     boolean* Can_TTIRQStatus )</pre>	
<b>Service ID[hex]:</b>	0x4d	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller	Controller from which the status of the time mark IRQ shall be retrieved.
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	Can_TTIRQStatus	Address to store return value: True if the timer for the time mark is pending.
<b>Return value:</b>	None	
<b>Description:</b>	Gets the IRQ status of the time mark.	
<b>Available via:</b>	Ttcan.h	

**Table 8.25: Can\_TTGetTimeMarkIRQStatus**

](SRS\_TtCan\_41005)

**[SWS\_TtCan\_00076]** [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTGetTimeMarkIRQStatus()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00077]** [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTGetTimeMarkIRQStatus()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

**[SWS\_TtCan\_00078]** [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTGetTimeMarkIRQStatus()` shall raise the error `CAN_E_PARAM_POINTER` and shall return `E_NOT_OK` if the parameter `Can_TT_IRQS-tatus` is a `NULL` pointer. ]()

### 8.4.8 Can\_TTReceive

**[SWS\_TtCan\_00108]** [

<b>Service name:</b>	Can_TTReceive	
<b>Syntax:</b>	<pre>void Can_TTReceive( uint8 Controller, uint8 Hrh, Can_IdType* CanId, uint8* CanDlc, uint8* CanSduPtr )</pre>	
<b>Service ID[hex]:</b>	0	
<b>Sync/Async:</b>	Synchronous	
<b>Reentrancy:</b>	Non Reentrant	
<b>Parameters (in):</b>	Controller Hrh	Controller for which data shall be read out Hardware receive handle of the hardware object, to read the received data from
<b>Parameters (inout):</b>	None	
<b>Parameters (out):</b>	CanId  CanDlc  CanSduPtr	Address to store return value: Can ID of the received frame Address to store return value: Length of the received frame Address to store return value: SDU of received frame
<b>Return value:</b>	None	
<b>Description:</b>	Reads received data from the controller by returning the pointer of the CanID, the DLC and the Data of the message in the requested HRH.	
<b>Available via:</b>	Ttcan.h	

**Table 8.26: Can\_TTReceive**

]()

**[SWS\_TtCan\_00110]** [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTReceive()` shall raise the error `CAN_E_UNINIT` if the driver is not yet initialized. ]()

**[SWS\_TtCan\_00111]** [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTReceive()` shall raise the error `CAN_E_PARAM_CONTROLLER` if the parameter `Controller` is out of range. ]()

**[SWS\_TtCan\_00112]** [ If development error detection for the `Ttcan module` is enabled: The function `Can_TTReceive()` shall raise the error `CAN_E_PARAM_POINTER` and shall return `E_NOT_OK` if one of the parameter `CanId`, `CanDlc` or `CanSduPtr` is a `NULL` pointer. ]()

## 8.5 Scheduled Functions

Additional TTCAN specific scheduled function definitions

### 8.5.1 Can\_TTMainFunction\_IRQ

**[SWS\_TtCan\_00113]** [

<b>Service name:</b>	Can_TTMainFunction_IRQ
<b>Syntax:</b>	void Can_TTMainFunction_IRQ( void )
<b>Service ID[hex]:</b>	0x50
<b>Description:</b>	Polls the interrupt flags specific to TTCAN
<b>Available via:</b>	SchM_Ttcan.h

**Table 8.27: Can\_TTMainFunction\_IRQ**

]()

Note: The generic items from CAN Driver SWS [4] regarding the main functions apply for `Can_TTMainFunction_IRQ()`, too.

## 8.6 Expected interfaces

### 8.6.1 Mandatory interfaces

Additional TTCAN specific mandatory interfaces

**[SWS\_TtCan\_00082]** [

<b>API function</b>	<b>Header File</b>	<b>Description</b>
CanIf_TTApplWatchdogError	TtcanIf.h	Reports an application watchdog error.
CanIf_TTGap	TtcanIf.h	Reports the occurrence of a gap.
CanIf_TTMasterStateChange	TtcanIf.h	Reports change of the master state between potential and current master.

Canlf_TTSevereError	Ttcanlf.h	Reports one of the following errors: - failed to serve appl. watchdog - config error - watch trigger reached
Canlf_TTStartOfCycle	Ttcanlf.h	Reports the start of a basic cycle.
Canlf_TTTimeDisc	Ttcanlf.h	Reports a time discontinuity.
Canlf_TTTimingError	Ttcanlf.h	Reports one of the following errors: - Change of error level - Tx overflow / underflow - Synchronization failed - Init watch trigger

**Table 8.28: Ttcan Mandatory Interfaces**

]([SRS\\_TtCan\\_41008](#))

Hint: These additional mandatory interfaces for TTCAN shall serve the interrupts that may occur during time triggered operation as described in [1, ISO 11898-4].

## 9 Sequence diagrams

### 9.1 Interaction between Ttcan and TtcanIf module

For sequence diagrams see the TTCAN Interface specification [7] and CAN Interface specification [9]. There are described the complete sequences for Transmission, Reception and Error Handling.

### 9.2 Wakeup sequence

For Wakeup sequence diagrams refer to specification of ECU State Manager [10].

## 10 Configuration specification

In general, this chapter defines configuration parameters and their clustering into containers. For general information about the definition of containers and parameters, refer to the [5, chapter 10.1 "Introduction to configuration specification" in SWS\_BSWGeneral].

chapter 10 specifies the structure (containers) and the parameters of the `Ttcan` module.

Figure 10.1.2 specifies published information of the `Ttcan` module.

### 10.1 Containers and configuration parameters

Additional TTCAN specific configuration parameters

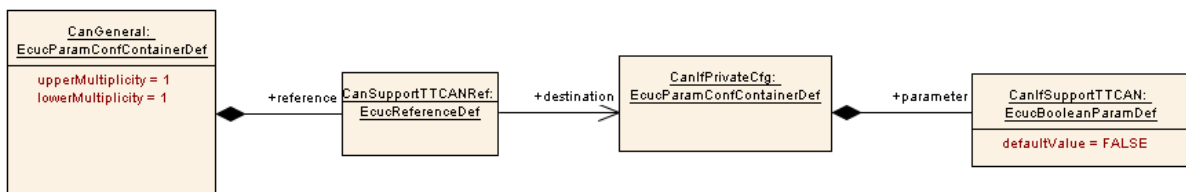


Figure 10.1: CAN Driver Time Triggered General Configuration

The reference `CanSupportTTCANRef` is described in Specification of CAN Driver [4], SWS Item Id `ECUC_Can_00430`.

[SWS\_TtCan\_00157]{DRAFT} [ The TT Can Driver module shall reject configurations with partition mappings which are not supported by the implementation. ]()

#### 10.1.1 CanTTController

<b>SWS Item</b>	[ECUC_Can_00001]
<b>Container Name</b>	CanTTController
<b>Description</b>	<p>CanTTController is specified in the SWS TTCAN and contains the configuration parameters of the TTCAN controller(s) (which are needed in addition to the configuration parameters of the CAN controller(s)).</p> <p>This container is only included and valid if TTCAN is supported by the controller, enabled (see <code>CanSupportTTCANRef</code>, <code>ECUC_Can_00430</code>), and used.</p>
<b>Configuration Parameters</b>	

<b>Name</b>	CanTTControllerApplWatchdogLimit [ECUC_Can_00139]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Defines the maximum time period (unit is 256 times NTU) after which the application has to serve the watchdog.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	0 .. 255		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU		

<b>Name</b>	CanTTControllerCycleCountMax [ECUC_Can_00138]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Defines the value for cycle_count_max. Allowed values: 0x00: 1 basic cycle 0x01: 2 basic cycles 0x03: 4 basic cycles 0x07: 8 basic cycles 0x0F: 16 basic cycles 0x1F: 32 basic cycles 0x3F: 64 basic cycles		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	0 .. 63		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU		

<b>Name</b>	CanTTControllerExpectedTxTrigger [ECUC_Can_00136]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Number of expected_tx_trigger.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	0 .. 255		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: local		



<b>Name</b>	CanTTControllerExternalClockSynchronisation [ECUC_Can_00135]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Enables/disables the external clock synchronization. TRUE: External clock synchronization enabled. FALSE: External clock synchronization disabled.  This parameter shall only be configurable if parameter CanTTControllerLevel2 equals TRUE.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucBooleanParamDef		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU dependency: CanTTControllerLevel2 (ECUC_Can_00131)		

<b>Name</b>	CanTTControllerGlobalTimeFiltering [ECUC_Can_00134]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Enables/disables the global time filtering. TRUE: Global time filtering enabled. FALSE: Global time filtering disabled.  This parameter shall only be configurable if parameter CanTTControllerLevel2 equals TRUE.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucBooleanParamDef		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: local dependency: CanTTControllerLevel2 (ECUC_Can_00131)		

<b>Name</b>	CanTTControllerInitialRefOffset [ECUC_Can_00128]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Defines the initial value for ref trigger offset.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	0 .. 127		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		

<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU		

<b>Name</b>	CanTTControllerInterruptEnable [ECUC_Can_00140]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	<p>Enables/disables the respective interrupts. Bit Position set to 1: Enable respective interrupt. Bit Position set to 0: Disable respective interrupt.</p> <p>Bit Position / Interrupt Source: 10: Application Watchdog. 9: Watch Trigger reached. 8: Initialization Watch Trigger reached. 7: Change of Error Level. 6: Tx Overflow. 5: Tx Underflow. 4: Global Time Error. 3: Gap. 2: Start of Cycle. 1: Time Discontinuity. 0: Master State Change.</p> <p>Bit position "1: Time Discontinuity" and "4: Global Time Error" shall only be configurable if parameter CanTTControllerLevel2 equals TRUE.</p>		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	0 .. 1023		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: local dependency: CanTTControllerLevel2 (ECUC_Can_00131)		

<b>Name</b>	CanTTControllerLevel2 [ECUC_Can_00131]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	<p>Defines whether Level 2 or Level 1 is used. TRUE: Level 2. FALSE: Level 1.</p> <p>If this parameter is set to FALSE then all parameters with dependency to CanTTControllerLevel2 need not be configured.</p>		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucBooleanParamDef		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: local		

<b>Name</b>	CanTTControllerNTUConfig [ECUC_Can_00141]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Defines the config value for NTU (network time unit). Value given in microseconds. The value configured shall be greater than 0. Together with the local oscillator period, the TUR (time unit ratio) can be derived from the NTU. This parameter shall only be configurable if parameter CanTTControllerLevel2 equals TRUE.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucFloatParamDef		
<b>Range</b>	[0 .. 100]		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU dependency: CanTTControllerLevel2 (ECUC_Can_00131)		

<b>Name</b>	CanTTControllerOperationMode [ECUC_Can_00127]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Defines the operation mode.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucEnumerationParamDef		
<b>Range</b>	CAN_TT_EVENT_SYNC_TIME_TRIGGERED		Event-synchronized time triggered operation
	CAN_TT_EVENT_TRIGGERED		Event triggered operation (normal can operation without time schedule)
	CAN_TT_TIME_TRIGGERED		Time triggered operation
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU		

<b>Name</b>	CanTTControllerSyncDeviation [ECUC_Can_00132]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Defines the maximum synchronization deviation: Given as a percentage value of the NTU (network time unit). The value configured shall be greater than 0. This parameter shall only be configurable if parameter CanTTControllerLevel2 equals TRUE.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucFloatParamDef		
<b>Range</b>	[0 .. 100]		
<b>Default Value</b>			

<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: local dependency: CanTTControllerLevel2 (ECUC_Can_00131)		

<b>Name</b>	CanTTControllerTimeMaster [ECUC_Can_00129]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Defines whether the controller acts as a potential time master. TRUE: Potential time master. FALSE: Time slave.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucBooleanParamDef		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU		

<b>Name</b>	CanTTControllerTimeMasterPriority [ECUC_Can_00130]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Defines the time master priority.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	0 .. 7		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU		

<b>Name</b>	CanTTControllerTURRestore [ECUC_Can_00133]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	<p>Enables/disables the TUR restore. Note that the value configured for TUR can be derived from the value configured for NTU and the local oscillator period. TRUE: TUR restore enabled. FALSE: TUR restore disabled.</p> <p>This parameter shall only be configurable if parameter CanTTControllerLevel2 equals TRUE.</p>		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucBooleanParamDef		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: local dependency: CanTTControllerLevel2 (ECUC_Can_00131)		

<b>Name</b>	CanTTControllerTxEnableWindowLength [ECUC_Can_00137]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Length of the tx enable window given in CAN bit times. Definition parameter "CanTTControllerTxEnableWindowlength" is used such that: Length of enable window = CanTTControllerTxEnableWindowLength + 1		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	1 .. 16		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU		

<b>Name</b>	CanTTControllerWatchTriggerGapTimeMark [ECUC_Can_00158]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	watch trigger time mark after a gap		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	0 .. 65535		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		

<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: local		

<b>Name</b>	CanTTControllerWatchTriggerTimeMark [ECUC_Can_00157]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	watch trigger time mark		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	0 .. 65535		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: local		

<b>Name</b>	CanTTIRQProcessing [ECUC_Can_00142]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	Enables / disables API Can_MainFunction_BusOff() for handling busoff events in polling mode.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucEnumerationParamDef		
<b>Range</b>	INTERRUPT	Interrupt Mode of operation.	
	POLLING	Polling Mode of operation.	
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU		

<b>Name</b>	CanTTControllerEcucPartitionRef [ECUC_Can_00493]		
<b>Parent Container</b>	<a href="#">CanTTController</a>		
<b>Description</b>	<p>Maps the Time triggered CAN controller to zero or one ECUC partitions. The ECUC partition referenced is a subset of the ECUC partitions where the CAN driver is mapped to.</p> <p><b>Tags:</b> atp.Status=draft</p>		
<b>Multiplicity</b>	0..1		
<b>Type</b>	Reference to EcucPartition		
<b>Post-Build Variant Multiplicity</b>	false		
<b>Post-Build Variant Value</b>	true		
<b>Multiplicity Configuration Class</b>	<b>Pre-compile time</b>	X	All Variants
	<b>Link time</b>	–	
	<b>Post-build time</b>	–	
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	All Variants
	<b>Link time</b>	–	
	<b>Post-build time</b>	–	
<b>Scope / Dependency</b>	scope: ECU		

**No Included Containers**

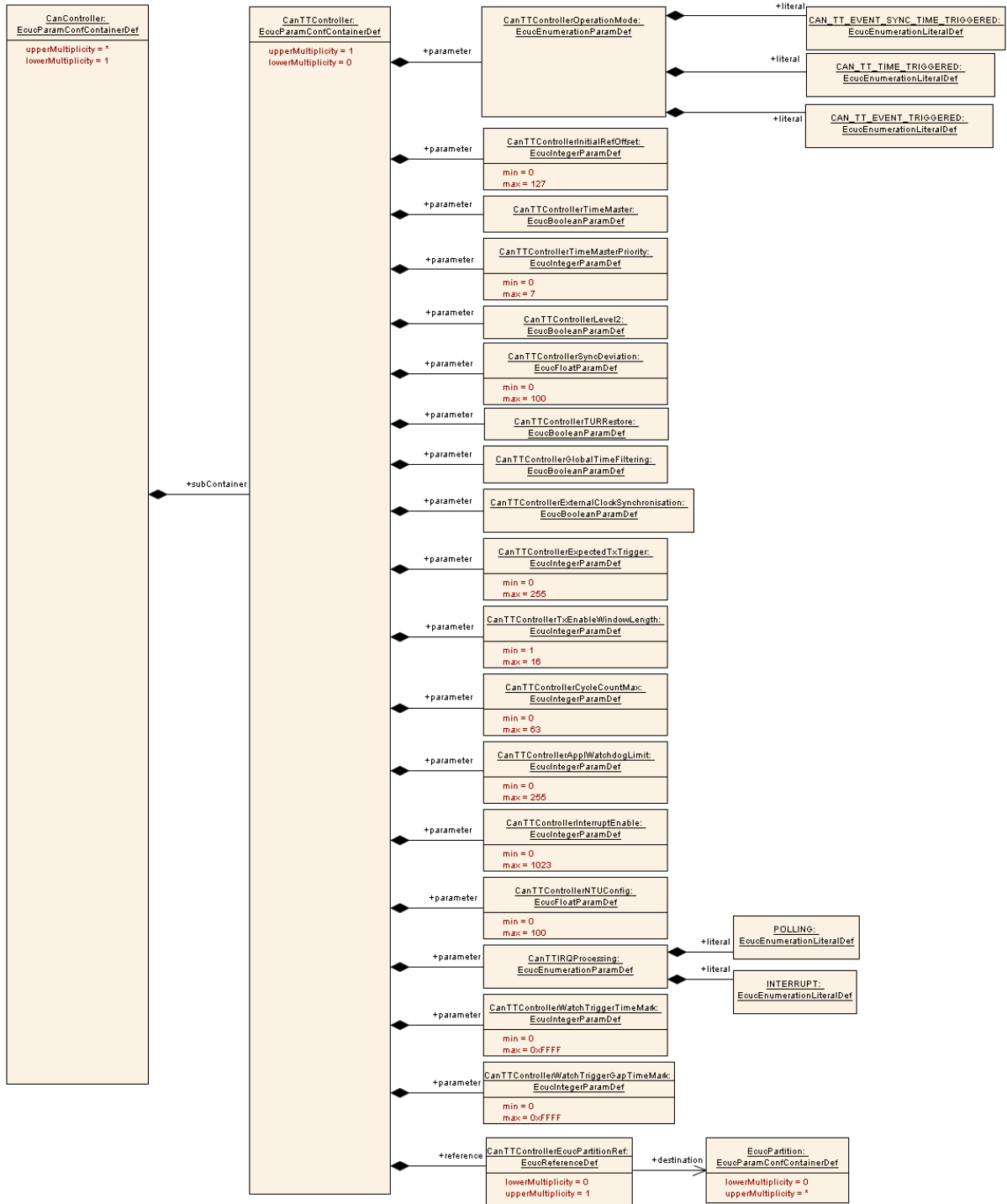


Figure 10.2: CAN Driver Time Triggered Controller Configuration

[SWS\_TtCan\_CONSTR\_0001]{DRAFT} [ The ECUC partitions referenced by CanTTControllerEcucPartitionRef shall be a subset of the ECUC partitions referenced by CanEcucPartitionRef. ]()



[SWS\_TtCan\_CONSTR\_00002]{DRAFT} [ CanTTController and CanTrcvChannel of one communication channel shall all reference the same ECUC partition. ]()

### 10.1.2 CanTTHardwareObjectTrigger

<b>SWS Item</b>	[ECUC_Can_00002]
<b>Container Name</b>	CanTTHardwareObjectTrigger
<b>Description</b>	<p>CanTTHardwareObjectTrigger is specified in the SWS TTCAN and contains the configuration (parameters) of TTCAN triggers for Hardware Objects, which are additional to the configuration (parameters) of CAN Hardware Objects.</p> <p>This container is only included and valid if TTCAN is supported by the controller and, enabled (see CanSupportTTCANRef, ECUC_Can_00430), and used.</p>
<b>Configuration Parameters</b>	

<b>Name</b>	CanTTHardwareObjectBaseCycle [ECUC_Can_00147]		
<b>Parent Container</b>	<a href="#">CanTTHardwareObjectTrigger</a>		
<b>Description</b>	Defines the cycle_offset. CanTTHardwareObjectBaseCycle must be not greater than cycle_count_max.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	0 .. 63		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	-	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU		

<b>Name</b>	CanTTHardwareObjectCycleRepetition [ECUC_Can_00148]		
<b>Parent Container</b>	<a href="#">CanTTHardwareObjectTrigger</a>		
<b>Description</b>	<p>Defines the repeat_factor.</p> <p>CanTTHardwareObjectCycleRepetition shall be a power of two (2), greater than cycle_offset but not greater than cycle_count_max + 1.</p>		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	1 .. 64		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		

<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: ECU		

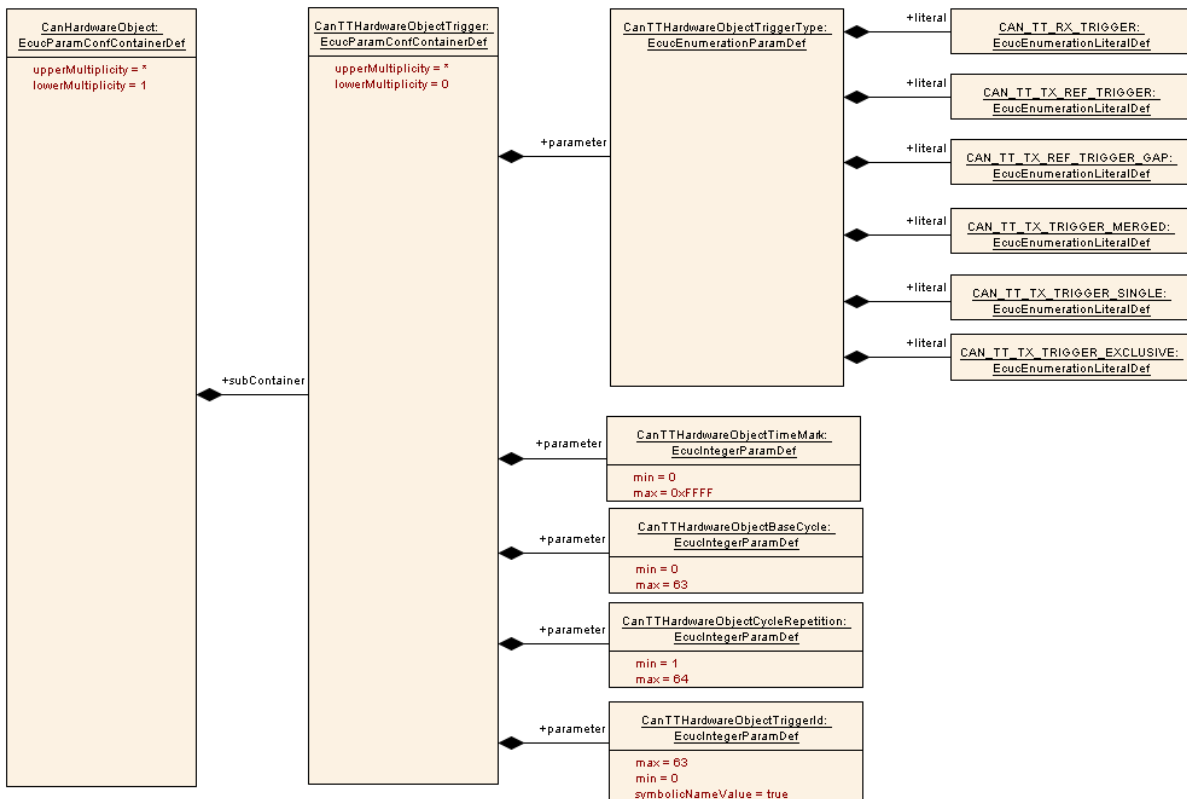
<b>Name</b>	CanTTHardwareObjectTimeMark [ECUC_Can_00146]		
<b>Parent Container</b>	<a href="#">CanTTHardwareObjectTrigger</a>		
<b>Description</b>	Defines the point in time, when the trigger will be activated. Value is given in cycle time.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef		
<b>Range</b>	0 .. 65535		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	true		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: local		

<b>Name</b>	CanTTHardwareObjectTriggerId [ECUC_Can_00155]		
<b>Parent Container</b>	<a href="#">CanTTHardwareObjectTrigger</a>		
<b>Description</b>	Sequential number which allows separation of different TTCAN triggers configured for one and the same hardware object.		
<b>Multiplicity</b>	1		
<b>Type</b>	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
<b>Range</b>	0 .. 63		
<b>Default Value</b>			
<b>Post-Build Variant Value</b>	false		
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	All Variants
	<b>Link time</b>	–	
	<b>Post-build time</b>	–	
<b>Scope / Dependency</b>	scope: local		

<b>Name</b>	CanTTHardwareObjectTriggerType [ECUC_Can_00145]	
<b>Parent Container</b>	<a href="#">CanTTHardwareObjectTrigger</a>	
<b>Description</b>	<p>Defines the type of the trigger associated with the hardware object. This parameter depends on plain CAN parameter CAN_OBJECT_TYPE. If CAN_OBJECT_TYPE equals RECEIVE than this parameter is fixed to CAN_TT_RX_TRIGGER. If CAN_OBJECT_TYPE equals TRANSMIT than one of the following literals is configurable: CAN_TT_TX_REF_TRIGGER, CAN_TT_TX_REF_TRIGGER_GAP, CAN_TT_TX_TRIGGER_MERGED, CAN_TT_TX_TRIGGER_SINGLE, CAN_TT_TX_TRIGGER_EXCLUSIVE.</p>	
<b>Multiplicity</b>	1	
<b>Type</b>	EcucEnumerationParamDef	
<b>Range</b>	CAN_TT_RX_TRIGGER	Trigger for verifying the successful reception of messages.
	CAN_TT_TX_REF_TRIGGER	Trigger for transmitting the reference message.
	CAN_TT_TX_REF_TRIGGER_GAP	Trigger for transmitting the reference message in case no event occurs after a gap.
	CAN_TT_TX_TRIGGER_EXCLUSIVE	<p>Trigger for transmitting a message in an exclusive time window.</p> <p>Note, that messages in an exclusive window are transmitted continuously, i.e. regardless whether the same message has been transmitted before, the message, which is currently available, will be transmitted every time the tx trigger occurs.</p>
	CAN_TT_TX_TRIGGER_MERGED	<p>Trigger for transmitting a message inside a merged arbitration window (the last tx trigger in a merged arbitration window is of type CAN_TT_TX_TRIGGER_SINGLE).</p> <p>Note, that messages in an arbitration window are transmitted only, if new data is available. When the transmission was not successful, it will be repeated at the next tx trigger for this message. When the transmission was successful, this message will not be transmitted again at the next tx triggers until a new message for this tx trigger is provided.</p>

<b>Post-Build Variant Value</b>	CAN_TT_TX_TRIGGER_SINGLE	Trigger for transmitting a message in a single (non-merged) arbitration window (or the last tx trigger in a merged arbitration window).	
	true	Note, that messages in an arbitration window are transmitted only, if new data is available. When the transmission was not successful, it will be repeated at the next tx trigger for this message. When the transmission was successful, this message will not be transmitted again at the next tx triggers until a new message for this tx trigger is provided.	
<b>Value Configuration Class</b>	<b>Pre-compile time</b>	X	VARIANT-PRE-COMPILE
	<b>Link time</b>	–	
	<b>Post-build time</b>	X	VARIANT-POST-BUILD
<b>Scope / Dependency</b>	scope: local dependency: CAN_OBJECT_TYPE		

**No Included Containers**



**Figure 10.3: CAN Driver Time Triggered Hardware Object Configuration**

## 10.2 Published information

For details refer to the chapter 10.3 "Published Information" in *SWS\_BSWGeneral* [5]

## A Not applicable requirements

[SWS\_TtCan\_00726] [ These requirements are not applicable to this specification. ]  
( )