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			△ • Removal of specification items covered by the new SWS BSW General • Formal rework
2011-12-22	4.0.3	AUTOSAR Administration	• Update of wake-up validation (power-up) • Several minor corrections (typos and wordings)
2010-09-30	3.1.5	AUTOSAR Administration	• Literals changed names: • the imported LIN interface parameters (from LINInterface) are removed, instead 3 local parameters are introduced • LINIF_TRCV_MODE_NORMAL -> LINTRCV_TRCV_MODE_NORMAL • LINIF_TRCV_MODE_STANDBY -> LINTRCV_TRCV_MODE_STANDBY • LINIF_TRCV_MODE_SLEEP -> LINTRCV_TRCV_MODE_SLEEP
2010-02-02	3.1.4	AUTOSAR Administration	• Initial release

Disclaimer

Contents

1 Introduction and functional overview

This specification specifies functionality, API and configuration of the module LIN transceiver driver. It is responsible to handle the LIN transceiver hardware on an ECU.

A LIN bus transceiver is a hardware device. It is the interface between LIN protocol controller and physical LIN bus. On one hand the transmit data stream of a LIN protocol controller is converted into LIN physical layer compliant bus signals. On the other hand LIN bus data streams are converted into protocol controller input signals. A LIN protocol controller is typically a microcontroller implementation.

Most LIN transceivers support power supply control and wakeup via the bus. A lot of different wakeup / sleep and power supply concepts are available on the market.

In addition so called system basis chips (SBC) are available. Beside LIN transceiver functionalities these devices provide additional features, e.g. detection of electrical malfunctions (e.g. short-circuit to dominant level (GND)), power supply control, advanced watchdogs, LIN transceiver, SPI etc.

1.1 Goal of LIN transceiver driver

The target of this document is to specify interfaces and behaviour, which are applicable to most current LIN transceiver hardware implementations.

[SWS_LinTrcv_00042]

Upstream requirements: SRS_BSW_00162

⌈The LIN transceiver driver abstracts the applied LIN transceiver hardware and covers hardware independent interfaces to the higher layers. It abstracts also from ECU layout by using APIs of MCAL layer to access LIN transceiver hardware.⌋

1.2 Explicitly uncovered LIN transceiver functionality

Some LIN bus transceivers offer additional functionality like ECU self test or error detection capability for diagnostics.

ECU self test and error detection are not defined within AUTOSAR and requiring such functionality in general would lock out most currently used transceiver hardware chips. Therefore, features like "ground shift detection", "selective wakeup", "slope control" and others are not supported.

2 Acronyms and Abbreviations

The glossary below includes acronyms and abbreviations relevant to the SWS_LINTransceiverDriver module that are not included in the [1, AUTOSAR glossary].

Abbreviation / Acronym:	Description:
API	Application Program Interface
Channel	A channel is a software exchange medium for data that are defined with the same criteria.
ComM	Communication Manager
Det	Default Error Tracer
Dio/DIO	Digital input output, one of the SPAL SW modules
EcuM	ECU State Manager
ECU	Electronic Control Unit
Frt	Free Running Timer
Gpt	General purpose Timer
ICU	Interrupt Control Unit
ISR	Interrupt Service Routine
LinTrcv	LIN Transceiver Driver
MCAL	Micro Controller Abstraction Layer
n/a	Not applicable
PDU	Protocol Data Unit
SBC	System Basis Chip; a device, which integrates e.g. LIN and / or LIN transceiver, watchdog and power control.
SPAL	Standard Peripheral Abstraction Layer
SW	Software
SPI	Serial Peripheral Interface
SPI Channel	A channel is a software exchange medium for data that are defined with the same criteria: configuration parameters, number of data elements with same size and data pointers (source & destination) or location. See specification of SPI driver for more details.
SPI Job	A job is composed of one or several channels with the same chip select. A job is considered to be atomic and therefore cannot be interrupted. A job has also an assigned priority. See specification of SPI driver for more details.
SPI Sequence	A sequence is a number of consecutive jobs to be transmitted. A sequence depends on a static configuration. See specification of SPI driver for more details.

Table 2.1: Acronyms and abbreviations used in the scope of this Document

3 Related documentation

3.1 Input documents & related standards and norms

[1] Glossary
AUTOSAR_FO_TR_Glossary

[2] General Specification of Basic Software Modules
AUTOSAR_CP_SWS_BSWGeneral

[3] General Requirements on Basic Software Modules
AUTOSAR_CP_RS_BSWGeneral

[4] Requirements on LIN
AUTOSAR_CP_RS_LIN

[5] Requirements on CAN
AUTOSAR_CP_RS_CAN

3.2 Related specification

AUTOSAR provides a General Specification on Basic Software modules [2, SWS BSW General], which is also valid for LIN Transceiver Driver.

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

4 Constraints and assumptions

4.1 Limitations

The used APIs of underlying drivers like DIO or SPI shall be synchronous. Implementations of underlying drivers, which do not support synchronous behavior, cannot be used together with LIN transceiver driver.

4.2 Applicability to car domains

This driver might be applicable in all car domains using LIN for communication.

5 Dependencies to other modules

Module	*Dependencies*
LinIf	All LIN transceiver drivers are arranged below LinIf.
ComM	ComM steers LIN transceiver driver communication modes via LinIf. Independent steering of each single LIN transceiver channel is possible.
Det	Det gets development error information from LIN transceiver driver.
Dio	Dio module is used to access LIN transceiver hardware connected via ports.
EcuM	EcuM gets wakeup information from LIN transceiver driver via LinIf.
Icu	Icu module might perform LIN transceiver hardware interrupts.
Spi	Spi module is used to access LIN transceiver hardware connected via Spi.

5.1 File structure

5.1.1 Naming convention for transceiver driver implementation

[SWS_LinTrcv_00070]

Upstream requirements: SRS_BSW_00347

⌈In case different LIN transceiver hardware implementations are used in one ECU the function names of the different LIN transceiver drivers must be modified such that no two functions with the same names are generated. The names may be extended with a vendor ID or a type ID.⌋

5.1.2 Code file structure

For details, refer to the section "Code file structure" of the [2].

5.1.3 Header file structure

[SWS_LinTrcv_00067]

Upstream requirements: SRS_BSW_00301, SRS_BSW_00409

⌈The include file structure shall be as follows:

LinTrcv.c shall include Det.h (needed to notify about development errors) if development error detection for the module LinTrcv is enabled.

LinTrcv.c shall include Dio.h (DIO APIs needed to access Transceiver pins)

LinTrcv.c shall include Icu.h (if ICU APIs needed to perform LIN transceiver hardware interrupts)

LinTrcv.c shall include Spi.h (if the LIN bus transceiver driver use drivers for Spi to control the LIN bus transceiver hardware)

LinTrcv.c shall include Tm.h (needed for wait states for changing transceiver operation modes)⌋

6 Requirements Tracing

The following tables reference the requirements specified in [3], [4], [5] and links to the fulfillment of these. Please note that if column "Satisfied by" is empty for a specific requirement this means that this requirement is not fulfilled by this document.

Requirement	Description	Satisfied by
[SRS_BSW_00101]	The Basic Software Module shall be able to initialize variables and hardware in a separate initialization function	[SWS_LinTrcv_00001]
[SRS_BSW_00162]	The AUTOSAR Basic Software shall provide a hardware abstraction layer	[SWS_LinTrcv_00042]
[SRS_BSW_00301]	All AUTOSAR Basic Software Modules shall only import the necessary information	[SWS_LinTrcv_00067]
[SRS_BSW_00310]	API naming convention	[SWS_LinTrcv_00001] [SWS_LinTrcv_00002] [SWS_LinTrcv_00005] [SWS_LinTrcv_00007] [SWS_LinTrcv_00008] [SWS_LinTrcv_00012]
[SRS_BSW_00327]	Error values naming convention	[SWS_LinTrcv_00050]
[SRS_BSW_00347]	A Naming seperation of different instances of BSW drivers shall be in place	[SWS_LinTrcv_00016] [SWS_LinTrcv_00070]
[SRS_BSW_00357]	For success/failure of an API call a standard return type shall be defined	[SWS_LinTrcv_00002]
[SRS_BSW_00358]	The return type of init() functions implemented by AUTOSAR Basic Software Modules shall be void	[SWS_LinTrcv_00001]
[SRS_BSW_00369]	All AUTOSAR Basic Software Modules shall not return specific development error codes via the API	[SWS_LinTrcv_00002] [SWS_LinTrcv_00005] [SWS_LinTrcv_00007] [SWS_LinTrcv_00008] [SWS_LinTrcv_00012]
[SRS_BSW_00375]	Basic Software Modules shall report wake-up reasons	[SWS_LinTrcv_00012]
[SRS_BSW_00377]	A Basic Software Module can return a module specific types	[SWS_LinTrcv_00005] [SWS_LinTrcv_00007]
[SRS_BSW_00385]	List possible error notifications	[SWS_LinTrcv_00050]
[SRS_BSW_00386]	The BSW shall specify the configuration and conditions for detecting an error	[SWS_LinTrcv_00050]
[SRS_BSW_00406]	API handling in uninitialized state	[SWS_LinTrcv_00002] [SWS_LinTrcv_00007] [SWS_LinTrcv_00008] [SWS_LinTrcv_00012]
[SRS_BSW_00407]	Each BSW module shall provide a function to read out the version information of a dedicated module implementation	[SWS_LinTrcv_00008]
[SRS_BSW_00409]	All production code error ID symbols are defined by the Dem module and shall be retrieved by the other BSW modules from Dem configuration	[SWS_LinTrcv_00067]
[SRS_BSW_00413]	An index-based accessing of the instances of BSW modules shall be done	[SWS_LinTrcv_00016]
[SRS_BSW_00414]	Init functions shall have a pointer to a configuration structure as single parameter	[SWS_LinTrcv_00001] [SWS_LinTrcv_00172] [SWS_LinTrcv_00173]

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Requirement	Description	Satisfied by
[SRS_Lin_01514]	The LIN Interface shall inform an upper layer about wake-up events	[SWS_LinTrcv_00066]
[SRS_Lin_01524]	The LIN Driver shall be able to put the LIN hardware to a reduced power operation mode if needed	[SWS_LinTrcv_00002] [SWS_LinTrcv_00055]
[SRS_Lin_01563]	The LIN Driver shall provide a notification for wake-up events	[SWS_LinTrcv_00066]
[SRS_Lin_01566]	Transition to sleep-mode shall be handled	[SWS_LinTrcv_00002] [SWS_LinTrcv_00055]
[SRS_Lin_01580]	The LIN Transceiver Driver shall support separate configuration parameters per bus	[SWS_LinTrcv_00074] [SWS_LinTrcv_00075]

Table 6.1: Requirements Tracing

7 Functional specification

7.1 LIN transceiver driver operation modes

[SWS_LinTrcv_00055]

Upstream requirements: SRS_Lin_01566, SRS_Lin_01524

⌈The LIN transceiver driver operation modes are described in the state diagram below.⌋

The main idea behind this diagram is to support the majority of available LIN bus transceivers in a common model view. Depending on the LIN transceiver hardware, the model may have one or two states more than necessary for a given LIN transceiver hardware, but this will clearly decouple the ComM and EcuM from the used hardware.

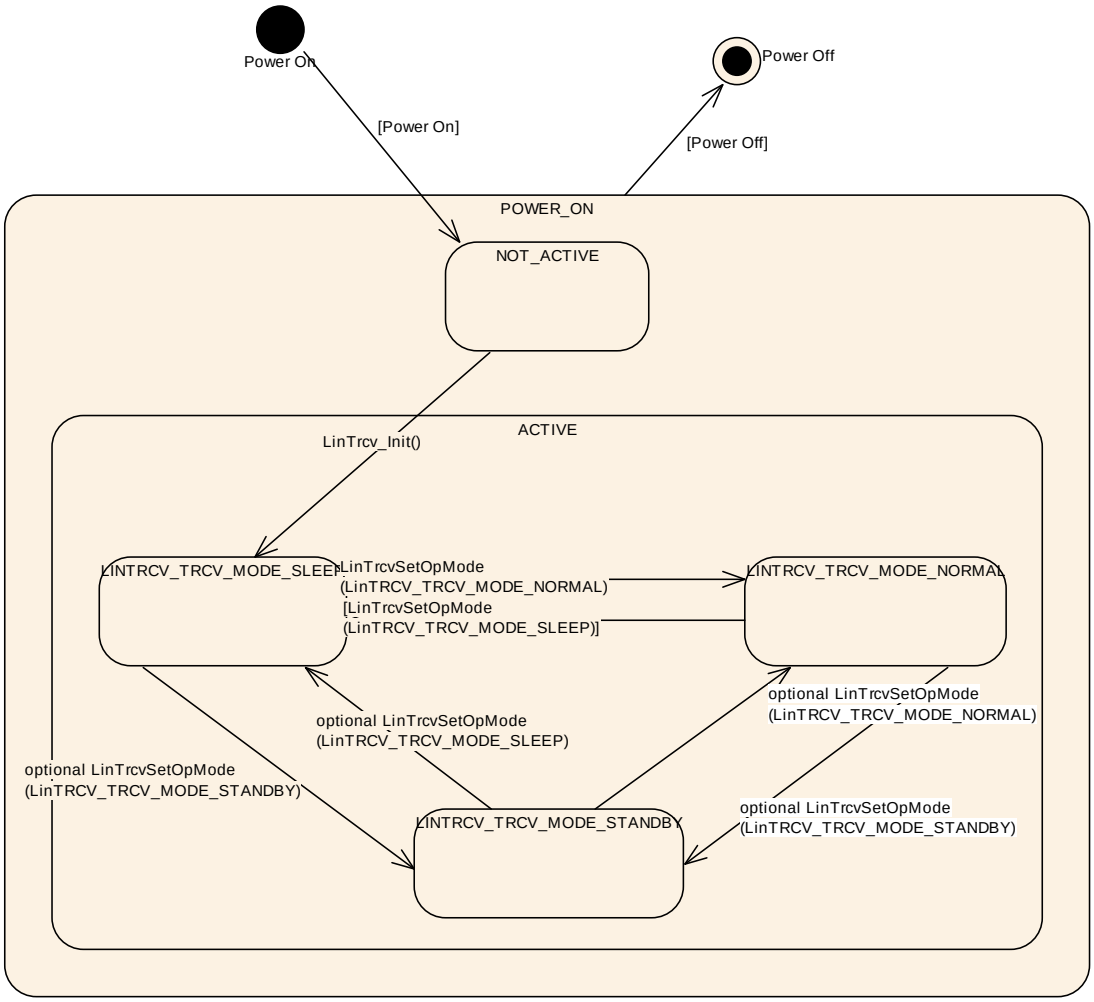

Figure 7.1: LIN Transceiver Operation Modes

Hint: There are several optional interfaces that might not be needed for current LIN transceiver hardware. E.g. the mode "LINTRCV_TRCV_MODE_STANDBY" might be only an internal state that is used for internal hardware transitions. Especially if func-

tionality of "inhibit pin" is used to control the uC only the states "LINTRCV_TRCV_MODE_SLEEP" and "LINTRCV_TRCV_MODE_NORMAL" are of interest.

State	Description
POWER_ON	MCU is fully powered.
NOT_ACTIVE	State of LIN transceiver hardware depend on ECU hardware and on Dio and Port driver configuration. LIN transceiver driver is not initialized and therefore not active.
ACTIVE	The function `LinTrcv_Init` was called. It carries LIN transceiver driver to active state. LIN transceiver driver enters state LINTRCV_TRCV_MODE_SLEEP.
LINTRCV_TRCV_MODE_NORMAL	Full bus communication. If LIN transceiver hardware controls MCU power supply, MCU is fully powered. The LIN transceiver driver detects no further wakeup information.
LINTRCV_TRCV_MODE_STANDBY	No communication is possible. If LIN transceiver hardware controls MCU power supply, the MCU is still powered. A wakeup by bus or by a local wakeup event is possible. Note: This is an optional state.
LINTRCV_TRCV_MODE_SLEEP	No communication is possible. If LIN transceiver hardware controls MCU power supply, the MCU is not powered. A wakeup by bus or by a local wakeup event is possible.

If a LIN transceiver driver covers more than one LIN channel, all channels are either in state NOT_ACTIVE or in state ACTIVE. In state ACTIVE each channel may be in a different sub state.

7.2 LIN transceiver hardware operation modes

The LIN transceiver hardware may support more mode transitions than the software. The dependencies and the recommended implementations behaviour are explained in this chapter.

It is up to the implementation to decide which LIN transceiver hardware state is covered by which LIN transceiver driver software state. An implementation has to guarantee that whole functionality of described LIN transceiver driver is given by the implementation.

7.3 LIN transceiver wakeup types

There are four different scenarios, which are often called wakeup:

1. MCU is not powered, parts of ECU including LIN transceiver hardware are powered. The considered LIN transceiver hardware is in mode LINTRCV_TRCV_MODE_SLEEP. A wakeup event on LIN is detected by LIN transceiver hardware. LIN transceiver hardware causes powering of MCU (e.g. via pin "inhibit"). In terms of AUTOSAR this is kept as a cold start and not as a wakeup.
2. MCU is in low power mode, parts of ECU including LIN transceiver hardware are powered. Depending on the hardware implementation the considered LIN

transceiver hardware is either in mode LINTRCV_TRCV_MODE_STANDBY or LINTRCV_TRCV_MODE_SLEEP. A wakeup event on LIN is detected by LIN transceiver hardware. LIN transceiver hardware is informing MCU about wakeup. In terms of AUTOSAR this is kept as a wakeup of the LIN channel and of the MCU.

3. MCU is in full power mode, at least parts of the ECU including LIN transceiver hardware are powered. Depending on the hardware implementation the considered LIN transceiver hardware is either in mode LINTRCV_TRCV_MODE_STANDBY or LINTRCV_TRCV_MODE_SLEEP. A wakeup event on LIN is detected by LIN transceiver hardware. LIN transceiver hardware is informing MCU about wakeup or is polled cyclically for wakeup events. In terms of AUTOSAR this is kept as a wakeup of a LIN channel.
4. MCU is in full power mode, at least parts of the ECU including LIN transceiver hardware are powered. Depending on the hardware implementation the considered LIN transceiver hardware is either in mode LINTRCV_TRCV_MODE_STANDBY or LINTRCV_TRCV_MODE_SLEEP. The MCU is now setting the LIN transceiver hardware to mode LINTRCV_TRCV_MODE_NORMAL and is waking up the LIN channel. In terms of AUTOSAR this is kept as an internal wakeup of a LIN channel (through MCU).

7.4 LIN transceiver wakeup modes

[SWS_LinTrcv_00066]

Upstream requirements: SRS_Lin_01514, SRS_Lin_01563

⌈Wakeup notification must be supported by LIN Transceiver driver, therefore LIN transceiver driver covers 2 wakeup modes, internal wakeup by an upper layer or external wakeup by LIN channel.⌋

1. Internal wakeup: An internal wakeup is initiated by an upper layer, e.g. by calling `LinTrcv_Init` or `LinTrcv_SetOpMode`.
2. External wakeup: Wakeup detected by LIN transceiver driver is forwarded to the upper layer through the API `LinTrcv_CheckWakeup` which has to be called by the LinIf.

Hint: WakeUp through ISR is not supported by the LIN Transceiver Driver but is only possible through ICU.

[SWS_LinTrcv_00074]

Upstream requirements: SRS_Lin_01580

⌈Selection of wakeup mode shall be done by configuration parameter `LinTrcvWakeUpSupport`.⌋

[SWS_LinTrcv_00075]

Upstream requirements: SRS_Lin_01580

⌈Support of wakeup shall be switched on and off for each LIN transceiver channel individually by configuration parameter `LinTrcvWakeupByBusUsed`.⌋

[SWS_LinTrcv_00161] ⌈LinTrcv driver shall use the following APIs provided by ICU driver, to enable and disable the wakeup event notification:

- Icu_EnableNotification
- Icu_DisableNotification

⌋

[SWS_LinTrcv_00162] ⌈LinTrcv driver shall enable the ICU channels when the transceiver transmits to standby mode (LINTRCV_STANDBY)⌋

[SWS_LinTrcv_00163] ⌈LinTrcv driver shall disable the ICU channels when the transceiver transmits to Normal mode (LINTRCV_NORMAL)⌋

Rationale: LinTrcv driver shall avoid the loss of wakeup events.

7.5 Error Classification

Section "Error Handling" of the document [2] "General Specification of Basic Software Modules" describes the error handling of the Basic Software in detail. Above all, it constitutes a classification scheme consisting of five error types which may occur in BSW modules.

Based on this foundation, the following section specifies particular errors arranged in the respective subsections below.

7.5.1 Development Errors

There are no development errors.

[SWS_LinTrcv_00050] Definiton of development errors in module LinTrcv

Upstream requirements: SRS_BSW_00327, SRS_BSW_00385, SRS_BSW_00386

⌈

Type of error	*Related error code*	*Error value*
API called with wrong parameter for LIN network	LINTRCV_E_INVALID_LIN_NETWORK	0x01
API called with null pointer parameter	LINTRCV_E_PARAM_POINTER	0x02
API service used without initialization	LINTRCV_E_UNINIT	0x11
API service called in wrong transceiver operation mode	LINTRCV_E_TRCV_NOT_SLEEP	0x21
API service called in wrong transceiver operation mode	LINTRCV_E_TRCV_NOT_NORMAL	0x22
API service called with invalid mode because optional transition is not enabled	LINTRCV_E_INVALID_TRCV_OPMODE	0x25

⌋

7.5.2 Runtime Errors

There are no runtime errors.

7.5.3 Production Errors

There are no production errors.

7.5.4 Extended Production Errors

There are no extended production errors.

7.6 Preconditions for driver initialization

[SWS_LinTrcv_00099] ⌈The LIN bus transceiver driver might use drivers for Dio or Spi to control the LIN bus transceiver hardware. Thus these drivers must be available and ready to operate before the LIN bus transceiver driver is initialized.⌋

The LIN transceiver driver may have timing requirements for the initialization sequence and the access to the transceiver device, which must be fulfilled by these used underlying drivers.

The timing requirements might be that

- The call of the LIN bus transceiver driver initialization has to be performed very early after power up to be able to read all necessary information out of the transceiver hardware in time for all other users within the ECU.
- The runtime of the used underlying services is very short and synchronous to enable the driver to keep his own timing requirements limited by the used hardware device.
- The runtime of the driver may be enlarged, as some hardware devices have the need to have the port pin level valid for e.g. 50μs before changing it again to reach a specific state, e.g. sleep.

7.7 Instance concept

[SWS_LinTrcv_00016]

Upstream requirements: SRS_BSW_00347, SRS_BSW_00413

⌈For each LIN transceiver hardware type an ECU has one LIN transceiver driver instance. One instance serves all LIN transceiver hardware of the same type.⌋

7.8 Wait states

For changing operation modes, the LIN transceiver hardware may have to perform wait states.

[SWS_LinTrcv_00171] ⌈The LIN Transceiver Driver shall use the Time service Tm_BusyWait1us16bit to realize the wait time for transceiver state changes.⌋

8 API specification

8.1 Imported types

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

[SWS_LinTrcv_91001] Definition of imported datatypes of module LinTrcv ⌈

Module	*Header File*	*Imported Type*
Dio	Dio.h	Dio_ChannelGroupType
	Dio.h	Dio_ChannelType
	Dio.h	Dio_LevelType
	Dio.h	Dio_PortLevelType
	Dio.h	Dio_PortType
EcuM	EcuM.h	EcuM_WakeupSourceType
Icu	Icu.h	Icu_ChannelType
Spi	Spi.h	Spi_ChannelType
	Spi.h	Spi_DataBufferType
	Spi.h	Spi_NumberOfDataType
	Spi.h	Spi_SequenceType
	Spi.h	Spi_StatusType
Std	Std_Types.h	Std_ReturnType
	Std_Types.h	Std_VersionInfoType

⌋

8.2 Type definitions

8.2.1 LinTrcv_ConfigType

[SWS_LinTrcv_00172] Definition of datatype LinTrcv_ConfigType

Upstream requirements: SRS_BSW_00414

⌈

Name	LinTrcv_ConfigType	
Kind	Structure	
Elements	implementation specific	
	Type	–
	Comment	–
Description	Configuration data structure of the LinTrcv module.	
Available via	LinTrcv.h	

⌋

8.2.2 LinTrcv_TrcvModeType

[SWS_LinTrcv_00168] Definition of datatype LinTrcv_TrcvModeType ⌈

Name	LinTrcv_TrcvModeType		
Kind	Enumeration		
Range	LINTRCV_TRCV_MODE_NORMAL	–	Transceiver mode NORMAL
	LINTRCV_TRCV_MODE_STANDBY	–	Transceiver mode STANDBY
	LINTRCV_TRCV_MODE_SLEEP	–	Transceiver mode SLEEP
Description	Operating modes of the LIN Transceiver Driver		
Available via	Lin_GeneralTypes.h		

⌋

8.2.3 LinTrcv_TrcvWakeupModeType

[SWS_LinTrcv_00169] Definition of datatype LinTrcv_TrcvWakeupModeType ⌈

Name	LinTrcv_TrcvWakeupModeType		
Kind	Enumeration		
Range	LINTRCV_WUMODE_ENABLE	–	The notification for wakeup events is enabled on the addressed network.
	LINTRCV_WUMODE_DISABLE	–	The notification for wakeup events is disabled on the addressed network.
	LINTRCV_WUMODE_CLEAR	–	A stored wakeup event is cleared on the addressed network.
Description	Wake up operating modes of the LIN Transceiver Driver.		
Available via	Lin_GeneralTypes.h		

⌋

8.2.4 LinTrcv_TrcvWakeupReasonType

[SWS_LinTrcv_00170] Definition of datatype LinTrcv_TrcvWakeupReasonType ⌈

Name	LinTrcv_TrcvWakeupReasonType		
Kind	Enumeration		
Range	LINTRCV_WU_ERROR	–	Due to an error wake up reason was not detected.

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	LINTRCV_WU_NOT_SUPPORTED	–	The transceiver does not support any information for the wake up reason.
	LINTRCV_WU_BY_BUS	–	The transceiver has detected, that the network has caused the wake up of the ECU.
	LINTRCV_WU_BY_PIN	–	The transceiver has detected a wake-up event at one of the transceiver's pins (not at the LIN bus).
	LINTRCV_WU_INTERNALLY	–	The transceiver has detected, that the network has been woken up by the ECU via a request to NORMAL mode.
	LINTRCV_WU_RESET	–	The transceiver has detected, that the wake up is due to an ECU reset.
	LINTRCV_WU_POWER_ON	–	The transceiver has detected, that the wake up is due to an ECU reset after power on.
Description	This type denotes the wake up reason detected by the LIN transceiver in detail.		
Available via	Lin_GeneralTypes.h		

⌋

8.3 Function definitions

8.3.1 LinTrcv_Init

[SWS_LinTrcv_00001] Definition of API function LinTrcv_Init

Upstream requirements: SRS_BSW_00310, SRS_BSW_00358, SRS_BSW_00414, SRS_BSW_-00101

⌈

Service Name	LinTrcv_Init	
Syntax	`void LinTrcv_Init ( const LinTrcv_ConfigType* ConfigPtr )`	
Service ID [hex]	0x00	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	ConfigPtr	Pointer to the selected configuration set.
Parameters (inout)	None	
Parameters (out)	None	
Return value	None	
Description	Initializes the Lin Transceiver Driver module.	
Available via	LinTrcv.h	

⌋

[SWS_LinTrcv_00173]

Upstream requirements: SRS_BSW_00414

⌈The Configuration pointer `ConfigPtr` shall always have a NULL_PTR value⌋

The Configuration pointer `ConfigPtr` is currently not used and shall therefore be set NULL_PTR value.

[SWS_LinTrcv_00119] ⌈The function `LinTrcv_Init` shall set the LIN transceiver hardware to the state LINTRCV_TRCV_MODE_SLEEP.⌋

Caveats: The initialization sequence after reset (e.g. power up) is a critical phase for the LIN transceiver driver. The driver will use SPAL functionality (DIO) to access the transceiver hardware. Therefore all necessary BSW drivers must be initialized and usable before.

8.3.2 LinTrcv_SetOpMode

[SWS_LinTrcv_00002] Definition of API function LinTrcv_SetOpMode

Upstream requirements: SRS_BSW_00310, SRS_BSW_00357, SRS_BSW_00369, SRS_BSW_-00406, SRS_Lin_01566, SRS_Lin_01524

⌈

Service Name	LinTrcv_SetOpMode	
Syntax	`Std_ReturnType LinTrcv_SetOpMode ( uint8 LinNetwork, LinTrcv_TrcvModeType OpMode )`	
Service ID [hex]	0x01	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (in)	LinNetwork	LIN network to wich API call has to be applied
	OpMode	The parameter says to which operation mode the change shall be performed.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	`E_OK`: will be returned if the transceiver state has been changed to the requested mode. `E_NOT_OK`: will be returned if the transceiver state change is not accepted or has failed or the parameter is out of the allowed range.
Description	The internal state of the LIN transceiver driver is switched to mode given in the parameter Op Mode.	
Available via	LinTrcv.h	

⌋

[SWS_LinTrcv_00108] ⌈The function `LinTrcv_SetOpMode` shall switch the internal state of channel `LinNetwork` to the value of the parameter `OpMode` which can be LINTRCV_TRCV_MODE_NORMAL, LINTRCV_TRCV_MODE_STANDBY or LINTRCV_TRCV_MODE_SLEEP.⌋

[SWS_LinTrcv_00109] ⌈The function `LinTrcv_SetOpMode` shall switch the internal state of channel `LinNetwork` to the value of LINTRCV_TRCV_MODE_STANDBY if one of the following conditions is fulfilled:

a) the channel `LinNetwork` is in mode LINTRCV_TRCV_MODE_SLEEP and the optional transition from this mode to LINTRCV_TRCV_MODE_STANDBY is enabled.

b) the channel `LinNetwork` is in mode LINTRCV_TRCV_MODE_NORMAL and the optional transition from this mode to LINTRCV_TRCV_MODE_STANDBY is enabled.⌋

[SWS_LinTrcv_00110] ⌈The function `LinTrcv_SetOpMode` shall switch the internal state of channel `LinNetwork` to the value of LINTRCV_TRCV_MODE_SLEEP if one of the following conditions is fulfilled:

a) the channel `LinNetwork` is in mode LINTRCV_TRCV_MODE_NORMAL

b) the channel `LinNetwork` is in mode LINTRCV_TRCV_MODE_STANDBY and the optional transition from this mode to LINTRCV_TRCV_MODE_SLEEP is enabled.⌋

[SWS_LinTrcv_00147] ⌈The function `LinTrcv_SetOpMode` shall switch the internal state of channel `LinNetwork` to the value of LINTRCV_TRCV_MODE_NORMAL if one of the following conditions is fulfilled:

a) the channel `LinNetwork` is in mode LINTRCV_TRCV_MODE_SLEEP

b) the channel `LinNetwork` is in mode LINTRCV_TRCV_MODE_STANDBY and the optional transition from this mode to LINTRCV_TRCV_MODE_NORMAL is enabled.⌋

[SWS_LinTrcv_00111] ⌈This API is applicable to each transceiver with each value for parameter `LinTrcv_SetOpMode` regardless of whether the transceiver hardware supports these modes or not. This is to simplify the view of the LinIf to the assigned bus.⌋

[SWS_LinTrcv_00112] ⌈If the requested mode is not supported by the underlying transceiver hardware, the function `LinTrcv_SetOpMode` shall return `E_NOT_OK`.⌋

[SWS_LinTrcv_00113] ⌈If there is no / incorrect communication to the transceiver, the function `LinTrcv_SetOpMode` shall return `E_NOT_OK`.⌋

[SWS_LinTrcv_00114] ⌈If development error detection for the module LinTrcv is enabled:

If the function LinTrcv_SetOpMode is called with OpMode == LINTRCV_TRCV_MODE_STANDBY and the channel LinNetwork is in mode LINTRCV_SLEEP but the optional transition from LINTRCV_SLEEP to LINTRCV_STANDBY is not enabled, the function LinTrcv_SetOpMode shall report the development error LINTRCV_E_INVALID_TRCV_OPMODE.⌋

[SWS_LinTrcv_00148] ⌈If development error detection for the module LinTrcv is enabled:

If the function LinTrcv_SetOpMode is called with OpMode == LINTRCV_TRCV_MODE_STANDBY and the channel LinNetwork is in mode LINTRCV_NORMAL but the optional transition from LINTRCV_NORMAL to LINTRCV_STANDBY is not enabled, the function LinTrcv_SetOpMode shall report the development error LINTRCV_E_INVALID_TRCV_OPMODE.⌋

[SWS_LinTrcv_00115] ⌈If development error detection for the module LinTrcv is enabled:

If optional transition from LINTRCV_STANDBY to LINTRCV_SLEEP is not enabled and the function LinTrcv_SetOpMode is called with OpMode == LINTRCV_TRCV_MODE_SLEEP and the channel LinNetwork is not in mode LINTRCV_TRCV_MODE_NORMAL, the function LinTrcv_SetOpMode shall report the development error LINTRCV_E_TRCV_NOT_NORMAL.⌋

[SWS_LinTrcv_00149] ⌈If development error detection for the module LinTrcv is enabled:

If optional transition from LINTRCV_STANDBY to LINTRCV_NORMAL is not enabled and the function LinTrcv_SetOpMode is called with OpMode == LINTRCV_TRCV_MODE_NORMAL and the channel LinNetwork is not in mode LINTRCV_TRCV_MODE_SLEEP, the function LinTrcv_SetOpMode shall report the development error LINTRCV_E_TRCV_NOT_SLEEP.⌋

[SWS_LinTrcv_00116] ⌈If development error detection for the module LinTrcv is enabled:

If called before the LinTrcv module has been initialized, the function LinTrcv_SetOpMode shall report the development error LINTRCV_E_UNINIT.⌋

[SWS_LinTrcv_00117] ⌈If development error detection for the module LinTrcv is enabled:

If called with an invalid network number LinNetwork, the function LinTrcv_SetOpMode shall report the development error LINTRCV_E_INVALID_LIN_NETWORK.⌋

[SWS_LinTrcv_00157] ⌈A mode request of the current mode is allowed and shall not lead to an error even if DET is enabled.⌋

8.3.3 LinTrcv_GetOpMode

[SWS_LinTrcv_00005] Definition of API function LinTrcv_GetOpMode

Upstream requirements: SRS_BSW_00310, SRS_BSW_00369, SRS_BSW_00377

⌈

Service Name	LinTrcv_GetOpMode	
Syntax	`Std_ReturnType LinTrcv_GetOpMode ( uint8 LinNetwork, LinTrcv_TrcvModeType* OpMode )`	
Service ID [hex]	0x02	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	LinNetwork	LIN network to which API call has to be applied
Parameters (inout)	None	
Parameters (out)	OpMode	Pointer to operation mode of the bus the API is applied to.
Return value	Std_ReturnType	E_OK: will be returned if the operation mode is detected E_NOT_OK: will be returned, if service request is failed due to operation mode is not detected.
Description	API detects the actual software state of LIN transceiver driver.	
Available via	LinTrcv.h	

⌋

[SWS_LinTrcv_00121] ⌈The function LinTrcv_GetOpMode shall return the actual state of the LIN transceiver driver in the parameter OpMode.⌋

[SWS_LinTrcv_00122] ⌈If there is no / incorrect communication to the transceiver, the function LinTrcv_GetOpMode shall return E_NOT_OK.⌋

[SWS_LinTrcv_00123] ⌈If development error detection for the module LinTrcv is enabled:

If called before the LinTrcv module has been initialized, the function LinTrcv_GetOpMode shall report the development error LINTRCV_E_UNINIT.⌋

[SWS_LinTrcv_00124] ⌈If development error detection for the module LinTrcv is enabled:

If called with an invalid network number LinNetwork, the function LinTrcv_GetOpMode shall report the development error LINTRCV_E_INVALID_LIN_NETWORK.⌋

[SWS_LinTrcv_00125] ⌈If development error detection for the module LinTrcv is enabled:

If called with `OpMode` == NULL, the function `LinTrcv_GetOpMode` shall report the development error `LINTRCV_E_PARAM_POINTER`.⌋

Configuration: The number of supported busses is statically set in the configuration phase.

8.3.4 LinTrcv_GetBusWuReason

[SWS_LinTrcv_00007] Definition of API function LinTrcv_GetBusWuReason

Upstream requirements: SRS_BSW_00310, SRS_BSW_00369, SRS_BSW_00377, SRS_BSW_00406

⌈

Service Name	LinTrcv_GetBusWuReason	
Syntax	`Std_ReturnType LinTrcv_GetBusWuReason ( uint8 LinNetwork, LinTrcv_TrcvWakeupReasonType* Reason )`	
Service ID [hex]	0x03	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	LinNetwork	LIN network to which API call has to be applied
Parameters (inout)	None	
Parameters (out)	Reason	Pointer to wakeup reason of the bus the API is applied to.
Return value	Std_ReturnType	`E_OK`: will be returned if the wake up reason is detected `E_NOT_OK`: will be returned, if service request is failed due to wakeup reason is not detected.
Description	This API provides the reason for the wakeup that the LIN transceiver has detected in the parameter "Reason". The ability to detect and differentiate the possible wakeup reasons depends strongly on the LIN transceiver hardware.	
Available via	LinTrcv.h	

⌋

[SWS_LinTrcv_00126] ⌈The function `LinTrcv_GetBusWuReason` shall return the reason for the wake up that the LIN transceiver has detected in the parameter `Reason`.⌋

[SWS_LinTrcv_00127] ⌈If there is no / incorrect communication to the transceiver, the function `LinTrcv_GetBusWuReason` shall return `E_NOT_OK`.⌋

[SWS_LinTrcv_00128] ⌈If development error detection for the module LinTrcv is enabled:

If called before the LinTrcv module has been initialized, the function LinTrcv_GetBusWuReason shall report development error LINTRCV_E_UNINIT.⌋

[SWS_LinTrcv_00129] ⌈If development error detection for the module LinTrcv is enabled:

If called with an invalid network number LinNetwork, the function LinTrcv_GetBusWuReason shall report development error LINTRCV_E_INVALID_LIN_NETWORK.⌋

[SWS_LinTrcv_00130] ⌈If development error detection for the module LinTrcv is enabled:

If called with Reason == NULL, the function LinTrcv_GetBusWuReason shall report the development error LINTRCV_E_PARAM_POINTER.⌋

Configuration: The number of supported busses is statically set in the configuration phase.

Caveats: Be aware that if more than one bus is available each bus may report a different wakeup reason. E.g. if an ECU has LIN, a wakeup by LIN may occur and the incoming data may cause an internal wakeup for another LIN bus.

The LIN transceiver driver has a "per bus" view and does not vote the more important reason or sequence internally. The same may be true if e.g. one transceiver controls the power supply and the other is just powered or un-powered.

8.3.5 LinTrcv_GetVersionInfo

[SWS_LinTrcv_00008] Definition of API function LinTrcv_GetVersionInfo

Upstream requirements: SRS_BSW_00310, SRS_BSW_00369, SRS_BSW_00406, SRS_BSW_00407

⌈

Service Name	LinTrcv_GetVersionInfo	
Syntax	`void LinTrcv_GetVersionInfo ( Std_VersionInfoType* versioninfo )`	
Service ID [hex]	0x04	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	None	
Parameters (inout)	None	
Parameters (out)	versioninfo	Pointer to version information of this module.

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Return value	None
Description	This service provides the version information of this module through the parameter "versioninfo".
Available via	LinTrcv.h

⌋

[SWS_LinTrcv_00131] ⌈The function `LinTrcv_GetVersionInfo` shall return the version information of this module. The version information contains all data defined in Std_VersionInfoType in "AUTOSAR_SWS_StandardTypes".⌋

[SWS_LinTrcv_00134] ⌈If development error detection for the module LinTrcv is enabled:

If called with `versioninfo` == NULL, the function `LinTrcv_GetVersionInfo` shall report development error `LINTRCV_E_PARAM_POINTER`.⌋

8.3.6 LinTrcv_CheckWakeup

[SWS_LinTrcv_00012] Definition of callback function LinTrcv_CheckWakeup

Upstream requirements: SRS_BSW_00310, SRS_BSW_00369, SRS_BSW_00375, SRS_BSW_00406

⌈

Service Name	LinTrcv_CheckWakeup	
Syntax	`Std_ReturnType LinTrcv_CheckWakeup ( uint8 LinNetwork )`	
Service ID [hex]	0x07	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	LinNetwork	LIN network to which API call has to be applied.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	`E_OK`: API call has been accepted `E_NOT_OK`: API call has not been accepted
Description	Notifies the calling function if a wakeup is detected.	
Available via	LinTrcv.h	

⌋

[SWS_LinTrcv_00144] ⌈If development error detection for the module LinTrcv is enabled:

If called before the LinTrcv module has been initialized, the function LinTrcv_CheckWakeup shall report the development error LINTRCV_E_UNINIT.⌋

[SWS_LinTrcv_00145] ⌈If development error detection for the module LinTrcv is enabled:

If called with an invalid network number LinNetwork, the function LinTrcv_CheckWakeup shall report the development error LINTRCV_E_INVALID_LIN_NETWORK.⌋

[SWS_LinTrcv_00166] ⌈The function LinTrcv_CheckWakeup shall evaluate the wakeup on the addressed LIN network. When a wake-up event on the addressed LIN network is detected (e.g. dominant bus state or negative edge at wakeup pin), the function LinTrcv_CheckWakeup shall notify the ECU State Manager module immediately via the EcuM_SetWakeupEvent and LinIf via LinIf_WakeupConfirmation callback function.⌋

[SWS_LinTrcv_00167] ⌈If development error detection for the module LinTrcv is enabled: If the addressed LIN network is not in mode LINTRCV_TRCV_MODE_SLEEP, the function LinTrcv_CheckWakeup shall report the development error LINTRCV_E_TRCV_NOT_SLEEP.⌋

Configuration: See configuration parameter LinTrcvWakeUpSupport.

8.3.7 LinTrcv_SetWakeupMode

[SWS_LinTrcv_00009] Definition of API function LinTrcv_SetWakeupMode ⌈

Service Name	LinTrcv_SetWakeupMode	
Syntax	`Std_ReturnType LinTrcv_SetWakeupMode ( uint8 LINNetwork, LinTrcv_TrcvWakeupModeType TrcvWakupMode )`	
Service ID [hex]	0x05	
Sync/Async	Synchronous	
Reentrancy	non Reentrant	
Parameters (in)	LINNetwork	LIN network to which API call has to be applied
	TrcvWakupMode	Requested transceiver wakup reason.
Parameters (inout)	None	
Parameters (out)	None	
Return value	Std_ReturnType	E_OK will be returned if the transceiver state has been changed to the requested mode. E_NOT_OK will be returned, if service request is failed due to wakeup mode is not set.

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Description	This API enables, disables and clears the notification for wakeup events on the addressed network.
Available via	LinTrcv.h

⌋

[SWS_LinTrcv_00135] ⌈Enabled: If the function `LinTrcv_SetWakeupMode` is called with `TrcvWakupMode` == LINTRCV_WUMODE_ENABLE and if the LinTrcv module has a stored wakeup event pending for the addressed bus, the LinTrcv module shall execute the notification within the API call or immediately after (depending on the implementation).⌋

[SWS_LinTrcv_00136] ⌈Disabled: If the function `LinTrcv_SetWakeupMode` is called with `TrcvWakupMode` == LINTRCV_WUMODE_DISABLE, then the notifications for wakeup events are disabled on the addressed network. It is required by the transceiver device and the underlying communication driver to detect the wakeup events and store it internally in order to raise the event when the wakeup notification is enabled again.⌋

[SWS_LinTrcv_00137] ⌈Clear: If the function `LinTrcv_SetWakeupMode` is called with `TrcvWakupMode` == LINTRCV_WUMODE_CLEAR, then a stored wakeup event is cleared on the addressed network. Clearing of wakeup events have to be used when the wake up notification is disabled to clear all stored wake up events under control of the higher layer.⌋

[SWS_LinTrcv_00138] ⌈If there is no / incorrect communication to the transceiver, the function `LinTrcv_SetWakeupMode` shall return `E_NOT_OK`.⌋

[SWS_LinTrcv_00139] ⌈If development error detection for the module LinTrcv is enabled:

If called before the LinTrcv has been initialized, the function `LinTrcv_SetWakeupMode` shall report development error `LINTRCV_E_UNINIT`.⌋

[SWS_LinTrcv_00140] ⌈If development error detection for the module LinTrcv is enabled:

If called with an invalid network number `LINNetwork`, the function `LinTrcv_SetWakeupMode` shall report development error `LINTRCV_E_INVALID_LIN_NETWORK`.⌋

8.4 Callback notifications

There are no callback notifications provided by LIN Transceiver Driver.

8.5 Scheduled functions

This chapter lists all functions provided by the LinTrcv module and called directly by the Basic Software Module Scheduler. There are no cyclical called functions provided by LIN Transceiver Driver.

8.6 Expected interfaces

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

8.6.1 Mandatory interfaces

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

[SWS_LinTrcv_91002] Definition of mandatory interfaces required by module Lin Trcv ⌈

API Function	*Header File*	*Description*
LinIf_WakeupConfirmation	LinIf.h	The LIN Driver or LIN Transceiver Driver will call this function to report the wake up source after the successful wakeup detection during CheckWakeup or after power on by bus.

⌋

8.6.2 Optional interfaces

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

[SWS_LinTrcv_91003] Definition of optional interfaces requested by module Lin Trcv ⌈

API Function	*Header File*	*Description*
Det_ReportError	Det.h	Service to report development errors.
Dio_ReadChannel	Dio.h	Returns the value of the specified DIO channel.
Dio_ReadChannelGroup	Dio.h	This Service reads a subset of the adjoining bits of a port.
Dio_ReadPort	Dio.h	Returns the level of all channels of that port.
Dio_WriteChannel	Dio.h	Service to set a level of a channel.

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API Function	*Header File*	*Description*
Dio_WriteChannelGroup	Dio.h	Service to set a subset of the adjoining bits of a port to a specified level.
Dio_WritePort	Dio.h	Service to set a value of the port.
EcuM_SetWakeupEvent	EcuM.h	Sets the wakeup event.
Icu_DisableNotification	Icu.h	This function disables the notification of a channel.
Icu_EnableNotification	Icu.h	This function enables the notification on the given channel.
Spi_GetStatus	Spi.h	Service returns the SPI Handler/Driver software module status.
Spi_ReadIB	Spi.h	Service for reading synchronously one or more data from an IB SPI Handler/Driver Channel specified by parameter.
Spi_SetupEB	Spi.h	Service to setup the buffers and the length of data for the EB SPI Handler/Driver Channel specified.
Spi_SyncTransmit	Spi.h	Service to transmit data on the SPI bus
Spi_WriteIB	Spi.h	Service for writing one or more data to an IB SPI Handler/Driver Channel specified by parameter.

⌋

[SWS_LinTrcv_00165] ⌈LinTrcv driver shall enable / disable ICU channels only if reference is configured for the parameter `LinTrcvIcuChannelRef`.⌋

8.6.3 Configurable interfaces

There are no configurable interfaces for LIN transceiver driver.

9 Sequence diagrams

For all wakeup related sequence diagrams please refer to chapter 9 of ECU State Manager.

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 LinTrcv.

Chapter 10.3 specifies published information of the module LinTrcv.

10.1 How to read this chapter

For details refer to the chapter "Introduction to configuration specification" in SWS_BSWGeneral.

[SWS_LinTrcv_00174] ⌈The LIN Transceiver Driver module shall reject configurations with partition mappings which are not supported by the implementation.⌋

10.2 Containers and configuration parameters

The following chapters summarize all configuration parameters. The detailed meanings of the parameters are described in preceding chapters.

10.2.1 Variants

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

10.2.2 LinTrcv

[ECUC_LinTrcv_00161] Definition of EcucModuleDef LinTrcv ⌈

Module Name	LinTrcv
Description	Configuration of LIN Transceiver Driver module
Post-Build Variant Support	false
Supported Config Variants	VARIANT-PRE-COMPILE

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
LinTrcvChannel	1..*	Container gives LIN transceiver driver information about a single LIN transceiver channel. Any LIN transceiver driver has such LIN transceiver channels.
LinTrcvGeneral	1	Container gives LIN transceiver driver basic information.

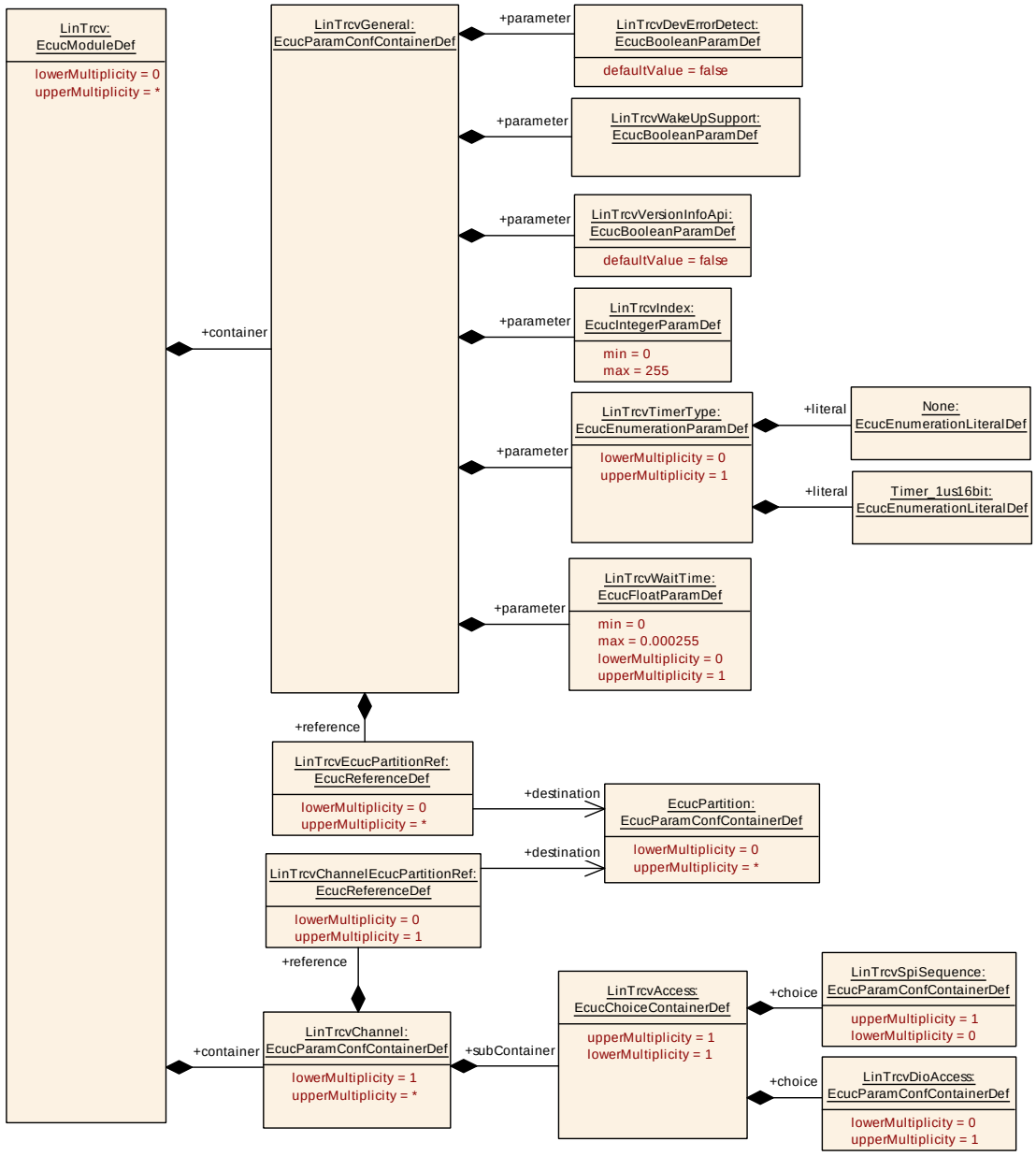

Figure 10.1: Overview about LIN Transceiver Driver configuration containers

10.2.3 LinTrcvGeneral

[ECUC_LinTrcv_00090] Definition of EcucParamConfContainerDef LinTrcvGeneral ⌈

Container Name	LinTrcvGeneral
Parent Container	LinTrcv
Description	Container gives LIN transceiver driver basic information.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
LinTrcvDevErrorDetect	1	[ECUC_LinTrcv_00001]
LinTrcvIndex	1	[ECUC_LinTrcv_00153]
LinTrcvTimerType	0..1	[ECUC_LinTrcv_00159]
LinTrcvVersionInfoApi	1	[ECUC_LinTrcv_00003]
LinTrcvWaitTime	0..1	[ECUC_LinTrcv_00160]
LinTrcvWakeUpSupport	1	[ECUC_LinTrcv_00107]
LinTrcvEcucPartitionRef	0..*	[ECUC_LinTrcv_00162]

No Included Containers

⌋

[ECUC_LinTrcv_00001] Definition of EcucBooleanParamDef LinTrcvDevErrorDetect ⌈

Parameter Name	LinTrcvDevErrorDetect		
Parent Container	LinTrcvGeneral		
Description	Switches the development error detection and notification on or off. • true: detection and notification is enabled. • false: detection and notification is disabled.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	false		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

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[ECUC_LinTrcv_00153] Definition of EcucIntegerParamDef LinTrcvIndex ⌈

Parameter Name	LinTrcvIndex		
Parent Container	LinTrcvGeneral		
Description	Specifies the InstanceId of this module instance. If only one instance is present it shall have the Id 0.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 255		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_LinTrcv_00159] Definition of EcucEnumerationParamDef LinTrcvTimerType ⌈

Parameter Name	LinTrcvTimerType		
Parent Container	LinTrcvGeneral		
Description	Type of the Time Service Predefined Timer.		
Multiplicity	0..1		
Type	EcucEnumerationParamDef		
Range	None	None	
	Timer_1us16bit	16 bit 1us timer	
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_LinTrcv_00003] Definition of EcucBooleanParamDef LinTrcvVersionInfoApi ⌈

Parameter Name	LinTrcvVersionInfoApi		
Parent Container	LinTrcvGeneral		
Description	Switches version information API on and off. If switched off, function need not be present in compiled code. True: Is used False: Is not used		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	false		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_LinTrcv_00160] Definition of EcucFloatParamDef LinTrcvWaitTime ⌈

Parameter Name	LinTrcvWaitTime		
Parent Container	LinTrcvGeneral		
Description	Wait time for transceiver state changes in seconds.		
Multiplicity	0..1		
Type	EcucFloatParamDef		
Range	[0 .. 2.55E-4]		
Default value	–		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_LinTrcv_00107] Definition of EcucBooleanParamDef LinTrcvWakeUpSupport ⌈

Parameter Name	LinTrcvWakeUpSupport		
Parent Container	LinTrcvGeneral		
Description	Informs whether wake up is supported or not. In case wake up is not supported by LIN transceiver hardware the setting shall be false. The wake up ability may be switched on or off for each channel of one LIN transceiver by LinTrcvWakeupSourceRef. True: Is used False: Is not used		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local dependency: LinTrcvWakeupByBusUsed		

⌋

[ECUC_LinTrcv_00162] Definition of EcucReferenceDef LinTrcvEcucPartitionRef ⌈

Parameter Name	LinTrcvEcucPartitionRef		
Parent Container	LinTrcvGeneral		
Description	Maps the Lin transceiver driver to zero or multiple ECUC partitions to make the modules API available in this partition.		
Multiplicity	0..*		
Type	Reference to EcucPartition		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

10.2.4 LinTrcvChannel

[ECUC_LinTrcv_00091] Definition of EcucParamConfContainerDef LinTrcvChannel ⌈

Container Name	LinTrcvChannel
Parent Container	LinTrcv
Description	Container gives LIN transceiver driver information about a single LIN transceiver channel. Any LIN transceiver driver has such LIN transceiver channels.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
LinTrcvChannelId	1	[ECUC_LinTrcv_00011]
LinTrcvChannelUsed	1	[ECUC_LinTrcv_00004]
LinTrcvWakeupByBusUsed	1	[ECUC_LinTrcv_00006]
LinTrcvChannelEcucPartitionRef	0..1	[ECUC_LinTrcv_00163]
LinTrcvIcuChannelRef	0..1	[ECUC_LinTrcv_00157]
LinTrcvWakeupSourceRef	0..1	[ECUC_LinTrcv_00012]

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
LinTrcvAccess	1	Container gives LIN transceiver driver access about a single LIN transceiver channel.

⌋

[ECUC_LinTrcv_00011] Definition of EcucIntegerParamDef LinTrcvChannelId ⌈

Parameter Name	LinTrcvChannelId		
Parent Container	LinTrcvChannel		
Description	Unique identifier of the LIN Transceiver Channel.		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	0 .. 255		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local withAuto = true		

⌋

[ECUC_LinTrcv_00004] Definition of EcucBooleanParamDef LinTrcvChannelUsed ⌈

Parameter Name	LinTrcvChannelUsed		
Parent Container	LinTrcvChannel		
Description	Shall the related LIN transceiver channel be used? True: Is used False Is not used		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	true		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_LinTrcv_00006] Definition of EcucBooleanParamDef LinTrcvWakeupByBusUsed ⌈

Parameter Name	LinTrcvWakeupByBusUsed		
Parent Container	LinTrcvChannel		
Description	Is wake up by bus supported? If LIN transceiver hardware does not support wake up by bus value is always FALSE. If LIN transceiver hardware supports wake up by bus value is TRUE or FALSE depending whether it is used or not. TRUE = Is used. FALSE = Is not used.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	false		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local dependency: LinTrcvWakeUpSupport		

⌋

[ECUC_LinTrcv_00163] Definition of EcucReferenceDef LinTrcvChannelEcucPartitionRef ⌈

Parameter Name	LinTrcvChannelEcucPartitionRef
Parent Container	LinTrcvChannel
Description	Maps one single Lin transceiver channel to zero or one ECUC partitions. The ECUC partition referenced is a subset of the ECUC partitions where the Lin transceiver driver is mapped to.
Multiplicity	0..1

▽

△

Type	Reference to EcucPartition		
Post-Build Variant Multiplicity	true		
Post-Build Variant Value	true		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_LinTrcv_00157] Definition of EcucReferenceDef LinTrcvIcuChannelRef ⌈

Parameter Name	LinTrcvIcuChannelRef		
Parent Container	LinTrcvChannel		
Description	Reference to the IcuChannel to enable/disable the interrupts for wakeups.		
Multiplicity	0..1		
Type	Symbolic name reference to IcuChannel		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

⌋

[ECUC_LinTrcv_00012] Definition of EcucReferenceDef LinTrcvWakeupSourceRef ⌈

Parameter Name	LinTrcvWakeupSourceRef		
Parent Container	LinTrcvChannel		
Description	Reference to a wakeup source in the EcuM configuration. This reference is only needed if LinTrcvWakeupByBusUsed is true. Implementation Type: reference to EcuM_WakeupSourceType.		
Multiplicity	0..1		
Type	Symbolic name reference to EcuMWakeupSource		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	

▽

△

	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU dependency: LinTrcvWakeupByBusUsed		

⌋

[SWS_LinTrcv_00176] ⌈The ECUC partitions referenced by `LinTrcvChannelEcucPartitionRef` shall be a subset of the ECUC partitions referenced by `LinTrcvEcucPartitionRef`.⌋

[SWS_LinTrcv_00178] ⌈If `LinTrcvEcucPartitionRef` references one or more ECUC partitions, `LinTrcvChannelEcucPartitionRef` shall have a multiplicity of one and reference one of these ECUC partitions as well.⌋

[SWS_LinTrcv_00177] ⌈`LinTrcvChannel` and LinChannel of one communication channel shall all reference the same ECUC partition.⌋

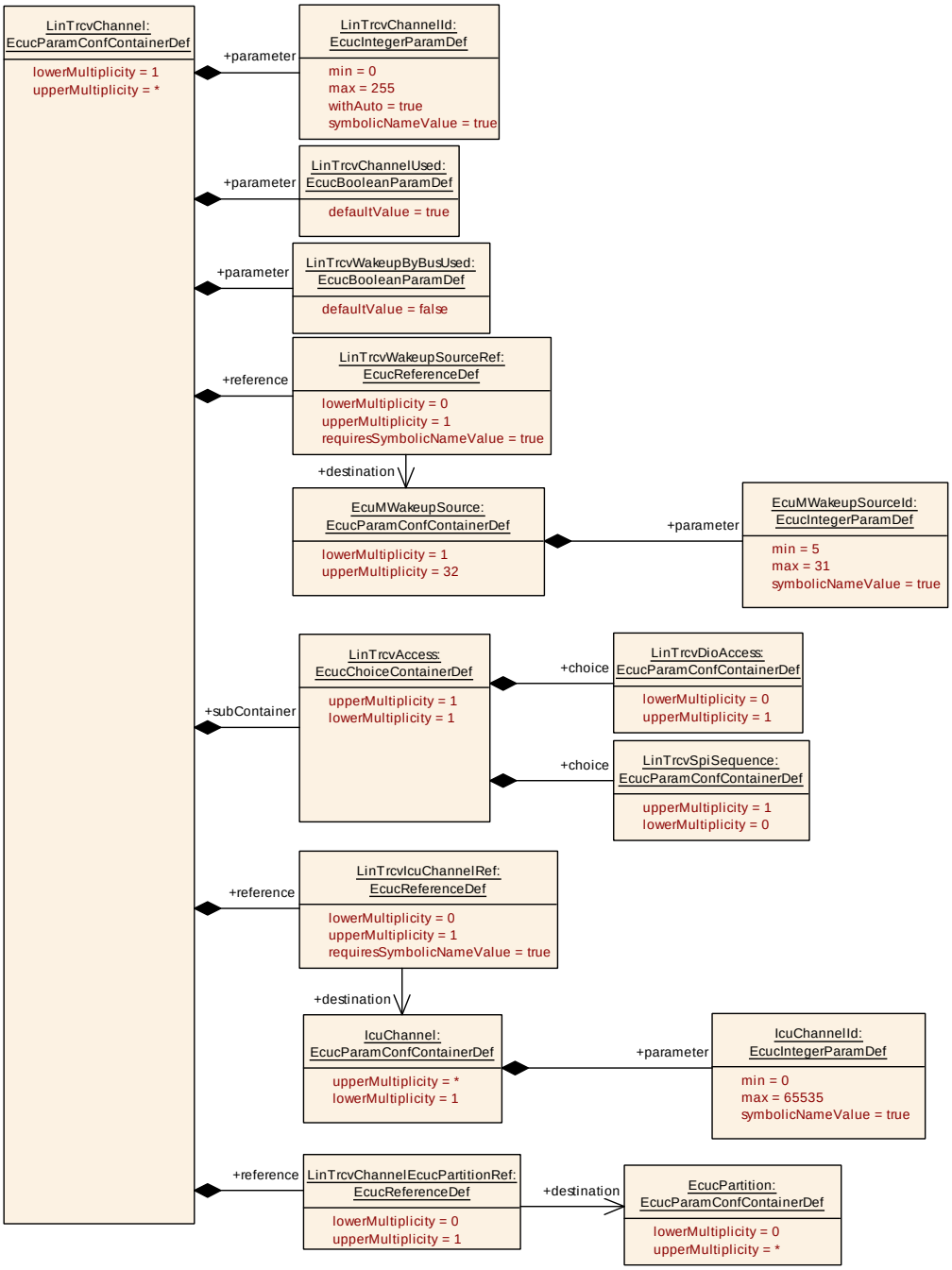

Figure 10.2: LinTrcvChannel configuration container

10.2.5 LinTrcvAccess

[ECUC_LinTrcv_00154] Definition of EcucChoiceContainerDef LinTrcvAccess ⌈

Choice Container Name	LinTrcvAccess
Parent Container	LinTrcvChannel
Description	Container gives LIN transceiver driver access about a single LIN transceiver channel.

No Included Parameters

Container Choices		
Container Name	**Multiplicity**	**Scope / Dependency**
LinTrcvDioAccess	0..1	Container gives LIN transceiver driver information about accessing ports and port pins. In addition relation between LIN transceiver hardware pin names and Dio port access information is given. If a LIN transceiver hardware has no Dio interface, there is no instance of this container.
LinTrcvSpiSequence	0..1	Container gives LIN transceiver driver information about one SPI sequence. One SPI sequence used by LIN transceiver driver is in exclusive use for it. No other driver is allowed to access this sequence. LIN transceiver driver may use one sequence to access n LIN transceiver hardwares chips of the same type or n sequences are used to access one single LIN transceiver hardware chip. If a LIN transceiver hardware has no SPI interface, there is no instance of this container.

⌋

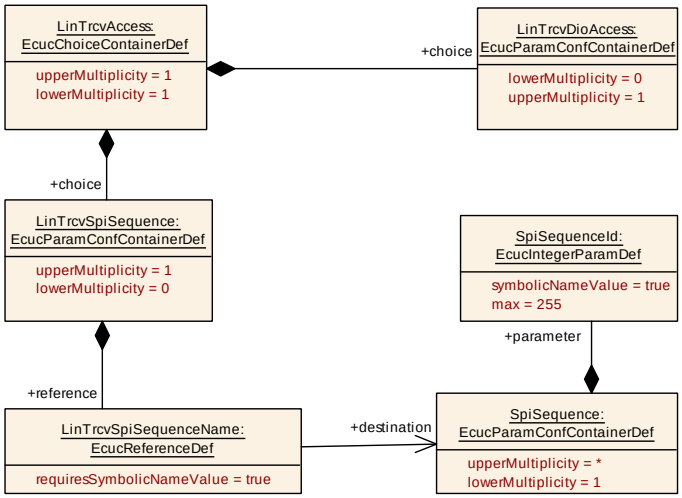

Figure 10.3: LinTrcvAccess configuration container

10.2.6 LinTrcvDioAccess

[ECUC_LinTrcv_00094] Definition of EcucParamConfContainerDef LinTrcvDioAccess ⌈

Container Name	LinTrcvDioAccess
Parent Container	LinTrcvAccess
Description	Container gives LIN transceiver driver information about accessing ports and port pins. In addition relation between LIN transceiver hardware pin names and Dio port access information is given. If a LIN transceiver hardware has no Dio interface, there is no instance of this container.
Configuration Parameters	

No Included Parameters

Included Containers		
Container Name	Multiplicity	Scope / Dependency
LinTrcvDioChannelAccess	1..*	Container gives DIO channel access by single Lin transceiver channel.

⌋

10.2.7 LinTrcvDioChannelAccess

[ECUC_LinTrcv_00158] Definition of EcucParamConfContainerDef LinTrcvDioChannelAccess ⌈

Container Name	LinTrcvDioChannelAccess
Parent Container	LinTrcvDioAccess
Description	Container gives DIO channel access by single Lin transceiver channel.
Configuration Parameters	

Included Parameters		
Parameter Name	Multiplicity	ECUC ID
LinTrcvHardwareInterfaceName	1	[ECUC_LinTrcv_00009]
LinTrcvDioSymRefName	1	[ECUC_LinTrcv_00102]

No Included Containers

⌋

[ECUC_LinTrcv_00009] Definition of EcucStringParamDef LinTrcvHardwareInterfaceName ⌈

Parameter Name	LinTrcvHardwareInterfaceName		
Parent Container	LinTrcvDioChannelAccess		
Description	LIN transceiver hardware interface name. It is typically the name of a pin. From a Dio point of view it is either a port, a single channel or a channel group. Depending on this fact either LINTRCV_DIO_PORT_SYMBOLIC_NAME or LINTRCV_DIO_CHANNEL_SYMBOLIC_NAME or LINTRCV_DIO_CHANNEL_GROUP_SYMBOLIC_NAME shall reference a Dio configuration. The LIN transceiver driver implementation description shall list up this name for the appropriate LIN transceiver hardware.		
Multiplicity	1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

[ECUC_LinTrcv_00102] Definition of EcucChoiceReferenceDef LinTrcvDioSymRefName ⌈

Parameter Name	LinTrcvDioSymRefName		
Parent Container	LinTrcvDioChannelAccess		
Description	Choice Reference to a DIO Port, DIO Channel or DIO Channel Group. This reference replaces the LINTRCV_DIO_PORT_SYM_NAME, LINTRCV_DIO_CHANNEL_SYM_NAME and LINTRCV_DIO_GROUP_SYM_NAME references in the Lin Trcv SWS.		
Multiplicity	1		
Type	Choice reference to [DioChannel, DioChannelGroup, DioPort]		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

⌋

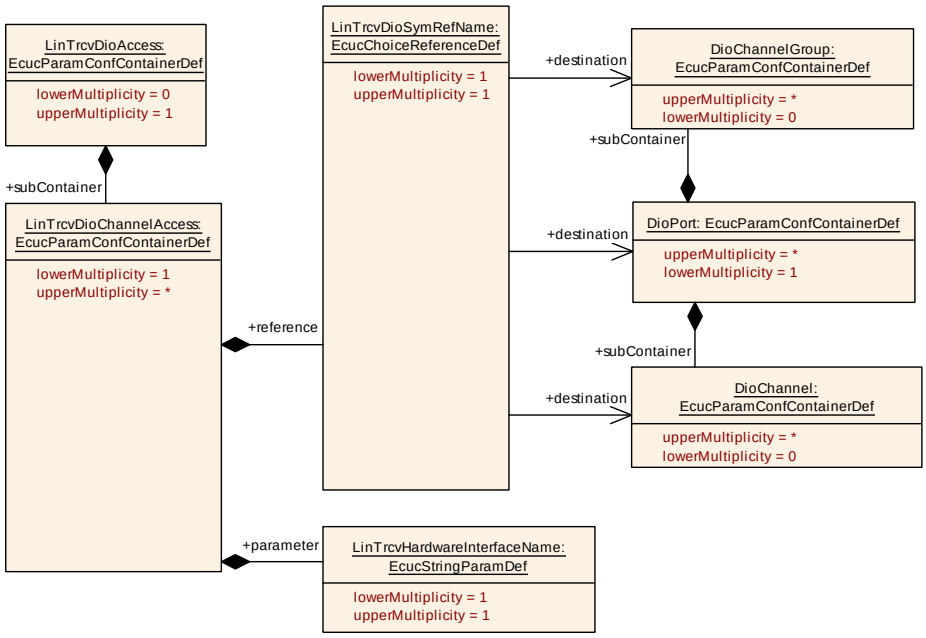

Figure 10.4: LinTrcvDioAccess configuration container

10.2.8 LinTrcvSpiSequence

[ECUC_LinTrcv_00155] Definition of EcucParamConfContainerDef LinTrcvSpiSequence ⌈

Container Name	LinTrcvSpiSequence
Parent Container	LinTrcvAccess
Description	Container gives LIN transceiver driver information about one SPI sequence. One SPI sequence used by LIN transceiver driver is in exclusive use for it. No other driver is allowed to access this sequence. LIN transceiver driver may use one sequence to access n LIN transceiver hardwares chips of the same type or n sequences are used to access one single LIN transceiver hardware chip. If a LIN transceiver hardware has no SPI interface, there is no instance of this container.
Configuration Parameters	

Included Parameters		
Parameter Name	**Multiplicity**	**ECUC ID**
LinTrcvSpiSequenceName	1	[ECUC_LinTrcv_00156]

No Included Containers

⌋

[ECUC_LinTrcv_00156] Definition of EcucReferenceDef LinTrcvSpiSequence Name ⌈

Parameter Name	LinTrcvSpiSequenceName		
Parent Container	LinTrcvSpiSequence		
Description	Reference to a Spi sequence configuration container.		
Multiplicity	1		
Type	Symbolic name reference to SpiSequence		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local dependency: SpiSequence		

⌋

10.3 Published Information

For details refer to the chapter "Published Information" in SWS_BSWGeneral.

A Not applicable requirements

[SWS_LinTrcv_NA_00999]

Upstream requirements: SRS_BSW_00336, SRS_BSW_00344, SRS_BSW_00383, SRS_BSW_00384, SRS_BSW_00398, SRS_BSW_00399, SRS_BSW_00400, SRS_BSW_00404, SRS_BSW_00405, SRS_BSW_00416, SRS_BSW_00417, SRS_BSW_00422, SRS_BSW_00423, SRS_BSW_00426, SRS_BSW_00427, SRS_BSW_00429, SRS_BSW_00432, SRS_BSW_00433, SRS_BSW_00159, SRS_BSW_00167, SRS_BSW_00168, SRS_BSW_00170, SRS_Lin_01576, SRS_Lin_01504, SRS_Lin_01522, SRS_Lin_01560, SRS_Lin_01577, SRS_Lin_01551, SRS_Lin_01568, SRS_Lin_01569, SRS_Lin_01564, SRS_Lin_01546, SRS_Lin_01549, SRS_Lin_01571, SRS_Lin_01515, SRS_Lin_01502, SRS_Lin_01558, SRS_Lin_01523, SRS_Lin_01553, SRS_Lin_01552, SRS_Lin_01503, SRS_Lin_01555, SRS_Lin_01547, SRS_Lin_01572, SRS_Lin_01556, SRS_Lin_01579, SRS_Lin_01540, SRS_Lin_01545, SRS_Lin_01534, SRS_Lin_01574, SRS_Lin_01539, SRS_Lin_01544

⌈These requirements are not applicable to this specification.⌋

B Change history of AUTOSAR traceable items

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

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

B.1.1 Added Specification Items in R24-11

none

B.1.2 Changed Specification Items in R24-11

Number	Heading
[ECUC_LinTrcv_-00162]	Definition of EcucReferenceDef LinTrcvEcucPartitionRef
[SWS_LinTrcv_91003]	Definition of optional interfaces requested by module LinTrcv

Table B.1: Changed Specification Items in R24-11

B.1.3 Deleted Specification Items in R24-11

Number	Heading
[SWS_LinTrcv_00175]	

Table B.2: Deleted Specification Items in R24-11