BOSCH

Invented for life

## Overview

The BOSCH C_LIN module is an autonomous LIN 1.3, 2.0 or 2.1 protocol controller, with embedded message handling for integration in a system on chip. It is described in VHDL on RTL level, prepared for synthesis.
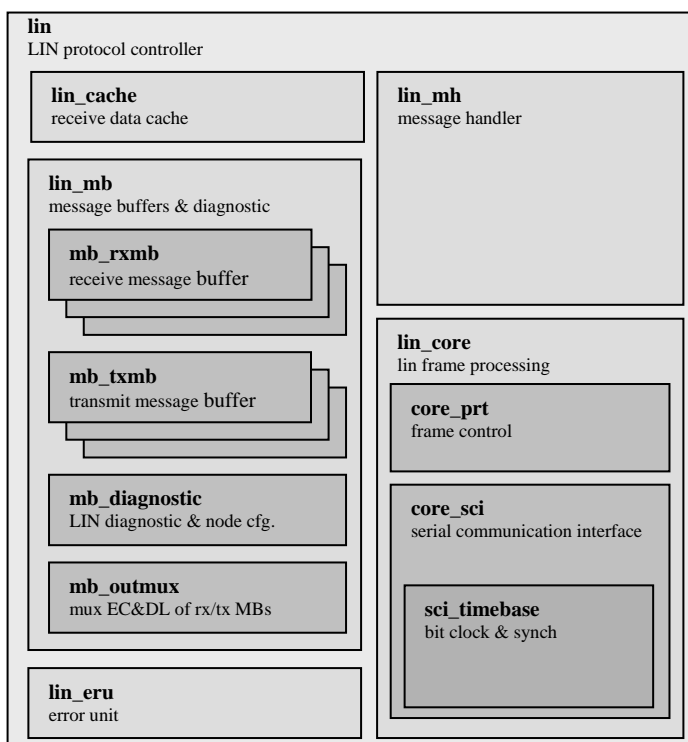
The network features are controlled by hard coded state machines without the need of a microcontroller. Discrete Receive Message Buffer outputs directly control application blocks and (vice versa) application layer outputs could be connected directly to the discrete Transmit Message Buffer inputs.

Thus the module is intended for low cost slave solutions. To meet this requirement, the module can be adapted by the user to the application by easy configuration methods. This makes it possible to avoid circuit overhead.

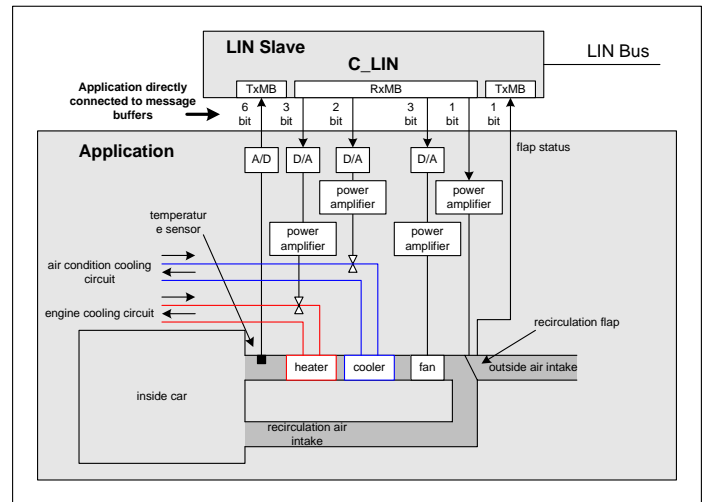The customization to get an application specific C_LIN is twofold: Before synthesis, the module can be basically adopted by easy scaling methods to avoid circuit overhead. While application run time, many parameters could be changed by a wide set of configuration inputs.

## Features

▸ Supports LIN Data Link Layer revisions 1.3, 2.0 and 2.1
▸ For 19.2 kbaud, a system clock of approx. 0.3 MHz with a accuracy of +/- 13% is needed
▸ Supports any system clock frequency higher than 307,2 kHz independent of baud rate (full synchronous design, no clock gating)
▸ High precision digital synchronization to LIN master, 0.2% Ftol_synch@lin_clk=1.5MHz
▸ Sleep Mode and Wake Up procedures are implemented
▸ Automatic start of Wake Up Procedure on No Bus Activity (optional)

▸ Detailed LIN protocol status signaling
  ▸ short break symbol
  ▸ frame processing interrupted by break symbol
  ▸ synchronization byte error
  ▸ parity error, checksum error, bit error, stopbit error
  ▸ maximum header time exceeded
  ▸ maximum frame time exceeded
  ▸ no bus-activity error
  ▸ response error

▸ LIN node configuration
  ▸ assign frame identifier for all implemented Rx & Tx buffers
  ▸ read by identifier
  ▸ free usage Master Request and Slave Response message buffers
  ▸ complete implementation of positive and negative responses



**lin**
LIN protocol controller

**lin_cache**
receive data cache

**lin_mb**
message buffers & diagnostic

**mb_rxmb**
receive message buffer

**mb_txmb**
transmit message buffer

**mb_diagnostic**
LIN diagnostic & node cfg.

**mb_outmux**
mux EC&DL of rx/tx MBs

**lin_eru**
error unit

**lin_mh**
message handler

**lin_core**
lin frame processing

**core_prt**
frame control

**core_sci**
serial communication interface

**sci_timebase**
bit clock & synch

▸ switches to disable "assign frame identifier" and "read by identifier" feature and to control LIN 1.3, 2.0 or 2.1 conform functionality
▸ switch to enable default identifiers

▸ Easy methods for application specific IP configuration:
  ▸ count of receive message buffers
  ▸ count of transmit message buffers
  ▸ count of Master Request and Slave Response message buffer pairs for free usage
  ▸ 1 to 64 data bits for each receive and transmit message buffer
  ▸ internal buffer registers of transmit message buffers could be disabled when application already contains registers
  ▸ count of 40bit vectors for user data

## Applications

▸ low cost sensors
▸ mechatronic modules
▸ system on chip without external oscillator

## Example

Configuration of LIN module for the application example "Air Condition":

▸ 1x 40bit user data
▸ Message buffer configuration:

| Message Buffer | No. of Bits |
|---|---|
| RxMB0 | 8 |
| TxMB0 | 7 |

Synthesis results for a LIN 2.0 implementation and a LIN 1.3 compatible implementation:

| | LIN v20 | LIN v13 |
|---|---|---|
| Total Cell Area (BCD6) | 0,2 mm² | 0,15 mm² |
| Gate Count (GS40) | 3900 | 3100 |

**Notes:**

▸ LIN v2.x:
  ▸ all features listed above are implemented
▸ LIN v13:
  ▸ default identifier enabled
  ▸ AssignFrameID disable
  ▸ ReadByID disabled

## Contact

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