

# FDLR\_CAN IP CAN FD light Responder IP

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# IP business @ Bosch Mobility Electronics

## IP Portfolio

### I/O Processing IP

## GTM IP Gen 4

... realtime oriented I/O co-processor  
(aka "Timer")

A scalable timer solution for ...

- digital input data processing (e.g. sensor data)
- digital output data generation (e. g., PWMs for actor control)

Integrated multi-threaded RISC cores for real-time oriented control loops

Generic architecture to address multiple domains

- Powertrain (combustion & electric)
- Chassis and Body applications
- Inverter, PFC,
- ...

### Communication IPs

## CAN Ips

... Controller Area Network IPs

### X\_CAN IP

- Triple-protocol support:<sup>1</sup>
  - Classical CAN, CAN FD and **CAN XL (new)** and CAN FD light commander
- Active DMA support
- Bitrates up to 20 Mbit/s
- Payload up to 2048 byte

### M\_CAN IP

- Dual-protocol support:<sup>1</sup>
  - Classical CAN and CAN FD and CAN FD light commander
- Bitrate up to 8 Mbit/s
- Payload up to 64 bytes

1) CAN FD light Commander up to 1 Mbit/s

### XS\_CAN IP

- Small gate count
- Triple-protocol support:
  - Classical CAN, CAN FD and **CAN XL (new)**
- Bitrates up to 20 Mbit/s
- Payload up to 2048 byte
- CAN FD light Commander up to 8Mbit/s **(new)**

### FDLR\_CAN IP

- CAN FD light responder IP
- For Responder Nodes, MCU less
- Bitrate up to 8 Mbit/s
- Payload up to 64 bytes

## DFA IP Data Flow Architecture

... HW based accelerator for advanced mathematical algorithms

- Ready for AI & ML (**A**rtificial **I**ntelligence, **M**achine **L**earning)
- Data-based modeling, signal processing, control theory, physical equations
- Enabler for new compute-intensive functions e. g., novel features + legal regulations like EU7, OBM

# CAN FD light

## What is CAN FD light?

### **CAN FD light is a cost optimized CAN FD ( $\approx$ 50% reduction)**

**Architecture:** 1x Commander and  $N$ x Responders

- CAN FD light commander controls communication (polling)

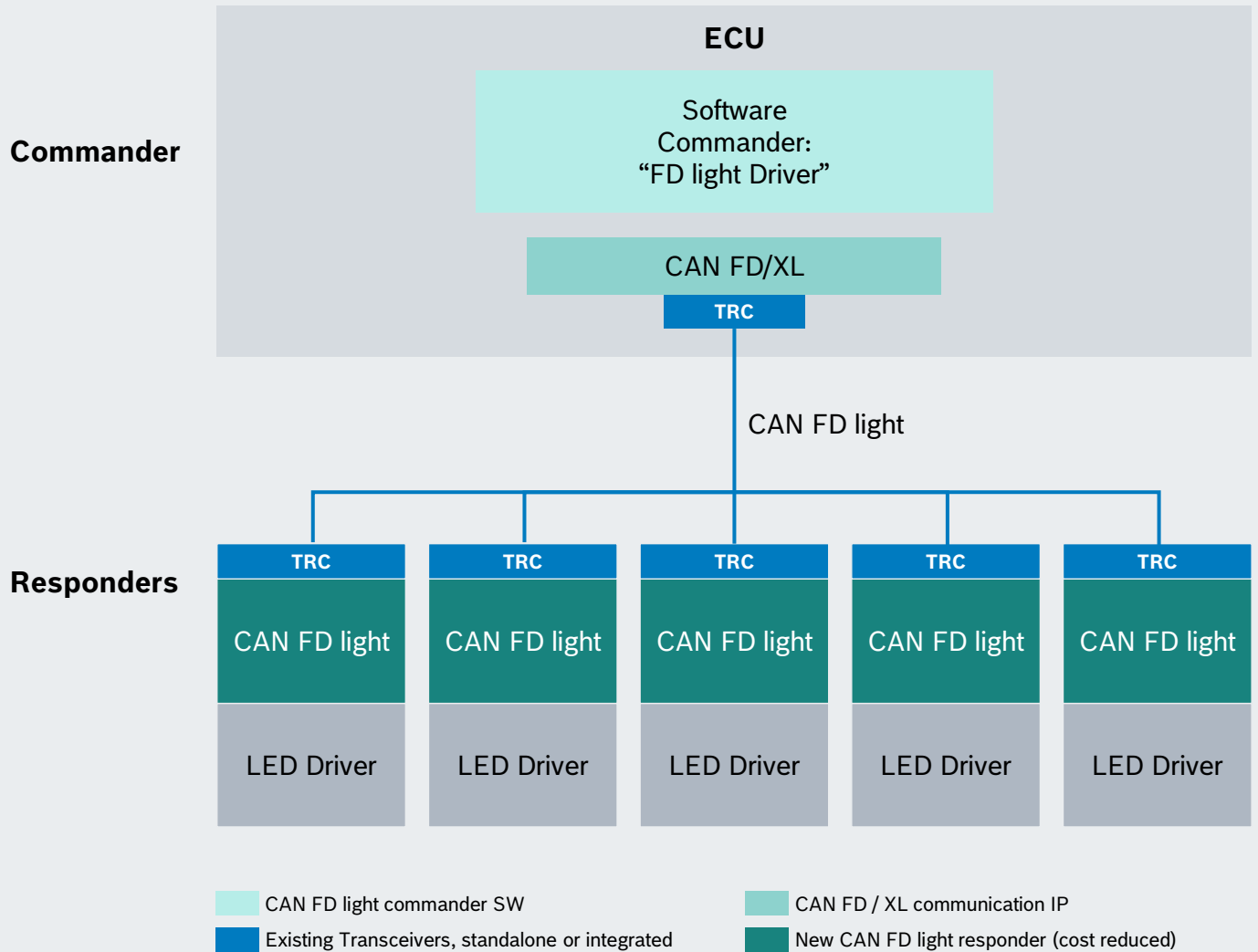
**Commander:** All existing CAN FD/XL nodes

**Responder:** low-cost CAN FD node

- [Layer 1] No change, all CAN transceivers usable
- [Layer 2] Simplified Protocol: sub-set of CAN FD
  - **No** arbitration, **No** error frames, **No** 29 Bit ID, **No** BRS bit rate switch...
  - **CAN FD frame format** with 11 Bit ID **used**
  - Standardized in ISO 11898-1:2024

### **Advantages**

- Low-Cost (e. g., clock with  $\pm 4\%$  usable, x10 more than FD  $\rightarrow$  Save 0,40 US\$)
- Monolithic integration possible of (1) Transceiver, (2) CAN FD light IP, (2) analog part
- Larger net bit rate of CAN FD light than CAN FD



# CAN FD light – Next Step in CAN Evolution

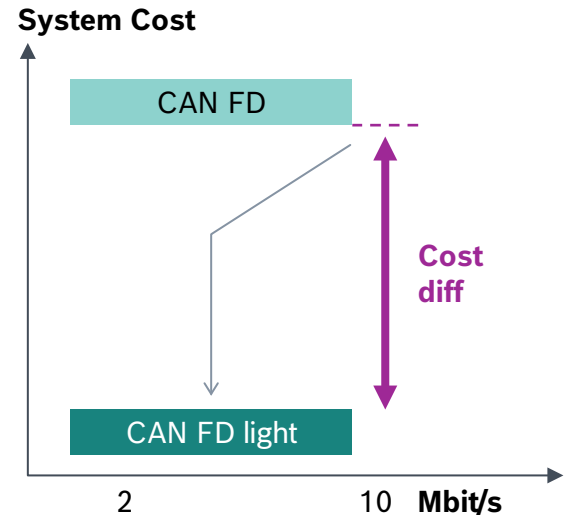
## Lower System Cost

### Target/ motivation



### Provide a low-cost CAN solution with respect to:

- Price (Transceiver, Pins, Cabling, ...)
- Clock requirements
- MCU less receiver node
- Monolithic device integration:
  - Transceiver, CAN FD light Responder, state machine + analog
- Standardization
- Preserve CAN properties:
- Robustness, long stubs, ...



### What is CAN FD light




Commander and Responder architecture based on the CAN FD protocol


### Compatibility of CAN FD and CAN FD light enables ...


... incremental upgrade path


- larger acceptance (re-use of CAN FD knowhow, tools, ECUs)
- allow CAN FD and CAN FD light on the same network


## Key Success Factors


- 


**01 Lower System cost**  
Save external crystal of **0.4\$** per CAN FD light node compared to CAN FD
- 

**02 MCU less Receiver node → lower cost**  
no firmware update, no maintenance
- 

**03 ISO Standard for CAN FD light responder**  
ISO 11898-1:2024 Annex A
- 

**04 Use standardized components**  
No change need in HW for CAN FD light commander, transceiver, wiring harness, tools
- 

**05 Shorter Frames on the bus than CAN FD**  
One speed on all bits transferred, e.g., 5 Mbit/s
- 

**06 Broad availability CAN FD light responder**  
All  $\mu$ C/ECU w/ CAN FD/XL can be CAN FD light commander, semiconductor vendor developing CAN FD light responder
- 

**07 Up to 8Mbit/s**  
Up to 1Mbit/s today w/ CAN FD/XL commander nodes and up to 8Mbit/s with tomorrows CAN FD/XL commander nodes

# CAN FD light

## Build on Proven CAN FD Protocol

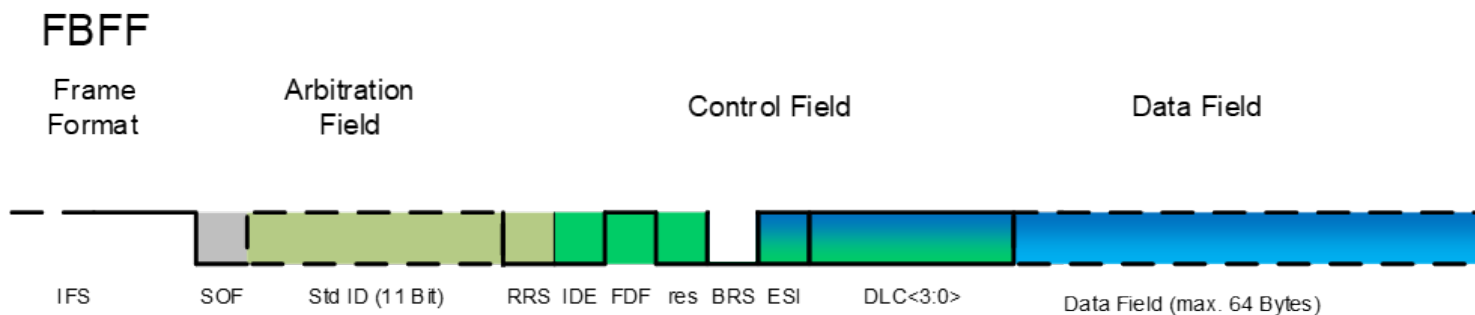
### CAN FD light ... A CAB FD protocol compatible communication

#### 01 CAN FD light is a cost-optimized sub-set of CAN FD

- Base identifier (11 bit) only
- FD Frames only (no Classical CAN Frame formats supported)
- BRS (Bit Rate Switch) = 0 only (one bit rate for the entire communication)

#### 02 The CAN FD light protocol re-uses the CAN FD protocol frame format

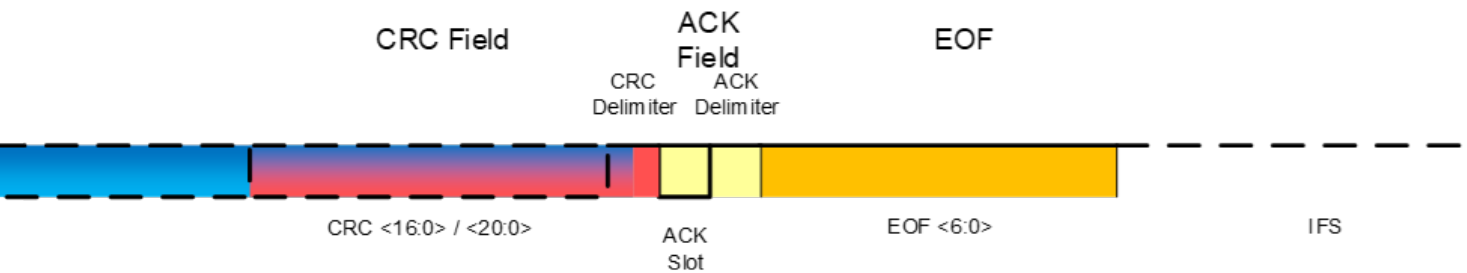
- Data length code – defining up to 64 byte of payload
- CRC Field – frame integrity protection
- Acknowledgement



03

### The CAN FD light protocol don't need

- No Arbitration– due to strict communication flow
- No Error Frames – clearly identified data flow, no advertising errors needed



F D L R \_ C A N

CAN FD light

Responder

Controller Area Network

# FDLR\_CAN IP Overview

## Features

### Support of CAN FD light responder

- Conform with ISO11898-1:2024 Annex A
- Conform with CiA604-1

### Full support of CAN FD light

- With up to 8Mbit/s

### 1x Message Buffer (MB)

- To store up to 1x full CAN FD frame
- Size configurable by the IP integrator

### Clock input needed

- Input clock of at least 10 times the bit rate
- Example: 8Mbit/s bit-rate need 80MHz +- 4%

### Small design, low gate count

- Only 8k gates without CCU
- Only 13k gate with CCU

### 4x Rx filters (11-bit wide) can be used for

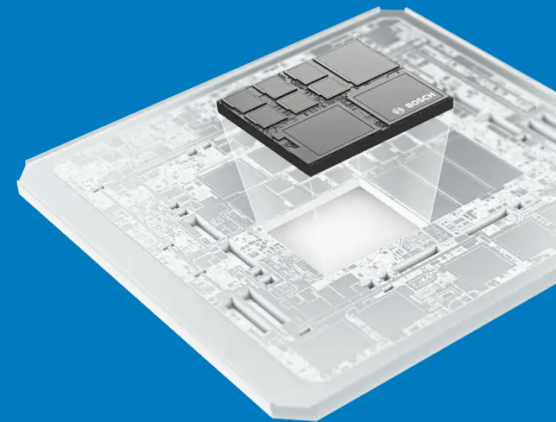
- single-cast message identifier
- multi-cast message identifier
- broad-cast message identifier
- synchronization message identifier

### 1x Mask filter 11bit on the 4th Rx filter

- Clock Calibration Unit (CCU), add-on optional
- E. g., 8Mbit/s bit rate need 170 MHz +- 10% accurate clock

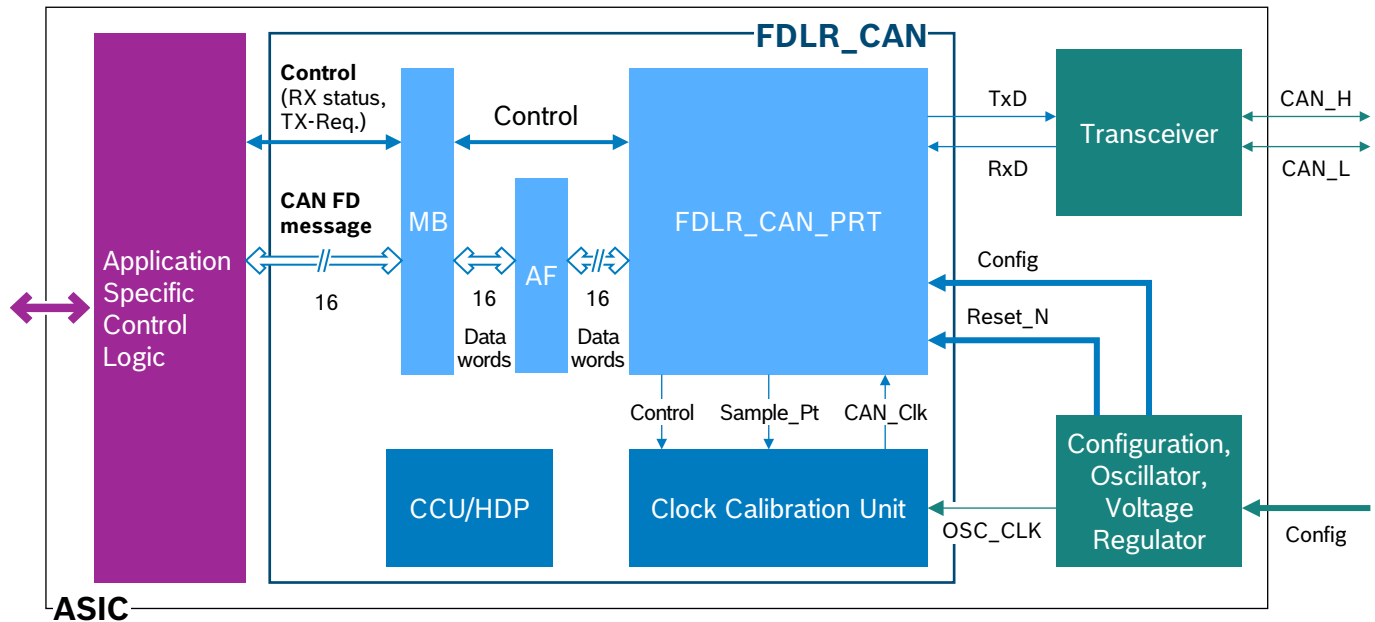
### ASIL D (ISO 26262) capable with external measures

### IP was developed according to ISO 21434



# FDLR\_CAN IP

## Architecture (Simplified View)



### Application

- Application Specific part of the ASIC

### CCU/HDP

- CCU Clock Calibration Unit – Optional add-on
- HDP: Hardware Debug Port – Optional

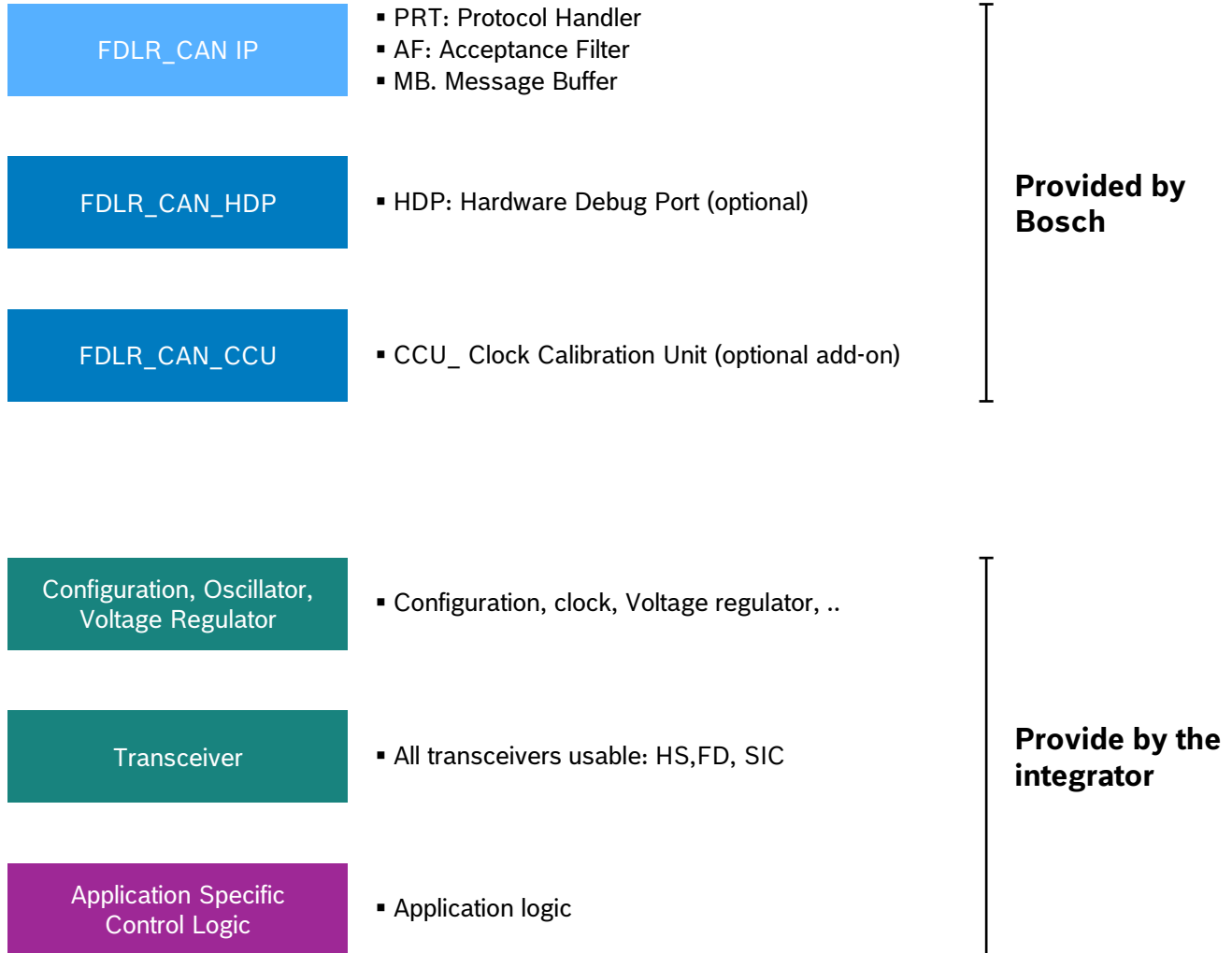
### Analog

- CAN FD/SIC Transceiver Module
- Voltage Regulator,
- Reset, Oscillator, Configuration

### FDLR\_CAN IP

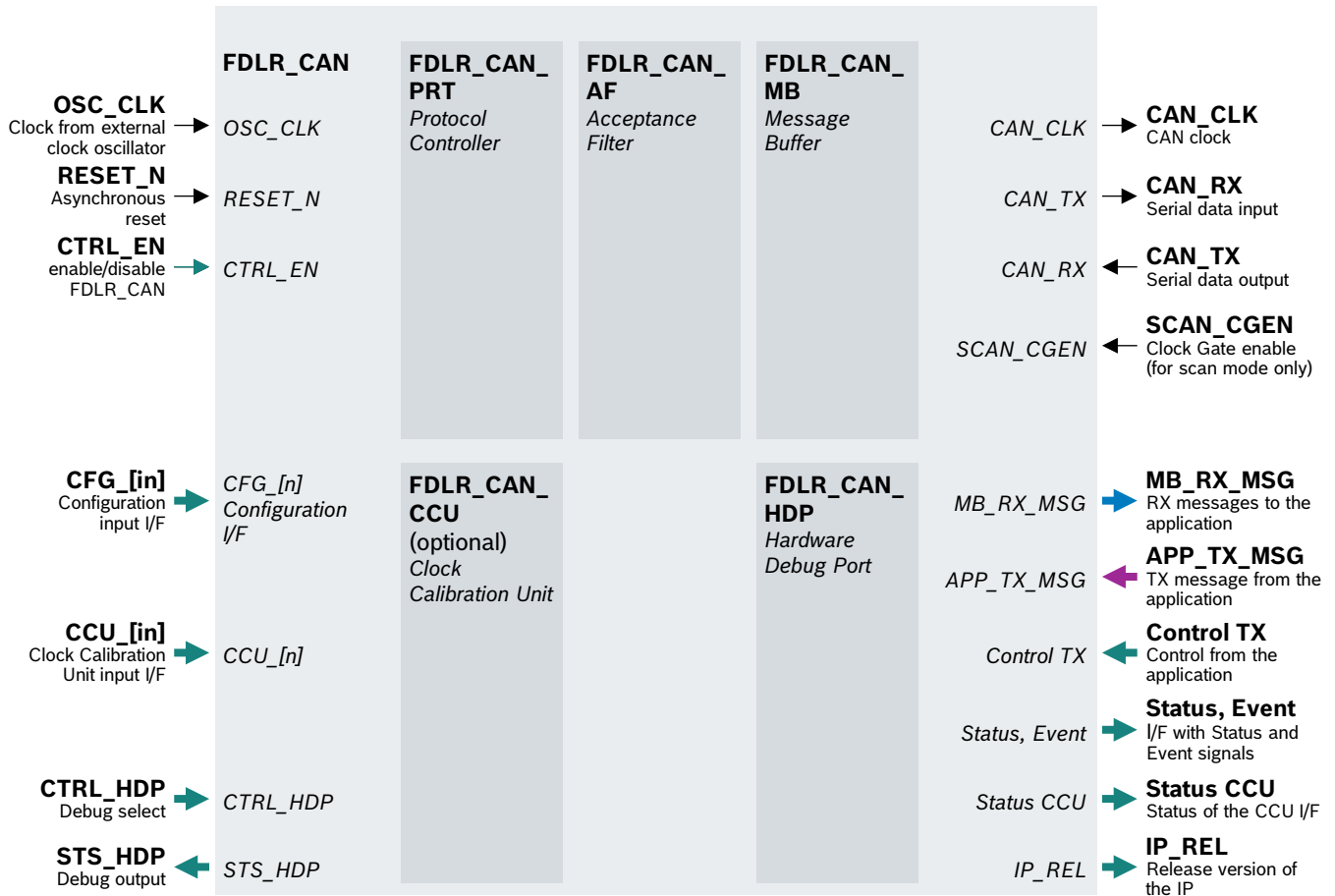
- **FDLR\_PRT**: FD Light Responder Protocol Controller
- **AF Accepted Field**: 4x Rx Filter and 1x Mask
- **Message Buffer (MB)**: 1x Buffer for Tx and RX

# Integration



# FDLR\_CAN IP

## FDLR\_CAN TOP Level Signals (Simplified)



### Glossary

PRT (Protocol Handler)

AF (Acceptance Filter)

MB (Message Buffer)

CCU (Clock Calibration Unit)

HDP (Hardware Debug Port)

MSG (Message)

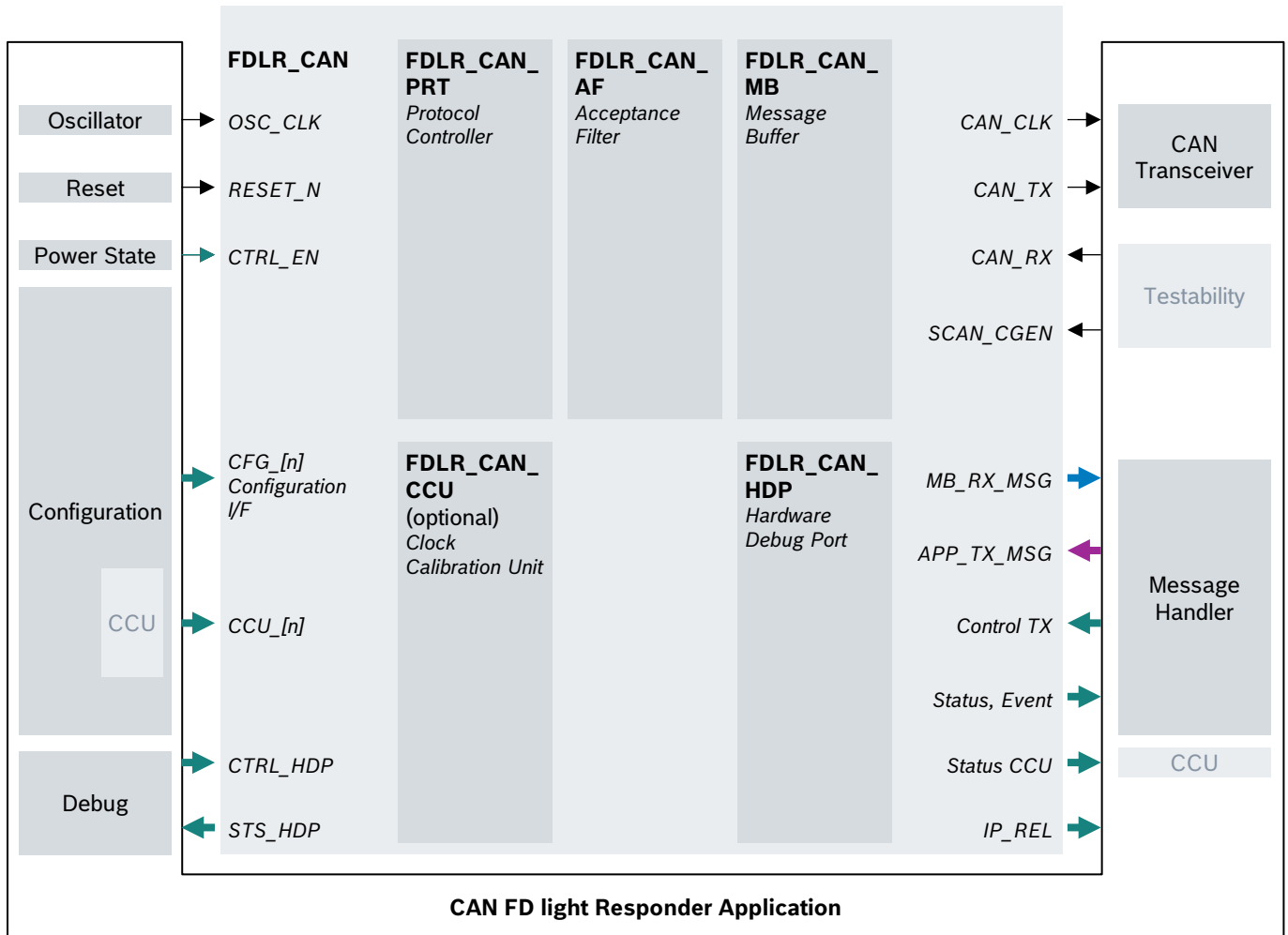
RX (Receive)

TX (Transmit)

SECCT (Discrete interconnect for Status, Event, Control, Configuration and Trigger)

# FDLR\_CAN IP

## ASIC Integration



# FDLR\_CAN IP

## Timeline & Deliverables



### Revision 1.0.0

July 2025

Deliverables include:

- VHDL Source Code
- Integration Guide (designer's view)
- FMEDA
- Safety Manual
- Security Manual
- Functional Safety assessment certificate
- Conformance Test Report for CAN FD light
  - Depending on availability of CT (Conformance Test)

Licensing conditions available at Bosch AE

Please see: <https://www.bosch-semiconductors.com/ip-modules/can-protocol-license/>



**Revision 1.0.0**

**CAN FD light Conformance tested**

**depending on availability of CAN FD light CT**

Planned for Q2/2027

Conformance Tested for CAN FD light



**THANK YOU!**