POSIF
Position Interface

XMC™ microcontrollers
September 2016

Agenda

1. Overview
2. Key feature: interface for linear/quadrature rotary encoder
3. Key feature: interface for hall sensors
4. Key feature: stand-alone multi-channel control
5. System integration
6. Application examples

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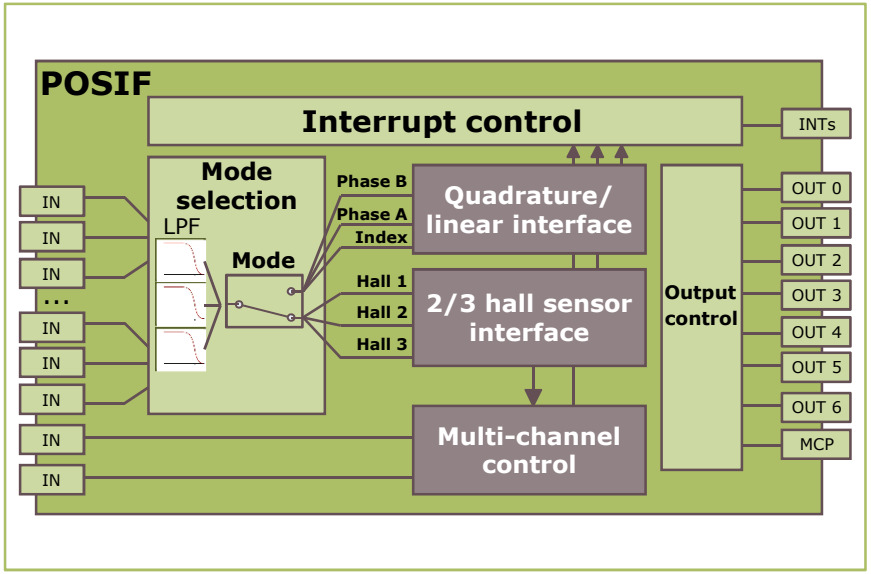
POSIF
Position Interface



Highlights

The POSIF module is the ideal solution for motor control applications using hall sensors and quadrature decoders. The user can configure freely the type and usage of the resources to perform an optimized mapping to the wanted application.

Key feature

- Interface for linear or quadrature rotary encoder
- Interface for hall sensors
- Stand-alone multi-channel control

Customer benefits

- Application tailored motor position and velocity measurement
- Tailored solution for 2 or 3 hall sensor applications. Coupling with PWM generation
- Perform multi-level modulation for PWM
- Tailored modulation development

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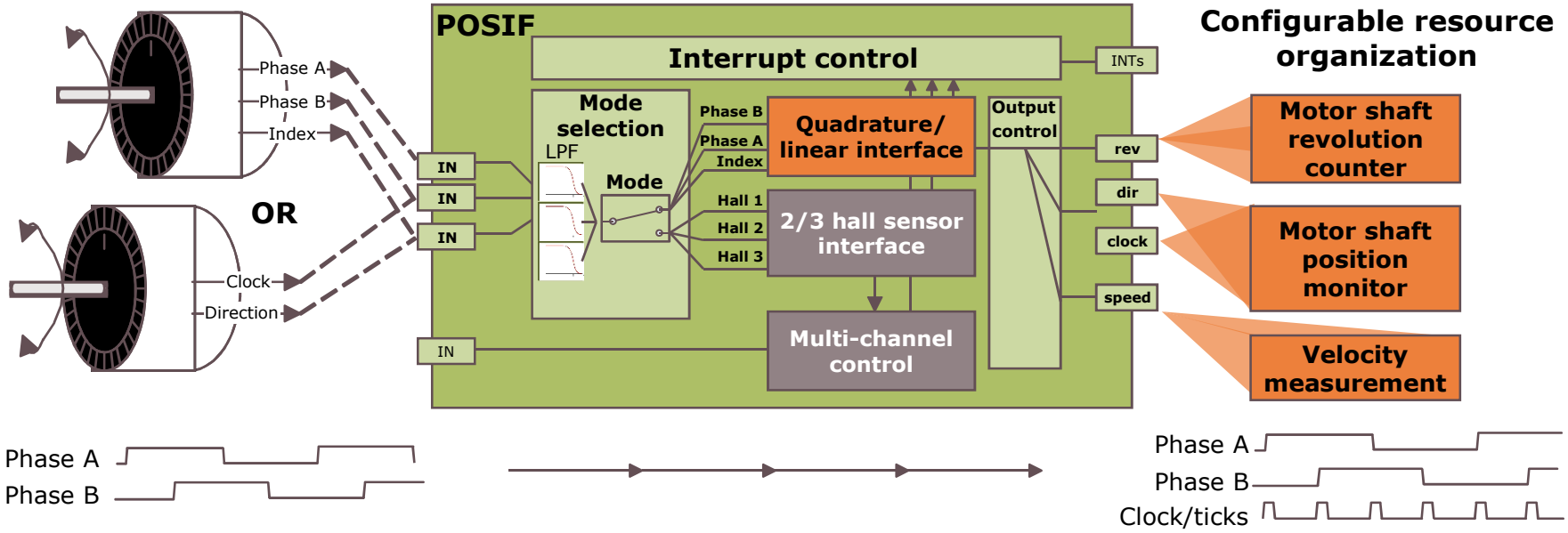
POSIF: interface for linear or quadrature rotary encoder

- Linear or quadrature interface
- Input signal filtering
- Position monitoring (tick counting + direction)
- Velocity monitoring (time between ticks or/and elapsed time for a number of ticks)
- Revolution monitoring



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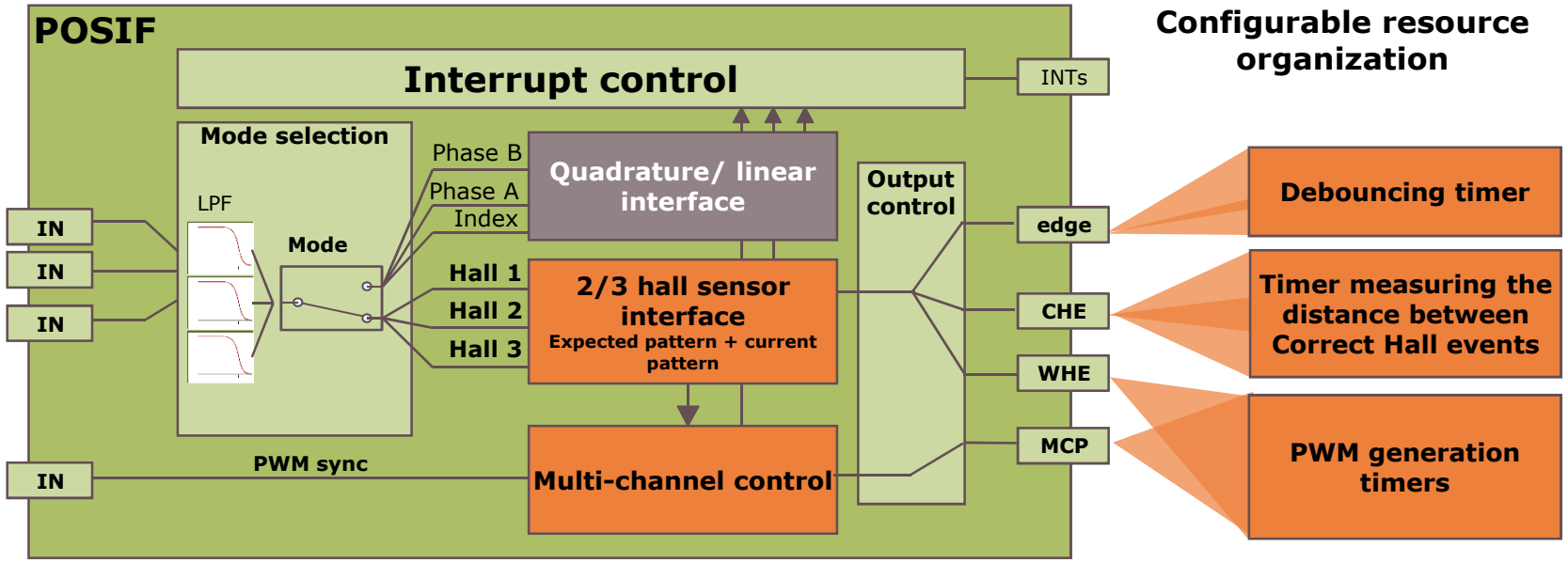
POSIF
Interface for hall sensors

- Current and expected pattern can be easily updated via SW
- Flexible input signal debouncing/ filtering
- Time measurement between **C**orrect **H**all **E**vents
- Programmable error handling (**W**rong **H**all **E**vent)
- Synchronization with the PWM generation



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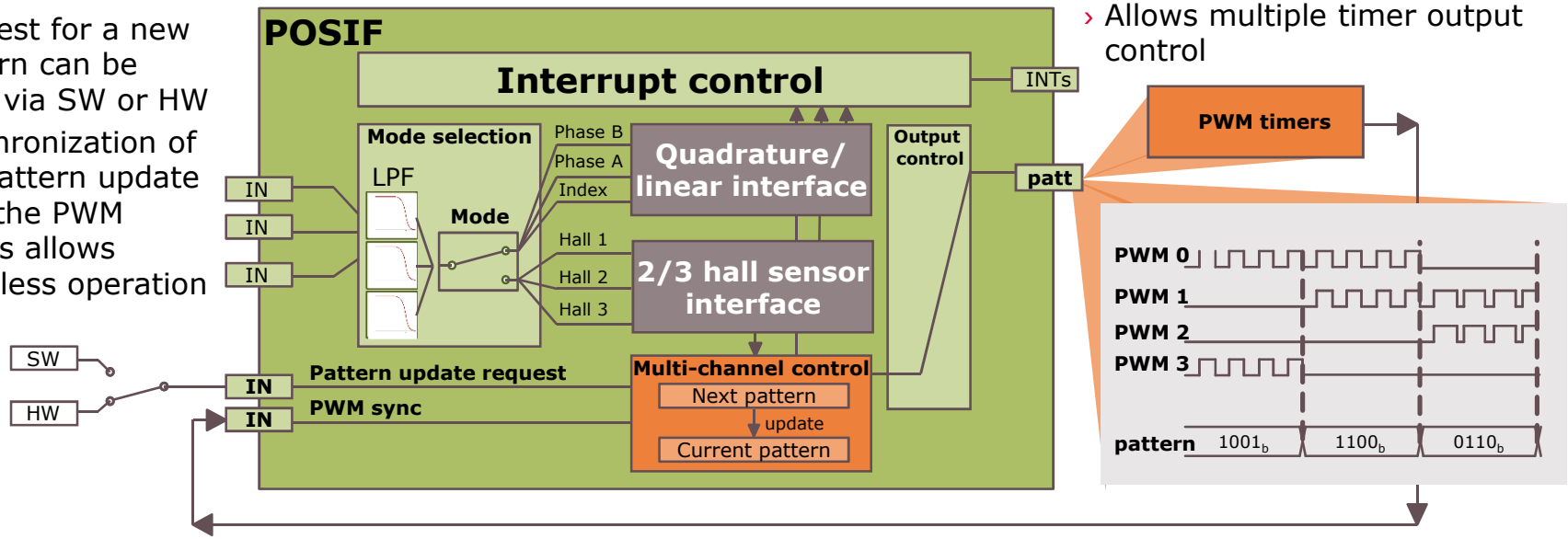
POSIF
Stand-alone multi-channel control

- Multi-channel control can work in stand-alone (without any of the other two modes)
- With multi-channel control it is possible to control a pattern (max. 16-bits) that is controlling the PWM outputs (of CCU4/CCU8)
- Pattern can be updated on-the-fly completely synchronous with the PWM timers
- The pattern is completely controlled by SW, allowing any type of PWM output control

- Request for a new pattern can be done via SW or HW
- Synchronization of the pattern update with the PWM timers allows glitchless operation



- Pattern is applied to the timers PWM outputs in parallel
- Allows multiple timer output control

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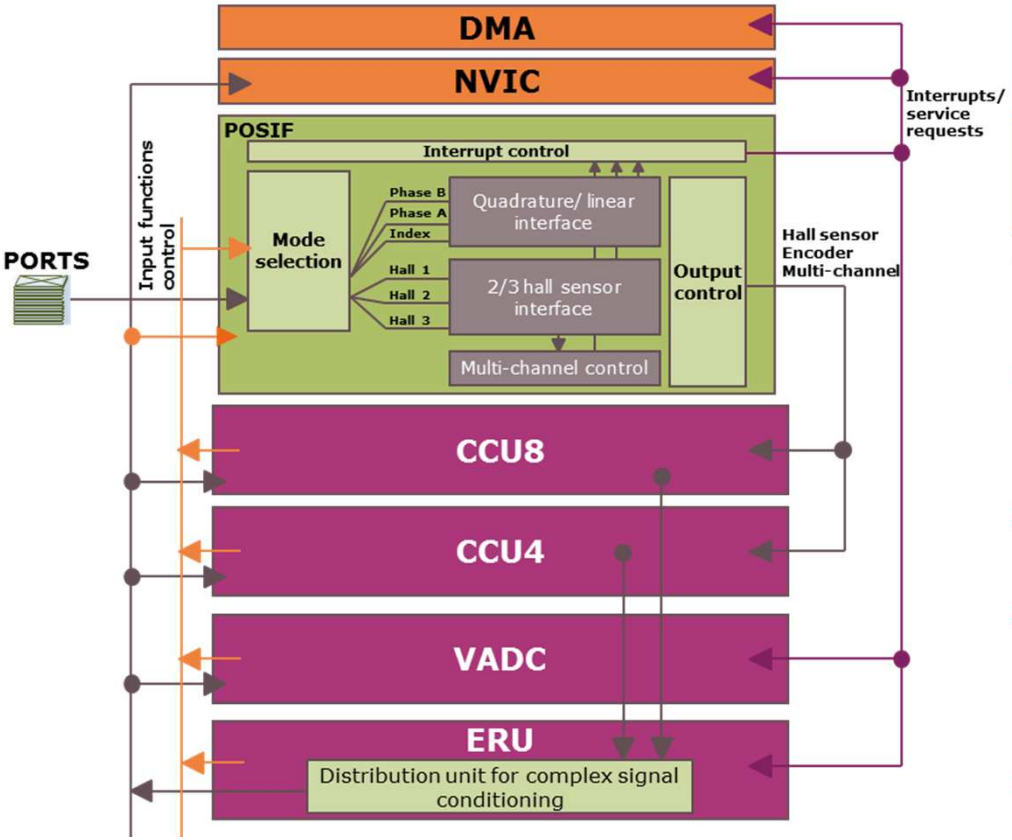
System integration



**Several components may be presented or not depending on the device*

The POSIF system integration offers several advantages:

- Distribution bus from CCU4/CCU8 over the ERU for complex signal conditioning application cases
- Distribution of control logic to all of the timer units (CCU4/CCU8)
- Connectivity to the ADC to perform signal monitoring (or emulation) for motor control

- Target applications
  - Motor control
  - Power conversion
  - Human machine interface
  - Connectivity
  - General purpose

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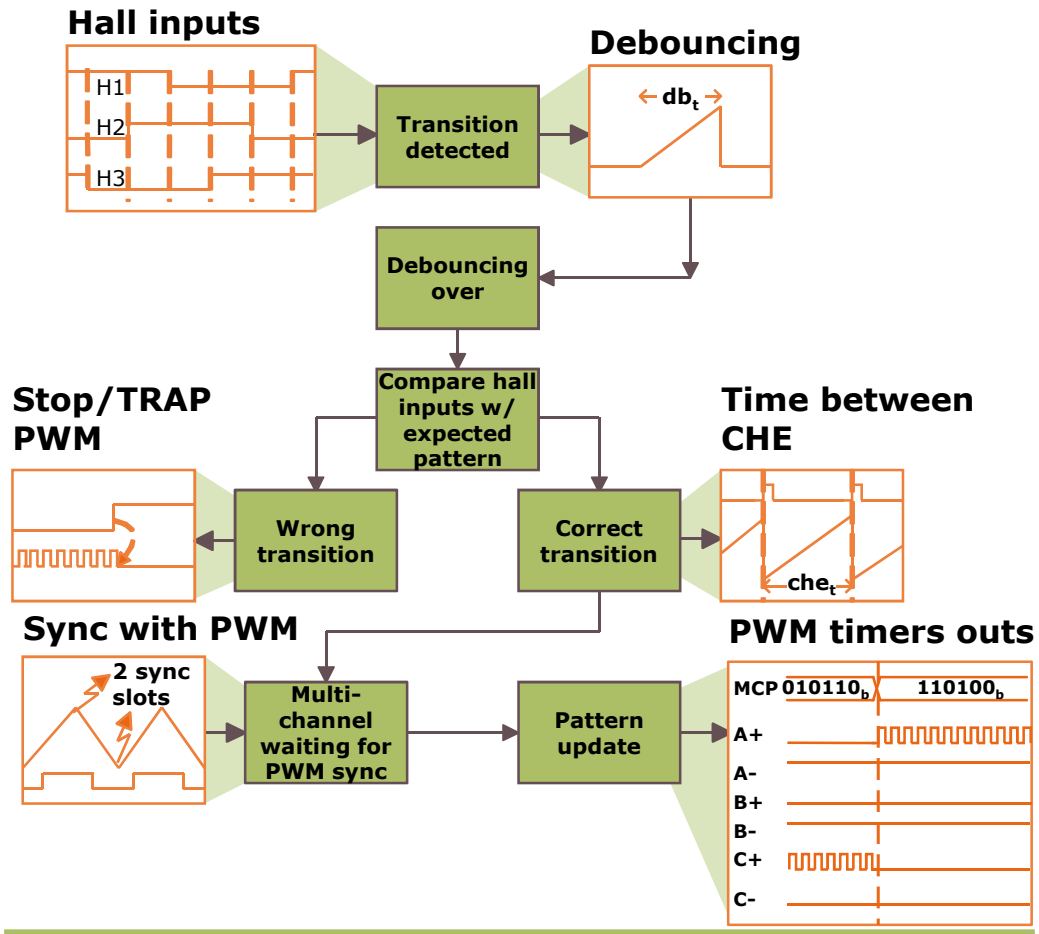
Application example
Hall sensor control BLDC (1/2)



In brief

Standard BLDC motor control

Overview

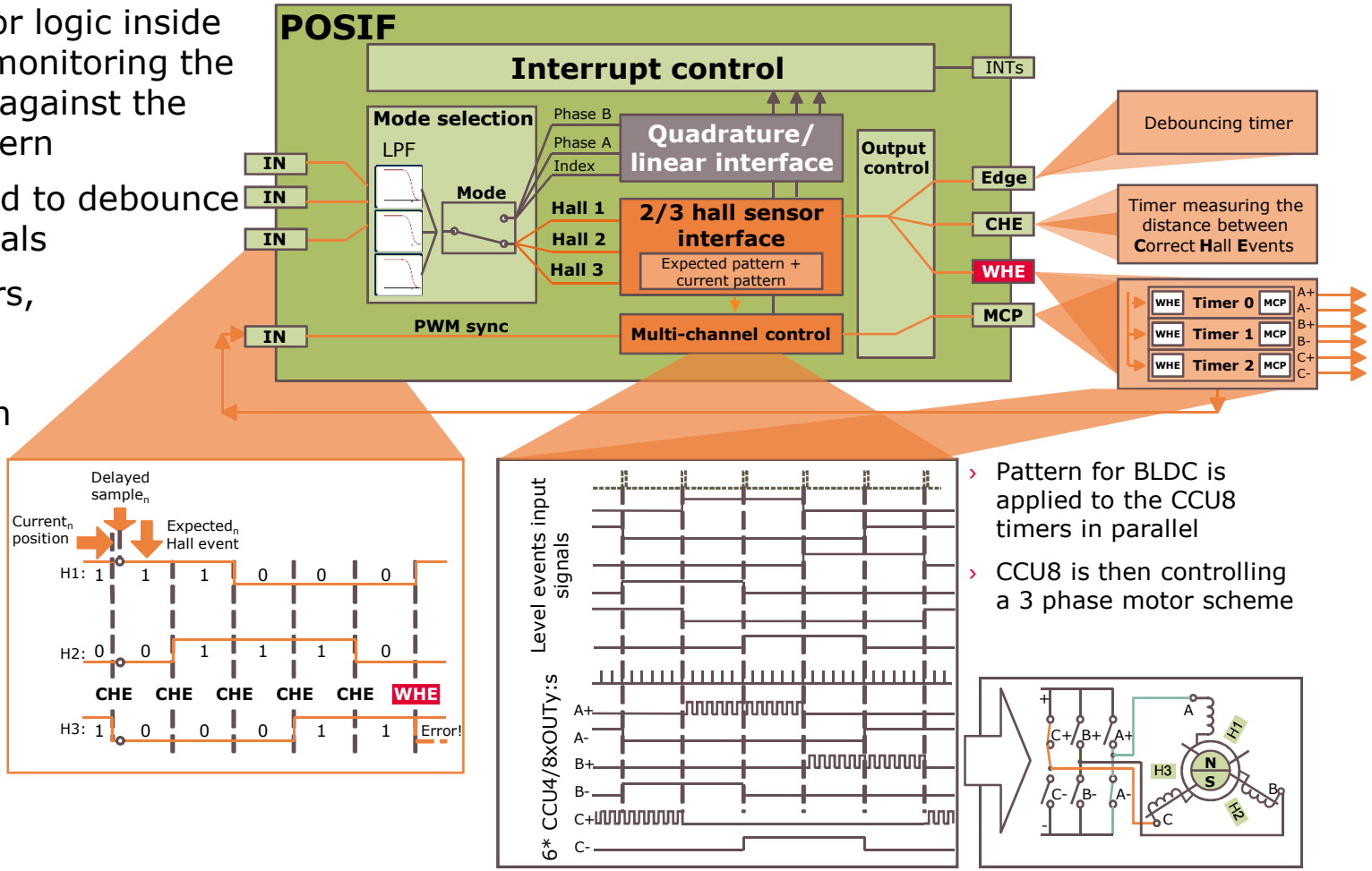
For a standard BLDC motor control application, **the POSIF is monitoring the hall sensor outputs**. In every transition of the hall sensors a **debouncing** timer is started.

If after the debouncing time the transition is the expected one, then the hall sensor control logic "informs" the multi-channel control that a pattern update is possible.

After this, **the multi-channel control waits for a sync signal from the PWM** timers to update the multi-channel pattern.

Application example
Hall sensor control BLDC (2/2)

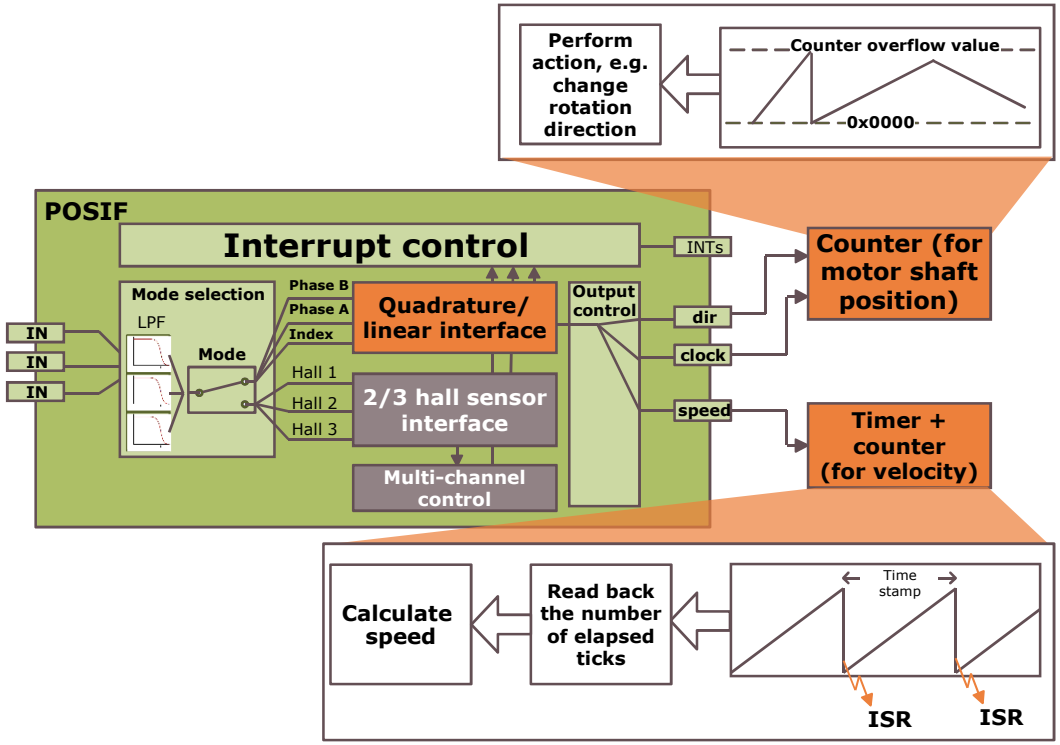
- The hall sensor logic inside the POSIF is monitoring the input pattern against the expected pattern
- A timer is used to debounce the input signals
- If a CHE occurs, then the PWM timers will signalize when the POSIF updates the multi-channel pattern
- Wrong hall event can be used to generate a TRAP for the PWM timers



- Pattern for BLDC is applied to the CCU8 timers in parallel
- CCU8 is then controlling a 3 phase motor scheme

Application example hall sensor control: detailed block diagram

Application example
Quadrature decoder – fixed time stamp (1/2)



In brief

Position monitoring plus velocity calculation within a fixed timestamp

Overview

The quadrature decoder interface of the POSIF, together with the flexible set of timers present in each derivative, can be used to:

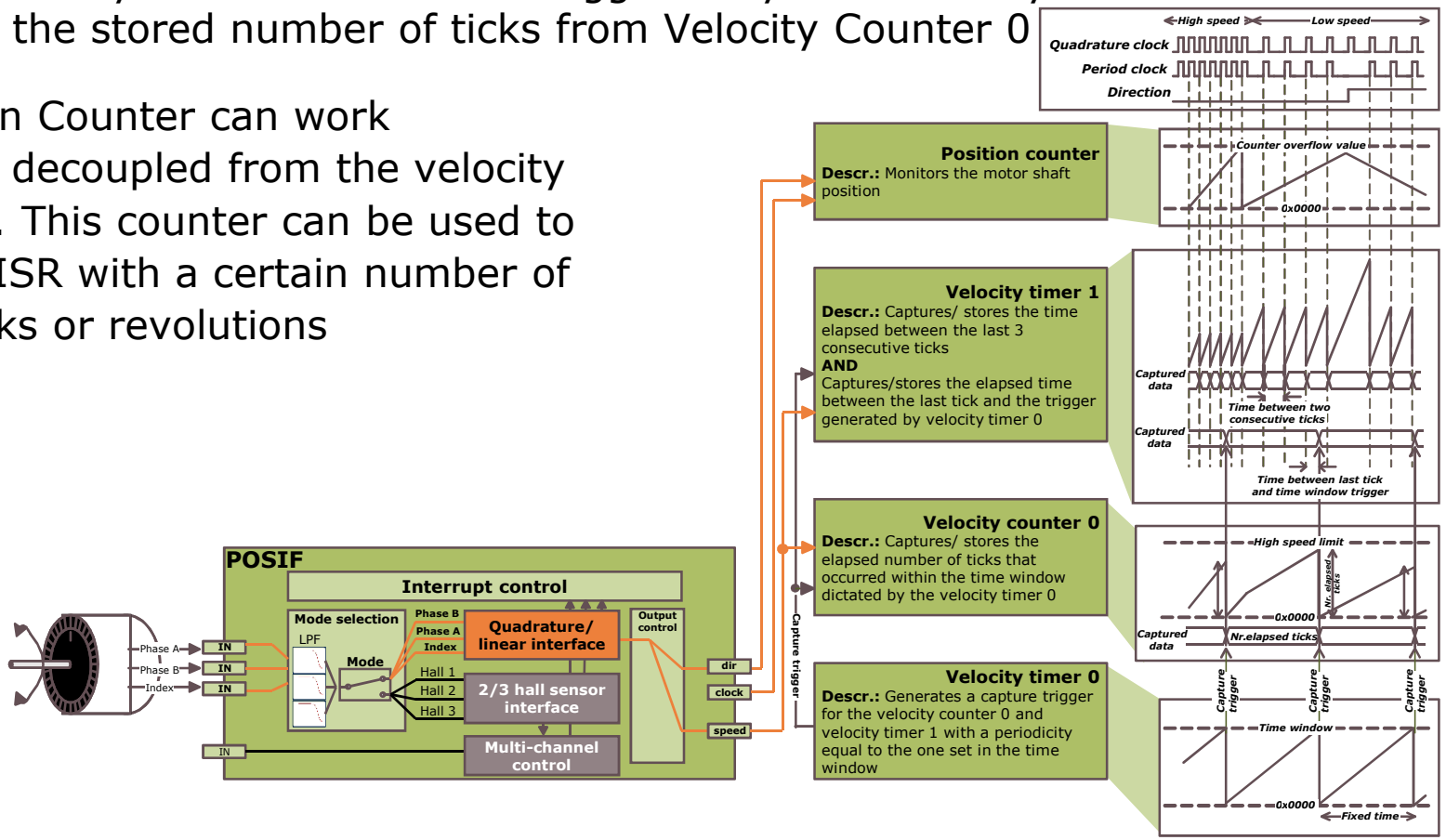
- Implement a tailored solution to monitor the motor shaft position
- Implement a robust velocity measurement algorithm

In this application case, **one counter is monitoring the motor shaft position**.

The velocity is monitored by storing/capturing the elapsed number of ticks within a fixed time windows.

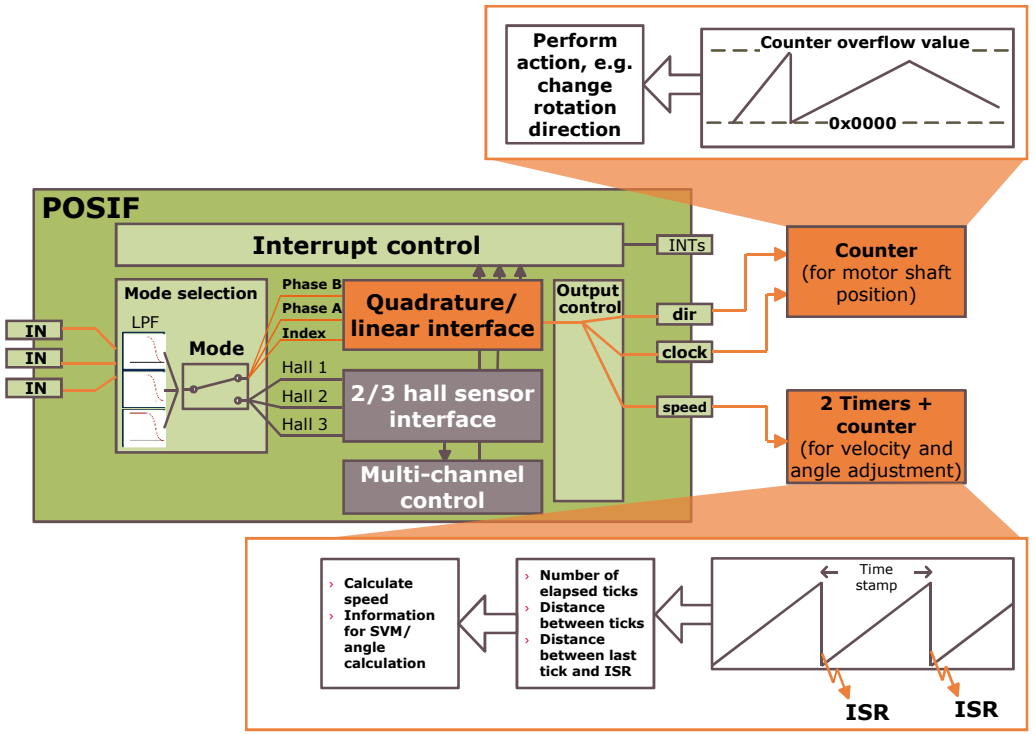
Application example
Quadrature decoder – fixed time stamp (2/2)

- With this setup it is possible to configure the ISR timestamp for velocity calculation. Every time that an ISR is triggered by the "Velocity Timer 0" the SW reads back the stored number of ticks from Velocity Counter 0
- The Position Counter can work completely decoupled from the velocity calculation. This counter can be used to trigger an ISR with a certain number of elapsed ticks or revolutions



Application example quadrature decoder fixed time stamp: detailed timing diagram

Application example: Quadrature decoder – enhanced position and velocity (1/2)



In brief

- Enhanced position and velocity monitoring

Overview

The flexible resource utilization between the POSIF and the CCU4/CCU8 modules, gives the possibility of having multiple timers/counters to monitor different variables.

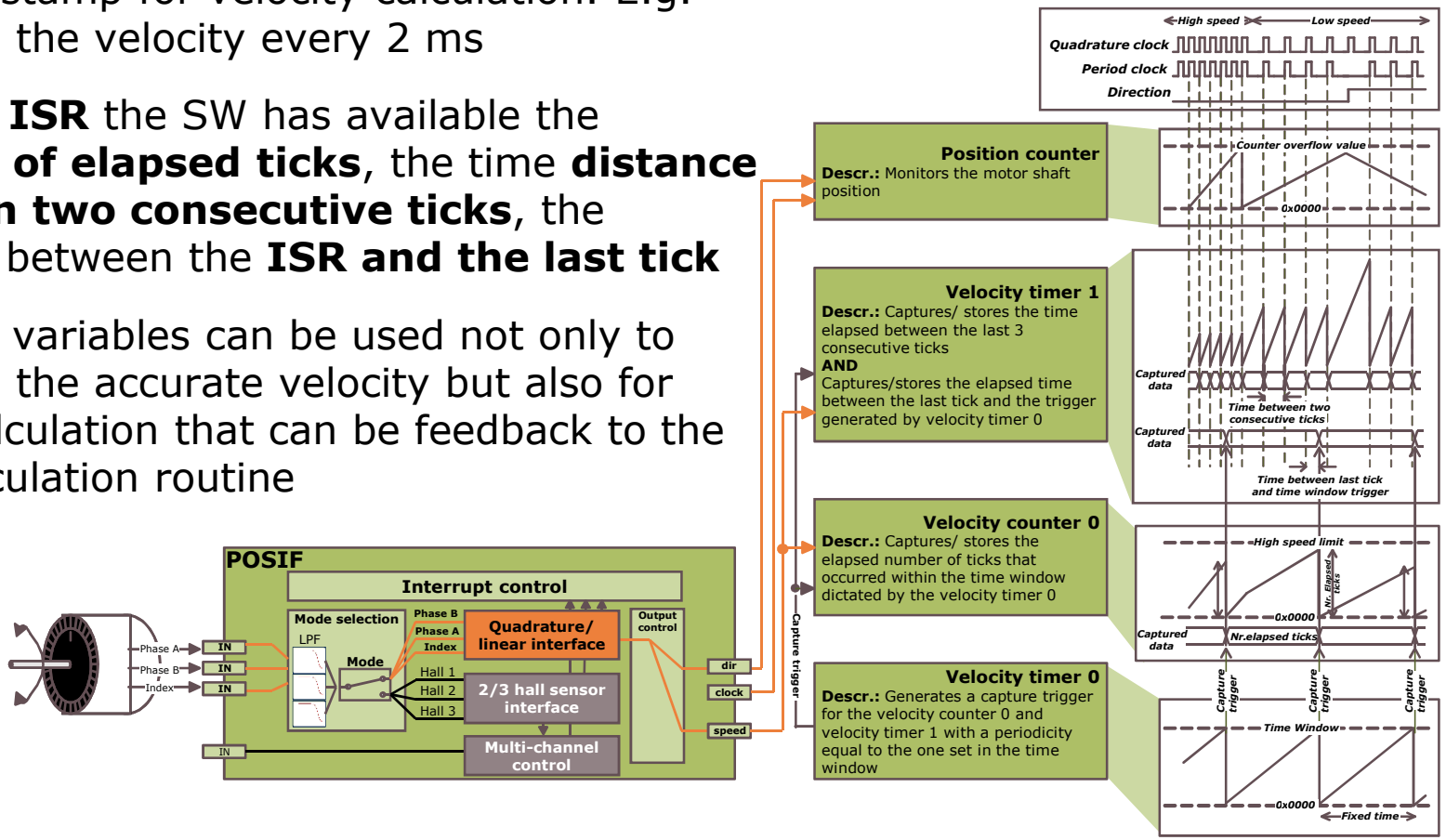
In this application case, a **position counter** is used to monitor the motor shaft position.

Besides that one additional counter and two timers are used to monitor:

- **The number of elapsed ticks between a fixed timestamp**
- **The time distance between ticks**
- **The jitter between the last tick and the ISR**

Application example: Quadrature decoder – enhanced position and velocity (2/2)

- With this setup it is possible to configure the ISR timestamp for velocity calculation. E.g. calculate the velocity every 2 ms
- **In each ISR** the SW has available the **number of elapsed ticks**, the time **distance between two consecutive ticks**, the distance between the **ISR and the last tick**
- All these variables can be used not only to calculate the accurate velocity but also for angle calculation that can be feedback to the SVM calculation routine



Application example enhanced position and velocity: block diagram

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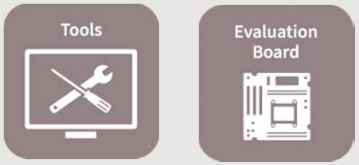
Technical Material 	– Application Notes – Technical Articles – Simulation Models – Datasheets, MCDS Files – PCB Design Data	– www.infineon.com/XMC – Kits and Boards – DAVE™ – Software and Tool Ecosystem
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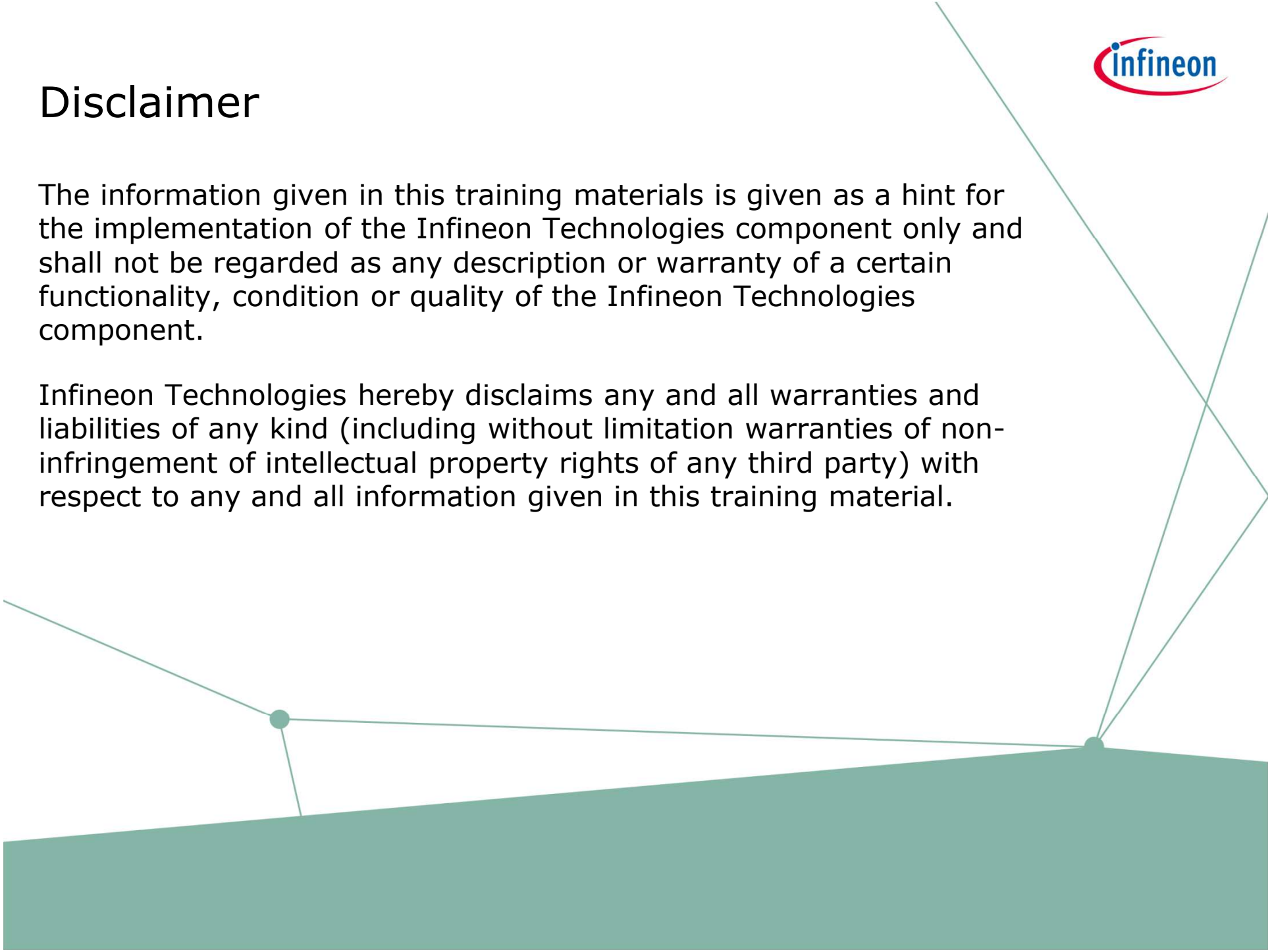

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