

DSD: Delta Sigma Demodulator

XMC™ microcontrollers
September 2016



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Overview

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Key feature: adjustable CIC filter

3

Key feature: parallel auxiliary CIC filter with boundaries

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Key feature: resolver support

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System integration

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Application examples

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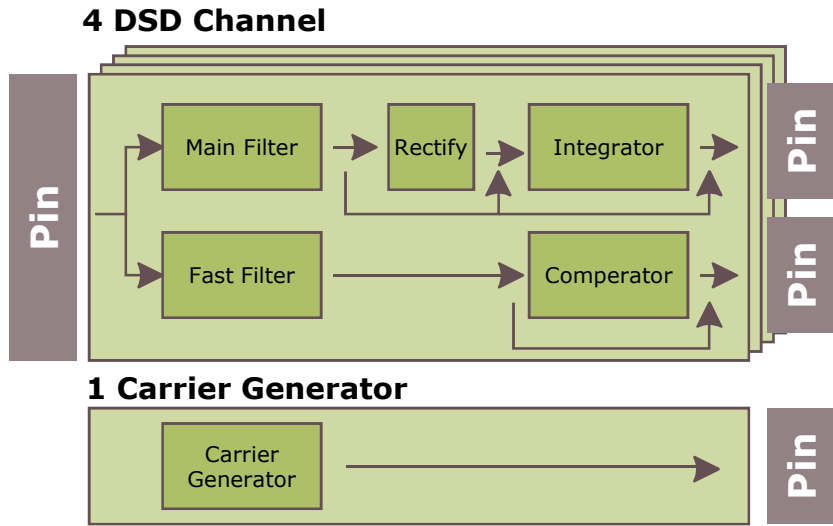
Key feature: resolver support

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Application examples



XMC™4000 provides four delta sigma demodulator channels and one carrier generator.

It is tailored to demodulate a bitstream from an external delta sigma modulator. This can be used for isolated current/voltage measurement and for sensor interfaces.

- › Adjustable CIC filter
- › Parallel auxiliary CIC filter with boundaries
- › Resolver support

- › External sigma delta modulator can be connected directly to XMC™ without ASIC
- › Simultaneous overcurrent/voltage detection with programmable boundary interrupt
- › Resolver excitation and feedback reading with full hardware support saving external ASIC

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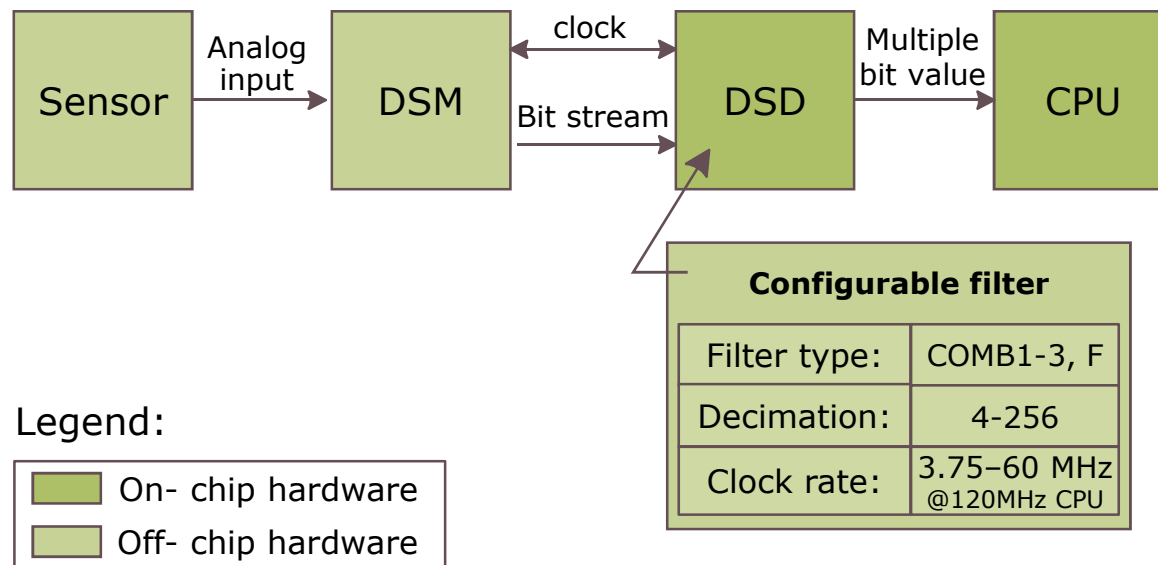
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Application examples

DSD

Adjustable CIC filter (1/2)

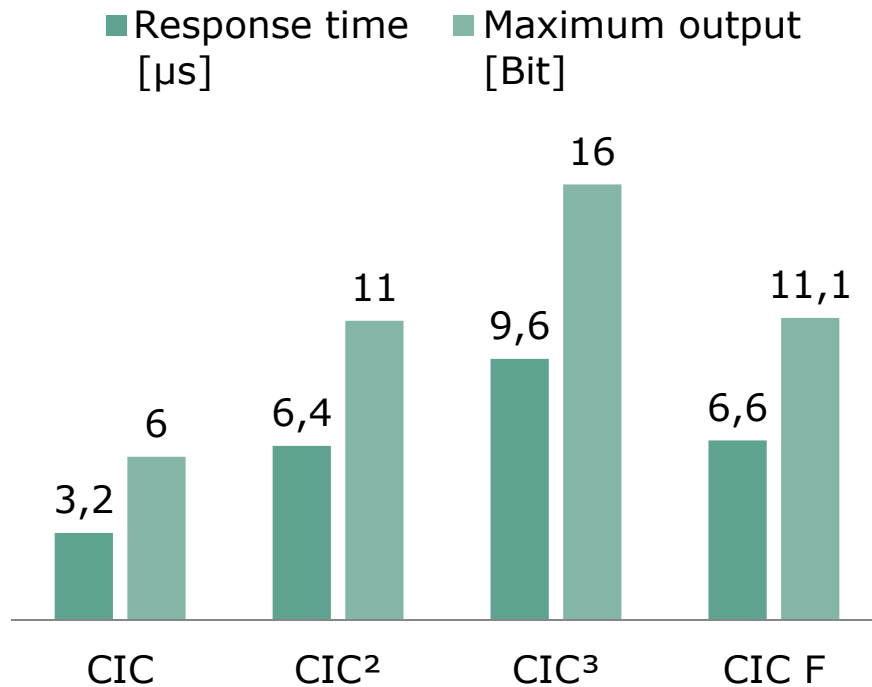
- › Each DSD channel supports 4 types of CIC filters:
 - CIC, CIC^2 , CIC^3 , CIC F
- › The decimation factor can be selected independent from other channels:
 - 4 to 256



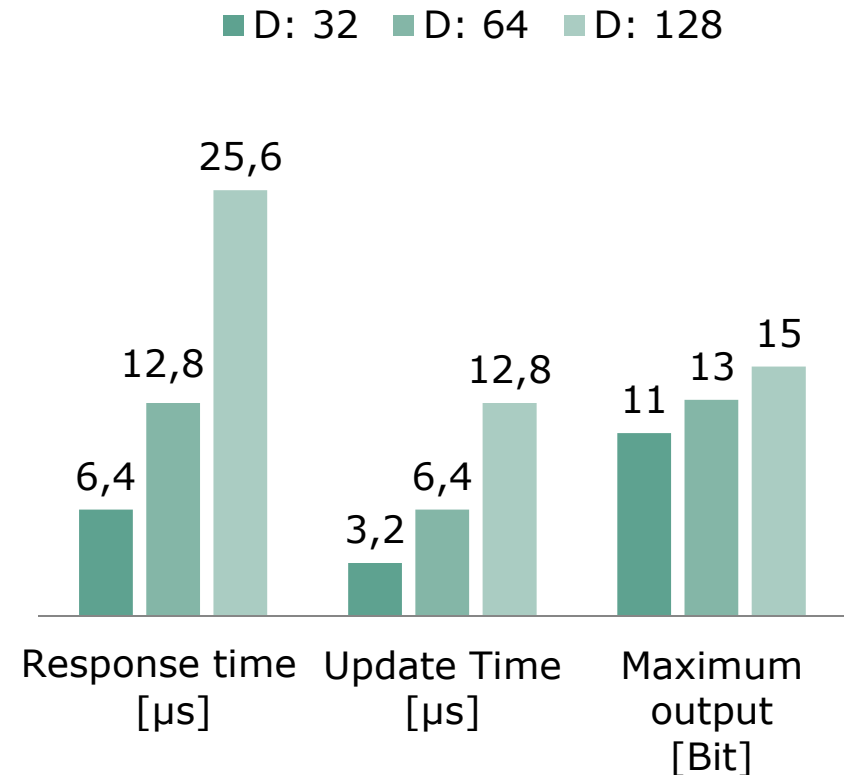
DSD

Adjustable CIC filter (2/2)

Filter comparison^{*1}



Decimation factor comparison^{*2}



*1: Sample frequency 10 Mhz, decimation factor: 32

*2: Sample frequency 10 MHz, filter type: CIC³

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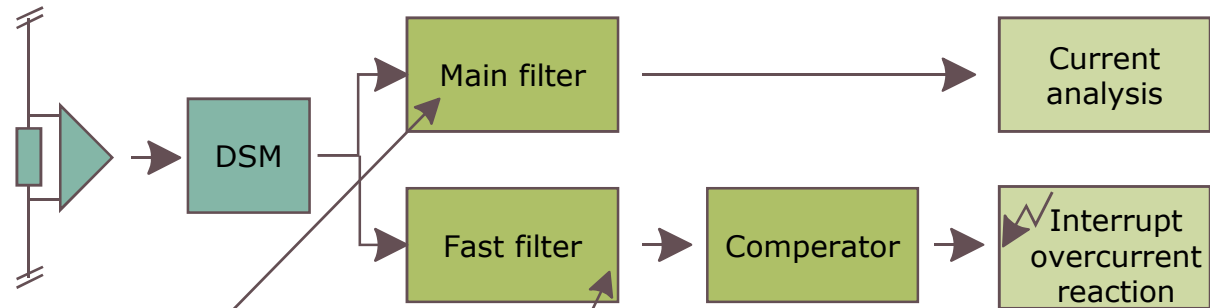
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Parallel auxiliary filter with boundaries





- › Each DSD channel has an auxiliary CIC filter
 - 4 filter types can be selected (CIC, CIC², CIC³, CIC F)
 - Decimation factor between 4 to 32
 - Hardware boundary check with interrupt to reduce CPU load



| Main filter | |
|-----------------|-------------------|
| Filter type: | COMB ³ |
| Decimation: | 64 |
| Response time: | 9.6 μs |
| Update time: | 3.2 μs |
| Maximum output: | 16-bit |

| Fast filter | |
|-----------------|-------------------|
| Filter type: | COMB ² |
| Decimation: | 16 |
| Response time: | 3.2 μs |
| Update time: | 1.6 μs |
| Maximum output: | 9-bit |

Legend:

| | |
|---|--------------------|
|  | On- chip hardware |
|  | Off- chip hardware |
|  | Software |
|  | Advantages |

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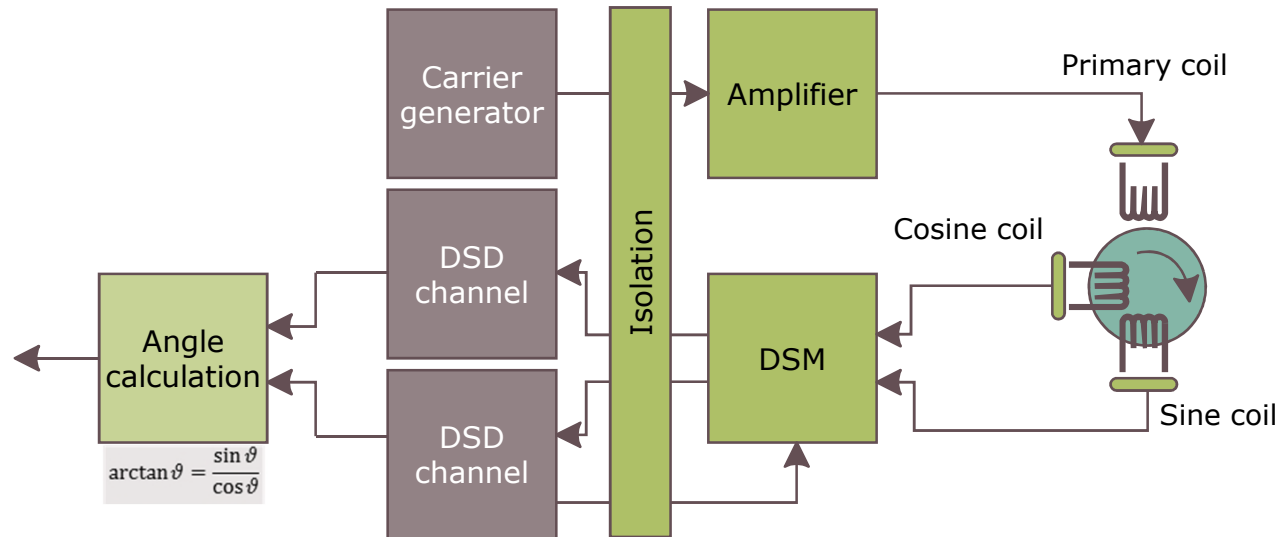
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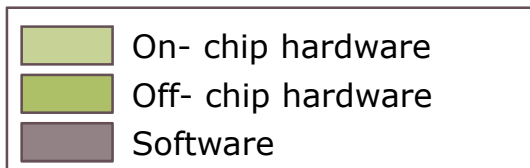
DSD

Resolver support (1/6)

- › Hardware for resolver support
 - Carrier generator
 - Rectify (part of DSD channel)
 - Integration (part of DSD channel)



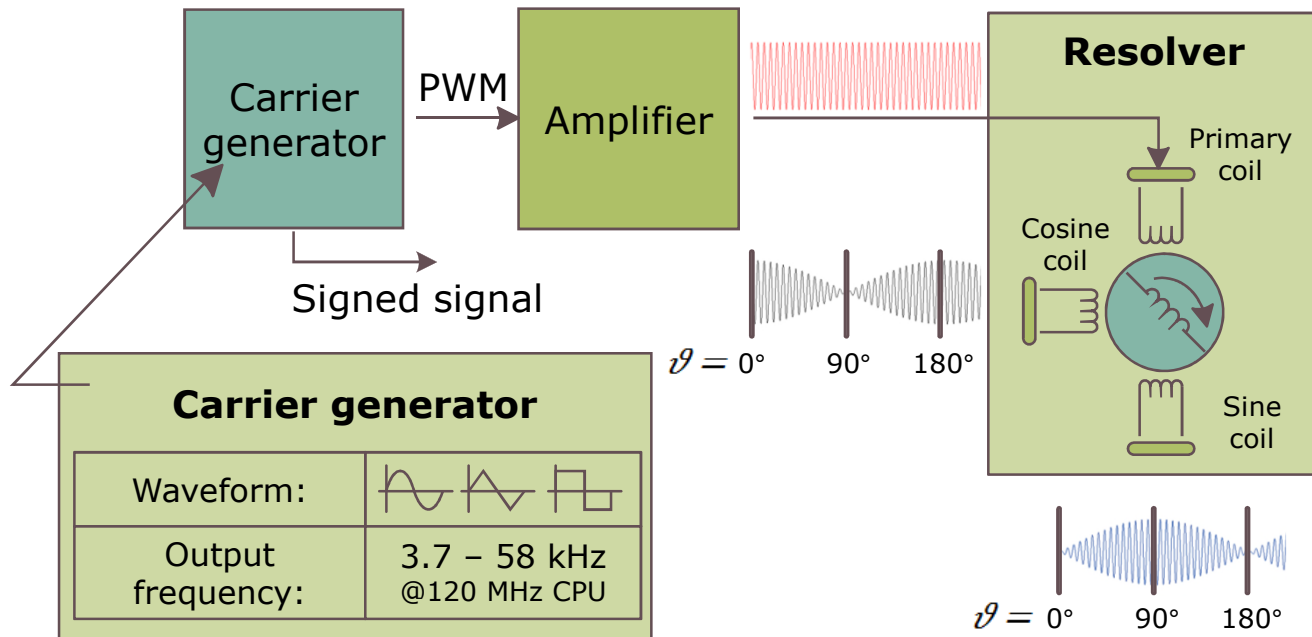
Legend:



Resolver support (2/6) – carrier generator

› Carrier generator

- Hardware generated waveform without CPU load
- Waveform: sine, triangle and rectangle
- Output frequency between 3,7 kHz and 58,6 kHz *
- Signed signal for rectification



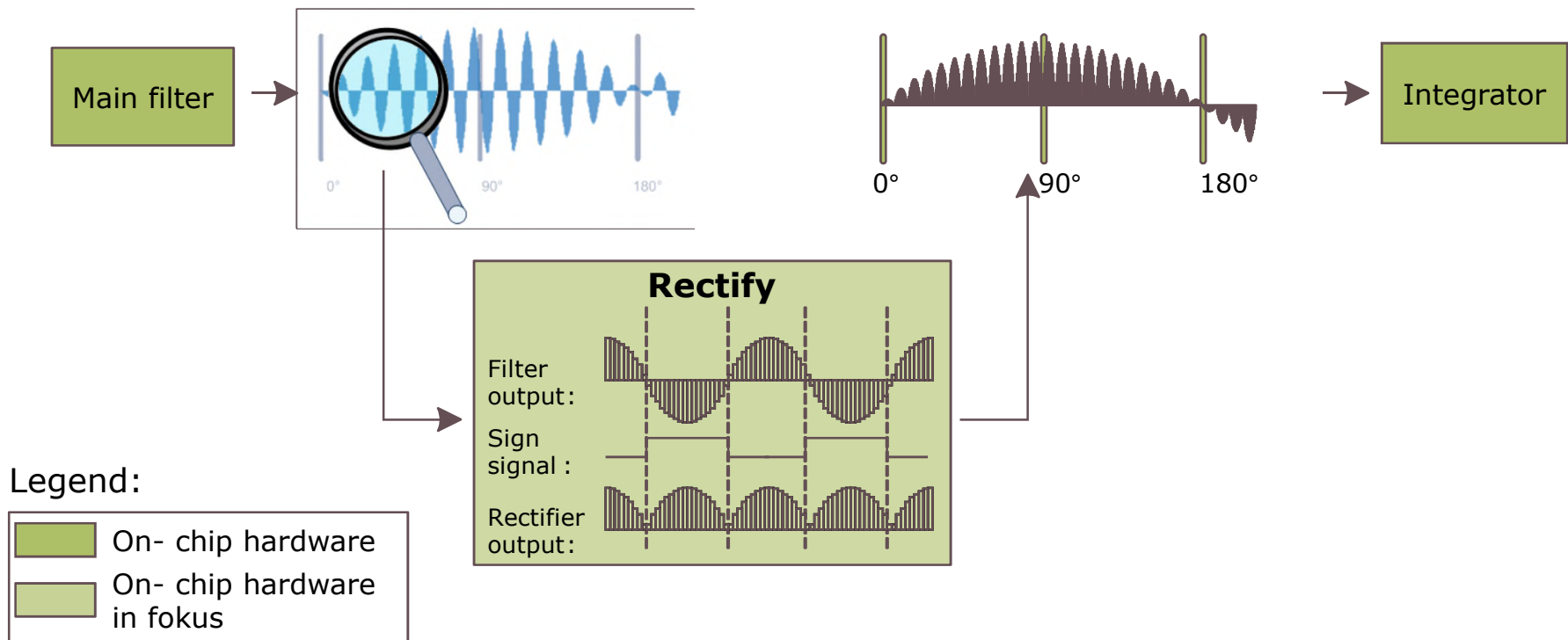
* Peripheral clock 120 MHz

DSD

Resolver support (3/6) – rectifier

› Rectifier

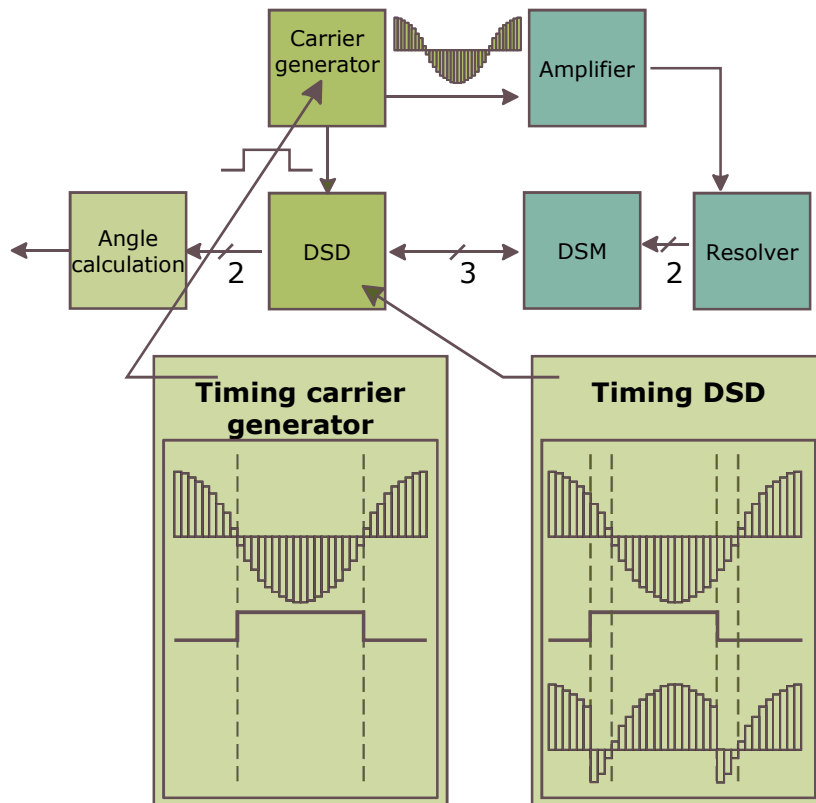
- Hardware rectifier for carrier cancellation
- Hardware sign delay capture
- Adjustable sign delay compensation



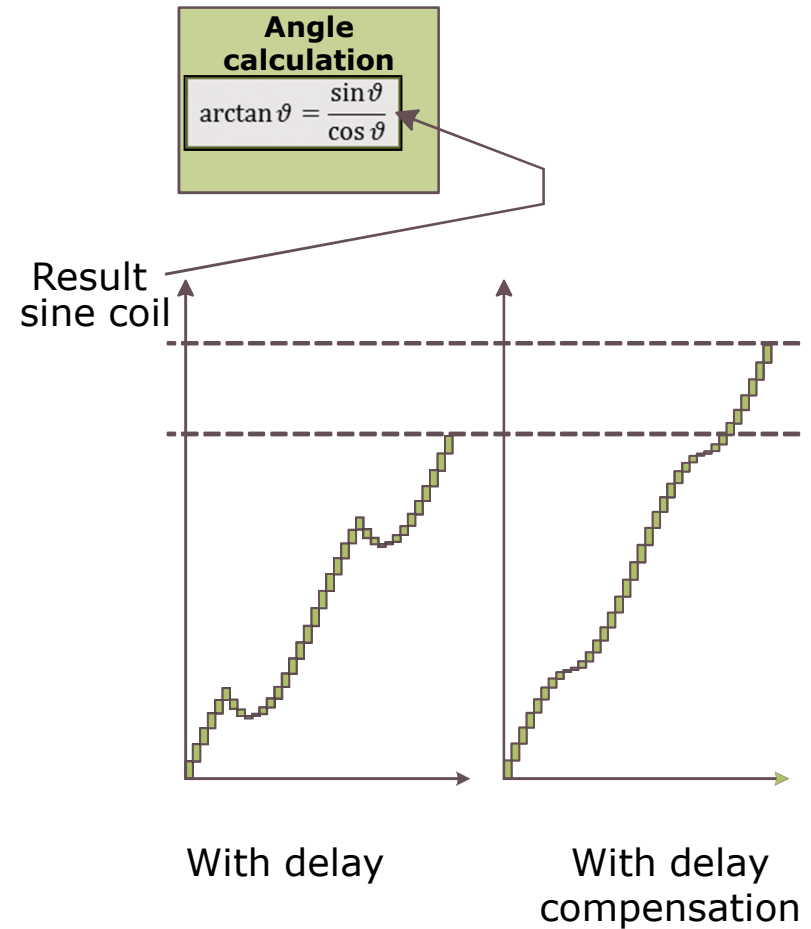
DSD

Resolver support (4/6) – rectifier

› Sign delay compensation



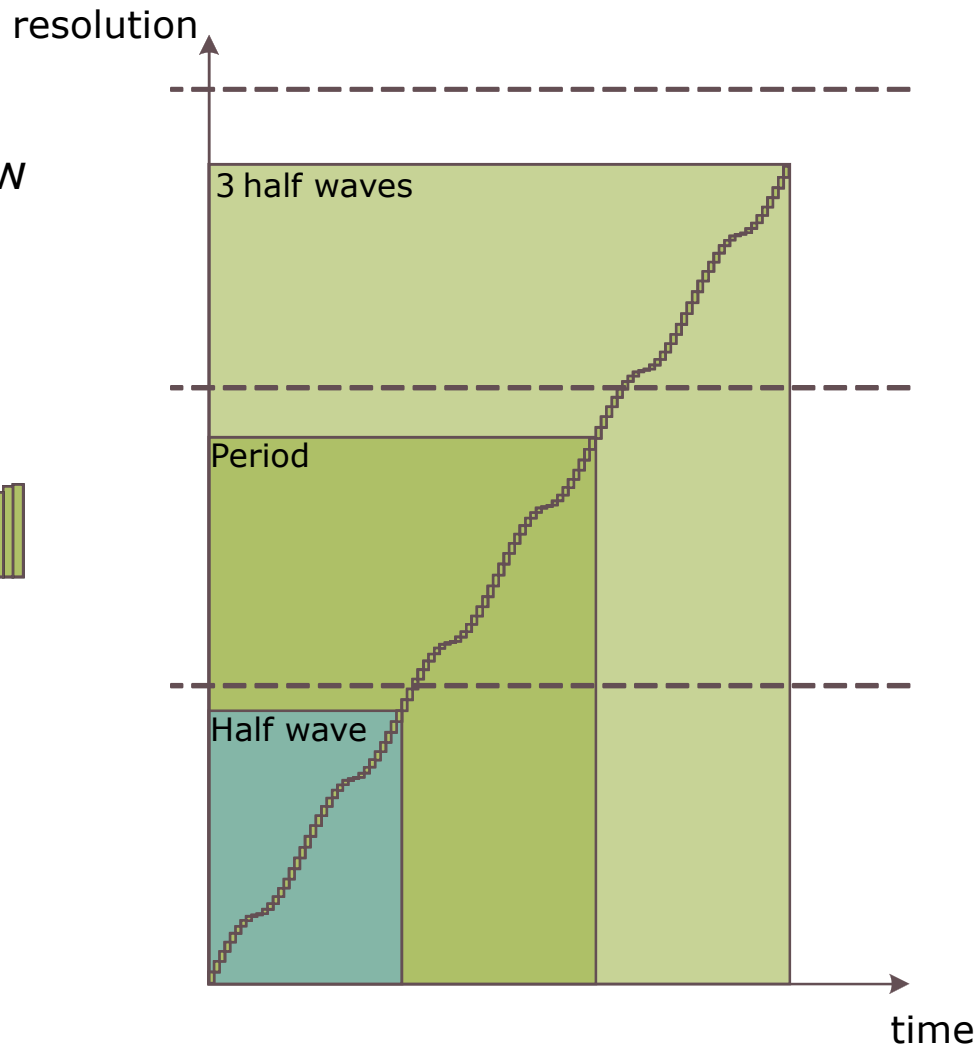
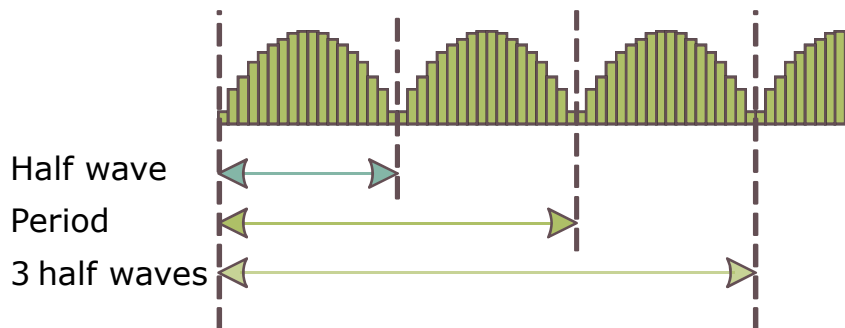
Angle calculation resolution depending on integration result

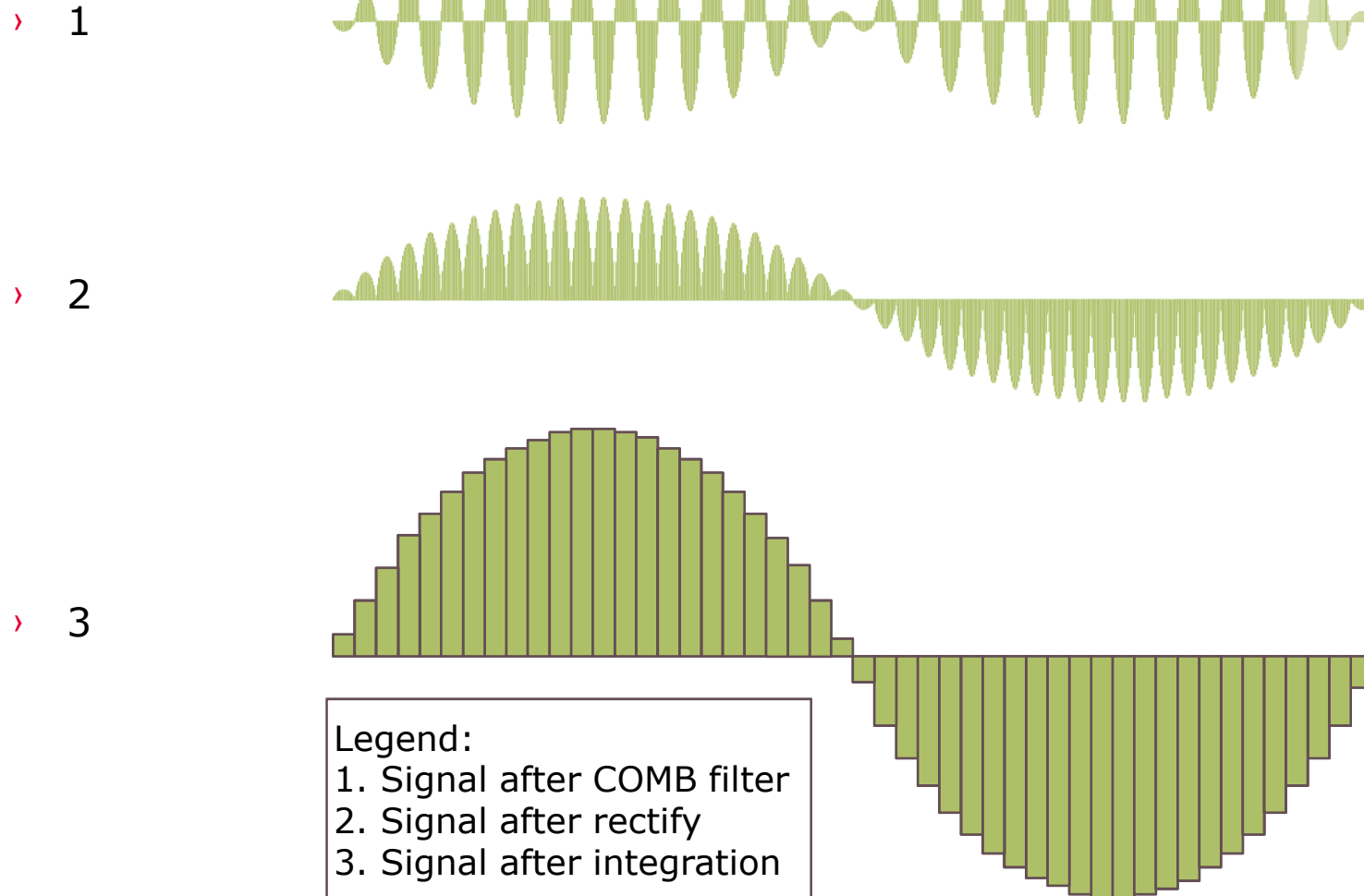


Resolver support (5/6) – integrator

› Integrator

- Hardware integrator
- Adjustable integration window
- Continuous and trigger mode





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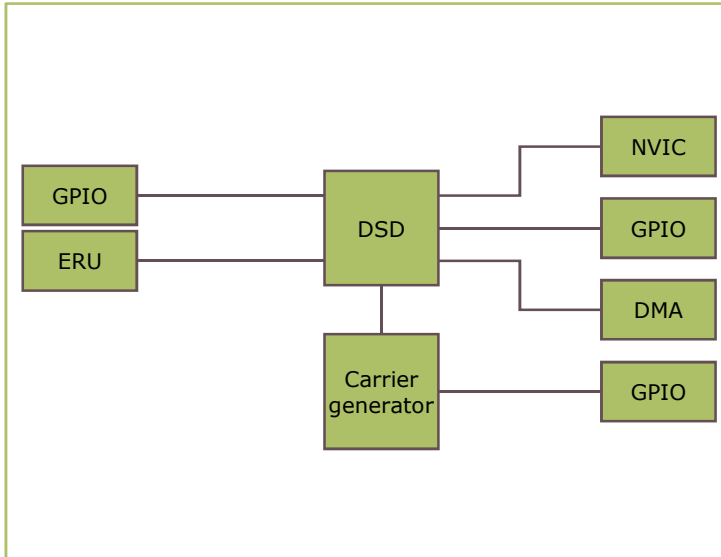
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DSD

System integration



| XMC™4100 | XMC™4200 | XMC™4400 | XMC™4500 |
|----------|----------|----------|----------|
| | | ● | ● |

DSD is connected to GPIO, ERU, NVIC and DMA.

In many applications it is mandatory to synchronize the carrier generator, the DSD and the external DSM. Therefore the DSD has implemented the carrier generator and provides a clock via GPIO for the DSM.

The connection to the ERU enables a various of trigger sources.

- › Target applications
 - Motor control
 - Isolated current measurement
 - Isolated voltage measurement

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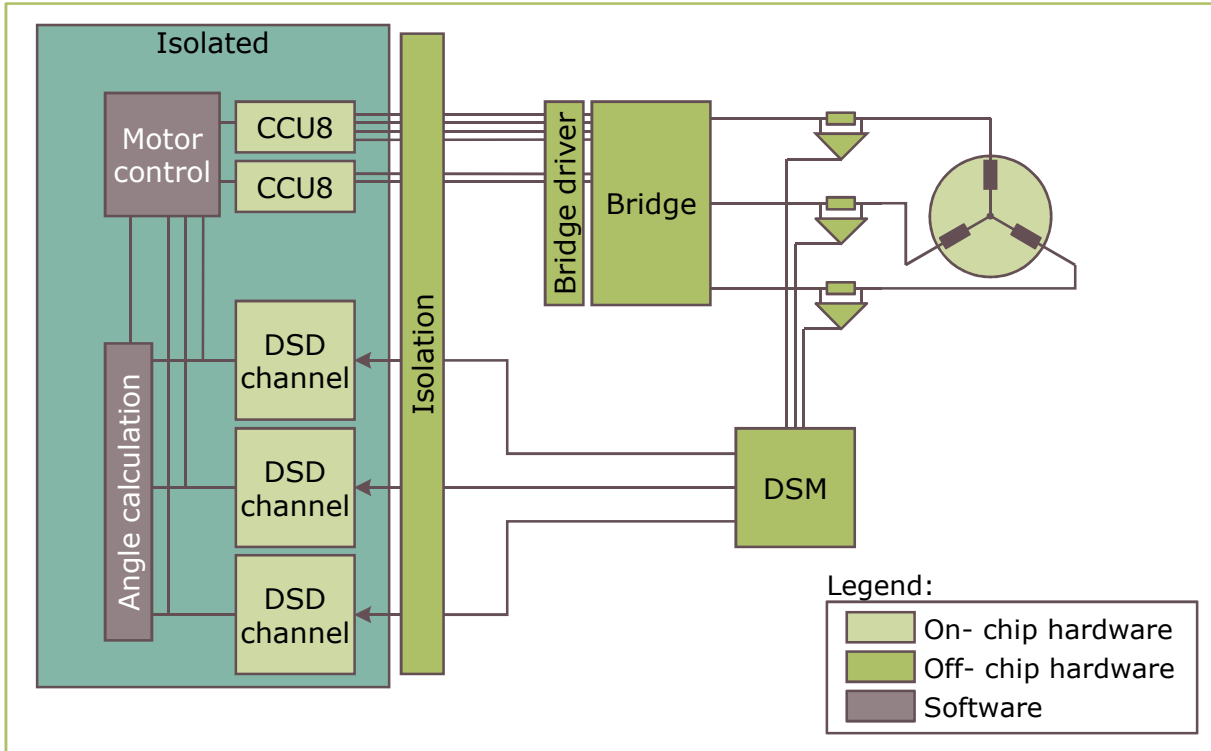
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Application example

Isolated current measurement



Overview

All three currents are measured in phase with a DSM. The bits stream allows a cost-efficient digital isolation. The microcontroller is isolated against the high voltage part. Also a benefit is the good signal to noise ratio based on the oversampling.

In brief

In many high voltage applications an isolation is needed. The DSD offers the possibility for an isolation of the XMC™ MCU against the high voltage.



The angle coming as sine and cosine analog value from resolver are multiplied by the carrier signal. The XMC™ DSD provides hardware for carrier cancelation and data calibration.

In addition on high voltage boards the resolver has to be isolated against the high voltage. In this case the XMC™ is on the high voltage side and the resolver is isolated.

In brief

For a resolver analysis a data processing is necessary. The XMC™ offers many of these calculation in hardware.

General information

- › For latest updates, please refer to:

www.infineon.com/xmc4000

- › For support:

<http://www.infineonforums.com/forums/8-XMC-Forum>

Support material

Collaterals and Brochures



- Product Briefs
- Selection Guides
- Application Brochures
- Presentations
- Press Releases, Ads

- www.infineon.com/XMC

Technical Material



- Application Notes
- Technical Articles
- Simulation Models
- Datasheets, MCDS Files
- PCB Design Data

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