恩智浦基于S32K3的车载电机控制方案

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GPIS System AE

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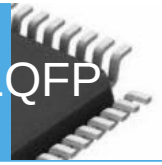
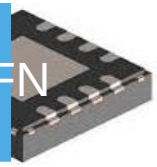
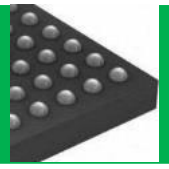
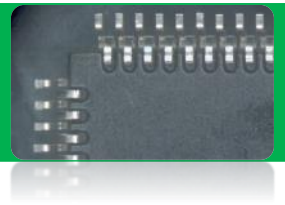
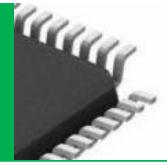
SECURE CONNECTIONS
FOR A SMARTER WORLD

AGENDA

- S32K3产品简介
- S32K3用于电机控制的外设介绍
- S32K3在车用电机中的应用
- 恩智浦基于S32K3的车用电机方案
- S32K3的电机控制生态
- 总结

S32K3产品简介

S32K3产品简介 – S32K3的新特性

	S32K1	S32K3
PERFORMANCE	M0+ @ 48 MHz or M4F @ 80 - 112 MHz Single-core	1 - 4 M7 @ 120 - 320 MHz Single-core, Multi-core or Lockstep core
MEMORY	128 KB – 2 MB P-Flash 17 – 256 KB RAM	512 KB - 8 MB P-Flash 128 KB - 1152 KB RAM
SECURITY & OTA	**CSEc** Sym Cipher Up to 20 keys OTA Support (RWW)	**HSE B** Sym & Asym Ciphers; 100+ Keys, Side channel protection Seamless OTA (RWW, Memory remapping for A/B Swap, FW rollback option)
SAFETY	**ASIL B**	**ASIL B / D**
KEY PERIPHERALS	100 Mb Ethernet (AVB), up to 3 CAN FD FlexTimer module, TRGMUX, FlexIO, PDB for Motor control	Up to 1 Gbps Ethernet (TSN, AVB), up to 8 CAN FD eMIOS, BCTU, LCU for Motor control Advanced peripherals I3C, Enhanced FlexIO
PACKAGING	BGA  LQFP  QFN 	BGA  MaxQFP  LQFP 

S32K3: EXPANDING THE S32 PLATFORM

NXP's S32 Automotive Platform enables software reuse across multiple applications, reducing development complexity and easing the burden for Tier 1s and carmakers

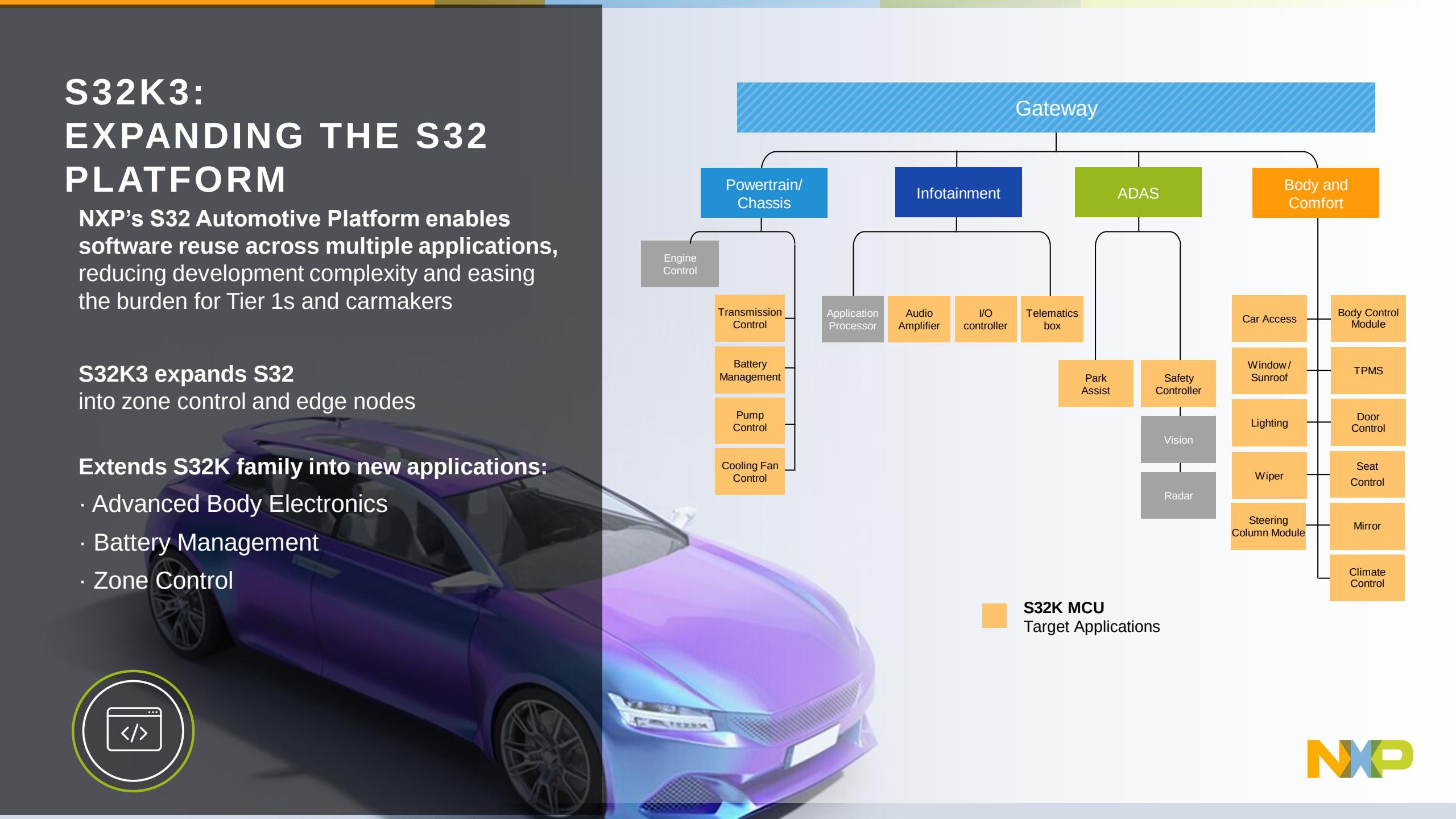
S32K3 expands S32
into zone control and edge nodes

Extends S32K family into new applications:

· Advanced Body Electronics

· Battery Management

· Zone Control



S32K3XX 512 KB - 4 MB DEVICE FEATURE OVERVIEW

IN PRODUCTION

S32K310	S32K311	S32K312	S32K314	S32K322	S32K324	S32K341	S32K342	S32K344
1x Cortex-M7 @ 120MHz			1x Cortex-M7 @ 160MHz	2x Cortex-M7 @ 160MHz		1x LS Cortex-M7 @ 160MHz		
ASIL B	ASIL B	ASIL B	ASIL B	ASIL B	ASIL B	ASIL D	ASIL D	ASIL D
HSE B	HSE B	HSE B	HSE B	HSE B	HSE B	HSE B	HSE B	HSE B
512KB Flash	1MB Flash	2MB Flash	4MB Flash	2MB Flash	4MB Flash	1MB Flash	2MB Flash	4MB Flash
64K SRAM incl. 64K TCM	128K SRAM incl. 96K TCM	192K SRAM incl. 96K TCM	512K SRAM incl. 96K TCM	256K SRAM incl. 192K TCM	512K SRAM incl. 192K TCM	256K SRAM incl. 192K TCM	256K SRAM incl. 192K TCM	512K SRAM incl. 192K TCM
up to 84 I/Os	up to 84 I/Os	up to 145 I/Os	up to 218 I/Os	up to 142 I/Os	up to 218 I/Os	up to 142 I/Os	up to 142 I/Os	up to 218 I/Os
16 channel eDMA			32ch eDMA	32 channel eDMA				
3x FlexCAN w/ CAN FD		6x FlexCAN w/ CAN FD		4x FlexCAN w/ CAN FD	6x FlexCAN w/ CAN FD	4xFlexCAN w/ CAN FD	4x FlexCAN w/ CAN FD	6x FlexCAN w/ CAN FD
			No Ethernet / 1x 100Mbps Ethernet (TSN)	No Ethernet / 1x 100Mbps Ethernet (TSN)				
1x I3C, 2x I2C			2x I2C	1x I3C, 2x I2C	2x I2C	1x I3C, 2x I2C	1x I3C, 2x I2C	2x I2C
4x SPI**			6x SPI**	4x SPI**	6x SPI**	4x SPI**	4x SPI**	6x SPI**
2x 24ch 12-bit ADC			3x 24ch 12-bit ADC	2x 24ch 12-bit ADC	3x 24ch 12-bit ADC	2x 24ch 12-bit ADC	2x 24ch 12-bit ADC	3x 24ch 12-bit ADC
			2 x SAI (I2S)	2x SAI (I2S)				
			Quad SPI	Quad SPI				
LQFP-48		MaxQFP-172		MaxQFP-172				
MaxQFP-100				MaxQFP-100		MaxQFP-100	MaxQFP-100	
			MAPBGA-257		MAPBGA-257			MAPBGA-257

Common HW: LPUART, FlexIO, eMIOS Timers, ACMP, LCU, BCTU, TRGMUX

Common SW: Real-Time Drivers (RTD), Security FW, Safety SW Framework, Core Self-Test Libraries, etc

*K314 100MaxQFP room temp CES only, not for production

**Ethernet 10BaseT1S supported by SPI + external MAC&PHY

S32K3XX 6 MB - 8 MB DEVICE FEATURE OVERVIEW

PRELIMINARY INFO, SUBJECT TO CHANGE

S32K328	S32K338	S32K348	S32K358
2x Cortex-M7 @ 160MHz	3x Cortex-M7 @ 240MHz	1x LS Cortex-M7 @ 240MHz	1x LS Cortex-M7 + 1x Cortex-M7 @ 240MHz
ASIL B	ASIL B	ASIL D	ASIL D
HSE B	HSE B	HSE B	HSE B
8MB Flash			
1152K SRAM			
up to 218 I/Os			
32 channel eDMA			
8x FlexCAN w/ CAN-FD			
No Ethernet / 1x 1Gbps Ethernet (TSN)			
1x I3C, 2x I2C			
6x SPI**			
3x 24ch 12-bit ADC			
2x SAI (I2S)			
SDHC(SDIO)			
MaxQFP-172			
MAPBGA-289			

Common HW: LPUART, FlexIO, eMIOS Timers, ACMP, LCU, BCTU, TRGMUX

Common SW: Real-Time Drivers (RTD), Security FW, Safety SW Framework, Core Self-Test Libraries, etc

S32K3用于电机控制的外设介绍

S32K3用于电机控制的外设介绍 – 总览

Arm Cortex – M7

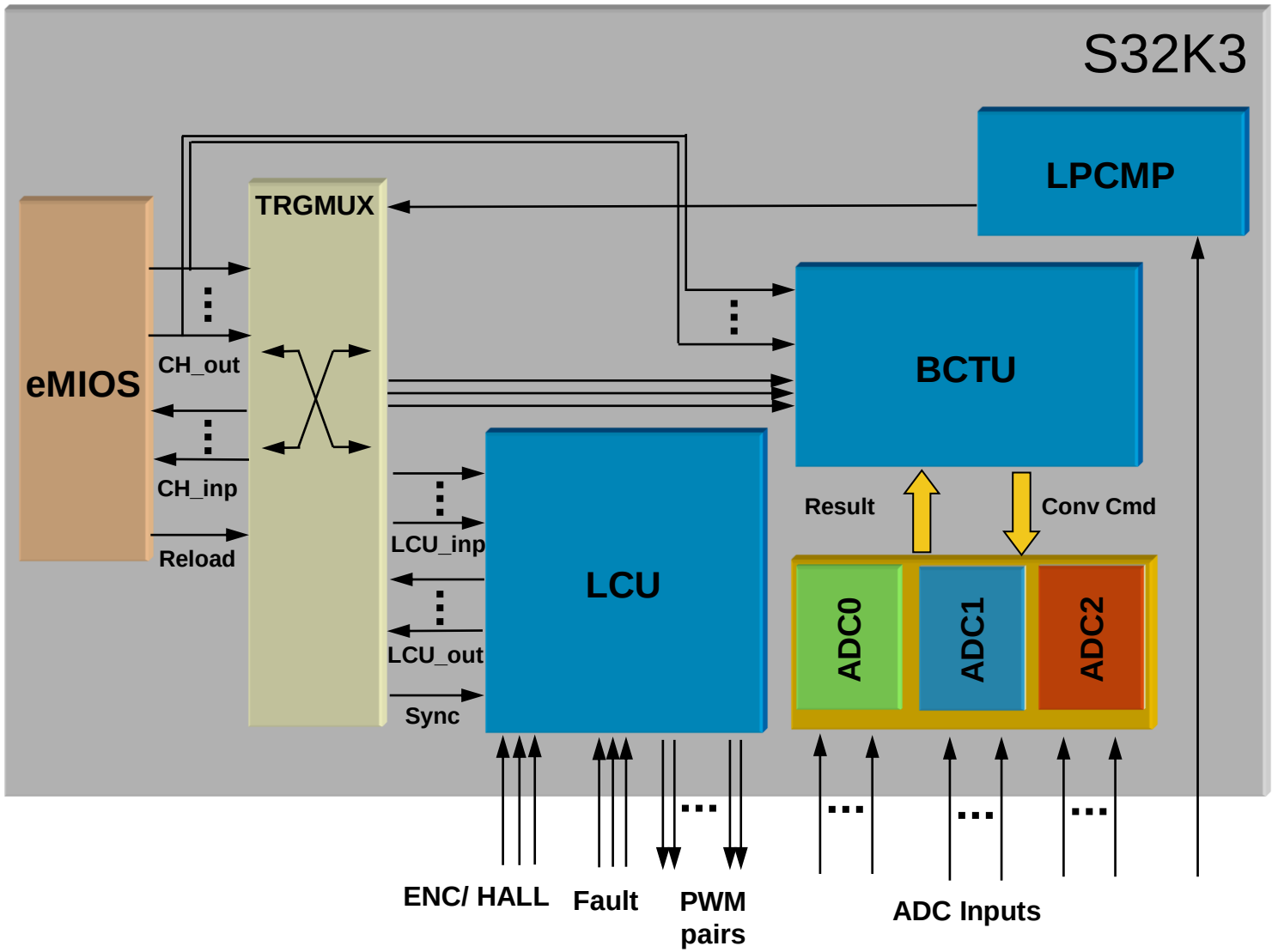
- 32-bit processor 160MHz
- DSP and FPU instructions
- 8kB I cache 8kB D cache
- (96 – 384)kB TCM
- SWD & JTAG debug interfaces

eMIOS 0/1/2

- 24 channels
- Multiple time bases selection
- Double buffed registers and reload signal generation
- 13 various modes for input capture/ output compare operations

LCU 0/1

- 3 LCs(Logic Cells) embedded each with 4 inputs and outputs. Configurable true table for each output.
- Force and sync inputs to support fast reaction to fault.
- Rise and fall edge delay to support deadtime generation and glitch filter.



LPCMP 0/1/2

- 8 external inputs
- 8 bit dac

TRGMUX

- Flexible mechanism for introjection of internal signals
- Debugging real time events; routing internal signal to I/O pin.

BCTU

- 72 channels (trigger sources)
- Singe conversion or list of conversions
- priority selection logic
- FIFO support

ADC 0/1/2.

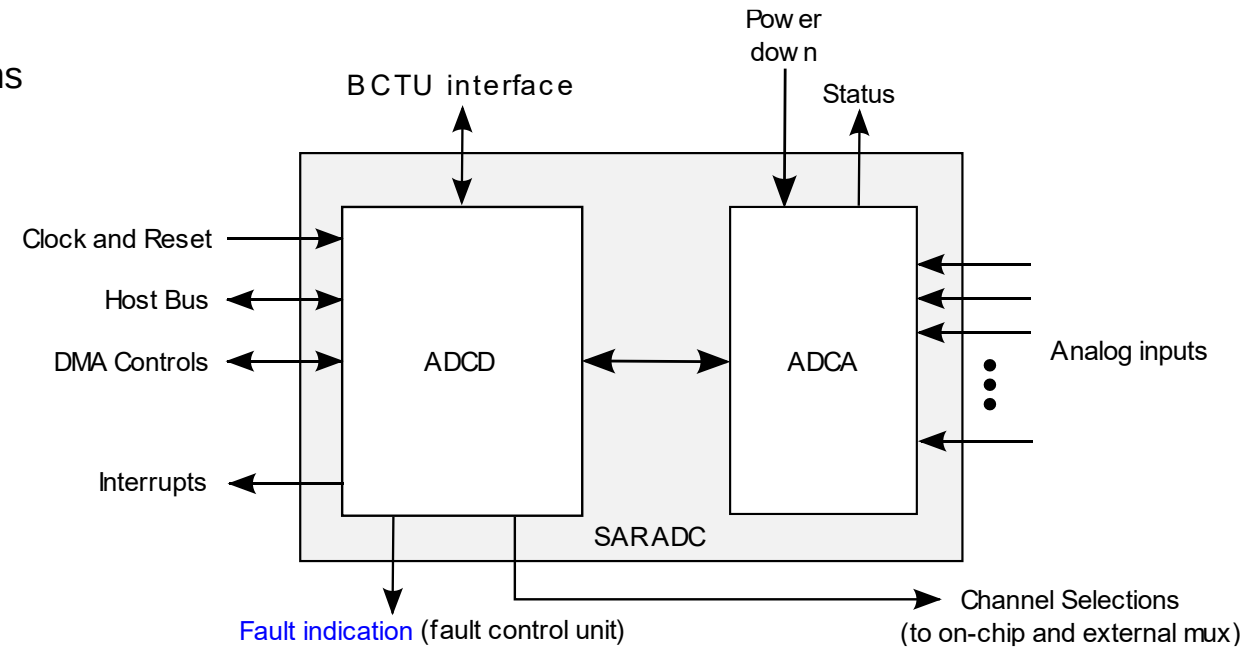
- 15 bit resolution
- 8 precision channels
- 16 standard channels
- 4 internal channels
- 32 external channels

S32K3用于电机控制的外设介绍

- Analog-to-Digital Converter (SAR-ADC)
- Body Cross triggering unit (BCTU)
- Logic Control Unit (LCU)
- Configurable Enhanced Modular IO Subsystem (eMIOS)
- Trigger MUX (TRGMUX)

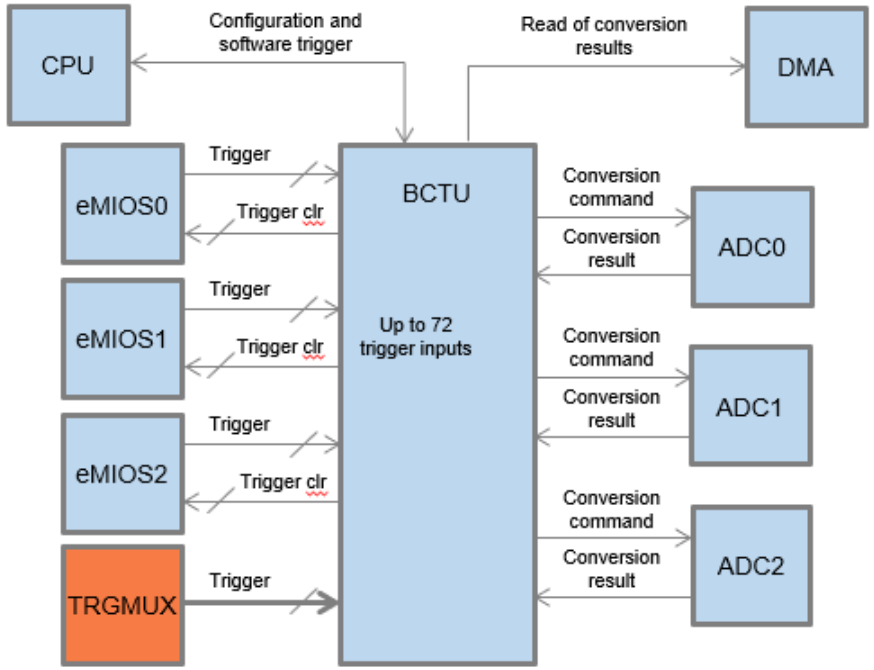
S32K3用于电机控制的外设介绍 – SAR ADC

- Fixed resolution 15bit (precision channels target for TSI application);
  - The conversion data is always 15 bit wide, although the actual successive approximation steps might be less than 15
- Sampling and conversion time: ~1uS (@80 MHz conversion clock) Up to 1M samples/sec ;
  - Programmable clock pre-scaler: (bus clock) or (bus clock)/2
- Accuracy: TUE Maximum +/- 6LSB without adjacent pin current injection;
- Three conversion modes:
  - Normal conversion supports one-shot and continuous conversions
  - Injected conversion supports one-shot conversions only
  - CTU conversion runs single conversion per trigger
- Independent data registers per channel
- Programmable DMA enable per channel
- Programmable pre-sampling enable per channel
- Configurable analog watchdogs for different channels
- Individual interrupt flags for the following conditions:
  - Single channel, chain or CTU end-of-conversion
  - Watchdog thresholds violation
- Software initiated calibration
- Built-in Self-Test (BIST) feature



S32K3用于电机控制的外设介绍 – BCTU

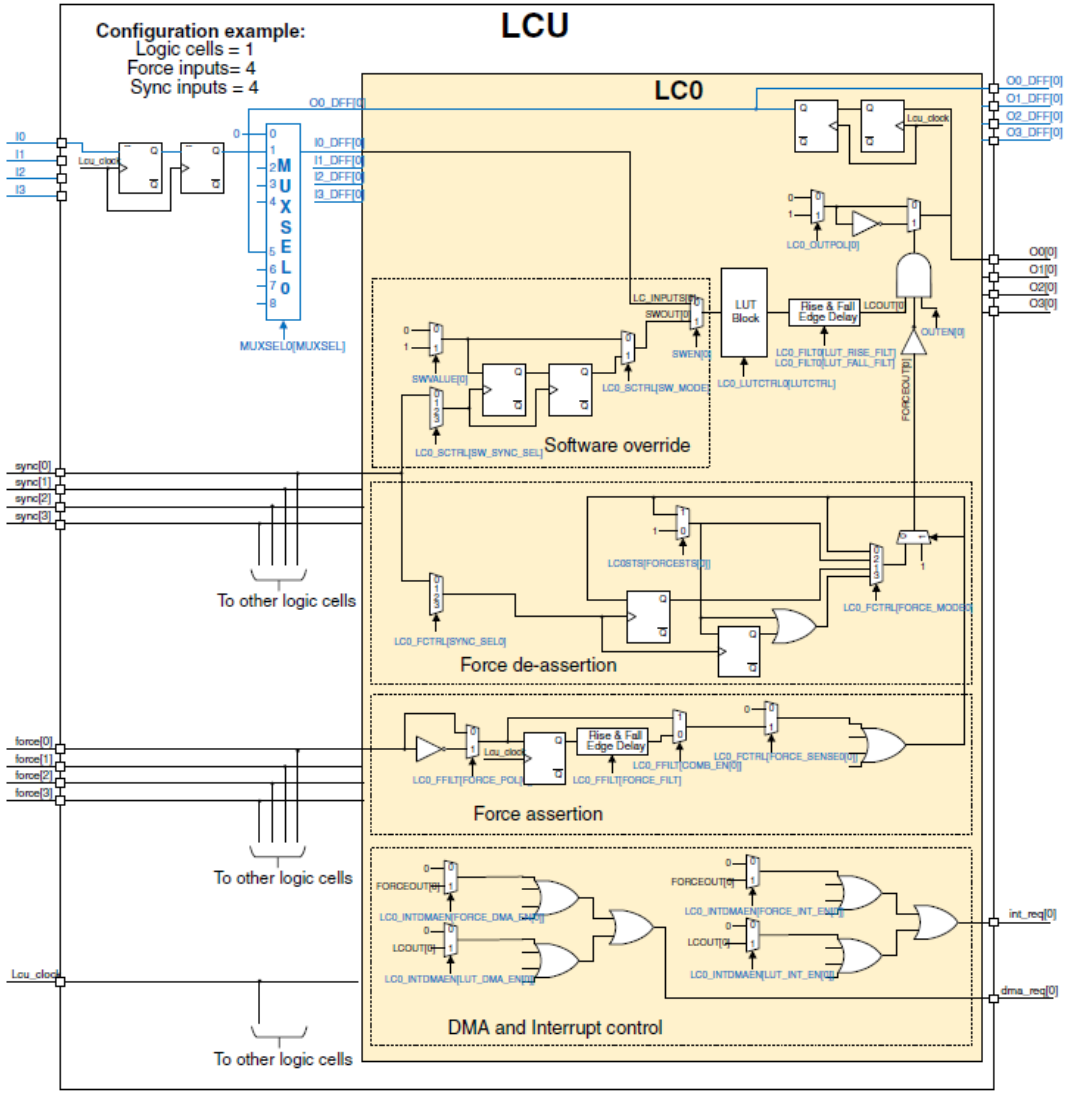
- Used to trigger three on-chip ADCs
- Runs at 160MHz clock frequency
- Trigger sources:
  - eMIOS timer channels
  - TRGMUX inputs
  - Software
- Up to 72 conversion configuration registers TRGCFG
- Multiple Parallel Conversions functionality
- One priority selection logic per ADC
- A LIST of ADC channels - repeat triggering capability for the ADC channels
  - Command list in BCTU allows greater control of ADC conversions
  - Easy to convert single channels multiple times
  - Group conversions by a single source possible
  - Optional halting of the list execution till next trigger (new feature since K2TV)
- 3 result registers for 3 ADC modules respectively
- 2 FIFOs for reading ADC results (new feature on K3)



S32K3用于电机控制的外设介绍 – LCU（1/2）

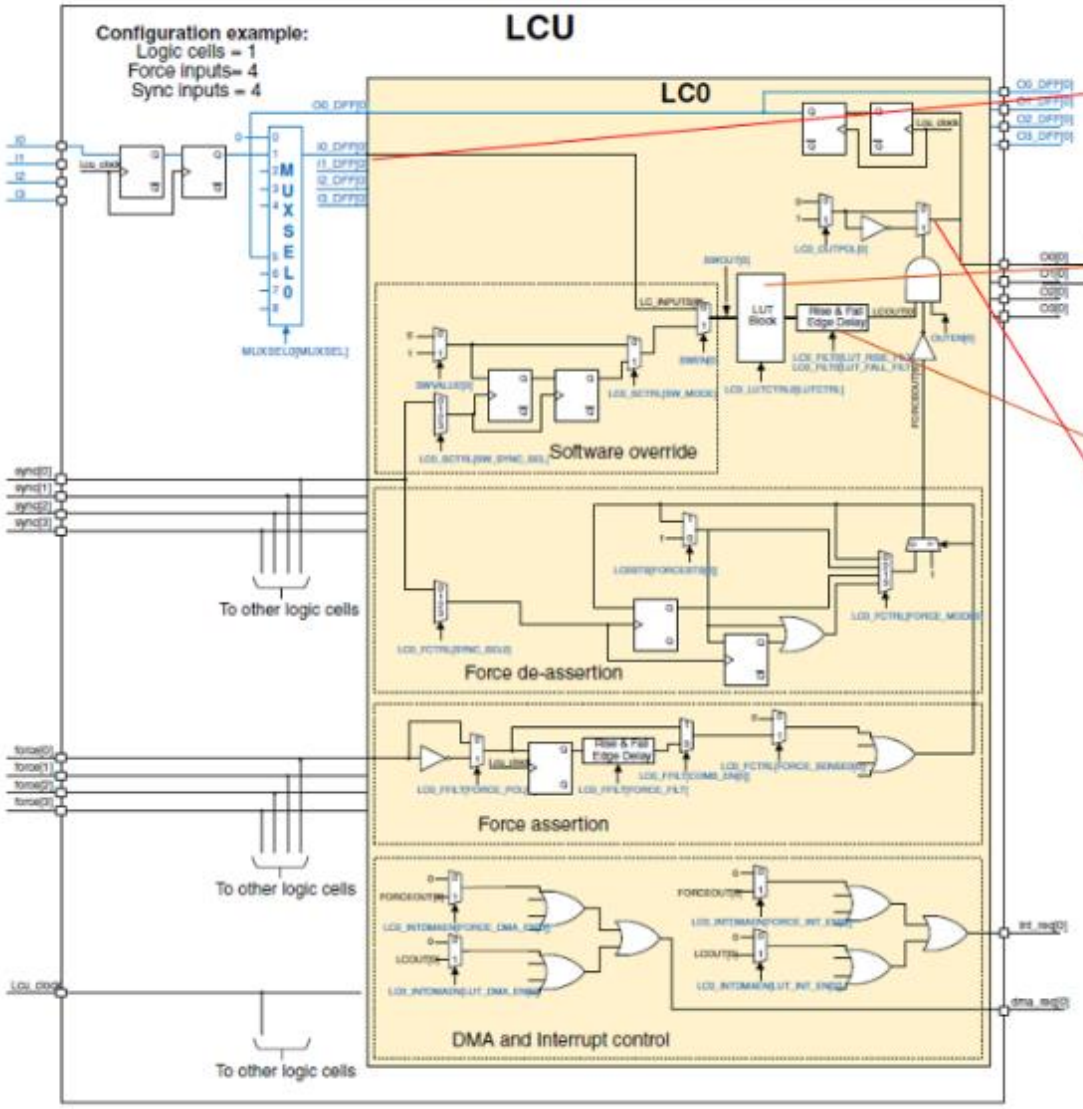
- Logic Control Unit (LCU) comprises logic cells with programmable logic that operates outside the speed limitations of software execution.
- Logic cell takes up to 4 input signals and through the Look Up Table (LUT) generates 4 output signals
- Input sources are a combination of the following:
  - I/O pins
  - Peripheral outputs
  - Register bits
- Output can be directed internally to peripherals and to an output pin.
- Combinatorial Logic:
  - Any 16 x 4 Truth Table such AND, NAND, AND-OR, AND-OR-INVERT, OR-XOR, OR-XNOR and their combinations
- Latches:
  - S-R, D-flip flop, JK-flip flop
- Advanced:
  - Incremental encoder, ACIM, PMSM & BLDC motor controllers

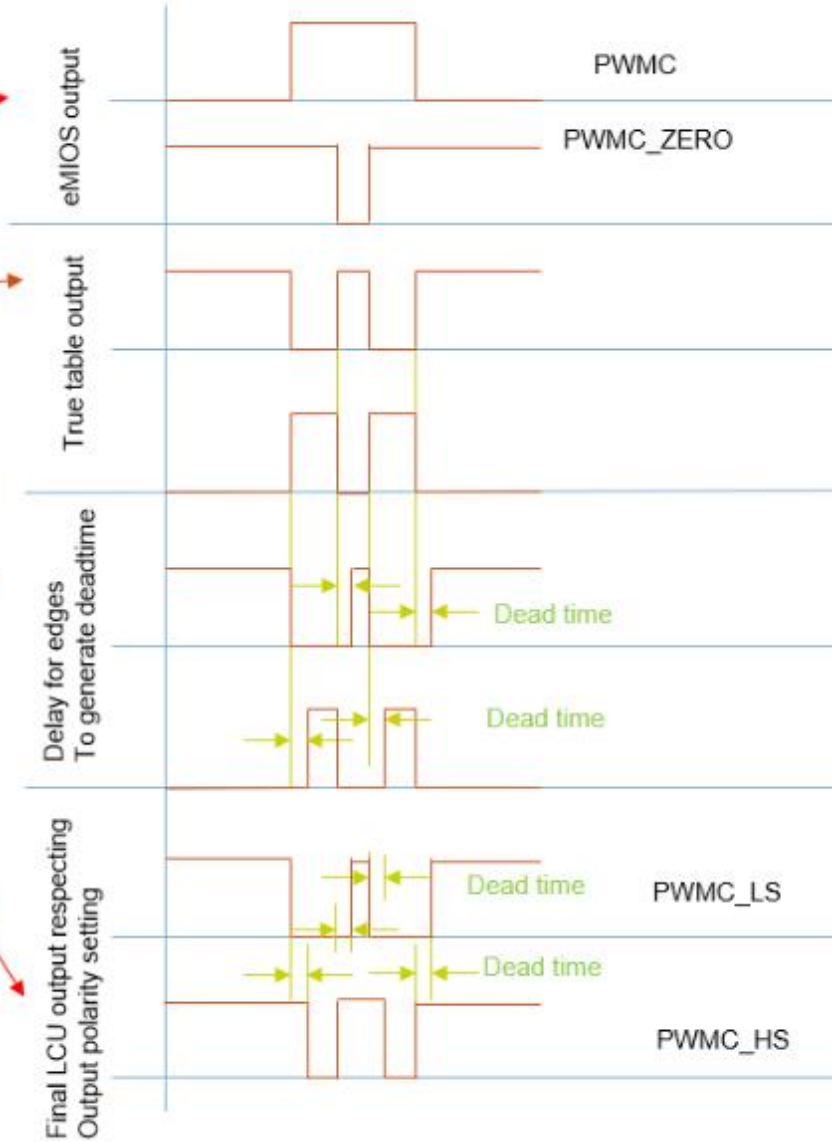
LCU0 and LCU1, 3 LCs Per LCU



S32K3用于电机控制的外设介绍 – LCU（2/2）

单电阻实例





S32K3用于电机控制的外设介绍 – EMIOS介绍（1/3）

- Runs at 160MHz clock frequency (at CORE_CLK)
- Triggers eDMA channels and interconnects with TRGMUX
- Supports unified channel reload signal output generated optionally at every 1,2,3, …,32 counter bus reload event
- S32K3xx integration:

Module	S32K311	S32K3x2	S32K3x4	S32K3x8
eMIOS0	24ch	24ch	24ch	24ch
eMIOS1	24ch	24ch	24ch	24ch
eMIOS2	-	-	24ch	24ch

- Configurations:

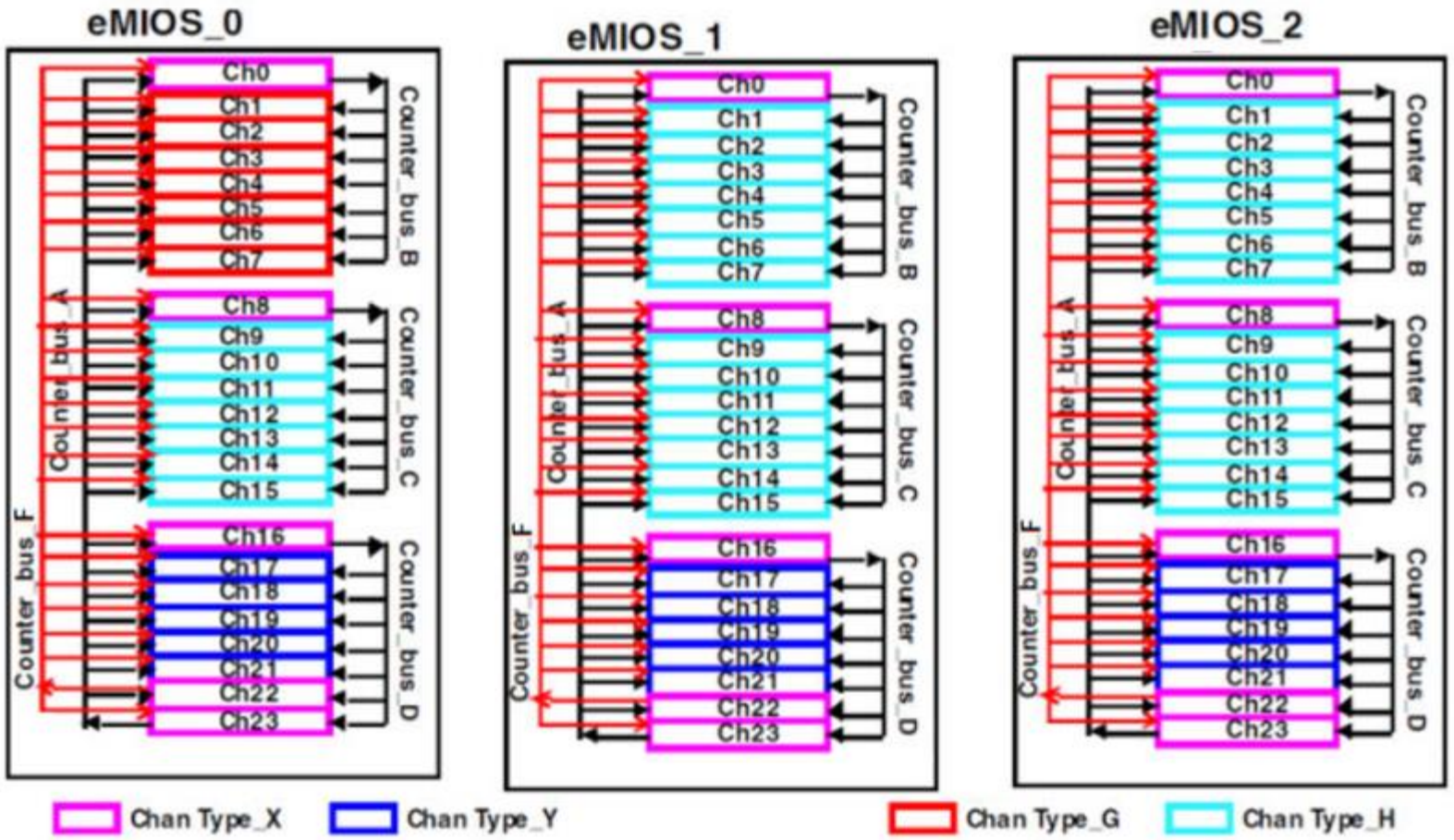
Parameter	eMIOS0	eMIOS1	eMIOS2
Timer width	16 bits		
Number of channels	24		
Local channel pre-scaler width	4 (1-16)		
Number of global counter buses	2		
Number of global pre-scalers	1		
Global channel pre-scaler width	8 (1-256)		

S32K3用于电机控制的外设介绍 – EMIOS介绍（2/3）

Feature	eMIOS0	eMIOS1	eMIOS2
Clock frequency	160 MHz	160 MHz	160 MHz
No. of channels*	72	72	72
No. of DMA sources	8	8	8
No. of TRGMUX outputs	14	14	0
No. of TRGMUX inputs	18	18	0
Channel types	X/G/H/Y	X/H/Y	X/H/Y

Mode	Type			
General-Purpose Input/Output (GPIO) mode	X	G	Y	H
Single Action Input Capture (SAIC) Mode	X	G	Y	H
Single Action Output Compare (SAOC) Mode	X	G	Y	H
Input Pulse Width Measurement (IPWM) Mode		G		H
Input Period Measurement (IPM) Mode		G		H
Double Action Output Compare (DAOC) Mode		G		H
Modulus Counter (MC) Mode	X			
Modulus Counter Buffered (MCB) Mode	X	G		
Output Pulse Width and Frequency Modulation Buffered (OPWFMB) Mode	X	G		
Center Aligned Output Pulse Width Modulation with Dead Time Insertion Buffered (OPWMCB) Mode		G		
Output Pulse Width Modulation Buffered (OPWMB) Mode	X	G	Y	H
Output Pulse Width Modulation with Trigger (OPWMT) Mode	X	G	Y	H
Pulse Edge Counting (PEC)		G		

S32K3用于电机控制的外设介绍 – EMIOS介绍（3/3）



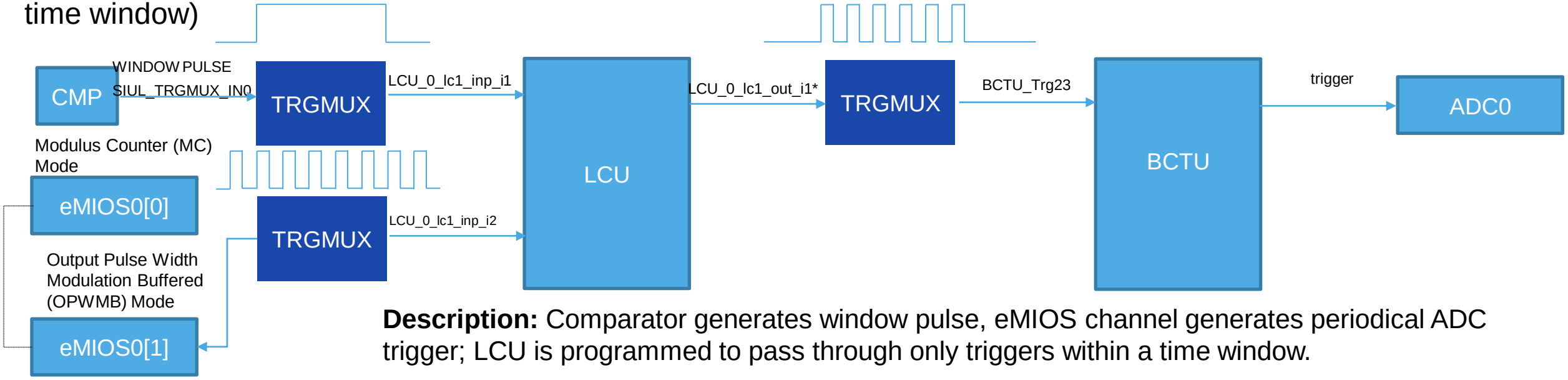
- TypeG: full feature with internal timer; (7 channels)
- TypeX: MCB, OPWFMB, OPWMB, SAIC, GPIO, with internal timer. (15 channels)
- TypeH: OPWMB, IPWM, SAIC,GPIO, no internal timer; (35 channels)
- TypeY: OPWMB, SAIC, GPIO, no internal timer; (15 channels)

S32K3用于电机控制的外设介绍 – TRGMUX

- Eextremely flexible mechanism for connecting various trigger sources to multiple pins / peripherals.
- The signal interconnection can be programmed by software.

Note: S32K344 supports 128 x 111 signal routing paths

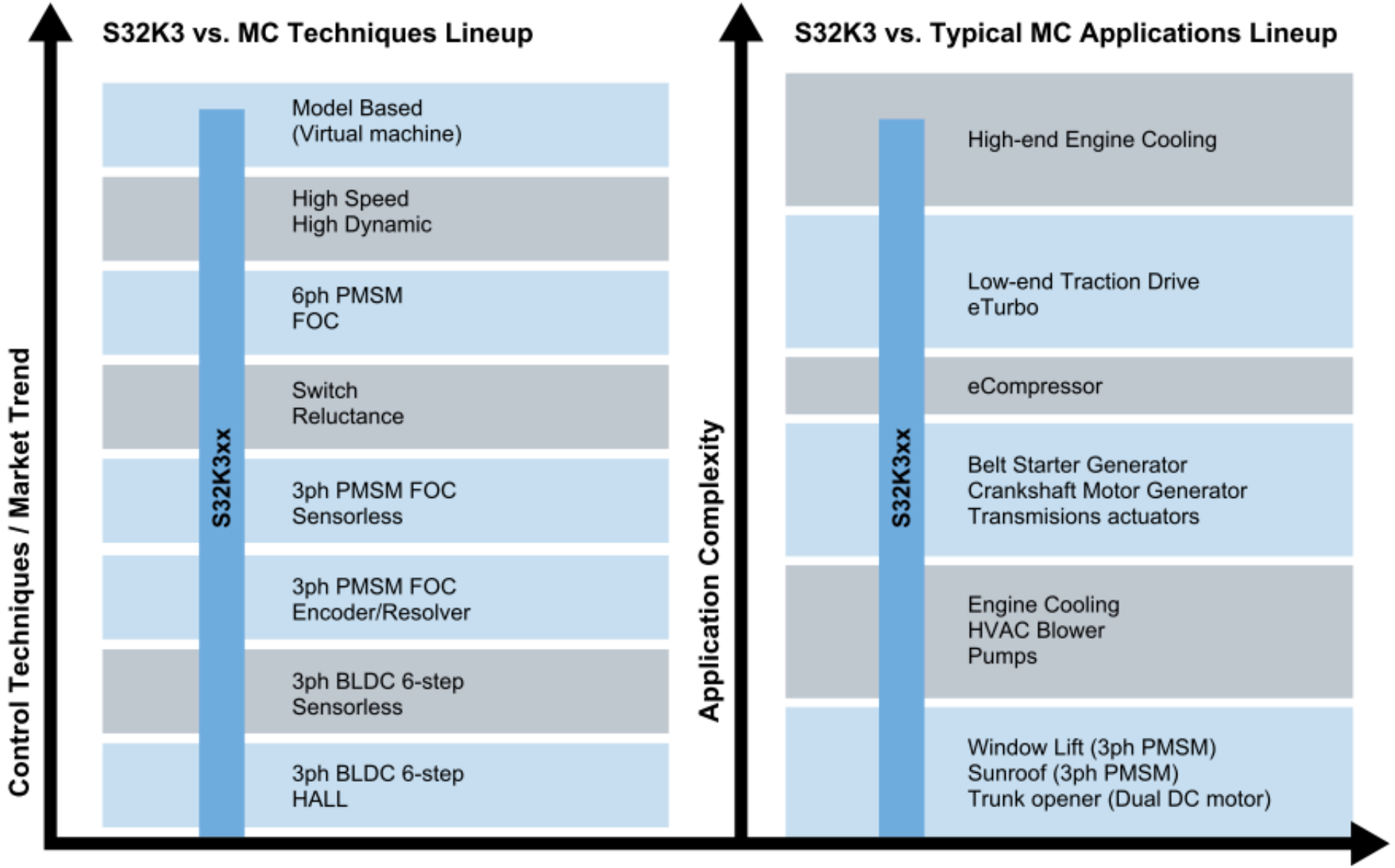
Use-case: Triggering ADC conversion upon logic operation evaluation (for example periodical conversion within a time window)



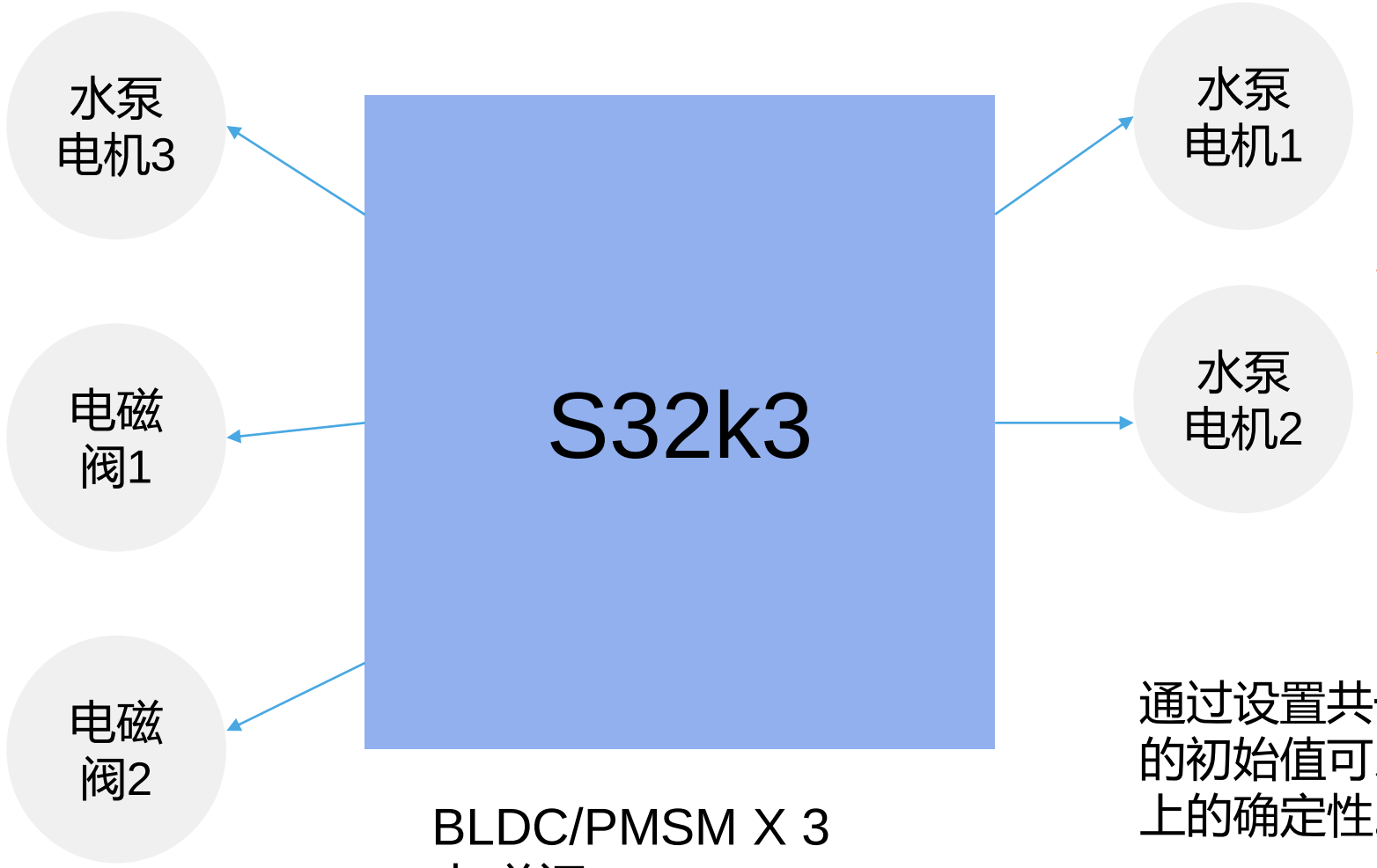
Description: Comparator generates window pulse, eMIOS channel generates periodical ADC trigger; LCU is programmed to pass through only triggers within a time window.

S32K3在车用电机中的应用

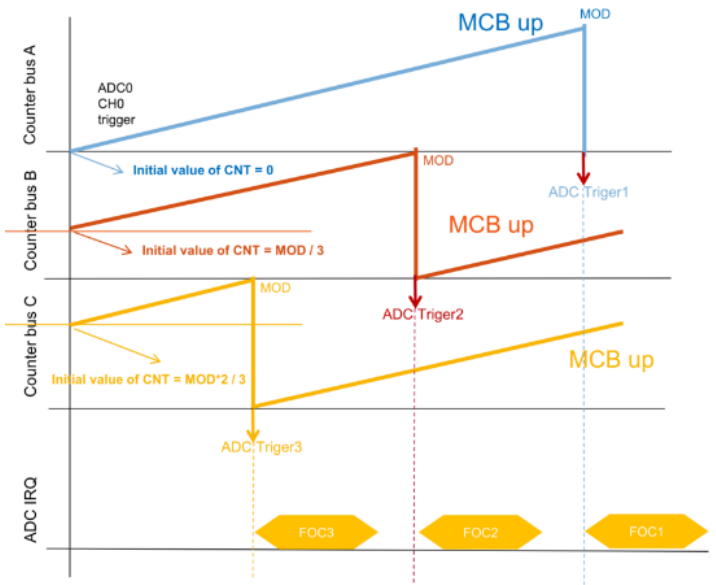
S32K3在车用电机中的应用 – 总览



S32K3在车用电机中的应用 – 集中式热管理系统

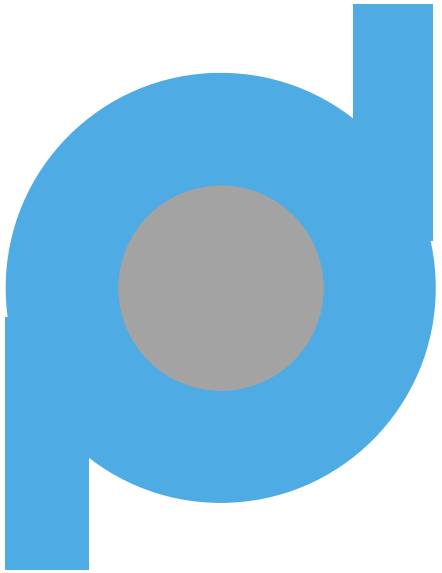


BLDC/PMSM X 3
电磁阀 X 2



通过设置共一个时基的三个eMIOS通道的初始值可以确保三个电机控制在时间上的确定性。

S32K3在车用电机中的应用 – 超高速电机

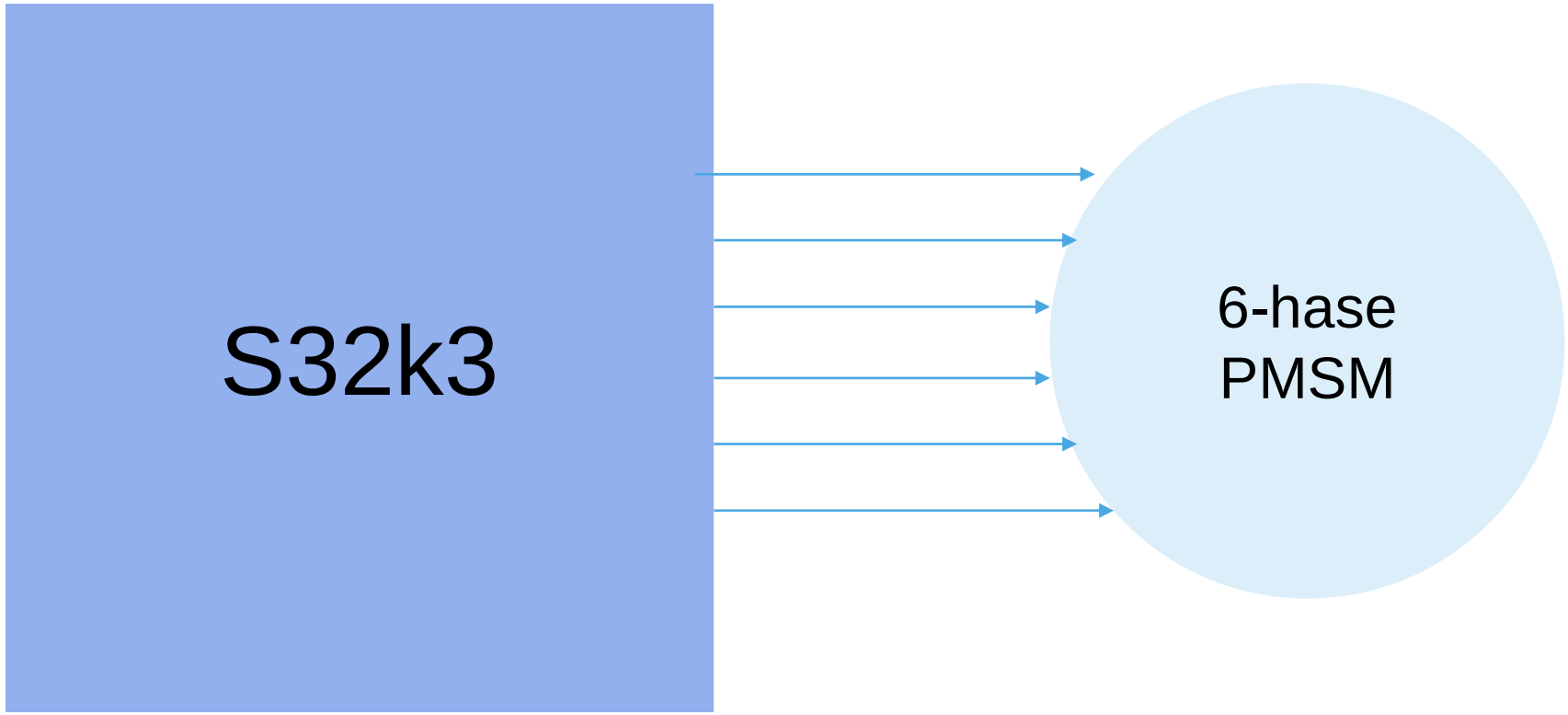


Turbo Charger

Turbo Charger的速度需求是约3万转每分钟。高速电机需要较高的开关频率和较强的运算能力。这些都是S32K3具备的。

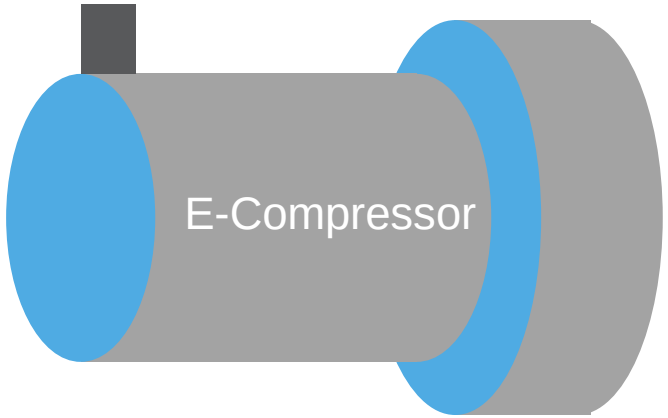
氢能源燃料电池车的空压机是一个高压大功率高转速的应用，需要一款高性能，高安全性的处理器。S32K3正好符合需求。

S32K3在车用电机中的应用 – 6相电机控制



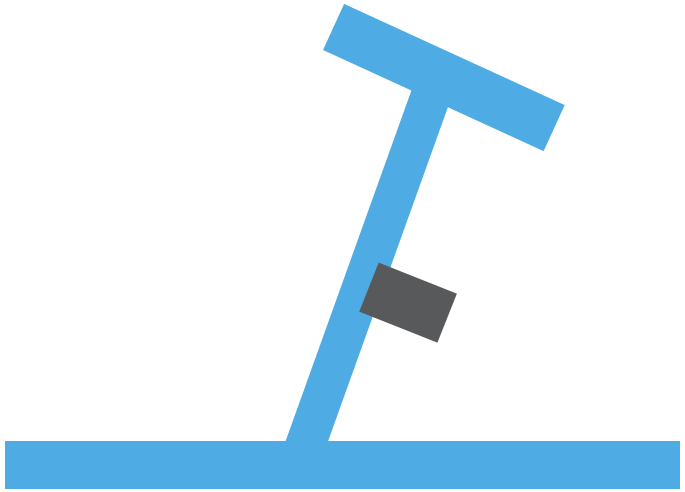
得益于S32K3超丰富的eMIOS通道和LCU，使其非常适合一个六相电机的控制或者2个三相电机的控制。

S32K3在车用电机中的应用 – 电动压缩机



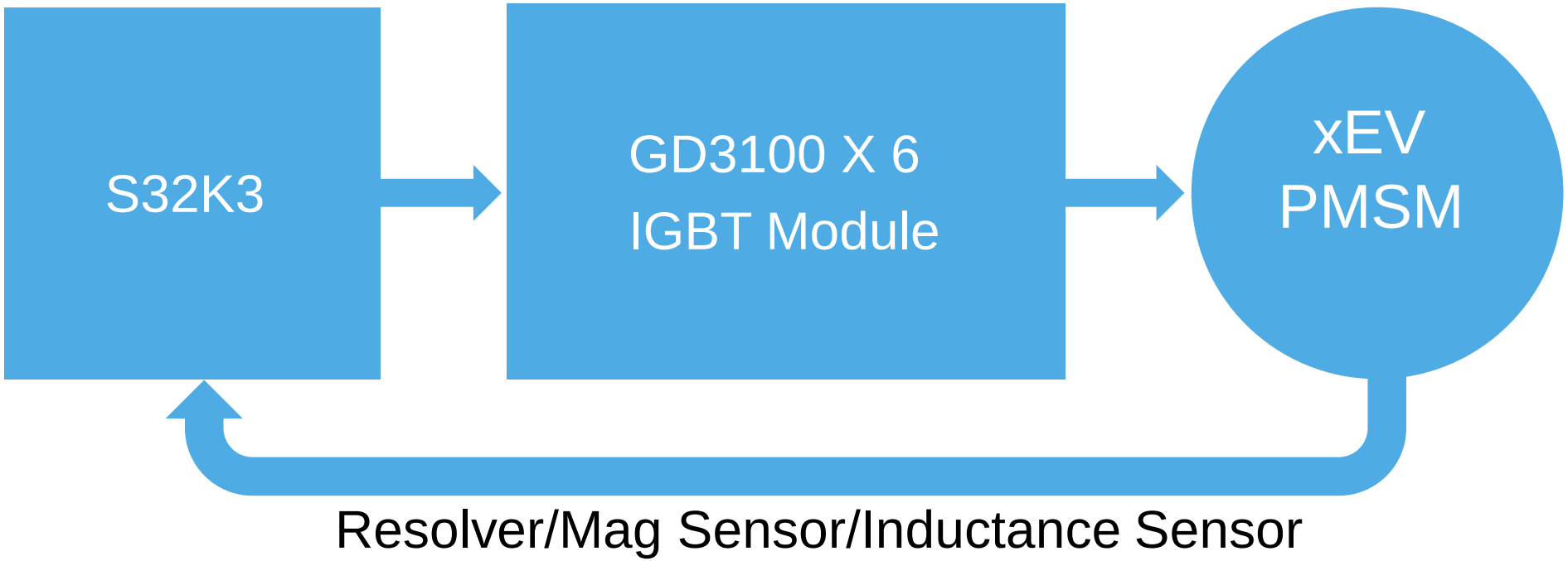
- 目前新能源汽车的电池电压等级不断提高，对于充电时候的安全就变得更加重要。压缩机的冷气除了乘客的舒适性，也需要用于电池冷却，因此对于压缩机的功能安全提高了。
- 另外热泵技术和CO2压缩机的出现对于压缩机的要求也提高了，除了高转速，还需要其他高级算法，这样对芯片的算力有一定要求。
- S32K1已经广泛在电动压缩机行业内得到应用，基于同平台的更高算力，更安全的S32K3可以满足下一代压缩机的需要

S32K3在车用电机中的应用 – EPS和刹车助力



- EPS与IBOOSTER都需要功能安全等级D。对于具备锁步核的高功能安全等级芯片S32K3来讲正好适合。
- NXP除了提供ASILD的S32K3的Silicon之后，还提供功能安全的软件包，让客户的功能安全设计So Easy。

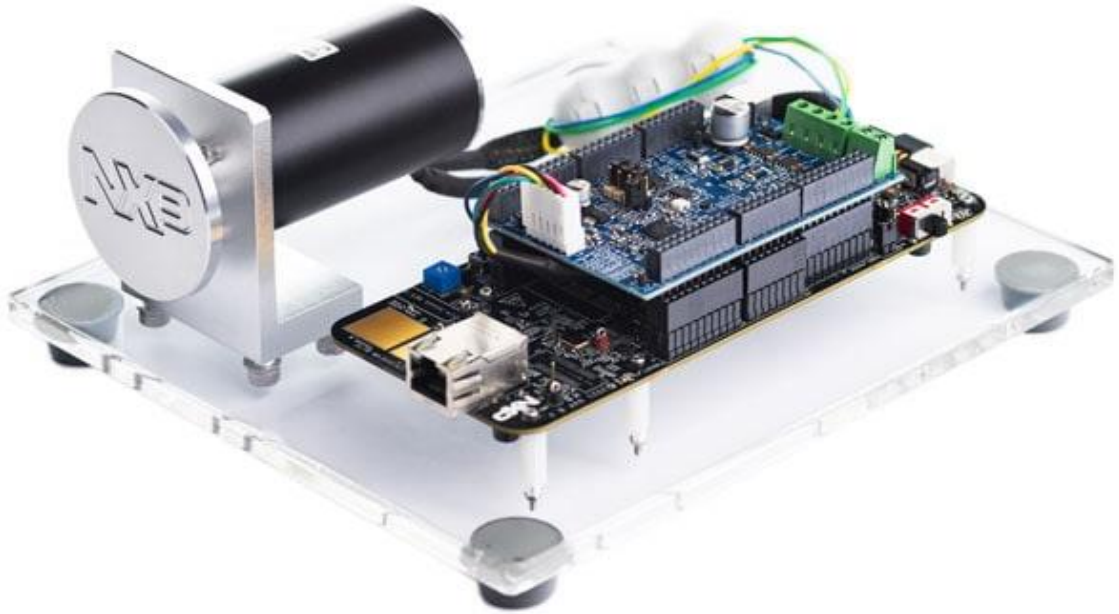
S32K3在车用电机中的应用 – 主驱电机



- S32K3具备xEV电机驱动的大部分要素，可以用于较低成本的主驱主芯片。
- S32K3搭配NXP的GD3100和PMIC，可以实现ASIL-D的设计
- 如果追求高性能的主驱，S32K3E和S32S可以满足需求

恩智浦基于S32K3的车用电机方案

恩智浦基于S32K3的车用电机方案 – MCSPTE1AK344总体介绍



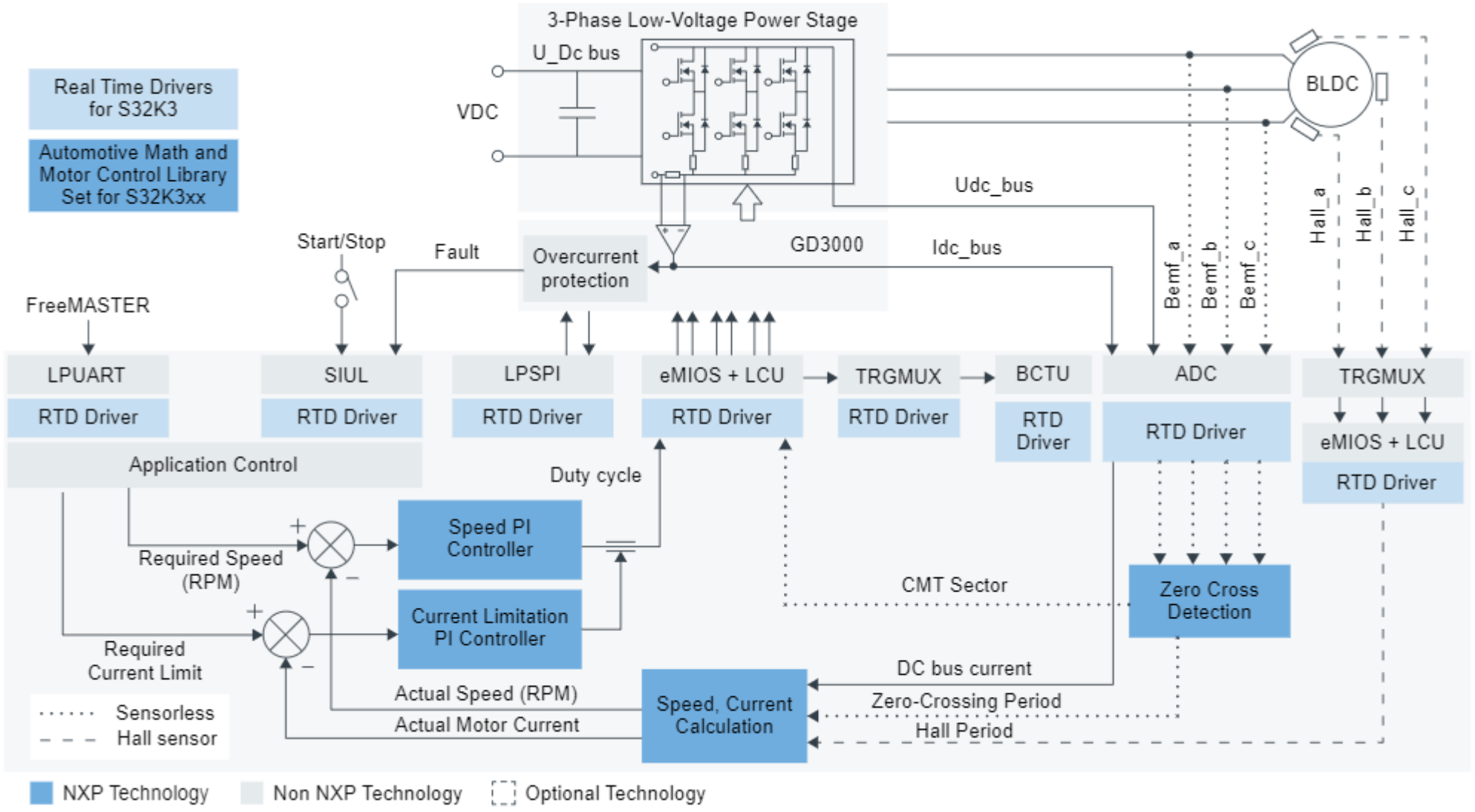
Pre-Product

MCSPTE1AK344 由 S32K3X4EVB-Q172 和DEVKIT-MOTORGD 组成，搭配 42BLY3A78-24110 三相无刷电机。

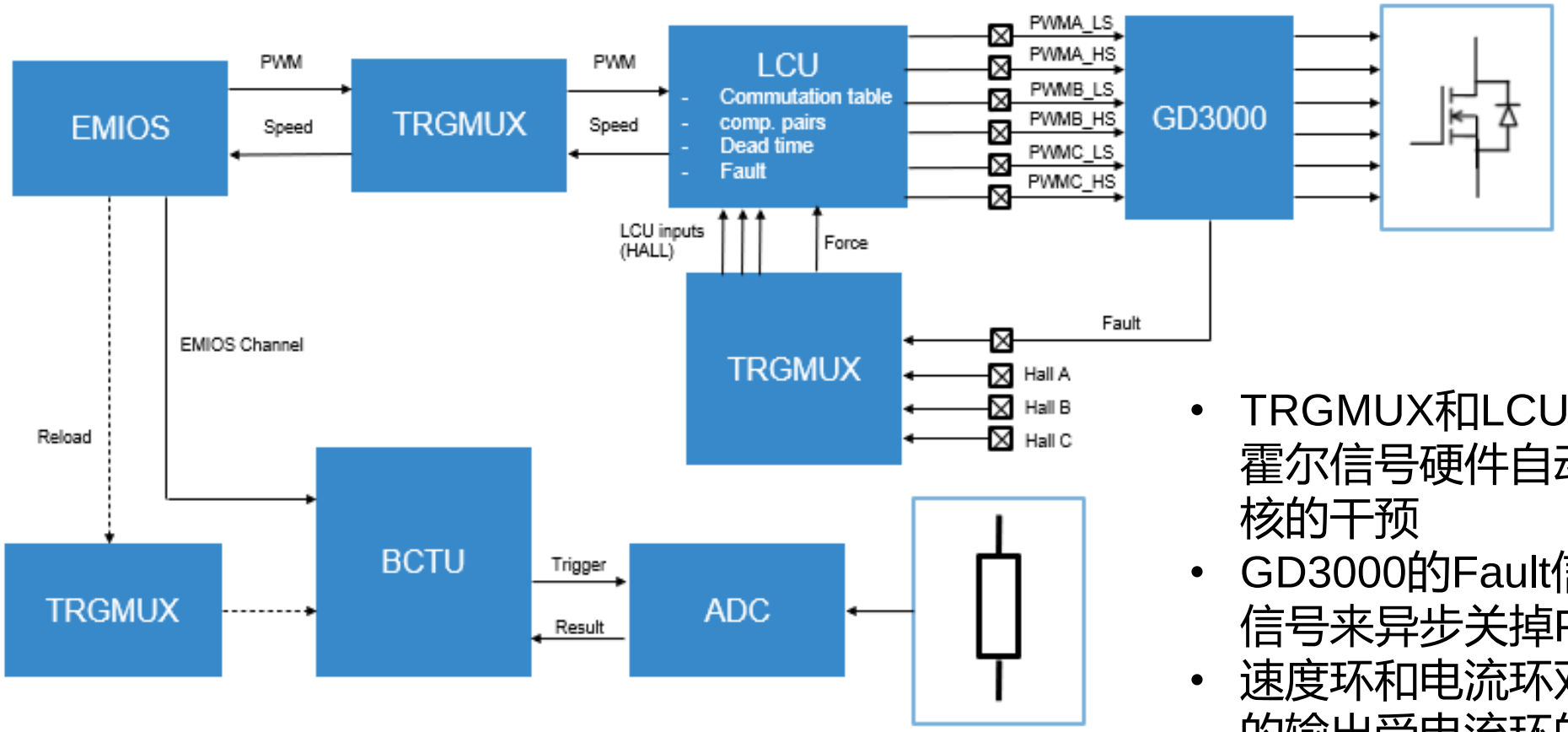
- 支持10-18V输入，最高100W
- 支持单、双和三电阻采样
- 支持霍尔/光电编码器/无感控制
- 支持低压三相电机，包括BLDC/PMSM

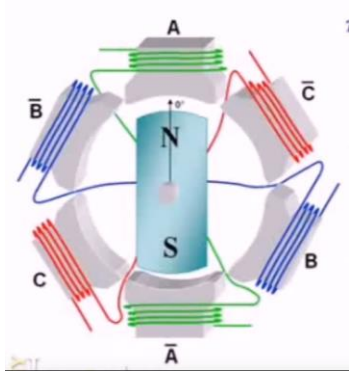
- 硬件支持CAN/LIN
- 硬件支持Ethernet（RJ45连接器）
- 支持板载调试器
- 支持外置的JTAG调试接口

恩智浦基于S32K3的车用电机方案 – BLDC方案框图



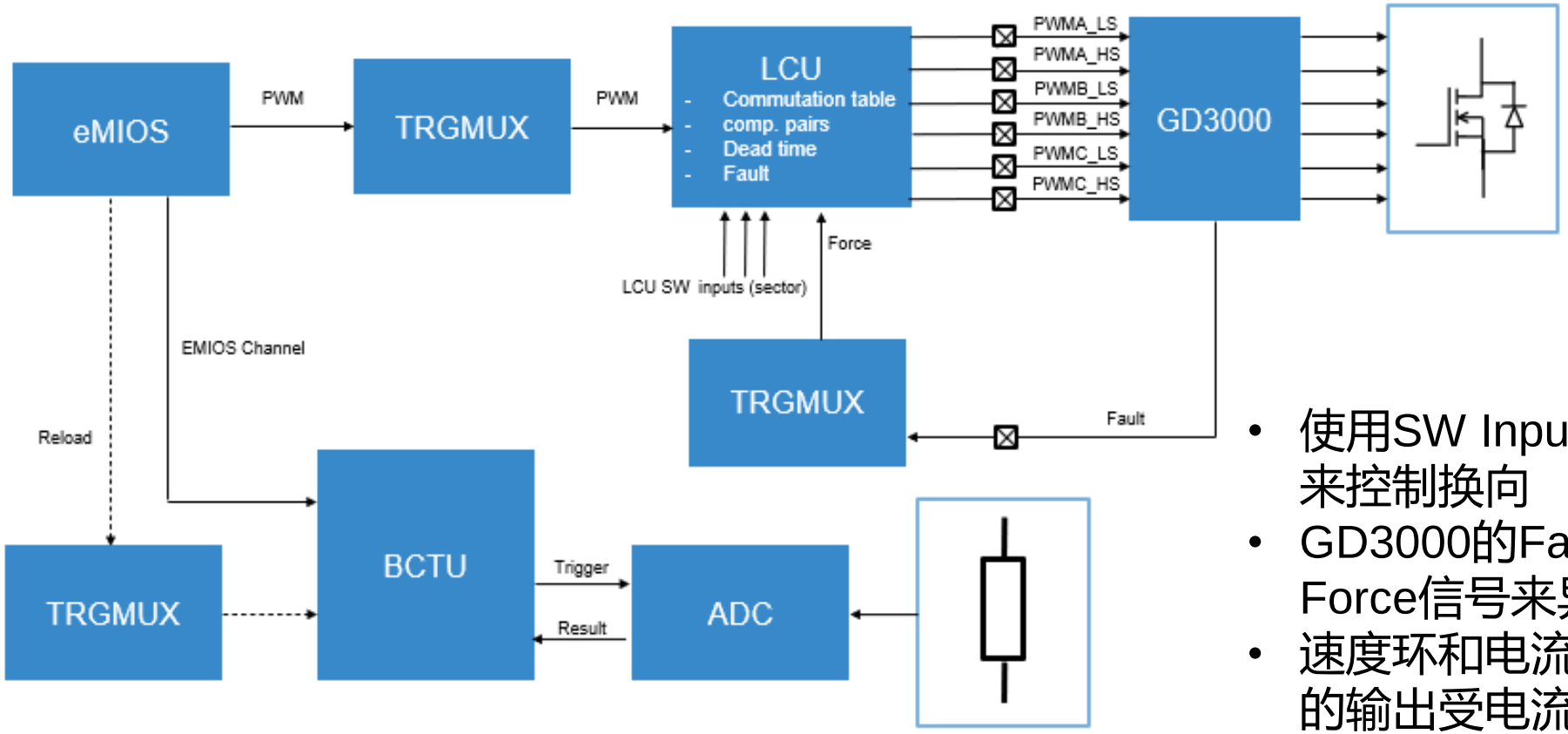
恩智浦基于S32K3的车用电机方案 – BLDC软件 – 带霍尔传感器

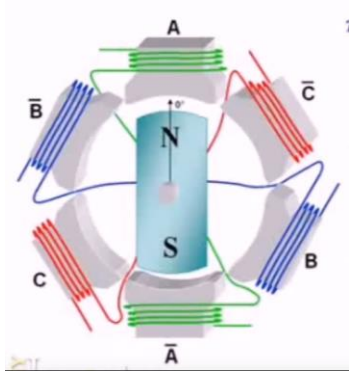




- TRGMUX和LCU结合，实现了根据霍尔信号硬件自动换向的，无需内核的干预
- GD3000的Fault信号可以通过Force信号来异步关掉PWM的输出
- 速度环和电流环双环控制，速度环的输出受电流环的限制

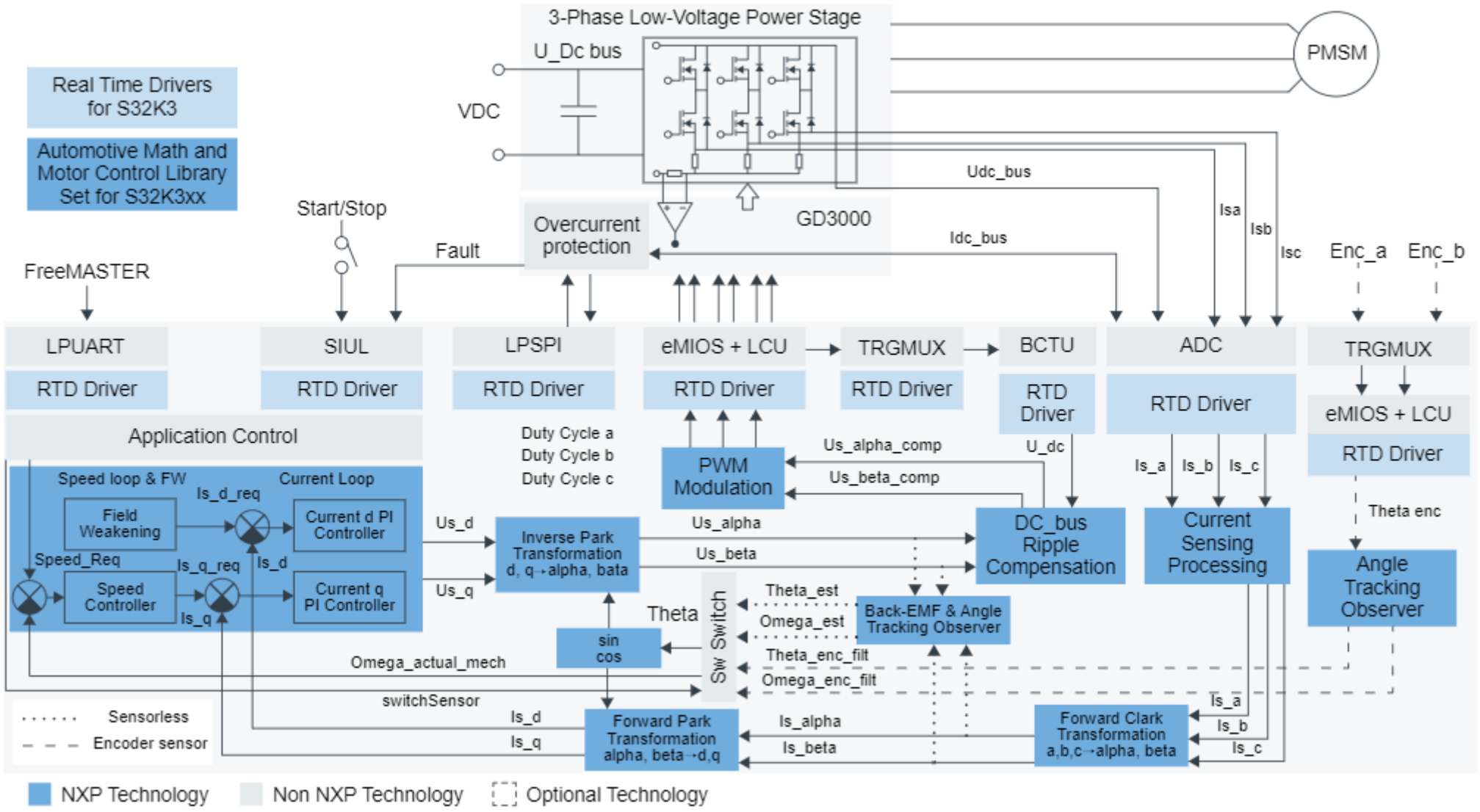
恩智浦基于S32K3的车用电机方案 – BLDC软件 – 无感控制



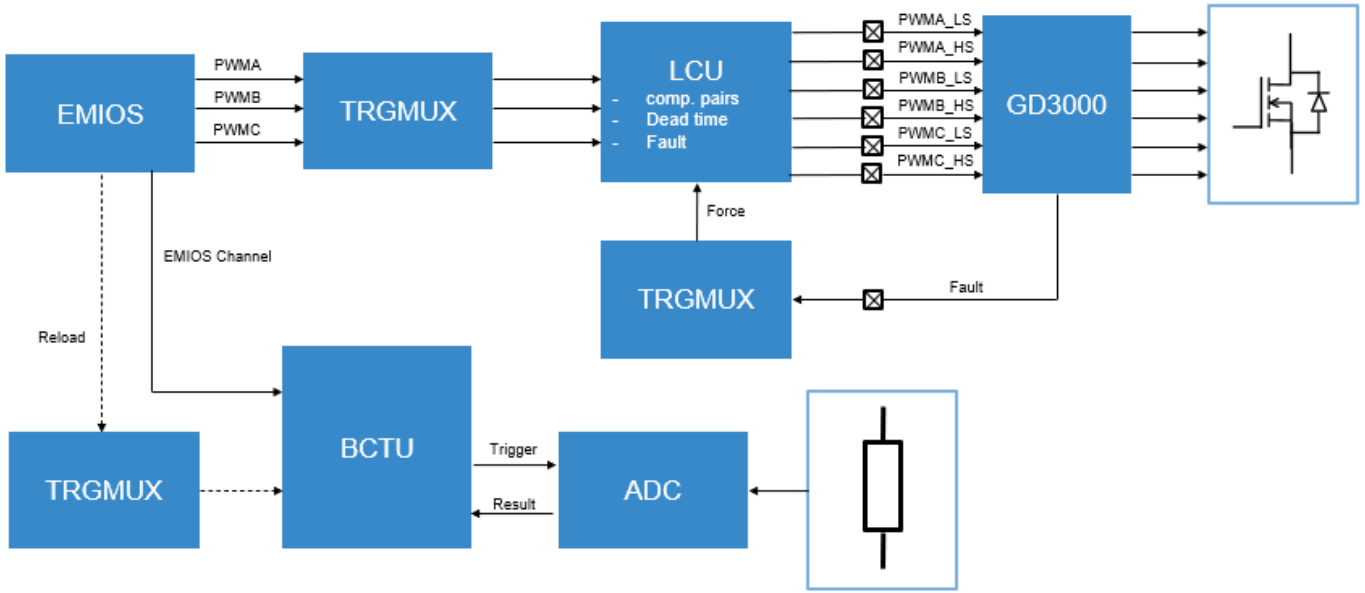


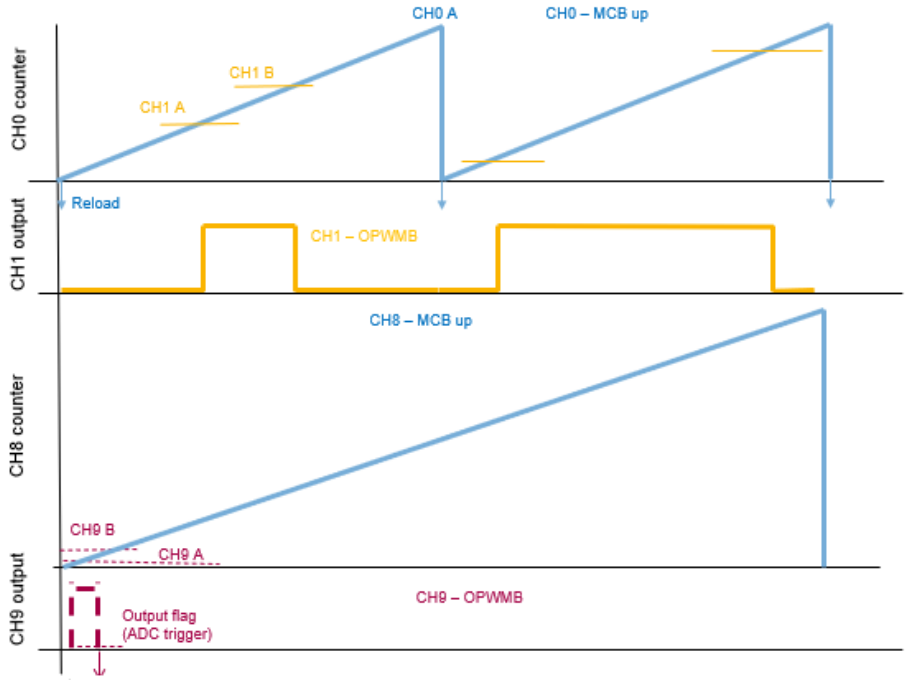
- 使用SW Inputs做为LCU的输入用来控制换向
- GD3000的Fault信号可以通过Force信号来异步关掉PWM的输出
- 速度环和电流环双环控制，速度环的输出受电流环的限制

恩智浦基于S32K3的车用电机方案 – PMSM方案框图



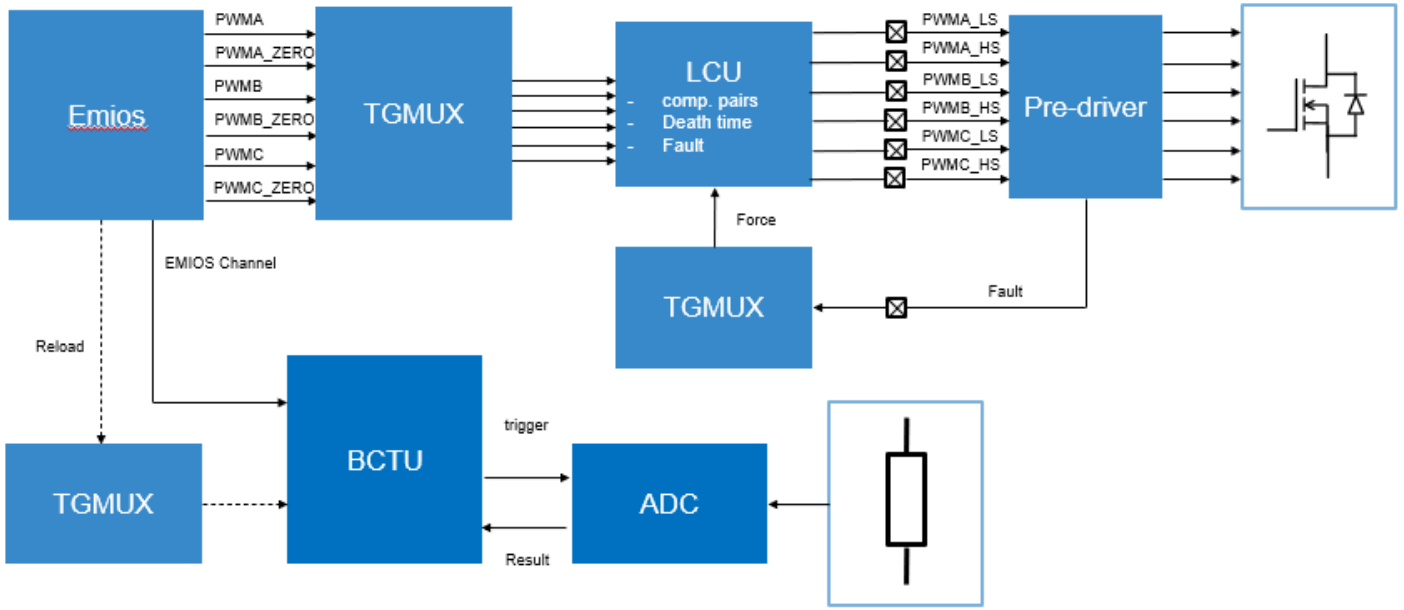
恩智浦基于S32K3的车用电机方案 – PMSM软件 – 三电阻采样

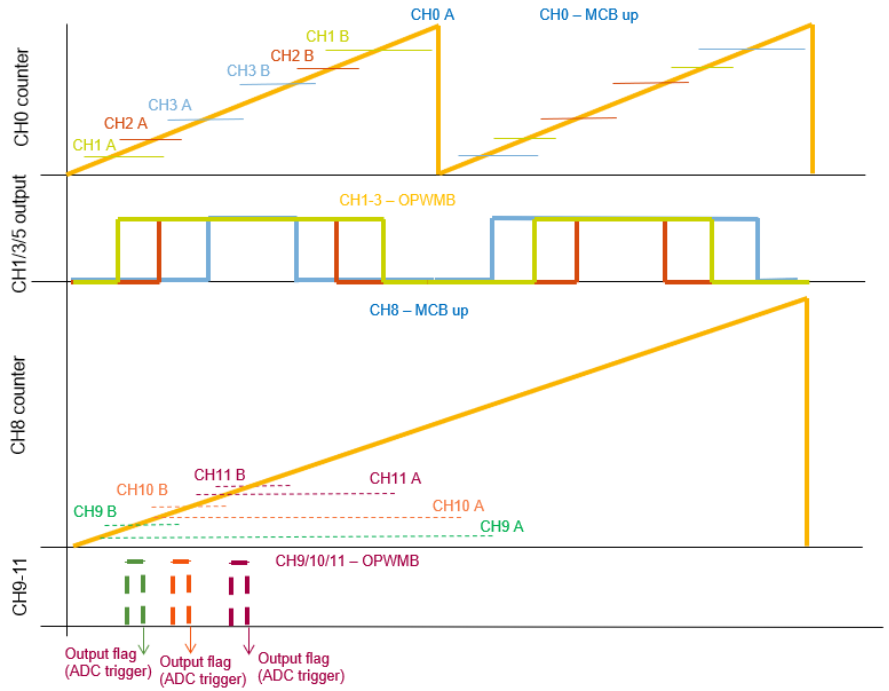




- 三电阻适合较大功率的电机驱动，因为较好的电流采样质量
- 三电阻在下桥开通的中间位置进行采样，能获得同一时刻的电流
- LCU将输入的3路PWM变成带死区的6路PWM输出，且开通和关断死区可单独设置
- 无感FOC控制，采样扩展的反电动势观测器（BEMF Observer），结合角度追踪器（ATO）
- 带弱磁控制

恩智浦基于S32K3的车用电机方案 – PMSM软件 – 单电阻采样



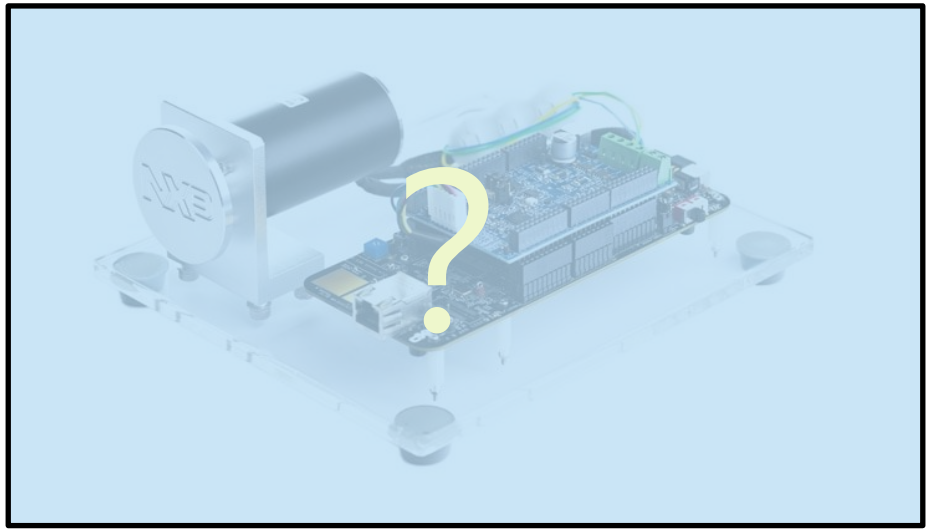


- 单电阻适合较小功率或者较大电感的电机驱动
- 单电阻的电流采样位置会随PWM变化而变化，因此其触发位置会一直变化
- 单电阻采用Double Switch技术，依靠LCU的逻辑运算功能可轻松实现
- 无感FOC控制，采样扩展的反电动势观测器（BEMF Observer），结合角度追踪器（ATO）实现对电机的磁场定向控制
- 带弱磁控制

恩智浦基于S32K3的车用电机方案 – SUMMARY

- MCSPTE1AK344 提供BLDC和PMSM的参考程序，里面包含基于RTD LLD和RTD MCAL两个版本，非常适合客户用S32K3开发车载电机控制的参考

- MCSPTE1AK344 将在今年的Q1面向大众市场，有需要的客户可以直接联系恩智浦的销售代表或者市场人员。



2022新的K3电机控制参考设计正在定义中，敬请期待…

也可以向恩智浦的销售代表或者市场人员表达对于参考设计的想法。

S32K3的电机控制生态

S32K3的电机控制生态 – 总览

Model Based Design Toolbox (MBDT)

MATLAB Simulink integrated tool chain for configuring and generating software to execute motor control algorithms on NXP MCUs:

- Includes AMMCLib Library set
- plug in to MATLAB™/Simulink™ model-based design environment
- optimized for fast execution on our MCUs with bit-accurate results compared to Simulink® simulation

Motor Control Application Tuning Tool (MCAT)

Tune your drive:

- Graphical User Interface, plugin to FreeMaster
- interfacing with the target MCU, modify software variables during runtime to tune your motor control algorithms to achieve control objectives (i.e. PI parameters)

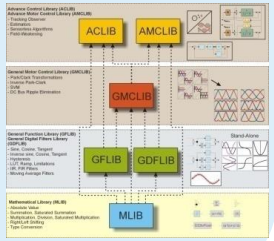
Motor Control Devkit Package

Comprehensive solution:

- All Motor Control Development Kits supported by application software in source code
- Documentation, Out-of-Box experience, Webinars available

Automotive Math and Motor Control Library Set

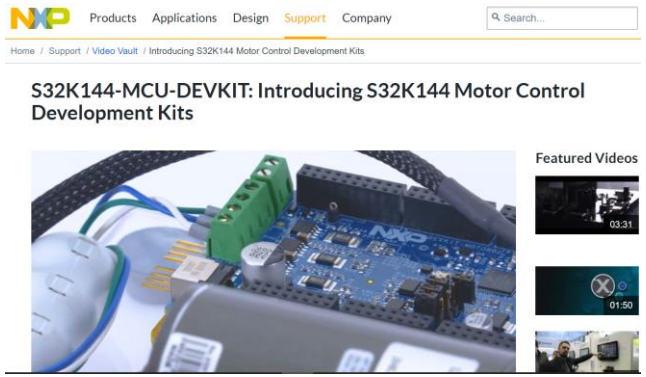
- Precompiled software library containing building blocks for a wide range of motor control applications
- Easy migration between platforms with minimized effort
- Production ready SW (SPICE Level 3, CMMI and ISO9001/TS16949)
- Control loop modeling with Matlab/Simulink® models



FreeMASTER (Lite)

Debugger for Real-time Applications:

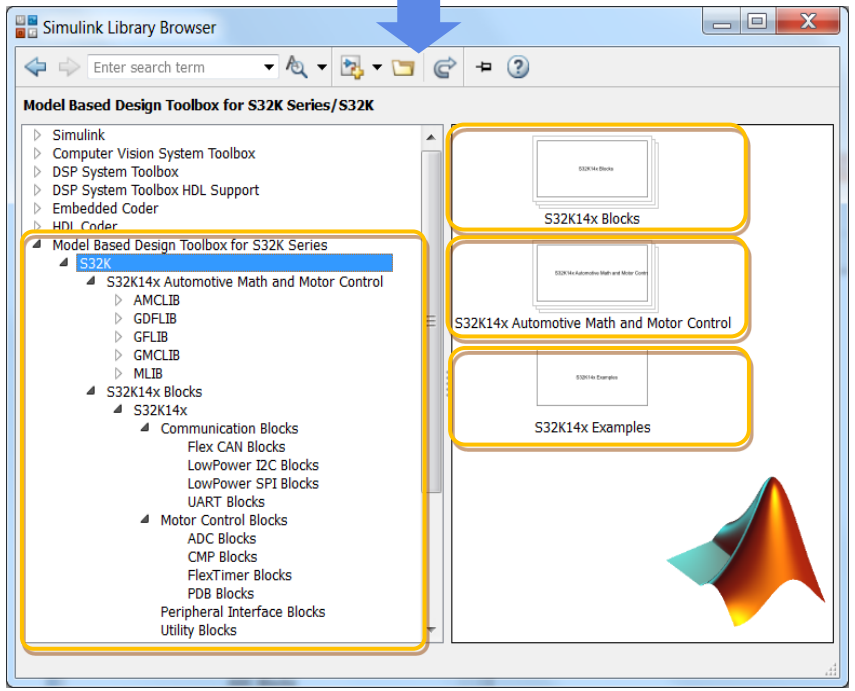
- Graphical User Interface
- View & Modify variables run-time
- Real-time Monitor Tool
- Track & trace your variables
- Demonstration Platform
- Design your own dashboard



→ 减少开发时间，降低开发难度
→ 加速产品上市

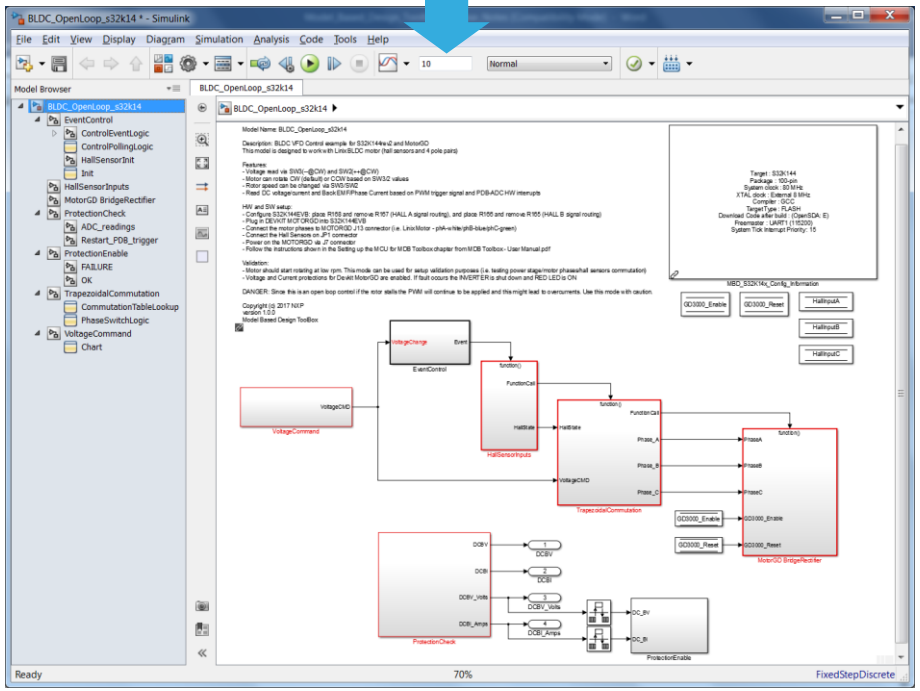
S32K3的电机控制生态 – MODEL BASED DESIGN TOOLBOX (MBDT)

1 Basic/Advanced Building Blocks



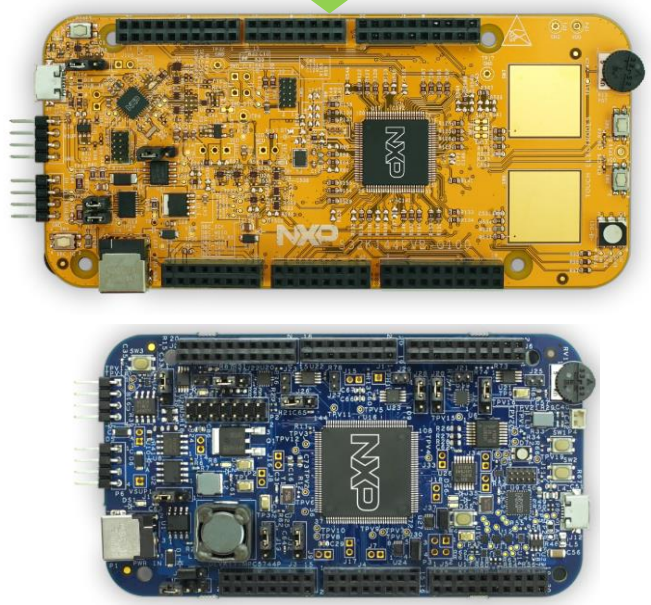
- ✓ Simulink® Library Integration
- ✓ Automatic Code Generation
- ✓ UI Abstractization for NXP peripherals
- ✓ Target Support for S32K and others

2 Ideas & Designs



- ✓ Minimal knowledge about hardware
- ✓ Fast development – drag&drop approach
- ✓ Simulation environment for testing & validation

3 Easy Prototyping



- ✓ **Easy migration between NXP solution**
- ✓ **Matching solution for TI, Arduino, Raspberry**

S32K3的电机控制生态 – FREEMASTER

www.nxp.com/FreeMASTER

FreeMASTER

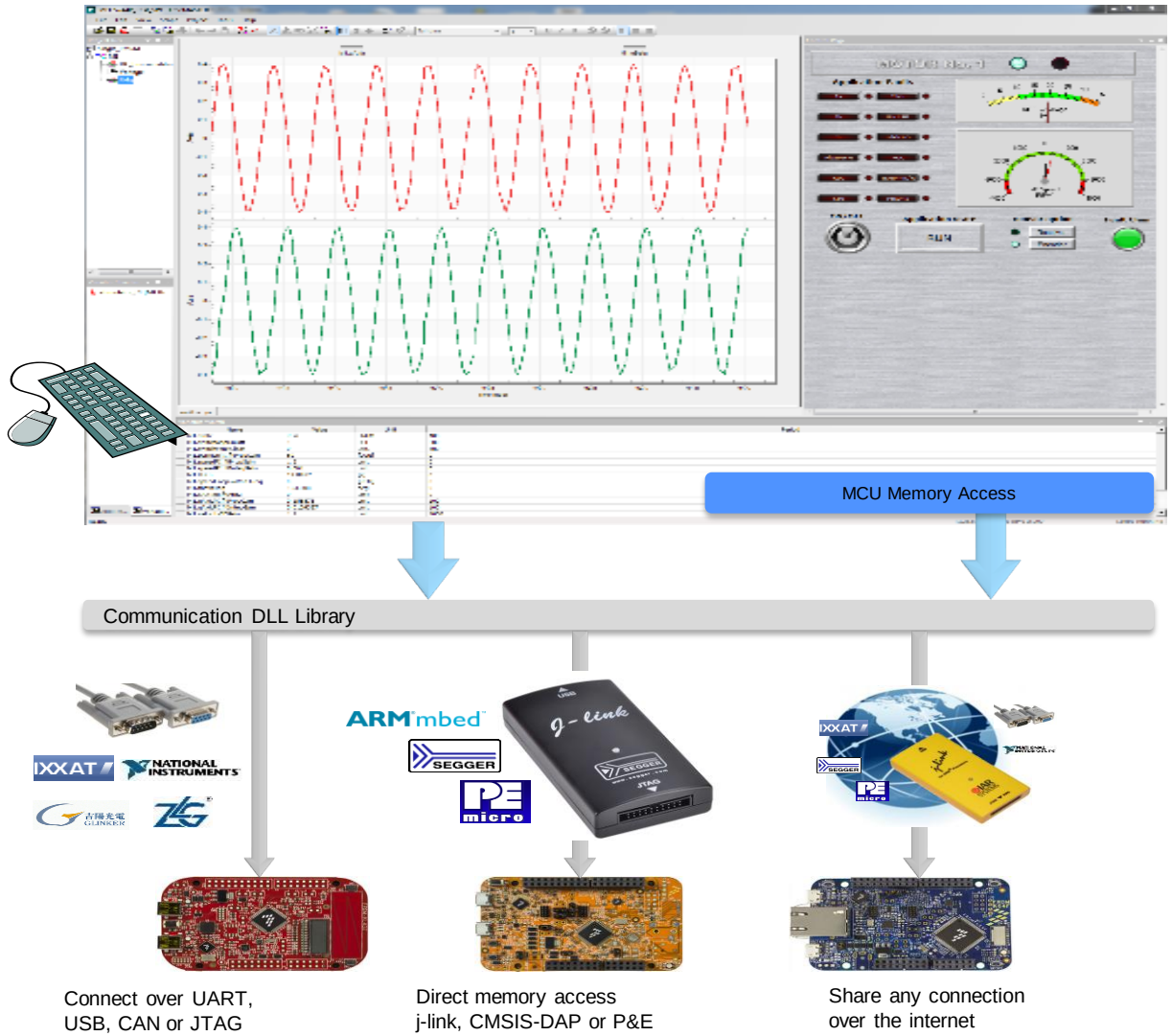
Host

- ❖ Data Visualization Tool
- ❖ Monitor & Control Embedded Applications
- ❖ Demo Framework
- ❖ Framework To Build Other Control & Configuration Tools

NXP Proprietary Comm Protocol

Embedded

- ❖ Application Code Running On The Target
- ❖ Embedded FreeMASTER library is added to user's application to have support for communication protocol



S32K3的电机控制生态 – MCAT

Short development cycle for PMSM FOC and BLDC motor control

HOST:

- **Web based GUI**

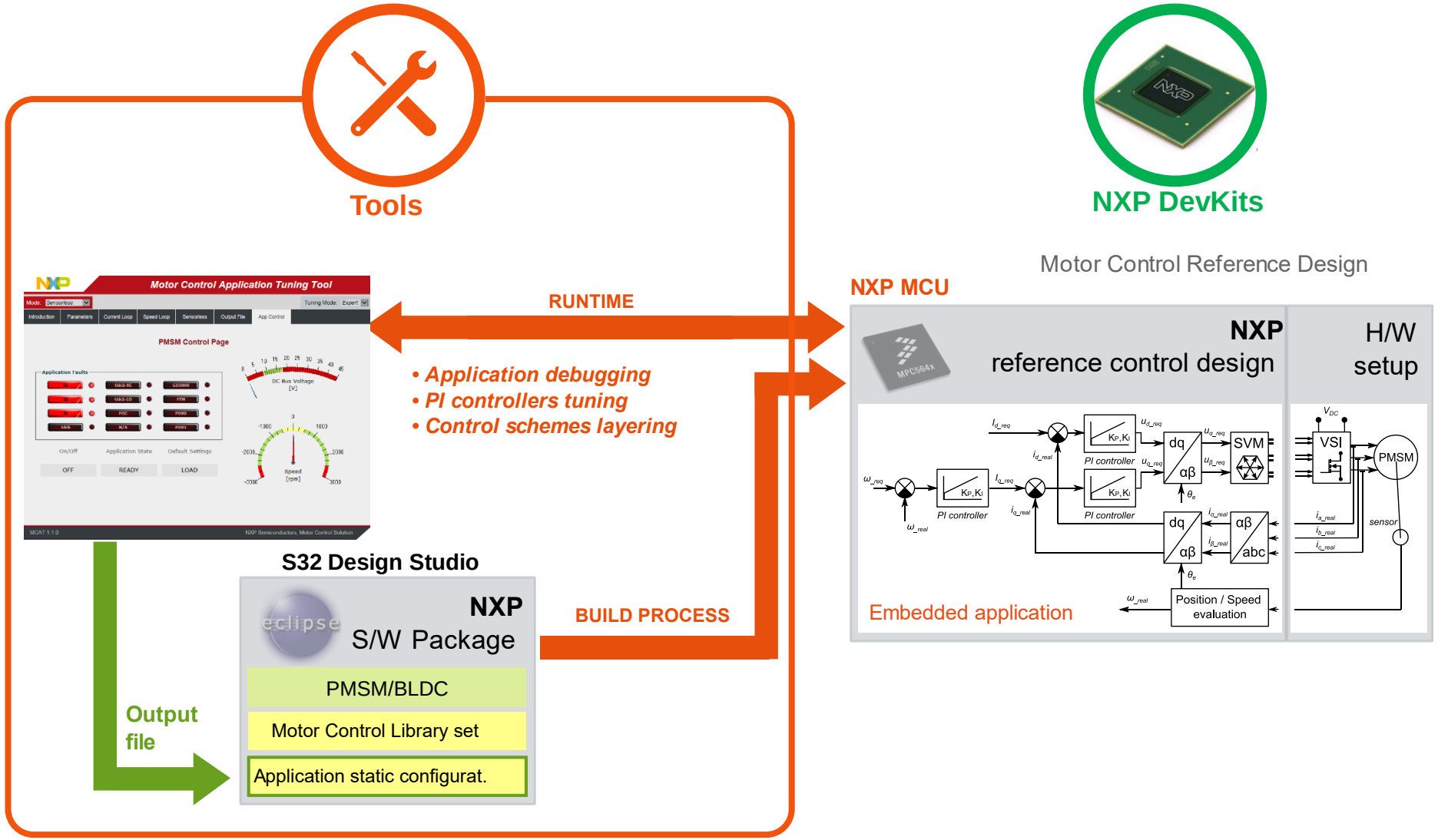
  Users configure parameters & generate C project customized for our platforms as an output file.

TARGET:

- **Embedded Example**

  Application made for our target to take into account user's choices.

S32 Design Studio Debugger is needed to build and run the generated application on the target.



S32K3的电机控制生态 – AMMCLIB

- ✓ Precompiled software library containing building blocks for a wide range of motor control applications
- ✓ Production ready SW (SPICE Level 3, CMMI and ISO9001/TS16949)
- ✓ Free of charge evaluation version available
- ✓ Matlab/Simulink® models provided for all functions, supporting the modeling of the control loop
- ✓ Layered architecture with support of fixed-point 32-bit, fixed-point 16-bit and single precision floating point arithmetic

MLIB

- **Absolute Value, Negative Value**
  - MLIB_Abs, MLIB_AbsSat
  - MLIB_Neg, MLIB_NegSat
- **Add/Subtract Functions**
  - MLIB_Add, MLIB_AddSat
  - MLIB_Sub, MLIB_SubSat
- **Multiply/Divide/Add-multiply Functions**
  - MLIB_Mul, MLIB_MulSat
  - MLIB_Div, MLIB_DivSat
  - MLIB_Mac, MLIB_MacSat
  - MLIB_Mnac, MLIB_Msu
  - MLIB_VMac
- **Shifting**
  - MLIB_ShL, MLIB_ShLSat
  - MLIB_ShR
  - MLIB_ShBi, MLIB_ShBiSat
- **Normalisation, Round Functions**
  - MLIB_Norm, MLIB_Round
- **Conversion Functions**
  - MLIB_ConvertPU, MLIB_Convert

GFLIB

- **Trigonometric Functions**
  - GFLIB_Sin, GFLIB_Cos, GFLIB_SinCos, GFLIB_Tan
  - GFLIB_Asin, GFLIB_Acos, GFLIB_Atan, GFLIB_AtanYX
  - GFLIB_AtanYXShifted
- **Limitation Functions**
  - GFLIB_Limit, GFLIB_VectorLimit
  - GFLIB_LowerLimit, GFLIB_UpperLimit
- **PI Controller Functions**
  - GFLIB_ControllerPIr, GFLIB_ControllerPIrAW
  - GFLIB_ControllerPIp, GFLIB_ControllerPIpAW
- **Interpolation**
  - GFLIB_Lut1D, GFLIB_Lut2D
- **Hysteresis Function**
  - GFLIB_Hyst
- **Signal Integration Function**
  - GFLIB_IntegratorTR
- **Sign Function**
  - GFLIB_Sign
- **Signal Ramp Function**
  - GFLIB_Ramp
- **Square Root Function**
  - GFLIB_Sqrt

GDFLIB

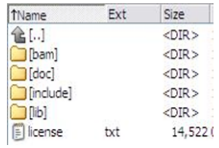
- **Finite Impulse Filter**
  - GDFLIB_FilterFIR
- **Moving Average Filter**
  - GDFLIB_FilterMA
- **1st Order Infinite Impulse Filter**
  - GDFLIB_FilterIIR1init
  - GDFLIB_FilterIIR1
- **2nd Order Infinite Impulse Filter**
  - GDFLIB_FilterIIR2init
  - GDFLIB_FilterIIR2

GMCLIB

- **Clark Transformation**
  - GMCLIB_Clark
  - GMCLIB_ClarkInv
- **Park Transformation**
  - GMCLIB_Park
  - GMCLIB_ParkInv
- **Duty Cycle Calculation**
  - GMCLIB_SvmStd
- **Elimination of DC Ripples**
  - GMCLIB_ElimDcBusRip
- **Decoupling of PMSM Motors**
  - GMCLIB_DecouplingPMSM

AMCLIB

- **BEMF Observer DQ**
  - AMCLIB_BemfObsrvDQ
- **Tracking Observer**
  - AMCLIB_TrackObsrv



Delivery Content

→ Matlab/Simulink Bit Accurate Models
→ User Manuals
→ Header files
→ Compiled Library File
→ License File (to be accepted at install time)

Availability	
Delivery format	Binary or Source Code
Quality level	QM
Supported compilers	GCC, IAR, GHS, CodeWarrior® Eclipse IDE, Wind River Diab, Cosmic Software

S32K3的电机控制生态 – 更多信息，访问

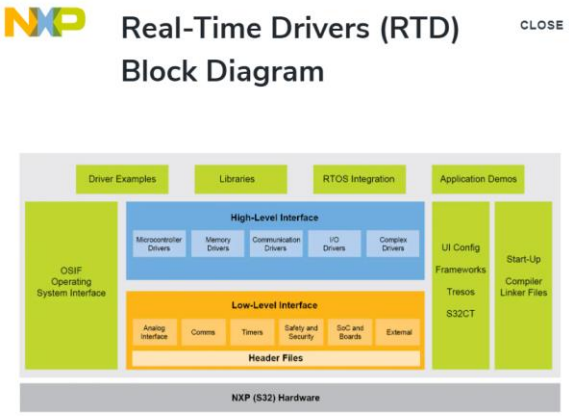
S32K3 产品信息
nxp.com/S32K3

S32K3 讨论区
nxp.com/S32K1Community

S32K 电机开发套件
nxp.com/S32KMCdevKits

S32 Design Studio
nxp.com/S32DS

S32 的RTD
nxp.com/RTD



汽车数学与电机控制库函数
nxp.com/AMMCLIB

FreeMASTER实时调试工具
nxp.com/FreeMASTER

MCAT电机控制的配置工具
nxp.com/MCAT

总结

总结

- S32K3因其强大安全的内核、灵活的外设以及恩智浦丰富的电机控制生态资源而成为车载电机控制界的新宠
- S32K3非常适合用于高功能安全等级、高信息安全等级以及较高性能要求的车载小电机控制、多电机控制以及新能源低成本大电机主驱等场景
- 从S32K1到S32K3，从MagniV S12ZVM到S32M2，恩智浦将持续投入并引领车载电机微处理器市场

提问环节-谢谢聆听

SECURE CONNECTIONS
FOR A SMARTER WORLD

VERSION CONTROL

V1.0 INITIAL VERSION, CREATED BY RAYMOND TANG