MOTOR CONTROL SOLUTIONS BASED ON S32K1 MCUS

The S32K1 family of 32-bit AEC-Q100 qualified MCUs combines a scalable family of Arm® Cortex®-M0-based microcontrollers built on long-lasting features with a comprehensive suite of production-grade tools. S32K1 MCUs are included in NXP's Product Longevity Program, guaranteeing a minimum of 15 years of assured supply.

S32K1 VALUE PROPOSITION FOR MOTOR CONTROL

SCALABLE MCU PLATFORM

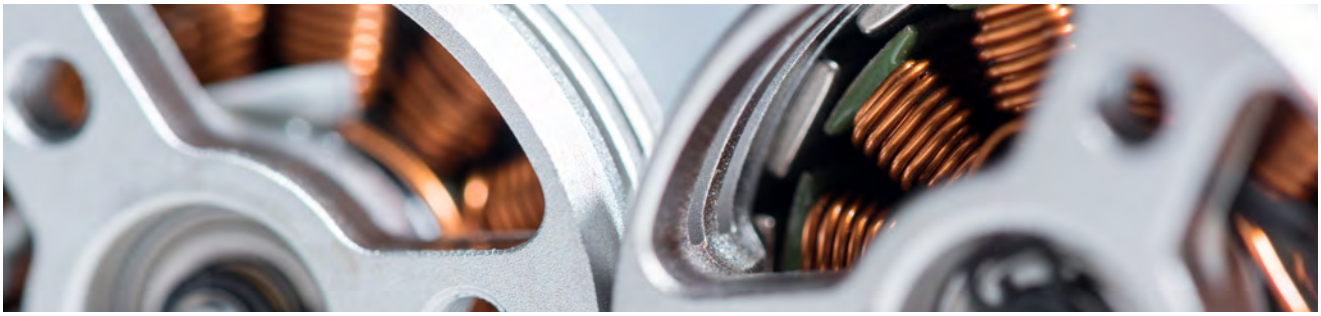
- Hardware- and Software- compatible MCU family
- 48 MHz Arm Cortex-M0+ core or
  up to 112 MHz Arm Cortex-M4F core
- Flash memory: from 128 KB up to 2 MB
- QFN, LQFP, MAPBGA packages,
  from 32 to 176 pin count
- CAN FD, FlexIO, and QSPI
  Ethernet and serial audio interfaces
- AEC-Q100 qualified:
  Grade 0 = -40° C to +150° C
  Grade 1 = -40° C to +125° C
  Grade 2 = -40° C to +105° C
- Functional Safety compliant: ISO 26262 up to ASIL B
- Cryptographic Services Engine compressed (CSEc) security engine: AES-128 and SHE compliant

MOTOR CONTROL COVERAGE

- Engineered tools for Brushed DC motors, 3-phase PMSM, and 3-phase BLDC motor control targeting body and chassis
- Dedicated peripherals set for rapid motor control loop implementation: FlexTimer (FTM), TRGMUX, Programmable Delay Block (PDB), Analog to Digital Converter (ADC), and Analog Comparator (CMP)

COMPREHENSIVE MOTOR CONTROL ECOSYSTEM

- Diverse hardware solutions supporting motor control applications
- S32K1 software ecosystem with production-ready algorithm library:
  - AMMCLIB set
  - FreeMASTER and MCAT tool
  - Model-Based Design Toolbox (MBDT)
- Dedicated technical support and on-line community

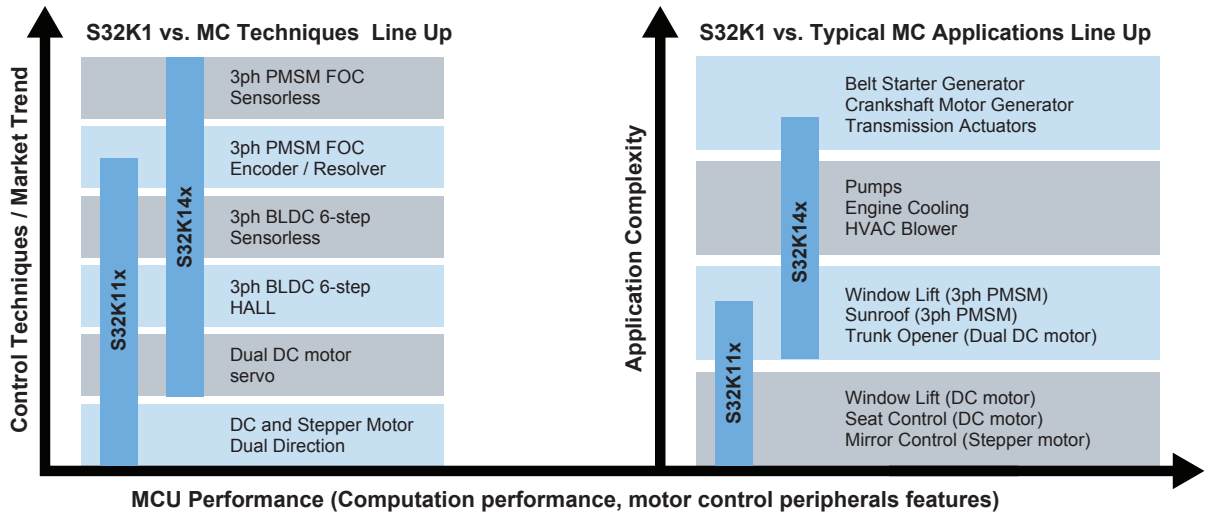


S32K1 PRODUCT OVERVIEW

S32K1 provides a scalable platform with high hardware and software compatibility to address various motor control techniques and applications.

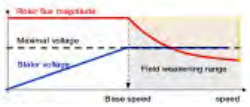
S32K116	S32K118	Common Features	S32K142	S32K144	S32K146	S32K148
Arm® Cortex®-M0+ @ 48 MHz		AEC-Q100	Arm Cortex-M4F @ up to 112 MHz			
128 KB Flash	256 KB Flash	CSEc Security Module	256 KB Flash	512 KB Flash	1 MB Flash	2 MB Flash
17 KB SRAM	24 KB SRAM	ASIL B Compliant	32 KB SRAM	64 KB SRAM	128 KB SRAM	256 KB SRAM
up to 42 I/Os	up to 58 I/Os	Low Power	up to 89 I/Os		up to 128 I/Os	up to 156 I/Os
4 channel eDMA		LPUART, LPSPI, LPIIC, FlexIO	16-channel eDMA			
1 x FlexCAN with 1 x FD		JTAG (K14x only)	2 x FlexCAN with 1 x FD	3 x FlexCAN with 2 x FD	3 x FlexCAN with 2 x FD	3 x FlexCAN with 3 x FD
1x 13-ch. 12-bit ADC	1x 16-ch. 12-bit ADC		2 x 16-ch. 12-bit ADC		2 x 24-ch. 12-bit ADC	2 x 32-ch. 12-bit ADC
1 x PDB		TRGMUX	2 x PDB			
2 x 16-bit FTM (16-ch.)		**Motor Control Peripherals**	4 x 16-bit FTM (32-ch.)		6 x 16-bit FTM (48-ch.)	8 x 16-bit FTM (64-ch.)
QFN-32	LQFP-64		LQFP-64			LQFP-176
LQFP-48			S32K142LQFP-48		S32K146LQFP-144	
			LQFP-100			
				MAPBGA-100		
						IEEE® 1588 Ethernet
						Quad SPI
						ETM Trace
						2 x SAI

S32K1 MOTOR CONTROL LINE-UP

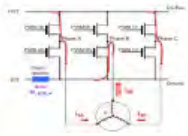


S32K1 MOTOR CONTROL SOFTWARE ECOSYSTEM

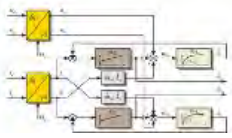
Field-weakening



Single-shut I meas.



Sensorless PMSM



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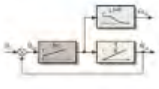
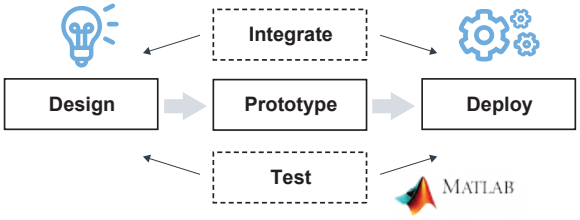


AUTOMOTIVE MATH AND MOTOR CONTROL LIBRARY (AMMCLIB) SET

- Precompiled software library including NXP-patented control math algorithms
- Automotive production-ready software (SPICE Level 3, CMMI and ISO 9001/TS 16949)
- Delivered as bit-accurate models for MATLAB®/Simulink® and C code
- Single API across NXP MCUs, simple migration across platforms



MODEL-BASED DESIGN TOOLBOX (MBDT)

- Model-based design environment in MATLAB/Simulink for motor control software on S32K MCUs
- Automatic code generation for S32K1xx peripherals and applications prototyping
- Extensive online community and tutorials available
- Model-based design approach helps to save R&D time and test efforts

FREEMASTER (LITE)

- Real-time data visualization tool for debugging and tuning embedded algorithm during development
- Graphs, tabular grids, and web views embedded directly in the desktop application
- FreeMASTER Lite supports JSON RPC protocol and is able to run on Windows® or Linux® host PC, enabling custom UI on web browsers

MOTOR CONTROL APPLICATION TUNNING (MCAT)

- HMTL-based graphical user interface tool, plug-in to FreeMASTER and fully compliant with AMMCLlib set API
- Real-time tuning and updating of control parameters

S32K1 ADDITIONAL SOFTWARE

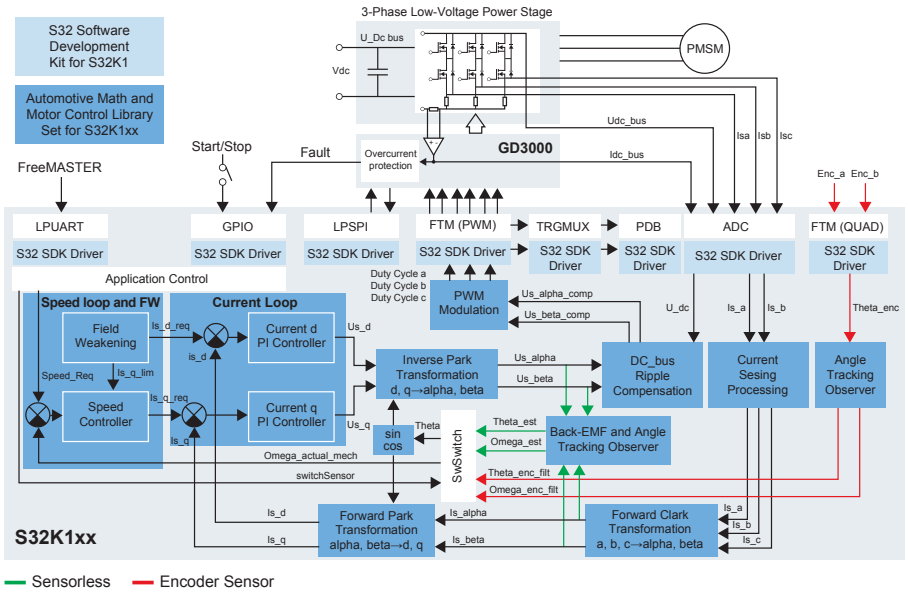
- S32 Design Studio IDE: Eclipse, GCC, and debugger
- Production-grade S32 Software Development Kit (S32 SDK): SPICE Level 3 compliant, MISRA tested
- NXP AUTOSAR® MCAL (QM and ISO 26262 compliant) and OS
- Security firmware – NXP provided
- Core Self-Test Library for functional safety applications
- Production-grade ASIL compliant Real Time Drivers (RTD) support
- Third-party ecosystem support to reduce time-to-market

S32K1 MOTOR CONTROL HARDWARE TOOLS

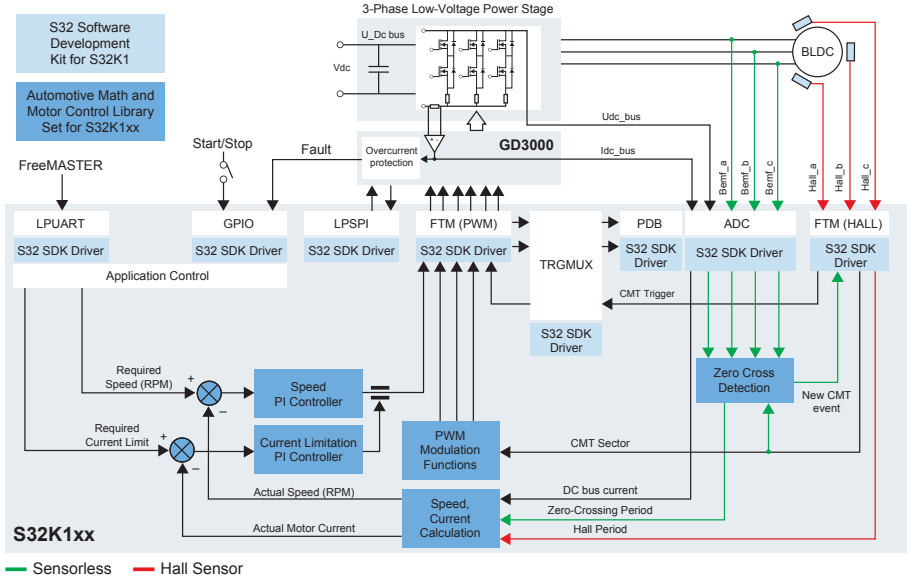
	3-Phase Low-Power Motor Control Development Kits		3-Phase High-Power Motor Control Development Board
	MCSPTE1AK116	**MCSPTE1AK144**	**MCSXTE2BK142**
			
PRODUCTS			
MCU	S32K116	S32K144	S32K142
Analog	UJA1169 – Mini high-speed system basis chip GD3000 – MOSFET gate driver for 3-phase motor		TJA1021 – LIN PHY TJA1043 – CAN PHY GD3000 – MOSFET gate Driver for 3-phase motor
HARDWARE			
Motor	3-phase BLDC motor with Hall sensor 24 VDC, 9000 RPM, 95 W	3-phase BLDC motor with Hall sensor 24 VDC, 4000 RPM, 40 W	N/A
Power	Up to 100 W		Up to 800 W
Voltage	12 V (10-18 V)		12/24 V (10-36 V)
Current sensing	Single-, dual-, and triple-shunt		
Position sensing	Hall, encoder		
Communication	CAN (FD), LIN, UART, PWM		
MOTOR CONTROL SOFTWARE APPLICATION			
PMSM FOC	3-phase field-oriented control (FOC) with field weakening (FW) Sensor (Encoder) or sensorless control (back-EMF observer) Single-shunt and dual-shunt current sensing and 3-phase stator current reconstruction		
BLDC Six-step	3-phase 6-step commutation control Sensor (Hall) or sensorless control based on back-EMF zero-cross detection method		
TOOLS			
Integrated development environment	S32 Design Studio for Arm®		
MCU peripherals settings and control	S32K1 SDK and software configuration tool		
Motor control library	Automotive Math and Motor Control Library		
Visualization and motor control tuning	FreeMASTER and Motor Control Application Tuning (MCAT)		

S32K1 MOTOR CONTROL BLOCK DIAGRAMS

FIELD ORIENTED CONTROL (FOC)
FOR PMSM MOTOR



SIX-STEP COMMUTATION CONTROL
FOR BLDC MOTOR



S32K1 RESOURCES

S32K1 MCUs
nxp.com/S32K1

S32K Motor Control Development kits
nxp.com/S32KMCdevKits

S32 Design Studio IDE
nxp.com/S32DS

Model-Based Design Toolbox
nxp.com/MBDT

FreeMASTER
nxp.com/FreeMaster

Automotive Math and Motor Control Library
nxp.com/AMMCLib

S32K online support
nxp.com/S32K1community

MBDT online support
nxp.com/MBDTcommunity

nxp.com/S32KMCdevKits

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