S32K3 Arm® Cortex®-M7 based MCUs simplifying software development for automotive and industrial

The S32K3 family includes scalable 32-bit Arm Cortex-M7 based MCUs in single, dual and Lockstep core configurations supporting up to ASIL D level safety. Features include a hardware security subsystem with NXP firmware, support for firmware over-the-air (FOTA) updates, and ISO 26262 compliant Real-Time Drivers (RTD) software package for AUTOSAR® and non-AUTOSAR applications.

S32K3 MCUs are also available in NXP's new HDQFP packaging technology which reduces package footprint by up to 55% compared with standard QFP packages.

Features and performance

- Single, dual and Lockstep Arm Cortex-M7 cores, 120-320 MHz + FPU
- Up to 1152 KB RAM and 12 MB Flash, all memories with ECC
- FOTA, A/B firmware swap with zero downtime, rollback support and automatic address translation
- 12-bit 1 Msps ADCs, 16-bit eMIOS timers with logic control unit for motor control
- Low power run and standby modes, fast wake-up, clock and power gating
- LQFP, HDQFP and MapBGA packages

HDQFP package technology

- QFP 'gull-wing and PLCC J-lead' in single package
- 172-pin (16 x 16 mm), 100-pin (10 x 10 mm), 0.65 mm pin pitch
- AEC-Q100 qualified: Grade 1 (-40 °C to +125 °C) and Grade 2 (-40 °C to +115 °C)

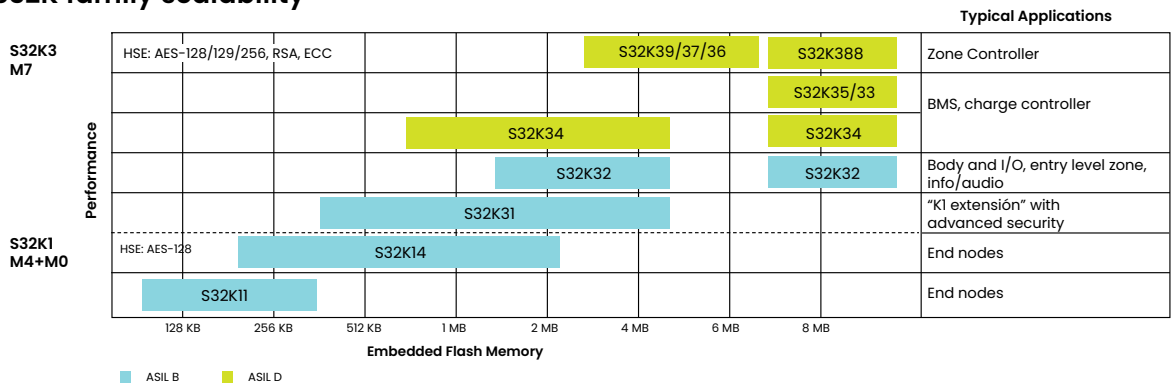
Safety, security and connectivity

- ISO 26262 up to ASIL D
- Fault collection and control unit (FCCU)
- Hardware and software watchdogs, clock/power/temperature monitors
- Safety documentation and SafeAssure® community support
- HSE security engine: AES-128/192/256, RSA and ECC encryption, secure boot and key storage, side channel protection, ISO 21434 intended
- Ethernet TSN and AVB (100 Mbps/1 Gbps), CAN-FD, FlexIO (SPI/IIC/IIS/SENT protocol), serial audio interface, QSPI

Production-grade software

- Real Time Drivers (RTD): free of charge (AUTOSAR and non-AUTOSAR), ASIL D compliant
- Security firmware: NXP provided, field upgradeable
- Safety Framework Software (SAF) and Structural Core Self-Test (SCST) library for functional safety applications
- S32 Design Studio IDE (S32DS): Eclipse, GCC and debugger, third-party support
- Automotive Math and Motor Control Library Set (AMMCLib): free of charge in object code version

S32K family scalability



S32K3 family block diagram

Common features	K310	K311	K312	K314
AEC-Q100, 125 °C, 3.3/5 V	1 x Arm® Cortex®-M7 @120 MHz			1 x Arm® Cortex®-M7 @160 MHz
HSE-B Crypto Security Engine	512 KB Flash	1 MB Flash	2 MB Flash	4 MB Flash
FOTA (Firmware Over-the-Air)	112 KB SRAM (incl. 96 KB TCM)	128 KB SRAM (incl. 96 KB TCM)	192 KB SRAM (incl. 96 KB TCM)	512 KB SRAM (incl. 96 KB TCM)
Low-Power Operarting Modes and Peripherals (LPUART, FlexIO)	38/83 I/Os	38/83 I/Os	83/145 I/Os	142/218 I/Os
ASIL B/D Safety: (ECC Memories, MPU, CRC, Watchdogs)	12-ch eDMA			32-ch eDMA
eMIOS Timers Logic Control Unit Body Cross Triggering Unit Trigger Mux	3 x CAN (FD)		6 x CAN (FD)	
Debug/Trace (SWD/JTAG/ETB)				100 Mbit/s Ethernet (TSN)
S32 Design Studio IDE S32 Configuration Tool	2 x I2C, 4 x UART(LIN)		2 x I2C, 8 x UART(LIN)	2 x I2C, 16 x UART(LIN)
Real-Time Drivers (AUTOSAR® and Non-AUTOSAR)	4 x SPI			6 x SPI
Security F/W Safety Software Framework Communication Stacks Application Software	2 x 24ch 12-bit ADC			3 x 24ch 12-bit ADC
Model-Based Design Toolbox	Analog Comparator		2 x Analog Comparator	3 x Analog Comparator
				2 x SAI (I2S)
				Quad SPI (4-bit data)
	LQFP-48			
	HDQFP-100			
			HDQFP-172	
				MAPBGA-257

Common Features	K322	K324	K341	K342	K344
AEC-Q100, 125 °C, 3.3/5 V	2 x Arm® Cortex®-M7 @160 MHz		1 x LockStep Arm® Cortex®-M7 @160 MHz		
HSE-B Crypto Security Engine	2 MB Flash	4 MB Flash	1 MB Flash	2 MB Flash	4 MB Flash
FOTA (Firmware Over-the-Air)	256 KB SRAM (incl. 192 KB TCM)	512 KB SRAM (incl. 192 KB TCM)	256 KB SRAM (incl. 192 KB TCM)	256 KB SRAM (incl. 192 KB TCM)	512 KB SRAM (incl. 192 KB TCM)
Low-Power Operarting Modes and Peripherals (LPUART, FlexIO)	80/142 I/Os	142/218 I/Os	80/142 I/Os	80/142 I/Os	142/218 I/Os
ASIL B/D Safety: (ECC Memories, MPU, CRC, Watchdogs)	32-ch eDMA				
eMIOS Timers Logic Control Unit Body Cross Triggering Unit Trigger Mux	4 x CAN (FD)	6 x CAN (FD)	4 x CAN (FD)	4 x CAN (FD)	6 x CAN (FD)
Debug/Trace (SWD/JTAG/ETB)	100 Mbit/s Ethernet (TSN)				
S32 Design Studio IDE S32 Configuration Tool	4 x UART(LIN)	16 x UART(LIN)	4 x UART(LIN)		16 x UART(LIN)
Real-Time Drivers (AUTOSAR® and Non-AUTOSAR)	2 x I2C				
Security F/W Safety Software Framework Communication Stacks Application Software	4 x SPI	6 x SPI	4 x SPI		6 x SPI
Model-Based Design Toolbox	2 x 24-ch 12-bit ADC	3 x 24-ch 12-bit ADC	2 x 24-ch 12-bit ADC		3 x 24-ch 12-bit ADC
	2 x Analog Comparator	3 x Analog comparator	2 x Analog comparator		3 x Analog comparator
	2 x SAI (I2S)				
	Quad SPI (4-bit data)				
	HDQFP-100		HDQFP-100		
	HDQFP-172				
		MAPBGA-257			MAPBGA-257

S32K3 family block diagram continued

Common Features	K328	K338	K348	K358	K388	K389*
AEC-Q100, 125 °C, 3.3/5 V	2 x Arm® Cortex®-M7 @240 MHz	3 x Arm® Cortex®-M7 @240 MHz	1 x LockStep Arm® Cortex®-M7 @240 MHz	1 x LockStep + 1 Arm® Cortex®-M7 @240 MHz	1 x LockStep + 3 or 2 x LockStep + 1 Arm® Cortex®-M7 @320 MHz	1 x LockStep + 3 or 2 x LockStep + 1 Arm® Cortex®-M7 @300 MHz
HSE-B Crypto Security Engine	8 MB Flash					12 MB Flash
FOTA (Firmware Over-the-Air)	1152 KB SRAM (incl. 192 TCM)	1152 KB SRAM (incl. 384 TCM)	1152 KB SRAM (incl. 192 TCM)	1152 KB SRAM (incl. 384 TCM)		2304 KB SRAM (incl. 384 TCM)
Low-Power Operarting Modes and Peripherals (LPUART, FlexIO)	137/235 I/Os				202 I/Os	321 I/Os
ASIL B/D Safety: (ECC Memories, MPU, CRC, Watchdogs)	32-ch eDMA					
eMIOS Timers Analog Comparator Logic Control Unit Body Cross Triggering Unit Trigger Mux	8 x CAN (FD)					12 x CAN (FD)
Debug/Trace (SWD/JTAG/ETB)	1 Gbit/s Ethernet (TSN)				2x 1 Gbit/s Ethernet (TSN)	
S32 Design Studio IDE S32 Configuration Tool	2 x I2C, 16 x UART(LIN)					
Real-Time Drivers (AUTOSAR® and Non-AUTOSAR)	6 x SPI					
Security F/W Safety Software Framework Communication Stacks Application Software	3 x 24-ch 12-bit ADC					
Model-Based Design Toolbox	2 x SAI (I2S)					
	Quad SPI (8-bit data width, SDR and DDR mode)				Quad SPI (4-bit data)	
	uSDHC (SDIO)					
	HDQFP-EP-172					
	MAPBGA-289					
						MAPBGA-437

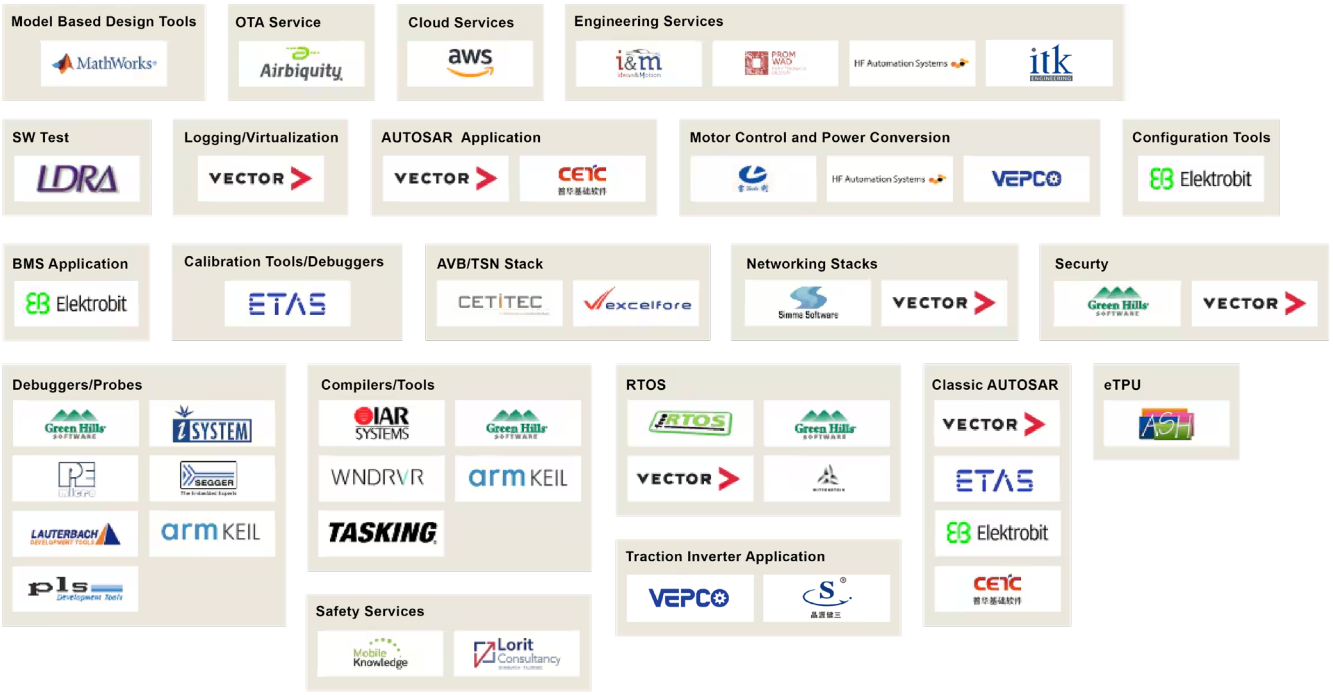
*S32K389 feature set is under evaluation and subject to change.

Common Features	K364	K366	K374	K376	K394	K396
AEC-Q100, 125 °C, 3.3/5 V	1 x LockStep + 1 Arm® Cortex®-M7 @320 MHz		1 x LockStep + 2 x Split-Lock Arm® Cortex®-M7 @320 MHz			
HSE_B Crypto Security Engine	2 x motor control coprocessor (2x 16ch)				2 x motor control coprocessor (2x 32ch)	
FOTA (Firmware Over-the-Air)	4 MB Flash	6 MB Flash	4 MB Flash	6 MB Flash	4 MB Flash	6 MB Flash
Low-Power Operarting Modes and Peripherals (LPUART, FlexIO)	704 KB SRAM (incl. 192 KB TCM)		800 KB SRAM (incl. 288 KB TCM)			
ASIL D Safety: (ECC Memories, MPU, CRC, Watchdogs)	127/ 209+8LVDS I/Os					
eMIOS Timers Logic Control Unit Body Cross Triggering Unit Trigger Mux	64-ch eDMA with 32ch LockStep					
Debug/Trace (SWD/JTAG/ETB)	6 x CAN (FD)					
S32 Design Studio IDE S32 Configuration Tool	100 Mbit/s Ethernet (AVB/TSN)					
Real-Time Drivers (AUTOSAR® and Non-AUTOSAR)	ZipWire					
Security F/W Safety Software Framework Communication Stacks Application Software	6 x SPI, 4x UART(LIN), 2 x I2C					
ASIL-D SW Resolver, IPCF, MBDT	2x 12-ch eFlexPWM with NanoEdge (8-ch each high-resolution PWM)					
	2 x sigma-delta ADC with programmable DSP		4 x sigma-delta ADC with programmable DSP			
	4 x 12-bit SAR-ADC (48 inputs)		7 x 12-bit SAR-ADC (69 inputs)			
	2x Sine wave generator, 2 x analog comparator					
	Quad SPI (8-bit data width, SDR and DDR mode)					
	LQFP-EP-176					
	MAPBGA-289					

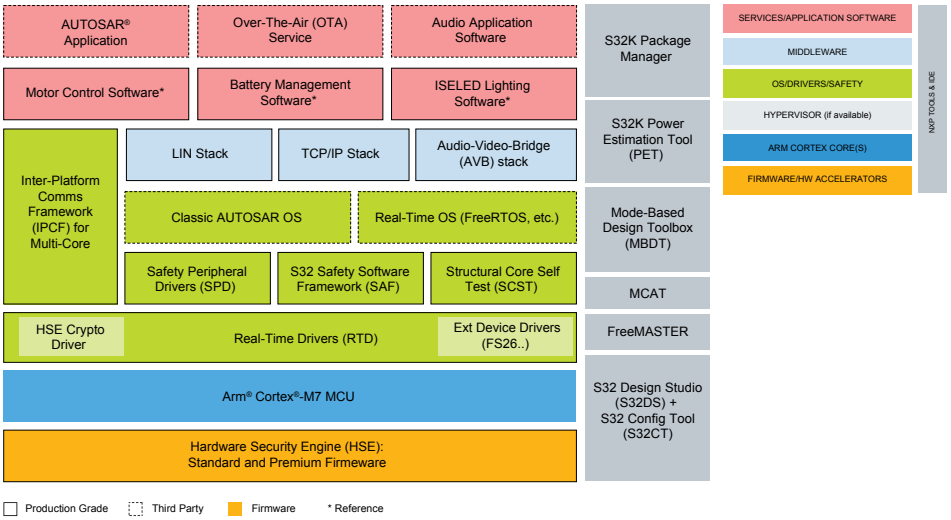
Target applications

- Domain controllers
- Traction Inverter
- eSteering
- Body controllers
- Zone controllers
- Battery Management System (BMS)
- Infotainment IO controller
- E-shifter
- Motor control: Belt-Starter Generator (BSG), turbo charger, fan/pump controller

Partner Ecosystem



S32K3 software enablement



Standard software

For production use, included in silicon cost

- **S32 Design Studio IDE for S32 Platform:** Eclipse-based, GNU compiler and debugger with support for third-party toolchains. S32 Config Tool for configuring RTD, pins, clocks, peripherals, stacks and OS.
- **Real-Time Drivers (RTD):** software drivers for AUTOSAR®/non-AUTOSAR applications. Full processor IP coverage. ISO 26262 ASIL D compliant, AUTOSAR 4.4, SPICE level 3. Configure with S32 Config Tool, Elektrobit Tresos Studio or other partners' tools.
- **Safety Peripheral Drivers:** low-level drivers for safety peripherals: BIST manager and Extended Microcontroller Error Manager (eMcem) for safety framework development.
- **HSE Firmware (standard version):** SHE+ support, field upgradeable, extended symmetric/asymmetric services, AUTOSAR compliant, industry-proven.
- **Inter-Platform Communication Framework (IPCF):** middleware for inter-core communications and resource access and sharing, e.g., AUTOSAR/non-AUTOSAR on Cortex-M cores
- **Model-Based Design Toolbox (MBDT):** plug-in for MathWorks® MATLAB® Software and MathWorks Simulink® Software.
- **Motor Control Tools:** pre-compiled version of AMMCLib, FreeMASTER real-time debug monitor and Motor Control Application Tuning (MCAT) to simplify motor control development.
- **Automotive Math and Motor Control Library (AMMCLib):** pre-compiled, highly optimized libraries for a wide range of motor control and general math functions.

Premium software

For production use, available under license

- **Safety Software Framework (SAF):** libraries for fault detection and reaction to single-point/latent faults during boot-up, runtime and fault recovery. Reduces development effort for safety implementation. Full coverage of software safety mechanisms within the MCU in S32K3xx Safety Manual.
- **Structural Core Self-Test (SCST) Library:** for runtime detection of permanent hardware faults in processor cores, with 90% diagnostic coverage.
- **HSE Firmware (OEM-customized version):** OEM-specific security firmware.
- **Battery Management System (BMS) Safety Library:** in BMS reference design.
- **ISELED LED Lighting Driver:** supports S32K MCUs in ISELED LED lighting applications.

Reference software

For reference use, included in silicon cost

- **Platform Integration Software:** general software examples.
- **Communication Stacks (TCP/IP, LIN)**
- **FreeRTOS OS**
- **Zephyr® RTOS**
- **Mbed TLS**
- **OTA demo**
- **AWS Libraries for S32K3**

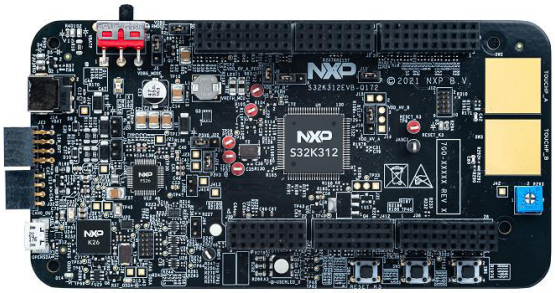
S32K3 hardware tools

S32K31XEVB-Q100

- Supports S32K311/10 (100 HDQFP)
- FS23 Power SBC: +5.0 V, +3.3 V, CAN FD and LIN PHYs
- Arduino® footprint-compatible with expansion support
- On-board S32K3 debug interface and 10-Pin JTAG connector for S32K3 debug interface
- Easy access to all the MCU I/O pins for prototyping
- Touch pad interface, push buttons, RGB LED and ADC potentiometer
- On-board CAN FD
- On-board LIN

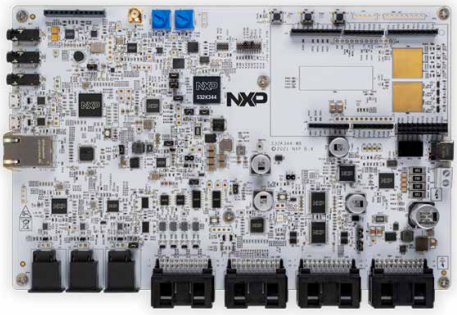
S32K3X4EVB-T172

- Supports S32K344/24/14 (172HDQFP)
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- Arduino® UNO footprint compatible with expansion support
- Integrated debug adapter with P&E firmware and JTAG connectors for external debuggers
- Micro USB debug interface with virtual COM port
- Easy access to all the MCU I/O pins for prototyping
- Ethernet 100BASE-T1 Physical layer interface with TJA1103
- Touch pad interface, 2x user push buttons, user RGB LED, and ADC rotary potentiometer
- [1] CAN physical layer with TJA1153 Secure HS-CAN (FD) Transceiver with Sleep Mode
- [2] LIN physical layers with TJA1022 Dual LIN 2.2A/SAE J2602 Transceiver



S32K312EVB-Q172

- Supports S32K312 (172 HDQFP)
- FS26 Power SBC: +5.0 V, +3.3 V, and +1.5 V
- Arduino® UNO footprint-compatible with expansion support
- Integrated debug interface with P&E firmware and 10-pin JTAG connectors for external debuggers
- Easy access to all the MCU I/O pins for prototyping
- Touch pad interface, push buttons, RGB LED, ADC Potentiometers
- [1] CAN physical layers with the TJA1043 CAN-FD transceiver with sleep mode
- [2] LIN physical layers with the TJA1022T: LIN 2.1/SAE J2602 transceiver



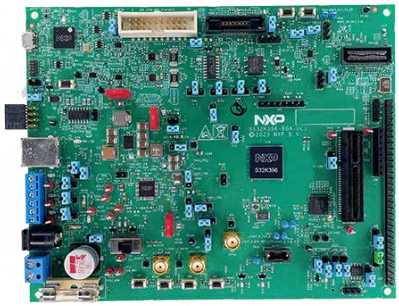
S32K344-WB

- Supports S32K3 automotive general-purpose MCU
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- JTAG connectors for external debuggers
- SGTL5000 ultra-low power audio codec
- High-side driver, low-side driver and H-bridge driver
- Ethernet switch and 3x 100BASE-T1 with SJA1105QEL Five-ports AVB & TSN automotive Ethernet switch
- RF receiver
- NJJ29C2 low-frequency driver and receiver IC
- [4] CAN physical layers with TJA1044GT and TJA1145T high-speed CAN transceivers
- [8] LIN physical layers with TJA1124 and SJA1124 quad LIN commander transceivers

S32K3 hardware tools cont.

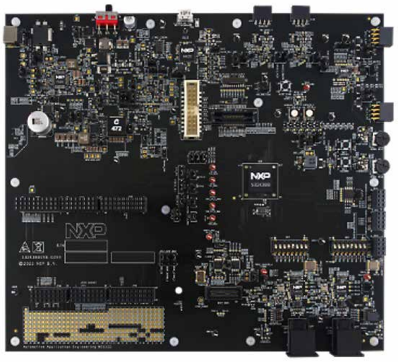
S32K3X8EVB-Q289

- Supports S32K358/48/38/28 (289 MAPBGA)
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- Arduino® footprint-compatible with expansion support
- On-board S32K3 debug interface and multiple JTAG connectors for S32K3 debug interface
- Easy access to all the MCU I/O pins for prototyping
- Touch pad interface, push buttons, RGB LED, ADC potentiometer, SD card slot
- [2] CAN physical layer with TJA1153 Secure HS-CAN (FD) Transceiver with Sleep Mode
- [2] LIN physical layers with TJA1021 LIN 2.2A/SAE J2602 Transceivers
- SGTL5000 ultra-low power audio codec
- USB-to-UART interface
- SABRE connector to Ethernet interface



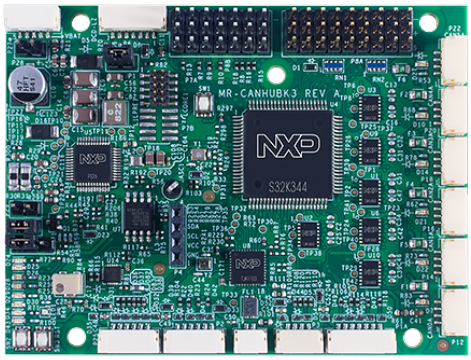
S32K396-BGA-DC1

- Supports S32K396 (289 MAPBGA)
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- Controls up to 1x 3-phase PMSM or BLDC motor
- CAN FD with TJA1044GT
- [2] LIN with TJA1022T
- Serial Interfaces: 2x USB/UART, 1x QSPI, 1x Zipwire, 2x I2C
- MC and Ethernet (no PHY) connector, MSC, FlexIO and eMIOS Headers
- Push buttons and RGB LED



S32K388EVB-Q289

- Supports S32K388 (289 MAPBGA)
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- Arduino® footprint-compatible with expansion support
- On-board S32K3 debug interface and multiple JTAG connectors for S32K3 debug interface
- Easy access to all the MCU I/O pins for prototyping
- Push buttons, RGB LED, and ADC potentiometers
- [2] TJA1120: 10/100/1000 Gbps Ethernet Interfaces (or optional PHY via Sabre connector)
- [2] CAN physical layer with TJA1153 Secure HS-CAN (FD) Transceiver with Sleep Mode
- [4] LIN physical layers with TJA1024 Quad LIN 2.2A/SAE J2602 Transceiver



MR-CANHUBK344

- Supports S32K3 automotive general-purpose MCU
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- UART, SPI, I^2C on JST-GH easy-to-build “Dronecode” standard connectors
- Expansion header for Motor PWM and GPIO
- Connector for 3rd party IMU (accel/gyro/mag)
- 100BASE-T1 Ethernet PHY with TJA1103 ASIL B Compliant
- SE050 Secure element with NFC (Near Field Communication)
- [6] CAN physical layers with TJA1443 (HS-CAN), TJA1463 (CAN SiC) and TJA1153 (Secure HS-CAN) and transceivers
- Broad range of accessories

S32K3 hardware tools cont.

S32K3-T-BOX

- Reference design for cost-effective vehicle networking and telematics applications.
- Supports S32K344 with lockstep Arm® Cortex®-M7 (172 HDQFP)
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V.
- Features SJA1110 TSN Ethernet switch
- Features LIN, CAN FD and HS-CAN transceivers
- Features the SGTL5000 audio codec
- Wireless connectivity featuring the AW690 Wi-Fi® 6 SoC
- [1] CAN physical layers with the TJA1153 -Secure HS-CAN transceiver with sleep mode
- [2] CAN physical layers with the TJA1463 and TJA1462 CAN transceivers with sleep and standby modes
- [1] CAN FD physical layers with the TJA144x transceiver
- [4] LIN physical layers with the TJA1124 Quad-LIN commander

S32K344 Motor Control Kit (MCSPTE1AK344)

- Supports S32K3 automotive general-purpose MCU
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- GD3000 3-phase brushless motor pre-driver
- Integrated motor control shield compatible up to 12 V/5 A 3-phase power stage board based on SMARTMOS™ GD3000 pre-driver with condition monitoring and fault detection
- Low-cost 3-phase BLDC motor equipped with Hall sensor, 24 VDC, 9000 RPM, 95 W, 42BLY3A78-24110
- USB cable
- 12 VDC power supply
- On-board S32K3 debug interface (including serial communication)
- On-board CAN, LIN and Ethernet (RJ45 connector for S32K3X4EVB-Q172 or MATEnet connector for new S32K3X4EVB-T172)interfaces

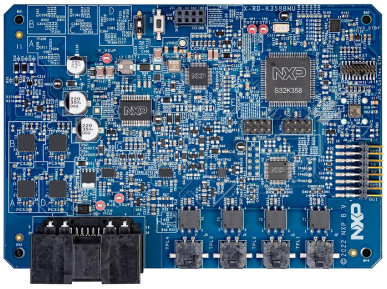
S32K324 TRIPLE MOTOR CONTROL BOARD (MCTPTX1AK324)

- Supports dual-core S32K324 (172 HDQFP)
- Supports control 3x PMSM, 1x DCM and 4x valves, independently
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- [3] GD3000 3-phase brushless motor pre-driver
- HB2001: H-Bridge driver module for legacy direct current (DC) motor control
- MC12XS6 High Side Driver module
- 10 pins SWD/JTAG Debugger interface
- On-board CAN, LIN and USB to UART interfaces

S32K396BMS-EVB

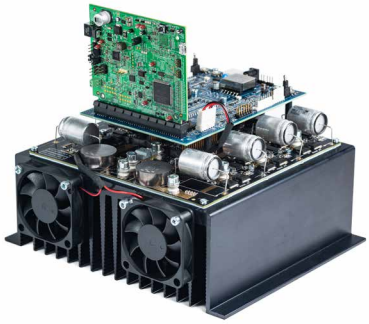
- Supports S32K39/S32K37 (289 MAPBGA)
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- MC33665 as communication gateway and TPL transceiver to support daisy chain of BCC device MC33774 communication
- [4] High-side and 11x low-side switch with XS2410
- 10-ch switch to ground input and 4-ch switch to programmable input MSDI interfaces
- LPUART, 3x CAN interface with TJA144x, LIN interface with TJA1022 and 1x 100BASE-T1 interface with TJA1101
- 2-ch PWM capture interface

S32K3 hardware tools cont.



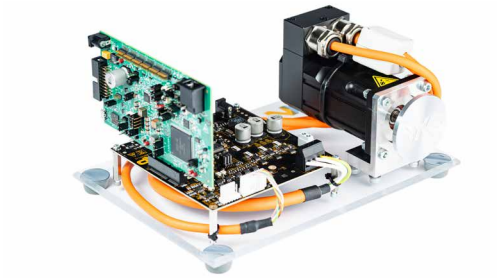
RD-K358BMU (Coming soon)

- Supports S32K358 (289 MAPBGA)
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- MC12XS6: External automotive lighting multi-channel extreme switch
- HB2000: SPI programmable 10 a h-bridge brushed dc motor driver
- PCA2131: Nano-power highly accurate rtc with integrated quartz crystal for automotive applications
- [4] Electrical transport protocol link (ETPL) interfaces with MC33665A.
- [4] Contactor drivers with PWM economization and current monitoring
- On-board pressure sensor for thermal runaway detection with NBP8-9x
- [3] CAN FD interfaces, one with partial networking with TJA1057, TJA144x and TJA1145A
- On-board pressure sensor and PWM-based interlock



48V Motor Control Kit (March 2025)

- Supports S32K3 automotive general-purpose MCU
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- For PMSM / BLDC / ACIM motors up to 3.8 kVA for 3ph or up to 7.6 kVA for 2x3ph design.
- Modular system consists of the power stage, adapter, and controller boards
- Main and redundant SMPS DC/DC converter
- Supports Resolver, Hall, and Encoder types of sensors
- Fault logic for condition monitoring and fault detection with Over-Current, Over-Voltage, and Over-Temperature protection plus Under-Voltage detection
- Massive passive heatsink with optional active cooling fans
- On-board S32K3 debug interface (including serial communication)
- On-board CAN, Isolated CAN, LIN, and Ethernet (screw connector) interfaces



S32K39 Motor Control Kit (MCSPTR2AK396) (January 2025)

- Supports S32K396 (176 LQFP-EP)
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- On-board PEmicro debugger (micro-USB connector) and 20-pin Arm standard JTAG connector
- Access to many MCU I/O pins for prototyping
- Push button, three LEDs
- [2] CAN (FD) physical layer with TJA1152AT
- [1] Automotive Ethernet physical layer with TJA1103A
- [1] 3-Phase field effect transistor pre-driver MC33937A
- 3-phase inverters with built-in feedback processing circuits with MC33937A
- USB-to-UART interface
- PCIe motor control interface
- Button for external wakeup event trigger

nxp.com/S32K3

Document Number: S32KBRA4 REV 8