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)

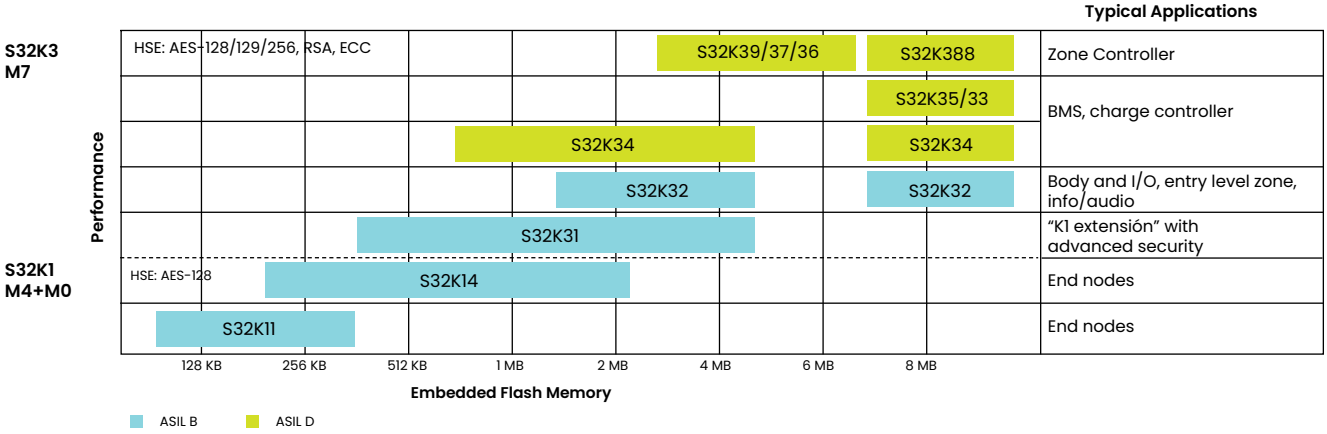
Safety, security and connectivity

- 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	K322	K324	K341	K342	K344
AEC-Q100, 125 °C, 3.3/5 V	1 x Arm® Cortex®-M7 @120 MHz			1x Cortex-M7 @160 MHz	2 x Cortex-M7 @160 MHz		1 lockstep Cortex-M7 @ 160 MHz		
HSE-B Crypto Security Engine	512 KB Flash	1 MB Flash	2 MB Flash	4 MB Flash	2 MB Flash	4 MB Flash	1 MB Flash	2 MB Flash	4 MB Flash
FOTA (Firmware Over-the-Air)	112 KB SRAM	128 KB SRAM	192 KB SRAM	512 KB SRAM	256 KB SRAM	512 KB SRAM	256 KB SRAM	256 KB SRAM	512 KB SRAM
Low-Power Operating Modes and Peripherals (LP UART, FlexIO)	up to 84 I/Os		up to 143 I/Os	up to 218 I/Os	up to 143 I/Os	up to 218 I/Os	up to 143 I/Os	up to 143 I/Os	up to 218 I/Os
ASIL B/D Safety: (ECC Memories, MPU, CRC, Watchdogs)	12-ch. eDMA	16-ch. eDMA		32-ch. eDMA					
eMIOS Timers, Analog Comparator, Logic Control Unit, Body Cross Triggering Unit, Trigger Mux	3 x CAN (3 x FD)		6 x CAN (6 x FD)		4 x CAN (4 x FD)	6 x CAN (6 x FD)	4 x CAN (4 x FD)	4 x CAN (4 x FD)	6 x CAN (6 x FD)
JTAG				100 Mbit/s Ethernet (TSN)	100 Mbit/s Ethernet (TSN)				
S32 Design Studio IDE	2 x I2C		2 x I2C	2 x I2C	2 x I2C	2 x I2C	2 x I2C	2 x I2C	2 x I2C
Real-Time Drivers (AUTOSAR® and Non-AUTOSAR)	4 x SPI*			6 x SPI*	4 x SPI*	6 x SPI*	4 x SPI*	4 x SPI*	6 x SPI*
Security Framework Safety Software Framework Application Software	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 24-ch. 12-bit ADC	2 x 24-ch. 12-bit ADC	3 x 24-ch. 12-bit ADC
				2 x SAI (I2S)					
				Quad SPI	Quad SPI				
	LQFP-48		HDQFP-172						
	HDQFP-100				HDQFP-100		HDQFP-100		
				MAPBGA-257		MAPBGA-257			MAPBGA-257

Common Features	K328	K338	K348	K358	S32K388
AEC-Q100, 125 °C, 3.3/5 V	2 x Cortex-M7 @ 160 MHz	3 x Cortex-M7 @ 240 MHz	1 LS Cortex-M7 @ 160 MHz	1 LS Cortex-M7 + 1 Cortex-M7 @ 240 MHz	1xM7 LS+3xM7 or 2xM7 LS+1xM7@ 320 MHz
HSE-B Crypto Security Engine	8 MB Flash				
FOTA (Firmware Over-the-Air)	1152K SRAM Incl 192K TCM for K328,348. Incl 384K TCM for K338,358, 388				
Low-Power Operating Modes and Peripherals (LP UART, FlexIO)	up to 218 I/Os			Up to 235 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	8x FlexCAN w/ CAN FD				
JTAG	1 Gbit/s Ethernet (TSN)				2x Gbit/s Ethernet (TSN)
S32 Design Studio IDE	2 x I²C				
Real-Time Drivers (AUTOSAR® and Non-AUTOSAR)	6x SPI				
Security Framework Safety Software Framework Application Software	3x 24-ch. 12-bit ADC				
	2 x SAI (I²S)				
	Quad SPI + SDHC (SDIO)				Quad SPI
	HDQFP-172				
		MAPBGA-289			Only 289 MAPBGA

S32K3K9 family block diagram

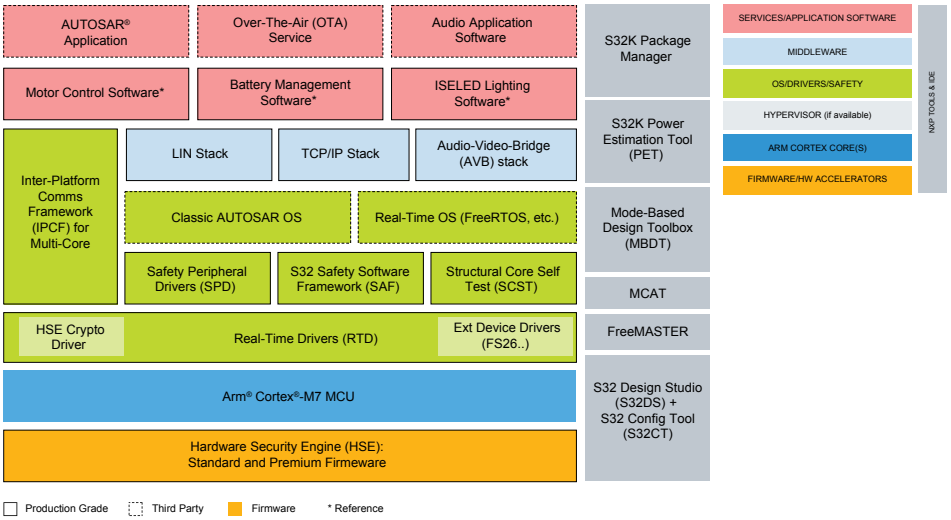
Common Features	K396	K394	K376	K374	K366	K364
AEC-Q100, 125°C, 3.3/5 V	1 lockstep Cortex-M7 + 2 split-lock Cortex-M7 @ 320 MHz				1 lockstep Cortex-M7 + 1 Single Cortex-M7 @320 MHz	
HSE_B Hardware Security Engine	4x sigma-delta ADC with programmable DSP				2x sigma-delta ADC with programmable DSP	
AEC-Q100, 125°C, 3.3/5 V	2x motor control coprocessors (2x 32-ch.)				2x motor control coprocessors (2x 16-ch.)	
HSE_B Hardware Security Engine	6 MB Flash	4 MB Flash	6 MB Flash	4 MB Flash	6 MB Flash	4 MB Flash
FOTA Firmware Over-the-Air	800 KB SRAM (512 KB System RAM + 288 KB TCM)				704 KB SRAM (512 KB System RAM + 192 kB TCM)	
Low-Power Operating Modes and Peripherals LPUART, FlexIO	Up to 211 IOs				Up to 211 IOs	
ASIL D Safety (ECC Memories, Lockstep Cores, CRC, Watchdog)	64-ch DMA with 32-ch. lockstep					
eMIOS Timer, Analog Comparators, Logic Control Units, Trigger Mux (es)	6x CAN (FD), 4x LPUART (LIN)					
JTAG	100 Mbit/s Ethernet (AVB/TSN)					
S32 Design Studio IDE	Zipwire					
Real-Time Drivers (AUTOSAR® and non-AUTOSAR)	2 x I²C, 6x SPI					
Security Firmware S32 Safety Software Framework Application Software	2x eFlexPWM with 12-ch. each (8-ch each high-resolution PWM)					
	7x SAR-ADC 12-bit, 1 Msps (69 analog inputs) 2x SWG (Sine Wave Generator)				4x SAR-ADC 12-bit, 1 Msps(48 analog inputs) 1x SWG(Sign Wave Generator)	
	QuadSPI					
	MAPBGA-289					
	176LQFP-EP					

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

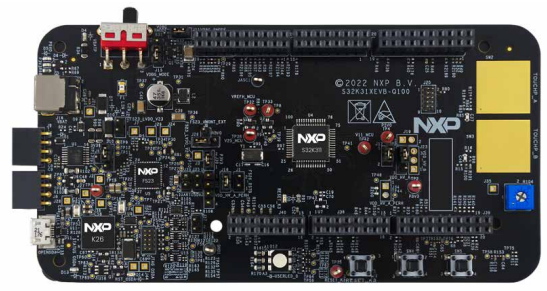
- **Safety Software Framework (SAF):** libraries for fault detection and reaction to single-point/latent faults during boot-up, runtime and fault recovery. Reduces development effort for safety implementation. Full coverage of software safety mechanisms within the MCU in S32K3xx Safety Manual.
- **Structural 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

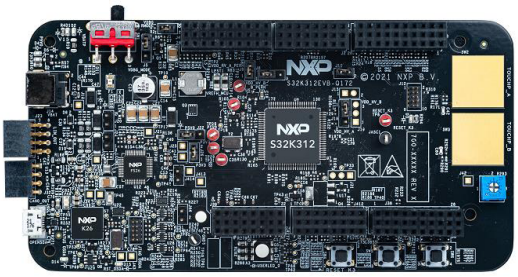
- **Platform Integration Software:** general software examples.
- **Communication Stacks (TCP/IP, LIN)**
- **FreeRTOS OS**
- **Zephyr® RTOS**
- **Mbed TLS**
- **OTA demo**
- **AWS Libraries for S32K3**

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

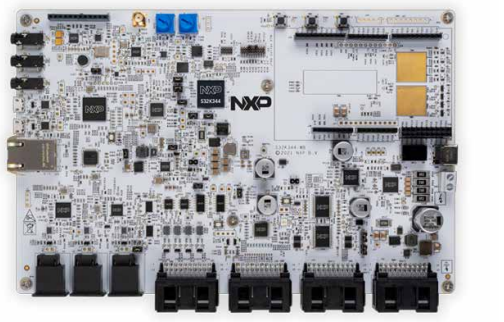


S32K312EVB-Q172

- 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

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



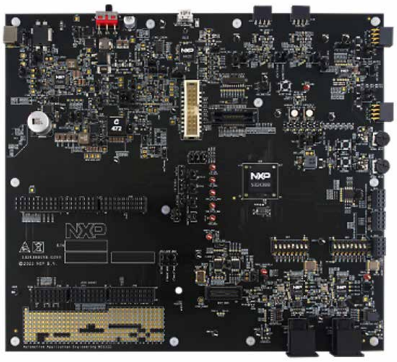
S32K344-WB

- 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.

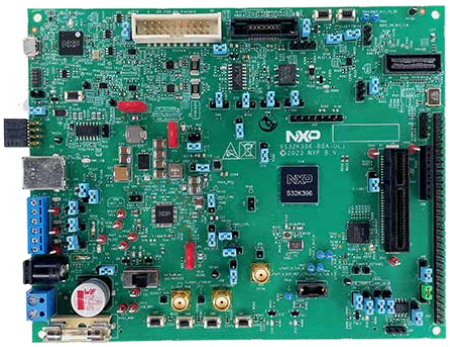
S32K3X8EVB-Q289

- 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



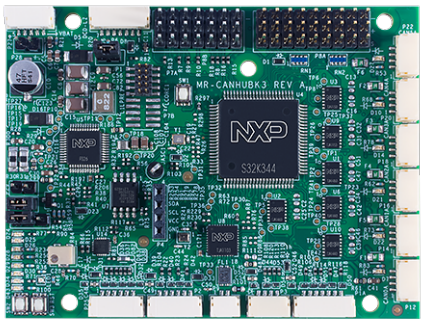
S32K388EVB-Q289 (September 2024)

- 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



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



MR-CANHUBK344

- Supports S32K3 automotive general-purpose MCU
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- UART, SPI, I²C 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

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

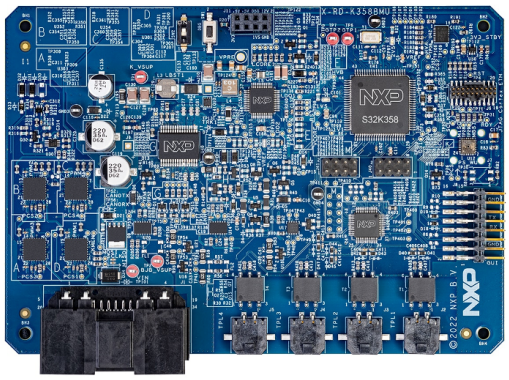
S32K344 Motor Control Kit (MCSPTE1AK344)

- 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

S32K396BMS-EVB

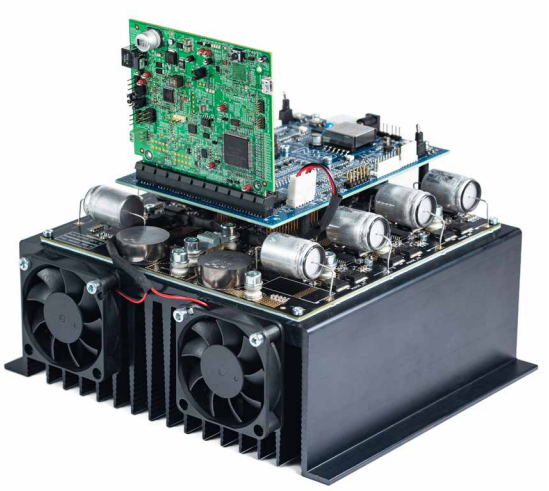
- Supports S32K39/S32K37 (289 MAPBGA)
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V
- MC33665 as communication gateway and TPL transceiver to support daisy chain of BCC device MC33774 communication
- [4] High-side and 11x low-side switch with XS2410
- 10-ch switch to ground input and 4-ch switch to 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 (October 2024)

- 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

nxp.com/S32K3

Document Number: S32KBRA4 REV 7

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

NXP:

S32K3X4EVB-Q257 S32K3X4EVB-Q172 S32K3X4EVBQ257ND S32K31XEVB-Q100