



SECURE CONNECTIONS  
FOR A SMARTER WORLD

# 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.

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

## FEATURES AND PERFORMANCE

- Lockstep Arm Cortex-M7 cores, 120–240 MHz + FPU
- 512 KB, 8 MB Flash 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
- HDQFP and BGA 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)

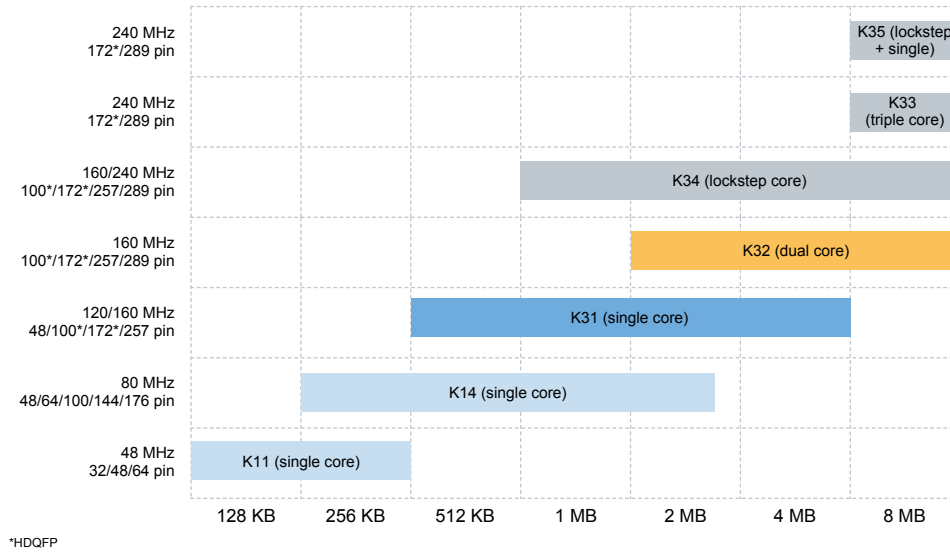
- Fault collection and control unit (FCCU)
- Hardware and software watchdogs, clock/power/temperature monitors
- Safety documentation and SafeAssure® community support
- HSE security engine: AES-128/192/256, RSA and ECC encryption, secure boot and key storage, side channel protection, ISO 21434 intended
- 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
- Model-Based Design Toolbox (MBDT) for MathWorks® MATLAB® software



## S32K FAMILY SCALABILITY



## S32K3 FAMILY BLOCK DIAGRAM

K311	K312	K314	Common Features	K322	K324	K341	K342	K344	K328	K338	K348	K358
1 x Arm® Cortex®-M7 @120 MHz	1x Cortex-M7 @160 MHz	1x Cortex-M7 @160 MHz	AEC-Q100, 125 °C, 3.3/5 V	2 x Cortex-M7 @160 MHz		1 lockstep Cortex-M7 @ 160 MHz			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
1 MB Flash	2 MB Flash	4 MB Flash	HSE-B Crypto Security Engine	2 MB Flash	4 MB Flash	1 MB Flash	2 MB Flash	4 MB Flash	8 MB Flash			
128 KB SRAM	192 KB SRAM	512 KB SRAM	FOTA (Firmware Over-the-Air)	256 KB SRAM	512 KB SRAM	256 KB SRAM	256 KB SRAM	512 KB SRAM	1152 KB SRAM	1152 KB SRAM	1152 KB SRAM	1152 KB SRAM
up to 84 I/Os	up to 143 I/Os	up to 218 I/Os	Low-Power Operating Modes and Peripherals (LP UART, FlexIO)	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	up to 218 I/Os			
16-ch. eDMA	32-ch. eDMA		ASIL B/D Safety: (ECC Memories, MPU, CRC, Watchdogs)	32-ch. eDMA		32-ch. eDMA		32-ch. eDMA		32-ch. eDMA		
3 x CAN (3 x FD)	6 x CAN (6 x FD)		eMIOS Timers, Analog Comparator, Logic Control Unit, Body Cross Triggering Unit, Trigger Mux	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)	8 x CAN (8 x FD)	8 x CAN (8 x FD)	8 x CAN (8 x FD)	8 x CAN (8 x FD)
2 x PC	2 x PC	2 x PC	JTAG	2 x PC	2 x PC	2 x PC	2 x PC	2 x PC	2 x PC			
4 x SPI*	6 x SPI*		S32 Design Studio IDE	4 x SPI*	6 x SPI*	4 x SPI*	4 x SPI*	6 x SPI*				
2 x 24-ch. 12-bit ADC	3 x 24-ch. 12-bit ADC		Real-Time Drivers (AUTOSAR® and Non-AUTOSAR)	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	2 x 24-ch. 12-bit ADC		3 x 24-ch. 12-bit ADC		
	2 x SAI (FS)		Security Framework Safety Software Framework Application Software	2 x SAI (FS)		2 x SAI (FS)		2 x SAI (FS)				
	Quad SPI			Quad SPI		Quad SPI		Quad SPI		Quad SPI + SDHC (SDIO)		
LQFP-48	HDQFP-172			HDQFP-172								
HDQFP-100				HDQFP-100		HDQFP-100	HDQFP-100					
	MAPBGA-257				MAPBGA-257			MAPBGA-257	MAPBGA-289			

\*Low Power Serial Peripheral Interface (LPSPI) modules with DMA support

## S32K3 FAMILY OVERVIEW

Family	Arm® Cortex®-M Cores	Flash/RAM	Package	CAN-FD/ Ethernet (Optional)	Ambient Temperature (°C)
S32K358	CM7 LS + CM7	8 MB/1MB	172 HDQFP, 289 MAPBGA	8/1 Gbps	-40 to 105/125
S32K348	CM7 LS	8 MB/1MB	172 HDQFP, 289 MAPBGA	8/1 Gbps	-40 to 105/125
S32K338	3x CM7	8 MB/1MB	172 HDQFP, 289 MAPBGA	8/1 Gbps	-40 to 105/125
S32K328	2x CM7	8 MB/1MB	172 HDQFP, 289 MAPBGA	8/1 Gbps	-40 to 105/125
S32K344	CM7 LS	4 MB/512 KB	172 HDQFP, 257 MAPBGA	6/100 Mbps	-40 to 105/125
S32K342	CM7 LS	2 MB/256 KB	100/172 HDQFP	4/100 Mbps	-40 to 105/125
S32K341	CM7 LS	1 MB/256 KB	100/172 HDQFP	4/100 Mbps	-40 to 105/125
S32K324	2x CM7	4 MB/512 KB	172 HDQFP, 257 MAPBGA	6/100 Mbps	-40 to 105/125
S32K322	2x CM7	2 MB/256 KB	100/172 HDQFP	4/100 Mbps	-40 to 105/125
S32K314	CM7	4 MB/512 KB	172 HDQFP, 257 MAPBGA	6/100 Mbps	-40 to 105/125
S32K312	CM7	2 MB/192 KB	100/172 HDQFP	6/-	-40 to 105/125
S32K311	CM7	1 MB/128 KB	48 LQFP, 100 HDQFP	3/-	-40 to 105/125

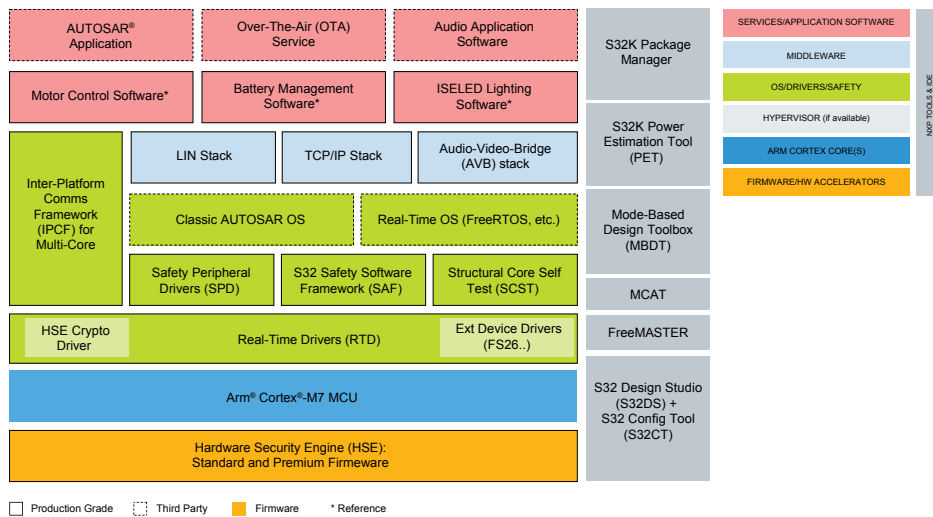
### TARGET APPLICATIONS

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

### PARTNERS



## S32K3 SOFTWARE ENABLEMENT



### 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.
- **Automotive Math and Motor Control Library (AMMCLib):** pre-compiled, highly optimized libraries for a wide range of motor control and general math functions.
- **Battery Management System (BMS) Safety Library:** in BMS reference design.
- **ISELED LED Lighting Driver:** supports S32K MCUs in ISELED LED lighting applications.

### STANDARD SOFTWARE

For production use, included in silicon cost

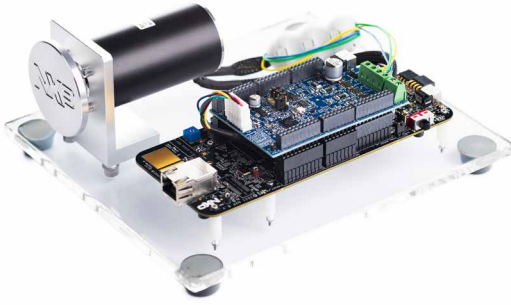
- **S32 Design Studio IDE for S32 Platform:** Eclipse-based, GNU compiler and debugger with support for third-party versions. S32 Config Tool for configuring RTD, pins, clocks, peripherals, DDR memory and OS.
- **Real-Time Drivers (RTD):** software drivers for AUTOSAR®/ non-AUTOSAR applications. Full 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.

### REFERENCE SOFTWARE

For reference use, included in silicon cost

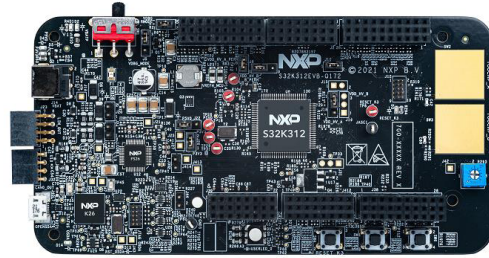
- **Platform Integration Software:** general software examples.
- **Communication Stacks (TCP/IP, LIN)**
- **FreeRTOS OS**
- **Zephyr® RTOS**
- **Mbed TLS**
- **OTA demo**

## S32K3 HARDWARE TOOLS



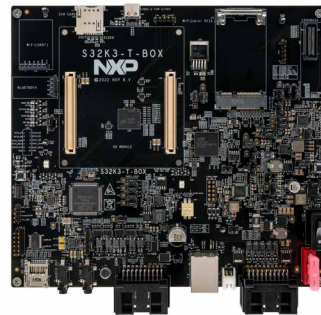
### [S32K344 MOTOR CONTROL KIT \(MCSPT1AK344\)](#)

- 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 SMARTMOST™ GD3000 pre-driver with condition monitoring and fault detection
- Low-Cost PM motor—3-phase PM 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) interfaces



### [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
- 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

### [S32K3-T-BOX](#)

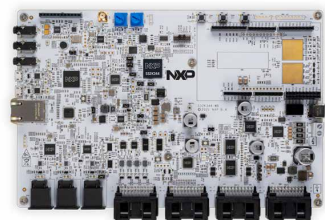
- Reference design for cost-effective vehicle networking and telematics applications.
- Supports S32K344 with lockstep Arm® Cortex®-M7 (172 HDQFP)
- FS26 Power SBC, with +5.0 V, +3.3 V and +1.5 V.
- Features SJA1110 TSN Ethernet switch
- Features LIN, CAN FD and HS-CAN transceivers
- Features the SGTL5000 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

## S32K3 HARDWARE TOOLS cont.



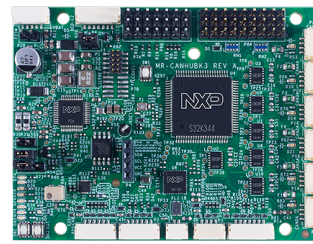
### [S32K324 TRIPLE MOTOR CONTROL BOARD \(MCTPTX1AK324\)](#)

- Supports S32K3 automotive general-purpose MCU
- 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
- 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-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



### [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<sup>2</sup>C 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

## S32K3 RESOURCES

S32K3 product information  
[nxp.com/S32K3](http://nxp.com/S32K3)

S32K community  
[community.nxp.com](http://community.nxp.com)

Real-Time Drivers  
[nxp.com/RTD](http://nxp.com/RTD)

SafeAssure® community  
[nxp.com/SafeAssureCommunity](http://nxp.com/SafeAssureCommunity)

Product Longevity information  
[nxp.com/ProductLongevity](http://nxp.com/ProductLongevity)

[nxp.com/S32K3](http://nxp.com/S32K3)

NXP, the NXP logo, NXP SECURE CONNECTIONS FOR A SMARTER WORLD and SafeAssure are trademarks of NXP B.V. All other product or service names are the property of their respective owners. Arm and Cortex are trademarks or registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere. The related technology may be protected by any or all of patents, copyrights, designs and trade secrets. All rights reserved. MATLAB and Simulink are registered trademarks of The MathWorks, Inc. All other product or service names are the property of their respective owners. © 2023 NXP B.V.

Document Number: S32KBRA4 REV 6

