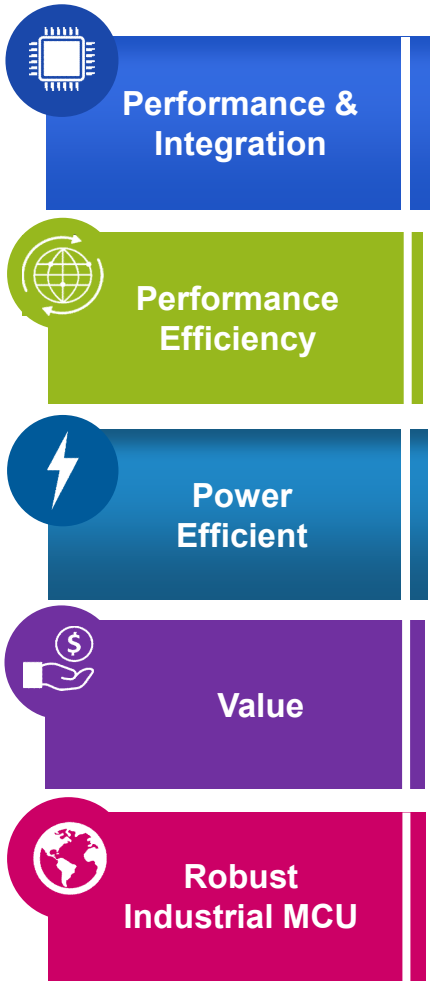
LPC553X/S3X MCU FAMILY

PUBLIC – 6 PACK

MARCH 2022

SECURE CONNECTIONS FOR A SMARTER WORLD

NXP'S ARM® CORTEX®-M BASED MCU PORTFOLIO



i.MX RT Crossover MCUs for Ultimate Real-time Performance & Integration

Kinetis K, LPC54000 MCUs & **LPC5500 for Performance Efficiency**

Kinetis L & **K32 L MCUs for Cost-, Power-Sensitive Applications**

S08 (8-bit) and **LPC800 (32-bit)** MCUs for Entry-Level Applications

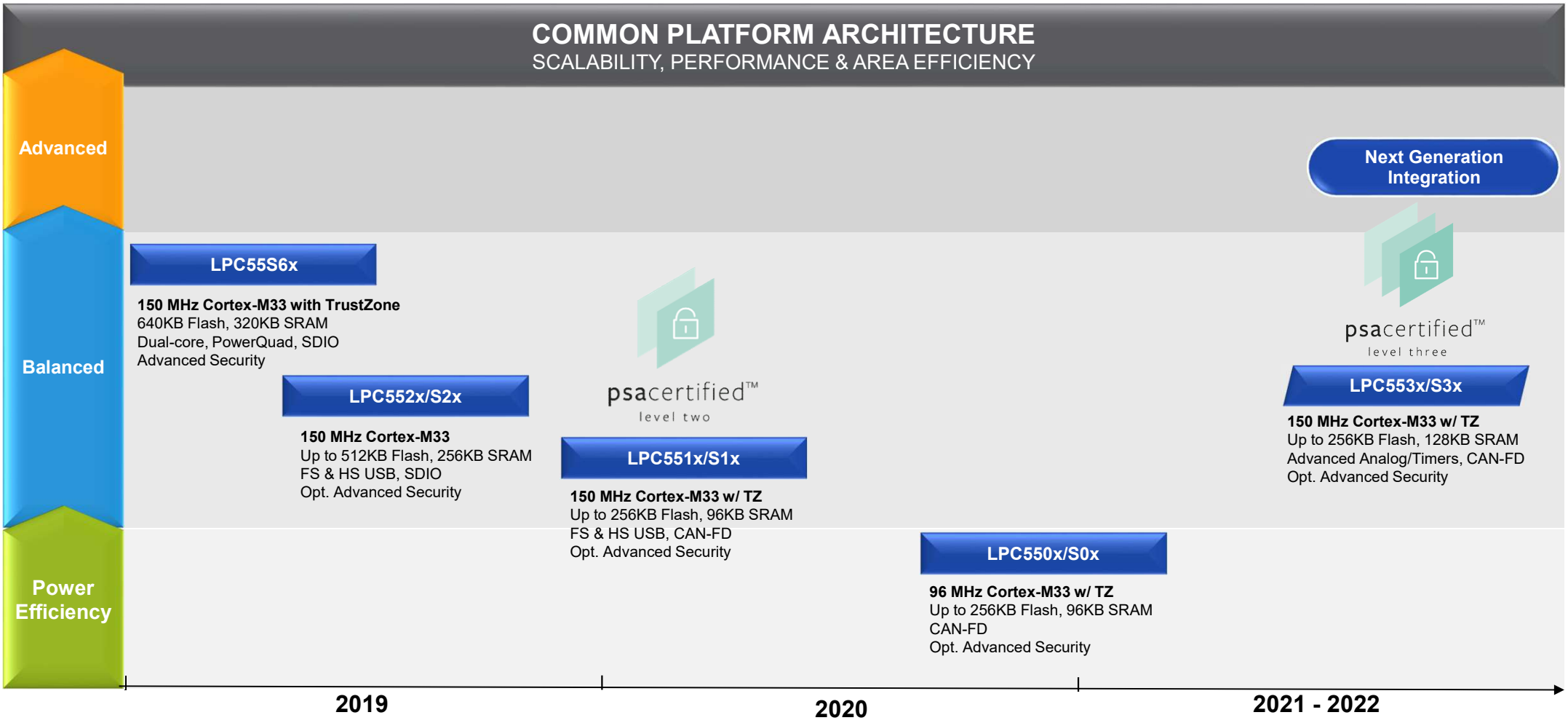
KE (Industrial) & **S32K (Automotive)** for Safe and Reliable 5V MCU Applications

DSC/KV for Motor Control & Digital Power; & **KM** for Metering Applications

LPC5500 MCU SERIES ROADMAP

Arm CM7 | Arm CM33 | Arm CM4

Product: Proposal, Planning, Execution, Production — Samples



Motor Control

Security

Root of Trust

LPC553X/S3X MCUS BRING NEW LEVELS OF ANALOG INTEGRATION AND HIGH SYSTEM RELIABILITY TO THE LPC5500 SERIES

An Arm® Cortex®-M33 MCU family

- High-efficient 40-nm flash technology with 112kB Parity + 16kB ECC RAM
- Over 600 Core Mark (4.17 /MHz running in Flash with Cache) and active power as low as 57 uA/MHz
- Enhanced safety and security with TrustZone-M
- System Integration with DSP acceleration –Cordic engine providing >3.5X improvement for Motor Control Applications
- High-precision & fast ADCs, instrumentation class OpAmp with PGA supporting 64x and DAC
- Motor Control PWM and Quad Encoder/Decoder
- Comprehensive enablement with MCUXpresso Ecosystem

NXP LPC5500 MCU SERIES
COMMON PLATFORM ARCHITECTURE FOR COMPLETE SCALABILITY

Common features across families

- FS/HS USB with PHY, 50MHz SPI, up to 8 Serial Interfaces (FlexComm)
- 5x 32b Timers, SCTimer, and FlexPWM (on LPC553x)
- Up to 2Msps 16-bit SAR ADC, Comparator, Temperature Sensor and RTC… OpAmp and DAC (on LPC553x)
- 1.8 to 3.6V, -40 to 105 °C

LPC5500 Family	Samples [Launch]	Memory	Max Freq	Dual Core	Security	DSP Accel	USB*	SDIO	CAN-FD*	FlexSPI	I3C	DMIC	Analog**	Serial Interface
Adv. Analog LPC553x/S3x *(S3x version available in Q4-22)*	Now [Feb 22]	Up to 256KB Flash, 128KB SRAM	150 MHz w 8KB Cache Opt TZ	-	Opt.	Yes	FS	-	1x	1	1	2 ch	4x ADC 3x Analog Comparator 3x DAC 3x OpAmp	8x FlexComm, HS SPI
Efficiency LPC55S6x	Q4-18 [Mar-19]	Up to 640KB Flash, 320KB SRAM	150 MHz Opt TZ	Yes	Yes	Yes	FS & HS	Yes	-		-		2x 16b ADC 1Msps	8x FlexComm, HS SPI
Mainstream LPC552x/S2x	Q3-19 [Sep-19]	Up to 512KB Flash, 256KB SRAM	150 MHz Opt TZ	-	Opt.	-	FS & HS	Yes	-		-		2x 16b ADC 1Msps	8x FlexComm, HS SPI
Entry LPC551x/S1x	Q4-19 [Feb-20]	Up to 256KB Flash, 96KB SRAM	150 MHz Opt TZ	-	Opt.	-	HS	-	1x		-		2x 16b ADC 2Msps	8x FlexComm, HS SPI
Baseline LPC550x	Q3-20 [Nov-20]	Up to 256KB Flash, 96KB SRAM	96 MHz Opt TZ	-	Opt.	-	-	-	1x		-		2x 16b ADC 2Msps	8x FlexComm, HS SPI

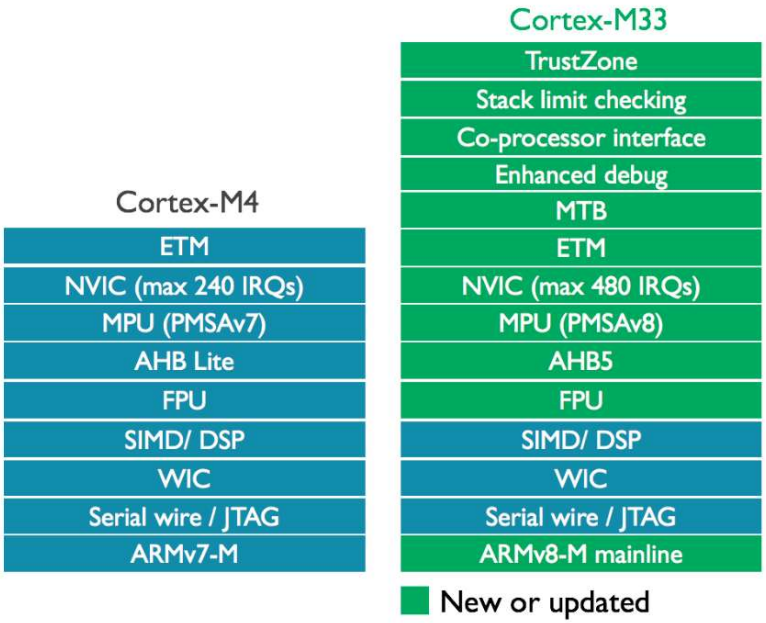
**HS USB/CAN-FD not available on all part numbers within the family, check data sheet for specific configurations ;*
***ADC specified for Single Ended configuration*

Key Features and Comparisons

- Nearly 20% performance improvement over Cortex-M4 based MCUs (over 50% vs Cortex-M23) with redesigned pipeline - up to two instructions per clock cycle

	Cortex-M0+	Cortex-M23	Cortex-M3	Cortex-M4	Cortex-M33
DMIPS/MHz	0.95	0.98	1.25	1.25	1.50
CoreMark®/MHz	2.46	2.50	3.32	3.40	4.02

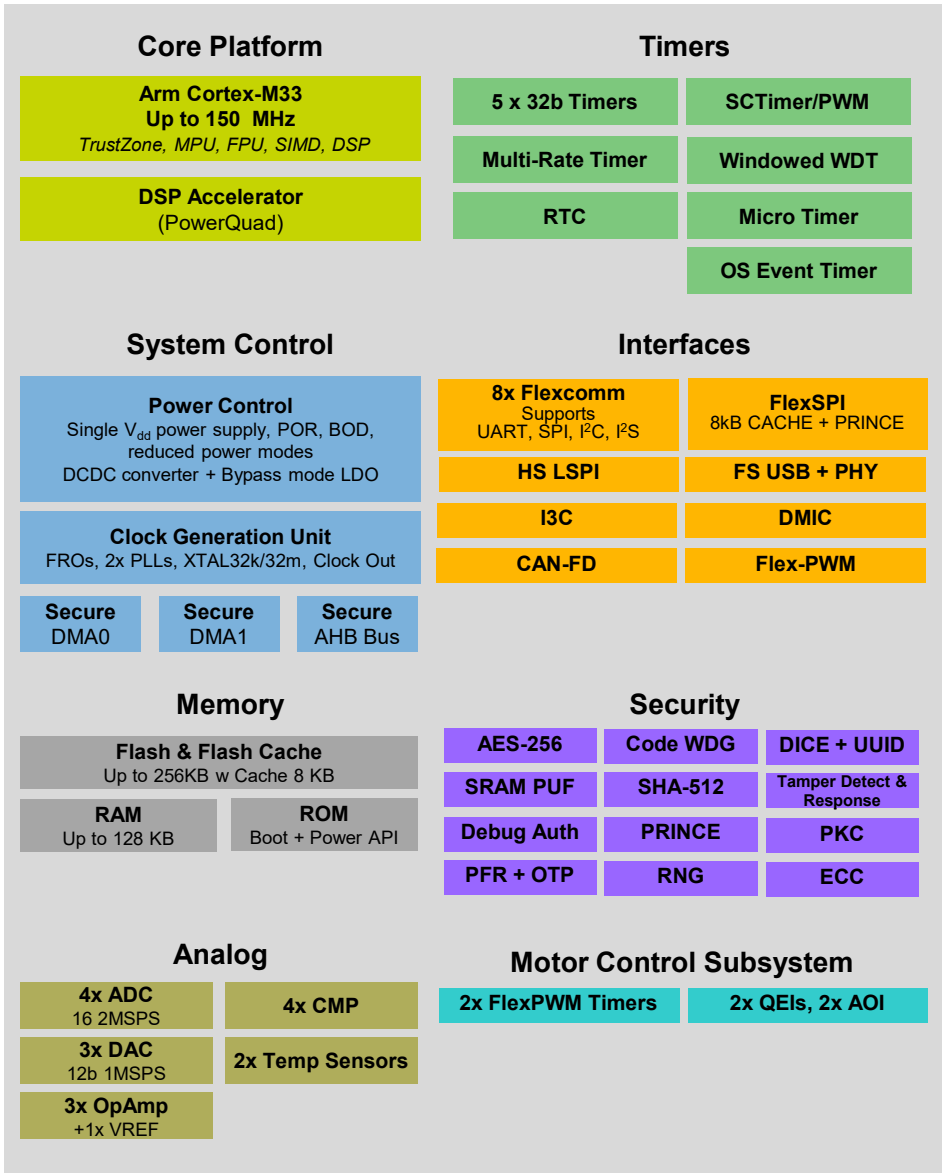
- **LPC553x/S3x achieved 4.17 CoreMark/MHz running from Flash w cache**
- Tightly coupled accelerators with coprocessor interface & extensions (Arm's single precision FPU along with NXP accelerators)
- TrustZone for system-wide, secure resource isolation enabling trusted runtime execution and physical protection in embedded MCU applications



LPC5500 MCU SERIES OVERVIEW

	LPC550x/S0x	LPC551x/S1x	LPC552x/S2x	LPC553x/S3x	LPC55S6x
Cortex-M33 Max Frequency	Up to 96MHz	Up to 150MHz	Up to 150MHz	Up to 150MHz & 8KB Cache	Up to 150MHz (w 2nd M33)
Accelerators/ Co-proccessors	Crypto Accelerator	Crypto Accelerator	Crypto Accelerator	PowerQuad DSP, PKC	PowerQuad DSP, Crypto Accelerator
Flash	Up to 256 KB	Up to 256 KB	Up to 512KB	Up to 256KB	Up to 640KB
SRAM	Up to 96KB	Up to 96KB	Up to 256KB	Up to 112kB w Parity + 16kB ECC	Up to 320 KB
Security	TrustZone, HW SRAM PUF, Debug Authentication, real-time encryption/ decryption, TRNG, Secure boot, SHA-2, AES-256, PFR	TrustZone, HW SRAM PUF, Debug Authentication, real-time encryption/ decryption, TRNG, Secure boot, SHA-2, AES-256, PFR	HW SRAM PUF, Debug Authentication, real-time encryption/ decryption, TRNG, Secure boot, SHA-2, AES-256, PFR	CSS, TrustZone,HW SRAM PUF, Debug Authentication, real-time encryption/ decryption, TRNG, Secure boot, SHA-2, AES-256, PFR	TrustZone, HW SRAM PUF, Debug Authentication, real-time encryption/ decryption, TRNG, Secure boot, SHA-2, AES-256, PFR
CoreMarks	384	600	600	625	1150+ (Dual-core)
Serial Interfaces	Up to 8 FlexComm supporting USART, SPI, I2C and I2S. 1x HS LSPI	Up to 8 FlexComm supporting USART, SPI, I2C and I2S. 1x HS LSPI	Up to 8 FlexComm supporting USART, SPI, I2C and I2S. 1x HS LSPI	Up to 8 FlexComm supporting USART, SPI, I2C and I2S. 1x HS LSPI	Up to 8 FlexComm supporting USART, SPI, I2C and I2S. 1x HS LSPI
USB	-	USB FS w/PHY	USB FS w/PHY, USB HS w/PHY	USB FS w/PHY	USB FS w/PHY, USB HS w/PHY
SDIO	-	-	SDIO/SD/MMC	-	SDIO/SD/MMC
FlexSPI				Support 2 SPI Flash or 1 Flash + 1 PSRAM	
CAN	CAN FD/ CAN 2.0	CAN FD/CAN 2.0	-	CAN FD/CAN 2.0	-
ADC	2x 16b 2 Msps	2x 16b 2 Msps	2x 16b 1 Msps	4x 16b 2 Msps (4x12b 3.13Msps)	2x 16b 1 Msps
GPIO	Up to 45	Up to 64	Up to 64	Up to 66	Up to 64
Active Power Consumption	32uA/MHz	32uA/MHz	32uA/MHz	57uA/MHz	32uA/MHz
Packages	HTQFP64, HVQFN48	HTQFP64, HLQFP100, VFBGA98	HTQFP64, HLQFP100, VFBGA98	HTQFP64, HLQFP100, QFN48	HTQFP64, HLQFP100, VFBGA98

LPC553X / LPC55S3X BLOCK DIAGRAM



Core Platform

- Up to 150MHz Cortex-M33
  - TrustZone, MPU, FPU, SIMD, DSP
- DSP Accelerator (PowerQUAD, w CP intf)
- Secure Multilayer Bus Matrix

Memory

- Up to 256KB FLASH bank
  - 8kB Low Power Cache
- Up to 128KB RAM
  - 112KB with parity check
  - 16KB ECC RAM
- ROM

Timers

- 5 x 32b Timers
- SCTimer/PWM
- Muiti-Rate Timer
- Windowed Watchdog Timer
- RTC with Calendar function
- Micro Timer
- OS Event Timer

Analog

- 4x 16b ADC (Single ended) up to 23 ch
  - 2M sps 16bit
  - 3.3M sps 12bit
  - Up to 8 Differential/ 16 Single Ended channels
- Temperature Sensor
- 3x Analog Comparator
- 3x 12b 1Msps DAC
- 3x OpAmp

Packages

- HVQFN48, HLQFP64, HLQFP100
  - VFBGA98 and CSP upon request

Advanced Security

- AES-256, SHA-2, RNG
- ECC-256 (ECDSA, ECDH)
- PKC (Math accelerator)
- SRAM PUF for Key Generation support
- PRINCE real-time Encrypt/Decrypt for SPI flash
- Debug authentication
- Protected Flash Region (PFR)
- DICE and UID
- Code Watchdog IP (CodeWDG)
- Anti-tampering and Glitch Detector

Interfaces

- USB Full-speed (H/D), Crystal-less
- 1 x High-Speed SPI up to 50MHz (HS SPI)
- 8 x Flexcomms each supports SPI, I2C, UART, I2S
  - I2S Pin-sharing
- External SPI -FlexSPI Interface support XIP
  - Octal/Quad Flash
  - with 8kCache
  - PRINCE to encrypt & decrypt on the fly
- 1x CAN-FD
- 1x I3C
- 1x DMIC 2 ch
- 2x FlexPWM with 4 sub-modules, providing 12 PWM outputs
- 2x Quadrature Encoder/Decoder (QEI)

Other

- Buck DC-DC
- Operating voltage: 1.8 to 3.6V
- Two Main IO supplies (VDDIO_1: 1.8 V to 3.6 V, VDDIO_2: 1.08 v to 3.6 V).
- Temperature range: -40 to 105 °C

LIST OF PART NUMBERS AT FEB 2022 LAUNCH

Part Number	Trust Zone	Power Quad	Flash (KB)	RAM (KB)	USB	CAN-FD	HS SPI	UART/SPI/I2C/I2S	Quad/Octal SPI	ADC
LPC5536JBD100	-	YES	256	128	FS	1	1 x 50MHz	8 total	Octal	4x 16b, 2MSPS, 23ch
LPC5536JBD64	-	YES	256	128	-	1	1 x 50MHz	8 total	Quad	4x 16b, 2MSPS, 13ch
LPC5536JHI48/00	-	YES	256	128	-	1	1 x 50MHz	8 total	Quad	4x 16b, 2MSPS, 10ch
LPC5534JBD100	-	YES	128	80	FS	1	1 x 50MHz	8 total	Octal	4x 16b, 2MSPS, 23ch
LPC5534JBD64	-	YES	128	80	-	1	1 x 50MHz	8 total	Quad	4x 16b, 2MSPS, 13ch
LPC5534JHI48/00	-	YES	128	80	-	1	1 x 50MHz	8 total	Quad	4x 16b, 2MSPS, 10ch
LPC55S36JBD100*	YES	YES	256	128	FS	1	1 x 50MHz	8 total	Octal	4x 16b, 2MSPS, 20ch
LPC55S36JHI48*	Yes	YES	256	128	-	1	1 x 50MHz	8 total	Quad	4x 16b, 2MSPS, 11ch

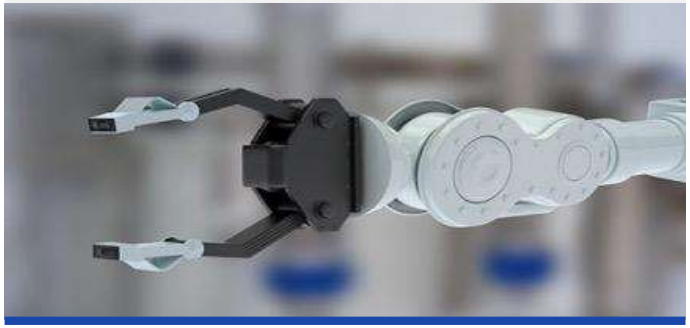
**LPC55S3x parts available in Q4 2022*

LPC553X/S3X MCU FAMILY TARGET APPLICATIONS AND BENEFITS

Industrial & Building Automation

- Motor Control
- Power Inverters

- 150MHz Cortex-M33 & package flexibility for compact design
- High precision & high-speed ADC
- On chip OpAmp reduces BOM & PCB space



Smart Home

- Secure/Biometric Access Control
- Security Systems

- Trust Zone for memory protection
- PRINCE for real-time de-/encryption for external flash/PSRAM
- Built-in SRAM PUF for key storage

Consumer & General Embedded

- Power Tools
- Appliances

- High-Speed SPI for efficient module interface
- Secure boot supports FW update
- Large SRAM for easy FW development
- Low power consumption

Ecosystem Overview

SECURE CONNECTIONS
FOR A SMARTER WORLD

MCUXpresso Software and Tools

for General Purpose MCUs and Crossover Processors

MCUXpresso IDE

Edit, compile, debug and optimize in an intuitive and powerful IDE

MCUXpresso SDK

Runtime software including peripheral drivers, middleware, RTOS, demos and more

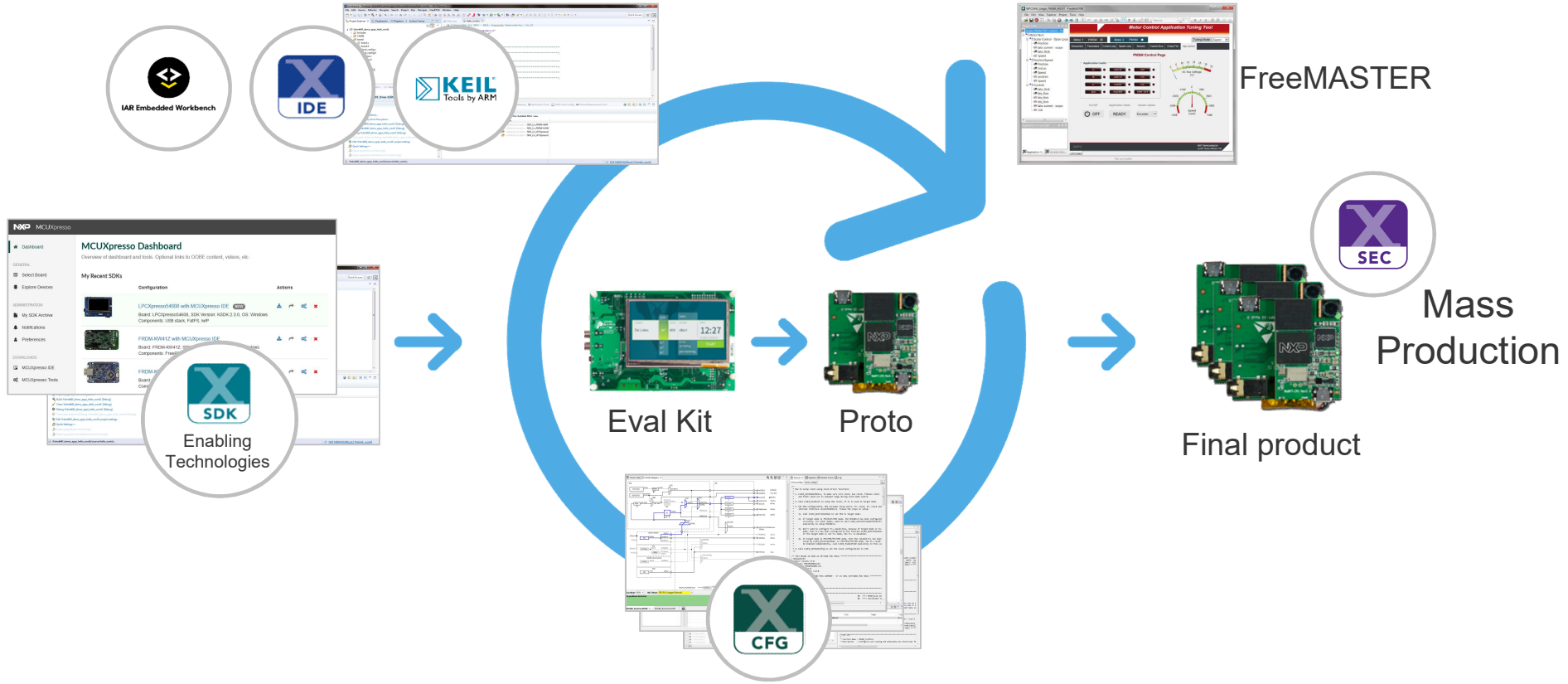
MCUXpresso Config Tools

Online and desktop tool suite for system configuration and optimization

MCUXpresso Secure Provisioning Tool

Graphical and command line tool for securely provisioning and programming MCUs with secure boot

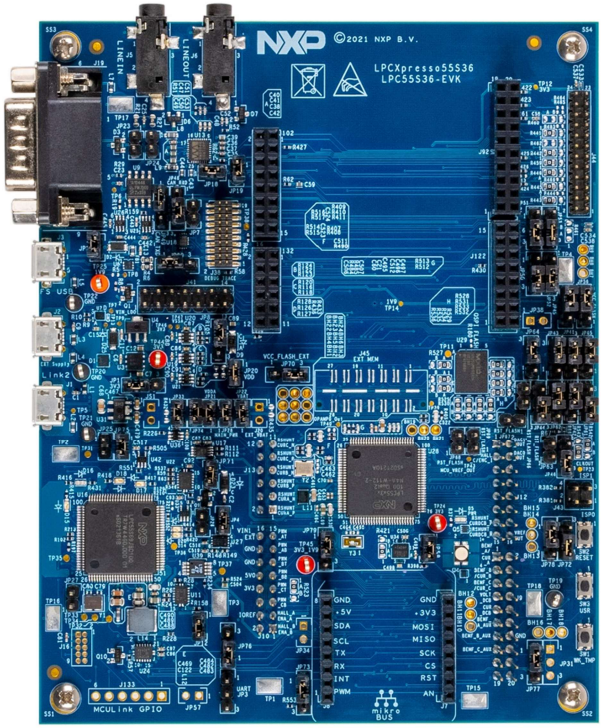
STREAMLINED MCUXPRESSO DEVELOPMENT FLOW



LPC553X/S3X MCU SERIES ENABLEMENT

Hardware Platform for Ease of Development

- **LPC5536 MCU Series EVK**
  - LPC5536JBD100 Cortex-M33 microcontroller running at up to 150 MHz
  - NXP TJA1044GTJ High-Speed CAN Transceiver
  - Support direct connection to FRDM-MC-LVPMSM: NXP® Freedom Development Platform for Low-Voltage, 3-Phase PMSM Motor Control
  - MikroEletronika click expansion option
- On-board debug circuit
- PCB layout, schematic and board files available



ARM KEIL Microcontroller Tools

IAR SYSTEMS

LPC5536-EVK

Development Board

LPC5536-EVK: LPCXpresso55S36 Development Board	

Complimentary with Extensive Support

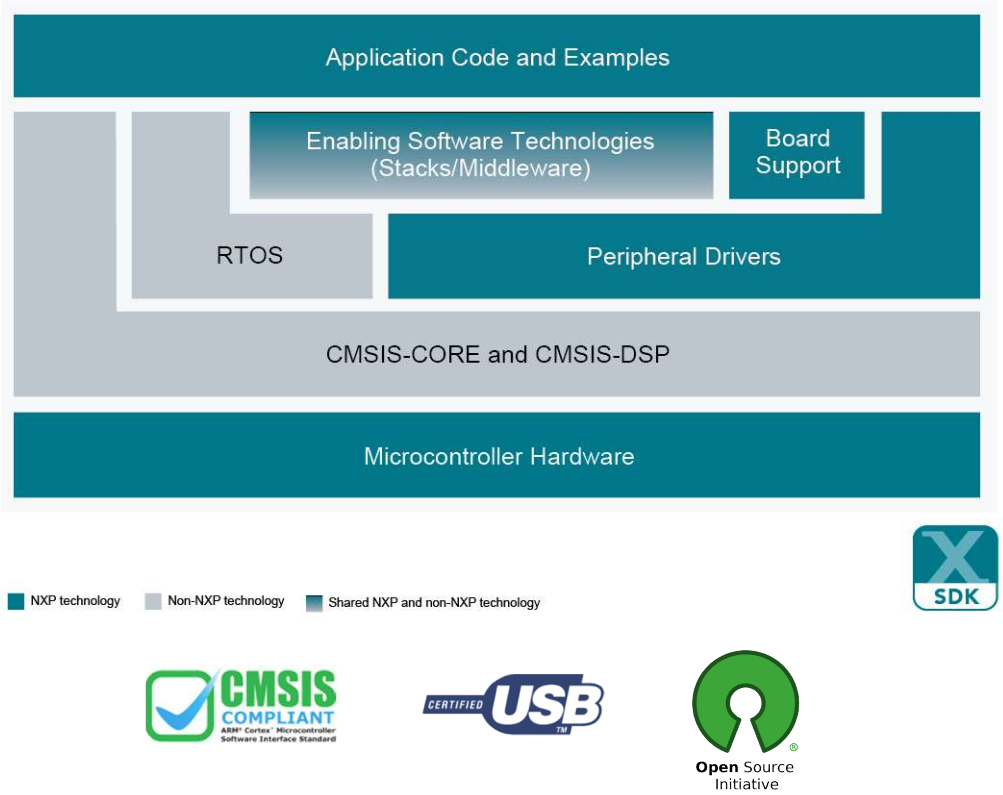
MCUXpresso SDK

MCUXpresso IDE

MCUXpresso Config Tools

www.nxp.com/mcuxpresso/sdk

MCUXPRESSO SDK
SOFTWARE FRAMEWORK AND DRIVERS



Architecture:
- CMSIS-CORE compatible
- Single driver for each peripheral
- Transactional APIs w/ optional DMA support for communication peripherals

Integrated RTOS options:
- Azure RTOS ThreadX
- FreeRTOS
- RTOS-native driver wrappers

Enabling SW Technologies:
- Connectivity (wired/wireless)
- HMI (Graphics, Voice, Touch)
- Audio
- Motor Control
- eIQ Machine Learning
- Cloud connectivity
- Accelerators and specialized peripherals
- Safety
- Security
- Storage

Reference Software:
- Peripheral driver usage examples
- Application demos
- Azure RTOS and FreeRTOS usage demos
- IoT connectivity examples

License:
- BSD 3-clause for startup, drivers, USB stack
- All code Black Duck scanned

Download options:
- Custom SDK web builder for optimized download size
- Direct download within MCUXpresso
- GitHub repository leveraging community engagement
- CMSIS Packs for supported toolchains

Toolchains:
- MCUXpresso IDE
- IAR®, ARM® Keil®, GCC w/ Cmake

Quality:
- Production-grade software
- Consistent API architecture across all releases
- MISRA 2012 compliance
- Checked with Coverity® static analysis tools
- Extensive Continuous Integration testing across range of compatible development boards, supported toolchains, and debug probes

Motor Control SW Enablement

SECURE CONNECTIONS
FOR A SMARTER WORLD

RTCESL – REAL-TIME CONTROL EMBEDDED SOFTWARE LIBRARIES

(HTTPS://WWW.NXP.COM/RTCESL)

Libraries of S/W Algorithms

- Math lib
- General function lib
- Motor control lib
- General digital filter lib
- Advanced control lib
- Power conversion lib

Deep Algorithm Testing

- Millions of patterns
- MATLAB reference models
- 64-bit double precision

Easy-to-use

- Unified API & types
- Detailed algorithms description
- Easy installation & inclusion

Compilers

- **i.MX RT, Kinetis & LPC MCUs:**
  - IAR
  - Keil
  - MCUXpresso
- **DSC:**
  - CodeWarrior

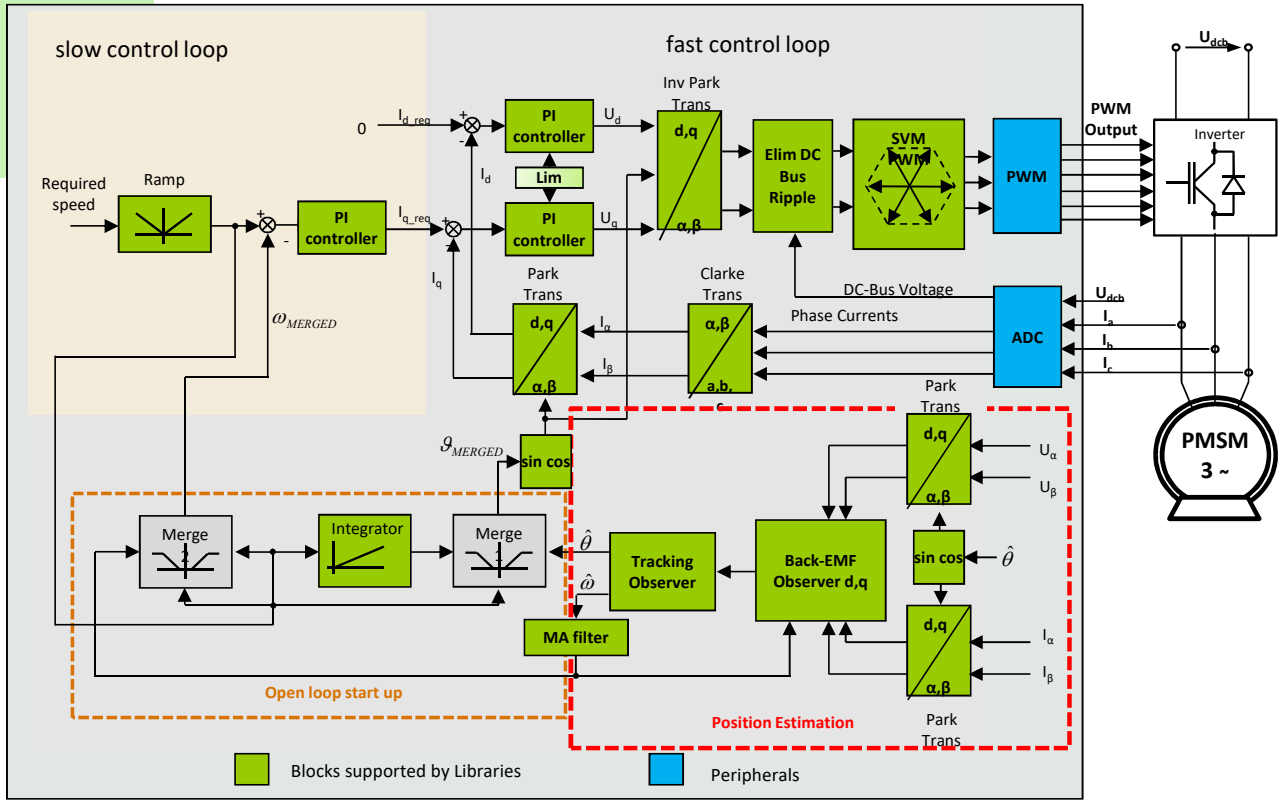
Arithmetic

- fixed point: 16, 32 and 64-bit
- floating point: 32-bit single precision

Cores

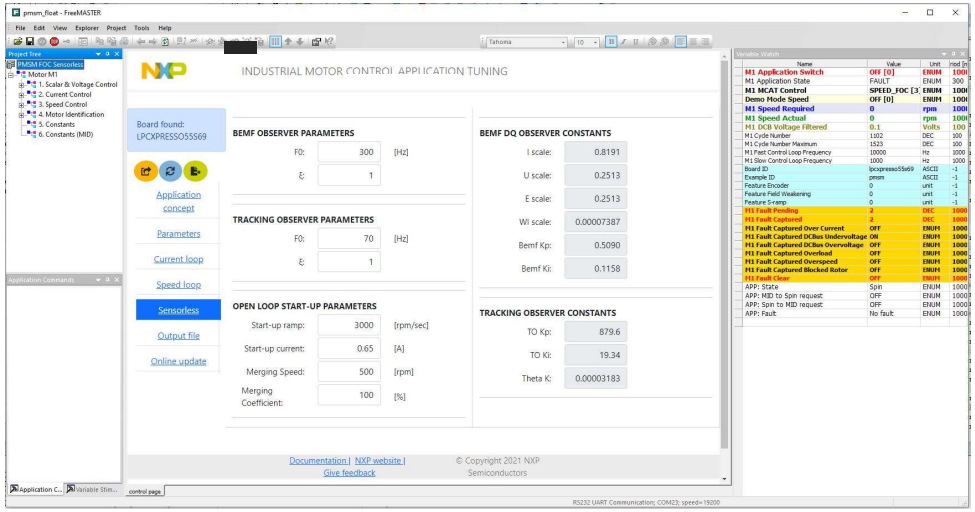
- **i.MX RTxx, LPC, Kinetis:**
  - Arm® Cortex ®-M0+ (incl. hw div & sqrt)
  - Arm Cortex-M33
  - Arm Cortex-M4
  - Arm Cortex-M7
- **DSC:**
  - DSP56800E(X)

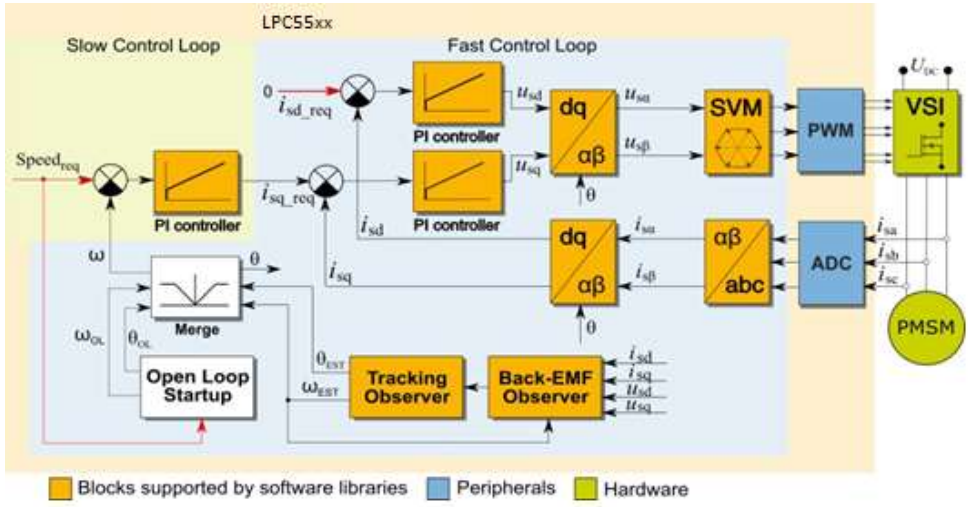
Library algorithms are validated against Matlab/Simulink models



MOTOR CONTROL LIBRARIES

- MCUXpresso SDK includes optional motor control libraries for LPC553x/S3x devices
- Permanent Magnet Synchronous Motor (PMSM) example provided in MCUXpresso SDK (for LPC5536-EVK)
  - Support MCUXpresso, IAR and Keil IDE's
  - Real time parameter watching via FreeMASTER
  - Updated MCAT for motor parameter setting and tuning
  - Full motor parameters estimation (electrical & mechanical)
  - Control modes enabling advanced motor tuning:
    - Scalar, Voltage FOC, Current FOC, Sensorless Speed FOC (BEMF observer based)
  - Examples in SDK:
    - PMSM sensor(encoder)/sensorless
    - Dual PMSM

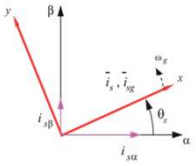


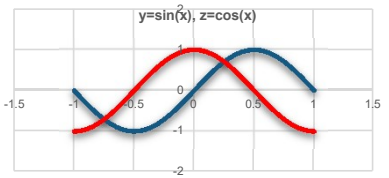


RTCESL – REAL-TIME CONTROL EMBEDDED SOFTWARE MOTOR CONTROL AND POWER CONVERSION LIBRARIES

Math Library (MLIB)

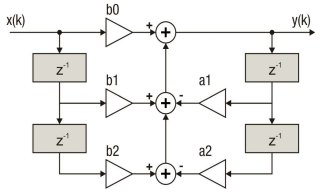
Simple math functions (addition, subtraction, multiplication, division, shifts...) with and without saturation. The aim of this lib is to have efficient and fast mathematical function built using MCU instructions.

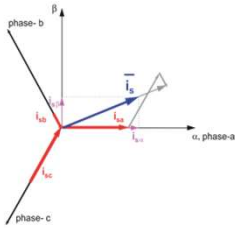


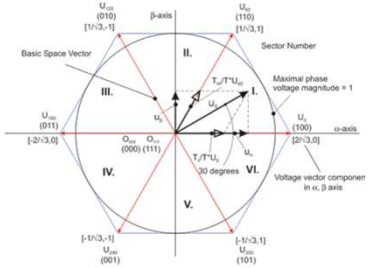


General Function Library (GFLIB)

Contains the basic building blocks of a real-time control applications. Functions for basic mathematical calculations, trigonometric functions, simple look-up table and control algorithms such as PI and PID controllers.





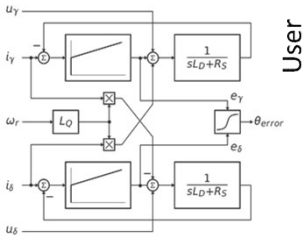


General Motor Control Library (GMCLIB)

The fundamental blocks of a motor control application. The library contains modulation techniques, Park and Clarke transformations and specific motor related functions supporting FOC control topology.

General Digital Filter Library (GDFLIB)

Contains digital filters for signal processing, moving average and IIR filters.

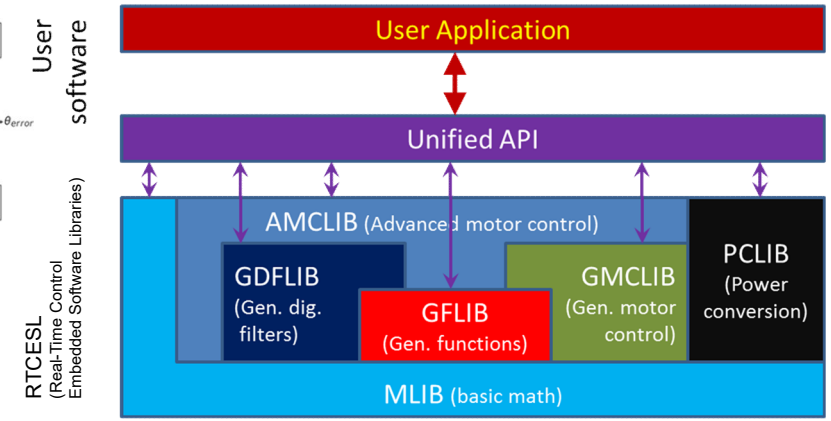


Advanced Motor Control Library (AMCLIB)

Functions that enable building variable speed AC motor drive systems based on the FOC technique without position or speed sensors to provide the cost optimal solution.

Power Conversion Library (PCLIB)

Contains digital controller algorithms optimized for power conversion applications.



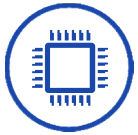
LPC553X/S3X | MORE INFORMATION

Overview

www.nxp.com/lpc553x

Ecosystem Support

LPCXpresso55S36 SDK Builder



Development Board

www.nxp.com/lpc55s36-evk

Training

Design Support

Support

www.nxp.com/support

Community

LPC Microcontrollers

SECURE CONNECTIONS
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