



## 32-bit Microcontroller Support Pages

*The following excerpts are from an online campaign to promote NXP's 32-bit microcontrollers.*

*The campaign, which is still in progress, highlights the four interfaces that NXP adds for embedded: USB, LCD, Ethernet and motor control.*

*Each interface has its own support page. The pages give engineers a quick introduction to the technology, highlight NXP's advantages, and provide links to product information, design tools, presentations, and so on.*

*The excerpts show the text that I provided – that is, the introductions and the NXP advantages.*

## NXP - The widest choice in embedded USB technology

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### Introduction

Fast, reliable, easy-to-use, and able to draw power without a separate AC connection, the Universal Serial Bus (USB) is the world's most popular connector technology. Today, it appears in embedded applications of all kinds.

NXP leads the market in USB-equipped ARM MCUs:

- More than 50 options for ARM7, ARM9, and Cortex-M3 technologies (see comparison table and products below)
- LPC3130 is the industry's lowest-cost ARM9 with High-Speed USB 2.0 OTG (with on-chip PHY)
- Certified USB operation
- Special USB features and comprehensive software support

### NXP Advantage

#### Lowest Price

The LPC3130 is the industry's lowest-cost ARM9 with High-Speed USB 2.0 OTG (with on-chip PHY). It is priced at \$2.80 each in 10K quantities.

#### Complete, Fully-Certified USB Operation



The **NXP portfolio** includes the latest USB technologies, including full- and high-speed USB 2.0 device, host, and On-The-Go (OTG) functions. And, unlike most other vendors, NXP supports all four transfer types: control, interrupt, bulk, and, in particular, isochronous, which is required for streaming audio.

NXP is a leading member of the USB-IF, the organization that maintains the USB specifications and verifies USB compliance. NXP's USB-equipped ARM MCUs are submitted for certification, so designers can be certain that their systems will deliver the best in reliability and plug-and-play operation. As of the end of 2008, most of our USB 2.0-based processors with host and device functions have been certified; the OTG function is in process. A complete list of compliant products appears on the USB-IF web site, [www.usb.org](http://www.usb.org).

### Special USB Features

NXP has been a leading supplier of standalone USB ICs and has developed special features that enhance the robust USB architecture. We now integrate these same features into our ARM MCUs, providing designers with a range of features that improve overall performance.

NXP's special USB features include the following:

- Dedicated DMA lets the USB interface operate with minimal CPU intervention.
- SoftConnect™ uses software to determine when a USB device will connect to the bus.
- GoodLink™ uses an LED to indicate that a USB device has been enumerated and configured on the bus. (To save power, the LED is turned off during suspend.)
- Double-buffering maximizes throughput on bulk and isochronous endpoints.
- Integrated transceivers minimize the number of external components.

## NXP microcontrollers with LCD - unique functions, low-cost integration

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### Introduction

Liquid Crystal Displays (LCDs), especially those with color and touchscreen capabilities, make embedded systems much easier to use. As a result, they've become commonplace across the consumer, medical, industrial, recreational, communication, and automotive sectors. In recent years, the external LCD interface that has traditionally connected the LCD panel to the MCU has moved onto the MCU itself, providing engineers with integrated options that reduce cost, shrink the design, increase reliability, and shorten time-to-market.

### NXP Advantage

NXP offers the industry's most advanced line of LCD-based MCUs. It began in 2007, when NXP acquired Sharp's BlueStreak product line. The acquisition added a family of LCD-based ARM7 and ARM9 MCUs to the portfolio, and established a team of NXP system and software engineers with extensive expertise in LCD connectivity. Since then, NXP has continued to grow its LCD-based MCU line.

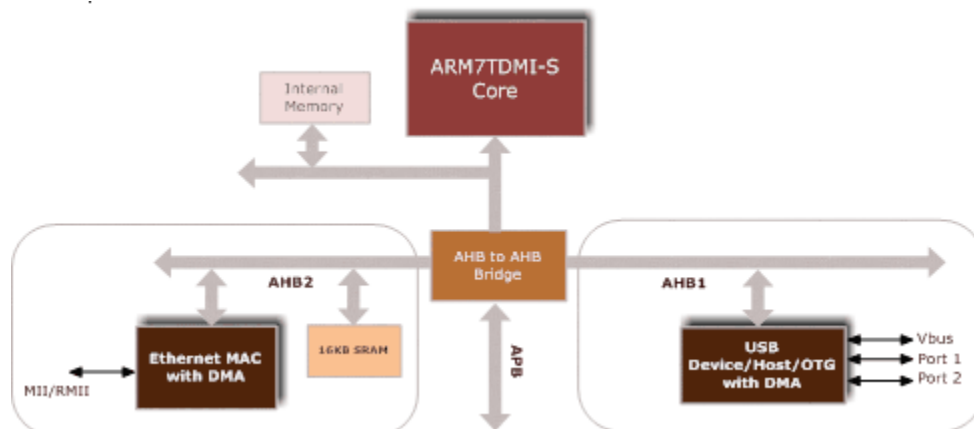
Controlling an LCD panel requires high bandwidth and constant refreshes. The higher the display's resolution, the harder the controller has to work. NXP's LCD controller architecture is designed to lessen these impacts. The architecture delivers best-in-class performance while offloading the CPU and improving power efficiency.

### Power-Saving Performance

NXP's LCD controller supports up to 24-bpp color space and up to 1024 x 768 pixels. It works with STN and TFT colors and uses a color palette that reduces bus utilization while supporting a large number of colors. It also includes its own DMA controller, for full operation independent of the CPU and other system functions. Support for a hardware cursor further reduces the amount of CPU time needed to operate the display, and a built-in FIFO acts as a buffer for display data, enabling flexible system timing.

### Dual AHB bus (ARM7)

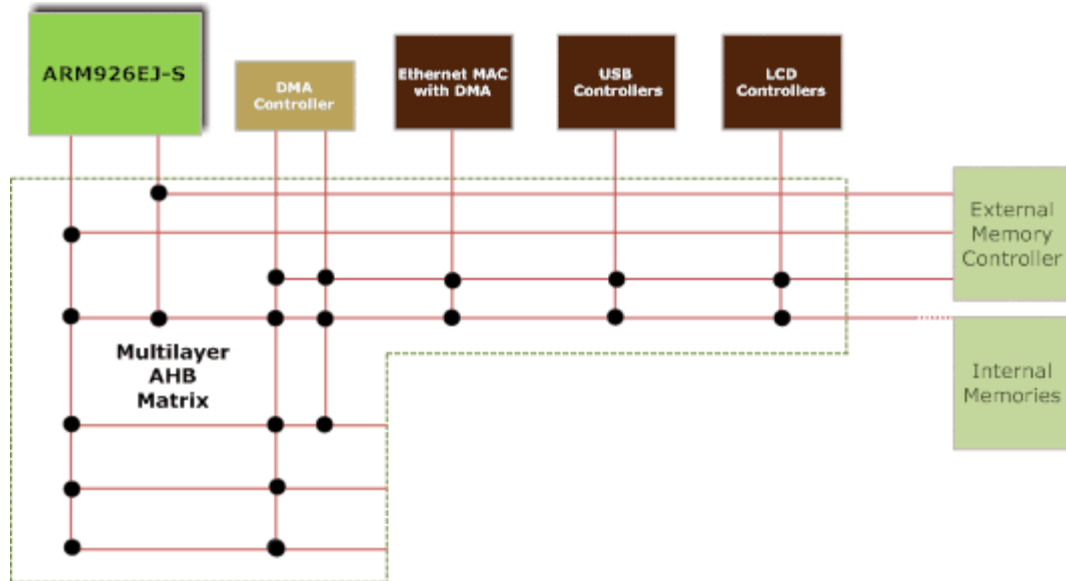
NXP's ARM7 MCUs include an LCD controller and support USB and Ethernet connectivity. To improve the performance of these demanding operations, the ARM7 architecture uses a second AHB bus dedicated to Ethernet operations. This frees up the main bus to provide bandwidth for LCD refreshes.



## Dual AHB Structure (LPC24xx)

### Multilayered Bus Matrix (ARM9)

In its ARM9 MCUs, NXP uses a multilayered bus matrix connecting the ARM CPU and other bus masters (e.g. LCD controller, Ethernet, USB) to peripherals and the external bus interface. The structure adds flexibility and optimizes performance by allowing peripherals that are on different layers of the matrix to be accessed simultaneously by different bus masters.



### Larger Cache Size and Internal RAM

To make display refreshes more efficient, NXP's LCD controller integrates a larger-than-average cache and internal SRAM. The large cache size gives the LCD controller extra bandwidth by reducing the CPU's need to access external memory. The SRAM can be used as a frame buffer, to further reduce or even eliminate the need to access external memory for refreshes.

### Integrated Touchscreen Controller

NXP's LCD-based MCUs integrate an A/D converter with support for a touchscreen controller, so it's easy and cost-effective to add touchscreen capabilities to a system.


## Products

### Comparison Table

Core	Product	LCD Controller (bpp)	Touchscreen Interface	USB	Ethernet 10/100
ARM7TDMI	LH75401	12-Bit	Yes	No	No
	LH75411	12-Bit	Yes	No	No
	LPC247x	24-Bit	Yes	Yes	Yes
ARM720T	LH79520	16-Bit	No	No	No
	LH79524	24-Bit	Yes	Yes	Yes
	LH79525	24-Bit	Yes	Yes	Yes
ARM922T	LH7A400	16-Bit	No	Yes	No
	LH7A404	16-Bit	Yes	Yes	No
ARM926EJ	LPC3230	24-Bit	Yes	Yes	No
	LPC3250	24-Bit	Yes	Yes	Yes

### ARM7-Based MCUs with LCD Controller

Click  for [datasheet](#). Also, see [datasheet disclaimer](#).

, ,  indicate product status. Click  or  for more or less detail.

## NXP microcontrollers with Ethernet — highest bandwidth, easy-to-use

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### Introduction

Ethernet is the most widely-installed Local Area Network (LAN) technology in the world. It's been in use since the early 1980s and is covered by the IEEE standard 802.3, which specifies a number of speed grades. In embedded systems, the most commonly used format runs at both 10 Mbps and 100 Mbps (and is often referred to as 10/100 Ethernet).

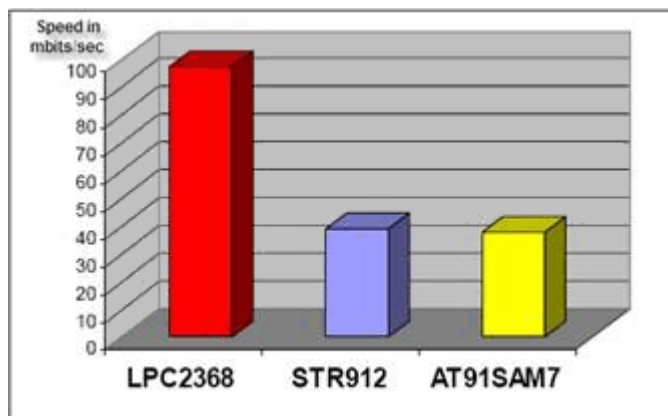
Using Ethernet in embedded applications enables high-bandwidth data transfer and, in particular, lets the system connect to the Internet without using a computer. That opens up a number of possibilities, including the ability to report status to a web page or receive instructions remotely.

### NXP Advantage

There are more than 20 NXP ARM MCUs with built-in Ethernet, covering all three generations of ARM (ARM7, ARM9, and the new Cortex-M3). A list of NXP's Ethernet-equipped products can be found in the [Products section](#) below. NXP uses essentially the same implementation across all three generations, so designers can save time and resources by reusing their Ethernet function when systems move to the next generation of ARM.

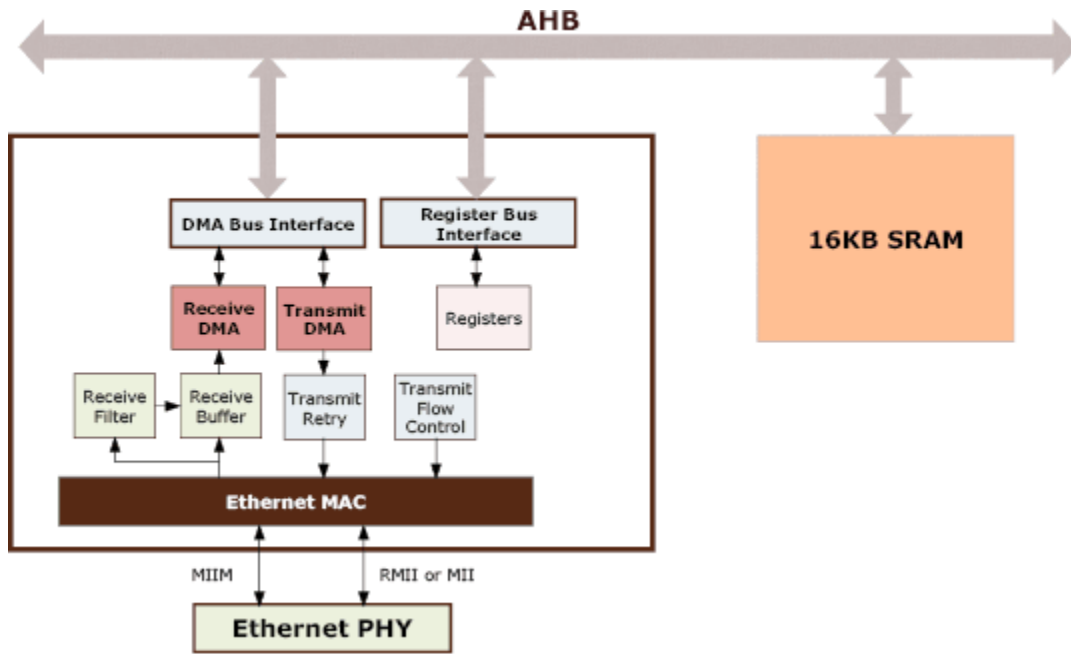
### Highest Bandwidth

NXP's ARM7 MCUs offer the industry's fastest Ethernet performance. In a recent comparison, the independent software company [CMX Systems](#) used their CMX-Micronet software to evaluate the Ethernet-throughput of three ARM-based devices: the NXP LPC2368, the ST Microelectronics STR912, and the Atmel AT91SAM7. Each device was used to transmit 1000 UDP packets loaded with 1460 bytes of data. As shown below, the NXP LPC2368 was twice as fast as the competition.



### Superior Implementation

NXP's Ethernet block (see below) contains a full-featured 10/100 Ethernet MAC (media access controller) that uses DMA hardware acceleration to increase performance. The MAC is fully-compliant with IEEE standard 802.3 and interfaces with an off-chip Ethernet PHY (physical layer) using the MII (Media Independent Interface) or RMII (Reduced MII) protocol along with the on-chip MIIM (Media Independent Interface Management) serial bus.



LPC24xx Ethernet Block

The NXP Ethernet block is distinguished by the following:

*Full Ethernet Functionality*

The block supports full Ethernet operation, as specified in the 802.3 standard.

*Enhanced Architecture*

NXP has enhanced the architecture with several additional features including receive filtering, automatic collision back-off and frame retransmission, power management via clock switching, and more.

*DMA Hardware Acceleration*

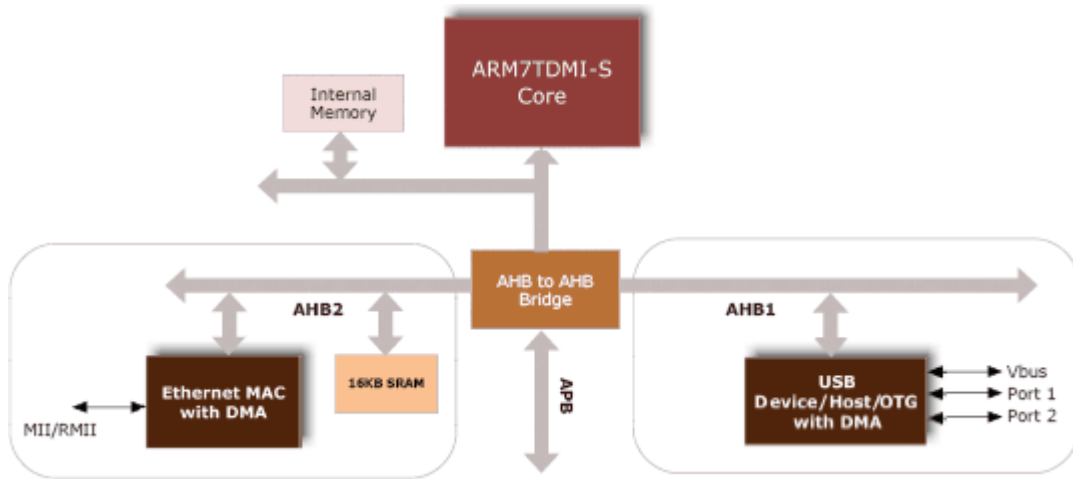
The block has two DMA managers, one each for transmit and receive. Automatic frame transmission and reception with Scatter-Gather DMA offloads the CPU even further.

**Superior System Performance**

Designers often want to use Ethernet in combination with USB, but this can have a serious impact on performance. NXP's ARM MCUs use an infrastructure that's designed to perform several tasks at once.

**Dual AHB Bus (ARM7)**

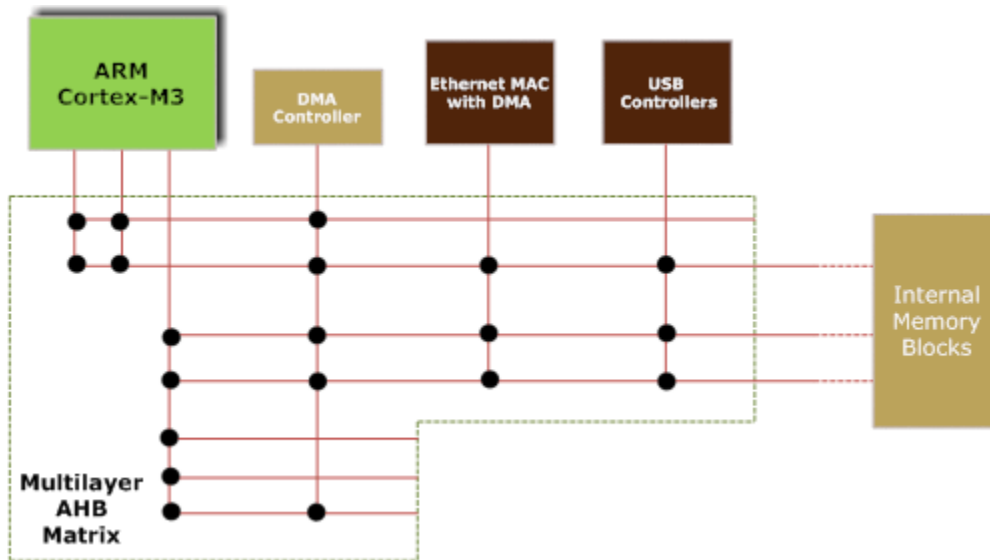
NXP's ARM7 procesors combine Ethernet with USB connectivity and an integrated LCD controller. To improve the performance of these demanding operations, the ARM7 architecture uses a second AHB bus dedicated to Ethernet operations. Supported by DMA blocks, the dual-bus system offloads the CPU considerably, freeing it up for other tasks.



Dual AHB Structure (LPC24xx)

### Multi-Layered Bus Matrix (ARM9, Cortex-M3)

In its ARM9 and Cortex-M3 processors, NXP incorporates a multilayered bus matrix. Different bus masters can access the matrix simultaneously, so there's greater system flexibility and performance is optimized. The matrix provides enhanced support for Ethernet, USB, and LCD peripherals, since they act like independent bus masters.



NXP's Cortex-M3 Architecture

### Complete Software Support


Easy-to-use stacks and operating systems reduce the time it takes to implement the complex protocols used with the Ethernet channel. NXP partners with a number of leading suppliers to offer complete software support for Ethernet.

### Products

#### ARM7-Based MCUs with Ethernet

Click  for [datasheet](#). Also, see [datasheet disclaimer](#).

✓, ⚠, ✗ indicate product status. Click  or  for more or less detail.

 <b>LH79524</b>	System-on-Chip with ARM720T microcontroller, 16KB SRAM, LCD controller up to true color or XGA, touch screen controller, MMU, AHB, APB, 32-bit external memory interface, USB 1.1 full speed device, 10/100 ethernet, I <sup>2</sup> C, 10-bit ADC
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## Motor control with NXP microcontrollers — sophisticated features and performance to spare

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### Introduction

Electric motors drive motion in all kinds of applications, from washing machines and exercise treadmills to the HVAC (heating, ventilation, and air conditioning) systems in commercial buildings. The drawback is that they can consume quite a bit of energy. Refrigeration for homes and offices accounts for nearly 10% of the world's energy usage, and roughly 60% of all the electrical power generated in the US is consumed by electric motors.

Designers are using 32-bit MCUs to add sophisticated motor control to their systems, and thereby improving efficiency, reducing cost, and saving energy. In consumer appliances, for example, the trend is away from motors that cycle on and off (and require high starting torque) and more toward smaller, electrically-controlled motors that operate continuously, at a slower speed, and adapt their torque (and speed) to maintain the desired performance. These new, electrically-controlled motors save power and, as an added bonus, reduce maintenance and extend service life because they use fewer mechanical components.

### NXP Advantage

Design challenges for electric motors include finding ways to improve accuracy, increase speed, reduce power consumption, limit electromagnetic interference (EMI), lower cost, and expand the number of tasks the system can perform. NXP's 32-bit ARM MCUs meet all of these challenges. They offer ample performance with integrated options specially tailored to motor control:

- All the ARM MCUs integrate general-purpose PWMs for basic motor control
- Four families offer 6-channel PWMs for control of three-phase motors (LPC21xx, LPC22xx, LPC23xx, LPC24xx)
- Three families offer dedicated motor-control PWMs (LPC29xx, LPC32x0, LPC17xx)
- Two families offer a Quadrature Encoder Interface (QEI) for very precise control (LPC29xx, LPC17xx)

Many of today's motor-control applications use 8- or 16-bit MCUs or DSPs. Designers looking to upgrade to 32-bit performance will find plenty of choices in NXP's portfolio. Our MCUs offer a range of motor-control options, in a wide variety of formats:

- Package sizes from 48 to 320 pins
- Memories from 8KB to 1MB of flash, with flashless options
- Clocks from 1kHz to 267MHz
- Integrated ADCs in 10- and 12-bit formats, for Field Oriented Control (FOC)
- Built-in peripherals, including Ethernet, USB, LCD, and CAN

### General-Purpose PWMs with 2 or 3 Channels

General-purpose Pulse Width Modulators (PWMs) with two or three channels are often used for basic motor control. They are well-suited for use with universal, brushed DC, and other single-phase motors and are a good choice for low-cost applications that require only limited features. All NXP ARM MCUs have built-in 2- or 3-channel PWMs and can provide basic motor-control functions.

### General-Purpose PWMs with 6 Channels

MCUs equipped with six or more general-purpose PWMs can be used for simple but powerful control of three-phase motors. They can be programmed to provide edge or center alignment, which helps reduce power consumption and EMI noise. Six-channel PWMs are available with the LPC21xx, LPC22xx, LPC23xx, and LPC24xx families.

### Dedicated PWMs for Motor Control

For designs that need good performance at a low cost, the LPC32xx, LPC17xx, and LPC29xx families integrate dedicated motor-control PWMs. The dedicated PWMs dramatically reduce CPU load (they require, in many cases, only 1% of the CPU's capabilities), so the MCU is free to perform lots of other tasks at the same time.

The LPC32xx and the LPC17xx use the same PWM architecture (nine channels with the LPC32xx; six with the LPC17xx). The LPC29xx family uses a special PWM architecture designed for higher precision. With 24 PWM channels, it offers greater flexibility and supports dual-edge control and dead-band insertion.

## Quadrature Encoder Interface (QEI)

For high-performance applications that require more intelligent algorithms (and thus higher computational power), the LPC29xx and LPC17xx families augment the dedicated motor-control PWMs with a quadrature encoder interface (QEI). The QEI can handle position, direction, and speed monitoring on its own, without involving the CPU. It works with the dedicated motor-control PWMs to monitor the motor's movements and to generate interrupts and aborts as needed.

## Products

### Comparison Table








Below, are NXP's ARM MCUs featuring dedicated PWMs for motor control and Quadrature Encoder Interfaces (QEIs):

Product(s)	ARM Core	Motor Control PWM (# Channels)	Quadrature Encoder Interface
<a href="#">LPC29xx</a>	ARM968E-S	24	✓
<a href="#">LPC32x0</a>	ARM926EJ	9	
<a href="#">LPC17xx</a>	Cortex-M3	6	✓

## 80C51-Based MCUs with Dedicated Motor Control PWMs

Click  for [datasheet](#). Also, see [datasheet disclaimer](#).

✓, ⚠, ✗ indicate product status. Click  or  for more or less detail.










 <a href="#">P89LPC932A1</a> ✓	Microcontroller with 8KB 3V flash, 512-byte data EEPROM
 <a href="#">P89LPC9321</a> ✓	Microcontroller with 8KB 3V flash, 512-byte data EEPROM, accelerated core
 <a href="#">P89LPC935</a> ✓	Microcontroller with 8KB 3V flash, 8-bit ADCs, 4 PWMs,
 <a href="#">P89LPC9351</a> ✓	Microcontroller with 8KB 3V flash, 512-byte data EEPROM, accelerated core, 8-bit ADC
 <a href="#">P89LPC936</a> ✓	Microcontroller with 16KB 3V flash, 8-bit ADCs, 4 PWMs,
 <a href="#">P89LPC938</a> ✓	Microcontroller with 8KB 3V flash, 10-bit A/D converter, 4 PWMs, I <sup>2</sup> C and SPI and UART interfaces
 <a href="#">P89LPC9408</a> ✓	Microcontroller with 8KB 3V byte-erasable flash, 32 segment x 4 LCD driver, 10-bit ADC

Refine These with the [80C51 Core MCUs Parametric Filter](#)

## ARM9-Based MCUs with Dedicated Motor Control PWMs

Click  for [datasheet](#). Also, see [datasheet disclaimer](#).

✓, ⚠, ✗ indicate product status. Click  or  for more or less detail.

 <a href="#">LPC2917/01</a> ⚠	ARM968E-S microcontroller with 512KB flash, 56KB SRAM, 2 CAN channels, 2 LIN masters
 <a href="#">LPC2919/01</a> ⚠	ARM968E-S microcontroller with 768KB flash, 56KB SRAM, 2 CAN channels, 2 LIN masters
 <a href="#">LPC2921</a> ⚠	ARM968E-S microcontroller with 128KB flash, CAN, USB device
 <a href="#">LPC2923</a> ⚠	ARM968E-S microcontroller with 256KB flash, CAN, USB device
 <a href="#">LPC2925</a> ⚠	ARM968E-S microcontroller with 512KB flash, CAN, USB device
 <a href="#">LPC2927</a> ⚠	ARM968E-S microcontroller with 512KB flash, CAN, LIN, USB OTG device
 <a href="#">LPC2929</a> ⚠	ARM968E-S microcontroller with 768KB flash, CAN, LIN, USB OTG device
 <a href="#">LPC2930</a> ⚠	ARM968E-S flashless microcontroller CAN, LIN, USB OTG host
 <a href="#">LPC2939</a> ⚠	ARM968E-S microcontroller with 768KB flash, CAN, LIN, USB OTG host