

Selection guide for the 80C51 microcontroller family

Now you can choose among the largest selection of feature-rich 80C51 derivatives in the world.

Philips has developed the broadest line of derivative devices in the industry, all based on the 80C51 core architecture. Designed for real-time applications, these 80C51 derivative products are used in applications ranging from consumer products and computer peripherals to automotive systems and aerospace designs.

When you need a full range of memory options for your microcontroller applications, turn to Philips 80C51 derivatives for: FLASH, OTP-EPROM, and ROM from 1K to 64K, and ROMless versions that can address up to 64K bytes of external memory.

For applications operating on battery power, low-power devices are essential. Philips has a growing family of 80C51 microcontrollers that operate as low as 2.7V. For applications requiring lower voltage, the 8XCL51 family operates as low as 1.8V—significantly lower than most other 80C51 microcontrollers on the market. Philips' low-power microcontrollers also have idle and power-down modes that can reduce total power consumption and allow you to get maximum battery life from your application. Philips has also reduced the supply current of the 80C51/52/54/58 and FX series by 50%. So, Philips' low-power microcontrollers give you an important advantage over your competitors.

Because today's 8-bit designs require increasing performance, Philips has added 80C51 devices with increased performance and additional features. However, many designs require a dramatic performance increase. These designs can only be satisfied by a powerful 16-bit core. Recognizing the fact that thousands of customers currently use 80C51 in their applications and have a considerable investment in code libraries and development tools, Philips created a 16-bit architecture that enables customers to leverage their investment and move to 16-bit performance along an upwardly compatible growth path. The Philips eXtended Architecture (XA) enables the migration of 80C51 devotees to 16-bit microcontroller designs. The XA is much more than a simple 16-bit extension of the 80C51; it provides four to five times the performance of an 8-bit 80C51 running at the same clock frequency, with the same source code. The XA provides a 16-bit performance punch that many of today's applications demand while maintaining the 80C51 development investment.

To make your selection of Philips 80C51 derivative microcontrollers easy, the following pages summarize the available devices in seven key categories. A complete listing of the full family of Philips 80C51 microcontrollers, divided by memory size, may be found on the last four pages of this brochure. Each category features key design solutions and highlights individual product features.

These feature categories include:

Memory and Speed

Devices listed in this section by memory size include the 8XC750, the smallest 80C51 with 1K of ROM/OTP, to the largest memory device 8XCE560 and P8XC51RD+ with 64K ROM/OTP/FLASH. For applications requiring a small package footprint, Philips offers the PQFP and the 7XX series in the very small SSOP. Speeds are on the increase with most devices specified for 33MHz and 750 at 40MHz.

Counters/Timers

Philips offers the widest selection of derivatives with built-in counters and timers including Watchdog timers and Programmable Counter Arrays (PCA).

Serial Interface

Offering more serial interface options than any other supplier, Philips microcontrollers feature I²C, UART, enhanced UART, and CAN bus interface options to meet your needs.

Low Voltage Operation

Philips offers a full family of low voltage derivatives including low volt OTP devices optimized at 16MHz.

Analog Features

With a variety of devices featuring 8- and 10-bit A/D converters, Philips has the products to meet your specific analog-to-digital application needs.

Protection Capabilities and Reduced EMI/RFI

Philips offers several built-in protection circuits such as Watchdog timers, oscillator failure detection, and low V_{CC} detection capabilities. And, as the demand for reduced EMI products rises, Philips family of devices with low EMI/RFI grows to meet that demand.

Additional Features

Many of Philips unique additional features are detailed in this section including: On-Screen Display, Universal Peripheral Interface, and Smart Card.

Microcontroller Characteristic Guide

Philips created the *Microcontroller Characteristic Guide* as a quick-reference for the full line of Philips 80C51 derivatives.

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MEMORY AND SPEED

The Philips family of 80C51 derivative microcontrollers provides the broadest range of memory and speed capabilities offered by any supplier.

OTP-EPROM

Philips offers more OTPs than any other microcontroller supplier, providing effective solutions for prototyping, low- and high-volume production runs, and applications requiring unique codes.

At each step of the design cycle, Philips' broad range of user-programmable devices provides outstanding flexibility and choice. From the software development stage through device emulation and the system debug stage, our FLASH devices are the most effective solutions to your design challenges. Because these devices are electrically erasable, you can reuse them until your design is perfected.

Early in the production phase, OTP microcontrollers are ideal because they provide the flexibility to make software changes quickly and easily. In many applications, OTP devices are being used for volume production runs because they allow you to respond quickly to changes in production requirements. And, if you have to make a software change during production, OTP devices allow you to put the software changes into production at a lower cost-because there are no NRE (Non-Recurring Engineering) charges, no work-in-process charges, no need to scrap large amounts of inventory, and none of the long lead times required by mask devices. Best of all, OTP microcontrollers mean you can respond to your market quickly.

FLASH

FLASH microcontrollers offer maximum flexibility in user programmability. FLASH microcontrollers can be electrically erased and reprogrammed again and again. As a user you can determine when in the production flow the devices should be programmed. And if revisions are needed, the device can be reprogrammed with new updated software.

The FLASH devices can be programmed with the standard parallel programmer or depending on the device they can be serially programmed. Parallel programmable devices are primarily programmed out of the application. The device is probably mounted on the PC board in a socket. To upgrade the devices software, the device is removed from the socket, reprogrammed, and then put back into the socket. Programming the device out of the application eliminates the requirement to have circuitry on the PC board to enable programming. The P89C51RX+ Family, P89C738, P89C138, P89C238, and P89C132 can be parallel programmed.

Serial programming devices makes it simpler to program devices permanently mounted on the PC board and reduces the amount of

programming hardware when compared to the Parallel method. There are two Serial programming methods. First method is controlled external to the application. This normally is done through the use of an external connector mounted on the PC board. The P89C138/238 uses this method.

The other serial programming method uses the device to control the programming. The code is updated through the standard UART or I/O configured as the serial port. In this method the processor handles the communication to call the program updates and then erases and programs the FLASH memory. A minimum of programming hardware has to be added to accomplish the erase and reprogram. Small sections of code can be changed in the P89C51RX+ and P89C132. The boot handler can be customized by the user depending on the application requirements.

EEPROM

EEPROM memory means you decide when you want to program-either in circuit or in a programmer.

With the Philips 8XC864, 8XC858, 8XC855, 83C852 and 8XC851 we are now offering a range of 80C51 microcontrollers that have EEPROM data memory. The EEPROM data memory that stores critical data even when the power is turned off.

Speed and Performance

Philips has extended its line of high performance 80C51 microcontrollers that run at speeds up to 33MHz and, additionally, offers the 8XC750 which operates at 40MHz. This means you may not have to move up to a more expensive microcontroller architecture to get the processing power required. These new microcontrollers which operate at speeds up to 33MHz require 50% less supply currents than previous designs.

If your design requires low power dissipation and speed is not that important, you can select from devices that operate down to 0 frequency, feature static operation, and operate down to 2.7V or 1.8V. Philips developed processing capability that yields high speed and low voltage operation. Philips is the first to offer OTPs with 2.7V operation without sacrificing speed. Philips has extended the performance features of standard devices (8XC51/52/54/58 and FX series) to operate down to 2.7V.

If your design requires more performance than you can obtain from the 80C51 product line, you can select from a compatible, high-performance, 16-bit microcontroller family. The Philips eXtended Architecture (XA) family of microcontrollers offers 10 to 100 times the performance of the 80C51 allowing an easy migration up the performance curve.

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MEMORY AND SPEED

Memory Size	Part Number	OTP-FLASH EPROM (bytes)	ROM (bytes)	RAM (bytes)	External Memory Capability	Speed (MHz) Min–Max	Comments/Special Features
1K	87C750/83C750	1K	1K	64	No	3.5–40	40MHz, 24-Pin Skinny DIP and SSOP
2K	87C748/83C748	2K	2K	64	No	3.5–16	24-Pin Skinny DIP Package and SSOP
	87C751/83C751	2K	2K	64	No	3.5–16	24-Pin Skinny DIP Package and SSOP
	87C749/83C749	2K	2K	64	No	3.5–16	Pulse Width Modulation and SSOP
	87C752/83C752	2K	2K	64	No	3.5–16	Pulse Width Modulation and SSOP
4K	87C754/83C754	4K	4K	256	No	3.5–16	8-bit DAC, Comparator, Reference and MUX Input
	87C51/80C51/80C31	4K	4K	128	Yes	0–33	ROM/ROMless: 2.7V to 5.5V @ 16MHz; Freq. to 0Hz
	80CL51/80CL31	4K	4K	128	Yes	0–16	Low Voltage/Power (1.8V to 6V)
	83CL410/80CL410	4K	4K	128	Yes	0–12	Low Voltage/Power (1.8V to 6V)
	87C451/83C451/80C451	4K	4K	128	Yes	3.5–16	7 I/O Ports, Processor Bus Interface
	87C550/83C550/80C550	4K	4K	128	Yes	3.5–16	Watchdog Timer to reset the microcontroller
	83C851/80C851	4K	4K	128	Yes	1.2–16	256 Bytes EEPROM, 80C51 Pin-Compatible
6K	83C852/80C852	6K	6K	256	No	1–6	Smart Card, 2K EEPROM, CCU
	83CL580/80CL580	6K	6K	256	Yes	0–12	Watchdog Timer, Pulse Width Modulation, Low Voltage (2.5V to 6V)
8K	89C52/87C52/80C52/80C32	8K	8K	256	Yes	0–33	2.7V to 5.5V @ 16MHz; Freq. to 0Hz
	83C845		8K	256	No	3.5–12	OSD, 9 Pulse Width Modulation output
	S87C652/P83C652/P80C652	8K	8K	256	Yes	1.2–24	I ² C Serial Bus
	87C51FA/83C51FA/80C51FA	8K	8K	256	Yes	0–33	Industry Standard; 2.7V to 5.5V @ 16MHz; Freq. to 0 Hz
	89C51RA+/87C51RA+/83C51RA+/80C51RA+	8K	8K	512	Yes	0–33	2.7 to 5.5V @ 16MHz; Freq. to 0Hz; FLASH (89) 5V only
	87C575/83C575/80C575	8K	8K	256	Yes	4–16	8XC575/8XC576 extended Feature Set includes Low V _{CC} Detect, Low Active Reset, Oscillator Fail Detect, Reduced EMI and 4 Analog Comparators.
	87C576/83C576/80C576	8K	8K	256	Yes	6–16	UPI, on-board programming, 8XC575/8XC576 extended Feature Set includes Low V _{CC} Detect, Low Active Reset, Oscillator Fail Detect, Reduced EMI and 4 Analog Comparators.
	83C562/80C562	—	8K	256	Yes	8.5–16	Pulse Width Modulation, Watchdog Timer, Capture/Compare Counter/Timer with High Speed Output
	87C552/83C552/80C552	8K	8K	256	Yes	1.2–30	Pulse Width Modulation, Watchdog Timer, Capture/Compare Counter/Timer with High Speed Output
	87C453/83C453	8K	8K	256	Yes	3.5–16	Processor bus interface
12K	83C145		12K	256	No	3.5–12	OSD, 9 Pulse Width Modulation output

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MEMORY AND SPEED (continued)

Memory Size	Part Number	OTP-FLASH EPROM (bytes)	ROM (bytes)	RAM (bytes)	External Memory Capability	Speed (MHz) Min–Max	Comments/Special Features
16K	87C055/83C055	16K	16K	256	No	3.5–12	Reduced EMI, OSD, 9 PWM Outputs
	89C54/87C54/80C54	16K	16K	256	Yes	0–33	2.7V to 5.5V @ 16MHz; Freq. to 0Hz (Ex. (89C))
	S87C654/P83C654	16K	—	256	Yes	1.2–24	I ² C Serial Bus
	83CL781	—	16K	256	Yes	0–12	Low Voltage/Power (1.8V to 6V)
	83CL782	—	16K	256	Yes	0–12	83CL781 optimized for 12MHz @ 3.1V
	87C51FB/83C51FB	16K	16K	256	Yes	0–33	Industry Standard; 2.7V to 5.5V @ 16MHz; Freq. to 0Hz
	89C51RB+/87C51RB+/ 83C51RB+	16K	16K	512	Yes	0–33	2.7V to 5.5V @ 16MHz; Freq. to 0Hz; FLASH 5V only
	87C524/83C524	16K	—	512	Yes	1.2–16	512 RAM, Watchdog Timer
	83C858	—	16K	512	No	1.2–10	8K Bytes EEPROM, Smart Card
83C592/80C592	16K	16K	512	Yes	1.2–16	CAN 2.0A, Watchdog Timer, Capture/Compare Counter/Timer with High Speed Output, PWM	
32K	89C58/87C58/80C58	32K	32K	256	Yes	0–33	2.7V to 5.5V @ 16MHz; Freq. to 0Hz
	87C51FC/83C51FC	32K	32K	256	Yes	0–33	Industry Standard, 2.7V to 5.5V @ 16MHz;
	89C51RC+/87C51RC+/ 83C51RC+	32K	32K	512	Yes	0–33	Freq. to 0Hz; FLASH (89C) 5V only
	87C528/83C528/80C528	32K	32K	512	Yes	2.5–20	Large memory for high level languages, Watchdog Timer
	83CE598/80CE598	32K	32K	512	Yes	1.2–16	CAN bus, Watchdog Timer, T2, PWM, reduced EMI
	89CE558/83CE558/80CE558	32K		1024	Yes	3.5–16	Watchdog Timer, Pulse Width Modulation, Low EMI
64K	89C51RD+/87C51RD+/ 83C51RD+	64K	6K	1024	Yes	0–33	2.7V to 5.5V; Freq. to 0Hz; FLASH 5V only
XA Family							
32K	P51XAG30/G37/G33	32K	32K	512	Yes	0–30	High performance, 16-bit 80C51 compatible
	P51XAS3		32K	1024	Yes	30	16MByte Address Range

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COUNTERS/TIMERS

To better meet your design needs, Philips offers a wide range of timer configurations on many of its microcontrollers, including the three standard 16-bit 80C51 timers: Timer 0, Timer 1, and Timer 2. We also offer enhancements to these standard timers on selected products that feature other specialized timers, such as PCAs and hardware Watchdog timers.

PCA

The Philips PCA (Programmable Counter Array) is identical in function to the industry-standard PCA and offers significant timing advantages over standard 80C51 timers.

A PCA is a special timer with up to five associated 16-bit capture/compare modules. Offered as an integral part of the device to enable you to simplify your software design, each module of the PCA can be programmed individually to operate in one of four modes: rising- and/or falling-edge capture, software timer, high-speed output, or pulse width modulator. And each PCA module has an associated pin in Port 1 which you can use as input or output for that module.

All of our microcontrollers that feature a PCA, such as the 8XC51FX and 8XC51RX+ family, the 8XC754, the 8XC575 and the 8XC576,

are ideal for applications requiring pulse width modulation, high-speed I/O, and counting capabilities. Some key applications most likely to benefit from the PCA are automotive control, cellular and cordless phones, high-end storage device controls, instrumentation, medical diagnostics, power supply control and sequencing, and monitoring equipment.

Hardware Watchdog Timer

The Philips hardware Watchdog timer assures you that the microcontroller in your application will continue to operate properly.

Watchdog timers protect your design from disruptions to microcontroller execution, which can be caused by voltage spiking or other external conditions. If a Watchdog timer is allowed to overflow, it will reset the microcontroller. To prevent an overflow, a Watchdog timer must be cleared before it overflows. A specific load sequence is used to clear the timer so it can't be cleared accidentally. The time-out period for the Philips Watchdog timer is adjustable from 2,000 instruction cycles to 512,000. (See also Protection Capabilities section for more information on the special features of the Philips Watchdog timer.)

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COUNTERS/TIMERS

Device		Timer Types					Capture	Compare	High-speed Outputs
1 Timer	87C750/83C750	ET0							
	87C751/83C751	ET0							
	87C752/83C752	ET0							
2 Timers	87C748/83C748	ET0	TR						
	87C749/83C749	ET0	TR						
	87C51/80C51/80C31	T0	T1						
	80CL51/80CL31	T0	T1						
	83CL410/80CL410	T0	T1						
	87C451/83C451/80C451	T0	T1						
	87C550/83C550/80C550	T0	T1						
	83C851/80C851	T0	T1						
	83C852/80C852	T0	T1						
	S87C652/P83C652/P80C652	T0	T1						
	87C453/83C453/80C453	T0	T1			Watchdog			
	87C055/83C055	T0	T1						
	S87C654/P83C654	T0	T1						
	83C845	TO	TI						
83C145	TO	TI							
3 Timers	83CL580/80CL580	T0	T1	T2		Watchdog	X		
	87C52/80C52/80C32	T0	T1	T2			X		
	89C52/87C552/83C562/80C562	T0	T1	ST2		Watchdog	X	X	
	87C552/83C552/80C552	T0	T1	ST2		Watchdog	X	X	
	89C54/87C54/80C54	T0	T1	T2					
	83CL781	T0	T1	T2			X		
	83CL782	T0	T1	T2			X		
	87C524/83C524	T0	T1	T2		Watchdog	X		
	87C592/83C592/80C592	T0	T1	T2		Watchdog	X	X	
	89C51RB+/87C51FC/83C51FC	T0	T1	T2	PCA	X	X	X	
	87C528/83C528/80C528	T0	T1	T2		Watchdog	X		
	83CE598/80CE598	T0	T1	T2		Watchdog	X	X	
	87CE558/83CE558/80CE558	T0	T1	ST2		Watchdog	X	X	
87C754/83C754	T0	T1	PCA	X	X	X			
4 Timers	87C51FA/83C51FA/80C51FA	T0	T1	ET2	PCA	X	X	X	
	89C51RA+/87C51RA+/83C51RA+/80C51RA+	T0	T1	ET2	PCA	Watchdog	X	X	
	87C575/83C575/80C575	T0	T1	ET2	PCA	Watchdog	X	X	
	87C576/83C576/80C576	T0	T1	ET2	PCA	Watchdog	X	X	
	87C51FB/83C51FB	T0	T1	ET2	PCA	X	X	X	
	87C51FC/83C51FC	T0	T1	ET2	PCA	X	X	X	
4 Timers	89C51RB+/87C51RB+/83C51RB+	T0	T1	ET2	PCA	Watchdog	X	X	
	89C51RC+/87C51RC+/83C51RC+	T0	T1	ET2	PCA	Watchdog	X	X	
	89C51RD+/87C51RD+/83C51RD+	T0	T1	ET2	PCA	Watchdog	X	X	
XA Family									
4 Timers	P51XAG30/G37/G33	ET0	ET1	ET2		Watchdog	X		X
	P51XAS3	ET0	ET1	ET2	PCA	Watchdog	X		X

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SERIAL INTERFACE

Philips microcontrollers offer a broad range of serial communication protocols. These serial interfaces are designed to meet all the different performance and cost requirements of your design.

UART/Enhanced UART

The 80C51 UART is an interface for microcontrollers that provides all the features you need to implement simple serial communication. The 80C51 UART is bi-directional and can simultaneously send and receive data. The 80C51 UART is the serial I/O most often used on 80C51 microcontrollers.

Philips also offers the Enhanced 80C51 UART on selected microcontrollers. Enhanced UART has all the standard UART functions plus framing error detection and automatic address recognition.

I²C

Philips I²C, or Inter-Integrated Circuit, is a 2-wire serial communication with unique start-and-stop conditions, bi-directional communication, full synchronization, and multimaster operation.

I²C is primarily used to communicate between two ICs, or multiple ICs in close proximity (13 feet, at 100K bit/sec). By using Philips I²C Bus Extender, P82B715, the communication is increased by a factor of 10 (excess of 130 feet). This enables I²C to be used in applications between a central control box and remote locations.

The Philips proprietary I²C serial bus protocol is an industry standard found in more than 100 products and licensed to more than 30 IC manufacturers.

CAN bus

The CAN (Control Area Network) bus operates well in noisy, harsh environments, such as in industrial and heavy equipment applications, and in numeric control equipment, such as lathes and mills.

The CAN bus is ideal for designs requiring reliable serial communication or multiplexed wiring. The CAN 2-wire serial bus in our 8XC592 and 8XCE598 microcontrollers is able to transmit data at speeds up to 1 million bits per second and over distances of up to 5,000 meters.

The 8XC592 and 8XCE598 are the first members of a growing family of Philips products that support CAN, and we are continually developing new products to add to this family of powerful serial interface parts.

High-Speed Serial Interface

For very high-speed data transmission between the CPU and other peripheral devices, the 8-bit, 3-wire serial I/O features a maximum speed of 1MHz baud rate. Other features include an interrupt generated whenever a complete byte has been sent or received, baud rate clocks, Schmitt trigger inputs on clock and data-in ports, and software-select of LSB or MSB first.

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Device	UART	Enhanced UART	I ² C Bit	I ² C Byte	CAN Bus	High-speed Serial	Comments/Special Features
87C751/83C751			X				24-Pin Skinny DIP Package and SSOP
87C752/83C752			X				Pulse Width Modulation and SSOP
87C754/83C754		X					8BIT DAC, Comparator, Reference and MUX Input
87C51/80C51/80C31		X					Operation at 2.7V to 5.5V @ 16MHz
80CL51/80CL31	X						Low Voltage/Power (1.8V to 6V)
83CL410/80CL410				X			Low Voltage/Power (1.8V to 6V)
87C451/83C451/80C451	X						7 I/O Ports, Processor Bus Interface
87C550/83C550/80C550	X						Watchdog Timer to reset the microcontroller
83C851/80C851	X						256 Bytes EEPROM, 80C51 Pin-Compatible
83CL580/80CL580	X			X			Watchdog Timer, Pulse Width Modulation, Low Voltage (2.5V to 6V)
89C52/87C52/80C52/80C32		X					Operation at 2.7V to 5.5V @ 16MHz
S87C652/P83C652/P80C652	X						I ² C Serial Bus
87C51FA/83C51FA/80C51FA		X					Industry Standard
89C51RA+/87C51RA+ /83C51RA+/80C51RA+		X					512 RAM & WD
87C575/83C575/80C575		X					See Extended Feature Set below*
87C576/83C576/80C576		X					See Extended Feature Set below*, plus UPI, on-board programming
83C562/80C562	X						Pulse Width Modulation, Watchdog Timer, Capture/Compare Counter/Timer
87C552/83C552/80C552	X			X			Pulse Width Modulation, Watchdog Timer, Capture/Compare Counter/Timer
87C453/83C453/80C453		X					Processor bus interface
89C54/87C54/80C54		X					Operation at 2.7V to 5.5V @ 16MHz
S87C654/P83C654	X			X			I ² C Serial Bus
83CL781	X			X			Low Voltage/Power (1.8V to 6V)
83CL782	X			X			83CL781 optimized for 12MHz @ 3.1V
87C51FB/83C51FB		X					Industry Standard
89C51RB+/87C51RB+/83C51RB+		X					512 RAM & WD
87C524/83C524	X		X				512 RAM, Watchdog Timer
87C592/83C592/80C592	X					X	CAN 2.0A, Watchdog Timer, Capture/Compare Counter/Timer, Pulse Width Modulation
89C58/87C58/80C58		X					Operation at 2.7V to 5.5V @ 16MHz
87C51FC/83C51FC		X					Industry Standard
89C51RC+/87C51RC+/83C51RC+		X					512 RAM & WD
87C528/83C528/80C528	X		X				Large memory for high level languages, Watchdog Timer
83CE528	X		X				Reduced EMI version of 8XC528
83CE598/80CE598		X				X	CAN bus, Watchdog Timer, Capture/Compare Counter/Timer, Pulse Width Modulation, reduced EMI
87CE558/83CE558/80CE558	X			X			Watchdog Timer, Pulse Width Modulation, Low EMI
89C51RD+/82C51RD+/83C51RD+		X					1K RAM, Watchdog Timer
XA Family							
P51XAG30/G37/G33		X (2)					2 enhanced UARTs
P51XAS3		X(2)	X				

* Extended Feature Set includes Low V_{CC} Detect, Low Active Reset, Oscillator Fail Detect, Reduced EMI and 4 Analog Comparators.

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LOW VOLTAGE OPERATION

Philips offers 80C51 derivative microcontrollers that have the lowest operating voltages available today. In addition, you can select from devices that operate from 5.5V down to 2.7V or 6V down to 1.8V, with such features as idle and power-down modes and a fully static core. This enables the tailoring of performance for lowest power consumption.

Static and 2.7V/1.8V Operation

Philips offers two voltage range choices for low voltage operation, 2.7V to 5.5V and 1.8V to 6V.

The 8XCLXXX family of devices addresses your need for very low power and very low operating voltage microcontrollers. Our

8XCLXXX family of microcontrollers is designed to operate down to 1.8V and have an operating frequency range from DC to 16MHz. The 8XCL580 is designed to operate down to 2V.

Designed with a static core, the expanding family of 2.7V to 5.5V devices include the mask and OTP-EPROM versions, 87/80C51/52/54/58, ROMless 80C31 and 80C32, and FX series. Philips is planning a broad family of OTPs and will be adding mask devices which have 2.7V to 5.5V operation, all designed with a static core. The fully static core enables the oscillator to be stopped for minimal power consumption and then be restarted easily without complicated restart procedures or loss of data.

LOW VOLTAGE (BROAD RANGE) OTP ROM, AND ROMLESS MICROCONTROLLERS

Device	ROM	OTP	RAM	Operating Voltage Range	Frequency	Fully Static	Timers	Special Features
80C31	—	—	128	2.7–5.5V	DC–16MHz	Yes	2	
80CL31	—	—	128	1.8V–6V	DC–16MHz	Yes	2	80C31 Pin-Compatible, UART
87C51/80C51	4K	4K	128	2.7–5.5V	DC–16MHz	Yes	2	
80CL51	4K	—	128	1.8V–6V	DC–16MHz	Yes	2	80C31 Pin-Compatible, UART
80CL410/83CL410	4K	—	128	1.8V–6V	DC–12MHz	Yes	2	80C31 Pin-Compatible, I ² C
80CL580/83CL580	6K	—	256	2.5V–6V	DC–12MHz	Yes	3+ Watch-dog	4x8-bit A/D, PWM, I ² C, UART
80C32	—	—	256	2.7V–5.5V	DC–16MHz	Yes	3	
87C52/80C52	8K	8K	256	2.7V–5.5V	DC–16MHz	Yes	3	
87C51FA/83C51FA/80C51FA	8K	8K	256	2.7V–5.5V	DC–16MHz	Yes	4	PCA
87C51RA+/83C51RA+/80C51RA+	8K	8K	512	2.7V–5.5V	DC–16MHz	Yes	4	PCA, Hardware Watchdog
87C51RB+/83C51RB+	16K	16K	512	2.7V–5.5V	DC–16MHz	Yes	4	PCA, Hardware Watchdog
87C51RC+/83C51RC+	32K	32K	512	2.7V–5.5V	DC–16MHz	Yes	4	PCA, Hardware Watchdog
87C51RD+/83C51RD+	64K	64K	1024	2.7V–5.5V	DC–16MHz	Yes	4	PCA, Hardware Watchdog
83CL267	12K	—	256	4.5V–5.5V	4MHz–8MHz		3	OSD, 9 PWM Outputs, 4 Channel 4-bit A/D, 9 LED Drivers
83CL268	12K	—	256	4.5V–5.5V	4MHz–8MHz		3	OSD, 9 PWM, Outputs, 4 Channel 4-bit A/D, 9 LED Drivers
87C54/80C54	16K	16K	256	2.7V–5.5V	DC–16MHz	Yes	3	
83CL781	16K	—	256	1.8V–6V	DC–12MHz	Yes	3	UART, I ² C
83CL782	16K	—	256	1.8V–6V	DC–12MHz	Yes	3	Optimized for 12MHz@3.1V, UART, I ² C
87C51FB/83C51FB	16K	16K	256	2.7V–5.5V	DC–16MHz	Yes	4	PCA
83CL167	16K	—	256	4.5–5.5V	4MHz–8MHz		3	OSD, 9 PWM Outputs, 4 Software A/D Inputs, 8 LED Drivers
83CL168	16K	—	256	4.5–5.5V	4MHz–8MHz		3	OSD, 9PWM Outputs, 4 Software A/D Inputs, 8 LED Drivers
87C51FC/83C51FC	32K	32K	256	2.7V–5.5V	DC–16MHz	Yes	4	PCA
XAFamily								
P51XAG30/G33	32K	—	512	2.7–5.5V	0–30MHz	Yes	3+ Watch-dog	High performance, 16-bit, 80C51 compatible
P51XAS3		32K	1024	2.7V–5.5V	0–30MHz	Yes	4	16Mbyte Address Range

Selection guide for the 80C51 microcontroller family

ANALOG FEATURES

Philips offers a variety of 80C51 derivative microcontrollers with on-board, 8-bit and 10-bit A/D converters. Also offered are 80C51 derivatives with 8-bit DAC, Pulse Width Modulated (PWM) output, and those with precision comparators.

Analog-to-Digital Converters

Philips offers 8-bit and 10-bit analog-to-digital (A/D) and digital-to-analog converters (D/A). The A/Ds have multiplexed inputs which enable the selection of up to eight analog sources, and a sample-and-hold front end, making it easier for high frequency measurement. Each input has a high input impedance to reduce loading, resulting in a more accurate measurement.

Pulse Width Modulation (PWM)

The Pulse Width Modulated output allows wave forms to be generated with a very precise frequency and duty cycle. The PWM

output offers two features that provide a wide degree of design flexibility: variable frequency and adjustable duty cycle. For the 8-bit PWM, the duty cycle is adjustable from 0% to 100% in 255 steps. These PWM outputs are useful in the design of low cost digital-to-analog converters and, with a comparator, an analog-to-digital converter can be designed.

Comparators

Philips integrated precision comparators provide low-input offset and high flexibility. To reduce the number of external components, Philips has integrated four comparators on the 8XC575 and 8XC576 and one on the 8XC754 which can be used for many functions, such as low cost A/D conversion and cross-over detection.

ANALOG FEATURES

Device	Analog-to-Digital		Pulse Width Modulation		Number of Comparators
	Bits	Multiplexed Inputs	# PWM Timers	Frequency Range @12MHz	
83C749/87C749	8	5	1 8-bit	90Hz–23.5KHz	
83C752/87C752	8	5	1 8-bit	90Hz–23.5KHz	
83C754/87C754			1 8-bit (PCA)	15Hz–11.7KHz	1
80C550/83C550/87C550	8	8	1 8-bit	90Hz–23.5KHz	
80CL580/83CL580	8	4	1 8-bit	90Hz–23.5KHz	
83C145			5 8-bit (PCA)	15Hz–11.7KHz	
80C562/83C562	8	8	2 8-bit	90Hz–23.5KHz	
80C552/83C552/87C552	10	8	2 8-bit	90Hz–23.5KHz	
80C592/83C592/87C592	10	8	2 8-bit	90Hz–23.5KHz	
80CE598/83CE598/87CE598	10	8	2 8-bit	90Hz–23.5KHz	
80CE558/83CE558/89CE558	10	8	2 8-bit	90Hz–23.5KHz	
80C575/83C575/87C575			5 8-bit (PCA)	15Hz–11.7KHz	4
80C576/83C576/87C576	10	6	5 8-bit (PCA)	15Hz–11.7KHz	4
83C845			5 8-bit (PCA)	15Hz–11.7KHz	
80C51FA/83C51FA/87C51FA			5 8-bit (PCA)	15Hz–11.7KHz	
80C51RA+/83C51RA+ /87C51RA+/89C51RA+			5 8-bit (PCA)	15Hz–11.7KHz	
83C51FB/87C51FB			5 8-bit (PCA)	15Hz–11.7KHz	
83C51RB+/87C51RB+/89C51RB+			5 8-bit (PCA)	15Hz–11.7KHz	
83C055/87C055			1 14-bit/8 6-bit (MTV)	60Hz–47KHz	
83CL267/83CL268	4	4	1 14-bit/4 6-bit/ 4 7-bit	90Hz–20KHz@8MHz	
83CL167/83CL168	4	4	1 14-bit/4 6-bit/ 4 7-bit	90Hz–20KHz@8MHz	
83C51FC/87C51FC			5 8-bit (PCA)	15Hz–11.7KHz	
83C51RC+/87C51RC+/89C51RC+			5 8-bit (PCA)	15Hz–11.7KHz	
83C51RD+/87C51RD+/89C51RD+			5 8-bit (PCA)	15Hz–11.7KHz	
P51XAS3	10	8	4 8-bit (PCA)		

Selection guide for the 80C51 microcontroller family

PROTECTION CAPABILITIES AND REDUCED EMI/RFI

The Philips family of microcontrollers that contains extremely low levels of EMI and RFI can result in easier FCC certification, lower board design costs, simpler shielding solutions, easier power and ground layout, and reduced cross-talk. In addition, Philips offers protection circuits, such as Watchdog timers, oscillator-failure detection, and low-voltage detection, giving you shorter design cycles, lower system costs, and no external component requirements.

Protection Circuits for High Reliability

Reliability is always a key design concern. This concern is amplified when a circuit is used in life-critical applications such as medical instrumentation, aboard aircraft or on vehicles where circuit lock-up could be disastrous. And, in industrial applications, the failure of one component could shut down an entire production line. Philips offers a wide range of protection circuits that addresses these concerns with a sophisticated set of built-in, hardware-based protection circuits that enhance your system's fault tolerance and improve its reliability: a Watchdog timer, low voltage detection, and oscillator failure detection.

Watchdog Timer

The Philips Watchdog timer is designed to be fail-safe. The Watchdog timer actually resets the microcontroller within a programmable time if the microcontroller enters any potentially fatal processor state. If the user program fails to reload the Watchdog timer within a specified time, the Watchdog circuitry automatically generates a system reset. Protection circuits, such as the Philips Watchdog timer, greatly increase a designer's confidence that the microcontroller will reliably recover from any uncontrolled situations.

Because Philips Watchdog timers are hardware configured, they cannot be corrupted by software-based problems or events that often can occur in microcontroller applications. For added flexibility, the Watchdog timer offers an adjustable time-out period, from 2ms to 512ms at 12MHz oscillator depending on the demands of your applications. (See also Counters/Timers section for more information on the special features of the Philips Watchdog timer.)

Failure Detection Circuits

Other protection features integrated into the Philips products with Watchdog timers are Oscillator Failure Detection (OFD) and Low Voltage Detection. Like the Watchdog timer, these features generate a reset if the oscillator frequency slows below a predefined frequency range or if voltage levels to the part are reduced.

Our integrated protection features mean you don't have to spend extra design time adding components to protect the microcontroller and system. The result is a highly reliable design featuring reduced part count, quicker time-to-market, and reduced cost.

Reduced EMI

Recognizing the challenges in meeting FCC certification, Philips has developed a family of products that has significantly reduced EMI signatures. By changing the internal circuitry on our reduced EMI microcontrollers, radiated noise is reduced by more than 20dB, especially important for frequencies greater than 100MHz where board-level noise reduction is difficult and expensive to achieve.

With our reduced EMI/RFI devices, your design is simpler, your costs are lower, and your power, ground layout, and shielding are simplified. And by using our reduced EMI/RFI products, you're already a step closer to FCC approval.

One example of our family of reduced EMI/RFI devices is the 8XC575, on which many techniques are used to reduce EMI/RFI to a level that is 100 times lower than emissions from a standard 80C51 microcontroller. And everything we've learned from the 8XC575 has been incorporated into the growing list of reduced EMI/RFI products.

ADDITIONAL FEATURES

To make your designs easier, Philips has several specialty microcontroller products, each offered in a range of packages.

On-Screen Display (OSD)

Philips OSD, featured on our 8XC055, 83C145 and 83C845 and 83C366/566/766, allows you to put text over video easily, and with a surprising degree of color and shading flexibility.

Philips OSD offers a user-defined character set, including font types and sizes, starting position, character matrix, foreground and background colors and shadowing, as well as character blinking ratio and vertical jitter canceling. With Philips OSD you can put as many as 128 characters on screen at a time. Both the number of rows and the number of characters per row are user-defined.

Philips OSD microcontroller capability offers all the design flexibility you need to custom tailor your system. In addition, Philips combines that flexibility with hard-ware that makes OSD simple to include in many different designs.

Universal Peripheral Interface (UPI)

For products that require interface to the ISA bus in personal computer and other host CPU buses, the 8XC451, 87C453, and 8XC576 are ideal because they have the UPI built in. On-board UPI means it's easier for you to design serial I/O controllers, servo controllers, and keyboard scanners.

Smart Card

The Philips Smart Card microcontroller provides features for a range of applications and devices, such as credit cards, electronic keys, medical records, and identification.

Typical access control applications that use Smart Cards are satellite TV networks, mobile phones, computers, pay TV, auto key cards, and electronic keys. Other Smart Card applications are medical records, patient passports, and cash cards. In production markets, Smart Card is used in flow control, tool handling, maintenance, and process control.

Philips' Smart Card microcontroller, the 83C852, features 6K bytes of ROM, 256 bytes of RAM, and 2K bytes of EEPROM. The 83C852 has a cryptographic calculation unit (CCU) to enhance data security, and it comes in a credit card style package or can be purchased in die form.

Also available are the P83C855, P83C858 and P83C864 designed specifically for smart card applications.

Selection guide for the 80C51 microcontroller family

PROTECTION CAPABILITIES AND REDUCED EMI/RFI

Device	Watchdog	Oscillator Failure Detection	Low Voltage Detection	Reduced EMI	Comments/Special Features
80C51/80C31/87C51				X	Operation at 2.7V to 5.5V @ 16MHz
80C550/83C550/87C550	X				8 Channel 8-bit Analog-to-Digital Converter
80CL580/83CL580	X			X	4 Channel 8-bit Analog-to-Digital Converter, Pulse Width Modulation Output, Low Power/Volt (2.5V to 6V)
80C52/80C32/87C52				X	Operation at 2.7V to 5.5V @ 16MHz
83C145				X	OSD, 9 PWM Outputs, 3 Software Analog-to-Digital Converter Inputs
83C51FA/80C51FA/87C51FA	PCA			X	Industry Standard
80C575/83C575/87C575	X	X	X	X	High Reliability, Low V _{CC} /Osc Fail Detect, Analog Comparators, Programmable Counter Array
80C576/83C576/87C576	X	X	X	X	Same as 8XC575 plus UPI and 10-bit Analog-to-Digital Converter
80C562/83C562	X				8 Channel 8-bit Analog-to-Digital Converter, 2 Pulse Width Modulation Outputs, Capture/Compare Timer
80C552/83C552/87C552	X				8 Channel 10-bit Analog-to-Digital Converter, 2 Pulse Width Modulation Outputs, Capture/Compare Timer
83C845				X	OSD, 9 PWM Outputs, 3 Software Analog-to-Digital Converter Inputs
83C055/87C055				X	OSD, 9 PWM Outputs, 3 Software Analog-to-Digital Converter Inputs
80C54/87C54				X	Operation at 2.7V to 5.5V @ 16MHz
83C51FB/87C51FB	PCA			X	Industry Standard
83C524/87C524	X				512 RAM
80C58/87C58				X	Operation at 2.7V to 5.5V @ 16MHz
83C51FC/87C51FC	PCA			X	Industry Standard
80C528/83C528/87C528	X				Large memory for high-level languages
80CE598/83CE598/87CE598	X			X	CAN Bus, 8x10-bit Analog-to-Digital Converter, Low Electro-Magnetic Interference, 2 Pulse Width Modulation Outputs, Enhanced UART
80CE558/83CE558/89CE558	X			X	Low EMI, 8 Channel 10-bit Analog-to-Digital Converter, 2 Pulse Width Modulation Outputs, Capture/Compare
89C51RA+/87C51RA+/ 83C51RA+/80C51RA+	X			X	Double RAM/512 bytes & WD
89C51RB+/87C51RB+/83C51RB+	X			X	Double RAM/512 bytes & WD
89C51RC+/87C51RC+/83C51RC+	X			X	Double RAM/512 bytes & WD
89C51RD+/87C51RD+/83C51RD+	X			X	1KRAM & WD