78K4 family

Product Letter

μPD78403x

16-bit Microcontrollers

Description

The μPD78403x microcontrollers are members of NEC's 16-bit 78K4 family. This family is pin-compatible to the predecessor 78402x and 7823x families. They also offer an easy migration path from NEC's 78K0 8-bit microcontrollers for applications requiring large on-chip memory and high processing performance.

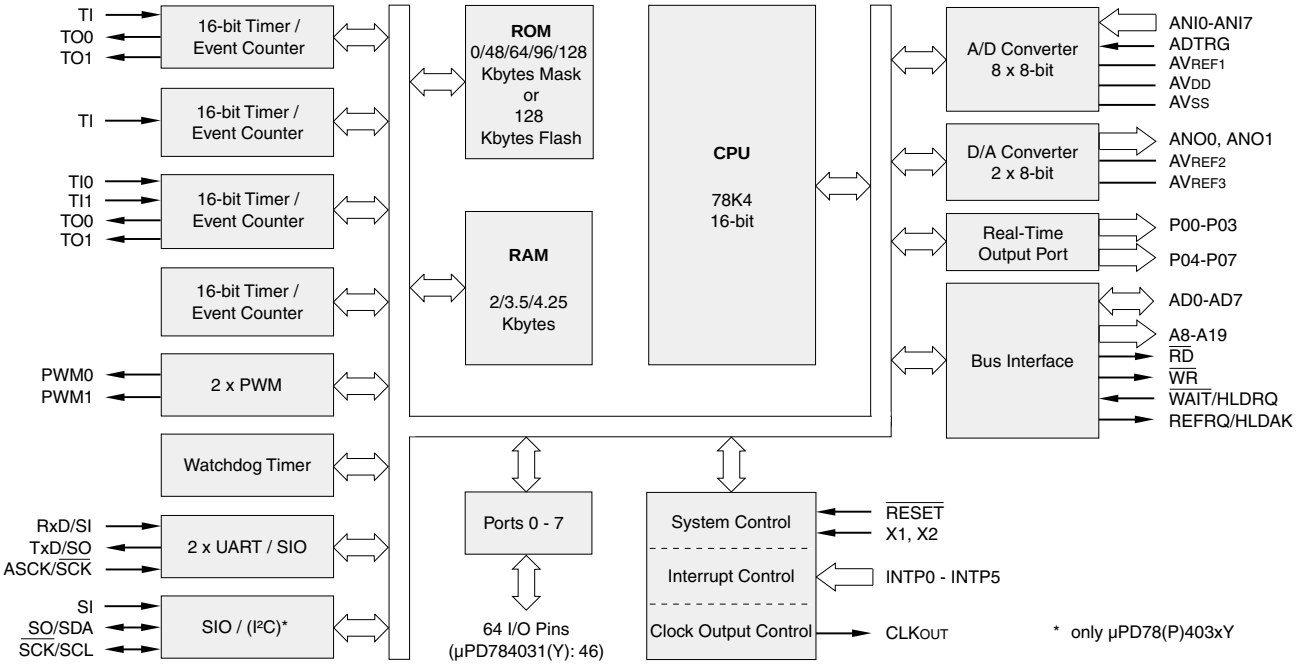
Applications

μPD78403x devices are designed for use in printers, telephones and DC motor control applications.

Features

- ROMless version available
- Up to 128 Kbytes Mask ROM and PROM versions
- Up to 4352 bytes RAM
- 1 Mbyte linear address space
- 125 ns instruction cycle time at 32 MHz
- Bit manipulation over the entire address space
- 3 serial interfaces including 2 UARTs
- I²C interface optional
- 8-channel A/D converter
- 2-channel D/A converter
- 8-channel real-time output port
- 4 x 16-bit timer/counter
- 2-channel PWM output with 12-bit resolution
- 64 I/O pins (46 for ROMless version)
- Interrupt controller (4 programmable priority levels)
- External memory interface with bus hold function
- Clock prescaler
- Standby control (HALT, IDLE, STOP)
- Power supply voltage: 2.7 – 5.5 V
- 80-pin QFP and TQFP packages

Block Diagram



Functional Block Description

CPU

The 78K4 CPU features 8 general register banks with 8 x 16-bit or 16 x 8-bit registers plus 4 x 8-bit registers for 24-bit address expansion. The general-purpose registers are mapped to the internal RAM. Register banks can be switched by software or context switching. Registers can be manipulated in 8-bit units. Pairs of 8-bit general-purpose registers can be manipulated in 16-bit units. For 24-bit address expansion, four of the 16-bit registers can be combined with 8-bit registers. High speed instruction fetch is made possible by a prefetch queue with 5 bytes for internal fetch and 3 bytes for external fetch.

Memory

µPD78403x devices have a 1 Mbyte linear address space and offer an ample choice of on-chip memory combinations, including a ROMless version and a PROM version (see table).

Ports

ROM/PROM-based devices have 8 (8)* input pins, 64 (48)* input/output pins, 24 (8)* of which are capable of directly driving LEDs. 54 (32) input/output pins have internal pull-up resistors that can be enabled via software. 8 port pins can drive Darlington transistors directly.

Real Time Output Ports

An interrupt generated by a timer/counter or an external interrupt causes these ports to output data which has previously been stored in a buffer for a jitter-free pulse output.

A/D Converter

An 8-channel A/D converter with 8-bit resolution is provided on chip using successive approximation. The overall power consumption of the system can be reduced by disabling the A/D resistor chain.

D/A Converter

A 2-channel D/A converter with 8-bit resolution uses the R-2R resistor ladder method. The D/A converter can be used in real-time mode. In this case, analog voltage output is synchronized with the output trigger. This mode allows sine wave generation.

Serial Interfaces

Three serial interfaces include two full-duplex UARTs with on-chip baud rate generators (conforming to RS232). The maximum UART speed is 2 Mbps. The additional CSI (clocked serial interface) supports data transfer of up to 1.44 Mbps and can be used in I^2C mode (at 400 kHz) on the µPD78403xY.

Timers

All devices have 4 channels of 16-bit timers controlled by 7 interrupts. All timers are equipped with a capture register and three timers can be used as event counters and feature additional compare registers. Two timers are able to output PWM/PPG signals or single pulses. The on-chip watchdog timer monitors CPU operation.

PWM Output

Two channels of PWM output circuits with 12-bit resolution are provided. At this resolution PWM frequencies up to 62.5 kHz can be generated. Both channels can select either a high or low active level. These outputs are ideal for controlling the speed of DC motors.

Clock Generator

The on-chip clock generator oscillates at frequencies between 2 and 32 MHz.

Interrupt Controller

Powerful interrupt handling capability is based on a macro service, context switching and vectored interrupts. An external non-maskable interrupt is provided. The interrupt controller handles the different maskable and non-maskable interrupt requests issued by internal peripheral hardware (17 sources plus 1 for I^2C version) or external devices (6 sources plus 1 for I^2C version).

* Numbers in brackets apply to ROMless versions.

Ordering Information

Devices

Part Number	ROM (Kbytes)	PROM (Kbytes)	RAM (bytes)
μPD784031GC	None	—	2048
μPD784035GC	48	—	2048
μPD784036GC	64	—	2048
μPD784037GC	96	—	3584
μPD784038GC	128	—	4352
μPD78P4038GC	—	128	4352

GC: 80-pin LQFP (14 x 14 mm², 0.65 mm pin pitch)
All devices are also available with I²C bus.

Documentation

Reference	Device	Type
U13919EE	NEC Microcontrollers	Data Book (CD-ROM)
U10905EJ	78K4	Instruction Manual
U11316EJ	μPD78(P)403x	User's Manual
U11507EJ	μPD784031	Datasheet
U11504EJ	μPD784031Y	Datasheet
U10847EJ	μPD784035/6/7/8	Datasheet
U10741EJ	μPD784035/6/7/8Y	Datasheet
U10848EJ	μPD78P4038	Datasheet
U10742EJ	μPD78P4038Y	Datasheet
U13285EJ	μPD78(P)403x(Y)	Application note

For further information on NEC's 78K4 family or other NEC products visit our European website at **www.ee.nec.de**

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