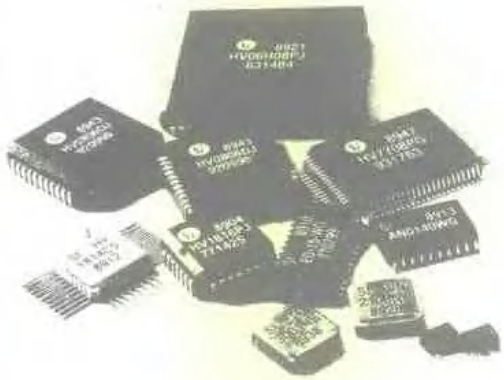
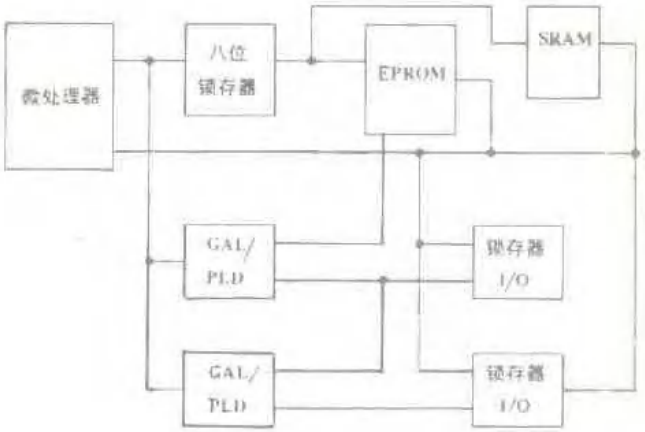
世界微处理器集锦 第一卷

A COLLECTION OF WORLD MICROPROCESSOR

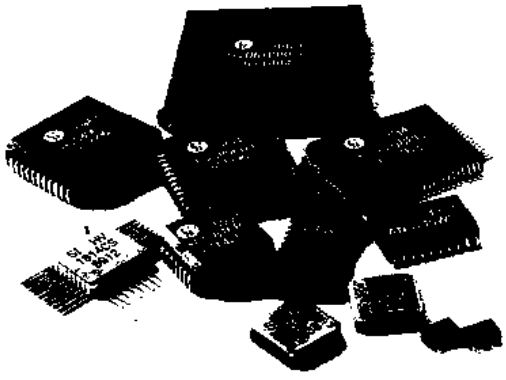


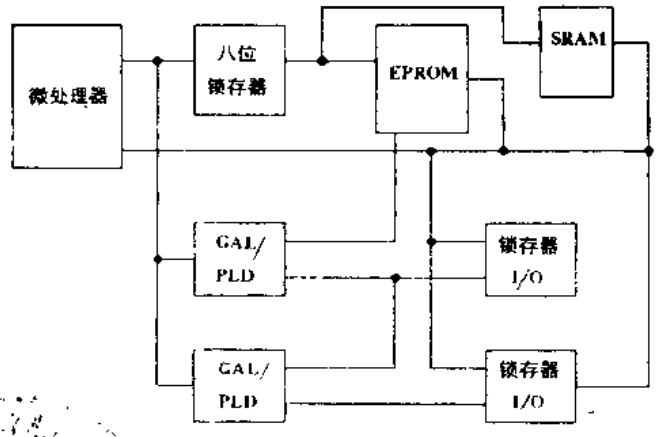


电子工业出版社

世界微处理器集锦 第一卷

A COLLECTION OF WORLD MICROPROCESSOR Volume I





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内 容 提 要

本书收集了 INTEL, MOTORALA, HARRIS, TI, SGS－THOMSON, TOSHIBA, NEC, FUJITSU, OKI, NSC 等世界知名厂商生产的八位微处理器及部分微 控制器，资料均取材于各厂商的 OEM 手册，数据翔实准确，资料新颖全面，并直接采用 原文，避免因翻译而引起的失真。为了便于读者快速阅读和浏览，在每章的开头，都有一个简单的中文简介，言简意赅地描述了本章所介绍的微处理器或微控制器的主要特性。

本书可供科研院所的科研人员，大专院校师生在科研学习过程 中作为参考书使用，也可供系统维护及维修人员，硬件营销人员参考。

世界微处理器集锦
第一卷
八位机
舆森　顺年选编
责任编辑　　韩瑞宗　舆森

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编 者 的 话

随着计算机产业的蓬勃发展，作为计算机心脏的微处理器的应用越来越广泛，从家用电器到航空航天事业，无处不用到微处理器和微控制器。而国内的科研人员面对浩若繁星的国外各厂商的微处理器，常有茫然不知所措之感觉。有鉴于此，为了帮助国内科研人员对世界各大厂商生产的微处理器有一个全面的了解，北京瑞特电子技术公司集多年器件、信息资料服务之经验，凭借与国外各大厂商之密切关系，搜集国外最新资料，与电子工业出版社通力合作，编纂而成这套《世界微处理器集锦》，以奉献给国内读者。本书编排思想以最新、最全、最实用为主旨，紧跟国际潮流，适应国内需求，力求能解决读者在工作中遇到的实际问题，在选型上力求全而新，以扩大读者的视野，在此基础上，侧重国内外流行的微处理器，并注重当前流行的"绿色浪潮"，较多的选用了一些低功耗，高集成度，小型化的型号，另外，根据国内客观环境和市场调研，本书也注意选用一些军用、工业用抗恶劣环境的高性能微处理器。

另外，在此书成书之前，我们作了大量的调查研究工作，广泛听取了用户和科研人员的意见和建议，吸取了国内其他单位编写同类书刊的经验，根据此书读者的知识结构和外语水平，在内容上大胆采用OEM手册中的原文，以避免因翻译而引起失真和笔误。这样作会给部分读者造成阅读上的困难，在此深表抱歉。

因时间仓促，且编者能力有限，本书必有不少不尽人意之处，望各界同仁通过书后所附意见反馈表提出宝贵意见和建议，以期我们进一步改进。

编　　者

编 写 说 明

《世界微处理器集锦》即微处理器产品使用说明手册是我公司在销售国外IC器件过程中，应广大用户的迫切要求，为适应国内用户在使用国外基础元器件的同时，但又缺乏相关技术资料的状况而编辑的。在编辑此书中，我们得到了国外半导体厂商的大力协助。本书收录了Intel、Motorola、NEC、Toshiba、OKI、Fujitsu、Philips、Harris、SGS－THOMSON、TI、NS、AMD、Samsung、Hitachi、Mitsubishi、HMC等世界著名厂商生产的较常用的微处理器。书中详尽地介绍了每一种微处理器的特性、封装、管脚定义、直流特性、主要时序、测试方法、测试曲线、CPU寻址方式、各模块详细的功能描述(如定时器、UART等)、存储器及I/O接口、时钟振荡器、汇编语言、开发手段等。本书收录内容新而全，并在每章前均有一中文简介，描述了本章所讲述微处理器的特性，以便于用户快速阅读、比较、选型。因此，《集锦》是目前国内关于微处理器产品介绍最全、最详细、最有实用价值的一本参考资料。

目前，我公司在销售元器件的同时，力争配套其相关的技术资料，使用户在科研生产中，得心应手。《集锦》这本书就是针对此目的而编辑的。为编辑此书，我公司投入大量人力、物力、财力。但由于经验不足难免有欠缺之处，敬请参阅者给我们提出宝贵意见，《集锦》仅限于专业人员在科研生产及销售中作为参考使用，不得作为其他商业用途。

另外，我公司对现有的馆藏有关IC方面的技术资料拟编其他类似《集锦》的书，以便于我们在经销IC产品同时给用户提供以技术支援。目前拟编的参考书有：

- 常用计算机外围电路手册
- 74ALS/AS/HCT电路手册
- 常用电话集成电路
- 常用语音集成电路

北京瑞特电子技术公司

一九九四年七月

公司索引

型 号 索 引

第一章
富士通(FUJITSU)

本章介绍了 FUJITSU 公司生产的 MB89640,MB89630 微处理器。

MB89640 特性如下:

. 压缩的高性能 CPU 内核。
. 低工作电压,高执行速度。
. 五种执行速度,可使用户灵活配置系统性能及操作模式。
. 八位 A/D 和 D/A 转换器。
. 八位脉宽计数器/定时器。
. 16 位计数器/定时器。
. 两个串行接口通道。
蜂鸣器音频输出。
九个外部中断。
有 watchdog 监视器。

MB89630 特性如下:

. 压缩的高性能 CPU 内核。
. 低工作电压,高执行速度。
. 10 位 A/D 转换器。
. 通用异步收发器。
. 16 位定时器/计数器。
. 串行接口。
. 中断控制器。
. 有 watchdog 监视器。
. 强有力的开发工具。

索　　引

F²MC®-8L Family 8-Bit Single-Chip Microcontroller: MB89640 Series

Enhanced microcontroller is ideal for battery-operated applications

Features

- *Compact, high-performance CPU core*
- *High speed operation at low supply voltage*
- *Five execution speeds*
- *8-bit A/D and D/A converters*
- *8-bit pulse width counter/timer*
- *16-bit timer/counter*
- *Two serial interface channels*
- *Beep tone output*
- *Nine external interrupts*
- *Watchdog function*

Photo 1. External View

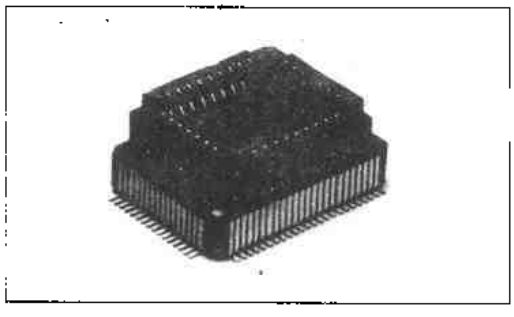
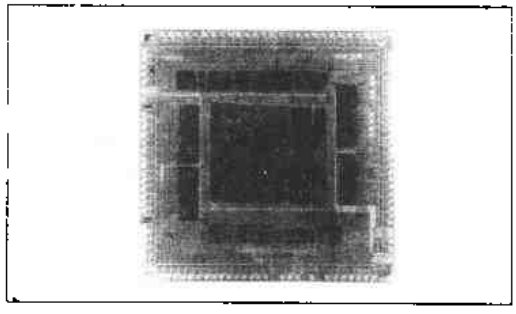


Photo 2. Chip

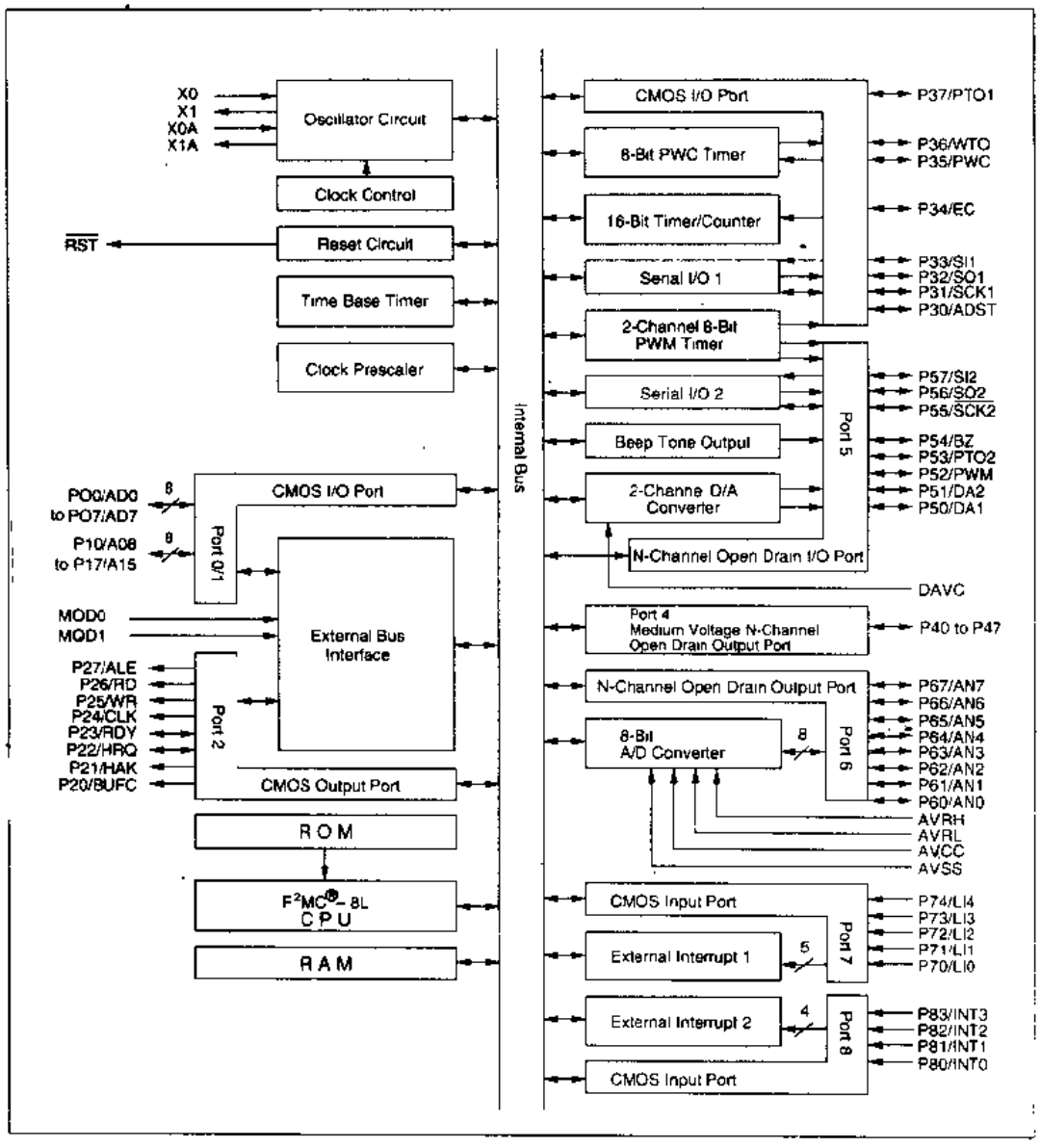


Overview

FUJITSU developed the MB89640 Series of microcontrollers by improving and expanding on the popular MB89620 Series of microcontrollers. Both the MB89620 and MB89640 controllers are based on FUJITSU's proprietary F^{2}MC®-8L Family 8-bit CPU core. The improved and expanded functions include an upgrade of timing circuit functions, a built-in D/A converter, and expanded I/O ports.

". . . improving and expanding on the popular MB89620 Series . . ."

Figure 1. MB89640 Block Diagram



instruction-cycle switching and low-speed clock functions were added to the clock control section. These two additional functions give the user control over power consumption of the CPU, making the MB89640 Series microcontrollers ideal for use as system controllers in battery-operated equipment.

Table 1 (see p. 44) lists some of the features of the MB89640 Series microcontrollers.

Product Features

Compact, High-Performance CPU Core

A number of changes to the F^{2}MC®-8L (MB89600) CPU core instruction set were made to enhance the microcontroller's performance. The instruction set generates more efficient code and the bit instructions were enhanced. These changes result in a CPU core with the optimum instruction set for controller applications.

". . . optimum instruction set for controller applications."

Low Operating Voltage, High Operating Speed

The microcontroller is capable of operating at 0.4 µs using a 10 MHz clock (V_{CC} = 3.5V). It is also capable of 2 µs operation at a low input voltage (V_{CC} = 2.2V).

Five Instruction Execution Speeds

The MB89640 microcontrollers provide five levels of instruction execution speeds. This capability gives the system designer the ability to fine-tune system performance and operating modes. Power consumption of the microcontroller can be minimized by matching the instruction execution speed to each operating mode of the application. This significantly extends the length of time an application can run on battery power.

8-Bit A/D Converter

The built-in A/D converter is an 8-channel, 8-bit, successive approximation-type A/D converter. This converter supports a minimum conversion time of 18 µs. Interrupts can be generated upon completing the conversion process.

The A/D converter also provides a Sense mode. In this mode, the A/D converter compares the contents of a register with the input data. The comparison is completed in as fast as 5 µs.

The conversion process can be triggered in the following ways:

- By software
- By an external signal via one of the ports
- Continuously restarted at intervals of one 2^8th of oscillation frequency of the high-speed clock

8-Bit D/A Converter

The built-in D/A converter is a 2-channel 8-bit R2-R-type D/A converter.

". . . significantly extends the length of time an application can run on battery power."

When the system comes to the Stop or Clock mode, the user's software controls whether or not the converter operation is halted. That is, even in Standby mode, the user can select to continue to output analog voltages or to halt the operation, and thus enter the low power consumption state.

Figure 2. Pin Assignment (QFP-80 [0.65 mm/.026 in. pitch] = FPT-80P-M11)

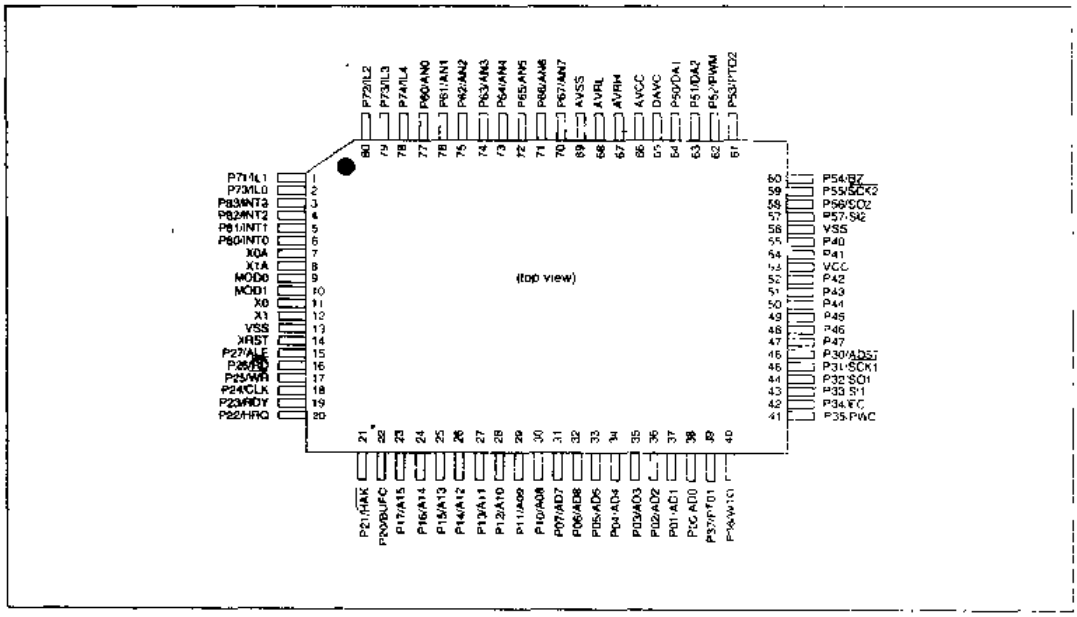
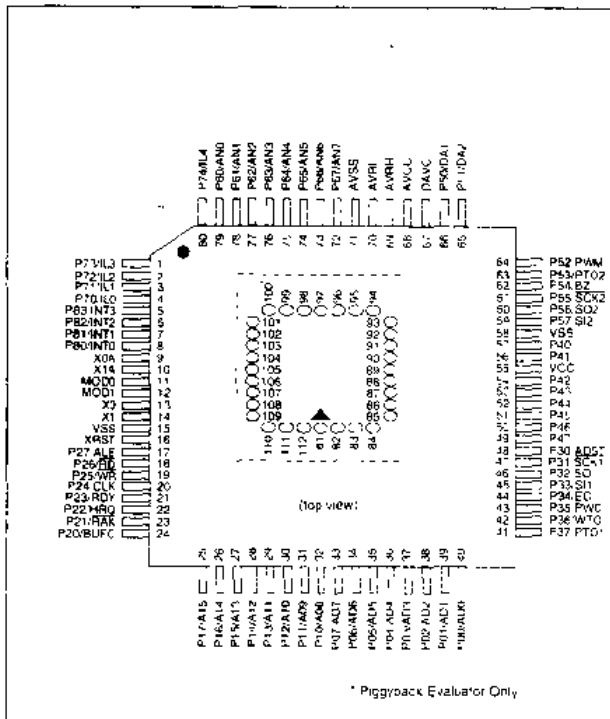


Figure 3. Pin Assignment (QFP-80 = FPT-80P-M06/MOP-80C-P01)



Top of Package Pin Assignments
(piggyback/evaluator only)

Pin	Terminal	Pin	Terminal
81	NC	97	NC
82	V_{PP}	98	04
83	A12	99	05
84	A7	100	06
85	A6	101	07
86	A5	102	08
87	A4	103	$\overline{CE}$
88	A3	104	A10
89	A2	105	$\overline{OE}$
90	A1	106	NC
91	A0	107	A11
92	NC	108	A9
93	01	109	A8
94	02	110	A13
95	03	111	A14
96	V_{SS}	112	V_{CC}

NC - Do not connect to "NC" pins
(pins are connected internally)

Two-Channel 8-Bit PWM Timer with Five Operating Modes

The Pulse-Width Modulation (PWM) timer supports the following operating modes

- Timer mode provides a 0.8 µs toggle output and interval up to 0.4 µs
- 8-bit PWM mode generates a 9.8 kHz (max.) PWM waveform
- 7-bit high-speed PWM mode generates a 19.5 kHz (max.) PWM waveform. This mode can be used at critical frequencies in the audible range
- Connected in a cascade where channel 1 operates in Timer mode and its toggle output is used as the clock source for channel 2
- PWM mode: channel 1's timer determines the <L> (logic 0) width, and channel 2's timer determines the period of the cycle

8-Bit Pulse-Width Counter/Timer

As a timer, it can operate at either Reload Timer mode or One-Shot mode. The Reload Timer mode enables counting to start from a pre-loaded value down to the underflow of the counter and then start it over from a reloaded value. The One-Shot mode also enables downcounting from a pre-loaded value, but will halt operation once the counter underflows.

". . . can also be used to . . . receive signals from a remote control unit."

The pulse-width function can be used to continuously measure the width of the <H> (logic 1) or <L> (logic 0) portions of the input signal's cycle. It can also be used to measure the signal's cycle length of pulse-type input signals and to interpret signals received from a remote control unit.

16-Bit Timer/Counter

This function can operate in either of two modes: Timer and Counter. The Timer mode uses the internal clock source as a count clock. The Counter mode can be configured to detect and count either edge of the external source.

Two Serial Interface Channels

Each MB89640 Series microcontroller includes a built-in 2-channel serial interface that is capable of performing 8-bit serial data transfers. The interface includes powerful functions that provide the flexibility to specify bit-shift direction, multiple clocks and operation using an external clock.

". . . port is ideal for driving LEDs."

Beep Tone Output

A beep tone can be output through a port. This output is ideal for functions such as keyboard entry feedback or warning tones.

Medium Voltage Port

Port 4 is a dedicated output-only port. This port provides an open drain output capable of withstanding voltages up to 15V. This port is ideal for driving LEDs.

". . . ideal for use as a system controller in battery-operated equipment."

Interrupts

The MB89640 Series supports up to nine internal and three external interrupts. Multilevel interrupts can be nested up to three levels. Levels and priorities are configurable by the application software.

Nine External Interrupt Pins

Multiple wakeup interrupts can be generated via external pins.

Table 1. MB89640 Product Configuration

Product Name	MB89645	MB89646	MB89647	MB89P647	MB89PV640
Classification	Mass-Products (mask ROM product)			Small-Scale Production (one-time PROM)	Evaluation Development Device use (piggyback/ evaluation)
Instruction Bit Length	8 Bits				
Instruction Length	1 to 3 Bytes				
Data Bit Length	1, 8, 16 Bits				
Number of Basic Instructions	136 Instructions				
Clock Generator	Built-In				
Minimum Instruction Execution Time	0.4 µs/10 MHz to 6.4 µs/10 MHz, 61 µs/32 KHz				
Interrupt Processing Time	3.6 µs/10 MHz to 57.6 µs/10 MHz, 562.5 µs/32 KHz				
ROM Size	16 K x 8 Bits (built-in ROM)	24 K x 8 Bits (built-in ROM)	32 K x 8 Bits (built-in ROM)	32 K x 8 Bits (built-in ROM)	32 K x 8 Bits (external ROM)
RAM Size	512 x 8 Bits	768 x 8 Bits	1K x 8 Bits	1K x 8 Bits	1K x 8 Bits
Ports Shared pins in parentheses ( ) Input Output Input/Output Total	9 (9) 24 (16) 32 (32) 65				
Timer PWM	8-Bit x 2				
Pulse-Width Timer	8-Bit x 1				
Timer/Counter	16-Bit x 1				
Serial I/O	8-Bit x 2				
A/D Converter	8-Bit x 8 Channels				
D/A Converter	8-Bit x 2 Channels				
Number of External Interrupts	9				
Standby Modes	Clock Mode, Sub Mode, Sleep Mode, and Stop Mode				
Process	CMOS				
Package	FPT-80P-M11, FPT-80P-M06				MQP-80C-P01
Operating Voltage	2.2 to 6V*			2.7 to 6V*	4.5 to 5.5V
EPROM Compatible					MBM27C256A-20

*This voltage varies depending on conditions such as operating frequency.

Watchdog Function

A watchdog timer is provided to detect endless loops or errors in the application software. A CPU reset is generated when the timer overflows.

Support Environment

A number of tools are available to support the development of efficient and effective application software. An ANSI standard C compiler and C language-level debugger are available. The REALOS/96 real-time operating system is currently being developed.

The MB89PV640 is provided as a functional operation-evaluation version of the MB89640 Series microcontrollers. This product provides both evaluation and piggyback capabilities.

The MB89PV640 is used as an evaluation chip by connecting a development tool connector to the socket on the top of the package. By mounting an EPROM, the MB89PV640 can be used as a piggyback device. The evaluator is the functional equivalent of the mask ROM product and provides a highly-efficient evaluation capability.

Device Characteristics

A block diagram of the MB89640 is shown in Figure 1 (see p. 40). The pin assignment is shown in Figures 2 and 3 (see p. 42). ◆