Future Products August 1997

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INTRODUCTION

MICROCHIP TECHNOLOGY INC.

Building for the Future

INTRODUCTION

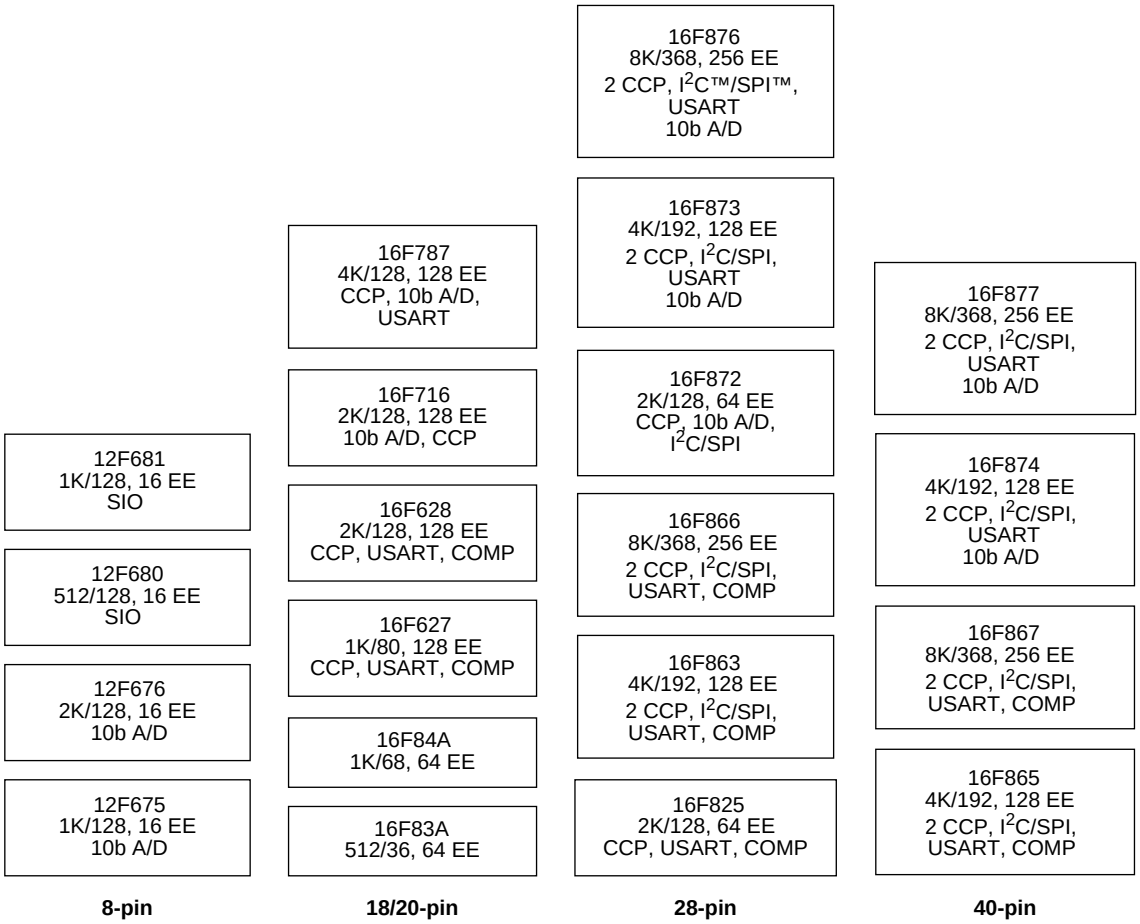
Today you are creating the products of tomorrow. Products with more complex features, faster operating speeds, reduced time-to-market, and optimized cost. Well-informed design engineers and their manufacturing partners understand the selection of a microcontroller architecture, and the company behind it, is a critical factor for success. It's a decision made not only for the present, but also for the future.

To help design engineers balance the demands of an ever-changing market, Microchip Technology Inc. combines its worldwide design expertise, process technology innovation, world-class manufacturing capability and commitment to quality to offer a complete product solution. Our highly integrated products, development tools, technical resources and global support ensure your competitive edge, while making your world just a little easier.

Now we introduce our first Future Products guide, a compilation of product briefs on the planned members in the Microchip product line including the world-standard PICmicro™ 8-bit enhanced RISC MCU family, related Serial EEPROMs, KEELOQ® secure data products and supporting development systems. In this guide you will find comprehensive technical reference for key components in our future product roadmap. We believe that by sharing these devices with you now, you will be better prepared to plan your designs and make the right architecture selection for the future.

We invite you to join the thousands of designers and their manufacturing partners around the world who have specified nearly half-a-billion PICmicro 8-bit Enhanced RISC MCUs to-date, and swiftly move toward success in the future with Microchip Technology at their side.

1997 – 1998 PICmicro *Enhanced* FLASH Future Product Roadmap



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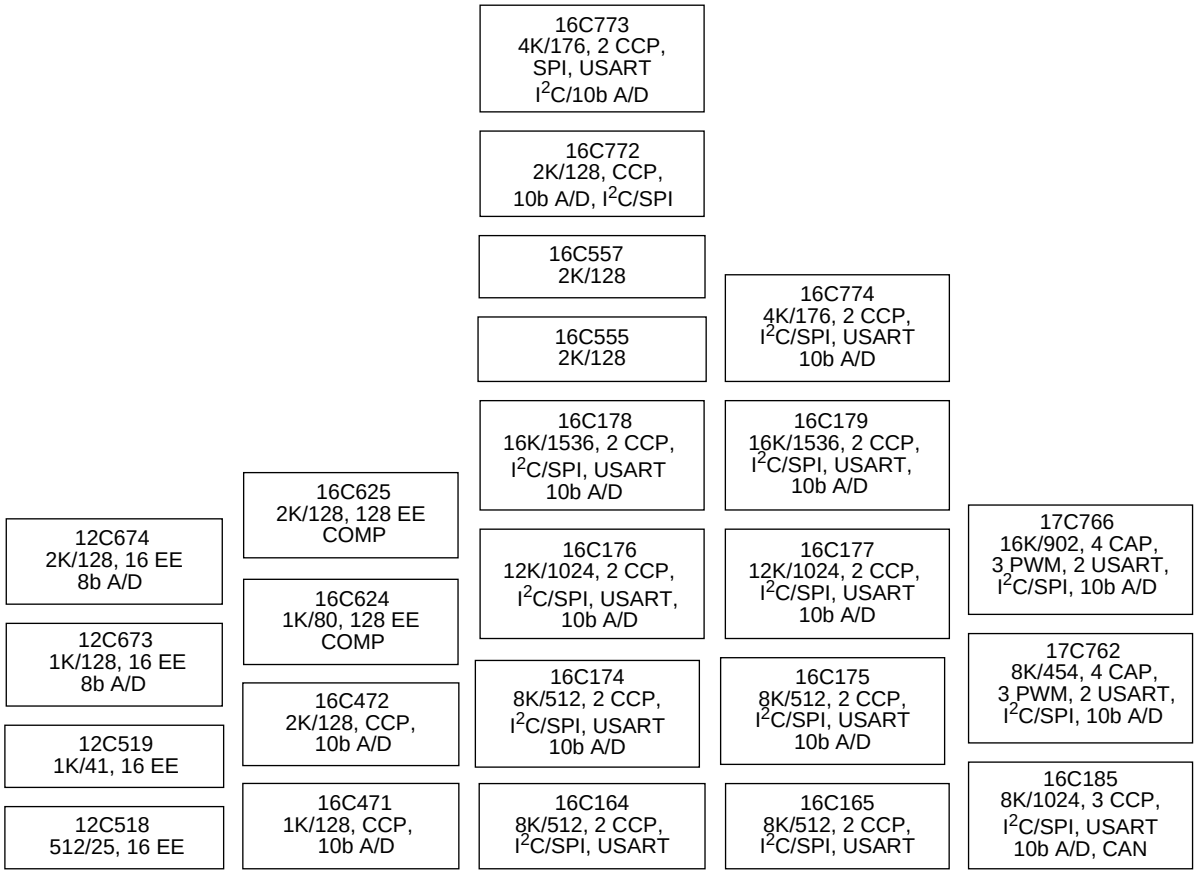
SPI is a trademark of Motorola.

1997 – 1998 PICmicro OTP Future Product Roadmap



NOTES:

SECTION 2
PICmicro™ 8-BIT RISC MICROCONTROLLERS

CMOS OTP Microcontrollers:

Enhanced FLASH Microcontrollers:

PICmicro is a trademark of Microchip Technology, Inc.

PIC12C518/519

8-Pin, 8-Bit CMOS Microcontroller with EEPROM Data Memory Product Brief

Devices:

PIC12C518 and PIC12C519 are 8-bit OTP microcontrollers packaged in 8-lead packages. They are based on the Enhanced PIC16C5X family.

High-Performance RISC CPU:

- Only 33 single word instructions to learn
- All instructions are single cycle (1 µs) except for program branches which are two-cycle
- Operating speed: DC - 4 MHz clock input
  DC - 1 µs instruction cycle

Device	Memory		
	Program	Data	EEPROM Data
PIC12C518	512 x 12	25 x 8	16 x 8
PIC12C519	1024 x 12	41 x 8	16 x 8

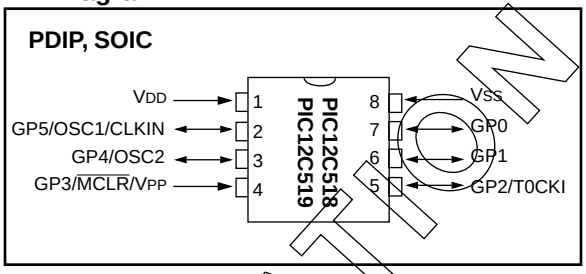
- 12-bit wide instructions
- 8-bit wide data path
- Special function hardware registers
- 2-level deep hardware stack
- Direct, indirect and relative addressing modes for data and instructions

Peripheral Features:

- 8-bit real-time clock/counter (TMR0) with 8-bit programmable prescaler
- 1,000,000 erase/write cycle EEPROM data memory
- EEPROM data retention > 40 years

Pin Diagram:

PDIP, SOIC



Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) (via two pins)
- Internal 4 MHz RC oscillator with programmable calibration
- Power-on Reset (POR)
- Device Reset Timer (DRT)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code-protection
- Power saving SLEEP mode
- Wake-up from SLEEP on pin change
- Internal weak pull-ups on I/O pins
- Internal pull-up on $\overline{MCLR}$ pin
- Selectable oscillator options:
  - INTRC: Internal 4 MHz RC oscillator
  - EXTRC: External low-cost RC oscillator
  - XT: Standard crystal/resonator
  - LP: Power saving, low frequency crystal

CMOS Technology:

- Low-power, high-speed CMOS EPROM/EEPROM technology
- Fully static design
- Wide operating voltage range – 2.5V to 5.5V
- Commercial, Industrial, and Extended temperature ranges
- Low power consumption
  - < 2 mA @ 5V, 4 MHz
  - 15 µA typical @ 3V, 32 kHz
  - < 1 µA typical standby current

ICSP is a trademark of Microchip Technology.

PIC12C673/674

8-Pin, 8-Bit CMOS Microcontroller with A/D Converter and EEPROM Data Memory Product Brief

Devices:

PIC12C673 and PIC12C674 are 8-bit OTP microcontrollers with 8-bit A/D Converter packaged in 8-lead packages. They are based on the 14-bit PICmicro™ MCU architecture.

High-Performance RISC CPU:

- Only 35 single word instructions to learn
- All instructions are single cycle (400 ns) except for program branches which are two-cycle
- Operating speed: DC - 10 MHz clock input
  DC - 400 ns instruction cycle

Device	Memory		
	Program	Data	Data EEPROM
PIC12C673	1024 x 14	128 x 8	16 x 8
PIC12C674	2048 x 14	128 x 8	16 x 8

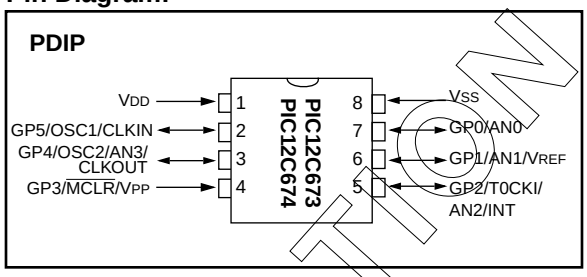
- 14-bit wide instructions
- 8-bit wide data path
- Interrupt capability
- Special function hardware registers
- 8-level deep hardware stack
- Direct, indirect and relative addressing modes for data and instructions

Peripheral Features:

- 8-bit real time clock/counter (TMR0) with 8-bit programmable prescaler
- Interrupt on pin change (GP0, GP1, GP3)
- 1,000,000 erase/write cycle EEPROM data memory
- EEPROM data retention > 40 years
- Four-channel, 8-bit A/D converter

Pin Diagram:

PDIP



Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) (via two pins)
- Internal 4 MHz oscillator with programmable calibration
- Selectable clockout
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving SLEEP mode
- Internal pull-ups on I/O pins (GP0, GP1, GP3)
- Internal pull-up on $\overline{MCLR}$ pin
- Selectable oscillator options:
  - INTRC: Precision internal 4 MHz oscillator
  - EXTRC: External low-cost RC oscillator
  - XT: Standard crystal/resonator
  - HS: High speed crystal/resonator
  - LP: Power saving, low frequency crystal

CMOS Technology:

- Low-power, high-speed CMOS EPROM/EEPROM technology
- Fully static design
- Wide operating voltage range – 2.5V to 5.5V
- Commercial, Industrial, and Extended temperature ranges
- Low power consumption
  - < 2 mA @ 5V, 4 MHz
  - 15 µA typical @ 3V, 32 kHz
  - < 1 µA typical standby current

PICmicro and ICSP are a trademarks of Microchip Technology.

PIC16C164/165

OTP 8-Bit High-Performance CMOS Microcontroller Product Brief

Device	Program Memory	Data SRAM	Pins	CCP (PWM)	SSP	USART	PSP
PIC16C164	8192 x 16	512 x 8	28	2	Yes	Yes	No
PIC16C165	8192 x 16	512 x 8	40-44	2	Yes	Yes	Yes

High-Performance RISC CPU:

- C-compiler optimized instruction set
- Linear program memory addressing to 128K bytes
- Linear data memory addressing to 4K bytes
- Operating speed:
  - DC - 25 MHz clock input, DC -160 ns instruction cycle
- 8192 x 16 on-chip EPROM program memory
- 512 x 8 general purpose registers (SRAM)
- Sixteen levels of hardware stack
- Software stack capability
- Multi-vector Interrupt capability

Peripheral Features:

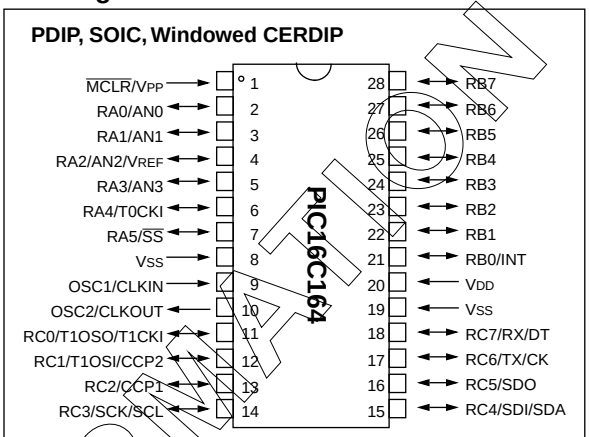
- High current sink/source
- Three timers: TMR0 (8-bit timer/counter), TMR1 (16-bit timer/counter - time-base for capture/compare), TMR2 (8-bit timer/counter - time-base for PWM)
- Independent 32 kHz timer oscillator
- Two CCP pins that can be configured as capture input, PWM output, or compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bit. Maximum PWM frequency@ 8-bit resolution = 100 kHz, 10-bit resolution = 25 kHz
- Analog comparator module with two independent analog comparators and programmable voltage reference module
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ master / slave mode
- USART (supports high and low speeds) / SCI
- Parallel Slave Port (PSP), 8-bits wide with external $\overline{RD}$, $\overline{WR}$, and $\overline{CS}$ controls (40-pin devices only)

Special Microcontroller Features:

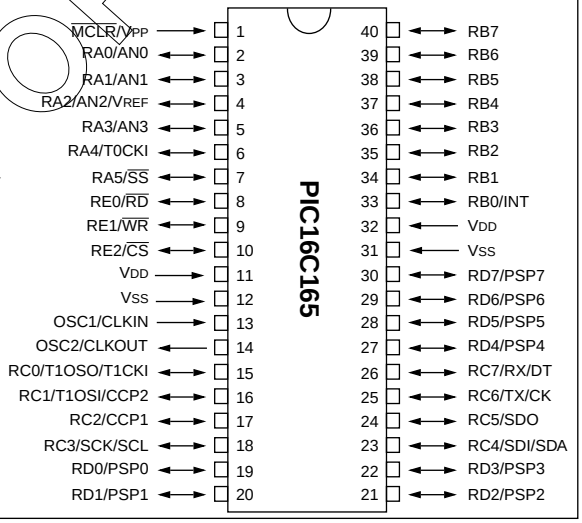
- In-Circuit Serial Programming (ICSP™) (via two pins)
- Power-on Reset (POR), Power-up Timer (PWRT) and selectable Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with on-chip RC oscillator
- Programmable code protection
- Power saving SLEEP mode
- Selectable oscillator options, multi-speed clocking

Pin Diagram:

PDIP, SOIC, Windowed CERDIP



PDIP, Windowed CERDIP (Also PLCC, TQFP, MQFP)



- Brown-out Reset (BOR) and low voltage detection circuitry

CMOS Technology:

- Low-power, high-speed CMOS EPROM technology, with a fully static design
- Wide operating voltage range (3.0V to 5.5V)
- Commercial, Industrial and Extended temperature ranges
- Low power consumption

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PIC16C174/175

OTP 8-Bit High-Performance CMOS Microcontroller Product Brief

Device	Program Memory	Data SRAM	Pins	10-Bit A/D	CCP (PWM)	SSP	USART	PSP
PIC16C174	8992 x 16	512 x 8	28	5 ch	2	Yes	Yes	No
PIC16C175	8992 x 16	512 x 8	40-44	8 ch	2	Yes	Yes	Yes

High-Performance RISC CPU:

- C-compiler optimized instruction set
- Linear program memory addressing to 128K bytes
- Linear data memory addressing to 4K bytes
- Operating speed:
  - DC - 25 MHz clock input
  - DC -160 ns instruction cycle
- 8992 x 16 on-chip EPROM program memory
- 512 x 8 general purpose registers (SRAM)
- Sixteen levels of hardware stack
- Software stack capability
- Multi-vector Interrupt capability

Peripheral Features:

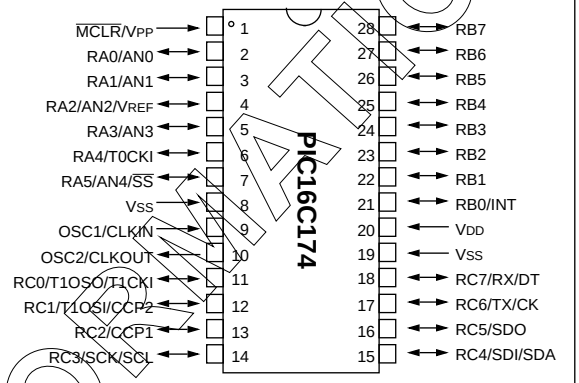
- High current sink/source
- Three timers: TMR0 (8-bit timer/counter), TMR1 (16-bit timer/counter - time-base for capture/compare), TMR2 (8-bit timer/counter - time-base for PWM)
- Independent 32 kHz timer oscillator
- Two CCP pins that can be configured as capture input, PWM output, or compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bit. Maximum PWM frequency @ 8-bit resolution = 100 kHz, 10-bit resolution = 25 kHz
- 10-bit Analog-to-Digital Converter (A/D) with high speed conversion rate (25 µs). Can also operate during sleep.
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ master / slave mode
- USART (supports high and low speeds) / SCI
- Parallel Slave Port (PSP), 8-bits wide with external $\overline{RD}$, $\overline{WR}$, and $\overline{CS}$ controls (40-pin device only)

Special Microcontroller Features:

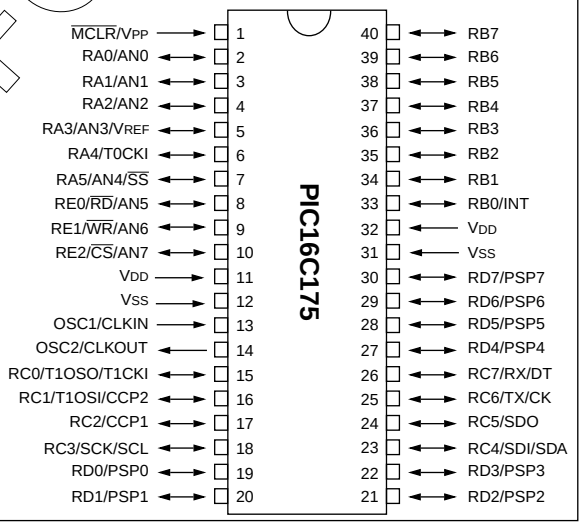
- In-Circuit Serial Programming (ICSP™) (via two pins)
- Mixed Signal Microcontroller
- Power-on Reset (POR), Power-up Timer (PWRT) and selectable Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving SLEEP mode
- Selectable oscillator options, multi-speed clocking

Pin Diagram:

PDIP, SOIC, Windowed CERDIP



PDIP, Windowed CERDIP (Also PLCC, TQFP, MQFP)



- Brown-out Reset (BOR) and low voltage detection circuitry

CMOS Technology:

- Low-power, high-speed CMOS EPROM technology
- Fully static design
- Wide operating voltage range (3.0V to 5.5V)
- Commercial, Industrial and Extended temperature ranges
- Low power consumption

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PIC16C176/177

OTP 8-Bit High-Performance CMOS Microcontroller Product Brief

Device	Program Memory	Data SRAM	Pins	10-Bit A/D	CCP (PWM)	SSP	USART	PSP
PIC16C176	12288 x 16	1024 x 8	28	5 ch	2	Yes	Yes	No
PIC16C177	12288 x 16	1024 x 8	40-44	8 ch	2	Yes	Yes	Yes

High-Performance RISC CPU:

- C-compiler optimized instruction set
- Linear program memory addressing to 128K bytes
- Linear data memory addressing to 4K bytes
- Operating speed:
  - DC - 25 MHz clock input
  - DC -160 ns instruction cycle
- 12288 x 16 on-chip EPROM program memory
- 1024 x 8 general purpose registers (SRAM)
- Sixteen levels of hardware stack
- Software stack capability
- Multi-vector Interrupt capability

Peripheral Features:

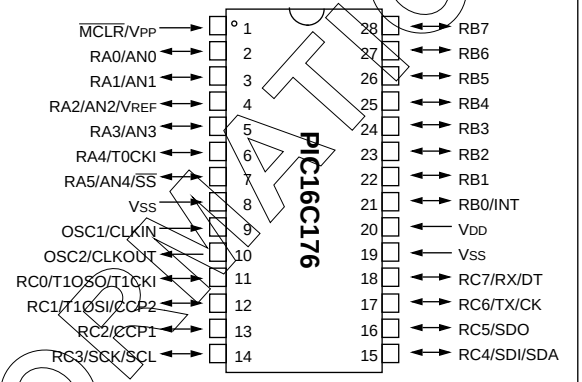
- High current sink/source
- Three timers: TMR0 (8-bit timer/counter), TMR1 (16-bit timer/counter - time-base for capture/compare), TMR2 (8-bit timer/counter - time-base for PWM)
- Independent 32 kHz timer oscillator
- Two CCP pins that can be configured as capture input, PWM output, or compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bit. Maximum PWM frequency @ 8-bit resolution = 100 kHz, 10-bit resolution = 25 kHz
- 10-bit Analog-to-Digital Converter (A/D) with high speed conversion rate (25 µs). Can also operate during sleep.
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ master / slave mode
- USART (supports high and low speeds) / SCI
- Parallel Slave Port (PSP), 8-bits wide with external $\overline{RD}$, $\overline{WR}$, and $\overline{CS}$ controls (40-pin device only)

Special Microcontroller Features:

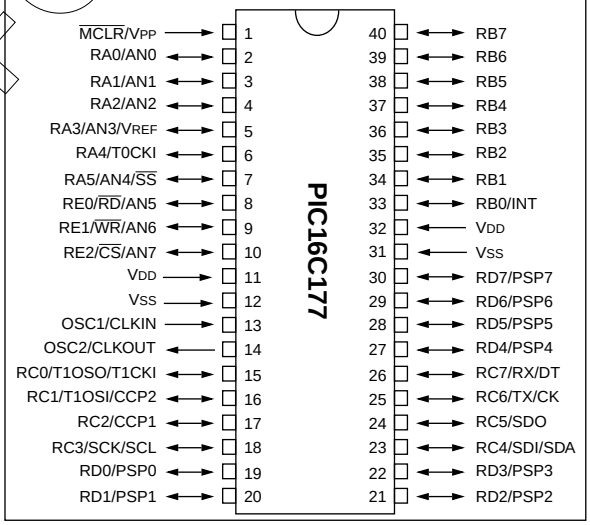
- In-Circuit Serial Programming (ICSP™) (via two pins)
- Mixed Signal Microcontroller
- Power-on Reset (POR), Power-up Timer (PWRT) and selectable Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving SLEEP mode
- Selectable oscillator options, multi-speed clocking

Pin Diagram:

PDIP, SOIC, Windowed CERDIP



PDIP, Windowed CERDIP (Also PLCC, TQFP, MQFP)



- Brown-out Reset (BOR) and low voltage detection circuitry

CMOS Technology:

- Low-power, high-speed CMOS EPROM technology
- Fully static design
- Wide operating voltage range (3.0V to 5.5V)
- Commercial, Industrial, and Extended temperature ranges
- Low power consumption

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PIC16C178/179

OTP 8-Bit High Performance CMOS Microcontroller Product Brief

Device	Program Memory	Data SRAM	Pins	10-Bit A/D	CCP (PWM)	SSP	USART	PSP
PIC16C178	16384 x 16	1536 x 8	28	5 ch*	2	Yes	Yes	No
PIC16C179	16384 x 16	1536 x 8	40-44	8 ch*	2	Yes	Yes	Yes

High-Performance RISC CPU:

- C-compiler optimized instruction set
- Linear program memory addressing to 128K bytes
- Linear data memory addressing to 4K bytes
- Operating speed:
  - DC - 25 MHz clock input
  - DC -160 ns instruction cycle
- 16384 x 16 on-chip EPROM program memory
- 1536 x 8 general purpose registers (SRAM)
- Sixteen levels of hardware stack
- Software stack capability
- Multi-vector Interrupt capability

Peripheral Features:

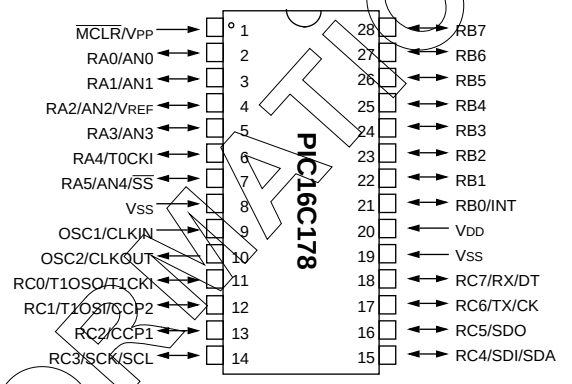
- High current sink/source
- Three timers: TMR0 (8-bit timer/counter), TMR1 (16-bit timer/counter - time-base for capture/compare), TMR2 (8-bit timer/counter - time-base for PWM)
- Independent 32 kHz timer oscillator
- Two CCP pins that can be configured as capture input, PWM output, or compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bit. Maximum PWM frequency @ 8-bit resolution = 100 kHz, 10-bit resolution = 25 kHz
- 10-bit Analog-to-Digital Converter (A/D) with high speed conversion rate (25 µs). Can also operate during sleep.
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ master / slave mode
- USART (supports high and low speeds)/SCI
- Parallel Slave Port (PSP), 8-bits wide with external RD, WR, and CS controls (40-pin device only)

Special Microcontroller Features:

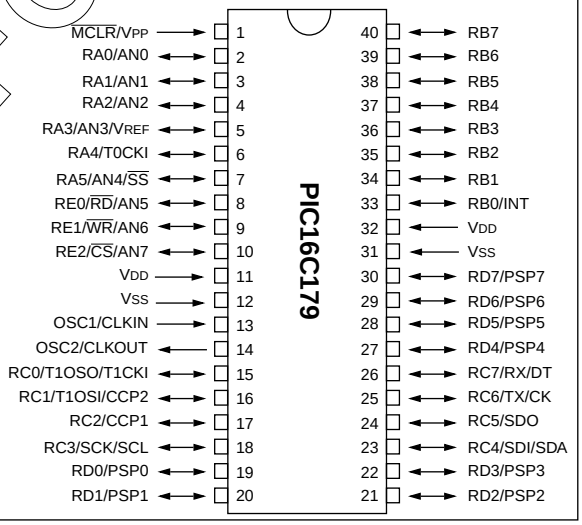
- In-Circuit Serial Programming (ICSP™) (via two pins)
- Mixed Signal Microcontroller
- Power-on Reset (POR), Power-up Timer (PWRT) and selectable Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection

Pin Diagram:

PDIP, SOIC, Windowed CERDIP



PDIP, Windowed CERDIP (Also PLCC, TQFP, MQFP)



- Power saving SLEEP mode
- Selectable oscillator options, multi-speed clocking
- Brown-out Reset (BOR) and low voltage detection circuitry

CMOS Technology:

- Low-power, high-speed CMOS EPROM technology
- Fully static design
- Wide operating voltage range (3.0V to 5.5V)
- Commercial, Industrial, and Extended temperature ranges
- Low power consumption

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PIC16C185

OTP 8-Bit High Performance CMOS Microcontroller with CAN Product Brief

Device	Program Memory	Data SRAM	Pins	10-Bit A/D	CCP (PWM)	SSP	USART	CAN Bus	PSP
PIC16C185	8192 x 16	1024 x 8	68	5 ch	3	Yes	Yes	Yes	No

High-Performance RISC CPU:

- C-compiler optimized instruction set
- Linear program memory addressing to 128K bytes
- Linear data memory addressing to 4K bytes
- Operating speed:
  - DC - 33 MHz clock input
  - DC -120 ns instruction cycle
- 8192 x 16 on-chip EPROM program memory
- 1024 x 8 general purpose registers (SRAM)
- Sixteen levels of hardware stack
- Software stack capability
- Multi-vector Interrupt capability

CAN BUS Module Features:

- Implements FULL CAN model
- Message bit rates up to 1 MHz
- Conforms to CAN 2.0B ACTIVE Spec
- 29-bit identifier fields
- 8-Byte message length
- Three transmit message buffers with individual prioritization
- Two receive message buffers and one receive message assembly buffer
- Six full 29-bit acceptance filters mapped to receive buffers
- Prioritization of acceptance filters
- Two full 29-bit acceptance filter masks
- Multiple receive buffers for high priority messages to ensure messages are not lost due to overflow
- Advanced error management features

Peripheral Features:

- Four timers: TMR0 (8-bit timer/counter), TMR1 (16-bit timer/counter - time-base for capture/compare), TMR2 (8-bit timer/counter - time-base for PWM), TMR3 (16-bit timer/counter)
- Independent 32 kHz timer oscillator
- CCP pins that can be configured as capture input, PWM output, or compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bit. Maximum PWM frequency @ 8-bit resolution = 80 kHz, 10-bit resolution = 20 kHz
- 10-bit Analog-to-Digital Converter (A/D) with high speed conversion rate (25 µs). Can also operate during sleep.
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ master / slave mode
- USART (supports high and low speeds) / SCI

Special Microcontroller Features:

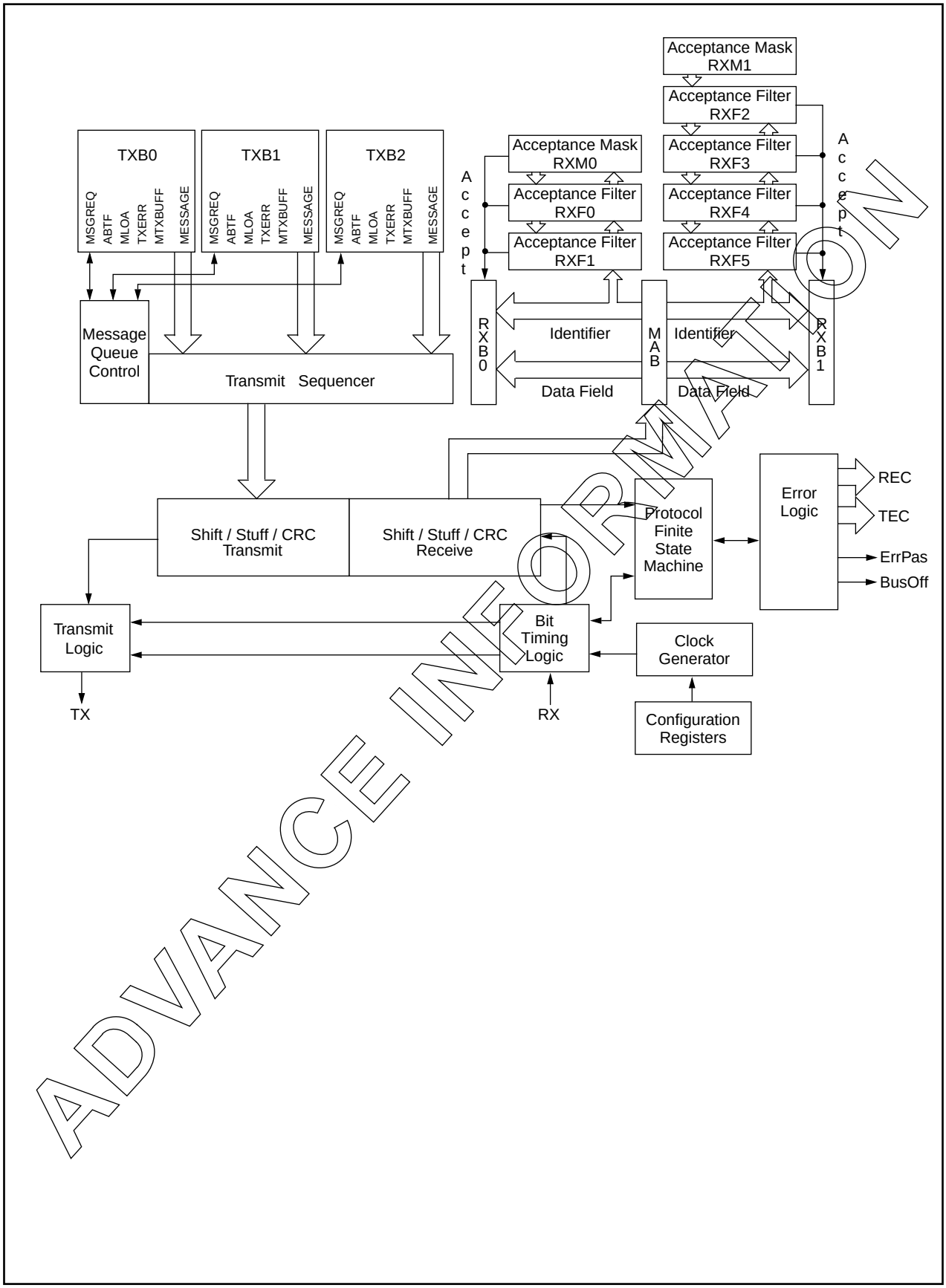
- In-Circuit Serial Programming (ICSP™) (via two pins)
- Power-on Reset (POR), Power-up Timer (PWRT) and selectable Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving SLEEP mode
- Selectable oscillator options, multi-speed clocking
- Internal precision RC oscillator
- Brown-out Reset (BOR) and low voltage detection circuitry

CMOS Technology:

- Low-power, high-speed CMOS EPROM technology
- Fully static design
- Wide operating voltage range (3.0V to 6.0V)
- Commercial, Industrial and, Extended temperature ranges
- Low power consumption

I^2C is a trademark of Philips Corporation. SPI is a trademark of Motorola Corporation.

FIGURE 1: CAN BUFFERS AND PROTOCOL ENGINE BLOCK DIAGRAM



PIC16C471/472

14-Pin, 8-Bit CMOS OTP Microcontroller With A/D Converter Product Brief

High-Performance RISC CPU:

- Only 35 instructions to learn
- Operating speed:
  - DC - 20 MHz clock input
  - DC - 200 ns instruction cycle
- Direct, indirect and relative addressing modes

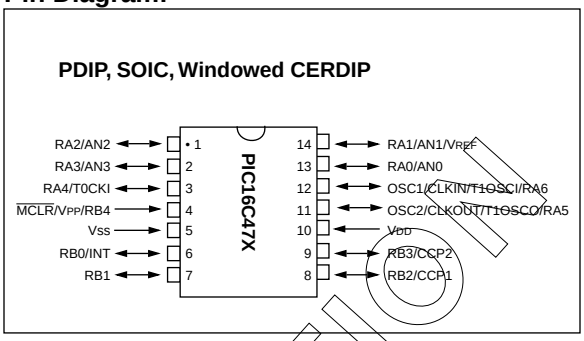
Device	Memory	
	Program	Data
PIC16C471	1024 x 14	128 x 8
PIC16C472	2048 x 14	128 x 8

- Interrupt capability
- 8-level deep hardware stack
- Special Function Hardware Register
- All single cycle instructions (200 ns) except for program branches which are two-cycle

Peripheral Features:

- 12 I/O pins with individual direction control
- High current sink/source for direct LED drive
- Four-channel,10-bit A/D converter
- Timer0: 8-bit timer/counter with 8-bit programmable prescaler
- Timer1: 16-bit timer/counter with prescaler, TMR1 can be incremented during Sleep via external crystal/clock
- Capture, Compare, PWM module
  - Capture is 16-bit, max. resolution 12.5 ns
  - Compare is 16-bit, max. resolution 200 ns
  - PWM max. resolution 10-bits

Pin Diagram:



Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) (via two pins)
- Internal 4 MHz RC oscillator option
- Internal pull-up on MCLR Pin
- Internal calibrated RC oscillator
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with dedicated on-chip RC oscillator for reliable operation
- Programmable Code Protection
- Power-saving Sleep mode
- Brown-out Reset (BOR)
- Selectable oscillator options:
  - INTRC: Precision internal 4 MHz oscillator
  - EXTRC: External low-cost RC oscillator
  - XT: Standard crystal/resonator
  - HS: High speed crystal/resonator
  - LP: Power saving, low frequency crystal

CMOS Technology:

- Low-power, high-speed CMOS EPROM technology
- Fully static design
- Wide operating voltage range (2.5V to 5.5V)
- Commercial, Industrial and Extended temperature ranges
- Low power consumption
  - < 2.0 mA @ 5V, 4 MHz
  - 15 μA typical @ 5.0V, 32 kHz for TMR0 running in SLEEP mode
  - < 1.0 μA typical standby current @ 5V

ICSP is a trademark of Microchip Technology.

PIC16C555/557

OTP 8-Bit CMOS Microcontroller Product Brief

Devices:

- PIC16C555
- PIC16C557

High-Performance RISC CPU:

- Only 35 instructions to learn
- All single-cycle instructions (200 ns), except for program branches which are two-cycle
- Operating speed:
  - DC - 20 MHz clock input
  - DC - 200 ns instruction cycle

Device	Memory	
	Program	Data
PIC16C555	512 x 14	80 x 8
PIC16C557	2048 x 14	128 x 8

- Interrupt capability
- Special function hardware registers
- 8-level deep hardware stack
- Direct, Indirect and Relative addressing modes

Peripheral Features:

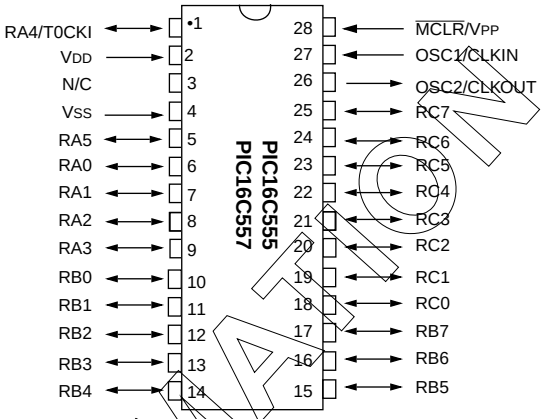
- 22 I/O pins with individual direction control
- High current sink/source for direct LED drive
- Timer0: 8-bit timer/counter with 8-bit programmable prescaler

Special Microcontroller Features:

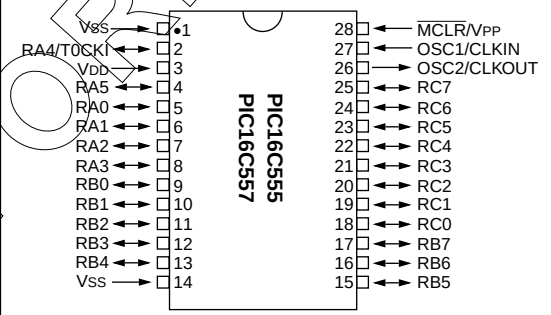
- In-Circuit Serial Programming (ICSP™) (via two pins)
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Four user programmable ID locations
- Selectable oscillator options

Pin Diagram:

PDIP, SOIC, Windowed CERDIP



SSOP



CMOS Technology:

- Low-power, high-speed CMOS EPROM technology
- Fully static design
- Wide operating voltage range
  - 2.5V to 5.5V
- Commercial, Industrial and Extended temperature ranges
- Low power consumption
  - < 2.0 mA @ 5.0V, 4.0 MHz
  - 15 µA typical @ 3.0V, 32 kHz
  - < 1.0 µA typical standby current @ 3.0V

ICSP is a trademark of Microchip Technology.

PIC16C624/625

OTP 8-Bit CMOS Microcontroller with EEPROM Data Memory
Product Brief

Devices:

- PIC16C624
- PIC16C625

High-Performance RISC CPU:

- Only 35 instructions to learn
- All single cycle instructions (200 ns), except for program branches which are two-cycle
- Operating speed:
  - DC - 20 MHz clock input
  - DC - 200 ns instruction cycle

Device	Memory		
	Program	Data	EEPROM Data
PIC16C624	1024 x 14	80 x 8	128 x 8
PIC16C625	2048 x 14	128 x 8	128 x 8

- Interrupt capability
- Special function hardware registers
- 8-level deep hardware stack
- Direct, Indirect and relative addressing modes

Peripheral Features:

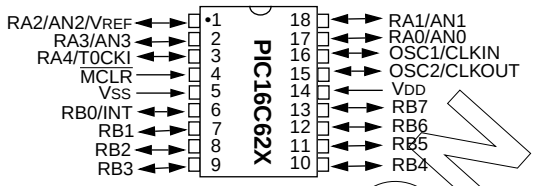
- 13 I/O pins with individual direction control
- High current sink/source for direct LED drive
- Analog comparator module with:
  - Two analog comparators
  - Programmable on-chip voltage reference (V_{REF}) module
  - Programmable input multiplexing from device inputs and internal voltage reference
  - Comparator outputs can be output signals
- Timer0: 8-bit timer/counter with 8-bit programmable prescaler

Special Microcontroller Features:

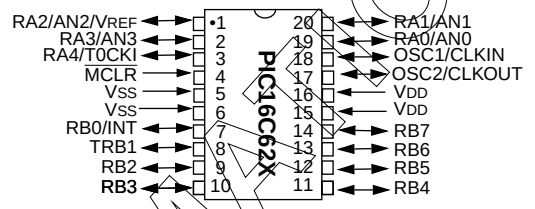
- In-Circuit Serial Programming (ICSP™) (via two pins)
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Brown-out Reset (BOR)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation

Pin Diagram:

PDIP, SOIC, Windowed CERDIP



SSOP



Special Microcontroller Features (Continued):

- 1,000,000 erase/write cycle EEPROM data memory
- EEPROM data retention > 40 years
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options:
  - LP, XT, HS External RC
- Four user-programmable ID locations

CMOS Technology:

- Low-power, high-speed CMOS EPROM/EEPROM technology
- Fully static design
- Wide operating voltage range
  - 2.5V to 5.5V
- Commercial and Industrial temperature ranges
- Low power consumption
  - < 2 mA @ 5V, 4 MHz
  - 15 µA typical @ 3V, 32 kHz
  - < 1 µA typical standby current @ 3V

ICSP is a trademark of Microchip Technology.

PIC16C772

Mixed Signal OTP Microcontroller Product Brief

Device	Program Memory	Data Memory	Pins	A/D	CCP	SSP	BOR
PIC16C772	2048 x 14	128 x 8	28	5 ch; 10-bits	1 pin	Yes	Yes

High-Performance RISC CPU:

- Operating speed: DC - 20 MHz clock input
  DC - 200 ns instruction cycle
- 14-bit wide instructions
- 8-bit wide data path
- 2048 x 14 on-chip EPROM program memory
- 128 x 8 general purpose registers (SRAM)

Advanced Analog Features:

- High precision A/D converter
  - 10-bit (+/- 1 LSb) accuracy
- On-chip absolute voltage reference generator
- Programmable Brown-out Detection Circuitry
- Programmable low-voltage Detection circuitry

Peripheral Features:

- High current sink/source 25 mA / 25 mA
- Timer0: 8-bit timer/counter with 8-bit programmable prescaler
- Timer1: 16-bit timer/counter (time-base for capture/compare). TMR1 can be incremented during sleep via external crystal/clock (for real-time clock)
- Timer2: 8-bit timer/counter with 8-bit period register (time-base for PWM), prescaler and postscaler
- One pin that can be configured as Capture input, PWM output, or Compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bits. Maximum PWM frequency @ 8-bit resolution = 80 kHz
    10-bit resolution = 20 kHz
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ mode

Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) (via two pins)
- Power-on Reset (POR), Power-up Timer (PWRT) and selectable Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code-protection
- Power saving Sleep mode
- Selectable oscillator options, multi-speed clocking
- Internal precision RC oscillator

CMOS Technology:

- Low-power, high-speed CMOS EPROM technology
- Fully static design
- Wide operating voltage range (3.0V to 5.5V)
- Commercial and Industrial temperature ranges
- Low power consumption

Package Options:

- 28-pin packages: PDIP, SOIC, SSOP, and CERDIP (for development)
- Footprint compatible with popular PIC16C72

I^2C is a trademark of Philips Corporation. SPI is a trademark of Motorola Corporation. ICSP is a trademark of Microchip Technology.

PIC16C773/774

Mixed Signal OTP Microcontroller Product Brief

Device	Program Memory	Data Memory	Pins	A/D	CCP	SSP	USART	PSP	BOR
PIC16C773	4096 x 14	176 x 8	28	8 ch; 10-bits	2 pins	Yes	Yes	No	Yes
PIC16C774	4096 x 14	176 x 8	40-44	11 ch; 10-bits	2 pins	Yes	Yes	Yes	Yes

High-Performance RISC CPU:

- Operating speed: DC - 20 MHz clock input
  DC - 200 ns instruction cycle
- 14-bit wide instructions
- 8-bit wide data path
- 4096 x 14 on-chip EPROM program memory
- 176 x 8 general purpose registers (SRAM)

Advanced Analog Features:

- High precision A/D converter
  - 10-bit (+/- 1 LSb) accuracy
- On-chip absolute voltage reference generator
- Programmable Brown-out Detection Circuitry
- Programmable low-voltage Detection circuitry

Peripheral Features:

- High current sink/source 25 mA / 25 mA
- Timer0: 8-bit timer/counter with 8-bit programmable prescaler
- Timer1: 16-bit timer/counter (time-base for capture/compare). TMR1 can be incremented during sleep via external crystal/clock (for real-time clock)
- Timer2: 8-bit timer/counter with 8-bit period register (time-base for PWM), prescaler and postscaler
- Two pins that can be configured as Capture input, PWM output, or Compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bits. Maximum PWM frequency @ 8-bit resolution = 80 kHz
    10-bit resolution = 20 kHz
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ mode
- USART (supports high and low speed) / SCI

Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) (via two pins)
- Power-on Reset (POR), Power-up Timer (PWRT) and selectable Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code-protection
- Power saving SLEEP mode
- Selectable oscillator options, multi-speed clocking
- Internal precision RC oscillator

CMOS Technology:

- Low-power, high-speed CMOS EPROM technology
- Fully static design
- Wide operating voltage range (3.0V to 5.5V)
- Commercial and Industrial temperature ranges
- Low power consumption

Package Options:

- PIC16C773 will be offered in 28-pin PDIP, SOIC, SSOP, and CERDIP (for development) packages
  - Footprint compatible with popular PIC16C73 device
- PIC16C774 will be offered in 40-pin PDIP, 44-pin PLCC, 44-pin QFP, and 48-pin CERDIP (for development) packages
  - Footprint compatible with popular PIC16C74 device

SPI is a trademark of Motorola. I^2C is a trademark of Philips Corporation. ICSP is a trademark of Microchip Technology.

PIC17C762/766

80/84-Pin 8-Bit OTP High-Performance Microcontroller with 10-Bit A/D Product Brief

Device	Program Memory	Data Memory	Pins	HW Multiplier	A/D	Capture	PWM
PIC17C762	8192 x 16	454 x 8	80-84	Yes	16 ch; 10 bits	4 pins	3 pins
PIC17C766	16384 x 16	902 x 8	80-84	Yes	16 ch; 10 bits	4 pins	3 pins

Devices:

- PIC17C762
- PIC17C766

High-Performance RISC CPU Features

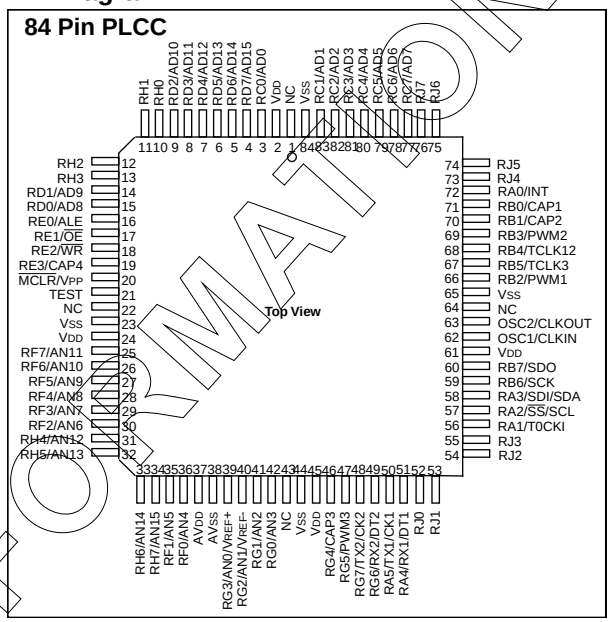
- Operating speed:
  - DC - 33 MHz clock input
  - DC - 120 ns instruction cycle
- Up to **16384 x 16** on-chip EPROM program memory
- Up to **902 x 8** general purpose registers (SRAM)
- Interrupt capability
- Sixteen levels deep hardware stack
- Direct, indirect and relative addressing modes
- Internal/External program memory execution

Peripheral Features:

- Up to 66 I/O pins with individual direction control
- High current sink/source
- **Four** pins that can be configured as capture input
- **Three** pins can be configured as PWM output
- Capture is 16-bit, max resolution 120 ns
- PWM resolution is 1- to 10-bit. Maximum PWM frequency @ 8-bit resolution = 133 kHz 10-bit resolution = 33 kHz
- TMR0: 16-bit timer/counter with 8-bit programmable prescaler
- TMR1: 8-bit timer/counter
- TMR2: 8-bit timer/counter
- TMR3: 16-bit timer/counter
- **Two** Serial Communications Interfaces (SCI/ USART)
- Synchronous serial port (SSP) with two modes of operation:
  - 3-wire SPI™
  - I^2C™ compatible including **master mode** support
- **10-bit** 16-channel A/D:
  - High speed conversion rate
  - Can convert while in Sleep mode

Pin Diagram:

84 Pin PLCC



Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™)
- Power-on Reset (POR)
- Power-up Timer (PWRT)
- Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code Protection
- Power saving Sleep Mode
- Selectable oscillator options

CMOS Technology:

- Low-power, high-speed CMOS EPROM technology
- Fully static design
- Wide-operating voltage range (3.0V to 5.5V)
- Commercial and Industrial temperature ranges
- Low-power consumption
  - < 5.0 mA @ 5V, 4.0 MHz
  - 50 μA typical @ 3.0V, 32 kHz
  - <1.0 μA typical standby current @ 3.0V

I^2C is a trademark of Philips Corporation. SPI is a trademark of Motorola Corporation. ICSP is a trademark of Microchip Technology.

PIC12F675/676

8-Pin, 8-Bit CMOS *Enhanced* FLASH Microcontroller with A/D Converter and EEPROM Data Memory Product Brief

Devices:

PIC12F675 and PIC12F676 are 8-bit *Enhanced* FLASH microcontrollers with 10-bit A/D Converter packaged in 8-lead packages. They are based on the 14-bit PICmicro™ MCU architecture.

High-Performance RISC CPU:

- Only 35 single word instructions to learn
- All instructions are single cycle (400 ns) except for program branches which are two-cycle
- Operating speed: DC - 10 MHz clock input
  DC - 400 ns instruction cycle

Device	Memory		
	Enhanced FLASH	Data	EEPROM Data
PIC12F675	1024 x 14	128 x 8	16 x 8
PIC12F676	2048 x 14	128 x 8	16 x 8

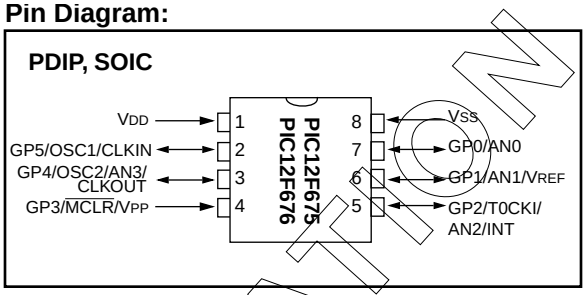
- 14-bit wide instructions
- 8-bit wide data path
- Interrupt capability
- Special function hardware registers
- 8-level deep hardware stack
- Direct, indirect and relative addressing modes for data and instructions

Peripheral Features:

- 8-bit real time clock/counter (TMR0) with 8-bit programmable prescaler
- Interrupt on pin change (GP0, GP1, GP3)
- 10,000 erase/write cycle *Enhanced* FLASH program memory
- 1,000,000 erase/write cycle EEPROM data memory
- EEPROM data retention > 40 years
- Four-channel 10-bit A/D converter

Pin Diagram:

PDIP, SOIC



Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) (via two pins)
- Internal 4 MHz oscillator with programmable calibration
- Selectable clockout
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code-protection
- Power saving SLEEP mode
- Internal pull-ups on I/O pins (GP0, GP1, GP3)
- Internal pull-up on $\overline{MCLR}$ pin
- Selectable oscillator options:
  - INTRC: Precision internal 4 MHz oscillator
  - EXTRC: External low-cost RC oscillator
  - XT: Standard crystal/resonator
  - HS: High speed crystal/resonator
  - LP: Power saving, low frequency crystal

CMOS Technology:

- Low-power high-speed CMOS *Enhanced* FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range – 2.5V to 5.5V
- Commercial, Industrial, and Extended temperature ranges
- Low power consumption
  - < 2 mA @ 5V, 4 MHz
  - 15 µA typical @ 3V, 32 kHz
  - < 1 µA typical standby current

PIC12F680/681

8-Pin, 8-Bit CMOS *Enhanced* FLASH Microcontroller with Serial I/O Interface
Product Brief

Devices:

PIC12F680 and PIC12F681 are 8-bit *Enhanced* FLASH microcontrollers with serial I/O interface packaged in 8-lead packages. They are based on the 14-bit PICmicro™ MCU architecture.

High-Performance RISC CPU:

- Only 35 single word instructions to learn
- All instructions are single cycle (400 ns) except for program branches which are two-cycle
- Operating speed: DC - 10 MHz clock input
  DC - 400 ns instruction cycle

Device	Memory		
	***Enhanced* FLASH**	**Data**	**EEPROM Data**
PIC12F680	512 x 14	128 x 8	16 x 8
PIC12F681	1024 x 14	128 x 8	16 x 8

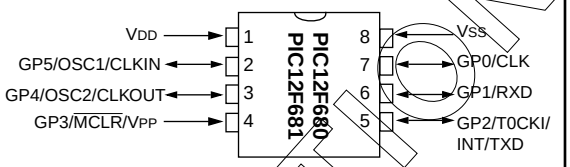
- 14-bit wide instructions
- 8-bit wide data path
- Interrupt capability
- Special function hardware registers
- 8-level deep hardware stack
- Direct, indirect and relative addressing modes for data and instructions

Peripheral Features:

- 8-bit real-time clock/counter (TMR0) with 8-bit programmable prescaler
- Interrupt on pin change (GP0, GP1, GP3)
- 10,000 erase/write cycle *Enhanced* FLASH program memory
- 1,000,000 erase/write cycle EEPROM data memory
- EEPROM data retention > 40 years
- Serial I/O interface

Pin Diagram:

PDIP, SOIC



Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) (via two pins)
- Internal 4 MHz oscillator with programmable calibration
- Selectable clockout
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving SLEEP mode
- Internal pull-ups on I/O pins (GP0, GP1, GP3)
- Internal pull-up on $\overline{MCLR}$ pin
- Selectable oscillator options:
  - INTRC: Precision internal 4 MHz oscillator
  - EXTRC: External low-cost RC oscillator
  - XT: Standard crystal/resonator
  - HS: High speed crystal/resonator
  - LP: Power saving, low frequency crystal

CMOS Technology:

- Low-power, high-speed CMOS *Enhanced* FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range – 2.0V to 5.5V
- Commercial, Industrial, and Extended temperature ranages.
- Low power consumption
  - < 2 mA @ 5V, 4 MHz
  - 15 μA typical @ 3V, 32 kHz
  - < 1 μA typical standby current

PIC16F627/628

Enhanced FLASH 8-Bit CMOS Microcontroller with EEPROM Data Memory
Product Brief

Devices:

- PIC16F627
- PIC16F628

High-Performance RISC CPU:

- Only 35 instructions to learn
- All single cycle instructions (200 ns), except for program branches which are two-cycle
- Operating speed:
  - DC - 20 MHz clock input
  - DC - 200 ns instruction cycle

Device	Memory		
	Enhanced FLASH	Data	EEPROM Data
PIC16F627	1024 x 14	80 x 8	128 x 8
PIC16F628	2048 x 14	128 x 8	128 x 8

- Interrupt capability
- Special function hardware registers
- 8-level deep hardware stack
- Direct, Indirect and relative addressing modes

Peripheral Features:

- 16 I/O pins with individual direction control
- High current sink/source for direct LED drive
- Analog comparator module with:
  - Two analog comparators
  - Programmable on-chip voltage reference (V_{REF}) module
  - Programmable input multiplexing from device inputs and internal voltage reference
  - Comparator outputs can be output signals
- Timer0: 8-bit timer/counter with 8-bit programmable prescaler
- Timer1: 16-bit timer/counter with prescaler, can be incremented during Sleep via external crystal/clock
- USART/SCI
- Capture, Compare, PWM module
  - Capture is 16-bit, max resolution is 12.5 ns
  - Compare is 16-bit, max resolution is 200 ns
  - PWM max resolution is 10-bit

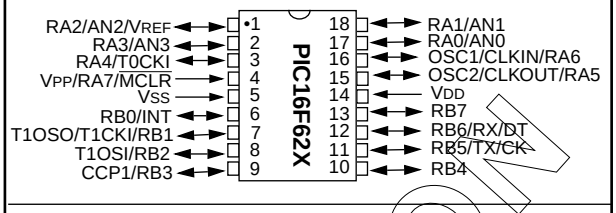
Special Microcontroller Features:

- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Brown-out Reset (BOR)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation

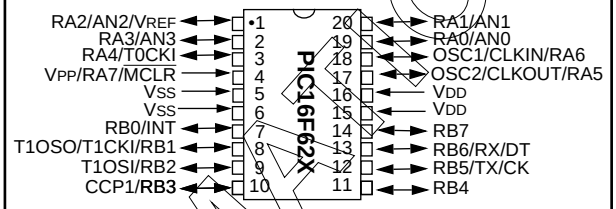
ICSP is a trademark of Microchip Technology.

Pin Diagram:

PDIP, SOIC



SSOP



Special Microcontroller Features (Continued):

- In-Circuit Serial Programming (ICSP™) (via two pins)
- 10,000 erase/write cycles *Enhanced* FLASH program memory
- 1,000,000 erase/write cycles EEPROM data memory
- EEPROM data retention > 40 years
- Internal pull-up on $\overline{MCLR}$ pin
- Internal pull-ups on I/O pins
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options:
  - LP, XT, HS
  - External RC, Precision Internal RC
- Four user-programmable ID locations

CMOS Technology:

- Low-power, high-speed CMOS *Enhanced* FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range
  - 2.5V to 5.5V
- Commercial and Industrial temperature ranges
- Low power consumption
  - < 2 mA @ 5V, 4 MHz
  - 15 µA typical @ 3V, 32 kHz
  - < 1 µA typical standby current @ 3V

PIC16F716

Enhanced FLASH 8-Bit CMOS Microcontroller with A/D Converter and EEPROM Data Memory Product Brief

High-Performance RISC CPU:

- Only 35 single word instructions to learn
- All single cycle instructions (200 ns) except for program branches which are two cycle
- Operating speed: DC - 20 MHz clock input
  DC - 200 ns instruction cycle
- 2048 x 14 on-chip *Enhanced* FLASH program memory
- 128 x 8 general purpose registers (SRAM)
- 128 x 8 EEPROM Data Memory
- Special function hardware registers
- Interrupt capability
- 8-level deep hardware stack
- Direct, indirect, and relative addressing modes

Peripheral Features:

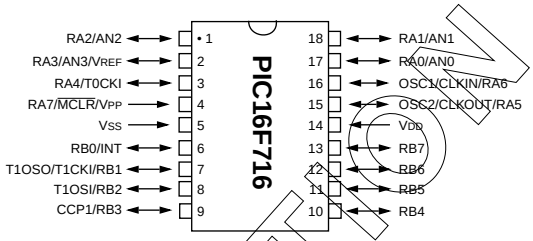
- 16 I/O pins with individual direction control
- High current sink/source for LED drive
- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler can be incremented during Sleep via external crystal/clock
- Four-channel, 10-bit analog-to-digital converter
- Capture, Compare, PWM modules
  - Capture is 16-bit max, resolution is 12.5 ns
  - Compare is 16-bit max, resolution is 200 ns
  - PWM max, resolution is 10-bit

Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) (via two pins)
- 10,000 erase/write cycles *Enhanced* FLASH program memory
- 1,000,000 erase/write cycles EEPROM data memory
- EEPROM data retention > 40 years
- Power-on Reset (POR)
- Power-up Timer (PWRT)
- Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Brown-out detection circuitry for Brown-out Reset (BOR)
- Programmable code-protection
- Power saving Sleep mode
- Selectable oscillator options:
  - LP, XT, HS
  - External RC, Precision Internal RC
- Four user-programmable ID locations
- Internal pull-up on $\overline{MCLR}$ pin
- Internal pull-up on I/O pins

Pin Diagrams:

PDIP, SOIC



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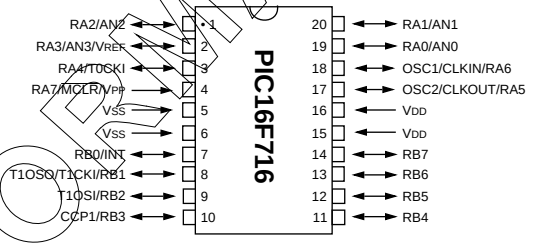


CMOS Technology:

- Low-power, high-speed CMOS *Enhanced* FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range: 2.5V to 5.5V
- Commercial, Industrial and Extended temperature ranges
- Low-power consumption:
  - < 2 mA @ 5V, 4 MHz
  - 5 µA typical @ 3V, 32 kHz
  - < 1 µA typical standby current

ICSP is a trademark of Microchip Technology.

PIC16F787

Enhanced FLASH 8-Bit CMOS Microcontroller with A/D Converter and EEPROM Data Memory Product Brief

High-Performance RISC CPU

- Only 35 single word instructions to learn
- All single cycle instructions except for program branches which are two cycle
- Operating speed: DC - 20 MHz clock input
  DC - 200 ns instruction cycle
- 4096 x 14 words of Program Memory
- 128 x 8 bytes of Data Memory (RAM)
- 128 x 8 bytes of EEPROM data memory
- Interrupt capability
- 8-level deep hardware stack
- Direct, indirect, and relative addressing modes
- 4x phase lock loop

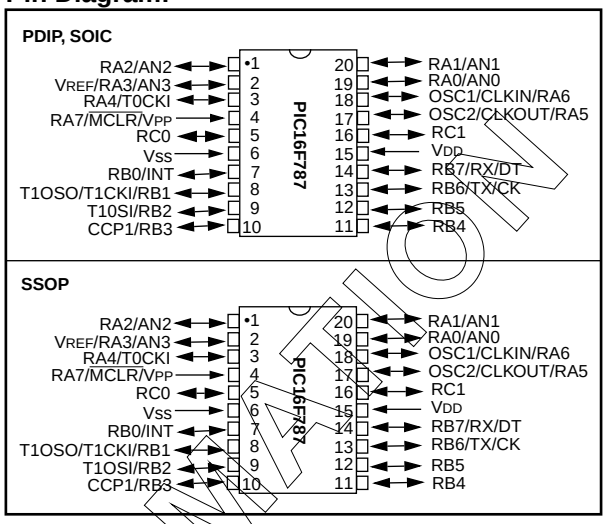
Peripheral Features:

- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler, can be incremented during sleep via external crystal/clock
- Capture, Compare, PWM module
- Capture is 16-bit, max. resolution is 12.5 ns, Compare is 16-bit, max. resolution is 200 ns, PWM max. resolution is 10-bit
- 10-bit analog-to-digital converter:
  - Max. 4 channel single ended inputs
  - Max. 2 channel differential inputs
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI)
- Brown-out Reset (BOR)
- Programmable gain amplifier
- 18 I/O pins with individual direction control
- High Sink/Source Current 25 mA / 25 mA

Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) (via two pins)
- 10,000 erase/write cycles *Enhanced* FLASH program memory
- 1,000,000 erase/write cycles EEPROM data memory
- EEPROM data retention > 40 years
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode

Pin Diagram:



Special Microcontroller Features (Continued):

- Selectable oscillator options:
  - LP, XT, HS
  - External RC, Precision Internal RC
- Internal pull-up on $\overline{MCLR}$ pin
- Internal pull-ups on I/O pins

CMOS Technology:

- Low-power, high-speed CMOS *Enhanced* FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range: 2.5V to 5.5V
- Commercial, Industrial, and Extended temperature ranges
- Low-power consumption:
  - < 2 mA @ 5V, 4 MHz
  - 15 µA typical @ 3V, 32 kHz
  - < 1 µA typical standby current

ICSP is a trademark of Microchip Technology.

PIC16F83A/84A

18-Pin *Enhanced* FLASH/EEPROM 8-Bit Microcontroller Product Brief

Devices:

- PIC16F83A
- PIC16F84A

High-Performance RISC CPU:

- Only 35 single word instructions to learn
- All instructions single cycle (200 ns @ 20 MHz) except for program branches which are two-cycle
- Operating speed: DC - 20 MHz clock input
  DC - 200 ns instruction cycle

Device	Memory			Freq Max.
	Enhanced FLASH	Data		
		RAM	EEPROM	
PIC16F83A	512 words	36	64	20 MHz
PIC16F84A	1K words	68	64	20 MHz

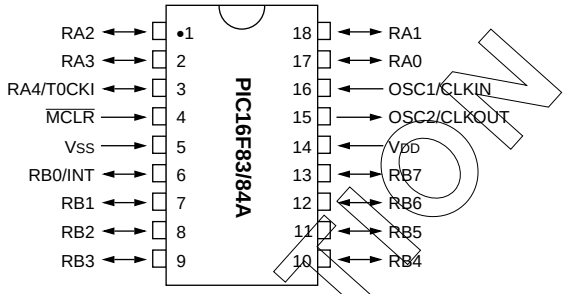
- 14-bit wide instructions
- 8-bit wide data path
- 15 special function hardware registers
- 8-level deep hardware stack
- Direct, indirect and relative addressing modes
- Four interrupt sources:
  - External RB0/INT pin
  - TMR0 timer overflow
  - PORTB<7:4> interrupt on change
  - Data EEPROM write complete

Peripheral Features:

- 13 I/O pins with individual direction control
- High current sink/source for direct LED drive
  - 25 mA sink max. per pin
  - 20 mA source max. per pin
- TMR0: 8-bit timer/counter with 8-bit programmable prescaler

Pin Diagram:

PDIP, SOIC



Special Microcontroller Features:

- 10,000 erase/write cycles *Enhanced* FLASH program memory
- 1,000,000 erase/write cycles EEPROM data memory
- EEPROM Data Retention > 40 years
- In-Circuit Serial Programming (ICSP™) (via two pins)
- Power-on Reset (POR)
- Power-up Timer (PWRT)
- Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Code protection
- Power saving Sleep mode
- Selectable oscillator options

CMOS Technology:

- Low-power, high-speed CMOS *Enhanced* FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range:
  - Commercial: 2.0V to 5.5V
  - Industrial: 2.0V to 5.5V
- Low power consumption:
  - < 2 mA typical @ 5V, 4 MHz
  - 15 μA typical @ 2V, 32 kHz
  - < 0.5 μA typical standby current @ 2V

ICSP is a trademark of Microchip Technology.

PIC16F825

Enhanced FLASH/EEPROM 8-Bit Microcontroller With Analog Comparators Product Brief

High Performance RISC CPU:

- Simple instruction set – 35 total
- All single-cycle instructions (200 ns), except for program branches which are two-cycle
- Operating speed:
- DC - 20 MHz clock input
- DC - 200 ns instruction cycle
- 2048 x 14 *Enhanced* FLASH program memory
- 64 x 8 EEPROM data memory
- 128 x 8 RAM data memory
- Interrupt capability
- Eight levels of hardware stack
- Direct, indirect and relative addressing modes

Peripheral Features:

- High current sink/source for direct LED drive
- Three timers: TMR0 (8-bit timer/counter), TMR1 (16-bit timer/counter time-base for capture/compare), TMR2 (8-bit timer/counter time-base for PWM)
- One CCP pin that can be configured as capture input, PWM output, or compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bit. Maximum PWM frequency @ 8-bit resolution = 80 kHz, 10-bit resolution = 20 kHz
- USART (supports high and low speeds)/SCI
- Analog comparator module with:
  - Two independent analog comparators
  - Programmable on-chip voltage reference (V_{REF}) module
  - Programmable input multiplexing from device inputs and internal voltage reference
  - Comparator outputs can be output signals

Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) (via two pins)
- 10,000 erase/write cycles *Enhanced* FLASH program memory
- 1,000,000 erase/write cycles EEPROM data memory
- EEPROM data retention > 40 years
- Power-on Reset (POR), Power-up Timer (PWRT), Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options, multi-speed clocking
- Internal Precision RC oscillator
- Only single 5V supply required for programming
- Processor read/write access to program memory
- Four user programmable ID locations
- Brown-out Reset circuitry and low voltage detection

CMOS Technology:

- Low-power, high-speed CMOS Enhanced FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range
  - 2.0V to 5.5V
- Commercial, Industrial, and Extended temperature ranges
- Low power consumption
  - < 2.0 mA @ 5.0V, 4.0 MHz
  - 20 μA typical @ 3.0V, 32 kHz
  - < 1.0 μA typical standby current @ 3.0V

Package Options:

- 28-pin package options: PDIP, SOIC, and SSOP
- Footprint compatible with popular PIC16C62/63 devices

ICSP is a trademark of Microchip Technology.

PIC16F863/865

Enhanced FLASH/EEPROM 8-Bit Microcontroller Product Brief

Device	Program Flash	Data SRAM	Data EEPROM	Pins	CCP (PWM)	SSP	USART	PSP
PIC16F863	4096 x 14	192 x 8	128 x 8	28	2	Yes	Yes	No
PIC16F865	4096 x 14	192 x 8	128 x 8	40-44	2	Yes	Yes	Yes

High Performance RISC CPU:

- Simple instruction set – 35 total
- All single-cycle instructions (200 ns), except for program branches which are two-cycle
- Operating speed:
  - DC - 20 MHz clock input
  - DC - 200 ns instruction cycle
- 4096 x 14 *Enhanced* FLASH program memory
- 192 x 8 general purpose registers (SRAM)
- 128 x 8 on-chip EEPROM data memory
- Eight levels of hardware stack
- Interrupt capability

Peripheral Features:

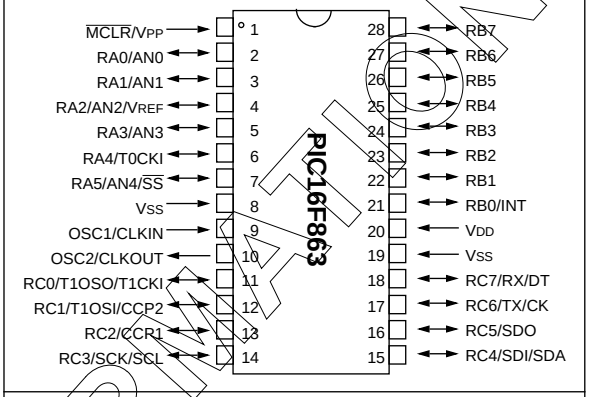
- High current sink/source
- Three timers: TMR0 (8-bit timer/counter), TMR1 (16-bit timer/counter time-base for capture/compare), TMR2 (8-bit timer/counter time-base for PWM)
- Two CCP pins that can be configured as capture input, PWM output, or compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bit. Maximum PWM frequency @ 8-bit resolution = 80 kHz, 10-bit resolution = 20 kHz
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ mode
- USART (supports high and low speeds)/SCI
- Parallel Slave Port (PSP), 8-bits wide with external $\overline{RD}$, $\overline{WR}$, and $\overline{CS}$ controls (PIC16F865 only)

Special Microcontroller Features:

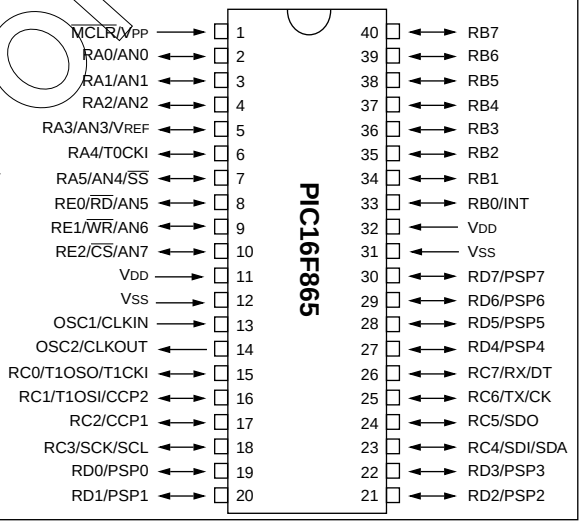
- In-Circuit Serial Programming (ICSP™) (via two pins)
- Power-on Reset (POR), Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options
- Only single 5V supply required for programming
- Processor read/write access to program memory
- Brown-out Reset circuitry (BOR)

Pin Diagram:

PDIP, SOIC



PDIP (Also PLCC, TQFP, MQFP)



CMOS Technology:

- Low-power, high-speed CMOS *Enhanced* FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range (2.0V to 5.5V)
- Commercial, industrial and automotive temperature
- Low power consumption
  - < 2.0 mA @ 5.0V, 4.0 MHz
  - 20 µA typical @ 3.0V, 32 kHz
  - < 1.0 µA typical standby current @ 3.0V

I^2C is a trademark of Philips Corporation. SPI is a trademark of Motorola Corporation. ICSP is a trademark of Microchip Technology.

PIC16F866/867

Enhanced FLASH/EEPROM 8-Bit Microcontroller With Analog Comparators
Product Brief

Device	Program FLASH	Data SRAM	Data EEPROM	Pins	CCP (PWM)	SSP	USART	PSP
PIC16F866	8192 x 14	368 x 8	256 x 8	28	2	Yes	Yes	No
PIC16F867	8192 x 14	368 x 8	256 x 8	40-44	2	Yes	Yes	Yes

High Performance RISC CPU:

- Simple instruction set - 35 total
- All single-cycle instructions (200 ns), except for program branches which are two-cycle
- Operating speed:
  - DC - 20 MHz clock input
  - DC - 200 ns instruction cycle
- 8192 x 14 *Enhanced* FLASH program memory
- 368 x 8 general purpose registers (SRAM)
- 256 x 8 on-chip EEPROM data memory
- Eight levels of hardware stack
- Interrupt capability

Peripheral Features:

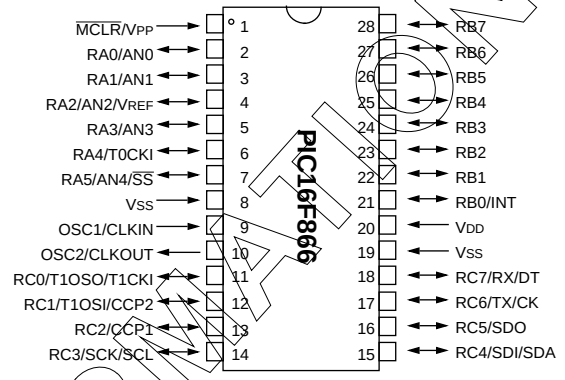
- Three timers: TMR0 (8-bit timer/counter), TMR1 (16-bit timer/counter time-base for capture/compare), TMR2 (8-bit timer/counter time-base for PWM)
- Two CCP pins that can be configured as capture input, PWM output, or compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bits. Maximum PWM frequency @ 8-bit resolution = 80 kHz, 10-bit resolution = 20 kHz
- Analog comparator module with:
- Two independent analog comparators
- Programmable on-chip voltage reference (V_{REF}) module
- Comparator outputs can be output signals
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ mode
- USART (supports high and low speeds)/SCI
- Parallel Slave Port (PSP), 8-bits wide with external $\overline{RD}$, $\overline{WR}$, and $\overline{CS}$ controls (PIC16F867 only)

Special Microcontroller Features:

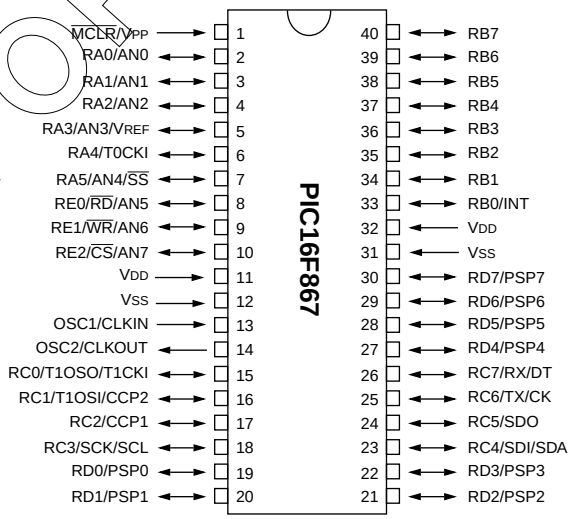
- In-Circuit Serial Programming (ICSP™) (via two pins)
- Power-on Reset (POR), Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options
- Only single 5V supply required for programming
- Processor read/write access to program memory
- Brown-out Reset circuitry (BOR)

Pin Diagram:

PDIP, SOIC



PDIP (Also PLCC, TQFP, MQFP)



CMOS Technology:

- Low-power, high-speed CMOS *Enhanced* FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range (2.0V to 5.5V)
- Commercial, industrial and automotive temperature
- Low power consumption
  - < 2.0 mA @ 5.0V, 4.0 MHz
  - 20 µA typical @ 3.0V, 32 kHz
  - < 1.0 µA typical standby current @ 3.0V

I^2C is a trademark of Philips Corporation. SPI is a trademark of Motorola Corporation. ICSP is a trademark of Microchip Technology.

PIC16F872

Enhanced FLASH/EEPROM 8-Bit Microcontroller With A/D Module Product Brief

High-Performance RISC CPU:

- Simple instruction set - 35 total
- All single-cycle instructions (200 ns), except for program branches which are two-cycle
- Operating speed:
- DC - 20 MHz clock input
- DC - 200 ns instruction cycle
- 2048 x 14 *Enhanced* FLASH program memory
- 64 x 8 EEPROM data memory
- 128 x 8 RAM data memory
- Interrupt capability
- Eight levels of hardware stack
- Direct, indirect and relative addressing modes

Peripheral Features:

- High current sink/source for direct LED drive
- Three timers: TMR0 (8-bit timer/counter), TMR1 (16-bit timer/counter time-base for capture/compare), TMR2 (8-bit timer/counter time-base for PWM)
- One CCP pin that can be configured as capture input, PWM output, or compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bit. Maximum PWM frequency @ 8-bit resolution = 80 kHz, 10-bit resolution = 20 kHz
- 10-bit Analog to Digital Converter (A/D) with high speed conversion rate (25 µs). Can also operate during Sleep.
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ slave mode

Special Microcontroller Features:

- In-Circuit Serial Programming (ICSP™) (via two pins)
- Power-on Reset (POR), Power-up Timer (PWRT), Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options, multi-speed clocking
- Internal Precision RC oscillator
- Only single 5V supply required for programming
- Processor read/write access to program memory
- Four user-programmable ID locations
- Brown-out Reset circuitry and low voltage detection

CMOS Technology:

- Low-power, high-speed CMOS Enhanced FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range
  - 3.0V to 5.5V
- Commercial, industrial, and automotive temperature ranges
- Low power consumption
  - < 2.0 mA @ 5.0V, 4.0 MHz
  - 20 µA typical @ 3.0V, 32 kHz
  - < 1.0 µA typical standby current @ 3.0V

Package Options:

- 28-pin package options: PDIP, SOIC, and SSOP
- Footprint compatible with popular PIC16C72/73 devices

SPI is a trademark of Motorola. ICSP is a trademark of Microchip Technology.

PIC16F873/874

Enhanced FLASH/EEPROM 8-Bit Microcontroller With A/D Module Product Brief

Device	Program FLASH	Data SRAM	Data EEPROM	Pins	10-Bit A/D	CCP (PWM)	SSP	USART	PSP
PIC16F873	4096 x 14	192 x 8	128 x 8	28	5 ch	2	Yes	Yes	No
PIC16F874	4096 x 14	192 x 8	128 x 8	40-44	8 ch	2	Yes	Yes	Yes

High-Performance RISC CPU:

- Simple instruction set - 35 total
- All single-cycle instructions (200 ns), except for program branches which are two-cycle
- Operating speed:
  - DC - 20 MHz clock input
  - DC - 200 ns instruction cycle
- 4096 x 14 *Enhanced* FLASH program memory
- 192 x 8 general purpose registers (SRAM)
- 128 x 8 on-chip EEPROM data memory
- Eight levels of hardware stack
- Interrupt capability

Peripheral Features:

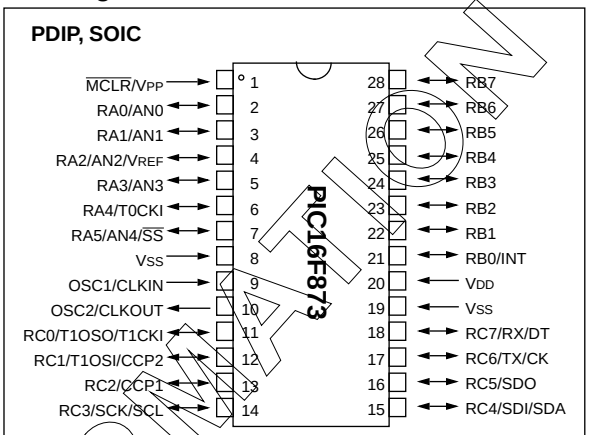
- High current sink/source for direct LED drive
- Three timers: TMR0 (8-bit timer/counter), TMR1 (16-bit timer/counter, time-base for capture/compare), TMR2 (8-bit timer/counter, time-base for PWM)
- Two CCP pins that can be configured as capture input, PWM output, or compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bit. Maximum PWM frequency @ 8-bit resolution = 80 kHz, 10-bit resolution = 20 kHz
- 10-bit Analog to Digital Converter (A/D) with high speed conversion rate (25 µs). Can also operate during Sleep.
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ mode
- USART (supports high and low speeds)/SCI
- Parallel Slave Port (PSP), 8-bits wide with external $\overline{RD}$, $\overline{WR}$, and $\overline{CS}$ controls (PIC16F874 only)

Special Microcontroller Features:

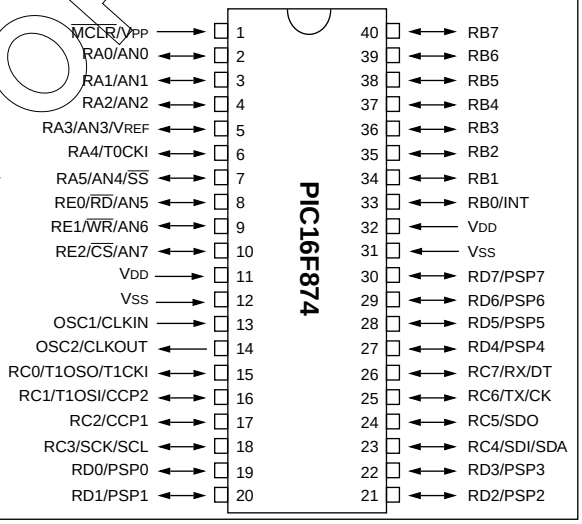
- Mixed Signal Microcontroller
- In-Circuit Serial Programming (ICSP™) (via two pins)
- 10,000 erase/write cycles *Enhanced* FLASH program memory
- 1,000,000 erase/write cycles EEPROM data memory
- Power-on Reset (POR), Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options
- Only single 5V supply required for programming
- Processor read/write access to program memory
- Brown-out Reset circuitry (BOR)

Pin Diagrams:

PDIP, SOIC



PDIP (Also PLCC, TQFP, MQFP)



CMOS Technology:

- Low-power, high-speed CMOS *Enhanced* FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range (2.5V to 5.5V)
- Commercial, industrial, and automotive temperature
- Low power consumption
  - < 2.0 mA @ 5.0V, 4.0 MHz
  - 20 µA typical @ 3.0V, 32 kHz
  - < 1.0 µA typical standby current @ 3.0V

I^2C is a trademark of Philips Corporation. SPI is a trademark of Motorola Corporation. ICSP is a trademark of Microchip Technology.

PIC16F876/877

Enhanced FLASH/EEPROM 8-Bit Microcontroller With A/D Module Product Brief

Device	Program FLASH	Data SRAM	Data EEPROM	Pins	10-Bit A/D	CCP (PWM)	SSP	USART	PSP
PIC16F876	8192 x 14	368 x 8	256 x 8	28	5 ch	2	Yes	Yes	No
PIC16F877	8192 x 14	368 x 8	256 x 8	40-44	8 ch	2	Yes	Yes	Yes

High-Performance RISC CPU:

- Simple instruction set – 35 total
- All single-cycle instructions (200 ns), except for program branches which are two-cycle
- Operating speed:
  - DC - 20 MHz clock input
  - DC - 200 ns instruction cycle
- 8192 x 14 *Enhanced* FLASH program memory
- 368 x 8 general purpose registers (SRAM)
- 256 x 8 on-chip EEPROM data memory
- Eight levels of hardware stack
- Interrupt capability

Peripheral Features:

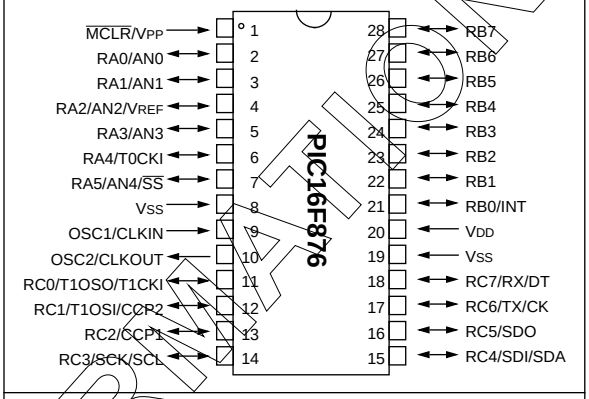
- High current sink/source
- Three timers: TMR0 (8-bit timer/counter), TMR1 (16-bit timer/counter, time-base for capture/compare), TMR2 (8-bit timer/counter, time-base for PWM)
- Two CCP pins that can be configured as capture input, PWM output, or compare output
  - Capture is 16-bit, max resolution 12.5 ns
  - Compare is 16-bit, max resolution 200 ns
  - PWM resolution is 1- to 10-bits. Maximum PWM frequency @ 8-bit resolution = 80 kHz, 10-bit resolution = 20 kHz
- 10-bit Analog to Digital Converter (A/D) with high speed conversion rate (25 µs). Can also operate during Sleep.
- Synchronous Serial Port (SSP) with two modes of operation:
  - 3-wire SPI™ (Supports all 4 SPI modes)
  - I^2C™ mode
- USART (supports high and low speeds)/SCI
- Parallel Slave Port (PSP), 8-bits wide with external $\overline{RD}$, $\overline{WR}$, and $\overline{CS}$ controls (PIC16F877 only)

Special Microcontroller Features:

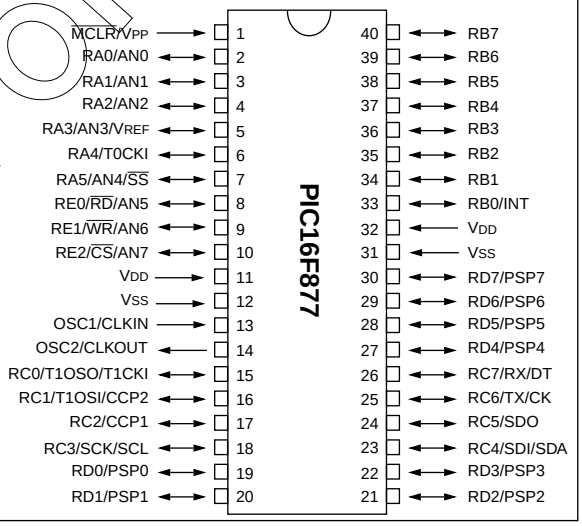
- Mixed Signal Microcontroller
- In-Circuit Serial Programming (ICSP™) (via two pins)
- 10,000 erase/write cycles *Enhanced* FLASH program memory
- 1,000,000 erase/write cycles EEPROM data memory
- Power-on Reset (POR), Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options
- Only single 5V supply required for programming
- Processor read/write access to program memory
- Brown-out Reset circuitry (BOR)

Pin Diagram:

PDIP, SOIC



PDIP (Also PLCC, TQFP, MQFP)



CMOS Technology:

- Low-power, high-speed CMOS *Enhanced* FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range (2.5V to 5.5V)
- Commercial, industrial, and automotive temperature
- Low power consumption
  - < 2.0 mA @ 5.0V, 4.0 MHz
  - 20 µA typical @ 3.0V, 32 kHz
  - < 1.0 µA typical standby current @ 3.0V

I^2C is a trademark of Philips Corporation. SPI is a trademark of Motorola Corporation. ICSP is a trademark of Microchip Technology.

SECTION 3
SERIAL EEPROMS

25AA040/25LC040/25C040

4K SPI™ Bus Serial EEPROM Product Brief

DEVICE SELECTION TABLE

Part Number	Vcc Range	Max Clock Frequency	Temp Ranges
25AA040	1.8-5.5V	1 MHz	C,I
25LC040	2.5-5.5V	2 MHz	C,I
25C040	4.5-5.5V	3 MHz	C,I,E

FEATURES

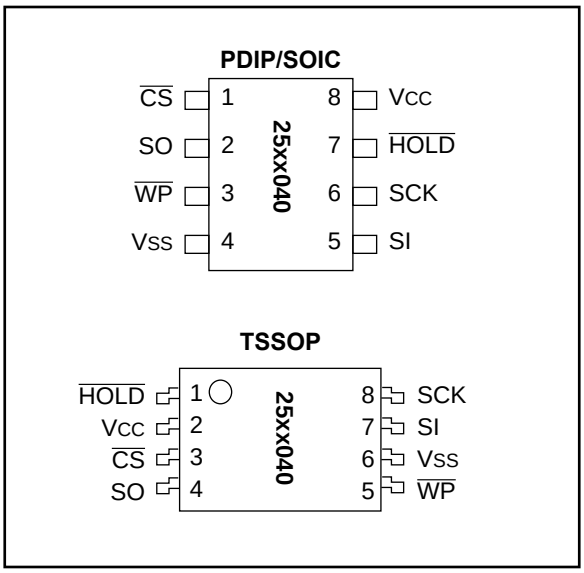
- Low power CMOS technology
  - Write current: 3 mA typical
  - Read current: 500 μA typical
  - Standby current: 500 nA typical
- 512 x 8 bit organization
- 16 byte page
- Write cycle time: 5ms max.
- Self-timed ERASE and WRITE cycles
- Block write protection
  - Protect none, 1/4, 1/2, or all of array
- Built-in write protection
  - Power on/off data protection circuitry
  - Write enable latch
  - Write protect pin
- Sequential read
- High reliability
  - Endurance: 10M cycles (guaranteed)
  - Data retention: > 200 years
  - ESD protection: > 4000V
- 8-pin PDIP, SOIC, and TSSOP packages
- Temperature ranges supported:
  - Commercial (C): 0°C to +70°C
  - Industrial (I): -40°C to +85°C
  - Automotive (E) (25C040): -40°C to +125°C

DESCRIPTION

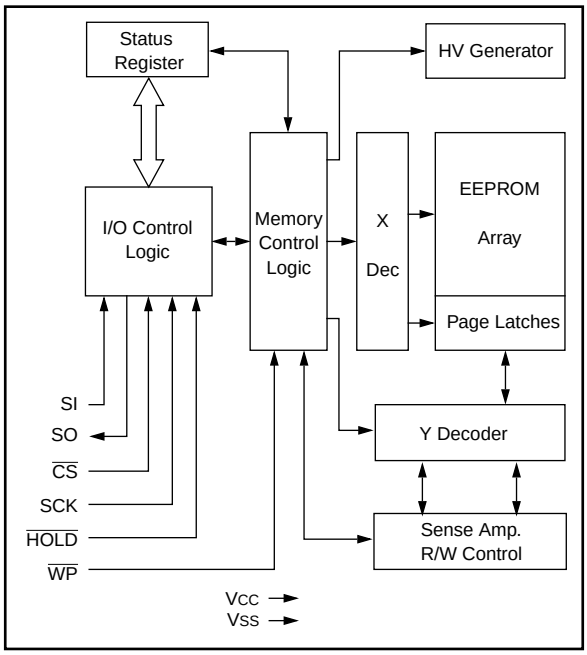
The 25AA040/25LC040/25C040 (25xx040*) is a 4K bit serial Electrically Erasable PROM. The memory is accessed via a simple Serial Peripheral Interface (SPI) compatible serial bus. The bus signals required are a clock input (SCK) plus separate data in (SI) and data out (SO) lines. Access to the device is controlled through a chip select ($\overline{CS}$) input.

Communication to the device can be paused via the hold pin ($\overline{HOLD}$). While the device is paused, transitions on its inputs will be ignored, with the exception of chip select, allowing the host to service higher priority interrupts. Also, write operations to the device can be disabled via the write protect pin ($\overline{WP}$).

PACKAGE TYPES



BLOCK DIAGRAM



SPI is a trademark of Motorola.
*25xx040 is used in this document as a generic part number for the 25AA040/25LC040/25C040 devices.

25xx640/128/256

64K/128K/256K SPI‘ Bus Serial EEPROMs Product Brief

DEVICE SELECTION TABLE

Device	Voltage	Organization	Temp. Range
25AA640	1.8-5.5V	8192 x 8 bits	C & I
25LC640	2.5-5.5V	8192 x 8 bits	C & I
25C640	4.5-5.5V	8192 x 8 bits	C, I, & E
25AA128	1.8-5.5V	16384 x 8 bits	C & I
25LC128	2.5-5.5V	16384 x 8 bits	C & I
25C128	4.5-5.5V	16384 x 8 bits	C, I, & E
25AA256	1.8-5.5V	32768 x 8 bits	C & I
25LC256	2.5-5.5V	32768 x 8 bits	C & I
25C256	4.5-5.5V	32768 x 8 bits	C, I, & E

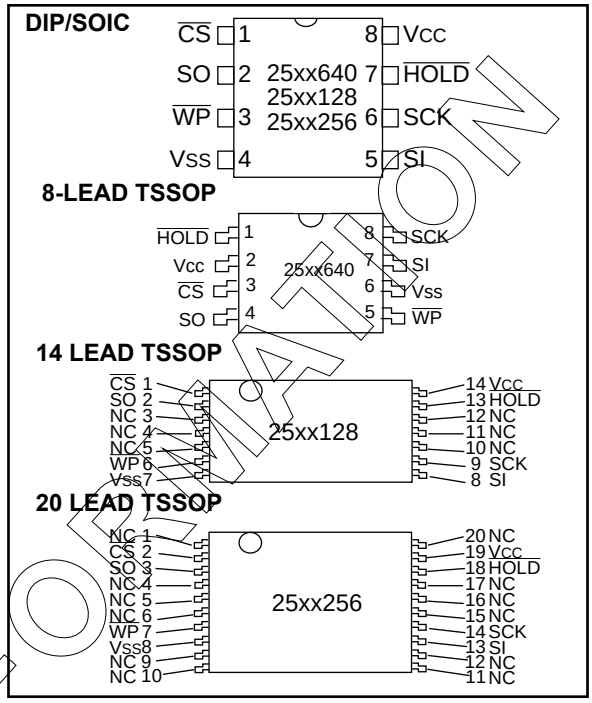
FEATURES

- SPI modes 0,0 and 1,1
- 3.0 MHz Clock Rate
- Single supply with operation down to 1.8V
- Low power CMOS technology
  - Max write current: 5.0 mA maximum
  - Read current: 500 µA typical
  - Standby Current: 1 µA typical
- 32-byte page (25xx640)
- 64-byte page (25xx128 and 25xx256)
- Sequential read
- Self-timed ERASE/WRITE cycles
- Block write protection
  - Protect none, 1/4, 1/2, or all of Array
- Built-in write protection
  - Power on/off data protection circuitry
  - Write-enable latch
  - Write-protect pin
- High reliability
  - Endurance: 1M cycles (guaranteed)
  - Data Retention: > 200 years
  - ESD protection: > 4000V
- 8-pin PDIP/SOIC, 8-lead TSSOP (25xx640), 14-lead TSSOP (25xx128), and 20-lead TSSOP (25xx256)
- Temperature ranges supported:
  - Commercial (C): 0°C to +70°C
  - Industrial (I): -40°C to +85°C
  - Automotive (E): -40°C to +125°C

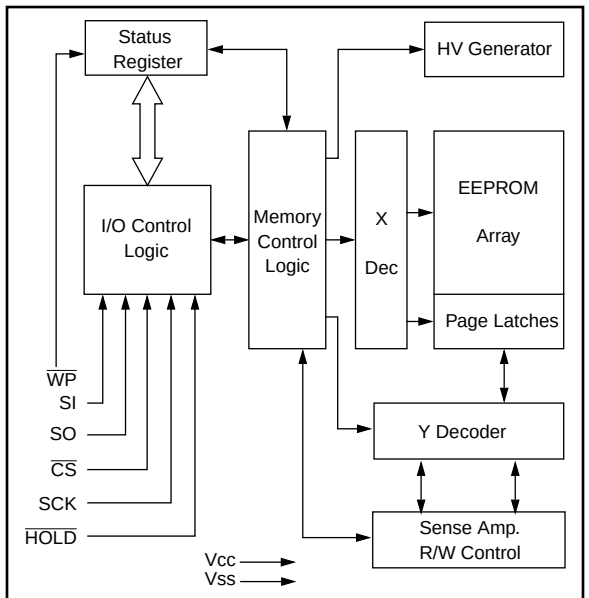
DESCRIPTION

The 25xx640/128/256 are serial Electrically Erasable PROMs (EEPROM). The memory is accessed via a simple Serial Peripheral Interface (SPI) compatible serial bus. The bus signals required are a clock input (SCK) plus separate data in (SI) and data out (SO) lines. Access to the device is controlled through a chip select (CS) input, allowing any number of devices to share the same bus. Also, write operations to the Status Register can be disabled via the write protect pin (WP).

PACKAGE TYPES



BLOCK DIAGRAM



NOTE: These devices are under consideration for development by Microchip Technology. This advance information is subject to change without notice.

SPI is a trademark of Motorola.

24AA64/24LC64/24C64

64K I²C™ CMOS Serial EEPROM Product Brief

DEVICE SELECTION TABLE

Part Number	Vcc Range	Max Clock Frequency	Temp Ranges
24AA64	1.8-5.5V	400 kHz†	C,I
24LC64	2.5-5.5V	400 kHz	C,I
24C64	4.5-5.5V	100 kHz	C,I,E

†100 kHz for Vcc < 2.5V

FEATURES

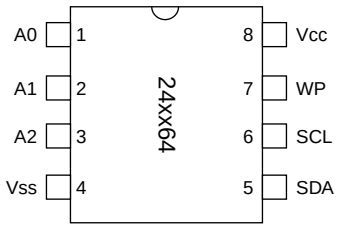
- Low power CMOS technology
  - Maximum write current 3 mA at 5.5V
  - Maximum read current 250 µA at 5.5V
  - Standby current 500 nA typical at 5.5V
- Two wire serial interface bus, I²C™ compatible
- Cascadable for up to eight devices
- Self-timed ERASE/WRITE cycle
- 32 byte page or byte write modes available
- 5 ms max write cycle time
- Hardware write protect for entire array
- Output slope control to eliminate ground bounce
- Schmitt trigger inputs for noise suppression
- 1,000,000 erase/write cycles guaranteed
- Electrostatic discharge protection > 4000V
- Data retention > 200 years
- 8-pin PDIP, SOIC (150 and 200 mil), and TSSOP packages; 14-pin SOIC package
- Temperature ranges:
  - Commercial (C): 0°C to +70°C
  - Industrial (I): -40°C to +85°C
  - Automotive (E): -40°C to +125°C

DESCRIPTION

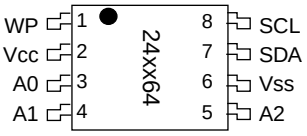
The 24AA64/24LC64/24C64 (24xx64*) is a 8K x 8 (64K bit) Serial Electrically Erasable PROM capable of operation across a broad voltage range (1.8V to 5.5V). It has been developed for advanced, low power applications such as personal communications or data acquisition. This device also has a page-write capability of up to 32 bytes of data. This device is capable of both random and sequential reads up to the 64K boundary. Functional address lines allow up to eight devices on the same bus, for up to 512 Kbits address space. This device is available in the standard 8-pin plastic DIP, 8-pin SOIC (150 mil and 200 mil), 8-pin TSSOP and 14-pin SOIC packages.

PACKAGE TYPE

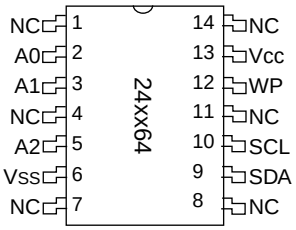
8L PDIP/SOIC



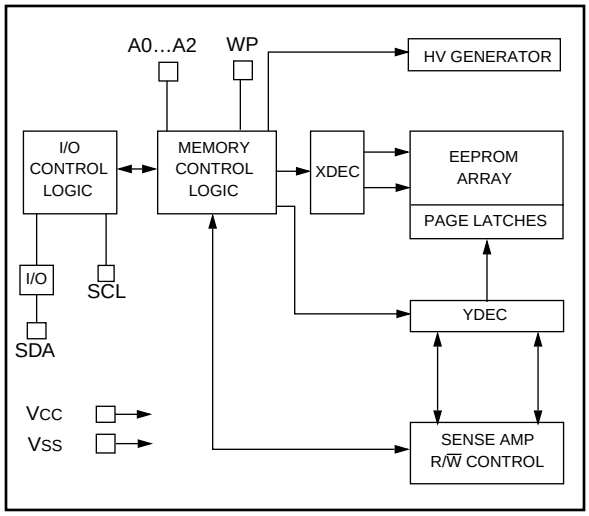
8L TSSOP



14L SOIC



BLOCK DIAGRAM



I²C is a trademark of Philips Corporation.

*24xx64 is used in this document as a generic part number for the 24AA64/24LC64/24C64 devices.

24AA128/24LC128/24C128

128K I²C™ CMOS Serial EEPROM Product Brief

DEVICE SELECTION TABLE

Part Number	Vcc Range	Max Clock Frequency	Temp Ranges
24AA128	1.8-5.5V	400 kHz†	C,I
24LC128	2.5-5.5V	400 kHz†	C,I
24C128	4.5-5.5V	400 kHz‡	C,I,E

†100 kHz for VCC < 4.5V.
‡100 kHz for E temperature range.

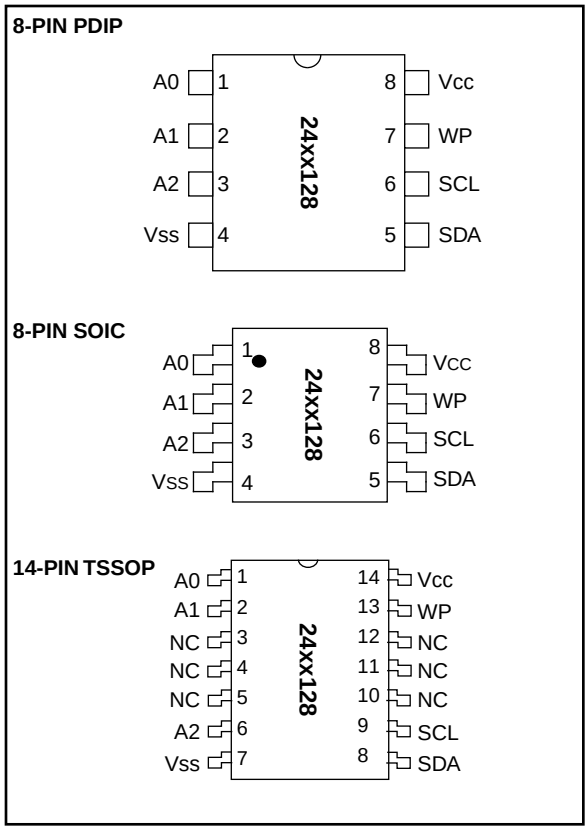
FEATURES

- Low power CMOS technology
  - Maximum write current 3 mA at 5.5V
  - Maximum read current 400 µA at 5.5V
  - Standby current 500 nA typical at 5.5V
- 2-wire serial interface bus, I²C compatible
- Cascadable for up to eight devices
- Self-timed ERASE/WRITE cycle
- 64-byte page-write mode available
- Fast write cycle time in byte or page mode
  - 5 ms max for 24LC128 and 24C128
  - 10 ms max for 24AA128
- Hardware write protect for entire array
- Output slope control to eliminate ground bounce
- Schmitt trigger inputs for noise suppression
- 1,000,000 erase/write cycles guaranteed
- Electrostatic discharge protection > 4000V
- Data retention > 200 years
- 8-pin PDIP and SOIC (150 & 208 mil) packages
- 14-pin TSSOP package
- Temperature ranges:
  - Commercial (C): 0°C to +70°C
  - Industrial (I): -40°C to +85°C
  - Automotive (E): -40°C to +125°C

DESCRIPTION

The 24AA128/24LC128/24C128 (24xx128*) is a 16K x 8 (128K bit) Serial Electrically Erasable PROM, capable of operation across a broad voltage range (1.8V to 5.5V). It has been developed for advanced, low power applications such as personal communications or data acquisition. This device also has a page-write capability of up to 64 bytes of data. This device is capable of both random and sequential reads up to the 128K boundary. Functional address lines allow up to eight devices on the same bus, for up to 1M bit address space. This device is available in the standard 8-pin plastic DIP, 8-pin SOIC (150 & 208 mil), and 14-pin TSSOP packages.

PACKAGE TYPE



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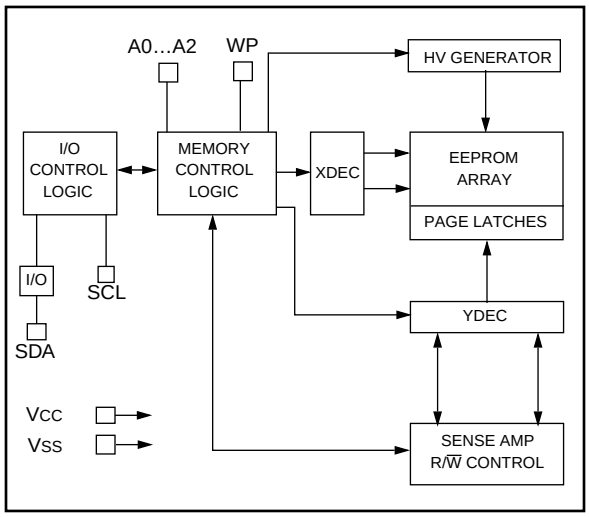


I²C is a trademark of Philips Corporation.
*24xx128 is used in this document as a generic part number for the 24AA128/24LC128/24C128 devices.

24AA256/24LC256/24C256

256K I²C™ CMOS Serial EEPROM Product Brief

DEVICE SELECTION TABLE

Part Number	Vcc Range	Max Clock Frequency	Temp Ranges
24AA256	1.8-5.5V	400 kHz†	C,I
24LC256	2.5-5.5V	400 kHz	C,I
24C256	4.5-5.5V	400 kHz‡	C,I,E

† 100 kHz for Vcc < 2.5V.
‡ 100 kHz for E temperature range.

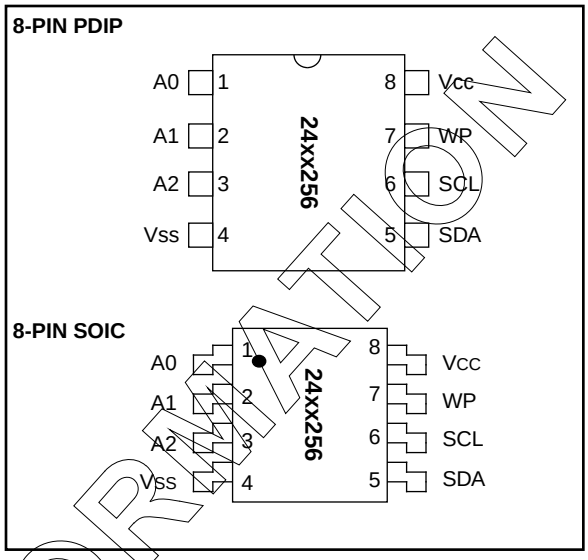
FEATURES

- Low power CMOS technology
  - Maximum write current 3 mA at 5.5V
  - Maximum read current 400 µA at 5.5V
  - Standby current 500 nA typical at 5.5V
- 2-wire serial interface bus, I²C compatible
- Cascadable for up to eight devices
- Self-timed ERASE/WRITE cycle
- 64-byte page-write mode available
- Fast write cycle time in byte or page mode
  - 5 ms max for 24LC256 and 24C256
  - 10 ms max for 24AA256
- Hardware write protect for entire array
- Schmitt trigger inputs for noise suppression
- 1,000,000 erase/write cycles guaranteed
- Electrostatic discharge protection > 4000V
- Data retention > 200 years
- 8-pin PDIP and SOIC (208 mil) packages
- Temperature ranges:
  - Commercial (C): 0°C to +70°C
  - Industrial (I): -40°C to +85°C
  - Automotive (E): -40°C to +125°C

DESCRIPTION

The 24AA256/24LC256/24C256 (24xx256*) is a 32K x 8 (256K bit) Serial Electrically Erasable PROM, capable of operation across a broad voltage range (1.8V to 5.5V). It has been developed for advanced, low power applications such as personal communications or data acquisition. This device also has a page-write capability of up to 64 bytes of data. This device is capable of both random and sequential reads up to the 256K boundary. Functional address lines allow up to eight devices on the same bus, for up to 2Mbit address space. This device is available in the standard 8-pin plastic DIP, and 8-pin SOIC (208 mil) packages.

PACKAGE TYPE



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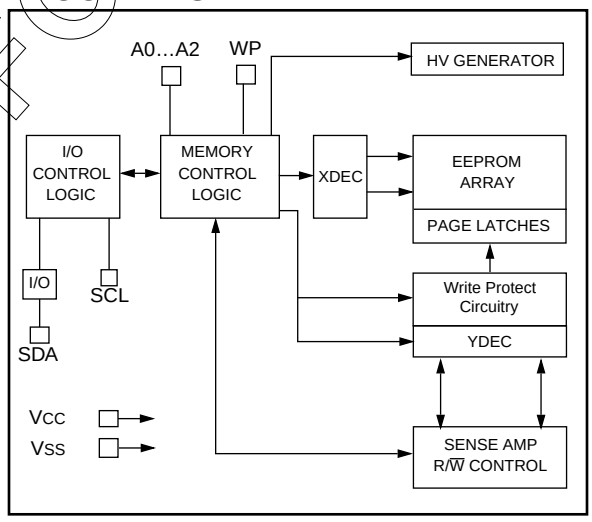


I²C is a trademark of Philips Corporation.
*24xx256 is used in this document as a generic part number for the 24AA256/24LC256/24C256 devices.

54CS08/54LCS08

8K Serial EEPROM with Password Protection Product Brief

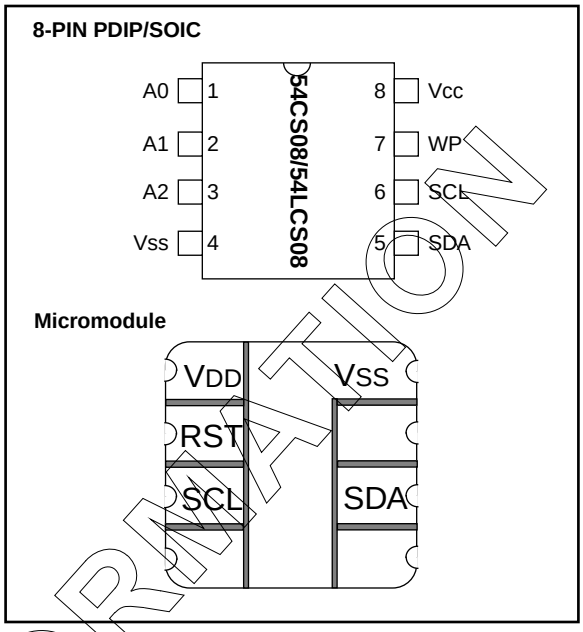
FEATURES

- Single supply operation
  - 54CS08: 4.5V to 5.5V
  - 54LCS08: 2.5V to 5.5V
- ISO 7816-3 “Answer to Reset” Compatible for synchronous cards
- Three levels of security:
  - Transport mode
  - Issuer mode
  - User mode
- Security Features
  - Separate 8 byte configuration, read and write passwords
  - Transport Code
  - User programmable partitioning of memory for READ/WRITE password protection
  - 8 byte password length
  - Invalid Password counter with permanent lockout
  - Erase All command
  - Erase all counter with array disable feature
- Low power CMOS technology
  - 1 mA active current typical
  - 1 μA standby current
- 400 kHz (5V) compatibility
- Self-timed write cycle (including auto-erase)
- Page-write buffer for up to 16 bytes
- Available in 8-pin PDIP and SOIC packages
- Also available in Die, Wafer, and Micromodules for Smart Card applications
- Temperature ranges supported:
  - Commercial (C): 0˚C to +70˚C
  - Industrial (I): -40˚C to +85˚C

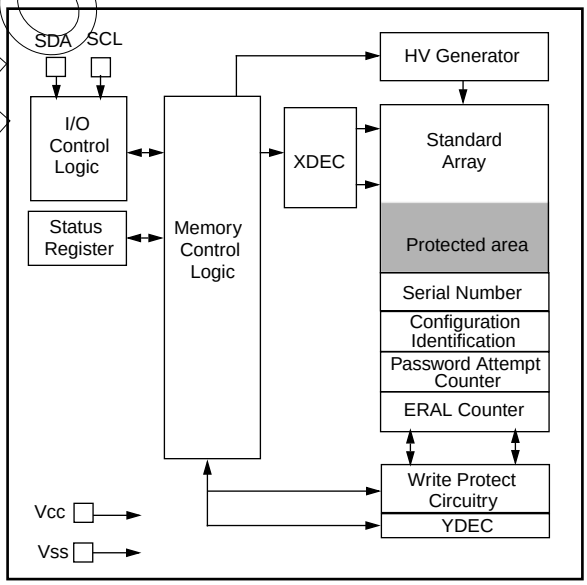
DESCRIPTION

The 54CS08/54LCS08 is a 8K bit Electrically Erasable PROM for smart card applications. The device is designed to allow the card issuer to partition the array into a standard array and a read/write protected array. The protected array can then only be accessed if the password is entered immediately prior to the command. A non-volatile counter is maintained to track invalid password attempts and will lock the device from access if the counter overflows. Another counter tracks the number of times the array is erased and prevents further erase commands when the counter overflows.

PACKAGE TYPE



BLOCK DIAGRAM



NOTE: *This device is under consideration for development by Microchip Technology. This advance information is subject to change without notice.*

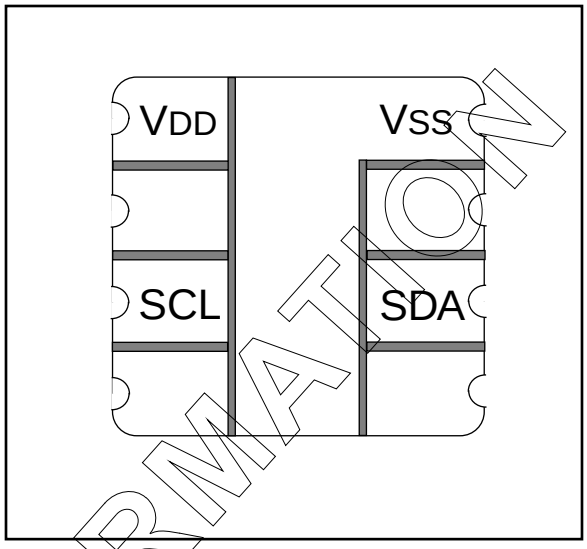
24LC01SC - 24LC64

1K - 64K 2.5V CMOS Serial EEPROMs in ISO Modules Product Brief

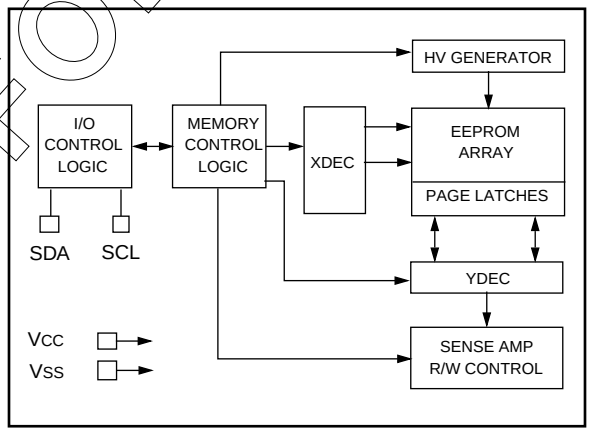
PRODUCT OFFERING

Device	Organization	Page length
24C01SC	128 x 8 bits	16 bytes
24C02SC	256 x 8 bits	16 bytes
24LC04B	512 x 8 bits	16 bytes
24LC08B	1024 x 8 bits	16 bytes
24LC16B	2048 x 8 bits	16 bytes
24LC32A	4096 x 8 bits	32 bytes
24LC64	8192 x 8 bits	32 bytes

ISO MODULE LAYOUT



BLOCK DIAGRAM



FEATURES

- Single supply with operation down to 2.5V
- Low power CMOS technology
  - 1 mA active current typical
  - 10 µA standby current typical at 5.5V
  - 5 µA standby current typical at 3.0V
- 2-wire serial interface bus, I²C™ compatible
- 100 kHz (2.5V) and 400 kHz (5V) compatibility
- Self-timed write cycle (including auto-erase)
- 2 ms typical write cycle time for page-write
- ESD protection > 4,000V
- 1,000,000 ERASE/WRITE cycles guaranteed
- Data retention > 200 years
- Temperature ranges available:
  - Commercial (C): 0˚C to +70˚C
  - Industrial (I): -40˚C to +85˚C

DESCRIPTION

The 24LCxx is a family of Electrically Erasable PROMs offered in ISO compatible modules. This family offers densities from 1K bits through 64K bits. Communication with any device in this family is done with a standard two wire serial interface. Low voltage design permits operation down to 2.5 volts with standby and active currents of only 5 µA and 1 mA respectively.

I²C is a trademark of Phillips Corporation

SECTION 4
SECURE DATA PRODUCTS

HCS100/120

KEELOQ™ Bi-directional Authenticator Product Brief

FEATURES

Security

- Secure storage of 64-bit encryption key
- 32-bit challenge and 32-bit response or 16-bit challenge and 16-bit response
- KEELOQ code hopping algorithm
- 32-bit serial number

Operating

- 3.0 to 6.0V operation
- On-chip oscillator
- PWM and Manchester Encoding

Other

- 102 bits EEPROM (HCS100)
- 192 bits EEPROM (HCS120)
- 5-pin SOT-23 package

Commands

- Read
- IFF
- Write (requires 20V on VPP for HCS100)

Typical Applications

- Subsystem authentication
- Software dongles
- Identity tokens
- Electronic key

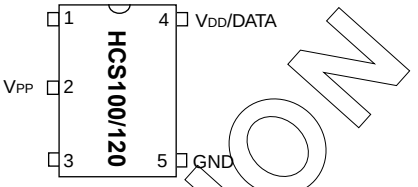
DESCRIPTION

The HCS100/120 are low cost authentication devices with on-chip EEPROM. Authentication is done by sending a challenge to the HCS100/120 and verifying the response. The authentication is based on a nonlinear encryption algorithm.

The HCS100 can be used in electronic keys that are typically programmed once at time of manufacture. The HCS120 with EEPROM can be used in applications where dynamic information needs to be stored in the key. The HCS120 can be completely reprogrammed.

PIN DIAGRAM

SOT-23



OPERATION

The HCS100/120 is in low power shutdown while DATA is low. When DATA is taken high, a communication sequence is started by issuing a command. The command can also include data. The HCS100/120 will respond with the relevant data or acknowledge.

KEELOQ is a registered trademark of Microchip Technology Inc.
*Code hopping encoder patents issued in Europe, U.S.A., R.S.A.—U.S.A.: 5,517,187; Europe: 0459781

HCS365

KEELOQ™ Code Hopping Encoder* Product Brief

FEATURES

Security

- Programmable 28/32-bit serial number
- Each transmission is unique
- 69-bit transmission length
- 32-bit hopping code
- 37-bit nonencrypted part (28/32-bit serial number, 4/0-bit function code, 1-bit battery low, 2-bit CRC, 2-bit queue)
- Encryption keys are read protected
- 60-bit seed used for secure learning

Operating

- 2.0 to 6.6V operation
- Four switch inputs [S3, S2, S1, S0] – 15 functions
- Two queue bits for 4x15 functions
- Selectable baud rate and code blanking
- Automatic code word completion
- Battery low signal transmitted
- Non-volatile synchronization
- PWM, VPWM, PPM, and Manchester encoding
- IR modulation
- RF enable out
- High voltage generator (3V to 6V step-up)

Other

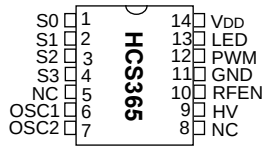
- Easy to use programming interface
- On-chip EEPROM
- On-chip tunable oscillator and timing components or external resonator
- 14-pin PDIP/SOIC and die

Typical Applications

Automotive remote entry systems
Automotive alarm systems
Automotive immobilizers
Gate and garage openers
Electronic door locks (Home/Office/Hotel)
Burglar alarm systems

PIN DIAGRAM

PDIP, SOIC



Description

The HCS365 is a code hopping transponder device designed for secure entry systems. The HCS365 utilizes the patented KEELOQ code hopping system for logical and physical access control. High security learning mechanisms make this a canned solution when used with the KEELOQ decoders. The transmitter keys and synchronization information are stored in protected on-chip EEPROM.

The HCS365 is a superset of the HCS360/361 and features all the previous encoding schemes as well as PPM. An internal tuned oscillator or external ceramic resonator can be used for applications that require an accurate bit rate. The RF-enable output can be used to switch the RF circuit on such as required for FM transmitters. The high-voltage generator provides a signal for voltage doubling (3V to 6V) for circuits that use one 3V lithium cells but, require 6V for the RF circuit.

KEELOQ is a registered trademark of Microchip Technology Inc.
*Code hopping patents issued in Europe, USA and RSA Patent Numbers - USA: 5,517,187; Europe: 0459781

HCS405

KEELOQ™ Code Hopping Transponder* Product Brief

FEATURES

Security

- Two programmable 64-bit encryption keys
- 16/32-bit bi-directional challenge and response using one of two keys
- Encryption keys are read protected
- Programmable 32-bit serial number
- Two IFF encryption algorithms
- Asynchronous transponder communication

Operating

- 2.0V to 6.5V operation
- Bi-directional transponder
- Selectable baud rate
- PWM or PPM encoding
- Anti-collision of multiple transponders
- Passive proximity activation (no battery)

Other

- Easy to use programming interface
- On-chip tunable RC oscillator
- On-chip EEPROM
- 128-bit user EEPROM in transponder mode
- SQTP serialization quick-time programming
- 8-pin PDIP/SOIC/TSSOP and die

Typical Applications

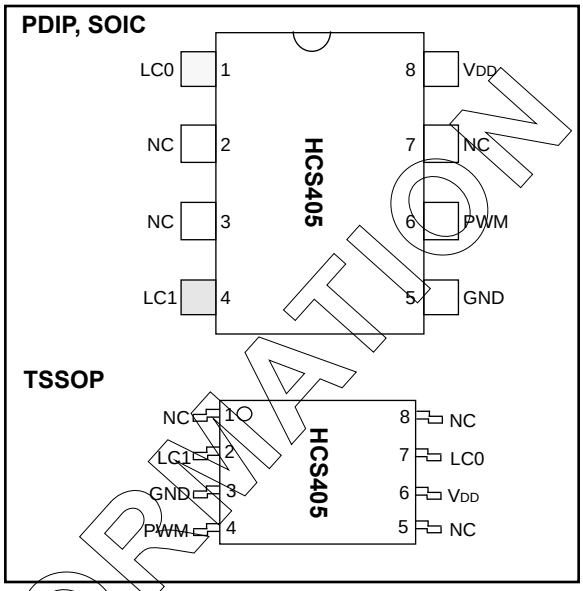
- Automotive remote entry systems
- Automotive immobilizers
- Electronic door locks (Home/Office/Hotel)
- Burglar alarm systems
- Proximity access control

Description

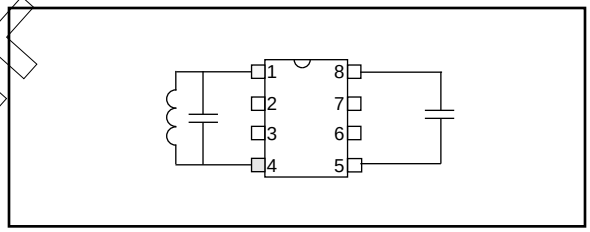
The HCS405 is a code hopping transponder device designed for secure entry systems. The HCS405 utilizes the patented KEELOQ bi-directional challenge-and-response for logical and physical access control. High system learning mechanisms make this a turnkey solution when used with the KEELOQ decoders. The keys and synchronization information are stored in protected on-chip EEPROM.

A low cost, batteryless transponder can be implemented with the addition of an inductor and two capacitors. A packaged module including the inductor and capacitor will also be offered.

PACKAGE TYPES



TRANSPONDER CIRCUIT REQUIRING NO BATTERY



KEELOQ is a registered trademark of Microchip Technology Inc.
*Code hopping encoder patents issued in Europe, U. S. A., R. S. A.—U.S.A.:5,517,187; Europe:0459781.

HCS410

KEELOQ™ Code Hopping Encoder and Transponder* Product Brief

FEATURES

Security

- Two programmable 64-bit encoder keys
- 16/32-bit bi-directional challenge and response using one of two keys
- 69-bit transmission length
- 32-bit unidirectional code hopping, 37-bit nonencrypted portion
- Encoder keys are read protected
- Programmable 28/32-bit serial number
- 60-bit, read-protected seed used for secure learning
- Two IFF encryption algorithms
- Delayed increment mechanism
- Asynchronous transponder communication
- Queuing information transmitted

Operating

- 2.0V to 6.6V operation
- Three switch inputs [S2, S1, S0] – seven functions
- Batteryless bi-directional transponder
- Selectable baud rate and code word blanking
- Automatic code word completion
- Battery low signal transmitted
- Nonvolatile synchronization
- PWM or Manchester RF encoding
- Combined transmitter, transponder operation
- Anti-collision of multiple transponders
- Passive proximity activation
- Reverse battery protection in typical RKE applications

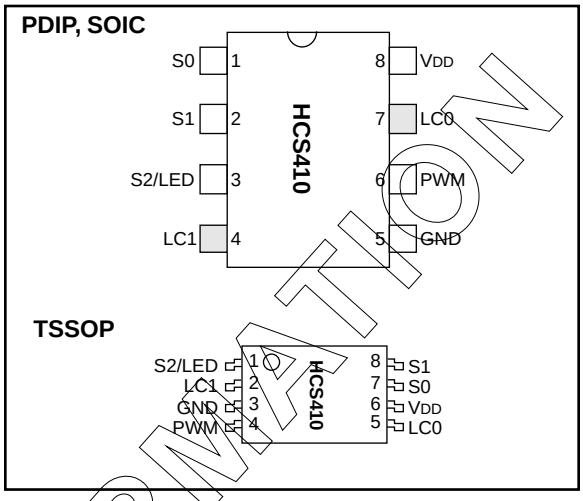
Other

- 37-bit nonencrypted part contains 28/32-bit serial number, 4/0-bit function code, 1-bit battery low, 2-bit CRC, 2-bit queue
- Easy to use programming interface
- On-chip tunable RC oscillator (±10%)
- On-chip EEPROM
- 64-bit user EEPROM in transponder mode
- Battery-low LED indication
- SQTP-serialized, quick-turn programming
- 8-pin PDIP/SOIC/TSSOP and die

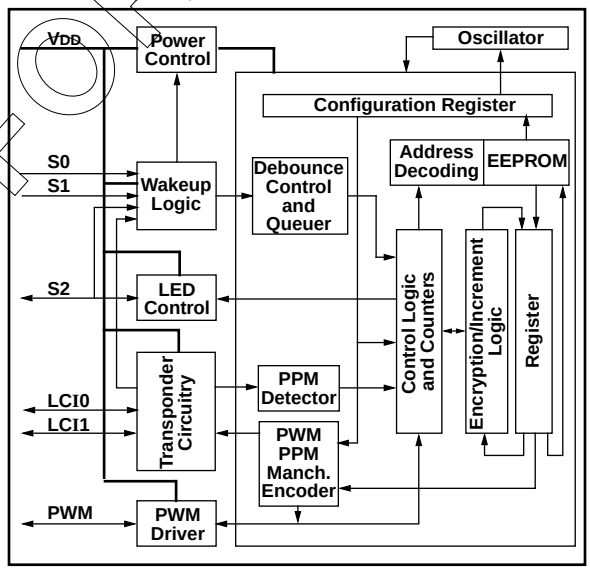
Typical Applications

- Automotive remote entry systems
- Automotive alarm systems
- Automotive immobilizers
- Gate and garage openers
- Electronic door locks (Home/Office/Hotel)
- Burglar alarm systems
- Proximity access control

PACKAGE TYPES



BLOCK DIAGRAM



KEELOQ is a registered trademark of Microchip Technology Inc.
*Code hopping encoder patents issued in Europe, U.S.A., R.S.A.—U.S.A.: 5,517,187; Europe: 0459781

SCS156

KEELOQ™ Reloadable Token Card Chip Product Brief

FEATURES

- ISO 7816-3:1989 “Answer to Reset” compatible for synchronous cards
- Industry standard 4406 command set compatible
- Extended commands:
  - Combined WRITE and ERASE-WITH-CARRY function
  - Cryptographic signature of the EEPROM contents and challenge
  - Cipher block chaining signature mode
- 40-bit and 64-bit user programmable areas with lock bit
- Two 64-bit cryptographic keys
- 64-bit transport code
- 33352 token units (78888_8)
- Internal protection against token counter value corruption (anti-tearing)
- Reloadable
  - Reload counter to limit number of reload operations
  - Bi-directional authentication

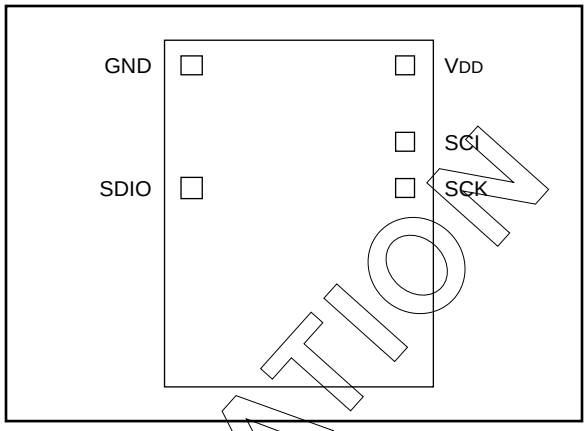
DESCRIPTION

The SCS156 is a third-generation token card integrated circuit intended for prepaid applications. Typical applications of the SCS156 include disposable telephone cards, vending machine cards, low value debit cards, access control, and authentication.

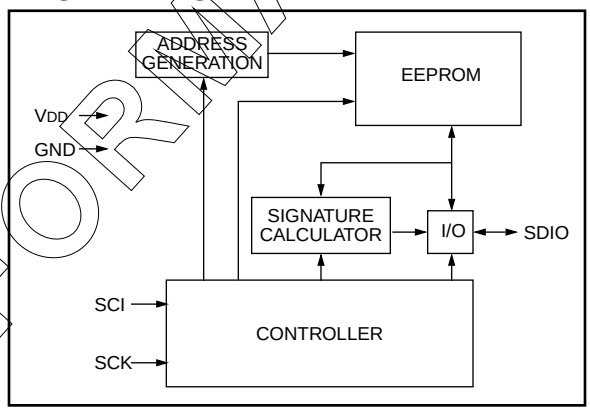
The SCS156 incorporates several security features, including an internal signature function and a long transport code. The SCS156 has two modes – issuer mode and user mode. During wafer testing, it is placed in issuer mode for card manufacturing and transportation to the issuer. In issuer mode, the transport code is needed to program the device and, thus, is protected from unauthorized use before personalization by the issuer.

During personalization, two cryptographic keys, unique to the card, are programmed into EEPROM. These keys can not be read. The system using the card must be able to determine what key was programmed from examining the memory map (i.e., not the token counter) containing the issuer and serial number information.

DIE LAYOUT



BLOCK DIAGRAM



The signature function computes a 16-bit value based on a system supplied value (challenge) and the visible memory map. Because of the nature of the signature function and the fact that the key is not known outside the system, it is practically impossible to predict the value which the signature will compute.

A correct signature indicates that the memory contents have not been altered. It can, therefore, be used to check the serial number, or that changes to the token counter have actually occurred.

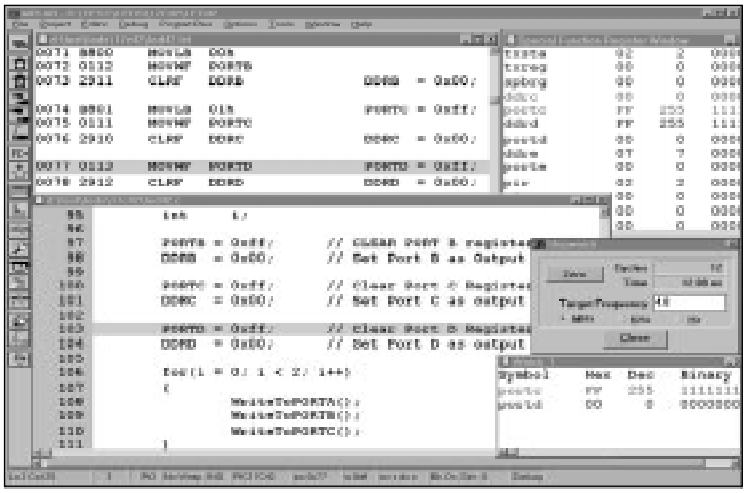
Programming the token counter uses a special circuit to ensure that the programming will either be complete or will not happen at all, if the external supply is suddenly removed. This is called **Fail Safe Programming™**, and, when used in conjunction with the extended write and erase command, removes the need for special ‘tear-out’ protection to be performed by the reader.

KEELOQ is a registered trademark of Microchip Technology Inc.
*Patents applied for.

SECTION 5
DEVELOPMENT SYSTEMS

MPLAB™C V2.XX

Universal C Compiler for PICmicro™ MCUs



Features:

- MPLAB-compatible for source level debugging in an easy-to-use project environment
- Full ANSI C compatibility
- Provides Object, Listing, Symbol and special files for debugging with MPLAB
- Supports interrupt routines
- Generates tight, efficient code
- Full relocatable Linker/Librarian
- Extensive PICmicro Libraries
- Can link MPLAB-C code with relocatable MPASM source code
- Local and global optimization
- Re-entrant code
- Floating point support
- In-line PICmicro assembly

Full ANSI C compatible MPLAB-C provides powerful integration and ease of use.

The **MPLAB-C** Universal C Compiler is a complete high-level language compiler for the Microchip Technology PICmicro families of 8-bit MCUs. Since MPLAB-C is compatible with Microchip's MPLAB Integrated Development Environment (IDE), it functions with the PICMASTER® in-circuit emulator and the MPLAB-SIM simulator. When using MPLAB-C with MPLAB, you get full source level debugging in an easy-to-use project environment which helps you reduce development time.

The MPLAB-C C compiler generates relocatable code that can be linked with powerful PICmicro Libraries, user defined Libraries and relocatable MPASM code.

MPLAB-C allows you to write code for PICmicro MCU applications in a high level language. The detailed operation of the target processor is mostly hidden which means less time is devoted to considering the details of the processors's architecture. This feature also permits easy code portability between different PICmicro MCU devices – often as simple as changing one line of source code.

MPLAB-C is Windows® compatible and runs on any IBM PC/AT® or compatible computer running DOS 5.0 or later. MPLAB-C supports the 12-bit, 14-bit and 16-bit Microchip microcontroller cores.

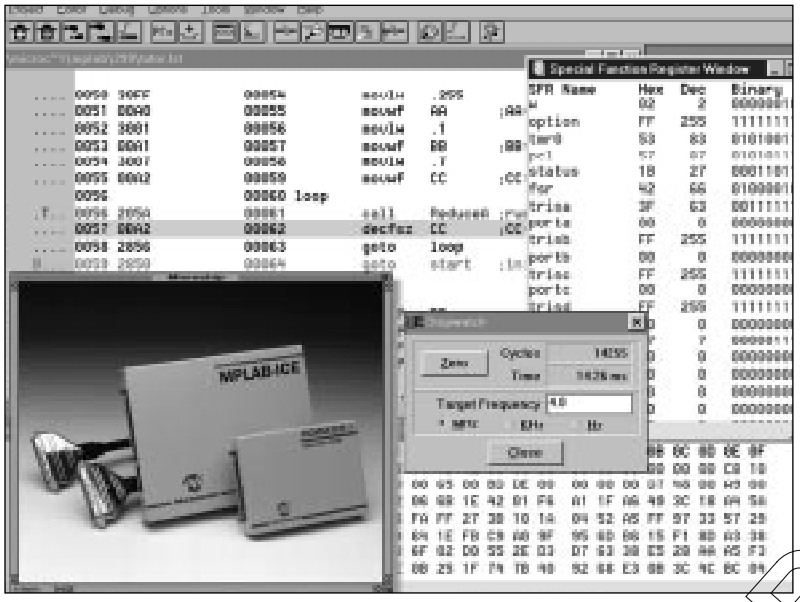
The MPLAB-C Universal C Compiler comes complete with the MPLAB IDE including MPLINK, MPASM, MPLIB and an extensive set of PICmicro Libraries.

MPLAB-C V. 2.XX provides specific support for MCU environments, including:

- I/O Ports (read only, write only and read/write)
- Interrupt vectors
- Fix variables and functions in memory
- PICmicro banked and shared memory areas

MPLAB™ICE

Full-Featured CE Compliant In-Circuit Emulator



MPLAB-ICE offers maximum power, flexibility and rapid design turn-around!

The **MPLAB-ICE** in-circuit emulator systems from Microchip Technology provide a high-quality, universal platform for emulating the entire line of Microchip 8-bit, PICmicro™ microcontrollers. MPLAB-ICE is compatible with PICMASTER® Probe Kits.

MPLAB-ICE is a high-performance, real-time in-circuit emulator. Included in the complete system are the emulator, MPLAB™ integrated development environment, MPASM full-featured macro assembler, and MPLAB-SIM, an unusually sophisticated simulator program. Sample programs and Demo Boards are provided to help quickly familiarize the user with the development system and the PICmicro 8-bit MCU families. The MPLAB IDE user interface features a built-in text editor, project management, and full integration with MPASM and high level languages that support the Common Object Description format (i.e. MPLAB-C).

MPLAB-ICE meets or exceeds the stringent Electromagnetic Compatibility requirements known as CE compliance directives established by the European Union (EU) countries. These include limiting radiated emission, improving susceptibility to radiated emission and improving susceptibility to Electrostatic Discharge (ESD).

CE Compliant.

PICmicro is a trademark of Microchip Technology, Inc.

Features:

- High-performance PC-based development system for PICmicro MCUs
- Real-time in-circuit emulation to maximum speed of PICmicro MCUs
- Program memory emulation and memory mapping capability up to 64k words
- Includes MPLAB Integrated Development Environment
- Real-time trace
- Low voltage emulation
- Unlimited breakpoints
- Software programmable target clock speeds
- Assembly and C source level debugging
- Complex breakpoints with 4 levels of triggering
- Break on register value
- Pass/delay counters
- External trigger/trace
- Trigger break on bit values
- Trace buffer 136 bits by 32k cycles deep
- Parallel port (printer) interface

APPENDIX A
COMPANY PROFILE

Microchip Technology Inc.

Company Profile

The Embedded Control Solutions Company®

Since its inception, Microchip Technology has focused its resources on delivering innovative semiconductor products to the global embedded control marketplace. To do this, we have focused our technology, engineering, manufacturing and marketing resources on two synergistic product lines: field-programmable 8-bit PICmicro™ microcontrollers (MCUs) and high-endurance Serial EEPROMs. Today, Microchip's expanding product portfolio is aimed at delivering a more comprehensive array of high-value solutions to a growing base of customers.

Highlights

Inside Microchip Technology you will find:

- An experienced executive team focused on innovation and committed to listening to our customers
- A focus on providing high-performance, cost-effective, field-programmable embedded control solutions
- 8-bit RISC field-programmable OTP and ROM MCUs
- The world's first 8-pin MCU
- Patented KEELOQ® code hopping technology products
- QuickASIC™ gate array conversion technology
- A full family of leadership Serial EEPROM products plus Parallel EEPROMs and EPROMs
- A variety of end-user Application-Specific Standard Products (ASSP)
- Fully integrated manufacturing capabilities
- A global network of manufacturing and customer support facilities
- A unique corporate culture dedicated to continuous improvement
- Distributor network support worldwide including certified distribution FAEs

Business Scope

Microchip Technology Inc. manufacturers and markets a variety of VLSI CMOS semiconductor components to support the market for cost-effective embedded control solutions. In particular, we specializes in highly integrated, field-programmable RISC MCUs, application-specific standard products, secure data products, application-specific integrated circuits and related Serial EEPROM memory products to meet growing market requirements for high performance, yet economical embedded control capability in products. Microchip's products feature the industry's most economical One-Time-Programmable (OTP) EPROM, reprogrammable Flash and EEPROM, and ROM capability, along with the compact size, integrated functionality, ease of development and technical support so essential to timely and cost-effective product development by our customers.

Chandler, Arizona: Company headquarters near Phoenix, Arizona; executive offices, R&D and wafer fabrication occupy this 242,000-square-foot multi-building facility.

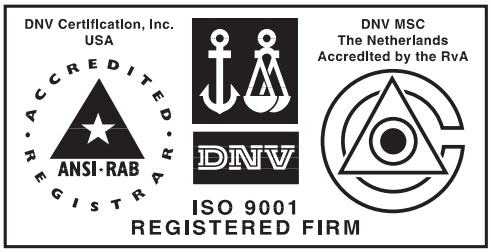
Tempe, Arizona: Microchip's 170,000-square-foot wafer fabrication facility provides increased manufacturing capacity today and for the future.

Market Focus

Microchip targets select markets where our advanced designs, progressive process technology and industry-leading product performance enables us to deliver decidedly superior performance. Our company is positioned to maintain a dominant role as a supplier of high-performance, field-programmable OTP MCUs and associated memory for embedded control applications found throughout the consumer, automotive, telecommunication, office automation and industrial control markets. Microchip products are also meeting the unique design requirements of targeted embedded applications including security, battery management and field-programmable gate array conversions.

Certified Quality Systems

Microchip received ISO 9001 Quality System certification for its worldwide headquarters and wafer fabrication facilities in January 1997. Our field-programmable 8-bit MCUs, Serial EEPROMs, related specialty memory products and development systems conform to the stringent quality standards of the International Standards Organization (ISO).



Our assembly and test facility in Kaohsiung, Taiwan is ISO 9002 certified. In addition, Microchip's manufacturing and engineering systems were audited to meet the Automotive Electronics Council A100 guidelines for overall quality, reliability and demonstrated conformance to the requirements of QS-9000.

Fully Integrated Manufacturing

Microchip delivers fast turnaround and consistent quality through total control over all phases of production. Research and development, design, mask making, wafer fabrication, and the major part of assembly and quality assurance testing are conducted at facilities wholly-owned and operated by Microchip. Our integrated approach to manufacturing along with rigorous use of advanced Statistical Process Control (SPC) and a continuous improvement culture has resulted in high and consistent yields which have positioned Microchip as a quality leader in its global markets. Microchip's unique approach to SPC provides customers with excellent pricing, quality, reliability and on-time delivery.

Bangkok, Thailand: Microchip's 140,000-square-foot manufacturing facility houses the technology and assembly/test equipment for high speed testing and packaging.

A Global Network of Plants and Facilities

Microchip is a global competitor providing local service to the world's technology centers. Our design, technology advancement, front-end wafer fabrication, and wafer probe and sort facilities are located in Chandler and Tempe, Arizona.

The Tempe facility provides an additional 170,000 square feet of manufacturing space that meets the increased production requirements of a growing customer base, and provides production capacity which more than doubles that of Chandler. Assembly and test facilities, predominantly located in Kaohsiung, Taiwan and Bangkok, Thailand house the technology and assembly and test equipment necessary for modern plastic and ceramic packaging.

During fiscal 1996, Microchip invested more than $115 million for capital additions to its Tempe fabrication facility and for construction of the additional Bangkok testing facility in Asia. These investments have led to significant improvements in our output and overall cost structure.

Sales and application offices are located in key cities throughout the Americas, Asia/Pacific, Japan and Europe. Offices are staffed to meet the high quality expectations of our customers, and can be accessed for technical and business support.

Embedded Control Overview

Unlike “processor” applications such as personal computers and workstations, the computing or controlling elements of embedded control applications are embedded inside the application. The consumer is only concerned with the very top-level user interface such as keypads, displays and high-level commands. Very rarely does an end-user know (or care to know) the embedded controller inside (unlike the conscientious PC users, who are intimately familiar not only with the processor type, but also its clock speed, DMA capabilities and so on).

It is, however, most vital for designers of embedded control products to select the most suitable controller and companion devices. Embedded control products are found in all market segments: consumer, commercial, PC peripherals, telecommunications (including personal telecom products), automotive and industrial. Most embedded control products must meet special requirements: cost effectiveness, low-power, small-footprint and a high level of system integration.

Typically, most embedded control systems are designed around a MCU which integrates on-chip program memory, data memory (RAM) and various peripheral functions, such as timers and serial communication. In addition, these systems usually require complementary Serial EEPROM, display drivers, keypads or small displays.

Microchip has established itself as a leading supplier of field-programmable embedded control solutions. The combination of high-performance MCUs from the PIC12CXXX, PIC16C5X, PIC16CXXX and PIC17CXXX families, along with non-volatile memory products, provide the basis for this leadership.

Microchip is committed to continuous innovation and improvement in design, manufacturing and technical support to provide the best possible embedded control solutions to you.

PICmicro MCU Overview and Roadmap

Microchip PICmicro MCUs combine high-performance, low-cost, and small package size, offering the best price/performance ratio in the industry. More than 100 million of these devices ship each year to cost-sensitive consumer products, computer peripherals, office automation, automotive control systems, security and telecommunication applications.

Microchip offers four families of 8-bit MCUs to best fit your needs: PIC16C5X 12-bit program word, PIC16CXXX 14-bit program word, PIC17CXXX 16-bit program word and PIC12CXXX 8-pin 12-bit/14-bit program word MCU families.

All families offer OTP, low-voltage and low-power options, with a variety of package options. Selected members are available in ROM or reprogrammable Flash versions.

The widely-accepted PIC16C5X, PIC16CXXX and PIC17CXXX families are the industry’s only 8-bit MCUs using a high-speed RISC architecture. Today, these families are joined by the industry’s first and only 8-pin MCU family – the PIC12CXXX. The PIC12CXXX family combines the 8-bit high-speed RISC architecture of the PICmicro MCUs with the smallest footprint MCU. Microchip pioneered the use of RISC architecture to obtain high speed and instruction efficiency.

PIC12CXXX: 8-Pin, 8-Bit Family

The PIC12CXXX family packs Microchip’s powerful RISC-based PICmicro architecture into 8-pin DIP and SOIC packages. These PIC12CXXX products are available with either a 12-bit or 14-bit wide instruction set, a low operating voltage of 2.5V, small package footprints, interrupt handling and a deeper hardware stack. All of these features provide an intelligence level not previously available in applications because of cost or size considerations.

PIC16C5X: 12-Bit Architecture Family

The PIC16C5X is the well established base-line family which offers the most cost-effective solution. These PIC16C5X products have a 12-bit wide instruction set and are currently offered in 18-, 20- and 28-pin packages. In the SOIC and SSOP packaging options, these are among the smallest footprint MCUs. Low-voltage operation, down to 2.0V for OTPs, make this family ideal for battery operated applications.

PIC16CXXX: 14-Bit Architecture Family

The PIC16CXXX family offers a wide-range of options, from 18-pin to 68-pin packages as well as low to high levels of peripheral integration. This family has a 14-bit wide instruction set, interrupt handling capability and a deep, 8-level hardware stack. The PIC16CXXX family provides the performance and versatility to meet the more demanding requirements of todays cost-sensitive marketplace for mid-range 8-bit applications.

The PIC14C000 Programmable Mixed-Signal Controller allows engineers to design intelligent controllers for smart batteries, battery chargers, battery status monitoring, uninterruptible power supplies, HVAC, and other data acquisition and processing required for managing energy. The PIC14C000 can support any battery technology including Li Ion, NiMH, NiCd, Pb acid, Zinc Air. In addition, the product’s I^2C™ port enables any system OEM, battery pack VAR, and battery manufacturer to design, build, and market SBD-compliant products supporting the System Management Bus standard.

PIC17CXXX: 16-Bit Architecture Family

The PIC17CXXX family offers the world’s fastest execution performance of any 8-bit MCU family in the industry. The PIC17CXXX family extends the PICmicro MCU’s high-performance RISC architecture with a 16-bit instruction word, enhanced instruction set and powerful vectored interrupt handling capabilities. A powerful array of precise on-chip peripheral features provide the performance for the most demanding 8-bit applications.

PICmicro MCU Naming Convention

The PICmicro architecture offers users a wider range of cost/performance options than any 8-bit MCU family. In order to identify the families, the following naming conventions have been applied to the PICmicro MCUs.

TABLE 1: PICMICRO MCU NAMING CONVENTION*

Family		Architectural Features	Name	Technology	Products
PIC17CXXX	8-bit High-Performance MCU Family	• 16-bit wide instruction set • Internal/external vectored interrupts • DC - 33 MHz clock speed • 120 ns instruction cycle (@ 33 MHz) • Hardware multiply	PIC17C4X	OTP program memory, digital only	PIC17C42A, PIC17C43, PIC17C44
			PIC17CR4X	ROM program memory, digital only	PIC17CR42, PIC17CR43
			PIC17C75X	OTP program memory with mixed-signal functions	PIC17C756
PIC16CXXX	8-bit Mid-Range MCU Family	• 14-bit wide instruction set • Internal/external interrupts • DC - 20 MHz clock speed (Note 1) • 200 ns instruction cycle (@ 20 MHz)	PIC14CXXX	OTP program memory with A/D and D/A functions	PIC14C000
			PIC16C55X	OTP program memory, digital only	PIC16C554, PIC16C556, PIC16C558
			PIC16C6X	OTP program memory, digital only	PIC16C62, PIC16C62A, PIC16C63, PIC16C64, PIC16C64A, PIC16C65, PIC16C65A, PIC16C66, PIC16C67
			PIC16CR6X	ROM program memory, digital only	PIC16CR62, PIC16CR63, PIC16CR64, PIC16CR65
			PIC16C62X	OTP program memory with comparators	PIC16C620, PIC16C621, PIC16C622
			PIC16C7X	OTP program memory with analog functions (i.e. A/D)	PIC16C710, PIC16C71, PIC16C711, PIC16C715, PIC16C72, PIC16C73, PIC16C73A, PIC16C74, PIC16C74A, PIC16C76, PIC16C77
			PIC16F8X	Flash program and EEPROM data memory	PIC16C84
					PIC16F83, PIC16F84
			PIC16CR8X	ROM program and EEPROM data memory	PIC16CR83, PIC16CR84
			PIC16C9XX	OTP program memory, LCD driver	PIC16C923, PIC16C924
PIC16C5X	8-bit Base-Line MCU Family	• 12-bit wide instruction set • DC - 20 MHz clock speed • 200 ns instruction cycle (@ 20 MHz)	PIC16C5X PIC16C5XA	OTP program memory, digital only	PIC16C52, PIC16C54, PIC16C54A, PIC16C55, PIC16C56, PIC16C57, PIC16C58A
			PIC16CR5X PIC16CR5XA	ROM program memory, digital only	PIC16CR54A, PIC16CR57B, PIC16CR58A
PIC12CXXX	8-bit, 8-pin MCU Family	• 12- or 14-bit wide instruction set • DC - 10 MHz clock speed • 400 ns instruction cycle (@ 10 MHz)	PIC12C5XX	OTP program memory, digital only	PIC12C508, PIC12C509
			PIC12C67X	OTP program memory with analog functions	PIC12C671, PIC12C672

Note 1: The maximum clock speed for some devices is less than 20 MHz.

Please check with your local Microchip distributor, sales representative or sales office for the latest product information.

*As of April 1997.

The Advantage of Field Programmability

The PICmicro MCU family provides a unique combination of a high-performance RISC processor with cost-effective OTP technology. Cost-effective OTP provides many benefits to the user at prices which can be comparable to competing ROM solutions. The benefits include:

1. Quick time-to-market.
2. Ease of code changes.
3. Ability to provide adaptable solutions to end-customer requirements.
4. Ability to meet upside potential via inventory positions at Microchip or worldwide distribution.
5. Reduced scrappage in manufacturing.
6. Reduced inventory in manufacturing.
7. Reduced work-in-process liability.

For most manufacturers, getting the product to market quickly has become the number one goal as global markets have become more competitive. Time-to-market puts pressure on all functions within the manufacturing process: development, purchasing, production, marketing and sales. Field-programmable OTP technology streamlines the process for all stages in the product life cycle. For example, in the early product development stages, a programmable MCU allows much of the functionality to be implemented in software which can be modified more easily than hardware-only solutions.

In the manufacturing stage, the compression of the product life cycle curve puts pressure on the management of inventory and manufacturing cycle times. Minimizing inventory reduces the ability to meet upside demand. Using a traditional ROM-based MCU limits the ability to respond to the market with product enhancements or semi-customized products for specific customers. Using the standard OTP-based PICmicro MCU solves all these issues. Inventory can be managed effectively by using the same devices for several different systems. Costs can be reduced due to volume purchasing. Upsides can be met from either safety stock, directly from Microchip, or local distributors who regularly inventory all PICmicro MCU devices. A sudden decline in demand means no work-in-process ROM-based inventory and any excess safety stock can be consumed by the other products using the same standard devices.

OTP is the ‘Flexible Manufacturing’ technology of the MCU world. As competition intensifies, the demand for customer-specific products increases. Having the ability to change (for example, the appearance of LCD displays or add extra features in a timely manner) can be a key competitive advantage. Programming the OTP device on the manufacturing floor allows easy customizing and internal tracking of the devices for each specific customer. Customization can significantly increase the overall product life cycle to provide better return on investment and help minimize the threat of competition.

Current PICmicro MCU product families include advanced features such as sophisticated timers, embedded analog-to-digital converters, extended instruction/data memory, inter-processor communication (I^2C bus, SPI™ and USARTs) and ROM, RAM, EPROM, EEPROM and Flash memories.

All PICmicro families are supported by user-friendly development systems including; assembler, software simulator, C Compiler, fuzzy logic development software, programmers and in-circuit emulators.

Development Systems

Microchip is committed to providing useful and innovative solutions to your embedded system designs. Our installed base of application development systems has grown to an impressive 90,000 systems worldwide. Significantly, more than half of the total system shipments over the past six years took place within the past 24 months.

Among support products offered are PICMASTER® Real-Time Universal In-circuit Emulator running under the Windows® environment. MPLAB™, a complete Integrated Development Environment (IDE), is provided with PICMASTER. MPLAB allows the user to edit, compile and emulate from a single user interface, making the developer productive very quickly. PICMASTER is designed to provide product development engineers with an optimized design tool for developing target applications. This universal in-circuit emulator provides a complete MCU design toolset for all MCUs in the PIC12CXXX, PIC16C5X, PIC16CXXX and PIC17CXXX families. A CE compliant version of PICMASTER is available for European Union (EU) countries.

ICEPIC is a low-cost in-circuit emulator solution for the Microchip PIC16C5X and PIC16CXXX MCU families. PRO MATE® II, the full-featured, modular device programmer, enables you to quickly and easily program user software into PICmicro MCUs. PRO MATE II runs under MPLAB IDE and operates as a stand-alone unit or in conjunction with a PC-compatible host system. The PICSTART® Plus and Lite development kits, are low-cost development systems for the PIC12CXXX, PIC16C5X/ PIC16CXXX and PIC17CXXX MCUs. PICDEM low-cost demonstration boards are simple boards which demonstrate the basic capabilities of the full range of Microchip's MCUs. Users can program the sample MCUs provided with PICDEM boards, on a PRO MATE II or PICSTART programmer, and easily test firmware. KEELOQ Evaluation and Programming Tools support Microchip's HCS Secure Data Products.

The Serial EEPROM Designer's Kit includes everything necessary to read, write, erase or program special features of any Microchip Serial EEPROM product including *Smart Serials*™ and secure serials. The *Total Endurance*™ Disk is included to aid in trade-off analysis and reliability calculations. The total kit can significantly reduce time-to-market and result in an optimized system.

TABLE 2: PICmicro SYNERGISTIC DEVELOPMENT TOOLS

Development Tool	Name	PIC12CXXX	PIC16C5X	PIC16CXXX	PIC17CXXX
Integrated Development Environment (IDE)	MPLAB™	✔	✔	✔	✔
Universal Macro-Assembler	MPASM	✔	✔	✔	✔
C Compiler	MPLAB-C	✔	✔	✔	✔
Full-Featured, Modular In-Circuit Emulator	PICMASTER®	✔	✔	✔	✔
Low-Cost Modular In-Circuit Emulator	ICEPIC	—	✔	✔	—
Full-Featured, Modular Device Programmer	PRO MATE® II	✔	✔	✔	✔
Entry-Level Development Kit with Programmer	PICSTART® Plus	✔	✔	✔	✔
Low-Cost Entry Level Development Kit	PICSTART® Lite	✔	✔	✔	Planned
Fuzzy Logic Development Software	*fuzzy*TECH®-MP	✔	✔	✔	✔
Application Code Generator	MP-DriveWay™	—	✔	✔	✔

Software Support

MPLAB is a Windows-based development platform for Microchip's PICmicro OTP MCUs. MPLAB IDE offers a project manager and program text editor, a user-configurable toolbar containing four pre-defined sets and a status bar which communicates editing and debugging information.

MPLAB is the common user interface for Microchip development systems tools including MPLAB Editor, MPASM Assembler, MPLAB-SIM Software Simulator, PICMASTER In-Circuit Emulator, PRO MATE II Programmer and PICSTART Plus Development Programmer.

Microchip's PICmicro MCUs are also supported by fuzzy logic development software, an application code generator and a C-Compiler. MP-DriveWay is an easy-to-use Windows-based Application Code Generator for visually configuring all the peripherals in a PICmicro device and, with a click of the mouse, generate all the initialization and many functional code modules in C language.

Microchip endeavors at all times to provide the best service and responsiveness possible to its customers. The Microchip Internet Home Page can provide you with the latest technical information, production released software for development tools, application notes and promotional news on Microchip products and technology. The Microchip World Wide Web address is http://www.microchip.com.

The Microchip Systems Bulletin Board Service (BBS) is one service to facilitate this service. It is a multi-faceted tool that can provide you with information on a number of different topics.

Special Interest Groups (SIGs) available through the BBS can provide you with the opportunity to discuss issues and topics of interest with others that share your interest or questions. The BBS is regularly used to distribute technical information, application notes, source code, errata sheets, bug reports, interim patches for Microchip systems products, and user contributed files for distribution.

Please see the "On-Line Technical Support" Section for more information on the Microchip BBS and WWW site.

Application-Specific Standard Products (ASSPs)

Secure Data Products Overview

Microchip's patented KEELOQ code hopping technology is the perfect solution for remote keyless entry and logical/physical access control systems. The initial device in the family, HCS300 encoder, will replace current fixed code encoders in transmitter applications and provide a low cost, integrated solution. The KEELOQ family is rapidly expanding with the HCS301 (high voltage encoder), HCS200 (low-end, low-cost encoder), and high-end encoders (HCS360 and HCS361) that meet OEM specifications and requirements.

Microchip provides flexible decoder solutions by providing optimized routines for Microchip's PICmicro MCUs. This allows the designer to combine the decoder and system functionality in a MCU. The decoder routines are available under a license agreement. The HCS509 and HCS512 are the first decoder devices in the KEELOQ family. These devices are single chip decoder solutions and simplify designs by handling learning and decoding of transmitters.

The KEELOQ product family is expanding to include enhanced encoders and decoders. Typical applications include automotive RKE, alarm and immobilizer systems, garage door openers and home security systems.

KEELOQ™ Rock Solid Security

Application-Specific Integrated Circuits (ASICs)

Microchip offers the QuickASIC™ Mask Gate Array (MPGA) family which replaces standard field-programmable gate arrays (FPGAs) and complex programmable logic devices (CPLDs) with a MPGA at a substantially reduced price per unit compared to programmable logic devices. Microchip's QuickASIC family offers turnkey digital design conversion of most FPGA/CPLD devices by transforming its net list into a masked gate array – with very fast lead times of four weeks from design signoff to prototype. QuickASIC devices can be used for any application prototyping with FPGAs/CPLDs including multimedia, data communications, telecommunications and computer peripherals.

In addition, Microchip plans call for customers being given the opportunity to combine Microchip's powerful RISC-based PICmicro MCU core with configurable gate arrays, providing a much wider range of flexibility, power ranges and custom functionality.

Serial EEPROM Overview

Microchip offers one of the broadest selections of CMOS Serial EEPROMs on the market for embedded control systems. Serial EEPROMs are available in a variety of densities, operating voltages, bus interface protocols, operating temperature ranges and space saving packages.

Densities:

Currently range from 128 bits to 64K bits with higher density devices in development.

Bus Interface Protocols:

All major protocols are covered: I^2C, Microwire® and SPI.

Operating Voltages:

In addition to standard 5V devices there are two low voltage families. The “LC” devices operate down to 2.5V, while the breakthrough “AA” family operates, in both read and write mode, down to 1.8V, making these devices highly suitable for alkaline and NiCd battery powered applications.

Temperature Ranges:

Like all Microchip devices, Serial EEPROMs are offered in Commercial (0°C to +70°C), Industrial (-40°C to +85°C) and Extended (-40°C to +125°C) operating temperature ranges.

Packages:

Small footprint packages include: industry standard 5-lead SOT-23, 8-lead DIP, 8-lead SOIC in JEDEC and EIAJ body widths, and 14-lead SOIC. The SOIC comes in two body widths; 150 mil and 207 mil.

Technology Leadership:

Microchip’s Serial EEPROMs are backed by a 10 million Erase/Write cycle guarantee. Microchip's erase/write cycle endurance is among the best in the world, and only Microchip offers such unique and powerful development tools as the Total Endurance disk. This mathematical software model is an innovative tool used by system designers to optimize Serial EEPROM performance and reliability within the application.

We have also developed the world’s first 64K Smart Serial EEPROM. Device densities range from 128 bits up to 64K bits. Another first is the 24LC21, a single chip DDC1/DDC2™-compatible solution for plug-and-play video monitors. In addition, Microchip released a high-speed 1 MHz 2-wire Serial EEPROM device ideal for high-performance embedded systems.

Microchip is a high-volume supplier of Serial EEPROMs to all the major markets worldwide including consumer, automotive, industrial, computer and communications. To date, more than 700 million units have been produced. Microchip continues to develop new Serial EEPROM solutions for embedded control applications.

Parallel EEPROM Overview

CMOS Parallel EEPROM devices from Microchip are available in 4K, 16K and 64K densities. The manufacturing process used for these EEPROMs ensures 10,000 to 100,000 erase/writecycles typical. Data retention is more than 10 years. Fast write times are less than 200 µs. These EEPROMs work reliably under demanding conditions and operate efficiently at temperatures from -40°C to +85°C. Microchip’s expertise in advanced SOIC, TSOP and VSOP surface mount packaging supports our customers’ needs in space-sensitive applications.

Typical applications include computer peripherals, engine control, telecommunications and pattern recognition.

OTP EPROM Overview

Microchip’s CMOS EPROM devices are produced in densities from 64K to 512K. Typical applications include computer peripherals, instrumentation, and automotive devices. Microchip’s expertise in surface mount Packaging on SOIC, TSOP and VSOP packages led to the development of the Surface Mount OTP EPROM market where Microchip is a leading supplier today. Microchip is also a leading supplier of low-voltage EPROMs for battery powered applications.

Ease of Production Utilizing Quick Turn Programming (QTP) and Serialized Quick Turn Programming (SQTP SM)

Recognizing the needs of high-volume manufacturing operations, Microchip has developed two programming methodologies which make the OTP products as easy to use in manufacturing as they are efficient in the system development stage.

Quick Turn Programming allows factory programming of OTP products prior to delivery to the system manufacturing operation. PICmicro, EPROM and Serial EEPROM products can be automatically programmed, with the users program, during the final stages of the test operation at Microchip’s assembly and test operations in the Philippine Islands, Taiwan and Thailand. This low-cost programming step allows the elimination of programming during system manufacturing and essentially allows the user to treat the PICmicro and memory products as custom ROM products. With one-to four-week lead times on QTP products, the user no longer needs to plan for the extended ROM masking lead times and masking charges associated with custom ROM products. This capability, combined with the off-the-shelf availability of standard OTP product, ensures the user of product availability and the ability to reduce his time-to-market once product development has been completed.

Unique in the 8-bit MCU market is Microchip’s ability to enhance the QTP capability with Serialized Quick Turn Programming (SQTP). SQTP allows for the programming of devices with unique, random or serialized identification codes. As each PICmicro device is programmed with the customers program code, a

portion of the program memory space can be programmed with a unique ID, accessible from normal program memory, which will allow the user to provide each device with a unique identification. This capability is ideal for embedded systems applications where the transmission of key codes or identification of the device as a node within a network is essential. Taking advantage of this capability allows the system designer to eliminate the requirement for expensive off-chip code implementation using DIP switches or non-volatile memory components. The SQTP offering, pioneered by Microchip, provides the embedded systems designer with a low cost means of putting a unique and custom device into every system or node.

Future Products and Technology

Microchip is constantly developing advanced process technology modules and new products that utilize our advanced manufacturing capabilities. Current production technology utilizes lithography dimensions down to 0.7 micron.

Microchip's research and development activities include exploring new process technologies and products that have industry leadership potential. Particular emphasis is placed on products that can be put to work in high-performance broad-based markets.

Equipment is continually updated to bring the most sophisticated process, CAD and testing tools online. Cycle times for new technology development are continuously reduced by using in-house mask generation, a high-speed pilot line within the manufacturing facility and continuously improving methodologies.

Objective specifications for new products are developed by listening to our customers and by close co-operation with our many customer-partners worldwide.

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