



PIC18F8723 Family Data Sheet

64/80-Pin, 1-Mbit,
Enhanced Flash Microcontrollers
with 12-Bit A/D and nanoWatt Technology

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MICROCHIP

PIC18F8723 FAMILY

64/80-Pin, 1-Mbit, Enhanced Flash Microcontrollers with 12-Bit A/D and nanoWatt Technology

Peripheral Highlights:

- 12-Bit, Up to 16-Channel Analog-to-Digital Converter module (A/D):
 - Auto-acquisition capability
 - Conversion available during Sleep
- Two Master Synchronous Serial Port (MSSP) modules supporting 2/3/4-Wire SPI (all four modes) and I²C™ Master and Slave modes
- Two Capture/Compare/PWM (CCP) modules
- Three Enhanced Capture/Compare/PWM (ECCP) modules:
 - One, two or four PWM outputs
 - Selectable polarity
 - Programmable dead time
 - Auto-shutdown and auto-restart
- Two Enhanced Addressable USART modules:
 - Supports RS-485, RS-232 and LIN 1.2
 - Auto-wake-up on Start bit
 - Auto-Baud Detect
- Dual Analog Comparators with Input Multiplexing
- High-Current Sink/Source 25 mA/25 mA
- Four Programmable External Interrupts
- Four Input Change Interrupts

External Memory Interface:

- Address Capability of Up to 2 Mbytes
- 8-Bit or 16-Bit Interface
- 8, 12, 16 and 20-Bit Address modes

Power-Managed Modes:

- Run: CPU on, Peripherals on
- Idle: CPU off, Peripherals on
- Sleep: CPU off, Peripherals off
- Idle mode Currents Down to 15 µA Typical
- Sleep Current Down to 0.2 µA Typical
- Timer1 Oscillator: 1.8 µA, 32 kHz, 2V
- Watchdog Timer: 2.1 µA

Special Microcontroller Features:

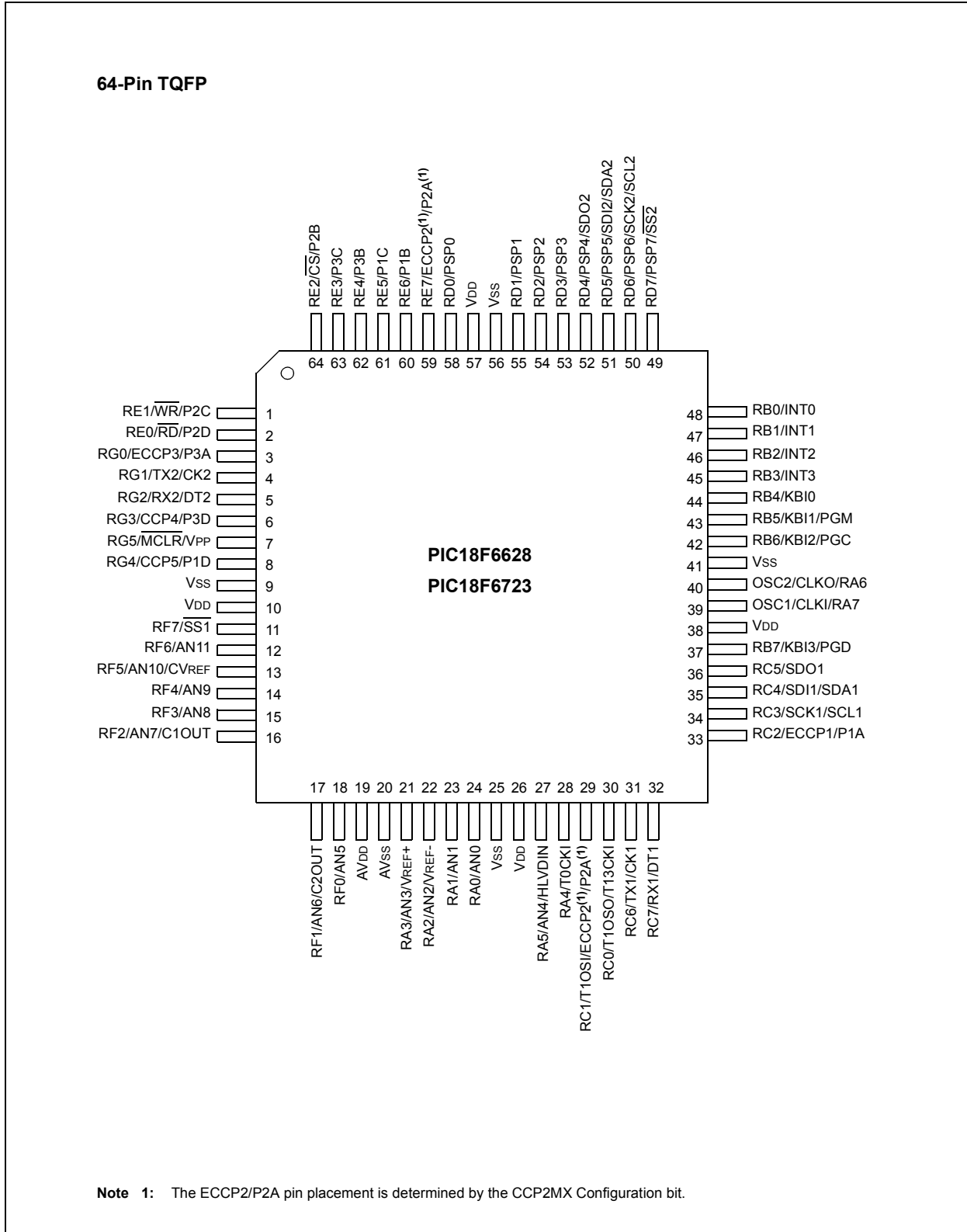
- C Compiler Optimized Architecture:
 - Optional extended instruction set designed to optimize re-entrant code
- 100,000 Erase/Write Cycle Enhanced Flash Program Memory Typical
- 1,000,000 Erase/Write Cycle Data EEPROM Memory Typical
- Flash/Data EEPROM Retention: 100 Years Typical
- Self-Programmable under Software Control
- Priority Levels for Interrupts
- 8 x 8 Single-Cycle Hardware Multiplier
- Extended Watchdog Timer (WDT):
 - Programmable period from 4 ms to 131s
- Single-Supply In-Circuit Serial Programming™ (ICSP™) via Two Pins
- In-Circuit Debug (ICD) via Two Pins
- Wide Operating Voltage Range: 2.0V to 5.5V
- Fail-Safe Clock Monitor
- Two-Speed Oscillator Start-up
- nanoWatt Technology

Note: This document is supplemented by the "PIC18F8722 Family Data Sheet" (DS39646). See **Section 1.0 "Device Overview"**.

| Device | Program Memory | | Data Memory | | I/O | 12-Bit A/D (ch) | CCP/ ECCP (PWM) | MSSP | | EUSART | Comparators | Timers 8/16-Bit | External Bus | |
|------------|----------------|----------------------------|--------------|----------------|-----|-----------------|-----------------|------|--------------------------|--------|-------------|-----------------|--------------|---|
| | Flash (bytes) | # Single-Word Instructions | SRAM (bytes) | EEPROM (bytes) | | | | SPI | Master I ² C™ | | | | | |
| PIC18F6628 | 96K | 49152 | 3936 | 1024 | 54 | 12 | 2/3 | 2 | Y | Y | 2 | 2 | 2/3 | N |
| PIC18F6723 | 128K | 65536 | 3936 | 1024 | 54 | 12 | 2/3 | 2 | Y | Y | 2 | 2 | 2/3 | N |
| PIC18F8628 | 96K | 49152 | 3936 | 1024 | 70 | 16 | 2/3 | 2 | Y | Y | 2 | 2 | 2/3 | Y |
| PIC18F8723 | 128K | 65536 | 3936 | 1024 | 70 | 16 | 2/3 | 2 | Y | Y | 2 | 2 | 2/3 | Y |

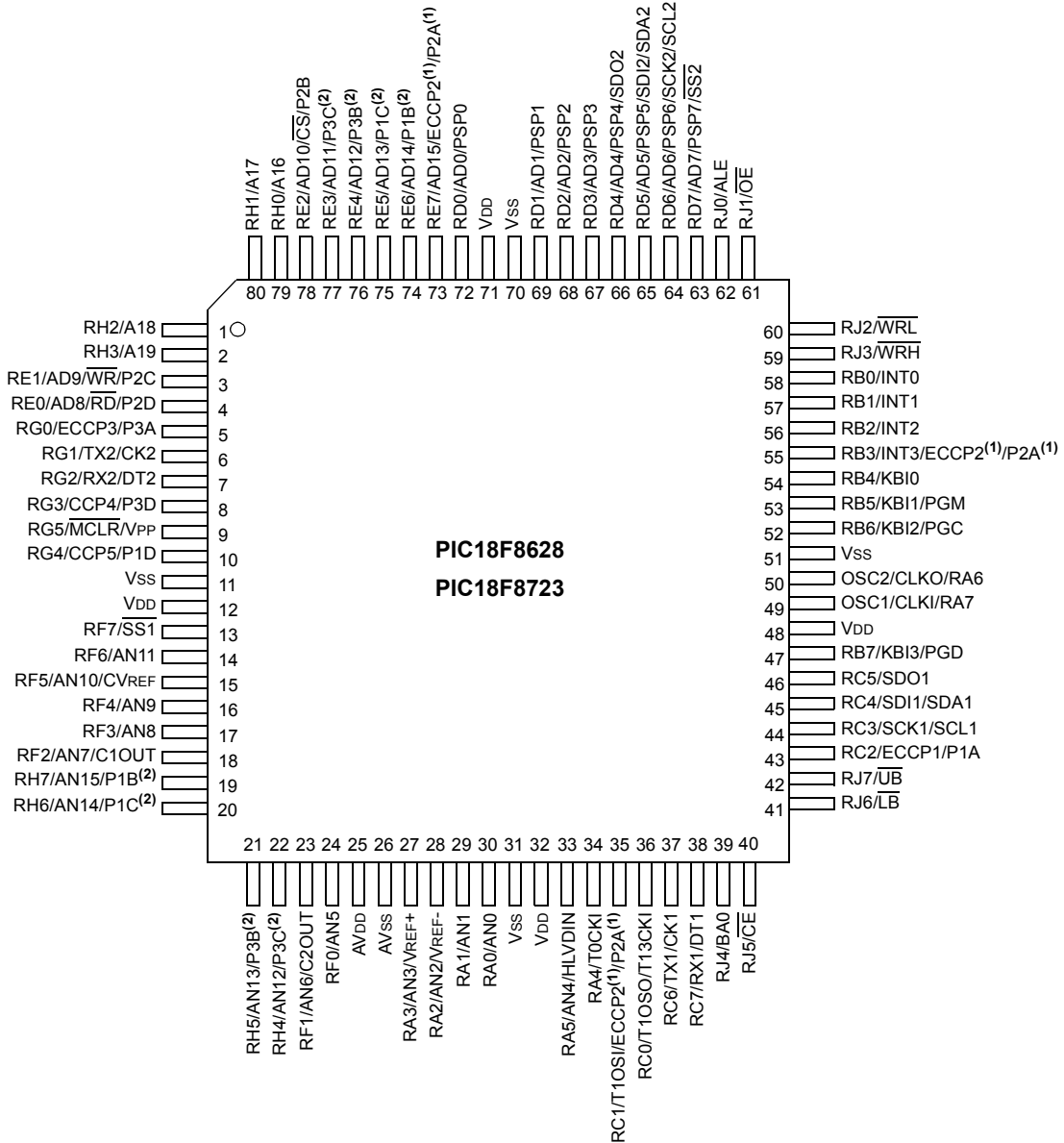
PIC18F8723

Pin Diagrams



Pin Diagrams (Continued)

80-Pin TQFP



Note 1: The ECCP2/P2A pin placement is determined by the CCP2MX Configuration bit and Processor mode settings.
Note 2: P1B, P1C, P3B and P3C pin placement is determined by the ECCPMX Configuration bit.

PIC18F8723

Table of Contents

| | | |
|-----|--|----|
| 1.0 | Device Overview | 9 |
| 2.0 | 12-Bit Analog-to-Digital Converter (A/D) Module | 31 |
| 3.0 | Special Features of the CPU | 41 |
| 4.0 | Electrical Characteristics | 43 |
| 5.0 | Packaging Information..... | 49 |
| | Appendix A: Revision History..... | 51 |
| | Appendix B: Device Differences..... | 51 |
| | Appendix C: Conversion Considerations | 52 |
| | Appendix D: Migration From Baseline to Enhanced Devices..... | 52 |
| | Appendix E: Migration From Mid-Range to Enhanced Devices | 53 |
| | Appendix F: Migration From High-End to Enhanced Devices | 53 |
| | Index | 55 |
| | The Microchip Web Site | 57 |
| | Customer Change Notification Service | 57 |
| | Customer Support | 57 |
| | Reader Response | 58 |
| | PIC18F8723 family Product Identification System | 59 |

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PIC18F8723

NOTES:

PIC18F8723 FAMILY

1.0 DEVICE OVERVIEW

This document contains device-specific information for the following devices:

- PIC18F6628
- PIC18F6723
- PIC18F8628
- PIC18F8723
- PIC18LF6628
- PIC18LF6723
- PIC18LF8628
- PIC18LF8723

Note: This data sheet documents only the devices' features and specifications that are in addition to the features and specifications of the PIC18F8722 family devices. For information on the features and specifications shared by the PIC18F8723 family and PIC18F8722 family devices, see the "*PIC18F8722 Family Data Sheet*" (DS39646).

The PIC18F8723 family of devices offers the advantages of all PIC18 microcontrollers – namely, high computational performance at an economical price – with the addition of high-endurance, Enhanced Flash program memory. In addition to these features, the PIC18F8723 introduces design enhancements that make these microcontrollers a logical choice for many high-performance, power-sensitive applications.

1.1 Special Features

- **12-Bit A/D Converter:** The PIC18F8723 family implements a 12-bit A/D Converter. A/D Converters in both families incorporate programmable acquisition time. This allows for a channel to be selected and a conversion to be initiated, without waiting for a sampling period and thus, reducing code overhead.

1.2 Details on Individual Family Members

Devices in the PIC18F8723 family are available in 64-pin and 80-pin packages. Block diagrams for the two groups are shown in Figure 1-1 and Figure 1-2.

The devices are differentiated from each other in the following ways:

- Flash program memory (96 Kbytes for PIC18FX628 devices and 128 Kbytes for PIC18FX723).
- A/D channels (12 for PIC18F6628/6723 devices and 16 for PIC18F8628/8723 devices).
- I/O ports (seven bidirectional ports on PIC18F6628/6723 devices and nine bidirectional ports on PIC18F8628/8723 devices).
- External Memory Bus, configurable for 8 and 16-bit operation

All other features for devices in this family are identical. These are summarized in Table 1-1.

The pinouts for all devices are listed in Table 1-2 and Table 1-3.

Like all Microchip PIC18 devices, members of the PIC18F8723 family are available as both standard and low-voltage devices. Standard devices with Enhanced Flash memory, designated with an "F" in the part number (such as PIC18F6628), accommodate an operating V_{DD} range of 4.2V to 5.5V. Low-voltage parts, designated by "LF" (such as PIC18LF6628), function over an extended V_{DD} range of 2.0V to 5.5V.

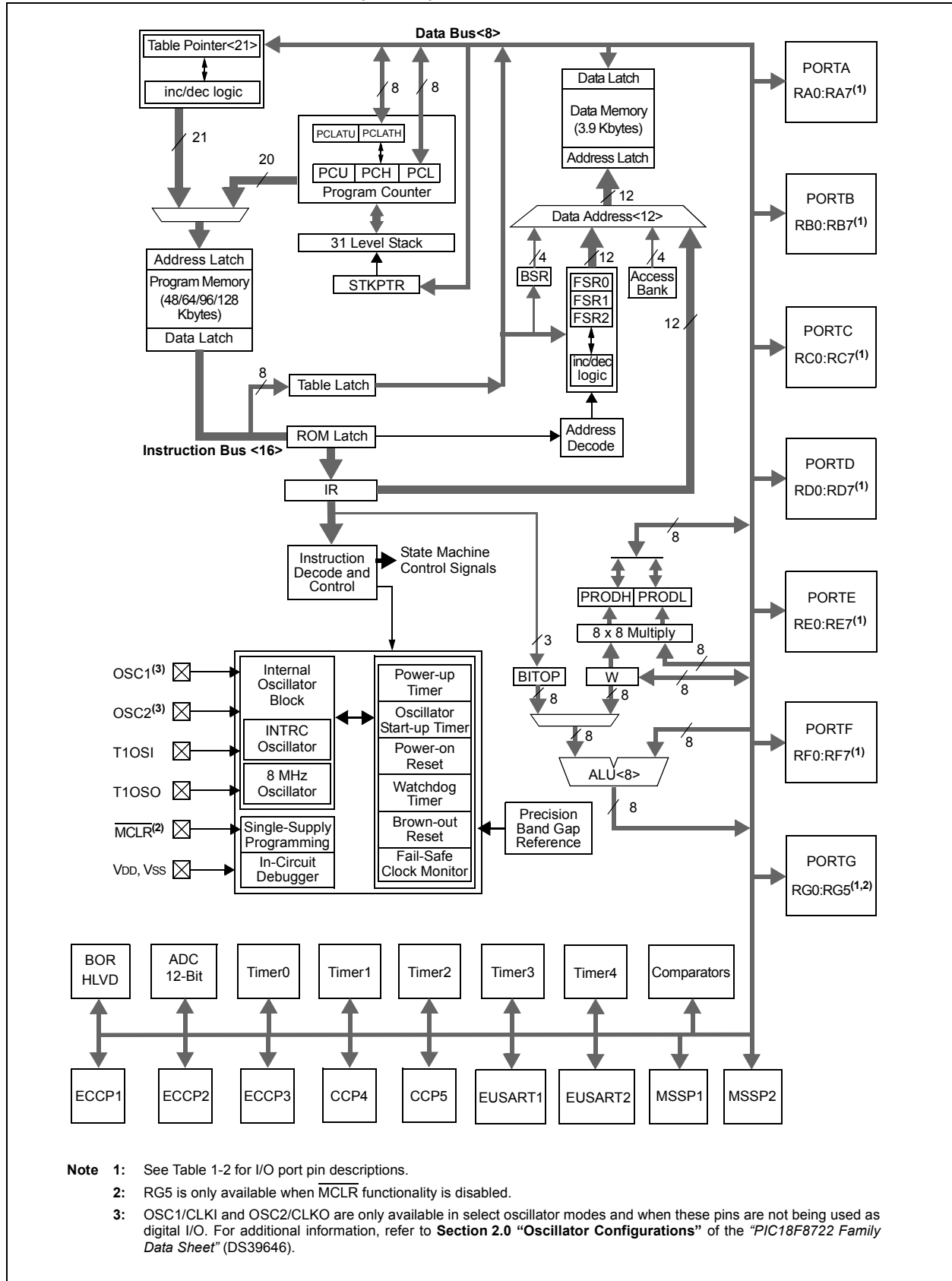
PIC18F8723 FAMILY

TABLE 1-1: DEVICE FEATURES

| Features | PIC18F6628 | PIC18F6723 | PIC18F8628 | PIC18F8723 |
|--------------------------------------|--|--|--|--|
| Operating Frequency | DC – 40 MHz | DC – 40 MHz | DC – 40 MHz | DC – 40 MHz |
| Program Memory (Bytes) | 96K | 128K | 96K | 128K |
| Program Memory (Instructions) | 49152 | 65536 | 49152 | 65536 |
| Data Memory (Bytes) | 3936 | 3936 | 3936 | 3936 |
| Data EEPROM Memory (Bytes) | 1024 | 1024 | 1024 | 1024 |
| Interrupt Sources | 28 | 28 | 29 | 29 |
| I/O Ports | Ports A, B, C, D, E, F, G | Ports A, B, C, D, E, F, G | Ports A, B, C, D, E, F, G, H, J | Ports A, B, C, D, E, F, G, H, J |
| Timers | 5 | 5 | 5 | 5 |
| Capture/Compare/PWM Modules | 2 | 2 | 2 | 2 |
| Enhanced Capture/Compare/PWM Modules | 3 | 3 | 3 | 3 |
| Enhanced USART | 2 | 2 | 2 | 2 |
| Serial Communications | MSSP, Enhanced USART | MSSP, Enhanced USART | MSSP, Enhanced USART | MSSP, Enhanced USART |
| Parallel Communications (PSP) | Yes | Yes | Yes | Yes |
| 12-Bit Analog-to-Digital Module | 12 Input Channels | 12 Input Channels | 16 Input Channels | 16 Input Channels |
| Resets (and Delays) | POR, BOR, RESET Instruction, Stack Full, Stack Underflow (PWRT, OST), MCLR (optional), WDT | POR, BOR, RESET Instruction, Stack Full, Stack Underflow (PWRT, OST), MCLR (optional), WDT | POR, BOR, RESET Instruction, Stack Full, Stack Underflow (PWRT, OST), MCLR (optional), WDT | POR, BOR, RESET Instruction, Stack Full, Stack Underflow (PWRT, OST), MCLR (optional), WDT |
| Programmable High/Low-Voltage Detect | Yes | Yes | Yes | Yes |
| Programmable Brown-out Reset | Yes | Yes | Yes | Yes |
| Instruction Set | 75 Instructions; 83 with Extended Instruction Set Enabled | 75 Instructions; 83 with Extended Instruction Set Enabled | 75 Instructions; 83 with Extended Instruction Set Enabled | 75 Instructions; 83 with Extended Instruction Set Enabled |
| Packages | 64-Pin TQFP | 64-Pin TQFP | 80-Pin TQFP | 80-Pin TQFP |

PIC18F8723 FAMILY

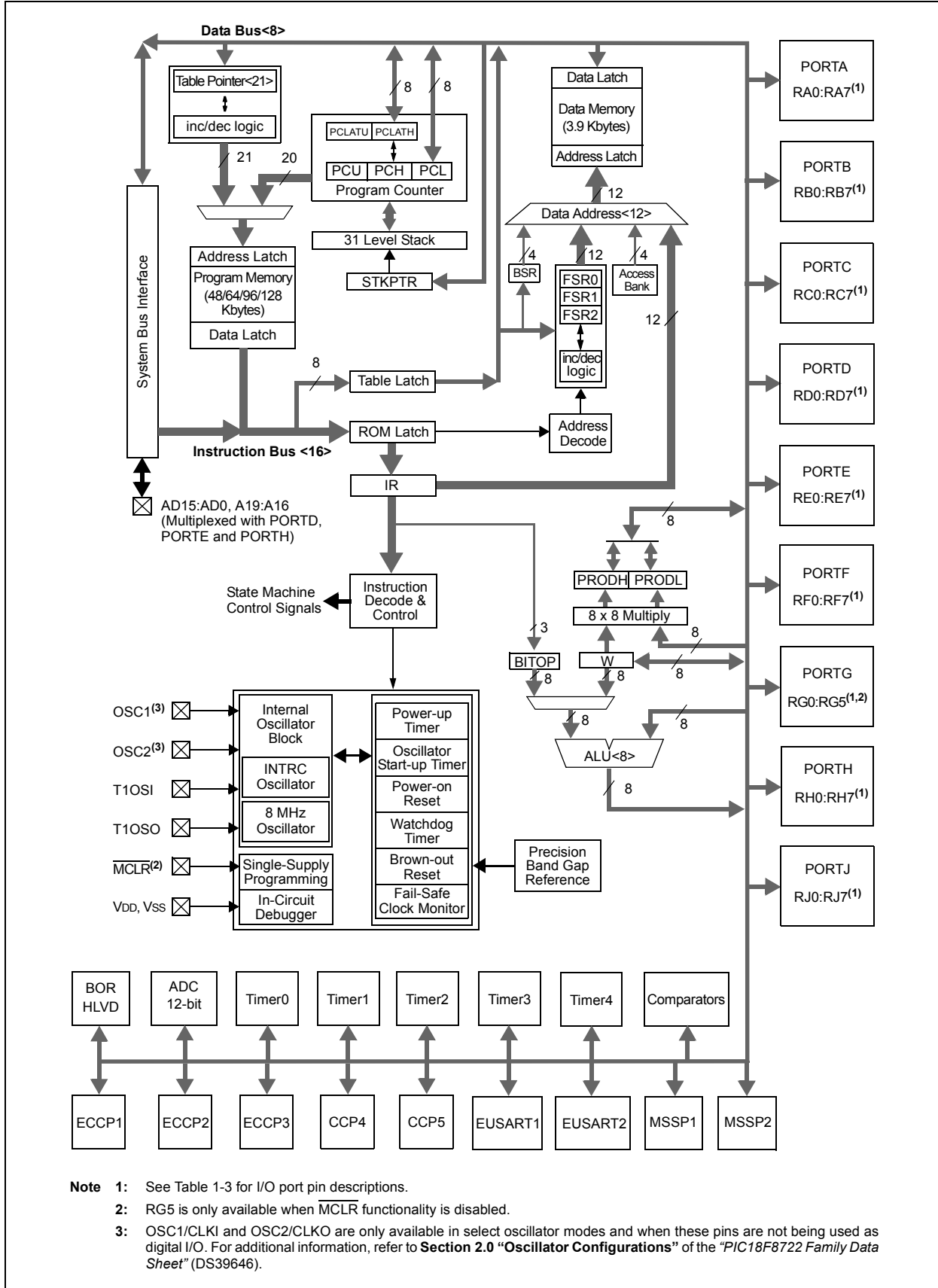
FIGURE 1-1: PIC18F6628/6723 (64-PIN) BLOCK DIAGRAM



- Note**
- 1: See Table 1-2 for I/O port pin descriptions.
 - 2: RG5 is only available when $\overline{\text{MCLR}}$ functionality is disabled.
 - 3: OSC1/CLKI and OSC2/CLKO are only available in select oscillator modes and when these pins are not being used as digital I/O. For additional information, refer to **Section 2.0 "Oscillator Configurations"** of the "PIC18F8722 Family Data Sheet" (DS39646).

PIC18F8723 FAMILY

FIGURE 1-2: PIC18F8628/8723 (80-PIN) BLOCK DIAGRAM



PIC18F8723 FAMILY

TABLE 1-2: PIC18F6628/6723 (64-PIN) PINOUT I/O DESCRIPTIONS

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|--|------------|-------------------|-----------------------|---|
| | TQFP | | | |
| RG5/MCLR/VPP RG5 MCLR VPP | 7 | I I P | ST ST | Master Clear (input) or programming voltage (input). Digital input. Master Clear (Reset) input. This pin is an active-low Reset to the device. Programming voltage input. |
| OSC1/CLKI/RA7 OSC1 CLKI RA7 | 39 | I I I/O | ST CMOS TTL | Oscillator crystal or external clock input. Oscillator crystal input or external clock source input. ST buffer when configured in RC mode, CMOS otherwise. External clock source input. Always associated with pin function OSC1. (See related OSC1/CLKI, OSC2/CLKO pins.) General purpose I/O pin. |
| OSC2/CLKO/RA6 OSC2 CLKO RA6 | 40 | O O I/O | — — TTL | Oscillator crystal or clock output. Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode. In RC mode, OSC2 pin outputs CLKO, which has 1/4 the frequency of OSC1 and denotes the instruction cycle rate. General purpose I/O pin. |

Legend: TTL = TTL compatible input CMOS = CMOS compatible input or output
ST = Schmitt Trigger input with CMOS levels Analog = Analog input
I = Input O = Output
P = Power I²C™ = I²C/SMBus input buffer

Note 1: Default assignment for ECCP2 when Configuration bit, CCP2MX, is set.

2: Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared.

PIC18F8723 FAMILY

TABLE 1-2: PIC18F6628/6723 (64-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|----------------|------------|----------|-------------|-------------------------------------|
| | TQFP | | | |
| RA0/AN0 | 24 | I/O | TTL | PORTA is a bidirectional I/O port. |
| RA0 | | I | Analog | Digital I/O. |
| AN0 | | | | Analog input 0. |
| RA1/AN1 | 23 | I/O | TTL | Digital I/O. |
| RA1 | | I | Analog | Analog input 1. |
| RA2/AN2/VREF- | 22 | I/O | TTL | Digital I/O. |
| RA2 | | I | Analog | Analog input 2. |
| AN2 | | I | Analog | A/D reference voltage (low) input. |
| VREF- | | | | |
| RA3/AN3/VREF+ | 21 | I/O | TTL | Digital I/O. |
| RA3 | | I | Analog | Analog input 3. |
| AN3 | | I | Analog | A/D reference voltage (high) input. |
| VREF+ | | | | |
| RA4/T0CKI | 28 | I/O | ST | Digital I/O. |
| RA4 | | I | ST | Timer0 external clock input. |
| T0CKI | | | | |
| RA5/AN4/HLVDIN | 27 | I/O | TTL | Digital I/O. |
| RA5 | | I | Analog | Analog input 4. |
| AN4 | | I | Analog | High/Low-Voltage Detect input. |
| HLVDIN | | | | |
| RA6 | | | | See the OSC2/CLKO/RA6 pin. |
| RA7 | | | | See the OSC1/CLKI/RA7 pin. |

Legend: TTL = TTL compatible input CMOS = CMOS compatible input or output
 ST = Schmitt Trigger input with CMOS levels Analog = Analog input
 I = Input O = Output
 P = Power I²C™ = I²C/SMBus input buffer

Note 1: Default assignment for ECCP2 when Configuration bit, CCP2MX, is set.
2: Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared.

PIC18F8723 FAMILY

TABLE 1-2: PIC18F6628/6723 (64-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|---------------|------------|----------|---|---|
| | TQFP | | | |
| RB0/INT0/FLT0 | 48 | | | PORTB is a bidirectional I/O port. PORTB can be software programmed for internal weak pull-ups on all inputs. |
| RB0 | | I/O | TTL | Digital I/O. |
| INT0 | | I | ST | External interrupt 0. |
| FLT0 | | I | ST | PWM Fault input for ECCPx. |
| RB1/INT1 | 47 | | | |
| RB1 | | I/O | TTL | Digital I/O. |
| INT1 | I | ST | External interrupt 1. | |
| RB2/INT2 | 46 | | | |
| RB2 | | I/O | TTL | Digital I/O. |
| INT2 | I | ST | External interrupt 2. | |
| RB3/INT3 | 45 | | | |
| RB3 | | I/O | TTL | Digital I/O. |
| INT3 | I | ST | External interrupt 3. | |
| RB4/KBI0 | 44 | | | |
| RB4 | | I/O | TTL | Digital I/O. |
| KBI0 | I | TTL | Interrupt-on-change pin. | |
| RB5/KBI1/PGM | 43 | | | |
| RB5 | | I/O | TTL | Digital I/O. |
| KBI1 | | I | TTL | Interrupt-on-change pin. |
| PGM | I/O | ST | Low-Voltage ICSP™ Programming enable pin. | |
| RB6/KBI2/PGC | 42 | | | |
| RB6 | | I/O | TTL | Digital I/O. |
| KBI2 | | I | TTL | Interrupt-on-change pin. |
| PGC | I/O | ST | In-Circuit Debugger and ICSP programming clock pin. | |
| RB7/KBI3/PGD | 37 | | | |
| RB7 | | I/O | TTL | Digital I/O. |
| KBI3 | | I | TTL | Interrupt-on-change pin. |
| PGD | I/O | ST | In-Circuit Debugger and ICSP programming data pin. | |

Legend: TTL = TTL compatible input

ST = Schmitt Trigger input with CMOS levels

I = Input

P = Power

CMOS = CMOS compatible input or output

Analog = Analog input

O = Output

I²C™ = I²C/SMBus input buffer

Note 1: Default assignment for ECCP2 when Configuration bit, CCP2MX, is set.

2: Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared.

PIC18F8723 FAMILY

TABLE 1-2: PIC18F6628/6723 (64-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|----------------------|------------|----------|-------------|---|
| | TQFP | | | |
| RC0/T1OSO/T13CKI | 30 | | | PORTC is a bidirectional I/O port. |
| RC0 | | I/O | ST | Digital I/O. |
| T1OSO | | O | — | Timer1 oscillator output. |
| T13CKI | | I | ST | Timer1/Timer3 external clock input. |
| RC1/T1OSI/ECCP2/P2A | 29 | | | |
| RC1 | | I/O | ST | Digital I/O. |
| T1OSI | | I | CMOS | Timer1 oscillator input. |
| ECCP2 ⁽¹⁾ | | I/O | ST | Enhanced Capture 2 input/Compare 2 output/PWM2 output. |
| P2A ⁽¹⁾ | | O | — | ECCP2 PWM output A. |
| RC2/ECCP1/P1A | 33 | | | |
| RC2 | | I/O | ST | Digital I/O. |
| ECCP1 | | I/O | ST | Enhanced Capture 1 input/Compare 1 output/PWM1 output. |
| P1A | | O | — | ECCP1 PWM output A. |
| RC3/SCK1/SCL1 | 34 | | | |
| RC3 | | I/O | ST | Digital I/O. |
| SCK1 | | I/O | ST | Synchronous serial clock input/output for SPI mode. |
| SCL1 | | I/O | ST | Synchronous serial clock input/output for I ² C™ mode. |
| RC4/SDI1/SDA1 | 35 | | | |
| RC4 | | I/O | ST | Digital I/O. |
| SDI1 | | I | ST | SPI data in. |
| SDA1 | | I/O | ST | I ² C data I/O. |
| RC5/SDO1 | 36 | | | |
| RC5 | | I/O | ST | Digital I/O. |
| SDO1 | | O | — | SPI data out. |
| RC6/TX1/CK1 | 31 | | | |
| RC6 | | I/O | ST | Digital I/O. |
| TX1 | | O | — | EUSART1 asynchronous transmit. |
| CK1 | | I/O | ST | EUSART1 synchronous clock (see related RX1/DT1). |
| RC7/RX1/DT1 | 32 | | | |
| RC7 | | I/O | ST | Digital I/O. |
| RX1 | | I | ST | EUSART1 asynchronous receive. |
| DT1 | | I/O | ST | EUSART1 synchronous data (see related TX1/CK1). |

Legend: TTL = TTL compatible input CMOS = CMOS compatible input or output
 ST = Schmitt Trigger input with CMOS levels Analog = Analog input
 I = Input O = Output
 P = Power I²C™ = I²C/SMBus input buffer

Note 1: Default assignment for ECCP2 when Configuration bit, CCP2MX, is set.
2: Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared.

PIC18F8723 FAMILY

TABLE 1-2: PIC18F6628/6723 (64-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|---|------------|--------------------------|---|--|
| | TQFP | | | |
| RD0/PSP0 RD0 PSP0 | 58 | I/O I/O | ST TTL | PORTD is a bidirectional I/O port. Digital I/O. Parallel Slave Port data. |
| RD1/PSP1 RD1 PSP1 | 55 | I/O I/O | ST TTL | Digital I/O. Parallel Slave Port data. |
| RD2/PSP2 RD2 PSP2 | 54 | I/O I/O | ST TTL | Digital I/O. Parallel Slave Port data. |
| RD3/PSP3 RD3 PSP3 | 53 | I/O I/O | ST TTL | Digital I/O. Parallel Slave Port data. |
| RD4/PSP4/SDO2 RD4 PSP4 SDO2 | 52 | I/O I/O O | ST TTL — | Digital I/O. Parallel Slave Port data. SPI data out. |
| RD5/PSP5/SDI2/ SDA2 RD5 PSP5 SDI2 SDA2 | 51 | I/O I/O I I/O | ST TTL ST I ² C/SMB | Digital I/O. Parallel Slave Port data. SPI data in. I ² C™ data I/O. |
| RD6/PSP6/SCK2/ SCL2 RD6 PSP6 SCK2 SCL2 | 50 | I/O I/O I/O I/O | ST TTL ST I ² C/SMB | Digital I/O. Parallel Slave Port data. Synchronous serial clock input/output for SPI mode. Synchronous serial clock input/output for I ² C mode. |
| RD7/PSP7/SS2 RD7 PSP7 SS2 | 49 | I/O I/O I | ST TTL TTL | Digital I/O. Parallel Slave Port data. SPI slave select input. |

Legend: TTL = TTL compatible input CMOS = CMOS compatible input or output
ST = Schmitt Trigger input with CMOS levels Analog = Analog input
I = Input O = Output
P = Power I²C™ = I²C/SMBus input buffer

Note 1: Default assignment for ECCP2 when Configuration bit, CCP2MX, is set.
2: Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared.

PIC18F8723 FAMILY

TABLE 1-2: PIC18F6628/6723 (64-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|--|------------|-----------------|----------------|---|
| | TQFP | | | |
| RE0/ $\overline{\text{RD}}$ /P2D RE0 $\overline{\text{RD}}$ P2D | 2 | I/O I O | ST TTL — | <p>PORTE is a bidirectional I/O port.</p> <p>Digital I/O. Read control for Parallel Slave Port. ECCP2 PWM output D.</p> |
| RE1/ $\overline{\text{WR}}$ /P2C RE1 $\overline{\text{WR}}$ P2C | 1 | I/O I O | ST TTL — | <p>Digital I/O. Write control for Parallel Slave Port. ECCP2 PWM output C.</p> |
| RE2/ $\overline{\text{CS}}$ /P2B RE2 $\overline{\text{CS}}$ P2B | 64 | I/O I O | ST TTL — | <p>Digital I/O. Chip select control for Parallel Slave Port. ECCP2 PWM output B.</p> |
| RE3/P3C RE3 P3C | 63 | I/O O | ST — | <p>Digital I/O. ECCP3 PWM output C.</p> |
| RE4/P3B RE4 P3B | 62 | I/O O | ST — | <p>Digital I/O. ECCP3 PWM output B.</p> |
| RE5/P1C RE5 P1C | 61 | I/O O | ST — | <p>Digital I/O. ECCP1 PWM output C.</p> |
| RE6/P1B RE6 P1B | 60 | I/O O | ST — | <p>Digital I/O. ECCP1 PWM output B.</p> |
| RE7/ECCP2/P2A RE7 ECCP2 ⁽²⁾ P2A ⁽²⁾ | 59 | I/O I/O O | ST ST — | <p>Digital I/O. Enhanced Capture 2 input/Compare 2 output/ PWM2 output. ECCP2 PWM output A.</p> |

Legend: TTL = TTL compatible input CMOS = CMOS compatible input or output
ST = Schmitt Trigger input with CMOS levels Analog = Analog input
I = Input O = Output
P = Power I²C™ = I²C/SMBus input buffer

Note 1: Default assignment for ECCP2 when Configuration bit, CCP2MX, is set.
2: Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared.

PIC18F8723 FAMILY

TABLE 1-2: PIC18F6628/6723 (64-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|--|------------|---------------|------------------------|---|
| | TQFP | | | |
| RF0/AN5 RF0 AN5 | 18 | I/O I | ST Analog | PORTF is a bidirectional I/O port. Digital I/O. Analog input 5. |
| RF1/AN6/C2OUT RF1 AN6 C2OUT | 17 | I/O I O | ST Analog — | Digital I/O. Analog input 6. Comparator 2 output. |
| RF2/AN7/C1OUT RF2 AN7 C1OUT | 16 | I/O I O | ST Analog — | Digital I/O. Analog input 7. Comparator 1 output. |
| RF3/AN8 RF3 AN8 | 15 | I/O I | ST Analog | Digital I/O. Analog input 8. |
| RF4/AN9 RF4 AN9 | 14 | I/O I | ST Analog | Digital I/O. Analog input 9. |
| RF5/AN10/CVREF RF5 AN10 CVREF | 13 | I/O I O | ST Analog Analog | Digital I/O. Analog input 10. Comparator reference voltage output. |
| RF6/AN11 RF6 AN11 | 12 | I/O I | ST Analog | Digital I/O. Analog input 11. |
| RF7/SS1 RF7 SS1 | 11 | I/O I | ST TTL | Digital I/O. SPI slave select input. |

Legend: TTL = TTL compatible input
ST = Schmitt Trigger input with CMOS levels
I = Input
P = Power
CMOS = CMOS compatible input or output
Analog = Analog input
O = Output
I²C™ = I²C/SMBus input buffer

Note 1: Default assignment for ECCP2 when Configuration bit, CCP2MX, is set.

2: Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared.

PIC18F8723 FAMILY

TABLE 1-2: PIC18F6628/6723 (64-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|---------------|----------------|----------|-------------|--|
| | TQFP | | | |
| RG0/ECCP3/P3A | 3 | | | PORTG is a bidirectional I/O port. |
| RG0 | | I/O | ST | Digital I/O. |
| ECCP3 | | I/O | ST | Enhanced Capture 3 input/Compare 3 output/PWM3 output. |
| P3A | | O | — | ECCP3 PWM output A. |
| RG1/TX2/CK2 | 4 | | | |
| RG1 | | I/O | ST | Digital I/O. |
| TX2 | | O | — | EUSART2 asynchronous transmit. |
| CK2 | | I/O | ST | EUSART2 synchronous clock (see related RX2/DT2). |
| RG2/RX2/DT2 | 5 | | | |
| RG2 | | I/O | ST | Digital I/O. |
| RX2 | | I | ST | EUSART2 asynchronous receive. |
| DT2 | | I/O | ST | EUSART2 synchronous data (see related TX2/CK2). |
| RG3/CCP4/P3D | 6 | | | |
| RG3 | | I/O | ST | Digital I/O. |
| CCP4 | | I/O | ST | Capture 4 input/Compare 4 output/PWM4 output. |
| P3D | | O | — | ECCP3 PWM output D. |
| RG4/CCP5/P1D | 8 | | | |
| RG4 | | I/O | ST | Digital I/O. |
| CCP5 | | I/O | ST | Capture 5 input/Compare 5 output/PWM5 output. |
| P1D | | O | — | ECCP1 PWM output D. |
| RG5 | | | | See RG5/ $\overline{\text{MCLR}}$ /VPP pin. |
| VSS | 9, 25, 41, 56 | P | — | Ground reference for logic and I/O pins. |
| VDD | 10, 26, 38, 57 | P | — | Positive supply for logic and I/O pins. |
| AVSS | 20 | P | — | Ground reference for analog modules. |
| AVDD | 19 | P | — | Positive supply for analog modules. |

Legend: TTL = TTL compatible input
 ST = Schmitt Trigger input with CMOS levels
 I = Input
 P = Power
 CMOS = CMOS compatible input or output
 Analog = Analog input
 O = Output
 $\text{I}^2\text{C}^{\text{TM}}$ = $\text{I}^2\text{C}/\text{SMBus}$ input buffer

- Note 1:** Default assignment for ECCP2 when Configuration bit, CCP2MX, is set.
2: Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared.

PIC18F8723 FAMILY

TABLE 1-3: PIC18F8628/8723 (80-PIN) PINOUT I/O DESCRIPTIONS

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|--|------------|-----------------------|---------------------------|--|
| | TQFP | | | |
| RG5/MCLR/VPP RG5 MCLR VPP | 9 | I I P | ST ST | Master Clear (input) or programming voltage (input). Digital input. Master Clear (Reset) input. This pin is an active-low Reset to the device. Programming voltage input. |
| OSC1/CLKI/RA7 OSC1 CLKI RA7 | 49 | I I I/O | ST CMOS TTL | Oscillator crystal or external clock input. Oscillator crystal input or external clock source input. ST buffer when configured in RC mode, CMOS otherwise. External clock source input. Always associated with pin function OSC1. (See related OSC1/CLKI, OSC2/CLKO pins.) General purpose I/O pin. |
| OSC2/CLKO/RA6 OSC2 CLKO RA6 | 50 | O O I/O | — — TTL | Oscillator crystal or clock output. Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode. In RC mode, OSC2 pin outputs CLKO, which has 1/4 the frequency of OSC1 and denotes the instruction cycle rate. General purpose I/O pin. |

Legend: TTL = TTL compatible input CMOS = CMOS compatible input or output
 ST = Schmitt Trigger input with CMOS levels Analog = Analog input
 I = Input O = Output
 P = Power I²C™/SMB = I²C/SMBus input buffer

- Note 1:** Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared (all operating modes except Microcontroller mode).
- 2:** Default assignment for ECCP2 in all operating modes (CCP2MX is set).
- 3:** Alternate assignment for ECCP2 when CCP2MX is cleared (Microcontroller mode only).
- 4:** Default assignment for P1B/P1C/P3B/P3C (ECCPMX is set).
- 5:** Alternate assignment for P1B/P1C/P3B/P3C (ECCPMX is clear).

PIC18F8723 FAMILY

TABLE 1-3: PIC18F8628/8723 (80-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|--|------------|---------------|-------------------------|--|
| | TQFP | | | |
| RA0/AN0 RA0 AN0 | 30 | I/O I | TTL Analog | PORTA is a bidirectional I/O port. Digital I/O. Analog input 0. |
| RA1/AN1 RA1 AN1 | 29 | I/O I | TTL Analog | Digital I/O. Analog input 1. |
| RA2/AN2/VREF- RA2 AN2 VREF- | 28 | I/O I I | TTL Analog Analog | Digital I/O. Analog input 2. A/D reference voltage (low) input. |
| RA3/AN3/VREF+ RA3 AN3 VREF+ | 27 | I/O I I | TTL Analog Analog | Digital I/O. Analog input 3. A/D reference voltage (high) input. |
| RA4/T0CKI RA4 T0CKI | 34 | I/O I | ST ST | Digital I/O. Timer0 external clock input. |
| RA5/AN4/HLVDIN RA5 AN4 HLVDIN | 33 | I/O I I | TTL Analog Analog | Digital I/O. Analog input 4. High/Low-Voltage Detect input. |
| RA6 | | | | See the OSC2/CLKO/RA6 pin. |
| RA7 | | | | See the OSC1/CLKI/RA7 pin. |

Legend: TTL = TTL compatible input CMOS = CMOS compatible input or output
 ST = Schmitt Trigger input with CMOS levels Analog = Analog input
 I = Input O = Output
 P = Power I²C™/SMB = I²C/SMBus input buffer

- Note 1:** Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared (all operating modes except Microcontroller mode).
2: Default assignment for ECCP2 in all operating modes (CCP2MX is set).
3: Alternate assignment for ECCP2 when CCP2MX is cleared (Microcontroller mode only).
4: Default assignment for P1B/P1C/P3B/P3C (ECCPMX is set).
5: Alternate assignment for P1B/P1C/P3B/P3C (ECCPMX is clear).

PIC18F8723 FAMILY

TABLE 1-3: PIC18F8628/8723 (80-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description | | |
|----------------------|------------|----------|--|---|-----|--------------------------|
| | TQFP | | | | | |
| RB0/INT0/FLT0 | 58 | I/O | TTL | PORTB is a bidirectional I/O port. PORTB can be software programmed for internal weak pull-ups on all inputs. | | |
| RB0 | | | | Digital I/O. | | |
| INT0 | | | | External interrupt 0. | | |
| FLT0 | | | | PWM Fault input for ECCPx. | | |
| RB1/INT1 | 57 | I/O | TTL | Digital I/O. | | |
| INT1 | | | | External interrupt 1. | | |
| RB2/INT2 | 56 | I/O | TTL | Digital I/O. | | |
| INT2 | | | | External interrupt 2. | | |
| RB3/INT3/ECCP2/P2A | 55 | I/O | TTL | Digital I/O. | | |
| RB3 | | | | External interrupt 3. | | |
| INT3 | | O | — | Enhanced Capture 2 input/Compare 2 output/ PWM2 output. | | |
| ECCP2 ⁽¹⁾ | | | | ECCP2 PWM output A. | | |
| P2A ⁽¹⁾ | O | — | | | | |
| RB4/KBI0 | 54 | I/O | TTL | Digital I/O. | | |
| RB4 | | | | I | TTL | Interrupt-on-change pin. |
| KBI0 | | | | | | |
| RB5/KBI1/PGM | 53 | I/O | TTL | Digital I/O. | | |
| RB5 | | | | I | TTL | Interrupt-on-change pin. |
| KBI1 | | | | | | |
| PGM | I/O | ST | Low-Voltage ICSP™ Programming enable pin. | | | |
| RB6/KBI2/PGC | 52 | I/O | TTL | Digital I/O. | | |
| RB6 | | | | I | TTL | Interrupt-on-change pin. |
| KBI2 | | | | | | |
| PGC | I/O | ST | In-Circuit Debugger and ICSP™ programming clock pin. | | | |
| RB7/KBI3/PGD | 47 | I/O | TTL | Digital I/O. | | |
| RB7 | | | | I | TTL | Interrupt-on-change pin. |
| KBI3 | | | | | | |
| PGD | I/O | ST | In-Circuit Debugger and ICSP programming data pin. | | | |

Legend: TTL = TTL compatible input CMOS = CMOS compatible input or output
 ST = Schmitt Trigger input with CMOS levels Analog = Analog input
 I = Input O = Output
 P = Power I²C™/SMB = I²C/SMBus input buffer

- Note 1:** Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared (all operating modes except Microcontroller mode).
- 2:** Default assignment for ECCP2 in all operating modes (CCP2MX is set).
- 3:** Alternate assignment for ECCP2 when CCP2MX is cleared (Microcontroller mode only).
- 4:** Default assignment for P1B/P1C/P3B/P3C (ECCPMX is set).
- 5:** Alternate assignment for P1B/P1C/P3B/P3C (ECCPMX is clear).

PIC18F8723 FAMILY

TABLE 1-3: PIC18F8628/8723 (80-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|---|------------|----------------------|-----------------------|--|
| | TQFP | | | |
| RC0/T1OSO/T13CKI RC0 T1OSO T13CKI | 36 | I/O O I | ST — ST | PORTC is a bidirectional I/O port. Digital I/O. Timer1 oscillator output. Timer1/Timer3 external clock input. |
| RC1/T1OSI/ECCP2/ P2A RC1 T1OSI ECCP2 ⁽²⁾ P2A ⁽²⁾ | 35 | I/O I I/O O | ST CMOS ST — | Digital I/O. Timer1 oscillator input. Enhanced Capture 2 input/Compare 2 output/ PWM2 output. ECCP2 PWM output A. |
| RC2/ECCP1/P1A RC2 ECCP1 P1A | 43 | I/O I/O O | ST ST — | Digital I/O. Enhanced Capture 1 input/Compare 1 output/ PWM1 output. ECCP1 PWM output A. |
| RC3/SCK1/SCL1 RC3 SCK1 SCL1 | 44 | I/O I/O I/O | ST ST ST | Digital I/O. Synchronous serial clock input/output for SPI mode. Synchronous serial clock input/output for I ² C™ mode. |
| RC4/SDI1/SDA1 RC4 SDI1 SDA1 | 45 | I/O I I/O | ST ST ST | Digital I/O. SPI data in. I ² C data I/O. |
| RC5/SDO1 RC5 SDO1 | 46 | I/O O | ST — | Digital I/O. SPI data out. |
| RC6/TX1/CK1 RC6 TX1 CK1 | 37 | I/O O I/O | ST — ST | Digital I/O. EUSART1 asynchronous transmit. EUSART1 synchronous clock (see related RX1/DT1). |
| RC7/RX1/DT1 RC7 RX1 DT1 | 38 | I/O I I/O | ST ST ST | Digital I/O. EUSART1 asynchronous receive. EUSART1 synchronous data (see related TX1/CK1). |

Legend: TTL = TTL compatible input
 ST = Schmitt Trigger input with CMOS levels
 I = Input
 P = Power
 CMOS = CMOS compatible input or output
 Analog = Analog input
 O = Output
 I²C™/SMB = I²C/SMBus input buffer

- Note 1:** Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared (all operating modes except Microcontroller mode).
2: Default assignment for ECCP2 in all operating modes (CCP2MX is set).
3: Alternate assignment for ECCP2 when CCP2MX is cleared (Microcontroller mode only).
4: Default assignment for P1B/P1C/P3B/P3C (ECCPMX is set).
5: Alternate assignment for P1B/P1C/P3B/P3C (ECCPMX is clear).

PIC18F8723 FAMILY

TABLE 1-3: PIC18F8628/8723 (80-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|------------------------|------------|----------|----------------------|--|
| | TQFP | | | |
| RD0/AD0/PSP0 | 72 | | | PORTD is a bidirectional I/O port. |
| RD0 | | I/O | ST | Digital I/O. |
| AD0 | | I/O | TTL | External memory address/data 0. |
| PSP0 | | I/O | TTL | Parallel Slave Port data. |
| RD1/AD1/PSP1 | 69 | | | |
| RD1 | | I/O | ST | Digital I/O. |
| AD1 | | I/O | TTL | External memory address/data 1. |
| PSP1 | | I/O | TTL | Parallel Slave Port data. |
| RD2/AD2/PSP2 | 68 | | | |
| RD2 | | I/O | ST | Digital I/O. |
| AD2 | | I/O | TTL | External memory address/data 2. |
| PSP2 | | I/O | TTL | Parallel Slave Port data. |
| RD3/AD3/PSP3 | 67 | | | |
| RD3 | | I/O | ST | Digital I/O. |
| AD3 | | I/O | TTL | External memory address/data 3. |
| PSP3 | | I/O | TTL | Parallel Slave Port data. |
| RD4/AD4/PSP4/SDO2 | 66 | | | |
| RD4 | | I/O | ST | Digital I/O. |
| AD4 | | I/O | TTL | External memory address/data 4. |
| PSP4 | | I/O | TTL | Parallel Slave Port data. |
| SDO2 | | O | — | SPI data out. |
| RD5/AD5/PSP5/SDI2/SDA2 | 65 | | | |
| RD5 | | I/O | ST | Digital I/O. |
| AD5 | | I/O | TTL | External memory address/data 5. |
| PSP5 | | I/O | TTL | Parallel Slave Port data. |
| SDI2 | | I | ST | SPI data in. |
| SDA2 | | I/O | I ² C/SMB | I ² C™ data I/O. |
| RD6/AD6/PSP6/SCK2/SCL2 | 64 | | | |
| RD6 | | I/O | ST | Digital I/O. |
| AD6 | | I/O | TTL | External memory address/data 6. |
| PSP6 | | I/O | TTL | Parallel Slave Port data. |
| SCK2 | | I/O | ST | Synchronous serial clock input/output for SPI mode. |
| SCL2 | | I/O | I ² C/SMB | Synchronous serial clock input/output for I ² C mode. |
| RD7/AD7/PSP7/SS2 | 63 | | | |
| RD7 | | I/O | ST | Digital I/O. |
| AD7 | | I/O | TTL | External memory address/data 7. |
| PSP7 | | I/O | TTL | Parallel Slave Port data. |
| SS2 | | I | TTL | SPI slave select input. |

Legend: TTL = TTL compatible input CMOS = CMOS compatible input or output
ST = Schmitt Trigger input with CMOS levels Analog = Analog input
I = Input O = Output
P = Power I²C™/SMB = I²C/SMBus input buffer

- Note 1:** Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared (all operating modes except Microcontroller mode).
- 2:** Default assignment for ECCP2 in all operating modes (CCP2MX is set).
- 3:** Alternate assignment for ECCP2 when CCP2MX is cleared (Microcontroller mode only).
- 4:** Default assignment for P1B/P1C/P3B/P3C (ECCPMX is set).
- 5:** Alternate assignment for P1B/P1C/P3B/P3C (ECCPMX is clear).

PIC18F8723 FAMILY

TABLE 1-3: PIC18F8628/8723 (80-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|---------------------------------------|------------|----------|-------------|--|
| | TQFP | | | |
| RE0/AD8/ $\overline{\text{RD}}$ /P2D | 4 | | | PORTE is a bidirectional I/O port. |
| RE0 | | I/O | ST | Digital I/O. |
| AD8 | | I/O | TTL | External memory address/data 8. |
| $\overline{\text{RD}}$ | | I | TTL | Read control for Parallel Slave Port. |
| P2D | | O | — | ECCP2 PWM output D. |
| RE1/AD9/ $\overline{\text{WR}}$ /P2C | 3 | | | |
| RE1 | | I/O | ST | Digital I/O. |
| AD9 | | I/O | TTL | External memory address/data 9. |
| $\overline{\text{WR}}$ | | I | TTL | Write control for Parallel Slave Port. |
| P2C | | O | — | ECCP2 PWM output C. |
| RE2/AD10/ $\overline{\text{CS}}$ /P2B | 78 | | | |
| RE2 | | I/O | ST | Digital I/O. |
| AD10 | | I/O | TTL | External memory address/data 10. |
| $\overline{\text{CS}}$ | | I | TTL | Chip select control for Parallel Slave Port. |
| P2B | | O | — | ECCP2 PWM output B. |
| RE3/AD11/P3C | 77 | | | |
| RE3 | | I/O | ST | Digital I/O. |
| AD11 | | I/O | TTL | External memory address/data 11. |
| P3C ⁽⁴⁾ | | O | — | ECCP3 PWM output C. |
| RE4/AD12/P3B | 76 | | | |
| RE4 | | I/O | ST | Digital I/O. |
| AD12 | | I/O | TTL | External memory address/data 12. |
| P3B ⁽⁴⁾ | | O | — | ECCP3 PWM output B. |
| RE5/AD13/P1C | 75 | | | |
| RE5 | | I/O | ST | Digital I/O. |
| AD13 | | I/O | TTL | External memory address/data 13. |
| P1C ⁽⁴⁾ | | O | — | ECCP1 PWM output C. |
| RE6/AD14/P1B | 74 | | | |
| RE6 | | I/O | ST | Digital I/O. |
| AD14 | | I/O | TTL | External memory address/data 14. |
| P1B ⁽⁴⁾ | | O | — | ECCP1 PWM output B. |
| RE7/AD15/ECCP2/ P2A | 73 | | | |
| RE7 | | I/O | ST | Digital I/O. |
| AD15 | | I/O | TTL | External memory address/data 15. |
| ECCP2 ⁽³⁾ | | I/O | ST | Enhanced Capture 2 input/Compare 2 output/ PWM2 output. |
| P2A ⁽³⁾ | | O | — | ECCP2 PWM output A. |

Legend: TTL = TTL compatible input CMOS = CMOS compatible input or output
ST = Schmitt Trigger input with CMOS levels Analog = Analog input
I = Input O = Output
P = Power I²C™/SMB = I²C/SMBus input buffer

- Note 1:** Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared (all operating modes except Microcontroller mode).
- 2:** Default assignment for ECCP2 in all operating modes (CCP2MX is set).
- 3:** Alternate assignment for ECCP2 when CCP2MX is cleared (Microcontroller mode only).
- 4:** Default assignment for P1B/P1C/P3B/P3C (ECCPMX is set).
- 5:** Alternate assignment for P1B/P1C/P3B/P3C (ECCPMX is clear).

PIC18F8723 FAMILY

TABLE 1-3: PIC18F8628/8723 (80-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|--|------------|---------------|------------------------|--|
| | TQFP | | | |
| RF0/AN5 RF0 AN5 | 24 | I/O I | ST Analog | PORTF is a bidirectional I/O port. Digital I/O. Analog input 5. |
| RF1/AN6/C2OUT RF1 AN6 C2OUT | 23 | I/O I O | ST Analog — | Digital I/O. Analog input 6. Comparator 2 output. |
| RF2/AN7/C1OUT RF2 AN7 C1OUT | 18 | I/O I O | ST Analog — | Digital I/O. Analog input 7. Comparator 1 output. |
| RF3/AN8 RF3 AN8 | 17 | I/O I | ST Analog | Digital I/O. Analog input 8. |
| RF4/AN9 RF4 AN9 | 16 | I/O I | ST Analog | Digital I/O. Analog input 9. |
| RF5/AN10/CVREF RF5 AN10 CVREF | 15 | I/O I O | ST Analog Analog | Digital I/O. Analog input 10. Comparator reference voltage output. |
| RF6/AN11 RF6 AN11 | 14 | I/O I | ST Analog | Digital I/O. Analog input 11. |
| RF7/SS1 RF7 SS1 | 13 | I/O I | ST TTL | Digital I/O. SPI slave select input. |

Legend: TTL = TTL compatible input CMOS = CMOS compatible input or output
ST = Schmitt Trigger input with CMOS levels Analog = Analog input
I = Input O = Output
P = Power I²C™/SMB = I²C/SMBus input buffer

- Note 1:** Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared (all operating modes except Microcontroller mode).
2: Default assignment for ECCP2 in all operating modes (CCP2MX is set).
3: Alternate assignment for ECCP2 when CCP2MX is cleared (Microcontroller mode only).
4: Default assignment for P1B/P1C/P3B/P3C (ECCPMX is set).
5: Alternate assignment for P1B/P1C/P3B/P3C (ECCPMX is clear).

PIC18F8723 FAMILY

TABLE 1-3: PIC18F8628/8723 (80-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|---------------|------------|----------|-------------|---|
| | TQFP | | | |
| RG0/ECCP3/P3A | 5 | I/O | ST | PORTG is a bidirectional I/O port. Digital I/O. Enhanced Capture 3 input/Compare 3 output/ PWM3 output. ECCP3 PWM output A. |
| RG0 | | | ST | |
| ECCP3 | | | | |
| P3A | O | — | | |
| RG1/TX2/CK2 | 6 | I/O | ST | |
| RG1 | | | ST | |
| TX2 | | O | — | |
| CK2 | I/O | ST | | |
| RG2/RX2/DT2 | 7 | I/O | ST | Digital I/O. EUSART2 asynchronous receive. EUSART2 synchronous data (see related TX2/CK2). |
| RG2 | | | ST | |
| RX2 | | I | ST | |
| DT2 | I/O | ST | | |
| RG3/CCP4/P3D | 8 | I/O | ST | |
| RG3 | | | ST | |
| CCP4 | | I/O | ST | |
| P3D | O | — | | |
| RG4/CCP5/P1D | 10 | I/O | ST | Digital I/O. Capture 5 input/Compare 5 output/PWM5 output. ECCP1 PWM output D. |
| RG4 | | | ST | |
| CCP5 | | I/O | ST | |
| P1D | O | — | | |
| RG5 | | | | |

Legend: TTL = TTL compatible input
 ST = Schmitt Trigger input with CMOS levels
 I = Input
 P = Power
 CMOS = CMOS compatible input or output
 Analog = Analog input
 O = Output
 I²C™/SMB = I²C/SMBus input buffer

- Note 1:** Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared (all operating modes except Microcontroller mode).
- 2:** Default assignment for ECCP2 in all operating modes (CCP2MX is set).
- 3:** Alternate assignment for ECCP2 when CCP2MX is cleared (Microcontroller mode only).
- 4:** Default assignment for P1B/P1C/P3B/P3C (ECCPMX is set).
- 5:** Alternate assignment for P1B/P1C/P3B/P3C (ECCPMX is clear).

PIC18F8723 FAMILY

TABLE 1-3: PIC18F8628/8723 (80-PIN) PINOUT I/O DESCRIPTIONS (CONTINUED)

| Pin Name | Pin Number | Pin Type | Buffer Type | Description |
|--|----------------|----------|-------------|---|
| | TQFP | | | |
| RJ0/ALE RJ0 ALE | 62 | I/O O | ST — | PORTJ is a bidirectional I/O port. Digital I/O. External memory address latch enable. |
| RJ1/ $\overline{\text{OE}}$ RJ1 $\overline{\text{OE}}$ | 61 | I/O O | ST — | Digital I/O. External memory output enable. |
| RJ2/ $\overline{\text{WRL}}$ RJ2 $\overline{\text{WRL}}$ | 60 | I/O O | ST — | Digital I/O. External memory write low control. |
| RJ3/ $\overline{\text{WRH}}$ RJ3 $\overline{\text{WRH}}$ | 59 | I/O O | ST — | Digital I/O. External memory write high control. |
| RJ4/BA0 RJ4 BA0 | 39 | I/O O | ST — | Digital I/O. External memory byte address 0 control. |
| RJ5/ $\overline{\text{CE}}$ RJ4 $\overline{\text{CE}}$ | 40 | I/O O | ST — | Digital I/O External memory chip enable control. |
| RJ6/ $\overline{\text{LB}}$ RJ6 $\overline{\text{LB}}$ | 41 | I/O O | ST — | Digital I/O. External memory low byte control. |
| RJ7/ $\overline{\text{UB}}$ RJ7 $\overline{\text{UB}}$ | 42 | I/O O | ST — | Digital I/O. External memory high byte control. |
| VSS | 11, 31, 51, 70 | P | — | Ground reference for logic and I/O pins. |
| VDD | 12, 32, 48, 71 | P | — | Positive supply for logic and I/O pins. |
| AVSS | 26 | P | — | Ground reference for analog modules. |
| AVDD | 25 | P | — | Positive supply for analog modules. |

Legend: TTL = TTL compatible input

ST = Schmitt Trigger input with CMOS levels

I = Input

P = Power

CMOS = CMOS compatible input or output

Analog = Analog input

O = Output

I²C[™]/SMB = I²C/SMBus input buffer

Note 1: Alternate assignment for ECCP2 when Configuration bit, CCP2MX, is cleared (all operating modes except Microcontroller mode).

2: Default assignment for ECCP2 in all operating modes (CCP2MX is set).

3: Alternate assignment for ECCP2 when CCP2MX is cleared (Microcontroller mode only).

4: Default assignment for P1B/P1C/P3B/P3C (ECCPMX is set).

5: Alternate assignment for P1B/P1C/P3B/P3C (ECCPMX is clear).

PIC18F8723 FAMILY

2.0 12-BIT ANALOG-TO-DIGITAL CONVERTER (A/D) MODULE

The Analog-to-Digital (A/D) Converter module has 12 inputs for the 64-pin devices (PIC18F6628/6723) and 16 for the 80-pin devices (PIC18F8628/8723). This module allows conversion of an analog input signal to a corresponding 12-bit digital number.

The module has five registers:

- A/D Result High Register (ADRESH)
- A/D Result Low Register (ADRESL)
- A/D Control Register 0 (ADCON0)
- A/D Control Register 1 (ADCON1)
- A/D Control Register 2 (ADCON2)

The ADCON0 register, shown in Register 2-1, controls the operation of the A/D module. The ADCON1 register, shown in Register 2-2, configures the functions of the port pins. The ADCON2 register, shown in Register 2-3, configures the A/D clock source, programmed acquisition time and justification.

REGISTER 2-1: ADCON0: A/D CONTROL REGISTER 0

| | | | | | | | |
|-------|-----|-------|-------|-------|-------|---------|-------|
| U-0 | U-0 | R/W-0 | R/W-0 | R/W-0 | R/W-0 | R/W-0 | R/W-0 |
| — | — | CHS3 | CHS2 | CHS1 | CHS0 | GO/DONE | ADON |
| bit 7 | | | | | | bit 0 | |

Legend:

R = Readable bit

W = Writable bit

U = Unimplemented bit, read as '0'

-n = Value at POR

'1' = Bit is set

'0' = Bit is cleared

x = Bit is unknown

bit 7-6 **Unimplemented:** Read as '0'

bit 5-2 **CHS3:CHS0:** Analog Channel Select bits

- 0000 = Channel 0 (AN0)
- 0001 = Channel 1 (AN1)
- 0010 = Channel 2 (AN2)
- 0011 = Channel 3 (AN3)
- 0100 = Channel 4 (AN4)
- 0101 = Channel 5 (AN5)
- 0110 = Channel 6 (AN6)
- 0111 = Channel 7 (AN7)
- 1000 = Channel 8 (AN8)
- 1001 = Channel 9 (AN9)
- 1010 = Channel 10 (AN10)
- 1011 = Channel 11 (AN11)
- 1100 = Channel 12 (AN12)^(1,2)
- 1101 = Channel 13 (AN13)^(1,2)
- 1110 = Channel 14 (AN14)^(1,2)
- 1111 = Channel 15 (AN15)^(1,2)

bit 1 **GO/DONE:** A/D Conversion Status bit

When ADON = 1:

- 1 = A/D conversion in progress
- 0 = A/D Idle

bit 0 **ADON:** A/D On bit

- 1 = A/D Converter module is enabled
- 0 = A/D Converter module is disabled

Note 1: These channels are not implemented on PIC18F6628/6723 devices.

2: Performing a conversion on unimplemented channels will return a floating input measurement.

PIC18F8723 FAMILY

REGISTER 2-2: ADCON1: A/D CONTROL REGISTER 1

| | | | | | | | |
|-------|-----|-------|-------|-------|-------|-------|-------|
| U-0 | U-0 | R/W-0 | R/W-0 | R/W-0 | R/W-0 | R/W-0 | R/W-0 |
| — | — | VCFG1 | VCFG0 | PCFG3 | PCFG2 | PCFG1 | PCFG0 |
| bit 7 | | | | | | | bit 0 |

Legend:

R = Readable bit W = Writable bit U = Unimplemented bit, read as '0'
 -n = Value at POR '1' = Bit is set '0' = Bit is cleared x = Bit is unknown

bit 7-6 **Unimplemented:** Read as '0'

bit 5-4 **VCFG1:VCFG0:** Voltage Reference Configuration bits

| | A/D VREF+ | A/D VREF- |
|----|----------------|----------------|
| 00 | AVDD | AVSS |
| 01 | External VREF+ | AVSS |
| 10 | AVDD | External VREF- |
| 11 | External VREF+ | External VREF- |

bit 3-0 **PCFG3:PCFG0:** A/D Port Configuration Control bits:

| PCFG<3:0> | AN15 ⁽¹⁾ | AN14 ⁽¹⁾ | AN13 ⁽¹⁾ | AN12 ⁽¹⁾ | AN11 | AN10 | AN9 | AN8 | AN7 | AN6 | AN5 | AN4 | AN3 | AN2 | AN1 | AN0 |
|-----------|---------------------|---------------------|---------------------|---------------------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0000 | A | A | A | A | A | A | A | A | A | A | A | A | A | A | A | A |
| 0001 | D | D | A | A | A | A | A | A | A | A | A | A | A | A | A | A |
| 0010 | D | D | D | A | A | A | A | A | A | A | A | A | A | A | A | A |
| 0011 | D | D | D | D | A | A | A | A | A | A | A | A | A | A | A | A |
| 0100 | D | D | D | D | D | A | A | A | A | A | A | A | A | A | A | A |
| 0101 | D | D | D | D | D | D | A | A | A | A | A | A | A | A | A | A |
| 0110 | D | D | D | D | D | D | D | A | A | A | A | A | A | A | A | A |
| 0111 | D | D | D | D | D | D | D | D | A | A | A | A | A | A | A | A |
| 1000 | D | D | D | D | D | D | D | D | D | A | A | A | A | A | A | A |
| 1001 | D | D | D | D | D | D | D | D | D | D | A | A | A | A | A | A |
| 1010 | D | D | D | D | D | D | D | D | D | D | D | A | A | A | A | A |
| 1011 | D | D | D | D | D | D | D | D | D | D | D | D | A | A | A | A |
| 1100 | D | D | D | D | D | D | D | D | D | D | D | D | D | A | A | A |
| 1101 | D | D | D | D | D | D | D | D | D | D | D | D | D | D | A | A |
| 1110 | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | A |
| 1111 | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |

A = Analog input D = Digital I/O

Note 1: AN15 through AN12 are available only on PIC18F8628/8723 devices.

PIC18F8723 FAMILY

REGISTER 2-3: ADCON2: A/D CONTROL REGISTER 2

| | | | | | | | |
|-------|-----|-------|-------|-------|-------|-------|-------|
| R/W-0 | U-0 | R/W-0 | R/W-0 | R/W-0 | R/W-0 | R/W-0 | R/W-0 |
| ADFM | — | ACQT2 | ACQT1 | ACQT0 | ADCS2 | ADCS1 | ADCS0 |
| bit 7 | | | | | | | bit 0 |

Legend:

R = Readable bit W = Writable bit U = Unimplemented bit, read as '0'
 -n = Value at POR '1' = Bit is set '0' = Bit is cleared x = Bit is unknown

- bit 7 **ADFM:** A/D Result Format Select bit
 1 = Right justified
 0 = Left justified
- bit 6 **Unimplemented:** Read as '0'
- bit 5-3 **ACQT2:ACQT0:** A/D Acquisition Time Select bits
 111 = 20 TAD
 110 = 16 TAD
 101 = 12 TAD
 100 = 8 TAD
 011 = 6 TAD
 010 = 4 TAD
 001 = 2 TAD
 000 = 0 TAD⁽¹⁾
- bit 2-0 **ADCS2:ADCS0:** A/D Conversion Clock Select bits
 111 = FRC (clock derived from A/D RC oscillator)⁽¹⁾
 110 = FOSC/64
 101 = FOSC/16
 100 = FOSC/4
 011 = FRC (clock derived from A/D RC oscillator)⁽¹⁾
 010 = FOSC/32
 001 = FOSC/8
 000 = FOSC/2

Note 1: If the A/D FRC clock source is selected, a delay of one T_{CY} (instruction cycle) is added before the A/D clock starts. This allows the *SLEEP* instruction to be executed before starting a conversion.

PIC18F8723 FAMILY

The analog reference voltage is software selectable to either the device's positive and negative supply voltage (VDD and VSS), or the voltage level on the RA3/AN3/VREF+ and RA2/AN2/VREF-/CVREF pins.

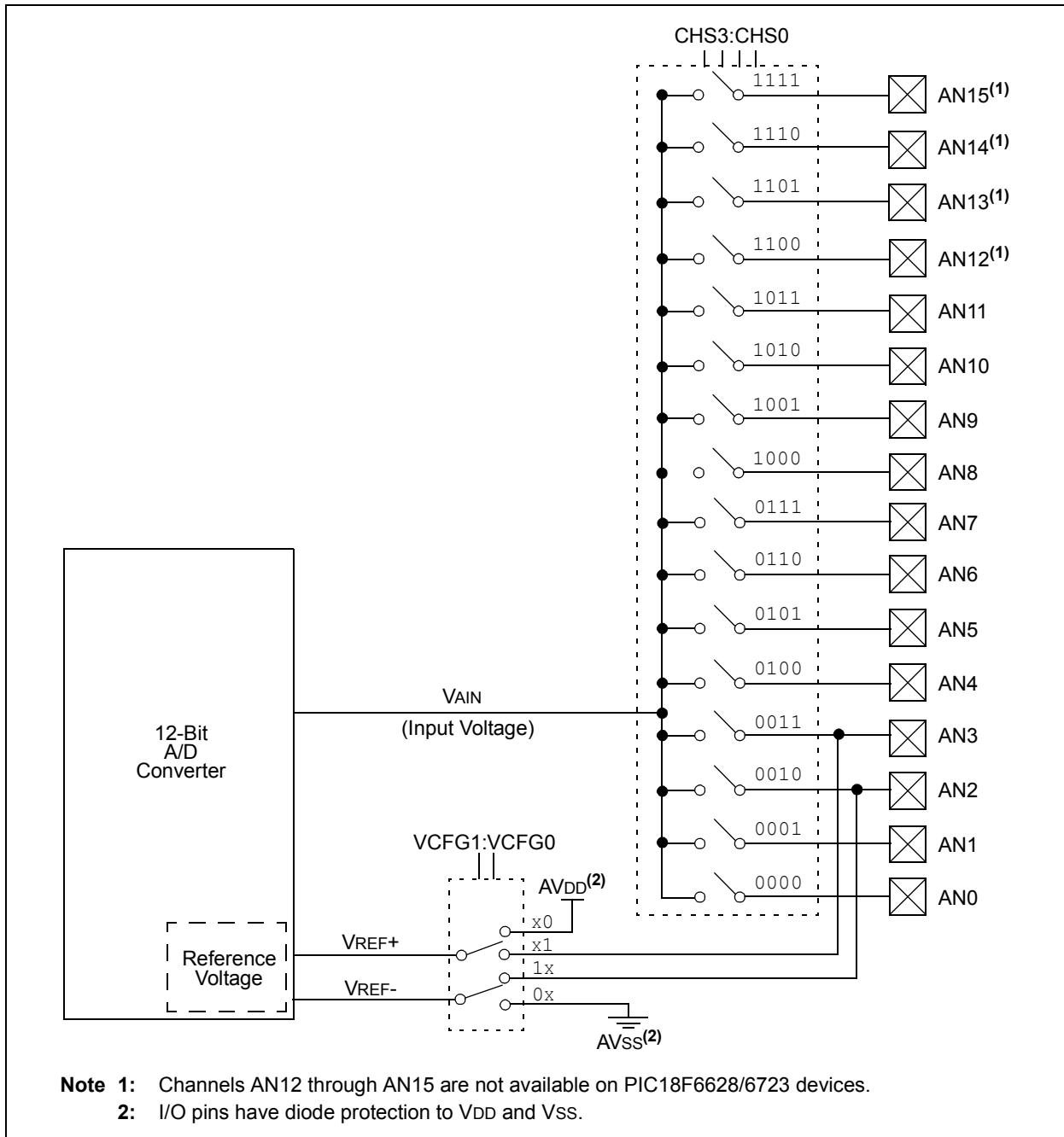
The A/D Converter has a unique feature of being able to operate while the device is in Sleep mode. To operate in Sleep, the A/D conversion clock must be derived from the A/D's internal RC oscillator.

The output of the sample and hold is the input into the converter, which generates the result via successive approximation.

A device Reset forces all registers to their Reset state. This forces the A/D module to be turned off and any conversion in progress is aborted.

Each port pin associated with the A/D Converter can be configured as an analog input or a digital I/O. The ADRESH and ADRESL registers contain the result of the A/D conversion. When the A/D conversion is complete, the result is loaded into the ADRESH:ADRESL register pair, the GO/DONE bit (ADCON0<1>) is cleared and the A/D Interrupt Flag bit, ADIF, is set. The block diagram of the A/D module is shown in Figure 2-1.

FIGURE 2-1: A/D BLOCK DIAGRAM



PIC18F8723 FAMILY

The value in the ADRESH:ADRESL registers is unknown following Power-on and Brown-out Resets and is not affected by any other Reset.

After the A/D module has been configured as desired, the selected channel must be acquired before the conversion is started. The analog input channels must have their corresponding TRIS bits selected as an input. To determine acquisition time, see **Section 2.1 “A/D Acquisition Requirements”**. After this acquisition time has elapsed, the A/D conversion can be started. An acquisition time can be programmed to occur between setting the GO/DONE bit and the actual start of the conversion.

The following steps should be followed to perform an A/D conversion:

1. Configure the A/D module:
 - Configure analog pins, voltage reference and digital I/O (ADCON1)
 - Select A/D input channel (ADCON0)
 - Select A/D acquisition time (ADCON2)
 - Select A/D conversion clock (ADCON2)
 - Turn on A/D module (ADCON0)
2. Configure A/D interrupt (if desired):
 - Clear ADIF bit
 - Set ADIE bit
 - Set GIE bit
3. Wait the required acquisition time (if required).
4. Start conversion:
 - Set GO/DONE bit (ADCON0<1>)

5. Wait for A/D conversion to complete by either:
 - Polling for the GO/DONE bit to be cleared
 OR
 - Waiting for the A/D interrupt
6. Read A/D Result registers (ADRESH:ADRESL); clear bit, ADIF, if required.
7. For next conversion, go to step 1 or step 2, as required. The A/D conversion time per bit is defined as T_{AD}. A minimum wait of 2 T_{AD} is required before the next acquisition starts.

FIGURE 2-2: A/D TRANSFER FUNCTION

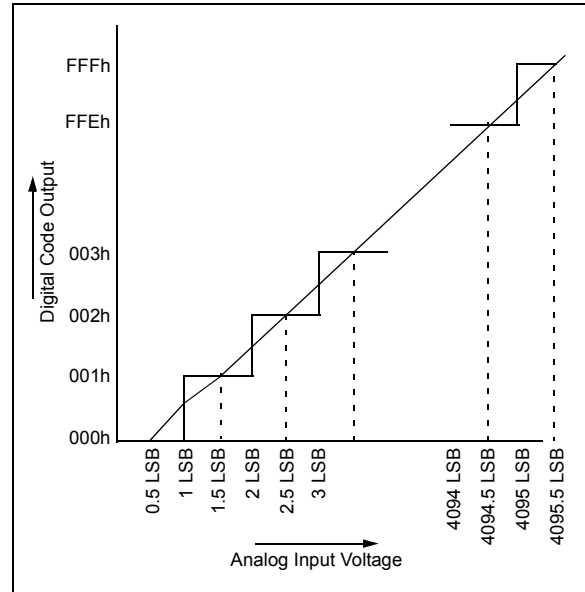
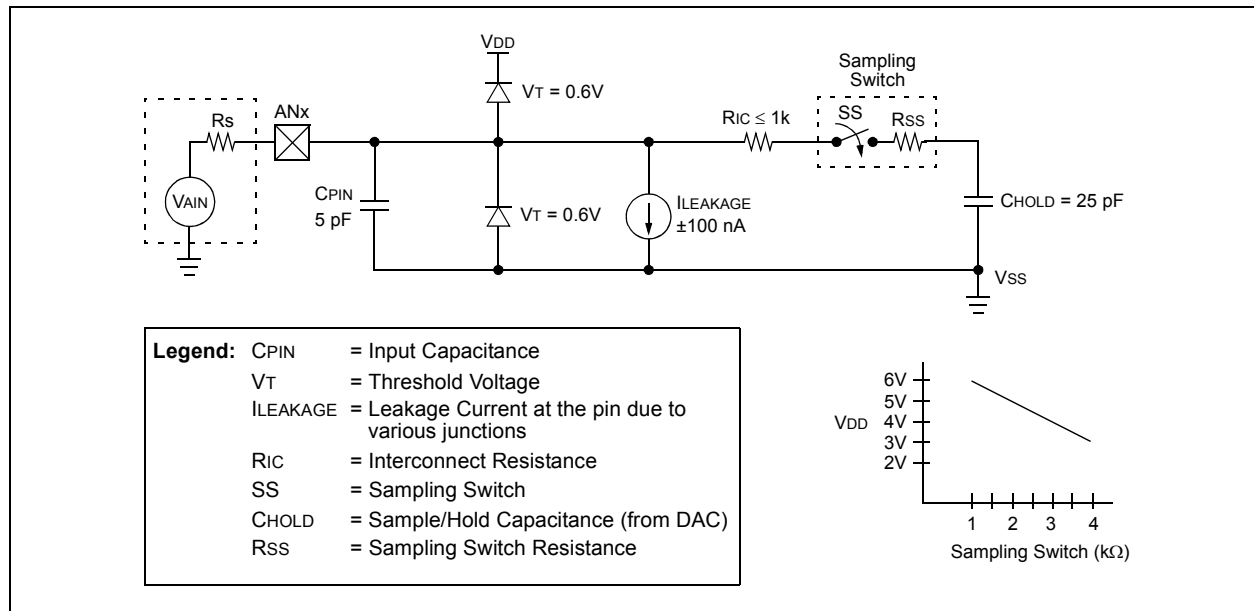


FIGURE 2-3: ANALOG INPUT MODEL



PIC18F8723 FAMILY

2.1 A/D Acquisition Requirements

For the A/D Converter to meet its specified accuracy, the charge holding capacitor (CHOLD) must be allowed to fully charge to the input channel voltage level. The analog input model is shown in Figure 2-3. The source impedance (Rs) and the internal sampling switch (Rss) impedance directly affect the time required to charge the capacitor, CHOLD. The sampling switch (Rss) impedance varies over the device voltage (VDD). The source impedance affects the offset voltage at the analog input (due to pin leakage current). **The maximum recommended impedance for analog sources is 2.5 kΩ.** After the analog input channel is selected (changed), the channel must be sampled for at least the minimum acquisition time before starting a conversion.

Note: When the conversion is started, the holding capacitor is disconnected from the input pin.

To calculate the minimum acquisition time, Equation 2-1 may be used. This equation assumes that 1/2 LSB error is used (4096 steps for the 12-bit A/D). The 1/2 LSB error is the maximum error allowed for the A/D to meet its specified resolution.

Example 2-3 shows the calculation of the minimum required acquisition time, TACQ. This calculation is based on the following application system assumptions:

| | | |
|------------------|---|--------------------|
| CHOLD | = | 25 pF |
| Rs | = | 2.5 kΩ |
| Conversion Error | ≤ | 1/2 LSB |
| VDD | = | 3V → Rss = 4 kΩ |
| Temperature | = | 85°C (system max.) |

EQUATION 2-1: ACQUISITION TIME

$$\begin{aligned} \text{TACQ} &= \text{Amplifier Settling Time} + \text{Holding Capacitor Charging Time} + \text{Temperature Coefficient} \\ &= \text{TAMP} + \text{TC} + \text{TCOFF} \end{aligned}$$

EQUATION 2-2: A/D MINIMUM CHARGING TIME

$$\begin{aligned} \text{V}_{\text{HOLD}} &= (\text{V}_{\text{REF}} - (\text{V}_{\text{REF}}/4096)) \cdot (1 - e^{-(\text{TC}/\text{CHOLD})(\text{RIC} + \text{R}_{\text{SS}} + \text{R}_{\text{S}})}) \\ \text{or} \\ \text{TC} &= -(\text{CHOLD})(\text{RIC} + \text{R}_{\text{SS}} + \text{R}_{\text{S}}) \ln(1/4096) \end{aligned}$$

EQUATION 2-3: CALCULATING THE MINIMUM REQUIRED ACQUISITION TIME

$$\begin{aligned} \text{TACQ} &= \text{TAMP} + \text{TC} + \text{TCOFF} \\ \text{TAMP} &= 0.2 \mu\text{s} \\ \text{TCOFF} &= (\text{Temp} - 25^\circ\text{C})(0.02 \mu\text{s}/^\circ\text{C}) \\ &\quad (85^\circ\text{C} - 25^\circ\text{C})(0.02 \mu\text{s}/^\circ\text{C}) \\ &\quad 1.2 \mu\text{s} \end{aligned}$$

Temperature coefficient is only required for temperatures > 25°C. Below 25°C, TCOFF = 0 μs.

$$\begin{aligned} \text{TC} &= -(\text{CHOLD})(\text{RIC} + \text{R}_{\text{SS}} + \text{R}_{\text{S}}) \ln(1/4096) \mu\text{s} \\ &\quad -(25 \text{ pF})(1 \text{ k}\Omega + 4 \text{ k}\Omega + 2.5 \text{ k}\Omega) \ln(0.0002441) \mu\text{s} \\ &\quad 1.56 \mu\text{s} \\ \text{TACQ} &= 0.2 \mu\text{s} + 1.56 \mu\text{s} + 1.2 \mu\text{s} \\ &\quad 2.96 \mu\text{s} \end{aligned}$$

2.2 Selecting and Configuring Acquisition Time

The ADCON2 register allows the user to select an acquisition time that occurs each time the GO/DONE bit is set. It also gives users the option to use an automatically determined acquisition time.

Acquisition time may be set with the ACQT2:ACQT0 bits (ADCON2<5:3>), which provide a range of 2 to 20 TAD. When the GO/DONE bit is set, the A/D module continues to sample the input for the selected acquisition time, then automatically begins a conversion. Since the acquisition time is programmed, there may be no need to wait for an acquisition time between selecting a channel and setting the GO/DONE bit.

Manual acquisition is selected when ACQT2:ACQT0 = 000. When the GO/DONE bit is set, sampling is stopped and a conversion begins. The user is responsible for ensuring the required acquisition time has passed between selecting the desired input channel and setting the GO/DONE bit. This option is also the default Reset state of the ACQT2:ACQT0 bits and is compatible with devices that do not offer programmable acquisition times.

In either case, when the conversion is completed, the GO/DONE bit is cleared, the ADIF flag is set and the A/D begins sampling the currently selected channel again. If an acquisition time is programmed, there is nothing to indicate if the acquisition time has ended or if the conversion has begun.

2.3 Selecting the A/D Conversion Clock

The A/D conversion time per bit is defined as TAD. The A/D conversion requires 13 TAD per 12-bit conversion. The source of the A/D conversion clock is software selectable. There are seven possible options for TAD:

- 2 TOSC
- 4 TOSC
- 8 TOSC
- 16 TOSC
- 32 TOSC
- 64 TOSC
- Internal RC Oscillator

For correct A/D conversions, the A/D conversion clock (TAD) must be as short as possible, but greater than the minimum TAD (see parameter 130 for more information).

Table 2-1 shows the resultant TAD times derived from the device operating frequencies and the A/D clock source selected.

TABLE 2-1: TAD vs. DEVICE OPERATING FREQUENCIES

| A/D Clock Source (TAD) | | Assumes TAD Min. = 0.8 μ s |
|------------------------|-------------|--------------------------------|
| Operation | ADCS2:ADCS0 | Maximum FOSC |
| 2 TOSC | 000 | 2.50 MHz |
| 4 TOSC | 100 | 5.00 MHz |
| 8 TOSC | 001 | 10.00 MHz |
| 16 TOSC | 101 | 20.00 MHz |
| 32 TOSC | 010 | 40.00 MHz |
| 64 TOSC | 110 | 40.00 MHz |
| RC ⁽¹⁾ | x11 | 1.00 MHz ⁽²⁾ |

Note 1: The RC source has a typical TAD time of 2.5 μ s.

- 2:** For device frequencies above 1 MHz, the device must be in Sleep for the entire conversion or a FOSC divider should be used instead; otherwise, the A/D accuracy specification may not be met.

PIC18F8723 FAMILY

2.4 Operation in Power-Managed Modes

The selection of the automatic acquisition time and A/D conversion clock is determined in part by the clock source and frequency while in a power-managed mode.

If the A/D is expected to operate while the device is in a power-managed mode, the AD_{CS}2:AD_{CS}0 bits in AD_{CON}2 should be updated in accordance with the clock source to be used. The AC_{QT}2:AC_{QT}0 bits do not need to be adjusted as the AD_{CS}2:AD_{CS}0 bits adjust the T_{AD} time for the new clock speed. After entering the mode, an A/D acquisition or conversion may be started. Once started, the device should continue to be clocked by the same clock source until the conversion has been completed.

If desired, the device may be placed into the corresponding Idle mode during the conversion. If the device clock frequency is less than 1 MHz, the A/D RC clock source should be selected.

Operation in Sleep mode requires the A/D FRC clock to be selected. If the AC_{QT}2:AC_{QT}0 bits are set to '000' and a conversion is started, the conversion will be delayed one instruction cycle to allow execution of the SLEEP instruction and entry to Sleep mode. The IDLEN bit (OSCCON<7>) must have already been cleared prior to starting the conversion.

2.5 Configuring Analog Port Pins

The AD_{CON}1, TRISA, TRISF and TRISH registers all configure the A/D port pins. The port pins needed as analog inputs must have their corresponding TRIS bits set (input). If the TRIS bit is cleared (output), the digital output level (V_{OH} or V_{OL}) will be converted.

The A/D operation is independent of the state of the CHS3:CHS0 bits and the TRIS bits.

Note 1: When reading the PORT register, all pins configured as analog input channels will read as cleared (a low level). Analog conversion on pins configured as digital pins can be performed. The voltage on the pin will be accurately converted.

2: Analog levels on any pin defined as a digital input may cause the digital input buffer to consume current out of the device's specification limits.

2.6 A/D Conversions

Figure 2-4 shows the operation of the A/D Converter after the $\overline{\text{GO/DONE}}$ bit has been set and the ACQT2:ACQT0 bits are cleared. A conversion is started after the following instruction to allow entry into Sleep mode before the conversion begins.

Figure 2-5 shows the operation of the A/D Converter after the $\overline{\text{GO/DONE}}$ bit has been set, the ACQT2:ACQT0 bits are set to '010' and a 4 TAD acquisition time has been selected before the conversion starts.

Clearing the $\overline{\text{GO/DONE}}$ bit during a conversion will abort the current conversion. The A/D Result register pair will NOT be updated with the partially completed A/D conversion sample. This means the ADRESH:ADRESL registers will continue to contain the value of the last completed conversion (or the last value written to the ADRESH:ADRESL registers).

After the A/D conversion is completed or aborted, a 2 T_{CY} wait is required before the next acquisition can be started. After this wait, acquisition on the selected channel is automatically started.

Note: The $\overline{\text{GO/DONE}}$ bit should **NOT** be set in the same instruction that turns on the A/D. Code should wait at least 2 μs after enabling the A/D before beginning an acquisition and conversion cycle.

2.7 Discharge

The discharge phase is used to initialize the value of the holding capacitor. The array is discharged before every sample. This feature helps to optimize the unity gain amplifier, as the circuit always needs to charge the capacitor array, rather than charge/discharge based on previous measure values.

FIGURE 2-4: A/D CONVERSION TAD CYCLES (ACQT<2:0> = 000, TACQ = 0)

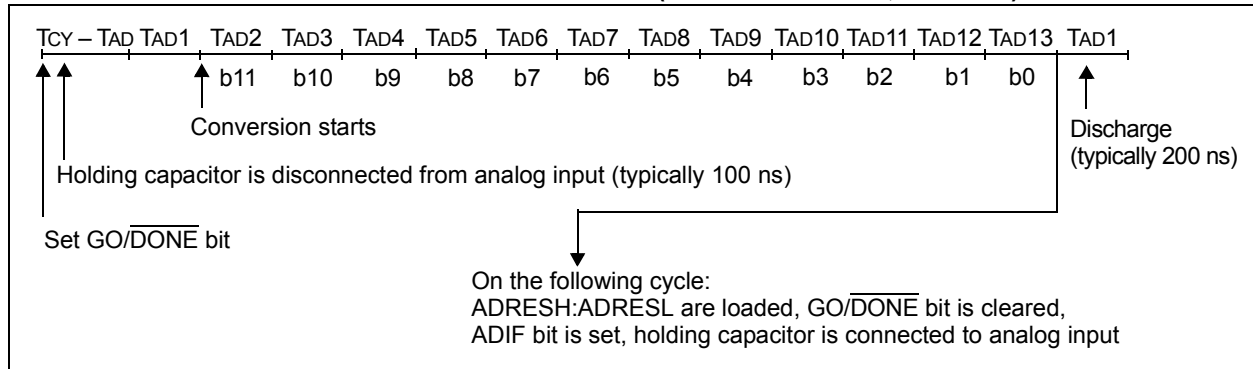
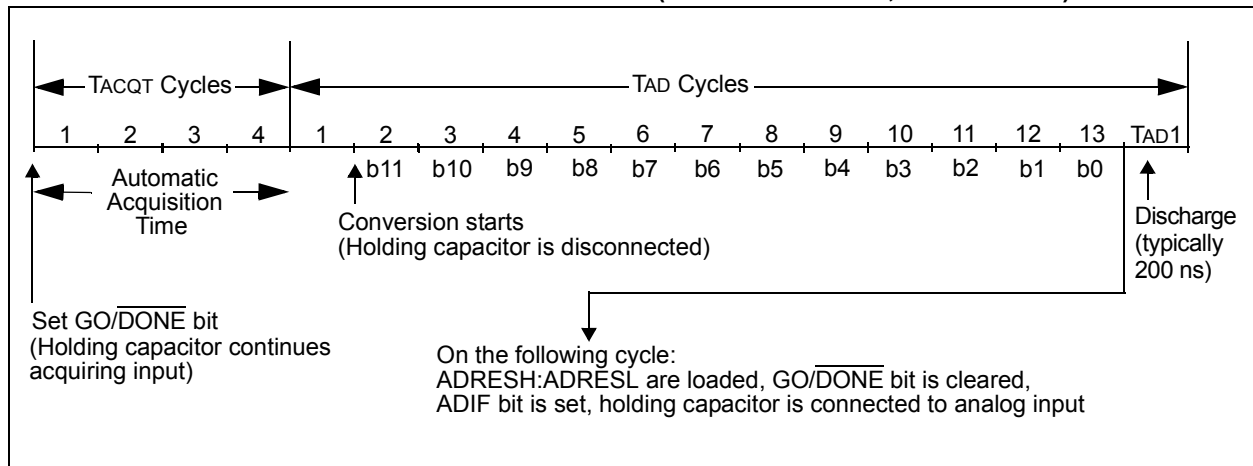


FIGURE 2-5: A/D CONVERSION TAD CYCLES (ACQT<2:0> = 010, TACQ = 4 TAD)



PIC18F8723 FAMILY

2.8 Use of the ECCP2 Trigger

An A/D conversion can be started by the Special Event Trigger of the ECCP2 module. This requires that the CCP2M3:CCP2M0 bits (CCP2CON<3:0>) be programmed as '1011' and that the A/D module is enabled (ADON bit is set). When the trigger occurs, the GO/DONE bit will be set, starting the A/D acquisition and conversion, and the Timer1 (or Timer3) counter will be reset to zero. Timer1 (or Timer3) is reset to automatically repeat the A/D acquisition period with minimal software overhead (moving ADRESH:ADRESL to the

desired location). The appropriate analog input channel must be selected and the minimum acquisition period is either timed by the user, or an appropriate TACQ time selected before the Special Event Trigger sets the GO/DONE bit (starts a conversion).

If the A/D module is not enabled (ADON is cleared), the Special Event Trigger will be ignored by the A/D module but will still reset the Timer1 (or Timer3) counter.

TABLE 2-2: REGISTERS ASSOCIATED WITH A/D OPERATION

| Name | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Reset Values |
|----------------------|-------------------------------|-----------------------|--------|--------|--------|--------|---------|--------|--------------|
| INTCON | GIE/GIEH | PEIE/GIEL | TMR0IE | INT0IE | RBIE | TMR0IF | INT0IF | RBIF | (3) |
| PIR1 | PSPIF | ADIF | RC1IF | TX1IF | SSP1IF | CCP1IF | TMR2IF | TMR1IF | (3) |
| PIE1 | PSPIE | ADIE | RC1IE | TX1IE | SSP1IE | CCP1IE | TMR2IE | TMR1IE | (3) |
| IPR1 | PSPIP | ADIP | RC1IP | TX1IP | SSP1IP | CCP1IP | TMR2IP | TMR1IP | (3) |
| PIR2 | OSCFIF | CMIF | — | EEIF | BCL1IF | HLVDIF | TMR3IF | CCP2IF | (3) |
| PIE2 | OSCFIE | CMIE | — | EEIE | BCL1IE | HLVDIE | TMR3IE | CCP2IE | (3) |
| IPR2 | OSCFIP | CMIP | — | EEIP | BCL1IP | HLVDIP | TMR3IP | CCP2IP | (3) |
| ADRESH | A/D Result Register High Byte | | | | | | | | (3) |
| ADRESL | A/D Result Register Low Byte | | | | | | | | (3) |
| ADCON0 | — | — | CHS3 | CHS2 | CHS1 | CHS0 | GO/DONE | ADON | (3) |
| ADCON1 | — | — | VCFG1 | VCFG0 | PCFG3 | PCFG2 | PCFG1 | PCFG0 | (3) |
| ADCON2 | ADFM | — | ACQT2 | ACQT1 | ACQT0 | ADCS2 | ADCS1 | ADCS0 | (3) |
| TRISA | TRISA7 ⁽¹⁾ | TRISA6 ⁽¹⁾ | TRISA5 | TRISA4 | TRISA3 | TRISA2 | TRISA1 | TRISA0 | (3) |
| TRISF | TRISF7 | TRISF6 | TRISF5 | TRISF4 | TRISF3 | TRISF2 | TRISF1 | TRISF0 | (3) |
| TRISH ⁽²⁾ | TRISH7 | TRISH6 | TRISH5 | TRISH4 | TRISH3 | TRISH2 | TRISH1 | TRISH0 | (3) |

Legend: — = unimplemented, read as '0'. Shaded cells are not used for A/D conversion.

Note 1: PORTA<7:6> and their direction bits are individually configured as port pins based on various primary oscillator modes. When disabled, these bits read as '0'.

2: These registers are not implemented on PIC18F6628/6723 devices.

3: For these Reset values, see the "PIC18F8722 Family Data Sheet" (DS39646).

3.0 SPECIAL FEATURES OF THE CPU

Note: For additional details on the Configuration bits, refer to **Section 25.1 “Configuration Bits”** in the *“PIC18F8722 Family Data Sheet”* (DS39646). Device ID information presented in this section is for the PIC18F8723 family only.

PIC18F8723 family devices include several features intended to maximize reliability and minimize cost through elimination of external components. These include:

- Device ID Registers

3.1 Device ID Registers

The Device ID registers are “read-only” registers. They identify the device type and revision to device programmers and can be read by firmware using table reads.

TABLE 3-1: DEVICE IDs

| File Name | | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Default/ Unprogrammed Value |
|-----------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-----------------------------------|
| 3FFFFEh | DEVID1 | DEV2 | DEV1 | DEV0 | REV4 | REV3 | REV2 | REV1 | REV0 | xxxx xxxx ⁽¹⁾ |
| 3FFFFFh | DEVID2 | DEV10 | DEV9 | DEV8 | DEV7 | DEV6 | DEV5 | DEV4 | DEV3 | xxxx xxxx ⁽¹⁾ |

Legend: x = unknown

Note 1: See Register 3-1 and Register 3-2 for DEVID values. DEVID registers are read-only and cannot be programmed by the user.

PIC18F8723 FAMILY

REGISTER 3-1: DEVID1: DEVICE ID REGISTER 1 FOR PIC18F8723 FAMILY DEVICES

| | | | | | | | |
|-------|------|------|------|------|------|------|-------|
| R | R | R | R | R | R | R | R |
| DEV2 | DEV1 | DEV0 | REV4 | REV3 | REV2 | REV1 | REV0 |
| bit 7 | | | | | | | bit 0 |

Legend:

R = Read-only bit P = Programmable bit U = Unimplemented bit, read as '0'
 -n = Value when device is unprogrammed u = Unchanged from programmed state

bit 7-5 **DEV2:DEV0:** Device ID bits
 See Register 3-2 for a complete listing.

bit 4-0 **REV4:REV0:** Revision ID bits
 These bits are used to indicate the device revision.

REGISTER 3-2: DEVID2: DEVICE ID REGISTER 2 FOR PIC18F8723 FAMILY DEVICES

| | | | | | | | |
|-------|------|------|------|------|------|------|-------|
| R | R | R | R | R | R | R | R |
| DEV10 | DEV9 | DEV8 | DEV7 | DEV6 | DEV5 | DEV4 | DEV3 |
| bit 7 | | | | | | | bit 0 |

Legend:

R = Read-only bit P = Programmable bit U = Unimplemented bit, read as '0'
 -n = Value when device is unprogrammed u = Unchanged from programmed state

bit 7-0 **DEV10:DEV3:** Device ID bits

| DEV10:DEV3 (DEVID2<7:0>) | DEV2:DEV0 (DEVID1<7:5>) | Device |
|-----------------------------|----------------------------|------------|
| 0100 1001 | 110 | PIC18F6628 |
| 0100 1010 | 000 | PIC18F6723 |
| 0100 1001 | 111 | PIC18F8628 |
| 0100 1010 | 001 | PIC18F8723 |

PIC18F8723 FAMILY

4.0 ELECTRICAL CHARACTERISTICS

Note: Other than some basic data, this section documents only the PIC18F8723 family's specifications that differ from those of the PIC18F8722 family devices. For detailed information on the electrical specifications shared by the PIC18F8723 family and PIC18F8722 family devices, see the "PIC18F8722 Family Data Sheet" (DS39646).

Absolute Maximum Ratings^(†)

| | |
|---|-----------------------------------|
| Ambient temperature under bias | -40°C to +125°C |
| Storage temperature | -65°C to +150°C |
| Voltage on any pin with respect to V _{SS} (except V _{DD} and $\overline{\text{MCLR}}$) | -0.3V to (V _{DD} + 0.3V) |
| Voltage on V _{DD} with respect to V _{SS} | -0.3V to +7.5V |
| Voltage on $\overline{\text{MCLR}}$ with respect to V _{SS} (Note 2) | 0V to +13.25V |
| Total power dissipation (Note 1) | 1.0W |
| Maximum current out of V _{SS} pin | 300 mA |
| Maximum current into V _{DD} pin | 250 mA |
| Input clamp current, I _{IK} (V _I < 0 or V _I > V _{DD}) | ±20 mA |
| Output clamp current, I _{OK} (V _O < 0 or V _O > V _{DD}) | ±20 mA |
| Maximum output current sunk by any I/O pin | 25 mA |
| Maximum output current sourced by any I/O pin | 25 mA |
| Maximum current sunk by all ports | 200 mA |
| Maximum current sourced by all ports | 200 mA |

Note 1: Power dissipation is calculated as follows:

$$P_{dis} = V_{DD} \times \{I_{DD} - \sum I_{OH}\} + \sum \{(V_{DD} - V_{OH}) \times I_{OH}\} + \sum (V_{OL} \times I_{OL})$$

2: Voltage spikes below V_{SS} at the RG5/ $\overline{\text{MCLR}}$ /V_{PP} pin, inducing currents greater than 80 mA, may cause latch-up. Thus, a series resistor of 50-100Ω should be used when applying a "low" level to the RG5/ $\overline{\text{MCLR}}$ /V_{PP} pin, rather than pulling this pin directly to V_{SS}.

† **NOTICE:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

PIC18F8723 FAMILY

FIGURE 4-1: PIC18F8723 FAMILY VOLTAGE-FREQUENCY GRAPH (INDUSTRIAL)

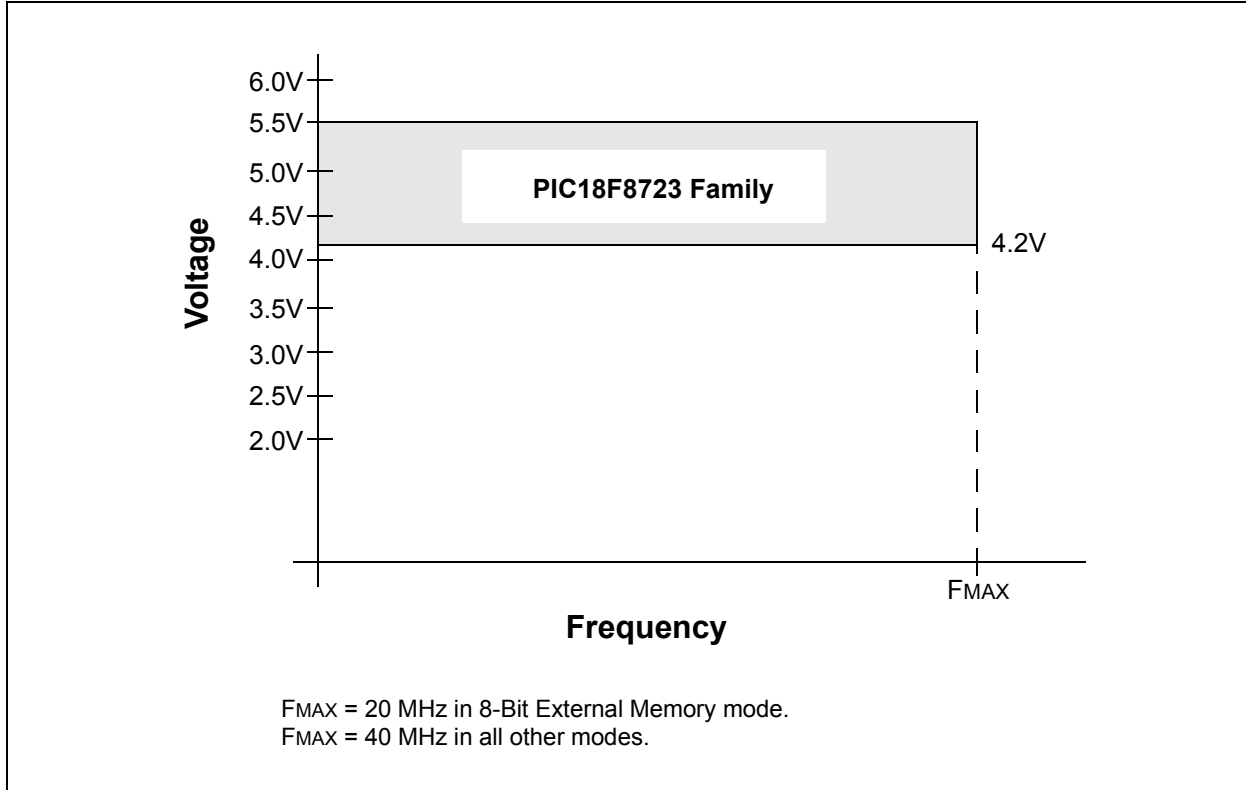
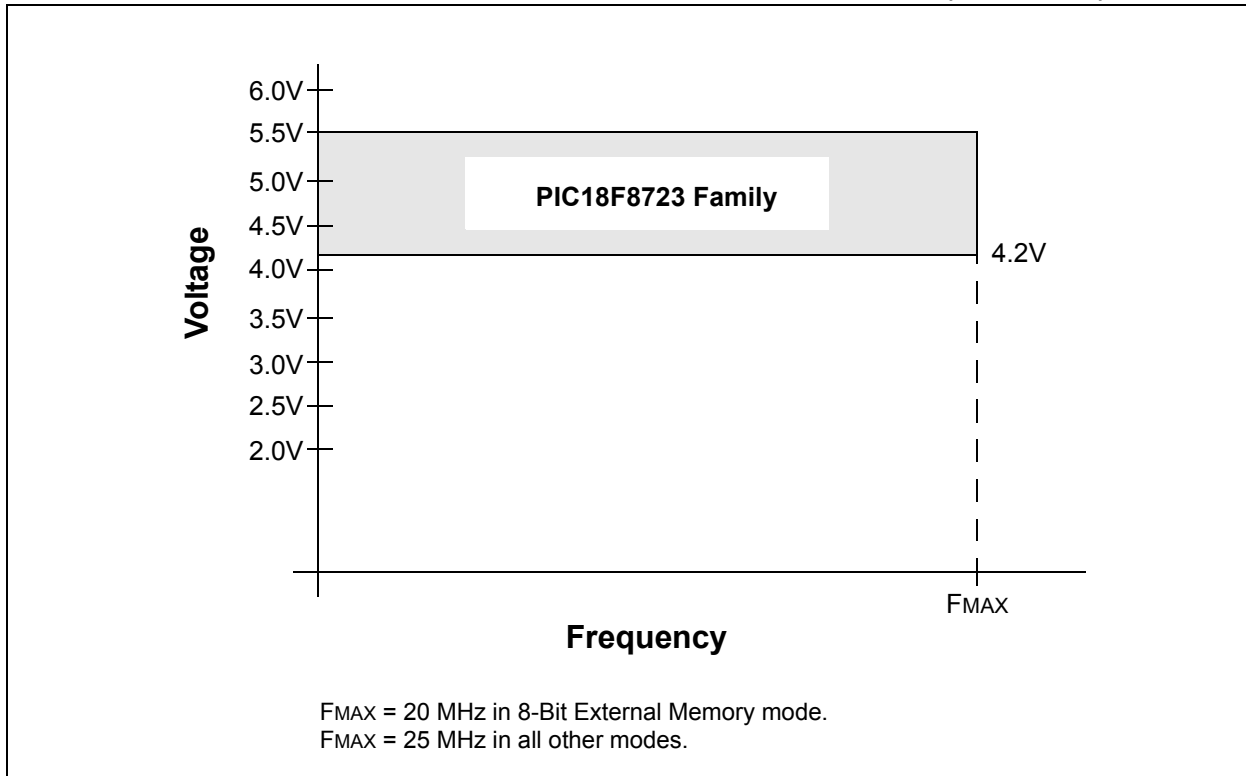
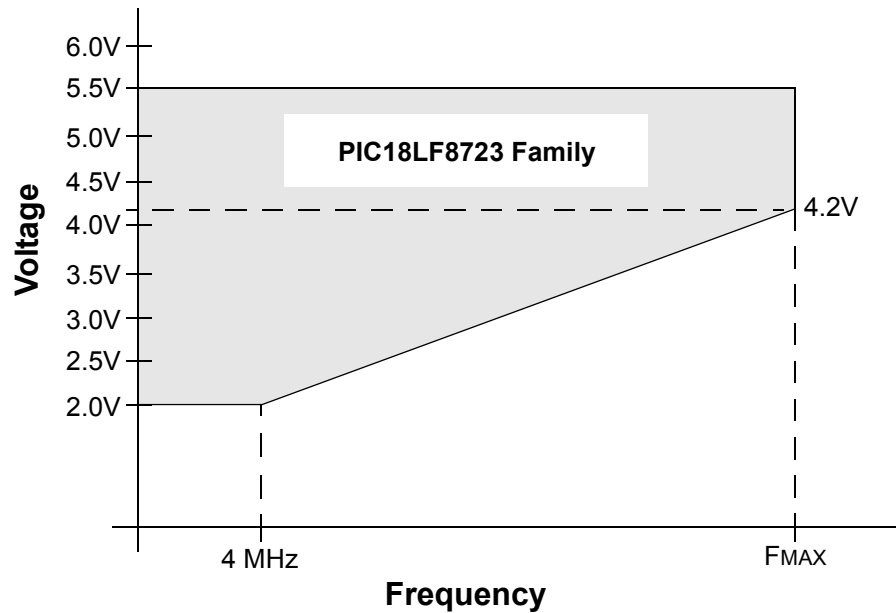


FIGURE 4-2: PIC18F8723 FAMILY VOLTAGE-FREQUENCY GRAPH (EXTENDED)



PIC18F8723 FAMILY

FIGURE 4-3: PIC18LF8723 FAMILY VOLTAGE-FREQUENCY GRAPH (INDUSTRIAL)



In 8-Bit External Memory mode:

$F_{MAX} = (9.55 \text{ MHz/V}) (V_{DDAPP_{MIN}} - 2.0\text{V}) + 4 \text{ MHz}$, if $V_{DDAPP_{MIN}} \leq 4.2\text{V}$;
 $F_{MAX} = 25 \text{ MHz}$, if $V_{DDAPP_{MIN}} > 4.2\text{V}$.

In all other modes:

$F_{MAX} = (16.36 \text{ MHz/V}) (V_{DDAPP_{MIN}} - 2.0\text{V}) + 4 \text{ MHz}$;
 $F_{MAX} = 40 \text{ MHz}$, if $V_{DDAPP_{MIN}} > 4.2\text{V}$.

Note: $V_{DDAPP_{MIN}}$ is the minimum voltage of the PIC[®] device in the application.

PIC18F8723 FAMILY

TABLE 4-1: A/D CONVERTER CHARACTERISTICS: PIC18F8723 FAMILY (INDUSTRIAL)

| Param No. | Sym | Characteristic | Min | Typ | Max | Units | Conditions | |
|-----------|------------------|---|---------------------------|----------|-------------------|------------|-----------------|---|
| A01 | NR | Resolution | — | — | 12 | bit | | $\Delta V_{REF} \geq 3.0V$ |
| A03 | EIL | Integral Linearity Error | — | $<\pm 1$ | ± 2.0 | LSB | $V_{DD} = 3.0V$ | $\Delta V_{REF} \geq 3.0V$ |
| | | | — | — | ± 2.0 | LSB | $V_{DD} = 5.0V$ | |
| A04 | EDL | Differential Linearity Error | — | $<\pm 1$ | +1.5/-1.0 | LSB | $V_{DD} = 3.0V$ | $\Delta V_{REF} \geq 3.0V$ |
| | | | — | — | +1.5/-1.0 | LSB | $V_{DD} = 5.0V$ | |
| A06 | EOFF | Offset Error | — | $<\pm 1$ | ± 5 | LSB | $V_{DD} = 3.0V$ | $\Delta V_{REF} \geq 3.0V$ |
| | | | — | — | ± 3 | LSB | $V_{DD} = 5.0V$ | |
| A07 | EGN | Gain Error | — | $<\pm 1$ | ± 1.25 | LSB | $V_{DD} = 3.0V$ | $\Delta V_{REF} \geq 3.0V$ |
| | | | — | — | ± 2.00 | LSB | $V_{DD} = 5.0V$ | |
| A10 | — | Monotonicity | Guaranteed ⁽¹⁾ | | | — | | $V_{SS} \leq V_{AIN} \leq V_{REF}$ |
| A20 | ΔV_{REF} | Reference Voltage Range ($V_{REFH} - V_{REFL}$) | 3 | — | $V_{DD} - V_{SS}$ | V | | For 12-bit resolution |
| A21 | V_{REFH} | Reference Voltage High | $V_{SS} + 3.0V$ | — | $V_{DD} + 0.3V$ | V | | For 12-bit resolution |
| A22 | V_{REFL} | Reference Voltage Low | $V_{SS} - 0.3V$ | — | $V_{DD} - 3.0V$ | V | | For 12-bit resolution |
| A25 | V_{AIN} | Analog Input Voltage | V_{REFL} | — | V_{REFH} | V | | |
| A30 | Z_{AIN} | Recommended Impedance of Analog Voltage Source | — | — | 2.5 | k Ω | | |
| A50 | I _{REF} | V_{REF} Input Current ⁽²⁾ | — | — | 5 | μA | | During V_{AIN} acquisition. During A/D conversion cycle. |
| | | | — | — | 150 | μA | | |

- Note 1:** The A/D conversion result never decreases with an increase in the input voltage and has no missing codes.
- Note 2:** V_{REFH} current is from the RA3/AN3/ V_{REF+} pin or V_{DD} , whichever is selected as the V_{REFH} source. V_{REFL} current is from the RA2/AN2/ V_{REF-}/CV_{REF} pin or V_{SS} , whichever is selected as the V_{REFL} source.

PIC18F8723 FAMILY

FIGURE 4-4: A/D CONVERSION TIMING

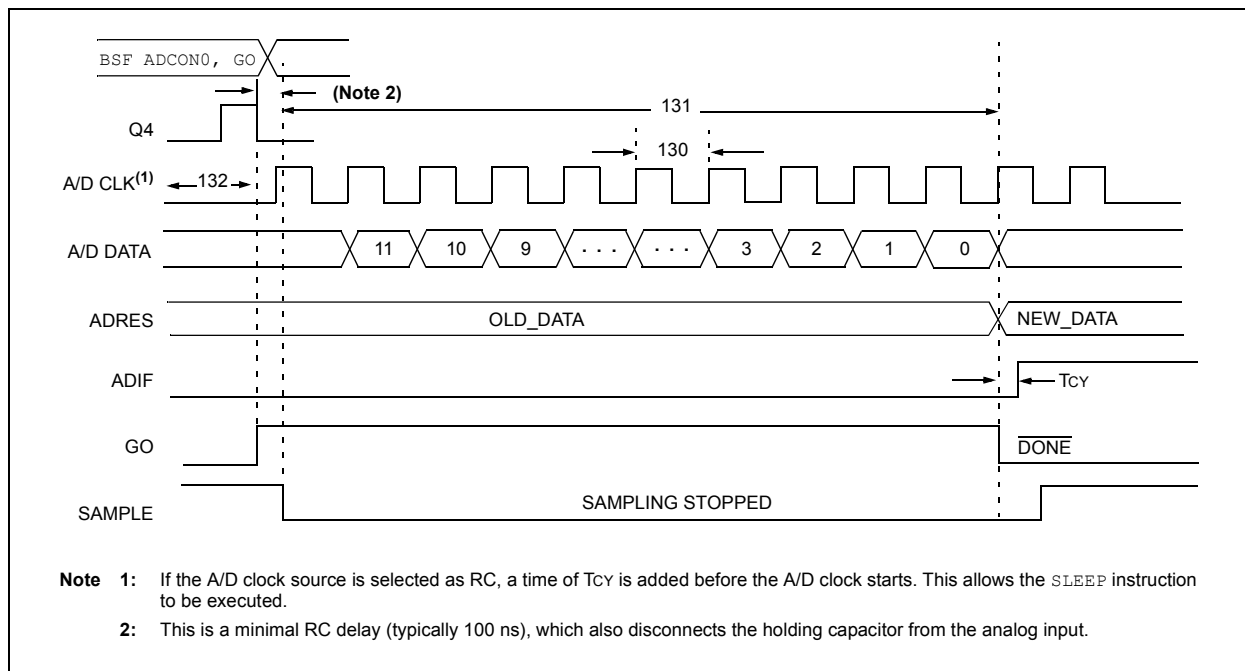


TABLE 4-2: A/D CONVERSION REQUIREMENTS

| Param No. | Symbol | Characteristic | Min | Max | Units | Conditions | |
|-----------|-------------------|---|-------------|----------|---------------------|-------------------------|--|
| 130 | TAD | A/D Clock Period | PIC18FXXXX | 0.8 | 12.5 ⁽¹⁾ | μs | TOSC based, VREF ≥ 3.0V |
| | | | PIC18LFXXXX | 1.4 | 25.0 ⁽¹⁾ | μs | VDD = 3.0V; TOSC based, VREF full range |
| | | PIC18FXXXX | — | 1 | μs | A/D RC mode | |
| | | PIC18LFXXXX | — | 3 | μs | VDD = 3.0V; A/D RC mode | |
| 131 | T _{CONV} | Conversion Time (not including acquisition time) ⁽²⁾ | 13 | 14 | TAD | | |
| 132 | T _{ACQ} | Acquisition Time ⁽³⁾ | 1.4 | — | μs | | |
| 135 | T _{SWC} | Switching Time from Convert → Sample | — | (Note 4) | | | |
| 137 | T _{DIS} | Discharge Time | 0.2 | — | μs | | |

Note 1: The time of the A/D clock period is dependent on the device frequency and the TAD clock divider.

Note 2: ADRES registers may be read on the following T_{CY} cycle.

Note 3: The time for the holding capacitor to acquire the “New” input voltage when the voltage changes full scale after the conversion (VDD to VSS or VSS to VDD). The source impedance (R_S) on the input channels is 50Ω.

Note 4: On the following cycle of the device clock.

PIC18F8723 FAMILY

NOTES:

5.0 PACKAGING INFORMATION

For packaging information, see the “*PIC18F8722 Family Data Sheet*” (DS39646).

PIC18F8723 FAMILY

NOTES:

PIC18F8723 FAMILY

APPENDIX A: REVISION HISTORY

Revision A (August 2007)

Original data sheet for the PIC18F8723 family of devices.

Revision B (October 2009)

Updated to remove Preliminary status.

APPENDIX B: DEVICE DIFFERENCES

The differences between the devices listed in this data sheet are shown in Table B-1.

TABLE B-1: PIC18F8723 FAMILY DEVICE DIFFERENCES

| Features | PIC18F6628 | PIC18F6723 | PIC18F8628 | PIC18F8723 |
|--------------------------------------|---------------------------|---------------------------|---------------------------------|---------------------------------|
| Program Memory (Bytes) | 96K | 128K | 96K | 128K |
| Program Memory (Instructions) | 49152 | 65536 | 49152 | 65536 |
| Interrupt Sources | 28 | 28 | 29 | 29 |
| I/O Ports | Ports A, B, C, D, E, F, G | Ports A, B, C, D, E, F, G | Ports A, B, C, D, E, F, G, H, J | Ports A, B, C, D, E, F, G, H, J |
| Capture/Compare/PWM Modules | 2 | 2 | 2 | 2 |
| Enhanced Capture/Compare/PWM Modules | 3 | 3 | 3 | 3 |
| Parallel Communications (PSP) | Yes | Yes | Yes | Yes |
| External Memory Bus | No | No | Yes | Yes |
| 12-Bit Analog-to-Digital Module | 12 Input Channels | 12 Input Channels | 16 Input Channels | 16 Input Channels |
| Packages | 64-Pin TQFP | 64-Pin TQFP | 80-Pin TQFP | 80-Pin TQFP |

PIC18F8723 FAMILY

APPENDIX C: CONVERSION CONSIDERATIONS

This appendix discusses the considerations for converting from previous versions of a device to the ones listed in this data sheet. Typically, these changes are due to the differences in the process technology used. An example of this type of conversion is from a PIC16C74A to a PIC16C74B.

Not Applicable

APPENDIX D: MIGRATION FROM BASELINE TO ENHANCED DEVICES

This section discusses how to migrate from a Baseline device (i.e., PIC16C5X) to an Enhanced MCU device (i.e., PIC18FXXX).

The following are the list of modifications over the PIC16C5X microcontroller family:

Not Currently Available

APPENDIX E: MIGRATION FROM MID-RANGE TO ENHANCED DEVICES

A detailed discussion of the differences between the mid-range MCU devices (i.e., PIC16CXXX) and the enhanced devices (i.e., PIC18FXXX) is provided in AN716, “*Migrating Designs from PIC16C74A/74B to PIC18C442*”. The changes discussed, while device specific, are generally applicable to all mid-range to enhanced device migrations.

This Application Note is available on our web site, www.microchip.com, as Literature Number DS00716.

APPENDIX F: MIGRATION FROM HIGH-END TO ENHANCED DEVICES

A detailed discussion of the migration pathway and differences between the high-end MCU devices (i.e., PIC17CXXX) and the enhanced devices (i.e., PIC18FXXX) is provided in AN726, “*PIC17CXXX to PIC18CXXX Migration*”.

This Application Note is available on our web site, www.microchip.com, as Literature Number DS00726.

PIC18F8723 FAMILY

NOTES:

INDEX

A

| | |
|--|--------|
| A/D | 31 |
| A/D Converter Interrupt, Configuring | 35 |
| Acquisition Requirements | 36 |
| ADCON0 Register | 31 |
| ADCON1 Register | 31 |
| ADCON2 Register | 31 |
| ADRESH Register | 31, 34 |
| ADRESL Register | 31 |
| Analog Port Pins, Configuring | 38 |
| Associated Registers | 40 |
| Configuring the Module | 35 |
| Conversion Clock (TAD) | 37 |
| Conversion Status (GO/DONE Bit) | 34 |
| Conversions | 39 |
| Converter Characteristics | 46 |
| Discharge | 39 |
| Operation in Power-Managed Modes | 38 |
| Selecting and Configuring Acquisition Time | 37 |
| Special Event Trigger (ECCP2) | 40 |
| Transfer Function | 35 |
| Use of the ECCP2 Trigger | 40 |
| Absolute Maximum Ratings | 43 |
| ADCON0 Register | 31 |
| GO/DONE Bit | 34 |
| ADCON1 Register | 31 |
| ADCON2 Register | 31 |
| ADRESH Register | 31 |
| ADRESL Register | 31, 34 |
| Analog-to-Digital Converter. <i>See</i> A/D. | |

B

| | |
|--------------------------|----|
| Block Diagrams | |
| A/D | 34 |
| Analog Input Model | 35 |
| PIC18F6628/6723 | 11 |
| PIC18F8628/8723 | 12 |

C

| | |
|--|----|
| Compare (ECCP2 Module) | |
| Special Event Trigger | 40 |
| Conversion Considerations | 52 |
| Customer Change Notification Service | 57 |
| Customer Notification Service | 57 |
| Customer Notification System | 7 |
| Customer Support | 57 |

D

| | |
|---------------------------|----|
| Device Differences | 51 |
| Device ID Registers | 41 |
| Device Overview | |
| Features (table) | 10 |
| Special Features | 9 |

E

| | |
|---|----|
| Electrical Characteristics | 43 |
| Equations | |
| A/D Acquisition Time | 36 |
| A/D Minimum Charging Time | 36 |
| Calculating the Minimum Required Acquisition Time | 36 |
| Errata | 7 |
| External Memory Interface | 3 |

F

| | |
|------------------------------|---|
| Features Summary Table | 3 |
|------------------------------|---|

I

| | |
|-------------------------------|----|
| Internet Address | 57 |
| Interrupt Sources | |
| A/D Conversion Complete | 35 |

M

| | |
|--|----|
| Microchip Internet Web Site | 57 |
| Migration From Baseline to Enhanced Devices | 52 |
| Migration From High-End to Enhanced Devices | 53 |
| Migration From Mid-Range to Enhanced Devices | 53 |
| More Information | 7 |
| Customer Notification System | 7 |
| Errata | 7 |

O

| | |
|--|---|
| Overview | |
| External Memory Interface | 3 |
| Features Summary Table | 3 |
| Peripheral Highlights | 3 |
| Power-Managed Modes | 3 |
| Special Microcontroller Features | 3 |

P

| | |
|-----------------------------|--------|
| Packaging Information | 49 |
| Peripheral Highlights | 3 |
| Pin Diagrams | |
| 64-Pin TQFP | 4 |
| 80-Pin TQFP | 5 |
| Pin Functions | |
| AVDD (64-pin) | 20 |
| AVDD (80-pin) | 30 |
| AVss (64-pin) | 20 |
| AVss (80-pin) | 30 |
| OSC1/CLKI/RA7 | 13, 21 |
| OSC2/CLKO/RA6 | 13, 21 |
| RA0/AN0 | 14, 22 |
| RA1/AN1 | 14, 22 |
| RA2/AN2/VREF- | 14, 22 |
| RA3/AN3/VREF+ | 14, 22 |
| RA4/T0CKI | 14, 22 |
| RA5/AN4/HLVDIN | 14, 22 |
| RB0/INT0/FLT0 | 15, 23 |
| RB1/INT1 | 15, 23 |
| RB2/INT2 | 15, 23 |
| RB3/INT3 | 15 |
| RB3/INT3/ECCP2/P2A | 23 |
| RB4/KBI0 | 15, 23 |
| RB5/KBI1/PGM | 15, 23 |
| RB6/KBI2/PGC | 15, 23 |
| RB7/KBI3/PGD | 15, 23 |
| RC0/T1OSO/T13CKI | 16, 24 |
| RC1/T1OSI/ECCP2/P2A | 16, 24 |
| RC2/ECCP1/P1A | 16, 24 |
| RC3/SCK1/SCL1 | 16, 24 |
| RC4/SDI1/SDA1 | 16, 24 |
| RC5/SDO1 | 16, 24 |
| RC6/TX1/CK1 | 16, 24 |
| RC7/RX1/DT1 | 16, 24 |
| RD0/AD0/PSP0 | 25 |
| RD0/PSP0 | 17 |

PIC18F8723 FAMILY

| | |
|-----------------------------|--------|
| RD1/AD1/PSP1..... | 25 |
| RD1/PSP1..... | 17 |
| RD2/AD2/PSP2..... | 25 |
| RD2/PSP2..... | 17 |
| RD3/AD3/PSP3..... | 25 |
| RD3/PSP3..... | 17 |
| RD4/AD4/PSP4/SDO2..... | 25 |
| RD4/PSP4/SDO2..... | 17 |
| RD5/AD5/PSP5/SDI2/SDA2..... | 25 |
| RD5/PSP5/SDI2/SDA2..... | 17 |
| RD6/AD6/PSP6/SCK2/SCL2..... | 25 |
| RD6/PSP6/SCK2/SCL2..... | 17 |
| RD7/AD7/PSP7/SS2..... | 25 |
| RD7/PSP7/SS2..... | 17 |
| RE0/AD8/RD/P2D..... | 26 |
| RE0/RD/P2D..... | 18 |
| RE1/AD9/WR/P2C..... | 26 |
| RE1/WR/P2C..... | 18 |
| RE2/AD10/CS/P2B..... | 26 |
| RE2/CS/P2D..... | 18 |
| RE3/AD11/P3C..... | 26 |
| RE3/P3C..... | 18 |
| RE4/AD12/P3B..... | 26 |
| RE4/P3B..... | 18 |
| RE5/AD13/P1C..... | 26 |
| RE5/P1C..... | 18 |
| RE6/AD14/P1B..... | 26 |
| RE6/P1B..... | 18 |
| RE7/AD15/ECCP2/P2A..... | 26 |
| RE7/ECCP2/P2A..... | 18 |
| RF0/AN5..... | 19, 27 |
| RF1/AN6/C2OUT..... | 19, 27 |
| RF2/AN7/C1OUT..... | 19, 27 |
| RF3/AN8..... | 19, 27 |
| RF4/AN9..... | 19, 27 |
| RF5/AN10/CVREF..... | 19, 27 |
| RF6/AN11..... | 19, 27 |
| RF7/SS1..... | 19, 27 |
| RG0/ECCP3/P3A..... | 20, 28 |
| RG1/TX2/CK2..... | 20, 28 |
| RG2/RX2/DT2..... | 20, 28 |
| RG3/CCP4/P3D..... | 20, 28 |
| RG4/CCP5/P1D..... | 20, 28 |
| RG5..... | 20, 28 |
| RG5/MCLR/VPP..... | 13, 21 |
| RH0/A16..... | 29 |
| RH1/A17..... | 29 |
| RH2/A18..... | 29 |
| RH3/A19..... | 29 |
| RH4/AN12/P3C..... | 29 |
| RH5/AN13/P3B..... | 29 |
| RH6/AN14/P1C..... | 29 |
| RH7/AN15/P1B..... | 29 |
| RJ0/ALE..... | 30 |
| RJ1/OE..... | 30 |
| RJ2/WRL..... | 30 |
| RJ3/WRH..... | 30 |
| RJ4/BA0..... | 30 |
| RJ5/CE..... | 30 |
| RJ6/LB..... | 30 |
| RJ7/UB..... | 30 |
| VDD..... | 20 |
| VDD..... | 30 |
| VSS..... | 20 |
| VSS..... | 30 |

| | |
|------------------------------------|----|
| Pinout I/O Descriptions | |
| PIC18F6628/6723..... | 13 |
| PIC18F8628/8723..... | 21 |
| Power-Managed Modes..... | 3 |
| and A/D Operation..... | 38 |
| Product Identification System..... | 59 |

R

| | |
|-----------------------------|----|
| Reader Response..... | 58 |
| Registers | |
| ADCON0 (A/D Control 0)..... | 31 |
| ADCON1 (A/D Control 1)..... | 32 |
| ADCON2 (A/D Control 2)..... | 33 |
| DEVID1 (Device ID 1)..... | 42 |
| DEVID2 (Device ID 2)..... | 42 |
| Revision History..... | 51 |

S

| | |
|---------------------------------------|----|
| Special Features of the CPU..... | 41 |
| Device ID Registers..... | 41 |
| Special Microcontroller Features..... | 3 |

T

| | |
|------------------------------------|----|
| Timing Diagrams | |
| A/D Conversion..... | 47 |
| Timing Diagrams and Specifications | |
| A/D Conversion Requirements..... | 47 |

V

| | |
|-------------------------------|----|
| Voltage-Frequency Graphs | |
| Extended (PIC18F8723)..... | 44 |
| Industrial (PIC18F8723)..... | 44 |
| Industrial (PIC18LF8723)..... | 45 |

W

| | |
|---------------------------|----|
| WWW Address..... | 57 |
| WWW, On-Line Support..... | 7 |

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PIC18F8723 FAMILY

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PIC18F8723 FAMILY

PIC18F8723 FAMILY PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

| <u>PART NO.</u> | <u>X</u> | <u>/XX</u> | <u>XXX</u> |
|---------------------------|--|------------|------------|
| Device | Temperature Range | Package | Pattern |
| Device ^{(1) (2)} | PIC18F6628/6723, PIC18F8628/8723, VDD range 4.2V to 5.5V PIC18LF6628/6723, PIC18LF8628/8723 ⁽¹⁾ , VDD range 2.0V to 5.5V | | |
| Temperature Range | I = -40°C to +85°C (Industrial) E = -40°C to +125°C (Extended) | | |
| Package | PT = TQFP (Thin Quad Flatpack) | | |
| Pattern | QTP, SQTP, Code or Special Requirements (blank otherwise) | | |

Examples:

- a) PIC18LF6723-I/PT 301 = Industrial temp., TQFP package, Extended VDD limits, QTP pattern #301.
- b) PIC18F6723-E/PT = Extended temp., TQFP package, standard VDD limits.

Note 1: F = Standard Voltage Range
LF = Wide Voltage Range

2: T = in tape and reel TQFP packages only.



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