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"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

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Details

Product Status	Active
Core Processor	PIC
Core Size	16-Bit
Speed	32MHz
Connectivity	I ² C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, LVD, POR, PWM, WDT
Number of I/O	53
Program Memory Size	64KB (22K x 24)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	16K x 8
Voltage - Supply (Vcc/Vdd)	2V ~ 3.6V
Data Converters	A/D 16x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	64-TQFP
Supplier Device Package	64-TQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic24fj64ga106-e-pt

PIC24FJ256GA110 FAMILY

1.2 Other Special Features

- **Peripheral Pin Select:** The Peripheral Pin Select (PPS) feature allows most digital peripherals to be mapped over a fixed set of digital I/O pins. Users may independently map the input and/or output of any one of the many digital peripherals to any one of the I/O pins.
- **Communications:** The PIC24FJ256GA110 family incorporates a range of serial communication peripherals to handle a range of application requirements. There are three independent I²C™ modules that support both Master and Slave modes of operation. Devices also have, through the Peripheral Pin Select (PPS) feature, four independent UARTs with built-in IrDA® encoder/decoders and three SPI modules.
- **Analog Features:** All members of the PIC24FJ256GA110 family include a 10-bit A/D Converter module and a triple comparator module. The A/D module incorporates program-mable acquisition time, allowing for a channel to be selected and a conversion to be initiated without waiting for a sampling period, as well as faster sampling speeds. The comparator module includes three analog comparators that are configurable for a wide range of operations.
- **CTMU Interface:** In addition to their other analog features, members of the PIC24FJ256GA110 family include the brand new CTMU interface module. This provides a convenient method for precision time measurement and pulse generation, and can serve as an interface for capacitive sensors.
- **Parallel Master Port:** One of the general purpose I/O ports can be reconfigured for enhanced parallel data communications. In this mode, the port can be configured for both master and slave operations, and supports 8-bit transfers with up to 16 external address lines in Master modes.
- **Real-Time Clock/Calendar:** This module implements a full-featured clock and calendar with alarm functions in hardware, freeing up the timer resources and program memory space for the use of the core application.

1.3 Details on Individual Family Members

Devices in the PIC24FJ256GA110 family are available in 64-pin, 80-pin and 100-pin packages. The general block diagram for all devices is shown in Figure 1-1.

The devices are differentiated from each other in four ways:

1. Flash program memory (64 Kbytes for PIC24FJ64GA1 devices, 128 Kbytes for PIC24FJ128GA1 devices, 192 Kbytes for PIC24FJ192GA1 devices and 256 Kbytes for PIC24FJ256GA1 devices).
2. Available I/O pins and ports (53 pins on 6 ports for 64-pin devices, 69 pins on 7 ports for 80-pin devices and 85 pins on 7 ports for 100-pin devices).
3. Available Interrupt-on-Change Notification (ICN) inputs (same as the number of available I/O pins for all devices).
4. Available remappable pins (31 pins on 64-pin devices, 42 pins on 80-pin devices and 46 pins on 100-pin devices)

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

A list of the pin features available on the PIC24FJ256GA110 family devices, sorted by function, is shown in Table 1-4. Note that this table shows the pin location of individual peripheral features and not how they are multiplexed on the same pin. This information is provided in the pinout diagrams in the beginning of this data sheet. Multiplexed features are sorted by the priority given to a feature, with the highest priority peripheral being listed first.

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TABLE 1-2: DEVICE FEATURES FOR THE PIC24FJ256GA110 FAMILY: 80-PIN DEVICES

Features	PIC24FJ64GA108	PIC24FJ128GA108	PIC24FJ192GA108	PIC24FJ256GA108
Operating Frequency	DC – 32 MHz			
Program Memory (bytes)	64K	128K	192K	256K
Program Memory (instructions)	22,016	44,032	67,072	87,552
Data Memory (bytes)	16,384			
Interrupt Sources (soft vectors/NMI traps)	66 (62/4)			
I/O Ports	Ports A, B, C, D, E, F, G			
Total I/O Pins	69			
Remappable Pins	42 (31 I/O, 11 input only)			
Timers:				
Total Number (16-bit)	5 ⁽¹⁾			
32-Bit (from paired 16-bit timers)	2			
Input Capture Channels	9 ⁽¹⁾			
Output Compare/PWM Channels	9 ⁽¹⁾			
Input Change Notification Interrupt	69			
Serial Communications:				
UART	4 ⁽¹⁾			
SPI (3-wire/4-wire)	3 ⁽¹⁾			
I ² C™	3			
Parallel Communications (PMP/PSP)	Yes			
JTAG Boundary Scan	Yes			
10-Bit Analog-to-Digital Module (input channels)	16			
Analog Comparators	3			
CTMU Interface	Yes			
Resets (and delays)	POR, BOR, RESET Instruction, MCLR, WDT; Illegal Opcode, REPEAT Instruction, Hardware Traps, Configuration Word Mismatch (PWRT, OST, PLL Lock)			
Instruction Set	76 Base Instructions, Multiple Addressing Mode Variations			
Packages	80-Pin TQFP			

Note 1: Peripherals are accessible through remappable pins.

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TABLE 1-3: DEVICE FEATURES FOR THE PIC24FJ256GA110 FAMILY: 100-PIN DEVICES

Features	PIC24FJ64GA110	PIC24FJ128GA110	PIC24FJ192GA110	PIC24FJ256GA110
Operating Frequency	DC – 32 MHz			
Program Memory (bytes)	64K	128K	192K	256K
Program Memory (instructions)	22,016	44,032	67,072	87,552
Data Memory (bytes)	16,384			
Interrupt Sources (soft vectors/NMI traps)	66 (62/4)			
I/O Ports	Ports A, B, C, D, E, F, G			
Total I/O Pins	85			
Remappable Pins	46 (32 I/O, 14 input only)			
Timers:				
Total Number (16-bit)	5 ⁽¹⁾			
32-Bit (from paired 16-bit timers)	2			
Input Capture Channels	9 ⁽¹⁾			
Output Compare/PWM Channels	9 ⁽¹⁾			
Input Change Notification Interrupt	85			
Serial Communications:				
UART	4 ⁽¹⁾			
SPI (3-wire/4-wire)	3 ⁽¹⁾			
I ² C™	3			
Parallel Communications (PMP/PSP)	Yes			
JTAG Boundary Scan	Yes			
10-Bit Analog-to-Digital Module (input channels)	16			
Analog Comparators	3			
CTMU Interface	Yes			
Resets (and delays)	POR, BOR, RESET Instruction, MCLR, WDT; Illegal Opcode, REPEAT Instruction, Hardware Traps, Configuration Word Mismatch (PWRT, OST, PLL Lock)			
Instruction Set	76 Base Instructions, Multiple Addressing Mode Variations			
Packages	100-Pin TQFP			

Note 1: Peripherals are accessible through remappable pins.

TABLE 4-6: TIMER REGISTER MAP

File Name	Addr	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	All Resets
TMR1	0100	Timer1 Register																0000
PR1	0102	Timer1 Period Register																FFFF
T1CON	0104	TON	—	TSIDL	—	—	—	—	—	—	TGATE	TCKPS1	TCKPS0	—	TSYNC	TCS	—	0000
TMR2	0106	Timer2 Register																0000
TMR3HLD	0108	Timer3 Holding Register (for 32-bit timer operations only)																0000
TMR3	010A	Timer3 Register																0000
PR2	010C	Timer2 Period Register																FFFF
PR3	010E	Timer3 Period Register																FFFF
T2CON	0110	TON	—	TSIDL	—	—	—	—	—	—	TGATE	TCKPS1	TCKPS0	T32	—	TCS	—	0000
T3CON	0112	TON	—	TSIDL	—	—	—	—	—	—	TGATE	TCKPS1	TCKPS0	—	—	TCS	—	0000
TMR4	0114	Timer4 Register																0000
TMR5HLD	0116	Timer5 Holding Register (for 32-bit operations only)																0000
TMR5	0118	Timer5 Register																0000
PR4	011A	Timer4 Period Register																FFFF
PR5	011C	Timer5 Period Register																FFFF
T4CON	011E	TON	—	TSIDL	—	—	—	—	—	—	TGATE	TCKPS1	TCKPS0	T32	—	TCS	—	0000
T5CON	0120	TON	—	TSIDL	—	—	—	—	—	—	TGATE	TCKPS1	TCKPS0	—	—	TCS	—	0000

Legend: — = unimplemented, read as '0'. Reset values are shown in hexadecimal.

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REGISTER 7-7: IFS2: INTERRUPT FLAG STATUS REGISTER 2

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	PMPIF	OC8IF	OC7IF	OC6IF	OC5IF	IC6IF
bit 15							bit 8

R/W-0	R/W-0	R/W-0	U-0	U-0	U-0	R/W-0	R/W-0
IC5IF	IC4IF	IC3IF	—	—	—	SPI2IF	SPF2IF
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 15-14 **Unimplemented:** Read as '0'
- bit 13 **PMPIF:** Parallel Master Port Interrupt Flag Status bit
 - 1 = Interrupt request has occurred
 - 0 = Interrupt request has not occurred
- bit 12 **OC8IF:** Output Compare Channel 8 Interrupt Flag Status bit
 - 1 = Interrupt request has occurred
 - 0 = Interrupt request has not occurred
- bit 11 **OC7IF:** Output Compare Channel 7 Interrupt Flag Status bit
 - 1 = Interrupt request has occurred
 - 0 = Interrupt request has not occurred
- bit 10 **OC6IF:** Output Compare Channel 6 Interrupt Flag Status bit
 - 1 = Interrupt request has occurred
 - 0 = Interrupt request has not occurred
- bit 9 **OC5IF:** Output Compare Channel 5 Interrupt Flag Status bit
 - 1 = Interrupt request has occurred
 - 0 = Interrupt request has not occurred
- bit 8 **IC6IF:** Input Capture Channel 6 Interrupt Flag Status bit
 - 1 = Interrupt request has occurred
 - 0 = Interrupt request has not occurred
- bit 7 **IC5IF:** Input Capture Channel 5 Interrupt Flag Status bit
 - 1 = Interrupt request has occurred
 - 0 = Interrupt request has not occurred
- bit 6 **IC4IF:** Input Capture Channel 4 Interrupt Flag Status bit
 - 1 = Interrupt request has occurred
 - 0 = Interrupt request has not occurred
- bit 5 **IC3IF:** Input Capture Channel 3 Interrupt Flag Status bit
 - 1 = Interrupt request has occurred
 - 0 = Interrupt request has not occurred
- bit 4-2 **Unimplemented:** Read as '0'
- bit 1 **SPI2IF:** SPI2 Event Interrupt Flag Status bit
 - 1 = Interrupt request has occurred
 - 0 = Interrupt request has not occurred
- bit 0 **SPF2IF:** SPI2 Fault Interrupt Flag Status bit
 - 1 = Interrupt request has occurred
 - 0 = Interrupt request has not occurred

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REGISTER 7-15: IEC4: INTERRUPT ENABLE CONTROL REGISTER 4

U-0	U-0	R/W-0	U-0	U-0	U-0	U-0	R/W-0
—	—	CTMUIE	—	—	—	—	LVDIE
bit 15							bit 8

U-0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	U-0
—	—	—	—	CRCIE	U2ERIE	U1ERIE	—
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 15-14 **Unimplemented:** Read as '0'
- bit 13 **CTMUIE:** CTMU Interrupt Enable bit
 - 1 = Interrupt request enabled
 - 0 = Interrupt request not enabled
- bit 12-9 **Unimplemented:** Read as '0'
- bit 8 **LVDIE:** Low-Voltage Detect Interrupt Enable bit
 - 1 = Interrupt request enabled
 - 0 = Interrupt request not enabled
- bit 7-4 **Unimplemented:** Read as '0'
- bit 3 **CRCIE:** CRC Generator Interrupt Enable bit
 - 1 = Interrupt request enabled
 - 0 = Interrupt request not enabled
- bit 2 **U2ERIE:** UART2 Error Interrupt Enable bit
 - 1 = Interrupt request enabled
 - 0 = Interrupt request not enabled
- bit 1 **U1ERIE:** UART1 Error Interrupt Enable bit
 - 1 = Interrupt request enabled
 - 0 = Interrupt request not enabled
- bit 0 **Unimplemented:** Read as '0'

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REGISTER 7-20: IPC3: INTERRUPT PRIORITY CONTROL REGISTER 3

U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
—	—	—	—	—	—	—	—
bit 15							bit 8

U-0	R/W-1	R/W-0	R/W-0	U-0	R/W-1	R/W-0	R/W-0
—	AD1IP2	AD1IP1	AD1IP0	—	U1TXIP2	U1TXIP1	U1TXIP0
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 15-7 **Unimplemented:** Read as '0'

bit 6-4 **AD1IP<2:0>:** A/D Conversion Complete Interrupt Priority bits

111 = Interrupt is priority 7 (highest priority interrupt)

•
•
•

001 = Interrupt is priority 1

000 = Interrupt source is disabled

bit 3 **Unimplemented:** Read as '0'

bit 2-0 **U1TXIP<2:0>:** UART1 Transmitter Interrupt Priority bits

111 = Interrupt is priority 7 (highest priority interrupt)

•
•
•

001 = Interrupt is priority 1

000 = Interrupt source is disabled

7.4 Interrupt Setup Procedures

7.4.1 INITIALIZATION

To configure an interrupt source:

1. Set the NSTDIS control bit (INTCON1<15>) if nested interrupts are not desired.
2. Select the user-assigned priority level for the interrupt source by writing the control bits in the appropriate IPCx register. The priority level will depend on the specific application and type of interrupt source. If multiple priority levels are not desired, the IPCx register control bits for all enabled interrupt sources may be programmed to the same non-zero value.

Note: At a device Reset, the IPCx registers are initialized, such that all user interrupt sources are assigned to priority level 4.

3. Clear the interrupt status flag bit associated with the peripheral in the associated IFSx register.
4. Enable the interrupt source by setting the interrupt enable control bit associated with the source in the appropriate IECx register.

7.4.2 INTERRUPT SERVICE ROUTINE

The method that is used to declare an ISR and initialize the IVT with the correct vector address will depend on the programming language (i.e., 'C' or assembler) and the language development toolsuite that is used to develop the application. In general, the user must clear the interrupt flag in the appropriate IFSx register for the source of the interrupt that the ISR handles. Otherwise, the ISR will be re-entered immediately after exiting the routine. If the ISR is coded in assembly language, it must be terminated using a RETFIE instruction to unstack the saved PC value, SRL value and old CPU priority level.

7.4.3 TRAP SERVICE ROUTINE

A Trap Service Routine (TSR) is coded like an ISR, except that the appropriate trap status flag in the INTCON1 register must be cleared to avoid re-entry into the TSR.

7.4.4 INTERRUPT DISABLE

All user interrupts can be disabled using the following procedure:

1. Push the current SR value onto the software stack using the PUSH instruction.
2. Force the CPU to priority level 7 by inclusive ORing the value E0h with SRL.

To enable user interrupts, the POP instruction may be used to restore the previous SR value.

Note that only user interrupts with a priority level of 7 or less can be disabled. Trap sources (level 8-15) cannot be disabled.

The DISI instruction provides a convenient way to disable interrupts of priority levels 1-6 for a fixed period of time. Level 7 interrupt sources are not disabled by the DISI instruction.

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10.4.3.4 Mapping Limitations

The control schema of the Peripheral Pin Select is extremely flexible. Other than systematic blocks that prevent signal contention caused by two physical pins being configured as the same functional input or two functional outputs configured as the same pin, there are no hardware enforced lock outs. The flexibility extends to the point of allowing a single input to drive multiple peripherals or a single functional output to drive multiple output pins.

10.4.3.5 Mapping Exceptions for PIC24FJ256GA110 Family Devices

Although the PPS registers theoretically allow for up to 64 remappable I/O pins, not all of these are implemented in all devices. For PIC24FJ256GA110 family devices, the maximum number of remappable pins available are 46, which includes 14 input only pins. In addition, some pins in the RPN and RPI sequences are unimplemented in lower pin count devices. The differences in available remappable pins are summarized in Table 10-4.

When developing applications that use remappable pins, users should also keep these things in mind:

- For the RPNRx registers, bit combinations corresponding to an unimplemented pin for a particular device are treated as invalid; the corresponding module will not have an input mapped to it. For all PIC24FJ256GA110 family devices, this includes all values greater than 45 ('101101').
- For RPORx registers, the bit fields corresponding to an unimplemented pin will also be unimplemented. Writing to these fields will have no effect.

10.4.4 CONTROLLING CONFIGURATION CHANGES

Because peripheral remapping can be changed during run time, some restrictions on peripheral remapping are needed to prevent accidental configuration changes. PIC24F devices include three features to prevent alterations to the peripheral map:

- Control register lock sequence
- Continuous state monitoring
- Configuration bit remapping lock

10.4.4.1 Control Register Lock

Under normal operation, writes to the RPNRx and RPORx registers are not allowed. Attempted writes will appear to execute normally, but the contents of the registers will remain unchanged. To change these registers, they must be unlocked in hardware. The register lock is controlled by the IOLOCK bit (OSCCON<6>). Setting IOLOCK prevents writes to the control registers; clearing IOLOCK allows writes.

To set or clear IOLOCK, a specific command sequence must be executed:

1. Write 46h to OSCCON<7:0>.
2. Write 57h to OSCCON<7:0>.
3. Clear (or set) IOLOCK as a single operation.

Unlike the similar sequence with the oscillator's LOCK bit, IOLOCK remains in one state until changed. This allows all of the Peripheral Pin Selects to be configured with a single unlock sequence, followed by an update to all control registers, then locked with a second lock sequence.

10.4.4.2 Continuous State Monitoring

In addition to being protected from direct writes, the contents of the RPNRx and RPORx registers are constantly monitored in hardware by shadow registers. If an unexpected change in any of the registers occurs (such as cell disturbances caused by ESD or other external events), a Configuration Mismatch Reset will be triggered.

10.4.4.3 Configuration Bit Pin Select Lock

As an additional level of safety, the device can be configured to prevent more than one write session to the RPNRx and RPORx registers. The IOL1WAY (CW2<4>) Configuration bit blocks the IOLOCK bit from being cleared after it has been set once. If IOLOCK remains set, the register unlock procedure will not execute and the Peripheral Pin Select Control registers cannot be written to. The only way to clear the bit and re-enable peripheral remapping is to perform a device Reset.

In the default (unprogrammed) state, IOL1WAY is set, restricting users to one write session. Programming IOL1WAY allows users unlimited access (with the proper use of the unlock sequence) to the Peripheral Pin Select registers.

TABLE 10-4: REMAPPABLE PIN EXCEPTIONS FOR PIC24FJ256GA110 FAMILY DEVICES

Device Pin Count	RP Pins (I/O)		RPI Pins	
	Total	Unimplemented	Total	Unimplemented
64-pin	29	RP5, RP15, RP31	2	RPI32-36, RPI38-44
80-pin	31	RP31	11	RPI32, RPI39, RPI41
100-pin	32	—	14	—

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REGISTER 10-5: RPINR4: PERIPHERAL PIN SELECT INPUT REGISTER 4

U-0	U-0	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
—	—	T5CKR5	T5CKR4	T5CKR3	T5CKR2	T5CKR1	T5CKR0
bit 15							bit 8

U-0	U-0	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
—	—	T4CKR5	T4CKR4	T4CKR3	T4CKR2	T4CKR1	T4CKR0
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 15-14 **Unimplemented:** Read as '0'
bit 13-8 **T5CKR<5:0>:** Assign Timer5 External Clock (T5CK) to Corresponding RPn or RPIn Pin bits
bit 7-6 **Unimplemented:** Read as '0'
bit 5-0 **T4CKR<5:0>:** Assign Timer4 External Clock (T4CK) to Corresponding RPn or RPIn Pin bits

REGISTER 10-6: RPINR7: PERIPHERAL PIN SELECT INPUT REGISTER 7

U-0	U-0	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
—	—	IC2R5	IC2R4	IC2R3	IC2R2	IC2R1	IC2R0
bit 15							bit 8

U-0	U-0	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
—	—	IC1R5	IC1R4	IC1R3	IC1R2	IC1R1	IC1R0
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 15-14 **Unimplemented:** Read as '0'
bit 13-8 **IC2R<5:0>:** Assign Input Capture 2 (IC2) to Corresponding RPn or RPIn Pin bits
bit 7-6 **Unimplemented:** Read as '0'
bit 5-0 **IC1R<5:0>:** Assign Input Capture 1 (IC1) to Corresponding RPn or RPIn Pin bits

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REGISTER 10-22: RPOR0: PERIPHERAL PIN SELECT OUTPUT REGISTER 0

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP1R5	RP1R4	RP1R3	RP1R2	RP1R1	RP1R0
bit 15						bit 8	

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP0R5	RP0R4	RP0R3	RP0R2	RP0R1	RP0R0
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 15-14 **Unimplemented:** Read as '0'

bit 13-8 **RP1R<5:0>:** RP1 Output Pin Mapping bits

Peripheral output number n is assigned to pin, RP1 (see Table 10-3 for peripheral function numbers).

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

bit 5-0 **RP0R<5:0>:** RP0 Output Pin Mapping bits

Peripheral output number n is assigned to pin, RP0 (see Table 10-3 for peripheral function numbers).

REGISTER 10-23: RPOR1: PERIPHERAL PIN SELECT OUTPUT REGISTER 1

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP3R5	RP3R4	RP3R3	RP3R2	RP3R1	RP3R0
bit 15						bit 8	

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP2R5	RP2R4	RP2R3	RP2R2	RP2R1	RP2R0
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 15-14 **Unimplemented:** Read as '0'

bit 13-8 **RP3R<5:0>:** RP3 Output Pin Mapping bits

Peripheral output number n is assigned to pin, RP3 (see Table 10-3 for peripheral function numbers).

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

bit 5-0 **RP2R<5:0>:** RP2 Output Pin Mapping bits

Peripheral output number n is assigned to pin, RP2 (see Table 10-3 for peripheral function numbers).

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REGISTER 10-24: RPOR2: PERIPHERAL PIN SELECT OUTPUT REGISTER 2

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP5R5 ⁽¹⁾	RP5R4 ⁽¹⁾	RP5R3 ⁽¹⁾	RP5R2 ⁽¹⁾	RP5R1 ⁽¹⁾	RP5R0 ⁽¹⁾
bit 15				bit 8			

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP4R5	RP4R4	RP4R3	RP4R2	RP4R1	RP4R0
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 15-14 **Unimplemented:** Read as '0'

bit 13-8 **RP5R<5:0>:** RP5 Output Pin Mapping bits⁽¹⁾

Peripheral output number n is assigned to pin, RP5 (see Table 10-3 for peripheral function numbers).

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

bit 5-0 **RP4R<5:0>:** RP4 Output Pin Mapping bits

Peripheral output number n is assigned to pin, RP4 (see Table 10-3 for peripheral function numbers).

Note 1: Unimplemented in 64-pin devices; read as '0'.

REGISTER 10-25: RPOR3: PERIPHERAL PIN SELECT OUTPUT REGISTER 3

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP7R5	RP7R4	RP7R3	RP7R2	RP7R1	RP7R0
bit 15				bit 8			

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP6R5	RP6R4	RP6R3	RP6R2	RP6R1	RP6R0
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 15-14 **Unimplemented:** Read as '0'

bit 13-8 **RP7R<5:0>:** RP7 Output Pin Mapping bits

Peripheral output number n is assigned to pin, RP7 (see Table 10-3 for peripheral function numbers).

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

bit 5-0 **RP6R<5:0>:** RP6 Output Pin Mapping bits

Peripheral output number n is assigned to pin, RP6 (see Table 10-3 for peripheral function numbers).

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REGISTER 10-26: RPOR4: PERIPHERAL PIN SELECT OUTPUT REGISTER 4

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP9R5	RP9R4	RP9R3	RP9R2	RP9R1	RP9R0
bit 15							bit 8

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP8R5	RP8R4	RP8R3	RP8R2	RP8R1	RP8R0
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 15-14 **Unimplemented:** Read as '0'
 bit 13-8 **RP9R<5:0>:** RP9 Output Pin Mapping bits
 Peripheral output number n is assigned to pin, RP9 (see Table 10-3 for peripheral function numbers).
 bit 7-6 **Unimplemented:** Read as '0'
 bit 5-0 **RP8R<5:0>:** RP8 Output Pin Mapping bits
 Peripheral output number n is assigned to pin, RP8 (see Table 10-3 for peripheral function numbers).

REGISTER 10-27: RPOR5: PERIPHERAL PIN SELECT OUTPUT REGISTER 5

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP11R5	RP11R4	RP11R3	RP11R2	RP11R1	RP11R0
bit 15							bit 8

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP10R5	RP10R4	RP10R3	RP10R2	RP10R1	RP10R0
bit 7							bit 0

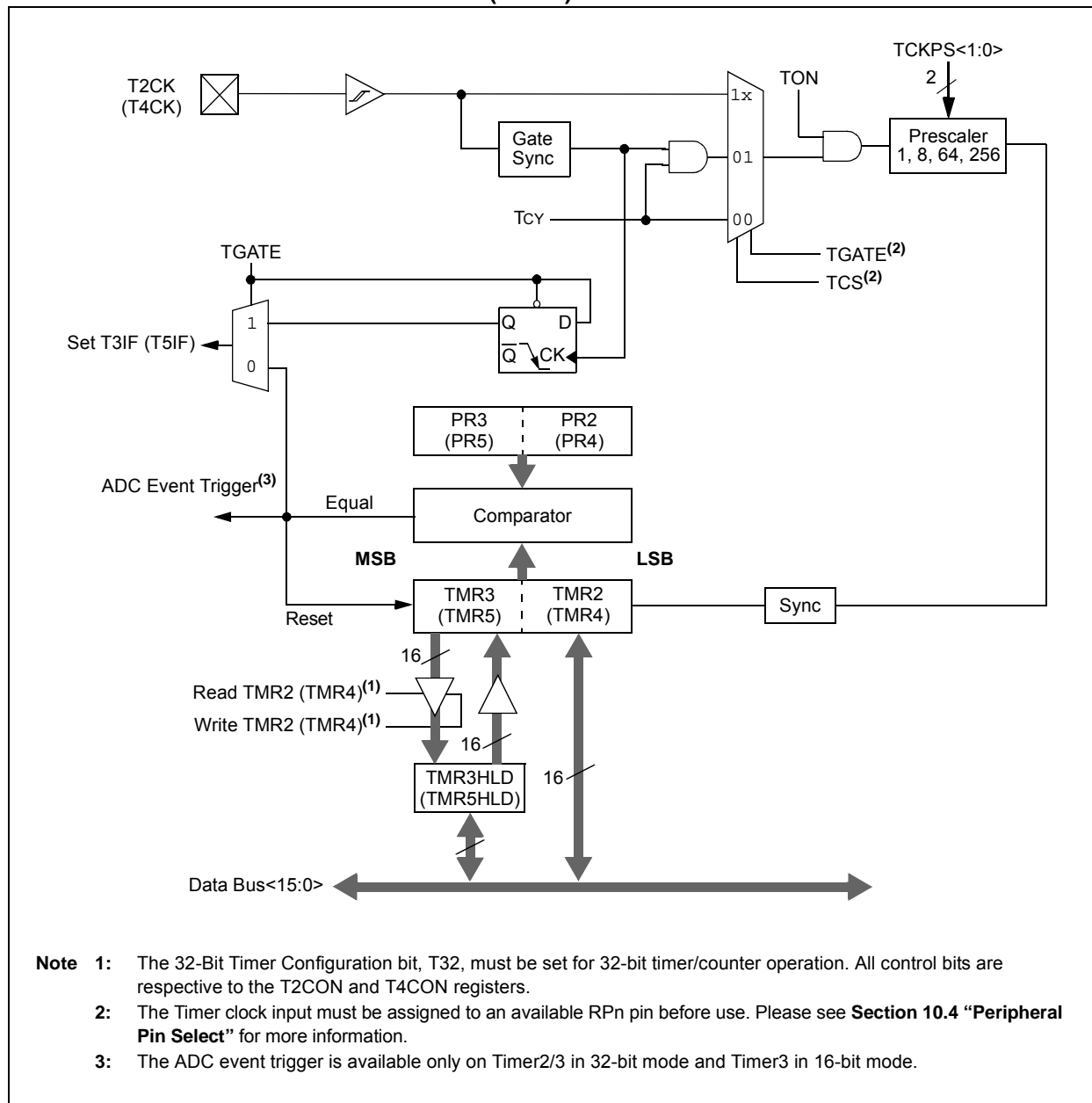
Legend:

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 15-14 **Unimplemented:** Read as '0'
 bit 13-8 **RP11R<5:0>:** RP11 Output Pin Mapping bits
 Peripheral output number n is assigned to pin, RP11 (see Table 10-3 for peripheral function numbers).
 bit 7-6 **Unimplemented:** Read as '0'
 bit 5-0 **RP10R<5:0>:** RP10 Output Pin Mapping bits
 Peripheral output number n is assigned to pin, RP10 (see Table 10-3 for peripheral function numbers).

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FIGURE 12-1: TIMER2/3 AND TIMER4/5 (32-BIT) BLOCK DIAGRAM



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REGISTER 17-2: UxSTA: UARTx STATUS AND CONTROL REGISTER

R/W-0	R/W-0	R/W-0	U-0	R/W-0 HC	R/W-0	R-0	R-1
UTXISEL1	UTXINV ⁽¹⁾	UTXISEL0	—	UTXBRK	UTXEN ⁽²⁾	UTXBF	TRMT
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R-1	R-0	R-0	R/C-0	R-0
URXISEL1	URXISEL0	ADDEN	RIDLE	PERR	FERR	OERR	URXDA
bit 7							bit 0

Legend:	C = Clearable bit	HC = Hardware Clearable bit
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 15,13 **UTXISEL<1:0>:** Transmission Interrupt Mode Selection bits
 11 = Reserved; do not use
 10 = Interrupt when a character is transferred to the Transmit Shift Register (TSR), and as a result, the transmit buffer becomes empty
 01 = Interrupt when the last character is shifted out of the Transmit Shift Register; all transmit operations are completed
 00 = Interrupt when a character is transferred to the Transmit Shift Register (this implies there is at least one character open in the transmit buffer)
- bit 14 **UTXINV:** IrDA[®] Encoder Transmit Polarity Inversion bit⁽¹⁾
IREN = 0:
 1 = UxTX Idle '0'
 0 = UxTX Idle '1'
IREN = 1:
 1 = UxTX Idle '1'
 0 = UxTX Idle '0'
- bit 12 **Unimplemented:** Read as '0'
- bit 11 **UTXBRK:** Transmit Break bit
 1 = Send Sync Break on next transmission – Start bit, followed by twelve '0' bits, followed by Stop bit; cleared by hardware upon completion
 0 = Sync Break transmission disabled or completed
- bit 10 **UTXEN:** Transmit Enable bit⁽²⁾
 1 = Transmit enabled; UxTX pin controlled by UARTx
 0 = Transmit disabled; any pending transmission is aborted and the buffer is reset, UxTX pin controlled by port
- bit 9 **UTXBF:** Transmit Buffer Full Status bit (read-only)
 1 = Transmit buffer is full
 0 = Transmit buffer is not full; at least one more character can be written
- bit 8 **TRMT:** Transmit Shift Register Empty bit (read-only)
 1 = Transmit Shift Register is empty and transmit buffer is empty (the last transmission has completed)
 0 = Transmit Shift Register is not empty, a transmission is in progress or queued
- bit 7-6 **URXISEL<1:0>:** Receive Interrupt Mode Selection bits
 11 = Interrupt is set on RSR transfer, making the receive buffer full (i.e., has 4 data characters)
 10 = Interrupt is set on RSR transfer, making the receive buffer 3/4 full (i.e., has 3 data characters)
 0x = Interrupt is set when any character is received and transferred from the RSR to the receive buffer. Receive buffer has one or more characters.

- Note 1:** Value of bit only affects the transmit properties of the module when the IrDA[®] encoder is enabled (IREN = 1).
Note 2: If UARTEN = 1, the peripheral inputs and outputs must be configured to an available RPN pin. See **Section 10.4 “Peripheral Pin Select”** for more information.

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REGISTER 18-1: PMCON: PARALLEL MASTER PORT CONTROL REGISTER (CONTINUED)

- bit 2 **BEP:** Byte Enable Polarity bit
1 = Byte enable active-high (PMBE)
0 = Byte enable active-low (PMBE)
- bit 1 **WRSP:** Write Strobe Polarity bit
For Slave Modes and Master Mode 2 (PMMODE<9:8> = 00, 01, 10):
1 = Write strobe active-high (PMWR)
0 = Write strobe active-low (PMWR)
For Master Mode 1 (PMMODE<9:8> = 11):
1 = Enable strobe active-high (PMENB)
0 = Enable strobe active-low (PMENB)
- bit 0 **RDSP:** Read Strobe Polarity bit
For Slave Modes and Master Mode 2 (PMMODE<9:8> = 00, 01, 10):
1 = Read strobe active-high (PMRD)
0 = Read strobe active-low (PMRD)
For Master Mode 1 (PMMODE<9:8> = 11):
1 = Read/write strobe active-high (PMRD/PMWR)
0 = Read/write strobe active-low (PMRD/PMWR)

Note 1: These bits have no effect when their corresponding pins are used as address lines.

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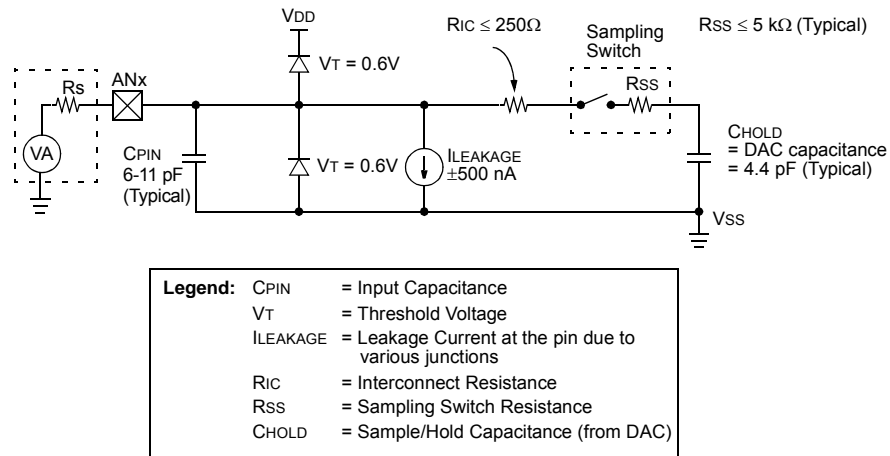
EQUATION 21-1: A/D CONVERSION CLOCK PERIOD⁽¹⁾

$$T_{AD} = T_{CY} \cdot (ADCS + 1)$$

$$ADCS = \frac{T_{AD}}{T_{CY}} - 1$$

Note 1: Based on $T_{CY} = 2 \cdot T_{OSC}$, Doze mode and PLL are disabled.

FIGURE 21-2: 10-BIT A/D CONVERTER ANALOG INPUT MODEL



Note: CPIN value depends on device package and is not tested. The effect of CPIN is negligible if $R_s \leq 5 \text{ k}\Omega$.

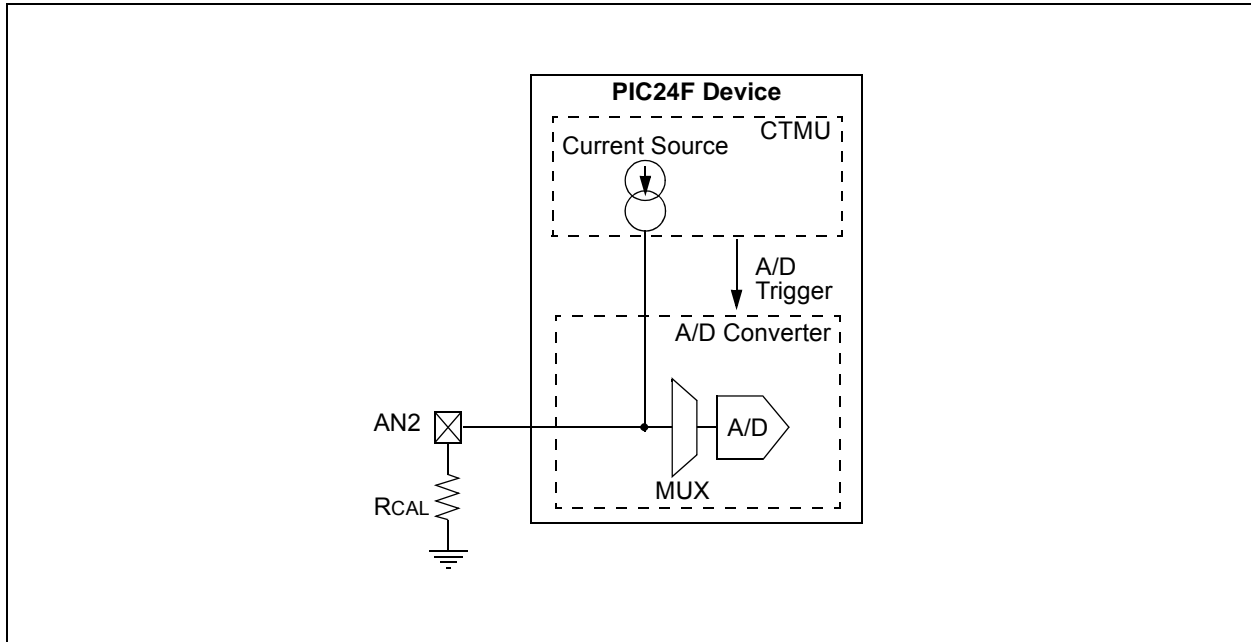
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TABLE 28-6: DC CHARACTERISTICS: POWER-DOWN CURRENT (IPD)

DC CHARACTERISTICS			Standard Operating Conditions: 2.0V to 3.6V (unless otherwise stated)	
			Operating temperature	-40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended
Parameter No.	Typical ⁽¹⁾	Max	Units	Conditions
Power-Down Current (IPD): PMD Bits are Set, PMSLP Bit is '0'⁽²⁾				
DC60	0.1	1.0	μA	-40°C
DC60a	0.15	1.0	μA	+25°C
DC60m	2.25	11	μA	+60°C
DC60b	3.7	18.0	μA	+85°C
DC60j	18.0	85.0	μA	+125°C
DC60c	0.2	1.4	μA	-40°C
DC60d	0.25	1.4	μA	+25°C
DC60n	2.6	16.5	μA	+60°C
DC60e	4.2	27	μA	+85°C
DC60k	20.0	110	μA	+125°C
DC60f	3.6	10.0	μA	-40°C
DC60g	4.0	10	μA	+25°C
DC60p	8.1	25.2	μA	+60°C
DC60h	11.0	36	μA	+85°C
DC60l	36.0	120	μA	+125°C
DC61	1.75	3	μA	-40°C
DC61a	1.75	3	μA	+25°C
DC61m	1.75	3	μA	+60°C
DC61b	1.75	3	μA	+85°C
DC61j	3.5	6	μA	+125°C
DC61c	2.4	4	μA	-40°C
DC61d	2.4	4	μA	+25°C
DC61n	2.4	4	μA	+60°C
DC61e	2.4	4	μA	+85°C
DC61k	4.8	8	μA	+125°C
DC61f	2.8	5	μA	-40°C
DC61g	2.8	5	μA	+25°C
DC61p	2.8	5	μA	+60°C
DC61h	2.8	5	μA	+85°C
DC61l	5.6	10	μA	+125°C

- Note 1:** Data in the Typical column is at 3.3V, 25°C unless otherwise stated. Parameters are for design guidance only and are not tested.
- 2:** Base IPD is measured with all peripherals and clocks shut down. All I/Os are configured as inputs and pulled high. WDT, etc., are all switched off.
- 3:** On-chip voltage regulator disabled (ENVREG tied to VSS).
- 4:** On-chip voltage regulator enabled (ENVREG tied to VDD).
- 5:** The Δ current is the additional current consumed when the module is enabled. This current should be added to the base IPD current.

FIGURE 28-3: CTMU CURRENT SOURCE CALIBRATION CIRCUIT



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NOTES: