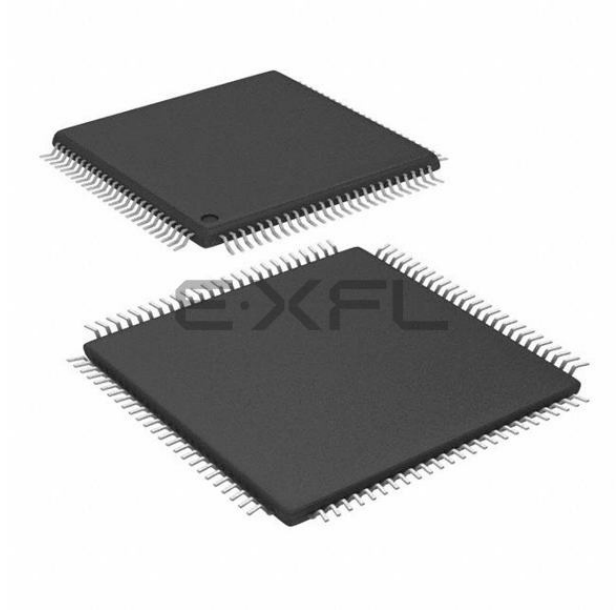
Microchip Technology - PIC24HJ256GP210T-I/PT Datasheet



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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	PIC
Core Size	16-Bit
Speed	40 MIPs
Connectivity	I²C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, POR, PWM, WDT
Number of I/O	85
Program Memory Size	256KB (85.5K x 24)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	16K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 32x10b, 32x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	100-TQFP
Supplier Device Package	100-TQFP (12x12)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic24hj256gp210t-i-pt

Pin Diagrams (Continued)

100-Pin TQFP

= Pins are up to 5V tolerant

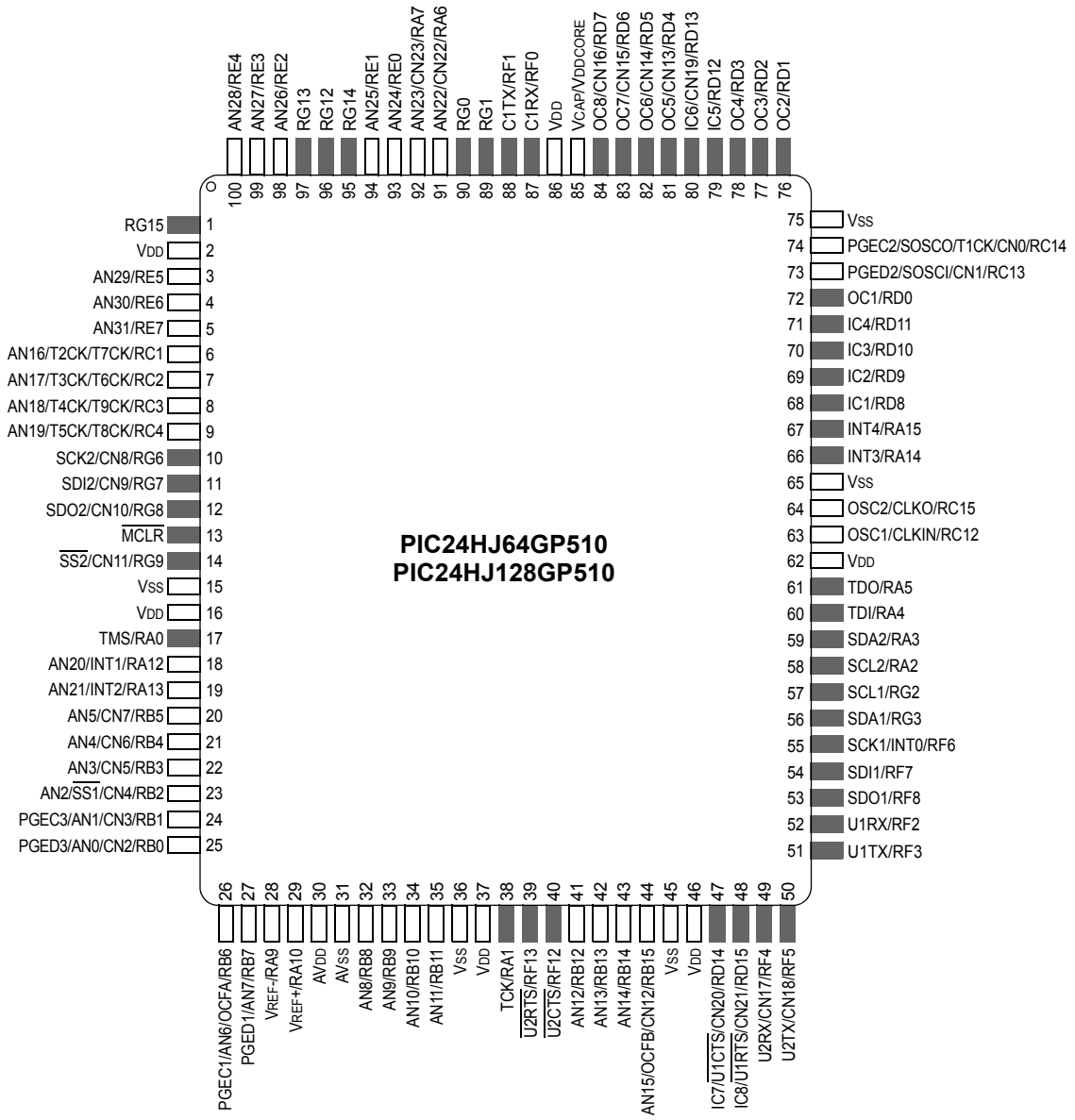


TABLE 4-12: UART2 REGISTER MAP

SFR Name	SFR 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
U2MODE	0230	UARTEN	—	USIDL	IREN	RTSMD	—	UEN1	UEN0	WAKE	LPBACK	ABAUD	URXINV	BRGH	PDSEL<1:0>		STSEL	0000
U2STA	0232	UTXISEL1	UTXINV	UTXISEL0	—	UTXBRK	UTXEN	UTXBF	TRMT	URXISEL<1:0>		ADDEN	RIDLE	PERR	FERR	OERR	URXDA	0110
U2TXREG	0234	—	—	—	—	—	—	—	UART Transmit Register									xxxx
U2RXREG	0236	—	—	—	—	—	—	—	UART Receive Register									0000
U2BRG	0238	Baud Rate Generator Prescaler																0000

Legend: x = unknown value on Reset, — = unimplemented, read as '0'. Reset values are shown in hexadecimal for PinHigh devices.

TABLE 4-13: SPI1 REGISTER MAP

SFR Name	SFR 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
SPI1STAT	0240	SPIEN	—	SPISIDL	—	—	—	—	—	—	SPIROV	—	—	—	—	SPITBF	SPIRBF	0000
SPI1CON1	0242	—	—	—	DISSCK	DISSDO	MODE16	SMP	CKE	SSEN	CKP	MSTEN	SPRE<2:0>			PPRE<1:0>		0000
SPI1CON2	0244	FRMEN	SPIFSD	FRMPOL	—	—	—	—	—	—	—	—	—	—	—	FRMDLY	—	0000
SPI1BUF	0248	SPI1 Transmit and Receive Buffer Register																0000

Legend: x = unknown value on Reset, — = unimplemented, read as '0'. Reset values are shown in hexadecimal for PinHigh devices.

TABLE 4-14: SPI2 REGISTER MAP

SFR Name	SFR 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
SPI2STAT	0260	SPIEN	—	SPISIDL	—	—	—	—	—	—	SPIROV	—	—	—	—	SPITBF	SPIRBF	0000
SPI2CON1	0262	—	—	—	DISSCK	DISSDO	MODE16	SMP	CKE	SSEN	CKP	MSTEN	SPRE<2:0>			PPRE<1:0>		0000
SPI2CON2	0264	FRMEN	SPIFSD	FRMPOL	—	—	—	—	—	—	—	—	—	—	—	FRMDLY	—	0000
SPI2BUF	0268	SPI2 Transmit and Receive Buffer Register																0000

Legend: x = unknown value on Reset, — = unimplemented, read as '0'. Reset values are shown in hexadecimal for PinHigh devices.

TABLE 4-31: SYSTEM CONTROL 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
RCON	0740	TRAPR	IOPUWR	—	—	—	—	—	VREGS	EXTR	SWR	SWDTEN	WDTO	SLEEP	IDLE	BOR	POR	xxxx(1)
OSCCON	0742	—	COSC<2:0>			—	NOSC<2:0>			CLKLOCK	—	LOCK	—	CF	—	LPOSCEN	OSWEN	0300(2)
CLKDIV	0744	ROI	DOZE<2:0>			DOZEN	FRCDIV<2:0>			PLLPOST<1:0>		—	PLLPRE<4:0>					3040
PLLFBD	0746	—	—	—	—	—	—	—	PLLDIV<8:0>									0030
OSCTUN	0748	—	—	—	—	—	—	—	—	—	—	TUN<5:0>						0000

Legend: x = unknown value on Reset, — = unimplemented, read as '0'. Reset values are shown in hexadecimal for PinHigh devices.
Note 1: RCON register Reset values dependent on type of Reset.
2: OSCCON register Reset values dependent on the FOSC Configuration bits and by type of Reset.

TABLE 4-32: NVM 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
NVMCON	0760	WR	WREN	WRERR	—	—	—	—	—	—	ERASE	—	—	NVMOP<3:0>				0000(1)
NVMKEY	0766	—	—	—	—	—	—	—	—	NVMKEY<7:0>								0000

Legend: x = unknown value on Reset, — = unimplemented, read as '0'. Reset values are shown in hexadecimal for PinHigh devices.
Note 1: Reset value shown is for POR only. Value on other Reset states is dependent on the state of memory write or erase operations at the time of Reset.

TABLE 4-33: PMD 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
PMD1	0770	T5MD	T4MD	T3MD	T2MD	T1MD	—	—	—	I2C1MD	U2MD	U1MD	SPI2MD	SPI1MD	C2MD	C1MD	AD1MD	0000
PMD2	0772	IC8MD	IC7MD	IC6MD	IC5MD	IC4MD	IC3MD	IC2MD	IC1MD	OC8MD	OC7MD	OC6MD	OC5MD	OC4MD	OC3MD	OC2MD	OC1MD	0000
PMD3	0774	T9MD	T8MD	T7MD	T6MD	—	—	—	—	—	—	—	—	—	—	I2C2MD	AD2MD	0000

Legend: x = unknown value on Reset, — = unimplemented, read as '0'. Reset values are shown in hexadecimal for PinHigh devices.

5.0 FLASH PROGRAM MEMORY

Note: This data sheet summarizes the features of the PIC24HJXXXGPX06/X08/X10 family of devices. However, it is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to the *"PIC24H Family Reference Manual"*, **Section 5. "Flash Programming"** (DS70228), which is available from the Microchip website (www.microchip.com).

The PIC24HJXXXGPX06/X08/X10 devices contain internal Flash program memory for storing and executing application code. The memory is readable, writable and erasable during normal operation over the entire VDD range.

Flash memory can be programmed in two ways:

1. In-Circuit Serial Programming™ (ICSP™) programming capability
2. Run-Time Self-Programming (RTSP)

ICSP programming capability allows a PIC24HJXXXGPX06/X08/X10 device to be serially programmed while in the end application circuit. This is simply done with two lines for programming clock and programming data (one of the alternate programming pin pairs: PGECx/PGEDx, and three other lines for power (VDD), ground (VSS) and Master Clear ($\overline{MCLR}$). This allows customers to manufacture boards with unprogrammed devices and then program the digital signal controller just before shipping the product. This also allows the most recent firmware or a custom firmware to be programmed.

RTSP is accomplished using TBLRD (table read) and TBLWT (table write) instructions. With RTSP, the user can write program memory data either in blocks or 'rows' of 64 instructions (192 bytes) at a time, or single instructions and erase program memory in blocks or 'pages' of 512 instructions (1536 bytes) at a time.

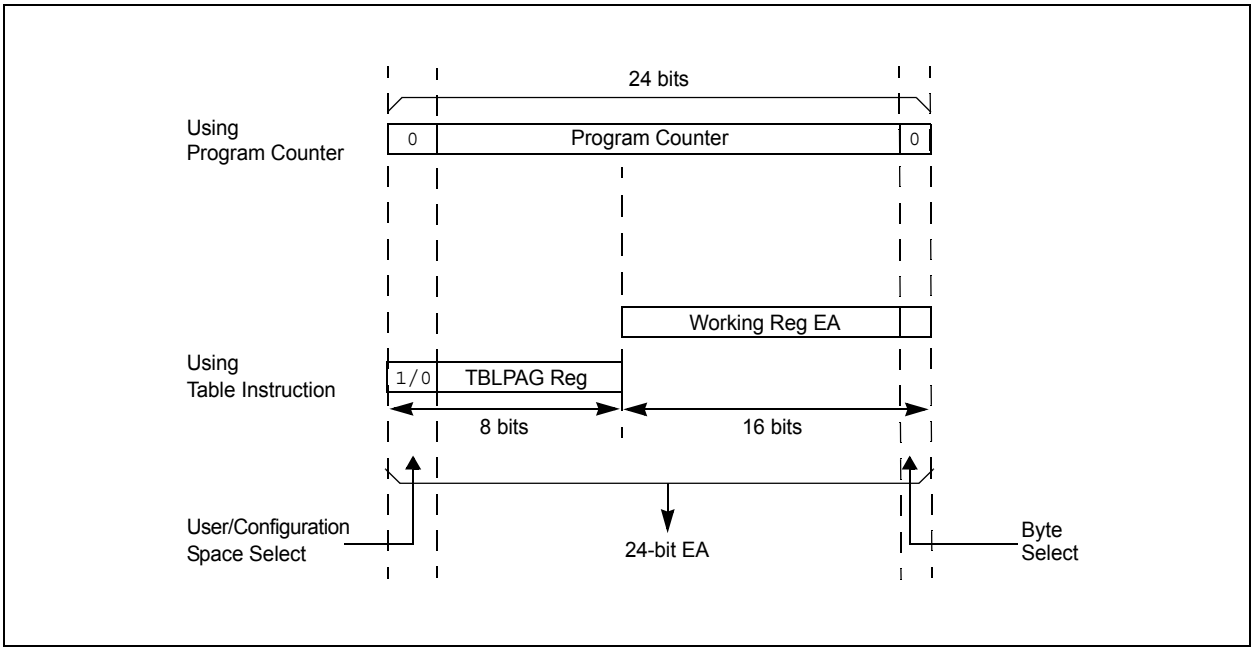
5.1 Table Instructions and Flash Programming

Regardless of the method used, all programming of Flash memory is done with the table read and table write instructions. These allow direct read and write access to the program memory space from the data memory while the device is in normal operating mode. The 24-bit target address in the program memory is formed using bits<7:0> of the TBLPAG register and the Effective Address (EA) from a W register specified in the table instruction, as shown in Figure 5-1.

The TBLRDL and the TBLWTL instructions are used to read or write to bits<15:0> of program memory. TBLRDL and TBLWTL can access program memory in both Word and Byte modes.

The TBLRDH and TBLWTH instructions are used to read or write to bits<23:16> of program memory. TBLRDH and TBLWTH can also access program memory in Word or Byte mode.

FIGURE 5-1: ADDRESSING FOR TABLE REGISTERS



REGISTER 6-1: RCON: RESET CONTROL REGISTER(1)

R/W-0	R/W-0	U-0	U-0	U-0	U-0	U-0	R/W-0
TRAPR	IOPUWR	—	—	—	—	—	VREGS
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-1	R/W-1
EXTR	SWR	SWDTEN(2)	WDTO	SLEEP	IDLE	BOR	POR
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 **TRAPR:** Trap Reset Flag bit
1 = A Trap Conflict Reset has occurred
0 = A Trap Conflict Reset has not occurred

bit 14 **IOPUWR:** Illegal Opcode or Uninitialized W Access Reset Flag bit
1 = An illegal opcode detection, an illegal address mode or uninitialized W register used as an Address Pointer caused a Reset
0 = An illegal opcode or uninitialized W Reset has not occurred

bit 13-9 **Unimplemented:** Read as '0'

bit 8 **VREGS:** Voltage Regulator Standby During Sleep bit
1 = Voltage regulator is active during Sleep
0 = Voltage regulator goes into Standby mode during Sleep

bit 7 **EXTR:** External Reset ($\overline{MCLR}$) Pin bit
1 = A Master Clear (pin) Reset has occurred
0 = A Master Clear (pin) Reset has not occurred

bit 6 **SWR:** Software Reset (Instruction) Flag bit
1 = A RESET instruction has been executed
0 = A RESET instruction has not been executed

bit 5 **SWDTEN:** Software Enable/Disable of WDT bit(2)
1 = WDT is enabled
0 = WDT is disabled

bit 4 **WDTO:** Watchdog Timer Time-out Flag bit
1 = WDT time-out has occurred
0 = WDT time-out has not occurred

bit 3 **SLEEP:** Wake-up from Sleep Flag bit
1 = Device has been in Sleep mode
0 = Device has not been in Sleep mode

bit 2 **IDLE:** Wake-up from Idle Flag bit
1 = Device was in Idle mode
0 = Device was not in Idle mode

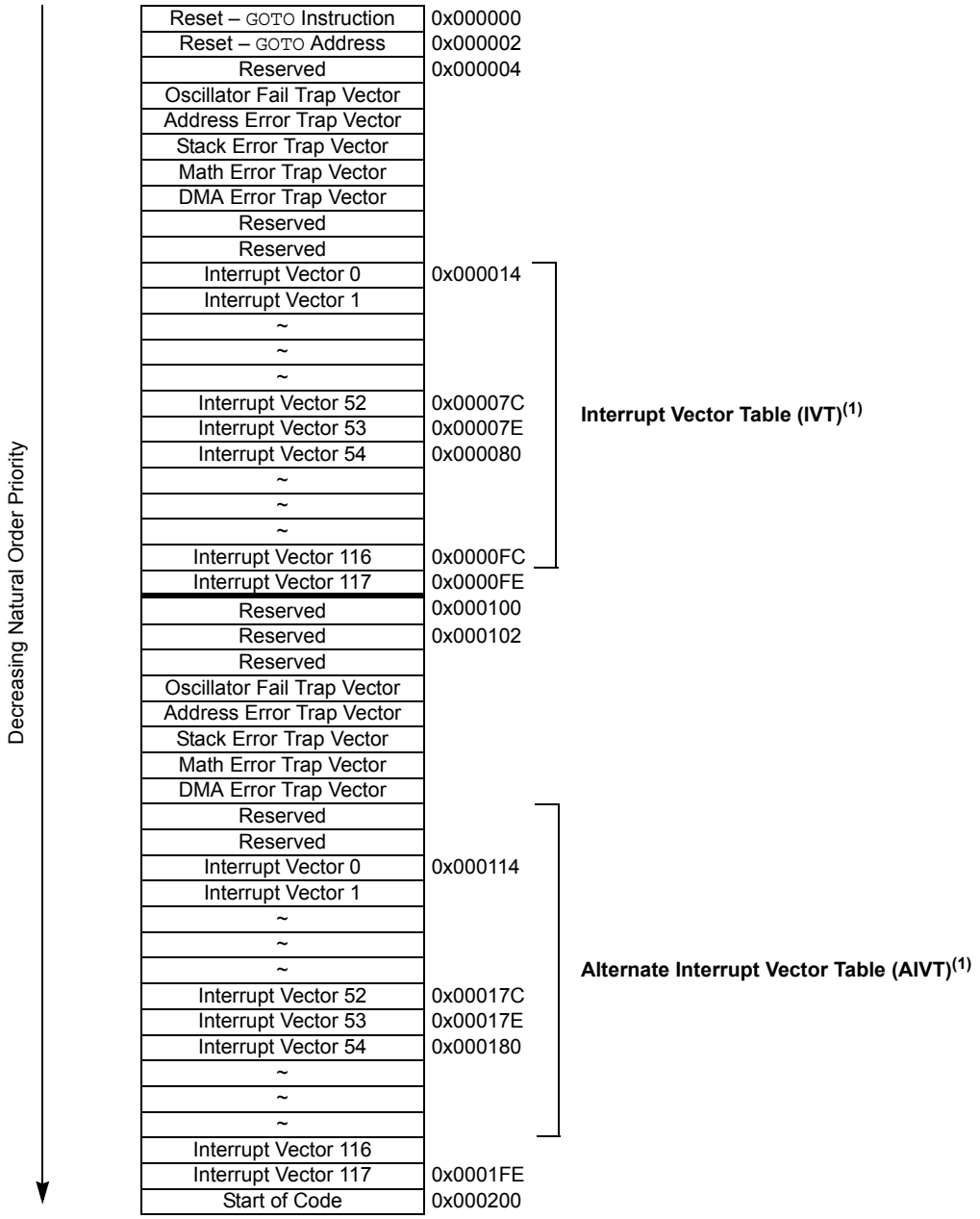
bit 1 **BOR:** Brown-out Reset Flag bit
1 = A Brown-out Reset has occurred
0 = A Brown-out Reset has not occurred

bit 0 **POR:** Power-on Reset Flag bit
1 = A Power-on Reset has occurred
0 = A Power-on Reset has not occurred

Note 1: All of the Reset status bits may be set or cleared in software. Setting one of these bits in software does not cause a device Reset.

2: If the FWDTEN Configuration bit is '1' (unprogrammed), the WDT is always enabled, regardless of the SWDTEN bit setting.

FIGURE 7-1: PIC24HJXXXGPX06/X08/X10 INTERRUPT VECTOR TABLE



Note 1: See Table 7-1 for the list of implemented interrupt vectors.

REGISTER 7-15: IPC0: INTERRUPT PRIORITY CONTROL REGISTER 0

U-0	R/W-1	R/W-0	R/W-0	U-0	R/W-1	R/W-0	R/W-0
—	T1IP<2:0>			—	OC1IP<2:0>		
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
—	IC1IP<2:0>			—	INT0IP<2:0>		
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 **Unimplemented:** Read as '0'

bit 14-12 **T1IP<2:0>:** Timer1 Interrupt Priority bits
111 = Interrupt is priority 7 (highest priority interrupt)
•
•
•
001 = Interrupt is priority 1
000 = Interrupt source is disabled

bit 11 **Unimplemented:** Read as '0'

bit 10-8 **OC1IP<2:0>:** Output Compare Channel 1 Interrupt Priority bits
111 = Interrupt is priority 7 (highest priority interrupt)
•
•
•
001 = Interrupt is priority 1
000 = Interrupt source is disabled

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

bit 6-4 **IC1IP<2:0>:** Input Capture Channel 1 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 **INT0IP<2:0>:** External Interrupt 0 Priority bits
111 = Interrupt is priority 7 (highest priority interrupt)
•
•
•
001 = Interrupt is priority 1
000 = Interrupt source is disabled

8.0 DIRECT MEMORY ACCESS (DMA)

Note: This data sheet summarizes the features of the PIC24HJXXXGPX06/X08/X10 family of devices. However, it is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to the *"PIC24H Family Reference Manual"*, **Section 22. "Direct Memory Access (DMA)"** (DS70223), which is available from the Microchip website (www.microchip.com).

Direct Memory Access (DMA) is a very efficient mechanism of copying data between peripheral SFRs (e.g., UART Receive register, Input Capture 1 buffer), and buffers or variables stored in RAM, with minimal CPU intervention. The DMA controller can automatically copy entire blocks of data without requiring the user software to read or write the peripheral Special Function Registers (SFRs) every time a peripheral interrupt occurs. The DMA controller uses a dedicated bus for data transfers and, therefore, does not steal cycles from the code execution flow of the CPU. To exploit the DMA capability, the corresponding user buffers or variables must be located in DMA RAM.

The PIC24HJXXXGPX06/X08/X10 peripherals that can utilize DMA are listed in Table 8-1 along with their associated Interrupt Request (IRQ) numbers.

TABLE 8-1: PERIPHERALS WITH DMA SUPPORT

Peripheral	IRQ Number
INT0	0
Input Capture 1	1
Input Capture 2	5
Output Compare 1	2
Output Compare 2	6
Timer2	7
Timer3	8
SPI1	10
SPI2	33
UART1 Reception	11
UART1 Transmission	12
UART2 Reception	30
UART2 Transmission	31
ADC1	13
ADC2	21
ECAN1 Reception	34
ECAN1 Transmission	70
ECAN2 Reception	55
ECAN2 Transmission	71

The DMA controller features eight identical data transfer channels.

Each channel has its own set of control and status registers. Each DMA channel can be configured to copy data either from buffers stored in dual port DMA RAM to peripheral SFRs, or from peripheral SFRs to buffers in DMA RAM.

The DMA controller supports the following features:

- Word or byte sized data transfers.
- Transfers from peripheral to DMA RAM or DMA RAM to peripheral.
- Indirect Addressing of DMA RAM locations with or without automatic post-increment.
- Peripheral Indirect Addressing – In some peripherals, the DMA RAM read/write addresses may be partially derived from the peripheral.
- One-Shot Block Transfers – Terminating DMA transfer after one block transfer.
- Continuous Block Transfers – Reloading DMA RAM buffer start address after every block transfer is complete.
- Ping-Pong Mode – Switching between two DMA RAM start addresses between successive block transfers, thereby filling two buffers alternately.
- Automatic or manual initiation of block transfers
- Each channel can select from 19 possible sources of data sources or destinations.

For each DMA channel, a DMA interrupt request is generated when a block transfer is complete. Alternatively, an interrupt can be generated when half of the block has been filled.

12.0 TIMER1

Note: This data sheet summarizes the features of the PIC24HJXXXGPX06/X08/X10 family of devices. However, it is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to the *"PIC24H Family Reference Manual"*, **Section 11. "Timers"** (DS70244), which is available from the Microchip website (www.microchip.com).

The Timer1 module is a 16-bit timer, which can serve as the time counter for the real-time clock, or operate as a free-running interval timer/counter. Timer1 can operate in three modes:

- 16-bit Timer
- 16-bit Synchronous Counter
- 16-bit Asynchronous Counter

Timer1 also supports these features:

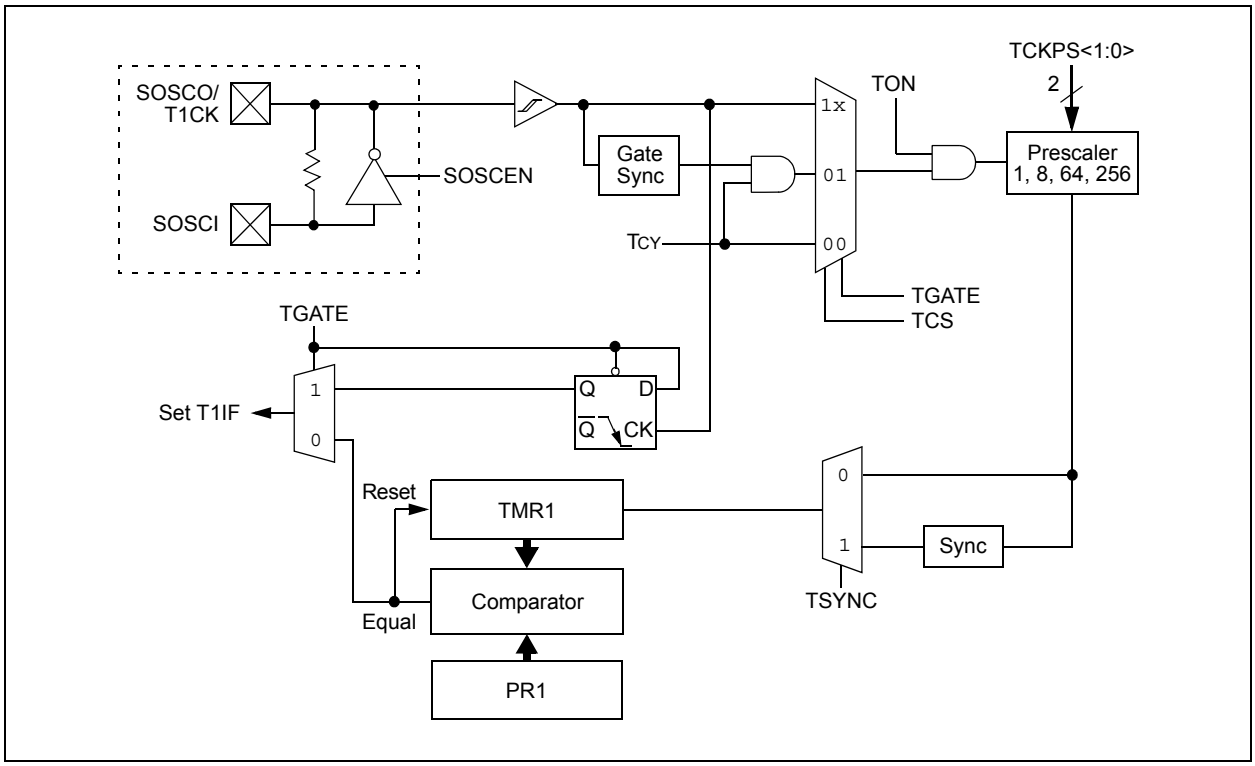
- Timer gate operation
- Selectable prescaler settings
- Timer operation during CPU Idle and Sleep modes
- Interrupt on 16-bit Period register match or falling edge of external gate signal

Figure 12-1 presents a block diagram of the 16-bit timer module.

To configure Timer1 for operation:

1. Set the TON bit (= 1) in the T1CON register.
2. Select the timer prescaler ratio using the TCKPS<1:0> bits in the T1CON register.
3. Set the Clock and Gating modes using the TCS and TGATE bits in the T1CON register.
4. Set or clear the TSYNC bit in T1CON to select synchronous or asynchronous operation.
5. Load the timer period value into the PR1 register.
6. If interrupts are required, set the interrupt enable bit, T1IE. Use the priority bits, T1IP<2:0>, to set the interrupt priority.

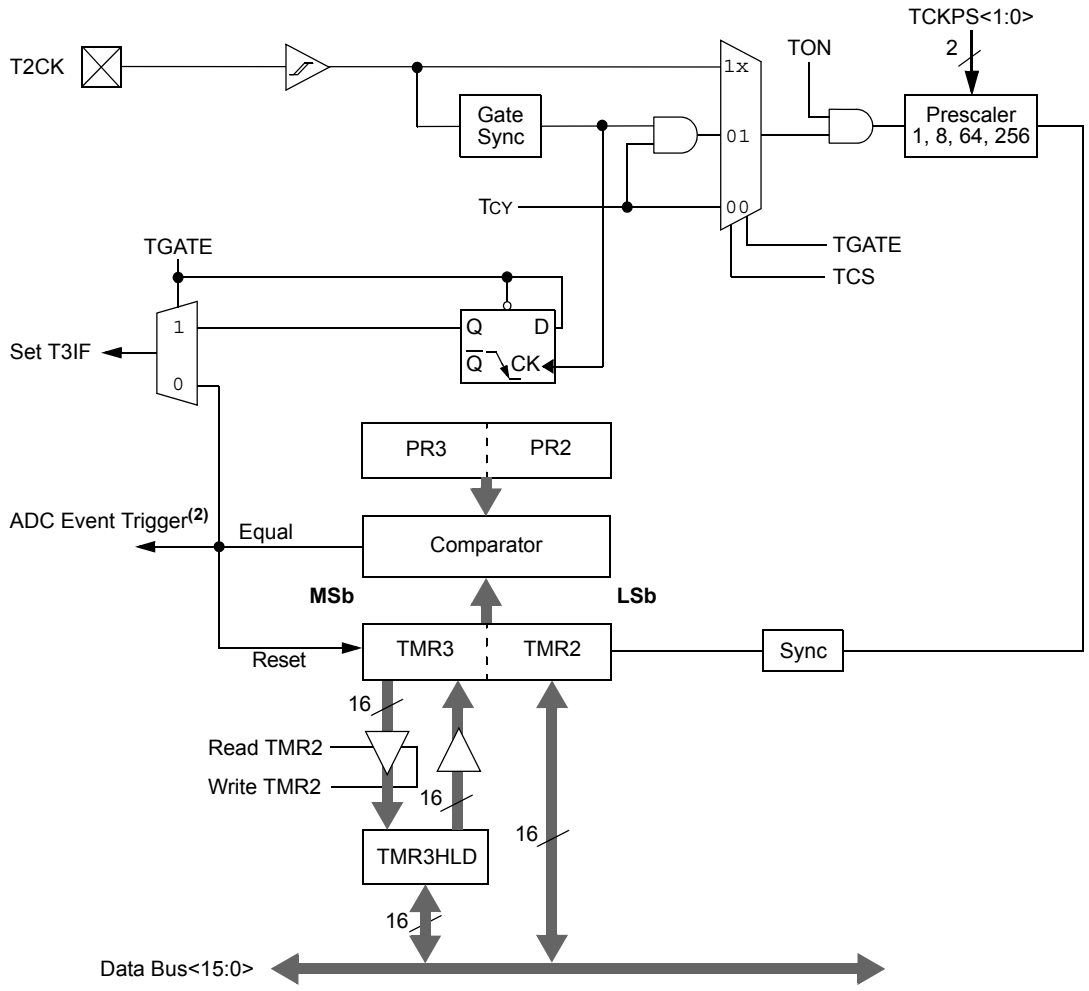
FIGURE 12-1: 16-BIT TIMER1 MODULE BLOCK DIAGRAM



A block diagram for a 32-bit timer pair (Timer4/5) example is shown in Figure 13-1 and a timer (Timer4) operating in 16-bit mode example is shown in Figure 13-2.

Note:	Only Timer2 and Timer3 can trigger a DMA data transfer.

FIGURE 13-1: TIMER2/3 (32-BIT) BLOCK DIAGRAM(1)



Note 1: The 32-bit timer control bit, T32, must be set for 32-bit timer/counter operation. All control bits are respective to the T2CON register.

2: The ADC event trigger is available only on Timer2/3.

15.1 Output Compare Modes

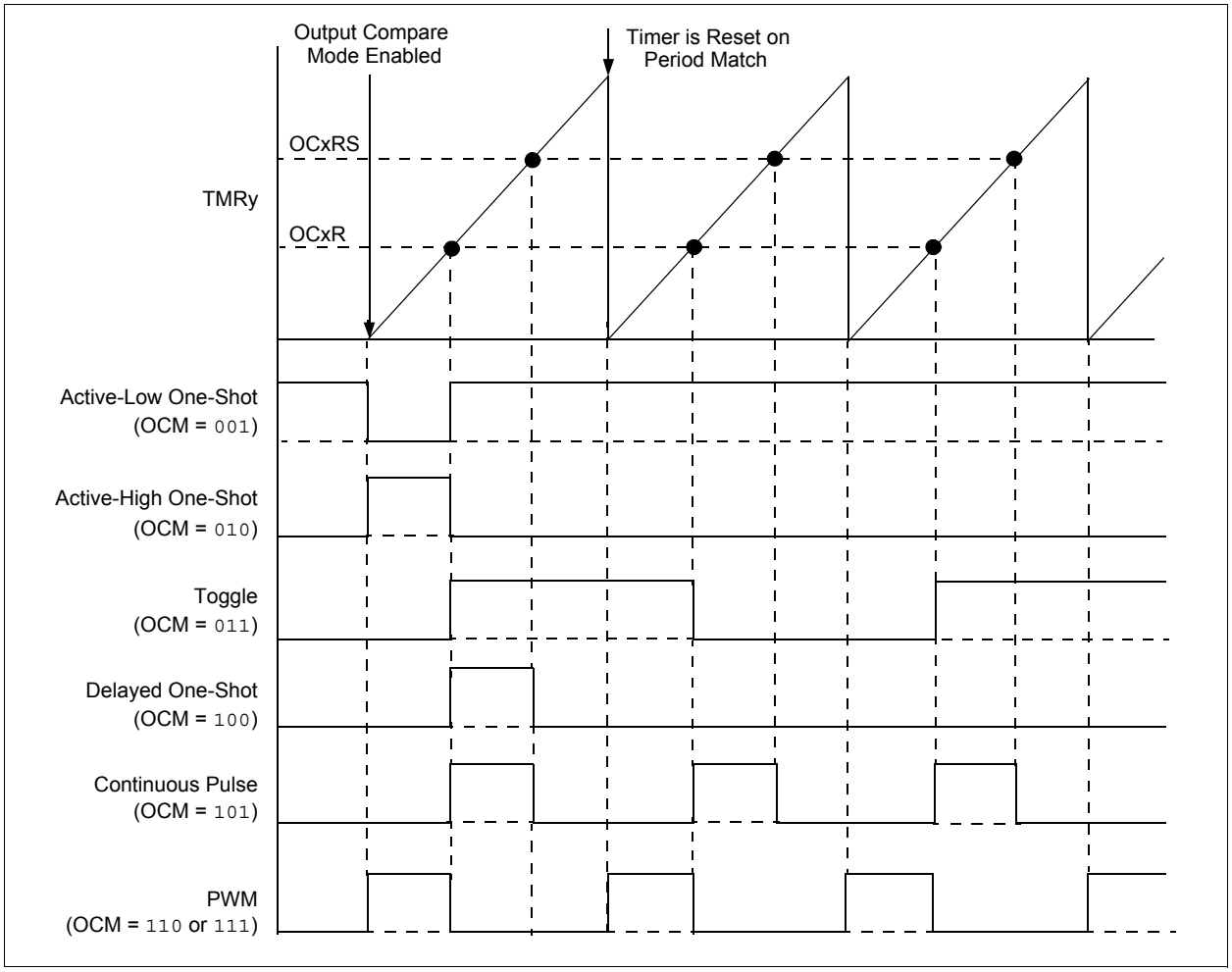
Configure the Output Compare modes by setting the appropriate Output Compare Mode (OCM<2:0>) bits in the Output Compare Control (OCxCON<2:0>) register. Table 15-1 lists the different bit settings for the Output Compare modes. Figure 15-2 illustrates the output compare operation for various modes. The user application must disable the associated timer when writing to the Output Compare Control registers to avoid malfunctions.

Note:	See **Section 13. "Output Compare"** in the *"PIC24H Family Reference Manual"* (DS70247) for OCxR and OCxRS register restrictions.

TABLE 15-1: OUTPUT COMPARE MODES

OCM<2:0>	Mode	OCx Pin Initial State	OCx Interrupt Generation
000	Module Disabled	Controlled by GPIO register	—
001	Active-Low One-Shot	0	OCx rising edge
010	Active-High One-Shot	1	OCx falling edge
011	Toggle	Current output is maintained	OCx rising and falling edge
100	Delayed One-Shot	0	OCx falling edge
101	Continuous Pulse	0	OCx falling edge
110	PWM without Fault Protection	'0', if OCxR is zero '1', if OCxR is non-zero	No interrupt
111	PWM with Fault Protection	'0', if OCxR is zero '1', if OCxR is non-zero	OCFA falling edge for OC1 to OC4

FIGURE 15-2: OUTPUT COMPARE OPERATION



17.0 INTER-INTEGRATED CIRCUIT™ (I^2C™)

Note: This data sheet summarizes the features of the PIC24HJXXXGPX06/X08/X10 family of devices. However, it is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to the *"PIC24H Family Reference Manual"*, **Section 19. "Inter-Integrated Circuit™ (I^2C™)"** (DS70235), which is available from the Microchip website (www.microchip.com).

The Inter-Integrated Circuit (I^2C) module provides complete hardware support for both Slave and Multi-Master modes of the I^2C serial communication standard, with a 16-bit interface.

The PIC24HJXXXGPX06/X08/X10 devices have up to two I^2C interface modules, denoted as I2C1 and I2C2. Each I^2C module has a 2-pin interface: the SCLx pin is clock and the SDAx pin is data.

Each I^2C module 'x' (x = 1 or 2) offers the following key features:

- I^2C interface supporting both master and slave operation.
- I^2C Slave mode supports 7 and 10-bit address.
- I^2C Master mode supports 7 and 10-bit address.
- I^2C Port allows bidirectional transfers between master and slaves.
- Serial clock synchronization for I^2C port can be used as a handshake mechanism to suspend and resume serial transfer (SCLREL control).
- I^2C supports multi-master operation; detects bus collision and will arbitrate accordingly.

17.1 Operating Modes

The hardware fully implements all the master and slave functions of the I^2C Standard and Fast mode specifications, as well as 7 and 10-bit addressing.

The I^2C module can operate either as a slave or a master on an I^2C bus.

The following types of I^2C operation are supported:

- I^2C slave operation with 7-bit address
- I^2C slave operation with 10-bit address
- I^2C master operation with 7 or 10-bit address

For details about the communication sequence in each of these modes, please refer to the *"PIC24H Family Reference Manual"*.

17.2 I^2C Registers

I2CxCON and I2CxSTAT are control and status registers, respectively. The I2CxCON register is readable and writable. The lower six bits of I2CxSTAT are read-only. The remaining bits of the I2CSTAT are read/write.

I2CxRSR is the shift register used for shifting data, whereas I2CxRCV is the buffer register to which data bytes are written, or from which data bytes are read. I2CxRCV is the receive buffer. I2CxTRN is the transmit register to which bytes are written during a transmit operation.

The I2CxADD register holds the slave address. A status bit, ADD10, indicates 10-bit Address mode. The I2CxBRG acts as the Baud Rate Generator (BRG) reload value.

In receive operations, I2CxRSR and I2CxRCV together form a double-buffered receiver. When I2CxRSR receives a complete byte, it is transferred to I2CxRCV and an interrupt pulse is generated.

REGISTER 17-3: I2CxMSK: I2Cx SLAVE MODE ADDRESS MASK REGISTER

U-0	U-0	U-0	U-0	U-0	U-0	R/W-0	R/W-0
—	—	—	—	—	—	AMSK9	AMSK8
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
AMSK7	AMSK6	AMSK5	AMSK4	AMSK3	AMSK2	AMSK1	AMSK0
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

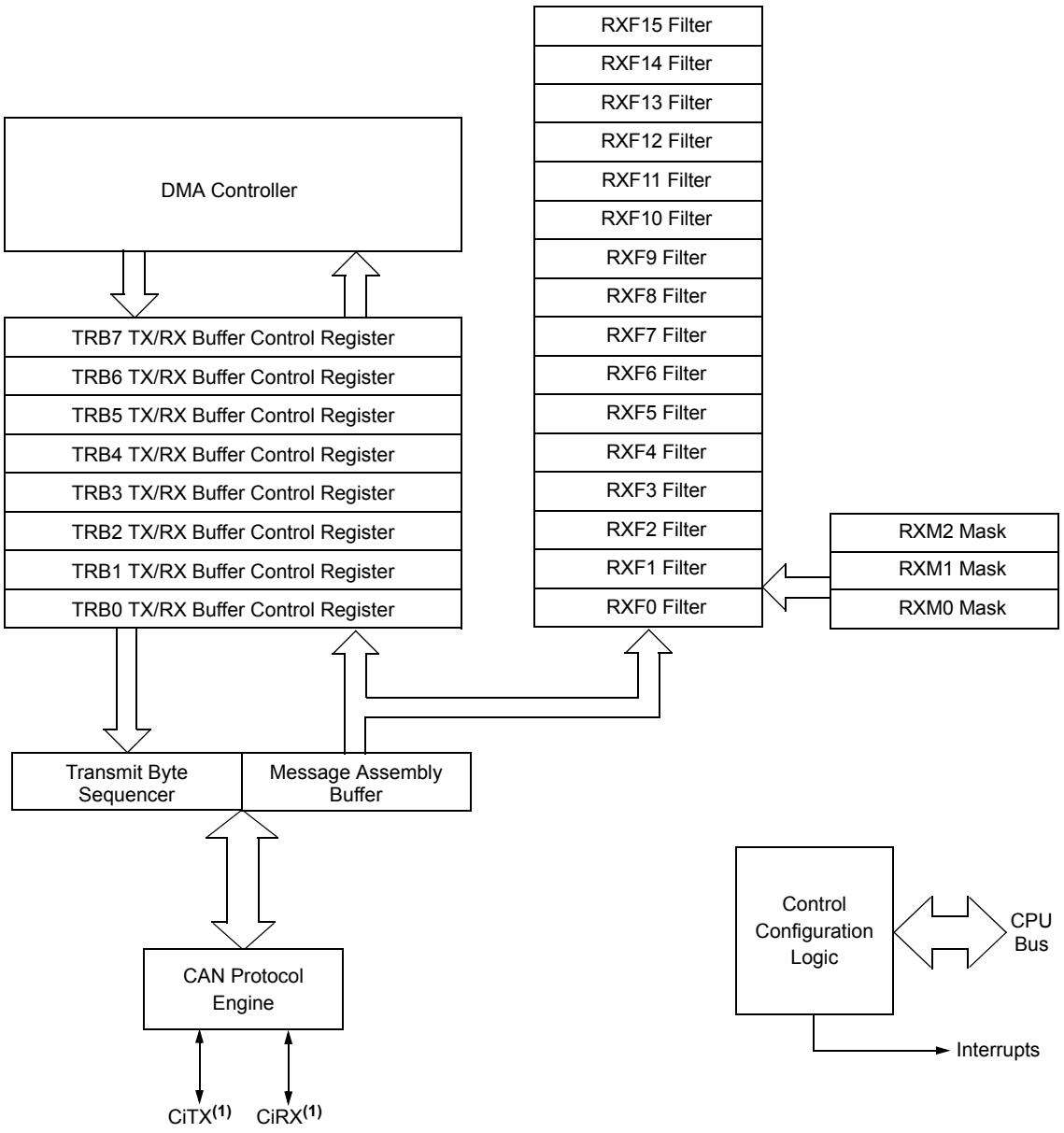
bit 15-10 **Unimplemented:** Read as '0'

bit 9-0 **AMSKx:** Mask for Address Bit x Select bit

1 = Enable masking for bit x of incoming message address; bit match not required in this position

0 = Disable masking for bit x; bit match required in this position

FIGURE 19-1: ECAN™ MODULE BLOCK DIAGRAM



Note 1: i = 1 or 2 refers to a particular ECAN™ module (ECAN1 or ECAN2).

REGISTER 19-7: CiINTE: ECAN™ MODULE INTERRUPT ENABLE REGISTER

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

R/W-0	R/W-0	R/W-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
IVRIE	WAKIE	ERRIE	—	FIFOIE	RBOVIE	RBIE	TBIE
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 15-8 **Unimplemented:** Read as '0'

bit 7 **IVRIE:** Invalid Message Received Interrupt Enable bit

bit 6 **WAKIE:** Bus Wake-up Activity Interrupt Flag bit

bit 5 **ERRIE:** Error Interrupt Enable bit

bit 4 **Unimplemented:** Read as '0'

bit 3 **FIFOIE:** FIFO Almost Full Interrupt Enable bit

bit 2 **RBOVIE:** RX Buffer Overflow Interrupt Enable bit

bit 1 **RBIE:** RX Buffer Interrupt Enable bit

bit 0 **TBIE:** TX Buffer Interrupt Enable bit

REGISTER 19-15: CiBUFPNT4: ECAN™ MODULE FILTER 12-15 BUFFER POINTER REGISTER

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
F15BP<3:0>				F14BP<3:0>			
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
F13BP<3:0>				F12BP<3:0>			
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 15-12 **F15BP<3:0>:** RX Buffer Written when Filter 15 Hits bits

bit 11-8 **F14BP<3:0>:** RX Buffer Written when Filter 14 Hits bits

bit 7-4 **F13BP<3:0>:** RX Buffer Written when Filter 13 Hits bits

bit 3-0 **F12BP<3:0>:** RX Buffer Written when Filter 12 Hits bits

REGISTER 19-19: CiFMSKSEL2: ECAN™ FILTER 15-8 MASK SELECTION REGISTER

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
F15MSK<1:0>		F14MSK<1:0>		F13MSK<1:0>		F12MSK<1:0>	
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
F11MSK<1:0>		F10MSK<1:0>		F9MSK<1:0>		F8MSK<1:0>	
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 **F15MSK<1:0>:** Mask Source for Filter 15 bit
11 = Reserved
10 = Acceptance Mask 2 registers contain mask
01 = Acceptance Mask 1 registers contain mask
00 = Acceptance Mask 0 registers contain mask

bit 13-12 **F14MSK<1:0>:** Mask Source for Filter 14 bit (same values as bit 15-14)

bit 11-10 **F13MSK<1:0>:** Mask Source for Filter 13 bit (same values as bit 15-14)

bit 9-8 **F12MSK<1:0>:** Mask Source for Filter 12 bit (same values as bit 15-14)

bit 7-6 **F11MSK<1:0>:** Mask Source for Filter 11 bit (same values as bit 15-14)

bit 5-4 **F10MSK<1:0>:** Mask Source for Filter 10 bit (same values as bit 15-14)

bit 3-2 **F9MSK<1:0>:** Mask Source for Filter 9 bit (same values as bit 15-14)

bit 1-0 **F8MSK<1:0>:** Mask Source for Filter 8 bit (same values as bit 15-14)

TABLE 24-9: DC CHARACTERISTICS: I/O PIN INPUT SPECIFICATIONS

DC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial				
Param No.	**Symbol**	**Characteristic**	**Min**	**Typ(1)**	**Max**	**Units**	**Conditions**
	VIL	**Input Low Voltage**					
DI10		I/O pins	VSS	—	0.2 VDD	V	
DI15		$\overline{\text{MCLR}}$	VSS	—	0.2 VDD	V	
DI16		I/O Pins with OSC1 or SOSCI	VSS	—	0.2 VDD	V	
DI18		I/O Pins with I2C	VSS	—	0.3 VDD	V	SMbus disabled
DI19		I/O Pins with I2C	VSS	—	0.2 VDD	V	SMbus enabled
	VIH	**Input High Voltage**					
DI20		I/O Pins Not 5V Tolerant(4)	0.8 VDD	—	VDD	V	
		I/O Pins 5V Tolerant(4)	0.8 VDD	—	5.5	V	
		I/O Pins Not 5V Tolerant(4)	2	—	VDD	V	VDD = 3.3V
		I/O Pins 5V Tolerant(4)	2	—	5.5	V	VDD = 3.3V
DI26		I/O Pins with OSC1 or SOSCI	0.7 VDD	—	VDD	V	
DI28		I/O Pins with I2C	0.7 VDD	—	5.5	V	SMbus disabled
DI29		I/O Pins with I2C	0.8 VDD	—	5.5	V	SMbus enabled
	ICNPU	**CNx Pull-up Current**					
DI30			50	250	400	µA	VDD = 3.3V, VPIN = VSS
	IIL	**Input Leakage Current(2,3)**					
DI50		I/O Pins	—	—	±2	µA	VSS ≤ VPIN ≤ VDD, Pin at high-impedance
DI51		I/O Pins Not 5V Tolerant(4)	—	—	±2	µA	VSS ≤ VPIN ≤ VDD, Pin at high-impedance
DI51a		I/O Pins Not 5V Tolerant(4)	—	—	±2	µA	Shared with external reference pins
DI51b		I/O Pins Not 5V Tolerant(4)	—	—	±3.5	µA	VSS ≤ VPIN ≤ VDD, Pin at high-impedance
DI51c		I/O Pins Not 5V Tolerant(4)	—	—	±8	µA	Analog pins shared with external reference pins
DI55		$\overline{\text{MCLR}}$	—	—	±2	µA	VSS ≤ VPIN ≤ VDD
DI56		OSC1	—	—	±2	µA	VSS ≤ VPIN ≤ VDD, XT and HS modes

Note 1: Data in "Typ" column is at 3.3V, 25°C unless otherwise stated.

2: The leakage current on the $\overline{\text{MCLR}}$ pin is strongly dependent on the applied voltage level. The specified levels represent normal operating conditions. Higher leakage current may be measured at different input voltages.

3: Negative current is defined as current sourced by the pin.

4: See **"Pin Diagrams"** for a list of 5V tolerant pins.

TABLE 24-38: ADC CONVERSION (12-BIT MODE) TIMING REQUIREMENTS

AC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial				
Param No.	Symbol	Characteristic	Min.	Typ(2)	Max.	Units	Conditions
Clock Parameters(1)							
AD50	TAD	ADC Clock Period	117.6	—	—	ns	—
AD51	tRC	ADC Internal RC Oscillator Period	—	250	—	ns	—
Conversion Rate							
AD55	tCONV	Conversion Time	—	14 TAD		ns	—
AD56	FCNV	Throughput Rate	—	—	500	ksps	—
AD57	TSAMP	Sample Time	3 TAD	—	—	—	—
Timing Parameters							
AD60	tPCS	Conversion Start from Sample Trigger(2)	2.0 TAD	—	3.0 TAD	—	Auto convert trigger not selected
AD61	tPSS	Sample Start from Setting Sample (SAMP) bit(2)	2.0 TAD	—	3.0 TAD	—	—
AD62	tCSS	Conversion Completion to Sample Start (ASAM = 1)(2)	—	0.5 TAD	—	—	—
AD63	tDPU	Time to Stabilize Analog Stage from ADC Off to ADC On(2,3)	—	—	20	μs	—

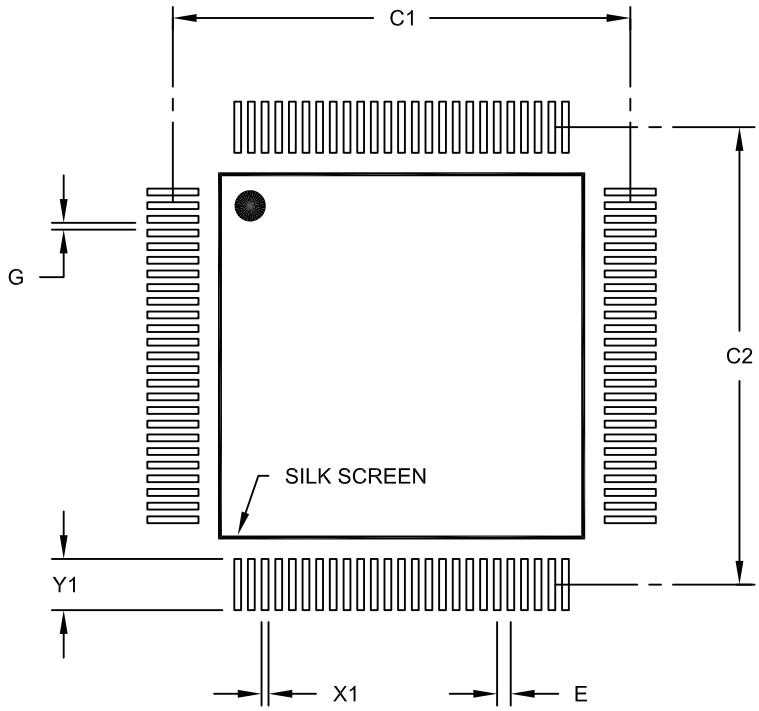
Note 1: Because the sample caps eventually loses charge, clock rates below 10 kHz may affect linearity performance, especially at elevated temperatures.

2: These parameters are characterized but not tested in manufacturing.

3: tDPU is the time required for the ADC module to stabilize when it is turned on (AD1CON1<ADON> = 1). During this time, the ADC result is indeterminate.

100-Lead Plastic Thin Quad Flatpack (PT) – 12x12x1 mm Body, 2.00 mm [TQFP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.40 BSC	
Contact Pad Spacing	C1		13.40	
Contact Pad Spacing	C2		13.40	
Contact Pad Width (X100)	X1			0.20
Contact Pad Length (X100)	Y1			1.50
Distance Between Pads	G	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2100A