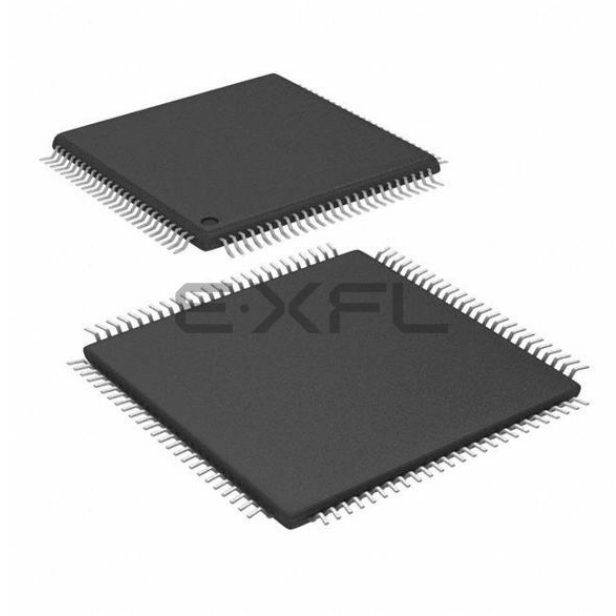
Microchip Technology - DSPIC33FJ64MC710A-I/PT Datasheet



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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.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	dsPIC
Core Size	16-Bit
Speed	40 MIPs
Connectivity	CANbus, I²C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, Motor Control PWM, POR, PWM, QEI, WDT
Number of I/O	85
Program Memory Size	64KB (64K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	16K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 24x10/12b
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/dspic33fj64mc710a-i-pt

TABLE 4-8: OUTPUT COMPARE 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
OC1RS	0180	Output Compare 1 Secondary Register																xxxx
OC1R	0182	Output Compare 1 Register																xxxx
OC1CON	0184	—	—	OCSIDL	—	—	—	—	—	—	—	—	OCFLT	OCTSEL	OCM<2:0>			0000
OC2RS	0186	Output Compare 2 Secondary Register																xxxx
OC2R	0188	Output Compare 2 Register																xxxx
OC2CON	018A	—	—	OCSIDL	—	—	—	—	—	—	—	—	OCFLT	OCTSEL	OCM<2:0>			0000
OC3RS	018C	Output Compare 3 Secondary Register																xxxx
OC3R	018E	Output Compare 3 Register																xxxx
OC3CON	0190	—	—	OCSIDL	—	—	—	—	—	—	—	—	OCFLT	OCTSEL	OCM<2:0>			0000
OC4RS	0192	Output Compare 4 Secondary Register																xxxx
OC4R	0194	Output Compare 4 Register																xxxx
OC4CON	0196	—	—	OCSIDL	—	—	—	—	—	—	—	—	OCFLT	OCTSEL	OCM<2:0>			0000
OC5RS	0198	Output Compare 5 Secondary Register																xxxx
OC5R	019A	Output Compare 5 Register																xxxx
OC5CON	019C	—	—	OCSIDL	—	—	—	—	—	—	—	—	OCFLT	OCTSEL	OCM<2:0>			0000
OC6RS	019E	Output Compare 6 Secondary Register																xxxx
OC6R	01A0	Output Compare 6 Register																xxxx
OC6CON	01A2	—	—	OCSIDL	—	—	—	—	—	—	—	—	OCFLT	OCTSEL	OCM<2:0>			0000
OC7RS	01A4	Output Compare 7 Secondary Register																xxxx
OC7R	01A6	Output Compare 7 Register																xxxx
OC7CON	01A8	—	—	OCSIDL	—	—	—	—	—	—	—	—	OCFLT	OCTSEL	OCM<2:0>			0000
OC8RS	01AA	Output Compare 8 Secondary Register																xxxx
OC8R	01AC	Output Compare 8 Register																xxxx
OC8CON	01AE	—	—	OCSIDL	—	—	—	—	—	—	—	—	OCFLT	OCTSEL	OCM<2:0>			0000

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

TABLE 4-17: ADC1 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
ADC1BUF0	0300	ADC1 Data Buffer 0																xxxx
AD1CON1	0320	ADON	—	ADSIDL	ADDMABM	—	AD12B	FORM<1:0>		SSRC<2:0>			—	SIMSAM	ASAM	SAMP	DONE	0000
AD1CON2	0322	VCFG<2:0>			—	—	CSCNA	CHPS<1:0>		BUFS	—	SMPI<3:0>				BUFM	ALTS	0000
AD1CON3	0324	ADRC	—	—	SAMC<4:0>					ADCS<7:0>								0000
AD1CHS123	0326	—	—	—	—	—	CH123NB<1:0>		CH123SB	—	—	—	—	—	CH123NA<1:0>		CH123SA	0000
AD1CHS0	0328	CH0NB	—	—	CH0SB<4:0>					CH0NA	—	—	CH0SA<4:0>					0000
AD1PCFGH(1)	032A	PCFG31	PCFG30	PCFG29	PCFG28	PCFG27	PCFG26	PCFG25	PCFG24	PCFG23	PCFG22	PCFG21	PCFG20	PCFG19	PCFG18	PCFG17	PCFG16	0000
AD1PCFGL	032C	PCFG15	PCFG14	PCFG13	PCFG12	PCFG11	PCFG10	PCFG9	PCFG8	PCFG7	PCFG6	PCFG5	PCFG4	PCFG3	PCFG2	PCFG1	PCFG0	0000
AD1CSSH(1)	032E	CSS31	CSS30	CSS29	CSS28	CSS27	CSS26	CSS25	CSS24	CSS23	CSS22	CSS21	CSS20	CSS19	CSS18	CSS17	CSS16	0000
AD1CSSL	0330	CSS15	CSS14	CSS13	CSS12	CSS11	CSS10	CSS9	CSS8	CSS7	CSS6	CSS5	CSS4	CSS3	CSS2	CSS1	CSS0	0000
AD1CON4	0332	—	—	—	—	—	—	—	—	—	—	—	—	—	DMABL<2:0>			0000

Legend: x = unknown value on Reset, — = unimplemented, read as '0'. Reset values are shown in hexadecimal.
Note 1: Not all ANx inputs are available on all devices. Refer to the device pin diagrams for available ANx inputs.

TABLE 4-18: ADC2 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
ADC2BUF0	0340	ADC2 Data Buffer 0																xxxx
AD2CON1	0360	ADON	—	ADSIDL	ADDMABM	—	AD12B	FORM<1:0>		SSRC<2:0>			—	SIMSAM	ASAM	SAMP	DONE	0000
AD2CON2	0362	VCFG<2:0>			—	—	CSCNA	CHPS<1:0>		BUFS	—	SMPI<3:0>				BUFM	ALTS	0000
AD2CON3	0364	ADRC	—	—	SAMC<4:0>					ADCS<7:0>								0000
AD2CHS123	0366	—	—	—	—	—	CH123NB<1:0>		CH123SB	—	—	—	—	—	CH123NA<1:0>		CH123SA	0000
AD2CHS0	0368	CH0NB	—	—	—	CH0SB<3:0>				CH0NA	—	—	—	CH0SA<3:0>				0000
Reserved	036A	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
AD2PCFGL	036C	PCFG15	PCFG14	PCFG13	PCFG12	PCFG11	PCFG10	PCFG9	PCFG8	PCFG7	PCFG6	PCFG5	PCFG4	PCFG3	PCFG2	PCFG1	PCFG0	0000
Reserved	036E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
AD2CSSL	0370	CSS15	CSS14	CSS13	CSS12	CSS11	CSS10	CSS9	CSS8	CSS7	CSS6	CSS5	CSS4	CSS3	CSS2	CSS1	CSS0	0000
AD2CON4	0372	—	—	—	—	—	—	—	—	—	—	—	—	—	DMABL<2:0>			0000

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

TABLE 4-19: DMA REGISTER MAP (CONTINUED)

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
DMA5PAD	03C4	PAD<15:0>																0000
DMA5CNT	03C6	—	—	—	—	—	—	CNT<9:0>										0000
DMA6CON	03C8	CHEN	SIZE	DIR	HALF	NULLW	—	—	—	—	—	AMODE<1:0>		—	—	MODE<1:0>		0000
DMA6REQ	03CA	FORCE	—	—	—	—	—	—	—	—	IRQSEL<6:0>							0000
DMA6STA	03CC	STA<15:0>																0000
DMA6STB	03CE	STB<15:0>																0000
DMA6PAD	03D0	PAD<15:0>																0000
DMA6CNT	03D2	—	—	—	—	—	—	CNT<9:0>										0000
DMA7CON	03D4	CHEN	SIZE	DIR	HALF	NULLW	—	—	—	—	—	AMODE<1:0>		—	—	MODE<1:0>		0000
DMA7REQ	03D6	FORCE	—	—	—	—	—	—	—	—	IRQSEL<6:0>							0000
DMA7STA	03D8	STA<15:0>																0000
DMA7STB	03DA	STB<15:0>																0000
DMA7PAD	03DC	PAD<15:0>																0000
DMA7CNT	03DE	—	—	—	—	—	—	CNT<9:0>										0000
DMACS0	03E0	PWCOL7	PWCOL6	PWCOL5	PWCOL4	PWCOL3	PWCOL2	PWCOL1	PWCOL0	XWCOL7	XWCOL6	XWCOL5	XWCOL4	XWCOL3	XWCOL2	XWCOL1	XWCOL0	0000
DMACS1	03E2	—	—	—	—	LSTCH<3:0>				PPST7	PPST6	PPST5	PPST4	PPST3	PPST2	PPST1	PPST0	0000
DSADR	03E4	DSADR<15:0>																0000

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

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(3)
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(3)
1 = Voltage regulator is active during Sleep mode
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

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.

3: For dsPIC33FJ256MCX06A/X08A/X10A devices, this bit is unimplemented and reads back a programmed value.

7.0 INTERRUPT CONTROLLER

Note 1: This data sheet summarizes the features of the dsPIC33FJXXXMCX06A/X08A/X10A family of devices. However, it is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **Section 6. "Interrupts"** (DS70184) in the *"dsPIC33F/PIC24H Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com).

2: Some registers and associated bits described in this section may not be available on all devices. Refer to **Section 4.0 "Memory Organization"** in this data sheet for device-specific register and bit information.

The interrupt controller for the dsPIC33FJXXXMCX06A/X08A/X10A family of devices reduces the numerous peripheral interrupt request signals to a single interrupt request signal to the dsPIC33FJXXXMCX06A/X08A/X10A CPU. It has the following features:

- Up to eight processor exceptions and software traps
- Seven user-selectable priority levels
- Interrupt Vector Table (IVT) with up to 118 vectors
- A unique vector for each interrupt or exception source
- Fixed priority within a specified user priority level
- Alternate Interrupt Vector Table (AIVT) for debug support
- Fixed interrupt entry and return latencies

7.1 Interrupt Vector Table

The Interrupt Vector Table (IVT) is shown in Figure 7-1. The IVT resides in program memory, starting at location 000004h. The IVT contains 126 vectors consisting of eight nonmaskable trap vectors plus up to 118 sources of interrupt. In general, each interrupt source has its own vector. Each interrupt vector contains a 24-bit wide address. The value programmed into each interrupt vector location is the starting address of the associated Interrupt Service Routine (ISR).

Interrupt vectors are prioritized in terms of their natural priority; this priority is linked to their position in the vector table. All other things being equal, lower addresses have a higher natural priority. For example, the interrupt associated with vector 0 will take priority over interrupts at any other vector address.

The dsPIC33FJXXXMCX06A/X08A/X10A family of devices implement up to 67 unique interrupts and five nonmaskable traps. These are summarized in Table 7-1 and Table 7-2.

7.1.1 ALTERNATE INTERRUPT VECTOR TABLE

The Alternate Interrupt Vector Table (AIVT) is located after the IVT, as shown in Figure 7-1. Access to the AIVT is provided by the ALTIVT control bit (INTCON2<15>). If the ALTIVT bit is set, all interrupt and exception processes use the alternate vectors instead of the default vectors. The alternate vectors are organized in the same manner as the default vectors.

The AIVT supports debugging by providing a means to switch between an application and a support environment without requiring the interrupt vectors to be reprogrammed. This feature also enables switching between applications for evaluation of different software algorithms at run time. If the AIVT is not needed, the AIVT should be programmed with the same addresses used in the IVT.

7.2 Reset Sequence

A device Reset is not a true exception because the interrupt controller is not involved in the Reset process. The dsPIC33FJXXXMCX06A/X08A/X10A device clears its registers in response to a Reset, which forces the PC to zero. The digital signal controller then begins program execution at location 0x000000. The user programs a GOTO instruction at the Reset address, which redirects program execution to the appropriate start-up routine.

Note: Any unimplemented or unused vector locations in the IVT and AIVT should be programmed with the address of a default interrupt handler routine that contains a RESET instruction.

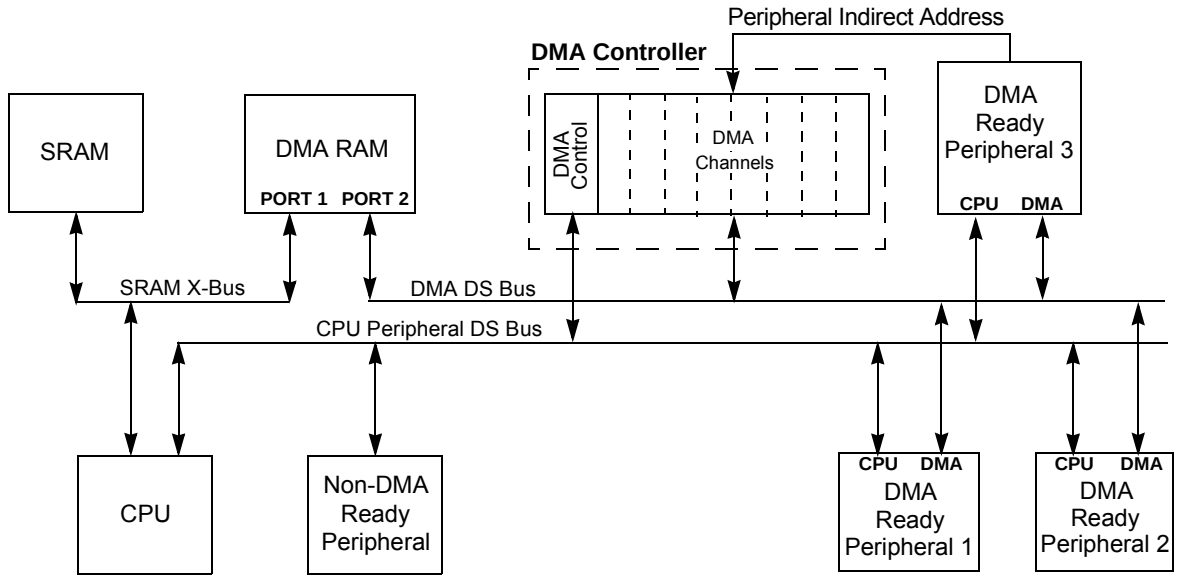
REGISTER 7-7: IFS2: INTERRUPT FLAG STATUS REGISTER 2 (CONTINUED)

bit 2 **C1RXIF:** ECAN1 Receive Data Ready Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 1 **SPI2IF:** SPI2 Event Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 0 **SPI2EIF:** SPI2 Error Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

FIGURE 8-1: TOP LEVEL SYSTEM ARCHITECTURE USING A DEDICATED TRANSACTION BUS



Note: For clarity, CPU and DMA address buses are not shown.

10.0 POWER-SAVING FEATURES

Note 1: This data sheet summarizes the features of the dsPIC33FJXXXMCX06A/X08A/X10A family of devices. However, it is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **Section 9. "Watchdog Timer and Power-Saving Modes"** (DS70196) in the *"dsPIC33F/PIC24H Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com).

2: Some registers and associated bits described in this section may not be available on all devices. Refer to **Section 4.0 "Memory Organization"** in this data sheet for device-specific register and bit information.

The dsPIC33FJXXXMCX06A/X08A/X10A devices provide the ability to manage power consumption by selectively managing clocking to the CPU and the peripherals. In general, a lower clock frequency and a reduction in the number of circuits being clocked constitutes lower consumed power. dsPIC33FJXXXMCX06A/X08A/X10A devices can manage power consumption in four different ways:

- Clock frequency
- Instruction-based Sleep and Idle modes
- Software-controlled Doze mode
- Selective peripheral control in software

Combinations of these methods can be used to selectively tailor an application's power consumption while still maintaining critical application features, such as timing-sensitive communications.

10.1 Clock Frequency and Clock Switching

dsPIC33FJXXXMCX06A/X08A/X10A devices allow a wide range of clock frequencies to be selected under application control. If the system clock configuration is not locked, users can choose low-power or high-precision oscillators by simply changing the NOSC bits (OSCCON<10:8>). The process of changing a system clock during operation, as well as limitations to the process, are discussed in more detail in **Section 9.0 "Oscillator Configuration"**.

10.2 Instruction-Based Power-Saving Modes

dsPIC33FJXXXMCX06A/X08A/X10A devices have two special power-saving modes that are entered through the execution of a special PWRSAV instruction. Sleep mode stops clock operation and halts all code execution. Idle mode halts the CPU and code execution, but allows peripheral modules to continue operation. The assembly syntax of the PWRSAV instruction is shown in Example 10-1.

Note: SLEEP_MODE and IDLE_MODE are constants defined in the assembler include file for the selected device.

Sleep and Idle modes can be exited as a result of an enabled interrupt, WDT time-out or a device Reset. When the device exits these modes, it is said to "wake-up".

10.2.1 SLEEP MODE

Sleep mode has the following features:

- The system clock source is shut down. If an on-chip oscillator is used, it is turned off.
- The device current consumption is reduced to a minimum, provided that no I/O pin is sourcing current.
- The Fail-Safe Clock Monitor does not operate during Sleep mode since the system clock source is disabled.
- The LPRC clock continues to run in Sleep mode if the WDT is enabled.
- The WDT, if enabled, is automatically cleared prior to entering Sleep mode.
- Some device features or peripherals may continue to operate in Sleep mode. This includes items such as the input change notification on the I/O ports and peripherals that use an external clock input. Any peripheral that requires the system clock source for its operation is disabled in Sleep mode.

The device will wake-up from Sleep mode on any of the following events:

- Any interrupt source that is individually enabled
- Any form of device Reset
- A WDT time-out

On wake-up from Sleep, the processor restarts with the same clock source that was active when Sleep mode was entered.

EXAMPLE 10-1: PWRSAV INSTRUCTION SYNTAX

```
PWRSAV  #SLEEP_MODE    ; Put the device into SLEEP mode
PWRSAV  #IDLE_MODE     ; Put the device into IDLE mode
```

REGISTER 16-2: PxTMR: PWMx TIMER COUNT VALUE REGISTER

R-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTDIR	PTMR<14:8>						
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
PTMR<7:0>							
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 **PTDIR:** PWM Time Base Count Direction Status bit (read-only)
1 = PWM time base is counting down
0 = PWM time base is counting up

bit 14-0 **PTMR <14:0>:** PWM Time Base Register Count Value bits

REGISTER 16-3: PxTPER: PWMx TIME BASE PERIOD REGISTER

U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	PTPER<14:8>						
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
PTPER<7:0>							
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 14-0 **PTPER<14:0>:** PWM Time Base Period Value bits

REGISTER 21-22: CiRXFUL1: ECAN™ RECEIVE BUFFER FULL REGISTER 1

R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0
RXFUL15	RXFUL14	RXFUL13	RXFUL12	RXFUL11	RXFUL10	RXFUL9	RXFUL8
bit 15							bit 8

R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0
RXFUL7	RXFUL6	RXFUL5	RXFUL4	RXFUL3	RXFUL2	RXFUL1	RXFUL0
bit 7							bit 0

Legend:		C= 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 15-0 **RXFUL15:RXFUL0:** Receive Buffer n Full bits
1 = Buffer is full (set by module)
0 = Buffer is empty (clear by application software)

REGISTER 21-23: CiRXFUL2: ECAN™ RECEIVE BUFFER FULL REGISTER 2

R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0
RXFUL31	RXFUL30	RXFUL29	RXFUL28	RXFUL27	RXFUL26	RXFUL25	RXFUL24
bit 15							bit 8

R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0
RXFUL23	RXFUL22	RXFUL21	RXFUL20	RXFUL19	RXFUL18	RXFUL17	RXFUL16
bit 7							bit 0

Legend:		C= 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 15-0 **RXFUL31:RXFUL16:** Receive Buffer n Full bits
1 = Buffer is full (set by module)
0 = Buffer is empty (clear by application software)

REGISTER 22-9: ADxPCFGH: ADCx PORT CONFIGURATION REGISTER HIGH(1,2,3,4)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PCFG31	PCFG30	PCFG29	PCFG28	PCFG27	PCFG26	PCFG25	PCFG24
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
PCFG23	PCFG22	PCFG21	PCFG20	PCFG19	PCFG18	PCFG17	PCFG16
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 15-0 **PCFG<31:16>:** ADC Port Configuration Control bits

1 = Port pin in Digital mode; port read input enabled; ADC input multiplexer connected to AVSS

0 = Port pin in Analog mode; port read input disabled; ADC samples pin voltage

Note 1: On devices without 32 analog inputs, all PCFG bits are R/W by user. However, PCFG bits are ignored on ports without a corresponding input on the device.

2: ADC2 only supports analog inputs, AN0-AN15; therefore, no ADC2 port Configuration register exists.

3: PCFGx = ANx, where x = 16 through 31.

4: The PCFGx bits have no effect if the ADC module is disabled by setting the ADxMD bit in the PMDx register. In this case, all port pins multiplexed with ANx will be in Digital mode.

REGISTER 22-10: ADxPCFGL: ADCx PORT CONFIGURATION REGISTER LOW(1,2,3,4)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PCFG15	PCFG14	PCFG13	PCFG12	PCFG11	PCFG10	PCFG9	PCFG8
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
PCFG7	PCFG6	PCFG5	PCFG4	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 15-0 **PCFG<15:0>:** ADC Port Configuration Control bits

1 = Port pin in Digital mode; port read input enabled; ADC input multiplexer connected to AVSS

0 = Port pin in Analog mode; port read input disabled; ADC samples pin voltage

Note 1: On devices without 16 analog inputs, all PCFG bits are R/W by user. However, PCFG bits are ignored on ports without a corresponding input on the device.

2: On devices with two analog-to-digital modules, both AD1PCFGL and AD2PCFGL will affect the configuration of port pins multiplexed with AN0-AN15.

3: PCFGx = ANx, where x = 0 through 15.

4: The PCFGx bits have no effect if the ADC module is disabled by setting the ADxMD bit in the PMDx register. In this case, all port pins multiplexed with ANx will be in Digital mode.

TABLE 24-1: SYMBOLS USED IN OPCODE DESCRIPTIONS (CONTINUED)

Field	Description
Wm*Wm	Multiplicand and Multiplier working register pair for Square instructions ∈ {W4 * W4,W5 * W5,W6 * W6,W7 * W7}
Wm*Wn	Multiplicand and Multiplier working register pair for DSP instructions ∈ {W4 * W5,W4 * W6,W4 * W7,W5 * W6,W5 * W7,W6 * W7}
Wn	One of 16 working registers ∈ {W0..W15}
Wnd	One of 16 destination working registers ∈ {W0...W15}
Wns	One of 16 source working registers ∈ {W0...W15}
WREG	W0 (working register used in file register instructions)
Ws	Source W register ∈ {Ws, [Ws], [Ws++], [Ws--], [++Ws], [--Ws]}
Wso	Source W register ∈ {Wns, [Wns], [Wns++], [Wns--], [++Wns], [--Wns], [Wns+Wb]}
Wx	X Data Space Prefetch Address register for DSP instructions ∈ {[W8]+ = 6, [W8]+ = 4, [W8]+ = 2, [W8], [W8]- = 6, [W8]- = 4, [W8]- = 2, [W9]+ = 6, [W9]+ = 4, [W9]+ = 2, [W9], [W9]- = 6, [W9]- = 4, [W9]- = 2, [W9 + W12], none}
Wxd	X Data Space Prefetch Destination register for DSP instructions ∈ {W4...W7}
Wy	Y Data Space Prefetch Address register for DSP instructions ∈ {[W10]+ = 6, [W10]+ = 4, [W10]+ = 2, [W10], [W10]- = 6, [W10]- = 4, [W10]- = 2, [W11]+ = 6, [W11]+ = 4, [W11]+ = 2, [W11], [W11]- = 6, [W11]- = 4, [W11]- = 2, [W11 + W12], none}
Wyd	Y Data Space Prefetch Destination register for DSP instructions ∈ {W4...W7}

TABLE 26-17: PLL CLOCK TIMING SPECIFICATIONS (VDD = 3.0V TO 3.6V)

AC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended				
Param No.	**Symbol**	**Characteristic**	**Min**	**Typ(1)**	**Max**	**Units**	**Conditions**
OS50	FPLLI	PLL Voltage Controlled Oscillator (VCO) Input Frequency Range	0.8	—	8.0	MHz	ECPLL, HSPLL, XTPLL modes
OS51	FSYS	On-Chip VCO System Frequency	100	—	200	MHz	—
OS52	TLOCK	PLL Start-up Time (Lock Time)	0.9	1.5	3.1	ms	—
OS53	DCLK	CLKO Stability (Jitter)	-3.0	0.5	3.0	%	Measured over 100 ms period

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

2: These parameters are characterized by similarity but are not tested in manufacturing. This specification is based on clock cycle by clock cycle measurements. To calculate the effective jitter for individual time base or communication clocks used by peripherals use the formula:

Peripheral Clock Jitter = DCLK / √(FOSC/Peripheral bit rate clock)

Example Only: Fosc = 80 MHz, DCLK = 3%, SPI bit rate clock, (i.e. SCK), is 5 MHz

SPI SCK Jitter = [DCLK / √(80 MHz/5 MHz)] = [3%/ √16] = [3% / 4] = 0.75%

TABLE 26-18: AC CHARACTERISTICS: INTERNAL FRC ACCURACY

AC CHARACTERISTICS		Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended					
Param No.	**Characteristic**	**Min**	**Typ**	**Max**	**Units**	**Conditions**	
	Internal FRC Accuracy @ FRC Frequency = 7.37 MHz(1)						
F20a	FRC	-2	—	+2	%	-40°C ≤ TA ≤ +85°C	VDD = 3.0-3.6V
F20b	FRC	-5	—	+5	%	-40°C ≤ TA ≤ +125°C	VDD = 3.0-3.6V

Note 1: Frequency calibrated at 25°C and 3.3V. TUN bits can be used to compensate for temperature drift.

TABLE 26-19: INTERNAL LPRC ACCURACY

AC CHARACTERISTICS		Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended					
Param No.	**Characteristic**	**Min**	**Typ**	**Max**	**Units**	**Conditions**	
	LPRC @ 32.768 kHz(1)						
F21a	LPRC	-30	—	+30	%	-40°C ≤ TA ≤ +85°C	—
F21b	LPRC	-35	—	+35	%	-40°C ≤ TA ≤ +125°C	—

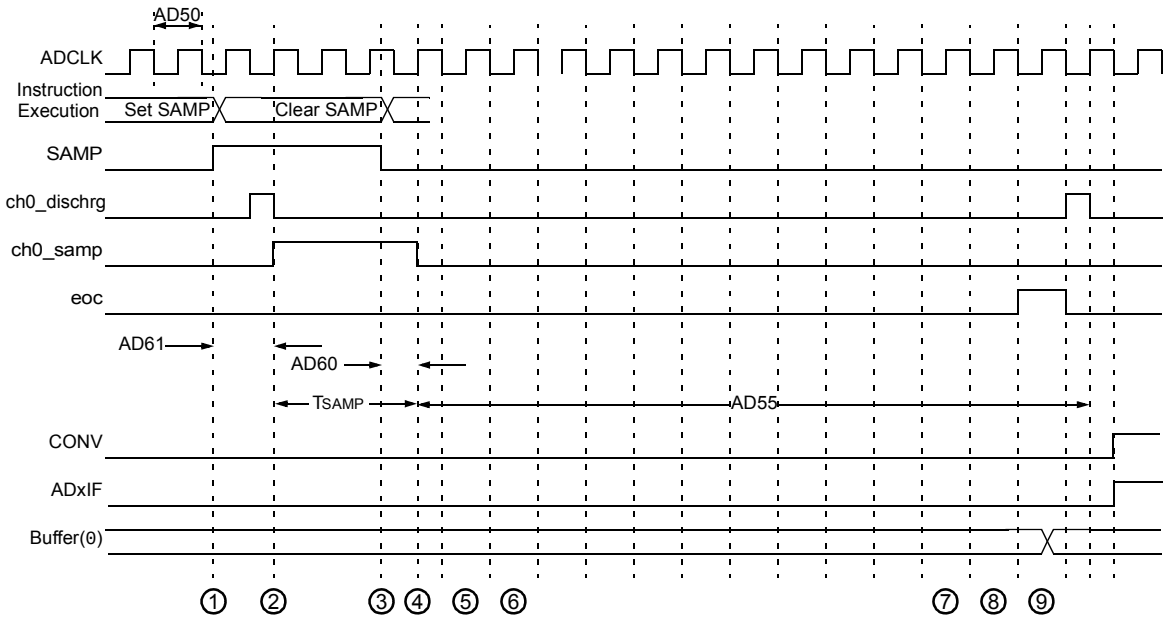
Note 1: Change of LPRC frequency as VDD changes.

TABLE 26-44: ADC MODULE SPECIFICATIONS (12-BIT MODE)(1)

AC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended				
Param No.	**Symbol**	**Characteristic**	**Min.**	**Typ**	**Max.**	**Units**	**Conditions**
ADC Accuracy (12-Bit Mode) – Measurements with External VREF+/VREF-							
AD20a	Nr	Resolution	12 data bits			bits	—
AD21a	INL	Integral Nonlinearity	-2	—	+2	LSb	VINL = AVSS = VREFL = 0V, AVDD = VREFH = 3.6V
AD22a	DNL	Differential Nonlinearity	>-1	—	<1	LSb	VINL = AVSS = VREFL = 0V, AVDD = VREFH = 3.6V
AD23a	GERR	Gain Error	—	3.4	10	LSb	VINL = AVSS = VREFL = 0V, AVDD = VREFH = 3.6V
AD24a	EOFF	Offset Error	Q	0.9	5	LSb	VINL = AVSS = VREFL = 0V, AVDD = VREFH = 3.6V
AD25a	—	Monotonicity	—	—	—	—	Guaranteed
ADC Accuracy (12-Bit Mode) – Measurements with Internal VREF+/VREF-							
AD20b	Nr	Resolution	12 data bits			bits	—
AD21b	INL	Integral Nonlinearity	-2	—	+2	LSb	VINL = AVSS = 0V, AVDD = 3.6V
AD22b	DNL	Differential Nonlinearity	>-1	—	<1	LSb	VINL = AVSS = 0V, AVDD = 3.6V
AD23b	GERR	Gain Error	—	10.5	20	LSb	VINL = AVSS = 0V, AVDD = 3.6V
AD24b	EOFF	Offset Error	—	3.8	10	LSb	VINL = AVSS = 0V, AVDD = 3.6V
AD25b	—	Monotonicity	—	—	—	—	Guaranteed
Dynamic Performance (12-Bit Mode)							
AD30a	THD	Total Harmonic Distortion	—	—	-75	dB	—
AD31a	SINAD	Signal to Noise and Distortion	68.5	69.5	—	dB	—
AD32a	SFDR	Spurious Free Dynamic Range	80	—	—	dB	—
AD33a	FNYQ	Input Signal Bandwidth	—	—	250	kHz	—
AD34a	ENOB	Effective Number of Bits	11.09	11.3	—	bits	—

Note 1: Injection currents > | 0 | can affect the ADC results by approximately 4-6 counts.

FIGURE 26-27: ADC CONVERSION (12-BIT MODE) TIMING CHARACTERISTICS (ASAM = 0, SSRC<2:0> = 000)



(1) – Software sets ADxCON. SAMP to start sampling.

(2) – Sampling starts after discharge period. TSAMP is described in **Section 16. "10/12-bit ADC with DMA"** in the *"dsPIC33F Family Reference Manual"*.

(3) – Software clears ADxCON. SAMP to start conversion.

(4) – Sampling ends, conversion sequence starts.

(5) – Convert bit 11.

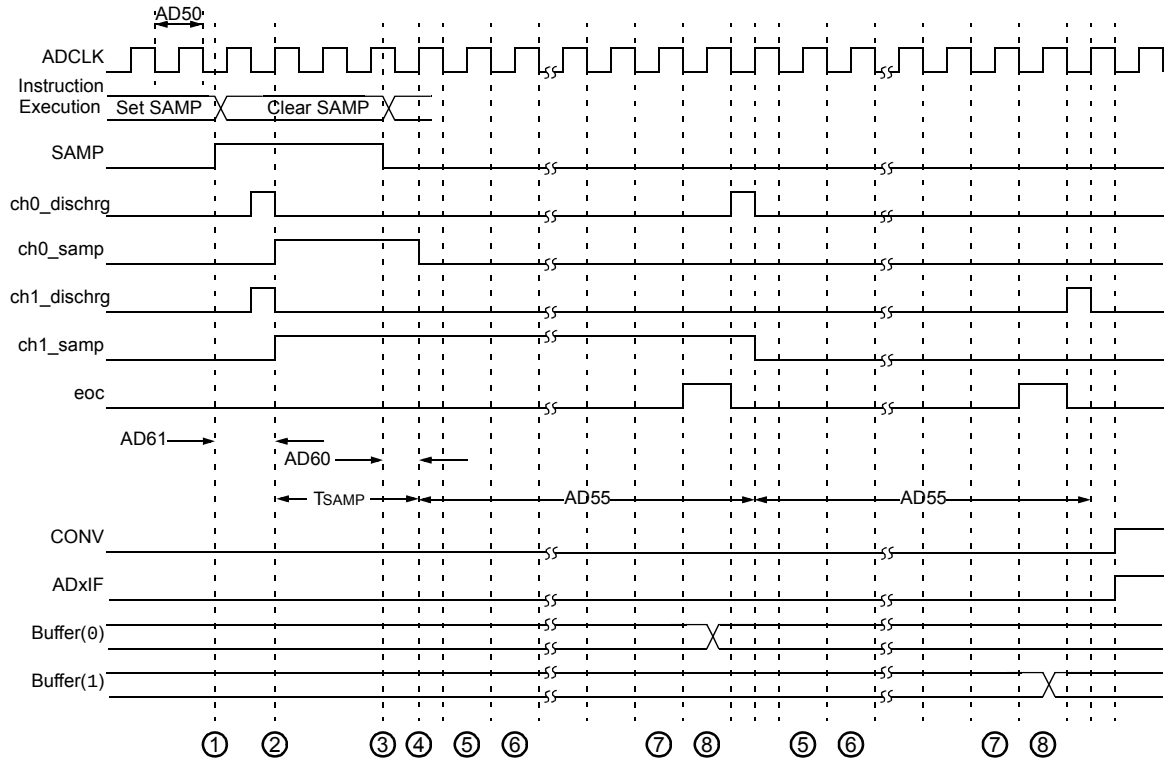
(6) – Convert bit 10.

(7) – Convert bit 1.

(8) – Convert bit 0.

(9) – One TAD for end of conversion.

FIGURE 26-28: ADC CONVERSION (10-BIT MODE) TIMING CHARACTERISTICS (CHPS<1:0> = 01, SIMSAM = 0, ASAM = 0, SSRC<2:0> = 000)



① – Software sets ADxCON. SAMP to start sampling.

② – Sampling starts after discharge period. TSAMP is described in **Section 16. "10/12-bit ADC with DMA"** in the *"dsPIC33F Family Reference Manual"*.

③ – Software clears ADxCON. SAMP to start conversion.

④ – Sampling ends, conversion sequence starts.

⑤ – Convert bit 9.

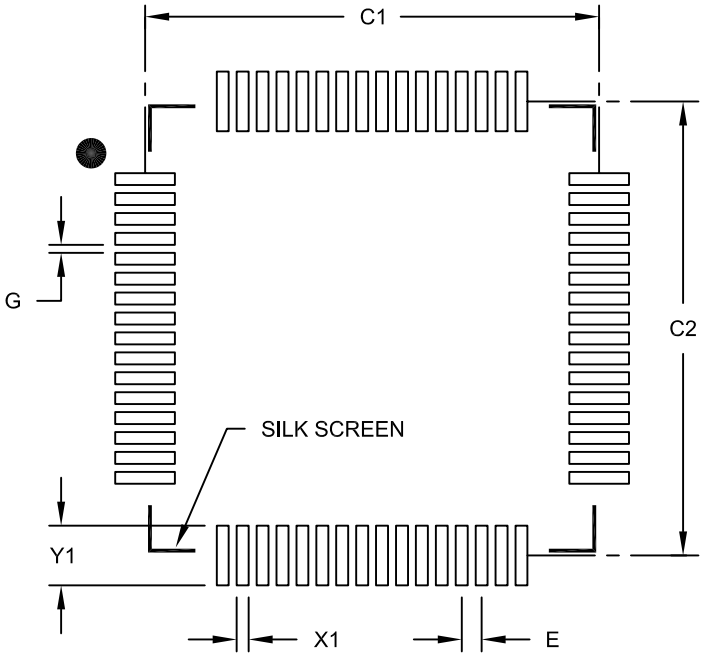
⑥ – Convert bit 8.

⑦ – Convert bit 0.

⑧ – One TAD for end of conversion.

64-Lead Plastic Thin Quad Flatpack (PT) 10x10x1 mm Body, 2.00 mm Footprint [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		0.50 BSC	
Contact Pad Spacing	C1		11.40	
Contact Pad Spacing	C2		11.40	
Contact Pad Width (X64)	X1			0.30
Contact Pad Length (X64)	Y1			1.50
Distance Between Pads	G	0.20		

Notes:

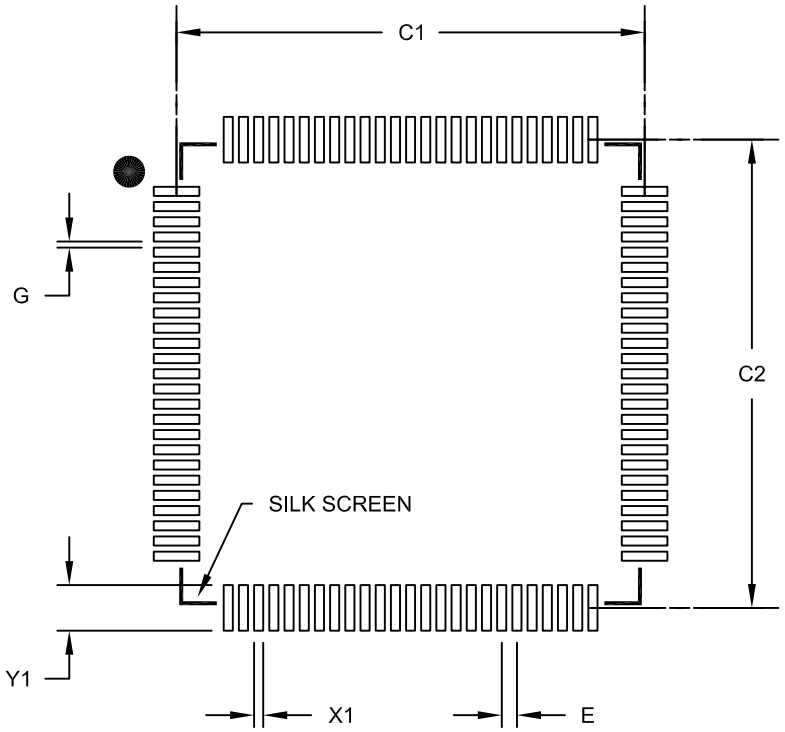
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2085B

100-Lead Plastic Thin Quad Flatpack (PF) - 14x14x1 mm Body 2.00 mm Footprint [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		0.50 BSC	
Contact Pad Spacing	C1		15.40	
Contact Pad Spacing	C2		15.40	
Contact Pad Width (X100)	X1			0.30
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. C04-2110B

TABLE B-2: MAJOR SECTION UPDATES (CONTINUED)

Section Name	Update Description
Section 26.0 "Electrical Characteristics"	Removed Note 4 from the DC Temperature and Voltage Specifications (see Table 26-4). Updated the maximum value for parameter DI19 and added parameters DI28, DI29, DI60a, DI60b, and DI60c to the I/O Pin Input Specifications (see Table 26-9). Removed Note 2 from the AC Characteristics: Internal RC Accuracy (see Table 26-18). Updated the characteristic description for parameter DI35 in the I/O Timing Requirements (see Table 26-20). Updated the ADC Module Specification minimum values for parameters AD05 and AD07, and updated the maximum value for parameter AD06 (see Table 26-43). Added Note 1 to the ADC Module Specifications (12-bit Mode) (see Table 26-44). Added Note 1 to the ADC Module Specifications (10-bit Mode) (see Table 26-45). Added DMA Read/Write Timing Requirements (see Table 26-48).
Section 27.0 "High Temperature Electrical Characteristics"	Updated all ambient temperature end range values to +150ºC throughout the chapter. Updated the storage temperature end range to +160ºC. Updated the maximum junction temperature from +145ºC to +155ºC. Updated the maximum values for High Temperature Devices in the Thermal Operating Conditions (see Table 27-2). Updated the ADC Module Specifications (12-bit Mode), removing all parameters with the exception of HAD33a (see Table 27-14). Updated the ADC Module Specifications (10-bit Mode), removing all parameters with the exception of HAD33b (see Table 27-16).

IPC13 (Interrupt Priority Control 13) 125
IPC14 (Interrupt Priority Control 14) 126
IPC15 (Interrupt Priority Control 15) 127
IPC16 (Interrupt Priority Control 16) 128
IPC17 (Interrupt Priority Control 17) 129
IPC2 (Interrupt Priority Control 2) 114
IPC3 (Interrupt Priority Control 3) 115
IPC4 (Interrupt Priority Control 4) 116
IPC5 (Interrupt Priority Control 5) 117
IPC6 (Interrupt Priority Control 6) 118
IPC7 (Interrupt Priority Control 7) 119
IPC8 (Interrupt Priority Control 8) 120
IPC9 (Interrupt Priority Control 9) 121
NVMCOM (Flash Memory Control) 75
OCxCON (Output Compare x Control) 177
OSCCON (Oscillator Control) 146
OSCTUN (FRC Oscillator Tuning) 150
PLLFBD (PLL Feedback Divisor) 149
PMD1 (Peripheral Module Disable Control 1) 155
PMD2 (Peripheral Module Disable Control 2) 157
PMD3 (Peripheral Module Disable Control 3) 159
PWMxCON1 (PWMx Control 1) 184
PWMxCON2 (PWMx Control 2) 185
PxDC1 (PWMx Duty Cycle 1) 191
PxDC2 (PWMx Duty Cycle 2) 191
PxDC3 (PWMx Duty Cycle 3) 192
PxDC4 (PWMx Duty Cycle 4) 192
PxDTCON1 (PWMx Dead-Time Control 1) 186
PxDTCON2 (PWMx Dead-Time Control 2) 187
PxFLTACON (PWMx Fault A Control) 188
PxFLTBCON (PWMx Fault B Control) 189
PxOVDCON (PWMx Override Control) 190
PxSECMP (PWMx Special Event Compare) 183
PxTCON (PWMx Time Base Control) 181
PxTMR (PWMx Timer Count Value) 182
PxTPER (PWMx Time Base Period) 182
QEIxCON (QEIx Control) 194
RCON (Reset Control) 80
SPIxCON1 (SPIx Control 1) 200
SPIxCON2 (SPIx Control 2) 202
SPIxSTAT (SPIx Status and Control) 199
SR (CPU STATUS) 90
SR (CPU Status) 26
T1CON (Timer1 Control) 166
TxCON (T2CON, T4CON, T6CON or T8CON Control) 170
TyCON (T3CON, T5CON, T7CON or T9CON Control) 171
UxMODE (UARTx Mode) 213
UxSTA (UARTx Status and Control) 215
Reset
Clock Source Selection 82
Special Function Register States 84
Times 82
Reset Sequence 85
Resets 79
Revision History 358

S

Serial Peripheral Interface (SPI) 197
Software Simulator (MPLAB SIM) 277
Software Stack Pointer, Frame Pointer
CALL Stack Frame 63
Special Features of the CPU 259
SPI Module
SPI1 Register Map 51
SPI2 Register Map 51
Symbols Used in Opcode Descriptions 268
System Control
Register Map 62

T

Temperature and Voltage Specifications
AC 290, 333
Timer1 165
Timer2/3, Timer4/5, Timer6/7 and Timer8/9 167
Timing Characteristics
CLKO and I/O 293
Timing Diagrams
10-Bit A/D Conversion (CHPS<1:0> = 01, SIMSAM = 0, ASAM = 0, SSRC<2:0> = 000) 326
10-Bit A/D Conversion (CHPS<1:0> = 01, SIMSAM = 0, ASAM = 1, SSRC<2:0> = 111, SAMC<4:0> = 00001) 327
12-Bit A/D Conversion (ASAM = 0, SSRC = 000) 324
CAN I/O 320
External Clock 291
I2Cx Bus Data (Master Mode) 316
I2Cx Bus Data (Slave Mode) 318
I2Cx Bus Start/Stop Bits (Master Mode) 316
I2Cx Bus Start/Stop Bits (Slave Mode) 318
Input Capture (CAPx) 298
Motor Control PWM 300
Motor Control PWM Fault 300
OC/PWM 299
Output Compare (OCx) 298
QEA/QEB Input 301
QEI Module Index Pulse 302
Reset, Watchdog Timer, Oscillator Start-up Timer and Power-up Timer 294
Timer1, 2, 3, 4, 5, 6, 7, 8, 9 External Clock 296
TimerQ (QEI Module) External Clock 303
Timing Requirements
ADC Conversion (10-bit mode) 337
ADC Conversion (12-bit Mode) 337
CLKO and I/O 293
External Clock 291
Input Capture 298
SPIx Master Mode (CKE = 0) 334
SPIx Module Master Mode (CKE = 1) 334
SPIx Module Slave Mode (CKE = 0) 335
SPIx Module Slave Mode (CKE = 1) 335