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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	dsPIC
Core Size	16-Bit
Speed	40 MIPS
Connectivity	I ² C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, Motor Control PWM, POR, PWM, QEI, WDT
Number of I/O	35
Program Memory Size	64KB (64K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 9x10b/12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	44-TQFP
Supplier Device Package	44-TQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/dspic33fj64mc204-e-pt

TABLE 4-1: CPU CORE REGISTERS MAP (CONTINUED)

SFR 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	
MODCON	0046	XMODEN	YMODEN	—	—	BWM<3:0>				YWM<3:0>				XWM<3:0>				0000	
XMODSRT	0048	XS<15:1>																0	xxxx
XMODEND	004A	XE<15:1>																1	xxxx
YMODSRT	004C	YS<15:1>																0	xxxx
YMODEND	004E	YE<15:1>																1	xxxx
XBREV	0050	BREN	XB<14:0>																xxxx
DISICNT	0052	—	—	Disable Interrupts Counter Register														xxxx	

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

TABLE 4-20: DMA 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	
DMA0CON	0380	CHEN	SIZE	DIR	HALF	NULLW	—	—	—	—	—	AMODE<1:0>		—	—	MODE<1:0>		0000	
DMA0REQ	0382	FORCE	—	—	—	—	—	—	—	—	IRQSEL<6:0>								0000
DMA0STA	0384	STA<15:0>																	0000
DMA0STB	0386	STB<15:0>																	0000
DMA0PAD	0388	PAD<15:0>																	0000
DMA0CNT	038A	—	—	—	—	—	—	CNT<9:0>											0000
DMA1CON	038C	CHEN	SIZE	DIR	HALF	NULLW	—	—	—	—	—	AMODE<1:0>		—	—	MODE<1:0>		0000	
DMA1REQ	038E	FORCE	—	—	—	—	—	—	—	—	IRQSEL<6:0>								0000
DMA1STA	0390	STA<15:0>																	0000
DMA1STB	0392	STB<15:0>																	0000
DMA1PAD	0394	PAD<15:0>																	0000
DMA1CNT	0396	—	—	—	—	—	—	CNT<9:0>											0000
DMA2CON	0398	CHEN	SIZE	DIR	HALF	NULLW	—	—	—	—	—	AMODE<1:0>		—	—	MODE<1:0>		0000	
DMA2REQ	039A	FORCE	—	—	—	—	—	—	—	—	IRQSEL<6:0>								0000
DMA2STA	039C	STA<15:0>																	0000
DMA2STB	039E	STB<15:0>																	0000
DMA2PAD	03A0	PAD<15:0>																	0000
DMA2CNT	03A2	—	—	—	—	—	—	CNT<9:0>											0000
DMA3CON	03A4	CHEN	SIZE	DIR	HALF	NULLW	—	—	—	—	—	AMODE<1:0>		—	—	MODE<1:0>		0000	
DMA3REQ	03A6	FORCE	—	—	—	—	—	—	—	—	IRQSEL<6:0>								0000
DMA3STA	03A8	STA<15:0>																	0000
DMA3STB	03AA	STB<15:0>																	0000
DMA3PAD	03AC	PAD<15:0>																	0000
DMA3CNT	03AE	—	—	—	—	—	—	CNT<9:0>											0000
DMA4CON	03B0	CHEN	SIZE	DIR	HALF	NULLW	—	—	—	—	—	AMODE<1:0>		—	—	MODE<1:0>		0000	
DMA4REQ	03B2	FORCE	—	—	—	—	—	—	—	—	IRQSEL<6:0>								0000
DMA4STA	03B4	STA<15:0>																	0000
DMA4STB	03B6	STB<15:0>																	0000
DMA4PAD	03B8	PAD<15:0>																	0000
DMA4CNT	03BA	—	—	—	—	—	—	CNT<9:0>											0000
DMA5CON	03BC	CHEN	SIZE	DIR	HALF	NULLW	—	—	—	—	—	AMODE<1:0>		—	—	MODE<1:0>		0000	
DMA5REQ	03BE	FORCE	—	—	—	—	—	—	—	—	IRQSEL<6:0>								0000
DMA5STA	03C0	STA<15:0>																	0000
DMA5STB	03C2	STB<15:0>																	0000

Legend: — = unimplemented, read as '0'.

TABLE 4-20: 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'.

TABLE 6-2: OSCILLATOR PARAMETERS

Symbol	Parameter	Value
VPOR	POR threshold	1.8V nominal
TPOR	POR extension time	30 μ s maximum
VBOR	BOR threshold	2.5V nominal
TBOR	BOR extension time	100 μ s maximum
TPWRT	Programmable power-up time delay	0-128 ms nominal
TfSCM	Fail-Safe Clock Monitor Delay	900 μ s maximum

Note: When the device exits the Reset condition (begins normal operation), the device operating parameters (voltage, frequency, temperature, etc.) must be within their operating ranges, otherwise, the device may not function correctly. The user application must ensure that the delay between the time power is first applied, and the time SYSRST becomes inactive, is long enough to get all operating parameters within specification.

6.4 Power-on Reset (POR)

A Power-on Reset (POR) circuit ensures the device is reset from power-on. The POR circuit is active until VDD crosses the VPOR threshold and the delay TPOR has elapsed. The delay TPOR ensures the internal device bias circuits become stable.

The device supply voltage characteristics must meet the specified starting voltage and rise rate requirements to generate the POR. Refer to [Section 31.0 “Electrical Characteristics”](#) for details.

The POR status bit (POR) in the Reset Control register (RCON<0>) is set to indicate the Power-on Reset.

6.4.1 Brown-out Reset (BOR) and Power-up Timer (PWRT)

The on-chip regulator has a Brown-out Reset (BOR) circuit that resets the device when the VDD is too low ($VDD < VBOR$) for proper device operation. The BOR circuit keeps the device in Reset until VDD crosses VBOR threshold and the delay TBOR has elapsed. The delay TBOR ensures the voltage regulator output becomes stable.

The BOR status bit (BOR) in the Reset Control register (RCON<1>) is set to indicate the Brown-out Reset.

The device will not run at full speed after a BOR as the VDD should rise to acceptable levels for full-speed operation. The PWRT provides power-up time delay (TPWRT) to ensure that the system power supplies have stabilized at the appropriate levels for full-speed operation before the SYSRST is released.

The power-up timer delay (TPWRT) is programmed by the Power-on Reset Timer Value Select bits (FPWRT<2:0>) in the POR Configuration register (FPOR<2:0>), which provides eight settings (from 0 ms to 128 ms). Refer to [Section 28.0 “Special Features”](#) for further details.

[Figure 6-3](#) shows the typical brown-out scenarios. The reset delay (TBOR + TPWRT) is initiated each time VDD rises above the VBOR trip point

7.6 Interrupt Setup Procedures

7.6.1 INITIALIZATION

To configure an interrupt source at initialization:

1. Set the NSTDIS 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 depends 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 can 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 flag status 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.

7.6.2 INTERRUPT SERVICE ROUTINE

The method used to declare an ISR and initialize the IVT with the correct vector address depends on the programming language (C or assembler) and the language development tool suite used to develop the application.

In general, the user application must clear the interrupt flag in the appropriate IFSx register for the source of interrupt that the ISR handles. Otherwise, the program re-enters the ISR 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.

7.6.3 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.

7.6.4 INTERRUPT DISABLE

All user interrupts can be disabled using this 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 OEh with SRL.

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

Note: Only user interrupts with a priority level of 7 or lower can be disabled. Trap sources (level 8-level 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.

REGISTER 8-8: DMACS1: DMA CONTROLLER STATUS REGISTER 1

U-0	U-0	U-0	U-0	R-1	R-1	R-1	R-1
—	—	—	—	LSTCH<3:0>			
bit 15				bit 8			

R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0
PPST7	PPST6	PPST5	PPST4	PPST3	PPST2	PPST1	PPST0
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 **Unimplemented:** Read as '0'

bit 11-8 **LSTCH<3:0>:** Last DMA Channel Active bits

1111 = No DMA transfer has occurred since system Reset

1110-1000 = Reserved

0111 = Last data transfer was by DMA Channel 7

0110 = Last data transfer was by DMA Channel 6

0101 = Last data transfer was by DMA Channel 5

0100 = Last data transfer was by DMA Channel 4

0011 = Last data transfer was by DMA Channel 3

0010 = Last data transfer was by DMA Channel 2

0001 = Last data transfer was by DMA Channel 1

0000 = Last data transfer was by DMA Channel 0

bit 7 **PPST7:** Channel 7 Ping-Pong Mode Status Flag bit

1 = DMA7STB register selected

0 = DMA7STA register selected

bit 6 **PPST6:** Channel 6 Ping-Pong Mode Status Flag bit

1 = DMA6STB register selected

0 = DMA6STA register selected

bit 5 **PPST5:** Channel 5 Ping-Pong Mode Status Flag bit

1 = DMA5STB register selected

0 = DMA5STA register selected

bit 4 **PPST4:** Channel 4 Ping-Pong Mode Status Flag bit

1 = DMA4STB register selected

0 = DMA4STA register selected

bit 3 **PPST3:** Channel 3 Ping-Pong Mode Status Flag bit

1 = DMA3STB register selected

0 = DMA3STA register selected

bit 2 **PPST2:** Channel 2 Ping-Pong Mode Status Flag bit

1 = DMA2STB register selected

0 = DMA2STA register selected

bit 1 **PPST1:** Channel 1 Ping-Pong Mode Status Flag bit

1 = DMA1STB register selected

0 = DMA1STA register selected

bit 0 **PPST0:** Channel 0 Ping-Pong Mode Status Flag bit

1 = DMA0STB register selected

0 = DMA0STA register selected

NOTES:

REGISTER 9-1: OSCCON: OSCILLATOR CONTROL REGISTER^(1,3) (CONTINUED)

- bit 3 **CF:** Clock Fail Detect bit (read/clear by application)
 1 = FSCM has detected clock failure
 0 = FSCM has not detected clock failure
- bit 2 **Unimplemented:** Read as '0'
- bit 1 **LPOSCEN:** Secondary (LP) Oscillator Enable bit
 1 = Enable secondary oscillator
 0 = Disable secondary oscillator
- bit 0 **OSWEN:** Oscillator Switch Enable bit
 1 = Request oscillator switch to selection specified by NOSC<2:0> bits
 0 = Oscillator switch is complete

- Note 1:** Writes to this register require an unlock sequence. Refer to **Section 39. “Oscillator (Part III)”** (DS70216) in the *“dsPIC33F/PIC24H Family Reference Manual”* (available from the Microchip web site) for details.
- 2:** Direct clock switches between any primary oscillator mode with PLL and FRCPLL mode are not permitted. This applies to clock switches in either direction. In these instances, the application must switch to FRC mode as a transition clock source between the two PLL modes.
- 3:** This register is reset only on a Power-on Reset (POR).

REGISTER 11-5: RPINR7: PERIPHERAL PIN SELECT INPUT REGISTER 7

U-0	U-0	U-0	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
—	—	—	IC2R<4:0>				
bit 15							bit 8

U-0	U-0	U-0	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
—	—	—	IC1R<4:0>				
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 15-13 **Unimplemented:** Read as '0'

bit 12-8 **IC2R<4:0>:** Assign Input Capture 2 (IC2) to the corresponding RPn pin

11111 = Input tied to Vss

11001 = Input tied to RP25

•

•

•

00001 = Input tied to RP1

00000 = Input tied to RP0

bit 7-5 **Unimplemented:** Read as '0'

bit 4-0 **IC1R<4:0>:** Assign Input Capture 1 (IC1) to the corresponding RPn pin

11111 = Input tied to Vss

11001 = Input tied to RP25

•

•

•

00001 = Input tied to RP1

00000 = Input tied to RP0

REGISTER 11-18: RPINR22: PERIPHERAL PIN SELECT INPUT REGISTER 22

U-0	U-0	U-0	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
—	—	—	SCK2R<4:0>				
bit 15							bit 8

U-0	U-0	U-0	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
—	—	—	SDI2R<4:0>				
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 15-13 **Unimplemented:** Read as '0'

bit 12-8 **SCK2R<4:0>:** Assign SPI2 Clock Input (SCK2) to the corresponding RPn pin

11111 = Input tied to Vss

11001 = Input tied to RP25

•

•

•

00001 = Input tied to RP1

00000 = Input tied to RP0

bit 7-5 **Unimplemented:** Read as '0'

bit 4-0 **SDI2R<4:0>:** Assign SPI2 Data Input (SDI2) to the corresponding RPn pin

11111 = Input tied to Vss

11001 = Input tied to RP25

•

•

•

00001 = Input tied to RP1

00000 = Input tied to RP0

REGISTER 18-3: SPIxCON2: SPIx CONTROL REGISTER 2

R/W-0	R/W-0	R/W-0	U-0	U-0	U-0	U-0	U-0
FRMEN	SPIFSD	FRMPOL	—	—	—	—	—
bit 15						bit 8	

U-0	U-0	U-0	U-0	U-0	U-0	R/W-0	U-0
—	—	—	—	—	—	FRMDLY	—
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 **FRMEN:** Framed SPIx Support bit
 1 = Framed SPIx support enabled (\overline{SSx} pin used as frame sync pulse input/output)
 0 = Framed SPIx support disabled
- bit 14 **SPIFSD:** Frame Sync Pulse Direction Control bit
 1 = Frame sync pulse input (slave)
 0 = Frame sync pulse output (master)
- bit 13 **FRMPOL:** Frame Sync Pulse Polarity bit
 1 = Frame sync pulse is active-high
 0 = Frame sync pulse is active-low
- bit 12-2 **Unimplemented:** Read as '0'
- bit 1 **FRMDLY:** Frame Sync Pulse Edge Select bit
 1 = Frame sync pulse coincides with first bit clock
 0 = Frame sync pulse precedes first bit clock
- bit 0 **Unimplemented:** This bit must not be set to '1' by the user application

REGISTER 25-2: PADCFG1: PAD CONFIGURATION CONTROL REGISTER

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

U-0	U-0	U-0	U-0	U-0	U-0	R/W-0	R/W-0
—	—	—	—	—	—	RTSECSEL ⁽¹⁾	PMPTTL
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 15-2 **Unimplemented:** Read as '0'

bit 1 **RTSECSEL:** RTCC Seconds Clock Output Select bit⁽¹⁾

1 = RTCC seconds clock is selected for the RTCC pin

0 = RTCC alarm pulse is selected for the RTCC pin

bit 0 **PMPTTL:** PMP Module TTL Input Buffer Select bit

1 = PMP module uses TTL input buffers

0 = PMP module uses Schmitt Trigger input buffers

Note 1: To enable the actual RTCC output, the RTCOE bit (RCFGCAL) needs to be set.

REGISTER 25-6: RTCVAL (WHEN RTCPTR<1:0> = 01): WKDYHR: WEEKDAY AND HOURS VALUE REGISTER⁽¹⁾

U-0	U-0	U-0	U-0	U-0	R/W-x	R/W-x	R/W-x
—	—	—	—	—	WDAY<2:0>		
bit 15						bit 8	

U-0	U-0	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
—	—	HRTEN<1:0>		HRONE<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 15-11 **Unimplemented:** Read as '0'bit 10-8 **WDAY<2:0>:** Binary Coded Decimal Value of Weekday Digit; contains a value from 0 to 6bit 7-6 **Unimplemented:** Read as '0'bit 5-4 **HRTEN<1:0>:** Binary Coded Decimal Value of Hour's Tens Digit; contains a value from 0 to 2bit 3-0 **HRONE<3:0>:** Binary Coded Decimal Value of Hour's Ones Digit; contains a value from 0 to 9**Note 1:** A write to this register is only allowed when RTCWREN = 1.**REGISTER 25-7: RTCVAL (WHEN RTCPTR<1:0> = 00): MINUTES AND SECONDS VALUE REGISTER**

U-0	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
—	MINTEN<2:0>			MINONE<3:0>			
bit 15				bit 8			

U-0	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
—	SECTEN<2:0>			SECONE<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 **Unimplemented:** Read as '0'bit 14-12 **MINTEN<2:0>:** Binary Coded Decimal Value of Minute's Tens Digit; contains a value from 0 to 5bit 11-8 **MINONE<3:0>:** Binary Coded Decimal Value of Minute's Ones Digit; contains a value from 0 to 9bit 7 **Unimplemented:** Read as '0'bit 6-4 **SECTEN<2:0>:** Binary Coded Decimal Value of Second's Tens Digit; contains a value from 0 to 5bit 3-0 **SECCONE<3:0>:** Binary Coded Decimal Value of Second's Ones Digit; contains a value from 0 to 9

TABLE 28-2: dsPIC33F CONFIGURATION BITS DESCRIPTION (CONTINUED)

Bit Field	Register	RTSP Effect	Description
GSS<1:0>	FGS	Immediate	General Segment Code-Protect bit 11 = User program memory is not code-protected 10 = Standard security 0x = High security
GWRP	FGS	Immediate	General Segment Write-Protect bit 1 = User program memory is not write-protected 0 = User program memory is write-protected
IESO	FOSCSEL	Immediate	Two-speed Oscillator Start-up Enable bit 1 = Start-up device with FRC, then automatically switch to the user-selected oscillator source when ready 0 = Start-up device with user-selected oscillator source
FNOSC<2:0>	FOSCSEL	If clock switch is enabled, RTSP effect is on any device Reset; otherwise, Immediate	Initial Oscillator Source Selection bits 111 = Internal Fast RC (FRC) oscillator with postscaler 110 = Internal Fast RC (FRC) oscillator with divide-by-16 101 = LPRC oscillator 100 = Secondary (LP) oscillator 011 = Primary (XT, HS, EC) oscillator with PLL 010 = Primary (XT, HS, EC) oscillator 001 = Internal Fast RC (FRC) oscillator with PLL 000 = FRC oscillator
FCKSM<1:0>	FOSC	Immediate	Clock Switching Mode bits 1x = Clock switching is disabled, Fail-Safe Clock Monitor is disabled 01 = Clock switching is enabled, Fail-Safe Clock Monitor is disabled 00 = Clock switching is enabled, Fail-Safe Clock Monitor is enabled
IOL1WAY	FOSC	Immediate	Peripheral Pin Select Configuration bit 1 = Allow only one reconfiguration 0 = Allow multiple reconfigurations
OSCIOFNC	FOSC	Immediate	OSC2 Pin Function bit (except in XT and HS modes) 1 = OSC2 is clock output 0 = OSC2 is general purpose digital I/O pin
POSCMD<1:0>	FOSC	Immediate	Primary Oscillator Mode Select bits 11 = Primary oscillator disabled 10 = HS Crystal Oscillator mode 01 = XT Crystal Oscillator mode 00 = EC (External Clock) mode
FWDTEN	FWDT	Immediate	Watchdog Timer Enable bit 1 = Watchdog Timer always enabled (LPRC oscillator cannot be disabled. Clearing the SWDTEN bit in the RCON register has no effect.) 0 = Watchdog Timer enabled/disabled by user software (LPRC can be disabled by clearing the SWDTEN bit in the RCON register)
WINDIS	FWDT	Immediate	Watchdog Timer Window Enable bit 1 = Watchdog Timer in Non-Window mode 0 = Watchdog Timer in Window mode
WDTPRE	FWDT	Immediate	Watchdog Timer Prescaler bit 1 = 1:128 0 = 1:32

Note 1: This Configuration register is not available on dsPIC33FJ32MC302/304 devices.

Most instructions are a single word. Certain double-word instructions are designed to provide all the required information in these 48 bits. In the second word, the 8 MSBs are '0's. If this second word is executed as an instruction (by itself), it executes as a NOP.

The double-word instructions execute in two instruction cycles.

Most single-word instructions are executed in a single instruction cycle, unless a conditional test is true, or the program counter is changed as a result of the instruction. In these cases, the execution takes two instruction cycles with the additional instruction cycle(s) executed as a NOP. Notable exceptions are the BRA

(unconditional/computed branch), indirect CALL/GOTO, all table reads and writes and RETURN/RETFIE instructions, which are single-word instructions but take two or three cycles. Certain instructions that involve skipping over the subsequent instruction require either two or three cycles if the skip is performed, depending on whether the instruction being skipped is a single-word or two-word instruction. Moreover, double-word moves require two cycles.

Note: For more details on the instruction set, refer to the "16-bit MCU and DSC Programmer's Reference Manual" (DS70157).

TABLE 29-1: SYMBOLS USED IN OPCODE DESCRIPTIONS

Field	Description
#text	Means literal defined by "text"
(text)	Means "content of text"
[text]	Means "the location addressed by text"
{ }	Optional field or operation
<n:m>	Register bit field
.b	Byte mode selection
.d	Double-Word mode selection
.S	Shadow register select
.w	Word mode selection (default)
Acc	One of two accumulators {A, B}
AWB	Accumulator write back destination address register $\in \{W13, [W13]+ = 2\}$
bit4	4-bit bit selection field (used in word addressed instructions) $\in \{0...15\}$
C, DC, N, OV, Z	MCU Status bits: Carry, Digit Carry, Negative, Overflow, Sticky Zero
Expr	Absolute address, label or expression (resolved by the linker)
f	File register address $\in \{0x0000...0x1FFF\}$
lit1	1-bit unsigned literal $\in \{0, 1\}$
lit4	4-bit unsigned literal $\in \{0...15\}$
lit5	5-bit unsigned literal $\in \{0...31\}$
lit8	8-bit unsigned literal $\in \{0...255\}$
lit10	10-bit unsigned literal $\in \{0...255\}$ for Byte mode, $\{0:1023\}$ for Word mode
lit14	14-bit unsigned literal $\in \{0...16384\}$
lit16	16-bit unsigned literal $\in \{0...65535\}$
lit23	23-bit unsigned literal $\in \{0...8388608\}$; LSb must be '0'
None	Field does not require an entry, can be blank
OA, OB, SA, SB	DSP Status bits: ACCA Overflow, ACCB Overflow, ACCA Saturate, ACCB Saturate
PC	Program Counter
Slit10	10-bit signed literal $\in \{-512...511\}$
Slit16	16-bit signed literal $\in \{-32768...32767\}$
Slit6	6-bit signed literal $\in \{-16...16\}$
Wb	Base W register $\in \{W0...W15\}$
Wd	Destination W register $\in \{Wd, [Wd], [Wd++], [Wd--], [++Wd], [--Wd]\}$
Wdo	Destination W register $\in \{Wnd, [Wnd], [Wnd++], [Wnd--], [++Wnd], [--Wnd], [Wnd+Wb]\}$
Wm, Wn	Dividend, Divisor working register pair (direct addressing)

TABLE 31-9: DC CHARACTERISTICS: I/O PIN INPUT SPECIFICATIONS

DC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for Industrial $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ for Extended				
Param No.	Symbol	Characteristic	Min	Typ ⁽¹⁾	Max	Units	Conditions
DI10	V _{IL}	Input Low Voltage I/O pins	V _{SS}	—	0.2 V _{DD}	V	PMPTTL = 1
DI11		PMP pins	V _{SS}	—	0.15 V _{DD}	V	
DI15		MCLR	V _{SS}	—	0.2 V _{DD}	V	
DI16		I/O Pins with OSC1 or SOSCI	V _{SS}	—	0.2 V _{DD}	V	
DI18		I/O Pins with SDAx, SCLx	V _{SS}	—	0.3 V _{DD}	V	SMbus disabled
DI19		I/O Pins with SDAx, SCLx	V _{SS}	—	0.8 V	V	SMbus enabled
DI20	V _{IH}	Input High Voltage I/O Pins Not 5V Tolerant ⁽⁴⁾	0.7 V _{DD}	—	V _{DD}	V	—
		I/O Pins 5V Tolerant ⁽⁴⁾	0.7 V _{DD}	—	5.5	V	
DI21		I/O Pins Not 5V Tolerant with PMP ⁽⁴⁾	0.24 V _{DD} + 0.8	—	V _{DD}	V	
		I/O Pins 5V Tolerant with PMP ⁽⁴⁾	0.24 V _{DD} + 0.8	—	5.5	V	
DI28		SDAx, SCLx	0.7 V _{DD}	—	5.5	V	SMbus disabled
DI29		SDAx, SCLx	2.1	—	5.5	V	SMbus enabled
DI30	ICNPU	CNx Pull-up Current	50	250	400	μA	V _{DD} = 3.3V, V _{PIN} = V _{SS}

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

2: The leakage current on the MCLR pin is strongly dependent on the applied voltage level. The specified levels represent normal operating conditions. Higher leakage current can be measured at different input voltages.

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

4: See “[Pin Diagrams](#)” for the 5V tolerant I/O pins.

5: V_{IL} source < (V_{SS} – 0.3). Characterized but not tested.

6: Non-5V tolerant pins V_{IH} source > (V_{DD} + 0.3), 5V tolerant pins V_{IH} source > 5.5V. Characterized but not tested.

7: Digital 5V tolerant pins cannot tolerate any “positive” input injection current from input sources > 5.5V.

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

9: Any number and/or combination of I/O pins not excluded under IICL or IICH conditions are permitted provided the mathematical “absolute instantaneous” sum of the input injection currents from all pins do not exceed the specified limit. Characterized but not tested.

31.2 AC Characteristics and Timing Parameters

This section defines dsPIC33FJ32MC302/304, dsPIC33FJ64MCX02/X04 and dsPIC33FJ128MCX02/X04 AC characteristics and timing parameters.

TABLE 31-14: TEMPERATURE AND VOLTAGE SPECIFICATIONS – AC

AC CHARACTERISTICS	Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated)
	Operating temperature $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for Industrial $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ for Extended Operating voltage V_{DD} range as described in Table 31-1 .

FIGURE 31-1: LOAD CONDITIONS FOR DEVICE TIMING SPECIFICATIONS

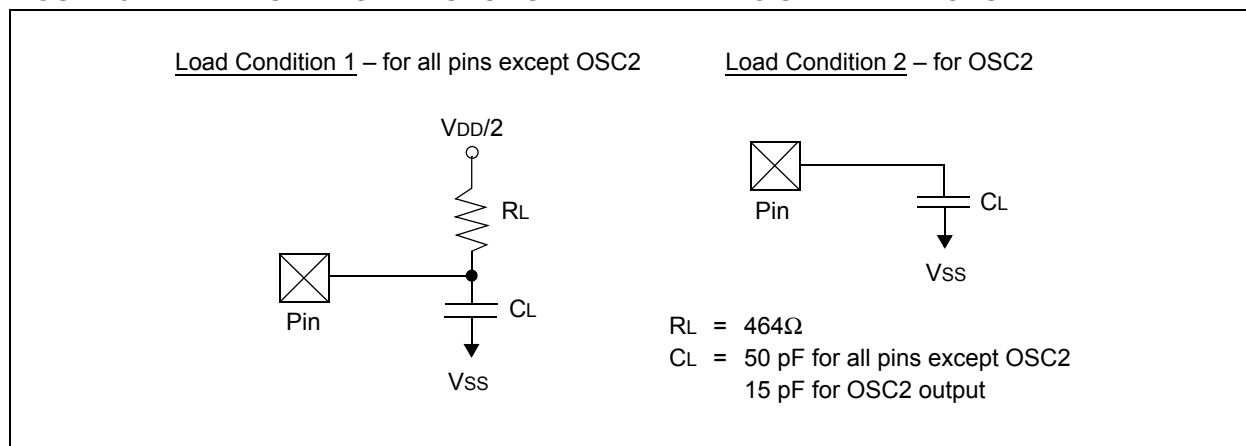


TABLE 31-15: CAPACITIVE LOADING REQUIREMENTS ON OUTPUT PINS

Param No.	Symbol	Characteristic	Min	Typ	Max	Units	Conditions
DO50	Cosco	OSC2/SOSCO pin	—	—	15	pF	In XT and HS modes when external clock is used to drive OSC1
DO56	Cio	All I/O pins and OSC2	—	—	50	pF	EC mode
DO58	CB	SCLx, SDAx	—	—	400	pF	In I ² C™ mode

TABLE 31-53: SETTING TIME SPECIFICATIONS

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
PS1	TdtV2wrH	Data in Valid before \overline{WR} or \overline{CS} Inactive (setup time)	20	—	—	ns	—
PS2	TwrH2dtI	\overline{WR} or \overline{CS} Inactive to Data-In Invalid (hold time)	20	—	—	ns	—
PS3	TrdL2dtV	\overline{RD} and \overline{CS} to Active Data-Out Valid	—	—	80	ns	—
PS4	TrdH2dtI	\overline{RD} Active or \overline{CS} Inactive to Data-Out Invalid	10	—	30	ns	—

FIGURE 31-31: PARALLEL MASTER PORT READ TIMING DIAGRAM

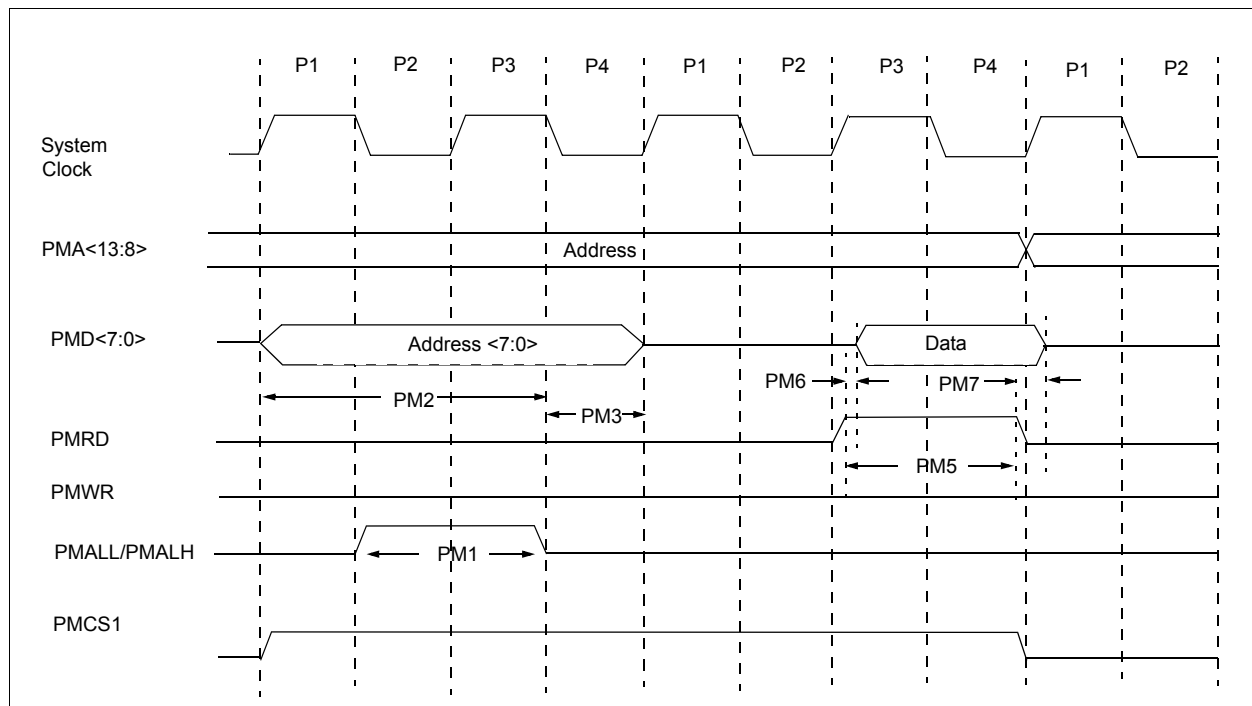


TABLE 32-4: DC CHARACTERISTICS: POWER-DOWN CURRENT (IPD)

DC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤TA ≤+150°C for High Temperature			
Parameter No.	Typical	Max	Units	Conditions		
Power-Down Current (IPD)						
HDC60e	250	2000	μA	+150°C	3.3V	Base Power-Down Current ^(1,3)
HDC61c	3	5	μA	+150°C	3.3V	Watchdog Timer Current: ΔI _{WDT} ^(2,4)

Note 1: Base IPD is measured with all peripherals and clocks shut down. All I/Os are configured as inputs and pulled to VSS. WDT, etc., are all switched off, and VREGS (RCON<8>) = 1.

2: The Δ current is the additional current consumed when the module is enabled. This current should be added to the base IPD current.

3: These currents are measured on the device containing the most memory in this family.

4: These parameters are characterized, but are not tested in manufacturing.

TABLE 32-5: DC CHARACTERISTICS: DOZE CURRENT (IDoZE)

DC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature $-40^{\circ}\text{C} \leq T_A \leq +150^{\circ}\text{C}$ for High Temperature			
Parameter No.	Typical ⁽¹⁾	Max	Doze Ratio	Units	Conditions	
HDC72a	39	45	1:2	mA	+150°C	3.3V
HDC72f	18	25	1:64	mA		
HDC72g	18	25	1:128	mA		

Note 1: Parameters with Doze ratios of 1:2 and 1:64 are characterized, but are not tested in manufacturing.

IPC18 (Interrupt Priority Control 18)	127, 128	AC	369, 418
IPC2 (Interrupt Priority Control 2)	114	Timer1	195
IPC3 (Interrupt Priority Control 3)	115	Timer2/3	199
IPC4 (Interrupt Priority Control 4)	116	Timing Characteristics	
IPC5 (Interrupt Priority Control 5)	117	CLKO and I/O	372
IPC6 (Interrupt Priority Control 6)	118	Timing Diagrams	
IPC7 (Interrupt Priority Control 7)	119	10-bit ADC Conversion (CHPS<1:0> = 01, SIMSAM = 0,	
IPC8 (Interrupt Priority Control 8)	120	ASAM = 0, SSRC<2:0> = 000)	405
IPC9 (Interrupt Priority Control 9)	121	10-bit ADC Conversion (CHPS<1:0> = 01, SIMSAM = 0,	
NVMCON (Flash Memory Control)	75	ASAM = 1, SSRC<2:0> = 111,	
NVMKEY (Nonvolatile Memory Key)	76	SAMC<4:0> = 00001)	405
OCxCON (Output Compare x Control)	212	10-bit ADC Conversion (CHPS<1:0> = 01, SIMSAM = 0,	
OSCCON (Oscillator Control)	147	ASAM = 1, SSRC<2:0> = 111, SAMC<4:0> =	
OSCTUN (FRC Oscillator Tuning)	151	00001)	405
P1DC3 (PWM Duty Cycle 3)	226	12-bit ADC Conversion (ASAM = 0, SSRC<2:0> = 000)	
PLLFBF (PLL Feedback Divisor)	150	403	
PMD1 (Peripheral Module Disable Control Register 1)...	158	Brown-out Situations	86
PMD2 (Peripheral Module Disable Control Register 2)...	160	ECAN I/O	399
PMD3 (Peripheral Module Disable Control Register 3)...	161	External Clock	370
PWMxCON1 (PWM Control 1)	220	I2Cx Bus Data (Master Mode)	395
PWMxCON2 (PWM Control 2)	221	I2Cx Bus Data (Slave Mode)	397
PxDC1 (PWM Duty Cycle 1)	226	I2Cx Bus Start/Stop Bits (Master Mode)	395
PxDC2 (PWM Duty Cycle 2)	226	I2Cx Bus Start/Stop Bits (Slave Mode)	397
PxDTCN1 (Dead-Time Control 1)	222	Input Capture (CAPx)	378
PxDTCN2 (Dead-Time Control 2)	223	Motor Control PWM	380
PxFLTACon (Fault A Control)	224	Motor Control PWM Fault	380
PxOVDCon (Override Control)	225	OC/PWM	379
PxSECMP (Special Event Compare)	219	Output Compare (OCx)	378
PxTCON (PWM Time Base Control)	217, 300, 301, 302	QEA/QEB Input	381
PxTMR (PWM Timer Count Value)	218	QEI Module Index Pulse	382
PxTPER (PWM Time Base Period)	218	Reset, Watchdog Timer, Oscillator Start-up Timer	
QEICON (QEI Control)	229	and Power-up Timer	373
RCON (Reset Control)	81	Timer1, 2, 3 External Clock	375
SPIxCON1 (SPIx Control 1)	236	TimerQ (QEI Module) External Clock	377
SPIxCON2 (SPIx Control 2)	238	Timing Requirements	
SPIxSTAT (SPIx Status and Control)	235	ADC Conversion (10-bit mode)	423
SR (CPU Status)	26, 94	ADC Conversion (12-bit Mode)	423
T1CON (Timer1 Control)	197	CLKO and I/O	372
TCxCON (Input Capture x Control)	207	External Clock	370
TxCON (Type B Time Base Control)	202	Input Capture	378
TyCON (Type C Time Base Control)	203	SPIx Master Mode (CKE = 0)	419
UxMODE (UARTx Mode)	249	SPIx Module Master Mode (CKE = 1)	419
UxSTA (UARTx Status and Control)	251	SPIx Module Slave Mode (CKE = 0)	420
Reset		SPIx Module Slave Mode (CKE = 1)	420
Illegal Opcode	79, 87	Timing Specifications	
Trap Conflict	86, 87	10-bit ADC Conversion Requirements	406
Uninitialized W Register	79, 87	12-bit ADC Conversion Requirements	404
Reset Sequence	89	CAN I/O Requirements	399
Resets	79	I2Cx Bus Data Requirements (Master Mode)	396
S		I2Cx Bus Data Requirements (Slave Mode)	398
Serial Peripheral Interface (SPI)	233	Motor Control PWM Requirements	380
Software Reset Instruction (SWR)	86	Output Compare Requirements	378
Software Simulator (MPLAB SIM)	355	PLL Clock	371, 418
Software Stack Pointer, Frame Pointer		QEI External Clock Requirements	377
CALLL Stack Frame	63	QEI Index Pulse Requirements	382
Special Features of the CPU	335	Quadrature Decoder Requirements	381
SPI Module		Reset, Watchdog Timer, Oscillator Start-up Timer,	
SPI1 Register Map	50	Power-up Timer and Brown-out Reset	
Symbols Used in Opcode Descriptions	346	Requirements	374
System Control		Simple OC/PWM Mode Requirements	379
Register Map	61, 62	Timer1 External Clock Requirements	375
T		Timer2 External Clock Requirements	376
Temperature and Voltage Specifications		Timer3 External Clock Requirements	376
		U	
		UART Module	
		UART1 Register Map	49
		Universal Asynchronous Receiver Transmitter (UART) ...	247