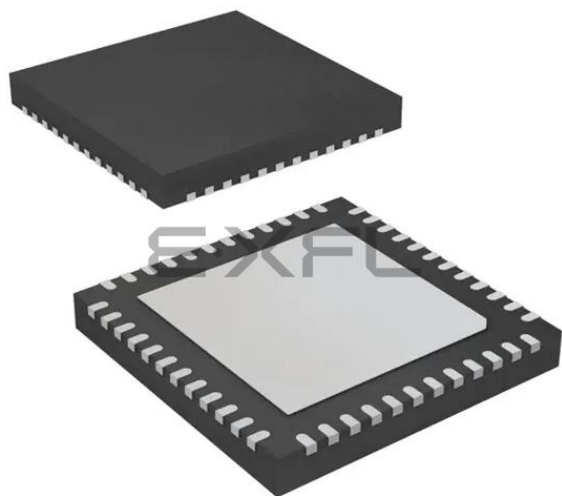




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Core Processor	dsPIC
Core Size	16-Bit
Speed	60 MIPS
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Peripherals	Brown-out Detect/Reset, DMA, POR, PWM, WDT
Number of I/O	35
Program Memory Size	64KB (22K x 24)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	4K x 16
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	48-UQFN Exposed Pad
Supplier Device Package	48-UQFN (6x6)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/dspic33ep64gp504-e-mv

REGISTER 3-2: CORCON: CORE CONTROL REGISTER

R/W-0	U-0	R/W-0	R/W-0	R/W-0	R-0	R-0	R-0
VAR	—	US1 ⁽¹⁾	US0 ⁽¹⁾	EDT ^(1,2)	DL2 ⁽¹⁾	DL1 ⁽¹⁾	DL0 ⁽¹⁾
bit 15							bit 8

R/W-0	R/W-0	R/W-1	R/W-0	R/C-0	R-0	R/W-0	R/W-0
SATA ⁽¹⁾	SATB ⁽¹⁾	SATDW ⁽¹⁾	ACCSAT ⁽¹⁾	IPL3 ⁽³⁾	SFA	RND ⁽¹⁾	IF ⁽¹⁾
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 **VAR:** Variable Exception Processing Latency Control bit
 1 = Variable exception processing latency is enabled
 0 = Fixed exception processing latency is enabled
- bit 14 **Unimplemented:** Read as '0'
- bit 13-12 **US<1:0>:** DSP Multiply Unsigned/Signed Control bits⁽¹⁾
 11 = Reserved
 10 = DSP engine multiplies are mixed-sign
 01 = DSP engine multiplies are unsigned
 00 = DSP engine multiplies are signed
- bit 11 **EDT:** Early D0 Loop Termination Control bit^(1,2)
 1 = Terminates executing D0 loop at end of current loop iteration
 0 = No effect
- bit 10-8 **DL<2:0>:** D0 Loop Nesting Level Status bits⁽¹⁾
 111 = 7 D0 loops are active
 •
 •
 •
 001 = 1 D0 loop is active
 000 = 0 D0 loops are active
- bit 7 **SATA:** ACCA Saturation Enable bit⁽¹⁾
 1 = Accumulator A saturation is enabled
 0 = Accumulator A saturation is disabled
- bit 6 **SATB:** ACCB Saturation Enable bit⁽¹⁾
 1 = Accumulator B saturation is enabled
 0 = Accumulator B saturation is disabled
- bit 5 **SATDW:** Data Space Write from DSP Engine Saturation Enable bit⁽¹⁾
 1 = Data Space write saturation is enabled
 0 = Data Space write saturation is disabled
- bit 4 **ACCSAT:** Accumulator Saturation Mode Select bit⁽¹⁾
 1 = 9.31 saturation (super saturation)
 0 = 1.31 saturation (normal saturation)
- bit 3 **IPL3:** CPU Interrupt Priority Level Status bit⁽³⁾
 1 = CPU Interrupt Priority Level is greater than 7
 0 = CPU Interrupt Priority Level is 7 or less

- Note 1:** This bit is available on dsPIC33EPXXXMC20X/50X and dsPIC33EPXXXGP50X devices only.
2: This bit is always read as '0'.
3: The IPL3 bit is concatenated with the IPL<2:0> bits (SR<7:5>) to form the CPU Interrupt Priority Level.

TABLE 4-5: INTERRUPT CONTROLLER REGISTER MAP FOR dsPIC33EPXXXGP50X DEVICES ONLY

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
IFS0	0800	—	DMA1IF	AD1IF	U1TXIF	U1RXIF	SPI1IF	SPI1EIF	T3IF	T2IF	OC2IF	IC2IF	DMA0IF	T1IF	OC1IF	IC1IF	INT0IF	0000
IFS1	0802	U2TXIF	U2RXIF	INT2IF	T5IF	T4IF	OC4IF	OC3IF	DMA2IF	—	—	—	INT1IF	CNIF	CMIF	MI2C1IF	SI2C1IF	0000
IFS2	0804	—	—	—	—	—	—	—	—	—	IC4IF	IC3IF	DMA3IF	C1IF	C1RXIF	SPI2IF	SPI2EIF	0000
IFS3	0806	—	—	—	—	—	—	—	—	—	—	—	—	—	MI2C2IF	SI2C2IF	—	0000
IFS4	0808	—	—	CTMUIF	—	—	—	—	—	—	C1TXIF	—	—	CRCIF	U2EIF	U1EIF	—	0000
IFS6	080C	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	PWM3IF	0000
IFS8	0810	JTAGIF	ICDIF	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
IFS9	0812	—	—	—	—	—	—	—	—	—	PTG3IF	PTG2IF	PTG1IF	PTG0IF	PTGWDTIF	PTGSTIEIF	—	0000
IEC0	0820	—	DMA1IE	AD1IE	U1TXIE	U1RXIE	SPI1IE	SPI1EIE	T3IE	T2IE	OC2IE	IC2IE	DMA0IE	T1IE	OC1IE	IC1IE	INT0IE	0000
IEC1	0822	U2TXIE	U2RXIE	INT2IE	T5IE	T4IE	OC4IE	OC3IE	DMA2IE	—	—	—	INT1IE	CNIE	CMIE	MI2C1IE	SI2C1IE	0000
IEC2	0824	—	—	—	—	—	—	—	—	—	IC4IE	IC3IE	DMA3IE	C1IE	C1RXIE	SPI2IE	SPI2EIE	0000
IEC3	0826	—	—	—	—	—	—	—	—	—	—	—	—	—	MI2C2IE	SI2C2IE	—	0000
IEC4	0828	—	—	CTMUIE	—	—	—	—	—	—	C1TXIE	—	—	CRCIE	U2EIE	U1EIE	—	0000
IEC8	0830	JTAGIE	ICDIE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
IEC9	0832	—	—	—	—	—	—	—	—	—	PTG3IE	PTG2IE	PTG1IE	PTG0IE	PTGWDTIE	PTGSTIEIE	—	0000
IPC0	0840	—	T1IP<2:0>			—	OC1IP<2:0>			—	IC1IP<2:0>			—	INT0IP<2:0>			4444
IPC1	0842	—	T2IP<2:0>			—	OC2IP<2:0>			—	IC2IP<2:0>			—	DMA0IP<2:0>			4444
IPC2	0844	—	U1RXIP<2:0>			—	SPI1IP<2:0>			—	SPI1EIP<2:0>			—	T3IP<2:0>			4444
IPC3	0846	—	—	—	—	—	DMA1IP<2:0>			—	AD1IP<2:0>			—	U1TXIP<2:0>			0444
IPC4	0848	—	CNIP<2:0>			—	CMIP<2:0>			—	MI2C1IP<2:0>			—	SI2C1IP<2:0>			4444
IPC5	084A	—	—	—	—	—	—	—	—	—	—	—	—	—	INT1IP<2:0>			0004
IPC6	084C	—	T4IP<2:0>			—	OC4IP<2:0>			—	OC3IP<2:0>			—	DMA2IP<2:0>			4444
IPC7	084E	—	U2TXIP<2:0>			—	U2RXIP<2:0>			—	INT2IP<2:0>			—	T5IP<2:0>			4444
IPC8	0850	—	C1IP<2:0>			—	C1RXIP<2:0>			—	SPI2IP<2:0>			—	SPI2EIP<2:0>			4444
IPC9	0852	—	—	—	—	—	IC4IP<2:0>			—	IC3IP<2:0>			—	DMA3IP<2:0>			0444
IPC11	0856	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
IPC12	0858	—	—	—	—	—	MI2C2IP<2:0>			—	SI2C2IP<2:0>			—	—	—	—	0440
IPC16	0860	—	CRCIP<2:0>			—	U2EIP<2:0>			—	U1EIP<2:0>			—	—	—	—	4440
IPC17	0862	—	—	—	—	—	C1TXIP<2:0>			—	—	—	—	—	—	—	—	0400
IPC19	0866	—	—	—	—	—	—	—	—	—	CTMUIP<2:0>			—	—	—	—	0040
IPC35	0886	—	JTAGIP<2:0>			—	ICDIP<2:0>			—	—	—	—	—	—	—	—	4400
IPC36	0888	—	PTG0IP<2:0>			—	PTGWDIP<2:0>			—	PTGSTIEIP<2:0>			—	—	—	—	4440
IPC37	088A	—	—	—	—	—	PTG3IP<2:0>			—	PTG2IP<2:0>			—	PTG1IP<2:0>			0444

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

TABLE 4-21: ECAN1 REGISTER MAP WHEN WIN (C1CTRL1<0>) = 0 OR 1 FOR dsPIC33EPXXXMC/GP50X DEVICES ONLY

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
C1CTRL1	0400	—	—	CSIDL	ABAT	CANCKS	REQOP<2:0>			OPMODE<2:0>			—	CANCAP	—	—	WIN	0480
C1CTRL2	0402	—	—	—	—	—	—	—	—	—	—	—	DNCNT<4:0>					0000
C1VEC	0404	—	—	—	FILHIT<4:0>					—	ICODE<6:0>							0040
C1FCTRL	0406	DMABS<2:0>			—	—	—	—	—	—	—	—	FSA<4:0>					0000
C1FIFO	0408	—	—	FBP<5:0>						—	—	FNRB<5:0>						0000
C1INTF	040A	—	—	TXBO	TXBP	RXBP	TXWAR	RXWAR	EWARN	IVRIF	WAKIF	ERRIF	—	FIFOIF	RBOVIF	RBIF	TBIF	0000
C1INTE	040C	—	—	—	—	—	—	—	—	IVRIE	WAKIE	ERRIE	—	FIFOIE	RBOVIE	RBIE	TBIE	0000
C1EC	040E	TERRCNT<7:0>								RERRCNT<7:0>								0000
C1CFG1	0410	—	—	—	—	—	—	—	—	SJW<1:0>		BRP<5:0>						0000
C1CFG2	0412	—	WAKFIL	—	—	—	SEG2PH<2:0>			SEG2PHTS	SAM	SEG1PH<2:0>			PRSEG<2:0>			0000
C1FEN1	0414	FLTEN15	FLTEN14	FLTEN13	FLTEN12	FLTEN11	FLTEN10	FLTEN9	FLTEN8	FLTEN7	FLTEN6	FLTEN5	FLTEN4	FLTEN3	FLTEN2	FLTEN1	FLTEN0	FFFF
C1FMSKSEL1	0418	F7MSK<1:0>		F6MSK<1:0>		F5MSK<1:0>		F4MSK<1:0>		F3MSK<1:0>		F2MSK<1:0>		F1MSK<1:0>		F0MSK<1:0>		0000
C1FMSKSEL2	041A	F15MSK<1:0>		F14MSK<1:0>		F13MSK<1:0>		F12MSK<1:0>		F11MSK<1:0>		F10MSK<1:0>		F9MSK<1:0>		F8MSK<1:0>		0000

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

TABLE 4-22: ECAN1 REGISTER MAP WHEN WIN (C1CTRL1<0>) = 0 FOR dsPIC33EPXXXMC/GP50X DEVICES ONLY

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
	0400-041E	See definition when WIN = x																
C1RXFUL1	0420	RXFUL15	RXFUL14	RXFUL13	RXFUL12	RXFUL11	RXFUL10	RXFUL9	RXFUL8	RXFUL7	RXFUL6	RXFUL5	RXFUL4	RXFUL3	RXFUL2	RXFUL1	RXFUL0	0000
C1RXFUL2	0422	RXFUL31	RXFUL30	RXFUL29	RXFUL28	RXFUL27	RXFUL26	RXFUL25	RXFUL24	RXFUL23	RXFUL22	RXFUL21	RXFUL20	RXFUL19	RXFUL18	RXFUL17	RXFUL16	0000
C1RXOVF1	0428	RXOVF15	RXOVF14	RXOVF13	RXOVF12	RXOVF11	RXOVF10	RXOVF9	RXOVF8	RXOVF7	RXOVF6	RXOVF5	RXOVF4	RXOVF3	RXOVF2	RXOVF1	RXOVF0	0000
C1RXOVF2	042A	RXOVF31	RXOVF30	RXOVF29	RXOVF28	RXOVF27	RXOVF26	RXOVF25	RXOVF24	RXOVF23	RXOVF22	RXOVF21	RXOVF20	RXOVF19	RXOVF18	RXOVF17	RXOVF16	0000
C1TR01CON	0430	TXEN1	TXABT1	TXLARB1	TXERR1	TXREQ1	RTREN1	TX1PRI<1:0>		TXEN0	TXABAT0	TXLARB0	TXERR0	TXREQ0	RTREN0	TX0PRI<1:0>		0000
C1TR23CON	0432	TXEN3	TXABT3	TXLARB3	TXERR3	TXREQ3	RTREN3	TX3PRI<1:0>		TXEN2	TXABAT2	TXLARB2	TXERR2	TXREQ2	RTREN2	TX2PRI<1:0>		0000
C1TR45CON	0434	TXEN5	TXABT5	TXLARB5	TXERR5	TXREQ5	RTREN5	TX5PRI<1:0>		TXEN4	TXABAT4	TXLARB4	TXERR4	TXREQ4	RTREN4	TX4PRI<1:0>		0000
C1TR67CON	0436	TXEN7	TXABT7	TXLARB7	TXERR7	TXREQ7	RTREN7	TX7PRI<1:0>		TXEN6	TXABAT6	TXLARB6	TXERR6	TXREQ6	RTREN6	TX6PRI<1:0>		xxxx
C1RXD	0440	ECAN1 Receive Data Word																xxxx
C1TXD	0442	ECAN1 Transmit Data Word																xxxx

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

4.4.4 SOFTWARE STACK

The W15 register serves as a dedicated Software Stack Pointer (SSP) and is automatically modified by exception processing, subroutine calls and returns; however, W15 can be referenced by any instruction in the same manner as all other W registers. This simplifies reading, writing and manipulating of the Stack Pointer (for example, creating stack frames).

Note: To protect against misaligned stack accesses, W15<0> is fixed to '0' by the hardware.

W15 is initialized to 0x1000 during all Resets. This address ensures that the SSP points to valid RAM in all dsPIC33EPXXXGP50X, dsPIC33EPXXXMC20X/50X and PIC24EPXXXGP/MC20X devices, and permits stack availability for non-maskable trap exceptions. These can occur before the SSP is initialized by the user software. You can reprogram the SSP during initialization to any location within Data Space.

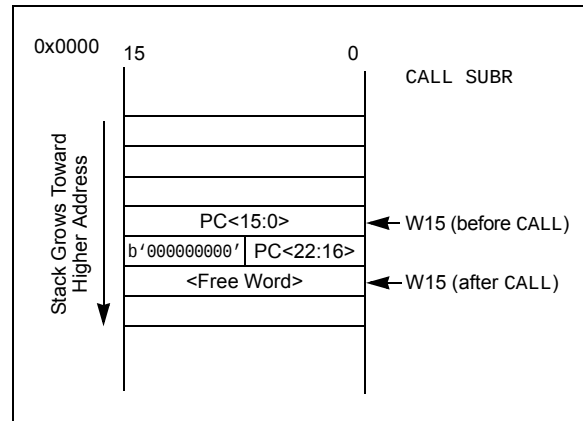
The Software Stack Pointer always points to the first available free word and fills the software stack working from lower toward higher addresses. Figure 4-19 illustrates how it pre-decrements for a stack pop (read) and post-increments for a stack push (writes).

When the PC is pushed onto the stack, PC<15:0> are pushed onto the first available stack word, then PC<22:16> are pushed into the second available stack location. For a PC push during any CALL instruction, the MSB of the PC is zero-extended before the push, as shown in Figure 4-19. During exception processing, the MSB of the PC is concatenated with the lower 8 bits of the CPU STATUS Register, SR. This allows the contents of SRL to be preserved automatically during interrupt processing.

Note 1: To maintain system Stack Pointer (W15) coherency, W15 is never subject to (EDS) paging, and is therefore restricted to an address range of 0x0000 to 0xFFFF. The same applies to the W14 when used as a Stack Frame Pointer (SFA = 1).

2: As the stack can be placed in, and can access X and Y spaces, care must be taken regarding its use, particularly with regard to local automatic variables in a C development environment

FIGURE 4-19: CALL STACK FRAME



REGISTER 9-2: CLKDIV: CLOCK DIVISOR REGISTER (CONTINUED)

bit 4-0 **PLLPRE<4:0>**: PLL Phase Detector Input Divider Select bits (also denoted as 'N1', PLL prescaler)
11111 = Input divided by 33
•
•
•
00001 = Input divided by 3
00000 = Input divided by 2 (default)

- Note 1:** The DOZE<2:0> bits can only be written to when the DOZEN bit is clear. If DOZEN = 1, any writes to DOZE<2:0> are ignored.
- 2:** This bit is cleared when the ROI bit is set and an interrupt occurs.
- 3:** The DOZEN bit cannot be set if DOZE<2:0> = 000. If DOZE<2:0> = 000, any attempt by user software to set the DOZEN bit is ignored.

REGISTER 10-3: PMD3: PERIPHERAL MODULE DISABLE CONTROL REGISTER 3

U-0	U-0	U-0	U-0	U-0	R/W-0	U-0	U-0
—	—	—	—	—	CMPMD	—	—
bit 15						bit 8	
R/W-0	U-0	U-0	U-0	U-0	U-0	R/W-0	U-0
CRCMD	—	—	—	—	—	I2C2MD	—
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 **CMPMD:** Comparator Module Disable bit
1 = Comparator module is disabled
0 = Comparator module is enabled
- bit 9-8 **Unimplemented:** Read as '0'
- bit 7 **CRCMD:** CRC Module Disable bit
1 = CRC module is disabled
0 = CRC module is enabled
- bit 6-2 **Unimplemented:** Read as '0'
- bit 1 **I2C2MD:** I2C2 Module Disable bit
1 = I2C2 module is disabled
0 = I2C2 module is enabled
- bit 0 **Unimplemented:** Read as '0'

REGISTER 10-4: PMD4: PERIPHERAL MODULE DISABLE CONTROL REGISTER 4

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	R/W-0	R/W-0	U-0	U-0
—	—	—	—	REFOMD	CTMUMD	—	—
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 15-4 **Unimplemented:** Read as '0'
- bit 3 **REFOMD:** Reference Clock Module Disable bit
1 = Reference clock module is disabled
0 = Reference clock module is enabled
- bit 2 **CTMUMD:** CTMU Module Disable bit
1 = CTMU module is disabled
0 = CTMU module is enabled
- bit 1-0 **Unimplemented:** Read as '0'

REGISTER 11-13: RPINR23: PERIPHERAL PIN SELECT INPUT REGISTER 23

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

U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	SS2R<6:0>						
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 15-7 **Unimplemented:** Read as '0'

bit 6-0 **SS2R<6:0>:** Assign SPI2 Slave Select ($\overline{SS2}$) to the Corresponding RPn Pin bits (see Table 11-2 for input pin selection numbers)

1111001 = Input tied to RPI121

.

.

.

0000001 = Input tied to CMP1

0000000 = Input tied to Vss

**REGISTER 11-14: RPINR26: PERIPHERAL PIN SELECT INPUT REGISTER 26
(dsPIC33EPXXXGP/MC50X DEVICES ONLY)**

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

U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	C1RXR<6:0>						
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 15-7 **Unimplemented:** Read as '0'

bit 6-0 **C1RXR<6:0>:** Assign CAN1 RX Input (CRX1) to the Corresponding RPn Pin bits (see Table 11-2 for input pin selection numbers)

1111001 = Input tied to RPI121

.

.

.

0000001 = Input tied to CMP1

0000000 = Input tied to Vss

15.0 OUTPUT COMPARE

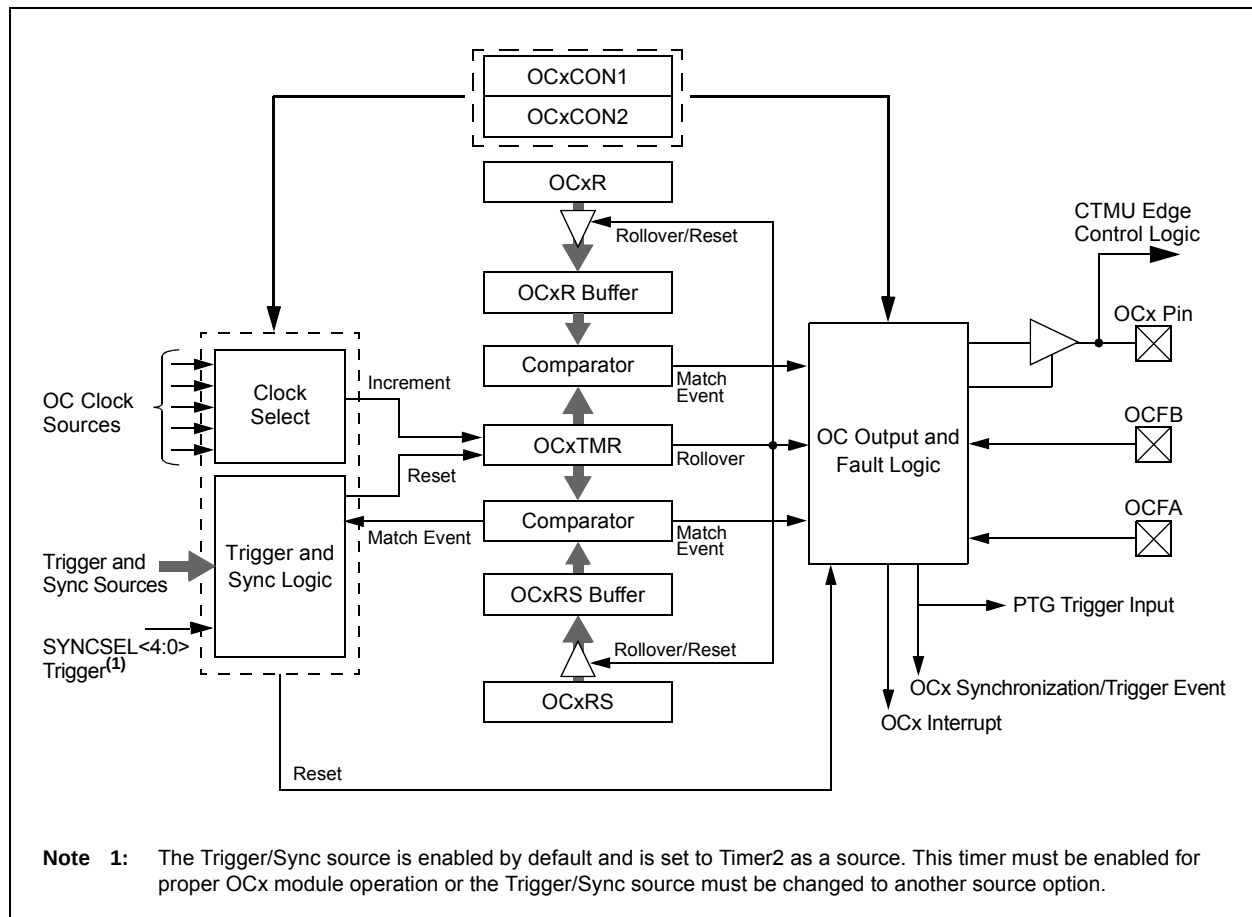
Note 1: This data sheet summarizes the features of the dsPIC33EPXXXGP50X, dsPIC33EPXXXMC20X/50X and PIC24EPXXXGP/MC20X families of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to “**Output Compare**” (DS70358) in the “dsPIC33/PIC24 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 output compare module can select one of seven available clock sources for its time base. The module compares the value of the timer with the value of one or two compare registers depending on the operating mode selected. The state of the output pin changes when the timer value matches the compare register value. The output compare module generates either a single output pulse or a sequence of output pulses, by changing the state of the output pin on the compare match events. The output compare module can also generate interrupts on compare match events and trigger DMA data transfers.

Note: See “**Output Compare**” (DS70358) in the “dsPIC33/PIC24 Family Reference Manual” for OCxR and OCxRS register restrictions.

FIGURE 15-1: OUTPUT COMPARE x MODULE BLOCK DIAGRAM



REGISTER 16-13: IOCONx: PWMx I/O CONTROL REGISTER⁽²⁾ (CONTINUED)

- bit 1 **SWAP:** SWAP PWMxH and PWMxL Pins bit
 1 = PWMxH output signal is connected to PWMxL pins; PWMxL output signal is connected to PWMxH pins
 0 = PWMxH and PWMxL pins are mapped to their respective pins
- bit 0 **OSYNC:** Output Override Synchronization bit
 1 = Output overrides via the OVRDAT<1:0> bits are synchronized to the PWMx period boundary
 0 = Output overrides via the OVDDAT<1:0> bits occur on the next CPU clock boundary

- Note 1:** These bits should not be changed after the PWMx module is enabled (PTEN = 1).
- 2:** If the PWMLOCK Configuration bit (FOSCSEL<6>) is a '1', the IOCONx register can only be written after the unlock sequence has been executed.

REGISTER 16-15: FCLCONx: PWMx FAULT CURRENT-LIMIT CONTROL REGISTER⁽¹⁾

U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	CLSRC4	CLSRC3	CLSRC2	CLSRC1	CLSRC0	CLPOL ⁽²⁾	CLMOD
bit 15						bit 8	

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-0	R/W-0	R/W-0
FLTSRC4	FLTSRC3	FLTSRC2	FLTSRC1	FLTSRC0	FLTPOL ⁽²⁾	FLTMOD1	FLTMOD0
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 14-10 **CLSRC<4:0>:** Current-Limit Control Signal Source Select for PWM Generator # bits

11111 = Fault 32

11110 = Reserved

.

.

.

01100 = Reserved

01011 = Comparator 4

01010 = Op Amp/Comparator 3

01001 = Op Amp/Comparator 2

01000 = Op Amp/Comparator 1

00111 = Reserved

00110 = Reserved

00101 = Reserved

00100 = Reserved

00011 = Fault 4

00010 = Fault 3

00001 = Fault 2

00000 = Fault 1 (**default**)bit 9 **CLPOL:** Current-Limit Polarity for PWM Generator # bit⁽²⁾

1 = The selected current-limit source is active-low

0 = The selected current-limit source is active-high

bit 8 **CLMOD:** Current-Limit Mode Enable for PWM Generator # bit

1 = Current-Limit mode is enabled

0 = Current-Limit mode is disabled

Note 1: If the PWMLOCK Configuration bit (FOSCSEL<6>) is a '1', the IOCONx register can only be written after the unlock sequence has been executed.

2: These bits should be changed only when PTEN = 0. Changing the clock selection during operation will yield unpredictable results.

21.2 Modes of Operation

The ECAN module can operate in one of several operation modes selected by the user. These modes include:

- Initialization mode
- Disable mode
- Normal Operation mode
- Listen Only mode
- Listen All Messages mode
- Loopback mode

Modes are requested by setting the REQOP<2:0> bits (CxCTRL1<10:8>). Entry into a mode is Acknowledged by monitoring the OPMODE<2:0> bits (CxCTRL1<7:5>). The module does not change the mode and the OPMODEx bits until a change in mode is acceptable, generally during bus Idle time, which is defined as at least 11 consecutive recessive bits.

21.3 ECAN Resources

Many useful resources are provided on the main product page of the Microchip web site for the devices listed in this data sheet. This product page, which can be accessed using this link, contains the latest updates and additional information.

Note: In the event you are not able to access the product page using the link above, enter this URL in your browser: http://www.microchip.com/wwwproducts/Devices.aspx?dDocName=en555464
--

21.3.1 KEY RESOURCES

- **“Enhanced Controller Area Network (ECAN™)”** (DS70353) in the *“dsPIC33/PIC24 Family Reference Manual”*
- Code Samples
- Application Notes
- Software Libraries
- Webinars
- All Related *“dsPIC33/PIC24 Family Reference Manual”* Sections
- Development Tools

REGISTER 21-19: CxFMSKSEL2: ECANx FILTER 15-8 MASK SELECTION REGISTER 2

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 bits

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 bits (same values as bits<15:14>)bit 11-10 **F13MSK<1:0>**: Mask Source for Filter 13 bits (same values as bits<15:14>)bit 9-8 **F12MSK<1:0>**: Mask Source for Filter 12 bits (same values as bits<15:14>)bit 7-6 **F11MSK<1:0>**: Mask Source for Filter 11 bits (same values as bits<15:14>)bit 5-4 **F10MSK<1:0>**: Mask Source for Filter 10 bits (same values as bits<15:14>)bit 3-2 **F9MSK<1:0>**: Mask Source for Filter 9 bits (same values as bits<15:14>)bit 1-0 **F8MSK<1:0>**: Mask Source for Filter 8 bits (same values as bits<15:14>)

BUFFER 21-7: ECAN™ MESSAGE BUFFER WORD 6

R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
Byte 7							
bit 15				bit 8			

R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
Byte 6							
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 **Byte 7<15:8>:** ECAN Message Byte 7 bits

bit 7-0 **Byte 6<7:0>:** ECAN Message Byte 6 bits

BUFFER 21-8: ECAN™ MESSAGE BUFFER WORD 7

U-0	U-0	U-0	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
—	—	—	FILHIT4 ⁽¹⁾	FILHIT3 ⁽¹⁾	FILHIT2 ⁽¹⁾	FILHIT1 ⁽¹⁾	FILHIT0 ⁽¹⁾
bit 15				bit 8			

U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-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 **FILHIT<4:0>:** Filter Hit Code bits⁽¹⁾
Encodes number of filter that resulted in writing this buffer.

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

Note 1: Only written by module for receive buffers, unused for transmit buffers.

30.1 DC Characteristics

TABLE 30-1: OPERATING MIPS VS. VOLTAGE

Characteristic	VDD Range (in Volts)	Temp Range (in °C)	Maximum MIPS
			dsPIC33EPXXXGP50X, dsPIC33EPXXXMC20X/50X and PIC24EPXXXGP/MC20X
—	3.0V to 3.6V ⁽¹⁾	-40°C to +85°C	70
—	3.0V to 3.6V ⁽¹⁾	-40°C to +125°C	60

Note 1: Device is functional at $V_{BORMIN} < V_{DD} < V_{DDMIN}$. Analog modules (ADC, op amp/comparator and comparator voltage reference) may have degraded performance. Device functionality is tested but not characterized. Refer to Parameter BO10 in Table 30-13 for the minimum and maximum BOR values.

TABLE 30-2: THERMAL OPERATING CONDITIONS

Rating	Symbol	Min.	Typ.	Max.	Unit
Industrial Temperature Devices					
Operating Junction Temperature Range	TJ	-40	—	+125	°C
Operating Ambient Temperature Range	TA	-40	—	+85	°C
Extended Temperature Devices					
Operating Junction Temperature Range	TJ	-40	—	+140	°C
Operating Ambient Temperature Range	TA	-40	—	+125	°C
Power Dissipation: Internal chip power dissipation: $P_{INT} = V_{DD} \times (I_{DD} - \sum I_{OH})$ I/O Pin Power Dissipation: $I/O = \sum (\{V_{DD} - V_{OH}\} \times I_{OH}) + \sum (V_{OL} \times I_{OL})$	PD	PINT + PI/O			W
Maximum Allowed Power Dissipation	PDMAX	$(T_J - T_A)/\theta_{JA}$			W

TABLE 30-3: THERMAL PACKAGING CHARACTERISTICS

Characteristic	Symbol	Typ.	Max.	Unit	Notes
Package Thermal Resistance, 64-Pin QFN	θ_{JA}	28.0	—	°C/W	1
Package Thermal Resistance, 64-Pin TQFP 10x10 mm	θ_{JA}	48.3	—	°C/W	1
Package Thermal Resistance, 48-Pin UQFN 6x6 mm	θ_{JA}	41	—	°C/W	1
Package Thermal Resistance, 44-Pin QFN	θ_{JA}	29.0	—	°C/W	1
Package Thermal Resistance, 44-Pin TQFP 10x10 mm	θ_{JA}	49.8	—	°C/W	1
Package Thermal Resistance, 44-Pin VTLA 6x6 mm	θ_{JA}	25.2	—	°C/W	1
Package Thermal Resistance, 36-Pin VTLA 5x5 mm	θ_{JA}	28.5	—	°C/W	1
Package Thermal Resistance, 28-Pin QFN-S	θ_{JA}	30.0	—	°C/W	1
Package Thermal Resistance, 28-Pin SSOP	θ_{JA}	71.0	—	°C/W	1
Package Thermal Resistance, 28-Pin SOIC	θ_{JA}	69.7	—	°C/W	1
Package Thermal Resistance, 28-Pin SPDIP	θ_{JA}	60.0	—	°C/W	1

Note 1: Junction to ambient thermal resistance, Theta-JA (θ_{JA}) numbers are achieved by package simulations.

TABLE 30-11: DC CHARACTERISTICS: I/O PIN INPUT SPECIFICATIONS (CONTINUED)

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.	Max.	Units	Conditions
DI60a	I _{ICL}	Input Low Injection Current	0	—	-5 ^(4,7)	mA	All pins except V _{DD} , V _{SS} , AV _{DD} , AV _{SS} , MCLR, VCAP and RB7
DI60b	I _{ICH}	Input High Injection Current	0	—	+5 ^(5,6,7)	mA	All pins except V _{DD} , V _{SS} , AV _{DD} , AV _{SS} , MCLR, VCAP, RB7 and all 5V tolerant pins ⁽⁶⁾
DI60c	ΣI_{ICT}	Total Input Injection Current (sum of all I/O and control pins)	-20 ⁽⁸⁾	—	+20 ⁽⁸⁾	mA	Absolute instantaneous sum of all $\pm$ input injection currents from all I/O pins ($ I_{ICL} + I_{ICH} $) $\leq \Sigma I_{ICT}$

- Note 1:** 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.
- 2:** Negative current is defined as current sourced by the pin.
- 3:** See the “Pin Diagrams” section for the 5V tolerant I/O pins.
- 4:** V_{IL} source < (V_{SS} – 0.3). Characterized but not tested.
- 5:** Non-5V tolerant pins V_{IH} source > (V_{DD} + 0.3), 5V tolerant pins V_{IH} source > 5.5V. Characterized but not tested.
- 6:** Digital 5V tolerant pins cannot tolerate any “positive” input injection current from input sources > 5.5V.
- 7:** Non-zero injection currents can affect the ADC results by approximately 4-6 counts.
- 8:** Any number and/or combination of I/O pins not excluded under I_{ICL} or I_{ICH} 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.

TABLE 30-24: TIMER2 AND TIMER4 (TYPE B TIMER) EXTERNAL CLOCK TIMING REQUIREMENTS

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				
Param No.	Symbol	Characteristic ⁽¹⁾		Min.	Typ.	Max.	Units	Conditions
TB10	TtxH	TxCK High Time	Synchronous mode	Greater of: 20 or (TCY + 20)/N	—	—	ns	Must also meet Parameter TB15, N = prescale value (1, 8, 64, 256)
TB11	TtxL	TxCK Low Time	Synchronous mode	Greater of: 20 or (TCY + 20)/N	—	—	ns	Must also meet Parameter TB15, N = prescale value (1, 8, 64, 256)
TB15	TtxP	TxCK Input Period	Synchronous mode	Greater of: 40 or (2 TCY + 40)/N	—	—	ns	N = prescale value (1, 8, 64, 256)
TB20	TCKEXTMRL	Delay from External TxCK Clock Edge to Timer Increment		0.75 TCY + 40	—	1.75 TCY + 40	ns	

Note 1: These parameters are characterized, but are not tested in manufacturing.

TABLE 30-25: TIMER3 AND TIMER5 (TYPE C TIMER) EXTERNAL CLOCK TIMING REQUIREMENTS

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 ⁽¹⁾		Min.	Typ.	Max.	Units	Conditions
TC10	TtxH	TxCK High Time	Synchronous	Tcy + 20	—	—	ns	Must also meet Parameter TC15
TC11	TtxL	TxCK Low Time	Synchronous	Tcy + 20	—	—	ns	Must also meet Parameter TC15
TC15	TtxP	TxCK Input Period	Synchronous, with prescaler	2 Tcy + 40	—	—	ns	N = prescale value (1, 8, 64, 256)
TC20	TCKEXTMRL	Delay from External TxCK Clock Edge to Timer Increment		0.75 Tcy + 40	—	1.75 Tcy + 40	ns	

Note 1: These parameters are characterized, but are not tested in manufacturing.

FIGURE 30-9: HIGH-SPEED PWMx MODULE FAULT TIMING CHARACTERISTICS
(dsPIC33EPXXXMC20X/50X and PIC24EPXXXMC20X DEVICES ONLY)

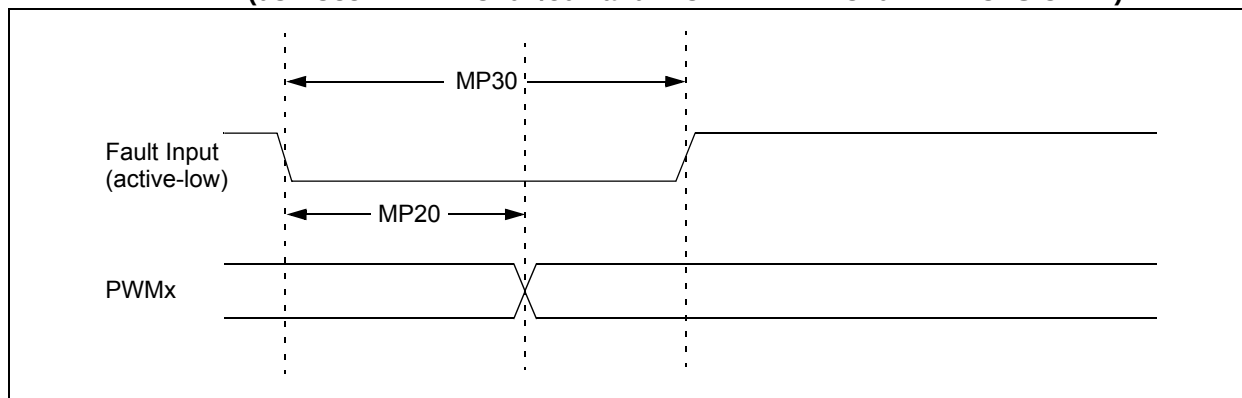


FIGURE 30-10: HIGH-SPEED PWMx MODULE TIMING CHARACTERISTICS
(dsPIC33EPXXXMC20X/50X and PIC24EPXXXMC20X DEVICES ONLY)

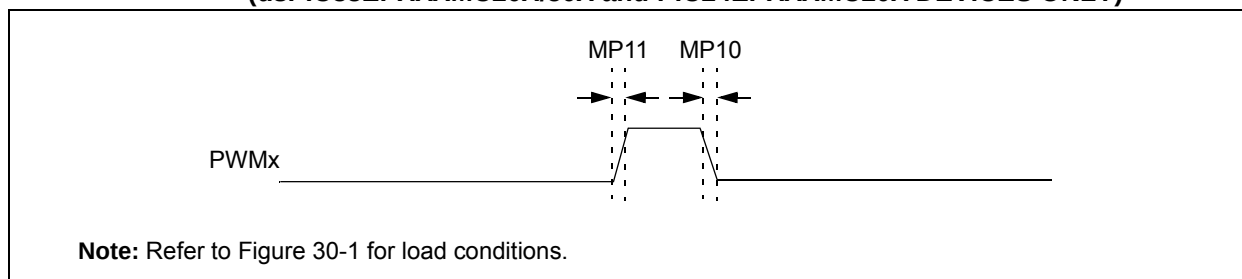


TABLE 30-29: HIGH-SPEED PWMx MODULE TIMING REQUIREMENTS
(dsPIC33EPXXXMC20X/50X and PIC24EPXXXMC20X DEVICES ONLY)

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 ⁽¹⁾	Min.	Typ.	Max.	Units	Conditions
MP10	TFPWM	PWMx Output Fall Time	—	—	—	ns	See Parameter DO32
MP11	TRPWM	PWMx Output Rise Time	—	—	—	ns	See Parameter DO31
MP20	T _{FD}	Fault Input ↓ to PWMx I/O Change	—	—	15	ns	
MP30	T _{FH}	Fault Input Pulse Width	15	—	—	ns	

Note 1: These parameters are characterized but not tested in manufacturing.

FIGURE 30-13: QEI MODULE INDEX PULSE TIMING CHARACTERISTICS
(dsPIC33EPXXXMC20X/50X and PIC24EPXXXMC20X DEVICES ONLY)

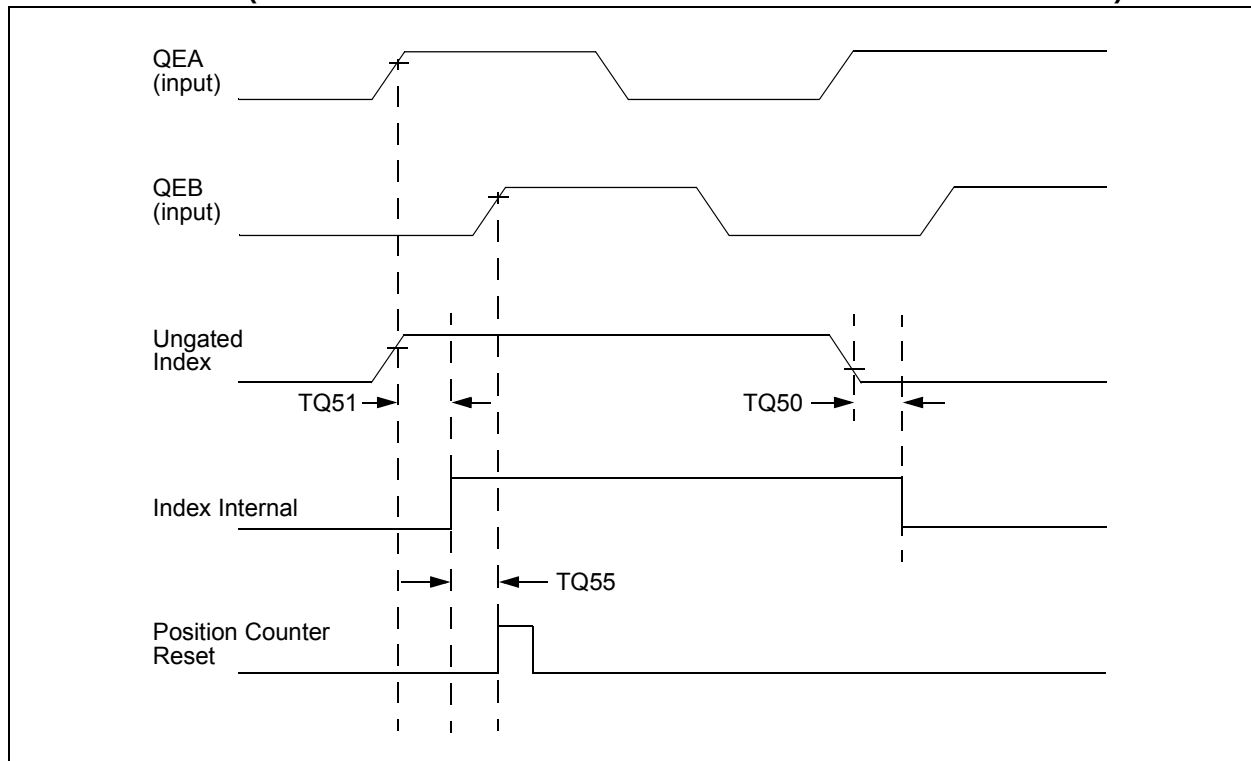


TABLE 30-32: QEI INDEX PULSE TIMING REQUIREMENTS
(dsPIC33EPXXXMC20X/50X and PIC24EPXXXMC20X DEVICES ONLY)

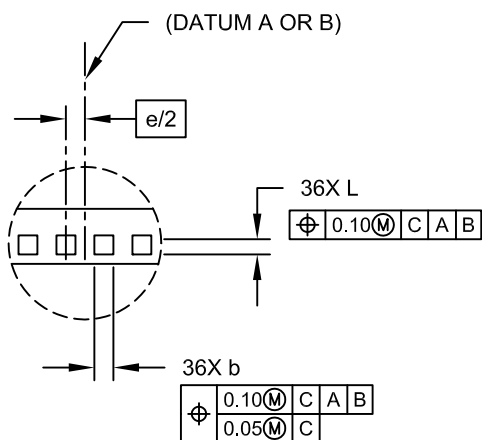
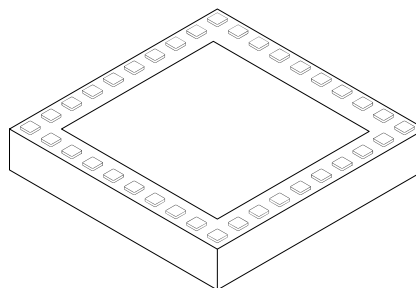
AC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for Industrial $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ for Extended			
Param No.	Symbol	Characteristic ⁽¹⁾	Min.	Max.	Units	Conditions
TQ50	TqiL	Filter Time to Recognize Low, with Digital Filter	$3 * N * T_{CY}$	—	ns	N = 1, 2, 4, 16, 32, 64, 128 and 256 (Note 2)
TQ51	TqiH	Filter Time to Recognize High, with Digital Filter	$3 * N * T_{CY}$	—	ns	N = 1, 2, 4, 16, 32, 64, 128 and 256 (Note 2)
TQ55	Tqidxr	Index Pulse Recognized to Position Counter Reset (ungated index)	$3 T_{CY}$	—	ns	

Note 1: These parameters are characterized but not tested in manufacturing.

2: Alignment of index pulses to QEA and QEB is shown for position counter Reset timing only. Shown for forward direction only (QEA leads QEB). Same timing applies for reverse direction (QEA lags QEB) but index pulse recognition occurs on the falling edge.

36-Terminal Very Thin Thermal Leadless Array Package (TL) – 5x5x0.9 mm Body with Exposed Pad [VTLA]

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

**DETAIL A**

Dimension	Units	MILLIMETERS		
	Limits	MIN	NOM	MAX
Number of Pins	N	36		
Number of Pins per Side	ND	10		
Number of Pins per Side	NE	8		
Pitch	e	0.50 BSC		
Overall Height	A	0.80	0.90	1.00
Standoff	A1	0.025	-	0.075
Overall Width	E	5.00 BSC		
Exposed Pad Width	E2	3.60	3.75	3.90
Overall Length	D	5.00 BSC		
Exposed Pad Length	D2	3.60	3.75	3.90
Contact Width	b	0.20	0.25	0.30
Contact Length	L	0.20	0.25	0.30
Contact-to-Exposed Pad	K	0.20	-	-

Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- Package is saw singulated.
- Dimensioning and tolerancing per ASME Y14.5M.
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-187C Sheet 2 of 2

INDEX

A

Absolute Maximum Ratings	401	Timer1 External Clock Requirements	418
AC Characteristics	413, 471	Timer2/Timer4 External Clock Requirements	419
10-Bit ADC Conversion Requirements	465	Timer3/Timer5 External Clock Requirements	419
12-Bit ADC Conversion Requirements	463	UARTx I/O Requirements	454
ADC Module	459	ADC	
ADC Module (10-Bit Mode)	461, 473	Control Registers	325
ADC Module (12-Bit Mode)	460, 473	Helpful Tips	324
Capacitive Loading Requirements on		Key Features	321
Output Pins	413	Resources	324
DMA Module Requirements	465	Arithmetic Logic Unit (ALU)	44
ECANx I/O Requirements	454	Assembler	
External Clock	414	MPASM Assembler	398
High-Speed PWMx Requirements	422	B	
I/O Timing Requirements	416	Bit-Reversed Addressing	115
I2Cx Bus Data Requirements (Master Mode)	451	Example	116
I2Cx Bus Data Requirements (Slave Mode)	453	Implementation	115
Input Capture x Requirements	420	Sequence Table (16-Entry)	116
Internal FRC Accuracy	415	Block Diagrams	
Internal LPRC Accuracy	415	Data Access from Program Space	
Internal RC Accuracy	472	Address Generation	117
Load Conditions	413, 471	16-Bit Timer1 Module	203
OCx/PWMx Mode Requirements	421	ADC Conversion Clock Period	323
Op Amp/Comparator Voltage Reference		ADC with Connection Options for ANx Pins	
Settling Time Specifications	457	and Op Amps	322
Output Compare x Requirements	421	Arbiter Architecture	110
PLL Clock	415, 471	BEMF Voltage Measurement Using ADC	34
QE1 External Clock Requirements	423	Boost Converter Implementation	32
QE1 Index Pulse Requirements	425	CALL Stack Frame	111
Quadrature Decoder Requirements	424	Comparator (Module 4)	356
Reset, Watchdog Timer, Oscillator Start-up Timer,		Connections for On-Chip Voltage Regulator	384
Power-up Timer Requirements	417	CPU Core	36
SPI1 Master Mode (Full-Duplex, CKE = 0, CKP = x,		CRC Module	373
SMP = 1) Requirements	441	CRC Shift Engine	374
SPI1 Master Mode (Full-Duplex, CKE = 1, CKP = x,		CTMU Module	316
SMP = 1) Requirements	440	Digital Filter Interconnect	357
SPI1 Master Mode (Half-Duplex, Transmit Only)		DMA Controller	141
Requirements	439	DMA Controller Module	139
SPI1 Maximum Data/Clock Rate Summary	438	dsPIC33EPXXXGP50X, dsPIC33EPXXXMC20X/50X	
SPI1 Slave Mode (Full-Duplex, CKE = 0,		and PIC24EPXXXGP/MC20X	25
CKP = 0, SMP = 0) Requirements	449	ECAN Module	288
SPI1 Slave Mode (Full-Duplex, CKE = 0,		EDS Read Address Generation	105
CKP = 1, SMP = 0) Requirements	447	EDS Write Address Generation	106
SPI1 Slave Mode (Full-Duplex, CKE = 1,		Example of MCLR Pin Connections	30
CKP = 0, SMP = 0) Requirements	443	High-Speed PWMx Architectural Overview	227
SPI1 Slave Mode (Full-Duplex, CKE = 1,		High-Speed PWMx Register Interconnection	228
CKP = 1, SMP = 0) Requirements	445	I2Cx Module	274
SPI2 Master Mode (Full-Duplex, CKE = 0, CKP = x, SMP		Input Capture x	213
= 1) Requirements	429	Interleaved PFC	34
SPI2 Master Mode (Full-Duplex, CKE = 1,		Multiphase Synchronous Buck Converter	33
CKP = x, SMP = 1) Requirements	428	Multiplexing Remappable Output for RPN	180
SPI2 Master Mode (Half-Duplex, Transmit Only)		Op Amp Configuration A	358
Requirements	427	Op Amp Configuration B	359
SPI2 Maximum Data/Clock Rate Summary	426	Op Amp/Comparator Voltage Reference Module	356
SPI2 Slave Mode (Full-Duplex, CKE = 0,		Op Amp/Comparator x (Modules 1, 2, 3)	355
CKP = 0, SMP = 0) Requirements	437	Oscillator System	153
SPI2 Slave Mode (Full-Duplex, CKE = 0, CKP = 1, SMP		Output Compare x Module	219
= 0) Requirements	435	PLL	154
SPI2 Slave Mode (Full-Duplex, CKE = 1,		Programmer's Model	38
CKP = 0, SMP = 0) Requirements	431	PTG Module	338
SPI2 Slave Mode (Full-Duplex, CKE = 1,		Quadrature Encoder Interface	250
CKP = 1, SMP = 0) Requirements	433	Recommended Minimum Connection	30