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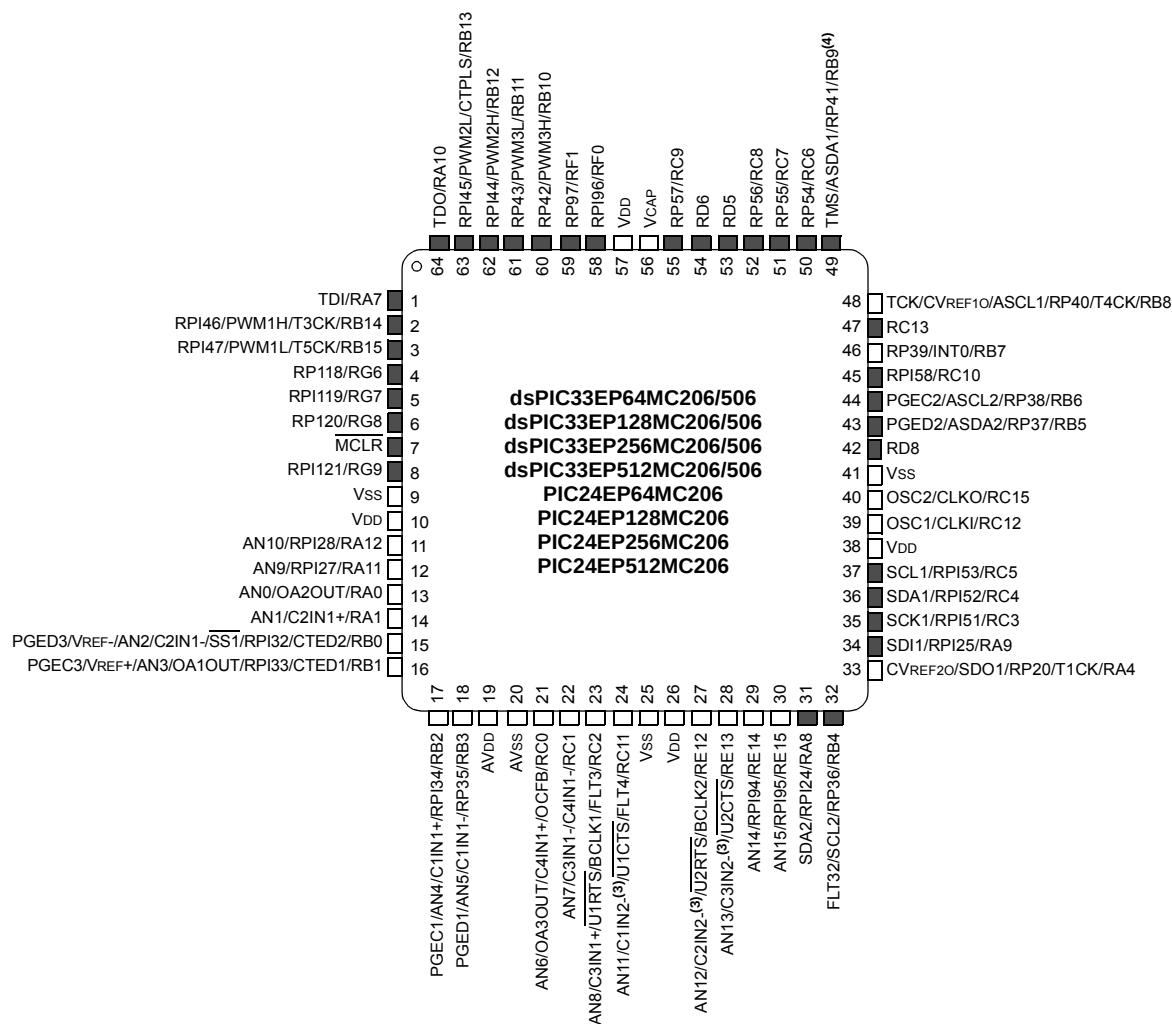
Details

Product Status	Obsolete
Core Processor	dsPIC
Core Size	16-Bit
Speed	60 MIPS
Connectivity	I ² C, IrDA, LINbus, QEI, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, Motor Control PWM, POR, PWM, WDT
Number of I/O	25
Program Memory Size	32KB (10.7K x 24)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	2K x 16
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 8x10b/12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 150°C (TA)
Mounting Type	Surface Mount
Package / Case	36-VFTLA Exposed Pad
Supplier Device Package	36-VTLA (5x5)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/dspic33ep32mc203-h-tl

Pin Diagrams (Continued)

64-Pin TQFP^(1,2,3)

■ = Pins are up to 5V tolerant



- Note 1:** The RPN/RPIn pins can be used by any remappable peripheral with some limitation. See **Section 11.4 “Peripheral Pin Select (PPS)”** for available peripherals and for information on limitations.
- Note 2:** Every I/O port pin (RAX-RGX) can be used as a Change Notification pin (CNAX-CNGX). See **Section 11.0 “I/O Ports”** for more information.
- Note 3:** The metal pad at the bottom of the device is not connected to any pins and is recommended to be connected to VSS externally.
- Note 4:** There is an internal pull-up resistor connected to the TMS pin when the JTAG interface is active. See the JTAGEN bit field in Table 27-2.

TABLE 4-1: CPU CORE REGISTER MAP FOR dsPIC33EPXXXMC20X/50X AND dsPIC33EPXXXGP50X DEVICES ONLY (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	
SR	0042	OA	OB	SA	SB	OAB	SAB	DA	DC	IPL2	IPL1	IPL0	RA	N	OV	Z	C	0000	
CORCON	0044	VAR	—	US<1:0>		EDT	DL<2:0>			SATA	SATB	SATDW	ACCSAT	IPL3	SFA	RND	IF	0020	
MODCON	0046	XMODEN	YMODEN	—	—	BWM<3:0>				YWM<3:0>				XWM<3:0>				0000	
XMODSRT	0048	XMODSRT<15:0>																—	0000
XMODEND	004A	XMODEND<15:0>																—	0001
YMODSRT	004C	YMODSRT<15:0>																—	0000
YMODEND	004E	YMODEND<15:0>																—	0001
XBREV	0050	BREN	XBREV<14:0>																0000
DISCNT	0052	—	—	DISCNT<13:0>															0000
TBLPAG	0054	—	—	—	—	—	—	—	—	TBLPAG<7:0>									0000
MSTRPR	0058	MSTRPR<15:0>																0000	

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

TABLE 4-10: OUTPUT COMPARE 1 THROUGH OUTPUT COMPARE 4 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	
OC1CON1	0900	—	—	OCSIDL	OCTSEL<2:0>			—	ENFLTB	ENFLTA	—	OCFLTB	OCFLTA	TRIGMODE	OCM<2:0>			0000	
OC1CON2	0902	FLTMD	FLTOUT	FLTTRIEN	OCINV	—	—	—	OC32	OCTRIG	TRIGSTAT	OCTRIS	SYNCSEL<4:0>					000C	
OC1RS	0904	Output Compare 1 Secondary Register																	xxxx
OC1R	0906	Output Compare 1 Register																	xxxx
OC1TMR	0908	Timer Value 1 Register																	xxxx
OC2CON1	090A	—	—	OCSIDL	OCTSEL<2:0>			—	ENFLTB	ENFLTA	—	OCFLTB	OCFLTA	TRIGMODE	OCM<2:0>			0000	
OC2CON2	090C	FLTMD	FLTOUT	FLTTRIEN	OCINV	—	—	—	OC32	OCTRIG	TRIGSTAT	OCTRIS	SYNCSEL<4:0>					000C	
OC2RS	090E	Output Compare 2 Secondary Register																	xxxx
OC2R	0910	Output Compare 2 Register																	xxxx
OC2TMR	0912	Timer Value 2 Register																	xxxx
OC3CON1	0914	—	—	OCSIDL	OCTSEL<2:0>			—	ENFLTB	ENFLTA	—	OCFLTB	OCFLTA	TRIGMODE	OCM<2:0>			0000	
OC3CON2	0916	FLTMD	FLTOUT	FLTTRIEN	OCINV	—	—	—	OC32	OCTRIG	TRIGSTAT	OCTRIS	SYNCSEL<4:0>					000C	
OC3RS	0918	Output Compare 3 Secondary Register																	xxxx
OC3R	091A	Output Compare 3 Register																	xxxx
OC3TMR	091C	Timer Value 3 Register																	xxxx
OC4CON1	091E	—	—	OCSIDL	OCTSEL<2:0>			—	ENFLTB	ENFLTA	—	OCFLTB	OCFLTA	TRIGMODE	OCM<2:0>			0000	
OC4CON2	0920	FLTMD	FLTOUT	FLTTRIEN	OCINV	—	—	—	OC32	OCTRIG	TRIGSTAT	OCTRIS	SYNCSEL<4:0>					000C	
OC4RS	0922	Output Compare 4 Secondary Register																	xxxx
OC4R	0924	Output Compare 4 Register																	xxxx
OC4TMR	0926	Timer Value 4 Register																	xxxx

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

TABLE 4-42: OP AMP/COMPARATOR 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
CMSTAT	0A80	PSIDL	—	—	—	C4EVT	C3EVT	C2EVT	C1EVT	—	—	—	—	C4OUT	C3OUT	C2OUT	C1OUT	0000
CVRCON	0A82	—	CVR2OE	—	—	—	VREFSEL	—	—	CVREN	CVR1OE	CVRR	CVRSS	CVR<3:0>				0000
CM1CON	0A84	CON	COE	CPOL	—	—	OPMODE	CEVT	COUT	EVPOL<1:0>		—	CREF	—	—	CCH<1:0>		0000
CM1MSKSRC	0A86	—	—	—	—	SELSRCC<3:0>				SELSRCB<3:0>				SELSRCA<3:0>				0000
CM1MSKCON	0A88	HLMS	—	OCEN	OCNEN	OBEN	OBNEN	OAEN	OANEN	NAGS	PAGS	ACEN	ACNEN	ABEN	ABNEN	AAEN	AANEN	0000
CM1FLTR	0A8A	—	—	—	—	—	—	—	—	—	CFSEL<2:0>			CFLTREN	CFDIV<2:0>			0000
CM2CON	0A8C	CON	COE	CPOL	—	—	OPMODE	CEVT	COUT	EVPOL<1:0>		—	CREF	—	—	CCH<1:0>		0000
CM2MSKSRC	0A8E	—	—	—	—	SELSRCC<3:0>				SELSRCB<3:0>				SELSRCA<3:0>				0000
CM2MSKCON	0A90	HLMS	—	OCEN	OCNEN	OBEN	OBNEN	OAEN	OANEN	NAGS	PAGS	ACEN	ACNEN	ABEN	ABNEN	AAEN	AANEN	0000
CM2FLTR	0A92	—	—	—	—	—	—	—	—	—	CFSEL<2:0>			CFLTREN	CFDIV<2:0>			0000
CM3CON ⁽¹⁾	0A94	CON	COE	CPOL	—	—	OPMODE	CEVT	COUT	EVPOL<1:0>		—	CREF	—	—	CCH<1:0>		0000
CM3MSKSRC ⁽¹⁾	0A96	—	—	—	—	SELSRCC<3:0>				SELSRCB<3:0>				SELSRCA<3:0>				0000
CM3MSKCON ⁽¹⁾	0A98	HLMS	—	OCEN	OCNEN	OBEN	OBNEN	OAEN	OANEN	NAGS	PAGS	ACEN	ACNEN	ABEN	ABNEN	AAEN	AANEN	0000
CM3FLTR ⁽¹⁾	0A9A	—	—	—	—	—	—	—	—	—	CFSEL<2:0>			CFLTREN	CFDIV<2:0>			0000
CM4CON	0A9C	CON	COE	CPOL	—	—	—	CEVT	COUT	EVPOL<1:0>		—	CREF	—	—	CCH<1:0>		0000
CM4MSKSRC	0A9E	—	—	—	—	SELSRCC<3:0>				SELSRCB<3:0>				SELSRCA<3:0>				0000
CM4MSKCON	0AA0	HLMS	—	OCEN	OCNEN	OBEN	OBNEN	OAEN	OANEN	NAGS	PAGS	ACEN	ACNEN	ABEN	ABNEN	AAEN	AANEN	0000
CM4FLTR	0AA2	—	—	—	—	—	—	—	—	—	CFSEL<2:0>			CFLTREN	CFDIV<2:0>			0000

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

Note 1: These registers are unavailable on dsPIC33EPXXGP502/MC502/MC202 and PIC24EP256GP/MC202 (28-pin) devices.

TABLE 4-43: CTMU 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
CTMUCON1	033A	CTMUEN	—	CTMUSIDL	TGEN	EDGEN	EDGSEQEN	IDISSEN	CTTRIG	—	—	—	—	—	—	—	—	0000
CTMUCON2	033C	EDG1MOD	EDG1POL	EDG1SEL<3:0>				EDG2STAT	EDG1STAT	EDG2MOD	EDG2POL	EDG2SEL<3:0>				—	—	0000
CTMUICON	033E	ITRIM<5:0>						IRNG<1:0>		—	—	—	—	—	—	—	—	0000

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

TABLE 4-44: JTAG INTERFACE 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
JDATAH	0FF0	—	—	—	—	JDATAH<27:16>												xxxx
JDATAL	0FF2	JDATAL<15:0>																0000

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

6.1 Reset 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
--

6.1.1 KEY RESOURCES

- **“Reset”** (DS70602) 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 11-4: RPINR7: PERIPHERAL PIN SELECT INPUT REGISTER 7

U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	IC2R<6:0>						
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
—	IC1R<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 **Unimplemented:** Read as '0'

bit 14-8 **IC2R<6:0>:** Assign Input Capture 2 (IC2) 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

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

bit 6-0 **IC1R<6:0>:** Assign Input Capture 1 (IC1) 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 16-7: PWMCONx: PWMx CONTROL REGISTER (CONTINUED)

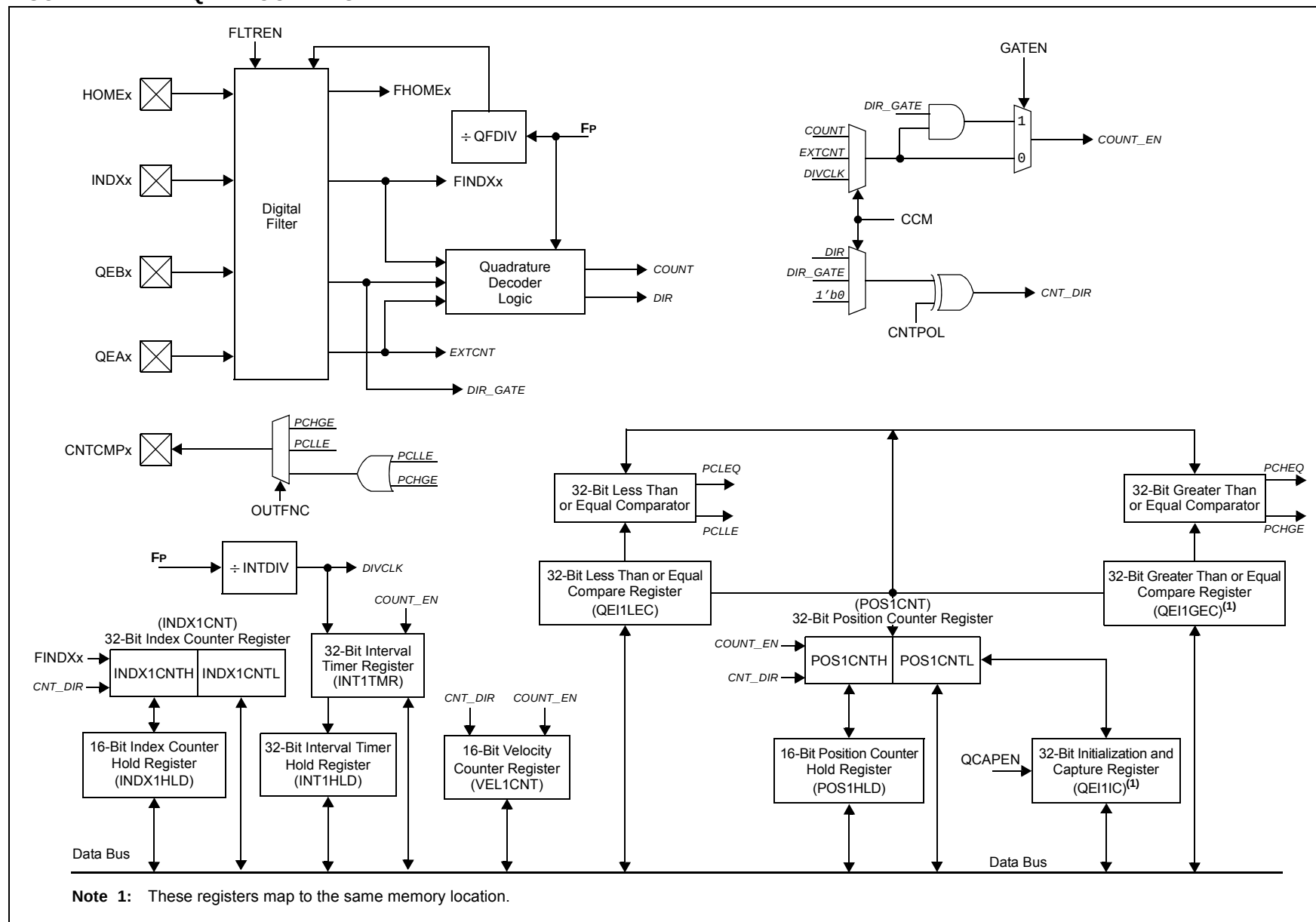
bit 7-6	DTC<1:0> : Dead-Time Control bits 11 = Dead-Time Compensation mode 10 = Dead-time function is disabled 01 = Negative dead time is actively applied for Complementary Output mode 00 = Positive dead time is actively applied for all output modes
bit 5	DTCP : Dead-Time Compensation Polarity bit ⁽³⁾ <u>When Set to '1':</u> If DTCMPx = 0, PWMxL is shortened and PWMxH is lengthened. If DTCMPx = 1, PWMxH is shortened and PWMxL is lengthened. <u>When Set to '0':</u> If DTCMPx = 0, PWMxH is shortened and PWMxL is lengthened. If DTCMPx = 1, PWMxL is shortened and PWMxH is lengthened.
bit 4	Unimplemented : Read as '0'
bit 3	MTBS : Master Time Base Select bit 1 = PWM generator uses the secondary master time base for synchronization and as the clock source for the PWM generation logic (if secondary time base is available) 0 = PWM generator uses the primary master time base for synchronization and as the clock source for the PWM generation logic
bit 2	CAM : Center-Aligned Mode Enable bit ^(2,4) 1 = Center-Aligned mode is enabled 0 = Edge-Aligned mode is enabled
bit 1	XPRES : External PWMx Reset Control bit ⁽⁵⁾ 1 = Current-limit source resets the time base for this PWM generator if it is in Independent Time Base mode 0 = External pins do not affect PWMx time base
bit 0	IUE : Immediate Update Enable bit ⁽²⁾ 1 = Updates to the active MDC/PDCx/DTRx/ALTDTRx/PHASEx registers are immediate 0 = Updates to the active MDC/PDCx/DTRx/ALTDTRx/PHASEx registers are synchronized to the PWMx period boundary

- Note 1:** Software must clear the interrupt status here and in the corresponding IFSx bit in the interrupt controller.
- 2:** These bits should not be changed after the PWMx is enabled (PTEN = 1).
- 3:** DTC<1:0> = 11 for DTCP to be effective; otherwise, DTCP is ignored.
- 4:** The Independent Time Base (ITB = 1) mode must be enabled to use Center-Aligned mode. If ITB = 0, the CAM bit is ignored.
- 5:** To operate in External Period Reset mode, the ITB bit must be '1' and the CLMOD bit in the FCLCONx register must be '0'.

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

- bit 7-3 **FLTSRC<4:0>**: Fault Control Signal Source Select for PWM Generator # bits
- 11111 = Fault 32 (**default**)
 - 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
- bit 2 **FLTPOL**: Fault Polarity for PWM Generator # bit⁽²⁾
- 1 = The selected Fault source is active-low
 - 0 = The selected Fault source is active-high
- bit 1-0 **FLTMOD<1:0>**: Fault Mode for PWM Generator # bits
- 11 = Fault input is disabled
 - 10 = Reserved
 - 01 = The selected Fault source forces PWMxH, PWMxL pins to FLTDAT values (cycle)
 - 00 = The selected Fault source forces PWMxH, PWMxL pins to FLTDAT values (latched condition)

- 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.

FIGURE 17-1: QEI BLOCK DIAGRAM

REGISTER 19-3: I2CxMSK: I2Cx SLAVE MODE ADDRESS MASK REGISTER

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

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
AMSK7	AMSK6	AMSK5	AMSK4	AMSK3	AMSK2	AMSK1	AMSK0
bit 7						bit 0	

Legend:

R = Readable bit

W = Writable bit

U = Unimplemented bit, read as '0'

-n = Value at POR

'1' = Bit is set

'0' = Bit is cleared

x = Bit is unknown

bit 15-10

Unimplemented: Read as '0'

bit 9-0

AMSK<9:0>: Address Mask Select bitsFor 10-Bit Address:

1 = Enables masking for bit Ax of incoming message address; bit match is not required in this position

0 = Disables masking for bit Ax; bit match is required in this position

For 7-Bit Address (I2CxMSK<6:0> only):

1 = Enables masking for bit Ax + 1 of incoming message address; bit match is not required in this position

0 = Disables masking for bit Ax + 1; bit match is required in this position

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>)

22.2 CTMU Control Registers

REGISTER 22-1: CTMUCON1: CTMU CONTROL REGISTER 1

R/W-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
CTMUEN	—	CTMUSIDL	TGEN	EDGEN	EDGSEQEN	IDISSEN ⁽¹⁾	CTTRIG
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 **CTMUEN:** CTMU Enable bit
 1 = Module is enabled
 0 = Module is disabled
- bit 14 **Unimplemented:** Read as '0'
- bit 13 **CTMUSIDL:** CTMU Stop in Idle Mode bit
 1 = Discontinues module operation when device enters Idle mode
 0 = Continues module operation in Idle mode
- bit 12 **TGEN:** Time Generation Enable bit
 1 = Enables edge delay generation
 0 = Disables edge delay generation
- bit 11 **EDGEN:** Edge Enable bit
 1 = Hardware modules are used to trigger edges (TMRx, CTEDx, etc.)
 0 = Software is used to trigger edges (manual set of EDGxSTAT)
- bit 10 **EDGSEQEN:** Edge Sequence Enable bit
 1 = Edge 1 event must occur before Edge 2 event can occur
 0 = No edge sequence is needed
- bit 9 **IDISSEN:** Analog Current Source Control bit⁽¹⁾
 1 = Analog current source output is grounded
 0 = Analog current source output is not grounded
- bit 8 **CTTRIG:** ADC Trigger Control bit
 1 = CTMU triggers ADC start of conversion
 0 = CTMU does not trigger ADC start of conversion
- bit 7-0 **Unimplemented:** Read as '0'

Note 1: The ADC module Sample-and-Hold capacitor is not automatically discharged between sample/conversion cycles. Software using the ADC as part of a capacitance measurement must discharge the ADC capacitor before conducting the measurement. The IDISSEN bit, when set to '1', performs this function. The ADC must be sampling while the IDISSEN bit is active to connect the discharge sink to the capacitor array.

23.0 10-BIT/12-BIT ANALOG-TO-DIGITAL CONVERTER (ADC)

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 “**Analog-to-Digital Converter (ADC)**” (DS70621) 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 dsPIC33EPXXXGP50X, dsPIC33EPXXXMC20X/50X and PIC24EPXXXGP/MC20X devices have one ADC module. The ADC module supports up to 16 analog input channels.

On ADC1, the AD12B bit (AD1CON1<10>) allows the ADC module to be configured by the user as either a 10-bit, 4 Sample-and-Hold (S&H) ADC (default configuration) or a 12-bit, 1 S&H ADC.

Note: The ADC module needs to be disabled before modifying the AD12B bit.

23.1 Key Features

23.1.1 10-BIT ADC CONFIGURATION

The 10-bit ADC configuration has the following key features:

- Successive Approximation (SAR) conversion
- Conversion speeds of up to 1.1 Msps
- Up to 16 analog input pins
- Connections to three internal op amps
- Connections to the Charge Time Measurement Unit (CTMU) and temperature measurement diode
- Channel selection and triggering can be controlled by the Peripheral Trigger Generator (PTG)
- External voltage reference input pins
- Simultaneous sampling of:
 - Up to four analog input pins
 - Three op amp outputs
 - Combinations of analog inputs and op amp outputs
- Automatic Channel Scan mode
- Selectable conversion Trigger source
- Selectable Buffer Fill modes
- Four result alignment options (signed/unsigned, fractional/integer)
- Operation during CPU Sleep and Idle modes

23.1.2 12-BIT ADC CONFIGURATION

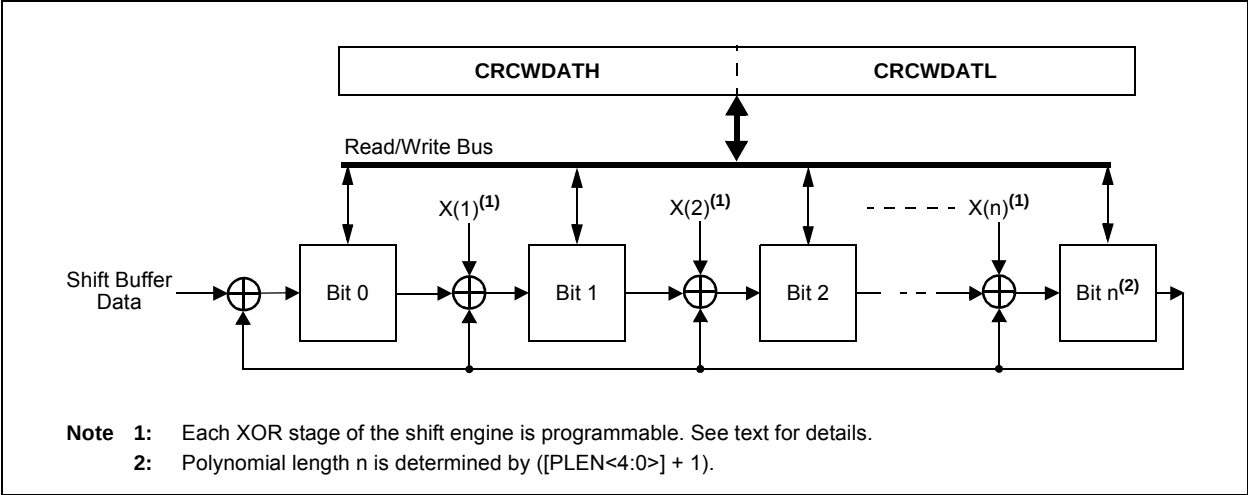
The 12-bit ADC configuration supports all the features listed above, with the exception of the following:

- In the 12-bit configuration, conversion speeds of up to 500 ksps are supported
- There is only one S&H amplifier in the 12-bit configuration; therefore, simultaneous sampling of multiple channels is not supported.

Depending on the particular device pinout, the ADC can have up to 16 analog input pins, designated AN0 through AN15. These analog inputs are shared with op amp inputs and outputs, comparator inputs, and external voltage references. When op amp/comparator functionality is enabled, or an external voltage reference is used, the analog input that shares that pin is no longer available. The actual number of analog input pins, op amps and external voltage reference input configuration depends on the specific device.

A block diagram of the ADC module is shown in Figure 23-1. Figure 23-2 provides a diagram of the ADC conversion clock period.

FIGURE 26-2: CRC SHIFT ENGINE DETAIL



26.1 Overview

The CRC module can be programmed for CRC polynomials of up to the 32nd order, using up to 32 bits. Polynomial length, which reflects the highest exponent in the equation, is selected by the PLEN<4:0> bits (CRCCON2<4:0>).

The CRCXORL and CRCXORH registers control which exponent terms are included in the equation. Setting a particular bit includes that exponent term in the equation; functionally, this includes an XOR operation on the corresponding bit in the CRC engine. Clearing the bit disables the XOR.

For example, consider two CRC polynomials, one a 16-bit equation and the other a 32-bit equation:

$$x^{16} + x^{12} + x^5 + 1$$

and

$$x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$$

To program these polynomials into the CRC generator, set the register bits as shown in Table 26-1.

Note that the appropriate positions are set to '1' to indicate that they are used in the equation (for example, X26 and X23). The 0 bit required by the equation is always XORed; thus, X0 is a don't care. For a polynomial of length N, it is assumed that the Nth bit will always be used, regardless of the bit setting. Therefore, for a polynomial length of 32, there is no 32nd bit in the CRCXOR register.

TABLE 26-1: CRC SETUP EXAMPLES FOR 16 AND 32-BIT POLYNOMIAL

CRC Control Bits	Bit Values	
	16-bit Polynomial	32-bit Polynomial
PLEN<4:0>	01111	11111
X<31:16>	0000 0000 0000 000x	0000 0100 1100 0001
X<15:0>	0001 0000 0010 000x	0001 1101 1011 011x

26.2 Programmable CRC 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>

26.2.1 KEY RESOURCES

- “Programmable Cyclic Redundancy Check (CRC)” (DS70346) in the “dsPIC33/PIC24 Family Reference Manual”
- Code Samples
- Application Notes
- Software Libraries
- Webinars
- All Related “dsPIC33/PIC24 Family Reference Manual” Sections
- Development Tools

TABLE 28-2: INSTRUCTION SET OVERVIEW

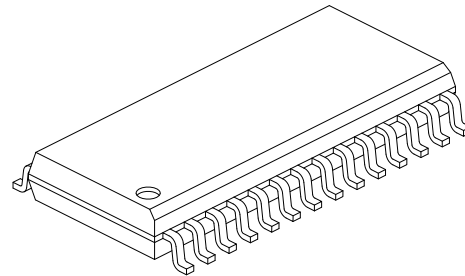
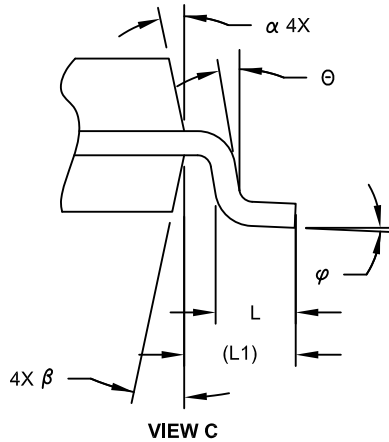
Base Instr #	Assembly Mnemonic	Assembly Syntax	Description	# of Words	# of Cycles ⁽²⁾	Status Flags Affected
1	ADD	ADD Acc ⁽¹⁾	Add Accumulators	1	1	OA,OB,SA,SB
		ADD f	f = f + WREG	1	1	C,DC,N,OV,Z
		ADD f, WREG	WREG = f + WREG	1	1	C,DC,N,OV,Z
		ADD #lit10, Wn	Wd = lit10 + Wd	1	1	C,DC,N,OV,Z
		ADD Wb, Ws, Wd	Wd = Wb + Ws	1	1	C,DC,N,OV,Z
		ADD Wb, #lit5, Wd	Wd = Wb + lit5	1	1	C,DC,N,OV,Z
		ADD Wso, #Slit4, Acc	16-bit Signed Add to Accumulator	1	1	OA,OB,SA,SB
2	ADDC	ADDC f	f = f + WREG + (C)	1	1	C,DC,N,OV,Z
		ADDC f, WREG	WREG = f + WREG + (C)	1	1	C,DC,N,OV,Z
		ADDC #lit10, Wn	Wd = lit10 + Wd + (C)	1	1	C,DC,N,OV,Z
		ADDC Wb, Ws, Wd	Wd = Wb + Ws + (C)	1	1	C,DC,N,OV,Z
		ADDC Wb, #lit5, Wd	Wd = Wb + lit5 + (C)	1	1	C,DC,N,OV,Z
3	AND	AND f	f = f .AND. WREG	1	1	N,Z
		AND f, WREG	WREG = f .AND. WREG	1	1	N,Z
		AND #lit10, Wn	Wd = lit10 .AND. Wd	1	1	N,Z
		AND Wb, Ws, Wd	Wd = Wb .AND. Ws	1	1	N,Z
		AND Wb, #lit5, Wd	Wd = Wb .AND. lit5	1	1	N,Z
4	ASR	ASR f	f = Arithmetic Right Shift f	1	1	C,N,OV,Z
		ASR f, WREG	WREG = Arithmetic Right Shift f	1	1	C,N,OV,Z
		ASR Ws, Wd	Wd = Arithmetic Right Shift Ws	1	1	C,N,OV,Z
		ASR Wb, Wns, Wnd	Wnd = Arithmetic Right Shift Wb by Wns	1	1	N,Z
		ASR Wb, #lit5, Wnd	Wnd = Arithmetic Right Shift Wb by lit5	1	1	N,Z
5	BCLR	BCLR f, #bit4	Bit Clear f	1	1	None
		BCLR Ws, #bit4	Bit Clear Ws	1	1	None
6	BRA	BRA C, Expr	Branch if Carry	1	1 (4)	None
		BRA GE, Expr	Branch if greater than or equal	1	1 (4)	None
		BRA GEU, Expr	Branch if unsigned greater than or equal	1	1 (4)	None
		BRA GT, Expr	Branch if greater than	1	1 (4)	None
		BRA GTU, Expr	Branch if unsigned greater than	1	1 (4)	None
		BRA LE, Expr	Branch if less than or equal	1	1 (4)	None
		BRA LEU, Expr	Branch if unsigned less than or equal	1	1 (4)	None
		BRA LT, Expr	Branch if less than	1	1 (4)	None
		BRA LTU, Expr	Branch if unsigned less than	1	1 (4)	None
		BRA N, Expr	Branch if Negative	1	1 (4)	None
		BRA NC, Expr	Branch if Not Carry	1	1 (4)	None
		BRA NN, Expr	Branch if Not Negative	1	1 (4)	None
		BRA NOV, Expr	Branch if Not Overflow	1	1 (4)	None
		BRA NZ, Expr	Branch if Not Zero	1	1 (4)	None
		BRA OA, Expr ⁽¹⁾	Branch if Accumulator A overflow	1	1 (4)	None
		BRA OB, Expr ⁽¹⁾	Branch if Accumulator B overflow	1	1 (4)	None
		BRA OV, Expr ⁽¹⁾	Branch if Overflow	1	1 (4)	None
		BRA SA, Expr ⁽¹⁾	Branch if Accumulator A saturated	1	1 (4)	None
		BRA SB, Expr ⁽¹⁾	Branch if Accumulator B saturated	1	1 (4)	None
		BRA Expr	Branch Unconditionally	1	4	None
		BRA Z, Expr	Branch if Zero	1	1 (4)	None
		BRA Wn	Computed Branch	1	4	None
7	BSET	BSET f, #bit4	Bit Set f	1	1	None
		BSET Ws, #bit4	Bit Set Ws	1	1	None
8	BSW	BSW.C Ws, Wb	Write C bit to Ws<Wb>	1	1	None
		BSW.Z Ws, Wb	Write Z bit to Ws<Wb>	1	1	None

Note 1: These instructions are available in dsPIC33EPXXXMC20X/50X and PIC24EPXXXMC20X devices only.

2: Read and Read-Modify-Write (e.g., bit operations and logical operations) on non-CPU SFRs incur an additional instruction cycle.

28-Lead Plastic Small Outline (SO) - Wide, 7.50 mm Body [SOIC]

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



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N	28		
Pitch	e	1.27 BSC		
Overall Height	A	-	-	2.65
Molded Package Thickness	A2	2.05	-	-
Standoff §	A1	0.10	-	0.30
Overall Width	E	10.30 BSC		
Molded Package Width	E1	7.50 BSC		
Overall Length	D	17.90 BSC		
Chamfer (Optional)	h	0.25	-	0.75
Foot Length	L	0.40	-	1.27
Footprint	L1	1.40 REF		
Lead Angle	θ	0°	-	-
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.18	-	0.33
Lead Width	b	0.31	-	0.51
Mold Draft Angle Top	α	5°	-	15°
Mold Draft Angle Bottom	β	5°	-	15°

Notes:

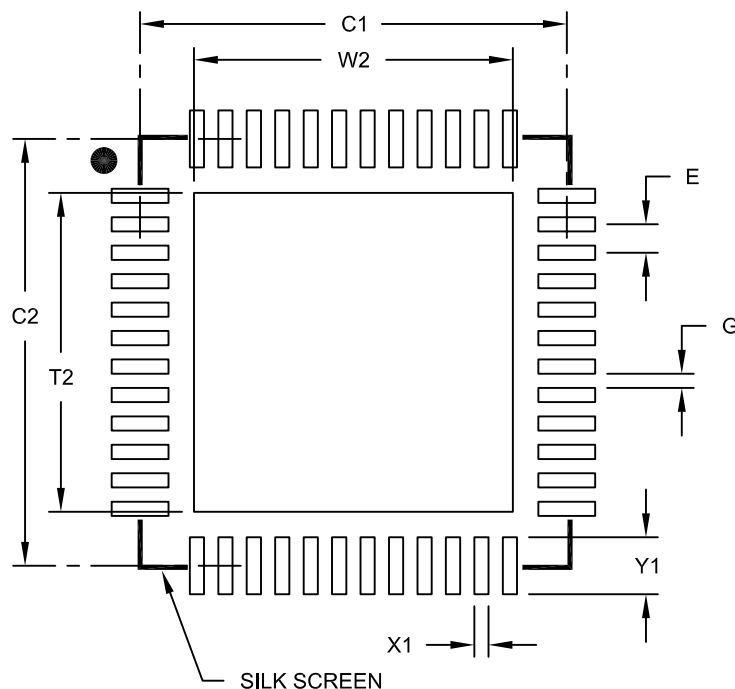
- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic
- Dimension D does not include mold flash, protrusions or gate burrs, which shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion, which shall not exceed 0.25 mm per side.
- 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.
- Datums A & B to be determined at Datum H.

Microchip Technology Drawing C04-052C Sheet 2 of 2



48-Lead Ultra Thin Plastic Quad Flat, No Lead Package (MV) - 6x6 mm Body [UQFN]
With 0.40 mm Contact Length

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



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	0.40 BSC		
Optional Center Pad Width	W2			4.45
Optional Center Pad Length	T2			4.45
Contact Pad Spacing	C1		6.00	
Contact Pad Spacing	C2		6.00	
Contact Pad Width (X28)	X1			0.20
Contact Pad Length (X28)	Y1			0.80
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. C04-2153A

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

ECAN Module	
Control Registers	290
Modes of Operation	289
Overview	287
Resources	289
Electrical Characteristics	401
AC	413, 471
Enhanced CAN (ECAN) Module	287
Equations	
Device Operating Frequency	154
FPLLO Calculation	154
FVCO Calculation	154
Errata	23
F	
Filter Capacitor (CEFC) Specifications	403
Flash Program Memory	119
Control Registers	120
Programming Operations	120
Resources	120
RTSP Operation	120
Table Instructions	119
Flexible Configuration	379
G	
Guidelines for Getting Started	29
Application Examples	32
Basic Connection Requirements	29
CPU Logic Filter Capacitor Connection (VCAP)	30
Decoupling Capacitors	29
External Oscillator Pins	31
ICSP Pins	31
Master Clear (MCLR) Pin	30
Oscillator Value Conditions on Start-up	32
Unused I/Os	32
H	
High-Speed PWM	225
Control Registers	230
Faults	225
Resources	229
High-Temperature Electrical Characteristics	467
Absolute Maximum Ratings	467
I	
I/O Ports	173
Helpful Tips	181
Parallel I/O (PIO)	173
Resources	182
Write/Read Timing	174
In-Circuit Debugger	386
In-Circuit Emulation	379
In-Circuit Serial Programming (ICSP)	379, 386
Input Capture	213
Control Registers	215
Resources	214
Input Change Notification (ICN)	174
Instruction Addressing Modes	112
File Register Instructions	112
Fundamental Modes Supported	112
MAC Instructions	113
MCU Instructions	112
Move and Accumulator Instructions	113
Other Instructions	113

Instruction Set	
Overview	390
Summary	387
Symbols Used in Opcode Descriptions	388
Inter-Integrated Circuit (I ² C)	273
Control Registers	276
Resources	275
Internal RC Oscillator	
Use with WDT	385
Internet Address	524
Interrupt Controller	
Control and Status Registers	131
INTCON1	131
INTCON2	131
INTCON3	131
INTCON4	131
INTTREG	131
Interrupt Vector Details	129
Interrupt Vector Table (IVT)	127
Reset Sequence	127
Resources	131
J	
JTAG Boundary Scan Interface	379
JTAG Interface	386
M	
Memory Maps	
Extended Data Space	109
Memory Organization	45
Resources	62
Microchip Internet Web Site	524
Modulo Addressing	114
Applicability	115
Operation Example	114
Start and End Address	114
W Address Register Selection	114
MPLAB Assembler, Linker, Librarian	398
MPLAB ICD 3 In-Circuit Debugger	399
MPLAB PM3 Device Programmer	399
MPLAB REAL ICE In-Circuit Emulator System	399
MPLAB X Integrated Development	
Environment Software	397
MPLAB X SIM Software Simulator	399
MPLIB Object Librarian	398
MPLINK Object Linker	398
O	
Op Amp	
Application Considerations	358
Configuration A	358
Configuration B	359
Op Amp/Comparator	355
Control Registers	360
Resources	359
Open-Drain Configuration	174
Oscillator	
Control Registers	156
Resources	155
Output Compare	219
Control Registers	221
Resources	220