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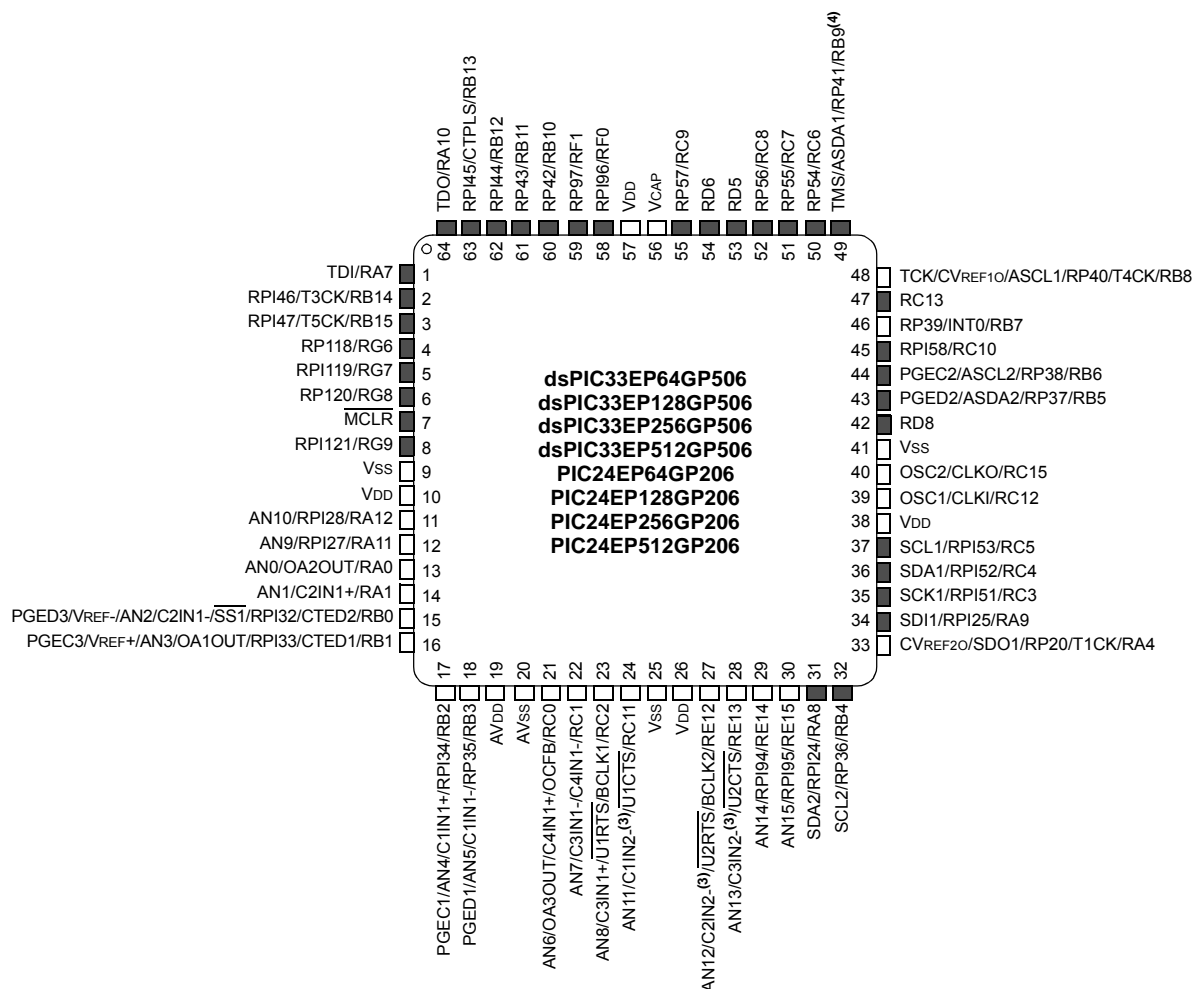
Details

Product Status	Active
Core Processor	PIC
Core Size	16-Bit
Speed	70 MIPS
Connectivity	I ² C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, 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 ~ 85°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/pic24ep32gp203t-i-tl

Pin Diagrams (Continued)

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

■ = Pins are up to 5V tolerant



- Note**
- 1: The RPN/RPI 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.
 - 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.
 - 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.
 - 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.

FIGURE 4-2: PROGRAM MEMORY MAP FOR dsPIC33EP64GP50X, dsPIC33EP64MC20X/50X AND PIC24EP64GP/MC20X DEVICES

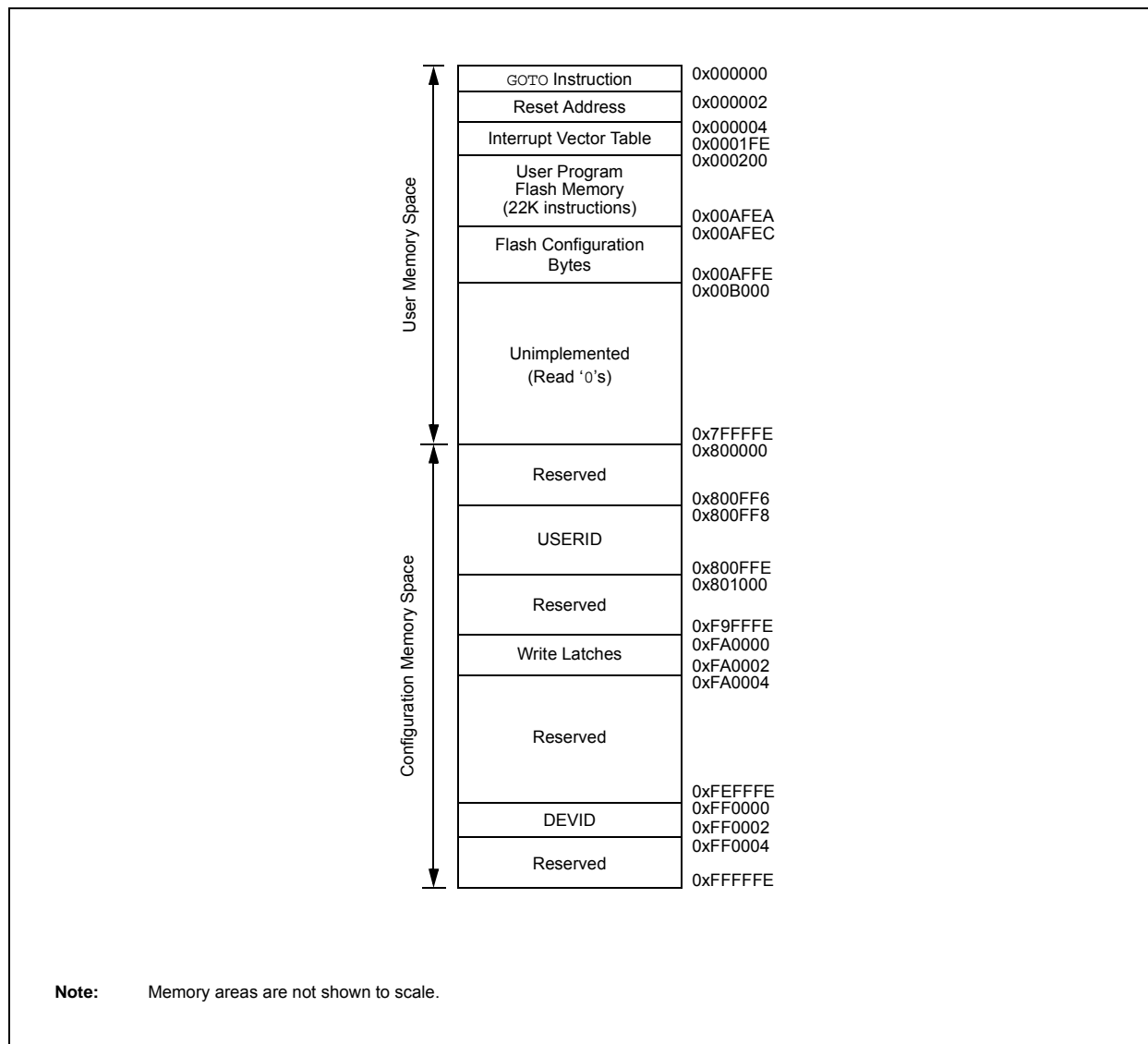


FIGURE 4-14: DATA MEMORY MAP FOR PIC24EP128GP/MC20X/50X DEVICES

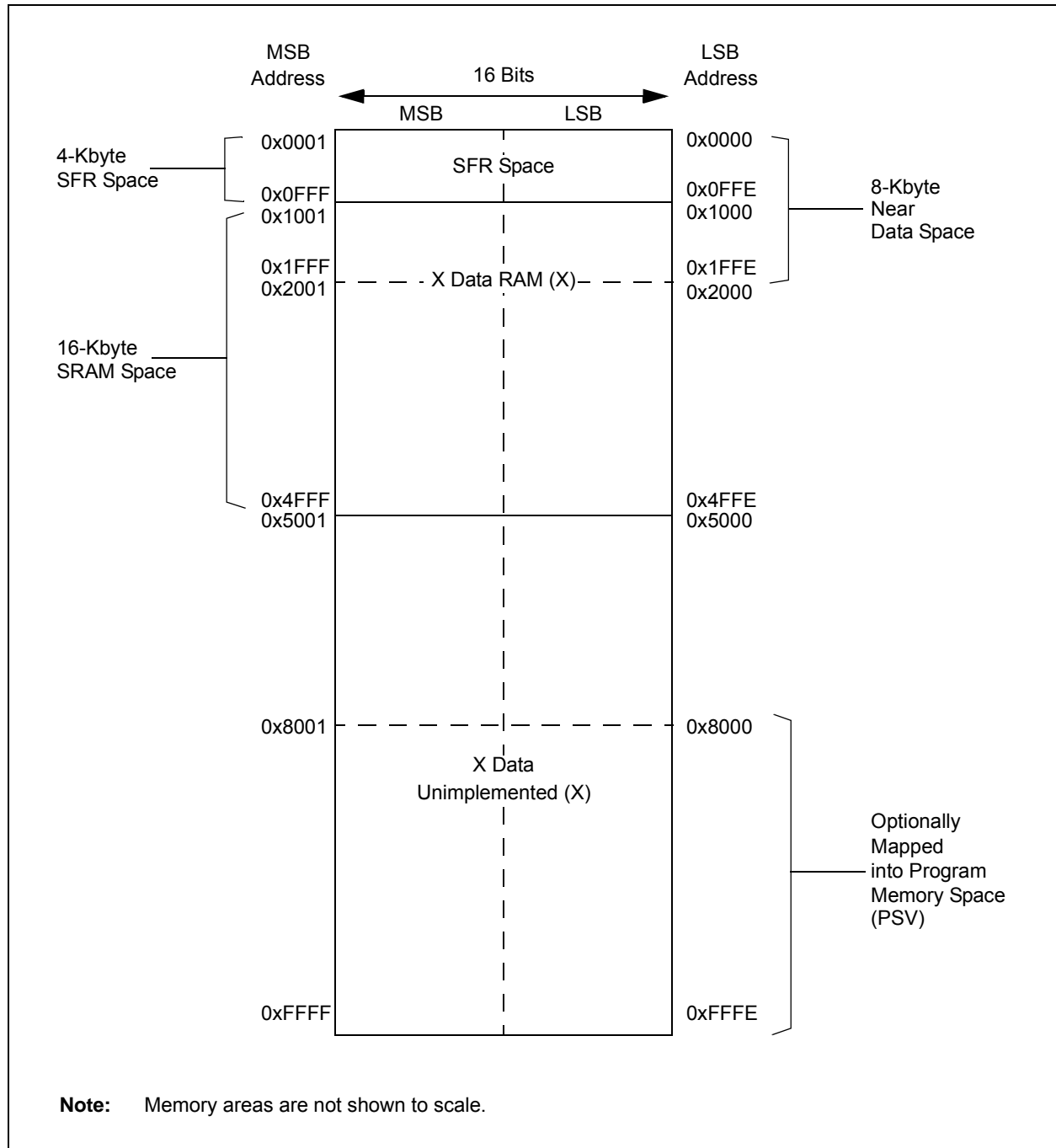


FIGURE 4-16: DATA MEMORY MAP FOR PIC24EP512GP/MC20X/50X DEVICES

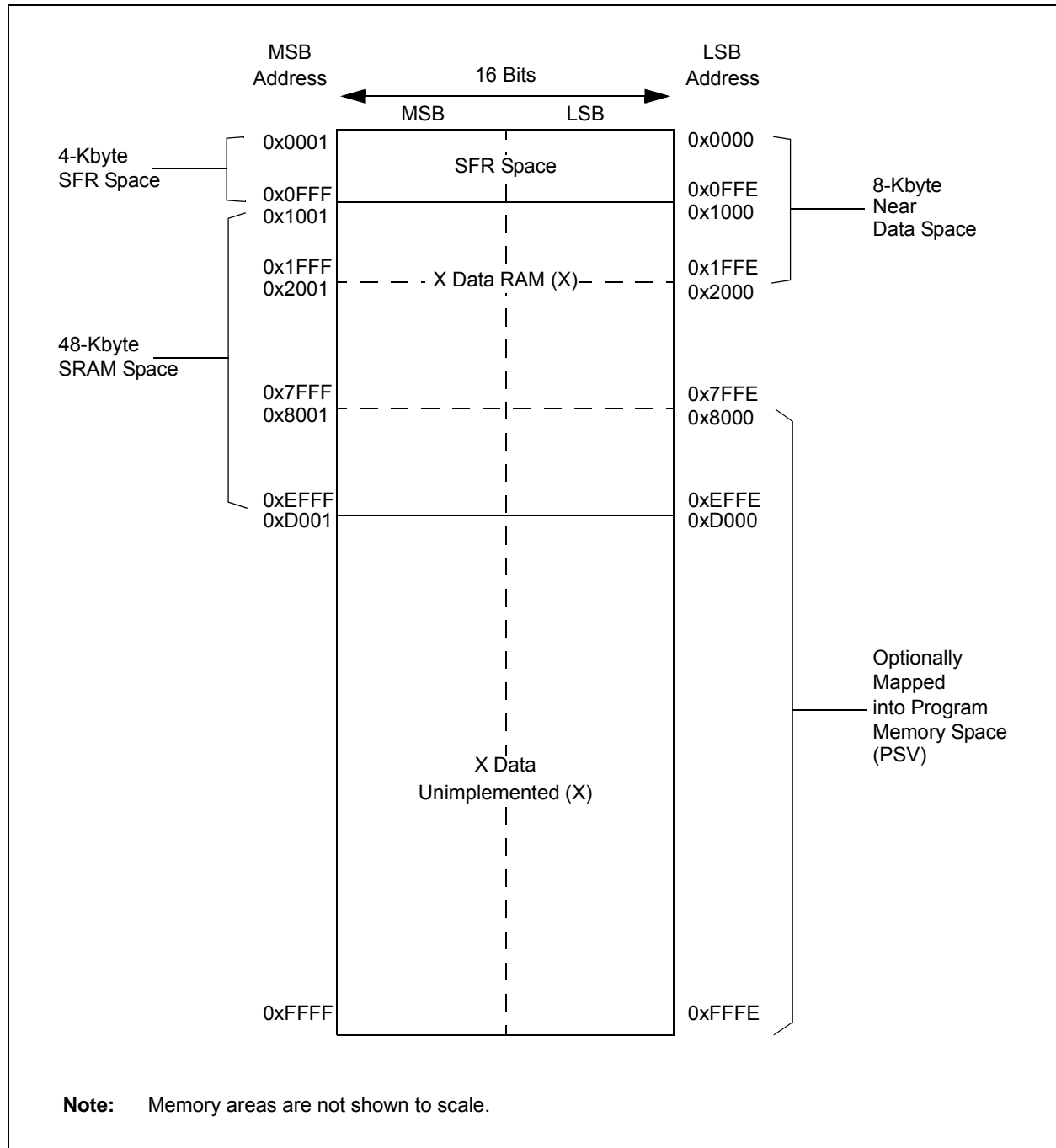


TABLE 4-5: INTERRUPT CONTROLLER REGISTER MAP FOR dsPIC33EPXXXGP50X DEVICES ONLY

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>			—	PTGWDTIP<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.

Allocating different Page registers for read and write access allows the architecture to support data movement between different pages in data memory. This is accomplished by setting the DSRPAG register value to the page from which you want to read, and configuring the DSWPAG register to the page to which it needs to be written. Data can also be moved from different PSV to EDS pages, by configuring the DSRPAG and DSWPAG registers to address PSV and EDS space, respectively. The data can be moved between pages by a single instruction.

When an EDS or PSV page overflow or underflow occurs, EA<15> is cleared as a result of the register indirect EA calculation. An overflow or underflow of the EA in the EDS or PSV pages can occur at the page boundaries when:

- The initial address prior to modification addresses an EDS or PSV page
- The EA calculation uses Pre-Modified or Post-Modified Register Indirect Addressing; however, this does not include Register Offset Addressing

In general, when an overflow is detected, the DSxPAG register is incremented and the EA<15> bit is set to keep the base address within the EDS or PSV window. When an underflow is detected, the DSxPAG register is decremented and the EA<15> bit is set to keep the base address within the EDS or PSV window. This creates a linear EDS and PSV address space, but only when using Register Indirect Addressing modes.

Exceptions to the operation described above arise when entering and exiting the boundaries of Page 0, EDS and PSV spaces. Table 4-61 lists the effects of overflow and underflow scenarios at different boundaries.

In the following cases, when overflow or underflow occurs, the EA<15> bit is set and the DSxPAG is not modified; therefore, the EA will wrap to the beginning of the current page:

- Register Indirect with Register Offset Addressing
- Modulo Addressing
- Bit-Reversed Addressing

TABLE 4-61: OVERFLOW AND UNDERFLOW SCENARIOS AT PAGE 0, EDS and PSV SPACE BOUNDARIES^(2,3,4)

O/U, R/W	Operation	Before			After		
		DSxPAG	DS EA<15>	Page Description	DSxPAG	DS EA<15>	Page Description
O, Read	[++Wn] or [Wn++]	DSRPAG = 0x1FF	1	EDS: Last page	DSRPAG = 0x1FF	0	See Note 1
O, Read		DSRPAG = 0x2FF	1	PSV: Last lsw page	DSRPAG = 0x300	1	PSV: First MSB page
O, Read		DSRPAG = 0x3FF	1	PSV: Last MSB page	DSRPAG = 0x3FF	0	See Note 1
O, Write		DSWPAG = 0x1FF	1	EDS: Last page	DSWPAG = 0x1FF	0	See Note 1
U, Read	[--Wn] or [Wn--]	DSRPAG = 0x001	1	PSV page	DSRPAG = 0x001	0	See Note 1
U, Read		DSRPAG = 0x200	1	PSV: First lsw page	DSRPAG = 0x200	0	See Note 1
U, Read		DSRPAG = 0x300	1	PSV: First MSB page	DSRPAG = 0x2FF	1	PSV: Last lsw page

Legend: O = Overflow, U = Underflow, R = Read, W = Write

Note 1: The Register Indirect Addressing now addresses a location in the base Data Space (0x0000-0x8000).

2: An EDS access with DSxPAG = 0x000 will generate an address error trap.

3: Only reads from PS are supported using DSRPAG. An attempt to write to PS using DSWPAG will generate an address error trap.

4: Pseudo-Linear Addressing is not supported for large offsets.

4.6 Modulo Addressing (dsPIC33EPXXXMC20X/50X and dsPIC33EPXXXGP50X Devices Only)

Modulo Addressing mode is a method of providing an automated means to support circular data buffers using hardware. The objective is to remove the need for software to perform data address boundary checks when executing tightly looped code, as is typical in many DSP algorithms.

Modulo Addressing can operate in either Data or Program Space (since the Data Pointer mechanism is essentially the same for both). One circular buffer can be supported in each of the X (which also provides the pointers into Program Space) and Y Data Spaces. Modulo Addressing can operate on any W Register Pointer. However, it is not advisable to use W14 or W15 for Modulo Addressing since these two registers are used as the Stack Frame Pointer and Stack Pointer, respectively.

In general, any particular circular buffer can be configured to operate in only one direction, as there are certain restrictions on the buffer start address (for incrementing buffers) or end address (for decrementing buffers), based upon the direction of the buffer.

The only exception to the usage restrictions is for buffers that have a power-of-two length. As these buffers satisfy the start and end address criteria, they can operate in a bidirectional mode (that is, address boundary checks are performed on both the lower and upper address boundaries).

4.6.1 START AND END ADDRESS

The Modulo Addressing scheme requires that a starting and ending address be specified, and loaded into the 16-bit Modulo Buffer Address registers: XMODSRT, XMODEND, YMODSRT and YMODEND (see Table 4-1).

Note: Y space Modulo Addressing EA calculations assume word-sized data (LSb of every EA is always clear).

The length of a circular buffer is not directly specified. It is determined by the difference between the corresponding start and end addresses. The maximum possible length of the circular buffer is 32K words (64 Kbytes).

4.6.2 W ADDRESS REGISTER SELECTION

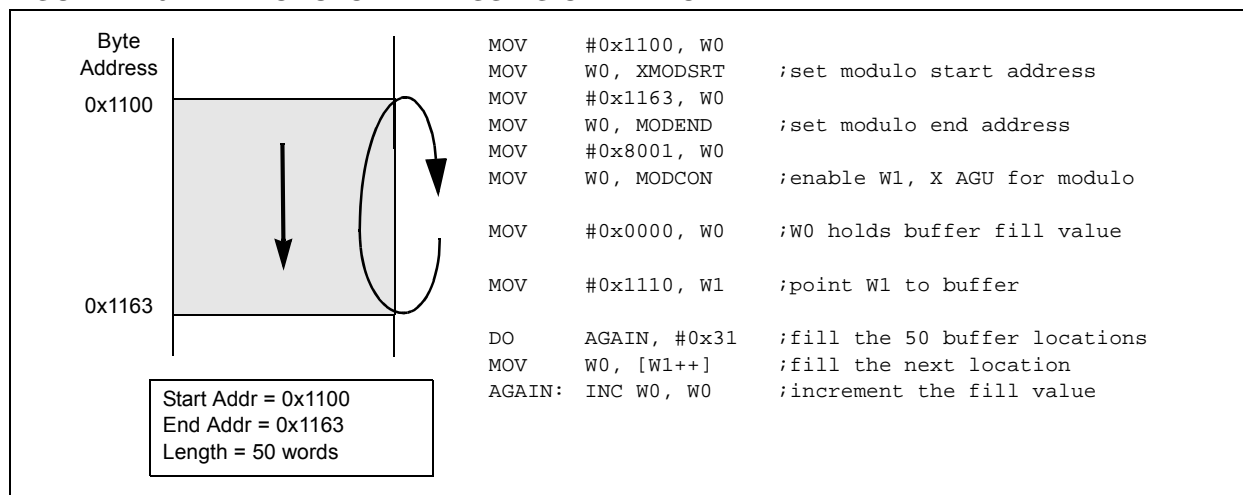
The Modulo and Bit-Reversed Addressing Control register, MODCON<15:0>, contains enable flags as well as a W register field to specify the W Address registers. The XWM and YWM fields select the registers that operate with Modulo Addressing:

- If XWM = 1111, X RAGU and X WAGU Modulo Addressing is disabled
- If YWM = 1111, Y AGU Modulo Addressing is disabled

The X Address Space Pointer W register (XWM), to which Modulo Addressing is to be applied, is stored in MODCON<3:0> (see Table 4-1). Modulo Addressing is enabled for X Data Space when XWM is set to any value other than '1111' and the XMODEN bit is set (MODCON<15>).

The Y Address Space Pointer W register (YWM), to which Modulo Addressing is to be applied, is stored in MODCON<7:4>. Modulo Addressing is enabled for Y Data Space when YWM is set to any value other than '1111' and the YMODEN bit is set at MODCON<14>.

FIGURE 4-20: MODULO ADDRESSING OPERATION EXAMPLE



REGISTER 14-2: ICxCON2: INPUT CAPTURE x CONTROL REGISTER 2

U-0	U-0	U-0	U-0	U-0	U-0	U-0	R/W-0
—	—	—	—	—	—	—	IC32
bit 15							bit 8

R/W-0	R/W/HS-0	U-0	R/W-0	R/W-1	R/W-1	R/W-0	R/W-1
ICTRIG ⁽²⁾	TRIGSTAT ⁽³⁾	—	SYNCSEL4 ⁽⁴⁾	SYNCSEL3 ⁽⁴⁾	SYNCSEL2 ⁽⁴⁾	SYNCSEL1 ⁽⁴⁾	SYNCSEL0 ⁽⁴⁾
bit 7							bit 0

Legend:	HS = Hardware Settable 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 15-9 **Unimplemented:** Read as '0'
- bit 8 **IC32:** Input Capture 32-Bit Timer Mode Select bit (Cascade mode)
 1 = Odd IC and Even IC form a single 32-bit input capture module⁽¹⁾
 0 = Cascade module operation is disabled
- bit 7 **ICTRIG:** Input Capture Trigger Operation Select bit⁽²⁾
 1 = Input source used to trigger the input capture timer (Trigger mode)
 0 = Input source used to synchronize the input capture timer to a timer of another module (Synchronization mode)
- bit 6 **TRIGSTAT:** Timer Trigger Status bit⁽³⁾
 1 = ICxTMR has been triggered and is running
 0 = ICxTMR has not been triggered and is being held clear
- bit 5 **Unimplemented:** Read as '0'

- Note 1:** The IC32 bit in both the Odd and Even IC must be set to enable Cascade mode.
- Note 2:** The input source is selected by the SYNCSEL<4:0> bits of the ICxCON2 register.
- Note 3:** This bit is set by the selected input source (selected by SYNCSEL<4:0> bits). It can be read, set and cleared in software.
- Note 4:** Do not use the ICx module as its own Sync or Trigger source.
- Note 5:** This option should only be selected as a trigger source and not as a synchronization source.
- Note 6:** Each Input Capture x (ICx) module has one PTG input source. See **Section 24.0 “Peripheral Trigger Generator (PTG) Module”** for more information.
 PTGO8 = IC1
 PTGO9 = IC2
 PTGO10 = IC3
 PTGO11 = IC4

16.3 PWMx Control Registers

REGISTER 16-1: PTCN: PWMx TIME BASE CONTROL REGISTER

R/W-0	U-0	R/W-0	HS/HC-0	R/W-0	R/W-0	R/W-0	R/W-0
PTEN	—	PTSIDL	SESTAT	SEIEN	EIPU ⁽¹⁾	SYNCPOL ⁽¹⁾	SYNCOEN ⁽¹⁾
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
SYNCEN ⁽¹⁾	SYNCSRC2 ⁽¹⁾	SYNCSRC1 ⁽¹⁾	SYNCSRC0 ⁽¹⁾	SEVTPS3 ⁽¹⁾	SEVTPS2 ⁽¹⁾	SEVTPS1 ⁽¹⁾	SEVTPS0 ⁽¹⁾
bit 7							bit 0

Legend:	HC = Hardware Clearable bit	HS = Hardware Settable 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 **PTEN:** PWMx Module Enable bit
 1 = PWMx module is enabled
 0 = PWMx module is disabled
- bit 14 **Unimplemented:** Read as '0'
- bit 13 **PTSIDL:** PWMx Time Base Stop in Idle Mode bit
 1 = PWMx time base halts in CPU Idle mode
 0 = PWMx time base runs in CPU Idle mode
- bit 12 **SESTAT:** Special Event Interrupt Status bit
 1 = Special event interrupt is pending
 0 = Special event interrupt is not pending
- bit 11 **SEIEN:** Special Event Interrupt Enable bit
 1 = Special event interrupt is enabled
 0 = Special event interrupt is disabled
- bit 10 **EIPU:** Enable Immediate Period Updates bit⁽¹⁾
 1 = Active Period register is updated immediately
 0 = Active Period register updates occur on PWMx cycle boundaries
- bit 9 **SYNCPOL:** Synchronize Input and Output Polarity bit⁽¹⁾
 1 = SYNCI1/SYNCO1 polarity is inverted (active-low)
 0 = SYNCI1/SYNCO1 is active-high
- bit 8 **SYNCOEN:** Primary Time Base Sync Enable bit⁽¹⁾
 1 = SYNCO1 output is enabled
 0 = SYNCO1 output is disabled
- bit 7 **SYNCEN:** External Time Base Synchronization Enable bit⁽¹⁾
 1 = External synchronization of primary time base is enabled
 0 = External synchronization of primary time base is disabled

Note 1: These bits should be changed only when PTEN = 0. In addition, when using the SYNCI1 feature, the user application must program the period register with a value that is slightly larger than the expected period of the external synchronization input signal.

2: See **Section 24.0 “Peripheral Trigger Generator (PTG) Module”** for information on this selection.

22.0 CHARGE TIME MEASUREMENT UNIT (CTMU)

Note 1: This data sheet summarizes the features of the dsPIC33EPXXXGP50X, dsPIC33EPXXXMC20X/50X and PIC24EPXXXGP/MC20X family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to “**Charge Time Measurement Unit (CTMU)**” (DS70661) in the “*dsPIC33/PIC24 Family Reference Manual*”, which is available on 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 Charge Time Measurement Unit is a flexible analog module that provides accurate differential time measurement between pulse sources, as well as asynchronous pulse generation. Its key features include:

- Four Edge Input Trigger Sources
- Polarity Control for Each Edge Source
- Control of Edge Sequence
- Control of Response to Edges
- Precise Time Measurement Resolution of 1 ns
- Accurate Current Source Suitable for Capacitive Measurement
- On-Chip Temperature Measurement using a Built-in Diode

Together with other on-chip analog modules, the CTMU can be used to precisely measure time, measure capacitance, measure relative changes in capacitance or generate output pulses that are independent of the system clock.

The CTMU module is ideal for interfacing with capacitive-based sensors. The CTMU is controlled through three registers: CTMUCON1, CTMUCON2 and CTMUICON. CTMUCON1 and CTMUCON2 enable the module and control edge source selection, edge source polarity selection and edge sequencing. The CTMUICON register controls the selection and trim of the current source.

REGISTER 23-8: AD1CSSL: ADC1 INPUT SCAN SELECT REGISTER LOW^(1,2)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
CSS15	CSS14	CSS13	CSS12	CSS11	CSS10	CSS9	CSS8
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
CSS7	CSS6	CSS5	CSS4	CSS3	CSS2	CSS1	CSS0
bit 7							bit 0

Legend:

R = Readable bit W = Writable bit U = Unimplemented bit, read as '0'
 -n = Value at POR '1' = Bit is set '0' = Bit is cleared x = Bit is unknown

bit 15-0 **CSS<15:0>**: ADC1 Input Scan Selection bits

- 1 = Selects ANx for input scan
- 0 = Skips ANx for input scan

Note 1: On devices with less than 16 analog inputs, all AD1CSSL bits can be selected by the user. However, inputs selected for scan, without a corresponding input on the device, convert VREFL.

2: CSSx = ANx, where x = 0-15.

24.2 PTG 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.

<p>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</p>
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24.2.1 KEY RESOURCES

- **“Peripheral Trigger Generator”** (DS70669) 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 24-4: PTGT0LIM: PTG TIMER0 LIMIT REGISTER⁽¹⁾

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGT0LIM<15:8>							
bit 15				bit 8			

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGT0LIM<7:0>							
bit 7				bit 0			

Legend:

R = Readable bit

W = Writable bit

U = Unimplemented bit, read as '0'

-n = Value at POR

'1' = Bit is set

'0' = Bit is cleared

x = Bit is unknown

bit 15-0 **PTGT0LIM<15:0>**: PTG Timer0 Limit Register bits
 General Purpose Timer0 Limit register (effective only with a PTGT0 Step command).

Note 1: This register is read-only when the PTG module is executing Step commands (PTGEN = 1 and PTGSTRT = 1).

REGISTER 24-5: PTGT1LIM: PTG TIMER1 LIMIT REGISTER⁽¹⁾

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGT1LIM<15:8>							
bit 15				bit 8			

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGT1LIM<7:0>							
bit 7				bit 0			

Legend:

R = Readable bit

W = Writable bit

U = Unimplemented bit, read as '0'

-n = Value at POR

'1' = Bit is set

'0' = Bit is cleared

x = Bit is unknown

bit 15-0 **PTGT1LIM<15:0>**: PTG Timer1 Limit Register bits
 General Purpose Timer1 Limit register (effective only with a PTGT1 Step command).

Note 1: This register is read-only when the PTG module is executing Step commands (PTGEN = 1 and PTGSTRT = 1).

TABLE 27-1: CONFIGURATION BYTE REGISTER MAP

File Name	Address	Device Memory Size (Kbytes)	Bits 23-8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	0057EC	32	—	—	—	—	—	—	—	—	—
	00AFEC	64									
	0157EC	128									
	02AFEC	256									
	0557EC	512									
Reserved	0057EE	32	—	—	—	—	—	—	—	—	
	00AFEE	64									
	0157EE	128									
	02AFEE	256									
	0557EE	512									
FICD	0057F0	32	—	Reserved ⁽³⁾	—	JTAGEN	Reserved ⁽²⁾	Reserved ⁽³⁾	—	ICS<1:0>	
	00AFF0	64									
	0157F0	128									
	02AFF0	256									
	0557F0	512									
FPOR	0057F2	32	—	WDTWIN<1:0>		ALTI2C2	ALTI2C1	Reserved ⁽³⁾	—	—	—
	00AFF2	64									
	0157F2	128									
	02AFF2	256									
	0557F2	512									
FWDT	0057F4	32	—	FWDTEN	WINDIS	PLLKEN	WDTPRE	WDTPOST<3:0>			
	00AFF4	64									
	0157F4	128									
	02AFF4	256									
	0557F4	512									
FOSC	0057F6	32	—	FCKSM<1:0>		IOL1WAY	—	—	OSCIOFNC	POSCMD<1:0>	
	00AFF6	64									
	0157F6	128									
	02AFF6	256									
	0557F6	512									
FOSCSEL	0057F8	32	—	IESO	PWMLOCK ⁽¹⁾	—	—	—	FNOSC<2:0>		
	00AFF8	64									
	0157F8	128									
	02AFF8	256									
	0557F8	512									
FGS	0057FA	32	—	—	—	—	—	—	—	GCP	GWRP
	00AFFA	64									
	0157FA	128									
	02AFFA	256									
	0557FA	512									
Reserved	0057FC	32	—	—	—	—	—	—	—	—	—
	00AFFC	64									
	0157FC	128									
	02AFFC	256									
	0557FC	512									
Reserved	057FFE	32	—	—	—	—	—	—	—	—	—
	00AFFE	64									
	0157FE	128									
	02AFFE	256									
	0557FE	512									

Legend: — = unimplemented, read as '1'.

Note 1: This bit is only available on dsPIC33EPXXXMC20X/50X and PIC24EPXXXMC20X devices.

2: This bit is reserved and must be programmed as '0'.

3: These bits are reserved and must be programmed as '1'.

TABLE 28-2: INSTRUCTION SET OVERVIEW (CONTINUED)

Base Instr #	Assembly Mnemonic	Assembly Syntax	Description	# of Words	# of Cycles ⁽²⁾	Status Flags Affected
53	NEG	NEG $Acc^{(1)}$	Negate Accumulator	1	1	OA,OB,OAB,SA,SB,SAB
		NEG f	$f = \bar{f} + 1$	1	1	C,DC,N,OV,Z
		NEG $f, WREG$	$WREG = \bar{f} + 1$	1	1	C,DC,N,OV,Z
		NEG Ws, Wd	$Wd = \bar{Ws} + 1$	1	1	C,DC,N,OV,Z
54	NOP	NOP	No Operation	1	1	None
		NOPR	No Operation	1	1	None
55	POP	POP f	Pop f from Top-of-Stack (TOS)	1	1	None
		POP Wdo	Pop from Top-of-Stack (TOS) to Wdo	1	1	None
		POP.D Wnd	Pop from Top-of-Stack (TOS) to $W(nd):W(nd + 1)$	1	2	None
		POP.S	Pop Shadow Registers	1	1	All
56	PUSH	PUSH f	Push f to Top-of-Stack (TOS)	1	1	None
		PUSH Wso	Push Wso to Top-of-Stack (TOS)	1	1	None
		PUSH.D Wns	Push $W(ns):W(ns + 1)$ to Top-of-Stack (TOS)	1	2	None
		PUSH.S	Push Shadow Registers	1	1	None
57	PWRSV	PWRSV $\#lit1$	Go into Sleep or Idle mode	1	1	WDTO,Sleep
58	RCALL	RCALL $Expr$	Relative Call	1	4	SFA
		RCALL Wn	Computed Call	1	4	SFA
59	REPEAT	REPEAT $\#lit15$	Repeat Next Instruction $lit15 + 1$ times	1	1	None
		REPEAT Wn	Repeat Next Instruction $(Wn) + 1$ times	1	1	None
60	RESET	RESET	Software device Reset	1	1	None
61	RETFIE	RETFIE	Return from interrupt	1	6 (5)	SFA
62	RETLW	RETLW $\#lit10, Wn$	Return with literal in Wn	1	6 (5)	SFA
63	RETURN	RETURN	Return from Subroutine	1	6 (5)	SFA
64	RLC	RLC f	$f = \text{Rotate Left through Carry } f$	1	1	C,N,Z
		RLC $f, WREG$	$WREG = \text{Rotate Left through Carry } f$	1	1	C,N,Z
		RLC Ws, Wd	$Wd = \text{Rotate Left through Carry } Ws$	1	1	C,N,Z
65	RLNC	RLNC f	$f = \text{Rotate Left (No Carry) } f$	1	1	N,Z
		RLNC $f, WREG$	$WREG = \text{Rotate Left (No Carry) } f$	1	1	N,Z
		RLNC Ws, Wd	$Wd = \text{Rotate Left (No Carry) } Ws$	1	1	N,Z
66	RRC	RRC f	$f = \text{Rotate Right through Carry } f$	1	1	C,N,Z
		RRC $f, WREG$	$WREG = \text{Rotate Right through Carry } f$	1	1	C,N,Z
		RRC Ws, Wd	$Wd = \text{Rotate Right through Carry } Ws$	1	1	C,N,Z
67	RRNC	RRNC f	$f = \text{Rotate Right (No Carry) } f$	1	1	N,Z
		RRNC $f, WREG$	$WREG = \text{Rotate Right (No Carry) } f$	1	1	N,Z
		RRNC Ws, Wd	$Wd = \text{Rotate Right (No Carry) } Ws$	1	1	N,Z
68	SAC	SAC $Acc, \#Slit4, Wdo^{(1)}$	Store Accumulator	1	1	None
		SAC.R $Acc, \#Slit4, Wdo^{(1)}$	Store Rounded Accumulator	1	1	None
69	SE	SE Ws, Wnd	$Wnd = \text{sign-extended } Ws$	1	1	C,N,Z
70	SETM	SETM f	$f = 0xFFFF$	1	1	None
		SETM $WREG$	$WREG = 0xFFFF$	1	1	None
		SETM Ws	$Ws = 0xFFFF$	1	1	None
71	SFTAC	SFTAC $Acc, Wn^{(1)}$	Arithmetic Shift Accumulator by (Wn)	1	1	OA,OB,OAB,SA,SB,SAB
		SFTAC $Acc, \#Slit6^{(1)}$	Arithmetic Shift Accumulator by $Slit6$	1	1	OA,OB,OAB,SA,SB,SAB

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.

TABLE 30-4: DC TEMPERATURE AND VOLTAGE SPECIFICATIONS

DC CHARACTERISTICS			Standard Operating Conditions (see Note 1): 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
Operating Voltage							
DC10	VDD	Supply Voltage	3.0	—	3.6	V	
DC16	VPOR	VDD Start Voltage to Ensure Internal Power-on Reset Signal	—	—	VSS	V	
DC17	SVDD	VDD Rise Rate to Ensure Internal Power-on Reset Signal	0.03	—	—	V/ms	0V-1V in 100 ms

Note 1: Device is functional at VBORMIN < VDD < VDDMIN. 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 30-5: FILTER CAPACITOR (CEFC) SPECIFICATIONS

Standard Operating Conditions (unless otherwise stated): Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended							
Param No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Comments
	CEFC	External Filter Capacitor Value ⁽¹⁾	4.7	10	—	μF	Capacitor must have a low series resistance (< 1 Ohm)

Note 1: Typical VCAP voltage = 1.8 volts when VDD ≥ VDDMIN.

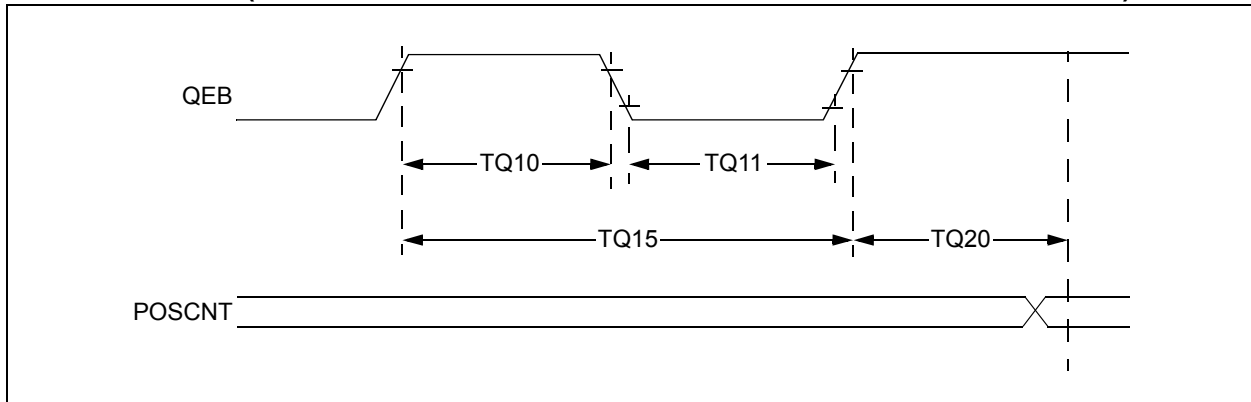
TABLE 30-7: DC CHARACTERISTICS: IDLE CURRENT (IDLE)

DC 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			
Parameter No.	Typ.	Max.	Units	Conditions		
Idle Current (IDLE) ⁽¹⁾						
DC40d	3	8	mA	-40°C	3.3V	10 MIPS
DC40a	3	8	mA	+25°C		
DC40b	3	8	mA	+85°C		
DC40c	3	8	mA	+125°C		
DC42d	6	12	mA	-40°C	3.3V	20 MIPS
DC42a	6	12	mA	+25°C		
DC42b	6	12	mA	+85°C		
DC42c	6	12	mA	+125°C		
DC44d	11	18	mA	-40°C	3.3V	40 MIPS
DC44a	11	18	mA	+25°C		
DC44b	11	18	mA	+85°C		
DC44c	11	18	mA	+125°C		
DC45d	17	27	mA	-40°C	3.3V	60 MIPS
DC45a	17	27	mA	+25°C		
DC45b	17	27	mA	+85°C		
DC45c	17	27	mA	+125°C		
DC46d	20	35	mA	-40°C	3.3V	70 MIPS
DC46a	20	35	mA	+25°C		
DC46b	20	35	mA	+85°C		

Note 1: Base Idle current (IDLE) is measured as follows:

- CPU core is off, oscillator is configured in EC mode and external clock is active; OSC1 is driven with external square wave from rail-to-rail (EC clock overshoot/undershoot < 250 mV required)
- CLKO is configured as an I/O input pin in the Configuration Word
- All I/O pins are configured as inputs and pulled to Vss
- $\overline{\text{MCLR}} = V_{DD}$, WDT and FSCM are disabled
- No peripheral modules are operating; however, every peripheral is being clocked (all PMDx bits are zeroed)
- The NVMSIDL bit (NVMCON<12>) = 1 (i.e., Flash regulator is set to standby while the device is in Idle mode)
- The VREGSF bit (RCON<11>) = 0 (i.e., Flash regulator is set to standby while the device is in Sleep mode)
- JTAG is disabled

**FIGURE 30-11: TIMERQ (QEI MODULE) EXTERNAL CLOCK TIMING CHARACTERISTICS
(dsPIC33EPXXXMC20X/50X AND PIC24EPXXXMC20X DEVICES ONLY)**



**TABLE 30-30: QEI MODULE EXTERNAL CLOCK 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.	Typ.	Max.	Units	Conditions
TQ10	TtQH	TQCK High Time	Synchronous, with prescaler	Greater of $12.5 + 25$ or $(0.5 T_{CY}/N) + 25$	—	—	ns	Must also meet Parameter TQ15
TQ11	TtQL	TQCK Low Time	Synchronous, with prescaler	Greater of $12.5 + 25$ or $(0.5 T_{CY}/N) + 25$	—	—	ns	Must also meet Parameter TQ15
TQ15	TtQP	TQCP Input Period	Synchronous, with prescaler	Greater of $25 + 50$ or $(1 T_{CY}/N) + 50$	—	—	ns	
TQ20	TCKEXTMRL	Delay from External TQCK Clock Edge to Timer Increment		—	1	T_{CY}	—	

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

TABLE 30-59: ADC MODULE SPECIFICATIONS (10-BIT MODE)

AC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) ⁽¹⁾ Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended				
Param No.	Symbol	Characteristic	Min.	Typ.	Max.	Units	Conditions
ADC Accuracy (10-Bit Mode)							
AD20b	Nr	Resolution	10 Data Bits			bits	
AD21b	INL	Integral Nonlinearity	-0.625	—	0.625	LSb	-40°C ≤ TA ≤ +85°C (Note 2)
			-1.5	—	1.5	LSb	+85°C < TA ≤ +125°C (Note 2)
AD22b	DNL	Differential Nonlinearity	-0.25	—	0.25	LSb	-40°C ≤ TA ≤ +85°C (Note 2)
			-0.25	—	0.25	LSb	+85°C < TA ≤ +125°C (Note 2)
AD23b	GERR	Gain Error	-2.5	—	2.5	LSb	-40°C ≤ TA ≤ +85°C (Note 2)
			-2.5	—	2.5	LSb	+85°C < TA ≤ +125°C (Note 2)
AD24b	EOFF	Offset Error	-1.25	—	1.25	LSb	-40°C ≤ TA ≤ +85°C (Note 2)
			-1.25	—	1.25	LSb	+85°C < TA ≤ +125°C (Note 2)
AD25b	—	Monotonicity	—	—	—	—	Guaranteed
Dynamic Performance (10-Bit Mode)							
AD30b	THD	Total Harmonic Distortion ⁽³⁾	—	64	—	dB	
AD31b	SINAD	Signal to Noise and Distortion ⁽³⁾	—	57	—	dB	
AD32b	SFDR	Spurious Free Dynamic Range ⁽³⁾	—	72	—	dB	
AD33b	FNYQ	Input Signal Bandwidth ⁽³⁾	—	550	—	kHz	
AD34b	ENOB	Effective Number of Bits ⁽³⁾	—	9.4	—	bits	

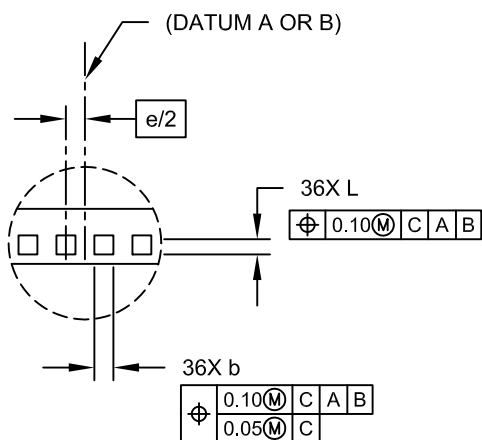
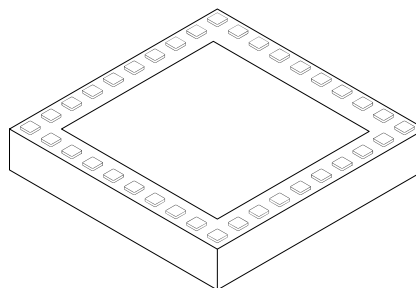
Note 1: Device is functional at VBORMIN < VDD < VDDMIN, but will have degraded performance. Device functionality is tested, but not characterized. Analog modules (ADC, op amp/comparator and comparator voltage reference) may have degraded performance. Refer to Parameter BO10 in Table 30-13 for the minimum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

2: For all accuracy specifications, VINL = AVSS = VREFL = 0V and AVDD = VREFH = 3.6V.

3: Parameters are characterized but not tested in manufacturing.

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**

	Units	MILLIMETERS		
Dimension	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