

Welcome to E-XFL.COM

#### What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "<u>Embedded -</u> <u>Microcontrollers</u>"

#### Details

·XF

Product Status	Active
Core Processor	MIPS32® M4K™
Core Size	32-Bit Single-Core
Speed	50MHz
Connectivity	I <sup>2</sup> C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, I <sup>2</sup> S, POR, PWM, WDT
Number of I/O	21
Program Memory Size	256КВ (256К х 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	64K x 8
Voltage - Supply (Vcc/Vdd)	2.3V ~ 3.6V
Data Converters	A/D 10x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	28-VQFN Exposed Pad
Supplier Device Package	28-QFN (6x6)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic32mx170f256b-50i-ml

Email: info@E-XFL.COM

Address: Room A, 16/F, Full Win Commercial Centre, 573 Nathan Road, Mongkok, Hong Kong

#### TABLE 12: PIN NAMES FOR 44-PIN USB DEVICES

#### 44-PIN TQFP (TOP VIEW)<sup>(1,2,3,5)</sup>

PIC32MX210F016D PIC32MX220F032D PIC32MX230F064D PIC32MX230F256D PIC32MX250F128D PIC32MX270F256D

44

1

Pin #	Full Pin Name	Pin #	Full Pin Name
1	RPB9/SDA1/CTED4/PMD3/RB9	23	AN4/C1INB/C2IND/RPB2/SDA2/CTED13/PMD2/RB2
2	RPC6/PMA1/RC6	24	AN5/C1INA/C2INC/RTCC/RPB3/SCL2/PMWR/RB3
3	RPC7/PMA0/RC7	25	AN6/RPC0/RC0
4	RPC8/PMA5/RC8	26	AN7/RPC1/RC1
5	RPC9/CTED7/PMA6/RC9	27	AN8/RPC2/PMA2/RC2
6	Vss	28	VDD
7	VCAP	29	Vss
8	PGED2/RPB10/D+/CTED11/RB10	30	OSC1/CLKI/RPA2/RA2
9	PGEC2/RPB11/D-/RB11	31	OSC2/CLKO/RPA3/RA3
10	VUSB3V3	32	TDO/RPA8/PMA8/RA8
11	AN11/RPB13/CTPLS/PMRD/RB13	33	SOSCI/RPB4/RB4
12	PGED4 <sup>(4)</sup> /TMS/PMA10/RA10	34	SOSCO/RPA4/T1CK/CTED9/RA4
13	PGEC4 <sup>(4)</sup> /TCK/CTED8/PMA7/RA7	35	TDI/RPA9/PMA9/RA9
14	CVREFOUT/AN10/C3INB/RPB14/VBUSON/SCK1/CTED5/RB14	36	AN12/RPC3/RC3
15	AN9/C3INA/RPB15/SCK2/CTED6/PMCS1/RB15	37	RPC4/PMA4/RC4
16	AVss	38	RPC5/PMA3/RC5
17	AVDD	39	Vss
18	MCLR	40	VDD
19	PGED3/VREF+/CVREF+/AN0/C3INC/RPA0/CTED1/PMD7/RA0	41	RPB5/USBID/RB5
20	PGEC3/VREF-/CVREF-/AN1/RPA1/CTED2/PMD6/RA1	42	VBUS
21	PGED1/AN2/C1IND/C2INB/C3IND/RPB0/PMD0/RB0	43	RPB7/CTED3/PMD5/INT0/RB7
22	PGEC1/AN3/C1INC/C2INA/RPB1/CTED12/PMD1/RB1	44	RPB8/SCL1/CTED10/PMD4/RB8

Note 1: The RPn pins can be used by remappable peripherals. See Table 1 for the available peripherals and Section 11.3 "Peripheral Pin Select" for restrictions.

2: Every I/O port pin (RAx-RCx) can be used as a change notification pin (CNAx-CNCx). See Section 11.0 "I/O Ports" for more information.

3: The metal plane at the bottom of the device is not connected to any pins and is recommended to be connected to Vss externally.

4: This pin function is not available on PIC32MX210F016D and PIC32MX220F032D devices.

5: Shaded pins are 5V tolerant.

Pull-up resistors, series diodes and capacitors on the PGECx and PGEDx pins are not recommended as they will interfere with the programmer/debugger communications to the device. If such discrete components are an application requirement, they should be removed from the circuit during programming and debugging. Alternatively, refer to the AC/DC characteristics and timing requirements information in the respective device Flash programming specification for information on capacitive loading limits and pin input voltage high (VIH) and input low (VIL) requirements.

Ensure that the "Communication Channel Select" (i.e., PGECx/PGEDx pins) programmed into the device matches the physical connections for the ICSP to MPLAB<sup>®</sup> ICD 3 or MPLAB REAL ICE<sup>TM</sup>.

For more information on ICD 3 and REAL ICE connection requirements, refer to the following documents that are available on the Microchip web site:

- "Using MPLAB<sup>®</sup> ICD 3" (poster) (DS50001765)
- *"MPLAB<sup>®</sup> ICD 3 Design Advisory"* (DS50001764)
- "MPLAB<sup>®</sup> REAL ICE™ In-Circuit Debugger User's Guide" (DS50001616)
- "Using MPLAB<sup>®</sup> REAL ICE™ Emulator" (poster) (DS50001749)

#### 2.6 JTAG

The TMS, TDO, TDI and TCK pins are used for testing and debugging according to the Joint Test Action Group (JTAG) standard. It is recommended to keep the trace length between the JTAG connector and the JTAG pins on the device as short as possible. If the JTAG connector is expected to experience an ESD event, a series resistor is recommended with the value in the range of a few tens of Ohms, not to exceed 100 Ohms.

Pull-up resistors, series diodes and capacitors on the TMS, TDO, TDI and TCK pins are not recommended as they will interfere with the programmer/debugger communications to the device. If such discrete components are an application requirement, they should be removed from the circuit during programming and debugging. Alternatively, refer to the AC/DC characteristics and timing requirements information in the respective device Flash programming specification for information on capacitive loading limits and pin input voltage high (VIH) and input low (VIL) requirements.

#### 2.7 External Oscillator Pins

Many MCUs have options for at least two oscillators: a high-frequency primary oscillator and a low-frequency secondary oscillator (refer to **Section 8.0 "Oscillator Configuration"** for details).

The oscillator circuit should be placed on the same side of the board as the device. Also, place the oscillator circuit close to the respective oscillator pins, not exceeding one-half inch (12 mm) distance between them. The load capacitors should be placed next to the oscillator itself, on the same side of the board. Use a grounded copper pour around the oscillator circuit to isolate them from surrounding circuits. The grounded copper pour should be routed directly to the MCU ground. Do not run any signal traces or power traces inside the ground pour. Also, if using a two-sided board, avoid any traces on the other side of the board where the crystal is placed. A suggested layout is illustrated in Figure 2-3.

#### FIGURE 2-3: SUGGESTED OSCILLATOR CIRCUIT PLACEMENT



#### 2.8 Unused I/Os

Unused I/O pins should not be allowed to float as inputs. They can be configured as outputs and driven to a logic-low state.

Alternatively, inputs can be reserved by connecting the pin to Vss through a 1k to 10k resistor and configuring the pin as an input.

Bit Range	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0
31:24	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
	_	_	_	IP03<2:0>			IS03	<1:0>
22:16	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
23.10	—	—	—		IP02<2:0>			<1:0>
15.9	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
15.0	—	—	—		IP01<2:0>		IS01·	<1:0>
7.0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
7:0		_			IP00<2:0>		IS00-	<1:0>

#### REGISTER 7-6: IPCx: INTERRUPT PRIORITY CONTROL REGISTER

#### 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 31-29 Unimplemented: Read as '0'
- bit 28-26 IP03<2:0>: Interrupt Priority bits
- 111 = Interrupt priority is 7 010 = Interrupt priority is 2 001 = Interrupt priority is 1 000 = Interrupt is disabled bit 25-24 IS03<1:0>: Interrupt Subpriority bits 11 = Interrupt subpriority is 3 10 = Interrupt subpriority is 2 01 = Interrupt subpriority is 1 00 = Interrupt subpriority is 0 bit 23-21 Unimplemented: Read as '0' bit 20-18 IP02<2:0>: Interrupt Priority bits 111 = Interrupt priority is 7 010 = Interrupt priority is 2 001 = Interrupt priority is 1 000 = Interrupt is disabled bit 17-16 IS02<1:0>: Interrupt Subpriority bits 11 = Interrupt subpriority is 3 10 = Interrupt subpriority is 2 01 = Interrupt subpriority is 1 00 = Interrupt subpriority is 0 bit 15-13 Unimplemented: Read as '0' bit 12-10 IP01<2:0>: Interrupt Priority bits 111 = Interrupt priority is 7 010 = Interrupt priority is 2 001 = Interrupt priority is 1
  - 000 = Interrupt is disabled
- **Note:** This register represents a generic definition of the IPCx register. Refer to Table 7-1 for the exact bit definitions.

Bit Range	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0	
	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	
31:24	—	RODIV<14:8> <sup>(1,3)</sup>							
00.40	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	
23:16	RODIV<7:0> <sup>(1,3)</sup>								
45.0	R/W-0	U-0	R/W-0	R/W-0	R/W-0	U-0	R/W-0, HC	R-0, HS, HC	
15:8	ON	_	SIDL	OE	RSLP <sup>(2)</sup>	-	DIVSWEN	ACTIVE	
7:0	U-0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	
		_	_	_	ROSEL<3:0> <sup>(1)</sup>				

#### **REGISTER 8-3: REFOCON: REFERENCE OSCILLATOR CONTROL REGISTER**

Legend: HC = Hardware Clearable		HS = Hardware Settable		
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 31 Unimplemented: Read as '0'

bit 30-16	RODIV<14:0> Reference Clock Divider bits <sup>(1,3)</sup>
	The value selects the reference clock divider bits. See Figure 8-1 for information.
bit 15	ON: Output Enable bit
	1 = Reference Oscillator module is enabled
	0 = Reference Oscillator module is disabled
bit 14	Unimplemented: Read as '0'
bit 13	SIDL: Peripheral Stop in Idle Mode bit

- 1 = Discontinue module operation when the device enters Idle mode
  - 0 =Continue module operation when the device enters lide mode
- bit 12 **OE:** Reference Clock Output Enable bit
  - 1 = Reference clock is driven out on REFCLKO pin
  - 0 = Reference clock is not driven out on REFCLKO pin
- bit 11 RSLP: Reference Oscillator Module Run in Sleep bit<sup>(2)</sup>
  - 1 = Reference Oscillator module output continues to run in Sleep
  - 0 = Reference Oscillator module output is disabled in Sleep
- bit 10 Unimplemented: Read as '0'
- bit 9 DIVSWEN: Divider Switch Enable bit
  - 1 = Divider switch is in progress
    - 0 = Divider switch is complete
- bit 8 ACTIVE: Reference Clock Request Status bit
  - 1 = Reference clock request is active
  - 0 = Reference clock request is not active
- bit 7-4 Unimplemented: Read as '0'
- **Note 1:** The ROSEL and RODIV bits should not be written while the ACTIVE bit is '1', as undefined behavior may result.
  - **2:** This bit is ignored when the ROSEL<3:0> bits = 0000 or 0001.
  - 3: While the ON bit is set to '1', writes to these bits do not take effect until the DIVSWEN bit is also set to '1'.

#### REGISTER 8-3: REFOCON: REFERENCE OSCILLATOR CONTROL REGISTER

- bit 3-0 ROSEL<3:0>: Reference Clock Source Select bits<sup>(1)</sup>
  - 1111 = Reserved; do not use
  - 1001 = Reserved; do not use 1000 = REFCLKI 0111 = System PLL output 0110 = USB PLL output 0101 = Sosc 0100 = LPRC 0011 = FRC 0010 = POSC 0001 = PBCLK 0000 = SYSCLK
- **Note 1:** The ROSEL and RODIV bits should not be written while the ACTIVE bit is '1', as undefined behavior may result.
  - 2: This bit is ignored when the ROSEL<3:0> bits = 0000 or 0001.
  - 3: While the ON bit is set to '1', writes to these bits do not take effect until the DIVSWEN bit is also set to '1'.

Bit Range	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0
21.24	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
31.24	—	—	—	—	—			—
22.16	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
23.10	_	—	_	_	_			_
15.0	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
15.0	—	—	—	—	—			—
7:0	U-0	U-0	U-0	U-0	U-0	R-0	R-0	R-0
						FRMH<2:0>		

#### REGISTER 10-14: U1FRMH: USB FRAME NUMBER HIGH REGISTER

#### 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 31-3 Unimplemented: Read as '0'

bit 2-0 **FRMH<2:0>:** The Upper 3 bits of the Frame Numbers bits The register bits are updated with the current frame number whenever a SOF TOKEN is received.

#### Bit Bit Bit Bit Bit Bit Bit Bit Bit 30/22/14/6 27/19/11/3 26/18/10/2 25/17/9/1 24/16/8/0 Range 31/23/15/7 29/21/13/5 28/20/12/4 U-0 U-0 U-0 U-0 U-0 U-0 U-0 U-0 31:24 \_\_\_ \_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_ \_\_\_\_ U-0 U-0 U-0 U-0 U-0 U-0 U-0 U-0 23:16 \_ \_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_ U-0 U-0 U-0 U-0 U-0 U-0 U-0 U-0 15:8 \_ \_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_\_ \_\_\_ \_\_\_\_ \_\_\_\_ R/W-0 R/W-0 R/W-0 R/W-0 R/W-0 R/W-0 R/W-0 R/W-0 7:0 PID < 3:0 > (1)EP<3:0>

#### **REGISTER 10-15: U1TOK: USB TOKEN REGISTER**

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 31-8 Unimplemented: Read as '0'

bit 7-4 **PID<3:0>:** Token Type Indicator bits<sup>(1)</sup>

1101 = SETUP (TX) token type transaction

- 1001 = IN (RX) token type transaction
- 0001 = OUT (TX) token type transaction

Note: All other values are reserved and must not be used.

bit 3-0 **EP<3:0>:** Token Command Endpoint Address bits The four bit value must specify a valid endpoint.

Note 1: All other values are reserved and must not be used.

Bit Range	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0		
21.24	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0		
31.24	—	—		—	—			—		
22.16	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0		
23.10	_	—		_	_			_		
15.0	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0		
15:8	—	—	-	—	—		-	—		
7:0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0		
				BDTPTR	H<23:16>					

#### REGISTER 10-18: U1BDTP2: USB BUFFER DESCRIPTOR TABLE PAGE 2 REGISTER

# Legend:R = Readable bitW = Writable bitU = Unimplemented bit, read as '0'-n = Value at POR'1' = Bit is set'0' = Bit is clearedx = Bit is unknown

#### bit 31-8 Unimplemented: Read as '0'

bit 7-0 **BDTPTRH<23:16>:** Buffer Descriptor Table Base Address bits This 8-bit value provides address bits 23 through 16 of the Buffer Descriptor Table base address, which defines the starting location of the Buffer Descriptor Table in system memory. The 32-bit Buffer Descriptor Table base address is 512-byte aligned.

Bit Range	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0		
21.24	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0		
51.24	—	—	—	—	—	—	—	—		
22:16	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0		
23.10	_	—	_	—	—	_	—	—		
15.0	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0		
15:8	—	—	—	—	—	—	—	—		
7:0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0		
				BDTPTR	U<31:24>					

#### REGISTER 10-19: U1BDTP3: USB BUFFER DESCRIPTOR TABLE PAGE 3 REGISTER

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

bit 31-8 Unimplemented: Read as '0'

bit 7-0 **BDTPTRU<31:24>:** Buffer Descriptor Table Base Address bits This 8-bit value provides address bits 31 through 24 of the Buffer Descriptor Table base address, defines the starting location of the Buffer Descriptor Table in system memory. The 32-bit Buffer Descriptor Table base address is 512-byte aligned.

Bit Range	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0
04.04	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
31.24	—	—	—	—	—	—		—
23:16	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
	—	—	—	—	—	—	—	—
15.0	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
15:8	—	—	—	—	—	—	-	—
7.0	R/W-0	R/W-0	U-0	R/W-0	U-0	U-0	U-0	R/W-0
7:0	UTEYE	UOEMON	—	USBSIDL	—	—	—	UASUSPND

#### REGISTER 10-20: U1CNFG1: USB CONFIGURATION 1 REGISTER

#### Legend:

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

#### bit 31-8 Unimplemented: Read as '0'

bit 7 UTEYE: USB Eye-Pattern Test Enable bit

- 1 = Eye-Pattern Test is enabled
- 0 = Eye-Pattern Test is disabled

#### bit 6 **UOEMON:** USB OE Monitor Enable bit

1 = OE signal is active; it indicates intervals during which the D+/D- lines are driving
 0 = OE signal is inactive

#### bit 5 Unimplemented: Read as '0'

- bit 4 USBSIDL: Stop in Idle Mode bit
  - 1 = Discontinue module operation when the device enters Idle mode
  - 0 = Continue module operation when the device enters Idle mode

#### bit 3-1 Unimplemented: Read as '0'

#### bit 0 UASUSPND: Automatic Suspend Enable bit

- 1 = USB module automatically suspends upon entry to Sleep mode. See the USUSPEND bit (U1PWRC<1>) in Register 10-5.
- 0 = USB module does not automatically suspend upon entry to Sleep mode. Software must use the USUSPEND bit (U1PWRC<1>) to suspend the module, including the USB 48 MHz clock.

#### 11.3.5 OUTPUT MAPPING

In contrast to inputs, the outputs of the PPS options are mapped on the basis of the pin. In this case, a control register associated with a particular pin dictates the peripheral output to be mapped. The RPnR registers (Register 11-2) are used to control output mapping. Like the [*pin name*]R registers, each register contains sets of 4 bit fields. The value of the bit field corresponds to one of the peripherals, and that peripheral's output is mapped to the pin (see Table 11-2 and Figure 11-3).

A null output is associated with the output register reset value of '0'. This is done to ensure that remappable outputs remain disconnected from all output pins by default.

#### FIGURE 11-3: EXAMPLE OF MULTIPLEXING OF REMAPPABLE OUTPUT FOR RPA0



### 11.3.6 CONTROLLING CONFIGURATION CHANGES

Because peripheral remapping can be changed during run time, some restrictions on peripheral remapping are needed to prevent accidental configuration changes. PIC32 devices include two features to prevent alterations to the peripheral map:

- Control register lock sequence
- Configuration bit select lock

#### 11.3.6.1 Control Register Lock Sequence

Under normal operation, writes to the RPnR and [*pin name*]R registers are not allowed. Attempted writes appear to execute normally, but the contents of the registers remain unchanged. To change these registers, they must be unlocked in hardware. The register lock is controlled by the Configuration bit, IOLOCK (CFGCON<13>). Setting IOLOCK prevents writes to the control registers; clearing IOLOCK allows writes.

To set or clear the IOLOCK bit, an unlock sequence must be executed. Refer to **Section 6. "Oscillator"** (DS60001112) in the *"PIC32 Family Reference Manual"* for details.

#### 11.3.6.2 Configuration Bit Select Lock

As an additional level of safety, the device can be configured to prevent more than one write session to the RPnR and [*pin name*]R registers. The Configuration bit, IOL1WAY (DEVCFG3<29>), blocks the IOLOCK bit from being cleared after it has been set once. If IOLOCK remains set, the register unlock procedure does not execute, and the PPS control registers cannot be written to. The only way to clear the bit and reenable peripheral remapping is to perform a device Reset.

In the default (unprogrammed) state, IOL1WAY is set, restricting users to one write session.

#### TABLE 11-4: PORTB REGISTER MAP

ess										Bits									
Virtual Addr (BF88_#)	Register Name	Bit Range	31/15	30/14	29/13	28/12	27/11	26/10	25/9	24/8	23/7	22/6	21/5	20/4	19/3	18/2	17/1	16/0	All Reset
6100	ANSEL B	31:16	_	—	—	—	-	-	_	—	-	-	—	_	_	—	—	_	0000
0100	,	15:0	ANSB15	ANSB14	ANSB13	ANSB12 <sup>(2)</sup>	_		—	—	_	_	—	—	ANSB3	ANSB2	ANSB1	ANSB0	E00F
6110	TRISB	31:16	_	_	—	—	_	—	—	—	—		—	_	—	—	—	—	0000
		15:0	TRISB15	TRISB14	TRISB13	TRISB12(2)	TRISB11	TRISB10	TRISB9	TRISB8	TRISB7	TRISB6(2)	TRISB5	TRISB4	TRISB3	TRISB2	TRISB1	TRISB0	FFFF
6120	PORTB	31:16	_		_		_	—	_	_	_		_						0000
		15:0	RB15	RB14	RB13	RB12(2)	RB11	RB10	RB9	RB8	RB7	RC6(2)	RB5	RB4	RB3	RB2	RB1	RB0	XXXX
6130	LATB	31:16		-	-		-	-	—	-			-	-	—	—	-	—	0000
		15:0	LAIB15	LAIB14	LAIB13	LAIB12(2)	LAI B11	LAIB10	LATB9	LAI B8	LAIB7	LAIB6(2)	LAI B5	LAI B4	LATB3	LATB2	LAIB1	LAIBO	XXXX
6140	ODCB	31:16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0000
		15:0	ODCB15	ODCB14	ODCB13	ODCB12	ODCB11	ODCB10	ODCB9	ODCB8	ODCB1	ODCB6	ODCB5	ODCB4	ODCB3	ODCB2	ODCB1	ODCR0	0000
6150	CNPUB	31:16																	0000
		15:0	CNPUB15	CNPUB14	CNPUB13	CNPUB12-	CNPUBIT	CNPUBIU	CNPUB9	CNPUB8	CNPUB/	CNPUB6-	CNP0B5	CNPUB4	CNP0B3	CNP0B2	CNPUBI	CNPUBU	0000
6160	CNPDB	31:10																	0000
		15.0	CNPDB15	CINPUB14	CNPDB13	CNPDB12	CNPDBTI	CNPDBIU	CNPDB9	CNPDBo	CNPDB/	CNPDB0-	CNPDB5	CNPDB4	CNPDB3	CNPDB2	CNPDBI	CNPDBU	0000
6170	CNCONB	15.0			SIDI														0000
		31.16																	0000
6180	CNENB	15.0	CNIEB15	CNIEB14	CNIEB13	CNIEB11(2)	CNIEB11	CNIEB10	CNIEB9	CNIEB8	CNIEB7	CNIEB6(2)	CNIEB5	CNIEB4	CNIEB3	CNIEB2	CNIEB1	CNIEB0	0000
		31:16	_	_	_	_	_	_				_							0000
6190	CNSTATB		CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	
		15:0	STATB15	STATB14	STATB13	STATB12(2)	STATB11	STATB10	STATB9	STATB8	STATB7	STATB6 <sup>(2)</sup>	STATB5	STATB4	STATB3	STATB2	STATB1	STATB0	0000

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

Note 1: All registers in this table have corresponding CLR, SET and INV registers at their virtual addresses, plus offsets of 0x4, 0x8 and 0xC, respectively. See Section 11.2 "CLR, SET and INV Registers" for more information.

2: This bit is not available on PIC32MX2XX devices. The reset value for the TRISB register when this bit is not available is 0x0000EFBF.

#### 16.0 OUTPUT COMPARE

Note: This data sheet summarizes the features of the PIC32MX1XX/2XX 28/36/44-pin Family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to Section 16. "Output Compare" (DS60001111), which is available from the *Documentation* > *Reference Manual* section of the Microchip PIC32 web site (www.microchip.com/pic32).

The Output Compare module is used to generate a single pulse or a train of pulses in response to selected time base events. For all modes of operation, the Output Compare module compares the values stored in the OCxR and/or the OCxRS registers to the value in the selected timer. When a match occurs, the Output Compare module generates an event based on the selected mode of operation. The following are some of the key features:

- · Multiple Output Compare Modules in a device
- Programmable interrupt generation on compare event
- Single and Dual Compare modes
- Single and continuous output pulse generation
- Pulse-Width Modulation (PWM) mode
- Hardware-based PWM Fault detection and automatic output disable
- Can operate from either of two available 16-bit time bases or a single 32-bit time base





#### 17.0 SERIAL PERIPHERAL INTERFACE (SPI)

Note: This data sheet summarizes the features of the PIC32MX1XX/2XX 28/36/44-pin Family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to Section 23. "Serial Peripheral Interface (SPI)" (DS60001106), which is available from the Documentation > Reference Manual section of the Microchip PIC32 web site (www.microchip.com/pic32).

The SPI module is a synchronous serial interface that is useful for communicating with external peripherals and other microcontrollers. These peripheral devices may be Serial EEPROMs, Shift registers, display drivers, Analog-to-Digital Converters (ADC), etc. The PIC32 SPI module is compatible with Motorola<sup>®</sup> SPI and SIOP interfaces. Some of the key features of the SPI module are:

- Master mode and Slave mode support
- Four clock formats
- Enhanced Framed SPI protocol support
- User-configurable 8-bit, 16-bit and 32-bit data width
- Separate SPI FIFO buffers for receive and transmit
   FIFO buffers act as 4/8/16-level deep FIFOs based on 32/16/8-bit data width
- Programmable interrupt event on every 8-bit, 16-bit and 32-bit data transfer
- · Operation during Sleep and Idle modes
- · Audio Codec Support:
  - I<sup>2</sup>S protocol
  - Left-justified
  - Right-justified
  - PCM



Bit Range	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0
24.24	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
31:24	—	—	—	—	—	_	—	-
00.40	U-0	U-0	U-0	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
23:10	—	—	—	MONTH10	MONTH01<3:0>			
45.0	U-0	U-0	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
15:8	—	—	DAY1	0<1:0>		DAY01	<3:0>	
7.0	U-0	U-0	U-0	U-0	U-0	R/W-x	R/W-x	R/W-x
7:0	_	_	_	_	_	WDAY01<2:0>		

#### REGISTER 21-6: ALRMDATE: ALARM DATE VALUE REGISTER

#### Legend:

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

bit 31-21 Unimplemented: Read as '0'

bit 20 MONTH10: Binary Coded Decimal value of months bits, 10s place digit; contains a value of 0 or 1

bit 19-16 **MONTH01<3:0>:** Binary Coded Decimal value of months bits, 1s place digit; contains a value from 0 to 9 bit 15-14 **Unimplemented:** Read as '0'

bit 13-12 DAY10<1:0>: Binary Coded Decimal value of days bits, 10s place digit; contains a value from 0 to 3

bit 11-8 **DAY01<3:0>:** Binary Coded Decimal value of days bits, 1s place digit; contains a value from 0 to 9

bit 7-3 Unimplemented: Read as '0'

bit 2-0 WDAY01<2:0>: Binary Coded Decimal value of weekdays bits; contains a value from 0 to 6

Bit Range	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0
21.24	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
51.24	EDG1MOD	EDG1POL		EDG1S	EDG2STAT	EDG1STAT		
22:16	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	U-0	U-0
23.10	EDG2MOD	EDG2POL		EDG2S	—	—		
15.0	R/W-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
15.0	ON	—	CTMUSIDL	TGEN <sup>(1)</sup>	EDGEN	EDGSEQEN	IDISSEN <sup>(2)</sup>	CTTRIG
7:0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
7.0		IRNG<1:0>						

#### REGISTER 25-1: CTMUCON: CTMU CONTROL REGISTER

#### Legend:

Logona						
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 31 EDG1MOD: Edge1 Edge Sampling Select bit
  - 1 = Input is edge-sensitive
  - 0 = Input is level-sensitive
- bit 30 EDG1POL: Edge 1 Polarity Select bit
  - 1 = Edge1 programmed for a positive edge response
  - 0 = Edge1 programmed for a negative edge response
- bit 29-26 EDG1SEL<3:0>: Edge 1 Source Select bits
  - 1111 = C3OUT pin is selected
    - 1110 = C2OUT pin is selected
    - 1101 = C1OUT pin is selected
    - 1100 = IC3 Capture Event is selected
    - 1011 = IC2 Capture Event is selected
    - 1010 = IC1 Capture Event is selected
    - 1001 = CTED8 pin is selected
    - 1000 = CTED7 pin is selected
    - 0111 = CTED6 pin is selected
    - 0110 = CTED5 pin is selected
    - 0101 = CTED4 pin is selected
    - 0100 = CTED3 pin is selected
    - 0011 = CTED1 pin is selected
    - 0010 = CTED2 pin is selected
    - 0001 = OC1 Compare Event is selected 0000 = Timer1 Event is selected

#### bit 25 EDG2STAT: Edge2 Status bit

Indicates the status of Edge2 and can be written to control edge source

- 1 = Edge2 has occurred
- 0 = Edge2 has not occurred
- Note 1: When this bit is set for Pulse Delay Generation, the EDG2SEL<3:0> bits must be set to '1110' to select C2OUT.
  - 2: The ADC module Sample and Hold capacitor is not automatically discharged between sample/conversion cycles. Software using the ADC as part of a capacitive measurement, must discharge the ADC capacitor before conducting the measurement. The IDISSEN bit, when set to '1', performs this function. The ADC module must be sampling while the IDISSEN bit is active to connect the discharge sink to the capacitor array.
  - 3: Refer to the CTMU Current Source Specifications (Table 30-41) in Section 30.0 "Electrical Characteristics" for current values.
  - 4: This bit setting is not available for the CTMU temperature diode.

DC CHA	RACTERIS	TICS	<b>Standar</b> Operatir	d Operating Con ng temperature	ditions: 2.3V to 3.6V (unless otherwise stated) -40°C $\leq$ TA $\leq$ +85°C for Industrial -40°C $\leq$ TA $\leq$ +105°C for V-temp				
Param. No.	Typical <sup>(2)</sup>	Max.	Units	Conditions					
Power-D	Power-Down Current (IPD) (Notes 1, 5)								
DC40k	44	70	μA	-40°C					
DC40I	44	70	μA	+25°C	Pasa Power Down Current				
DC40n	168	259	μA	+85°C	Base Fower-Down Guiteni				
DC40m	335	536	μA	+105°C					
Module	Differential	Current							
DC41e	5	20	μA	3.6V	Watchdog Timer Current: AIWDT (Note 3)				
DC42e	23	50	μA	3.6V	RTCC + Timer1 w/32 kHz Crystal: ΔIRTCC (Note 3)				
DC43d	1000	1100	μA	3.6V ADC: ΔΙΑDC (Notes 3,4)					

#### TABLE 30-7: DC CHARACTERISTICS: POWER-DOWN CURRENT (IPD)

**Note 1:** The test conditions for IPD current measurements are as follows:

Oscillator mode is EC (for 8 MHz and below) and EC+PLL (for above 8 MHz) with OSC1 driven by external square wave from rail-to-rail, (OSC1 input clock input over/undershoot < 100 mV required)

OSC2/CLKO is configured as an I/O input pin

• USB PLL oscillator is disabled if the USB module is implemented, PBCLK divisor = 1:8

• CPU is in Sleep mode, and SRAM data memory Wait states = 1

• No peripheral modules are operating, (ON bit = 0), but the associated PMD bit is set

• WDT, Clock Switching, Fail-Safe Clock Monitor, and Secondary Oscillator are disabled

• All I/O pins are configured as inputs and pulled to Vss

• MCLR = VDD

• RTCC and JTAG are disabled

2: Data in the "Typical" column is at 3.3V, 25°C unless otherwise stated. Parameters are for design guidance only and are not tested.

- **3:** The △ current is the additional current consumed when the module is enabled. This current should be added to the base IPD current.
- 4: Test conditions for ADC module differential current are as follows: Internal ADC RC oscillator enabled.
- 5: IPD electrical characteristics for devices with 256 KB Flash are only provided as Preliminary information.

#### TABLE 30-14: COMPARATOR VOLTAGE REFERENCE SPECIFICATIONS

DC CHARACTERISTICS			$\begin{array}{l} \mbox{Standard Operating Conditions: 2.3V to 3.6V} \\ \mbox{(unless otherwise stated)} \\ \mbox{Operating temperature} & -40^{\circ}C \leq TA \leq +85^{\circ}C \mbox{ for Industrial} \\ & -40^{\circ}C \leq TA \leq +105^{\circ}C \mbox{ for V-temp} \end{array}$					
Param. No.	Symbol	Characteristics	Min. Typ. Max. Units Comments					
D312	TSET	Internal 4-bit DAC Comparator Reference Settling time	_		10	μs	See Note 1	
D313 DACREFH	CVREF Input Voltage	AVss	—	AVDD	V	CVRSRC with CVRSS = 0		
		Reference Range	VREF-	—	VREF+	V	CVRSRC with CVRSS = 1	
D314	DVREF	CVREF Programmable Output Range	0	—	0.625 x DACREFH	V	0 to 0.625 DACREFH with DACREFH/24 step size	
			0.25 x DACREFH	_	0.719 x DACREFH	V	0.25 x DACREFH to 0.719 DACREFH with DACREFH/32 step size	
D315	DACRES	Resolution	—	—	DACREFH/24	-	CVRCON <cvrr> = 1</cvrr>	
			_	—	DACREFH/32	_	CVRCON <cvrr> = 0</cvrr>	
D316	DACACC	CACC Absolute Accuracy <sup>(2)</sup>		_	1/4	LSB	DACREFH/24, CVRCON <cvrr> = 1</cvrr>	
			—	_	1/2	LSB	DACREFH/32, CVRCON <cvrr> = 0</cvrr>	

**Note 1:** Settling time was measured while CVRR = 1 and CVR<3:0> transitions from '0000' to '1111'. This parameter is characterized, but is not tested in manufacturing.

**2:** These parameters are characterized but not tested.

#### TABLE 30-15: INTERNAL VOLTAGE REGULATOR SPECIFICATIONS

DC CHARACTERISTICS			$\begin{array}{l} \mbox{Standard Operating Conditions: 2.3V to 3.6V} \\ \mbox{(unless otherwise stated)} \\ \mbox{Operating temperature} & -40^{\circ}C \leq TA \leq +85^{\circ}C \mbox{ for Industrial} \\ & -40^{\circ}C \leq TA \leq +105^{\circ}C \mbox{ for V-temp} \end{array}$				
Param. No.	Symbol	Characteristics	Min.	Typical	Max.	Units	Comments
D321	Cefc	External Filter Capacitor Value	8	10	_	μF	Capacitor must be low series resistance (1 ohm). Typical voltage on the VCAP pin is 1.8V.

#### 31.0 50 MHz ELECTRICAL CHARACTERISTICS

This section provides an overview of the PIC32MX1XX/2XX 28/36/44-pin Family electrical characteristics for devices operating at 50 MHz.

The specifications for 50 MHz are identical to those shown in **Section 30.0** "Electrical Characteristics", with the exception of the parameters listed in this chapter.

Parameters in this chapter begin with the letter "M", which denotes 50 MHz operation. For example, parameter DC29a in **Section 30.0** "**Electrical Characteristics**", is the up to 40 MHz operation equivalent for MDC29a.

Absolute maximum ratings for the PIC32MX1XX/2XX 28/36/44-pin Family 50 MHz devices are listed below. Exposure to these maximum rating conditions for extended periods may affect device reliability. Functional operation of the device at these or any other conditions, above the parameters indicated in the operation listings of this specification, is not implied.

#### Absolute Maximum Ratings

#### (See Note 1)

Ambient temperature under bias	40°C to +85°C
Storage temperature	65°C to +150°C
Voltage on VDD with respect to Vss	-0.3V to +4.0V
Voltage on any pin that is not 5V tolerant, with respect to Vss (Note 3)	0.3V to (VDD + 0.3V)
Voltage on any 5V tolerant pin with respect to Vss when $VDD \ge 2.3V$ (Note 3)	-0.3V to +5.5V
Voltage on any 5V tolerant pin with respect to Vss when VDD < 2.3V (Note 3)	-0.3V to +3.6V
Voltage on D+ or D- pin with respect to VUSB3V3	0.3V to (VUSB3V3 + 0.3V)
Voltage on VBUS with respect to VSS	-0.3V to +5.5V
Maximum current out of Vss pin(s)	
Maximum current into VDD pin(s) (Note 2)	
Maximum output current sunk by any I/O pin	15 mA
Maximum output current sourced by any I/O pin	15 mA
Maximum current sunk by all ports	
Maximum current sourced by all ports (Note 2)	200 mA

**Note 1:** Stresses above those listed under "**Absolute Maximum Ratings**" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions, above those indicated in the operation listings of this specification, is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

- 2: Maximum allowable current is a function of device maximum power dissipation (see Table 30-2).
- 3: See the "Pin Diagrams" section for the 5V tolerant pins.

#### 28-Lead Plastic Shrink Small Outline (SS) - 5.30 mm Body [SSOP]

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



RECOMMENDED LAND PATTERN

	Units	nits MILLIMETERS		S
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.65 BSC	
Contact Pad Spacing	С		7.20	
Contact Pad Width (X28)	X1			0.45
Contact Pad Length (X28)	Y1			1.75
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. C04-2073A

#### 44-Terminal Very Thin Leadless Array Package (TL) – 6x6x0.9 mm Body With Exposed Pad [VTLA]





Microchip Technology Drawing C04-157C Sheet 1 of 2

(64 KB RAM, 256 KB Flash)	42
Memory Organization	37
Microchip Internet Web Site	. 341
MPLAB ASM30 Assembler, Linker, Librarian	. 254
MPLAB Integrated Development Environment Software	. 253
MPLAB PM3 Device Programmer	. 255
MPLAB REAL ICE In-Circuit Emulator System	. 255
MPLINK Object Linker/MPLIB Object Librarian	. 254

### 0

Oscillator Configuration	73
Output Compare	161

#### Ρ

-	
Packaging	
Details	313
Marking	
Parallel Master Port (PMP)	
PIC32 Family USB Interface Diagram	104
Pinout I/O Descriptions (table)	20
Power-on Reset (POR)	
and On-Chip Voltage Regulator	
Power-Saving Features	
CPU Halted Methods	233
Operation	
with CPU Running	233
-	

#### R

Real-Time Clock and Calendar (RTCC)	.199
Register Maps	5–??
Registers	
[pin name]R (Peripheral Pin Select Input)	.141
AD1CHS (ADC Input Select)	.217
AD1CON1 (ADC Control 1)	213
AD1CON2 (ADC Control 2)	215
AD1CON3 (ADC Control 3)	216
AD1CSSL (ADC Input Scan Select)	.218
ALRMDATE (Alarm Date Value)	208
ALRMTIME (Alarm Time Value)	207
BMXBOOTSZ (Boot Flash (IFM) Size	51
BMXCON (Bus Matrix Configuration)	46
BMXDKPBA (Data RAM Kernel Program	
Base Address)	47
BMXDRMSZ (Data RAM Size Register)	50
BMXDUDBA (Data RAM User Data Base Address)	48
BMXDUPBA (Data RAM User Program	
Base Address)	49
BMXPFMSZ (Program Flash (PFM) Size)	51
BMXPUPBA (Program Flash (PFM) User Program	
Base Address)	50
CFGCON (Configuration Control)	.248
CM1CON (Comparator 1 Control)	.221
CMSTAT (Comparator Status Register)	.222
CNCONx (Change Notice Control for PORTx)	.142
CTMUCON (CTMU Control)	229
CVRCON (Comparator Voltage Reference Control).	225
DCHxCON (DMA Channel 'x' Control)	93
DCHxCPTR (DMA Channel 'x' Cell Pointer)	.100
DCHxCSIZ (DMA Channel 'x' Cell-Size)	. 100
DCHxDAT (DMA Channel 'x' Pattern Data)	. 101
DCHxDPTR (Channel 'x' Destination Pointer)	99
DCHxDSA (DMA Channel 'x' Destination	
Start Address)	97
DCHxDSIZ (DMA Channel 'x' Destination Size)	98
DCHxECON (DMA Channel 'x' Event Control)	94
DCHxINT (DMA Channel 'x' Interrupt Control)	95

DCHxSPTR (DMA Channel 'x' Source Pointer)	9
DCHxSSA (DMA Channel 'x' Source Start Address) 97	7
DCHxSSIZ (DMA Channel 'x' Source Size) 98	В
DCRCCON (DMA CRC Control)	0
DCRCDATA (DMA CRC Data)	2
DCRCXOR (DMA CRCXOR Enable)	2
DEVCFG0 (Device Configuration Word 0) 24	1
DEVCFG1 (Device Configuration Word 1) 243	3
DEVCFG2 (Device Configuration Word 2)	5
DEVCFG3 (Device Configuration Word 3)	7
DEVID (Device and Revision ID)	9
DMAADDR (DMA Address)	g
DMACON (DMA Controller Control)	R
DMASTAT (DMA Status)	a
I2CxCON (I2C Control)	8
12CXCON (12C CONTO)	0
12CXSTAT (12C Status)	
	9
IECX (Interrupt Enable Control)	U
IFSX (Interrupt Flag Status)	0
INICON (Interrupt Control)	В
INTSTAT (Interrupt Status)	9
IPCx (Interrupt Priority Control)	1
IPTMR (Interrupt Proximity Timer)	9
NVMADDR (Flash Address) 56	6
NVMCON (Programming Control) 55	5
NVMDATA (Flash Program Data)	7
NVMKEY (Programming Unlock) 56	6
NVMSRCADDR (Source Data Address) 57	7
OCxCON (Output Compare 'x' Control)	3
OSCCON (Oscillator Control)	6
OSCTUN (FRC Tuning)	9
PMADDR (Parallel Port Address) 195	5
	_
PMAEN (Parallel Port Pin Enable) 196	n'
PMAEN (Parallel Port Pin Enable)	5 1
PMAEN (Parallel Port Pin Enable)	5 1 3
PMAEN (Parallel Port Pin Enable)	5 1 3 7
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         PEEOCON (Parallel Port Status (Slave Modes Only)       197         PEEOCON (Parallel Port Status (Slave Modes Only)       86	5 1 3 7
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       193         REFOCON (Reference Oscillator Control)       80         PEECTEIM (Reference Oscillator Trim)       97	5 1 3 7 0
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         PDRB (Derinbered Pin Solot Output)       144	5 1 3 7 0 2
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       193         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         DSWDET (Sefurers Parent)       64	6 1 3 7 2 1
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62	5 1 3 7 2 1 2
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCALRM (RTC Alarm Control)       200	
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCALRM (RTC Alarm Control)       203         RTCCON (RTC Control)       203	
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCALRM (RTC Alarm Control)       203         RTCON (RTC Control)       204         RTCDATE (RTC Date Value)       204	
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCALRM (RTC Alarm Control)       203         RTCON (RTC Control)       204         RTCDATE (RTC Date Value)       204         RTCTIME (RTC Time Value)       205	
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCALRM (RTC Alarm Control)       203         RTCON (RTC Control)       204         RTCDATE (RTC Date Value)       205         SPIXCON (SPI Control)       167	6 1 3 7 0 2 1 2 3 1 6 5 7
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCALRM (RTC Alarm Control)       203         RTCON (RTC Control)       204         RTCDATE (RTC Date Value)       204         RTCTIME (RTC Time Value)       204         SPIXCON (SPI Control)       167         SPIXCON2 (SPI Control 2)       170	6 1 3 7 0 2 1 2 3 1 6 5 7 0
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCALRM (RTC Alarm Control)       203         RTCCON (RTC Control)       204         RTCDATE (RTC Date Value)       206         RTCTIME (RTC Time Value)       206         SPIXCON (SPI Control)       167         SPIXCON2 (SPI Control 2)       170         SPIXSTAT (SPI Status)       177	513702123165701
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCALRM (RTC Alarm Control)       203         RTCCON (RTC Control)       204         RTCDATE (RTC Date Value)       206         RTCTIME (RTC Time Value)       206         SPIxCON (SPI Control)       167         SPIxCON2 (SPI Control 2)       177         SPIxSTAT (SPI Status)       177         T1CON (Type A Timer Control)       145	5137021231657015
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCALRM (RTC Alarm Control)       203         RTCCON (RTC Control)       204         RTCDATE (RTC Date Value)       206         RTCTIME (RTC Time Value)       206         SPIxCON (SPI Control)       167         SPIxCON2 (SPI Control 2)       177         SPIxSTAT (SPI Status)       177         T1CON (Type A Timer Control)       144         TxCON (Type B Timer Control)       145	51370212316570150
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCALRM (RTC Alarm Control)       203         RTCON (RTC Control)       204         RTCDATE (RTC Date Value)       205         SPIxCON (SPI Control)       167         SPIxCON2 (SPI Control 2)       177         SPIxSTAT (SPI Status)       177         T1CON (Type A Timer Control)       144         TxCON (USB Address)       126	513702123165701501
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCCON (RTC Control)       207         RTCCDATE (RTC Date Value)       206         RTCTIME (RTC Time Value)       206         SPIxCON (SPI Control)       167         SPIxCON2 (SPI Control 2)       177         SPIXCON2 (SPI Control 2)       177         TLCON (Type A Timer Control)       148         TxCON (Type B Timer Control)       145         U1ADDR (USB Address)       122         U1BDTP1 (USB BDT Page 1)       125	5137021231657015013
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       197         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCCON (RTC Control)       207         RTCON (RTC Control)       207         RTCDATE (RTC Date Value)       206         SPIXCON (SPI Control)       207         SPIXCON (SPI Control)       167         SPIXCON2 (SPI Control 2)       170         SPIXCON (Type A Timer Control)       147         TXCON (Type B Timer Control)       145         TXCON (Type B Timer Control)       145         TXCON (Type B Timer Control)       145         TADDR (USB Address)       122         U1BDTP1 (USB BDT Page 1)       122         U1BDTP2 (USB BDT Page 2)       124	51370212316570150134
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)207RTCCON (RTC Control)207RTCDATE (RTC Date Value)206SPIxCON (SPI Control)206SPIxCON2 (SPI Control 2)177SPIxCON2 (SPI Control 2)177T1CON (Type A Timer Control)145TxCON (Type B Timer Control)145TxCON (USB Address)122U1BDTP1 (USB BDT Page 1)122U1BDTP2 (USB BDT Page 2)124U1BDTP3 (USB BDT Page 3)124	513702123165701501344
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)207RTCON (RTC Control)207RTCDATE (RTC Date Value)206SPIxCON (SPI Control)206SPIxCON2 (SPI Control 2)177SPIxSTAT (SPI Status)177T1CON (Type A Timer Control)145TxCON (Type B Timer Control)145TxCON (USB Address)122U1BDTP1 (USB BDT Page 1)122U1BDTP3 (USB BDT Page 3)124U1CNFG1 (USB Configuration 1)125	6 1 3 7 0 2 1 2 3 1 6 5 7 0 1 5 0 1 3 4 4 5
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)207RTCCON (RTC Control)207RTCDATE (RTC Date Value)206SPIXCON (SPI Control)206SPIXCON (SPI Control 2)177SPIXCON2 (SPI Control 2)177T1CON (Type A Timer Control)145TXCON (Type B Timer Control)145TXCON (USB Address)122U1BDTP1 (USB BDT Page 1)122U1BDTP3 (USB BDT Page 3)124U1CNFG1 (USB Control)145U1CON (USB Control)145	61370212316570150134459
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)207RTCCON (RTC Control)207RTCDATE (RTC Date Value)206SPIXCON (SPI Control)167SPIXCON (SPI Control 2)177T1CON (Type A Timer Control)145TXCON (Type B Timer Control)145TXCON (Type B Timer Control)145TXCON (USB Address)122U1BDTP1 (USB BDT Page 1)122U1CNFG1 (USB Configuration 1)125U1CON (USB Control)117U1CON (USB Control)117	613702123165701501344597
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)207RTCCON (RTC Control)207RTCDATE (RTC Date Value)206RTCTIME (RTC Time Value)206SPIxCON (SPI Control)167SPIxCON2 (SPI Control 2)177T1CON (Type A Timer Control)148TxCON (Type B Timer Control)146TxCON (USB Address)127U1BDTP1 (USB BDT Page 1)122U1BDTP2 (USB BDT Page 3)124U1CNFG1 (USB Configuration 1)125U1CON (USB Control)115U1EIE (USB Error Interrupt Enable)117U1EIE (USB Error Interrupt Status)117	6137021231657015013445975
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)203RTCCON (RTC Control)204RTCDATE (RTC Date Value)206RTCTIME (RTC Time Value)206SPIxCON (SPI Control)167SPIxCON2 (SPI Control 2)177T1CON (Type A Timer Control)145TxCON (Type B Timer Control)145TxCON (USB Address)127U1BDTP1 (USB BDT Page 1)122U1BDTP3 (USB BDT Page 3)124U1CNFG1 (USB Configuration 1)125U1CON (USB Control)115U1EIE (USB Error Interrupt Enable)117U1EIR (USB Error Interrupt Status)116	61370212316570150134459756
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)203RTCCON (RTC Control)203RTCCON (RTC Control)204RTCTIME (RTC Time Value)205SPIxCON (SPI Control)167SPIxCON2 (SPI Control 2)177SPIxSTAT (SPI Status)177T1CON (Type A Timer Control)145TxCON (Type B Timer Control)145TxCON (USB Address)122U1BDTP1 (USB BDT Page 1)125U1BDTP3 (USB BDT Page 3)124U1CNFG1 (USB Configuration 1)125U1CON (USB Control)115U1EIR (USB Error Interrupt Enable)117U1EIR (USB Error Interrupt Status)115U1ERMH (USB Frame Number High)126U1ERMH (USB Frame Number High)126 <td>613702123165701501344597562</td>	613702123165701501344597562
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)203RTCCON (RTC Control)203RTCCDATE (RTC Date Value)204RTCTIME (RTC Time Value)205SPIxCON (SPI Control)167SPIxCON2 (SPI Control 2)177SPIxSTAT (SPI Status)177T1CON (Type A Timer Control)145TxCON (Type B Timer Control)145TxCON (USB Address)122U1BDTP1 (USB BDT Page 1)122U1BDTP3 (USB BDT Page 3)124U1CNFG1 (USB Control)115U1EIE (USB Error Interrupt Enable)117U1EIR (USB Error Interrupt Status)115U1EP0-U1EP15 (USB Endpoint Control)126U1FRMH (USB Frame Number High)122U1ERMM (USB Frame Number High)122U1ERMM (USB Frame Number High)124	6137021231657015013445975621
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)203RTCCON (RTC Control)203RTCCON (RTC Control)203RTCTIME (RTC Time Value)204SPIxCON (SPI Control)167SPIxCON2 (SPI Control 2)177SPIxSTAT (SPI Status)177T1CON (Type A Timer Control)145TxCON (Type B Timer Control)145TxCON (Type B Timer Control)145U1BDTP1 (USB BDT Page 1)122U1BDTP3 (USB BDT Page 3)124U1CNFG1 (USB Control)115U1EIE (USB Error Interrupt Enable)117U1EIR (USB Error Interrupt Status)115U1ERMH (USB Frame Number High)122U1FRMH (USB Frame Number Low)124U1FRML (USB Frame Number Low)124	61370212316570150134459756214
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)203RTCCON (RTC Control)203RTCCON (RTC Control)204RTCDATE (RTC Date Value)205SPIxCON (SPI Control)167SPIxCON2 (SPI Control)167SPIxSTAT (SPI Status)177T1CON (Type A Timer Control)145TxCON (Type B Timer Control)145TxCON (Type B Timer Control)145U1BDTP1 (USB BDT Page 1)122U1BDTP3 (USB BDT Page 3)124U1CNFG1 (USB Configuration 1)125U1CNFG1 (USB Control)115U1EIE (USB Error Interrupt Enable)117U1ERMH (USB Frame Number High)122U1FRMH (USB Frame Number Low)124U1ER (USB Interrupt Enable)114U1ER (USB Interr	613702123165701501344597562142
PMAEN (Parallel Port Pin Enable)       196         PMCON (Parallel Port Control)       197         PMMODE (Parallel Port Mode)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       193         PMSTAT (Parallel Port Status (Slave Modes Only)       193         REFOCON (Reference Oscillator Control)       80         REFOTRIM (Reference Oscillator Trim)       82         RPnR (Peripheral Pin Select Output)       147         RSWRST (Software Reset)       62         RTCALRM (RTC Alarm Control)       203         RTCCON (RTC Control)       204         RTCTIME (RTC Time Value)       206         SPIxCON (SPI Control)       167         SPIxCON2 (SPI Control 2)       177         SPIxCON2 (SPI Control 2)       177         SPIxCON (Type A Timer Control)       148         TxCON (Type A Timer Control)       145         TxCON (Type B Timer Control)       150         U1ADDR (USB Address)       122         U1BDTP1 (USB BDT Page 1)       123         U1CON (USB Control)       116         U1EIE (USB Error Interrupt Enable)       117         U1EIR (USB Error Interrupt Status)       116         U1FRMH (USB Frame Number Low)       124         U1FRMH (USB Frame Numb	6137021231657015013445975621431
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)207RTCCON (RTC Control)207RTCCON (RTC Control)207RTCTIME (RTC Time Value)206SPIxCON (SPI Control)206SPIxCON (SPI Control)167SPIxCON2 (SPI Control 2)177SPIxSTAT (SPI Status)177T1CON (Type A Timer Control)148TxCON (Type B Timer Control)146U1ADDR (USB Address)122U1BDTP1 (USB BDT Page 1)122U1BDTP3 (USB BDT Page 3)124U1CNFG1 (USB Configuration 1)125U1CON (USB Control)116U1EIR (USB Error Interrupt Enable)117U1EIR (USB Frame Number High)122U1FRMH (USB Frame Number High)122U1RRMH (USB Frame Number High)124U1R (USB Interrupt Enable)114U1R (USB Interrupt Enable)114U1ADTOCON (USB OTG Control)114U1ATOR (USB OTG Control)1	6137021231657015013445975621431
PMAEN (Parallel Port Pin Enable)196PMCON (Parallel Port Control)197PMMODE (Parallel Port Mode)193PMSTAT (Parallel Port Status (Slave Modes Only)197REFOCON (Reference Oscillator Control)80REFOTRIM (Reference Oscillator Trim)82RPnR (Peripheral Pin Select Output)147RSWRST (Software Reset)62RTCALRM (RTC Alarm Control)207RTCCON (RTC Control)207RTCDATE (RTC Date Value)206SPIxCON (SPI Control)206SPIxCON (SPI Control)107SPIxCON2 (SPI Control 2)177SPIxCON2 (SPI Control 2)177T1CON (Type A Timer Control)145TxCON (Type B Timer Control)145TxCON (Type B Timer Control)142U1BDTP1 (USB BDT Page 1)122U1BDTP3 (USB BDT Page 3)124U1CON (USB Control)116U1EIE (USB Error Interrupt Enable)117U1EIR (USB Error Interrupt Status)115U1ERMH (USB Frame Number High)122U1FRMH (USB Frame Number High)122U1RCON (USB Control)124U1R (USB Interrupt Enable)114U1R (USB Interrupt Enable)114U1OTGCON (USB OTG Control)114U1OTGED (USB OTG Control)114U1OTGED (USB OTG Interrupt Enable)114U1OTGED (USB OTG Interrupt Enable)115U1OTGED (USB OTG Interrupt Enable)116U1OTGED (USB OTG Interrupt Enable)116U1OTGIE (USB OTG Interrupt Enable)116<	613702123165701501344597562143192