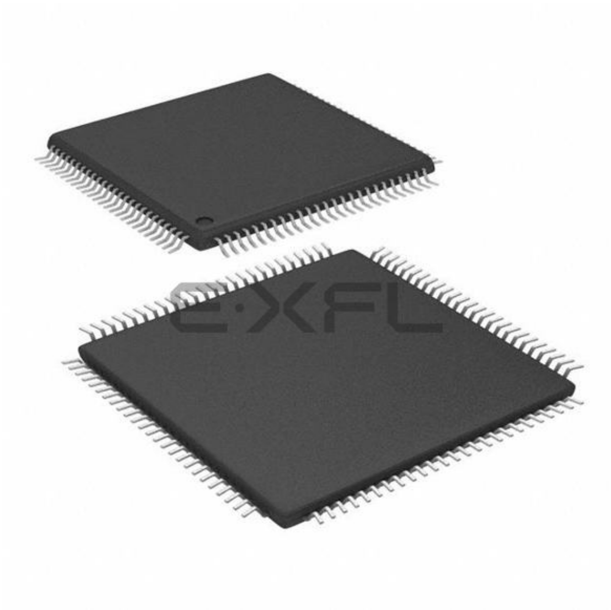
Microchip Technology - PIC32MX360F512LT-80V/PT Datasheet



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 "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	MIPS32® M4K™
Core Size	32-Bit Single-Core
Speed	80MHz
Connectivity	I²C, IrDA, LINbus, PMP, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, POR, PWM, WDT
Number of I/O	85
Program Memory Size	512KB (512K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	32K x 8
Voltage - Supply (Vcc/Vdd)	2.3V ~ 3.6V
Data Converters	A/D 16x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	100-TQFP
Supplier Device Package	100-TQFP (12x12)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic32mx360f512lt-80v-pt

TABLE 3: PIN NAMES: PIC32MX320F128L, PIC32MX340F128L, PIC32MX360F128L, AND PIC32MX360F512L DEVICES (CONTINUED)

Pin Number	Full Pin Name
K4	AN8/C1OUT/RB8
K5	No Connect (NC)
K6	$\overline{\text{U2CTS}}$/RF12
K7	AN14/PMALH/PMA1/RB14
K8	V_{DD}
K9	$\overline{\text{U1RTS}}$/CN21/RD15
K10	U1TX/RF3
K11	U1RX/RF2
L1	PGEC2/AN6/OCFA/RB6
L2	V_{REF}-/CV_{REF}-/PMA7/RA9
L3	AV_{SS}
L4	AN9/C2OUT/RB9
L5	AN10/CV_{REFOUT}/PMA13/RB10
L6	$\overline{\text{U2RTS}}$/RF13
L7	AN13/PMA10/RB13
L8	AN15/OCFB/PMALL/PMA0/CN12/RB15
L9	CN20/$\overline{\text{U1CTS}}$/RD14
L10	U2RX/PMA9/CN17/RF4
L11	U2TX/PMA8/CN18/RF5

TABLE 1-1: PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number[1]			Pin Type	Buffer Type	Description
	64-pin QFN/TQFP	100-pin TQFP	121-pin XBGA			
CN0	48	74	B11	I	ST	Change notification inputs. Can be software programmed for internal weak pull-ups on all inputs.
CN1	47	73	C10	I	ST	
CN2	16	25	K2	I	ST	
CN3	15	24	K1	I	ST	
CN4	14	23	J2	I	ST	
CN5	13	22	J1	I	ST	
CN6	12	21	H2	I	ST	
CN7	11	20	H1	I	ST	
CN8	4	10	E3	I	ST	
CN9	5	11	F4	I	ST	
CN10	6	12	F2	I	ST	
CN11	8	14	F3	I	ST	
CN12	30	44	L8	I	ST	
CN13	52	81	C8	I	ST	
CN14	53	82	B8	I	ST	
CN15	54	83	D7	I	ST	
CN16	55	84	C7	I	ST	
CN17	31	49	L10	I	ST	
CN18	32	50	L11	I	ST	
CN19	—	80	D8	I	ST	
CN20	—	47	L9	I	ST	
CN21	—	48	K9	I	ST	
IC1	42	68	E9	I	ST	Capture inputs 1-5.
IC2	43	69	E10	I	ST	
IC3	44	70	D11	I	ST	
IC4	45	71	C11	I	ST	
IC5	52	79	A9	I	ST	
OCFA	17	26	L1	I	ST	Output Compare Fault A Input.
OC1	46	72	D9	O	—	Output Compare output 1.
OC2	49	76	A11	O	—	Output Compare output 2
OC3	50	77	A10	O	—	Output Compare output 3.
OC4	51	78	B9	O	—	Output Compare output 4.
OC5	52	81	C8	O	—	Output Compare output 5.
OCFB	30	44	L8	I	ST	Output Compare Fault B Input.
INT0	35,46	55,72	H9,D9	I	ST	External interrupt 0.
INT1	42	18	61	I	ST	External interrupt 1.
INT2	43	19	62	I	ST	External interrupt 2.

Legend: CMOS = CMOS compatible input or output; Analog = Analog input; P = Power
ST = Schmitt Trigger input with CMOS levels; O = Output; I = Input
TTL = TTL input buffer

Note 1: Pin numbers are provided for reference only. See the **“Pin Diagrams”** section for device pin availability.

TABLE 4-17: COMPARATOR REGISTERS MAP[1]

Virtual Address (BF80_#)	Register Name	Bit Range	Bits																All Resets
			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	
A000	CM1CON	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	ON	COE	CPOL	—	—	—	—	COUT	EVPOL<1:0>		—	CREF	—	—	CCH<1:0>		00C3
A010	CM2CON	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	ON	COE	CPOL	—	—	—	—	COUT	EVPOL<1:0>		—	CREF	—	—	CCH<1:0>		00C3
A060	CMSTAT	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	SIDL	—	—	—	—	—	—	—	—	—	—	—	C2OUT	C1OUT	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 12.1.1 "CLR, SET and INV Registers"** for more information.

TABLE 4-18: COMPARATOR VOLTAGE REFERENCE REGISTERS MAP[1]

Virtual Address (BF80_#)	Register Name	Bit Range	Bits																All Resets
			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	
9800	CVRCON	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	ON	—	—	—	—	—	—	—	—	CVROE	CVRR	CVRSS	CVR<3:0>				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 12.1.1 "CLR, SET and INV Registers"** for more information.

TABLE 4-33: PORTG REGISTERS MAP FOR PIC32MX320F128L, PIC32MX340F128L, PIC32MX360F256L, PIC32MX360F512L, PIC32MX440F128L, PIC32MX460F256L AND PIC32MX460F512L DEVICES ONLY(1)

Virtual Address (BF88_#)	Register Name	Bit Range	Bits																All Resets
			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	
6180	TRISG	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	TRISG15	TRISG14	TRISG13	TRISG12	—	—	TRISG9	TRISG8	TRISG7	TRISG6	—	—	TRISG3	TRISG2	TRISG1	TRISG0	F3CF
6190	PORTG	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	RG15	RG14	RG13	RG12	—	—	RG9	RG8	RG7	RG6	—	—	RG3	RG2	RG1	RG0	xxxx
61A0	LATG	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	LATG15	LATG14	LATG13	LATG12	—	—	LATG9	LATG8	LATG7	LATG6	—	—	LATG3	LATG2	LATG1	LATG0	xxxx
61B0	ODCG	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	ODCG15	ODCG14	ODCG13	ODCG12	—	—	ODCG9	ODCG8	ODCG7	ODCG6	—	—	ODCG3	ODCG2	ODCG1	ODCG0	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 12.1.1 “CLR, SET and INV Registers”** for more information.

TABLE 4-34: PORTG REGISTERS MAP FOR PIC32MX320F032H, PIC32MX320F064H, PIC32MX320F128H, PIC32MX340F128H, PIC32MX340F256H, PIC32MX340F512H, PIC32MX420F032H, PIC32MX440F128H, PIC32MX440F256H AND PIC32MX440F512H DEVICES ONLY(1)

Virtual Address (BF88_#)	Register Name	Bit Range	Bits																All Resets
			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	
6180	TRISG	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	TRISG9	TRISG8	TRISG7	TRISG6	—	—	TRISG3	TRISG2	—	—	03cc
6190	PORTG	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	RG9	RG8	RG7	RG6	—	—	RG3	RG2	—	—	xxxx
61A0	LATG	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	LATG9	LATG8	LATG7	LATG6	—	—	LATG3	LATG2	—	—	xxxx
61B0	ODCG	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	ODCG9	ODCG8	ODCG7	ODCG6	—	—	ODCG3	ODCG2	—	—	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 12.1.1 “CLR, SET and INV Registers”** for more information.

TABLE 4-43: USB REGISTERS MAP(1)

Virtual Address (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 Resets
5040	U1OTGIR(2)	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		15:0	—	—	—	—	—	—	—	—	IDIF	T1MSECIF	LSTATEIF	ACTVIF	SESVDIF	SESENDIF	—	VBUSVDIF	0000
5050	U1OTGIE	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	IDIE	T1MSECIE	LSTATEIE	ACTVIE	SESVDIE	SESENDIE	—	VBUSVDIE	0000
5060	U1OTGSTAT(3)	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	ID	—	LSTATE	—	SESVD	SESEND	—	VBUSVD	0000
5070	U1OTGCON	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	DPPULUP	DMPULUP	DPPULDWN	DMPULDWN	VBUSON	OTGEN	VBUSCHG	VBUSDIS	0000
5080	U1PWRC	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	UACTPND(4)	—	—	USLPGRD	—	—	USUSPEND	USBPWR	0000
5200	U1IR(2)	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	STALLIF	ATTACHIF	RESUMEIF	IDLEIF	TRNIF	SOFIF	UERRIF	URSTIF DETACHIF	0000 0000
5210	U1IE	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	STALLIE	ATTACHIE	RESUMEIE	IDLEIE	TRNIE	SOFIE	UERRIE	URSTIE DETACHIE	0000 0000
5220	U1EIR	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	BTSEF	BMXEF	DMAEF	BTOEF	DFN8EF	CRC16EF	CRC5EF EOFEF	PIDEF	0000 0000
5230	U1EIE	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	BTSEE	BMXEE	DMAEE	BTOEE	DFN8EE	CRC16EE	CRC5EE EOFEE	PIDEE	0000 0000
5240	U1STAT(3)	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	ENDPT<3:0>(4)				DIR	PPBI	—	—	0000
5250	U1CON	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	JSTATE(4)	SE0(4)	PKTDIS TOKBUSY	USBRST	HOSTEN	RESUME	PPBRST	USBEN SOFEN	0000 0000
5260	U1ADDR	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	LSPDEN	DEVADDR<6:0>							0000
5270	U1BDTP1	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	—	—	—	—	—	—	—	—	BDTPTRL<7:1>							—	0000

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

Note 1: Except where noted, 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 12.1.1 "CLR, SET and INV Registers"** for more information.

2: This register does not have associated CLR, SET, and INV registers.

3: All bits in this register are read-only; therefore, CLR, SET, and INV registers are not supported.

4: The reset value for this bit is undefined.

5.0 FLASH PROGRAM MEMORY

> **Note 1:** This data sheet summarizes the features of the PIC32MX3XX/4XX family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **Section 5. "Flash Program Memory"** (DS61121) of the *"PIC32 Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com/PIC32).
>
> **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.

PIC32MX3XX/4XX devices contain an internal program Flash memory for executing user code. There are three methods by which the user can program this memory:

- Run-Time Self Programming (RTSP)
- In-Circuit Serial Programming™ (ICSP™)
- EJTAG Programming

RTSP is performed by software executing from either Flash or RAM memory. EJTAG is performed using the EJTAG port of the device and a EJTAG capable programmer. ICSP is performed using a serial data connection to the device and allows much faster programming times than RTSP. RTSP techniques are described in this chapter. The ICSP and EJTAG methods are described in the "*PIC32MX Flash Programming Specification*" (DS61145), which can be downloaded from the Microchip web site.

> **Note:** Flash LVD Delay (LVDstartup) must be taken into account between setting up and executing any Flash command operation. See Example 5-1 for a code example to set up and execute a Flash command operation.

EXAMPLE 5-1:

```
NVMCON = 0x4004;          // Enable and configure for erase operation
Wait(delay);              // Delay for 6 µs for LVDstartup

NVMKEY = 0xAA996655;
NVMKEY = 0x556699AA;
NVMCONSET = 0x8000;       // Initiate operation

while(NVMCONbits.WR==1);  // Wait for current operation to complete
```

NOTES:

17.0 SERIAL PERIPHERAL INTERFACE (SPI)

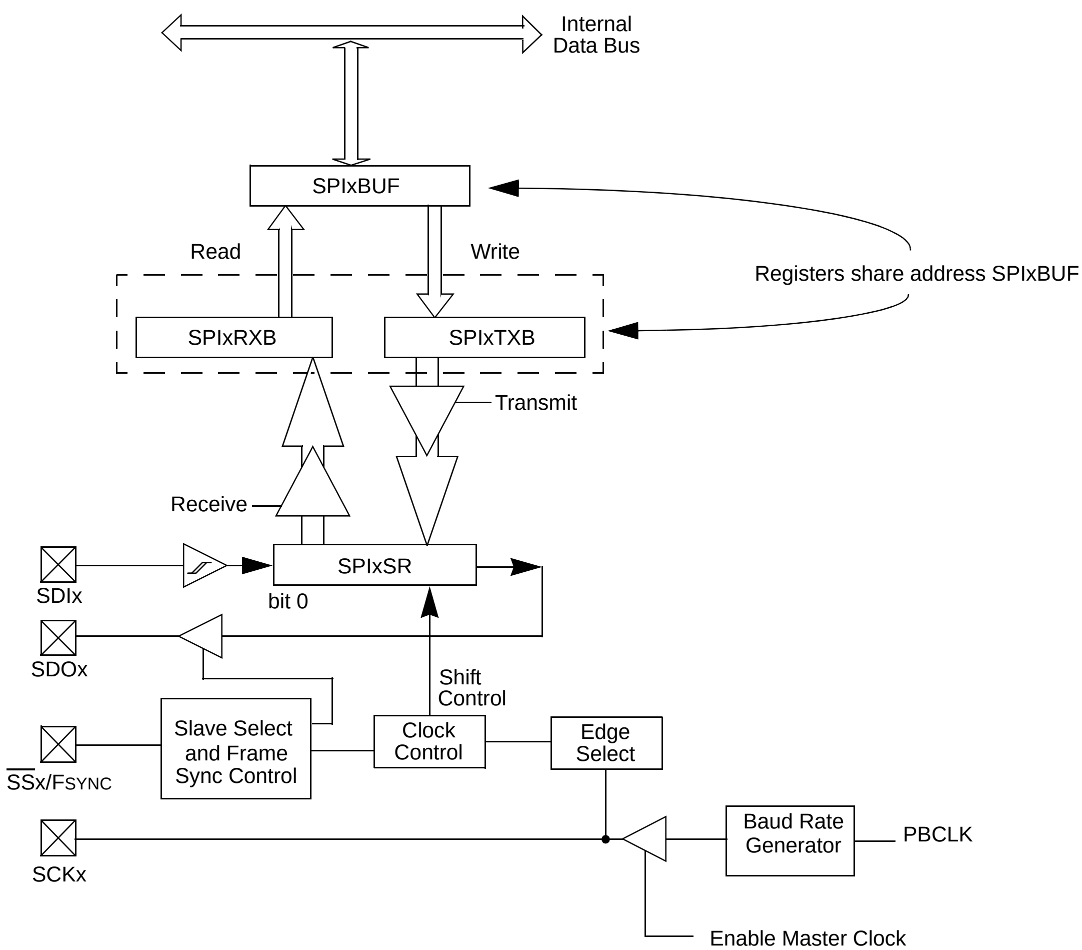
> **Note 1:** This data sheet summarizes the features of the PIC32MX3XX/4XX family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **Section 23. "Serial Peripheral Interface (SPI)"** (DS61106) of the *"PIC32 Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com/PIC32).
>
> **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 SPI module is a synchronous serial interface useful for communicating with external peripherals and other microcontroller devices. These peripheral devices may be Serial EEPROMs, shift registers, display drivers, Analog-to-Digital Converters, etc. The PIC32MX SPI module is compatible with Motorola® SPI and SIOP interfaces.

Following are some of the key features of this module:

- Master and Slave Modes Support
- Four Different Clock Formats
- Framed SPI Protocol Support
- User Configurable 8-bit, 16-bit and 32-bit Data Width
- Separate SPI Data Registers for Receive and Transmit
- Programmable Interrupt Event on every 8-bit, 16-bit and 32-bit Data Transfer
- Operation during CPU Sleep and Idle Mode
- Fast Bit Manipulation using CLR, SET and INV Registers

FIGURE 17-1: SPI MODULE BLOCK DIAGRAM



Note: Access SPIxTXB and SPIxRXB registers via SPIxBUF register.

19.0 UNIVERSAL ASYNCHRONOUS RECEIVER TRANSMITTER (UART)

Note	
1:	This data sheet summarizes the features of the PIC32MX3XX/4XX family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **Section 21. "Universal Asynchronous Receiver Transmitter (UART)"** (DS61107) of the *"PIC32 Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com/PIC32).
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.

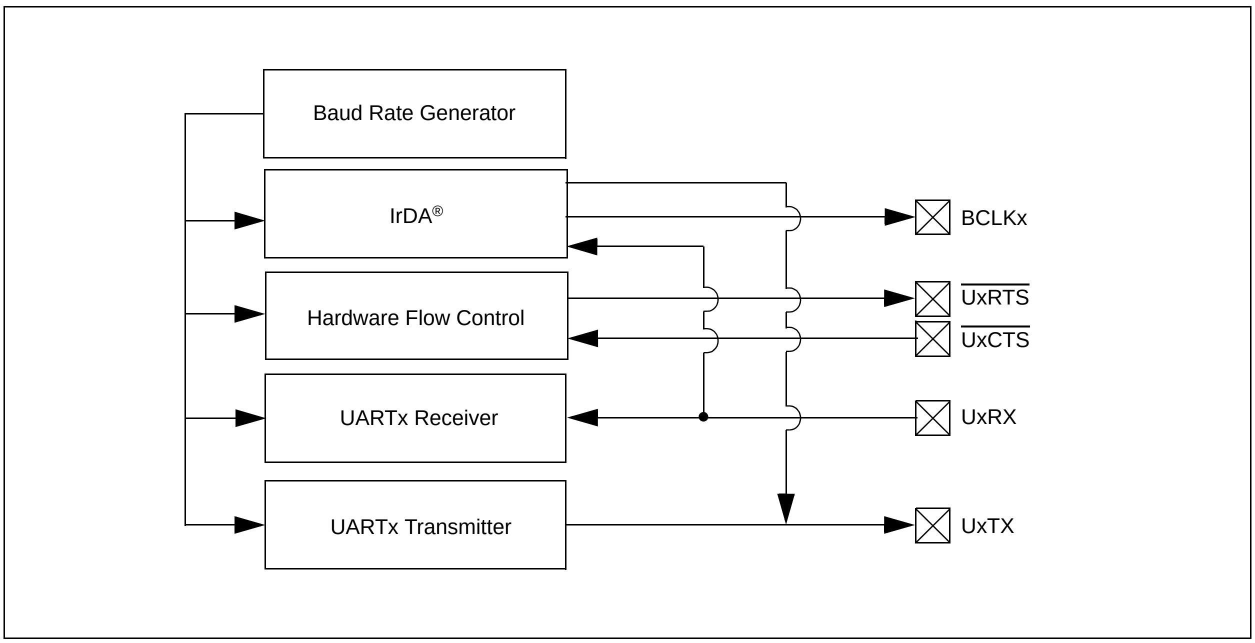
The UART module is one of the serial I/O modules available in PIC32MX3XX/4XX family devices. The UART is a full-duplex, asynchronous communication channel that communicates with peripheral devices and personal computers through protocols such as RS-232, RS-485, LIN 1.2 and IrDA®. The module also supports the hardware flow control option, with $\overline{\text{UxCTS}}$ and $\overline{\text{UxRTS}}$ pins, and also includes an IrDA encoder and decoder.

The primary features of the UART module are:

- Full-duplex, 8-bit or 9-bit data transmission
- Even, odd or no parity options (for 8-bit data)
- One or two Stop bits
- Hardware auto-baud feature
- Hardware flow control option
- Fully integrated Baud Rate Generator (BRG) with 16-bit prescaler
- Baud rates ranging from 76 bps to 20 Mbps at 80 MHz
- 4-level-deep First-In-First-Out (FIFO) Transmit Data Buffer
- 4-level-deep FIFO Receive Data Buffer
- Parity, framing and buffer overrun error detection
- Support for interrupt only on address detect (9th bit = 1)
- Separate transmit and receive interrupts
- Loopback mode for diagnostic support
- LIN protocol support
- IrDA encoder and decoder with 16x baud clock output for external IrDA encoder/decoder support

Figure 19-1 illustrates a simplified block diagram of the UART.

FIGURE 19-1: UART SIMPLIFIED BLOCK DIAGRAM



20.0 PARALLEL MASTER PORT (PMP)

Note 1: This data sheet summarizes the features of the PIC32MX3XX/4XX family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **Section 13. "Parallel Master Port (PMP)"** (DS61128) of the *"PIC32 Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com/PIC32).

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.

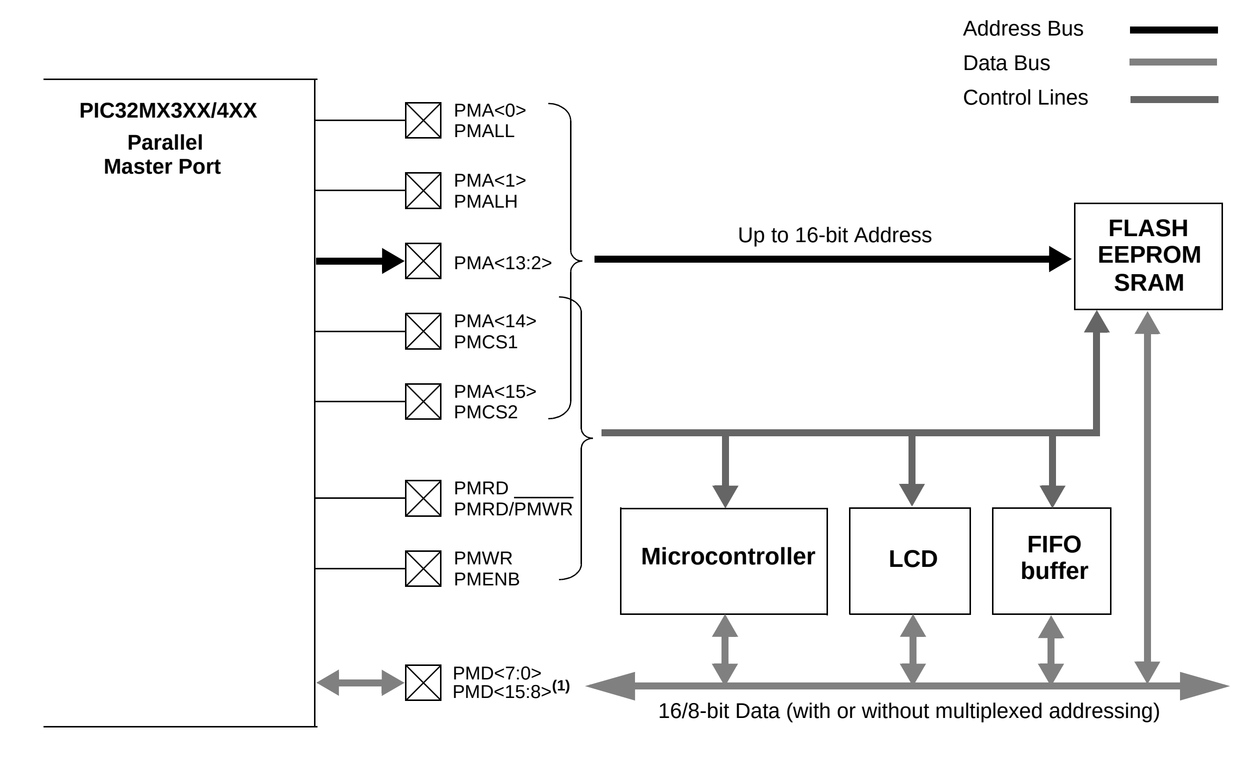
The PMP is a parallel 8-bit/16-bit input/output module specifically designed to communicate with a wide variety of parallel devices, such as communications peripherals, LCDs, external memory devices and microcontrollers. Because the interface to parallel peripherals varies significantly, the PMP module is highly configurable.

Key features of the PMP module include:

- 8-bit,16-bit interface
- Up to 16 programmable address lines
- Up to two Chip Select lines
- Programmable strobe options
  - Individual read and write strobes, or
  - Read/write strobe with enable strobe
- Address auto-increment/auto-decrement
- Programmable address/data multiplexing
- Programmable polarity on control signals
- Parallel Slave Port support
  - Legacy addressable
  - Address support
  - 4-byte deep auto-incrementing buffer
- Programmable Wait states
- Operate during CPU Sleep and Idle modes
- Fast bit manipulation using CLR, SET and INV registers
- Freeze option for in-circuit debugging

Note: On 64-pin devices, data pins PMD<15:8> are not available.

FIGURE 20-1: PMP MODULE PINOUT AND CONNECTIONS TO EXTERNAL DEVICES



Note 1: On 64-pin devices, data pins PMD<15:8> are not available in 16-bit Master modes.

NOTES:

22.0 10-BIT ANALOG-TO-DIGITAL CONVERTER (ADC)

Note 1:	This data sheet summarizes the features of the PIC32MX3XX/4XX family of devices. It is not intended to be a comprehensive reference source. Refer to **Section 17. "10-bit Analog-to-Digital Converter (ADC)"** (DS61104) of the *"PIC32 Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com/PIC32).
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 PIC32MX3XX/4XX 10-bit Analog-to-Digital Converter (ADC) includes the following features:

- Successive Approximation Register (SAR) conversion
- Up to 1000 kilo samples per second (ksps) conversion speed
- Up to 16 analog input pins
- External voltage reference input pins
- One unipolar, differential Sample-and-Hold Amplifier (SHA)
- Automatic Channel Scan mode
- Selectable conversion trigger source
- 16-word conversion result buffer
- Selectable Buffer Fill modes
- Eight conversion result format options
- Operation during CPU Sleep and Idle modes

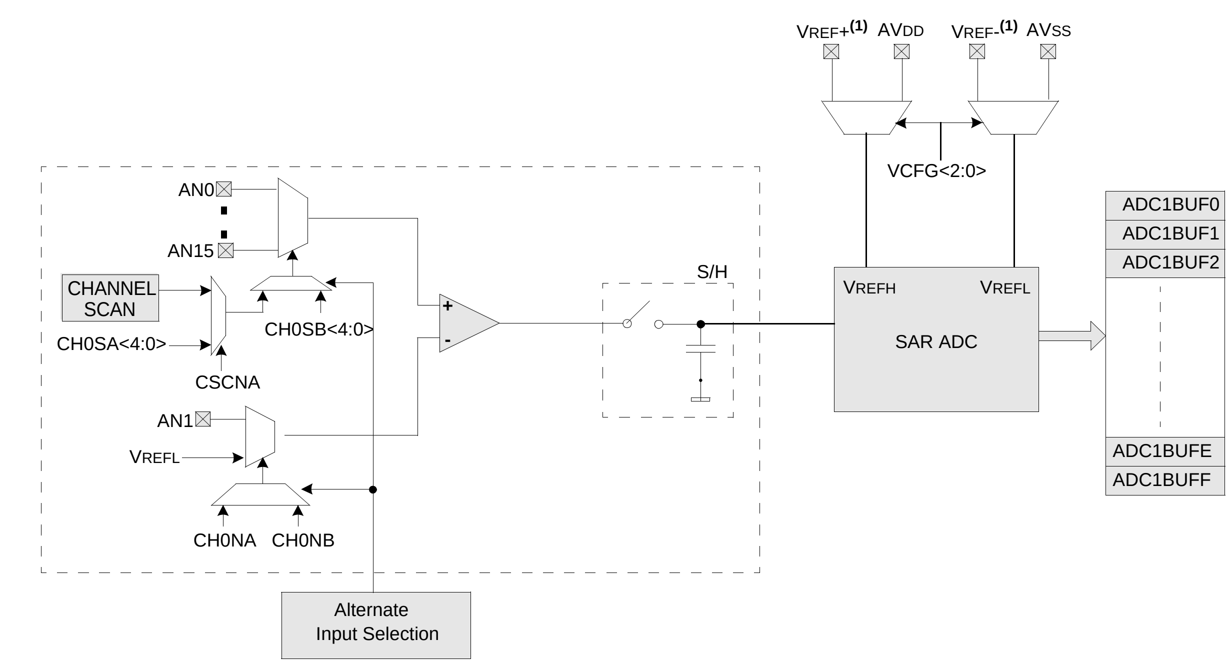
A block diagram of the 10-bit ADC is illustrated in Figure 22-1. The 10-bit ADC has 16 analog input pins, designated AN0-AN15. In addition, there are two analog input pins for external voltage reference connections. These voltage reference inputs may be shared with other analog input pins and may be common to other analog module references.

The analog inputs are connected through two multiplexers (MUXs) to one SHA. The analog input MUXs can be switched between two sets of analog inputs between conversions. Unipolar differential conversions are possible on all channels, other than the pin used as the reference, using a reference input pin (see Figure 22-1).

The Analog Input Scan mode sequentially converts user-specified channels. A control register specifies which analog input channels will be included in the scanning sequence.

The 10-bit ADC is connected to a 16-word result buffer. Each 10-bit result is converted to one of eight, 32-bit output formats when it is read from the result buffer.

FIGURE 22-1: ADC1 MODULE BLOCK DIAGRAM



Note 1: VREF+, VREF- inputs can be multiplexed with other analog inputs.

REGISTER 26-1: DEVCFG0: DEVICE CONFIGURATION WORD 0 (CONTINUED)

bit 19-12 **PWP<7:0>:** Program Flash Write-Protect bits

Prevents selected program Flash memory pages from being modified during code execution. The PWP bits represent the one's compliment of the number of write protected program Flash memory pages.

11111111 = Disabled
11111110 = 0xBD00_0FFF
11111101 = 0xBD00_1FFF
11111100 = 0xBD00_2FFF
11111011 = 0xBD00_3FFF
11111010 = 0xBD00_4FFF
11111001 = 0xBD00_5FFF
11111000 = 0xBD00_6FFF
11110111 = 0xBD00_7FFF
11110110 = 0xBD00_8FFF
11110101 = 0xBD00_9FFF
11110100 = 0xBD00_AFFF
11110011 = 0xBD00_BFFF
11110010 = 0xBD00_CFFF
11110001 = 0xBD00_DFFF
11110000 = 0xBD00_EFFF
11101111 = 0xBD00_FFFF
.
.
.
01111111 = 0xBD07_FFFF

bit 11-4 **Reserved:** Write '1'

bit 3 **ICESEL:** In-Circuit Emulator/Debugger Communication Channel Select bit

1 = PGEC2/PGED2 pair is used
0 = PGEC1/PGED1 pair is used

bit 2 **Reserved:** Write '1'

bit 1-0 **DEBUG<1:0>:** Background Debugger Enable bits (forced to '11' if code-protect is enabled)

11 = Debugger disabled
10 = Debugger enabled
01 = Reserved (same as '11' setting)
00 = Reserved (same as '11' setting)

REGISTER 26-2: DEVCFG1: DEVICE CONFIGURATION WORD 1 (CONTINUED)

bit 13-12 **FPBDIV<1:0>:** Peripheral Bus Clock Divisor Default Value bits
11 = PBCLK is SYSCLK divided by 8
10 = PBCLK is SYSCLK divided by 4
01 = PBCLK is SYSCLK divided by 2
00 = PBCLK is SYSCLK divided by 1

bit 11 **Reserved:** Write '1'

bit 10 **OSCIOFNC:** CLKO Enable Configuration bit
1 = CLKO output signal active on the OSCO pin; primary oscillator must be disabled or configured for the External Clock mode (EC) for the CLKO to be active (POSCMOD<1:0> = 11 OR 00)
0 = CLKO output disabled

bit 9-8 **POSCMOD<1:0>:** Primary Oscillator Configuration bits
11 = Primary oscillator disabled
10 = HS oscillator mode selected
01 = XT oscillator mode selected
00 = External clock mode selected

bit 7 **IESO:** Internal External Switchover bit
1 = Internal External Switchover mode enabled (Two-Speed Start-up enabled)
0 = Internal External Switchover mode disabled (Two-Speed Start-up disabled)

bit 6 **Reserved:** Write '1'

bit 5 **FSOSCEN:** Secondary Oscillator Enable bit
1 = Enable Secondary Oscillator
0 = Disable Secondary Oscillator

bit 4-3 **Reserved:** Write '1'

bit 2-0 **FNOSC<2:0>:** Oscillator Selection bits
111 = Fast RC Oscillator with divide-by-N (FRCDIV)
110 = FRCDIV16 Fast RC Oscillator with fixed divide-by-16 postscaler
101 = Low-Power RC Oscillator (LPRC)
100 = Secondary Oscillator (SOSC)
011 = Primary Oscillator with PLL module (XT+PLL, HS+PLL, EC+PLL)
010 = Primary Oscillator (XT, HS, EC)[1]
001 = Fast RC Oscillator with divide-by-N with PLL module (FRCDIV+PLL)
000 = Fast RC Oscillator (FRC)

Note 1: Do not disable POSC (POSCMOD = 00) when using this oscillator source.

TABLE 27-1: MIPS32® INSTRUCTION SET (CONTINUED)

Instruction	Description	Function
JAL	Jump and Link	GPR[31] = PC + 8 PC = PC[31:28] || offset<<2
JALR	Jump and Link Register	Rd = PC + 8 PC = Rs
JALR.HB	Jump and Link Register with Hazard Barrier	Like JALR, but also clears execution and instruction hazards
JR	Jump Register	PC = Rs
JR.HB	Jump Register with Hazard Barrier	Like JR, but also clears execution and instruction hazards
LB	Load Byte	Rt = (byte)Mem[Rs+offset]
LBU	Unsigned Load Byte	Rt = (ubyte))Mem[Rs+offset]
LH	Load Halfword	Rt = (half)Mem[Rs+offset]
LHU	Unsigned Load Halfword	Rt = (uhalf)Mem[Rs+offset]
LL	Load Linked Word	Rt = Mem[Rs+offset> LL_{bit} = 1 LLAdr = Rs + offset
LUI	Load Upper Immediate	Rt = immediate << 16
LW	Load Word	Rt = Mem[Rs+offset]
LWPC	Load Word, PC relative	Rt = Mem[PC+offset]
LWL	Load Word Left	Re = Re MERGE Mem[Rs+offset]
LWR	Load Word Right	Re = Re MERGE Mem[Rs+offset]
MADD	Multiply-Add	HI | LO += (int)Rs * (int)Rt
MADDU	Multiply-Add Unsigned	HI | LO += (uns)Rs * (uns)Rt
MFC0	Move from Coprocessor 0	Rt = CPR[0, Rd, sel]
MFHI	Move from HI	Rd = HI
MFLO	Move from LO	Rd = LO
MOVN	Move Conditional on Not Zero	if Rt ¼ 0 then Rd = Rs
MOVZ	Move Conditional on Zero	if Rt = 0 then Rd = Rs
MSUB	Multiply-Subtract	HI | LO -= (int)Rs * (int)Rt
MSUBU	Multiply-Subtract Unsigned	HI | LO -= (uns)Rs * (uns)Rt
MTC0	Move to Coprocessor 0	CPR[0, n, Sel] = Rt
MTHI	Move to HI	HI = Rs
MTLO	Move to LO	LO = Rs
MUL	Multiply with register write	HI | LO =Unpredictable Rd = $((int)Rs * (int)Rt)_{31..0}$
MULT	Integer Multiply	HI | LO = (int)Rs * (int)Rd
MULTU	Unsigned Multiply	HI | LO = (uns)Rs * (uns)Rd
NOP	No Operation (Assembler idiom for: SLL r0, r0, r0)	
NOR	Logical NOR	Rd = ~(Rs | Rt)
OR	Logical OR	Rd = Rs | Rt
ORI	Logical OR Immediate	Rt = Rs | Immed
RDHWR	Read Hardware Register (if enabled by $HWRE_{na}$ Register)	Re = HWR[Rd]

Note 1: This instruction is deprecated and should not be used.

TABLE 29-11: DC CHARACTERISTICS: PROGRAM MEMORY(3)

DC CHARACTERISTICS			Standard Operating Conditions: 2.3V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +105°C for V-Temp				
Param. No.	**Symbol**	**Characteristics**	**Min.**	**Typical(1)**	**Max.**	**Units**	**Conditions**
		Program Flash Memory					
D130	EP	Cell Endurance	1000	—	—	E/W	—
D131	VPR	VDD for Read	VMIN	—	3.6	V	—
D132	VPEW	VDD for Erase or Write	3.0	—	3.6	V	—
D134	TRETD	Characteristic Retention	20	—	—	Year	—
D135	IDDP	Supply Current during Programming	—	10	—	mA	—
	TWW	Word Write Cycle Time	20	—	40	µs	—
D136	TRW	Row Write Cycle Time(2) (128 words per row)	3	4.5	—	ms	—
D137	TPE	Page Erase Cycle Time	20	—	—	ms	—
	TCE	Chip Erase Cycle Time	80	—	—	ms	—
D138	LVDstartup	Flash LVD Delay	—	—	6	µs	—

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

2: The minimum SYSCLK for row programming is 4 MHz. Care should be taken to minimize bus activities during row programming, such as suspending any memory-to-memory DMA operations. If heavy bus loads are expected, selecting Bus Matrix Arbitration mode 2 (rotating priority) may be necessary. The default Arbitration mode is mode 1 (CPU has lowest priority).

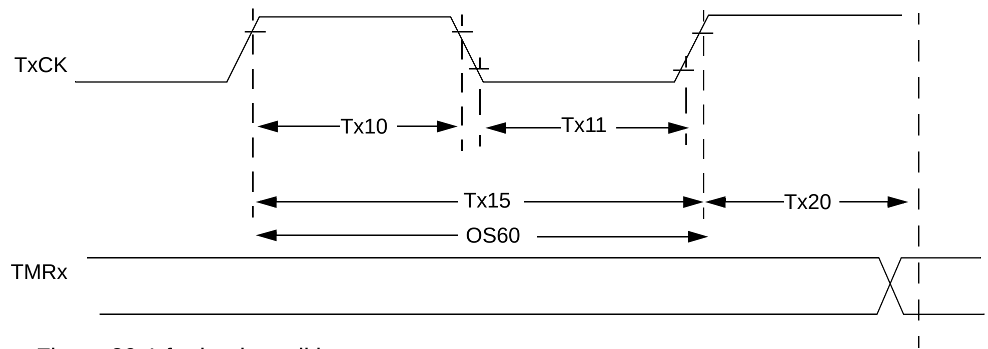
3: Refer to the “*PIC32MX Flash Programming Specification*” (DS61145) for operating conditions during programming and erase cycles.

TABLE 29-12: PROGRAM FLASH MEMORY WAIT STATE CHARACTERISTICS

DC CHARACTERISTICS	Standard Operating Conditions: 2.3V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +105°C for V-Temp		
Required Flash wait states	**SYSCLK**	**Units**	**Comments**
0 Wait State	0 to 30	MHz	—
1 Wait State	31 to 60		
2 Wait States	61 to 80		

Note 1: 40 MHz maximum for PIC32MX320F032H and PIC32MX420F032H devices.

FIGURE 29-6: TIMER1, 2, 3, 4, 5 EXTERNAL CLOCK TIMING CHARACTERISTICS



Note: Refer to Figure 29-1 for load conditions.

TABLE 29-23: TIMER1 EXTERNAL CLOCK TIMING REQUIREMENTS[1]

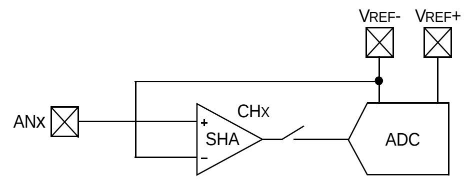
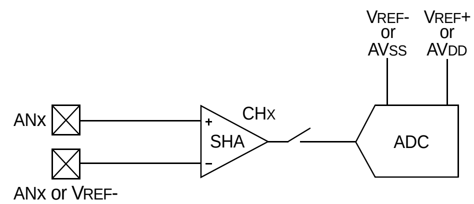
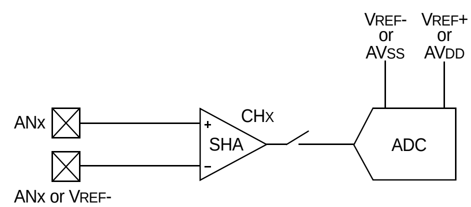
AC CHARACTERISTICS	**Standard Operating Conditions: 2.3V to 3.6V** (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +105°C for V-Temp

Param. No.	Symbol	Characteristics[2]		Min.	Typical	Max.	Units	Conditions
TA10	TTXH	TxCK High Time	Synchronous, with prescaler	[(12.5 ns or 1TPB)/N] + 25 ns	—	—	ns	Must also meet parameter TA15.
			Asynchronous, with prescaler	10	—	—	ns	—
TA11	TTXL	TxCK Low Time	Synchronous, with prescaler	[(12.5 ns or 1TPB)/N] + 25 ns	—	—	ns	Must also meet parameter TA15.
			Asynchronous, with prescaler	10	—	—	ns	—
TA15	TTXP	TxCK Input Period	Synchronous, with prescaler	[(Greater of 25 ns or 2TPB)/N] + 30 ns	—	—	ns	VDD > 2.7V
				[(Greater of 25 ns or 2TPB)/N] + 50 ns	—	—	ns	VDD < 2.7V
			Asynchronous, with prescaler	20	—	—	ns	VDD > 2.7V **(Note 3)**
				50	—	—	ns	VDD < 2.7V **(Note 3)**
OS60	FT1	SOSC1/T1CK Oscillator Input Frequency Range (oscillator enabled by setting TCS bit (T1CON<1>))		32	—	100	kHz	—
TA20	TCKEXTMRL	Delay from External TxCK Clock Edge to Timer Increment		—		1	TPB	—

Note 1: Timer1 is a Type A.
2: This parameter is characterized, but not tested in manufacturing.
3: N = prescale value (1, 8, 64, 256)

TABLE 29-35: 10-BIT ADC CONVERSION RATE PARAMETERS(2)

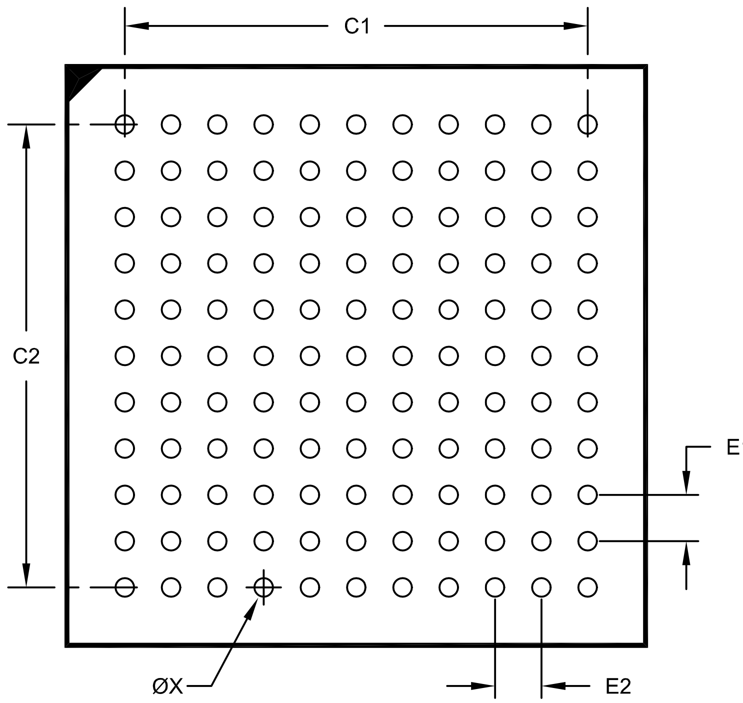
Standard Operating Conditions: 2.3V to 3.6V
(unless otherwise stated)
Operating temperature -40°C ≤ T_A ≤ +85°C for Industrial
-40°C ≤ T_A ≤ +105°C for V-Temp

ADC Speed	TAD Minimum	Sampling Time Min	RS Max	VDD	ADC Channels Configuration
1 MIPS to 400 ksps(1)	65 ns	132 ns	500Ω	3.0V to 3.6V	
Up to 400 ksps	200 ns	200 ns	5.0 kΩ	2.5V to 3.6V	
Up to 300 ksps	200 ns	200 ns	5.0 kΩ	2.5V to 3.6V	

Note 1: External VREF- and VREF+ pins must be used for correct operation.
2: These parameters are characterized, but not tested in manufacturing.

121-Lead Plastic Thin Profile Ball Grid Array (BG) - 10x10x1.10 mm Body [XBGA]

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	E1	0.80 BSC		
Contact Pitch	E2	0.80 BSC		
Contact Pad Spacing	C1		8.00	
Contact Pad Spacing	C2		8.00	
Contact Pad Diameter (X121)	X			0.32

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2148B

TABLE A-2: MAJOR SECTION UPDATES (CONTINUED)

Section Name	Update Description
Section 29.0 “Electrical Characteristics”	Updated the Absolute Maximum Ratings and added Note 3. Added Thermal Packaging Characteristics for the 121-pin XBGA package (see Table 29-3). Updated the conditions for parameters DC20, DC21, DC22 and DC23 in Table 29-5. Updated the comments for parameter D321 (C_{EFC}) in Table 29-15. Updated the SPIx Module Slave Mode (CKE = 1) Timing Characteristics, changing SP52 to SP35 between the MSb and Bit 14 on SDOx (see Figure 29-13).
Section 30.0 “Packaging Information”	Added the 121-pin XBGA package marking information and package details.
“Product Identification System”	Added the definition for BG (121-lead 10x10x1.1 mm, XBGA). Added the definition for Speed.