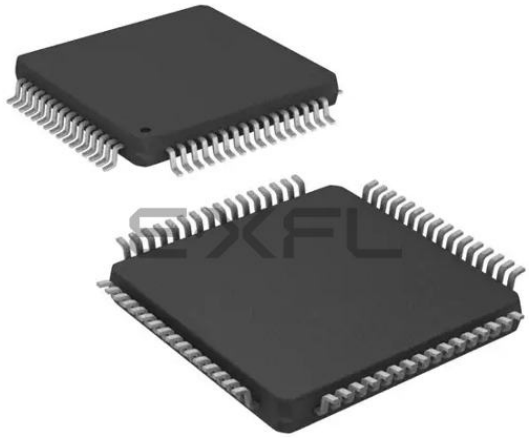
Microchip Technology - DSPIC33EP128MC506T-I/PT Datasheet



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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	dsPIC
Core Size	16-Bit
Speed	70 MIPs
Connectivity	CANbus, I²C, IrDA, LINbus, QEI, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, Motor Control PWM, POR, PWM, WDT
Number of I/O	53
Program Memory Size	128KB (43K x 24)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 16
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 16x10b/12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-TQFP
Supplier Device Package	64-TQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/dspic33ep128mc506t-i-pt

3.8 Arithmetic Logic Unit (ALU)

The dsPIC33EPXXXGP50X, dsPIC33EPXXXMC20X/50X and PIC24EPXXXGP/MC20X ALU is 16 bits wide, and is capable of addition, subtraction, bit shifts and logic operations. Unless otherwise mentioned, arithmetic operations are two's complement in nature. Depending on the operation, the ALU can affect the values of the Carry (C), Zero (Z), Negative (N), Overflow (OV) and Digit Carry (DC) Status bits in the SR register. The C and DC Status bits operate as Borrow and Digit Borrow bits, respectively, for subtraction operations.

The ALU can perform 8-bit or 16-bit operations, depending on the mode of the instruction that is used. Data for the ALU operation can come from the W register array or data memory, depending on the addressing mode of the instruction. Likewise, output data from the ALU can be written to the W register array or a data memory location.

Refer to the *"16-bit MCU and DSC Programmer's Reference Manual"* (DS70157) for information on the SR bits affected by each instruction.

The core CPU incorporates hardware support for both multiplication and division. This includes a dedicated hardware multiplier and support hardware for 16-bit divisor division.

3.8.1 MULTIPLIER

Using the high-speed 17-bit x 17-bit multiplier, the ALU supports unsigned, signed, or mixed-sign operation in several MCU multiplication modes:

- 16-bit x 16-bit signed
- 16-bit x 16-bit unsigned
- 16-bit signed x 5-bit (literal) unsigned
- 16-bit signed x 16-bit unsigned
- 16-bit unsigned x 5-bit (literal) unsigned
- 16-bit unsigned x 16-bit signed
- 8-bit unsigned x 8-bit unsigned

3.8.2 DIVIDER

The divide block supports 32-bit/16-bit and 16-bit/16-bit signed and unsigned integer divide operations with the following data sizes:

- 32-bit signed/16-bit signed divide
- 32-bit unsigned/16-bit unsigned divide
- 16-bit signed/16-bit signed divide
- 16-bit unsigned/16-bit unsigned divide

The quotient for all divide instructions ends up in W0 and the remainder in W1. The 16-bit signed and unsigned DIV instructions can specify any W register for both the 16-bit divisor (Wn) and any W register (aligned) pair (W(m + 1):Wm) for the 32-bit dividend. The divide algorithm takes one cycle per bit of divisor, so both 32-bit/16-bit and 16-bit/16-bit instructions take the same number of cycles to execute.

3.9 DSP Engine (dsPIC33EPXXXMC20X/50X and dsPIC33EPXXXGP50X Devices Only)

The DSP engine consists of a high-speed 17-bit x 17-bit multiplier, a 40-bit barrel shifter and a 40-bit adder/subtracter (with two target accumulators, round and saturation logic).

The DSP engine can also perform inherent accumulator-to-accumulator operations that require no additional data. These instructions are ADD, SUB and NEG.

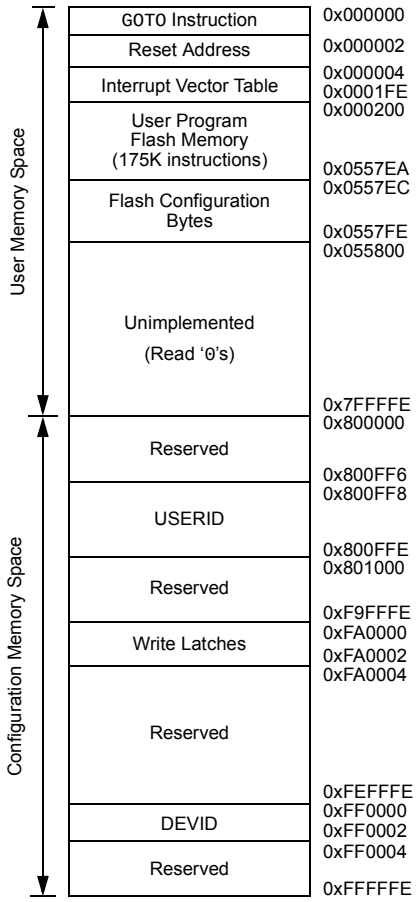
The DSP engine has options selected through bits in the CPU Core Control register (CORCON), as listed below:

- Fractional or integer DSP multiply (IF)
- Signed, unsigned or mixed-sign DSP multiply (US)
- Conventional or convergent rounding (RND)
- Automatic saturation on/off for ACCA (SATA)
- Automatic saturation on/off for ACCB (SATB)
- Automatic saturation on/off for writes to data memory (SATDW)
- Accumulator Saturation mode selection (ACCSAT)

TABLE 3-2: DSP INSTRUCTIONS SUMMARY

Instruction	Algebraic Operation	ACC Write Back
CLR	$A = 0$	Yes
ED	$A = (x - y)^2$	No
EDAC	$A = A + (x - y)^2$	No
MAC	$A = A + (x \cdot y)$	Yes
MAC	$A = A + x^2$	No
MOVSAC	No change in A	Yes
MPY	$A = x \cdot y$	No
MPY	$A = x^2$	No
MPY.N	$A = -x \cdot y$	No
MSC	$A = A - x \cdot y$	Yes

FIGURE 4-5: PROGRAM MEMORY MAP FOR dsPIC33EP512GP50X, dsPIC33EP512MC20X/50X AND PIC24EP512GP/MC20X DEVICES



Note: Memory areas are not shown to scale.

TABLE 4-37: PMD REGISTER MAP FOR PIC24EPXXXGP20X 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
PMD1	0760	T5MD	T4MD	T3MD	T2MD	T1MD	—	—	—	I2C1MD	U2MD	U1MD	SPI2MD	SPI1MD	—	—	AD1MD	0000
PMD2	0762	—	—	—	—	IC4MD	IC3MD	IC2MD	IC1MD	—	—	—	—	OC4MD	OC3MD	OC2MD	OC1MD	0000
PMD3	0764	—	—	—	—	—	CMPMD	—	—	CRCMD	—	—	—	—	—	I2C2MD	—	0000
PMD4	0766	—	—	—	—	—	—	—	—	—	—	—	—	REFOMD	CTMUMD	—	—	0000
PMD6	076A	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
PMD7	076C	—	—	—	—	—	—	—	—	—	—	—	DMA0MD DMA1MD DMA2MD DMA3MD	PTGMD	—	—	—	0000

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

TABLE 4-38: PMD REGISTER MAP FOR PIC24EPXXXMC20X 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
PMD1	0760	T5MD	T4MD	T3MD	T2MD	T1MD	QEI1MD	PWMMD	—	I2C1MD	U2MD	U1MD	SPI2MD	SPI1MD	—	—	AD1MD	0000
PMD2	0762	—	—	—	—	IC4MD	IC3MD	IC2MD	IC1MD	—	—	—	—	OC4MD	OC3MD	OC2MD	OC1MD	0000
PMD3	0764	—	—	—	—	—	CMPMD	—	—	CRCMD	—	—	—	—	—	I2C2MD	—	0000
PMD4	0766	—	—	—	—	—	—	—	—	—	—	—	—	REFOMD	CTMUMD	—	—	0000
PMD6	076A	—	—	—	—	—	PWM3MD	PWM2MD	PWM1MD	—	—	—	—	—	—	—	—	0000
PMD7	076C	—	—	—	—	—	—	—	—	—	—	—	DMA0MD DMA1MD DMA2MD DMA3MD	PTGMD	—	—	—	0000

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

TABLE 4-42: OP AMP/COMPARATOR REGISTER MAP

File Name	Addr.	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	All Resets
CMSTAT	0A80	PSIDL	—	—	—	C4EVT	C3EVT	C2EVT	C1EVT	—	—	—	—	C4OUT	C3OUT	C2OUT	C1OUT	0000
CVRCON	0A82	—	CVR2OE	—	—	—	VREFSEL	—	—	CVREN	CVR1OE	CVRR	CVRSS	CVR<3:0>				0000
CM1CON	0A84	CON	COE	CPOL	—	—	OPMODE	CEVT	COUT	EVPOL<1:0>		—	CREF	—	—	CCH<1:0>		0000
CM1MSKSRC	0A86	—	—	—	—	SELSRCC<3:0>				SELSRCB<3:0>				SELSRCA<3:0>				0000
CM1MSKCON	0A88	HLMS	—	OCEN	OCNEN	OBEN	OBNEN	OAEN	OANEN	NAGS	PAGS	ACEN	ACNEN	ABEN	ABNEN	AAEN	AANEN	0000
CM1FLTR	0A8A	—	—	—	—	—	—	—	—	—	CFSEL<2:0>			CFLTREN	CFDIV<2:0>			0000
CM2CON	0A8C	CON	COE	CPOL	—	—	OPMODE	CEVT	COUT	EVPOL<1:0>		—	CREF	—	—	CCH<1:0>		0000
CM2MSKSRC	0A8E	—	—	—	—	SELSRCC<3:0>				SELSRCB<3:0>				SELSRCA<3:0>				0000
CM2MSKCON	0A90	HLMS	—	OCEN	OCNEN	OBEN	OBNEN	OAEN	OANEN	NAGS	PAGS	ACEN	ACNEN	ABEN	ABNEN	AAEN	AANEN	0000
CM2FLTR	0A92	—	—	—	—	—	—	—	—	—	CFSEL<2:0>			CFLTREN	CFDIV<2:0>			0000
CM3CON(1)	0A94	CON	COE	CPOL	—	—	OPMODE	CEVT	COUT	EVPOL<1:0>		—	CREF	—	—	CCH<1:0>		0000
CM3MSKSRC(1)	0A96	—	—	—	—	SELSRCC<3:0>				SELSRCB<3:0>				SELSRCA<3:0>				0000
CM3MSKCON(1)	0A98	HLMS	—	OCEN	OCNEN	OBEN	OBNEN	OAEN	OANEN	NAGS	PAGS	ACEN	ACNEN	ABEN	ABNEN	AAEN	AANEN	0000
CM3FLTR(1)	0A9A	—	—	—	—	—	—	—	—	—	CFSEL<2:0>			CFLTREN	CFDIV<2:0>			0000
CM4CON	0A9C	CON	COE	CPOL	—	—	—	CEVT	COUT	EVPOL<1:0>		—	CREF	—	—	CCH<1:0>		0000
CM4MSKSRC	0A9E	—	—	—	—	SELSRCC<3:0>				SELSRCB<3:0>				SELSRCA<3:0>				0000
CM4MSKCON	0AA0	HLMS	—	OCEN	OCNEN	OBEN	OBNEN	OAEN	OANEN	NAGS	PAGS	ACEN	ACNEN	ABEN	ABNEN	AAEN	AANEN	0000
CM4FLTR	0AA2	—	—	—	—	—	—	—	—	—	CFSEL<2:0>			CFLTREN	CFDIV<2:0>			0000

Legend: — = unimplemented, read as '0'. Reset values are shown in hexadecimal.
Note 1: These registers are unavailable on dsPIC33EPXXXGP502/MC502/MC202 and PIC24EP256GP/MC202 (28-pin) devices.

TABLE 4-43: CTMU REGISTER MAP

File Name	Addr.	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	All Resets
CTMUCON1	033A	CTMUEN	—	CTMUSIDL	TGEN	EDGEN	EDGSEQEN	IDISSEN	CTTRIG	—	—	—	—	—	—	—	—	0000
CTMUCON2	033C	EDG1MOD	EDG1POL	EDG1SEL<3:0>				EDG2STAT	EDG1STAT	EDG2MOD	EDG2POL	EDG2SEL<3:0>				—	—	0000
CTMUICON	033E	ITRIM<5:0>						IRNG<1:0>		—	—	—	—	—	—	—	—	0000

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

TABLE 4-44: JTAG INTERFACE REGISTER MAP

File Name	Addr	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	All Resets
JDATAH	0FF0	—	—	—	—	JDATAH<27:16>												xxxx
JDATAL	0FF2	JDATAL<15:0>																0000

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

TABLE 4-46: PORTA REGISTER MAP FOR PIC24EPXXXGP/MC206 AND dsPIC33EPXXXGP/MC206/506 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
TRISA	0E00	—	—	—	TRISA12	TRISA11	TRISA10	TRISA9	TRISA8	TRISA7	—	—	TRISA4	—	—	TRISA1	TRISA0	1F93
PORTA	0E02	—	—	—	RA12	RA11	RA10	RA9	RA8	RA7	—	—	RA4	—	—	RA1	RA0	0000
LATA	0E04	—	—	—	LATA12	LATA11	LATA10	LATA9	LATA8	LATA7	—	—	LATA4	—	—	LA1TA1	LA0TA0	0000
ODCA	0E06	—	—	—	ODCA12	ODCA11	ODCA10	ODCA9	ODCA8	ODCA7	—	—	ODCA4	—	—	ODCA1	ODCA0	0000
CNENA	0E08	—	—	—	CNIEA12	CNIEA11	CNIEA10	CNIEA9	CNIEA8	CNIEA7	—	—	CNIEA4	—	—	CNIEA1	CNIEA0	0000
CNPUA	0E0A	—	—	—	CNPUA12	CNPUA11	CNPUA10	CNPUA9	CNPUA8	CNPUA7	—	—	CNPUA4	—	—	CNPUA1	CNPUA0	0000
CNPDA	0E0C	—	—	—	CNPDA12	CNPDA11	CNPDA10	CNPDA9	CNPDA8	CNPDA7	—	—	CNPDA4	—	—	CNPDA1	CNPDA0	0000
ANSELA	0E0E	—	—	—	ANSA12	ANSA11	—	—	—	—	—	—	ANSA4	—	—	ANSA1	ANSA0	1813

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

TABLE 4-47: PORTB REGISTER MAP FOR PIC24EPXXXGP/MC206 AND dsPIC33EPXXXGP/MC206/506 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
TRISB	0E10	TRISB15	TRISB14	TRISB13	TRISB12	TRISB11	TRISB10	TRISB9	TRISB8	TRISB7	TRISB6	TRISB5	TRISB4	TRISB3	TRISB2	TRISB1	TRISB0	FFFF
PORTB	0E12	RB15	RB14	RB13	RB12	RB11	RB10	RB9	RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0	xxxx
LATB	0E14	LATB15	LATB14	LATB13	LATB12	LATB11	LATB10	LATB9	LATB8	LATB7	LATB6	LATB5	LATB4	LATB3	LATB2	LATB1	LATB0	xxxx
ODCB	0E16	ODCB15	ODCB14	ODCB13	ODCB12	ODCB11	ODCB10	ODCB9	ODCB8	ODCB7	ODCB6	ODCB5	ODCB4	ODCB3	ODCB2	ODCB1	ODCB0	0000
CNENB	0E18	CNIEB15	CNIEB14	CNIEB13	CNIEB12	CNIEB11	CNIEB10	CNIEB9	CNIEB8	CNIEB7	CNIEB6	CNIEB5	CNIEB4	CNIEB3	CNIEB2	CNIEB1	CNIEB0	0000
CNPUB	0E1A	CNPUB15	CNPUB14	CNPUB13	CNPUB12	CNPUB11	CNPUB10	CNPUB9	CNPUB8	CNPUB7	CNPUB6	CNPUB5	CNPUB4	CNPUB3	CNPUB2	CNPUB1	CNPUB0	0000
CNPDB	0E1C	CNPDB15	CNPDB14	CNPDB13	CNPDB12	CNPDB11	CNPDB10	CNPDB9	CNPDB8	CNPDB7	CNPDB6	CNPDB5	CNPDB4	CNPDB3	CNPDB2	CNPDB1	CNPDB0	0000
ANSELB	0E1E	—	—	—	—	—	—	—	ANSB8	—	—	—	—	ANSB3	ANSB2	ANSB1	ANSB0	010F

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

TABLE 4-48: PORTC REGISTER MAP FOR PIC24EPXXXGP/MC206 AND dsPIC33EPXXXGP/MC206/506 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
TRISC	0E20	TRISC15	—	TRISC13	TRISC12	TRISC11	TRISC10	TRISC9	TRISC8	TRISC7	TRISC6	TRISC5	TRISC4	TRISC3	TRISC2	TRISC1	TRISC0	BFFF
PORTC	0E22	RC15	—	RC13	RC12	RC11	RC10	RC9	RC8	RC7	RC6	RC5	RC4	RC3	RC2	RC1	RC0	xxxx
LATC	0E24	LATC15	—	LATC13	LATC12	LATC11	LATC10	LATC9	LATC8	LATC7	LATC6	LATC5	LATC4	LATC3	LATC2	LATC1	LATC0	xxxx
ODCC	0E26	ODCC15	—	ODCC13	ODCC12	ODCC11	ODCC10	ODCC9	ODCC8	ODCC7	ODCC6	ODCC5	ODCC4	ODCC3	ODCC2	ODCC1	ODCC0	0000
CNENC	0E28	CNIEC15	—	CNIEC13	CNIEC12	CNIEC11	CNIEC10	CNIEC9	CNIEC8	CNIEC7	CNIEC6	CNIEC5	CNIEC4	CNIEC3	CNIEC2	CNIEC1	CNIEC0	0000
CNPUC	0E2A	CNPUC15	—	CNPUC13	CNPUC12	CNPUC11	CNPUC10	CNPUC9	CNPUC8	CNPUC7	CNPUC6	CNPUC5	CNPUC4	CNPUC3	CNPUC2	CNPUC1	CNPUC0	0000
CNPDC	0E2C	CNPDC15	—	CNPDC13	CNPDC12	CNPDC11	CNPDC10	CNPDC9	CNPDC8	CNPDC7	CNPDC6	CNPDC5	CNPDC4	CNPDC3	CNPDC2	CNPDC1	CNPDC0	0000
ANSELC	0E2E	—	—	—	—	ANSC11	—	—	—	—	—	—	—	—	ANSC2	ANSC1	ANSC0	0807

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

REGISTER 6-1: RCON: RESET CONTROL REGISTER(1)

R/W-0	R/W-0	U-0	U-0	R/W-0	U-0	R/W-0	R/W-0
TRAPR	IOPUWR	—	—	VREGSF	—	CM	VREGS
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-1	R/W-1
EXTR	SWR	SWDTEN(2)	WDTO	SLEEP	IDLE	BOR	POR
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 **TRAPR:** Trap Reset Flag bit
1 = A Trap Conflict Reset has occurred
0 = A Trap Conflict Reset has not occurred

bit 14 **IOPUWR:** Illegal Opcode or Uninitialized W Access Reset Flag bit
1 = An illegal opcode detection, an illegal address mode or Uninitialized W register used as an Address Pointer caused a Reset
0 = An illegal opcode or Uninitialized W register Reset has not occurred

bit 13-12 **Unimplemented:** Read as '0'

bit 11 **VREGSF:** Flash Voltage Regulator Standby During Sleep bit
1 = Flash voltage regulator is active during Sleep
0 = Flash voltage regulator goes into Standby mode during Sleep

bit 10 **Unimplemented:** Read as '0'

bit 9 **CM:** Configuration Mismatch Flag bit
1 = A Configuration Mismatch Reset has occurred.
0 = A Configuration Mismatch Reset has not occurred

bit 8 **VREGS:** Voltage Regulator Standby During Sleep bit
1 = Voltage regulator is active during Sleep
0 = Voltage regulator goes into Standby mode during Sleep

bit 7 **EXTR:** External Reset ($\overline{\text{MCLR}}$) Pin bit
1 = A Master Clear (pin) Reset has occurred
0 = A Master Clear (pin) Reset has not occurred

bit 6 **SWR:** Software RESET (Instruction) Flag bit
1 = A RESET instruction has been executed
0 = A RESET instruction has not been executed

bit 5 **SWDTEN:** Software Enable/Disable of WDT bit(2)
1 = WDT is enabled
0 = WDT is disabled

bit 4 **WDTO:** Watchdog Timer Time-out Flag bit
1 = WDT time-out has occurred
0 = WDT time-out has not occurred

Note 1: All of the Reset status bits can be set or cleared in software. Setting one of these bits in software does not cause a device Reset.

2: If the FWDTEN Configuration bit is '1' (unprogrammed), the WDT is always enabled, regardless of the SWDTEN bit setting.

11.4 Peripheral Pin Select (PPS)

A major challenge in general purpose devices is providing the largest possible set of peripheral features while minimizing the conflict of features on I/O pins. The challenge is even greater on low pin count devices. In an application where more than one peripheral needs to be assigned to a single pin, inconvenient workarounds in application code, or a complete redesign, may be the only option.

Peripheral Pin Select configuration provides an alternative to these choices by enabling peripheral set selection and their placement on a wide range of I/O pins. By increasing the pinout options available on a particular device, users can better tailor the device to their entire application, rather than trimming the application to fit the device.

The Peripheral Pin Select configuration feature operates over a fixed subset of digital I/O pins. Users may independently map the input and/or output of most digital peripherals to any one of these I/O pins. Hardware safeguards are included that prevent accidental or spurious changes to the peripheral mapping once it has been established.

11.4.1 AVAILABLE PINS

The number of available pins is dependent on the particular device and its pin count. Pins that support the Peripheral Pin Select feature include the label, “RPn” or “RPIn”, in their full pin designation, where “n” is the remappable pin number. “RP” is used to designate pins that support both remappable input and output functions, while “RPI” indicates pins that support remappable input functions only.

11.4.2 AVAILABLE PERIPHERALS

The peripherals managed by the Peripheral Pin Select are all digital-only peripherals. These include general serial communications (UART and SPI), general purpose timer clock inputs, timer-related peripherals (input capture and output compare) and interrupt-on-change inputs.

In comparison, some digital-only peripheral modules are never included in the Peripheral Pin Select feature. This is because the peripheral’s function requires special I/O circuitry on a specific port and cannot be easily connected to multiple pins. These modules include I^2C™ and the PWM. A similar requirement excludes all modules with analog inputs, such as the ADC Converter.

A key difference between remappable and non-remappable peripherals is that remappable peripherals are not associated with a default I/O pin. The peripheral must always be assigned to a specific I/O pin before it can be used. In contrast, non-remappable peripherals are always available on a default pin, assuming that the peripheral is active and not conflicting with another peripheral.

When a remappable peripheral is active on a given I/O pin, it takes priority over all other digital I/O and digital communication peripherals associated with the pin. Priority is given regardless of the type of peripheral that is mapped. Remappable peripherals never take priority over any analog functions associated with the pin.

11.4.3 CONTROLLING PERIPHERAL PIN SELECT

Peripheral Pin Select features are controlled through two sets of SFRs: one to map peripheral inputs and one to map outputs. Because they are separately controlled, a particular peripheral’s input and output (if the peripheral has both) can be placed on any selectable function pin without constraint.

The association of a peripheral to a peripheral-selectable pin is handled in two different ways, depending on whether an input or output is being mapped.

TABLE 11-2: INPUT PIN SELECTION FOR SELECTABLE INPUT SOURCES

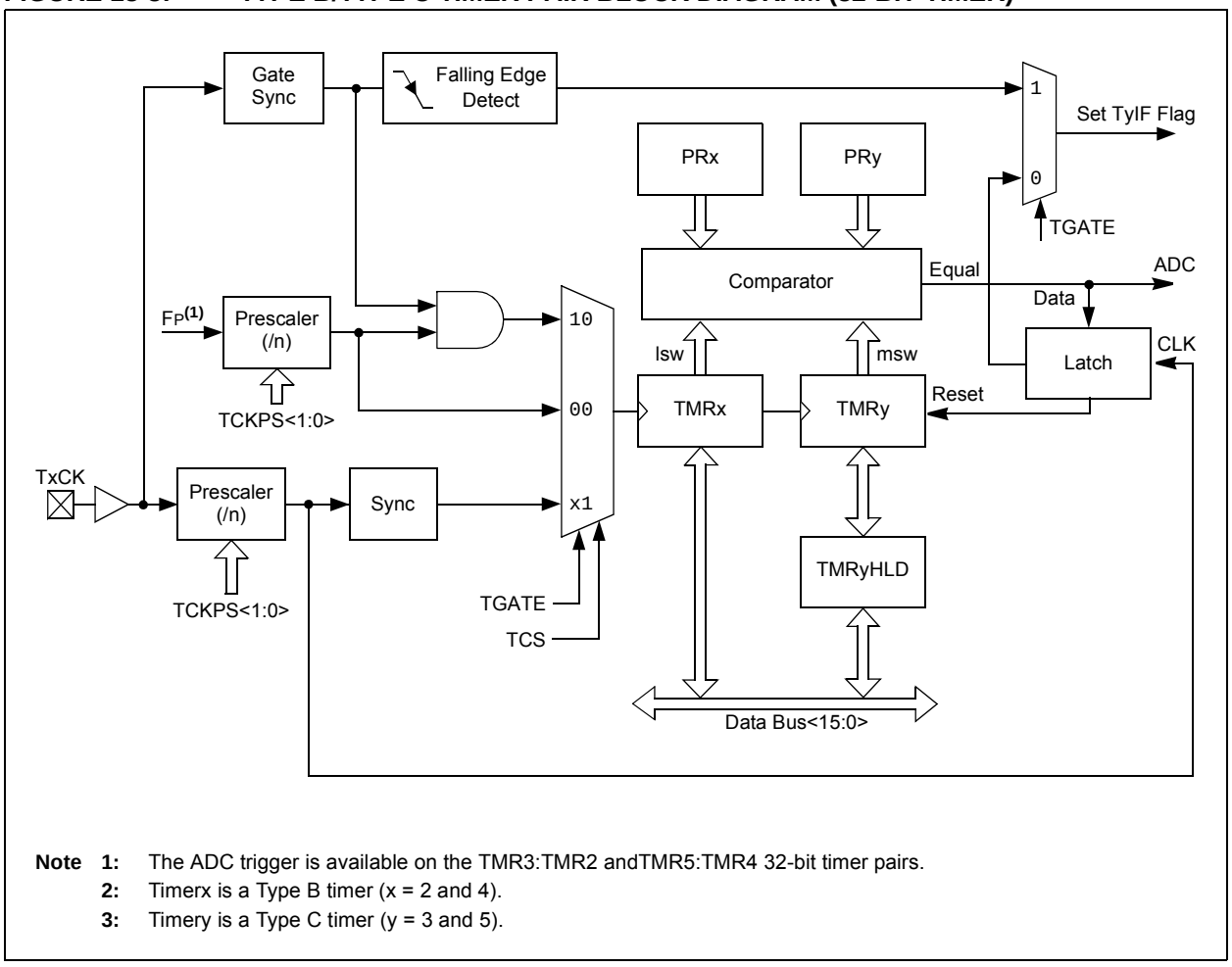
Peripheral Pin Select Input Register Value	Input/ Output	Pin Assignment	Peripheral Pin Select Input Register Value	Input/ Output	Pin Assignment
000 0000	I	Vss	010 1101	I	RPI45
000 0001	I	C1OUT(1)	010 1110	I	RPI46
000 0010	I	C2OUT(1)	010 1111	I	RPI47
000 0011	I	C3OUT(1)	011 0000	—	—
000 0100	I	C4OUT(1)	011 0001	—	—
000 0101	—	—	011 0010	—	—
000 0110	I	PTGO30(1)	011 0011	I	RPI51
000 0111	I	PTGO31(1)	011 0100	I	RPI52
000 1000	I	FINDX1(1,2)	011 0101	I	RPI53
000 1001	I	FHOME1(1,2)	011 0110	I/O	RP54
000 1010	—	—	011 0111	I/O	RP55
000 1011	—	—	011 1000	I/O	RP56
000 1100	—	—	011 1001	I/O	RP57
000 1101	—	—	011 1010	I	RPI58
000 1110	—	—	011 1011	—	—
000 1111	—	—	011 1100	—	—
001 0000	—	—	011 1101	—	—
001 0001	—	—	011 1110	—	—
001 0010	—	—	011 1111	—	—
001 0011	—	—	100 0000	—	—
001 0100	I/O	RP20	100 0001	—	—
001 0101	—	—	100 0010	—	—
001 0110	—	—	100 0011	—	—
001 0111	—	—	100 0100	—	—
001 1000	I	RPI24	100 0101	—	—
001 1001	I	RPI25	100 0110	—	—
001 1010	—	—	100 0111	—	—
001 1011	I	RPI27	100 1000	—	—
001 1100	I	RPI28	100 1001	—	—
001 1101	—	—	100 1010	—	—
001 1110	—	—	100 1011	—	—
001 1111	—	—	100 1100	—	—
010 0000	I	RPI32	100 1101	—	—
010 0001	I	RPI33	100 1110	—	—
010 0010	I	RPI34	100 1111	—	—
010 0011	I/O	RP35	101 0000	—	—
010 0100	I/O	RP36	101 0001	—	—
010 0101	I/O	RP37	101 0010	—	—
010 0110	I/O	RP38	101 0011	—	—
010 0111	I/O	RP39	101 0100	—	—

Legend: Shaded rows indicate PPS Input register values that are unimplemented.

Note 1: See **Section 11.4.4.1 “Virtual Connections”** for more information on selecting this pin assignment.

2: These inputs are available on dsPIC33EPXXXGP/MC50X devices only.

FIGURE 13-3: TYPE B/TYPE C TIMER PAIR BLOCK DIAGRAM (32-BIT TIMER)



Note 1: The ADC trigger is available on the TMR3:TMR2 andTMR5:TMR4 32-bit timer pairs.
2: Timerx is a Type B timer (x = 2 and 4).
3: Timery is a Type C timer (y = 3 and 5).

13.1 Timerx/y Resources

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

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

13.1.1 KEY RESOURCES

- **"Timers"** (DS70362) 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 15-2: OCxCON2: OUTPUT COMPARE x CONTROL REGISTER 2 (CONTINUED)

bit 4-0 **SYNCSEL<4:0>:** Trigger/Synchronization Source Selection bits

11111 = OCxRS compare event is used for synchronization
11110 = INT2 pin synchronizes or triggers OCx
11101 = INT1 pin synchronizes or triggers OCx
11100 = CTMU module synchronizes or triggers OCx
11011 = ADC1 module synchronizes or triggers OCx
11010 = CMP3 module synchronizes or triggers OCx
11001 = CMP2 module synchronizes or triggers OCx
11000 = CMP1 module synchronizes or triggers OCx
10111 = Reserved
10110 = Reserved
10101 = Reserved
10100 = Reserved
10011 = IC4 input capture event synchronizes or triggers OCx
10010 = IC3 input capture event synchronizes or triggers OCx
10001 = IC2 input capture event synchronizes or triggers OCx
10000 = IC1 input capture event synchronizes or triggers OCx
01111 = Timer5 synchronizes or triggers OCx
01110 = Timer4 synchronizes or triggers OCx
01101 = Timer3 synchronizes or triggers OCx
01100 = Timer2 synchronizes or triggers OCx **(default)**
01011 = Timer1 synchronizes or triggers OCx
01010 = PTGOx synchronizes or triggers OCx**(3)**
01001 = Reserved
01000 = Reserved
00111 = Reserved
00110 = Reserved
00101 = Reserved
00100 = OC4 module synchronizes or triggers OCx**(1,2)**
00011 = OC3 module synchronizes or triggers OCx**(1,2)**
00010 = OC2 module synchronizes or triggers OCx**(1,2)**
00001 = OC1 module synchronizes or triggers OCx**(1,2)**
00000 = No Sync or Trigger source for OCx

Note 1: Do not use the OCx module as its own Synchronization or Trigger source.

2: When the OCy module is turned OFF, it sends a trigger out signal. If the OCx module uses the OCy module as a Trigger source, the OCy module must be unselected as a Trigger source prior to disabling it.

3: Each Output Compare x module (OCx) has one PTG Trigger/Synchronization source. See **Section 24.0 "Peripheral Trigger Generator (PTG) Module"** for more information.
PTGO0 = OC1
PTGO1 = OC2
PTGO2 = OC3
PTGO3 = OC4

REGISTER 17-3: QEI1STAT: QEI1 STATUS REGISTER

U-0	U-0	HS, R/C-0	R/W-0	HS, R/C-0	R/W-0	HS, R/C-0	R/W-0
—	—	PCHEQIRQ	PCHEQIEN	PCLEQIRQ	PCLEQIEN	POSOVIRQ	POSOVIEN
bit 15							bit 8

HS, R/C-0	R/W-0	HS, R/C-0	R/W-0	HS, R/C-0	R/W-0	HS, R/C-0	R/W-0
PCIIRQ(1)	PCIIEN	VELOVIRQ	VELOVIEN	HOMIRQ	HOMIEN	IDXIRQ	IDXIEN
bit 7							bit 0

Legend:	HS = Hardware Settable bit	C = Clearable bit	
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 15-14 **Unimplemented:** Read as '0'

bit 13 **PCHEQIRQ:** Position Counter Greater Than or Equal Compare Status bit
1 = POS1CNT ≥ QEI1GEC
0 = POS1CNT < QEI1GEC

bit 12 **PCHEQIEN:** Position Counter Greater Than or Equal Compare Interrupt Enable bit
1 = Interrupt is enabled
0 = Interrupt is disabled

bit 11 **PCLEQIRQ:** Position Counter Less Than or Equal Compare Status bit
1 = POS1CNT ≤ QEI1LEC
0 = POS1CNT > QEI1LEC

bit 10 **PCLEQIEN:** Position Counter Less Than or Equal Compare Interrupt Enable bit
1 = Interrupt is enabled
0 = Interrupt is disabled

bit 9 **POSOVIRQ:** Position Counter Overflow Status bit
1 = Overflow has occurred
0 = No overflow has occurred

bit 8 **POSOVIEN:** Position Counter Overflow Interrupt Enable bit
1 = Interrupt is enabled
0 = Interrupt is disabled

bit 7 **PCIIRQ:** Position Counter (Homing) Initialization Process Complete Status bit(1)
1 = POS1CNT was reinitialized
0 = POS1CNT was not reinitialized

bit 6 **PCIIEN:** Position Counter (Homing) Initialization Process Complete interrupt Enable bit
1 = Interrupt is enabled
0 = Interrupt is disabled

bit 5 **VELOVIRQ:** Velocity Counter Overflow Status bit
1 = Overflow has occurred
0 = No overflow has not occurred

bit 4 **VELOVIEN:** Velocity Counter Overflow Interrupt Enable bit
1 = Interrupt is enabled
0 = Interrupt is disabled

bit 3 **HOMIRQ:** Status Flag for Home Event Status bit
1 = Home event has occurred
0 = No Home event has occurred

Note 1: This status bit is only applicable to PIMOD<2:0> modes, '011' and '100'.

REGISTER 20-1: UxMODE: UARTx MODE REGISTER (CONTINUED)

bit 5 **ABAUD:** Auto-Baud Enable bit
1 = Enables baud rate measurement on the next character – requires reception of a Sync field (55h) before other data; cleared in hardware upon completion
0 = Baud rate measurement is disabled or completed

bit 4 **URXINV:** UARTx Receive Polarity Inversion bit
1 = UxRX Idle state is '0'
0 = UxRX Idle state is '1'

bit 3 **BRGH:** High Baud Rate Enable bit
1 = BRG generates 4 clocks per bit period (4x baud clock, High-Speed mode)
0 = BRG generates 16 clocks per bit period (16x baud clock, Standard mode)

bit 2-1 **PDSEL<1:0>:** Parity and Data Selection bits
11 = 9-bit data, no parity
10 = 8-bit data, odd parity
01 = 8-bit data, even parity
00 = 8-bit data, no parity

bit 0 **STSEL:** Stop Bit Selection bit
1 = Two Stop bits
0 = One Stop bit

Note 1: Refer to the **"UART"** (DS70582) section in the *"dsPIC33/PIC24 Family Reference Manual"* for information on enabling the UARTx module for receive or transmit operation.
2: This feature is only available for the 16x BRG mode (BRGH = 0).
3: This feature is only available on 44-pin and 64-pin devices.
4: This feature is only available on 64-pin devices.

REGISTER 21-11: CxFEN1: ECANx ACCEPTANCE FILTER ENABLE REGISTER 1

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
FLTEN15	FLTEN14	FLTEN13	FLTEN12	FLTEN11	FLTEN10	FLTEN9	FLTEN8
bit 15							bit 8

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
FLTEN7	FLTEN6	FLTEN5	FLTEN4	FLTEN3	FLTEN2	FLTEN1	FLTEN0
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 **FLTEN<15:0>:** Enable Filter n to Accept Messages bits
1 = Enables Filter n
0 = Disables Filter n

REGISTER 21-12: CxBUFPNT1: ECANx FILTER 0-3 BUFFER POINTER 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
F3BP<3:0>				F2BP<3:0>			
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
F1BP<3:0>				F0BP<3:0>			
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 15-12 **F3BP<3:0>:** RX Buffer Mask for Filter 3 bits
1111 = Filter hits received in RX FIFO buffer
1110 = Filter hits received in RX Buffer 14
•
•
•
0001 = Filter hits received in RX Buffer 1
0000 = Filter hits received in RX Buffer 0

bit 11-8 **F2BP<3:0>:** RX Buffer Mask for Filter 2 bits (same values as bits<15:12>)

bit 7-4 **F1BP<3:0>:** RX Buffer Mask for Filter 1 bits (same values as bits<15:12>)

bit 3-0 **F0BP<3:0>:** RX Buffer Mask for Filter 0 bits (same values as bits<15:12>)

REGISTER 21-22: CxRXFUL1: ECANx RECEIVE BUFFER FULL REGISTER 1

R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0
RXFUL15	RXFUL14	RXFUL13	RXFUL12	RXFUL11	RXFUL10	RXFUL9	RXFUL8
bit 15							bit 8

R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0
RXFUL7	RXFUL6	RXFUL5	RXFUL4	RXFUL3	RXFUL2	RXFUL1	RXFUL0
bit 7							bit 0

Legend:	C = Writable bit, but only ‘0’ can be written to clear the 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 15-0 **RXFUL<15:0>:** Receive Buffer n Full bits
1 = Buffer is full (set by module)
0 = Buffer is empty (cleared by user software)

REGISTER 21-23: CxRXFUL2: ECANx RECEIVE BUFFER FULL REGISTER 2

R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0
RXFUL31	RXFUL30	RXFUL29	RXFUL28	RXFUL27	RXFUL26	RXFUL25	RXFUL24
bit 15							bit 8

R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0	R/C-0
RXFUL23	RXFUL22	RXFUL21	RXFUL20	RXFUL19	RXFUL18	RXFUL17	RXFUL16
bit 7							bit 0

Legend:	C = Writable bit, but only ‘0’ can be written to clear the 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 15-0 **RXFUL<31:16>:** Receive Buffer n Full bits
1 = Buffer is full (set by module)
0 = Buffer is empty (cleared by user software)

NOTES:

REGISTER 24-6: PTGSDLIM: PTG STEP DELAY LIMIT REGISTER(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
PTGSDLIM<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
PTGSDLIM<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 **PTGSDLIM<15:0>:** PTG Step Delay Limit Register bits
Holds a PTG Step delay value representing the number of additional PTG clocks between the start of a Step command and the completion of a Step command.

Note 1: A base Step delay of one PTG clock is added to any value written to the PTGSDLIM register (Step Delay = (PTGSDLIM) + 1).

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

REGISTER 24-7: PTGC0LIM: PTG COUNTER 0 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
PTGC0LIM<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
PTGC0LIM<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 **PTGC0LIM<15:0>:** PTG Counter 0 Limit Register bits
May be used to specify the loop count for the PTGJMPC0 Step command or as a limit register for the General Purpose Counter 0.

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

TABLE 30-22: RESET, WATCHDOG TIMER, OSCILLATOR START-UP TIMER, POWER-UP TIMER TIMING REQUIREMENTS

AC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended				
Param No.	**Symbol**	**Characteristic(1)**	**Min.**	**Typ.(2)**	**Max.**	**Units**	**Conditions**
SY00	TPU	Power-up Period	—	400	600	μs	
SY10	TOST	Oscillator Start-up Time	—	1024 TOSC	—	—	TOSC = OSC1 period
SY12	TWDT	Watchdog Timer Time-out Period	0.81	0.98	1.22	ms	WDTPRE = 0, WDTPOST<3:0> = 0000, using LPRC tolerances indicated in F21 (see Table 30-20) at +85ºC
			3.26	3.91	4.88	ms	WDTPRE = 1, WDTPOST<3:0> = 0000, using LPRC tolerances indicated in F21 (see Table 30-20) at +85ºC
SY13	TIOZ	I/O High-Impedance from MCLR Low or Watchdog Timer Reset	0.68	0.72	1.2	μs	
SY20	TMCLR	MCLR Pulse Width (low)	2	—	—	μs	
SY30	TBOR	BOR Pulse Width (low)	1	—	—	μs	
SY35	TFSCM	Fail-Safe Clock Monitor Delay	—	500	900	μs	-40°C to +85°C
SY36	TVREG	Voltage Regulator Standby-to-Active mode Transition Time	—	—	30	μs	
SY37	TOSCDFRC	FRC Oscillator Start-up Delay	46	48	54	μs	
SY38	TOSCDLPRC	LPRC Oscillator Start-up Delay	—	—	70	μs	

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

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

TABLE 30-47: SPI1 SLAVE MODE (FULL-DUPLEX, CKE = 0, CKP = 1, SMP = 0) TIMING REQUIREMENTS

AC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended				
Param.	**Symbol**	**Characteristic(1)**	**Min.**	**Typ.(2)**	**Max.**	**Units**	**Conditions**
SP70	FscP	Maximum SCK1 Input Frequency	—	—	15	MHz	**(Note 3)**
SP72	TscF	SCK1 Input Fall Time	—	—	—	ns	See Parameter DO32 **(Note 4)**
SP73	TscR	SCK1 Input Rise Time	—	—	—	ns	See Parameter DO31 **(Note 4)**
SP30	TdoF	SDO1 Data Output Fall Time	—	—	—	ns	See Parameter DO32 **(Note 4)**
SP31	TdoR	SDO1 Data Output Rise Time	—	—	—	ns	See Parameter DO31 **(Note 4)**
SP35	TscH2doV, TscL2doV	SDO1 Data Output Valid after SCK1 Edge	—	6	20	ns	
SP36	TdoV2scH, TdoV2scL	SDO1 Data Output Setup to First SCK1 Edge	30	—	—	ns	
SP40	TdiV2scH, TdiV2scL	Setup Time of SDI1 Data Input to SCK1 Edge	30	—	—	ns	
SP41	TscH2diL, TscL2diL	Hold Time of SDI1 Data Input to SCK1 Edge	30	—	—	ns	
SP50	TssL2scH, TssL2scL	$\overline{SS1}$ ↓ to SCK1 ↑ or SCK1 ↓ Input	120	—	—	ns	
SP51	TssH2doZ	$\overline{SS1}$ ↑ to SDO1 Output High-Impedance	10	—	50	ns	**(Note 4)**
SP52	TscH2ssH, TscL2ssH	$\overline{SS1}$ ↑ after SCK1 Edge	1.5 TCY + 40	—	—	ns	**(Note 4)**

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

2: Data in "Typical" column is at 3.3V, +25°C unless otherwise stated.

3: The minimum clock period for SCK1 is 66.7 ns. Therefore, the SCK1 clock generated by the master must not violate this specification.

4: Assumes 50 pF load on all SPI1 pins.

TABLE 30-58: ADC MODULE SPECIFICATIONS (12-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 (12-Bit Mode)							
AD20a	Nr	Resolution	12 Data Bits			bits	
AD21a	INL	Integral Nonlinearity	-2.5	—	2.5	LSb	-40°C ≤ TA ≤ +85°C **(Note 2)**
			-5.5	—	5.5	LSb	+85°C < TA ≤ +125°C **(Note 2)**
AD22a	DNL	Differential Nonlinearity	-1	—	1	LSb	-40°C ≤ TA ≤ +85°C **(Note 2)**
			-1	—	1	LSb	+85°C < TA ≤ +125°C **(Note 2)**
AD23a	GERR	Gain Error[3]	-10	—	10	LSb	-40°C ≤ TA ≤ +85°C **(Note 2)**
			-10	—	10	LSb	+85°C < TA ≤ +125°C **(Note 2)**
AD24a	EOFF	Offset Error	-5	—	5	LSb	-40°C ≤ TA ≤ +85°C **(Note 2)**
			-5	—	5	LSb	+85°C < TA ≤ +125°C **(Note 2)**
AD25a	—	Monotonicity	—	—	—	—	Guaranteed
Dynamic Performance (12-Bit Mode)							
AD30a	THD	Total Harmonic Distortion[3]	—	75	—	dB	
AD31a	SINAD	Signal to Noise and Distortion[3]	—	68	—	dB	
AD32a	SFDR	Spurious Free Dynamic Range[3]	—	80	—	dB	
AD33a	FNYQ	Input Signal Bandwidth[3]	—	250	—	kHz	
AD34a	ENOB	Effective Number of Bits[3]	11.09	11.3	—	bits	

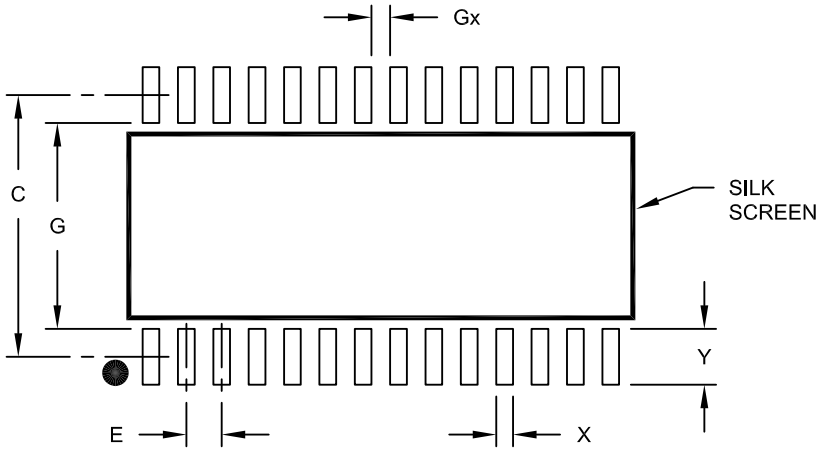
Note 1: Device is functional at VBORMIN < VDD < VDDMIN, but will have degraded performance. Device functionality is tested, but not characterized. Analog modules (ADC, op amp/comparator and comparator voltage reference) may have degraded performance. Refer to Parameter BO10 in Table 30-13 for the minimum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

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

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



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	1.27 BSC		
Contact Pad Spacing	C		9.40	
Contact Pad Width (X28)	X			0.60
Contact Pad Length (X28)	Y			2.00
Distance Between Pads	Gx	0.67		
Distance Between Pads	G	7.40		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2052A