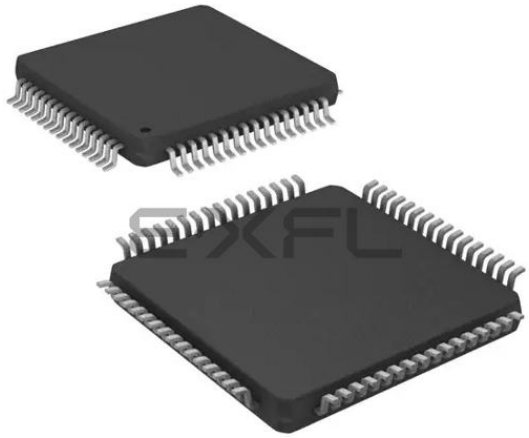
Microchip Technology - DSPIC33CK128MP506T-I/PT Datasheet



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"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	dsPIC
Core Size	16-Bit
Speed	100MHz
Connectivity	CANbus, I²C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, Motor Control PWM, POR, PWM, QEI, WDT
Number of I/O	53
Program Memory Size	128KB (128K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	16K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 20x12b; D/A 3x12b
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/dspic33ck128mp506t-i-pt

TABLE 4-12: SFR BLOCK B00h

Register	Address	All Resets	Register	Address	All Resets	Register	Address	All Resets
ADC			ADCMP1LO	B44	0000000000000000	ADTRIG2H	B8A	0000000000000000
ADCON1L	B00	000-00000---000	ADCMP1HI	B46	0000000000000000	ADTRIG3L	B8C	0000000000000000
ADCON1H	B02	--------011-----	ADCMP2ENL	B48	0000000000000000	ADTRIG3H	B8E	0000000000000000
ADCON2L	B04	00-0-00000000000	ADCMP2ENH	B4A	------0000000000	ADTRIG4L	B90	0000000000000000
ADCON2H	B06	00-0000000000000	ADCMP2LO	B4C	0000000000000000	ADTRIG4H	B92	0000000000000000
ADCON3L	B08	0000000000000000	ADCMP2HI	B4E	0000000000000000	ADTRIG5L	B94	0000000000000000
ADCON3H	B0A	000000000-----xx	ADCMP3ENL	B50	0000000000000000	ADTRIG5H	B96	0000000000000000
ADCON4L	B0C	------000-----xx	ADCMP3ENH	B52	------0000000000	ADTRIG6L	B98	0000000000000000
ADCON4H	B0E	00----------0000	ADCMP3LO	B54	0000000000000000	ADCMP0CON	BA0	0000000000000000
ADMOD0L	B10	0000000000000000	ADCMP3HI	B56	0000000000000000	ADCMP1CON	BA4	0000000000000000
ADMOD0H	B12	0000000000000000	ADFL0DAT	B68	0000000000000000	ADCMP2CON	BA8	0000000000000000
ADMOD1L	B14	0000000000000000	ADFL0CON	B6A	xxx0000000000000	ADCMP3CON	BAC	0000000000000000
ADMOD1H	B16	------------0000	ADFL1DAT	B6C	0000000000000000	ADLVLTRGL	BD0	0000000000000000
ADIEL	B20	xxxxxxxxxxxxxxxx	ADFL1CON	B6E	xxx0000000000000	ADLVLTRGH	BD2	------xxxxxxxxxx
ADIEH	B22	------xxxxxxxxxx	ADFL2DAT	B70	0000000000000000	ADCORE0L	BD4	0000000000000000
ADSTATL	B30	0000000000000000	ADFL2CON	B72	xxx0000000000000	ADCORE0H	BD6	0000001100000000
ADSTATH	B32	------0000000000	ADFL3DAT	B74	0000000000000000	ADCORE1L	BD8	0000000000000000
ADCMP0ENL	B38	0000000000000000	ADFL3CON	B76	xxx0000000000000	ADCORE1H	BDA	0000001100000000
ADCMP0ENH	B3A	------0000000000	ADTRIG0L	B80	0000000000000000	ADEIEL	BF0	xxxxxxxxxxxxxxxx
ADCMP0LO	B3C	0000000000000000	ADTRIG0H	B82	0000000000000000	ADEIEH	BF2	------xxxxxxxxxx
ADCMP0HI	B3E	0000000000000000	ADTRIG1L	B84	0000000000000000	ADEISTATL	BF8	xxxxxxxxxxxxxxxx
ADCMP1ENL	B40	0000000000000000	ADTRIG1H	B86	0000000000000000	ADEISTATH	BFA	------xxxxxxxxxx
ADCMP1ENH	B42	------0000000000	ADTRIG2L	B88	0000000000000000			

Legend: x = unknown or indeterminate value; "-" = unimplemented bits. Address values are in hexadecimal. Reset values are in binary.

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

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

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

Exceptions to the operation described above arise when entering and exiting the boundaries of Page 0 and PSV spaces. Table 4-17 lists the effects of overflow and underflow scenarios at different boundaries.

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

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

TABLE 4-17: OVERFLOW AND UNDERFLOW SCENARIOS AT PAGE 0 AND PSV SPACE BOUNDARIES(2,3,4)

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

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

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

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

3: Only reads from PS are supported using DSRPAG.

4: Pseudolinear Addressing is not supported for large offsets.

NOTES:

REGISTER 8-70: RPOR16: PERIPHERAL PIN SELECT OUTPUT REGISTER 16

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP65R5	RP65R4	RP65R3	RP65R2	RP65R1	RP65R0
bit 15							bit 8

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP64R5	RP64R4	RP64R3	RP64R2	RP64R1	RP64R0
bit 7							bit 0

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

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

bit 13-8 **RP65R<5:0>:** Peripheral Output Function is Assigned to RP65 Output Pin bits (see Table 8-7 for peripheral function numbers)

bit 7-6 **Unimplemented:** Read as '0'

bit 5-0 **RP64R<5:0>:** Peripheral Output Function is Assigned to RP64 Output Pin bits (see Table 8-7 for peripheral function numbers)

REGISTER 8-71: RPOR17: PERIPHERAL PIN SELECT OUTPUT REGISTER 17

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP67R5	RP67R4	RP67R3	RP67R2	RP67R1	RP67R0
bit 15							bit 8

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP66R5	RP66R4	RP66R3	RP66R2	RP66R1	RP66R0
bit 7							bit 0

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

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

bit 13-8 **RP67R<5:0>:** Peripheral Output Function is Assigned to RP67 Output Pin bits (see Table 8-7 for peripheral function numbers)

bit 7-6 **Unimplemented:** Read as '0'

bit 5-0 **RP66R<5:0>:** Peripheral Output Function is Assigned to RP66 Output Pin bits (see Table 8-7 for peripheral function numbers)

REGISTER 11-19: C1RXOVIFH: CAN RECEIVE OVERFLOW INTERRUPT STATUS REGISTER HIGH(1)

R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0
RFOVIF<31:24>							
bit 15							bit 8

R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0
RFOVIF<23:16>							
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 **RFOVIF<31:16>:** Unimplemented

Note 1: C1RXOVIFH: FIFO: RFOVIFx (flag needs to be cleared in the FIFO register).

REGISTER 11-20: C1RXOVIFL: CAN RECEIVE OVERFLOW INTERRUPT STATUS REGISTER LOW(1)

R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0
RFOVIF<15:8>							
bit 15							bit 8

R-0	R-0	R-0	R-0	R-0	R-0	R-0	U-0
RFOVIF<7:1>							—
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 15-8 **RFOVIF<15:8>:** Unimplemented

bit 7-1 **RFOVIF<7:1>:** Receive FIFO Overflow Interrupt Pending bits
1 = Interrupt is pending
0 = Interrupt is not pending

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

Note 1: C1RXOVIFL: FIFO: RFOVIFx (flag needs to be cleared in the FIFO register).

REGISTER 11-33: C1FIFOCONLx: CAN FIFO CONTROL REGISTER x (x = 1 TO 7) LOW

U-0	U-0	U-0	U-0	U-0	S/HC-1	R/W/HC-0	S/HC-0
—	—	—	—	—	FRESET	TXREQ	UINC
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
TXEN	RTREN	RXTSEN(1)	TXATIE	RXOVIE	TFERFFIE	TFHRFHIE	TFNRFNIE
bit 7							bit 0

Legend:	S = Settable bit	HC = Hardware 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 15-11 **Unimplemented:** Read as '0'

bit 10 **FRESET:** FIFO Reset bit
- 1 = FIFO will be reset when bit is set, cleared by hardware when FIFO is reset; user should poll whether this bit is clear before taking any action
- 0 = No effect

bit 9 **TXREQ:** Message Send Request bit

TXEN = 1 (FIFO configured as a transmit FIFO):
- 1 = Requests sending a message; the bit will automatically clear when all the messages queued in the FIFO are successfully sent
- 0 = Clearing the bit to '0' while set ('1') will request a message abort

TXEN = 0 (FIFO configured as a receive FIFO):
This bit has no effect.

bit 8 **UINC:** Increment Head/Tail bit

TXEN = 1 (FIFO configured as a transmit FIFO):
When this bit is set, the FIFO head will increment by a single message.

TXEN = 0 (FIFO configured as a receive FIFO):
When this bit is set, the FIFO tail will increment by a single message.

bit 7 **TXEN:** TX/RX Buffer Selection bit
- 1 = Transmits message object
- 0 = Receives message object

bit 6 **RTREN:** Auto-Remote Transmit (RTR) Enable bit
- 1 = When a Remote Transmit is received, TXREQ will be set
- 0 = When a Remote Transmit is received, TXREQ will be unaffected

bit 5 **RXTSEN:** Received Message Timestamp Enable bit(1)
- 1 = Captures timestamp in received message object in RAM
- 0 = Does not capture timestamp

bit 4 **TXATIE:** Transmit Attempts Exhausted Interrupt Enable bit
- 1 = Enables interrupt
- 0 = Disables interrupt

bit 3 **RXOVIE:** Overflow Interrupt Enable bit
- 1 = Interrupt is enabled for overflow event
- 0 = Interrupt is disabled for overflow event

Note 1: This bit can only be modified in Configuration mode (OPMOD<2:0> = 100).

REGISTER 13-6: ADCON3H: ADC CONTROL REGISTER 3 HIGH

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
CLKSEL1	CLKSEL0	CLKDIV5	CLKDIV4	CLKDIV3	CLKDIV2	CLKDIV1	CLKDIV0
bit 15							bit 8

R/W-0	U-0	U-0	U-0	U-0	U-0	R/W-0	R/W-0
SHREN	—	—	—	—	—	C1EN	C0EN
bit 7							bit 0

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

bit 15-14 **CLKSEL<1:0>:** ADC Module Clock Source Selection bits
11 = FVCO/4
10 = AFVCODIV
01 = FOSC
00 = FP (Peripheral Clock)

bit 13-8 **CLKDIV<5:0>:** ADC Module Clock Source Divider bits
The divider forms a TCORESRC clock used by all ADC cores (shared and dedicated) from the TSRC ADC module clock source selected by the CLKSEL<1:0> bits. Then, each ADC core individually divides the TCORESRC clock to get a core-specific TADCORE clock using the ADCS<6:0> bits in the ADCOREXH register or the SHRADCS<6:0> bits in the ADCON2L register.
111111 = 64 Source Clock Periods
...
000011 = 4 Source Clock Periods
000010 = 3 Source Clock Periods
000001 = 2 Source Clock Periods
000000 = 1 Source Clock Period

bit 7 **SHREN:** Shared ADC Core Enable bit
1 = Shared ADC core is enabled
0 = Shared ADC core is disabled

bit 6-2 **Unimplemented:** Read as '0'

bit 1 **C1EN:** Dedicated ADC Core 1 Enable bits
1 = Dedicated ADC Core 1 is enabled
0 = Dedicated ADC Core 1 is disabled

bit 0 **C0EN:** Dedicated ADC Core 0 Enable bits
1 = Dedicated ADC Core 0 is enabled
0 = Dedicated ADC Core 0 is disabled

REGISTER 16-5: UxBRG: UARTx BAUD RATE REGISTER

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
BRG<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
BRG<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 **BRG<15:0>:** Baud Rate Divisor bits

REGISTER 16-6: UxBRGH: UARTx BAUD RATE REGISTER HIGH

U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
—	—	—	—	—	—	—	—
bit 15							bit 8

U-0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	—	—	BRG<19:16>			
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 15-4 **Unimplemented:** Read as '0'

bit 3-0 **BRG<19:16>:** Baud Rate Divisor bits

REGISTER 16-10: UxP2: UARTx TIMING PARAMETER 2 REGISTER

U-0	U-0	U-0	U-0	U-0	U-0	U-0	R/W-0
—	—	—	—	—	—	—	P2<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
P2<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 15-9 **Unimplemented:** Read as '0'

bit 8-0 **P2<8:0>:** Parameter 2 bits

DMX RX:
The first byte number to receive – 1, not including Start code (bits<8:0>).

LIN Slave TX:
Number of bytes to transmit (bits<7:0>).

Asynchronous RX with Address Detect:
Address to start matching (bits<7:0>).

Smart Card Mode:
Block Time Counter bits. This counter is operated on the bit clock whose period is always equal to one ETU (bits<8:0>).

Other Modes:
Not used.

NOTES:

21.1 Timer1 Control Register

REGISTER 21-1: T1CON: TIMER1 CONTROL REGISTER

R/W-0	U-0	R/W-0	R/W-0	R-0	R-0	R/W-0	R/W-0
TON(1)	—	SIDL	TMWDIS	TMWIP	PRWIP	TECS1	TECS0
bit 15							bit 8

R/W-0	U-0	R/W-0	R/W-0	U-0	R/W-0	R/W-0	U-0
TGATE	—	TCKPS1	TCKPS0	—	TSYNC(1)	TCS(1)	—
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 **TON:** Timer1 On bit(1)
1 = Starts 16-bit Timer1
0 = Stops 16-bit Timer1

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

bit 13 **SIDL:** Timer1 Stop in Idle Mode bit
1 = Discontinues module operation when device enters Idle mode
0 = Continues module operation in Idle mode

bit 12 **TMWDIS:** Asynchronous Timer1 Write Disable bit
1 = Timer writes are ignored while a posted write to TMR1 or PR1 is synchronized to the asynchronous clock domain
0 = Back-to-back writes are enabled in Asynchronous mode

bit 11 **TMWIP:** Asynchronous Timer1 Write in Progress bit
1 = Write to the timer in Asynchronous mode is pending
0 = Write to the timer in Asynchronous mode is complete

bit 10 **PRWIP:** Asynchronous Period Write in Progress bit
1 = Write to the Period register in Asynchronous mode is pending
0 = Write to the Period register in Asynchronous mode is complete

bit 9-8 **TECS<1:0>:** Timer1 Extended Clock Select bits
11 = FRC clock
10 = FOSC
01 = TCY
00 = External Clock comes from the T1CK pin

bit 7 **TGATE:** Timer1 Gated Time Accumulation Enable bit
When TCS = 1:
This bit is ignored.
When TCS = 0:
1 = Gated time accumulation is enabled
0 = Gated time accumulation is disabled

bit 6 **Unimplemented:** Read as '0'

Note 1: When Timer1 is enabled in External Synchronous Counter mode (TCS = 1, TSYNC = 1, TON = 1), any attempts by user software to write to the TMR1 register are ignored.

REGISTER 24-2: PTGCON: PTG CONTROL/STATUS HIGH REGISTER

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGCLK2	PTGCLK1	PTGCLK0	PTGDIV4	PTGDIV3	PTGDIV2	PTGDIV1	PTGDIV0
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	U-0	R/W-0	R/W-0	R/W-0
PTGPWD3	PTGPWD2	PTGPWD1	PTGPWD0	—	PTGWDT2	PTGWDT1	PTGWDT0
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 15-13 **PTGCLK<2:0>:** PTG Module Clock Source Selection bits
111 = CLC1
110 = PLL VCO DIV 4 output
101 = PTG module clock source will be SCCP7
100 = PTG module clock source will be SCCP8
011 = Input from Timer1 Clock pin, T1CK
010 = PTG module clock source will be ADC clock
001 = PTG module clock source will be FOSC
000 = PTG module clock source will be FOSC/2 (FP)

bit 12-8 **PTGDIV<4:0>:** PTG Module Clock Prescaler (Divider) bits
11111 = Divide-by-32
11110 = Divide-by-31
...
00001 = Divide-by-2
00000 = Divide-by-1

bit 7-4 **PTGPWD<3:0>:** PTG Trigger Output Pulse-Width (in PTG clock cycles) bits
1111 = All trigger outputs are 16 PTG clock cycles wide
1110 = All trigger outputs are 15 PTG clock cycles wide
...
0001 = All trigger outputs are 2 PTG clock cycles wide
0000 = All trigger outputs are 1 PTG clock cycle wide

bit 3 **Unimplemented:** Read as ‘0’

bit 2-0 **PTGWDT<2:0>:** PTG Watchdog Timer Time-out Selection bits
111 = Watchdog Timer will time out after 512 PTG clocks
110 = Watchdog Timer will time out after 256 PTG clocks
101 = Watchdog Timer will time out after 128 PTG clocks
100 = Watchdog Timer will time out after 64 PTG clocks
011 = Watchdog Timer will time out after 32 PTG clocks
010 = Watchdog Timer will time out after 16 PTG clocks
001 = Watchdog Timer will time out after 8 PTG clocks
000 = Watchdog Timer is disabled

REGISTER 24-3: PTGBTE: PTG BROADCAST TRIGGER ENABLE LOW 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
PTGBTE<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
PTGBTE<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 **PTGBTE<15:0>:** PTG Broadcast Trigger Enable bits
1 = Generates trigger when the broadcast command is executed
0 = Does not generate trigger when the broadcast command is executed

Note 1: These bits are read-only when the module is executing Step commands.

REGISTER 24-4: PTGBTEH: PTG BROADCAST TRIGGER ENABLE HIGH 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
PTGBTE<31:24>							
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
PTGBTE<23:16>							
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 **PTGBTE<31:16>:** PTG Broadcast Trigger Enable bits
1 = Generates trigger when the broadcast command is executed
0 = Does not generate trigger when the broadcast command is executed

Note 1: These bits are read-only when the module is executing Step commands.

REGISTER 29-2: PMD2: PERIPHERAL MODULE DISABLE 2 CONTROL REGISTER

U-0	U-0	U-0	U-0	U-0	U-0	U-0	R/W-0
—	—	—	—	—	—	—	CCP9MD
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
CCP8MD	CCP7MD	CCP6MD	CCP5MD	CCP4MD	CCP3MD	CCP2MD	CCP1MD
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 15-9 **Unimplemented:** Read as '0'

bit 8 **CCP9MD:** MCCP9 Module Disable bit
1 = MCCP9 module is disabled
0 = MCCP9 module is enabled

bit 7 **CCP8MD:** SCCP8 Module Disable bit
1 = SCCP8 module is disabled
0 = SCCP8 module is enabled

bit 6 **CCP7MD:** SCCP7 Module Disable bit
1 = SCCP7 module is disabled
0 = SCCP7 module is enabled

bit 5 **CCP6MD:** SCCP6 Module Disable bit
1 = SCCP6 module is disabled
0 = SCCP6 module is enabled

bit 4 **CCP5MD:** SCCP5 Module Disable bit
1 = SCCP5 module is disabled
0 = SCCP5 module is enabled

bit 3 **CCP4MD:** SCCP4 Module Disable bit
1 = SCCP4 module is disabled
0 = SCCP4 module is enabled

bit 2 **CCP3MD:** SCCP3 Module Disable bit
1 = SCCP3 module is disabled
0 = SCCP3 module is enabled

bit 1 **CCP2MD:** SCCP2 Module Disable bit
1 = SCCP2 module is disabled
0 = SCCP2 module is enabled

bit 0 **CCP1MD:** SCCP1 Module Disable bit
1 = SCCP1 module is disabled
0 = SCCP1 module is enabled

REGISTER 29-5: PMD6: PERIPHERAL MODULE DISABLE 6 CONTROL REGISTER

U-0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	—	—	DMA3MD	DMA2MD	DMA1MD	DMA0MD
bit 15							bit 8

U-0	U-0	U-0	U-0	U-0	U-0	U-0	R/W-0
—	—	—	—	—	—	—	SPI3MD
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 **Unimplemented:** Read as '0'

bit 11 **DMA3MD:** DMA3 Module Disable bit
1 = DMA3 module is disabled
0 = DMA3 module is enabled

bit 10 **DMA2MD:** DMA2 Module Disable bit
1 = DMA2 module is disabled
0 = DMA2 module is enabled

bit 9 **DMA1MD:** DMA1 Module Disable bit
1 = DMA1 module is disabled
0 = DMA1 module is enabled

bit 8 **DMA0MD:** DMA0 Module Disable bit
1 = DMA0 module is disabled
0 = DMA0 module is enabled

bit 7-1 **Unimplemented:** Read as '0'

bit 0 **SPI3MD:** SPI3 Module Disable bit
1 = SPI3 module is disabled
0 = SPI3 module is enabled

TABLE 31-2: INSTRUCTION SET OVERVIEW (CONTINUED)

Base Instr #	Assembly Mnemonic	Assembly Syntax	Description	# of Words	# of Cycles(1)	Status Flags Affected
69	NEG	NEG Acc	Negate Accumulator	1	1	OA,OB,OAB, SA,SB,SAB
		NEG f	f = $\bar{f}$ + 1	1	1	C,DC,N,OV,Z
		NEG f,WREG	WREG = $\bar{f}$ + 1	1	1	C,DC,N,OV,Z
		NEG Ws,Wd	Wd = $\overline{Ws}$ + 1	1	1	C,DC,N,OV,Z
70	NOP	NOP	No Operation	1	1	None
		NOPR	No Operation	1	1	None
71	NORM	NORM Acc, Wd	Normalize Accumulator	1	1	N,OV,Z
72	POP	POP f	Pop f from Top-of-Stack (TOS)	1	1	None
		POP Wdo	Pop from Top-of-Stack (TOS) to Wdo	1	1	None
		POP.D Wnd	Pop from Top-of-Stack (TOS) to W(nd):W(nd + 1)	1	2	None
		POP.S	Pop Shadow Registers	1	1	All
73	PUSH	PUSH f	Push f to Top-of-Stack (TOS)	1	1	None
		PUSH Wso	Push Wso to Top-of-Stack (TOS)	1	1	None
		PUSH.D Wns	Push W(ns):W(ns + 1) to Top-of-Stack (TOS)	1	2	None
		PUSH.S	Push Shadow Registers	1	1	None
74	PWRSAV	PWRSAV #lit1	Go into Sleep or Idle mode	1	1	WDTO,Sleep
75	RCALL	RCALL Expr	Relative Call	1	4	SFA
		RCALL Wn	Computed Call	1	4	SFA
76	REPEAT	REPEAT #lit15	Repeat Next Instruction lit15 + 1 times	1	1	None
		REPEAT Wn	Repeat Next Instruction (Wn) + 1 times	1	1	None
77	RESET	RESET	Software Device Reset	1	1	None
78	RETFIE	RETFIE	Return from Interrupt	1	6 (5)	SFA
79	RETLW	RETLW #lit10,Wn	Return with Literal in Wn	1	6 (5)	SFA
80	RETURN	RETURN	Return from Subroutine	1	6 (5)	SFA
81	RLC	RLC f	f = Rotate Left through Carry f	1	1	C,N,Z
		RLC f,WREG	WREG = Rotate Left through Carry f	1	1	C,N,Z
		RLC Ws,Wd	Wd = Rotate Left through Carry Ws	1	1	C,N,Z
82	RLNC	RLNC f	f = Rotate Left (No Carry) f	1	1	N,Z
		RLNC f,WREG	WREG = Rotate Left (No Carry) f	1	1	N,Z
		RLNC Ws,Wd	Wd = Rotate Left (No Carry) Ws	1	1	N,Z
83	RRC	RRC f	f = Rotate Right through Carry f	1	1	C,N,Z
		RRC f,WREG	WREG = Rotate Right through Carry f	1	1	C,N,Z
		RRC Ws,Wd	Wd = Rotate Right through Carry Ws	1	1	C,N,Z
84	RRNC	RRNC f	f = Rotate Right (No Carry) f	1	1	N,Z
		RRNC f,WREG	WREG = Rotate Right (No Carry) f	1	1	N,Z
		RRNC Ws,Wd	Wd = Rotate Right (No Carry) Ws	1	1	N,Z
85	SAC	SAC Acc,#Slit4,Wdo	Store Accumulator	1	1	None
		SAC.R Acc,#Slit4,Wdo	Store Rounded Accumulator	1	1	None
86	SE	SE Ws,Wnd	Wnd = Sign-Extended Ws	1	1	C,N,Z
87	SETM	SETM f	f = 0xFFFF	1	1	None
		SETM WREG	WREG = 0xFFFF	1	1	None
		SETM Ws	Ws = 0xFFFF	1	1	None
88	SFTAC	SFTAC Acc,Wn	Arithmetic Shift Accumulator by (Wn)	1	1	OA,OB,OAB, SA,SB,SAB
		SFTAC Acc,#Slit6	Arithmetic Shift Accumulator by Slit6	1	1	OA,OB,OAB, SA,SB,SAB

Note 1: Read and Read-Modify-Write (e.g., bit operations and logical operations) on non-CPU SFRs incur an additional instruction cycle.

2: The divide instructions must be preceded with a "REPEAT #5" instruction, such that they are executed six consecutive times.

32.2 MPLAB XC Compilers

The MPLAB XC Compilers are complete ANSI C compilers for all of Microchip's 8, 16 and 32-bit MCU and DSC devices. These compilers provide powerful integration capabilities, superior code optimization and ease of use. MPLAB XC Compilers run on Windows, Linux or MAC OS X.

For easy source level debugging, the compilers provide debug information that is optimized to the MPLAB X IDE.

The free MPLAB XC Compiler editions support all devices and commands, with no time or memory restrictions, and offer sufficient code optimization for most applications.

MPLAB XC Compilers include an assembler, linker and utilities. The assembler generates relocatable object files that can then be archived or linked with other relocatable object files and archives to create an executable file. MPLAB XC Compiler uses the assembler to produce its object file. Notable features of the assembler include:

- Support for the entire device instruction set
- Support for fixed-point and floating-point data
- Command-line interface
- Rich directive set
- Flexible macro language
- MPLAB X IDE compatibility

32.3 MPASM Assembler

The MPASM Assembler is a full-featured, universal macro assembler for PIC10/12/16/18 MCUs.

The MPASM Assembler generates relocatable object files for the MPLINK Object Linker, Intel® standard HEX files, MAP files to detail memory usage and symbol reference, absolute LST files that contain source lines and generated machine code, and COFF files for debugging.

The MPASM Assembler features include:

- Integration into MPLAB X IDE projects
- User-defined macros to streamline assembly code
- Conditional assembly for multipurpose source files
- Directives that allow complete control over the assembly process

32.4 MPLINK Object Linker/ MPLIB Object Librarian

The MPLINK Object Linker combines relocatable objects created by the MPASM Assembler. It can link relocatable objects from precompiled libraries, using directives from a linker script.

The MPLIB Object Librarian manages the creation and modification of library files of precompiled code. When a routine from a library is called from a source file, only the modules that contain that routine will be linked in with the application. This allows large libraries to be used efficiently in many different applications.

The object linker/library features include:

- Efficient linking of single libraries instead of many smaller files
- Enhanced code maintainability by grouping related modules together
- Flexible creation of libraries with easy module listing, replacement, deletion and extraction

32.5 MPLAB Assembler, Linker and Librarian for Various Device Families

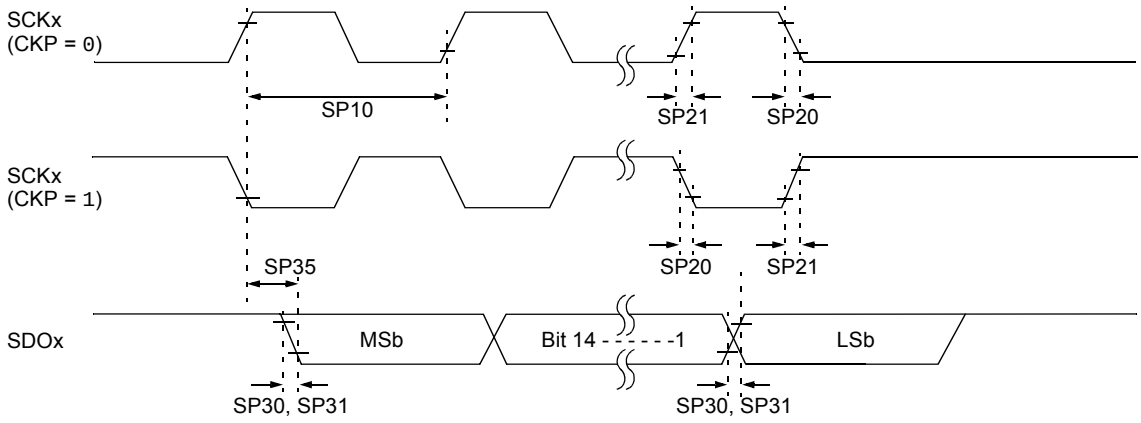
MPLAB Assembler produces relocatable machine code from symbolic assembly language for PIC24, PIC32 and dsPIC DSC devices. MPLAB XC Compiler uses the assembler to produce its object file. The assembler generates relocatable object files that can then be archived or linked with other relocatable object files and archives to create an executable file. Notable features of the assembler include:

- Support for the entire device instruction set
- Support for fixed-point and floating-point data
- Command-line interface
- Rich directive set
- Flexible macro language
- MPLAB X IDE compatibility

TABLE 33-27: SPIx MAXIMUM DATA/CLOCK RATE SUMMARY

SPI Master Transmit Only (Half-Duplex)	SPI Master Transmit/Receive (Full-Duplex)	SPI Slave Transmit/Receive (Full-Duplex)	CKE
Figure 33-7 Table 33-28	—	—	0
Figure 33-8 Table 33-28	—	—	1
—	Figure 33-9 Table 33-29	—	0
—	Figure 33-10 Table 33-30	—	1
—	—	Figure 33-11 Table 33-32	0
—	—	Figure 33-12 Table 33-33	1

FIGURE 33-7: SPIx MASTER MODE (HALF-DUPLEX, TRANSMIT ONLY, CKE = 0) TIMING CHARACTERISTICS



Note: Refer to Figure 33-1 for load conditions.

TABLE 33-36: ADC MODULE SPECIFICATIONS

Operating Conditions: 3.0V to 3.6V (unless otherwise stated)(4) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended							
Param No.	**Symbol**	**Characteristics**	**Min.**	**Typical**	**Max.**	**Units**	**Conditions**
Analog Input							
AD12	VINH-VINL	Full-Scale Input Span	AVSS	—	AVDD	V	
AD14	VIN	Absolute Input Voltage	AVSS – 0.3	—	AVDD + 0.3	V	
AD17	RIN	Recommended Impedance of Analog Voltage Source	—	100	—	Ω	For minimum sampling time **(Note 1)**
AD66	VBG	Internal Voltage Reference Source	—	1.2	—	V	
ADC Accuracy							
AD20c	Nr	Resolution	12 data bits			bits	
AD21c	INL	Integral Nonlinearity	> -11.3	—	< 11.3	LSb	AVSS = 0V, AVDD = 3.3V
AD22c	DNL	Differential Nonlinearity	> -1.5	—	< 11.5	LSb	AVSS = 0V, AVDD = 3.3V
AD23c	GERR	Gain Error	> -12	—	< 12	LSb	AVSS = 0V, AVDD = 3.3V
AD24c	EOFF	Offset Error	> -7.5	—	< 7.5	LSb	AVSS = 0V, AVDD = 3.3V
Dynamic Performance							
AD31b	SINAD	Signal-to-Noise and Distortion	56	—	70	dB	**(Notes 2, 3)**
AD34b	ENOB	Effective Number of Bits	9.0	—	11.4	bits	**(Notes 2, 3)**
AD50	TAD	ADC Clock Period	14.3	—	—	ns	
AD51	FTP	Throughput Rate	—	—	3.5	Msps	Dedicated Cores 0 and 1
			—	—	3.5	Msps	Shared core

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

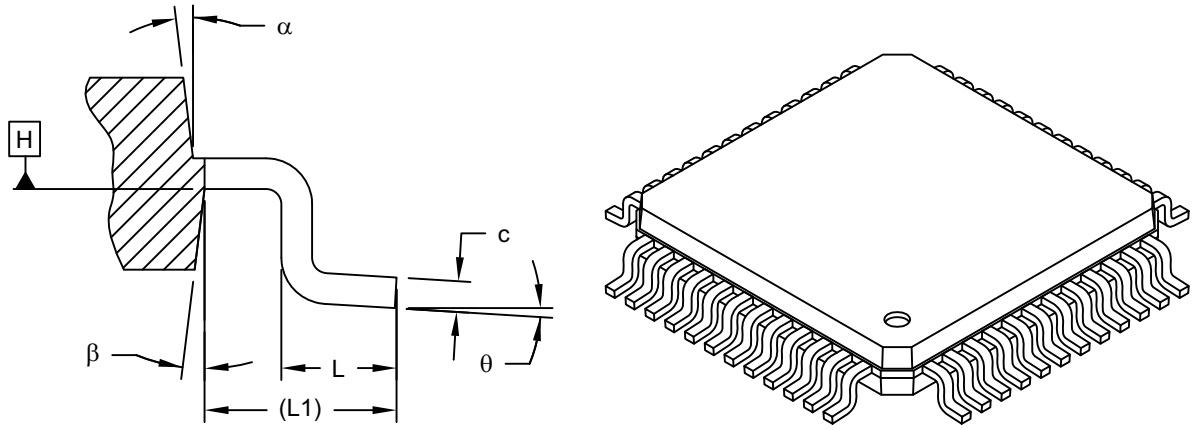
2: These parameters are characterized but not tested in manufacturing.

3: Characterized with a 1 kHz sine wave.

4: The ADC module is functional at VBORMIN < VDD < VDDMIN, but with degraded performance. Unless otherwise stated, module functionality is ensured, but not characterized.

48-Lead Thin Quad Flatpack (PT) - 7x7x1.0 mm Body [TQFP]

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



SECTION A-A

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Leads	N		48	
Lead Pitch	e		0.50 BSC	
Overall Height	A	-	-	1.20
Standoff	A1	0.05	-	0.15
Molded Package Thickness	A2	0.95	1.00	1.05
Foot Length	L	0.45	0.60	0.75
Footprint	L1		1.00 REF	
Foot Angle	ϕ	0°	3.5°	7°
Overall Width	E		9.00 BSC	
Overall Length	D		9.00 BSC	
Molded Package Width	E1		7.00 BSC	
Molded Package Length	D1		7.00 BSC	
Lead Thickness	c	0.09	-	0.16
Lead Width	b	0.17	0.22	0.27
Mold Draft Angle Top	α	11°	12°	13°
Mold Draft Angle Bottom	β	11°	12°	13°

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Chamfers at corners are optional; size may vary.
3. Dimensions D1 and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M

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

   REF: Reference Dimension, usually without tolerance, for information purposes only.
5. Datums A-B and D to be determined at center line between leads where leads exit plastic body at datum plane H

Microchip Technology Drawing C04-300-PT Rev A Sheet 2 of 2

