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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	PIC
Core Size	8-Bit
Speed	32MHz
Connectivity	I²C, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	17
Program Memory Size	14KB (8K x 14)
Program Memory Type	FLASH
EEPROM Size	256 x 8
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 3.6V
Data Converters	A/D 12x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	20-SOIC (0.295", 7.50mm Width)
Supplier Device Package	20-SOIC
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic16lf1829t-i-so

TABLE 3-3: PIC16(L)F1825/9 MEMORY MAP, BANKS 0-7

	BANK 0		BANK 1		BANK 2		BANK 3		BANK 4		BANK 5		BANK 6		BANK 7	
000h	INDF0	080h	INDF0	100h	INDF0	180h	INDF0	200h	INDF0	280h	INDF0	300h	INDF0	380h	INDF0
001h	INDF1	081h	INDF1	101h	INDF1	181h	INDF1	201h	INDF1	281h	INDF1	301h	INDF1	381h	INDF1
002h	PCL	082h	PCL	102h	PCL	182h	PCL	202h	PCL	282h	PCL	302h	PCL	382h	PCL
003h	STATUS	083h	STATUS	103h	STATUS	183h	STATUS	203h	STATUS	283h	STATUS	303h	STATUS	383h	STATUS
004h	FSR0L	084h	FSR0L	104h	FSR0L	184h	FSR0L	204h	FSR0L	284h	FSR0L	304h	FSR0L	384h	FSR0L
005h	FSR0H	085h	FSR0H	105h	FSR0H	185h	FSR0H	205h	FSR0H	285h	FSR0H	305h	FSR0H	385h	FSR0H
006h	FSR1L	086h	FSR1L	106h	FSR1L	186h	FSR1L	206h	FSR1L	286h	FSR1L	306h	FSR1L	386h	FSR1L
007h	FSR1H	087h	FSR1H	107h	FSR1H	187h	FSR1H	207h	FSR1H	287h	FSR1H	307h	FSR1H	387h	FSR1H
008h	BSR	088h	BSR	108h	BSR	188h	BSR	208h	BSR	288h	BSR	308h	BSR	388h	BSR
009h	WREG	089h	WREG	109h	WREG	189h	WREG	209h	WREG	289h	WREG	309h	WREG	389h	WREG
00Ah	PCLATH	08Ah	PCLATH	10Ah	PCLATH	18Ah	PCLATH	20Ah	PCLATH	28Ah	PCLATH	30Ah	PCLATH	38Ah	PCLATH
00Bh	INTCON	08Bh	INTCON	10Bh	INTCON	18Bh	INTCON	20Bh	INTCON	28Bh	INTCON	30Bh	INTCON	38Bh	INTCON
00Ch	PORTA	08Ch	TRISA	10Ch	LATA	18Ch	ANSELA	20Ch	WPUA	28Ch	—	30Ch	—	38Ch	INLVLA
00Dh	PORTB(1)	08Dh	TRISB(1)	10Dh	LATB(1)	18Dh	ANSELB(1)	20Dh	WPUB(1)	28Dh	—	30Dh	—	38Dh	INLVLB(1)
00Eh	PORTC	08Eh	TRISC	10Eh	LATC	18Eh	ANSELC	20Eh	WPUC	28Eh	—	30Eh	—	38Eh	INLVLC
00Fh	—	08Fh	—	10Fh	—	18Fh	—	20Fh	—	28Fh	—	30Fh	—	38Fh	—
010h	—	090h	—	110h	—	190h	—	210h	—	290h	—	310h	—	390h	—
011h	PIR1	091h	PIE1	111h	CM1CON0	191h	EEADRL	211h	SSP1BUF	291h	CCPR1L	311h	CCPR3L	391h	IOCAP
012h	PIR2	092h	PIE2	112h	CM1CON1	192h	EEADRH	212h	SSP1ADD	292h	CCPR1H	312h	CCPR3H	392h	IOCAN
013h	PIR3	093h	PIE3	113h	CM2CON0	193h	EEDATL	213h	SSP1MSK	293h	CCP1CON	313h	CCP3CON	393h	IOCAF
014h	PIR4(1)	094h	PIE4(1)	114h	CM2CON1	194h	EEDATH	214h	SSP1STAT	294h	PWM1CON	314h	—	394h	IOCBP(1)
015h	TMR0	095h	OPTION_REG	115h	CMOUT	195h	EECON1	215h	SSP1CON1	295h	CCP1AS	315h	—	395h	IOCBN(1)
016h	TMR1L	096h	PCON	116h	BORCON	196h	EECON2	216h	SSP1CON2	296h	PSTR1CON	316h	—	396h	IOCBF(1)
017h	TMR1H	097h	WDTCON	117h	FVRCON	197h	—	217h	SSP1CON3	297h	—	317h	—	397h	—
018h	T1CON	098h	OSCTUNE	118h	DACCON0	198h	—	218h	—	298h	CCPR2L	318h	CCPR4L	398h	—
019h	T1GCON	099h	OSCCON	119h	DACCON1	199h	RCREG	219h	SSP2BUF(1)	299h	CCPR2H	319h	CCPR4H	399h	—
01Ah	TMR2	09Ah	OSCSTAT	11Ah	SRCON0	19Ah	TXREG	21Ah	SSP2ADD(1)	29Ah	CCP2CON	31Ah	CCP4CON	39Ah	CLKRCON
01Bh	PR2	09Bh	ADRESL	11Bh	SRCON1	19Bh	SPBRGL	21Bh	SSP2MSK(1)	29Bh	PWM2CON	31Bh	—	39Bh	—
01Ch	T2CON	09Ch	ADRESH	11Ch	—	19Ch	SPBRGH	21Ch	SSP2STAT(1)	29Ch	CCP2AS	31Ch	—	39Ch	MDCON
01Dh	—	09Dh	ADCON0	11Dh	APFCON0	19Dh	RCSTA	21Dh	SSP2CON1(1)	29Dh	PSTR2CON	31Dh	—	39Dh	MDSRC
01Eh	CPSCON0	09Eh	ADCON1	11Eh	APFCON1	19Eh	TXSTA	21Eh	SSP2CON2(1)	29Eh	CCPTMRS	31Eh	—	39Eh	MDCARL
01Fh	CPSCON1	09Fh	—	11Fh	—	19Fh	BAUDCON	21Fh	SSP2CON3(1)	29Fh	—	31Fh	—	39Fh	MDCARH
020h	General Purpose Register 96 Bytes	0A0h	General Purpose Register 80 Bytes	120h	General Purpose Register 80 Bytes	1A0h	General Purpose Register 80 Bytes	220h	General Purpose Register 80 Bytes	2A0h	General Purpose Register 80 Bytes	320h	General Purpose Register 80 Bytes	3A0h	General Purpose Register 80 Bytes
06Fh		0EFh		16Fh		1EFh		26Fh		2EFh		36Fh		3EFh	
070h	Common RAM	0F0h	Accesses 70h – 7Fh	170h	Accesses 70h – 7Fh	1F0h	Accesses 70h – 7Fh	270h	Accesses 70h – 7Fh	2F0h	Accesses 70h – 7Fh	370h	Accesses 70h – 7Fh	3F0h	Accesses 70h – 7Fh
07Fh		0FFh		17Fh		1FFh		27Fh		2FFh		37Fh		3FFh	

Legend: = Unimplemented data memory locations, read as '0'

Note 1: Available only on PIC16(L)F1829.

TABLE 3-8: SPECIAL FUNCTION REGISTER SUMMARY

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR, BOR	Value on all other Resets
Bank 0											
000h(1)	INDF0	Addressing this location uses contents of FSR0H/FSR0L to address data memory (not a physical register)								xxxx xxxx	xxxx xxxx
001h(1)	INDF1	Addressing this location uses contents of FSR1H/FSR1L to address data memory (not a physical register)								xxxx xxxx	xxxx xxxx
002h(1)	PCL	Program Counter (PC) Least Significant Byte								0000 0000	0000 0000
003h(1)	STATUS	—	—	—	$\overline{TO}$	$\overline{PD}$	Z	DC	C	---1 1000	---q quuu
004h(1)	FSR0L	Indirect Data Memory Address 0 Low Pointer								0000 0000	uuuu uuuu
005h(1)	FSR0H	Indirect Data Memory Address 0 High Pointer								0000 0000	0000 0000
006h(1)	FSR1L	Indirect Data Memory Address 1 Low Pointer								0000 0000	uuuu uuuu
007h(1)	FSR1H	Indirect Data Memory Address 1 High Pointer								0000 0000	0000 0000
008h(1)	BSR	—	—	—	BSR<4:0>					---0 0000	---0 0000
009h(1)	WREG	Working Register								0000 0000	uuuu uuuu
00Ah(1)	PCLATH	—	Write Buffer for the upper 7 bits of the Program Counter							-000 0000	-000 0000
00Bh(1)	INTCON	GIE	PEIE	TMR0IE	INTE	IOCIE	TMR0IF	INTF	IOCIF	0000 0000	0000 0000
00Ch	PORTA	—	—	RA5	RA4	RA3	RA2	RA1	RA0	--xx xxxx	--xx xxxx
00Dh	PORTB(2)	RB7	RB6	RB5	RB4	—	—	—	—	xxxx ----	xxxx ----
00Eh	PORTC	RC7(2)	RC6(2)	RC5	RC4	RC3	RC2	RC1	RC0	xxxx xxxx	xxxx xxxx
00Fh	—	Unimplemented								—	—
010h	—	Unimplemented								—	—
011h	PIR1	TMR1GIF	ADIF	RCIF	TXIF	SSP1IF	CCP1IF	TMR2IF	TMR1IF	0000 0000	0000 0000
012h	PIR2	OSFIF	C2IF	C1IF	EEIF	BCL1IF	—	—	CCP2IF	0000 0--0	0000 0--0
013h	PIR3	—	—	CCP4IF	CCP3IF	TMR6IF	—	TMR4IF	—	--00 0-0-	--00 0-0-
014h	PIR4(2)	—	—	—	—	—	—	BCL2IF	SSP2IF	---- --00	---- --00
015h	TMR0	Timer0 Module Register								xxxx xxxx	uuuu uuuu
016h	TMR1L	Holding Register for the Least Significant Byte of the 16-bit TMR1 Register								xxxx xxxx	uuuu uuuu
017h	TMR1H	Holding Register for the Most Significant Byte of the 16-bit TMR1 Register								xxxx xxxx	uuuu uuuu
018h	T1CON	TMR1CS1	TMR1CS0	T1CKPS<1:0>		T1OSCEN	$\overline{T1SYNC}$	—	TMR1ON	0000 00-0	uuuu uu-u
019h	T1GCON	TMR1GE	T1GPOL	T1GTM	T1GSPM	$\overline{T1GGO}$/DONE	T1GVAL	T1GSS<1:0>		0000 0x00	uuuu uxuu
01Ah	TMR2	Timer2 Module Register								0000 0000	0000 0000
01Bh	PR2	Timer2 Period Register								1111 1111	1111 1111
01Ch	T2CON	—	T2OUTPS<3:0>				TMR2ON	T2CKPS<1:0>		-000 0000	-000 0000
01Dh	—	Unimplemented								—	—
01Eh	CPSCON0	CPSON	CPSRM	—	—	CPSRNG<1:0>		CPSOUT	T0XCS	00-- 0000	00-- 0000
01Fh	CPSCON1	—	—	—	—	CPSCH<3:0>				---- 0000	---- 0000

Legend: x = unknown, u = unchanged, q = value depends on condition, - = unimplemented, r = reserved.
Shaded locations are unimplemented, read as '0'.

Note 1: These registers can be addressed from any bank.
2: PIC16(L)F1829 only.
3: PIC16(L)F1825 only.
4: Unimplemented, read as '1'.

TABLE 3-8: SPECIAL FUNCTION REGISTER SUMMARY (CONTINUED)

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR, BOR	Value on all other Resets
Bank 7											
380h(1)	INDF0	Addressing this location uses contents of FSR0H/FSR0L to address data memory (not a physical register)								xxxx xxxx	xxxx xxxx
381h(1)	INDF1	Addressing this location uses contents of FSR1H/FSR1L to address data memory (not a physical register)								xxxx xxxx	xxxx xxxx
382h(1)	PCL	Program Counter (PC) Least Significant Byte								0000 0000	0000 0000
383h(1)	STATUS	—	—	—	$\overline{TO}$	$\overline{PD}$	Z	DC	C	---1 1000	---q quuu
384h(1)	FSR0L	Indirect Data Memory Address 0 Low Pointer								0000 0000	uuuu uuuu
385h(1)	FSR0H	Indirect Data Memory Address 0 High Pointer								0000 0000	0000 0000
386h(1)	FSR1L	Indirect Data Memory Address 1 Low Pointer								0000 0000	uuuu uuuu
387h(1)	FSR1H	Indirect Data Memory Address 1 High Pointer								0000 0000	0000 0000
388h(1)	BSR	—	—	—	BSR<4:0>					---0 0000	---0 0000
389h(1)	WREG	Working Register								0000 0000	uuuu uuuu
38Ah(1)	PCLATH	—	Write Buffer for the upper 7 bits of the Program Counter							-000 0000	-000 0000
38Bh(1)	INTCON	GIE	PEIE	TMR0IE	INTE	IOCIE	TMR0IF	INTF	IOCIF	0000 0000	0000 0000
38Ch	INLVLA	—	—	INLVLA5	INLVLA4	INLVLA3	INLVLA2	INLVLA1	INLVLA0	--00 0100	--00 0100
38Dh	INLVLB(2)	INLVLB7	INLVLB6	INLVLB5	INLVLB4	—	—	—	—	0000 ----	0000 ----
38Eh	INLVLC(3)	—	—	INLVLC5	INLVLC4	INLVLC3	INLVLC2	INLVLC1	INLVLC0	--00 0000	--00 0000
	INLVLC(2)	INLVLC7	INLVLC6	INLVLC5	INLVLC4	INLVLC3	INLVLC2	INLVLC1	INLVLC0	1111 1111	1111 1111
38Fh	—	Unimplemented								—	—
390h	—	Unimplemented								—	—
391h	IOCAP	—	—	IOCAP5	IOCAP4	IOCAP3	IOCAP2	IOCAP1	IOCAP0	--00 0000	--00 0000
392h	IOCAN	—	—	IOCAN5	IOCAN4	IOCAN3	IOCAN2	IOCAN1	IOCAN0	--00 0000	--00 0000
393h	IOCAF	—	—	IOCAF5	IOCAF4	IOCAF3	IOCAF2	IOCAF1	IOCAF0	--00 0000	--00 0000
394h	IOCBP(2)	IOCBP7	IOCBP6	IOCBP5	IOCBP4	—	—	—	—	0000 ----	0000 ----
395h	IOCBN(2)	IOCBN7	IOCBN6	IOCBN5	IOCBN4	—	—	—	—	0000 ----	0000 ----
396h	IOCBF(2)	IOCBF7	IOCBF6	IOCBF5	IOCBF4	—	—	—	—	0000 ----	0000 ----
397h	—	Unimplemented								—	—
398h	—	Unimplemented								—	—
399h	—	Unimplemented								—	—
39Ah	CLKRCON	CLKREN	CLKROE	CLKRSLR	CLKRDC<1:0>		CLKRDIV<2:0>			0011 0000	0011 0000
39Bh	—	Unimplemented								—	—
39Ch	MDCON	MDEN	MDOE	MDSLR	MDOPOL	MDOUT	—	—	MDBIT	0010 ---0	0010 ---0
39Dh	MDSRC	MDMSODIS	—	—	—	MDMS<3:0>				x--- xxxx	u--- uuuu
39Eh	MDCARL	MDCLODIS	MDCLPOL	MDCLSYNC	—	MDCL<3:0>				xxx- xxxx	uuu- uuuu
39Fh	MDCARH	MDCHODIS	MDCHPOL	MDCHSYNC	—	MDCH<3:0>				xxx- xxxx	uuu- uuuu

Legend: x = unknown, u = unchanged, q = value depends on condition, - = unimplemented, r = reserved.
Shaded locations are unimplemented, read as '0'.

Note 1: These registers can be addressed from any bank.
2: PIC16(L)F1829 only.
3: PIC16(L)F1825 only.
4: Unimplemented, read as '1'.

REGISTER 4-1: CONFIGURATION WORD 1

R/P-1/1	R/P-1/1	R/P-1/1	R/P-1/1	R/P-1/1	R/P-1/1
FCMEN	IESO	$\overline{\text{CLKOUTEN}}$	BOREN<1:0>		$\overline{\text{CPD}}$
bit 13					bit 8

R/P-1/1	R/P-1/1	R/P-1/1	R/P-1/1	R/P-1/1	R/P-1/1	R/P-1/1	R/P-1/1
$\overline{\text{CP}}$	MCLRE	$\overline{\text{PWRTE}}$	WDTE<1:0>		FOSC<2:0		
bit 7							bit 0

Legend:		
R = Readable bit	P = Programmable bit	U = Unimplemented bit, read as '1'
'0' = Bit is cleared	'1' = Bit is set	-n = Value when blank or after Bulk Erase

bit 13 **FCMEN:** Fail-Safe Clock Monitor Enable bit
1 = Fail-Safe Clock Monitor is enabled
0 = Fail-Safe Clock Monitor is disabled

bit 12 **IESO:** Internal External Switchover bit
1 = Internal/External Switchover mode is enabled
0 = Internal/External Switchover mode is disabled

bit 11 **$\overline{\text{CLKOUTEN}}$:** Clock Out Enable bit
If FOSC configuration bits are set to LP, XT, HS modes:
This bit is ignored, CLKOUT function is disabled. Oscillator function on the CLKOUT pin.
All other FOSC modes:
1 = CLKOUT function is disabled. I/O function on the CLKOUT pin.
0 = CLKOUT function is enabled on the CLKOUT pin

bit 10-9 **BOREN<1:0>:** Brown-out Reset Enable bits(1)
11 = BOR enabled
10 = BOR enabled during operation and disabled in Sleep
01 = BOR controlled by SBOREN bit of the BORCON register
00 = BOR disabled

bit 8 **$\overline{\text{CPD}}$:** Data Code Protection bit(2)
1 = Data memory code protection is disabled
0 = Data memory code protection is enabled

bit 7 **$\overline{\text{CP}}$:** Code Protection bit(3)
1 = Program memory code protection is disabled
0 = Program memory code protection is enabled

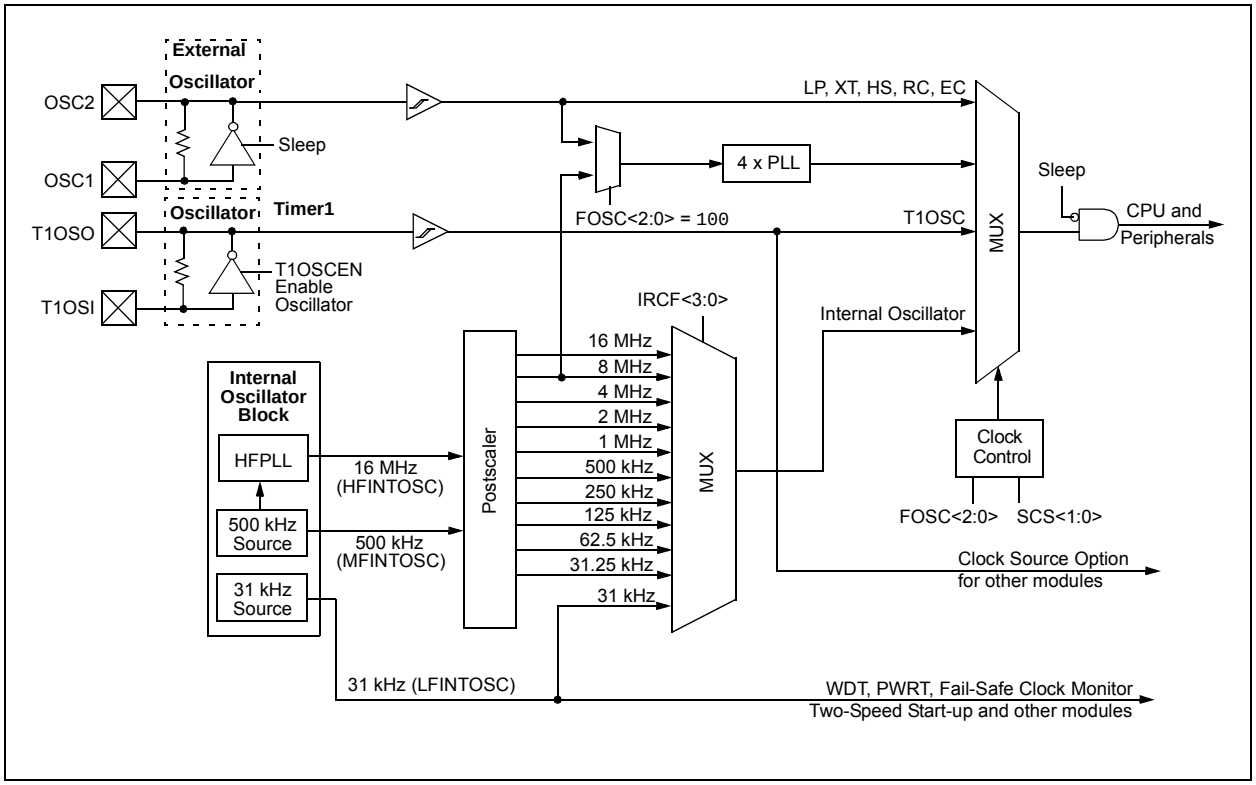
bit 6 **MCLRE:** RA3/$\overline{\text{MCLR}}$/V_{PP} Pin Function Select bit
If LVP bit = 1:
This bit is ignored.
If LVP bit = 0:
1 = $\overline{\text{MCLR}}$/V_{PP} pin function is $\overline{\text{MCLR}}$; Weak pull-up enabled.
0 = $\overline{\text{MCLR}}$/V_{PP} pin function is digital input; $\overline{\text{MCLR}}$ internally disabled; Weak pull-up under control of WPUA register.

bit 5 **$\overline{\text{PWRTE}}$:** Power-up Timer Enable bit(1)
1 = PWRT disabled
0 = PWRT enabled

bit 4-3 **WDTE<1:0>:** Watchdog Timer Enable bit
11 = WDT enabled
10 = WDT enabled while running and disabled in Sleep
01 = WDT controlled by the SWDTEN bit in the WDTCON register
00 = WDT disabled

Note 1: Enabling Brown-out Reset does not automatically enable Power-up Timer.
2: The entire data EEPROM will be erased when the code protection is turned off during an erase.
3: The entire program memory will be erased when the code protection is turned off.

FIGURE 5-1: SIMPLIFIED PIC® MCU CLOCK SOURCE BLOCK DIAGRAM



REGISTER 5-2: OSCSTAT: OSCILLATOR STATUS REGISTER

R-1/q	R-0/q	R-q/q	R-0/q	R-0/q	R-q/q	R-0/0	R-0/q
T1OSCR	PLLR	OSTS	HFIOFR	HFIOFL	MFIOFR	LFIOFR	HFIOFS
bit 7							bit 0

Legend:		
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as ‘0’
u = Bit is unchanged	x = Bit is unknown	-n/n = Value at POR and BOR/Value at all other Resets
‘1’ = Bit is set	‘0’ = Bit is cleared	q = Conditional

bit 7 **T1OSCR:** Timer1 Oscillator Ready bit
If T1OSCEN = 1:
1 = Timer1 oscillator is ready
0 = Timer1 oscillator is not ready
If T1OSCEN = 0:
1 = Timer1 clock source is always ready

bit 6 **PLLR** 4xPLL Ready bit
1 = 4xPLL is ready
0 = 4xPLL is not ready

bit 5 **OSTS:** Oscillator Start-up Timer Status bit
1 = Running from the clock defined by the FOSC<2:0> bits of the Configuration Word 1
0 = Running from an internal oscillator (FOSC<2:0> = 100)

bit 4 **HFIOFR:** High-Frequency Internal Oscillator Ready bit
1 = HFINTOSC is ready
0 = HFINTOSC is not ready

bit 3 **HFIOFL:** High-Frequency Internal Oscillator Locked bit
1 = HFINTOSC is at least 2% accurate
0 = HFINTOSC is not 2% accurate

bit 2 **MFIOFR:** Medium-Frequency Internal Oscillator Ready bit
1 = MFINTOSC is ready
0 = MFINTOSC is not ready

bit 1 **LFIOFR:** Low-Frequency Internal Oscillator Ready bit
1 = LFINTOSC is ready
0 = LFINTOSC is not ready

bit 0 **HFIOFS:** High-Frequency Internal Oscillator Stable bit
1 = HFINTOSC is at least 0.5% accurate
0 = HFINTOSC is not 0.5% accurate

TABLE 7-5: SUMMARY OF REGISTERS ASSOCIATED WITH RESETS

Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Register on Page
BORCON	SBOREN	—	—	—	—	—	—	BORRDY	76
PCON	STKOVF	STKUNF	—	—	$\overline{\text{RMCLR}}$	$\overline{\text{RI}}$	$\overline{\text{POR}}$	$\overline{\text{BOR}}$	80
STATUS	—	—	—	$\overline{\text{TO}}$	$\overline{\text{PD}}$	Z	DC	C	22
WDTCON	—	—	WDTPS<4:0>					SWDTEN	100

Legend: — Unimplemented bit, reads as '0'. Shaded cells are not used by Resets.

EXAMPLE 11-5: WRITING TO FLASH PROGRAM MEMORY

```
; This write routine assumes the following:
; 1. The 16 bytes of data are loaded, starting at the address in DATA_ADDR
; 2. Each word of data to be written is made up of two adjacent bytes in DATA_ADDR,
;    stored in little endian format
; 3. A valid starting address (the least significant bits = 000) is loaded in ADDRH:ADDRL
; 4. ADDRH and ADDRL are located in shared data memory 0x70 - 0x7F
;
        BCF         INTCON,GIE     ; Disable ints so required sequences will execute properly
        BANKSEL     EEADRH         ; Bank 3
        MOVF        ADDRH,W        ; Load initial address
        MOVWF       EEADRH         ;
        MOVF        ADDRL,W        ;
        MOVWF       EEADRL         ;
        MOVLW       LOW DATA_ADDR  ; Load initial data address
        MOVWF       FSR0L          ;
        MOVLW       HIGH DATA_ADDR ; Load initial data address
        MOVWF       FSR0H          ;
        BSF         EECON1,EEPGD   ; Point to program memory
        BCF         EECON1,CFGS    ; Not configuration space
        BSF         EECON1,WREN    ; Enable writes
        BSF         EECON1,LWLO    ; Only Load Write Latches
LOOP
        MOVIW       FSR0++         ; Load first data byte into lower
        MOVWF       EEDATL         ;
        MOVIW       FSR0++         ; Load second data byte into upper
        MOVWF       EEDATH         ;

        MOVF        EEADRL,W       ; Check if lower bits of address are '000'
        XORLW       0x07           ; Check if we're on the last of 8 addresses
        ANDLW       0x07           ;
        BTFSC       STATUS,Z       ; Exit if last of eight words,
        GOTO        START_WRITE    ;

  Required Sequence
        MOVLW       55h            ; Start of required write sequence:
        MOVWF       EECON2         ; Write 55h
        MOVLW       0AAh           ;
        MOVWF       EECON2         ; Write AAh
        BSF         EECON1,WR      ; Set WR bit to begin write
        NOP                        ; Any instructions here are ignored as processor
                                   ; halts to begin write sequence
        NOP                        ; Processor will stop here and wait for write to complete.

                                   ; After write processor continues with 3rd instruction.

        INCF        EEADRL,F       ; Still loading latches Increment address
        GOTO        LOOP           ; Write next latches

START_WRITE
        BCF         EECON1,LWLO    ; No more loading latches - Actually start Flash program
                                   ; memory write

  Required Sequence
        MOVLW       55h            ; Start of required write sequence:
        MOVWF       EECON2         ; Write 55h
        MOVLW       0AAh           ;
        MOVWF       EECON2         ; Write AAh
        BSF         EECON1,WR      ; Set WR bit to begin write
        NOP                        ; Any instructions here are ignored as processor
                                   ; halts to begin write sequence
        NOP                        ; Processor will stop here and wait for write complete.

                                   ; after write processor continues with 3rd instruction
        BCF         EECON1,WREN    ; Disable writes
        BSF         INTCON,GIE     ; Enable interrupts
```

11.7 EEPROM and Flash Control Registers

REGISTER 11-1: EEDATL: EEPROM LOW BYTE DATA REGISTER

R/W-x/u	R/W-x/u	R/W-x/u	R/W-x/u	R/W-x/u	R/W-x/u	R/W-x/u	R/W-x/u
EEDAT<7:0>							
bit 7							bit 0

Legend:		
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as ‘0’
u = Bit is unchanged	x = Bit is unknown	-n/n = Value at POR and BOR/Value at all other Resets
‘1’ = Bit is set	‘0’ = Bit is cleared	

bit 7-0 **EEDAT<7:0>**: Read/write value for EEPROM data byte or Least Significant bits of program memory

REGISTER 11-2: EEDATH: EEPROM DATA HIGH BYTE REGISTER

U-0	U-0	R/W-x/u	R/W-x/u	R/W-x/u	R/W-x/u	R/W-x/u	R/W-x/u
—	—	EEDAT<13:8>					
bit 7							bit 0

Legend:		
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as ‘0’
u = Bit is unchanged	x = Bit is unknown	-n/n = Value at POR and BOR/Value at all other Resets
‘1’ = Bit is set	‘0’ = Bit is cleared	

bit 7-6 **Unimplemented:** Read as ‘0’

bit 5-0 **EEDAT<13:8>**: Read/write value for Most Significant bits of program memory

REGISTER 11-3: EEADRL: EEPROM ADDRESS REGISTER

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

Legend:		
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as ‘0’
u = Bit is unchanged	x = Bit is unknown	-n/n = Value at POR and BOR/Value at all other Resets
‘1’ = Bit is set	‘0’ = Bit is cleared	

bit 7-0 **EEADR<7:0>**: Specifies the Least Significant bits for program memory address or EEPROM address

REGISTER 11-4: EEADRH: EEPROM ADDRESS HIGH BYTE REGISTER

U-1	R/W-0/0	R/W-0/0	R/W-0/0	R/W-0/0	R/W-0/0	R/W-0/0	R/W-0/0
—(1)	EEADR<14:8>						
bit 7							bit 0

Legend:		
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as ‘0’
u = Bit is unchanged	x = Bit is unknown	-n/n = Value at POR and BOR/Value at all other Resets
‘1’ = Bit is set	‘0’ = Bit is cleared	

bit 7 **Unimplemented:** Read as ‘1’

bit 6-0 **EEADR<14:8>**: Specifies the Most Significant bits for program memory address or EEPROM address

Note 1: Unimplemented, read as ‘1’.

12.1 Alternate Pin Function

The Alternate Pin Function Control 0 (APFCON0) and Alternate Pin Function Control 1 (APFCON1) registers are used to steer specific peripheral input and output functions between different pins. The APFCON0 and APFCON1 registers are shown in Register 12-1 and Register 12-2. For this device family, the following functions can be moved between different pins.

- RX/DT/TX/CK
- SDO1
- $\overline{SS}$ (Slave Select)
- T1G
- P1B/P1C/P1D/P2B
- CCP1/P1A/CCP2

These bits have no effect on the values of any TRIS register. PORT and TRIS overrides will be routed to the correct pin. The unselected pin will be unaffected.

20.2 Option and Timer0 Control Register

REGISTER 20-1: OPTION_REG: OPTION REGISTER

R/W-1/1	R/W-1/1	R/W-1/1	R/W-1/1	R/W-1/1	R/W-1/1	R/W-1/1	R/W-1/1
$\overline{\text{WPUEN}}$	INTEDG	TMR0CS	TMR0SE	PSA	PS<2:0>		
bit 7							bit 0

Legend:		
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'
u = Bit is unchanged	x = Bit is unknown	-n/n = Value at POR and BOR/Value at all other Resets
'1' = Bit is set	'0' = Bit is cleared	

bit 7 **$\overline{\text{WPUEN}}$:** Weak Pull-up Enable bit
1 = All weak pull-ups are disabled (except $\overline{\text{MCLR}}$, if it is enabled)
0 = Weak pull-ups are enabled by individual WPUx latch values

bit 6 **INTEDG:** Interrupt Edge Select bit
1 = Interrupt on rising edge of INT pin
0 = Interrupt on falling edge of INT pin

bit 5 **TMR0CS:** Timer0 Clock Source Select bit
1 = Transition on T0CKI pin
0 = Internal instruction cycle clock (FOSC/4)

bit 4 **TMR0SE:** Timer0 Source Edge Select bit
1 = Increment on high-to-low transition on T0CKI pin
0 = Increment on low-to-high transition on T0CKI pin

bit 3 **PSA:** Prescaler Assignment bit
1 = Prescaler is not assigned to the Timer0 module
0 = Prescaler is assigned to the Timer0 module

bit 2-0 **PS<2:0>:** Prescaler Rate Select bits

Bit Value	Timer0 Rate
000	1 : 2
001	1 : 4
010	1 : 8
011	1 : 16
100	1 : 32
101	1 : 64
110	1 : 128
111	1 : 256

TABLE 20-1: SUMMARY OF REGISTERS ASSOCIATED WITH TIMER0

Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Register on Page
CPSCON0	CPSON	CPSRM	—	—	CPSRNG<1:0>		CPSOUT	T0xCS	315
FVRCON	FVREN	FVRRDY	TSEN	TSRNG	CDAFVR<1:0>		ADFVR<1:0>		142
INLVLA	—	—	INLVLA5	INLVLA4	INLVLA3	INLVLA2	INLVLA1	INLVLA0	124
INTCON	GIE	PEIE	TMR0IE	INTE	IOCIE	TMR0IF	INTF	IOCIF	87
OPTION_REG	$\overline{\text{WPUEN}}$	INTEDG	TMR0CS	TMR0SE	PSA	PS<2:0>			176
TMR0	Timer0 Module Register								174*
TRISA	—	—	TRISA5	TRISA4	TRISA3	TRISA2	TRISA1	TRISA0	122

Legend: — Unimplemented location, read as '0'. Shaded cells are not used by the Timer0 module.
* Page provides register information.

FIGURE 21-3: TIMER1 GATE ENABLE MODE

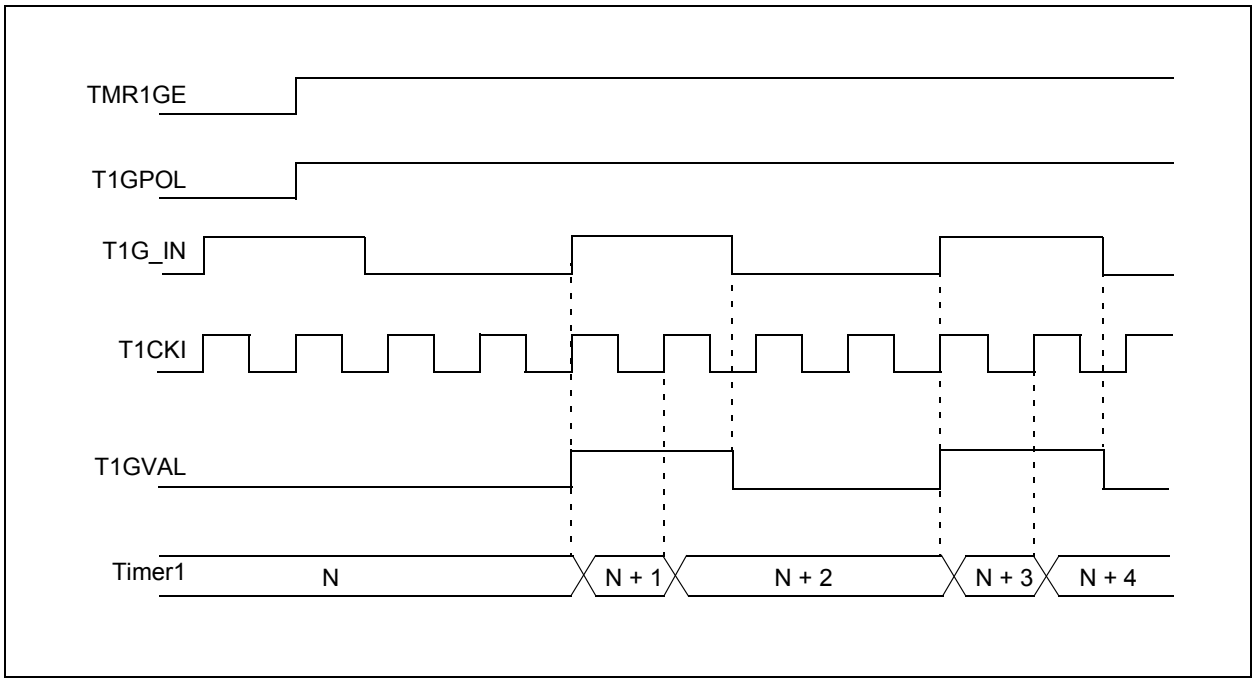
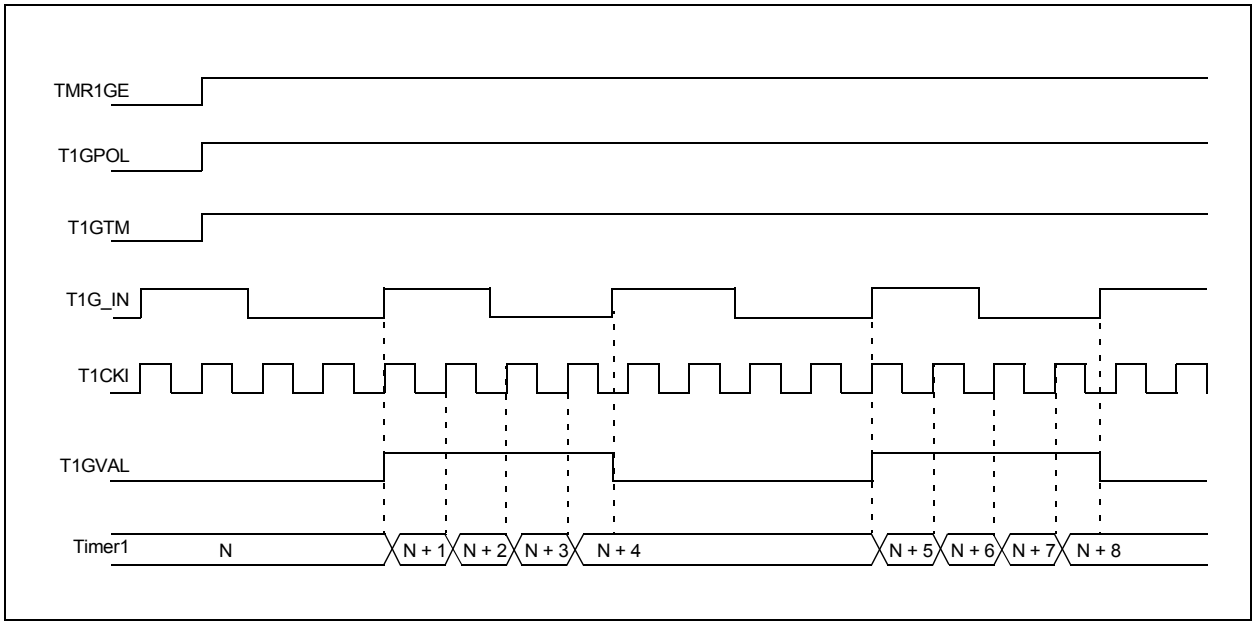


FIGURE 21-4: TIMER1 GATE TOGGLE MODE



24.3.2 SETUP FOR PWM OPERATION

The following steps should be taken when configuring the CCP module for standard PWM operation:

1. Disable the CCPx pin output driver by setting the associated TRIS bit.
2. Load the PRx register with the PWM period value.
3. Configure the CCP module for the PWM mode by loading the CCPxCON register with the appropriate values.
4. Load the CCPRxL register and the DCxBx bits of the CCPxCON register, with the PWM duty cycle value.
5. Configure and start Timer2/4/6:
   - Select the Timer2/4/6 resource to be used for PWM generation by setting the CxTSEL<1:0> bits in the CCPTMRS register.
   - Clear the TMRxIF interrupt flag bit of the PIRx register. See Note below.
   - Configure the TxCKPS bits of the TxCON register with the Timer prescale value.
   - Enable the Timer by setting the TMRxON bit of the TxCON register.
6. Enable PWM output pin:
   - Wait until the Timer overflows and the TMRxIF bit of the PIRx register is set. See Note below.
   - Enable the CCPx pin output driver by clearing the associated TRIS bit.

Note:	In order to send a complete duty cycle and period on the first PWM output, the above steps must be included in the setup sequence. If it is not critical to start with a complete PWM signal on the first output, then step 6 may be ignored.

24.3.3 TIMER2/4/6 TIMER RESOURCE

The PWM standard mode makes use of one of the 8-bit Timer2/4/6 timer resources to specify the PWM period.

Configuring the CxTSEL<1:0> bits in the CCPTMRS register selects which Timer2/4/6 timer is used.

24.3.4 PWM PERIOD

The PWM period is specified by the PRx register of Timer2/4/6. The PWM period can be calculated using the formula of Equation 24-1.

EQUATION 24-1: PWM PERIOD

$$PWM\ Period = [(PRx) + 1] \bullet 4 \bullet T_{OSC} \bullet (TMRx\ Prescale\ Value)$$

Note 1: TOSC = 1/FOSC

When TMRx is equal to PRx, the following three events occur on the next increment cycle:

- TMRx is cleared
- The CCPx pin is set. (Exception: If the PWM duty cycle = 0%, the pin will not be set.)
- The PWM duty cycle is latched from CCPRxL into CCPRxH.

Note:	The Timer postscaler (see **Section 22.1 "Timer2/4/6 Operation"**) is not used in the determination of the PWM frequency.

24.3.5 PWM DUTY CYCLE

The PWM duty cycle is specified by writing a 10-bit value to multiple registers: CCPRxL register and DCxB<1:0> bits of the CCPxCON register. The CCPRxL contains the eight MSbs and the DCxB<1:0> bits of the CCPxCON register contain the two LSbs. CCPRxL and DCxB<1:0> bits of the CCPxCON register can be written to at any time. The duty cycle value is not latched into CCPRxH until after the period completes (i.e., a match between PRx and TMRx registers occurs). While using the PWM, the CCPRxH register is read-only.

Equation 24-2 is used to calculate the PWM pulse width.

Equation 24-3 is used to calculate the PWM duty cycle ratio.

EQUATION 24-2: PULSE WIDTH

$$Pulse\ Width = (CCPRxL{:}CCPxCON\langle 5{:}4\rangle) \bullet T_{OSC} \bullet (TMRx\ Prescale\ Value)$$

EQUATION 24-3: DUTY CYCLE RATIO

$$Duty\ Cycle\ Ratio = \frac{(CCPRxL{:}CCPxCON\langle 5{:}4\rangle)}{4(PRx + 1)}$$

The CCPRxH register and a 2-bit internal latch are used to double buffer the PWM duty cycle. This double buffering is essential for glitchless PWM operation.

The 8-bit timer TMRx register is concatenated with either the 2-bit internal system clock (FOSC), or two bits of the prescaler, to create the 10-bit time base. The system clock is used if the Timer2/4/6 prescaler is set to 1:1.

When the 10-bit time base matches the CCPRxH and 2-bit latch, then the CCPx pin is cleared (see Figure 24-4).

FIGURE 25-9: SPI MODE WAVEFORM (SLAVE MODE WITH CKE = 0)

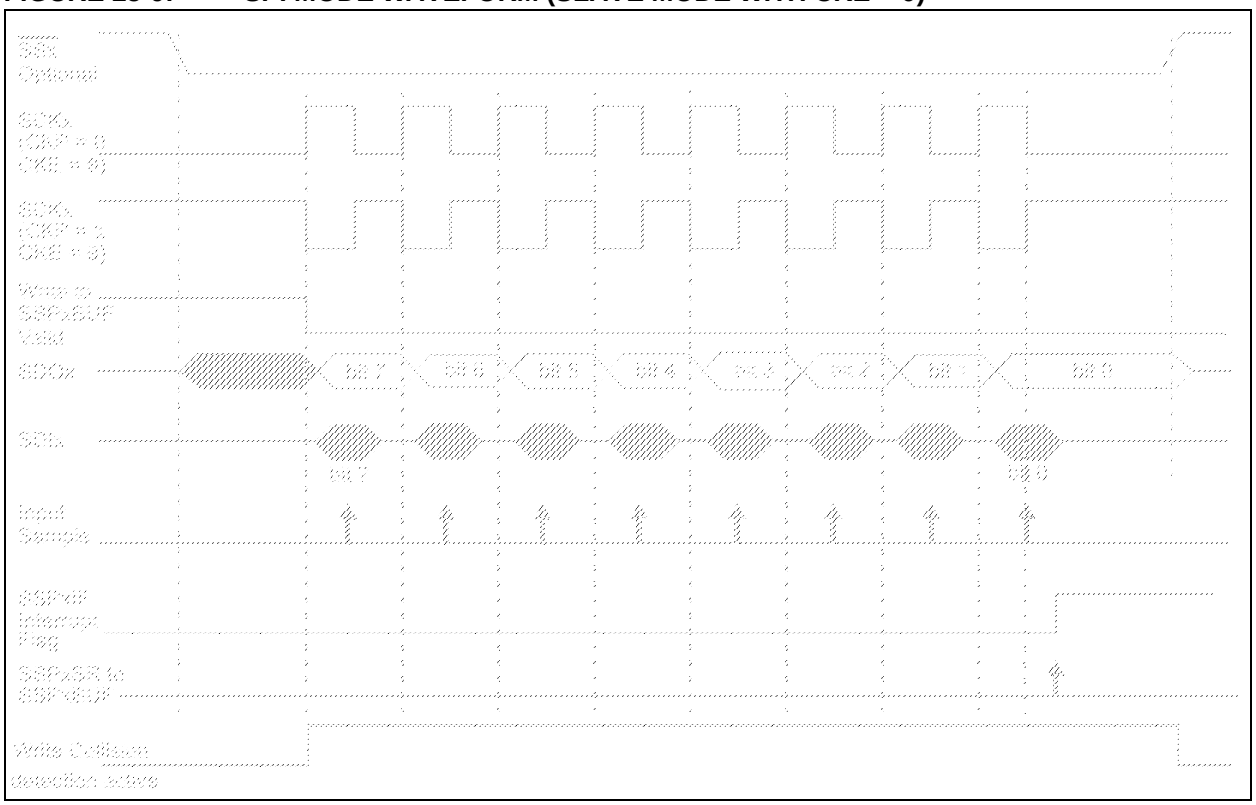


FIGURE 25-10: SPI MODE WAVEFORM (SLAVE MODE WITH CKE = 1)

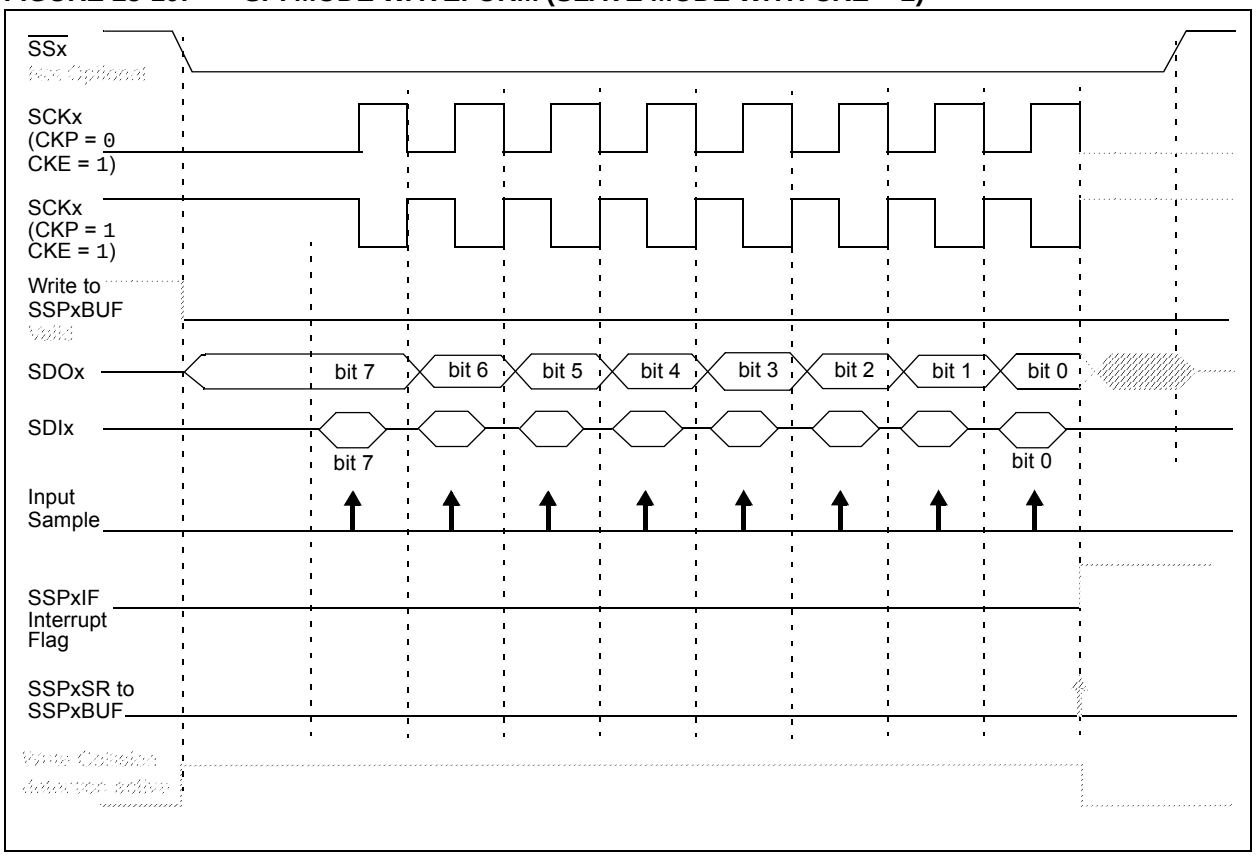
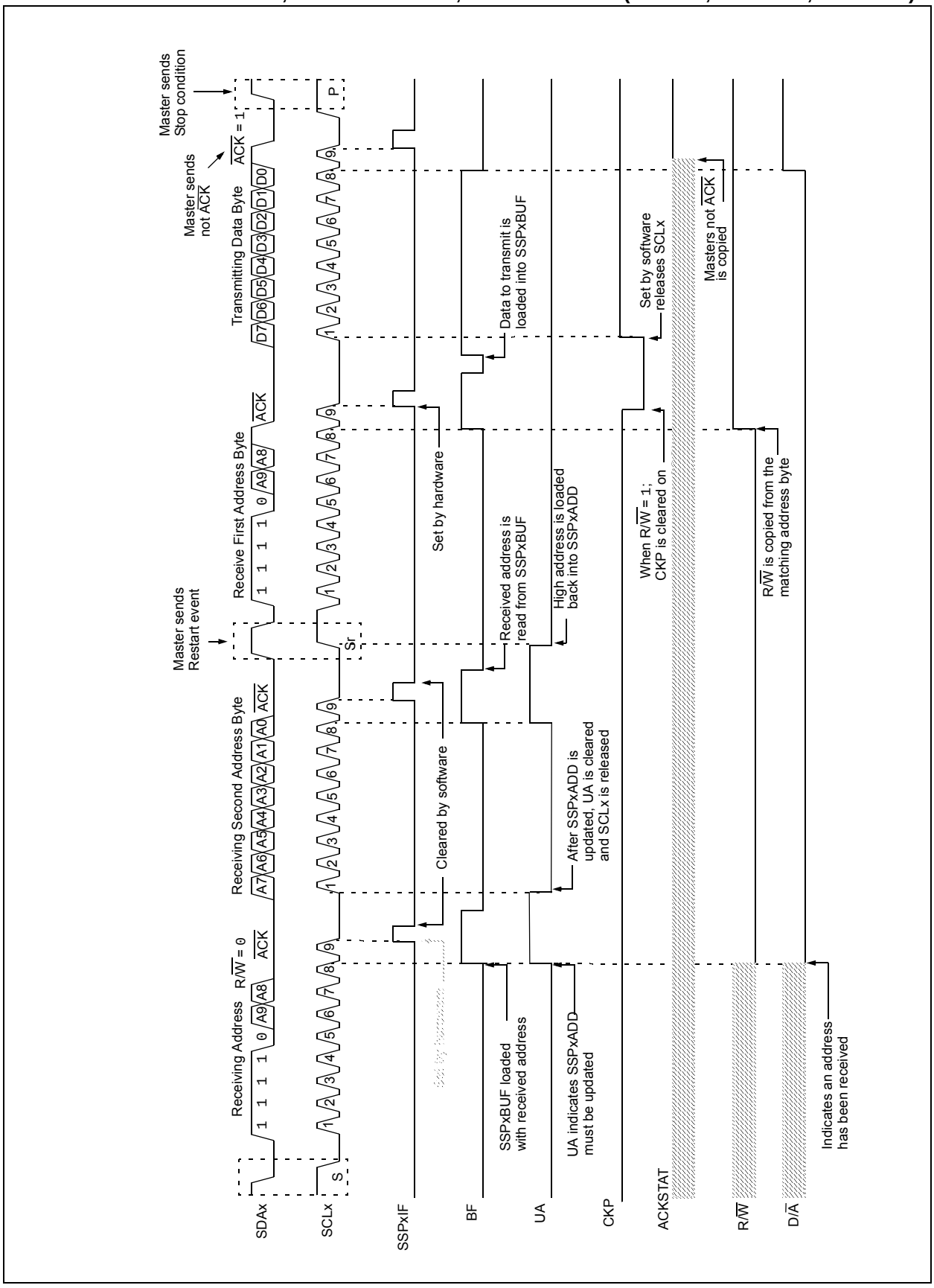


FIGURE 25-22: I²C SLAVE, 10-BIT ADDRESS, TRANSMISSION (SEN = 0, AHEN = 0, DHEN = 0)



26.1 EUSART Asynchronous Mode

The EUSART transmits and receives data using the standard non-return-to-zero (NRZ) format. NRZ is implemented with two levels: a VOH mark state which represents a '1' data bit, and a VOL space state which represents a '0' data bit. NRZ refers to the fact that consecutively transmitted data bits of the same value stay at the output level of that bit without returning to a neutral level between each bit transmission. An NRZ transmission port idles in the mark state. Each character transmission consists of one Start bit followed by eight or nine data bits and is always terminated by one or more Stop bits. The Start bit is always a space and the Stop bits are always marks. The most common data format is eight bits. Each transmitted bit persists for a period of 1/(Baud Rate). An on-chip dedicated 8-bit/16-bit Baud Rate Generator is used to derive standard baud rate frequencies from the system oscillator. See Table 26-5 for examples of baud rate configurations.

The EUSART transmits and receives the LSb first. The EUSART's transmitter and receiver are functionally independent, but share the same data format and baud rate. Parity is not supported by the hardware, but can be implemented in software and stored as the ninth data bit.

26.1.1 EUSART ASYNCHRONOUS TRANSMITTER

The EUSART transmitter block diagram is shown in Figure 26-1. The heart of the transmitter is the serial Transmit Shift Register (TSR), which is not directly accessible by software. The TSR obtains its data from the transmit buffer, which is the TXREG register.

26.1.1.1 Enabling the Transmitter

The EUSART transmitter is enabled for asynchronous operations by configuring the following three control bits:

- TXEN = 1
- SYNC = 0
- SPEN = 1

All other EUSART control bits are assumed to be in their default state.

Setting the TXEN bit of the TXSTA register enables the transmitter circuitry of the EUSART. Clearing the SYNC bit of the TXSTA register configures the EUSART for asynchronous operation. Setting the SPEN bit of the RCSTA register enables the EUSART and automatically configures the TX/CK I/O pin as an output. If the TX/CK pin is shared with an analog peripheral, the analog I/O function must be disabled by clearing the corresponding ANSEL bit.

Note 1:	The TXIF Transmitter Interrupt flag is set when the TXEN enable bit is set.

26.1.1.2 Transmitting Data

A transmission is initiated by writing a character to the TXREG register. If this is the first character, or the previous character has been completely flushed from the TSR, the data in the TXREG is immediately transferred to the TSR register. If the TSR still contains all or part of a previous character, the new character data is held in the TXREG until the Stop bit of the previous character has been transmitted. The pending character in the TXREG is then transferred to the TSR in one TCY immediately following the Stop bit transmission. The transmission of the Start bit, data bits and Stop bit sequence commences immediately following the transfer of the data to the TSR from the TXREG.

26.1.1.3 Transmit Data Polarity

The polarity of the transmit data can be controlled with the SCKP bit of the BAUDCON register. The default state of this bit is '0' which selects high true transmit idle and data bits. Setting the SCKP bit to '1' will invert the transmit data resulting in low true idle and data bits. The SCKP bit controls transmit data polarity in Asynchronous mode only. In Synchronous mode, the SCKP bit has a different function. See **Section 26.4.1.2 "Clock Polarity"**.

26.1.1.4 Transmit Interrupt Flag

The TXIF interrupt flag bit of the PIR1 register is set whenever the EUSART transmitter is enabled and no character is being held for transmission in the TXREG. In other words, the TXIF bit is only clear when the TSR is busy with a character and a new character has been queued for transmission in the TXREG. The TXIF flag bit is not cleared immediately upon writing TXREG. TXIF becomes valid in the second instruction cycle following the write execution. Polling TXIF immediately following the TXREG write will return invalid results. The TXIF bit is read-only, it cannot be set or cleared by software.

The TXIF interrupt can be enabled by setting the TXIE interrupt enable bit of the PIE1 register. However, the TXIF flag bit will be set whenever the TXREG is empty, regardless of the state of TXIE enable bit.

To use interrupts when transmitting data, set the TXIE bit only when there is more data to send. Clear the TXIE interrupt enable bit upon writing the last character of the transmission to the TXREG.

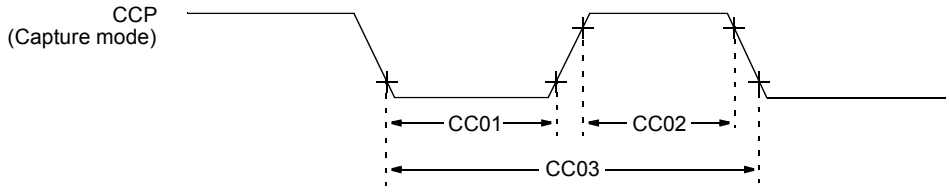
TABLE 30-6: TIMER0 AND TIMER1 EXTERNAL CLOCK REQUIREMENTS

Standard Operating Conditions (unless otherwise stated) Operating Temperature -40°C ≤ TA ≤ +125°C								
Param No.	**Sym.**	**Characteristic**		**Min.**	**Typ†**	**Max.**	**Units**	**Conditions**
40*	TT0H	T0CKI High-Pulse Width	No Prescaler	0.5 TCY + 20	—	—	ns	
			With Prescaler	10	—	—	ns	
41*	TT0L	T0CKI Low-Pulse Width	No Prescaler	0.5 TCY + 20	—	—	ns	
			With Prescaler	10	—	—	ns	
42*	TT0P	T0CKI Period		Greater of: 20 or TCY + 40 / N	—	—	ns	N = prescale value (2, 4, ..., 256)
45*	TT1H	T1CKI High Time	Synchronous, No Prescaler	0.5 TCY + 20	—	—	ns	
			Synchronous, with Prescaler	15	—	—	ns	
			Asynchronous	30	—	—	ns	
46*	TT1L	T1CKI Low Time	Synchronous, No Prescaler	0.5 TCY + 20	—	—	ns	
			Synchronous, with Prescaler	15	—	—	ns	
			Asynchronous	30	—	—	ns	
47*	TT1P	T1CKI Input Period	Synchronous	Greater of: 30 or TCY + 40 / N	—	—	ns	N = prescale value (1, 2, 4, 8)
			Asynchronous	60	—	—	ns	
48	FT1	Timer1 Oscillator Input Frequency Range (oscillator enabled by setting bit T1OSCEN)		32.4	32.768	33.1	kHz	
49*	TCKEZTMR1	Delay from External Clock Edge to Timer Increment		2 TOSC	—	7 TOSC	—	Timers in Sync mode

* These parameters are characterized but not tested.

† Data in "Typ" column is at 3.0V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

FIGURE 30-11: CAPTURE/COMPARE/PWM TIMINGS (CCP)



Note: Refer to Figure 30.5 for load conditions.

TABLE 30-7: CAPTURE/COMPARE/PWM REQUIREMENTS (CCP)

Standard Operating Conditions (unless otherwise stated) Operating Temperature -40°C ≤ TA ≤ +125°C								
Param No.	**Sym.**	**Characteristic**		**Min.**	**Typ†**	**Max.**	**Units**	**Conditions**
CC01*	TccL	CCP Input Low Time	No Prescaler	0.5TCY + 20	—	—	ns	
			With Prescaler	20	—	—	ns	
CC02*	TccH	CCP Input High Time	No Prescaler	0.5TCY + 20	—	—	ns	
			With Prescaler	20	—	—	ns	
CC03*	TccP	CCP Input Period		3TCY + 40 / N	—	—	ns	N = prescale value

* These parameters are characterized but not tested.

† Data in "Typ" column is at 3.0V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

FIGURE 30-18: SPI SLAVE MODE TIMING (CKE = 0)

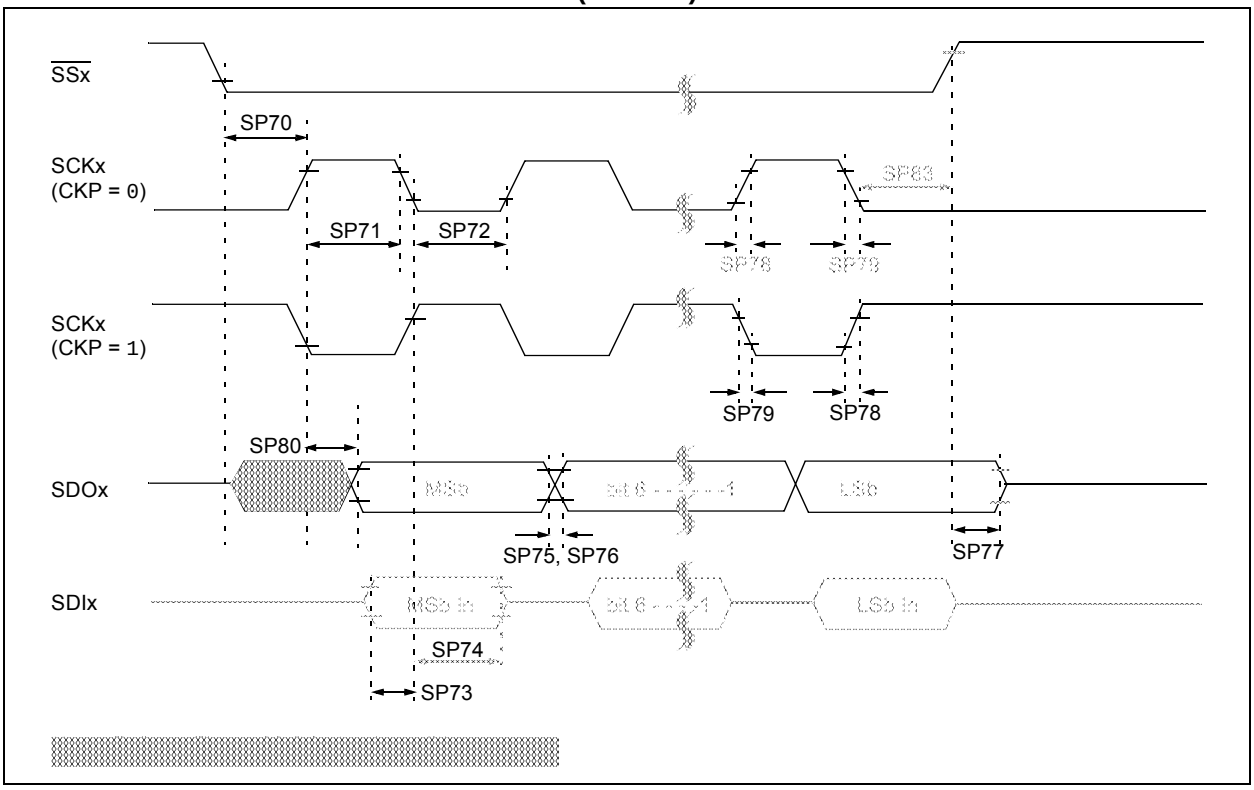


FIGURE 30-19: SPI SLAVE MODE TIMING (CKE = 1)

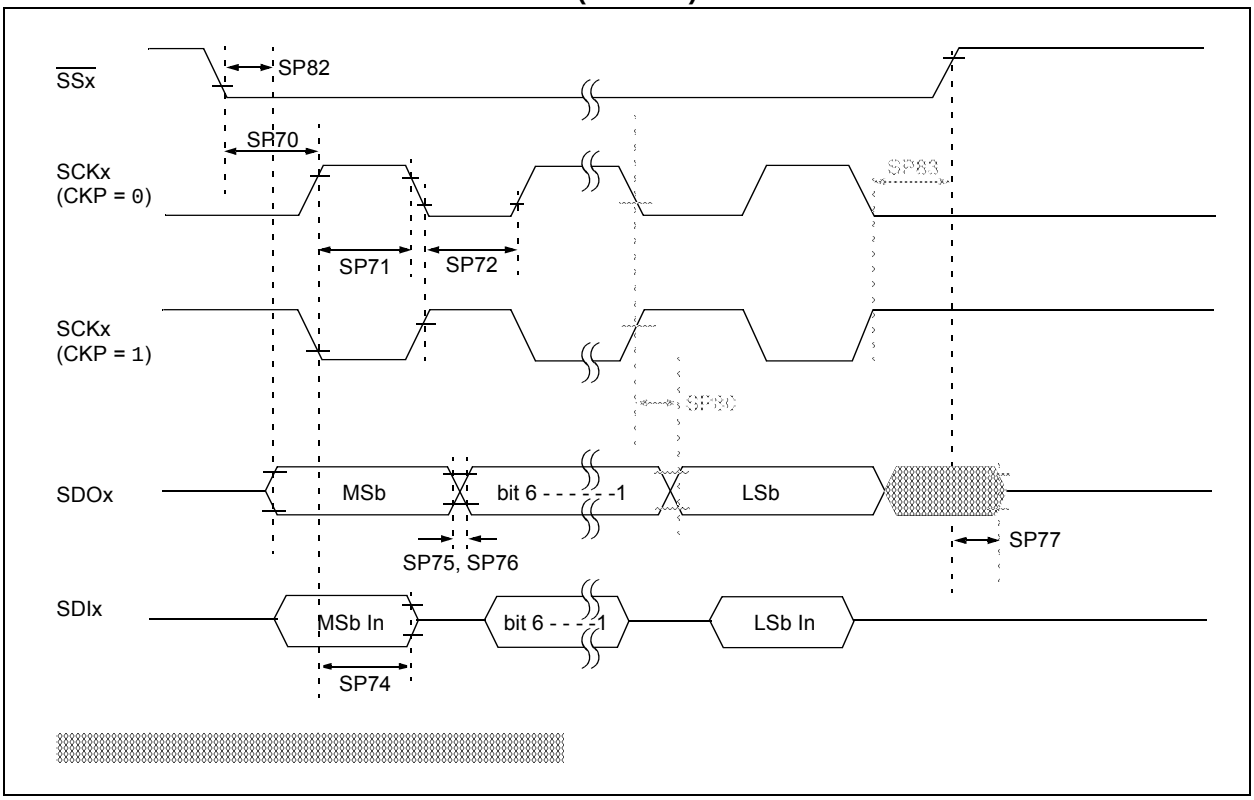


FIGURE 31-7: IDD TYPICAL, EC OSCILLATOR, MEDIUM-POWER MODE, PIC16LF1825/9 ONLY

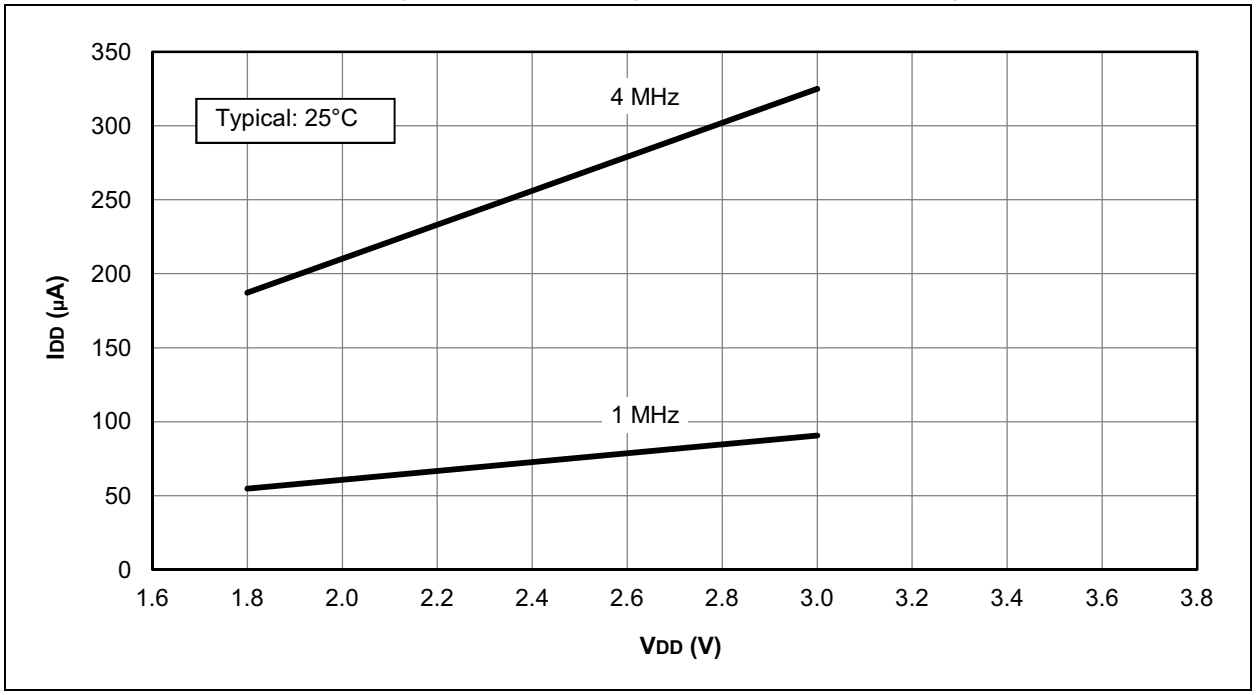
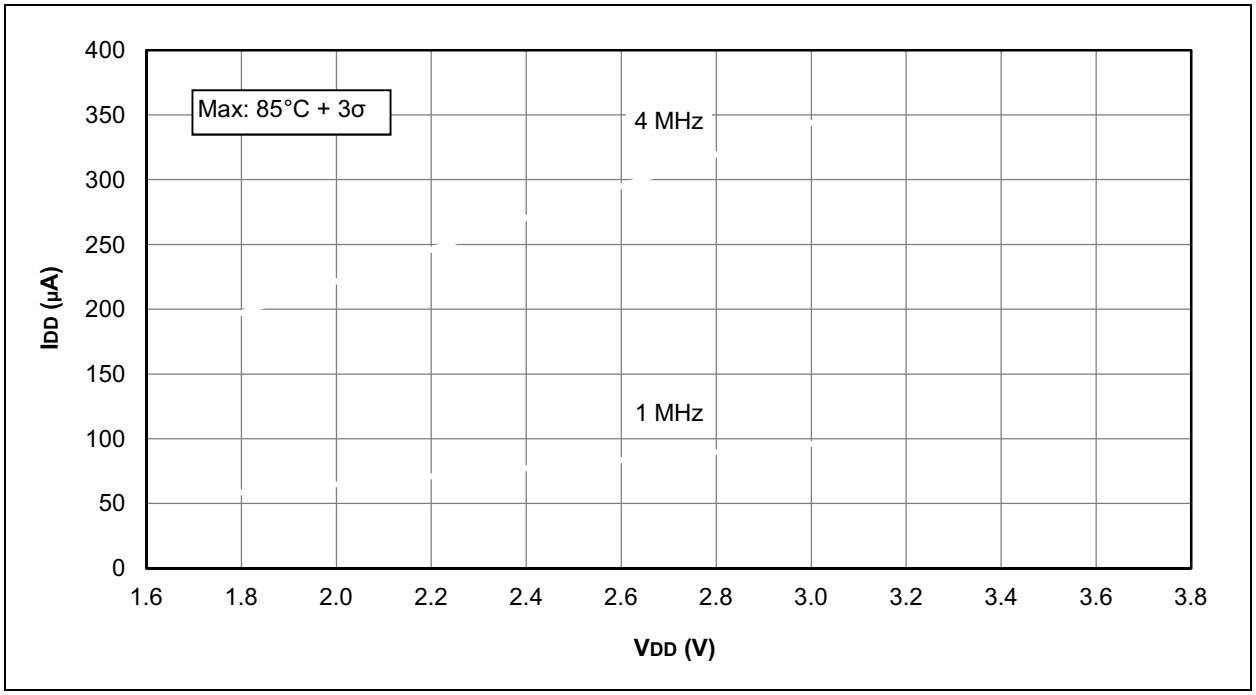


FIGURE 31-8: IDD MAXIMUM, EC OSCILLATOR, MEDIUM-POWER MODE, PIC16LF1825/9 ONLY



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