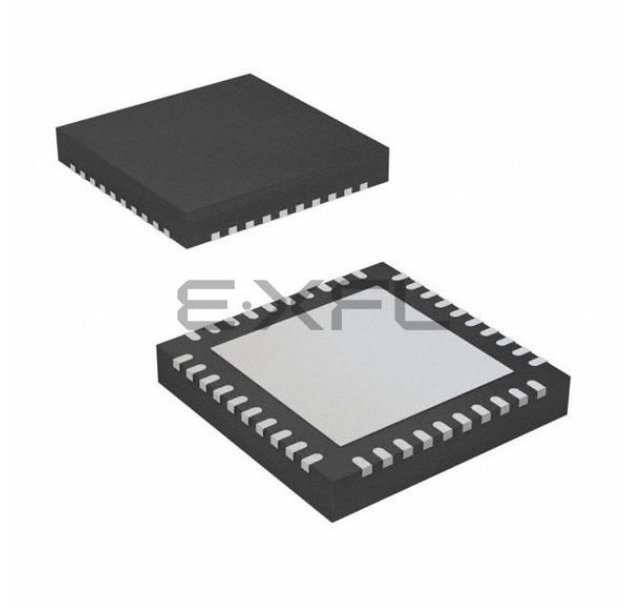

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Applications of "Embedded - Microcontrollers"

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	36
Program Memory Size	14KB (8K x 14)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 3.6V
Data Converters	A/D 34x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	40-UFQFN Exposed Pad
Supplier Device Package	40-UQFN (5x5)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic16lf1567-e-mv

TABLE 3-11: SPECIAL FUNCTION REGISTER SUMMARY (CONTINUED)

Addr.	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 5											
280h	INDF0(1)	Addressing this location uses contents of FSR0H/FSR0L to address data memory (not a physical register)								xxxx xxxx	uuuu uuuu
281h	INDF1(1)	Addressing this location uses contents of FSR1H/FSR1L to address data memory (not a physical register)								xxxx xxxx	uuuu uuuu
282h	PCL(1)	Program Counter (PC) Least Significant Byte								0000 0000	0000 0000
283h	STATUS(1)	—	—	—	$\overline{TO}$	$\overline{PD}$	Z	DC	C	---1 1000	---q quuu
284h	FSR0L(1)	Indirect Data Memory Address 0 Low Pointer								0000 0000	uuuu uuuu
285h	FSR0H(1)	Indirect Data Memory Address 0 High Pointer								0000 0000	0000 0000
286h	FSR1L(1)	Indirect Data Memory Address 1 Low Pointer								0000 0000	uuuu uuuu
287h	FSR1H(1)	Indirect Data Memory Address 1 High Pointer								0000 0000	0000 0000
288h	BSR(1)	—	—	—	BSR<4:0>					---0 0000	---0 0000
289h	WREG(1)	Working Register								0000 0000	uuuu uuuu
28Ah	PCLATH(1)	—	Write Buffer for the upper 7 bits of the Program Counter							-000 0000	-000 0000
28Bh	INTCON(1)	GIE	PEIE	TMR0IE	INTE	IOCIE	TMR0IF	INTF	IOCIF	0000 0000	0000 0000
28Ch	—	Unimplemented								—	—
28Dh	—	Unimplemented								—	—
28Eh	—	Unimplemented								—	—
28Fh	—	Unimplemented								—	—
290h	—	Unimplemented								—	—
291h	—	Unimplemented								—	—
292h	—	Unimplemented								—	—
293h	—	Unimplemented								—	—
294h	—	Unimplemented								—	—
295h	—	Unimplemented								—	—
296h	—	Unimplemented								—	—
297h	—	Unimplemented								—	—
298h	—	Unimplemented								—	—
299h	—	Unimplemented								—	—
29Ah	—	Unimplemented								—	—
29Bh	—	Unimplemented								—	—
29Ch	—	Unimplemented								—	—
29Dh	—	Unimplemented								—	—
29Eh	—	Unimplemented								—	—
29Fh	—	Unimplemented								—	—

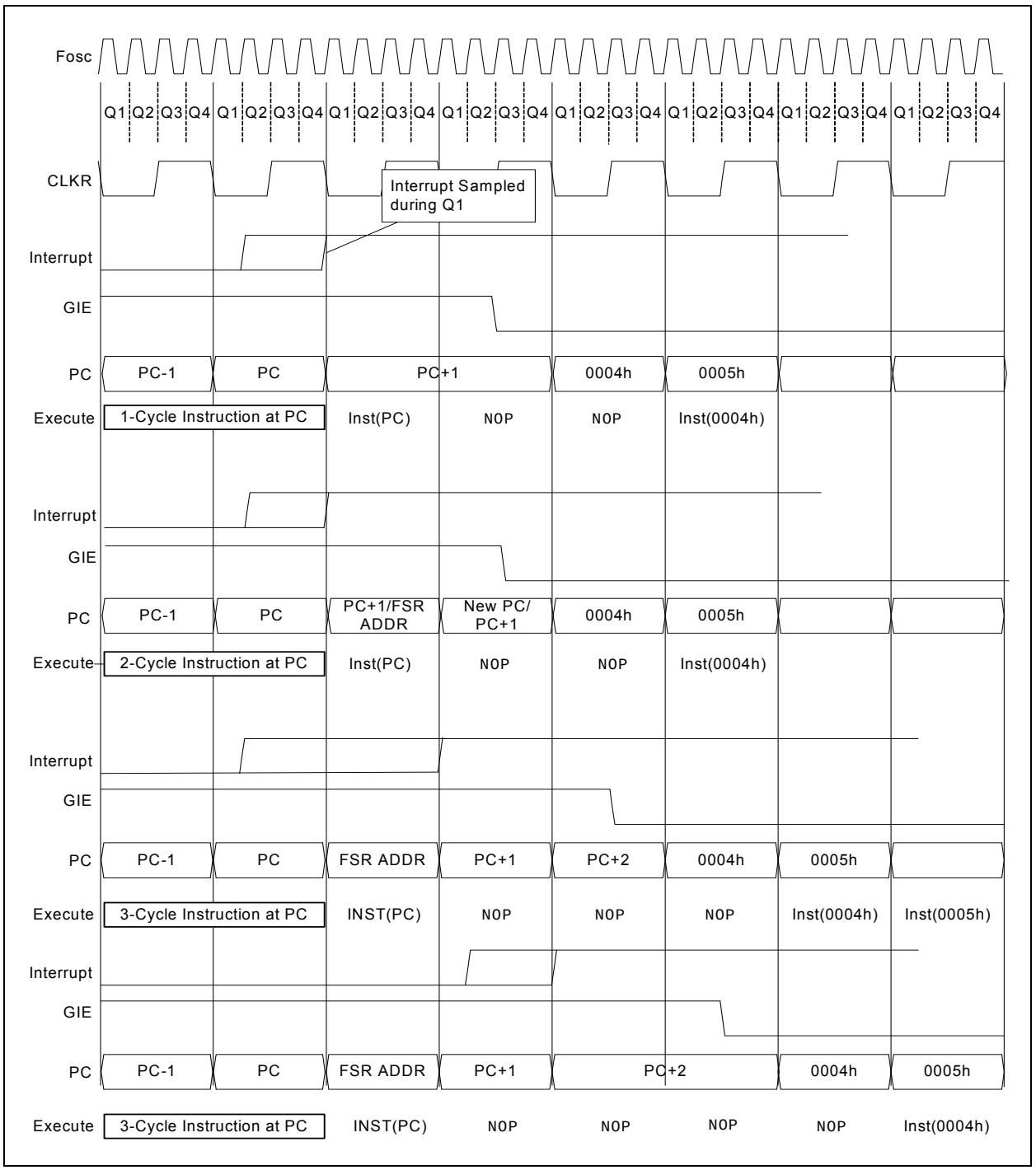
Legend: x = unknown, u = unchanged, q = depends on condition, - = unimplemented, read as '0', r = reserved. Shaded locations unimplemented, read as '0'.

Note 1: These registers can be accessed from any bank.
2: PIC16LF1567.
3: These registers/bits are available at two address locations, in Bank 1 and Bank 14.
4: PIC16LF1566 only.
5: Unimplemented, read as '1'.

7.2 Interrupt Latency

Interrupt latency is defined as the time from when the interrupt event occurs to the time code execution at the interrupt vector begins. The latency for synchronous interrupts is three or four instruction cycles. For asynchronous interrupts, the latency is three to five instruction cycles, depending on when the interrupt occurs. See Figure 7-2 and Figure 7-3 for more details.

FIGURE 7-2: INTERRUPT LATENCY



REGISTER 10-3: PMADRL: PROGRAM MEMORY ADDRESS LOW BYTE 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
PMADR<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 **PMADR<7:0>**: Specifies the Least Significant bits for program memory address

REGISTER 10-4: PMADRH: PROGRAM MEMORY 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
—	PMADR<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 **PMADR<14:8>**: Specifies the Most Significant bits for program memory address

REGISTER 10-5: PMCON1: PROGRAM MEMORY CONTROL 1 REGISTER

U-1	R/W-0/0	R/W-0/0	R/W/HC-0/0	R/W/HC-x/q	R/W-0/0	R/S/HC-0/0	R/S/HC-0/0
—	CFGS	LWLO	FREE	WRERR	WREN	WR	RD
bit 7							bit 0

Legend:		
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as ‘0’
S = Bit can only be set	x = Bit is unknown	-n/n = Value at POR and BOR/Value at all other Resets
‘1’ = Bit is set	‘0’ = Bit is cleared	HC = Bit is cleared by hardware

bit 7 **Unimplemented:** Read as ‘1’

bit 6 **CFGS:** Configuration Select bit
- 1 = Access Configuration, User ID and Device ID Registers
- 0 = Access Flash program memory

bit 5 **LWLO:** Load Write Latches Only bit(1)
- 1 = Only the addressed program memory write latch is loaded/updated on the next WR command
- 0 = The addressed program memory write latch is loaded/updated and a write of all program memory write latches will be initiated on the next WR command

bit 4 **FREE:** Program Flash Erase Enable bit
- 1 = Performs an erase operation on the next WR command (hardware cleared upon completion)
- 0 = Performs a write operation on the next WR command

bit 3 **WRERR:** Program/Erase Error Flag bit(2)
- 1 = Condition indicates an improper program or erase sequence attempt or termination (bit is set automatically on any set attempt (write ‘1’) of the WR bit).
- 0 = The program or erase operation completed normally.

bit 2 **WREN:** Program/Erase Enable bit
- 1 = Allows program/erase cycles
- 0 = Inhibits programming/erasing of program Flash

bit 1 **WR:** Write Control bit
- 1 = Initiates a program Flash program/erase operation.
  The operation is self-timed and the bit is cleared by hardware once operation is complete.
  The WR bit can only be set (not cleared) in software.
- 0 = Program/erase operation to the Flash is complete and inactive.

bit 0 **RD:** Read Control bit
- 1 = Initiates a program Flash read. Read takes one cycle. RD is cleared in hardware. The RD bit can only be set (not cleared) in software.
- 0 = Does not initiate a program Flash read.

Note 1: The LWLO bit is ignored during a program memory erase operation (FREE = 1).
2: The WRERR bit is automatically set by hardware when a program memory write or erase operation is started (WR = 1).

REGISTER 11-17: LATD(1): PORTD DATA LATCH 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
LATD7	LATD6	LATD5	LATD4	LATD3	LATD2	LATD1	LATD0
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 **LATD<7:0>**: PORTD Output Latch Value bits(2)

Note 1: Functions not available on PIC16LF1566.

2: Writes to PORTD are actually written to corresponding LATD register. Reads from PORTD register is return of actual I/O pin values.

REGISTER 11-18: ANSELD(1): PORTD ANALOG SELECT 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
ANSD7	ANSD6	ANSD5	ANSD4	ANSD3	ANSD2	ANSD1	ANSD0
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 **ANSD<7:0>**: Analog Select between Analog or Digital Function on pins RD<7:0>, respectively
1 = Analog input. Pin is assigned as analog input(2). Digital input buffer disabled.
0 = Digital I/O. Pin is assigned to port or digital special function.

Note 1: Functions not available on PIC16LF1566.

2: When setting a pin to an analog input, the corresponding TRIS bit must be set to Input mode in order to allow external control of the voltage on the pin.

TABLE 11-11: SUMMARY OF REGISTERS ASSOCIATED WITH PORTD

Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Register on Page
ANSELD(1)	ANSD7	ANSD6	ANSD5	ANSD4	ANSD3	ANSD2	ANSD1	ANSD0	127
LATD(1)	LATD7	LATD6	LATD5	LATD4	LATD3	LATD2	LATD1	LATD0	127
PORTD(1)	RD7	RD6	RD5	RD4	RD3	RD2	RD1	RD0	126
TRISD(1)	TRISD7	TRISD6	TRISD5	TRISD4	TRISD3	TRISD2	TRISD1	TRISD0	126

Legend: x = unknown, u = unchanged, - = unimplemented locations read as '0'. Shaded cells are not used by PORTD.

Note 1: Functions not available on PIC16LF1566.

15.2.6 INDIVIDUAL ADC CONVERSION PROCEDURE

This is an example procedure for using the ADCx to perform an Analog-to-Digital conversion:

1. Configure Port:
   - Disable pin output driver (Refer to the TRISx register)
   - Configure pin as analog (Refer to the ANSELx register)
   - Disable weak pull-ups either globally (Refer to the OPTION_REG register) or individually (Refer to the appropriate WPUx register)
2. Configure the ADCx module:
   - Select ADCx conversion clock
   - Configure voltage reference
   - Select ADCx input channel
   - Turn on ADCx module
3. Configure ADCx interrupt (optional):
   - Clear ADCx interrupt flag
   - Enable ADCx interrupt
   - Enable peripheral interrupt
   - Enable global interrupt**(1)**
4. Wait the required acquisition time**(2)**.
5. Start conversion by setting the GO/$\overline{\text{DONE}}$x bit.
6. Wait for ADCx conversion to complete by one of the following:
   - Polling the GO/$\overline{\text{DONE}}$x bit
   - Waiting for the ADCx interrupt (interrupts enabled)
7. Read ADCx Result.
8. Clear the ADCx interrupt flag (required if interrupt is enabled).

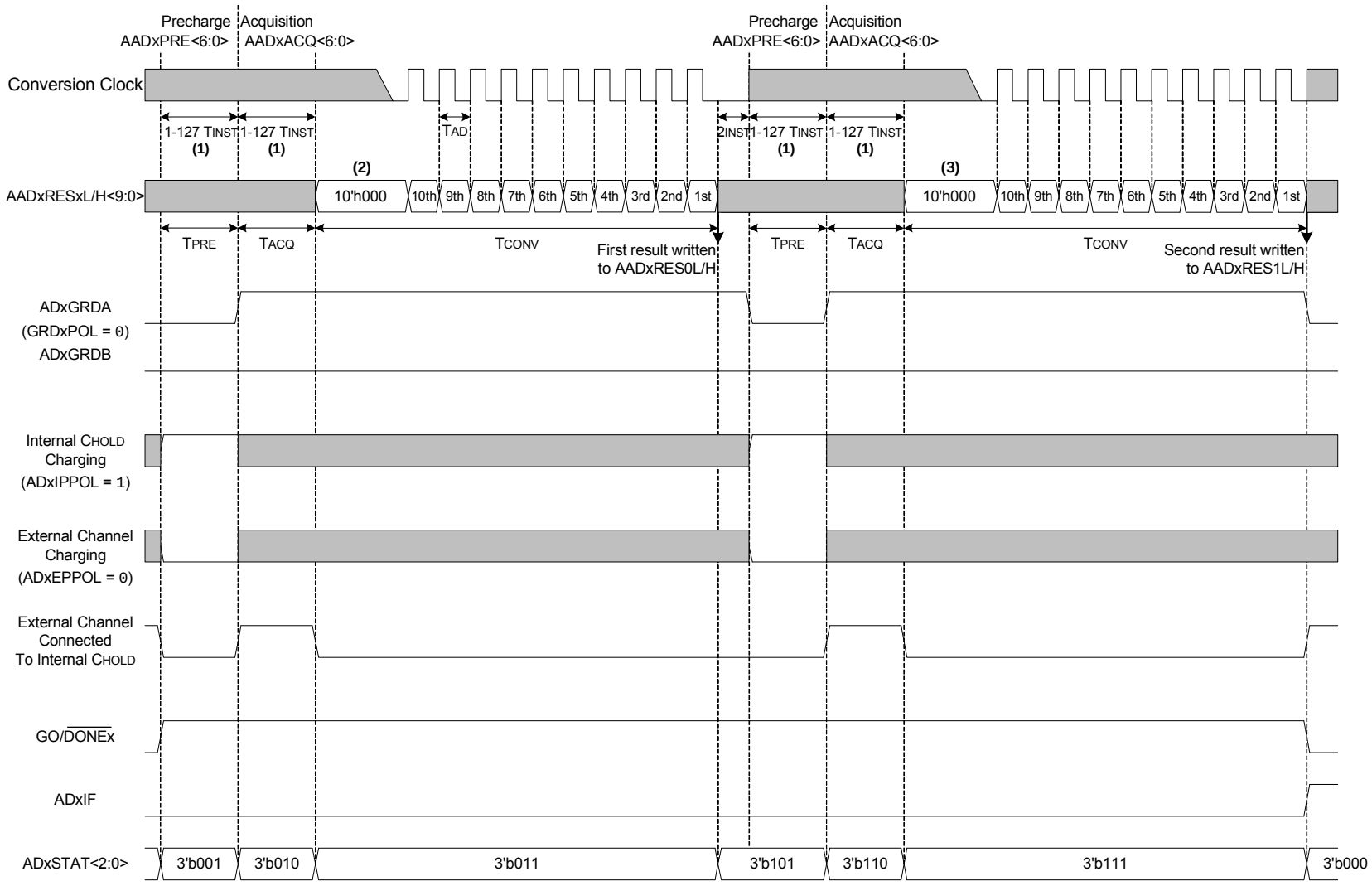
Note 1: The global interrupt can be disabled if the user is attempting to wake-up from Sleep and resume in-line code execution.

2: Refer to **Section 15.4 "ADC Acquisition Requirements"**.

EXAMPLE 15-1: ADC CONVERSION

```
;This code block configures the ADC1
;for polling, Vdd and Vss references, FRC
;oscillator and AN0 input.
;
;Conversion start and polling for completion
;are included.
;
BANKSEL   ADCON1       ;
MOVLW     B'11110000'  ;Right justify, FRC
                       ;oscillator
MOVWF     ADCON1       ;VDD is VREFH
BANKSEL   TRISA        ;
BSF       TRISA,0      ;Set RA0 to input
BANKSEL   ANSELA       ;
BSF       ANSELA,0     ;Set RA0 to analog
BANKSEL   WPUA
BCF       WPUA,0        ;Disable RA0 weak
                        pull-up
BANKSEL   ADCON0       ;
MOVLW     B'00000001'  ;Select channel AN0
MOVWF     ADCON0       ;Turn ADC On
MOVLW     .5
MOVWF     AAD1ACQ      ;Acquisiton delay
BSF       ADCON0,ADGO  ;Start conversion
BTFSC     ADCON0,ADGO  ;Is conversion done?
GOTO      $-1          ;No, test again
BANKSEL   AD1RES0H     ;
MOVF      AD1RES0H,W   ;Read upper 2 bits
MOVWF     RESULTHI     ;store in GPR space
BANKSEL   AD1RES0L     ;
MOVF      AD1RES0L,W   ;Read lower 8 bits
MOVWF     RESULTLO     ;Store in GPR space
```


FIGURE 16-6: DOUBLE SAMPLE CONVERSION SEQUENCE (ADDSEN = 1 AND ADIPEN = 0)



Note 1: When the conversion clock is ADCRC, the precharge and acquisition timers are clocked by ADCRC.
2: The AADxRES0L/H registers are set to zero during this period.
3: The AADxRES1L/H registers are set to zero during this period.

18.5.2.1 T1G Pin Gate Operation

The T1G pin is one source for Timer1 gate control. It can be used to supply an external source to the Timer1 gate circuitry.

18.5.2.2 Timer0 Overflow Gate Operation

When Timer0 increments from FFh to 00h, a low-to-high pulse will automatically be generated and internally supplied to the Timer1 gate circuitry.

18.5.3 TIMER1 GATE TOGGLE MODE

When Timer1 Gate Toggle mode is enabled, it is possible to measure the full-cycle length of a Timer1 gate signal, as opposed to the duration of a single level pulse.

The Timer1 gate source is routed through a flip-flop that changes state on every incrementing edge of the signal. See Figure 18-4 for timing details.

Timer1 Gate Toggle mode is enabled by setting the T1GTM bit of the T1GCON register. When the T1GTM bit is cleared, the flip-flop is cleared and held clear. This is necessary in order to control which edge is measured.

Note:	Enabling Toggle mode at the same time as changing the gate polarity may result in indeterminate operation.

18.5.4 TIMER1 GATE SINGLE-PULSE MODE

When Timer1 Gate Single-Pulse mode is enabled, it is possible to capture a single pulse gate event. Timer1 Gate Single-Pulse mode is first enabled by setting the T1GSPM bit in the T1GCON register. Next, the T1GGO/$\overline{\text{DONE}}$ bit in the T1GCON register must be set. The Timer1 will be fully enabled on the next incrementing edge. On the next trailing edge of the pulse, the T1GGO/$\overline{\text{DONE}}$ bit will automatically be cleared. No other gate events will be allowed to increment Timer1 until the T1GGO/$\overline{\text{DONE}}$ bit is once again set in software. See Figure 18-5 for timing details.

If the Single Pulse Gate mode is disabled by clearing the T1GSPM bit in the T1GCON register, the T1GGO/$\overline{\text{DONE}}$ bit should also be cleared.

Enabling the Toggle mode and the Single-Pulse mode simultaneously will permit both sections to work together. This allows the cycle times on the Timer1 gate source to be measured. See Figure 18-6 for timing details.

18.5.5 TIMER1 GATE VALUE STATUS

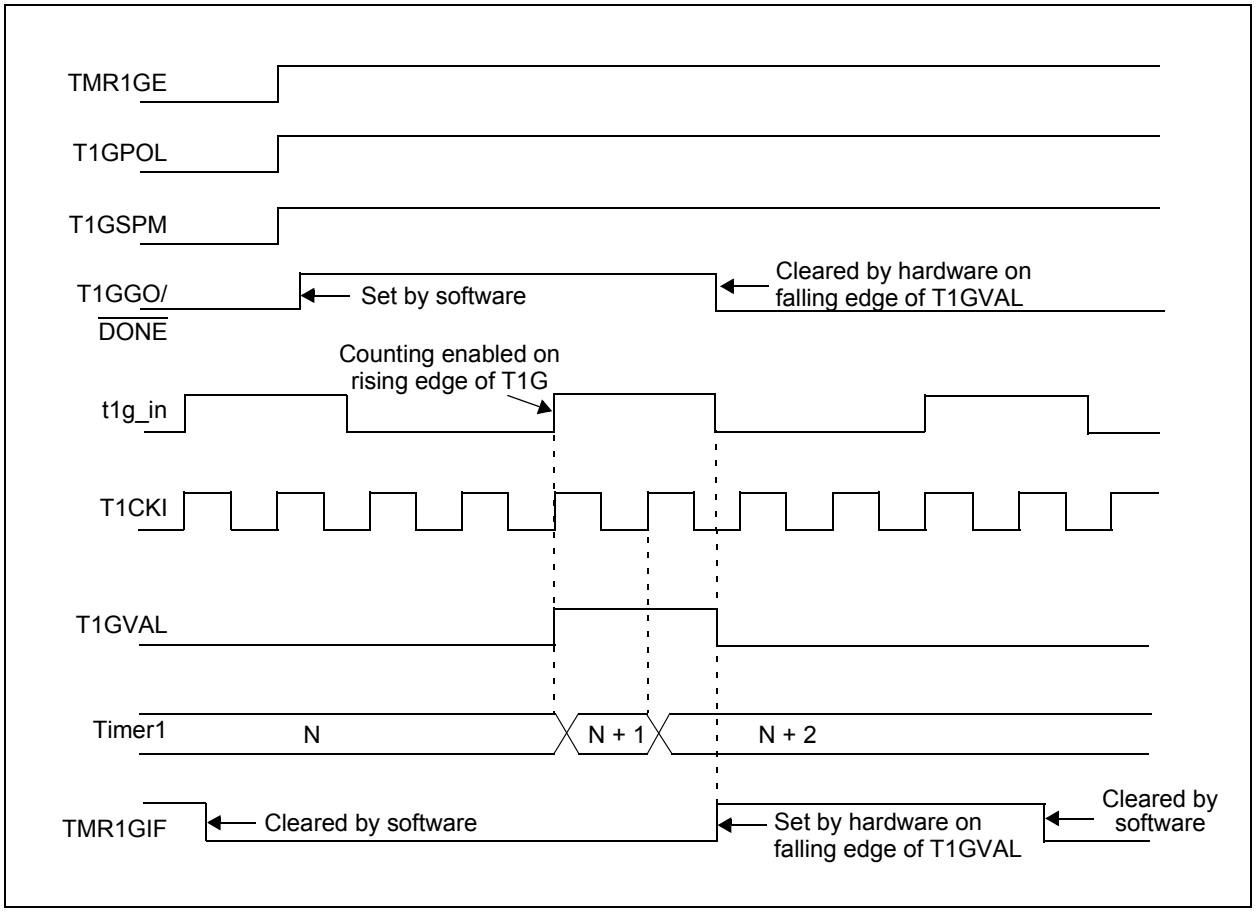
When Timer1 Gate Value Status is utilized, it is possible to read the most current level of the gate control value. The value is stored in the T1GVAL bit in the T1GCON register. The T1GVAL bit is valid even when the Timer1 gate is not enabled (TMR1GE bit is cleared).

18.5.6 TIMER1 GATE EVENT INTERRUPT

When Timer1 Gate Event Interrupt is enabled, it is possible to generate an interrupt upon the completion of a gate event. When the falling edge of T1GVAL occurs, the TMR1GIF flag bit in the PIR1 register will be set. If the TMR1GIE bit in the PIE1 register is set, then an interrupt will be recognized.

The TMR1GIF flag bit operates even when the Timer1 gate is not enabled (TMR1GE bit is cleared).

FIGURE 18-5: TIMER1 GATE SINGLE-PULSE MODE



The I^2C interface supports the following modes and features:

- Master mode
- Slave mode
- Byte NACKing (Slave mode)
- Limited Multi-master support
- 7-bit and 10-bit addressing
- Start and Stop interrupts
- Interrupt masking
- Clock stretching
- Bus collision detection
- General call address matching
- Address masking
- Address Hold and Data Hold modes
- Selectable SDAx hold times

Figure 20-2 is a block diagram of the I^2C Interface module in Master mode. Figure 20-3 is a diagram of the I^2C interface module in Slave mode.

The PIC12LF1552 has two MSSP modules, MSSP1 and MSSP2, each module operating independently from the other.

Note 1: In devices with more than one MSSP module, it is very important to pay close attention to SSPxCONx register names. SSP1CON1 and SSP1CON2 registers control different operational aspects of the same module, while SSP1CON1 and SSP2CON1 control the same features for two different modules.

2: Throughout this section, generic references to an MSSP module in any of its operating modes may be interpreted as being equally applicable to MSSP1 or MSSP2. Register names, module I/O signals, and bit names may use the generic designator 'x' to indicate the use of a numeral to distinguish a particular module when required.

FIGURE 20-2: MSSPX BLOCK DIAGRAM (I^2C MASTER MODE)

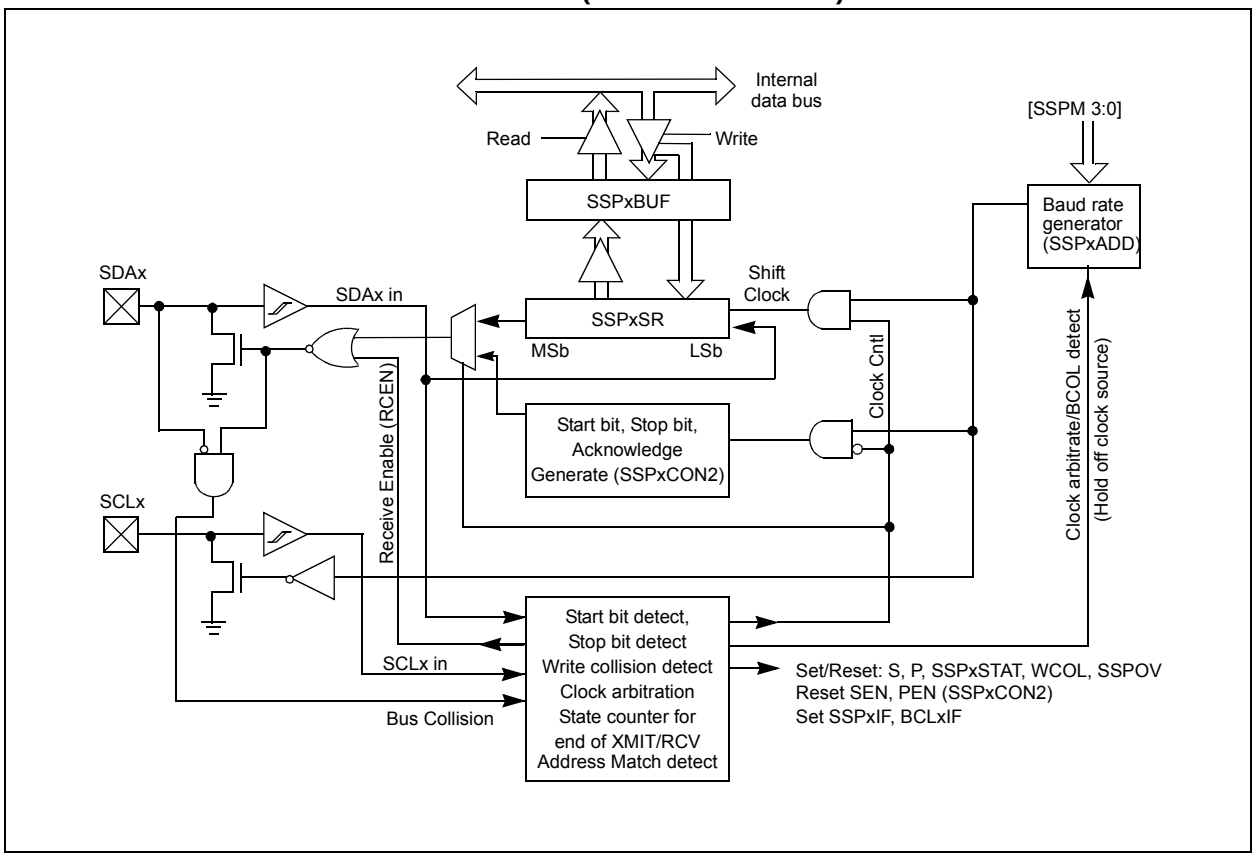
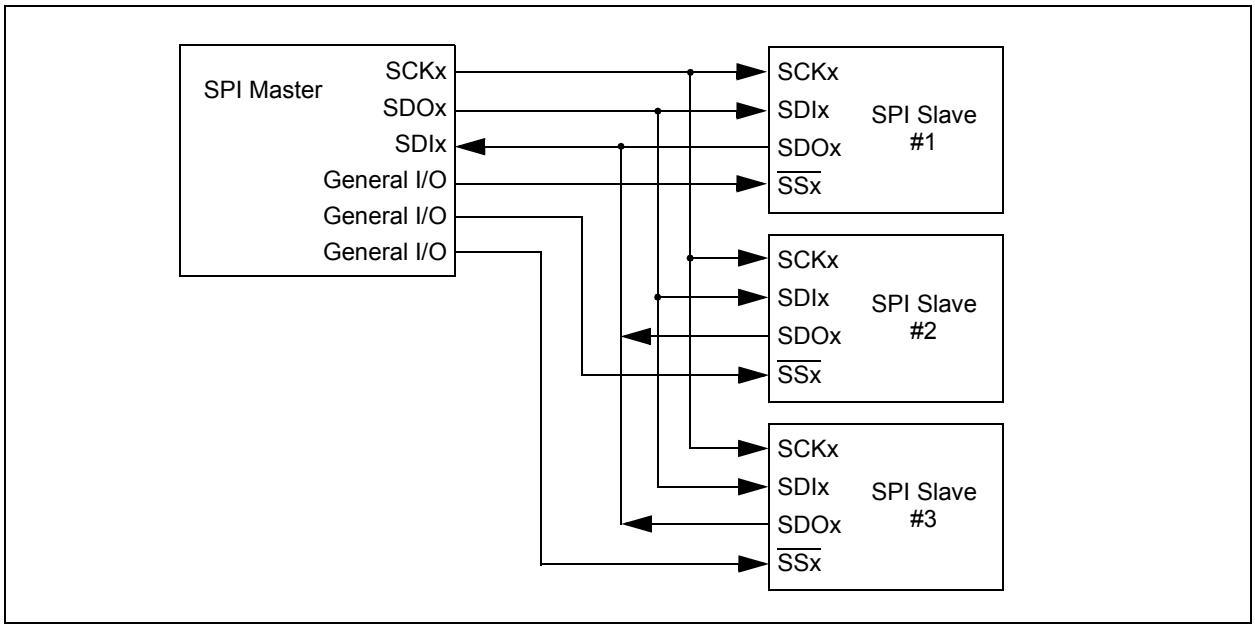


FIGURE 20-4: SPI MASTER AND MULTIPLE SLAVE CONNECTION



20.2.1 SPI MODE REGISTERS

The MSSPx module has five registers for SPI mode operation. These are:

- MSSPx STATUS register (SSPxSTAT)
- MSSPx Control register 1 (SSPxCON1)
- MSSPx Control register 3 (SSPxCON3)
- MSSPx Data Buffer register (SSPxBUF)
- MSSPx Address register (SSPxADD)
- MSSPx Shift register (SSPxSR) (Not directly accessible)

SSPxCON1 and SSPxSTAT are the control and STATUS registers in SPI mode operation. The SSPxCON1 register is readable and writable. The lower six bits of the SSPxSTAT are read-only. The upper two bits of the SSPxSTAT are read/write.

In one SPI master mode, SSPxADD can be loaded with a value used in the Baud Rate Generator. More information on the Baud Rate Generator is available in **Section 20.7 "Baud Rate Generator"**.

SSPxSR is the shift register used for shifting data in and out. SSPxBUF provides indirect access to the SSPxSR register. SSPxBUF is the buffer register to which data bytes are written, and from which data bytes are read.

In receive operations, SSPxSR and SSPxBUF together create a buffered receiver. When SSPxSR receives a complete byte, it is transferred to SSPxBUF and the SSPxIF interrupt is set.

During transmission, the SSPxBUF is not buffered. A write to SSPxBUF will write to both SSPxBUF and SSPxSR.

20.2.2 SPI MODE OPERATION

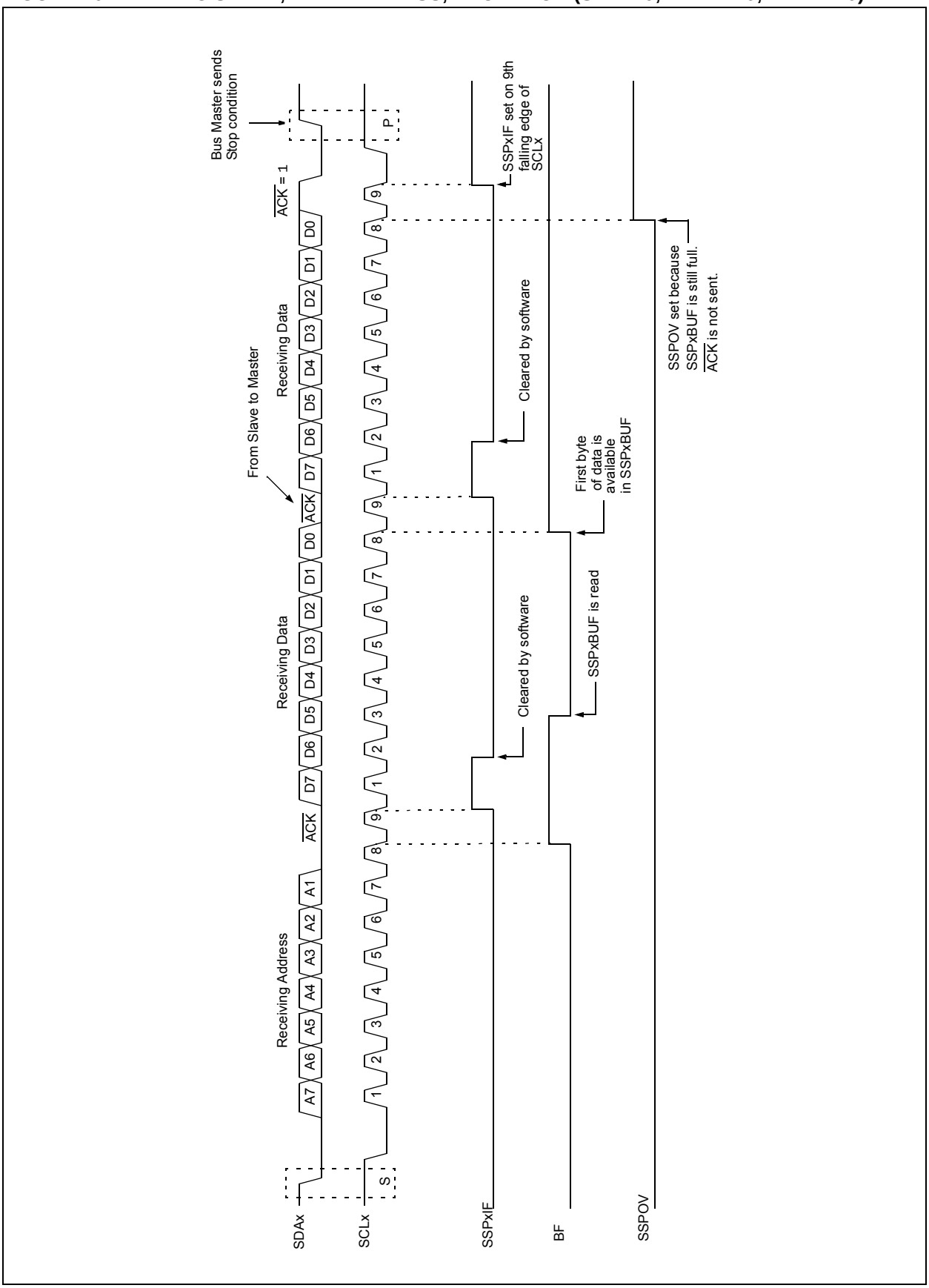
When initializing the SPI, several options need to be specified. This is done by programming the appropriate control bits (SSPxCON1<5:0> and SSPxSTAT<7:6>). These control bits allow the following to be specified:

- Master mode (SCKx is the clock output)
- Slave mode (SCKx is the clock input)
- Clock Polarity (Idle state of SCKx)
- Data Input Sample Phase (middle or end of data output time)
- Clock Edge (output data on rising/falling edge of SCKx)
- Clock Rate (Master mode only)
- Slave Select mode (Slave mode only)

To enable the serial port, SSPx Enable bit, SSPEN of the SSPxCON1 register, must be set. To reset or reconfigure SPI mode, clear the SSPEN bit, re-initialize the SSPxCONx registers and then set the SSPEN bit. This configures the SDIx, SDOx, SCKx and $\overline{SSx}$ pins as serial port pins. For the pins to behave as the serial port function, some must have their data direction bits (in the TRIS register) appropriately programmed as follows:

- SDIx must have corresponding TRIS bit set
- SDOx must have corresponding TRIS bit cleared
- SCKx (Master mode) must have corresponding TRIS bit cleared
- SCKx (Slave mode) must have corresponding TRIS bit set
- $\overline{SSx}$ must have corresponding TRIS bit set

FIGURE 20-14: I²C SLAVE, 7-BIT ADDRESS, RECEPTION (SEN = 0, AHEN = 0, DHEN = 0)



REGISTER 20-5: SSPxMSK: SSPx MASK 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
MSK<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 7-1 **MSK<7:1>:** Mask bits
1 = The received address bit n is compared to SSPxADD<n> to detect I^2C address match
0 = The received address bit n is not used to detect I^2C address match

bit 0 **MSK<0>:** Mask bit for I^2C Slave mode, 10-bit Address
I^2C Slave mode, 10-bit address (SSPM<3:0> = 0111 or 1111):
1 = The received address bit 0 is compared to SSPxADD<0> to detect I^2C address match
0 = The received address bit 0 is not used to detect I^2C address match
I^2C Slave mode, 7-bit address, the bit is ignored

21.3 Register Definitions: EUSART Control

REGISTER 21-1: TXSTA: TRANSMIT STATUS AND CONTROL REGISTER

R/W-/0	R/W-0/0	R/W-0/0	R/W-0/0	R/W-0/0	R/W-0/0	R-1/1	R/W-0/0
CSRC	TX9	TXEN(1)	SYNC	SENDB	BRGH	TRMT	TX9D
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 **CSRC:** Clock Source Select bit
Asynchronous mode:
Don't care
Synchronous mode:
1 = Master mode (clock generated internally from BRG)
0 = Slave mode (clock from external source)

bit 6 **TX9:** 9-bit Transmit Enable bit
1 = Selects 9-bit transmission
0 = Selects 8-bit transmission

bit 5 **TXEN:** Transmit Enable bit(1)
1 = Transmit enabled
0 = Transmit disabled

bit 4 **SYNC:** EUSART Mode Select bit
1 = Synchronous mode
0 = Asynchronous mode

bit 3 **SENDB:** Send Break Character bit
Asynchronous mode:
1 = Send Sync Break on next transmission (cleared by hardware upon completion)
0 = Sync Break transmission completed
Synchronous mode:
Don't care

bit 2 **BRGH:** High Baud Rate Select bit
Asynchronous mode:
1 = High speed
0 = Low speed
Synchronous mode:
Unused in this mode

bit 1 **TRMT:** Transmit Shift Register Status bit
1 = TSR empty
0 = TSR full

bit 0 **TX9D:** Ninth bit of Transmit Data
Can be address/data bit or a parity bit.

Note 1: SREN/CREN overrides TXEN in Sync mode.

DECFSZ **Decrement f, Skip if 0**

Syntax:	[*label*] DECFSZ f,d
Operands:	$0 \le f \le 127$ $d \in [0,1]$
Operation:	(f) - 1 → (destination); skip if result = 0
Status Affected:	None
Description:	The contents of register 'f' are decremented. If 'd' is '0', the result is placed in the W register. If 'd' is '1', the result is placed back in register 'f'. If the result is '1', the next instruction is executed. If the result is '0', then a NOP is executed instead, making it a 2-cycle instruction.

GOTO **Unconditional Branch**

Syntax:	[*label*] GOTO k
Operands:	$0 \le k \le 2047$
Operation:	k → PC<10:0> PCLATH<6:3> → PC<14:11>
Status Affected:	None
Description:	GOTO is an unconditional branch. The 11-bit immediate value is loaded into PC bits <10:0>. The upper bits of PC are loaded from PCLATH<4:3>. GOTO is a 2-cycle instruction.

INCF **Increment f**

Syntax:	[*label*] INCF f,d
Operands:	$0 \le f \le 127$ $d \in [0,1]$
Operation:	(f) + 1 → (destination)
Status Affected:	Z
Description:	The contents of register 'f' are incremented. If 'd' is '0', the result is placed in the W register. If 'd' is '1', the result is placed back in register 'f'.

INCFSZ **Increment f, Skip if 0**

Syntax:	[*label*] INCFSZ f,d
Operands:	$0 \le f \le 127$ $d \in [0,1]$
Operation:	(f) + 1 → (destination), skip if result = 0
Status Affected:	None
Description:	The contents of register 'f' are incremented. If 'd' is '0', the result is placed in the W register. If 'd' is '1', the result is placed back in register 'f'. If the result is '1', the next instruction is executed. If the result is '0', a NOP is executed instead, making it a 2-cycle instruction.

IORLW **Inclusive OR literal with W**

Syntax:	[*label*] IORLW k
Operands:	$0 \le k \le 255$
Operation:	(W) .OR. k → (W)
Status Affected:	Z
Description:	The contents of the W register are OR'ed with the 8-bit literal 'k'. The result is placed in the W register.

IORWF **Inclusive OR W with f**

Syntax:	[*label*] IORWF f,d
Operands:	$0 \le f \le 127$ $d \in [0,1]$
Operation:	(W) .OR. (f) → (destination)
Status Affected:	Z
Description:	Inclusive OR the W register with register 'f'. If 'd' is '0', the result is placed in the W register. If 'd' is '1', the result is placed back in register 'f'.

RRF **Rotate Right f through Carry**

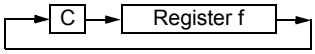
Syntax: [*label*] RRF f,d

Operands: $0 \le f \le 127$
$d \in [0,1]$

Operation: See description below

Status Affected: C

Description: The contents of register 'f' are rotated one bit to the right through the Carry flag. If 'd' is '0', the result is placed in the W register. If 'd' is '1', the result is placed back in register 'f'.



SLEEP **Enter Sleep mode**

Syntax: [*label*] SLEEP

Operands: None

Operation: 00h → WDT,
0 → WDT prescaler,
1 → $\overline{TO}$,
0 → $\overline{PD}$

Status Affected: $\overline{TO}$, $\overline{PD}$

Description: The power-down Status bit, $\overline{PD}$ is cleared. Time-out Status bit, $\overline{TO}$ is set. Watchdog Timer and its prescaler are cleared.
The processor is put into Sleep mode with the oscillator stopped.

SUBLW **Subtract W from literal**

Syntax: [*label*] SUBLW k

Operands: $0 \le k \le 255$

Operation: k - (W) → (W)

Status Affected: C, DC, Z

Description: The W register is subtracted (2's complement method) from the 8-bit literal 'k'. The result is placed in the W register.

C = 0	W > k
C = 1	W ≤ k
DC = 0	W<3:0> > k<3:0>
DC = 1	W<3:0> ≤ k<3:0>

SUBWF **Subtract W from f**

Syntax: [*label*] SUBWF f,d

Operands: $0 \le f \le 127$
$d \in [0,1]$

Operation: (f) - (W) → (destination)

Status Affected: C, DC, Z

Description: Subtract (2's complement method) W register from register 'f'. If 'd' is '0', the result is stored in the W register. If 'd' is '1', the result is stored back in register 'f.

C = 0	W > f
C = 1	W ≤ f
DC = 0	W<3:0> > f<3:0>
DC = 1	W<3:0> ≤ f<3:0>

SUBWFB **Subtract W from f with Borrow**

Syntax: SUBWFB f {,d}

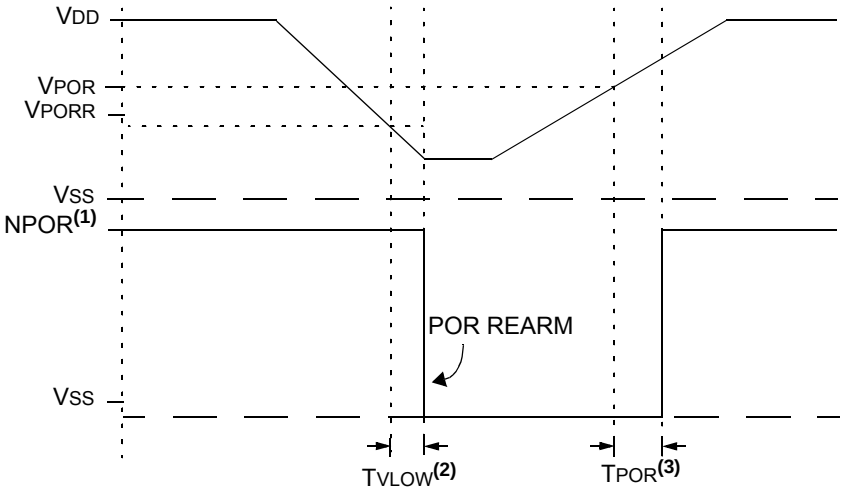
Operands: $0 \le f \le 127$
$d \in [0,1]$

Operation: (f) – (W) – ($\overline{B}$) → dest

Status Affected: C, DC, Z

Description: Subtract W and the BORROW flag (CARRY) from register 'f' (2's complement method). If 'd' is '0', the result is stored in W. If 'd' is '1', the result is stored back in register 'f'.

FIGURE 25-2: POR AND POR REARM WITH SLOW RISING VDD



Note 1: When NPOR is low, the device is held in Reset.
2: TPOR 1 μs typical.
3: TVLOW 2.7 μs typical.

TABLE 25-2: SUPPLY CURRENT (IDD)

PIC16LF1566/1567			Standard Operating Conditions (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for industrial -40°C ≤ TA ≤ +125°C for extended				
Param. No.	Device Characteristics	Min.	Typ.†	Max.	Units	Conditions	
						VDD	Note
	Supply Current (IDD)(1, 2)						
D010		—	2.5	18	μA	1.8	FOSC = 31 kHz LFINTOSC mode
		—	4	20	μA	3.0	
D011		—	0.35	0.70	mA	1.8	FOSC = 8 MHz HFINTOSC mode
		—	0.55	1.10	mA	3.0	
D012		—	0.5	1.2	mA	1.8	FOSC = 16 MHz HFINTOSC mode
		—	0.8	1.75	mA	3.0	
D013		—	1.5	3.5	mA	3.0	FOSC = 32 MHz HFINTOSC mode with PLL
D014		—	3	17	μA	1.8	FOSC = 32 kHz ECL mode
		—	5	20	μA	3.0	
D015		—	12	40	μA	1.8	FOSC = 500 kHz ECL mode
		—	18	60	μA	3.0	
D016		—	25	65	μA	1.8	FOSC = 1 MHz ECM mode
		—	40	100	μA	3.0	

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

Note 1: The test conditions for all IDD measurements in active operation mode are: CLKIN = external square wave, from rail-to-rail; all I/O pins tri-stated, pulled to VDD; $\overline{MCLR}$ = VDD; WDT disabled.
2: The supply current is mainly a function of the operating voltage and frequency. Other factors, such as I/O pin loading and switching rate, oscillator type, internal code execution pattern and temperature, also have an impact on the current consumption.

TABLE 25-13: PIC16LF1566/1567 ADC CONVERSION REQUIREMENTS

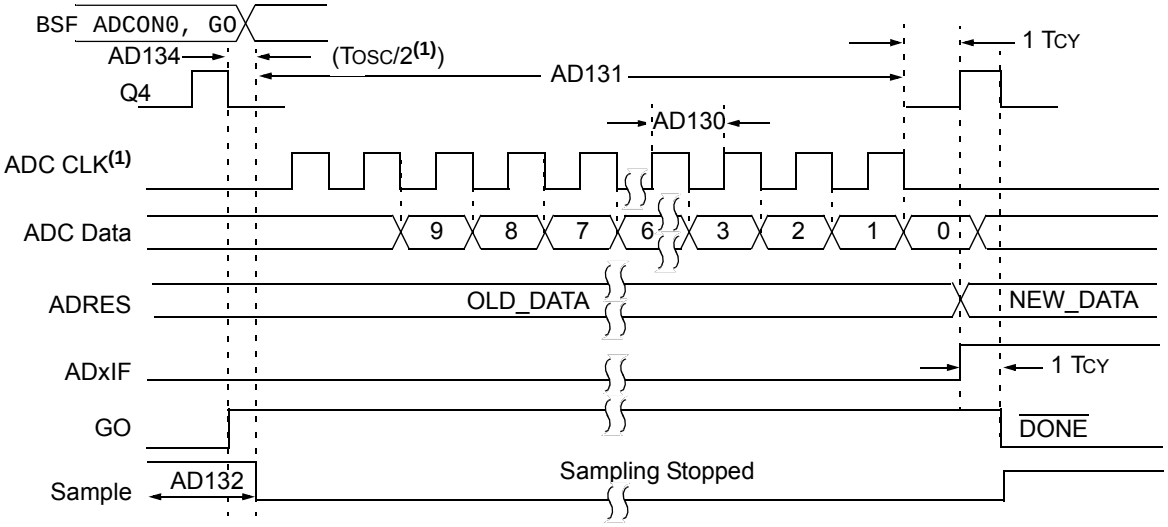
Standard Operating Conditions (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +125°C							
Param. No.	**Sym.**	**Characteristic**	**Min.**	**Typ.†**	**Max.**	**Units**	**Conditions**
AD130*	TAD	ADC Clock Period	0.25	—	25	µs	TOSC-based, -40°C to +85°C, VREF ≥ 2.4V
			0.7	—	25	µs	TOSC-based, -40°C to +85°C, VREF < 2.4V
			0.7	—	8	µs	TOSC-based, +86°C to +125°C
		ADC Internal FRC Oscillator Period	1.0	1.6	6.0	µs	ADCS<1:0> = 11 (ADFRC mode)
AD131	TCNV	Conversion Time (not including Acquisition Time)(1)	—	11	—	TAD	Set GO/$\overline{\text{DONE}}$x bit to conversion complete
AD132*	TACQ	Acquisition Time	—	5.0	—	µs	

* 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.

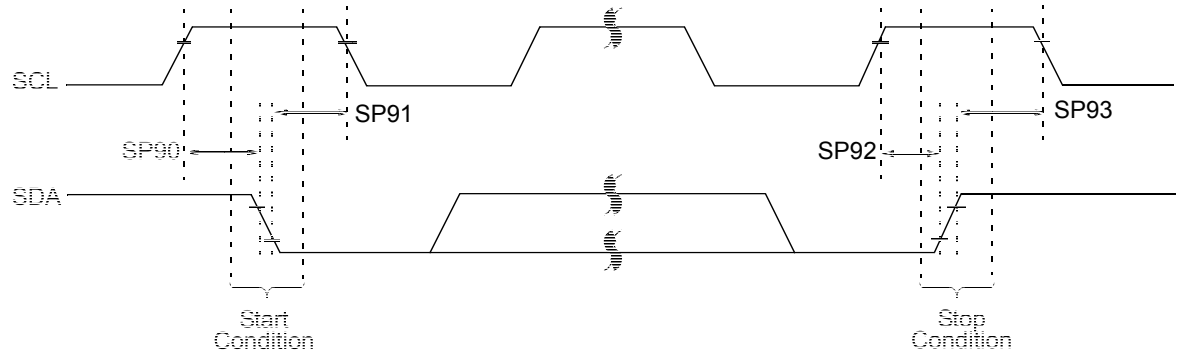
Note 1: The ADRES register may be read on the following TCY cycle.

FIGURE 25-9: PIC16LF1566/1567 ADC CONVERSION TIMING (NORMAL MODE)



Note 1: If the ADC clock source is selected as FRC, a time of TCY is added before the ADC clock starts. This allows the SLEEP instruction to be executed.

FIGURE 25-17: I²C BUS START/STOP BITS TIMING



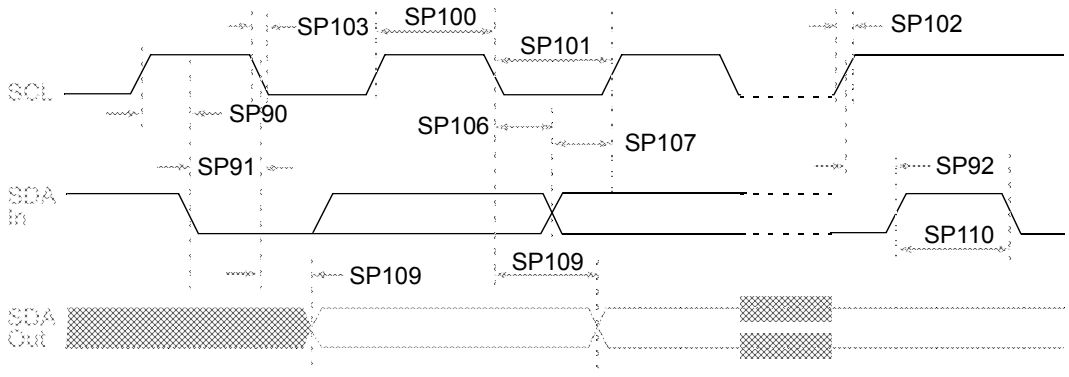
Note: Refer to Figure 25-3 for Load conditions.

TABLE 25-17: I²C BUS START/STOP BITS REQUIREMENTS

Standard Operating Conditions (unless otherwise stated)								
Param. No.	**Symbol**	**Characteristic**		**Min.**	**Typ.**	**Max.**	**Units**	**Conditions**
SP90*	TSU:STA	Start condition Setup time	100 kHz mode	4700	—	—	ns	Only relevant for Repeated Start condition
			400 kHz mode	600	—	—		
SP91*	THD:STA	Start condition Hold time	100 kHz mode	4000	—	—	ns	After this period, the first clock pulse is generated
			400 kHz mode	600	—	—		
SP92*	TSU:STO	Stop condition Setup time	100 kHz mode	4700	—	—	ns	
			400 kHz mode	600	—	—		
SP93	THD:STO	Stop condition Hold time	100 kHz mode	4000	—	—	ns	
			400 kHz mode	600	—	—		

* These parameters are characterized but not tested.

FIGURE 25-18: I²C BUS DATA TIMING



Note: Refer to Figure 25-3 for Load conditions.

TABLE 25-18: I²C BUS DATA REQUIREMENTS

Standard Operating Conditions (unless otherwise stated)							
Param. No.	**Symbol**	**Characteristic**		**Min.**	**Max.**	**Units**	**Conditions**
SP100*	THIGH	Clock high time	100 kHz mode	4.0	—	µs	Device must operate at a minimum of 1.5 MHz
			400 kHz mode	0.6	—	µs	Device must operate at a minimum of 10 MHz
			SSP module	1.5TCY	—		
SP101*	TLOW	Clock low time	100 kHz mode	4.7	—	µs	Device must operate at a minimum of 1.5 MHz
			400 kHz mode	1.3	—	µs	Device must operate at a minimum of 10 MHz
			SSP module	1.5TCY	—		
SP102*	TR	SDA and SCL rise time	100 kHz mode	—	1000	ns	
			400 kHz mode	20 + 0.1CB	300	ns	CB is specified to be from 10-400 pF
SP103*	TF	SDA and SCL fall time	100 kHz mode	—	250	ns	
			400 kHz mode	20 + 0.1CB	250	ns	CB is specified to be from 10-400 pF
SP106*	THD:DAT	Data input hold time	100 kHz mode	0	—	ns	
			400 kHz mode	0	0.9	µs	
SP107*	TSU:DAT	Data input setup time	100 kHz mode	250	—	ns	**(Note 2)**
			400 kHz mode	100	—	ns	
SP109*	TAA	Output valid from clock	100 kHz mode	—	3500	ns	**(Note 1)**
			400 kHz mode	—	—	ns	
SP110*	TBUF	Bus free time	100 kHz mode	4.7	—	µs	Time the bus must be free before a new transmission can start
			400 kHz mode	1.3	—	µs	
SP111	CB	Bus capacitive loading		—	400	pF	

* These parameters are characterized but not tested.

Note 1: As a transmitter, the device must provide this internal minimum delay time to bridge the undefined region (min. 300 ns) of the falling edge of SCL to avoid unintended generation of Start or Stop conditions.

2: A Fast mode (400 kHz) I²C bus device can be used in a Standard mode (100 kHz) I²C bus system, but the requirement TSU:DAT ≥ 250 ns must then be met. This will automatically be the case if the device does not stretch the low period of the SCL signal. If such a device does stretch the low period of the SCL signal, it must output the next data bit to the SDA line TR max. + TSU:DAT = 1000 + 250 = 1250 ns (according to the Standard mode I²C bus specification), before the SCL line is released.