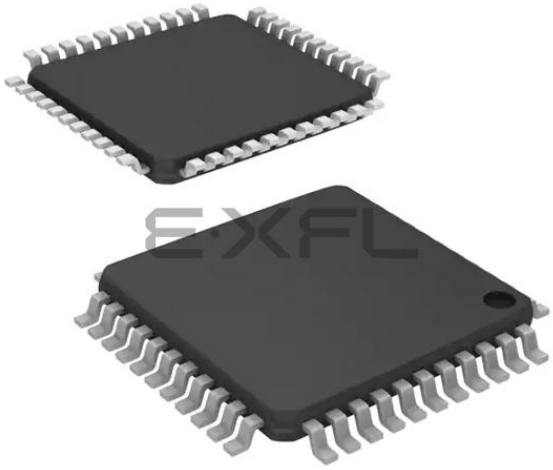

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"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable 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	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	35
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 28x10b; D/A 1x5b, 1x8b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	44-TQFP
Supplier Device Package	44-TQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic16lf1717-e-pt

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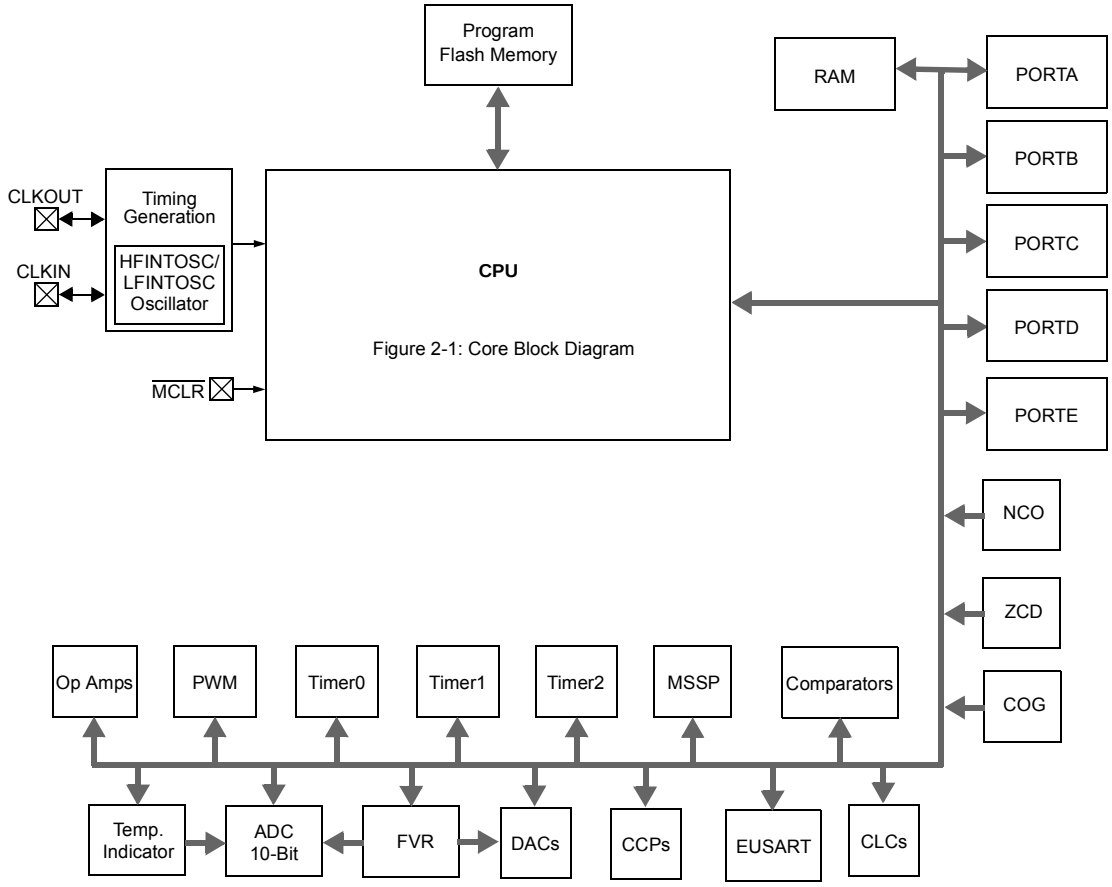
FIGURE 1-2: PIC16(L)F1717/9 BLOCK DIAGRAM



Note 1: See applicable chapters for more information on peripherals.

TABLE 1-3: PIC16(L)F1717/9 PINOUT DESCRIPTION (CONTINUED)

Name	Function	Input Type	Output Type	Description
RB1/AN10/C1IN3-/C2IN3-/ OPA2OUT	RB1	TTL/ST	CMOS	General purpose I/O.
	AN10	AN	—	ADC Channel 10 input.
	C1IN3-	AN	—	Comparator C1 negative input.
	C2IN3-	AN	—	Comparator C2 negative input.
	OPA2OUT	—	AN	Operational Amplifier 2 output.
RB2/AN8/OPA2IN-	RB2	TTL/ST	CMOS	General purpose I/O.
	AN8	AN	—	ADC Channel 8 input.
	OPA2IN-	AN	—	Operational Amplifier 2 inverting input.
RB3/AN9/C1IN2-/C2IN2-/ OPA2IN+	RB3	TTL/ST	CMOS	General purpose I/O.
	AN9	AN	—	ADC Channel 9 input.
	C1IN2-	AN	—	Comparator C1 negative input.
	C2IN2-	AN	—	Comparator C2 negative input.
	OPA2IN+	AN	—	Operational Amplifier 2 non-inverting input.
RB4/AN11	RB4	TTL/ST	CMOS	General purpose I/O.
	AN11	AN	—	ADC Channel 11 input.
RB5/AN13/T1G(1)	RB5	TTL/ST	CMOS	General purpose I/O.
	AN13	AN	—	ADC Channel 13 input.
	T1G	TTL/ST	—	Timer1 gate input.
RB6/CLCIN2(1)/ICSPCLK	RB6	TTL/ST	CMOS	General purpose I/O.
	CLCIN2	TTL/ST	—	Configurable Logic Cell source input.
	ICSPCLK	ST	—	Serial Programming Clock.
RB7/DAC1OUT2/DAC2OUT2/ CLCIN3(1)/ICSPDAT	RB7	TTL/ST	CMOS	General purpose I/O.
	DAC1OUT2	—	AN	Digital-to-Analog Converter output.
	DAC2OUT2	—	AN	Digital-to-Analog Converter output.
	CLCIN3	TTL/ST	—	Configurable Logic Cell source input.
	ICSPDAT	ST	CMOS	ICSP™ Data I/O.
RC0/T1CKI(1)/SOSCO	RC0	TTL/ST	CMOS	General purpose I/O.
	T1CKI	ST	—	Timer1 clock input.
	SOSCO	XTAL	XTAL	Secondary Oscillator Connection.
RC1/SOSCI/CCP2(1)	RC1	TTL/ST	CMOS	General purpose I/O.
	SOSCI	XTAL	XTAL	Secondary Oscillator Connection.
	CCP2	TTL/ST	—	Capture input.
RC2/AN14/CCP1(1)	RC2	TTL/ST	CMOS	General purpose I/O.
	AN14	AN	—	ADC Channel 14 input.
	CCP1	TTL/ST	—	Capture input.
RC3/AN15/SCK(1)/SCL(1)	RC3	TTL/ST	CMOS	General purpose I/O.
	AN15	AN	—	ADC Channel 15 input.
	SCK	TTL/ST	—	SPI clock input.
	SCL	I^2C	OD	I^2C clock.

Legend: AN = Analog input or output CMOS = CMOS compatible input or output OD = Open-Drain
TTL = TTL compatible input ST = Schmitt Trigger input with CMOS levels I^2C = Schmitt Trigger input with I^2C
HV = High Voltage XTAL = Crystal levels

Note 1: Default peripheral input. Alternate pins can be selected as the peripheral input with the PPS input selection registers.

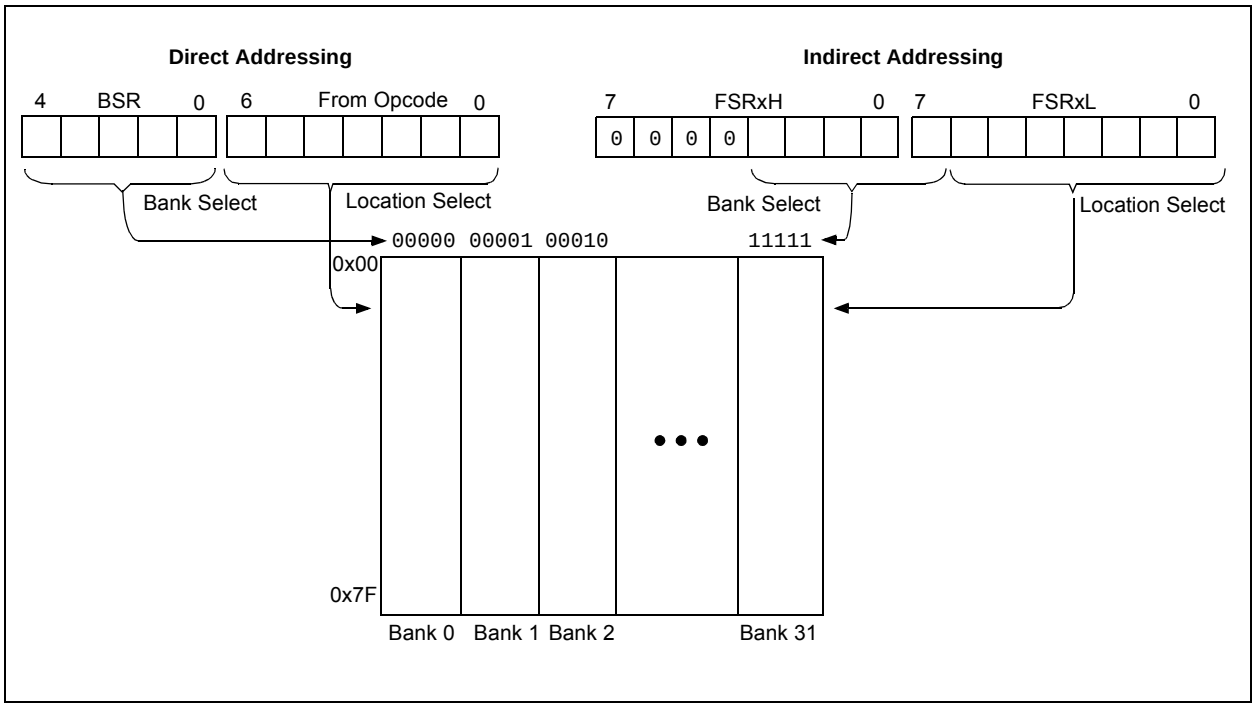
2: All pin digital outputs default to PORT latch data. Alternate outputs can be selected as the peripheral digital output with the PPS output selection registers.

3: These peripheral functions are bidirectional. The output pin selections must be the same as the input pin selections.

3.7.1 TRADITIONAL DATA MEMORY

The traditional data memory is a region from FSR address 0x000 to FSR address 0xFFF. The addresses correspond to the absolute addresses of all SFR, GPR and common registers.

FIGURE 3-10: TRADITIONAL DATA MEMORY MAP



5.0 RESETS

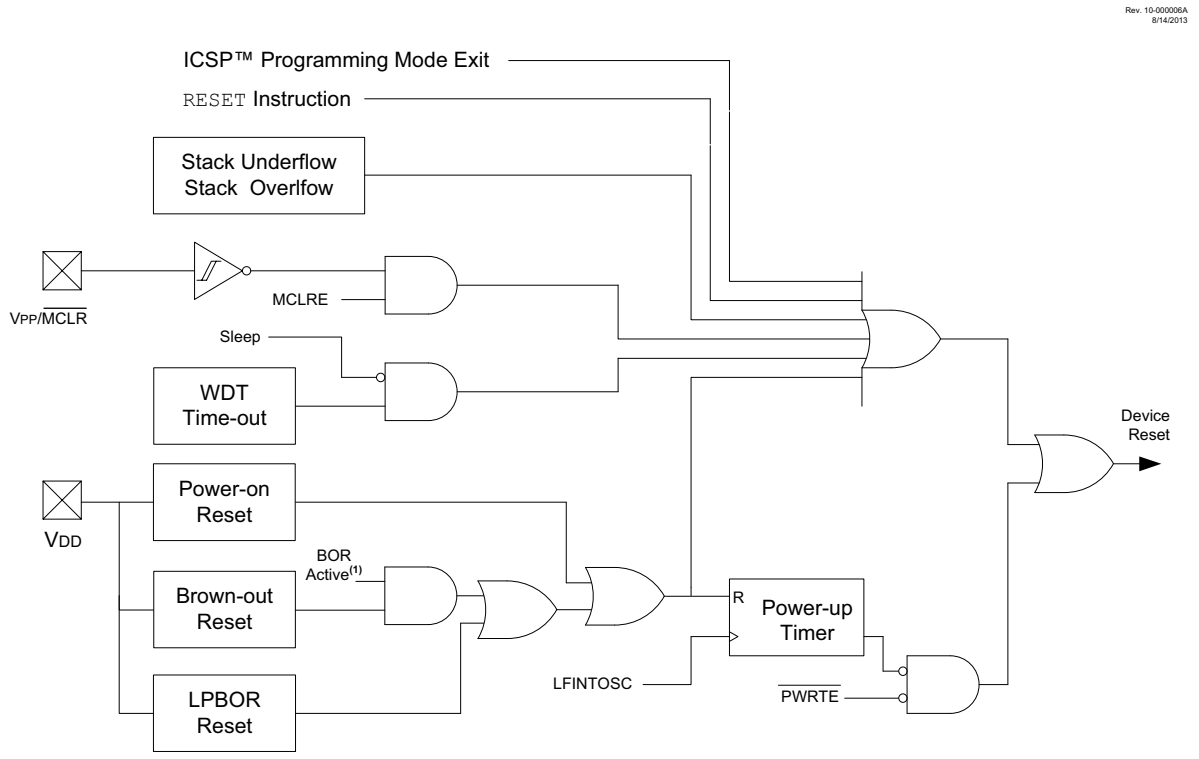
There are multiple ways to reset this device:

- Power-on Reset (POR)
- Brown-out Reset (BOR)
- Low-Power Brown-out Reset (LPBOR)
- MCLR Reset
- WDT Reset
- RESET instruction
- Stack Overflow
- Stack Underflow
- Programming mode exit

To allow VDD to stabilize, an optional Power-up Timer can be enabled to extend the Reset time after a BOR or POR event.

A simplified block diagram of the On-Chip Reset Circuit is shown in Figure 5-1.

FIGURE 5-1: SIMPLIFIED BLOCK DIAGRAM OF ON-CHIP RESET CIRCUIT



Note 1: See Table 5-1 for BOR active conditions.

FIGURE 7-2: INTERRUPT LATENCY

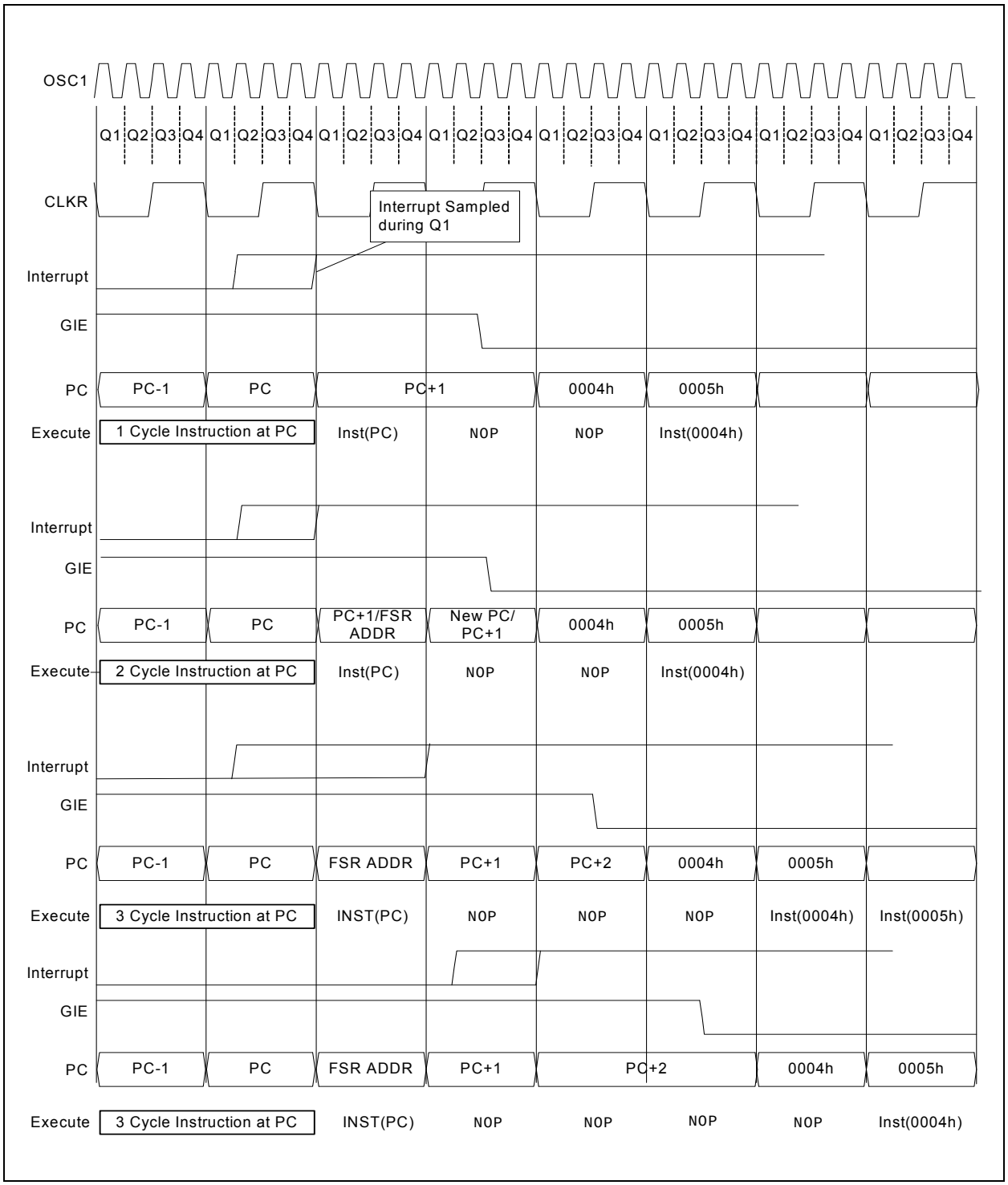


TABLE 7-1: SUMMARY OF REGISTERS ASSOCIATED WITH INTERRUPTS

Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Register on Page
INTCON	GIE	PEIE	TMR0IE	INTE	IOCIE	TMR0IF	INTF	IOCIF	90
OPTION_REG	$\overline{\text{WPUEN}}$	INTEDG	TMR0CS	TMR0SE	PSA	PS<2:0>			270
PIE1	TMR1GIE	ADIE	RCIE	TXIE	SSP1IE	CCP1IE	TMR2IE	TMR1IE	91
PIE2	OSFIE	C2IE	C1IE	—	BCL1IE	TMR6IE	TMR4IE	CCP2IE	92
PIE3	—	NCOIE	COGIE	ZCDIE	CLC4IE	CLC3IE	CLC2IE	CLC1IE	93
PIR1	TMR1GIF	ADIF	RCIF	TXIF	SSP1IF	CCP1IF	TMR2IF	TMR1IF	94
PIR2	OSFIF	C2IF	C1IF	—	BCL1IF	TMR6IF	TMR4IF	CCP2IF	95
PIR3	—	NCOIF	COGIF	ZCDIF	CLC4IF	CLC3IF	CLC2IF	CLC1IF	96

Legend: — = unimplemented location, read as '0'. Shaded cells are not used by interrupts.

9.3 Time-out Period

The WDTPS bits of the WDTCON register set the time-out period from 1 ms to 256 seconds (nominal). After a Reset, the default time-out period is two seconds.

9.4 Clearing the WDT

The WDT is cleared when any of the following conditions occur:

- Any Reset
- CLRWDT instruction is executed
- Device enters Sleep
- Device wakes up from Sleep
- Oscillator fail
- WDT is disabled
- Oscillator Start-up Timer (OST) is running

See Table 9-2 for more information.

9.5 Operation During Sleep

When the device enters Sleep, the WDT is cleared. If the WDT is enabled during Sleep, the WDT resumes counting.

When the device exits Sleep, the WDT is cleared again. The WDT remains clear until the OST, if enabled, completes. See **Section 6.0 "Oscillator Module (with Fail-Safe Clock Monitor)"** for more information on the OST.

When a WDT time-out occurs while the device is in Sleep, no Reset is generated. Instead, the device wakes up and resumes operation. The $\overline{TO}$ and $\overline{PD}$ bits in the STATUS register are changed to indicate the event. See STATUS Register (Register 3-1) for more information.

TABLE 9-2: WDT CLEARING CONDITIONS

Conditions	WDT
WDTE<1:0> = 00	Cleared
WDTE<1:0> = 01 and SWDTEN = 0	
WDTE<1:0> = 10 and enter Sleep	
CLRWDT Command	
Oscillator Fail Detected	
Exit Sleep + System Clock = T1OSC, EXTRC, INTOSC, EXTCLK	
Exit Sleep + System Clock = XT, HS, LP	Cleared until the end of OST
Change INTOSC divider (IRCF bits)	Unaffected

REGISTER 11-37: WPUE: WEAK PULL-UP PORTE REGISTER(1,2)

U-0	U-0	U-0	U-0	R/W-1/1	R/W-1/1	R/W-1/1	R/W-1/1
—	—	—	—	WPUE3	WPUE2(3)	WPUE1(3)	WPUE0(3)
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 7-4 **Unimplemented:** Read as '0'

bit 3-0 **WPUE<3:0>**: Weak Pull-up Register bits
1 = Pull-up enabled
0 = Pull-up disabled

Note 1: Global $\overline{\text{WPUEN}}$ bit of the OPTION_REG register must be cleared for individual pull-ups to be enabled.
2: The weak pull-up device is automatically disabled if the pin is configured as an output.
3: PIC16(L)F1717/9 only.

REGISTER 11-38: ODCONE: PORTE OPEN-DRAIN CONTROL REGISTER(1)

U-0	U-0	U-0	U-0	U-0	R/W-0/0	R/W-0/0	R/W-0/0
—	—	—	—	—	ODE2	ODE1	ODE0
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 7-3 **Unimplemented:** Read as '0'

bit 2-0 **ODE<2:0>:** PORTE Open-Drain Enable bits
For RE<2:0> pins, respectively
1 = Port pin operates as open-drain drive (sink current only)
0 = Port pin operates as standard push-pull drive (source and sink current)

Note 1: PIC16(L)F1717/9 only.

25.2 ZCD Logic Output

The ZCD module includes a Status bit, which can be read to determine whether the current source or sink is active. The ZCDxOUT bit of the ZCDxCON register is set when the current sink is active, and cleared when the current source is active. The ZCDxOUT bit is affected by the polarity bit.

25.3 ZCD Logic Polarity

The ZCDxPOL bit of the ZCDxCON register inverts the ZCDxOUT bit relative to the current source and sink output. When the ZCDxPOL bit is set, a ZCDxOUT high indicates that the current source is active, and a low output indicates that the current sink is active.

The ZCDxPOL bit affects the ZCD interrupts. See **Section 25.4 "ZCD Interrupts"**.

25.4 ZCD Interrupts

An interrupt will be generated upon a change in the ZCD logic output when the appropriate interrupt enables are set. A rising edge detector and a falling edge detector are present in the ZCD for this purpose.

The ZCDIF bit of the PIR3 register will be set when either edge detector is triggered and its associated enable bit is set. The ZCDxINTP enables rising edge interrupts and the ZCDxINTN bit enables falling edge interrupts. Both are located in the ZCDxCON register.

To fully enable the interrupt, the following bits must be set:

- ZCDIE bit of the PIE3 register
- ZCDxINTP bit of the ZCDxCON register (for a rising edge detection)
- ZCDxINTN bit of the ZCDxCON register (for a falling edge detection)
- PEIE and GIE bits of the INTCON register

Changing the ZCDxPOL bit will cause an interrupt, regardless of the level of the ZCDxEN bit.

The ZCDIF bit of the PIR3 register must be cleared in software as part of the interrupt service. If another edge is detected while this flag is being cleared, the flag will still be set at the end of the sequence.

25.5 Correcting for ZCPINV Offset

The actual voltage at which the ZCD switches is the reference voltage at the non-inverting input of the ZCD op amp. For external voltage source waveforms other than square waves this voltage offset from zero causes the zero-cross event to occur either too early or too late. When the waveform is varying relative to Vss then the zero cross is detected too early as the waveform falls and too late as the waveform rises. When the waveform is varying relative to VDD then the zero cross is detected too late as the waveform rises and too early as the waveform falls. The actual offset time can be determined for sinusoidal waveforms with the corresponding equations shown in Equation 25-2.

EQUATION 25-2: ZCD EVENT OFFSET

When External Voltage Source is relative to Vss:

$$T_{offset} = \frac{\text{asin}\left(\frac{Z_{cpinv}}{V_{peak}}\right)}{2\pi \bullet Freq}$$

When External Voltage Source is relative to VDD:

$$T_{offset} = \frac{\text{asin}\left(\frac{VDD - Z_{cpinv}}{V_{peak}}\right)}{2\pi \bullet Freq}$$

This offset time can be compensated for by adding a pull-up or pull-down biasing resistor to the ZCD pin. A pull-up resistor is used when the external voltage source is varying relative to Vss. A pull-down resistor is used when the voltage is varying relative to VDD.The resistor adds a bias to the ZCD pin so that the target external voltage source must go to zero to pull the pin voltage to the ZCPINV switching voltage. The pull-up or pull-down value can be determined with the equations shown in Equation 25-3.

EQUATION 25-3: ZCD PULL-UP/DOWN

When External Signal is relative to Vss:

$$R_{pullup} = \frac{R_{series}(V_{pullup} - Z_{cpinv})}{Z_{cpinv}}$$

When External Signal is relative to VDD:

$$R_{pulldown} = \frac{R_{series}(Z_{cpinv})}{(VDD - Z_{cpinv})}$$

The pull-up and pull-down resistor values are significantly affected by small variations of ZCPINV. Measuring ZCPINV can be difficult, especially when the waveform is relative to VDD. However, by combining Equation 25-2 and Equation 25-3 the resistor value

28.0 TIMER2/4/6 MODULE

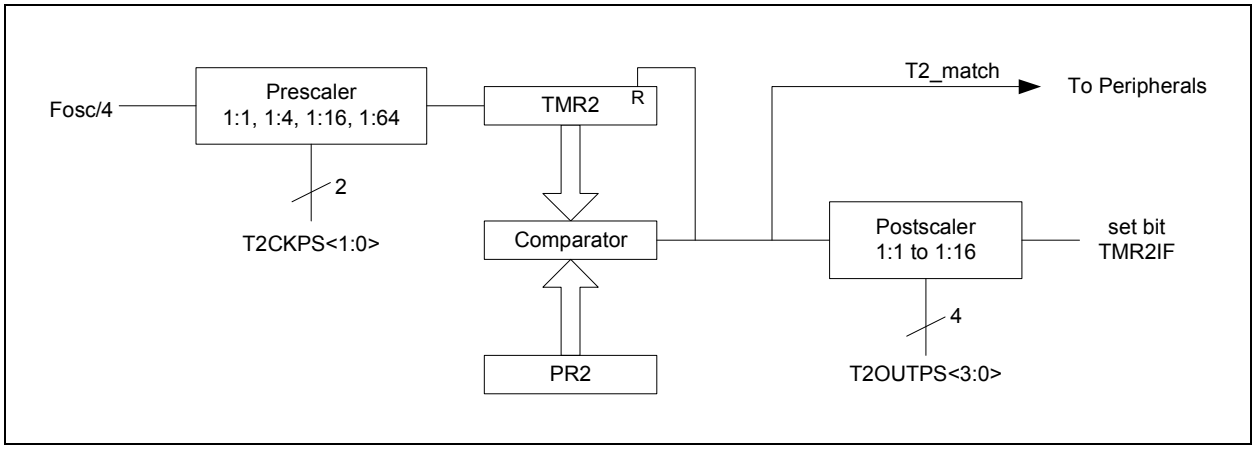
The Timer2/4/6 modules are 8-bit timers that incorporate the following features:

- 8-bit Timer and Period registers (TMR2 and PR2, respectively)
- Readable and writable (both registers)
- Software programmable prescaler (1:1, 1:4, 1:16, and 1:64)
- Software programmable postscaler (1:1 to 1:16)
- Interrupt on TMR2 match with PR2, respectively
- Optional use as the shift clock for the MSSP module

See Figure 28-1 for a block diagram of Timer2.

Three identical Timer2 modules are implemented on this device. To maintain consistency with earlier devices, the timers are named Timer2, Timer4, and Timer6. All references to Timer2 apply as well to Timer4 and Timer6.

FIGURE 28-1: TIMER2 BLOCK DIAGRAM



29.4 Register Definitions: CCP Control

REGISTER 29-1: CCPxCON: CCPx CONTROL REGISTER

U-0	U-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
—	—	DCxB<1:0>		CCPxM<3:0>			
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 Reset
‘1’ = Bit is set	‘0’ = Bit is cleared	

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

bit 5-4 **DCxB<1:0>:** PWM Duty Cycle Least Significant bits

Capture mode:
Unused

Compare mode:
Unused

PWM mode:
These bits are the two LSbs of the PWM duty cycle. The eight MSbs are found in CCPRxL.

bit 3-0 **CCPxM<3:0>:** CCPx Mode Select bits

11xx = PWM mode

1011 = Compare mode: Auto-conversion Trigger (sets CCPxIF bit), starts ADC conversion if TRIGSEL = CCPx (see Register 21-3)
1010 = Compare mode: generate software interrupt only
1001 = Compare mode: clear output on compare match (set CCPxIF)
1000 = Compare mode: set output on compare match (set CCPxIF)

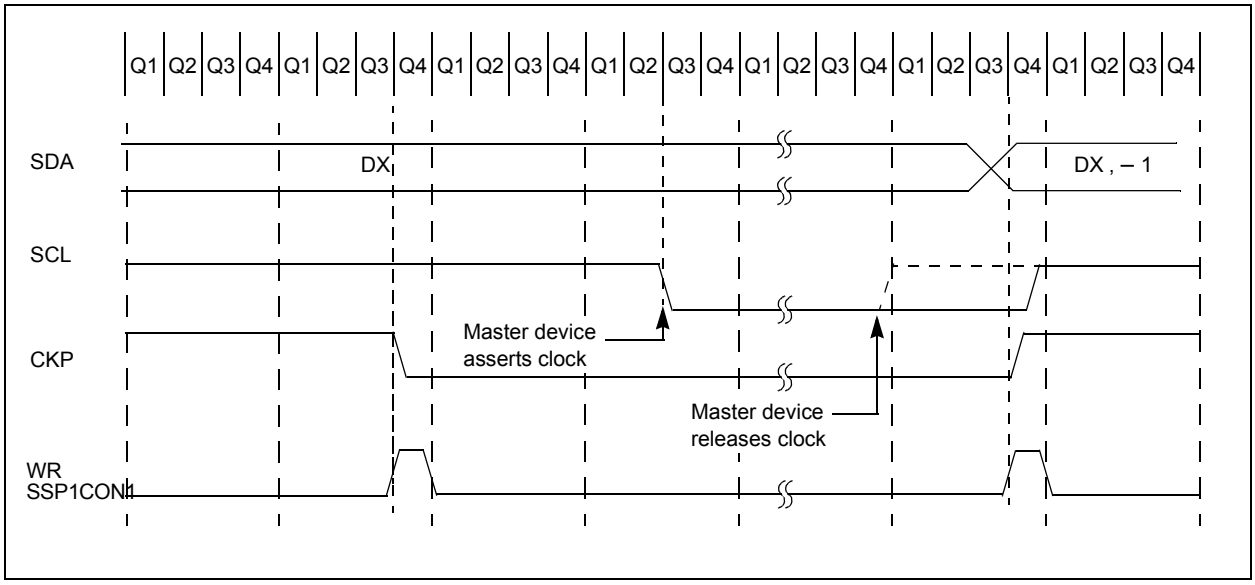
0111 = Capture mode: every 16th rising edge
0110 = Capture mode: every 4th rising edge
0101 = Capture mode: every rising edge
0100 = Capture mode: every falling edge

0011 = Reserved
0010 = Compare mode: toggle output on match
0001 = Reserved
0000 = Capture/Compare/PWM off (resets CCPx module)

30.5.7 CLOCK SYNCHRONIZATION AND THE CKP BIT

Any time the CKP bit is cleared, the module will wait for the SCL line to go low and then hold it. However, clearing the CKP bit will not assert the SCL output low until the SCL output is already sampled low. Therefore, the CKP bit will not assert the SCL line until an external I^2C master device has already asserted the SCL line. The SCL output will remain low until the CKP bit is set and all other devices on the I^2C bus have released SCL. This ensures that a write to the CKP bit will not violate the minimum high time requirement for SCL (see Figure 30-23).

FIGURE 30-23: CLOCK SYNCHRONIZATION TIMING



30.6 I²C Master Mode

Master mode is enabled by setting and clearing the appropriate SSPM bits in the SSP1CON1 register and by setting the SSPEN bit. In Master mode, the SDA and SCK pins must be configured as inputs. The MSSP peripheral hardware will override the output driver TRIS controls when necessary to drive the pins low.

Master mode of operation is supported by interrupt generation on the detection of the Start and Stop conditions. The Stop (P) and Start (S) bits are cleared from a Reset or when the MSSP module is disabled. Control of the I²C bus may be taken when the P bit is set, or the bus is Idle.

In Firmware Controlled Master mode, user code conducts all I²C bus operations based on Start and Stop bit condition detection. Start and Stop condition detection is the only active circuitry in this mode. All other communication is done by the user software directly manipulating the SDA and SCL lines.

The following events will cause the SSP Interrupt Flag bit, SSP1IF, to be set (SSP interrupt, if enabled):

- Start condition detected
- Stop condition detected
- Data transfer byte transmitted/received
- Acknowledge transmitted/received
- Repeated Start generated

Note 1: The MSSP module, when configured in I²C Master mode, does not allow queuing of events. For instance, the user is not allowed to initiate a Start condition and immediately write the SSP1BUF register to initiate transmission before the Start condition is complete. In this case, the SSP1BUF will not be written to and the WCOL bit will be set, indicating that a write to the SSP1BUF did not occur

2: Master mode suspends Start/Stop detection when sending the Start/Stop condition by means of the SEN/PEN control bits. The SSPxIF bit is set at the end of the Start/Stop generation when hardware clears the control bit.

30.6.1 I²C MASTER MODE OPERATION

The master device generates all of the serial clock pulses and the Start and Stop conditions. A transfer is ended with a Stop condition or with a Repeated Start condition. Since the Repeated Start condition is also the beginning of the next serial transfer, the I²C bus will not be released.

In Master Transmitter mode, serial data is output through SDA, while SCL outputs the serial clock. The first byte transmitted contains the slave address of the receiving device (7 bits) and the Read/Write (R/$\overline{W}$) bit. In this case, the R/$\overline{W}$ bit will be logic '0'. Serial data is transmitted eight bits at a time. After each byte is transmitted, an Acknowledge bit is received. Start and Stop conditions are output to indicate the beginning and the end of a serial transfer.

In Master Receive mode, the first byte transmitted contains the slave address of the transmitting device (7 bits) and the R/$\overline{W}$ bit. In this case, the R/$\overline{W}$ bit will be logic '1'. Thus, the first byte transmitted is a 7-bit slave address followed by a '1' to indicate the receive bit. Serial data is received via SDA, while SCL outputs the serial clock. Serial data is received eight bits at a time. After each byte is received, an Acknowledge bit is transmitted. Start and Stop conditions indicate the beginning and end of transmission.

A Baud Rate Generator is used to set the clock frequency output on SCL. See **Section 30.7 "Baud Rate Generator"** for more detail.

30.8 Register Definitions: MSSP Control

REGISTER 30-1: SSP1STAT: SSP STATUS REGISTER

R/W-0/0	R/W-0/0	R-0/0	R-0/0	R-0/0	R-0/0	R-0/0	R-0/0
SMP	CKE	D/$\overline{A}$	P	S	R/$\overline{W}$	UA	BF
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 **SMP:** SPI Data Input Sample bit
SPI Master mode:
1 = Input data sampled at end of data output time
0 = Input data sampled at middle of data output time
SPI Slave mode:
SMP must be cleared when SPI is used in Slave mode
In I^2C Master or Slave mode:
1 = Slew rate control disabled for Standard Speed mode (100 kHz and 1 MHz)
0 = Slew rate control enabled for High-Speed mode (400 kHz)

bit 6 **CKE:** SPI Clock Edge Select bit (SPI mode only)
In SPI Master or Slave mode:
1 = Transmit occurs on transition from active to Idle clock state
0 = Transmit occurs on transition from Idle to active clock state
In I^2C™ mode only:
1 = Enable input logic so that thresholds are compliant with SMBus specification
0 = Disable SMBus specific inputs

bit 5 **D/$\overline{A}$:** Data/$\overline{Address}$ bit (I^2C mode only)
1 = Indicates that the last byte received or transmitted was data
0 = Indicates that the last byte received or transmitted was address

bit 4 **P:** Stop bit
(I^2C mode only. This bit is cleared when the MSSP module is disabled, SSPEN is cleared.)
1 = Indicates that a Stop bit has been detected last (this bit is '0' on Reset)
0 = Stop bit was not detected last

bit 3 **S:** Start bit
(I^2C mode only. This bit is cleared when the MSSP module is disabled, SSPEN is cleared.)
1 = Indicates that a Start bit has been detected last (this bit is '0' on Reset)
0 = Start bit was not detected last

bit 2 **R/$\overline{W}$:** Read/$\overline{Write}$ bit information (I^2C mode only)
This bit holds the R/$\overline{W}$ bit information following the last address match. This bit is only valid from the address match to the next Start bit, Stop bit, or not ACK bit.
In I^2C Slave mode:
1 = Read
0 = Write
In I^2C Master mode:
1 = Transmit is in progress
0 = Transmit is not in progress
OR-ing this bit with SEN, RSEN, PEN, RCEN or ACKEN will indicate if the MSSP is in Idle mode.

bit 1 **UA:** Update Address bit (10-bit I^2C mode only)
1 = Indicates that the user needs to update the address in the SSP1ADD register
0 = Address does not need to be updated

bit 0 **BF:** Buffer Full Status bit
Receive (SPI and I^2C modes):
1 = Receive complete, SSP1BUF is full
0 = Receive not complete, SSP1BUF is empty
Transmit (I^2C mode only):
1 = Data transmit in progress (does not include the $\overline{ACK}$ and Stop bits), SSP1BUF is full
0 = Data transmit complete (does not include the $\overline{ACK}$ and Stop bits), SSP1BUF is empty

34.0 ELECTRICAL SPECIFICATIONS

34.1 Absolute Maximum Ratings(†)

Ambient temperature under bias ..... -40°C to +125°C
Storage temperature ..... -65°C to +150°C
Voltage on pins with respect to V_{SS}
- on V_{DD} pin
  - PIC16F1717/8/9 ..... -0.3V to +6.5V
  - PIC16LF1717/8/9 ..... -0.3V to +4.0V
- on $\overline{MCLR}$ pin ..... -0.3V to +9.0V
- on all other pins ..... -0.3V to (V_{DD} + 0.3V)

Maximum current
- on V_{SS} pin(1)
  - -40°C ≤ T_A ≤ +85°C ..... 340 mA
  - -40°C ≤ T_A ≤ +125°C ..... 140 mA
- on V_{DD} pin(1) PIC16(L)F1718 only
  - -40°C ≤ T_A ≤ +85°C ..... 250 mA
  - -40°C ≤ T_A ≤ +125°C ..... 85 mA
- on V_{DD} pin(1) PIC16(L)F1717/9 only
  - -40°C ≤ T_A ≤ +85°C ..... 350 mA
  - -40°C ≤ T_A ≤ +125°C ..... 120 mA
- Sunk by any standard I/O pin ..... 50 mA
- Sourced by any standard I/O pin ..... 50 mA
- Sourced by any Op Amp output pin ..... 100 mA

Clamp current, I_K (V_{PIN} < 0 or V_{PIN} > V_{DD}) ..... ±20 mA
Total power dissipation(2) ..... 800 mW

Note 1: Maximum current rating requires even load distribution across I/O pins. Maximum current rating may be limited by the device package power dissipation characterizations, see Table 34-6 to calculate device specifications.

2: Power dissipation is calculated as follows:

$Pdis = V_{DD} * \{Idd - \Sigma Ioh\} + \Sigma\{V_{DD} - Voh) * Ioh\} + \Sigma(Vol * Iol)$.

† NOTICE: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure above maximum rating conditions for extended periods may affect device reliability.

34.2 Standard Operating Conditions

The standard operating conditions for any device are defined as:

Operating Voltage: $V_{DDMIN} \leq V_{DD} \leq V_{DDMAX}$
Operating Temperature: $T_{A\_MIN} \leq T_A \leq T_{A\_MAX}$

V_{DD} — Operating Supply Voltage(1)

PIC16LF1717/8/9

V_{DDMIN} (Fosc ≤ 16 MHz) ..... +1.8V
V_{DDMIN} (Fosc > 16 MHz) ..... +2.5V
V_{DDMAX} ..... +3.6V

PIC16F1717/8/9

V_{DDMIN} (Fosc ≤ 16 MHz) ..... +2.3V
V_{DDMIN} (> 16 MHz) ..... +2.5V
V_{DDMAX} ..... +5.5V

T_A — Operating Ambient Temperature Range

Industrial Temperature

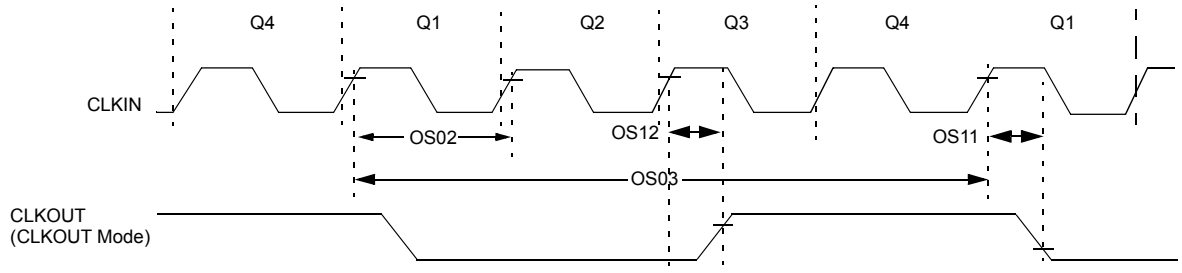
T_{A_MIN} ..... -40°C
T_{A_MAX} ..... +85°C

Extended Temperature

T_{A_MIN} ..... -40°C
T_{A_MAX} ..... +125°C

Note 1: See Parameter D001, DS Characteristics: Supply Voltage.

FIGURE 34-5: CLOCK TIMING



Note 1: See Table 34-10.

TABLE 34-7: CLOCK OSCILLATOR TIMING REQUIREMENTS

Standard Operating Conditions (unless otherwise stated)							
Param. No.	**Sym.**	**Characteristic**	**Min.**	**Typ.†**	**Max.**	**Units**	**Conditions**
OS01	FOSC	External CLKIN Frequency(1)	DC	—	0.5	MHz	External Clock (ECL)
			DC	—	4	MHz	External Clock (ECM)
			DC	—	20	MHz	External Clock (ECH)
		Oscillator Frequency(1)	—	32.768	—	kHz	LP Oscillator
			0.1	—	4	MHz	XT Oscillator
			1	—	4	MHz	HS Oscillator
			1	—	20	MHz	HS Oscillator, VDD > 2.7V
			DC	—	4	MHz	EXTRC, VDD > 2.0V
OS02	TOSC	External CLKIN Period(1)	27	—	∞	μs	LP Oscillator
			250	—	∞	ns	XT Oscillator
			50	—	∞	ns	HS Oscillator
			50	—	∞	ns	External Clock (EC)
		Oscillator Period(1)	—	30.5	—	μs	LP Oscillator
			250	—	10,000	ns	XT Oscillator
			50	—	1,000	ns	HS Oscillator
			250	—	—	ns	EXTRC
OS03	TCY	Instruction Cycle Time(1)	125	TCY	DC	ns	TCY = 4/FOSC
OS04*	TOSH, TOSL	External CLKIN High, External CLKIN Low	2	—	—	μs	LP Oscillator
			100	—	—	ns	XT Oscillator
			20	—	—	ns	HS Oscillator
OS05*	TOSR, TOSF	External CLKIN Rise, External CLKIN Fall	0	—	∞	ns	LP Oscillator
			0	—	∞	ns	XT Oscillator
			0	—	∞	ns	HS Oscillator

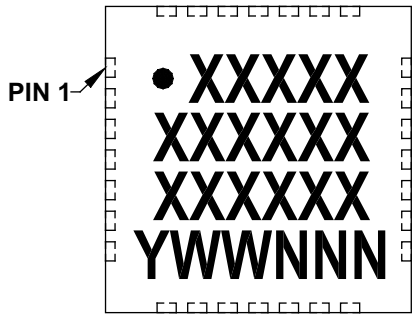
* These parameters are characterized but not tested.

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

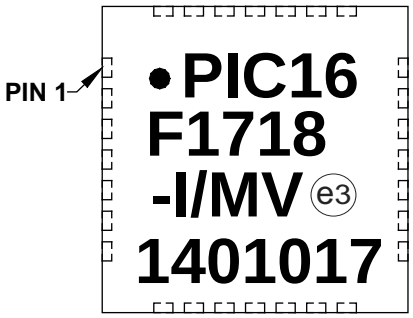
Note 1: Instruction cycle period (TCY) equals four times the input oscillator time base period. All specified values are based on characterization data for that particular oscillator type under standard operating conditions with the device executing code. Exceeding these specified limits may result in an unstable oscillator operation and/or higher than expected current consumption. All devices are tested to operate at "min" values with an external clock applied to OSC1 pin. When an external clock input is used, the "max" cycle time limit is "DC" (no clock) for all devices.

Package Marking Information (Continued)

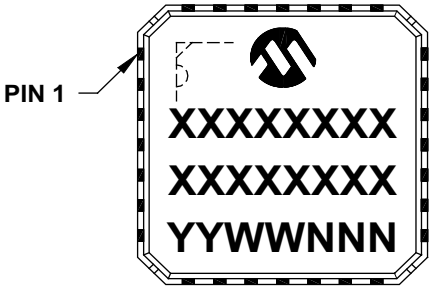
28-Lead UQFN (4x4x0.5 mm)



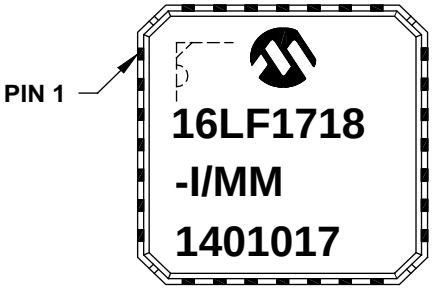
Example



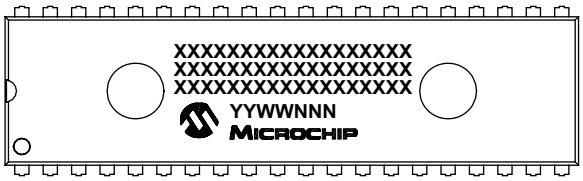
28-Lead QFN (6x6x0.9 mm)



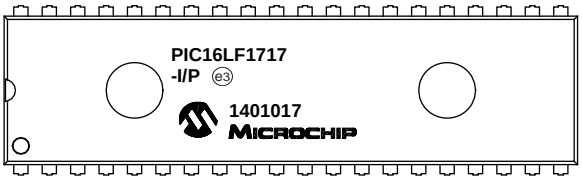
Example



40-Lead PDIP (600 mil)



Example



Legend:	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART NO.	[X](1)	-	X	/XX	XXX
Device	Tape and Reel Option		Temperature Range	Package	Pattern

Device:	PIC16F1717, PIC16LF1717, PIC16F1718, PIC16LF1718 PIC16F1719, PIC16LF1719	
Tape and Reel Option:	Blank T	= Standard packaging (tube or tray) = Tape and Reel(1)
Temperature Range:	I E	= -40°C to +85°C (Industrial) = -40°C to +125°C (Extended)
Package:(2)	MV MV MM P PT SO SP SS	= UQFN, 28-lead 4x4x0.5mm = UQFN, 40-lead 5x5x0.5mm = QFN-S, 28-lead 6x6x0.9mm = PDIP, 40-lead = TQFP, 44-lead 10x10x1mm = SOIC, 28-lead = SPDIP, 28-lead = SSOP, 28-lead
Pattern:	QTP, SQTP, Code or Special Requirements (blank otherwise)	

Examples:

a) PIC16LF1717- I/P
Industrial temperature
PDIP package

b) PIC16F1718- E/SS
Extended temperature,
SSOP package

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

2: Small form-factor packaging options may be available. Please check www.microchip.com/packaging for small-form factor package availability, or contact your local Sales Office.