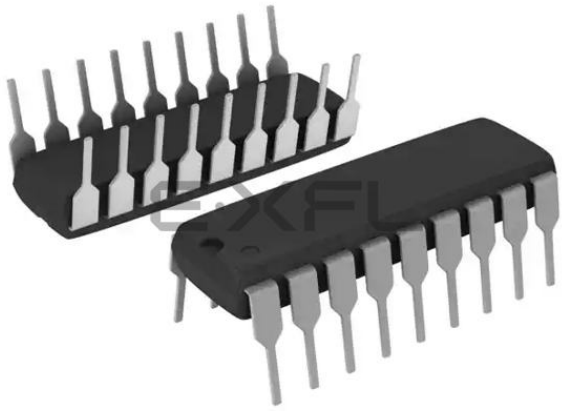

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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	dsPIC
Core Size	16-Bit
Speed	40 MIPs
Connectivity	I²C, IrDA, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	13
Program Memory Size	12KB (12K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 6x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Through Hole
Package / Case	18-DIP (0.300", 7.62mm)
Supplier Device Package	18-PDIP
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/dspic33fj12gp201-e-p

dsPIC33FJ12GP201/202 Product Families

The device names, pin counts, memory sizes, and peripheral availability of each family are listed below, followed by their pinout diagrams.

TABLE 1: dsPIC33FJ12GP201/202 CONTROLLER FAMILIES

Device	Pins	Program Flash Memory (Kbyte)	RAM (Kbyte)	Remappable Peripherals							10-Bit/12-Bit ADC	I^2C™	I/O Pins (Max)	Packages
				Remappable Pins	16-bit Timer	Input Capture	Output Compare Std. PWM	UART	External Interrupts(2)	SPI				
dsPIC33FJ12GP201	18	12	1	8	3(1)	4	2	1	3	1	1 ADC, 6 ch	1	13	PDIP SOIC
dsPIC33FJ12GP202	28	12	1	16	3(1)	4	2	1	3	1	1 ADC, 10 ch	1	21	SPDIP SOIC SSOP QFN

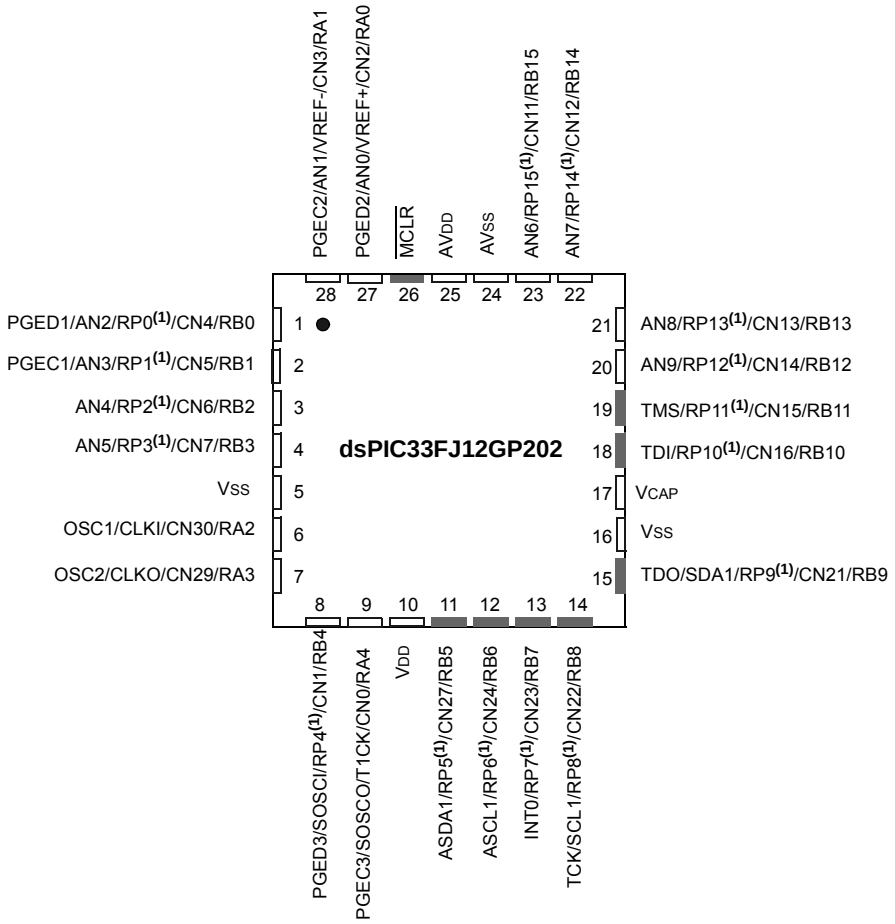
Note 1: Only two out of three timers are remappable.

2: Only two out of three interrupts are remappable.

Pin Diagrams (Continued)

28-Pin QFN(2)

■ = Pins are up to 5V tolerant



Note 1: The RPn pins can be used by any remappable peripheral. See Table 1 for the list of available peripherals.

2: The metal plane at the bottom of the device is not connected to any pins and is recommended to be connected to VSS externally.

4.0 MEMORY ORGANIZATION

Note: This data sheet summarizes the features of the dsPIC33FJ12GP201/202 family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **Section 4. "Program Memory"** (DS70202) of the *"dsPIC33F/PIC24H Family Reference Manual"*, which is available from the Microchip website (www.microchip.com).

The dsPIC33FJ12GP201/202 architecture features separate program and data memory spaces and buses. This architecture also allows the direct access of program memory from the data space during code execution.

4.1 Program Address Space

The program address memory space of the dsPIC33FJ12GP201/202 devices is 4M instructions. The space is addressable by a 24-bit value derived either from the 23-bit PC during program execution, or from table operation or data space remapping as described in **Section 4.6 "Interfacing Program and Data Memory Spaces"**.

User application access to the program memory space is restricted to the lower half of the address range (0x000000 to 0x7FFFFF). The exception is the use of TBLRD/TBLWT operations, which use TBLPAG<7> to permit access to the Configuration bits and Device ID sections of the configuration memory space.

The memory map for the dsPIC33FJ12GP201/202 family of devices is shown in Figure 4-1.

FIGURE 4-1: PROGRAM MEMORY FOR dsPIC33FJ12GP201/202 DEVICES

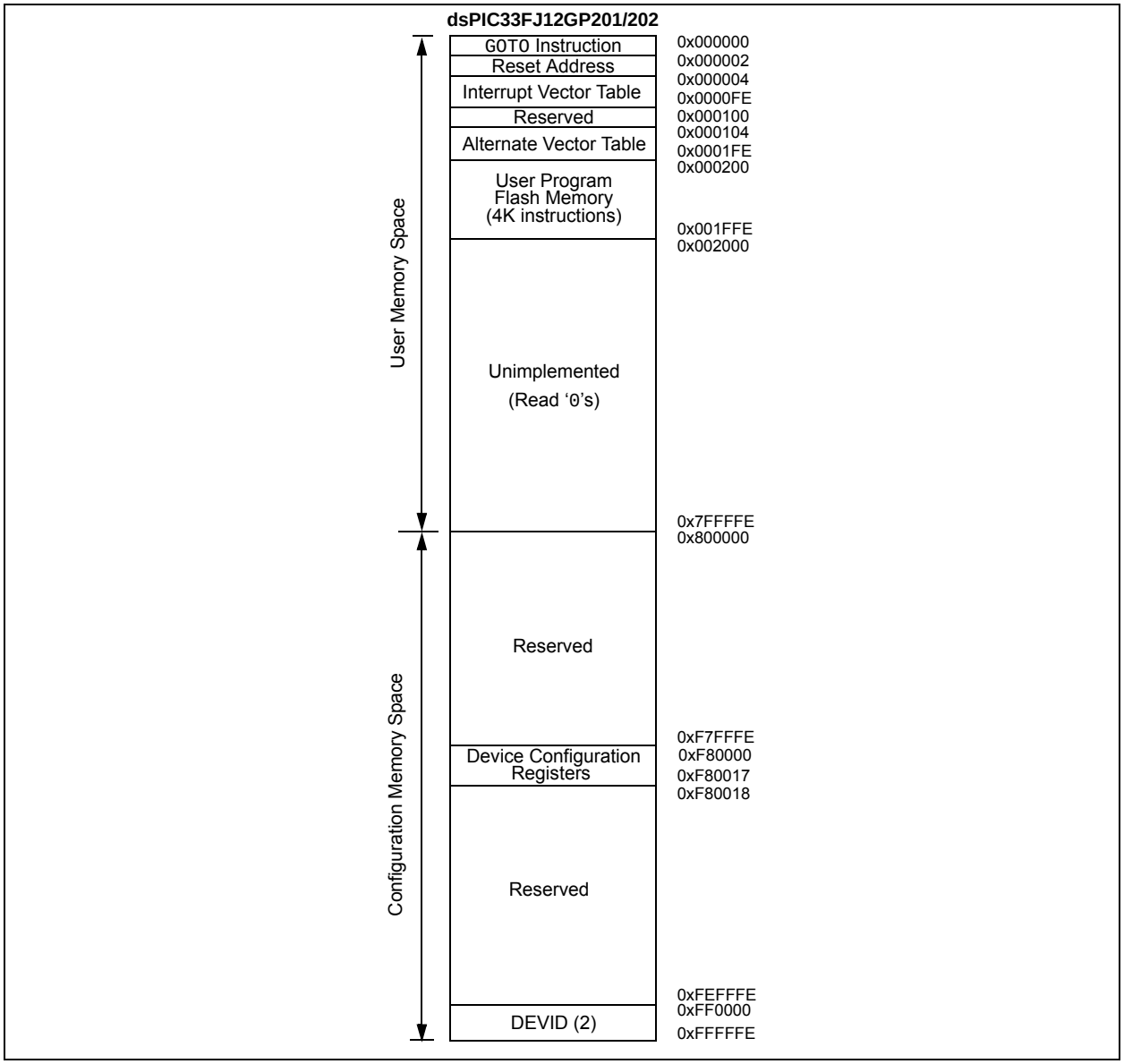


TABLE 4-1: CPU CORE REGISTERS MAP

SFR Name	SFR Addr	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	All Resets
WREG0	0000	Working Register 0																0000
WREG1	0002	Working Register 1																0000
WREG2	0004	Working Register 2																0000
WREG3	0006	Working Register 3																0000
WREG4	0008	Working Register 4																0000
WREG5	000A	Working Register 5																0000
WREG6	000C	Working Register 6																0000
WREG7	000E	Working Register 7																0000
WREG8	0010	Working Register 8																0000
WREG9	0012	Working Register 9																0000
WREG10	0014	Working Register 10																0000
WREG11	0016	Working Register 11																0000
WREG12	0018	Working Register 12																0000
WREG13	001A	Working Register 13																0000
WREG14	001C	Working Register 14																0000
WREG15	001E	Working Register 15																0800
SPLIM	0020	Stack Pointer Limit Register																xxxx
ACCAL	0022	Accumulator A Low Word Register																0000
ACCAH	0024	Accumulator A High Word Register																0000
ACCAU	0026	Accumulator A Upper Word Register																0000
ACCBL	0028	Accumulator B Low Word Register																0000
ACCBH	002A	Accumulator B High Word Register																0000
ACCBU	002C	Accumulator B Upper Word Register																0000
PCL	002E	Program Counter Low Word Register																0000
PCH	0030	—	—	—	—	—	—	—	—	Program Counter High Byte Register								0000
TBLPAG	0032	—	—	—	—	—	—	—	—	Table Page Address Pointer Register								0000
PSVPAG	0034	—	—	—	—	—	—	—	—	Program Memory Visibility Page Address Pointer Register								0000
RCOUNT	0036	Repeat Loop Counter Register																xxxx
DCOUNT	0038	DCOUNT<15:0>																xxxx
DOSTARTL	003A	DOSTARTL<15:1>															0	xxxx
DOSTARTH	003C	—	—	—	—	—	—	—	—	—	—	DOSTARTH<5:0>						00xx
DOENDL	003E	DOENDL<15:1>															0	xxxx
DOENDH	0040	—	—	—	—	—	—	—	—	—	—	DOENDH						00xx
SR	0042	OA	OB	SA	SB	OAB	SAB	DA	DC	IPL2	IPL1	IPL0	RA	N	OV	Z	C	0000
CORCON	0044	—	—	—	US	EDT	DL<2:0>			SATA	SATB	SATDW	ACCSAT	IPL3	PSV	RND	IF	0020
MODCON	0046	XMODEN	YMODEN	—	—	BWM<3:0>				YWM<3:0>				XWM<3:0>				0000

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

TABLE 4-22: FUNDAMENTAL ADDRESSING MODES SUPPORTED

Addressing Mode	Description
File Register Direct	The address of the file register is specified explicitly.
Register Direct	The contents of a register are accessed directly.
Register Indirect	The contents of Wn forms the Effective Address (EA.)
Register Indirect Post-Modified	The contents of Wn forms the EA. Wn is post-modified (incremented or decremented) by a constant value.
Register Indirect Pre-Modified	Wn is pre-modified (incremented or decremented) by a signed constant value to form the EA.
Register Indirect with Register Offset (Register Indexed)	The sum of Wn and Wb forms the EA.
Register Indirect with Literal Offset	The sum of Wn and a literal forms the EA.

4.3.3 MOVE AND ACCUMULATOR INSTRUCTIONS

Move instructions and the DSP accumulator class of instructions provide a greater degree of addressing flexibility than other instructions. In addition to the addressing modes supported by most MCU instructions, move and accumulator instructions also support Register Indirect with Register Offset Addressing mode, also referred to as Register Indexed mode.

Note: For the MOV instructions, the addressing mode specified in the instruction can differ for the source and destination EA. However, the 4-bit Wb (Register Offset) field is shared by both source and destination (but typically only used by one).

In summary, the following addressing modes are supported by move and accumulator instructions:

- Register Direct
- Register Indirect
- Register Indirect Post-modified
- Register Indirect Pre-modified
- Register Indirect with Register Offset (Indexed)
- Register Indirect with Literal Offset
- 8-bit Literal
- 16-bit Literal

Note: Not all instructions support all the addressing modes given above. Individual instructions may support different subsets of these addressing modes.

4.3.4 MAC INSTRUCTIONS

The dual source operand DSP instructions (CLR, ED, EDAC, MAC, MPY, MPY.N, MOVSAC, and MSC), also referred to as MAC instructions, use a simplified set of addressing modes to allow the user application to effectively manipulate the data pointers through register indirect tables.

The two-source operand prefetch registers must be members of the set {W8, W9, W10, W11}. For data reads, W8 and W9 are always directed to the X RAGU, and W10 and W11 are always directed to the Y AGU. The effective addresses generated (before and after modification) must, therefore, be valid addresses within X data space for W8 and W9 and Y data space for W10 and W11.

Note: Register Indirect with Register Offset Addressing mode is available only for W9 (in X space) and W11 (in Y space).

In summary, the following addressing modes are supported by the MAC class of instructions:

- Register Indirect
- Register Indirect Post-Modified by 2
- Register Indirect Post-Modified by 4
- Register Indirect Post-Modified by 6
- Register Indirect with Register Offset (Indexed)

4.3.5 OTHER INSTRUCTIONS

In addition to the addressing modes outlined previously, some instructions use literal constants of various sizes. For example, BRA (branch) instructions use 16-bit signed literals to specify the branch destination directly, whereas the DISI instruction uses a 14-bit unsigned literal field. In some instructions, such as ADD Acc, the source of an operand or result is implied by the opcode itself. Certain operations, such as NOP, do not have any operands.

4.4.3 MODULO ADDRESSING APPLICABILITY

Modulo Addressing can be applied to the EA calculation associated with any W register.

Address boundaries check for addresses equal to:

- The upper boundary addresses for incrementing buffers
- The lower boundary addresses for decrementing buffers

It is important to realize that the address boundaries also check for addresses less than or greater than these addresses. Address changes can, therefore, jump beyond boundaries and still be adjusted correctly.

Note:	The modulo corrected effective address is written back to the register only when Pre-Modify or Post-Modify Addressing mode is used to compute the effective address. When an address offset (such as [W7+W2]) is used, Modulo Address correction is performed, but the contents of the register remain unchanged.

4.5 Bit-Reversed Addressing

Bit-Reversed Addressing mode is intended to simplify data re-ordering for radix-2 FFT algorithms. It is supported by the X AGU for data writes only.

The modifier, which can be a constant value or register contents, is regarded as having its bit order reversed. The address source and destination are kept in normal order. Thus, the only operand requiring reversal is the modifier.

4.5.1 BIT-REVERSED ADDRESSING IMPLEMENTATION

Bit-Reversed Addressing mode is enabled in any of these situations:

- BWM bits (W register selection) in the MODCON register are any value other than ‘15’ (the stack cannot be accessed using Bit-Reversed Addressing)
- The BREN bit is set in the XBREV register
- The addressing mode used is Register Indirect with Pre-Increment or Post-Increment

If the length of a bit-reversed buffer is $M = 2^N$ bytes, the last ‘N’ bits of the data buffer start address must be zeros.

XB<14:0> is the Bit-Reversed Address modifier, or ‘pivot point,’ which is typically a constant. In the case of an FFT computation, its value is equal to half of the FFT data buffer size.

Note:	All bit-reversed EA calculations assume word-sized data (LSB of every EA is always clear). The XB value is scaled accordingly to generate compatible (byte) addresses.

When enabled, Bit-Reversed Addressing is executed only for Register Indirect with Pre-Increment or Post-Increment Addressing, and word-sized data writes. It will not function for any other addressing mode or for byte-sized data, and normal addresses are generated instead. When Bit-Reversed Addressing is active, the W Address Pointer is always added to the address modifier (XB), and the offset associated with the Register Indirect Addressing mode is ignored. In addition, as word-sized data is a requirement, the LSb of the EA is ignored (and always clear).

Note:	Modulo Addressing and Bit-Reversed Addressing should not be enabled together. If an application attempts to do so, Bit-Reversed Addressing will assume priority when active for the X WAGU, and X WAGU Modulo Addressing will be disabled. However, Modulo Addressing will continue to function in the X RAGU.

If Bit-Reversed Addressing has already been enabled by setting the BREN (XBREV<15>) bit, a write to the XBREV register should not be immediately followed by an indirect read operation using the W register that has been designated as the bit-reversed pointer.

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

bit 1 **BOR:** Brown-out Reset Flag bit
1 = A Brown-out Reset has occurred
0 = A Brown-out Reset has not occurred

bit 0 **POR:** Power-on Reset Flag bit
1 = A Power-up Reset has occurred
0 = A Power-up Reset has not occurred

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

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

REGISTER 7-5: IFS0: INTERRUPT FLAG STATUS REGISTER 0

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	AD1IF	U1TXIF	U1RXIF	SPI1IF	SPI1EIF	T3IF
bit 15							bit 8

R/W-0	R/W-0	R/W-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
T2IF	OC2IF	IC2IF	—	T1IF	OC1IF	IC1IF	INT0IF
bit 7							bit 0

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

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

bit 13 **AD1IF:** ADC1 Conversion Complete Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 12 **U1TXIF:** UART1 Transmitter Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 11 **U1RXIF:** UART1 Receiver Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 10 **SPI1IF:** SPI1 Event Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 9 **SPI1EIF:** SPI1 Fault Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 8 **T3IF:** Timer3 Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 7 **T2IF:** Timer2 Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 6 **OC2IF:** Output Compare Channel 2 Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 5 **IC2IF:** Input Capture Channel 2 Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 4 **Unimplemented:** Read as '0'

bit 3 **T1IF:** Timer1 Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 2 **OC1IF:** Output Compare Channel 1 Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

REGISTER 7-17: IPC7: INTERRUPT PRIORITY CONTROL REGISTER 7

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

U-0	R/W-1	R/W-0	R/W-0	U-0	U-0	U-0	U-0
—	INT2IP<2:0>			—	—	—	—
bit 7							bit 0

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

bit 15-7 **Unimplemented:** Read as ‘0’

bit 6-4 **INT2IP<2:0>:** External Interrupt 2 Priority bits
111 = Interrupt is priority 7 (highest priority interrupt)
•
•
•
001 = Interrupt is priority 1
000 = Interrupt source is disabled

bit 3-0 **Unimplemented:** Read as ‘0’

REGISTER 9-1: PMD1: PERIPHERAL MODULE DISABLE CONTROL REGISTER 1

U-0	U-0	R/W-0	R/W-0	R/W-0	U-0	U-0	U-0
—	—	T3MD	T2MD	T1MD	—	—	—
bit 15							bit 8

R/W-0	U-0	R/W-0	U-0	R/W-0	U-0	U-0	R/W-0
I2C1MD	—	U1MD	—	SPI1MD	—	—	AD1MD
bit 7							bit 0

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

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

bit 13 **T3MD**: Timer3 Module Disable bit
1 = Timer3 module is disabled
0 = Timer3 module is enabled

bit 12 **T2MD**: Timer2 Module Disable bit
1 = Timer2 module is disabled
0 = Timer2 module is enabled

bit 11 **T1MD**: Timer1 Module Disable bit
1 = Timer1 module is disabled
0 = Timer1 module is enabled

bit 10-8 **Unimplemented:** Read as '0'

bit 7 **I2C1MD**: I2C1 Module Disable bit
1 = I2C1 module is disabled
0 = I2C1 module is enabled

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

bit 5 **U1MD**: UART1 Module Disable bit
1 = UART1 module is disabled
0 = UART1 module is enabled

bit 4 **Unimplemented:** Read as '0'

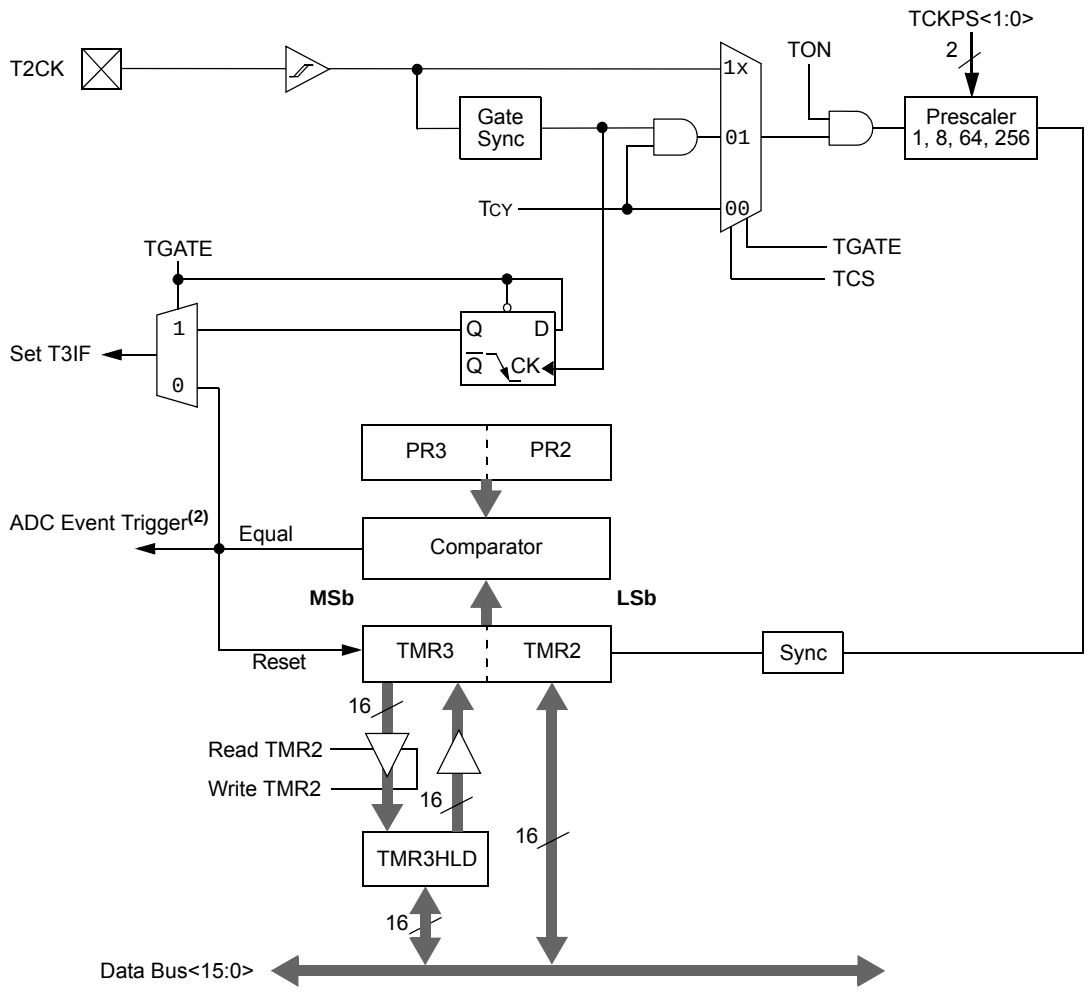
bit 3 **SPI1MD**: SPI1 Module Disable bit
1 = SPI1 module is disabled
0 = SPI1 module is enabled

bit 2-1 **Unimplemented:** Read as '0'

bit 0 **AD1MD**: ADC1 Module Disable bit(1)
1 = ADC1 module is disabled
0 = ADC1 module is enabled

Note 1: PCFGx bits have no effect if the ADC module is disabled by setting this bit. When the bit is set, all port pins that have been multiplexed with ANx will be in Digital mode.

FIGURE 12-1: TIMER2/3 (32-BIT) BLOCK DIAGRAM(1)



Note 1: The 32-bit timer control bit, T32, must be set for 32-bit timer/counter operation. All control bits are respective to the T2CON register.

2: The ADC event trigger is available only on Timer2/3.

13.0 INPUT CAPTURE

Note 1: This data sheet summarizes the features of the dsPIC33FJ12GP201/202 family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **Section 12. "Input Capture"** (DS70198) of the *"dsPIC33F/PIC24H Family Reference Manual"*, which is available from the Microchip website (www.microchip.com).

2: Some registers and associated bits described in this section may not be available on all devices. Refer to **Section 4.0 "Memory Organization"** in this data sheet for device-specific register and bit information.

The Input Capture module is useful in applications requiring frequency (period) and pulse measurement. The dsPIC33FJ12GP201/202 devices support up to eight input capture channels.

The Input Capture module captures the 16-bit value of the selected Time Base register when an event occurs at the ICx pin. The events that cause a capture event are listed below in three categories:

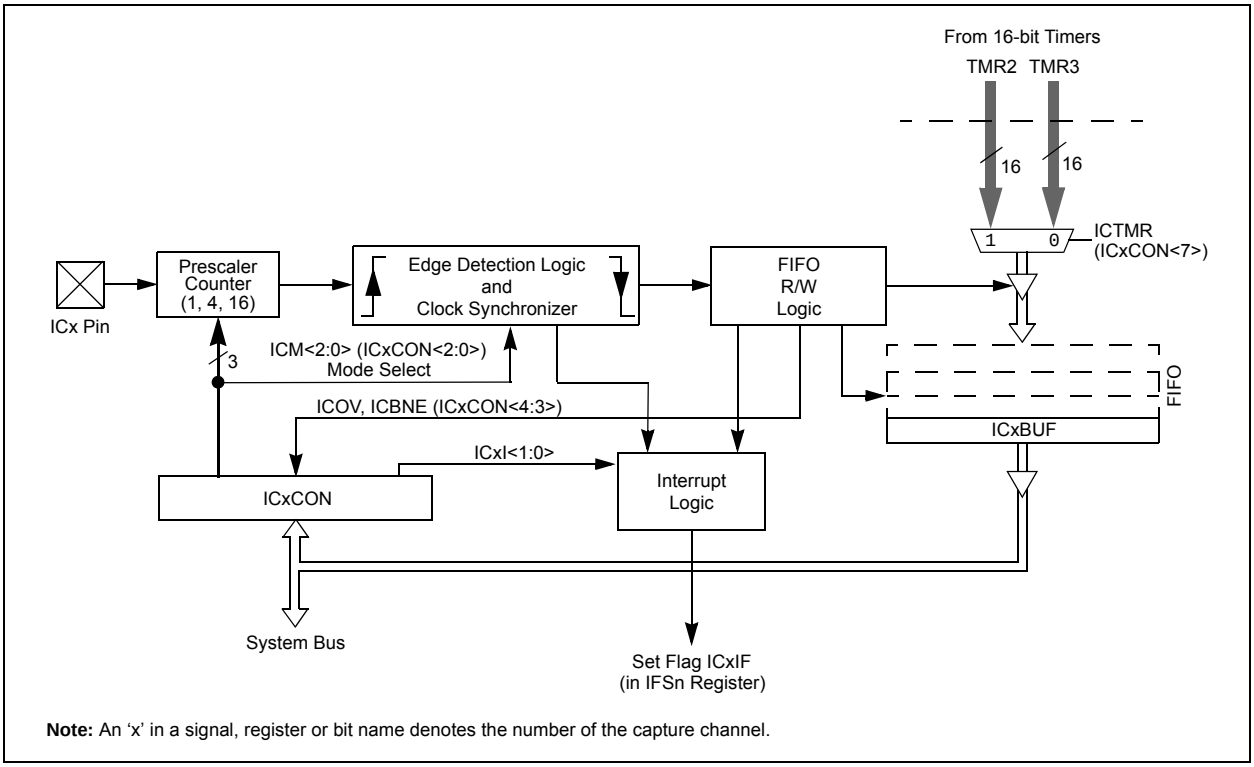
- Simple Capture Event modes:
  - Capture timer value on every falling edge of input at ICx pin
  - Capture timer value on every rising edge of input at ICx pin
- Capture timer value on every edge (rising and falling)
- Prescaler Capture Event modes:
  - Capture timer value on every 4th rising edge of input at ICx pin
  - Capture timer value on every 16th rising edge of input at ICx pin

Each Input Capture channel can select one of two 16-bit timers (Timer2 or Timer3) for the time base. The selected timer can use either an internal or external clock.

Other operational features include:

- Device wake-up from capture pin during CPU Sleep and Idle modes
- Interrupt on Input Capture event
- 4-word FIFO buffer for capture values
  - Interrupt optionally generated after 1, 2, 3, or 4 buffer locations are filled
- Use of Input Capture to provide additional

FIGURE 13-1: INPUT CAPTURE BLOCK DIAGRAM



Note: An 'x' in a signal, register or bit name denotes the number of the capture channel.

REGISTER 18-6: AD1CSSL: ADC1 INPUT SCAN SELECT REGISTER LOW(1,2)

U-0	U-0	U-0	U-0	U-0	U-0	R/W-0	R/W-0
—	—	—	—	—	—	CSS9	CSS8
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
CSS7	CSS6	CSS5	CSS4	CSS3	CSS2	CSS1	CSS0
bit 7							bit 0

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

bit 15-10 **Unimplemented:** Read as '0'

bit 9-0 **CSS<9:0>:** ADC Input Scan Selection bits
1 = Select ANx for input scan
0 = Skip ANx for input scan

Note 1: On devices without 10 analog inputs, all AD1CSSL bits can be selected by user application. However, inputs selected for scan without a corresponding input on device converts VREFL.

2: CSSx = ANx, where x = 0 through 9.

REGISTER 18-7: AD1PCFGL: ADC1 PORT CONFIGURATION REGISTER LOW(1,2,3)

U-0	U-0	U-0	U-0	U-0	U-0	R/W-0	R/W-0
—	—	—	—	—	—	PCFG9	PCFG8
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PCFG7	PCFG6	PCFG5	PCFG4	PCFG3	PCFG2	PCFG1	PCFG0
bit 7							bit 0

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

bit 15-10 **Unimplemented:** Read as '0'

bit 9-0 **PCFG<9:0>:** ADC Port Configuration Control bits
1 = Port pin in Digital mode, port read input enabled, ADC input multiplexer connected to AVSS
0 = Port pin in Analog mode, port read input disabled, ADC samples pin voltage

Note 1: On devices without 10 analog inputs, all PCFG bits are R/W by user. However, PCFG bits are ignored on ports without a corresponding input on device.

2: PCFGx = ANx, where x = 0 through 9.

3: PCFGx bits have no effect if the ADC module is disabled by setting the ADxMD bit in the PMDx register. When that bit is set, all port pins that have been multiplexed with ANx will be in Digital mode.

TABLE 19-2: dsPIC33FJ12GP201/202 CONFIGURATION BITS DESCRIPTION

Bit Field	Register	RTSP Effect	Description
BWRP	FBS	Immediate	Boot Segment Program Flash Write Protection 1 = Boot segment may be written 0 = Boot segment is write-protected
BSS<2:0>	FBS	Immediate	Boot Segment Program Flash Code Protection Size X11 = No Boot program Flash segment Boot space is 256 Instruction Words (except interrupt vectors) 110 = Standard security; boot program Flash segment ends at 0x0003FE 010 = High security; boot program Flash segment ends at 0x0003FE Boot space is 768 Instruction Words (except interrupt vectors) 101 = Standard security; boot program Flash segment, ends at 0x0007FE 001 = High security; boot program Flash segment ends at 0x0007FE Boot space is 1792 Instruction Words (except interrupt vectors) 100 = Standard security; boot program Flash segment ends at 0x000FFE 000 = High security; boot program Flash segment ends at 0x000FFE
GSS<1:0>	FGS	Immediate	General Segment Code-Protect bit 11 = User program memory is not code-protected 10 = Standard security 0x = High security
GWRP	FGS	Immediate	General Segment Write-Protect bit 1 = User program memory is not write-protected 0 = User program memory is write-protected
IESO	FOSCSEL	Immediate	Two-speed Oscillator Start-up Enable bit 1 = Start-up device with FRC, then automatically switch to the user-selected oscillator source when ready 0 = Start-up device with user-selected oscillator source
FNOSC<2:0>	FOSCSEL	If clock switch is enabled, RTSP effect is on any device Reset; otherwise, Immediate	Initial Oscillator Source Selection bits 111 = Internal Fast RC (FRC) oscillator with postscaler 110 = Internal Fast RC (FRC) oscillator with divide-by-16 101 = LPRC oscillator 100 = Secondary (LP) oscillator 011 = Primary (XT, HS, EC) oscillator with PLL 010 = Primary (XT, HS, EC) oscillator 001 = Internal Fast RC (FRC) oscillator with PLL 000 = FRC oscillator
FCKSM<1:0>	FOSC	Immediate	Clock Switching Mode bits 1x = Clock switching is disabled, fail-safe clock monitor is disabled 01 = Clock switching is enabled, fail-safe clock monitor is disabled 00 = Clock switching is enabled, fail-safe clock monitor is enabled
IOL1WAY	FOSC	Immediate	Peripheral Pin Select Configuration 1 = Allow only one reconfiguration 0 = Allow multiple reconfigurations
OSCIOFNC	FOSC	Immediate	OSC2 Pin Function bit (except in XT and HS modes) 1 = OSC2 is clock output 0 = OSC2 is general purpose digital I/O pin
POSCMD<1:0>	FOSC	Immediate	Primary Oscillator Mode Select bits 11 = Primary oscillator disabled 10 = HS Crystal Oscillator mode 01 = XT Crystal Oscillator mode 00 = EC (External Clock) mode

TABLE 20-2: INSTRUCTION SET OVERVIEW (CONTINUED)

Base Instr #	Assembly Mnemonic	Assembly Syntax	Description	# of Words	# of Cycles	Status Flags Affected
48	MPY	MPY Wm*Wn,Acc,Wx,Wxd,Wy,Wyd	Multiply Wm by Wn to Accumulator	1	1	OA,OB,OAB, SA,SB,SAB
		MPY Wm*Wm,Acc,Wx,Wxd,Wy,Wyd	Square Wm to Accumulator	1	1	OA,OB,OAB, SA,SB,SAB
49	MPY.N	MPY.N Wm*Wn,Acc,Wx,Wxd,Wy,Wyd	-(Multiply Wm by Wn) to Accumulator	1	1	None
50	MSC	MSC Wm*Wm,Acc,Wx,Wxd,Wy,Wyd, AWB	Multiply and Subtract from Accumulator	1	1	OA,OB,OAB, SA,SB,SAB
51	MUL	MUL.SS Wb,Ws,Wnd	{Wnd + 1, Wnd} = signed(Wb) * signed(Ws)	1	1	None
		MUL.SU Wb,Ws,Wnd	{Wnd + 1, Wnd} = signed(Wb) * unsigned(Ws)	1	1	None
		MUL.US Wb,Ws,Wnd	{Wnd + 1, Wnd} = unsigned(Wb) * signed(Ws)	1	1	None
		MUL.UU Wb,Ws,Wnd	{Wnd + 1, Wnd} = unsigned(Wb) * unsigned(Ws)	1	1	None
		MUL.SU Wb,#lit5,Wnd	{Wnd + 1, Wnd} = signed(Wb) * unsigned(lit5)	1	1	None
		MUL.UU Wb,#lit5,Wnd	{Wnd + 1, Wnd} = unsigned(Wb) * unsigned(lit5)	1	1	None
		MUL f	W3:W2 = f * WREG	1	1	None
52	NEG	NEG Acc	Negate Accumulator	1	1	OA,OB,OAB, SA,SB,SAB
		NEG f	f = $\bar{f}$ + 1	1	1	C,DC,N,OV,Z
		NEG f,WREG	WREG = $\bar{f}$ + 1	1	1	C,DC,N,OV,Z
		NEG Ws,Wd	Wd = $\overline{Ws}$ + 1	1	1	C,DC,N,OV,Z
53	NOP	NOP	No Operation	1	1	None
		NOPR	No Operation	1	1	None
54	POP	POP f	Pop f from Top-of-Stack (TOS)	1	1	None
		POP Wdo	Pop from Top-of-Stack (TOS) to Wdo	1	1	None
		POP.D Wnd	Pop from Top-of-Stack (TOS) to W(nd):W(nd + 1)	1	2	None
		POP.S	Pop Shadow Registers	1	1	All
55	PUSH	PUSH f	Push f to Top-of-Stack (TOS)	1	1	None
		PUSH Wso	Push Wso to Top-of-Stack (TOS)	1	1	None
		PUSH.D Wns	Push W(ns):W(ns + 1) to Top-of-Stack (TOS)	1	2	None
		PUSH.S	Push Shadow Registers	1	1	None
56	PWRSAV	PWRSAV #lit1	Go into Sleep or Idle mode	1	1	WDTO,Sleep
57	RCALL	RCALL Expr	Relative Call	1	2	None
		RCALL Wn	Computed Call	1	2	None
58	REPEAT	REPEAT #lit14	Repeat Next Instruction lit14 + 1 times	1	1	None
		REPEAT Wn	Repeat Next Instruction (Wn) + 1 times	1	1	None
59	RESET	RESET	Software device Reset	1	1	None
60	RETFIE	RETFIE	Return from interrupt	1	3 (2)	None
61	RETLW	RETLW #lit10,Wn	Return with literal in Wn	1	3 (2)	None
62	RETURN	RETURN	Return from Subroutine	1	3 (2)	None
63	RLC	RLC f	f = Rotate Left through Carry f	1	1	C,N,Z
		RLC f,WREG	WREG = Rotate Left through Carry f	1	1	C,N,Z
		RLC Ws,Wd	Wd = Rotate Left through Carry Ws	1	1	C,N,Z
64	RLNC	RLNC f	f = Rotate Left (No Carry) f	1	1	N,Z
		RLNC f,WREG	WREG = Rotate Left (No Carry) f	1	1	N,Z
		RLNC Ws,Wd	Wd = Rotate Left (No Carry) Ws	1	1	N,Z
65	RRC	RRC f	f = Rotate Right through Carry f	1	1	C,N,Z
		RRC f,WREG	WREG = Rotate Right through Carry f	1	1	C,N,Z
		RRC Ws,Wd	Wd = Rotate Right through Carry Ws	1	1	C,N,Z

22.1 DC Characteristics

TABLE 22-1: OPERATING MIPS VS. VOLTAGE

Characteristic	VDD Range (in Volts)	Temp Range (in °C)	Max MIPS
			dsPIC33FJ12GP201/202
	3.0-3.6V	-40°C to +85°C	40
	3.0-3.6V	-40°C to +125°C	40

TABLE 22-2: THERMAL OPERATING CONDITIONS

Rating	Symbol	Min	Typ	Max	Unit
Industrial Temperature Devices					
Operating Junction Temperature Range	T_J	-40	—	+125	°C
Operating Ambient Temperature Range	T_A	-40	—	+85	°C
Extended Temperature Devices					
Operating Junction Temperature Range	T_J	-40	—	+140	°C
Operating Ambient Temperature Range	T_A	-40	—	+125	°C
Power Dissipation: Internal chip power dissipation: $P_{INT} = V_{DD} \times (I_{DD} - \Sigma I_{OH})$ I/O Pin Power Dissipation: $I/O = \Sigma (\{V_{DD} - V_{OH}\} \times I_{OH}) + \Sigma (V_{OL} \times I_{OL})$	P_D	$P_{INT} + P_{I/O}$			W
Maximum Allowed Power Dissipation	P_{DMAX}	$(T_J - T_A)/\theta_{JA}$			W

TABLE 22-3: THERMAL PACKAGING CHARACTERISTICS

Characteristic	Symbol	Typ	Max	Unit	Notes
Package Thermal Resistance, 18-pin PDIP	θ_{JA}	45	—	°C/W	**1**
Package Thermal Resistance, 28-pin SPDIP	θ_{JA}	45	—	°C/W	**1**
Package Thermal Resistance, 18-pin SOIC	θ_{JA}	60	—	°C/W	**1**
Package Thermal Resistance, 28-pin SOIC	θ_{JA}	50	—	°C/W	**1**
Package Thermal Resistance, 28-pin SSOP	θ_{JA}	71	—	°C/W	**1**
Package Thermal Resistance, 28-pin QFN	θ_{JA}	35	—	°C/W	**1**

Note 1: Junction to ambient thermal resistance, Theta-JA (θ_{JA}) numbers are achieved by package simulations.

TABLE 22-6: DC CHARACTERISTICS: IDLE CURRENT (I_{IDLE})

DC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤TA ≤+85°C for Industrial -40°C ≤TA ≤+125°C for Extended			
Parameter No.	**Typical(1)**	**Max**	**Units**	**Conditions**		
Idle Current (I_{IDLE}): Core OFF Clock ON Base Current(2)						
DC40d	3	25	mA	-40°C	3.3V	10 MIPS(3)
DC40a	3	25	mA	+25°C		
DC40b	3	25	mA	+85°C		
DC40c	3	25	mA	+125°C		
DC41d	4	25	mA	-40°C	3.3V	16 MIPS(3)
DC41a	4	25	mA	+25°C		
DC41b	5	25	mA	+85°C		
DC41c	5	25	mA	125°C		
DC42d	6	25	mA	-40°C	3.3V	20 MIPS(3)
DC42a	6	25	mA	+25°C		
DC42b	7	25	mA	+85°C		
DC42c	7	25	mA	+125°C		
DC43d	9	25	mA	-40°C	3.3V	30 MIPS(3)
DC43a	9	25	mA	+25°C		
DC43b	9	25	mA	+85°C		
DC43c	9	25	mA	+125°C		
DC44d	10	25	mA	-40°C	3.3V	40 MIPS
DC44a	10	25	mA	+25°C		
DC44b	10	25	mA	+85°C		
DC44c	10	25	mA	+125°C		

Note 1: Data in "Typical" column is at 3.3V, 25°C unless otherwise stated.

2: Base I_{IDLE} current is measured with core off, clock on and all modules turned off. Peripheral Module Disable SFR registers are zeroed. All I/O pins are configured as inputs and pulled to V_{SS}.

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

TABLE 22-21: RESET, WATCHDOG TIMER, OSCILLATOR START-UP TIMER, POWER-UP TIMER TIMING REQUIREMENTS

AC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤TA ≤+85°C for Industrial -40°C ≤TA ≤+125°C for Extended				
Param No.	**Symbol**	**Characteristic(1)**	**Min**	**Typ(2)**	**Max**	**Units**	**Conditions**
SY10	TMCL	$\overline{\text{MCLR}}$ Pulse-Width (low)(1)	2	—	—	µs	-40°C to +85°C
SY11	TPWRT	Power-up Timer Period(1)	—	2 4 8 16 32 64 128	—	ms	-40°C to +85°C User programmable
SY12	TPOR	Power-on Reset Delay(3)	3	10	30	µs	-40°C to +85°C
SY13	TIOZ	I/O High-Impedance from $\overline{\text{MCLR}}$ Low or Watchdog Timer Reset(1)	0.68	0.72	1.2	µs	
SY20	TWDT1	Watchdog Timer Time-out Period(1)	—	—	—	ms	See **Section 19.4 "Watchdog Timer (WDT)"** and LPRC parameter F21a (Table 22-19).
SY30	TOST	Oscillator Start-up Time	—	1024 TOSC	—	—	TOSC = OSC1 period
SY35	TFSCM	Fail-Safe Clock Monitor Delay(1)	—	500	900	µs	-40°C to +85°C

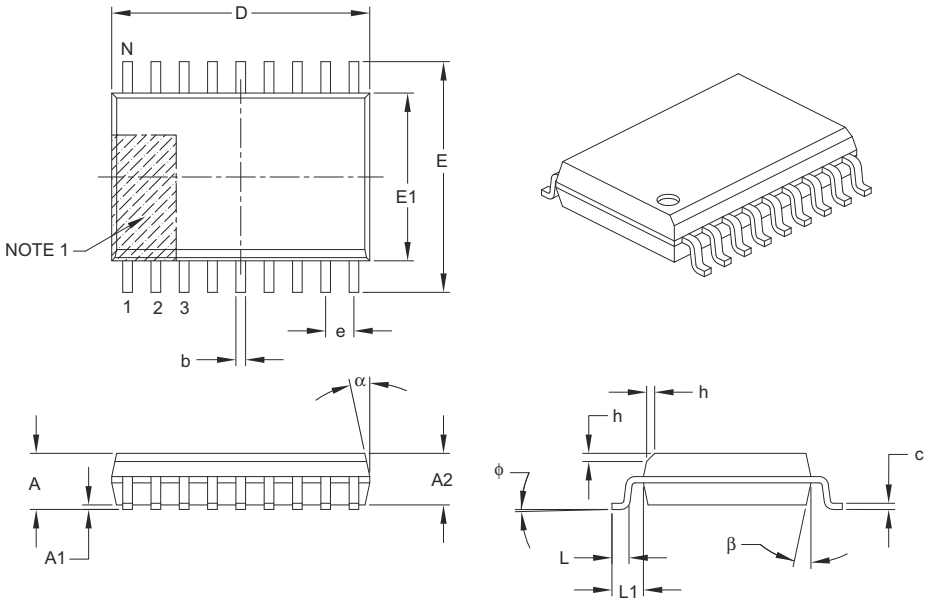
Note 1: These parameters are characterized but not tested in manufacturing.

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

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

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

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



Units		MILLMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		18	
Pitch	e		1.27 BSC	
Overall Height	A	–	–	2.65
Molded Package Thickness	A2	2.05	–	–
Standoff §	A1	0.10	–	0.30
Overall Width	E		10.30 BSC	
Molded Package Width	E1		7.50 BSC	
Overall Length	D		11.55 BSC	
Chamfer (optional)	h	0.25	–	0.75
Foot Length	L	0.40	–	1.27
Footprint	L1		1.40 REF	
Foot Angle	φ	0°	–	8°
Lead Thickness	c	0.20	–	0.33
Lead Width	b	0.31	–	0.51
Mold Draft Angle Top	α	5°	–	15°
Mold Draft Angle Bottom	β	5°	–	15°

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic.
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M.

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

   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-051B