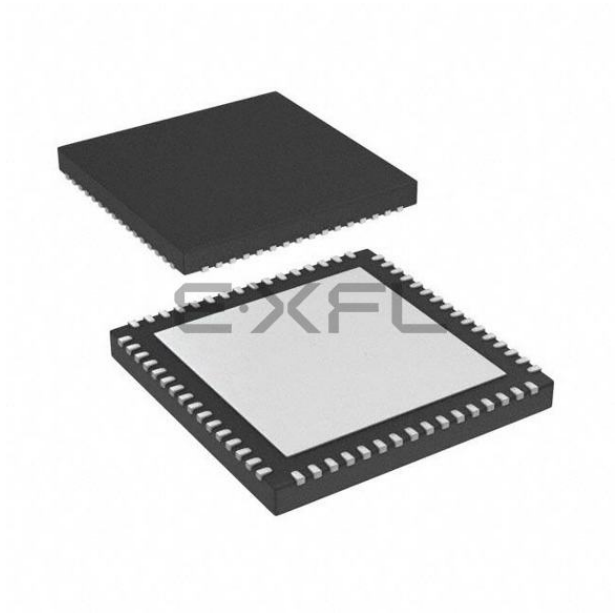
Microchip Technology - DSPIC33CH128MP206T-I/MR Datasheet



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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	dsPIC
Core Size	16-Bit Dual-Core
Speed	180MHz, 200MHz
Connectivity	I²C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, Motor Control PWM, POR, PWM, QEI, WDT
Number of I/O	53
Program Memory Size	152KB (152K x 8)
Program Memory Type	FLASH, PRAM
EEPROM Size	-
RAM Size	20K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 34x12b; D/A 4x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-VFQFN Exposed Pad
Supplier Device Package	64-QFN (9x9)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/dspic33ch128mp206t-i-mr

3.2.6 INSTRUCTION ADDRESSING MODES

The addressing modes shown in Table 3-20 form the basis of the addressing modes optimized to support the specific features of individual instructions. The addressing modes provided in the MAC class of instructions differ from those in the other instruction types.

3.2.6.1 File Register Instructions

Most file register instructions use a 13-bit address field (f) to directly address data present in the first 8192 bytes of data memory (Near Data Space). Most file register instructions employ a Working register, W0, which is denoted as WREG in these instructions. The destination is typically either the same file register or WREG (with the exception of the MUL instruction), which writes the result to a register or register pair. The MOV instruction allows additional flexibility and can access the entire Data Space.

3.2.6.2 MCU Instructions

The three-operand MCU instructions are of the form:

```
Operand 3 = Operand 1 <function> Operand 2
```

where `Operand 1` is always a Working register (that is, the addressing mode can only be Register Direct), which is referred to as Wb. `Operand 2` can be a W register fetched from data memory or a 5-bit literal. The result location can either be a W register or a data memory location. The following addressing modes are supported by MCU instructions:

- Register Direct
- Register Indirect
- Register Indirect Post-Modified
- Register Indirect Pre-Modified
- 5-Bit or 10-Bit Literal

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

TABLE 3-20: 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 form the Effective Address (EA).
Register Indirect Post-Modified	The contents of Wn form 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.

3.3.3.1 ECC Fault Injection

To test Fault handling, an EEC error can be generated. Both single and double-bit errors can be generated in both the read and write data paths. Read path Fault injection first reads the Flash data and then modifies it prior to entering the ECC logic. Write path Fault injection modifies the actual data prior to it being written into the target Flash and will cause an EEC error on subsequent Flash read. The following procedure is used to inject a Fault:

1. Load Flash target address into the ECCADDR register.
2. Select 1st Fault bit determined by FLT1PTRx (ECCCONH<7:0>). The target bit is inverted to create the Fault.
3. If a double Fault is desired, select the 2nd Fault bit determined by FLT2PTRx (ECCCONH<15:8>), otherwise set to all '1's.
4. Write the NVMKEY unlock sequence.
5. Enable the ECC Fault injection logic by setting the FLTINJ bit (ECCCONL<0>)
6. Perform a read or write to the Flash target address.

3.3.4 CONTROL REGISTERS

Five SFRs are used to write and erase the Program Flash Memory: NVMCON, NVMKEY, NVMADR, NVMADRU and NVMSRCADRL/H.

The NVMCON register (Register 3-4) selects the operation to be performed (page erase, word/row program, Inactive Partition erase) and initiates the program or erase cycle.

NVMKEY (Register 3-7) is a write-only register that is used for write protection. To start a programming or erase sequence, the user application must consecutively write 0x55 and 0xAA to the NVMKEY register.

There are two NVM Address registers: NVMADR and NVMADRU. These two registers, when concatenated, form the 24-bit Effective Address (EA) of the selected word/row for programming operations, or the selected page for erase operations. The NVMADRU register is used to hold the upper 8 bits of the EA, while the NVMADR register is used to hold the lower 16 bits of the EA.

For row programming operation, data to be written to Program Flash Memory is written into data memory space (RAM) at an address defined by the NVMSRCADRL/H register (location of first element in row programming data).

REGISTER 3-17: CORCON: CORE CONTROL REGISTER(1)

R/W-0	U-0	R/W-0	R/W-0	R/W-0	R-0	R-0	R-0
VAR	—	US1	US0	EDT	DL2	DL1	DL0
bit 15							bit 8

R/W-0	R/W-0	R/W-1	R/W-0	R/C-0	R-0	R/W-0	R/W-0
SATA	SATB	SATDW	ACCSAT	IPL3(2)	SFA	RND	IF
bit 7							bit 0

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

bit 15 **VAR:** Variable Exception Processing Latency Control bit
1 = Variable exception processing is enabled
0 = Fixed exception processing is enabled

bit 3 **IPL3:** CPU Interrupt Priority Level Status bit 3(2)
1 = CPU Interrupt Priority Level is greater than 7
0 = CPU Interrupt Priority Level is 7 or less

Note 1: For complete register details, see Register 3-2.
2: The IPL3 bit is concatenated with the IPL<2:0> bits (SR<7:5>) to form the CPU Interrupt Priority Level.

REGISTER 3-34: CNFx: INTERRUPT CHANGE NOTIFICATION FLAG FOR PORTx REGISTER

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
CNFx<15:8>							
bit 15							bit 8

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

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

bit 15- **CNFx<15:0>:** Interrupt Change Notification Flag for PORTx bits

When CNSTYLE (CNCONx<11>) = 1:

1 = An enabled edge event occurred on the PORTx[n] pin

0 = An enabled edge event did not occur on the PORTx[n] pin

REGISTER 3-130: C1TXQCONH: CAN TRANSMIT QUEUE CONTROL REGISTER HIGH

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PLSIZE2(1)	PLSIZE1(1)	PLSIZE0(1)	FSIZE4(1)	FSIZE3(1)	FSIZE2(1)	FSIZE1(1)	FSIZE0(1)
bit 15							bit 8

U-0	R/W-1	R/W-1	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	TXAT1	TXAT0	TXPRI4	TXPRI3	TXPRI2	TXPRI1	TXPRI0
bit 7							bit 0

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

bit 15-13 **PLSIZE<2:0>:** Payload Size bits(1)
111 = 64 data bytes
110 = 48 data bytes
101 = 32 data bytes
100 = 24 data bytes
011 = 20 data bytes
010 = 16 data bytes
001 = 12 data bytes
000 = 8 data bytes

bit 12-8 **FSIZE<4:0>:** FIFO Size bits(1)
11111 = FIFO is 32 messages deep
...
00010 = FIFO is 3 messages deep
00001 = FIFO is 2 messages deep
00000 = FIFO is 1 message deep

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

bit 6-5 **TXAT<1:0>:** Retransmission Attempts bits
This feature is enabled when RTXAT (C1CONH<0>) is set.
11 = Unlimited number of retransmission attempts
10 = Unlimited number of retransmission attempts
01 = Three retransmission attempts
00 = Disables retransmission attempts

bit 4-0 **TXPRI<4:0>:** Message Transmit Priority bits
11111 = Highest message priority
...
00000 = Lowest message priority

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

REGISTER 4-2: CORCON: CORE CONTROL REGISTER (CONTINUED)

bit 2 **SFA:** Stack Frame Active Status bit
1 = Stack frame is active; W14 and W15 address 0x0000 to 0xFFFF, regardless of DSRPAG
0 = Stack frame is not active; W14 and W15 address the base Data Space

bit 1 **RND:** Rounding Mode Select bit
1 = Biased (conventional) rounding is enabled
0 = Unbiased (convergent) rounding is enabled

bit 0 **IF:** Integer or Fractional Multiplier Mode Select bit
1 = Integer mode is enabled for DSP multiply
0 = Fractional mode is enabled for DSP multiply

Note 1: This bit is always read as '0'.
2: The IPL3 bit is concatenated with the IPL<2:0> bits (SR<7:5>) to form the CPU Interrupt Priority Level.

REGISTER 4-3: CTXTSTAT: CPU W REGISTER CONTEXT STATUS REGISTER

U-0	U-0	U-0	U-0	U-0	R-0	R-0	R-0
—	—	—	—	—	CCTXI2	CCTXI1	CCTXI0
bit 15							bit 8

U-0	U-0	U-0	U-0	U-0	R-0	R-0	R-0
—	—	—	—	—	MCTXI2	MCTXI1	MCTXI0
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 15-11 **Unimplemented:** Read as '0'

bit 10-8 **CCTXI<2:0>:** Current (W Register) Context Identifier bits
111 = Reserved
...
100 = Alternate Working Register Set 4 is currently in use
011 = Alternate Working Register Set 3 is currently in use
010 = Alternate Working Register Set 2 is currently in use
001 = Alternate Working Register Set 1 is currently in use
000 = Default register set is currently in use

bit 7-3 **Unimplemented:** Read as '0'

bit 2-0 **MCTXI<2:0>:** Manual (W Register) Context Identifier bits
111 = Reserved
...
100 = Alternate Working Register Set 4 was most recently manually selected
011 = Alternate Working Register Set 3 was most recently manually selected
010 = Alternate Working Register Set 2 was most recently manually selected
001 = Alternate Working Register Set 1 was most recently manually selected
000 = Default register set was most recently manually selected

4.5 Slave Interrupt Controller

Note 1: This data sheet summarizes the features of the dsPIC33CH128MP508 family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **"Interrupts"** (DS70000600) in the *"dsPIC33/PIC24 Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com).

The dsPIC33CH128MP508S1 family interrupt controller reduces the numerous peripheral interrupt request signals to a single interrupt request signal to the dsPIC33CH128MP508S1 family CPU.

The interrupt controller has the following features:

- Six Processor Exceptions and Software Traps
- Seven User-Selectable Priority Levels
- Interrupt Vector Table (IVT) with a Unique Vector for each Interrupt or Exception Source
- Fixed Priority within a Specified User Priority Level
- Fixed Interrupt Entry and Return Latencies

Note: There is no Alternate Interrupt Vector Table (AIVT) for the Slave.

4.5.1 INTERRUPT VECTOR TABLE

The dsPIC33CH128MP508S1 family Interrupt Vector Table (IVT), shown in Figure 4-16, resides in program memory, starting at location, 000004h. The IVT contains six non-maskable trap vectors and up to 246 sources of interrupts. In general, each interrupt source has its own vector. Each interrupt vector contains a 24-bit wide address. The value programmed into each interrupt vector location is the starting address of the associated Interrupt Service Routine (ISR).

Interrupt vectors are prioritized in terms of their natural priority. This priority is linked to their position in the vector table. Lower addresses generally have a higher natural priority. For example, the interrupt associated with Vector 0 takes priority over interrupts at any other vector address.

4.5.2 RESET SEQUENCE

A device Reset is not a true exception because the interrupt controller is not involved in the Reset process. The dsPIC33CH128MP508S1 family devices clear their registers in response to a Reset, which forces the PC to zero. The device then begins program execution at location, 0x000000. A GOTO instruction at the Reset address can redirect program execution to the appropriate start-up routine.

Note: Any unimplemented or unused vector locations in the IVT should be programmed with the address of a default interrupt handler routine that contains a RESET instruction.

6. The Peripheral Pin Select (PPS) pin mapping rules are as follows:
   a) Only one “output” function can be active on a given pin at any time, regardless if it is a dedicated or remappable function (one pin, one output).
   b) It is possible to assign a “remappable output” function to multiple pins and externally short or tie them together for increased current drive.
   c) If any “dedicated output” function is enabled on a pin, it will take precedence over any remappable “output” function.
   d) If any “dedicated digital” (input or output) function is enabled on a pin, any number of “input” remappable functions can be mapped to the same pin.
   e) If any “dedicated analog” function(s) are enabled on a given pin, “digital input(s)” of any kind will all be disabled, although a single “digital output”, at the user’s cautionary discretion, can be enabled and active as long as there is no signal contention with an external analog input signal. For example, it is possible for the ADC to convert the digital output logic level, or to toggle a digital output on a comparator or ADC input, provided there is no external analog input, such as for a Built-In Self-Test.
   f) Any number of “input” remappable functions can be mapped to the same pin(s) at the same time, including to any pin with a single output from either a dedicated or remappable “output”.
   g) The TRISx registers control *only* the digital I/O output buffer. Any other dedicated or remappable active “output” will automatically override the TRISx setting. The TRISx register *does not* control the digital logic “input” buffer. Remappable digital “inputs” do not automatically override TRISx settings, which means that the TRISx bit must be set to input for pins with only remappable input function(s) assigned.
   h) All analog pins are enabled by default after any Reset and the corresponding digital input buffer on the pin has been disabled. Only the Analog Select for PORTx (ANSELx) registers control the digital input buffer, *not* the TRISx register. The user must disable the analog function on a pin using the Analog Select for PORTx registers in order to use any “digital input(s)” on a corresponding pin, no exceptions.

4.6.7 I/O PORTS RESOURCES

Many useful resources are provided on the main product page of the Microchip web site for the devices listed in this data sheet. This product page contains the latest updates and additional information.

4.6.7.1 Key Resources

- **“I/O Ports with Edge Detect”** (DS70005322) in the *“dsPIC33/PIC24 Family Reference Manual”*
- Code Samples
- Application Notes
- Software Libraries
- Webinars
- All Related *“dsPIC33/PIC24 Family Reference Manual”* Sections
- Development Tools

REGISTER 4-37: RPINR1: PERIPHERAL PIN SELECT INPUT REGISTER 1

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
INT3R15	INT3R14	INT3R13	INT3R12	INT3R11	INT3R10	INT3R9	INT3R8
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
INT2R7	INT2R6	INT2R5	INT2R4	INT2R3	INT2R2	INT2R1	INT2R0
bit 7							bit 0

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

bit 15-8 **INT3R<15:8>:** Assign External Interrupt 3 (S1INT3) to the Corresponding S1RPn Pin bits
See Table 4-27.

bit 7-0 **INT2R<7:0>:** Assign External Interrupt 2 (S1INT2) to the Corresponding S1RPn Pin bits
See Table 4-27.

REGISTER 4-38: RPINR2: PERIPHERAL PIN SELECT INPUT REGISTER 2

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
T1CKR7	T1CKR6	T1CKR5	T1CKR4	T1CKR3	T1CKR2	T1CKR1	T1CKR0
bit 15							bit 8

U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-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 15-8 **T1CKR<7:0>:** Assign Timer1 External Clock (S1T1CK) to the Corresponding S1RPn Pin bits
See Table 4-27.

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

REGISTER 5-6: MSI1FIFOCS: MSI1 MASTER FIFO CONTROL/STATUS REGISTER

R/W-0	U-0	U-0	U-0	R/C-0	R-0	R-0	R-1
WFEN	—	—	—	WFOF(1)	WFUF(1)	WFFULL(1)	WFEMPTY(2)
bit 15							bit 8

R/W-0	U-0	U-0	U-0	R-0	R/C-0	R-0	R-1
RFEN	—	—	—	RFOF	RFUF	RFFULL	RFEMPTY
bit 7							bit 0

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

bit 15 **WFEN:** Write FIFO Enable bit
1 = Enables (Master) Write FIFO
0 = Disables and initializes (Master) Write FIFO

bit 14-12 **Unimplemented:** Read as '0'

bit 11 **WFOF:** Write FIFO Overflow bit(1)
1 = Write FIFO overflow is detected
0 = No Write FIFO overflow is detected

bit 10 **WFUF:** Write FIFO Underflow bit(1)
1 = Write FIFO underflow is detected
0 = No Write FIFO underflow is detected

bit 9 **WFFULL:** Write FIFO Full Status bit(1)
1 = Write FIFO is full, last write by Master to Write FIFO (WFDATA) was into the last free location
0 = Write FIFO is not full

bit 8 **WFEMPTY:** Write FIFO Empty Status bit(2)
1 = Write FIFO is empty; last read by Slave from Write FIFO (WFDATA) emptied the FIFO of all valid data or FIFO is disabled (and initialized to the empty state)
0 = Write FIFO contains valid data not yet read by the Slave

bit 7 **RFEN:** Read FIFO Enable bit
1 = Enables (Master) the Read FIFO
0 = Disables and initializes the (Master) Read FIFO

bit 6-4 **Unimplemented:** Read as '0'

bit 3 **RFOF:** Read FIFO Overflow bit
1 = Read FIFO overflow is detected
0 = No Read FIFO overflow is detected

bit 2 **RFUF:** Read FIFO Underflow bit
1 = Read FIFO underflow is detected
0 = No Read FIFO underflow is detected

bit 1 **RFFULL:** Read FIFO Full Status bit
1 = Read FIFO is full; last write by Slave to Read FIFO (RFDATA) was into the last free location
0 = Read FIFO is not full

bit 0 **RFEMPTY:** Read FIFO Empty Status bit
1 = Read FIFO is empty; last read by Master from Read FIFO (RFDATA) emptied the FIFO of all valid data or FIFO is disabled (and initialized to the empty state)
0 = Read FIFO contains valid data not yet read by the Master

Note 1: Once set, these bits can be cleared by making WFEN = 0.
2: Clearing WFEN will also cause the WFEMPTY status bit to be set. After WFEN is subsequently set, WFEMPTY will remain set until the Master writes data into the Write FIFO.

6.0 OSCILLATOR WITH HIGH-FREQUENCY PLL

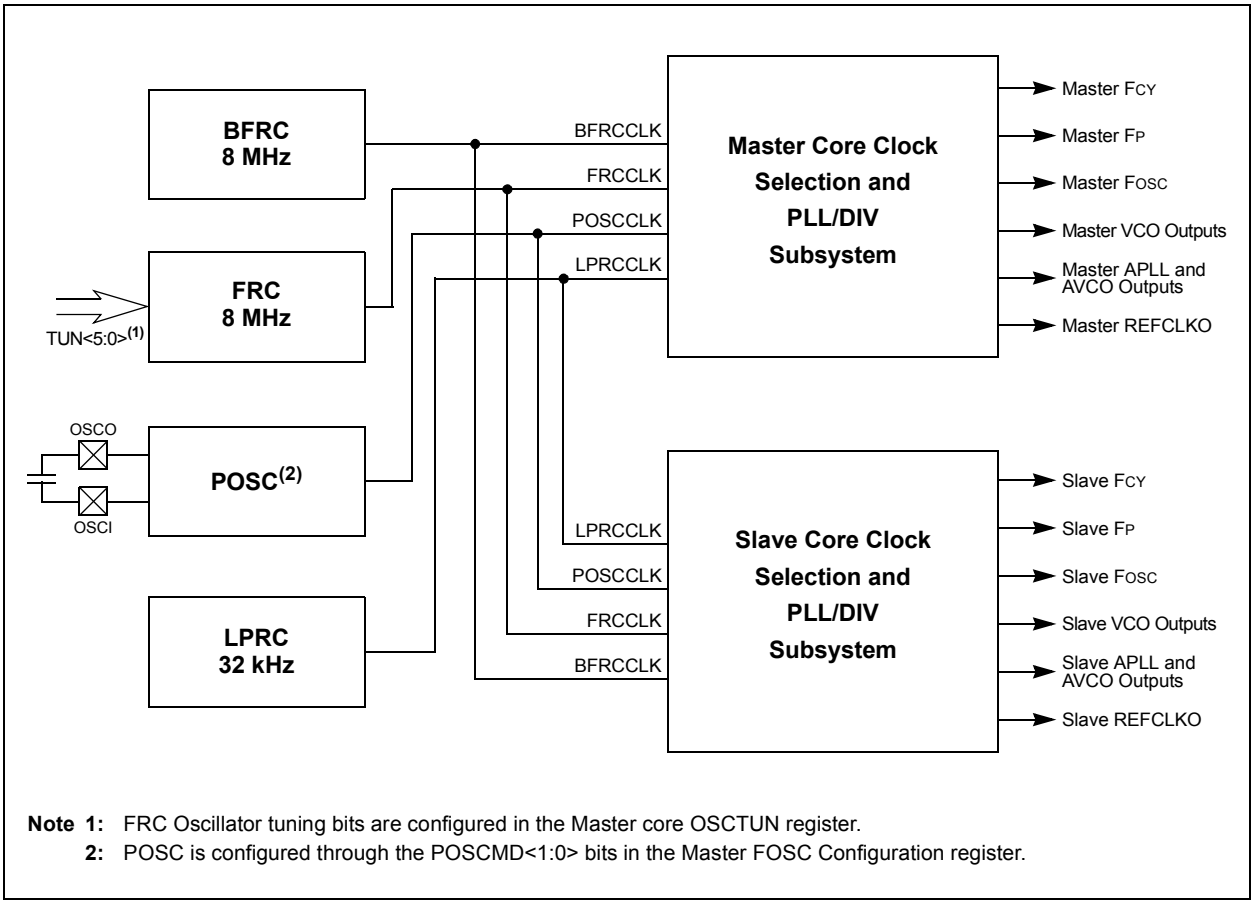
Note 1: This data sheet summarizes the features of the dsPIC33CH128MP508 family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **"Oscillator Module with High-Speed PLL"** (DS70005255) in the *"dsPIC33/PIC24 Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com).

The dsPIC33CH128MP508 family oscillator with high-frequency PLL includes these characteristics:

- Master and Core Subsystems
- Internal and External Oscillator Sources Shared between Master and Slave Cores
- Master and Slave Independent On-Chip Phase-Locked Loop (PLL) to Boost Internal Operating Frequency on Select Internal and External Oscillator Sources
- Master and Slave Independent Auxiliary PLL (APLL) Clock Generator to Boost Operating Frequency for Peripherals
- Master and Slave Independent Doze mode for System Power Savings
- Master and Slave Independent Scalable Reference Clock Output (REFCLKO)
- On-the-Fly Clock Switching between Various Clock Sources
- Fail-Safe Clock Monitoring (FSCM) that Detects Clock Failure and Permits Safe Application Recovery or Shutdown

A block diagram of the dsPIC33CH128MP508 oscillator system is shown in Figure 6-1.

FIGURE 6-1: MASTER AND SLAVE CORE SHARED CLOCK SOURCES BLOCK DIAGRAM



Note 1: FRC Oscillator tuning bits are configured in the Master core OSCTUN register.
2: POSC is configured through the POSCMD<1:0> bits in the Master FOSC Configuration register.

6.1 CPU Clocking

While the Master and Slave subsystems share access to a single set of oscillator sources, all other clocking logic is implemented individually. The Master and Slave core can be configured independently to use any of the following clock configurations:

- Primary Oscillator (POSC) on the OSCI and OSCO pins
- Internal Fast RC Oscillator (FRC) with optional clock divider
- Internal Low-Power RC Oscillator (LPRC)
- Primary Oscillator with PLL (ECPLL, HSPLL, XTPLL)
- Internal Fast RC Oscillator with PLL (FRCPLL)
- Backup Internal Fast RC Oscillator (BFRC)

Each core's system clock source is divided by two to produce the internal instruction cycle clock. In this document, the instruction cycle clock is denoted by FCY. The timing diagram in Figure 6-6 illustrates the relationship between the system clock (FOSC), the instruction cycle clock (FCY) and the Program Counter (PC).

The internal instruction cycle clock (FCY) can be output on the OSCO I/O pin if the Primary Oscillator mode (POSCMD<1:0>) is not configured as HS/XT.

FIGURE 6-6: CLOCK AND INSTRUCTION CYCLE TIMING

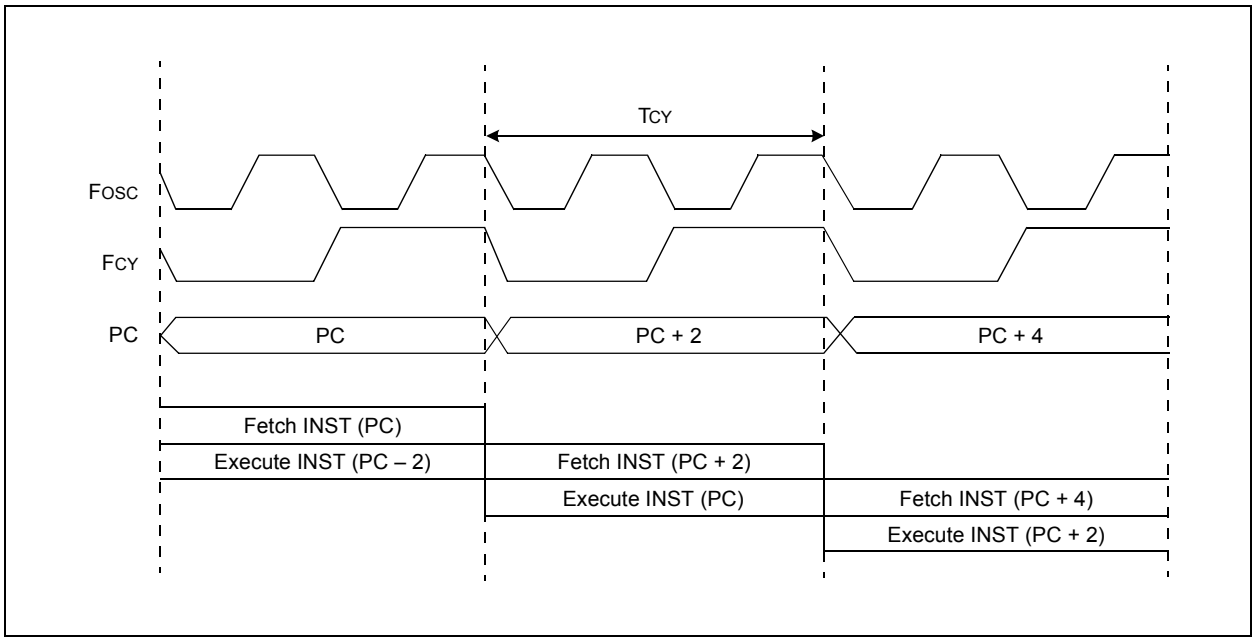


TABLE 7-2: MASTER PMD REGISTERS

Register	Bit 15	Bit14	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
PMDCONL	—	—	—	—	PMDLOCK	—	—	—	—	—	—	—	—	—	—	—
PMD1	—	—	—	—	T1MD	QEIMD	PWMMD	—	I2C1MD	U2MD	U1MD	SPI2MD	SPI1MD	—	C1MD	ADC1MD
PMD2	—	—	—	—	—	—	—	—	CCP8MD	CCP7MD	CCP6MD	CCP5MD	CCP4MD	CCP3MD	CCP2MD	CCP1MD
PMD3	—	—	—	—	—	—	—	—	CRCMD	—	—	—	—	—	I2C2MD	—
PMD4	—	—	—	—	—	—	—	—	—	—	—	—	REFOMD	—	—	—
PMD6	—	—	DMA5MD	DMA4MD	DMA3MD	DMA2MD	DMA1MD	DMA0MD	—	—	—	—	—	—	—	—
PMD7	—	—	—	—	—	—	—	CMP1MD	—	—	—	—	PTGMD	—	—	—
PMD8	—	—	—	SENT2MD	SENT1MD	—	—	—	—	—	CLC4MD	CLC3MD	CLC2MD	CLC1MD	BIASMD	—

TABLE 7-3: SLAVE PMD REGISTERS

Register	Bit 15	Bit14	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
PMDCON	—	—	—	—	PMDLOCK	—	—	—	—	—	—	—	—	—	—	—
PMD1	—	—	—	—	T1MD	QEIMD	PWMMD	—	I2C1MD	—	U1MD	—	SPI1MD	—	—	ADC1MD
PMD2	—	—	—	—	—	—	—	—	—	—	—	—	CCP4MD	CCP3MD	CCP2MD	CCP1MD
PMD4	—	—	—	—	—	—	—	—	—	—	—	—	REFOMD	—	—	—
PMD6	—	—	—	—	—	—	DMA1MD	DMA0MD	—	—	—	—	—	—	—	—
PMD7	—	—	—	—	—	CMP3MD	CMP2MD	CMP1MD	—	—	—	—	—	—	PGA1MD	—
PMD8	—	PGA3MD	—	—	—	PGA2MD	—	—	—	—	CLC4MD	CLC3MD	CLC2MD	CLC1MD	—	—

REGISTER 9-14: PGxSTAT: PWM GENERATOR x STATUS REGISTER (CONTINUED)

bit 5 **CAP:** Capture Status bit(1)
1 = PWM Generator time base value has been captured in PGxCAP
0 = No capture has occurred

bit 4 **UPDATE:** PWM Data Register Update Status/Control bit
1 = PWM Data register update is pending – user Data registers are not writable
0 = No PWM Data register update is pending

bit 3 **UPDREQ:** PWM Data Register Update Request bit
User software writes a '1' to this bit location to request a PWM Data register update. The bit location always reads as '0'. The UPDATE status bit will indicate '1' when an update is pending.

bit 2 **STEER:** Output Steering Status bit (Push-Pull Output mode only)
1 = PWM Generator is in 2nd cycle of Push-Pull mode
0 = PWM Generator is in 1st cycle of Push-Pull mode

bit 1 **CAHALF:** Half Cycle Status bit (Center-Aligned modes only)
1 = PWM Generator is in 2nd half of time base cycle
0 = PWM Generator is in 1st half of time base cycle

bit 0 **TRIG:** PWM Trigger Status bit
1 = PWM Generator is triggered and PWM cycle is in progress
0 = No PWM cycle is in progress

Note 1: User software may write a '1' to CAP as a request to initiate a software capture. The CAP status bit will be set when the capture event has occurred. No further captures will occur until CAP is cleared by software.

REGISTER 21-6: FWDT CONFIGURATION REGISTER

U-1	U-1	U-1	U-1	U-1	U-1	U-1	U-1
—	—	—	—	—	—	—	—
bit 23							bit 16

R/PO-1	R/PO-1	R/PO-1	R/PO-1	R/PO-1	R/PO-1	R/PO-1	R/PO-1
FWDTEN	SWDTPS4	SWDTPS3	SWDTPS2	SWDTPS1	SWDTPS0	WDTWIN1	WDTWIN0
bit 15							bit 8

R/PO-1	R/PO-1	R/PO-1	R/PO-1	R/PO-1	R/PO-1	R/PO-1	R/PO-1
WINDIS	RCLKSEL1	RCLKSEL0	RWDTPS4	RWDTPS3	RWDTPS2	RWDTPS1	RWDTPS0
bit 7							bit 0

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

bit 23-16 **Unimplemented:** Read as '1'

bit 15 **FWDTEN:** Watchdog Timer Enable bit
1 = WDT is enabled in hardware
0 = WDT controller via the ON bit (WDTCONL<15>)

bit 14-10 **SWDTPS<4:0>:** Sleep Mode Watchdog Timer Period Select bits
11111 = Divide by 2 ^ 30 = 1,073,741,824
11110 = Divide by 2 ^ 29 = 526,870,912
...
00001 = Divide by 2 ^ 2, 4
00000 = Divide by 2 ^ 1, 2

bit 9-8 **WDTWIN<1:0>:** Watchdog Timer Window Select bits
11 = WDT window is 25% of the WDT period
10 = WDT window is 37.5% of the WDT period
01 = WDT window is 50% of the WDT period
00 = WDT Window is 75% of the WDT period

bit 7 **WINDIS:** Watchdog Timer Window Enable bit
1 = Watchdog Timer is in Non-Window mode
0 = Watchdog Timer is in Window mode

bit 6-5 **RCLKSEL<1:0>:** Watchdog Timer Clock Select bits
11 = LPRC clock
10 = Uses FRC when WINDIS = 0, system clock is not INTOSC/LPRC and device is not in Sleep; otherwise, uses INTOSC/LPRC
01 = Uses peripheral clock when system clock is not INTOSC/LPRC and device is not in Sleep; otherwise, uses INTOSC/LPRC
00 = Reserved

bit 4-0 **RWDTPS<4:0>:** Run Mode Watchdog Timer Period Select bits
11111 = Divide by 2 ^ 30 = 1,073,741,824
11110 = Divide by 2 ^ 29 = 526,870,912
...
00001 = Divide by 2 ^ 2, 4
00000 = Divide by 2 ^ 1, 2

21.6 Brown-out Reset (BOR)

The Brown-out Reset (BOR) module is based on an internal voltage reference circuit that monitors the regulated supply voltage. The main purpose of the BOR module is to generate a device Reset when a brown-out condition occurs. Brown-out conditions are generally caused by glitches on the AC mains (for example, missing portions of the AC cycle waveform due to bad power transmission lines or voltage sags due to excessive current draw when a large inductive load is turned on).

A BOR generates a Reset pulse which resets the device. The BOR selects the clock source based on the device Configuration bit selections.

If an Oscillator mode is selected, the BOR activates the Oscillator Start-up Timer (OST). The system clock is held until OST expires. If the PLL is used, the clock is held until the LOCK bit (OSCCON<5>) is '1'.

Concurrently, the PWRT Time-out (T_{PWRT}) is applied before the internal Reset is released. If T_{PWRT} = 0 and a crystal oscillator is being used, then a nominal delay of T_{FSCM} is applied. The total delay in this case is T_{FSCM}. Refer to Parameter SY35 in Table 24-32 of **Section 24.0 "Electrical Characteristics"** for specific T_{FSCM} values.

The BOR status bit (RCON<1>) is set to indicate that a BOR has occurred. The BOR circuit continues to operate while in Sleep or Idle mode and resets the device should V_{DD} fall below the BOR threshold voltage.

TABLE 22-2: INSTRUCTION SET OVERVIEW (CONTINUED)

Base Instr #	Assembly Mnemonic	Assembly Syntax	Description	# of Words	# of Cycles(1)	Status Flags Affected
60	MIN	MIN Acc	If Accumulator A Less than B Load Accumulator with B or vice versa	1	1	N,OV,Z
		MIN.V Acc, Wd	If Accumulator A Less than B Accumulator Force Minimum Data Range Limit with Limit Excess Result	1	1	N,OV,Z
		MINZ Acc	Accumulator Force Minimum Data Range Limit	1	1	N,OV,Z
		MINZ.V Acc, Wd	Accumulator Force Minimum Data Range Limit with Limit Excess Result	1	1	N,OV,Z
61	MOV	MOV f,Wn	Move f to Wn	1	1	None
		MOV f	Move f to f	1	1	None
		MOV f,WREG	Move f to WREG	1	1	None
		MOV #lit16,Wn	Move 16-bit Literal to Wn	1	1	None
		MOV.b #lit8,Wn	Move 8-bit Literal to Wn	1	1	None
		MOV Wn,f	Move Wn to f	1	1	None
		MOV Wso,Wdo	Move Ws to Wd	1	1	None
		MOV WREG,f	Move WREG to f	1	1	None
		MOV.D Wns,Wd	Move Double from W(ns):W(ns + 1) to Wd	1	2	None
		MOV.D Ws,Wnd	Move Double from Ws to W(nd + 1):W(nd)	1	2	None
62	MOVPAG	MOVPAG #lit10,DSRPAG	Move 10-bit Literal to DSRPAG	1	1	None
		MOVPAG #lit8,TBLPAG	Move 8-bit Literal to TBLPAG	1	1	None
		MOVPAG Ws, DSRPAG	Move Ws<9:0> to DSRPAG	1	1	None
		MOVPAG Ws, TBLPAG	Move Ws<7:0> to TBLPAG	1	1	None
64	MOVSAC	MOVSAC Acc,Wx,Wxd,Wy,Wyd,AWB	Prefetch and Store Accumulator	1	1	None
65	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
66	MPY.N	MPY.N Wm*Wn,Acc,Wx,Wxd,Wy,Wyd	-(Multiply Wm by Wn) to Accumulator	1	1	None
67	MSC	MSC Wm*Wm,Acc,Wx,Wxd,Wy,Wyd, AWB	Multiply and Subtract from Accumulator	1	1	OA,OB,OAB, SA,SB,SAB
68	MUL	MUL.SS Wb,Ws,Wnd	{Wnd + 1, Wnd} = Signed(Wb) * Signed(Ws)	1	1	None
		MUL.SS Wb,Ws,Acc	Accumulator = Signed(Wb) * Signed(Ws)	1	1	None
		MUL.SU Wb,Ws,Wnd	{Wnd + 1, Wnd} = Signed(Wb) * Unsigned(Ws)	1	1	None
		MUL.SU Wb,Ws,Acc	Accumulator = Signed(Wb) * Unsigned(Ws)	1	1	None
		MUL.SU Wb,#lit5,Acc	Accumulator = Signed(Wb) * Unsigned(lit5)	1	1	None
		MUL.US Wb,Ws,Wnd	{Wnd + 1, Wnd} = Unsigned(Wb) * Signed(Ws)	1	1	None
		MUL.US Wb,Ws,Acc	Accumulator = Unsigned(Wb) * Signed(Ws)	1	1	None
		MUL.UU Wb,Ws,Wnd	{Wnd + 1, Wnd} = Unsigned(Wb) * Unsigned(Ws)	1	1	None
		MUL.UU Wb,#lit5,Acc	Accumulator = Unsigned(Wb) * Unsigned(lit5)	1	1	None
		MUL.UU Wb,Ws,Acc	Accumulator = Unsigned(Wb) * Unsigned(Ws)	1	1	None
		MULW.SS Wb,Ws,Wnd	Wnd = Signed(Wb) * Signed(Ws)	1	1	None
		MULW.SU Wb,Ws,Wnd	Wnd = Signed(Wb) * Unsigned(Ws)	1	1	None
		MULW.US Wb,Ws,Wnd	Wnd = Unsigned(Wb) * Signed(Ws)	1	1	None
		MULW.UU Wb,Ws,Wnd	Wnd = Unsigned(Wb) * Unsigned(Ws)	1	1	None
		MUL.SU Wb,#lit5,Wnd	{Wnd + 1, Wnd} = Signed(Wb) * Unsigned(lit5)	1	1	None
		MUL.SU Wb,#lit5,Wnd	Wnd = Signed(Wb) * Unsigned(lit5)	1	1	None
		MUL.UU Wb,#lit5,Wnd	{Wnd + 1, Wnd} = Unsigned(Wb) * Unsigned(lit5)	1	1	None
		MUL.UU Wb,#lit5,Wnd	Wnd = Unsigned(Wb) * Unsigned(lit5)	1	1	None
		MUL f	W3:W2 = f * WREG	1	1	None

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

2: Cycle times for Slave core are different for Master core, as shown in 2.

3: For dsPIC33CH128MP508 devices, the divide instructions must be preceded with a "REPEAT #5" instruction, such that they are executed six consecutive times

TABLE 24-32: RESET, WATCHDOG TIMER, OSCILLATOR START-UP TIMER, POWER-UP TIMER TIMING REQUIREMENTS

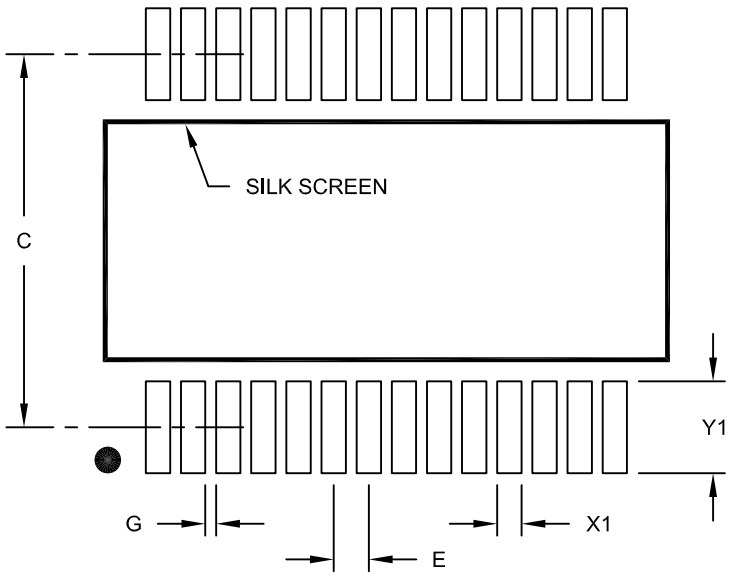
AC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended				
Param No.	**Symbol**	**Characteristic(1)**	**Min.**	**Typ.(2)**	**Max.**	**Units**	**Conditions**
SY00	TPU	Power-up Period	—	200	—	µs	
SY10	TOST	Oscillator Start-up Time	—	1024 TOSC	—	—	TOSC = OSCI period
SY13	TIOZ	I/O High-Impedance from $\overline{\text{MCLR}}$ Low or Watchdog Timer Reset	—	1.5	—	µs	
SY20	TMCLR	$\overline{\text{MCLR}}$ Pulse Width (low)	2	—	—	µs	
SY30	TBOR	BOR Pulse Width (low)	1	—	—	µs	
SY35	TFSCM	Fail-Safe Clock Monitor Delay	—	500	900	µs	-40°C to +85°C
SY36	TVREG	Voltage Regulator Standby-to-Active mode Transition Time	—	—	40	µs	Clock fail to BFRC switch
SY37	TOSCDFRC	FRC Oscillator Start-up Delay	—	—	15	µs	From POR event
SY38	TOSCDLPRC	LPRC Oscillator Start-up Delay	—	—	50	µs	From Reset event

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.

28-Lead Plastic Shrink Small Outline (SS) - 5.30 mm Body [SSOP]

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



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.65 BSC	
Contact Pad Spacing	C		7.20	
Contact Pad Width (X28)	X1			0.45
Contact Pad Length (X28)	Y1			1.75
Distance Between Pads	G	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2073A

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