Microchip Technology - DSPIC33FJ16MC101-E/SS Datasheet

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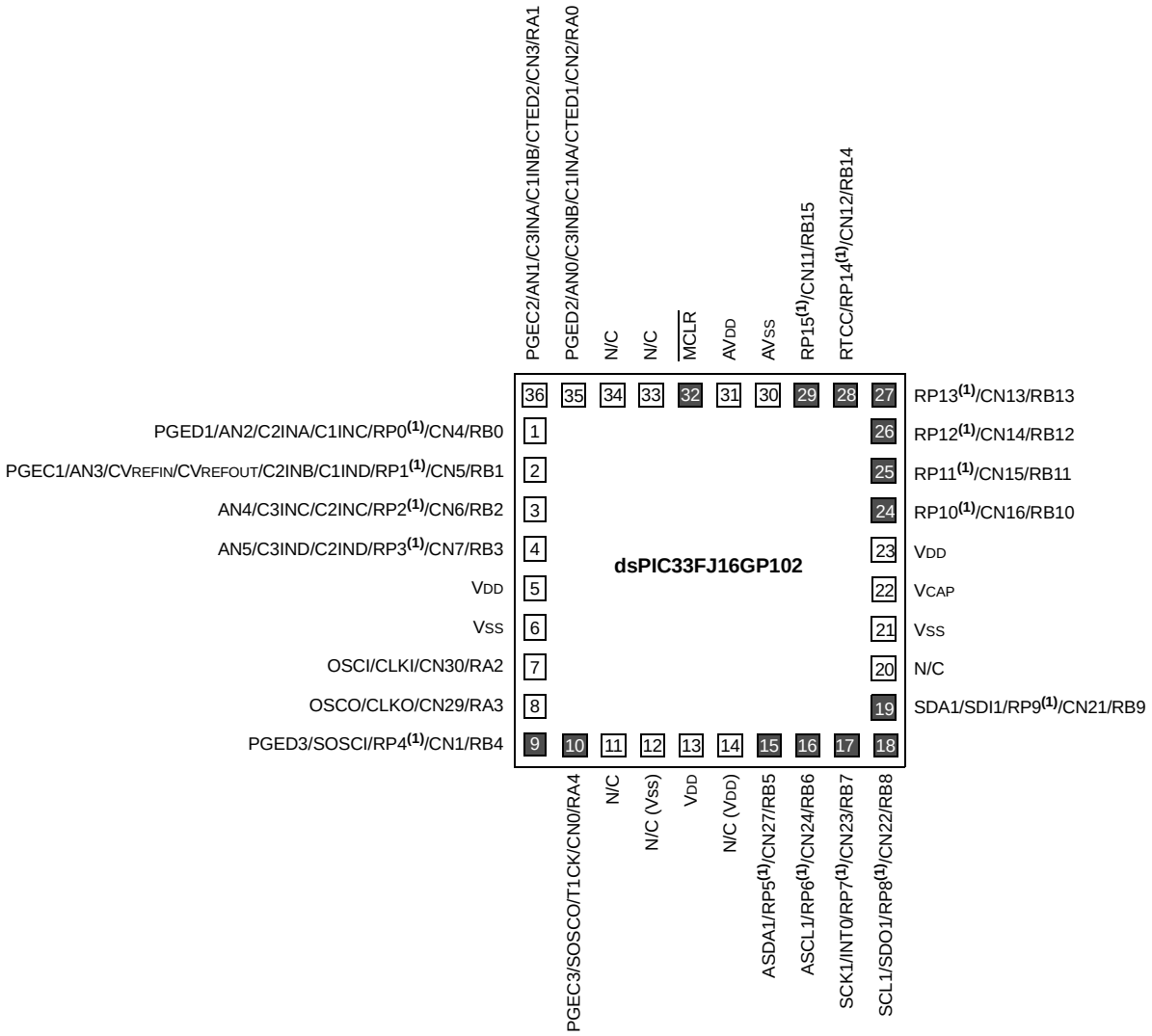
Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	dsPIC
Core Size	16-Bit
Speed	16 MIPs
Connectivity	I²C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, Motor Control PWM, POR, PWM, WDT
Number of I/O	15
Program Memory Size	16KB (16K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 4x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	20-SSOP (0.209", 5.30mm Width)
Supplier Device Package	20-SSOP
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/dspic33fj16mc101-e-ss

Pin Diagrams (Continued)

36-Pin VTLA(2)

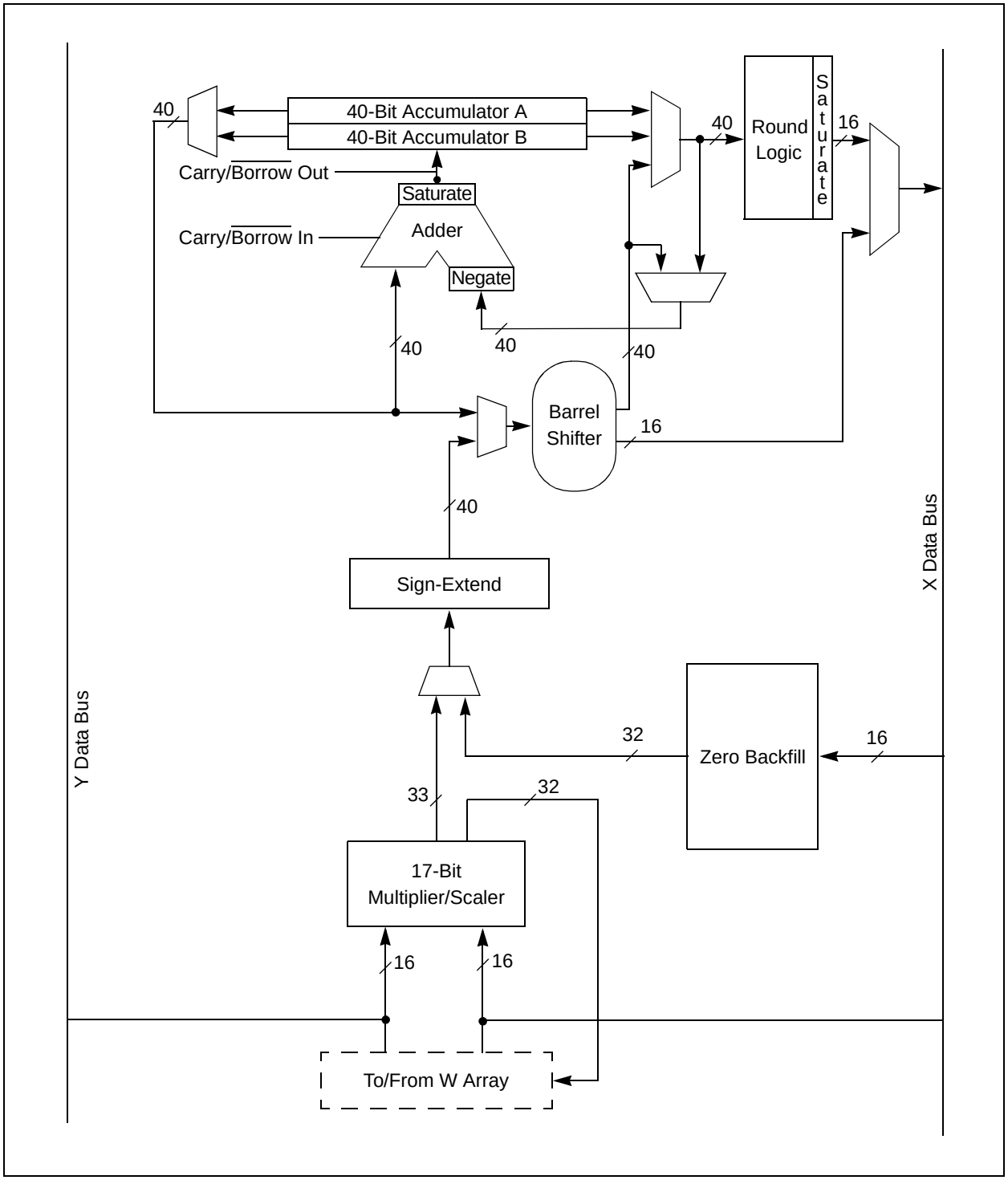
■ = Pins are up to 5V tolerant



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

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

FIGURE 3-3: DSP ENGINE BLOCK DIAGRAM



NOTES:

4.4.3 MODULO ADDRESSING APPLICABILITY

Modulo Addressing can be applied to the Effective Address (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 check for addresses less than or greater than the upper (for incrementing buffers) and lower (for decrementing buffers) boundary addresses (not just equal to). 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 Addressing 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 reordering 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<3:0> 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<14:0> 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 Y AGU, 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.

6.3 POR

A POR circuit ensures the device is reset from power-on. The POR circuit is active until VDD crosses the VPOR threshold and the delay, TPOR, has elapsed. The delay, TPOR, ensures that the internal device bias circuits become stable.

The device supply voltage characteristics must meet the specified starting voltage and rise rate requirements to generate the POR. Refer to **Section 26.0 "Electrical Characteristics"** for details.

The Power-on Reset (POR) status bit in the Reset Control (RCON<0>) register is set to indicate the Power-on Reset.

6.4 BOR and PWRT

The on-chip regulator has a BOR circuit that resets the device when the VDD is too low (VDD < VBOR) for proper device operation. The BOR circuit keeps the device in Reset until VDD crosses the VBOR threshold and the delay, TBOR, has elapsed. The delay, TBOR, ensures the voltage regulator output becomes stable.

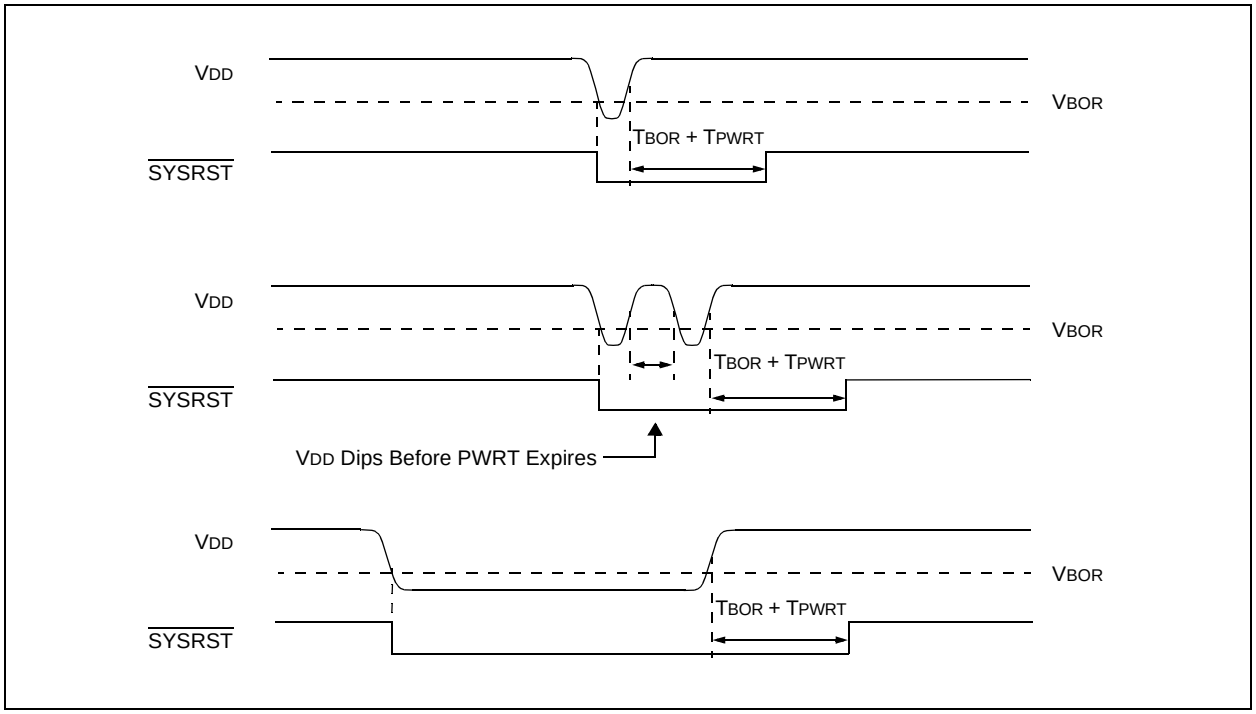
The Brown-out Reset (BOR) status bit in the Reset Control (RCON<1>) register is set to indicate the Brown-out Reset.

The device will not run at full speed after a BOR as the VDD should rise to acceptable levels for full-speed operation. The Power-up Timer (PWRT) provides power-up time delay (TPWRT) to ensure that the system power supplies have stabilized at the appropriate levels for full-speed operation before the $\overline{\text{SYSRST}}$ is released.

Refer to **Section 23.0 "Special Features"** for further details.

Figure 6-3 shows the typical brown-out scenarios. The Reset delay (TBOR + TPWRT) is initiated each time VDD rises above the VBOR trip point.

FIGURE 6-3: BROWN-OUT RESET SITUATIONS



REGISTER 7-5: IFS0: INTERRUPT FLAG STATUS REGISTER 0 (CONTINUED)

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

bit 1 **IC1IF:** Input Capture Channel 1 Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 0 **INT0IF:** External Interrupt 0 Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

REGISTER 7-6: IFS1: INTERRUPT FLAG STATUS REGISTER 1

U-0	U-0	R/W-0	R/W-0	R/W-0	U-0	U-0	U-0
—	—	INT2IF	T5IF(1)	T4IF(1)	—	—	—
bit 15							bit 8

U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	—	INT1IF	CNIF	CMIF	MI2C1IF	SI2C1IF
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 **INT2IF:** External Interrupt 2 Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 12 **T5IF:** Timer5 Interrupt Flag Status bit(1)
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 11 **T4IF:** Timer4 Interrupt Flag Status bit(1)
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 10-5 **Unimplemented:** Read as '0'

bit 4 **INT1IF:** External Interrupt 1 Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 3 **CNIF:** Input Change Notification Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 2 **CMIF:** Comparator Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 1 **MI2C1IF:** I2C1 Master Events Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 0 **SI2C1IF:** I2C1 Slave Events Interrupt Flag Status bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

Note 1: These bits are available in dsPIC33FJ32(GP/MC)10X devices only.

10.4.3 CONTROLLING CONFIGURATION CHANGES

Because peripheral remapping can be changed during run time, some restrictions on peripheral remapping are needed to prevent accidental configuration changes. dsPIC33FJ16(GP/MC)101/102 and dsPIC33FJ32(GP/MC)101/102/104 devices include three features to prevent alterations to the peripheral map:

- Control register lock sequence
- Continuous state monitoring
- Configuration bit pin select lock

10.4.3.1 Control Register Lock

Under normal operation, writes to the RPINRx and RPORx registers are not allowed. Attempted writes appear to execute normally, but the contents of the registers remain unchanged. To change these registers, they must be unlocked in hardware. The register lock is controlled by the IOLOCK bit (OSCCON<6>). Setting IOLOCK prevents writes to the control registers; clearing IOLOCK allows writes.

To set or clear IOLOCK, a specific command sequence must be executed:

1. Write 0x46 to OSCCON<7:0>.
2. Write 0x57 to OSCCON<7:0>.
3. Clear (or set) IOLOCK as a single operation.

Note: MPLAB® C30 provides built-in C language functions for unlocking the OSCCON register:

```
__builtin_write_OSCCONL(value)
__builtin_write_OSCCONH(value)
```

See MPLAB IDE Help for more information.

Unlike the similar sequence with the oscillator's LOCK bit, IOLOCK remains in one state until changed. This allows all of the Peripheral Pin Selects to be configured with a single unlock sequence followed by an update to all control registers, then locked with a second lock sequence.

10.4.3.2 Continuous State Monitoring

In addition to being protected from direct writes, the contents of the RPINRx and RPORx registers are constantly monitored in hardware by shadow registers. If an unexpected change in any of the registers occurs (such as cell disturbances caused by ESD or other external events), a Configuration Mismatch Reset will be triggered.

10.4.3.3 Configuration Bit Pin Select Lock

As an additional level of safety, the device can be configured to prevent more than one write session to the RPINRx and RPORx registers. The IOL1WAY (FOSC<5>) Configuration bit blocks the IOLOCK bit from being cleared after it has been set once. If IOLOCK remains set, the register unlock procedure will not execute and the Peripheral Pin Select Control registers cannot be written to. The only way to clear the bit and re-enable peripheral remapping is to perform a device Reset.

In the default (unprogrammed) state, IOL1WAY is set, restricting users to one write session. Programming IOL1WAY allows user applications unlimited access (with the proper use of the unlock sequence) to the Peripheral Pin Select registers.

REGISTER 10-9: RPINR20: PERIPHERAL PIN SELECT INPUT REGISTER 20

U-0	U-0	U-0	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
—	—	—	SCK1R4(1)	SCK1R3(1)	SCK1R2(1)	SCK1R1(1)	SCK1R0(1)
bit 15							bit 8

U-0	U-0	U-0	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
—	—	—	SDI1R4(1)	SDI1R3(1)	SDI1R2(1)	SDI1R1(1)	SDI1R0(1)
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 **Unimplemented:** Read as '0'

bit 12-8 **SCK1R<4:0>:** Assign SPI1 Clock Input (SCK1IN) to the Corresponding RPn Pin bits(1)

11111 = Input tied to Vss
11110 = Reserved
.
.
.
11010 = Reserved
11001 = Input tied to RP25
.
.
.
00001 = Input tied to RP1
00000 = Input tied to RP0

bit 7-5 **Unimplemented:** Read as '0'

bit 4-0 **SDI1R<4:0>:** Assign SPI1 Data Input (SDI1) to the Corresponding RPn Pin bits(1)

11111 = Input tied to Vss
11110 = Reserved
.
.
.
11010 = Reserved
11001 = Input tied to RP25
.
.
.
00001 = Input tied to RP1
00000 = Input tied to RP0

Note 1: These bits are available in dsPIC33FJ32(GP/MC)10X devices only.

REGISTER 10-23: RPOR12: PERIPHERAL PIN SELECT OUTPUT REGISTER 12

U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	—	RP25R<4:0>(1)				
bit 15							bit 8

U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	—	RP24R<4:0>(1)				
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 **Unimplemented:** Read as '0'

bit 12-8 **RP25R<4:0>:** Peripheral Output Function is Assigned to RP25 Output Pin bits(1)
(see Table 10-2 for peripheral function numbers)

bit 7-5 **Unimplemented:** Read as '0'

bit 4-0 **RP24R<4:0>:** Peripheral Output Function is Assigned to RP24 Output Pin bits(1)
(see Table 10-2 for peripheral function numbers)

Note 1: These bits are available in dsPIC33FJ32(GP/MC)104 devices only.

REGISTER 12-4: T5CON: TIMER5 CONTROL REGISTER(1)

R/W-0	U-0	R/W-0	U-0	U-0	U-0	U-0	U-0
TON(3)	—	TSIDL(2)	—	—	—	—	—
bit 15							bit 8

U-0	R/W-0	R/W-0	R/W-0	U-0	U-0	R/W-0	U-0
—	TGATE(3)	TCKPS1(3)	TCKPS0(3)	—	—	TCS(3)	—
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 **TON:** Timer5 On bit(3)
1 = Starts 16-bit Timer3
0 = Stops 16-bit Timer3

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

bit 13 **TSIDL:** Timer5 Stop in Idle Mode bit(2)
1 = Discontinues timer operation when device enters Idle mode
0 = Continues timer operation in Idle mode

bit 12-7 **Unimplemented:** Read as '0'

bit 6 **TGATE:** Timer5 Gated Time Accumulation Enable bit(3)
When TCS = 1:
This bit is ignored.
When TCS = 0:
1 = Gated time accumulation is enabled
0 = Gated time accumulation is disabled

bit 5-4 **TCKPS<1:0>:** Timer5 Input Clock Prescale Select bits(3)
11 = 1:256 prescale value
10 = 1:64 prescale value
01 = 1:8 prescale value
00 = 1:1 prescale value

bit 3-2 **Unimplemented:** Read as '0'

bit 1 **TCS:** Timer5 Clock Source Select bit(3)
1 = External clock from T5CK pin
0 = Internal clock (FOSC/2)

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

Note 1: This register is available in dsPIC33FJ32(GP/MC)10X devices only.

2: When 32-bit timer operation is enabled (T32 = 1) in the Timer4 Control register (T4CON<3>), the TSIDL bit must be cleared to operate the 32-bit timer in Idle mode.

3: When the 32-bit timer operation is enabled (T32 = 1) in the Timer4 Control register (T4CON<3>), these bits have no effect.

13.1 Input Capture Control Register

REGISTER 13-1: ICxCON: INPUT CAPTURE x CONTROL REGISTER

U-0	U-0	R/W-0	U-0	U-0	U-0	U-0	U-0
—	—	ICSIDL	—	—	—	—	—
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R-0, HC	R-0, HC	R/W-0	R/W-0	R/W-0
ICTMR	ICI1	ICI0	ICOV	ICBNE	ICM2	ICM1	ICM0
bit 7							bit 0

Legend:	HC = Hardware 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 15-14 **Unimplemented:** Read as '0'

bit 13 **ICSIDL:** Input Capture x Stop in Idle Control bit
1 = Input Capture x module will halt in CPU Idle mode
0 = Input Capture x module will continue to operate in CPU Idle mode

bit 12-8 **Unimplemented:** Read as '0'

bit 7 **ICTMR:** Input Capture x Timer Select bits
1 = TMR2 contents are captured on a capture event
0 = TMR3 contents are captured on a capture event

bit 6-5 **ICI<1:0>:** Select Number of Captures per Interrupt bits
11 = Interrupt on every fourth capture event
10 = Interrupt on every third capture event
01 = Interrupt on every second capture event
00 = Interrupt on every capture event

bit 4 **ICOV:** Input Capture x Overflow Status Flag bit (read-only)
1 = Input Capture x overflow occurred
0 = No Input Capture x overflow occurred

bit 3 **ICBNE:** Input Capture x Buffer Empty Status bit (read-only)
1 = Input Capture x buffer is not empty, at least one more capture value can be read
0 = Input Capture x buffer is empty

bit 2-0 **ICM<2:0>:** Input Capture x Mode Select bits
111 = Input Capture x functions as an interrupt pin only when device is in Sleep or Idle mode (rising edge detect only, all other control bits are not applicable)
110 = Unused (module is disabled)
101 = Capture mode, every 16th rising edge
100 = Capture mode, every 4th rising edge
011 = Capture mode, every rising edge
010 = Capture mode, every falling edge
001 = Capture mode, every edge, rising and falling (ICI<1:0> bits do not control interrupt generation for this mode)
000 = Input Capture x module is turned off

18.1 UART Helpful Tips

1. In multi-node, direct connect UART networks, UART receive inputs react to the complementary logic level defined by the URXINV bit (UxMODE<4>), which defines the Idle state, the default of which is logic high (i.e., URXINV = 0). Because remote devices do not initialize at the same time, it is likely that one of the devices, because the RX line is floating, will trigger a Start bit detection and will cause the first byte received after the device has been initialized to be invalid. To avoid this situation, the user should use a pull-up or pull-down resistor on the RX pin depending on the value of the URXINV bit.
   a) If URXINV = 0, use a pull-up resistor on the RX pin.
   b) If URXINV = 1, use a pull-down resistor on the RX pin.
2. The first character received on a wake-up from Sleep mode caused by activity on the UxRX pin of the UART module will be invalid. In Sleep mode, peripheral clocks are disabled. By the time the oscillator system has restarted and stabilized from Sleep mode, the baud rate bit sampling clock, relative to the incoming UxRX bit timing, is no longer synchronized, resulting in the first character being invalid; this is to be expected.

18.2 UART 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, which can be accessed using this link, contains the latest updates and additional information.

Note:	In the event you are not able to access the product page using the link above, enter this URL in your browser: http://www.microchip.com/wwwproducts/Devices.aspx?dDocName=en554109

18.2.1 KEY RESOURCES

- **"UART"** (DS70188) 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 19-6: AD1CSSL: ADC1 INPUT SCAN SELECT REGISTER LOW(1,2,3)

R/W-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
CSS15(4)	—	—	CSS<12:8>(4,6)				
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
CSS<7:0>(4,5)							
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 **CSS15:** ADC1 Input Scan Selection bit(4)
1 = Selects ANx for input scan
0 = Skips ANx for input scan

bit 14-13 **Unimplemented:** Read as '0'

bit 12-0 **CSS<12:0>:** ADC1 Input Scan Selection bits(4,5,6)
1 = Selects ANx for input scan
0 = Skips ANx for input scan

Note 1: On devices without 14 analog inputs, all AD1CSSL bits can be selected by the user application. However, inputs selected for scan without a corresponding input on the device converts VREFL.

2: CSSx = ANx, where x = 0 through 12 and 15.

3: CTMU temperature sensor input cannot be scanned.

4: The CSS<15,12:11,8:6> bits are available in the dsPIC33FJ32(GP/MC)104 devices only and are reserved in all other devices.

5: The CSS<5:4> bits are available on all devices, excluding the dsPIC33FJXX(GP/MC)101 devices, where they are reserved.

6: The CSS<10:9> bits are available on all devices, excluding the dsPIC33FJ16(GP/MC)101/102 devices, where they are reserved.

REGISTER 21-10: ALRMVAL (WHEN ALRMPTR<1:0> = 00): ALARM MINUTES AND SECONDS VALUE REGISTER

U-0	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
—	MINTEN2	MINTEN1	MINTEN0	MINONE3	MINONE2	MINONE1	MINONE0
bit 15							bit 8

U-0	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
—	SECTEN2	SECTEN1	SECTEN0	SECONE3	SECONE2	SECONE1	SECONE0
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 **Unimplemented:** Read as '0'

bit 14-12 **MINTEN<2:0>:** Binary Coded Decimal Value of Minute's Tens Digit bits
Contains a value from 0 to 5.

bit 11-8 **MINONE<3:0>:** Binary Coded Decimal Value of Minute's Ones Digit bits
Contains a value from 0 to 9.

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

bit 6-4 **SECTEN<2:0>:** Binary Coded Decimal Value of Second's Tens Digit bits
Contains a value from 0 to 5.

bit 3-0 **SECONE<3:0>:** Binary Coded Decimal Value of Second's Ones Digit bits
Contains a value from 0 to 9.

TABLE 23-4: dsPIC33F CONFIGURATION BITS DESCRIPTION

Bit Field	Description
GCP	General Segment Code-Protect bit 1 = User program memory is not code-protected 0 = Code protection is enabled for the entire program memory space
GWRP	General Segment Write-Protect bit 1 = User program memory is not write-protected 0 = User program memory is write-protected
IESO	Two-Speed Oscillator Start-up Enable bit 1 = Starts up device with FRC, then automatically switches to the user-selected oscillator source when ready 0 = Starts up device with user-selected oscillator source
PWMLOCK	PWM Lock Enable bit 1 = Certain PWM registers may only be written after a key sequence 0 = PWM registers may be written without a key sequence
WDTWIN<1:0>	Watchdog Timer Window Select bits 11 = WDT window is 24% of WDT period 10 = WDT window is 37.5% of WDT period 01 = WDT window is 50% of WDT period 00 = WDT window is 75% of WDT period
FNOSC<2:0>	Oscillator Selection bits 111 = Fast RC Oscillator with Divide-by-N (FRCDIVN) 110 = Reserved; do not use 101 = Low-Power RC Oscillator (LPRC) 100 = Secondary Oscillator (SOSC) 011 = Primary Oscillator with PLL module (MS + PLL, EC + PLL) 010 = Primary Oscillator (MS, HS, EC) 001 = Fast RC Oscillator with Divide-by-N and PLL module (FRCDIVN + PLL) 000 = Fast RC Oscillator (FRC)
FCKSM<1:0>	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	Peripheral Pin Select Configuration bit 1 = Allow only one reconfiguration 0 = Allow multiple reconfigurations
OSCIOFNC	OSC2 Pin Function bit (except in MS and HS modes) 1 = OSC2 is a clock output 0 = OSC2 is a general purpose digital I/O pin
POSCMD<1:0>	Primary Oscillator Mode Select bits 11 = Primary Oscillator is disabled 10 = HS Crystal Oscillator mode (10 MHz-32 MHz) 01 = MS Crystal Oscillator mode (3 MHz-10 MHz) 00 = EC (External Clock) mode (DC-32 MHz)
FWDTEN	Watchdog Timer Enable bit 1 = Watchdog Timer is always enabled (LPRC oscillator cannot be disabled; clearing the SWDTEN bit in the RCON register will have no effect) 0 = Watchdog Timer is enabled/disabled by user software (LPRC can be disabled by clearing the SWDTEN bit in the RCON register)
WINDIS	Watchdog Timer Window Enable bit 1 = Watchdog Timer in Non-Window mode 0 = Watchdog Timer in Window mode

TABLE 26-12: DC CHARACTERISTICS: PROGRAM MEMORY

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				
Param No.	**Symbol**	**Characteristic(3)**	**Min**	**Typ(1)**	**Max**	**Units**	**Conditions**
		Program Flash Memory					
D130a	EP	Cell Endurance	10,000	—	—	E/W	-40°C to +125°C
D131	VPR	VDD for Read	VMIN	—	3.6	V	VMIN = Minimum operating voltage
D132b	VPEW	VDD for Self-Timed Write	VMIN	—	3.6	V	VMIN = Minimum operating voltage
D134	TRETD	Characteristic Retention	20	—	—	Year	Provided no other specifications are violated
D135	IDDP	Supply Current during Programming	—	10	—	mA	
D137a	TPE	Page Erase Time	20.1	—	26.5	ms	TPE = 168517 FRC cycles, TA = +85°C, See **Note 2**
D137b	TPE	Page Erase Time	19.5	—	27.3	ms	TPE = 168517 FRC cycles, TA = +125°C, See **Note 2**
D138a	TWW	Word Write Cycle Time	47.4	—	49.3	µs	TWW = 355 FRC cycles, TA = +85°C, See **Note 2**
D138b	TWW	Word Write Cycle Time	47.4	—	49.3	µs	TWW = 355 FRC cycles, TA = +125°C, See **Note 2**

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

2: Other conditions: FRC = 7.37 MHz, TUN<5:0> = b'011111 (for Min), TUN<5:0> = b'100000 (for Max). This parameter depends on the FRC accuracy (see Table 26-18) and the value of the FRC Oscillator Tuning register (see Register 8-3). For complete details on calculating the Minimum and Maximum time, see **Section 5.3 "Programming Operations"**.

3: These parameters are ensured by design, but are not characterized or tested in manufacturing.

TABLE 26-13: INTERNAL VOLTAGE REGULATOR SPECIFICATIONS

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				
Param No.	**Symbol**	**Characteristics**	**Min**	**Typ**	**Max**	**Units**	**Comments**
—	CEFC	External Filter Capacitor Value(1)	4.7	10	—	µF	Capacitor must be low series resistance (< 5 ohms)

Note 1: Typical VCAP voltage = 2.5V when VDD ≥ VDDMIN.

FIGURE 26-2: EXTERNAL CLOCK TIMING

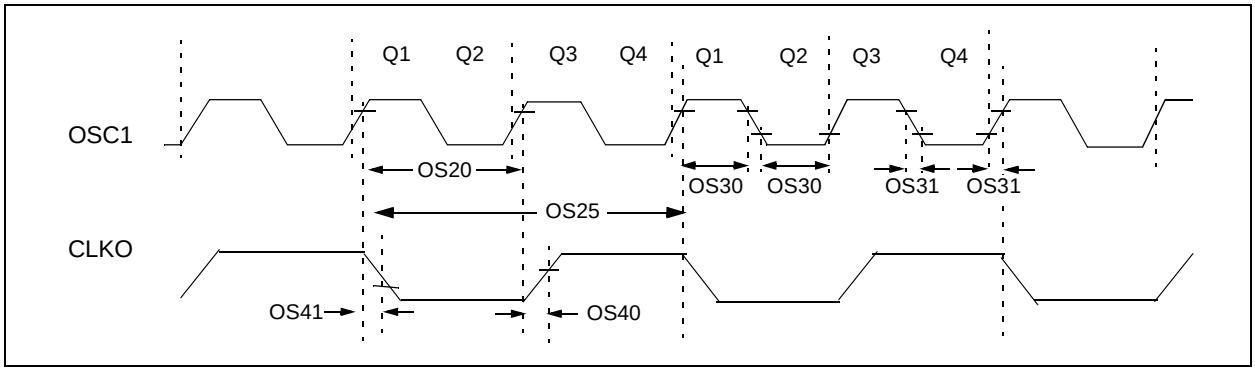


TABLE 26-16: EXTERNAL CLOCK TIMING REQUIREMENTS

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.	**Symb**	**Characteristic**	**Min**	**Typ(1)**	**Max**	**Units**	**Conditions**
OS10	FIN	External CLKI Frequency (External clocks allowed only in EC and ECPLL modes)	DC	—	32	MHz	EC
		Oscillator Crystal Frequency	3.0 10 31	— — —	10 32 33	MHz MHz kHz	MS HS SOSC
OS20	TOSC	TOSC = 1/FOSC	31.25	—	DC	ns	
OS25	TCY	Instruction Cycle Time(2,4)	62.5	—	DC	ns	
OS30	TosL, TosH	External Clock in (OSC1)(5) High or Low Time	0.45 x TOSC	—	—	ns	EC
OS31	TosR, TosF	External Clock in (OSC1)(5) Rise or Fall Time	—	—	20	ns	EC
OS40	TckR	CLKO Rise Time(3,5)	—	6	10	ns	
OS41	TckF	CLKO Fall Time(3,5)	—	6	10	ns	
OS42	GM	External Oscillator Transconductance(4)	14	16	18	mA/V	VDD = 3.3V, TA = +25°C

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

2: Instruction cycle period (TCY) equals two 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 the OSC1/CLKI pin. When an external clock input is used, the "max." cycle time limit is "DC" (no clock) for all devices.

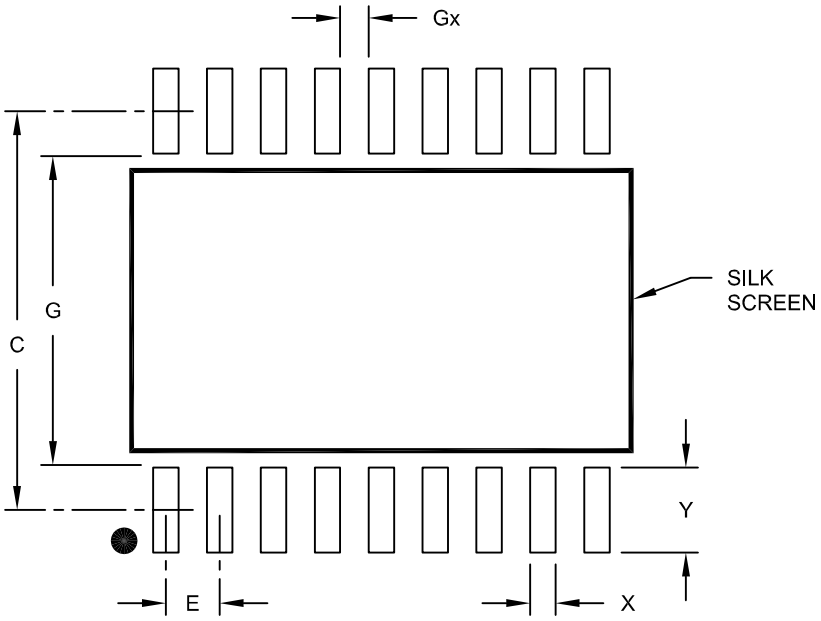
3: Measurements are taken in EC mode. The CLKO signal is measured on the OSC2 pin.

4: These parameters are characterized by similarity, but are tested in manufacturing at FIN = 32 MHz only.

5: These parameters are characterized by similarity, 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



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	1.27 BSC		
Contact Pad Spacing	C		9.40	
Contact Pad Width	X			0.60
Contact Pad Length	Y			2.00
Distance Between Pads	Gx	0.67		
Distance Between Pads	G	7.40		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2051A

Resets 87
BOR (Brown-out Reset) 87
BOR and Power-up Timer (PWRT) 92
CM (Configuration Mismatch Reset) 87
Configuration Mismatch (CM) 93
External (EXTR) 93
Illegal Condition 93
Illegal Opcode 93
Security 93, 94
Uninitialized W Register 93, 94
IOPUWR (Illegal Condition Reset) 87
Illegal Opcode 87
Security 87
Uninitialized W Register 87
MCLR (Master Clear Pin) 87
Oscillator Delays 90
POR (Power-on Reset) 87
Power-on Reset (POR) 92
Software RESET Instruction (SWR) 93
SWR (RESET Instruction) 87
System
Cold Reset 90
Warm Reset 90
Trap Conflict 93
TRAPR (Trap Conflict Reset) 87
Watchdog Timer Time-out (WDTO) 93
WDTO (Watchdog Timer Reset) 87
Revision History 373
RTCC
Control Registers 245
Module Registers 244
Register Mapping 244

S

Serial Peripheral Interface (SPI) 197
Control Registers 199
Helpful Tips 198
Resources 198
Software Stack Pointer, Frame Pointer
CALL Stack Frame 73
Special Features 261
Code Protection 261
Flexible Configuration 261
In-Circuit Emulation 261
In-Circuit Serial Programming (ICSP) 261
Watchdog Timer (WDT) 261

T

Timer1 165
Control Register 166
Timer2/3 and Timer4/5 167
16-Bit Operation 167
32-Bit Operation 167
Control Registers 170
Timing Diagrams
ADC Conversion Characteristics (CHPS<1:0> = 01, SIMSAM = 0, ASAM = 0, SSRC<2:0> = 000) 334
ADC Conversion Characteristics (CHPS<1:0> = 01, SIMSAM = 0, ASAM = 1, SSRC<2:0> = 111, SAMC<4:0> = 00001) 334
Brown-out Reset Situations 92
CLKO and I/O 297
External Clock 295
I2Cx Bus Data (Master Mode) 328
I2Cx Bus Data (Slave Mode) 330
I2Cx Bus Start/Stop Bits (Master Mode) 328
I2Cx Bus Start/Stop Bits (Slave Mode) 330
Input Capture x (ICx) 301
Motor Control PWMx 303
Motor Control PWMx Fault 303
OCx/PWMx 302
Output Compare x (OCx) 302
Output Compare x Operation 178
Reset, Watchdog Timer, Oscillator Start-up Timer and Power-up Timer 298
SPIx Master Mode (Full-Duplex, CKE = 0, CKP = x, SMP = 1) for dsPIC33FJ16(GP/MC)10X 307
SPIx Master Mode (Full-Duplex, CKE = 0, CKP = x, SMP = 1) for dsPIC33FJ32(GP/MC)10X 319
SPIx Master Mode (Full-Duplex, CKE = 1, CKP = x, SMP = 1) for dsPIC33FJ16(GP/MC)10X 306
SPIx Master Mode (Full-Duplex, CKE = 1, CKP = x, SMP = 1) for dsPIC33FJ32(GP/MC)10X 318
SPIx Master Transmit Mode (Half-Duplex, CKE = 0) for dsPIC33FJ16(GP/MC)10X 304
SPIx Master Transmit Mode (Half-Duplex, CKE = 0) for dsPIC33FJ32(GP/MC)10X 316
SPIx Master Transmit Mode (Half-Duplex, CKE = 1) for dsPIC33FJ16(GP/MC)10X 305
SPIx Master Transmit Mode (Half-Duplex, CKE = 1) for dsPIC33FJ32(GP/MC)10X 317
SPIx Slave Mode (Full-Duplex, CKE = 0, CKP = 0, SMP = 0) for dsPIC33FJ16(GP/MC)10X 314
SPIx Slave Mode (Full-Duplex, CKE = 0, CKP = 0, SMP = 0) for dsPIC33FJ32(GP/MC)10X 326
SPIx Slave Mode (Full-Duplex, CKE = 0, CKP = 1, SMP = 0) for dsPIC33FJ16(GP/MC)10X 312
SPIx Slave Mode (Full-Duplex, CKE = 0, CKP = 1, SMP = 0) for dsPIC33FJ32(GP/MC)10X 324
SPIx Slave Mode (Full-Duplex, CKE = 1, CKP = 0, SMP = 0) for dsPIC33FJ16(GP/MC)10X 308
SPIx Slave Mode (Full-Duplex, CKE = 1, CKP = 0, SMP = 0) for dsPIC33FJ32(GP/MC)10X 320
SPIx Slave Mode (Full-Duplex, CKE = 1, CKP = 1, SMP = 0) for dsPIC33FJ16(GP/MC)10X 310
SPIx Slave Mode (Full-Duplex, CKE = 1, CKP = 1, SMP = 0) for dsPIC33FJ32(GP/MC)10X 322
System Reset 91
Timer1/2/3 External Clock 299
Timing Requirements
10-Bit ADC Conversion 335
Capacitive Loading on Output Pins 294
CLKO and I/O 297
External Clock 295
I2Cx Bus Data (Master Mode) 329
I2Cx Bus Data (Slave Mode) 331
Input Capture x (ICx) 301
Motor Control PWMx 303
Output Compare x (OCx) 302
Reset, Watchdog Timer, Oscillator Start-up Timer, Power-up Timer and Brown-out Reset 298
Simple OCx/PWMx Mode 302
SPIx Master Mode (Full-Duplex, CKE = 0, CKP = x, SMP = 1) for dsPIC33FJ16(GP/MC)10X 307
SPIx Master Mode (Full-Duplex, CKE = 0, CKP = x, SMP = 1) for dsPIC33FJ32(GP/MC)10X 319
SPIx Master Mode (Full-Duplex, CKE = 1, CKP = x, SMP = 1) for dsPIC33FJ16(GP/MC)10X 306
SPIx Master Mode (Full-Duplex, CKE = 1, CKP = x, SMP = 1) for dsPIC33FJ32(GP/MC)10X 318