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PIC18F47J13 FAMILY

PIC18F47J13 Family 28/44-Pin, High-Performance Microcontrollers with XLP Technology

Power Management Features with XLP for eXtreme Low Power:

- Deep Sleep mode: CPU Off, Peripherals Off, SRAM Off, Currents Down to 9 nA and 700 nA with RTCC:
  - Able to wake-up on external triggers, programmable WDT or RTCC alarm
  - Ultra Low-Power Wake-up (ULPWU)
- Sleep mode: CPU Off, Peripherals Off, SRAM On, Fast Wake-up, Currents Down to 0.2 μA, 2V Typical
- Idle: CPU Off, SRAM On, Currents Down to 1.7 μA Typical
- Run: CPU On, SRAM On, Currents Down to 5.8 μA Typical
- Timer1 Oscillator w/RTCC: 0.7 μA, 32 kHz Typical
- Watchdog Timer: 0.33 μA, 2V Typical

Flexible Oscillator Structure:

- Two External Clock modes, Up to 48 MHz (12 MIPS)
- Integrated Crystal/Resonator Driver
- Low-Power 31 kHz Internal RC Oscillator
- Tunable Internal Oscillator (31 kHz to 8 MHz, ±0.15% Typical, ±1% Max.)
- Precision 48 MHz PLL or 4x PLL Options
- Low-Power Secondary Oscillator using Timer1 @ 32 kHz
- Fail-Safe Clock Monitor (FSCM):
  - Allows for safe shutdown if any clock stops
- Programmable Reference Clock Output Generator

Peripheral Highlights:

- Peripheral Pin Select:
  - Allows independent I/O mapping of many peripherals
  - Continuous hardware integrity checking and safety interlocks prevent unintentional configuration changes
- Hardware Real-Time Clock/Calendar (RTCC):
  - Provides clock, calendar and alarm functions
- High-Current Sink/Source 25 mA/25mA (PORTB and PORTC)
- Four Programmable External Interrupts
- Four Input Change Interrupts
- Three Enhanced Capture/Compare/PWM (ECCP) modules:
  - One, two or four PWM outputs
  - Selectable polarity
  - Programmable dead time
  - Auto-shutdown and auto-restart
  - Pulse steering control

Peripheral Highlights (cont.):

- Seven Capture/Compare/PWM (CCP) modules
- Two Master Synchronous Serial Port (MSSP) modules featuring:
  - 3-wire SPI (all 4 modes)
  - SPI Direct Memory Access (DMA) channel w/1024 byte count
  - I^2C Master and Slave modes
- 8-Bit Parallel Master Port/Enhanced Parallel Slave Port
- Three Analog Comparators with Input Multiplexing
- 12-Bit Analog-to-Digital (A/D) Converter module:
  - Up to 13 input channels
  - Auto-acquisition capability
  - 10-bit mode for 100 ksps conversion speed
  - Conversion available during Sleep
- High/Low-Voltage Detect module
- Charge Time Measurement Unit (CTMU):
  - Provides a precise resolution time measurement for both flow measurement and simple temperature sensing
  - Supports capacitive touch sensing for touch screens and capacitive switches
- Two Enhanced USART modules:
  - Supports RS-485, RS-232 and LIN/J2602
  - Auto-wake-up on Start bit
  - Auto-Baud Detect (ABD)

Special Microcontroller Features:

- 5.5V Tolerant Inputs (digital only pins)
- Low-Power, High-Speed CMOS Flash Technology
- C Compiler Optimized Architecture for Re-Entrant Code
- Priority Levels for Interrupts
- Self-Programmable under Software Control
- 8 x 8 Single-Cycle Hardware Multiplier
- Extended Watchdog Timer (WDT):
  - Programmable period from 4 ms to 131s
- Single-Supply In-Circuit Serial Programming™ (ICSP™) via Two Pins
- In-Circuit Debug (ICD) with 3 Breakpoints via Two Pins
- Operating Voltage Range of 2.0V to 3.6V
- On-Chip 2.5V Regulator
- Flash Program Memory of 10,000 Erase/Write Cycles Minimum and 20-Year Data Retention

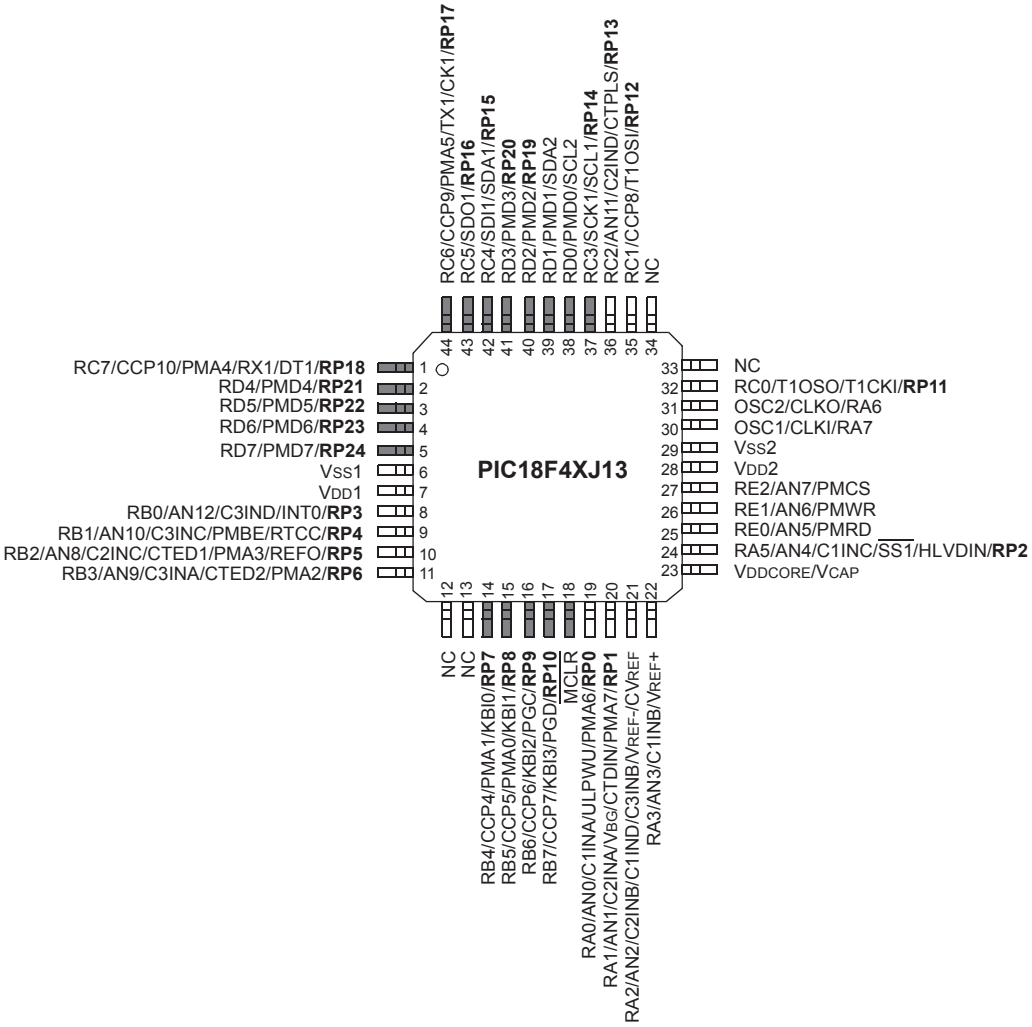
TABLE 1: PIC18F47J13 FAMILY TYPES

PIC18F Device	Pins	Program Memory (bytes)	SRAM (bytes)	Remappable Pins	Timers 8/16-Bit	ECCP/CCP	EUSART	MSSP			12-Bit A/D (ch)	Comparators	Deep Sleep	PMP/PSP	CTMU	RTCC
								SPI w/DMA		I^2C						
PIC18F26J13	28	64K	3760	19	4/4	3/7	2	2	Y	Y	10	3	Y	N	Y	Y
PIC18F27J13	28	128K	3760	19	4/4	3/7	2	2	Y	Y	10	3	Y	N	Y	Y
PIC18F46J13	44	64K	3760	25	4/4	3/7	2	2	Y	Y	13	3	Y	Y	Y	Y
PIC18F47J13	44	128K	3760	25	4/4	3/7	2	2	Y	Y	13	3	Y	Y	Y	Y
PIC18LF26J13	28	64K	3760	19	4/4	3/7	2	2	Y	Y	10	3	N	N	Y	Y
PIC18LF27J13	28	128K	3760	19	4/4	3/7	2	2	Y	Y	10	3	N	N	Y	Y
PIC18LF46J13	44	64K	3760	25	4/4	3/7	2	2	Y	Y	13	3	N	Y	Y	Y
PIC18LF47J13	44	128K	3760	25	4/4	3/7	2	2	Y	Y	13	3	N	Y	Y	Y

Pin Diagrams

44-Pin TQFP

= Pins are up to 5.5V tolerant

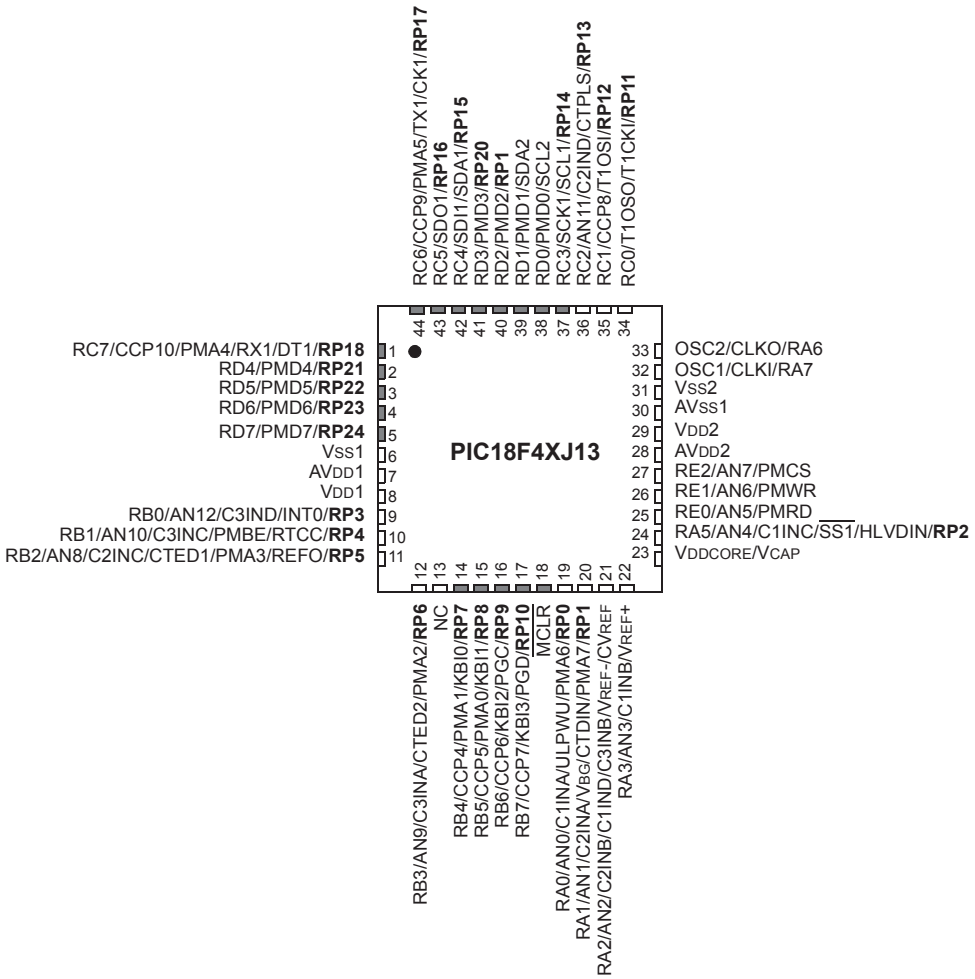


Legend: **RPn** represents remappable pins.Some input and output functions are routed through the Peripheral Pin Select (PPS) module and can be dynamically assigned to any of the RPn pins. For a list of the input and output functions, see Table 10-13 and Table 10-14, respectively. For details on configuring the PPS module, see **Section 10.7 "Peripheral Pin Select (PPS)"**.

Pin Diagrams (Continued)

44-Pin QFN

= Pins are up to 5.5V tolerant



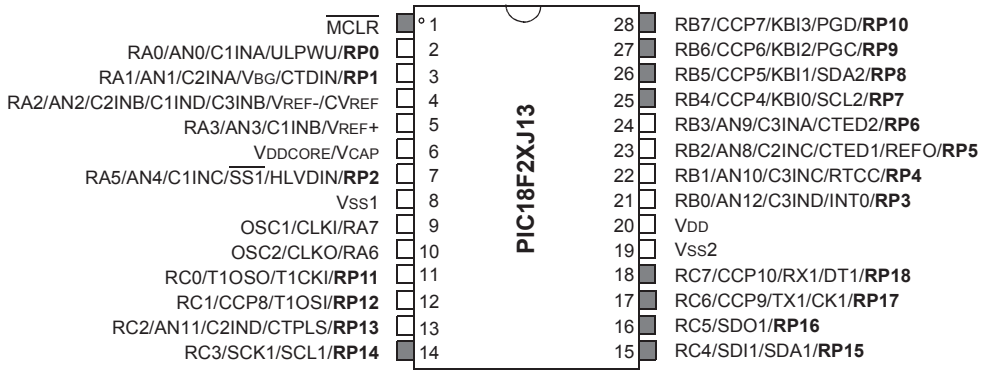
Legend: **RPn** represents remappable pins.Some input and output functions are routed through the Peripheral Pin Select (PPS) module and can be dynamically assigned to any of the RPn pins. For a list of the input and output functions, see Table 10-13 and Table 10-14, respectively. For details on configuring the PPS module, see **Section 10.7 "Peripheral Pin Select (PPS)"**.

Note: For the QFN package, it is recommended that the bottom pad be connected to VSS.

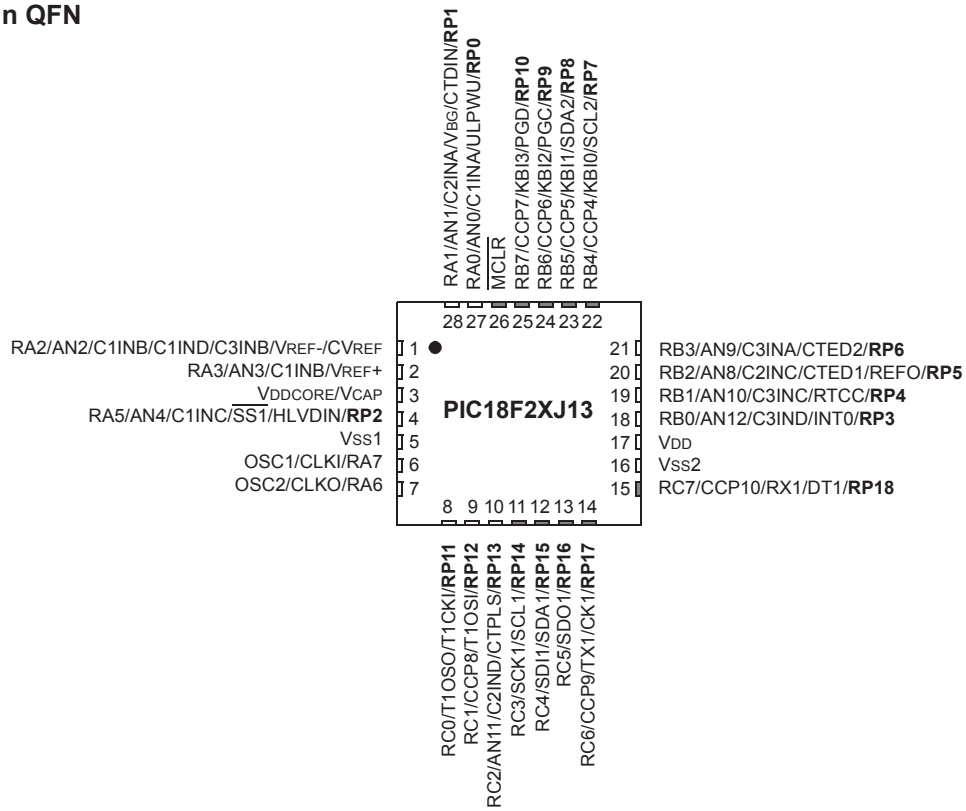
Pin Diagrams (Continued)

28-Pin SPDIP/SOIC/SSOP

■ = Pins are up to 5.5V tolerant



28-Pin QFN



Legend: **RPn** represents remappable pins.Some input and output functions are routed through the Peripheral Pin Select (PPS) module and can be dynamically assigned to any of the RPn pins. For a list of the input and output functions, see Table 10-13 and Table 10-14, respectively. For details on configuring the PPS module, see **Section 10.7 "Peripheral Pin Select (PPS)"**.

Note: For the QFN package, it is recommended that the bottom pad be connected to VSS.

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1.0 DEVICE OVERVIEW

This document contains device-specific information for the following devices:

- PIC18F26J13
- PIC18F27J13
- PIC18F46J13
- PIC18F47J13
- PIC18LF26J13
- PIC18LF27J13
- PIC18LF46J13
- PIC18LF47J13

1.1 Core Features

1.1.1 XLP TECHNOLOGY

All of the devices in the PIC18F47J13 Family incorporate a range of features that can significantly reduce power consumption during operation. Key features are:

- **Alternate Run Modes:** By clocking the controller from the Timer1 source or the internal RC oscillator, power consumption during code execution can be reduced by as much as 90%.
- **Multiple Idle Modes:** The controller can also run with its CPU core disabled but the peripherals still active. In these states, power consumption can be reduced even further, to as little as 4% of normal operational requirements.
- **On-the-Fly Mode Switching:** The power-managed modes are invoked by user code during operation, allowing the users to incorporate power-saving ideas into their application's software design.
- **Deep Sleep:** The 2.5V internal core voltage regulator on F parts can be shutdown to cut power consumption to as low as 15 nA (typical). Certain features can remain operating during Deep Sleep, such as the Real-Time Clock Calendar.
- **Ultra Low Power Wake-Up:** Waking from Sleep or Deep Sleep modes after a period of time can be done without an oscillator/clock source, saving power for applications requiring periodic activity.

1.1.2 OSCILLATOR OPTIONS AND FEATURES

All of the devices in the PIC18F47J13 Family offer five different oscillator options, allowing users a range of choices in developing application hardware. These include:

- Two Crystal modes, using crystals or ceramic resonators.
- Two External Clock modes, offering the option of a divide-by-4 clock output.
- An internal oscillator block, which provides an 8 MHz clock and an INTRC source (approximately 31 kHz, stable over temperature and V_{DD}), as well as a range of six user selectable clock frequencies, between 125 kHz to 4 MHz, for a total of eight clock frequencies. This option frees an oscillator pin for use as an additional general purpose I/O.
- A Phase Lock Loop (PLL) frequency multiplier available to the high-speed crystal, and external and internal oscillators, providing a clock speed up to 48 MHz.

The internal oscillator block provides a stable reference source that gives the PIC18F47J13 Family additional features for robust operation:

- **Fail-Safe Clock Monitor:** This option constantly monitors the main clock source against a reference signal provided by the internal oscillator. If a clock failure occurs, the controller is switched to the internal oscillator, allowing for continued low-speed operation or a safe application shutdown.
- **Two-Speed Start-up:** This option allows the internal oscillator to serve as the clock source from Power-on Reset (POR), or wake-up from Sleep mode, until the primary clock source is available.

1.1.3 EXPANDED MEMORY

The PIC18F47J13 Family provides ample room for application code, from 64 Kbytes to 128 Kbytes of code space. The Flash cells for program memory are rated to last in excess of 10000 erase/write cycles. Data retention without refresh is conservatively estimated to be greater than 20 years.

The Flash program memory is readable and writable during normal operation. The PIC18F47J13 Family also provides plenty of room for dynamic application data with up to 3.8 Kbytes of data RAM.

1.1.4 EXTENDED INSTRUCTION SET

The PIC18F47J13 Family implements the optional extension to the PIC18 instruction set, adding eight new instructions and an Indexed Addressing mode. Enabled as a device configuration option, the extension has been specifically designed to optimize re-entrant application code originally developed in high-level languages, such as C.

1.1.5 EASY MIGRATION

Regardless of the memory size, all devices share the same rich set of peripherals, allowing for a smooth migration path as applications grow and evolve.

The consistent pinout scheme used throughout the entire family also aids in migrating to the next larger device.

The PIC18F47J13 Family is also pin compatible with other PIC18 families, such as the PIC18F4550, PIC18F2450 and PIC18F46J50. This allows a new dimension to the evolution of applications, allowing developers to select different price points within Microchip's PIC18 portfolio, while maintaining the same feature set.

1.2 Other Special Features

- **Communications:** The PIC18F47J13 Family incorporates a range of serial and parallel communication peripherals. This device includes two independent Enhanced USARTs and two Master Synchronous Serial Port (MSSP) modules, capable of both Serial Peripheral Interface (SPI) and I^2C (Master and Slave) modes of operation. The device also has a parallel port and can be configured to serve as either a Parallel Master Port (PMP) or as a Parallel Slave Port (PSP).
- **CCP/ECCP Modules:** All devices in the family incorporate seven Capture/Compare/PWM (CCP) modules and three Enhanced Capture/Compare/PWM (ECCP) modules to maximize flexibility in control applications. ECCPs offer up to four PWM output signals each. The ECCPs also offer many beneficial features, including polarity selection, programmable dead time, auto-shutdown and restart and Half-Bridge and Full-Bridge Output modes.
- **10/12-Bit A/D Converter:** This module incorporates programmable acquisition time, allowing for a channel to be selected and a conversion to be initiated without waiting for a sampling period, and thus, reducing code overhead.
- **Extended Watchdog Timer (WDT):** This enhanced version incorporates a 16-bit prescaler, allowing an extended time-out range that is stable across operating voltage and temperature. See **Section 30.0 "Electrical Characteristics"** for time-out periods.

1.3 Details on Individual Family Devices

Devices in the PIC18F47J13 Family are available in 28-pin and 44-pin packages. Block diagrams for the two groups are shown in Figure 1-1 and Figure 1-2. The devices are differentiated from each other in two ways:

- Flash program memory (two sizes: 64 Kbytes for the PIC18FX6J13 and 128 Kbytes for PIC18FX7J13)
- I/O ports (three bidirectional ports on 28-pin devices, five bidirectional ports on 44-pin devices)

All other features for devices in this family are identical. These are summarized in Table 1-1 and Table 1-2.

The pinouts for the PIC18F2XJ13 devices are listed in Table 1-3. The pinouts for the PIC18F4XJ13 devices are shown in Table 1-4.

The PIC18F47J13 Family of devices provides an on-chip voltage regulator to supply the correct voltage levels to the core. Parts designated with an "F" part number (such as PIC18**F**47J13) have the voltage regulator enabled.

These parts can run from 2.15V-3.6V on V_{DD}, but should have the V_{DDCORE} pin connected to V_{SS} through a low-ESR capacitor. Parts designated with an "LF" part number (such as PIC18**LF**47J13) do not enable the voltage regulator nor support Deep Sleep mode. For "LF" parts, an external supply of 2.0V-2.7V has to be supplied to the V_{DDCORE} pin while 2.0V-3.6V can be supplied to V_{DD} (V_{DDCORE} should never exceed V_{DD}).

For more details about the internal voltage regulator, see **Section 27.3 "On-Chip Voltage Regulator"**.

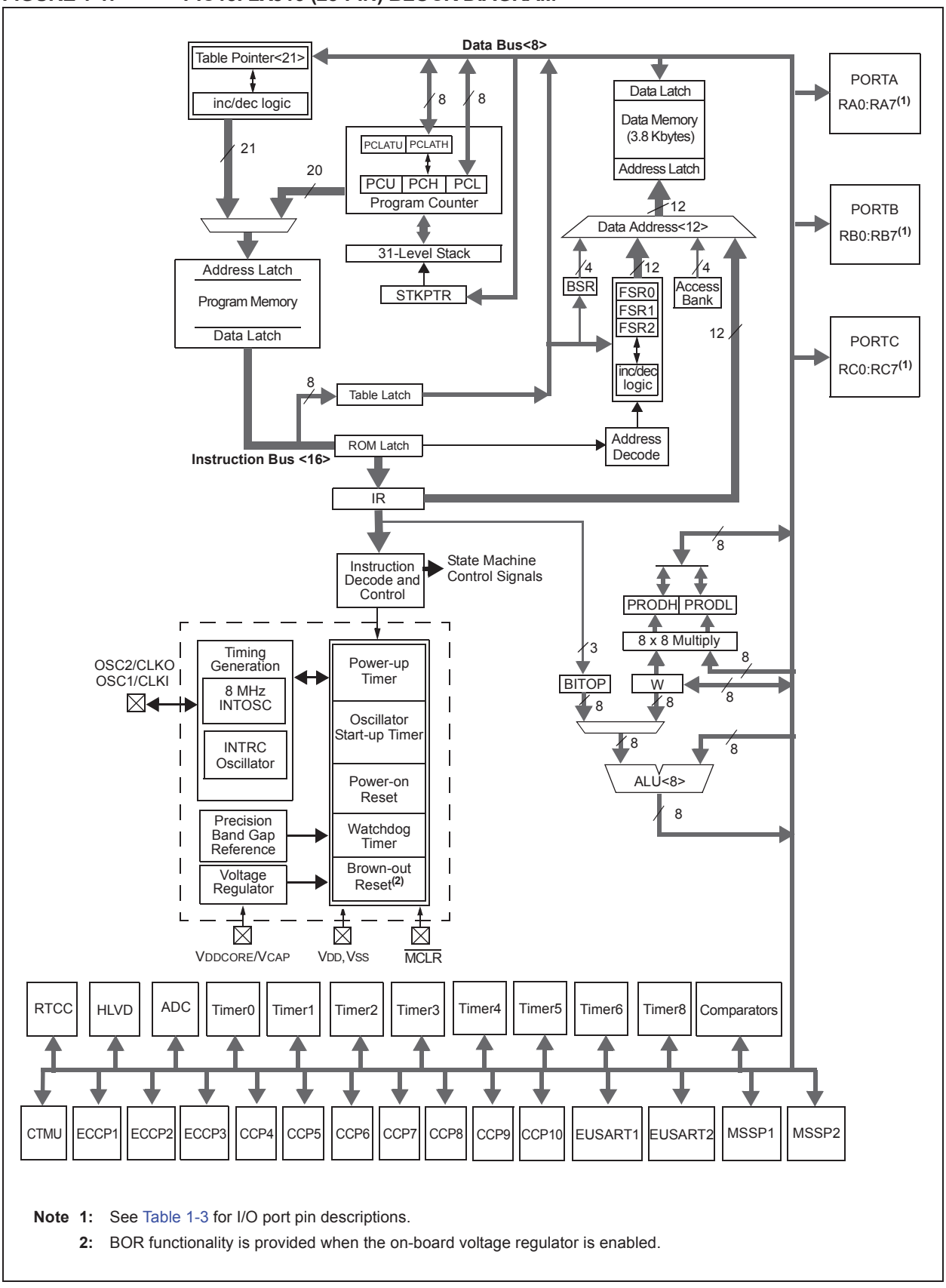
TABLE 1-1: DEVICE FEATURES FOR THE PIC18F2XJ13 (28-PIN DEVICES)

Features	PIC18F26J13	PIC18F27J13
Operating Frequency	DC – 48 MHz	DC – 48 MHz
Program Memory (Kbytes)	64	128
Program Memory (Instructions)	32,768	65,536
Data Memory (Kbytes)	3.8	3.8
Interrupt Sources	30	
I/O Ports	Ports A, B, C	
Timers	8	
Enhanced Capture/Compare/PWM Modules	3 ECCP and 7 CCP	
Serial Communications	MSSP (2), Enhanced USART (2)	
Parallel Communications (PMP/PSP)	No	
10/12-Bit Analog-to-Digital Module	10 Input Channels	
Resets (and Delays)	POR, BOR, RESET Instruction, Stack Full, Stack Underflow, $\overline{\text{MCLR}}$, WDT (PWRT, OST)	
Instruction Set	75 Instructions, 83 with Extended Instruction Set Enabled	
Packages	28-Pin QFN, SOIC, SSOP and SPDIP (300 mil)	

TABLE 1-2: DEVICE FEATURES FOR THE PIC18F4XJ13 (44-PIN DEVICES)

Features	PIC18F46J13	PIC18F47J13
Operating Frequency	DC – 48 MHz	DC – 48 MHz
Program Memory (Kbytes)	64	128
Program Memory (Instructions)	32,768	65,536
Data Memory (Kbytes)	3.8	3.8
Interrupt Sources	30	
I/O Ports	Ports A, B, C, D, E	
Timers	8	
Enhanced Capture/Compare/PWM Modules	3 ECCP and 7 CCP	
Serial Communications	MSSP (2), Enhanced USART (2)	
Parallel Communications (PMP/PSP)	Yes	
10/12-Bit Analog-to-Digital Module	13 Input Channels	
Resets (and Delays)	POR, BOR, RESET Instruction, Stack Full, Stack Underflow, $\overline{\text{MCLR}}$, WDT (PWRT, OST)	
Instruction Set	75 Instructions, 83 with Extended Instruction Set Enabled	
Packages	44-Pin QFN and TQFP	

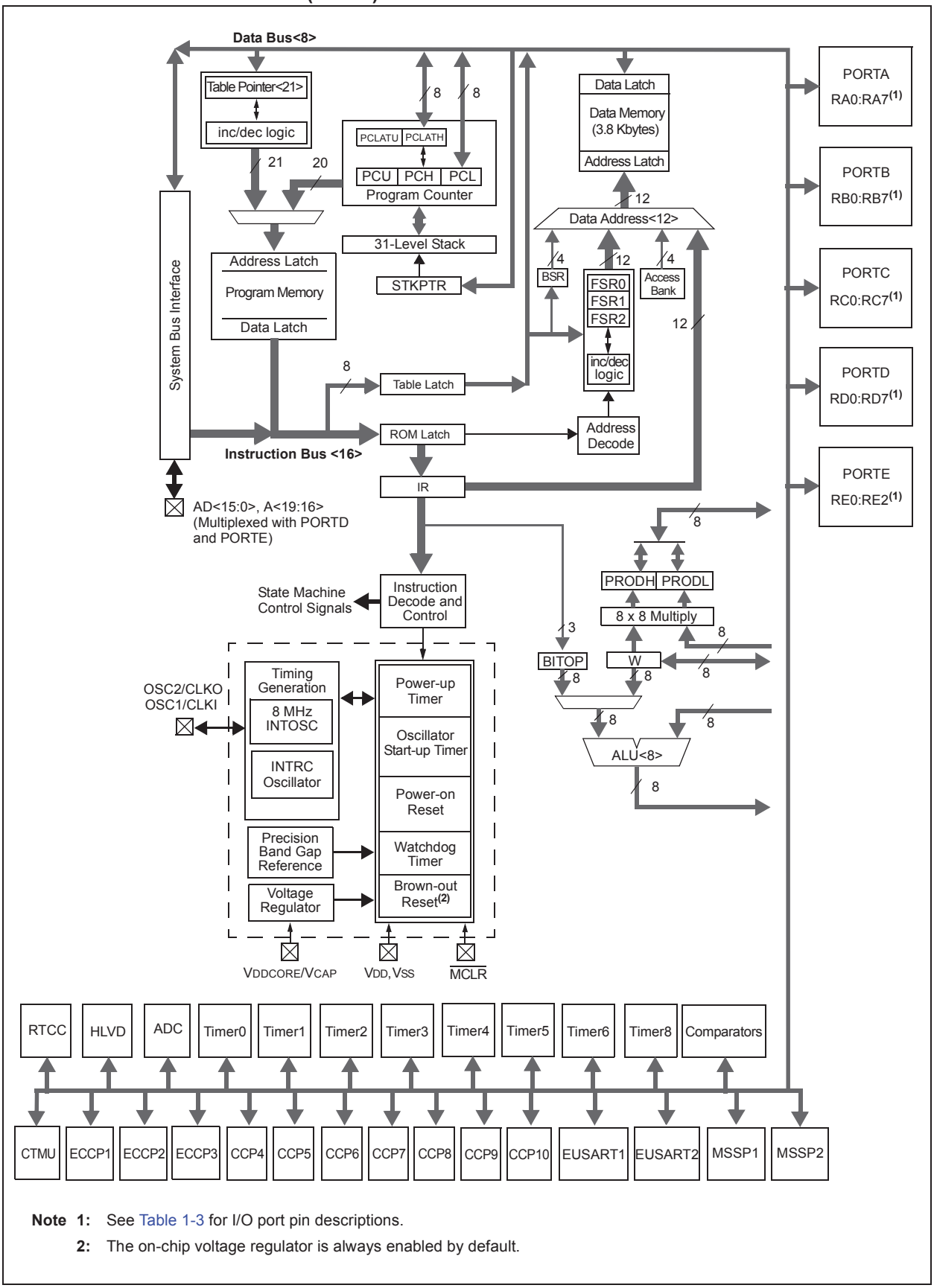
FIGURE 1-1: PIC18F2XJ13 (28-PIN) BLOCK DIAGRAM



Note 1: See Table 1-3 for I/O port pin descriptions.

2: BOR functionality is provided when the on-board voltage regulator is enabled.

FIGURE 1-2: PIC18F4XJ13 (44-PIN) BLOCK DIAGRAM



Note 1: See Table 1-3 for I/O port pin descriptions.

2: The on-chip voltage regulator is always enabled by default.

TABLE 1-3: PIC18F2XJ13 PINOUT I/O DESCRIPTIONS

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	28-SPDIP/ SSOP/ SOIC	28-QFN			
$\overline{MCLR}$	1(2)	26(2)	I	ST	Master Clear (Reset) input. This pin is an active-low Reset to the device.
OSC1/CLKI/RA7	9	6			Oscillator crystal or external clock input.
OSC1			I	ST	Oscillator crystal input or external clock source input. ST buffer when configured in RC mode; CMOS otherwise. Main oscillator input connection.
CLKI			I	CMOS	External clock source input; always associated with pin function, OSC1 (see related OSC1/CLKI pins).
RA7(1)			I/O	TTL/DIG	Digital I/O.
OSC2/CLKO/RA6	10	7			Oscillator crystal or clock output.
OSC2			O	—	Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode.
CLKO			O	DIG	Main oscillator feedback output connection. In RC mode, OSC2 pin outputs CLKO, which has 1/4 the frequency of OSC1 and denotes the instruction cycle rate.
RA6(1)			I/O	TTL/DIG	Digital I/O.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to V_{DD}); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: 5.5V tolerant.

TABLE 1-3: PIC18F2XJ13 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	28-SPDIP/ SSOP/ SOIC	28-QFN			
					PORTA is a bidirectional I/O port.
RA0/AN0/C1INA/ULPWU/RP0	2	27			
RA0			I/O	TTL/DIG	Digital I/O.
AN0			I	Analog	Analog Input 0.
C1INA			I	Analog	Comparator 1 Input A.
ULPWU			I	Analog	Ultra low-power wake-up input.
RP0			I/O	ST/DIG	Remappable Peripheral Pin 0 input/output.
RA1/AN1/C2INA/VBG/CTDIN/ RP1	3	28			
RA1			I/O	TTL/DIG	Digital I/O.
AN1			O	Analog	Analog Input 1.
C2INA			I	Analog	Comparator 2 Input A.
VBG			O	Analog	Band Gap Reference Voltage (VBG) output.
CTDIN			I	ST	CTMU pulse delay input.
RP1			I/O	ST/DIG	Remappable Peripheral Pin 1 input/output.
RA2/AN2/C2INB/C1IND/ C3INB/VREF-/CVREF	4	1			
RA2			I/O	TTL/DIG	Digital I/O.
AN2			I	Analog	Analog Input 2.
C2INB			I	Analog	Comparator 2 Input B.
C1IND			I	Analog	Comparator 1 Input D.
C3INB			I	Analog	Comparator 3 Input B.
VREF-			O	Analog	A/D reference voltage (low) input.
CVREF			I	Analog	Comparator reference voltage output.
RA3/AN3/C1INB/VREF+	5	2			
RA3			I/O	TTL/DIG	Digital I/O.
AN3			I	Analog	Analog Input 3.
C1INB			I	Analog	Comparator 1 Input B.
VREF+			I	Analog	A/D reference voltage (high) input.
RA5/AN4/C1INC/$\overline{SS1}$/ HLVDIN/RP2	7	4			
RA5			I/O	TTL/DIG	Digital I/O.
AN4			I	Analog	Analog Input 4.
C1INC			I	Analog	Comparator 1 Input C.
$\overline{SS1}$			I	TTL	SPI slave select input.
HLVDIN			I	Analog	High/Low-Voltage Detect input.
RP2			I/O	ST/DIG	Remappable Peripheral Pin 2 input/output.
RA6(1)					See the OSC2/CLKO/RA6 pin.
RA7(1)					See the OSC1/CLKI/RA7 pin.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to VDD); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: 5.5V tolerant.

TABLE 1-3: PIC18F2XJ13 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	28-SPDIP/ SSOP/ SOIC	28-QFN			
					PORTB is a bidirectional I/O port. PORTB can be software programmed for internal weak pull-ups on all inputs.
RB0/AN12/C3IND/INT0/RP3	21	18			
RB0			I/O	TTL/DIG	Digital I/O.
AN12			I	Analog	Analog Input 12.
C3IND			I	Analog	Comparator 3 Input D.
INT0			I	ST	External Interrupt 0.
RP3			I/O	ST/DIG	Remappable Peripheral Pin 3 input/output.
RB1/AN10/C3INC/RTCC/RP4	22	19			
RB1			I/O	TTL/DIG	Digital I/O.
AN10			I	Analog	Analog Input 10.
C3INC			I	Analog	Comparator 3 input.
RTCC			O	DIG	Real-Time Clock Calendar output.
RP4			I/O	ST/DIG	Remappable Peripheral Pin 4 input/output.
RB2/AN8/C2INC/CTED1/ REFO/RP5	23	20			
RB2			I/O	TTL/DIG	Digital I/O.
AN8			I	Analog	Analog Input 8.
C2INC			I	Analog	Comparator 2 Input C.
CTED1			I	ST	CTMU Edge 1 input.
REFO			O	DIG	Reference output clock.
RP5			I/O	ST/DIG	Remappable Peripheral Pin 5 input/output.
RB3/AN9/C3INA/CTED2/ RP6	24	21			
RB3			I/O	TTL/DIG	Digital I/O.
AN9			I	Analog	Analog Input 9.
C3INA			I	Analog	Comparator 3 Input A.
CTED2			I	ST	CTMU edge 2 Input.
RP6			I	ST/DIG	Remappable Peripheral Pin 6 input/output.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to V_{DD}); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: 5.5V tolerant.

TABLE 1-3: PIC18F2XJ13 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	28-SPDIP/ SSOP/ SOIC	28-QFN			
					PORTB (continued)
RB4/CCP4/KBI0/SCL2/RP7	25(2)	22(2)			
RB4			I/O	TTL/DIG	Digital I/O.
CCP4			I/O	ST/DIG	Capture/Compare/PWM input/output.
KBI0			I	TTL	Interrupt-on-change pin.
SCL2			I/O	I^2C	I^2C clock input/output.
RP7			I/O	ST/DIG	Remappable Peripheral Pin 7 input/output.
RB5/CCP5/KBI1/SDA2/RP8	26(2)	23(2)			
RB5			I/O	TTL/DIG	Digital I/O.
CCP5			I/O	ST/DIG	Capture/Compare/PWM input/output.
KBI1			I	TTL	Interrupt-on-change pin.
SDA2			I/O	I^2C	I^2C data input/output.
RP8			I/O	ST/DIG	Remappable Peripheral Pin 8 input/output.
RB6/CCP6/KBI2/PGC/RP9	27(2)	24(2)			
RB6			I/O	TTL/DIG	Digital I/O.
CCP6			I/O	ST/DIG	Capture/Compare/PWM input/output.
KBI2			I	TTL	Interrupt-on-change pin.
PGC			I	ST	ICSP™ clock input.
RP9			I/O	ST/DIG	Remappable Peripheral Pin 9 input/output.
RB7/CCP7/KBI3/PGD/RP10	28(2)	25(2)			
RB7			I/O	TTL/DIG	Digital I/O.
CCP7			I/O	ST/DIG	Capture/Compare/PWM input/output.
KBI3			I	TTL	Interrupt-on-change pin.
PGD			I/O	ST/DIG	In-Circuit Debugger and ICSP programming data pin.
RP10			I/O	ST/DIG	Remappable Peripheral Pin 10 input/output.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to V_{DD}); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: 5.5V tolerant.

TABLE 1-3: PIC18F2XJ13 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	28-SPDIP/ SSOP/ SOIC	28-QFN			
					PORTC is a bidirectional I/O port.
RC0/T1OSO/T1CKI/RP11	11	8			
RC0			I/O	ST/DIG	Digital I/O.
T1OSO			O	Analog	Timer1 oscillator output.
T1CKI			I	ST	Timer1 external digital clock input.
RP11			I/O	ST/DIG	Remappable Peripheral Pin 11 input/output.
RC1/CCP8/T1OSI/RP12	12	9			
RC1			I/O	ST/DIG	Digital I/O.
CCP8			I/O	ST/DIG	Capture/Compare/PWM input/output.
T1OSI			I	Analog	Timer1 oscillator input.
RP12			I/O	ST/DIG	Remappable Peripheral Pin 12 input/output.
RC2/AN11/C2IND/CTPLS/RP13	13	10			
RC2			I/O	ST/DIG	Digital I/O.
AN11			I	Analog	Analog Input 11.
C2IND			I	Analog	Comparator 2 Input D.
CTPLS			O	DIG	CTMU pulse generator output.
RP13			I/O	ST/DIG	Remappable Peripheral Pin 13 input/output.
RC3/SCK1/SCL1/RP14	14	11			
RC3			I/O	ST/DIG	Digital I/O.
SCK1			I/O	ST/DIG	SPI clock input/output.
SCL1			I/O	I^2C	I^2C clock input/output.
RP14			I/O	ST/DIG	Remappable Peripheral Pin 14 input/output.
RC4/SDI1/SDA1/RP15	15	12			
RC4			I/O	ST/DIG	Digital I/O.
SDI1			I	ST	SPI data input.
SDA1			I/O	I^2C	I^2C data input/output.
RP15			I/O	ST/DIG	Remappable Peripheral Pin 15 input/output.
RC5/SDO1/RP16	16	13			
RC5			I/O	ST/DIG	Digital I/O.
SDO1			O	DIG	SPI data output.
RP16			I/O	ST/DIG	Remappable Peripheral Pin 16 input/output.
RC6/CCP9/TX1/CK1/RP17	17(2)	14(2)			
RC6			I/O	ST/DIG	Digital I/O.
CCP9			I/O	ST/DIG	Capture/Compare/PWM input/output.
TX1			O	DIG	EUSART1 asynchronous transmit.
CK1			I/O	ST/DIG	EUSART1 synchronous clock (see related RX1/DT1).
RP17			I/O	ST/DIG	Remappable Peripheral Pin 17 input/output.
RC7/CCP10/RX1/DT1/RP18	18(2)	15(2)			
RC7			I/O	ST/DIG	Digital I/O.
CCP10			I/O	ST/DIG	Capture/Compare/PWM input/output.
RX1			I	ST	Asynchronous serial receive data input.
DT1			I/O	ST/DIG	Synchronous serial data output/input.
RP18			I/O	ST/DIG	Remappable Peripheral Pin 18 input/output.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to V_{DD}); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: 5.5V tolerant.

TABLE 1-3: PIC18F2XJ13 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	28-SPDIP/ SSOP/ SOIC	28-QFN			
VSS1	8	5	P	—	Ground reference for logic and I/O pins.
VSS2	19	16	—	—	
VDD	20	17	P	—	Positive supply for peripheral digital logic and I/O pins.
VDDCORE/VCAP	6	3	—	—	Core logic power or external filter capacitor connection.
VDDCORE			P	—	Positive supply for microcontroller core logic (regulator disabled).
VCAP			P	—	External filter capacitor connection (regulator enabled).

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to VDD); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: 5.5V tolerant.

TABLE 1-4: PIC18F4XJ13 PINOUT I/O DESCRIPTIONS

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	44-QFN	44-TQFP			
$\overline{MCLR}$	18(3)	18	I	ST	Master Clear (Reset) input; this is an active-low Reset to the device.
OSC1/CLKI/RA7	32	30			Oscillator crystal or external clock input.
OSC1			I	ST	Oscillator crystal input or external clock source input. ST buffer when configured in RC mode; otherwise CMOS. Main oscillator input connection.
CLKI			I	CMOS	External clock source input; always associated with pin function, OSC1 (see related OSC1/CLKI pins).
RA7(1)			I/O	TTL/DIG	Digital I/O.
OSC2/CLKO/RA6	33	31			Oscillator crystal or clock output.
OSC2			O	—	Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode.
CLKO			O	—	Main oscillator feedback output connection in RC mode, OSC2 pin outputs CLKO, which has 1/4 the frequency of OSC1 and denotes the instruction cycle rate.
RA6(1)			I/O	TTL/DIG	Digital I/O.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to V_{DD}); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: Available only on 44-pin devices (PIC18F46J13, PIC18F47J13, PIC18LF46J13 and PIC18LF47J13).

3: 5.5V tolerant.

TABLE 1-4: PIC18F4XJ13 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	44-QFN	44-TQFP			
					PORTA is a bidirectional I/O port.
RA0/AN0/C1INA/ULPWU/PMA6/RP0	19	19			
RA0			I/O	TTL/DIG	Digital I/O.
AN0			I	Analog	Analog Input 0.
C1INA			I	Analog	Comparator 1 Input A.
ULPWU			I	Analog	Ultra low-power wake-up input.
PMA6			I/O	ST/TTL/DIG	Parallel Master Port digital I/O.
RP0			I/O	ST/DIG	Remappable Peripheral Pin 0 input/output.
RA1/AN1/C2INA/VBG/CTDIN/PMA7/RP1	20	20			
RA1			I/O	TTL/DIG	Digital I/O.
AN1			O	Analog	Analog Input 1.
C2INA			I	Analog	Comparator 2 Input A.
VBG			O	Analog	Band Gap Reference Voltage (VBG) output.
CTDIN			I	ST	CTMU pulse delay input.
PMA7			I/O	ST/TTL/DIG	Parallel Master Port digital I/O.
RP1			I/O	ST/DIG	Remappable Peripheral Pin 1 input/output.
RA2/AN2/C2INB/C1IND/C3INB/VREF-/CVREF	21	21			
RA2			I/O	TTL/DIG	Digital I/O.
AN2			I	Analog	Analog Input 2.
C2INB			I	Analog	Comparator 2 Input B.
C1IND			I	Analog	Comparator 1 Input D.
C3INB			I	Analog	Comparator 3 Input B.
VREF-			I	Analog	A/D reference voltage (low) input.
CVREF			I	Analog	Comparator reference voltage output.
RA3/AN3/C1INB/VREF+	22	22			
RA3			I/O	TTL/DIG	Digital I/O.
AN3			I	Analog	Analog Input 3.
C1INB			I	Analog	Comparator 1 Input B.
VREF+			I	Analog	A/D reference voltage (high) input.
RA5/AN4/C1INC/$\overline{SS1}$/HLVDIN/RP2	24	24			
RA5			I/O	TTL/DIG	Digital I/O.
AN4			I	Analog	Analog Input 4.
C1INC			I	Analog	SPI slave select input.
$\overline{SS1}$			I	TTL	Comparator 1 Input C.
HLVDIN			I	Analog	High/Low-Voltage Detect input.
RP2			I/O	ST/DIG	Remappable Peripheral Pin 2 input/output.
RA6(1)					See the OSC2/CLKO/RA6 pin.
RA7(1)					See the OSC1/CLKI/RA7 pin.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to VDD); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: Available only on 44-pin devices (PIC18F46J13, PIC18F47J13, PIC18LF46J13 and PIC18LF47J13).

3: 5.5V tolerant.

TABLE 1-4: PIC18F4XJ13 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	44-QFN	44-TQFP			
					PORTB is a bidirectional I/O port. PORTB can be software programmed for internal weak pull-ups on all inputs.
RB0/AN12/C3IND/INT0/RP3	9	8			
RB0			I/O	TTL/DIG	Digital I/O.
AN12			I	Analog	Analog Input 12.
C3IND			I	Analog	Comparator 3 Input D.
INT0			I	ST	External Interrupt 0.
RP3			I/O	ST/DIG	Remappable Peripheral Pin 3 input/output.
RB1/AN10/C3INC/PMBE/RTCC/RP4	10	9			
RB1			I/O	TTL/DIG	Digital I/O.
AN10			I	Analog	Analog Input 10.
C3INC			I	Analog	Comparator 3 Input C.
PMBE(2)			O	DIG	Parallel Master Port byte enable.
RTCC			O	DIG	Asynchronous serial transmit data output.
RP4			I/O	ST/DIG	Remappable Peripheral Pin 4 input/output.
RB2/AN8/C2INC/CTED1/PMA3/REFO/RP5	11	10			
RB2			I/O	TTL/DIG	Digital I/O.
AN8			I	Analog	Analog Input 8.
C2INC			I	Analog	Comparator 2 Input C.
CTED1			I	ST	CTMU Edge 1 input.
PMA3(2)			O	DIG	Parallel Master Port address.
REFO			O	DIG	Reference output clock.
RP5			I/O	ST/DIG	Remappable Peripheral Pin 5 input/output.
RB3/AN9/C3INA/CTED2/PMA2/RP6	12	11			
RB3			I/O	TTL/DIG	Digital I/O.
AN9			I	Analog	Analog Input 9.
C3INA			I	Analog	Comparator 3 Input A.
CTED2			I	ST	CTMU Edge 2 input.
PMA2(2)			O	DIG	Parallel Master Port address.
RP6			I/O	ST/DIG	Remappable Peripheral Pin 6 input/output.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to V_{DD}); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: Available only on 44-pin devices (PIC18F46J13, PIC18F47J13, PIC18LF46J13 and PIC18LF47J13).

3: 5.5V tolerant.

TABLE 1-4: PIC18F4XJ13 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	44-QFN	44-TQFP			
					PORTB (continued)
RB4/CCP4/PMA1/KBI0/RP7	14(3)	14(3)			
RB4			I/O	TTL/DIG	Digital I/O.
CCP4(2)			I/O	ST/DIG	Capture/Compare/PWM input/output.
PMA1(2)			I/O	ST/TTL/DIG	Parallel Master Port address.
KBI0			I	TTL	Interrupt-on-change pin.
RP7			I/O	ST/DIG	Remappable Peripheral Pin 7 input/output.
RB5/CCP5/PMA0/KBI1/RP8	15(3)	15(3)			
RB5			I/O	TTL/DIG	Digital I/O.
CCP5			I/O	ST/DIG	Capture/Compare/PWM input/output.
PMA0(2)			I/O	ST/TTL/DIG	Parallel Master Port address.
KBI1			I	TTL	Interrupt-on-change pin.
RP8			I/O	ST/DIG	Remappable Peripheral Pin 8 input/output.
RB6/CCP6/KBI2/PGC/RP9	16(3)	16(3)			
RB6			I/O	TTL/DIG	Digital I/O.
CCP6			I/O	ST/DIG	Capture/Compare/PWM input/output.
KBI2			I	TTL	Interrupt-on-change pin.
PGC			I	ST	ICSP™ clock input.
RP9			I/O	ST/DIG	Remappable Peripheral Pin 9 input/output.
RB7/CCP7/KBI3/PGD/RP10	17(3)	17(3)			
RB7			I/O	TTL/DIG	Digital I/O.
CCP7			I/O	ST/DIG	Capture/Compare/PWM input/output.
KBI3			I	TTL	Interrupt-on-change pin.
PGD			I/O	ST/DIG	In-Circuit Debugger and ICSP programming data pin.
RP10			I/O	ST/DIG	Remappable Peripheral Pin 10 input/output.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to V_{DD}); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: Available only on 44-pin devices (PIC18F46J13, PIC18F47J13, PIC18LF46J13 and PIC18LF47J13).

3: 5.5V tolerant.

TABLE 1-4: PIC18F4XJ13 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	44-QFN	44-TQFP			
					PORTC is a bidirectional I/O port.
RC0/T1OSO/T1CKI/RP11	34	32			
RC0			I/O	STDIG	Digital I/O.
T1OSO			O	Analog	Timer1 oscillator output.
T1CKI			I	ST	Timer1/Timer3 external clock input.
RP11			I/O	ST/DIG	Remappable Peripheral Pin 11 input/output.
RC1/CCP8/T1OSI/RP12	35	35			
RC1			I/O	ST/DIG	Digital I/O.
CCP8			I/O	ST/DIG	Capture/Compare/PWM input/output.
T1OSI			I	Analog	Timer1 oscillator input.
RP12			I/O	ST/DIG	Remappable Peripheral Pin 12 input/output.
RC2/AN11/C2IND/CTPLS/RP13	36	36			
RC2			I/O	ST/DIG	Digital I/O.
AN11			I	Analog	Analog Input 11.
C2IND			I	Analog	Comparator 2 Input D.
CTPLS			O	DIG	CTMU pulse generator output.
RP13			I/O	ST/DIG	Remappable Peripheral Pin 13 input/output.
RC3/SCK1/SCL1/RP14	37	37			
RC3			I/O	ST/DIG	Digital I/O.
SCK1			I/O	ST/DIG	SPI clock input/output.
SCL1			I/O	I^2C	I^2C clock input/output.
RP14			I/O	ST/DIG	Remappable Peripheral Pin 14 input/output.
RC4/SDI1/SDA1/RP15	42	42			
RC4			I/O	ST/DIG	Digital I/O.
SDI1			I	ST	SPI data input.
SDA1			I/O	I^2C	I^2C data input/output.
RP15			I/O	ST/DIG	Remappable Peripheral Pin 15 input/output.
RC5/SDO1/RP16	43	43			
RC5			I/O	ST/DIG	Digital I/O.
SDO1			O	DIG	SPI data output.
RP16			I/O	ST/DIG	Remappable Peripheral Pin 16 input/output.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to V_{DD}); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: Available only on 44-pin devices (PIC18F46J13, PIC18F47J13, PIC18LF46J13 and PIC18LF47J13).

3: 5.5V tolerant.

TABLE 1-4: PIC18F4XJ13 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	44-QFN	44-TQFP			
					PORTC (continued)
RC6/CCP9/PMA5/TX1/CK1/RP17	44(3)	44(3)			
RC6			I/O	ST/DIG	Digital I/O.
CCP9			I/O	ST/DIG	Capture/Compare/PWM input/output.
PMA5			I/O	DIG	Parallel Master Port address.
TX1			O	ST/TTL/DIG	EUSART1 asynchronous transmit.
CK1			I/O	ST/DIG	EUSART1 synchronous clock (see related RX1/DT1).
RP17			I/O	ST/DIG	Remappable Peripheral Pin 17 input/output.
RC7/CCP10/PMA4/RX1/DT1/RP18	1(3)	1(3)			
RC7			I/O	ST/DIG	Digital I/O.
CCP10			I/O	ST/DIG	Capture/Compare/PWM input/output.
PMA4			I/O	ST/TTL/DIG	Parallel Master Port address.
RX1			I	ST	EUSART1 asynchronous receive.
DT1			I/O	ST/DIG	EUSART Synchronous data (see related TX1/CK1).
RP18			I/O	ST/DIG	Remappable Peripheral Pin 18 input/output.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to VDD); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: Available only on 44-pin devices (PIC18F46J13, PIC18F47J13, PIC18LF46J13 and PIC18LF47J13).

3: 5.5V tolerant.

TABLE 1-4: PIC18F4XJ13 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number		Pin Type	Buffer Type	Description
	44-QFN	44-TQFP			
					PORTD is a bidirectional I/O port.
RD0/PMD0/SCL2	38(3)	38(3)			
RD0			I/O	ST/DIG	Digital I/O.
PMD0			I/O	ST/TTL/DIG	Parallel Master Port data.
SCL2			I/O	I^2C	I^2C data input/output.
RD1/PMD1/SDA2	39(3)	39(3)			
RD1			I/O	ST/DIG	Digital I/O.
PMD1			I/O	ST/TTL/DIG	Parallel Master Port data.
SDA2			I/O	I^2C	I^2C data input/output.
RD2/PMD2/RP19	40(3)	40(3)			
RD2			I/O	ST/DIG	Digital I/O.
PMD2			I/O	ST/TTL/DIG	Parallel Master Port data.
RP19			I/O	ST/DIG	Remappable Peripheral Pin 19 input/output.
RD3/PMD3/RP20	41(3)	41(3)			
RD3			I/O	ST/DIG	Digital I/O.
PMD3			I/O	ST/TTL/DIG	Parallel Master Port data.
RP20			I/O	ST/DIG	Remappable Peripheral Pin 20 input/output.
RD4/PMD4/RP21	2(3)	2(3)			
RD4			I/O	ST/DIG	Digital I/O.
PMD4			I/O	ST/TTL/DIG	Parallel Master Port data.
RP21			I/O	ST/DIG	Remappable Peripheral Pin 21 input/output.
RD5/PMD5/RP22	3(3)	3(3)			
RD5			I/O	ST/DIG	Digital I/O.
PMD5			I/O	ST/TTL/DIG	Parallel Master Port data.
RP22			I/O	ST/DIG	Remappable Peripheral Pin 22 input/output.
RD6/PMD6/RP23	4(3)	4(3)			
RD6			I/O	ST/DIG	Digital I/O.
PMD6			I/O	ST/TTL/DIG	Parallel Master Port data.
RP23			I/O	ST/DIG	Remappable Peripheral Pin 23 input/output.
RD7/PMD7/RP24	5(3)	5(3)			
RD7			I/O	ST/DIG	Digital I/O.
PMD7			I/O	ST/TTL/DIG	Parallel Master Port data.
RP24			I/O	ST/DIG	Remappable Peripheral Pin 24 input/output.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to VDD); DIG = Digital output; I^2C = Open-Drain, I^2C specific

Note 1: RA7 and RA6 will be disabled if OSC1 and OSC2 are used for the clock function.

2: Available only on 44-pin devices (PIC18F46J13, PIC18F47J13, PIC18LF46J13 and PIC18LF47J13).

3: 5.5V tolerant.