PIC18FX7J94 Plug-In Module

User's Guide

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Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXA", where "XXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB IDE online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the PIC18FX7J94 Plug-In Module. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the PIC18FX7J94 Plug-In Module as a development tool to emulate and debug firmware on a target board, as well as how to program devices. The document is organized as follows:

- **Chapter 1. "Introduction"** – The board package's contents and the USB capabilities of the PIC18FX7J94 of devices
- **Chapter 2. "Board Hardware"** – The board's hardware elements and additional capabilities available by connecting the board to a PIC18 Explorer Board or PICDEM™ HPC Explorer Board
- **Chapter 3. "Preprogrammed Firmware"** – The board's preloaded demonstrations, and other demonstrations and projects available in the MCHPFSUSB Framework
- **Appendix A. "Troubleshooting Tips"** – Solutions for common issues
- **Appendix B. "Board Schematics"** – Schematic diagrams

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CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

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WARRANTY REGISTRATION

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in the Warranty Registration Card entitles users to receive new product updates. Interim software releases are available at the Microchip web site.

RECOMMENDED READING

This user's guide describes how to use the PIC18FX7J94 Plug-In Module. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

- *"PIC18F97J94 Family Data Sheet"* (DS30575)
- MCHPFSUSB Framework's release notes and other documentation

Microchip provides a variety of USB related application notes, firmware, drivers, PC application source code and other resources to assist application developers. The MCHPFSUSB Framework is included as part of the Microchip Libraries for Applications (MLA), which can be downloaded at:

http://www.microchip.com/mla

Additionally, other resources related to USB can also be found on the Microchip USB design center:

http://www.microchip.com/usb

Schematics and other support materials for the PIC18 Explorer Demonstration Board can be obtained at:

http://www.microchip.com/pic18explorer

The official USB 2.0 specifications also could be helpful. These materials can be obtained from the USB Implementer's Forum:

http://www.usb.org

Chapters 5, 8 and 9 of the USB 2.0 specifications are particularly important for application developers making USB peripheral devices. These chapters discuss important USB protocol fundamentals and the necessary device requests that must be supported to enable successful USB enumeration.

If considering use of the PIC18FX7J94 Plug-In Module User's Guide with one of the boards discussed in **Chapter 2. "Board Hardware"**, the following Microchip documents are recommended:

- *"PICDEM™ PIC18 Explorer Demonstration Board User's Guide"* (DS51721)
- *"Introducing the LCD Explorer Demonstration Board"* (DS52026)

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at www.microchip.com. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers, assemblers, linkers and other language tools. These include all MPLAB® C compilers; all MPLAB assemblers (including MPASM™ assembler); all MPLAB linkers (including MPLINK™ object linker); and all MPLAB librarians (including MPLIB™ object librarian).
- **Emulators** – The latest information on Microchip in-circuit emulators.This includes the MPLAB® REAL ICE™ and MPLAB ICE 2000 in-circuit emulators.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debuggers. This includes MPLAB ICD 3 in-circuit debuggers and PICkit™ 3 debug express.
- **MPLAB IDE** – The latest information on Microchip MPLAB IDE, the Windows® Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB IDE Project Manager, MPLAB Editor and MPLAB SIM simulator, as well as general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include production programmers such as MPLAB REAL ICE in-circuit emulator, MPLAB ICD 3 in-circuit debugger and MPLAB PM3 device programmers. Also included are nonproduction development programmers such as PICSTART® Plus and PICkit 2 and 3.

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CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers.

Technical support is available through the web site at:

http://www.microchip.com/support.

DOCUMENT REVISION HISTORY

Revision A (March 2013)

- Initial release covering the PIC18F87J94 and PIC18F97J94 Plug-In Modules.

NOTES:

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Chapter 1. Introduction

1.1 INTRODUCTION

The PIC18FX7J94 Plug-In Modules are designed as easy-to-use evaluation platforms for Microchip's full-speed, USB PIC18F97J94 family of microcontrollers.

The boards can be operated stand-alone without attaching them to another board. Alternately, for additional demonstration functionality, the PIC18F87J94 Plug-In Module can be used in conjunction with the PIC18 Explorer Board (DM183032). The PIC18F97J94 Plug-In Module can be used in conjunction with the LCD Explorer (DM240314). (www.microchipDIRECT.com)

All members of the PIC18F97J94 of microcontrollers fully support USB 2.0 full-speed and low-speed serial communications at signaling speeds of 12 Mbps or 1.5 Mbps.

The demonstration board packages provide all of the hardware and software needed to develop USB compliant communication solutions.

This chapter discusses:

- Demonstration Board Package Contents
- PIC18F97J94 Families' USB Capabilities

1.2 DEMONSTRATION BOARD PACKAGE CONTENTS

The demonstration board package contains:

- The PIC18FX7J94 Plug-In Module, preprogrammed with composite USB Human Interface Device (HID) and Mass Storage Device (MSD) class demonstration firmware
- A standard USB A to mini-B cable for power and communication
- A 6-pin, in-line ICSP™ to RJ-11 programming adapter board

1.3 PIC18FX7J94 FAMILIES' USB CAPABILITIES

The PIC18F97J94 microcontroller is the "superset" device of its family. Those devices have the largest memory and highest pin count in their family, but otherwise, share a nearly identical feature set with the other family devices. The only exclusionary exceptions are features that require pins not present on a family's 80/64-pin devices.

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All of the devices in the family are code compatible with each other and share these USB capabilities:

- USB 2.0 compliance
- Full-speed (12 Mbps) and low-speed (1.5 Mbps) operation
- Support of control, interrupt, bulk and isochronous transfers
- Support of up to 32 endpoints
- USB module can use any RAM location on the device as USB Endpoint Buffers
- On-chip features for single-chip USB implementation, including:
  - USB Serial Interface Engine (SIE)
  - USB transceiver
  - USB pull-up resistors
  - D+ and D- driver output impedance matching resistors
  - Internal oscillator and PLL with active clock tuning, suitable for operation in both Full-speed and Low-speed USB modes, without requiring an external crystal

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Chapter 2. Board Hardware

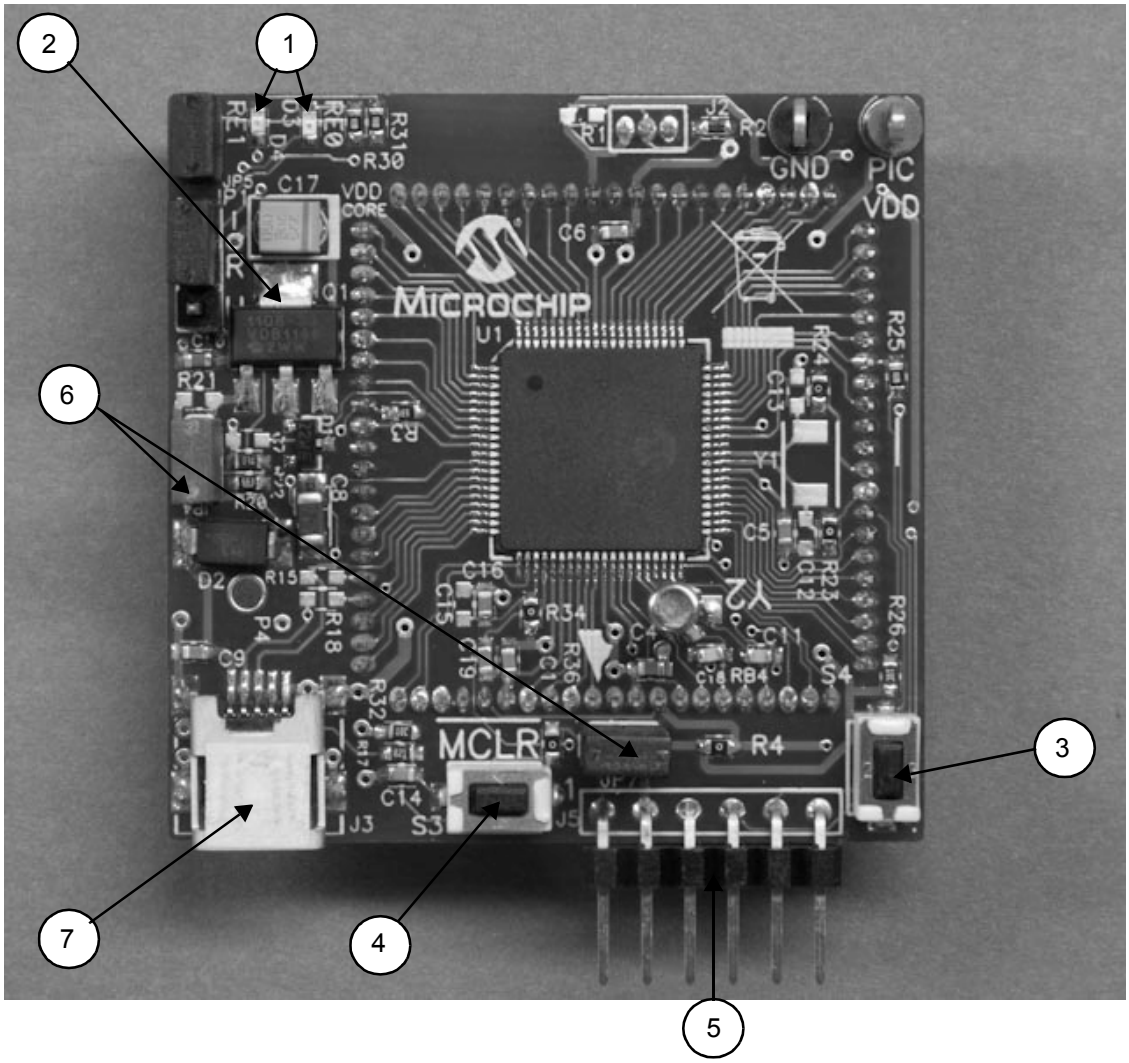
The PIC18F87J94 can be used as a stand-alone device or, for additional functionality, plugged into either PIC18 Explorer Board (www.microchipDIRECT.com).

When used alone, the board contains all of the hardware necessary to make a USB compliant, full-speed peripheral device. The board also has additional hardware elements for providing basic demonstration and development capability.

The additional elements of the PIC18F87J94 Plug-In Module include the following, with the element's number indicating its location on the board in Figure 2-1:

1. Two miniature SMT red LEDs – Connected to the RE0 and RE1 I/O pins
2. 5V to 3.3V LDO low quiescent current regulator (TC1108-3.3VDB) – Enables device to obtain power from the USB port
3. General purpose push button S4 – Connected to the RB4 I/O pin with a pull-up resistor
4. $\overline{\text{MCLR}}$ push button – For easy Reset of the microcontroller
5. 6-pin, right-angle In-Circuit Serial Programming™ (ICSP™) programmer/debug header
6. Jumpers for current measurement/power switching (JP4), LED control (JP5), VBAT control (JP7), and configuration (JP1)
7. A mini-B USB connector for power and communication

FIGURE 2-1: PIC18F87J94



The PIC18F97J94 Plug-In Module can be used as a stand-alone device or, for additional functionality, plugged into the PIC18 Explorer Board (www.microchipDIRECT.com) When used alone, the board contains all of the hardware necessary to make a USB compliant, full-speed peripheral device. The board also has additional hardware elements for providing basic demonstration and development capability.

The additional elements of the PIC18F97J94 Plug-In Module include the following, with the element's number indicating its location on the board in Figure 2-2:

1. Two miniature SMT red LEDs – Connected to the RB0 and RB1 I/O pins
2. 5V to 3.3V LDO low quiescent current regulator (TC1108-3.3VDB) – Enables device to obtain power from USB port
3. General purpose push button S2 – Connected to the RG7 I/O pin with a pull-up resistor
4. $\overline{\text{MCLR}}$ push button – For easy Reset of the microcontroller

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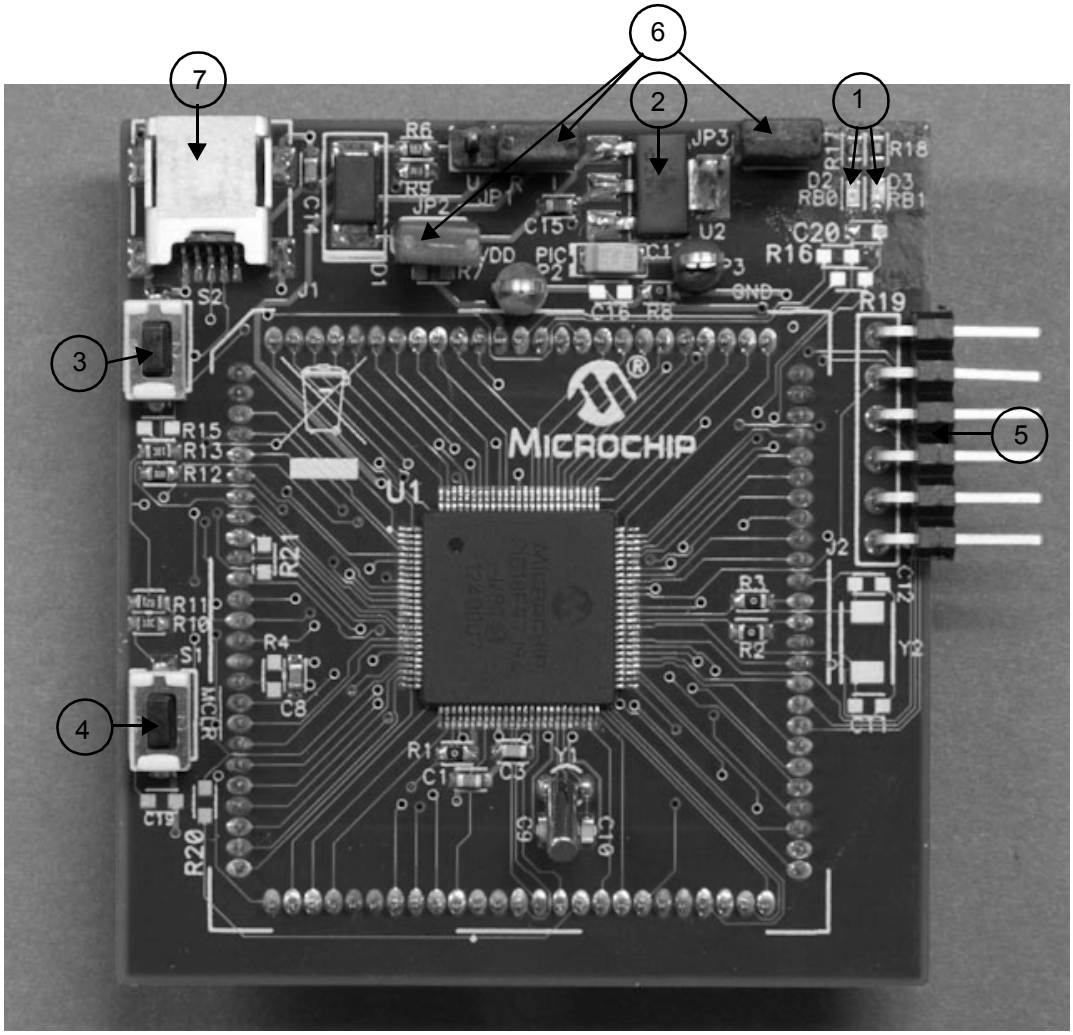
5. 6-pin, right-angle In-Circuit Serial Programming™ (ICSP™) programmer/debug header
6. Jumpers for LED control (JP3) current measurement (JP2) and configuration (JP1)
7. A mini-B USB connector for power and communication

Full schematics of the PIC18FX7J94 Plug-In Module User's Guide are in Appendix B.

FIGURE 2-2: PIC18F97J94



2.1 POWER MANAGEMENT

The USB interface provides +5V (nominal) power at up to 500 mA for use by USB peripheral devices. In order to take advantage of this bus provided power, a 3.3V, low dropout, low quiescent current linear regulator (TC1108-3.3VDB) has been included on the board. This enables the board to operate fully from USB bus power.

All USB compliant, bus powered devices should implement a low-power USB Suspend mode. This is because the USB host may, at its own discretion, halt all USB traffic, including Start-of-Frame packets, to a USB peripheral device for more than 3 ms. When a peripheral device detects this condition, it should drop to a low-power suspend state, so it draws no more than 2.5 mA from the +5V V_{BUS} supply pin.

Two USB interrupts: IDLEIF (UIR<4>) and ACTVIF (UIR<2>) are useful in detecting when the low-power suspend condition should begin and when it actually ends.

In order to meet this USB suspend current requirement, a USB peripheral should be designed so that it does not place large quiescent loads directly on the +5V V_{BUS} supply line from the USB port. If large loads will be supplied from the USB port, it is suggested that they be connected in a way that they can be turned off when the USB port is placed in the low-power suspend state.

The PIC18FX7J94 Plug-In Module User's Guide has been designed with these and other power management considerations in mind.

2.2 LEDs

Two high-efficiency, red LEDs have been included on the PIC18F87J94. The LEDs are connected to I/O pins, RE0 and RE1, and can be used for general purpose indication. The LEDs are connected so that they illuminate when the I/O pin controlling them is driven high.

Alternatively, if the I/O pin loading is undesirable (each LED consumes approximately 1 mA when turned on), a jumper cap covering (JP5 on the PIC18F87J94 board, JP3 on the PIC18F97J94 board) may be removed.

2.3 PUSH BUTTONS

Each board has two miniature push buttons. The Master Clear Reset ($\overline{MCLR}$) button resets the microcontroller.

Push button, S4 on the PIC18F87J94 board, and push button S2 on the PIC18F97J94 board, provides a simple user interface for interacting with demonstration firmware projects. Default factory firmware is installed on the board and other USB firmware projects are available in the MCHPFSUSB Framework. (See **Section 3.1 "Overview"**.)

The push buttons are connected to pin RB2 on the PIC18F87J94, and to pin RG7 on the PIC18F97J94 microcontroller. These lines are pulled up to V_{DD} through a 15 Kohm resistor. Pressing the buttons pulls the line to ground.

2.4 JUMPERS

2.4.1 JP1 Jumper

JP1 is a 3-pin header with the labels, "I", "R" and "U".

- "I" – Abbreviation referring to the ICE female header pin for the RB5 or RG6 signal
- "R" – Abbreviation referring to microcontroller pin, RB5 or RG6
- "U" – Abbreviation for the `USB_ATTACH` signal (see the schematics in Appendix B.)

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When the jumper is in the “R” to “I” position, the RB5 pin (on the PIC18F87J94) or the RG6 pin (on the PIC18F97J94) connects only to the ICE female header pin, just like most of the other general purpose I/O pins. When the jumper is in the “R” to “U” position, the pin can be used to sense when the USB cable has been attached to the host and when the host is actively providing power to the +5V VBUS line.

According to the USB 2.0 specifications, no device should ever pull the D+ or D- lines high (such as with the D+ or D- pull-up resistor) until the host actively powers the +5V VBUS line. This is intended to prevent self-powered peripherals from ever sourcing even small amounts of power to the host when the host is not powered. Small amounts of current could potentially prevent the host (and possibly other USB peripherals connected to that host) from fully becoming depowered, which could cause problems during power-up and initialization.

Self-powered peripherals should periodically monitor the +5V VBUS line and detect when it is driven high. Only when it is powered should user firmware enable the USB module and turn on the D+ (for full speed) or D- (for low speed) pull-up resistor, signaling the device attached to the host.

The JP1 jumper allows the microcontroller firmware to monitor the `USB_ATTACH` signal when the jumper cap is in the position, R - U.

The resistors, R20 and R22 of the schematics (see Appendix B.), serve multiple purposes. They level shift the +5V signal, provide a weak pull-down function on the VBUS line (to oppose any leakage that would interfere with measuring VBUS in the off/low state) and improve the ESD robustness of the circuit.

Peripherals that are purely bus-powered obtain all of their power directly from the +5V VBUS line. For these types of devices, it is unnecessary to monitor when the VBUS is powered as the peripheral will not be able to source current on the D+, D- or VBUS lines when the host is not powered.

2.4.2 Power Jumper

If the PIC18FX7J94 is used as a stand-alone device, it obtains its power from the USB cable. This requires a jumper cap to be installed (JP4 on the PIC18F87J94 board, JP2 on the PIC18F97J94 board), since the jumper is in series with the power supply from the +5V VBUS pin from the USB connector.

If the jumper cap is removed from the power jumper, a current meter can be connected across the header to measure the current consumption from the USB cable. This enables measurement of the total USB +5V VBUS current consumption, which is useful in developing USB devices to meet USB compliance specifications.

The current consumption measured at the power header will include the quiescent current of the linear regulator, Q1 and the microcontroller, as well as any leakage from other circuitry on the board.

2.4.3 LED Control Jumper

The LED control Jumper (JP5 on the PIC18F87J94 board, JP3 on the PIC18F97J94 board) provides a means of removing the LED pin loading (RE0 and RE1 on the PIC18F87J94, RB0 and RB1 on the PIC18F97J94).

2.4.4 JP7 (PIC18F87J94 Board Only)

On the PIC18F87J94 board, JP7 connects the VBAT pin on the microcontroller directly to VDD. In most cases, this is a desired and necessary connection, however, if the jumper is removed, the VBAT pin can be connected to battery power for applications in which VBAT operation is desired.

2.5 PROGRAMMING THE MICROCONTROLLER

The PIC18FX7J94 is too small to have the full-sized RJ-11 jack normally used to connect to Microchip In-Circuit Serial Programming™ (ICSP™) programmers. Instead, the board has a 6-pin ICSP header (J5 on the PIC18F87J94, J2 on the PIC18F97J94) that can be used as the connection for reprogramming the microcontroller.

The PICkit™ 3 ICSP programmer can be connected directly to the J4 header. Alternately, the 6-pin, ICSP to RJ-11 adapter board, included with the board, can be used to reprogram the microcontroller with other RJ-11 based programmers. Examples of other ICSP programmers that are supported (at the time of this document's publication) include the MPLAB® In-Circuit Debuggers/Programmers – PICkit 3 and ICD 3, and the REAL ICE™ In-Circuit Emulator.

When connecting to the 6-pin header, ensure that the polarity and alignment are correct. For reference, the board's silk screen denotes Pin 1 of the header ($\overline{MCLR}$) as the pin closest to the J2 marking on the PIC18F97J94 board, and the pin closest to the J5 marking on the PIC18F87J94 board.

The RJ-11 to ICSP adapter board also provides a reference on its silk screen with a square around the $\overline{MCLR}$ pin. When the adapter board connects correctly to the demonstration board, the square marking on the adapter board aligns with Pin 1 on the demonstration board.

If the PIC18F87J94 is being used with the PIC18 Explorer Board, that board's RJ-11 jack can also be used to reprogram or debug the PIC18F87J94. Similarly, when the PIC18F97J94 Plug-In Module is being used with the LCD Explorer Development board, the RJ-11 jack can be used to program or debug the microcontroller.

2.6 OPERATION WITH THE PIC18 EXPLORER BOARD (PIC18F87J94 ONLY)

The basic hardware capabilities of the PIC18F87J94 can be supplemented by plugging it into the PIC18 Explorer Board. These boards have additional hardware features, such as:

- A UART level translator
- An RS-232 connector
- Eight general purpose indicator LEDs
- A potentiometer – Facilitates some of the USB demonstrations that read the voltage output by the potentiometer
- A full-size RJ-11 style programming/debugging jack
- A PICtail™ daughter board connector – Enables easy probing of I/O pins or connection to other expansion boards (such as the SD/MMC PICtail™ daughter board, www.microchipDIRECT.com)

Before connecting the PIC18F87J94 to the PIC18 Explorer Board, ensure that the board's slider switch is in the "ICE" position. If the explorer board's switch is in the wrong position, Pin P4 on the PIC18F87J94 is designed to physically interfere with the switch.

When the explorer board's slider switch is in the ICE position, the $\overline{MCLR}$ pin of the PIC18 Explorer Board's PIC18F8722 microcontroller is held in Reset. This prevents I/O pin contention, even though the PIC18F8722 and PIC18F87J94 microcontrollers electrically share I/O pins when the two boards are connected.

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2.7 OPERATION WITH THE LCD EXPLORER DEVELOPMENT BOARD (PIC18F97J94 ONLY)

The basic hardware capabilities of the PIC18F97J94 Plug-In Module can be supplemented by plugging it into the LCD Explorer Development Board. This board has additional hardware features, such as:

- An RS-232 connector
- 96 Segment, 37 Segment x 8 Common LCD
- A potentiometer – Facilitates some of the USB demonstrations that read the voltage output by the potentiator
- A full-size RJ-11 style programming/debugging jack

NOTES:

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Chapter 3. Preprogrammed Firmware

3.1 OVERVIEW

Microchip provides a wide variety of USB related example firmware projects, PC application projects, drivers, and other related resources for developing complete USB peripheral and host devices. These resources are included in the USB section of the Microchip Libraries for Applications (MLA), which can be downloaded from:

www.microchip.com/mla

The free package can also be downloaded from the Microchip USB Design Center: www.microchip.com/usb

Many of the USB device demonstrations and projects in the MLA Framework are specifically intended for the PIC18FX7J94, so they require no hardware or other modifications.

Some example USB firmware is preprogrammed on the PIC18FX7J94. The microcontroller contains both demo firmware and a USB bootloader that is independent of the demo firmware. The bootloader can be used to program a new application's firmware `*.hex` files into the microcontroller's Flash memory, eliminating the need for a dedicated In-Circuit Serial Programming™ (ICSP™) programmer.

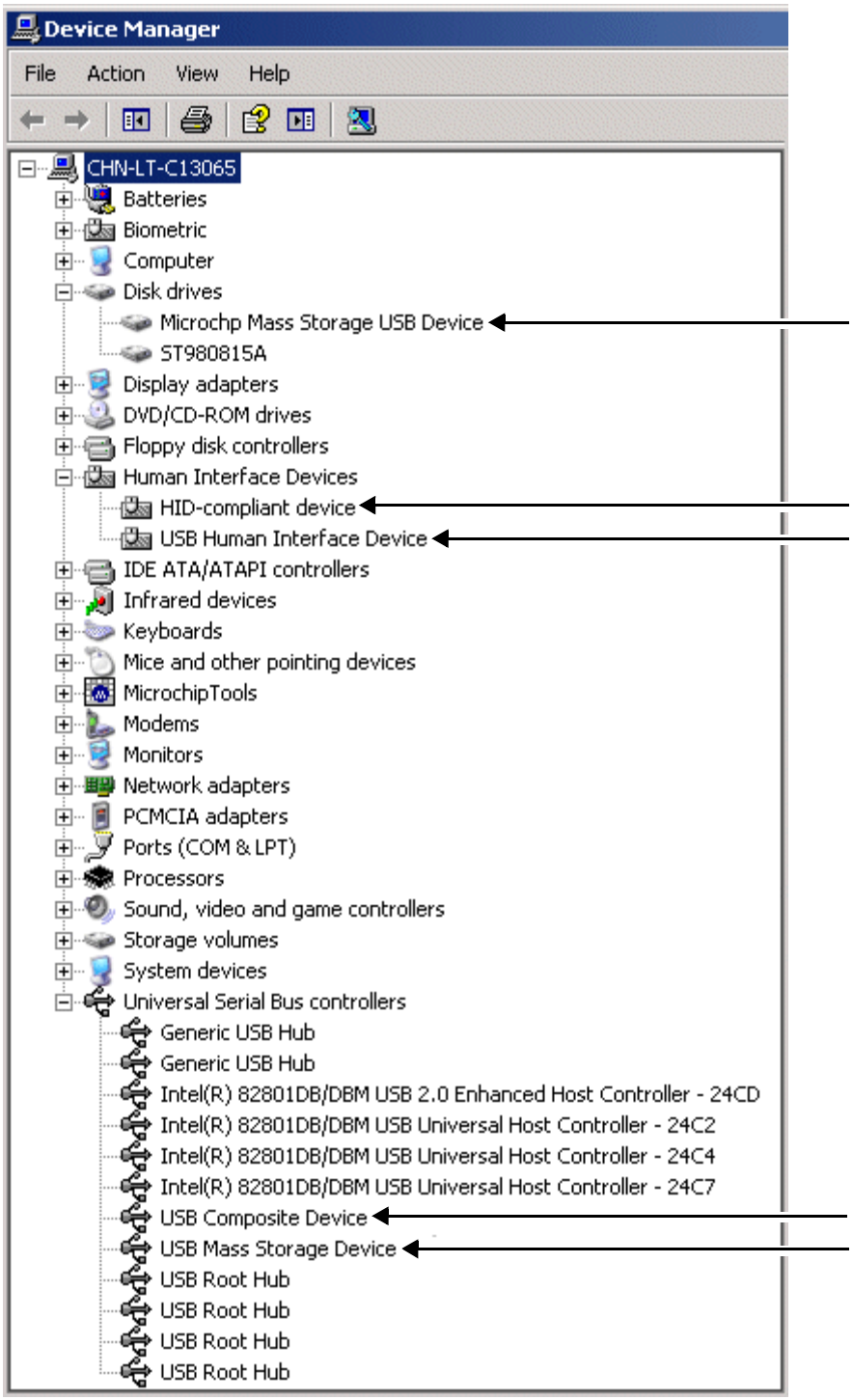
To enter the Bootloader mode, hold down the S4 push button on the PIC18F87J94, or the S2 push button on the PIC18F97J94, and momentarily press and release the MCLR push button. The microcontroller firmware checks the I/O pin state once after coming out of Reset. (For more information on the USB bootloader, see **Section 3.3 "Using the HID Bootloader Firmware"**.)

The microcontroller firmware will enter the Demo mode if the push button is not pressed during power-up or Reset. If the microcontroller is not in the Bootloader mode, it is in Demo mode. (For more information on the composite HID+MSD demo firmware, see **Section 3.2 "Using the Composite HID+MSD Class Demo Firmware"**.)

When a Demo mode device is plugged into a host PC, the device should automatically enumerate as a USB "composite" HID (Human Interface Device) and MSD (Mass Storage Device). Common operating systems (including Windows®, Mac OS® and Linux®) ship with built-in HID and MSD class USB drivers. Additional drivers should not be needed to use the default demo firmware programmed on the PIC18FX7J94 microcontroller.

With successful enumeration in Demo mode, under the Windows operating system, additional entries should appear in the Windows Device Manager dialog box. Figure 3-1 shows how the dialog box appears in the Windows XP® operating system with arrows indicating the new entries listed for the board. (The dialog box's appearance may vary in other versions of the Windows operating systems, such as Windows Vista®, Windows 7, or Windows 8.)

FIGURE 3-1: WINDOWS® XP DEVICE MANAGER ENTRIES (DEMO MODE)



Note: Lines indicate the new entries that appear because the device has been attached to the PC.

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3.2 USING THE COMPOSITE HID+MSD CLASS DEMO FIRMWARE

3.2.1 MSD Interface

The MSD (Mass Storage Device) interface displays the PIC18FX7J94 in My Computer as a new drive volume, similar to a USB "thumb drive" Flash memory device. Upon successful enumeration in Demo mode, the new drive volume will contain:

- *File.txt* – a writable text file stored in the microcontroller's Flash memory
- getting_started_PIC18F97J94.htm or getting_started_PIC18F87J94.htm – a link to the product web site
- `HID PnP Demo.exe` – the graphical user interface for interfacing with the HID demonstration firmware

If the device enumerates correctly in Demo mode and appears normal in the Device Manager, but fails to appear as a new drive volume, see **Appendix A. "Troubleshooting Tips"**.

3.2.2 HID Interface

The HID (Human Interface Device) interface enables generic USB data transfer to and from an attached device. Although the HID class is normally used for interface products, such as keyboards and mice, the HID interface alternatively can be used for other data transfer purposes.

The HID interface on the PIC18FX7J94's default firmware is meant to be used with the PC application project, `HID PnP Demo.exe`, provided on the Flash drive MSD volume located on the part itself. It can also be found in the USB section of the MLA, available from the Microchip USB Design Center:

www.microchip.com/usb

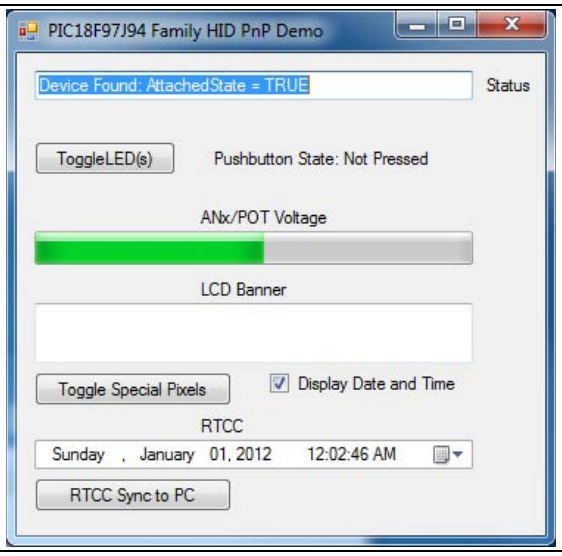
If the MLA is installed in the default directory (`C:\Microchip Solutions(date of release)`), the `HID PnP Demo.exe` executable file is in the directory:

```
C:\Microchip Solutions(date of release)\PC Software
Source\Microsoft Visual CSharp 2008 Express\bin\Release
```

The demo PC application is intended to be run under Windows and was written in Microsoft® Visual C# 2008. If the executable fails to launch correctly, review the PC's control panel – add or remove the programs list to ensure that the `.NET` Framework Version 3.5 (or later) redistributable package has been installed.

If the USB device has been plugged in and has successfully enumerated, the device should be detected automatically by the demo PC application. Figure 3-2 gives an example of how the PC application appears in Windows 7.

FIGURE 3-2: HID DEMO APPLICATION



The demo PC application provides a simple graphical user interface for sending and receiving small amounts of example data to and from the HID interface on the USB device. Full source code for both this PC application and the demo firmware are included in the MCHPFSUSB Framework. Assuming the MCHPFSUSB Framework has been installed in the default location, the source code for both the firmware and PC application are found in the following directory:

```
C:\Microchip Solutions(date of release)\USB\Precompiled
Demos\PIC18F97J94 PIM Family
```

The demo PC application can be used to toggle the LEDs on the demo board, determine the push button state, output the RTCC value of the PIC® device, as well as synchronize the time to that of the PC, measure the analog voltage on the micro-controller's RA0 I/O pin. The analog voltage on RA0 is measured by the ADC of the microcontroller and graphically displayed by the "ANx/POT Voltage" bar, as shown in Figure 3-2.

If the PIC18FX7J94 is used as a stand-alone device, it is recommended that an adjustable external power supply (between 0V and 3.3V) be attached to the RA0 pin to provide a more interesting demo experience. If the board is used in conjunction with the PIC18 Explorer Board or the LCD Explorer Development Board, the analog potentiometer on those boards, tied to RA0, can be adjusted to alter the HID demo's voltage display bar. In addition, if attached to one of the demonstration boards, the graphical interface can be used to output messages to the LCD displays on the respective boards.

3.3 USING THE HID BOOTLOADER FIRMWARE

The PIC18FX7J94 is preprogrammed with HID class USB bootloader firmware as well as the USB composite HID+MSD demo firmware. The HID bootloader is independent of the composite HID+MSD demo firmware.

The bootloader firmware can be used to update the Flash memory contents of the PIC18FX7J94 microcontroller, similar to using a dedicated, ICSP based programmer. When the bootloader is used, a new `.hex` file can be programmed into the device by sending it directly over the USB cable to the PIC18FX7J94.

The HID bootloader firmware uses self-programming operations to update the Flash memory contents of the microcontroller.

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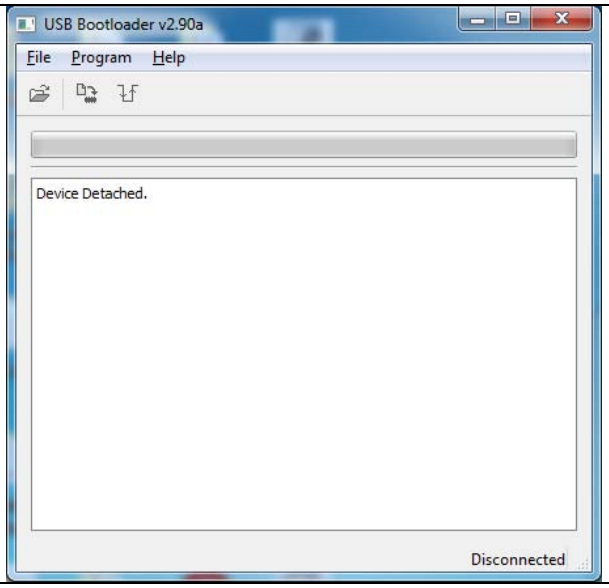
To use the HID bootloader:

1. Launch the HID bootloader application.

   The program is found in *C:\Microchip Solutions (date of release)\USB\Device-Bootloaders\HID*. The dialog box, shown in Figure 3-3, appears. (This dialog box appears whenever the USB device is not yet attached or the firmware is not in Bootloader mode.)

FIGURE 3-3: USB HID BOOTLOADER APPLICATION – NO DEVICE



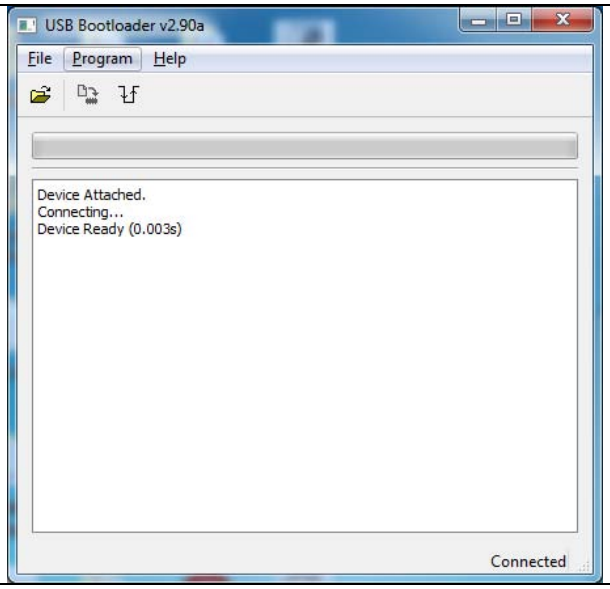
2. Plug the PIC18FX7J94 into a free USB port.
3. Place the board in the Bootloader mode by pressing and holding down the S4 push button on the PIC18F87J94, or the S2 push button on the PIC18F97J94. While still holding down the push button, momentarily press and release the MCLR push button to reset the device, keeping the S4 push button on the PIC18F87J94, or the S2 push button on the PIC18F97J94, depressed until after the device has come out of Reset.

   The bootloader firmware performs a quick check of the switch I/O pin after coming out of Reset to determine if the device should enter Bootloader or normal Demo mode.

As a result:

- The device re-enumerates as a generic HID class device (instead of a composite HID+MSD device)
- The “USB HID Bootloader” PC application automatically detects the PIC18FX7J94
- The dialog box, shown in Figure 3-4, appears

FIGURE 3-4: USB HID BOOTLOADER APPLICATION – DEVICE FOUND



Once the PC application has found the USB device, the application can be used to open the Intel® HEX 32-bit formatted `*.hex` firmware images and program them using the respective buttons.

MPLAB IDE can be used to create these firmware image files by:

1. Building a firmware project and using a modified linker script necessary for the bootloader.
2. Right clicking on the project and selecting **Export Hex** from the drop-down menu.

By default, the precompiled demo `.hex` files included in the MCHPFSUSB Framework distribution can be programmed using the USB bootloader application. The demo's firmware projects were created using the appropriately modified linker script, so the demos should work directly with the bootloader.

Programming a new firmware image using the bootloader does not erase or overwrite the bootloader firmware inside the microcontroller. To execute newly programmed firmware with the bootloader application, reset the microcontroller by pressing the $\overline{\text{MCLR}}$ push button.

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Appendix A. Troubleshooting Tips

This appendix gives solutions for common issues.

Problem 1:

The USB device enumerates correctly in Demo mode (and appears normal in the Device Manager), but a new drive volume does not appear for the MSD interface.

Resolution:

See if the target system has a drive letter conflict.

Common operating systems typically assign USB mass storage volumes (such as Flash memory devices and detachable CD-ROM or floppy drives) to the next available drive letter (often "E:"). If, however, the automatically assigned drive letter has already been assigned to some other device (such as a mapped network drive), a conflict can occur with some Windows operating systems.

See Microsoft Knowledge Base article 297694 at the following link:

http://support.microsoft.com/kb/297694

To resolve this issue, do one of the following:

- Obtain the hotfix available from Microsoft
- Manually reassign the conflicting drive volume (such as a mapped network drive) with a drive letter that is later in the alphabet (such as Z:)

Problem 2:

The USB device does not enumerate or appear in the Device Manager.

Resolution:

Verify the following:

- The microcontroller is powered
- Jumper cap, JP4 on the PIC18F87J94 board or JP2 on the PIC18F97J94 board, is installed so that the demonstration board is obtaining power from the USB cable
- The microcontroller is programmed with the correct firmware

The factory default firmware can be restored onto the microcontroller any time by using the ICSP programming header and programming the microcontroller with the correct `.hex` file. To do this:

1. Launch the MPLAB X IDE application and select the ICSP programmer and the correct device (PIC18FX7J94).
2. Select *File>Import>Hex/ELF... (Prebuilt) File*.
3. Select the correct `.hex` file.
4. Attach the programmer and click the **Make and Program Device Main Project** button.

Problem 3:

When a PC application, such as the HID bootloader and `HID PnP Demo.exe` are launched, an error message appears and the application does not open correctly.

Resolution:

The HID PnP Demo application was developed in the Microsoft® Visual C# 2008 development environment and will not run without the PC having the `.NET` Framework 3.5 (or higher) redistributable package installed. If the `.NET` package has not been installed, do so.

The `.NET` package can be downloaded from the Microsoft web site:

Go to the Microsoft Download Center and use the key words, "`.NET` Framework".

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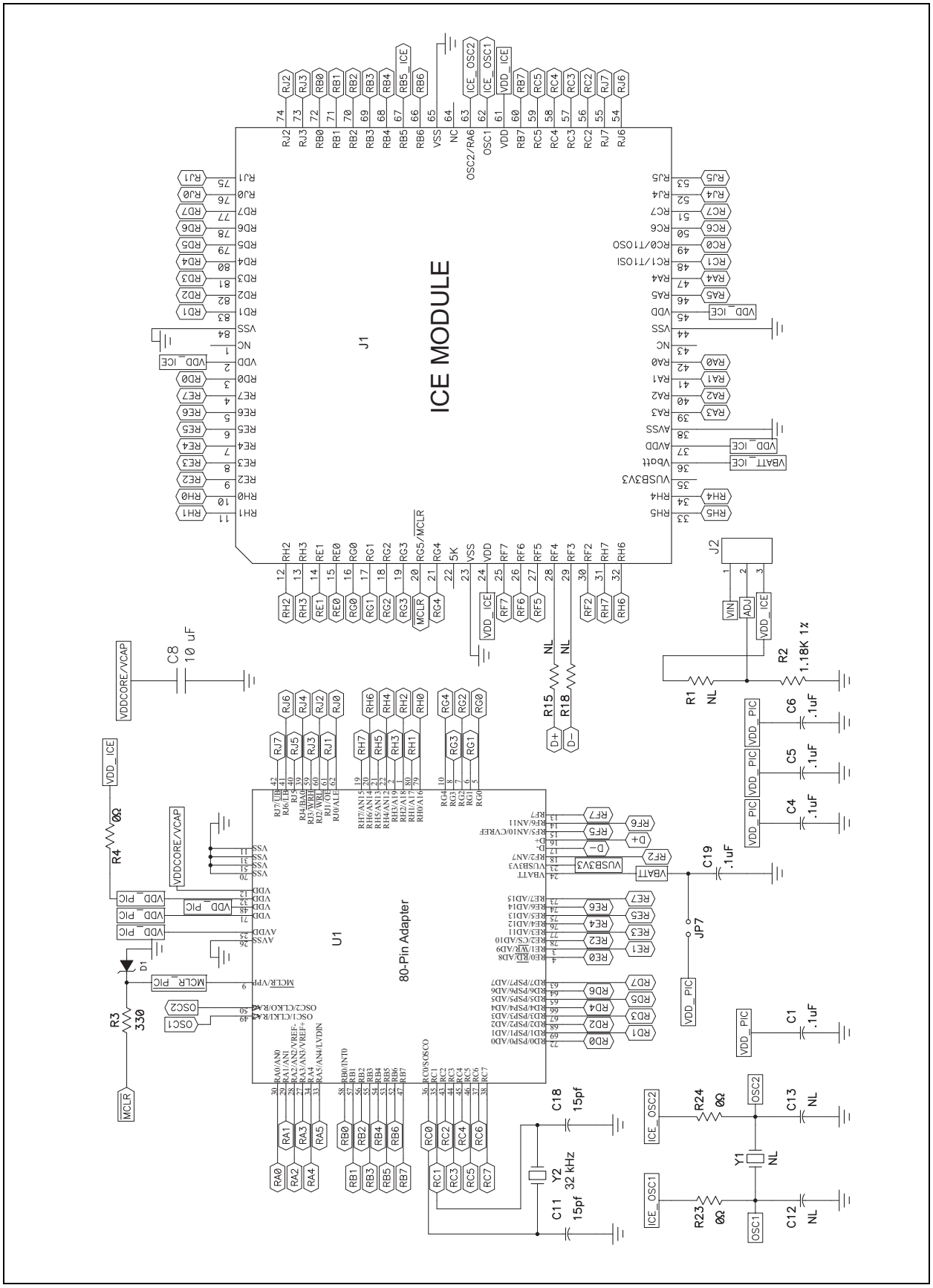
Appendix B. Board Schematics

Figure B-1 and Figure B-2 show the schematics for the PIC18F87J94 Plug-In Module. Figure B-3 and Figure B-4 show the schematics for the PIC18F97J94 Plug-In Module.

When designing a new USB application based around a PIC18FX7J9X microcontroller, it is recommended to design it to be USB 2.0 compliant. Many of the USB compliance criteria will already be met by virtue of the electrical signal quality of the silicon, but some factors are PCB board and application-level specific. This typically includes the application firmware behavior during USB suspend, the electrical inrush and current consumption requirements during USB suspend and normal operating modes, and the application firmware handling/response to required USB commands (ex: "Chapter 9" commands). It is suggested that those designing new USB applications review Section 7.2 of the official USB 2.0 specifications. That section includes important information related to power management (such as board inrush current) and specifications necessary to pass USB compliance tests.

FIGURE B-1: PIC18F87J94 PLUG-IN MODULE – PINS(1,2,3)



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Note 1: In order to be USB compliant, a USB device that is not purely bus powered (such as containing a battery or having a wall cube) should monitor the +5 V_{BUS} pin from the USB connector. If the host is not powered or the cable is not attached, the USB device should not enable the USB module or the D+ (for full speed) or D- (for low speed) bus pull-up resistor (~1.5 kΩ). The `USB_ATTACH` signal can be connected to the microcontroller pin, RC2, through the JP2 jumper header. This signal can be used to monitor V_{BUS}.

2: When laying out a new PCB, providing for ESD protection components is recommended, although they may not be necessary in all applications. The microcontroller has some built-in ESD protection, but it may not be sufficient for all applications depending on board layout and other system level considerations. Having provisions (solder pads) on the PCB for these extra components adds flexibility for later in the development process. ESD protection components will likely provide the best performance if they are located as close to the high-voltage entry point as possible (for example, next to the USB connector). When considering ESD components, it is recommended that selected components add little to no extra resistance in series with the D+ and D- pins, and no more than a few tens of pF of parasitic capacitance.

3: Zener diode D1 (and current limiting resistor R3) are not required for production designs, and may be omitted to save cost. They are included in this design to improve ruggedness, in the event of user error during development. Some microcontrollers use high voltages (beyond V_{DD} levels) to enter ICSP programming/debug modes. The PIC18FX7J94 Family devices do not use high-voltage ICSP entry. However, if a user incorrectly selects a high-voltage device in MPLAB, ignores user warning(s) from MPLAB, and then allows the programmer to connect to the device, this could temporarily subject the $\overline{MCLR}$ pin to destructively high voltages (without the R3+D1 components) when MPLAB tries to read the microcontroller's device ID number. The components R3 and D1 protect against damage in this scenario.

FIGURE B-2: PIC18F87J94 PLUG-IN MODULE – MICROPROCESSOR(1,2)

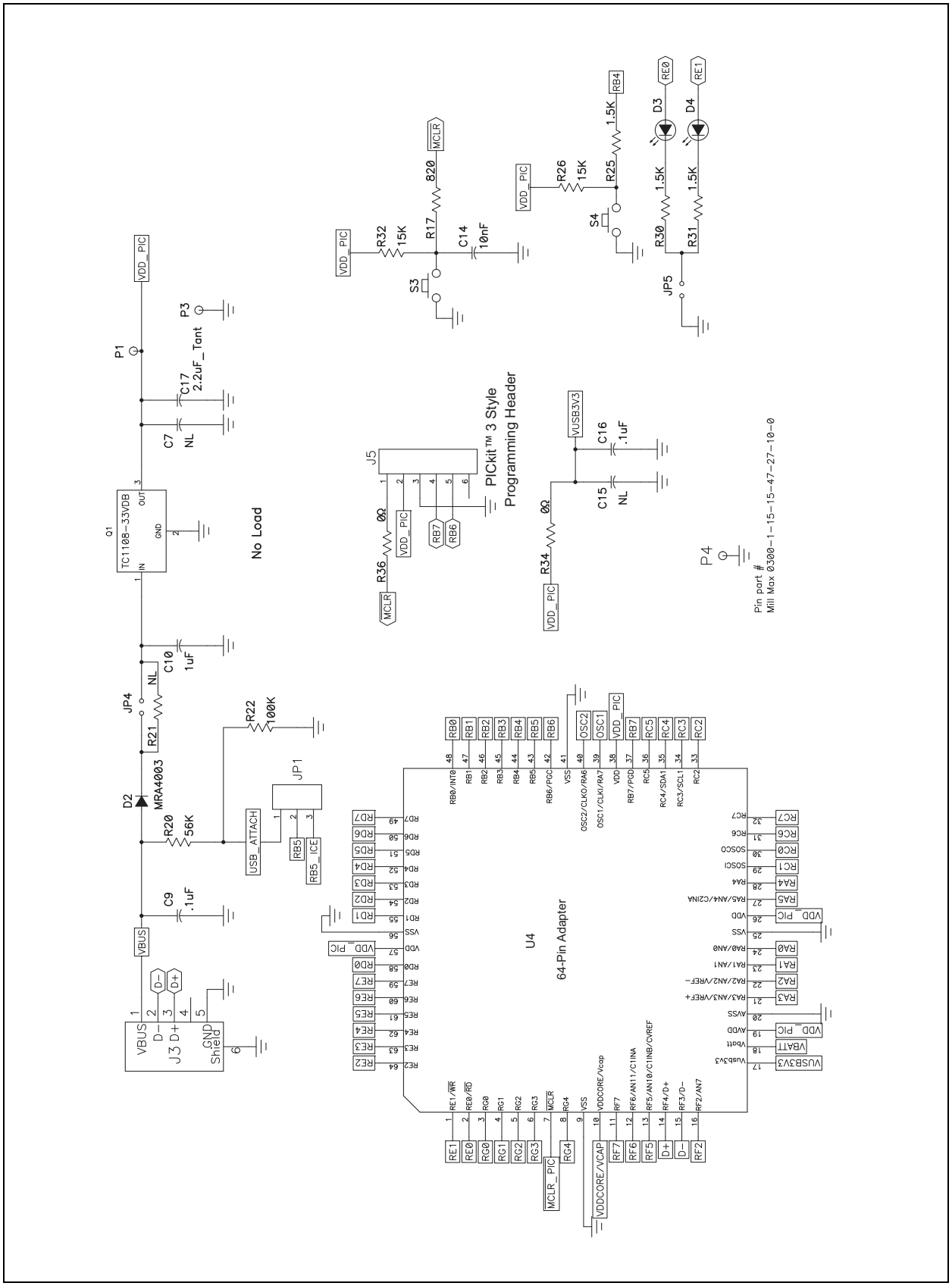

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FIGURE B-3: PIC18F97J94 PLUG-IN MODULE – ICE MODULE(1,2)

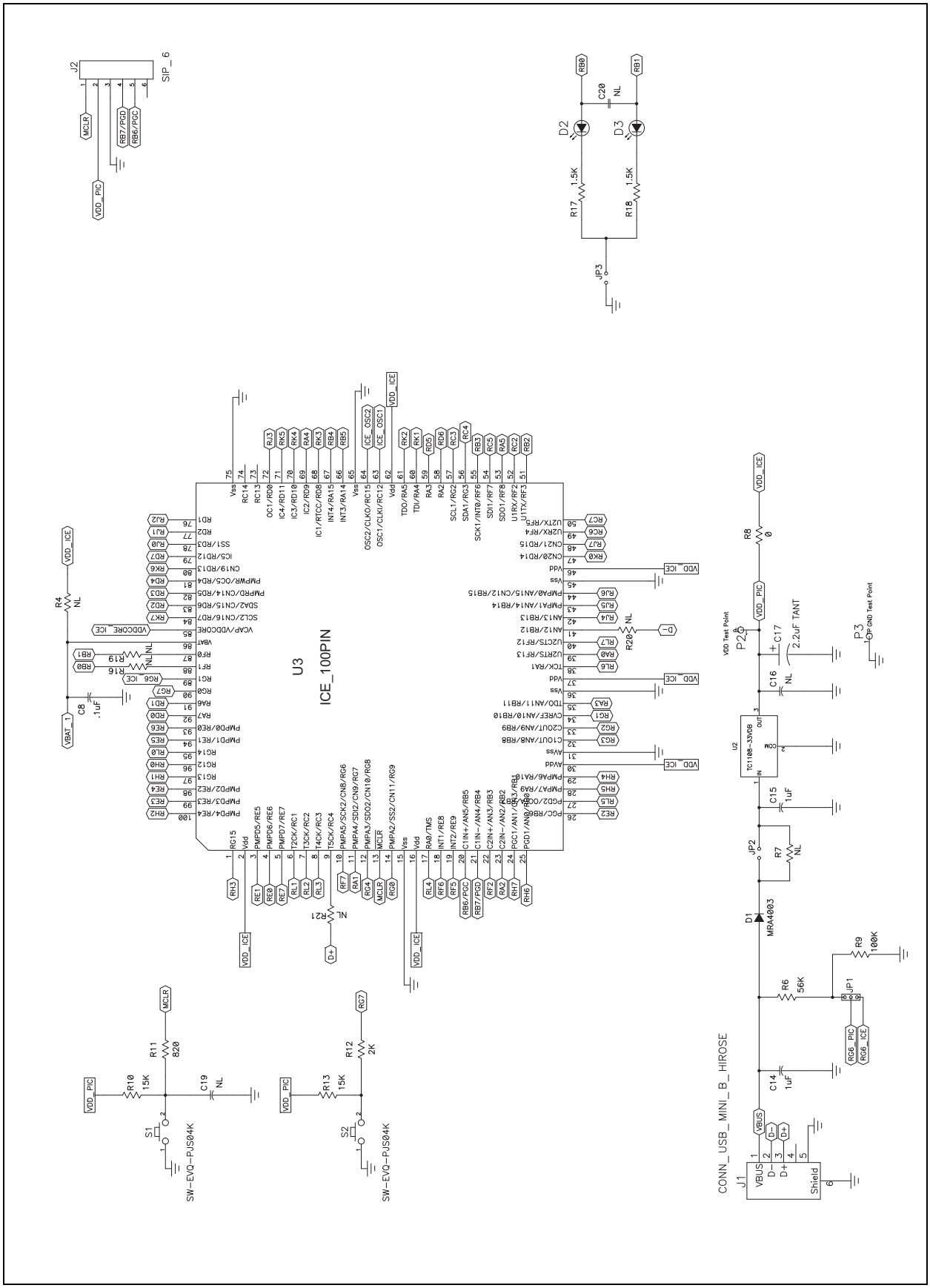
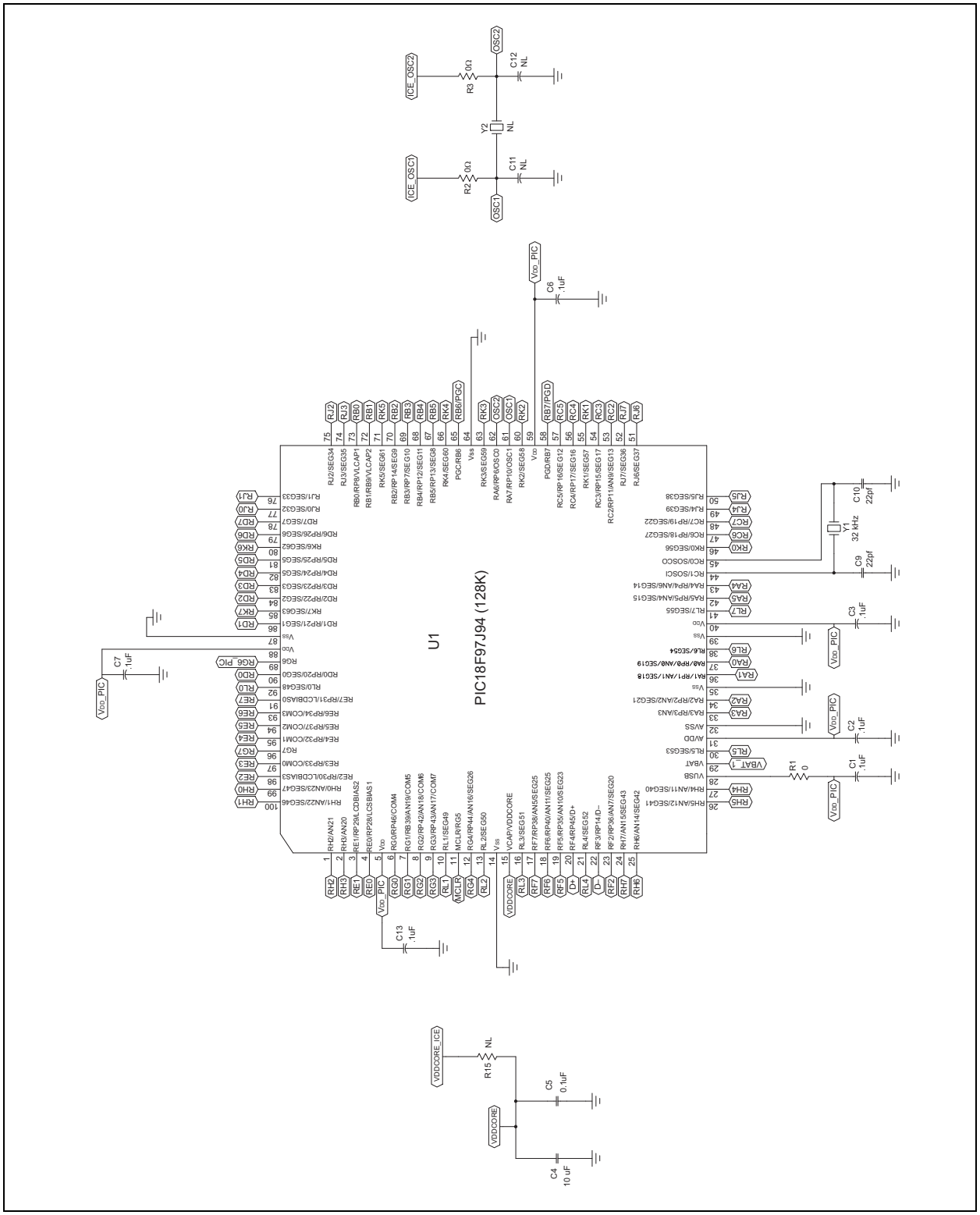


FIGURE B-4: PIC18F97J94 PLUG-IN MODULE – ICE MODULE(1,2)



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