PIC18 PoE Development Kit User's Guide

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.

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- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.

- Microchip is willing to work with the customer who is concerned about the integrity of their code.

- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

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Trademarks

Object of Declaration: PoE Main Board

EU Declaration of Conformity

This declaration of conformity is issued by the manufacturer.

The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not a Finished Appliance, nor is it intended for incorporation into Finished Appliances that are made commercially available as single functional units to end users under EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8th February 2010).

This development/evaluation tool complies with EU RoHS2 Directive 2011/65/EU.

This development/evaluation tool, when incorporating wireless and radio-telecom functionality, is in compliance with the essential requirement and other relevant provisions of the R&TTE Directive 1999/5/EC and the FCC rules as stated in the declaration of conformity provided in the module datasheet and the module product page available at www.microchip.com.

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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA.
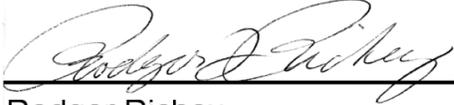
Rodger Richey
Director of Development Tools

4/4/17

Date

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PIC18 PoE DEVELOPMENT KIT
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PIC18 POE DEVELOPMENT KIT USER'S GUIDE

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 website (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 PIC18 PoE Development Kit. Items discussed in this chapter include:

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

DOCUMENT LAYOUT

This document describes how to use the PIC18 PoE Development Kit 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. "Overview"** – Overview of the PIC18 PoE Development Kit
- **Chapter 2. "Getting Started with the PoE Development Kit"** – Covers the use of the out-of-box demo firmware and of the PoE GUI demo
- **Chapter 3. "Programming"** – Gives details about programming the PIC18 PoE Main Board
- **Appendix A. "Schematics"** – Includes PIC18 PoE Main Board and I/O Starter Adapter schematics
- **Appendix B. "Pin Allocation"** – Includes the pin allocation tables for the PIC18F67J60
- **Appendix C. "References"** – Gives the links to the Microchip Ethernet of

Everything web page and associated application notes, development tools, and Internet Engineering Task Force (IETF) Request for Comments (RFCs)

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)`
		`{ ...`
		`}`

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 website.

RECOMMENDED READING

This user's guide describes how to use PIC18 PoE Development Kit. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

Release Notes for MPLAB® ICD 3 In-Circuit Debugger

For the latest information on using PIC18 PoE Development Kit, read the "Readme for PIC18 PoE Development Kit.htm" file (an HTML file) in the Readmes subdirectory of the MPLAB IDE installation directory. The release notes (Readme) contains update information and known issues that may not be included in this user's guide.

THE MICROCHIP WEBSITE

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

DEVELOPMENT SYSTEMS CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip website at www.microchip.com, click on Customer Change Notification and follow the registration instructions.

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.

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. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the website at:

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

REVISION HISTORY

Revision A (07/2017)

This is the initial release of this document.

Chapter 1. Overview

1.1 INTRODUCTION

The PIC18 Power over Ethernet (PoE) Development Kit provides an easy, low-cost way to evaluate the functionality of Microchip's family of microcontrollers and the TCP/IP (including CoAP) library. The kit provides a development platform which can help speed your next PoE design from concept to first prototype. The hardware works in conjunction with the extensive TCP/IP library in MCC (http://www.microchip.com/mplab/mplab-code-configurator), which provides all the source code necessary for the development of a PoE application. Greater detail is provided on the Microchip Ethernet of Everything web page at https://www.microchip.com/EoE.

1.2 DEVELOPMENT KIT CONTENTS

The PIC18 PoE Development Kit contains the following:

- PIC18 PoE Main Board (DM160230)
- PoE Programmer Adapter (DM160236)
- I/O Starter Extension (DM160233)
- AC/DC Wall-Mounted Power Supply 48V
- Micro-USB Cable
- Required but not included:
    - PoE Network Switch
    - Ethernet Cable (Cat5e or better)
    - PIC® MCU Programmer (i.e., PICkit™ 3 and associated cables)

FIGURE 1-1:   DEVELOPMENT KIT COMPONENTS
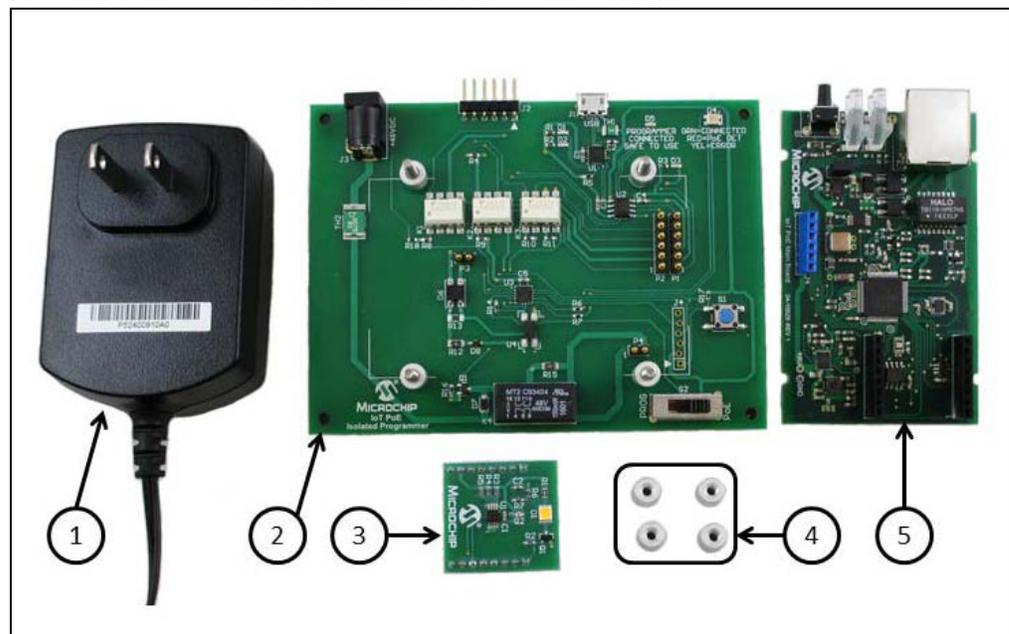
1. +48V Wall-Mounted Power Supply
2. PoE Programmer Adapter (DM160236)
3. I/O Starter Extension (DM160233)
4. Stand-offs included on the PoE Programmer Adapter
5. PIC18 PoE Main Board (DM160230)

1.3   CONSTRUCTION AND LAYOUT

The PIC18 PoE Main Board and components are shown in Figure 1-2, Figure 1-3, and Figure 1-4.

FIGURE 1-2:   PIC18 PoE MAIN BOARD TOP SIDE
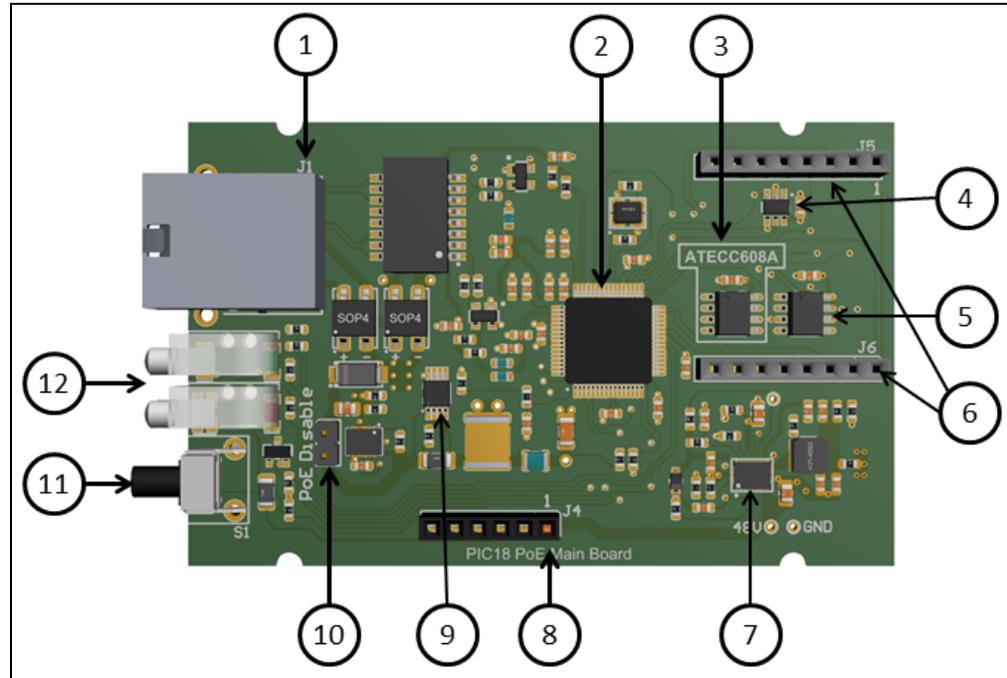
1. RJ-45 Ethernet Jack
2. PIC18F67J60: MCU with MAC/PHY
3. ATECC608A (optional): Secure Provisioning (Key Management and TLS)
4. 25AA02E48: MAC Address
5. AT25M02: 256 KB EEPROM
6. J5/6 Header: I/O Expansion Bus for Function Specific Modules (i.e., Sensors, Drivers, etc.)
7. MIC28512: +3.3V PSU
8. J4 Header: +48V Power and Ground
9. HV7802 Current Sense
10. PoE Disable Jumper
11. Push Button S1: DHCP Discovery or User Defined in Software
12. Ethernet Status LEDs (see Figure 1-4)

> **Note:** PoE Disable Jumper must be installed to power the PIC18 PoE Main Board over Ethernet.

FIGURE 1-3: **PIC18 PoE MAIN BOARD BOTTOM SIDE**
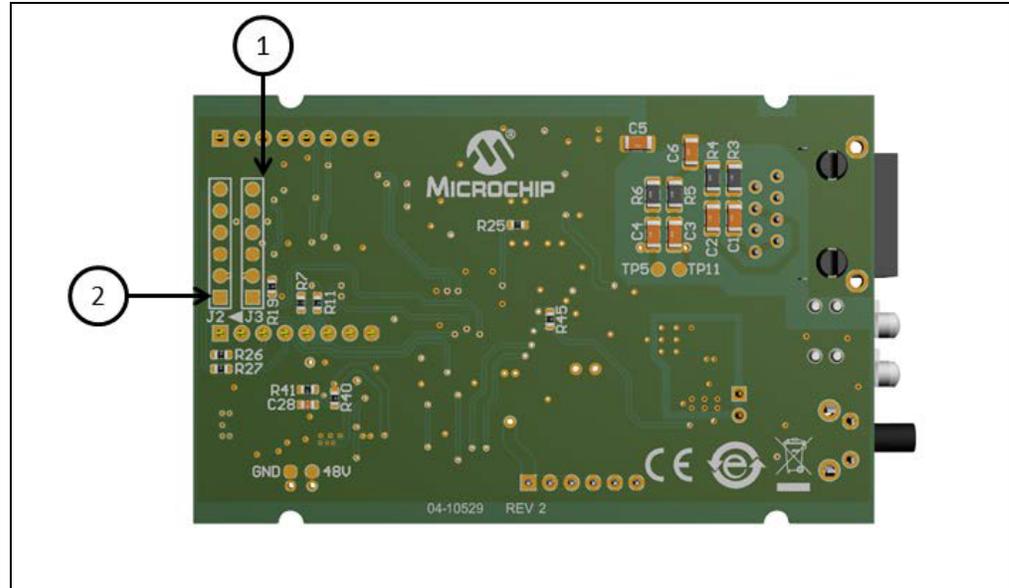
1. J3 PICkit/ICD/REAL ICE programming contact points
2. J2 PICkit Serial UART contact points

FIGURE 1-4: **PIC18 PoE MAIN BOARD STATUS LEDs**
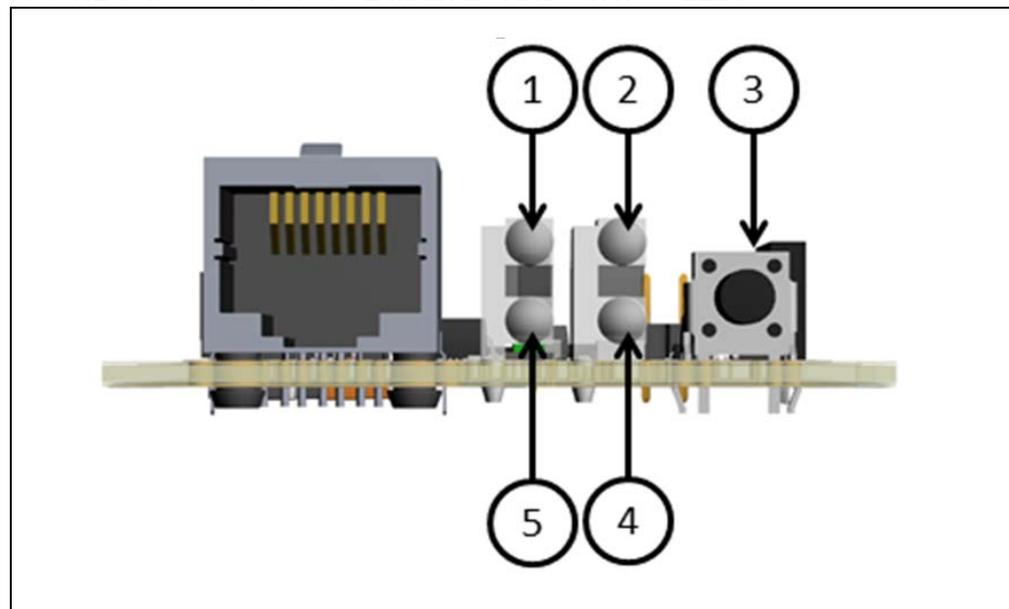
1. Link Status LED, green
2. +48V Status LED, red
3. Push Button S1: DHCP Discovery or User Defined in Software
4. TCP/IP Status LED, Bi-Color (red, green, combined amber)
5. RX/TX Ethernet Activity LED, green

PIC18 PoE Development Kit User's Guide

The PoE Programmer Adapter and components are shown in Figure 1-5.

FIGURE 1-5: PoE PROGRAMMING ADAPTER
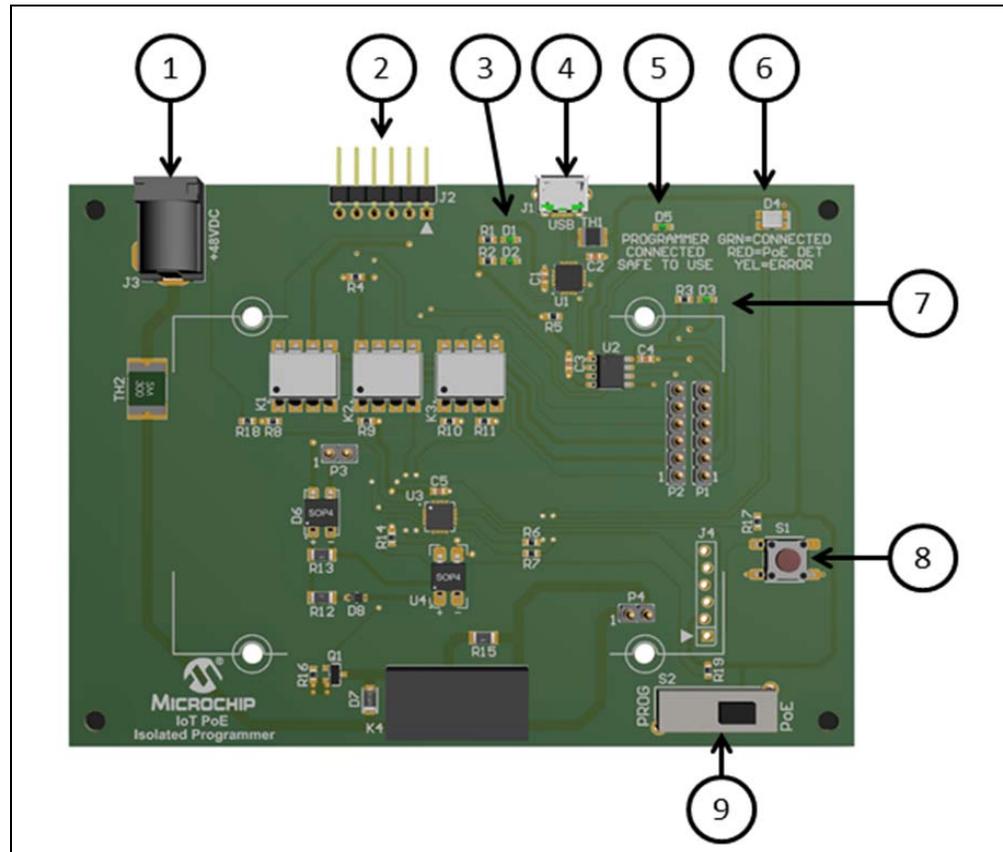
1. +48V Power Jack
2. PICkit/ICD/REAL ICE Programming Header
3. D1 and D2 USB serial communications RX/TX LEDs, both green
4. Micro-USB connector
5. D5 PICkit/ICD/REAL ICE connected to PoE Main Board Status LED, green
6. D4 Programmer Status LED, Bi-Color (Red, Green, combined amber)
7. D3 PoE Main Board +3.3V Power Status LED, green
8. Programmer Reset Switch S1
9. PoE/PROG Programming Switch S2

The I/O Starter Adapter and components are shown in Figure 1-6.

FIGURE 1-6:   **I/O STARTER EXTENSION**
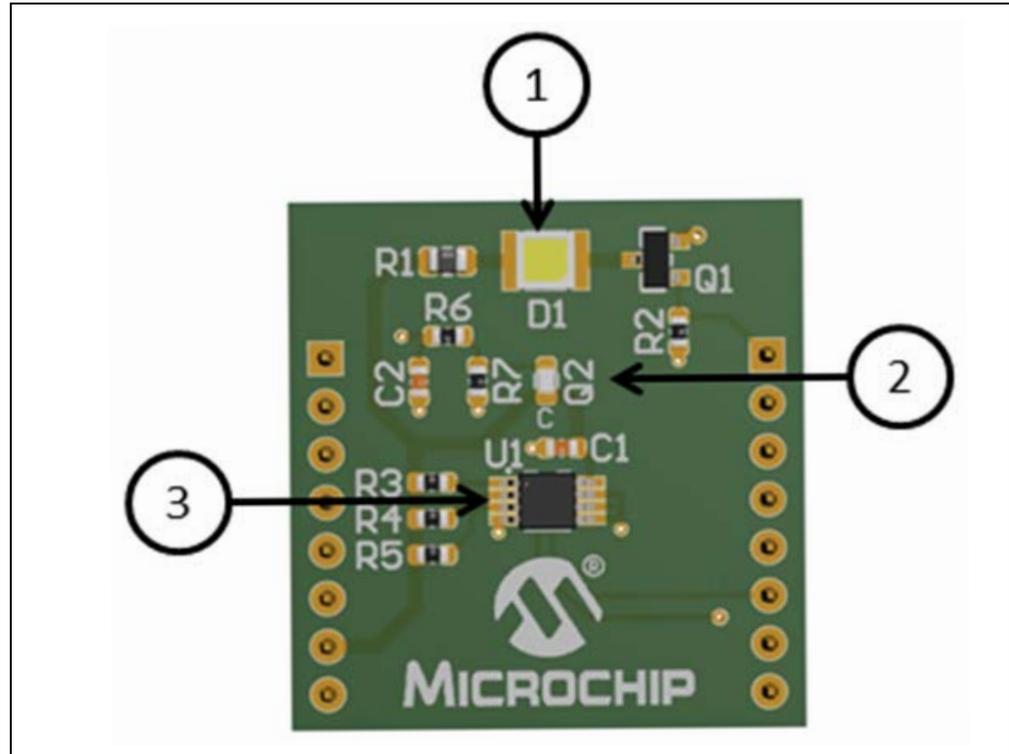
1. D1 1/3 Watt LED, white
2. Q2 phototransistor
3. AT30TS74-XM8M-B Temperature Sensor

NOTES:

Chapter 2. Getting Started with the PoE Development Kit

2.1 GETTING STARTED

The PIC18F67J60 microcontroller on the PIC18 PoE Main Board comes preprogrammed with example demo firmware. The firmware demonstrates the basic functionality of PoE and I/O Starter Adapter in conjunction with a GUI application provided on the Ethernet of Everything web page: https://www.microchip.com/EoE.

In order to run the demo program, a PoE switch and a DHCP server are needed to provide an IP address to the PIC18 PoE Main Board, which are available at PC/electronics outlets. Some PoE switches provide DHCP, while other lower-cost solutions will require a separate server, router, or access point to provide the IP address. To interact with the LED light and sensors (light and temperature) on the I/O Starter Extension, download the GUI application from: https://www.microchip.com/EoE.

2.2 USING THE OUT-OF-BOX DEMO FIRMWARE

The preprogrammed PoE demo firmware (on the PIC18F67J60) can be used to evaluate the PIC18 PoE Main Board, IO Starter Extension, PoE, and CoAP.

1. Attach the PIC18 PoE Main Board to the PoE Programmer Adapter and secure it with the provided stand-offs as shown in Figure 2-1. Verify that the PROG/PoE switch on the PoE Programmer Adapter is set to PoE.

2. Plug the I/O Starter Extension into the PIC18 PoE Main Board as shown in Figure 2-1.

FIGURE 2-1:   **PIC18 PoE MAIN, PROGRAMMER, AND I/O STARTER BOARDS ASSEMBLED**
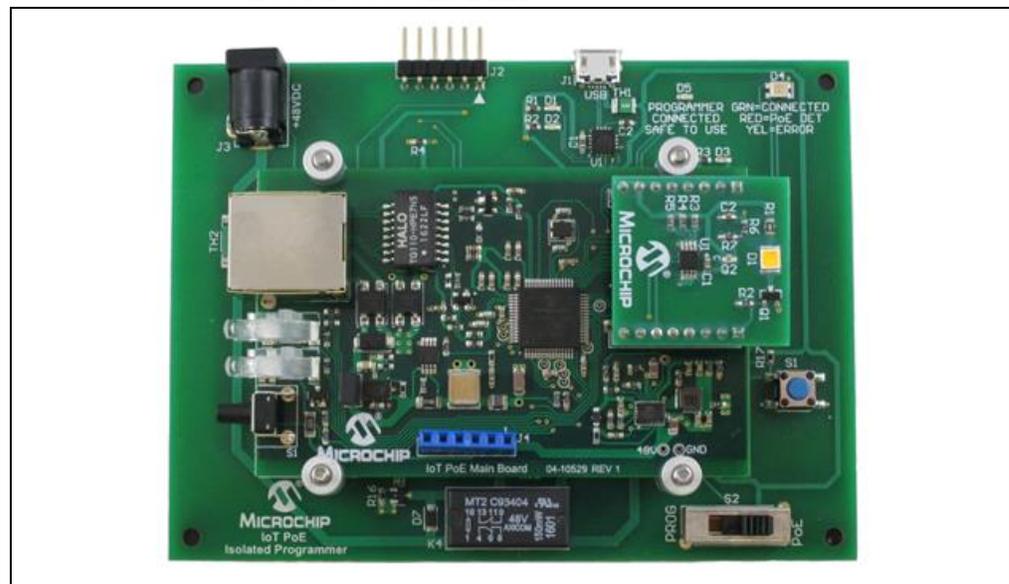
3. Make sure the PoE switch is powered and the IP addresses can be obtained.
4. Plug an Ethernet cable from the PoE Switch to the Ethernet port on the PIC18 PoE Main Board.
5. Verify that D4 on the PoE programmer adapter, the programmer status LED, is red.
6. The Ethernet status LEDs on the main board will blink, indicating activity. Once the TCP/IP Status LED turns amber, the PIC18 PoE main board has an IP address.
7. Now open the GUI application to interact with the I/O starter extension.

2.3   USING THE PoE GUI DEMO

The GUI allows the user to interact with the IO Starter Extension on the PIC18 PoE main board. Once **Section 2.2 "Using the Out-of-Box Demo Firmware"** is completed, the user can read the on-board sensors and control the high-power LED. Figure 2-2 below shows the layout of the GUI.

FIGURE 2-2:   PoE GUI
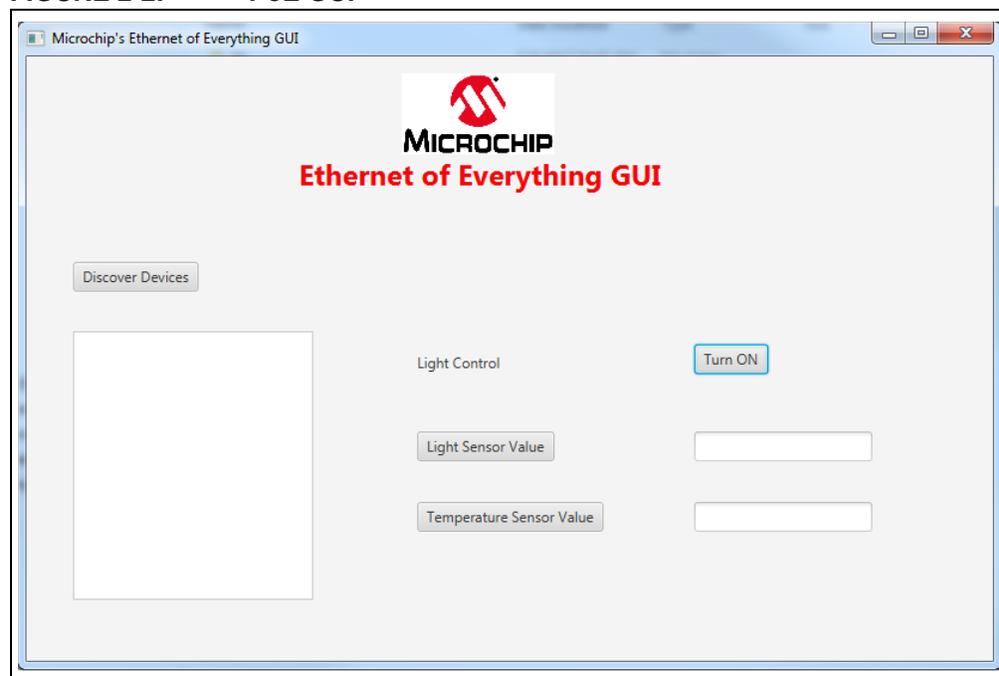
Once the GUI has started, the PIC18 PoE Main Board needs to be discovered by the application. Clicking on the "**Discover Devices**" button in the GUI will start the discovery process. In addition, pressing the push button S1 on the PIC18 PoE Main Board will initiate self-discovery over Ethernet. When the PIC18 PoE Main Board has been discovered, its IP address will be listed in the text box below the "**Discover Devices**" button as shown in Figure 2-3. Selecting the IP address of the PIC18 PoE Main Board will then allow control of the LED and reading of the sensors on the I/O Starter Extension.

FIGURE 2-3: **DISCOVERED DEVICES AND IP ADDRESS**

> **Note:** The IP address in Figure 2-3 above will be different as it is assigned by the router, server, or PoE switch.

The LED is controlled in the "Light Control" section of the GUI. By clicking on the "**Turn ON**" button, the LED on the I/O Starter Extension will light. The button name will change to "**Turn OFF**", so that the LED can be toggled on and off by clicking the button. Figure 2-4 and Figure 2-5 show the **Light Control** button as it is clicked ON and OFF.

FIGURE 2-4: **TURN ON LED**

FIGURE 2-5: **TURN OFF LED**

Reading the sensor values is accomplished by clicking on either the "**Light Sensor Value**" button or the "**Temperature Sensor Value**" button. The light sensor value that is returned is just the raw ADC result. The temperature sensor reading is shown in degrees Celsius. Figure 2-6 shows a sample reading of the light sensor after the button has been clicked.

FIGURE 2-6: **LIGHT SENSOR VALUE**

Figure 2-7 shows a sample reading of the temperature sensor after the button has been clicked.

FIGURE 2-7: **TEMPERATURE SENSOR VALUE**

NOTES:

Chapter 3. Programming

3.1 PROGRAMMING THE PIC18 PoE MAIN BOARD

The demo firmware can be updated as new versions are placed online. To update the firmware on the PIC18 PoE Main Board, it must first be downloaded from the Ethernet of Everything web page at: https://www.microchip.com/EoE. The MPLAB® X IDE or MPLAB IPE along with a programmer (PICkit™, ICD, REAL ICE) will also be required to update the development kit firmware.

Follow the steps below to update the firmware:

1. Start MPLAB X IDE or MPLAB IPE and locate the firmware downloaded for the PIC18 PoE Main Board. Using MPLAB X IDE requires the project, while using the IPE only requires the hex file. Load the project into the IDE or load the hex file into the IPE.
2. Make sure the PoE Switch is powered up and running.
3. Attach the PIC18 Main Board to the PoE Programmer Adapter and secure it with the provided stand-offs, as shown in the Figure 2-2. Verify that the PROG/PoE switch on the Programmer Adapter is set to PoE.
4. Plug the I/O Starter Extension onto the PIC18 PoE Main Board as shown in Figure 2-2.

FIGURE 3-1:   **PIC18 PoE MAIN, PROGRAMMER, AND I/O STARTER BOARDS ASSEMBLED**

5. Plug a Micro-USB cable into the Micro-USB connector on the PoE Programmer Adapter. See Figure 2-3.
6. Plug the PICkit/ICD/REAL ICE programmer into the programming header on the PoE Programmer Adapter. See Figure 2-3.

7. Plug in the +48V wall-mounted power supply into the +48V jack on the PoE Programmer Adapter. See Figure 2-3.

8. Plug an Ethernet cable from the PoE Switch to the Ethernet port on the PIC18 PoE Main Board. See Figure 2-3.

FIGURE 3-2:   BOARDS WITH ALL CONNECTIONS PLUGGED IN
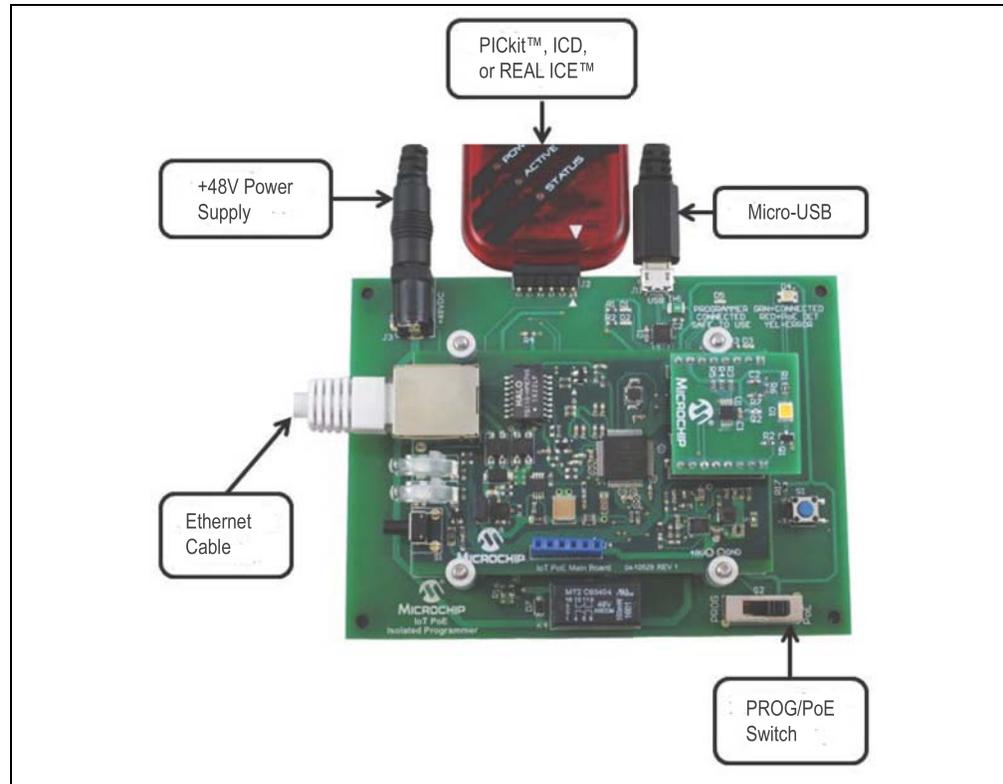
9. Verify that D4 on the PoE Programmer Adapter, the Programmer Status LED, is red.

10. Move PROG/PoE switch on the PoE Programming Adapter from PoE to PROG. Then unplug and re-plug in the Ethernet cable. This disables power from the PoE Switch so as not to cause interference during programming of the microcontroller.

11. Verify that D3, D4, and D5 on the PoE Programmer Adapter are green. This indicates that the PIC18 PoE Main Board has +3.3V power, +48V is being supplied by the wall-mounted power supply, and the PICkit, ICD, or REAL ICE is connected to the PIC18 PoE Main Board. If any of the LEDs is not green, then recheck your connections. Also check that the PROG/PoE Switch was moved to PROG, and that you unplugged then re-plugged in the Ethernet cable.

12. Program the board using the IDE or IPE.

13. Once the PIC18F67J60 has been programmed with the latest firmware, move the PROG/PoE Switch back to PoE. The D4 LED on the PoE Programmer Adapter should switch back to red.

14. The Ethernet status LEDs on the PIC18 PoE Main Board will blink, indicating activity. Once the TCP/IP Status LED turns amber, the PIC18 PoE Main Board has an IP address. Now open the GUI application to interact with the I/O Starter Extension as shown in **Chapter 2. "Getting Started with the PoE Development Kit"**.

Schematics

Appendix A. Schematics

A.1   INTRODUCTION

This appendix contains the PIC18 PoE Development Kit hardware diagrams. The schematic provided in this user's guide are for the DM160230 PIC18 PoE Main Board and the DM160233 I/O Starter Adapter. Information can be found at https://www.microchip.com/EoE.

FIGURE A-1:   **PIC18 PoE MAIN BOARD SCHEMATIC (FIGURE 1 OF 5)**
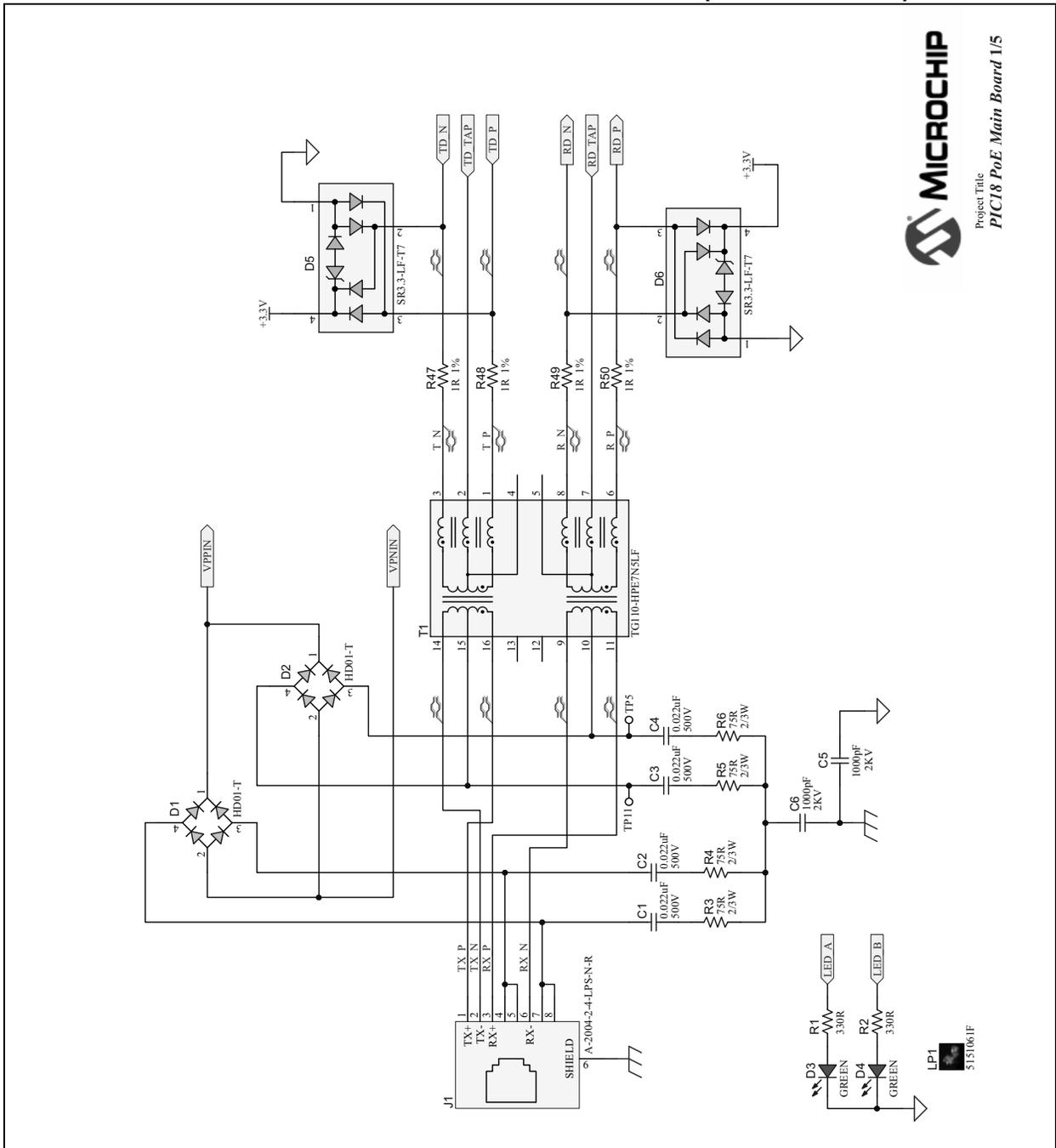
PIC18 PoE Development Kit User's Guide

FIGURE A-2: **PIC18 PoE MAIN BOARD SCHEMATIC (FIGURE 2 OF 5)**
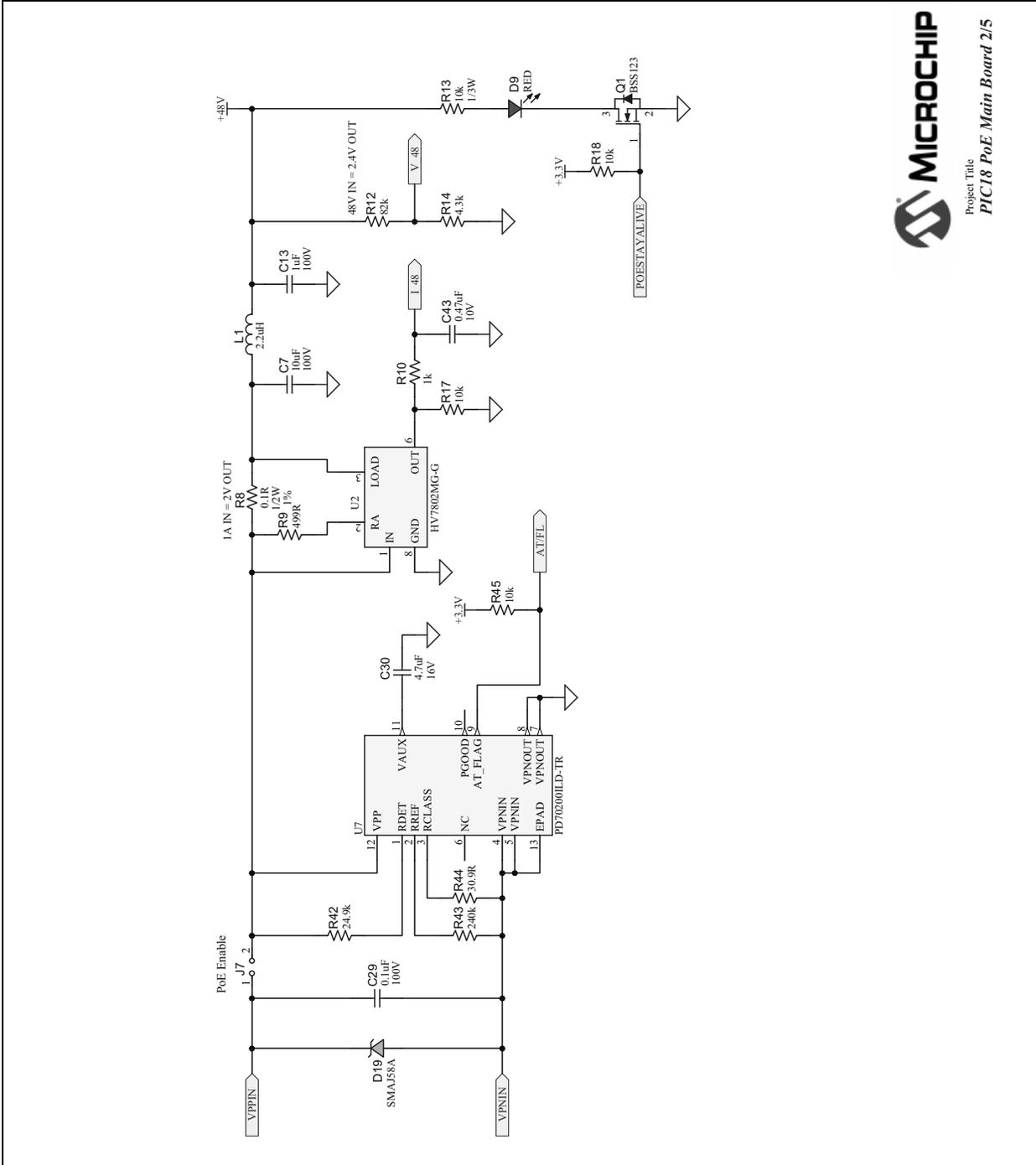
FIGURE A-3:   PIC18 PoE MAIN BOARD SCHEMATIC (FIGURE 3 OF 5)

FIGURE A-4: **PIC18 PoE MAIN BOARD SCHEMATIC (FIGURE 4 OF 5)**

FIGURE A-5:   **PIC18 PoE MAIN BOARD SCHEMATIC (FIGURE 5 OF 5)**

FIGURE A-6:   I/O STARTER EXTENSION SCHEMATIC
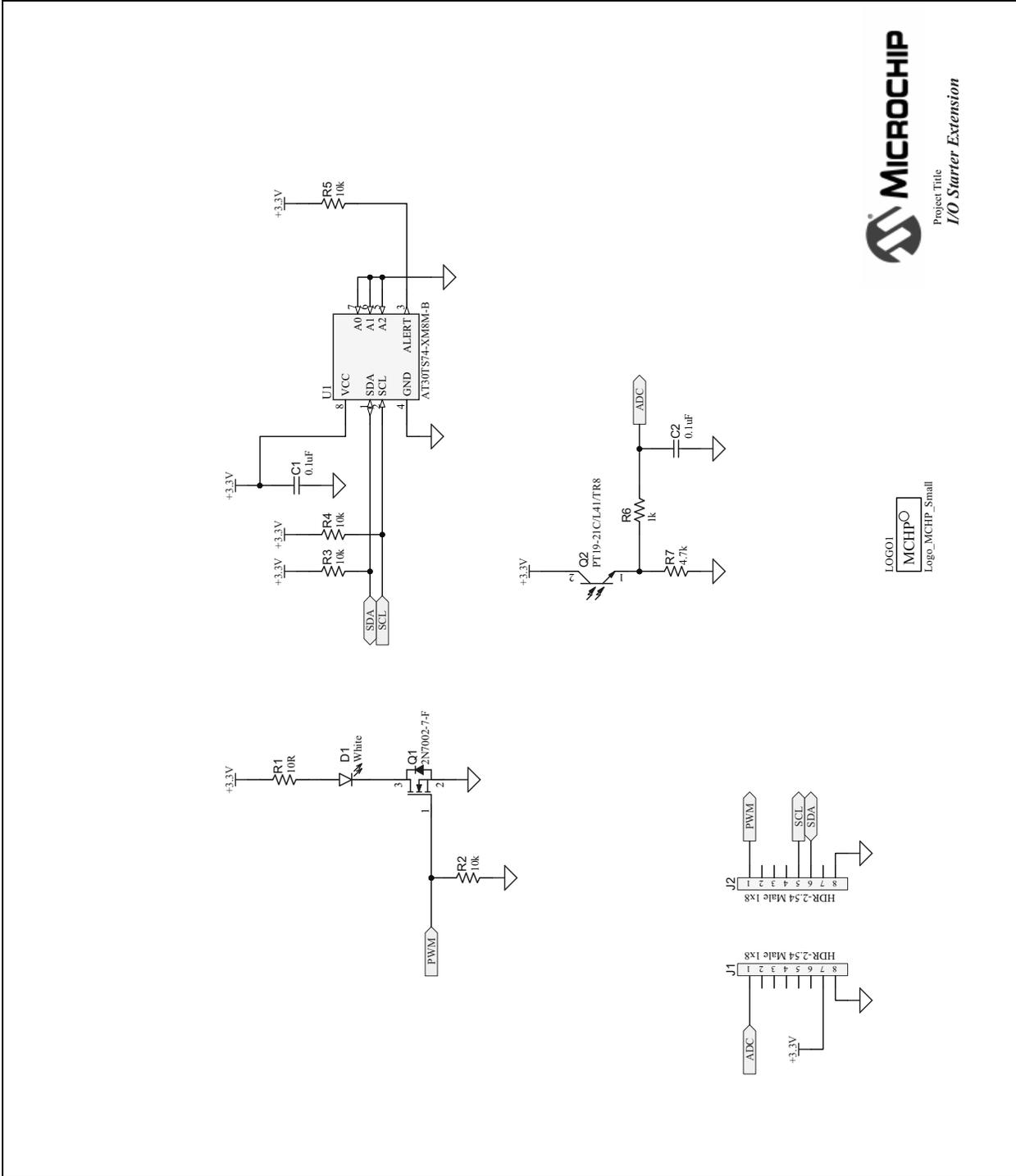
Appendix B. Pin Allocation

B.1 PIC18F67J60 PIN ALLOCATIONS

TABLE B-1: PIC18F67J60 TO J2 PICkit™ SERIAL HEADER (CONTACTS ONLY)

PIC18F67J60 Pins	J2 Pins	Function
31	6	UART TX from PIC® (RC6)
32	1	UART RX to PIC (RC7)
	2	V$_{DD}$
	3	GND
	4	NC
	5	NC

TABLE B-2: PIC18F67J60 TO J3 PROGRAMMING HEADER

PIC18F67J60 Pins	J3 Pins	Function
7	1	$\overline{MCLR}$
37	4	PGD (ICSPDAT) (RB7)
42	5	PGC (ICSPCLK) (RB6)
	2	V$_{DD}$
	3	GND
	6	NC

TABLE B-3: PIC18F67J60 TO J5 HEADER

PIC18F67J60 Pins	J5 Pins	Function
27	1	Analog Input (RA5/AN4)
34	4	SCK (RC3)
35	5	MISO (RC4)
36	6	MOSI (RC5)
59	3	Chip Select (RD1)
60	2	Reset (RD0)
	7	V$_{DD}$
	8	GND

TABLE B-4: PIC18F67J60 TO J6 HEADER

PIC18F67J60 Pins	J6 Pins	Function
5	2	Interrupt (RB2)
11	6	SDA (RF7)

TABLE B-4:   PIC18F67J60 TO J6 HEADER

PIC18F67J60 Pins	J6 Pins	Function
12	5	SCL (RF6)
31	4	TX (RC6)
32	3	RX (RC7)
32	1	PWM (RC2)
	7	NC
	8	GND

TABLE B-5:   PIC18F67J60 ADDITIONAL CONNECTIONS

PIC18F67J60 Pins	Component Connection	Function
3	Switch S1	User Input/Mode (RB0)
16	LED D9 (+48V Status)	POESTAYALIVE Status (RF2)
21	R12/R14 Resistor Divider	V_48 Analog Signal (RA3/AN3)
22	Out Signal from HV7802MG	I_48 Analog Signal (RA2/AN2)
23	LED D4	RX/TX Ethernet Activity (RA1)
24	LED D3	Ethernet Link Status (RA0)
43	Chip Select for AT25M02 Flash	CS_FLASH (RB5)
44	Chip Select for 25AA02E48 MAC	CS_E48
61	LED D10 Red	TCP/IP Status (RE5)
62	LED D10 Green	TCP/IP Status (RE4)
64	AT Flag from PD70200ILD	AT_FLAG Signal (RE2)

The list below indicates all the No Connect (NC) pins on the PIC18F67J60 microcontroller.

The NC pins are: 1, 2, 4, 6, 8, 13, 14, 15, 17, 28, 29, 30, and 63.

Appendix C. References

The references to the Microchip Ethernet of Everything web page and associated application notes, development tools, and Internet Engineering Task Force (IETF) Request for Comments (RFCs) can be found below.

- https://www.microchip.com/EoE
- http://ww1.microchip.com/downloads/en/AppNotes/00001921A.pdf
- http://www.microchip.com/mplab/mplab-code-configurator
- http://www.microchip.com/mplab/mplab-ide-home
- https://www.wireshark.org
- RFC 7252 – The Constrained Application Protocol (CoAP) - IETF Tools
- RFC 7049 – Concise Binary Object Representation (CBOR) - IETF Tools

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