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TC72
Digital Temperature Sensor
PICtail™ Demo Board
User's Guide

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TC72 DIGITAL TEMPERATURE SENSOR PICtail™ DEMO BOARD USER'S GUIDE

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Preface

NOTICE TO CUSTOMERS

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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 “DSXXXXA”, where “XXXX” is the document number and “A” is the revision level of the document.

INTRODUCTION

This chapter contains general information that will be useful to know before using the TC72 Digital Temperature Sensor PICtail™ Demo Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Web Site
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the TC72 Digital Temperature Sensor PICtail™ Demo Board as a development tool. The manual layout is as follows:

- **Chapter 1. “Product Overview”** – Important information about the TC72 Digital Temperature Sensor PICtail™ Demo Board.
- **Chapter 2. “Installation and Operation”**– Includes instructions on how to get started with the TC72 Digital Temperature Sensor PICtail™ Demo Board.
- **Appendix A. “Schematic and Layouts”** – Shows the schematic and layout diagrams for the TC72 Digital Temperature Sensor PICtail™ Demo Board.
- **Appendix B. “Bill Of Materials (BOM)”** – Lists the parts used to build the TC72 Digital Temperature Sensor PICtail™ Demo Board.

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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 | <i>MPLAB® IDE User's Guide</i> |
| | Emphasized text | ...is the <i>only</i> 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 | <u><i>File>Save</i></u> |
| 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 | <i>file.o</i> , where <i>file</i> can be any valid filename |
| Square brackets [] | Optional arguments | mcc18 [options] <i>file</i> [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) { ... } |

RECOMMENDED READING

For more information regarding the TC72 device, the following is recommended reading:

TC72 Data Sheet "Digital Temperature Sensor w/SPI Interface" (DS21743)

This data sheet provides detailed information regarding the TC72 device.

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
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- Technical Support
- Development Systems Information Line

Customers should contact their distributor, representative or field application engineer 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 web site at: <http://support.microchip.com>.

DOCUMENT REVISION HISTORY

Revision B (May 2006)

- Updated Bill of Materials (BOM) to show RoHS-compliant part numbers.

Revision A (June 2004)

- Initial Release of this Document.

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Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the TC72 Digital Temperature Sensor PICTail™ Demo Board and covers the following topics:

- What is the TC72 Digital Temperature Sensor PICTail™ Demo Board?
- What the TC72 Digital Temperature Sensor PICTail™ Demo Board Kit includes

1.2 WHAT IS THE TC72 DIGITAL TEMPERATURE SENSOR PICTAIL™ DEMO BOARD?

The TC72 Digital Temperature Sensor PICTail™ Demo Board demonstrates how to interface the TC72 device to a PICmicro® microcontroller using the PICKit™ 1 Flash Starter Kit as a platform. A PIC16F676 14-pin Flash-based 8-bit CMOS microcontroller device is included with the demo board, which can be used with the PICKit 1 Flash Starter Kit, along with firmware that provides the SPI interface and temperature conversion routines to communicate with the TC72 and convert the serial data to temperature.

The TC72 Digital Temperature Sensor PICTail™ Demo Board can also be used as a “stand-alone” module to quickly add thermal-sensing capability to any existing application. This basic sensor functionality is implemented on a small Printed Circuit Board (PCB) and interfaced via a standard 100 mil header.

1.3 WHAT THE TC72 DIGITAL TEMPERATURE SENSOR PICTAIL™ DEMO BOARD KIT INCLUDES

This TC72 Digital Temperature Sensor PICTail™ Demo Board Kit includes:

- The TC72 Digital Temperature Sensor PICTail™ Demo Board (102-00013)
- TC72 Digital Temperature Sensor PICTail™ Demo Board User's Guide (DS51482)
- AN940, “Interfacing the TC72 Digital Temperature Sensor to a PICmicro® Microcontroller” (DS00940)
- PIC16F676 14-pin Flash-based 8-bit CMOS Microcontroller
- PIC16F676 Firmware (TC72_PICTail.HEX)

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Chapter 2. Installation and Operation

2.1 INTRODUCTION

The TC72 Digital Temperature Sensor PICtail™ Demo Board demonstrates how to interface the TC72 to a microcontroller, for use by the system designer as an example of how to integrate a digital temperature sensor into their system.

2.2 FEATURES

The TC72 Digital Temperature Sensor PICtail™ Demo Board has the following features:

- Small PCB layout
- Standard 100 mil 14-pin header (P1) for easy interface to the PICkit 1 Flash Starter Kit or custom application

2.3 GETTING STARTED

This section describes how to quickly set up the TC72 Digital Temperature Sensor PICtail™ Demo Board and PICkit 1 Flash Starter Kit. A block diagram of the setup is presented in Figure 2-1. Refer to Application Note 940, “*Interfacing the TC72 Digital Temperature Sensor to a PICmicro® Microcontroller*” (DS00940) for detailed information on the TC72 Digital Temperature Sensor PICtail Board and the TC72 PICtail.HEX firmware.

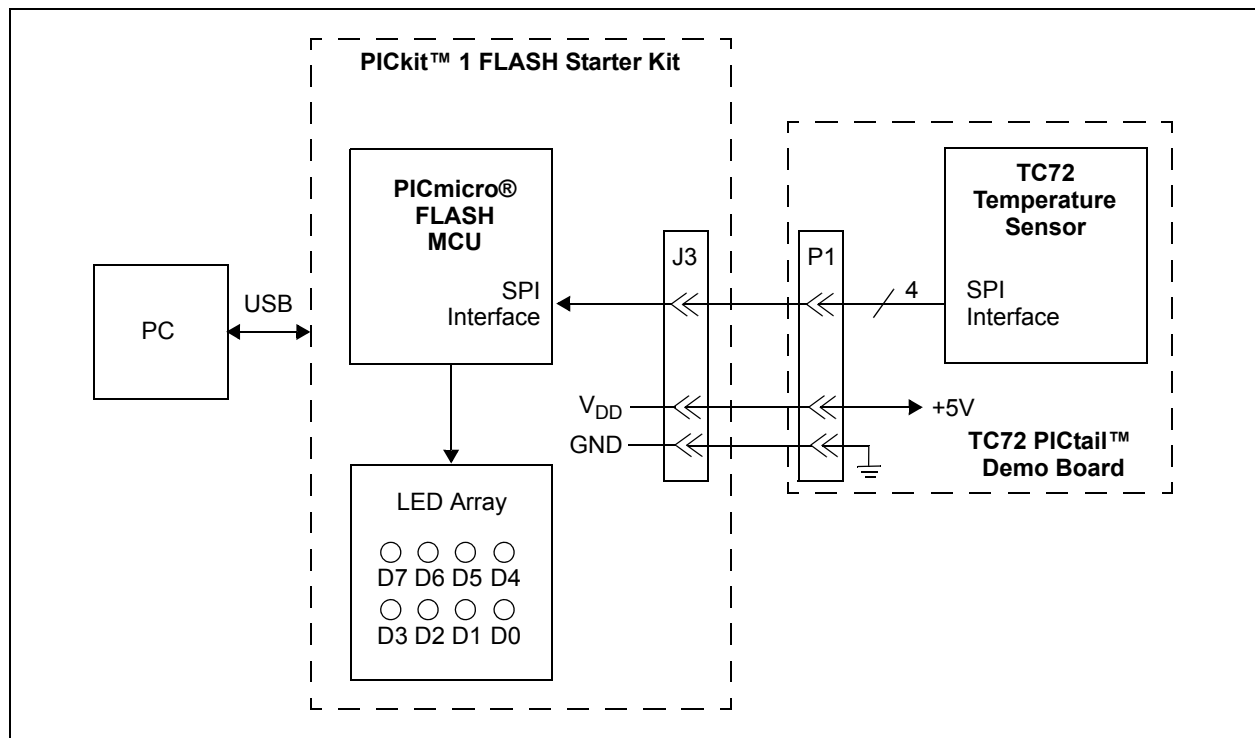


FIGURE 2-1: TC72 Digital Temperature Sensor PICtail™ Demo Board Block Diagram.

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2.3.1 Hardware Setup

1. Connect the P1 header of the TC72 Digital Temperature Sensor PICtail™ Demo Board to the J3 connector on the PICKit 1 Flash Starter Kit board. Refer to Figure 2-2 for proper orientation of the TC72 Digital Temperature Sensor PICtail™ Demo Board and Figure 2-3 for the simplified board schematic.
2. Insert the PIC16F676 into the evaluation socket of the PICKit 1 Flash Starter Kit board.
3. Connect the PICKit 1 Flash Starter Kit USB cable from the USB port of the PC to the USB port (J1) on the PICKit 1 Flash Starter Kit board. +5V power is supplied to the PICKit 1 Flash Starter Kit board via the USB cable. The green **POWER** LED and the red **BUSY** LED will turn on, indicating that power is being supplied to the board.

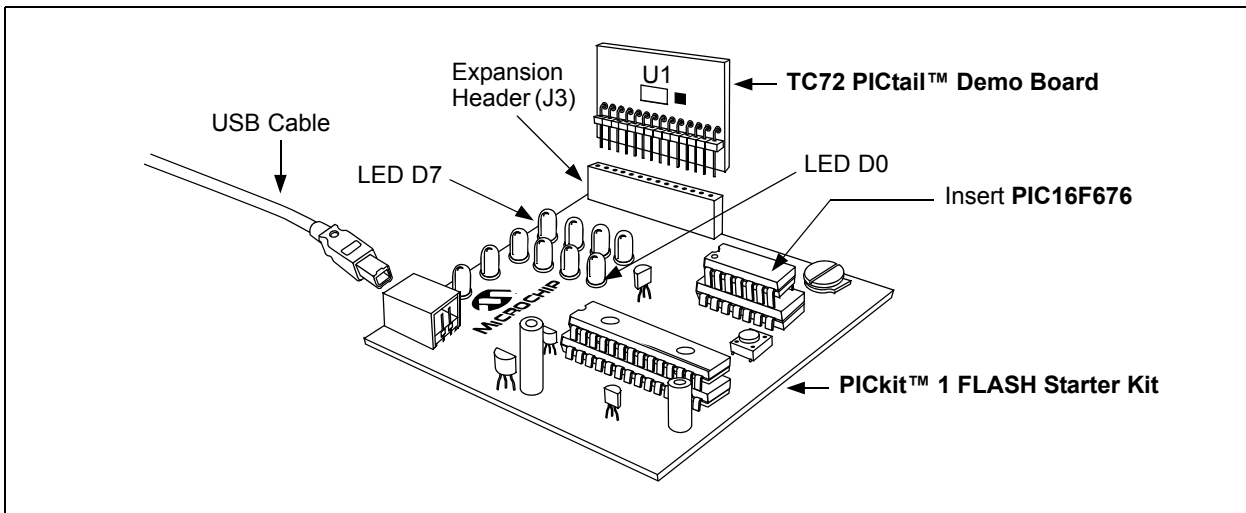


FIGURE 2-2: TC72 Digital Temperature Sensor PICtail™ Demo Board and PICKit™ 1 FLASH Starter Kit.

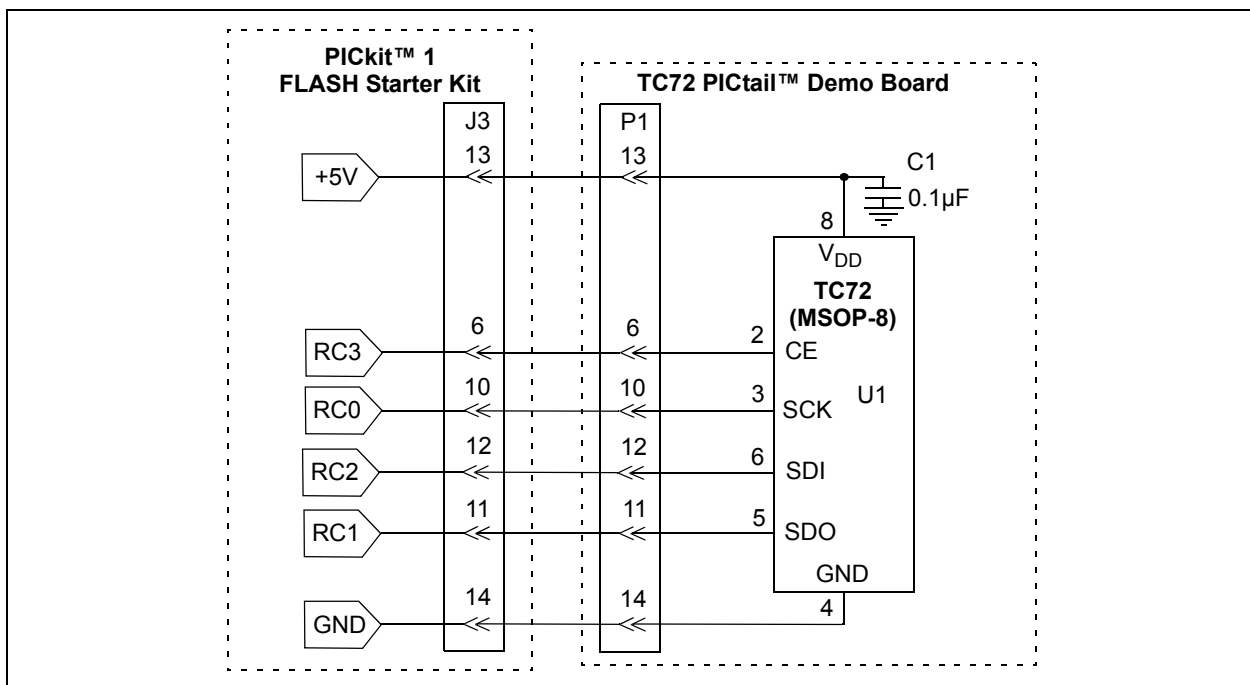


FIGURE 2-3: Simplified TC72 Digital Temperature Sensor PICtail™ Demo Board Schematic.

2.3.2 Programming the PIC16F676

1. Download and install the PICkit 1 Flash Starter Kit software to your PC.
2. Copy the TC72 PICtail.HEX file supplied on the CD that came with this kit to your PC.
3. Once the PICkit 1 Flash Starter Kit is started, the main window will be displayed on the PC as indicated in Figure 2-4.

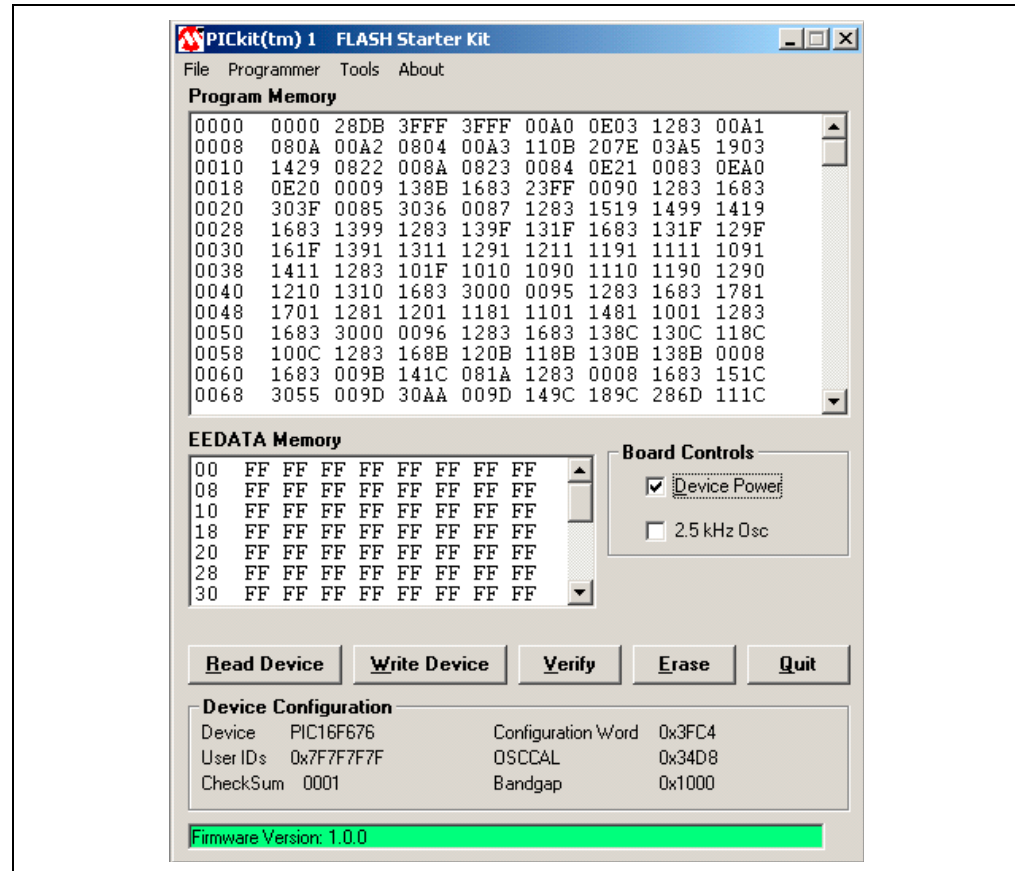


FIGURE 2-4: PICkit™ 1 Flash Starter Kit GUI Window on the PC.

4. Toggle device power off by unchecking the **Device Power** box under **Board Controls** in the PICkit 1 Flash Starter Kit window (Figure 2-4). The **BUSY** LED on the PICkit 1 Flash Starter Kit board will turn off once the device power is turned off.
5. Click on the **Erase** button in the window to ensure that the PIC16F676 device has been erased.
6. From the **File** pull down menu, select **Import HEX**. A file window will appear. Select and open "**TC72 PICtail.HEX**".
7. Click on the **Write Device** button in the PICkit 1 Flash Starter Kit window. The PIC16F676 device will be written to by the TC72 PICtail.HEX firmware. When completed, the status bar at the bottom of the window will indicate **Write Successful**.
8. Toggle the device power on by checking the **Device Power** box under **Board Controls** in the PICkit 1 Flash Starter Kit window. The **BUSY** LED on the PICkit 1 Flash Starter Kit board will turn on once the device power is turned on. Some of the red LEDs (D7-D0) will turn on as well.

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At this point, the PIC16F676 is reading the temperature data from the TC72 and displaying the temperature on the eight red LEDs (D7-D0) on the PICKit 1 Flash Starter Kit board. The ten's digit of the temperature data is represented by bits, D7-D4, with D7 being defined as the Most Significant bit (MSb). The one's digit is defined by bits, D3-D0, with D3 serving as the MSb.

The temperature can be displayed in degrees Fahrenheit or Celsius. The board defaults to the temperature being displayed in Fahrenheit. To display the temperature in Celsius, depress the **SW1** push button switch on the PICKit 1 Flash Starter Kit board. The display will change back to Fahrenheit once the **SW1** push button switch is released.

Table 2-1 provides a list of the LED patterns that correspond to the Binary Code Decimal (BCD) coding representation of the temperature measurement.

TABLE 2-1: BCD CODE REPRESENTATION ON PICKit™ 1 FLASH STARTER KIT LEDES

| Binary | BCD Number | D7 D3 | D6 D2 | D5 D1 | D4 D0 |
|--------|------------|----------|----------|----------|----------|
| 0000 | 0 | OFF | OFF | OFF | OFF |
| 0001 | 1 | OFF | OFF | OFF | ON |
| 0010 | 2 | OFF | OFF | ON | OFF |
| 0011 | 3 | OFF | OFF | ON | ON |
| 0100 | 4 | OFF | ON | OFF | OFF |
| 0101 | 5 | OFF | ON | OFF | ON |
| 0110 | 6 | OFF | ON | ON | OFF |
| 0111 | 7 | OFF | ON | ON | ON |
| 1000 | 8 | ON | OFF | OFF | OFF |
| 1001 | 9 | ON | OFF | OFF | ON |

For example, a temperature reading of 75°F will be displayed by turning on LEDs D6, D5, D4, D2 and D0 (LEDs D7, D3 and D1 will be turned off), as indicated in Figure 2-5.

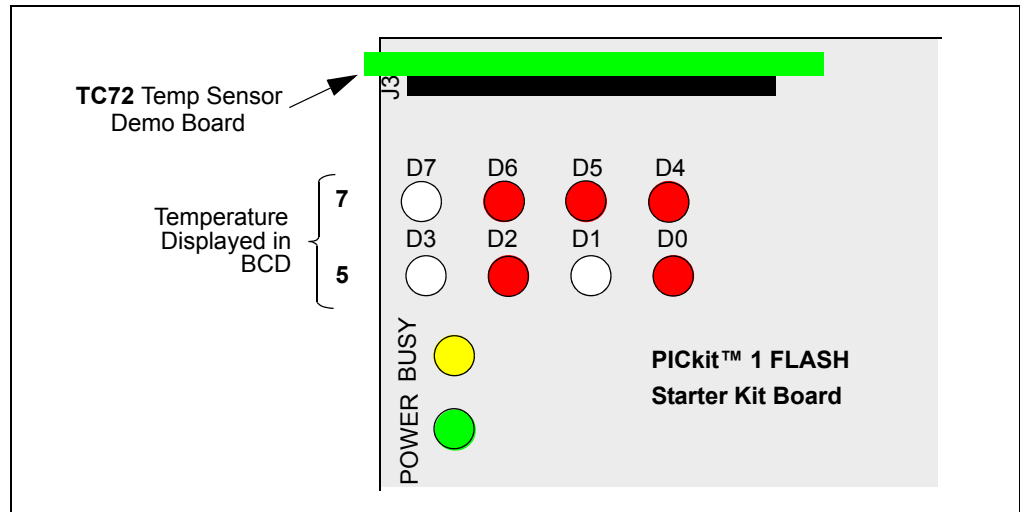


FIGURE 2-5: PICkit™ 1 Flash Starter Kit LED Display of 75°F.

The temperature display will change when the temperature of the TC72 is varied. A simple example of this can be seen by pressing your finger on the TC72 device (U1) on the TC72 Digital Temperature Sensor PICtail™ Demo Board. More dramatic changes can be seen by applying heat to the TC72 with a hair dryer or hot air gun, or by cooling the device down.

Refer to the TC72 data sheet, “*Digital Temperature Sensor with SPI™ Interface*” (DS21743), for more information on the TC72 and Application Note 940, “*Interfacing the TC72 Digital Temperature Sensor to a PICmicro® Microcontroller*” (DS00940) for more information on the TC72 Digital Temperature Sensor PICtail™ Demo Board and the TC72 PICtail.HEX firmware.

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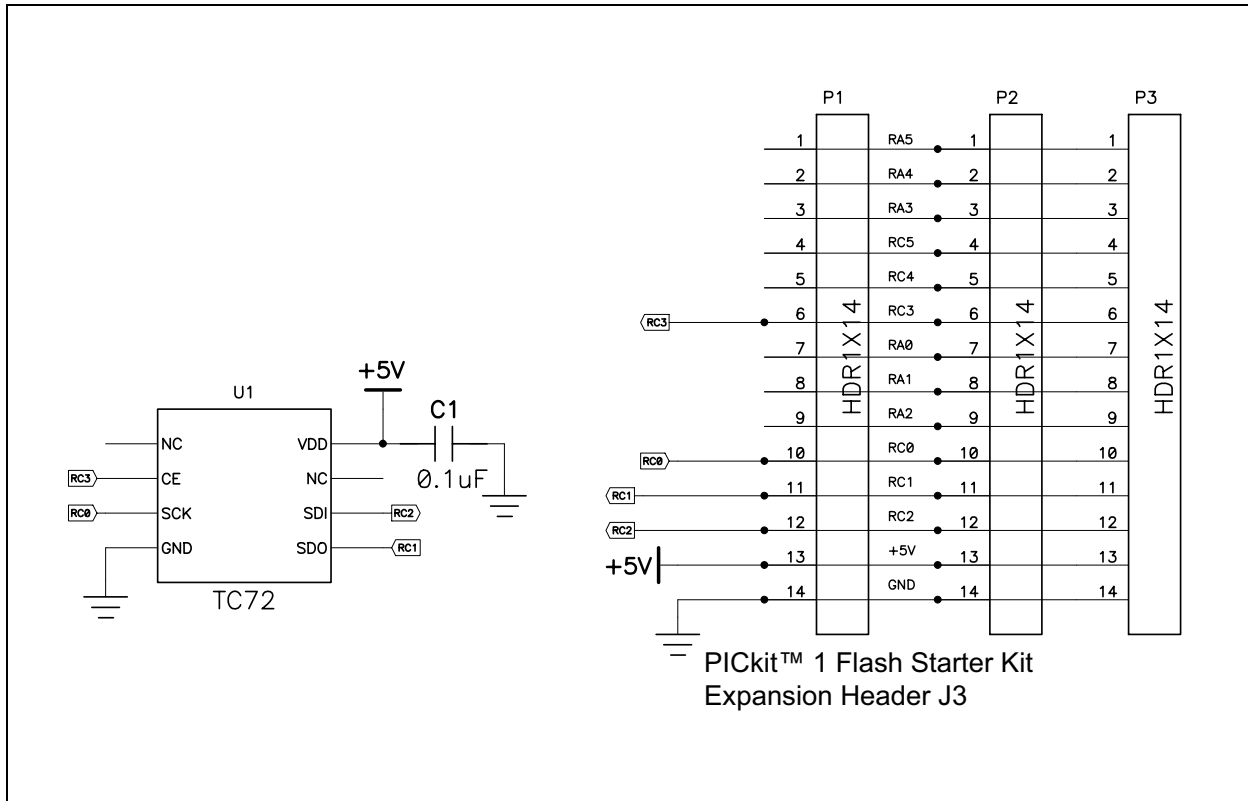
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

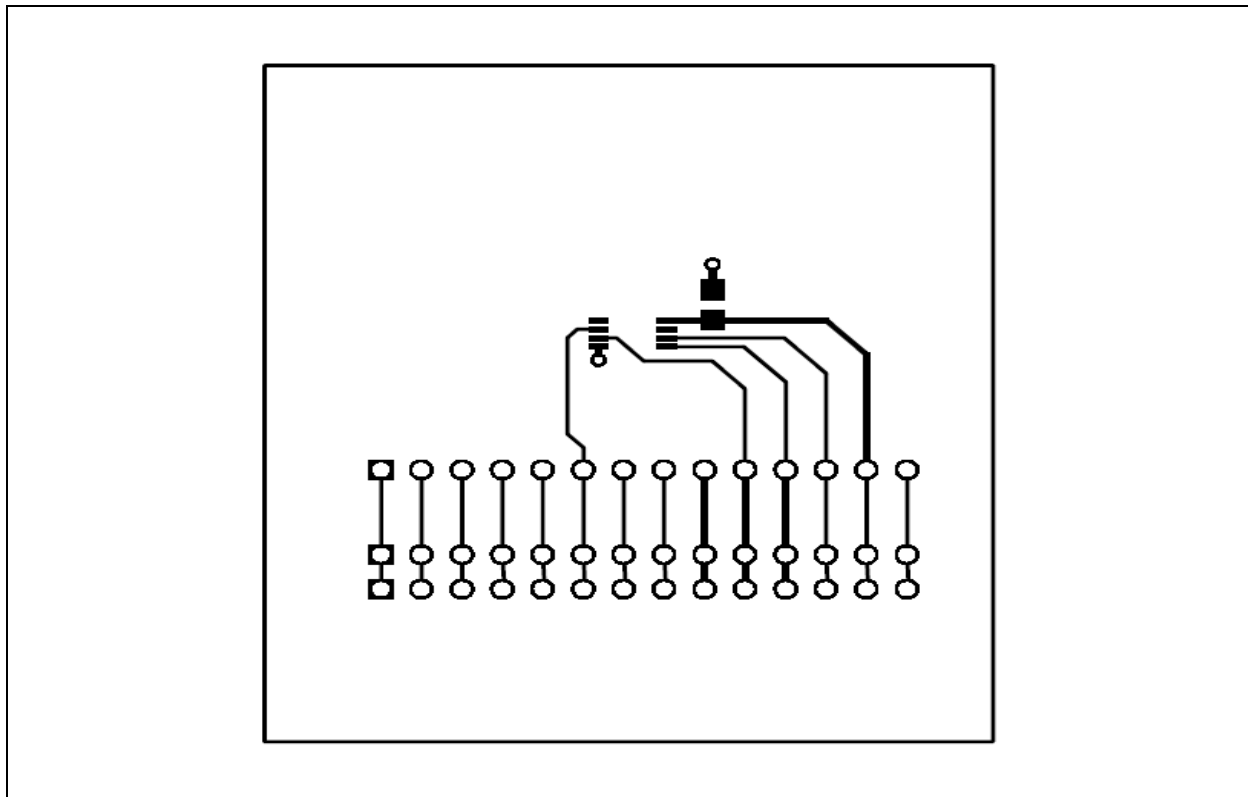
This appendix contains the following schematics and layouts for the TC72 Digital Temperature Sensor PICtail™ Demo Board:

- Board Schematic
- Board - Top Layer
- Board - Silk Screen Layer
- Board - Bottom Layer

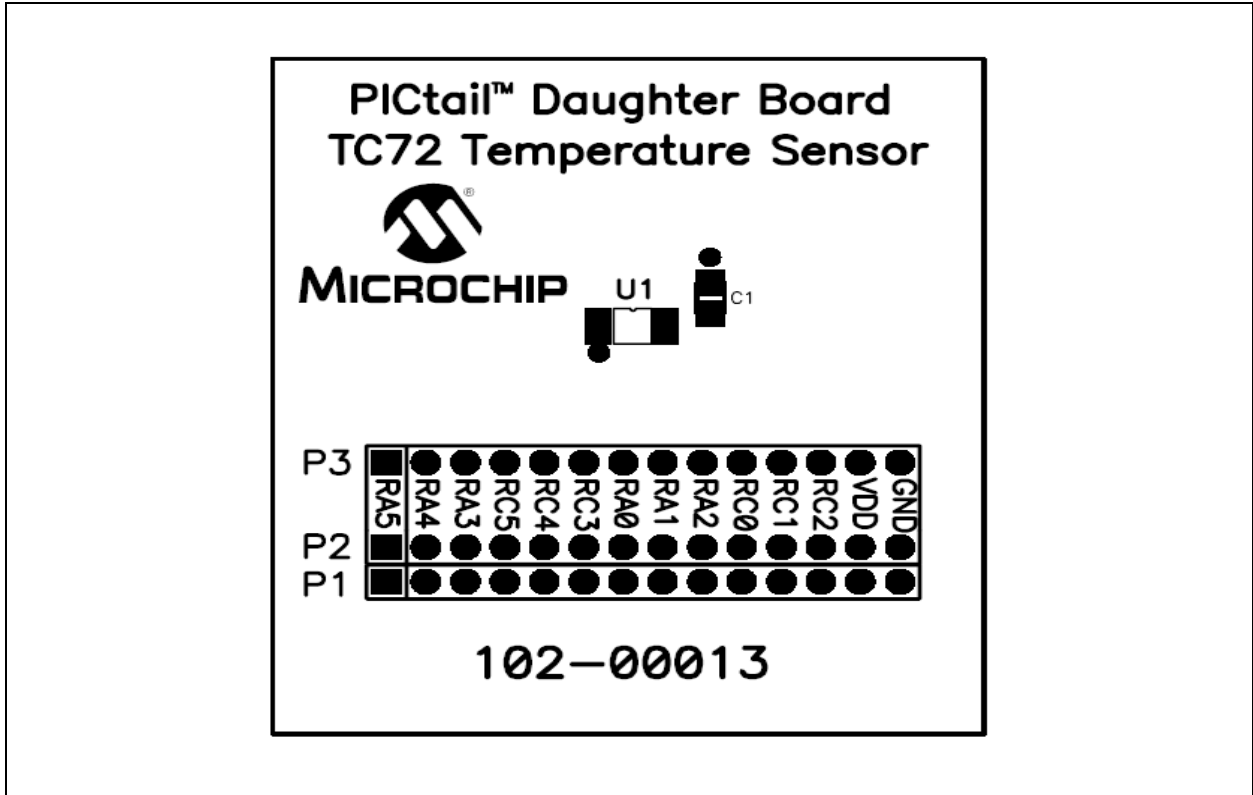
A.2 BOARD SCHEMATIC



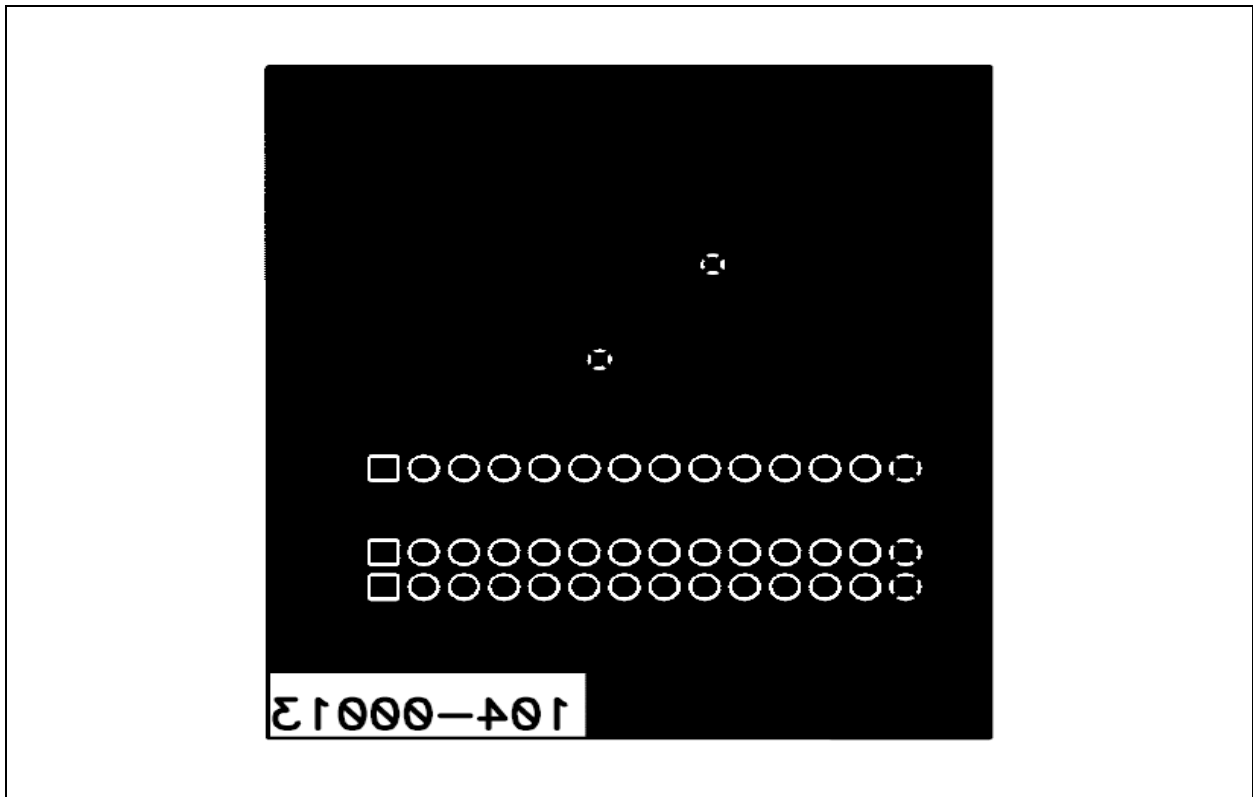
A.3 BOARD - TOP LAYER



A.4 BOARD - SILK SCREEN LAYER



A.5 BOARD - BOTTOM LAYER



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Appendix B. Bill Of Materials (BOM)

| Qty | Designator | Description | Manufacturer | Part Number |
|-----|--|---|---------------------------|---------------|
| 1 | C1 | CAP .1UF 25V CERAMIC X7R 0805 | Panasonic® - ECG | ECJ-2VB1E104K |
| 1 | P1 | CONN HEADER .100 SINGL R/A 14POS | Sullins Electronics Corp. | PEC14SBAN |
| 1 | Programmed PICmicro® Microcontroller | "Packaged in a Separate ESD Bag" PIC16F676 14-Pin Flash-based 8-bit CMOS Microcontroller. | Microchip Technology Inc. | PIC16F676-I/P |
| 1 | PCB | Lead Free RoHS-compliant PCBs | — | 104-00013 |
| 1 | U1 | TC72 Digital Temperature Sensor | Microchip Technology Inc. | TC72-5.0MUA |



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