MICROCHIP

MCP6031
Photodiode PICtail™ Plus
Demo Board
User's Guide

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MCP6031 PHOTODIODE PICtail™ PLUS DEMO BOARD 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 on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP6031 Photodiode PICtail™ Plus 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 MCP6031 Photodiode PICtail™ Plus Demo Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Provides the important information about the MCP6031 Photodiode PICtail™ Plus Demo Board .
- **Chapter 2. "Installation and Operation"** – Covers the installation and operation of the MCP6031 Photodiode PICtail™ Plus Demo Board .
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and board layouts for the MCP6031 Photodiode PICtail™ Plus Demo Board .
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MCP6031 Photodiode PICtail™ Plus Demo Board .

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)` `{ ...` `}`

RECOMMENDED READING

This user's guide describes how to use MCP6031 Photodiode PICtail™ Plus Demo Board . Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

- **MCP6031/2/3/4 Data Sheet,** *"0.9 µA, High Precision Op Amps"* **(DS22041)** - This data sheet provides detailed information regarding the MCP603X Op Amps.
- **AN951,** *"Amplifying High-Impedance Sensors - Photodiode Example"* **(DS00951) -** This application note shows how to condition the current out of a high-impedance sensor. A photodiode detector illustrates the theory.
- *"Signal Chain Design Guide"* **(DS21825)**
- *"Explorer 16 Development Board User's Guide"* **(DS51589)**

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

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 web site at: http://support.microchip.com

DOCUMENT REVISION HISTORY

Revision A (September 2008)

- Initial Release of this Document.

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

The MCP6031 Photodiode PICtail™ Plus Demo Board is described by the following:

- Assembly # : 114-00219
- Order # : MCP6031DM-PCTL
- Name: MCP6031 Photodiode PICtail™ Plus Demo Board

Items discussed in this chapter include:

- MCP6031 Photodiode PICtail™ Plus Demo Board Kit Contents
- MCP6031 Photodiode PICtail™ Plus Demo Board Description

1.2 MCP6031 PHOTODIODE PICtail™ PLUS DEMO BOARD KIT CONTENTS

- MCP6031 Photodiode PICtail™ Plus Demo Board (102-00219)
- Important Information "Read First"
- Analog and Interface Products Demonstration Boards CD-ROM (DS21912). It contains:
    - MCP6031 Photodiode PICtail™ Plus Demo Board User's Guide (DS51763)
    - Firmware files
    - Gerber files

FIGURE 1-1:   *MCP6031 Photodiode PICtail™ Plus Demo Board Kit.*

1.3   MCP6031 PHOTODIODE PICtail™ PLUS DEMO BOARD DESCRIPTION

The MCP6031 Photodiode PICtail™ Plus Demo Board demonstrates how to use a transimpedance amplifier, which consists of MCP6031 high precision op amp and external resistors, to convert photo-current (I_S) to voltage. The circuit was not calibrated for absolute accuracy.

The RC low-pass filter that is implemented in this circuit can remove the high frequency noise and interference from the signal path prior to the analog-to-digital (A/D) conversion.

The PICmicro® on the Explorer 16 Development Board communicates with the MCP6031 Photodiode PICtail™ Plus Demo Board and completes the analog-to-digital conversion.

> **Note:**   For high measurement accuracy, an external stand-alone ADC with higher resolution needs to be used.

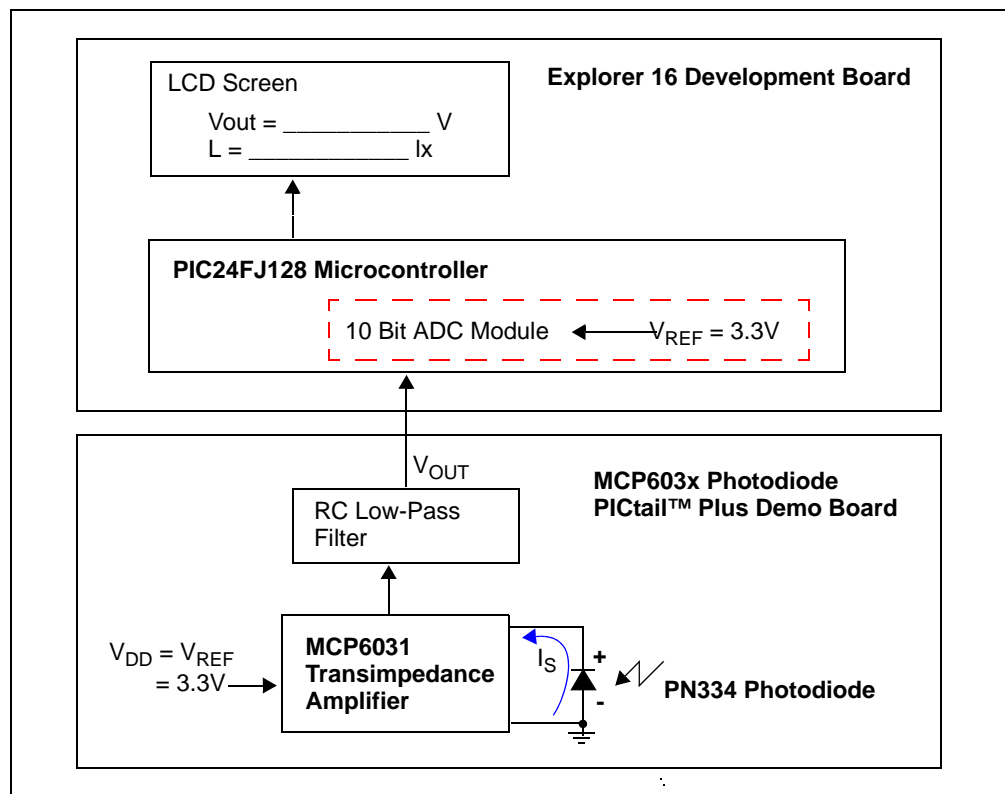The measured voltage (V_{OUT}) and calculated illuminance (L) will be shown on LCD screen on board. The illuminance (L) will be calculated by the equation:

EQUATION 1-1:

$$L = illuminance\ (l_x)$$
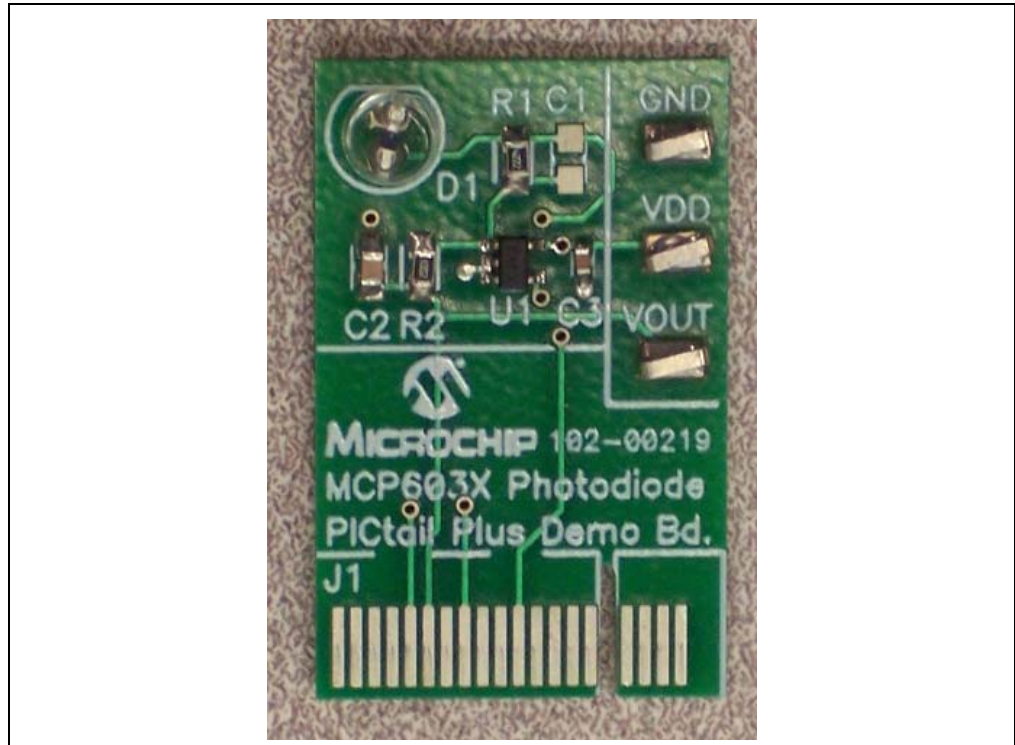$$= (V_{OUT}/R_1)(10000\ l_X\ /70\ \mu A)$$

Figure 1-2 shows the block diagram of the MCP6031 Photodiode PICtail™ Plus Demo Board .

FIGURE 1-2:   *MCP6031 Photodiode PICtail™ Plus Demo Board Function Block Diagram.*

Figure 1-3 shows the top view of the MCP6031 Photodiode PICtail™ Plus Demo Board.

FIGURE 1-3: *Top view of MCP6031 Photodiode PICtail™ Plus Demo Board*

Figure 1-4 shows the circuit diagram of MCP6031 Photodiode PICtail™ Plus Demo Board. C_1 is for compensation purpose and no need for the board. It may be needed when MCP6031 is replaced by the other Microchip's op amp.

The DC output voltage due to the source photo-current will be $V_{OUT} = I_S R_1$, where R_1 is the feedback resistor. The op amp will contribute a DC offset voltage, $V_{OS} + I_B R_1$, to the output, where V_{OS} is the op amp's input offset voltage and I_B is the op amp's input bias current. Select the value of R_1 to give a high gain to I_S. Usually, this gain is high enough to use most of the op amp's output voltage swing when I_S is at its extreme values. The op amp needs to have V_{OS} and I_B low enough to not cause a large DC offset. That is the reason why op amp MCP6031 is selected.
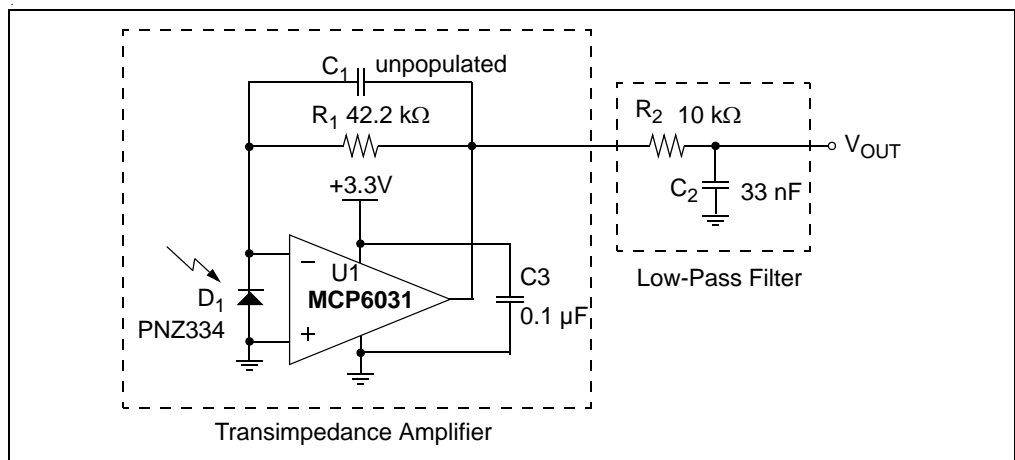
FIGURE 1-4: *MCP6031 Photodiode PICtail™ Plus Demo Board Circuit Diagram.*

For the design approach of this board, please refer to **AN951,** *"Amplifying High-Impedance Sensors - Photodiode Example"* **(DS00951)** as reference resource. This application note discusses the analog conditioning circuit used for high-impedance sensors that act like current sensors. The design approach illustrated in this application note, using op amps, is broken down into three design steps: DC, stability compensation, closed-loop gain and noise reduction. A design using a PIN photodiode (light detector) illustrates the principles discussed. Measurement results are provided to support the theory presented. The last sections of this application note contain supplemental information.

MCP6031 Photodiode PICtail™ Plus Demo Board has the following features:

• Supports Microchip MCP6031 high precision op amp
• Uses a transimpedance amplifier as sensor conditioning circuit
• Uses a PIN photodiode (PNZ334) as light detector
• Test points for connecting lab equipment

Chapter 2. Installation and Operation

2.1   INTRODUCTION

This chapter shows how to set up the MCP6031 Photodiode PICtail™ Plus Demo Board and explore the operation of a light sensing application.

Items discussed in this chapter include:

• Required Tools
• MCP6031 Photodiode PICtail™ Plus Demo Board Set-Up
• MCP6031 Photodiode PICtail™ Plus Demo Board Operation

2.2   REQUIRED TOOL

• Explorer 16 Development Board

2.3   MCP6031 PHOTODIODE PICtail™ PLUS DEMO BOARD SET-UP

Insert the MCP6031 Photodiode PICtail™ Plus Demo Board into the Explorer 16 Development Board as shown in Figure 2-1. An exploded view is shown in the Figure 2-2.
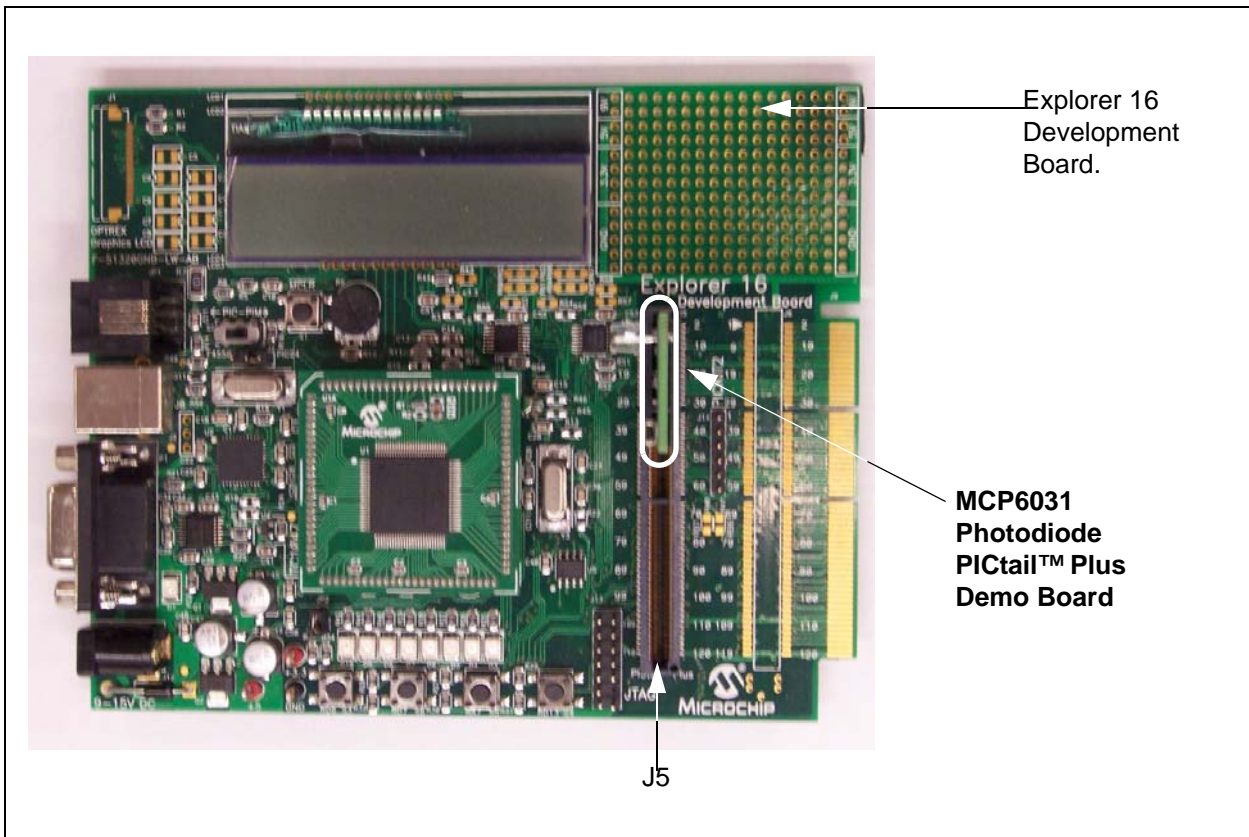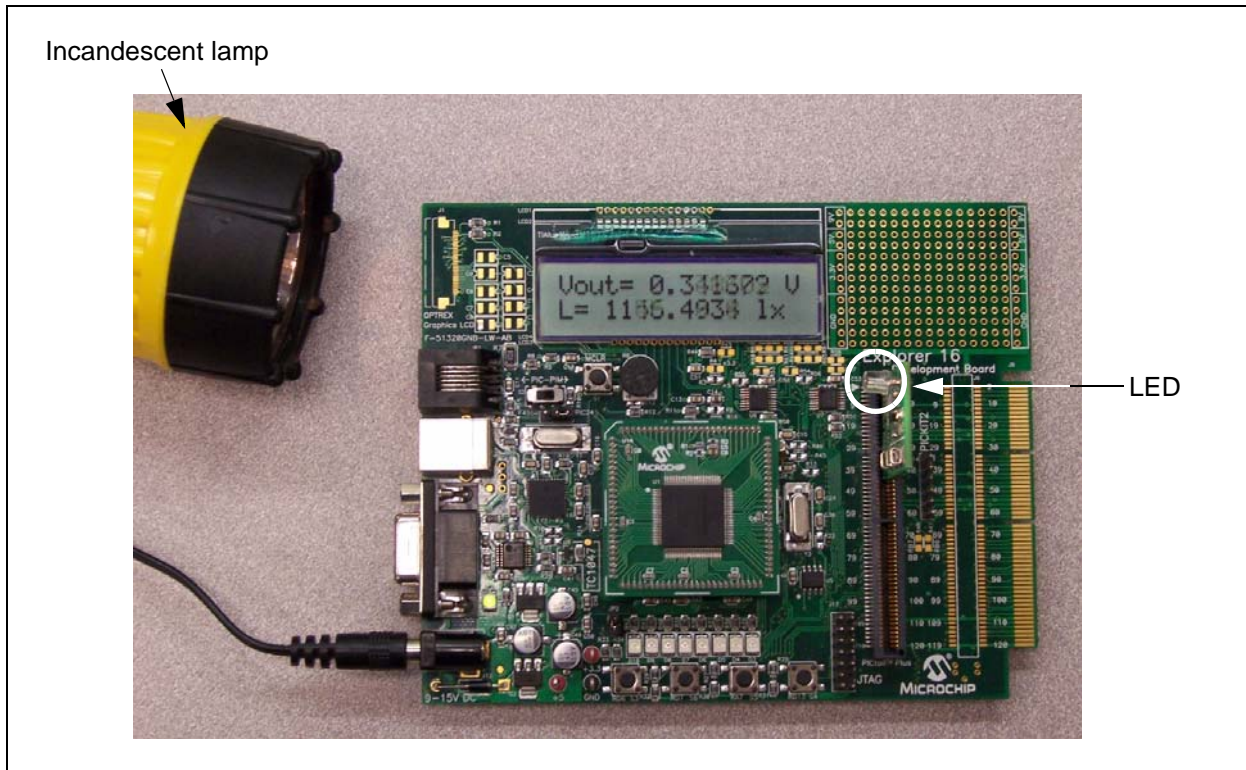

FIGURE 2-1:   *MCP6031 Photodiode PICtail™ Plus Demo Board Set-Up.*

2.4   MCP6031 PHOTODIODE PICtail™ PLUS DEMO BOARD OPERATION

Figure 2-2 shows data taken near an incandescent lamp powered by a battery.

FIGURE 2-2:   *MCP6031 Photodiode PICtail™ Plus Demo Board Operation.*

Appendix A. Schematic and Layouts
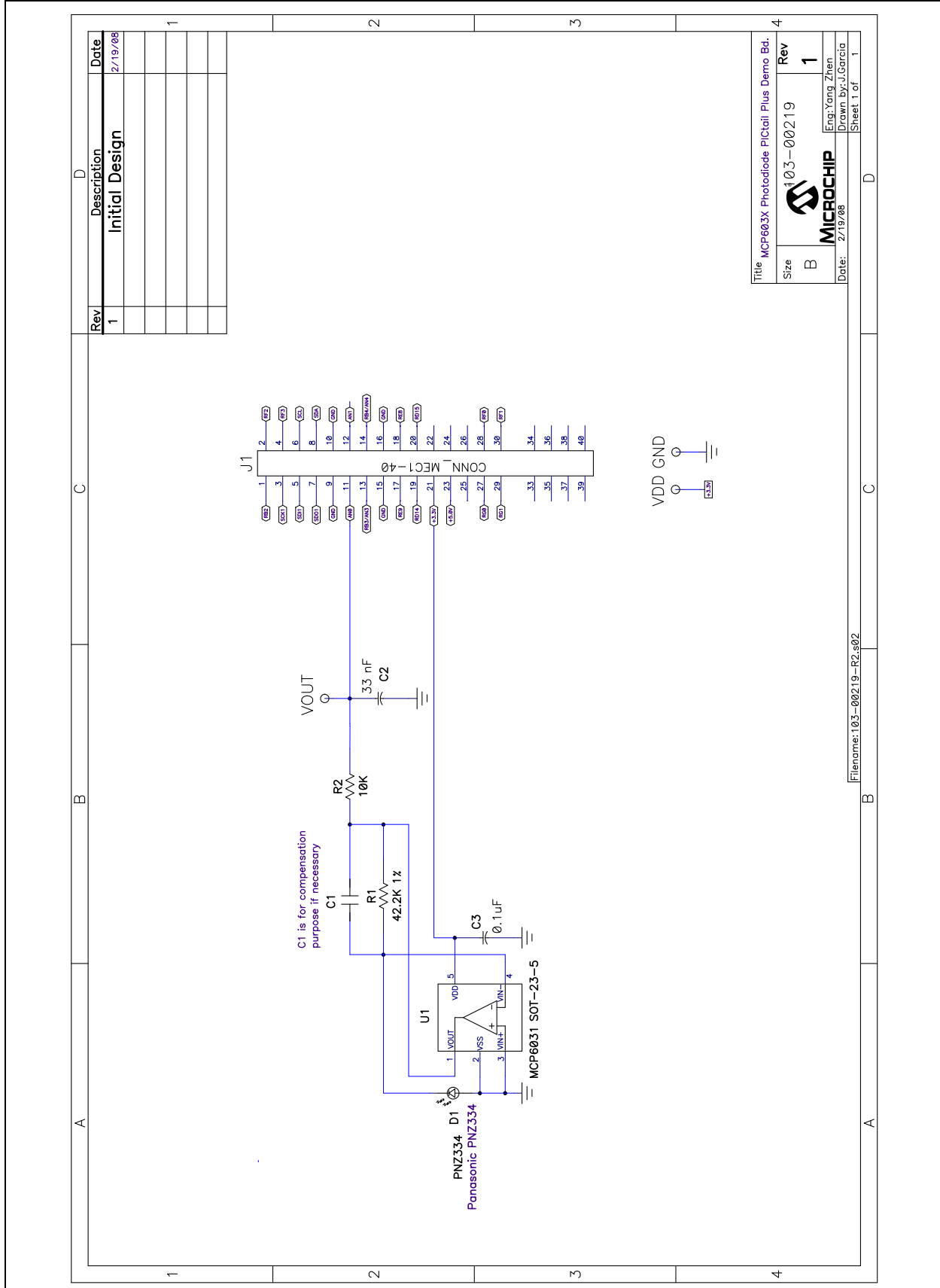
A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the MCP6031 Photodiode PICtail™ Plus Demo Board :
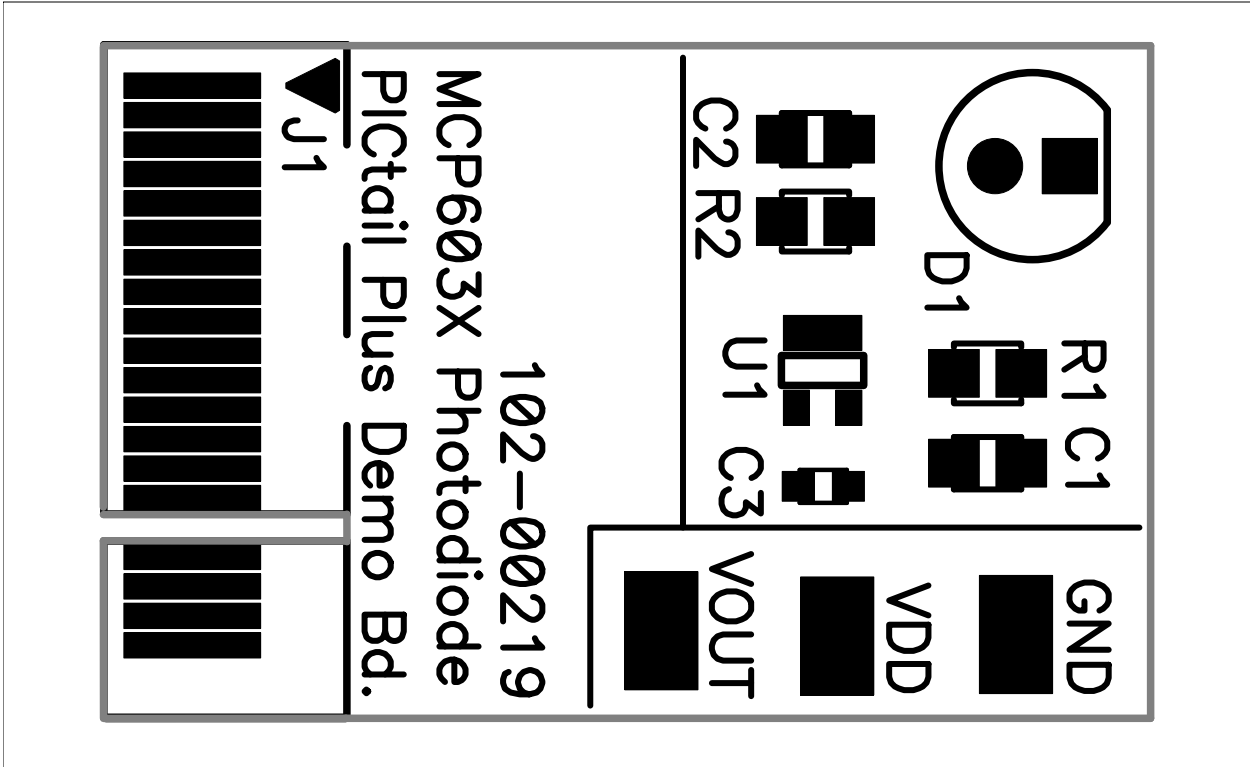
- Board – Schematic
- Board – Top Silk Layer
- Board - Top Metal And Top Silk Layers
- Board – Bottom Metal Layer
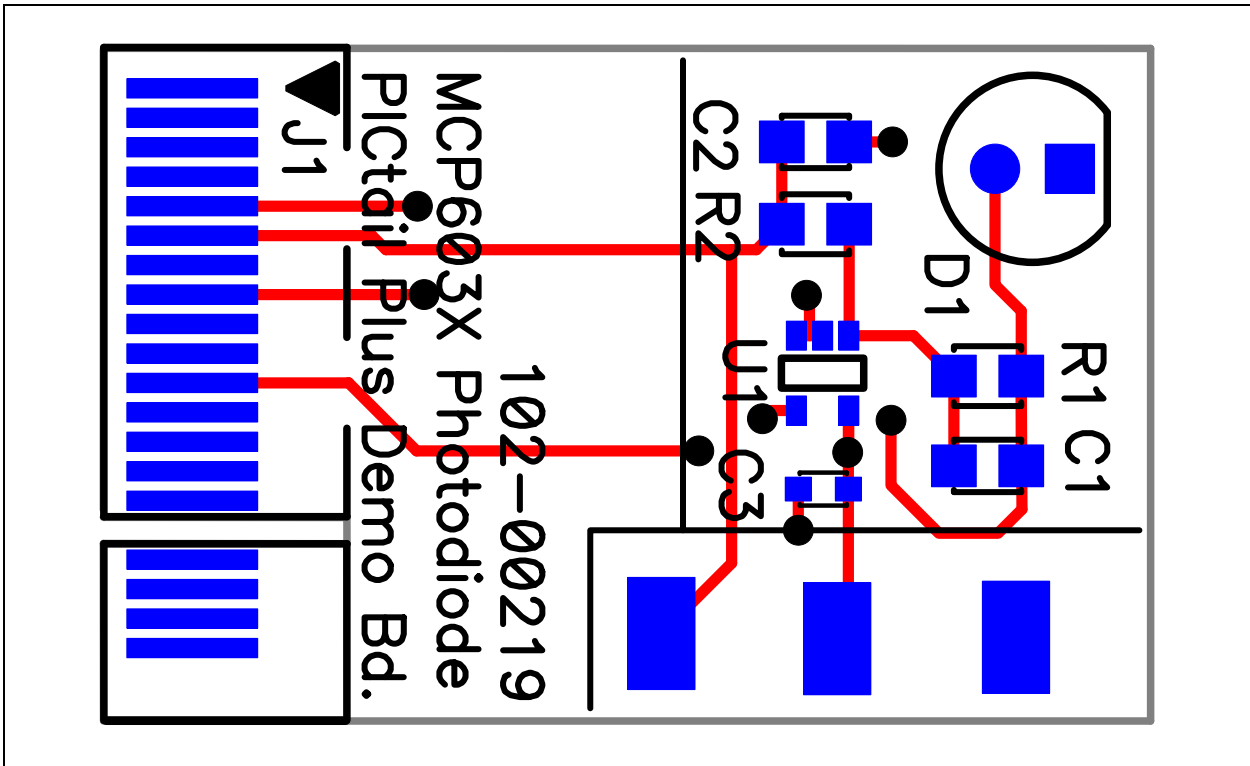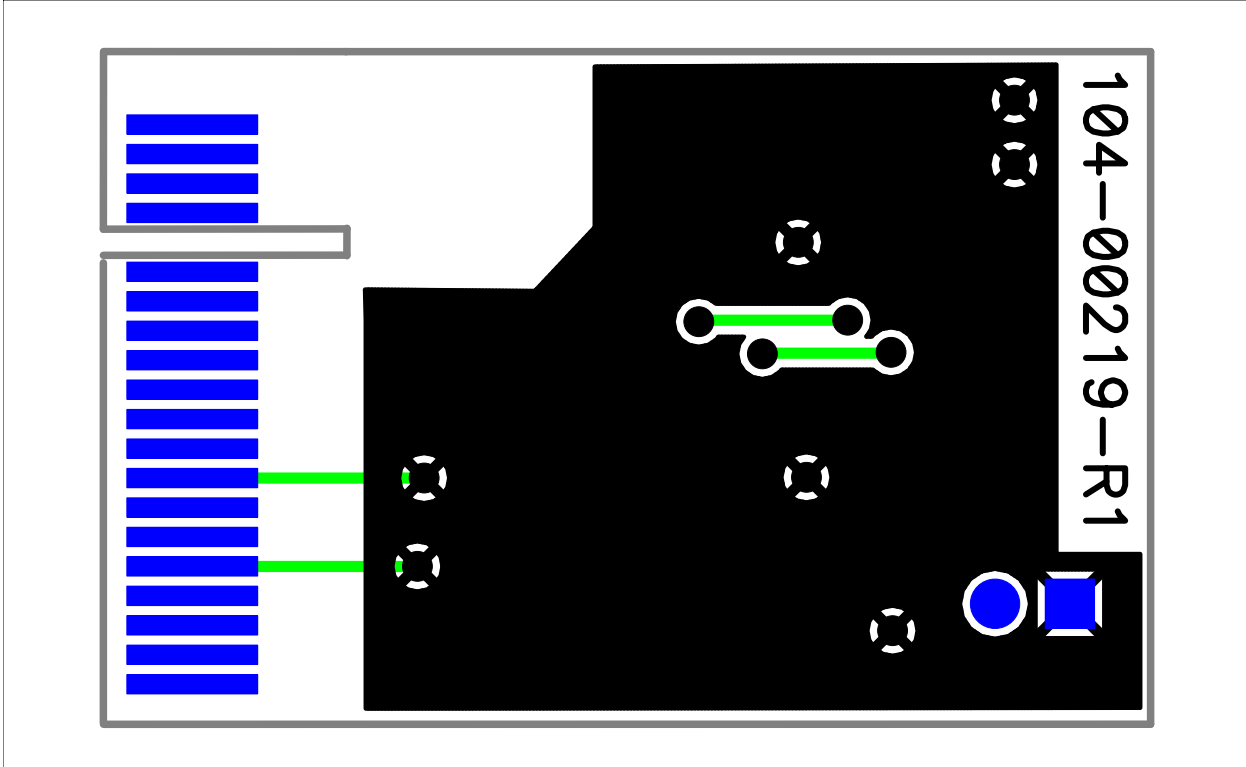
A.2 BOARD - SCHEMATIC

A.3 BOARD - TOP SILK LAYER

A.4 BOARD - TOP METAL AND TOP SILK LAYERS

A.5   BOARD - BOTTOM METAL LAYER

Appendix B. Bill of Materials (BOM)

TABLE B-1:   BILL OF MATERIALS (102-00219)

Qty	Reference	Description	Manufacturer	Part Number
1	C2	CAP 33,000PF 50V CERM X7R 0805	Panasonic®	ECJ-2VB1H333K
2	C3, C4	CAP .1UF 25V CERAMIC X7R 0805	Panasonic®	ECJ-2VB1E104K
1	C5	CAP 1.0UF 16V CERAMIC X7R 0805	Kemet® Electronics Corp.	C0805C105K4RACTU
1	D1	PIN PHOTODIODE	Panasonic®	PNZ334
1	R1	RES 42.2K OHM 1/10W 1% 0805 SMD	Panasonic®	ERJ-6ENF4222V
1	R2	RES 10.0K OHM 1/10W 1% 0805 SMD	Panasonic®	ERJ-6ENF1002V
3	TP1—TP3	TEST POINT PC COMPACT SMT	Keystone Electronics	5016
1	U1	MCP6031, SOT-23-5	Microchip Technology Inc.	MCP6031T-E/OT

Note: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

TABLE B-2:   BILL OF MATERIALS - UNPOPULATED PARTS

Qty	Reference	Description	Manufacturer	Part Number
1	C1	Not Populated when shipped to customer	—	—

Note: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

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