MICROCHIP MCP6031 Photodiode PICtail Plus Demo Board User Guide

MCP6031 Photodiode PICtail Plus Demo Board
User Guide
MCP6031
Photodiode PICtail™ Plus
Demo Board User's Guide

DS51763A

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Preface

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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	MPLAftw 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.	41:10010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <n>
Courier New font:		
Plain Courier New	Sample source code	!define START
	Filenames	autoexec.bat
	File paths	c: \mccle \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 fil ename
Square brackets [ ]	Optional arguments	mcc18 [options] file [options]
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments: an OR selection	errorlevel (01 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)

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- **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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- 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.

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 (IS) 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 (VOUT) and calculated illuminance (L) will be shown on LCD screen on board. The illuminance (L) will be calculated by the equation:

EQUATION 1-1:

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

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

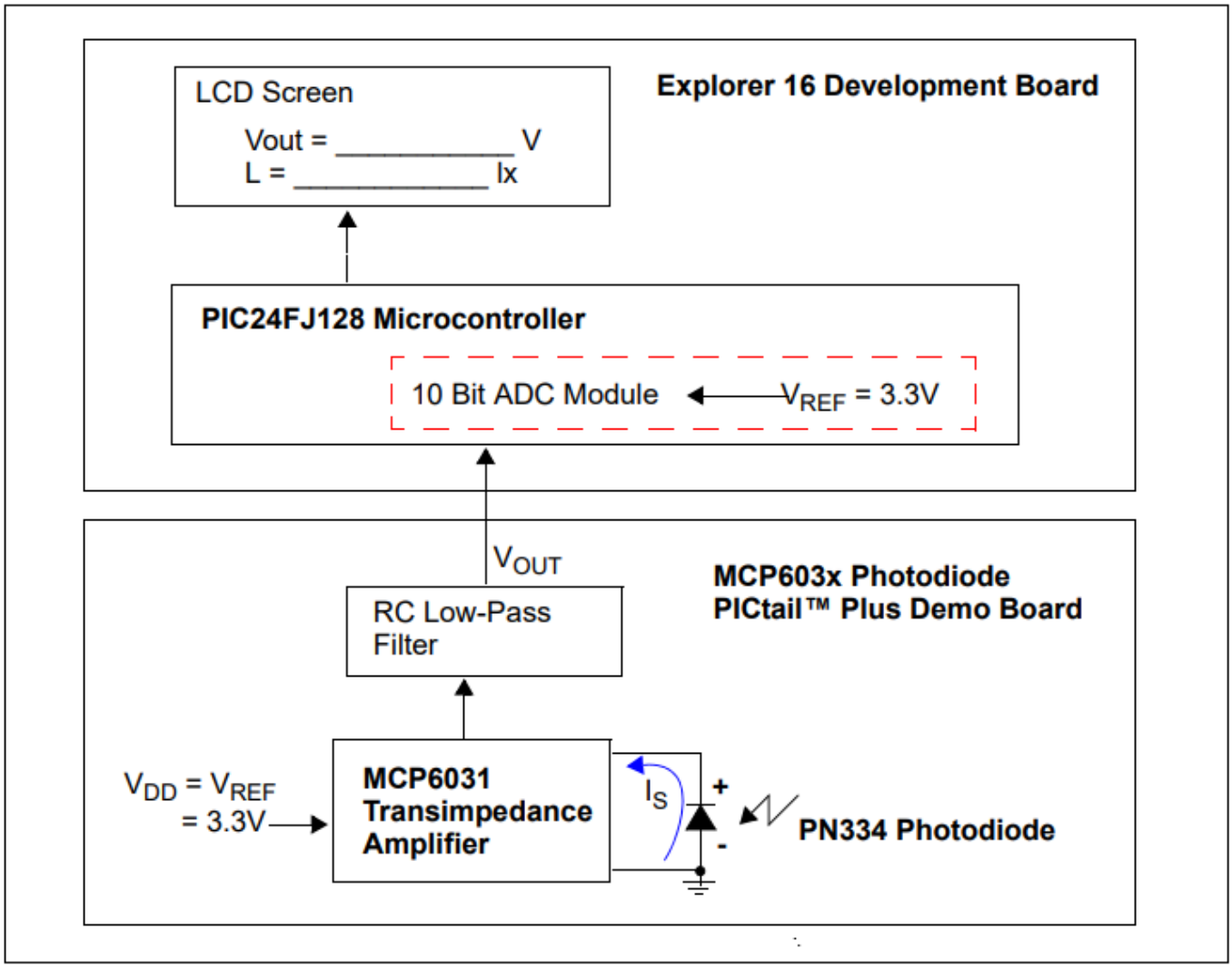


FIGURE 1-2: *MCP6031 Photodiode PICtail™ Plus Demo Board Function Block Diagram.*

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

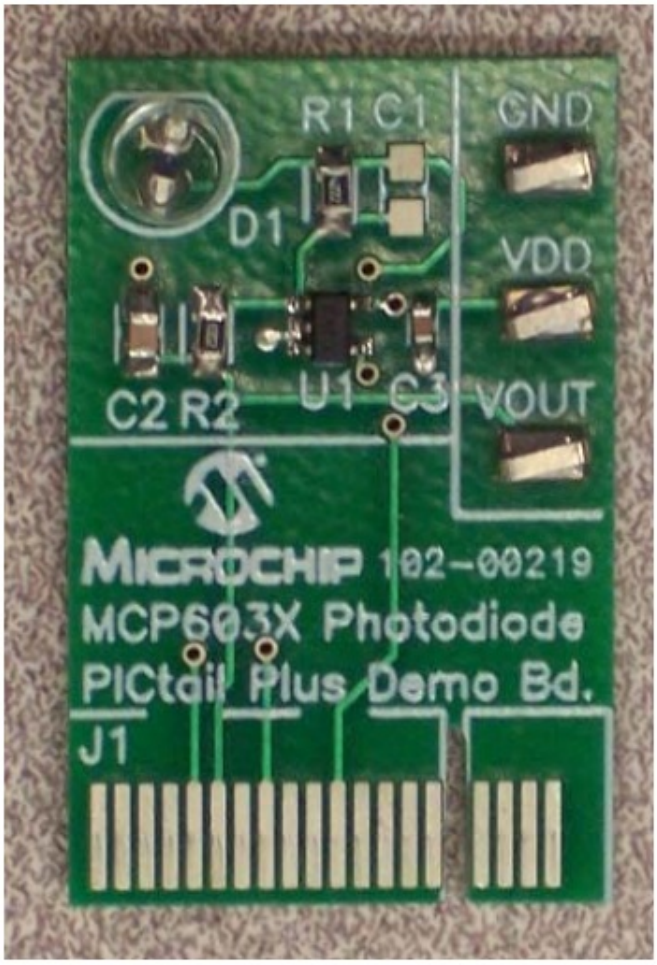


FIGURE 1-3: *Top view of MCP6031 Photodiode PICtail™ Plus Demo Board*

Figure 1-4 shows the circuit diagram of MCP6031 Photodiode PICtail™ Plus Demo Board. C1 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 VOUT = ISR1, where R1 is the feedback resistor. The op amp will contribute a DC offset voltage, VOS + IBR1, to the output, where VOS is the op amp's input offset voltage and IB is the op amp's input bias current. Select the value of R1 to give a high gain to IS. Usually, this gain is high enough to use most of the op amp's output voltage swing when IS is at its extreme values. The op amp needs to have VOS and IB low enough to not cause a large DC offset. That is the reason why op amp MCP6031 is selected.

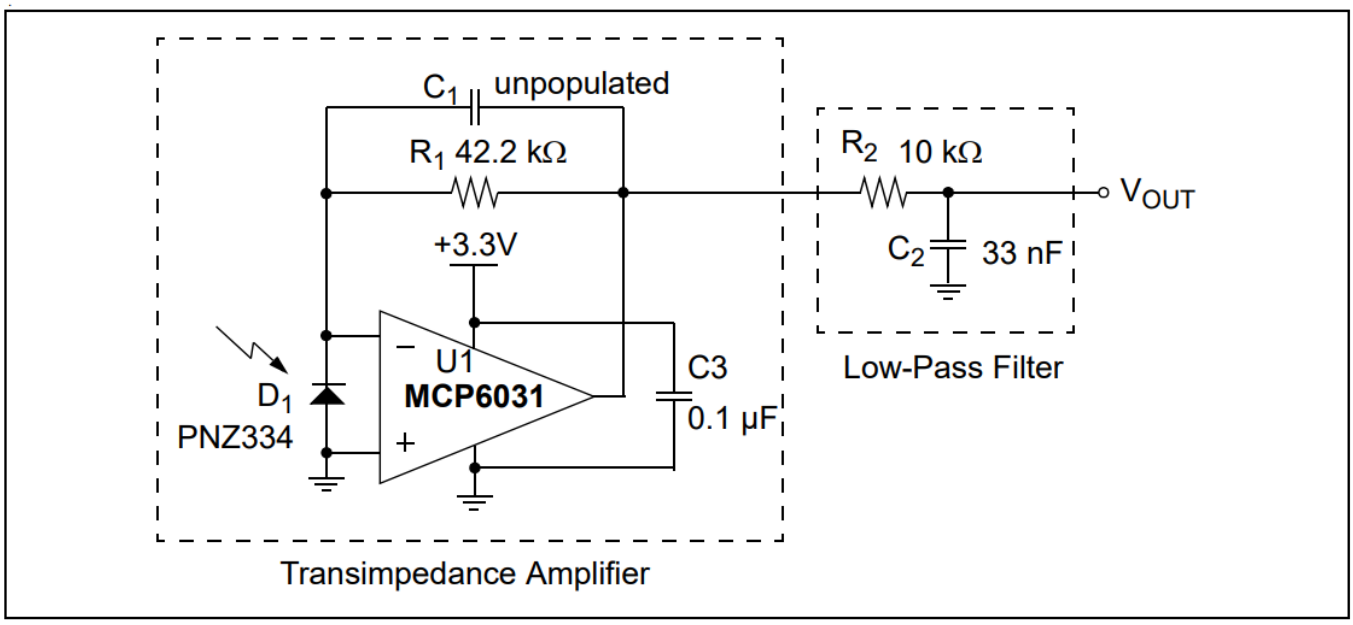


FIGURE 1-4: *MCP6031 Photodiode PICtail™ Plus Demo Board Circuit Diagram.*

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.

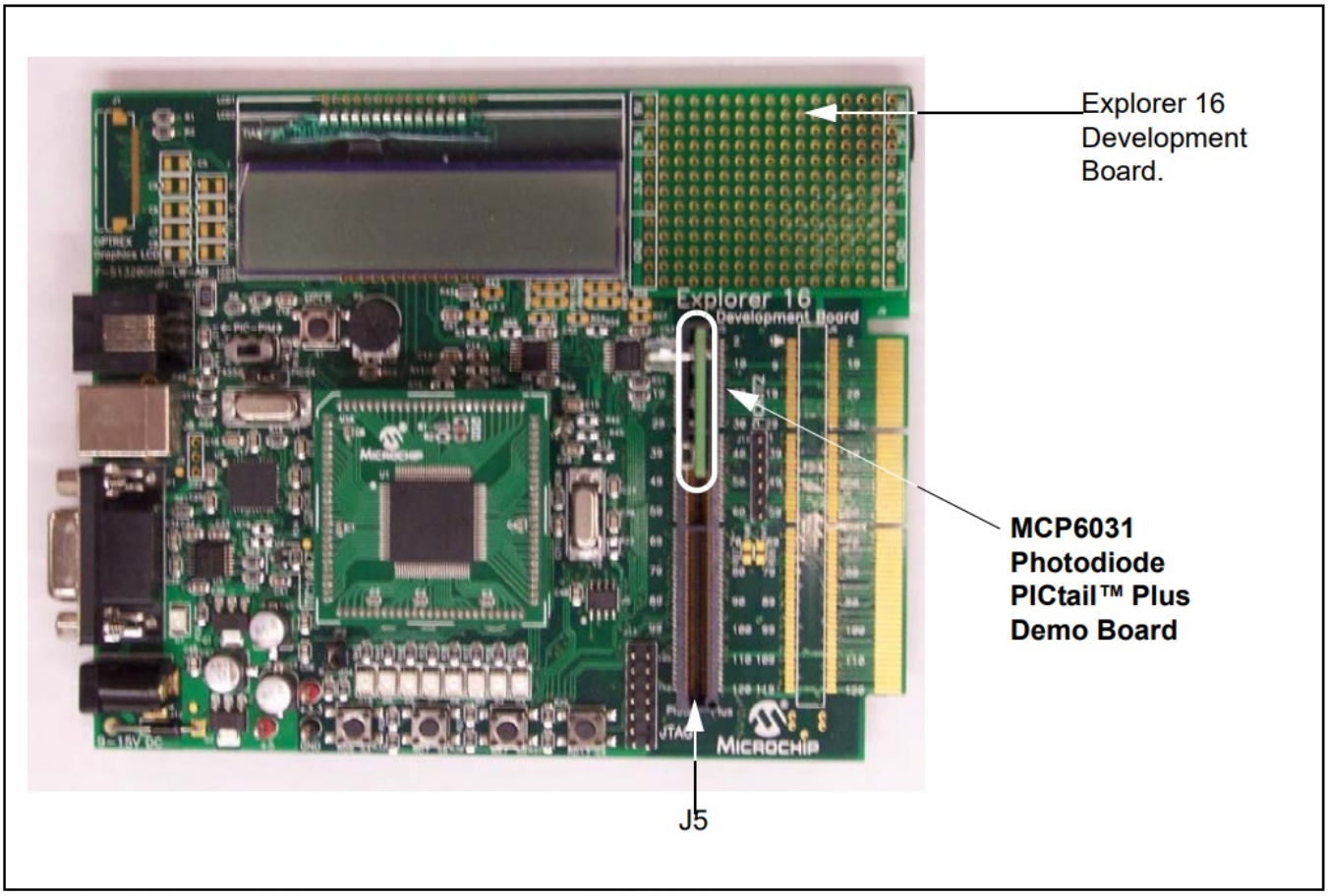


FIGURE 2-1: *MCP6031 Photodiode PICtail™ Plus Demo Board Set-Up.*

2.4 MCP6031 PHOTODIODE PICtail™ PLUS DEMO BOARD OPERATION

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

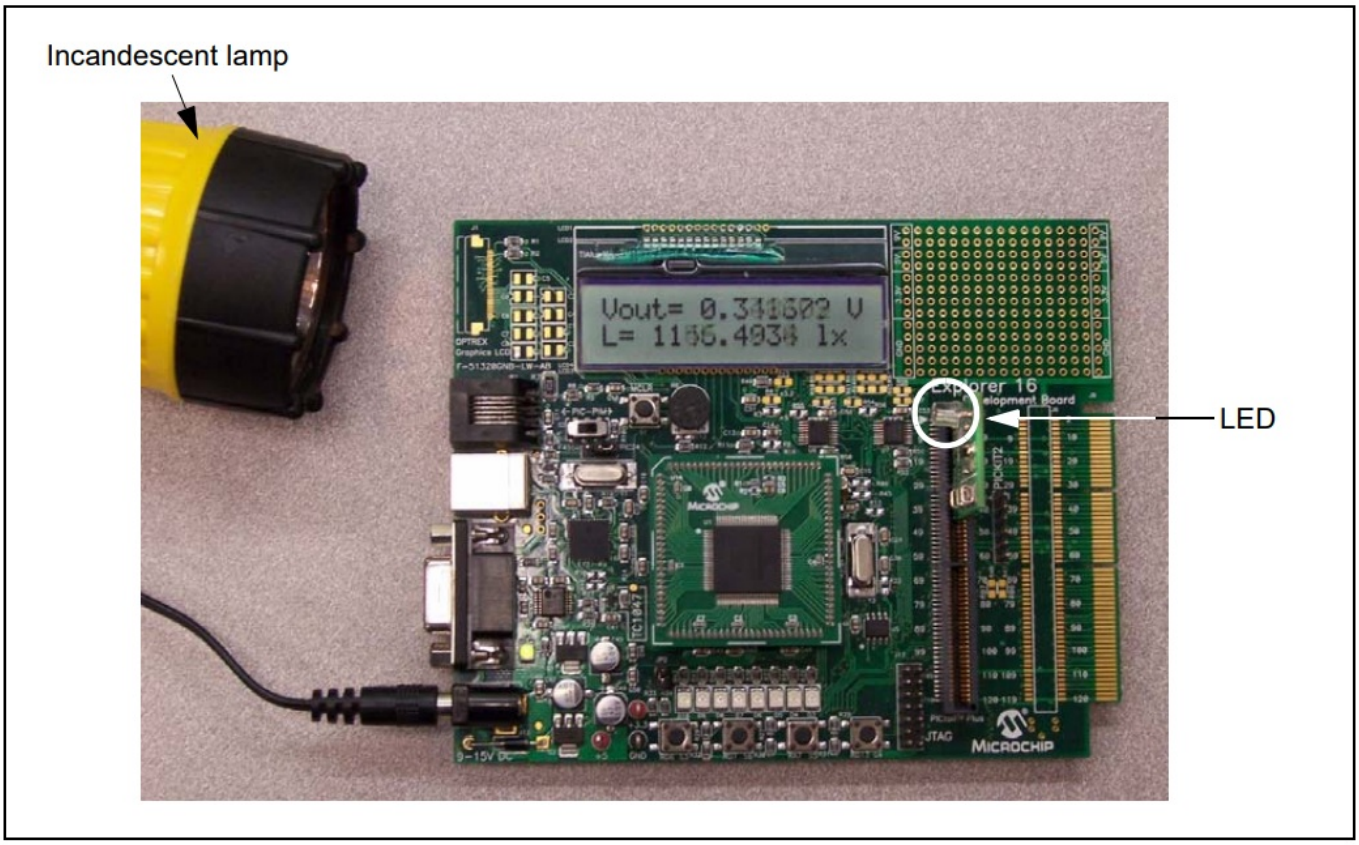


FIGURE 2-2: *MCP6031 Photodiode PICtail™ Plus Demo Board Operation.*

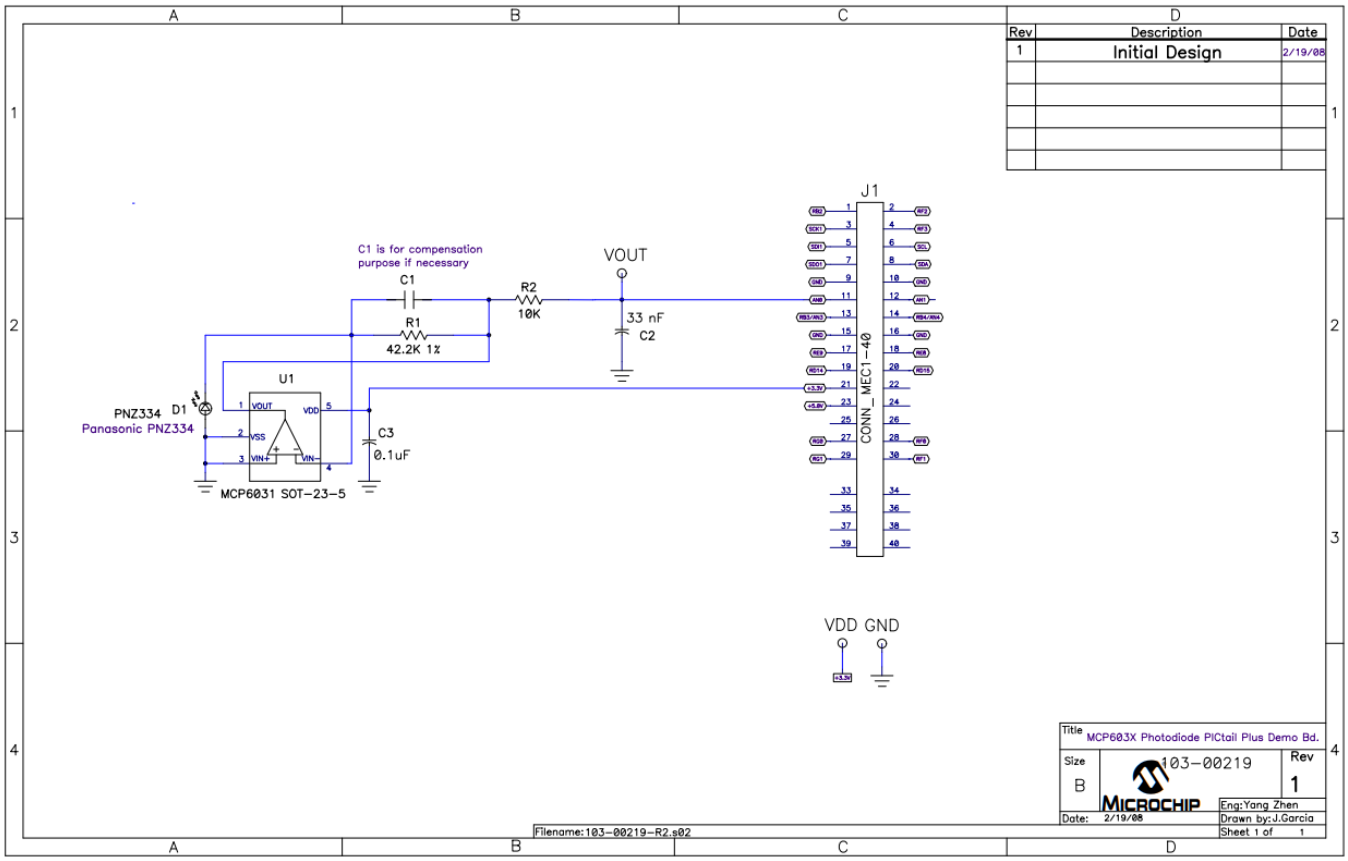
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

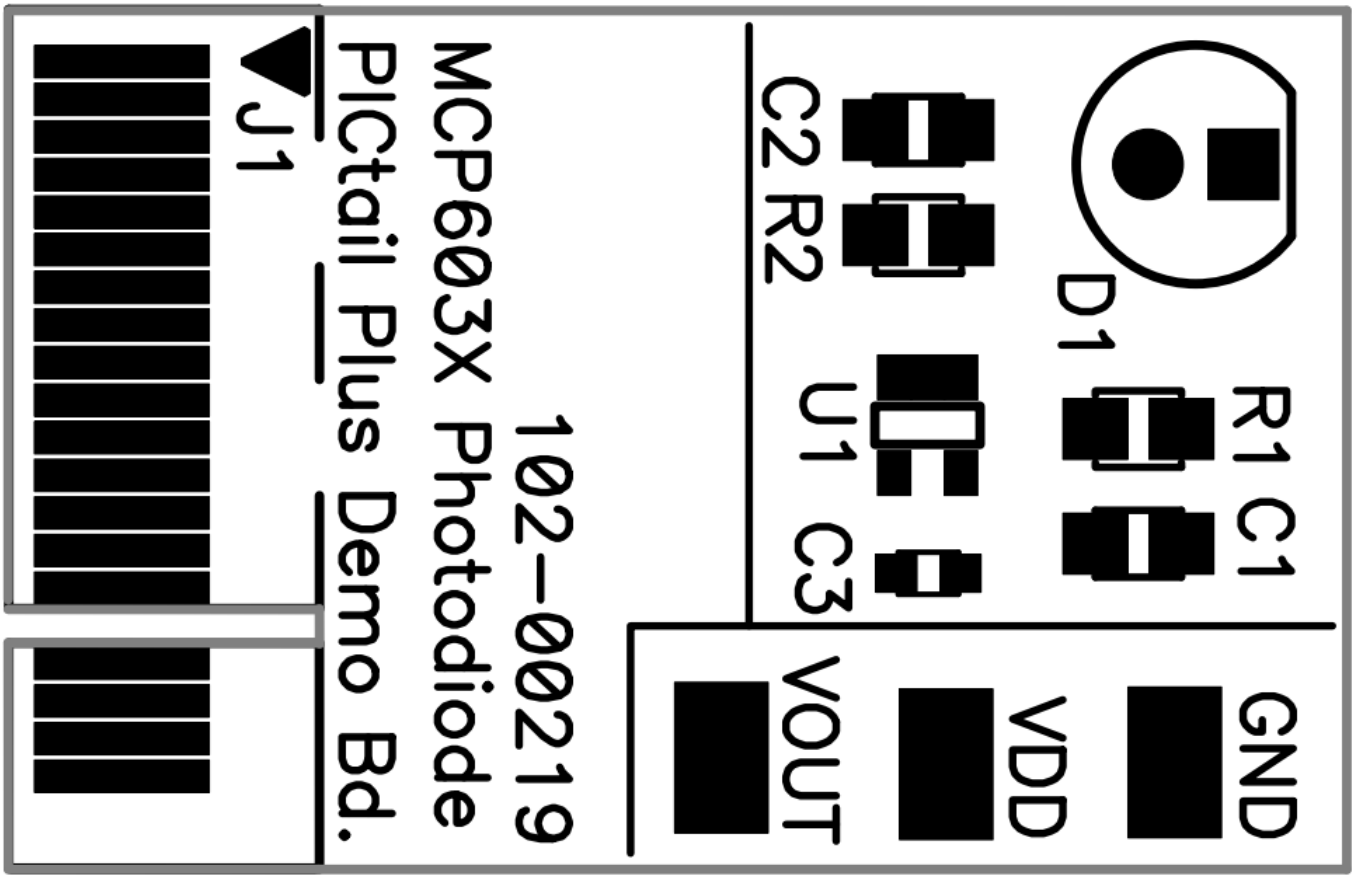
This appendix contains the following schematics and layouts for the MCP6031 Photodiode PICtail™ Plus Demo Board :

- Board – Schematic
- Board – Top Silk Layer
- Board – Top Metal And Top Silk Layers
- Board – Bottom Metal Layer

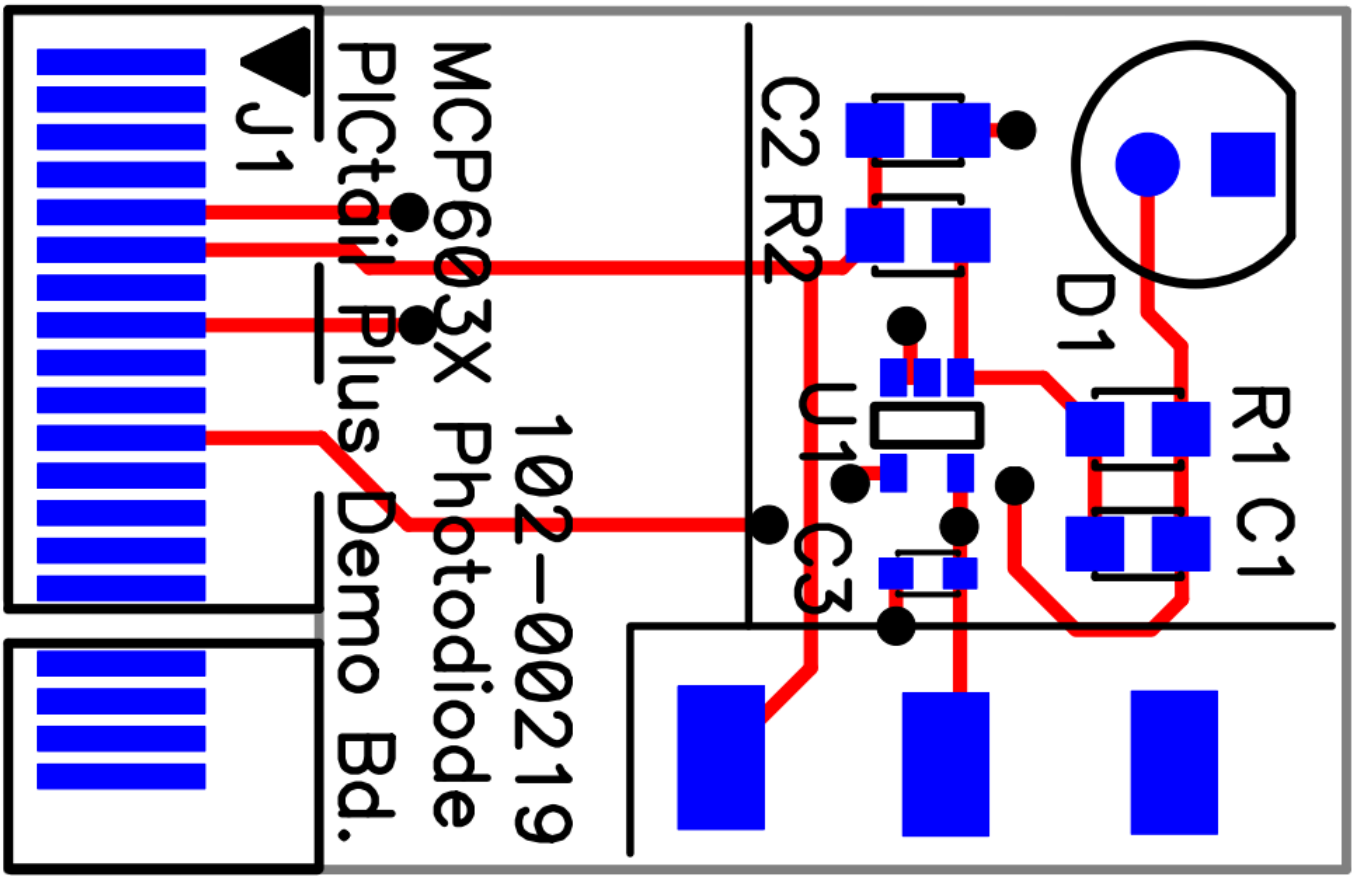
A.2 BOARD – SCHEMATIC



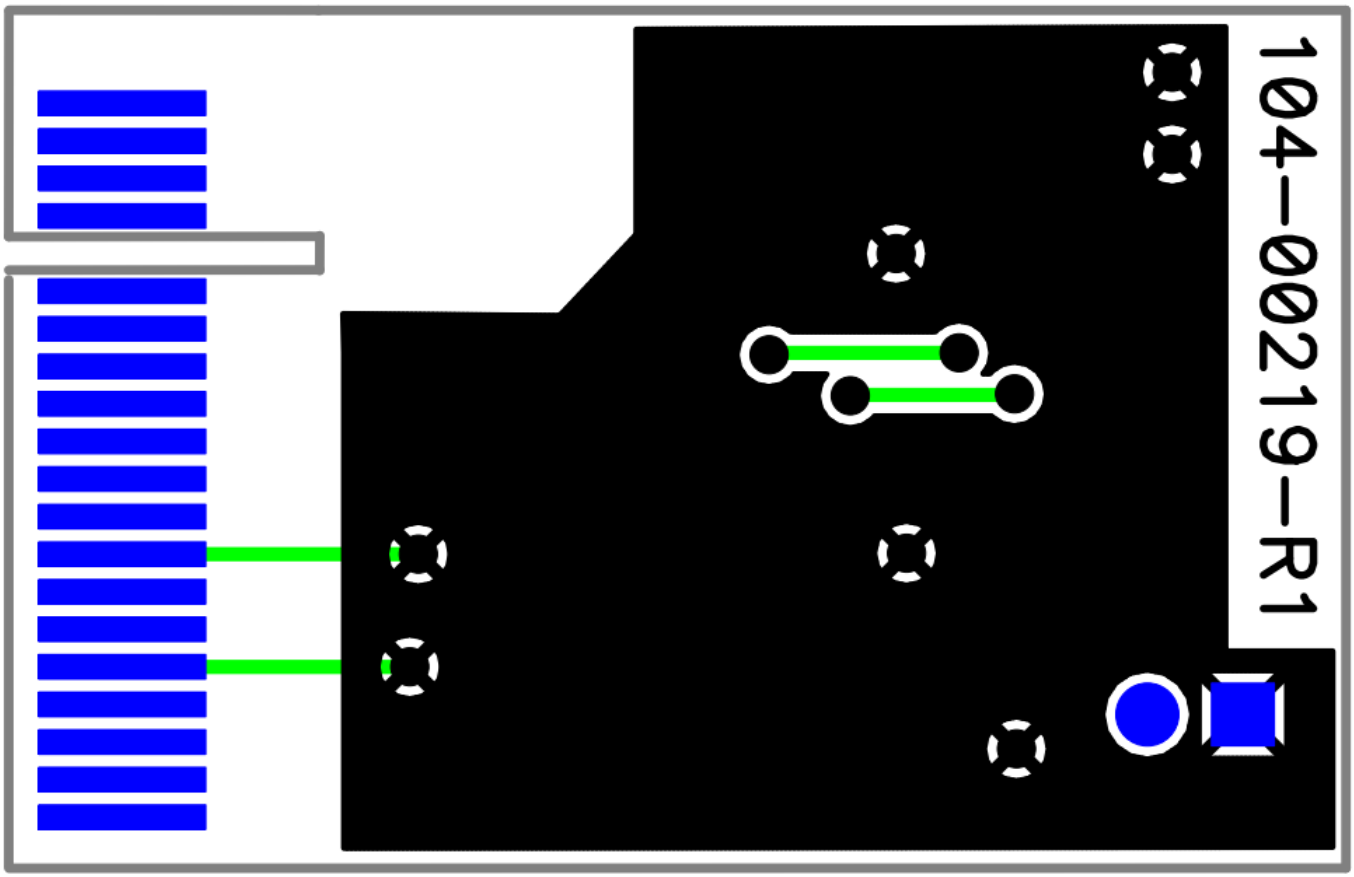
A.3 BOARD – TOP SILK LAYER



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% 08 05 SMD	Panasonic®	ERJ-6ENF4222V
1	R2	RES 10.0K OHM 1/10W 1% 08 05 SMD	Panasonic®	ERJ-6ENF1002V
3	TP1—TP3	TEST POINT PC COMPACT S MT	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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Documents / Resources

	MICROCHIP MCP6031 Photodiode PICtail Plus Demo Board [pdf] User Guide MCP6031 Photodiode PICtail Plus Demo Board, MCP6031, MCP6031 Demo Board, Photodiode PICtail Plus Demo Board, Demo Board, Photodiode Demo Board, PICtail Demo Board, Board

References

- _____ _____ _____ _____
- Empowering Innovation | Microchip Technology