MCP3551 22-Bit Delta-Sigma ADC PICtail™ Demo Board User's Guide

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MCP3551 PICtail™ DEMO BOARD USER'S GUIDE

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MCP3551 PICtail™ DEMO BOARD USER'S GUIDE

Preface

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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 "DSXXXXXA", where "XXXXX" 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 MCP3551 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 MCP3551 PICtail™ 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"** – Important information about the MCP3551 PICtail™ Demo Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with the MCP3551 PICtail™ Demo Board.
- **Appendix A. "Schematic and Layout"** – Shows the schematic and layout diagrams for the MCP3551 PICtail™ Demo Board.
- **Appendix B. "Bill Of Materials (BOM)"** – Lists the parts used to build the MCP3551 PICtail™ 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
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 the MCP3551 PICtail™ Demo Board. The following Microchip documents are available and recommended as supplemental reference resources.

MCP3550/1/3 Data Sheet, *"Low-Power, Single-Channel 22-Bit Delta-Sigma ADCs"* (DS21950)

This data sheet provides detailed information regarding the MCP3550/1/3 product family.

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- Technical Support
- Development Systems Information Line

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Technical support is available through the web site at: http://support.microchip.com

DOCUMENT REVISION HISTORY

Revision C (March 2006)

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

Revision B (January 2006)

- Updated references to MCP3550/1/3 data sheet.
- Removed USB cable from kit.

Revision A (September 2005)

- Initial Release of this document.

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Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MCP3551 PICtail™ Demo Board and covers the following topics:

- What is the MCP3551 PICtail™ Demo Board?
- What the MCP3551 PICtail™ Demo Board Kit includes

1.2 WHAT IS THE MCP3551 PICtail™ DEMO BOARD?

The MCP3551 PICtail™ Demo Board allows the system designer to evaluate the operation of the MCP3551 22-Bit Delta-Sigma Analog-to-Digital Converter (ADC). The board demonstrates the MCP3551 performance in a low-noise environment.

1.3 WHAT THE MCP3551 PICtail™ DEMO BOARD KIT INCLUDES

This MCP3551 PICtail™ Demo Board Kit includes:

- One MCP3551 PICtail™ Demo Board
- DataView® software for viewing the performance of the MCP3551
- MCP3550/1/3 Data Sheet (electronic version on CD)
- MCP3551 PICtail™ Demo Board User's Guide (electronic version on CD)

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Chapter 2. Installation and Operation

2.1 INTRODUCTION

This chapter discusses the setup and operation of the MCP3551 PICtail™ Demo Board.

The MCP3551 PICtail™ Demo Board is designed to demonstrate Microchip Technology's MCP3551 22-Bit Delta-Sigma Analog-to-Digital Converter performance using the DataView software installed on a Personal Computer (PC). The demo board can be used with the MPLAB® ICD 2, PICkit™ 1 Flash Starter Kit or PICkit™ 2 Development Programmer for developing demonstration/evaluation firmware.

This demo board is designed to evaluate the MCP3551 with minimum Printed Circuit Board (PCB) noise. The PCB layout practices low-noise design to reduce the signal noise as much as possible in order to demonstrate the 22-bit performance of the MCP3551.

2.2 FEATURES

The MCP3551 PICtail™ Demo Board has the following features:

- Three precision potentiometers for demonstrating the capabilities of the MCP3551
- USB interface for connecting to a PC
- On-board PIC18F4550 Microcontroller Unit (MCU) with USB for communication with DataView software
- DataView software with easy-to-read format and data logging
- Three headers/connectors for programming the PIC18F4550 MCU using any of the following (see schematic):
  - PICkit™ 1 Flash Starter Kit
  - PICkit™ 2 Development Programmer
  - MPLAB® ICD 2 (Debugger and Programmer)

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2.3 GETTING STARTED

The MCP3551 PICtail™ Demo Board is a fully functional, assembled and tested board for evaluation of the MCP3551 22-Bit Delta-Sigma ADC. The board is engineered to provide a virtually noise-free analog signal to the MCP3551, so that the capabilities of the device can be observed using a PC loaded with the DataView software.

The setup process is as follows:

1. Install the DataView software.
2. Since the board can be powered by USB power or with a 5V power supply, connect only the USB cable or the USB cable and a separate 5V power supply.
3. After applying power, the "Power" LED (D1) will illuminate and either D4 (externally-powered) or D7 (USB-powered) will illuminate.
4. The drivers will automatically install the first time the board is connected.
5. Run the DataView software.

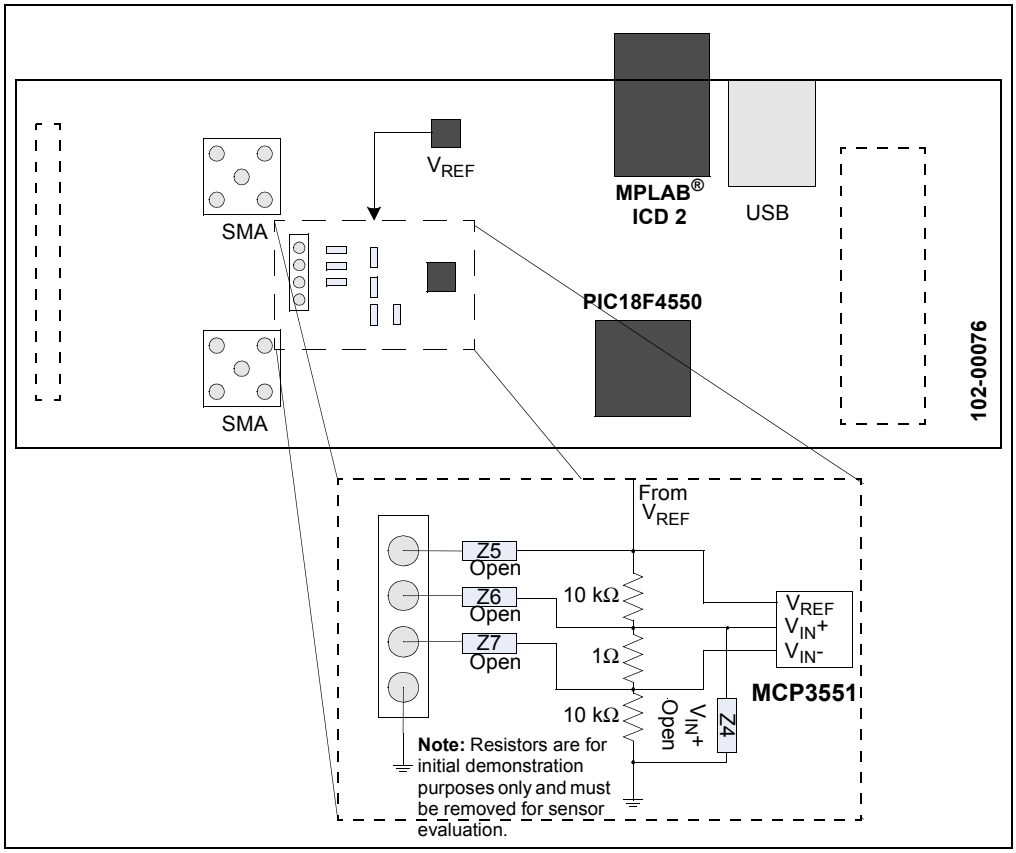

FIGURE 2-1: *MCP3551 PICtail™ Demo Board Block Diagram.*

2.4 MCP3551 PICtail™ DEMO BOARD DESCRIPTION

2.4.1 Major Board Components

1. PIC18F4550 MCU (U4)
2. SMA connectors (J1 and J3)
3. USB connector (J4)
4. PICkit™ 1 Flash Starter Kit (J2), PICkit™ 2 Development Programmer (J8) and MPLAB® ICD 2 (J5) connectors

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2.4.2 Hardware Power

The board can be powered directly from the USB cable or self-powered. LEDs, D4 and D7, indicate how the board is powered.

To power the board via the USB, simply connect the USB cable. D7 will illuminate.

To self-power the board, connect a 5V power supply to the power terminals. D4 will illuminate.

2.4.3 The Analog Input

By default, the analog input is provided by a voltage divider circuit on V_{IN}+, with V_{IN}- shorted to ground via a 0Ω resistor. These components are initially soldered on the board for demonstration purposes only and are not required by a typical MCP3551 system. These components should be removed when evaluating a sensor through JPX.

2.4.4 Customizing the Analog Input

For demonstration purposes, the voltage on the inputs is fixed via a voltage divider on V_{IN}+. However, experimentation with different voltages on the inputs is made possible by the two SMA connectors (J1 and J3) and/or the 4-pin header (J10).

There are several reference designators (Zn) which can be populated, as needed, to evaluate the MCP3551, external circuits, Z1, Z2 and Z3, are populated to create the voltage divider. These components will need to be removed to accommodate the custom circuit. All other Zn designators are unpopulated.

2.4.5 Reading the MCP3551 Output Using the DataView Software

The DataView software displays the digital output of the MCP3551 in a graphical format on Windows® 2000 and Windows XP® systems. The 22-bit value is transferred to the PC through the USB port, where it is converted to decimal and then plotted. The sample size of each window calculation (Histogram, Output and Auxiliary) can be configured through the Configuration dialog box. There are three different windows that display the data.

2.4.5.1 OUTPUT WINDOW

The Output window (Figure 2-2) shows the ADC output as a scope plot. The Y-axis can be configured LSB (default), PPM, percentage or volts (see Figure 2-5).

2.4.5.2 HISTOGRAM WINDOW

The Histogram window (Figure 2-3) shows the distribution over the selected sample size. Each bin of the histogram is always the equivalent of 1 LSB, showing the true output noise performance of the system with this quanta.

2.4.5.3 AUXILIARY DATA SCREEN

The Auxiliary Data window (Figure 2-4) displays calculated information, such as mean LSB, mean PPM, sample size and output noise RMS (PPM).

2.4.5.4 CONFIGURATION WINDOW

The Configuration window has three tabs for configuration and information.

The **Scope Plot** tab allows the Y-axis and the units to be changed. The X-axis is fixed. The defualt for the Y-axis is ‘Auto’ for the min/max and LSB for the units.

The **A/D Device** tab displays the ADC used (MCP3551) and is also where the sample rate for displaying the data is set. Please note that the minimum should be ~90 ms (see **Section 2.4.6 “MCP3551 Sample Rate Demo”** for more information).

The **USB Device** tab displays information about the board/device.

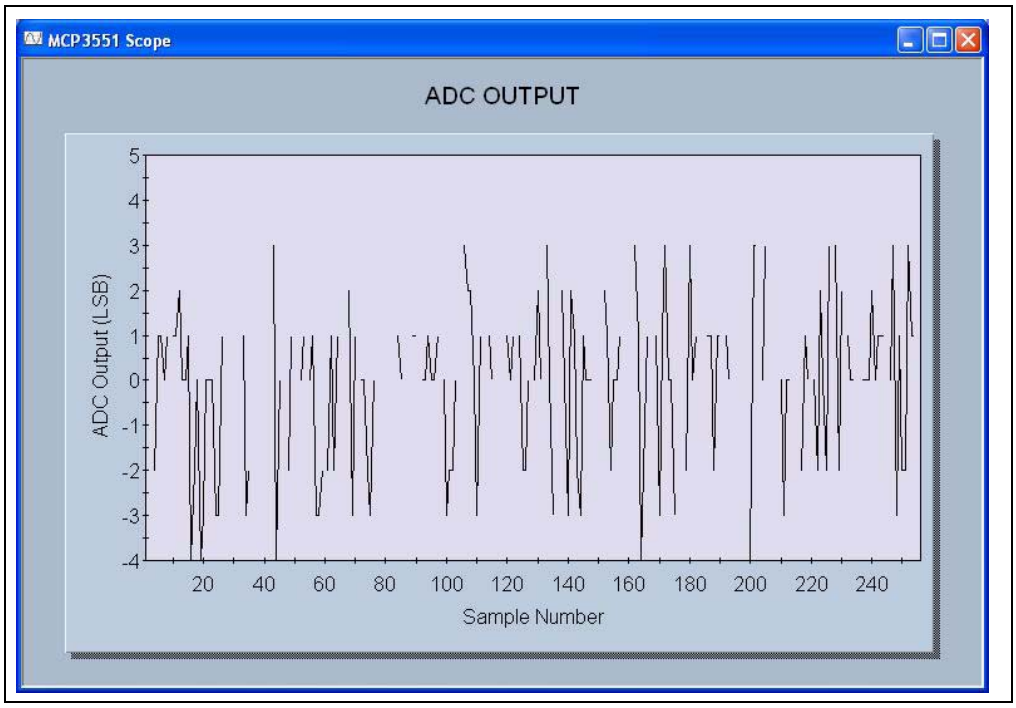

FIGURE 2-2: *Output Window.*

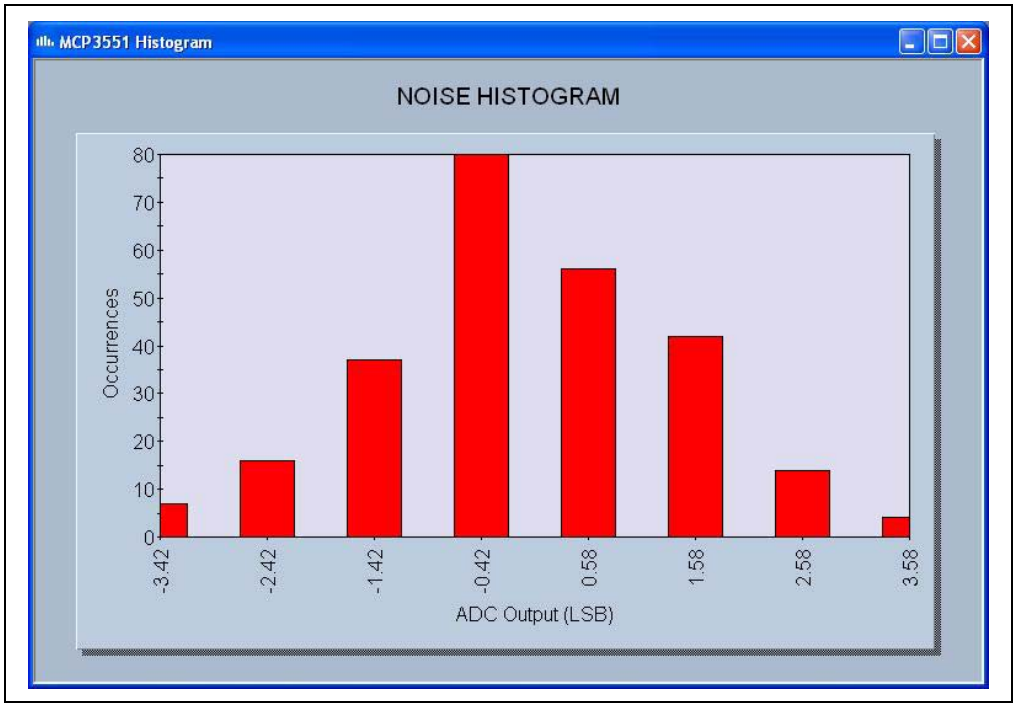

FIGURE 2-3: *Noise Histrogram Window.*

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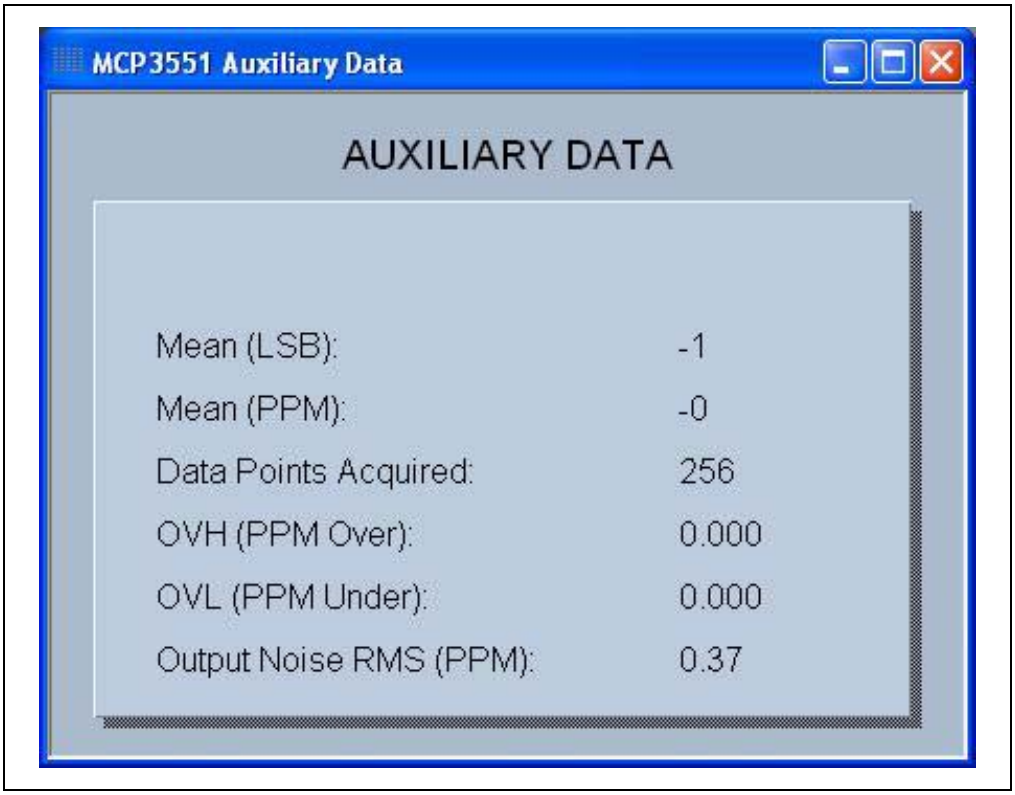

FIGURE 2-4: *Auxilary Data Window.*

2.4.6 MCP3551 Sample Rate Demo

The Sample Rate demo uses a combination of polling and time to sample the input signal. When the **Play** button in the software is pressed, the PIC18F4550 samples the Ready state of the MCP3551 every 10 ms by lowering $\overline{CS}$ and sampling the SDO/$\overline{RDY}$ pin. If the device is ready (i.e., the conversion is complete), the data is clocked out. Otherwise, $\overline{CS}$ is raised.

Note:	Once data is read out and $\overline{CS}$ is toggled for the first time, the device is placed in Single Conversion mode.

Since the conversion time of the MCP3551 is ~72 ms and the Ready state is sampled at ~10 ms intervals, the data is available to the PC approximately every 72 ms, ±10 ms. However, the USB host queries the board for data every 10 ms. This implies that the minimum sample rate for the software (see **Section 2.4.5.4 "Configuration Window"** for details on setting the sample rate) should be > 92 ms (or ~100 ms). If the DataView software is set to a shorter sample rate, data will be repeated and the software will not reflect the true operation of the device.

See the MCP3550/1/3 Data Sheet (DS21950) for more details on conversion time and Single Conversion mode.

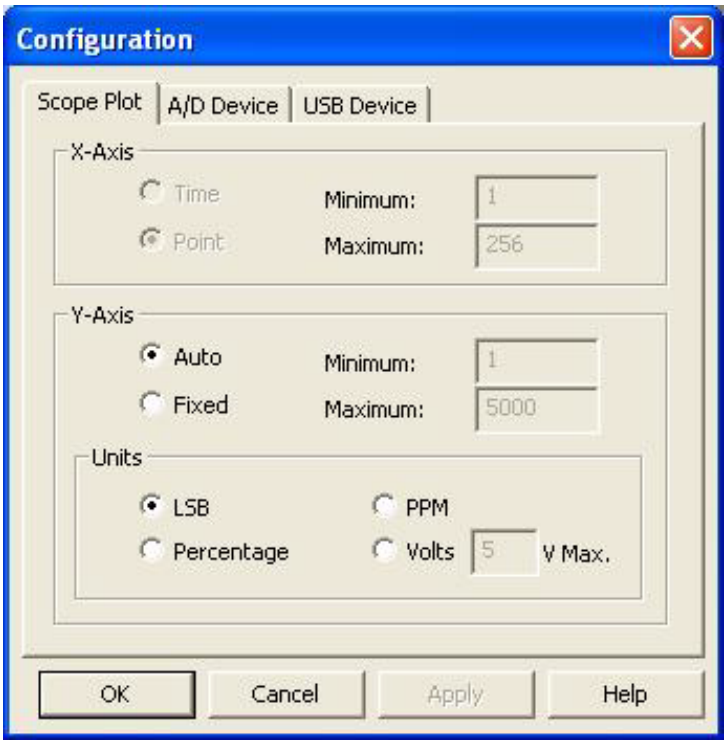

FIGURE 2-5: *Configuration Window Dialog.*

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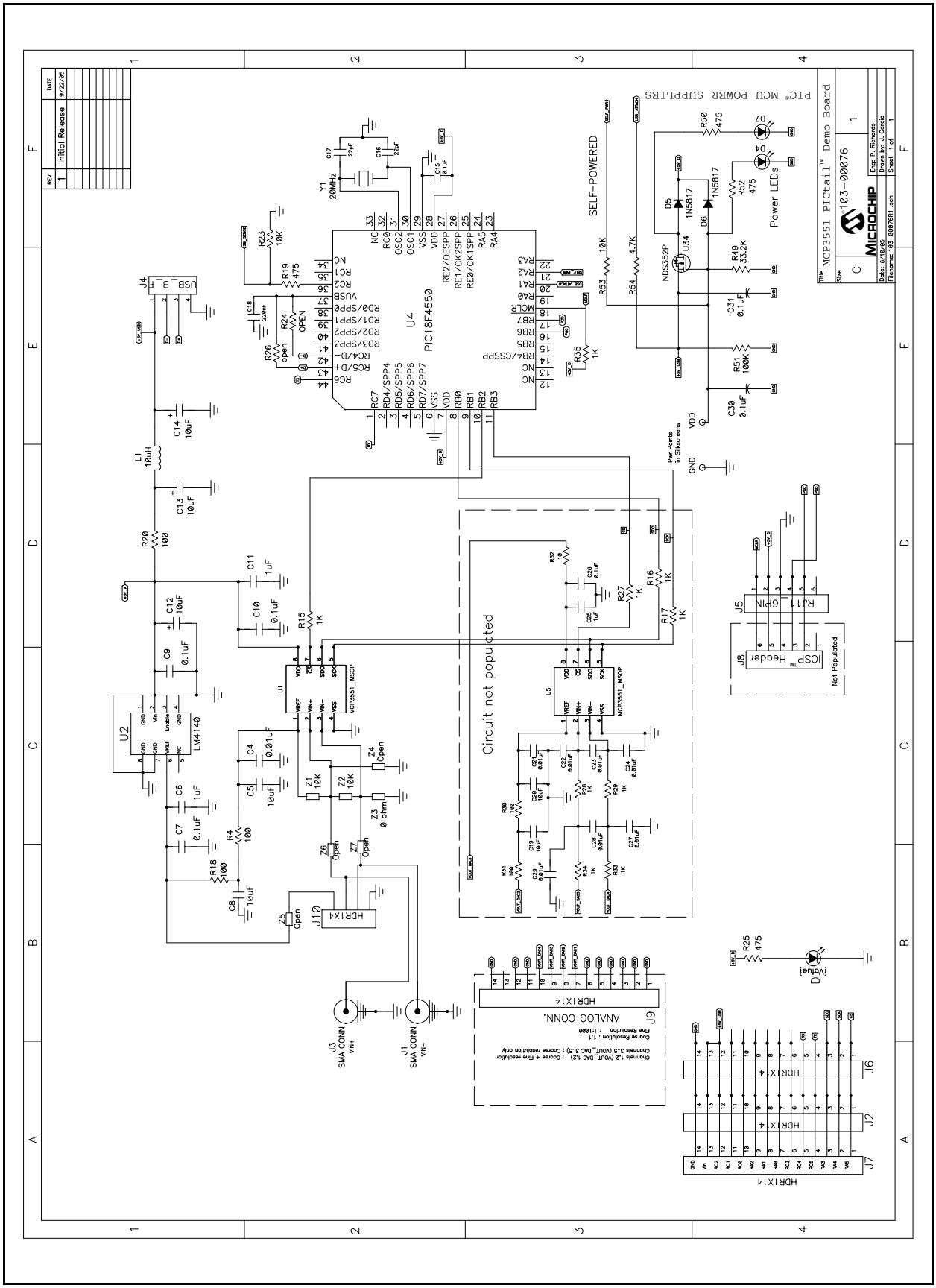
Appendix A. Schematic and Layout

A.1 INTRODUCTION

This appendix contains the schematic and layout diagrams for the MCP3551 PICtail™ Demo Board.

- Board Schematic
- Board – Top Layer (with Silk Screen)
- Board – Bottom Layer

A.2 BOARD SCHEMATIC



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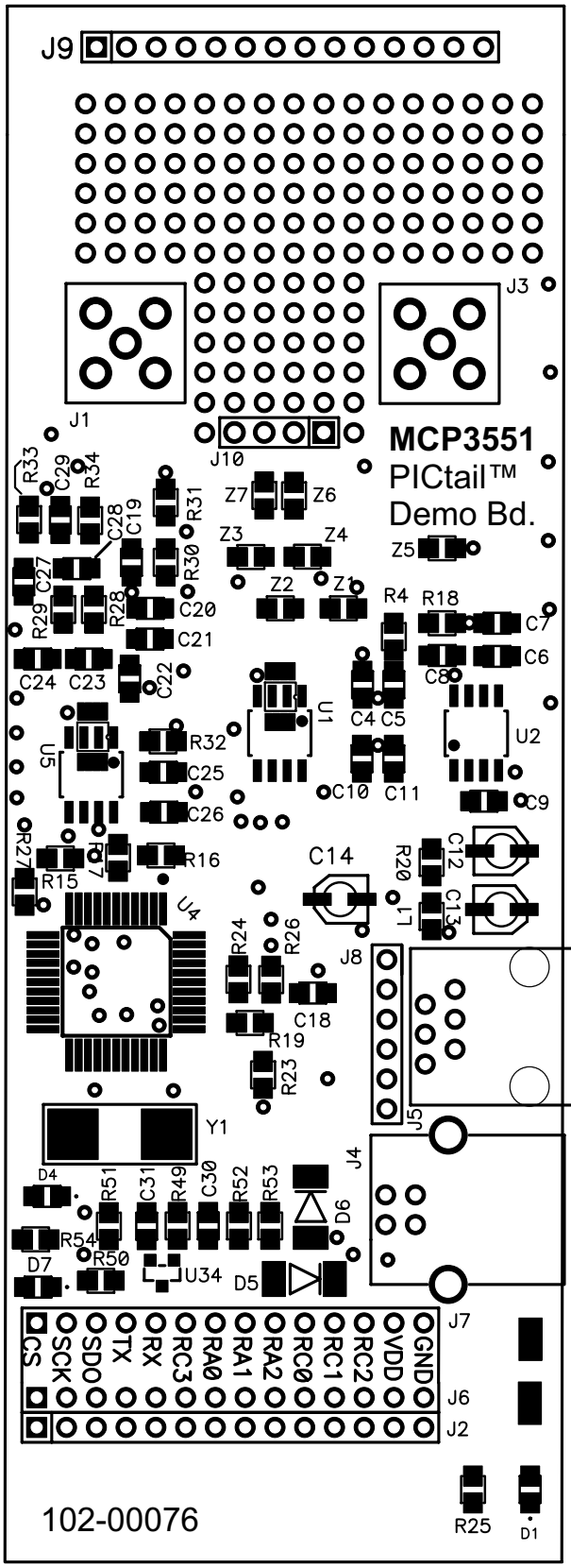
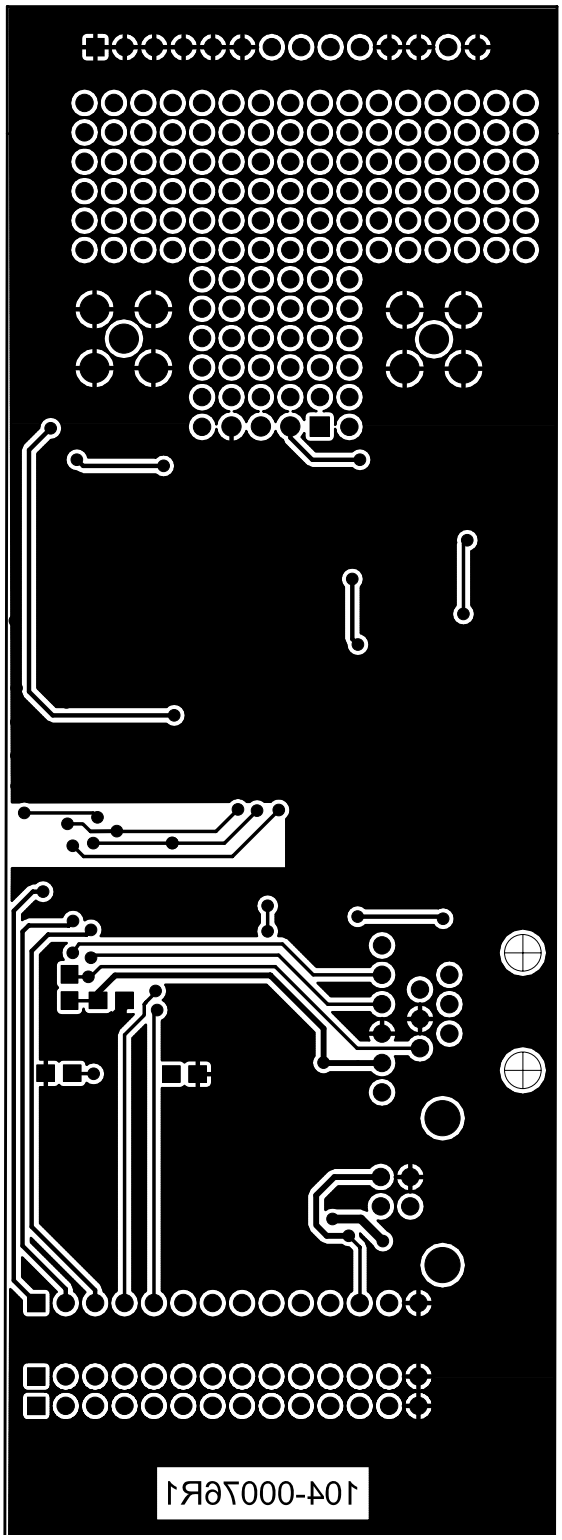
A.3 BOARD – TOP LAYER AND SILK SCREEN



A.4 BOARD – BOTTOM LAYER



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Appendix B. Bill Of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty	Reference	Description	Manufacturer	Part Number
1	C4	CAP 10000PF 50V CERAMIC X7R 0805	Kemet® Electronics	C0805C103K5RACTU
2	C5, C8	CAP CERAMIC 10UF 6.3V X5R 0805	Panasonic® - ECG	ECJ-CV50J106M
2	C6, C11	CAP 1.0UF 10V CERAMIC X7R 0805	Kemet Electronics	C0805C105K8RACTU
6	C7, C9,C10, C15, C30, C31	CAP .1UF 25V CERAMIC X7R 0805	Panasonic - ECG	ECJ-2VB1E104K
3	C12, C13, C14	10uF/16V CAP-SMT-ELCTRO	Value-Pro	SE10/16
2	C16, C17	CAP 22PF 50V CERM CHIP 0805 SMD	Panasonic - ECG	ECJ-2VC1H220J
1	C18	CAP .22UF 16V CERAMIC Y5V 0805	Panasonic - ECG	ECJ-2VF1C224Z
11	C19, C20, C21, C22 C23, C24 C25, C26, C27, C28, C29	**"Do not Populate"**	—	—
3	D1, D4, D7	LED RED CLEAR 0805 SMD	Lite-On Trading USA Inc	LTST-C170CKT
2	D5, D6	DIODE SCHOTTKY 20V 1A SOD87	Philips® Semiconductor	PRLL5817 T/R
2	J1, J3	SMA PCB Jack "Do Not Populate"	Value-Pro	901-144-8-RFX
4	J2, J6, J7, J9	**"Do Not Populate"** HDR1X14 CONN HEADER 14POS .100 VERT TIN	Molex®/Waldom® Electronics Corp	22-28-4141
1	J4	CONN USB RTANG FEMALE TYPE B PCB	Assmann Electronics, Inc	AU-Y1007-R
1	J5	CONN MOD JACK 6-6 R/A PCB 50AU	AMP®/Tyco® Electronics	5520470-3
1	J8	**"Do Not Populate"** HEADER,.1"ST MALE,1RW,6PIN.025"PST,.23GOLDTAIL	Value-Pro	JS1109-6-R
1	J10	**"Do Not Populate"** CONN HEADER 14POS .100 VERT TIN	Molex/Waldom Electronics Corp	22-28-4141
1	L1	FERRITE 500MA 600 OHM 0805 SMD	Steward® Inc.	HZ0805E601R-10
6	R4, R16, R17, R18, R20, R27	RES 100 OHM 1/10W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1000V
2	R15, R35	RES 1.00K OHM 1/10W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1001V
4	R19, R25, R50, R52	RES 47.5K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF4752V
4	R23, R53, Z1, Z2	RES 10.0K OHM 1/10W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1002V
13	R24, R26, R28, R29, R30, R31, R32, R33, R34, Z4, Z5, Z6, Z7	**"Do not Populate"**	—	—
1	R49	RES 33.2K OHM 1/10W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF3322V
1	R51	RES 100K OHM 1/10W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1003V
1	R54	RES 4.75K OHM 1/10W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF4751V

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TABLE B-1: BILL OF MATERIALS (BOM) (CONTINUED)

Qty	Reference	Description	Manufacturer	Part Number
2	TP1, TP2	TEST POINT PC MINIATURE SMT	Keystone Electronics®	5015
1	U1	MCP3551_MSOP	Microchip Technology, Inc.	MCP3551-E/MS
1	U2	LM4140 IC VOLT REF PREC MICROPWR 8-SOIC	National Semiconductor®	LM4140CCM-4.1/NOPB
1	U4	PIC18F4550	Microchip	PIC18F4550-I/PT
1	U5	MCP3551_MSOP Do Not Populate	Microchip	MCP3551-E/MS
1	U34	(NDS352P) MPSFET P-CH -20V .5 OHM SSOT3	Fairchild Ssemiconductor®	NDS352P
1	Y1	CRYSTAL 20.000MHZ 20PF SMD	ECS Inc	ECS-200-20-5PX-TR
1	Z3	RES 0.0 OHM 1/8W 5% 0805 SMD	Panasonic - ECG	ERJ-6GEY0R00V
4		BUMPON HEMISPHERE .44X.20 CLEAR	3M/ESM	SJ-5303 (CLEAR)

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Fax: 86-28-8676-6599

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- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
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