MCP3911
ADC Evaluation Board for 16-Bit MCUs User's Guide

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MCP3911 ADC EVALUATION BOARD FOR 16-BIT MCUs 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 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 MCP3911 ADC Evaluation Board for 16-Bit MCUs. 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 MCP3911 ADC Evaluation Board for 16-Bit MCUs as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Hardware Description"** – Provides important information about the MCP3911 ADC Evaluation Board for 16-Bit MCUs hardware.
- **Chapter 2. "Firmware"** – Describes the MCP3911 ADC Evaluation Board for 16-Bit MCUs firmware.
- **Chapter 2. "Evaluation Board PC Software"** – Provides information about the evaluation board software.
- **Appendix A. "Schematics and Layouts"**– Shows the schematic and board layouts for the MCP3911 ADC Evaluation Board for 16-Bit MCUs.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MCP3911 ADC Evaluation Board for 16-Bit MCUs.

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 MCP3911 ADC Evaluation Board for 16-Bit MCUs. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource:

- **MCP3911 Data Sheet - *"3.3V Two Channel Analog Front End"* (DS22286)**

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- Technical Support

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

DOCUMENT REVISION HISTORY

Revision A (March 2012)

- Initial release of this document.

NOTES:

Chapter 1. Hardware Description

1.1 OVERVIEW

The MCP3911 ADC Evaluation Board for 16-Bit MCUs system provides the opportunity to evaluate the performance of the MCP3911 dual-channel ADC. It also provides a development platform for 16-bit PIC®-based applications, using existing 100-pin PIC microcontroller Plug-in Module (PIM) systems that are compatible with the Explorer 16 and other high pin count PIC®-based demo boards. The system comes with a programmed PIC24FJ256GA110 PIM module that communicates with the Energy Management Utility software for data exchange and ADC setup.

1.1.1 Feature Highlights

- Dual ADC MCP3911 output display using serial communication to the PC software interface
- Simultaneous 55 ksps at OSR32 address loop ALL or 95 dB SINAD at OSR512 performance on MCP3911
- System and ADC performance analysis through graphical PC tools showing noise histogram, frequency domain (FFT), time domain scope plot, and statistical numerical analysis
- Robust hardware design with analog grounding and analog/digital separation, allowing low noise evaluation of MCP3911 devices; includes separate power supplies and power planes on a 4-layer board.
- PICtail™ Plus connectors for Explorer 16 daughter board compatibility

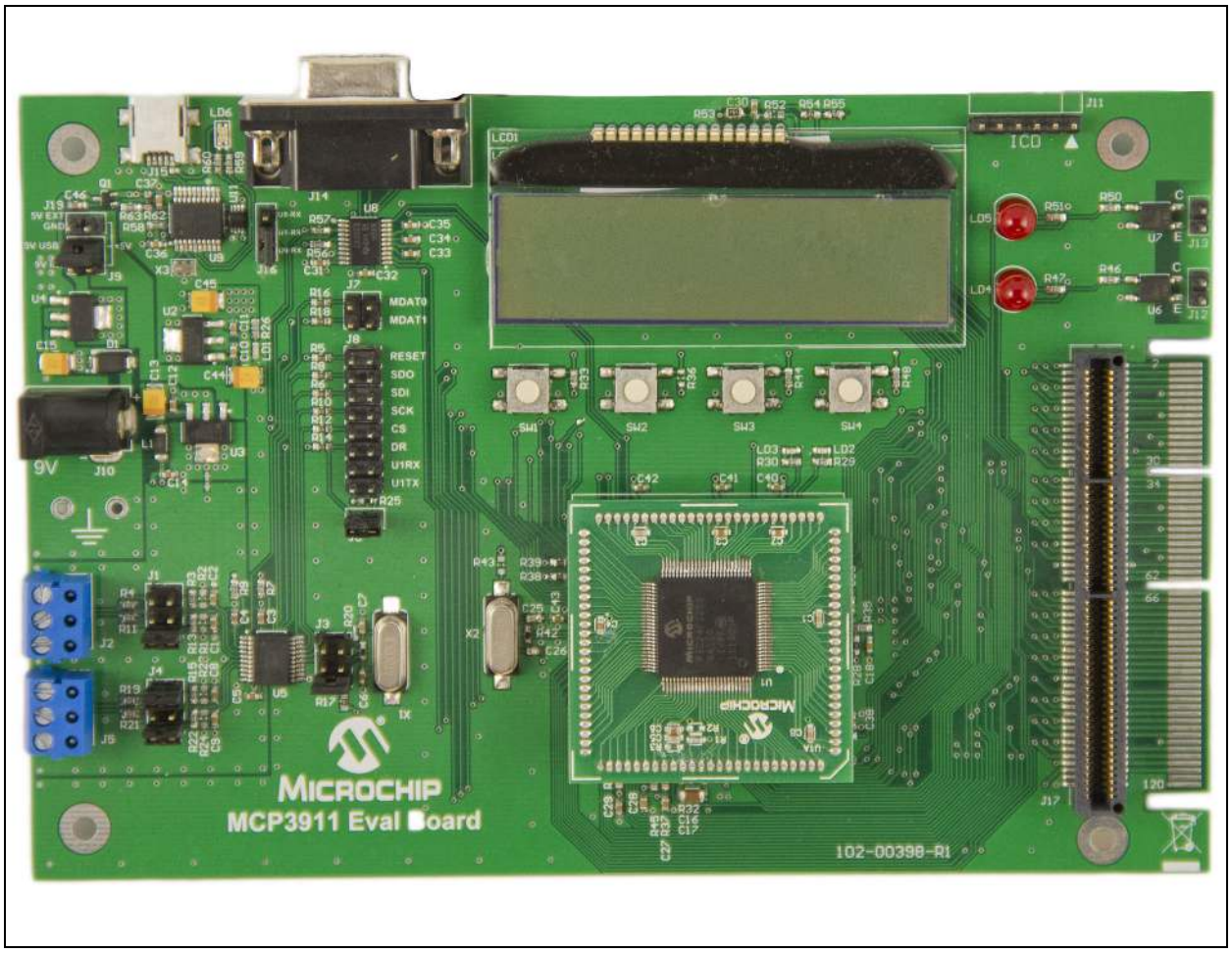


FIGURE 1-1: *MCP3911 Evaluation Board.*

1.2 PIM MODULE/MCP3911 CONNECTION AND PERIPHERAL USAGE OVERVIEW

The MCP3911 ADC Evaluation Board for 16-Bit MCUs contains a 100-pin PIM socket compatible with Microchip's PIM modules. The system comes with one PIM module, the PIC24FJ128GA110.

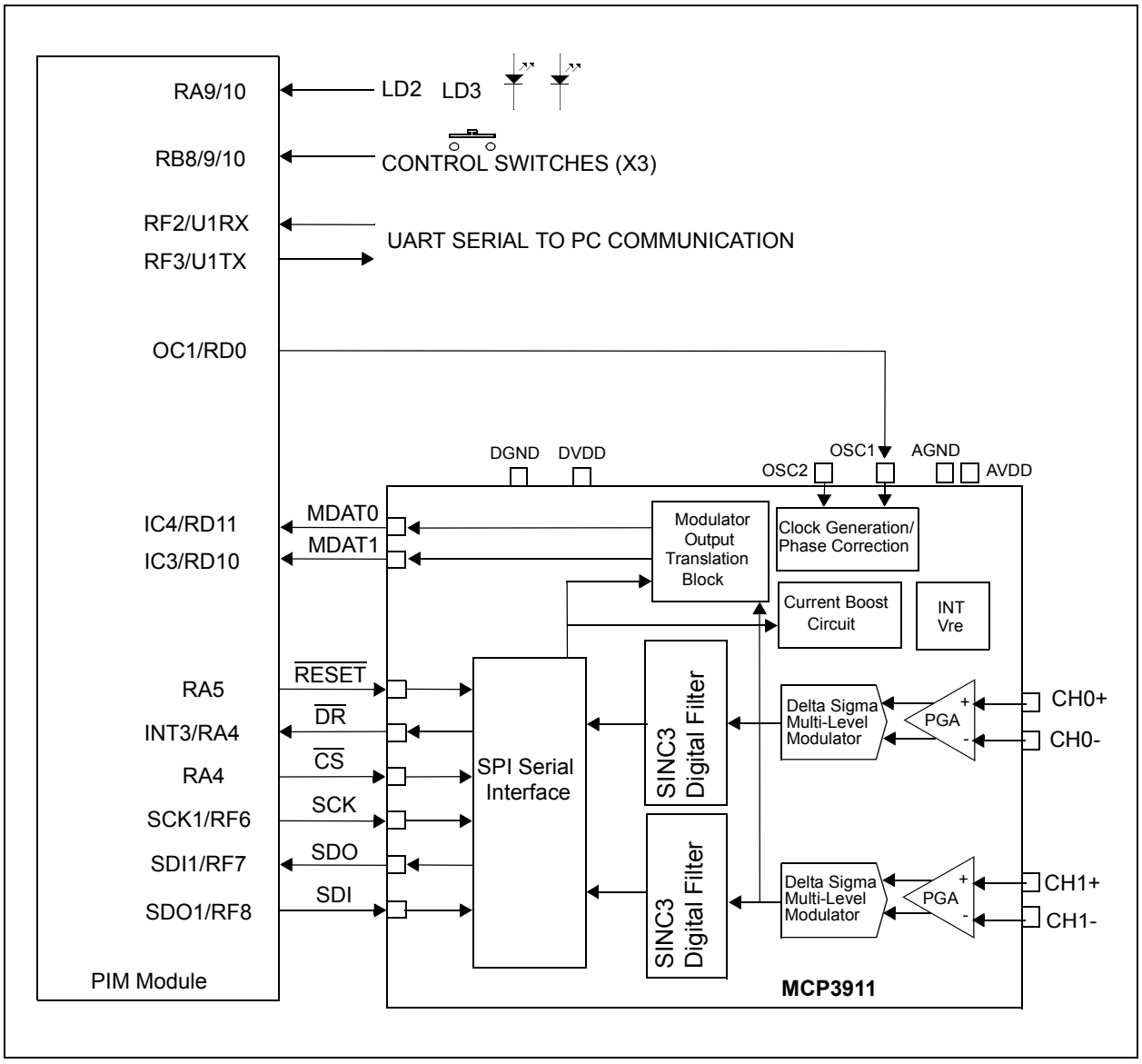


FIGURE 1-2: *Digital Connection Overview PIM/MCP3911 Connections.*

Ports A, B, and D are used for signals such as push buttons, output LEDs, $\overline{CS}$ and $\overline{MCLR}$ (for MCP3911 data mode setting). Output Capture 1 is used for clock generation in the MCP3911. Serial communication is achieved through the MSSP module 1.

The MCP3911 device is an ADC with a second order modulator and a third order sinc filter, plus a first order sinc filter used for higher OSR's values. This Delta-Sigma A/D converter has an adjustable oversampling ratio. The CLKIN pin of the MCP3911 is the oversampling clock (MCLK) input. The MCP3911 ADC Evaluation Board for 16-Bit MCUs offers two different options for the MCP3911 master clock (MCLK).

1.2.1 Using the Crystal X1

The MCP3911 ADC Evaluation Board for 16-Bit MCUs is populated with a 3.58 MHz crystal, used as a clock source, by placing jumpers in the following position on the MCP3911 Digital I/O header block:

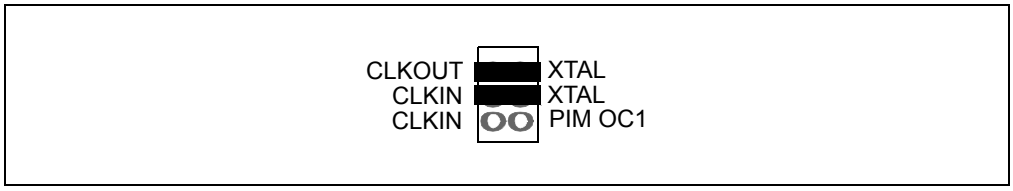


FIGURE 1-3: *ADC Clock Selection Jumpers - External Crystal.*

1.2.2 Driving the Clock with the PIM Module

The PIC® MCU can be used to generate the CLKIN (MCLK) signal for the MCP3911, setting the ADC sample rate through the use of the output compare module OC1. To use this feature, make the following jumper change to the MCP3911 Digital I/O header block:

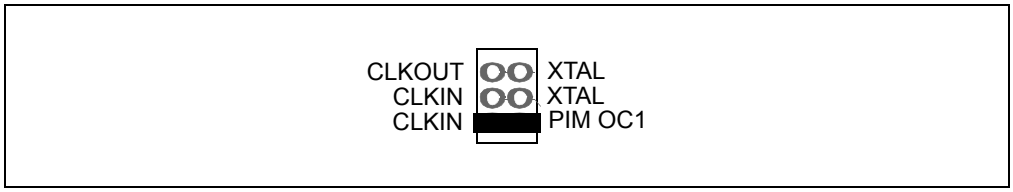


FIGURE 1-4: *ADC Clock Selection Jumpers - Clock from MCU.*

The frequency of the OC1 output is based on the PR1 bits settings in the firmware.

1.3 ANALOG INPUT STRUCTURE

Two differential input paths allow external signal sources to be easily connected to the MCP3911 input. Screw-terminal connectors J2 and J5 are 3-pin connectors that act as both screw-type and clip-on post connectors.

> **Note:** To use a screw-terminal connector as a post connector, pull up the blue plastic top to access the posts.

The connectors J2 and J5 can be used to force either channel from a differential to single-ended configuration. R4 and R11 (on CH0), and R19 and R21 (on CH1) act as locations for burden resistor connectors for any current transformer inputs.

1.4 UNIVERSAL SERIAL BUS (USB)

The MCP3911 ADC Evaluation Board for 16-Bit MCUs also contains a USB connection for connecting the evaluation board to a PC. On the board, there is an MCP2200 USB to UART converter that creates a virtual COMM port on the PC. The MCP3911 ADC Evaluation Board for 16-Bit MCUs also features a RS232 connector, just in case it is required. The RS232 line driver is connected to the same UART pins of the MCU. For this reason, a 3-pin jumper (J16) is present on the evaluation board to select which serial communication will be used: USB or RS232. The following figure summarizes the connections between the ADC, MCU, USB to serial converter and the RS232 line driver.

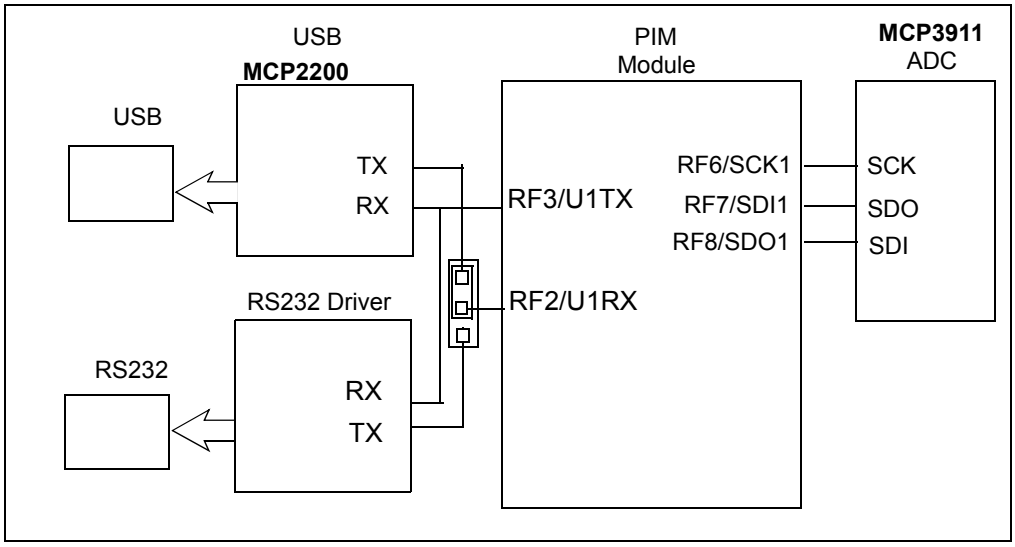


FIGURE 1-5: *USB Block Diagram.*

The MCP2200 is powered from the USB with 5V. The Q1 transistor (see **Appendix A.**) is used to disconnect the board from the PC when it is powered down to avoid power consumption.

Since the PIC24F runs at 3.3V, a level shifter was used to modify the signal level to 5V as required by the MCP2200; this is done with U11 (see **Appendix A.**).

The 7.3728 MHz value of the crystal is required to achieve the correct baud rate values for higher speed. This design uses a baud rate of 920.6 kbaud and for this baud rate, the register value is 3 (decimal).

NOTES:

Chapter 2. Evaluation Board PC Software

2.1 OVERVIEW

This evaluation board uses the Energy Management Utility software for evaluation of the MCP3911 via a USB connection to the board. A download link for this software can be found on the evaluation board's web page. For instructions on the use of this software, refer to the software's supporting documentation included within the application install package.

NOTES:

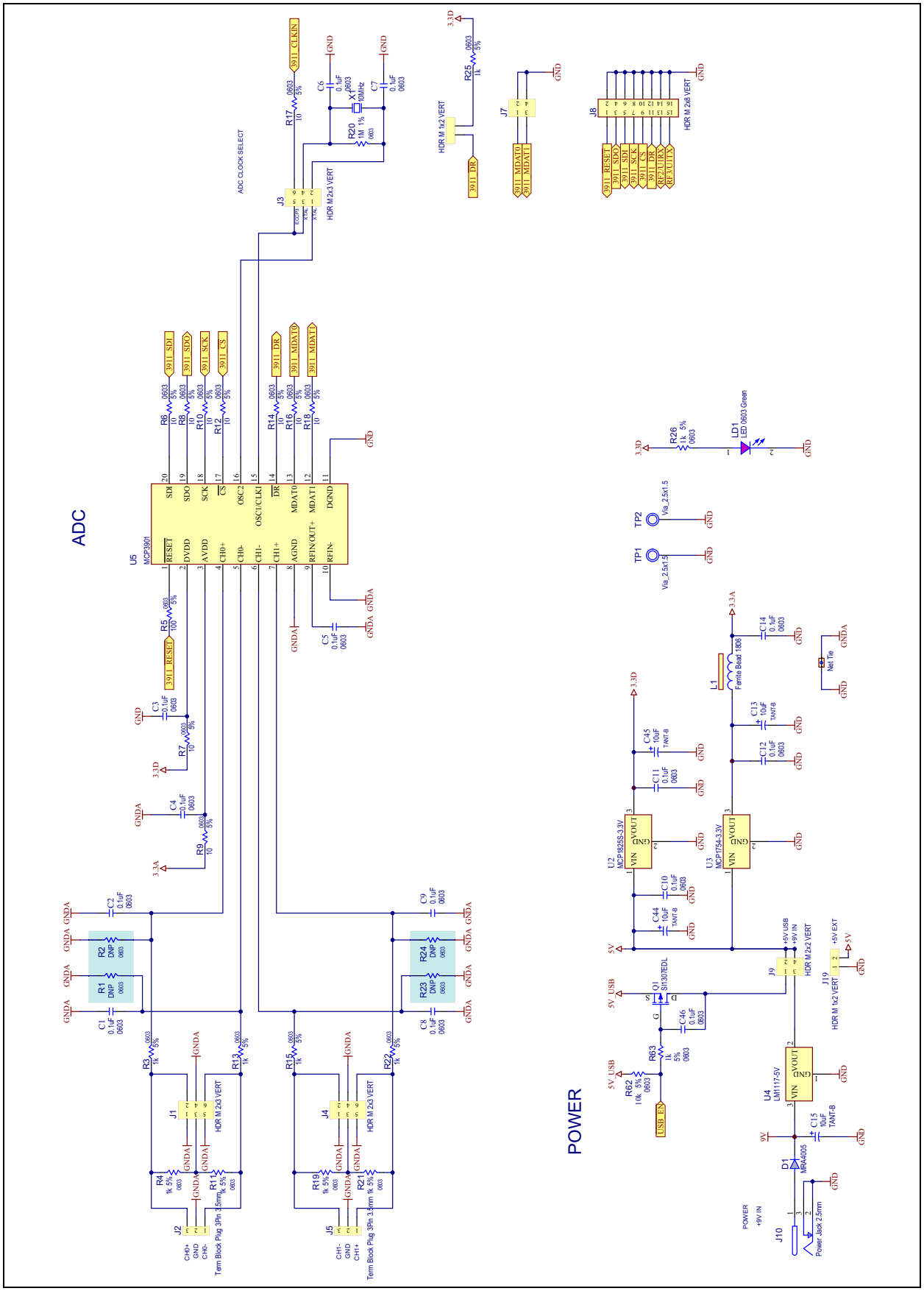
Appendix A. Schematics and Layouts

A.1 INTRODUCTION

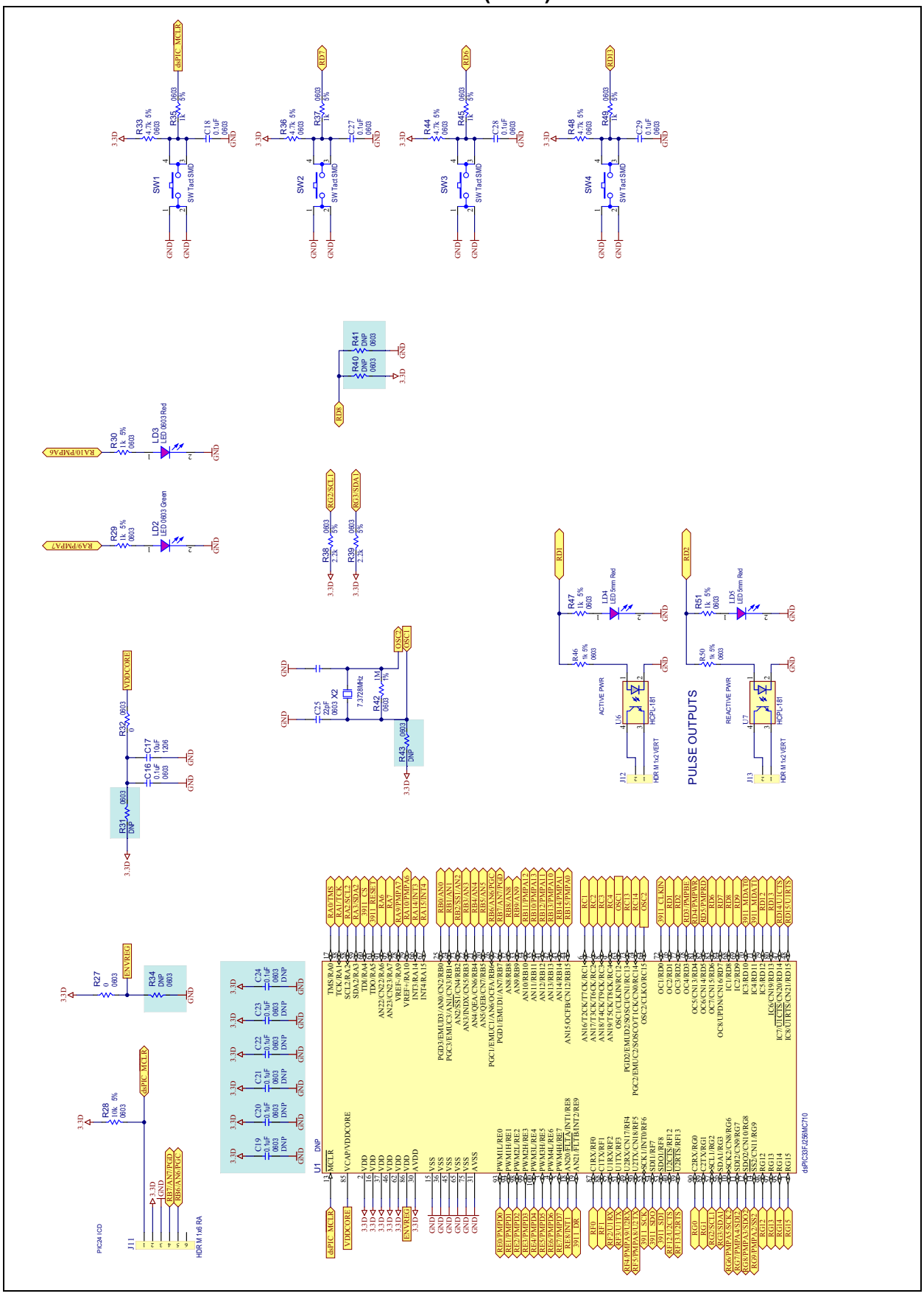
This appendix contains the following schematics of the MCP3911 ADC Evaluation Board for 16-Bit MCUs:

- Schematic - ADC and Power
- Schematic - Microcontroller (MCU)
- Schematic - PIM Module
- Schematic - LCD and UART
- Board - Top Trace and Top Silk
- Board - Bottom Trace and Bottom Silk
- Board - Layer #2 GND
- Board - Layer #3 V_{DD}
- Board - Top Silk and Pads
- Board - Bottom Silk and Pads

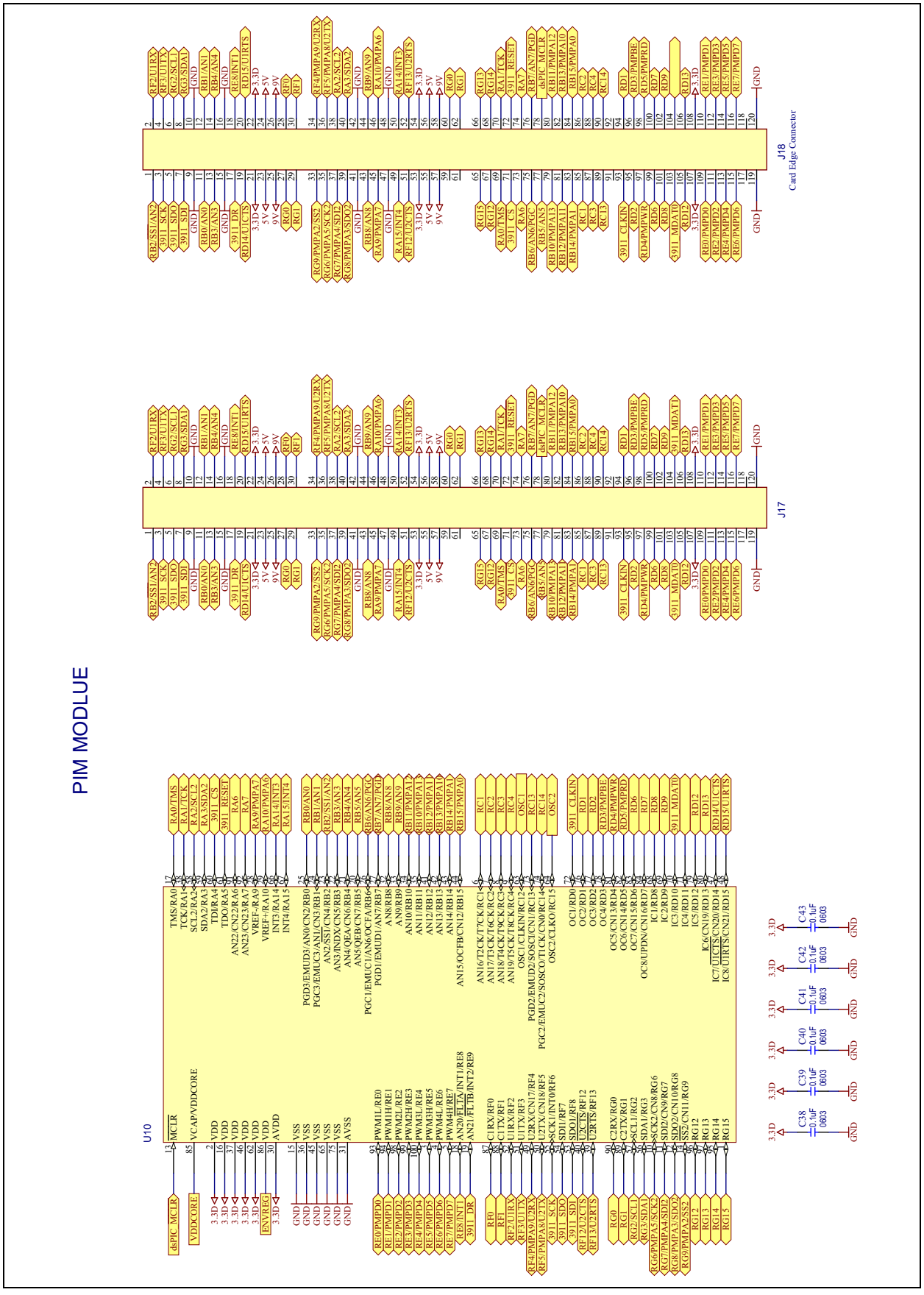
A.2 SCHEMATIC - ADC AND POWER



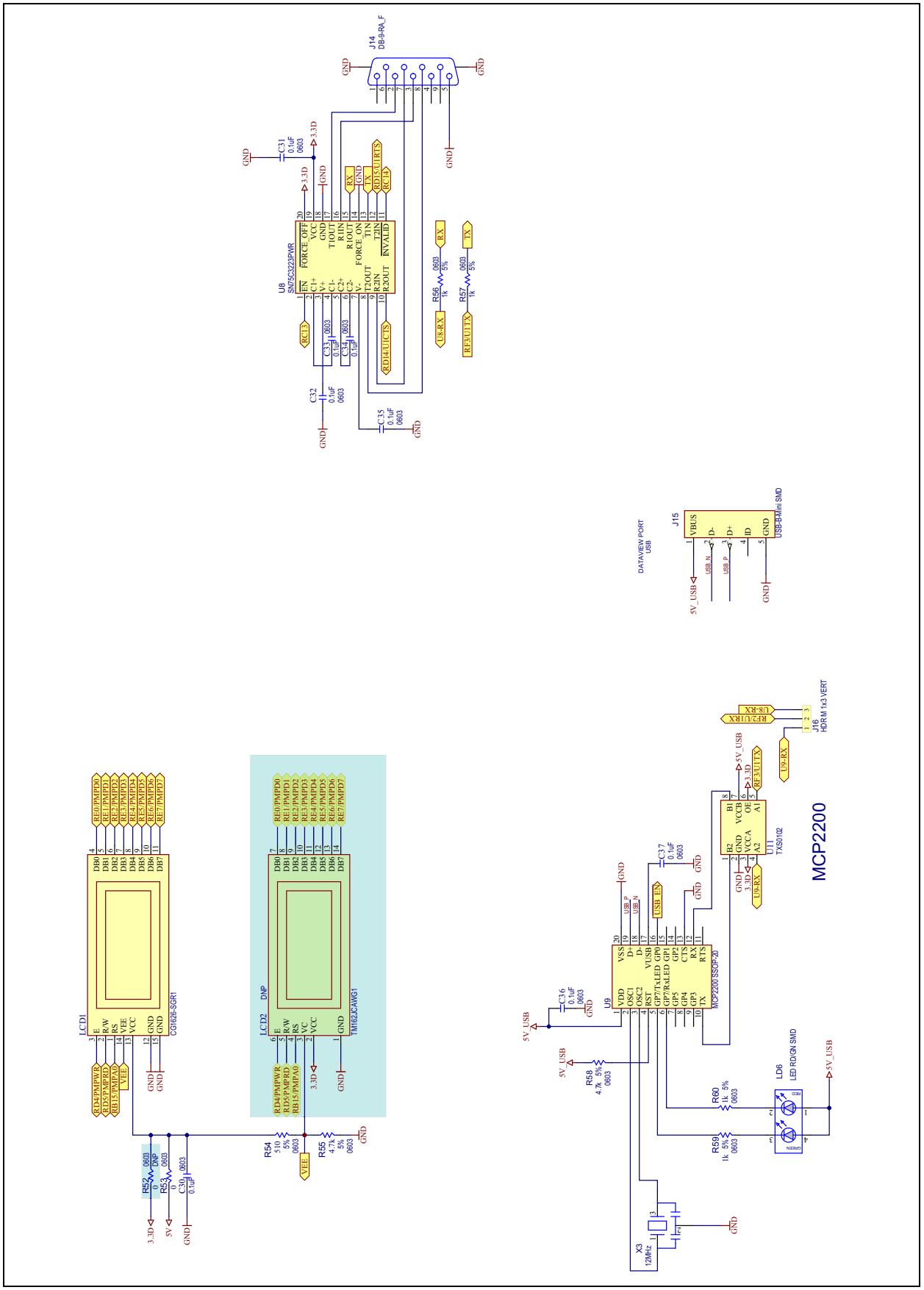
A.3 SCHEMATIC - MICROCONTROLLER (MCU)



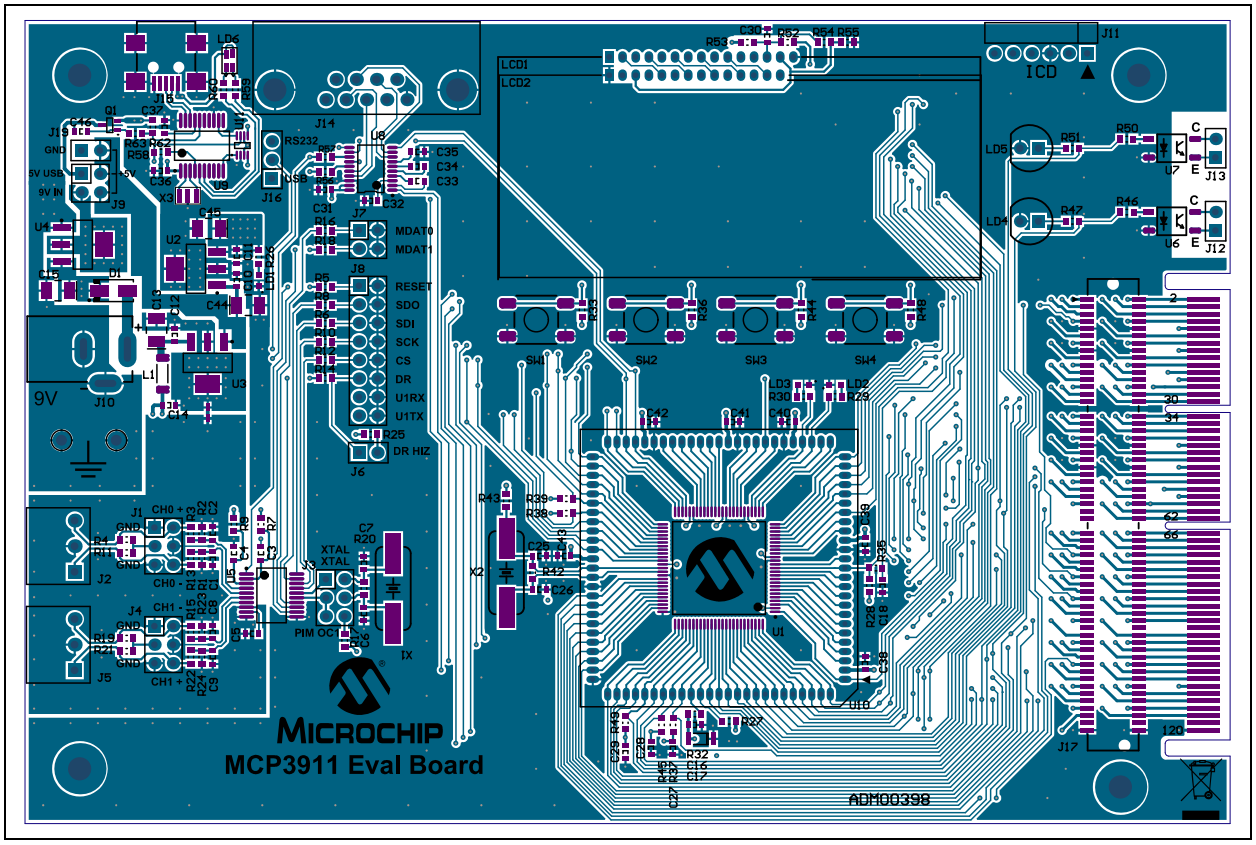
A.4 SCHEMATIC - PIM MODULE



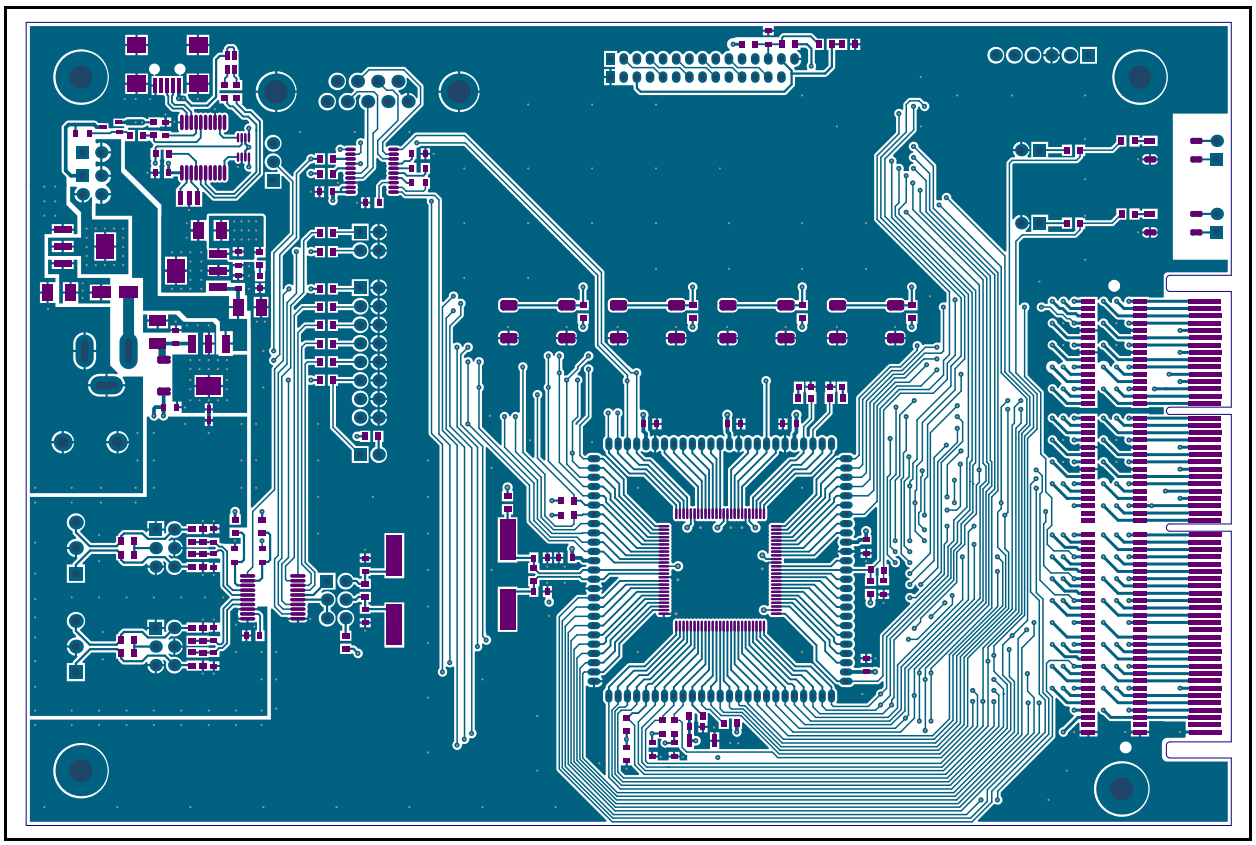
A.5 SCHEMATIC - LCD AND UART



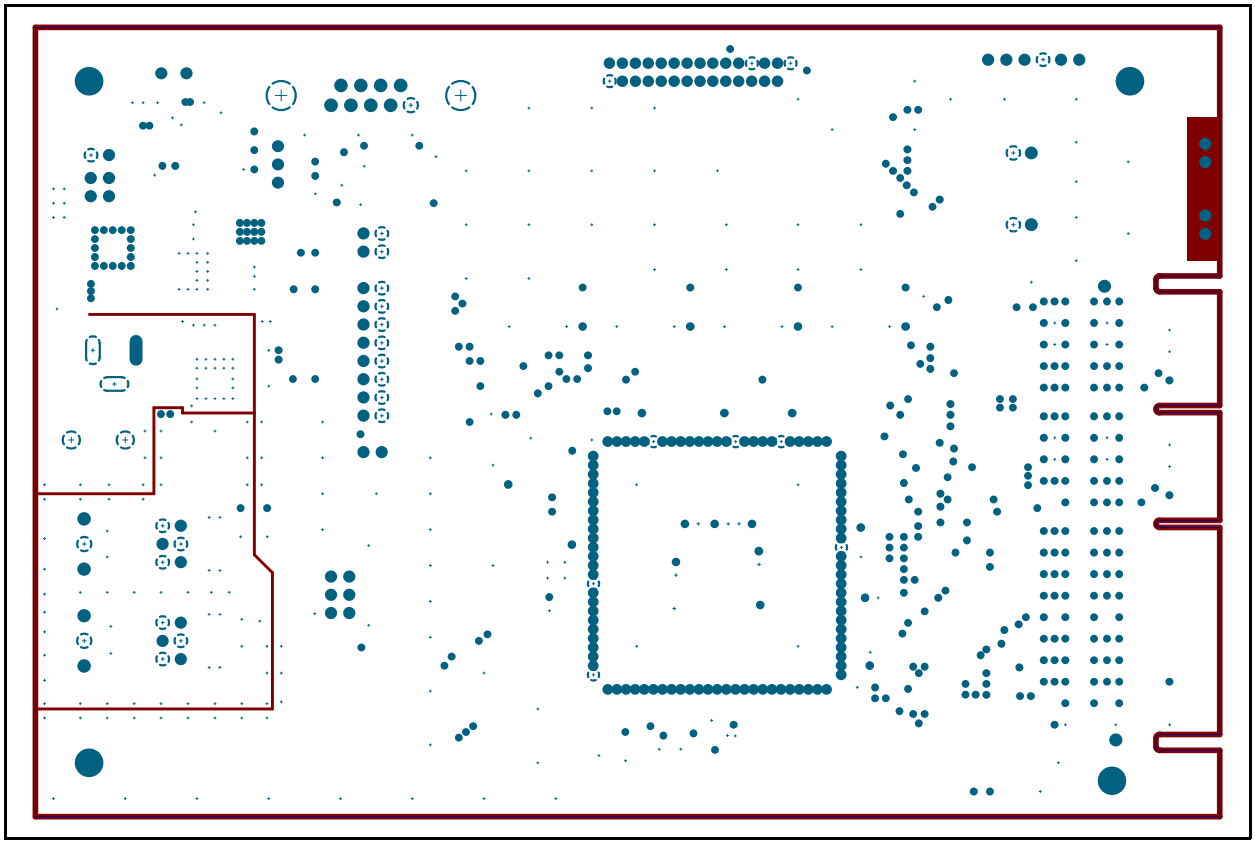
A.6 BOARD - TOP TRACE AND TOP SILK



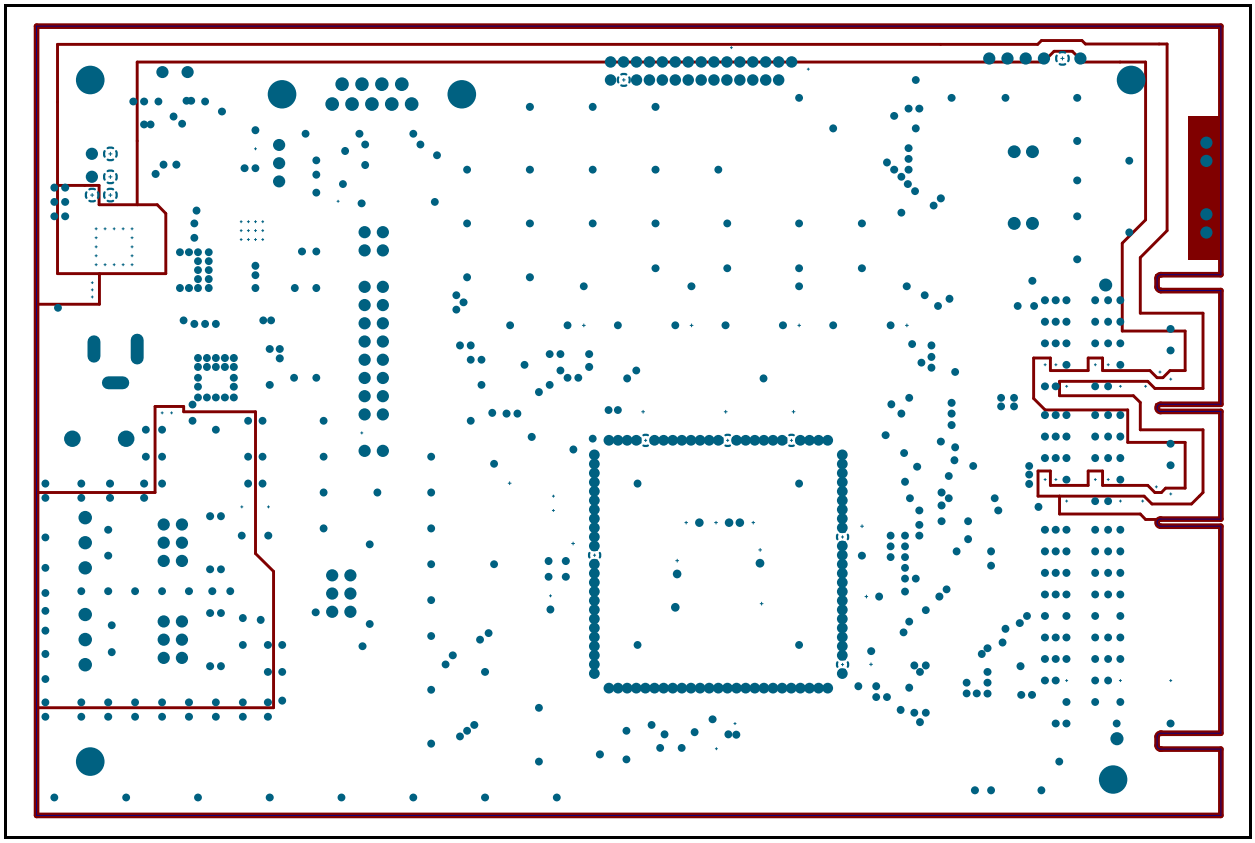
A.7 BOARD - BOTTOM TRACE AND BOTTOM SILK



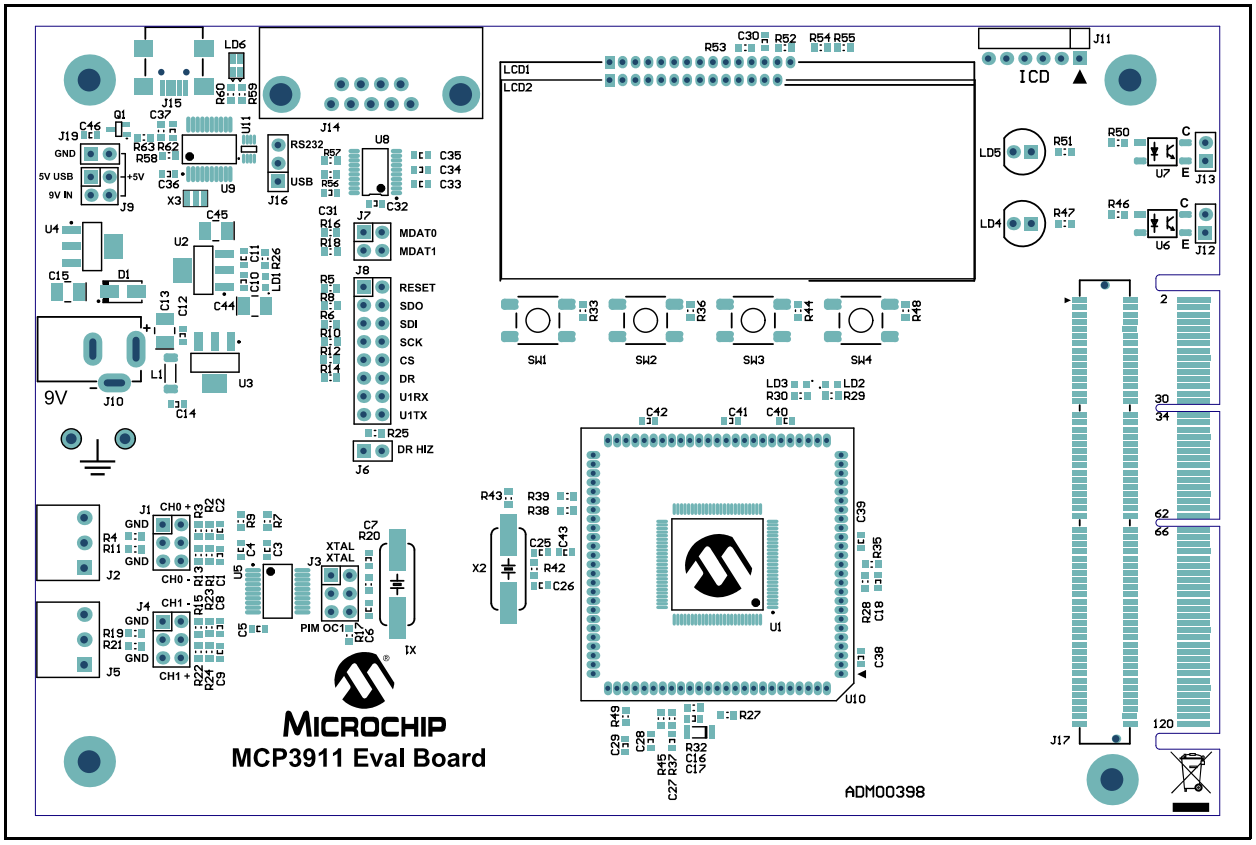
A.8 BOARD - LAYER #2 GND



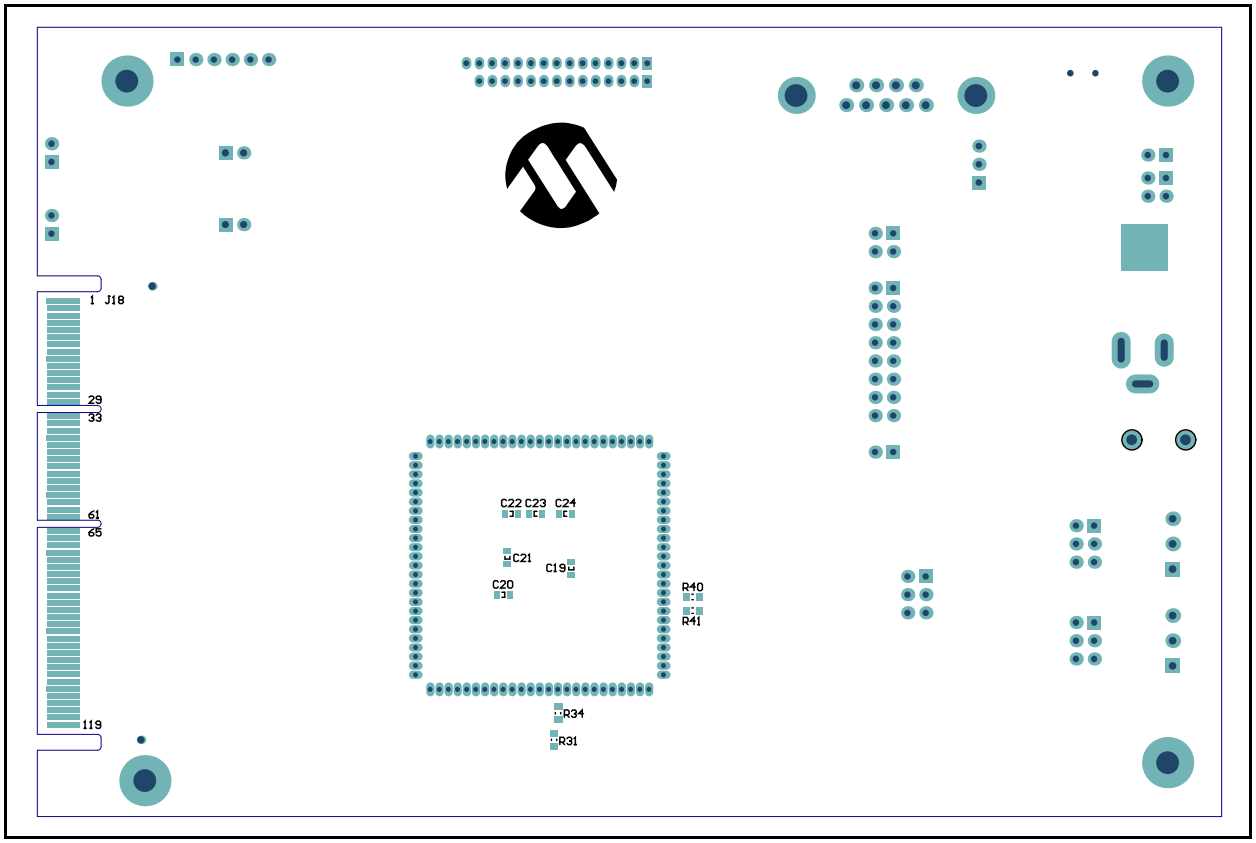
A.9 BOARD - LAYER #3 VDD



A.10 BOARD - TOP SILK AND PADS



A.11 BOARD - BOTTOM SILK AND PADS



Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty	Reference	Description	Manufacturer	Part Number
6	Jumper	Conn. Jumper Shorting .100" Gold	Sullins Connector Solutions	SPC02SVGN-RC
1	L1	Ferrite 300 mA 150 Ohm 1806 SMD	Laird Technologies	LI1806C151R-10
1	LCD1	LCD 16 X 2 Chip on glass reflective	Fema Electronics	CG1626-SGR1
1	LCD2	**DO NOT POPULATE -** LCD 16 X 2 FTN Reflective No. Blwt. Cog 3V	Tianma Microelectronics	TM162JCAWG1
2	LD1, LD2	LED Smartled Green 570 nm 0603	OSRAM Opto Semiconductors	LG L29K-G2J1-24-Z
1	LD3	LED Smartled 630 nm Red 0603 SMD	OSRAM Opto Semiconductors	LS L29K-G1J2-1-0-2-R18-Z
2	LD4, LD5	LED SS 5 mm 640 nm Red Diff.	Kingbright Corp.	WP7113LSRD
1	LD6	LED 2 X 1.2 mm Red/Green Wtr. Clr. SMD	Kingbright Corp.	APHBM2012SURKCGKC
1	Q1	MOSFET P-Ch G-S 12V SC-70-3	Vishay Siliconix	SI1307EDL-T1-GE3
10	R1, R2, R23, R24, R40, R41, R43, R52, R31, R34	**DO NOT POPULATE** - Res. 0603 SMD		
2	R20, R42	Res. 1M Ohm 1/10W 1% 0603 SMD	Panasonic - ECG	ERJ-3EKF1004V
2	R27, R32	Res. 0 Ohm 1/10W 0603 SMD	Panasonic - ECG	ERJ-3GEY0R00V
2	R28, R62	Res. 10k Ohm 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ103V
25	R3, R4, R11, R13, R15, R19, R21, R22, R25, R26, R29, R30, R35, R37, R45, R46, R47, R49, R50, R51, R56, R57, R59, R60, R63	Res. 1k Ohm 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ102V
5	R33, R36, R44, R48, R58	Res. 4.7k Ohm 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ472V
2	R38, R39	Res. 2.2k Ohm 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ222V
1	R53	Res. 56 Ohm 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ560V Digi-Key P56GCT-ND
1	R54	Res. 510 Ohm 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ511V Digi-Key P510GCT-ND
9	R5, R6, R8, R10, R12, R14, R16, R17, R18	Res. 100 Ohm 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ101V
4	R7, R9, R31, R34	Res. 10 Ohm 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ100V

Note 1: 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-1: BILL OF MATERIALS (BOM) (CONTINUED)

Qty	Reference	Description	Manufacturer	Part Number
4	SW1, SW2, SW3, SW4	Switch Tact. 6 mm 160 GF H = 4.3 mm	Omron Electronics	B3S-1000P
1	U1	**DO NOT POPULATE** - IC dsPIC® MCU/DSP 256K 100 TQFP	Microchip	dsPIC33FJ256MC710-I/PF
4	U10	25 X 1 Header 1.27 mm pitch (100-pin socket)	Samtec, Inc.	MTMS-125-01-G-S-230
1	U11	IC Volt-Level Translator US-8	Texas Instruments	TXS0102DCUR
1	U2	IC LDO Reg. 500 mA 3.3V SOT-223-3	Microchip	MCP1825S-3302E/DB
1	U3	IC Reg. LDO 150 mA 3.3V SOT-223-3	Microchip	MCP1754ST-3302E/DB
1	U4	IC Reg. LDO 800 mA 5V SOT-223	National Semiconductor	LM1117MPX-5.0/NOPB
1	U5	3.3V Two-Channel Analog Front End SSOP-20	Microchip	MCP3911A0T-I/SS
2	U6, U7	Photocoupler Trans. Out 4-Minipak	Avago Technologies	HCPL-181-00CE
1	U8	IC Line Driver/Receiver RS232 20-TSSOP	Texas Instruments	SN75C3223PWR
1	U9	IC USB to UART 20 SSOP	Microchip	MCP2200-I/SS
1	X1	Crystal 10.000 MHz 18 pF SMD	Abracon Corporation	ABLS-10.000MHZ-B4-T
1	X2	Crystal 7.3728 MHz 18 pF SMD	Abracon Corporation	ABLS-7.3728MHZ-B4-T
1	X3	Cer. Resonator 12.0 MHz SMD	Murata Electronics	CSTCE12M0G55-R0

Note 1: 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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Korea - Seoul
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