ECAN/LIN PICtail™ Plus Daughter Board User's Guide

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO/TS 16949:2002

Microchip received ISO/TS-16949:2002 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

ECAN/LIN PICtail™ PLUS DAUGHTER BOARD USER'S GUIDE

Table of Contents

NOTES:

ECAN/LIN PICtail™ PLUS DAUGHTER BOARD USER'S GUIDE

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 ECAN/LIN PICtail™ Plus Daughter Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the ECAN/LIN PICtail Plus Daughter Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. Introduction** – This chapter introduces the ECAN/LIN PICtail Plus Daughter Board and provides an overview of its features.
- **Chapter 2. Hardware** – This chapter provides a functional overview of the ECAN/LIN PICtail Plus Daughter Board and identifies the major hardware components.
- **Appendix A. Drawings and Schematics** – This appendix provides detailed technical drawings and schematic diagrams of the ECAN/LIN PICtail Plus Daughter 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) { ... }`

WARRANTY REGISTRATION

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in the Warranty Registration Card entitles users to receive new product updates. Interim software releases are available at the Microchip web site.

RECOMMENDED READING

This user's guide describes how to use ECAN/LIN PICtail Plus Daughter Board. Other useful documents are listed below. Microchip documents are available and recommended as supplemental reference resources.

Device Data Sheets

Refer to the data sheet for the specific dsPIC33F or PIC24 device you are using. Specifically, refer to the sections in these data sheets that provide detailed information on the device UART and ECAN modules.

Readme Files

For the latest information on using other tools, read the tool-specific Readme files in the Readmes subdirectory of the MPLAB® IDE installation directory. The Readme files contain update information and known issues that may not be included in this user's guide.

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

DEVELOPMENT SYSTEMS CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip web site at www.microchip.com, click on Customer Change Notification and follow the registration instructions.

The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools. These include the MPLAB C18 and MPLAB C30 C compilers; MPASM™ and MPLAB ASM30 assemblers; MPLINK™ and MPLAB LINK30 object linkers; and MPLIB™ and MPLAB LIB30 object librarians.
- **Emulators** – The latest information on Microchip in-circuit emulators.This includes the MPLAB ICE 2000 and MPLAB ICE 4000.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 2.
- **MPLAB® IDE** – The latest information on Microchip MPLAB IDE, the Windows® Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB SIM simulator, MPLAB IDE Project Manager and general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 and PRO MATE® II device programmers and the PICSTART® Plus and PICkit™ 1 development programmers.

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 (January 2008)

- Initial Release of this Document.

Chapter 1. Introduction

Thank you for purchasing Microchip Technology's ECAN/LIN PICtail Plus Daughter Board. This board is used with the Explorer 16 Development Board to facilitate rapid implementation and evaluation of applications that use Controller Area Network (CAN) and Local Interconnect Network (LIN) interfaces and are implemented on dsPIC33F Digital Signal Controllers and PIC24 16-bit microcontrollers.

This chapter introduces the ECAN/LIN PICtail Plus Daughter Board and provides an overview of its features. Topics covered include:

- Overview
- Functional Overview

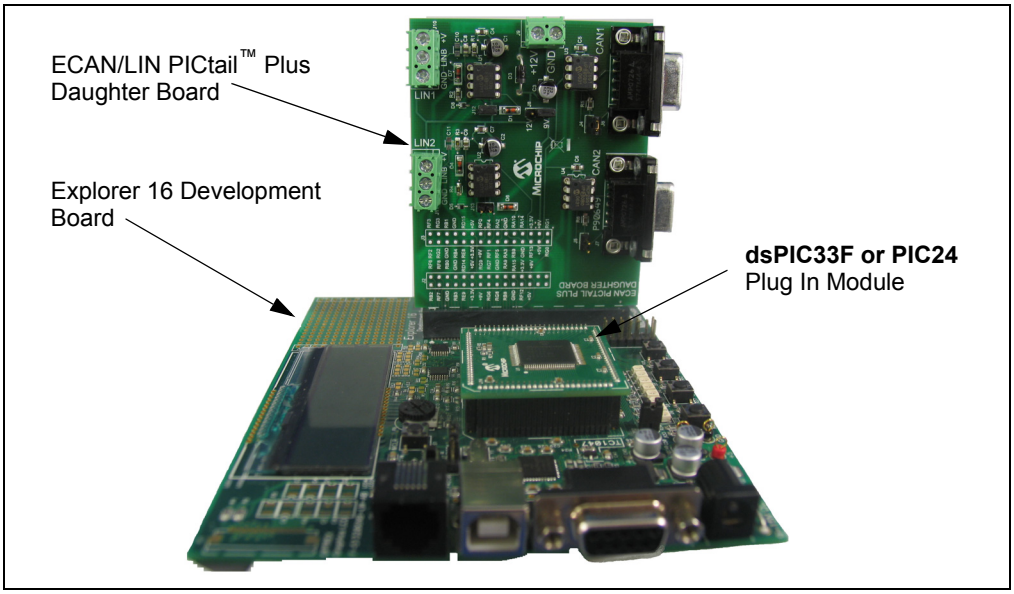
1.1 OVERVIEW

The ECAN/LIN PICtail Plus Daughter Board augments development of dsPIC33F and PIC24 based applications on the Explorer 16 Development Board. It offers two interfaces: one for a CAN Bus and one for a LIN Bus. Although CAN and LIN protocols are used most extensively in automotive applications, the ECAN/LIN PICtail Plus Daughter Board can be used in any application that requires interfacing to a CAN and LIN bus.

Both interfaces can be used simultaneously. Appropriate bus transceivers on the ECAN/LIN PICtail Plus Daughter Board complete the physical layer requirements of the CAN and LIN bus protocols. In both cases, communication is driven by the dsPIC33F or PIC24 device on the Explorer 16 board.

Figure 1-1 shows the ECAN/LIN PICtail Plus Daughter Board plugged into the PICtail Plus slot on the Explorer 16 Development Board. The ECAN/LIN PICtail Plus Daughter Board draws 9V, 5V and 3.3V DC power from the Explorer 16 Development Board. The external power supply and MPLAB ICD 2 are plugged into the Explorer 16 board.

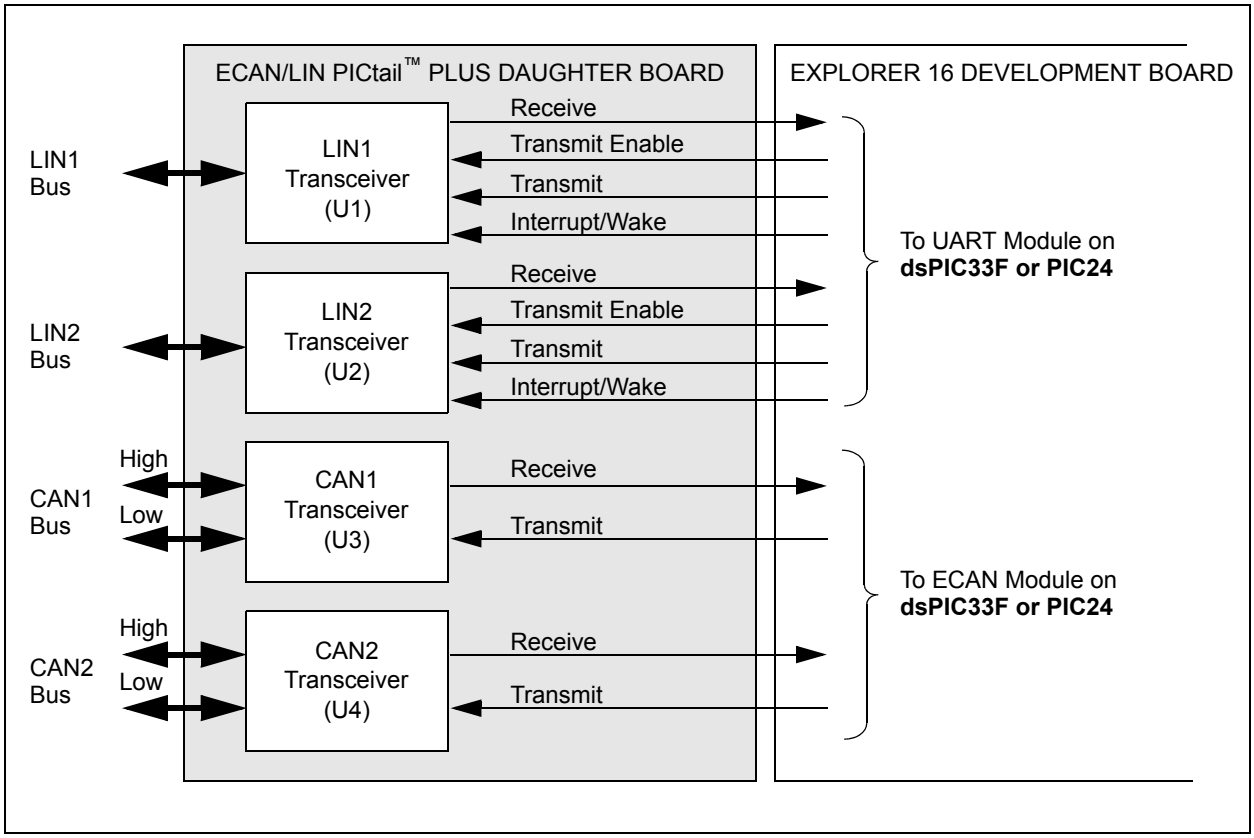
FIGURE 1-1: ECAN/LIN PICtail™ PLUS DAUGHTER BOARD



1.2 FUNCTIONAL OVERVIEW

The block diagram shown in Figure 1-2 illustrates the mainstream operation of the ECAN/LIN PICtail Plus Daughter Board. The board contains two LIN signal conditioning circuits and two CAN signal conditioning circuits. The board also enables power to be provided by the Explorer 16 Development Board or by an external 12V DC source.

FIGURE 1-2: ECAN/LIN PICtail™ PLUS DAUGHTER BOARD BLOCK DIAGRAM



1.2.1 LIN Operation

The ECAN/LIN PICtail Plus Daughter Board connects two LIN transceivers with integrated voltage regulators to UART modules on a dsPIC33F or PIC24 control device on the Explorer 16 board. The LIN transceiver monitors the LIN bus, conditions the incoming signal and passes it to the UART module on the control device. The LIN transceiver responds to a "Transmit Enable" from the control device by conditioning an output signal and placing it on the LIN bus.

A power-down mode turns the transmitter and voltage regulator off, leaving only the receiver and wake-up circuits in operation. Each LIN circuit includes a Master/Slave jumper to accommodate a Master node on the LIN bus.

For detailed information on the MCP2021-330 LIN Transceiver, refer to Microchip Data Sheet MCP202X *"LIN Transceiver with Voltage Regulator"* (DS22018).

1.2.2 CAN Operation

The ECAN/LIN PICtail Plus Daughter Board connects two high-speed CAN transceivers to ECAN modules on the control device on the Explorer 16 board. The CAN transceivers convert the differential signal on the CAN bus to a digital signal for the ECAN module. It also converts the ECAN output digital signal to a differential signal for the CAN bus.

In Sleep mode, the CAN transmitter is turned off, and the receiver operates at a lower current level. The control device monitors CAN activity and switches the transceiver back to normal operation when needed.

For detailed information on the MCP2551 High-Speed CAN Transceiver, refer to Microchip Data Sheet MCP2551 *"High-Speed CAN Transceiver"* (DS21667).

NOTES:

Chapter 2. Hardware

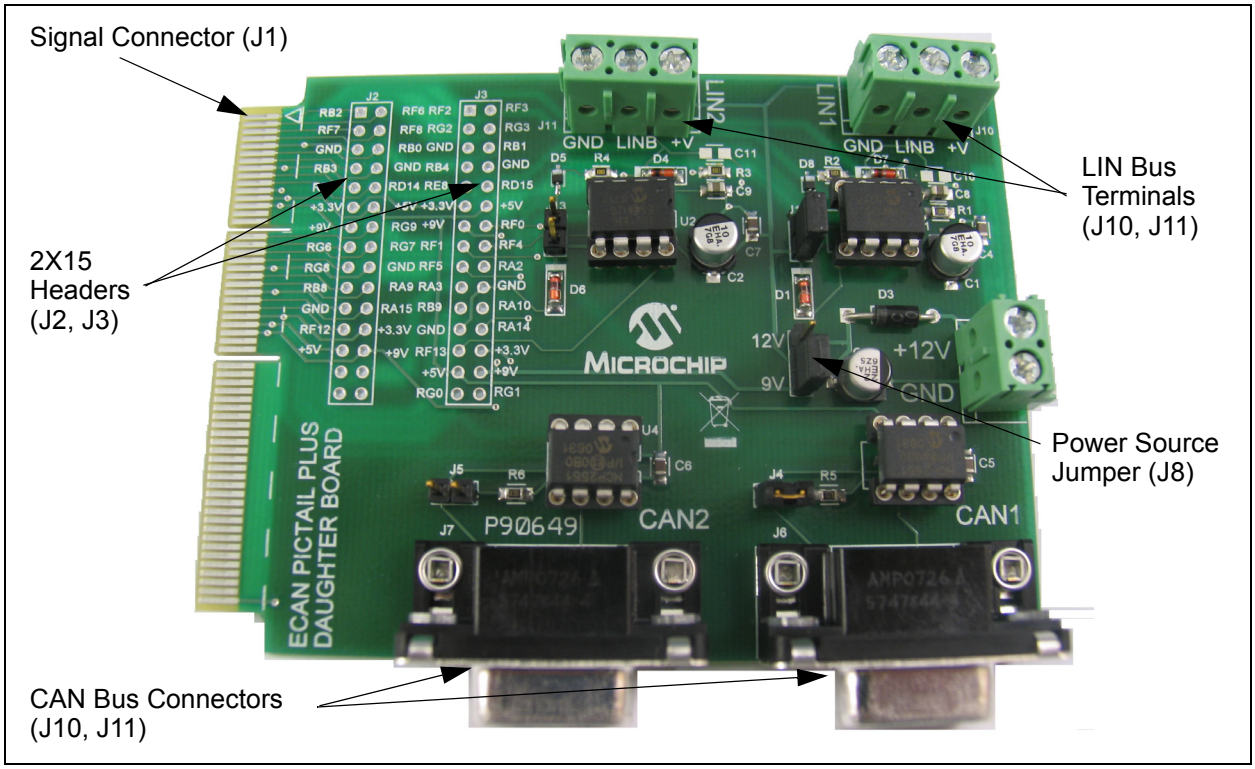
This chapter provides a functional overview of the ECAN/LIN PICtail Plus Daughter Board and identifies the major hardware components. Topics covered include:

- Board Setup
- Hardware Components

2.1 BOARD SETUP

Figure 2-1 is a photograph of ECAN/LIN PICtail Plus Daughter Board. Callouts indicate the CAN bus, LIN bus and signal connections on the daughter board. Also shown are two 2x15 headers that provide signals from the Explorer 16 board. These headers can be probed for development, testing or monitoring of the application.

FIGURE 2-1: ECAN/LIN PICtail™ PLUS DAUGHTER BOARD

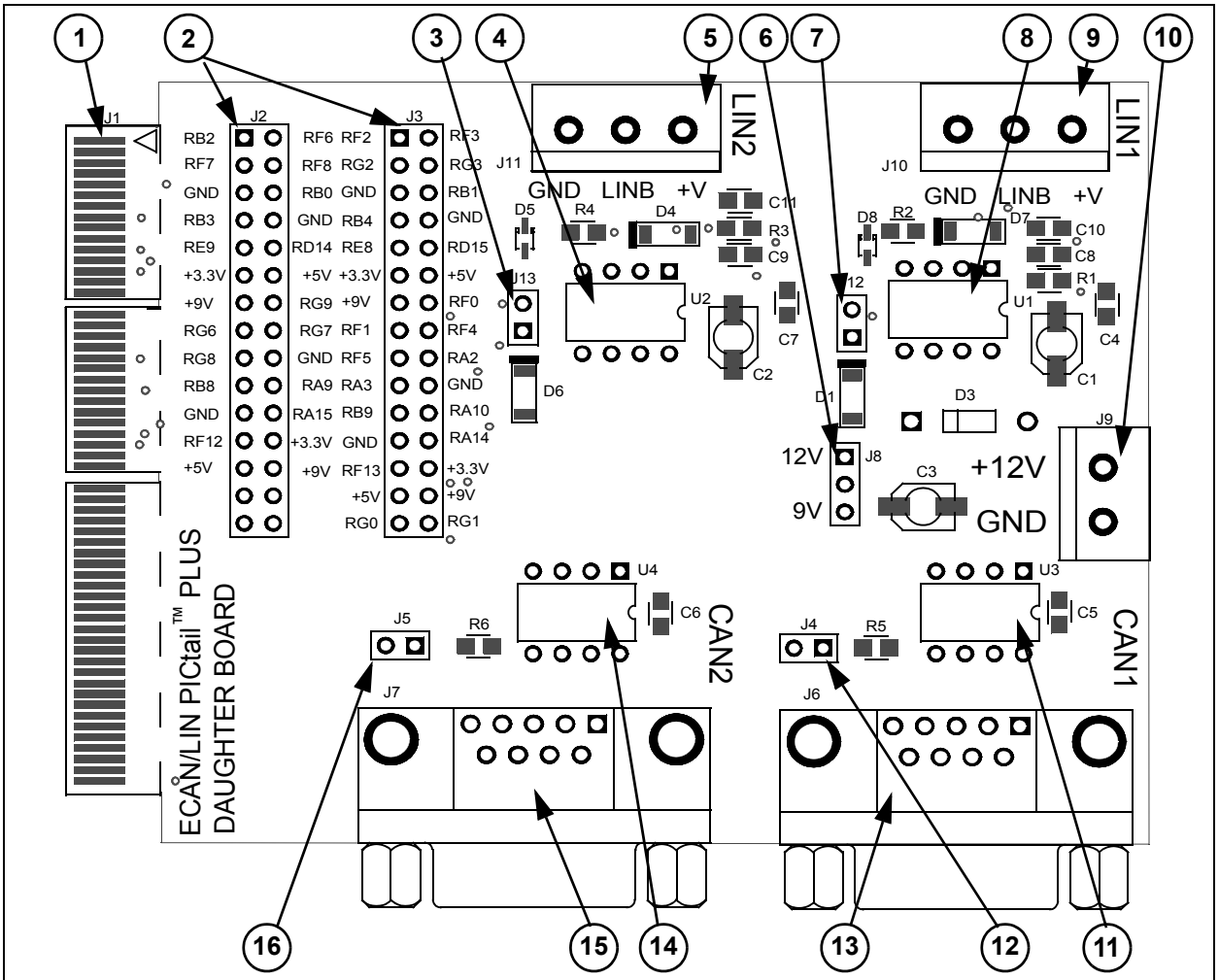


The daughter board obtains 9V DC input power from the Explorer 16 Development Board through the 120-pin signal connector (J1). The power supply to the LIN Bus Transceivers is switchable between the 9V available from Explorer 16 Development Board or an external +12V supply. This external power supply must be connected to J9. Jumper J8 must be set to use the required power supply.

2.2 HARDWARE COMPONENTS

Figure 2-2 identifies the key hardware components on the ECAN/LIN PICtail Plus Daughter Board.

FIGURE 2-2: ECAN/LIN PICtail™ PLUS DAUGHTER BOARD



No.	Description	No.	Description
1	Explorer 16 Board PICtail™ Connector (J1)	9	LIN1 Bus Connector (J10)
2	Auxilliary Headers (J2, J3)	10	LIN External +12V DC Terminal Block (J9)
3	LIN2 Master/Slave Jumper (J13)	11	CAN1 Transceiver (U3)
4	LIN2 Transceiver (U2)	12	CAN1 Bus Termination Jumper (J4)
5	LIN2 Bus Connector (J11)	13	CAN1 Bus Connector (J6)
6	LIN Power Select Jumper (J8)	14	CAN2 Transceiver (U4)
7	LIN1 Master/Slave Jumper (J12)	15	CAN2 Bus Connector (J7)
8	LIN1 Transceiver (U1)	16	CAN2 Bus Termination Jumper (J5)

2.2.1 Explorer 16 Board PICtail™ Connector (J1)

Explorer 16 Board PICtail connector J1 (see Reference 1) is a 120-pin signal connector that carries signals from the I/O pins of the dsPIC33F or PIC24 device on the Explorer 16 board to the ECAN/LIN PICtail Plus Daughter Board. This connector handles the following signals:

- 9V, 5V and 3.3V DC input to the ECAN/LIN PICtail Plus Daughter Board
- Signals from the ECAN modules on the dsPIC33F or PIC24 device to the CAN transceivers on the ECAN/LIN PICtail Plus Daughter Board
- Signals from the UART modules on the dsPIC33F or PIC24 device to the LIN transceivers on the ECAN/LIN PICtail Plus Daughter Board
- LIN Bus Fault Communication

2.2.2 Auxilliary Headers (J2, J3)

Auxilliary Headers J2 and J3 (see Reference 2) make available a various set of signals from the Explorer 16 Development Board. These headers can be used for monitoring, testing and development purposes. Refer to the Board schematic for more details of these headers.

2.2.3 LIN Bus Master/Slave Select Jumpers (J12, J13)

The LIN1 and LIN2 Bus Master/Slave Select Jumpers (see Reference 3 or Reference 7) are used to indicate the presence of a master device on the LIN Bus. Placing jumper J13 or J12 pulls the LIN Bus high via a 1K pull-up resistor. This can be detected by nodes on the LIN bus as an indication that a Master node is present. There can be only one Master node on a LIN bus.

2.2.4 LIN Transceivers (U1, U2)

A set of MCP2021 LIN Transceivers (see Reference 8 and Reference 4) provide the interface between the UART modules on the dsPIC33F or PIC24 device and the LIN bus. The transceiver converts the signals from the UART modules on the control device to a 5V regulated signal for the LIN Bus. The power supply to the LIN Transceivers is selectable between +12V or +9V with jumper J8 (see Reference 6). While the +9V is available from the Explorer 16 Development Board, the +12V supply must be connected externally to J9 (see Reference 10).

2.2.5 LIN Bus Connectors (J10, J11)

The LIN1 and LIN2 Bus Connectors are 3-pin terminal blocks that connect the ECAN/LIN PICtail Plus Daughter Board to a LIN Bus. LIN1 connector J10 (see Reference 9) connects UART1 module on the dsPIC33F or PIC24 control device to the LIN Bus via the LIN1 Transceiver. LIN2 connector J11 (see Reference 5) connects UART 2 module on the dsPIC33F or PIC24 control device to the LIN Bus via the LIN2 Transceiver.

2.2.6 LIN Transceiver Power Supply Select Jumper (J8)

This 3-pin jumper (see Reference 6) selects the power supply to LIN Transceivers U1 and U2. Either +9V DC is supplied from the Explorer 16 Development Board or +12V DC is supplied from an external power supply connected to J9 (see Reference 10).

2.2.7 External +12V DC LIN Power Supply Terminal Block (J9)

External +12V DC power for the LIN transceivers must be connected to J9 (see Reference 10).

2.2.8 CAN Transceivers (U3, U4)

A pair of MCP2551 CAN Transceivers (see Reference 11 and Reference 14) provide the interface between the ECAN modules on the dsPIC33F or PIC24 control device and the CAN bus. The transceiver converts the signals from the ECAN modules on the dsPIC33F or PIC24 device to a pair of differential CAN Bus signals.

2.2.9 CAN Bus Termination Jumpers (J4, J5)

Termination Jumpers (J4, J5) are provided to terminate the CAN Bus. Jumper J4 (see Reference 12) places a 120 ohm termination resistor across the CAN bus connected to CAN1. Jumper J5 (see Reference 16) places a 120 ohm termination resistor across the CAN bus connected to CAN2.

2.2.10 CAN Bus Connectors (J6, J7)

Nine-pin D-type connectors connect the ECAN/LIN PICtail Plus Daughter Board to a CAN Bus. CAN1 connector J6 (see Reference 13) connects ECAN 1 module on the dsPIC33F or PIC24 control device to the CAN Bus via the CAN Transceiver. CAN2 connector J7 (see Reference 15) connects ECAN 2 module on the dsPIC33F or PIC24 device to the CAN Bus via the CAN Transceiver. The CAN bus provides high and low differential signals.

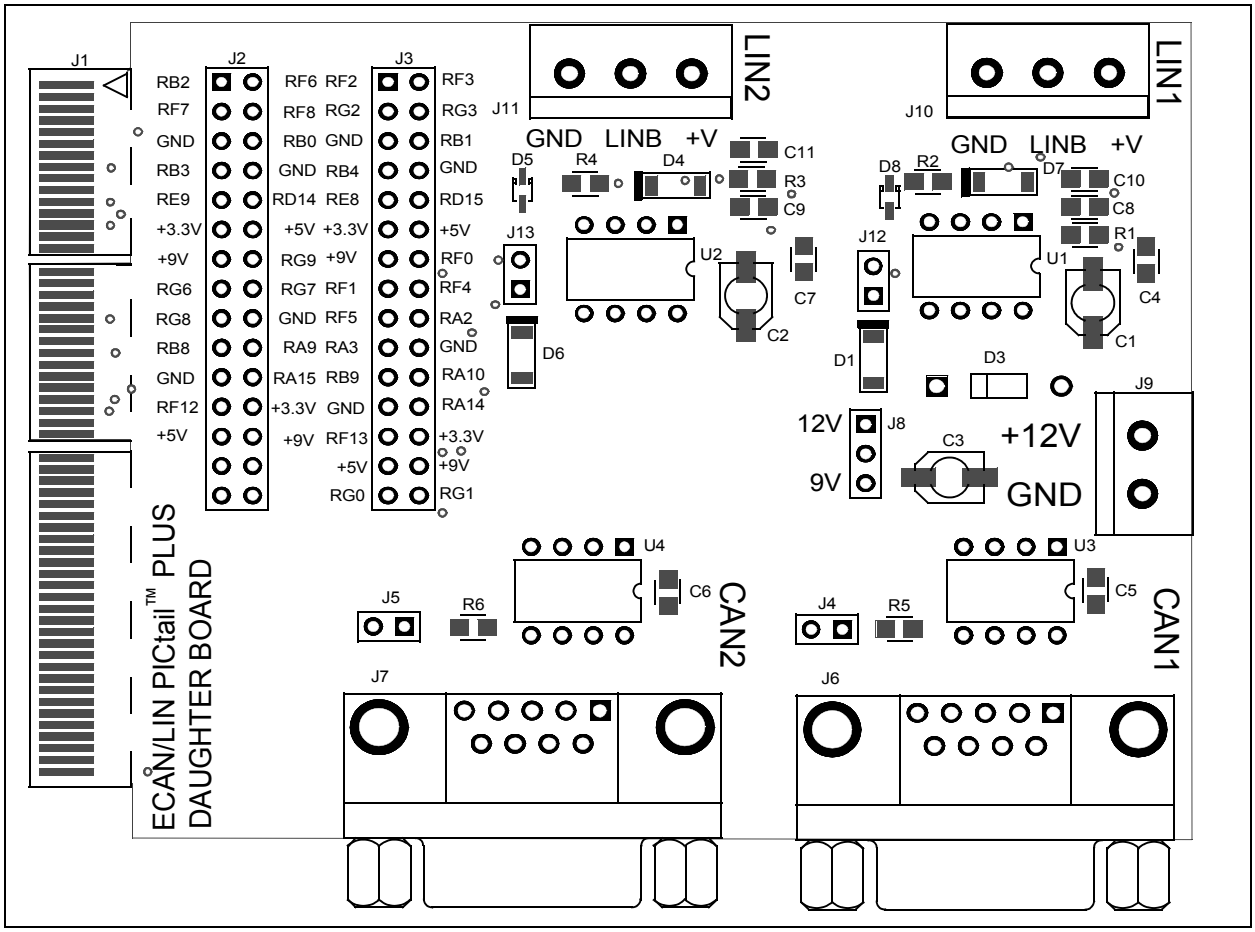
Appendix A. Drawings and Schematics

This appendix provides drawings and schematic diagrams of the ECAN/LIN PICtail Plus Daughter Board.

A.1 ECAN/LIN PICTAIL PLUS DAUGHTER BOARD LAYOUT

Figure A-1 is a drawing of the ECAN/LIN PICtail Plus Daughter Board layout.

FIGURE A-1: ECAN/LIN PICtail™ PLUS DAUGHTER BOARD LAYOUT



A.2 SCHEMATIC DIAGRAMS

The following schematic diagrams are included in this appendix:

- Figure A-2: LIN Circuit Schematics
- Figure A-3: CAN Circuit Schematics
- Figure A-4: Connector and Header Pinout Schematics

FIGURE A-2: LIN CIRCUIT SCHEMATICS

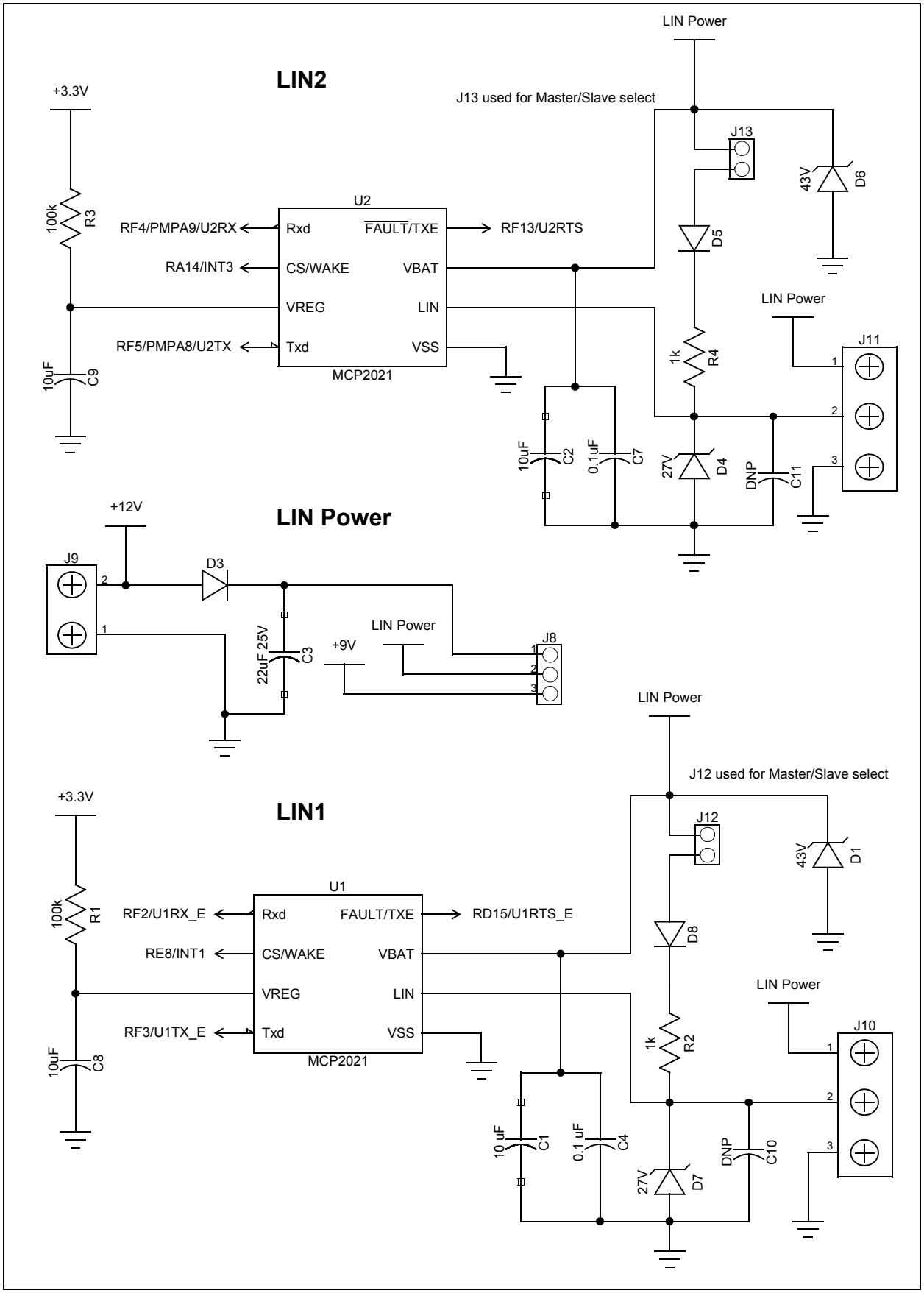


FIGURE A-3: CAN CIRCUIT SCHEMATICS

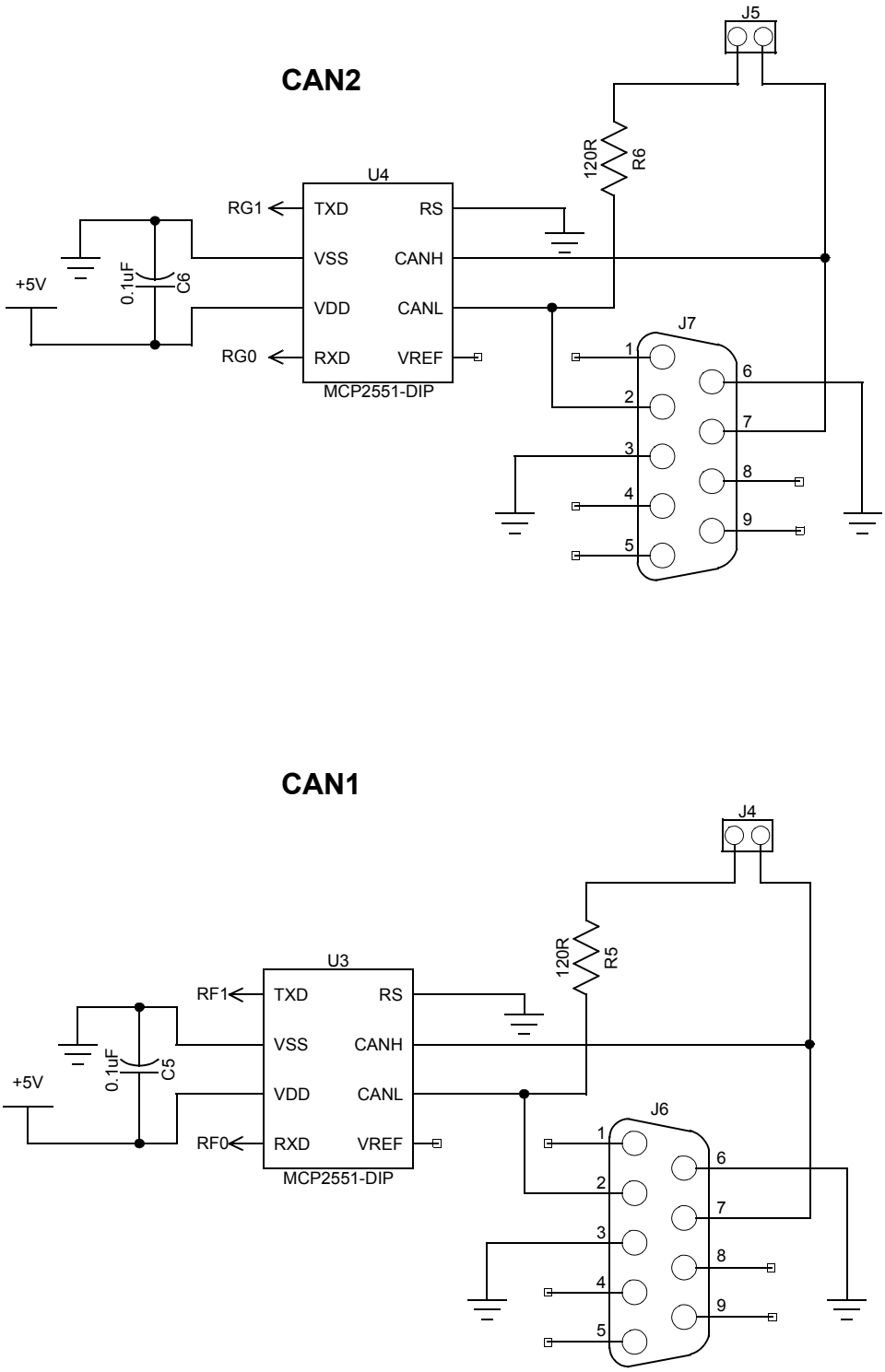
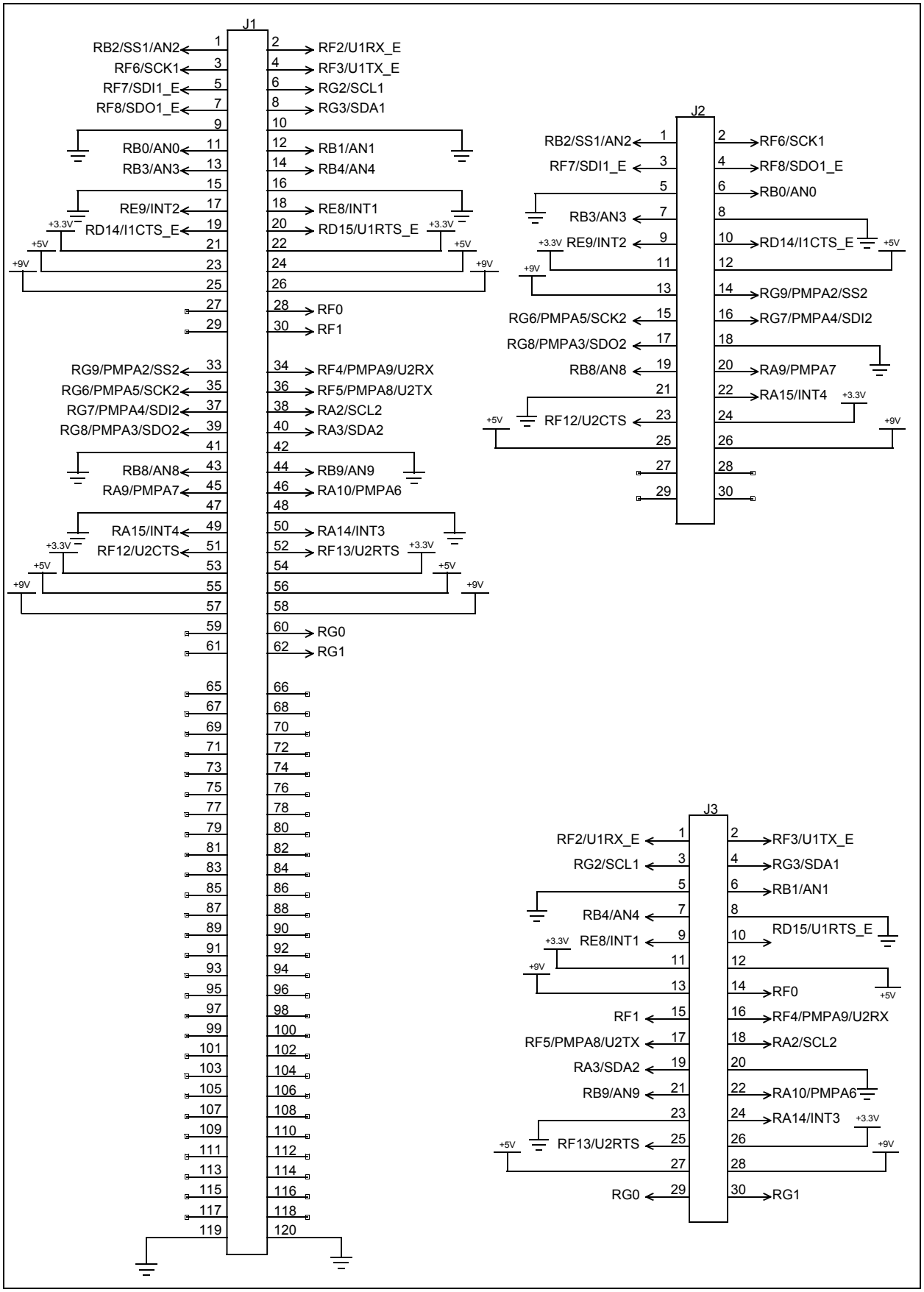


FIGURE A-4: CONNECTOR AND HEADER PINOUT SCHEMATICS



Index

WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://support.microchip.com
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

Santa Clara
Santa Clara, CA
Tel: 408-961-6444
Fax: 408-961-6445

Toronto
Mississauga, Ontario,
Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-4182-8400
Fax: 91-80-4182-8422

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Yokohama
Tel: 81-45-471- 6166
Fax: 81-45-471-6122

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-572-9526
Fax: 886-3-572-6459

Taiwan - Kaohsiung
Tel: 886-7-536-4818
Fax: 886-7-536-4803

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

01/02/08