Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!

Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Buck/Boost Converter 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.

Trademarks

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.

BUCK/BOOST CONVERTER PICtail™ PLUS DAUGHTER BOARD USER'S GUIDE

Table of Contents

NOTES:

BUCK/BOOST CONVERTER 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 Chapter Name. 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 Buck/Boost Converter 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 describes the Buck/Boost Converter PICtail Plus Daughter Board and provides a brief description of the hardware.
- **Chapter 2. "Hardware Overview"** – This chapter describes the Buck/Boost Converter PICtail Plus Daughter Board hardware.
- **Chapter 3. "Getting Started"** – This chapter describes the step-by-step process for getting your Buck/Boost Converter PICtail Plus Daughter Board up and running with the MPLAB® In-Circuit Debugger 2 (ICD 2) using a dsPIC33FJ16GS502 device.

- **Chapter 4. "Demonstration Program Operation"** – This chapter describes the operation of the Buck/Boost Converter PICtail Plus Daughter Board.
- **Appendix A. "Schematics and Layouts"** – This appendix illustrates the Buck/Boost Converter PICtail Plus Daughter Board layout and provides hardware schematic diagrams.

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 the Chapter Name. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

Readme for Chapter Name

For the latest information on using Chapter Name, read the "`Readme.txt`" (an ASCII text file) in the `Readme` subdirectory of the MPLAB IDE installation directory from the Buck/Boost Converter PICtail Plus Daughter Board CD. The Readme file contains update information and known issues that may not be included in this user's guide.

Readme Files

For the latest information on using other tools, read the tool-specific Readme files in the `Readme` subdirectory of the MPLAB IDE installation directory. The Readme files contain updated 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, MPLAB ICE 4000, and MPLAB REAL ICE™ in-circuit emulator.
- **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 (August 2008)

This is the initial release of this document.

NOTES:

Chapter 1. Introduction

Modern power supplies are becoming smaller, more efficient, more flexible and less expensive. These desirable enhancements have come about as digital signal controllers are incorporated into Switch Mode Power Supply (SMPS) designs. Buck converters are used when the desired output voltage is smaller than the input voltage. Boost converters are used when the desired output voltage is higher than the input voltage.

This chapter introduces and provides an overview of the Buck/Boost Converter PICtail Plus Daughter Board. The following topics are included in this chapter:

- Overview
- Features
- Product Package

1.1 OVERVIEW

The Buck/Boost Converter PICtail Plus Daughter Board (also referred to as Daughter Board) is a power supply board. It consists of two independent DC/DC synchronous buck converters and one independent DC/DC boost converter. Figure 1-1 illustrates a block diagram of the Daughter Board.

All of the necessary power, drive and control signals are available in the J1 and J2 connectors. The 16-bit 28-pin Starter Development Board can be used to control one independent DC/DC synchronous buck converters. This board can also control two buck stages, or one buck and one boost stage with hardware modification on the 16-bit 28-pin Starter Development Board. Refer to **Section 2.4.2 "16-bit 28-pin Starter Development Board Controls Buck 1 and Boost Stages"** for more details.

The block diagram of the Daughter Board using the 16-bit 28-pin Starter Development Board is shown in Figure 1-2. All three stages of the Buck/Boost Converter PICtail Plus Daughter Board are controlled by the Explorer 16 Development Board. Figure 1-3 shows a block diagram of the Daughter Board using the Explorer 16 Development Board.

The control boards provide closed-loop Proportional-Integral-Derivative (PID) control in the software to maintain the desired output voltage level. The dsPIC® DSC device provides the necessary memory and peripherals for A/D conversion, PWM generation, analog comparison and general purpose I/O, excluding the need to perform these functions in external circuitry.

SMPS dsPIC® DSC devices are specifically designed to provide low-cost and efficient control for a wide range of power supply topologies. The specialized peripherals facilitate closed-loop feedback control of switch mode power supplies, providing communication for remote monitoring and supervisory control.

The Daughter Board enables the end user to easily transition from analog-to-digital implementation of the power application. The Daughter Board also aids in rapid development of buck converter, boost converter, multi-phase buck converter and two parallel buck converters.

The dsPIC33F SMPS family of devices provides the following features:

- Integrated program and data memory on a single chip
- Ultra-fast interrupt response time and hardware interrupt priority logic
- Up to 4 Msps, on-chip ADC with two SARs, and up to four dedicated and two shared sample/hold circuits for multiple loop control
- Four independent, high-resolution PWM generators specially designed to support different power topologies
- Four analog comparators for control loop implementation and system protection
- On-chip system communications (I^2C™/SPI/UART)
- On-chip Fast RC oscillator for lower system cost
- High-current sink/source for PWM pins: 16 mA/16 mA
- CPU performance: 40 MIPS
- Extensive power saving
- CodeGuard™ Security enabled

FIGURE 1-1: DAUGHTER BOARD BLOCK DIAGRAM

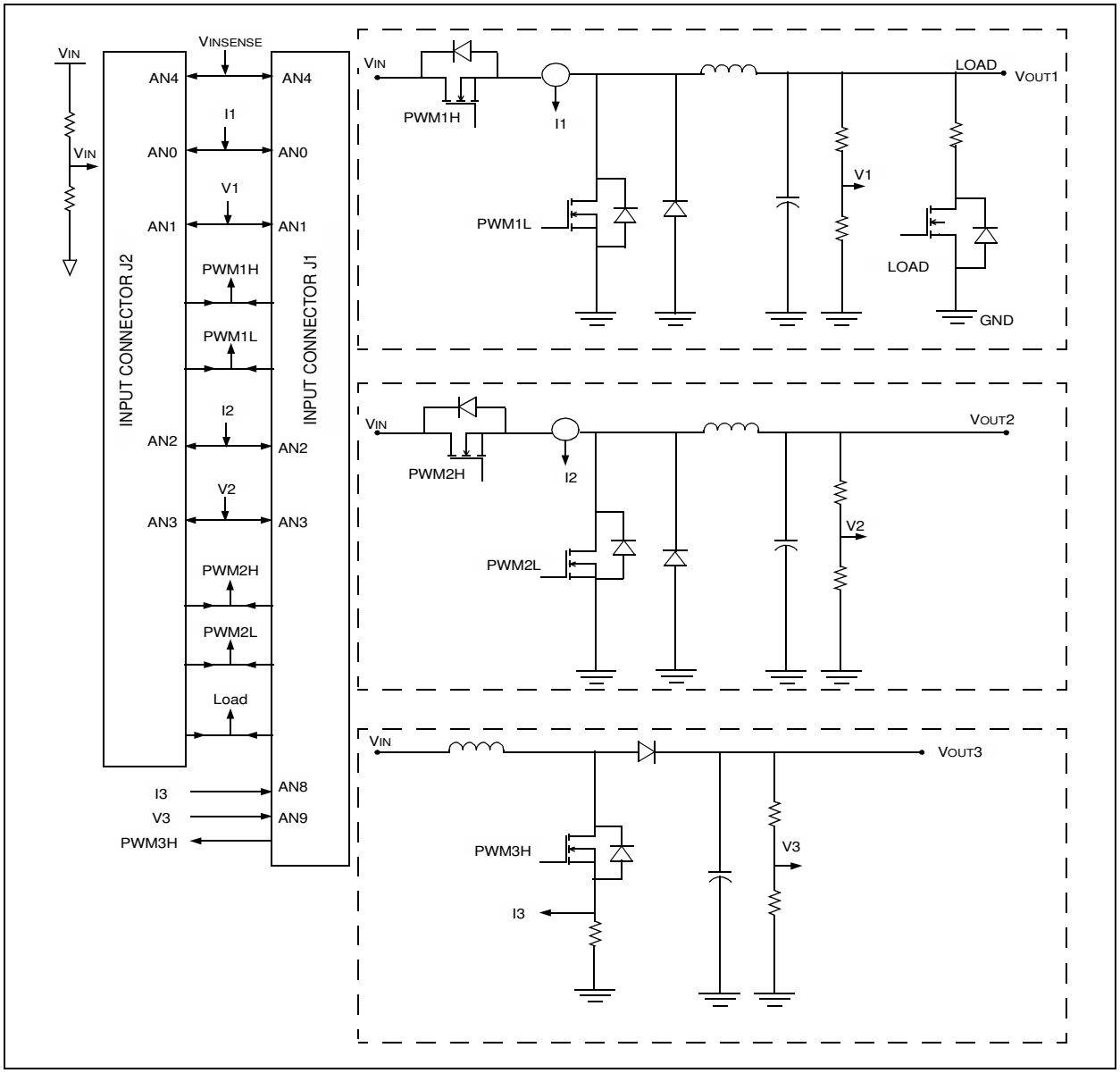


FIGURE 1-2: 16-BIT 28-PIN STARTER DEVELOPMENT BOARD WITH DAUGHTER BOARD

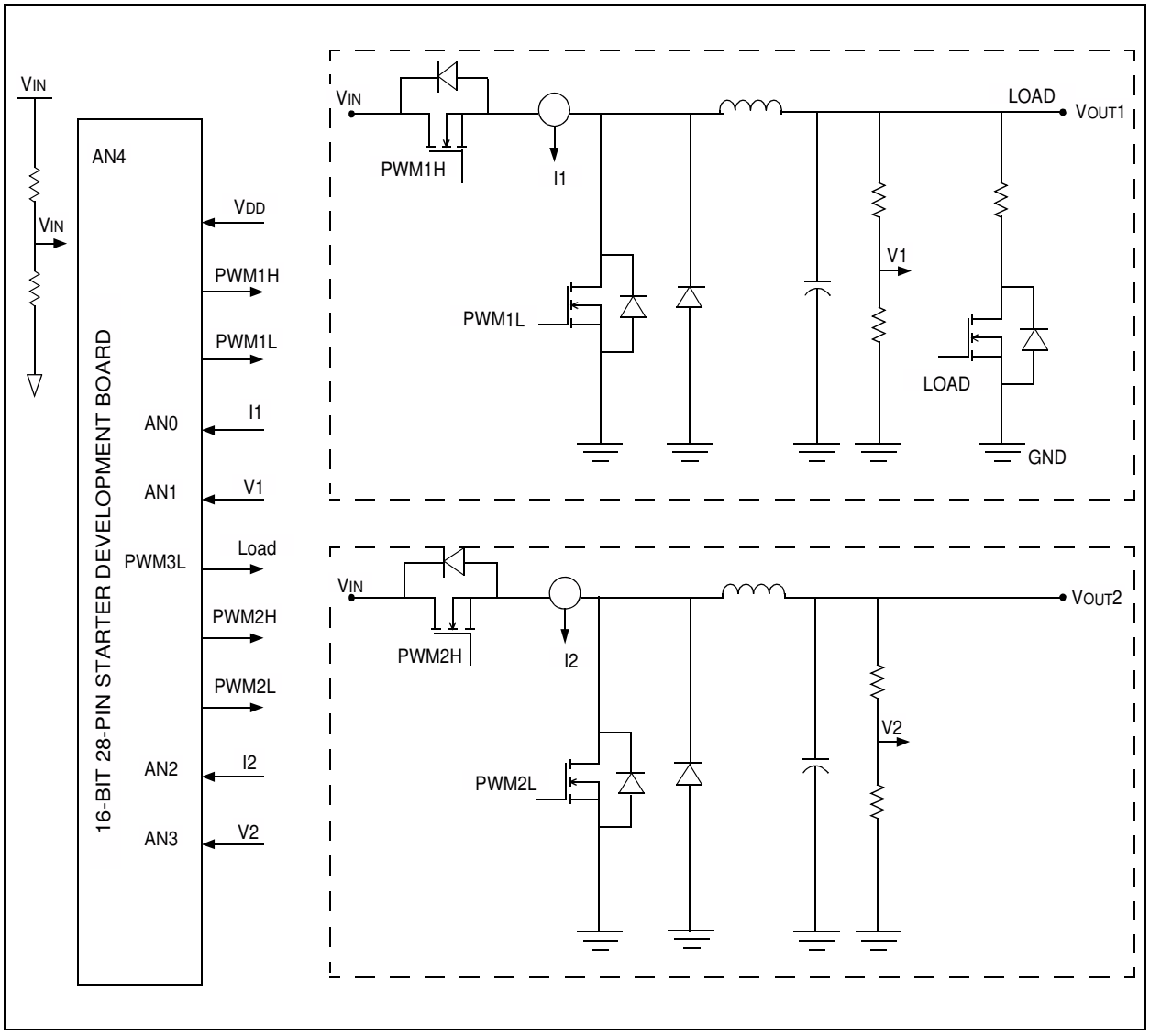
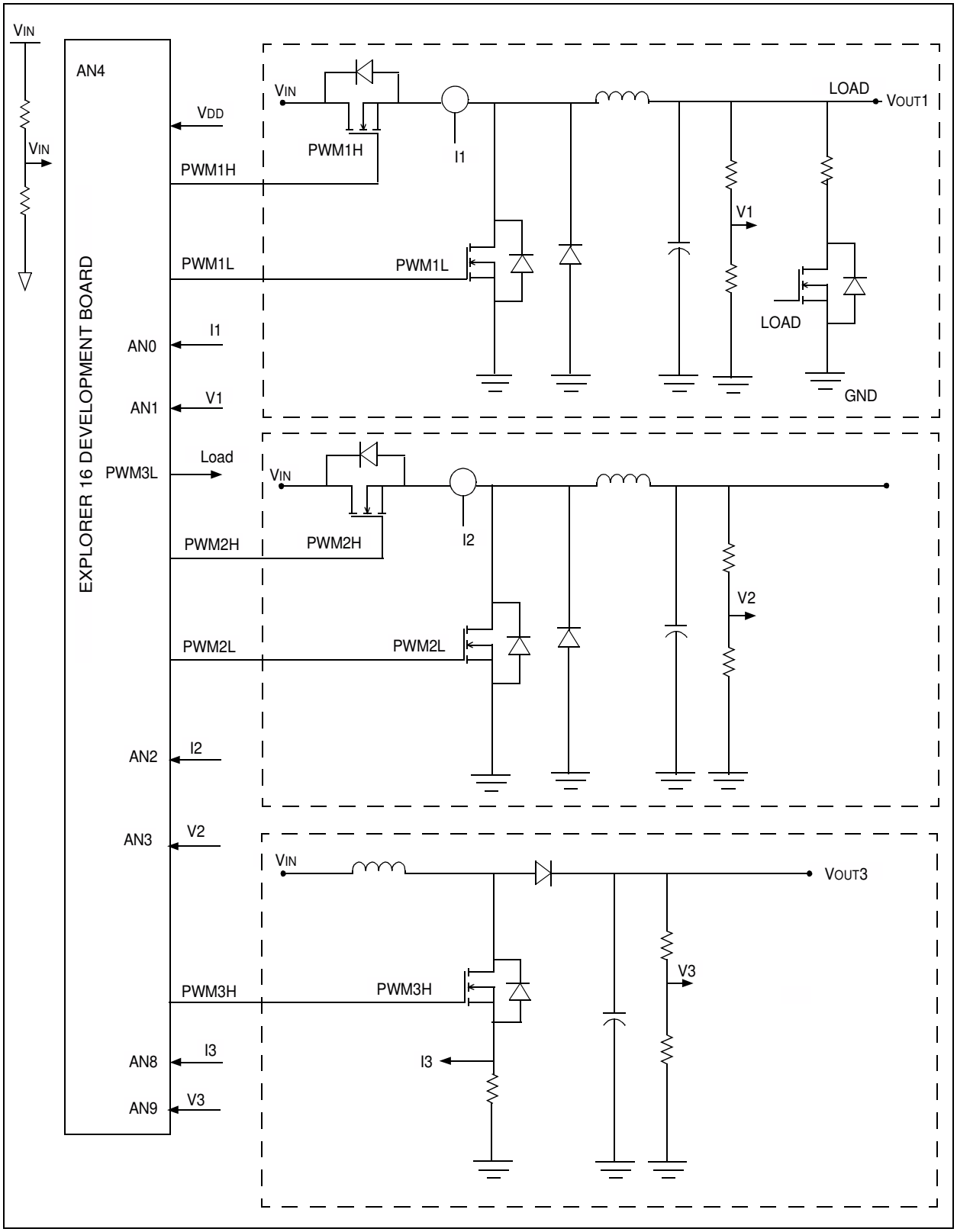


FIGURE 1-3: EXPLORER 16 DEVELOPMENT BOARD WITH DAUGHTER BOARD



1.2 FEATURES

The Buck/Boost Converter PICtail Plus Daughter Board provides the following features:

1.2.1 Power Stages

- Two synchronous buck converter power stages
- One boost converter power stage
- Voltage/current measurement for digital control of buck converters
- Voltage/current measurement for digital control of boost converter
- Switchable, one 5Ω/5W resistive load on Buck Converter 1 output (VOUT1)
- Buck Converter 1 output (VOUT1) on J4 connector for external loading
- Buck Converter 2 output (VOUT2) on J5 connector for external loading
- Boost Converter output (VOUT3) on J8 connector for external loading
- Connector J9 for auxiliary power input

1.2.2 Additional Features

- 5 kΩ Potentiometer (RP1) connected via jumper J10
- Input voltage source selection via jumper J6
- Additional resistive load R46 via jumper J11
- Connectors J1 and J2 (Explorer 16/16-bit 28-pin Starter Development Board)
- PMBus™ Connector (J3)

1.2.3 Daughter Board Power

- Auxiliary power input (J9): +7V to +15V (+9V nominal)
- 9V power input is through input connectors J2 and J1
- LED power-on indicator (D14)
- LED output voltage indicators (D11, D12 and D13)

Note: 9V input is supplied from the controller card (16-bit 28-pin Starter Development Board or Explorer 16 Development Board). All 16-bit 28-pin Starter Development Boards should have a blue wire connecting Pin 1 of J1 to Pin 28 of J2. If no blue wire connects them, connect a wire between them to supply the 9V input to the Buck/Boost Converter PICtail Plus Daughter Board.

1.3 PRODUCT PACKAGE

The Buck/Boost Converter PICtail Plus Daughter Board kit consists of the following items:

- Buck/Boost Converter PICtail Plus Daughter Board
- Buck/Boost Converter PICtail Plus Daughter Board CD

The CD consists of the application software, example code, Readme file and User's Guide.

NOTES:

Chapter 2. Hardware Overview

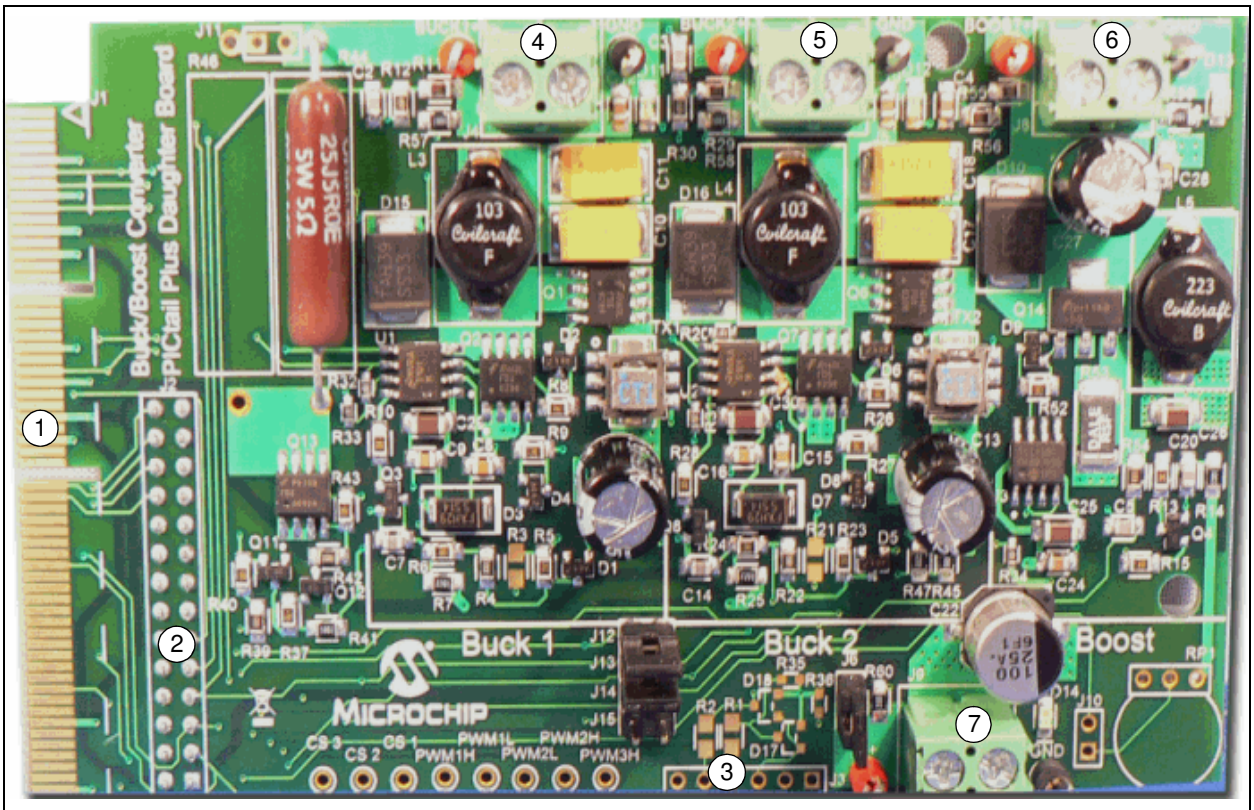
This chapter lists and describes the hardware elements and components of the Buck/Boost Converter PICtail Plus Daughter Board (also referred to as Daughter Board). The following topics are included:

- Daughter Board Connectors
- Using the Daughter Board with the Explorer 16 Development Board
- Using the Daughter Board with the 16-bit 28-pin Starter Development Board
- Power Rating of Converter Stage
- Power Rating of Converter Stage

2.1 DAUGHTER BOARD CONNECTORS

The Daughter Board consists of different power sections along with the input and output connectors for signal and power connections. Figure 2-1 depicts the Daughter Board, the input and output connectors and their locations.

FIGURE 2-1: BUCK/BOOST CONVERTER PICtail™ PLUS DAUGHTER BOARD



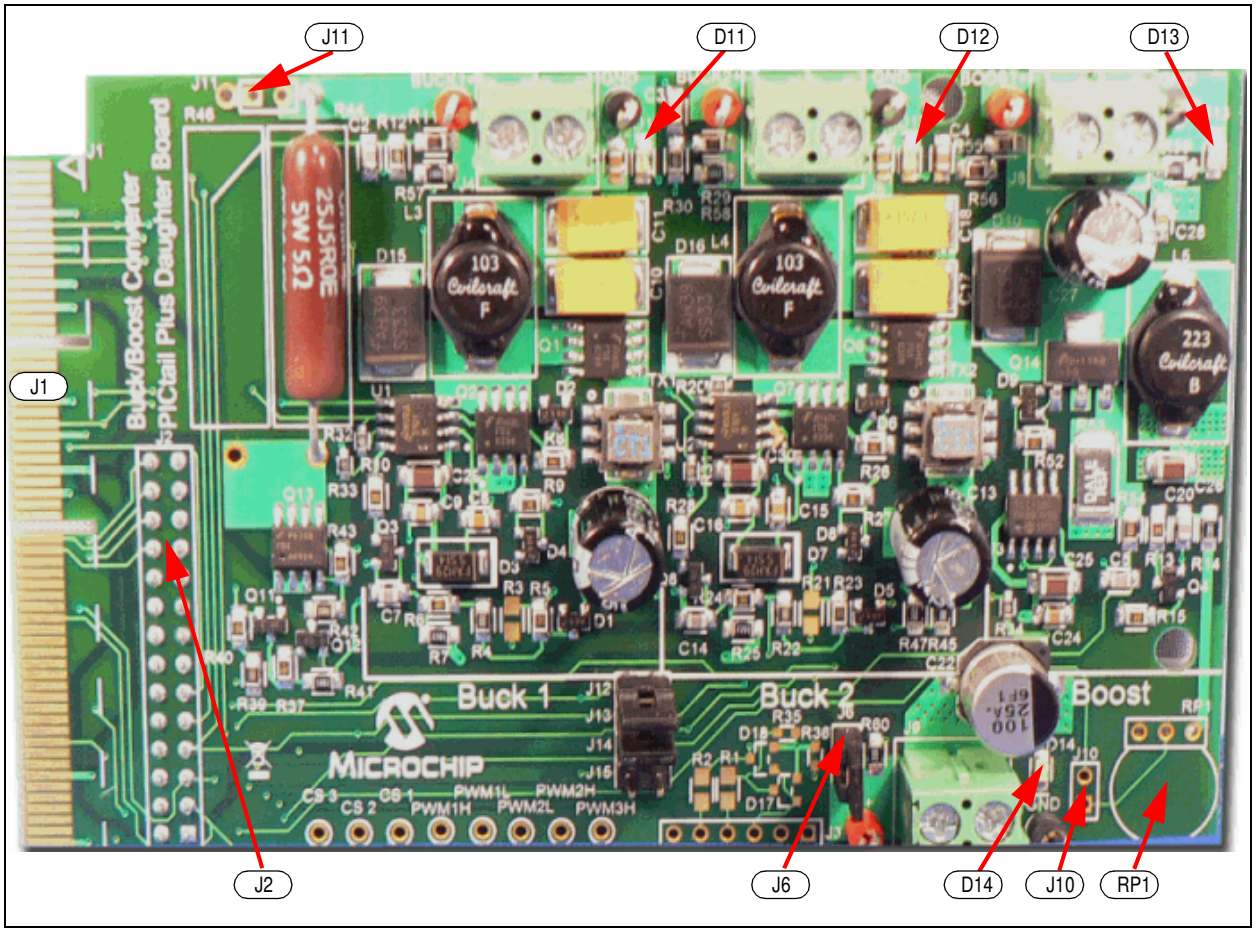
1. J1 – To connect Explorer 16 Development Board
2. J2 – To connect 16-bit 28-pin Starter Development Board
3. J3 – PMBus™ interface connector
4. J4 – VOUT1 connector
5. J5 – VOUT2 connector
6. J8 – VOUT3 connector
7. J9 – Auxiliary input power connector

Note: The Daughter Board only consists of the three power trains of the DC/DC converter sections. Either the 16-bit 28-pin Starter Development Board with the dsPIC33FJ16GS502 device, or the Explorer 16 Development Board with the dsPIC33FJ16GS504 device can be used to control the DC/DC power sections of the Daughter Board. The J1 and J2 connectors provide the necessary signals for control purposes.

2.2 DAUGHTER BOARD USER HARDWARE INTERFACE

This section describes the hardware interface of the Daughter Board and the power rating of each converter's section. Figure 2-2 displays the hardware elements (pin headers, jumpers, LED and potentiometer).

FIGURE 2-2: BUCK/BOOST CONVERTER PICtail™ PLUS DAUGHTER BOARD HARDWARE ELEMENTS



2.2.1 Auxiliary Input Power Connector

The Daughter Board can be connected to the auxiliary/bench power DC source through the J9 input connector. Jumper J6 should be removed while working with the auxiliary/bench power DC source. See Figure A-5 for the location of this jumper.

2.2.2 PMBus Interface Connector J3

The Daughter Board allows the user to implement the PMBus on the SMPS dsPIC DSC device using the J3 connector. See Figure A-6 for the location of this jumper.

2.2.3 16-bit 28-pin Starter Development Board Connector J2

The two converter stage sections of the Daughter Board can be controlled using the 16-bit 28-pin Starter Development Board. Table 2-1 lists all of the power and signal connections on the Daughter Board J2 connector to the user interface with the 16-bit 28-pin Starter Development Board. See Figure A-6 for the location of this connector.

TABLE 2-1: SIGNAL AND POWER CONNECTION FOR 16-BIT 28-PIN STARTER DEVELOPMENT BOARD (J2)

Pin Number Primary	Assignment	Primary Use
1	NC	Not Connected
2	AN0	Analog Input 0 (Buck Converter 1 current)
3	AN1	Analog Input 1 (Buck Converter 1 voltage)
4	AN2	Analog Input 2 (Buck Converter 2 current)
5	AN3	Analog Input 3 (Buck Converter 2 voltage)
6	AN4	Analog Input 4 (Input Voltage)
7	NC	Not Connected
8	VSS	Ground reference for logic and I/O pins
9	NC	Not Connected
10	NC	Not Connected
11	NC	Not Connected
12	NC	Not Connected
13	VDD	Positive supply for logic and I/O pins
14	NC	Not Connected
15	RB15	PMBUSAUX2
16	RB5	PMBUSAUX1
17	SCL	SCL/TX
18	SDA	SCL/RX
19	VSS	Ground reference for logic and I/O pins
20	VDD	+3.3V_DIG
21	PWM3H	PWM Boost Converter
22	I/O	Load
23	PWM2H	PWM 2 High Output (Buck Converter 2)
24	PWM2L	PWM 2 Low Output (Buck Converter 2)
25	PWM1H	PWM 1 High Output (Buck Converter 1)
26	PWM1L	PWM 1 Low Output (Buck Converter 1)
27	NC	Not Connected
28	+9V	Input Voltage for two buck stages

2.2.4 Explorer 16 Development Board Connector J1

The two buck sections and one boost section of the Daughter Board can be controlled using the Explorer 16 Development Board. Table 2-2 lists all the power and signal connections on the Daughter Board J1 connector to the user interface with the Explorer 16 Development Board. See Figure A-6 for the location of this connector.

TABLE 2-2: SIGNAL AND POWER CONNECTION FOR THE EXPLORER 16 DEVELOPMENT BOARD (J1)

Pin Number Primary	Assignment	Primary Use
79	AN0	Analog Input 0 (Buck Converter 1 current)
80	AN1	Analog Input 1 (Buck Converter 1 voltage)
45	PWM1H	PWM 1 High Output (Buck Converter 1 drive)
46	PWM1L	PWM 1 Low Output (Buck Converter 1 drive)
8	AN2	Analog Input 2 (Buck Converter 2 current)
6	AN3	Analog Input 3 (Buck Converter 2 voltage)
12	PWM2H	PWM 2 High Output (Buck Converter 2 drive)
11	PWM2L	PWM 2 Low Output (Buck Converter 2 drive)
50	AN4	Analog Input 4 (Input Voltage)
102	AN8	Analog Input 8 (Boost Converter Voltage)
80	AN9	Analog Input 9 (Boost Converter Voltage)
17	PWM3H	PWM3H High Output (Boost Converter drive)
13	I/O	Load Drive for Buck Converter 1 Load
101	AN10	Analog Input 10 (POT RP1)
65	RB15	PMBUSAUX2
66	RB5	PMBUSAUX1
67	SCL	SCL/TX
68	SDA	SCL/RX
9, 10, 119, 120	3.3VDIG_GND	Ground Reference for Digital I/O pins
21, 22, 53, 54, 107, 108	+3.3V_DIG	Digital 3.3V
15, 16, 41, 42	9VANA_GND	Ground Reference for Logic and I/O pins
25, 26, 57, 58	+9V	9V Input Voltage
1-5, 14, 18-20, 23, 24, 27-30, 33-40, 43, 44, 49, 51, 52, 55, 56, 59-62, 69-78, 81-95, 97-100, 103-106, 109-118	NC	Not Connected

2.2.5 VOUT1 J4 (Buck1+)

An external load can be connected to VOUT1 through the J4 connector. One on-board parallel resistor, R44 (5Ω/5W), is connected at the output of VOUT1 through MOSFET Q13 to optionally load the Buck 1 converter circuit. Resistor R45 is on-board, and there is space to solder resistor R46 onto the board. When resistor R46 is connected to VOUT1, the J11 jumper must be open while working with +9V power from the control board. The on-board load resistor can be connected to VOUT1 by controlling the signal name “Load”. The “Load” signal is the I/O pin of the SMPS dsPIC DSC device, and is active-high. See Figure A-2 for the location of this connector.

2.2.6 VOUT2 J5 (Buck2+)

An external load can be connected to VOUT2 through the J5 connector. VOUT2 can load up to a maximum of 3 amps when the auxiliary input voltage source is connected at the J9 input connector. See Figure A-3 for the location of this connector.

2.2.7 VOUT3 J8 (Boost)

An external load can be connected to VOUT3 through the J8 connector. VOUT3 can load up to 0.75 amps when the auxiliary input voltage source is connected at the J9 input connector. See Figure A-4 for the location of this connector.

2.2.8 Jumpers

The Daughter Board consists of three jumpers that determine its features. Table 2-3 lists jumpers and their functions.

TABLE 2-3: JUMPERS

Jumpers	Description	Default Configurations
J6	Select either 9V power provided by the Explorer 16 Development Board or 16-bit 28-pin Starter Development Board, and an external power supply	Short with jumper header (closed)
J10	Connects potentiometer RP1 to AN10 on Explorer 16 Development Board	Open
J11	Connects R46 load resistor to VOUT1	Open
J12	Buck 2 voltage feedback selection	Short with jumper header (closed)
J13	Buck 2 current feedback selection	Short with jumper header (closed)
J14	Boost current feedback selection	Open
J15	Boost voltage feedback selection	Open

2.2.9 Potentiometer and LED

The Daughter Board consists of a potentiometer and LEDs for the user application. Table 2-4 lists components and their functions.

TABLE 2-4: POTENTIOMETERS AND LED

Label	Hardware Elements
RP1	Potentiometer connected to AN10 of Explorer 16 Development Board controller
D11	Buck 1 output LED
D12	Buck 2 output LED
D13	Boost output voltage LED
D14	Input voltage LED

2.2.10 Test Points

The Daughter Board provides the various test points of the PWM signals, feedback signals and input and output voltages for the user application. Table 2-5 lists the PWM test points that can be used to check the PWM gate pulse for all three power stages.

TABLE 2-5: PWM TEST POINTS

Test Points	Description
PWM1H	Buck MOSFET gate drive of Buck 1 converter stage
PWM1L	Synchronous MOSFET gate drive of Buck 1 converter stage
PWM2H	Buck MOSFET gate drive of Buck 2 converter stage
PWM2L	Synchronous MOSFET gate drive of Buck 2 converter stage
PWM3H	Boost MOSFET gate drive for Boost converter stage

Table 2-6 lists the feedback signal test points that can be used to check the feedback signal waveforms and values.

TABLE 2-6: FEEDBACK SIGNAL TEST POINTS

Test Points	Description
Current Sense1	Current feedback signal for Buck 1 converter stage
Current Sense2	Current feedback signal for Buck 2 converter stage
Current Sense3	Current feedback signal for Boost converter stage

Table 2-7 shows the power test points that can be used to verify the input and output voltages.

TABLE 2-7: POWER TEST POINTS

Test Points	Description
V+	Input Voltage Test Point
Buck1+	VOUT1 voltage test point
Buck2+	VOUT2 voltage test point
Boost+	VOUT3 voltage test point
GND	Ground potential test point

2.3 USING THE DAUGHTER BOARD WITH THE EXPLORER 16 DEVELOPMENT BOARD

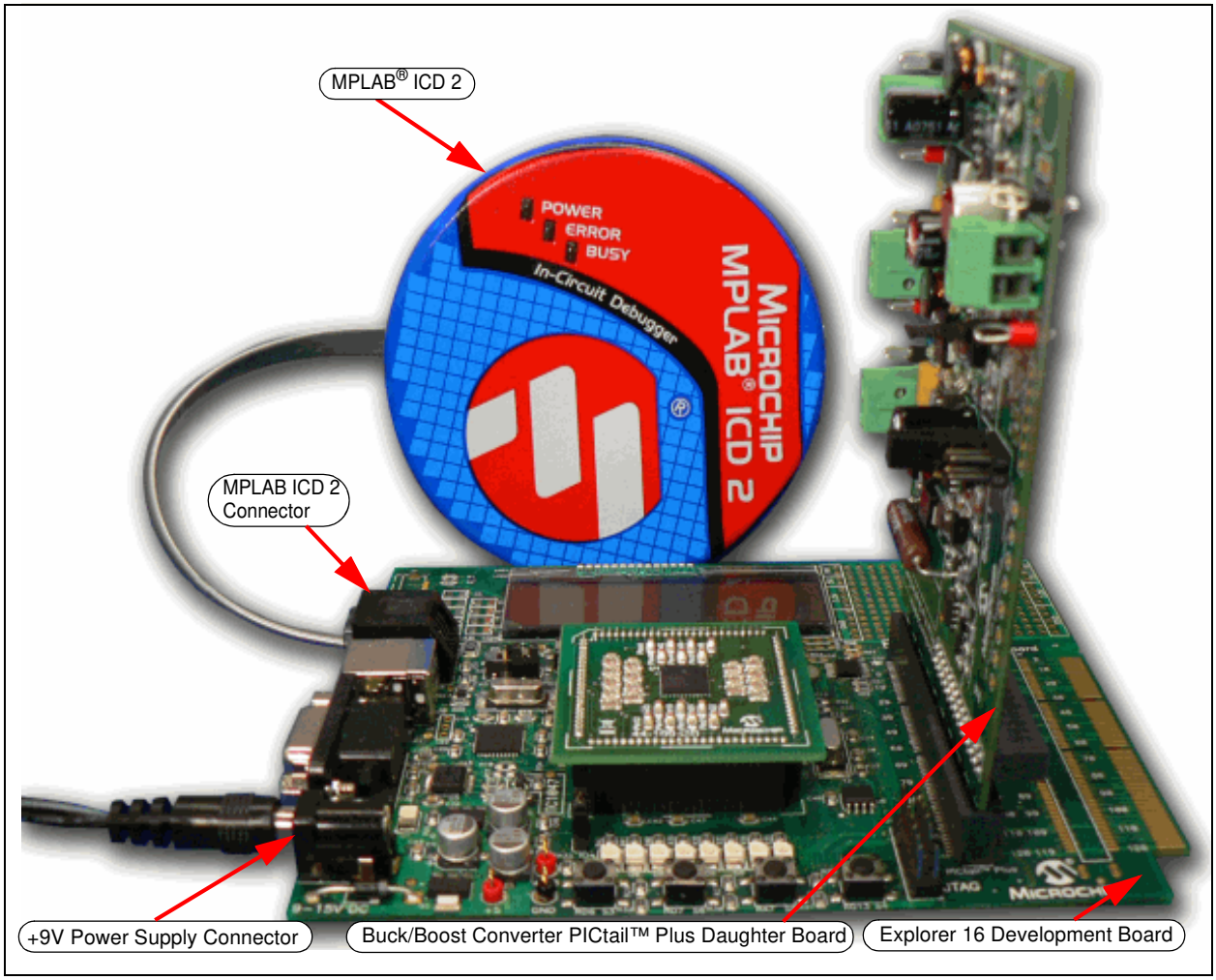
This section describes the hardware connection of the Daughter Board with the Explorer 16 Development Board. Figure 2-3 displays the Daughter Board hardware connection (MPLAB ICD 2 and power supply) to the Explorer 16 Development Board.

The dsPIC33FJ16GS504 SMPS device controls both buck stages (Buck 1 and Buck 2), as well as the boost stage through the Explorer 16 Development Board simultaneously.

> **Note:** To operate all three converters using the Explorer 16 Development Board, ensure that J12, J13 and J6 are shorted with the jumper header, and J14 and J15 are open before powering up the board.

The potentiometer R6 (10 kΩ), in series with the R12 resistor on the Explorer 16 Development Board, is connected to analog input channel (AN5) of the SMPS dsPIC DSC device. The potentiometer R6 on the Daughter Board is connected to the analog input channel (AN10) through the J10 jumper. Both potentiometers can be used for development purposes to simulate any feedback signal.

FIGURE 2-3: DAUGHTER BOARD CONNECTED TO THE EXPLORER 16 DEVELOPMENT BOARD

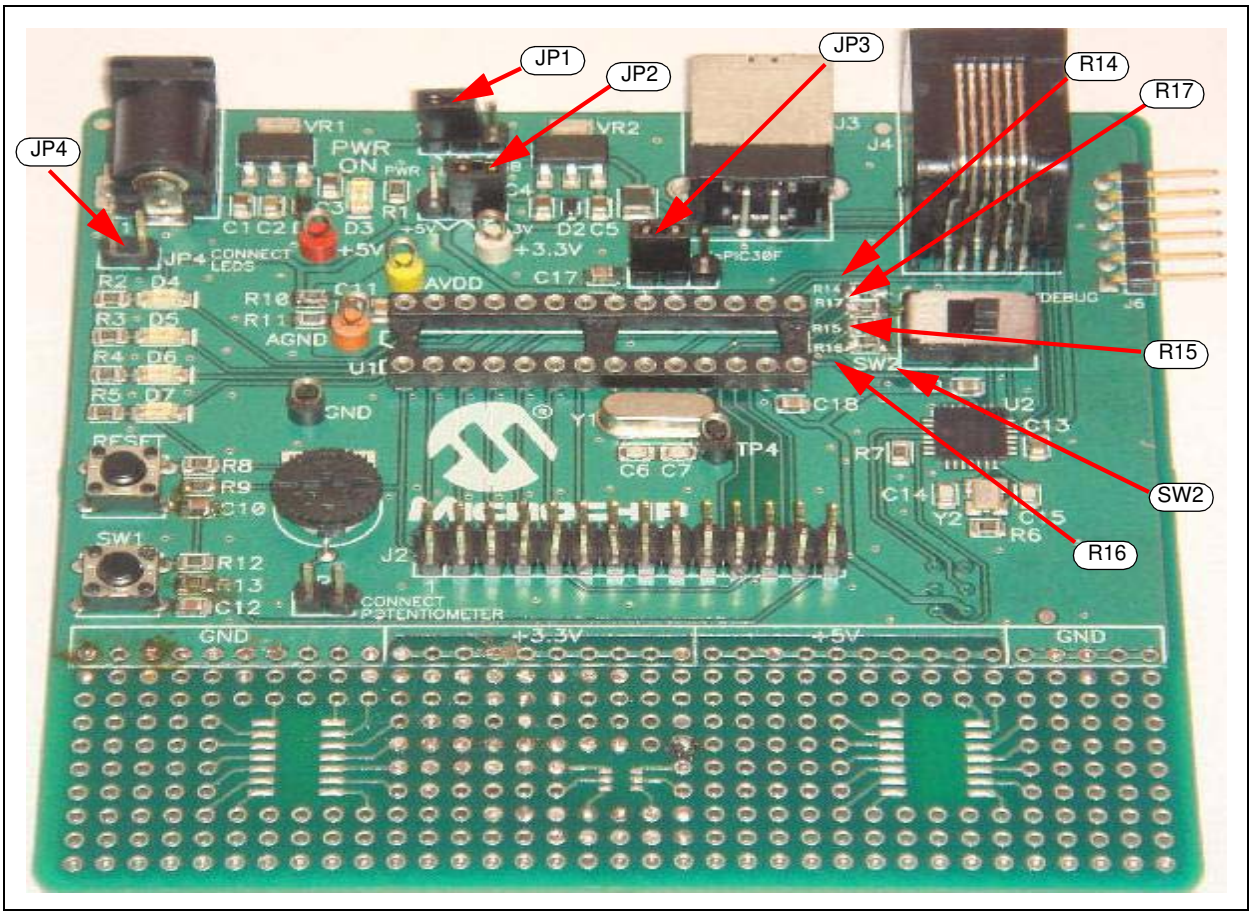


2.4 USING THE DAUGHTER BOARD WITH THE 16-BIT 28-PIN STARTER DEVELOPMENT BOARD

This section describes the use of a 16-bit 28-pin Starter Development Board with the Buck/Boost Converter PICtail Plus Daughter Board.

Figure 2-4 shows the 16-bit 28-pin Starter Development Board and its hardware elements. For more details, refer to the "*16-Bit 28-Pin Starter Development Board User's Guide*" (DS51656), which is available from the Microchip website (http://www.microchip.com).

FIGURE 2-4: 16-BIT 28-PIN STARTER DEVELOPMENT BOARD

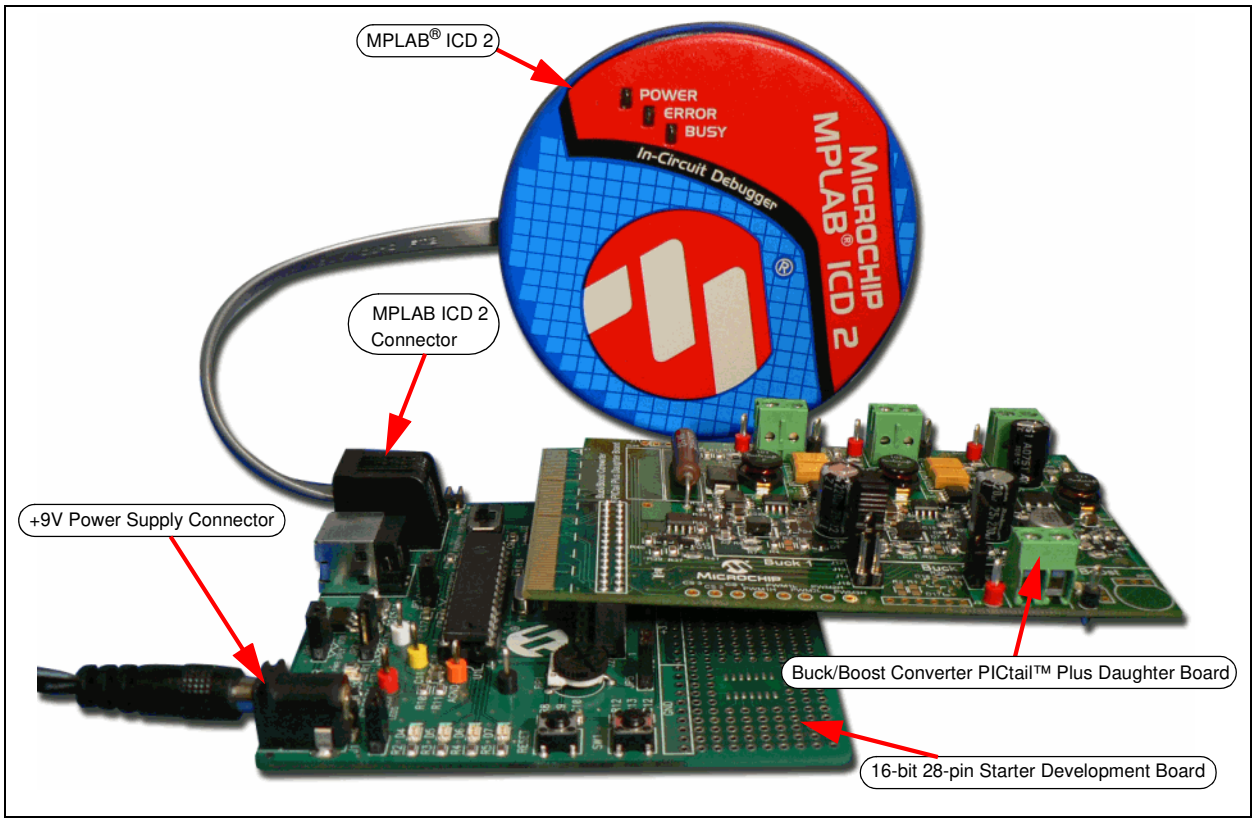


The potentiometer, RP1 (10 kΩ), with the J5 jumper on the 16-bit 28-pin Starter Development Board, is connected to the analog input channel (AN5) of the SMPS dsPIC DSC device. Figure 2-5 shows the connection of a 16-bit 28-pin Starter Development Board to a Daughter Board with ICD 2 and a 9V power supply.

Ensure that the following changes are made to the 16-bit 28-pin Starter Development Board prior to connecting the 16-bit 28-pin Starter Development Board to the Daughter Board:

- Remove resistors R14 and R15 (to control Buck 2 or Boost converter)
- JP1 in pin 1-2 position (supply)
- JP2 in pin 2-3 position (+3.3V)
- JP3 in 1-2 position (dsPIC33F/PIC24)
- JP4 open
- SW2 in USB/DEBUG mode

FIGURE 2-5: DAUGHTER BOARD HARDWARE CONNECTED TO A 16-BIT 28-PIN STARTER DEVELOPMENT BOARD



2.4.1 16-bit 28-pin Starter Development Board Controls Buck 1 and Buck 2 Stages (Default Jumper Configuration)

The dsPIC33FJ16GS502 SMPS device controls buck stages Buck 1 and Buck 2 through the 16-bit 28-pin Starter Development Board as the default configuration on the Daughter Board, refer to Table 2-3. The two buck stages can be controlled as multi-phase or as two parallel converters by shorting the VOUT1 (Buck1+) and VOUT2 (Buck2+) output, and by programming the output of buck stages to the same output voltage value.

Note 1:	To operate the two buck converters using the 16-bit 28-pin Starter Development Board, ensure that J12, J13 and J6 are shorted with the jumper header, and J14 and J15 are open before powering up the board.
2:	The software file `Buck1 Voltage Mode with 28P Starter Board` on the Buck/Boost Converter PICtail Plus Daughter Board CD only provides control for the Buck 1 stage.

2.4.2 16-bit 28-pin Starter Development Board Controls Buck 1 and Boost Stages

This section describes the hardware changes that must be performed to control the Buck 1 and Boost stages. Figure 2-6 displays the feedback jumper, which must be modified in the Daughter Board. See Figure A-4 for the complete Daughter Board schematics.