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# **PICDEM™ Z Demonstration Kit**

## **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](http://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 PICDEM™ Z Demonstration Kit Demonstration Kit. 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 LAYOUT

This document describes how to use the PICDEM Z Demonstration Kit as a development tool to evaluate and experiment with Microchip RF solutions. The manual layout is as follows:

- **Chapter 1: PICDEM™ Z Demonstration Kit Overview** – Describes the PICDEM Z Demonstration Kit and how it works.
- **Chapter 2: Getting Started with the PICDEM™ Z Demonstration Kit** – What you need to know to start using the PICDEM Z Demonstration Kit.
- **Chapter 3: Experimenting with the PICDEM™ Z Demonstration Kit** – How to program and use the PICDEM Z Demonstration Kit.
- **Chapter 4: Troubleshooting** – How to solve common operation problems with the PICDEM™ Z Demonstration Kit.
- **Appendix A: PICDEM™ Z Motherboard Schematics** – Hardware information on the PICDEM Z demonstration board.
- **Appendix B: PICDEM™ Z 2.4 GHz RF Card** – Hardware information on the PICDEM Z RF card.

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## CONVENTIONS USED IN THIS GUIDE

Where applicable, this manual uses the following documentation conventions:

### DOCUMENTATION CONVENTIONS

Description	Represents	Examples
<b>Arial font:</b>		
Italic characters	Referenced books	MPLAB® IDE User's Guide
	Emphasized text	...is the <i>only</i> 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	<u>File&gt;Save</u>
Bold characters	A dialog button	Click <b>OK</b>
	A tab	Click the <b>Power</b> tab
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
0xnnnn	A hexadecimal number where n is a hexadecimal digit	0xFFFF, 0x007A
<b>Courier New font:</b>		
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
	A binary number	'b00100, 'b10
Italic Courier New	A variable argument	<i>file.o</i> , where <i>file</i> can be any valid filename
Square brackets [ ]	Optional arguments	mcc18 [options] <i>file</i> [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 PICDEM™ Z Demonstration Kit. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

**AN965 “Microchip Stack for the ZigBee™ Protocol” (DS00965)**

**AN1066, “MiWi™ Wireless Networking Protocol Stack” (DS01066)**

These application notes describe how you can use the Microchip RF solutions to quickly build your application without the need to acquire detailed knowledge of ZigBee or MiWi protocol specifications. To illustrate the usage of the Stack, two working demo applications are included. These demo applications can be used as a reference or simply modified and adapted to your requirements.

## THE MICROCHIP WEB SITE

Microchip provides online support via our web site at [www.microchip.com](http://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 (FAQ), 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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## 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](http://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 C17, 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 REAL ICE™.
- **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® operating system Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB SIM and MPLAB SIM30 simulators, 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 programmer.

## CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support
- Development Systems Information Line

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>

In addition, there is a Development Systems Information Line which lists the latest versions of Microchip's development systems software products. This line also provides information on how customers can receive currently available upgrade kits.

The Development Systems Information Line numbers are:

1-800-755-2345 – United States and most of Canada

1-480-792-7302 – Other International Locations



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## **Chapter 1. PICDEM™ Z Demonstration Kit Overview**

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### **1.1 INTRODUCTION**

This chapter presents an overview of the features and requirements of the PICDEM™ Z Demonstration Kit. Topics covered in this chapter include:

- What is the PICDEM™ Z Demonstration Kit?
- PICDEM™ Z Demonstration Kit Components
- Overview of the PICDEM™ Z Demonstration Kit
- PICDEM™ Z Motherboard
- PICDEM™ Z RF Card
- PICDEM™ Z Software CD

### **1.2 WHAT IS THE PICDEM™ Z DEMONSTRATION KIT?**

The PICDEM Z Demonstration Kit is designed to allow developers to evaluate and experiment with Microchip RF solutions. It is designed to work with either the ZigBee™ or MiWi™ protocol. The PICDEM Z Demonstration Kit provides two nodes to create a simple two-node network. If required, additional nodes may be purchased to expand the network. The preprogrammed demo application firmware shows a simple two-node ZigBee protocol network. Using either the MiWi Wireless Networking Protocol Stack or the Microchip Stack for ZigBee Protocol source code, available free-of-charge from the Microchip web site, developers can develop their own applications.

### **1.3 PICDEM™ Z DEMONSTRATION KIT COMPONENTS**

Your demonstration kit contains the following items:

1. Two PICDEM™ Z demonstration motherboards.
2. Two MRF24J40 daughter cards.
3. Two 9V batteries.
4. The PICDEM Z Demonstration Kit CD-ROM, which contains installations and application notes for Microchip's RF solutions.
5. This manual (included on the CD-ROM in Adobe® Acrobat® format).
6. A warranty registration card.

# PICDEM Z Demonstration Kit User's Guide

## 1.4 OVERVIEW OF THE PICDEM™ Z DEMONSTRATION KIT

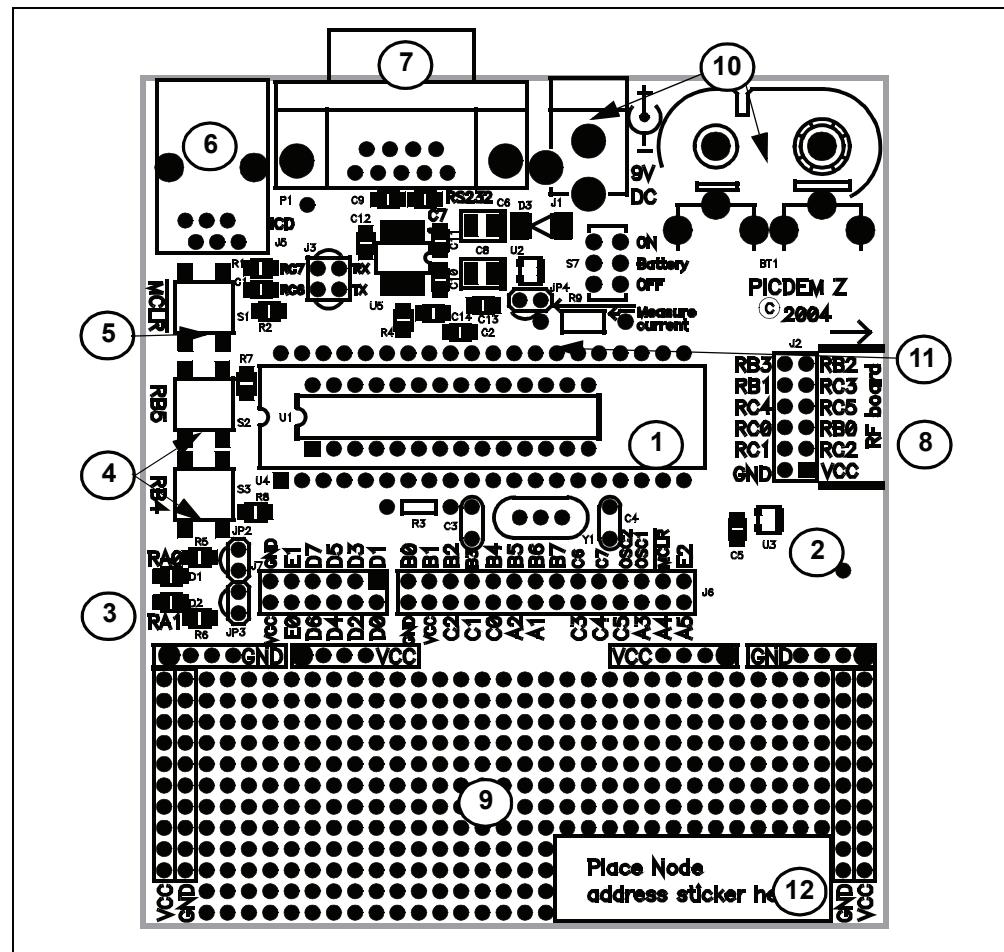
The PICDEM Z Demonstration Kit (also referred to as the PICDEM Z kit) is designed to demonstrate Microchip's RF solutions. The PICDEM Z kit includes two nodes, each preprogrammed with demo coordinator and Reduced Function Device (RFD) applications using the ZigBee protocol. Each node consists of two boards – one motherboard and one RF card. The PICDEM Z motherboard is designed to support the Microchip MRF24J40 RF transceiver. Microchip will be adding support for new RF transceivers as time progresses. For the complete list of supported RF transceivers, visit the Microchip web site.

In addition to demonstrating standard ZigBee protocol functionality, the PICDEM Z kit can also be used to develop custom applications based on either the ZigBee protocol or the Microchip MiWi protocol. The kit includes the complete source code for both protocols. The Microchip application note "AN965, *Microchip Stack for the ZigBee™ Protocol*" (DS00965) discusses the Microchip ZigBee Protocol Stack in more detail. The Microchip application note AN1066, "*MiWi™ Wireless Networking Protocol Stack*" (DS01066) discusses the Microchip MiWi protocol in more detail.

## 1.5 PICDEM™ Z MOTHERBOARD

The PICDEM Z demonstration board or motherboard has all of the features necessary to begin developing RF applications using the Microchip PIC18F family of microcontrollers. The preprogrammed firmware allows users to begin evaluating the board right out of the box, with no additional programming or configuration.

**FIGURE 1-1: PICDEM™ Z MOTHERBOARD**



# PICDEM™ Z Demonstration Kit Overview

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Features on the PICDEM Z demonstration board include:

1. **Microcontroller Socket (U4):** 40 and 28-pin PDIP sockets are provided for the user's choice of Microchip PIC18 microcontrollers. The board is equipped from the factory with a PIC18LF4620 high-performance microcontroller, clocked at 4 MHz and preprogrammed with the demo application firmware using the Microchip Stack. The microcontroller on each board included in the demonstration kit contains a label that identifies it as either a ZigBee protocol coordinator or RFD.
2. **Temperature Sensor (U3: TC77):** This is a 5-pin thermal sensor with an SPI interface from Microchip.
3. **User-defined LEDs (D1, D2):** These two LEDs are driven by digital I/O pins of the controller, and may be used to simulate a digital output to an embedded device. These LEDs are enabled/disabled by jumpers JP2 and JP3. By default, LEDs are enabled by permanently shorting jumpers via PCB traces. If required, you may cut the traces and install your own jumpers.
4. **User-Defined Push Buttons (S2, S3):** These switches are connected to digital I/O pins on the controller, and may be used to simulate a digital input in an embedded application. These switches do not have external pull-up resistors; as a result, you must enable the internal pull-up option on PORTB to correctly read the switch status.
5. **Reset Push Button (S1):** This switch is tied to the MCLR pin on the controller, and is used to reset the board.
6. **RJ-11 (six-wire) Modular Connector (J5):** This connector allows the demonstration board to be connected to Microchip MPLAB ICD 2 systems for advanced microcontroller debugging and programming.
7. **RS-232 (DB9F) Connector (P1):** This connector allows the demonstration board to be connected to any other board or PC serial port. The preprogrammed demo application firmware uses this connector to communicate with a PC and offer application configuration options. If required, you may disconnect the on-board RS-232 driver circuit from the controller by breaking the PCB traces on the J3 jumper.
8. **RF Card Connector (J2):** This is a common connector to connect all supported RF cards. This connector provides +3.3 VDC, an SPI bus and a few discrete digital I/O control signals.
9. **Prototype Area:** A prototype area is provided to breadboard additional circuitry for development. Connections are provided for +3.3 VDC, ground and all I/O ports of a microcontroller.
10. **On-Board Power:** An on-board regulator provides 9 VDC to 3.3 VDC rated at 100 mA. The board may be powered via either an external 9 VDC input (J1) or the on-board 9V battery (B1). The board contains a diode to protect against an accidental reverse power connection. When using a 9V battery to power the board, switch S7 must be set to ON. The 2.5 mm 9 VDC jack is wired such that when a 9 VDC plug is inserted, the on-board battery is automatically disconnected from the circuit.
11. **Measure Current (JP4):** This jumper can be used to measure current drawn by all of the circuits on the board. By default, this jumper is shorted via a PCB trace. To measure the current, cut the JP4 trace and insert an ammeter between the JP4 terminals. You may also install your choice of resistor at R9 and measure voltage across it to determine the current.
12. **Revision Level Indicator (Back Side):** The text on the solder side of the board indicates the hardware revision level.

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## 1.6 PICDEM™ Z RF CARD

The PICDEM Z motherboard is designed to support RF cards using RF transceivers from various vendors. Microchip is planning to add support for new RF transceivers. Please check the Microchip web site for the list of supported RF transceivers. You may find details of an individual RF card in its respective user's guide document.

See **Appendix B. “PICDEM™ Z 2.4 GHz RF Card”** for information on the RF cards supplied in your PICDEM Z Demonstration Kit.

## 1.7 PICDEM™ Z SOFTWARE CD

The CD provides the complete source code for the Microchip Stacks for the ZigBee protocol and the MiWi protocol.

You may download the latest version of the Microchip Stacks from the Application Design Center at the Microchip web site.



# PICDEM™ Z DEMONSTRATION KIT USER'S GUIDE

## Chapter 2. Getting Started with the PICDEM™ Z Demonstration Kit

### 2.1 INTRODUCTION

Topics covered in this chapter include:

- Host Computer Requirements
- Using the PICDEM™ Z Boards for the First Time
- Executing Preprogrammed Demo Applications

### 2.2 HOST COMPUTER REQUIREMENTS

The preprogrammed demo applications do not require the host computer to observe the functionality. However, a host computer is required if you want to change the default demo application configuration.

To change the default demo application configuration, you must have a system that meets the following hardware and software requirements:

- Any computer system with one available standard serial port (DB9)
- Any operating system that provides a standard RS-232 terminal program using the available hardware serial port

The PICDEM Z Demonstration Kit includes a CD that contains the complete source code for both demo applications and the Microchip Stack. To view the contents of the CD, modify demo applications or develop your own application, you must have a system that meets Microchip MPLAB IDE system requirements. Please visit the Microchip web site for up to date system requirements and to download the Microchip MPLAB IDE software.

### 2.3 USING THE PICDEM™ Z BOARDS FOR THE FIRST TIME

#### 2.3.1 Assembling PICDEM™ Z Nodes

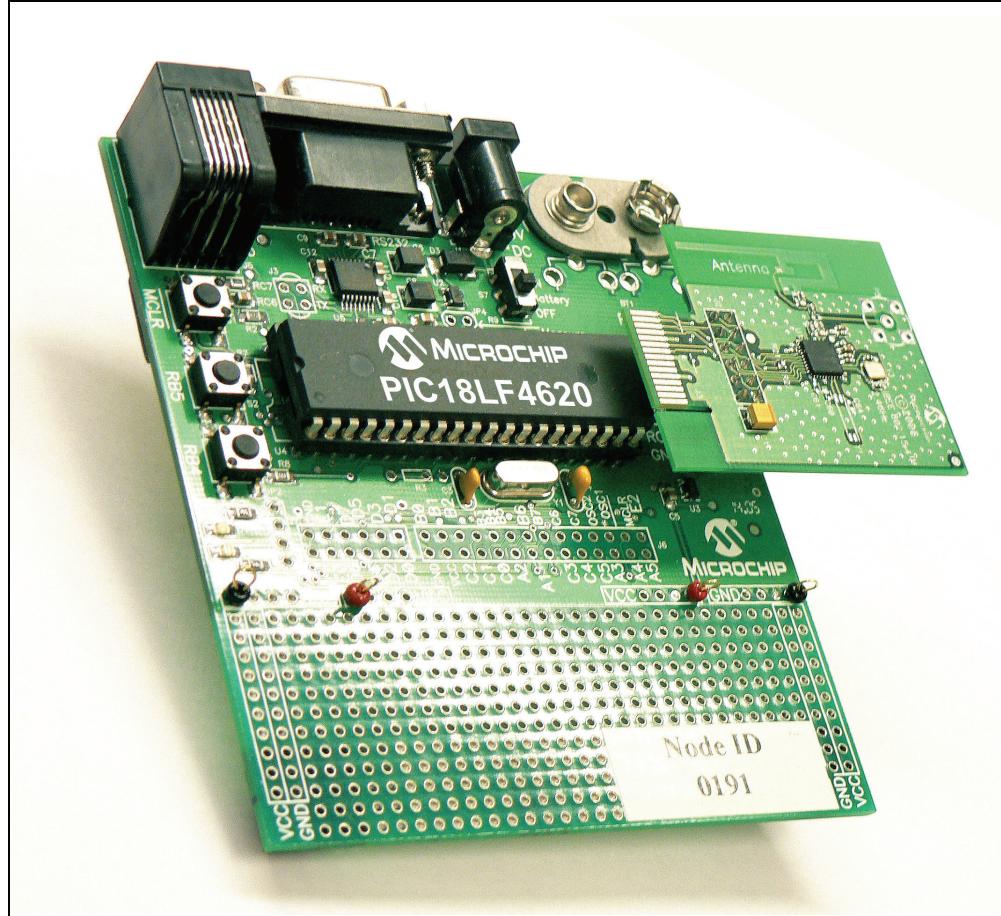
The PICDEM Z Demonstration Kit consists of two nodes. Each node consists of one motherboard and one RF card packaged separately. You must assemble each node before applying power.

Perform the following steps to prepare each node:

1. Unbox and unwrap each board and place on a non-conductive surface.
2. Carefully plug the RF card into the J2 connector on the motherboard. Note that the connectors on the motherboard and the RF card are polarized and will not allow incorrect insertion.
3. If you have a 9 VDC power supply with a 2.5 mm plug, power-up the board. If not, connect one of the supplied 9V batteries to the BT1 connector and slide switch S7 to the ON position.

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FIGURE 2-1: MOTHERBOARD AND RF CARD CONNECTION



### 2.3.2 Installing PICDEM™ Z Software Files

The PICDEM Z Demonstration Kit contains the complete source code for both the Microchip Stack for the ZigBee protocol and the Microchip MiWi protocol. Both Stacks are available free of charge to Microchip customers. As part of the installation process, you must accept a no-cost electronic software license to continue installation.

To install the files:

1. Insert the PICDEM Z software CD into your system's CD-ROM drive.
2. Using Windows Explorer, open the CD and start the installation process by double-clicking the icon for the desired stack installation.
3. Follow the on-screen prompts to install the software. When presented, review the software license agreement and click **I accept** to accept the license agreement and continue the installation process. If you decide to click **I do not accept**, the installation will terminate.
4. After successful completion, the selected Stack will be installed on your computer.

# Getting Started with the PICDEM™ Z Demonstration Kit

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## 2.4 EXECUTING PREPROGRAMMED DEMO APPLICATIONS

The PICDEM Z nodes are preprogrammed with the ZigBee protocol demo program provided with the ZigBee Protocol Stack. Refer to AN965, “*Microchip Stack for the ZigBee Protocol*”, for more information on running this demo.

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**NOTES:**

## **Chapter 3. Experimenting with the PICDEM™ Z Demonstration Kit**

### **3.1 INTRODUCTION**

Topics covered in this chapter include:

- Modifying the Hardware Configuration
- Developing Your Application
- Programming Your Application
- Restoring Demo Firmware

### **3.2 MODIFYING THE HARDWARE CONFIGURATION**

The PICDEM Z boards are designed to be flexible in terms of enabling/disabling on-board components and adding your own circuit.

Jumper	Purpose
J2	To connect/disconnect on-board RS-232 driver to the PIC® MCU (RC7 and RC6 are shorted via PCB trace to RX and TX, respectively)
JP2	To enable/disable D1 LED (factory enabled by PCB trace shorts)
JP3	Enable/disable D2 LED (factory enabled by PCB trace shorts)
JP4	To measure current draw of entire board (factory shorted via PCB trace)

### **3.3 DEVELOPING YOUR APPLICATION**

The PICDEM Z kit can be used with either the ZigBee or MiWi protocol. For more information on the ZigBee protocol, refer to AN965. For more information on the MiWi protocol, refer to AN1066.

### **3.4 PROGRAMMING YOUR APPLICATION**

Once you have developed your application, you must program it into one of the PICDEM Z nodes. All PICDEM Z motherboards are exactly the same and can be programmed to run any ZigBee or MiWi protocol application.

The PICDEM Z kit does not include the tools for clearing and reprogramming the microcontroller. To do this, you must use an appropriate device programmer. You may also use the MPLAB ICD 2 in-circuit debugger, which provides a complete development suite for device debugging and programming. The PICDEM Z motherboard contains a modular connector to connect MPLAB ICD 2, PRO MATE II and other compatible programmers.

Use the following configuration options when programming the microcontroller:

1. HSPLL (or HS) Oscillator mode depending on your application requirement.
2. Watchdog Timer disabled (demo applications use software enabled Watchdog Timer).
3. Low-Voltage Programming (LVP) disabled.
4. All other options should be changed as per your requirements.

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## 3.5 RESTORING DEMO FIRMWARE

You may restore the original demo firmware by reprogramming and reconfiguring the PICDEM Z node. You may either use the factory built hex file or a rebuilt hex file to program the microcontroller. The factory built hex file is available in the demo application directories of the installed ZigBee Protocol Stack.

Use the file, C:\MpZBee\DemoCoordinator.hex, for the demo coordinator application and, C:\MpZBee\DemoRFD.hex, for the demo RFD application. If you want to rebuild the demo firmware, please refer to the Microchip application note AN965 (DS00965) for detailed instructions. The demo firmware is embedded with the necessary PIC device configuration options appropriate for the PICDEM Z hardware. You must have access to a compatible PIC device programmer to program the on-board microcontroller.

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## Chapter 4. Troubleshooting

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### 4.1 INTRODUCTION

This chapter discusses common operational issues and how to resolve them. Topics covered in this chapter include:

- Common Issues

### 4.2 COMMON ISSUES

#### 1. A PICDEM Z node does not communicate with the host system.

The primary reason for this issue would be the lack of power and/or incorrectly programmed firmware.

- Verify that the on-board microcontroller is programmed correctly with the appropriate hex file. Refer to **Section 3.5 “Restoring Demo Firmware”** for details.
- Make sure that the on-board RS-232 driver is connected to the microcontroller by appropriately shorting the J3 jumper.
- Make sure that your terminal program is set to use 19200 bps, 8-N-1, no flow control.
- Make sure that the RF card is correctly plugged into the motherboard.

#### 2. A PICDEM Z node is observed to be reset periodically.

The on-board firmware is stuck in some unexpected infinite loop. This may occur if there is a short or open on certain RF card signals, or if there is a programming mistake in the firmware.

- Verify that the on-board microcontroller is programmed correctly with the appropriate hex file. Refer to **Section 3.5 “Restoring Demo Firmware”** for details.
- Make sure that the RF card is correctly plugged into the motherboard.
- If you have modified the hardware, make sure that any of the RF card signals are not shorted or open.
- Try plugging in a different RF card to eliminate a bad RF card problem.

#### 3. Cannot control the LEDs on another node.

The primary reason for this issue would be that the demo coordinator is not running and/or the switch is not correctly bound to the target LED.

- Make sure that on-board LEDs on the node you are controlling are enabled by shorting the JP3 jumper.
- Make sure that nodes are bound properly.
- Make sure that the demo coordinator is powered and running.
- Make sure that two nodes are within the radio sphere of the Coordinator.

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4. Binding of the switch and LED on the same coordinator node is not allowed.  
The primary reason for this issue would be that the demo coordinator is not running and/or the switch is not correctly bound to the LED.
  - Make sure that you have performed the proper binding operation using the procedure described in AN965 “*Microchip Stack for the ZigBee™ Protocol*” (DS00965).
  - Make sure that the demo coordinator is powered and running.
  - Make sure that the node is within the radio sphere of the coordinator.
5. RFD node does not associate with the demo coordinator node.
  - Make sure that both the RFD and the coordinator are within each other’s radio sphere.



# **PICDEM™ Z**

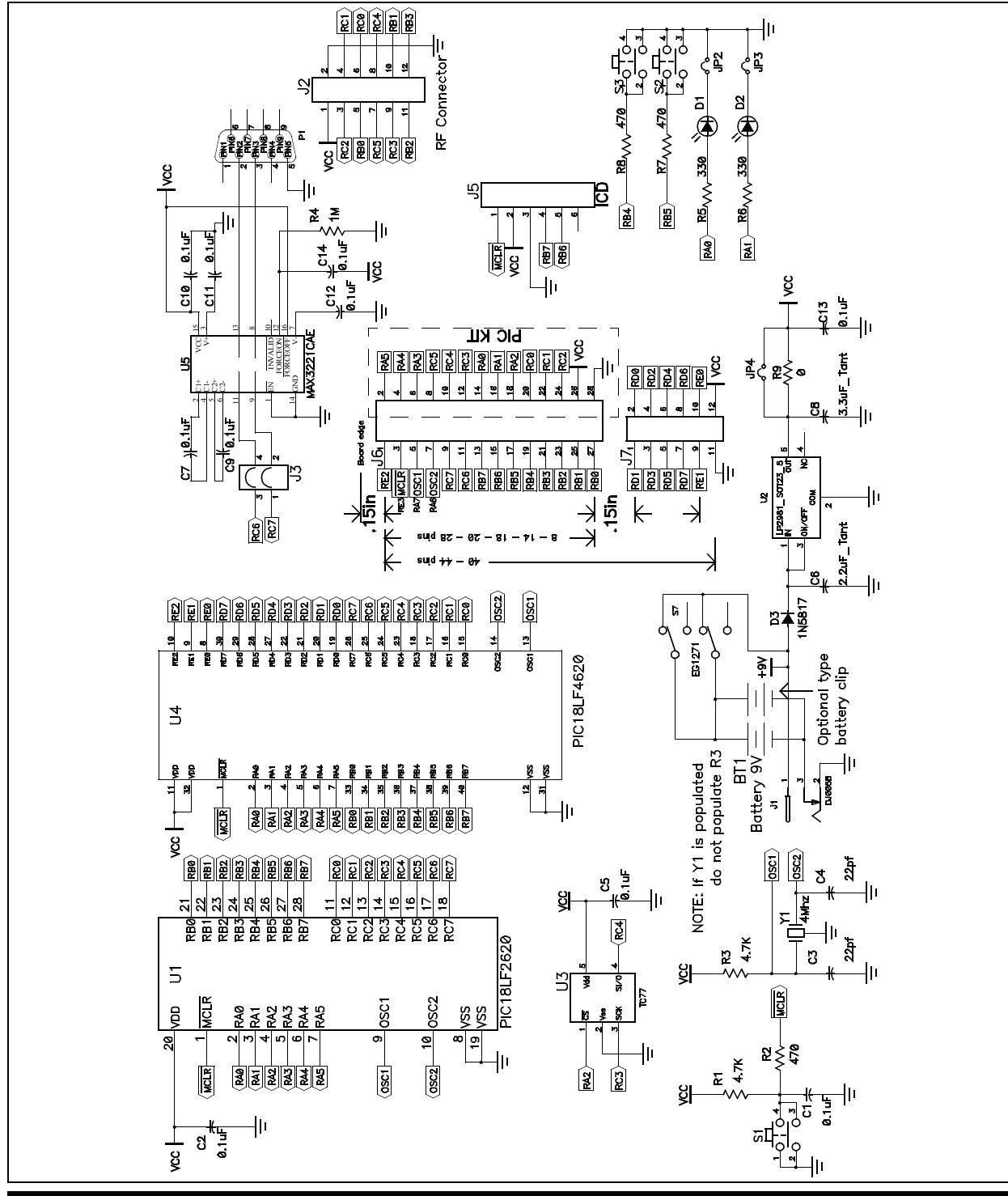
## **DEMONSTRATION KIT**

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## **Appendix A. PICDEM™ Z Motherboard Schematics**

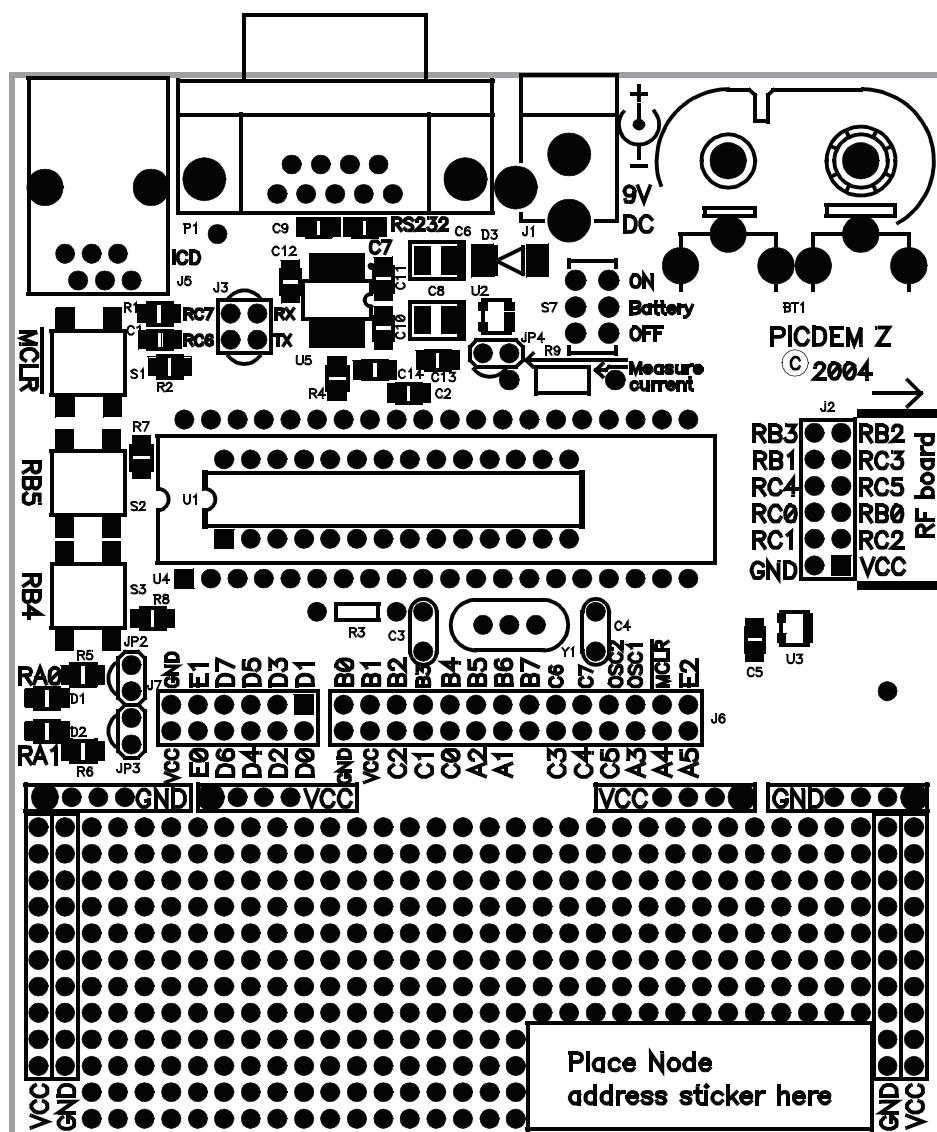
## A.1 PICDEM Z MOTHERBOARD SCHEMATICS

## **FIGURE A-1: PICDEM™ Z MOTHERBOARD**



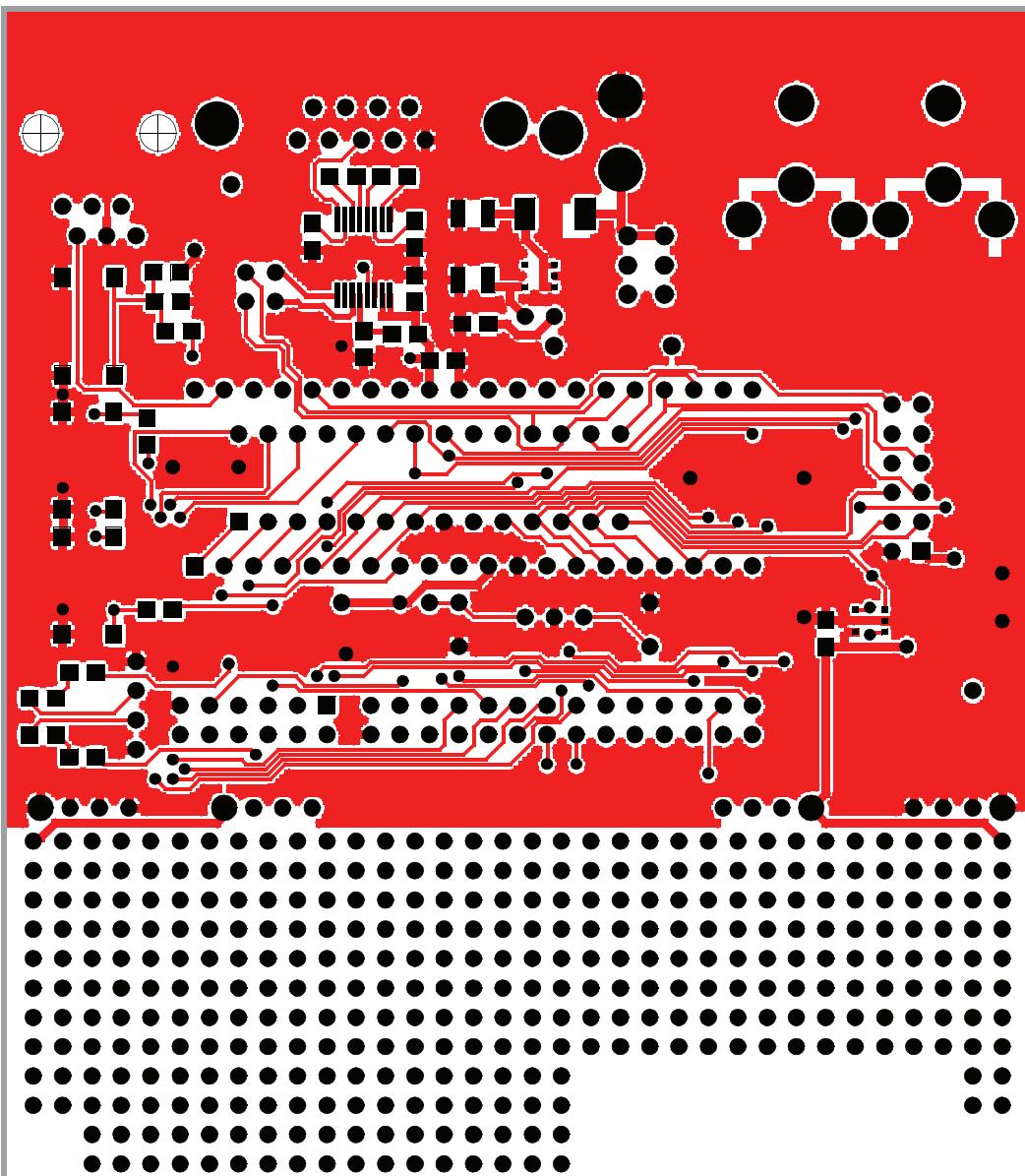
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FIGURE A-2: PICDEM™ Z MOTHERBOARD TOP ASSEMBLY



# PICDEM™ Z Motherboard Schematics

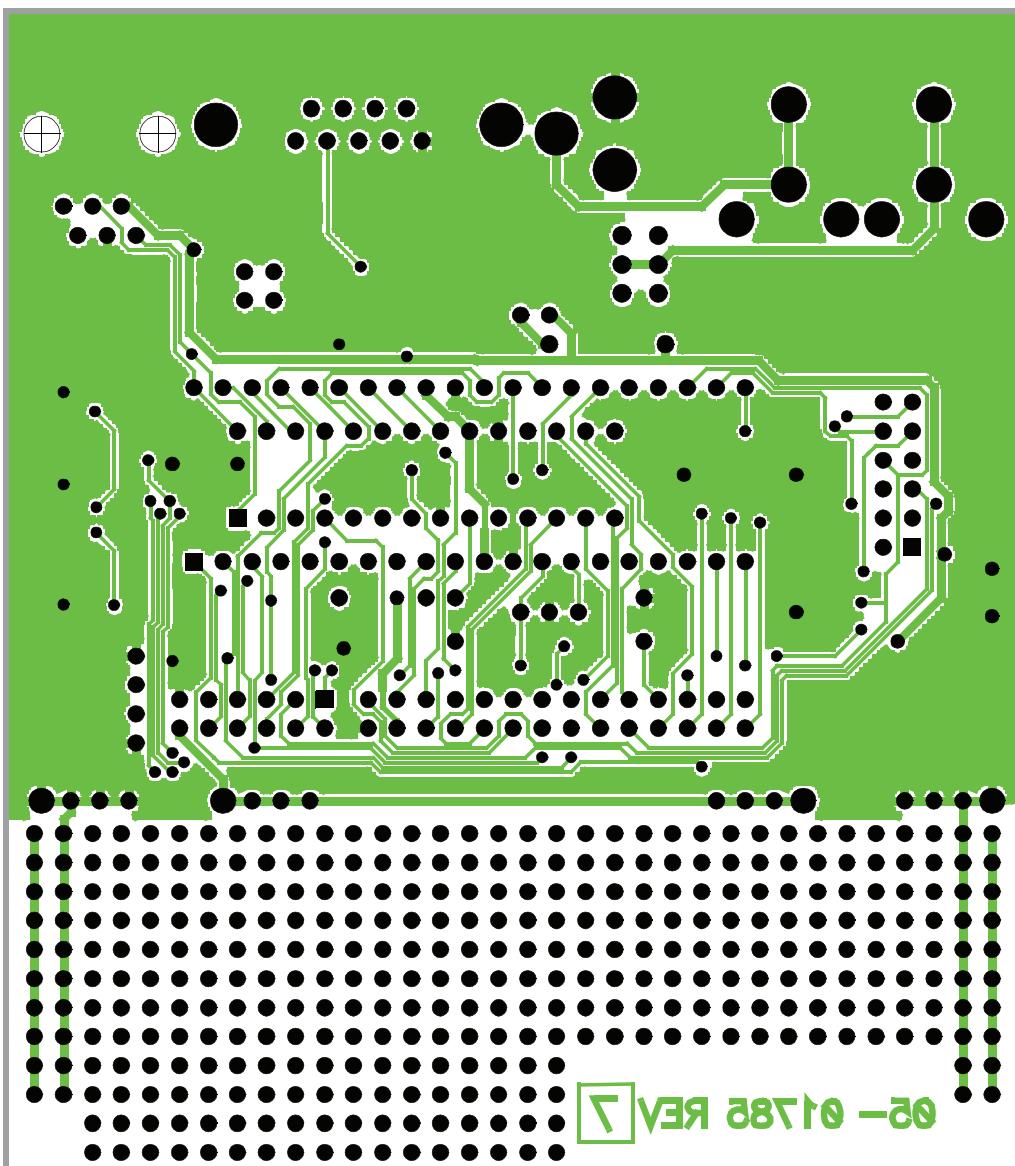
FIGURE A-3: PICDEM™ Z MOTHERBOARD LAYER 1



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FIGURE A-4: PICDEM™ Z MOTHERBOARD LAYER 2



# PICDEM™ Z Motherboard Schematics

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## A.2 PICDEM Z MOTHERBOARD BILL OF MATERIALS

**TABLE A-1: PICDEM™ Z MOTHERBOARD BILL OF MATERIALS (BOM)**

Reference	Description	Vendor	Vendor P/N
D3	Diode Schottky 20V 1A SMD MELF	Diodes Inc.	1N5817M-13
BT1	Conn Batt Male 9V Horz Snap-on	Keystone Electronics	593
BT1	Conn Batt Fem 9V Horz Snap-on	Keystone Electronics	594
	Conn PC Vert 9V Snap-on	Keystone Electronics	968
C3, C4	22 pF 100V 5% Monolith Cerm Cap	Panasonic - ECG	ECU-S2A220JCA
C1, C2, C5, C7, C9, C10, C11, C12, C13, C14	Cap .1 µF 16V Ceramic X7R 0805	Panasonic - ECG	ECJ-2VB1C104K
C6	Capacitor Tant 2.2 µF 25V 10% SMD	Kemet	T491B225K025AS
C8	Capacitor Tant 3.3 µF 16V 10% SMD	Kemet	T491B335K016AS
Y1	Crystal 4.000 MHz 20 pF HC-49/US	ECS Inc.	ECS-40-20-4
P1	DB9 F		
J1	Conn Powerjack Mini .1" R/A PCMT	Switchcraft Inc.	RAPC712
J3			
J2	2 x 6 .100" Socket/Terminal	Samtec	LST-106-07-F-D
JP2, JP3, JP4			
D1, D2	LED Thin 565NM Grn Diff 0805 SMD	Lumex Opto	SML-LXT0805GW-TR
U2	IC Reg LDO Micropower SOT23-5	National Semiconductor	LP2981AIM5-3.3
U5		Maxim	MAX3221CAE
U1	28-pin Socket	Mill-Max	110-99-328-41-001
U4	40-pin Socket (needs to have no internal ribs)	Mill-Max	110-99-640-41-001
U4	PIC® MCU	Microchip	PIC18LF4620-I/P
R3	No Load		
R5, R6	Res 330 OHM 1/8W 5% 0805 SMD	Yageo America	9C08052A3300JLHFT
R2, R7, R8	Res 470 OHM 1/8W 5% 0805 SMD	Yageo America	9C08052A4700JLHFT
R1	Res 4.7K OHM 1/8W 5% 0805 SMD	Yageo America	9C08052A4701JLHFT
R4	Res 1.0M OHM 1/8W 5% 0805 SMD	Yageo America	9C08052A1004JLHFT
J5	Conn Mod Jack 6-6 R/A PCB 50AU	AMP/Tyco	520470-3
S1, S2, S3	Switch Tact 6MM SMD MOM 230GF	Omron Electronics	B3S-1002
S7	Switch Slide SPDT PC MNT L = 2 MM	E-Switch, Inc.	EG1271
U3	IC Sensor Thermal SPI 3.3V SOT235	Microchip	TC77-3.3MCTTR
	Test Point PC Multi-Purpose Blk	Keystone Electronics	5011
	Test Point PC Multi-Purpose Red	Keystone Electronics	5010

# **PICDEM Z Demonstration Kit User's Guide**

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**NOTES:**



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## **Appendix B. PICDEM™ Z 2.4 GHz RF Card**

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### **B.1 INTRODUCTION**

This appendix presents an overview of the features and requirements of the PICDEM Z 2.4 GHz RF card. Topics covered in this appendix include:

- What is the PICDEM™ Z 2.4 GHz RF Card?
- PICDEM™ Z 2.4 GHz RF Card Kit Components
- Overview of the PICDEM™ Z 2.4 GHz RF Card
- The PICDEM™ Z 2.4 GHz RF Card Features
- The PICDEM™ Z Software
- Getting Started with the PICDEM™ Z 2.4 GHz RF Card
- PICDEM Z 2.4 GHz RF Card Schematics
- PICDEM Z MRF24J40 Daughter Card Bill of Materials

### **B.2 WHAT IS THE PICDEM™ Z 2.4 GHz RF CARD?**

The PICDEM Z 2.4 GHz RF card is designed to plug into a PICDEM Z motherboard. This board uses the Microchip MRF24J40 RF 2.4 GHz transceiver. The MRF24J40 is an IEEE 802.15.4 compatible RF transceiver for the 2.4 GHz band.

The PICDEM Z 2.4 GHz RF card uses a PCB trace antenna. If required, the card may be easily modified to use a standard monopole antenna.

### **B.3 PICDEM™ Z 2.4 GHz RF CARD KIT COMPONENTS**

The PICDEM Z 2.4 GHz RF card is designed to be part of the PICDEM Z Demonstration Kit.

Your PICDEM Z 2.4 GHz RF Card Kit contains the following items:

1. One PICDEM Z 2.4 GHz RF card
2. A warranty registration card

You may download the complete schematic and PCB design files from the Microchip web site.

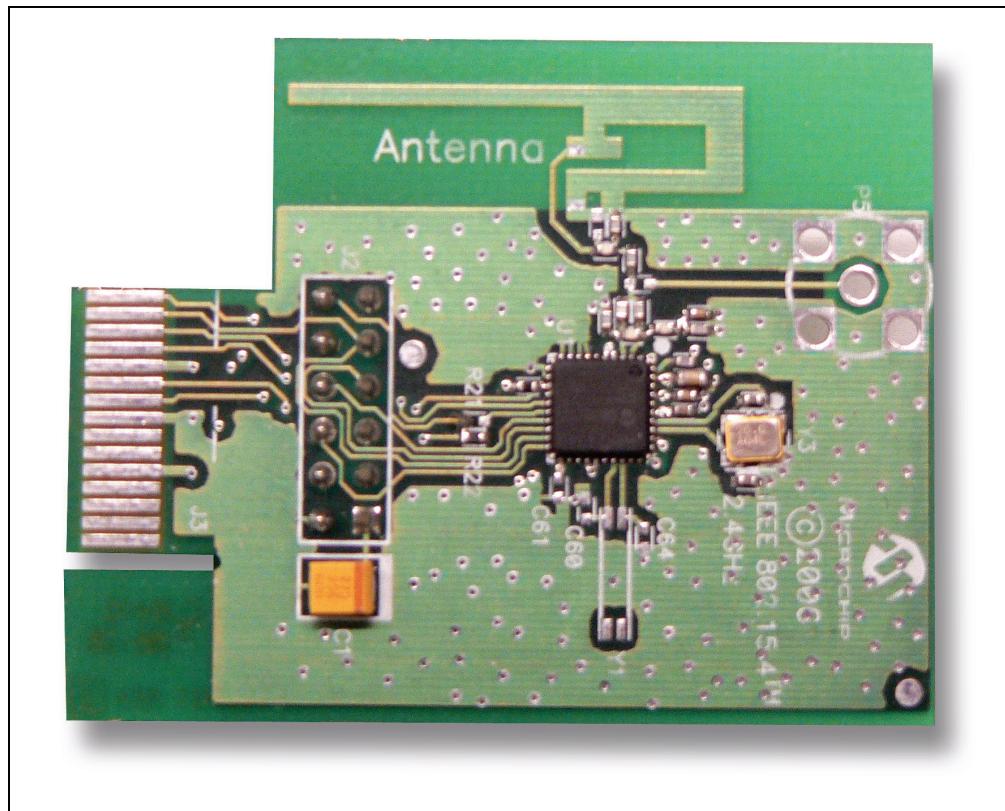
# PICDEM Z Demonstration Kit User's Guide

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## B.4 OVERVIEW OF THE PICDEM™ Z 2.4 GHz RF CARD

The PICDEM Z 2.4 GHz RF card is designed to demonstrate the Microchip solution for the ZigBee protocol for the 2.4 GHz frequency band. All design files related to the RF card are available from the Microchip web site. You may use this board directly in your design or plug it into a PICDEM Z motherboard to complete the ZigBee node. The current version of the Microchip Stack for the ZigBee Protocol provides the necessary software to support this card.

**FIGURE B-1: PICDEM™ Z 2.4 GHz RF CARD**

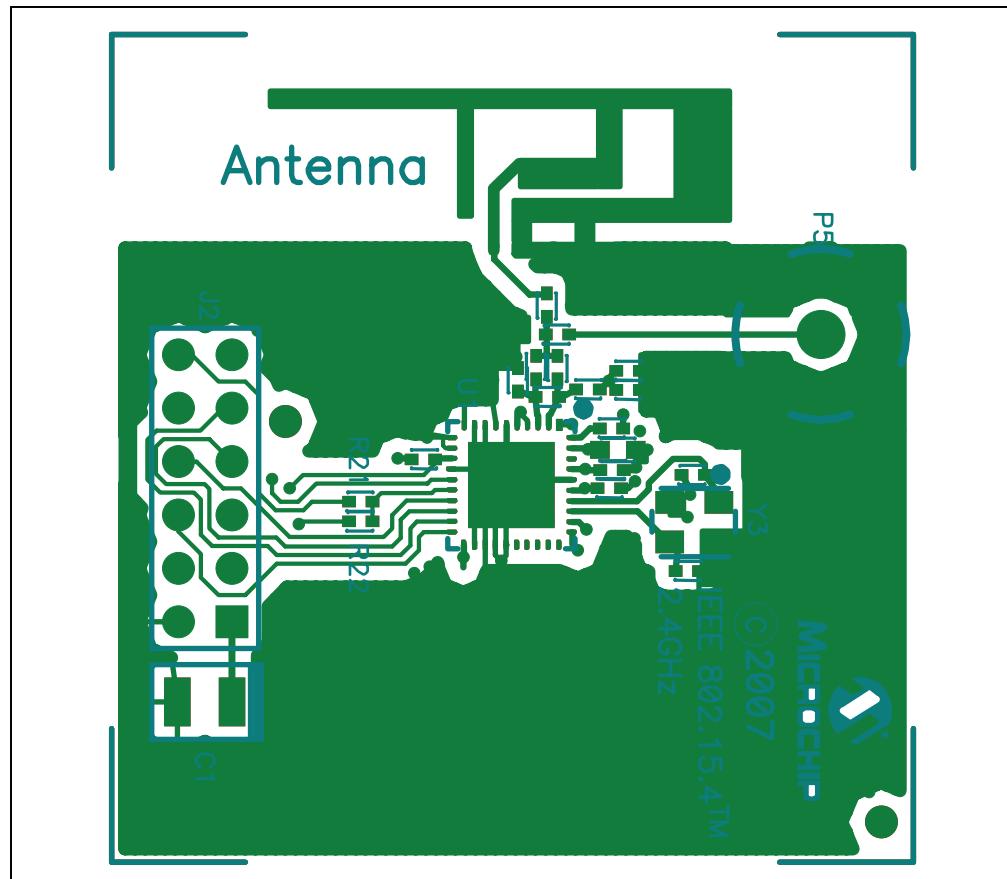


## B.5 THE PICDEM™ Z 2.4 GHz RF CARD FEATURES

The PICDEM Z 2.4 GHz RF card is designed to use the MRF24J40 RF transceiver. The MRF24J40 is an IEEE 802.15.4 compliant RF transceiver in the 2.4 GHz frequency band. The card provides a two-row header to connect to a PICDEM Z motherboard.

The current version of the PICDEM Z 2.4 GHz RF card with on-board PCB trace antenna was found to provide a line sight radio range of about 200 ft. Exact range depends on many factors, including but not limited to obstacles, PCB and antenna design. For more information about RF characteristics, refer to MRF24J40 data sheet on the Microchip web site.

**FIGURE B-2: PICDEM™ Z 2.4 GHz RF CARD**



Features on the PICDEM Z 2.4 GHz RF card include:

1. **RF Transceiver** (U1): 40-pin QLP packaged MRF24J40 RF transceiver. This chip implements complete PHY and part of the MAC layer.
  2. **RF Board Connector** (J2): This connector is used to connect to the PICDEM Z motherboard. This connector includes +3.3V DC, an SPI bus, and a few discrete digital I/O control signals.
  3. **Optional SMA Connector** (P5): This is an optional connector to use with an external antenna. You must remove C63 and install C62 to connect P5 to the transceiver. This connector is designed to accept a mini-SMA connector.
  4. **PCB Antenna**: This is the inverted F-type PCB antenna.
  5. **Revision Level Indicator** (back side): The text on the solder side of the board indicates the hardware revision level.

# PICDEM Z Demonstration Kit User's Guide

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## B.6 THE PICDEM™ Z SOFTWARE

You may download the latest version of the PICDEM Z software from the Microchip web site.

## B.7 GETTING STARTED WITH THE PICDEM™ Z 2.4 GHZ RF CARD

### B.7.1 Introduction

This section covers the following topics:

- Motherboard Requirements
- Using the PICDEM™ Z 2.4 GHz RF Card for the First Time

### B.7.2 Motherboard Requirements

The PICDEM Z 2.4 GHz RF card is designed for use with a PICDEM Z motherboard or similar board. If you are planning to use the RF card with your custom board, use the PICDEM Z motherboard schematic as a reference (see **Section Figure A-1: "PICDEM™ Z Motherboard"**).

### B.7.3 Using the PICDEM™ Z 2.4 GHz RF Card for the First Time

The PICDEM Z 2.4 GHz RF card must be properly plugged into the PICDEM Z motherboard to complete the setup. Refer to Figure 2-1 for an example.

Perform the following steps to prepare each node:

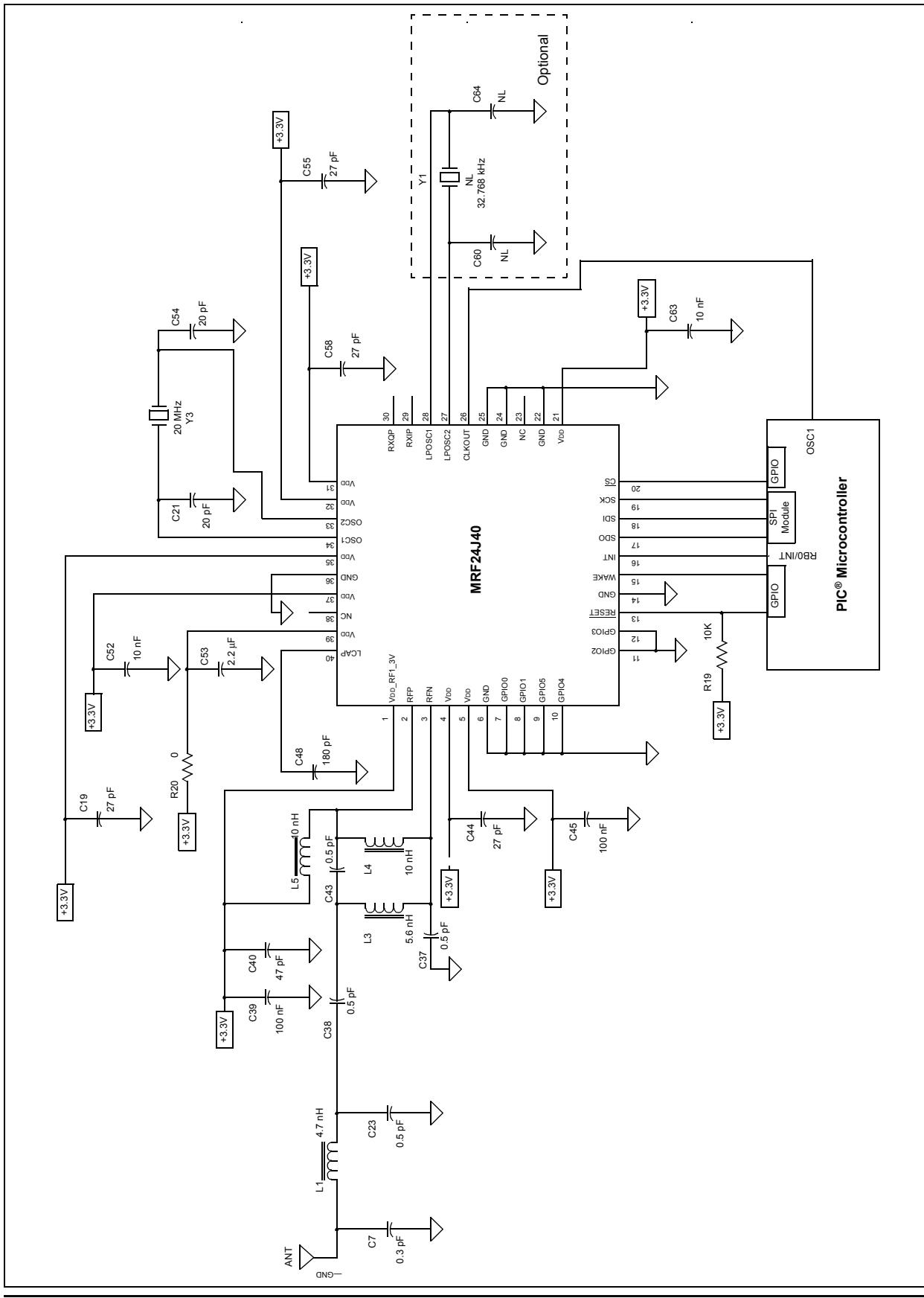
1. Remove from box and unwrap each board and place on a non-conductive surface.
2. Carefully plug the PICDEM Z 2.4 GHz RF card into the J2 connector on the main board. Note that the connectors on the main board and RF card are polarized and will not allow incorrect insertion.
3. Power the PICDEM Z motherboard.

**Note:** Before transmitting an RF signal, check with your local telecommunication authorities to ensure that no restriction on the use of the 2400-2483.5 MHz ISM band is in effect.

The MRF24J40 operates in the 2.4 GHz frequency band; however, be advised that even though this band is commonly thought of as a world-wide band, some countries do not allow unlicensed operation in this band.

## B.8 PICDEM Z 2.4 GHz RF CARD SCHEMATICS

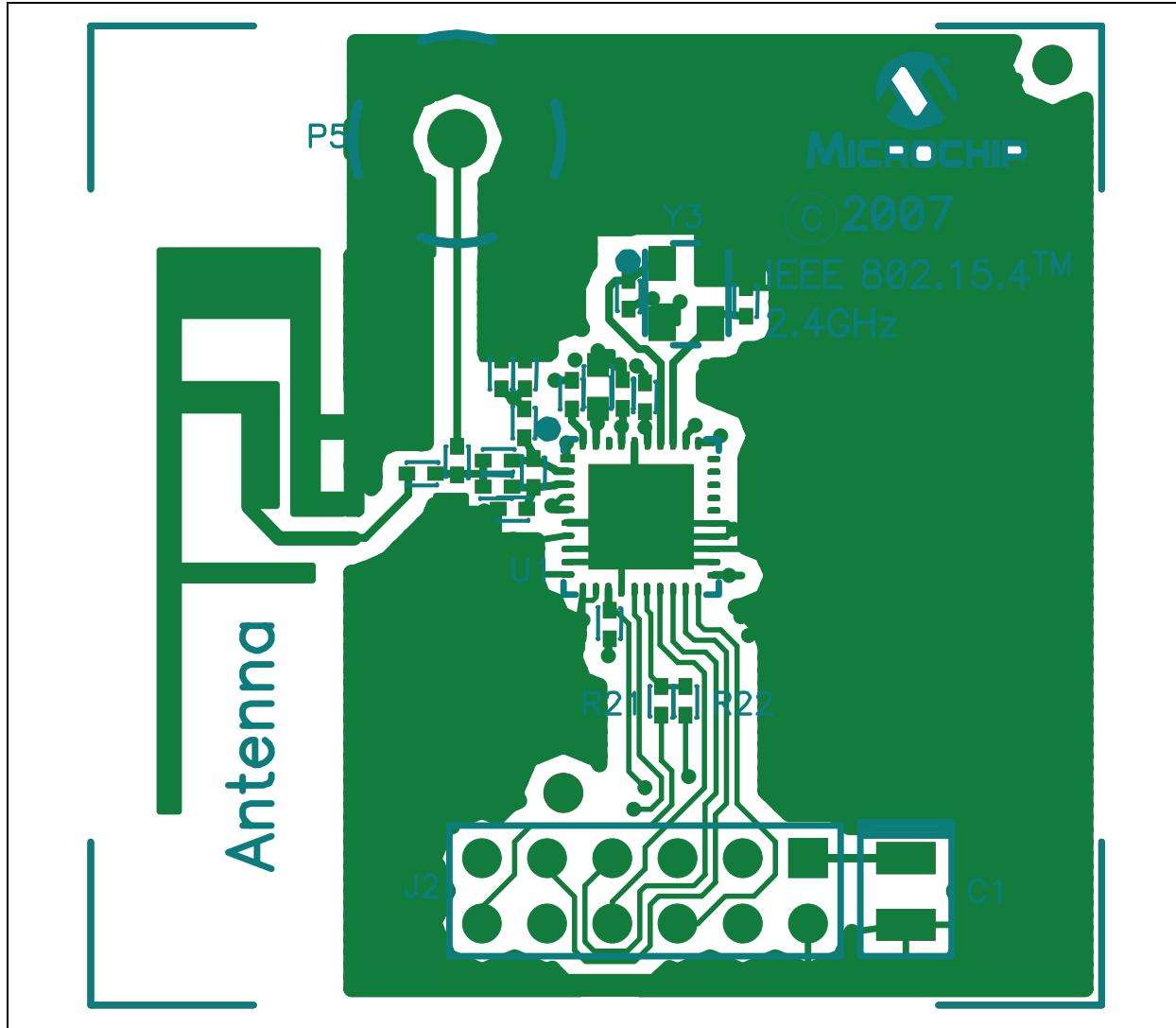
FIGURE B-3: PICDEM™ Z 2.4 GHz RF CARD SCHEMATICS



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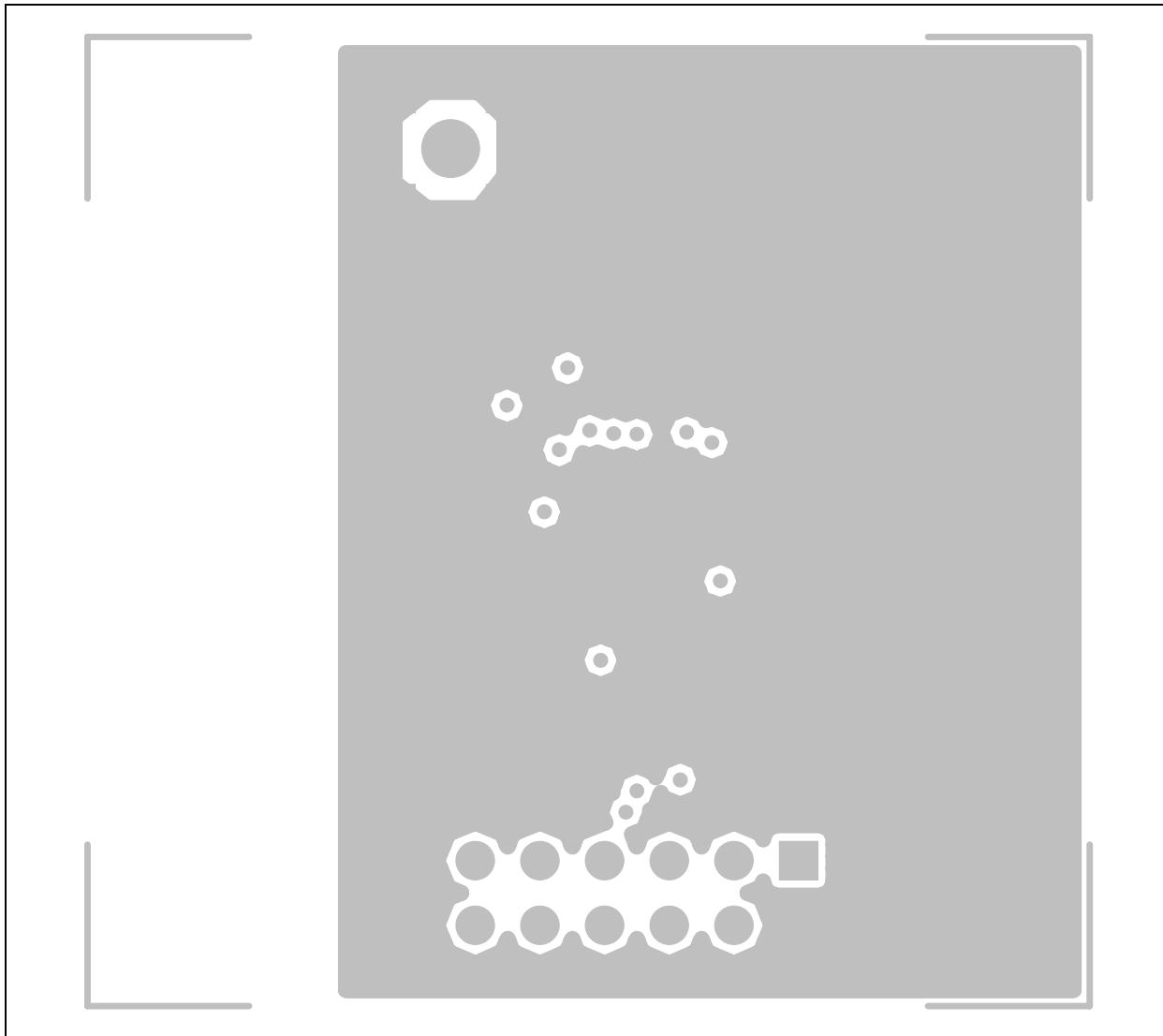
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FIGURE B-4: PICDEM™ Z 2.4 GHz RF CARD TOP ASSEMBLY



# PICDEM™ Z 2.4 GHz RF Card

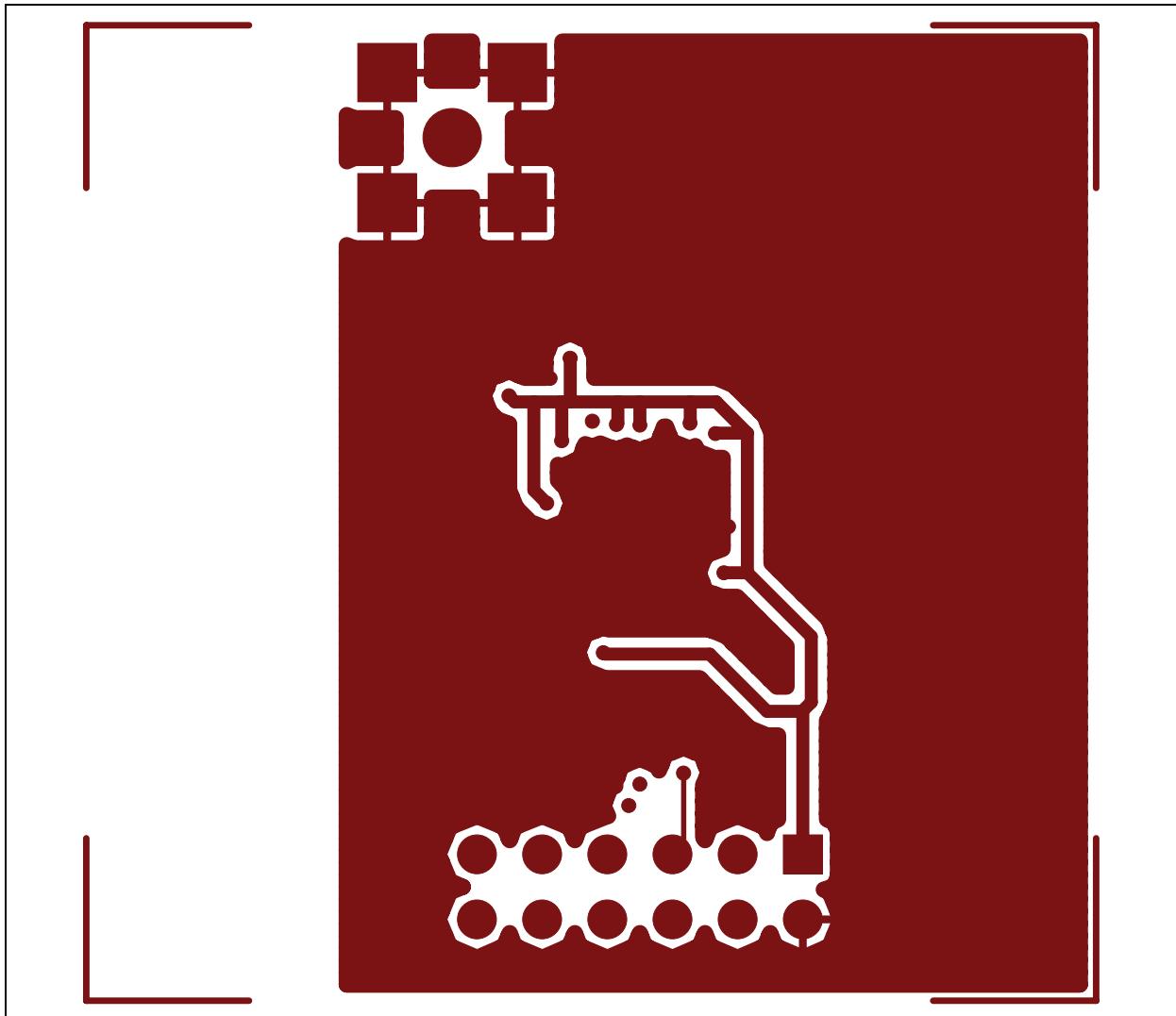
**FIGURE B-5: PICDEM™ Z 2.4 GHz RF CARD LAYER 2**



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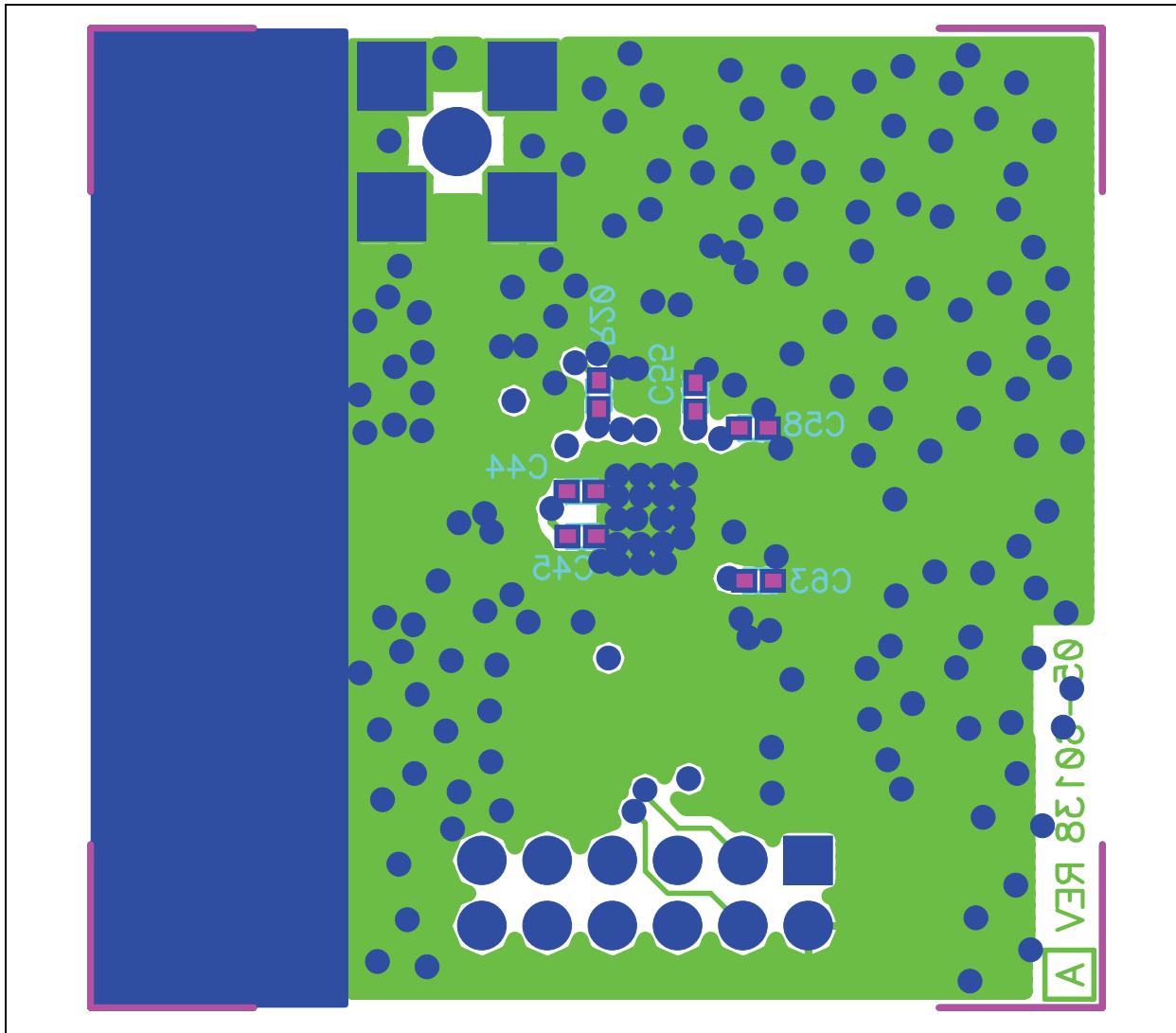
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FIGURE B-6: PICDEM™ Z 2.4 GHz RF CARD LAYER 3



# PICDEM™ Z 2.4 GHz RF Card

FIGURE B-7: PICDEM™ Z 2.4 GHz RF CARD LAYER 4



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## B.9 PICDEM Z MRF24J40 DAUGHTER CARD BILL OF MATERIALS

TABLE B-1: MRF24J40 DAUGHTER CARD BILL OF MATERIALS

Quantity	Component Name	Reference Description	Value	Description	Vendor	Vendor #
1	CAP3528	C1	2.2 $\mu$ F_Tant	Capacitor TANT, 2.2 $\mu$ F, 25V, 10%, SMD	Kemet	T491B225K025AT
4	CAP0402	C23, C37, C38, C43	0.5 pF	CAP, Ceramic, 0.5 pF, 50V, NP0, 0402	Yageo America	0402CG508C9B200
2	CAP0402	C21, C54	20 pF	CAP, Ceramic, 20 pF, 50V, 5%, C0G, 0402	Murata Electronics	GRM1555C1H200JZ01D
4	CAP0402	C19, C44, C55, C58	27 pF	CAP, Ceramic, 27 pF, 50V, 0402, SMD	Panasonic - ECG	ECJ-0EC1H270J
1	CAP0402	C40	47 pF	CAP, Ceramic, 47 pF, 50V, C0G, 5%, 0402	TDK Corporation	C1005C0G1H470J
2	CAP0402	C52, C63	10 nF	CAP, Ceramic, 10000 pF, 16V, X7R, 0402	Kemet	C0402C103K4RACTU
2	CAP0402	C39, C45	100 nF	C0402C104K8PACTU	Kemet	C0402C104K8PACTU
1	CAP0402	C48	180 pF	CAP, Ceramic, 180 pF, 50V, C0G, 5%, 0402	TDK Corporation	C1005C0G1H181J
1	CAP0603	C53	2.2 $\mu$ F	CAP, Ceramic, 2.2 $\mu$ F, 10V, Y5V, 0603	Taiyo Yuden	LMK107F225ZA-T
1	CRYSTAL_ABM8	Y3	20 MHz	Crystal, 20.000 MHz, 18 pF, FUND, SMD	Abracan Corporation	ABM8-20.000MHZ-B2-T
1	MRF24J40_QLP40	U1		MRF24J40, Single Chip Transceiver	Microchip	MRF24J40-I/ML
1	IND0402	L1	4.7 nH	Inductor Multilayer, 4.7 nH, 0402	TDK Corporation	MLK1005S4N7S
1	IND0402	L3	5.6 nH	Inductor Multilayer, 5.6 nH, 0402	TDK Corporation	MLK1005S5N6D
2	IND0402	L4, L5	10 nH	Inductor Multilayer, 10 nH, 0402	TDK Corporation	MLK1005S10NJ
2	RES0402	R20, R22	0 $\Omega$	RES, 0 $\Omega$ , 1/16W, 5%, 0402, SMD	Panasonic - ECG	ERJ-2GE0R00X
1	RES0402	R19	10K	RES, 10 k $\Omega$ , 1/16W, 5%, 0402, SMD	Yageo America	RC0402JR-0710KL
1	HDR6X2	J2		.100" Socket/Terminal	Samtec	LST-106-07-F-D

# **PICDEM™ Z 2.4 GHz RF Card**

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## **NOTES:**



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