

PICDEM.net[™] Embedded Internet/Ethernet Demonstration Board User's Guide

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Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999 and Mountain View, California in March 2002. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUS, KEEL0Q® code hopping devices, Serial EEPROMs, microperipherals, non-volatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.



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General Information

Introduction

This chapter contains general information about this manual and contacting customer support.

Highlights

Topics covered in this chapter:

- About this Guide
- Recommended Reading
- · Warranty Registration
- Troubleshooting
- The Microchip Internet Web Site
- Development Systems Customer Notification Service
- Customer Support

About This Guide

Document Layout

This document describes how to use PICDEM.net as an evaluation tool for embedded connectivity solutions using PICmicro[®] devices. The manual layout is as follows:

- Chapter 1: Introduction to the PICDEM.net Board Describes what PICDEM.net is, and what features are available on the board.
- Chapter 2: Getting Started with the PICDEM.net Board Describes how to connect and begin to use the PICDEM.net board.
- Chapter 3: Exploring Demo Web Site Describes the demonstration web site provided with the PICDEM.net firmware.
- Chapter 4: Using the Microchip TCP/IP Stack Demo Application Provides a brief overview of the Demo Application firmware and source code, and how to modify the application and the Demo Web Site.
- Chapter 5: Reconfiguring and Restoring the Firmware Provides instructions on loading a Web page into the on-board EEPROM, and reconfiguring the network settings.
- Chapter 6: Troubleshooting Provides information on solving common problems.

- Appendix A: PICDEM.net Board Schematics Provides schematic diagrams of the PICDEM.net board.
- Appendix B: PICDEM.net Connectivity Solutions CD Provides a summary of the software solutions on the accompanying CD-ROM.
- Worldwide Sales and Service Lists Microchip Sales and Service locations and telephone numbers, worldwide.

Conventions Used in this Guide

This manual uses the following documentation conventions:

Documentation Conventions

Description	Represents	Examples		
Code (Courier font):				
Plain characters	Sample code Filenames and paths	<pre>#define START c:\autoexec.bat</pre>		
Angle brackets: < >	Variables	<label>, <exp></exp></label>		
Square brackets []	Optional arguments	MPASMWIN [main.asm]		
Curly brackets and pipe character: { }	Choice of mutually exclusive arguments An OR selection	errorlevel {0 1}		
Lower case characters in quotes	Type of data	"filename"		
Ellipses	Used to imply (but not show) additional text that is not relevant to the example	<pre>list ["list_option , "list_option"]</pre>		
0xnnn	A hexadecimal number where n is a hexadecimal digit	0xFFFF, 0x007A		
Italic characters	A variable argument; it can be either a type of data (in lower case characters), or a specific example (in uppercase characters)	char isascii (char, <i>ch</i>);		
Interface (Arial font):				
Underlined, italic text with right arrow	A menu selection from the menu bar	<u>File > Save</u>		
Bold characters	A window or dialog button to click	OK, Cancel		
Characters in angle brackets < >	A key on the keyboard	<tab>, <ctrl-c></ctrl-c></tab>		
Documents (Arial font):				
Italic characters	Referenced books	MPLAB [®] IDE User's Guide		

Documentation Updates

All documentation becomes dated, and this user's guide is no exception. Since MPLAB[®] IDE, MPLAB C1X and other Microchip tools are constantly evolving to meet customer needs, some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site to obtain the latest documentation available.

Documentation Numbering Conventions

Documents are numbered with a "DS" number. The number is located on the bottom of each page, in front of the page number. The numbering convention for the DS Number is: DSXXXXA,

where:

XXXXX	=	The document number.
А	=	The revision level of the document

Warranty Registration

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in your Warranty Registration Card entitles you 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.net Ethernet/Internet Demonstration Kit. The data sheets contain current information on programming the specific microcontroller devices.

MPLAB[®] IDE, Simulator, Editor User's Guide (DS51025)

Comprehensive guide that describes installation and features of Microchip's MPLAB Integrated Development Environment (IDE), as well as the editor and simulator functions in the MPLAB environment.

 $MPASM^{TM}$ User's Guide with $MPLINK^{TM}$ and $MPLIB^{TM}$ (DS33014)

Describes how to use Microchip Universal PICmicro Microcontroller Assembler (MPASM), Linker (MPLINK), and Librarian (MPLIB).

Technical Library CD-ROM (DS00161)

This CD-ROM contains comprehensive data sheets for Microchip PICmicro[®] MCU devices available at the time of print. To obtain this disk, contact the nearest Microchip Sales and Service location (see back page), or download individual data sheet files from the Microchip web site (www.microchip.com).

Embedded Control Handbook (DS00711)

This handbook consists of several documents that contain a wealth of information about microcontroller applications. To obtain these documents, contact the nearest Microchip Sales and Service location (see back page).

The application notes described in these manuals are also obtainable from Microchip Sales and Service locations, or from the Microchip web site (www.microchip.com).

Microchip Application Note AN833, "The Microchip TCP/IP Stack" (DS00833)

This particular application note (also included on the CD-ROM accompanying this kit) gives a detailed explanation of the Free Microchip TCP/IP Stack on which the kit's firmware is based. It is referred to throughout this manual as a primary reference.

PICmicro[®] Mid-Range MCU Family Reference Manual (DS33023) and PICmicro[®] 18C MCU Family Reference Manual (DS39500)

These manuals explain the general details and operation of the mid-range and advanced MCU family architecture and peripheral modules. They are designed to complement the device data sheets.

Microsoft Windows[®] Manuals

This manual assumes that users are familiar with Microsoft Windows operating system. Many excellent references exist for this software program, and should be consulted for general operation of Windows.

Troubleshooting

See Chapter 6 for information on common problems.

The Microchip Internet Web Site

Microchip provides on-line support on the Microchip web site at:

www.microchip.com

A file transfer site is also available by using an FTP service connecting to:

ftp://ftp.microchip.com

The web site and file transfer site provide a variety of services. Users may download files for the latest development tools, data sheets, application notes, user's guides, articles and sample programs. A variety of Microchip specific business information is also available, including listings of Microchip sales offices and distributors. Other information available on the web site includes:

- Latest Microchip press releases
- Technical support section with FAQs
- Design tips
- Device errata
- Job postings

- Microchip consultant program member listing
- Links to other useful web sites related to Microchip products
- Conferences for products, development systems, technical information and more
- Listing of seminars and events

Development Systems Customer Notification Service

Microchip started the customer notification service to help customers stay current on Microchip products with the least amount of effort. Once you subscribe, you will receive email notification whenever we change, update, revise or have errata related to your specified product family, or development tool of interest.

Go to the Microchip web site (www.microchip.com) and click on Customer Change Notification. Follow the instructions to register.

The Development Systems product group categories are:

- Compilers
- Emulators
- In-Circuit Debuggers
- MPLAB IDE
- Programmers

Here is a description of these categories:

Compilers - The latest information on Microchip C compilers, linkers and assemblers. These include MPLAB C17 C compiler, MPLAB C18 C compiler, MPLINK Object Linker (as well as the MPLIB Object Librarian) and MPASM Assembler.

Emulators - The latest information on Microchip in-circuit emulators. This includes MPLAB ICE 2000 In-Circuit Emulator.

In-Circuit Debuggers - The latest information on Microchip in-circuit debuggers. This includes the MPLAB ICD and MPLAB ICD 2.

MPLAB - 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 PICmicro device programmers. These include the PRO MATE[®] II device programmer and PICSTART[®] Plus development programmer.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributors
- Local Sales Office
- Field Application Engineer (FAE)
- Corporate Applications Engineer (CAE)
- Systems Information and Upgrade Hot Line

Customers should call their distributor or field application engineer (FAE) for support. Local sales offices are also available to help customers. See the back cover for a listing of sales offices and locations.

Corporate applications engineers (CAEs) may be contacted at (480) 792-7627.

In addition, there is a Systems Information and Upgrade Information Line. This line provides system users a listing of the latest versions of all of Microchip's development systems software products. This line also provides information on how customers can receive currently available upgrade kits.

The Information Line Numbers are:

1-800-755-2345 for U.S. and most of Canada.

1-480-792-7302 for the rest of the world.



Chapter 1. Introduction to the PICDEM.net Board

1.1 Introduction

The PICDEM.net Demonstration Board Kit has been created to allow developers to examine the possibilities of embedded connectivity solutions for Ethernet networks and the Internet. Using the Free Microchip TCP/IP Stack source code, developers can experiment with the pre-programmed Microchip TCP/IP Demo Application. Users can also explore other solutions offered by Microchip's connectivity partners.

1.2 Highlights

This chapter covers the following:

- PICDEM.net Demonstration Kit contents
- PICDEM.net Demonstration Board features
- The Guide Book
- The Connectivity Solutions CD

1.3 The Demonstration Kit: What's In The Box

Your Demonstration Kit contains the following items:

- 1. The PICDEM.net Embedded Internet/Ethernet Demonstration Board
- 2. A universal power supply (110-230 VAC input, 9 VDC output) for the Demonstration Board
- 3. A serial cable (DB9, M/F connectors) for use in programming the board
- 4. A CAT5 "crossover" network cable (10 BaseT connectors) for networking the board
- 5. The guide book *TCP/IP Lean: Web Servers for Embedded Systems* (*Second Edition*), with accompanying software on CD-ROM
- 6. The "PICDEM.net Connectivity Solutions" CD-ROM, which contains various connectivity solutions provided by Microchip and its partners
- 7. This manual (included on the CD-ROM in Adobe[®] Acrobat[®] format)
- 8. A warranty registration card

1.4 The PICDEM.net Demonstration Board

The PICDEM.net board has all the features to begin developing Internet connectivity applications over an Ethernet connection. The pre-programmed firmware allows users to begin evaluating the board right out of the box, with no additional programming or configuration. All that is required to begin exploring the board is a network-enabled computer with an Ethernet card and Internet browser software. (See the "Getting Started" chapter for more specific information.)



Figure 1.1: PICDEM.net Board

Features on the PICDEM.net board include:

1. MICROCONTROLLER SOCKET: A 40-pin DIP socket (600 mil) is provided for the user's choice of Microchip PICmicro microcontrollers. The board is equipped from the factory with a PIC18F452 highperformance microcontroller, clocked at 19.6608 MHz and preprogrammed with the Demo Application firmware using the Microchip TCP/IP Stack.

The board also supports other Microchip 40-pin DIP pin-compatible controllers, such as the PIC16F877, PIC18C452 and PIC18F458.

- MEMORY: A Microchip 24LC256 serial EEPROM provides 256 Kbit (32 Kbyte) of storage for Web pages. The 24LC256 is programmable via a two-wire serial I²CTM interface.
- LCD DISPLAY: This two-line by 16-character dot matrix display shows diagnostic and error messages with the factory programmed firmware. It may be used for other applications with appropriate re-programming.

- 4. ETHERNET CONTROLLER: The PICDEM.net board uses the Realtek RTL8019AS single chip Ethernet controller and transceiver to provide network connectivity.
- 5. STATUS LEDs: Four LEDs are provided:
 - SYSTEM flashes to show the board is powered up and connected correctly.
 - LINK STATUS lights to show that the Ethernet connection is active (Revision 5 and later versions). On Revision 4 versions (shipped with previous version of the Demonstration Kit), this LED flashes to indicate a Collision Detect state.
 - XMIT and RX when the board is connected correctly, these are normally lit, and flash OFF (inverted logic), when the board is transmitting or receiving a packet (respectively).
- 6. USER-DEFINED LEDs: 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. They may also be enabled or disabled by jumper selection on the board (located at 6a).
- 7. USER-DEFINED PUSH BUTTON: This switch is connected to a digital I/O pin on the microcontroller, and may be used to simulate a digital input in an embedded application.
- 8. USER-DEFINED POTENTIOMETERS: Two 10 kOhm potentiometers are connected to analog I/O pins of the microcontroller. These can be used to simulate analog inputs in an embedded application.
- 9. RESET PUSH BUTTON: This switch is tied to the MCLR pin on the controller, and is used to reset the board.
- 10. RJ-45 (10-Base T) MODULAR CONNECTOR: This provides standard Ethernet connectivity.
- 11. RJ-11 (SIX-WIRE) MODULAR CONNECTOR: This allows the demonstration board to be connected to Microchip MPLAB ICD systems for advanced microcontroller emulation and debugging.
- 12. RS-232 (DB9M) CONNECTOR: This allows the demonstration board to be configured for IP and Ethernet address through a standard serial connection. This interface also allows users to download new Web pages to the EEPROM.
- PROTOTYPE AREA: A 24x27 grid is provided for users to breadboard additional circuitry for development. Connections are provided for +5 VDC, ground, and four different I/O ports (RA<5:0>, RB<4:0>, RC<7:0> and RD<7:0>).
- 14. ON-BOARD POWER: An on-board full-wave bridge allows for AC or DC power input. An on-board regulator provides 5 VDC at 1 A.
- 15. ETHERNET ID: This unique serial number represents the two Least Significant Bytes of the pre-programmed Media Access Control (MAC), which is by the Ethernet transceiver to identify and filter packets. The Ethernet ID of the PICDEM.net board can be changed in firmware.
- 16. REVISION LEVEL INDICATOR (BACK SIDE): The silk-screened text on the reverse (trace) side of the board, directly beneath the Prototype Area, indicates the hardware revision level.

1.5 The Guide Book

Also included in this kit is the book *TCP/IP Lean: Web Servers for Embedded System (Second Edition).* Written by Jeremy Bentham of Iosoft, Ltd. (one of Microchip's connectivity partners), *TCP/IP Lean* provides a comprehensive introduction to the many protocols embedded in TCP/IP, and how to implement lean TCP/IP Stack software on 8-bit microcontrollers.

The book is accompanied by its own CD, which provides the source code for the connectivity solutions discussed.

1.6 The Connectivity Solutions CD

Although the Free Microchip TCP/IP Stack firmware has been provided with the board, it is important to note that any of the accompanying solutions from Microchip's connectivity partners can be programmed into the board. A complete list of Microchip partners and their evaluation software is provided on the CD.

The CD provides sample software solutions and additional information for several different vendors. Specifically included are examples from losoft, LiveDevices and Yipee, which may be used in exploring connectivity solutions for both the PIC16C and PIC18C families of microcontrollers. Additional details are provided in Appendix B.

The most up-to-date information on these and other solution providers is available from the Design Center at the Microchip Web Site. The address for the PICDEM.net Connectivity Solutions page is:

http://www.microchip.com/1010/suppdoc/design/netdez/index
.htm



Chapter 2. Getting Started with the PICDEM.net Board

2.1 Highlights

This chapter will cover the following topics:

- Network Precautions
- Using a Host System
- Connecting the PICDEM.net Board
- Configuring the PICDEM.net Board
- Establishing Communications

2.2 Network Precautions: Before You Start

The PICDEM.net board provided in your kit has been designed to demonstrate the possibilities of networking with embedded Microchip controllers over Ethernet and the Internet. As with any experimental system, however, some precautions are in order before you start.

Whenever new hardware or software is added to a network, it is always advisable to create a separate test network that is isolated from your LAN. This allows testing the new system in a controlled environment and minimizes the possibilities of network interference from the new equipment. The major sources of potential interference include:

- ADDRESSING—Each device on the network must have a unique address. If Dynamic Host Configuration Protocol (DHCP) is in use, the PICDEM.net board will automatically acquire a valid IP address. If DHCP is not used or a fixed address is required, adding the board to the network without assigning an address may create network problems.
- TRAFFIC LEVELS—While the on-board Ethernet controller will filter out unwanted messages, a highly-loaded network with many broadcast messages may place a sizable burden on the PICDEM.net board.
- DATA SECURITY—Although it is unlikely that the addition of a single device will compromise the integrity or privacy of sensitive information, it is always a good idea to perform extensive testing with new equipment before adding it to a secure network.
- EXPERIMENTATION—Even as a simple microcontroller-based device, the PICDEM.net board is capable of generating a high volume of network traffic which may severely disrupt normal network operations.

2.3 Using PICDEM.net with a Local Host System

Although the PICDEM.net board is ready to communicate on a DCHP-enabled Ethernet network out of the box, you may have reasons not to do this. Besides those we've already mentioned, there may be others, such as:

- You don't have an Ethernet network available to experiment with
- Your network doesn't use DHCP, and the PICDEM.net board must be configured with an IP address before it's allowed on the network
- Your network administrator forbids you to put the board on the network

For these reasons, the PICDEM.net board can also communicate directly with a properly configured desktop system, known here as a *local host system*. In this configuration, the host system can communicate and configure the board through its network connection; it can also configure the board through the serial port. When configured this way, the setup is referred to as a *test system*.

The PICDEM.net board can also communicate to a network and a local host system separately. In this setup, the board participates on the network through its Ethernet connection. At the same time, it is connected to the local host system through the serial port, from which it can be directly configured.

To function as a local host, the system must meet the following basic requirements:

- Any computer system capable of network communication
- CD-ROM drive (for use with the accompanying CD)
- Standard Ethernet card (10/100 Mbps) with RJ45 connector
- One available standard serial port with a matching COM port available through the operating system
- · Any operating system with TCP/IP Stack software
- · Any Internet Browser software supporting HTTP 1.0 or higher
- Any terminal emulation package, such as HyperTerminal[®] for Microsoft Windows[®] (for optional serial configuration of the PICDEM.net board)
- **Note:** Throughout this chapter, as well as other places in this manual, we will give configuration examples in terms of various versions of Microsoft Windows operating systems. These are, of course, not the only operating systems capable of working with TCP/IP; they are, however, the most commonly available. Users of other operating systems should refer to the appropriate documentation for appropriate instructions, using the instructions provided as a guideline.

2.4 Hooking Up the PICDEM.net Board

As far as hardware is concerned, there are two basic network configurations for the PICDEM.net board: direct connection to a network, and connection to a local host system through a crossover cable. But if DHCP is not enabled on the network, the board will need to be configured before a direct network connection can be used.

If you are connecting the PICDEM.net board to a DHCP-enabled network, follow the steps in Section 2.4.1.

If you are using the board for the first time on a network using fixed IP addresses, follow the steps in Section 2.4.2. Once the IP address is configured the first time, you will be able to connect the board directly to the network as described in Section 2.4.1 without using a local host.

If you are connecting the board to a local host in a test system configuration, you will also follow the steps in Section 2.4.2. If DHCP is enabled on the local host, the board will configure itself. Otherwise, you will need to configure both the host and board IP addresses according to the directions in Section 2.5.

All of this assumes that the PICDEM.net board is running the pre-programmed Demo Application firmware. If the board has been programmed with one of the other software solutions from the Connectivity CD, refer to the accompanying documentation for that software for the types of networks supported. The general principles for hardware discussed in the following sections still apply, and may be used as a guideline.

Note: This section assumes that an Ethernet card has already been installed in the host system and is working properly, and that the TCP/IP protocol has been installed and bound to the card. If this has not been done, or if you are uncertain if this has been done, please contact your Information Systems support person for further assistance.

2.4.1 Connecting Directly to a Network

This configuration, sometimes referred to as *Demonstration Mode*, is the basic method of networking the PICDEM.net board. This assumes a stable Ethernet network using TCP/IP for communications, and that at least one DHCP server is present on the network.

To set up the board for direct networking (Figure 2.1):

- 1. Unbox and unwrap the board, and set it on a non-conductive surface near the host computer.
- 2. Connect a standard Ethernet cable (10 Base T connectors) to the board, then to an available network or Ethernet hub port.

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- **Note:** Do NOT use the Ethernet cable provided with the PICDEM.net Demonstration kit if you are directly connecting the board to a network or hub. The provided crossover cable is to be used only for connecting the board directly to a computer.
- 3. Connect the barrel plug of the power supply to the Power Input jack on the board.
- 4. Plug the power adapter into your wall socket or power strip.



Figure 2.1: Connecting the PICDEM.net Board Directly to a Network

2.4.2 Connecting to a Host System

This option is used when the PICDEM.net board requires reconfiguration (such as an IP address change or firmware reprogramming), or when a direct connection to a network is not possible. For initial setup, this is the preferred configuration.

To set up the board for connection to a local host (Figure 2.2):

- 1. Unbox and unwrap the board, and set it on a non-conductive surface near the host computer.
- 2. Connect the serial cable (supplied in the kit) to the board, then to the available serial port on your computer.

Note: If your available serial port is the 25-pin D shell type, you will need to use a DB25F-to-DB9M port adapter, sometimes known as an "external modem adapter". Check with your local electronics parts store or your Information Services provider for additional information.

- 3. Depending on the network connection to be used, do one of the following:
 - For connections to an existing network or hub: connect a standard Ethernet cable to the board, then to the network port (Option "A" in Figure 2.2).
 - For direct connections to a host system: connect the Ethernet crossover cable (supplied in the kit) to the board, then to the computer (Option "B" in Figure 2.2).
- 4. Connect the barrel plug of the power supply to the Power Input jack on the board.
- 5. Plug the power adapter into your wall socket or power strip.



Figure 2.2: Connections between the PICDEM.net Board and the Host Computer for Direct Network Connection (A) and Test System (B)

2.4.3 Confirming Operation

Once the PICDEM.net board is properly connected and powered up, you should see all of the following:

- The System LED is blinking
- The User LEDs are dark
- On current (Rev 5) boards, the LINK LED is lit; on previous versions (Rev 4 and earlier boards), the LINK LED is dark

Note: The Revision Label is on the reverse (trace) side of the board, directly underneath the Prototype Area grid (see Figure 1.1, item 16). For additional information on the LINK Led, refer to Chapter 6 ("Troubleshooting").

- The XMIT LED should blink at approximately one per second. The RX LED may be solidly lit or blinking.
- The LCD display shows the message:

MCHPStack v2.11 DHCP/Gleaning...

Note: The actual version of the firmware will be reflected in the first line of the LCD display. Version 2.11 is the revision available at the time this manual was prepared. Your display may differ.

If the network uses DHCP, the display should change after several seconds to

MCHPStack v2.11 ?.?.?. 1

where "?.?.?" is the board IP address as assigned by your network server. At this point, the XMIT LED will go out.

The number to the right of the IP address shows how many times the current DHCP configuration has been renewed; it will increment if the board is connected to network for longer than DHCP lease period.

If your PICDEM.net board does not show all of these things, check all connections with the power supply and the board. For additional assistance, refer to Chapter 6 ("Troubleshooting").

If you a using a configuration with a local host system, power the system up now. If the board and/or local host require IP configuration, proceed to the next section. Otherwise, skip over to Section 2.6 ("Establishing Communications").

2.5 Configuring the PICDEM.net Board

Once the board is properly connected, it needs to be configured to operate on the network or host system that is connected to. As already mentioned, the board is factory-configured for DHCP operation; it should automatically acquire an IP address on DHCP-enabled networks and be available for immediate use. If this describes your configuration, you can proceed to Section 2.6 and begin experimenting.

If the PICDEM.net board is connected to a network without DHCP support, you will need to assign an IP address to the board. Follow the directions in Section 2.5.2.

If your PICDEM.net board is directly connected to a host system, you will need to determine the IP address of the host system (or assign it one, if necessary), and then configure the board's IP address accordingly. Start with the directions in Section 2.5.1, then configure the board as described in Section 2.5.2

2.5.1 Obtaining the Host IP Address (Host System Configuration Only)

This process will vary, depending on the operating system used on the host system and the absence or presence of DHCP configuration on the host system. If you are unsure if your network uses DHCP to assign individual machine IP addresses, contact your network support group.

Regardless of the operating system, these steps only need to be done once before using the PICDEM.net board.

Obtaining Host IP Address (Windows 95 only:)

- 1. From the Start menu, select **Run**, then type the command winipcfg. Press <ENTER>. The IP Configuration window will appear with the IP Configuration of the host system (Figure 2.3).
 - If the IP address is 0.0.0, or if the system is using DCHP: If you are creating a test system a with crossover cable, continue with Step 2. For other fixed-address networks, contact your system administrator to obtain a unique IP address.
 - If the IP address is anything except 0.0.0.0: Make a note of the IP address and continue with the procedure for "Configuring the PICDEM.net IP Address" (page 20).

🕎 IP Configuration 📃 🗖 🗙				
Ethernet Adapter Information				
	EL574ND3 Eth	ernet Adapter	_	
Adapter Address	00-10-5A-0	D4-7B-9E		
IP Address	24.200.1	65.183		
Subnet Mask	255.255.255.0			
Default Gateway	24.200	.165.1		
	Relea <u>s</u> e Benew All	Re <u>n</u> ew		
	Refie <u>w</u> All	<u>M</u> ore mio	<u> </u>	

Figure 2.3: IP Configuration Window (Windows 95)

- 2. Click **Release**. The IP Address and Subnet mask are both now "0.0.0.0". Close the IP Configuration dialog.
- 3. From the Start menu, select <u>Settings>Control Panel.</u> Click on the Network applet icon.
- 4. At the Network dialog box, select the Configuration tab.
- 5. Select **TCP/IP** from the list of installed components. Click **Properties**.
- 6. Select the IP Address tab. Select the Specify an IP Address option:
 - If you are creating local test network with crossover cable: Enter "10.10.5.1" for the IP Address, and "255.255.255.0" for the Subnet Mask.
 - For fixed address network: Use the IP configuration provided by your system administrator.

Click Apply.

- 7. Close the Network dialog box, and reboot the system.
- 8. Close the dialog box, then re-run the winipcfg command. The IP address is now a non-zero address; make a note of it.

Obtaining Host IP Address (Windows 98/NT/2000/XP):

- Open a command prompt window. From the Start menu, select <u>Programs>Accessories>MS-DOS Prompt</u> (Windows 98) or <u>Programs>Accessories>Command Prompt</u> (all others).
- 2. At the prompt, type the command ipconfig. This will return the IP Configuration for the host system, including the IP address tied to the Ethernet card (Figure 2.4).
 - If the IP address is 0.0.0.0, or the system is configured for DHCP: Continue with Step 3.

- If the IP address is anything except 0.0.0.0: Make a note of the IP address and continue with the procedure for "Configuring the PICDEM.net IP Address" (page 20).
- 3. Type the command ipconfig/release and press <ENTER>. You may receive a message that addresses were automatically configured and cannot be released; this is normal.
- Type the command ipconfig/renew and press <ENTER>. Wait for about one minute for the system to return a command prompt. You may receive a message that the DHCP server was unavailable; this is also normal.
- 5. Close the window, then open a new command window.
- 6. Type the command ipconfig and press <ENTER>. The new IP address is now a non-zero address. Make a note of this.

🖾 Command Prompt				
Microsoft Windows 2000 [Version 5.00.2195] (C) Copyright 1985–2000 Microsoft Corp.	-			
C:\>ipconfig				
Windows 2000 IP Configuration				
Ethernet adapter Local Area Connection:				
Connection-specific DNS Suffix .: microchip.com IP Address				
C:\>ipconfig/release				
Windows 2000 IP Configuration				
IP address successfully released for adapter "Local Area Connection"				
C:∖>ipconfig/renew				
Windows 2000 IP Configuration				
The following error occurred when renewing adapter Local Area Connection: DHCP S erver unreachable				
C:\>ipconfig				
Windows 2000 IP Configuration				
Ethernet adapter Local Area Connection:				
Connection-specific DNS Suffix .: microchip.com Autoconfiguration IP Address: 169.254.15.190 Subnet Mask: 255.255.0.0 Default Gateway				
C:∖>	-			

Figure 2.4: The ipconfig Screen (Windows 2000)

Note: The example shown in Figure 2.4 is specific to Windows 2000. The prompts and command responses shown differ slightly for other Windows operating systems; however, the IP Address will always be clearly identified as such.

2.5.2 Configuring the PICDEM.net IP Address

There are two methods to set the PICDEM.net IP configuration:

- 1. Serial Configuration (RS-232 connection from Host System)
- 2. IP Gleaning over the network

Serial Configuration assigns a permanent IP address to the board by rewriting the IP configuration in the board's EEPROM; it requires a direct serial connection between the board and a host system. IP Gleaning, on the other hand, assigns a temporary IP address that expires when the board is removed from the network. It can be done remotely from across the network.

2.5.2.1 Serial Configuration

Note: These instructions are written specifically for use with the HyperTerminal emulator package that ships with Windows operating systems. If you are using another terminal emulation package, the procedure you use to configure a terminal session may vary slightly. Please consult the documentation for the terminal software for additional information.

To configure the board through the serial port:

- From the Start menu, select <u>Programs>Accessories></u> <u>Communications>HyperTerminal</u> (for some operating systems, <u>Programs>Accessories>HyperTerminal</u>).
- 2. At the initial "Connection Description" dialog box, enter a name for the connection. You may call the terminal session any name that you can easily remember. Click **OK**.
- 3. At the "Connect To" dialog box that follows, choose the appropriate COM port from the drop-down menu. Click **OK**.
- 4. At the COM Properties dialog box that follows, select the settings:
 - Bits per second: 19200

8

1

- Data bits:
- Parity: none
- Stop bits:
- Flow Control: none

Click **OK**. The terminal window opens with a flashing cursor. The message "Connected" appears in the status bar at the bottom of the terminal window, along with an elapsed time display.

 From the menu bar, select <u>Files>Properties</u>, then the Settings tab on the Properties dialog. Click on the ASCII Setup button and check the Echo typed characters locally check box in the following dialog box. Click on OK to exit the dialog, then OK to exit the Properties dialog. Press and hold button <u>RB5 on</u> the PICDEM.net board; while holding, press and release the MCLR button. The terminal responds with the serial configuration menu (Figure 2.5). At the same time, the LCD displays:

MCHPStack v2.11 Board Setup...

At this point, release RB5.

MCHPStack Demo Application v1.0 (Microchip TCP/IP Stack 2.11)				
1: Change board Serial number.				
2: Change default IP address.				
3: Change default gateway address.				
4: Change default subnet mask.				
5: Enable DHCP and IP Gleaning.				
6: Disable DHCP and IP Gleaning.				
7: Download MPFS image.				
8: Save & Quit.				
Enter a menu choice (1-8):				

Figure 2.5: The Serial Configuration Menu

Note: The actual version of the Demo Application firmware will be reflected in the first line of the display. Version 2.11 is the revision available at the time this manual was prepared. Your display may differ.

- 7. Select item 2. At the prompt, enter the board's new IP address based on the configuration you are using:
 - If the board is connected to the local host system through a crossover cable, use your host system's IP address INCREMENTED BY ONE IN THE FINAL POSITION. For example, if the host system's IP address is 169.225.150.10, enter "169.225.150.11".
 - If the board is connected to a fixed-address network, use the IP address assigned by your system administrator.

Press <ENTER>.

- 8. Select option 6 to disable DHCP and IP Gleaning. This menu will configure the board to use previously assigned IP address.
- 9. Select option 8 to save changes and quit. The LCD should change to:

MCHPStack v2.11 ?.?.??"

where "?.?.?" is the IP address you just assigned to the board.

10. Close the terminal session. For your convenience, you may save the terminal session when prompted. You are now ready to communicate with the board.

2.5.2.2 IP Gleaning

IP Gleaning is a unique and non-standard method that allows a remote client to configure the IP address for the PICDEM.net board. It is discussed in more detail in the Microchip TCP/IP Application Note (AN833).

Make sure that the board is connected to either a local system or an existing fixed address network. Procedures described in this section use Microsoft Windows, but may be easily modified to other operating systems with compatible commands.

Follow these steps to perform IP Gleaning:

- 1. Convert the board's serial number (located on component side of the board) to its 4-digit (16-bit) hexadecimal equivalent. For example, if the serial number is 1234, the hexadecimal form is 04D2.
- 2. Open a command window.
- 3. At the prompt, type the command:

arp -s ?.?.? 00-04-a3-00-xx-xx

where "?.?.?" is the board's new IP address, and "xx-xx" is the hexadecimal serial number from Step 1.

As with serial configuration, the IP address depends on the configuration you are using:

- If the board is connected to the local host system through a crossover cable, use your host system's IP address INCREMENTED BY ONE IN THE FINAL POSITION. For example, if the host system's IP address is 169.225.150.10, enter "169.225.150.11".
- If the board is connected to a fixed-address network, use the IP address assigned by your system administrator.

In our example here, the command would be:

arp -s 169.225.150.11 00-04-a3-00-04-d2

Press <ENTER>. If you receive any command error, check the command string and try again.

4. Now type the command ping ?.?.?, where "?.?.?" is the IP address just assigned to the PICDEM.net board. Press <ENTER>. The system should respond with a series of ping replies from the board, indicating the node has been successfully assigned the IP address.

If the command returns a "timed out" response, check the board for network and power connections.

5. Close the command window. You are now ready to communicate with the board.

2.6 Establishing Communications

Your PICDEM.net board has already been programmed with the Demo Application using Microchip TCP/IP Stack. The on-board external data EEPROM is also pre programmed with the Demo Web Site. Once it is hooked up, it is ready to go – no further software programming is required. At this point, all that remains is to "log on".

If you are trying to contact the Demo Web Site across the network, you can do it the same way you would browse for any site with a hard IP address: enter http://x.x.x.x in the browser's address bar, where "x.x.x.x" is the IP address of the board. (Check the board's LCD display for the address).

If the PICDEM.net board is connected to a local host system using a crossover cable, it will be necessary to make some minor changes to your browser's configuration.

- **Note:** These instructions are written specifically for use with Microsoft Internet Explorer. If you are using Netscape Navigator or another Web browser, the procedure you use will vary. Please consult the documentation for your browser for additional information.
- 1. Access the browser's configuration settings in one of two ways:
 - From the Start menu, select <u>Settings>Control Panel</u>, then click on the Internet Options applet; or
 - Launch the browser, then select <u>Tools>Internet Options</u> from the menu.
- 2. Select the "Connections" tab, then click on the "LAN Settings" button.
- 3. Verify that the "Use a Proxy Server" box is deselected.
- 4. Click OK, then OK to close the Internet Properties dialog box.
- 5. Launch the Web browser (if not running already).

Note: For users of later versions of Internet Explorer, the message will begin with "No connection to the Internet is currently available....". There will be a choice of two buttons, "Work Offline" or "Try Again". *Always* choose "Try Again". If you choose "Work Offline", you will not be able to establish an external connection and will need to close and restart Explorer.

- 6. At the address bar, enter http://x.x.x., where x.x.x.x is the IP address of the PICDEM.net board. Press <Enter>.
- 7. After several seconds, the Microchip TCP/IP Stack page appears:

PICDEM.net™ User's Guide



You are now ready to experiment with PICDEM.net.



Chapter 3. Exploring The Demo Web Site

3.1 Highlights

This chapter will cover the following topics:

- Structure of the Demo Web Site
- Contents of the Web Site Frames

3.2 Structure of the Page

It's nice to know that the PICDEM.net evaluation board can send a real Web page to your computer. But the important question needs to be, "What can this page do in the real world?"

The Demo Web Site is not meant to demonstrate a typical Internet-type Web application – looking up information, buying something, checking a bank account balance, what have you. The idea is to show how an embedded system can send device-state and control information over an Ethernet connection – information that is useful to other systems, as well as human users. The demo web site provides a simple demonstration of several important concepts for an embedded control system:

- · Display of analog and digital information
- Real-time control of remote devices
- User-friendly information.

The initial "home page" is actually an HTML "frameset"; this is a common techniques where two or more pages are displayed simultaneously to give the appearance of a single page. The home page is really four different "frames": top, middle, left bottom and right bottom. Each is implemented using simple HTML and demonstrates a different concept. Frames can play an important role in an embedded web site. Normally information that is static, should be displayed in its own frame and not updated. The information that changes frequently should be grouped in its own frame and refreshed as required. This approach reduces overall network traffic as well as the display flicker that may result when the entire page content is updated.

If desired, you may change all or part of this web site. See Section 4.5 ("Experimenting with the Demo Web Site") for more information.

3.2.1 The Top Frame

This frame occupies the top third of the main page and acts as a header for the virtual page. It contains the Microchip logo, the web page title and links to several other pages. This frame is static; it is downloaded only once and is not downloaded again unless a full-page refresh is performed. Selecting one of the links causes the middle frame to update its contents.

3.2.2 The Middle Frame

This frame, which displays text information about the Microchip TCP/IP Stack, is another example of a static page. Clicking on the various links in the top frame changes the text content.

When the PICDEM.net board is first connected, the "Home" content page is displayed as the default. If a complete page refresh is performed while viewing another page content, this frame reverts to "Home" content.

3.2.3 The Left Bottom Frame

This frame reports on the real-time status of the PICDEM.net board. It displays the values of the potentiometers (AN0 and AN1), input switch (RB5) and User LEDs (D5 and D6). The content is refreshed every 3 seconds.

The page demonstrates how a page can be modified on-the-fly to display realtime information. Although simple text is used here to show real-time status, it is almost as easy to write HTML script to display graphics instead.

3.2.4 The Right Bottom Frame

This frame provides both real-time status reporting and remote control to the PICDEM.net board. It contains two push buttons, one for each of the user LEDs. The "Toggle LED1" button toggles the state of User LED D5, while "Toggle LED2" toggles User LED D6. While each click on a button toggles its corresponding LED immediately, the actual LED status displayed in the left bottom page is updated only when the page is refreshed (up to 3 seconds).



Chapter 4. Using the Microchip TCP/IP Stack Demo Application

4.1 Highlights

This chapter will cover the following topics:

- Demo Applications Source Code
- Experimenting with the Demo Application
- Experimenting with the Demo Web Site

4.2 Overview

The PICDEM.net board's pre-programmed firmware (referred to throughout this manual as the "Demo Application") makes it functional directly out of the box. Some of the main features are:

- Based on the Free Microchip TCP/IP Stack
- Portable across Microchip PIC18 microcontrollers
- Includes HTTP Server, FTP Server, DHCP Client, IP Gleaning
- User-configurable over RS-232 serial connection
- Web site updatable over RS-232 or Ethernet
- Supports Microchip C18 and HiTech PICC[™] 18 'C' Compilers

This on-board firmware utilizes the Free Microchip TCP/IP Stack Library. In addition to firmware programmed into the microcontroller, the Demo Application uses the on-board external serial data EEPROM to store configuration data and demo web site pages.

Your PICDEM.net board is factory-configured with the correct board serial number and Demo Web Site image. With its RS-232-based serial configuration mode, you can reconfigure the board to make it work on a variety of Ethernet networks. All PICDEM.net boards are factory programmed to make use of DHCP module. As a result, you can simply connect the board to a DHCP-enabled network and start evaluating the PICDEM.net board hardware.

4.3 The Source Code

The complete source code for the Demo Application can be installed on any PC-compatible system by running the installer file MCHPStack.2.11.exe. There is no license or royalty fee to use this source code. For installation details, refer to Appendix B.

You can use either the Microchip C18 or the HiTech PICC 18 'C' Compiler to build this application. The Demo Application can be compiled in several different configurations. To do this, you will need MPLAB IDE to open and compile Demo Application projects. In addition, you will need a device programmer (such as Microchip PROMATE[®] II or MPLAB ICD) to program the microcontroller with the application code.

The Demo Application requires the following configuration options to be programmed:

- Oscillator: HS
- Watchdog Timer: Disabled
- Low Voltage Programming: Disabled

There are several MPLAB project files designed to illustrate all of the different configurations in which the Demo Application can be compiled. These are listed in Table 4.1.

Project Name	Purpose	
HtNICEE.pjt	Demo application using Network Interface Controller (NIC) and external serial EEPROM as web site storage – HiTech Compiler	
HtNICPG.pjt	Demo application using NIC and internal program memory as web site storage – HiTech Compiler	
HtSIEE.pjt	Demo application using Serial Line Internet Protocol (SLIP) and external serial EEPROM as web site storage – HiTech Compiler	
HtSIPG.pjt	Demo application using SLIP and internal program memory as web site storage – HiTech Compiler	
MpNICEE.pjt ¹	Demo application using NIC and external serial EEPROM as web site storage – Microchip C18 Compiler	
MpNICPG.pjt	Demo application using NIC and internal program memory as web site storage – Microchip C18 Compiler	
MpSIEE.pjt	Demo application using SLIP and external serial EEPROM as web site storage – Microchip C18 Compiler	
MpSIPG.pjt	Demo application using SLIP and internal program memory as web site storage – Microchip C18 Compiler	

 Table 4.1: Project Files for the Demo Application

Note 1: The PICDEM.net board uses this project file.

For more information about the Demo Application, refer to Microchip Application Note AN833, *"The Microchip TCP/IP Stack"* (DS00833).

4.4 Experimenting With Demo Application Firmware

You may modify supplied Demo Application code to your requirements. The core of the Demo Application is implemented by the file websrvr.c, which in turn calls the standard Microchip TCP/IP Stack files; the Stack modules are configured in the header file StackTask.h. The selection of appropriate Microchip TCP/IP Stack modules is done as command-line macro definitions in the compiler settings tab of MPLAB. To change the Demo Application, it is only necessary to modify websrvr.c, unless you also want to modify the individual TCP/IP Stack modules.

A complete discussion of the Microchip TCP/IP Stack and the Demo Application is out of the scope of this User's Guide. Users who are interested in the details of the Microchip Stack are encouraged to read Application Note AN833.

4.4.1 Changing the FTP Login Account

The default login values for the Demo Application are "ftp" for the FTP user name and "microchip" for the password. These text values are stored in the file websrvr.c in the variables FTP_USER_NAME and FTP_USER_PASS, respectively. You may modify one or both of these values as needed. You must rebuild the project and reprogram the device for the changes to take effect.

4.4.2 Changing the Default IP Configuration

The Demo Application uses hard-coded IP configuration values as its default. These may be modified as needed through serial configuration, or by changing the values of MY_DEFAULT_??? in the header file StackTsk.h. You must rebuild the project and reprogram the device for the changes to take effect.

4.5 Experimenting with the Demo Web Site

The PICDEM.net Demo Web Site is written in HTML. The complete source files are available on the Connectivity Solutions CD, in the directory \Microchip\WebPages. You must have working knowledge of HTML in order to correctly modify or create new web pages. You may design the page by hand (using a text editor) or use a web-authoring tool.

The Demo Web Site is organized as multiple files within a single directory. The Demo Application includes a special command-line utility program, MPFS.exe. The utility is written for 32-bit versions of Microsoft Windows 95/98, Windows NT[®], Windows 2000, Windows XP) to convert a group of files into a Microchip File (MPFS) image. Depending on where the MPFS will ultimately be stored, the utility gives you the option to generate either a 'C' data file or a binary file representing the MPFS image.

The complete command line syntax for the utility is:

mpfs [/?] [/c] [/b] [/r<Block>] <InputDir> <OutputFile>

where: /? Displays command-line help

 $/\,\mathrm{c}$ generates a 'C' data file as output

/b generates a binary data file as output (default)

/r reserves a block of memory at the beginning of the file (valid only in Binary Output mode, with a default value of 32 bytes)

 ${\tt <InputDir>}$ is the directory containing the files for creating the MPFS image

<OutputFile> is the output file name

For example, the command:

mpfs /c <Your Webpage Dir> mypages.c

generates the MPFS image as a 'C' data file mypages.c from the content of the directory "Your Webpage Dir". In contrast, the command:

mpfs <Your Webpage Dir> mypages.bin

generates a binary file of the image with 32-byte reserved block, while:

mpfs /r128 <Your Webpage Dir> mypages.bin

generates the same file with a 128-byte reserved block.

Note: Using a reserve block size other than the default size of 32 bytes requires a change to the compiler define MPFS_RESERVE_BLOCK in the header file "StackTsk.h".

If the MPFS image is to be stored in internal program memory, the generated 'C' data file must be linked with the application project. If the image is to be stored in an external serial data EEPROM, the binary file must be downloaded there.

Modifying the content of the static pages, or even adding additional static pages, only requires minor changes to the Demo Web Site files, but it will be necessary to rebuild the MPFS image using the MPFS utility and download it into the external EEPROM. If you want to display additional real-time information or support additional HTML forms, you must also modify the HTTP Server callback functions in websrvr.c. For more information on the callback function, refer to Application Note AN833.



Chapter 5. Reconfiguring and Restoring the Firmware

5.1 Highlights

This chapter covers the following:

- Reconfiguring the PICDEM.net hardware
- Reconfiguring the PICDEM.net firmware
- Entering Configuration Mode
- Changing the Network Configuration
- Loading (or Reloading) the Web Site into EEPROM
- Restoring the Demo Application Firmware

5.2 Reconfiguring the PICDEM.net Hardware

The basic hardware of the PICDEM.net board, as shipped from Microchip, is a fixed configuration. Outside of disabling the User LEDs by removing the associated jumper, there are no features on the board that can be changed by the user.

5.3 Reconfiguring the PICDEM.net Firmware

Note: These instructions are valid only with the Demo Application using the Microchip TCP/IP Stack as originally programmed on the PICDEM.net board. If you have since loaded a different firmware package from another vendor, consult that vendor's instructions for how to proceed.

To be ready for use out of the box, the PICDEM.net board is shipped with pre-loaded firmware. The firmware has three different components:

- The Demo Web Site page, written in HTML and stored in the external EEPROM
- The IP configuration, written in binary and also stored in the external EEPROM
- The PICDEM.net operating firmware (including the Microchip TCP/IP Stack and the Demo Application), stored in the Program Memory of the microcontroller.

Once in Configuration mode, you can choose to download new/modified web site or change network configuration without affecting operating firmware.

5.3.1 Entering Configuration Mode

In order to change the web site or the network settings, it is necessary to first put the board into Configuration Mode. To do this:

- 1. Hook up the board to the local host system, if this is not already done (see Section 2.4.2, page 14).
- 2. Connect to the board through the serial port via the terminal emulator (Section 2.5.2, page 20).
- 3. Press and hold the User push button (RB5).
- 4. While holding RB5, press and release the Reset push button.
- 5. The terminal responds with the Configuration Mode menu (Figure 5.1). At the same time, the LCD displays:

MCHPStack v2.11 Board Setup...

6. Release RB5.

MCHPStack Demo Application v1.0 (Microchip TCP/IP Stack 2.11)				
1: Change board Serial number.				
2: Change default IP address.				
3: Change default gateway address.				
4: Change default subnet mask.				
5: Enable DHCP and IP Gleaning.				
6: Disable DHCP and IP Gleaning.				
7: Download MPFS image.				
8: Save & Quit.				
Enter a menu choice (1-8):				

Figure 5.1: The Serial Configuration Screen

5.3.2 Changing the Network Configuration

At this point, the PICDEM.net board's network configuration can be changed.

To change the PICDEM.net board's serial number:

- 1. Enter '1'.
- At the "Serial Number (x):" prompt, enter the serial number from the Ethernet ID sticker on the board, or a new Ethernet ID number. Current value of the serial number will be displayed in the prompt string.
- 3. Press <ENTER> to submit the changes. Alternatively, simply press <ENTER> to leave the serial number unchanged.

If input consists of a non-numerical string, a value of zero will be used.

To change the default IP address:

- 1. Select item '2'.
- 2. At the "Default IP Address (x.x.x.):" prompt, enter a new IP address in dotted-decimal notation. The current value of the default IP address will be displayed in the prompt string. Alternatively, simply press <ENTER> to leave the IP address unchanged.

If the input does not conform to IP address format, it will be ignored; no error message will be given.

Note: The factory default address is 10.10.5.15.

To change the default gateway address:

- 1. Select item '3'.
- 2. At the "Default Gateway Address (x.x.x):" prompt, enter the new gateway address in dotted-decimal notation. The current value of the default gateway address will be displayed in the prompt string.

Alternatively, press <ENTER> to leave the IP address unchanged. If the input does not conform to the standard IP address format, it will be ignored.

To change the default subnet mask:

- 1. Select item '4'.
- 2. At the "Default Subnet Mask (x.x.x.x):" prompt, enter a new subnet mask value in dotted-decimal notation. The current value of the subnet mask will be displayed in the prompt string.

Alternatively, press <ENTER> to leave the subnet mask value unchanged. If the input does not conform to the standard IP address format, it will be ignored.

To change DHCP and IP Gleaning modes:

Enter '5' to enable, or enter '6' to disable.

To finish configuration:

Enter '8'. The new network configuration is now programmed into the controller's EEPROM.

NOTES ON IP ADDRESS CONFIGURATION:

- If more than one PICDEM.net board is being evaluated, give each board a different IP address even if one is connected at a time. The system may become confused with different Ethernet IDs being linked to a single IP address.
- Rapid changes in Ethernet IDs and/or IP addresses, especially when more than one PICDEM.net board is being evaluated, may cause a situation where the boards respond erratically. This is likely due to ARP caching by the host system, where it retains a mapping of MACs and IP addresses.

5.3.3 Loading (or Reloading) the Web Page

Before loading the web page, the HTML file(s) must be translated into the appropriate binary format using the Microchip File System (MPFS) software utility. The software utility is included with the Connectivity Solutions CD.

In general, creating a new web page involves the following:

- Create or modify existing web pages. You can add as many new files as you want, provided that the total size does not exceed the external data EEPROM's capacity of 32 KB. There is no restriction on the size of any of the files, as long as they fit in the available EEPROM space. You may hand-write your pages or use professional web authoring tools.
- 2. Place the files into a single directory.
- 3. Use the MPFS utility to create MPFS image of your web site. Refer to Section 4.5 ("Experimenting with the Demo Web Site") for details on using MPFS.
- 4. Verify that the size of the finished file is within the capacity of the EEPROM (32 KB). The MPFS utility will display the actual size of the image.

If you are reloading the original Demo Web Site, the file image is available in the proper format on the Connectivity Solutions CD. The complete path is: \Microchip\mpfsimg.bin.

Note: Your terminal emulation software must support the standard XMODEM protocol. Variants such as XMODEM-1K or any of the CRC variants will not work. HyperTerminal supports both XMODEM and XMODEM-1K.

The web site image can be loaded in one of two ways:

- Serial Configuration mode (RS-232) from a local host system
- File Transfer Protocol (FTP) over the network

To Load a Web Site using Serial Configuration:

- 1. Hook up the board to the host system and enter Configuration Mode (Section 5.3.1, page 32).
- 2. Select item 7 from the Serial Configuration menu to download the MPFS image. The board returns the prompt "Ready to download MPFS image Use Xmodem protocol". At the same time, User LED D6 begins blinking.
- 3. Select <u>*Transfer>Send File*</u> from the main menu for HyperTerminal (the "Send File" command for other terminal emulators). Specify the location of the file, and select "XMODEM" for the Transfer Protocol.
- 4. As the file is downloaded, User LED D5 will blink as fast as data is received. After the transfer has finished, the configuration menu is displayed. Select item '8' to exit Configuration Mode.

To load a web site using FTP:

- 1. Check that the board is powered up and connected. The method is not important, as long as the proper network connection for the configuration (crossover cable to host system, straight cable to network) has been made.
- 2. Open a command window.
- 3. At the command prompt, type the command ftp x.x.x.x., where "x.x.x.x" is the IP address of the PICDEM.net board. Press <ENTER>.
- 4. When prompted, enter the FTP user name and password.
- 5. After successfully logging in, type the command put xxxxx.bin, where "xxxxx.bin" is the name of the MPFS binary image file. Press <ENTER>.
- 6. After notification that the transfer is complete, type "quit" to log off.

A typical exchange between a user and the board is shown in Figure 5.2. FTP client actions (i.e., manual input from the user) are shown in **bold**. System prompts and FTP server responses are in plainface.

```
c:\ftp 10.10.5.15
220 ready
User (10.10.5.15: (none)): ftp
331 Password required
Password: microchip
230 Logged in
ftp> put mpfsimg.bin
200 ok
150 Transferring data...
226 Transfer complete
ftp> 16212 bytes transferred in...
ftp> quit
221 Bye
```



Note 1: The FTP server does NOT echo back the password as the user types it in. In the instance above, it is shown to illustrate what the user would enter.
 2: See Section 4.4.1 for instructions on changing the FTP account login from the default values shown.
 3: This example assumes that the MPFS binary image is located in the root of C:\. If the file is located elsewhere, be sure to include the full path.

5.4 Reprogramming and Restoring the Application Firmware

After investigating the PICDEM.net board and the Demo Application, you may be ready to modify the application, or perhaps even design your own. To do this, it will be necessary to clear the existing firmware in the FLASH Program Memory of the PIC18F452 microcontroller.

The PICDEM.net. Ethernet/Internet Demonstration Board does not include the tools for clearing and reprogramming the microcontroller. You must use an appropriate device programmer, or a development environment such as the MPLAB ICD Development System, which provides a complete set of tools for device emulation and programming.

If you have the appropriate development tools (device programmer, development environment, etc.), you already have everything you need to begin immediately. The PICDEM.net Connectivity Solutions CD enclosed with the PICDEM.net Development Kit not only includes the source code for the Free Microchip TCP/IP Stack, but also the solutions from other vendors to assist you in developing embedded Ethernet solutions.

Note: The MPLAB Development System and the PICDEM.net Connectivity Solutions CDs contain tools and solutions for both the PIC[®] 16 and PIC 18 families of microcontrollers.

To restore the Demo Application, use the HEX file <code>mpnicee.hex</code> (located in the Microchip folder of the Connectivity Solutions CD) to program the microcontroller. Follow the standard procedure for your device programmer when programming the microcontroller. Make sure that the following configuration options are set:

- Oscillator: HS
- Watchdog Timer: Disabled
- Low Voltage Programming: Disabled

After programming the controller, reconnect the board to the network or local host system and verify that the Demo Application is working correctly. If you have experimented with the connectivity solutions of other vendors and re-programmed the on-board serial EEPROM, you must also download the Demo Web Site image file (mpfsimg.bin) from the Connectivity Solutions CD.



Chapter 6. Troubleshooting

6.1 Highlights

This chapter discusses common operational issues and how to resolve them.

6.2 Common Issues

1. The System LED is not lit or flashing

Check the PICDEM.net board for power:

- Verify that the power supply is plugged in and the wall outlet has power.
- Check that voltage is available (9 VDC) at the barrel plug.
- Check that the regulated voltage (5 VDC) is available at the connectors at the prototype area of the board.
- Make sure that the microcontroller is programmed and installed correctly.

2. The LINK LED is not lit, or only lights intermittently

Check the Revision Level of the PICDEM.net board:

- On the most current versions of the board (Revision 5), the LINK LED is tied to pin LEDBNC of the transceiver; the LED functions as a Link Status indicator, and should be lit if the board is configured and connected correctly to another Ethernet node or hub.
- On Revision 4 boards (shipped with previous versions of the PICDEM.net Demonstration kits), the LINK LED is tied to pin LED0 of the Ethernet transceiver. When using the losoft firmware, this pin functions as an Ethernet Collision Sense indicator; it will normally be dark unless a packet collision is detected.

Note: The Revision Label is on the reverse (trace) side of the board, directly underneath the Prototype Area grid (see Figure 1.1, item 16).

If the PICDEM.net board is Revision 5 or higher and the LINK LED is not lit:

- Check the board for power (see Issue 1, above).
- Make sure that microcontroller is programmed and installed correctly.

3. The LCD doesn't display a message when power is applied to the PICDEM.net board

Check the board for power (see Issue 1, above).

If the board functions normally otherwise (including connectivity to the host system), the LCD display itself may be faulty. Contact Customer Service for additional assistance.

4. The PICDEM.net board will not communicate with the host system

A. Verify that the correct Ethernet cable is being used:

- When the PICDEM.net board is directly connected to the host system as described in Chapter 2, a crossover cable must be used.
- When the PICDEM.net board is connected to the host system through an Ethernet hub, a standard ("straight-through") cable must be used. Do NOT use the crossover cable supplied with the kit.

Verify that the Ethernet cable is connected and undamaged.

Verify that the IP address as displayed on the LCD is used to communicate.

- **Note:** If you suspect that the Ethernet cable supplied with the kit is damaged, be certain to replace it only with an *Ethernet crossover cable*. A conventional CAT5 cable will not work if the PICDEM.net board is directly connected to the host system.
- B. If the board fails when connected through a hub, verify that the hub is working properly. If it is, try connecting the host system directly to the Ethernet board, as described in Chapter 2. Also check that the proper cable is being used (see above).
- C. Check TCP/IP connectivity with the ping command:
 - 1. Launch a DOS (or Command Prompt) window.
 - 2. Type ping x.x.x.x , where "x.x.x.x" is that of the PICDEM.net board.

If ping returns the message "Request timed out", check the RECEIVE LED on the PICDEM.net board:

- If the LED blinks during attempted communications, the IP addressing may be wrong (i.e., the board and the host are not in the same subnet). Refer to Chapter 3 of the book *"TCP/IP Lean: Web Servers* for Embedded Systems (Second Edition)" for more information.
- If the LED does NOT blink, the Ethernet cable is defective or the wrong type, or the host system has not been properly configured for TCP/IP.

- D. Verify the operation of the Ethernet card. In Microsoft Windows operating systems, this is done through the System or Network applet in the Control Panel (the exact applet and method of getting there varies from version to version). Other operating systems may use different methods. Consult the documentation for your operating system to get detailed information:
- E. Check the PICDEM.net board for power (see Issue 1, above).
- F. If all else fails, reconfigure the PICDEM.net board's network settings, using the default Ethernet ID and IP address. See Section 5.3.1 and Section 5.3.2 for more information.

5. The host system communicates with the board, but the Demo Web Site is not present or does not function correctly

If the external serial data EEPROM is blank or absent, any attempt to access the demo web site will result in the message "File Not Found". If this message appears, reload the web site to the EEPROM from the Connectivity Solutions CD (see Section 5.3.3 for more information).

If the a web page display is "broken" (disjointed display, frames not working, error messages displayed), use your browser's "Reload" command to refresh the page. If the page is still broken, reload the EEPROM (Section 5.3.3).

6. The board will not communicate with the host system after changing the IP address and/or Ethernet ID

Check the PICDEM.net board and host system as in Issue 3, above.

Verify that the host system is setup correctly.

If these steps don't work, restore the PICDEM.net board's default network configuration to see if communications can be re-established. See Section 5.3.1 and Section 5.3.2 for more information.

7. Unable to initiate a serial connection with the PICDEM.net board

Carefully review the instructions for the terminal emulation software you are using. Make certain that the software is correctly installed, and that you are able to successfully configure a session.

Verify that you are using the correct serial port. Check that the COM port you have selected in the terminal software is actually the physical port that the serial cable is connected to.

Verify that the serial cable is properly connected at the host system and the PICDEM.net board, and that the cable is undamaged.

8. The LCD always displays "DHCP/Gleaning..."

The PICDEM.net Board is configured with DHCP/IP Gleaning mode enabled. If you do not want to use DHCP Gleaning, disable it using the Serial Configuration procedure (see Section 5.3 for details). If you do want to use DHCP mode, make sure that the board is connected to a network with at least one DHCP server.

9. Occasionally the Demo Web Site displays "Service Unavailable"

When the PICDEM.net board is updating the web site image via FTP transfer, all attempted access to the web site will result in the "Service Unavailable" message. Refresh the page after the FTP transfer is finished.

10. The text displayed on the LCD is "backwards" (i.e., the display reads from right to left, as if you were looking at it in a mirror).

Reset the board by pressing and releasing the Reset push button.



Appendix A. PICDEM.net Board Schematics





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Figure A.2: PICDEM.net Board Schematic, Part 2 (Ethernet Transceiver System)



Figure A.3: PICDEM.net Board Schematic, Part 3 (Serial Port, EEPROM and Power Supply)

NOTES:



Appendix B. PICDEM.net Connectivity Solutions CD

B.1 Highlights

This chapter summarizes the contents of the PICDEM.net Connectivity Solutions CD-ROM. This includes solutions provided by Microchip and Microchip's partners:

- losoft
- LiveDevices
- Yipee

B.2 What's on the CD

The PICDEM.net Connectivity Solutions CD includes software solutions from these vendors.

B.2.1 Microchip

The complete source code for the Free Microchip TCP/IP Stack and the Demo Application are included in this folder. To install the source code and necessary support files on your computer, run the installer file MCHPStack.2.11.exe. If you are restoring the Demo Application firmware and/ or the Demo web site as originally shipped from the factory, use the appropriate HEX files as previously described.

Note: Be sure to use the destination directory suggested by the installer program. Although the files will install correctly if you select another destination, they may not be available to your development environment if you decide to create a new project using the TCP/IP Stack.

Also included is a complete selection of technical documentation for Microchip's various connectivity solutions. Of particular note is AN833 (*"The Microchip TCP/IP Stack"*), which is referred to throughout this manual.

B.2.2 losoft

The full source code for the ChipWeb embedded server (version 2.x) is included in this folder, as well its Web pages and the WEBROM page-merging utility.

Additional losoft demonstration code and utilities are provided on the CD accompanying the guide book, *TCP/IP Lean: Web Systems for Embedded Servers (Second Edition)*.

B.2.3 LiveDevices

LiveDevices has provided a copy of its small TCP/IP Stack, developed for the PIC18C family and either Ethernet or modem (PPP) connectivity. This folder also contains demonstration software and information on other LiveDevices solutions.

B.2.4 Yipee

Yipee has provided an evaluation version of its TCP/IP Stack developed for the PIC16F877 microcontroller and Ethernet connectivity. This folder also contains demonstration software, a movie file and detailed information on their solution.



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Corporate Office 2355 West Chandler Blvd. Chandler, AZ 85224-6199 Tel: 480-792-7200 Fax: 480-792-7277 Technical Support: 480-792-7627 Web Address: http://www.microchip.com

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Tel: 949-263-1888 Fax: 949-263-1338 New York

150 Motor Parkway, Suite 202 Hauppauge, NY 11788 Tel: 631-273-5305 Fax: 631-273-5335

San Jose

Microchip Technology Inc. 2107 North First Street, Suite 590 San Jose, CA 95131 Tel: 408-436-7950 Fax: 408-436-7955

Toronto

6285 Northam Drive, Suite 108 Mississauga, Ontario L4V 1X5, Canada Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

Australia

Microchip Technology Australia Pty Ltd Suite 22, 41 Rawson Street Epping 2121, NSW Australia Tel: 61-2-9868-6733 Fax: 61-2-9868-6755 China - Beijing Microchip Technology Consulting (Shanghai) Co., Ltd., Beijing Liaison Office Unit 915 Bei Hai Wan Tai Bldg. No. 6 Chaoyangmen Beidajie Beijing, 100027, No. China Tel: 86-10-85282100 Fax: 86-10-85282104 China - Chengdu Microchip Technology Consulting (Shanghai) Co., Ltd., Chengdu Liaison Office Rm. 2401, 24th Floor, Ming Xing Financial Tower

No. 88 TIDU Street Chengdu 610016, China Tel: 86-28-86766200 Fax: 86-28-86766599 China - Fuzhou

Microchip Technology Consulting (Shanghai) Co., Ltd., Fuzhou Liaison Office Unit 28F, World Trade Plaza No. 71 Wusi Road Fuzhou 350001, China Tel: 86-591-7503506 Fax: 86-591-7503521 China - Shanghai

Microchip Technology Consulting (Shanghai) Co., Ltd. Room 701, Bldg. B Far East International Plaza No. 317 Xian Xia Road Shanghai, 200051 Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

China - Shenzhen

Microchip Technology Consulting (Shanghai) Co., Ltd., Shenzhen Liaison Office Rm. 1315, 13/F, Shenzhen Kerry Centre, Renminnan Lu Shenzhen 518001, China Tel: 86-755-82350361 Fax: 86-755-82366086

China - Hong Kong SAR Microchip Technology Hongkong Ltd. Unit 901-6, Tower 2, Metroplaza 223 Hing Fong Road Kwai Fong, N.T., Hong Kong Tel: 852-2401-1200 Fax: 852-2401-3431

India

Microchip Technology Inc. India Liaison Office **Divyasree Chambers** 1 Floor, Wing A (A3/A4) No. 11, O'Shaugnessey Road Bangalore, 560 025, India Tel: 91-80-2290061 Fax: 91-80-2290062

Japan

Microchip Technology Japan K.K. Benex S-1 6F 3-18-20, Shinyokohama Kohoku-Ku, Yokohama-shi Kanagawa, 222-0033, Japan Tel: 81-45-471- 6166 Fax: 81-45-471-6122 Korea Microchip Technology Korea 168-1, Youngbo Bldg. 3 Floor Samsung-Dong, Kangnam-Ku Seoul, Korea 135-882 Tel: 82-2-554-7200 Fax: 82-2-558-5934 Singapore Microchip Technology Singapore Pte Ltd. 200 Middle Road #07-02 Prime Centre Singapore, 188980 Tel: 65-6334-8870 Fax: 65-6334-8850 Taiwan Microchip Technology (Barbados) Inc., Taiwan Branch 11F-3, No. 207 Tung Hua North Road Taipei, 105, Taiwan Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Austria Microchip Technology Austria GmbH Durisolstrasse 2 A-4600 Wels Austria Tel: 43-7242-2244-399 Fax: 43-7242-2244-393 Denmark Microchip Technology Nordic ApS Regus Business Centre Lautrup hoj 1-3 Ballerup DK-2750 Denmark Tel: 45 4420 9895 Fax: 45 4420 9910 France Microchip Technology SARL Parc d'Activite du Moulin de Massy 43 Rue du Saule Trapu Batiment A - ler Etage 91300 Massy, France Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79 Germany Microchip Technology GmbH Steinheilstrasse 10 D-85737 Ismaning, Germany Tel: 49-89-627-144 0 Fax: 49-89-627-144-44 Italy Microchip Technology SRL Centro Direzionale Colleoni Palazzo Taurus 1 V. Le Colleoni 1 20041 Agrate Brianza Milan, Italy Tel: 39-039-65791-1 Fax: 39-039-6899883 **United Kingdom** Microchip Ltd 505 Eskdale Road Winnersh Triangle

Wokingham Berkshire, England RG41 5TU Tel: 44 118 921 5869 Fax: 44-118 921-5820

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