



MPLAB™-ICD
USER'S GUIDE

MPLAB™-ICD USER'S GUIDE

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General Information

Introduction

This first chapter contains general information that will be useful to know before using MPLAB-ICD.

Highlights

The information you will garner from 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 MPLAB-ICD as a development tool to debug firmware on a target board. The manual layout is as follows:

- **Chapter 1: MPLAB-ICD Preview** – What MPLAB-ICD is and how it works.
- **Chapter 2: MPLAB-ICD Installation** – How to install MPLAB-ICD hardware and software and establish communications.
- **Chapter 3: Getting Started with MPLAB-ICD** – How to get MPLAB-ICD up and running.
- **Chapter 4: MPLAB-ICD Basic Functions** – The basic functions of MPLAB-ICD.
- **Chapter 5: Demo Board Example of Use** – The menu options of MPLAB-ICD.
- **Chapter 6: MPLAB-ICD Menu Options** – The menu options of MPLAB-ICD.
- **Chapter 7: Troubleshooting** – How to solve common problems.
- **Appendix A: MPLAB-ICD Hardware** – A description of the header, module and demo board hardware.

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- **Glossary** – A glossary of terms used in this guide.
- **Index** – Cross-reference listing of terms, features, and sections of this document.
- **Worldwide Sales and Service** – A listing of 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
Angle Brackets: < >	Delimiters for special keys.	<TAB>, <ESC>
Italic characters	Referenced books.	<i>MPLAB User's Guide</i>
Courier Font	User entered code or sample code.	#define ENIGMA
Underlined, Italics Text with Right Arrow	Defines a menu selection from the menu bar.	<u><i>File > Save</i></u>
0xn timer	0xn timer represents a hexadecimal number where n is a hexadecimal digit.	0xFFFF, 0x007A
In-text Bold Characters	Designates a button.	OK, Cancel

Updates

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

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 MPLAB-ICD. The user may also find the data sheets for specific microcontroller devices informative in developing firmware.

README.ICD

For the latest information on using MPLAB-ICD, read the README.ICD file (ASCII text file) included with the MPLAB-ICD software. The README.ICD file contains update information that may not be included in this document.

README.XXX

For the latest information on other Microchip tools (MPLAB, MPASM, etc.), read the associated README files (ASCII text file) included with the MPLAB software.

MPLAB User's Guide (DS51025)

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

MPASM User's Guide with MPLINK and MPLIB (DS33014)

This user's guide describes how to use the Microchip PICmicro assembler (MPASM), the linker (MPLINK) and the librarian (MPLIB).

Technical Library CD-ROM (DS00161)

This CD-ROM contains comprehensive data sheets for Microchip PICmicro[®] 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 website (<http://www.microchip.com>).

Embedded Control Handbook Vol.1 & 2 (DS00092 & DS00167)

These handbooks 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 (<http://www.microchip.com>).

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 7 for information on common problems.

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The Microchip Internet Web Site

Microchip provides on-line support on the Microchip World Wide Web (WWW) site.

The web site is used by Microchip as a means to make files and information easily available to customers. To view the site, the user must have access to the Internet and a web browser, such as Netscape® Navigator or Microsoft® Internet Explorer®. Files are also available for FTP download from our FTP site.

Connecting to the Microchip Internet Web Site

The Microchip website is available by using your favorite Internet browser to attach to:

<http://www.microchip.com>

The file transfer site is available by using an FTP program/client to connect to:

<ftp://ftp.microchip.com>

The website 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, distributors, and factory representatives. Other data available for consideration is:

- Latest Microchip Press Releases
- Technical Support Section with Frequently Asked Questions
- 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 our customers keep current on Microchip products with the least amount of effort. Once you subscribe to one of our list servers, you will receive email notification whenever we change, update, revise or have errata related to that product family or development tool. See the Microchip WWW page for other Microchip list servers.

The Development Systems list names are:

- Compilers
- Emulators
- Programmers
- MPLAB
- Otools

Once you have determined the names of the lists that you are interested in, you can subscribe by sending a message to:

```
listserv@mail.microchip.com
```

with the following as the body:

```
subscribe <listname> yourname
```

Here is an example:

```
subscribe mplab John Doe
```

To UNSUBSCRIBE from these lists, send a message to:

```
listserv@mail.microchip.com
```

with the following as the body:

```
unsubscribe <listname> yourname
```

Here is an example:

```
unsubscribe mplab John Doe
```

The following sections provide descriptions of the available Development Systems lists.

Compilers

The latest information on Microchip C compilers, Linkers, and Assemblers. These include MPLAB-C17, MPLAB-C18, MPLINK, MPASM as well as the Librarian, MPLIB for MPLINK.

To SUBSCRIBE to this list, send a message to:

```
listserv@mail.microchip.com
```

with the following as the body:

```
subscribe compilers yourname
```

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Emulators

The latest information on Microchip In-Circuit Emulators. These include MPLAB-ICE and PICMASTER.

To SUBSCRIBE to this list, send a message to:

`listserv@mail.microchip.com`

with the following as the body:

`subscribe emulators yourname`

Programmers

The latest information on Microchip PICmicro device programmers. These include PRO MATE II and PICSTART Plus.

To SUBSCRIBE to this list, send a message to:

`listserv@mail.microchip.com`

with the following as the body:

`subscribe programmers yourname`

MPLAB

The latest information on Microchip MPLAB, the Windows Integrated Development Environment for development systems tools. This list is focused on MPLAB, MPLAB-SIM, MPLAB's Project Manager and general editing and debugging features. For specific information on MPLAB compilers, linkers, and assemblers, subscribe to the COMPILERS list. For specific information on MPLAB emulators, subscribe to the EMULATORS list. For specific information on MPLAB device programmers, please subscribe to the PROGRAMMERS list.

To SUBSCRIBE to this list, send a message to:

`listserv@mail.microchip.com`

with the following as the body:

`subscribe mplab yourname`

Otools

The latest information on other development system tools provided by Microchip. For specific information on MPLAB and its integrated tools refer to the other mail lists.

To SUBSCRIBE to this list, send a message to:

`listserv@mail.microchip.com`

with the following as the body:

`subscribe otools yourname`

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Corporate Applications Engineer (CAE)
- Hot line

Customers should call their distributor, representative, 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) 786-7627.

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

The Hot Line Numbers are:

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

1-480-786-7302 for the rest of the world.

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NOTES:



Chapter 1. MPLAB-ICD Preview

1.1 Introduction

This section gives you a preview of MPLAB-ICD (In-Circuit Debugger) features and functions, as well as its hardware and software elements.

1.2 Highlights

Topics covered in this chapter:

- What is MPLAB-ICD
- How MPLAB-ICD Helps You
- Trade-Offs of Using MPLAB-ICD
- MPLAB-ICD Components
- MPLAB Integrated Development Environment (IDE)
- MPLAB Development Tools
- Host Computer System Requirements

1.3 What is MPLAB-ICD

MPLAB-ICD is a low cost evaluation kit for the PIC16F87X series microcontrollers. Utilizing the In-Circuit Debugging capability of the PIC16F87X and Microchip's In-Circuit Serial Programming™ (ICSP™) protocol, the MPLAB-ICD is a programmer as well as an in-circuit debugger. It operates under the MPLAB IDE, connects to an application, and runs like the actual PIC16F87X microcontroller in the design.

MPLAB-ICD is intended to be used as an evaluation and debugging aid in a laboratory environment.

The MPLAB-ICD offers these features:

- Real-time code execution
- In-circuit debugging
- Built-in programmer
- 3.0V to 5.5V operating range
- Operation from voltage (VDD) supplied by the target application
- Operating frequencies from 32 kHz to 20 MHz
- Source level and symbolic debugging
- MPLAB user interface
- Microsoft Windows® 3.X/95/98 compatible
- RS-232 Interface

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1.4 How MPLAB-ICD Helps You

The MPLAB-ICD allows you to:

- Debug your source code in your own application
- Debug your hardware in real-time
- Program a target PIC16F87X using Microchip's ICSP protocol

1.5 Trade-offs of Using MPLAB-ICD

Due to the built-in in-circuit debugging capability of the PIC16F87X and ICSP function offered by the Debugger, the MPLAB-ICD will use the following on-chip resources:

- MCLR/VPP shared for programming
- RB3 reserved for low-voltage programming

Note: MPLAB-ICD does not support low-voltage programming. Disable this function while using the ICD.

- RB6 and RB7 reserved for programming and in-circuit debugging
- Six (6) general purpose file registers reserved for debug monitor: 70h, 1EBh to 1EFh
- First program memory location (address 0x000) must be a NOP instruction
- Program memory 0x1F00-0x1FFF reserved for Debug Code
- One stack level not available

1.6 MPLAB-ICD Components

The MPLAB-ICD consists of four basic components:

1. MPLAB-ICD Module
2. MPLAB-ICD Header
3. MPLAB-ICD Demo Board
4. MPLAB software

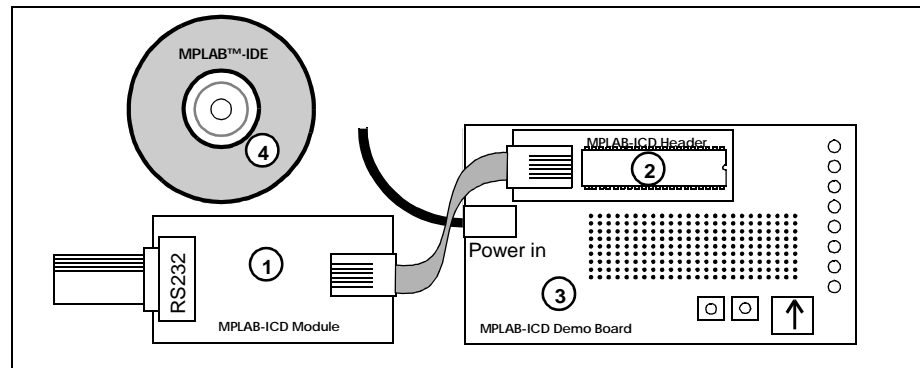


Figure 1.1: MPLAB-ICD Components

1.6.1 MPLAB-ICD Module

The MPLAB-ICD Module contains all debugging, programming, and control logic. It is connected to the PC's serial port via a 9-pin serial cable and to the MPLAB-ICD Header or target using a 6-wire modular cable. This module contains the firmware to provide serial communications to the PC, to drive the MPLAB-ICD communications to the Header/target board, and to program a target PIC16F87X using ICSP, all from the MPLAB IDE. The module is powered from the target application and requires 70 mA (max) in addition to what the target consumes.

1.6.2 MPLAB-ICD Header

The MPLAB-ICD Module connects to the MPLAB-ICD Header via a 9-inch modular cable. For in-circuit emulation, a PIC16F877 needs to be plugged into the header which then plugs into a 28-pin or 40-pin PIC16F87X DIP socket on an application or the MPLAB-ICD Demo Board. The MPLAB-ICD Header is powered by the target application, from a 3.0V to 5.5V source.

The modular cable also can be plugged into a modular connector on the application circuit with the appropriate connections to the PIC16F87X to allow in-circuit emulation of QFP and DIE parts.

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1.6.3 MPLAB-ICD Demo Board

The Demo Board is provided for demonstration/evaluation of the PIC16F87X in the absence of a target application board. It is connected to the MPLAB-ICD Module via the MPLAB-ICD Header. The PIC16F877 can be unplugged from the Header and plugged directly into the demo board for stand-alone operation.

The Demo Board (Figure 1.2) has the following hardware features:

1. 40- and 28-pin sockets. See Appendix A for how to use stand-offs to select the desired pin count socket.
2. Eight DIP switches to connect/disconnect each of the eight LEDs to/from their respective PORTC pin.
3. Eight red LEDs connected to PORTC for displaying 8-bit binary values.
4. Two push-button switches, one for RESET and one for external stimulus on RB0.
5. A potentiometer for analog input on RA0.
6. A small prototyping area.
7. A connector area to access the I/O pins of the PIC16F87X for expansion prototyping.
8. A jumper to select the RC oscillator (approximately 2 MHz) or an external crystal.
9. Socket for external crystal.
10. A connector for a 9V, 0.75A power supply, similar to the PICSTART® Plus programmer power supply.
11. Provisions for a MAX232 and associated hardware that may be populated to add RS-232 capability.

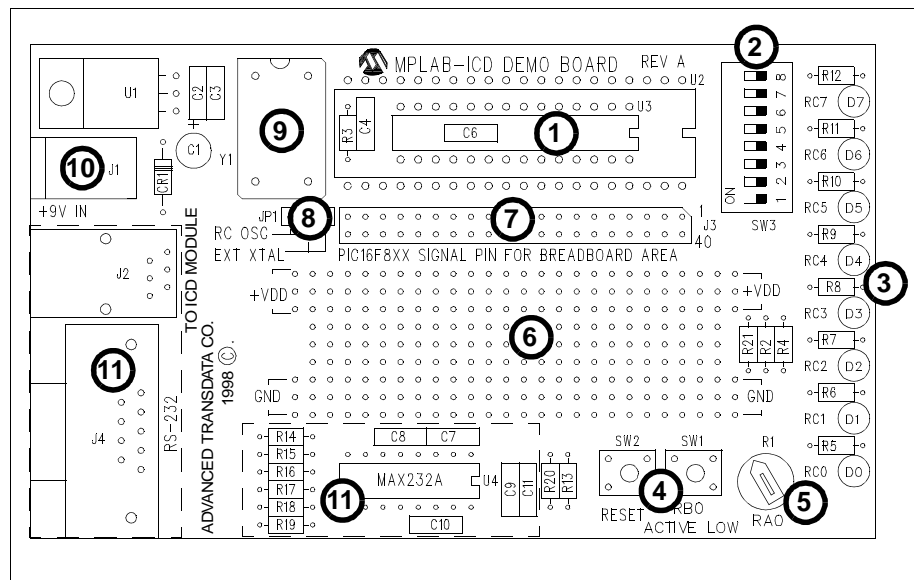


Figure 1.2: MPLAB-ICD Demo Board

1.6.4 MPLAB Software

The MPLAB software runs in the Windows 3.1/95/98 environment. It provides full display, modification, and control of the target application under emulation.

1.7 MPLAB Integrated Development Environment

The MPLAB desktop provides an environment for developing and debugging your application. MPLAB-ICD is integrated into the MPLAB IDE.

This document covers the basic setup and operation of the MPLAB-ICD, but it does not cover all functions of the MPLAB IDE. Read the *MPLAB User's Guide* (DS51025) to get a full understanding of the features and debug capabilities of the MPLAB IDE.

1.8 MPLAB Development Tools

The MPLAB IDE integrates several tools to provide a complete development environment.

- **MPLAB Project Manager**

Use the Project Manager to create a project and work with the specific files related to the project. When using a project, source code is rebuilt and downloaded to the simulator or emulator with a single mouse click.

- **MPLAB Editor**

Use the MPLAB Editor to create and edit text files such as source files, code, and linker script files.

- **MPLAB-SIM Simulator**

The software simulator models the instruction execution and I/O of the PICmicro Microcontrollers (MCUs).

- **MPLAB-ICE Emulator**

The MPLAB-ICE emulator uses hardware to emulate PICmicros in real time, either with or without a target system.

- **MPASM Universal Assembler/MPLINK Relocatable Linker/
MPLIB Librarian**

The MPASM assembler allows source code to be assembled without leaving MPLAB. MPLINK creates the final application by linking relocatable modules from MPASM and MPLAB-C17 (PIC17CXXX C compiler). MPLIB manages custom libraries for maximum code reuse.

- **PRO MATE® II and PICSTART® Plus Programmers**

Develop code with the simulator or an emulator, assemble or compile it, and then use one of these tools to program devices. This can all be accomplished with MPLAB. Although PRO MATE II does not require MPLAB to operate, programming is easier using MPLAB.

- **PICMASTER® and PICMASTER-CE Emulators**

These emulators use hardware to emulate PICmicros in real time, either with or without a target system. MPLAB-ICE is the newest emulator from Microchip.

- **Third Party Tools**

Many other companies have development tools for Microchip products that work with MPLAB. Consult the *Microchip Third Party Guide* (DS00104).



Chapter 2. MPLAB-ICD Installation

2.1 Introduction

How to install the MPLAB-ICD hardware and software and how to communicate between the MPLAB-ICD Demo Board and PC is discussed in this chapter.

2.2 Highlights

Topics covered in this chapter:

- MPLAB-ICD Kit Components
- Host Computer System Requirements
- Installing the Hardware
- Installing the Software

2.3 MPLAB-ICD Kit Components

The MPLAB-ICD system kit includes the following items (Figure 2.1),

1. The MPLAB-ICD Header (plugged inside the 40-pin DIP socket on the MPLAB-ICD Demo Board)
2. The MPLAB-ICD Module
3. The MPLAB-ICD Demo Board
4. RS-232 Cable
5. 40-pin DIP and 28-pin SDIP connection sockets (the 40-pin socket has been used for connecting the MPLAB-ICD Header to the 40-pin socket on the MPLAB-ICD Demo Board)
6. 9-inch 6-conductor modular cable
7. Disks/CD with complete system software and documentation
8. Manuals:
 - MPLAB-ICD User's Guide (this document)
 - MPLAB User's Guide (not shown)
 - MPASM with MPLINK and MPLIB User's Guide (not shown)
9. A Warranty Registration card (not shown)

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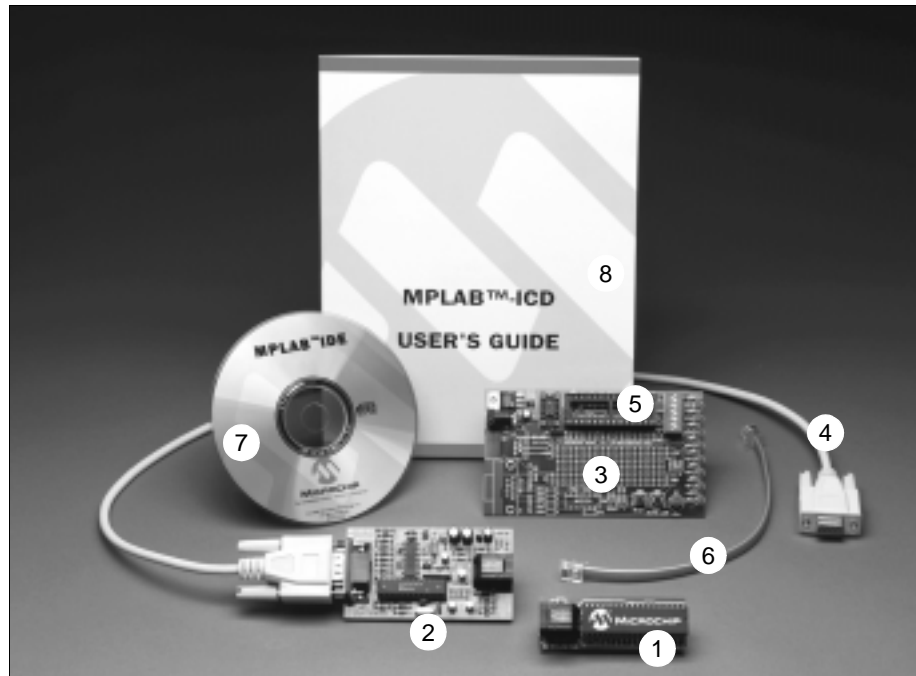


Figure 2.1: MPLAB-ICD Kit Components

2.4 Host Computer System Requirements

To take advantage of the debugger system features, you must install the MPLAB software on a host computer having the following minimum configuration:

- PC compatible machine: 486 or higher
- VGA required, super VGA recommended
- MS-DOS/PC-DOS version 5.0 or greater
- Microsoft Windows 3.X/95/98
- 4 MB RAM, 16 MB recommended
- 8 MB available hard disk space, 20MB recommended
- One free serial port
- Mouse or other pointing device
- 9V, 0.75A Power Supply (PICSTART Plus or Equivalent)

2.5 Installing the Hardware

Install the MPLAB-ICD system hardware by following these steps:

1. Plug a PIC16F87X into the 40-pin DIP socket in the MPLAB-ICD Header.
2. Connect the 9-inch modular cable between the MPLAB-ICD Module and the MPLAB-ICD Header.
3. Plug the 40-pin connection socket into the 40-pin DIP socket in the MPLAB-ICD Demo Board or target application. If using the Demo Board, make sure to insert the 40-pin stand-off first (See Section A.3.1).
4. Plug the MPLAB-ICD Header into the connection socket in the Demo Board or target application (Figure 2.2). You can also connect the MPLAB-ICD Header to a 28-pin SDIP socket in the Demo Board/target via the 28-pin SDIP connection socket.
5. Connect the RS-232 cable between the serial port of the host computer and the MPLAB-ICD Module.
6. Turn on the power to the host computer.
7. Turn on the power to the MPLAB-ICD Demo Board/target application which also powers the MPLAB-ICD Module. (For the Demo Board, you can use the 9 VDC center-positive power adapter supplied with PICSTART Plus Programmer.)

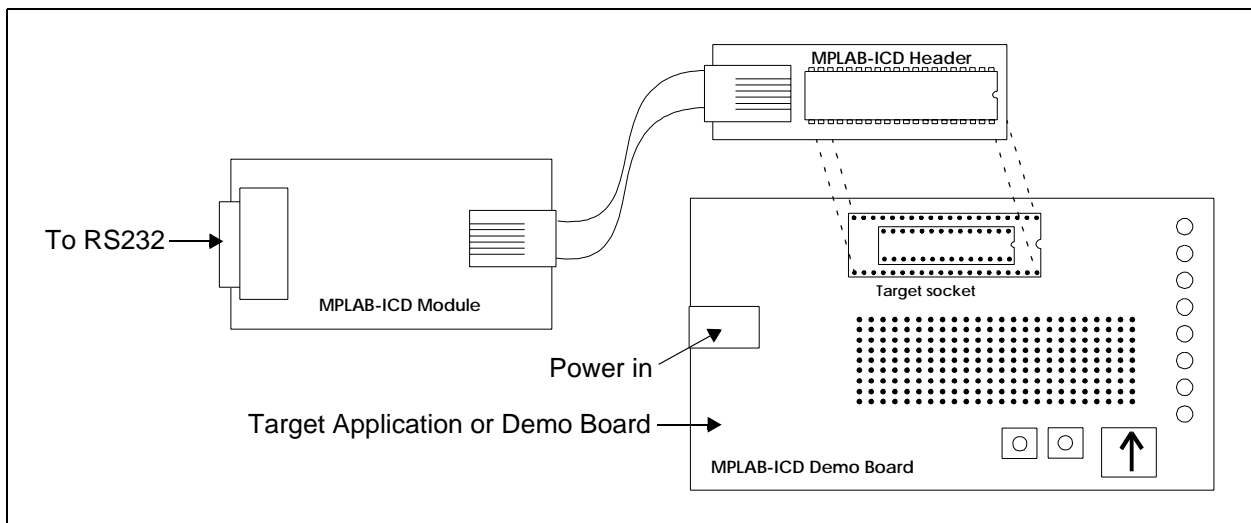


Figure 2.2: MPLAB-ICD Hardware Connection

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2.6 Installing the Software

The MPLAB-ICD is an add-on tool for the MPLAB Software. To install MPLAB, follow these steps:

1. Enter Microsoft Windows and insert the MPLAB CD-ROM into the CD-ROM drive.
2. Execute the setup program:
 - a) Windows 3.1: From the File Manager, or from the *Program Manager>Run* option, run **X:\MPvvvvv.exe**, where **X** is the drive designation of the CD-ROM drive, and **vvvvv** is the version number of MPLAB.
 - b) Windows 95/98: Click the Start button and select Run. Enter **X:\MPvvvvv.exe**, where **X** is the drive designation of the CD-ROM drive, and **vvvvv** is the version number of MPLAB. Then click **OK**.
3. Follow the instructions to install the MPLAB IDE with MPLAB-ICD support.



Chapter 3. Getting Started with MPLAB-ICD

3.1 Introduction

This chapter describes how to get the hardware and software for MPLAB-ICD up and working.

3.2 Highlights

Topics covered in this chapter:

- Communicating with MPLAB-ICD
- MPLAB-ICD Operations
- Getting the Most from MPLAB – Using Projects

3.3 Communicating with MPLAB-ICD

Follow the steps listed below to set up MPLAB for use with the MPLAB-ICD hardware. Once proper operation is established, no further changes are needed, unless reconfiguration is desired. To reconfigure, follow steps 6 through 9.

1. Make sure the MPLAB-ICD is connected to the host PC via the RS-232 cable.
2. Make sure there is power provided to the target application from which the MPLAB-ICD Module will be drawing power.
3. From the Microchip MPLAB program group, run MPLAB.
4. If MPLAB was previously in ICD mode, MPLAB will either find the MPLAB-ICD Module and start, or it will display a message that it cannot find the MPLAB-ICD.
5. If MPLAB cannot find the MPLAB-ICD, select the Editor Only option from the dialog and MPLAB will start without attempting to connect to the MPLAB-ICD.
6. Select the *Options > Development Mode* menu item to open the Development Mode dialog (Figure 3.1).

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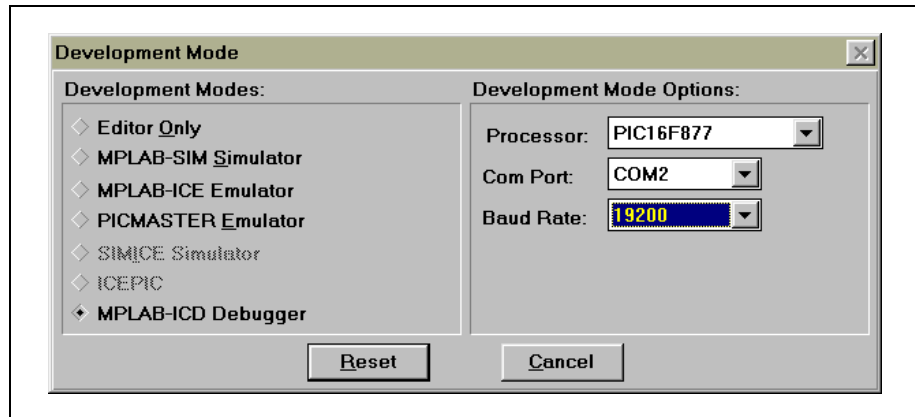


Figure 3.1: Development Mode Dialog Box

7. Select MPLAB-ICD.
8. Select the desired processor, COM port, and baud rate for communication with MPLAB-ICD.
9. Click the **Reset** button.

If no problems occur, the Development Mode dialog will close and the MPLAB-ICD dialog will open. See Chapter 4 for more information on the MPLAB-ICD dialog.

If MPLAB still cannot find MPLAB-ICD, see Chapter 7.

3.4 MPLAB-ICD Operations

The MPLAB-ICD is a programmer as well as an in-circuit debugger. It programs hex files into the PIC16F87X and offers basic debugging features like real-time code execution, stepping, and breakpoint. Its debug feature is built inside the PIC16F87X and activated by programming the Debug Code into the target processor. It has limited functions when compared to a full-featured in-circuit emulator but provides cost-effective functions to debug and program applications for a PIC16F87X.

To enable in-circuit debugging, the Debug Code residing in the microcontroller in the MPLAB-ICD Module is programmed into the target PIC16F87X. The code is an MPASM module that will be programmed into the PIC16F87X on the MPLAB-ICD Header automatically by MPLAB. This code will reside in the last 0x100 words of program memory. For example, it will reside in 0x1F00 to 0x1FFF of the PIC16F877 processor.

Note: MPLAB-ICD does not support low voltage programming.

3.5 Getting the Most from MPLAB – Using Projects

MPLAB is the host software for the MPLAB-ICD and the MPLAB-SIM simulator. It functions as a sophisticated debugging tool, providing access to RAM, ROM, EEPROM, and a variety of other debug functions.

Note: If you do not put your source files into a project, MPLAB cannot debug properly.

3.5.1 Creating a Project

Developing and debugging code in the MPLAB environment is based on projects. Although emulation can be performed without having a project open, projects have the following advantages:

- Single or multiple source files can be easily built and maintained.
- Symbolic debugging is available.
- The debugging environment can be saved for later use.

Some of the information that is retained with a project is:

- Development mode and processor
- Source files associated with the project
- Name of the final PICmicro executable file
- Open windows and their sizes and positions
- Named break settings
- Configuration bit settings

For more information on creating and using projects, refer to the *MPLAB User's Guide* (DS51025).

3.5.2 Saving a Project

Once you have the MPLAB-ICD system and software configured, it is advisable to save your current project to retain the values for later use, or use as a backup or default as you continue with your debugging.

Development Mode

The selected development mode is retained with the project information. To change the development mode for a project, follow these steps:

- Open the project. The previously used development mode will be selected.
- Change the development mode by selecting *Options>Development Mode* to access the Development Mode dialog.
- Save the project.



Chapter 4. MPLAB-ICD Basic Functions

4.1 Introduction

This chapter discusses the basic operations of MPLAB-ICD and MPLAB debugging functions of the In-Circuit Debugger. For more information on general debugging features, refer to the *MPLAB User's Guide*.

4.2 Highlights

Topics covered in this chapter:

- The MPLAB-ICD Dialog
- Program Execution
- Breakpoints
- How to use MPLAB-ICD

4.3 The MPLAB-ICD Dialog

The MPLAB-ICD dialog (Figure 4.1) has all the programming and setup functions for the MPLAB-ICD. These functions include basic programmer functions like blank check, program, read, verify, erase and set the ICD to debug mode. Other functions like Run, Halt, and Step are on the Debug menu and MPLAB toolbar.

The MPLAB-ICD dialog is always open when the ICD is enabled. Closing this window will disable the ICD.

The next sections describe components found in the ICD Module dialog.

MPLAB™-ICD User's Guide

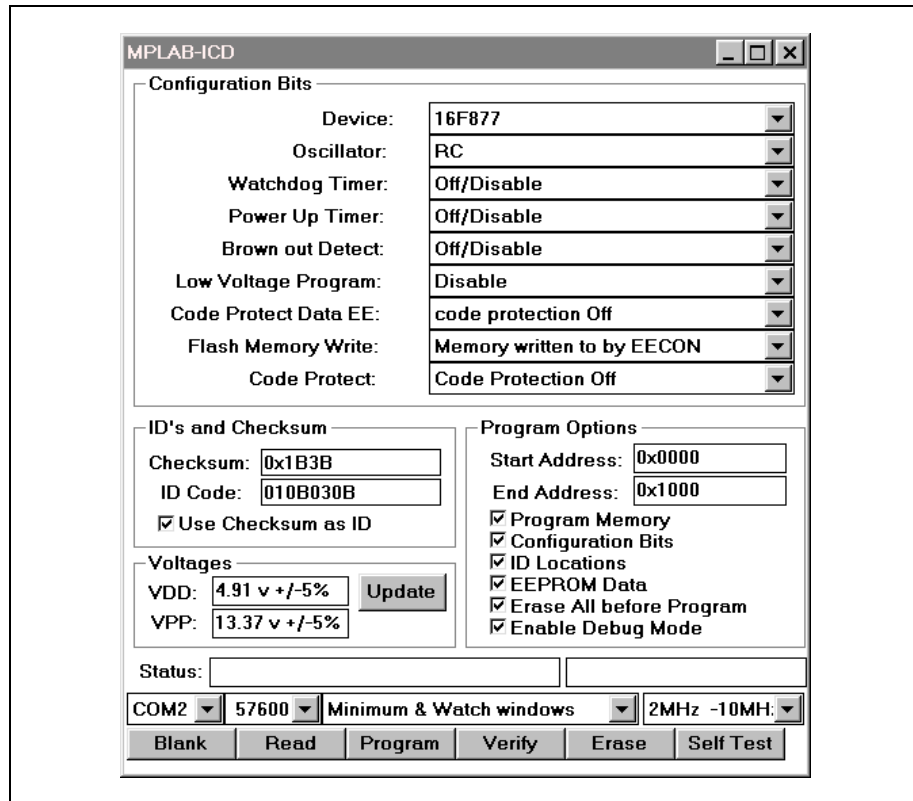


Figure 4.1: MPLAB-ICD Dialog

4.3.1 Configuration Bits and Device Selection

This section of the dialog allows you to set the various configuration bits on the PIC16F87X processors. To select, click on the arrow to see the drop-down list and then highlight the option desired.

Table 4.1: Configuration Bits and Device Selection Options

Item	Options
Device	See the Product Line Card (DS00148) for available devices. If you change the device here, any open MPLAB projects (except in Editor Only mode) will close and program memory, configuration bits, and ID's will be cleared.
Oscillator	RC, LP, XT or HP
Watchdog Timer	On/Off
Power Up Timer	On/Off
Brown Out Detect	On/Off
Low Voltage Program (Should be disabled when using ICD)	Select low voltage programming function or use RB3 as digital I/O and use HV on MCLR for programming

MPLAB-ICD Basic Functions

Table 4.1: Configuration Bits and Device Selection Options (Continued)

Item	Options
Code Protect Data EE	On/Off
Flash Memory Write	Select whether to allow unprotected program memory to be written by EECON control
Code Protect	0000h to 1FFFh code protected 1000 to 1FFFF 1F00h to 1FFFh code protected Code Protection Off

4.3.2 ID's and Checksum

Displays the checksum for the data and the ID code. To use the checksum as the ID, select the checkbox.

4.3.3 Voltages

Allows you to check the value of the VDD and VPP voltages on the target application by clicking the Update button.

MPLAB-ICD develops its needed VPP \approx 12V from the target board's VDD through use of a charge pump.

4.3.4 Program Options

The default program address range is set to the maximum program memory available based on the device you selected. However, you can set the program address range yourself. Enter the Start and End Addresses of program memory for the function performed (e.g., program, read, or verify).

The program address range does not apply to the erase function.

Note: The erase function will erase all data on the PIC16F87X including memory, ID, and configuration bits.

Click the box next to the item to select or unselect the memory areas for the programmer functions. For example, if you want to read program memory only, select Program Memory and unselect the other memory types.

To erase all memory before programming, select Erase All before Program. To program debug code into a device, select Enable Debug Mode.

If you are only using MPLAB-ICD to program a part, you should uncheck the Enable Debug Mode box. This will not download the debug code to 0x1F00 to 0x1FFF and will not enable MPLAB-ICD for debug operations. Keep this box checked to enable debug mode each time you press the Program button.

4.3.5 Status

The Status bar displays the executed MPLAB-ICD function and the status.

4.3.6 COM Port Pull-Down Menu

Select the COM port (COM1, COM2, COM3 or COM4) for MPLAB-ICD communications. The value shown in the dialog is the one last chosen, usually from the Development Mode dialog.

4.3.7 Baud Rate Pull-Down Menu

Select the COM port baud rate for MPLAB-ICD communications. The value shown in the dialog is the one last chosen, usually from the Development Mode dialog.

4.3.8 Upload Options Pull-Down Menu

The options for the amount of data uploaded are:

- Minimum (FSR, W, Status, PCLATH) (Very Fast)
- SFRs only (Fast)
- Minimum and Watch windows (Slow)
- All Registers (Very Slow)

Options selection affects the time between single step events. The first selection has less than a second delay, where as the last selection will have about a 2 second delay.

4.3.9 Operating Frequency Range Pull-Down Menu

Select the operation frequency range of the MPLAB-ICD. Options are:

- 32 kHz – 500 kHz
- 500 kHz – 2 MHz
- 2 MHz – 10 MHz
- 10 MHz – 20 MHz

4.3.10 Function Buttons

Click these buttons to perform the assigned function on the PIC16F87X in the MPLAB-ICD Header. If you have specified an address range in the Program Options section, the assigned function will be performed on the specified memory range and type only (except for the erase function).

The function buttons are:

- **Blank** – Checks to see if device is blank.
- **Read** – Reads memory areas specified under Program Options, i.e., program memory, configuration bits, ID locations and/or EEPROM data.
- **Program** – Programs memory areas specified under Program Options, i.e., program memory, configuration bits, ID locations and/or EEPROM data. Also downloads debug code at IF00 to IFFF if Enabled Debug Mode is checked.
- **Verify** – Verifies programming of memory areas specified under Program Options, i.e., program memory, configuration bits, ID locations, and/or EEPROM data.
- **Erase** – Erases all memory areas.
- **Self Test** – Performs a self-test on the MPLAB ICD hardware.

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4.4 Program Execution

The MPLAB-ICD executes in real-time mode or in step mode.

- Real-time execution occurs when the PIC16F87X in the MPLAB-ICD Header is put in MPLAB's Run mode.
- Step mode execution can be accessed after the processor is halted.

4.4.1 Real-Time Execution

When the MPLAB-ICD is run in real time, instructions execute just as the processor would without the debugger. The PIC16F87X executes in real time until a breakpoint halts the debugger or until the HALT function is manually executed.

To execute in real time, click the Run icon on the Tool Bar or issue the *Debug > Run > Run* command. The Debug Tool Bar provides Run, Halt, and Step buttons for controlling the debugger. While in the run mode, Register displays on the screen will not update.

4.4.2 Step Mode Execution

Step Mode Execution occurs when you single step the processor or execute *Debug > Run > Step*. Step mode execution provides the capability to step through the code one instruction at a time, to watch the program flow, and to see the register contents at each instruction (as set in the dialog box).

Debug > Run > Animate is a method to automatically single step the processor. To view the changing registers in the Special Function Register window or the Watch windows, use Animate. Obviously, Animate runs slower than the Run function.

4.5 Breakpoints

A breakpoint is a state where the processor halts after a certain condition is met. The MPLAB-ICD provides the followings ways to set a breakpoint:

- Break on Address Match
- Break on User Halt

4.5.1 Break on Address Match

The Debug function of the PIC16F87X allows one breakpoint to be set. This breakpoint can be at any program memory address location. The processor breaks only after the instruction is executed. For example, if a breakpoint is set at address 005Ah, the processor breaks after executing the instruction at address 005Ah.

To set a breakpoint, either select *Debug>Break Settings* or select the source code address in the Program Memory window and click the right mouse button.

MPLAB-ICD Basic Functions

4.5.2 Break on User Halt

The PIC16F87X executes until you press the Halt button or select *Debug>Run>Halt*.

4.6 How to use MPLAB-ICD

The MPLAB-ICD is a programmer as well as an in-circuit debugger. The typical functions that would be used to debug and test an application are discussed in the following sections.

4.6.1 Load the Hex File for Debug

Load the hex codes to MPLAB using *File > Import > Download to Memory* command. Your codes should be limited to 0h to 1EFFh because the last 100 words of code memory on the PIC16F87X will be reserved for the Debug Code.

Note: Data for the EEPROM memory should be placed at 0x2100 to 0x217F in your source code.

Once the hex file is imported, you can go to the Windows Menu and open the following windows:

- Program Memory
- Special File Registers
- File Registers
- EEPROM Memory

4.6.2 Program the Target Processor

In the MPLAB-ICD dialog box, check that you have chosen the correct device, oscillator, and configuration bit settings under Device Specifications. Next, make sure the Program Options are correct for your application. If you have Enabled Debug Mode checked, the debug code will be downloaded and the PIC16F87X will be enabled for debug operations. Then, click the **Program** button to program the PIC16F87X in the MPLAB-ICD Header. Programming will take a couple of minutes and will be a little longer if the target application is running at a low voltage.

Note: The debug code is a special code at 1F00h-1FFFh in the PIC16F877 and must be present to use the in-circuit debugging capabilities of the MPLAB-ICD.

After this, you may minimize the MPLAB-ICD dialog, but do not close it. Closing the MPLAB-ICD dialog will disable the ICD.

4.6.3 Debug Functions

You can use the following functions with MPLAB-ICD. You can only set one breakpoint at a time.

- **Run** – Real time program execution.
- **Reset** – Reset the PIC16F87X (MCLR Reset).
- **Break Settings** – Set breakpoints.
- **Halt** – Halt program execution.
- **Step** – Single step through program execution. After the program is halted, each selection of Step will execute one line of the program.
- **Animate** – Single step through program execution automatically. After the program is halted, select Animate to execute one line of the program at a time.
- **Change PC** – Change program counter.

4.6.4 Modify Functions

If you need to modify the program being debugged, simply assemble a new hex file and download it. You can also use the Modify Dialog to edit program memory before downloading it into the 16F87x with the **Program** button. If you do this, the object code generated by your source code will not match the code in the PIC16F87X.

You can use *Window>Modify* to change a register, words of program memory, or data in the EEPROM area. Use *Window>File Registers* and *Window>Special Function Registers* to view internal data registers.



Chapter 5. Demo Board Example of Use

5.1 Introduction

This chapter discusses an example of use for the MPLAB-ICD Demo Board.

5.2 Highlights

Topics covered in this chapter:

- A/D Example Overview
- A/D Example Main Routine
- A/D Example Source Code

5.3 A/D Example Overview

The `demo.asm` program is a simple implementation of the PIC16F87X's analog-to-digital (A/D) converter using the MPLAB-ICD demo board. This program configures the A/D Module to convert on A/D channel 0 (the potentiometer) and display the results on the LEDs on PORTC.

To setup the device, program the PIC16F87X with a compiled version of the `demo877.asm` program, e.g., `demo877.hex`. You can use MPASM or any other third-party assembler.

To set up the demo board, make sure that:

- an oscillator type has been selected using jumper JP1. The program was developed using RC OSC.
- the DIP switch (SW3) has all switches in the ON position, to connect all LEDs to their respective PORTC pin.

For more information on A/D module operation, please refer to the *PICmicro Midrange Microcontroller Family Reference Manual (DS33023)* for an operational description and a list of related application notes. For detailed information on the demo board hardware, please refer to Chapter A.

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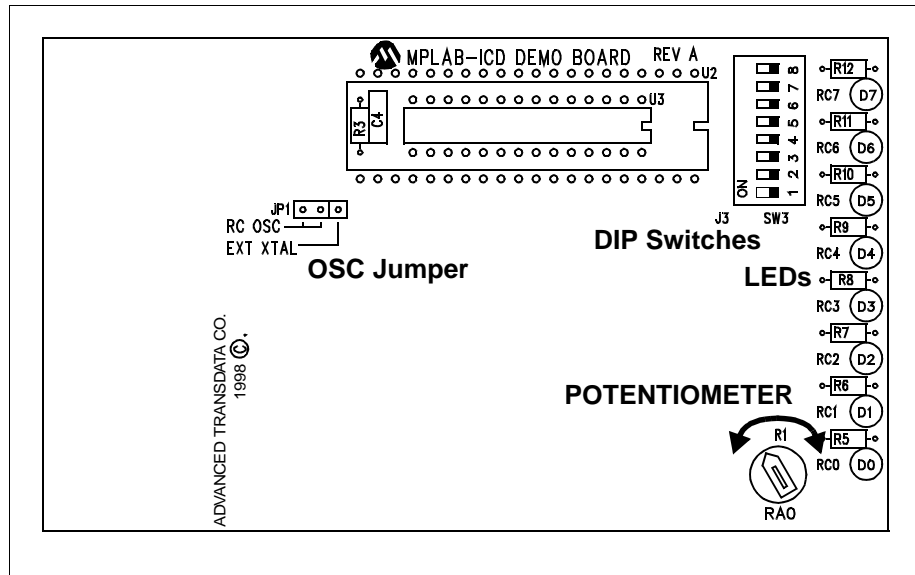


Figure 5.1: A/D Example

5.4 A/D Example Main Routine

The main routine of `demo877.asm` (Figure 5.2) begins by configuring PORTC, the A/D module and Timer0. It then waits for a Timer0 overflow to start the A/D conversion of the value from the potentiometer. When the conversion is complete, the value is displayed on the LEDs, and the program loops back to wait for another Timer0 overflow to start another A/D conversion.

Demo Board Example of Use

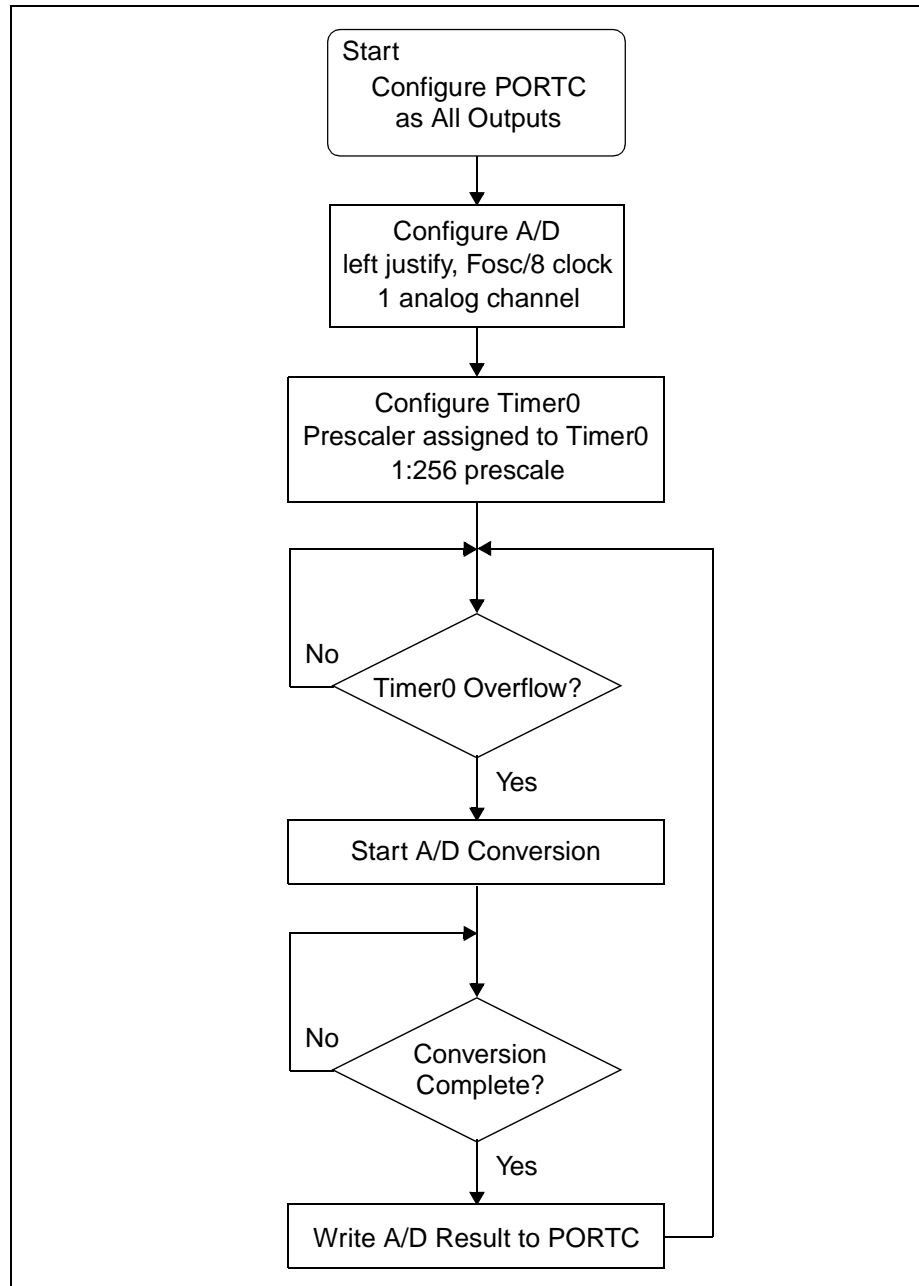


Figure 5.2: Program Flow Chart

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5.5 A/D Example Source Code

```
*****
;* DEMO877.ASM
*****
;* Microchip Technology Incorporated
;* 16 December 1998
;* Assembled with MPASM V2.20
*****
;* This program configures the A/D Module to convert on
;* A/D channel 0 (the potentiometer) and display the
;* results on the LEDs on PORTC. Make sure that the DIP
;* switch SW3 has all switches in the ON position.
*****

    list p=16f877

    ; Include file, change directory if needed
    include "c:\progra~1\mplab\pl16f877.inc"

    ; Start at the reset vector
    org    0x000
    nop

Start
    bcf    STATUS,RP0    ;Go to BANK0
    bcf    STATUS,RP1
    clrf   PORTC         ;Clear PORTC
    movlw  B'01000001'   ;Fosc/8, A/D enabled
    movwf  ADCON0

    bsf    STATUS,RP0    ;Go to BANK1
    movlw  B'10000111'   ;TMR0 prescaler, 1:256
    movwf  OPTION_REG
    clrf   TRISC         ;PORTC all outputs
    movlw  B'00001110'   ;Left justify, 1 analog channel
    movwf  ADCON1       ;VDD and VSS references

    bcf    STATUS,RP0    ;Go to BANK0

Main
    btfss  INTCON,T0IF   ;Wait for Timer0 to timeout
    goto  Main
    bcf    INTCON,T0IF

    bsf    ADCON0,GO     ;Start A/D conversion
```

Demo Board Example of Use

```
Wait
    btfss    PIR1,ADIF    ;Wait for conversion to complete
    goto    Wait

    movf    ADRESH,W      ;Write A/D result to PORTC
    movwf   PORTC        ;LEDs

    goto    Main         ;Do it again

end
```

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NOTES:



Chapter 6. MPLAB-ICD Menu Options

6.1 Introduction

This chapter gives detailed information on using the MPLAB menu options directly applicable to the ICD Debugger.

6.2 Highlights

Topics covered in this chapter:

- File Menu
- Debug Menu
- Options Menu

6.3 File Menu

Instead of using MPLAB projects, you can use the *File > Import > Download to Memory* command to load the hex file to MPLAB-ICD. Once loaded into memory, you can open different windows under the Windows Menu to view program memory, special file registers, file registers, and source window.

6.4 Debug Menu

The following debug functions are available to control the MPLAB-ICD.

6.4.1 Run

Run options allow you to run your program in real-time or single-step mode. See Section 4.6.3 for a discussion of each run option.

6.4.2 Breakpoint Settings

The MPLAB-ICD debug function supports a single breakpoint at a time. Use the *Debug > Breakpoint Settings* command or press **F2** to open the Breakpoint Setting dialog. Enter the address location where the breakpoint is to be set. You can also use the right mouse button to set a breakpoint.

6.5 Options Menu

Go to *Options > Development Mode* to select MPLAB-ICD. Also, specify the processor to be debugged, the COM port, and baud rate used to communicate with the PC host.

You may also specify the com port, baud rate, and amount of data uploaded in the MPLAB-ICD dialog (Chapter 4). This dialog appears after you have clicked **Reset** in the Development Mode dialog.

If you are using breakpoints and single step, you can upload selected data to improve speed. Data upload options are:

- Minimum (FSR, W, Status, PCLATH) (Very Fast)
- SFRs only (Fast)
- Minimum and Watch windows (Slow)
- All Registers (Very Slow)

Data will be uploaded on a single step, a breakpoint or a halt.



Chapter 7. Troubleshooting

7.1 Introduction

This section describes some common problems associated with running MPLAB-ICE and steps to follow to resolve those problems.

7.2 Highlights

Topic covered in this chapter:

- Common Problems

7.3 Common Problems

Communications cannot be established with MPLAB-ICD.

If you cannot establish communications with MPLAB-ICD, follow these steps:

1. Make sure there is power to the demo board/target application. MPLAB-ICD is powered by the demo board/target application. Also, if you are using the demo board, make sure the power supply has the correct rating (9.0V, 0.75A).
2. Check that the MPLAB-ICD Header is plugged in to the demo board/target application correctly, e.g., all header pins are plugged into the socket and the header is correctly oriented. Also, make sure you are using the correct stand-off if you are using the demo board.
3. Check that the PIC16F87X is plugged in to the MPLAB-ICD Header correctly, e.g., all pins are plugged into the socket and the PIC16F87X is correctly oriented.
4. Check that the connection between the MPLAB-ICD and the host computer, via the RS-232 cable, is secure.
5. Check that the connection between the MPLAB-ICD Header and MPLAB-ICD Module, via the 9-inch modular cable, is secure.
6. Check the settings for MPLAB-ICD in the Development Mode dialog (*Options>Development Mode*) in MPLAB. Make sure you selected the correct PICmicro, COM port, and baud rate for your application.

If communications still cannot be established, contact Microchip Customer Support, as described in *General Information*.

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The MPLAB-ICD Module returns a communications error on Reset, Single Step, Halt or Run.

When using the MPLAB-ICD Demo Board, make sure that the oscillator select jumper is correctly set to RC or oscillator and that the part is correctly programmed for this selection. If using an oscillator, make sure that there is one in the socket. This problem usually results in the part being programmed OK and debug mode set OK but when a reset, single step, halt or run command is executed, the ICD Module returns a communications error.

The LED on the MPLAB-ICD Module is blinking.

If the LED on the MPLAB-ICD Module is blinking, reset the module by cycling the power to the application on and off. Then reselect the COM port for the MPLAB-ICD in the MPLAB-ICD dialog box. The LED should stop blinking.

Debug mode doesn't seem to be working.

1. Closing the MPLAB-ICD dialog will disable the ICD. So, if you have closed this dialog, you will need to re-enable MPLAB-ICD. Select *Options > Development Mode*, select MPLAB-ICD Programmer/Debugger, and click **Reset**.
2. Debug code must be programmed into the device before debug mode will work. Select **Debug Mode** from the MPLAB-ICD dialog to program the device with debug code.

When single stepping, the program runs too slowly.

Check the upload options in the MPLAB-ICD dialog. If you are uploading a large amount of data, e.g., all memory, you can expect about a 5 second delay between steps. To reduce the delay, select an option that uploads less data.

When single stepping, the program runs too quickly OR some registers are not updated.

Check the upload options in the MPLAB-ICD dialog. If you are uploading a small amount of data, the time between steps will be less than if you were uploading all memory. If you are not getting all of the data uploaded that you expect, check that you have selected the correct type(s) of registers for upload.

When halting, single stepping, or stopping on a breakpoint, MPLAB seems to lock up.

Check the upload options in the MPLAB-ICD dialog. If you are uploading a large amount of data, e.g., all memory, you can expect about a 5 second delay between steps. To reduce the delay, select an option that uploads less data.

The following I/O pins are not functioning correctly: RB3, RB6 or RB7.

These pins are reserved for programming/debugging. Refer to Section 1.5 for more information.



Appendix A. MPLAB-ICD Hardware

A.1 Introduction

The MPLAB-ICD hardware consists of the MPLAB-ICD Module, Header and, if included, Demo Board.

A.2 MPLAB-ICD Module and Header

The MPLAB-ICD Module and Header are used to perform the ICD functions on the Demo Board or in the target application.

A.2.1 Voltage and Current Specifications

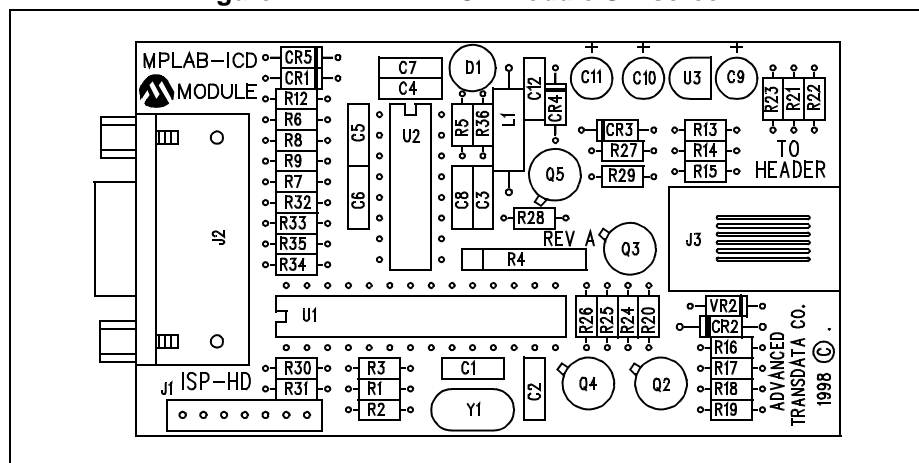
The MPLAB-ICD Header is powered by the target application, from a 3.0V to 5.5V source. The current ratings for the ICD in different operating modes and voltages are as follows:

	5V	3V
Debug	35 mA (max)	20 mA (max)
Run	40 mA	25 mA
Verify	60 mA	50 mA
Program	60 mA	50 mA

A.2.2 Silkscreens and Schematics

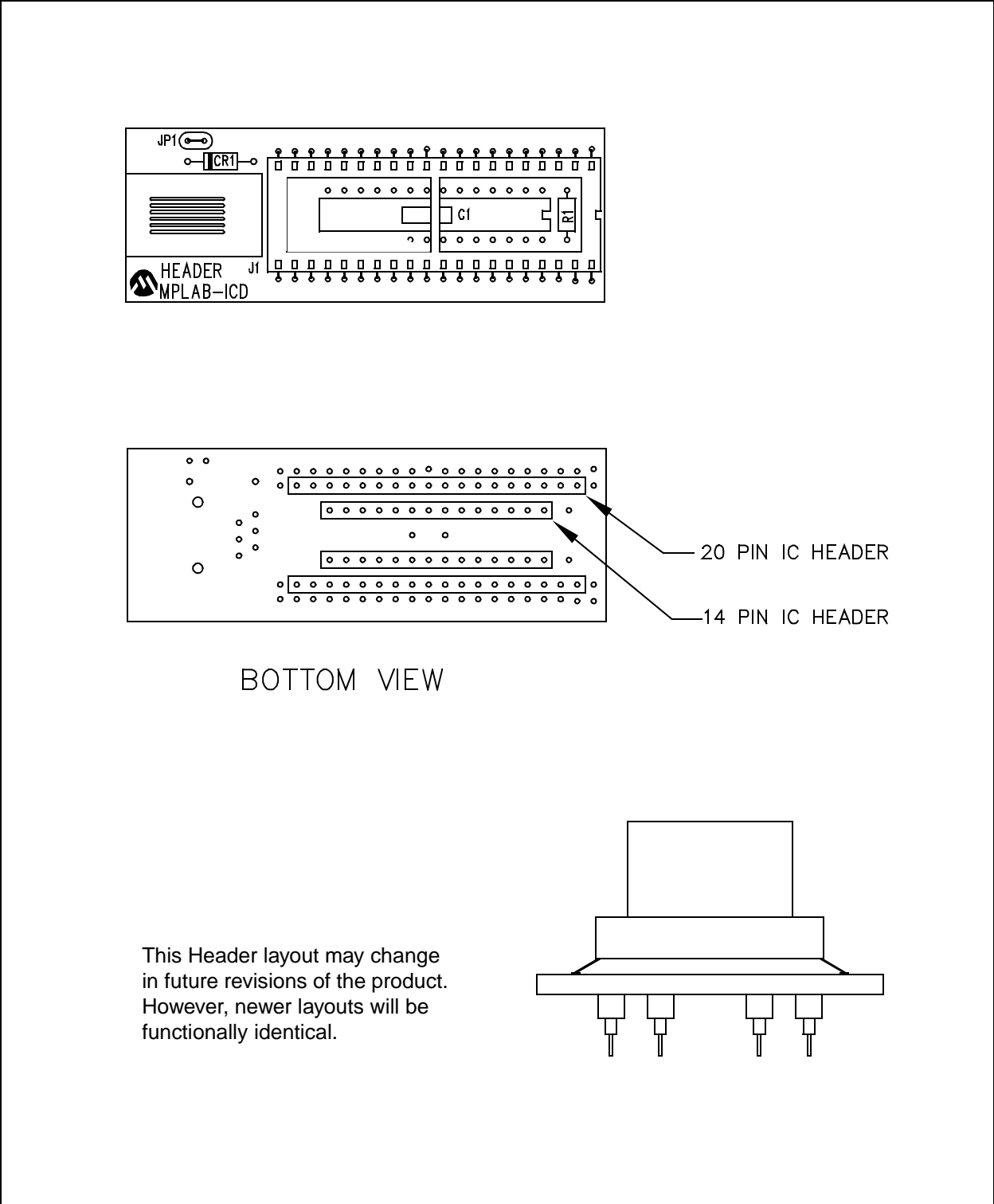
This section contains the silkscreen and schematic diagrams for the MPLAB-ICD Module and Header.

Figure A.1: MPLAB-ICD Module Silkscreen



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Figure A.4: MPLAB-ICD Header Silkscreen



A.3 MPLAB-ICD Demo Board

The MPLAB-ICD Demo Board is a simple demonstration board that supports PIC16F87X microcontrollers. The board can be used stand-alone with a pre-programmed part, or with the MPLAB-ICD Module and Header. A sample program is provided to demonstrate the unique features of the devices. Although a 40-pin and a 28-pin socket are provided to accommodate the different packages, only one processor can be run at a time.

A.3.1 Processor Sockets

Available sockets are:

- 40-pin socket for PIC16F874/877
- 28-pin socket for PIC16F873/876

Additional 40- and 28-pin sockets have been provided as stand-offs. Simply insert the desired socket onto the Demo Board and then insert the MPLAB-ICD Header. Without the stand-off, the Header would plug into both sockets, and not function properly.

A.3.2 Display

Eight red LEDs are connected to PORTC of each processor type. The PORTC pins are set high to light the LEDs.

A.3.3 DIP Switches

Eight DIP Switches are provided in a package as SW3. When all switches are in the ON position, each of eight red LEDs is connected to a pin of PORTC.

A.3.4 Power Supply

The MPLAB-ICD Module is powered by the target application's VDD with a voltage range of 3.0V to 5.5V (and current value of 0.75A or larger). If you own a PICSTART Plus Programmer, you can use its power adapter to power the Demo Board.

A.3.5 RS-232 Serial Port

An RS-232 level shifting IC has been provided to support connection to an RS-232 host through the DB9 connector. The port is configured as DCE, and can be connected to a PC using a straight through cable, as opposed to a null modem cable. The circuitry must be populated by the user:

- U4 – Analog Devices MAX233A or equivalent
- R14-R19 – 330 Ω , 1/8W resistor
- C7-C11 – 0.1 μ F capacitors

A.3.6 Push-button Switches

Two push buttons provide the following functions:

- MCLR to reset the processor
- Active low switch connected to RB0

A.3.7 Oscillator Options

You can use the on-board RC oscillator circuit or plug an oscillator in the 4-pin socket. Make sure to set the jumper (JP1) to the proper selection.

- Socket provided for clock oscillator – use an oscillator from 32 kHz to 20 Mhz
- RC circuit – the frequency generated by the 4.7K resistor and 20 pF capacitor ranges from about 3.5 Mhz to 6 Mhz depending on the operating voltage and ambient temperature.

A.3.8 Analog Input

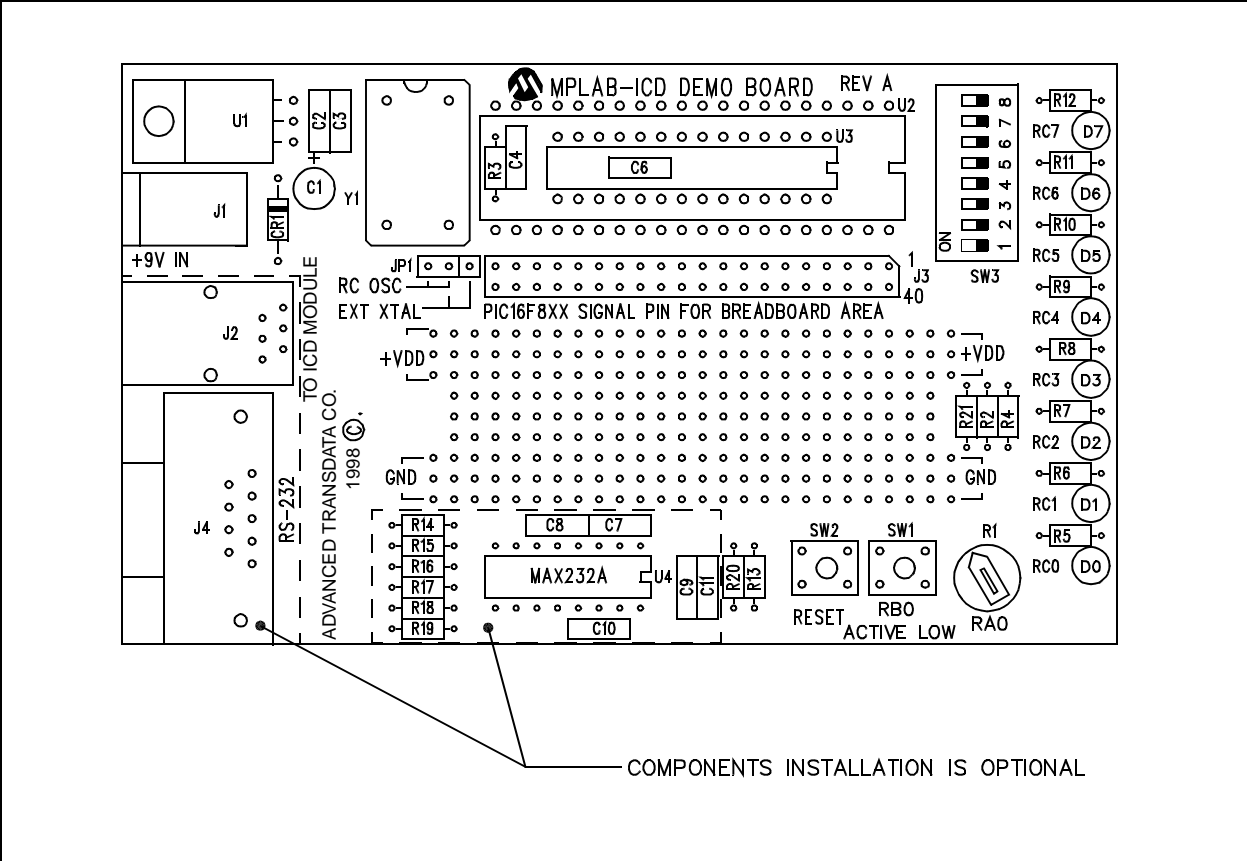
A 1K ohm potentiometer is connected through a series 470 ohm resistor (to protect the part should the pin be configured as an output) to RA0/AN0. The port can be adjusted from VDD to GND to provide an analog input to the PIC16F87X parts.

A.3.9 Silkscreens and Schematics

This section contains the silkscreen and schematic diagrams for the MPLAB-ICD Demo Board.

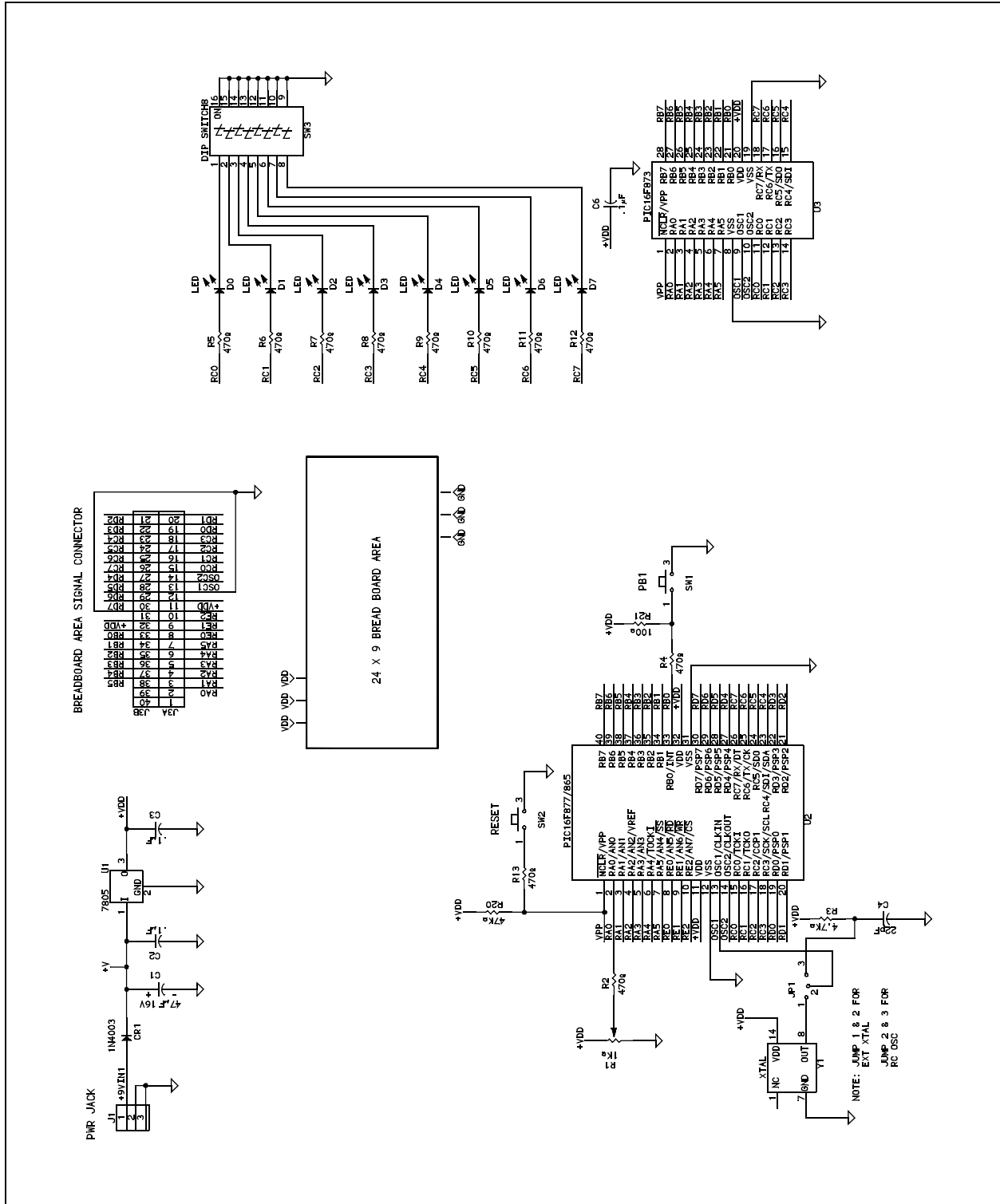
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Figure A.6: MPLAB-ICD Demo Board Silkscreen



MPLAB-ICD Hardware

Figure A.7: MPLAB-ICD Demo Board Schematic, Part 1





Glossary

Introduction

To provide a common frame of reference, this glossary defines the terms that follow.

Highlights

This glossary contains definitions for the following systems:

- MPLAB IDE
- MPLAB-ICD

Terms

Application

A set of software and hardware developed by the user, usually designed to be a product controlled by a PICmicro microcontroller.

Assembler Source Code

A text file that is processed by an assembler to produce a one-to-one correspondence between assembler instructions and PICmicro machine code.

Assemble

To translate a user's "ASM" source text code into machine code.

Breakpoint – Software

An address where execution of the firmware will halt.

Build

A function that recompiles all the source files for an application.

C Source Code

A program written in the high level language called "C," and which will be converted into PICmicro machine code.

Compile

To translate a user's "C" source text code into machine code.

Configuration Bits

Unique bits programmed to set modes of operation. A configuration bit may or may not be preprogrammed. These bits are set in the device specifications section of the MPLAB-ICD dialog.

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Data RAM

General purpose file registers from RAM on the PICmicro device being debugged. The File Register window displays data RAM.

Download

Download is the process of sending data from the host PC to the debugger or to the target board.

Debug Code

Code, written in assembly or C, that you are using the ICD to debug.

EEPROM

Electrically Erasable Programmable Read Only Memory.

Export

Send data out of MPLAB in a standardized format.

File Registers

On-chip general purpose and special function registers.

Halt

The command that stops the debugger. Executing Halt is the same as stopping at a break point. The program counter stops, and the user can inspect and change register values, and single step through code.

Hex Code

A file of executable instructions assembled or compiled from source code into standard hex format code. Hex code can be directly converted to object code.

High Level Language

A language for writing programs that is of a higher level of abstraction from the processor than assembler code. High level languages (such as C) employ a compiler to translate statements into machine instructions that the target processor can execute.

ICD

In-Circuit Debugger. MPLAB-ICD is Microchip's in-circuit debugger for PIC16F87X devices that works with MPLAB.

ICE

In-Circuit Emulator. MPLAB-ICE is Microchip's in-circuit emulator that works with MPLAB.

IDE

Integrated Development Environment. An application that has multiple functions for firmware development. The MPLAB IDE integrates a compiler, an assembler, a project manager, an editor, a debugger, a simulator, and an assortment of other tools within one Windows application. A user developing an application should be able to write code, compile, debug and test an application without leaving the MPLAB desktop.

Import

Bring data into the MPLAB Integrated Development Environment (IDE) from an outside source

Make Project

A command that rebuilds an application, re-compiling only those source files that have changed since the last complete compilation.

MPLAB-ICD

Microchip's in-circuit debugger for PIC16F87X devices that works with MPLAB.

MPLAB-ICE

Microchip's in-circuit emulator that works with MPLAB.

MPLAB-SIM

Microchip's simulator that works with MPLAB.

MPLAB Software

The name of the main executable program that supports the IDE with an Editor, Project Manager, and Emulator/Simulator Debugger. The MPLAB Software resides on the PC host. The executable file name is MPLAB.EXE. MPLAB.EXE calls many other files.

MRU

Most Recently Used. Refers to files and windows available to be selected from MPLAB main pull down menus.

Non Real-Time

Refers to the processor executing single step instructions, or MPLAB being run in simulator mode.

Object code

The machine code that is produced from the source code after it is processed by an assembler or compiler. This code will be the memory-resident code that will run on the PICmicro in the user's application. Relocatable code is code produced by MPASM or MPLAB-C17 that can be run through MPLINK.

PC

Any IBM® or compatible Personal Computer. MPLAB needs a 486X or better machine.

PC Host

The computer running Windows 3.1x or Windows 95/98.

PICmicro

PICmicro refers to the PIC12CXX, PIC14000, PIC16C5X, PIC16CXX, and PIC17CXX Microchip microcontroller families.

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PICMASTER

The hardware unit that provides tools for emulating and debugging firmware applications. This unit contains emulation memory, break point logic, counters, timers, and a trace analyzer among some of its tools. MPLAB-ICE is the newest emulator from Microchip.

Pod

The external emulator box that contains emulation memory, trace memory, event and cycle timers, and trace/break point logic. Occasionally used as an abbreviated name for the MPLAB-ICE Emulator.

Power-on-Reset Emulation

A software randomization process that writes random values in data RAM areas to simulate uninitialized values in RAM upon initial power application.

Program Counter

A register that specifies the current execution address.

Program Memory

Memory in the emulator or simulator containing the downloaded target application firmware.

Project

A set of source files and instructions to build the object code for an application.

Prototype System

A term referring to a user's target application, or target board.

PWM Signals

Pulse Width Modulation Signals. Certain PICmicro devices have a PWM peripheral.

Radix

The number base, hex, or decimal, used in selecting an address and for entering data in the *Window > Modify* command.

Real-time

When released from the halt state, the processor runs in real-time mode and behaves exactly as the normal chip would behave. In real-time mode, the real-time trace buffer is enabled and constantly captures all selected cycles, and all break logic is enabled. In the MPLAB-ICD, the processor executes in real-time until a valid break point causes a halt, or until the user halts the debugger.

In the simulator real-time simply means execution of the microcontroller instructions as fast as they can be simulated by the host CPU.

Run

The command that releases the debugger from halt, allowing it to run the application code and change or respond to I/O in real time.

SFR

Special Function Registers of a PICmicro.

Simulator

A software program that models the operation of the PICmicro microprocessor.

Simulator Stimulus

Data generated to exercise the response of simulation to external signals. Often the data is put into the form of a list of actions in a text file.

Single Step

This command steps through code, one instruction at a time. After each instruction, MPLAB updates register windows, watch variables, and status displays so you can analyze and debug instruction execution.

You can also single step C compiler source code, but instead of executing single instructions, MPLAB will execute all assembly level instructions generated by the line of the high level C statement.

Source

Source code, usually a text file of assembly instructions or C code.

Special Function Registers

Registers that control I/O processor functions, I/O status, timers, or other modes or peripherals.

Stack

“Push-Down” list of calling routines. Each time a PICmicro microcontroller executes a call or responds to an interrupt, the software pushes the return address to the stack. A return command pops the address from the stack.

Step-Into

This command is the same as Single Step. Step-Into (as opposed to Step-Over) follows a CALL instruction into a subroutine.

Step-Over

Step-Over allows you to debug code without stepping into subroutines. When stepping over a CALL instruction, the next break point will be set at the instruction after the CALL. If for some reason, the subroutine gets into an endless loop or does not return properly, the next break point will never be reached.

The Step-Over command is similar to Single Step except for its handling of CALL instructions.

Symbol

An label usually produced by an assembler or compiler that refers to machine locations by function names, variable locations, constant declarations, source line-number, or other reference to user source code.

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System Button

The System Button is located in the upper left corner of Windows and some dialogs. This button usually has “Minimize,” “Maximize,” and “Close.” In some MPLAB windows, additional modes or functions can be found under the System Button.

Target

Refers to user hardware.

Target Application

Firmware residing on the target board.

Target Board

The circuitry and programmable device that makes up the target application.

Target Processor

The microcontroller device on the target application board that is being debugged.

Template

Lines of text that you build for inserting into your files at a later time. The MPLAB Editor stores templates in template files.

Tool Bar

A row or column of icons that you can click on to execute MPLAB functions.

Trace

An emulator or simulator function that logs program execution. The emulator logs program execution into its trace buffer which is uploaded to MPLAB's trace window. MPLAB-ICD does not have this feature.

Trace Memory

Trace memory contained within the Emulator. Trace Memory is sometimes called the Trace Buffer.

Trigger Output

Trigger output refers to an emulator output signal that can be generated at any address or address range, and is independent of the trace and break point settings. Any number of trigger output points can be set.

Upload

The Upload function transfers data from the debugger to the host PC or from the target board to the debugger.

Warning

An alert that is provided to warn you of a situation that would cause physical damage to a device, software file, or equipment.

Watch Dog Timer

A timer on a PICmicro microcontroller that resets the processor after a selectable length of time.

Watch Variable

A variable that you may monitor during a debugging session. Watch windows contain a list of watch variables that are updated at each break point, as set by the MPLAB-ICD mode.

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Microchip received ISO 9001 Quality System certification for its worldwide headquarters, design, and wafer fabrication facilities in January, 1997. Our field-programmable PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, related specialty memory products and development systems conform to the stringent quality standards of the International Standard Organization (ISO).

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