



PICDEM™ LCD 2 Demonstration Kit User's Guide

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Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a “DS” number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is “DSXXXXXA”, where “XXXXX” is the document number and “A” is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.

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INTRODUCTION

This chapter contains general information that will be useful to know before using the PICDEM™ LCD 2 Demonstration Kit User's Guide. Items discussed in this chapter include:

- About this Guide
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support

ABOUT THIS GUIDE

Document Layout

This document describes how to use the PICDEM LCD 2 as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. Introduction** – Describes the hardware of the PICDEM LCD 2 Demonstration Board.
- **Chapter 2. Getting Started** – Describes how to use the PICDEM LCD 2 Demonstration Board.
- **Chapter 3. Using the Demo Software** – Describes how to use the application in Demo mode and also how it can be customized.
- **Appendix A. Board Technical Information** – Shows the schematic and layout diagrams for the PICDEM LCD 2 Demonstration Board.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

| Description | Represents | Examples |
|--|---|---|
| Arial font: | | |
| Italic characters | Referenced books | <i>PICDEM LCD 2 User's Guide</i> |
| | Emphasized text | ...is the <i>only</i> compiler... |
| Initial caps | A window | the Output window |
| | A dialog | the Settings dialog |
| | A menu selection | select Enable Programmer |
| Quotes | A field name in a window or dialog | "Save project before build" |
| Underlined, italic text with right angle bracket | A menu path | <u><i>File>Save</i></u> |
| Bold characters | A dialog button | Click OK |
| | A tab | Click the Power tab |
| Text in angle brackets < > | A key on the keyboard | Press <Enter>, <F1> |
| Courier font: | | |
| Plain Courier New | Sample source code | #define START |
| | Filenames | autoexec.bat |
| | File paths | c:\mcc18\h |
| | Keywords | _asm, _endasm, static |
| | Command-line options | -Opa+, -Opa- |
| | Bit values | 0, 1 |
| | A binary number | 'b00100, 'b10 |
| Italic Courier New | A variable argument | <i>file.o</i> , where <i>file</i> can be any valid filename |
| 0xnnnn | A hexadecimal number where n is a hexadecimal digit | 0xFFFF, 0x007A |
| Square brackets [] | Optional arguments | mcc18 [options] <i>file</i> [options] |
| Curly brackets and pipe character: { } | Choice of mutually exclusive arguments; an OR selection | errorlevel {0 1} |
| Ellipses... | Replaces repeated text | var_name [, var_name...] |
| | Represents code supplied by user | void main (void) {... } |

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RECOMMENDED READING

This user's guide describes how to use the PICDEM LCD 2 Demonstration Kit. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

Readme Files

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

The following documents are comprehensive references for Microchip's enhanced microcontrollers with LCD driver:

"PIC18F85J90 Family Data Sheet" (DS39770)
"PIC18F6390/6490/8390/8490 Data Sheet" (DS39629)
"PIC16C9XX Data Sheet" (DS30444)
"PIC16C925/926 Data Sheet" (DS39544)
"PIC16F917/916/914/913 Data Sheet" (DS41250)

THE MICROCHIP WEB SITE

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- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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

The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools. These include the MPLAB C17, MPLAB C18 and MPLAB C30 C compilers; MPASM™ and MPLAB ASM30 assemblers; MPLINK™ and MPLAB LINK30 object linkers; and MPLIB™ and MPLAB LIB30 object librarians.
- **Emulators** – The latest information on Microchip in-circuit emulators. This includes the MPLAB ICE 2000 and MPLAB ICE 4000.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 2.
- **MPLAB IDE** – The latest information on Microchip MPLAB IDE, the Windows® operating system Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB SIM and MPLAB SIM30 simulators, MPLAB IDE Project Manager and general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 and PRO MATE® II device programmers and the PICSTART® Plus development programmer.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

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

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at:

<http://support.microchip.com>

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

The Development Systems Information Line numbers are:

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

1-480-792-7302 – Other International Locations



PICDEM™ LCD 2 DEMONSTRATION KIT USER'S GUIDE

Chapter 1. Introduction

1.1 WELCOME

Thank you for purchasing the PICDEM LCD 2 Demonstration Kit from Microchip Technology Incorporated. The PICDEM LCD 2 demonstrates the capabilities of the PIC18FXXJ90, PIC18FXX90 and PIC16X9XX families of devices.

The PICDEM LCD 2 can be used stand-alone with a preprogrammed part, with an in-circuit emulator (e.g., MPLAB® ICE) or with an in-circuit debugger (e.g., MPLAB ICD 2). Sample programs are provided to demonstrate the unique features of the supported devices.

The PICDEM LCD 2 Demonstration Kit comes with the following:

1. PICDEM LCD 2 Demonstration Board (Figure 1-1)
2. Sample Plug-in Module (PIM)
3. CD-ROM which contains:
 - Sample Programs
 - *"PICDEM™ LCD 2 Demonstration Kit User's Guide"*

If you are missing any part of the kit, please contact your nearest Microchip sales office listed in the back of this publication for help.

1.2 PICDEM LCD 2 DEMONSTRATION BOARD HARDWARE FEATURES

The PICDEM LCD 2 Demonstration Board has the following hardware features; each feature's number corresponding to the number in Figure 1-1:

1. The demonstration board provides a daughter board option for the PIC18F85J90, PIC18F8490, PIC16F914/917 and PIC16F946 families of devices and MPLAB ICE. The board is also supplied with a PIM populated with a PIC18F85J90 device.

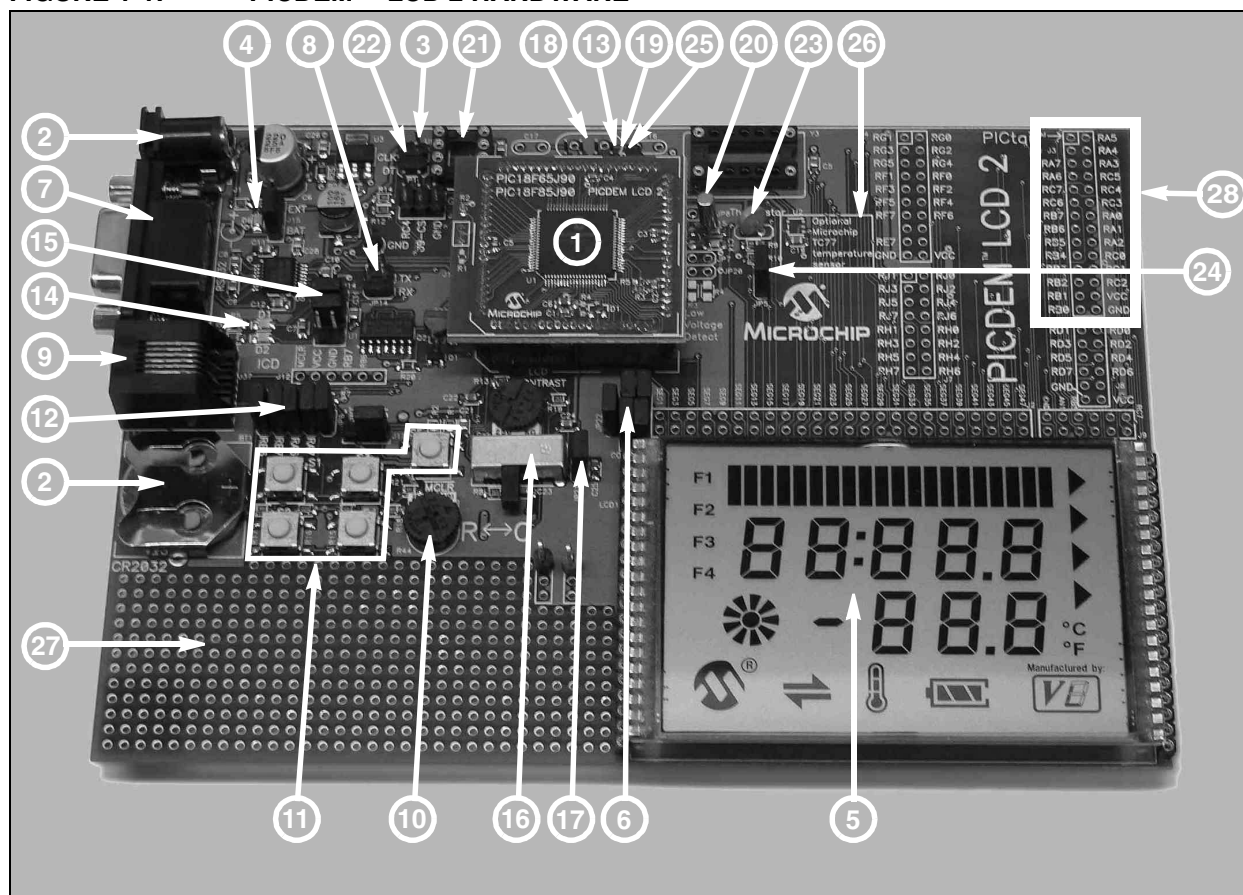
Note: Optional PIMs populated with PIC18FXX90 and PIC16F9XX devices are available for purchase from Microchip Direct (www.microchipdirect.com).

The MPLAB ICE can be plugged onto the board without any transition socket for PIC18FXX90 devices. For other devices, a transition socket may be needed.

2. On-board adjustable voltage regulator for direct input from 9V, 100 mA AC/DC wall adapter or 3V button cell battery.
3. Jumper J15 to select different power options.
4. Green power-on indicator LED for direct input from 9V.
5. Varitronix custom segmented LCD display.
6. Jumpers, COM0, COM1, COM2 and COM3, to disconnect COM pins from on-board LCD and allow the usage of any customized LCD glass.
7. RS-232 connection and associated hardware for direct connection to RS-232 interface.
8. Jumpers, JP13 and JP14, to disconnect TX and RX.
9. In-Circuit Debugger (ICD) connector.
10. R44, 10 k Ω , potentiometer for devices with analog inputs.
11. Five push button switches (S1 through S5) for external stimulus and Reset.
12. Jumpers, JP19, JP18, JP1 and JP2, to disconnect switches from RB6, RB7, RA6 and RA7 input pins.
13. Jumper, J11, to select either 10 k Ω (POT R44) or the S1-S4 switches to AN0 (RA0).
14. Two green LEDs connected to RC3 and RC4 (device dependent).
15. Jumpers in J14 to disconnect LEDs from RC3 and RC4.
16. A slide switch (S6) to select either the resistor ladder or the charge pump option for generating the bias values for the LCD pins.
17. Jumper, JP21, to physically tie the resistor ladder to ground.
18. Unpopulated holes provided for crystal connection.
19. Jumpers, JP11 and JP12, to disconnect crystal from OSC1 and OSC2.
20. 32.768 kHz crystal with Timer1 for Real-Time Clock (RTC) operation.
21. A Microwire EEPROM 93AA46C provided on a socket.
22. Jumpers, JP15 and JP16, to disconnect EEPROM from CK and DT. Jumper, J6, to connect CS to GND or to RC4 (device dependent). Jumper, J13, to select either 128 x 8 or 64 x 16 memory organization.
23. Thermistor for sensing temperature.
24. Jumper, JP5, to connect thermistor to AN1 (RA1) (device dependent).
25. Jumper, JP17, to select either VCC or I/O to power the peripherals.
26. Unpopulated option for TC77 temperature sensor.
27. Prototype area for user hardware.
28. PICtail™ daughter board connection. (The pin names on the board are valid only for the PIC18F8490 device. For other devices, the PICtail daughter board pin connections may be different or not connected.)

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FIGURE 1-1: PICDEM™ LCD 2 HARDWARE



1.3 SAMPLE DEVICES

A PIM, populated with the PIC18F85J90, is included.

1.4 SAMPLE PROGRAMS

The PICDEM LCD 2 Demonstration Kit includes a CD-ROM with sample demonstration programs. Depending on the device, these programs may be used with some of the included sample devices with an In-Circuit Emulator (ICE) or with an In-Circuit Debugger (ICD). For each type of device (PIC16F946, PIC16F917, PIC18F8490 and PIC18F85J90), demo source code, several C and/or .asm files and compiled code (one HEX file) are provided.

NOTES:

Chapter 2. Getting Started

The PICDEM LCD 2 may be used as a stand-alone board with a preprogrammed device, with an In-Circuit Emulator (ICE) or with an In-Circuit Debugger (ICD). For a list of PIC® microcontroller compatible ICEs or ICDs, please refer to the “*Microchip Development Systems Ordering Guide*” (DS30177).

2.1 PICDEM LCD 2 AS A STAND-ALONE BOARD – PREPROGRAMMED DEVICE

The PICDEM LCD 2 may be demonstrated immediately by following the steps listed below:

- Apply power to the PICDEM LCD 2. For information on acceptable power sources, see **Appendix A. “Board Technical Information”**.

Note: In the event that the preprogrammed PICDEM LCD 2 Demonstration Board with the PIC18F85J90 PIM does not operate, check the following conditions:

- The jumper, J15, is configured as per the power supply used. The slide switch, S6, is switched to C.
- JP1, JP2, JP6, JP18 and JP19 are connected.
- The middle two jumpers of J14 are connected.
- JP9 and JP10 are connected.
- J11 connecting POT to AN0 and JP17 connecting Vcc to I/O.

The status of all other jumpers will not affect the preprogrammed demonstration.

Refer to Figure A-1 in **Appendix A. “Board Technical Information”**.

To reprogram the sample device, the following will be necessary:

1. User source code may be programmed to the device or the sample program may be restored from the file on the included CD-ROM.
2. An assembler, such as the MPASM™ Assembler (available with MPLAB IDE), or a compiler, such as MPLAB C18 C Compiler (PIC18XXXX/18XXJXX devices only) must be used.

Source code must be assembled or compiled into a HEX file before it can be programmed into the device. Microchip Technology's MPASM Assembler or MPLAB C18 C Compiler may be used. Both are compatible with MPLAB IDE; however, other assemblers/compilers may be used.

3. Once the sample program is in the HEX file format, it can be programmed to a Flash device using an MPLAB ICD 2 or PM3 with an ICSP™ module. Microchip Technology's MPLAB ICD 2 is compatible with MPLAB IDE.

If the code protection bit(s) have not been programmed, the on-chip program memory can be read out for verification purposes.

2.2 PICDEM LCD 2 USED WITH AN IN-CIRCUIT EMULATOR OR IN-CIRCUIT DEBUGGER

To use the PICDEM LCD 2 with an In-Circuit Emulator (ICE) or In-Circuit Debugger (ICD), refer to the tool's user's guide for instructions on how to power-up and configure the ICE/ICD, as well as how to connect to target boards.

Configure the PICDEM LCD 2 for the desired oscillator as described in Table 2-1. Refer to the ICE/ICD user's guide for any oscillator configuration requirements.

TABLE 2-1: OSCILLATOR SELECTION

| Oscillator Selection on PICDEM™ LCD 2 | Modification on PICDEM™ LCD 2 |
|--|---|
| Crystal | JP9 and JP10 not connected. No canned oscillator on board, crystal in Y2, JP11 and JP12 connected, caps in C16 and C17. |
| Canned Oscillator | Put canned oscillator on socket Y3. Y2 empty, JP9, JP11 and JP12 not connected. |
| Device Internal Oscillator | JP11 and JP12 not connected. No canned oscillator on board. |
| Ceramic Resonator – no internal caps | JP9 and JP10 not connected. No canned oscillator on board, resonator in Y2, JP11 and JP12 connected, caps in C16 and C17. |
| Ceramic Resonator – with internal caps | JP9 and JP10 not connected. No canned oscillator on board, resonator in Y2, JP11 and JP12 connected, C16 and C17 empty. |

| |
|---|
| <p>Note: The MPLAB ICE can be plugged onto the board without any transition socket for PIC18FXX90 devices. For other devices, a transition socket may be needed.</p> |
|---|

Chapter 3. Using the Demo Software

The demo programs are preprogrammed into the sample devices. Also, this program is included on the CD-ROM program disk for user reference. This demo program uses the functions or macros provided by the firmware LCD driver module to display the required characters, strings or icons on the LCD.

3.1 DEMO FIRMWARE OPERATION

The demo firmware is made up of four components, which are individually displayed on the LCD. The PIC microcontroller's internal RC oscillator is used as the system clock source.

1. **Voltmeter (F1)**

This mode uses the A/D module to measure the voltage of the R44 pot through analog channel AN0, and displays a voltage between 0.00V and 3.30V on the LCD using the LCD module. Voltage is continually updated until the mode is exited by pressing either the S1 or S2 switch.

2. **Thermometer (F2)**

This mode uses the A/D module to measure the voltage of the thermistor R11 through analog channel AN1, and converts to temperature both in Celsius and Fahrenheit and displays the temperature on the LCD using the LCD module. Temperature is continually updated until the mode is exited by pressing either the S1 or S2 switch.

3. **Clock (F3)⁽¹⁾**

This mode uses the Timer1 module and a 32 kHz clock crystal. Once this mode is entered from the main menu, the Real-Time Clock will start counting from 00:00:00. The S3 switch is used to increment minutes and the S4 switch is used to increment hours. To perform the increment operations, press and hold the switches. The clock keeps running continuously until the mode is exited by pressing either the S1 or S2 switch.

4. **Charge Pump and Software Contrast (F4)⁽¹⁾**

This mode is available only for the PIC18F85J90 family of devices and uses the on-board charge pump and LCD voltage regulator. The LCD module is configured in Charge Pump mode and software contrast is achieved by either pressing S3 to increase the contrast or S4 to decrease the contrast until the mode is exited by pressing either the S1 or S2 switch. By exiting this mode, the Voltmeter mode is entered and retains the contrast level.

Note 1: For low-power battery operation in JP17, remove jumper on Vcc and I/O and connect I/O and RB0.

FIGURE 3-1: DEMO PROGRAM FLOWCHART

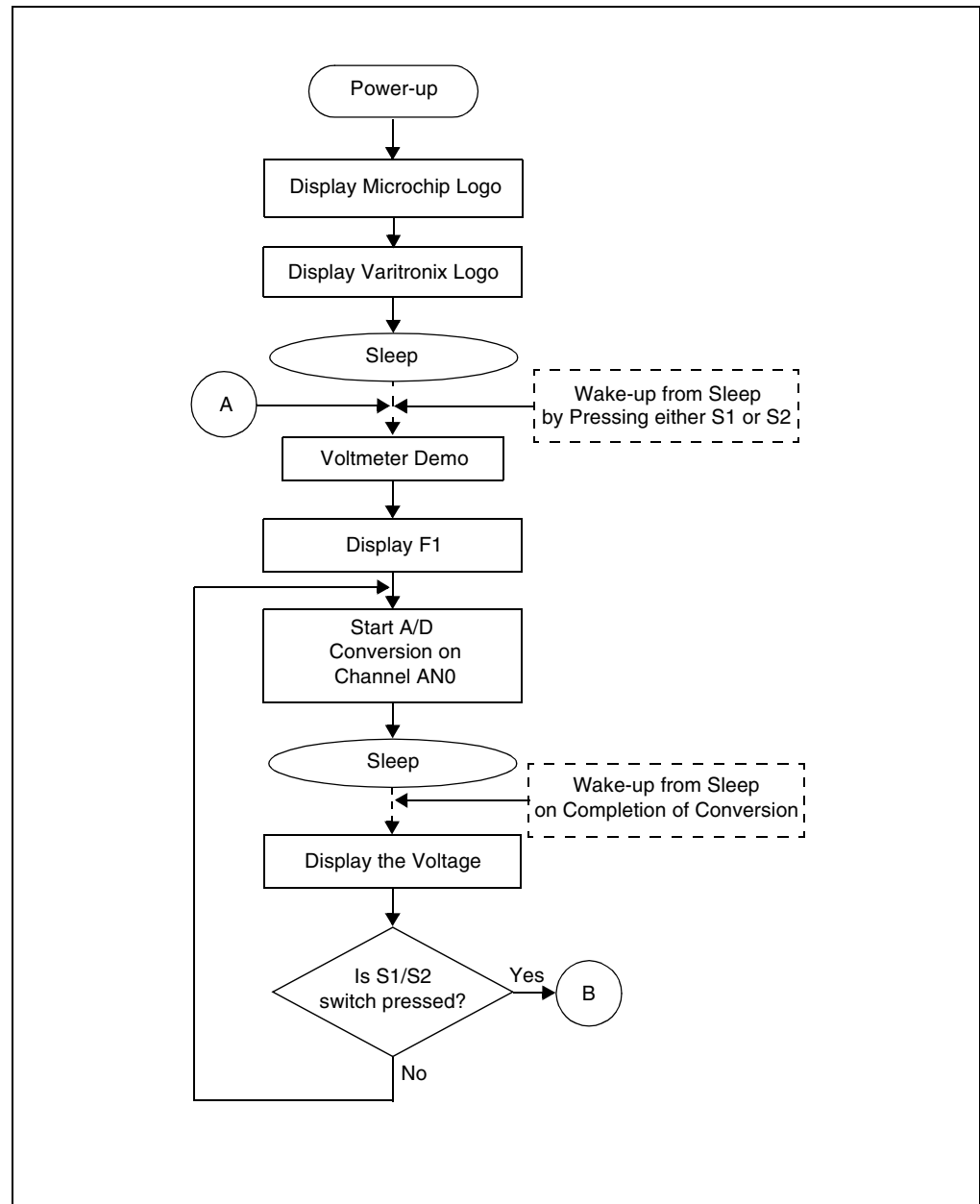


FIGURE 3-2: DEMO PROGRAM FLOWCHART

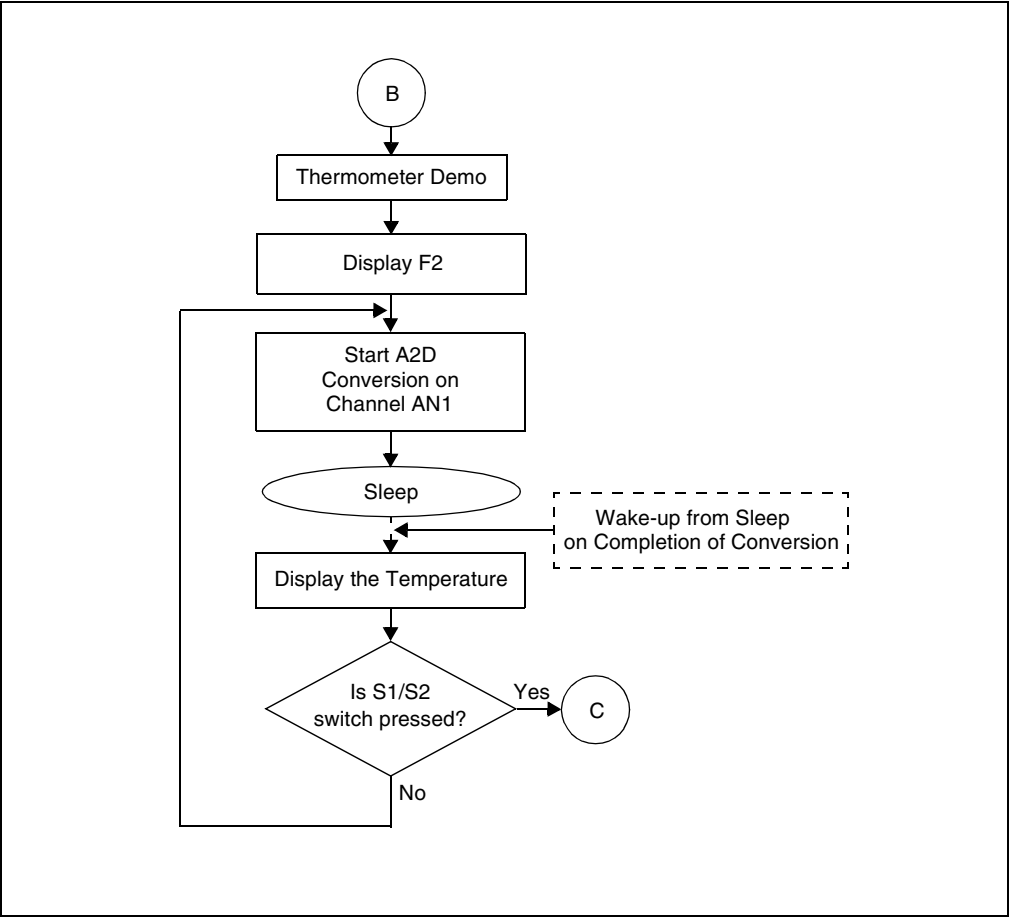


FIGURE 3-3: DEMO PROGRAM FLOWCHART

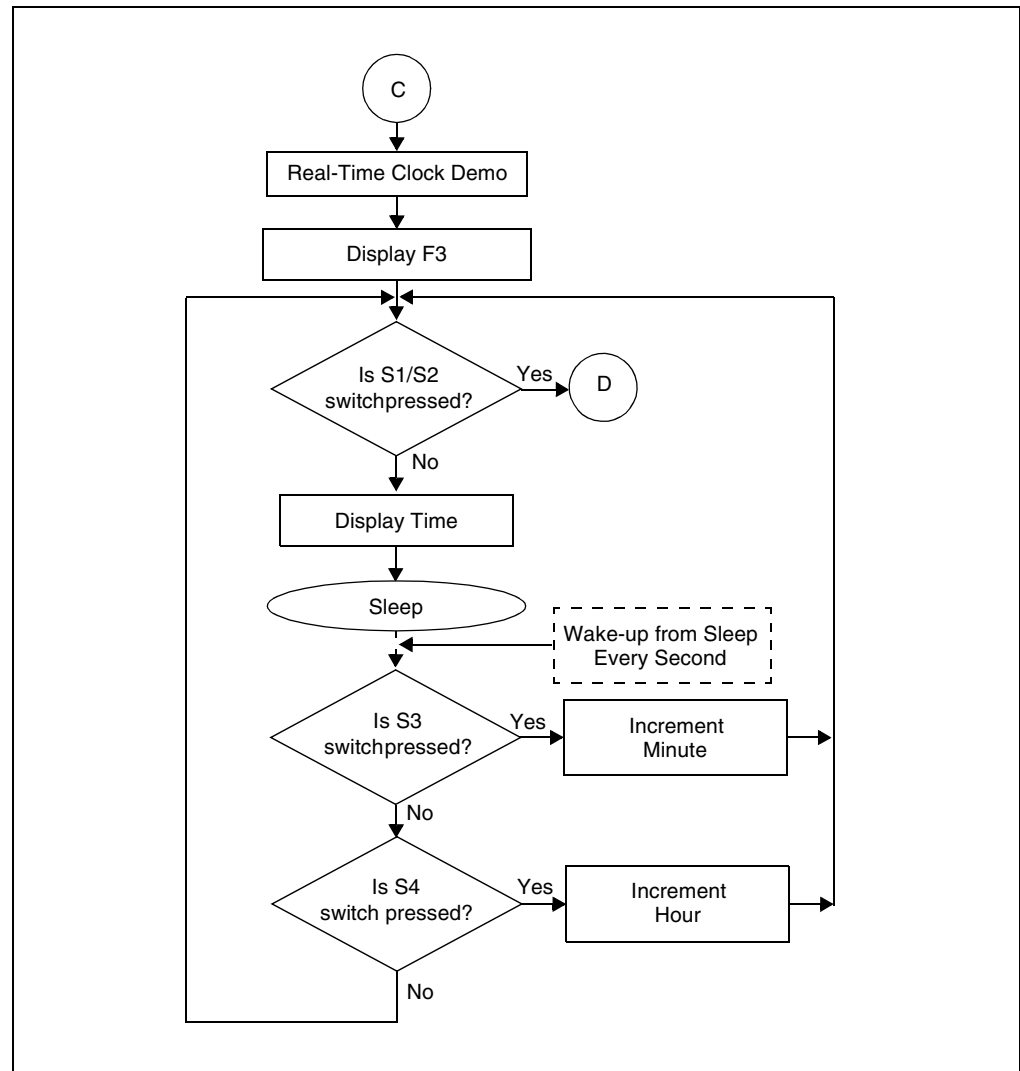


FIGURE 3-4: DEMO PROGRAM FLOWCHART

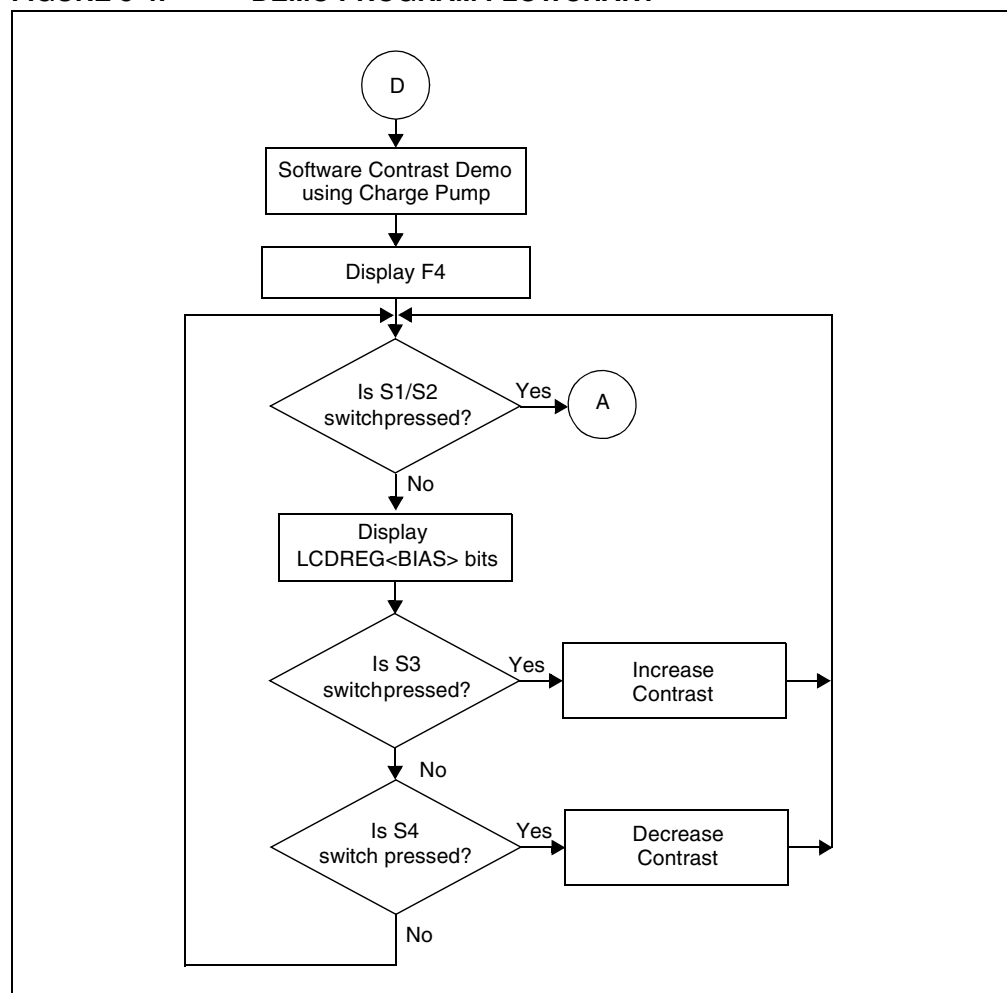
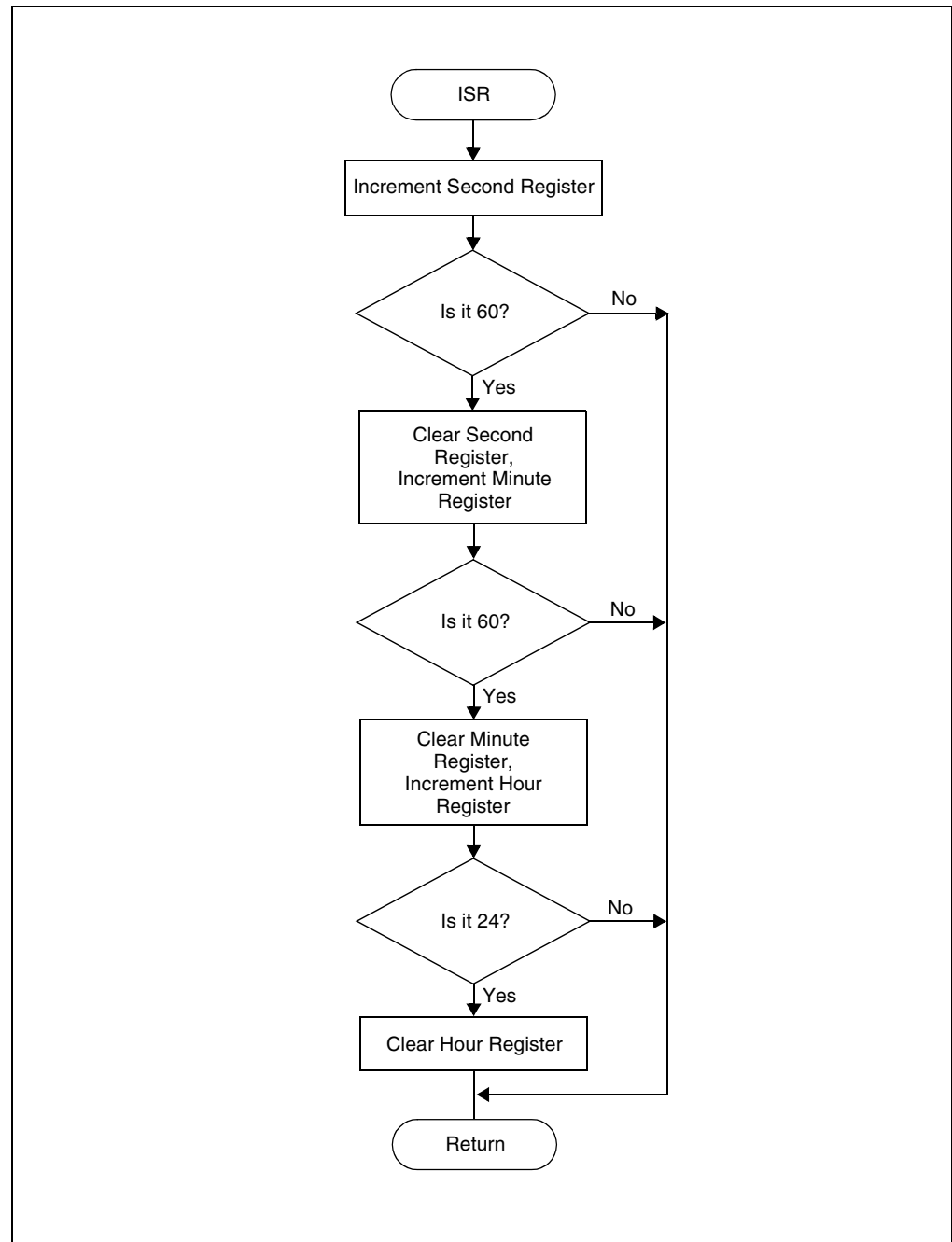


FIGURE 3-5: DEMO PROGRAM FLOWCHART





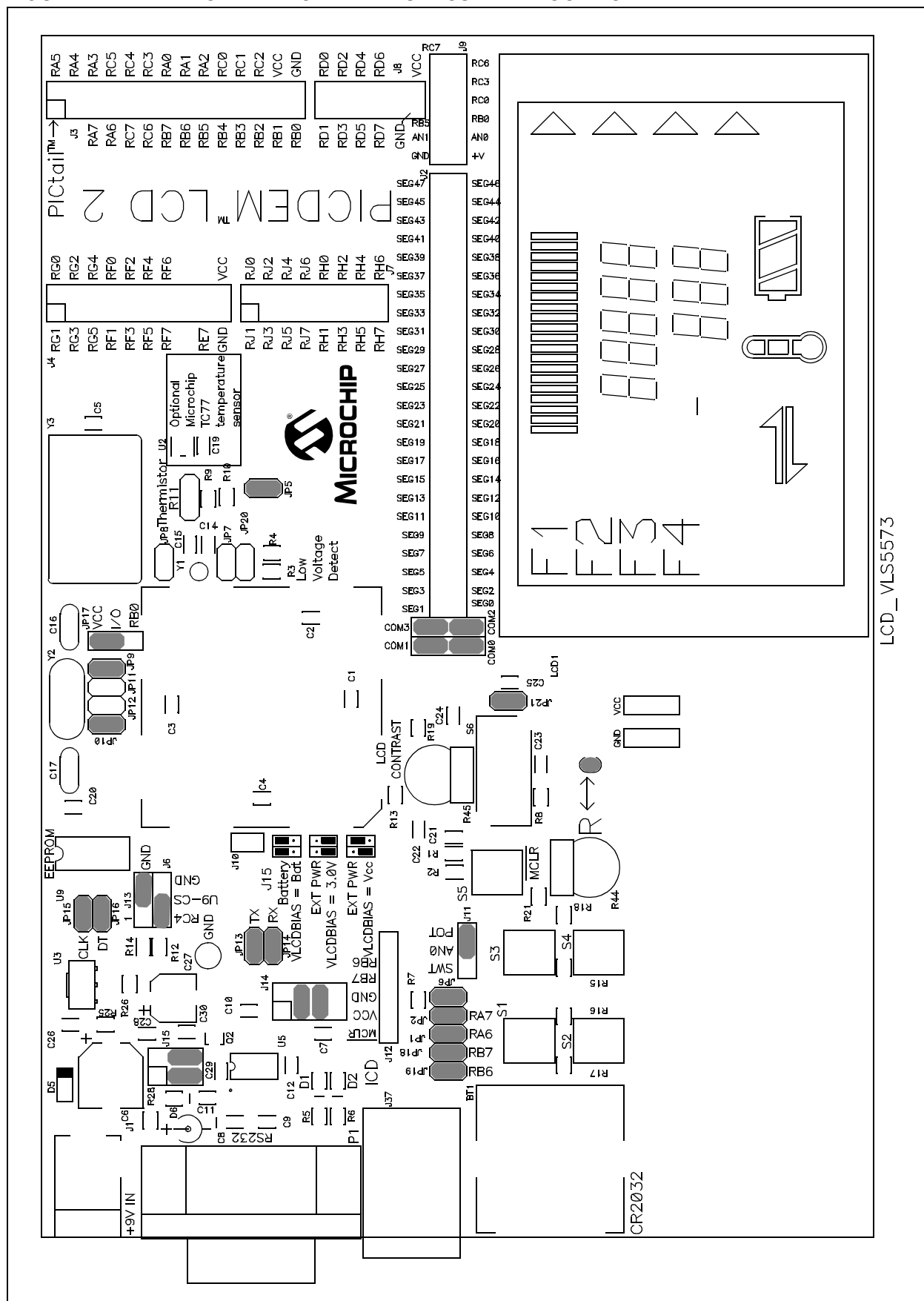
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Appendix A. Board Technical Information

The PICDEM LCD 2 hardware is not complicated and is intended to illustrate the ease of use of various PIC® microcontrollers. The PICDEM LCD 2 features the following hardware elements.

Note: Many of the following hardware sections will require specific demo board jumper configurations. If a jumper is not listed in a particular section, then that jumper has no effect on the circuitry within the hardware section you are working. Figure A-1 shows a diagram of the PICDEM LCD 2 silkscreen with all necessary jumpers highlighted in gray. Also, refer to the schematic for circuit connections.

FIGURE A-1: PICDEM™ LCD 2 DEFAULT JUMPER LOCATION



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A.1 PROCESSORS

While there is no actual processor populated on the board, a processor is provided with the plug-in module (PIM) that is shipped with the demonstration board. The default processor on the PIM is the PIC18F85J90.

The board also supports the PIC18F8490, PIC16F946 and PIC16F917 processors, which have been designed for use with the PICDEM LCD 2. These three processors are in the PICDEM LCD 2 PIM Pack which is available for separate purchase.

The part numbers for a replacement PIC18F85J90 and the PIM pack are given in Table A-1.

TABLE A-1: PART NUMBERS^(†)

| Item | Part number |
|--|-------------|
| PICDEM LCD 2 PIM Pack <ul style="list-style-type: none">• PIC18F8490 PIM• PIC16F946 PIM• PIC16F917 PIM | MA180019 |
| PIC18F85J90 PIM | MA180022 |

† For the availability and pricing of parts, go to www.microchipdirect.com.

A.2 LCD DISPLAY

A custom made segmented LCD glass, manufactured by the Varitronix Corporation, is provided as shown in Figure A-2. This LCD has 4 commons and 32 segments. Table A-2 provides a few of the specifics for the display. Refer to the Varitronix specification sheet (VL_5573_V00) for additional details.

FIGURE A-2: PICDEM™ LCD 2 DISPLAY

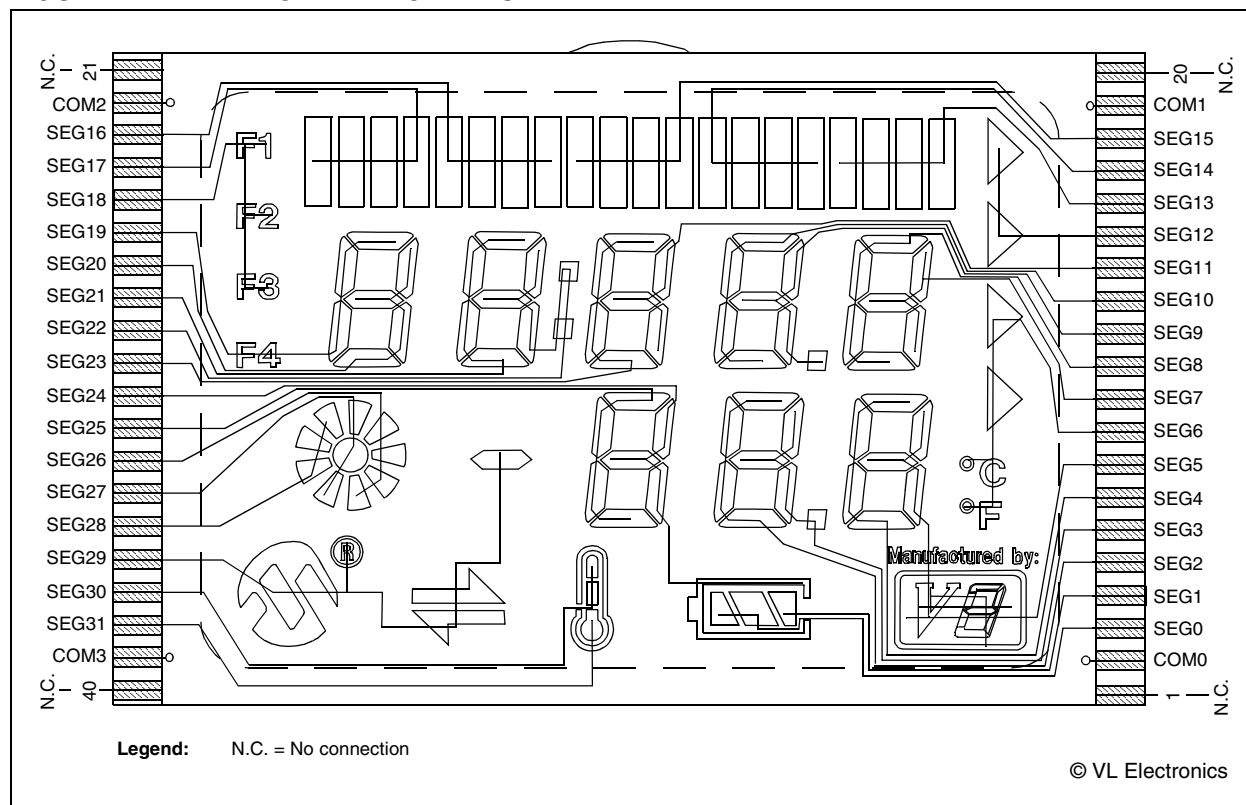


TABLE A-2: LCD GLASS SPECIFICATIONS

| Type | Specification |
|-----------------------|------------------------|
| P.I.D. | VL_5573_V00 |
| Mode/Color/Type | Positive / -- / TN |
| Viewing Direction | 6:00 O'Clock |
| Driving Scheme | 1/4 Duty, 1/3 Bias |
| Drive Voltage (VLCD) | ~3.0 Volt (p-p), +20°C |
| Operating Temperature | 0°C - +50°C |
| Storage Temperature | -10°C - +60°C |
| Polarizer – Front | STD.Transmissive |
| Polarizer – Back | STD.Reflective |

Since the glass used on the PICDEM LCD 2 operates at 3V, there is a voltage protection circuit on the LCDBIAS3 pin, which is enabled in the default configuration. When enabled, even if the VDD is greater than 3V, it regulates the LCDBIAS3 voltage such that it always maintains the value to 3V. This is not necessary for operation of the LCD module, but it is a protection circuit to prevent accidentally applying voltages higher than 3V to the LCD glass present on the board.

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FIGURE A-3: DISPLAY DEFINITIONS

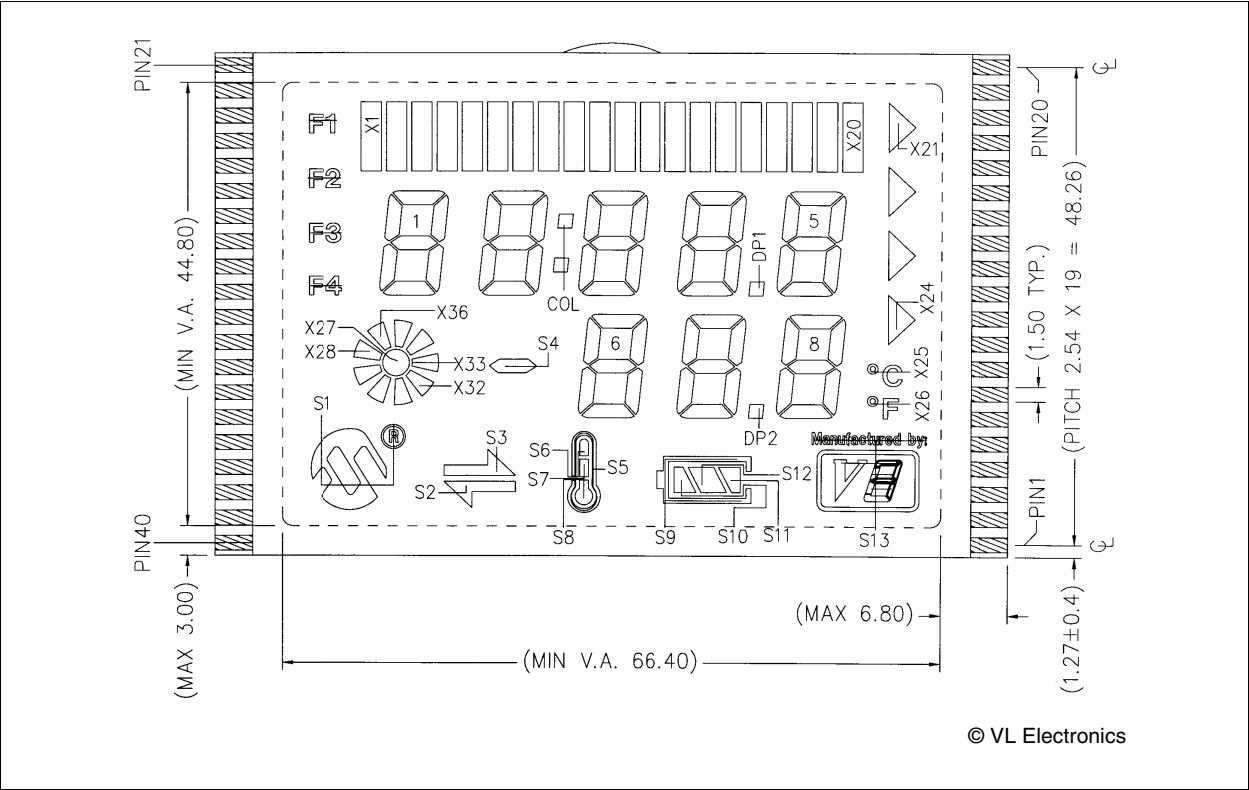


FIGURE A-4: DIGIT DESCRIPTION

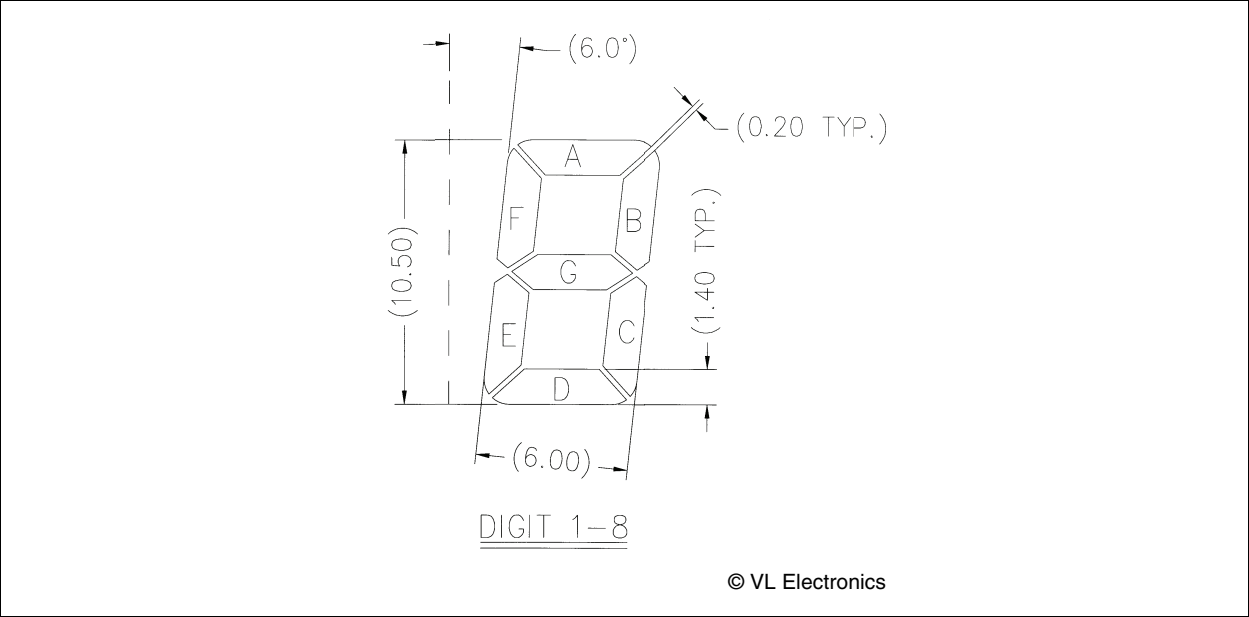


TABLE A-3: LCD SEGX AND COMX

| Pin | ICE Pin | COM0 | COM1 | COM2 | COM3 |
|-----|---------|------|------|------|------|
| 1 | | N.C. | N.C. | N.C. | N.C. |
| 2 | | COM0 | — | — | — |
| 3 | SEG0 | S12 | — | — | S10 |
| 4 | SEG1 | S11 | — | — | — |
| 5 | SEG2 | 7D | 7F | 7A | 7E |
| 6 | SEG3 | DP2 | 7G | 7B | 7C |
| 7 | SEG4 | 8D | 8F | 8A | 8E |
| 8 | SEG5 | S13 | 8G | 8B | 8C |
| 9 | SEG6 | X23 | X25 | X26 | X24 |
| 10 | SEG7 | 5B | 5C | — | 5G |
| 11 | SEG8 | 5A | 5E | 5D | 5F |
| 12 | SEG9 | 4B | 4C | DP1 | 4G |
| 13 | SEG10 | 4A | 4E | 4D | 4F |
| 14 | SEG11 | 3B | 3C | — | 3G |
| 15 | SEG12 | — | X22 | X21 | — |
| 16 | SEG13 | X17 | X19 | X20 | X18 |
| 17 | SEG14 | X16 | X14 | X13 | X15 |
| 18 | SEG15 | X9 | X11 | X12 | X10 |
| 19 | | — | COM1 | — | — |
| 20 | | N.C. | N.C. | N.C. | N.C. |
| 21 | | N.C. | N.C. | N.C. | N.C. |
| 22 | | — | — | COM2 | — |
| 23 | SEG16 | X8 | X6 | X5 | X7 |
| 24 | SEG17 | X1 | X3 | X4 | X2 |
| 25 | SEG18 | — | F2 | F1 | F3 |
| 26 | SEG19 | 1A | 1E | F4 | 1F |
| 27 | SEG20 | 1B | 1C | 1D | 1G |
| 28 | SEG21 | 2A | 2E | 2D | 2F |
| 29 | SEG22 | 2B | 2C | COL | 2G |
| 30 | SEG23 | 3A | 3E | 3D | 3F |
| 31 | SEG24 | S9 | 6G | 6B | 6C |
| 32 | SEG25 | 6D | 6F | 6A | 6E |
| 33 | SEG26 | X31 | X33 | X34 | X32 |
| 34 | SEG27 | — | X27 | X35 | X30 |
| 35 | SEG28 | — | X28 | X36 | X29 |
| 36 | SEG29 | S1 | S3 | S4 | S2 |
| 37 | SEG30 | S6 | — | — | S7 |
| 38 | SEG31 | S5 | — | — | S8 |
| 39 | | — | — | — | COM3 |
| 40 | | N.C. | N.C. | N.C. | N.C. |

Legend: N.C. = No connection

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A.2.1 Device-Specific LCD Segment Configuration

The following figures and tables detail which segments are available for specific PIC® devices.

TABLE A-4: PIC18F85J90 PIM AND ICE PIN/PORT COMPARISON

| PIC18F85J90 PIM Pin No. | PIC18F85J90 Port | PIC18F85J90 Pin | ICE Pin | ICE Port | ICE Pin No. | PIC18F85J90 PIM Pin No. | PIC18F85J90 Port | PIC18F85J90 Pin | ICE Pin | ICE Port | ICE Pin No. |
|----------------------------|---------------------|--------------------|------------|-------------|----------------|----------------------------|---------------------|--------------------|--------------|-------------|----------------|
| 1 | RH2 | SEG45 | SEG30 | RG0 | 16 | 41 | RJ6 | SEG37 | SEG37 | RJ6 | 54 |
| 2 | RH3 | SEG44 | SEG29 | RG1 | 17 | 42 | RJ7 | SEG36 | SEG36 | RJ7 | 55 |
| 3 | RE1 | BIAS2 | BIAS2 | RE1 | 14 | 43 | RC2 | SEG13 | SEG13 | RC2 | 56 |
| 4 | RE0 | BIAS1 | BIAS1 | RE0 | 15 | 44 | RC3 | SEG17 | SEG17 | RA3 | 39 |
| 5 | RG0 | BIAS0 | BIAS0 | RB5 | 67 | 45 | RC4 | SEG16 | SEG16 | RA2 | 40 |
| 6 | RG1 | NC | NC | | | 46 | RC5 | SEG12 | SEG12 | RC5 | 59 |
| 7 | RG2 | VLCAP1 | VLCAP1 | RC3 | 57 | 47 | RB7 | RB7 | RB7 | RB7 | 60 |
| 8 | RG3 | VLCAP2 | VLCAP2 | RC4 | 58 | 48 | VDD | ICEVDD | ICEVDD | VDD | 61 |
| 9 | RG5 | MCLR | ICEMCLR | RG5 | 20 | 49 | RA7 | OSC1 | OSC1 | RA7 | 62 |
| 10 | RG4 | SEG26 | SEG26 | RG4 | 21 | 50 | RA6 | OSC2 | OSC2 | RA6 | 63 |
| 11 | VSS | VSS | VSS | VSS | 23 | 51 | VSS | VSS | VSS | VSS | 65 |
| 12 | VDDCORE | VDDCORE | VDD | VDD | 24 | 52 | RB6 | RB6 | RB6 | RB6 | 66 |
| 13 | RF7 | SEG25 | SEG25 | RF7 | 25 | 53 | RB5 | SEG29 | SEG27 | RG3 | 19 |
| 14 | RF6 | SEG24 | SEG24 | RF6 | 26 | 54 | RB4 | SEG11 | SEG11 | RB4 | 68 |
| 15 | RF5 | SEG23 | SEG23 | RF5 | 27 | 55 | RB3 | SEG10 | SEG10 | RB3 | 69 |
| 16 | RF4 | SEG22 | SEG22 | RF4 | 28 | 56 | RB2 | SEG9 | SEG9 | RB2 | 70 |
| 17 | RF3 | SEG21 | SEG21 | RF3 | 29 | 57 | RB1 | SEG8 | SEG8 | RB1 | 71 |
| 18 | RF2 | SEG20 | SEG20 | RF2 | 30 | 58 | RB0 | RB0 | RB0 | RB0 | 72 |
| 19 | RH7 | SEG43 | SEG43 | RH7 | 31 | 59 | RJ3 | SEG35 | SEG35 | RJ3 | 73 |
| 20 | RH6 | SEG42 | SEG42 | RH6 | 32 | 60 | RJ2 | SEG34 | SEG34 | RJ2 | 74 |
| 21 | RH5 | SEG41 | SEG41 | RH5 | 33 | 61 | RJ1 | SEG33 | SEG33 | RJ1 | 75 |
| 22 | RH4 | SEG40 | SEG40 | RH4 | 34 | 62 | RJ0 | NC | NC | | |
| 23 | RF1 | SEG19 | SEG19 | RF1 | 35 | 63 | RD7 | SEG7 | SEG7 | RD7 | 77 |
| 24 | ENVREG | ENVREG | | | | 64 | RD6 | SEG6 | SEG6 | RD6 | 78 |
| 25 | AVDD | AVDD | ICEVDD | AVDD | 37 | 65 | RD5 | SEG5 | SEG5 | RD5 | 79 |
| 26 | AVSS | AVSS | AVSS | AVSS | 38 | 66 | RD4 | SEG4 | SEG4 | RD4 | 80 |
| 27 | RA3 | NC | NC | | | 67 | RD3 | SEG3 | SEG3 | RD3 | 81 |
| 28 | RA2 | AN2 | AN1 | RA1 | 41 | 68 | RD2 | SEG2 | SEG2 | RD2 | 82 |
| 29 | RA1 | SEG18 | SEG18 | RF0 | 36 | 69 | RD1 | SEG1 | SEG1 | RD1 | 83 |
| 30 | RA0 | AN0 | AN0 | RA0 | 42 | 70 | VSS | VSS | VSS | VSS | 84 |
| 31 | VSS | VSS | VSS | VSS | 44 | 71 | VDD | VDD | VDD | VDD | 2 |
| 32 | VDD | ICEVDD | ICEVDD | VDD | 45 | 72 | RD0 | SEG0 | SEG0 | RD0 | 3 |
| 33 | RA5 | SEG15 | SEG15 | RA5 | 46 | 73 | RE7 | SEG31 | SEG28 | RG2 | 18 |
| 34 | RA4 | SEG14 | SEG14 | RA4 | 47 | 74 | RE6 | COM3 | COM3 | RE6 | 5 |
| 35 | RC1 | T1OSCI | T1OSCI | RC1 | 48 | 75 | RE5 | COM2 | COM2 | RE5 | 6 |
| 36 | RC0 | T1OSCO | T1OSCO | RC0 | 49 | 76 | RE4 | COM1 | COM1 | RE4 | 7 |
| 37 | RC6 | TX/CK | TX/CK | RC6 | 50 | 77 | RE3 | COM0 | COM0 | COM0 | 8 |
| 38 | RC7 | RX/DT | RX/DT | RC7 | 51 | 78 | RE2 | BIAS3 | BIAS3 | RE2 | 9 |
| 39 | RJ4 | SEG39 | SEG39 | RJ4 | 52 | 79 | RH0 | SEG47 | SEG32 | RJ0 | 76 |
| 40 | RJ5 | SEG38 | SEG38 | RJ5 | 53 | 80 | RH1 | SEG46 | SEG31 | RE7 | 4 |

Legend: Unshaded cells indicate where a perfect match between PIM and ICE pins and ports exists.

Shaded cells indicate where differences between PIM and ICE ports and pins exist.

Bold text indicates the PIM pins that are not connected to any ICE pins or ports.

TABLE A-5: PIC18F85J90 LCD CONNECTIONS COMPARISON

| PIC18F85J90 | ICE | Pin # | | | | Pin # | ICE | PIC18F85J90 |
|-------------|-------|-------|-----------------|--|-----------------|-------|-------|-------------|
| | NC | 21 | NC | | NC | 20 | NC | |
| COM2 | COM2 | 22 | COM3 | | COM2 | 19 | COM1 | COM1 |
| SEG16 | SEG16 | 23 | X8,X6,X5,X7 | | X9,X11,X12,X10 | 18 | SEG15 | SEG15 |
| SEG17 | SEG17 | 24 | X1,X3,X4,X2 | | X16,X14,X13,X15 | 17 | SEG14 | SEG14 |
| SEG18 | SEG18 | 25 | -,F2,F1,F3 | | X17,X19,X20,X18 | 16 | SEG13 | SEG13 |
| SEG19 | SEG19 | 26 | 1A,1E,F4,1F | | -,X22,X21,- | 15 | SEG12 | SEG12 |
| SEG20 | SEG20 | 27 | 1B,1C,1D,1G | | 3B,3C,-,3G | 14 | SEG11 | SEG11 |
| SEG21 | SEG21 | 28 | 2A,2E,2D,2F | | 4A,4E,4D,4F | 13 | SEG10 | SEG10 |
| SEG22 | SEG22 | 29 | 2B,2C,COL,2G | | 4B,4C,DP1,4G | 12 | SEG9 | SEG9 |
| SEG23 | SEG23 | 30 | 3A,3E,3D,3F | | 5A,5E,5D,5F | 11 | SEG8 | SEG8 |
| SEG24 | SEG24 | 31 | S9,6G,6B,6C | | 5B,5C,-,5G | 10 | SEG7 | SEG7 |
| SEG25 | SEG25 | 32 | 6D,6F,6A,6E | | X23,X25,X26,X24 | 9 | SEG6 | SEG6 |
| SEG26 | SEG26 | 33 | X31,X33,X34,X32 | | S13,8G,8B,8C | 8 | SEG5 | SEG5 |
| SEG29 | SEG27 | 34 | -,X27,X35,X30 | | 8D,8F,8A,8E | 7 | SEG4 | SEG4 |
| SEG31 | SEG28 | 35 | -,X28,X36,X29 | | DP2,7G,7B,7C | 6 | SEG3 | SEG3 |
| SEG44 | SEG29 | 36 | S1,S3,S4,S2 | | 7D,7F,7A,7E | 5 | SEG2 | SEG2 |
| SEG45 | SEG30 | 37 | S6,-,-,S7 | | S11,-,-,- | 4 | SEG1 | SEG1 |
| SEG46 | SEG31 | 38 | S5,-,-S8 | | S12,-,-,S10 | 3 | SEG0 | SEG0 |
| COM3 | COM3 | 39 | COM4 | | COM1 | 2 | COM0 | COM0 |
| | NC | 40 | NC | | NC | 1 | NC | |

Legend: Unshaded cells indicate a perfect match between the PIM and the glass.

Shaded cells indicate the pins that are remapped to the corresponding pin on the PIM.

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FIGURE A-5: SEGMENT CONFIGURATION FOR PIC18F85J90 DEVICES

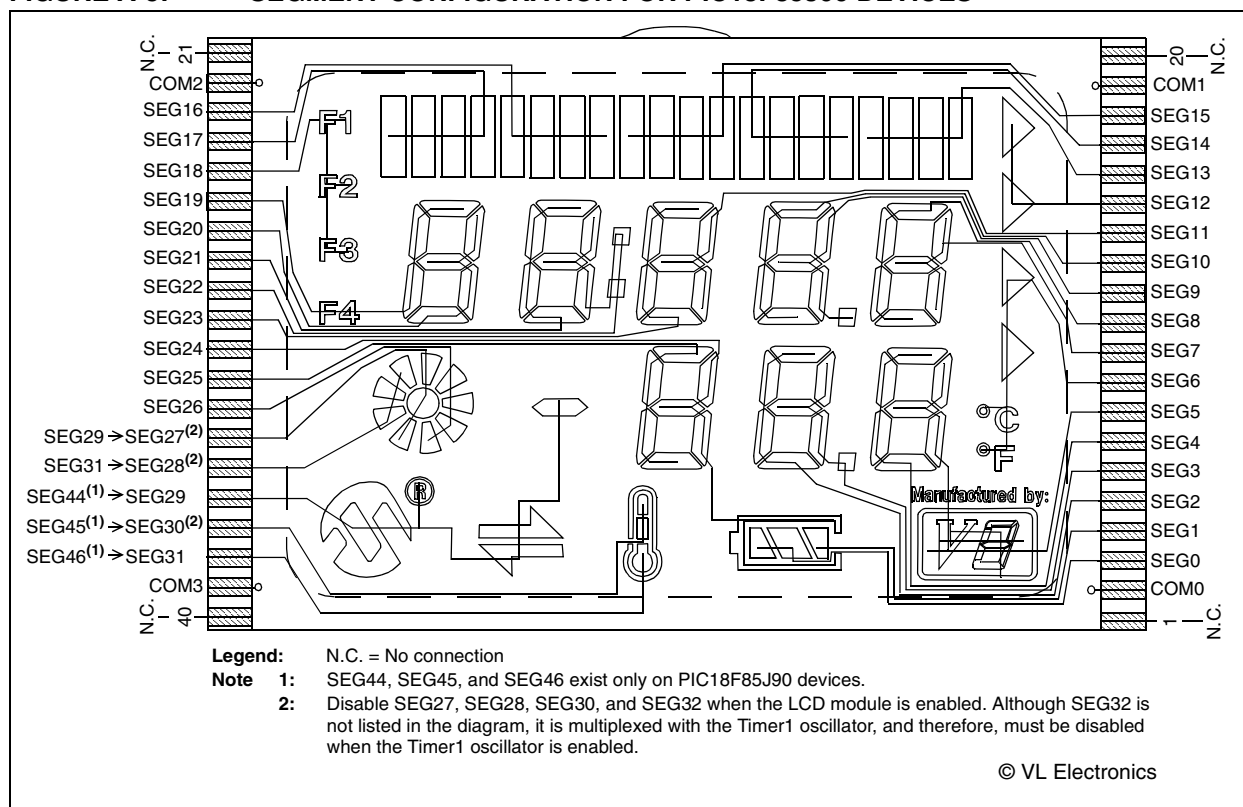


TABLE A-6: PIC18F85J90 PORT AND PIN COMPARISON

| PIC18F85J90 Port | PIC18F85J90 PIN | ICE Pin | ICE Port |
|------------------|-----------------|---------|----------|
| RA0 | AN0 | AN0 | RA0 |
| RA1 | SEG18 | SEG18 | RF0 |
| RA6 | OSC2 | OSC2 | RA6 |
| RA7 | OSC1 | OSC1 | RA7 |
| RB0 | RB0 | RB0 | RB0 |
| RB5 | SEG29 | SEG27 | RG3 |
| RB6 | RB6 | RB6 | RB6 |
| RB7 | RB7 | RB7 | RB7 |
| RC0 | T1OSC1 | T1OSC0 | RC0 |
| RC1 | T1OSC0 | T1OSC1 | RC1 |
| RC3 | SEG17 | SEG17 | RA3 |
| RC4 | SEG16 | SEG16 | RA2 |
| RC6 | TX/CK | TX/CK | RC6 |
| RC7 | RX/DT | RX/DT | RC7 |

Legend: Unshaded cells indicate a perfect match between the PIM and the glass.
Shaded cells indicate the pins that are remapped to the corresponding pin on the PIM.

TABLE A-7: PIC18F8490 PIM AND ICE PORT/PIN COMPARISON

| PIC18F8490 PIM Pin No. | PIC18F8490 Port | PIC18F8490 Pin | ICE Pin | ICE Port | ICE Pin No. | PIC18F8490 PIM Pin No. | PIC18F8490 Port | PIC18F8490 Pin | ICE Pin | ICE Port | ICE Pin No. |
|---------------------------|--------------------|-------------------|---------|-------------|-------------------|---------------------------|--------------------|-------------------|---------|-------------|-------------------|
| 1 | RH2 | SEG45 | SEG45 | RH2 | 12 | 41 | RJ6 | SEG37 | SEG37 | RJ6 | 54 |
| 2 | RH3 | SEG44 | SEG44 | RH3 | 13 | 42 | RJ7 | SEG36 | SEG36 | RJ7 | 55 |
| 3 | LCDBIAS2 | LCDBIAS2 | BIAS2 | RE1 | 14 | 43 | RC2 | SEG13 | SEG13 | RC2 | 56 |
| 4 | LCDBIAS1 | LCDBIAS1 | BIAS1 | RE0 | 15 | 44 | RC3 | RC3 | RC3 | RC3 | 57 |
| 5 | RG0 | SEG30 | SEG30 | RG0 | 16 | 45 | RC4 | RC4 | RC4 | RC4 | 58 |
| 6 | RG1 | SEG29 | SEG29 | RG1 | 17 | 46 | RC5 | SEG12 | SEG12 | RC5 | 59 |
| 7 | RG2 | SEG28 | SEG28 | RG2 | 18 | 47 | RB7 | RB7 | RB7 | RB7 | 60 |
| 8 | RG3 | SEG27 | SEG27 | RG3 | 19 | 48 | VDD | VDD | ICEVDD | VDD | 61 |
| 9 | RG5 | MCLR | ICEMCLR | RG5 | 20 | 49 | RA7 | OSC1 | OSC1 | RA7 | 62 |
| 10 | RG4 | SEG26 | SEG26 | RG4 | 21 | 50 | RA6 | OSC2 | OSC2 | RA6 | 63 |
| 11 | VSS | VSS | VSS | VSS | 23 | 51 | VSS | VSS | VSS | VSS | 65 |
| 12 | VDD | VDD | ICEVDD | VDD | 24 | 52 | RB6 | RB6 | RB6 | RB6 | 66 |
| 13 | RF7 | SEG25 | SEG25 | RF7 | 25 | 53 | RB5 | RB5 | RB5 | RB5 | 67 |
| 14 | RF6 | SEG24 | SEG24 | RF6 | 26 | 54 | RB4 | SEG11 | SEG11 | RB4 | 68 |
| 15 | RF5 | SEG23 | SEG23 | RF5 | 27 | 55 | RB3 | SEG10 | SEG10 | RB3 | 69 |
| 16 | RF4 | SEG22 | SEG22 | RF4 | 28 | 56 | RB2 | SEG9 | SEG9 | RB2 | 70 |
| 17 | RF3 | SEG21 | SEG21 | RF3 | 29 | 57 | RB1 | SEG8 | SEG8 | RB1 | 71 |
| 18 | RF2 | SEG20 | SEG20 | RF2 | 30 | 58 | RB0 | RB0 | RB0 | RB0 | 72 |
| 19 | RH7 | SEG43 | SEG43 | RH7 | 31 | 59 | RJ3 | SEG35 | SEG35 | RJ3 | 73 |
| 20 | RH6 | SEG42 | SEG42 | RH6 | 32 | 60 | RJ2 | SEG34 | SEG34 | RJ2 | 74 |
| 21 | RH5 | SEG41 | SEG41 | RH5 | 33 | 61 | RJ1 | SEG33 | SEG33 | RJ1 | 75 |
| 22 | RH4 | SEG40 | SEG40 | RH4 | 34 | 62 | RJ0 | SEG32 | SEG32 | RJ0 | 76 |
| 23 | RF1 | SEG19 | SEG19 | RF1 | 35 | 63 | RD7 | SEG7 | SEG7 | RD7 | 77 |
| 24 | RF0 | SEG18 | SEG18 | RF0 | 36 | 64 | RD6 | SEG6 | SEG6 | RD6 | 78 |
| 25 | AVDD | AVDD | ICEVDD | AVDD | 37 | 65 | RD5 | SEG5 | SEG5 | RD5 | 79 |
| 26 | AVSS | AVSS | AVSS | AVSS | 38 | 66 | RD4 | SEG4 | SEG4 | RD4 | 80 |
| 27 | RA3 | SEG17 | SEG17 | RA3 | 39 | 67 | RD3 | SEG3 | SEG3 | RD3 | 81 |
| 28 | RA2 | SEG16 | SEG16 | RA2 | 40 | 68 | RD2 | SEG2 | SEG2 | RD2 | 82 |
| 29 | RA1 | AN1 | AN1 | RA1 | 41 | 69 | RD1 | SEG1 | SEG1 | RD1 | 83 |
| 30 | RA0 | AN0 | AN0 | RA0 | 42 | 70 | VSS | VSS | VSS | VSS | 84 |
| 31 | VSS | VSS | VSS | VSS | 44 | 71 | VDD | VDD | VDD | VDD | 2 |
| 32 | VDD | VDD | ICEVDD | VDD | 45 | 72 | RD0 | SEG0 | SEG0 | RD0 | 3 |
| 33 | RA5 | SEG15 | SEG15 | RA5 | 46 | 73 | RE7 | SEG31 | SEG31 | RE7 | 4 |
| 34 | RA4 | SEG14 | SEG14 | RA4 | 47 | 74 | RE6 | COM3 | COM3 | RE6 | 5 |
| 35 | RC1 | TIOSC0 | TIOSC1 | RC1 | 48 | 75 | RE5 | COM2 | COM2 | RE5 | 6 |
| 36 | RC0 | T1OSC1 | T1OSC0 | RC0 | 49 | 76 | RE4 | COM1 | COM1 | RE4 | 7 |
| 37 | RC6 | TX/CK | TX/CK | RC6 | 50 | 77 | COM0 | COM0 | COM0 | RE3 | 8 |
| 38 | RC7 | RX/DT | RX/DT | RC7 | 51 | 78 | LCDBIAS3 | LCDBIAS3 | BIAS3 | RE2 | 9 |
| 39 | RJ4 | SEG39 | SEG39 | RJ4 | 52 | 79 | RH0 | SEG47 | SEG47 | RH0 | 10 |
| 40 | RJ5 | SEG38 | SEG38 | RJ5 | 53 | 80 | RH1 | SEG46 | SEG46 | RH1 | 11 |

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TABLE A-8: PIC18F8490 LCD CONNECTIONS COMPARISON

| PIC18F8490 | ICE | Pin # | | | | Pin # | ICE | PIC18F8490 |
|------------|-------|-------|-----------------|--|-----------------|-------|-------|------------|
| | NC | 21 | NC | | NC | 20 | NC | |
| COM2 | COM2 | 22 | COM3 | | COM2 | 19 | COM1 | COM1 |
| SEG16 | SEG16 | 23 | X8,X6,X5,X7 | | X9,X11,X12,X10 | 18 | SEG15 | SEG15 |
| SEG17 | SEG17 | 24 | X1,X3,X4,X2 | | X16,X14,X13,X15 | 17 | SEG14 | SEG14 |
| SEG18 | SEG18 | 25 | -,F2,F1,F3 | | X17,X19,X20,X18 | 16 | SEG13 | SEG13 |
| SEG19 | SEG19 | 26 | 1A,1E,F4,1F | | -,X22,X21,- | 15 | SEG12 | SEG12 |
| SEG20 | SEG20 | 27 | 1B,1C,1D,1G | | 3B,3C,-,3G | 14 | SEG11 | SEG11 |
| SEG21 | SEG21 | 28 | 2A,2E,2D,2F | | 4A,4E,4D,4F | 13 | SEG10 | SEG10 |
| SEG22 | SEG22 | 29 | 2B,2C,COL,2G | | 4B,4C,DP1,4G | 12 | SEG9 | SEG9 |
| SEG23 | SEG23 | 30 | 3A,3E,3D,3F | | 5A,5E,5D,5F | 11 | SEG8 | SEG8 |
| SEG24 | SEG24 | 31 | S9,6G,6B,6C | | 5B,5C,-,5G | 10 | SEG7 | SEG7 |
| SEG25 | SEG25 | 32 | 6D,6F,6A,6E | | X23,X25,X26,X24 | 9 | SEG6 | SEG6 |
| SEG26 | SEG26 | 33 | X31,X33,X34,X32 | | S13,8G,8B,8C | 8 | SEG5 | SEG5 |
| SEG27 | SEG27 | 34 | -,X27,X35,X30 | | 8D,8F,8A,8E | 7 | SEG4 | SEG4 |
| SEG28 | SEG28 | 35 | -,X28,X36,X29 | | DP2,7G,7B,7C | 6 | SEG3 | SEG3 |
| SEG29 | SEG29 | 36 | S1,S3,S4,S2 | | 7D,7F,7A,7E | 5 | SEG2 | SEG2 |
| SEG30 | SEG30 | 37 | S6,-,S7 | | S11,-,- | 4 | SEG1 | SEG1 |
| SEG31 | SEG31 | 38 | S5,-,S8 | | S12,-,-,S10 | 3 | SEG0 | SEG0 |
| COM3 | COM3 | 39 | COM4 | | COM1 | 2 | COM0 | COM0 |
| | NC | 40 | NC | | NC | 1 | NC | |

FIGURE A-6: SEGMENT CONFIGURATION FOR PIC18F8490 DEVICES

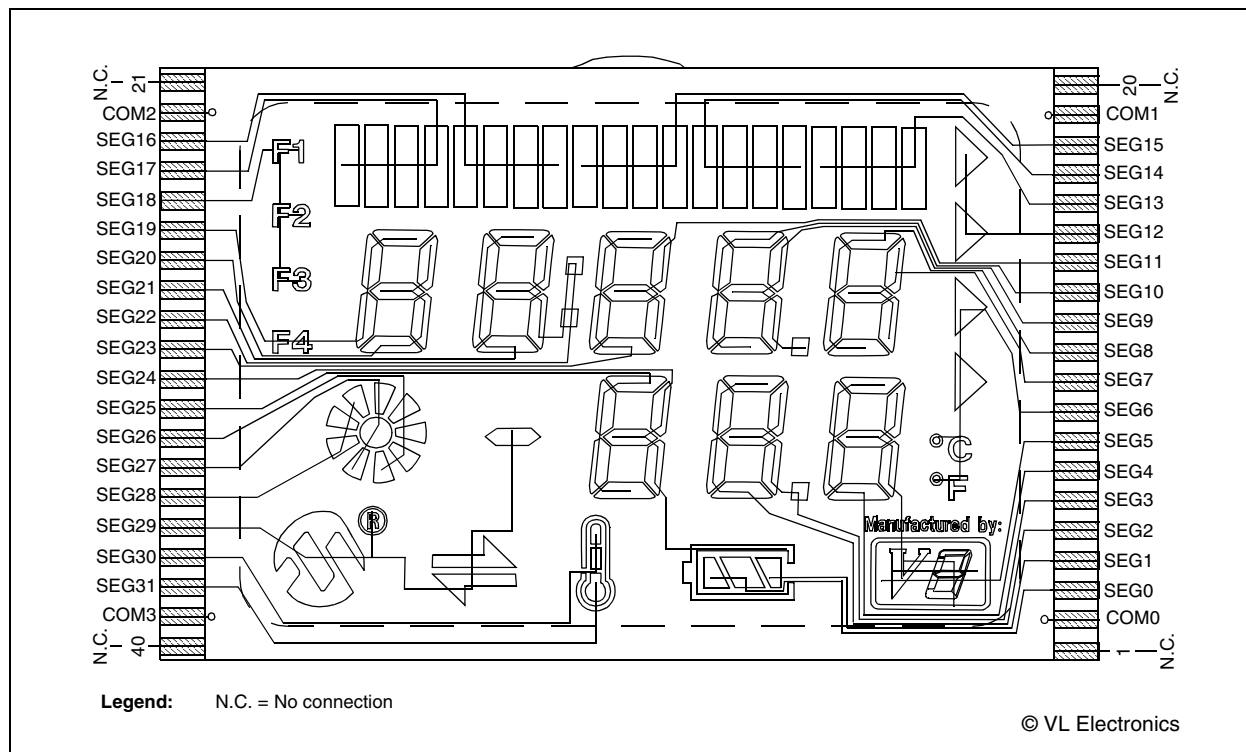


TABLE A-9: PIC18F8490 PIN AND PORT COMPARISON

| PIC18F8490 Port | PIC18F8490 Pin | ICE Pin | ICE Port |
|-----------------|----------------|---------|----------|
| RA0 | AN0 | AN0 | RA0 |
| RA1 | AN1 | AN1 | RA1 |
| RA6 | OSC2 | OSC2 | RA6 |
| RA7 | OSC1 | OSC1 | RA7 |
| RB0 | RB0 | RB0 | RB0 |
| RB5 | RB5 | RB5 | RB5 |
| RB6 | RB6 | RB6 | RB6 |
| RB7 | RB7 | RB7 | RB7 |
| RC0 | T1OSC1 | T1OSC0 | RC0 |
| RC1 | T1OSC0 | T1OSC1 | RC1 |
| RC3 | RC3 | RC3 | RC3 |
| RC4 | RC4 | RC4 | RC4 |
| RC6 | TX/CK | TX/CK | RC6 |
| RC7 | RX/DT | RX/DT | RC7 |

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TABLE A-10: PIC16F946 PIM AND ICE PIN/PORT COMPARISON

| PIC16F946 PIM Pin No. | PIC16F946 Port | PIC16F946 Pin | ICE Pin | ICE Port | ICE Pin No. | PIC16F946 PIM Pin No. | PIC16F946 Port | PIC16F946 Pin | ICE Pin | ICE Port | ICE Pin No. |
|-----------------------------|-------------------|------------------|---------|----------|-------------------|-----------------------------|-------------------|------------------|-----------|----------------|-------------------|
| 1 | RD6 | SEG19 | SEG19 | RF1 | 35 | 33 | RE0 | SEG21 | SEG21 | RF3 | 29 |
| 2 | RD7 | SEG20 | SEG20 | RF2 | 30 | 34 | RE1 | SEG22 | SEG22 | RF4 | 28 |
| 3 | RG0 | SEG36 | SEG36 | RB1 | 71 | 35 | RE2 | SEG23 | SEG23 | RF5 | 27 |
| 4 | RG1 | SEG37 | SEG37 | RB2 | 70 | 36 | ICEMCLR | ICEMCLR | ICEMCLR | ICEMCLR | 20 |
| 5 | RG2 | SEG38 | SEG38 | RJ5 | 53 | 37 | RE4 | SEG24 | SEG24 | RF6 | 26 |
| 6 | RG3 | SEG39 | SEG39 | RJ4 | 52 | 38 | ICEVDD | ICEVDD | ICEVDD | ICEVDD | 61 |
| 7 | RG4 | SEG40 | SEG40 | RH4 | 34 | 39 | RA7 | T1OSCI | T1OSCI | RC1 | 48 |
| 8 | RG5 | SEG41 | SEG41 | RH5 | 33 | 40 | RA6 | T1OSCO | T1OSCO | RC0 | 49 |
| 9 | Vss | Vss | Vss | Vss | 23 | 41 | Vss | Vss | Vss | Vss | 65 |
| 10 | VDD | VDD | ICEVDD | ICEVDD | 24 | 42 | RE5 | SEG25 | SEG25 | RF7 | 25 |
| 11 | RF0 | SEG32 | SEG32 | RJ0 | 76 | 43 | RE6 | SEG26 | SEG26 | RG4 | 21 |
| 12 | RF1 | SEG33 | SEG33 | RD0 | 3 | 44 | RE7 | SEG27 | SEG27 | RG3 | 19 |
| 13 | RF2 | SEG34 | SEG34 | RD6 | 78 | 45 | RE4 | SEG28 | SEG28 | RG2 | 18 |
| 14 | RF3 | SEG35 | SEG35 | RD7 | 77 | 46 | RF5 | SEG29 | SEG29 | RG1 | 17 |
| 15 | RB0 | RB0 | RB0 | RB0 | 72 | 47 | RF6 | SEG30 | SEG30 | RG0 | 16 |
| 16 | RB1 | SEG1 | SEG1 | RD1 | 83 | 48 | RF7 | SEG31 | SEG31 | RE7 | 4 |
| 17 | RB2 | SEG2 | SEG2 | RD2 | 82 | 49 | RC0 | VLCD1 | BIAS1 | RE0 | 15 |
| 18 | RB3 | SEG3 | SEG3 | RD3 | 81 | 50 | RC1 | VLCD2 | BIAS2 | RE1 | 14 |
| 19 | VDD | VDD | ICEVDD | ICEVDD | 37 | 51 | RC2 | VLCD3 | BIAS3 | RE2 | 9 |
| 20 | Vss | Vss | Vss | AVss | 38 | 52 | RC3 | RC3 | VLCAP1 | RC3 | 57 |
| 21 | RB4 | COM0 | COM0 | RE3 | 8 | 53 | RD0 | COM3 | COM3 | RE6 | 5 |
| 22 | RB5 | COM1 | COM1 | RE4 | 7 | 54 | RD1 | NC | NC | | |
| 23 | RB6 | RB6 | RB6 | RB6 | 66 | 55 | RD2 | NC | NC | | |
| 24 | RB7 | RB7 | RB7 | RB7 | 60 | 56 | Vss | Vss | Vss | Vss | 1 |
| 25 | AVDD | AVDD | ICEVDD | ICEVDD | 45 | 57 | VDD | VDD | VDD | VDD | 2 |
| 26 | AVss | AVss | AVss | AVss | 44 | 58 | RD3 | SEG16 | SEG16 | RA2 | 40 |
| 27 | RA0 | AN0 | AN0 | RA0 | 42 | 59 | RC4 | RC4 | RC4 | VLCAP1\ RC4 | 58 |
| 28 | RA1 | AN1 | AN1 | RA1 | 41 | 60 | RC5 | SEG10 | SEG10 | RB3 | 69 |
| 29 | RA2 | COM2 | COM2 | RE5 | 6 | 61 | RC6 | TX/CK | TX/CK | TX/CK | 50 |
| 30 | RA3 | SEG15 | SEG15 | RA5 | 46 | 62 | RC7 | RX/DT | RX/DT | RX/DT | 51 |
| 31 | RA4 | SEG4 | SEG4 | RD4 | 80 | 63 | RD4 | SEG17 | SEG17 | RA3 | 39 |
| 32 | RA5 | SEG5 | SEG5 | RD5 | 79 | 64 | RD5 | SEG18 | SEG18 | RF0 | 36 |

Legend: Unshaded cells indicate where a perfect match between PIM and ICE pins and ports exists.

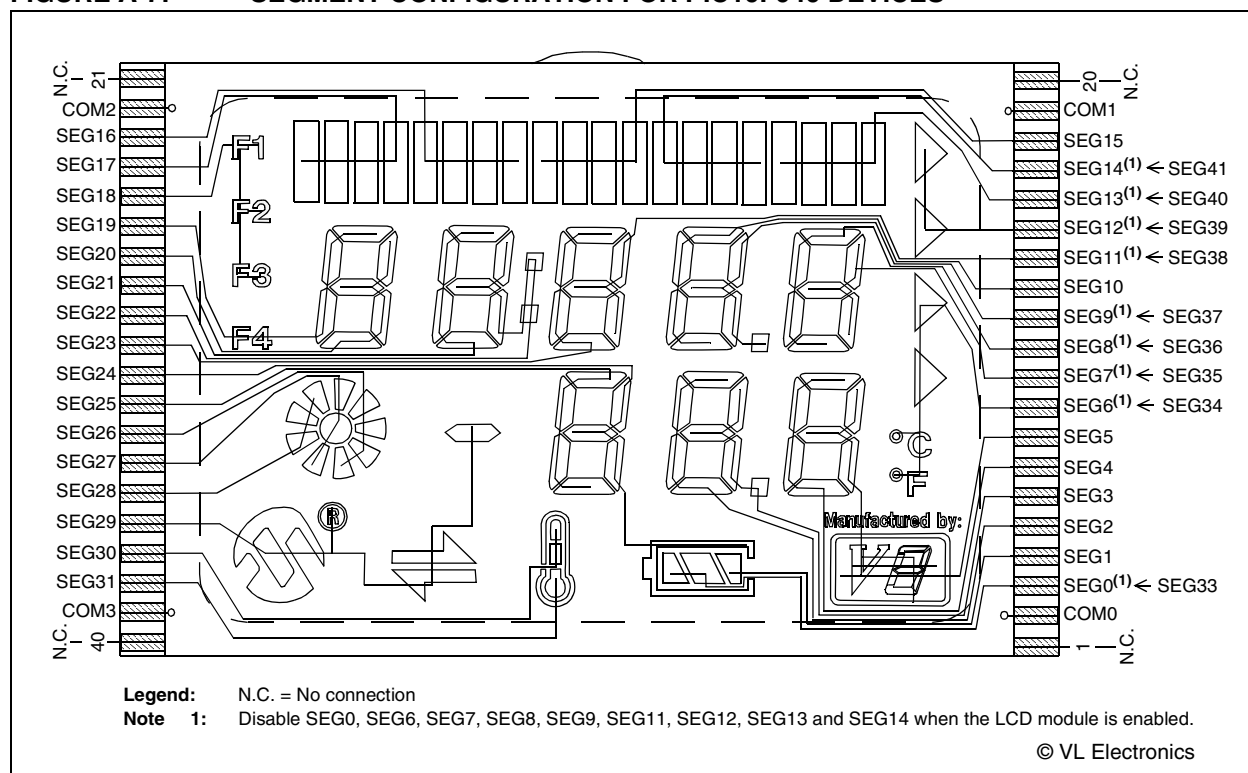
Shaded cells indicate where differences between PIM and ICE ports and pins exist.

Bold text indicates the PIM pins that are not connected to any ICE pins or ports.

TABLE A-11: PIC16F946 LCD CONNECTIONS COMPARISON

| PIC16F946 | ICE | Pin # | | | | Pin # | ICE | PIC16F946 |
|-----------|-------|-------|-----------------|--|-----------------|-------|-------|-----------|
| | NC | 21 | NC | | NC | 20 | NC | |
| COM2 | COM2 | 22 | COM3 | | COM2 | 19 | COM1 | COM1 |
| SEG16 | SEG16 | 23 | X8,X6,X5,X7 | | X9,X11,X12,X10 | 18 | SEG15 | SEG15 |
| SEG17 | SEG17 | 24 | X1,X3,X4,X2 | | X16,X14,X13,X15 | 17 | SEG14 | SEG41 |
| SEG18 | SEG18 | 25 | -,F2,F1,F3 | | X17,X19,X20,X18 | 16 | SEG13 | SEG40 |
| SEG19 | SEG19 | 26 | 1A,1E,F4,1F | | -,X22,X21,- | 15 | SEG12 | SEG39 |
| SEG20 | SEG20 | 27 | 1B,1C,1D,1G | | 3B,3C,-,3G | 14 | SEG11 | SEG38 |
| SEG21 | SEG21 | 28 | 2A,2E,2D,2F | | 4A,4E,4D,4F | 13 | SEG10 | SEG10 |
| SEG22 | SEG22 | 29 | 2B,2C,COL,2G | | 4B,4C,DP1,4G | 12 | SEG9 | SEG37 |
| SEG23 | SEG23 | 30 | 3A,3E,3D,3F | | 5A,5E,5D,5F | 11 | SEG8 | SEG36 |
| SEG24 | SEG24 | 31 | S9,6G,6B,6C | | 5B,5C,-,5G | 10 | SEG7 | SEG35 |
| SEG25 | SEG25 | 32 | 6D,6F,6A,6E | | X23,X25,X26,X24 | 9 | SEG6 | SEG34 |
| SEG26 | SEG26 | 33 | X31,X33,X34,X32 | | S13,8G,8B,8C | 8 | SEG5 | SEG5 |
| SEG27 | SEG27 | 34 | -,X27,X35,X30 | | 8D,8F,8A,8E | 7 | SEG4 | SEG4 |
| SEG28 | SEG28 | 35 | -,X28,X36,X29 | | DP2,7G,7B,7C | 6 | SEG3 | SEG3 |
| SEG29 | SEG29 | 36 | S1,S3,S4,S2 | | 7D,7F,7A,7E | 5 | SEG2 | SEG2 |
| SEG30 | SEG30 | 37 | S6,-,-,S7 | | S11,-,-,- | 4 | SEG1 | SEG1 |
| SEG31 | SEG31 | 38 | S5,-,-S8 | | S12,-,-,S10 | 3 | SEG0 | SEG33 |
| COM3 | COM3 | 39 | COM4 | | COM1 | 2 | COM0 | COM0 |
| | NC | 40 | NC | | NC | 1 | NC | |

Legend: Unshaded cells indicate a perfect match between the PIM and the glass.
Shaded cells indicate the pins that are remapped to the corresponding pin on the PIM.

FIGURE A-7: SEGMENT CONFIGURATION FOR PIC16F946 DEVICES


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TABLE A-12: PIC16F946 PORT AND PIN COMPARISON

| PIC16F946 Port | PIC16F946 Pin | ICE Pin | ICE Port |
|----------------|---------------|---------|----------|
| RA0 | AN0 | AN0 | RA0 |
| RA1 | AN1 | AN1 | RA1 |
| RA6 | T1OSCO | T1OSCO | RC0 |
| RA7 | T1OSCI | T1OSCI | RC1 |
| RB0 | RB0 | RB0 | RB0 |
| RB5 | COM1 | COM1 | RE4 |
| RB6 | RB6 | RB6 | RB6 |
| RB7 | RB7 | RB7 | RB7 |
| RC0 | VLCD1 | BIAS1 | RE0 |
| RC1 | VLCD2 | BIAS2 | RE1 |
| RC3 | RC3 | RC3 | RC3 |
| RC4 | RC4 | RC4 | RC4 |
| RC6 | TX/CK | TX/CK | RC6 |
| RC7 | RX/DT | RX/DT | RC7 |

Legend: Unshaded cells indicate a perfect match between the PIM and the glass.
Shaded cells indicate the pins that are remapped to the corresponding pin/port on the PIM.

TABLE A-13: PIC16F917 PIM AND ICE PIN/PORT COMPARISON

| PIC16F917 PIM Pin No. | PIC16F917 Port | PIC16F917 Pin | ICE Pin | ICE Port | ICE Pin No. |
|--------------------------|-------------------|------------------|---------|----------|-------------|
| 1 | RC7 | RX/DT | RX/DT | RC7 | 51 |
| 2 | RD4 | SEG17 | SEG17 | RA3 | 17 |
| 3 | RD5 | SEG18 | SEG18 | RF0 | 18 |
| 4 | RD6 | SEG19 | SEG19 | RF1 | 19 |
| 5 | RD7 | SEG20 | SEG20 | RF2 | 20 |
| 6 | Vss | Vss | Vss | Vss | Vss |
| 7 | VDD | ICEVDD | ICEVDD | VDD | 45 |
| 8 | RB0 | RB0 | RB0 | RB0 | 72 |
| 9 | RB1 | SEG1 | SEG6 | RD6 | 78 |
| 10 | RB2 | SEG2 | SEG7 | RD7 | 77 |
| 11 | RB3 | SEG3 | SEG8 | RB1 | 71 |
| 14 | RB4 | COM0 | COM0 | RE3 | 8 |
| 15 | RB5 | COM1 | COM1 | RE4 | 7 |
| 16 | RB6 | RB6 | RB6 | RB6 | 66 |
| 17 | RB7 | RB7 | RB7 | RB7 | 60 |
| 18 | ICEMCLR | ICEMCLR | ICEMCLR | ICEMCLR | 20 |
| 19 | RA0 | AN0 | AN0 | RA0 | 42 |
| 20 | RA1 | AN1 | AN1 | RA1 | 41 |
| 21 | RA2 | COM2 | COM2 | RE5 | 6 |
| 22 | RA3 | SEG15 | SEG15 | RA5 | 15 |
| 23 | RA4 | SEG4 | SEG9 | RB2 | 4 |
| 24 | RA5 | SEG5 | SEG10 | RB3 | 5 |
| 25 | RE0 | SEG21 | SEG21 | RF3 | 21 |
| 26 | RE1 | SEG22 | SEG22 | RF4 | 22 |
| 27 | RE2 | SEG23 | SEG23 | RF5 | 23 |
| 28 | VDD | ICEVDD2 | ICEVDD | VDD | 2 |
| 29 | Vss | Vss | Vss | Vss | Vss |
| 30 | RA7 | T1OSCI | T1OSCI | RC1 | 48 |
| 31 | RA6 | T1OSCO | T1OSCO | RC0 | 49 |
| 32 | RC0 | VLCD1 | BIAS1 | RE0 | 15 |
| 35 | RC1 | VLCD2 | BIAS2 | RE1 | 14 |
| 36 | RC2 | VLCD3 | BIAS3 | RE2 | 9 |
| 37 | RC3 | SEG6 | SEG11 | RB4 | 68 |
| 38 | RD0 | COM3 | COM3 | RE6 | 5 |
| 39 | RD1 | RD1 | RC3 | RC3 | 57 |
| 40 | RD2 | RD2 | RC4 | RC4 | 58 |
| 41 | RD3 | SEG16 | SEG16 | RA2 | 16 |
| 42 | RC4 | SEG11 | SEG14 | RA4 | 47 |
| 43 | RC5 | SEG10 | SEG13 | RC2 | 56 |
| 44 | RC6 | TX/CK | TX/CK | RC6 | 50 |

Legend: Unshaded cells indicate where a perfect match between PIM and ICE pins and ports exists.
Shaded cells indicate where differences between PIM and ICE ports and pins exist.
Bold text indicates the PIM pins that are not connected to any ICE pins or ports.

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TABLE A-14: PIC16F917 LCD CONNECTIONS COMPARISON

| PIC16F917 | ICE | Pin # | | | | Pin # | ICE | PIC16F917 |
|-----------|-------|-------|-----------------|--|-----------------|-------|-------|-----------|
| | NC | 21 | NC | | NC | 20 | NC | |
| COM2 | COM2 | 22 | COM3 | | COM2 | 19 | COM1 | COM1 |
| SEG16 | SEG16 | 23 | X8,X6,X5,X7 | | X9,X11,X12,X10 | 18 | SEG15 | SEG15 |
| SEG17 | SEG17 | 24 | X1,X3,X4,X2 | | X16,X14,X13,X15 | 17 | SEG14 | SEG11 |
| SEG18 | SEG18 | 25 | -,F2,F1,F3 | | X17,X19,X20,X18 | 16 | SEG13 | SEG10 |
| SEG19 | SEG19 | 26 | 1A,1E,F4,1F | | -,X22,X21,- | 15 | SEG12 | NC |
| SEG20 | SEG20 | 27 | 1B,1C,1D,1G | | 3B,3C,-,3G | 14 | SEG11 | SEG6 |
| SEG21 | SEG21 | 28 | 2A,2E,2D,2F | | 4A,4E,4D,4F | 13 | SEG10 | SEG5 |
| SEG22 | SEG22 | 29 | 2B,2C,COL,2G | | 4B,4C,DP1,4G | 12 | SEG9 | SEG4 |
| SEG23 | SEG23 | 30 | 3A,3E,3D,3F | | 5A,5E,5D,5F | 11 | SEG8 | SEG3 |
| NC | SEG24 | 31 | S9,6G,6B,6C | | 5B,5C,-,5G | 10 | SEG7 | SEG2 |
| NC | SEG25 | 32 | 6D,6F,6A,6E | | X23,X25,X26,X24 | 9 | SEG6 | SEG1 |
| NC | SEG26 | 33 | X31,X33,X34,X32 | | S13,8G,8B,8C | 8 | SEG5 | NC |
| NC | SEG27 | 34 | -,X27,X35,X30 | | 8D,8F,8A,8E | 7 | SEG4 | NC |
| NC | SEG28 | 35 | -,X28,X36,X29 | | DP2,7G,7B,7C | 6 | SEG3 | NC |
| NC | SEG29 | 36 | S1,S3,S4,S2 | | 7D,7F,7A,7E | 5 | SEG2 | NC |
| NC | SEG30 | 37 | S6,-,-,S7 | | S11,-,-,- | 4 | SEG1 | NC |
| NC | SEG31 | 38 | S5,-,-,S8 | | S12,-,-,S10 | 3 | SEG0 | NC |
| COM3 | COM3 | 39 | COM4 | | COM1 | 2 | COM0 | COM0 |
| | NC | 40 | NC | | NC | 1 | NC | |

Legend: Unshaded cells indicate a perfect match between the PIM and the glass.
Shaded cells indicate the pins that are remapped to the corresponding pin on the PIM.
Bold text indicates the PIM pins that are not connected.

FIGURE A-8: SEGMENT CONFIGURATION FOR PIC16F914/917 DEVICES

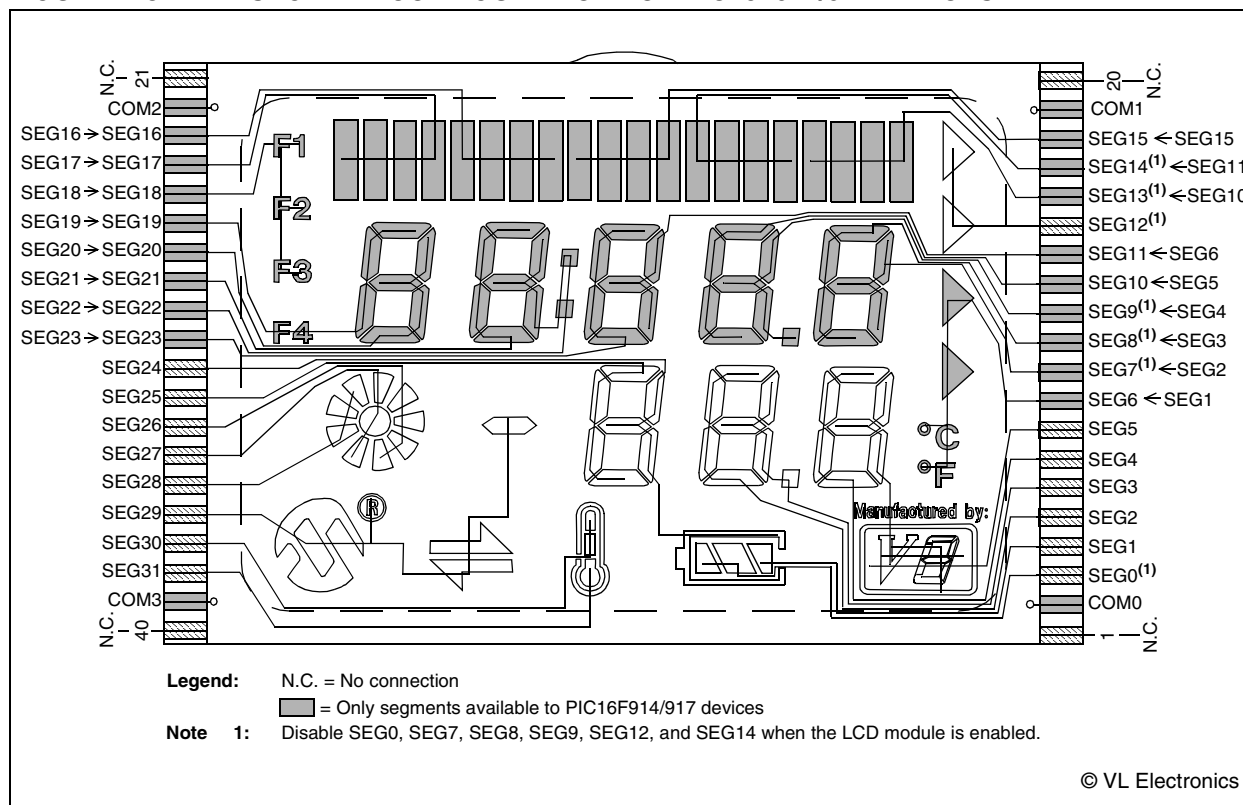


TABLE A-15: PIC16F917 PIN AND PORT COMPARISON

| PIC16F917 Port | PIC16F917 Pin | ICE Pin | ICE Port |
|----------------|---------------|---------|----------|
| RA0 | AN0 | AN0 | RA0 |
| RA1 | AN1 | AN1 | RA1 |
| RA6 | T1OSCO | T1OSCO | RC0 |
| RA7 | T1OSCI | T1OSCI | RC1 |
| RB0 | RB0 | RB0 | RB0 |
| RB5 | COM1 | COM1 | RE4 |
| RB6 | RB6 | RB6 | RB6 |
| RB7 | RB7 | RB7 | RB7 |
| RC0 | VLCD1 | BIAS1 | RE0 |
| RC1 | VLCD2 | BIAS2 | RE1 |
| RC3 | SEG6 | SEG11 | RB4 |
| RC4 | SEG11 | SEG14 | RA4 |
| RC6 | TX/CK | TX/CK | RC6 |
| RC7 | RX/DT | RX/DT | RC7 |

Legend: Unshaded cells indicate a perfect match between the PIM and the glass.
Shaded cells indicate the pins that are remapped to the corresponding pin on the PIM.

A.3 LED DISPLAY

Two green LEDs are connected to RC3 and RC4 of U1A through the J14 pins, 1, 2 and 7, 8 (outer ends), respectively.

One green LED is provided to determine whether there is power to the LCD 2 Demonstration Board (LED on) or not (LED off).

- Note 1:** For the PIC18F85J90 PIM, the RG2 and RG3 pins are connected to RC3 and RC4 of U1A, respectively.
- 2:** For the PIC16F17 PIM, the RD1 and RD2 pins are connected to RC3 and RC4 of U1A, respectively.
- 3:** For the PIC18F8490 PIM, the RC3 and RD4 pins are connected to RC3 and RC4 of U1A, respectively

A.4 CHARGE PUMP AND VLCDP

For charge pump mode operation in PIC18F85J90 devices, it is required that RC3 and RC4 of U1A connect to charge pump capacitor C7 through the J14 pins, 3, 4 and 5, 6 (inner pins), respectively.

A.5 RESISTIVE LADDER VERSUS CHARGE PUMP

The switch, S6, allows the connection of either the resistor ladder or the capacitors to the BIAS pins to generate the BIAS voltages for the LCD operation. For the charge pump mode operation in PIC18F85J90 devices, it is required that the S6 switch is flipped towards C and the VLCDP is connected through the inner jumpers of J14. For the resistor ladder, S6 must be flipped towards R. The R45 potentiometer controls the contrast to the LCD in the Resistive Ladder mode.

A.5.1 Jumper JP21

When jumper JP21 is on, the LCDBIAS0 is physically tied to ground. The jumper needs to be on for PIC18F85J90 devices when the bias voltages are generated through the resistor ladder.

A.6 OSCILLATOR OPTIONS

The on-board firmware uses the internal RC oscillator running at 8 MHz.

- Internal RC oscillator running at 8 MHz can be used.
- Pads provided for user-furnished crystal/resonator (Y2) and two capacitors (C16 and C17).
- Socket provided for a canned oscillator (Y3). This oscillator can be disabled by removing jumpers, JP9, JP11 and JP12.
- 32.768 kHz (watch-type) crystal for Timer1 (Y1) is always connected to RC0 and RC1.

A.7 RS-232 SERIAL PORT

An RS-232 level shifting IC has been provided with all necessary hardware to support connection of an RS-232 host through the DB9 connector (PI). The port is configured as DCE and can be connected to a PC using a serial cable.

A.8 REAL-TIME CLOCK

This circuit allows the user to configure a PIC microcontroller for timekeeping using a 32.768 kHz clock crystal connected to Timer1 module's T1OSO and T1OSI pins.

A.9 SERIAL EEPROM

A socket for a Microwire EEPROM is provided on the board to illustrate usage of the Synchronous mode of operation of the USART module. For its operation:

- Jumpers, JP15 and JP16, should be connected.
- In the jumper, J6, U9-CS should be connected with RB5.
- In the jumper, J13, U9-ORG (pin 6) should be connected to GND.

Note 1: For the PIC18F85J90 PIM, the RG2 and RG3 pins are connected to RC3 and RC4 of U1A, respectively.

2: For the PIC16F917 PIM, the RD1 and RD2 pins are connected to RC3 and RC4 of U1A, respectively.

3: For the PIC18F8490 and the PIC16F946 PIMs, the RC3 and RC4 pins are connected to RC3 and RC4 of U1A, respectively.

A.10 ANALOG INPUT

A 10 kΩ potentiometer is connected through a series of 100Ω resistors to AN0. The potentiometer can be adjusted from VCC to GND. The jumper, J11, should be connecting the potentiometer to AN0.

A.11 TEMPERATURE SENSOR

A 10 k Ω TC thermistor (R11) is provided to sense the temperature. It is connected to AN1 (RA1) through the jumper, JP5. An optional unpopulated TC77-based circuit is provided to read the temperature serially using the USART module. The jumpers, JP15 and JP16, are to be connected and RA1 of U1A should be made digital to be used to enable TC77.

- Note 1:** For the PIC18F85J90 PIM, the RA2 pin is connected to RA1 of U1A and AN2 is used instead of AN1.
- 2:** For the PIC18F8490, PIC16F946, and PIC16F917 PIMs, the RA1 pin is connected to RA1 of U1A.

A.12 SWITCHES

Four switches provide the following functions for digital I/Os:

- S1 – Active-low switch connected to RB6.
- S2 – Active-low switch connected to RB6 and RB7.
- S3 – Active-low switch connected to RB6, RB7 and RA6.
- S4 – Active-low switch connected to RB6, RB7, RA6 and RA7.

For this type of sensing, the jumpers, JP1, JP2, JP6, JP18, JP19, JP9 and JP10, should be connected and the potentiometer should be connected to AN0 through J11. Sensing should be done in the sequence, S1, S2, S3 and S4, only. Individual switch sensing is not allowed.

Additionally, the four switches provide the following functions for analog input (AN0):

- S1 – AN0 will be approximately at $V_{CC}/2$.
- S2 – AN0 will be approximately at $V_{CC}/3$.
- S3 – AN0 will be approximately at $V_{CC}/5.2$.
- S4 – AN0 will be approximately at $V_{CC}/7.7$.

For this type of sensing, the jumpers, JP1, JP2, JP6, JP18 and JP19, should not be connected and the SWT should be connected to AN0 through J11.

A.13 ICD CONNECTOR

By way of the modular connector (J37), the MPLAB ICD 2 can be connected for low-cost debugging. The ICD connector utilizes RB6/PGC and RB7/PGD of the microcontrollers for in-circuit debugging.

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A.14 POWER SUPPLY

There are four ways to supply power to the PICDEM LCD 2:

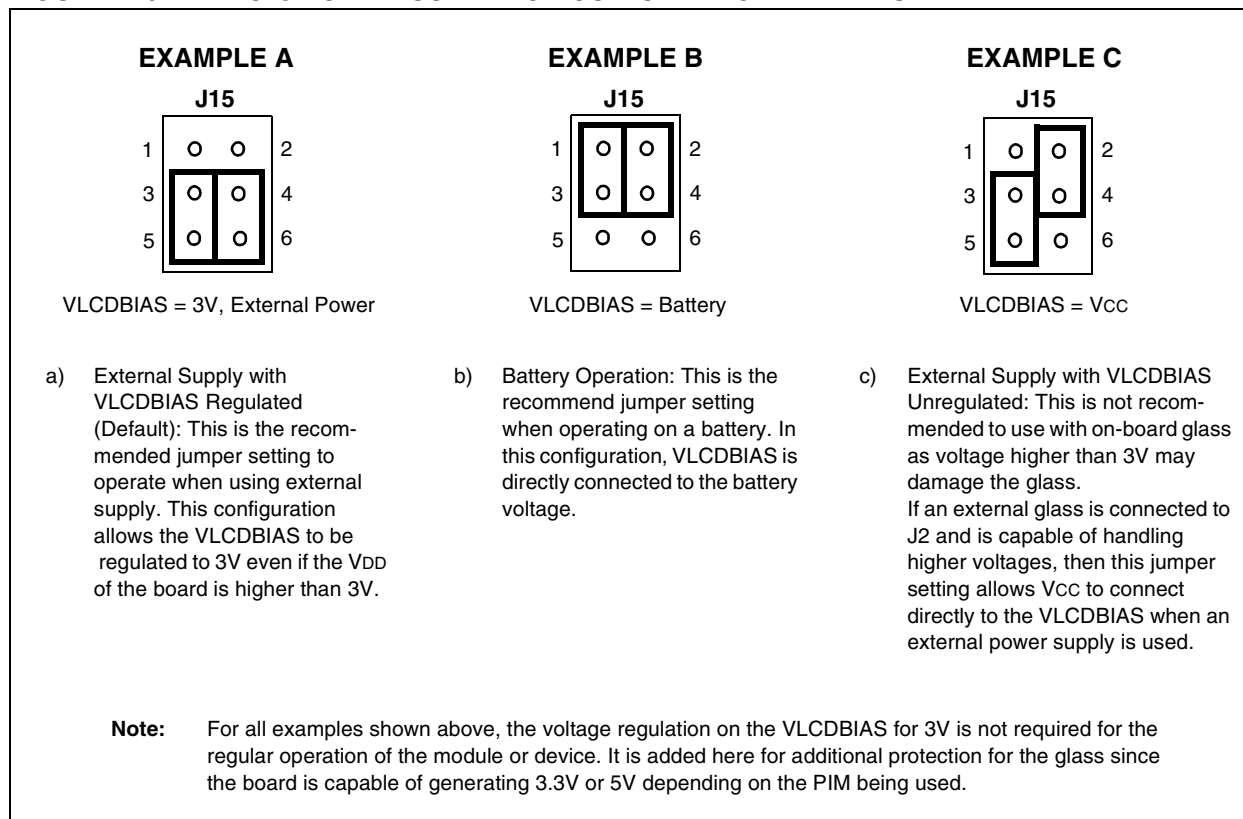
- A 3V button cell (CR2032) can be plugged into BT1.
- A 9V, 100 mA unregulated AC to DC supply can be plugged into J5. A power supply can be purchased through Microchip Technology (Part Number AC162039).
- A 100 mA regulated DC supply of maximum +5V can be connected to the hooks provided.

Note: There is one J15 jumper associated with the power supply circuit. This jumper must be correctly connected to select the required power supply. Refer to Figure A-9 for jumper setting examples.

MPLAB ICD 2 users may use the ICD to power the target board to 5V, up to 200 mA, for the following devices *only*: PIC18F8490, PIC16F946 and PIC16F916. The PIC18F85J90 family of devices do not support this capability.

The default power on the board is 5V. The board voltage can be varied based on resistors populated on the PIM in conjunction with the processor being used.

FIGURE A-9: J15 POWER SUPPLY CIRCUIT SETTING EXAMPLES



A.14.1 Using the Adjustable Voltage Regulator

The PICDEM LCD 2 board features an adjustable voltage regulator, the venerable LM317. It is U3 on the board, and can be recognized by the SO-223 package on the upper left side. Nearby, there is a header, J10, and two resistors, R25 and R26. R25 and R26 are used to set the output voltage of the LM317. By default, R25 = 1K and R26 = 330R, which results in an output voltage of 5.0V.

The reason an adjustable voltage regulator is provided is so that the PICDEM LCD 2 Demonstration Board can be used with a wide range of LCD PIC microcontrollers. The PIC18FXXJ90 family of devices tolerates a maximum VDD of 3.6V, whereas the PIC18FXX90, PIC16F91X and PIC16F946 tolerate a maximum VDD of 5.5V. The adjustable voltage regulator allows a different VDD to be provided for PIC18FJ devices and PIC18F and PIC16F LCD devices.

The switching between 3.6V and 5.5V parts is very convenient. The plug-in module boards are populated with the R101 and R102, appropriately, according to the processor module requirement which mates with the daughterboard/emulator header that surrounds the ICE module (U1A). J10 on the PICDEM LCD 2 board is intended to connect with the 3-pin header on the plug-in module. This allows the resistors, R101 and R102, on the plug-in module to be connected in parallel to the resistors, R25 and R26. This way VDD can automatically be adjusted to the voltage appropriate to the part soldered onto the plug-in module.

The plug-in module is prepopulated with the values shown in Table A-16:

TABLE A-16: PIM PREPOPULATED VALUES

| Module | R101 | R102 | VDD |
|---------------|------|-------|------|
| PIC18F85J90 | Open | 1.18K | 3.3V |
| PIC18F8490 | Open | Open | 5.0V |
| PIC16F914/917 | Open | Open | 5.0V |
| PIC16F946 | Open | Open | 5.0V |

For VDD = 3.3 volts, R101 can be left unpopulated and R102 can be 1.18K. (1% resistors are recommended for precise adjustment of VDD.)

Now, let's look at how to determine R101 and R102 if a different VDD is desired. First, it is a good idea to look at the data sheet for the LM317 to understand how the voltage is adjusted. We won't duplicate all the details here. The following equation is taken from an LM317 data sheet:

EQUATION A-1:

$$V_{OUT} = V_{REF} (1 + R2/R1) + I_{ADJ} * R2$$

IADJ is minimized by the LM317, so it can be assumed to be zero or at least very small. VREF = 1.25V; it is the reference voltage developed by the LM317 between the output and adjustment terminal.

That gives us the following equation:

EQUATION A-2:

$$\begin{aligned} V_{OUT} &= 1.25V(1 + R2/R1) \\ R2 &= R25 \parallel R102 = (R25 * R102) / (R25 + R102) \\ R1 &= R26 \parallel R101 = (R26 * R101) / (R26 + R101) \end{aligned}$$

As stated previously, R25 = 1K and R26 = 330. You can see that without R102 and R101, VOUT = 1.25V(1 + 1K/330R) = 5.04V.

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For a desired V_{OUT} , first solve for R_2 , given $R_1 = R_{26} = 330R$. Then, knowing R_2 and R_{25} , solve for R_{102} . Determine the nearest available resistor value for R_{102} and recalculate the resulting V_{DD} to make sure it doesn't exceed the maximum V_{DD} for the part you will be using.

Table A-17 shows values for R_{101} and R_{102} for different V_{DD} values, assuming that R_{25} and R_{26} on the PICDEM LCD 2 Board are left as their default values of 1K and 330R.

TABLE A-17: R_{101} AND R_{102} V_{DD} VALUES

| V_{DD} | R_{101} | R_{102} |
|----------|-----------|-----------|
| 5V | Open | Open |
| 3.6V | Open | 1.62K |
| 3.3V | Open | 1.18K |
| 3.0V | Open | 866R |

Recommended operating voltages for the various PIMs are:

- PIC18F85J90 family of devices – 3.3V
- PIC18F8490 family of devices – 5V
- PIC16F917/914 devices – 5V
- PIC16F946 – 5V (when operating on an external 9V DC supply)

A.14.2 Slide Switch (S6)

The slide switch allows choosing the BIAS values, either generated by the resistor ladder, or by the capacitive charge pump. When S6 is switched to the left, the LCDBIAS pins of the microcontroller are connected to the resistor ladder. When S6 is switched to the right, the LCDBIAS pins of the microcontroller are connected to the capacitor network.

A.15 BOARD LAYOUT AND SCHEMATICS

The following figures show the parts layout (silkscreen) and schematics for the PICDEM LCD 2 board.

FIGURE A-10: PICDEM™ LCD 2 DEMONSTRATION BOARD PARTS LAYOUT (SILKSCREEN)

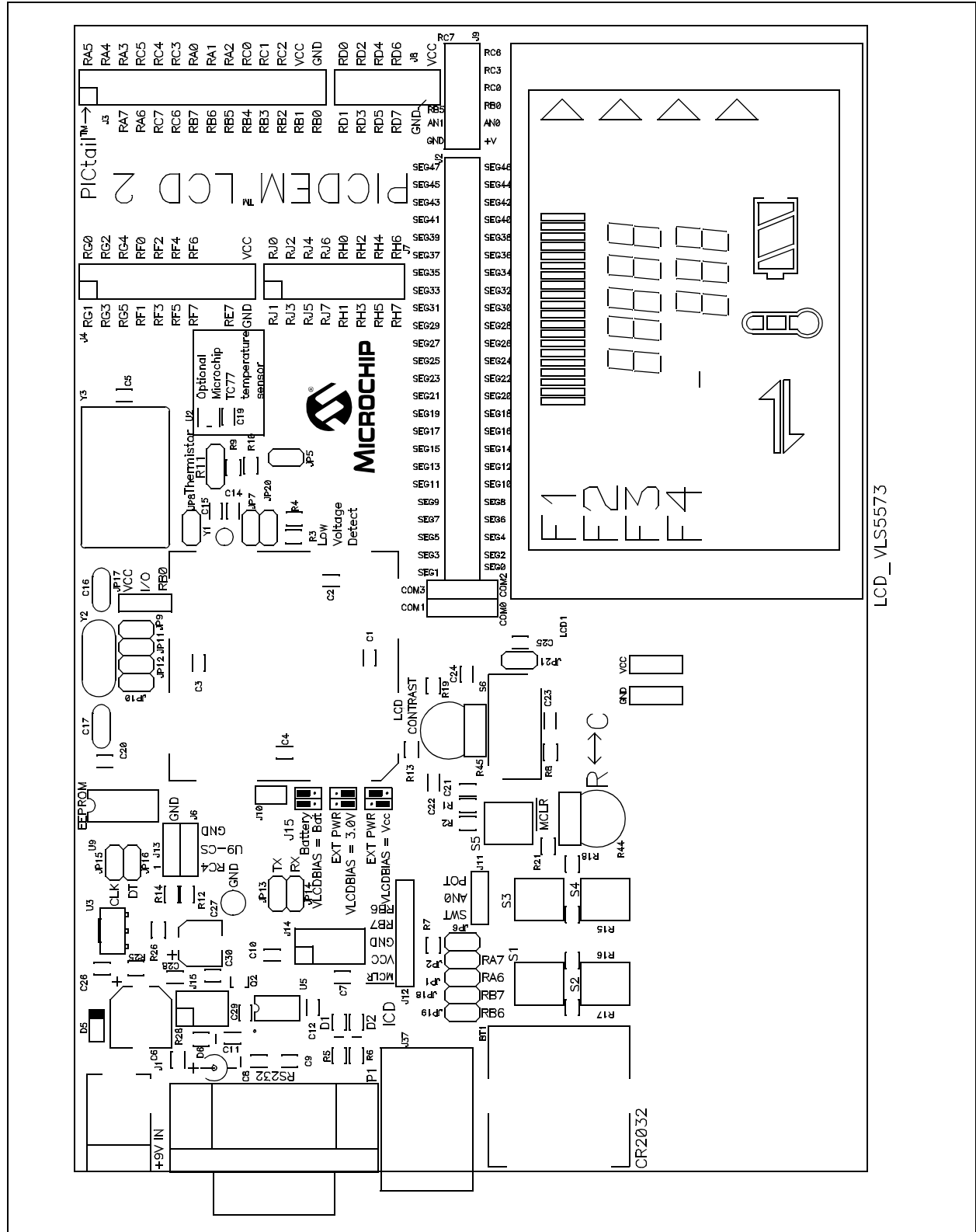
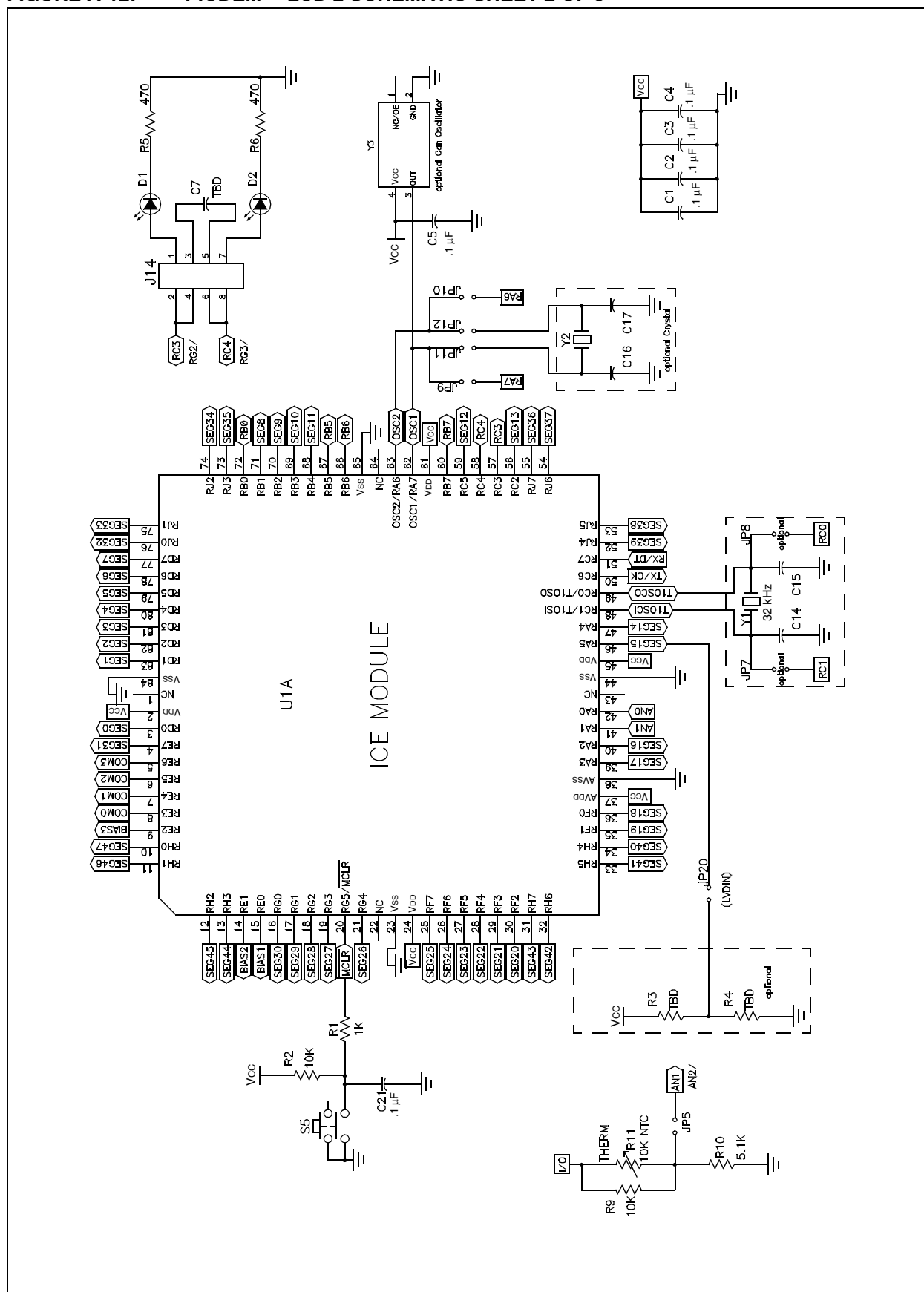


FIGURE A-12: PICDEM™ LCD 2 SCHEMATIC SHEET 2 OF 3



A.16 PIM LAYOUT AND SCHEMATICS

The following figures show the layout (silkscreen) for the individual PIMs.

FIGURE A-14: PIC18F65J90 AND PIC18F85J90 PIM LAYOUT

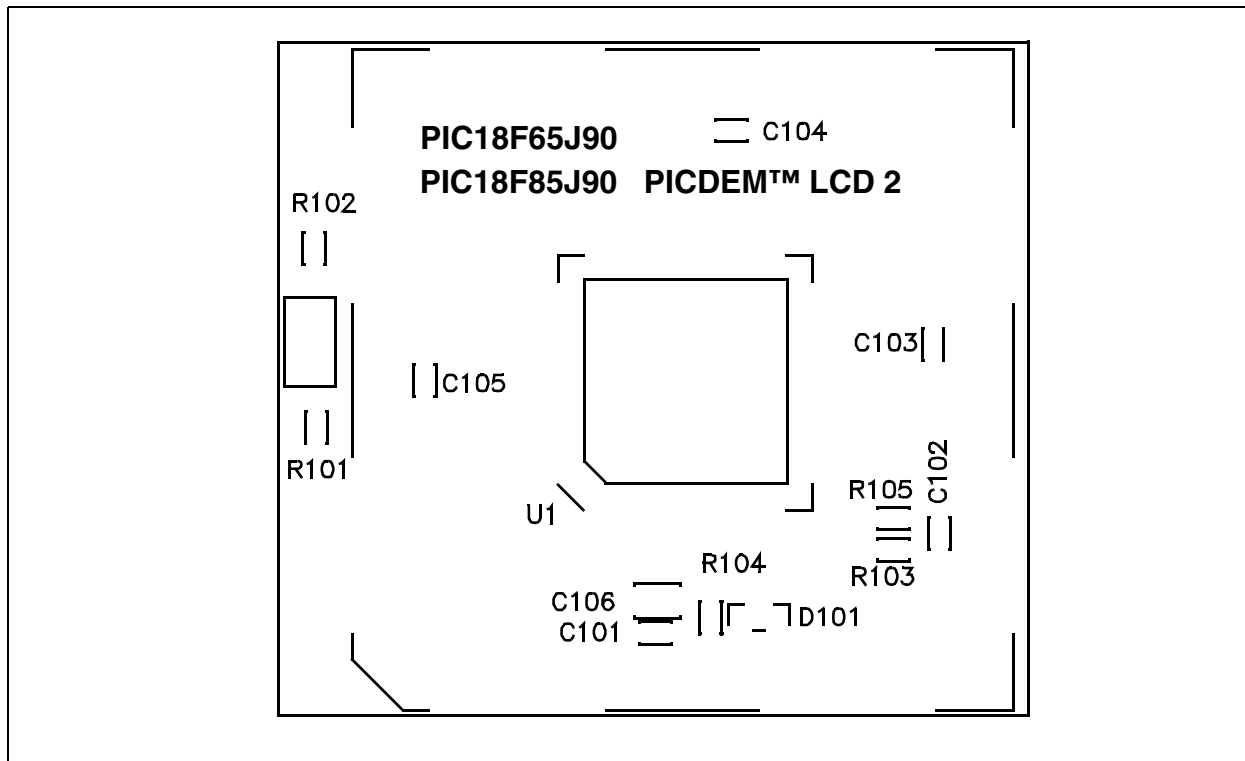
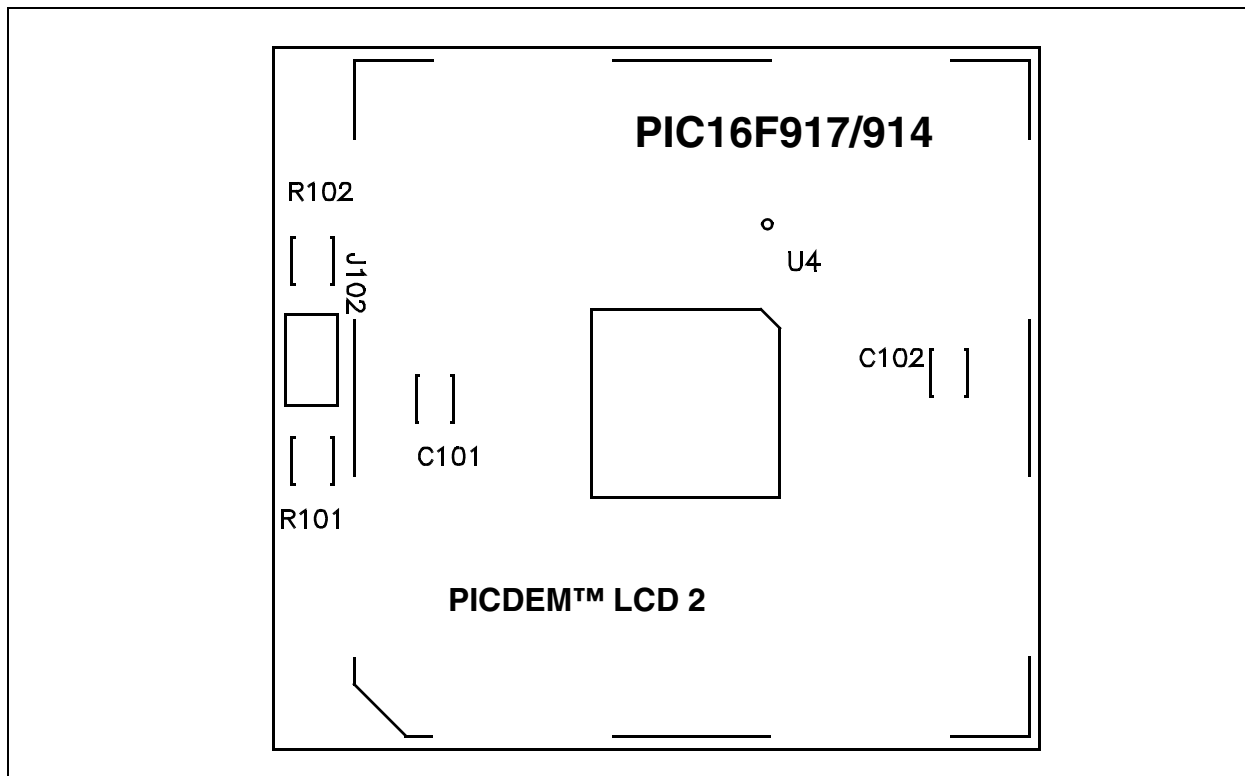


FIGURE A-15: PIC16F914/917 PIM LAYOUT



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FIGURE A-16: PIC16F946 PIM LAYOUT

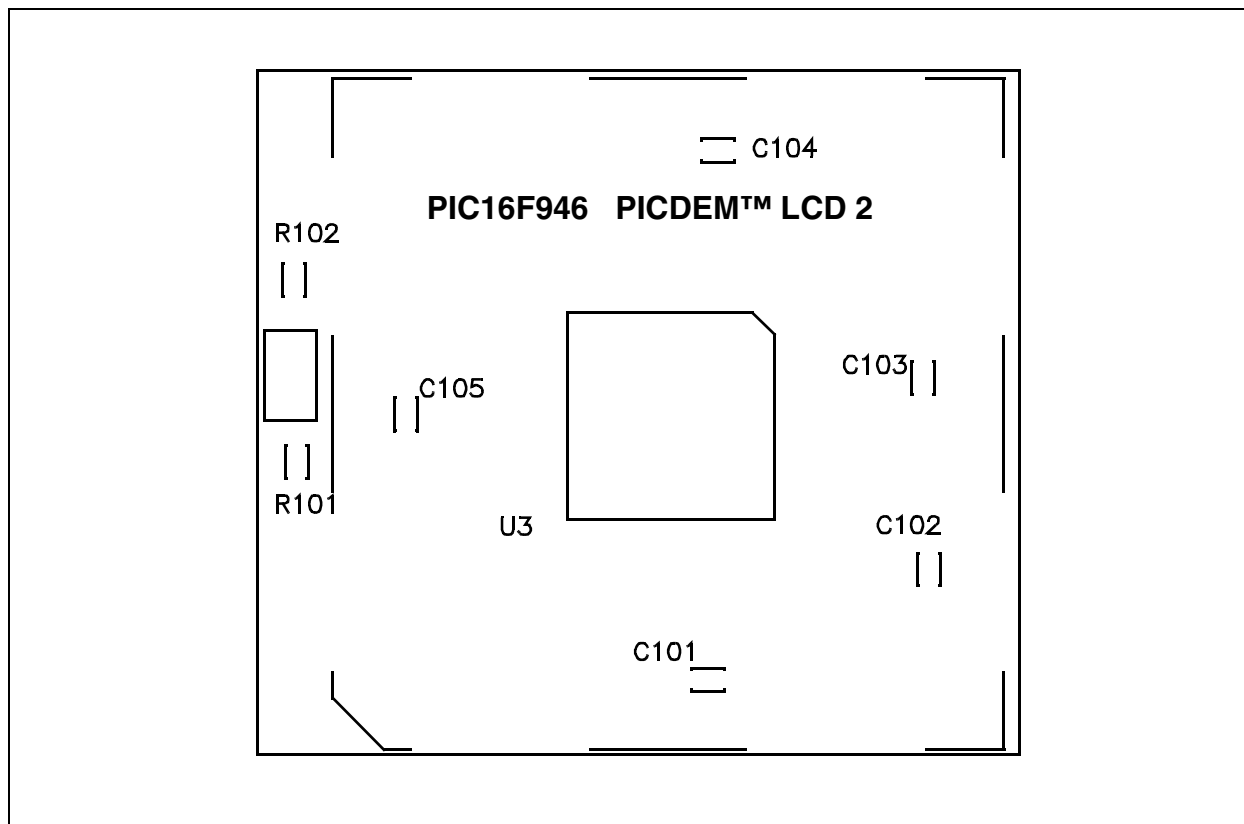


FIGURE A-17: PIC18F6490/8490 PIM LAYOUT

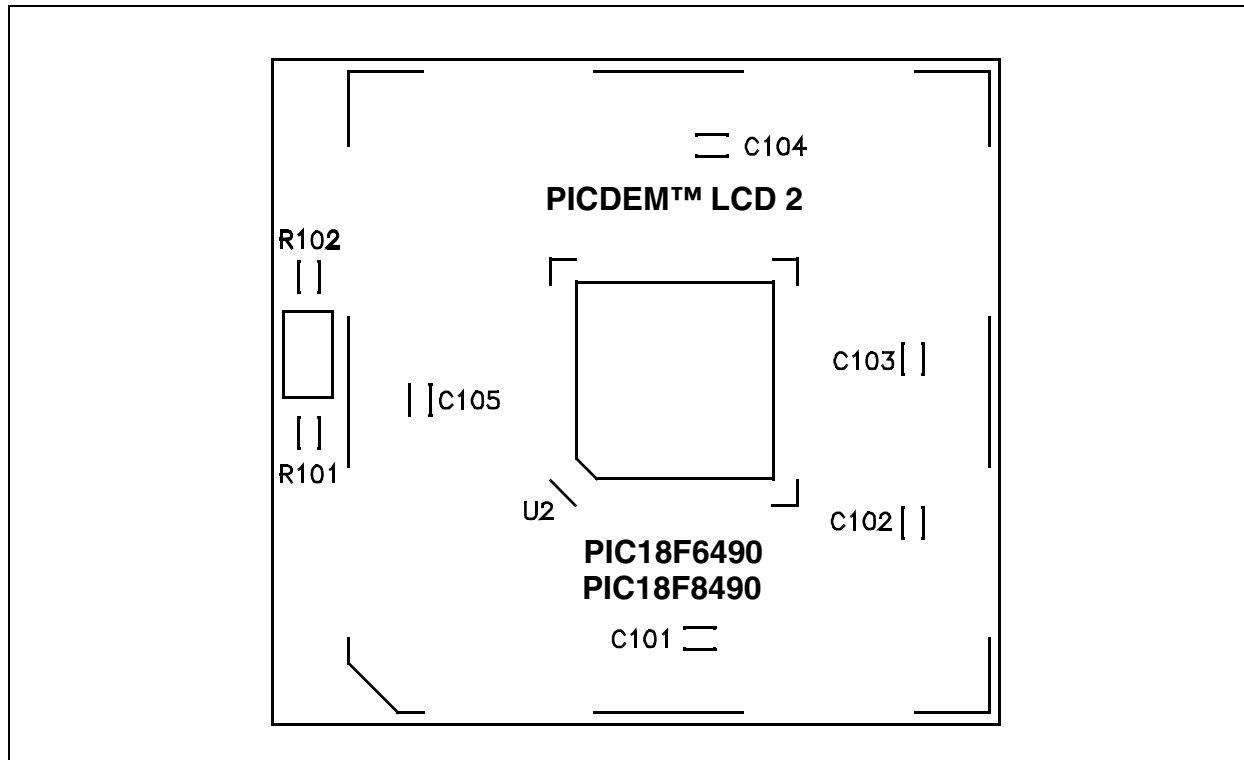


FIGURE A-18: PICDEM™ LCD 2 PIC16F914/917 PIM SCHEMATIC

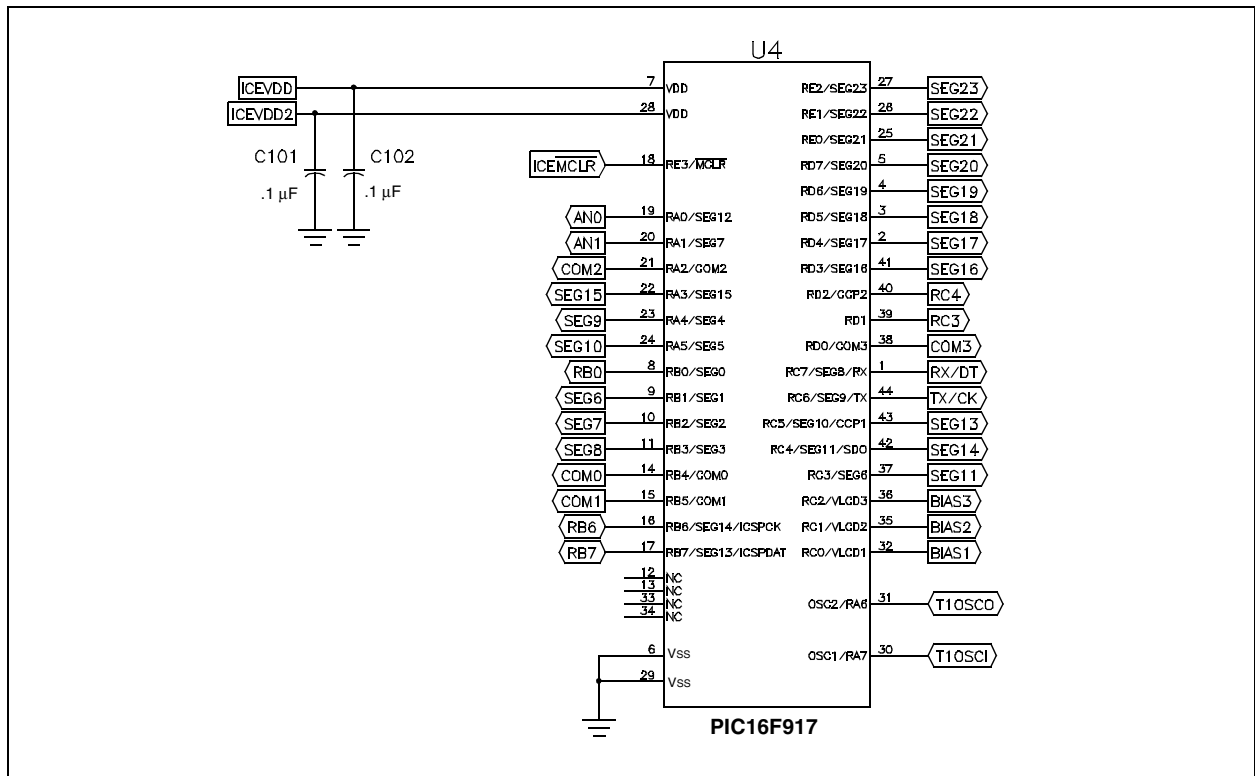
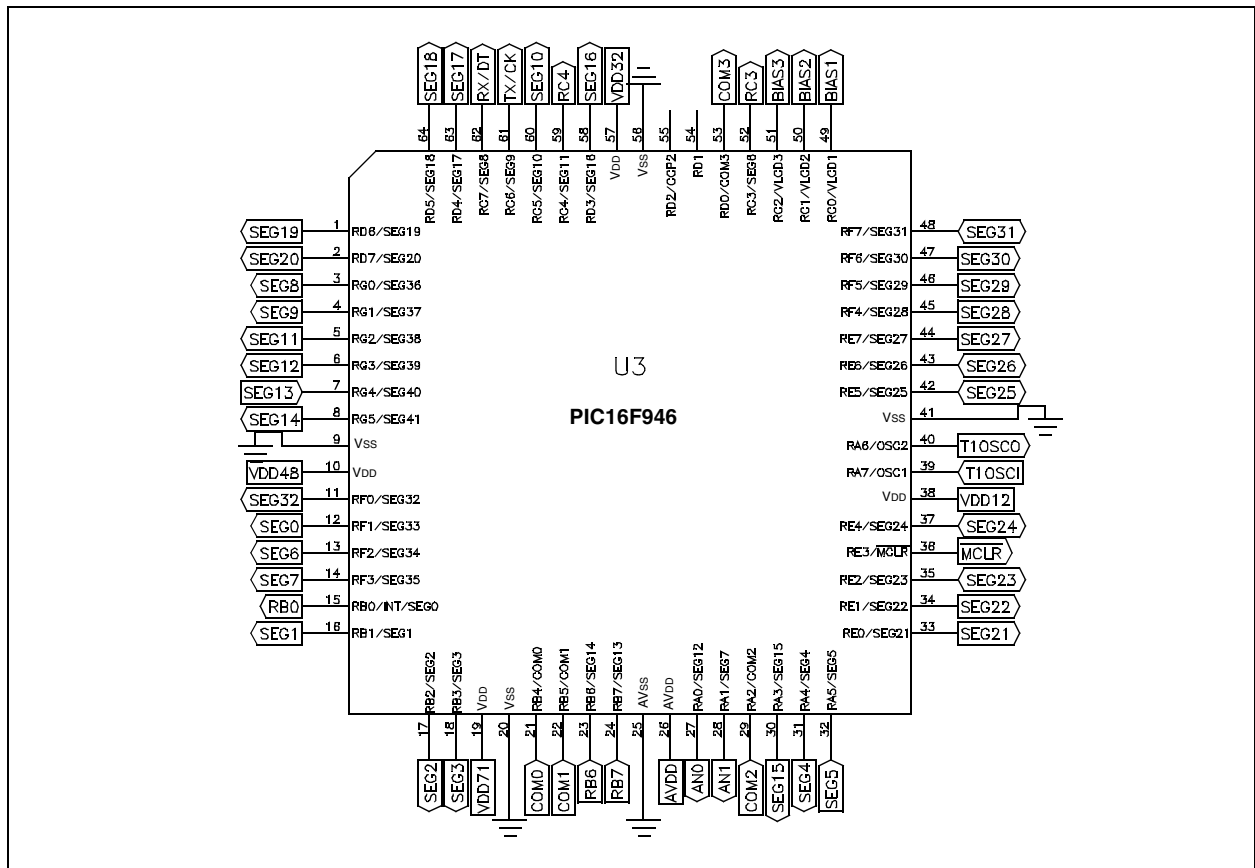


FIGURE A-19: PICDEM™ LCD 2 PIC16F946 PIM SCHEMATIC



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FIGURE A-20: PICDEM™ LCD 2 PIC18F6490 64-PIN PIM SCHEMATIC

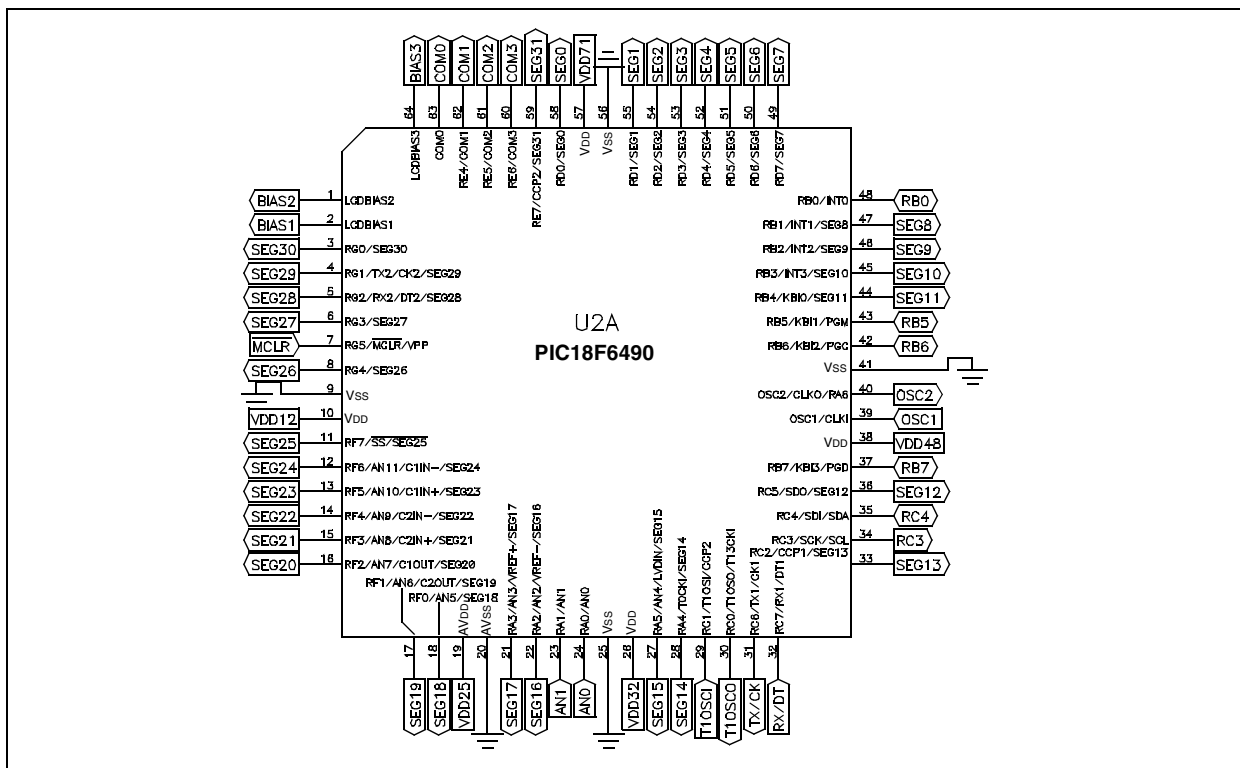


FIGURE A-21: PICDEM™ LCD 2 PIC18F8490 80-PIN PIM SCHEMATIC

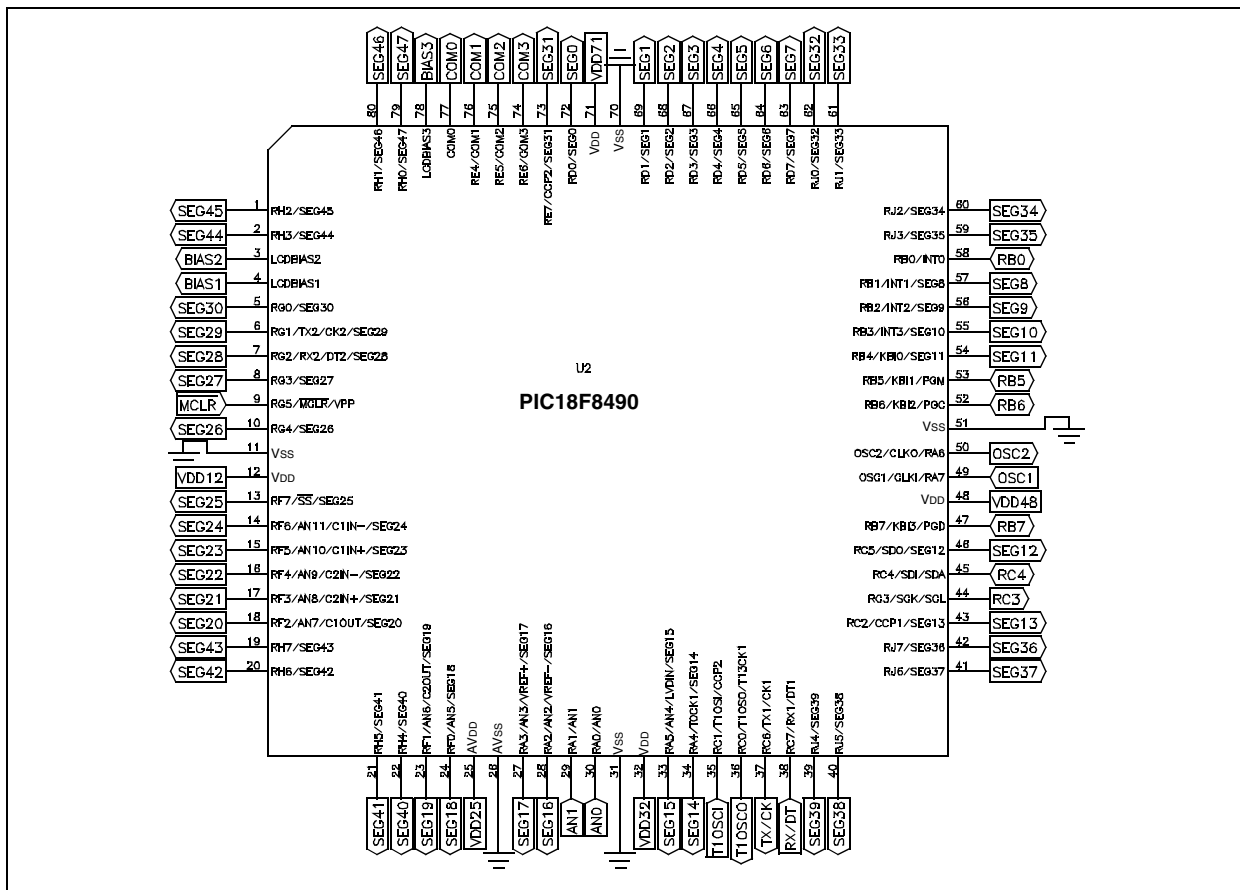
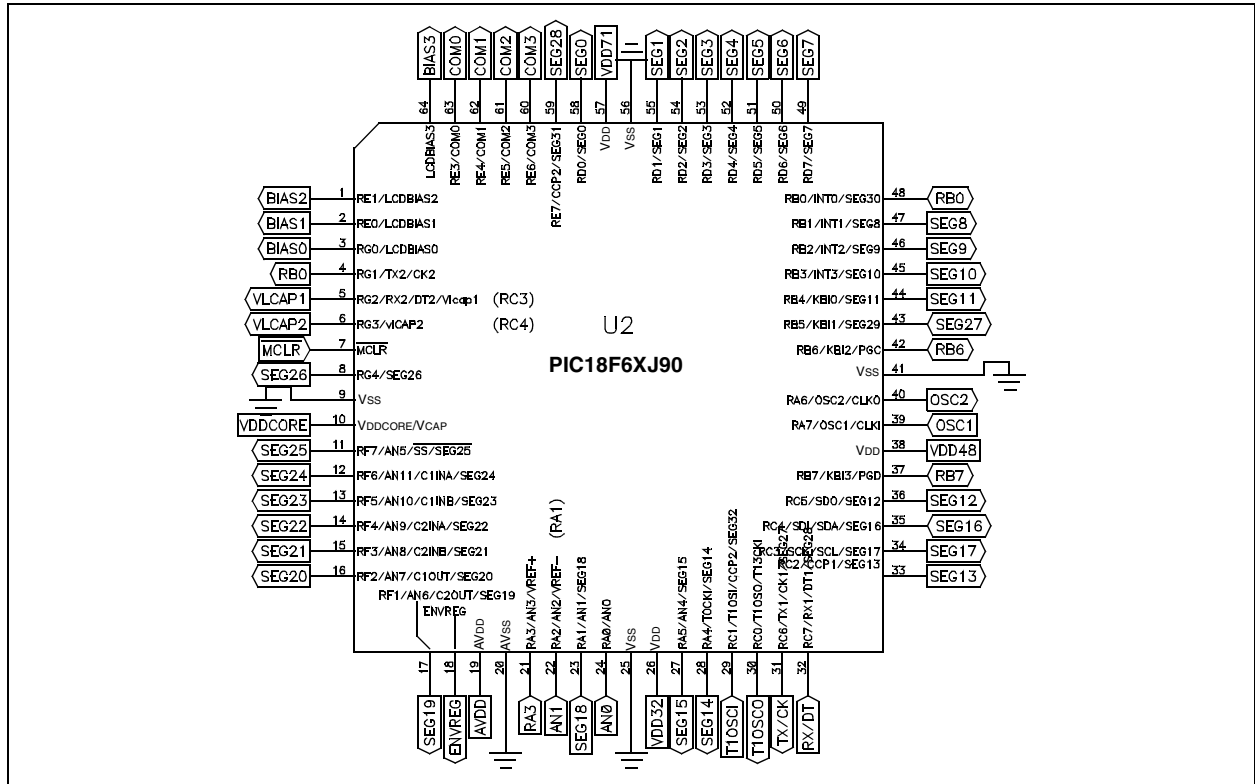
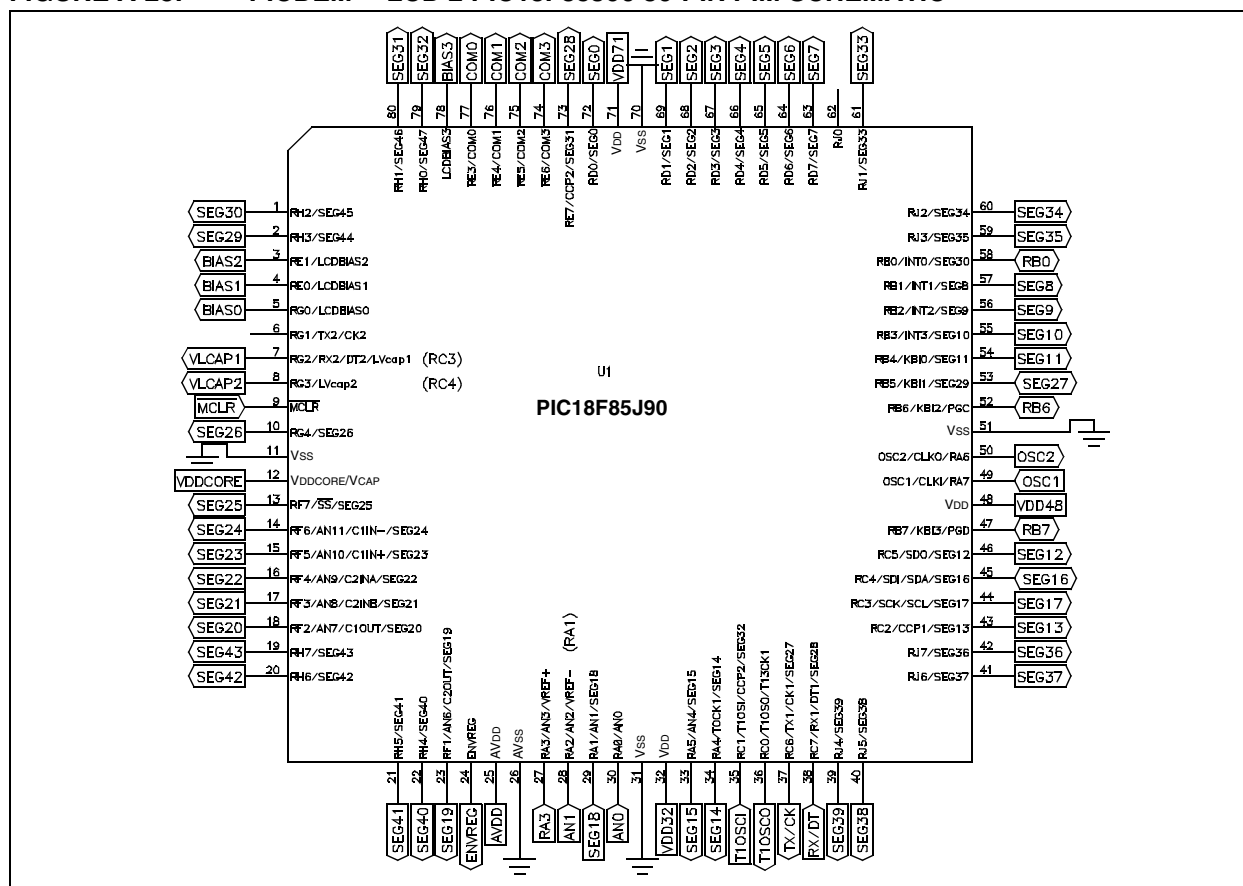


FIGURE A-22: PICDEM™ LCD 2 PIC18F6XJ90 64-PIN PIM SCHEMATIC



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FIGURE A-23: PICDEM™ LCD 2 PIC18F85J90 80-PIN PIM SCHEMATIC



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