PICDEM™ LCD 2 Demonstration Kit User's Guide

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PICDEM™ LCD 2 DEMONSTRATION KIT USER'S GUIDE

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Preface

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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 online 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 Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the 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	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

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WARRANTY REGISTRATION

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in the Warranty Registration Card entitles users to receive new product updates. Interim software releases are available at the Microchip web site.

RECOMMENDED READING

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)
"PIC18F87J90 Family Data Sheet" (DS39933)
"PIC18F6390/6490/8390/8490 Data Sheet" (DS39629)
"PIC16C9XX Data Sheet" (DS30444)
"PIC16C925/926 Data Sheet" (DS39544)
"PIC16F917/916/914/913 Data Sheet" (DS41250)
"PIC16F/LF1946/47 Data Sheet" (DS41414)

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
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- **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® Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB SIM simulator, MPLAB IDE Project Manager and general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 and PRO MATE® II device programmers and the PICSTART® Plus and PICkit™ 1 development programmers.

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- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

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Technical support is available through the web site at: http://support.microchip.com

DOCUMENT REVISION HISTORY

Revision C (November 2010)

- Added device information for the PIC16F/LF1946/7.

NOTES:

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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, PIC16X9XX, and PIC16X19XX 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, PIC18F87J90, PIC18F8490, PIC16F914/917, PIC16F946, and PIC16F/LF1946/47 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, PIC18FXX90, PIC16F9XX, and PIC16X19XX 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 kΩ, 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 kΩ (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 V_{CC} 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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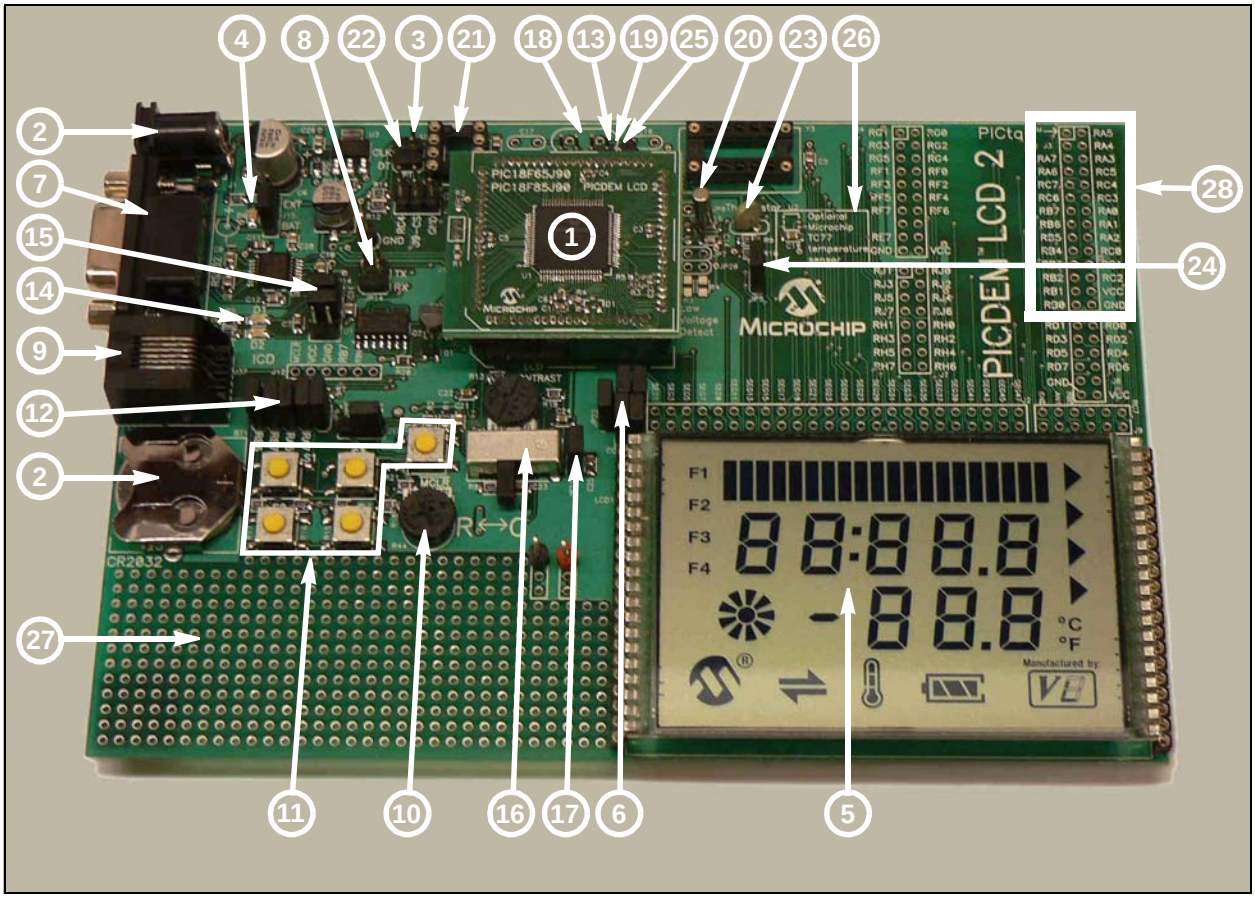
FIGURE 1-1: PICDEM™ LCD 2 HARDWARE



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, PIC18F85J90, PIC18F87J90 and PIC16F/LF1946/47), demo source code, several C and/or `.asm` files and compiled code (one HEX file) are provided.

NOTES:

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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.

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.

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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 and PIC18F87J90 families 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

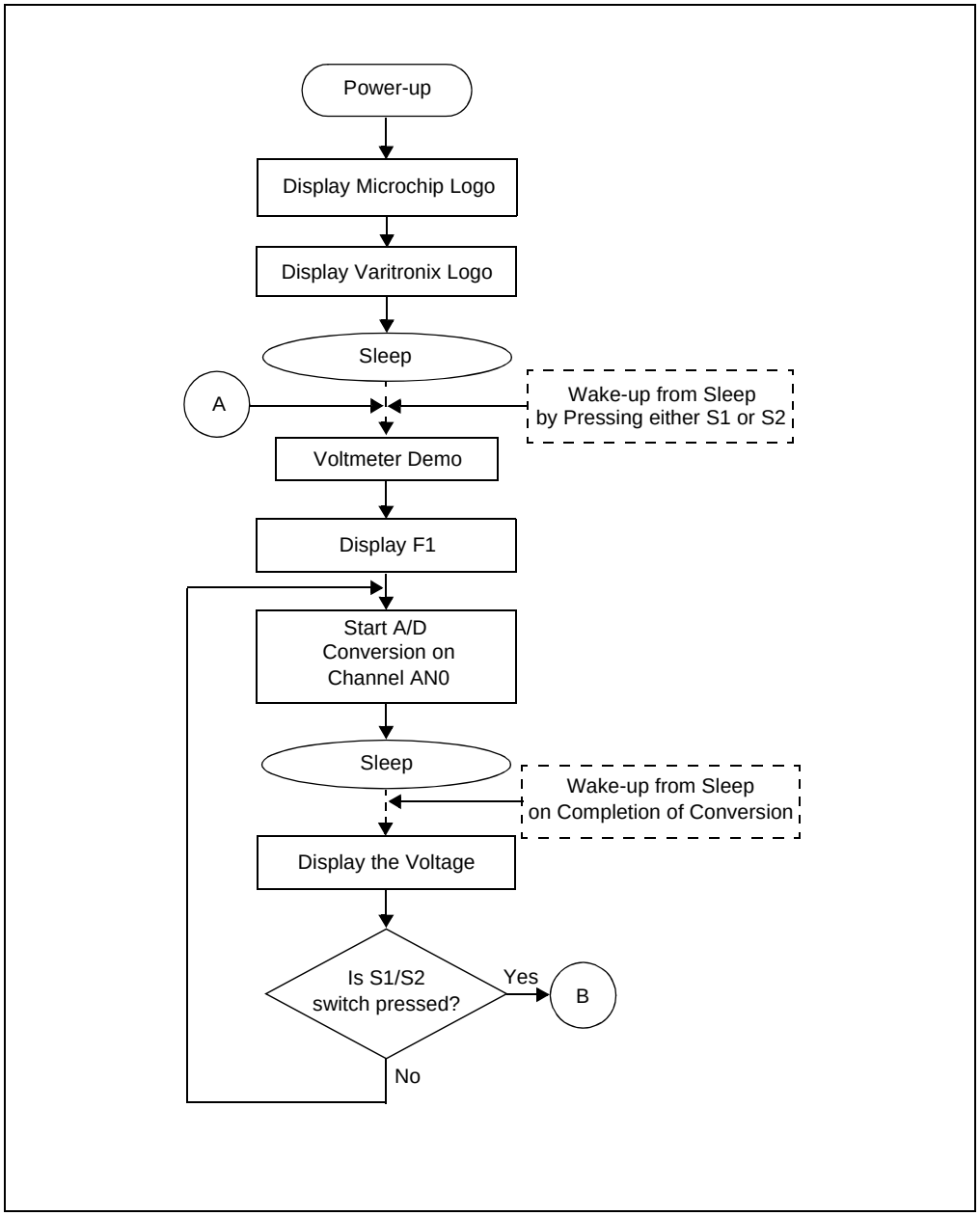

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FIGURE 3-2: DEMO PROGRAM FLOWCHART

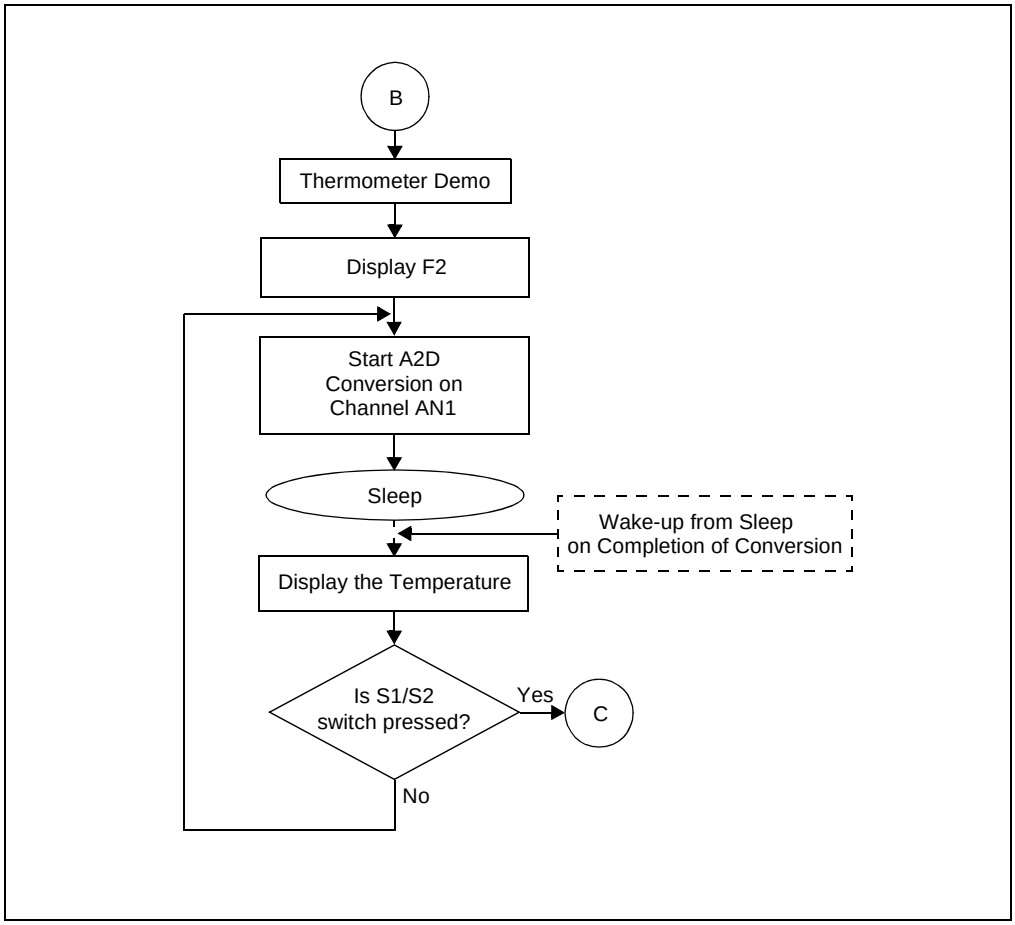

FIGURE 3-3: DEMO PROGRAM FLOWCHART

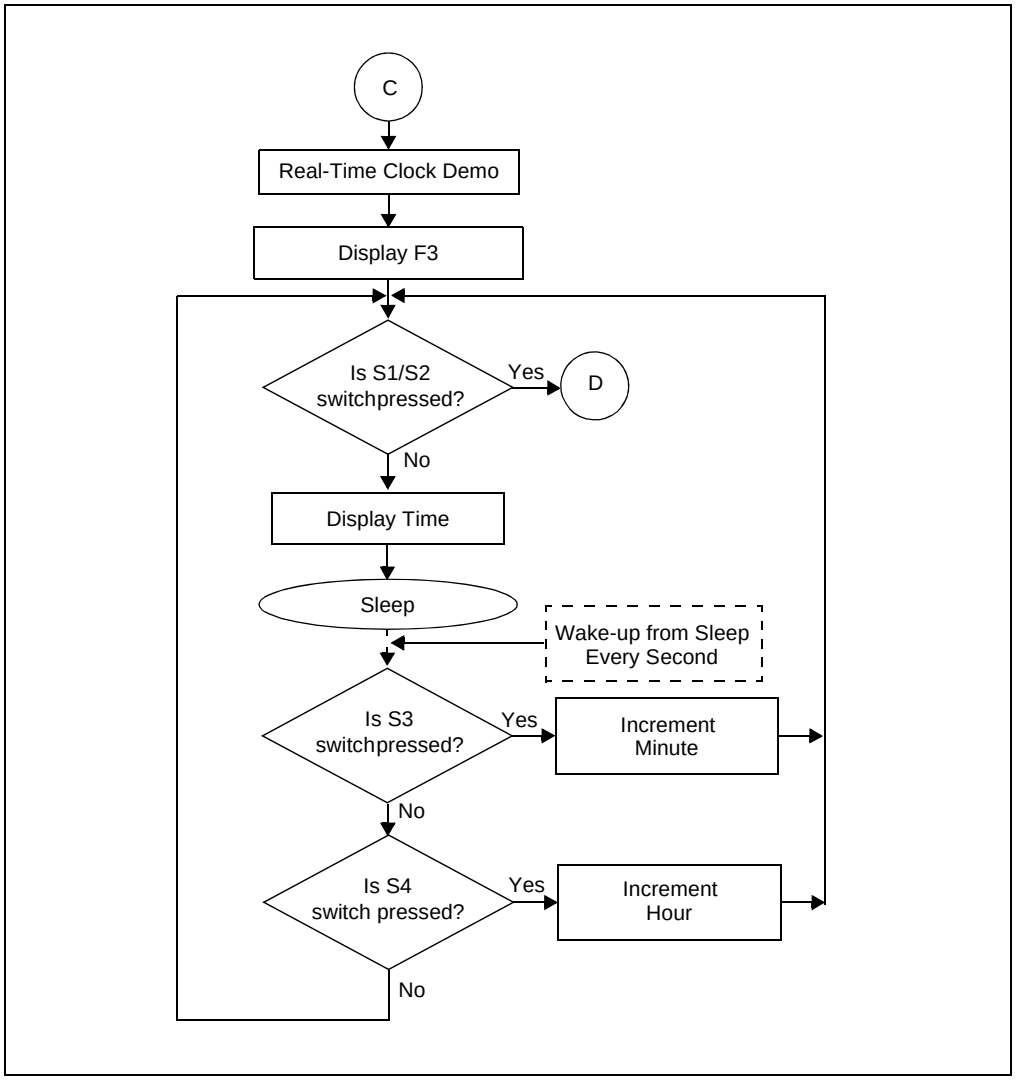

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FIGURE 3-4: DEMO PROGRAM FLOWCHART

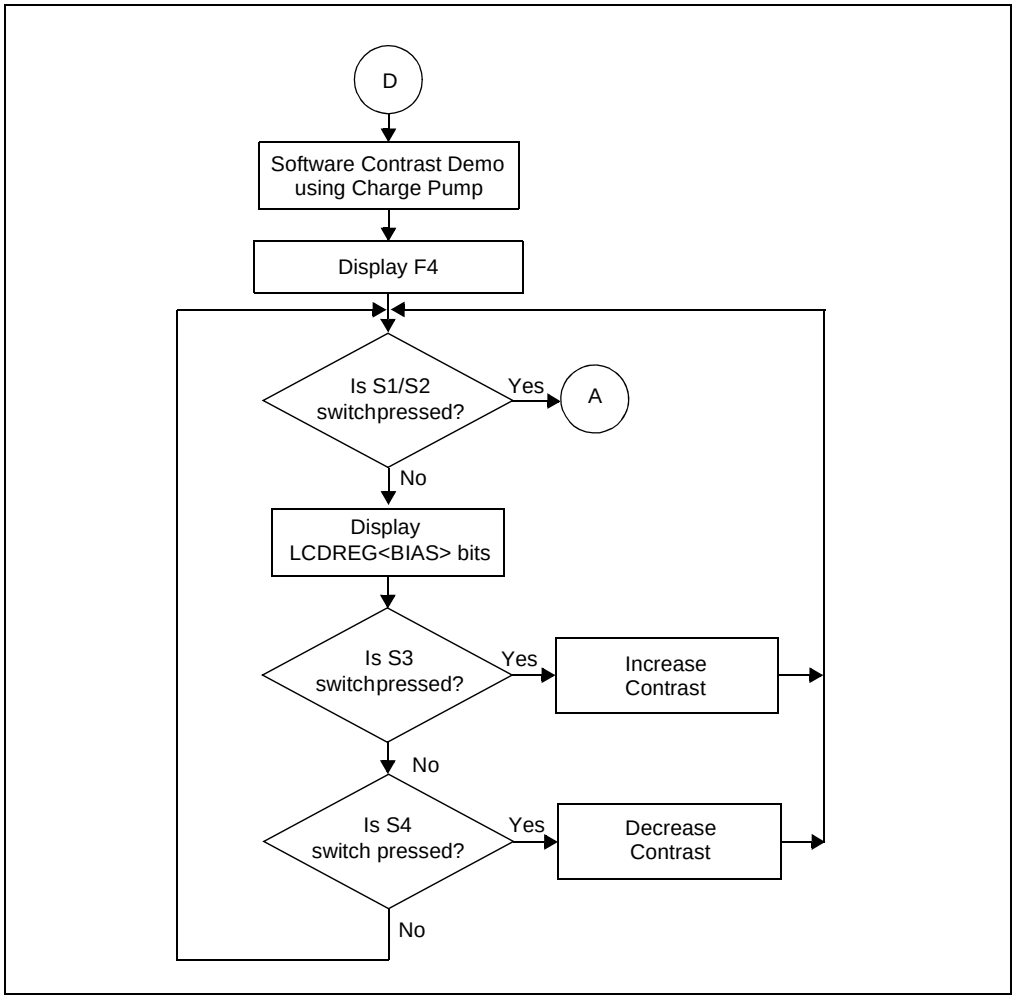
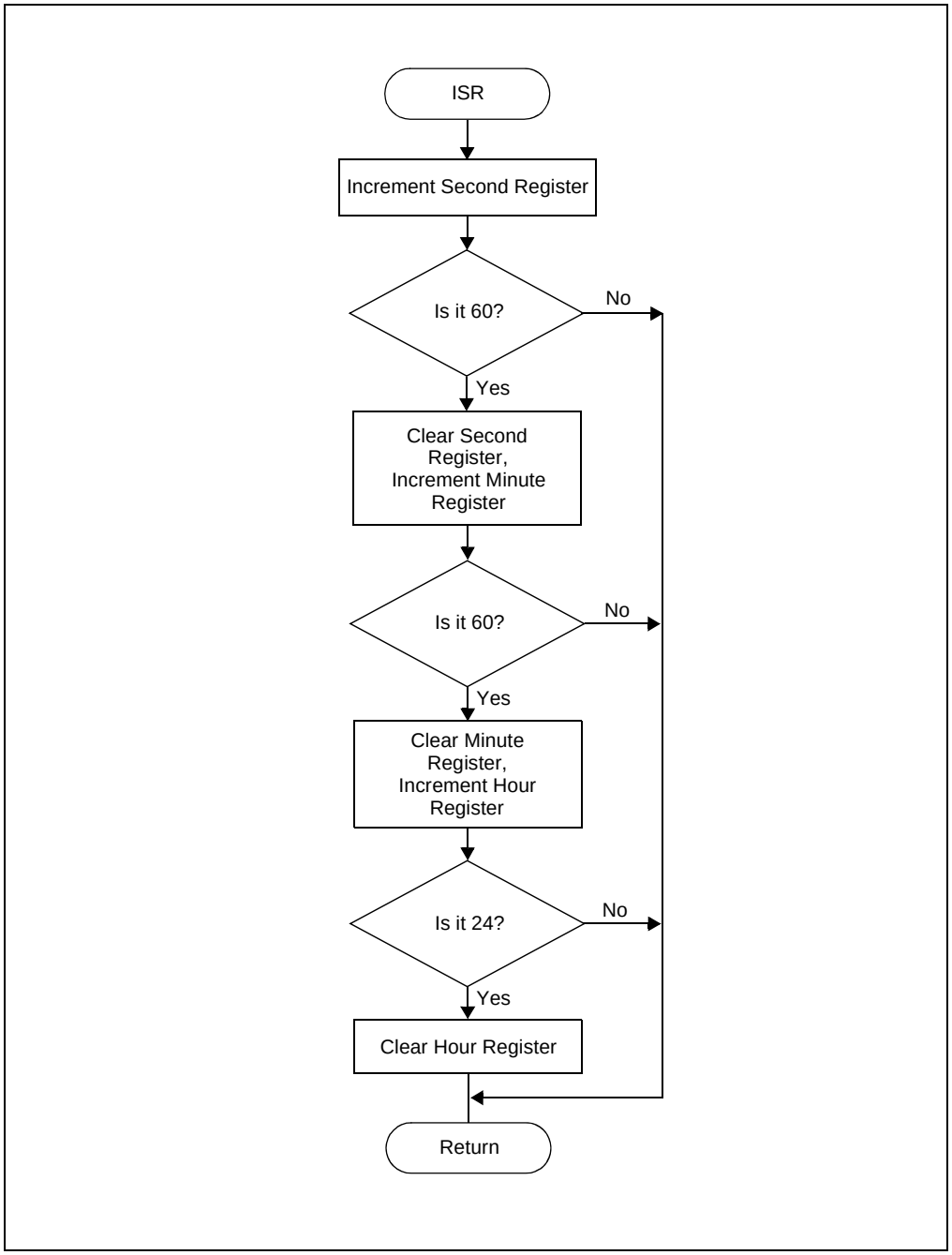


FIGURE 3-5: DEMO PROGRAM FLOWCHART



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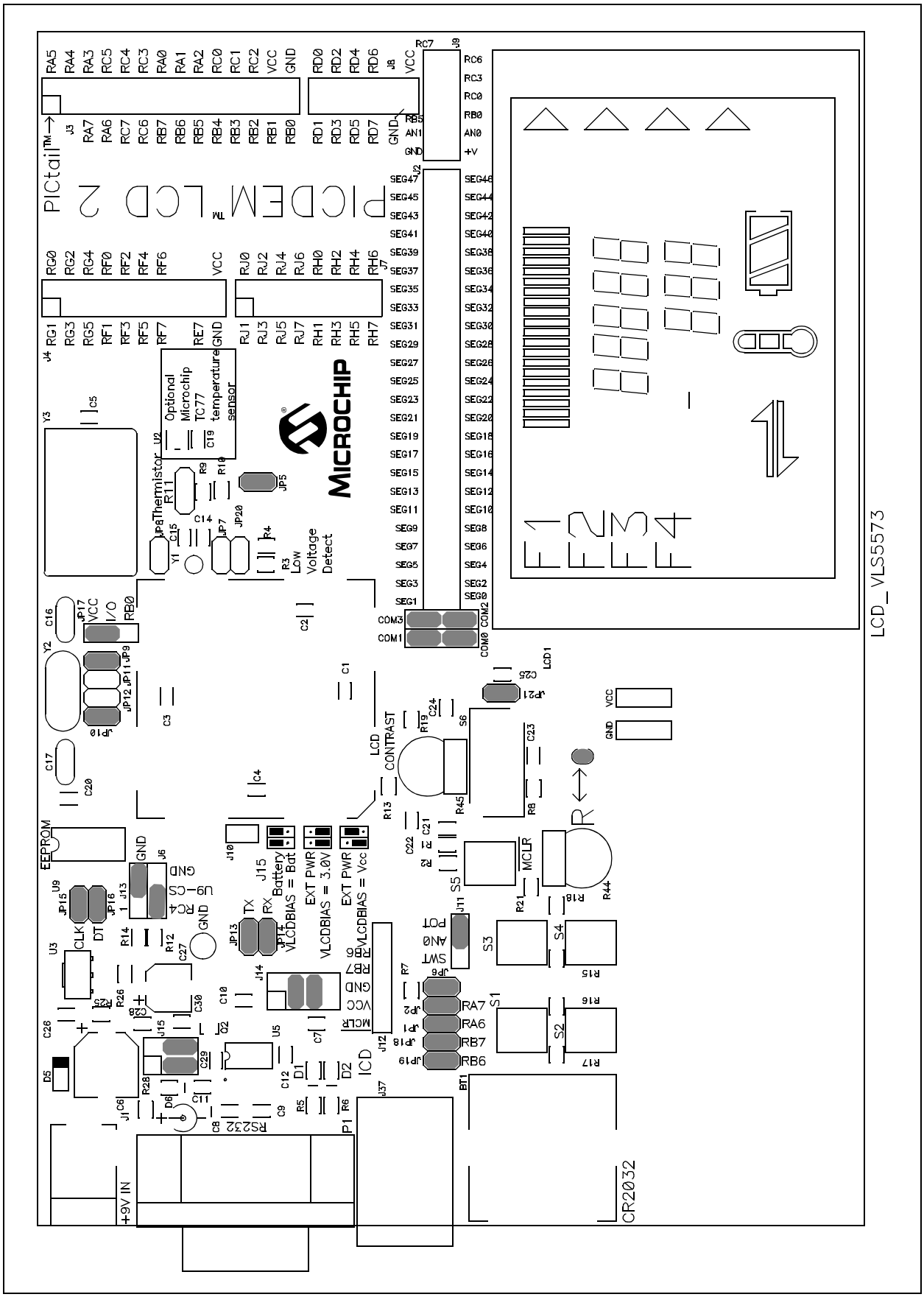
Appendix A. Board Technical Information

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 PIC18F87J90, PIC18F8490, PIC16F946, PIC16F917, and PIC16F/LF1946/47 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 • PIC18F8490 PIM • PIC16F946 PIM • PIC16F917 PIM	MA180019
PIC18F85J90 PIM	MA180022
PIC16F1946/7 PIM PIC16LF1946/7 PIM	MA160016 MA160015

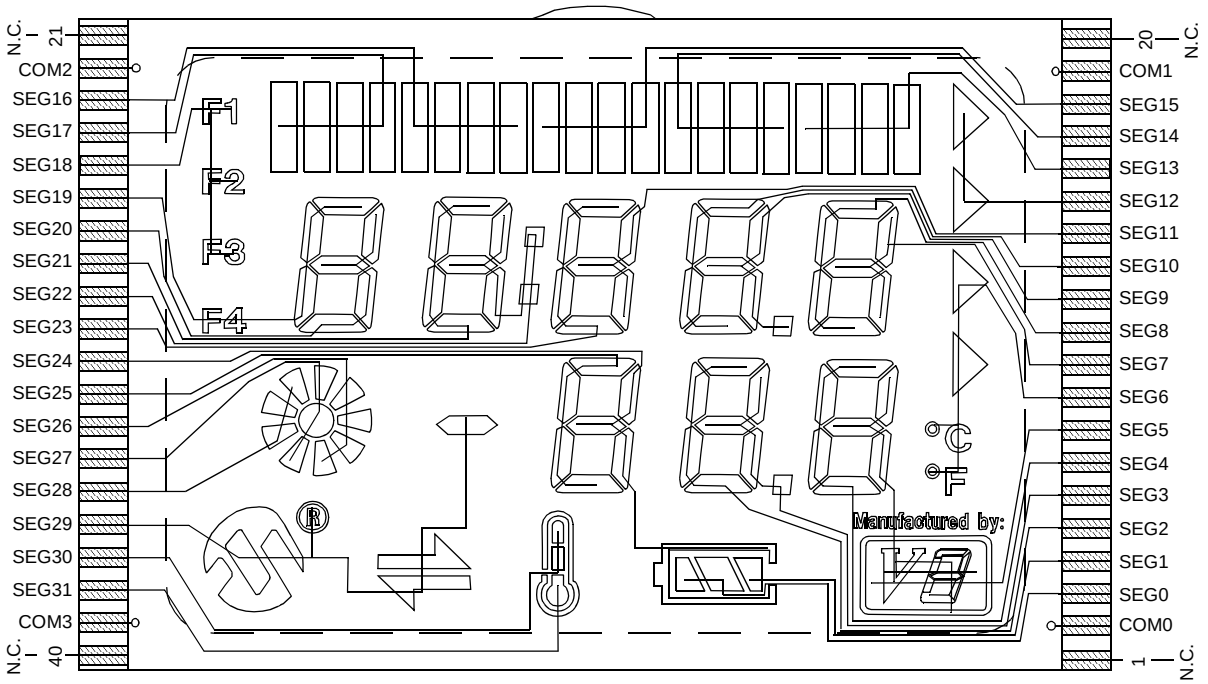
† For the availability and pricing of parts, go to www.microchipdirect.com.

Note: The PIC16LF1946/7 PIM (MA160015) is limited to a maximum of 3.3V operating voltage.

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



Legend: N.C. = No connection

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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 V_{DD} 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

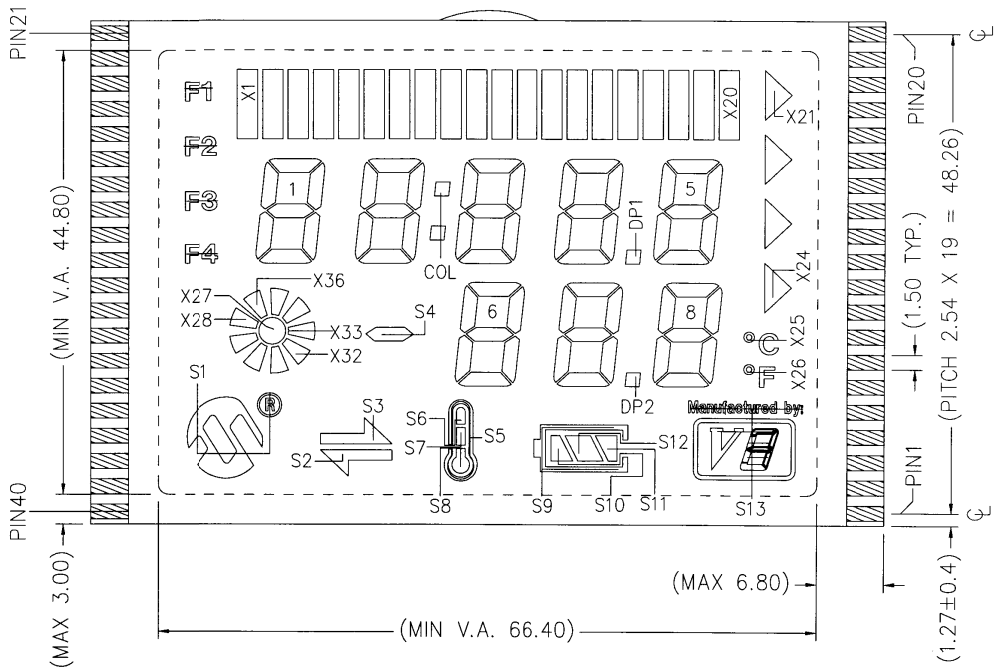

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FIGURE A-4: DIGIT DESCRIPTION

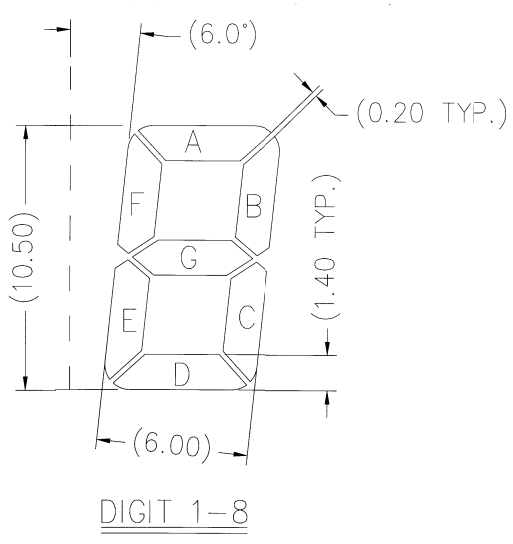

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TABLE A-3: LCD SEGx AND COMx

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	$\overline{\text{MCLR}}$	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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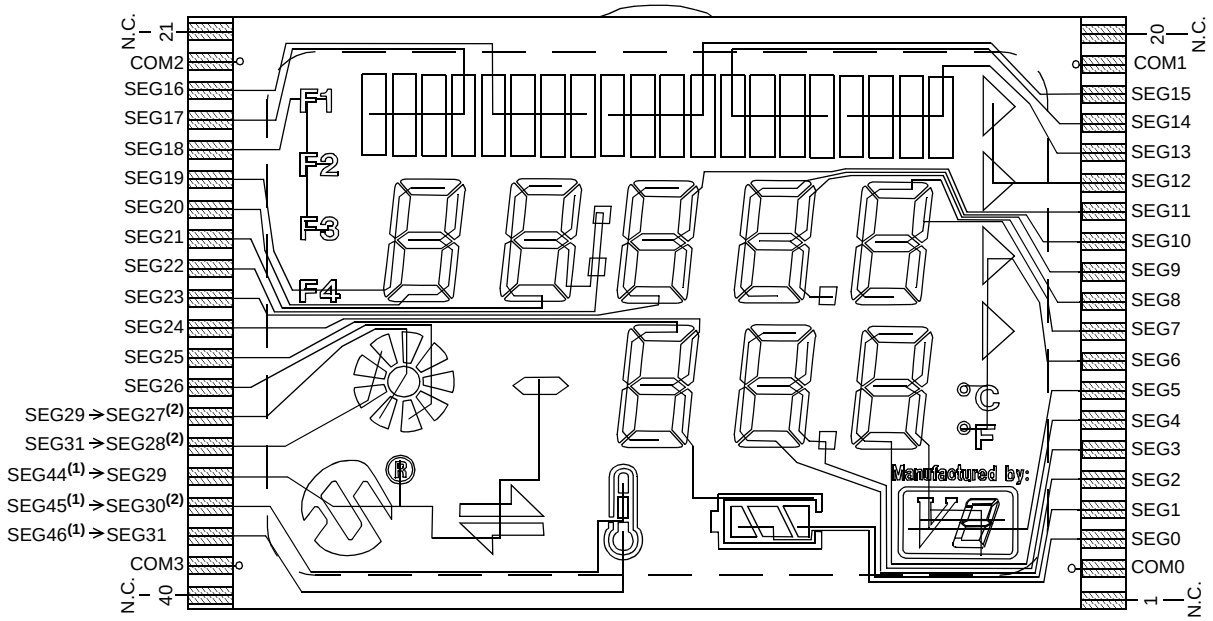
FIGURE A-5: SEGMENT CONFIGURATION FOR PIC18F85J90 DEVICES



Legend: N.C. = No connection

Note 1: SEG44, SEG45, and SEG46 exist only on PIC18F85J90 devices.

2: Disable SEG27, SEG28, SEG30, and SEG32 when the LCD module is enabled. Although SEG32 is not listed in the diagram, it is multiplexed with the Timer1 oscillator, and therefore, must be disabled when the Timer1 oscillator is enabled.

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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	TIOSC0	TIOSC1	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: PIC18F87J90 PIM AND ICE PIN/PORT COMPARISON

PIC18F87J90 PIM Pin No.	PIC18F87J90 Port	PIC18F87J90 Pin	ICE Pin	ICE Port	ICE Pin No.	PIC18F87J90 PIM Pin No.	PIC18F87J90 Port	PIC18F87J90 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	$\overline{\text{MCLR}}$	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	SEG18	RF0	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**	**CTMU**	**NC**			67	RD3	SEG3	SEG3	RD3	81
28	RA2	AN2	AN1	RA1	41	68	RD2	SEG2	SEG2	RD2	82
29	RA1	CTMU	NC		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.

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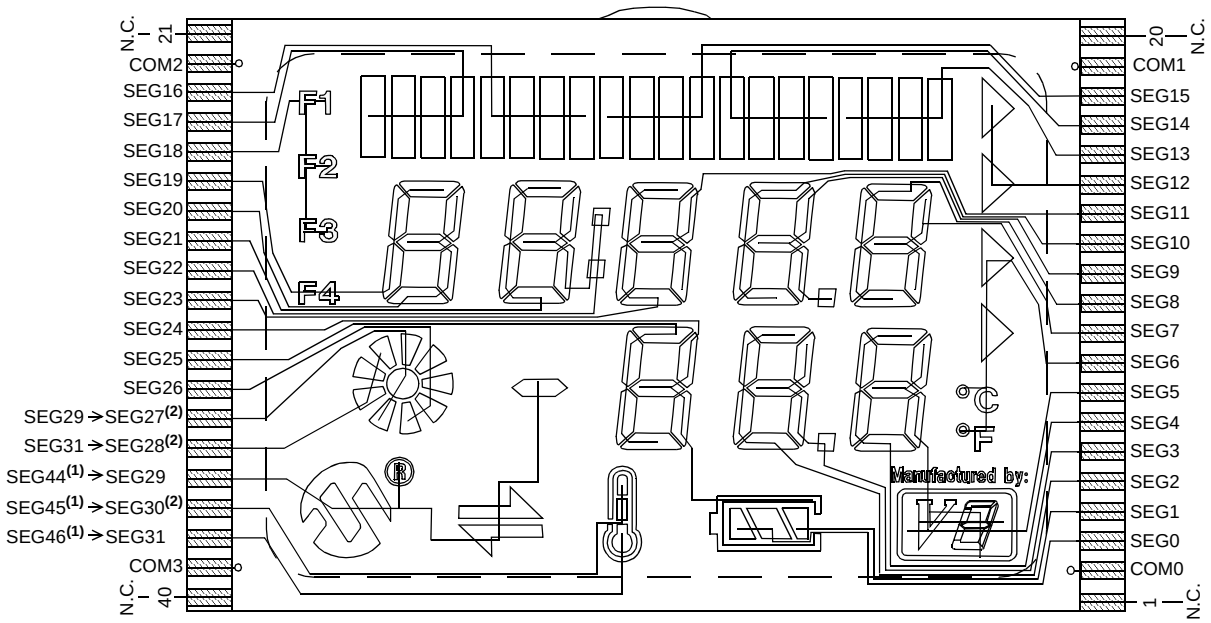
TABLE A-8: PIC18F87J90 LCD CONNECTIONS COMPARISON

PIC18F87J90	ICE	Pin #				Pin #	ICE	PIC18F87J90
	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
SEG40	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.

FIGURE A-6: SEGMENT CONFIGURATION FOR PIC18F87J90 DEVICES



Legend: N.C. = No connection

Note 1: SEG44, SEG45, and SEG46 exist only on PIC18F87J90 devices.

2: Disable SEG27, SEG28, SEG30, and SEG32 when the LCD module is enabled. Although SEG32 is not listed in the diagram, it is multiplexed with the Timer1 oscillator, and therefore, must be disabled when the Timer1 oscillator is enabled.

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TABLE A-9: PIC18F87J90 PORT AND PIN COMPARISON

PIC18F87J90 Port	PIC18F87J90 PIN	ICE Pin	ICE Port
RA0	AN0	AN0	RA0
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	TIOSC0	TIOSC1	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.

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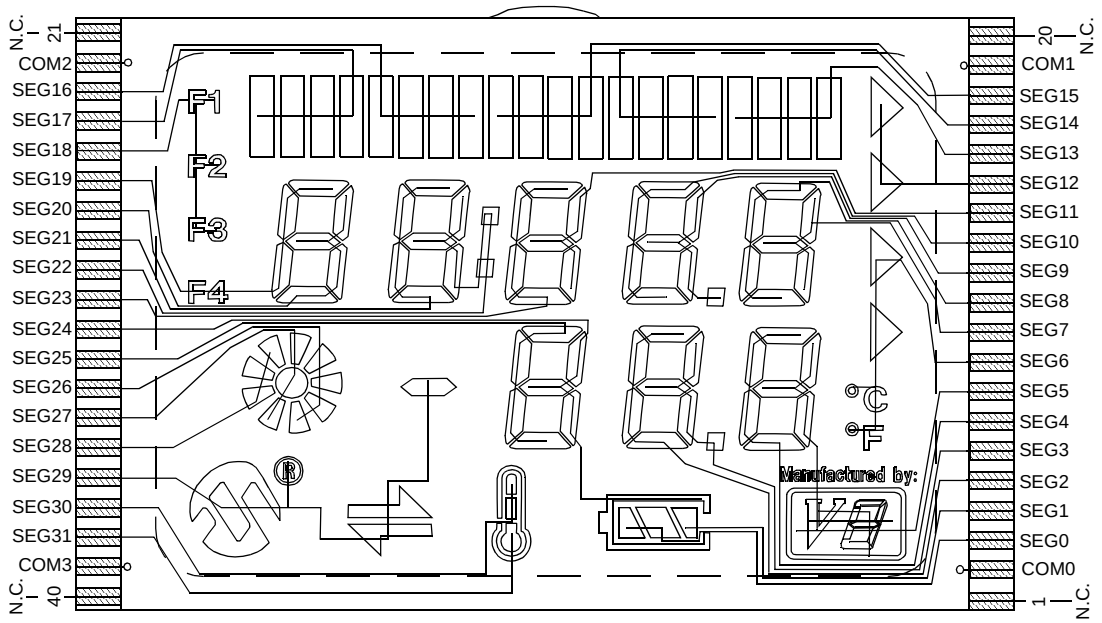
TABLE A-10: PIC18F8490 PIM AND ICE PORT/PIN COMPARISON

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	$\overline{\text{MCLR}}$	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

TABLE A-11: 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-7: SEGMENT CONFIGURATION FOR PIC18F8490 DEVICES



Legend: N.C. = No connection

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TABLE A-12: 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	TIOSC0	TIOSC1	RC1
RC3	RC3	RC3	RC3
RC4	RC4	RC4	RC4
RC6	TX/CK	TX/CK	RC6
RC7	RX/DT	RX/DT	RC7

TABLE A-13: 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.

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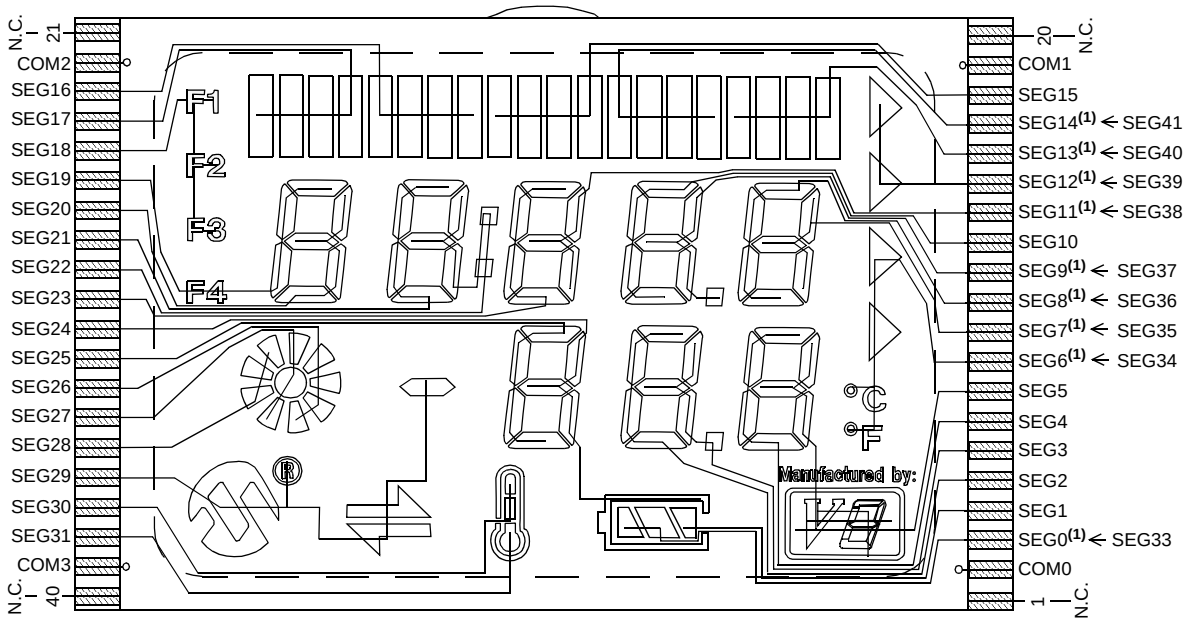
TABLE A-14: PIC16F946 LCD CONNECTIONS COMPARISON

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-8: SEGMENT CONFIGURATION FOR PIC16F946 DEVICES



Legend: N.C. = No connection
Note 1: Disable SEG0, SEG6, SEG7, SEG8, SEG9, SEG11, SEG12, SEG13 and SEG14 when the LCD module is enabled.

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TABLE A-15: 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.

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TABLE A-16: PIC16F/LF1946/7 PIM AND ICE PIN/PORT COMPARISON

PIC16/LF1946/7 PIM Pin No.	PIC16F/LF 1946/7 Port	PIC16F/LF 1946/7 Pin	ICE Pin	ICE Port	ICE Pin No.	PIC16F/LF 1946/7PIM Pin No.	PIC16F/LF 1946/7 Port	PIC16F/LF 1946/7 Pin	ICE Pin	ICE Port	ICE Pin No.
1	RE1	VLCD2	BIAS2	E1	14	33	C2	SEG13	SEG13	RC2	56
2	RE0	VLCD1	BIAS1	E0	15	34	C3	RC3	RC3	RC3	57
3	RG0	SEG42	SEG42	RH6	32	35	RE2	RC4	RC4	RC4	58
4	RG1	SEG43	SEG43	RH7	31	36	RC5	SEG12	SEG12	RC5	59
5	RG2	SEG44	SEG44	RJ3	13	37	RB7	RB7	RB7	RB7	60
6	RG3	SEG45	SEG45	RG5	20	38	VDD	VDD	ICEVDD	ICEVDD	61
7	RG5	$\overline{\text{MCLR}}$	ICEMCLR	RG5	20	39	OSC1	OSC1	OSC1	RC1	62
8	RG4	SEG26	SEG26	RG4	21	40	RA6	OSC2	OSC2	RA6	63
9	VSS	VSS	VSS	VSS	23	41	VSS	VSS	VSS	VSS	65
10	VDD	VDD	ICEVDD	ICEVDD	24	42	RB6	RB6	RB6	RB6	66
11	RF7	SEG25	SEG25	RF7	25	43	RB5	RB5	RB5	RB5	67
12	RF6	SEG24	SEG24	RF6	26	44	RB4	SEG11	SEG11	RB4	68
13	RF5	SEG23	SEG23	RF5	27	45	RB3	SEG10	SEG10	RB3	69
14	RF4	SEG22	SEG22	RF4	28	46	RB2	SEG9	SEG9	RB2	70
15	RF3	SEG21	SEG21	RF3	29	47	RB1	SEG8	SEG8	RB1	71
16	RF2	SEG20	SEG20	RF2	30	48	RB0	RB0	RB0	RB0	72
17	RF1	SEG19	SEG19	RF1	35	49	RD7	SEG7	SEG7	RD7	77
18	RF0	SEG41	SEG41	RH5	33	50	RD6	SEG6	SEG6	RD6	78
19	VDD	VDD	ICEVDD	ICEVDD	37	51	RD5	SEG5	SEG5	RD5	79
20	VSS	VSS	VSS	VSS	38	52	RD4	SEG4	SEG4	RD4	80
21	RA3	SEG35	SEG35	RJ3	73	53	RD3	SEG3	SEG3	RD3	81
22	RA2	SEG34	SEG34	RJ2	74	54	**RD2**	**SEG2**	**SEG2**	**RD2**	82
23	RA1	AN1	AN1	RA1	41	55	**RD1**	**SEG1**	**SEG1**	**RD1**	83
24	RA0	AN0	AN0	RA0	42	56	VSS	VSS	VSS	VSS	84
25	VSS	VSS	ICEVSS	ICEVSS	44	57	VDD	VDD	VDD	VDD	2
26	VDD	VDD	ICDVDD	ICDVDD	45	58	RD0	SEG0	SEG0	RD0	3
27	RA5	SEG15	SEG15	RA5	46	59	RE7	SEG31	SEG31	RE7	4
28	RA4	SEG14	SEG14	RA4	47	60	RE6	COM3	COM3	RE6	5
29	RC1	T1OSC1	T1OSC1	RC1	48	61	RE5	COM2	COM2	RE5	6
30	RC0	T1OSC0	T1OSC0	RC0	49	62	RE4	COM1	COM1	RE4	7
31	RC6	TX/CK	TX/CK	RC6	50	63	RE3	COM0	COM0	RE3	8
32	RC7	RX/DT	RX/DT	RC7	79	51	RE2	VLCD3	BIAS3	RE2	9

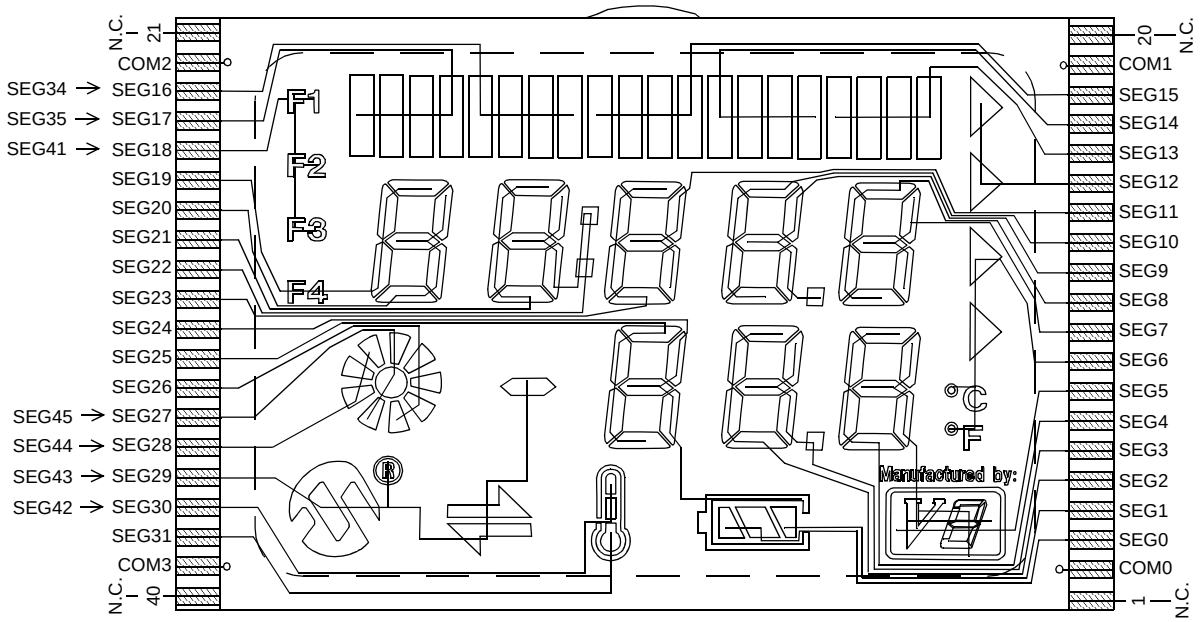
Legend: Unshaded cells indicate where a perfect match between PIM and ICE pins and ports exists.
Shaded cells indicate where differences between PIM and ICE ports and pins exist.
Bold text indicates the PIM pins that are not connected to any ICE pins or ports.

TABLE A-17: PIC16F/LF1946/7 LCD CONNECTIONS COMPARISON

PIC16F/LF 1946/7	ICE	LCD Pin #				LCD Pin #	ICE	PIC16F/LF1 946/7
	NC	21	NC		NC	20	NC	
COM2	COM2	22	COM3		COM2	19	COM1	COM1
SEG34	SEG16	23	X8,X6,X5,X7		X9,X11,X12,X10	18	SEG15	SEG15
SEG35	SEG17	24	X1,X3,X4,X2		X16,X14,X13,X15	17	SEG14	SEG14
SEG41	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
SEG45	SEG27	34	-,X27,X35,X30		8D,8F,8A,8E	7	SEG4	SEG4
SEG44	SEG28	35	-,X28,X36,X29		DP2,7G,7B,7C	6	SEG3	SEG3
SEG43	SEG29	36	S1,S3,S4,S2		7D,7F,7A,7E	5	SEG2	SEG2
SEG42	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-9: SEGMENT CONFIGURATION FOR PIC16F/LF1946/7 DEVICES



Legend: N.C. = No connection
Note 1: Disable SEG16, SEG17, SEG18, SEG27, SEG28, SEG29, SEG30 when the LCD module is enabled.

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TABLE A-18: PIC16F/LF1946/7 PORT AND PIN COMPARISON

PIC16F/LF1946/7 Port	PIC16F/LF1946/7 Pin	ICE Pin	ICE Port
RA0	AN0	AN0	RA0
RA1	AN1	AN1	RA1
RC0	T1OSCO	T1OSCO	RC0
RC1	T1OSCI	T1OSCI	RC1
RB0	RB0	RB0	RB0
RE3	COM0	COM0	RE3
RB5	COM1	COM1	RE4
RE5	COM2	COM2	RE5
RE6	COM3	COM3	RE6
RB6	RB6	RB6	RB6
RB7	RB7	RB7	RB7
RE0	VLCD1	BIAS1	RE0
RE1	VLCD2	BIAS2	RE1
RE2	VLCD3	BIAS3	RE2
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-19: 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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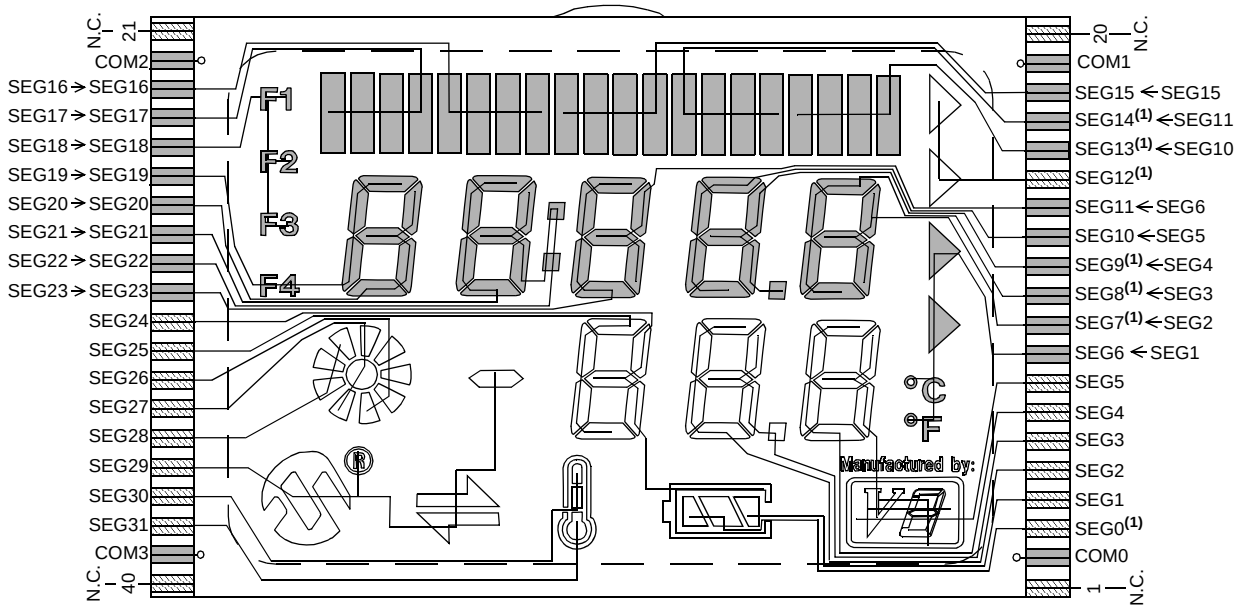
TABLE A-20: PIC16F917 LCD CONNECTIONS COMPARISON

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-10: SEGMENT CONFIGURATION FOR PIC16F914/917 DEVICES



Legend: N.C. = No connection
= Only segments available to PIC16F914/917 devices

Note 1: Disable SEG0, SEG7, SEG8, SEG9, SEG12, and SEG14 when the LCD module is enabled.

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TABLE A-21: 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 and PIC18F87J90 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 VLCAP

For charge pump mode operation in PIC18F85J90 and PIC18F87J90 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 and PIC18F87J90 devices, it is required that the S6 switch is flipped towards C and the VLCAP 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 and PIC18F87J90 devices when the bias voltages are generated through the resistor ladder.

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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 and PIC18F87J90 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, PIC16F946 and PIC16F/LF/1946/7 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 V_{CC} to GND. The jumper, J11, should be connecting the potentiometer to AN0.

A.11 TEMPERATURE SENSOR

A 10 kΩ 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 and PIC18F87J90 PIM, the RA2 pin is connected to RA1 of U1A and AN2 is used instead of AN1.

2: For the PIC18F8490, PIC16F/LF/1946/7, 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 VCC/2.
- S2 – AN0 will be approximately at VCC/3.
- S3 – AN0 will be approximately at VCC/5.2.
- S4 – AN0 will be approximately at VCC/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.

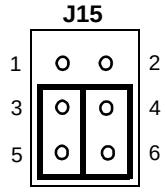
Note: There is one J15 jumper associated with the power supply circuit. This jumper must be correctly connected to select the required power supply. Refer to Figure A-11 for jumper setting examples.

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, PIC16F/LF/1946/7, PIC16F946 and PIC16F916. The PIC18F85J90 and PIC18F87J90 families 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-11: J15 POWER SUPPLY CIRCUIT SETTING EXAMPLES

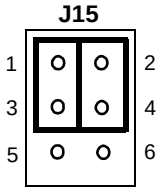
EXAMPLE A



VLCDBIAS = 3V, External Power

a) External Supply with VLCDBIAS Regulated (Default): This is the recommended jumper setting to operate when using external supply. This configuration allows the VLCDBIAS to be regulated to 3V even if the V_{DD} of the board is higher than 3V.

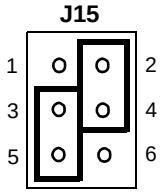
EXAMPLE B



VLCDBIAS = Battery

b) Battery Operation: This is the recommend jumper setting when operating on a battery. In this configuration, VLCDBIAS is directly connected to the battery voltage.

EXAMPLE C



VLCDBIAS = V_{CC}

c) External Supply with VLCDBIAS Unregulated: This is not recommended to use with on-board glass as voltage higher than 3V may damage the glass.
If an external glass is connected to J2 and is capable of handling higher voltages, then this jumper setting allows V_{CC} to connect directly to the VLCDBIAS when an external power supply is used.

Note: For all examples shown above, the voltage regulation on the VLCDBIAS for 3V is not required for the regular operation of the module or device. It is added here for additional protection for the glass since the board is capable of generating 3.3V or 5V depending on the PIM being used.

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 V_{DD} of 3.6V, whereas the PIC18FXX90, PIC16F91X and PIC16F946 tolerate a maximum V_{DD} of 5.5V. The adjustable voltage regulator allows a different V_{DD} 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 daughter board/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 V_{DD} 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-22:

TABLE A-22: PIM PREPOPULATED VALUES

Module	R101	R102	V_{DD}
PIC18F87J90	Open	1.18K	3.3V
PIC18F85J90	Open	1.18K	3.3V
PIC18F8490	Open	Open	5.0V
PIC16F914/917	Open	Open	5.0V
PIC16F946	Open	Open	5.0V
PIC16F1946/7	Open	Open	5.0V
PIC16LF1946/7	Open	1.18K	3.3V

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

Now, let's look at how to determine R101 and R102 if a different V_{DD} 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 will not duplicate all the details here. The following equation is taken from an LM317 data sheet:

EQUATION A-1:

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

I_{ADJ} is minimized by the LM317, so it can be assumed to be zero or at least very small. V_{REF} =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:

$$V_{OUT} = 1.25V(1+R2/R1)$$

$$R2 = R25 \,||\, R102 = (R25* R102)/(R25+R102)$$

$$R1 = R26 \,||\, R101.= (R26* R101)/(R26+R101)$$

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

For a desired V_{OUT}, first solve for R2, given R1 = R26 = 330R. Then, knowing R2 and R25, solve for R102. Determine the nearest available resistor value for R102 and recalculate the resulting V_{DD} to make sure it does not exceed the maximum V_{DD} for the part you will be using.

Table A-23 shows values for R101 and R102 for different V_{DD} values, assuming that R25 and R26 on the PICDEM LCD 2 Board are left as their default values of 1K and 330R.

TABLE A-23: R101 AND R102 V_{DD} VALUES

V_{DD}	R101	R102
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 and PIC18F87J90 families of devices – 3.3V
- PIC18F8490 family of devices – 5V
- PIC16F917/914 devices – 5V
- PIC16F946 – 5V (when operating on an external 9V DC supply)
- PIC16F1946/7 – 5V
- PIC16LF1946/7 – 3.3V

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-12: PICDEM™ LCD 2 DEMONSTRATION BOARD PARTS LAYOUT (SILKSCREEN)

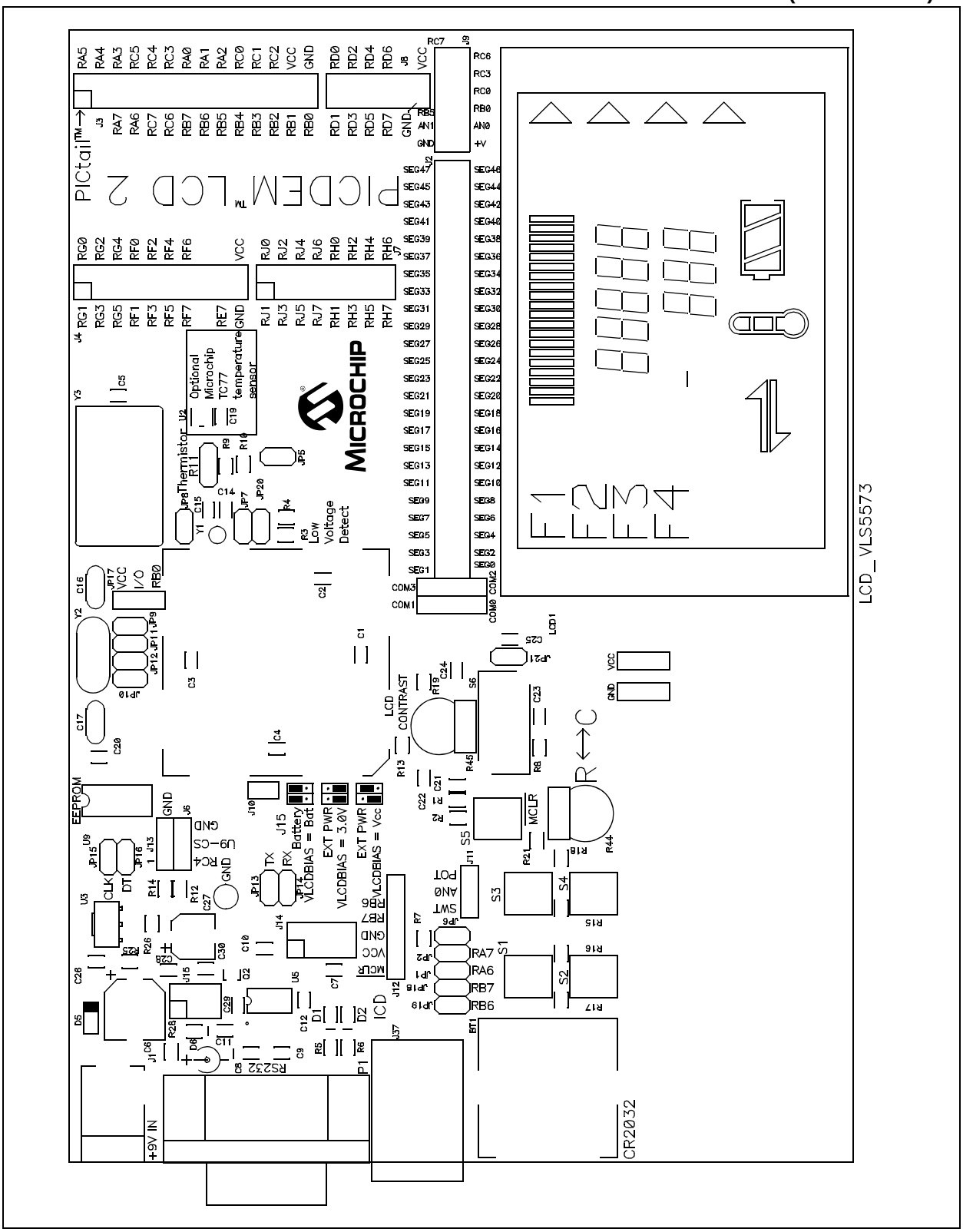

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FIGURE A-13: PICDEM™ LCD 2 SCHEMATIC SHEET 1 OF 3

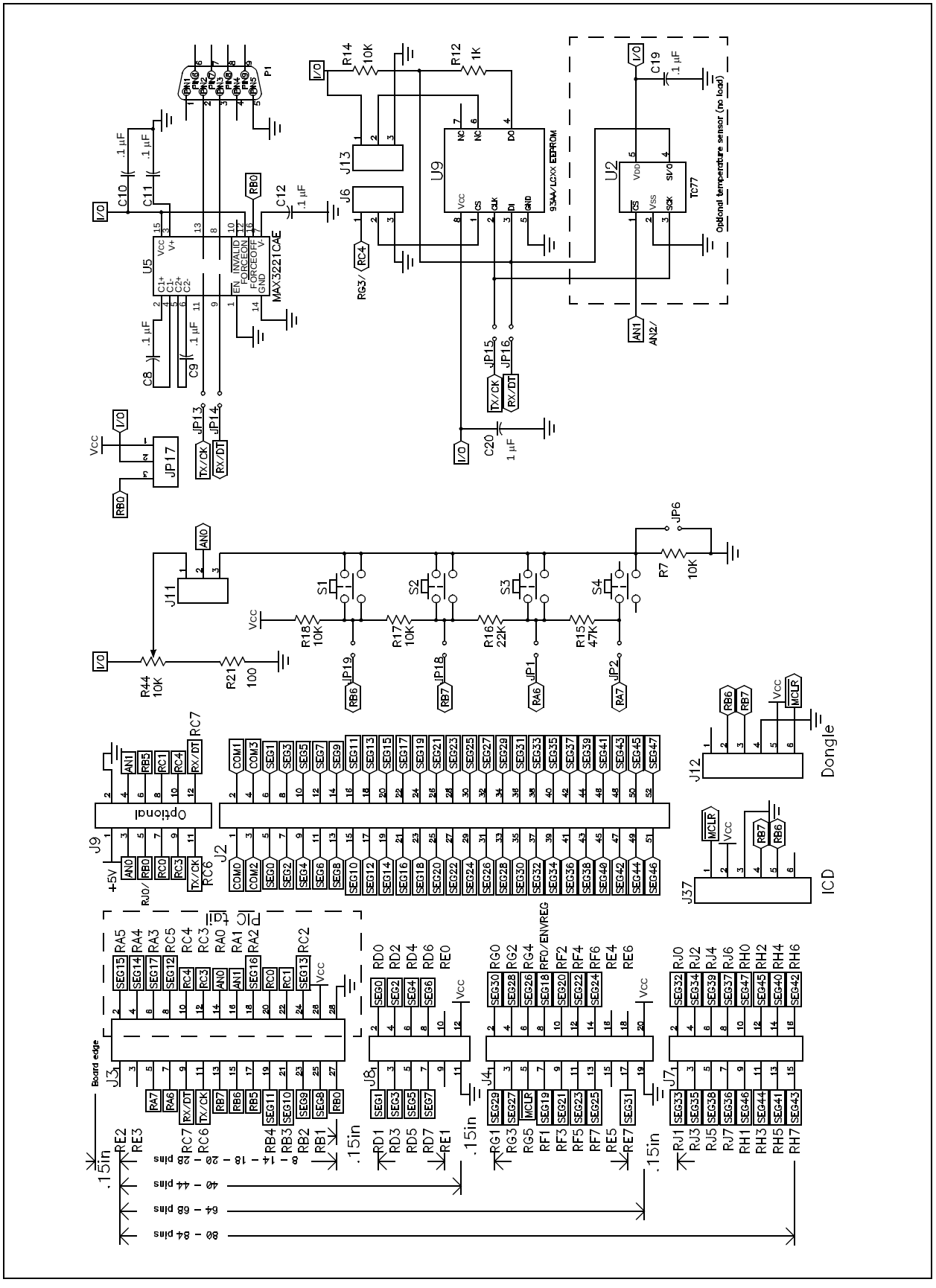

FIGURE A-14: PICDEM™ LCD 2 SCHEMATIC SHEET 2 OF 3

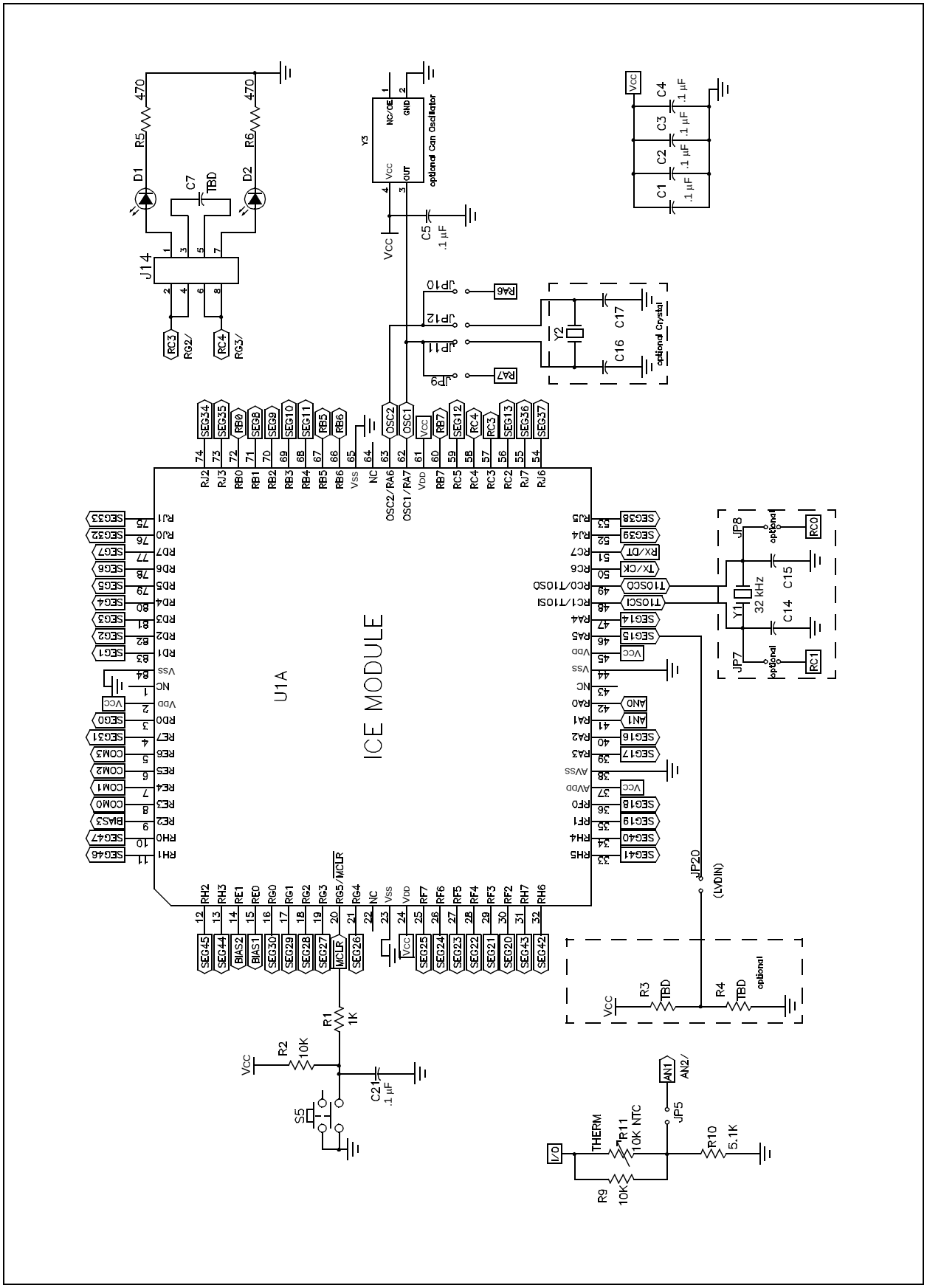

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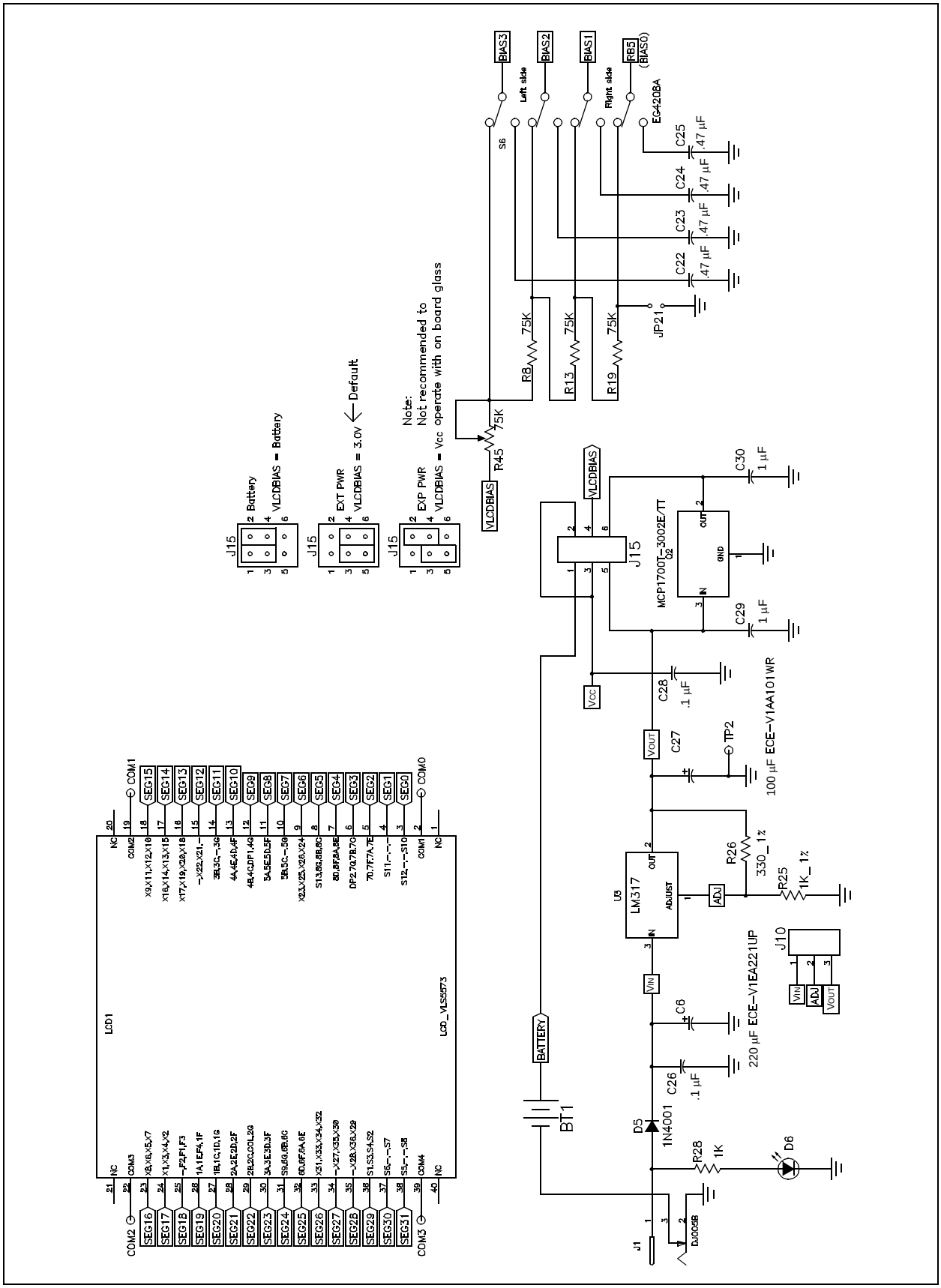
FIGURE A-15: PICDEM™ LCD 2 SCHEMATIC SHEET 3 OF 3



A.16 PIM LAYOUT AND SCHEMATICS

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

FIGURE A-16: PIC18F65J90 AND PIC18F85J90 PIM LAYOUT

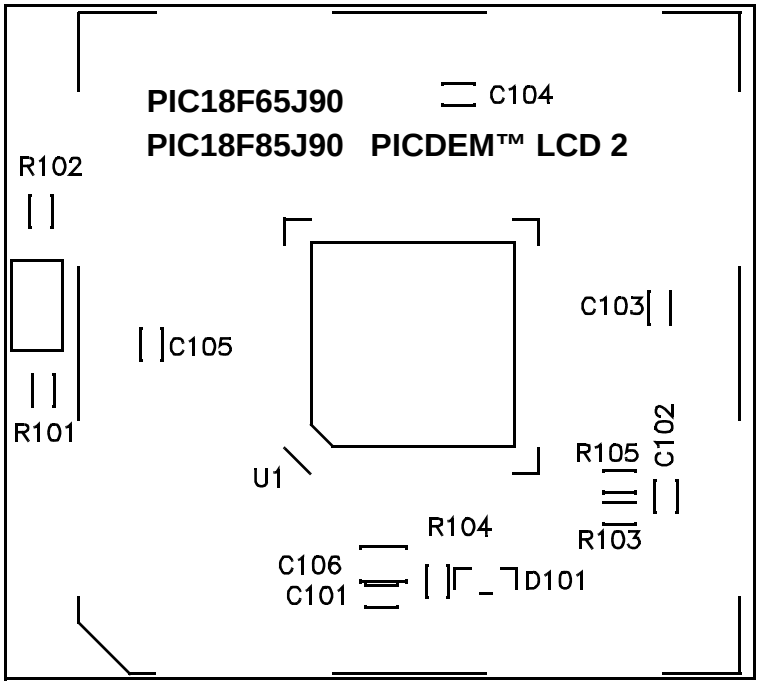


FIGURE A-17: PIC16F914/917 PIM LAYOUT

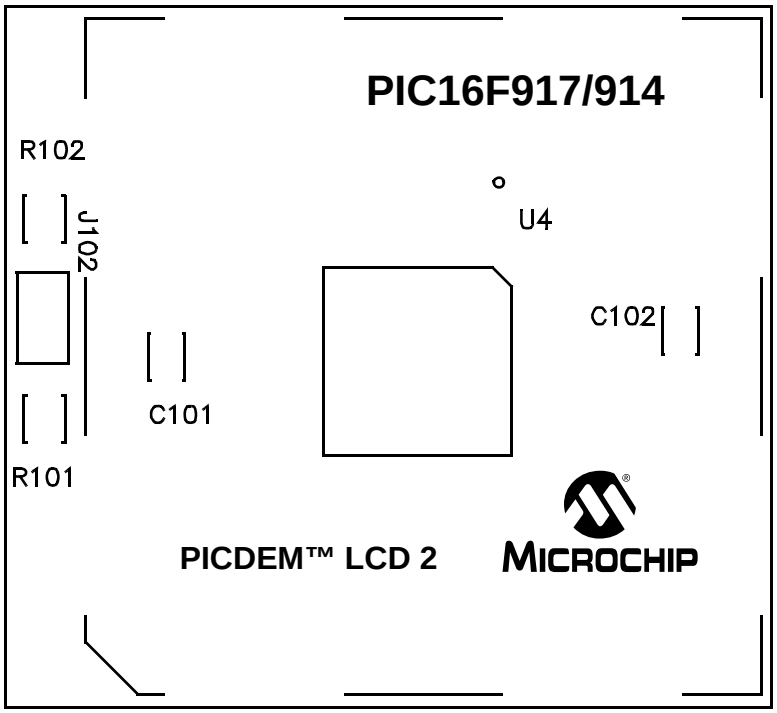


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FIGURE A-18: PIC16F946 PIM LAYOUT

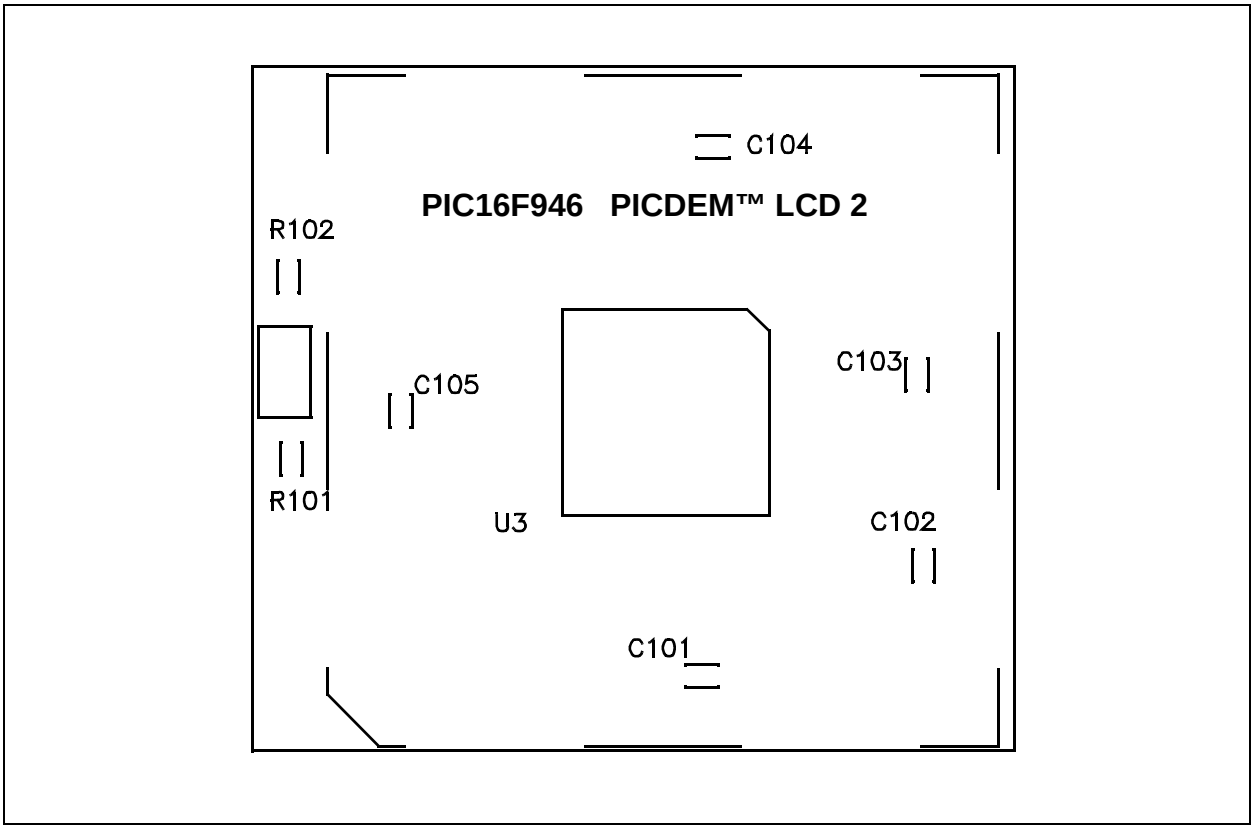

FIGURE A-19: PIC16F/LF1946/7 PIM LAYOUT

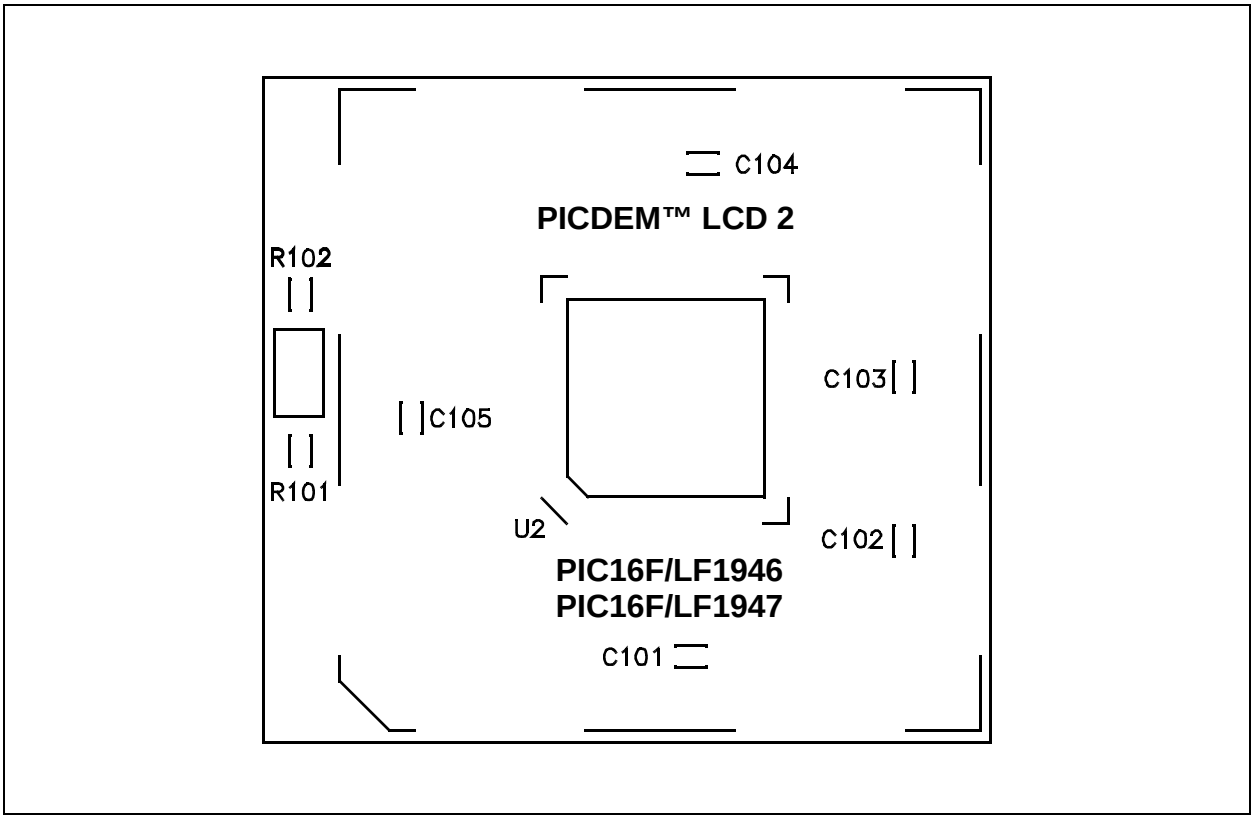

FIGURE A-20: PIC18F6490/8490 PIM LAYOUT

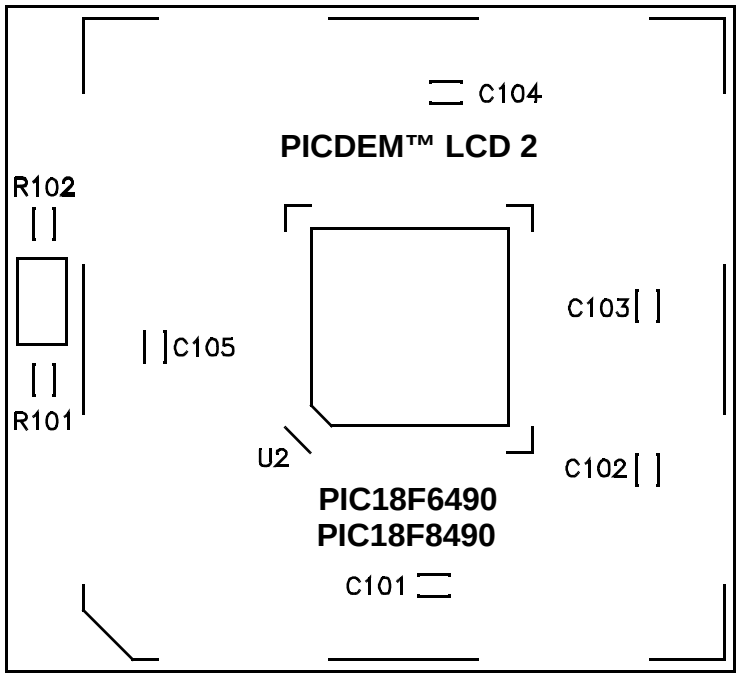

FIGURE A-21: PIC18F87J90 PIM LAYOUT

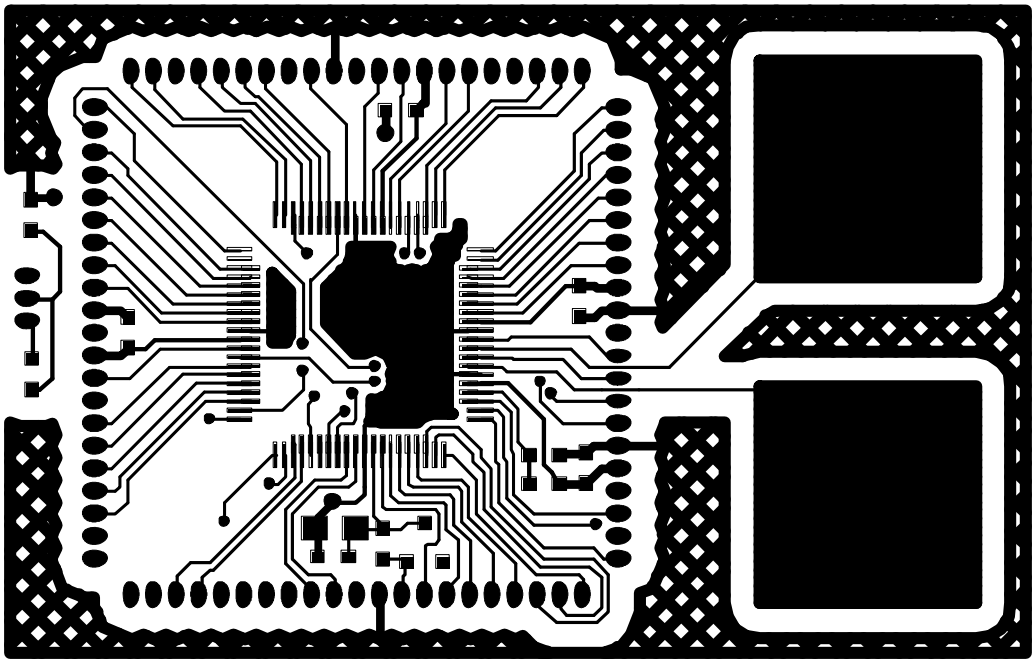

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FIGURE A-22: PICDEM™ LCD 2 PIC16F914/917 PIM SCHEMATIC

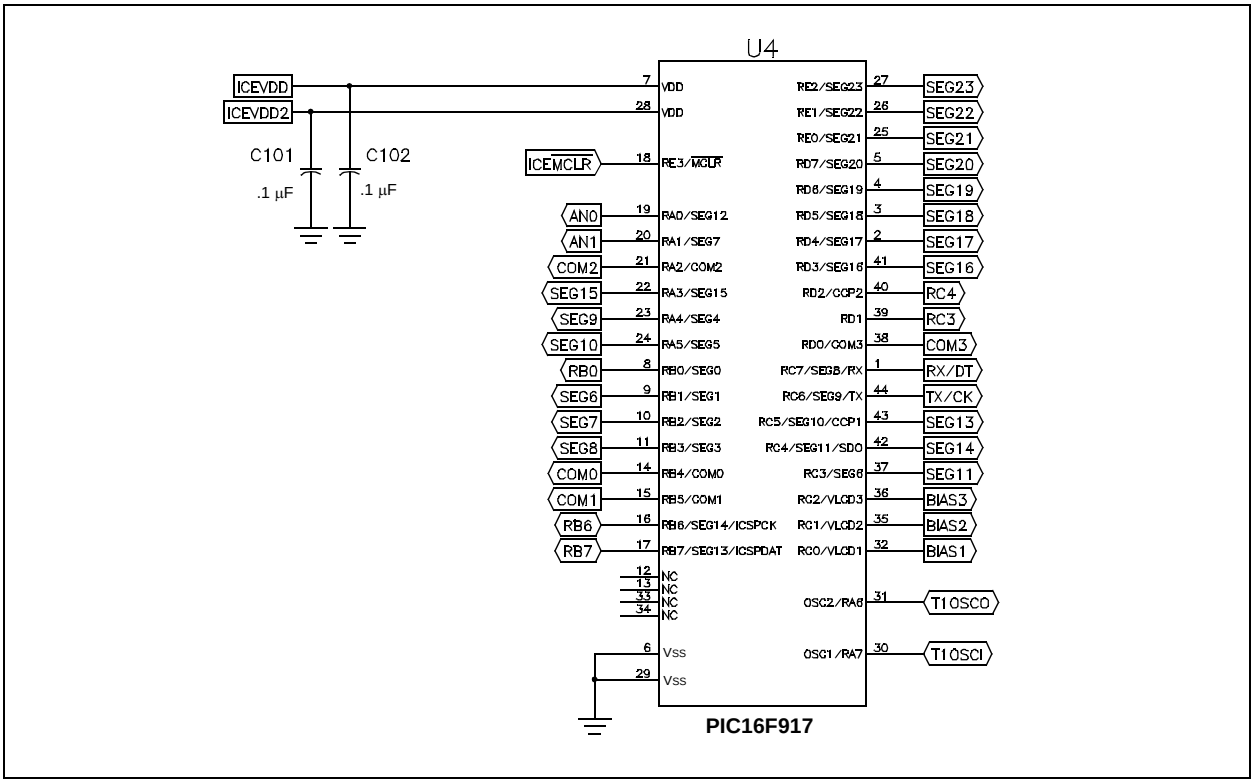

FIGURE A-23: PICDEM LCD 2 PIC16F/LF1946/7 64-PIN PIM SCHEMATIC

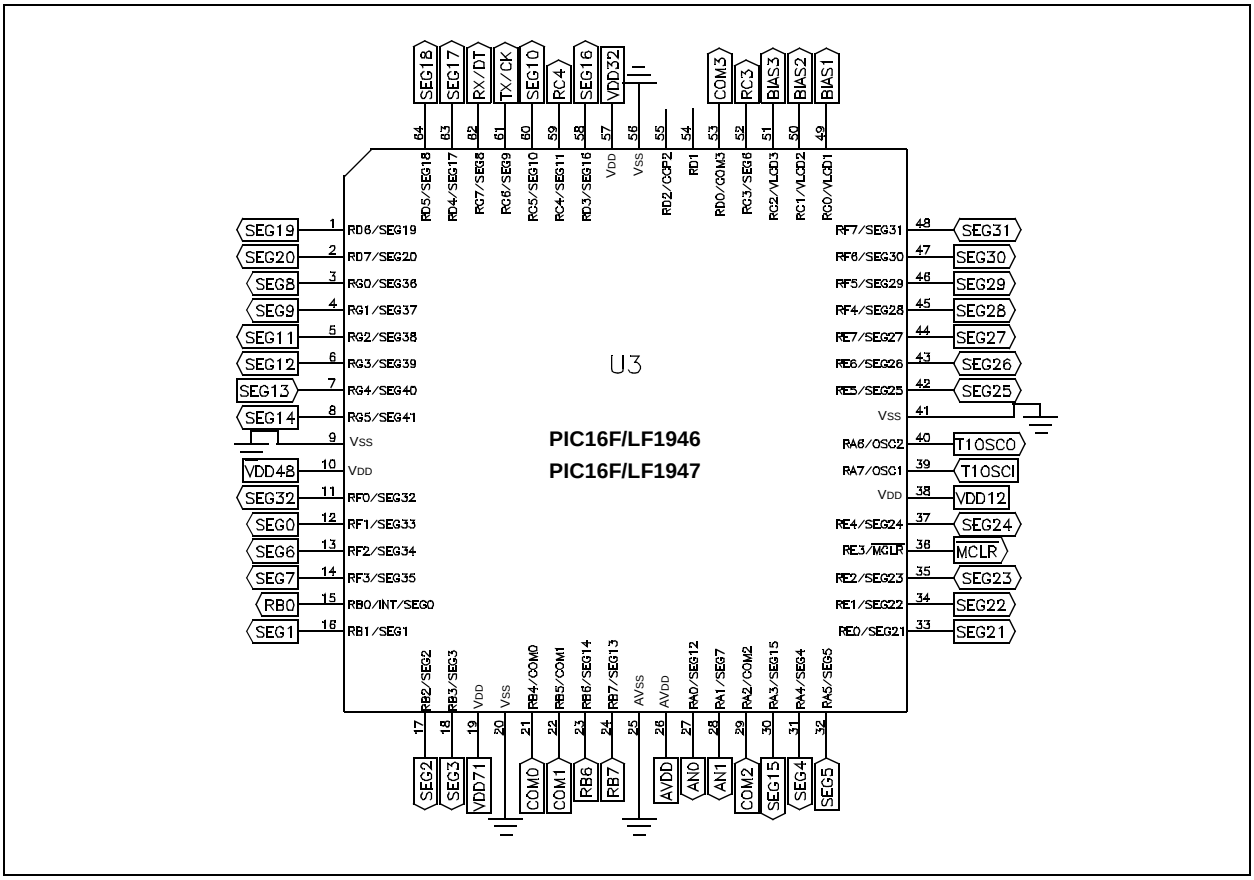

FIGURE A-24: PICDEM™ LCD 2 PIC16F946 PIM SCHEMATIC

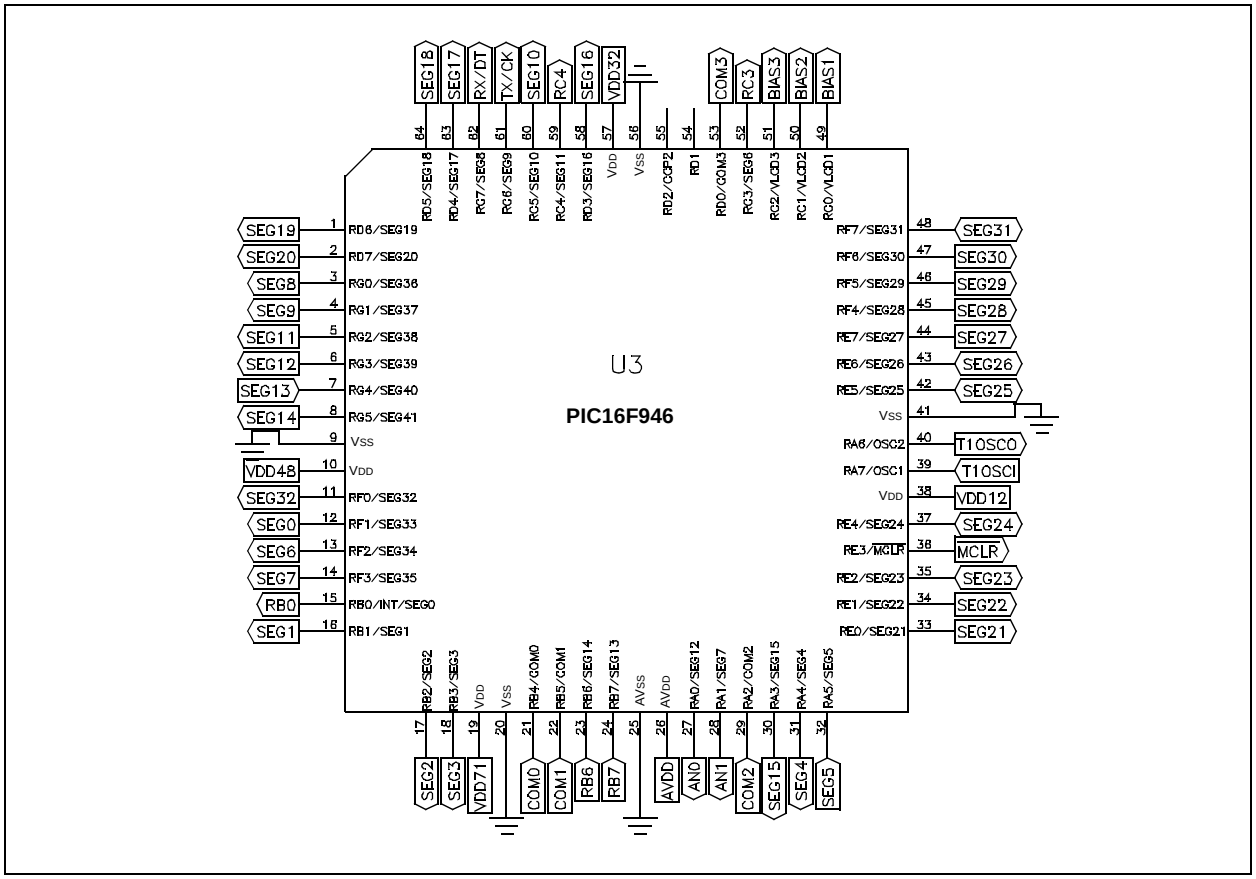

FIGURE A-25: PICDEM™ LCD 2 PIC18F6490 64-PIN PIM SCHEMATIC

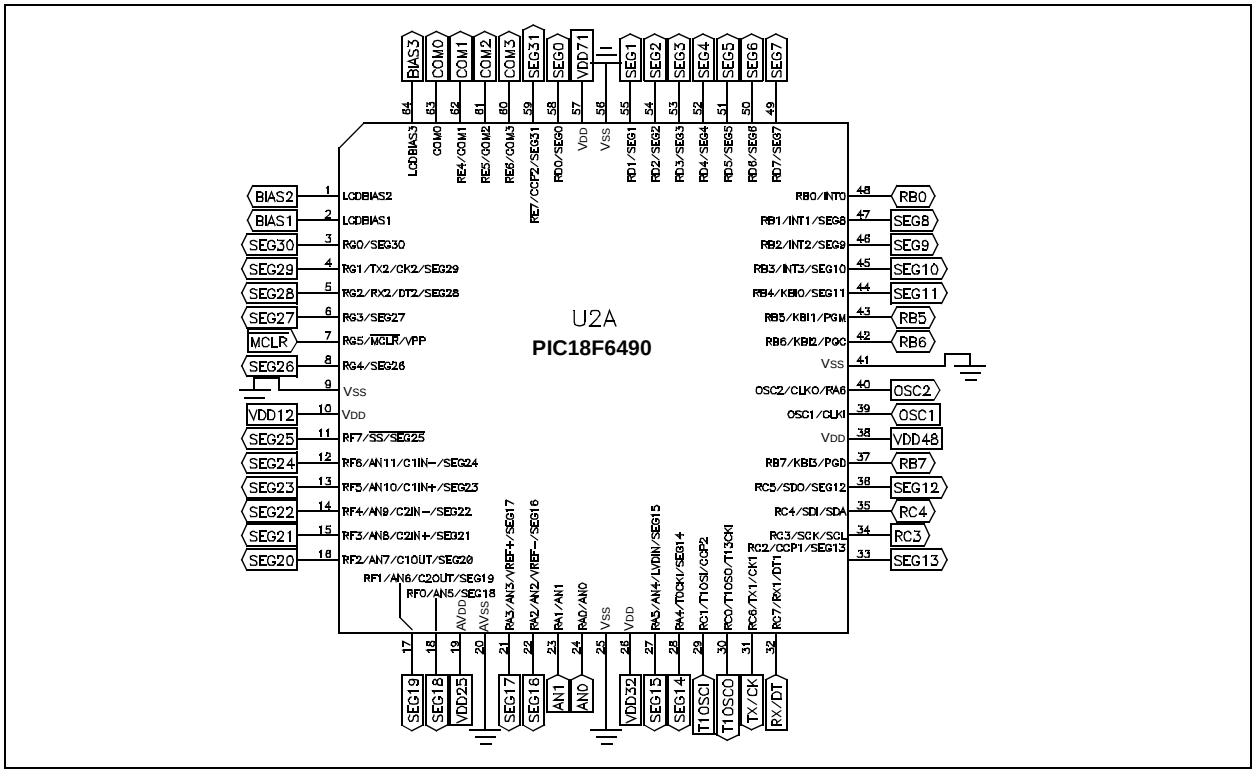

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FIGURE A-26: PICDEM™ LCD 2 PIC18F8490 80-PIN PIM SCHEMATIC

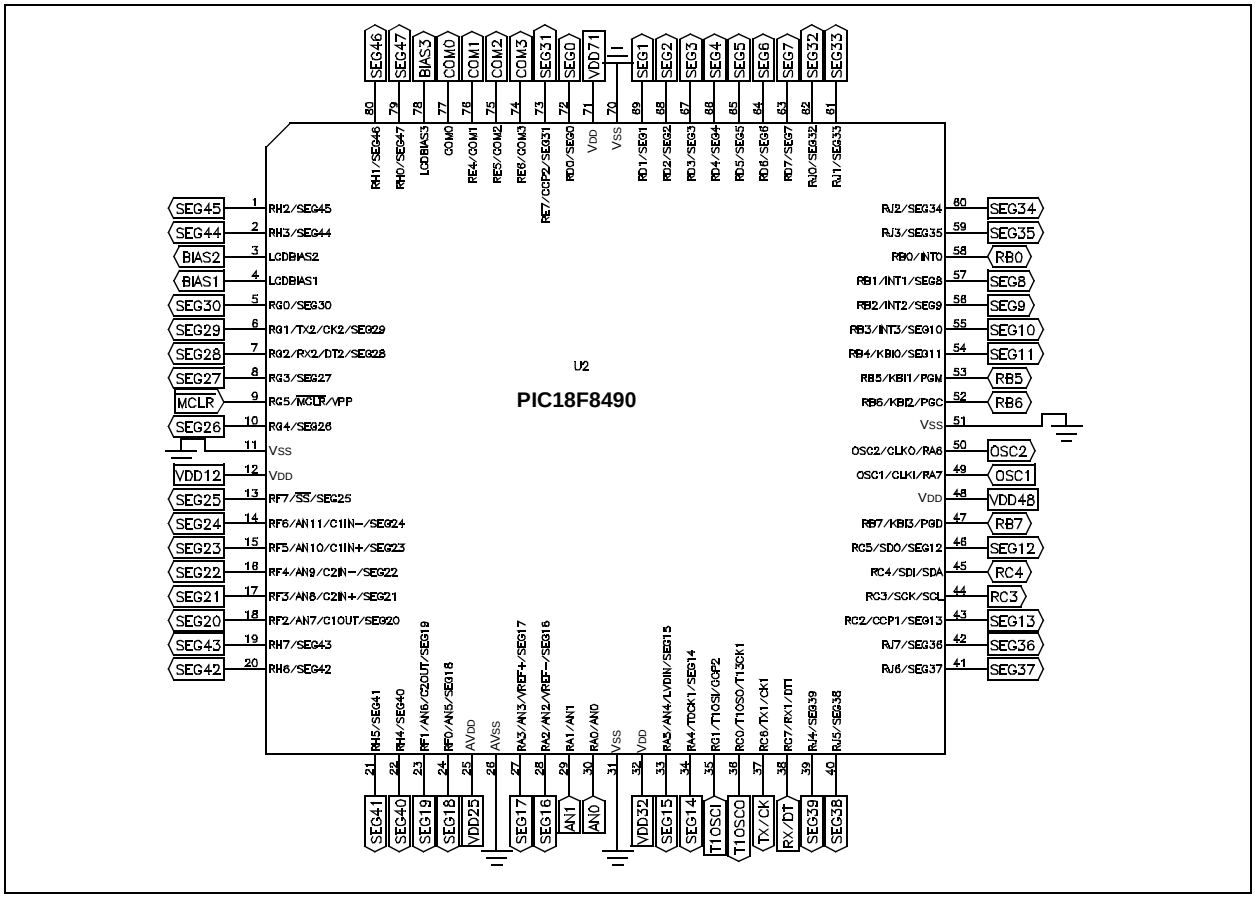

FIGURE A-27: PICDEM™ LCD 2 PIC18F6XJ90 64-PIN PIM SCHEMATIC

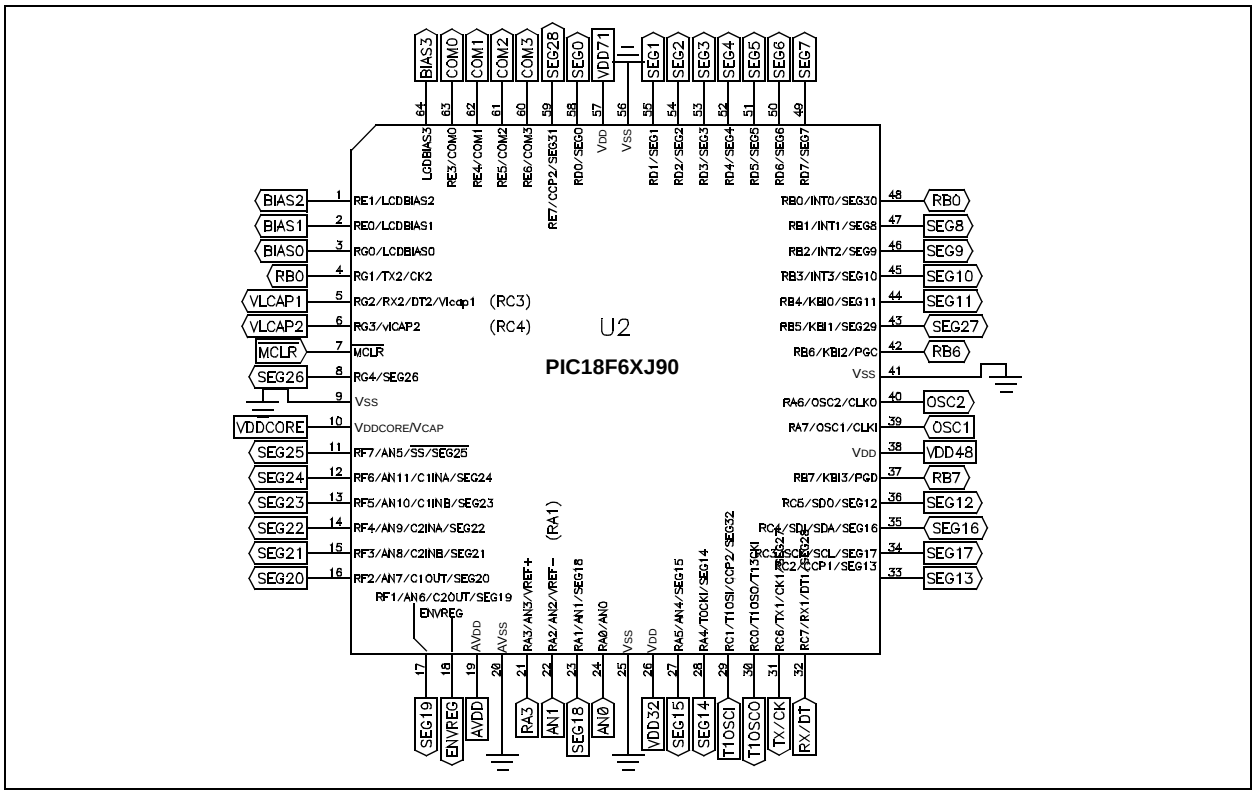

FIGURE A-28: PICDEM™ LCD 2 PIC18F87J90 80-PIN PIM SCHEMATIC

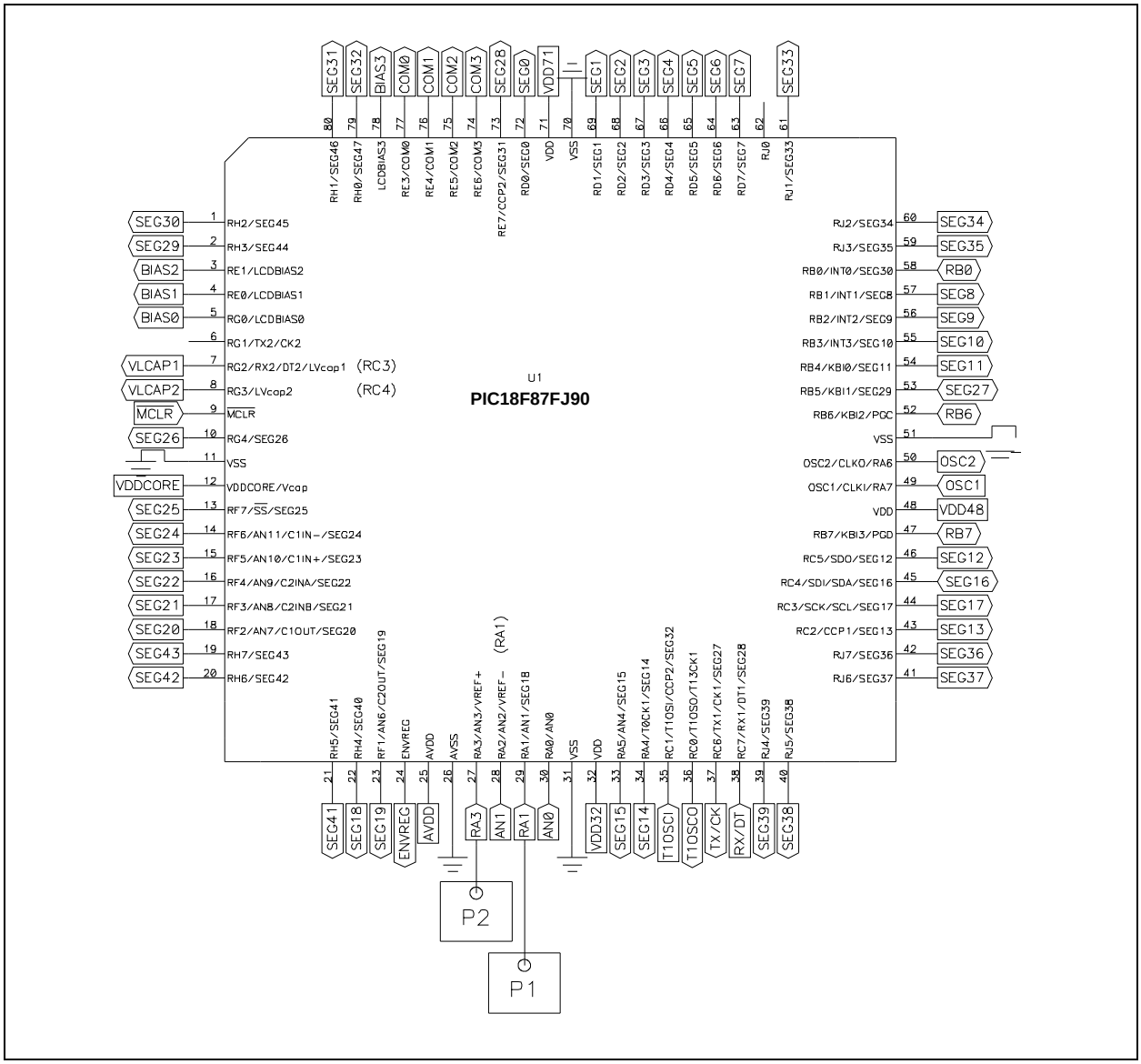

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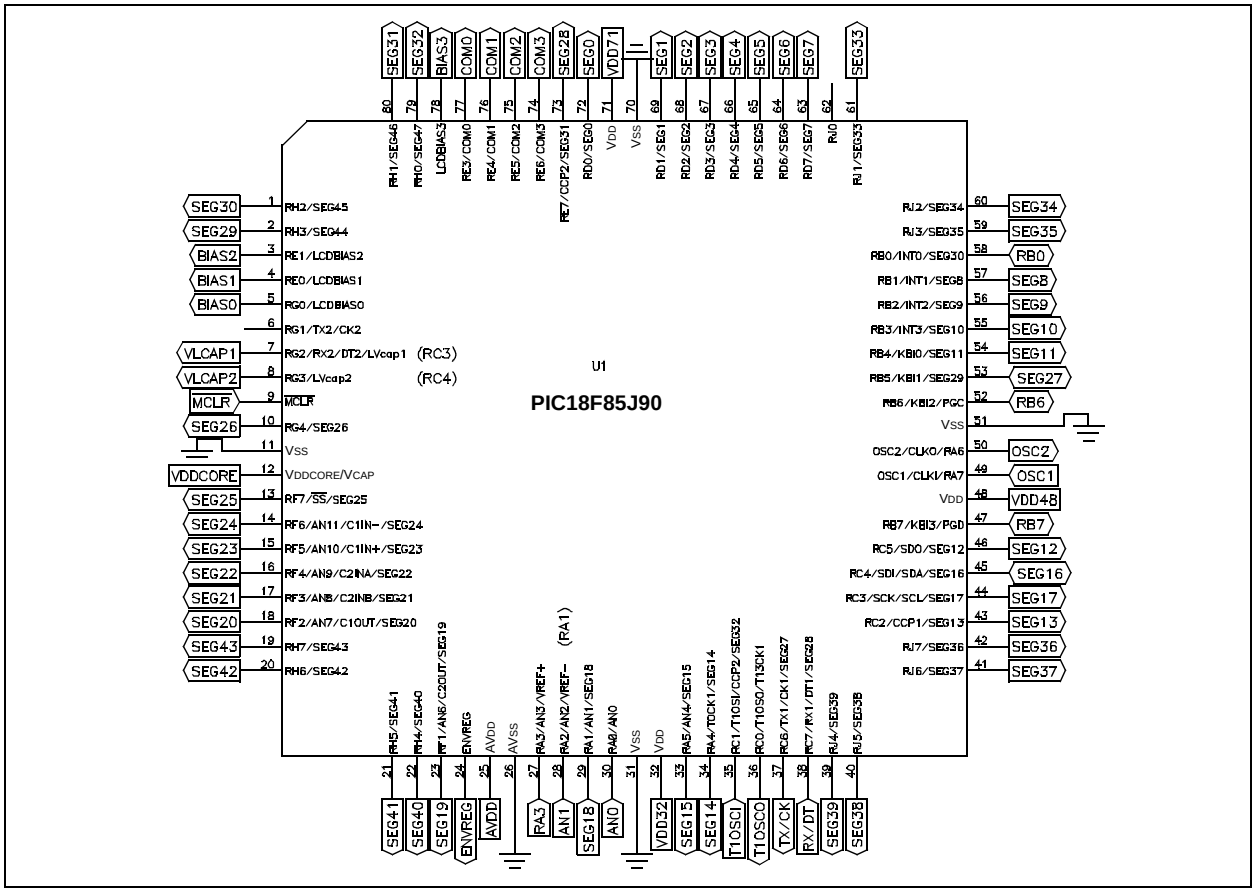
FIGURE A-29: PICDEM™ LCD 2 PIC18F85J90 80-PIN PIM SCHEMATIC



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