PICDEM™ 4
User's Guide

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PICDEM™ 4 USER'S GUIDE

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PICDEM™ 4 USER'S GUIDE

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.

INTRODUCTION

This chapter contains general information that will be useful to know before using the PICDEM™ 4 development 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™ 4 board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Introduction"** – Introduces the PICDEM 4 and provides a brief description of the hardware
- **Chapter 2. "Getting Started"** – Goes through a basic, step-by-step process for getting the PICDEM 4 running as a stand-alone board or with an ICE or ICD
- **Chapter 3. "Tutorial"** – Provides a detailed description of the tutorial program
- **Appendix A. "Hardware Detail"** – Gives hardware details of the PICDEM 4 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) { ... }`

WARRANTY REGISTRATION

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

RECOMMENDED READING

This user's guide describes how to use PICDEM 4. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

- Individual Data Sheets:
  - *PIC16F627A/628A/648A Data Sheet* (DS40044)
  - *PIC18F1220/1320 Data Sheet* (DS39605)
  - *PICmicro® Mid-Range MCU Family Reference Manual* (DS33023)
  - *PICmicro® 18C MCU Family Reference Manual* (DS39500)
- *MPLAB® IDE Simulator, Editor User's Guide* (DS51025)
- *MPASM™ Assembler, MPLINK™ Object Linker, MPLIB™ Object Librarian User's Guide* (DS33014)
- *PRO MATE® II User's Guide* (DS30082)
- *PICSTART® Plus User's Guide* (DS51028)
- *MPLAB® ICE Emulator User's Guide* (DS51159)
- *MPLAB® ICD 2 In-Circuit Debugger Quick Start Guide* (DS51268)

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at www.microchip.com. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (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

DEVELOPMENT SYSTEMS CUSTOMER CHANGE NOTIFICATION SERVICE

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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 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® 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.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

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

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

DOCUMENT REVISION HISTORY

Revision B (October 2007)

- Updated schematic in Appendix A
- Updated the document format to the new standard

Revision A (2003)

- Initial Release of this Document.

Chapter 1. Introduction

1.1 INTRODUCTION

The PICDEM™ 4 demonstration board demonstrates the capabilities of the 8, 14 and 18-pin PIC16XXXX and PIC18XXXX devices.

The PICDEM 4 can be used stand-alone with a programmed part or with an in-circuit emulator (such as MPLAB® ICE) or in-circuit debugger (such as MPLAB ICD 2). Sample programs are provided to demonstrate the unique features of the supported devices.

The PICDEM 4 Kit comes with the following:

- PICDEM 4 Demonstration Board (Figure 1-1)
- Sample Devices
- CD-ROM, which contains:
  - Sample programs
  - PICDEM 4 Demonstration Board User's Guide
  - Application notes

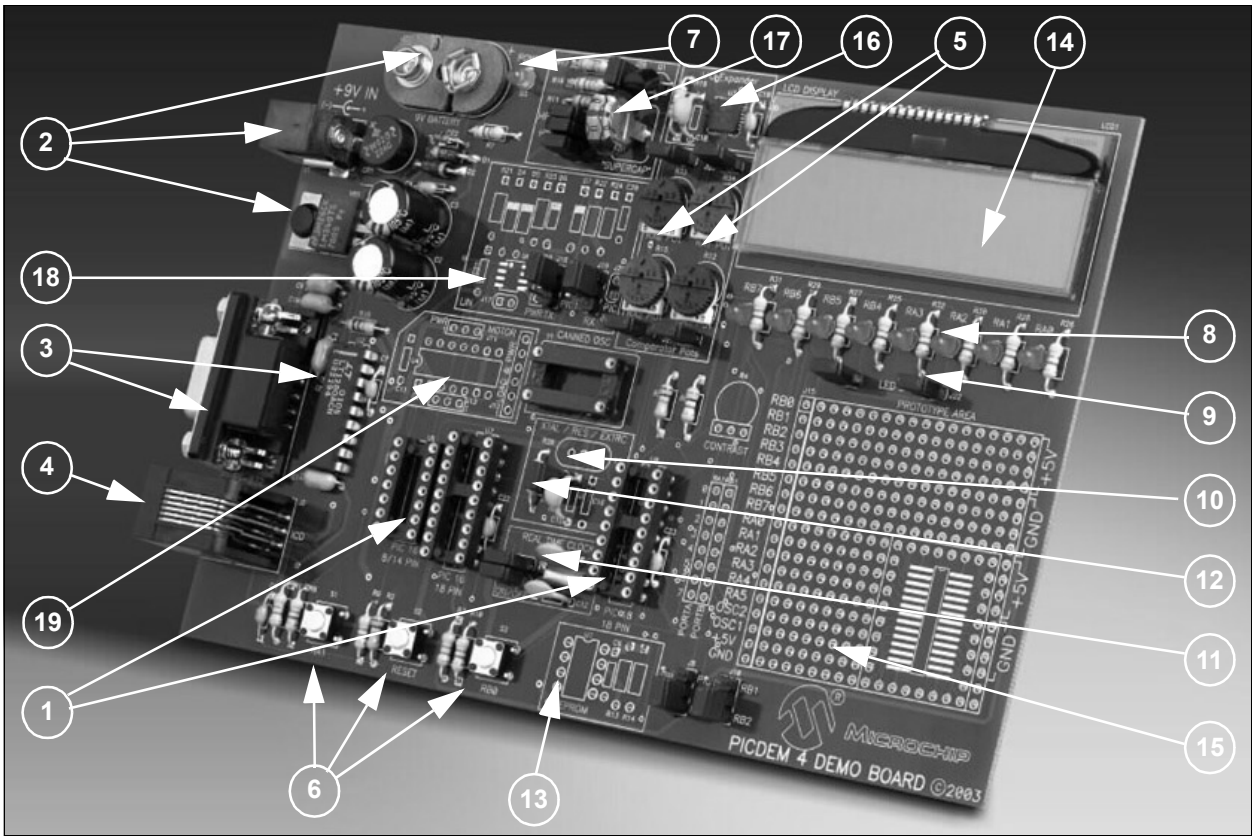
If you are missing any part of the kit, please contact your nearest Microchip sales office listed in the back of this publication.

1.2 PICDEM™ 4 DEMONSTRATION BOARD

The PICDEM 4 demonstration board has the following hardware features, with the feature number corresponding to the call-out in Figure 1-1:

1. 8, 14 and 18-pin DIP sockets
   (Although three sockets are provided, only one device may be used at a time.)
2. On-board, +5V regulator for direct input from 9V, 100 mA AC/DC wall adapter or 9V battery, or hooks for a +5V, 100 mA regulated DC supply
3. RS-232 connection and associated hardware for direct connection to RS-232 interface
4. In-Circuit Debugger (ICD) connector
5. Four, 5 kΩ pots for devices with analog inputs and comparators
6. Three pushbutton switches for external stimulus and Reset
7. Green, power-on indicator LED
8. Eight red LEDs connected to PORTA and PORTB
9. Jumpers, J21 and J22, to disconnect LEDs from PORTA and PORTB
10. Unpopulated holes provided for crystal connection
11. 32.768 kHz crystal for Timer1 Real-Time Clock (RTC) operation
12. Jumper, J14, to disconnect on-board RC oscillator (R20 and C15, approx. 2 MHz)
13. Unpopulated holes for EEPROM
14. 2 x 16 LCD display
15. Prototype area for user hardware
16. PIC16LF72 I/O expander
17. Supercapacitor circuitry
18. Unpopulated holes for a LIN transceiver
19. Unpopulated holes for a motor driver

FIGURE 1-1: PICDEM™ 4 HARDWARE



1.3 SAMPLE DEVICES

Two Flash devices are included. The device types may change, but generally include PIC16XXXX and PIC18XXXX 18-pin, DIP devices.

1.4 SAMPLE PROGRAMS

The PICDEM 4 Kit includes a CD-ROM with sample demonstration programs. These programs may be used with the included sample devices, with an In-Circuit Emulator (ICE) or with an In-Circuit Debugger (ICD). For each type of device (PIC16XXXX or PIC18XXXX), demo source code (several ASM files) and compiled code (one hex file) are provided.

NOTES:

Chapter 2. Getting Started

The PICDEM 4 may be used as a stand-alone board with a preprogrammed device or with an In-Circuit Emulator (ICE) or In-Circuit Debugger (ICD). For a list of PIC® microcontroller compatible ICEs or ICDs, see the "*Development Systems Ordering Guide".*

2.1 PICDEM™ 4 AS A STAND-ALONE BOARD – PREPROGRAMMED DEVICE

The PICDEM 4 may be demonstrated immediately by following the steps listed below:

1. Place the preprogrammed sample device in the appropriate socket on the PICDEM 4 board.
2. Apply power to the PICDEM 4.

   For information on acceptable power sources, see **Appendix A. "Hardware Detail"**.

Note: In the event that the preprogrammed PICDEM 4 demonstration board does not operate, check the following conditions:

- J8/J10 must be connected for the appropriate device
- J3, J4, J7, J9 and J24-J27 must be ON
- J23 and J28 must be OFF

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

To reprogram the sample device, the following items are needed:

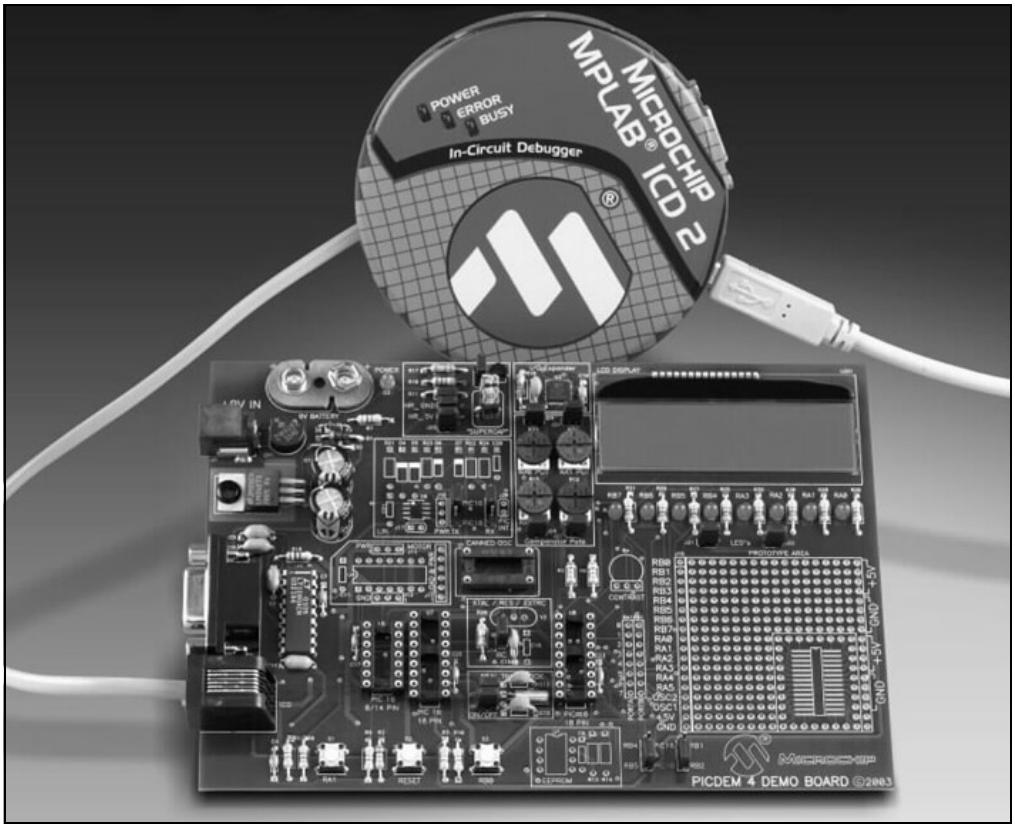
- Program source code.
- User source code may be used to program the device (If this is done, the sample program can be restored from the file on the included CD-ROM.)
- An assembler, such as MPASM™ assembler (available with MPLAB IDE), or a compiler, such as MPLAB C18 (PIC18XXXX devices only).
- Source 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.
- A device programmer, such as PRO MATE® II, PICSTART® Plus or MPLAB ICD 2 (programmer functionality available with MPLAB IDE v6.00 or greater).
- Once the sample program is in hex file format, a programmer may be used to program a Flash device. Microchip Technology's PRO MATE II device programmer, PICSTART Plus development programmer or MPLAB ICD 2 may be used. All are compatible with MPLAB IDE. However, other programmers may be used.

  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™ 4 USED WITH AN IN-CIRCUIT EMULATOR OR IN-CIRCUIT DEBUGGER

To use PICDEM 4 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 and make connections to target boards, such as in Figure 2-1.

FIGURE 2-1: PICDEM™ 4 CONNECTED TO MPLAB® ICD 2 USING USB



Configure the PICDEM 4 for the desired oscillator, as described in Table 2-1. For any oscillator configuration requirements, refer to the ICE/ICD user's guide.

TABLE 2-1: OSCILLATOR SELECTION

Oscillator Selection on PICDEM™ 4	Modification on PICDEM™ 4
RC	• J14 – ON • Y3 – Empty • Y1 – Empty
Crystal	• J14 – OFF • Y1 – Empty • Y3 – Crystal in • C15 – Capped • C16 – Capped
Canned Oscillator	• J14 – OFF • Y1 – Oscillator in • Y3 – Empty • C15 – Empty • C16 – Empty
Device Internal Oscillator	• J14 – OFF • Y1 – Empty • Y3 – Empty
Resonator – No Internal Caps	• J14 – OFF • Y1 – Empty • Y3 – Resonator in • C15 – Capped • C16 – Capped
Resonator – With Internal Caps	• J14 – OFF • Y1 – Empty • Y3 – Resonator in • C15 – Empty • C16 – Empty

NOTES:

Chapter 3. Tutorial

The tutorial program is preprogrammed into the PICDEM 4 demonstration board's sample device. (For PIC16XXXX devices, there is the program file, `p16PDEM4_Demo.hex`. For PIC18XXXX devices, there is a `p18PDEM4_Demo.hex` file.)

These programs also are on the CD-ROM program disc included with the device. If the sample device has been reprogrammed, the CD can be used to reprogram the device with the tutorial.

For detailed information on the PICDEM 4 hardware, see **Appendix A. "Hardware Detail"**.

3.1 TUTORIAL FIRMWARE OPERATION

3.1.1 PIC18F Tutorial Firmware

The PIC18F tutorial firmware has two components which are individually displayed on the LCD. The tutorial's program flow is shown in Figure 3-1.

The PIC® microcontroller's internal RC oscillator is used as the system clock source.

The PIC18F tutorial firmware components are:

- Voltmeter

  This mode uses the A/D module to measure the voltage of the R33 pot and displays a voltage between 0.00V and 5.00V on the LCD.

  Voltage is continually updated until the mode is exited by pressing SW3 (RB0).

  To operate the voltmeter:

  1. After the main menu, with the board's name, appears on the LCD, start the test by pressing SW3.
     The LCD displays the voltage measurement.
  2. Exit the test by pressing SW3.
     The tutorial advances to the clock component.

- Clock

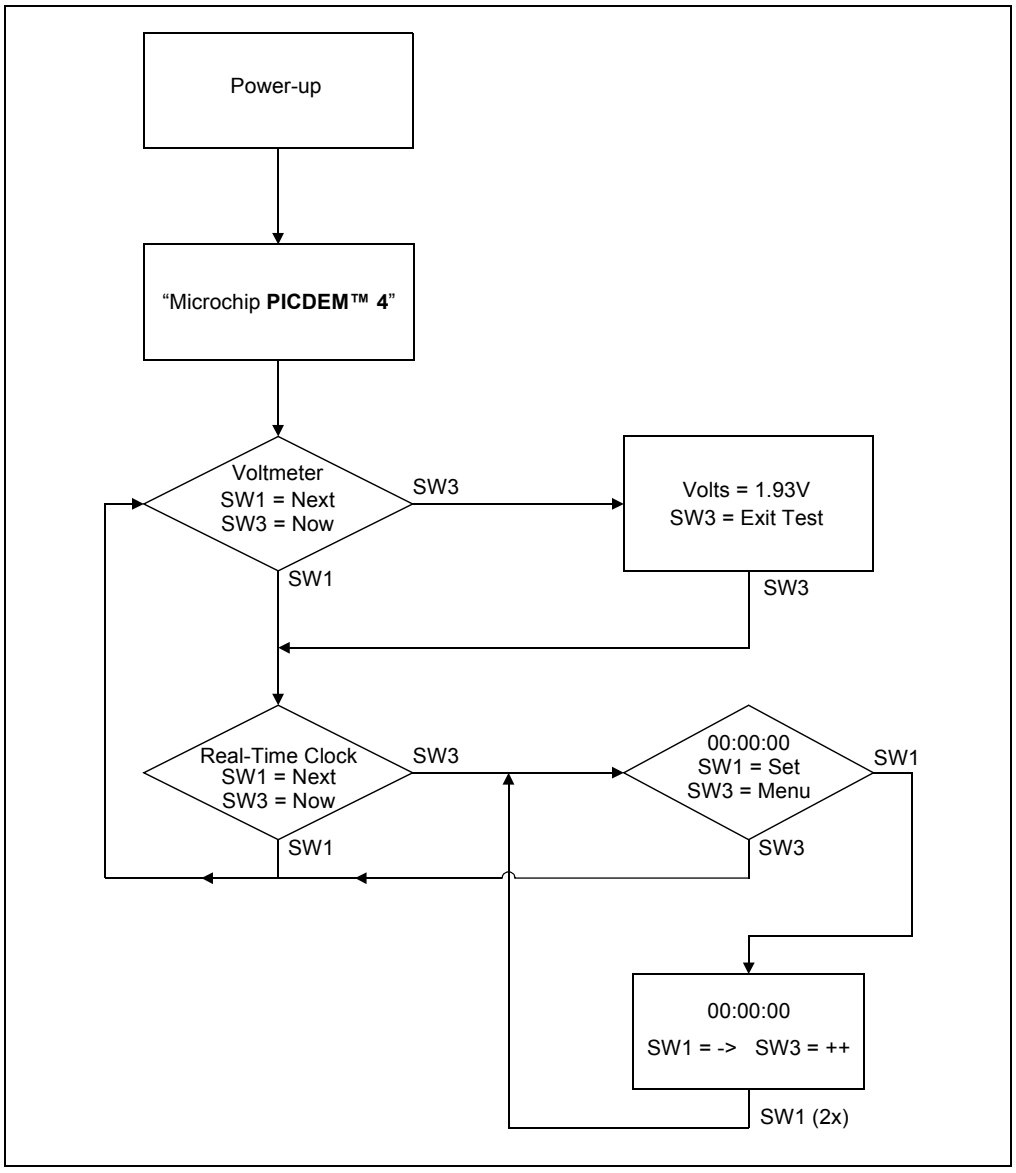
  Once this mode is entered from the main menu, a Real-Time Clock will start counting from 00:00:00. The Timer1 module and a 32 kHz clock crystal is used to establish a Real-Time Clock.

  To set the clock time:

  1. Do one of the following:
     - If you have completed the Voltmeter mode, proceed to Step 2.
     - If you are at the beginning, device name display, advance to the Clock mode by pressing SW3.
  2. Start the clock setting process by pressing SW1.
     The cursor begins flashing over the *hours* digits.
  3. Increment the hours as desired by pressing SW3.

4. When the desired hours are set, move the cursor to the *minutes* digits by pressing SW1 *twice*.
   The cursor begins flashing over the *minutes* digits.
5. Increment the minutes by pressing SW3.
6. Save the time setting by pressing SW1 *twice*.
   The time is set and the LCD returns to an active clock display.
7. Exit the Clock mode by pressing SW3.

FIGURE 3-1: PIC18F TUTORIAL PROGRAM FLOWCHART



3.1.2 PIC16F Tutorial Firmware

The PIC16F tutorial firmware has one component that uses the comparator module and potentiometers, R12, R15, R33 and R34.

By turning the potentiometers, the PIC16 input voltages vary, changing the values of the comparator outputs. The changing values are displayed on the LCD.

3.2 SOURCE CODE AND APPLICATION NOTES

The assembled tutorial programs (hex files), and the source code used to create them, are on the PICDEM 4 CD-ROM. The source code and hex files for each device are stored in separate directories.

The CD-ROM also contains application notes with other usage examples.

For information on reprogramming the device with new or modified code or restoring the tutorial program, see **Section 2.1 "PICDEM™ 4 as a Stand-Alone Board – Preprogrammed Device"**.

NOTES:

Appendix A. Hardware Detail

This section provides details on the features, options, configurations, and components of the PICDEM 4 hardware.

> **Note:** Many of this section's discussed features and options require specific configurations of the board's jumpers. If a section does not list a setting for a jumper, that jumper has no effect on the circuitry being discussed in that section.
> For more information, see the PICDEM 4 silkscreen with all necessary jumpers highlighted, in Figure A-1, and the schematics for the circuit connections.

A.1 PROCESSOR SOCKETS

Three sockets are provided, but only one device can be used at a time. The sockets are:

- 8 or 14-pin socket (U5) – used for 8 or 14-pin devices
  (8-pin devices are inserted in the upper 8 pins of U5)
- 18-pin PIC16 socket (U7)
- 18-pin PIC18 socket (U8)

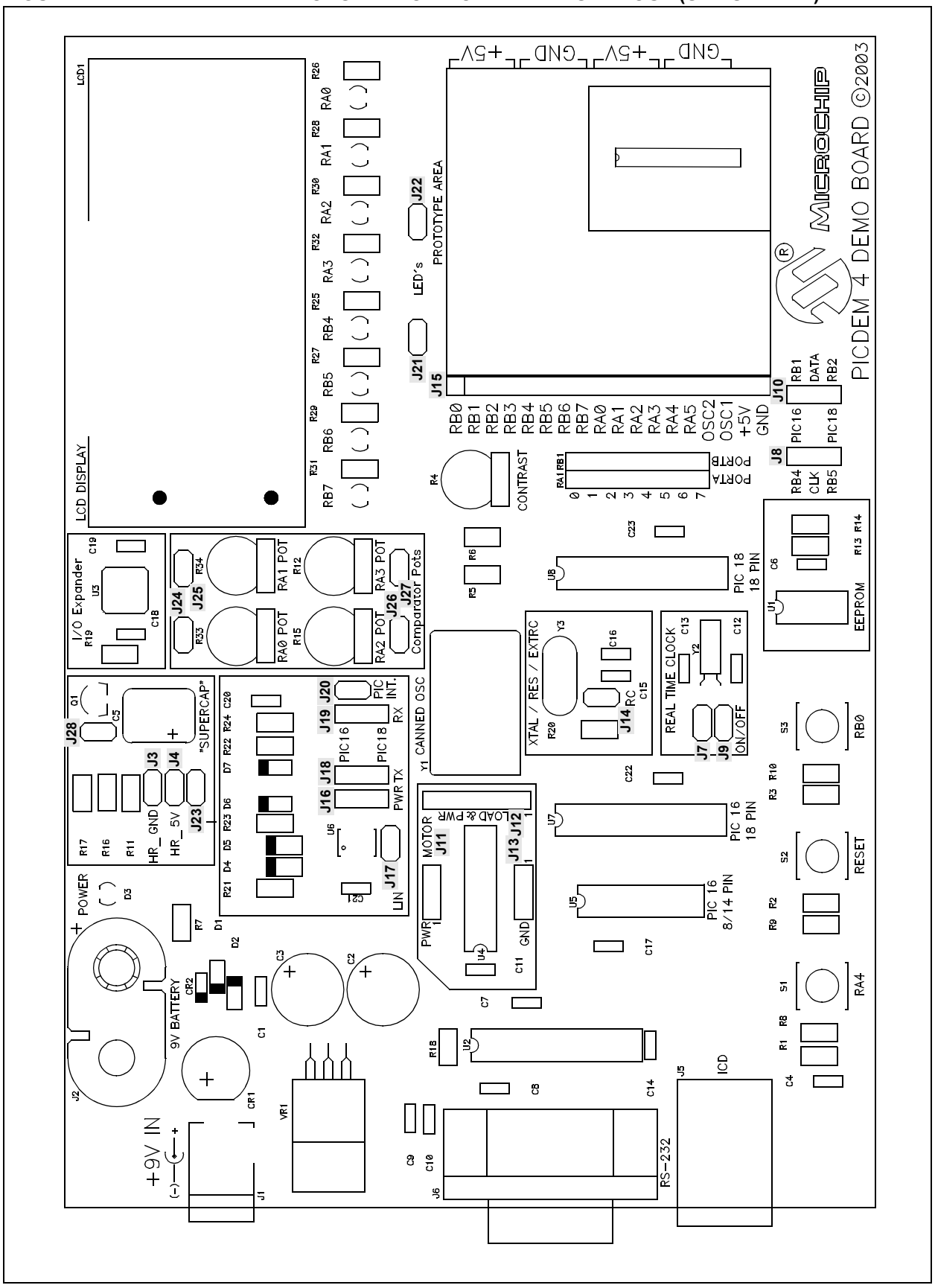
A.2 LED DISPLAY

Eight red LEDs are connected to PORTA and PORTB of U7 and U8, with five of the eight LEDs connected to U5. To light the LEDs, the PORTA and PORTB pins are set high.

To disconnect these LEDs from PORTA and PORTB, remove jumpers, J21 and J22.

One green LED indicates when there is power to the PICDEM 4 board (LED on) or not (LED off).

FIGURE A-1: PICDEM™ 4 DEMONSTRATION BOARD PARTS LAYOUT (SILKSCREEN)



A.3 POWER SUPPLY

There are three ways to supply power to PICDEM 4:

- Plug a 9V battery into J2.
- Plug a 9V, 100-mA, unregulated AC or DC supply into J1.
  A power supply can be purchased through Microchip, Part #AC162039.
- Connect a +5V, 100-mA, regulated DC supply to the provided hooks.

Note 1: There are two jumpers (J3 and J4) associated with the power supply circuit. These jumpers must be on for all functions, with the exception of the Supercapacitor circuit. For more details, see **Section A.12 "Supercapacitor"**.

2: The PICDEM 4 kit does not include a power supply.

MPLAB® ICE 2000 users have a regulated +5V power supply available in the logic probe connector and easily can connect to the hooks on the PICDEM 4. (Connect the red probe to +5V and the black probe to GND.)

MPLAB ICD 2 users can use the ICD to power the target board to 5V, up to 200 mA. This requires the MPLAB ICD 2 to be connected to the PC with a serial cable.

A.4 RS-232 SERIAL PORT

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

The PIC16/PIC18 RX and TX pins are tied to the RX and TX lines of the LT1280ACN.

Unlike previous demo boards, the RS-232 chip has an ON/OFF pin which is connected to I/O pin, RB3. For RS-232 operation, these jumpers must be configured as follows:

PIC16

- J18/19 – Upper two pins ON
- J20 – OFF (if populated)

PIC18

- J18/19 – Lower two pins ON

A.5 SWITCHES

Three board switches provide the following functions:

- S1 – Active-low switch connected to RA4
- S2 – $\overline{\text{MCLR}}$ to hard reset the processor
- S3 – Active-low switch connected to RB0

The S2 switch has a debounce capacitor, but S1 and S3 do not. This enables the user to investigate debounce techniques.

When pressed, the switches are grounded. When Idle, the switches are pulled high (+5V).

A.6 OSCILLATOR OPTIONS

- RC oscillator (2 MHz approximately) supplied.
  This oscillator may be disabled by removing jumper J14.
- Pads provided for user-furnished crystal/resonator and two capacitors (Y3).
- Socket provided for a canned oscillator (Y1).
- 32.768 kHz (watch type) crystal for Timer1 (Y2).
  This oscillator can be disabled by removing jumpers J7 and J9.

A.7 ANALOG INPUT

There are four, 5 kΩ potentiometers (R12, R15, R33, R34) on the PICDEM 4 board. These are all connected to PORTA (RA0-RA3) and can be adjusted from V_{SS} to V_{DD} to provide an analog input to the devices with an A/D or comparator module.

Potentiometers, R12, R15, R33, and R34, all have individual jumpers. For a potentiometer to function, its specific jumper must be on. A removed jumper will allow for other I/O functions to take place.

For all of the potentiometers to be functional, the jumpers must be configured as follows:

- J22 – OFF (PORTA LEDs)
- J24 – ON
- J25 – ON
- If J26 is ON, then J23 is OFF
- If J27 is ON, then J28 is OFF

A.8 ICD CONNECTOR

By way of the modular connector (J5), the MPLAB ICD 2 can be connected for low-cost debugging. The ICD connector utilizes RB6 and RB7 of the microcontroller for in-circuit debugging.

For ICD operation:

- The Real-time Clock connections to the microcontroller must be disabled
- These jumpers must be configured as follows:
  - J7 – OFF (RTC)
  - J9 – OFF (RTC)
  - J21 – OFF (PORTB LEDs)

A.9 SERIAL EEPROM

For EEPROM operation, these jumpers must be configured as follows:

PIC16

- J8/10 – Upper two pins ON
- J21 – OFF (PORTB LEDs)

PIC18

- J8/10 – Lower two pins ON
- J21 – OFF (PORTB LEDs)

A.10 MOTOR

There are three headers (J11, J12 and J13) for the motor driver circuit. These will allow for external power and load connections.

For motor control operation, these jumpers must be configured as follows:

J11

- Left 2 pins – Board PWR
- Right 2 pins – External PWR

J13

- Left 2 pins – Board GND
- Right 2 pins – External GND

J12

- Connect External Power Source and Load.
  (Lower pin (1) is PWR, top pin is GND.)
- J19 – OFF

A.10.1 PICDEM™ 4 Motor Control Demo

The TC4467 devices are a family of four output CMOS buffers/MOSFET drivers. The PIC MCU PWM output is connected to these drivers to create a variety of possible driving conditions.

Figure A-2 through Figure A-5 show some possible configurations. The driver can directly drive the small load or can act as a MOSFET driver for a bigger load request.

FIGURE A-2: SINGLE OUTPUT MODE PWM

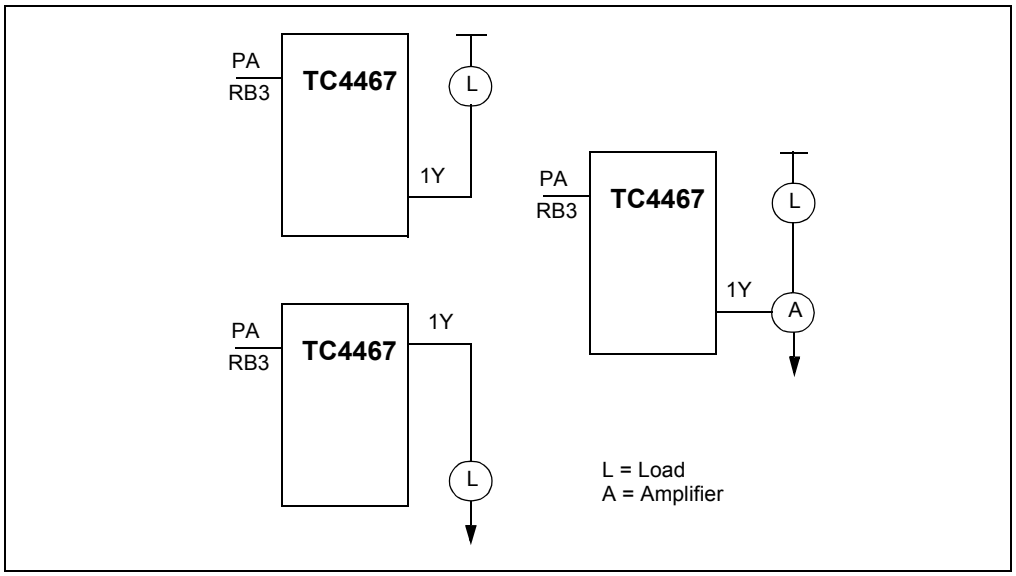


FIGURE A-3: DIRECT H-BRIDGE DRIVER IN ECCP HALF-BRIDGE OUTPUT MODE

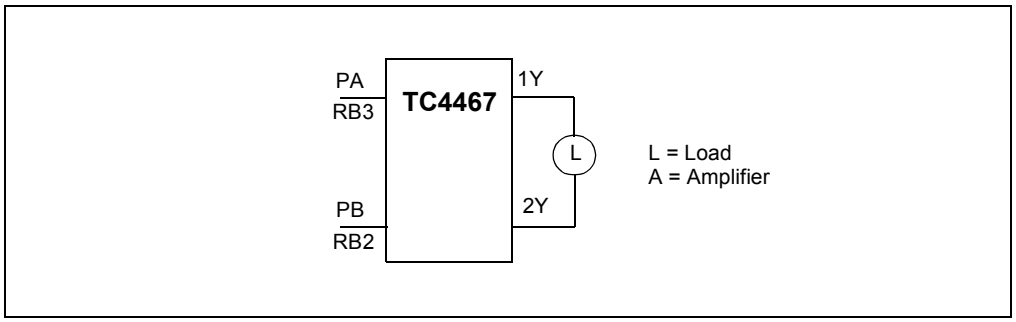


FIGURE A-4: HALF-BRIDGE MODE PWM

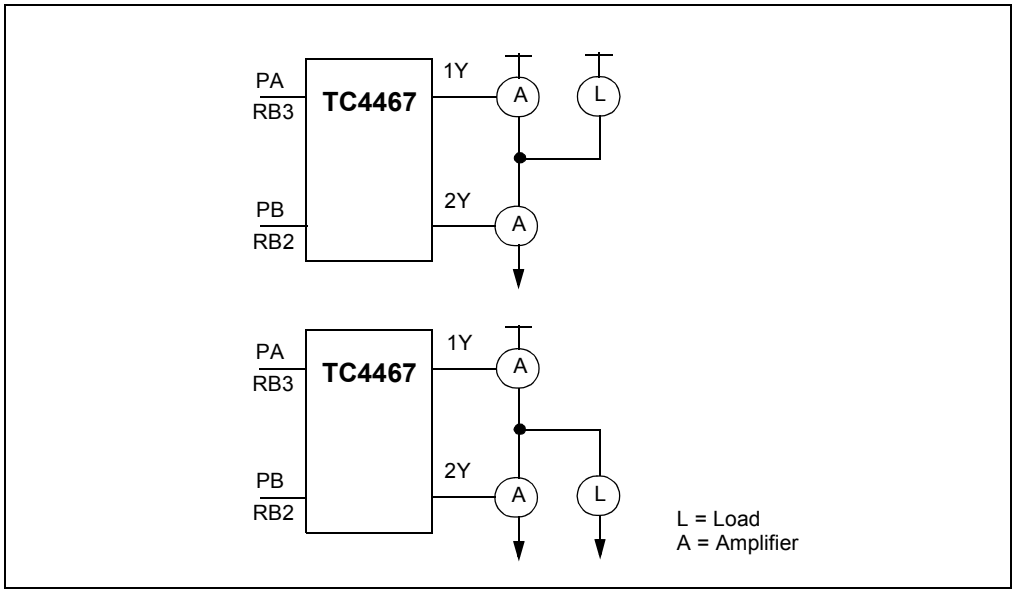
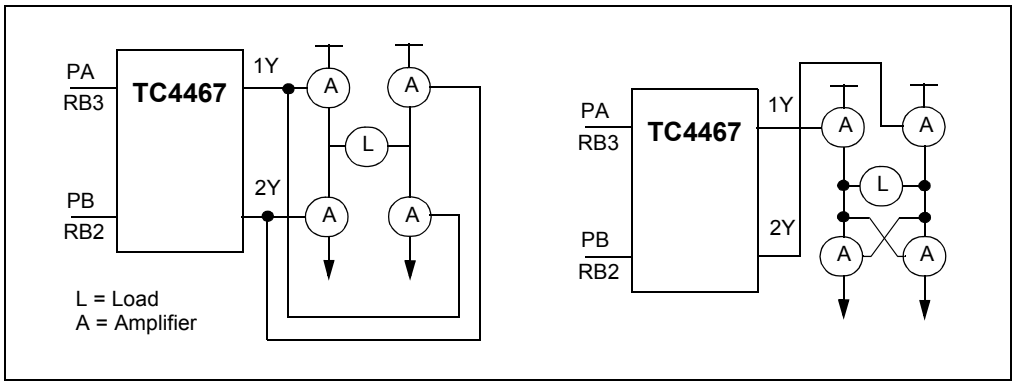


FIGURE A-5: DUAL OUTPUT PWM IN H-BRIDGE CONFIGURATION



A.11 LIN

The PICDEM 4 is designed with an optional, Local Interconnect Network (LIN) circuit (not populated). This circuit provides the essential circuitry to interface a PIC microcontroller to a LIN. The circuit includes a MCP201 LIN transceiver, reverse voltage protection and overvoltage protection.

Jumpers, J16, J17, J18, J19 and J20, are provided to set up and connect a PIC microcontroller on the PICDEM 4 to the LIN bus. External jumper, J16, provides the connection to the LIN bus.

With the MCP201 installed, power to the PICDEM 4 can be supplied from the LIN bus battery connection via J16. Shorting J17 enables bus power to the circuitry beyond the LIN interface circuit. (For maximum conditions, refer to the MCP201 voltage regulator specifications.)

Jumpers, J18, J19 and J20, provide connections to the microcontroller on the PICDEM 4. Shorting the appropriate pins (shown on the schematic) can connect either a PIC16 or PIC18 device to the LIN transceiver.

- J18 connects the LIN TX pin to either a PIC16 or PIC18 microcontroller.
- J19 connects the LIN RX pin to either a PIC16 or PIC18 microcontroller.
- J20 provides an additional receive connection for PIC16 devices.

For LIN operation, these jumpers must be configured as follows:

- J17 – ON

PIC18

- J18/J19 – Lower two pins ON
- J21 – OFF

PIC16

- J18/J19 – Upper two pins ON
- J20 – ON
- J21 – OFF

A.12 SUPERCAPACITOR

The 0.33F (C5) supercapacitor is used to demonstrate the low-power capabilities of PIC devices. This circuit requires all other peripherals to be disconnected from the circuit.

The supercapacitor code, included on your PICDEM 4 CD, is configured so that the device will remain in Sleep most of the time, while a 32 kHz watch crystal (Y2), connected to Timer1, keeps the PIC MCU running.

The device wakes up every second and toggles a port pin and a second port pin indicates the power start-up. If a power source is present, a high level is maintained. In the absence of power, the pin will go low.

In the event of a power failure, the supercapacitor will supply the PIC MCU with power through an internal protection diode on a port pin. If the user desires to measure the supercapacitor supply time, they will have to observe the power signals with an oscilloscope or another demo board.

Note: The supercapacitor circuit described in this manual is used only to demonstrate the low-power capability of the device. The supercapacitor is used as an example for the low-power source. **DO NOT use this circuit as a general design practice.**

For supercapacitor operation, these jumpers must be configured as follows:

- J3 – OFF (Power Supply)
- J4 – OFF (Power Supply)
- J22 – OFF (PORTA LEDs)
- J23 – ON (Supercapacitor)
- J26 – OFF (Potentiometer)
- J27 – OFF (Potentiometer)
- J28 – ON (LVD)

A.13 REAL-TIME CLOCK

This circuit allows the user to configure a PIC MCU in either the U7 or U8 socket for timekeeping, using a 32.768 kHz clock crystal connected to Timer1's T1OSO and T1OSI pins. ICD operation will not be functional when the Real-Time Clock circuit is enabled.

For RTC operation, these jumpers must be configured as follows:

- J7 – ON
- J9 – ON
- J21 – OFF

A.14 LCD DISPLAY

The LCD display has two lines with 16 characters per line. It is connected to the I/O expander (U3) which can be driven by all three device sockets.

A 10K pot may be installed into R4 to adjust contrast on the LCD. If this is done, R5 and R6 need to be removed.

The LCD is connected to the I/O expander by three control lines (E, R/W and RS) and four data lines (DB7:DB4).

For LCD operation, these jumpers must be configured as follows:

PIC16

- J8/10 – Upper two pins ON
- J21 – OFF (PORTB LEDs)

PIC18

- J8/10 – Lower two pins ON
- J21 – OFF (PORTB LEDs)

A.15 DEVICE CONFIGURATION OVERVIEW

Table A-1 lists the I/O features and port connections for each processor type.

TABLE A-1: PORT CONNECTIONS

Connection Type	Device		
	PIC12/PIC16 8 or 14-Pin	PIC16 18-Pin	PIC18 18-Pin
LEDs	RA0:RA2, RB4, RB5	ALL	ALL
RS-232	RB1/RB4	RB2/RB5	RB1/RB4
S1	RA4	RA4	RA4
S2	RA5	RA5	RA5
S3	RB0	RB0	RB0
R33 Pot	RA0	RA0	RA0
R34 Pot	RA1	RA1	RA1
R15 Pot	RA2	RA2	RA2
R12 Pot	N/A	RA3	RA3
LCD	RB1/RB4	RB1/RB4	RB1/RB4
EEPROM	RB1/RB4	RB1/RB4	RB1/RB4
ICD	N/A	RB6/RB7	RB6/RB7
LIN	N/A	RB2/RB5/RB1	RB1/RB4
Motor	RB2/RB3	RB2/RB3	RB2/RB3
RTC	N/A	RB6/RB7	RB6/RB7
Canned OSC	OSC1	OSC1	OSC1
RC Oscillator	OSC1	OSC1	OSC1
Crystal/Resonator	OSC1/OSC2	OSC1/OSC2	OSC1/OSC2
Supercapacitor Circuits	N/A	RA2/RA3	RA2/RA3

A.16 BOARD LAYOUT AND SCHEMATICS

Figure A-6 shows the PICDEM 4 board's parts layout (silkscreen) and Figure A-7 the schematic.

FIGURE A-6: PICDEM™ 4 PARTS LAYOUT

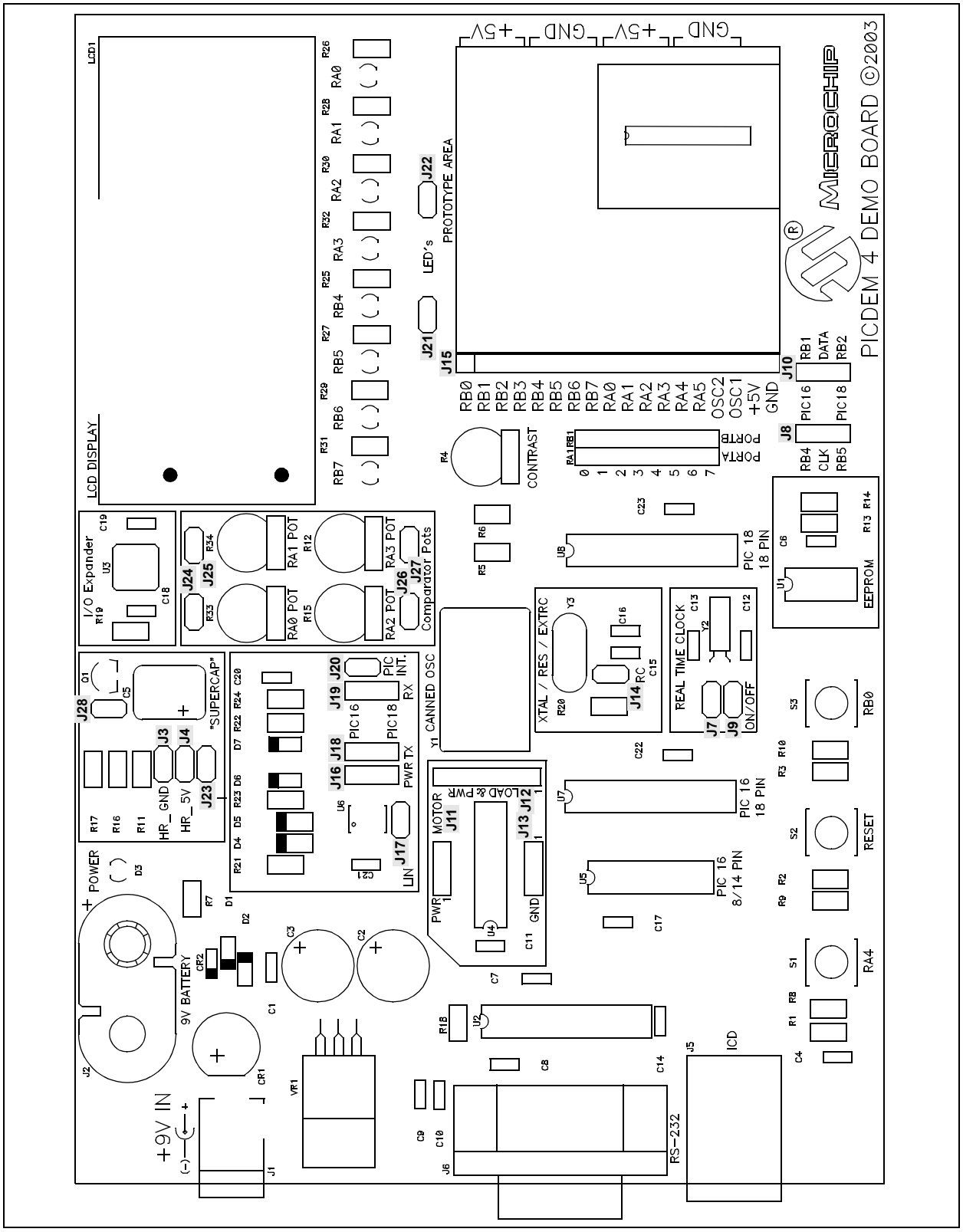
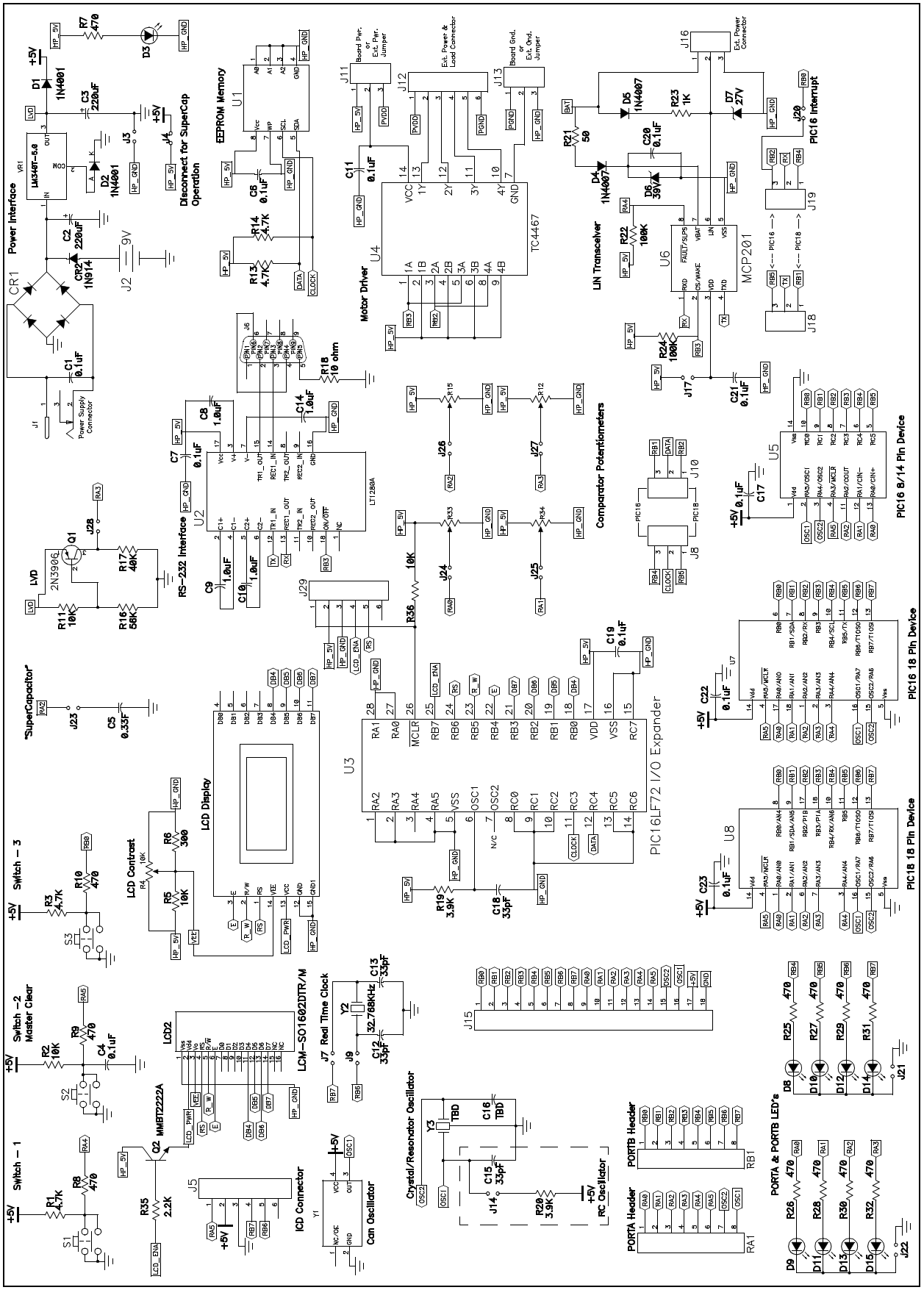


FIGURE A-7: PICDEM™ 4 SCHEMATIC 1



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