PICDEM-14A Demo Board

Overview

The PICDEM-14A is a general purpose platform which is provided to help evaluate the PIC14C000 mixed signal microcontroller. The board includes a full peripheral set that allows users to display data on an LCD panel, send data to a PC via RS-232, read/write to and from serial EEPROM, switch signals into the device, and prototype custom circuitry to interface with the microcontroller. Each peripheral set will be explained in this document.

Firmware Function

Each PICDEM-14A is populated with a pre-programmed PIC14C000 in the microcontroller socket. This device is programmed to perform the following functions.

1. Read the potentiometer (R4) voltage and display it in volts
2. Read the temperature sensor voltage, calculate a centigrade output, and display it in degrees centigrade

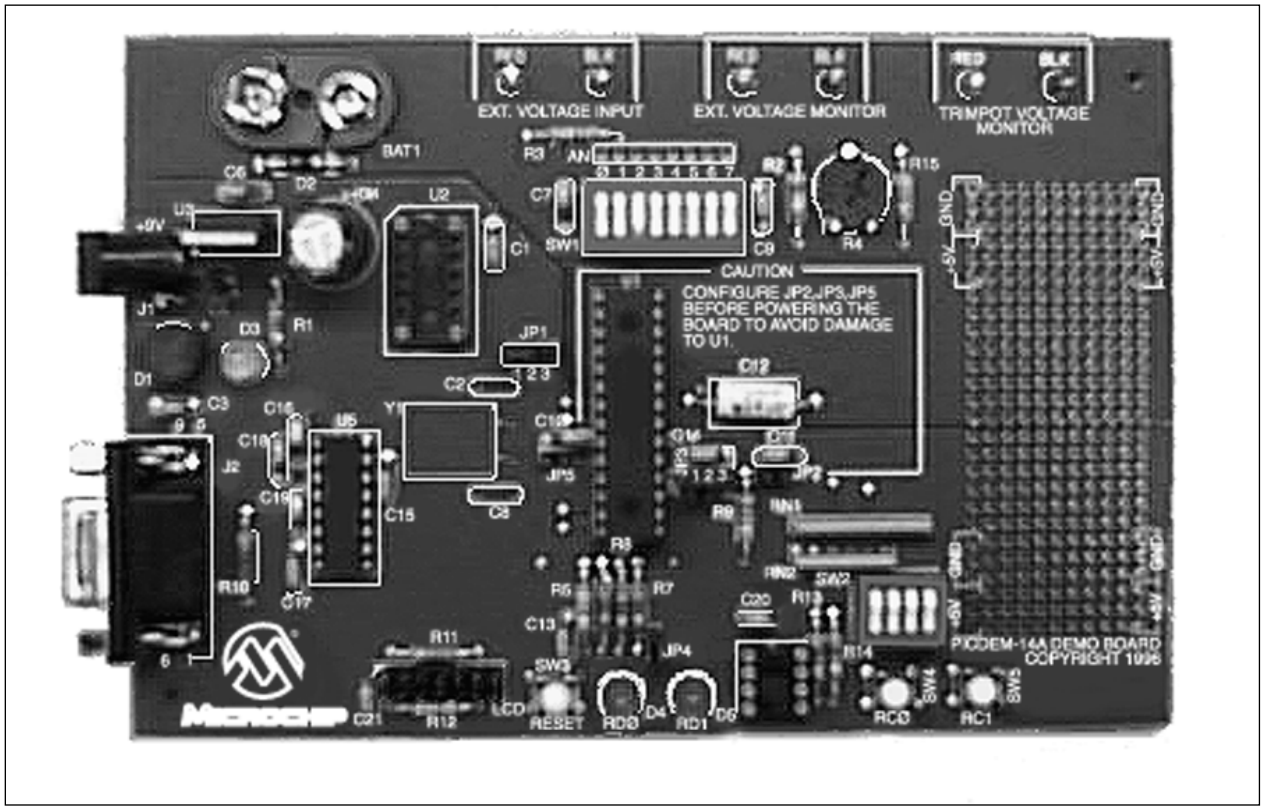


Figure 1: PICDEM-14A Demo Board Layout

3. Transmit this data in RS-232 format via the DB-9 connector (J2). An RS-232 level-shifting IC has been provided with the necessary hardware to support this connection. The port is configured as DCE, PICDEM-14A Demonstration Board and must be connected to a PC using a straight-through cable. The RS-232 data that is transferred may be viewed using a terminal emulation program, such as Windows® Terminal. To properly view the data that is sent from the PICDEM-14A, the terminal settings should be made as follows:
   - Baud rate: 9600
   - Data bits: 8
   - Stop bits: 1
   - Parity: None
   - Flow control: None
   - Connector: Select the COM port which is used to receive data

Setup and Operation

Step 1: Remove the PICDEM-14A from its packaging and connect either a 9V power supply or 9V battery, as specified in *Power Supply* on page 4. The green D3 LED should illuminate. The red D4 LED should also begin flashing. This is an indication that the programmed PIC14C000 sample is running A/D conversions and transmitting RS-232 data as described in *Firmware Function* on page 1.

If D3 is not illuminated, verify power supply connection. If D4 is not flashing, ensure the PIC14C000 is properly installed, and press SW3 to hard-reset the microcontroller.

Step 2: Connect a straight-through DB-9 cable from J2 on the PICDEM-14A to a serial port on a PC. Start Windows Terminal, and set the software switches as specified in *Firmware Function* on page 1.

Step 3: A data stream displaying the information specified in *Firmware Function* on page 1 will begin scrolling across the screen. Refer to Figure : for an example of what this data looks like when viewed using Windows95 HyperTerminal. Notice that there are three columns of data, separated by commas. The first column is the voltage from potentiometer R4, the second is the temperature in degrees celsius, and the third is the RS-232 auto-adjust scale which is being used to maintain the baud rate at 9600 bps using the PIC14C000 internal oscillator.

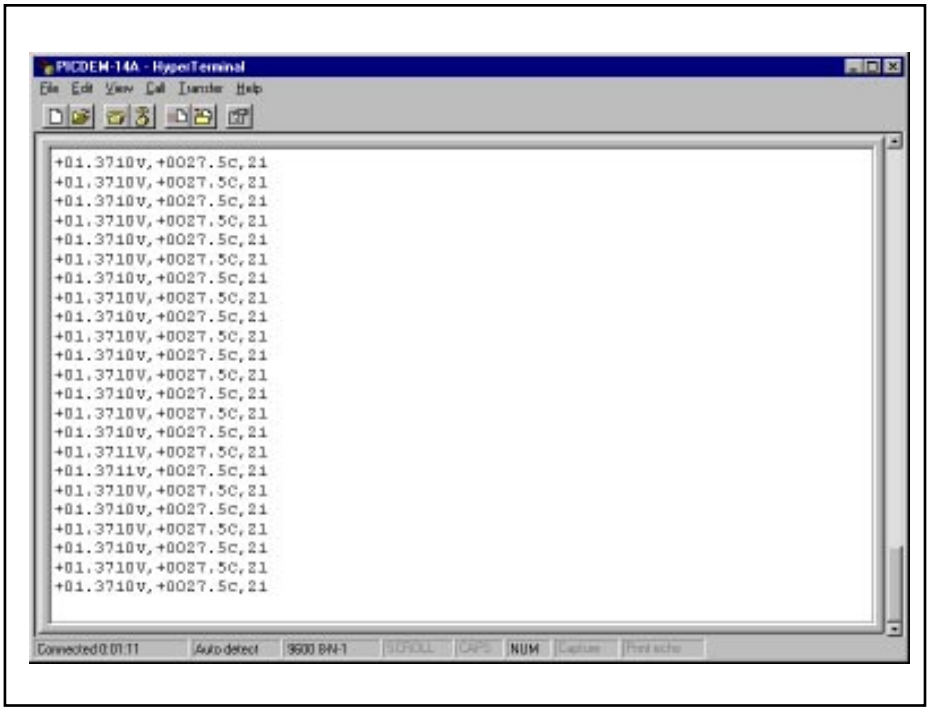


Figure 2: RS-232 Data Displayed in Window95 Hyperterminal

Processor Socket

The board is equipped with a 300 mil 28 pin socket (U1) for the PIC14C000 processor. Table 1 lists the jumper configurations which must be set to select the PIC14C000 processor. Failure to configure the jumpers may result in damaged parts.

Table 1: Processor Jumper Configurations

Jumper	PIC14C000
JP2	Remove
JP3	Pins 1&2
JP5	Remove

Display

One green LED (D3) will illuminate when power to the board is available.

Two red LEDs (D5 & D4) are connected, one each, to port pins RD1 and RD0 respectively. A high level on either pin will cause the corresponding LED to illuminate. These two LEDs can be disabled by removing jumper JP4.

Power Supply

There are two ways to power the boards:

- A 9V battery can be connected to BAT1.
- A 9V, 100mA unregulated AC or DC supply can be connected to J1.

RS-232 Serial Port

The board is equipped with a RS-232 driver chip to support connection to a host computer through the DB9 connector (J2). The port is configured as DCE, and can be connected to a PC via a straight-through serial cable.

The transmit line is connected to port pin RC4, and the receive line to port pin RC5. Since the PIC14C000 does not have a UART peripheral, the RS-232 implementation is done in software.

Switches

The board is equipped with several switch configurations for user inputs. The port lines to all of these switches are equipped with pull up resistors. These switches are described below.

- Momentary N-O push button switch (SW3) on $\overline{\text{MCLR}}$ to hard-reset the microcontroller.
- Momentary N-O push button switches (SW5 and SW4) on port pins RC1 & RC0 respectively for interactive user input.
- DIP switches (SW2)<4:1> on port pins RC<3:0> for user configuration inputs.

Note that port pins RC1 and RC0 are shared between push button switches (SW5 and SW4) and DIP switches (SW2)<2:1>. Therefore, to use SW4 or SW5, the corresponding DIP switch must be set in the open position.

Oscillator Options

The board is equipped with a socket for a clock oscillator (U2), such as those provided by ECS, P/N OECS-40-1-A101A, and the pads for a crystal (Y1) and its associated capacitors, C2 and C8. If the microcontroller is used with either of these external oscillator configurations, jumper JP1 must be configured to select the correct oscillator. The jumper configuration are shown in Table 2. Refer to Section 10.2 of the PIC14C000 data sheet, DS40122 for information on capacitor/crystal oscillator selection.

Table 2: External Clock Selection

JP1 Position	External Clock Source
Pins 2 and 3	Clock Oscillator
Pins 1and 2	Crystal

Analog Inputs

The analog inputs to the PIC14C000 can be from the following sources:

- External voltage input across J3 test point connectors. The red test point is positive, and the black test point is ground.
- Potentiometer R4 voltage. This ranges between 0 and 3.4V.
- User input on AN<7:0> pads.

The external input on J3 and the R4 potentiometer voltages go through RC low pass filters, and then DIP switches (SW1)<8:1> before connecting to the PIC14C000 analog inputs. To assist the user in comparing multiple A/D channel performance, the J3 external input connects to SW1<2,6:8>, and the R4 potentiometer input connects to SW1<1,3:5>. To input a voltage from any of the AN<7:0> pads, the corresponding DIP switch(es) must be set to the open position. Table 3 shows the analog input selection of the PIC14C000 depending on DIP switch (SW1) configuration.

Table 3: Analog input selection

Switch	Analog Input if Switch Open	Analog Input if Switch Closed
SW1<8>	AN7 = AN7 pad	AN7 = J3
SW1<7>	AN6 = AN6 pad	AN6 = J3
SW1<6>	AN5 = AN5 pad	AN5 = J3
SW1<5>	AN4 = AN4 pad	AN4 = R4
SW1<4>	AN3 = AN3 pad	AN3 = R4
SW1<3>	AN2 = AN2 pad	AN2 = R4
SW1<2>	AN1 = AN1 pad	AN1 = J3
SW1<1>	AN0 = AN0 pad	AN0 = R4

The J3 filtered external input and the R4 potentiometer voltage can be monitored using a DVM on J4 and J5 respectively.

Integrating Capacitor

The board is equipped with a 10nF poly-propylene capacitor (C12) for the PIC14C000 A/D converter.

Serial EEPROM Socket

The board is equipped with a socket (U4) for a 24LCxx serial EEPROM. The SDA pin of the EEPROM is connected to port pin RC7 (SDAA) on the PIC14C000. The SCL pin is connected to port pin RC6 (SCLA). Pull up resistors are also provided on the SDA and SCL signal lines for the I^2C protocol between the PIC14C000 and the EEPROM.

LCD Module Header

The board is equipped with a 14-pin header for ribbon cable connection of an LCD module such as Optrex DMC-16207N, or a compatible display. Refer to Table 4 for the pin definition of the LCD connector.

The LCD module is only connected to the microcontroller in the four-bit data bus configuration.

Table 4: LCD Module Header Definition

Pin	LCD signal	Description	PIC14C000 Connections
1	Ground	Ground	
2	+5V	Power	
3	V_L	Contrast/viewing angle	
4	RS	Data/instruction input	RD3
5	R/$\overline{W}$	Read/write signal	RD2
6	E	Enable signal	RD0
7	D0	Data bit 0	
8	D1	Data bit 1	
9	D2	Data bit 2	
10	D3	Data bit 3	
11	D4	Data bit 4	RD4
12	D5	Data bit 5	RD5
13	D6	Data bit 6	RD6
14	D7	Data bit 7	RD7

Analog Ground Plane

To achieve the best performance with the PIC14C000 microcontroller, the analog portion of the board is equipped with an analog ground plane on the component side. The purpose of this plane is for shielding and signal reference, not for power return. More specifically, if the user is attempting to resolve twelve or more bits with the A/D converter, the digital ground must be used for power return.

Prototype Area

The board is equipped with 1" x 2.5" prototype area of through-hole pads on 0.1" centers. This is provided for the user to build additional circuitry. The power supply and ground pads are available on the corners of this prototype area.

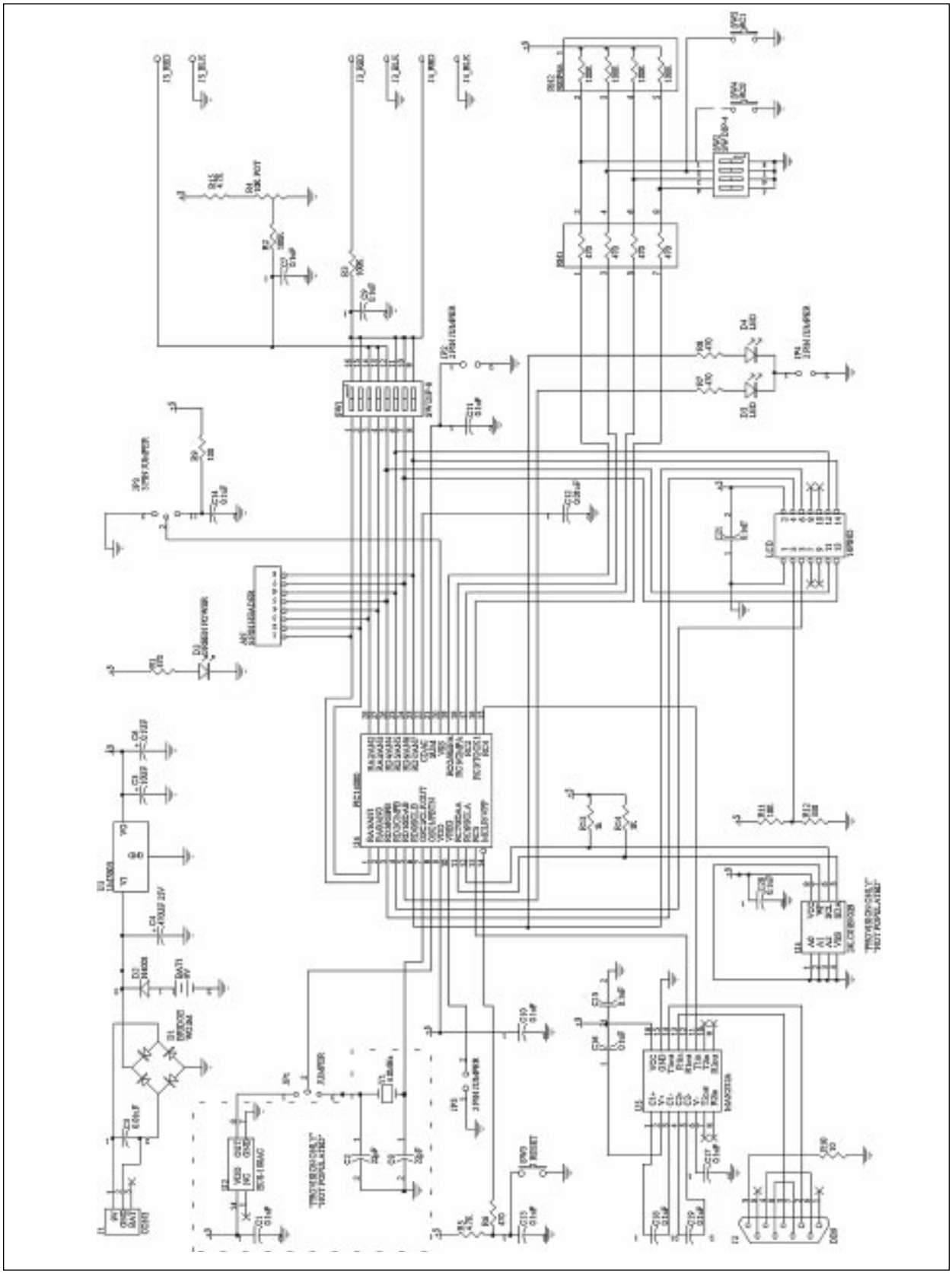
Port Utilization

Table 5 summarizes the PIC14C000 port connections to the PICDEM-14A peripherals.

Table 5: Processor port utilization

Socket Pin #	PIC14C000 I/O Port and A/D Input	PICDEM-14A Connections
27	RA3/AN3	AN3 Pad, J5
28	RA2/AN2	AN2 Pad, J5
1	RA1/AN1	AN1 Pad, J3, J4
2	RA0/AN0	AN0 Pad, J5
23	RD7/AN7	AN7 Pad, J3, J4, LCD-D7
24	RD6/AN6	AN6 Pad, J3, J4, LCD-D6
25	RD5/AN5	AN5 Pad, J3, J4, LCD-D5
26	RD4/AN4	AN4 Pad, J5 LCD-D4
3	RD3	LCD-RS
4	RD2	LCD-R/$\overline{W}$
5	RD1	D5
6	RD0	D4, LCD-E
11	RC7	EEPROM: SDA
12	RC6	EEPROM: SCL
13	RC5	RS-232: RX
15	RC4	RS-232: TX
16	RC3	SW2<4>
17	RC2	SW2<3>
18	RC1	SW2<2>, SW5
19	RC0	SW2<1>, SW4

Figure 3: PICDEM-14A Schematic



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