The Digital LCD Thermometer

Students will be breadboarding a self calibrating digital thermometer using the CTI SB-147 breadboard system. The temperature sensor I.C. used in this project, an LM34DZ, produces a +10mv change in output voltage for every degree (F) of temperature change.

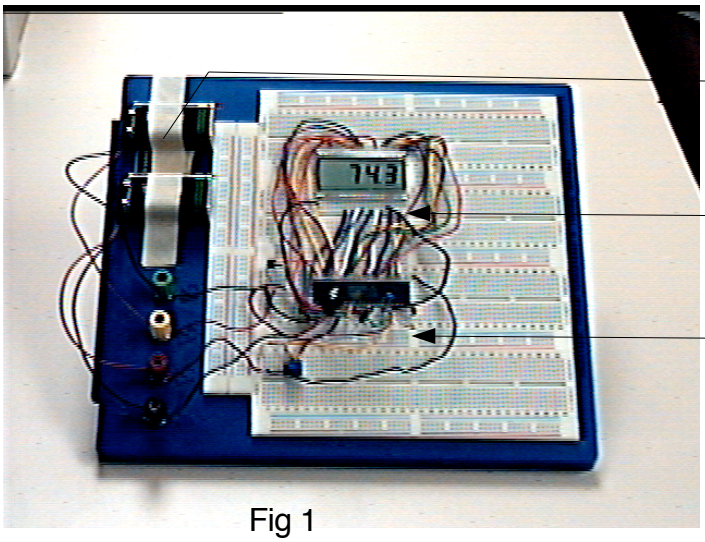


Fig 1

The heart of this project is an application specific integrated circuit , (ASIC) TC7106 that functions as a digital millivolt meter. The meter has a range of 0 to 1.999 volts dc. As a result of using the LM34DZ sensor the combined system can accurately measure temperature without upper and lower scale calibration procedures. When the room temperature is 74.9 deg. F, the LM34DZ temperature sensor produces an output of 10mv x 74.9 = 749mv. This value is directly displayed by the millivolt meter. With a little decimal point trickery (moving the decimal point one place to the left) our display shows 74.9 deg. The digital meter uses two (2) 9 volt batteries, one for the meter/display, the other for the temperature sensor circuit. The sensor circuit will function for a year or longer with one battery, however the digital display will only last about 1 week of continuous display before the battery will need to be replaced.

Part 1: Breadboarding

Students have used this breadboard system in the EE151 project, the LED Flasher, however in this project special techniques will be introduced in using the breadboard. **Both the LCD display and the digital volt meter I.C. are extremely fragile. Please be very careful when inserting and removing the parts.**

1. Cable transition: Each breadboard is equipped with 5-way banana/binding posts on .75" centers. These posts provide the function of interconnecting wire transition. The breadboards are capable of holding solid 22ga wire. Cables of larger or smaller diameter can be converted into 22ga wiring by use of the holding and connection features of the 5-way binding posts incorporated on the breadboard unit.

2. Structured Wiring: Students will be employing a technique of structured wiring in which we will use color coding for different functions of the circuit. Students will color code each segement of the LCD display with a different color wire.

3. Students will use a wiring practice the places all wires around the components so components can be removed without removing wiring.

Note the location of the liquid crystal insertion point. There is a small break in the left hand border of the display. When positioned in this manner pin #1 is directly below the artwo

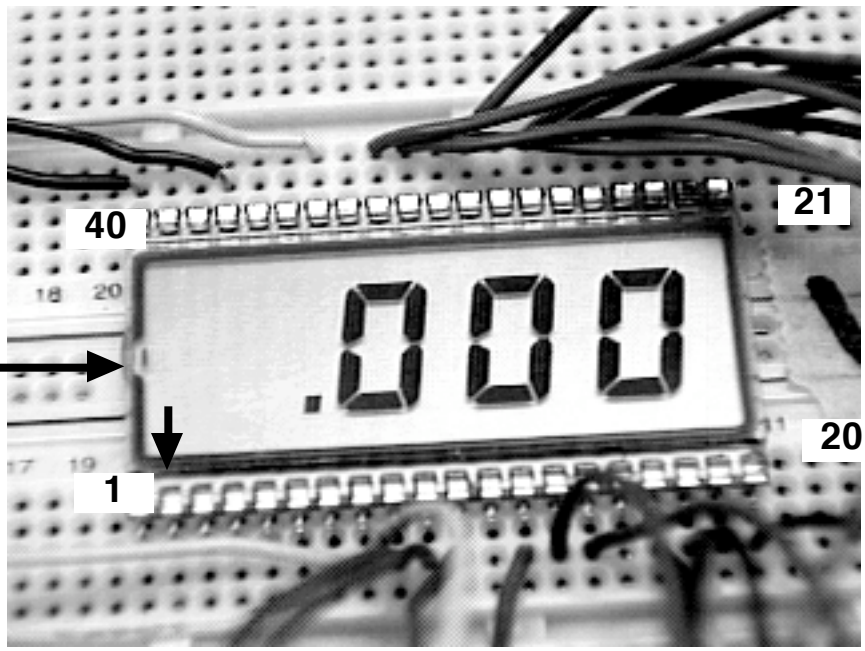


Fig 2

Fig 2 depicts the an input voltage of 0.00 volts . The circuit has the capacity to measure 1.999 volts DC.

In order to scale the display for degrees the design will cause the decimal point to be fixed two places to the right of the view in Figure 2.

Figure 3 is an example of the high density of wiring at the I.C. The Figure also shows many wires obstrucing the device, which is incorrect practice. Try to keep all wiring flat on the breadboard, and route all wires around, not over the electronic components.

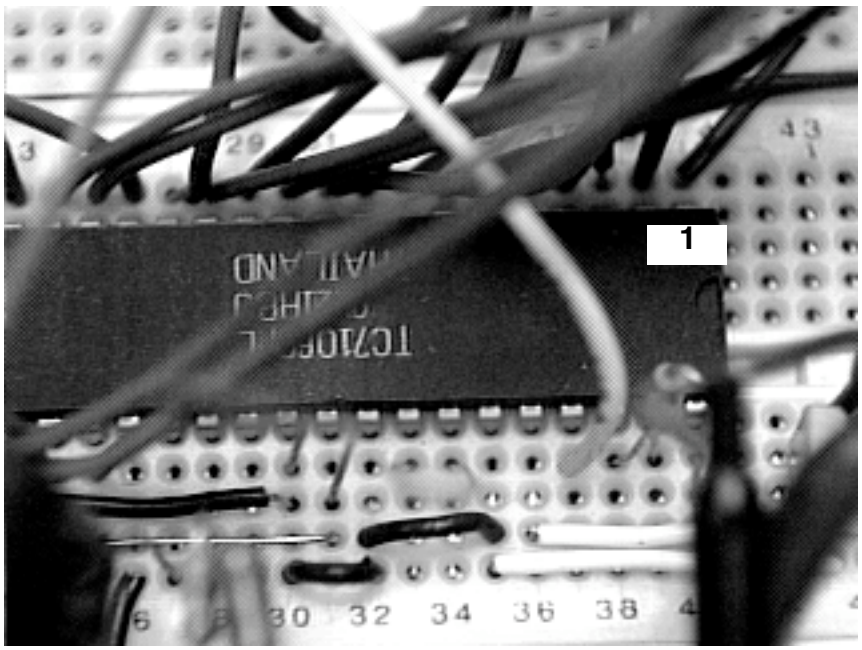


Fig 3

Part 2 Assembly of the PC Board

Students will be removing parts from the breadboards and placing them on the printed circuit board for final assembly. Follow the step by step instructions to avoid mistakes.

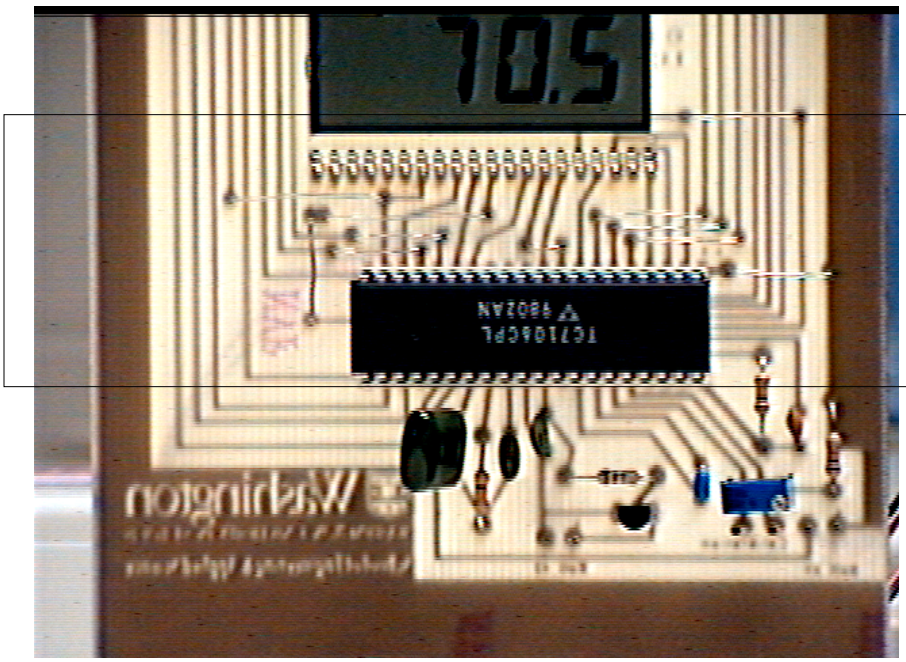
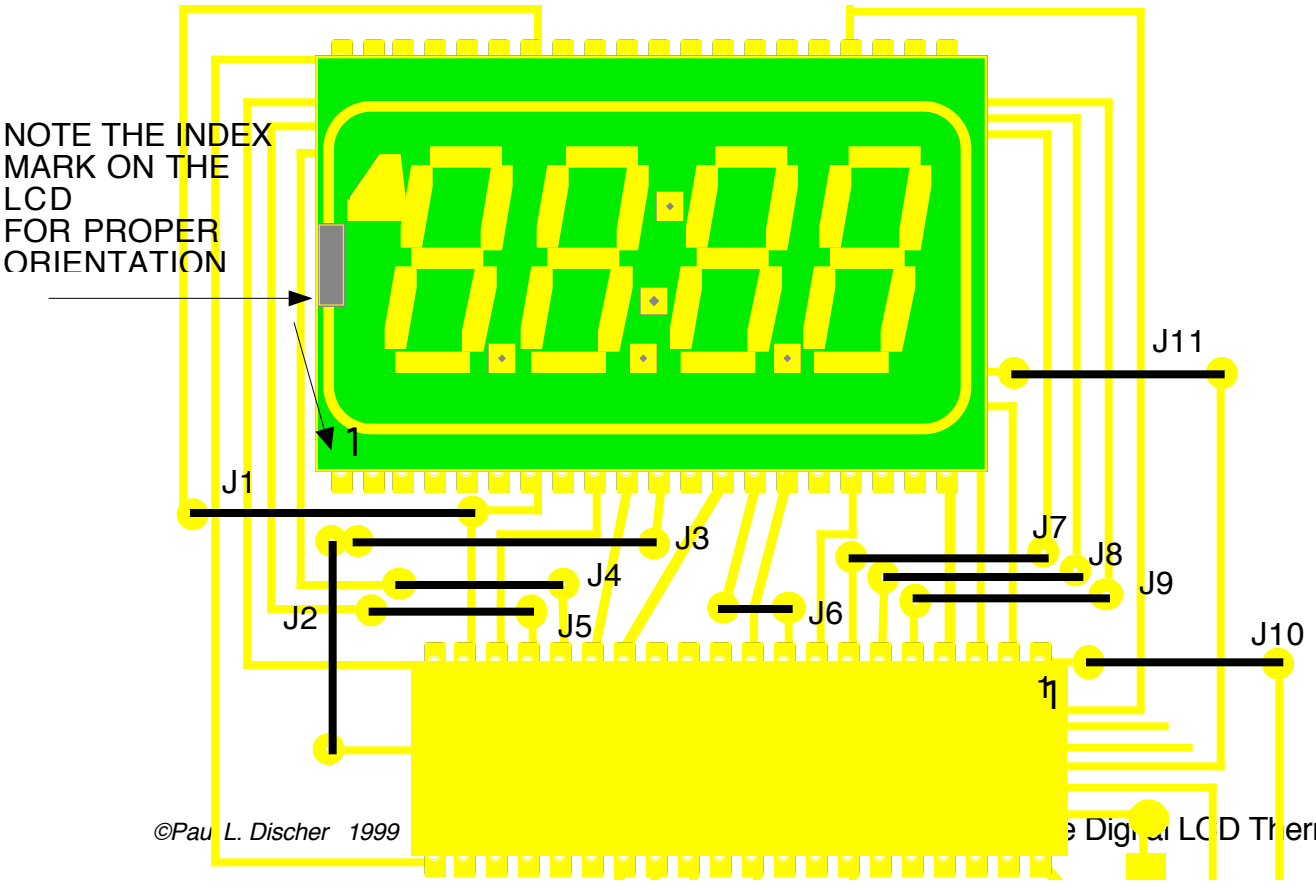


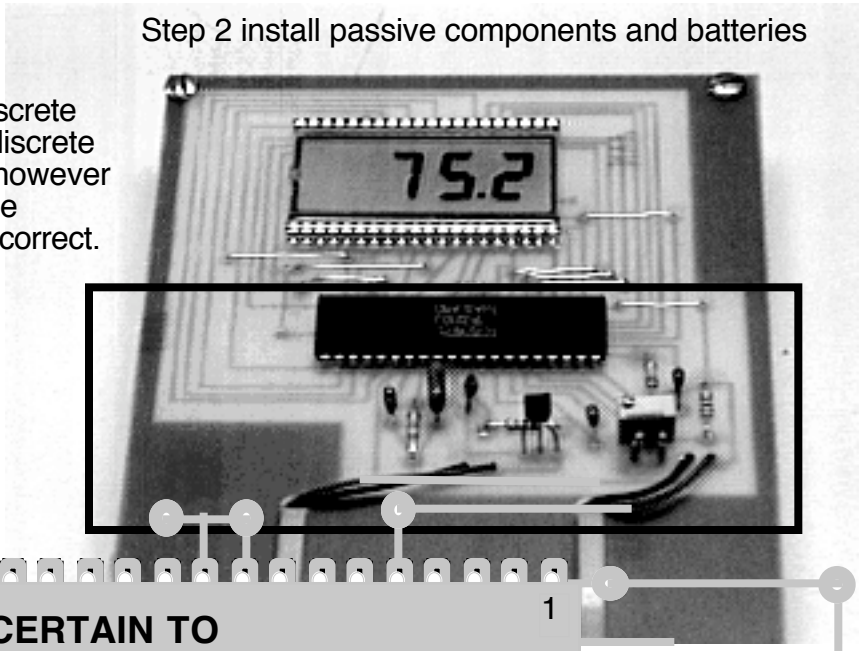
Fig 4
Component side of the PC Board with all components mounted

STEP #1 Install 11 bare wire jumpers on the board. Then install the LCD display. Make certain that the display is positioned correctly.



Step 2 install passive components and batteries

:STEP #2 Install all of the discrete components. None of the discrete components are polarized, however the batteries and and it will be important to get the polarity correct.



MAKE CERTAIN TO LOCATE PIN 1 ON THE I.C. FOR CORRECT LOCATION IN THE PRINTED CIRCUIT BOARD.

1

100KΩ
100pF
22KΩ
.01μF
.22μF
1MegΩ
.047μF
470KΩ
.1μF
25KΩ
- +
B2
TP
B1
LM34
Temp Sensor
RED
BLACK
BLACK
RED

BATTERIES NEED TO BE CONNECTED W TH CORRECT POLARITY.

THE TEMPERATURE SENSOR LM34, IS VERY FRAGILE, AND CAN BE DAMAGE IF PLACED INTO THE CIRCUIT INCORRECTLY. MAKE CERTAIN THAT THE FLAT SIDE OF THE DEVICE POINTS TOWARDS THE I.C.

B2 B2

Step 3 setup of the voltmeter system

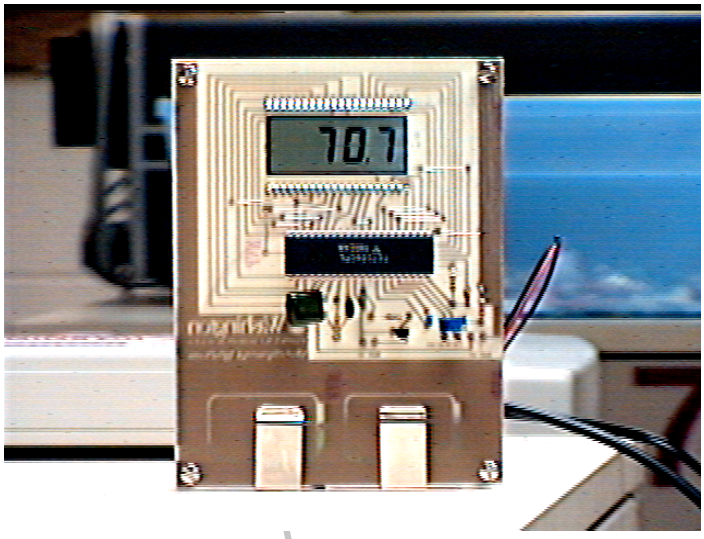
ASSEMBLED PC BOARD

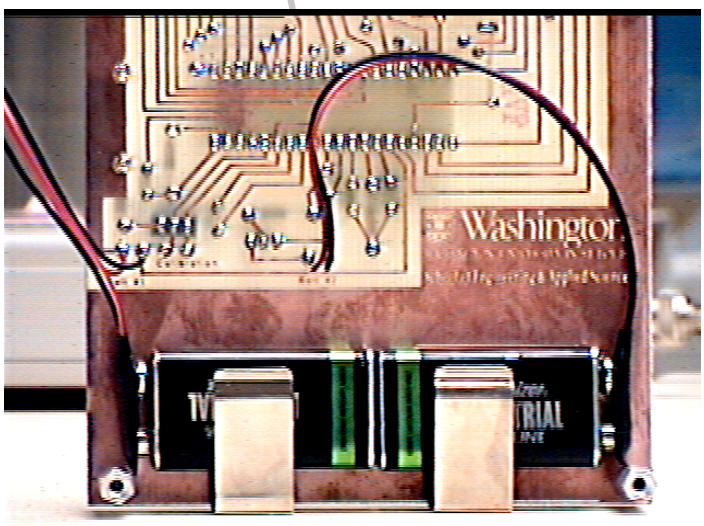
Final assembly includes attachment of the standoffs and hardware.

The twin 9v batteries are attached via two plastic ty-wraps. The batteries can be mounted either on the component side or the printed circuit side of the board. There is enough room in the ty-wrap hole to feed the power wires.

The battery in the meter circuit will last about 1 week in continuous use. The battery in the sensor circuit will last about 1-year.

Setup of the Digital Meter system is accomplished by attaching a voltmeter to the test pins near the adjustable resistor. Adjust the screw on the resistor so that the voltage at the test points is 1.000 volts dc.





Options:

You may choose to mount the meter in your own choice of suitable enclosure or just display it by itself.

You can also obtain an inexpensive wall mount 9v dc power adaptor from Radio Shack and operate the meter from a power line for continuous duty. (Radio Shack part 273-1665 $7.99) You will need to cut the connector off of the end of the power unit for direct soldering onto the thermometer board. You can also obtain a mating connector for external power if you wish. Make certain you get the polarity correct or you may damage the temperature circuit.

You can place the temperature sensor on a length of wire for remote sensing. If you choose to do this you may need to add some capacitors between the sensor wires and ground in order to bypass the added noise (filter) that will be detected by the extra wires.