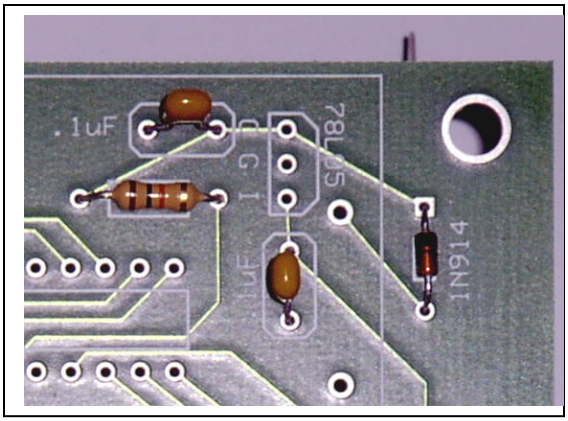
ARRL ETP Solder 101 24-Hour Clock Kit Construction Manual

Do a complete parts check cross checking the individual parts against the parts list. Pay particular attention to the color code for the resistors: the 10K (brown/black/orange), 1K (brown/black/red). Separate these resistors so that they are easily identified during component installation. Similarly, use care to correctly identify the 78L05 voltage regulator, it is similar in appearance with the 2N3906 transistors.

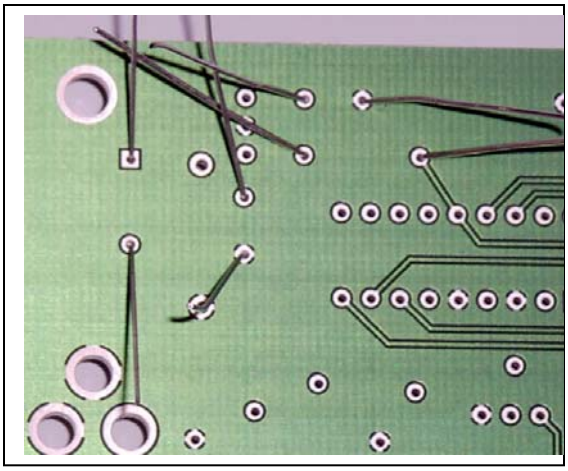
Power Circuits

Locate a 10K-ohm resistor (brown/black/orange) and install the resistor at the specified location near the 78L05 voltage regulator.



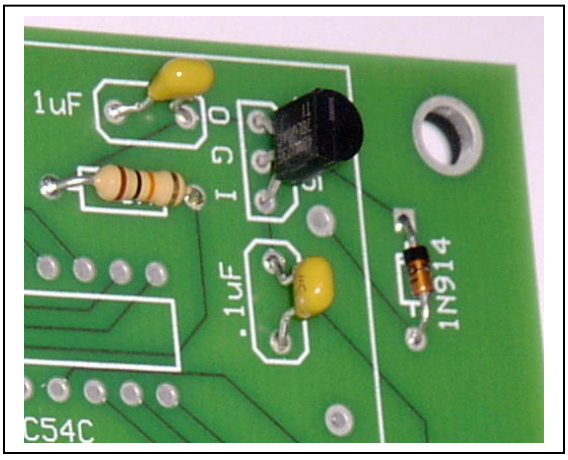
Locate the two .1uF capacitors (104) and install the capacitors at the specified locations near the 78L05 voltage regulator.

Locate the 1N914 diode and take note of the lead with the banded end. Install this diode in the specified location taking care to install the diode with the banded end collated with the band end of the component outline.



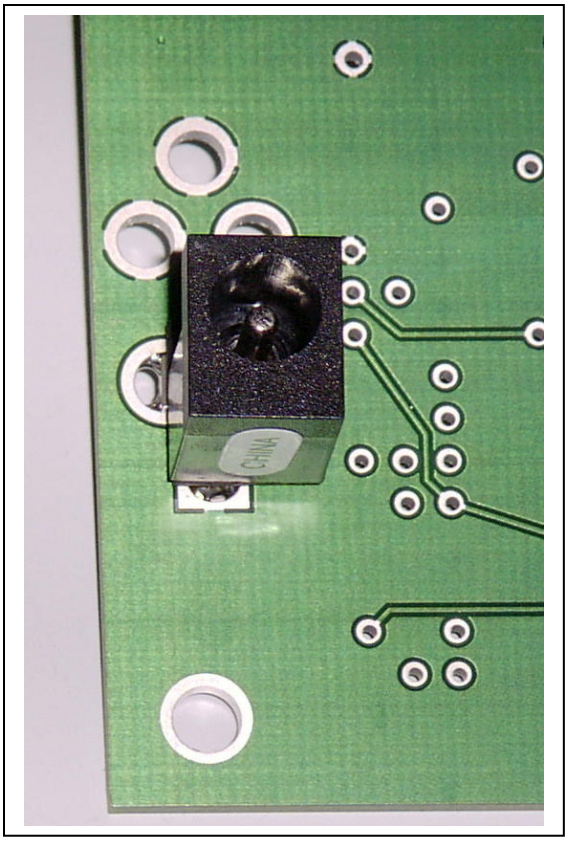
Solder all leads and clip off the excess. Use care when clipping off the excess leads because they can flip up and cause eye injury. A good technique is to hold the lead with your fingers while you clip it as close as possible to the board surface.

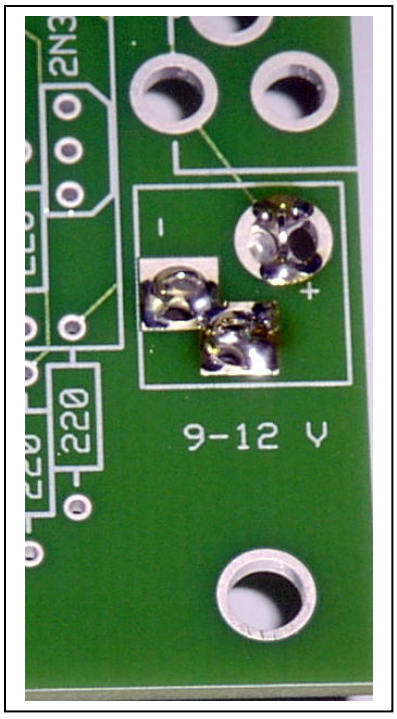
Locate the 78L05 voltage regulator. Make sure that you have not confused the voltage regulator with a 2N3906 transistor. Note that the voltage regulator has a flat side and note that the component outline on the board also has a flat side. When installing the voltage regulator, make sure the component is oriented as indicated on the circuit board outline. Push the component down toward the board surface until the component body is approximately ¼ inch above the board surface. Slightly bend the component leads outward to hold the component in place until you have soldered it.



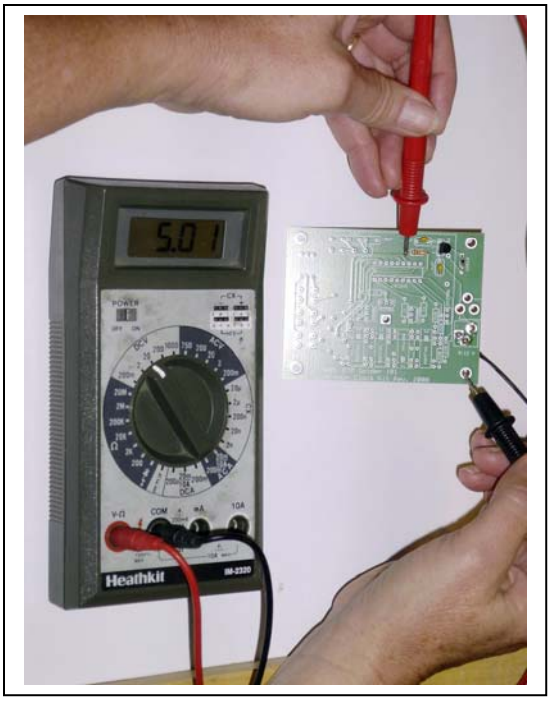
Solder and clip off excess leads and inspect your solder joints for cold joints.

Locate the power connector. A vertical oriented power connector is supplied with the kit. If you prefer for your clock installation, you can substitute a horizontal connector. The vertical connector is installed from the solder side of the board. Install the connector and hold it in place against the work table surface while you solder a single pin. Check that the connector is flush against the circuit board surface and re-melt the solder joint while applying light pressure to properly seat the connector. When it is flush, completely solder the other two pins.

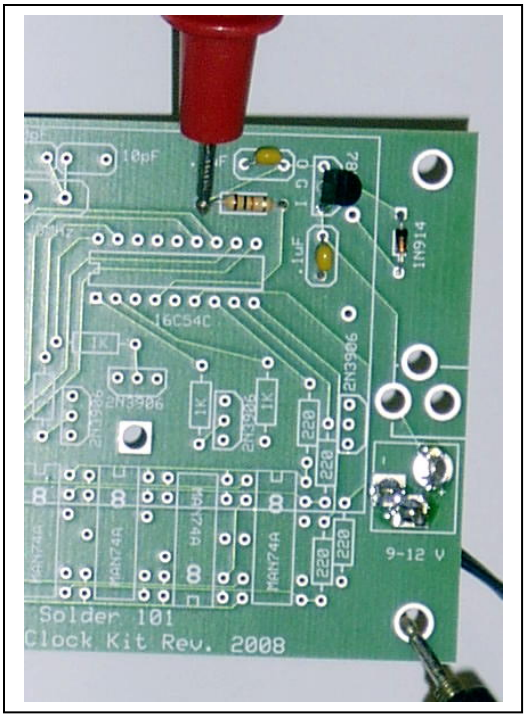




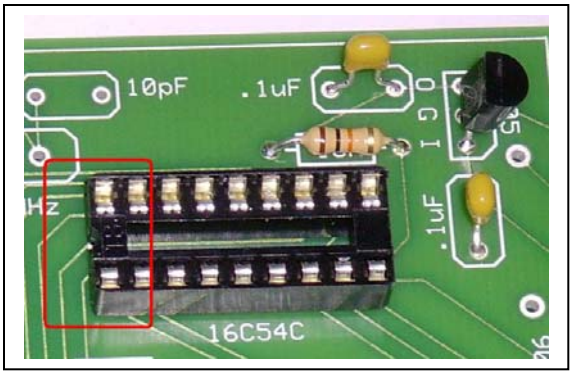
You will now do a voltage check. Locate the 10K-ohm resistor lead that you just installed that is nearest the voltage regulator. Locate the exposed foil surface surrounding the mounting hole for the board, this will be the ground lead contact point for your VOM. Set your VOM to measure about 20-volts DC. Connect a 9 to 12-volt DC wall-wart power supply (that has the center pin positive) to the power connector and plug the wall-wart into a wall outlet. Now measure the voltage between the 10K-ohm resistor lead and ground. You should get a reading of around 5-volts. If not, unplug the wall-wart and check your wiring.



If this reading was okay, locate the non-banded end of the diode. While the wall-wart is still connected and powering the board, measure the voltage between the non-banded end of the diode and ground. You should get little or no voltage reading. If you get a high voltage reading, recheck the wiring of the diode after you remove power from the board.

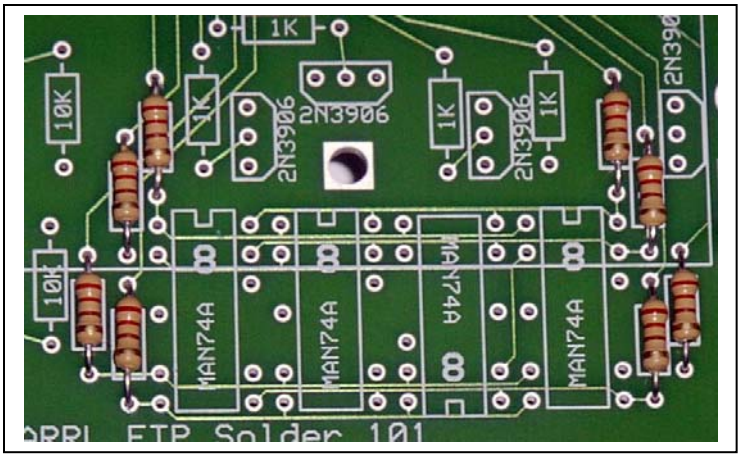


PIC Socket Installation

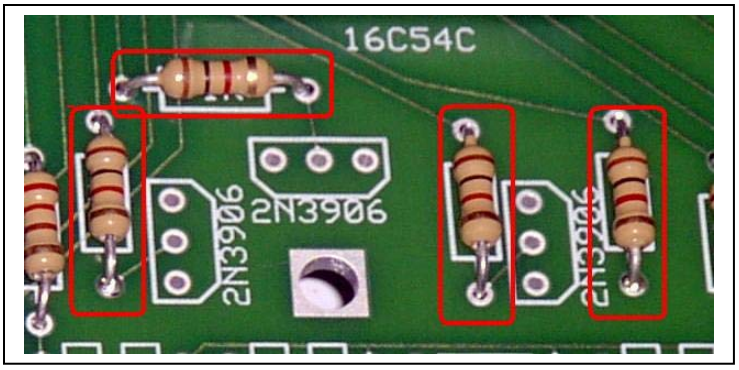


Locate the 18-pin IC socket. Notice that on one end of the socket there is a notch. Take note of the socket outline on the circuit board and you will also see a notch. When you install the socket in position, orient the socket so that the notch of the socket corresponds to the notch in the component outline. Hold the socket in place against the work surface and solder a single pin. Check that the socket is flush against the circuit board surface. If it is not, re-melt the pin while applying pressure with your finger. Once the socket is installed flush against the board surface, solder the remaining pins of the socket. The integrated circuit will be installed later.

Current Limiting Resistor Installation

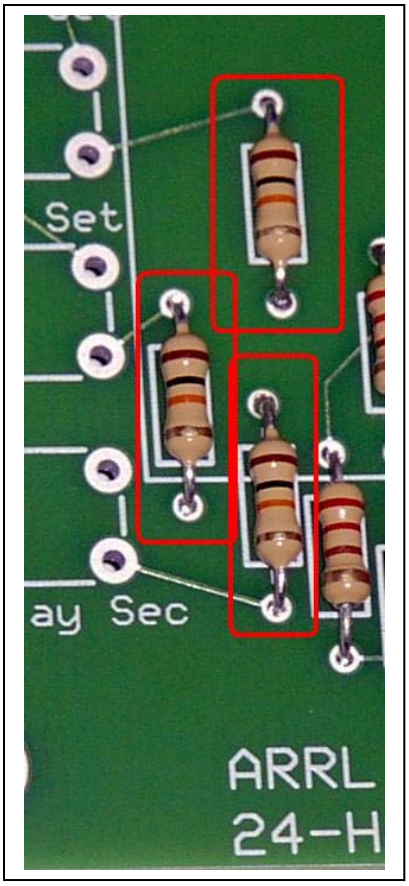


Locate the 8 220-ohm resistors (red/red/brown) and install them in the indicated locations flush against the circuit board surface. Use care to install only 220-ohm resistors at this time, and install them in the correctly labeled positions. It would be easy to mistake these resistors for similar values and in incorrect, but similarly labeled, positions. Solder and clip off the excess leads.



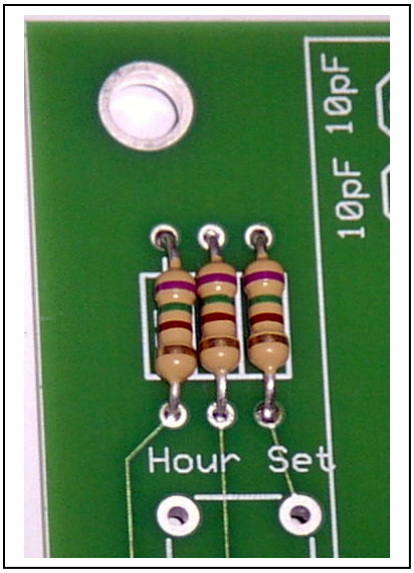
Locate the 4 1K-ohm resistors (brown/black/red) and install them in the indicated locations flush against the circuit board surface. Solder and clip off the excess leads.

Locate the 3 10K-om resistors (brown/black/orange) and install them in the indicated locations flush against the circuit board surface. Solder and clip off the excess leads.



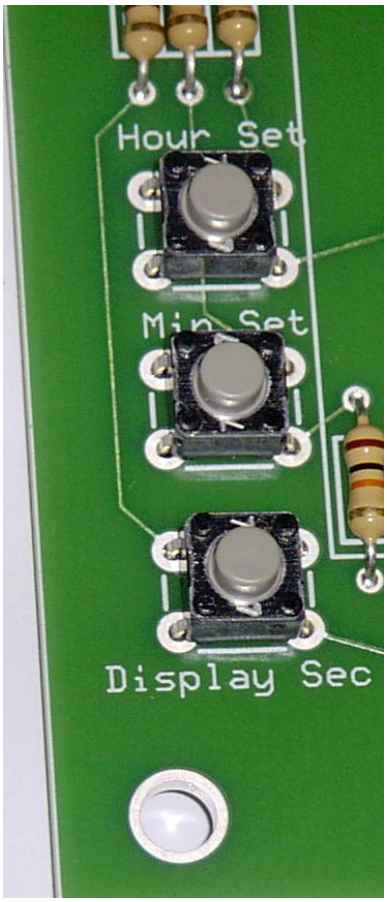
Locate the 3 750-ohm resistors (violet/green/brown [it might look like brown/green/brown]) and install them in the indicated locations flush against the circuit board surface. Solder and clip off the excess leads.

You should have no resistors remaining.



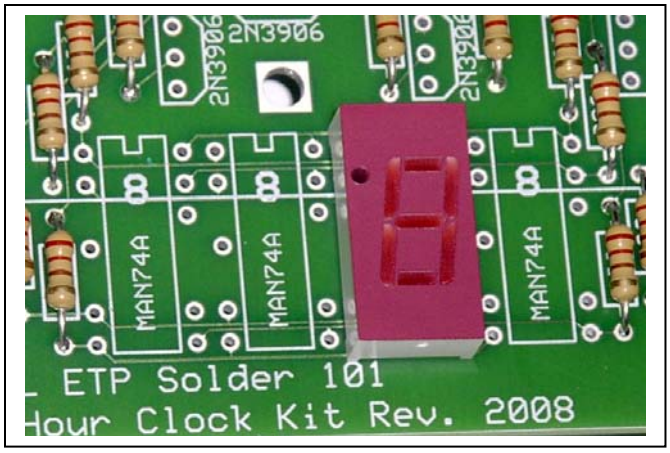
Time setting switch installation

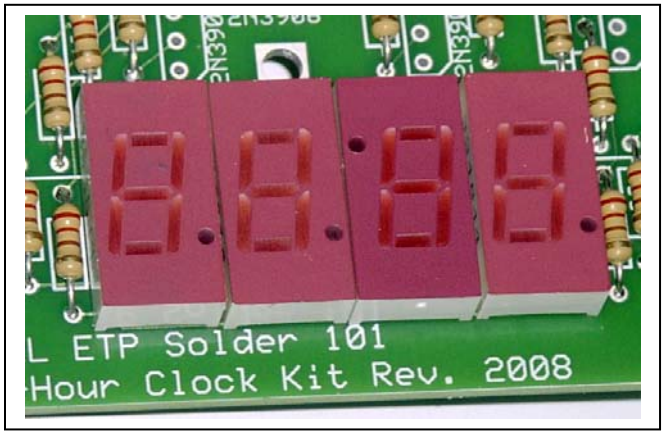
You now have a choice to make, the side the time setting switches are located. If you intend to put a face in front of your clock when it is completed, you should consider mounting the pushbuttons on the back side of the board so that they are accessible from behind. If you do not intend to put a face in front of your clock when it is completed, they you should consider mounting the pushbuttons on the front side of the board. Notice that the switches have four pins. Orient the pins so that they are on the right and left side of the switch and install them in the indicated locations. If you have to force fit the switches to get the pins into the circuit board mounting holes, you might have the switches oriented incorrectly. Solder one pin of a switch and check that the switch is flush against the board surface. If not, re-melt the solder while applying pressure on the component with your finger. Once the switch is flush, solder the 3 remaining pins. Repeat for the other two switches.



Display 7-Segment LED installation

Locate the 4 7-segment LEDs that will make up the clock display. Notice that there are unequal numbers of pins on each side of the LEDs. This helps prevent installing the LEDs incorrectly, but if you force them into place, you can overcome this simple safeguard. Notice that the 10s-minute digit on the board is upside down. This is necessary to use the decimal point of that LED as part of the hour/minute separating colon on the display. Using the same technique you used to install the IC socket, install the 10s-hour digit. Make sure the LED is flush against the circuit board surface, and make sure you do not force the pins into the mounting holes. Likewise, install the 1s-hour and the 1s-minutes digits. Finally, invert the 10s-minute digit and install it in the indicated position.

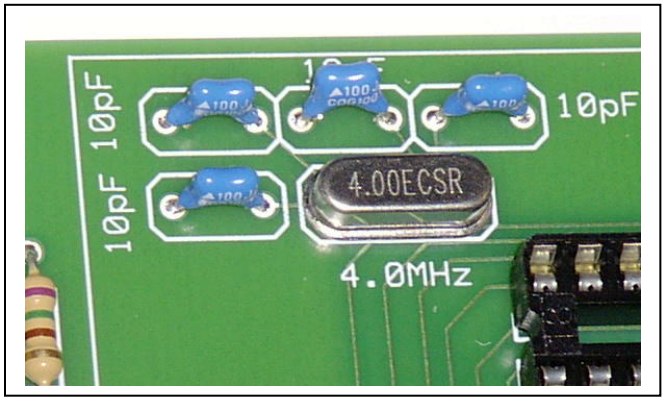




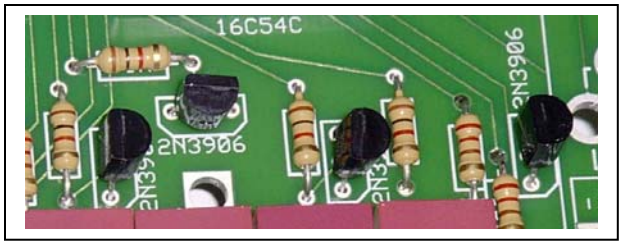
PIC Oscillator installation

Locate the 4MHz crystal and install it in the indicated position. The orientation of the crystal is not critical.

Locate the 4 10pF capacitors and install them in the indicated locations. Solder and clip off excess leads.

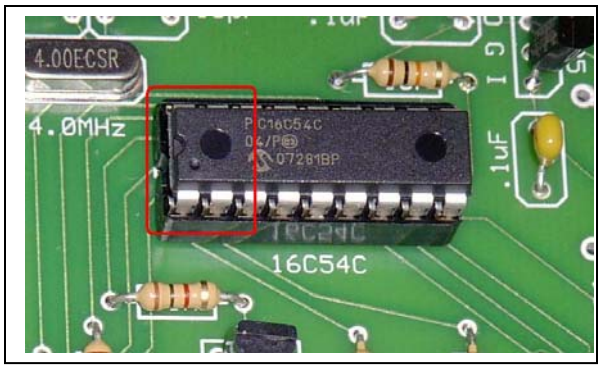


Switching transistor installation



Locate the 4 2N3906 transistors. Notice that they have a flat surface. Also note that the component outline also has a flat side. Install the transistors in the indicated locations with the flats side corresponding. Install the transistors so that they are approximately ¼ inch above the circuit board surface. Solder and clip off excess leads.

Installing the Microcontroller



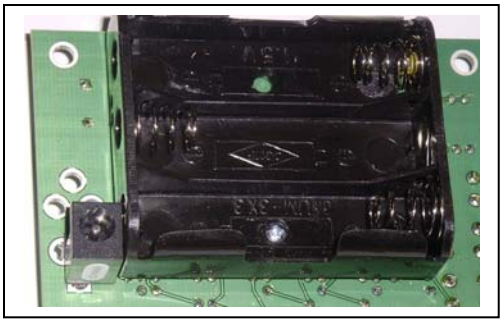
You will now install the microcontroller (PIC). Notice that there is a notch on one end of the PIC, this indicates where pin number 1 is located. Notice that the IC socket has a notch at one end also. When the PIC is installed, make sure the notches correspond. Gently place the PIC in position and check the orientation of the pins relative to the socket. You might have to gently bend the PIC pins inward ever so slightly to get them to line up with the socket. Once you are satisfied that the pins and socket line up, using thumb pressure and seat the PIC into the socket. Once in place, inspect the PIC pins to ensure that none got bent and crimped under the IC or force outward away and to the side of the socket body.

Tests and operation

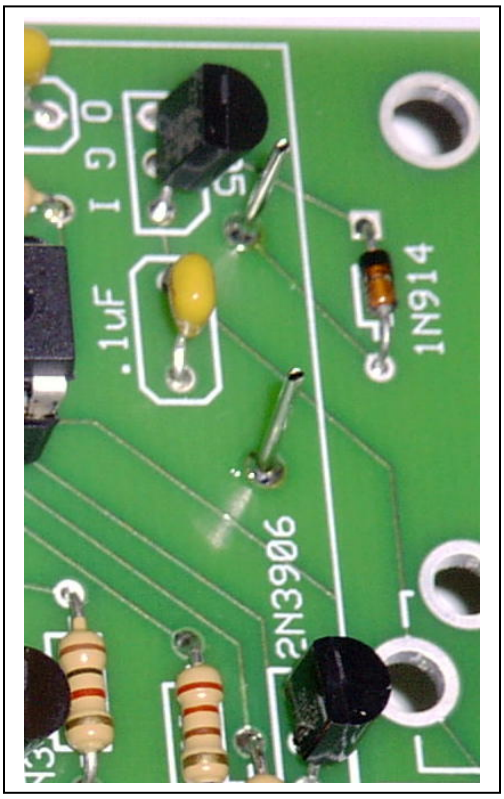
It is now time to fire-up your completed solder project. Install the wall-wart power plug and plug the wall-wart into an outlet. Within a few moments, the digits of your clock will illuminate and the center colon dots should flash at 1-second intervals. If you press and hold the hour-set switch, the hour digits will advance, release the switch at the desired hour. Likewise press and hold the minute-set switch to set the correct minutes. If you want to see the seconds, press and hold the seconds display switch for as long as you want to see the seconds displayed. Once released, the time display returns to normal. Unplug and remove the wall-wart.

Battery Pack installation

Install the back-up battery pack from the back side of the circuit board. You will solder the leads from the component side of the board. You can use either a single screw (flat head 2-56 is best), nylon washer, and nut to hold the battery pack in place or hot glue the battery pack to the bottom of the board. Install the battery pack using the screw first and then complete the soldering of the pins from the component side of the board.



This completes the soldering of your clock.



Final Set-up and Operation

Disconnect the wall-wart from the wall outlet and install 3-AA battery cells in the battery pack. Use care to orient the battery polarity as indicated in the battery pack. The clock should start operating on batteries, but the primary source of power is the wall-wart. Once you reconnect the wall-wart to a wall outlet and set the proper time, your clock project is ready to enjoy and show off to your shack visitors.