Assembly Instructions for SanDevices E680 Ethernet Pixel Controller

March 30, 2011

Revision History:

03/30/11 added single-source parts list for all components except WIZ812 module, from Digi-Key

03/29/11 added parts sourcing and pricing information, minor layout revisions, corrected vendor part for dip jumper

03/28/11 minor text changes, added assembly photos

03/22/11 first published

Parts List

Part Ident	Description
PC Board	Bare printed circuit board
ETH1	Wiznet WIZ812MJ Ethernet Module
IC1	Parallax “Propeller” CPU, P8X32A-D40
IC2	EEPROM, 1mb, Atmel 24C1024BPU25 (do not substitute another manufacturer’s part)
IC3	3.3V Regulator, 500ma, ST Micro LF33CV or equivalent
F1	Pigtail Fuse, 1.6A typical
C1-C4	.1uf/25V Capacitor, .2” lead spacing
C6	47uf/16V Aluminum Electrolytic Capacitor, .1” lead spacing
C7	22uf/6.3V Aluminum Electrolytic Capacitor, .06” lead spacing
R1-R6	Resistor, 1/8W, 330 ohm (orange orange brown gold)
R7-R9	Resistor, 1/8W, 10K ohm (brown black orange gold)
X1	Crystal, 5MHZ, HC-49US
HS1	Heat Sink, also ¼” machine screw, nut, and lockwasher, #4-40
SW1,SW2	Pushbutton Switch, SPST, 6mm
LED1,LED4	GREEN Led, 3mm
LED2,LED5	RED Led 3mm
LED3	YELLOW Led, 3mm
SKT-1	8-pin IC Socket
SKT-2	40-pin IC Socket
J1-J16	4-pin .1” Male Polarized Head Connector
J17,J18	2-positionl Screw Terminal Block, 5.08mm (.2”) spacing, 24A
J19	2-position Screw terminal Block, 2.54mm (.1”) spacing
J21	4-pin .1” male header
J20	2-pin .1” male header
JUMPER	DIP Jumper (for J20: see instructions)

Multi-Vendor Suggested Parts Sourcing: VERIFY PART NUMBERS BEFORE ORDERING

Quan Req'd	Part Ident	Manufacturer	Manufacturers Part Number	Vendor	Vendor Part #	Unit Cost	Ext Cost
1	ETH1	Wiznet	WIZ812MJ	Saelig	WIZ812MJ	$19.50	$19.50
1	IC1	Parallax	P8X32A-D40	Digi-Key	P8X32A-D40-ND	$7.99	$7.99
1	IC2	Atmel	24C1024BPU25	Mouser	556-A24C1024BPU25	$4.30	$4.30
1	IC3	ST Micro	LF33CV	Digi-Key	497-7313-5-ND	$1.35	$1.35
1	F1	Littelfuse		Mouser	576-087601.6MXEP	$0.51	$0.51
4	C1-C4	Vishay	K104Z15Y5VE5TH5	Mouser	594- K104Z15Y5VE5TH5	$0.05	$0.20
1	C6	Panasonic	ECE-A1CKS470	Digi-Key	P969-ND	$0.27	$0.27
1	C7	Panasonic	ECE-A0JKS220	Digi-Key	P955-ND	$0.26	$0.26
6	R1-R6	Xicon	399-330-RC	Mouser	299-330-RC	$0.09	$0.54
3	R7-R9	Xicon	299-10K-RC	Mouser	299-10K-RC	$0.09	$0.27
1	X1	ECS	50-18-4XEN	Digi-Key	XC1711-ND	$0.55	$0.55
1	HS1	Aavid	577202B00000G	Digi-Key	HS107-ND	$0.33	$0.33
2	J17,J18	Tyco	282857-2	Digi-Key	A98359-ND	$0.86	$1.72
1	J19	Tyco	282834-2	Digi-Key	A98333-ND	$0.66	$0.66
2	SW1-2	Omron		Digi-Key	SW404-ND	$0.31	$0.62
1	SKT1			All Electronics	HRICS-8	$0.50	$0.50
1	SKT2			All Electronics	HRICS-40	$1.20	$1.20
2	LED1,4	Kingbright	WP3A8GD	Digi-Key	754-1217-ND	$0.10	$0.20
2	LED2,5	Kingbright	WP7104LID	Digi-Key	754-1245-ND	$0.10	$0.20
1	LED3	Kingbright	WP7104-YD	Digi-Key	754-1261-ND	$0.10	$0.10
1	J20,21			All Electronics	SHS-32	$0.40	$0.40
16	J1-J16	Molex	22-27-2041	Digi-Key	WM4113-ND	$0.48	$7.68
16	P1-P16	Molex	22-01-3047	Digi-Key	WM2002-ND	$0.27	$4.38

The following items are the contact pins for the Molex connector housings J1-J16, and the dip jumper to bridge the terminals on J20 when powering the board from pixel power input. Note min order quantity 10 on the jumper, only one is needed.

64	pins	Molex	08-50-0114	Digi-Key	WM1114-ND	$0.14	$8.83
10	jumper	Sullins	SPC02SYAN	Digi-Key	S9001-ND	$0.08	$0.87

Single-Source Parts list from Digi-Key for E680 Pixel Controller

	Quan	Digi-Key Part#	Description	Each	Total
IC1	1	P8X32A-D40-ND	IC PROPELLER 8 32BIT COGS 40-DIP	7.99000	$7.99
F1	1	F2323-ND	FUSE PICO FAST 1.25A 125V AXIAL	0.63000	$0.63
IC3	1	497-7313-5-ND	IC REG VLDO 500MA 3.3V TO-220	1.35000	$1.35
C1-C4	4	BC1154CT-ND	CAP .10UF 25V CERAMIC +80/-20%	0.44000	$1.76
C6	1	P969-ND	CAP ELECT 47UF 16V KS RADIAL	0.27000	$0.27
C7	1	P955-ND	CAP ELECT 22UF 6.3V KS RADIAL	0.26000	$0.26
R1-R6	6	CF18JT330RCT-ND	RES 330 OHM 1/8W 5% CF AXIAL	0.09000	$0.54
R7-R9	3	CF18JT10K0CT-ND	RES 10K OHM 1/8W 5% CF AXIAL	0.09000	$0.27
X1	1	XC1711-ND	CRYSTAL 5.000 MHZ 18PF 49US	0.55000	$0.55
HS1	1	HS107-ND	HEAT SINK TO-220 .500" COMPACT	0.33000	$0.33
J17,J18	2	A98359-ND	TERM BLOCK 2POS SIDE ENT 5.08MM	0.86000	$1.72
J19	1	A98333-ND	TERM BLOCK 2POS SIDE ENT 2.54MM	0.66000	$0.66
SW1,SW2	2	SW404-ND	SWITCH TACT 6MM MOM 100GF	0.31000	$0.62
LED1,4	2	754-1217-ND	LED SS 3MM 568NM GRN DIFF	0.10000	$0.20
LED2,5	2	754-1245-ND	LED SS 3MM 625NM RED DIFF	0.09000	$0.18
LED3	1	754-1261-ND	LED SS 3MM 588NM YELLOW DIFF	0.11000	$0.11
J1-J16	16	WM4113-ND	CONN HEADER 4POS .100 VERT TIN	0.48000	$7.68
P1-P16	16	WM2002-ND	CONN HOUS 4POS .100 W/RAMP/RIB	0.27400	$4.38
Pins	64	WM1114-ND	CONN TERM FEMALE 22-30AWG TIN	0.13840	$8.86
SKT2	1	3M5471-ND	SOCKET IC OPEN FRAME 40POS .6"	0.45000	$0.45
SKT1	1	3M5473-ND	SOCKET IC OPEN FRAME 8POS .3"	0.18000	$0.18
J21	1	A31114-ND	CONN HEADER VERT 4POS .100 TIN	0.20000	$0.20
J20	1	A31112-ND	CONN HEADER VERT 2POS .100 TIN	0.20000	$0.20
jumper	10	S9001-ND	CONN JUMPER SHORTING GOLD FLASH	0.08700	$0.87
				Kit Subtotal:	$40.26

Notes:

This is everything except the PC Board, EEPROM, and WIZ812MJ Ethernet Module, Saelig is the recommended vendor for the WIZ812MJ.

Fuse F1 is 1.25A instead of the original 1.6A, this is what's stocked at Digi-Key, not critical

The .1uf caps, C1-C4, are a bit pricy. You may find something comparable at a better price

The specified IC sockets, SKT1 and SKT2 are stamped, not the "high rel" type. Those "high rel" sockets are pretty expensive at Digi-Key.

Only 1 dip jumper is needed, but min order quantity is 10.

As always, please double-check these part numbers before ordering!!

Notes concerning possible component substitutions:

ETH1:

You may use a WIZ811MJ module in place of the specified WIZ812MJ, however the 3 ethernet status LEDs won't light. If you're making this substitution, you can also delete LED1 through LED3, and you can delete 3 of the 4 330 ohm resistors that mount between LED1 and LED2. (The lower-left resistor of this group is required.)

If desired you can use two 20-pin sockets for the Ethernet module, instead of soldering it directly to the PC board. They are pretty pricey and will raise the module off of the board a bit. I believe that a compatible socket is Digi-Key part# A26460-ND, 2 required. The Ethernet module has .025" square pins. If you use connectors for this part, **VERIFY that the connectors you purchase will properly mate with the Ethernet module BEFORE you solder them to the board.**

IC3:

Any TO-220 style +3.3 volt regulator that has the proper pinout (matching the legend on the board), and at least a 500ma current rating may be used. Be aware that some regulators, particularly the higher current ones, have an 'oddball' pinout. The heat sink is generally only required when powering the board from a supply greater than 7VDC. Even if you don't use the heat sink, make sure that the voltage regulator is bolted to the PC board as the large copper area of the PC boards helps dissipate heat.

IC2:

The specified EEPROM (IC2) is a 1 megabit part to allow for future software enhancements. A 512k-bit part (24C512) may be substituted but may not be compatible with future upgrades. **Do not substitute a non-Atmel part for the 1mb EEPROM as it may not be compatible; different manufacturers use different addressing schemes for the 1 mb parts.**

SKT1,SKT2:

The use of IC sockets for the eeprom and CPU is highly recommended. If the eeprom is soldered in place, software updates will have to be done via the programming port. The use of a socket allows firmware updates via swapping of the eeprom.

F1,J19,J20:

F1 is only needed if powering the board from the pixel power supply. If powering from a separate supply via J19, F1 and J20 may be omitted. J19 is only required if not powering the board from the pixel supply.

C7:

The specified part for the 22uf capacitor, C7, has 0.06" lead spacing. There is an extra hole in the PC board to accommodate a larger, .1" spacing part (more common), in this location.

R1-R9:

R1-R6 may be any value from about 120 to about 1K ohms. R7-R9 may be any value between about 1K and 10K ohms. 1/4W resistors may be used, but they will have to be mounted vertically due to their longer length.

Connectors:

J17 and J18 may be omitted if you will be hard-wiring pixel power to the board.

J21 may be omitted if you will do firmware upgrades by swapping the eeprom, rather than using the program port.

J1-J16 may be omitted if you will be hard-wiring the pixel cables directly to the board, or if you will not need the full 16-string capacity. The mounting holes for these connectors are deliberately over-sized to facilitate direct soldering of wires to the board in place of the connectors.

Tools and Supplies Required for Assembly:

Soldering iron with a fine-point tip.

Solder, Kester #44 63/37, .02” or .031” diameter recommended.

Small flush-cutting diagonal cutters for trimming component leads of resistors, capacitors, LEDs, etc.

A small amount of heat sink compound. A #4-40 steel machine screw (1/4”), lockwasher, and nut and a screwdriver and pliers or nutdriver, to secure the #4-40 hardware to the heat sink.

Component Identification:

Capacitors C1-C4, .1uf

Capacitors C6 and C7

(C6 is larger than C7)

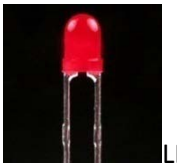
Resistors R1-R9

Crystal X1

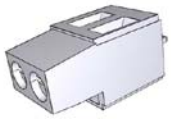
Fuse F1

Switch SW1 and SW2

Voltage Regulator IC3



LED LED1-LED5



Terminal Blocks, Large: J17,J18 Small: J19

Heat Sink

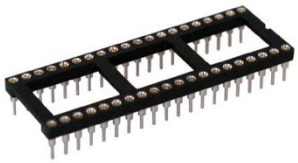
CPU, IC1

EEPROM IC2, (2 pcs shown, use only 1)

Molex 4-pin connector, J1-J16

4-pin header J21, J20 same but only 2 pins

JUMPER for J20



IC Socket, 40-pin shown

Ethernet Module: WIZ812MJ, ETH1

Before You Start

The E680 pixel controller is a very straightforward build, however It is strongly recommended that you have some previous soldering experience with PC boards. You will need a soldering iron with a fairly small tip. To get into the fine points of soldering is beyond the scope of this document. If in doubt, there are several fine soldering tutorials on the internet.

All components are through-hole mounted from the component side of the board; this is the side with the white printing (silkscreen) that identifies component locations; then soldered from the solder side of the board. The routing of traces between closely-spaced pads on the solder side of the board has been deliberately minimized to reduce the likelihood of unintentional 'solder bridges'. In addition, the board has a full solder mask.

General Assembly Notes:

Please use standard anti-static precautions when handling the Ethernet module and the ICs.

Please refer to the PC board layout diagramand assembly photographs to identify component locations. All references to the PC board, as in "top, bottom, left, right" are related to the orientation shown in the drawing.

Although components may generally be installed in any order, the order given below is suggested. Generally the lowest-profile components should be soldered in place first. When installing long-lead components such as resistors, capacitors, and LEDs, it is suggested that you do only a few components at a time, rather than trying to place too many at once. After inserting each long-lead component, bend the leads out slightly to help hold the part in place when the board is turned over for soldering. Once you solder a group of long-lead components, use a small pair of flush-cutting diagonal cutters to trim the leads off as close to the PC board as possible. This procedure (working in groups of a few components at a time), reduces the number of long component leads on the solder side of the board that you have to maneuver the iron around, and allows easier access to the leads being soldered. A good pair of small, sharp flush-cutting diagonal pliers will make it easy to trim leads cleanly and very close to the board.

The leads of the 9 resistors, the fuse, and the voltage regulator IC will have to be bent at right angles to the body of the part before installation. The leads of the two integrated circuits will have to be straightened before inserting in their sockets.

Please refer to the silk-screened legends printed on the component side of the PC board, and to the layout drawing and photographs, to verify proper positioning and polarity (where applicable) of all components. All polarized components, (in other words components that must be installed with a specific orientation), are noted in the instructions that follow. Refer to the parts illustrations to help with identification of small parts.

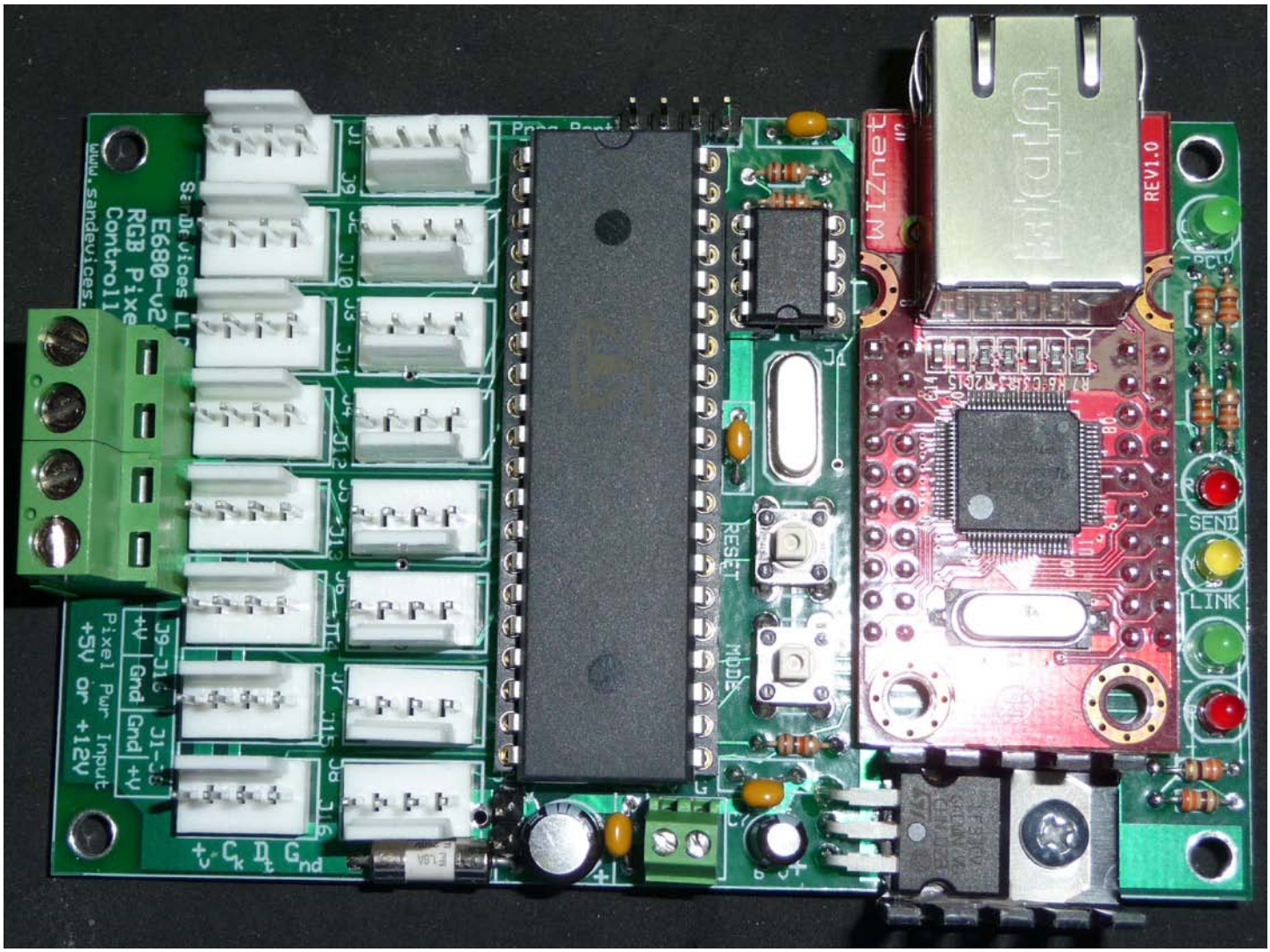
Recommended Technique for Installing Multi-Pin Sockets and Connectors

When installing IC sockets, and multi-pin connectors, the following technique is recommended to insure that the part is fully seated against the PC board prior to final soldering:

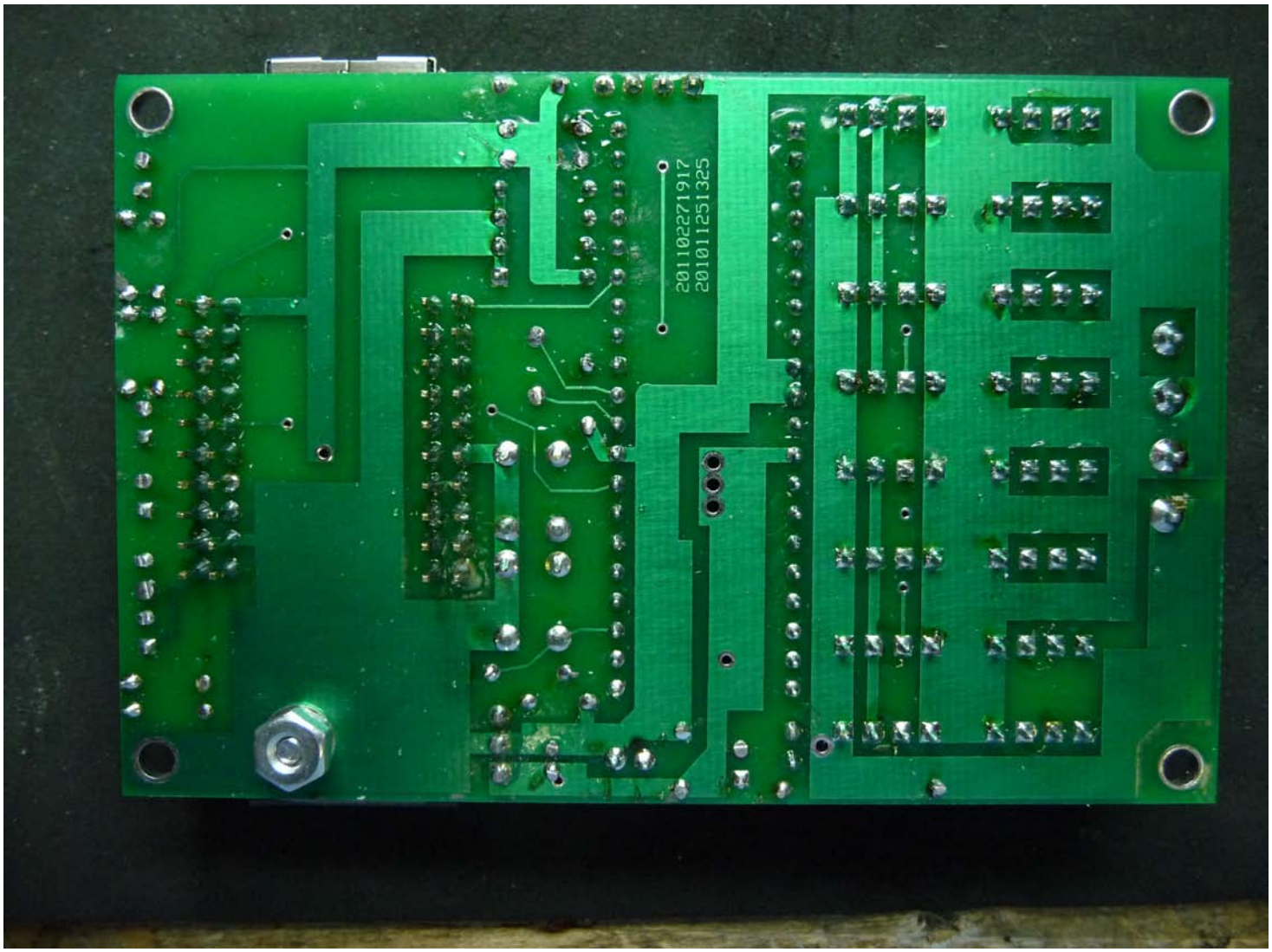
Place the part in position, and apply solder to a middle pin, or a middle pin of each row for multi-row components such as IC sockets.

Then, while holding the board in your non-soldering hand, apply a bit of downward pressure on the component. While doing this, use the iron in your other hand to heat the pins you previously soldered, one at a time. Usually, when the solder melts, you will feel the part 'pop' into place, flat against the PC board. Once you are certain that the part is flat against the board, you can turn the board over and solder every pin. You don't want to solder every pin of a 40-pin IC socket and then discover that the socket wasn't fully seated against the PC board. Correcting that won't be fun.

Assembly Photos



Component Side, fully Assembled

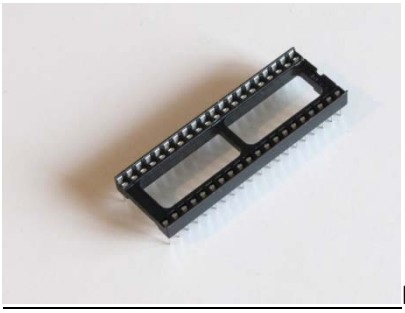


Solder Side, Fully Assembled

Assembly of Components

Since it is assumed that the builder has some prior PC assembly experience, the following instructions are pretty much limited to listing a recommended order of component installation, tips for identifying components, and information as to where they mount on the PC board. Refer to the parts photographs to aid in identification of components.

1) Install the 40-pin IC socket at IC1. **Note that PIN 1, usually marked by a notch, faces the top edge of the board.** Use the technique discussed earlier to insure that the socket is seated flat against the PC board before final soldering.

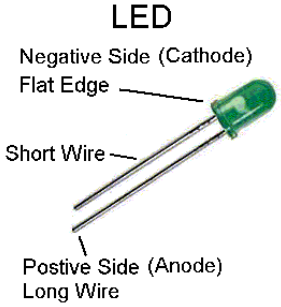


Note notch denoting pin 1 end toward upper right in this photo

2) Install the 8-pin IC socket at IC2. **Note that Pin 1 of IC2 faces DOWN.**

3) The resistors are small 2-lead components with 4 colored bands on the body. Install the six 330-ohm resistors (orange orange brown gold) along the right-hand edge of the board. Bend the leads at a 90-degree angle near the resistor body before inserting. Similar to this illustration, but bend leads close to resistor body:

4) Install the 5 colored LEDs along the right-hand edge of the board. From top to bottom they are: GREEN, RED, YELLOW, GREEN, and RED. **Observe proper polarity when installing LEDs. The (-) side of the LEDs is always closest to the bottom edge of the board. The (-) side will be denoted by a 'flat' on the body of the LED and/or will be the shorter of the two leads as shown in this illustration**



5) Install the four .1uf capacitors C1-C4. These are very small components with 2 long parallel leads. One at the top of the board to the left of the Ethernet module, one at the center of the board to the right of the CPU chip, and the last two near the bottom center.

6) Install the 3 remaining resistors, R7-R9, 10k ohms, (brown black orange gold) . All 3 mount just to the left of the Ethernet module, 2 near the top edge and 1 near the bottom.

7) Install the 5 mhz crystal X1, between the CPU chip and the Ethernet module, to the right of the .1uf capacitor.

8) Install the 2 pushbutton switches SW1 and SW2. Please note that the 'footprint' of the 4 pads is rectangular, make sure that the more-closely spaced pairs of pins are to the top and bottom. These switches will snap into place with a bit of force. Make sure they are fully seated against the PC board, with no bent pins, before soldering.

9) Install the pigtail fuse, F1, along the bottom edge of the board.

10) Install the 2 electrolytic capacitors, C6 and C7, near the bottom center of the board. C6 (47uf) is the larger of the 2. **Note: Polarity must be observed. The (-) lead of these capacitors must be toward the top of the board. The (-) side is usually marked with a grey stripe.** Note that if a .06" spacing part is not available for C7, a .1" spacing part may be used by placing the (+) lead into the alternate hole slightly below and to the left of the normal (+) hole.
11) Install the 2 .1" headers, a 4-pin header at J21 (near top center) , and a 2-pin header at J20 (near bottom, just below and to the left of the 40-pin IC socket. These may be provided as a single multi-pin header that you will have to cut to the proper lengths.

12) Install the small 2-position screw terminal block at J19, near bottom center. **Make sure that the orientation is such that the holes for wire insertion face the bottom of the board.**

13) Install IC3, the 3.3 volt regulator, and the heat sink. Note regarding the heat sink: The heat sink isn't needed if the E680 module will be powered from 5-6 VDC. For supply voltages greater than about 6 volts, the use of a heat sink is recommended. First, bend the 3 regulator leads down 90 degrees at the proper point to line up the mounting hole in the regulator with the hole in the PC board. The 'flat' side of the regulator is the back. Put the regulator in place but don't solder it just yet. Now slide the heat sink between the PC board and the regulator, with the mounting hole towards the right, lining up the holes in the board, regulator, and heat sink. **The flat side of the regulator is the back and will lie against the heat sink.** It is recommended that a *small* amount of heat sink compound be placed between the PC board and the heat sink, and between the heat sink and the back of the voltage regulator. Basically the PC board, a layer of heat sink compound, the heat sink, more heat sink compound, and the voltage regulator IC form a "sandwich"; use the metal #4-40 hardware (bolt, lockwasher, nut) to secure the parts. There is sufficient 'play' in the mounting holes to allow some adjustment of the heat sink position. The heat sink should be mounted as far 'down' as possible (toward the bottom of the PC board) to make room for the Ethernet module that will be installed later. Note that when properly oriented, the lower 'fins' of the heat sink will extend beyond the lower edge of the PC board. After mechanically mounting the parts, solder the 3 leads of the regulator. Use plenty of solder when soldering the heavy wire leads of the voltage regulator. **When properly positioned, the heat sink will not come in contact with the voltage regulator leads, or the 2 330-ohm resistors mounted to the right of the heat sink.**

The next step is to insert the CPU and EEPROM ICs (IC1 and IC2) into their respective sockets, observing proper orientation-**please fully read the instructions below before inserting ICs and please use static precautions when handling ICs.**

Note on IC insertion. As supplied, ICs tend to have their rows of leads "splayed out" slightly from vertical(as you look at the IC from an end). Before attempting to insert the ICs into their sockets, use a flat surface such as a table top, lay the IC on its side with one row of pins in contact with the table, and 'roll' the body of the IC slightly in the direction of the row of pins, while applying some downward pressure, in order to bend the entire row of pins in ever so slightly. Do this for both rows of pins. When done, the IC pins should point straight down when viewing the ICs from the ends, as shown in the following illustration showing an IC as viewed from the end (splayed lead view somewhat exaggerated!):

Please don't skip this step as it's very difficult to insert the ICs into their sockets if every pin isn't perfectly straight and perpendicular to the body of the IC.

This is especially important if you are using 'high reliability' IC sockets. These sockets have small round entry holes for the pins, and the pins must be lined up exactly with these holes for proper insertion.

Start with the 8-pin IC, the eeprom, IC2. **Note that this part installs with the pin 1 end, denoted by a notch or dot, facing the bottom edge of the board (toward the crystal).** Press the IC gently against the socket and verify that every pin is started into its socket hole. When you are satisfied that all pins are started properly, press firmly down on the IC to seat it in the socket. Visually check to make sure that all pins inserted properly, a mis-aligned pin will just bend over and not seat.

If you do have a bent pin, remove the IC carefully, straighten the pin **VERY** carefully, and try again. **Trust me, it's MUCH better to spend more time up front straightening the pins and insuring proper alignment than it is to try to straighten a bent pin!**

Repeat the process with the CPU chip**. Note that pin 1 of the CPU faces the TOP of the board.** Press firmly with both thumbs as It will take quite a bit of force to seat the CPU in its socket. Once again, verify that there are no bent pins by sighting along the rows of pins.

Now would be a good time to double-check the orientation of those ICs, pin 1 down on the eeprom, pin 1 up on the CPU.

At this time please check the solder side of the board for solder bridges, poor-quality solder joints, or pads that weren't soldered.

Optional Preliminary Test

It's suggested that you do a preliminary test at this point to verify basic operation of the CPU. This will identify any serious errors re the board assembly or components.

To do a preliminary test of the board, connect a source of 5 to 8 volts DC to the 2-position terminal block at the bottom of the board, +V to the left, and -/GROUND to the right. After applying power you should see a distinctive pattern on the 2 lower LEDs. After a few seconds (up to 15), The GREEN LED will blink one or more times, then the RED LED will blink 4 times; after the 4th blink it may come on a 5th time and stay on, or go out. If you see a pattern like this, the board is working. If so, disconnect the power and continue with the installation of the Ethernet module.

Troubleshooting: If you don't see the indicated pattern, most likely you're not seeing the LEDs light at all. Double check a few things:

LEDs installed properly (flat toward bottom edge of board)?

Both socketed ICs installed correctly (all pins in socket, no bent pins, proper orientation)?

Proper power to the board (5-8 VDC), correct polarity?

Check solder side of PC board for unintentional solder 'bridges' or unsoldered pads.

If still no-go then do some Voltage Checks:

Measure voltage from the lower right PC board mounting hole (ground) to:

BE CAREFUL THAT YOU DON'T SLIP WITH THE VOLTMETER LEADS AND SHORT ADJACENT PINS TOGETHER!

Top-most lead of the voltage regulator (input): should be the same as your power supply voltage, 5-8VDC.

Bottom-most lead of the voltage regulator (output): should be 3.3VDC.

Pin 8 of IC2 (lower left pin): 3.3 volts.

Pin 4 of IC2 (upper right pin): less than .1 volts.

Pin 12 of IC1 (12th pin from top on left side) **BE CAREFUL NOT TO SHORT METER LEAD TO AN ADJACENT IC PIN:** 3.3V.

Pin 32 of IC1 (9th pin from top on right side): 3.3V.

Final Assembly

Once the board passes the initial test, complete the assembly by installing the final parts:

14) If you will be using the 4-pin male headers for connecting the strings, install them now. **Please note that these connectors are polarized.** The polarizing tab is closest to the upper edge of the board for the left-hand row of connectors (j9-J16), and closest to the lower edge of the board for the right-hand row of connectors (J1-J8). These can be a bit tricky to install since it's difficult to hold them in place while you turn the board over to solder. (The mounting holes for these parts are intentionally oversized a bit to accommodate direct soldering of pixel wires to the board, for those who don't want to use connectors.) One suggestion is to slip a female housing over the male header before soldering . That way you can use finger pressure against the plastic housing to hold the header in place , without burning your fingers. I recommend soldering one of the inner pins first. Then, hold the board in your non-soldering hand in such a way that you can apply a bit of pressure to the header, and use your other hand with the iron to reheat the pin, this allows you to make sure that the header is fully seated against the component side of the board. Once it's seated properly, go ahead and solder all pins. Use a generous amount of solder on the outer pins as these connectors can be subject to a lot of force as you connect and disconnect the mating plugs.
    The outer pins will take a bit more time to solder due to the mass of the large copper traces.

15) Once all string connectors are installed, install the two 2-pin screw terminal blocks. First connect the 2 blocks together by sliding one into the other, basically like a tongue and groove. Once they are connected to form a single 4-pin block, install the block at the left center of the board. Again, **verify that the side entry holes for wiring face to the left**. Make sure that the terminal block is seated firmly against the PC board before soldering. Use plenty of solder on these connections for mechanical strength and because they may carry a lot of current.

16) Finally install the Ethernet module ETH1. You may need to slightly adjust the position of the heat sink downward to make room for this module. Carefully line up all pins and work the module down flat against the PC board by rocking it. The Ethernet connector faces the top edge of the board. When soldering this module, it's easiest if you solder half of the pins (the row on each side that's on your soldering-iron-hand side, then rotate the board 180 degrees and solder the remaining pins. The idea is to keep the soldering iron from having to reach through one row of pins to solder the adjacent row, which could lead to unintentional solder bridges.

This completes the assembly of the E680. Please refer to the connection and startup information in the users manual for setup and testing.