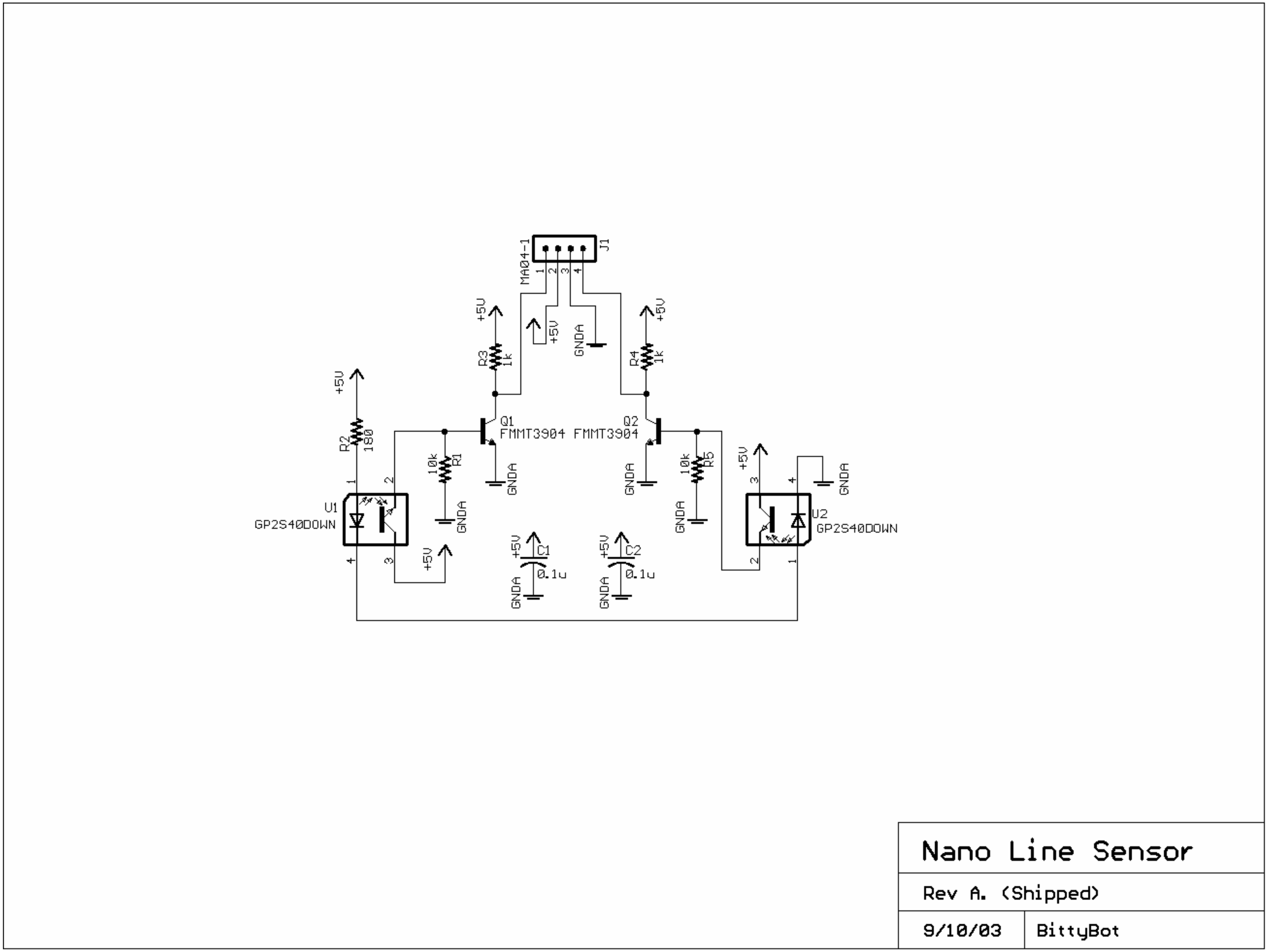
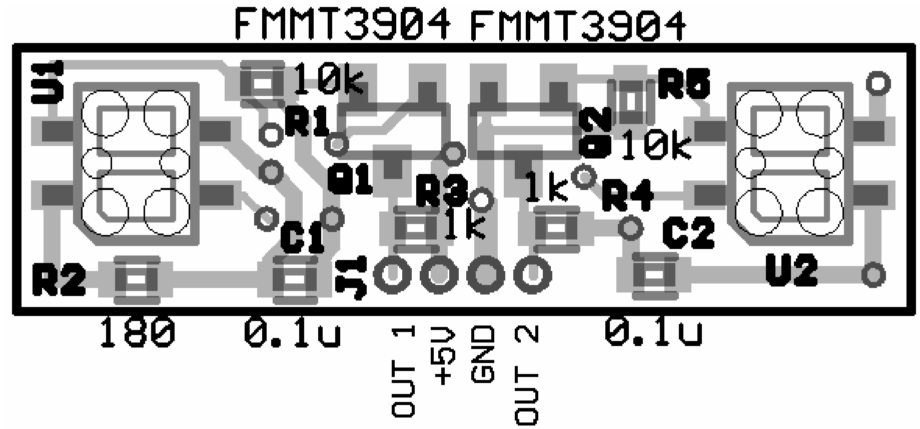
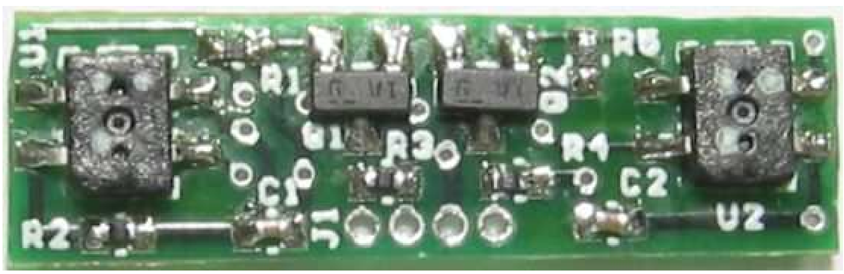
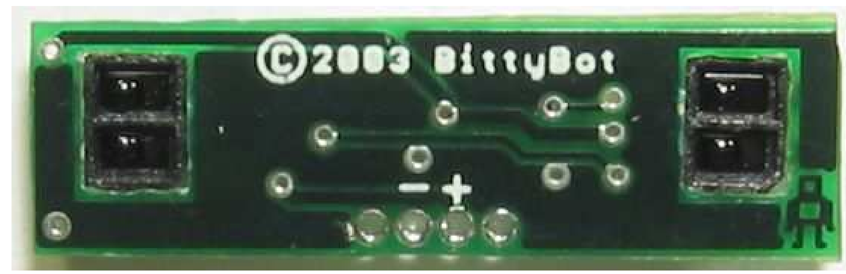

J1
MA04-1
+5V
GNDA
R3
1k
R4
1k
R2
180
Q1
FMMT3904
Q2
FMMT3904
R1
10k
R5
10k
U1
GP2S40DOWN
U2
GP2S40DOWN
C1
0.1u
C2
0.1u
Nano Line Sensor
Rev A. (Shipped)
9/10/03
BittyBot

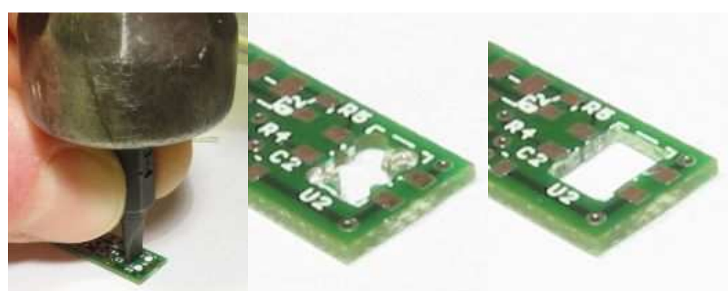






Board Preparation

U1 & U2 are mounted upside down, protruding through the board. That is, when the board is viewed from the top, the lenses should point down. Holes for U1 & U2 need to be cut out. Use small wire clippers to snip the web between the drill-holes and use an Xacto knife to shave down the sides. If small wire clippers are not handy, use a small flat-blade screwdriver or a small chisel to cut the web as shown in the figures below. Also, shave off any tab stubs on the board edges with an Xacto knife.



Board Soldering

The MEGAbitty Nano Line Sensor board has a number of extremely small 0402-sized surface-mount components that may be challenging to solder if you don't already have a lot of soldering experience and a good soldering iron. Consider seeking out some simpler learn-to-surface-mount solder kits to practice on. The following section presents some soldering tips for the LineSensor components. There is also a good surface-mount soldering guide on www.avrfreaks.org: Look for the "Low Cost SMD Soldering Guide."

First, use a good temperature-controlled soldering iron, such as the popular Hakko 936. Some connections heat up readily, while other connections, like pads connected to the ground plane, take a bit more energy. A temperature controlled iron will deliver more power to the tip as needed to maintain the desired temperature. A fixed-wattage iron, on the other hand, will always apply the same amount of power, which will often be more than needed. The extra power can overheat and damage parts. With a temperature-controlled iron, use as low of a temperature as possible that still allows solder to flow readily into the joint within a few seconds of heating.

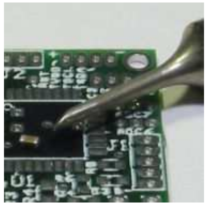


Figure 1: micro-bevel tip

Figure 2: fine-point tip

Second, use a small soldering tip. My favorite is a "micro bevel" (Hakko P900M-T-1C) (Figure 1) – it seems to provide a good mix of contact area for better heating, and fine edge for precision. I've also used a fine-point tip (Figure 2) but didn't like it as well as the micro bevel.

Third, use small gauge solder. The typical .032" RadioShack solder is too big and will flood the small joints and potentially result in solder bridges.

Anchor the board to provide a stable surface for soldering. This can be done simply by taping the ends down to a flat surface. If possible, anchor the board to a surface that can be freely repositioned to achieve the best angle for soldering each component.

When assembling the board, make sure that soldering a component on will not restrict access to other unsoldered pads. For this board, there is not too much of a problem with this. A good strategy may be to solder all the R's and C's, then the transistors, and finally the sensors.

Soldering the Rs & Cs

Soldering the small resistors and capacitors can be challenging, but is not too bad if you use fine-tip tweezers (Figure 3). Place a tiny amount of solder on one of the pads, use tweezers to place and hold the component, and heat the joint until the part settles into the solder. Now the opposite side can be soldered as usual. Touch up the first side to insure there is a good solder joint.

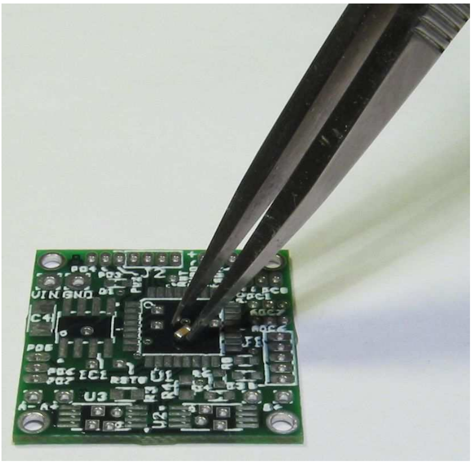


Figure 3: Fine tipped tweezers are necessary for soldering small parts.

Soldering the Transistors

The transistors may be soldered in the same fashion as the other components – melt a little solder onto an easily accessible pad, anchor the part down to that pad, and finish off the remaining pads. Be sure to touch up the first pad to insure a good joint.

Soldering the Sensors

Carefully straighten the leads of U1 & U2 – bending more than a few times may make break them. Note that one corner of the sensor is beveled – orient the sensor so that this corner matches up with the beveled corner in the board diagram on page 2. Depending on how the MEGAbitty Line Sensor board is to be used, either mount the sensors with the lens side flush with the back side of the board and bend the leads down as shown above, or mount the sensors so that they protrude beyond the back side of the board and the leads lie flat. Keep in mind that there should be at least ~1mm between the sensor's lenses and the surface to be detected for proper operation. Cut each lead so that it covers about ½ to ¾ of the pad. For reference, the cut leads on the left of the part in the final picture above are about right; the leads on the right are too long and will be hard to solder.

Final Inspection

Carefully inspect each solder joint using a magnifying glass or pocket microscope. Apply a little more solder to joints that look a little dry; use solder-wick to remove any bridges; and redo joints that look dull (wick old solder away and apply new solder). Check the sensor orientations to make sure they are not rotated and check that the lenses point down. Once you are confident that all is soldered properly, use an ohm meter to make sure there are no shorts between power and ground.

First Power

If everything looks good then it's time to try it out! The board is designed to use 5V, so you will need a 5V power supply. If you're lucky enough to have a power supply with an adjustable current limit, then set the current to ~50mA and apply 5V to the board. The current limiting is nice because if there is a problem, there isn't enough current to do too much damage. If you have a MEGAbitty controller board, you can tap 5V off of the regulated "+5V" net. (See the MEGAbitty Controller Assembly document for appropriate locations.) If your power supply has a current readout, then expect to see ~13mA when the board is over a black surface, ~18mA with one sensor over a white surface, and ~24mA for both sensors over a white surface. Measure the voltages of the left and right outputs. Over a white surface, each output should be under 1V. Over a black surface, the output should be ~5V. If not, move the board further or closer to the white surface. If there is still no output, move on to the "Troubleshooting" section.

Troubleshooting

1. If the output voltages don't change when sensing different surfaces, measure the voltage across the caps (C1 & C2) to make sure the board has power. If it doesn't, check for continuity between the board's "+5V" trace and the power supply, and between the "GND" trace and the supply. Also check for a short between "+5V" and "GND".

2. Next check for a voltage drop across the sensor's IR emitters (pins 1 & 4). There should be approximately a 1V drop. If there isn't, remove power from the board and use an ohm meter to check for continuity between the sensor pins and the board. If the sensor leads were not bent down far enough before soldering, there could be a gap between the board and the lead. It may look soldered from the top, but it may really not be.

RefDes	Description	Manufacturer	Manufacture Part #	Vendor	Vendor Part #	Qty in Kit
U1,U2	PHOTOINTERRUPTER REFLEC 6.5MM PC	Sharp	GP2S40	DigiKey	425-1096-5-ND	2
Q1,Q2	SOT-23 SOT-23 NPN GEN PUR	Fairchild Semiconductor	MMBT3904	Mouser	512-MMBT3904	2
C1,C2	CAP .10UF 10V CERAMIC X5R 0402	Kemet	C0402C104K8PACTU	DigiKey	399-3027-1-ND	3
R1,R5	RES 10K OHM 1/16W 5% 0402 SMD	Panasonic - ECG	ERJ-2GEJ103X	DigiKey	P10KJCT-ND	3
R2	RES 180 OHM 1/16W 5% 0402 SMD	Panasonic - ECG	ERJ-2GEJ181X	DigiKey	P180JCT-ND	2
R3,R4	RES 1.0K OHM 1/16W 5% 0402 SMD	Panasonic - ECG	ERJ-2GEJ102X	DigiKey	P1.0KJCT-ND	3

Resistor R2 sets the current through the infrared LEDs at ~10mA. The board should draw around 13mA over a black surface and 24mA over a white surface.

With the component values shown, the output voltage should remain under 1V for a white surface ~1mm-5mm from the detector, and should increase to 5V over a few mm beyond 5mm. By keeping the output voltage under 1V over a wide range, the detector will work well with the MEGAbitty Controller Board interrupt inputs.