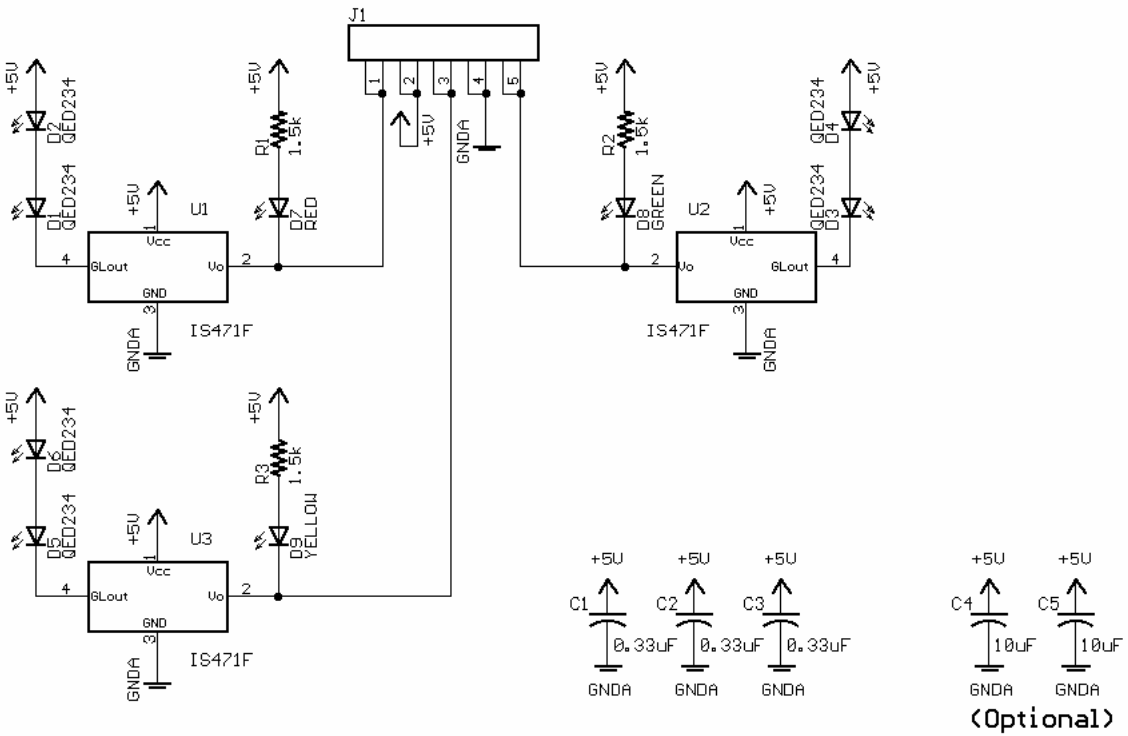
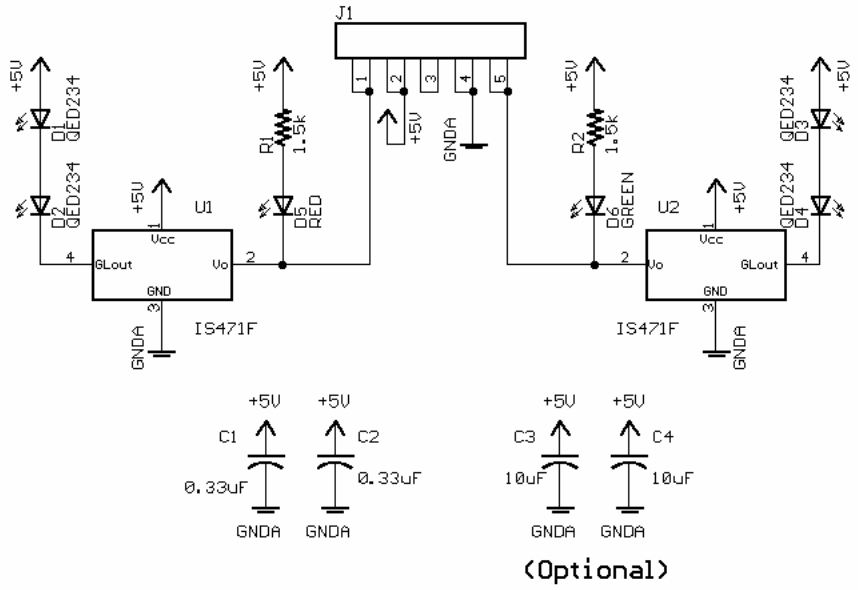
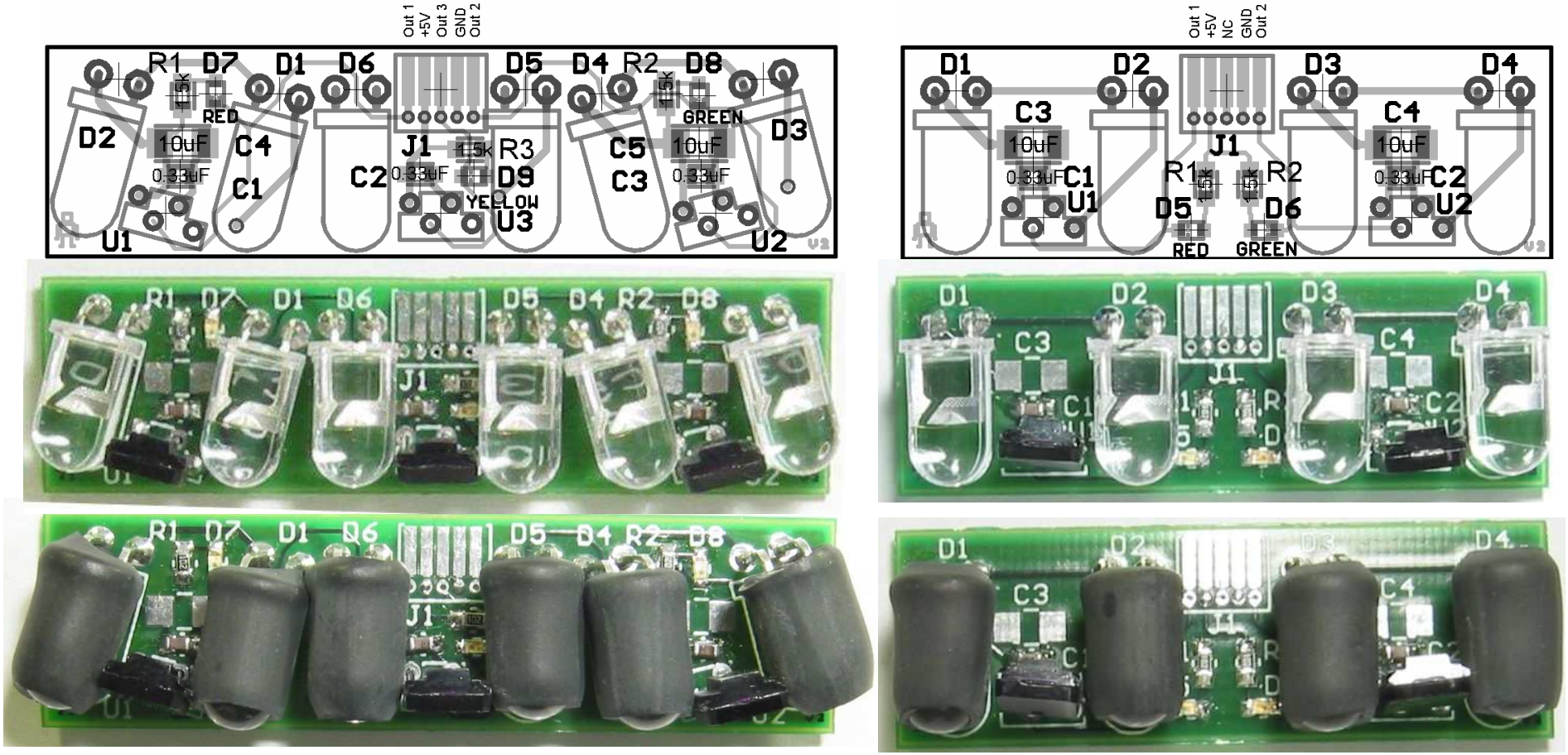


3-Way Obj. Sensor	
Rev B. (Shipped)	
11/12/03	Monty Goodson



2-Way Obj. Sensor	
Rev B. (Shipped)	
11/12/03	Monty Goodson



Note that the 10uF caps are not required for proper operation, and are not included in the kit.

When installing the IR emitter LEDs on either board, note that the LEDs have a rim around the base, and that the rim is flattened on one side. Make sure this flat side matches up with the LED diagrams on the board.

Board Soldering

While the MEGAbitty Object Sensor boards do not have as many small surface-mount components as the other MEGAbitty boards, these components may be challenging to solder if you don't already have some soldering experience and a good soldering iron. A number of MEGAbitty product users attempting surface-mount soldering for the first time have found the soldering to be not too bad, however. The following section presents some soldering tips for the Object Sensor 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 increase the energy as needed to achieve the desired temperature. A fixed-wattage iron, on the other hand, will always apply the same amount of energy, which will often be more than needed. The extra energy can overheat and damage parts. With a temperature-controlled iron, use as low of temperature as possible that still allows solder to flow readily into the joint within a few seconds of heating.

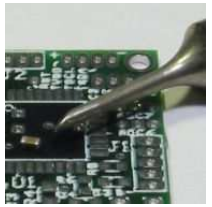


Figure 1: micro-bevel tip

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, or by mounting it with the screw holes. 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. Start with the surface mount components, and then solder the through-hole components.

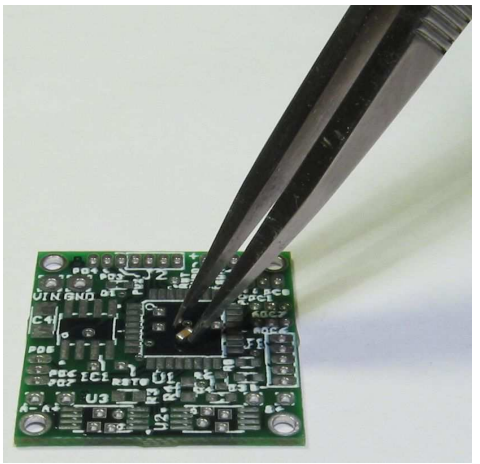


Figure 3: Fine tipped tweezers are necessary for soldering small parts.

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.

Soldering the SMD Indicator LEDs

The LED's are a bit trickier than the caps and resistors. Be careful about squeezing them too hard with the tweezers (especially while heating?), as the lens and body appears to be glass and can chip. As with all LEDs, polarity is important. Look closely at the top (glass part) of the LED and find the little square LED die just off center – a magnifying glass helps here. This die should line up with the little white silk-screened stubs located between the LED pads on the board.

Figure 4: Proper LED orientation

Soldering the Detectors

After successfully tackling the SMD components, the through-hole IS471F IR detectors should be a piece-of-cake. Start by soldering one leg of each detector. Check that each detector is seated properly (the part's leads are inserted through the board up to the bends in the leads, and the detector is standing up straight) – reposition the detector as needed while heating the solder. Once all detectors are positioned correctly, solder the remaining leads.

Soldering the IR LEDs

First, bend the leads of the IR LEDs close to the base as shown in Figure 5. Make sure that you bend the leads such that the flat side the flange at the base of the LED will match up with the silk-screened LED on the board. Prop or hold the board upside down so that it is resting on the IR Detectors. Insert one of the IR LEDs with bent leads from underneath, and allow it to rest on the table. Solder one leg of the IR LED. Check that the top of the LED is about level with the top of the detectors, and that the LED is straight. Solder the remaining leg. Repeat with the other IR LEDs.

Figure 5: Bend LED legs close to base

Final Inspection

Carefully inspect each solder joint using a magnifying glass or pocket microscope. Apply a little more solder to joints that look inadequate; use solder-wick to remove any bridges; and redo joints that look dull (wick old solder away and apply new solder). Check all part orientations -- make sure the flat face of each IR detector is facing forward and that none of the LEDs are backwards. Once confident that all is soldered properly, use an ohm meter to make sure there are no shorts between power and ground.

Isolating the IR Detectors from the Emitters

The IR LEDs emit some IR out the sides, which interferes with the detectors. This IR leakage must be blocked to keep the sensors from sticking "on". Cover each IR LED with a short piece of black heat-shrink tubing (included in the kit.) Cut a 3/8" (10mm) long piece of tubing and slip it over the LED until it touches the LED's leads. The tubing should extend out the front to a bit past the middle of the LED's domed tip. If the tubing extends past the LED's tip, it will shrink shut and restrict too much of the forward IR emissions. If too much of the domed tip is left exposed, IR may directly illuminate the sensor. Using a heat-gun, hot hair-dryer, or even the radiant heat of a solder iron tip (be careful not to touch the tubing directly with the tip though), shrink the tubing, adjusting it's position as needed along the way. Pay attention that the tubing does not close off too much of the LED's tip.

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 between the "GND" and "+5V" connections. 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.) Current limiting is nice because if there is a problem, there isn't enough current to do too much damage. If your power supply has a current reading, then expect to see ~10mA for the 2-way detector and ~16mA for the 3-way when the board is not detecting any objects, and then an additional 4-5mA for each indicator LED that is on when an object is in range. If a white card or piece of paper is held directly in front of the detectors, the red, green and, for the 3-way board, yellow LED should light immediately upon applying power. If they don't, move the board further or closer to the white surface. If there is still no light, move on to the "Troubleshooting" section.

Troubleshooting

1. If the indicator LEDs do not light up when power is applied and a white card is held in front of the detector, there are two likely problems to check: Possibly, power is not getting to the sensors; or either the IR LEDs or the indicator LEDs are soldered in backwards.
    a. First use a voltmeter to insure that power is applied properly. Look for +5V at the input connector and at the sensors (U1-U3). At the sensors, measure across the rear two pins (closest to the capacitors).
    b. If the board has power, then measure the output voltage of the detectors. It should be "low" (close to zero volts) when a white card is held in front of the sensors. If not, there may be a problem with the IR LEDs. Check the polarity of the IR LEDs – there is a flat side on the flange at the LED's base that needs to match up with the silkscreen on the board. If you have a diode test function on your multimeter, use it to check the voltage drop across each LED to insure that none are burned out and to double check the polarity.

c. If the sensor outputs are low, but the color indicator LEDs do not light up, then check the polarity of the indicator LEDs, referring to Figure 4 for the proper orientation. Also, use your multimeter's diode test function to insure these LEDs did not get damaged during soldering.

2. If the indicator LEDs light up, but won't turn off even when no objects are within the detection range, then most likely there is some direct IR leakage between the IR LEDs and the sensors. There is also a possibility that the external light may be overpowering the sensors causing them to give false readings – make sure that direct sunlight, or bright work lamps are not causing problems.
   a. First, isolate the problem sensor/IR LED group from the other sensors on the board – place an opaque card between D2 & D3 on the 2-Way board, or between either D1 & D6, D4 & D5, or both for the 3-Way board. Make sure that the card blocks all direct optical paths between the sensors, but does not extend so far out front that it might be intruding into the sensor's detection range.
   b. If the indicator LEDs still don't turn off, place another opaque card between the sensor and each it's accompanying IR LEDs to determine which IR LED (or both) is the culprit. Try nudging the problem LED forward a little bit, or the detector back a little bit – it might be just enough to eliminate the direct leakage. Otherwise, the heatshrink tubing for the suspect LED(s) may need to be replaced with a longer piece.

3-Way Object Sensor Parts List

RefDes	Description	Manufacturer	Manufacture Part #	Vendor	Vendor Part #	Qty in Kit
D1-D6	DIODE EMIT LED IR 940NM T-1 3/4	Fairchild	QED234	DigiKey	QED234-ND	6
D7	LED SUPER RED CLR THIN 0603 SMD	Lite-On Inc.	LTST-C191KRKT	DigiKey	160-1447-1-ND	1
D8	LED SUPER GREEN CLR THIN 0603 SMD	Lite-On Inc.	LTST-C191KGKT	DigiKey	160-1446-1-ND	1
D9	LED SUPER YELLOW CLR THIN 0603 SMD	Lite-On Inc.	LTST-C191KSKT	DigiKey	160-1448-1-ND	1
U1-U3	LIGHT DETECTOR OPIC 940NM	Sharp	IS471F	DigiKey	425-1178-5-ND	3
C4,C5 (*1)	CAP 10UF 16V CERAMIC F 1206	Panasonic - ECG	ECJ-3YF1C106Z	DigiKey	PCC2300CT-ND	0
C1-C3	CAP .33UF 16V CERAMIC Y5V 0603	Kemet	ECJ-1VF1C334Z	DigiKey	PCC1791CT-ND	3
R1-R3	RES 1.5K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ152V	DigiKey	P1.5KGCT-ND	4

Notes:

1.) C4 & C5 are optional. They are not required for proper operation.

2-Way Object Sensor Parts List

RefDes	Description	Manufacturer	Manufacture Part #	Vendor	Vendor Part #	Qty in kit
D1-D4	DIODE EMIT LED IR 940NM T-1 3/4	Fairchild	QED234	DigiKey	QED234-ND	4
D5	LED SUPER RED CLR THIN 0603 SMD	Lite-On Inc.	LTST-C191KRKT	DigiKey	160-1447-1-ND	1
D6	LED SUPER GREEN CLR THIN 0603 SMD	Lite-On Inc.	LTST-C191KGKT	DigiKey	160-1446-1-ND	1
U1,U2	LIGHT DETECTOR OPIC 940NM	Sharp	IS471F	DigiKey	425-1178-5-ND	2
C3,C4 (*1)	CAP 10UF 10V CERAMIC Y5V 1206	Panasonic - ECG	ECJ-3YF1A106Z	DigiKey	PCC1894CT-ND	0
C1,C2	CAP .33UF 16V CERAMIC Y5V 0603	Kemet	ECJ-1VF1C334Z	DigiKey	PCC1791CT-ND	2
R1,R2	RES 1.5K OHM 1/10W 5% 0603 SMD	Panasonic - ECG	ERJ-3GEYJ152V	DigiKey	P1.5KGCT-ND	3

Notes:

1.) C3 & C4 are optional. They are not required for proper operation.