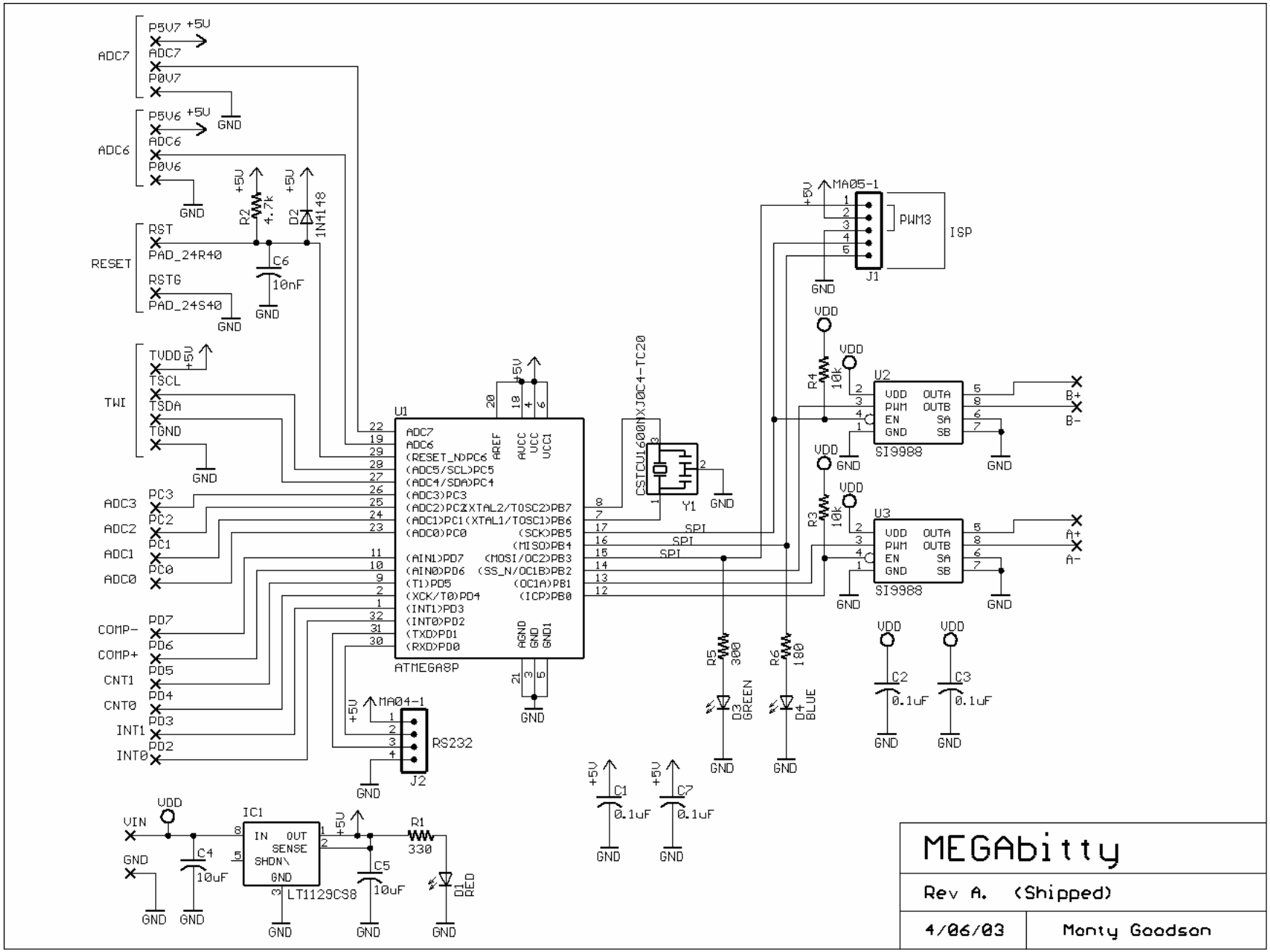
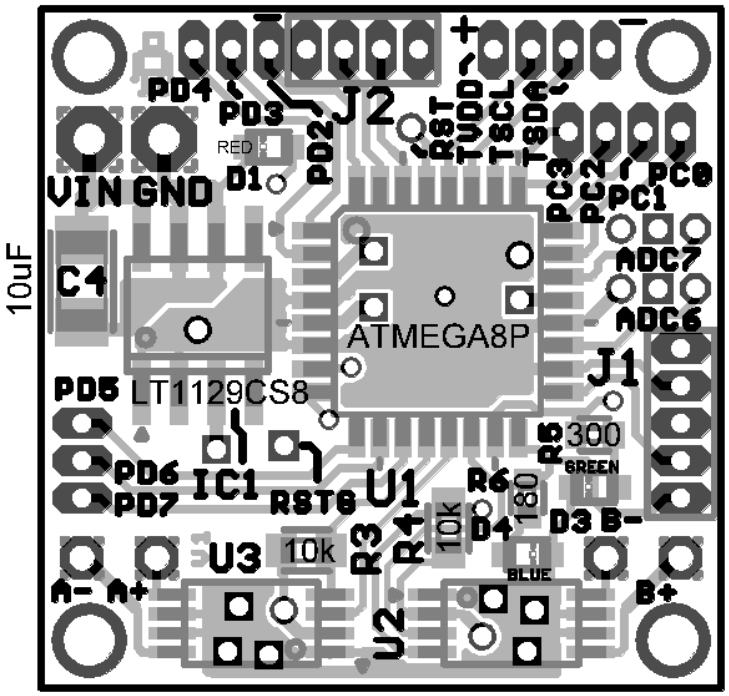
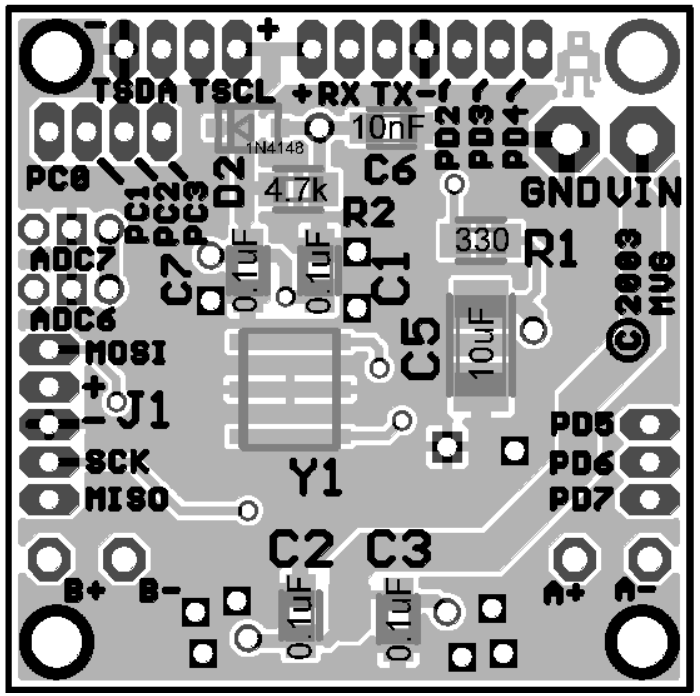

MEGAbitty
Rev A. (Shipped)
4/06/03
Monty Goodson
ATMEGA8P
SI9988
LT1129CS8
RS232
PWM3
ISP
TWI
RESET

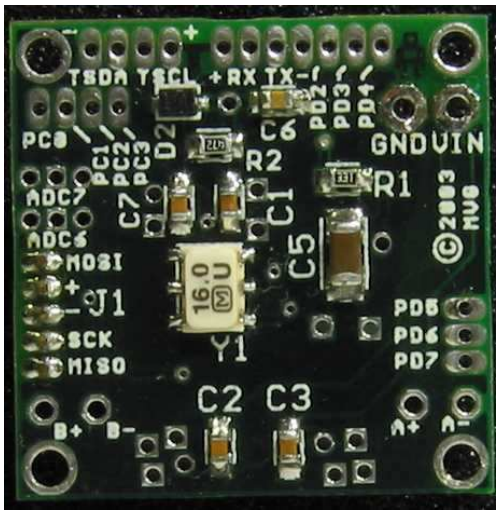
TOP



BOTTOM



SI9988 SI9988



Bill Of Materials

RefDes	Description	Manufacturer	Manufacture Part #	Vendor	Vendor Part #	Qty In Kit
U1	IC AVR MCU 8K 16MHZ COM 32-TQFP	Atmel	ATMEGA8-16AC	DigiKey	ATMEGA8-16AC-ND	1
U2, U3	H-Bridge TSSOP-8	Vishay-Siliconix	SI9988DQ	Mouser	781-SI9988DQ	2
IC1	IC LDO REG W/SHTDN 5V 700MA8SOIC	Linear Tech.	LT1129CS8-5	DigiKey	LT1129CS8-5-ND	1
Y1 (*1)	RESONATR CERM W/CAP 16.00MHZ SMD	Panasonic	EFO-BM1605E5	DigiKey	PX160BCT-ND	1
(Y1 alt.)	Ceramic Resonator 16.00MHz 0.5%	Murata	CSTCV16.00MXJ0C4-TC20	Mouser	81-CSTCV16.00MX40C4	0
D1	LED SUPER RED CLR THIN 0603 SMD	Lite-On	LTST-C191KRKT	DigiKey	160-1447-1-ND	1
D2	diode, small signal, switching, 0.15A	VISHAY	1N4148WS	Alliled	950-1558	1
(D2 alt.)	DIODE SWITCH 75V 200MW SOD-323	Diodes,Inc.	1N4148WS-7	DigiKey	1N4148WSCT-ND	0
D3	LED GREEN CLEAR THIN 0603 SMD	Lite-On	LTST-C191GKT	DigiKey	160-1443-1-ND	1
D4	LED BLUE CLEAR THIN 0603 SMD	Lite-On	LTST-C191CBKT	DigiKey	160-1441-1-ND	1
C1,C2,C3,C7	CAP .10UF 16V CERAMIC X7R 0603	Kemet	C0603C104K4RACTU	DigiKey	399-1096-1-ND	6
C4	CAP 10UF 16V CERAMIC F 1206	Panasonic	ECJ-3YF1C106Z	DigiKey	PCC2300CT-ND	1
C5 (*2)	1206 SMD Monolythic Ceramic Chips 10V 10uF Y5V +80-20	Murata	GRM31MF51A106ZA01L	Mouser	81-GRM426Y106Z10L	1
C6	CAP 10000PF 50V CERAMIC X7R 0603	Kemet	C0603C103K5RACTU	DigiKey	399-1091-1-ND	3
R1	RES 330 OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEYJ331V	DigiKey	P330GCT-ND	3
R2	RES 4.7K OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEYJ472V	DigiKey	P4.7KGCT-ND	3
R3,R4	RES 10K OHM 1/10W 5% 0603 SMD	Panasonic	ERJ-3GEYJ103V	DigiKey	P10KGCT-ND	4
R5 (*3)	RES 300 OHM 1/16W 5% 0402 SMD	Panasonic	ERJ-2GEJ301X	DigiKey	P300JCT-ND	2
R6 (*3)	RES 180 OHM 1/16W 5% 0402 SMD	Panasonic	ERJ-2GEJ181X	DigiKey	P180JCT-ND	2
J1, J2 (*4)	CONN STRIP SOCKET 50POS .050	Mill-Max	851-93-050-10-001000	DigiKey	ED8450-ND	1x4,1x5
(*5)	CONN STRIP HEADER 50POS .050	Mill-Max	850-10-050-10-001000	DigiKey	ED8250-ND	1x4,1x5
(*6)	SWITCH LIGHT TOUCH 240GF SMD	Panasonic	EVQ-PQMB55	DigiKey	P8091SCT-ND	0

Notes:

1.) The board was originally designed for the Murata ceramic resonator, but the Panasonic is a lower-profile and cheaper part. The Panasonic lead spacing is less than the board was designed for, but it still fits ok.

2.) If board thickness is not a concern, the same cap used for C4 may be used for C5 (It's cheaper and has a higher voltage)

3.) To squeeze in two general purpose LED's, resistors in an 0402 size package were chosen. These are extremely small. The pads, however, are just big enough to allow a 0603 sized package to be soldered on instead, if desired.

4.) The 50mil sockets can be used on any, all, or none of the I/O lines. For a board that will be programmed primarily via ISP, stuff J1 with a 5 pin 50-mil socket on the board. For a board that will be programmed primarily via RS232, stuff J2 with a 4-pin 50-mil socket on the board. Unfortunately, there is not much of a selection of 50mil connectors on the market. DigiKey and Mouser only carry the ones listed, and only in 50pin strips. They need to be cut apart -- plan on sacrificing a pin for each cut. I used an Xacto knife saw and miter box (available at hardware or craft stores for ~$15)

5.) The 50mil headers can be used for constructing cables to interface with the board. For ISP programming, a 5pin header with a 6-conductor cable is required -- see the "MEGAbitty Programming and Usage Instructions" for details. For RS232 programming, a 4-pin cable with a RS232 level shifter is required – again, see the "MEGAbitty Programming and Usage Instructions" (coming soon…) for details.

6.) This switch or similar can optionally be used as a reset switch. Mount it on top of the processor (U1) with double-sided tape or with glue, and hook the switch leads up to the small holes labeled "RST" and "RSTG"

(This page intentionally left blank)

Board Preparation

Before soldering, perform a quick continuity test to make sure there are no shorts or opens on the board itself. Test at least for shorts between Vin & Gnd, and V+ & Gnd. Note that all GND vias are square, while others are round. If you're not in a hurry, consider testing for shorts between adjacent runs and vias. I don't expect there to be any problems because this board did not push the spacing limits of the fabrication process, but doing these quick tests will allow you to rule out a board defect if a short is found after soldering.

Shave off any tab stubs on the board edges with an Xacto knife.

If the board has been handled a lot, consider wiping it down with isopropyl alcohol (rubbing alcohol) before soldering.

Board Soldering

The MEGAbitty contains many small surface mount components that will seem impossible to solder for those without a lot of soldering experience and a good soldering iron. If you are up to the challenge, then read on, otherwise this kit is probably not for you. (Sorry!) Consider seeking out some simpler learn-to-surface-mount-solder kits to practice on. The follow section is not intended to be a how-to-solder guide, but presents some soldering tips for MEGAbitty's components. There is a good how-to-solder surface-mount guide on www.avrfreaks.org

First, use a good temperature controlled soldering iron. Some connections heat up readily, while other connections, like pads connected to the ground plane, do not. A good soldering iron used properly makes life easier and won't be as likely to cause over-temp damage. Use as low of temperature as possible that still allows solder to flow readily into the joint within a few seconds of heating. Even though the soldering iron is temperature controlled, increasing the temperature for connections to large copper planes may be required.

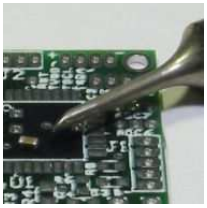


Figure 1: micro-bevel tip

Figure 2: fine-point tip

Second, use a small soldering tip. My favorite is a "micro bevel" (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 – 0.016" diameter works well. Too big of solder will flood the small joints and cause solder bridges.

Use a fan blowing away from the work area to pull the smoke away and keep it out of your nose and eyes – soldering small components is challenging enough without irritated eyes!

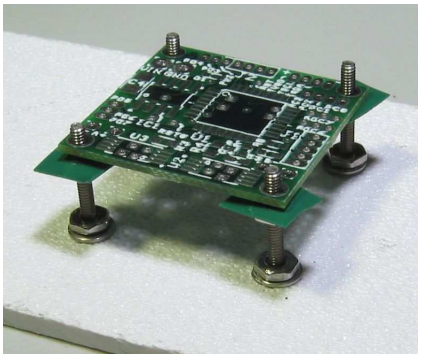


Figure 3: Board held securely. Note green electrical tape to insulate the nuts from nearby pins and vias – this allows the board to be safely powered-up and tested in the jig as well.

Anchor the board to provide a stable surface for soldering. A jig can be easily made from a thin sheet of plastic, such as ABS, and 0-80 sized hardware (Figure 3). MEGAbitty's mounting holes are 0.780"

apart on each side. However it is anchored, the board should lie flat and be easy to reposition to get the best angle for soldering.

To assemble the board, start with the bottom and tackle the resistors and capacitors. One or two extra pieces are included in the kit for some components, so warm up your SMT soldering skills with these. Before soldering a component down, make sure doing so will not restrict access to other unsoldered pads. A good place to start is with C1, C2, C3 & C7, and then perhaps R2 & C6. Note that soldering R1 may make it harder to solder C5, so do C5 first; there is only one C5 included in the kit though, so be careful here. If you are doing well so far, then try the final two components – D2 and the ceramic resonator, Y1. Be sure to read the soldering tips for the different types of components below first.

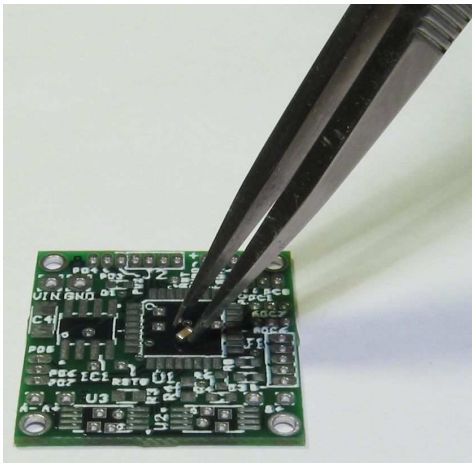


Figure 4: Fine tipped tweezers are necessary for soldering small parts.

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 4). 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 (Figure 5). Now the opposite side can be soldered as usual. Touch up the first side to insure there is a good solder joint. When choosing which pad to solder first, study the board layout diagrams on page 2 and choose the pad that connects to the smallest copper area. With less copper to act as a heat sink, the joint will be easier to solder. While there are thermal reliefs for pads connected to planes, they don't provide enough "relief" as they probably should.

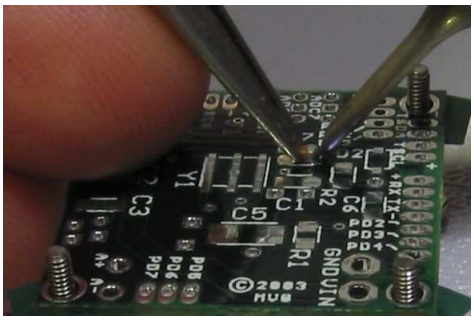


Figure 5: Place component on pre-tinned pad and melt solder to fix in place

Soldering the resonator

The ceramic resonator is probably the most difficult part to solder. When soldered professionally in a reflow process, each pad is entirely soldered down. The best that can be hoped for in hand soldering is a good connection on the edges. Because of the small amount of gold pad that wraps up the side of the resonator, a small soldering tip is necessary to make contact with it. As with the other components, apply a little solder to one of the pads (avoid the middle pad since it connects to the ground plane), but only apply it to the end of one pad. Too much solder on the whole pad will not allow the part to seat flush to the board, and melting all the solder to allow the part to drop down is difficult. Using tweezers, position the part and heat up the pre-applied solder until it tacks the resonator down. Make sure the resonator is seated properly, as in Figure 7. Solder down both ends of the pad on the resonator's other end, and then the rest of the pad ends. Be sure to go back and rework the first pad end to insure a good solder joint.

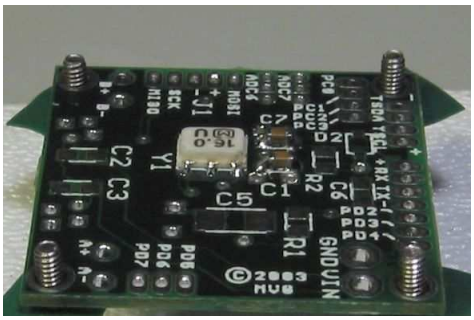


Figure 6: Resonator soldered down.

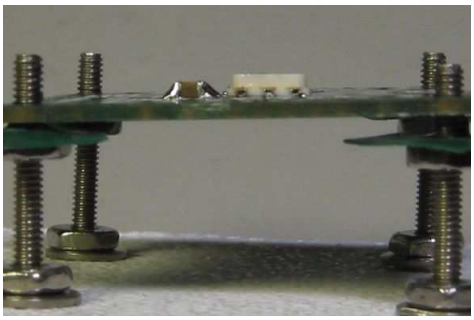


Figure 7: After soldering the first resonator pad, make sure it lies flat and there is no gap between it and the board.

Soldering the IC's

To assemble the top side, start from the center and work out, again making sure that soldering a component down will not restrict access to unsoldered pads of other parts. I typically start with the microcontroller and work out. While the microcontroller may look like the most intimidating component, I find it is one of the easier to solder. The hardest part is aligning it and soldering the first pin.

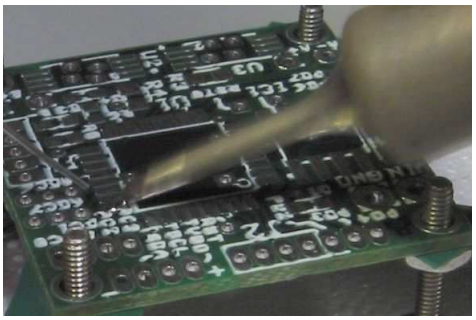


Figure 8: To solder an IC, start by applying a little solder to the 1st pad.

To do this, I first melt just a little bit of solder onto an easily accessible pad (usually a corner, as in Figure 8). Place and center the part, making sure that the orientation is correct (look for a silkscreened dot in a corner of the chip outline on the board, and a orientation indicator on the chip – for the Mega8 (U1), this is a beveled corner; for the voltage regulator, this is a beveled side; and for the H-Bridges, this is a dot pressed into one of the corners. There is also a little white silk-screened arrow on the board pointing to pad 1 of each IC.) While applying light down-pressure with a finger or tool, make sure than all pins are centered on the pads, and heat up the first pin until it drops into the solder (Figure 9). Make any required minor alignment adjustments, and solder a pin on the opposite side. Now that the part is sufficiently anchored, the rest of the pins may be soldered in succession.

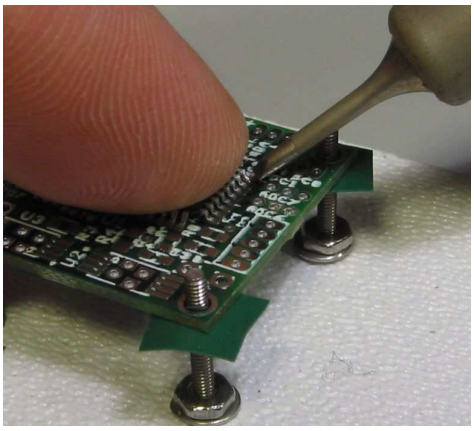


Figure 9: Align the IC, hold it in place, and tack down the first pin.

There are a couple of methods for soldering large numbers of fine-pitch pins; one is the glob-and-wick method. Heat each pin or even a couple pins while applying ample solder; in fact, more solder than needed. There will be solder bridges and it will look like a mess. Lay a length of solder wick across a row of pins to be soldered and heat until solder just starts to show through the wick. Remove the wick and if all works well, just enough solder will be left on each pin to provide a good connection. This method works ok, but I found it important to insure all pins are soldered well before wicking (i.e. no cold solder joints), and that the wick is not held in place for too long, as too much solder will be removed from the joint. This method is probably best suited for those attempting to use too big of a soldering tip to solder each pin individually. In fact, a larger tip works better for this method.

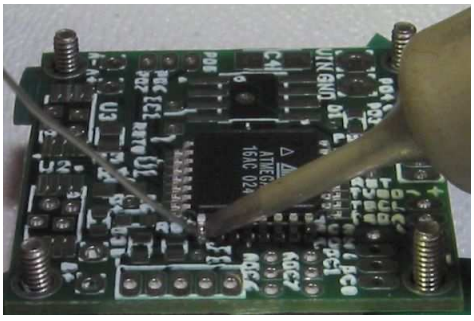


Figure 10: Once anchored, pins may be soldered in succession.

The preferred method is to solder each pin individually. With the right tip, this is not as bad as it sounds. The "micro bevel" tip really shined here. I start by placing the tip on the first pin in a row at an angle with the bevel side up and applying solder at the pad-pin junction – see Figure 10. Once soldered, just drag the tip to the next pin and apply solder. The key is to not apply too much solder, or dragging the tip will drag solder and form a solder

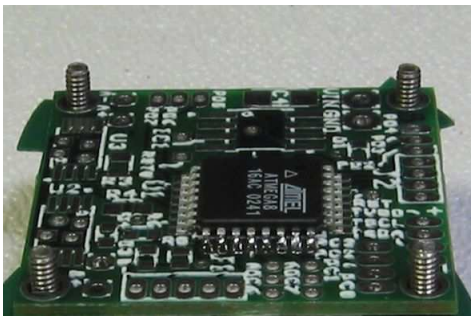


Figure 11: One side completed.

bridge. When heating the first pin, the second pin is also getting a lot of heat, so it does not take a long contact period on the second pin to melt solder. Proceed from pin-to-pin until it's all soldered. Inspect carefully for joints with a dull color, not enough solder, and for solder bridges. Use solder-wick to clean up bridges, and rework dull or unsoldered connections. I made heavy use of a Radio-Shack pocket microscope for close inspections.

After soldering an IC, especially the Mega8, do a quick continuity check between power & GND. The earlier you catch a short, the easier it will be to track down and repair. Be sure to check the correct power. The H-Bridges use the unregulated "Vin" while all other IC's use regulated "+5V".

Soldering the diode and 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 are glass and can chip. The green band on the top side of the LED should line up with the little white stubs in the silk-screened part outline to insure proper polarity. Beware of the green band on the bottom of the LED -- it should not be used for determining LED polarity.

Insure D2 is soldered in the proper orientation – there is a barely-visible band on one end of the diode. The marked end should be placed closest to the "D2" silkscreen.

Final Inspection

Carefully inspect each solder joint using a magnifying glass or pocket microscope. Apply a bit 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 all part orientations to make sure no IC's are rotated or backwards, and that all LED's and diodes are correctly orientated. Once you are confident that all is soldered properly, use an ohm meter to make sure there are no shorts between power and ground – both at the regulator input, "Vin", and the output, "+5V". Also check that "Vin" and "+5V" are not shorted.

First Power

If everything looks good then it's time to try it out! If you have a current limited power supply then set the current to ~50mA and apply 6V to the board. If you don't, then a 9V battery will do. The current limiting is nice because if there is a problem, there isn't enough current to do too much damage. The red LED (D1) should light immediately upon applying power. If it doesn't, measure the regulator output voltage. If you measure 5V, then R1 or D1 is not solder properly, D1 is backwards, or D1 is damaged. Use an ohm meter to check connections. If you have a diode test function on your multimeter, check the voltage drop across D1. It should be around 1.2-1.5V with the negative test probe on the cathode (the end closest to the power connector), and ~0.6V the with positive test probe on the cathode (normally, the meter would see an open-circuit in this case, but other current-carrying paths in the circuit cause the lower voltage reading.) You may or may not be able to see a faint red glow from the LED.

If the red LED lights upon apply power, then congratulations! Go ahead and measure the regulator's output voltage to insure it is 5V. If so, then you're ready to program the microcontroller. To do this, refer to the "MEGAbitty Programming and Usage Instructions." (coming soon…)