D Bit Reflow Oven Controller Shield

The D Bit reflow oven controller shield enables an Arduino SBC to control a toaster oven, thermocouple, and LCD display, for reflow soldering. It connects a K-type thermocouple, solid-state relay, and LCD display to almost any standard-size Arduino. Either 3.3- or 5-volt signaling is supported automatically.

What else you need:

- Arduino – standard size (e.g. Uno or Due). **Not** Nano!
- Toaster oven, modified so that it's always on when AC power is applied. Do not attempt this if you are not experienced with working with line voltages! If the wiring is done wrong, the unit will be extremely dangerous to use.
- Solid-state relay to switch the toaster oven on and off. It must be able to handle the amount of current that your toaster oven draws at full power (employ mathematics to find this value, then add a large safety margin), and switch on based on an input signal as little as 3 VDC (almost all can). eBay is a great source for cheap SSRs.
- Type K thermocouple with a tip consisting of bare wires (*not* shielded inside a metal tube) which can rest directly on the PCB being heated. If you don't do this, you're just measuring the air temperature (after a long delay if there's shielding), and you will scorch your PCBs. The thermocouple may have loose bare wires for the electrical connection, or a standard type K thermocouple plug (e.g. Omega SMP-K-M). Sparkfun no. SEN-00251 is perfect.
- LCD display with a 16-pin male SIP header on the bottom (of the top edge, ideally), and an HD44780-style controller. 20x4 is nice but 16x2 is good enough. The source file to the software has a place to set this. Again eBay is a great source – it's amazing how cheap these are.

First off, plug the Arduino into a computer using a USB cable. Download and install the Arduino development environment (from www.arduino.cc), and start it up. Go into the "Tools" menu and set the "Board" to the Arduino model you're using, and "Port" to the serial port where it appears (it may take some experimentation to figure out which is correct, if you have multiple devices that act as serial ports).

Now download the REFLOW.pde sketch from (www.dbit.com/reflow). Open that sketch in the Arduino IDE and modify the LCDCOLS and LCDROWS parameters as needed to match the number of columns and rows in your LCD module. Then click the right-arrow button (near the top of the window) to compile the program and program it into the Arduino's flash. Now the Arduino may be disconnected (forever!) and moved to the reflow oven setup.

Connections:

- Power the Arduino from a wall wart. There's no need for it to stay connected to a computer.
- Plug the shield into the Arduino. The ICSP connectors must line up, which will help find correct alignment when the Arduino has more pins than the reflow shield does.
- SSR+/SSR- go to the control input on the solid-state relay. Be sure to keep the polarity correct.
- TC+/TC- *or* the large plastic socket in the lower right corner of the shield connect to the thermocouple. Again polarity is important. There are two screw terminals per wire in case the thermocouple has fork spade terminals on it intended for a single larger screw – the two tips of each terminal should each fit into its own screw. With bare wires, use only one screw from each pair. It doesn't matter which as

long as it's one of each. If the thermocouple has an Omega SMP-K-M style plug, insert it into the jack in the lower right (it's keyed and fits only the right way around) and ignore the TC+/TC- terminals.

- The LCD module plugs into the 16-pin female SIP header near the upper edge of the shield. It will cover most of the rest of the shield, so plug it in last.

Operation is simple. The LCD display shows the current temperature reported by the thermocouple, and the current stage in the reflow temperature curve. Pressing the "RESET" button will turn off the oven at any point and return the software to its idle state. This button is located in the near corner of the shield to make it easy to find in an emergency. Pressing the "START" button begins the heating procedure. The oven will cycle on and off a lot (this is normal) so that the temperature will follow the profile in the software. This is defined in the "profile[]" array, which should be self-explanatory and may easily be modified if necessary, before programming the code into the Arduino again. The supplied profile has worked well with lead-free solder paste and PCBs from oshpark.com. The two status LEDs show the current state: red means stopped (idle and ready for the START button to be pressed), and green means active.

The trimpot on the shield may be adjusted with a screwdriver to correct the LCD contrast, if it is not easily readable.

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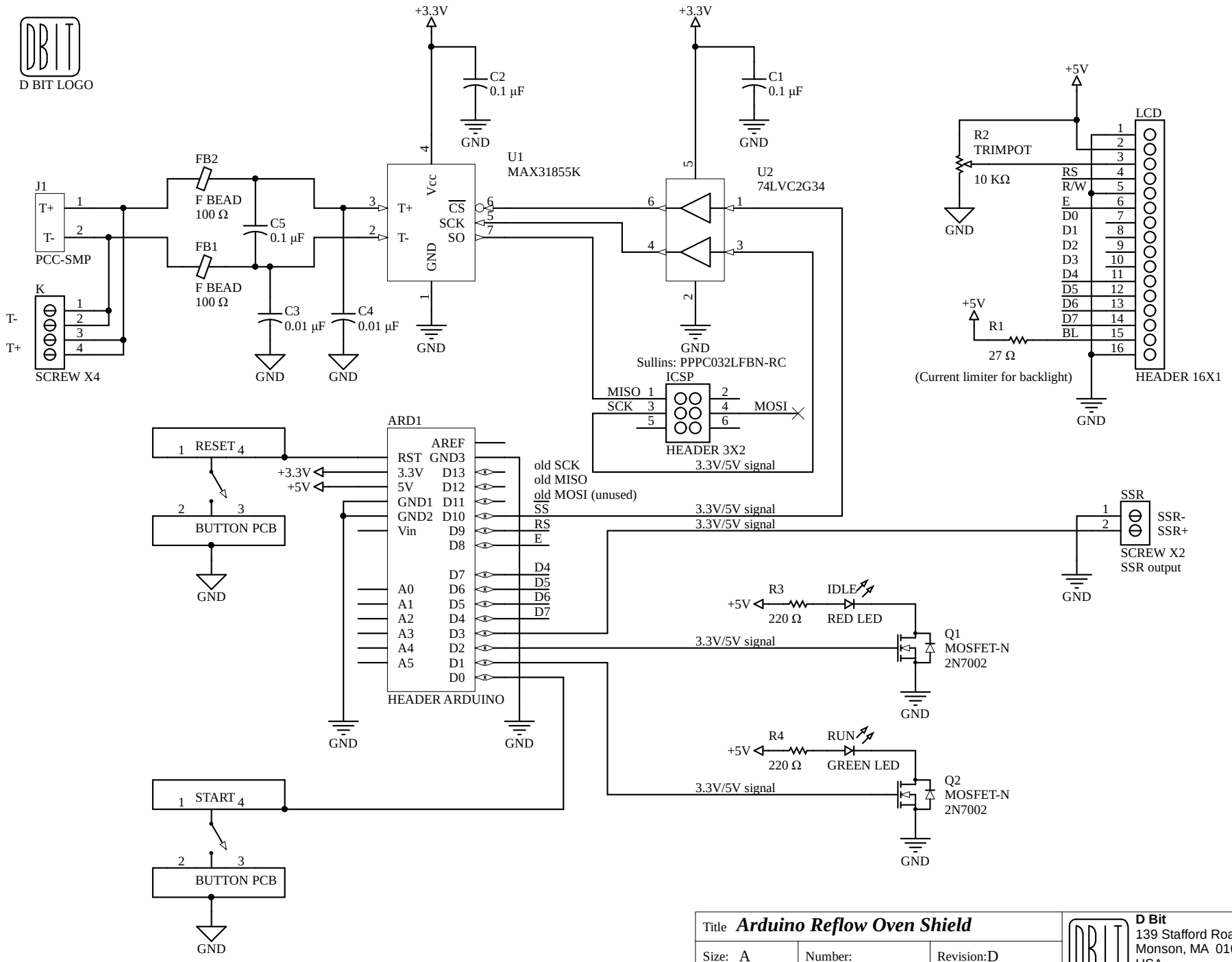

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