

Assembly Instructions for Reactor Core

General Advice for SMD Soldering

When soldering SMD (surface mounted devices) electrical components, you should start with the smallest parts first and if possible work your way from one side to the other or top to bottom. This would usually mean starting with the resistors and ceramic capacitors.

For hand soldering, always keep the soldering iron wetted with some fresh solder. When you press against the part with a soldering iron it will want to move. It is best to fix one end before soldering the rest. One method is to melt a little solder onto one of the pads. Then place the part and hold it over the pads. Use your soldering iron to heat both the part and the solder below. Once you have one pad soldered and secured, it is easier to solder the rest in place normally.

If you have any have any solder bridges, this is especially true when working with parts with multiple small pins, add flux to the pins and use solder braid/wick to draw off the extra solder.

Hot-Air Reflow Soldering

This is a simple process that requires first the application of solder paste using a stencil, then the components are added. Finally the parts are put into an oven and heated through a given temperature cycle for melt the solder and join the parts to the circuit board.

You start by placing the PCB on a flat surface. You can block it in place by surrounding it with spare/scrap circuit boards of similar stock. Then you lay over the top the stencil and tape it in place. The pads should show through the stencil. Apply solder paste around the pads. Use a spatula to scrap away extra solder and to fill in all the holes in the stencil. Extra solder can cause solder bridges, so be sure to scrape away extra solder paste.

Carefully remove the stencil. Begin placing components onto the board and lightly pressing them into the solder paste. Follow the same rules for placement as above, e.g., adds the smallest parts first.

A sharp movement or tap could dislodge a part. You should double check part locations when putting the board(s) into the oven. Use a baking sheet or similar to hold the parts while in the oven.

The heat cycle for the provided lead-free solder sample, including heating time, is as follows:

140°C (285°F) 120 seconds minimum (+60 seconds, $\pm 5^\circ\text{C}$ or 10°F), not critical.

219°C (425°F) 90 seconds (± 15 seconds, $\pm 5^\circ\text{C}$ or 10°F), semi-critical.

240°C (465°F) 45 seconds (± 15 seconds, 240°C max or 465°F max), critical time and temperature.

Cool to 170°C (340°F) in around 60 seconds, not critical but important to cool down. This can be done by opening oven door an inch or two.

The time above 219°C is critical. The solder will melt above this temperature. **Do not** heat too long or the parts may be damaged.

Reactor Core Final Assembly and Testing

For both the ATmega328P and the FT232RL chips, check continuity between any two neighboring pins, e.g., pins 1 and 2. Only on the FT232RL on pins 25 & 26 will there be continuity. Otherwise continuity between two pins will mean you have a solder bridge that must be removed.

Use flux and solder wick to remove the solder bridge. Do not over heat the FT232RL or ATmega328P when removing a solder bridge, this could damage the part. If necessary add a lower melt solder (e.g. 60/40 solder) to the solder bridge, and then use the solder wick to draw off the extra solder.

Once all the SMD parts are soldered in place, you have all of the parts needed for the communication circuit. Hand solder on switch, S1, for power. You can now plug the board into a USB cable and connect to your computer. Turn on the power switch, S1. The computer should recognize your board as a USB device. If you need drivers that can be found at the FTDI website, here: <http://www.ftdichip.com/FTDrivers.htm>.

Power off the board, and solder on resonator Q2 (16Mhz), the jumper pins, switch S2, and S4. Add the two jumpers to the Rx and Tx jumper pins.

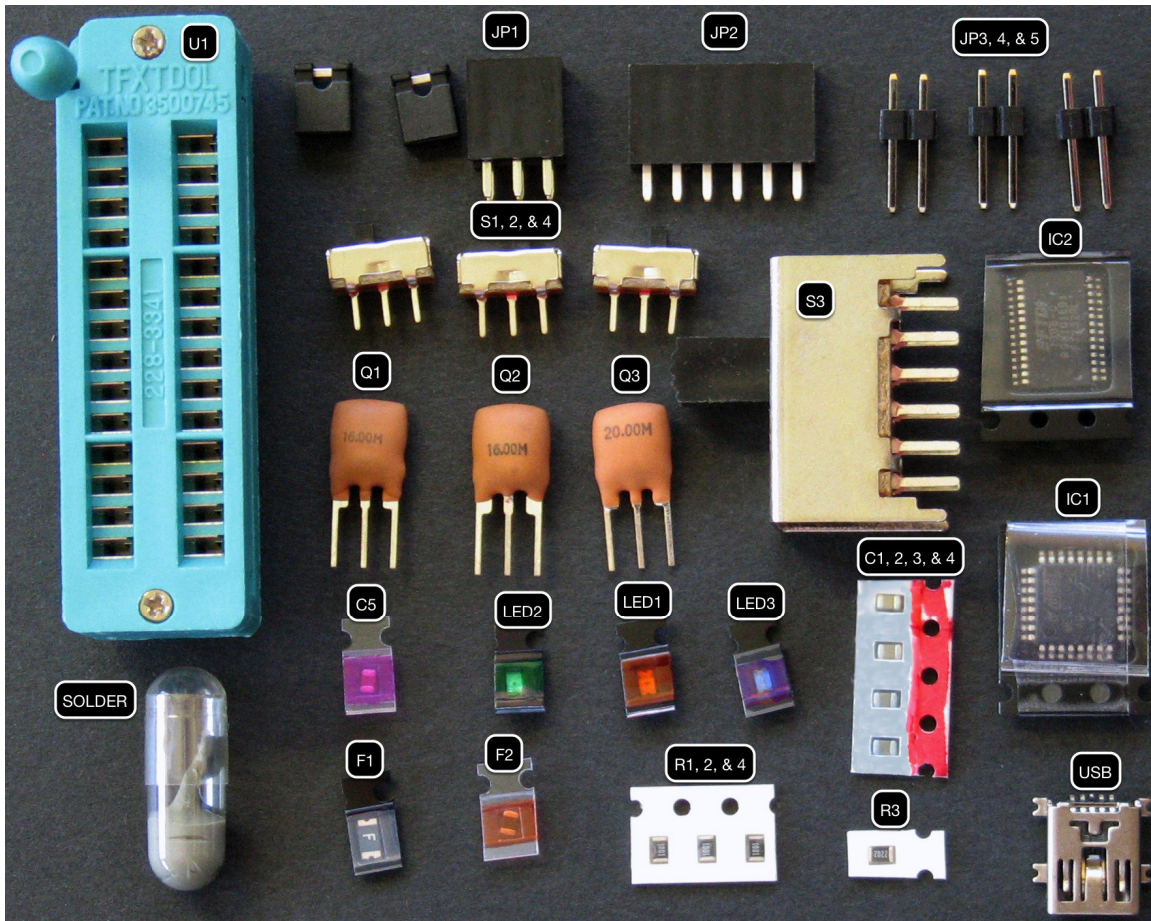
You can now connect the board to the computer again. Open the Arduino software. Select the board (Arduino Uno). Open the ArduinoISP sketch in the Examples. Upload the sketch to the Reactor Core. For more details see our Instructables here: <http://www.instructables.com/howto/jouletime/>.

Finish hand soldering on the remaining headers, switches, and ZIF socket. You can now test burning bootloaders to microcontrollers inserted in the ZIF socket. All chips must have the number 1 pin facing to the left. The ATmega328P will use all spaces of the ZIF socket. Switch S2, S3, and S4 should all be to the left.

The ATtiny85 will go into the far left. The ATtiny84 will be to the far right of the socket. For these, switch S2 to the left, but S3 and S4 to the right.

Warning! Proper loading of the microcontroller, correct orientation of the number one pin, and program switch direction is important. This step connects the wires to the microcontroller, including power and ground. Using the wrong setup will send power to the wrong pins. This may damage the chip you are trying to program.

In the Arduino software, select the board type based on the chip in the ZIF socket. Select Arduino as ISP. Then select burn bootloader. For more details see our Instructables here: <http://www.instructables.com/howto/jouletime/>.



Description	Part No.	Parts	Case	Case Film	MARKINGS
IC, 32-TQFP; Atmega328	IC1	1	BPL	CLEAR	ATMEGA328P
IC, FT232RL, SSOP-28	IC2	1	BPL	CLEAR	FT232RL
SLIDING SWITCH	S1, S2, S4	3	NA	NA	SILVER
4P2T Switch	S3	1	NA	NA	SILVER
ZIF Socket, 28 Pin	U1	1	NA	NA	Blue
MINI USB CONN. SMD	USB	1	NA	NA	SILVER
Header SOCKET, 6WAY, 2ROW	JP1	1	NA	NA	BLACK/SILVER
Header SOCKET, 6WAY, 1ROW	JP2	1	NA	NA	BLACK/SILVER
HEADER, 2WAY, 1ROW	JP3, JP4, JP5	3	NA	NA	BLACK/SILVER
Jumper	NA	2	NA	NA	BLACK/SILVER
RESONATOR, 16MHZ	Q1, Q2	2	NA	NA	16.00M/Orange
RESONATOR, 20MHZ	Q3	1	NA	NA	20.00M/Orange
LED - Green, 0805	LED2	1	BPL	Green	Clear/White
LED - Red, 0805	LED1	1	BPL	RED	Clear/White
LED - Blue, 0805	LED3	1	BPL	BLUE	Clear/White
RESISTOR, 1KOHM	R1, R2, R4	3	WPA	CLEAR	1001
RESISTOR, 22KOHM	R3	1	WPA	CLEAR	2202
CAPACITOR 10uF, 0805;	C5	1	CLEAR	Pink	BROWN
CAPACITOR, 0.1uF, 0805	C1, C2, C3, C4	4	CLEAR	LT. BLUE /Red	BROWN
Stencil	NA	1	NA	NA	White
SOLDER PASTE, Sn/Ag /Cu	NA	1	Clear	CLEAR	Grey
FUSE, PTC, 16V, 500mA	F1	1	BPL	CLEAR	F
VARISTOR, 5.5V, 17.5V, 0805	F2	1	CLEAR	Orange	BROWN

BPL-Black Plastic, WPA-White Paper

How it Works

USB-Mini Connector, this provides both the power and the serial data communication from the computer to the Reactor Core programmer.

USB/Serial FT232RL, the communication IC chip by FTDI. It converts the USB signal to 5 volt TTY serial for the microcontroller level communication.

S1-Power Switch, simple 2 pole single throw slide switch. It connects the 5 volt line on the board to the 5 volts from the USB-Mini connector. After the switch are a 500mA PTC and a 5.5 V varistor for circuit protection.

Power On LED, this LED will light up once the power is switched on.

Comm. LEDs, these LEDs are powered by the FT232RL chip. They indicate the direction of the communication.

Serial Header, the header connects directly to the FT232RL chip.

Jumpers-Serial, from the serial header there is a set of jumper points to the internal ATmega328P chip. The TX line requires a jumper. Serial communication out from the header must have the TX jumper removed; otherwise the communication from the internal ATmega328P will interfere. Leaving the RX jumper in place will write data to internal ATmega328P, but this does not affect external programming. The RX line has a trace that can be broken.

ISP Header, In-System Programmer interface is a communication interface used by Atmel for many of their microcontrollers <http://www.atmel.com/images/doc0943.pdf>.

S2-PROG. Direction, the ISP header can be used to either bring the signal into the internal ATmega328P for burning its bootloader, or it can switch to send out the signal to the header and ZIF socket. The reset line is what has to change from RESET for incoming signals to pin 10 for outgoing signals.

Internal Atmega328P, this is the 32-pin TQFP version of the microcontroller used on the Arduino Uno board. It uses the same device ID for burning bootloader as the Uno.

S3-Device Selector, this 16 pin switch swaps which inputs go to the ZIF socket. Left is for the Atmega328P. Right is for both the ATTiny 84 and 85 microcontrollers.

S4-ATTiny85-Xtal, this switch makes the second crystal connection between Q3 and the ZIF. All other connections are done with S3. This should be switched to the left for programming ATmega328P.

Chip Insertion Graphic, a pictogram that shows which direction the microcontrollers should face and where to install the ATTinys.

