

# MADLAB JELLYBEAN

## Construction

First fit and solder the resistors (R1 to R5) and trim their legs. Identify the resistors by the coloured stripes on the body.

Solder the three wire links (LINK) bending them to the correct lengths.

Next fit and solder the two diodes (D1 and D2). Match the stripes at one end of the diodes to the small 'k' symbols on the board.

Solder the crystal (XTAL) either way around.

Fit the chip socket (IC1) matching the notch in the socket against the notch in the symbol on the board. Care should be taken when soldering this component to avoid solder bridges between the pins. It is not recommended that the PIC chip is soldered directly to the circuit board.

Next fit and solder the electrolytic capacitors (C1, C2 and C5) paying attention to the polarity (negative is marked by a stripe on the side of the body and should match the minus sign on the board). Solder the other capacitors (C3, C4, C6 and C7) either way around.

Solder the pushbutton (S1).

Solder the LED (LED1) matching the shorter leg (also the flat on the rim) to the hole with the line.

Solder the transistor (TR1) matching the shape to the symbol on the board.

Solder the polyswitch fuse (FUSE) either way around.

Solder the USB socket making sure there are no solder bridges between the pins.

Solder the power socket (POWER).

Solder the regulator (REG) to the board matching its metal heatsink side to the solid part of the symbol on the board. The regulator should be mounted upright.

Don't fit the chip into its socket until you have thoroughly checked your construction. Check that all the components have been inserted correctly and that there are no dry joints and no solder bridges between pins. Match the notch in the chip to the notch in the socket when fitting the chip.

Optionally push the heatsink on to the regulator (see below for whether a heatsink is necessary). Note that it is quite difficult to remove the heatsink once it has been attached.

Additional holes are provided either side of the power socket for optionally attaching a battery snap and either a 4 x AA or 6 x AA battery box.

## Circuit Notes

*JellyBean* can either be powered by the USB cable or by an external power supply. If an external supply is used then it should be able to supply between 6 and 12V regulated dc, and be fitted with a 2.1mm connector with centre positive. The power rating of the external supply depends on what circuits are connected to *JellyBean*. Note that external power takes precedence over USB power.

The polyswitch fuse is a self-resettable fuse. It is included in the circuit to protect the host PC from excessive current drawn from the USB port. If the current exceeds 500mA then the fuse will trip and break the connection. Once the fuse has cooled down it resets itself automatically and allows the connection to be re-established.

The LED is used to display the status of the USB connection, and is shared with pin 1 so is also available to user programs. Under some circumstances it may not be desirable to have pin 1 driven high or low by the system firmware. In this case the LED can be removed from the board. Note that pin 1 is configured as an output by default.

The pushbutton can function as a master clear reset for the PIC, or as a button available to user programs. Note that if used as a reset then it will force a USB re-enumeration when pressed.

The clip-on heatsink may not always be required. It depends on the power source and current drawn. If *JellyBean* is powered exclusively via the USB port then the regulator is not used and can be ignored. It only functions when an external power supply or battery is connected to the board. The circuit is designed such that the external power supply takes preference over power from the USB connection.

The regulator is responsible for dropping the external voltage to 5V internally. The higher the external voltage the more heat that is generated by the regulator. Also the more current that is drawn by the target circuit the hotter the regulator will become. The worst case is a 12V external source supplying 1A which requires the regulator to dissipate 7W ( $12 - 5 \times 1$ ). Without a heatsink the regulator will become extremely hot to the touch and will probably shut down to protect itself from thermal damage.

Note that the polyswitch fuse has a resistance of 0.5 to 1 $\Omega$ . Consequently a small voltage is dropped across it when a large current is drawn from USB which reduces the supply voltage to the processor. If this is significant then the fuse can be replaced with a wire link. In many cases it is redundant anyway as host USB ports already have over-current protection.

When driving high-current peripherals such as motors it is preferable to use an external power supply rather than USB power, and additionally with a supply voltage close to 6V (and obviously capable of supplying sufficient current that the motors require).

*JellyBean* can be battery powered, typically either by 4 or 6 primary (i.e. disposable) AA cells to give an input voltage of 6V or 9V respectively, or 6 secondary (i.e. rechargeable, such as NiMH) AA cells to give a voltage of 7.2 Volts. (Note 4 rechargeable AA cells only add up to 4.8V which is too low to ensure pins are driven at 5V but is still sufficient to allow *JellyBean* to function.)

The circuit is designed to supply an accurate 5V to the processor irrespective of whether the board is USB or externally powered.

The 'sea of holes' is a prototyping area for user circuits. Certain pads are connected together and these are indicated by lines drawn on the circuit board. Specifically, at the top of the board is a line of pads connected to Vdd (5V) and at the bottom is a line of pads connected to ground (0V).

Each one of the 12 pins available to user circuits is taken to a pair of pads at the centre of the board. Note that all I/O is 5V.

The pads at the right of the board are drilled to take edge connectors.

The mounting holes around the printed circuit board take 4mm screws or pillars.

## **Interfacing to Third-Party Applications**

*JellyBean* communicates with the host PC using a virtual serial port. This allows easy interfacing to other applications. Any program that can read and write to a serial port can interface with *JellyBean*.

The serial port in use can be determined by opening the Control Panel and navigating to System|Hardware|Device Manager. Expand the Ports section and one or more Communications Ports should be shown. The particular port connected to *JellyBean* can be ascertained by right-clicking each port in turn, selecting Properties, and looking for the name "JellyBean". The associated COM number is then the port number to use in the application.

*JellyBean* accesses the virtual serial port via use of the BASIC instructions **SEND USB** and **RECEIVE USB** (see MadLab PIC BASIC Reference).

## **Component List**

### Resistors

R1	100R (brown, black, brown, gold)
R2	4k7 (yellow, purple, red, gold)
R3	47k (yellow, purple, orange, gold)
R4	470R (yellow, purple, brown, gold)
R5	1k (brown, black, red, gold)

### Capacitors

C1, C2	100uF electrolytic (blue or black)
C3	470nF ceramic (blue, marked '474')
C4	100nF ceramic (brown, marked '104')
C5	10uF electrolytic (blue or black)
C6, C7	22pF ceramic (brown, marked '22')

### Semiconductors

TR1	ZTX790A transistor (black)
D1, D2	1N4001 diode (black with silver stripe)
LED1	5mm red LED
REG	LM2940 LDO 1A regulator (black/silver)
IC1	20-pin DIL socket + PIC18F14K50-I/P microcontroller (A91X)

### Miscellaneous

XTAL	12MHz low-profile crystal (silver)
FUSE	500mA polyswitch fuse (light brown, marked 'XF050')
S1	miniature tactile pushbutton
USB	USB B series connector
POWER	2.1mm dc power socket
LINK	3 x wire link

### PCB

Clip-on heatsink