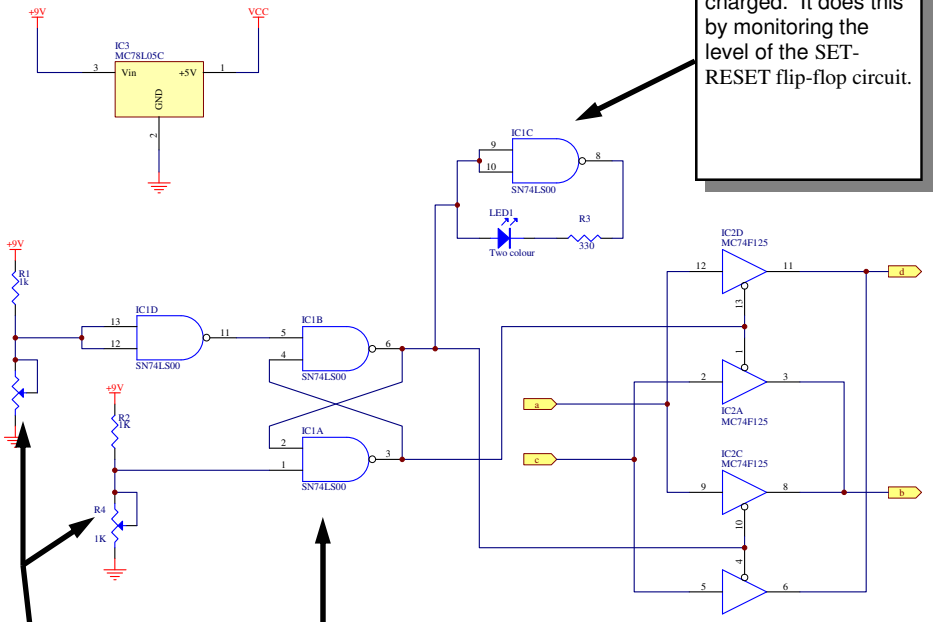
So... How's it work, anyway?...

This Voltage Regulator converts the 9V battery voltage to +5V, suitable for most integrated circuits

This is the circuit which turns the small LED on when the robot is sufficiently charged. It does this by monitoring the level of the SET-RESET flip-flop circuit.

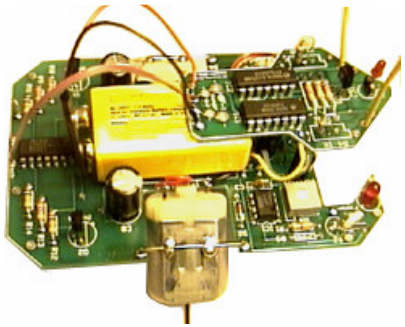


This circuit is known as a **SET_RESET Flip-flop**. It is designed so that voltages greater that 9V will cause pin 6 to go high. This high voltage will be maintained until the input voltage goes below 6.5V. At that point, pin 6 will go low. This is the circuit which monitors battery level (Hunger).

This circuit actually switches the behavior of our CYBUG from photo-tropic to photo-phobic behavior, depending on the action of the SET-RESET flip-flop.

These two potentiometers are actually fixed resistors in your kit (so you won't have to fiddle with adjustments. (You may purchase 1K potentiometer for these if you like fiddling!)
-**R4 is 270 ohms,** and sets the minimum voltage at which the CYBUG will feel "hungry" and begin to chase light. (270 ohms = 6.6V threshold)
-**R5 is 180 ohms**, and sets the voltage at which the CYBUG feels "full" and will begin avoiding light! (180 ohms=9.2V threshold.)

CYBUG HBF-1: Hunger!



When studying mother nature, you learn that energy levels and intelligence go hand in hand. Those creatures which expend energy at a high rate (relative to their mass) also appear to be quite clever. For instance, predators must have a good degree of intelligence to be able to locate and dispatch their prey, whereas the slower and more sedate herbivores generally have less need for cunning and strategy, and therefore require less brain-power.

Higher Brain functions are those parts of our intelligence which transcend the basic survival instincts in order to interact more fully with their environments.

The HBF-1 is such an evolutionary advantage for your CYBUG. It continually monitors the robots energy level and change it's behavior from photo-phobic to photo-tropic as necessary. When energy is low, your CYBUG will be drawn to the light of the SUNFLOWER for a meal, but once full, it must leave the watering hole for the safety of dark areas.

ASSEMBLY NOTES

Caution:

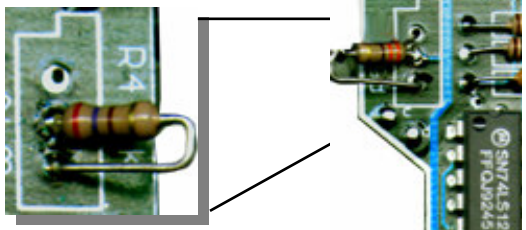
Building an electronic project is enjoyable, but please resist the temptation to hurry ahead and omit instruction steps. Please be sure that you:

- Read all instructions carefully.
- Read the entire step before you perform each operation.
- Be careful when handling hot soldering iron. Tip temperature may approach 700° F.
- Make certain that you **WEAR APPROPRIATE SAFETY GLASSES AT ALL TIMES** and work in a well ventilated area.
- When cutting wires, make sure that the cut end is directed away from everyone.
- Solder a part or group or parts only when you are instructed to do

Please follow all instructions carefully, and be very careful that you use safety glasses at all times when building your kit! Be careful when handling your soldering iron… the tip is very hot!

Component Identification

Quantity	Parts Designator	Item and Full Description	Component Label
1	LED 1	Two-Colour LED	None
1	IC1	74LS00 Quad NAND gate	74LS00
1	IC2	74LS125 Quad Tristate Buffer	74LS125
1	IC3	78L05 5 Volt regulator	78L05
2	R1, R2	1K Resistor (1/4W)	Brown, Black, Red, Gold
1	R3	330 ohm Resistor (1/4W)	Orange, Orange, Brown, Gold
1	R4 *	270 ohm Resistor (1/4W)	Red, Violet, Brown, Gold
1	R5 *	180 ohm Resistor (1/4W)	Brown, Grey, Brown, Gold
1	None	6" length of steel guitar string wire	
1	None	12" of 22 gauge insulated wire	
1	None	Printed Circuit Board (Green)	



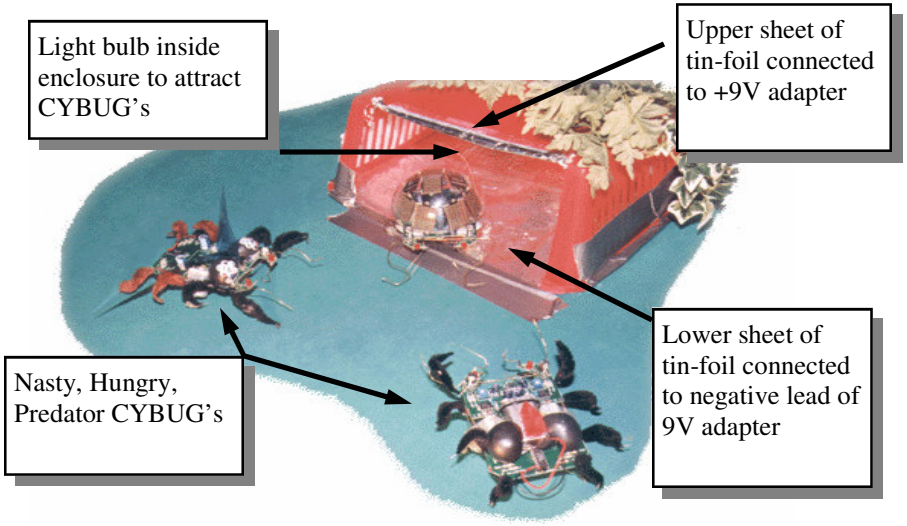
Resistors R4 and R5 must be soldered across the two holes (pads) as shown.

Step 1: Install all resistors...

Neatly bend the leads of the resistors and place them in the correct location on the circuit board. You may wish to spread the leads slightly apart on the back side of the board to prevent the resistors from falling out when the board is turned over for soldering. There is no polarity on resistors: they may go in either direction.

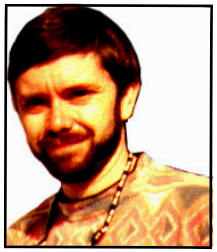
Invert the board and solder the resistors in. Use side-cutters to clip off excess leads.

Note: *R5 sets the battery voltage, above which the CYBUG will switch from photo-tropic (light seeking) to photo-phobic (light avoiding). 180 ohms will set that switching voltage to 9.2 Volts. You may, if you wish, place a 1K potentiometer in it's place, and adjust this level to whatever you like! (not included)*



Here's a simple feeding station with a small CYBUG coming out to the waiting claws of two predator CYBUG's (That's another kit!) Notice that the feeding station is nothing more than a pair of horizontal sheets of aluminum or tin foil, separated by the height of a small box!

The fancy effects on the Predator CYBUG's are simply creative applications of fun-fur and pipecleaners! If it's frightening enough to send my cat to therapy, it's good enough for me!



I hope you enjoy watching the new behavior of your CYBUG with it's new hunger instinct as much as I enjoyed designing it. If you have any questions or comments, please contact me: I'd like to hear from you! Also... try out my web-page for some new interesting idea's for your CYBUG!

We would love to see you and your robots at the WESTERN CANADIAN ROBOT GAMES in Calgary, Alberta this year! (http://www.robotgames.com)

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Building a Feeding Station:

Designing a feeding station for CYBUG's is simply a matter of providing a ground sheet (tin-foil) and a positively charged top sheet (also tin foil.). Acquire a small 9V adapter (at least 300ma output) and connect the positive terminal to the top sheet and the negative terminal to the bottom sheet..

A small, bright light source should be provided inside the feeding station to attract the hungry CYBUG's in! When the CYBUG's are charged sufficiently, they will leave the feeding station and seek the protection of darkness. **When the CYBUG is charged, the RED LED on the front of the Hunger Board will be on.**

Care and Cleaning of your CYBUG's

Here are some tips I have learned to keep your artificial life-forms happy and healthy

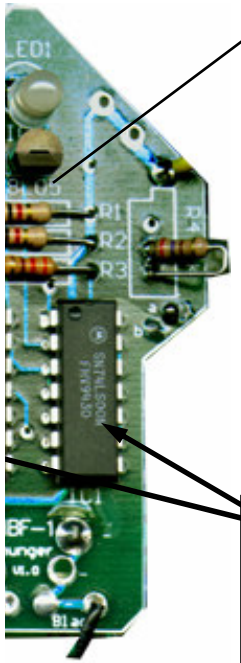
- Clean their cage! Every once in a while you should gently sand the surface of the upper and lower plates of the feeding stations to permit better electrical contact with the antennae.
- Clean their antennae! Both the ground brush and the antennae should occasionally be wiped clean with a fine sandpaper to improve electrical conductivity.
- When it looks as though your CYBUG is not eating enough to keep him active, place a small block beneath him to lift his wheels off the ground while he is in the feeding station to give him a good charge. Make sure that you feel his ni-cad battery occasionally to make certain that it is not getting too warm!

- I recommend placing a little fun-fur of various colours on your CYBUG herbivore for a couple of reasons... (1) It looks cool! (2) It will protect the electronics on your herbivore from the probing metallic touch sensors of *other* CYBUG's. You can use small quantities of hot glue to paste the fun-fur
- down. (You can get all types of fun-fur from your local hobby shop)

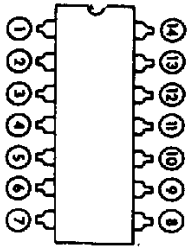
Step 3: Install IC3 and LED 1

Install the 78L05 voltage regulator carefully into the marked location on the circuit board. **THIS COMPONENT HAS POLARITY** and must be placed so that the flat side of the package is aligned as shown on the drawing on the board.

The LED IS **ALSO POLARITY SENSITIVE!** The base of the LED has a flat side which must be lined up with the silk-screen flat line!



This is the correct way to insert the integrated circuits.



Step 2: Install IC1 and IC2…

Caution: Polarity Sensitive Components! Make sure that dimple on top of IC packages aligns with dimple marked on boards white silk-screen.

Carefully insert the IC's (Integrated Circuits) IC1 and IC2 into the correct location on the board.

You will notice that several numbers appear on each integrated circuit package. Many of these numbers are only production date codes and manufacturer logos.

Check to make sure the *correct* chip is in the *correct* spot with the *correct* polarity This is your last chance!!!

Solder the integrated circuits in place and cut off excess leads

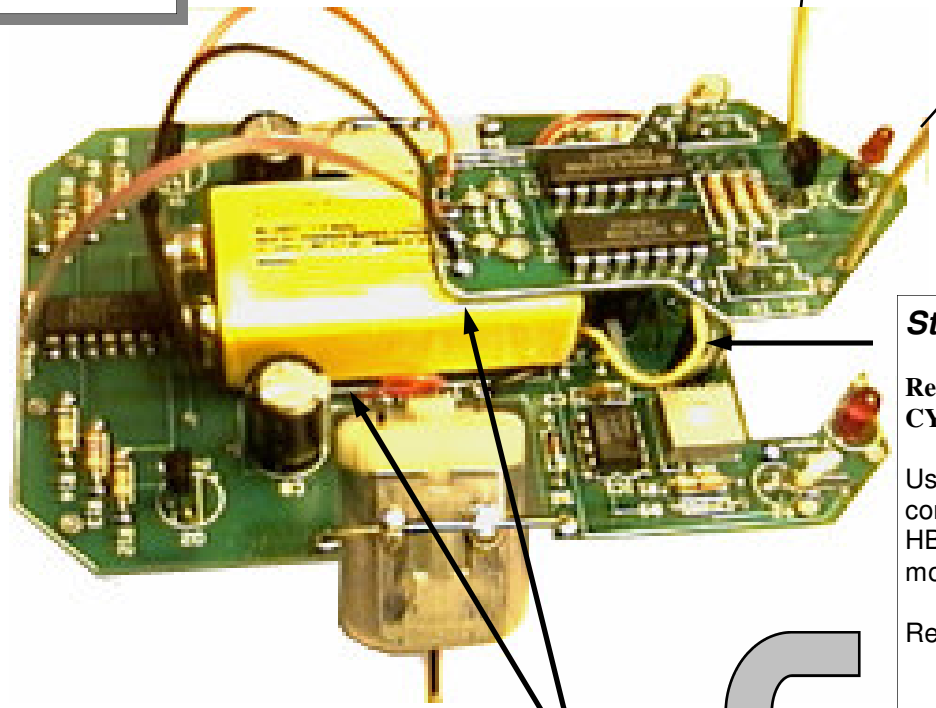
Step 4a: Attaching Power leads

Remove the 9V battery clip from the CYBUG and attach it to the HBF-1 pad's labeled "**red and black"** as shown.

With two pieces of stranded coloured wire, connect the CYBUG pad's labeled **red and black** to the HBF-1 pads labeled **red and black.** (Red to red, black to black

Step 4b: Attaching the Antenna

Cut two 3 inch lengths of guitar wire and solder on the left and right sides as shown. Cut two 1 inch lengths of insulation from a piece of wire and push it down each antenna to insulate the lower regions.

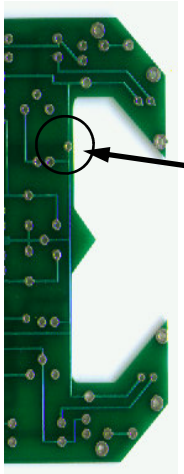


Step 4c:

Remove the jumper wires J1 and J2 on the CYBUG

Using the 2 inch stranded coloured wire, connect the pads marked **"a and b"** on the HBF board to the pads on the CYBUG motherboard marked **"a and b".**

Repeat for pads **"c and d"** on the other side.



Step 4e: Attach the ground wiper

Attach a 1.5" length of guitar wire from the pad shown by the arrow extending downward to the surface.

Place a small twist at the bottom of the guitar wire as shown

This wire will be used to allow the negative pole of the CYBUG battery to contact the ground plane.

Step 4d: Mount the HBF board

Use two-sided foam tape to attach the Ni-Cad battery to the CYBUG as shown, and to attach the HBF board to the top of the Ni-Cad