MADLAB BUGLET

Construction

First fit and solder the resistors (R1 to R16) and trim their legs. Identify the resistors by the coloured stripes on the body. Next fit and solder the capacitors, paying attention to the polarity of the electrolytic capacitors C1, C3 and C4 (negative is marked by a stripe on the side of the body, and also the shorter leg). The polyester (C5 and C6) and ceramic (C2) capacitors can be fitted either way around. Note that there should be two capacitors left over, these are soldered directly to the motors (see below).

Then fit the transistors (TR1 and TR2). The symbol on the board indicates the orientation of the transistors (flat side of the component against the flat side of the symbol).

Solder the light sensor (LDR) to the board either way around. Be careful when soldering as excessive heat may melt the plastic.

Solder the light (LED1) matching the recessed corner to pin '1' on the board. Take care when soldering that adjacent pins are not bridged with solder. Solder the IR transmitters (IR1 and IR2) matching the shorter leg with 'k' on the board. The small lenses on the transmitters should be pointing towards the front of the board. Next solder the IR module (RECEIVER). Again its lens should be pointing forwards.

Solder the wire link (LINK) and the sounder (PIEZO). The polarity of the sounder doesn't matter. Pull off the paper tab from the top of the sounder.

Solder the preset (VR1) to the board and firmly push the spindle into the small hole in the top.

Thread a worm gear onto the other link wire then solder it to the two holes at the end of the board marked ROLLER. The wire ends should be pushed through the board from the metal side rather than the usual component side, then soldered as normal to the metal side and finally trimmed on the component side. This is to provide enough clearance for the worm gear to turn freely.

Next 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 chip is soldered directly to the board.

Solder the three battery boxes (BATT1, BATT2 and BATT3). The spring ends (-) of the battery boxes should be at the end of the board.

Push worm gears onto the spindles of the two motors. Then solder the remaining two ceramic capacitors (C7 and C8) across the tags of the motors using short pieces of the sleeving (cut each piece in two) to insulate the legs and prevent them from shorting on the metal casing of the motor. Then solder the insulated flexible wires to the tags of each motor as well. The other ends of the wires are soldered to the holes on the board within the marked outlines MOTOR1 and MOTOR2. Each tag is soldered to its nearest hole.

The cable ties and sticky pads are used to attach the motors to the board. The motors are positioned within the cut-outs such that they are angled at about 45 degrees to the board with the shafts extending out to the sides. The worm gears should be level and both making contact with the ground. Use the cable ties to hold the motors tightly in place. The cable ties should pass between the capacitors and the bodies of the motors and the ends of the cable ties should be on the top side of the board. Adjust the positions of the motors such that both worm gears turn when *Buglet* is pushed along a table top. The sticky pads can then be used to fix the motors securely in position, stuck half on the motor and half on the underside of the circuit board.

Note that *Buglet* will only really work on hard surfaces such as wooden or kitchen floors. The motors have insufficient drive (in the absence of a gearbox) to propel it over carpets.

Don't fit the chip 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. Then carefully bend the legs of the chips inwards a little with your fingers. Fit the chip into its socket matching the small notch in the chip to the notch in the socket.

Insert 3 AAA cells into the battery boxes, observing the correct polarity. The cells used should ideally be rechargeable NiMH or NiCd types, but if disposable cells are used they should be good quality alkaline ones. It is recommended that rechargeable NiMH cells are used.

The software includes a power-on self-test. The three component colours in LED1 are tested first, so you should see red, green and blue flashes. This is followed by a double beep, then the infrared components are tested. If they're functioning correctly you should see red - green - red - green. Finally another double beep sounds, and then the two motors are driven briefly.

There is an additional test that can be performed. If the preset VR1 is moved fully left to right, or fully right to left, during the self-test, then the light sensor LDR is echoed to LED1.

After you've checked that the board is working correctly, you can fit the Ping Pong ball such that it covers LED1 using the sticky dots to secure it in place (in the corners between the pairs of resistors). The ball acts as a light diffuser and mixes the individual red, green and blue component colours to enable any colour to be obtained.

The rubber bungs can be placed over the horns to stop *Buglets* damaging each other when 'rutting', as they may collide with each other with some force (see Owner's Guide below). The bungs will also protect furniture from scratches.

Owner's Guide

Buglets can be either male or female, and interact in different ways depending on this.

To make a *Buglet* female, turn the preset (VR1) fully to the left (anticlockwise), and to make a *Buglet* male turn it fully to the right (clockwise). Whether a *Buglet* is male or female is indicated by either a blue or pink flash respectively after the power-on self test described above.

If two male *Buglets* directly face each other they will 'rut', that is to say they will hiss and threaten each other, and may decide to charge. They can hit each other at some speed, hence the need for rubber bungs as mentioned above.

One *Buglet* may possibly show submission when charging. The submissive *Buglet* will glow green, whereas the dominant *Buglet* will flash red and blue while beeping in triumph. The submissive *Buglet* will remember the particular *Buglet* it has submitted to, and when it next meets the same *Buglet* it will show submission again by glowing green.

Two female *Buglets* will interact with call-and-response chirruping and synchronised colours.

A male and female *Buglet* will also interact with sound, colour and movement.

A *Buglet* deprived of all communication with others of its species will eventually exhibit aberrant behaviour. *Buglets* are social creatures and need the companionship of their own kind.

Component List

Resistors

R1	220R (red, red, brown, gold)
R2, R4	10k (brown, black, orange, gold)
R3, R5, R6, R7, R8, R14	47R (yellow, purple, black, gold)
R9, R10	1k (brown, black, red, gold)
R11, R13, R15	1R (brown, black, gold, gold)
R12, R16	10R (brown, black, black, gold)
VR1	47k preset + spindle

Capacitors

C1, C3, C4	100u electrolytic
C2, C7, C8	100n ceramic (brown, marked '104')
C5, C6	22n polyester (yellow or blue, square)

Semiconductors

TR1, TR2	MPSA13 transistor
LED1	RGB full colour
IR1, IR2	IR transmitter (clear)
RECEIVER	IR module (black)
IC1	18-pin socket + PIC16F628A-I/P microcontroller (A110)

Miscellaneous

LINK, ROLLER	wire link
LDR	light dependent resistor
PIEZO	sounder
MOTOR1, MOTOR2	motor
BATT1, BATT2, BATT3	AAA battery box
Worm gears (+ heatshrink)	x 3
Sticky pads	x 2
Cable ties	x 2
Pre-cut wires	x 4
Sleeving	x 2
Sticky dots	x 4
Rubber bung	x 2
Ping Pong ball	

PCB