HeyPhone Assembly and Alignment

Issued: 14-Jan-03

In following these instructions you will need to refer to the parts list and the PCB layout diagrams for the transmitter, receiver and control boards. You might also find it useful to refer to the circuit diagrams for these three boards and the general wiring diagram.

These instructions refer extensively to wiring points which are shown in bold text (e.g. point **Q**). In some cases these points are identified on the boards themselves but not in all cases. In particular, none of the points are marked on the control board. However, all points are indicated on the PCB layout diagrams (and the circuit diagrams). Occasionally, the point on the PCB has a different label from the official wiring point designation as shown in these instructions, the PCB layouts, and the circuit diagrams. In these few cases, these instructions also indicate, in brackets, the label on the PCB. Physically, most of these wiring points consist of a wiring pin. Since connection can be made to either end of a wiring pin, wiring instructions specifically indicate whether you should solder to the top side of the board (i.e. the component side) or the bottom side of the board (i.e. the non-component side).

All components are referred to by their part numbers and are listed in the parts list. Pin numbers for plugs, sockets, switches and ICs are referred to be the component number, followed by a slash and then the pin number. For example, pin 12 of *PL6* would be shown as *PL6/12*.

Assembling the Transmitter Board

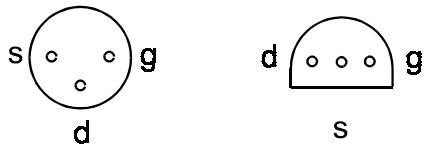
1. Fit the resistors excluding the variable resistors.
2. Fit the IC sockets.
3. Fit the polystyrene axial capacitors (*C31*, *C32*, *C33* and *C34*).
4. Fit the remaining non-polarised (i.e. not electrolytic or tantalum) capacitors.
5. Fit *C46*. Make sure you observe the polarity as shown on the PCB layout diagram.
6. Fit the inductor (*L3*). Holes for this component are precision drilled but can still be a little fiddly to fit. Push well down to the board and solder all pins including the location tags.
7. Fit the wiring pins (11 needed) for points **9V**, **T**, **E**, **M**, **R**, **A**, **P**, **m**, **12V** and **L** (there are two **L** points). Note that wiring pins are no required for points **I**, **Q**, **0V**, **RL** and **GL**.
8. Fit *Q4*, orienting it as shown on the PCB layout diagram. When oriented correctly, from left to right the pins are emitter, base, collector.
9. Fit *U14*. If you're using the more common vertically-mounting version (TDA2003V) you must first prepare it for horizontal mounting. Bend pins 2 and 4 at 90° about 3mm from the body and pins 1, 3 and 5 about 2mm further on. If you're using the horizontally-mounting version (TDA2003H) you should omit this

stage. Now wiggle it onto the board. Slide *Heatsink1* under *U14* until the holes line up making sure that it's clear of the negative connection hole for *C43*. Drill a 3mm hole through the board, clear the burrs, and fasten with a 10mm M3 machine screw with slotted cheese head and an M3 hexagonal nut. Now solder all 5 pins.

10. Fit *C43* on top pf *U14* as shown in the PCB layout diagram. Note its polarity and push its leads through either of the positive holes and negative hole till it sits above *U14*.
11. Fit the two relays (*RLA1* and *RLA2*).
12. Fit the variable resistors. You will find that *VR2* should snap into place.
13. Take 160mm lengths of green and black wires and twist them together tightly. Slot the ferrite bead (*FB1*) onto the green wire before soldering it to point **M** on the top side of the board. Solder the black wire to point **E** on the top side of the board. Route the twisted pair down the length of the board (i.e. toward the space which will be occupied by the transformer).
14. Connect a 100mm length of orange wire to point **9V** on the top side of the board.
15. Connect a 120mm length of turquoise wire to point **R** on the top side of the board. Route down the length of the board (i.e. away from the space which will be occupied by the transformer).
16. Connect a 90mm length of grey wire to point **A** on the top side of the board.
17. Connect a 100mm length of purple wire to point **P** on the top side of the board. Note that nothing connects to the pin to the right of point **P**.
18. Connect a 90mm length of green wire to point **m** on the top side of the board.
19. Connect a 100mm length of red wire to point **12V** on the top side of the board.
20. Route the purple, red and green wires toward the end of the board which will not be occupied by the transformer and pull the grey wire over these to the closest edge of the board.
21. Bend a piece of solid wire (e.g. a resistor lead off-cut) into a U-loop. Fix it into the lower of the two holes between *U11* and *U13* (as identified on the PCB layout diagram), leaving a few mm above the board surface. Solder a 50mm length of orange to the loop (this is point **Q**).
22. If possible, thread a 50mm length of yellow wire from the top side of the board through the closest hole to the board edge of the two holes between *U12* and *U13*. If it doesn't prove possible, open the hole to 1.5mm – nothing connects to this pad. On the bottom side of the board solder the yellow wire to the pad which connects to pin *U13/9* (this is point **I**). Run the wire between the IC pins being careful to avoid puncturing the insulation.
23. Push four 30mm, M3 machine screws with slotted cheese heads through the four mounting holes which line up with holes in the receiver and control boards. Fit four 18mm M3 female-female non-insulated spacers onto these screws and tighten down.
24. Fit *X1*, seating the body down against the board surface.
25. Fit all ICs except for *U14* (which has already been soldered into place) into their sockets.

Assembling the Receiver Board

1. Fit the resistors, excluding the variable resistor.
2. Fit *D1*. Make sure you observe the polarity (i.e. the position of the band which donates the cathode) as shown on the PCB layout diagram.
3. Fit the IC sockets. Note that the socket for *U6* is rotated through 180° compared to the other sockets.
4. Fit the polystyrene axial capacitors (*C12*, *C13*, *C14* and *C15*).
5. Fit the remaining non-polarised (i.e. not electrolytic or tantalum) capacitors.
6. Fit the polarised capacitors. Make sure you observe the polarity as shown on the PCB layout diagram.
7. Fit the two inductors (*L1* and *L2*). Holes for these components are precision drilled but can still be a little fiddly to fit. Push well down to the board and solder all pins including the location tags.
8. Fit the wiring pins (7 needed) for points **A**, **V**, **R**, **E**, **12V**, **9V** and **S**. Note that wiring pins are not required for points **0V** and **B**.
9. Fit the transistors orienting them as shown on the PCB layout diagram. Note that there are two slightly different packages for the 2N3819 which is used for *Q1* and *Q2*. The PCB layout diagram corresponds to what we believe to be the more common variant. It would be wise to double check with your supplier, though, since some manufacturers produce a 2N3819 with the leads in the opposite order, i.e. drain, source, gate instead of gate, source, drain. If you use the other variant of 2N3819 you should mount them the opposite way from shown in the PCB layout diagram. i.e. with the flats on the body towards *C1* and *C3*. When oriented correctly, from top to bottom the pins for *Q1* and *Q2* are source, gate, drain. You'll need to refer to the pin-out diagram for the MEF103 below to correctly orientate *Q3*. Note that this diagram shows the transistors from above (i.e. not the normal pin view) for consistency with the PCB layout diagram. If you have difficulty in obtaining the specified MEF103 for *Q3* you could substitute a 2N5457. Note, however, that the pin-out is different as shown in the diagram below so you will need to cross the leads for the source and drain (insulating one of the crossed leads) to match the holes on the PCB. When oriented correctly, from left to right the pins for *Q3* are source, drain, gate.



MEF103 2N5457

10. Fit *U7* orienting it as shown on the PCB layout diagram. When oriented correctly, from left to right the pins are out, common, in.
11. Fit *VR3*. You might find it necessary to re-drill the holes to 1mm.
12. Fit *C59* on the bottom side of the board as shown in the PCB layout diagram. The positive lead goes to the centre pin of *VR3*, the negative lead goes to the pin which is closest to *C17*.

13. Using a knife, scrape away a small patch of the green solder resist from the large copper area under *U16* (which joins pins 3,4, 5, 7, 10, 11 and 12) on the bottom side of the board to reveal bare metal. To this, solder a 60mm length of blue wire (point **B**) and a 50mm length of black wire (point **0V**).
14. Twist together a 40mm length of white wire and a 40mm length of black wire. Connect the white wire to point **R** (next to *C25*) on the top side of the board and the black wire to point **E** on the top side of the board.
15. Fit all ICs except for *U7* (which has already been soldered into place) into their sockets. Note that *U6* is rotated through 180° compared to the other DIL ICs.

Connecting the Transmitter and Receiver Boards Together

1. Lay the transmitter board, component side up. Alongside, but upside down, lay the receiver board. Solder the yellow wire from point **I** on the transmitter board to point **I** on the bottom side of the receiver board and the orange wire from point **Q** on the transmitter board to point **Q** on the bottom side of the receiver board. Note that wiring pins are not used for points **I** and **Q** on the receiver board as the holes aren't sufficiently large. Note also that the yellow and the orange wires should cross each other as they pass between the two boards.
2. Lower the receiver board onto the four machine screws which are attached to the transmitter board. Do not fasten.
3. Solder the turquoise wire from point **R** on the transmitter board to point **A** on the bottom side of the receiver board.
4. Solder the orange wire from point **9V** on the transmitter board to point **9V** on the bottom side of the board receiver.
5. Route the green and black twisted pair from points **E** and **M** on the transmitter board between *Heatsink1* and the closest support pillar.
6. Solder the red wire from point **12V** on the transmitter board to point **12V** (actually marked "+" on the PCB) on the bottom side of the receiver board.
7. Solder the green wire from point **m** on the transmitter board to point **S** (actually marked "vol" on the PCB) on the bottom side of the receiver board. Note that the purple and grey wires and the green/black twisted pair are not connected at this stage.
8. Solder an 80mm length of green wire to point **S** (actually marked "vol" on the PCB) on the top side of the receiver board.
9. Solder a 50mm length of yellow wire to point **V** (between *C21* and *C22*) on the top side of the receiver board.
10. Solder the black wire from point **0V** on the receiver board to the negative lead of *C43* (which is mounted on top of *U14*) on the transmitter board (this is point **0V**). At the same time, solder an 80mm length of black wire to the same point (point **0V**).
11. Solder a 60mm length of red wire to point **12V** (actually marked "+" on the PCB) on the top side of the board receiver.

Assembling the Control Board

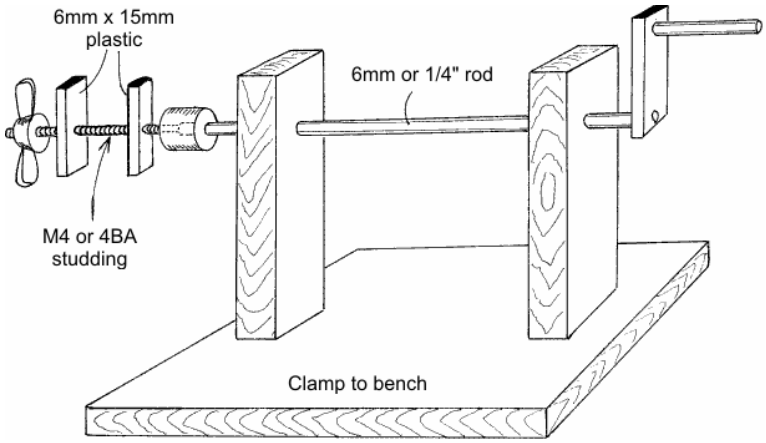
1. The hole for point **B**, which is in the earth plane near the edge of the board, adjacent to *U18*, has been missed in some PCBs. If the hole isn't present, drill a 1mm hole. Also, widen the hole for point **C**, which is in the centre of the board near *R108* and *R109*, to 1mm so that a wiring pin can be fitted.
2. Fit the resistors.
3. Fit the diodes. Make sure you observe the polarity (i.e. the position of the band which donates the cathode) as shown on the PCB layout diagram.
4. Fit the IC sockets.
5. Fit the non-polarised (i.e. not electrolytic or tantalum) capacitors except for *C50*.
6. Fit the polarised capacitor (*C54*). Make sure you observe the polarity as shown on the PCB layout diagram.
7. Fit the wiring pins (7 needed) for points **A**, **C**, **12V**, **P**, **R**, **0V** and **B**.
8. Fit *Q5*, orienting it as shown on the PCB layout diagram and mounting it about 3mm clear of the board surface. When oriented correctly the pins are emitter, base, collector from left to right.
9. Fit *C50* on the bottom side of the board between *U17/1* and *U16/8*, keeping the leads short.
10. We now recommend the confidence bleep has a 30 second period rather than the 15 seconds in the initial design. To make this modification, cut the track to *U18/5* and, using a thin piece of wire, connect the track to *U18/4* instead.
11. Fit all ICs into their sockets.

Initial Testing and Alignment

1. Temporarily connect a loudspeaker to the black and white twisted pair from points **E** and **R** on the receiver board.
2. Temporarily connect the yellow wire from point **V** on the receiver board to the top terminal of a 10k potentiometer, the green wire from point **S** (actually marked "vol" on the PCB) on the receiver board to its slider, and the blue wire from point **B** on the receiver board to its bottom terminal. Set the potentiometer to mid travel.
3. Temporarily connect a microphone insert to the green and black twisted pair from points **E** and **M** on the transmitter board.
4. Temporarily connect the black wire from point **0V** on the transmitter board to the negative terminal of a 12V battery and the red wire from point **12V** (actually marked "+" on the PCB) on receiver board to its positive terminal. A low audible hiss should be heard from the speaker.
5. Temporarily connect the grey wire from point **A** on the transmitter board to the live output of an AF or RF signal generator and clip the signal generator's earth to the support pillar next to the relays on the transmitter board.
6. Set the signal generator to 88kHz at a level of 3μV RMS. A 1kHz tone should be heard. Carefully tune the two inductors on the receiver board (*L1* and *L2*) to maximise the tone; this might have a rough sound to it at this stage. From its clockwise end, slowly rotate the slider of *VR3*. Suddenly the roughness will clear leaving a pure tone. Reduce the generator to 1μV RMS; the tone should still be audible. Increase the generator's output to 10μV RMS or 30μV RMS and swing the frequency downward past zero beat; the tone should disappear. This completes the receiver alignment.
7. Remove the power. Gently lift the receiver board from its screws and turn through about 90° to allow access to the transmitter. Make sure that nothing is shorting live parts.
8. Connect an oscilloscope in place of the signal generator using a x10 probe. Select a sensitivity of a few hundred millivolts and a timebase of about 1kHz although this isn't critical.
9. Set *VR2* to 1 o'clock.
10. Reconnect the power.
11. Temporarily connect the purple wire from point **P** on the transmitter board to any 0V point. The relays will click and the oscilloscope trace will fill the screen. Adjust *VR1* slowly. Suddenly the trace will reduce to almost a line, but while say half way down, adjust the inductor *L3* for maximum signal. Now adjust *VR1* for minimum trace. It might be necessary to try a few times as this is a careful adjustment. Turn *VR2* to 11 o'clock and speak into the microphone. The screen will fill with signal. This completes the transmitter alignment.
12. Disconnect all the peripheral components which have been temporarily connected.
13. Sit the receiver board back onto the four machine screws and secure with four 18mm M3 female-female non-insulated spacers. Tighten.

Winding and Fitting the Transformer

1. Construct a winding machine out of a piece of wood with two uprights. Slot a 6mm rod through the two uprights and bend or attach a crank handle at one end and an M4 piece of studding at the other end as shown in the diagram below.



2. Unpack the transformer (*T1*) and carefully place the two cores in a safe place as these are brittle.
3. With two strips of plastic slotted onto the studding, secure the transformer bobbin with a nut.
4. Cut a few lengths of brown parcel paper each 25mm wide.
5. Start by winding the secondary. Strip a small portion of enamel from your 24 SWG wire and tin. Attach this to the furthermost connection pin, pushing well down, and solder. Begin the winding, counting the turns and making sure the wire lies closely in each turn. The first layer will end at about turn 37. As you wind, feed a paper strip under the wire. The paper will try to slew, but a firm grip of the paper and feed wire allows a one and a half turn of paper to insulate the last layer. Cut off the paper where turn 38 now appears from under. Continue winding over the paper to the other end, about turn 74. Again feed in a short length of paper and continue winding. At turn 99, feed in the paper strip as the last turn crosses over the last layer to connect with the remote tag. In the production sets, a drop of RS electrical varnish was applied at each new layer stage which soaked in to the paper strips. Over the completed secondary winding, wind on three layers of paper tape. ***Do not*** use transparent adhesive tape (e.g. Sellotape) to secure either windings or insulation papers as the adhesive breaks down under large voltages and attacks the copper. If you end up with 97 turns or 102, it doesn't matter.
6. Now wind the primary. Wind on just ten turns of the 19 SWG wire, anchoring at the wiring pins, and again as turn 9 becomes turn 10, the wire crosses over the layer and a strip of paper should be used. All four pins should be soldered. Cover the final winding with two or three layers of paper. To hold down the paper, we tied a couple of turns of thin string and varnished over the top.
7. The two core ferrites are super-glued together Apply a smear to all three surfaces, push into the core and push the other in to match and squeeze together hard for 20 seconds.
8. Pushing the various wires clear, fit the completed transformer into the transmitter, making sure the primary is next to the components and solder all 12 pins.

Connecting the Control Board to the Transmitter and Receiver Boards

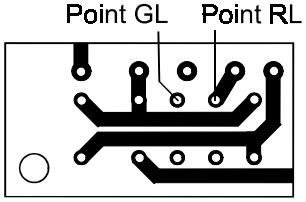
1. Mount the completed control board onto the spacers and secure four 6mm, M3 machine screws with slotted cheese heads.
2. Solder the unconnected black wire from point **0V** on the transmitter board to point **0V** on the bottom side of the control board.
3. Solder the red wire from point **12V** (actually marked "+" on the PCB) the receiver board to point **12V** on the bottom side of the control board.
4. Solder the purple wire from point **P** on the transmitter board to point **R** on the top side of the control board (next to *Q5*).
5. Connect a 80mm yellow wire from point **A** on the top side of the control board to point **T** on the top side of the transmitter board.

Connecting the Transceiver Boards to the D-connector

The HeyPhones are built with the main electronics separated from the controls by a waterproof shield into which is fitted a 25-way male D-type connector (*PL6*). The description presented here will assume a similar method of construction even if individual constructors choose differently.

1. Position *PL6* (male D-type connector) over the transformer with pins 1 to 13 outermost and its pins facing outwards. Until you solder the first wire to it, of course, it's hanging in mid-air.
2. Solder two 70mm lengths of pink wire to the two points **L** on the top side of the transmitter board. Solder the other end of one of the pink wires to *PL6/1* and the other to *PL6/3*.
3. Solder the grey wire from point **A** on the transmitter board to *PL6/4*.
4. Connect a 90mm length of red wire from point **12V** on the top of the control board to *PL6/5*.
5. Solder the white wire of the black and white twisted pair from point **R** on the receiver board to *PL6/6*.
6. Connect a 100mm length of orange wire from point **C** on the top side of the control board to *PL6/8*. Note that *PL6/7* is blank.
7. Connect a 100mm length of brown wire from point **B** on the top side of the control board to *PL6/9*.
8. Solder the green wire from point **S** (actually marked "vol" on the PCB) on the receiver board to *PL6/10*.
9. Solder the yellow wire from point **V** on the receiver board to *PL6/11*.
10. Connect a 70mm length of purple wire from point **P** on the top side of the control board to *PL6/12*.
11. Solder the green wire of the green and black twisted pair from point **M** on the transmitter board to *PL6/13*.
12. Turn the board to face the other way and turn over *PL6* to reveal the other row.

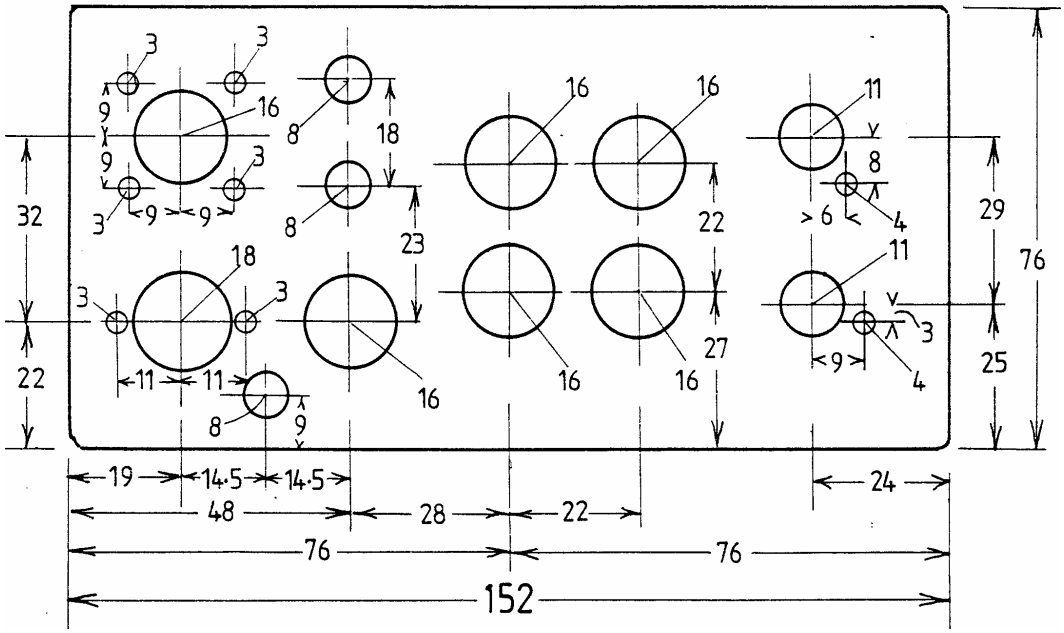
13. Connect a 100mm length of black wire from point **0V** on the top side of the control board to *PL6/14*.
14. Solder the black wire of the green and black twisted pair from point **E** on the transmitter board to *PL6/25*.
15. Solder the blue wire from point **B** on the receiver board to *PL6/23*.
16. Solder the black wire of the black/white twisted pair from point **E** on the receiver board to *PL6/18*.
17. Solder a 120mm length of red wire from *PL6/16* to point **RL** on the bottom side of the transmitter board. Since this point is difficult to identify from the PCB layout diagram you should refer to the diagram below which shows the appropriate corner of the bottom side of the transmitter board.



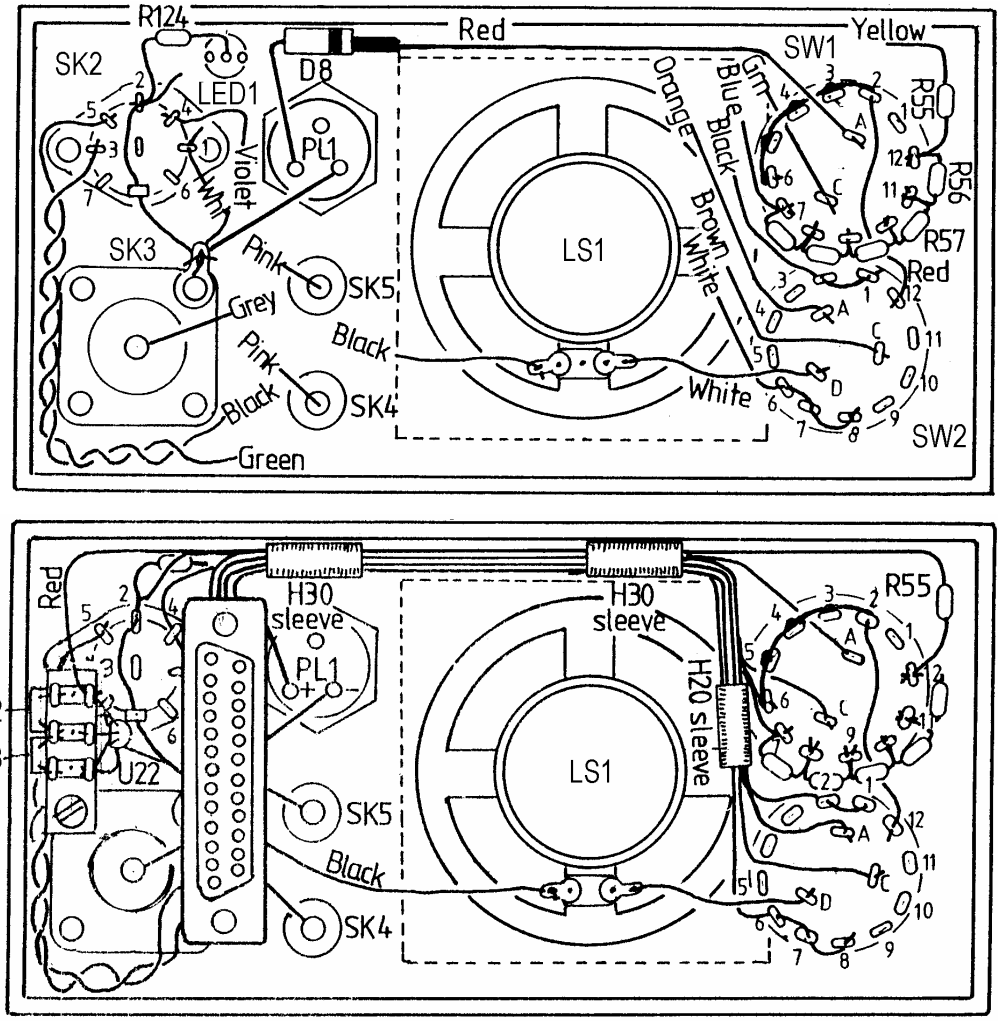
18. Solder a 120mm length of green wire from *PL6/17* to point **GL** on the bottom side of the transmitter board. Since this point is difficult to identify from the PCB layout diagram you should refer to the diagram above which shows the appropriate corner of the bottom side of the transmitter board.

Wiring the Control Box

1. Drill the control box according to the following diagram. Dimensions are in millimetres.



You will find it helpful to refer to the following diagrams as you perform the remaining steps in this section. These diagrams show the control box flipped over vertically to reveal the solder side of the components. In other words, it is upside-down.



2. Fit *SW1*, *SW2*, *LS1* (plus *Grille1*), *SK2* (using two 6mm M3 machine screws with slotted countersunk heads and two M3 hexagonal nuts), *SK3* (using four 6mm M3 machine screws with slotted countersunk heads and four M3 hexagonal nuts and an M3 solder tag on the lower left screw), *SK4*, *SK5*, *PL1* and *LED1* (plus *Bezel1*) as shown in the wiring drawings at the end of this section. Apply bathroom sealant to *SK2* and *SK3* and to the threads and location pips of *SW1* and *SW2* before fitting. Apply electrical varnish to *PL1*, *SK4* and *SK5* before fitting. Attach *LS1* to *Grille1* using two-part epoxy adhesive (Araldite or similar) and then attach *Grille1* to the plastic box with plumbers' solvent-free PVC bonding paste.

3. Take *D8* and, holding it in a vice, solder a red wire to its cathode lead which is indicated by a band on its body. Cover the joint with a short piece of heat shrink sleeving and heat. Bend the anode lead to just over 90° and, again bending and cutting, place into *PL1/1* and solder.

4. Route the red wire along to *SW1* and solder to *SW1/A*.

5. Strip a red wire appropriately and use the stripped end to connect *SW1/2*, *SW1/3*, *SW1/4*, *SW1/5* and *SW1/6* with the main length of the wire leaving *SW1* at *SW1/6*.

Leave *SW1/2* unsoldered at this stage. Route the red wire along the top edge of the box and bending it through 90° to pass between *PL1* and *SK2*. You can cut to the exact length when you come to solder this wire to *SK6* but, for now, leave sufficient to reach to the bottom edge of the box. At the same time as you solder this red wire solder another red wire to *SW1/6* and run along the top edge of the box to *SW2*.

6. Fit *R60* between *SW1/7* and *SW1/8*.
7. Fit *R59* between *SW1/8* and *SW1/9*, solder *SW1/8*.
8. Fit *R58* between *SW1/9* and *SW1/10*, solder *SW1/9*.
9. Fit *R57* between *SW1/10* and *SW1/11*, solder *SW1/10*.
10. Fit *R56* between *SW1/11* and *SW1/12*, solder *SW1/11*.
11. Cut both leads of *R55* to 10mm and, using a vice, solder a yellow wire to one lead and cover with heat shrink. Push other end of *R55* into *SW1/12* and solder. Route the yellow wire along with the red wire.
12. Fit a blue wire to *SW1/7*. Solder the blue wire together with *R60* and route it with the red and yellow wires.
13. Solder a green wire to *SW1/C* and route with the red, yellow and blue wires.
14. Strip a white wire appropriately and use the stripped end to connect *SW2/6*, *SW2/7* and *SW2/8* with the main length of wire leaving *SW2* at *SW2/6*. Route along bottom edge of the box to *SK2* along with the red wire.
15. Solder a white wire between *LS1* and *SW2/D*.
16. Solder an orange wire to *SW2/A* and route with the red, yellow, blue and green wires.
17. Solder a brown wire to *SW2/C* and route with the red, yellow, blue, green and orange wires.
18. Solder a black wire to *SW2/1* and *SW2/2* and route with the red and white wires.
19. Solder a red wire to *SW1/2* along with the wire already there. Route and solder to *SW2/12*.
20. Take the white, brown, orange and black wires and slot on a half-length of No.20 Hellerman rubber sleeve to the position shown. Cut a No.30 Hellerman rubber in two and slide onto the whole wire group in the two positions shown.
21. At *SK2*, strip sufficient insulation from the black wire, tin the end for convenience and slot through *SK2/2*, bypassing *SK2/8* and through the earth tag. Push through the solder tag mounted on *SK3*, but don't solder yet. Solder a short black wire to *PL1/3* and, stripping, push through the solder tag. Prepare a short black wire and connect to the solder tag, soldering all three.
22. Fit *R124* together with the black wire and the "common" lead of *U22* to *SK2/2* and solder all three. Refer to the wiring diagram to identify the "common" lead of *U22* and use sleeving to prevent shorts.
23. Solder the other end of *R124* to the centre leg of *LED1*.
24. Twist a green and black pair of wires and solder the green wire to *SK2/3* and the black wire to *SK2/5*. Route round the edge of the box as shown.

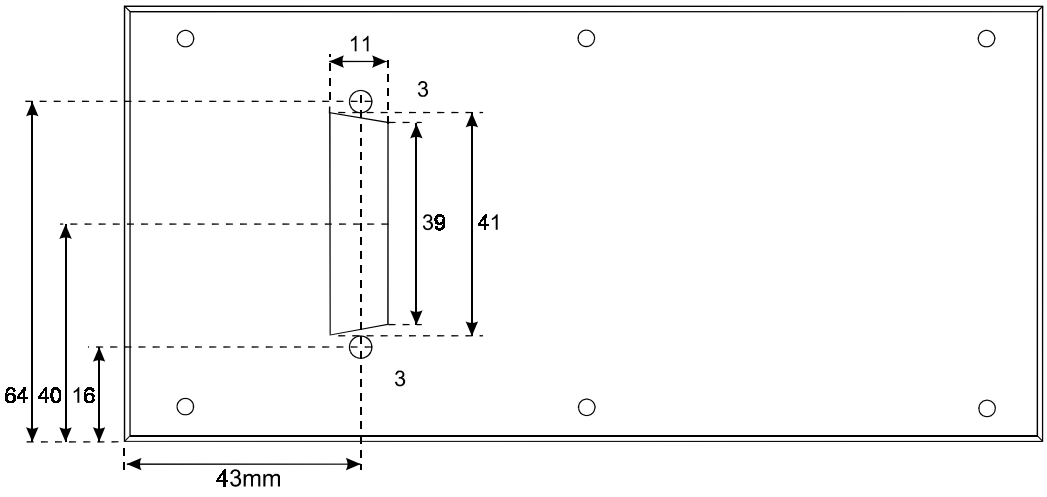
25. Solder a short purple wire to *SK2/4*.
26. Solder the white wire from the cable group, along with a short length of white wire, to *SK2/1*.
27. Solder a 70mm length of black wire to the unused terminal of *LS1*.
28. Solder short pieces of pink wire to *SK4* and *SK5*.
29. Tag strip is used to mount *U22* and the associated capacitors *C62* and *C63*. Two types are generally available – one with its own mounting lug in the centre, the other a simple long strip. If you use the former you need a strip with three pairs of tags; if you use the latter, use a strip with four pairs of tags and remove the end tag so that the space can be used for a mounting hole. Now remove the nut from the mounting screw for *SK3* which is closest both to *SK2* and the end of the control box, replace with a 10mm M3 female-female non-insulating spacer and, using a 6mm M3 machine screw with slotted countersunk head, secure the tag strip.
30. Fit *C62* between one of the outer tags and the centre tag and *C63* between the other of the outer tags and the centre tag as shown in the wiring diagram.
31. Fit *U22* to all three tags as shown in the wiring diagram. Note that, from top to bottom the leads of *U22* are in, out, earth.
32. If you're using the type of tag strip with its own mounting lug in the centre, the centre tag will already be connected to 0V via the screw to *SK3*. If you're using the other type, connect a bare wire from the centre tag to the solder tag on *SK3*.
33. Solder a red wire from the bottom tag of the tag strip (i.e. the one to which the output lead of *U22* is connected) to *SK2/7*.
34. Solder the shorter of the two red wires (i.e. the one which was routed to *SK2* as opposed to the one which was routed to the top of the box for subsequent connection to *SK6*) to the top tag of the tag strip (i.e. the one to which the input lead of *U22* is connected).
35. Position *SK6* (female D-type connector) over the *SK4*, *SK5* and *PL1* on its side with the pins facing outwards. Until you solder the first wire to it, of course, it's hanging in mid-air although you might be able to use the speaker magnet as an anchor.
36. Keeping wires as short as practicable, solder the nearest pink wire to *SK6/1* and the other to *SK6/3*.
37. Solder a grey wire from the centre pin of *SK1* to *SK6/4* keeping this wire short.
38. Solder the red wire of the group to *SK6/5*.
39. Solder the white wire of the group to *SK6/6*; *SK6/7* is blank.
40. Solder the orange wire of the group to *SK6/8*.
41. Solder the brown wire of the group to *SK6/9*.
42. Solder the green wire of the group to *SK6/10*.
43. Solder the yellow wire of the group to *SK6/11*.
44. Solder the purple wire from *SK2* to *SK6/12*.
45. Solder the green of the twisted pair from *SK2* to *SK6/13*.

46. Turn over *SK6* to reveal the other row of pins.
47. Solder the black wire from the solder tag to *SK6/14*.
48. Solder the black wire of the twisted pair from *SK2* to *SK6/25*.
49. Solder the black wire from *LS1* to *SK6/18*.
50. Solder the orange wire from *SK2* to *SK6/20*.
51. Solder the blue wire of the group to *SK6/23*.
52. Solder a red wire from the "red" lead of *LED1* to *SK6/16*. Refer to the wiring diagram to identify the "red" lead of *LED1*.
53. Solder a green wire from the "green" lead of *LED1* to *SK6/17*. Refer to the wiring diagram to identify the "green" lead of *LED1*.
54. This completes all the wiring. Turn over *SK6*, which should now mate up with the *PL6* of the transceiver assembly, and lie flat.
55. As *SK2* can leak cover the connections with hot melt glue.

Final Assembly

Much of the information in this section is a reiteration of the instructions given in the article on the construction of the two-part plastic box. Ideally you should refer to this article as it contains photographs which clarify these instructions.

1. Cut a hole in the top plate of the bottom box as shown in the following diagram. Dimensions are in millimetres.



2. Take the transceiver block (i.e. the assembly comprising the three PCBs) and insert *PL6* into the hole in the top plate of the bottom box using bathroom sealant. Secure using two 6mm M3 machine screws with slotted cheese heads and two M3 hexagonal nuts.
3. Attach *SK6* to *PL6* and carry out a full functional test before separating the two halves again.
4. Centre the transceiver block and the top plate of the bottom box on a sheet of 5mm neoprene and push it carefully into the bottom box. Tuck the corners of the

neoprene sheet under the top plate using a wooden spatula and locate the top plate into position.

5. Centre the top plate in the bottom box to leave an even gap all round and secure using a pair of light clamps. Apply a bead of solvent glue. When this is dry (4 – 5 hours) remove the clamps and fill with glue any gaps which remain.
6. Attach the top box to the bottom box by connecting SK6 and PL6. Take care to avoid straining the wires. Now align the two halves of the box and secure using the six 30mm M3 machine screws – this sometimes takes a little fiddling. The boxes can bow a little so you may have to use some skill and occasionally modify the holes to locate the screws. Screw down evenly but don't over-tighten – remember that you are screwing into plastic.
7. Now carry out a final functional test before continuing.
8. Run a bead of solvent glue all around the joint between the top and bottom boxes and leave to dry. Check that the seal is good and if you see any air bubbles cut them out using a sharp knife and re-fill. For cosmetic reasons, run a small bead of glue along the outside corner edges. Because each corner has a bonding pillar this is not really necessary but it looks better.