ROCK DRILL 4069

Build Instructions and User Guide

Lushprojects.com

Getting Started

- To build the Rock Drill 4069 you will need:
  - Solder
  - Wire Cutters
  - Soldering Iron
  - Small pliers
- The kit is suitable for beginners or more experienced builders
- If you are new to soldering, or want a refresher, the cartoon book “Soldering Is Easy, And Here’s How To Do It” by Mitch Altman, Andie Nordgren and Jeff Keyzer is a great introduction.

  http://lushprojects.com/vpc/build/FullSolderComic_EN.pdf

Reminder

- Building electronics rewards care and precision.
  - Take your time.
  - Focus on getting things right first time.
- Soldering is potentially dangerous
  - Follow all safety precautions

Build order

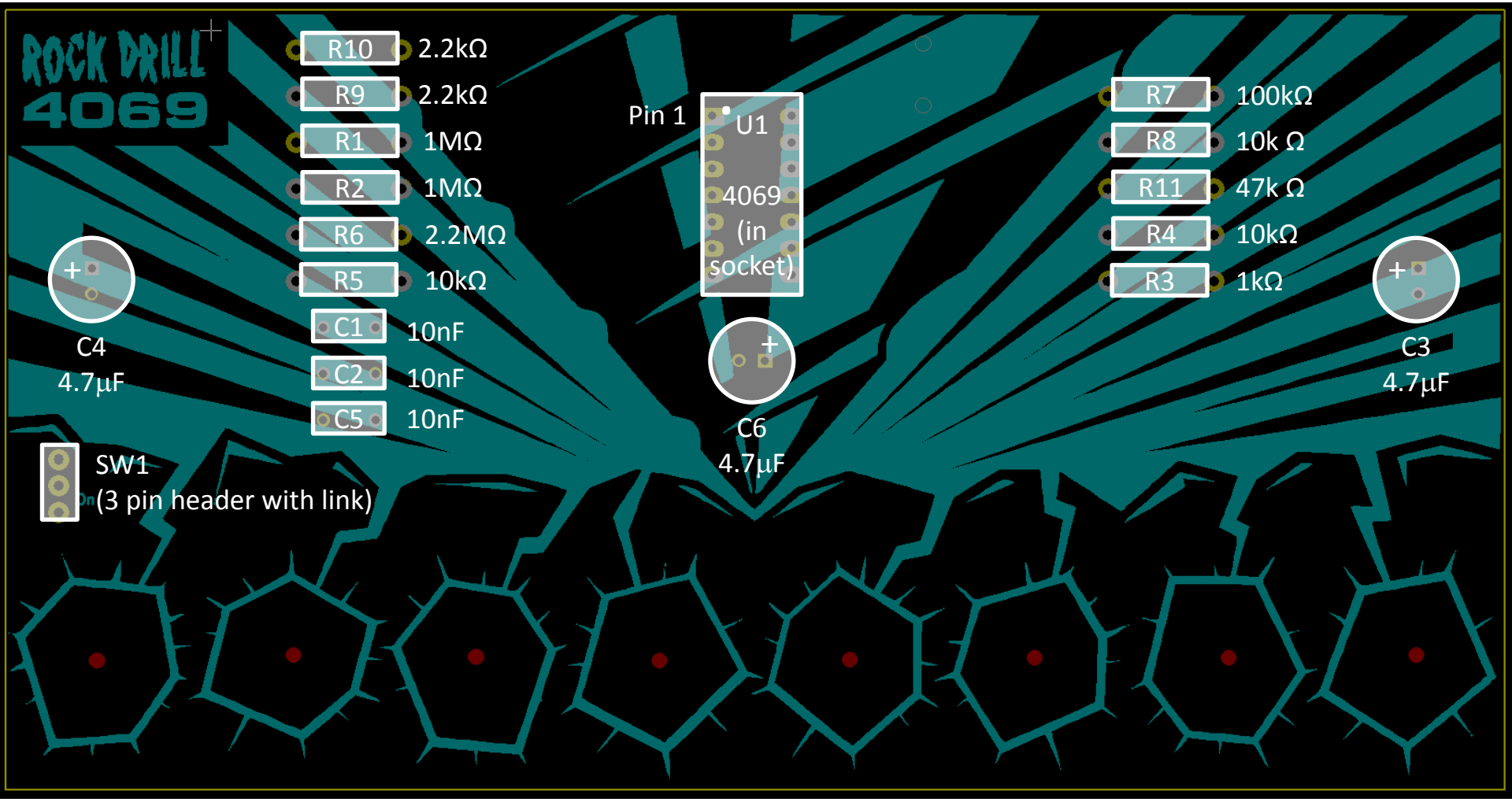
My suggested build order:

1. Battery holder and audio socket on back of board
2. Resistors on front of board
3. 4069 IC on front of board
4. Capacitors on front of board
5. 3 pin header (used as switch) on front of board
6. Rubber feet on back of board

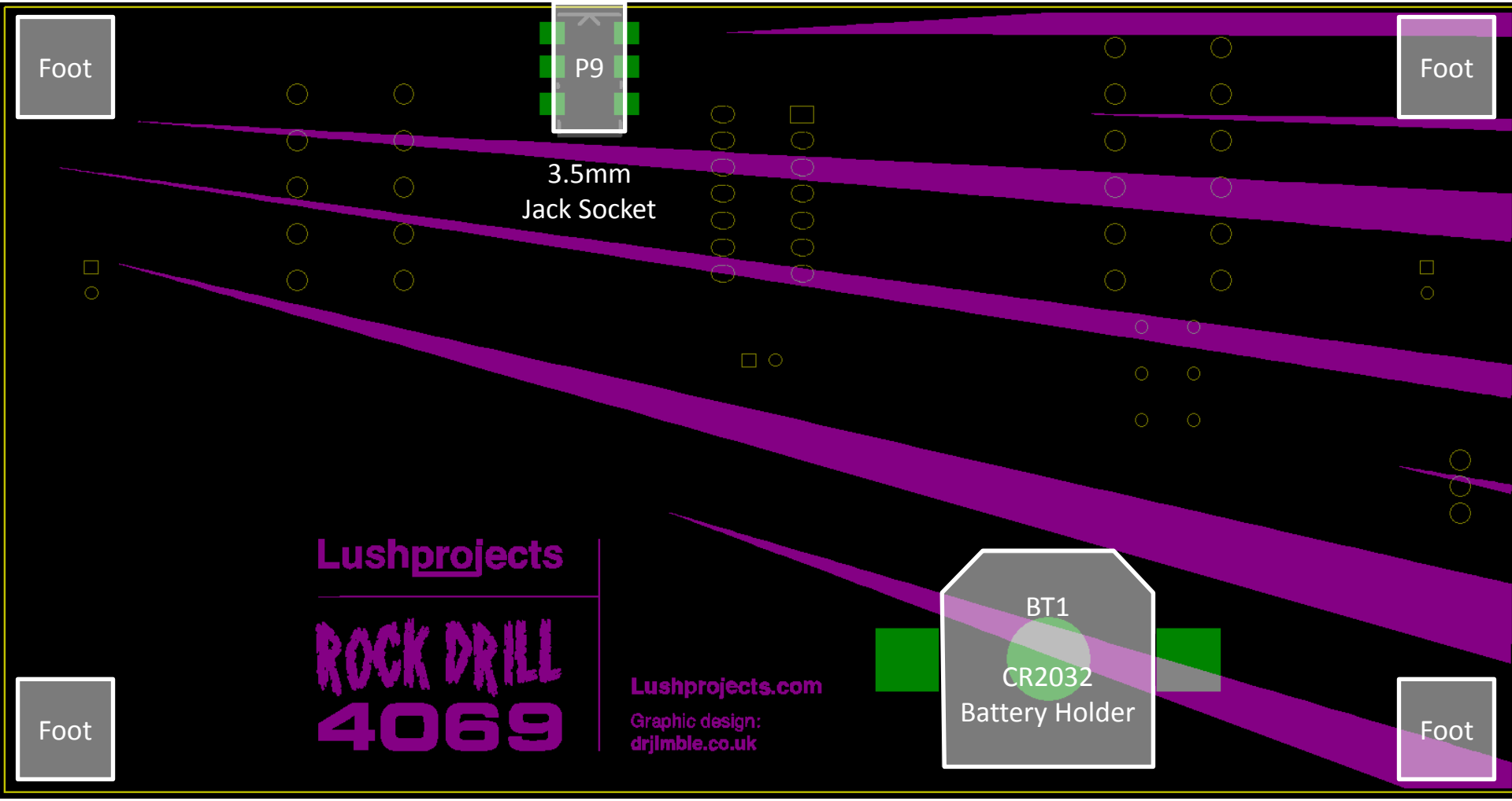
Component locations

- To keep the board graphics looking nice the component locations are not marked on the board. Fortunately the layout is simple so it is easy to locate components.
- Refer to the following charts for component locations.

Front



Back


Foot
P9
Foot
3.5mm
Jack Socket
Lushprojects
ROCK DRILL
4069
Lushprojects.com
Graphic design:
drjimble.co.uk
BT1
CR2032
Battery Holder
Foot
Foot

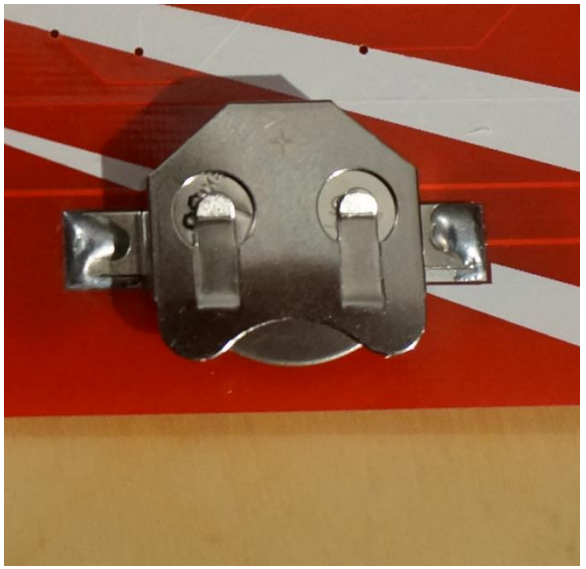
Build Step 1 (1 of 4)

- Soldering the two components on the back (battery holder and audio socket) is the most demanding part of the build– but fear not – it's not too hard.
- I suggest you do this first so the board is stable and level while you do it.

Build Step 1 (2 of 4)

Battery Holder

- Refer to diagram of back of board and identify the three large pads used for the battery holder BT1
- Place a small amount of solder (less than 0.5mm thick) on the central, circular, pad to provide a contact for the battery
  - This is probably not essential, but it will help get a secure battery contact
- Take the battery holder and position the tabs over the square pads. Make sure the opening for the battery faces the edge of the board (see photo).
- Bring the soldering iron in contact with the tab and pad. Wait for the joint to heat up and then apply solder generously to make the joint.
  - Repeat on the second joint
- Do not insert the battery until you have completed, and checked, the build.



Battery Holder

Build Step 1 (3 of 4)

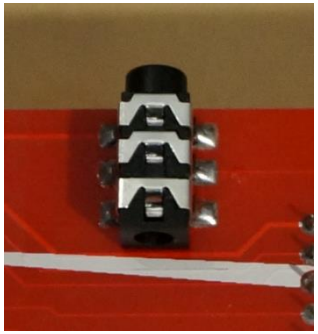
Tips for Soldering The Battery Holder

- The battery holder and its pads are large and will suck a lot of heat from the soldering iron. This may make it hard to get the joints to heat up enough to solder well.
- Here are some tips that might help:
  - Apply a little molten solder to the end of the iron before you touch it on the joint to increase the thermal contact
  - Give the iron time to heat the joint. Don't expect to be able to melt new solder on to the joint as soon as you touch the iron on it.
  - It is easiest if you use a powerful, thermostatically controlled, iron for this job. Try and borrow one if you don't own one.
  - If your iron isn't thermostatically controlled then hold the iron in free air for a few minutes before starting to solder to let it heat up as much as possible.
  - If your iron is thermostatically controlled, but not powerful enough, then try increasing the temperature, just for this job, to give it more ooomph

Build Step 1 (4 of 4)

Audio Socket

- The remaining component to go on the back of the board is the audio socket
- This is a surface-mount part, but don't panic! It's relatively large and not difficult to mount.
- Locate the 6 pads near the edge of the board that hold the socket
- Put solder blob on one pad
- Melt solder and push socket in to place using the locating holes as a guide
  - Make sure the input is facing the edge of the board
- Check socket is sitting nicely
- Solder up the other pads



Audio Socket

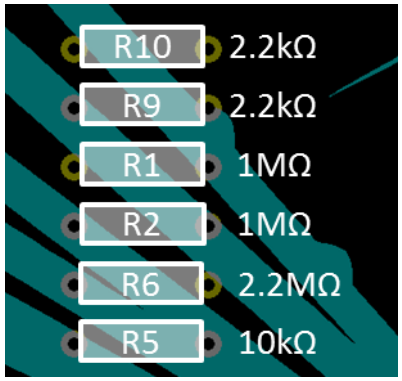
Build Step 2 (1 of 2)

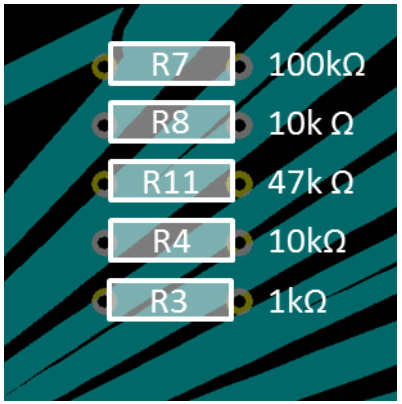
Resistors on front of board

- Identify the resistor locations using the diagram of the front of the board and the cross-reference on the next page
- I suggest you work from top to bottom of each column of resistors to make sure you keep them in the right places
- For each resistor:
  - Bend the leads at about 90^{o} to fit the pads
  - Insert the resistor from the front of the board
  - Solder the leads on the back of the board
  - Clip the leads to length
- Note that resistors can go in either way round

Resistor with leads bent

Build Step 2 (2 of 2)



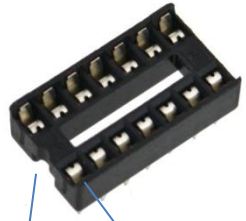


Resistor Value	Part Number(s)	Colour Code
2.2MΩ	R6	Red, Red, Green, Gold
1MΩ	R1, R2	Brown, Black, Green, Gold
100kΩ	R7	Brown, Black, Yellow, Gold
47kΩ	R11	Yellow, Purple, Orange, Gold
10kΩ	R4, R5, R8	Brown, Black, Orange, Gold
2.2kΩ	R9, R10	Red, Red, Red, Gold
1kΩ	R3	Brown, Black, Red, Gold

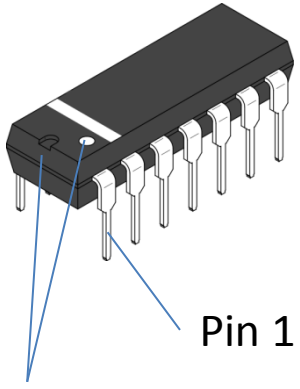
Build Step 3 (1 of 2)

4069 Socket and Integrated Circuit (IC)

- The 4069 hex-inverter CMOS IC is the heart of the circuit
- We have provided a socket for this chip to prevent accidental damage during soldering
  - If you prefer a neater look and are confident in your soldering ability mount the IC without a socket
- Note that the IC must be mounted in the correct orientation
  - Pin 1 is marked on the board by the square pad
  - See diagrams for how to find Pin 1 on the IC
  - Though the socket will work either way round it is better to mount it so that the notch that indicates the Pin 1 end is in the right position



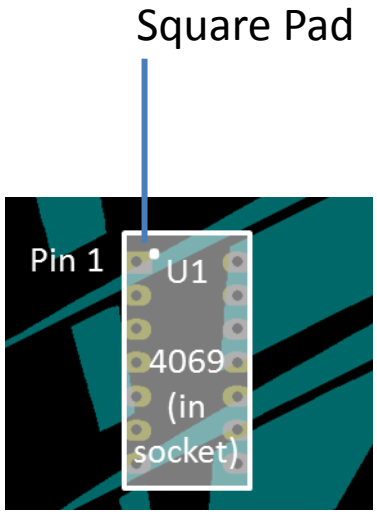
Socket



6049 IC

Build Step 3 (2 of 2)

- Insert the socket (or the 4069 IC if you are not using the socket) in the correct orientation
- Solder opposite corners and check the socket is well positioned
  - If not melt the corner again and adjust the socket
- Solder the remaining leads
- With a small pair of pliers bend the leads of the IC to 90^{o} so it fits in the socket
- Offer the IC up to the socket
  - Check the position of Pin 1
  - Check all the pins are correctly positioned in to the socket
- Push the IC home in to the socket

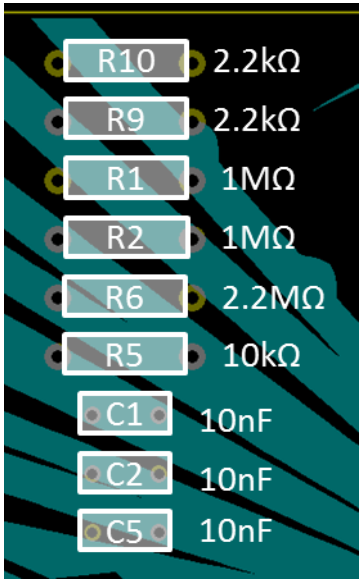


Build Step 4 (1 of 2)

10nF Ceramic Capacitors

- The kit contains three, brown, circular ceramic capacitors of value 10nF. They may be labelled “103”
- These are C1, C2 and C5
- Insert in the positions indicated
- Solder in place
- Clip the leads
- These capacitors can go in either way round

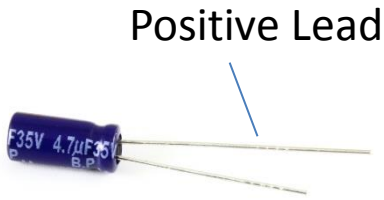
10nF Ceramic Capacitor



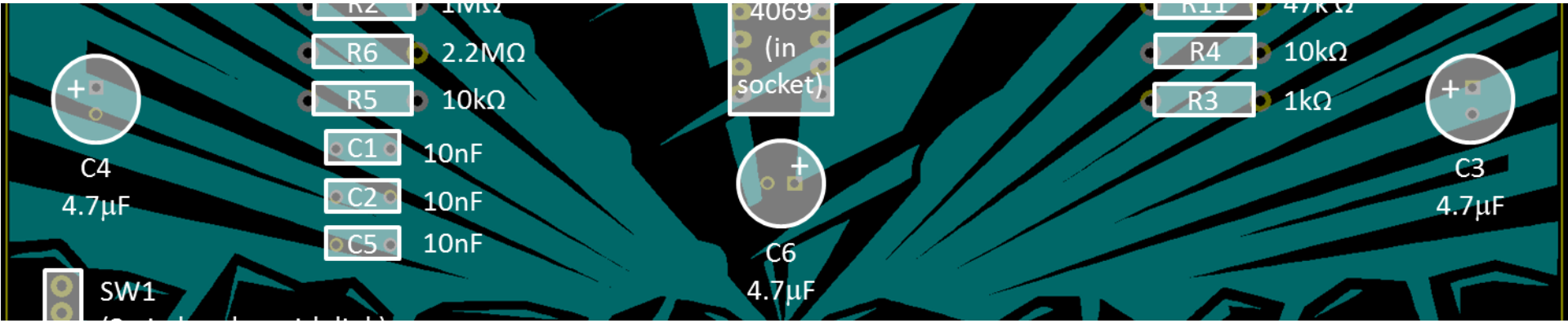
Build Step 4 (2 of 2)

4.7µF Electrolytic Capacitors

- The kit contains three, electrolytic capacitors of value 4.7µF. These are C3, C4 and C6
- Insert in the positions indicated
- Observe the polarity. The square pad indicates the positive (longer) lead.
- Solder in place
- Clip the leads

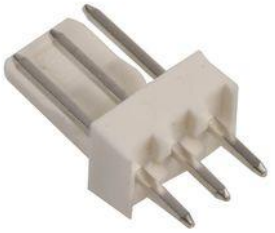


4.7µF Electrolytic Capacitor

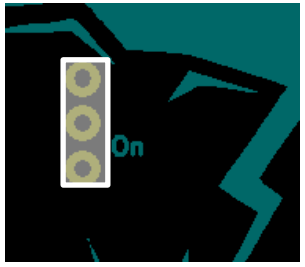


Build Step 5

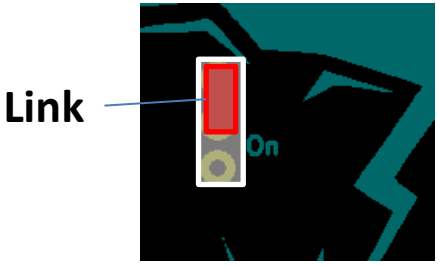
- The Rock Drill 4069 uses a three pin header and a link as an on/off switch
- Mount the three pin header were indicated and solder
- Insert the link in the off position



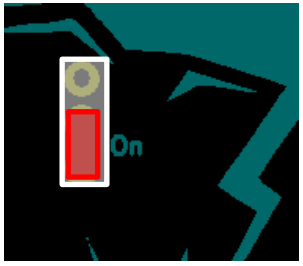
3 Pin Header



Header Location



Link in Off Position



Link in On Position

Build Step 6

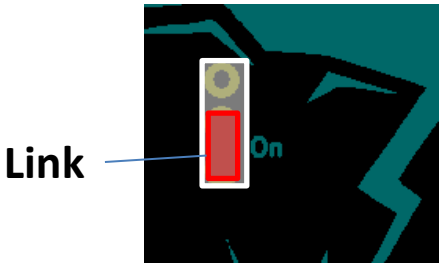
- Add the four self-adhesive feet to the corners of the rear board

Checking time

- Congratulations – building should now be complete!
  - Take a break
- Time to check:
  - No parts left-over
  - 4069 IC and electrolytic capacitors in the right way round
  - No bad solder joints or unsoldered joints
  - No solder bridges or other problems
- Insert the battery with the +ve terminal facing away from the PCB

User Guide (1 of 2)

- Connect the audio jack to powered PC speakers or a mixer
  - The Rock Drill 4069 isn't suitable for driving headphones directly
- Move the link on the power switch to the "on" position

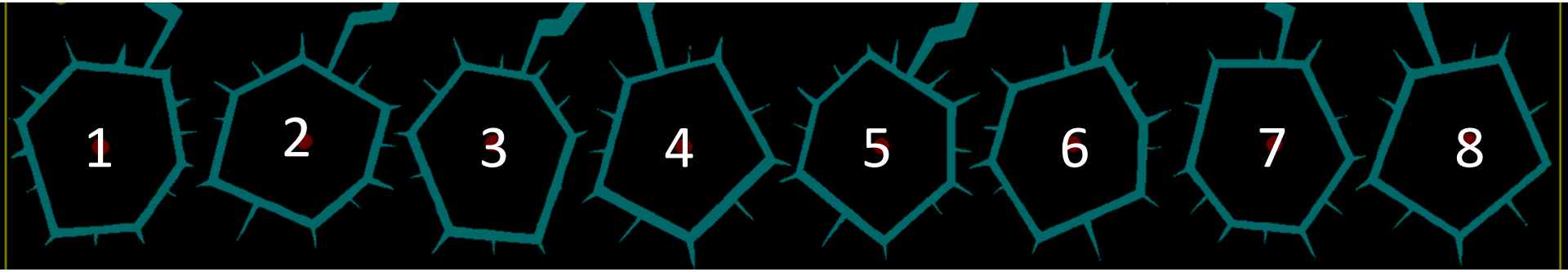


Link in On Position

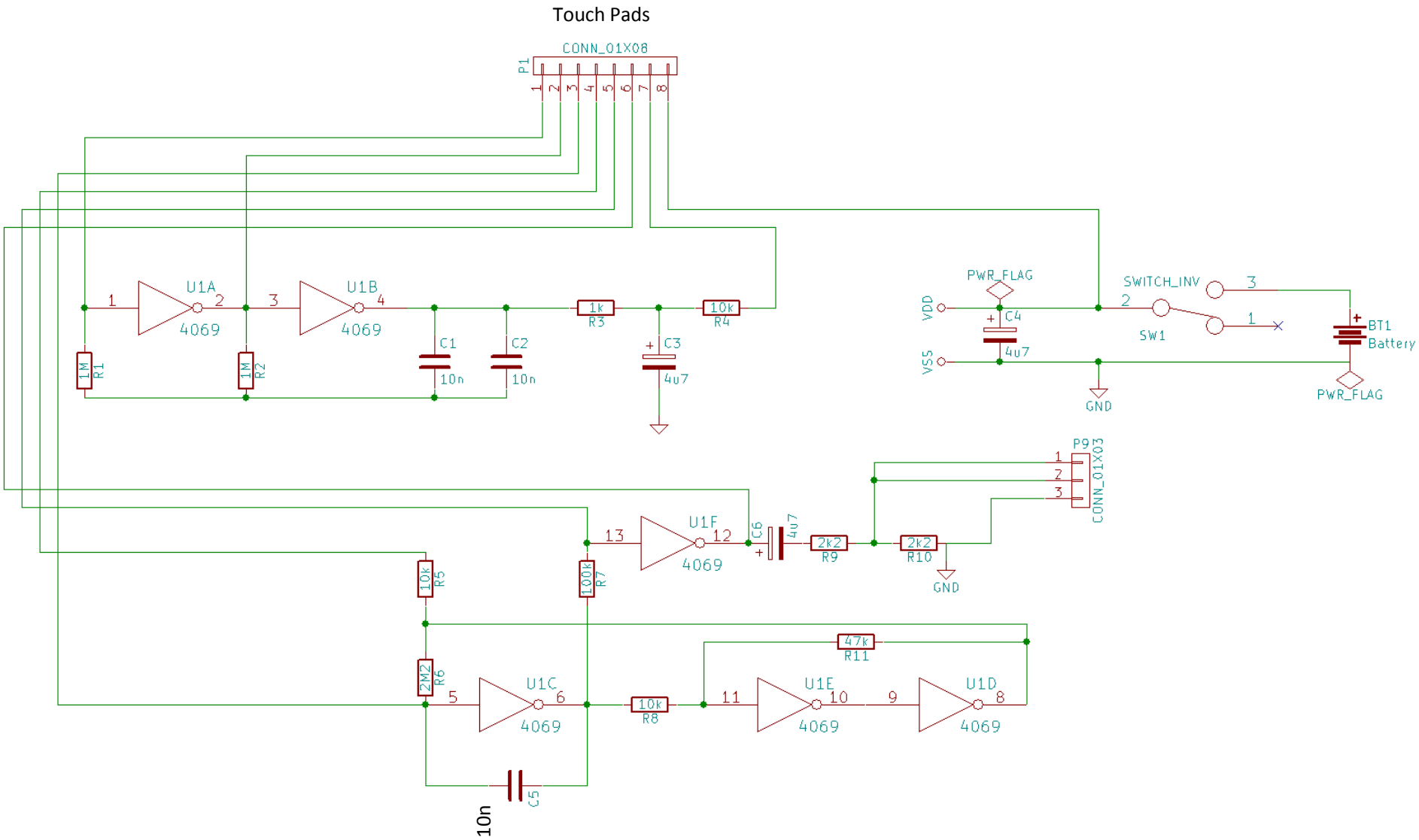
- You should hear a low-frequency buzz which is the default sound of the Rock Drill 4069

User Guide (2 of 2)

- Use the touch pads to vary the sound – experiment to find different effects
- It's tempting to mash all the pads together, and this can be effective, but also try individual pads and pairs of pads
- Try light pressures and heavy pressures
- Here are some specific technical points, but the pads interact in surprising and interesting ways, so don't over-intellectualize!
  - Pads 3 and 4 are particularly powerful as they control the frequency of the base oscillator. You will normally want to use one or both of these.
  - Pad 7 provides a kind-of Low Frequency Oscillator (LFO) wave that modifies other sounds. It's frequency depends on pads 1 and 2.



Schematic



How it works (roughly)

- The main oscillator is formed by U1C, U1D and U1E with R5, R6, R7, R8, R11 and C5. U1C is an integrator that generates the basic wave shape. U1D and U1E form a schmitt trigger to reverses the slope of the wave every half-cycle. This oscillator has a triangle wave shape which can give rise to interesting distortions and gives a different sound from the square waves normally generated in simple circuits.
  - Touch pads 3 and 4 provide a kind-of voltage controlled effect on the frequency of this oscillator.
- U1F acts as a thresholder/distorting amplifier with the effect modified by the feedback via touch pads 5 and 6. This changes the wave shape (and hence sound) emitted by the circuit.
- C6, R9 and R10 set the output level suitable for line level connection to external circuits
- U1A, U1B, R1, R2, C1 and C2 form a second oscillator (LFO) which can distort/modify the other functions. The frequency depends on touch pads 1 and 2.
  - R3, C3 and R4 smooth the output of this oscillator to create a more analogue sound. The smoothed output goes to touch pad 7.