LushOne Synth
Build Instructions

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Getting started

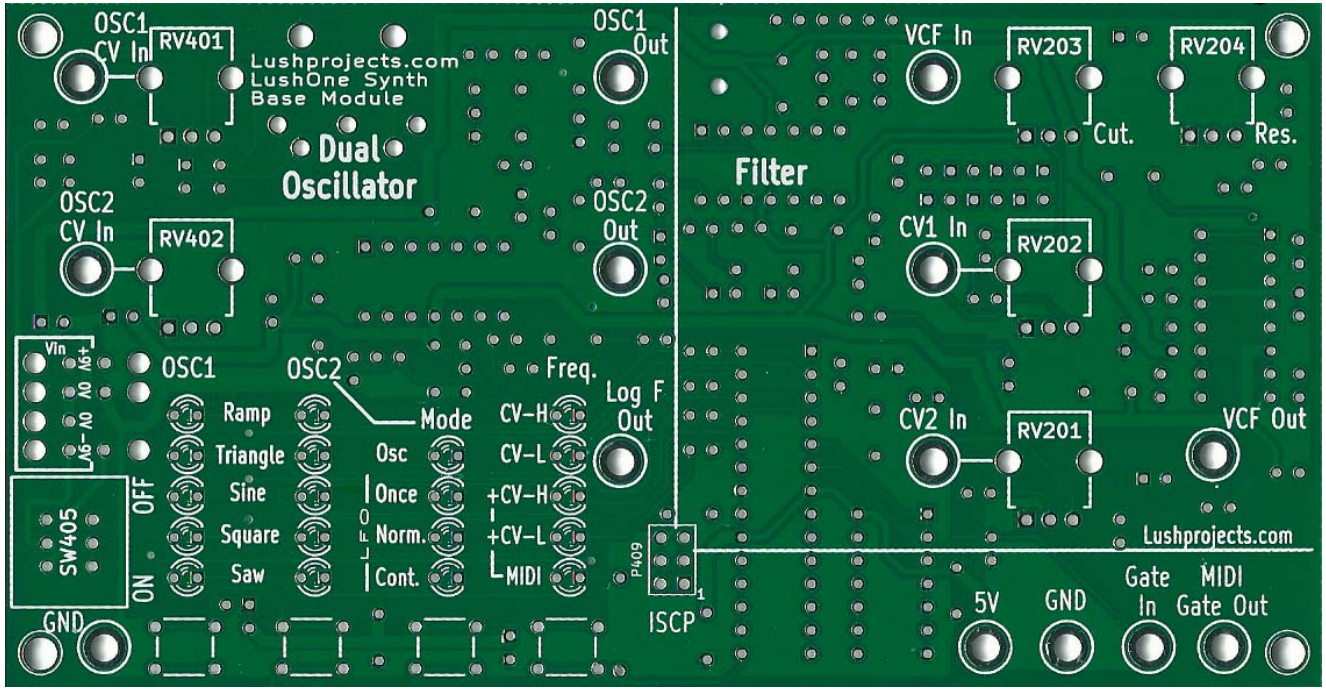
- The LushOne is not a difficult build but there are a lot of parts and they have to go in the right places
  - Not really suitable for complete beginners
  - If you've built a few things that worked then should be OK
  - You should be able to solder ICs without destroying them!
- Accuracy and neatness is more important than speed
  - Get it working first time
- These instructions will guide you but I assume you are familiar with basic techniques and equipment
  - The instructions should be suitable for someone with a skill level appropriate to the project
- All components except batteries are mounted on the circuit board – no slow, fiddly point to point wiring!

Build order

Build in any order you like, but I suggest:

- Patch sockets
- ICs and IC sockets
- Resistors, capacitors
- Transistor, diodes, crystal
- LEDs
- Switches and connectors
- Battery leads
- Variable resistors

Front



The following components are mounted from the front:

- Patch sockets
- LEDs
- Power and push switches
- ICSP programming header
- Variable resistors

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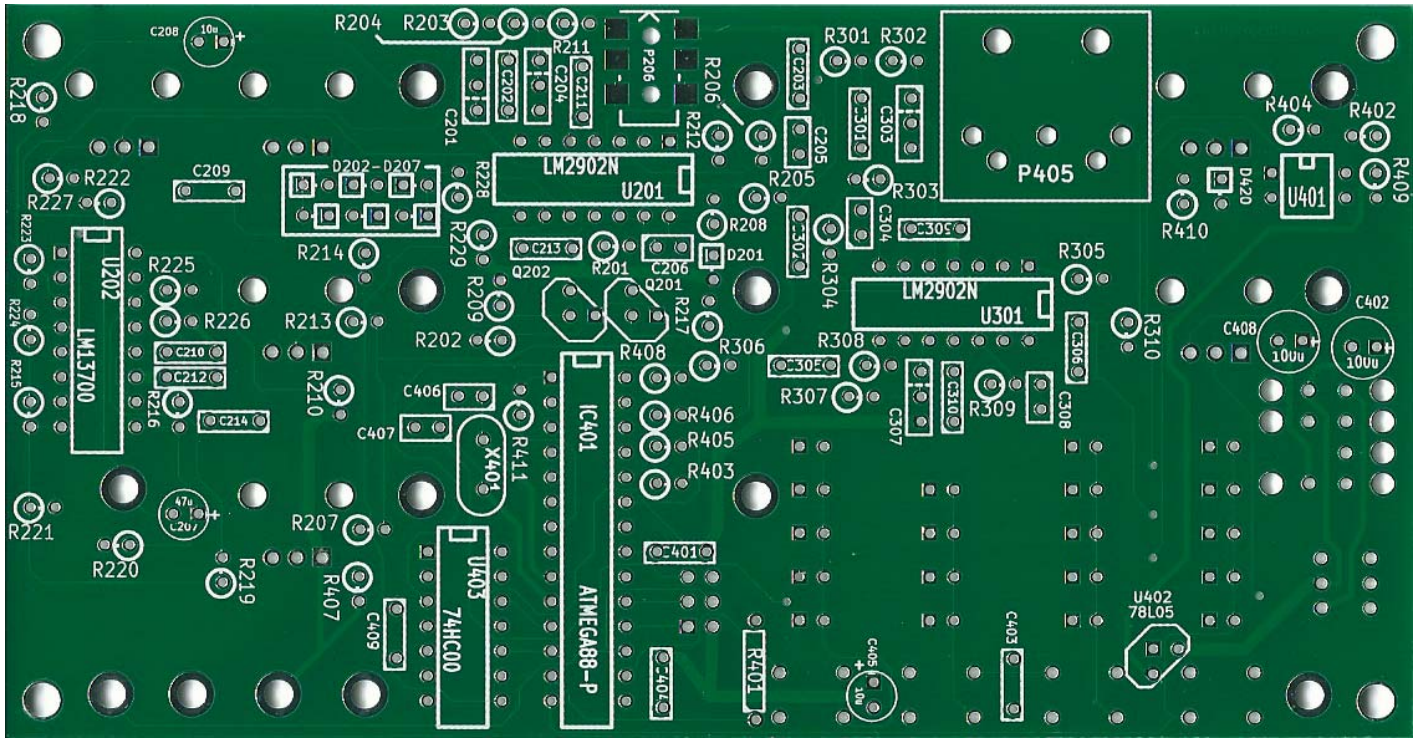
Back



The following components are mounted from the back:

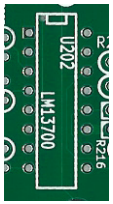
- Everything not on the front!
- (Except the batteries)

Patch sockets

- 14 small silver patch sockets fit from front of board
- Fit in the large, labelled circles
  - Not the four mounting holes in the extreme corners
- Solder round rim on back
- Suggest you fit first so you can make them sit nicely flush with the board

ICs and IC sockets

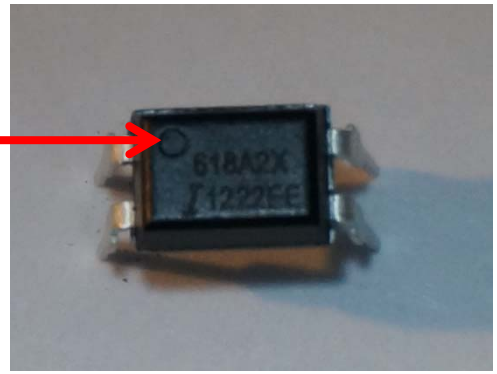
Designation	Type	Comment
IC401	ATMEGA88	28 Pin
U201	LM324 or LM2902N	14 Pin
U202	LM13700	16 Pin
U301	LM324 or LM2902N	14 Pin
U401	SFH618	4 Pin – See comments on next page!
U402	78L05	3 Pin transistor-style case
U403	74HC00	14 Pin



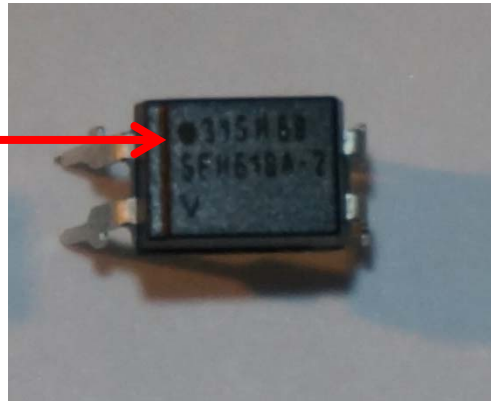
- All ICs are mounted from the back
- ICs are provided unsocketed except for the IC401
  - You can add sockets if you like!
- Positions and orientations are marked on the silk-screen
  - Pin 1 also has a square pad
- The voltage regulator has the same case as the two transistors – check the labels!
  - Orientation is shown on silk-screen

SFH618 Orientation

Small dent in plastic indicates pin 1



Whiteish dot next to text indicates pin 1



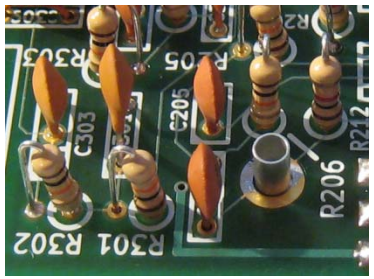
- Markings on U401 / SFH618 can be very hard to see
- Use this guide to help find pin 1
  - There are several different packages depending on the source
  - Other markings (eg a notch at the pin 1 end) may also be used

Resistors

R201	470k
R202	8.2k
R203	68k
R204	10k
R205	10k
R206	10k
R207	47k
R208	4.7k
R209	2.2k
R210	10M
R211	12k
R212	1k
R213	47k
R214	47k
R215	10k
R216	10k
R217	2.2k
R218	10k
R219	10k
R220	10k
R221	10k
R222	8.2k
R223	220R
R224	220R
R225	220R
R226	220R
R227	2.2k
R228	10k
R229	2.2k

R301	10k
R302	10k
R303	10k
R304	10k
R305	1k
R306	10k
R307	10k
R308	10k
R309	10k
R310	1k
R401	220R
R402	1k
R403	220R
R404	1k
R405	220R
R406	220R
R407	10k
R408	220R
R409	470R
R410	220R
R411	10k

- All resistors are mounted from the back
- Resistors are all mounted vertically except R401
  - See photos below
- Labels are not in a set position relative to the symbol – look for the closest label
  - Also some clarifications on next page
- The round silk-screen symbol shown above shows the resistor locations (except R401)
  - Note the short line on the silk screen indicating the direction of the second lead



Value	Colours
220R	Red, Red, Brown, Gold
470R	Yellow, Purple, Brown, Gold
1k	Brown, Black, Red, Gold
2.2k	Red, Red, Red, Gold
4.7k	Yellow, Purple, Red, Gold
8.2k	Grey, Red, Red, Gold
10k	Brown, Black, Orange, Gold
12k	Brown, Red, Orange, Gold
47k	Yellow, Purple, Orange, Gold
68k	Blue, Grey, Orange, Gold
470k	Yellow, Purple, Yellow, Gold
10M	Brown, Black, Blue, Gold

See cross-reference on last slide for list sorted by value!

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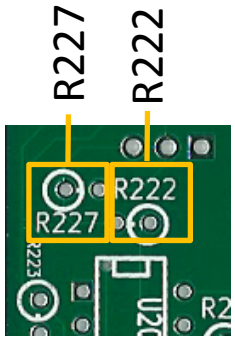
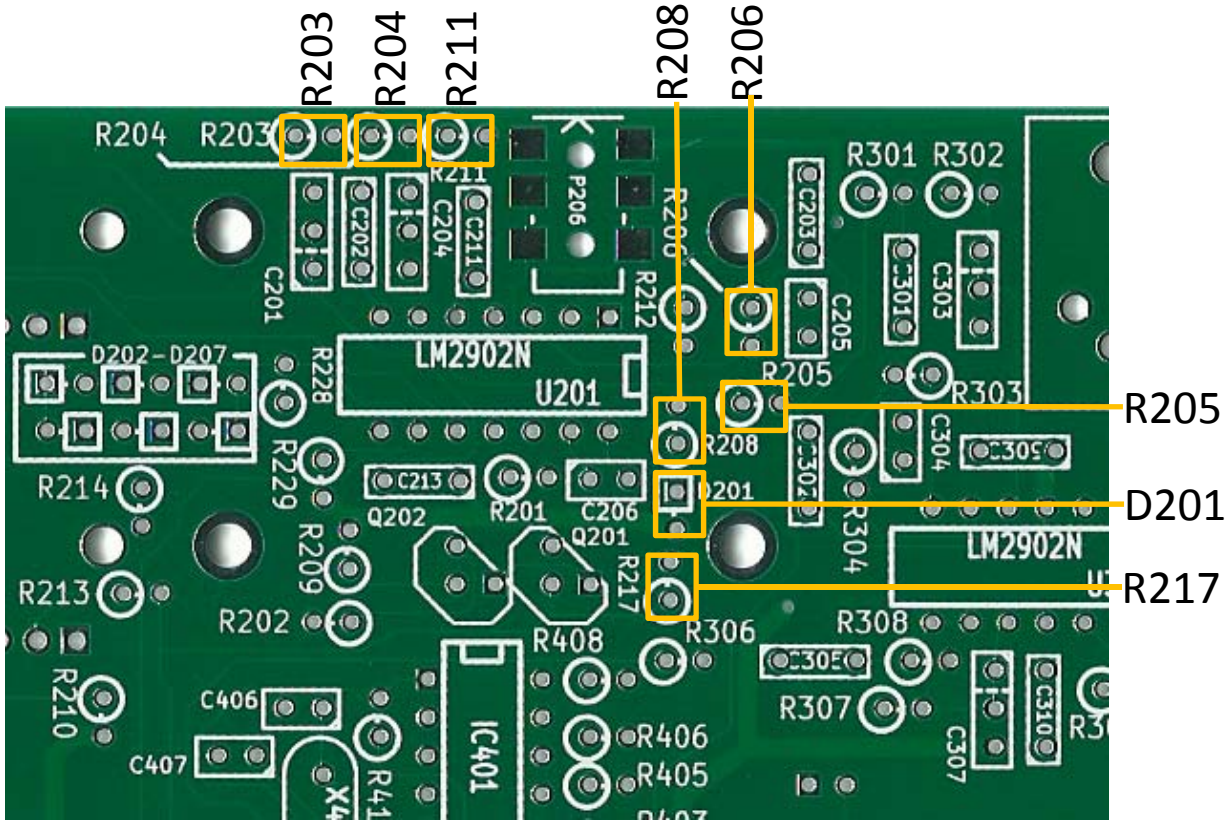
Tricky designators

The middle of the board is crowded.

This is a guide to some of the components where the label might be ambiguous





Capacitors

C201	1u	Ceramic
C202	820p	Ceramic
C203	2n2	Ceramic
C204	680p	Ceramic
C205	270p	Ceramic
C206	1n	Ceramic
C207	47u	Electrolytic
C208	10u	Electrolytic
C209	2n2	Ceramic
C210	2n2	Ceramic
C211	100n	Ceramic
C212	100n	Ceramic
C213	100n	Ceramic
C214	100n	Ceramic
C301	820p	Ceramic
C302	2n2	Ceramic
C303	680p	Ceramic
C304	270p	Ceramic
C305	820p	Ceramic
C306	2n2	Ceramic
C307	680p	Ceramic
C308	270p	Ceramic
C309	100n	Ceramic
C310	100n	Ceramic
C401	100n	Ceramic
C402	100u	Electrolytic
C403	100n	Ceramic
C404	100n	Ceramic
C405	10u	Electrolytic
C406	22p	Ceramic
C407	22p	Ceramic
C408	100u	Electrolytic
C409	100n	Ceramic

- All capacitors are mounted from the back
- Capacitors are marked with one of the symbols shown above
- For electrolytic capacitors the “+” lead (longer lead) is labelled and indicated by the square pad.
- Some capacitors (like C303) may come with either wide or narrow leg spacing. Connect as shown below.

Connect narrow legs to these pads

Connect wide legs to these pads

Value	Marking
22p	220 or 22 or 22p
270p	271
680p	681
820p	821
1n	102
2n2	222
100n	104
1u	105

See cross-reference on last slide for list sorted by value!

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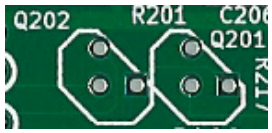
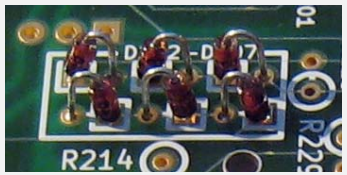
Transistors, diodes, crystal



Q201	2N3906
Q202	2N3906

D201	1N4148
D202	1N4148
D203	1N4148
D204	1N4148
D205	1N4148
D206	1N4148
D207	1N4148
D420	1N4148

X401	16MHz



Note arrangement of these diodes in the filter!

- All Transistors and diodes and the crystal are mounted from the back.
- Crystal location is marked near IC401
- Transistors are marked showing the package orientation. Check you have the two transistors and not the voltage regulator!
- Diodes are all vertically mounted and shown with the square symbol.
  - The diode's stripe should be towards the printed square / square pad
  - All diodes are mounted vertically (like the resistors)
  - Small line coming out of square on silk screen shows direction of the lead.

"you expect a diode to have its arrow pointing toward the painted band (sometimes called the cathode by the snobbish)"
Bob Pease

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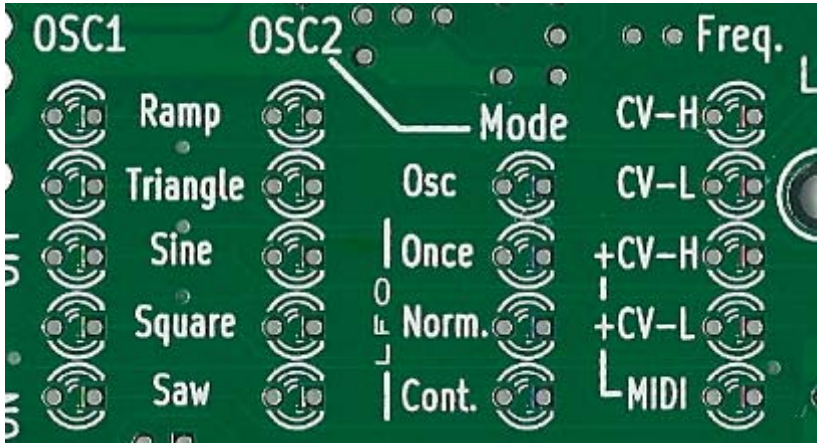
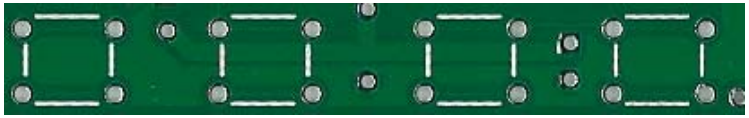
LEDs



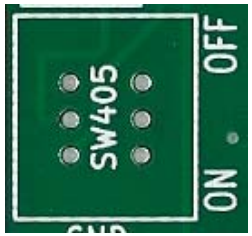
- All LEDs are mounted from the front
- Short-lead goes towards the square pad
- Depending on your case design you might want to lift the LEDs up above the board

Switches

- All switches are mounted from the front

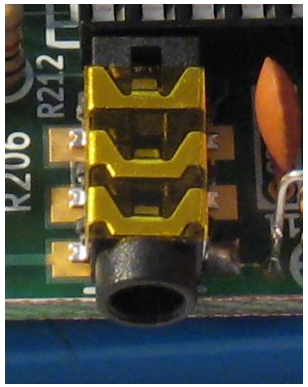


- Four tall “tactile” buttons mount on the four points under the LEDs
  - These only fit properly in one orientation. If you are having trouble fitting try turning 90°
- Sliding power switch fits on the left of the board



Connectors

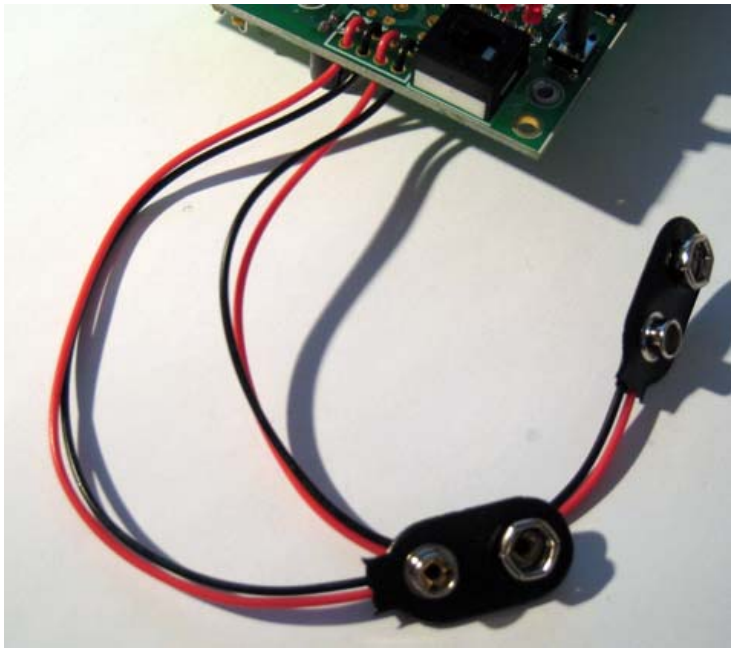
Surface mount pads for jack socket

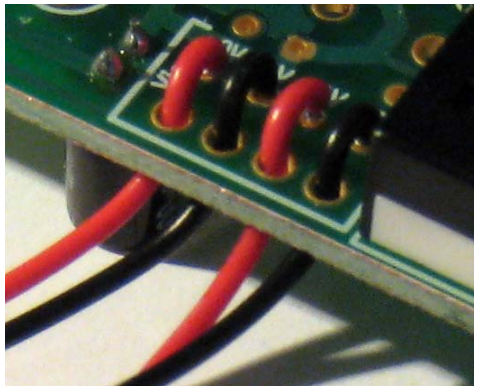


Jack socket tacked in place with one pad

- The DIN connector and the 3.5mm jack socket are mounted from the back
- DIN connector mounts easily on the “P405” label
- 3.5mm jack socket is a surface-mount part!
  - Don’t panic! It’s huge and easy to handle
  - Fits on “P206” pads
  - Put solder blob on one pad
  - Melt solder and push socket in to place using 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
- The 6 pin “ISCP” (sorry about the typo – should be ICSP) header is mounted from the front
  - Solder in where indicated
  - If you don’t plan to change the firmware you can omit this part

Battery leads





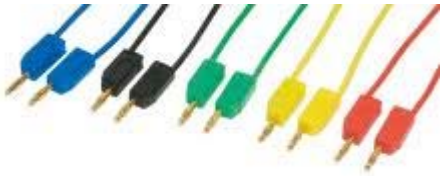
- The LushOne runs from two 9V “PP3” batteries
- Battery connectors are mounted as shown in the photos
- Leads terminate in the box labelled “Vin” next to the power switch
- Connectors are (see photo):
  - “9V” – 1st connector – red
  - “0V” – 1st connector – black
  - “0V” – 2nd connector – red
  - “-9V” – 2nd connector – black
- Remember for a split-rail power supply the ground is negative of one battery and the positive of the other!

Variable resistors

RV201	10k
RV202	10k
RV203	10k
RV204	10k
RV401	10k
RV402	10k

- Five variable resistors are mounted where shown on front of board
- You may need to bend the pins slightly to make them sit properly

Patch Leads



- You may have pre-built patch leads or parts to make patch leads.
- If you have your patch leads as separate parts:
  - Cut the patch wire in to three equal lengths
  - Strip a short amount of insulation from each end of the wire lengths
  - Connect a 2mm stacking patch connector to each end as shown in this video: http://youtu.be/WA6blg6HNP0

Checking time

- Congratulations – building should now be complete!
  - Take a break
  - Insert IC401 in the socket if you haven't done so already
- Time to check:
  - No parts left-over
  - All parts (particularly ICs) in the right way
  - No bad solder joints or unsoldered joints
  - Battery connectors on correctly (very important!)
  - No solder bridges or other problems
- Good luck
- See the training for how to use the LushOne

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Firmware

- The microcontroller in the kit comes with firmware pre-loaded
- If you have an AVR serial programmer you can update the firmware using the ICSP header (on some old boards labelled “ISCP” – blush)
- This connector does not force correct orientation.
    - Pin 1 is labelled
    - Check and double check orientation before connecting the programmer!

Resistor and Capacitor Cross Reference

You can use this chart to easily find all components of the same value

Value	Qty	Components																		
Resistors																				
220R	10	R223	R224	R225	R226	R401	R403	R405	R406	R408	R410									
470R	1	R409																		
1k	5	R212	R305	R310	R402	R404														
2.2k	4	R209	R217	R227	R229															
4.7k	1	R208																		
8.2k	2	R202	R222																	
10k	20	R204	R205	R206	R215	R216	R218	R219	R220	R221	R228	R301	R302	R303	R304	R306	R307	R308	R309	R407	R411
12k	1	R211																		
47k	3	R207	R213	R214																
68k	1	R203																		
470k	1	R201																		
10M	1	R210																		
Capacitors																				
22p	2	C406	C407																	
270p	3	C205	C304	C308																
680p	3	C204	C303	C307																
820p	3	C202	C301	C305																
1n	1	C206																		
2.2n	5	C203	C209	C210	C302	C306														
100n	10	C211	C212	C213	C214	C309	C310	C401	C403	C404	C409									
1u	1	C201																		
10u	2	C208	C405																	
47u	1	C207																		
100u	2	C402	C408																	