A brief, non-exhaustive introduction to synth DIY

(or: what I wish I had known when I started)

HERZLICH LABS

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Objectives

Why DIY?

Tools & Skills

Kits & Components

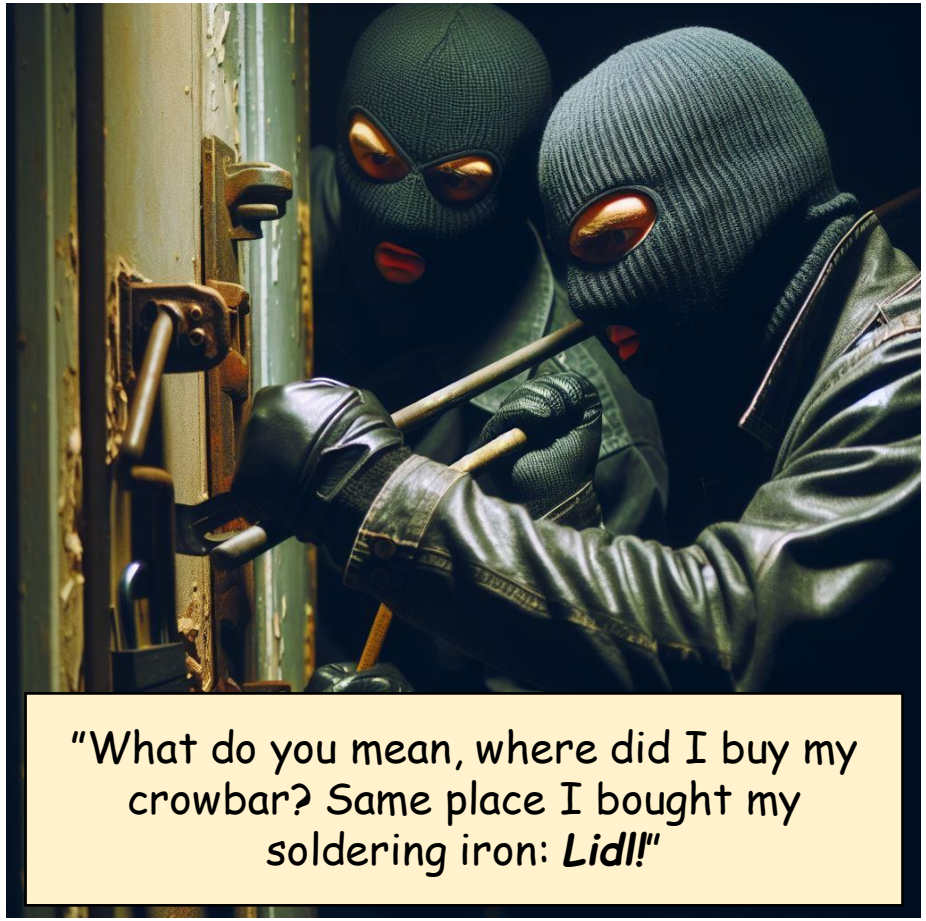
Next steps

Why DIY?

- It’s fun, relaxing and rewarding
- It’s cheaper than buying assembled modules
- You gain access to the whole world of DIY-only
- You learn to build, repair, modify and maintain
- You learn problem solving skills and resilience

Barriers to entry

- How do I even get started?
- What tools will I need?
- How will I learn to solder?
- Where do I find good kits?
- What if I don't succeed?
- What if I fry something important/expensive?

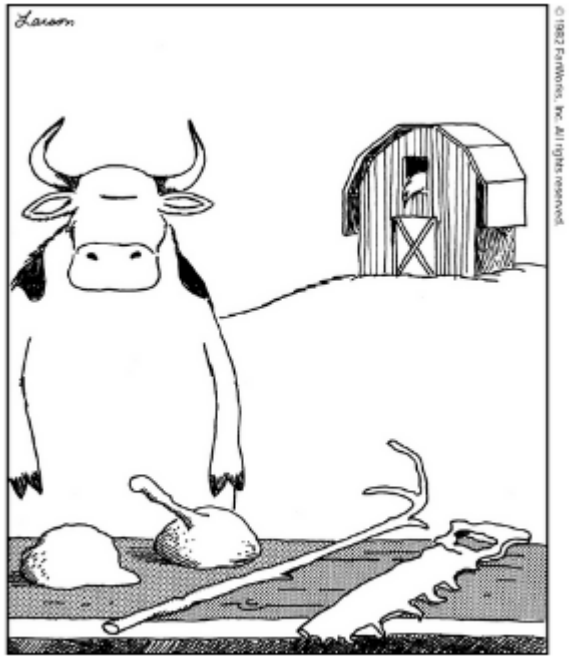


Scope & Exceptions

- Non-exhaustive recommendations.
- Yes, I know you can get NASA-grade flush cutters that will snip through tank armor.
- I won't teach you to solder (yet?)
- Getting started for <€90
- If you buy a LIDL soldering iron do not email me.
- If you like the LIDL soldering iron do not email me.

My background

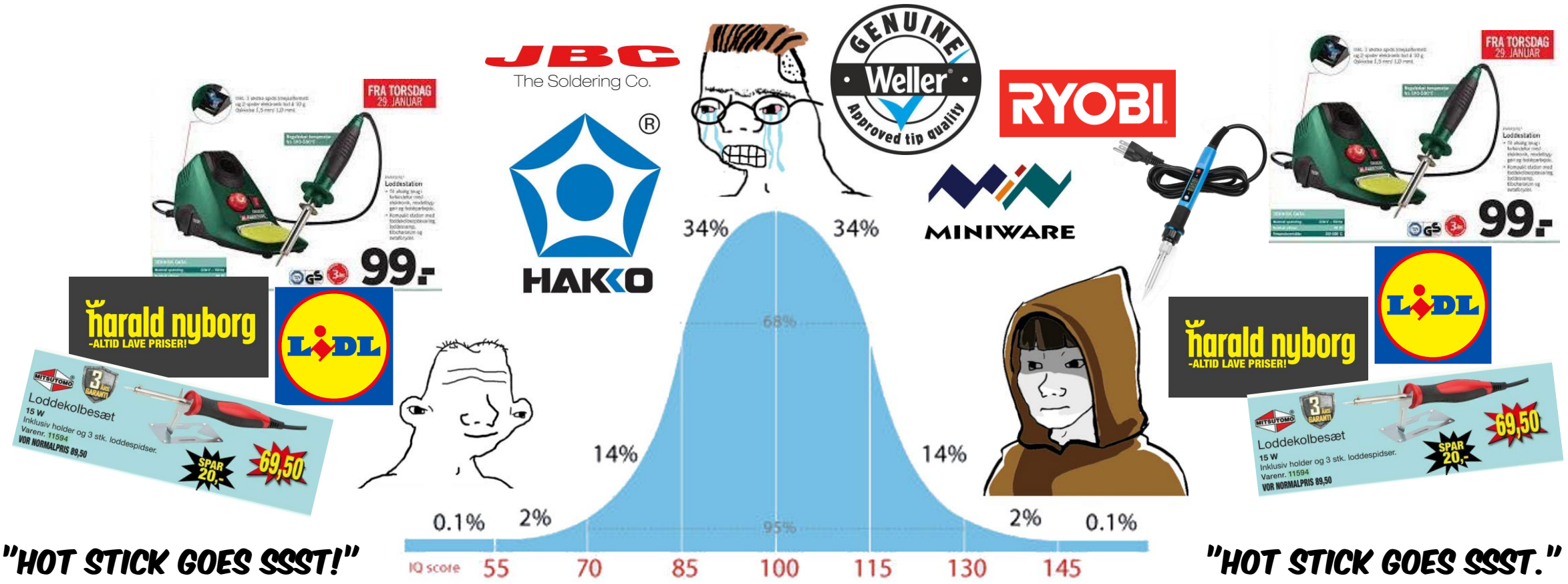
- I have owned *many* bad tools.
- I currently own a few good tools.
- I have spent a great deal of time, money and frustration on the former.
- I wish I had discovered the latter sooner.
- I hope I can enlighten you.



Cow tools

Tools & Skills

"NOOO! SOLDERING IRONS ARE NOT FUNCTIONALLY EQUIVALENT!"



"HOT STICK GOES SSST!"

"HOT STICK GOES SSST."

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Introducing the BARF System©

B	**Budget** choice for beginners that will do the job.
A	**Awesome** tool that anyone will enjoy using.
R	**Ridiculously** good tool for enthusiastic novices.
F	**Frivolous** waste of money, don't bother.

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Soldering irons

B	**Lytool digital soldering iron** Very cheap, probably not temperature calibrated, comes with questionable accessories, but it *will* do the job. Cheap replacement tips, LED temperature indicator, risky holder and suspicious solder included.	**€16**
A	**Miniware TS101 soldering iron** Excellent tool with great selection of decent quality tips, smart features and customizable firmware. Can run off many different power sources, but with a 24v laptop charger it can easily match the performance of significantly more expensive irons. Superior portability.	**€99**
R	**Aixun T3A soldering station w/ T245 handle** Quality clone of high end soldering tool with the option to use high-grade T245 tips. Requires some amount of careful fiddling with Chinese firmware, but the station will handle even the most demanding DIY tasks.	**€139**
F	**That soldering iron from LIDL/soldering guns/irons without temperature control** Be careful with devices that output less than 50W, devices that do not specify what type of replacement tips they use, devices that do not have silicone wire, devices that use batteries, soldering guns, etc.	**No.**

Soldering accessories

R-grade solder types

- Stannol Kristall 600/611
- Kester K100LD 0.8mm

Things to look for:

- Approximately 0.8mm gauge
- Water washable or no-clean
- Lead-free alloys
- "Made in Germany/USA/Japan"

R-grade desoldering gear

- MG Chemicals #426 Fine Braid Super Wick
- ENGINEER SS-02 Desoldering Pump

Things to look for:

- If it's from ENGINEER you're going to love it
- German, American or Japanese desoldering braids tend to be more reliable

Soldering accessories

A-grade tip cleaner

- Weller Brass Cleaning Sponge (with holder)
- ERSA Lötspitzen-Reaktivator (Tip Reactivator)

Things to look for:

- Brass sponges with holders for tip cleaning
- Lead-free tip reactivator for deep cleaning

A-grade work area tools

- Any silicone soldering mat
- Bollé Silpsi Silium Safety Glasses

Things to look for:

- Silicone mats prevent most sharp and hot accidents to your work area
- Proper safety glasses prevent your eyeballs from meeting an untimely end

Soldering accessories

B-grade multimeter

- Uni-T UT133A
- PeakTech 1040

Things to look for:

- Any multimeter which can do diode testing, continuity testing, resistance value testing and measure voltages will be very useful

F-grade tools and equipment

- Most cheap solder is garbage
- Cheap desoldering pumps (they don't suck, and that's the problem)
- Any multimeter that looks like this:

On soldering

- Effective soldering skills are the basis of your DIY hobby
- Good soldering is mostly a matter of practice, but proper equipment helps
- There is a great deal of tips/cartridges available to suit different tasks and preferences
- Conical tips are equally bad at every task, forget them

Learning new skills

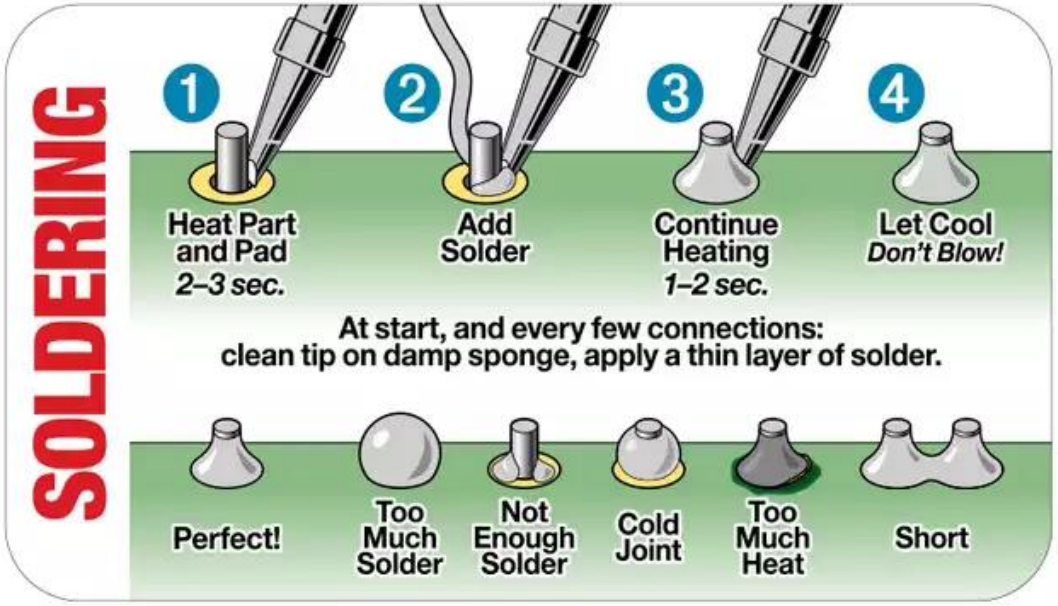
Introduction to soldering:

https://www.makerspaces.com/how-to-solder/

Understanding continuity testing (and keeping the magic smoke inside your system):

https://www.youtube.com/watch?v=qS0SoIiiQCo

Practice, practice, practice.



Hand tools

- Your **side cutters** are the second-most important tool after the soldering iron
- The rusty old tools in your home-maintenance toolbox are probably not helpful at all
- Good tools are a joy to use

Side cutters/flush cutters

B	**Generic Chinese blue-handled side cutters** Cheap, sharp and moderately dangerous. Any search for side cutters will turn up plenty of these, and while they may break sooner rather than later, they are servicable tools for the budget-conscious beginner.	**€6**
A	**Engineer NS-04** Extremely sharp and precise Japanese side cutters, which can cut flush with practically any surface. Reduced to A-grade as Engineer tools have an addictive quality to them. You have been warned.	**€29**
R	**Knipex Electronic Super-Knips® ESD (w/ lead catch)** High-quality German engineering, including a version that comes with a little catch to prevent your cut leads from turning into projectiles. Will cut through most materials like a hot knife through butter.	**€29**
F	**Everything else** Do not email me about that pair of side cutters that NASA uses, the ones that cost several hundred euros, I've told you already that I don't care and it doesn't matter. Also don't buy anything too large.	**Stop.**

Other hand tools

R-grade pliers

- Engineer PS-03 Long-nose
- Engineer PZ-58 Neji-saurus
- Knipex Cobra XS

Things to look for:

- There is no problem the above three pliers cannot solve, either alone or together
- Thank me later, you'll see

R-grade screw drivers

- Anything from Wera ♥
- I will buy Wera until the day I die

Things to look for:

- You will benefit from having a precision screwdriver set
- It may also be worth your while to have a ratcheting screwdriver and bit set

Other hand tools

R-grade socket wrenches

- Bahco 7mm, 8mm and 10mm socket wrench

Things to look for:

- The aforementioned socket wrench sizes are useful for mounting and dismounting most synth hardware you come across, including jacks, switches and pots
- Bahco socket wrenches are bead blasted and will not scratch your panels

R-grade PCB vises

- Stickvise
- PanaVise

Things to look for:

- A PCB vise is not a strictly necessary tool to own, but it can be very useful in some cases
- Preferences in terms of vises vary and tend to be very personal, so it may be wise to try different vises and see what style you enjoy

Other hand tools

A-grade tweezers

- Knipex ESD Precision Tweezers (Straight and Bent)
- Generic reverse ceramic tweezers

Things to look for:

- Precision tweezers are often useful when working in tight areas and with SMD
- Reverse ceramic tweezers are non-conductive and heat resistant, and can hold boards and components in place while you work

A-grade wire stripper

- Jokari 20050 Super 4 Plus Wire Stripper

Things to look for:

- Don't spend too much on a wire stripper, you won't be using it that often

Other hand tools

Occassionally useful tools

- Hook-up wire
- Alligator clips
- A razor or scalpel
- Fine permanent marker
- Bright light
- Magnification
- Isopropyl alcohol (99%)
- Desoldering needles

Kits & Components

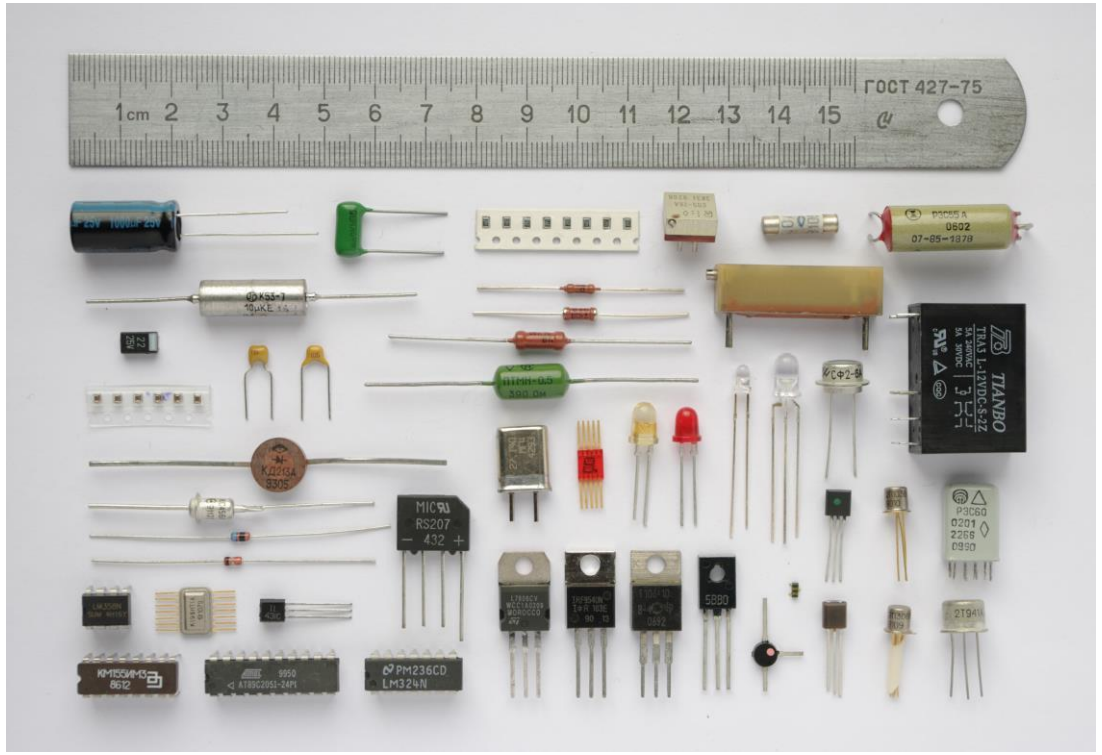
- There are **plenty of places** to find interesting DIY kits, at every complexity level and every price level.
- Some devices are only available as **DIY kits.**
- Some devices are only even available as **PCB's and panels.**

Finding kits

- Using the **Build Type>DIY** filter on Modular Grid is a great starting point
- **Exploding Shed** is an excellent resource for DIY kits in the EU
- Many kits from smaller manufacturers can also be found on **Etsy** and **Tindie**
- Some kits are only available **directly** from the manufacturer, such as Non-Linear Circuits

Finding components

- Get comfortable reading **BOMs** - a bill of material helps you identify where components go on a circuit board, and which components you may need to buy
- Many retailers of components are outside the EU – be mindful of **taxes and duties**
- Be **careful** when buying components from AliExpress



Finding components

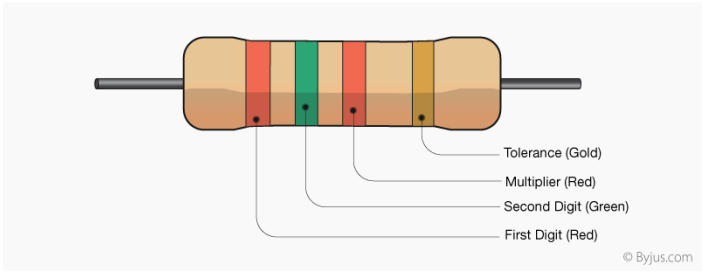
- **Mouser:** can be expensive, complex inventory search, but extensive selection and has duty paid, free international shipping
- **Tayda:** cheap, but be mindful of taxes and duties – buying in bulk can still be worthwhile
- **eBay:** useful for vintage, rare and unusual components
- **AliExpress:** mostly useful for cheap hardware and knobs, scams and fake IC's are common

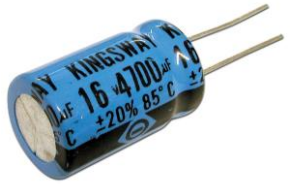
Tips for buying components

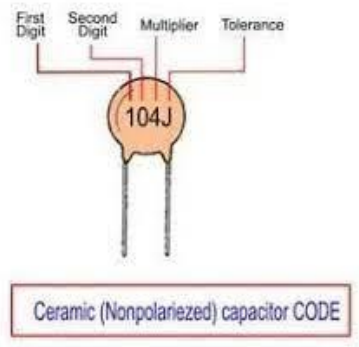
- **Buy more than you need:** buying in bulk can work out cheaper, especially for SMD, and spare components will come in handy sooner or later. You will break, drop and misplace things.
- **Learn to identify equivalents:** a BOM may specify a certain component, which may be out of stock. Learning to identify equivalent replacements will help you complete your projects.
- **Get used to reading datasheets:** datasheets have all the knowledge you will want about components – and more.

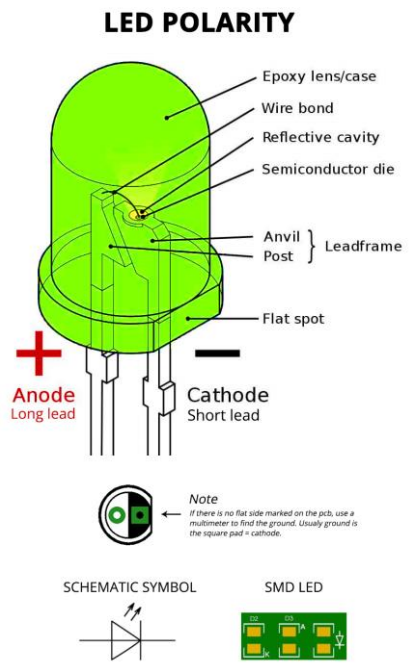
Handling components

- **Most components can be visually identified**
- Resistor color codes
- LED long lead/short lead
- Polarity indicators on diodes and polarized capacitors
- Capacitance values on capacitors
- Dots on ICs
- If in doubt: search online!



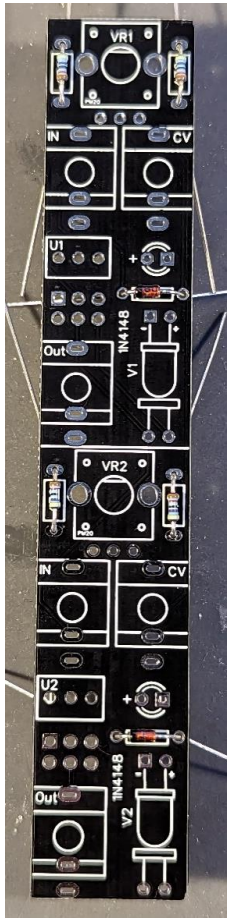






Components and PCBs

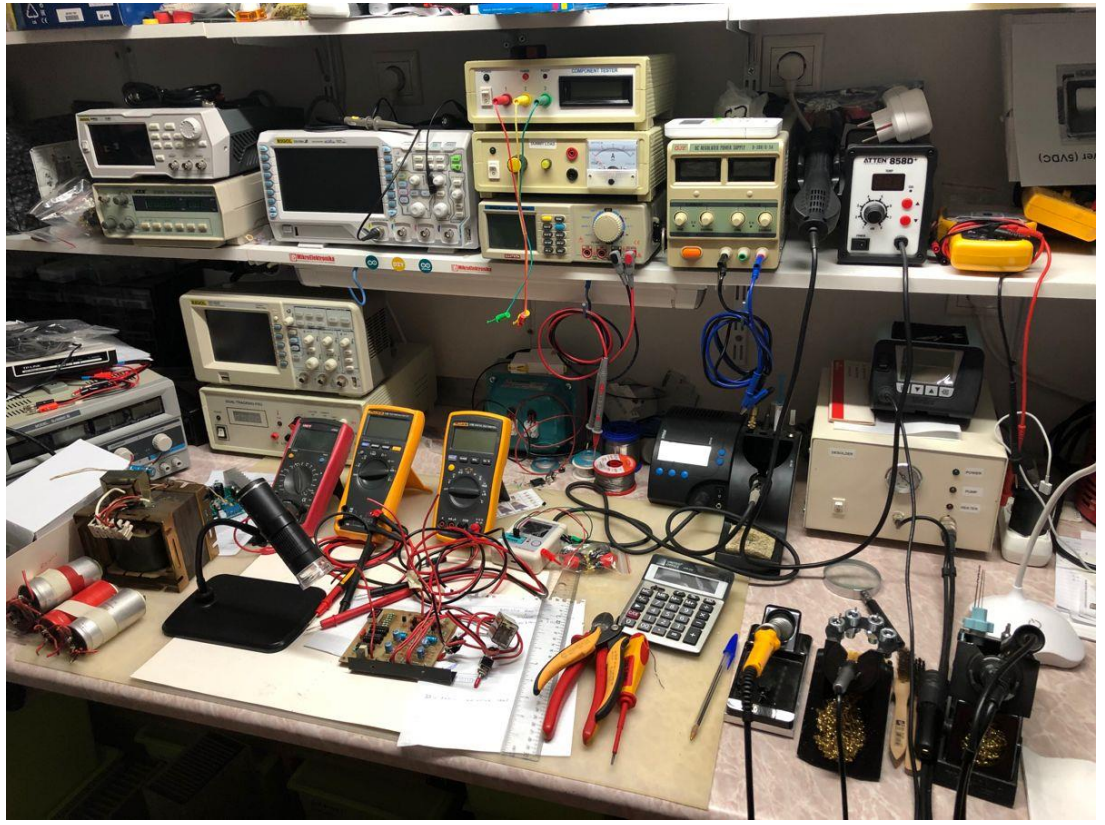
- **The silkscreen on a PCB is like paint by numbers**
- Refer to the BOM to see what part goes where
- Install components on the side with the silkscreen illustration
- The silkscreen will help indicate polarity and other important information



Next steps

What do I need to start today?

- Soldering iron and solder
- Tip cleaning sponge/brass sponge
- Side cutters
- Safety glasses
- A suitable DIY kit



Next steps

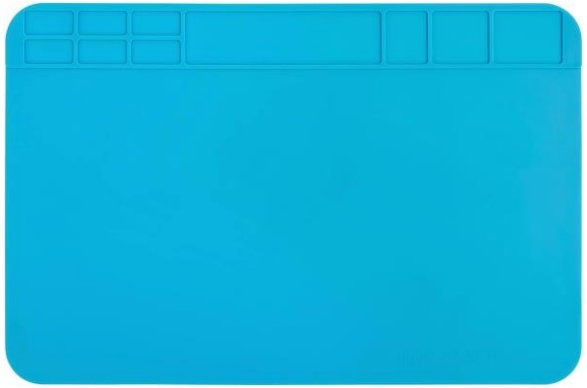
B-tier entry level kit that doesn't suck: **~€70**

Next steps

A-tier nice to haves:

- Multimeter
- Ceramic tweezers
- Long-nosed pliers
- Silicone soldering mat
- Desoldering pump

~€99



Next steps

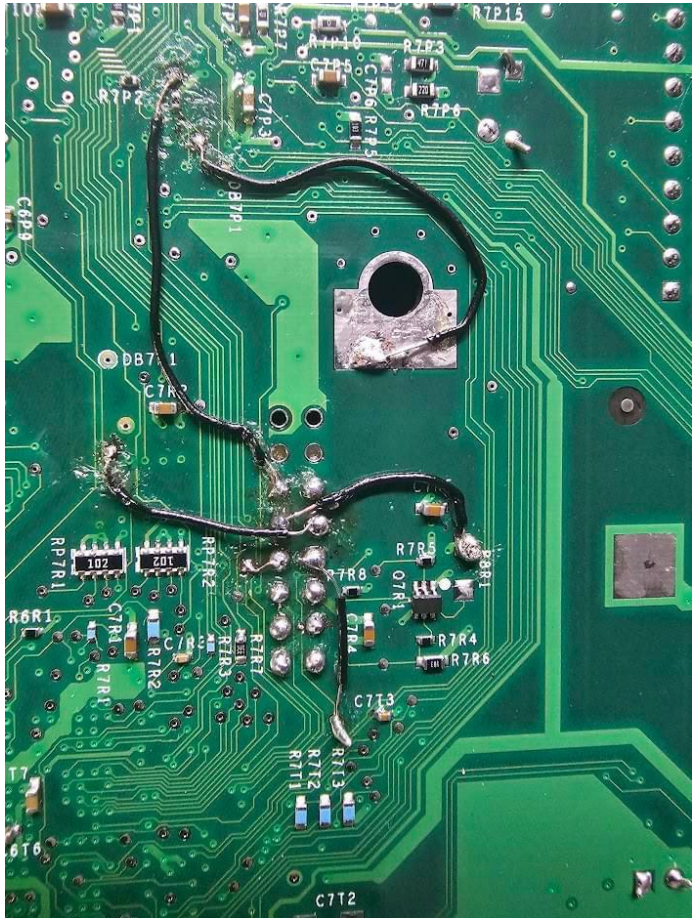
You can learn to solder in one afternoon!

- DIY is a fun and safe activity involving dangerously hot and sharp objects
- Like cooking, it only requires you to be safe and attentive to avoid hurting yourself

Next steps

What if I mess up?

- You will! Sooner or later, anyway.
- Identifying what went wrong, fixing it and succeeding in the end is very rewarding.
- Soldering is fairly forgiving – you can almost always fix mistakes.
- DIY kit designers are often glad to help you figure out what you did wrong.



Next steps

Make your own cables!

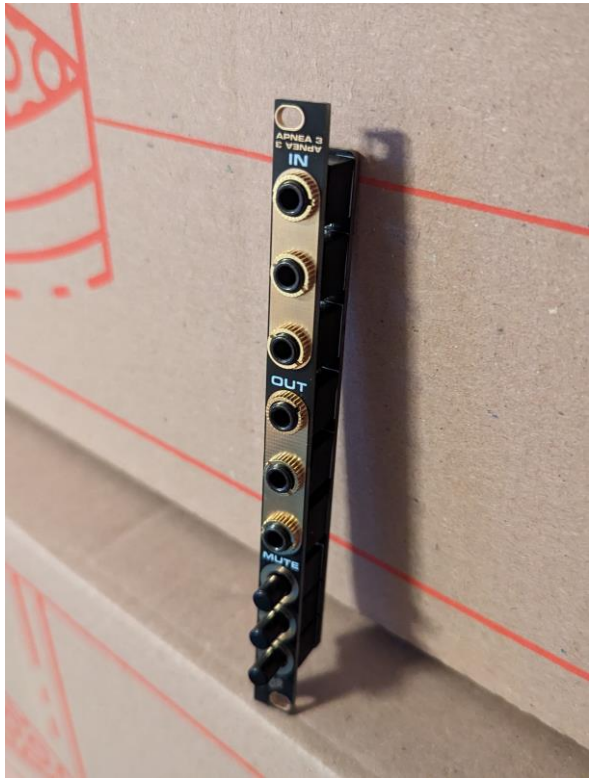
- Cables have a very high markup
- Save lots of money for modules
- Great first project for beginners
- Build your own high quality cables
- Easily make custom lengths and strange, forbidden adapters
- Fix old, scratchy cables with ease

Next steps

Easy beginner kit idea

- Clear and well-documented build guide
- Inexpensive and low parts count
- High quality components
- Teaches good basic principles of DIY that will help you in future builds
- Difficult to mess up

Herzlich Labs Apnea 3 Mute

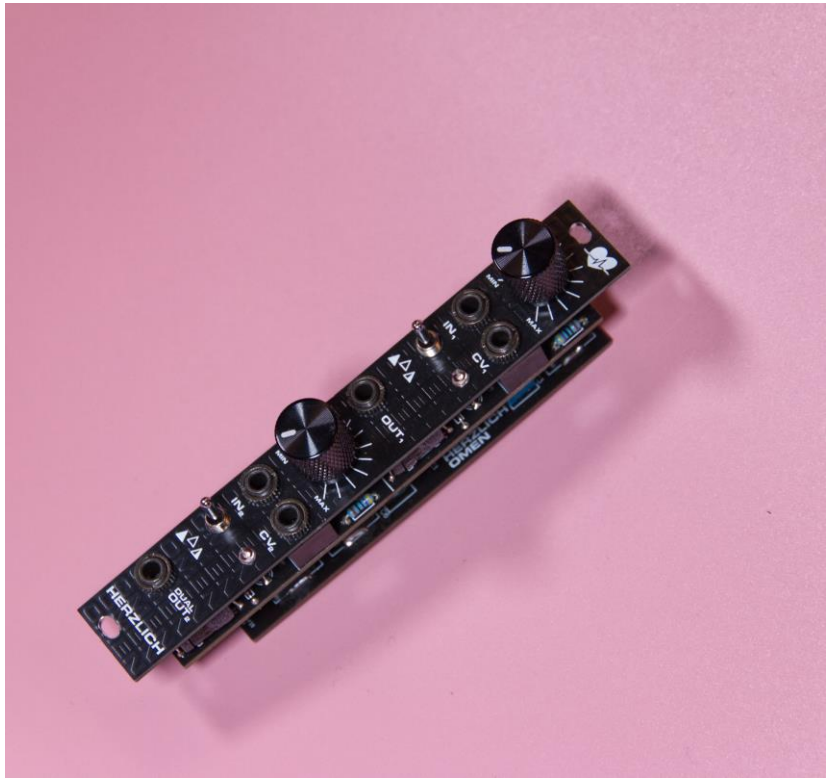


Next steps

Ambitious beginner kit idea

- Clear and well-documented build guide
- Unique LPG that can be modified through DIY
- Teaches you about many different components and their functions
- Teaches extensive good DIY practices
- Can reliably be built by absolute beginners (after some hardship)

Herzlich Labs Omen Dual LPG



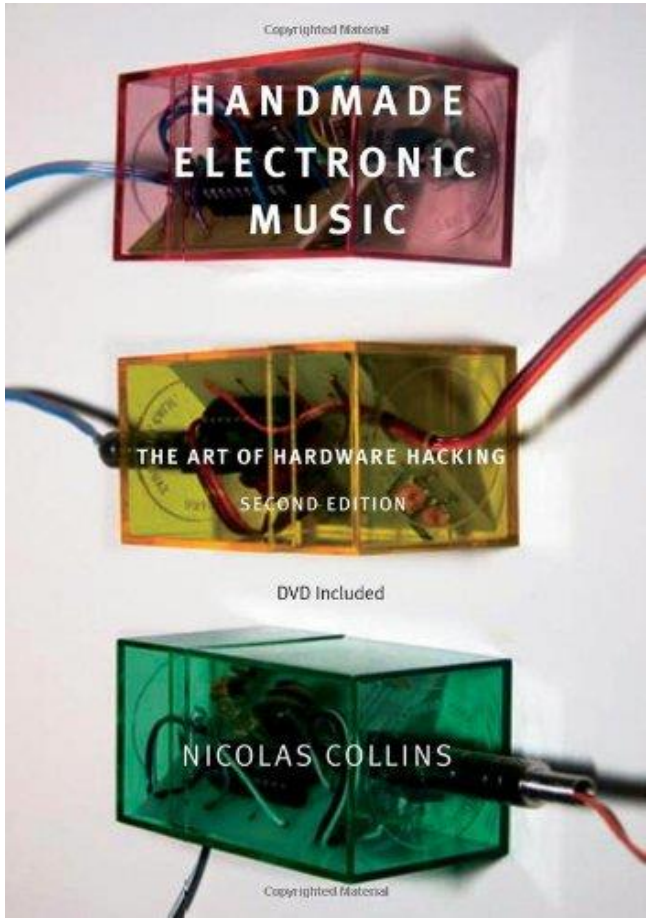
Suggested reading

Handmade Electronic Music: The Art of Hardware Hacking
Nicolas Collins

Make: Analog Synthesizers
Ray Wilson

The Art of Electronics
Paul Horowitz, Winfield Hill

Circuit-Bending : Build Your Own Alien Instruments
Reed Ghazala



Questions?

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And remember: buy nice or buy twice

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