Part D: Electronic Prototyping

Breadboards, Stripboards, PCBs

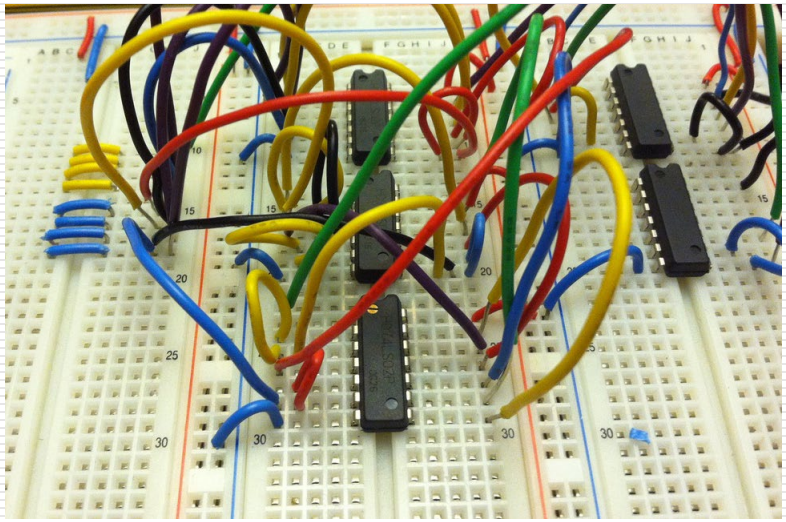
Electronic Prototyping

- Prototype
  - An early sample/model/mock-up of the project
  - Allows testing
  - Allows modification
- Techniques
  - Breadboarding
  - Stripboarding
  - PCB fabrication

Ref: Collins Lab – Breadboard & Perfboard

Breadboarding

- A construction base for prototyping electronics.
- Advantages
  - Does not require soldering
  - Reusable
  - Easy to use for temporary circuits
- Disadvantages
  - Gets complex very easily with more connections
  - Loose connections
  - May be inaccurate

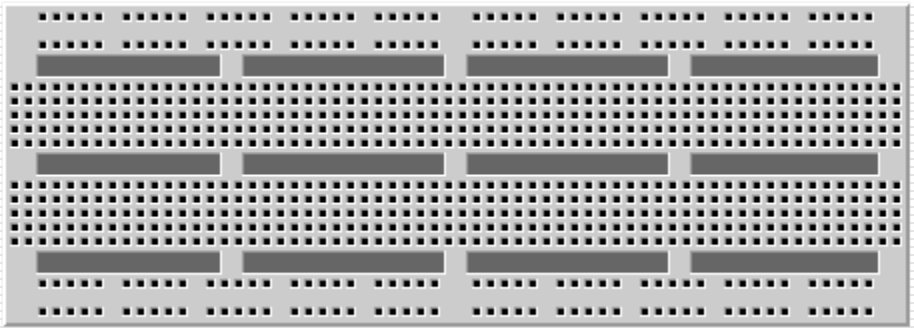


fritzing

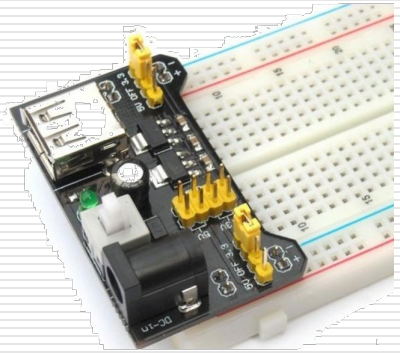
Software for schematic to breadboard
Popular with hobbyists

Ref: Wikipedia - Breadboard

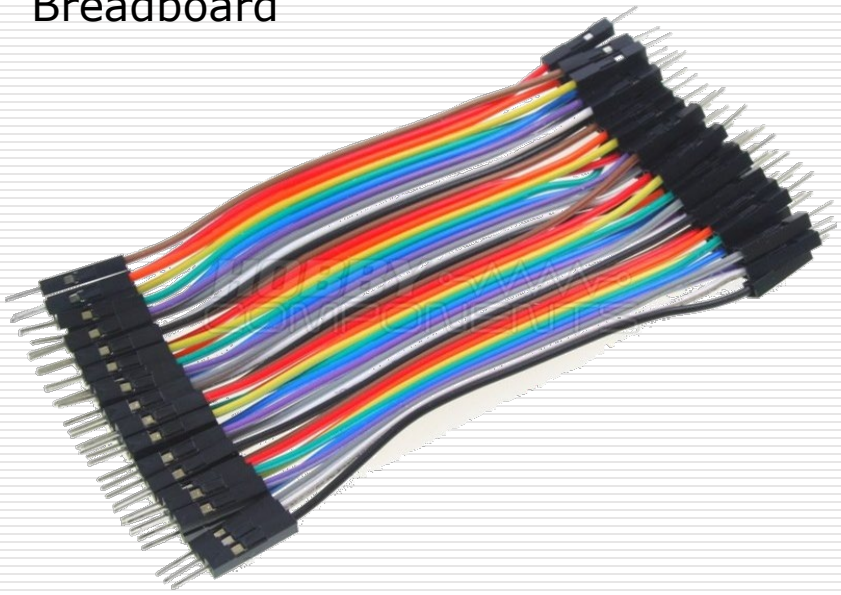
Breadboarding tools



Breadboard



Power Rails connector
+5, 3.3 and GND



Dupont Jumper wires
Male-Male connections

Modern accessories have made breadboarding simpler. Jumper wires provide better connectivity and power rails simplify the availability of power and ground lines.

Ref: [Sparkfun – How to use a breadboard]

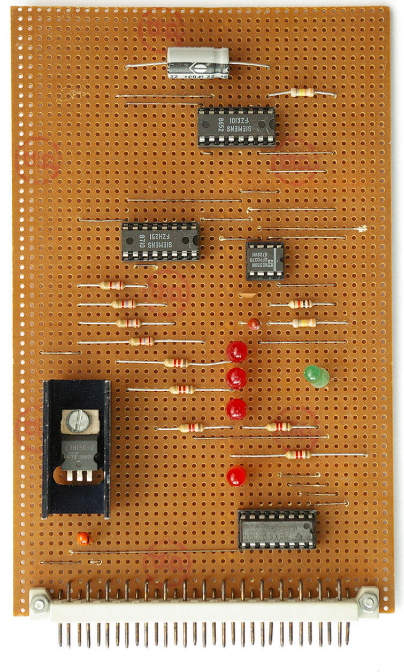
How to use Breadboard

- YouTube: How to use Breadboard

Ref: Start Electronics Now – 555 LED Flasher

Stripboarding

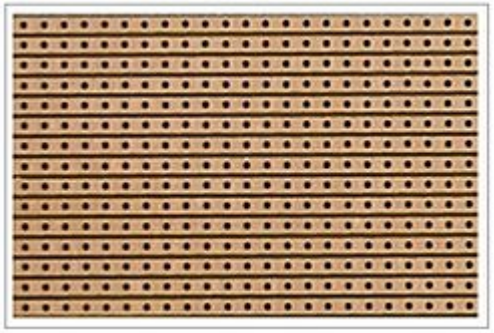
- An electronics prototyping board which provides a grid for placement and connectivity of components.
- Advantages
  - Can handle simple to relatively complex circuits
  - Can handle variety of components
  - Secure connections
- Disadvantages
  - Requires soldering
  - Planning needed for complex circuits
  - Medium complexity



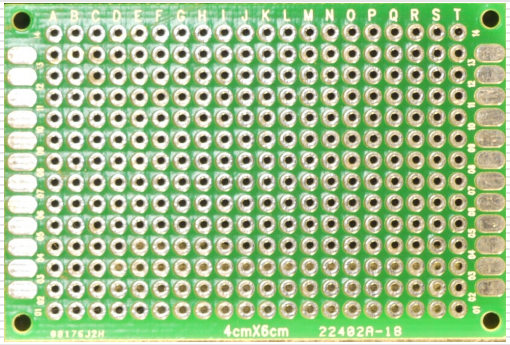
Ref: [Wikipedia - Stripboard]

Stripboarding

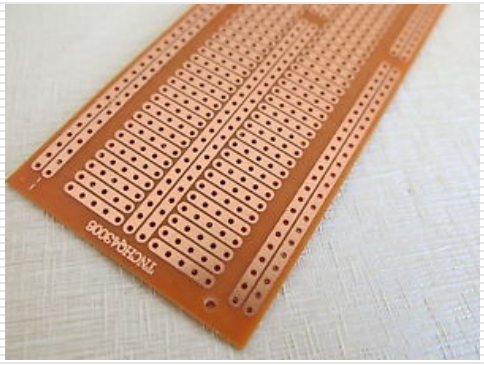
Ebay: Different types of stripboard



Veroboard



Stripboard (holes only)



Stripboard (strips)

- Veroboard – most common prototype board
- Some skill, soldering, tools required
- Very stable designs can be built, tested and used
- Software for design: VeeCad, VeroDes, Stripboard Magic

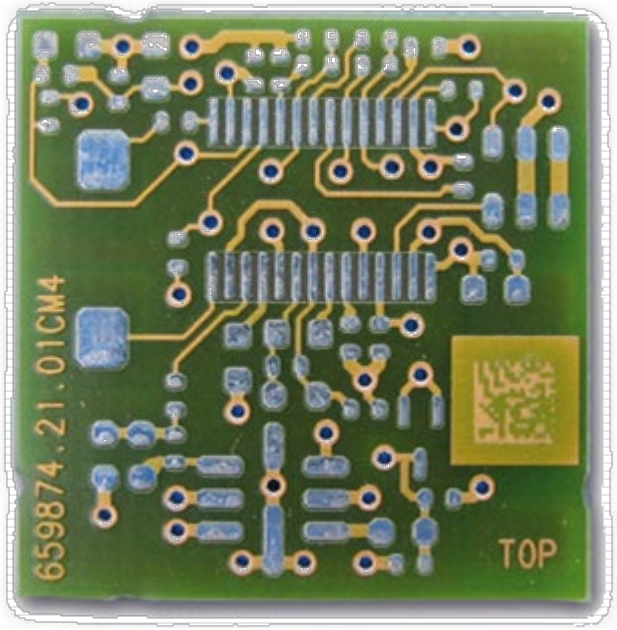
Ref: Instructables – Practical circuit construction
From Schematic to Veroboard

Making a prototype using Veroboard

- YouTube: Starting Electronics - Making a permanent circuit using stripboard

Printed Circuit Boards

- A board which connects electronic components using copper tracks. Components are usually soldered onto the PCB.
- PCBs can be single, double or multi-layered. This refers to the conductive copper substrate layer (s) used on the board.
- Methods of manufacture:
  - Chemical etching
  - Mechanical engraving/milling



Chemically Etched boards

- Masks are created for the board, component, solder, silkscreen layers.
- The board is treated with a photosensitive substrate and the mask exposed with light.
- The boards are then developed/chemically treated to remove the unexposed photosensitive layer.
- Ferrous Chloride is used to chemically etch away the exposed copper.
- Method used in manufacturing
- Not recommended for prototyping because of the toxicity of chemicals used.

The Printed Circuit Board Process

- Manufacturing Process of Multi-layered Board
- YouTube: Eurocircuits - how to make a 4-layer PCB

Mechanically engraved/milled boards

- Using a 2D Router/Mill to etch/mill copper tracks. No chemicals involved.
  - Dedicated PCB mill systems
  - DIY systems with NC capabilities
- Clean process, suited to Surface Mount Devices.
- Ideal for prototyping microcontroller boards
  - Soldering skills required
  - Can create complex boards
  - Fast and efficient solution to prototyping.

Mechanically Milled PCB

- YouTube: Collin's Lab PCB Milling

Video: PCB Making with UniTech CNC Router

Electronic Fabrication

Rodney Dorville