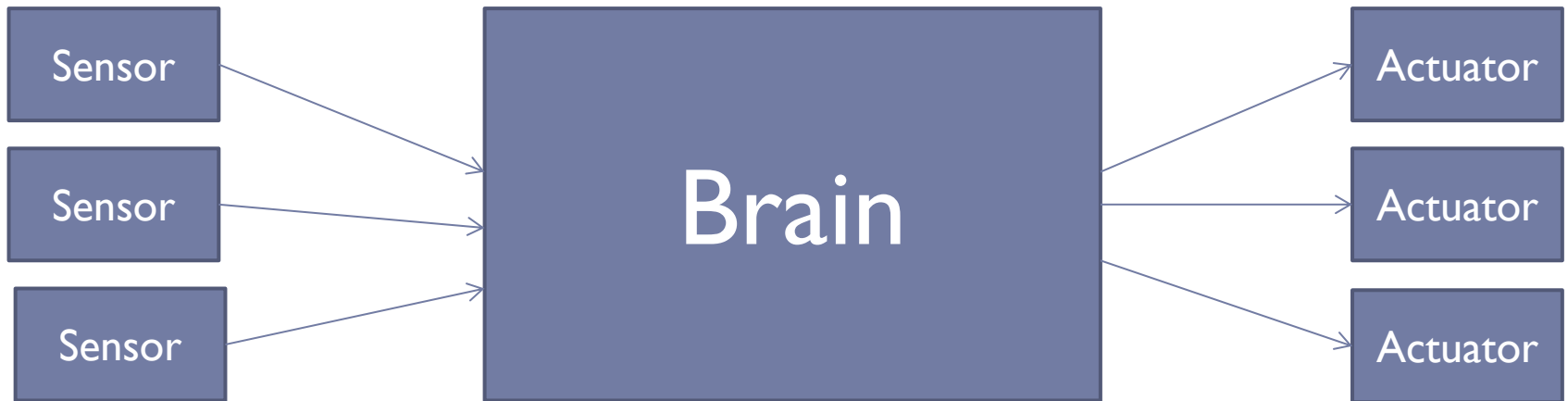


Basics of Embedded Systems

Konstantin Tretyakov (kt@ut.ee)











Driver

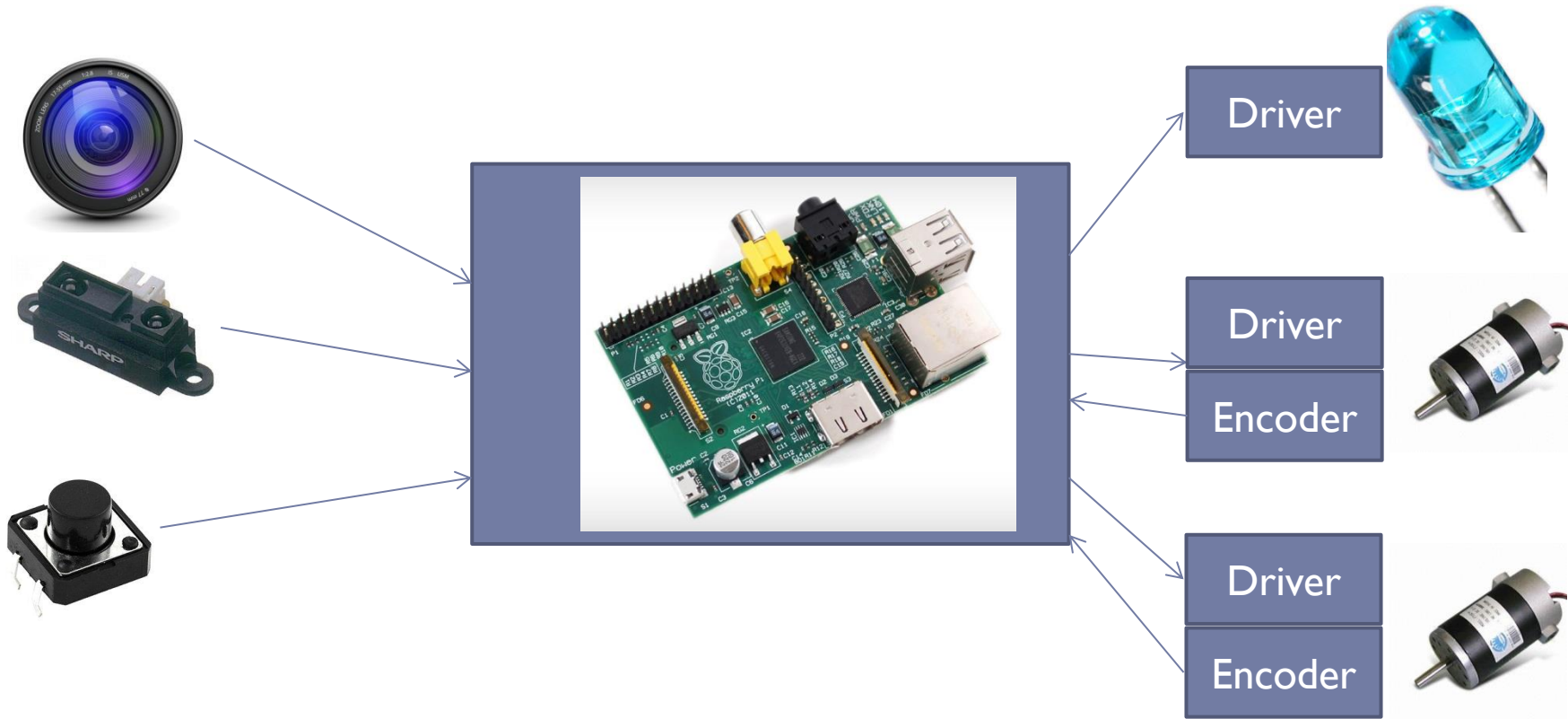


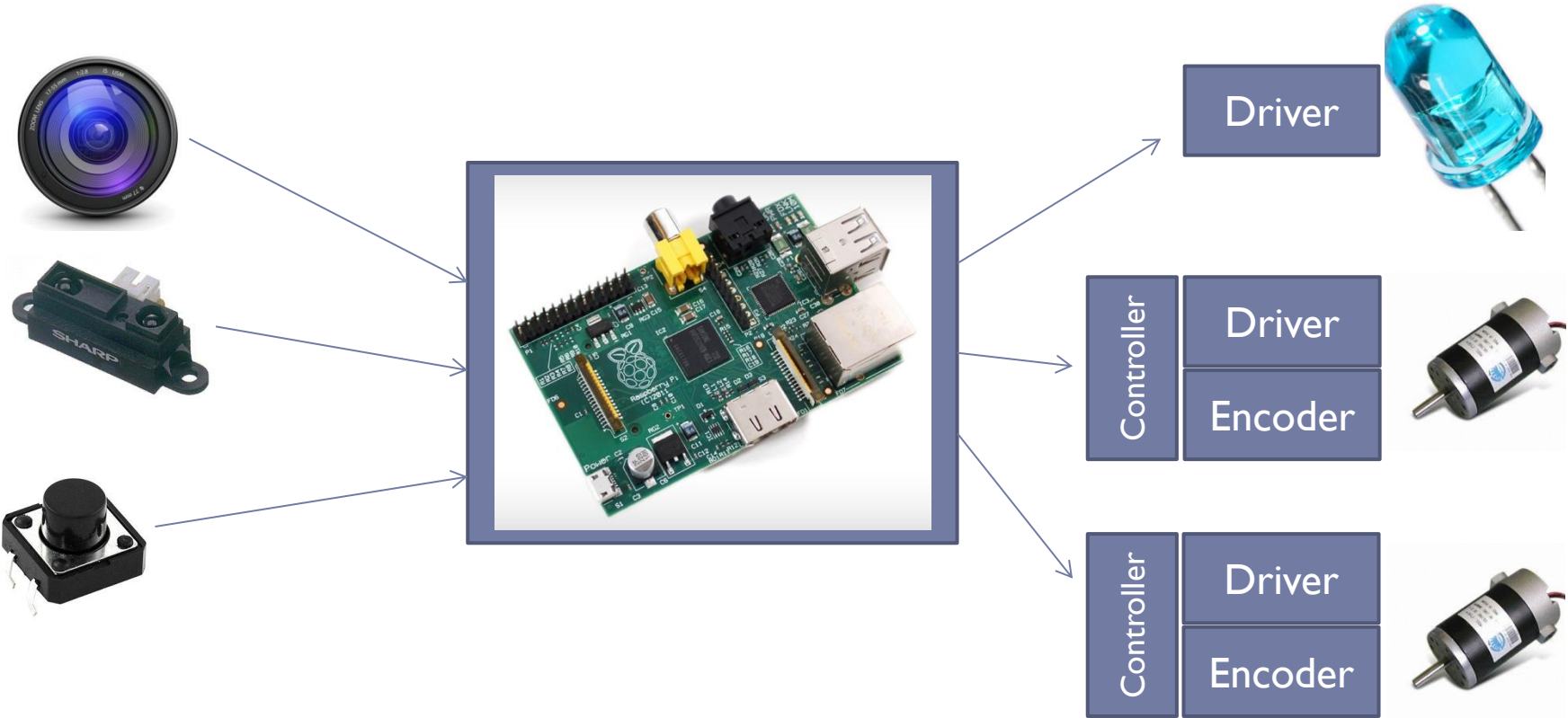
Driver

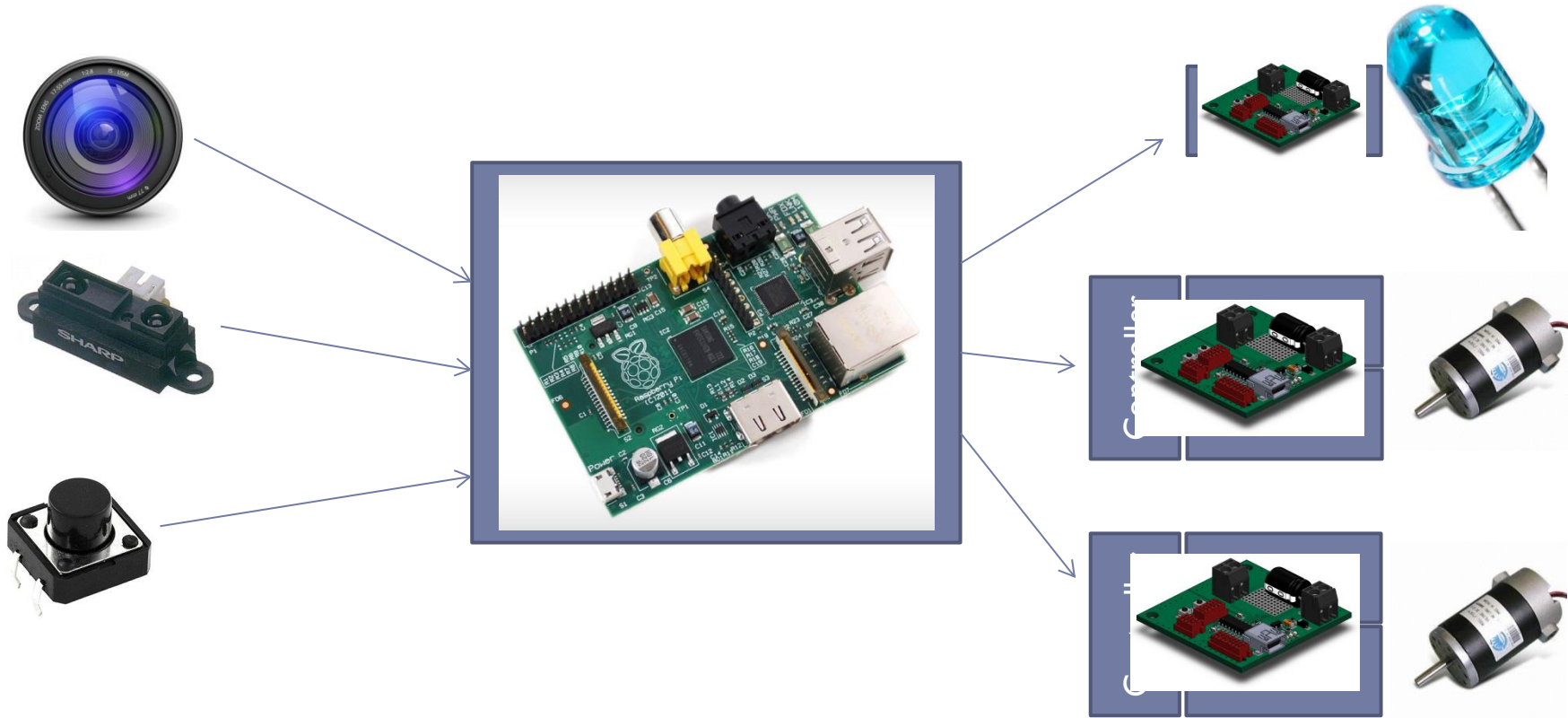


Driver









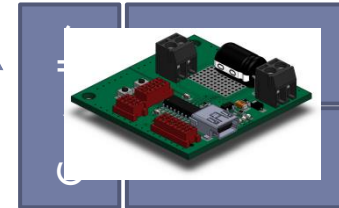
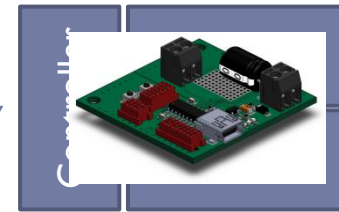
“Brain”



High-level actuators



“Spinal cord”



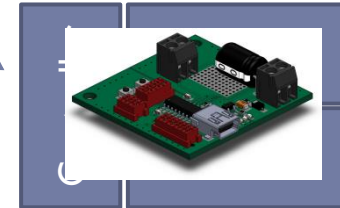
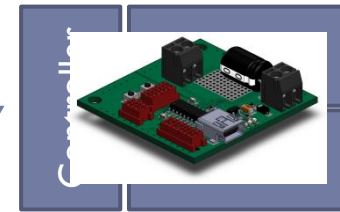
“Brain”



High-level actuators

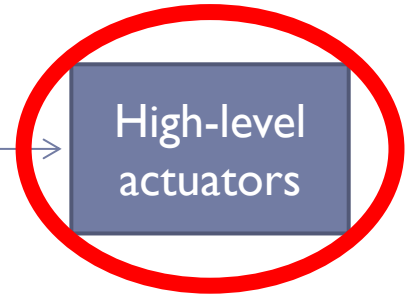


“Spinal cord”

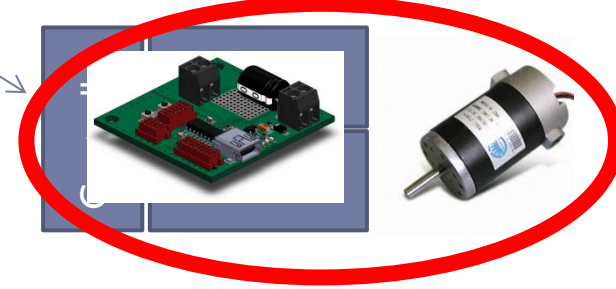
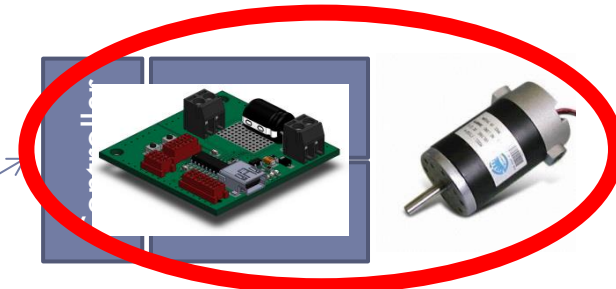
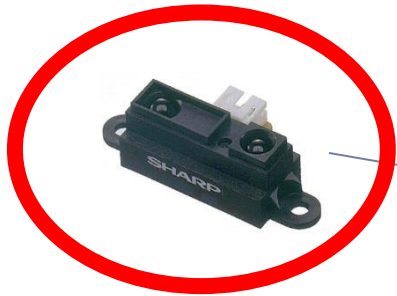


How many microcontrollers do you see on the picture?

“Brain”

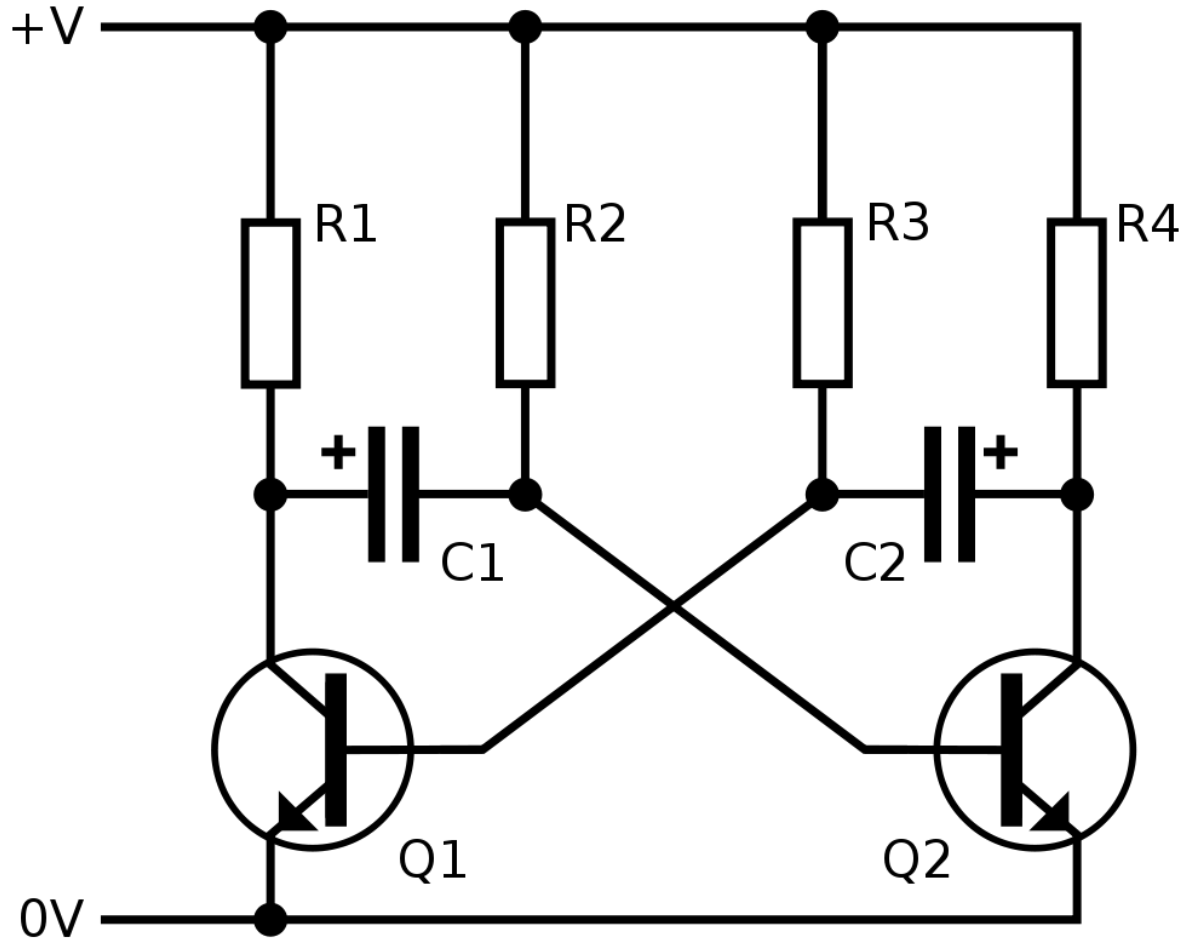


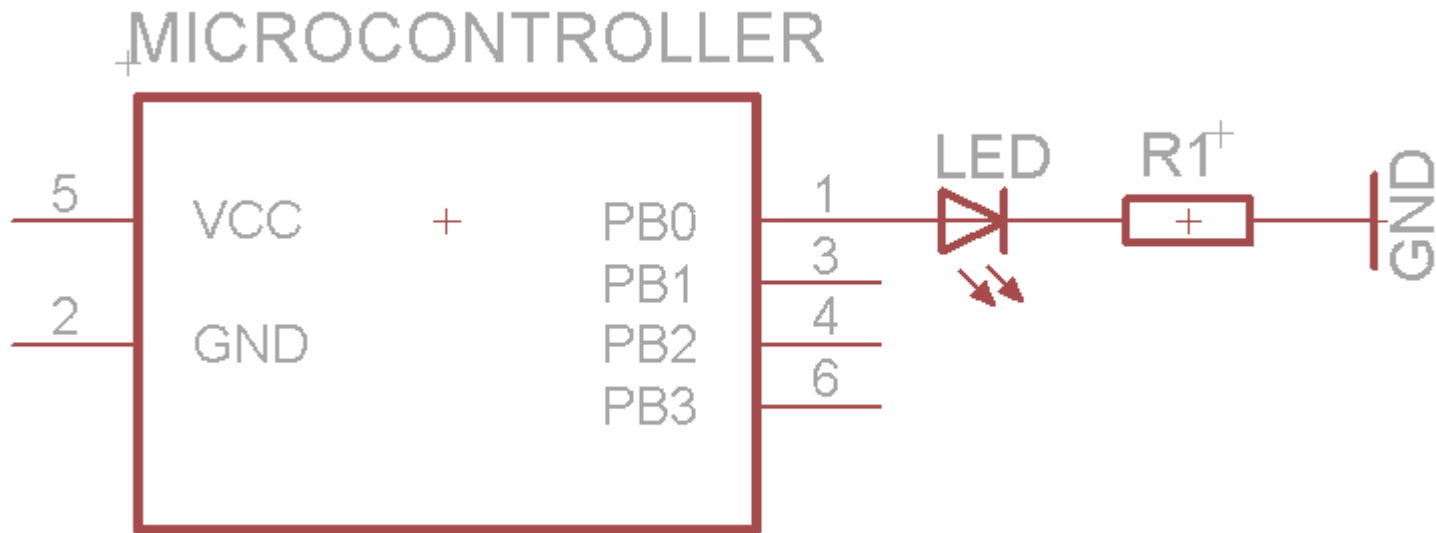
“Spinal cord”



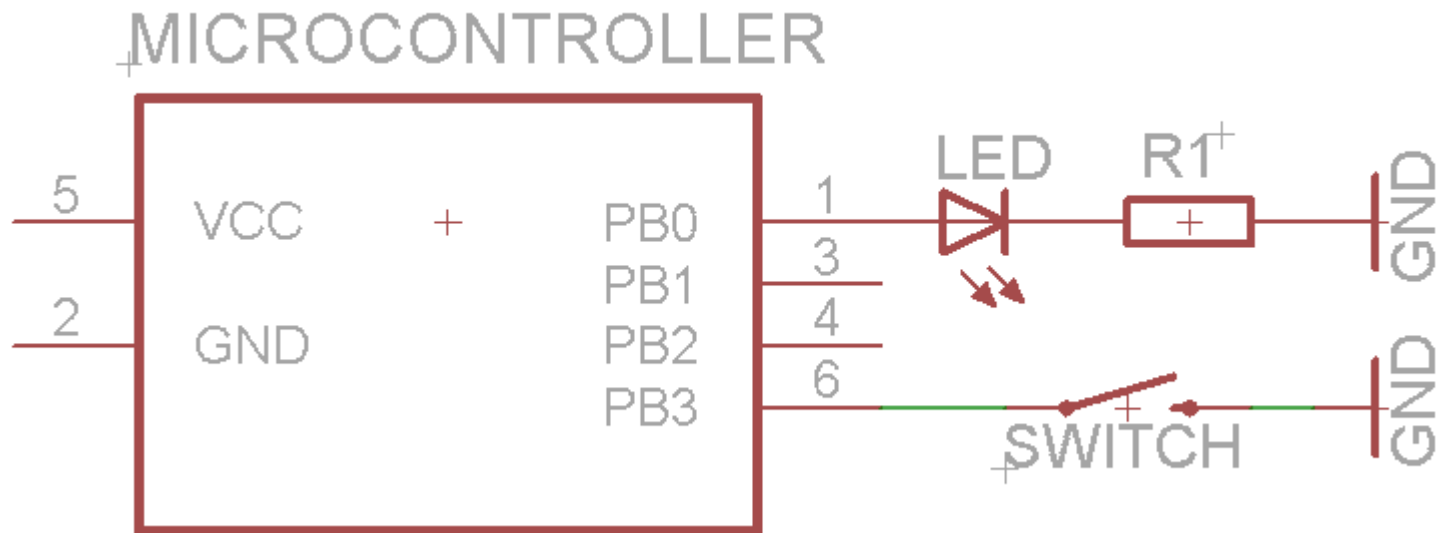
“Embedded systems”







```
while (true) {  
    toggle (PB0);  
    delay_ms (1000);  
}
```



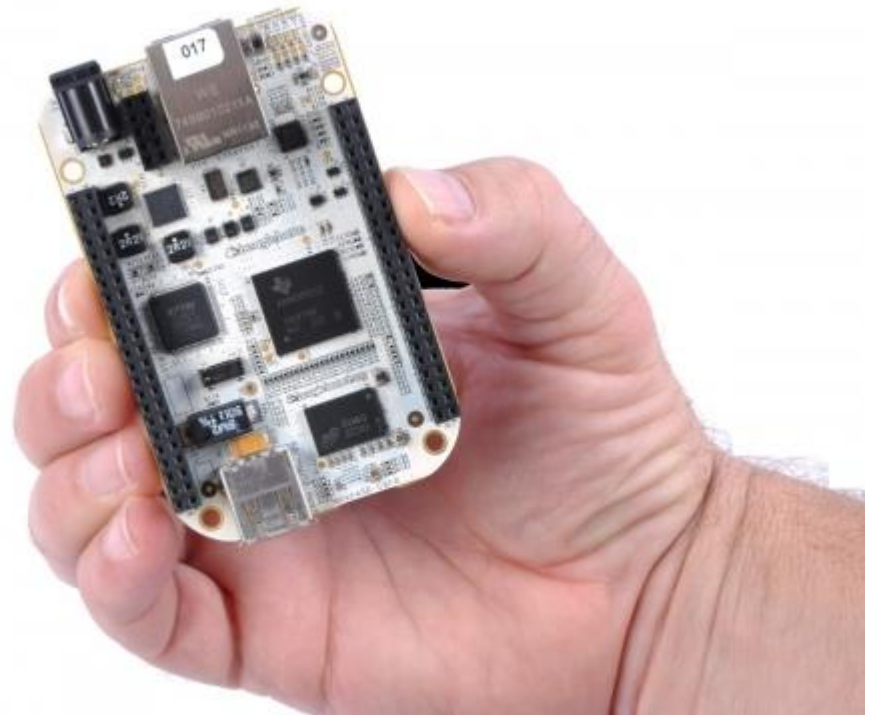
```

while (true) {
    toggle (PB0);
    delay_ms (PB3 ? 1000 : 500);
}

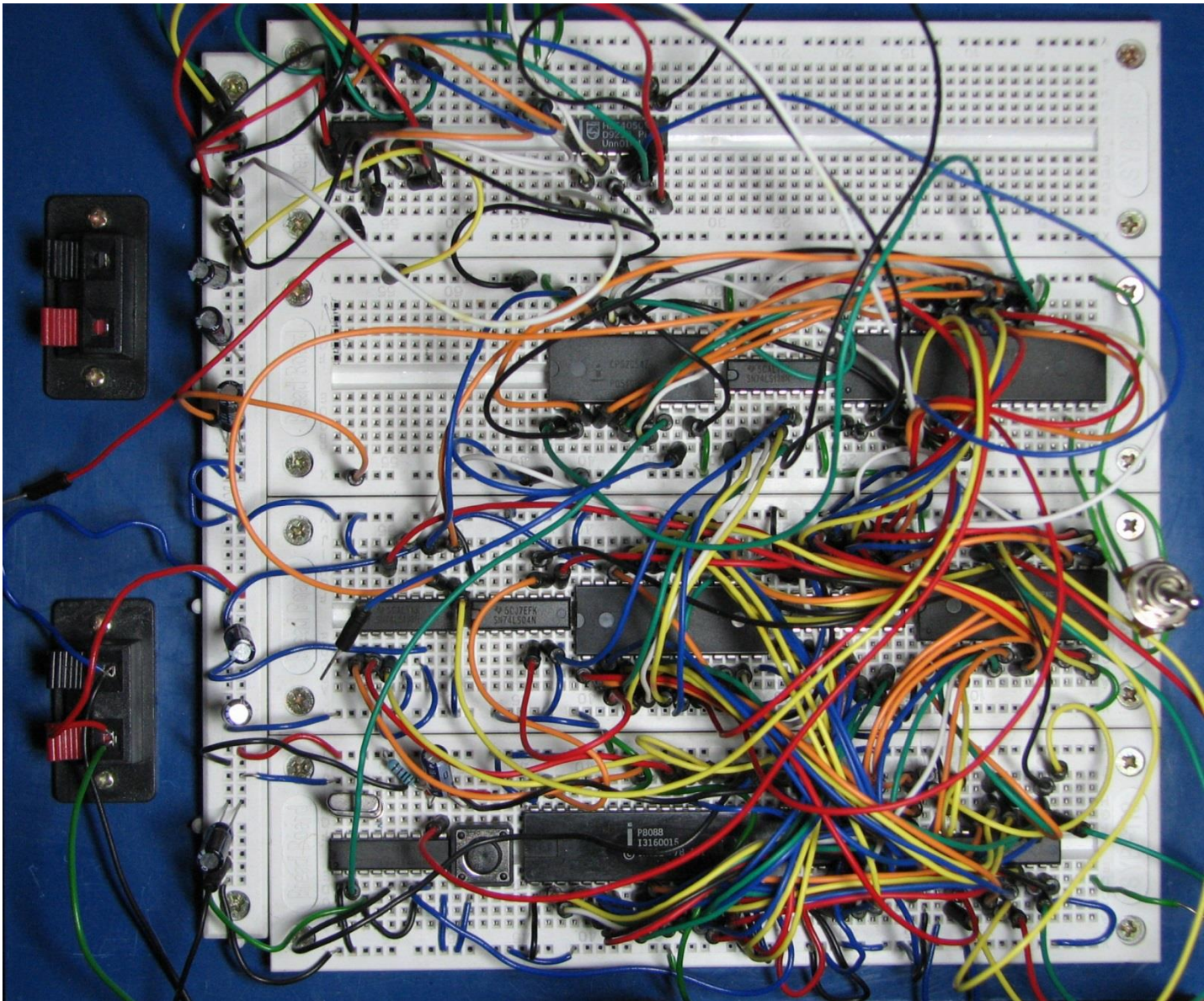
```

Prototyping boards

- ▶ MSP430 LaunchPad
- ▶ STM32F Discovery
- ▶ Grasshopper AVR
- ▶ Teensy
- ▶ FEZ Panda/Hydra/...
- ▶ Mbed
- ▶ BeagleBone/CubieBoard
- ▶ Arduino/Pinguino/Netduino/Freduino/...
- ▶ ...









Romo— The Smartphone Robot

by Romotive

Romo is a highly functional robotic toy that uses your smartphone as its brain.

📍 Seattle, WA

SUCCESSFUL!

358% **\$114,796** **FUNDED**
FUNDED PLEDGED NOV 21, 2011



OpenROV - The Open Source Underwater Robot

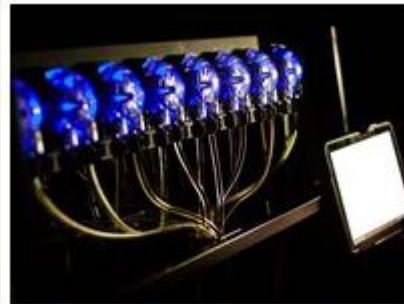
by OpenROV

OpenROV is an open-source underwater robot for exploration and education. We want to provide kits for the DIY community.

📍 San Francisco, CA

SUCCESSFUL!

558% **\$111,622** **FUNDED**
FUNDED PLEDGED AUG 01, 2012



Bartendro - A Cocktail Dispensing Robot

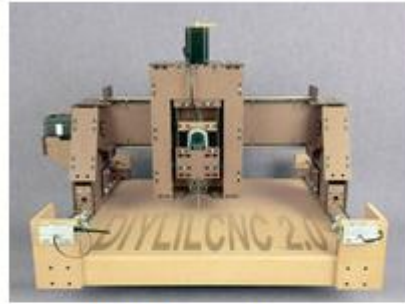
by Party Robotics

Bartendro is a modular and open-source cocktail dispensing robot!

📍 San Luis Obispo, CA

SUCCESSFUL!

146% **\$197,464** **FUNDED**
FUNDED PLEDGED MAR 31, 2013



DIYLILCNC 2.0 - Open-source plans for a low-cost CNC mill.

by DIYLILCNC

We're preparing to release version 2.0 of our free, open-source plans for a robotic cutting machine that you can build yourself.

📍 Chicago, IL

SUCCESSFUL!

106% **\$7,421** **FUNDED**
FUNDED PLEDGED AUG 23, 2011



Neko: a Color Field Oil Painter

by Laura Lippincott

Neko is a robotic arm built from hobby parts and a 3D printer. I'm priming him with color data, trying to make him creative.

📍 New York, NY

SUCCESSFUL!

111% **\$3,356** **FUNDED**



OCULUS ROBOT

OCULUS Surveillance and Telepresence Robot

by Colin Adamson

Oculus is a motorized frame and software kit that instantly converts a small laptop into a web controlled ROBOT

📍 Vancouver, Canada

SUCCESSFUL!

167% **\$25,161** **FUNDED**



HackRF, an open source SDR platform

by Michael Ossmann

Transmit or receive any radio signal from 30 MHz to 6000 MHz on USB power with HackRF.

📍 Evergreen, CO

SUCCESSFUL!

129% **\$103,322** **34**



The Practical Meter: Know your power!

by David Toledo

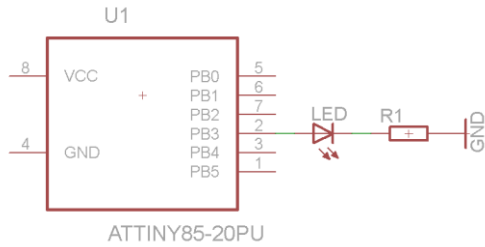
The Practical Meter helps you charge your phone faster by solving a problem millions of people experience.

📍 Salt Lake City, UT

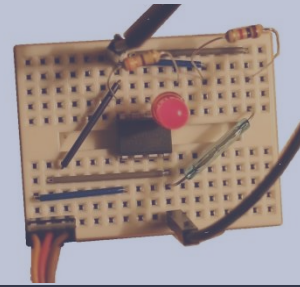
SUCCESSFUL!

1,070% **\$167,000** **FUNDED**

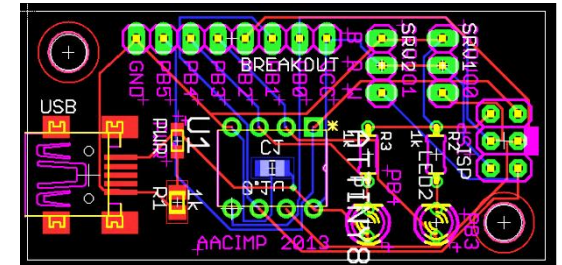
1. Circuit design



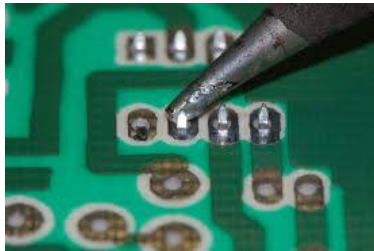
2. Prototyping



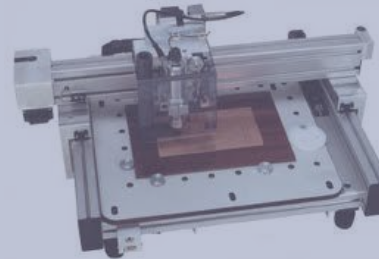
3. PCB Design



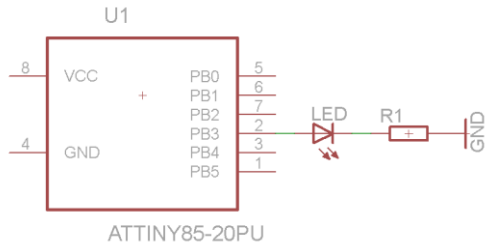
5. Soldering



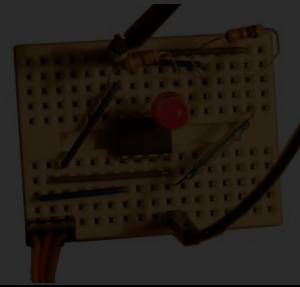
4. Manufacturing



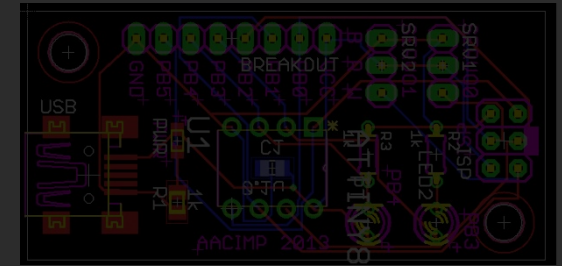
1. Circuit design



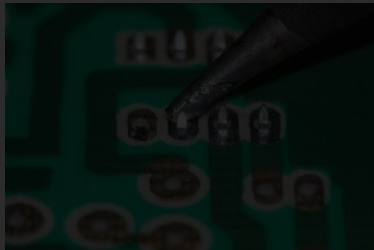
2. Prototyping



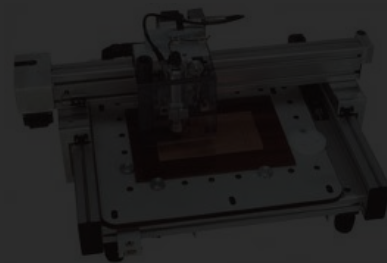
3. PCB Design

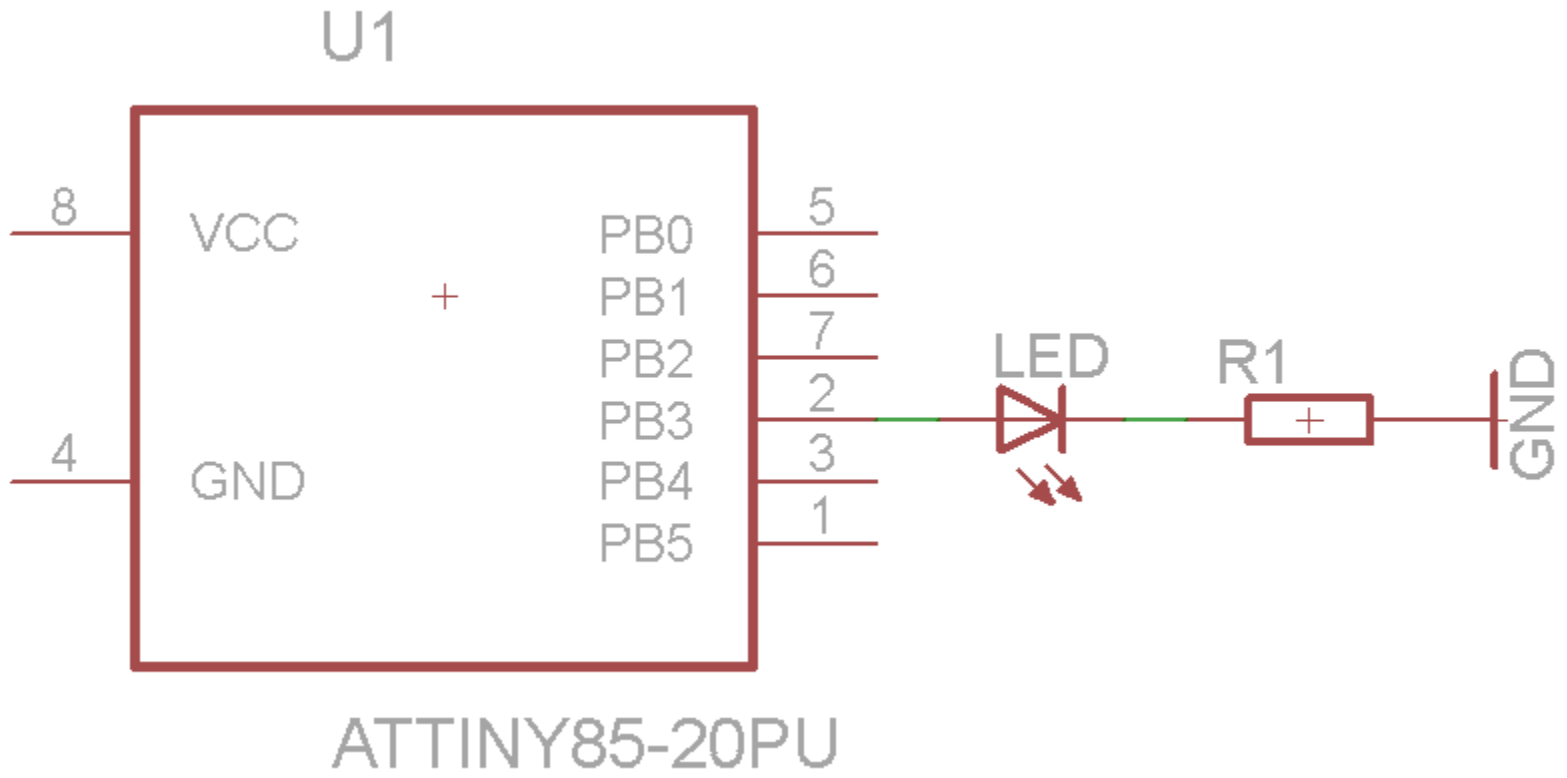


5. Soldering



4. Manufacturing





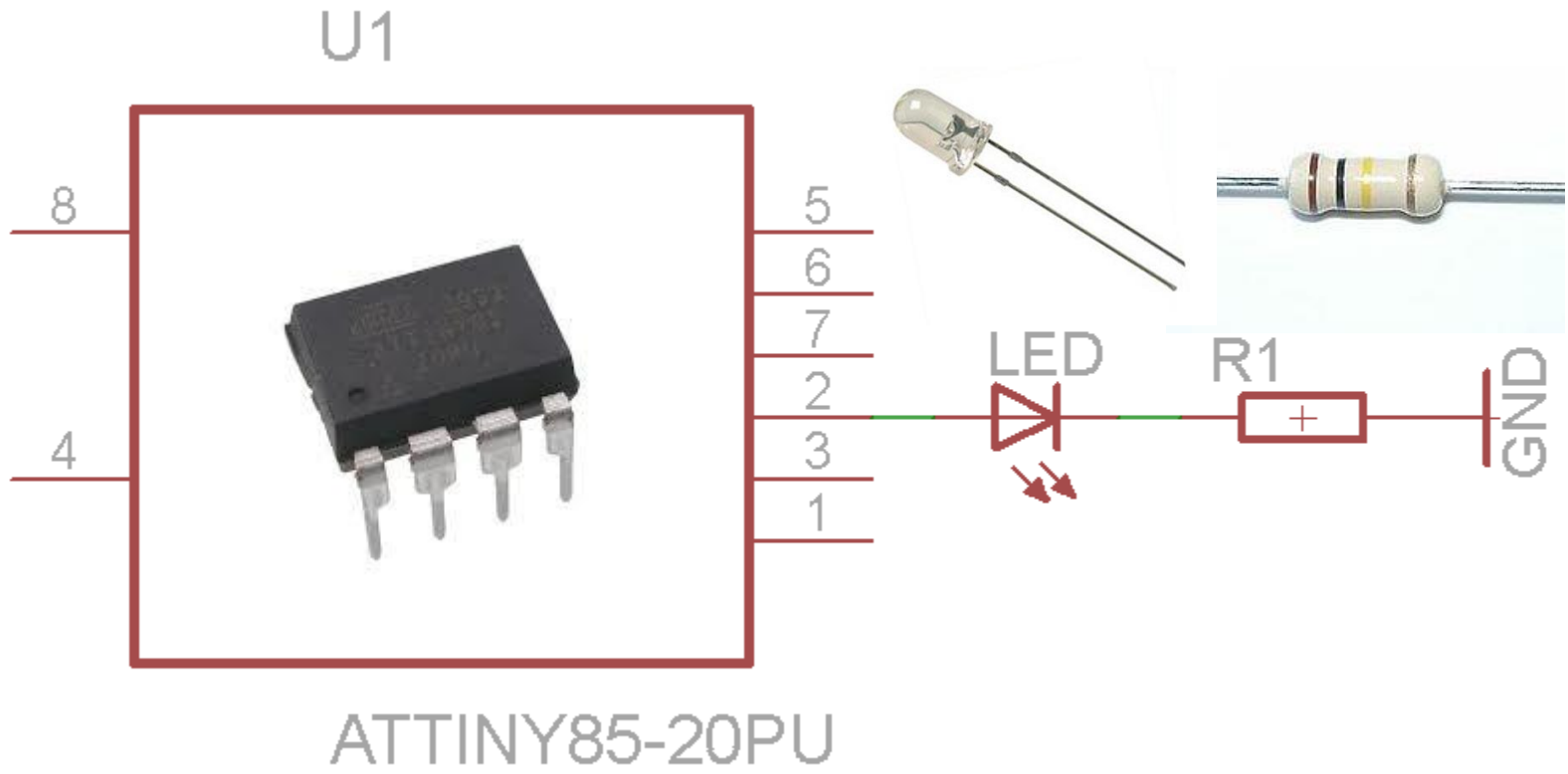


Atmel 8-bit AVR Microcontroller with 2/4/8K Bytes In-System Programmable Flash

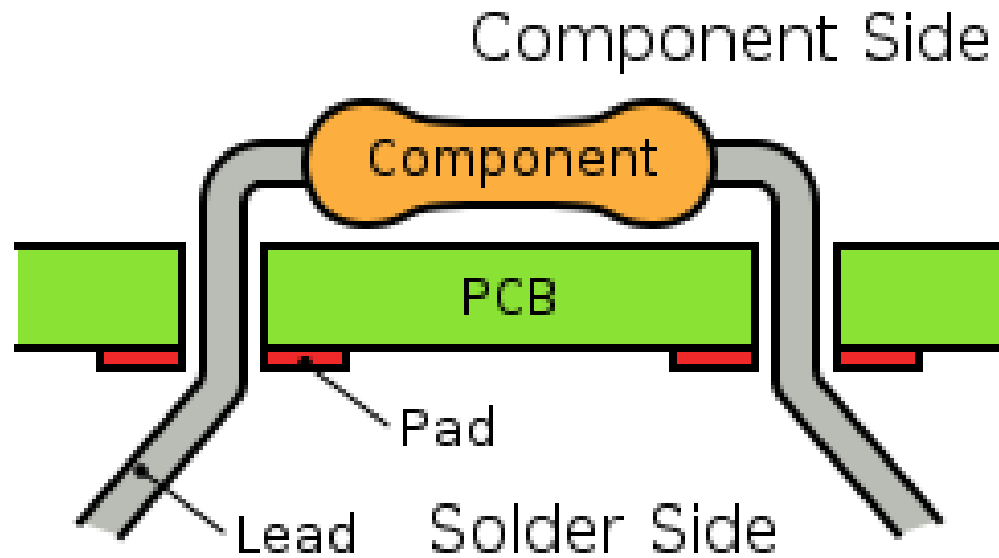
ATtiny25/V / ATtiny45/V / ATtiny85/V

Features

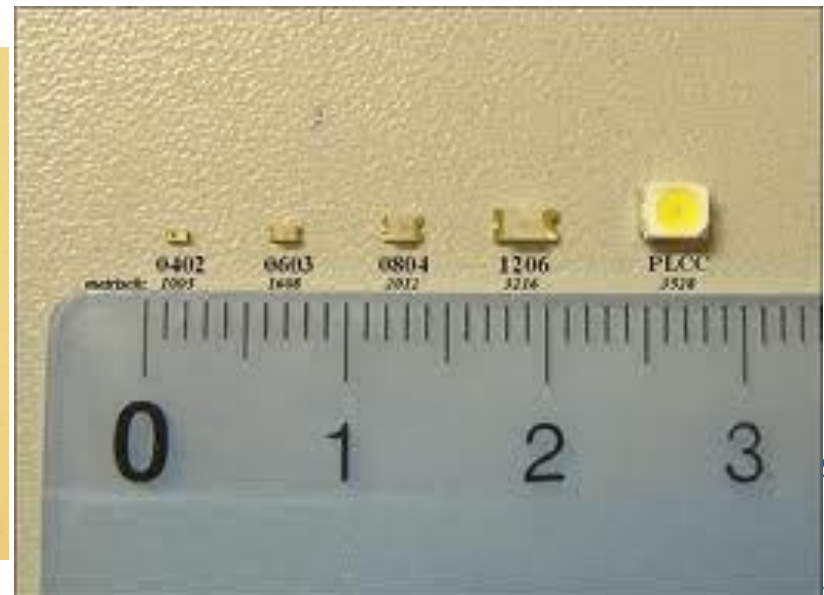
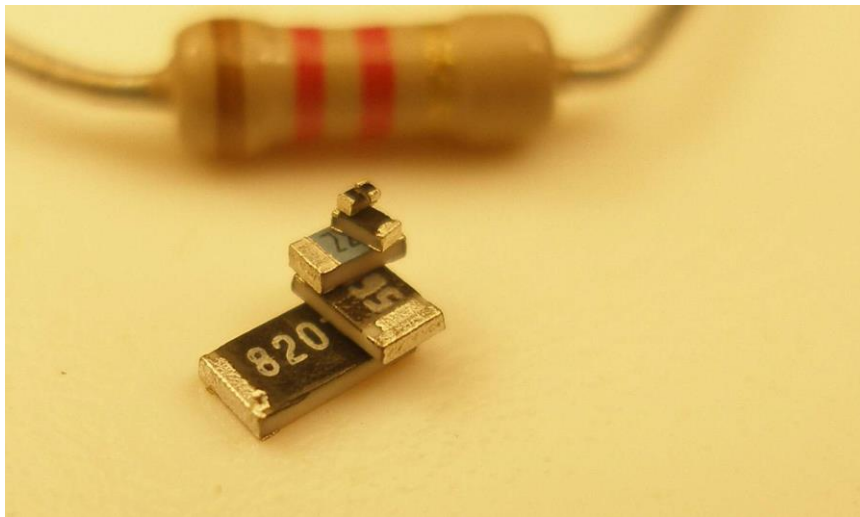
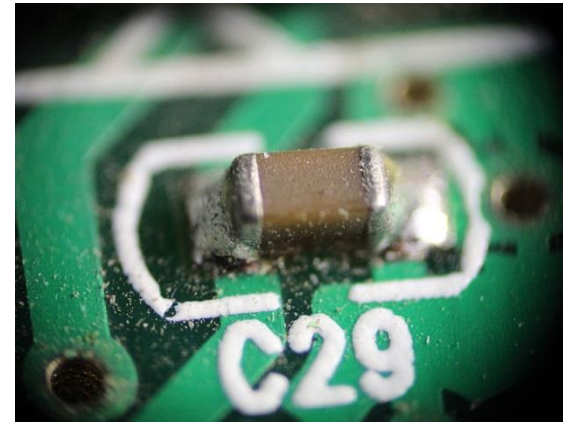
- High Performance, Low Power AVR[®] 8-Bit Microcontroller
- Advanced RISC Architecture
 - 120 Powerful Instructions – Most Single Clock Cycle Execution
 - 32 x 8 General Purpose Working Registers
 - Fully Static Operation
- Non-volatile Program and Data Memories
 - 2/4/8K Bytes of In-System Programmable Program Memory Flash
 - Endurance: 10,000 Write/Erase Cycles
 - 128/256/512 Bytes In-System Programmable EEPROM
 - Endurance: 100,000 Write/Erase Cycles
 - 128/256/512 Bytes Internal SRAM
 - Programming Lock for Self-Programming Flash Program and EEPROM Data Security
- Peripheral Features
 - 8-bit Timer/Counter with Prescaler and Two PWM Channels
 - 8-bit High Speed Timer/Counter with Separate Prescaler
 - 2 High Frequency PWM Outputs with Separate Output Compare Registers
 - Programmable Dead Time Generator

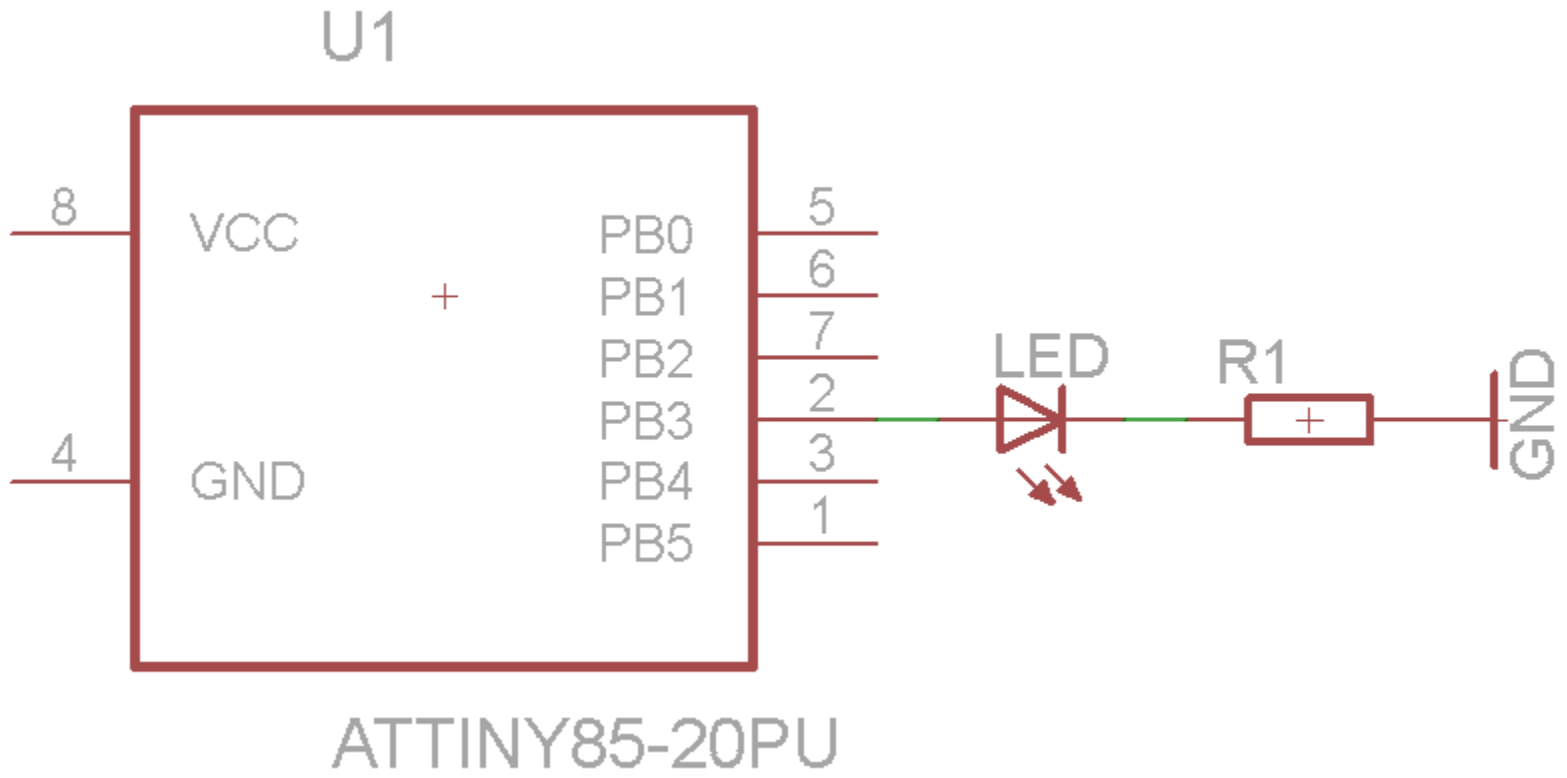


Through-hole technology

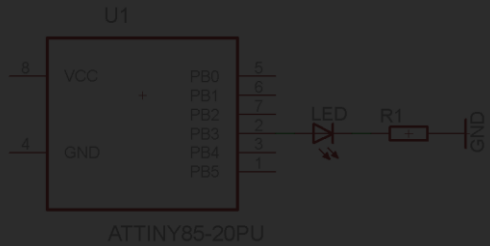


Surface mount technology

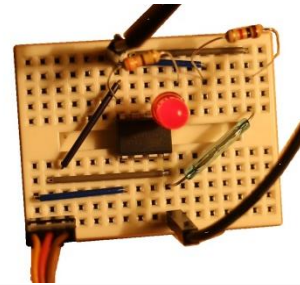




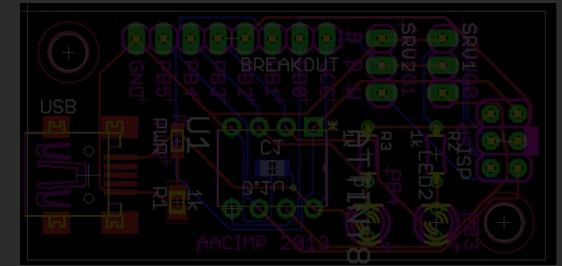
1. Circuit design



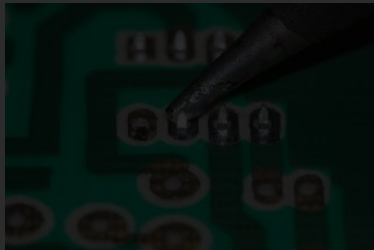
2. Prototyping



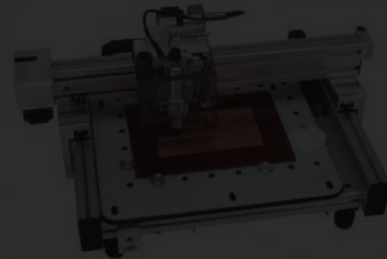
3. PCB Design



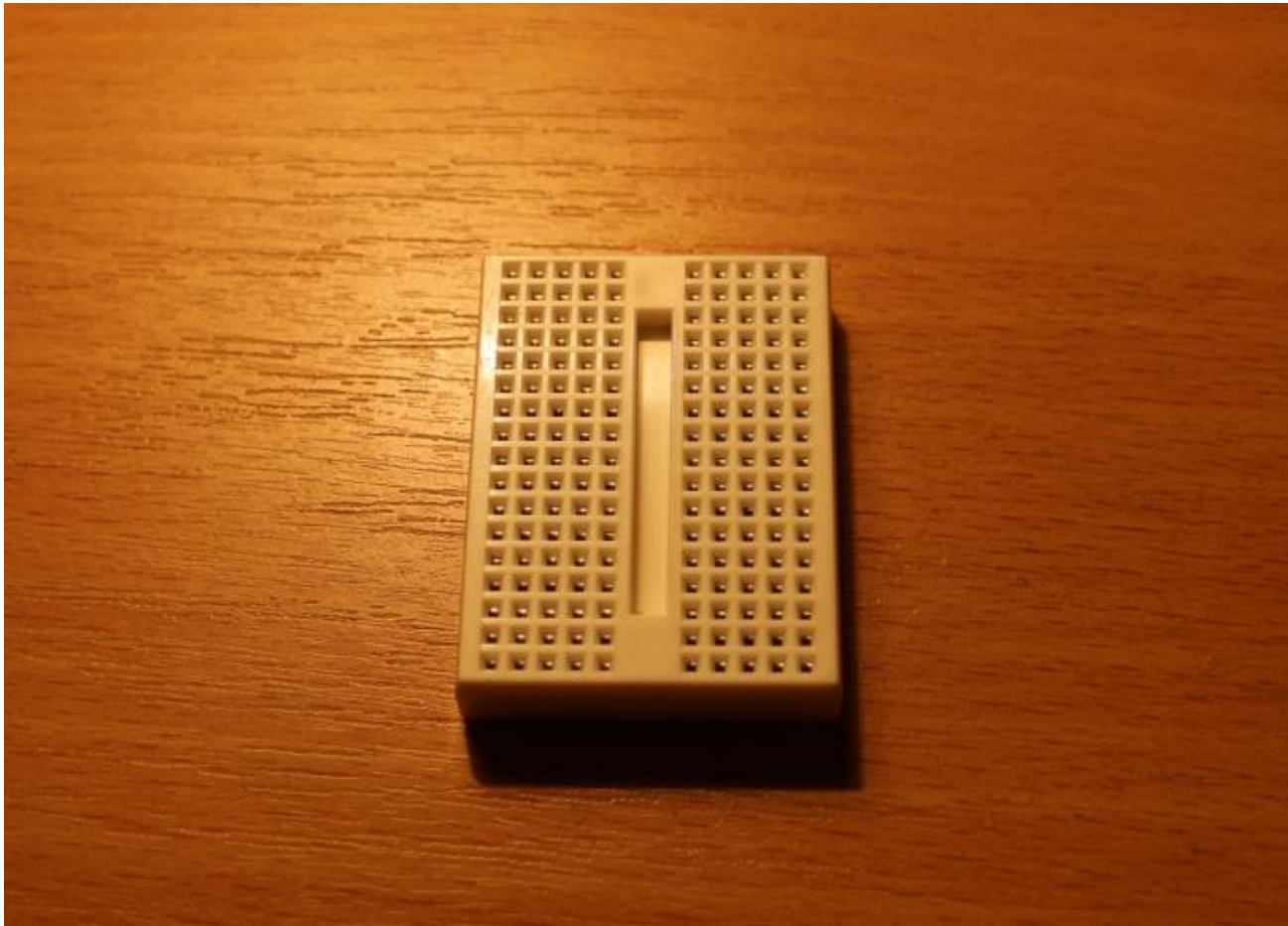
5. Soldering



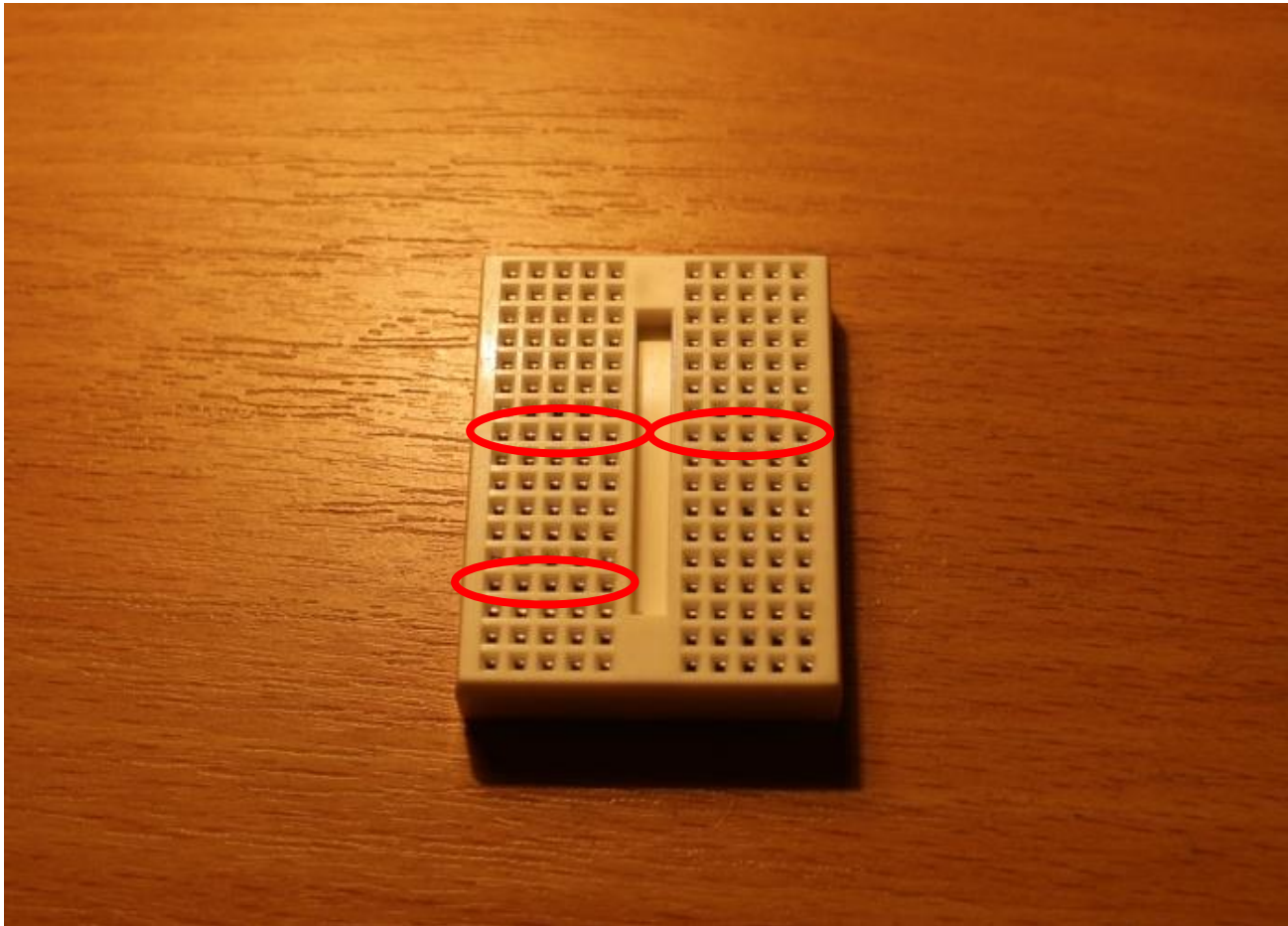
4. Manufacturing



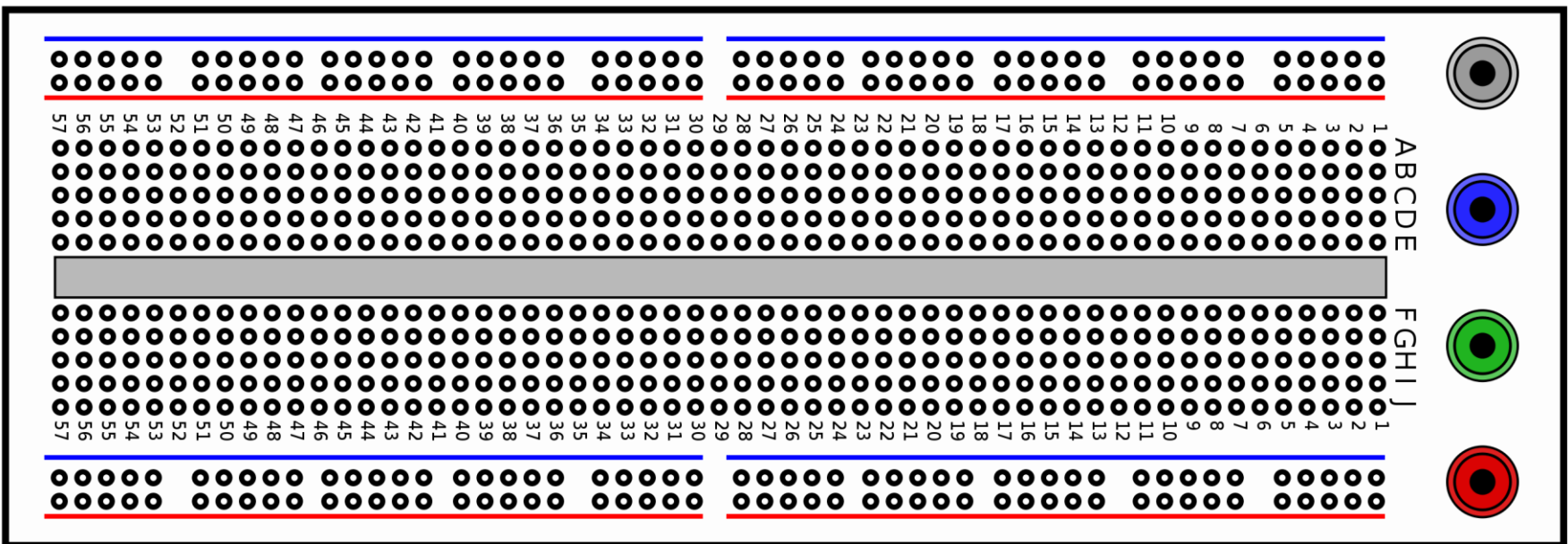
Breadboard



Breadboard



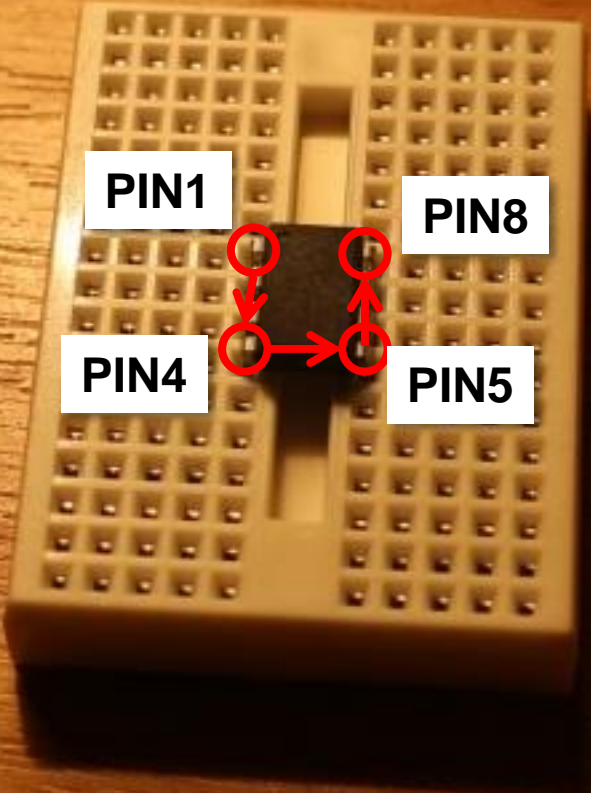
Breadboard





PIN1



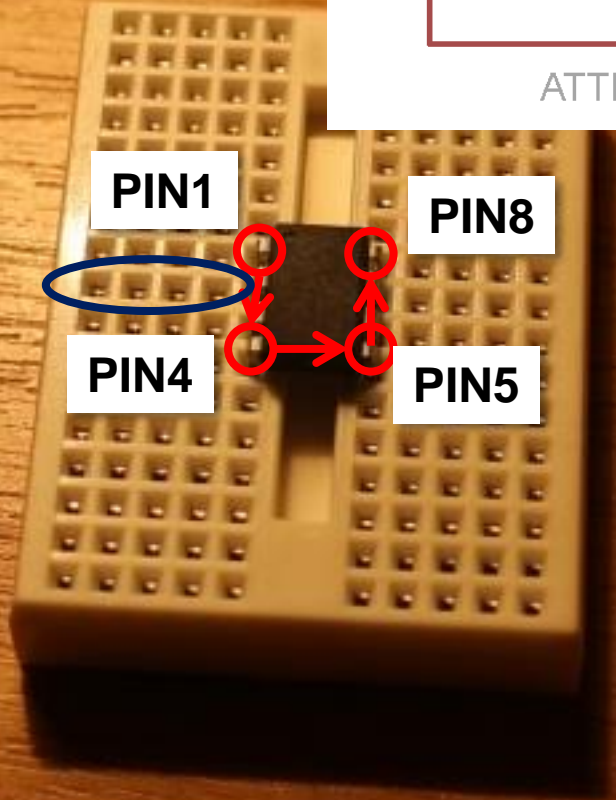
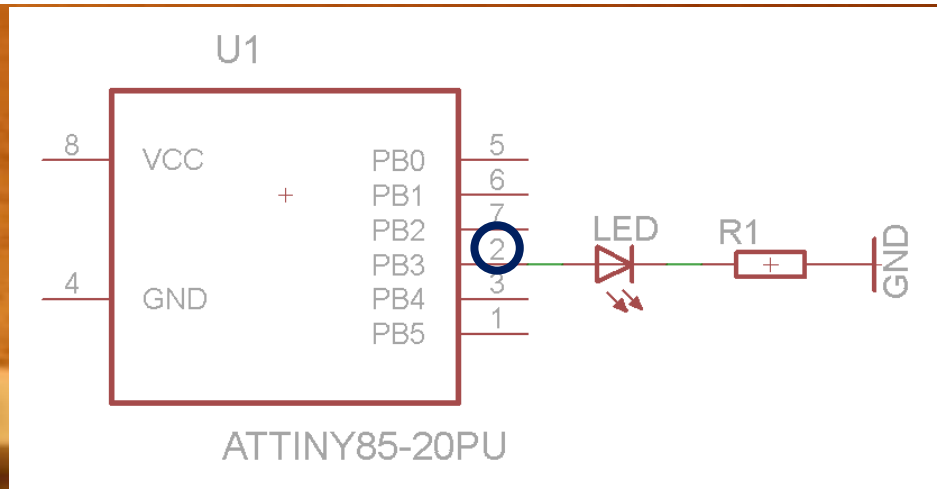


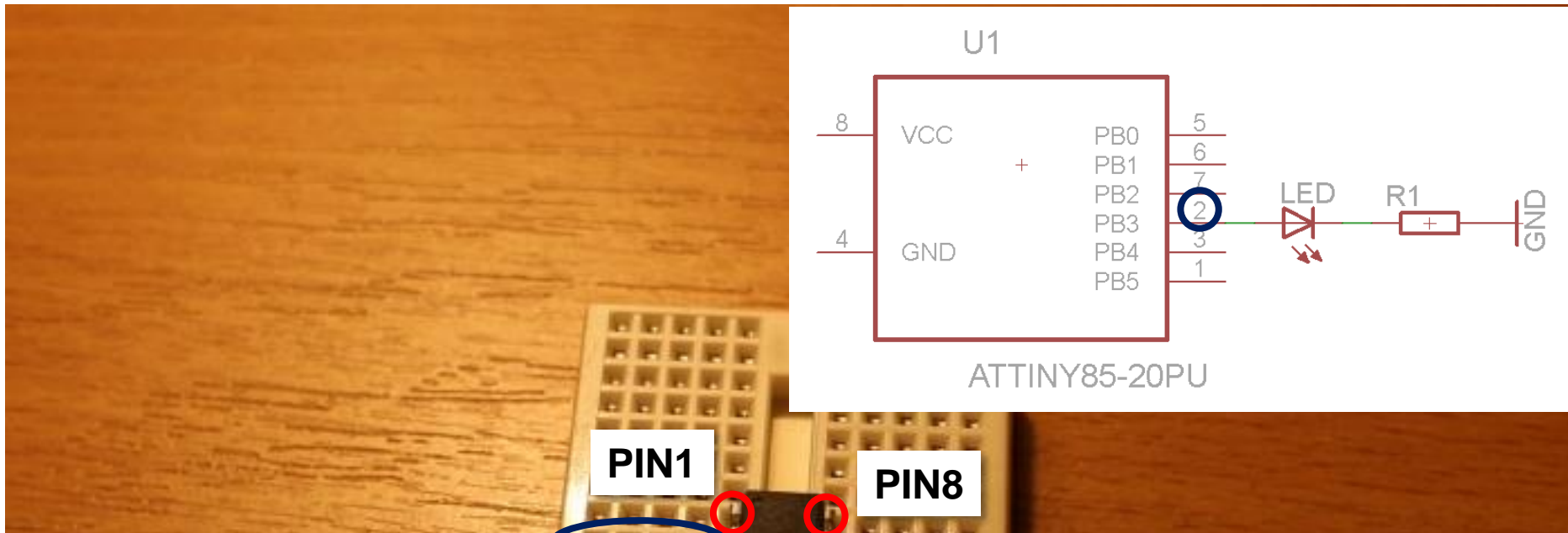
PIN1

PIN8

PIN4

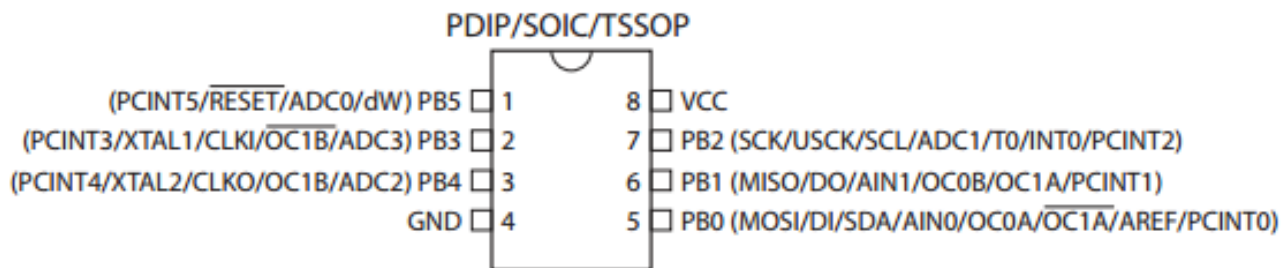
PIN5



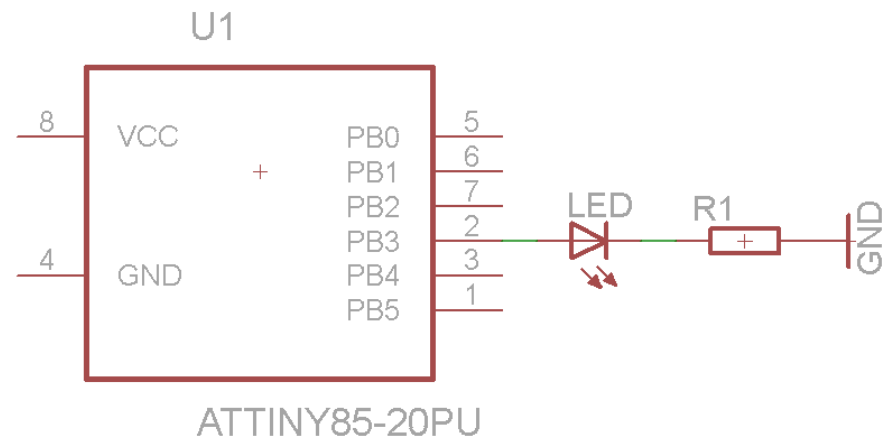
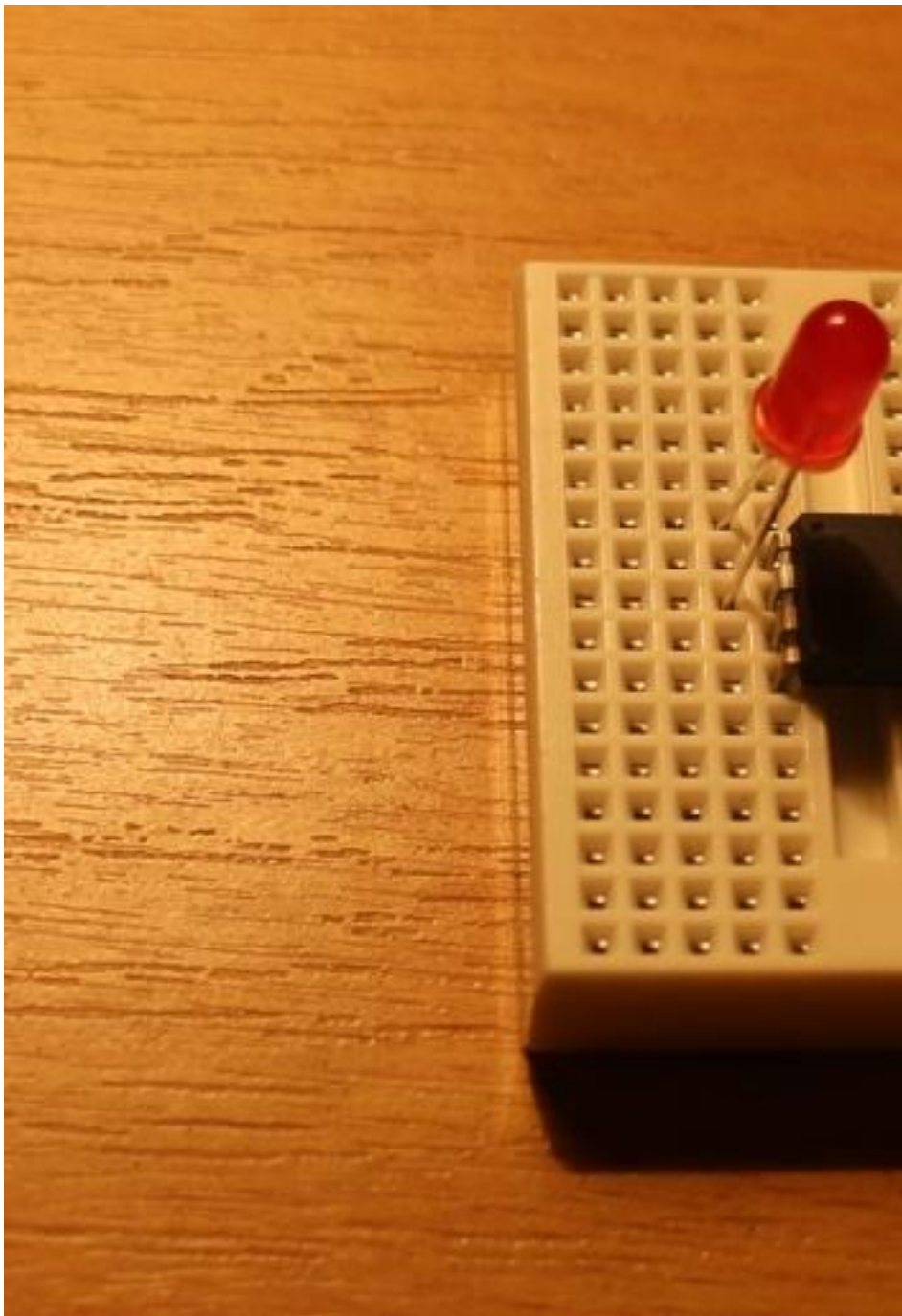


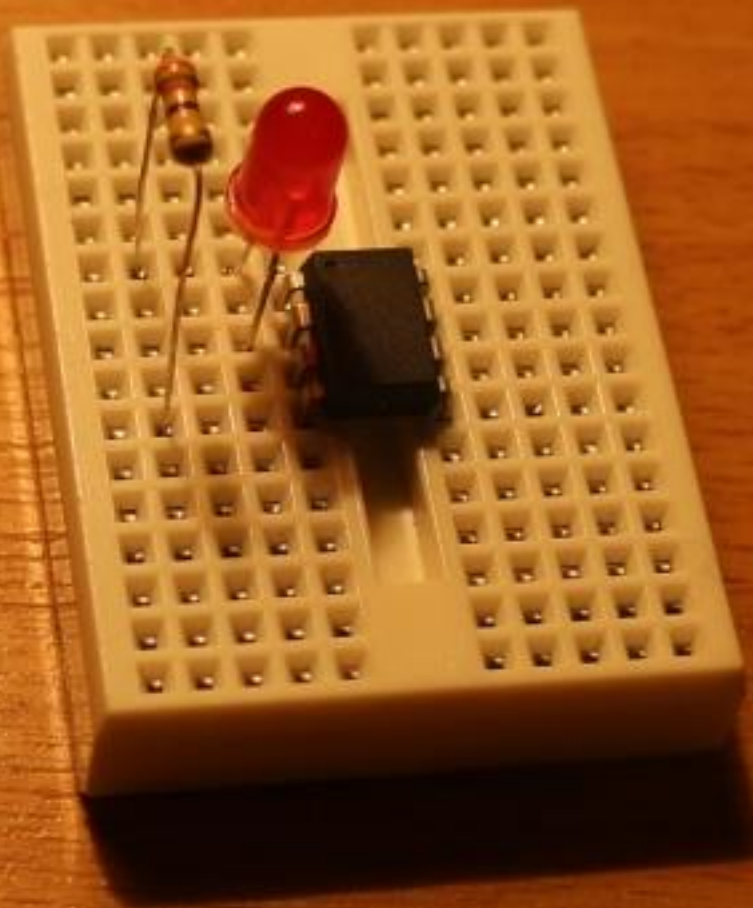
1. Pin Configurations

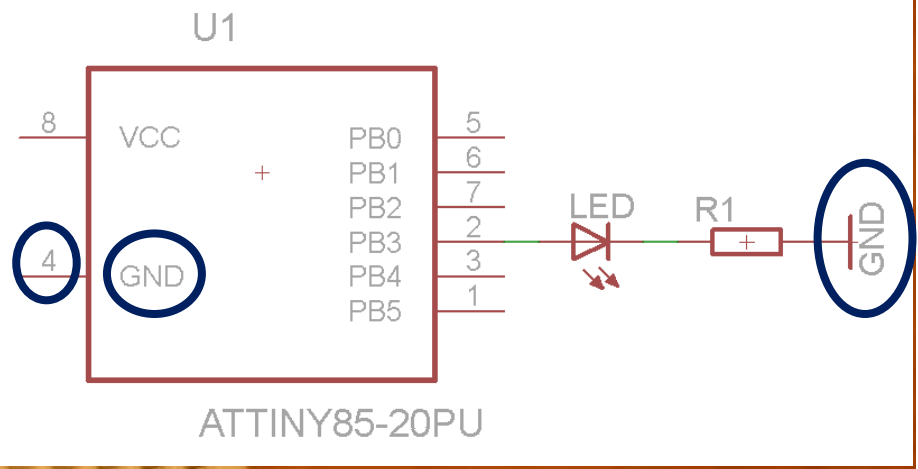
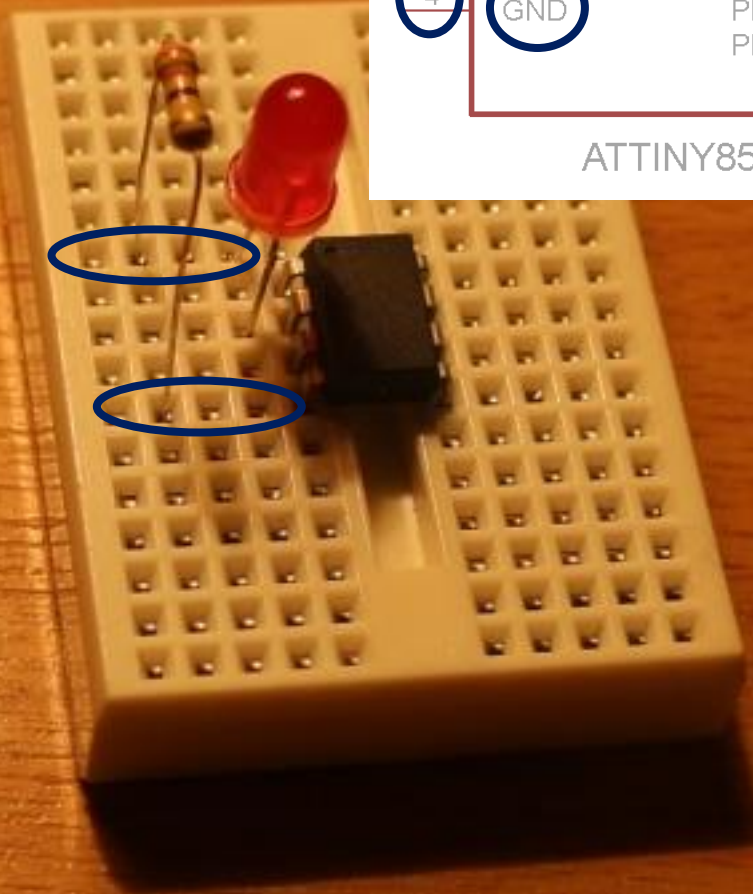
Figure 1-1. Pinout ATtiny25/45/85

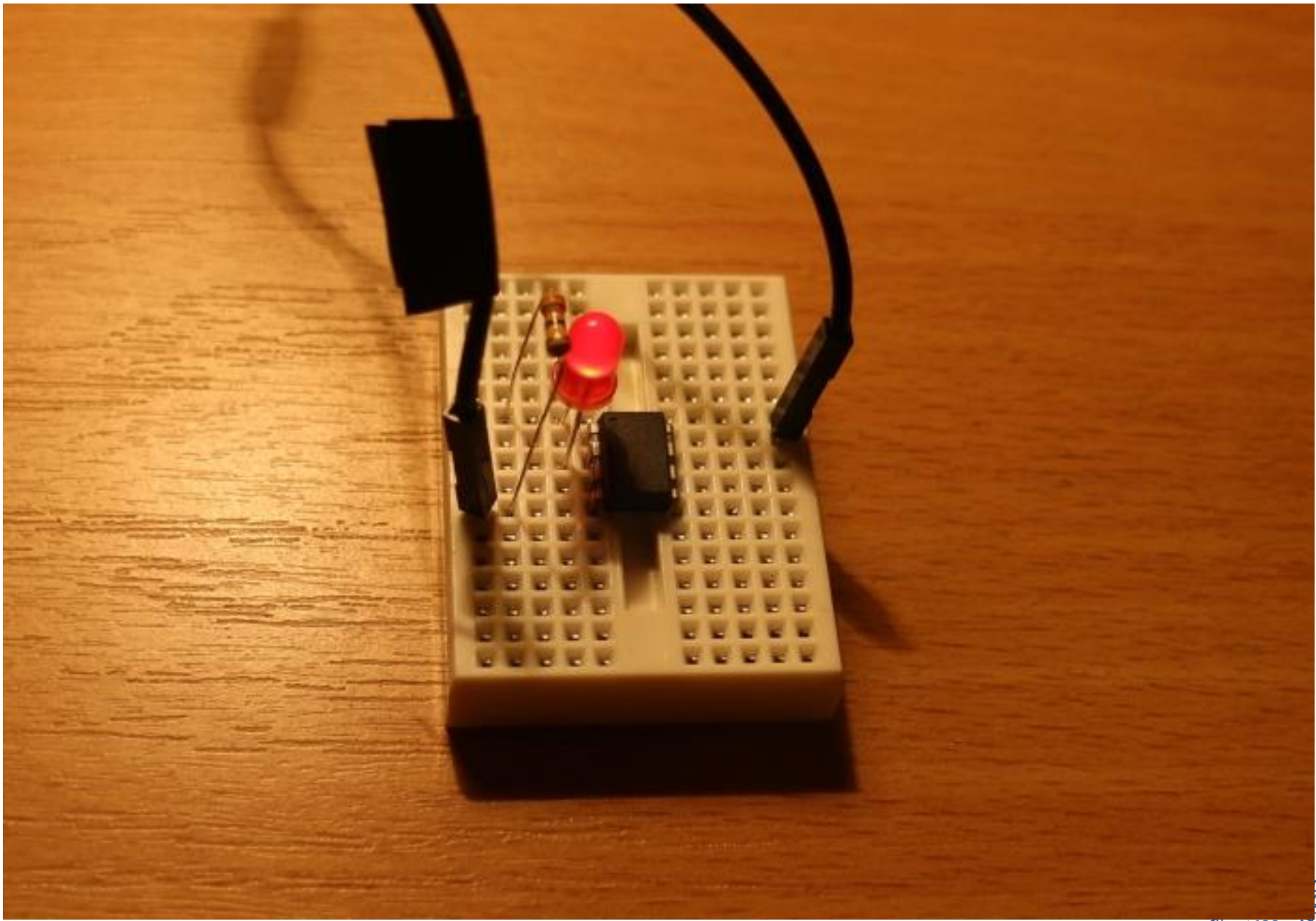


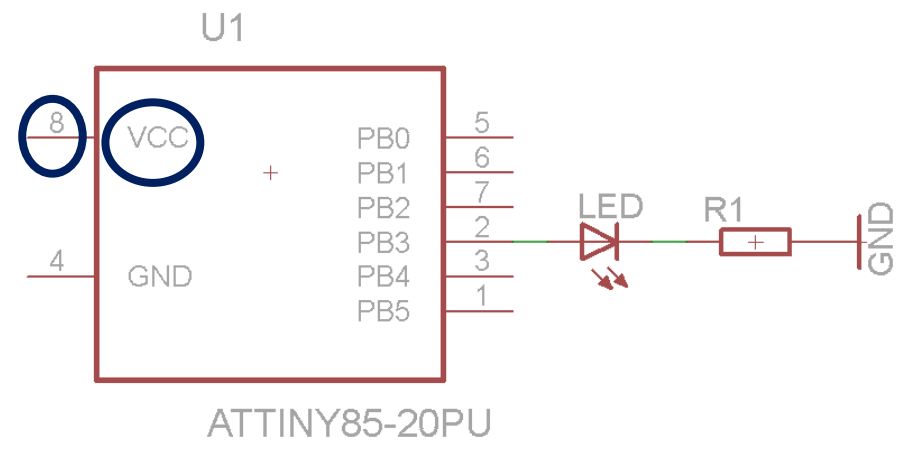
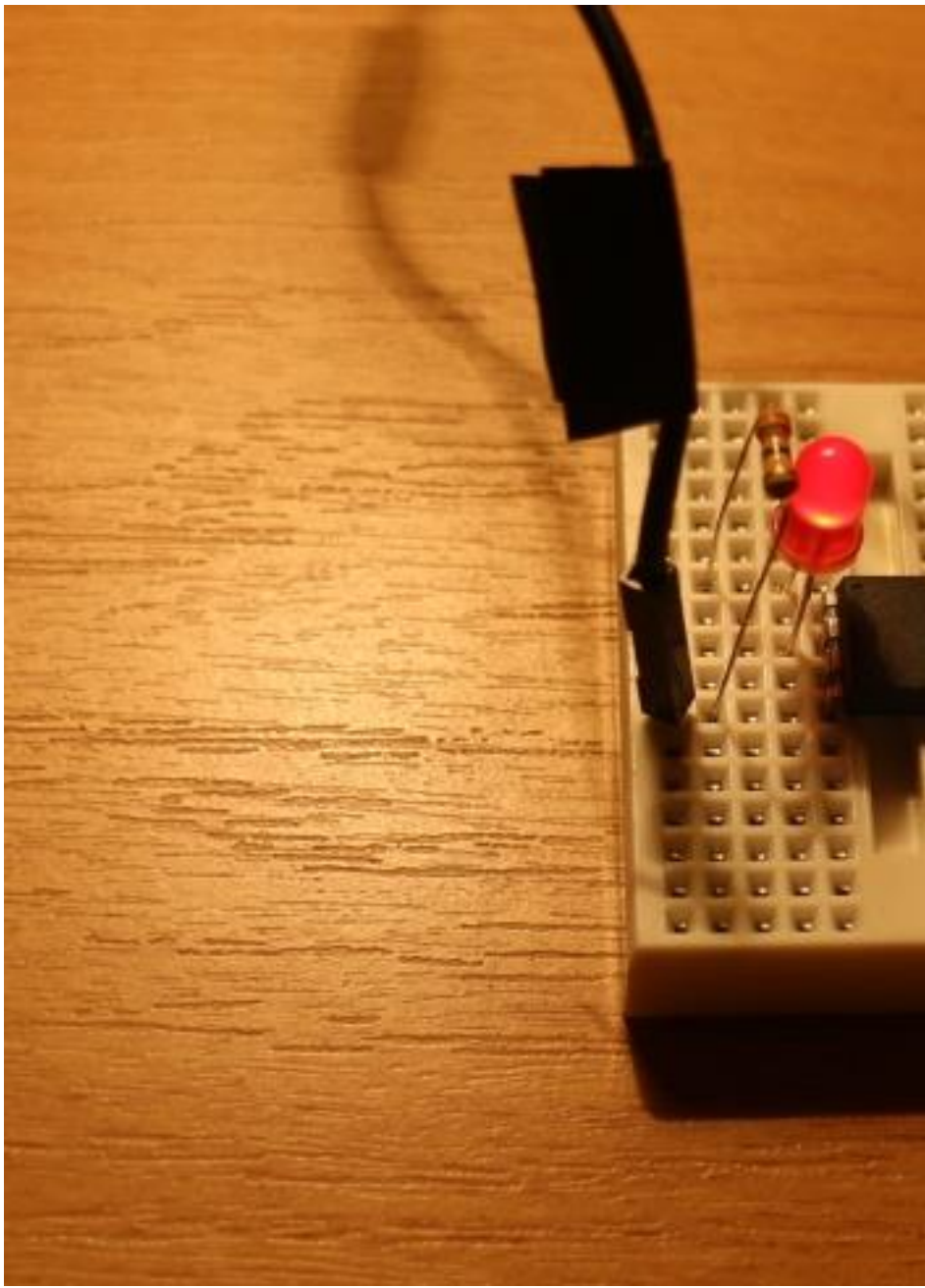
NOTE: TSSOP only for ATtiny45/V

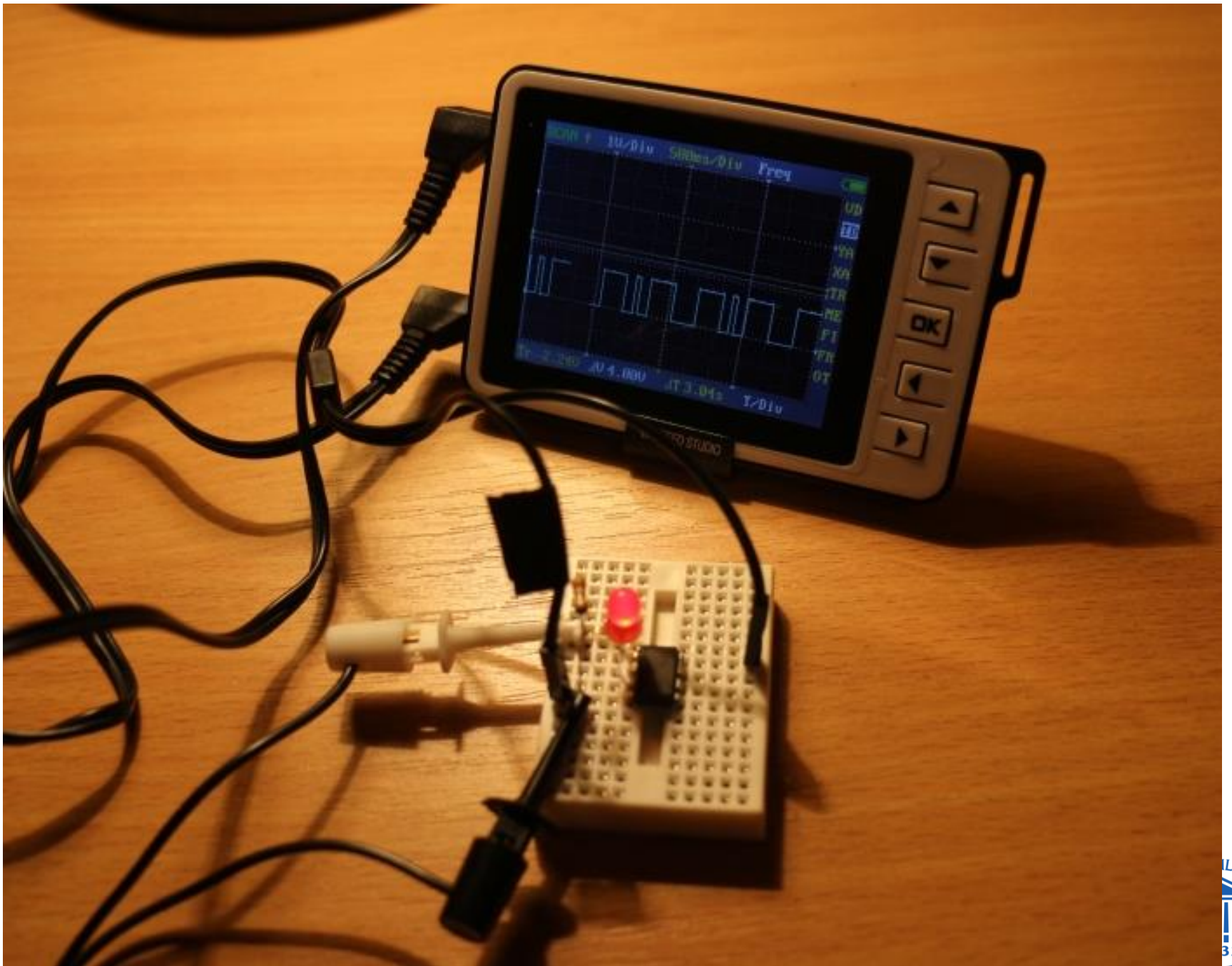


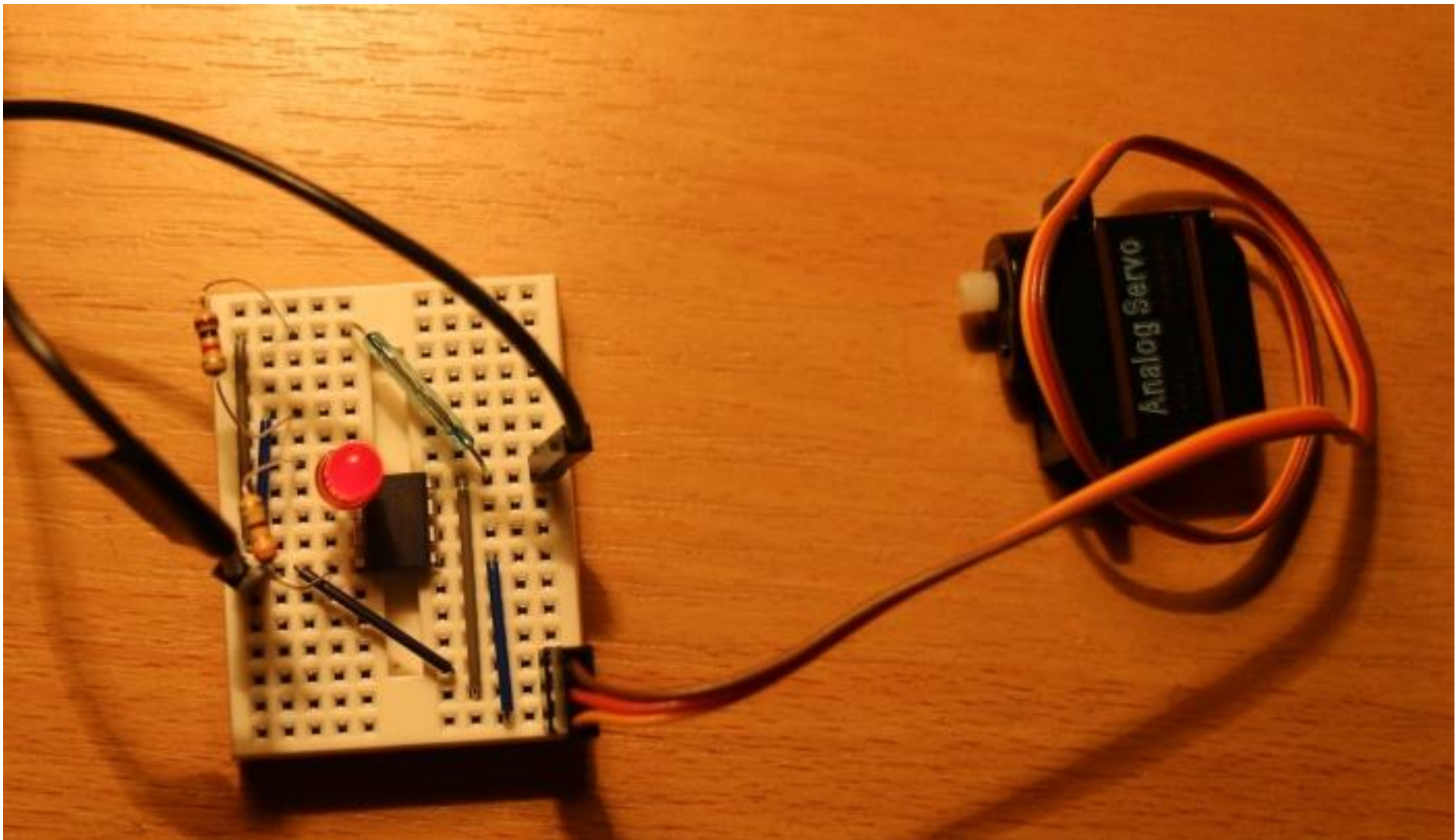


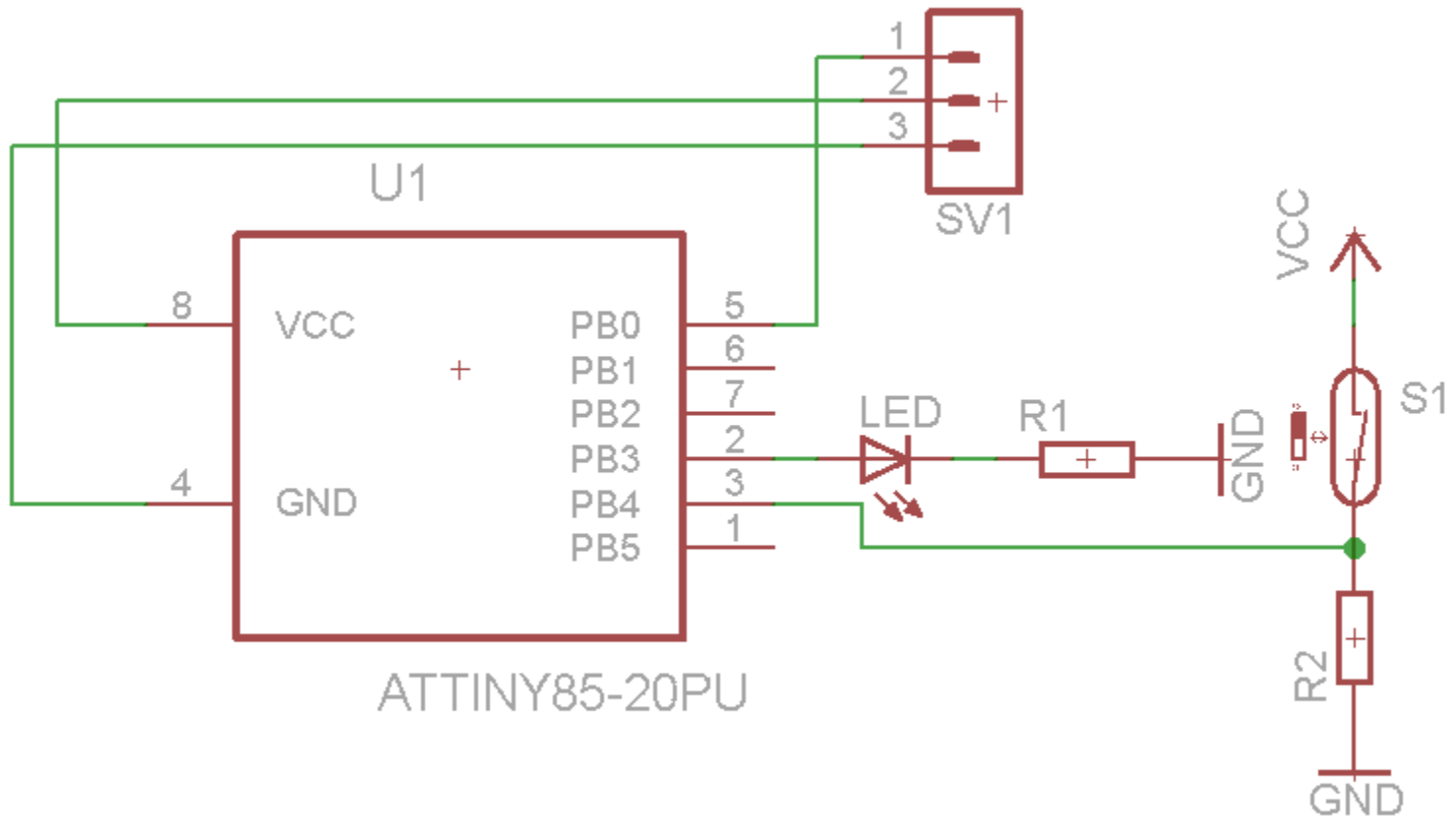


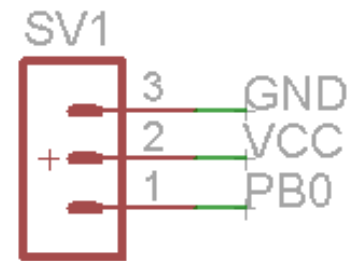
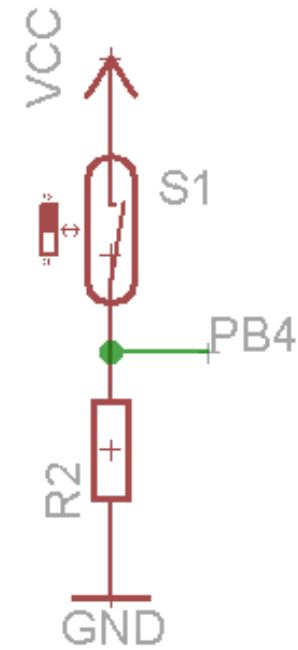
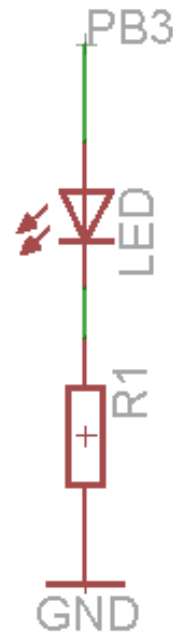
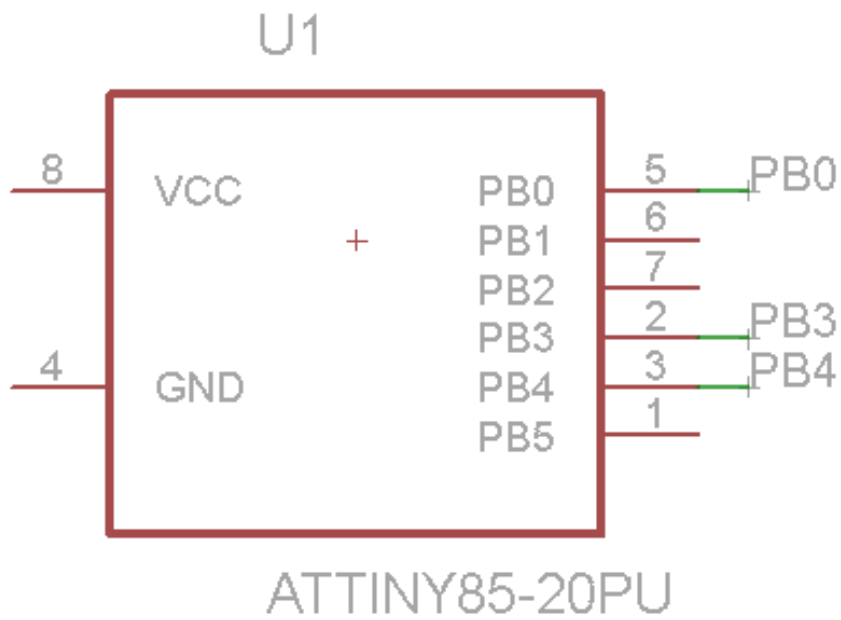




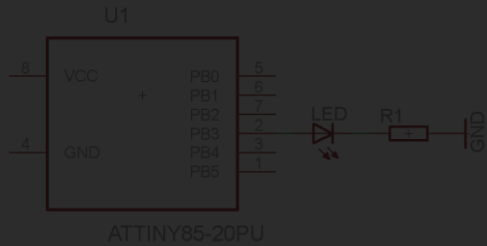




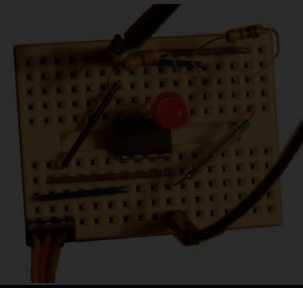




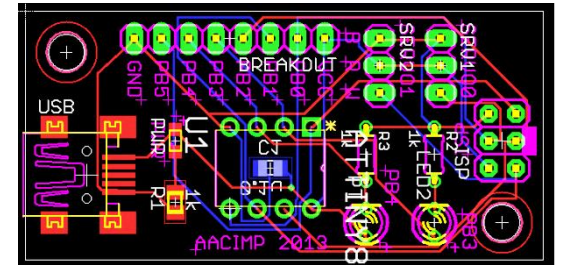
1. Circuit design



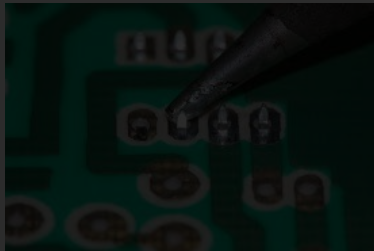
2. Prototyping



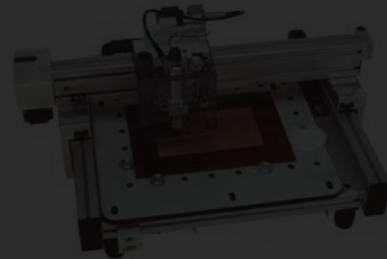
3. PCB Design



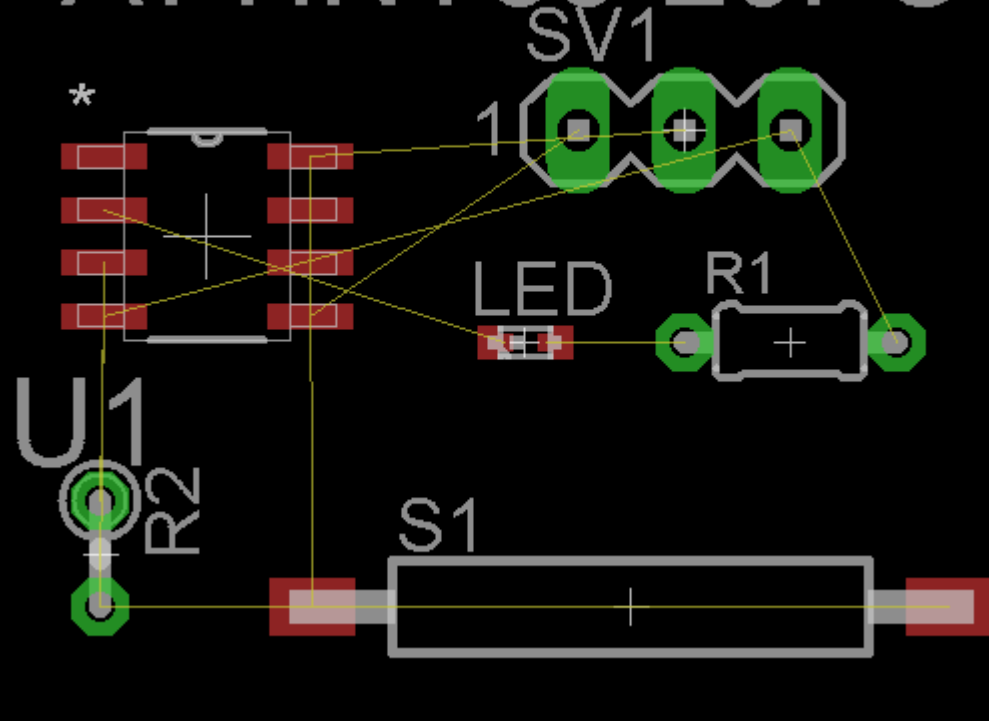
5. Soldering



4. Manufacturing



ATTINY85-20PU

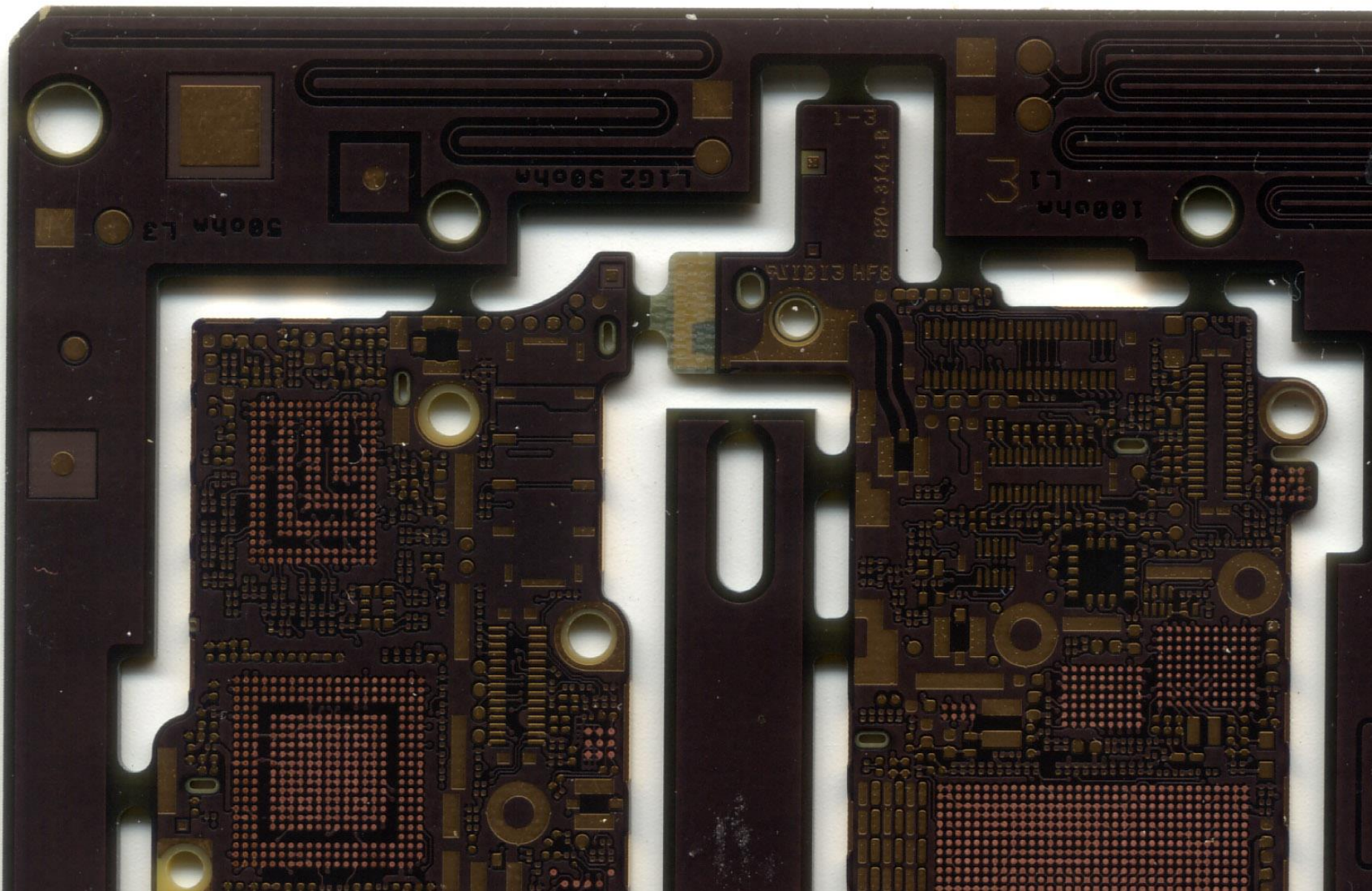




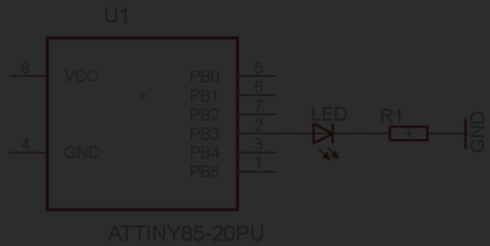
IA-21
processor

NPP E-Board v2.0
highfrequency

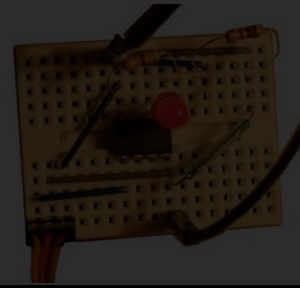
5243



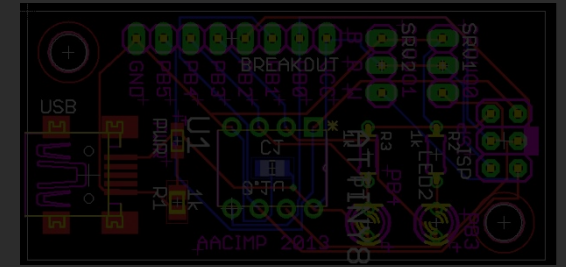
1. Circuit design



2. Prototyping



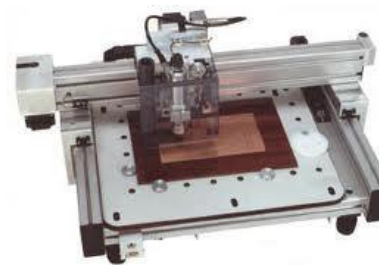
3. PCB Design



5. Soldering



4. Manufacturing



Chemical etching



CNC milling



The easy way



Product Options:
File No file chosen

Upload your design

Please don't forget to include the drill drawing

1



Qty:
Layer:
PCB Thickness:
PCB Dimension:
PCB Color:
Surface Finish:
E-Test:
* One time charges may apply

Fill in the PCB parameters

2

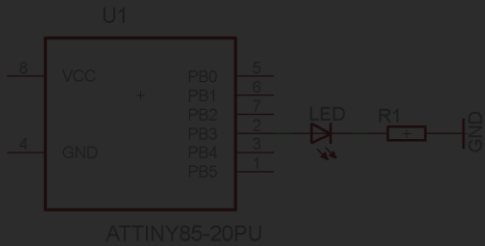


Price: Starting at 30.90 (Price Feedback)
SKU: PCB06511P
Weight: 80Gram
Units in Stock: 4015
Designed by: Others
Other products from Designer
Quantity: Max: 4015

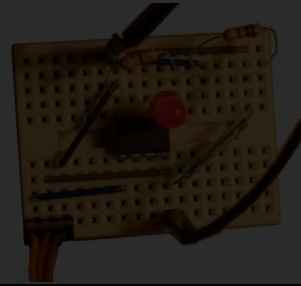
Add to the cart

3

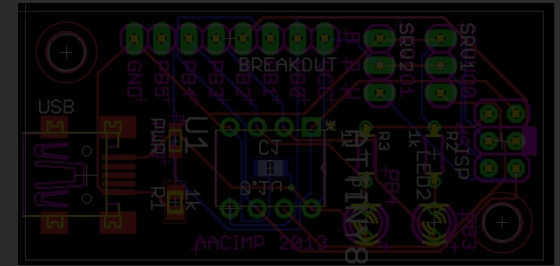
1. Circuit design



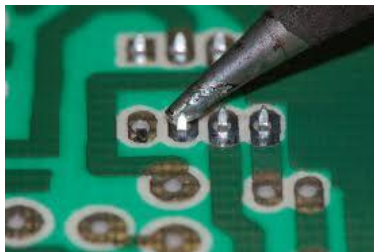
2. Prototyping



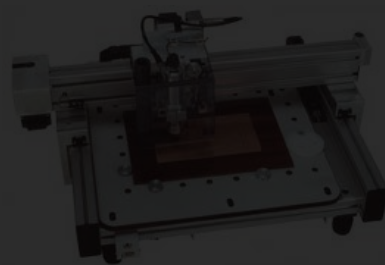
3. PCB Design



5. Soldering



4. Manufacturing



Soldering

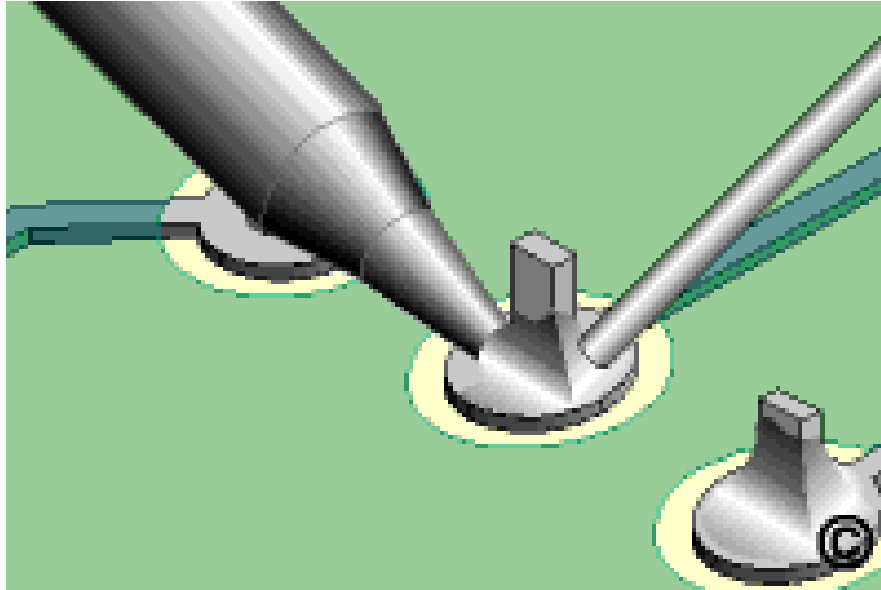
▶ General:

- ▶ Use an ESD mat,
- ▶ Use a ventilated room,
- ▶ Be careful with the tip of the soldering iron.

▶ Set up:

- ▶ Wet the sponge, clean the tip, tin the tip
- ▶ 350-360 C is good for lead-based solder
- ▶ 370-380 C is good for lead-free solder

Soldering



*slightly different approach for SMDs

<http://www.circuitrework.com>

▶ Soldering

- ▶ Solder smaller components first
- ▶ Solder corners first
- ▶ Use the flux
- ▶ **Check for bridges** after finishing

Soldering

- ▶ In the end
 - ▶ Clean the tip, **tin the tip**

 - ▶ If the flux is conductive:
 - ▶ Clean it away with alcohol
 - ▶ Check for bridges
 - ▶ Use a current limiter at first

