



**University of  
Nottingham**

UK | CHINA | MALAYSIA

# Printed Circuit Board Design Workshop

Introduction to PCB & Schematic Capture  
Naim Fuad , CID

Department of Electrical and Electronic  
Engineering

# Printed Circuit Board

Invented since 20<sup>th</sup> century

Also called as *Printed Wiring Board* (PWB)

## Function

- Provide electrical connectivity
- Component population
- Act as heat sink
- Provide mechanical support

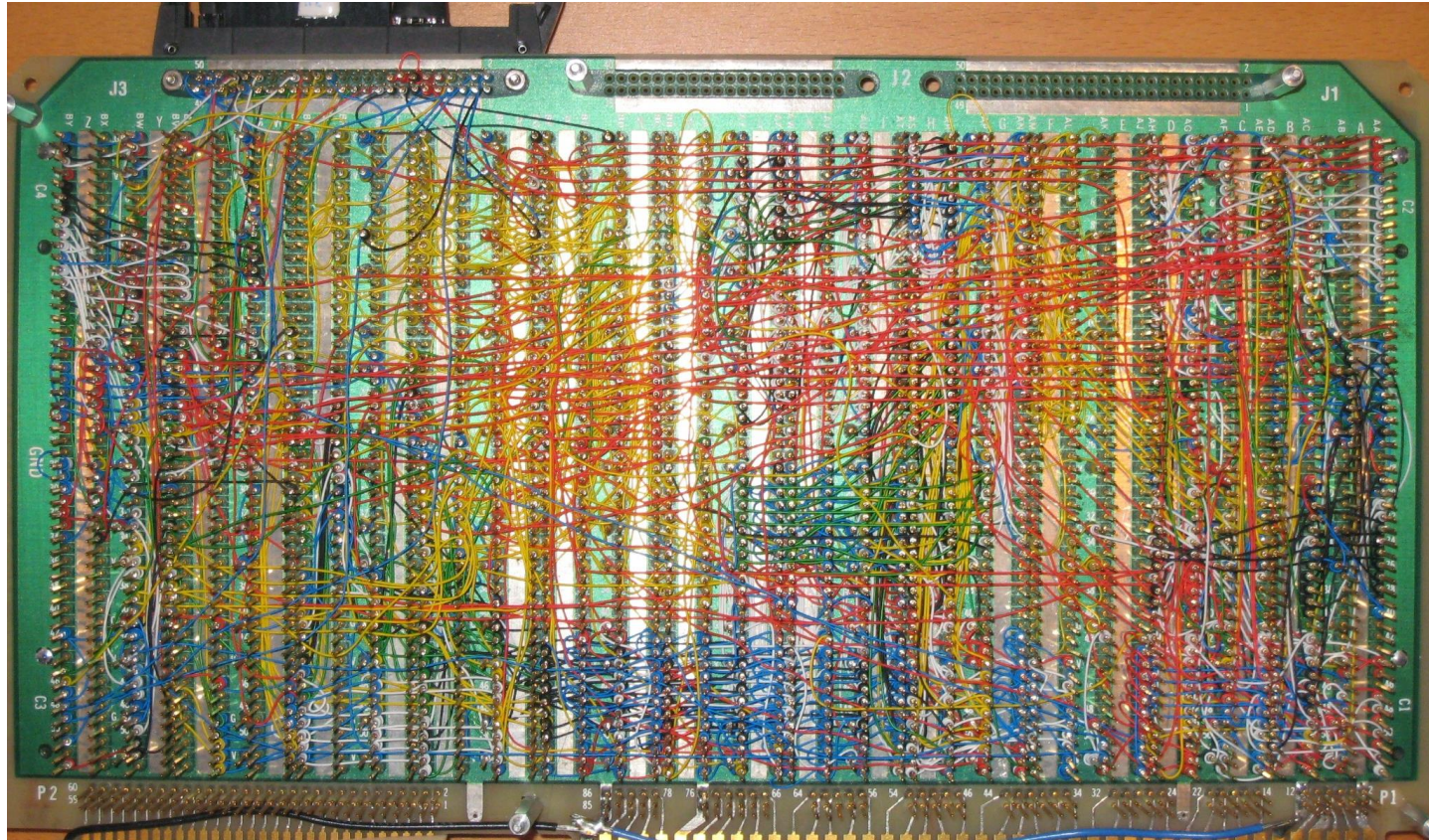
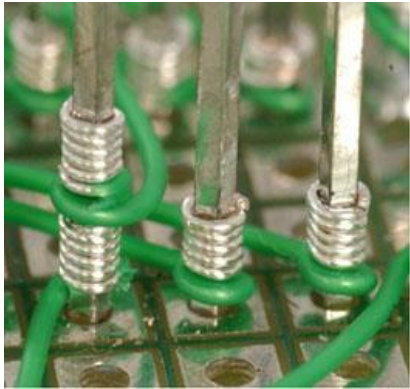






# Introduction

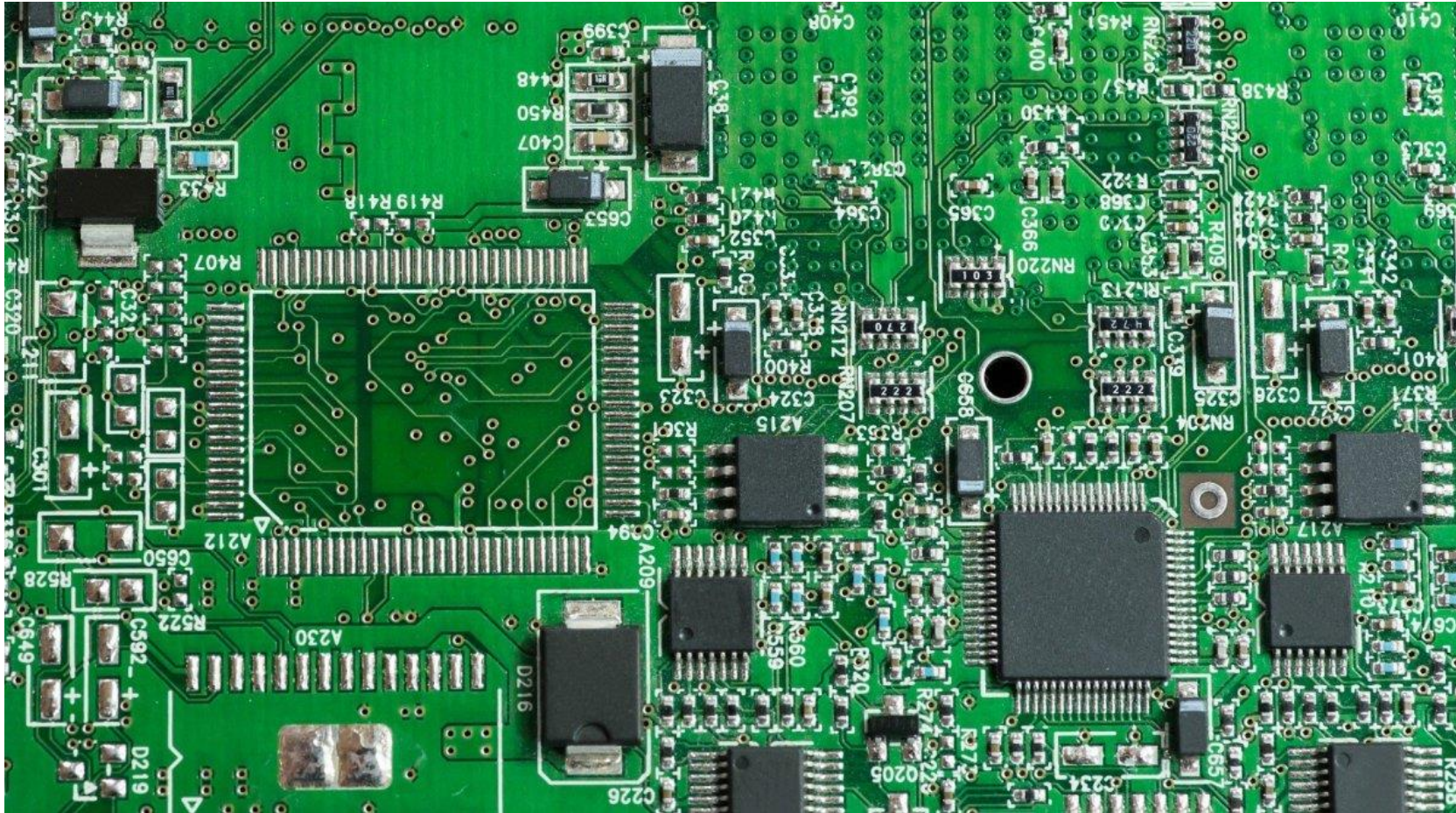
## History - Wire Wrap





# Schematic Editing

## History - Modern PCB



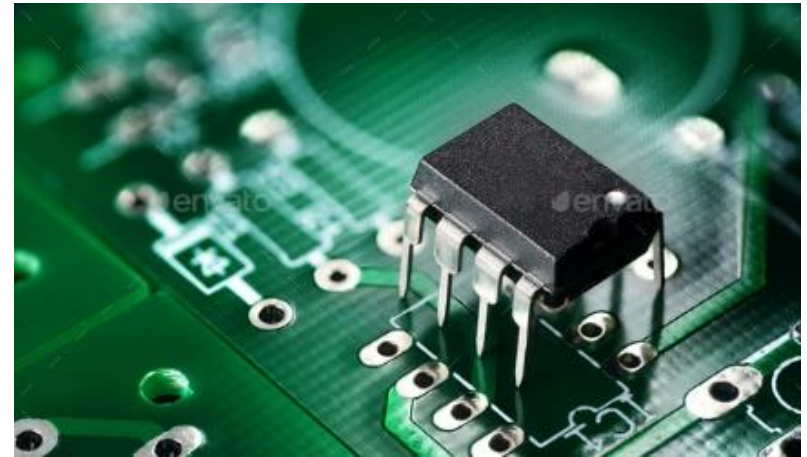
A printed circuit board can have multiple copper layers.  
A two-layer board has copper on both sides; multi layer boards sandwich additional copper layers between layers of insulating material.  
Conductors on different layers are connected with vias



# Through Hole Technology

Board are drilled, then plated

Provide connectivity between layers



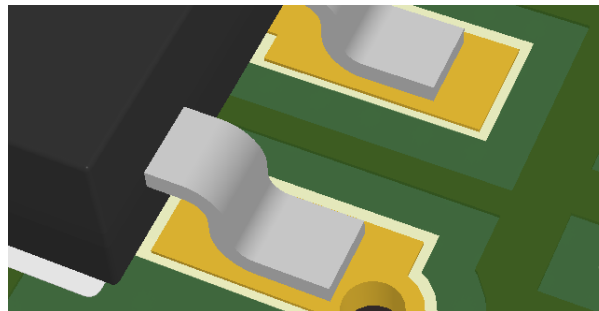
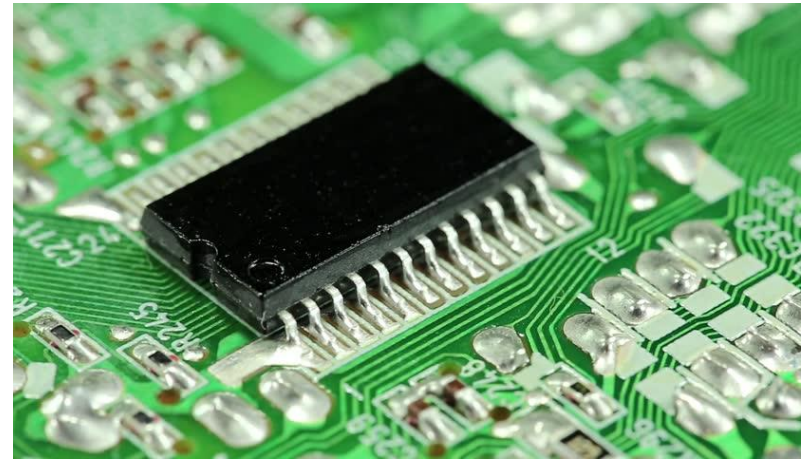




## Surface Mount Technology

Land pattern are etched

Component may or may not have leads



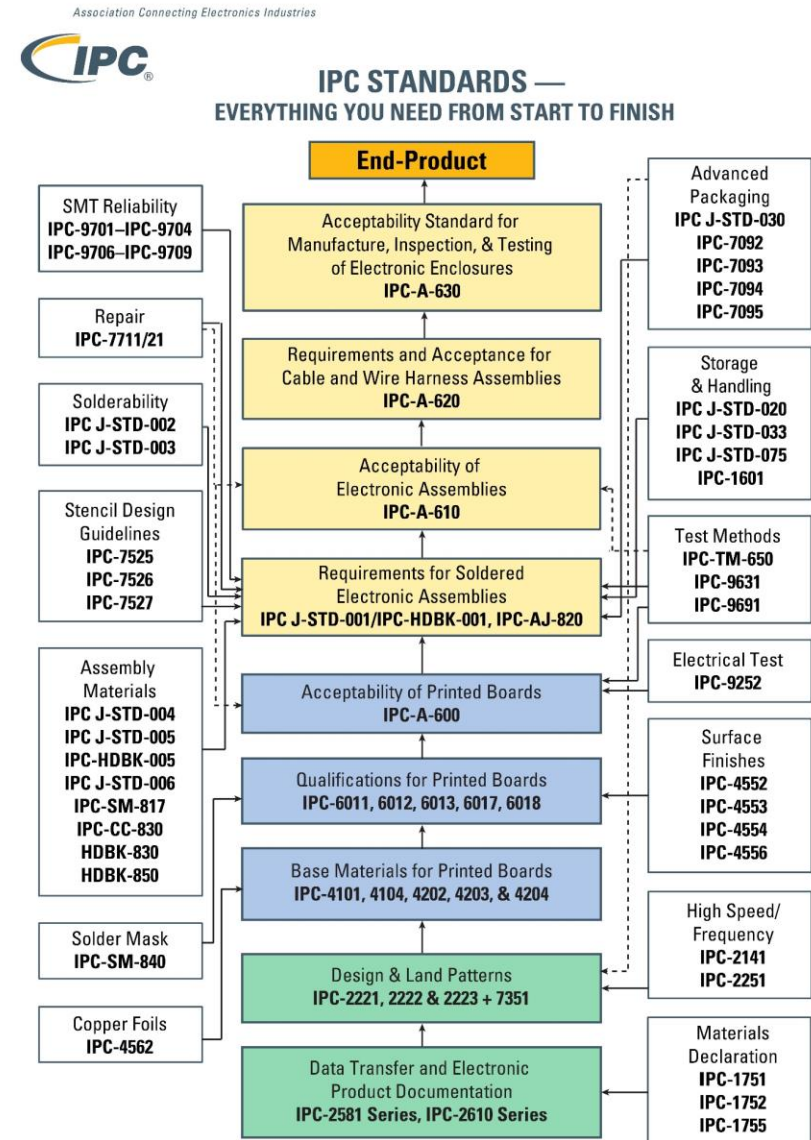
# IPC Standard

Institute for Interconnecting and Packaging Electronic Circuit

Founded in 1957

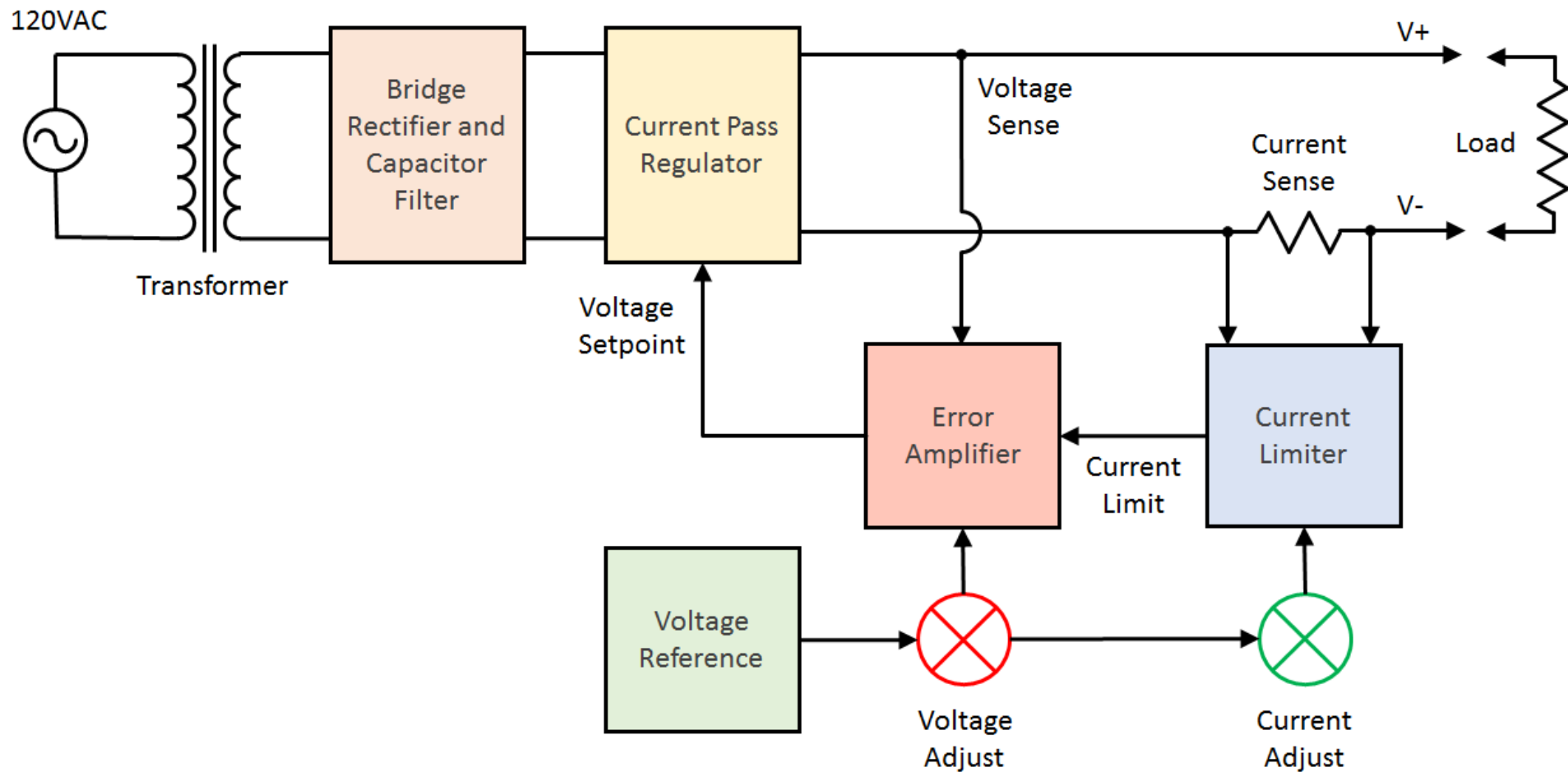
Develop standards used by electronics manufacturing industry and is used worldwide  
By original equipment manufacturer OEM

Standards are created by committees of industry volunteers





### Block Diagram

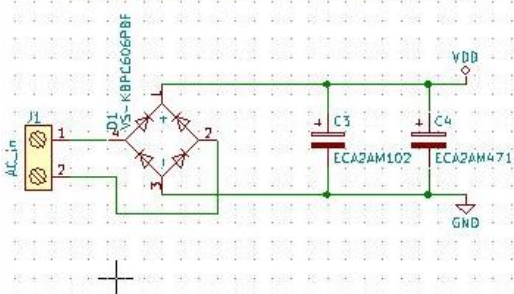




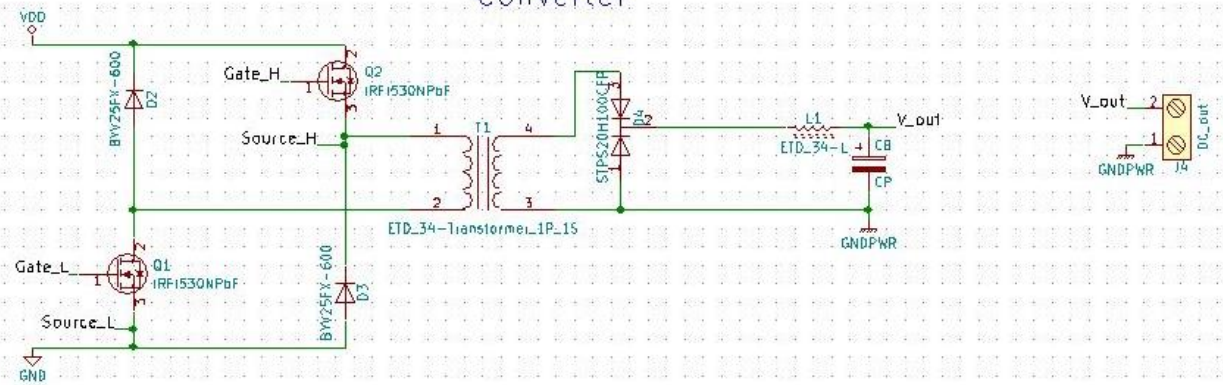


### Schematic Diagram

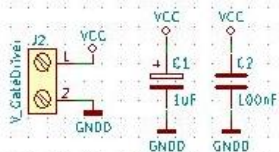
Rectifier and Smoothing



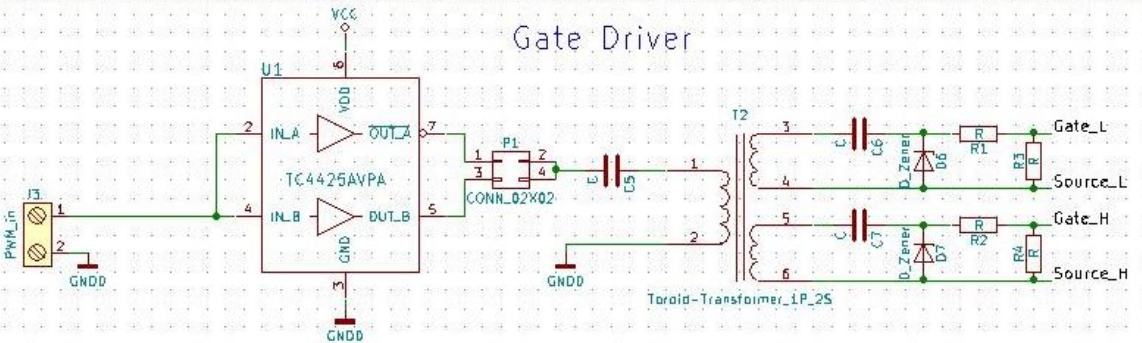
Converter



Gate Driver Supply



Gate Driver





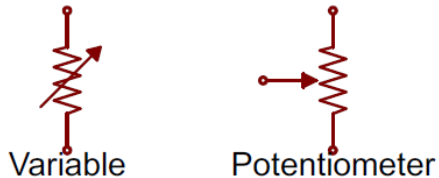
# Schematic Editing

## Schematic Symbols

### Resistors



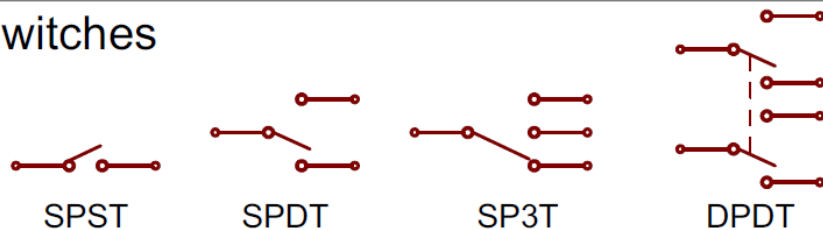
### Variable Resistors



Variable

Potentiometer

### Switches



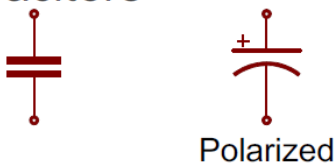
SPST

SPDT

SP3T

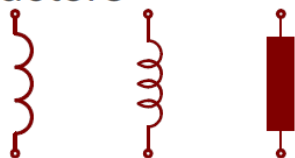
DPDT

### Capacitors



Polarized

### Inductors



### Diodes



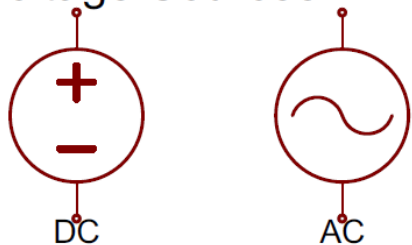
LED

Photodiode

Schottky

Zener

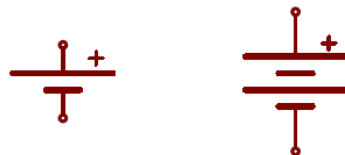
### Voltage Sources



DC

AC

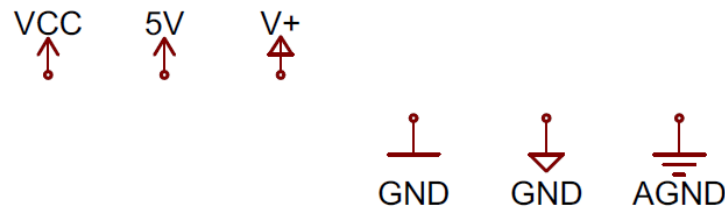
### Batteries



1 cell

2 cells

### Voltage Nodes



VCC

5V

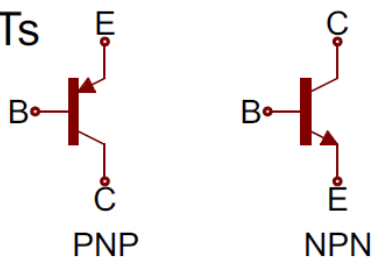
V+

GND

GND

AGND

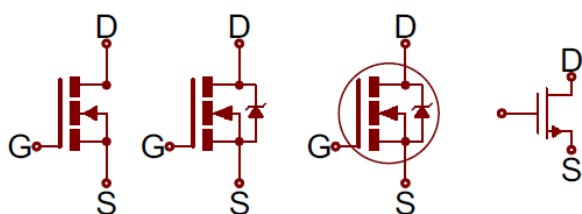
### BJTs



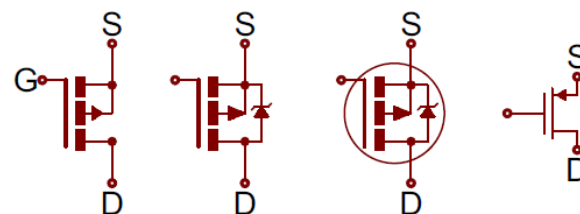
PNP

NPN

### n-Channel MOSFETs

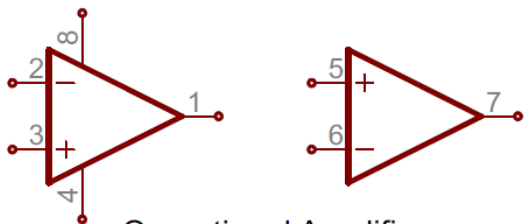


### p-Channel MOSFETs

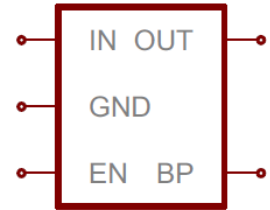
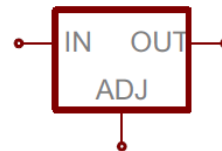
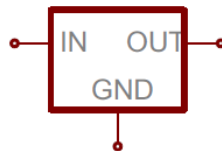




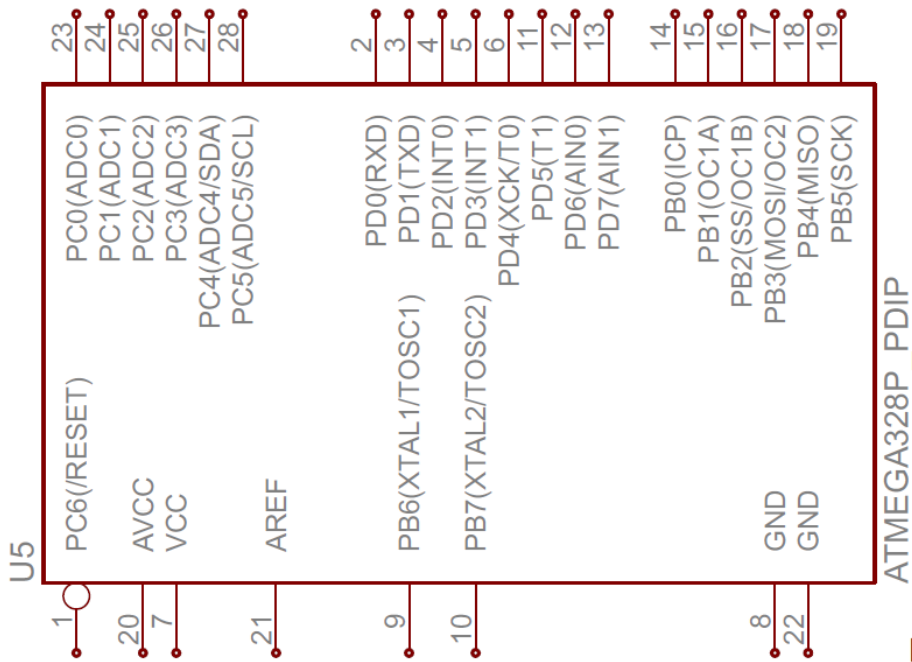
### Integrated Circuits



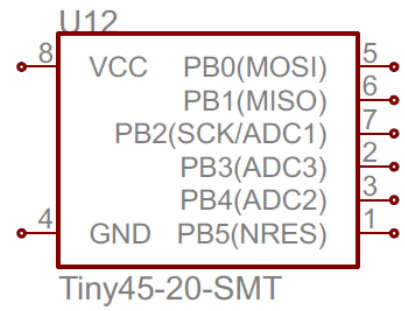
Operational Amplifiers

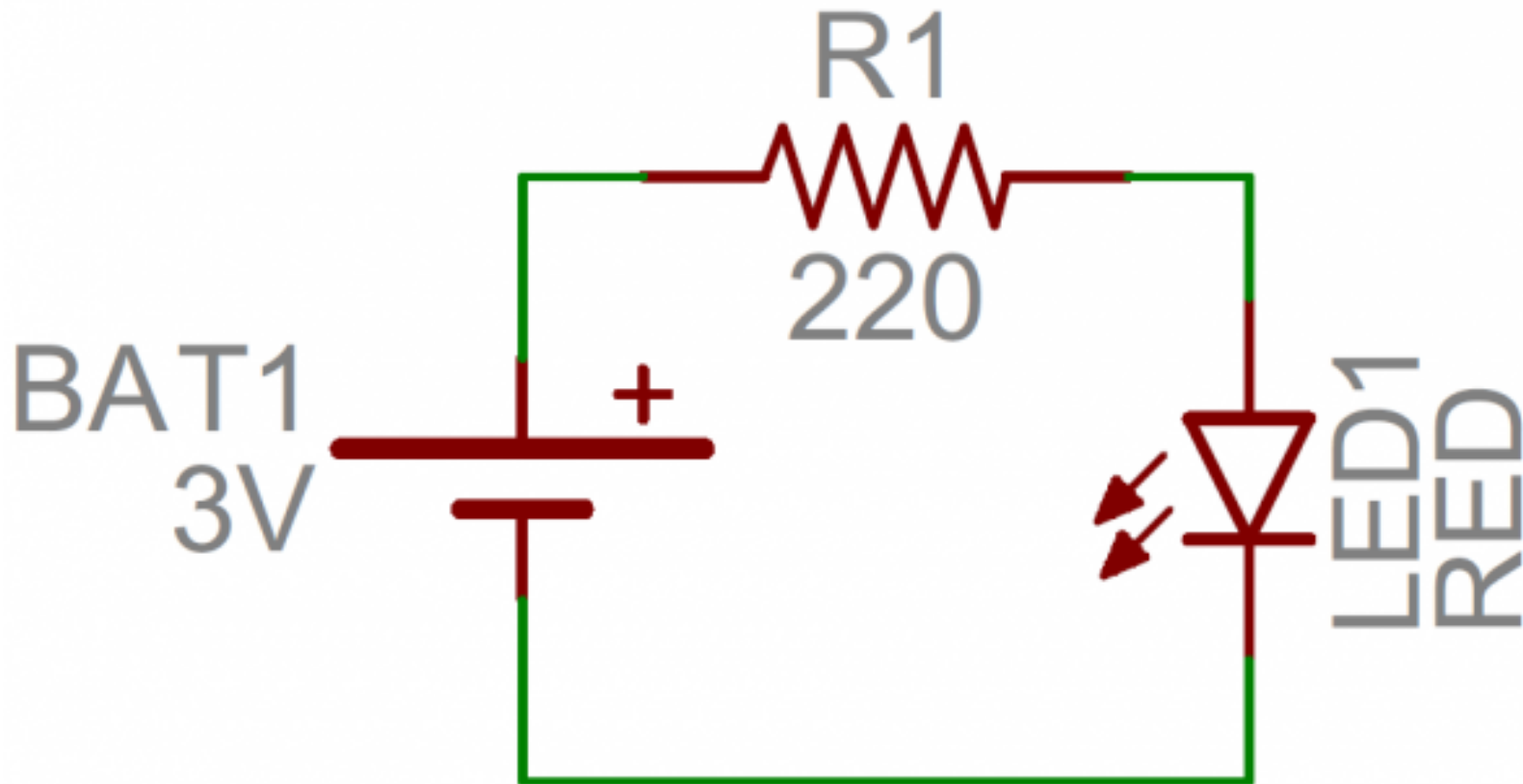


Voltage Regulators



Microcontrollers

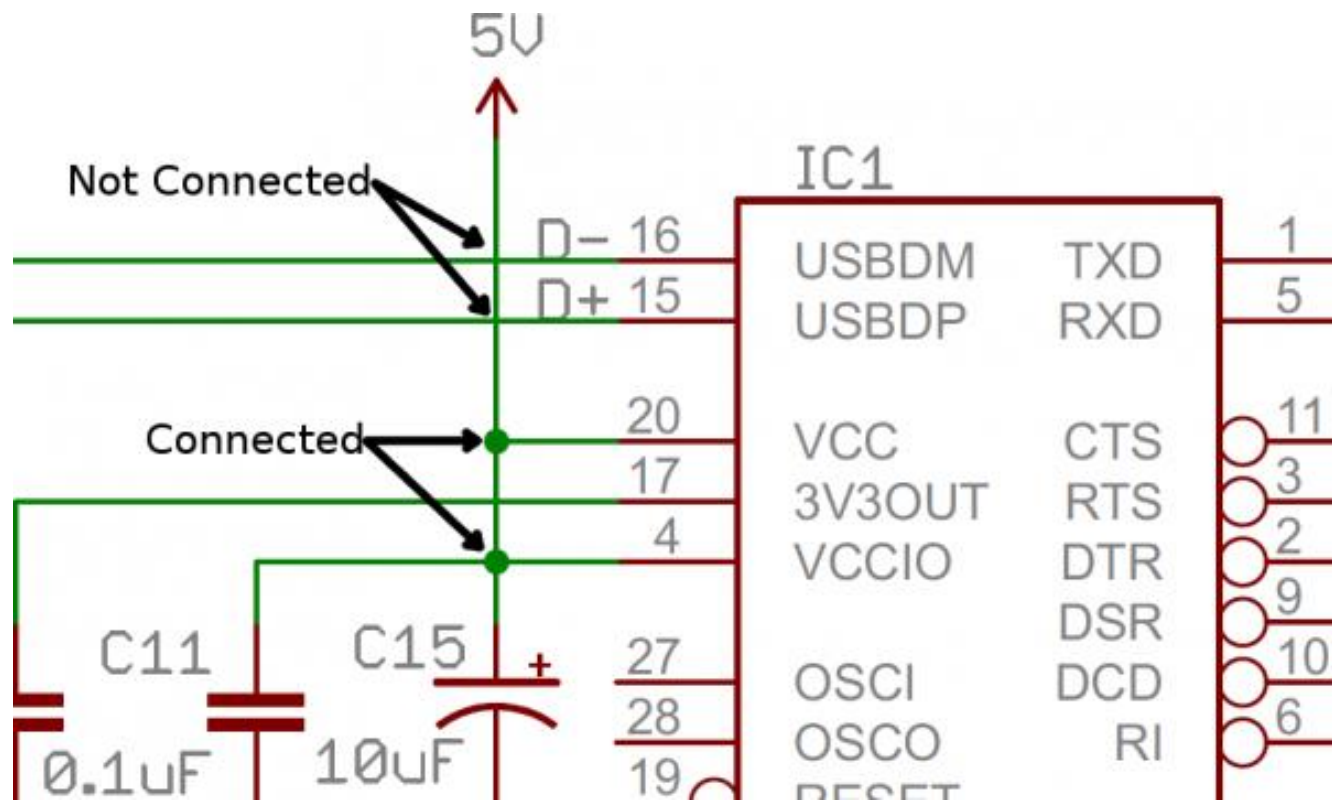
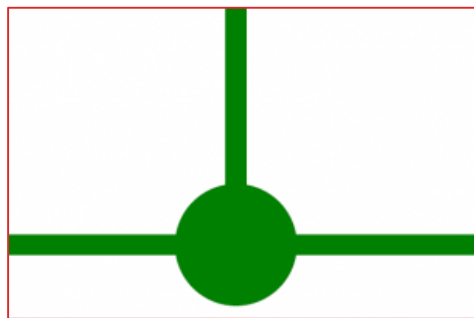








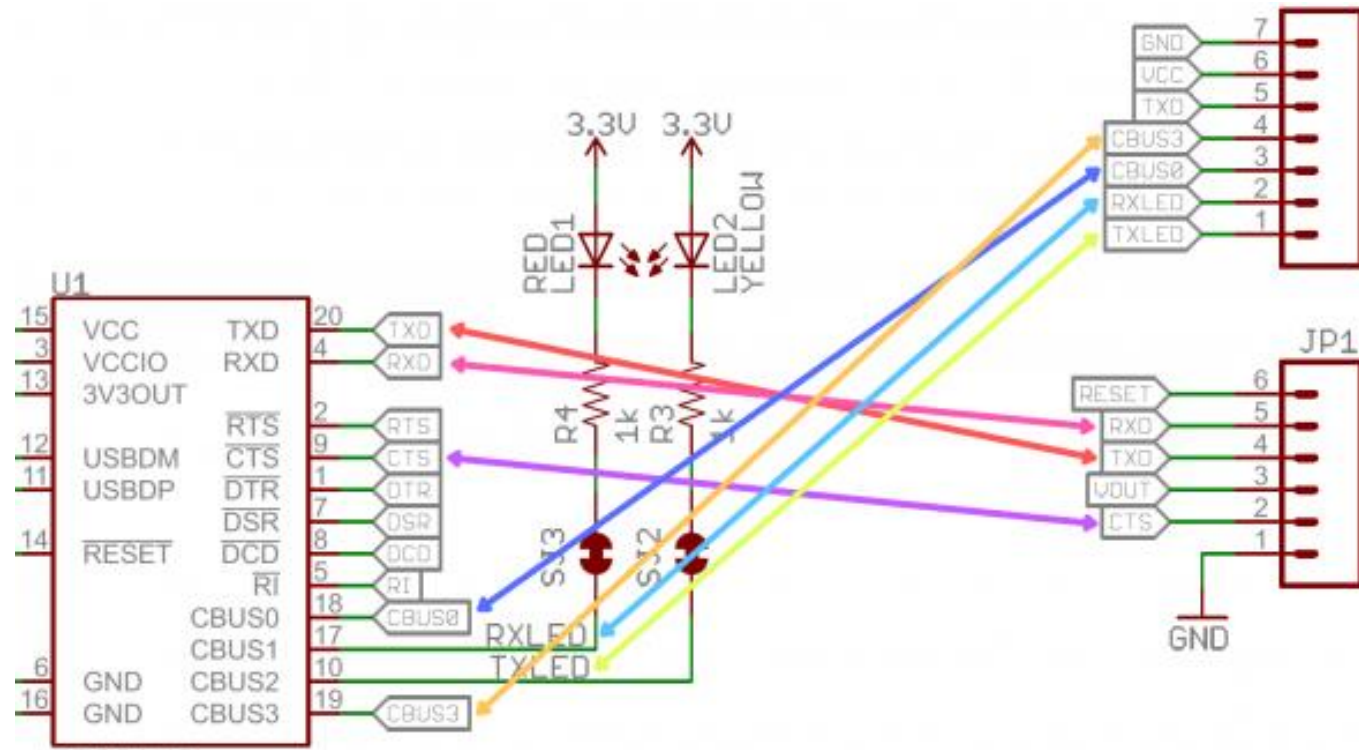
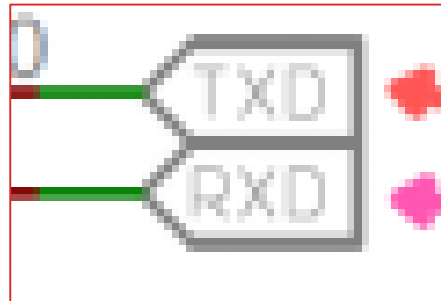
# Schematic Editing Nodes





# Schematic Editing

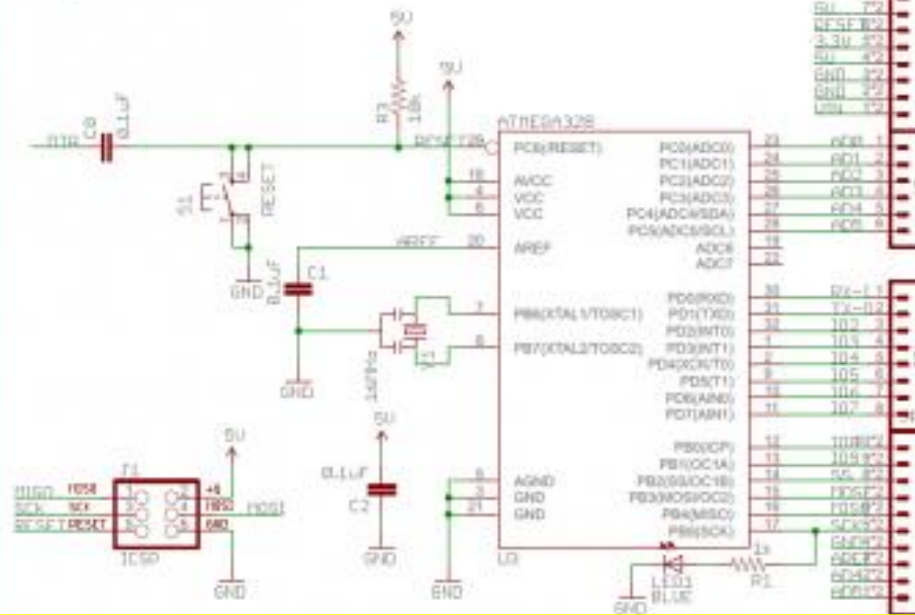
## Net Label



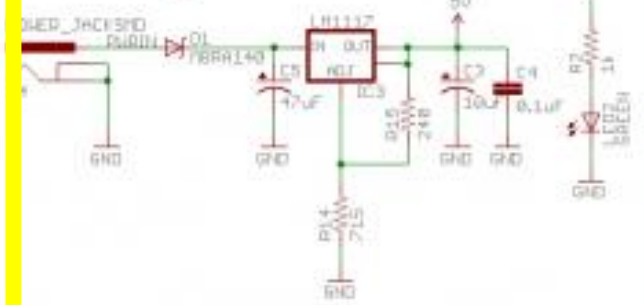


## Schematic Editing Block

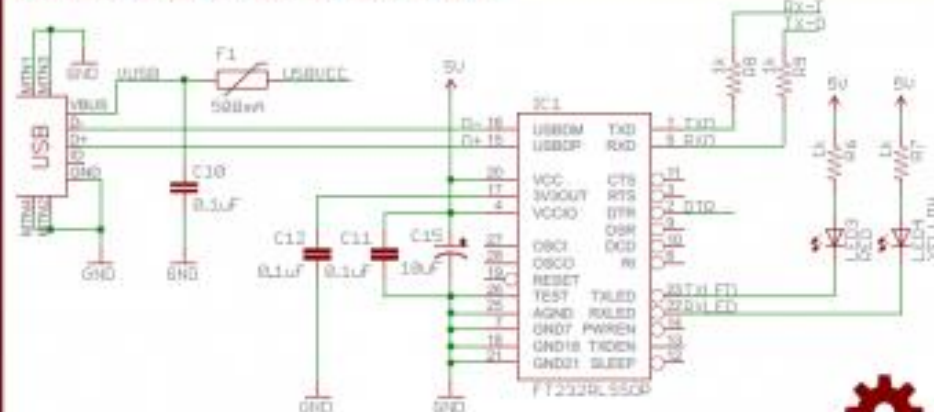
ATmega328



in / 5U Regulator

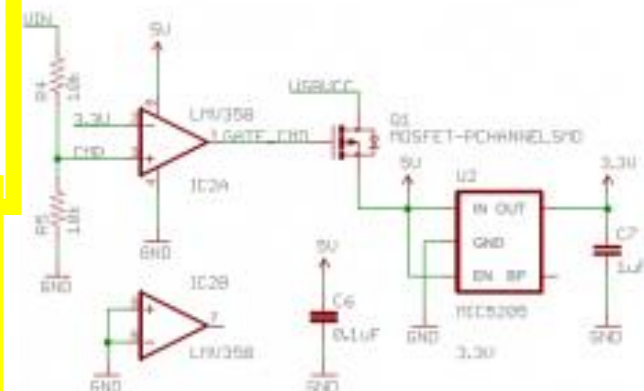


FT232RL (USB-to-Serial Converter)



open hardware

Accepted: 23 Feb 2016 Accepted Manuscript



Released under the Creative Commons Attribution Share-Alike 3.0 License  
<https://creativecommons.org/licenses/by-sa/3.0/>

(Banzil, D.Cuartelleles, T.Igne, G.Martino, B.Weltis, J.Lindblom)

③ ④

TITLE: RedBoard-v06

SFE

Document Number:

REV:

Date: 11/14/2012 11:39:07 AM

Sheet: 1/1



# Schematic Editing

## Reference Designator

<b>A</b>	separable assembly	<b>LS</b>	loudspeaker, buzzer
<b>AR</b>	amplifier	<b>M</b>	meter
<b>AT</b>	attenuator; isolator	<b>MG</b>	motor-generator
<b>B</b>	blower, motor	<b>MH*</b>	mounting hole
<b>BT</b>	battery	<b>MK</b>	microphone
<b>C</b>	capacitor	<b>MP</b>	mechanical part
<b>CB</b>	circuit breaker	<b>P</b>	connector, plug, male
<b>CP</b>	connector adapter, coupling	<b>PS</b>	power supply
<b>CN</b>	capacitor network	<b>Q</b>	transistor
<b>D or CR</b>	diode	<b>R</b>	resistor
<b>D or VR</b>	breakdown diode	<b>RN</b>	resistor network
<b>DC</b>	directional coupler	<b>RT</b>	thermistor
<b>DL</b>	delay line	<b>S</b>	switch
<b>DS</b>	display, lamp	<b>T</b>	transformer
<b>E</b>	terminal	<b>TB</b>	terminal board, terminal strip
<b>F</b>	fuse	<b>TC</b>	thermocouple
<b>FD*</b>	fiducial	<b>TP<sup>~</sup></b>	test point, In-circuit test points
<b>FL</b>	filter	<b>TZ</b>	transzorb
<b>G</b>	generator, oscillator	<b>U</b>	inseparable assembly, IC pkg
<b>GN</b>	general network	<b>V</b>	electron tube
<b>H</b>	hardware	<b>VR</b>	voltage regulator
<b>HY</b>	circulator, directional coupler	<b>W</b>	wire, cable, cable assembly
<b>J</b>	connector, jack, female	<b>X</b>	fuse holder, lamp holder, socket
<b>K</b>	contactor, relay	<b>Y</b>	crystal, magnetostriction oscillator
<b>L</b>	coil, inductor, bead, ferrite bead	<b>Z</b>	miscellaneous





University of  
Nottingham  
UK | CHINA | MALAYSIA

# Schematic Editing

## Schematic Symbols