Platinenlayout mit EAGLE und 3D Konstruktion mit OpenSCAD

Sven Kratz

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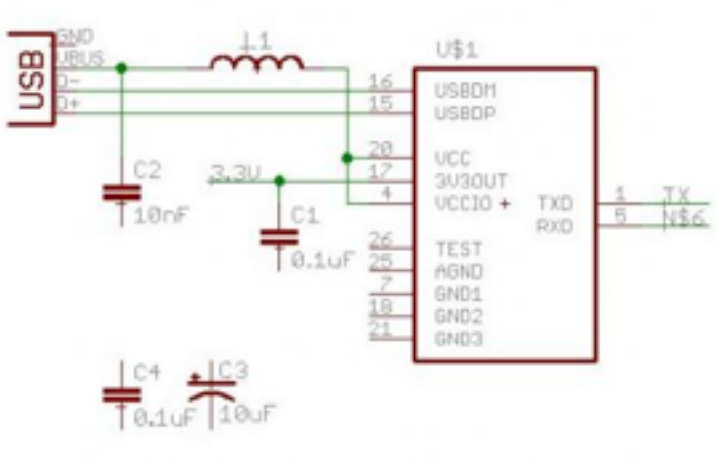
AK Hardware

LMU

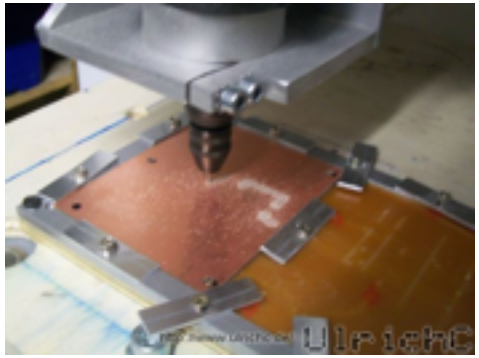
SS 2011

CAD, CAM und EAGLE

- CAD: **C**omputer-**A**ided **D**esign
  - Komponentenbibliothek
  - Schaltplan
  - Platinenlayout
  - Auto-Router



- CAM: **C**omputer-**A**ided **M**achining
  - Ätzen / Platinenhersteller: .pdf, .egl
  - Fräsen: Gerber-Files
  - Durch plugins erweiterbar

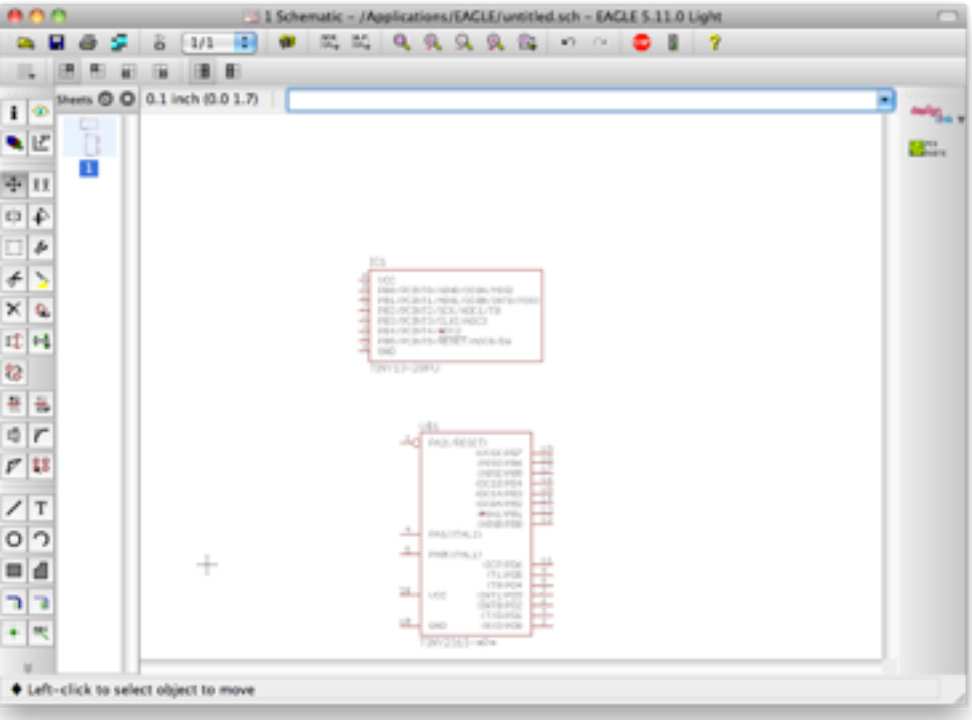


- EAGLE
  - “**E**infach **A**nzuwendender **G**rafischer **L**ayout **E**ditor”

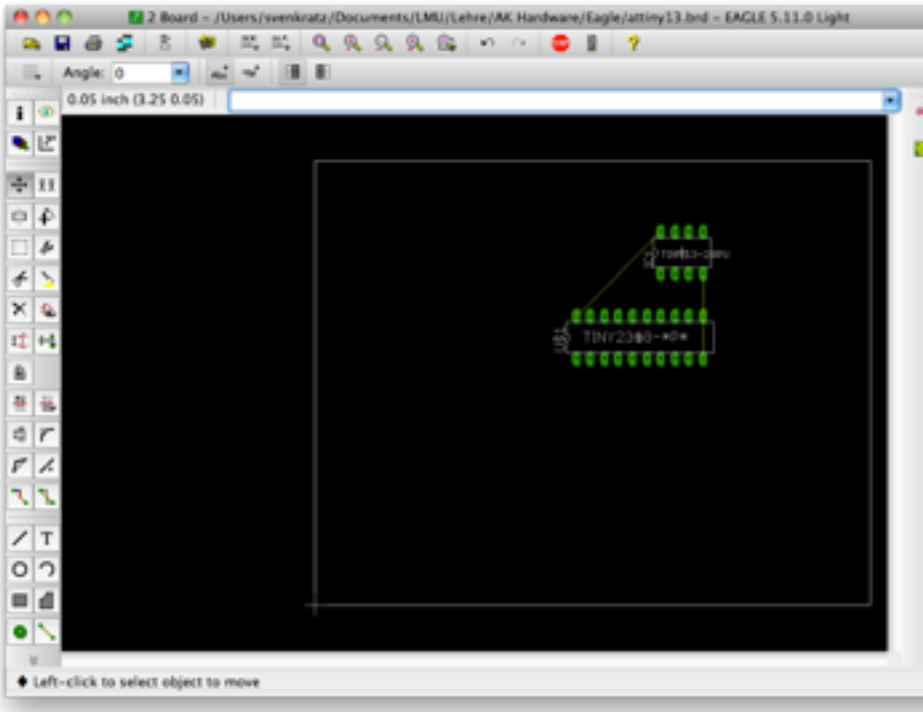
Eagle Bootstrapping

- Freeware-Version: http://www.cadsoft.de/download.htm
- Erste Schritte hier nach SparkFun:
  http://www.sparkfun.com/tutorials/108
- SparkFun Eagle Library Installieren (viele Bauteile und Sensoren im Bereich Physical Computing und UI Prototyping) :
  http://www.opencircuits.coSFE_Footprint_Library_Eagle
- Sparkfun Keyboard Shortcuts Installieren:
  http://www.opencircuits.com/SFE_Eagle_Shortcuts
- Atmel Library von CADSoft: http://goo.gl/dUICJ (dort auch nach anderen interessanten Sachen ausschau halten)

Eagle: Wichtigste Ansichten

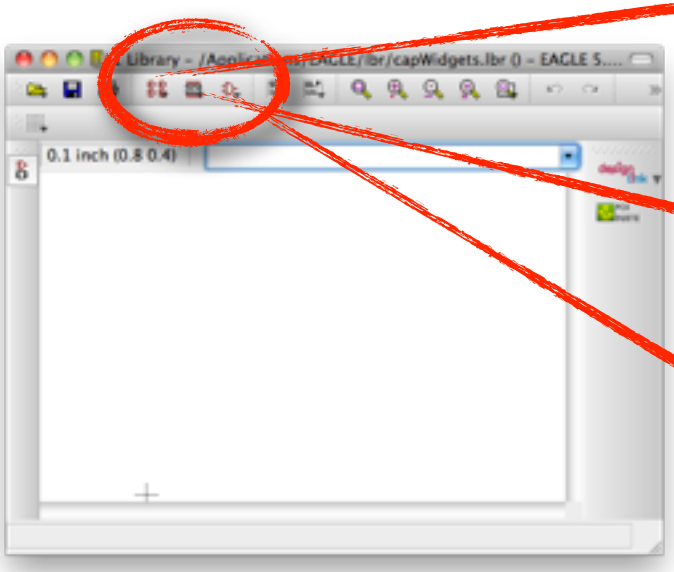


Schematic



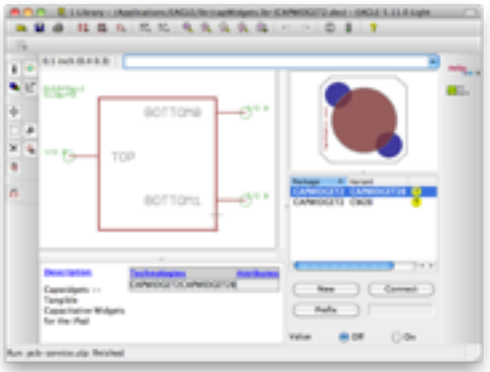
Board

Eagle: Wichtigste Ansichten

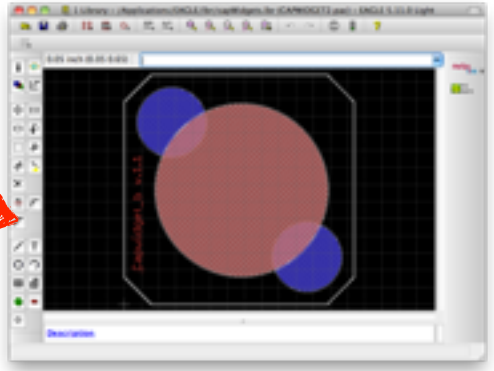


Library

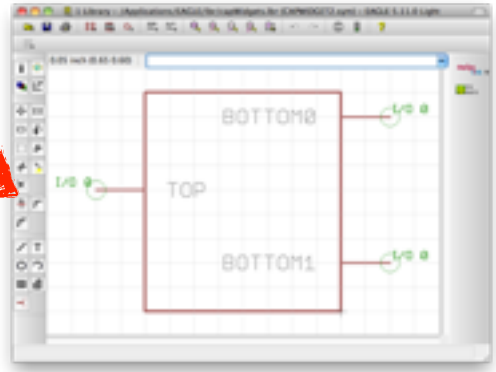
Device



Package

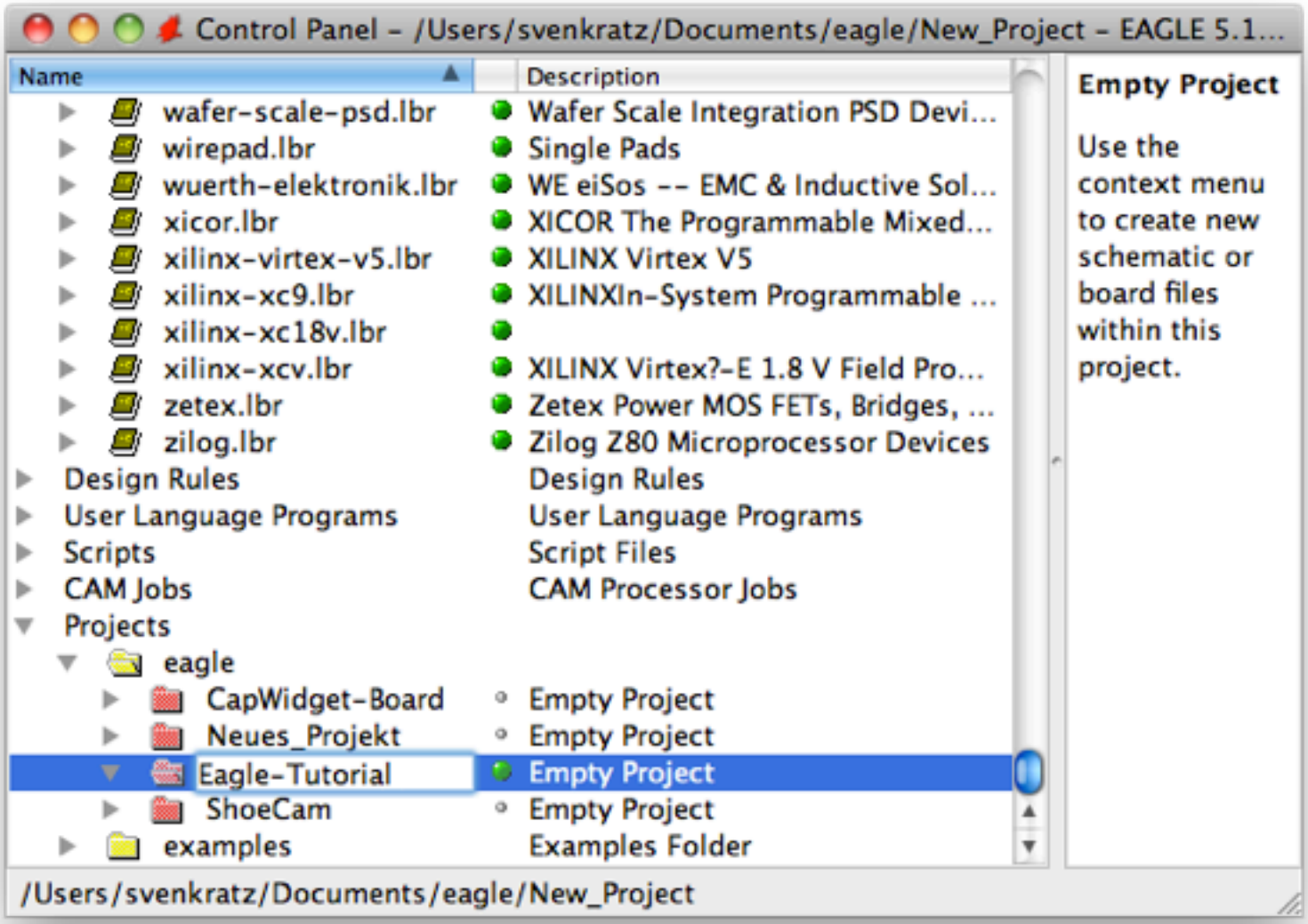


Symbol

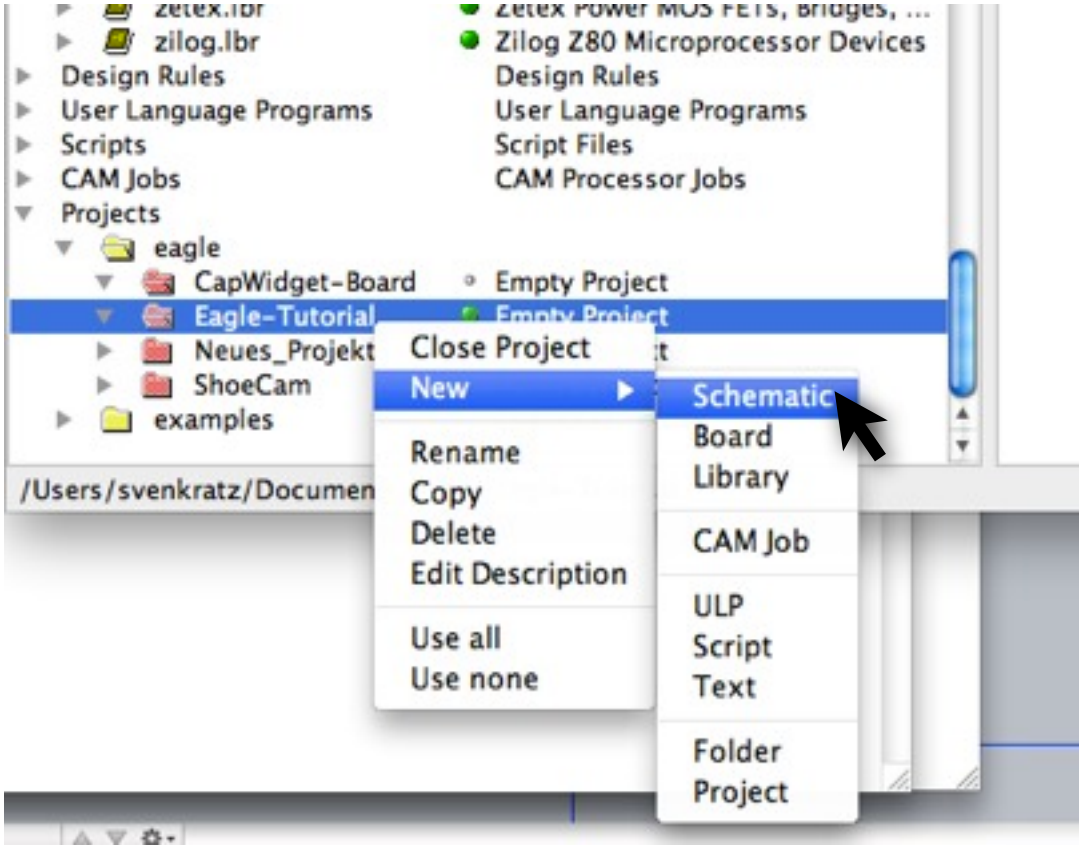


Schaltpläne

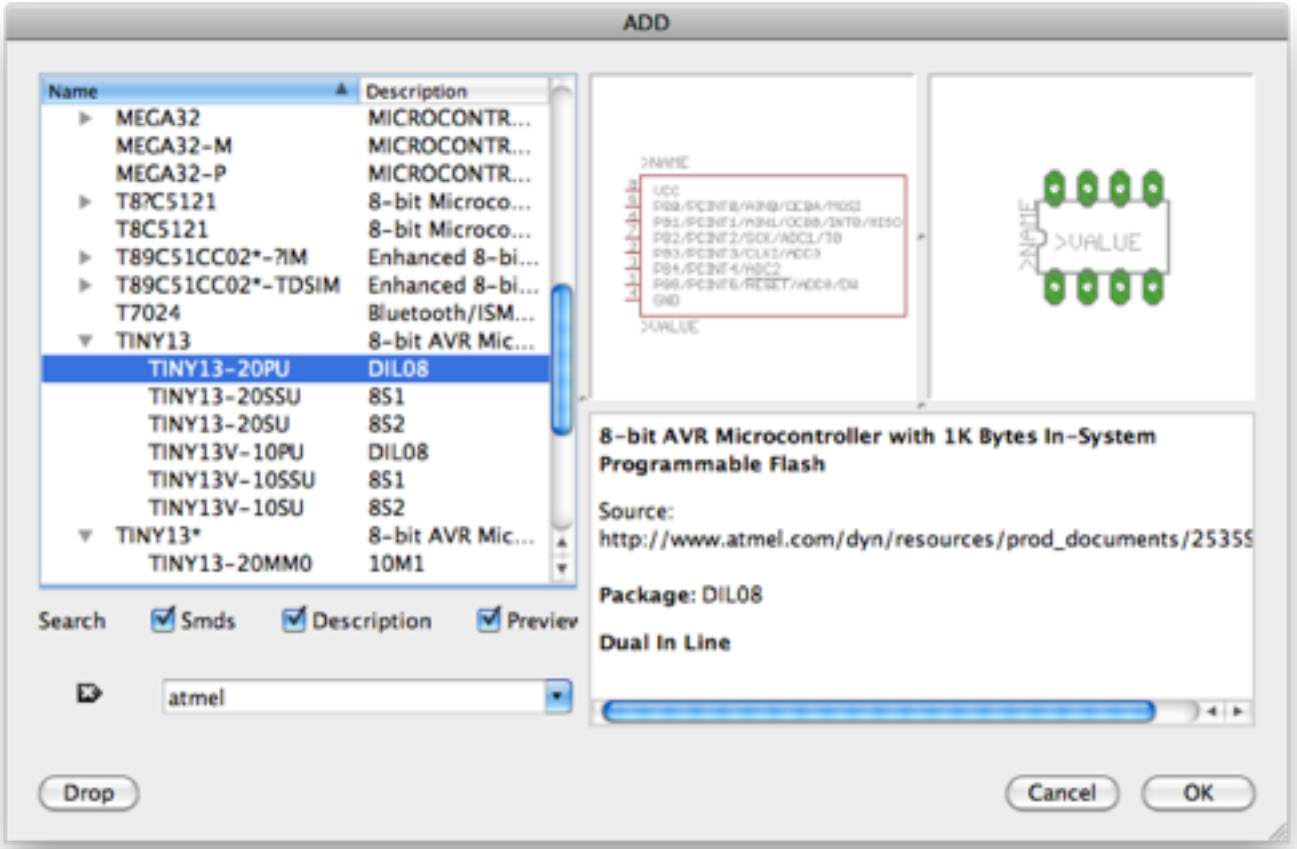
File -> New -> Project

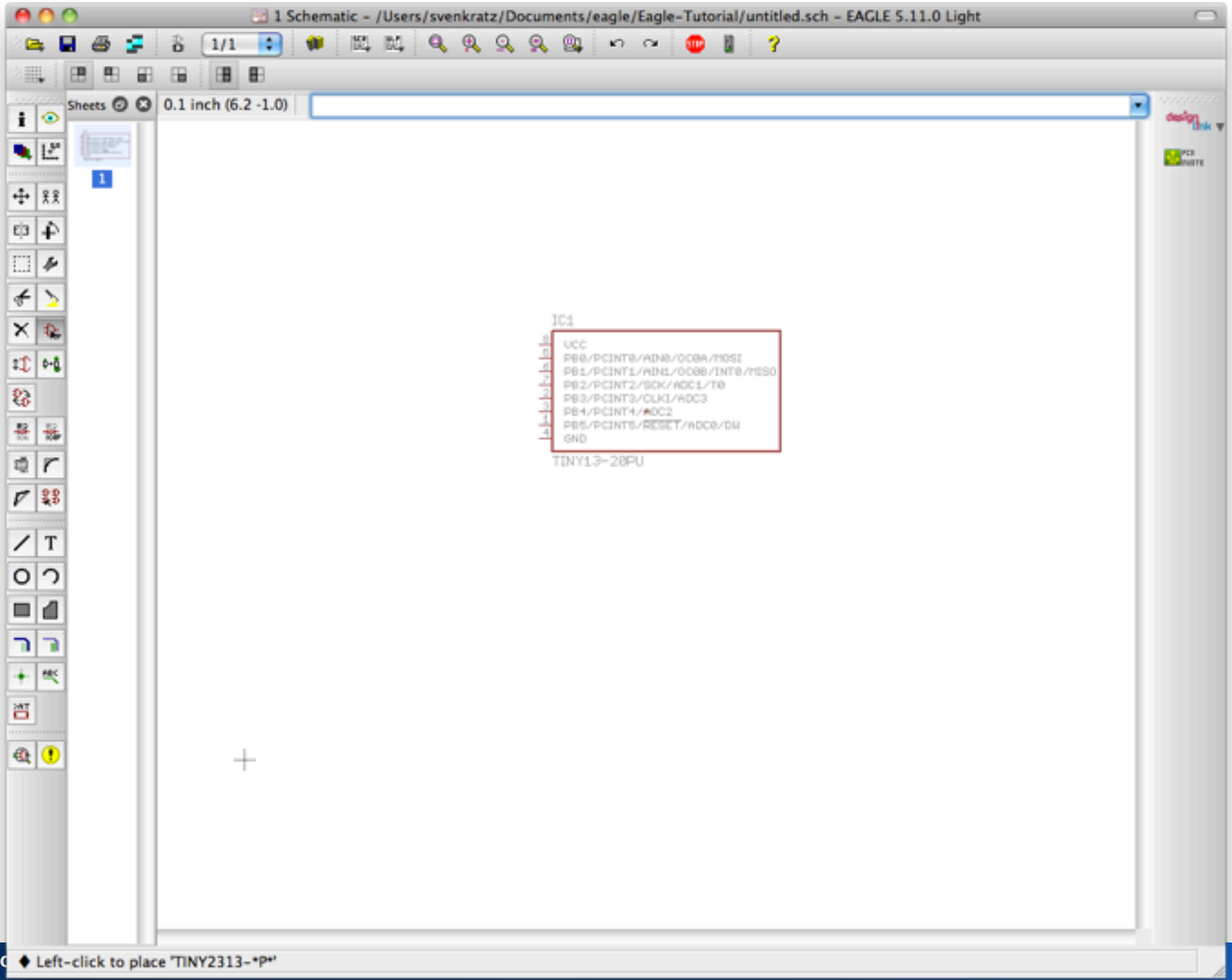


Schaltpläne

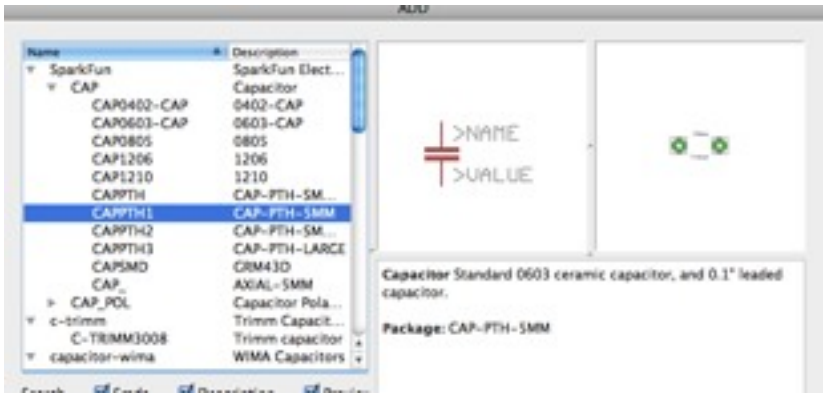


Schaltpläne: Bauteil Hinzufügen

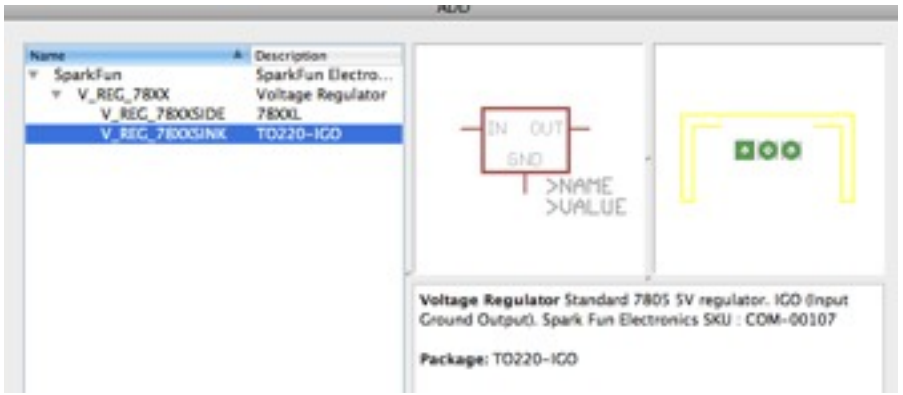



1 Schematic - /Users/svenkratz/Documents/eagle/Eagle-Tutorial/untitled.sch - EAGLE 5.11.0 Light
1/1
Sheets
0.1 inch (6.2 -1.0)
1
IC1
UCC
PB0/PCINT0/AIN0/OC0A/MOSI
PB1/PCINT1/AIN1/OC0B/INT0/MISO
PB2/PCINT2/SCK/ADC1/T0
PB3/PCINT3/CLKI/ADC3
PB4/PCINT4/ADC2
PB5/PCINT5/RESET/ADC0/DW
GND
TINY13-20PU
Left-click to place 'TINY2313-*P*'

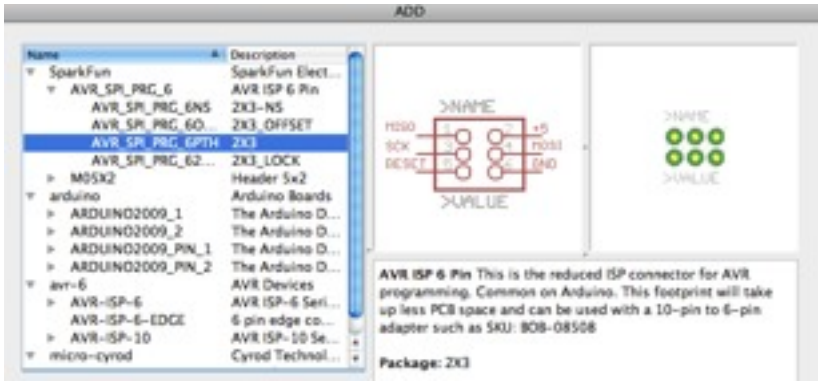
Schaltplan: Weitere Bauteile



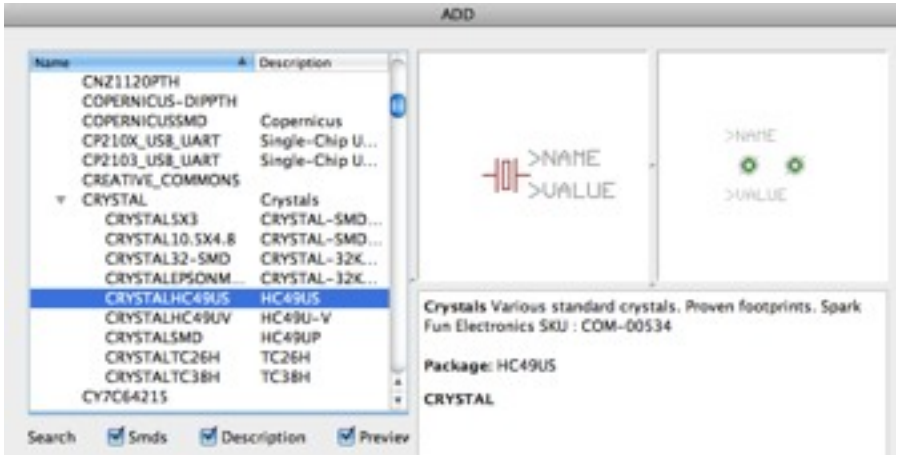
Kondensator 0.1pf



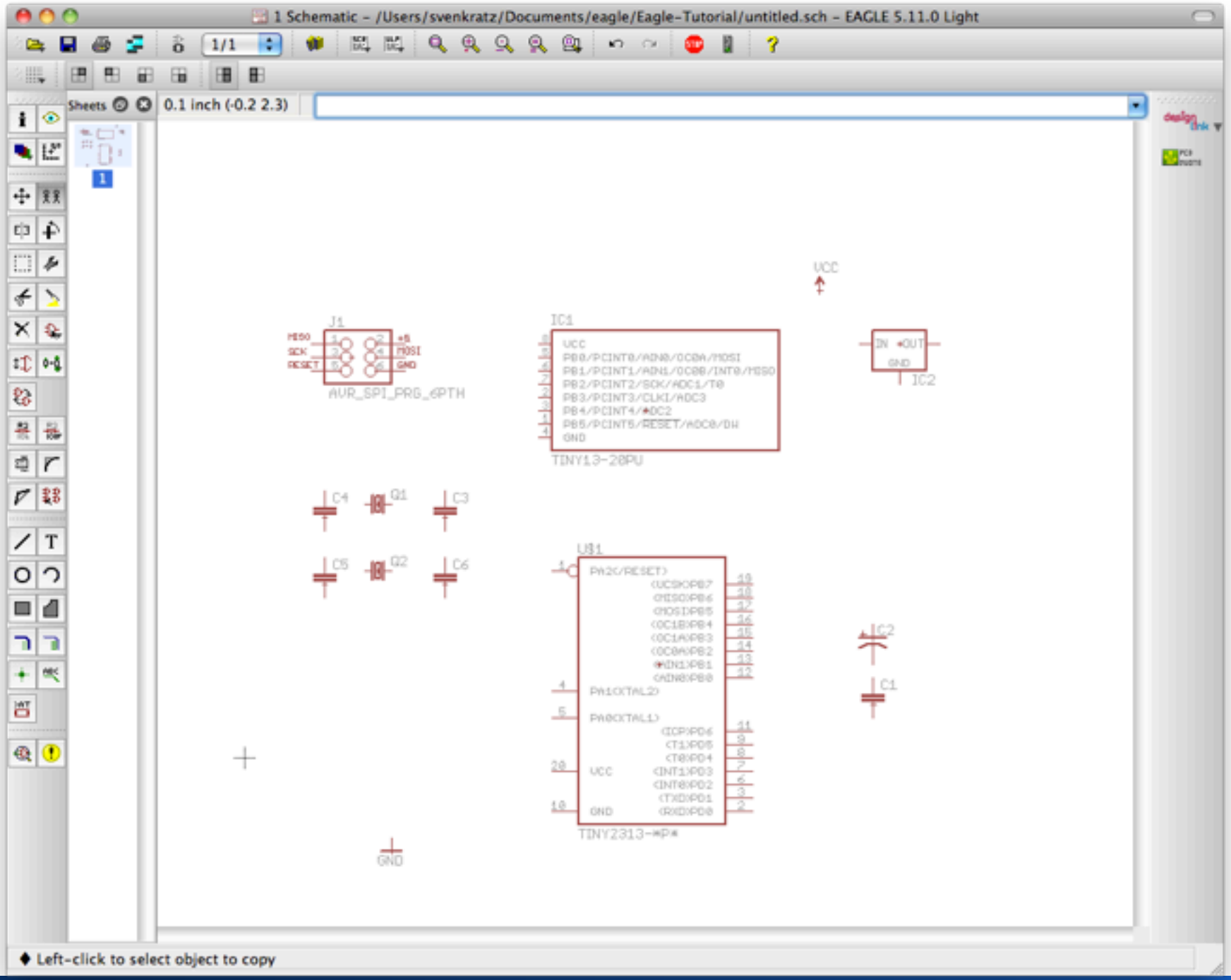
7805 5V Spannungsregler



ISP-Header

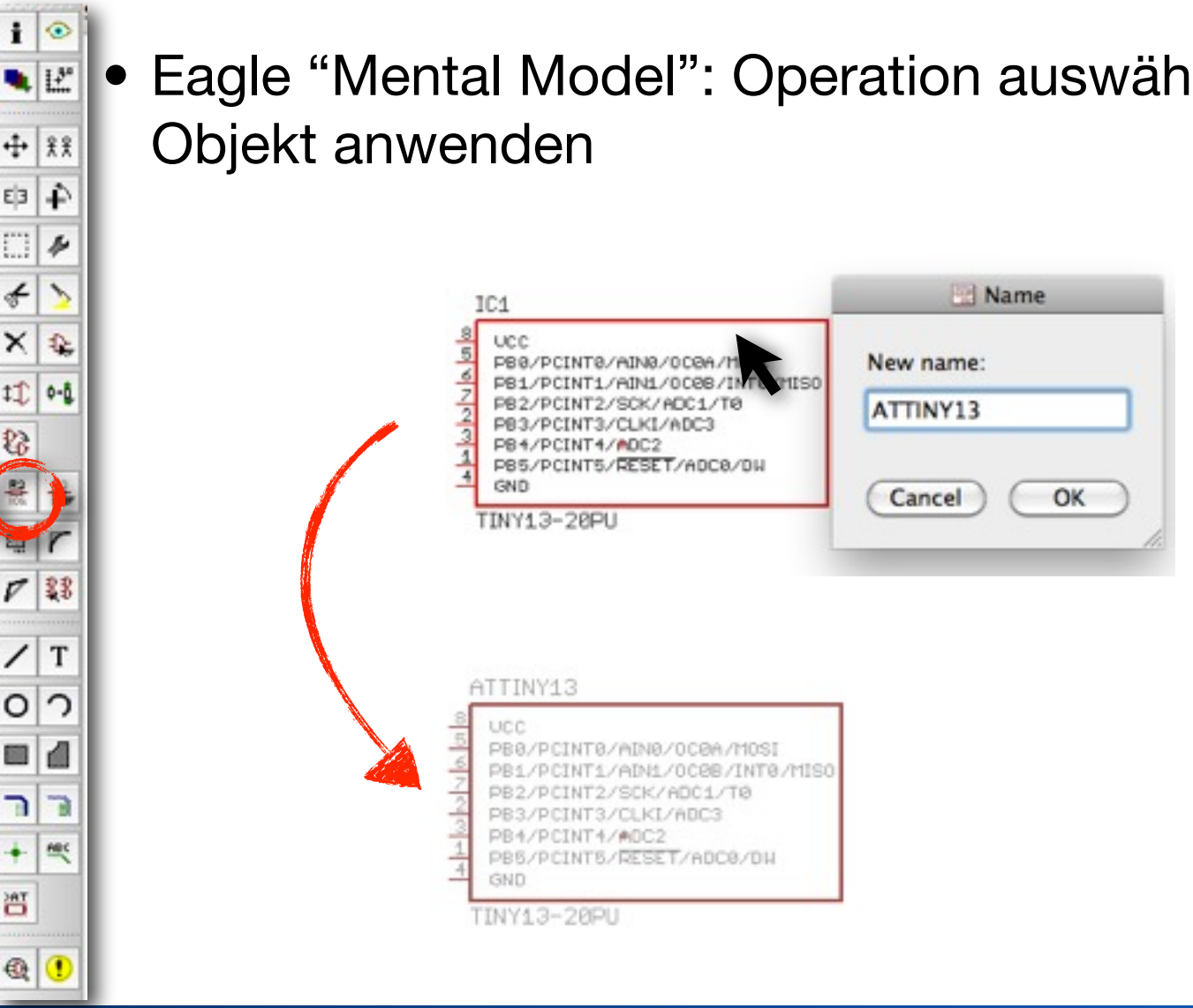


Quartz (Generisch)


1 Schematic - /Users/svenkratz/Documents/eagle/Eagle-Tutorial/untitled.sch - EAGLE 5.11.0 Light
Sheets
0.1 inch (-0.2 2.3)
VCC
J1
AVR_SPI_PRG_6PTH
IC1
TINY13-20PU
IC2
C4
Q1
C3
C5
Q2
C6
U$1
TINY2313-xPx
C2
C1
GND
Left-click to select object to copy

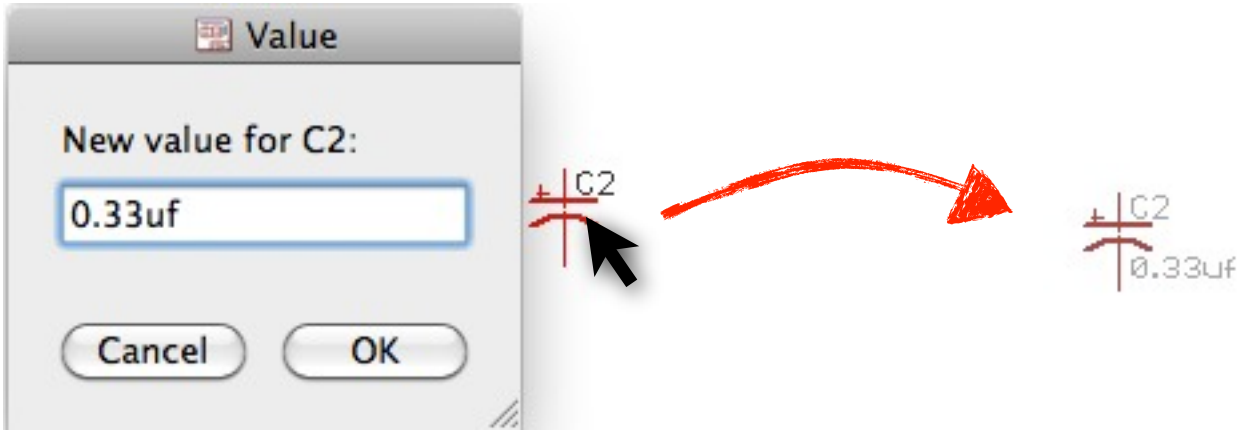
Schematic: Namen Setzen (F4)

- Eagle “Mental Model”: Operation auswählen, dann auf Objekt anwenden

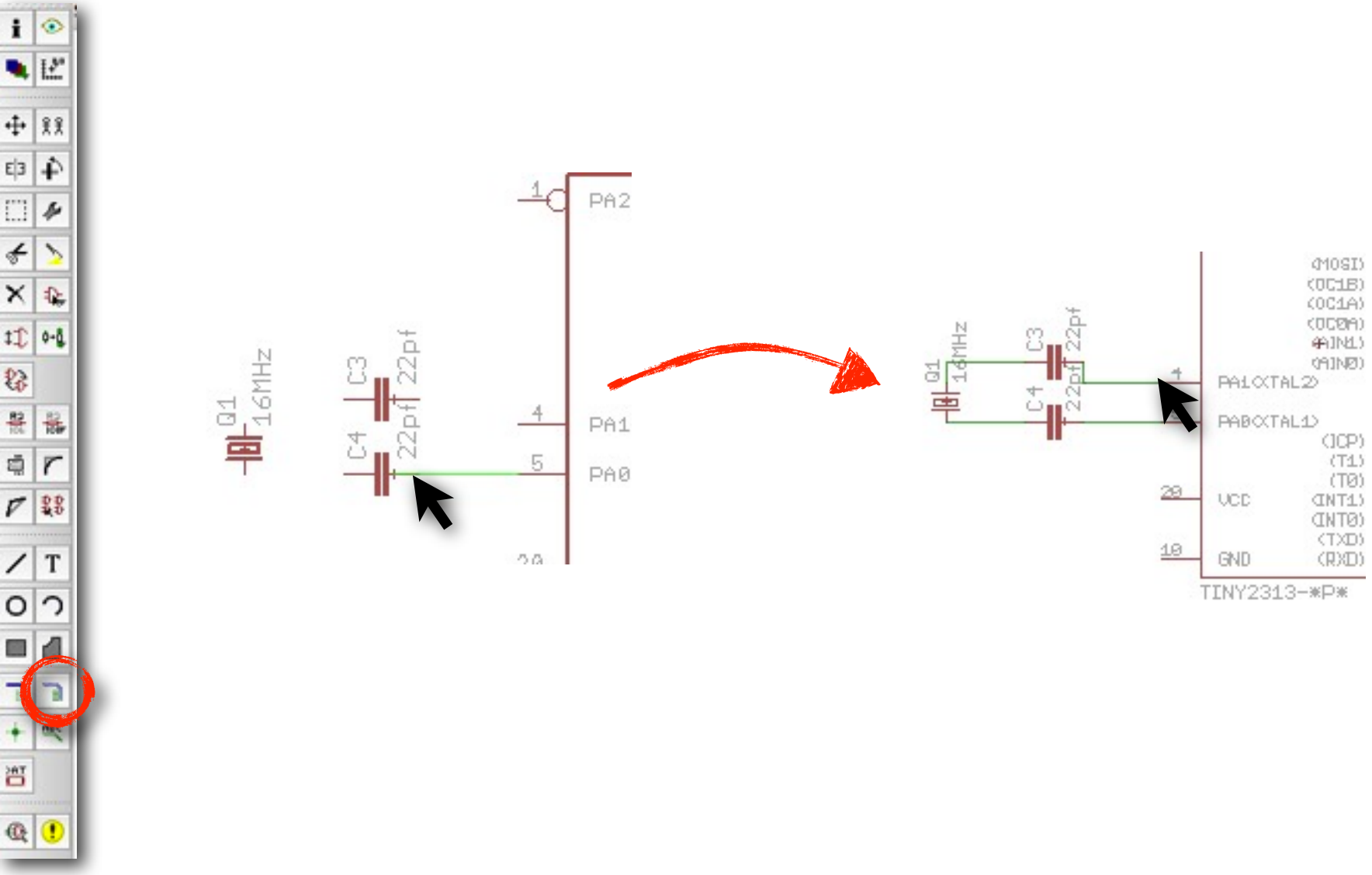


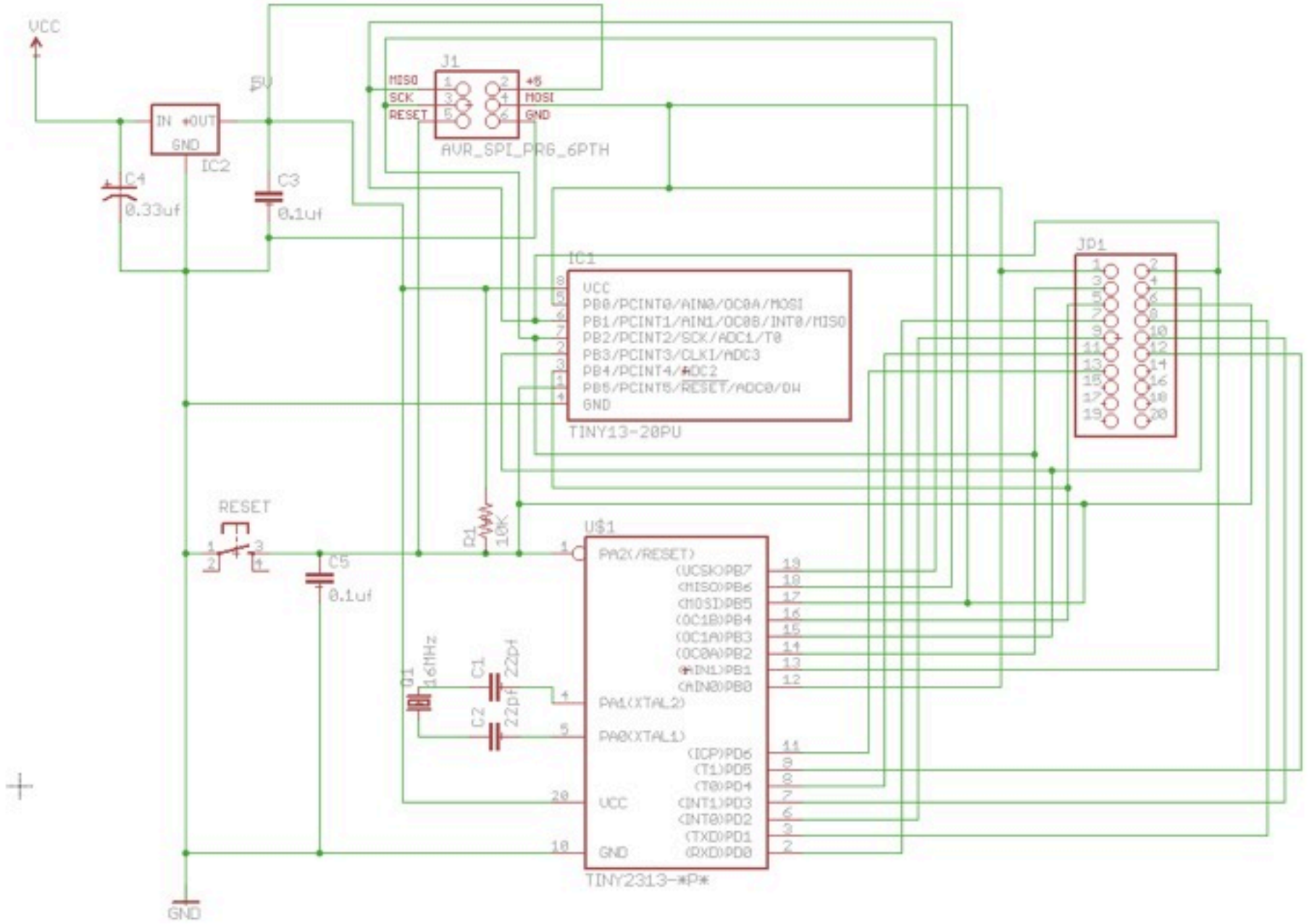
Schematic: Wert Setzen (F5)

- Die elektrische Eigenschaft, die das Bauteil am besten beschreibt, in das Feld setzen



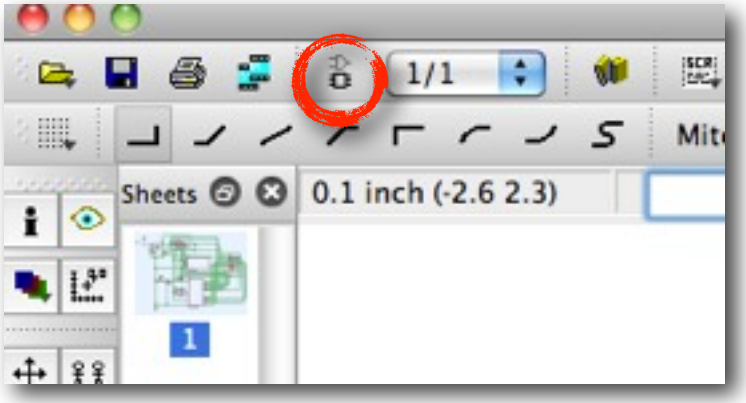
Schematic: Leitung (F9)

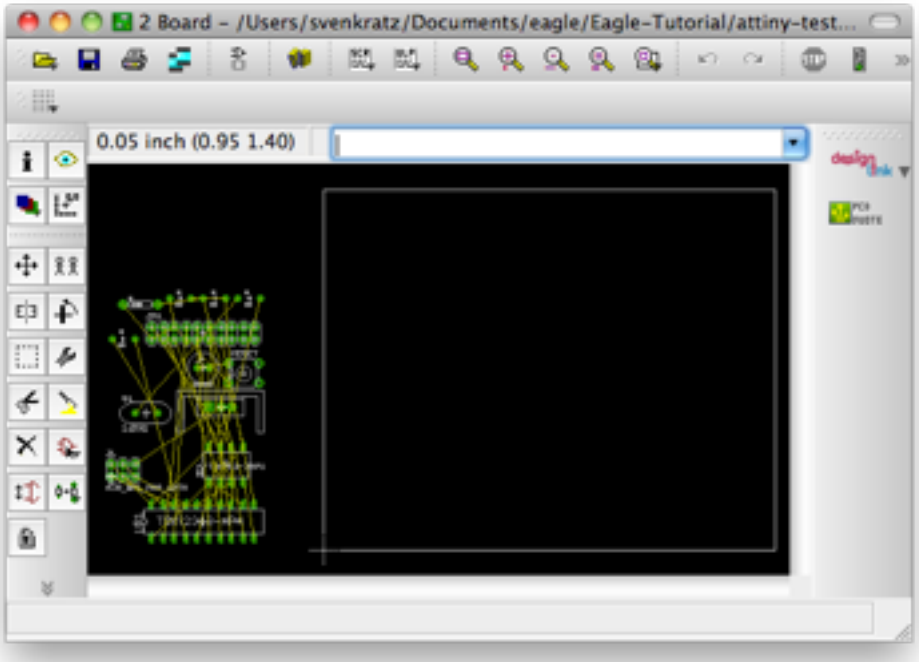



VCC
5V
J1
MISO
SCK
RESET
+5
MOSI
GND
AVR_SPI_PRG_6PTH
IN
+OUT
GND
IC2
C4
0.33uf
C3
0.1uf
IC1
VCC
PB0/PCINT0/AIN0/OC0A/MOSI
PB1/PCINT1/AIN1/OC0B/INT0/MISO
PB2/PCINT2/SCK/ADC1/T0
PB3/PCINT3/CLKI/ADC3
PB4/PCINT4/ADC2
PB5/PCINT5/RESET/ADC0/DW
GND
TINY13-20PU
JP1
RESET
R1
10K
U$1
PA2(/RESET)
(UCSK)PB7
(MISO)PB6
(MOSI)PB5
(OC1B)PB4
(OC1A)PB3
(OC0A)PB2
(AIN1)PB1
(AIN0)PB0
PA1(XTAL2)
PA0(XTAL1)
(ICP)PD6
(T1)PD5
(T0)PD4
VCC
(INT1)PD3
(INT0)PD2
(TXD)PD1
GND
(RXD)PD0
TINY2313-*P*
C5
0.1uf
Q1
16MHz
C1
22pF
C2
22pF
GND

Board

- Von der Schematic zur Board-Ansicht wechseln

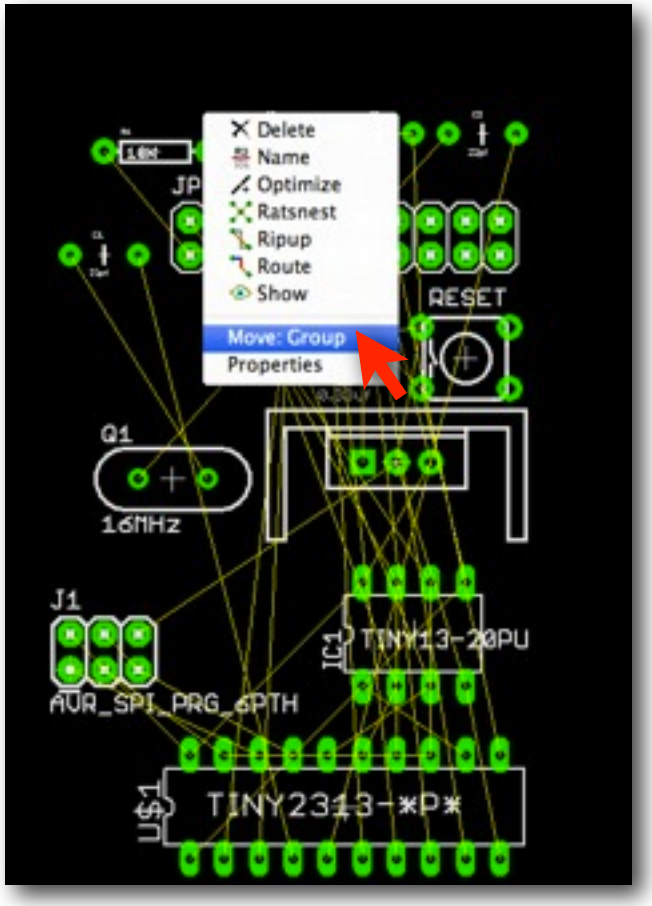




Zunächst ist alles verschoben!

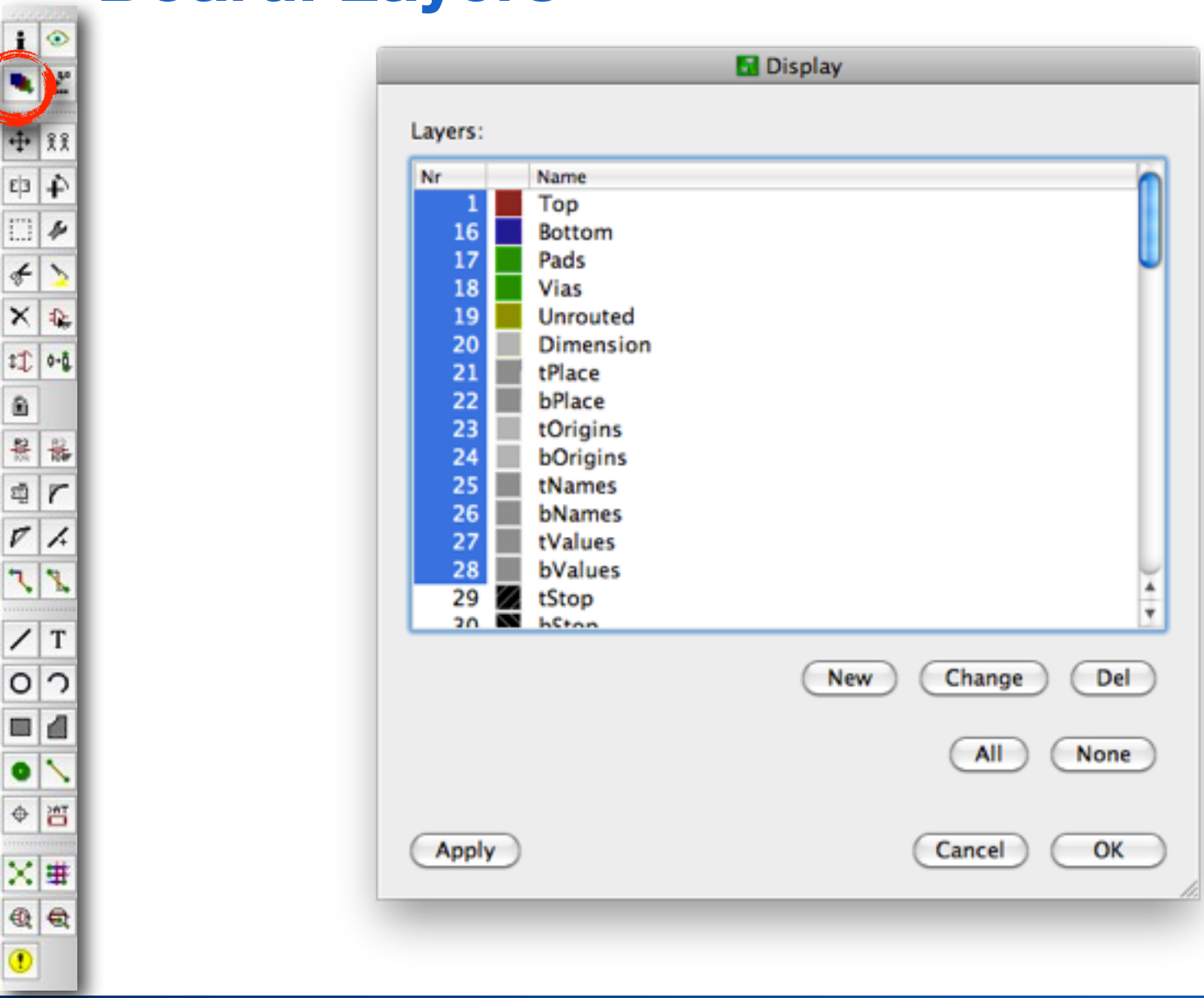
Board: Group Select & Move

- Gruppe Auswählen (ALT-F7)
- Move Auswählen (F7), Rechtsklick --> Group Move

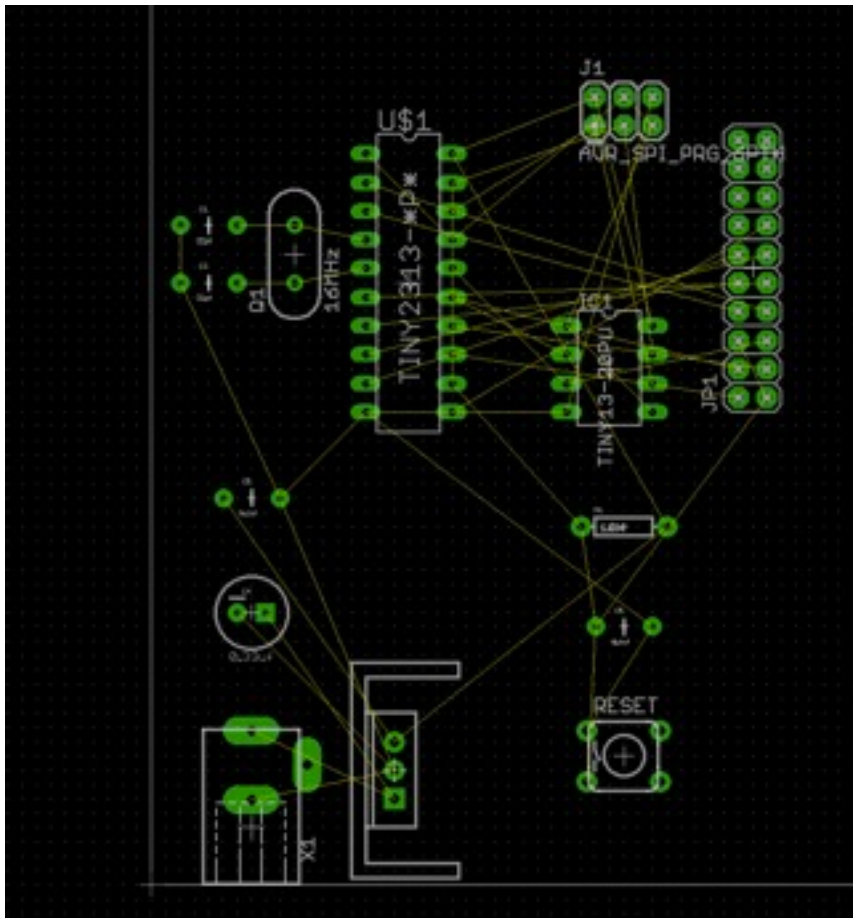


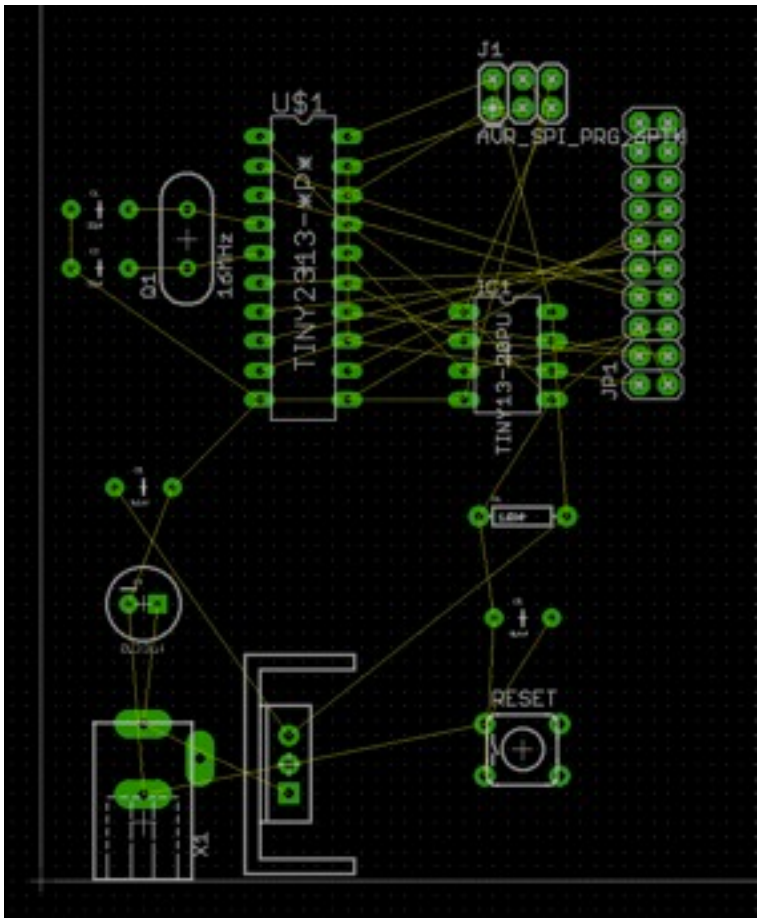
Gelb: “air wires”

Board: Layers

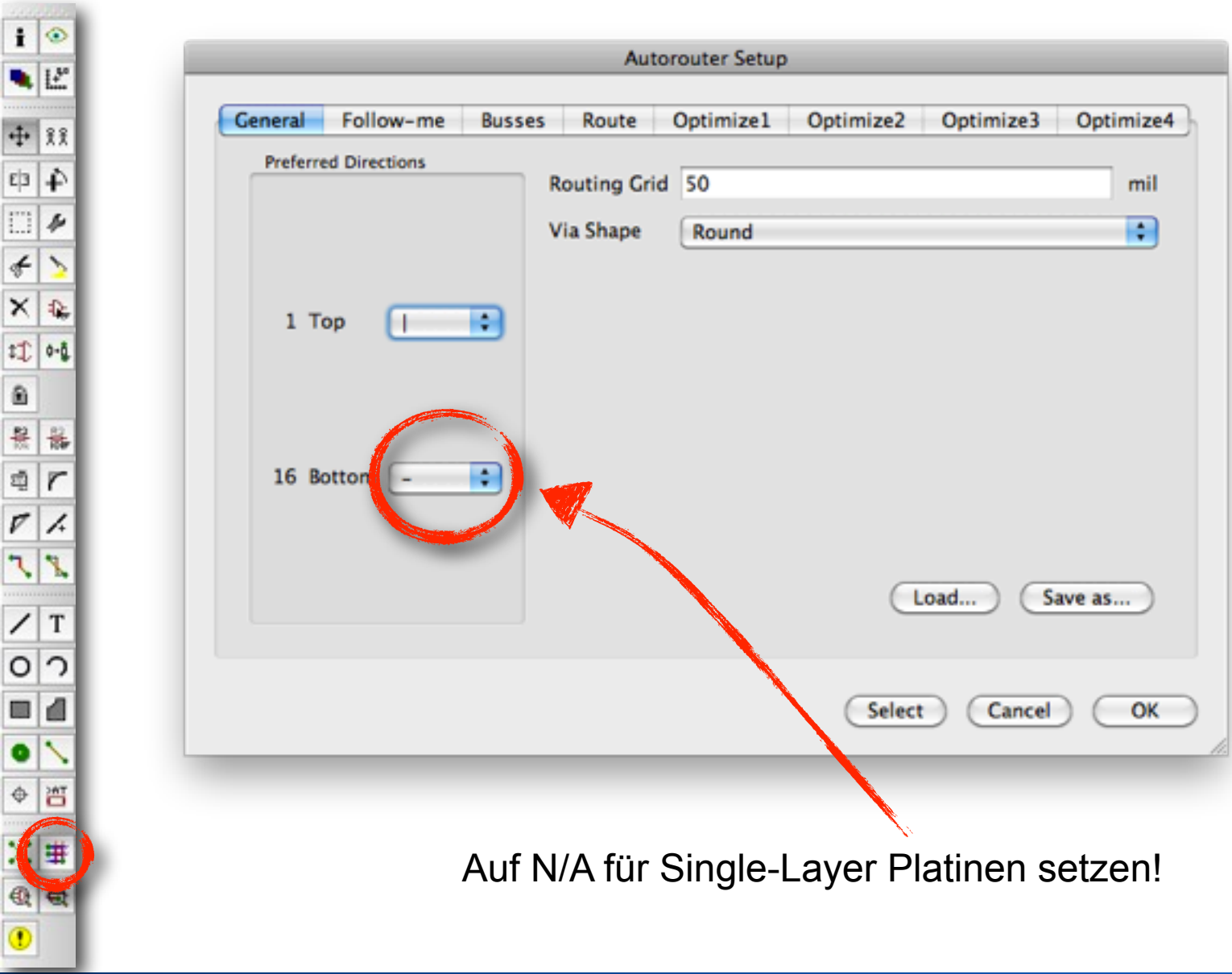


Board: Ratsnest



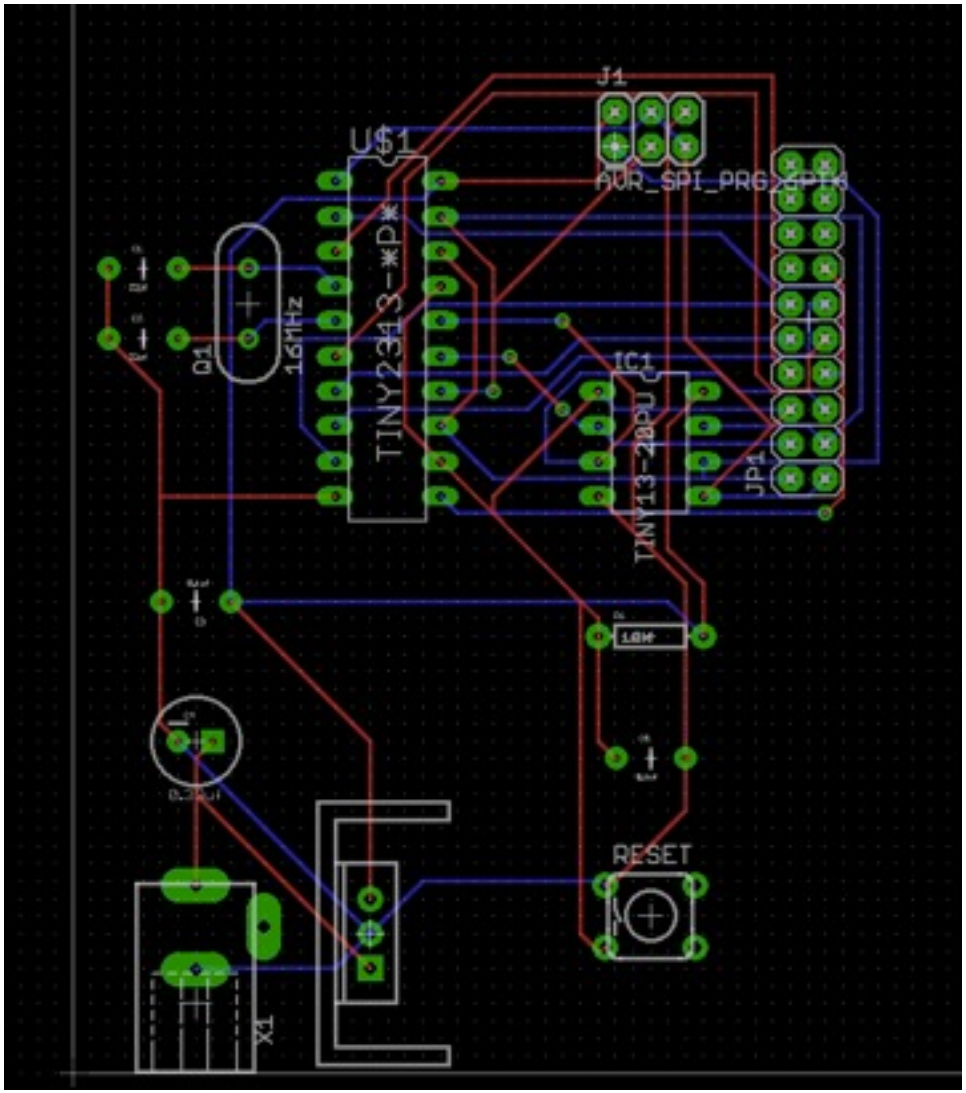


Board: AutoRouter



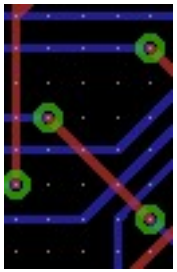
Auf N/A für Single-Layer Platinen setzen!

Board: Auto-Router



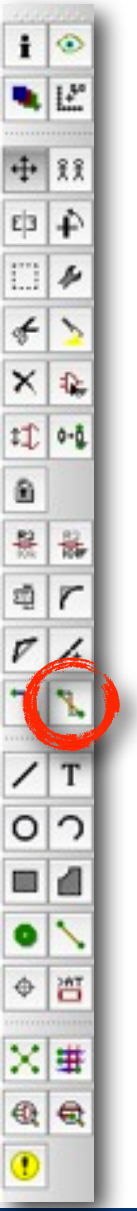
Top

Bottom



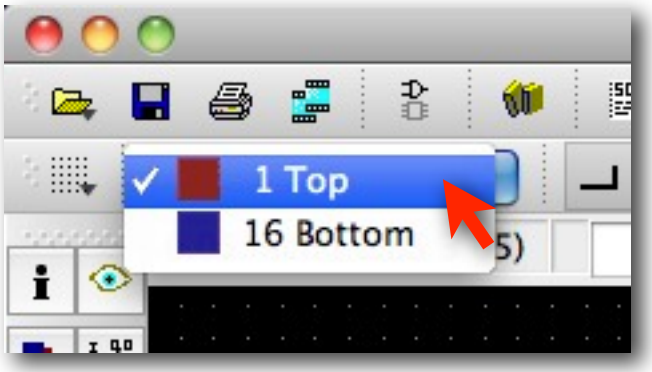
Vias

Board: Ripup Tool

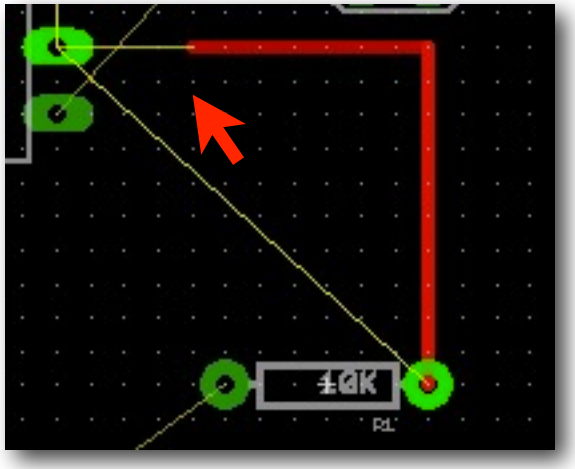


- Alle gelegten Verbindungen “Aufreißen”
- Auf Ripup Tool Clicken
- Dann auf “Ampel” Clicken

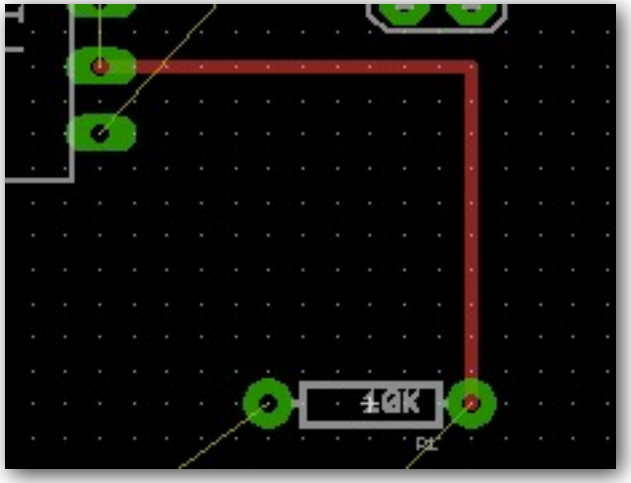
Board: Manuelles Routing



Layer Auswählen



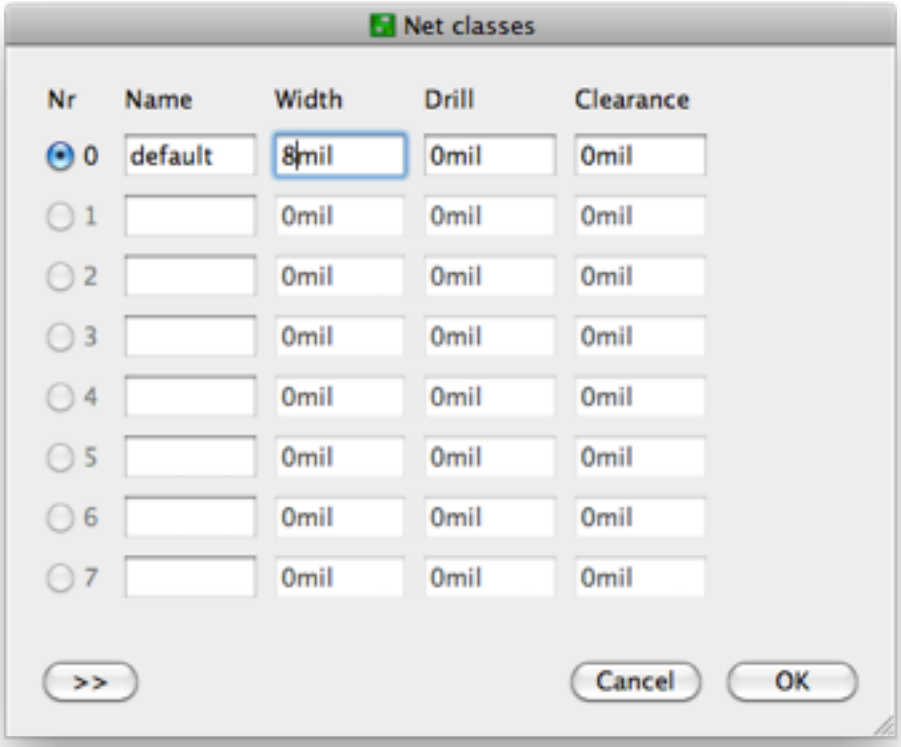
Verbindung ziehen



Fertige Verbindung

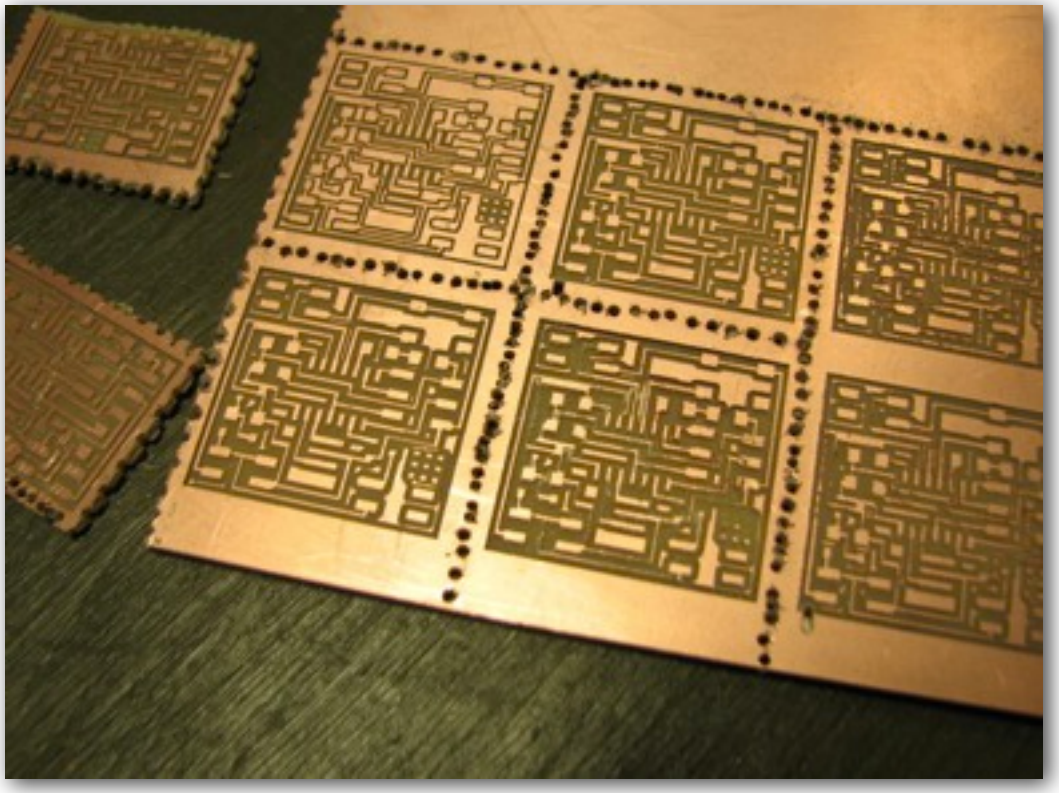
Board: Netzklassen

- Für unterschiedliche Leitungsstärken
- Edit --> net Classes

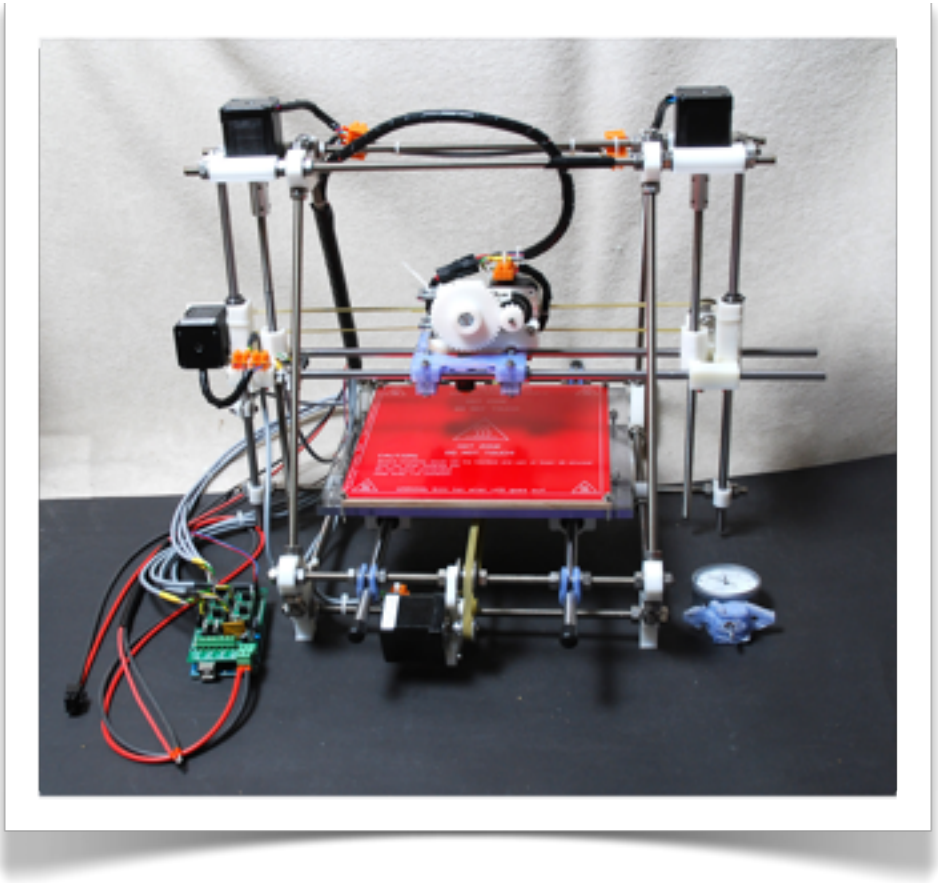


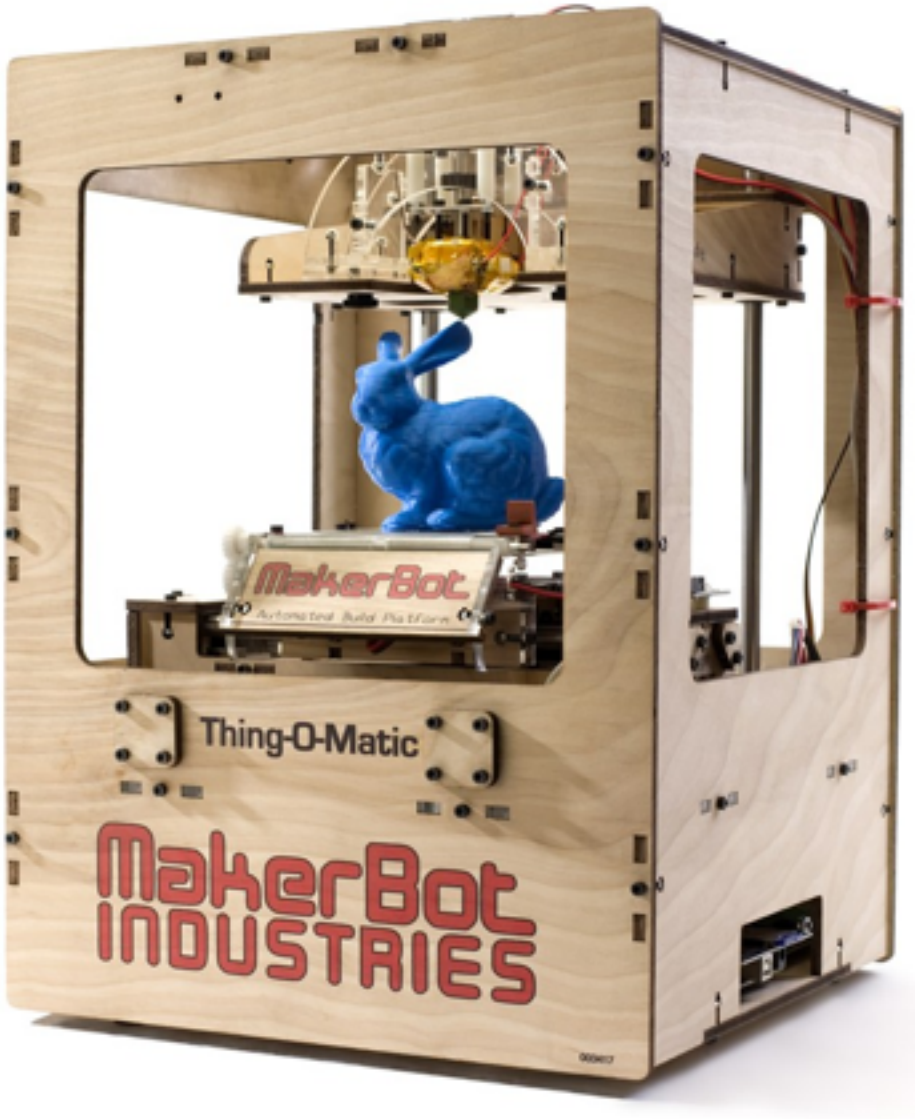
Fräsen

- Modela MDX-20
- Evil Genius AVR Projects --> Design Rules File
- CAM.py

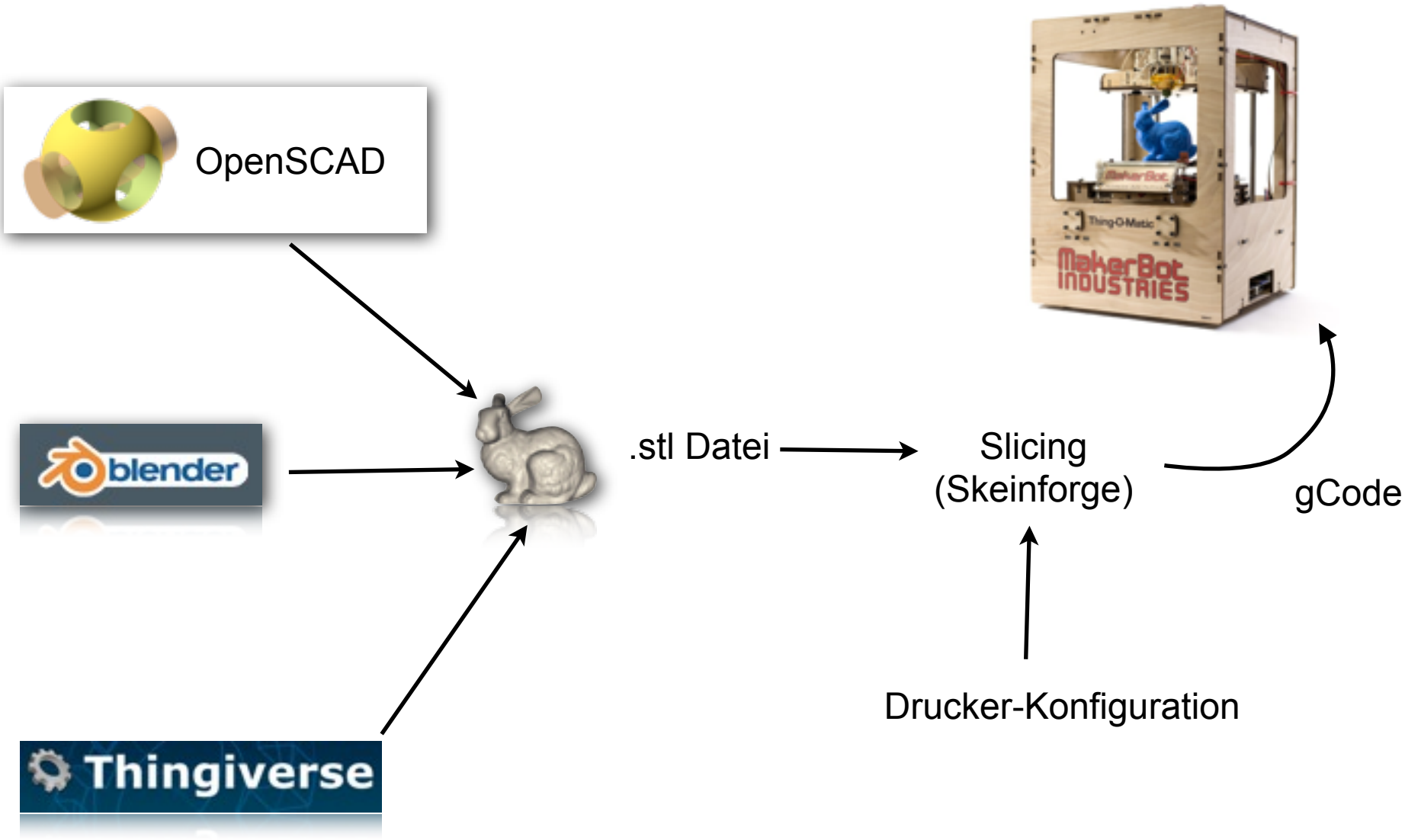


3D Drucker

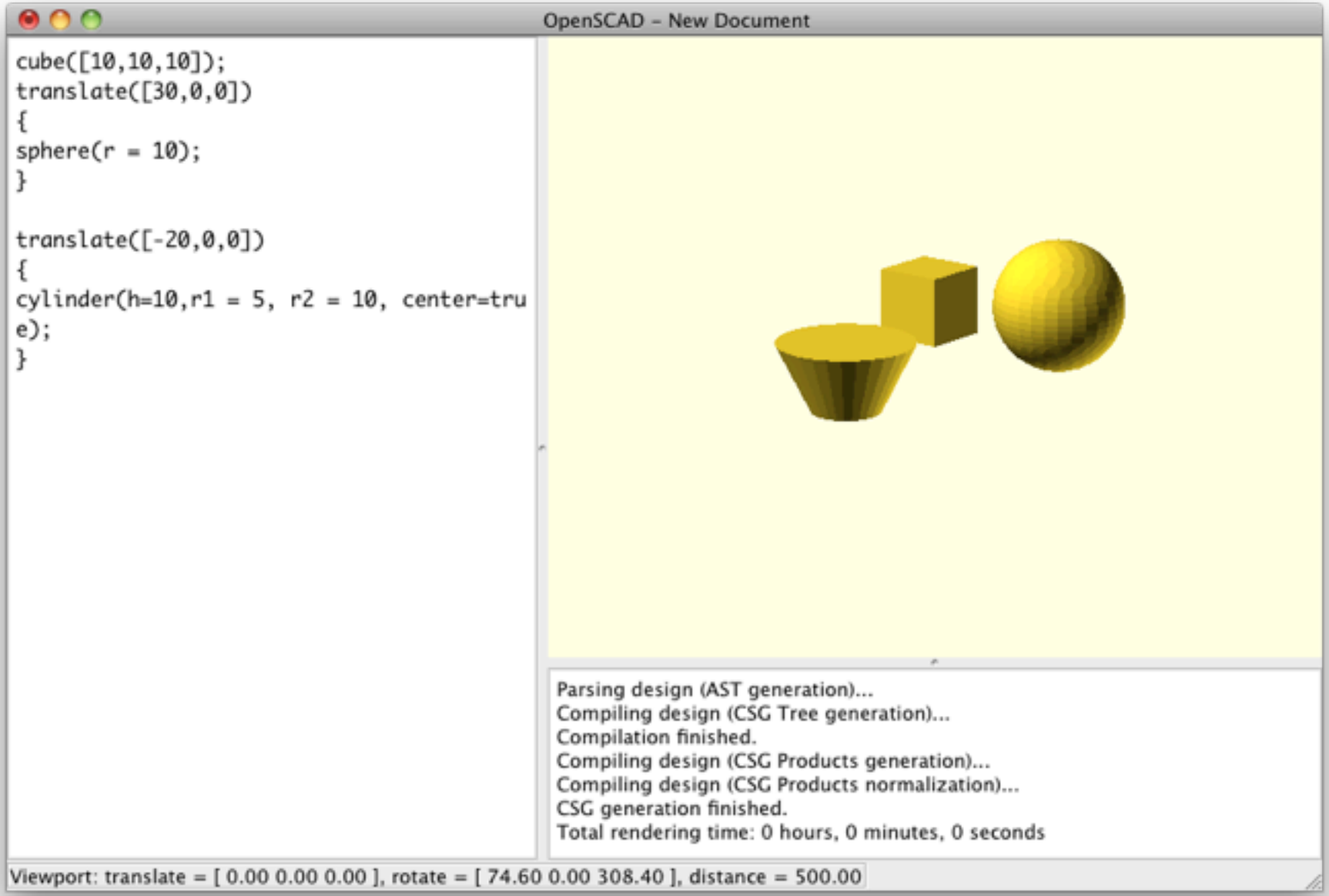




3D Drucker: Workflow



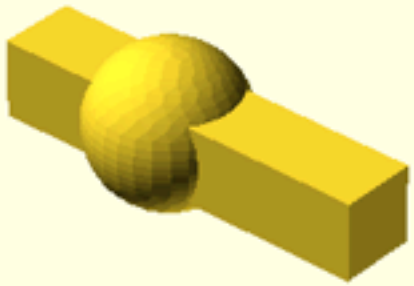
OpenSCAD


OpenSCAD – New Document
cube([10,10,10]);
translate([30,0,0])
{
sphere(r = 10);
}
translate([-20,0,0])
{
cylinder(h=10,r1 = 5, r2 = 10, center=tru
e);
}
Parsing design (AST generation)...
Compiling design (CSG Tree generation)...
Compilation finished.
Compiling design (CSG Products generation)...
Compiling design (CSG Products normalization)...
CSG generation finished.
Total rendering time: 0 hours, 0 minutes, 0 seconds
Viewport: translate = [0.00 0.00 0.00], rotate = [74.60 0.00 308.40], distance = 500.00

OpenSCAD: Constructive Solid Geometry

OpenSCAD – New Document

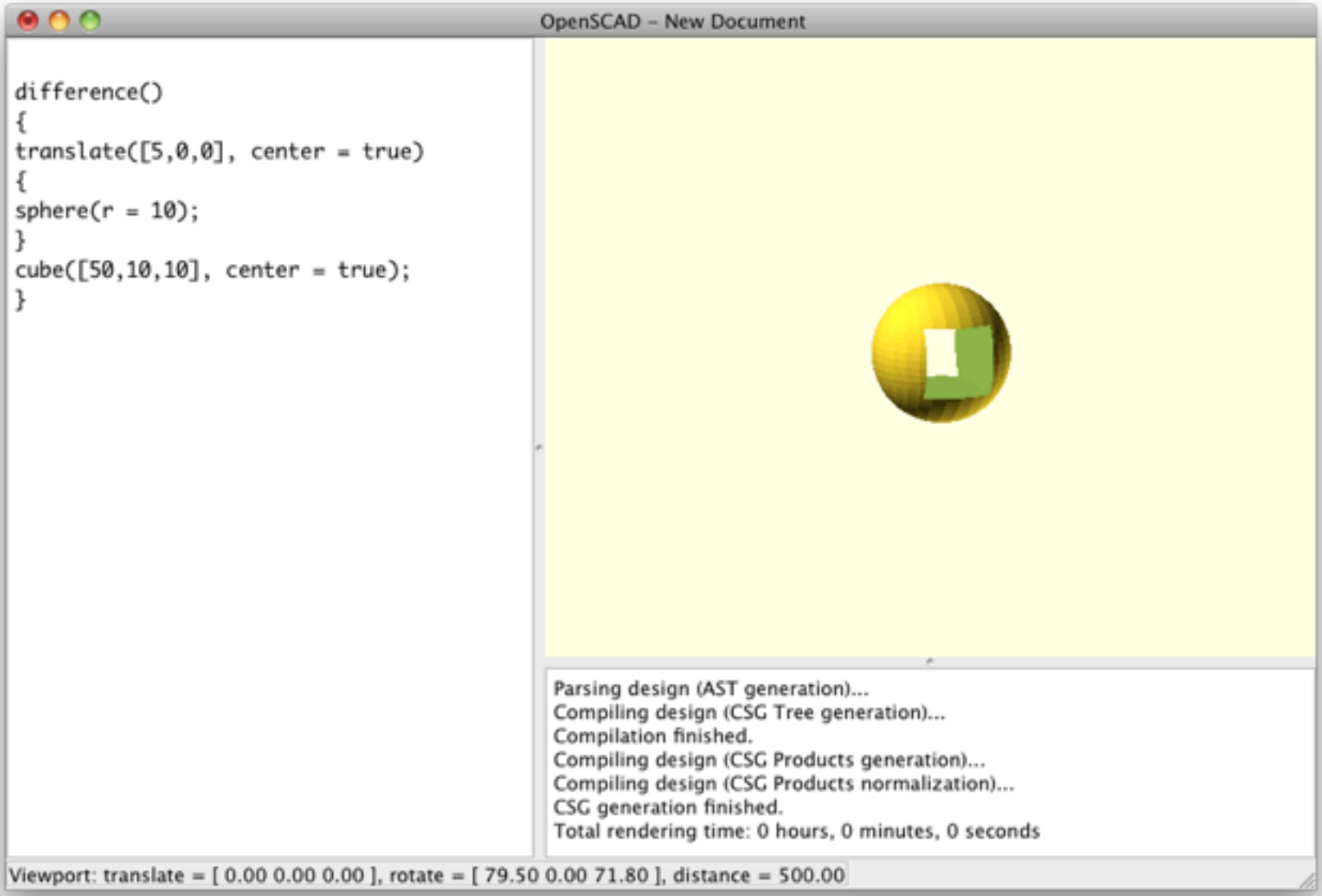
```
cube([50,10,10], center = true);
translate([5,0,0], center = true)
{
sphere(r = 10);
}
```



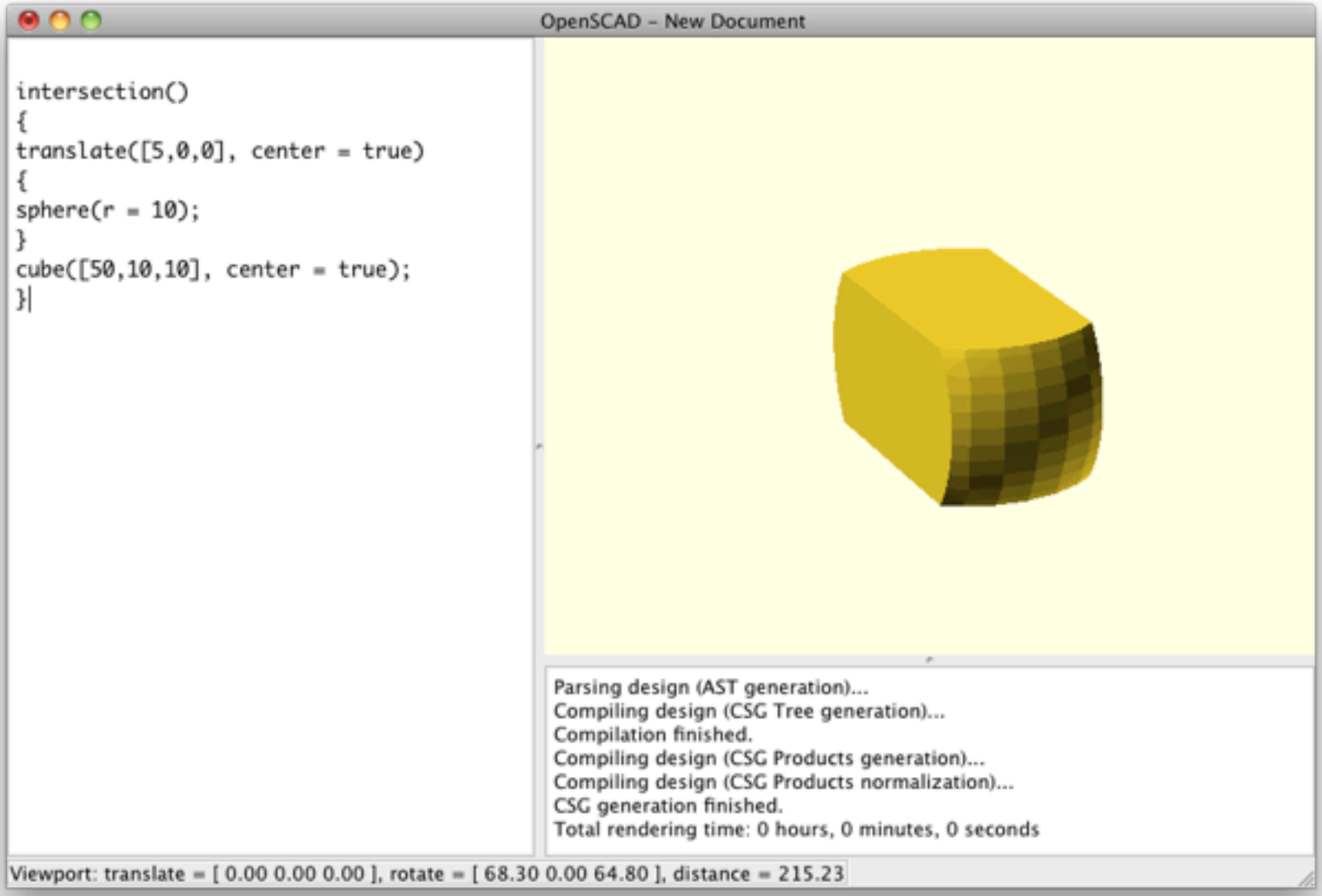
```
Parsing design (AST generation)...
Compiling design (CSG Tree generation)...
Compilation finished.
Compiling design (CSG Products generation)...
Compiling design (CSG Products normalization)...
CSG generation finished.
Total rendering time: 0 hours, 0 minutes, 0 seconds
```

Viewport: translate = [0.00 0.00 0.00], rotate = [56.40 0.00 220.90], distance = 500.00

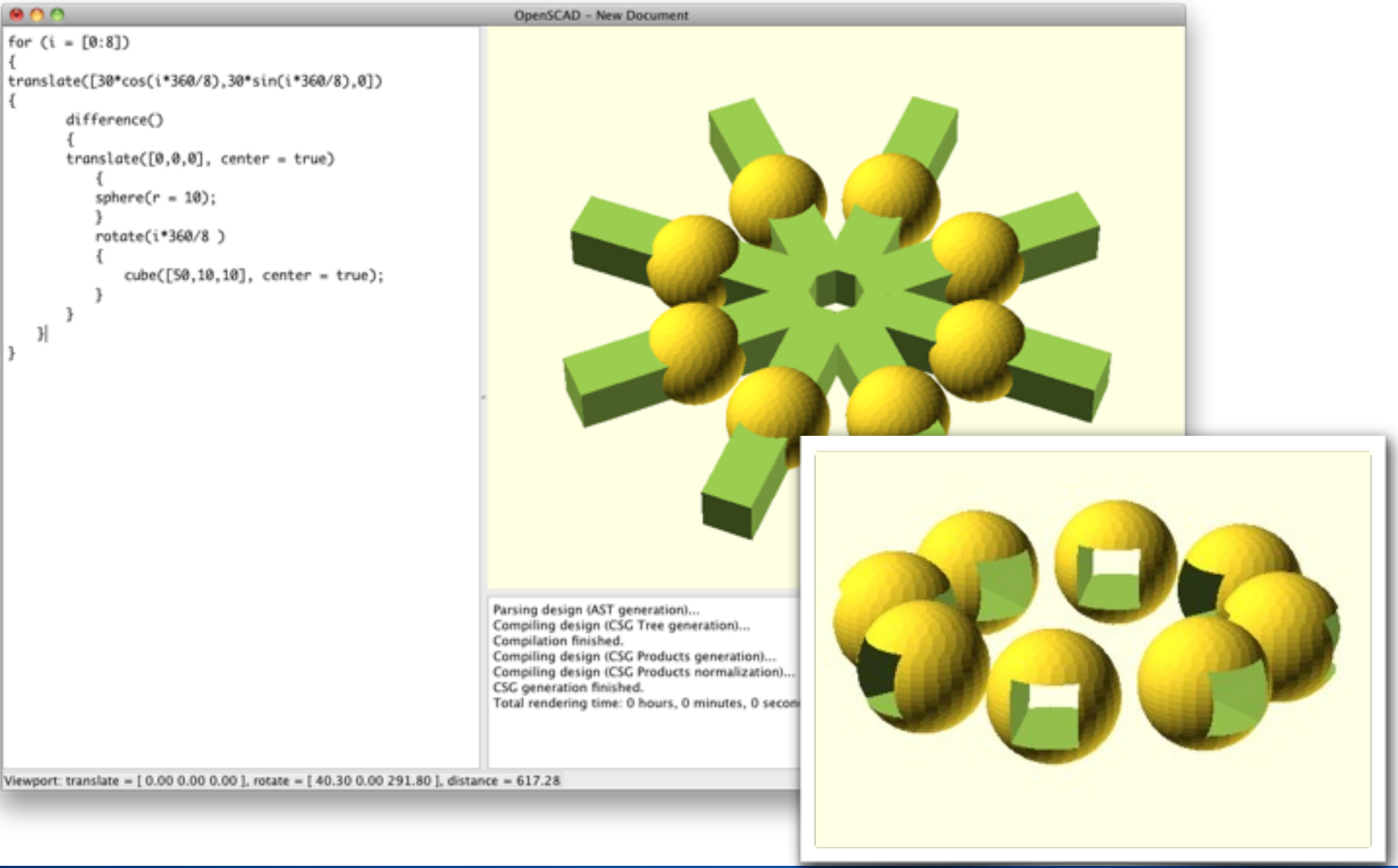
OpenSCAD: Constructive Solid Geometry



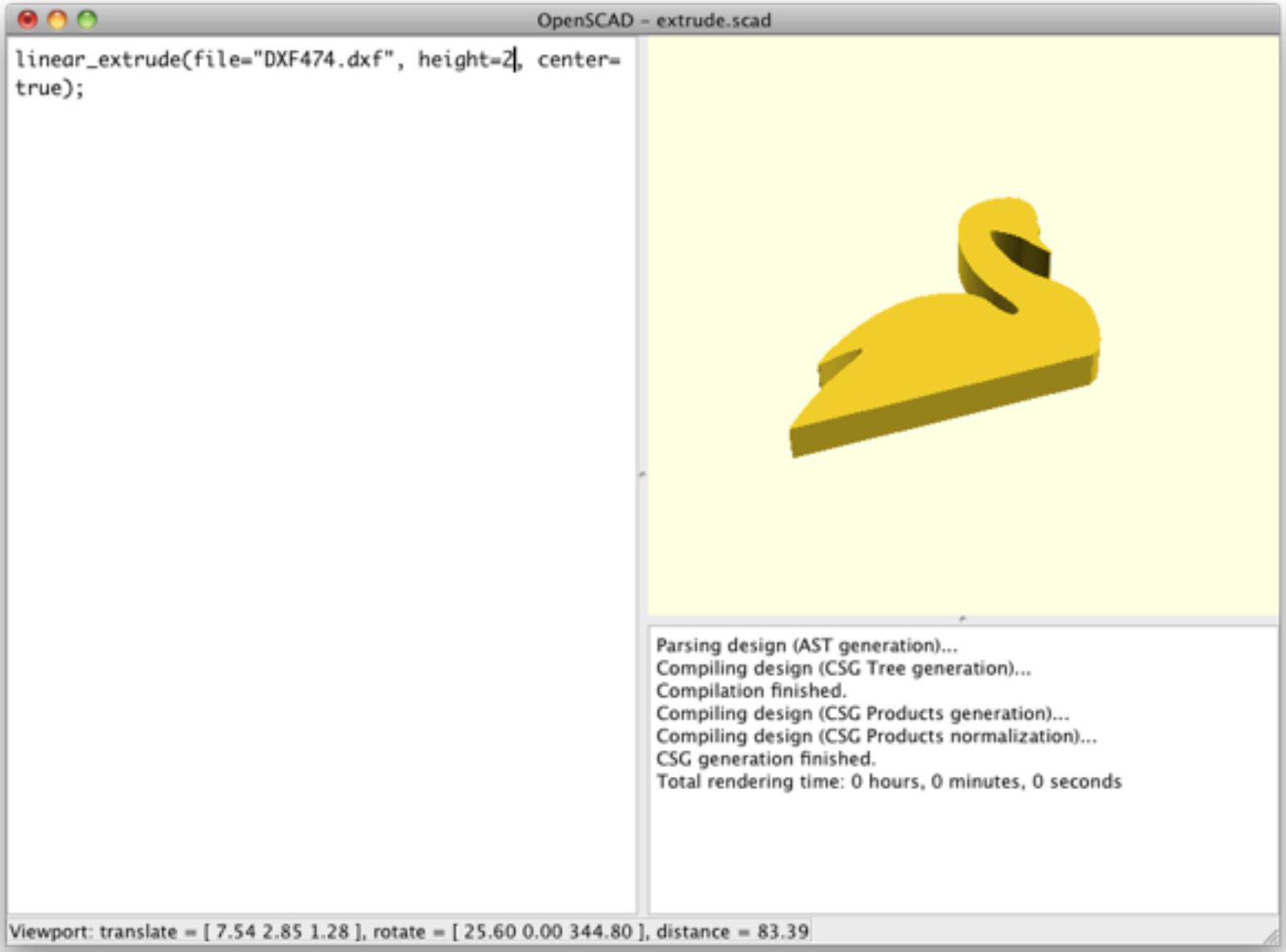
OpenSCAD: Constructive Solid Geometry



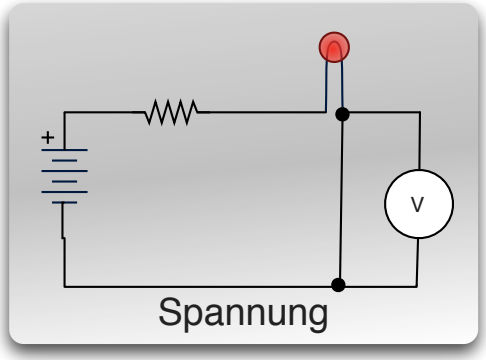
OpenSCAD: Iteration

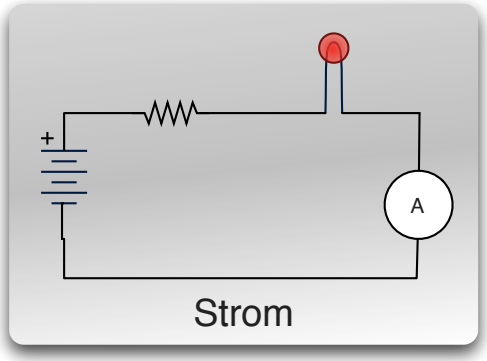


OpenSCAD: dxf Extrusion



Multimeter





∿ Wechselstrom (AC)

⎓ Gleichstrom (DC)

Schwarzes Messkabel immer auf COM

Strom (A, ma)

Spannung (V), Widerstand (Ohm),
Frequenz (Hz), Dioden