

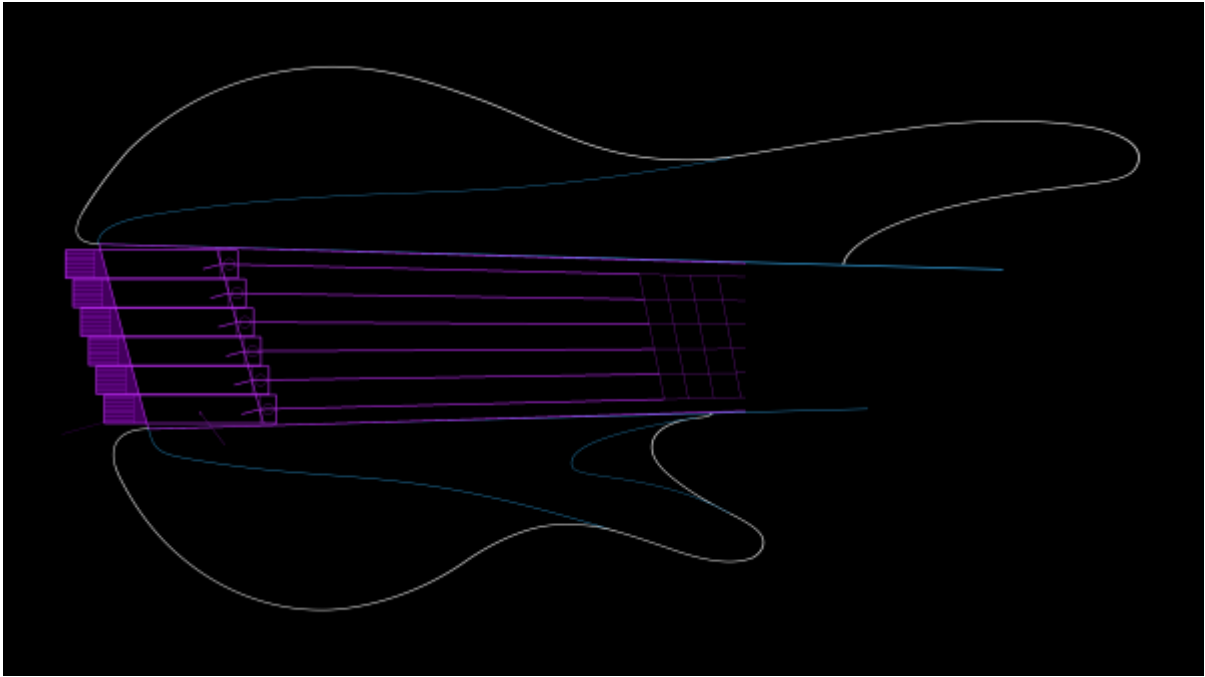
## Ressourcen

### Holz

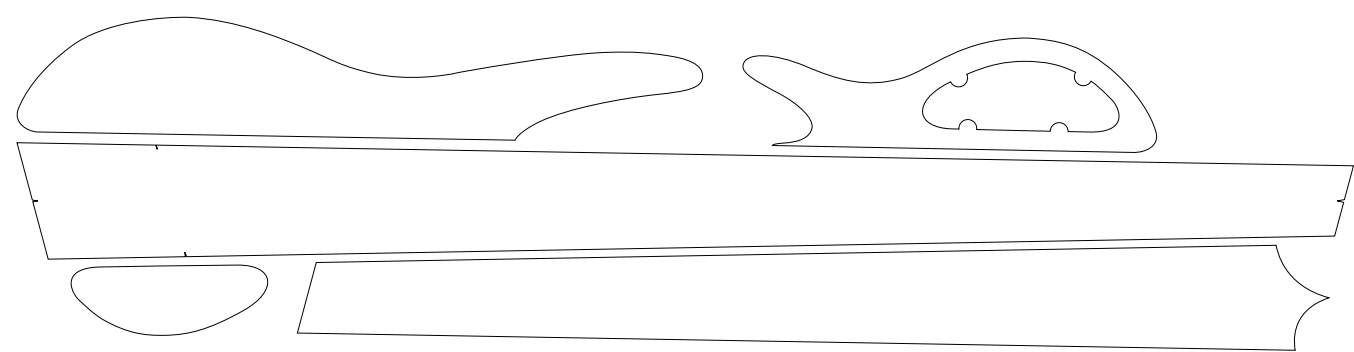
- Bubinga
- Ebenholz
- Mahagonie
- Wenge Furnier
- Walnuss Wurzelholz

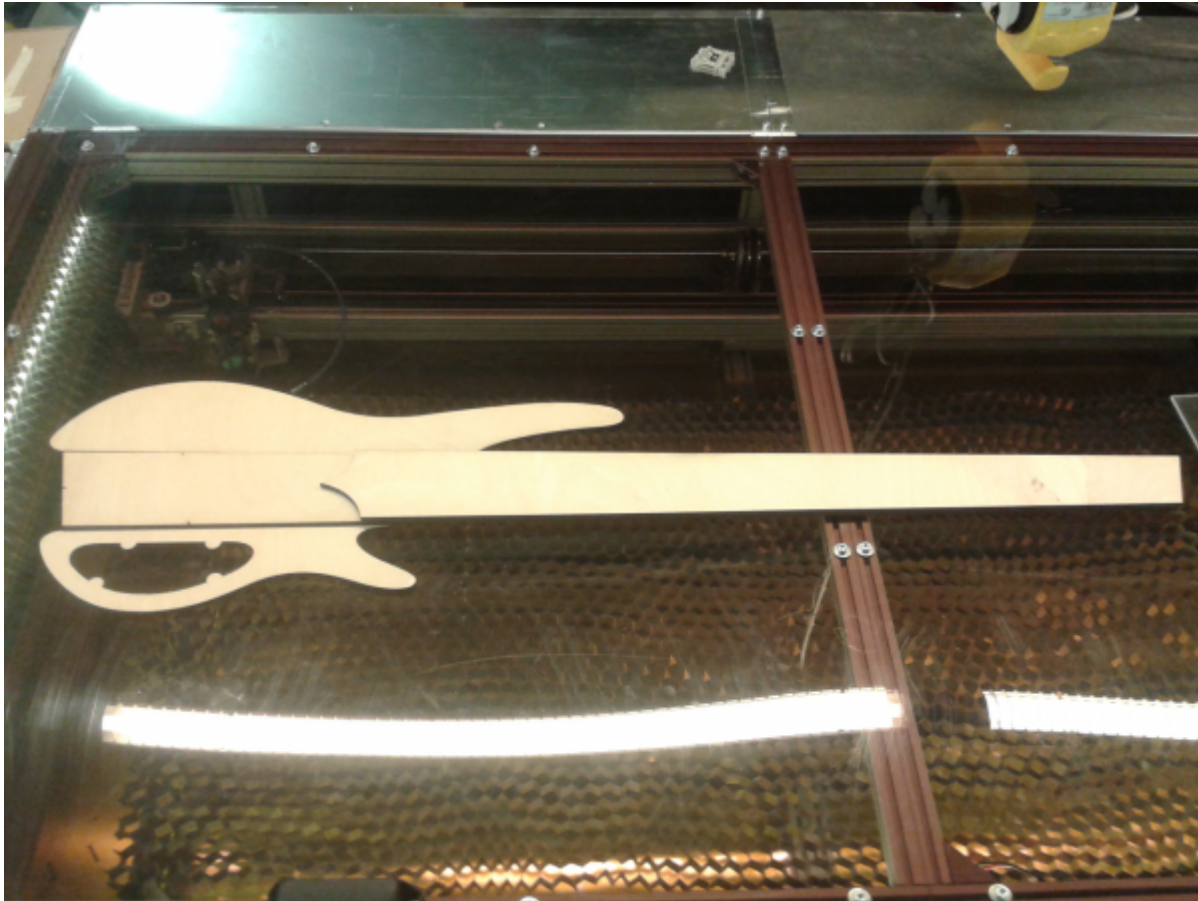


### Design



**Lasercutting Templates**

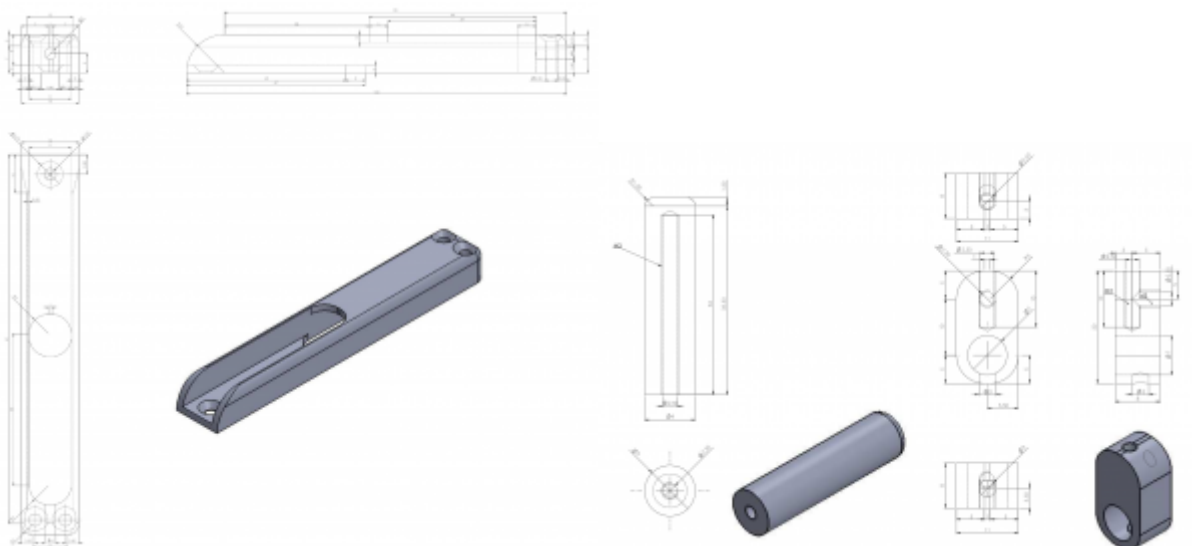




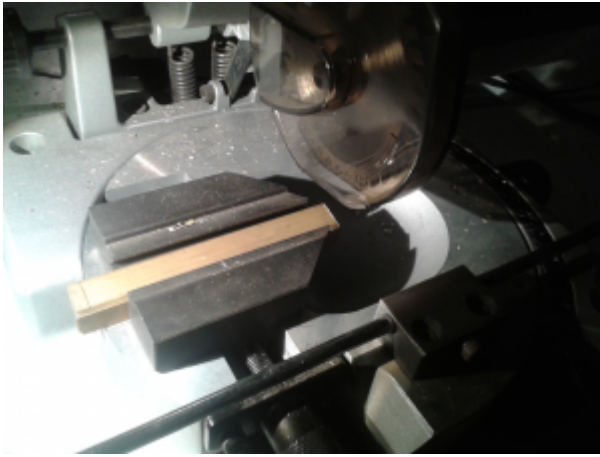
[Video](#)

## Mechanik

- CAD Design



- Messing Profile auf Maße kappen



- Fräsen, Drehen, Bohren, Senken, Schleifen, ...

[Video \(Prototyp\)](#)







- GCode:

Werkbett 1

%

(Creates a nice bed to place the workpiece)

G21 (using mm)

G40 (manual toolrad comp)

(Operation config)

#<z-safe> = 20 (safe height)

#<z-feed> = 0.5 (depth feed steps)

#<toolrad> = 4

#<feedrate> = 200

(Workpiece params)

#<width> = [15 + 0.5] (2 x .25mm margin for workpiece)

#<length> = [93.8 + 0.5] (2 x .25mm margin for workpiece)

#<depth> = -2

G00 X0 Y0 Z[#<z-safe>]

(Corners)

G00 X[#<width> \* 0.5] Y[#<length> \* 0.5]

G01 Z[#<depth>] F[#<feedrate>]

G00 Z[#<z-safe>]

G00 X[#<width> \* -0.5]

G01 Z[#<depth>] F[#<feedrate>]

G00 Z[#<z-safe>]

G00 Y[#<length> \* -0.5]

G01 Z[#<depth>] F[#<feedrate>]

G00 Z[#<z-safe>]

G00 X[#<width> \* 0.5]

G01 Z[#<depth>] F[#<feedrate>]

G00 Z[#<z-safe>]

(Return to Origin)

G00 X0 Y0 Z[#<z-safe>]

(Square)

G00 X[#<width> \* 0.5 - #<toolrad>]

G01 Z[#<depth>] F[#<feedrate>]

G01 Y[#<length> \* -0.5 + #<toolrad>] F[#<feedrate>]

G01 X[#<width> \* -0.5 + #<toolrad>] F[#<feedrate>]

G01 Y[#<length> \* 0.5 - #<toolrad>] F[#<feedrate>]

G01 X[#<width> \* 0.5 - #<toolrad>] F[#<feedrate>]

G01 Y0 F[#<feedrate>]

G00 Z[#<z-safe>]

(Return to Origin)

G00 X0 Y0 Z[#<z-safe>]

%

## Aussparung 1

%

(Creates the first, closed pocket)

G21 (using mm)

G40 (manual toolrad comp)

(Operation config)

#<z-safe> = 20 (safe height)

#<z-feed> = 0.25 (depth feed steps)

#<toolrad> = 4

#<feedrate> = 200

(Workpiece params)

#<wp\_length> = 93.8

#<width> = [12 + 0.2] (0.1mm margin on each side)

#<length> = 40

#<depth> = [8 + 1] (1mm safety margin)

#<steps> = [#<depth> / #<z-feed>]

G00 X0 Y0 Z[#<z-safe>]

G00 Y[#<wp\_length> \* 0.5 - #<toolrad> - 8] X[#<width> \* 0.5 - #<toolrad>]

#<current\_depth> = [#<depth>]

0101 repeat [#<steps>]

    #<current\_depth> = [#<current\_depth> - #<z-feed>]

    G01 Z[#<current\_depth>] F[#<feedrate> \* 0.05]

    G01 Y[#<wp\_length> \* 0.5 - #<toolrad> - #<length> - 8] F[#<feedrate>]

    G01 X[#<width> \* -0.5 + #<toolrad>] F[#<feedrate>]

    G01 Y[#<wp\_length> \* 0.5 - #<toolrad> - 8] F[#<feedrate>]

    G01 X[#<width> \* 0.5 - #<toolrad>] F[#<feedrate>]

0101 endrepeat

G00 Z[#<z-safe>]

(Return to Origin)

G00 X0 Y0 Z[#<z-safe>]

%

## Aussparung 2

%

(Creates a the second, open pocket)  
(flip workpiece with closed pocket facing down on the clamped side)

G21 (using mm)

G40 (manual toolrad comp)

(Operation config)

#<z-safe> = 20 (safe height)

#<z-feed> = 0.25 (depth feed steps)

#<toolrad> = 4

#<feedrate> = 200

(Workpiece params)

#<wp\_length> = 93.8

#<width> = [12 + 0.2] (0.1mm margin on each side)

#<length> = 46.9

#<depth> = [8 + 1] (1mm safety margin)

#<steps> = [#<depth> / #<z-feed>]

G00 X0 Y0 Z[#<z-safe>]

G00 Y[#<wp\_length> \* 0.5 + #<toolrad>] X[#<width> \* 0.5 - #<toolrad>]

#<current\_depth> = [#<depth>]

0101 repeat [#<steps>]

    #<current\_depth> = [#<current\_depth> - #<z-feed>]

    G01 Z[#<current\_depth>] F[#<feedrate>]

    G01 Y[#<wp\_length> \* 0.5 - #<toolrad> - #<length>] F[#<feedrate>]

    G01 X[#<width> \* -0.5 + #<toolrad>] F[#<feedrate>]

    G01 Y[#<wp\_length> \* 0.5 + #<toolrad>] F[#<feedrate>]

    G01 X[#<width> \* 0.5 - #<toolrad>] F[#<feedrate>]

0101 endrepeat

G00 Z[#<z-safe>]

(Return to Origin)

G00 X0 Y0 Z[#<z-safe>]

%

Seitliche Verrundung

%

(creates a bevel on the back side)



(clamp workpiece on open pocket)

G21 (using mm)

G40 (manual toolrad comp)

(Operation config)

#<z-safe> = 20 (safe height)

#<z-feed> = 0.25 (depth feed steps)

#<toolrad> = 4

#<feedrate> = 200

(Workpiece params)

#<wp\_width> = 15

#<depth> = [10 + 1] (1mm safety margin)

#<bevel> = 3

#<wp\_length> = [93.8 - #<bevel> + 2.5]

#<steps> = [#<depth> / #<z-feed> \* 0.5]

G00 X0 Y0 Z[#<z-safe>]

G00 Y[#<wp\_length> \* 0.5 + #<toolrad> - [#<bevel> + #<toolrad>]]

X[#<wp\_width> \* 0.5 + #<toolrad>]

#<current\_depth> = [#<depth>]

0101 repeat [#<steps>]

    #<current\_depth> = [#<current\_depth> - #<z-feed>]

    G01 Z[#<current\_depth> - 2] F[#<feedrate>]

    G03 X[#<wp\_width> \* 0.5 + #<toolrad> - [#<bevel> + #<toolrad>]]

Y[#<wp\_length> \* 0.5 + #<toolrad>] I[#<bevel> + #<toolrad>] \* -1]

F[#<feedrate>]

    G01 X[#<wp\_width> \* -0.5 - #<toolrad> + [#<bevel> + #<toolrad>]]

F[#<feedrate>]

    G03 X[#<wp\_width> \* -0.5 - #<toolrad>] Y[#<wp\_length> \* 0.5 + #<toolrad>  
- [#<bevel> + #<toolrad>]] J[#<bevel> + #<toolrad>] \* -1] F[#<feedrate>]

    #<current\_depth> = [#<current\_depth> - #<z-feed>]

    G01 Z[#<current\_depth> - 2] F[#<feedrate>]

    G02 X[#<wp\_width> \* -0.5 - #<toolrad> + [#<bevel> + #<toolrad>]]

Y[#<wp\_length> \* 0.5 + #<toolrad>] I[#<bevel> + #<toolrad>]] F[#<feedrate>]

    G01 X[#<wp\_width> \* 0.5 + #<toolrad> - [#<bevel> + #<toolrad>]]

F[#<feedrate>]

    G02 Y[#<wp\_length> \* 0.5 + #<toolrad> - [#<bevel> + #<toolrad>]]

X[#<wp\_width> \* 0.5 + #<toolrad>] J[#<bevel> + #<toolrad>] \* -1]

F[#<feedrate>]

0101 endrepeat

```
G00 Z[#<z-safe>]

(Return to Origin)
G00 X0 Y0 Z[#<z-safe>]

%
```

## Werkbett 2

```
%

(Creates a nice bed to place the workpiece)

G21 (using mm)
G40 (manual toolrad comp)

(Operation config)
#<z-safe> = 20 (safe height)
#<z-feed> = 0.5 (depth feed steps)
#<toolrad> = 4
#<feedrate> = 200

(Workpiece params)
#<width> = [10 + 0.5] (2 x .25mm margin for workpiece)
#<length> = [93.8 + 0.5] (2 x .25mm margin for workpiece)
#<depth> = -2

G00 X0 Y0 Z[#<z-safe>]

(Corners)

    G00 X[#<width> * 0.5] Y[#<length> * 0.5]
    G01 Z[#<depth>] F[#<feedrate>]
    G00 Z[#<z-safe>]

    G00 X[#<width> * -0.5]
    G01 Z[#<depth>] F[#<feedrate>]
    G00 Z[#<z-safe>]

    G00 Y[#<length> * -0.5]
    G01 Z[#<depth>] F[#<feedrate>]
    G00 Z[#<z-safe>]

    G00 X[#<width> * 0.5]
    G01 Z[#<depth>] F[#<feedrate>]
    G00 Z[#<z-safe>]
(Return to Origin)
G00 X0 Y0 Z[#<z-safe>]

(Square)
```

```

G00 X[#<width> * 0.5 - #<toolrad>]
G01 Z[#<depth>] F[#<feedrate>]
G01 Y[#<length> * -0.5 + #<toolrad>] F[#<feedrate>]

G01 X[#<width> * -0.5 + #<toolrad>] F[#<feedrate>]
G01 Y[#<length> * 0.5 - #<toolrad>] F[#<feedrate>]
G01 X[#<width> * 0.5 - #<toolrad>] F[#<feedrate>]
G01 Y0 F[#<feedrate>]

G00 Z[#<z-safe>]
(Return to Origin)
G00 X0 Y0 Z[#<z-safe>]

%
```

## Vordere Verrundung

```

%

(Creates the second bevel on the front side)
(flip workpiece with closed pocket facing down on the clamped side)

G21 (using mm)
G40 (manual toolrad comp)

(Operation config)
#<z-safe> = 20 (safe height)
#<z-feed> = 0.25 (depth feed steps)
#<toolrad> = 4
#<feedrate> = 200

(Workpiece params)
#<wp_length> = 88
#<wp_width> = 10
#<depth> = [15 + 1] (1mm safety margin)
#<bevel> = [10 + #<toolrad>]

#<steps> = [#<depth> / #<z-feed> * 0.5]

G00 X0 Y0 Z[#<z-safe>]

G00 Y[#<wp_length> * 0.5 + #<toolrad> - #<bevel>] X[#<wp_width> * 0.5 +
#<toolrad>]

#<current_depth> = [#<depth>]

0101 repeat [#<steps>]

    #<current_depth> = [#<current_depth> - #<z-feed>]

    G01 Z[#<current_depth> - 2] F[#<feedrate>]
```

```

    G03 X[#<wp_width> * 0.5 + #<toolrad> - #<bevel>] Y[#<wp_length> * 0.5 +
#<toolrad>] I[#<bevel> * -1] F[#<feedrate>]
    #<current_depth> = [#<current_depth> - #<z-feed>]

    G01 Z[#<current_depth> - 2] F[#<feedrate>]
    G02 X[#<wp_width> * 0.5 + #<toolrad>] Y[#<wp_length> * 0.5 + #<toolrad>
- #<bevel>] J[#<bevel> * -1] F[#<feedrate>]

0101 endrepeat

G00 Z[#<z-safe>]

(Return to Origin)
G00 X0 Y0 Z[#<z-safe>]
%
```

- Kopfstück designen
- Fräsen, Bohren
- Auf Halsprofil anpassen (Feilen)

## Hals

- Trussrod Kanal fräsen



- Template mit Lasersaur schneiden ✓
- Grob mit Band- oder Stichsäge zusägen ✓
- Feinarbeit mit Kopierfräser and der Unterfräse ✓
- ...



## Korpus

- Template mit Lasersaur schneiden ✓
- Grob mit Band- oder Stichsäge zusägen ✓
- Bubinga Flügel:
  - ~~Kammern mit Forstner Bohrern an der Bohrpresse verteilen~~
  - Aussparung für Elektronik fräsen → CNC
    - GCode mit inkscape erzeugen und editieren: ✓

%

G21 (using mm)

G40 (manual toolrad comp)

#<feed\_rate> = 400.000000 (Feed definition)

#<z\_feed\_rate> = 100.000000 (Feed definition)

#<depth> = 32 (Pocket depth)

#<z\_feed> = 0.5

#<z\_offset> = [-1 \* #<depth>] (Z axis offset)

#<x\_offset> = 0 (X axis offset)

#<y\_offset> = 0 (Y axis offset)

#<z\_safe> = [30 - #<z\_offset>]

G00 Z[#<z\_safe> + #<z\_offset>]

#<steps> = [#<depth> / #<z\_feed>]

#<current\_depth> = [#<depth>]

0101 repeat [#<steps>]

#<current\_depth> = [#<current\_depth> - #<z\_feed>]

G01 X[32.054936 + #<x\_offset>] Y[22.882033 + #<y\_offset>]

```

G01 Z[ #<current_depth> + #<z_offset>] F [ #<z_feed_rate>](Penetrate)

...

G01 X[-19.484225 + #<x_offset>] Y[16.651272 + #<y_offset>] Z[
#<current_depth> + #<z_offset>]

0101 endrepeat

G00 Z[#<z_safe> + #<z_offset>]
G00 X0 Y0
%
```

- Fräsen <https://www.youtube.com/watch?v=IJDeGeCIE6Y>  
<https://www.youtube.com/watch?v=X-4hhXkSM1g>
- Walnuss Wurzelholz Top:
- Resawing (in 10mm dicke Bretter sägen) ✓



- evtl. mit Epoxy stabilisieren (Astlöcher) ✓





- Walnuss Wurzelholz Decke und Bubinga Flügel verleimen ✓



- Feinarbeit mit Kopierfräser an der Unterfräse
  - Im Kampf Fräse gegen Bubinga gewann meistens dann doch das Holz: Sehr dicht, Extrem lange Fasern und sehr spröde ... -> Trommelschleifer ✓



- Flügel mit Hals verleimen



## Pickups

- 3D Drucken
- Wickeln
- mit 2/3 Bienenwachs/Paraffin einkapseln um mikrofonische Effekte zu verhindern
- Ausmessen (Spectrum Analyzer?)

## Elektronik

- Passiv/Aktiv?
- DSP?

## Griffbrett

- Oberfläche glatt hobeln ✓



- Template Lasern ✓
- Grob zusägen an der Bandsäge ✓
- Feinschliff mit Kopierfräser ✓
- Mit Hals verleimen
- Schnitte für Bünde/Furnierstreifen
  - Radius (<http://en.wikipedia.org/wiki/Fingerboard#Parameters>):
  - konstant (12,,) mit Schleifklotz erzeugen
  - Konisch mit Schlitten und Oberfräse

## Finish

- Hartwachsöl (Selber mischen oder Osmo High Solid)

## Weiterführende Links

- [Thread auf TalkBass](#)