System Driven Hardware Design

- Schematic / Layout / Breadboard-

LabExcesize 1

International Master of Science

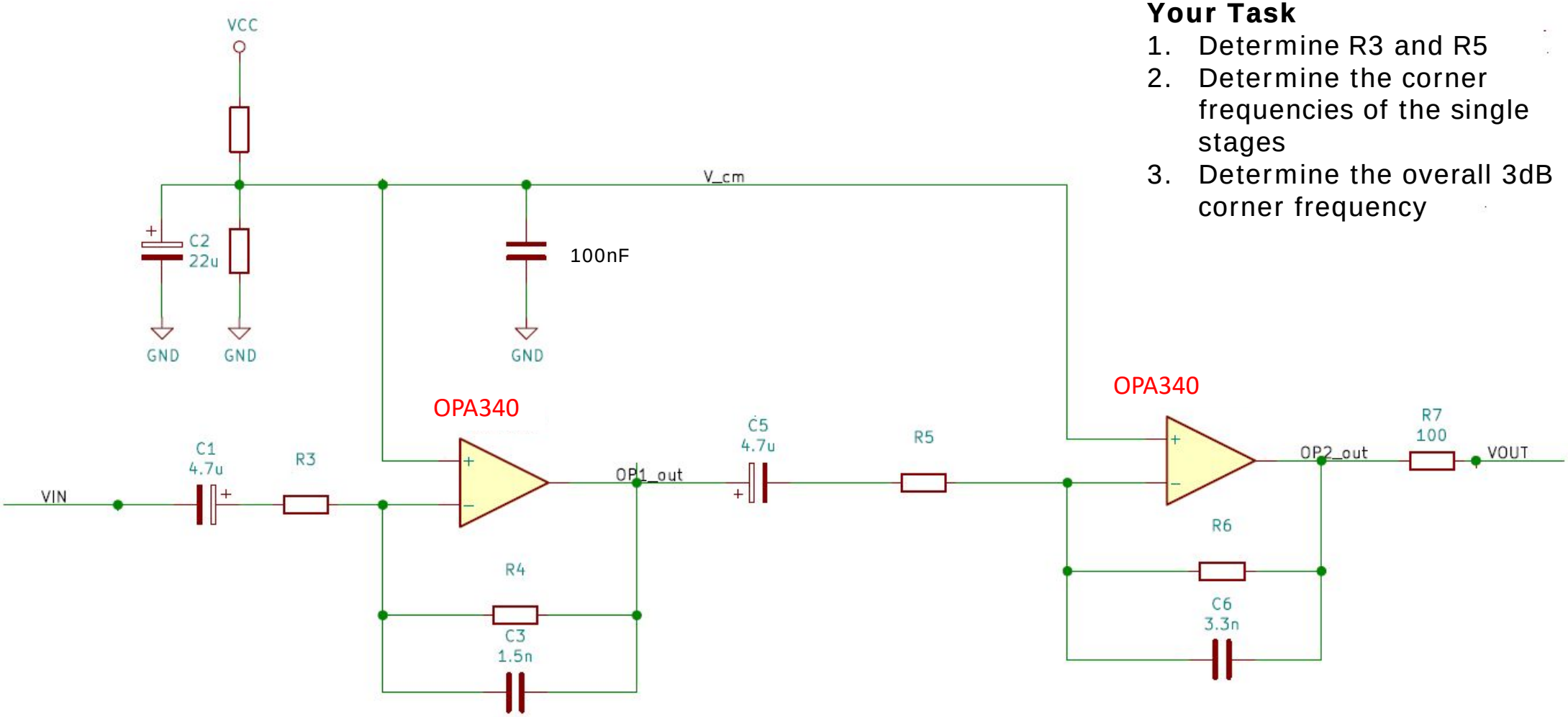
Prof. Dr.-Ing. Stephan Bannwarth

SS23

Agenda

- Amplifier Schematic
- PCB Constraints
- Tasks
- Scoring Scheme
- Breadboard

Schematic Capture: Amplifier: 4th order Bandpass



Your Task

1. Determine R3 and R5
2. Determine the corner frequencies of the single stages
3. Determine the overall 3dB corner frequency

A=100,
R4= 220k

A=3
R6=100k

Agenda

- Amplifier Schematic
- PCB Constraints
- Tasks
- Scoring Scheme
- Breadboard

PCB and Electronic Constraints

Amplifier
- Think about which signals should get a testpoint and write them down
- Used Device: OPA340
- Use the Operational Amplifier in a DIL8 Package
- Use an DIL8 Socket for the OpAmp

Power Supply
- Derive the Power Supply form the FreeSoc2
- Use a red LED as a control for the power supply

Hardware-Constraints
- Use a 3 pin 90° connector (i.e. connector is parallel to your board) to connect the PCB with the radar sensor

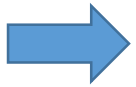
Digital Part
- Insert a Push-Button
- Use 3 LEDs (red – yellow – green) as digital control LEDs

Technology
- Use through hole technology (THT) all components.
- Use E24 series for the resistors in THT.

PCB
- Use the Arduino UNO Shield Template from KiCad. See the HowTo in Moodle.
- Separate Analog and Digital Ground as good as possible
- Stay inside the market area of the Arduino shield with your components
- Work with a 4 layer PCB: Signal – GND – Power - Signal
- Fill out the PCB Specification (Link / Elekonta Webpage)
- **Only use** PTH Vias: vias size 0.8mm with via drill 0.4mm
- **Minimum track width**: 0.20 mm
- **Do not use** buried vias or blind vias

PCB and Electronic Constraints: Pin-Mapping

		Pin Mapping	
Lfd.Nr	Adruino - Cape / Function	Adruino	FreeSoc2
1		D0	P[2]0
2		D1	P[2]1
3		D2	P[2]2
4		D3	P[2]3
5	LED1 (green)	D4	P[2]4
6	LED2 (ornage)	D5	P[2]5
7	LEDe (redd)	D6	P[2]6
8	Push Button	D7	P[2]7
9		D8	P[12]4
10		D9	P[12]5
11		D10	P[6]4
12		D11	P[6]5
13		D12	P[6]6
14		D13	P6[7] & Red Use
15		GND	GND
16		AREF	NC
17		SDA	P[6]1
18		SCL	P[6]0
19		NC	NC
20		IOREF	VDDIO_Arduino/
21		Reset	nReset/2 &P[12]
22		3.3V	3.3V
23		5V	5V
24		GND	GND
25		GND	GND
26		Vin	Vin/2
27	Vout (Ampliffier out)	A0	P15[5]
28		A1	P[15]4



See Moodle for Full Table

Agenda

- Amplifier Schematic
- PCB Constraints
- Tasks
- Scoring Scheme
- Breadboard

PCB and Electronic Constraints

Moodle
- Use the Project template

Tasks
- Requirement Specification for the Bandpass Design
- Design the Bandpass based on the expected input frequencies and amplitude range
- Calculate the resistors for the Amplifier based on the gain and bandwidth, use the E24 series
- Design the PCB in KiCad

Deliverables
- KiCad-Project
- Gerberfiles
- BOM

… in a zip-archive as done in the KiCad Training and descirbed in the project template

Upload – Deadline

→ See Moodle ←

Agenda

- Amplifier Schematic
- PCB Constraints
- Tasks
- Scoring Scheme
- Breadboard

PCB Development - Scoring

No Copy and Paste From Others: 0%.
All similar boards are dismissed.

40%: Schematic correct and Working Layout,
For example and not limited to:

Mechanical: Board Size correct, Mounting holes in position
ERC free
DRC free
Project Info on Silk layer
All components used and correct footprints used
Mounting and Integration possible
Using the right grid and staying in one for components placing
Project can be opened

60%: Well grouped schematic and layout, for example and not limited to:

All Constraints are fulfilled
Board filling is correct
Clean connection, no extra edges and turns in the tracks
Schematic
- Grouped by sub functions
- Test- and ground pins defined

Layout
- Grouped subcomponents
- Tracks as short as possible

70%: Clean design with minor issues, for example and not limited to:

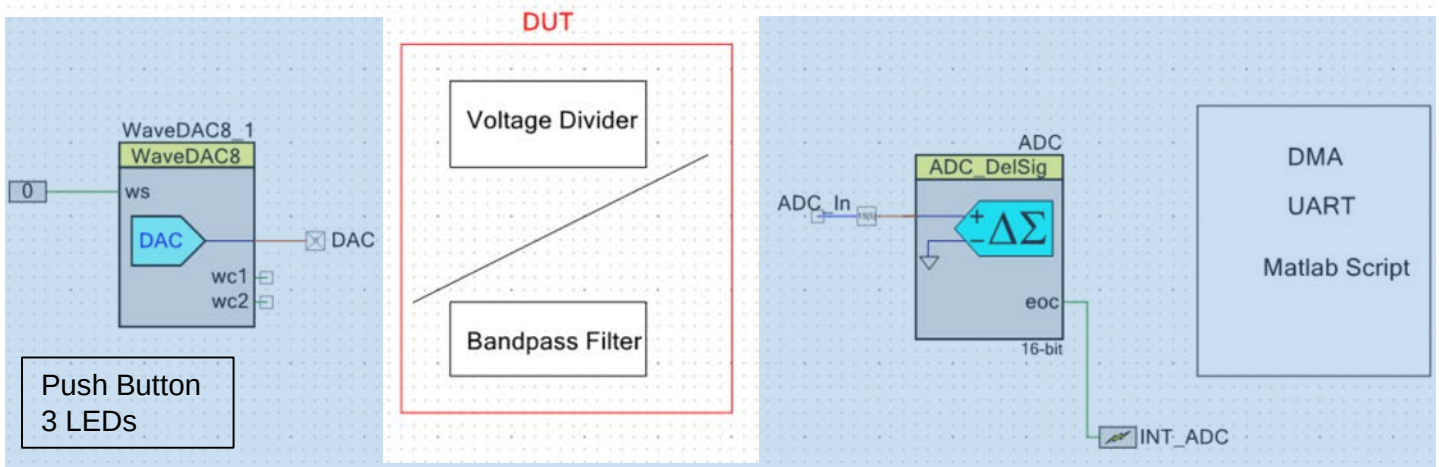
No Minimum tracks width
Layers used as declared
Silk layer: more than minimum Spacing
No fragile connections to solder points
Good ground connection to IC
Short distance to stabilizing caps

80%-100%: Your ideas beyond the said and further considerations.

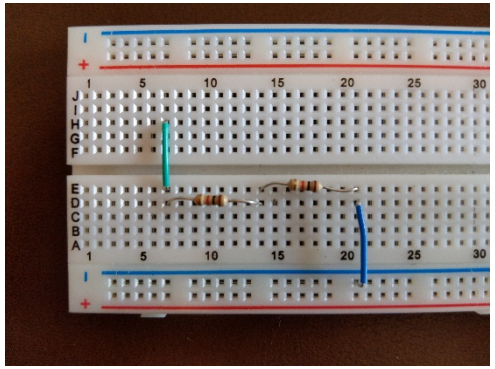
Agenda

- Amplifier Schematic
- PCB Constraints
- Tasks
- Scoring Scheme
- Breadboard

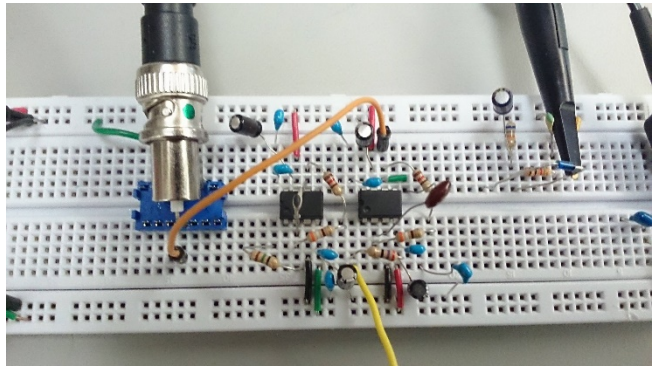
Testbench with FreeSoc 2: Use a Breadboard before you PCB is ready



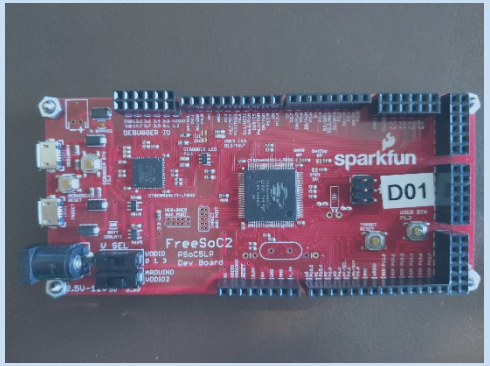
FreeSoC 2 Testbench



Testing the Testbench

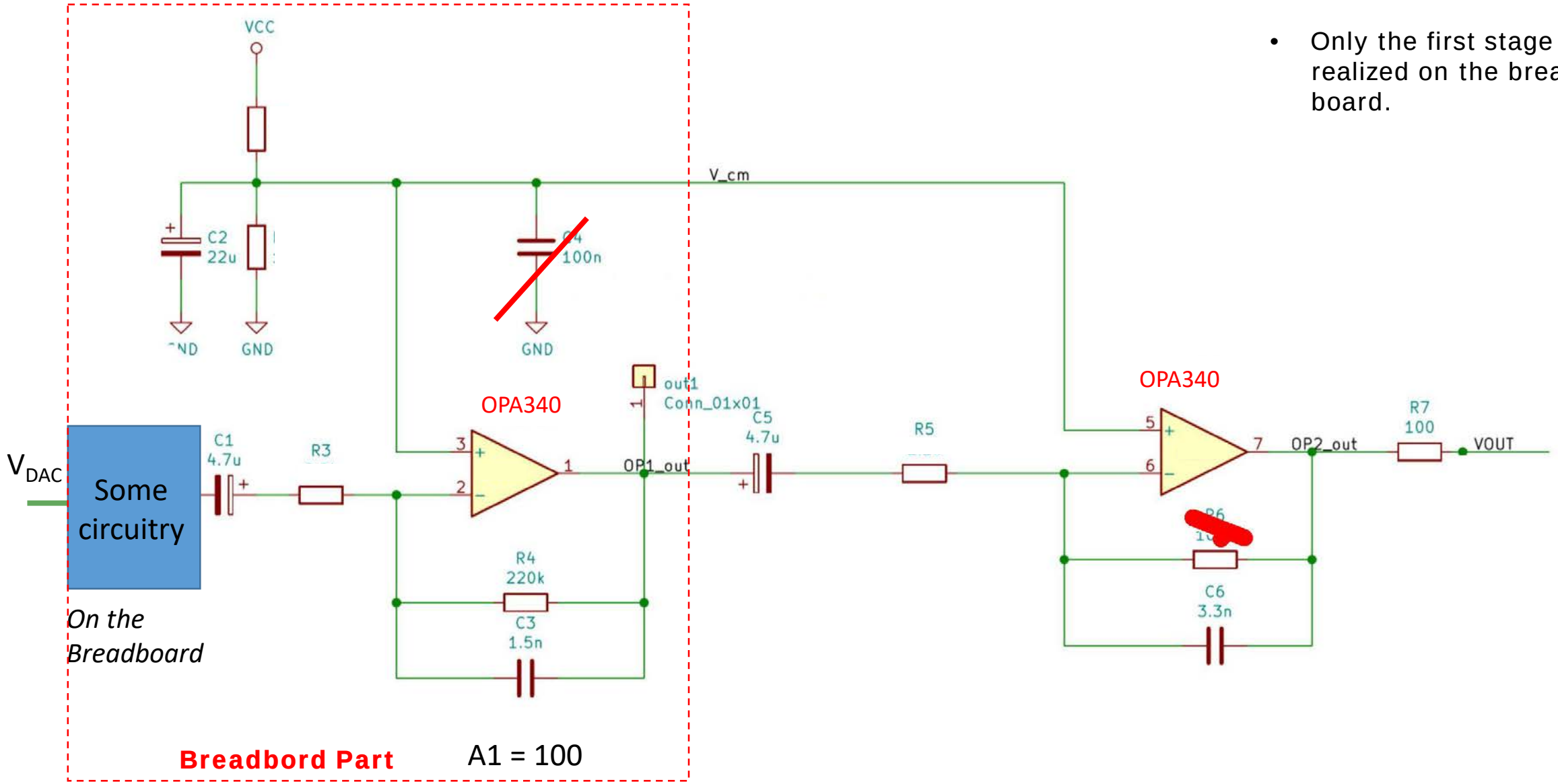


Testing your Bread Board Design



FreeSoc2 Testbench

Changes to the Amplifier for Breadboarding



- Only the first stage is realized on the bread board.