System Driven Hardware Design

- Schematic / Layout / Breadboard-

LabExcesize 1

International Master of Science

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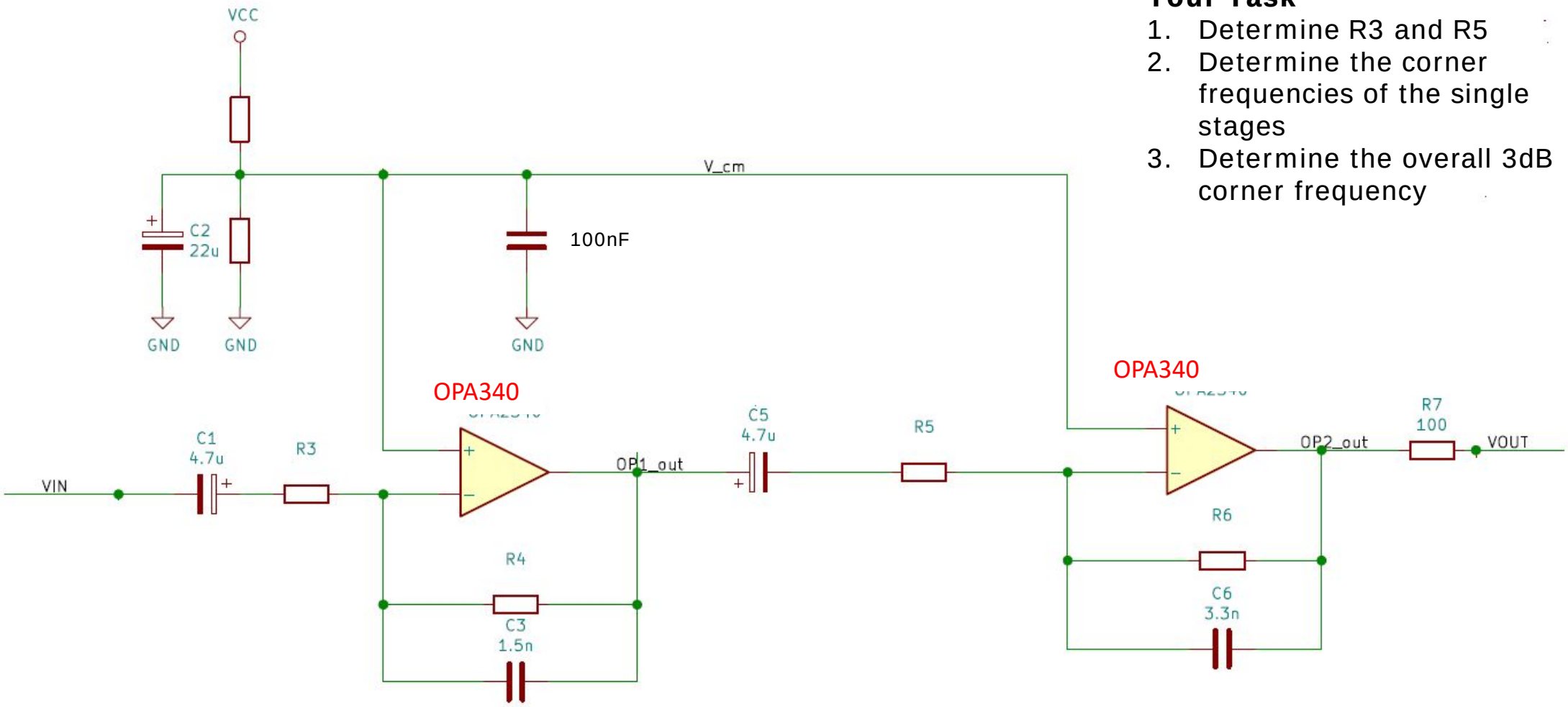
SS25

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

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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

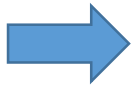
Technology
- Use through hole technology (THT) all components.
- Use E24 series for the resistors in THT.

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

KiCad
- Use the design constraints and settings from the ELEKONTA preclass presentation.

PCB and Electronic Constraints: Pin-Mapping

w		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

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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 ←

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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 (term/Group/Name)
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.

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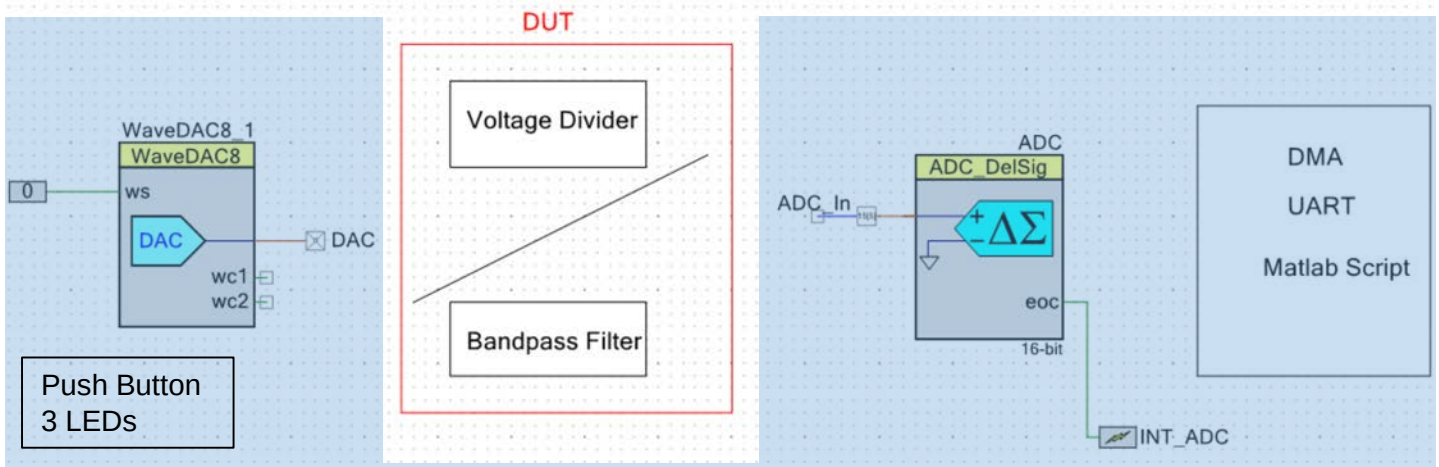
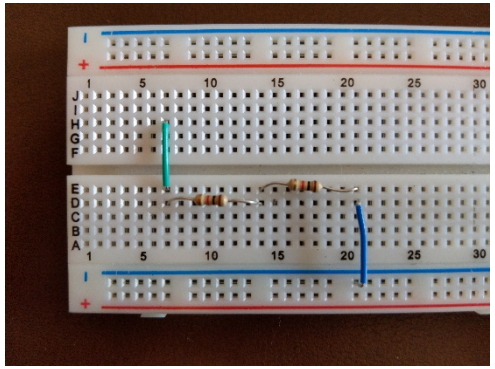
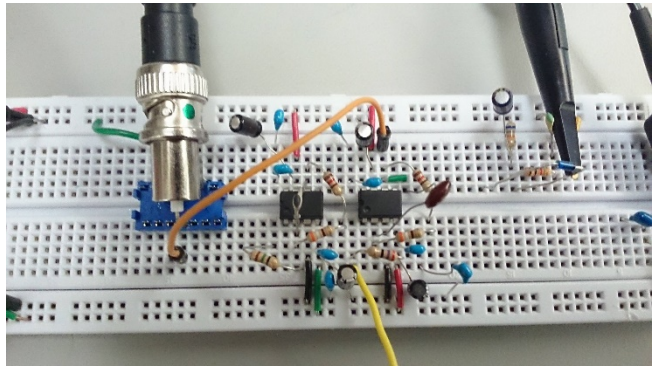
Testbench with FreeSoc 2: Use a Breadboard before you PCB is ready



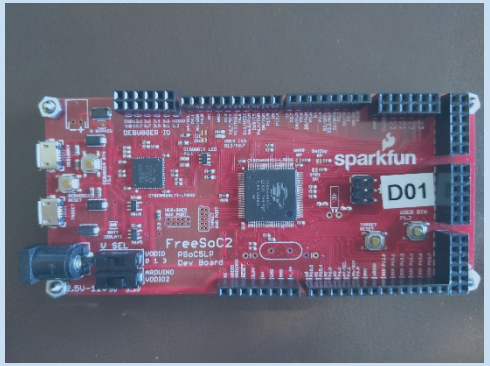
FreeSoC 2 Testbench



Testing the Testbench

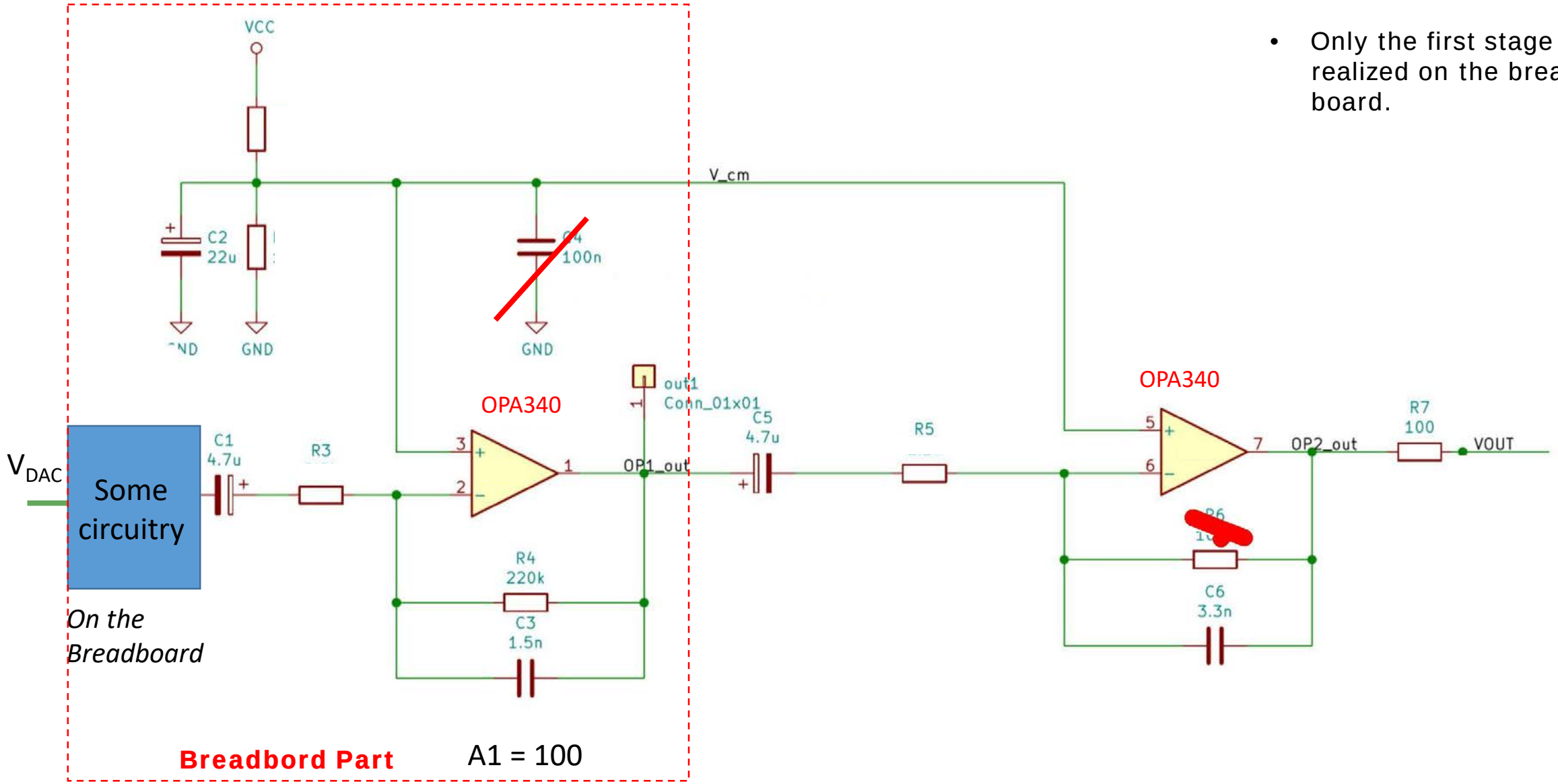


Testing your Bread Board Design



FreeSoc2 Testbench

Changes to the Amplifier for Breadboarding



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