

Power and Upstream Connectors



File: PowerUpstreamConnectors.kicad_sch

MCU



File: MCU.kicad_sch

Boost converter



File: BoostConverter.kicad_sch

Current Source And Monitoring



File: CurrentSourceAndMonitoring.kicad_sch

Process Connectors



File: ProcessConnectors.kicad_sch

Display Connector



File: DisplayConnector.kicad_sch

LEDES



File: leds.kicad_sch

Mechanical

Case mount



Screen mount



I2C PROCESS bus addresses allocation

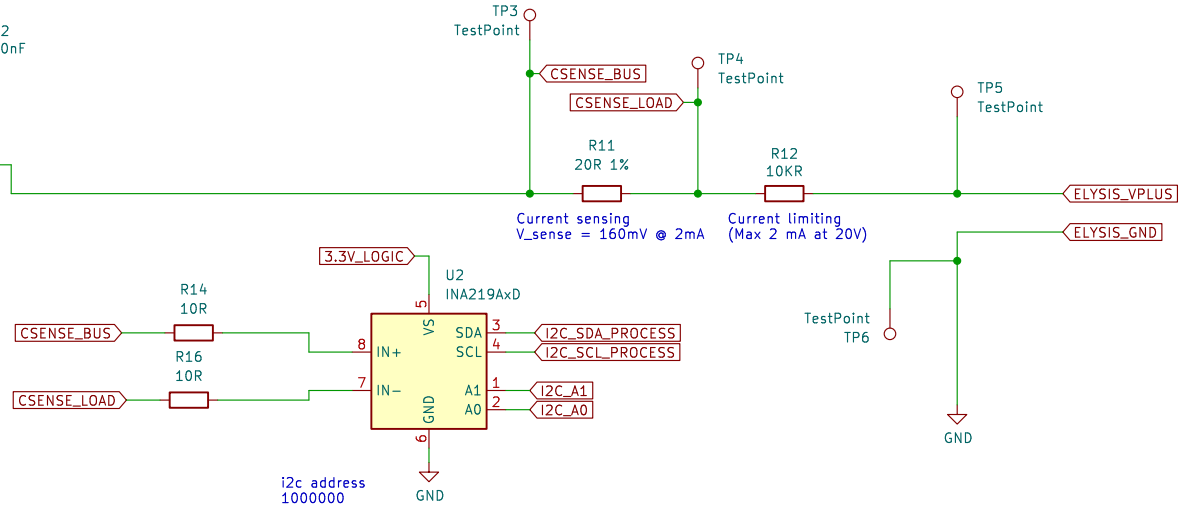
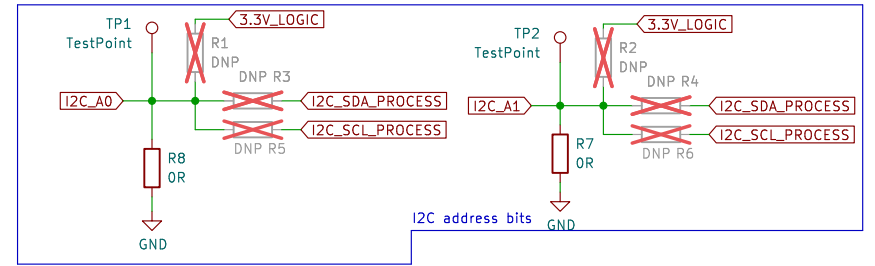
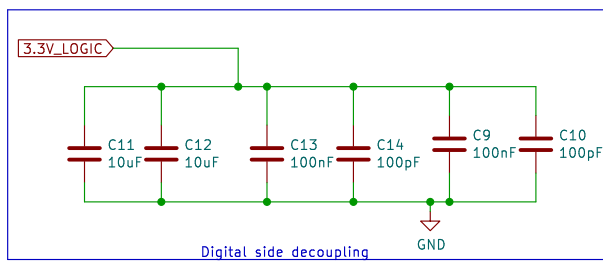
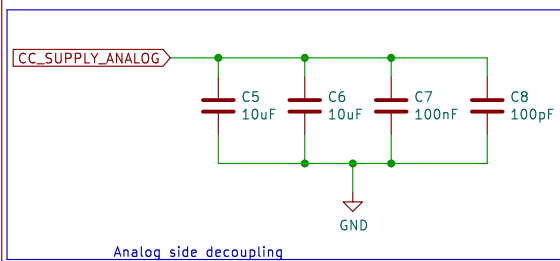
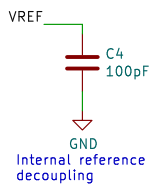
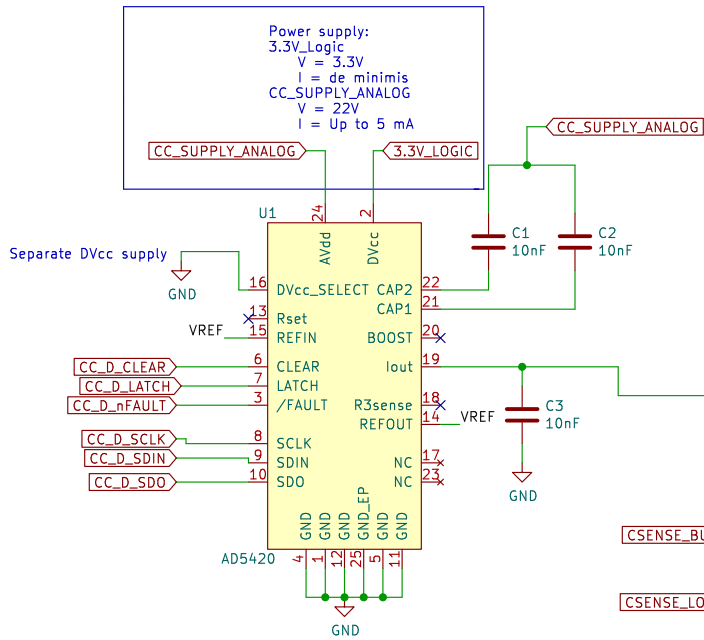
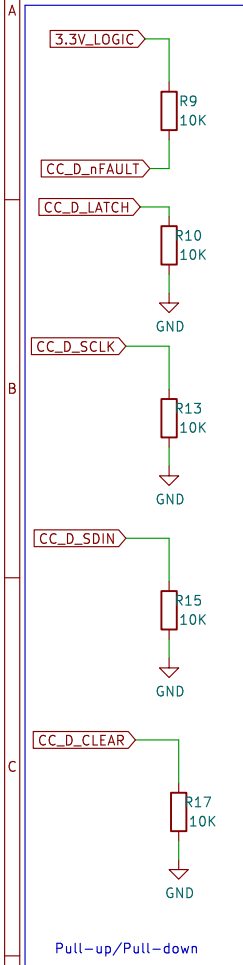
INA219 i2c address 1000000
 Boost digipot i2c address 0101111
 TCA6408 i2c address 01000010

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Sheet: /	
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Current Source and Monitoring

AD5420 Transfer function (0 to 20mA mode) $I_{out} = \left[\frac{20 \text{ mA}}{2^{20}} \right] \times D$
 Each endpoint is 0.000305 mA = 0.305 uA
 NB: Available in P&P @ JLC



Sheet: /Current Source And Monitoring/
 File: CurrentSourceAndMonitoring.kicad_sch

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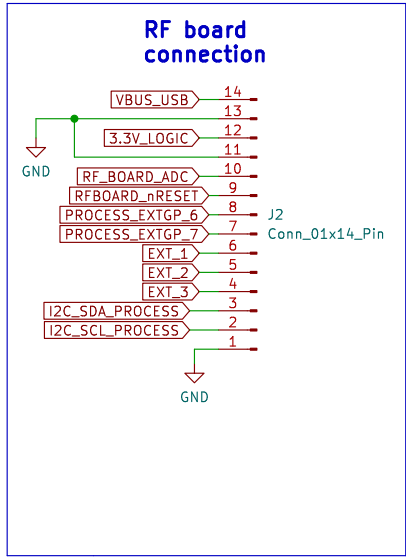
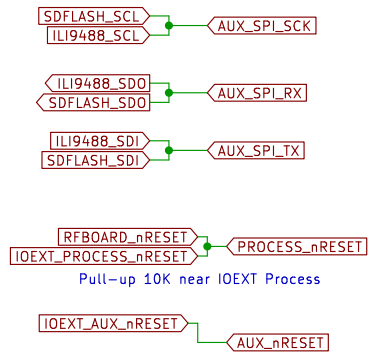
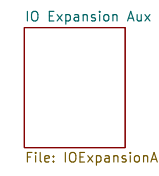
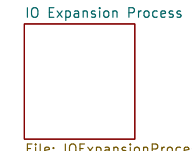
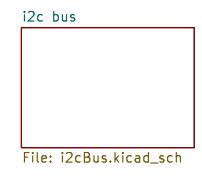
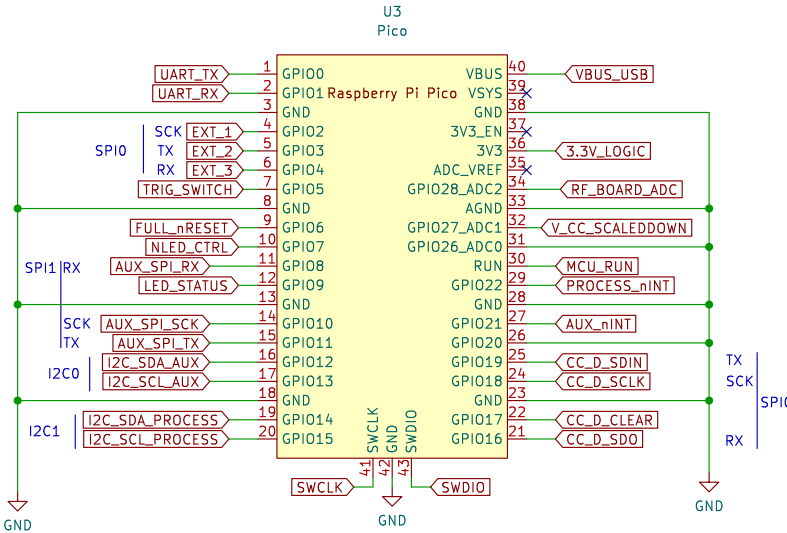
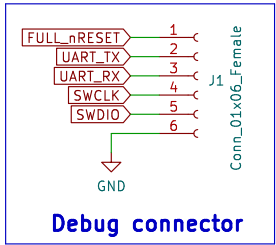
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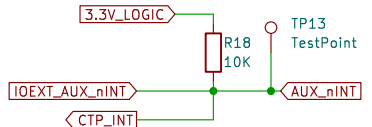
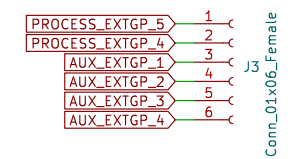
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Header for unused connections that might be handy to keep accessible



Sheet: /MCU/		File: MCU.kicad_sch	
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Took whatever JLC had at around the 5 cent pricepoint with a not too annoying footprint

Under worse case assumptions:
 $V_{out} = 30V$ $I_{out} = 50\text{ mA}$
 $V_{in} = 4.5V$ Efficiency = 0.5

$$I(L) = (30 \cdot 0.050) / (4.5 \cdot 0.5)$$

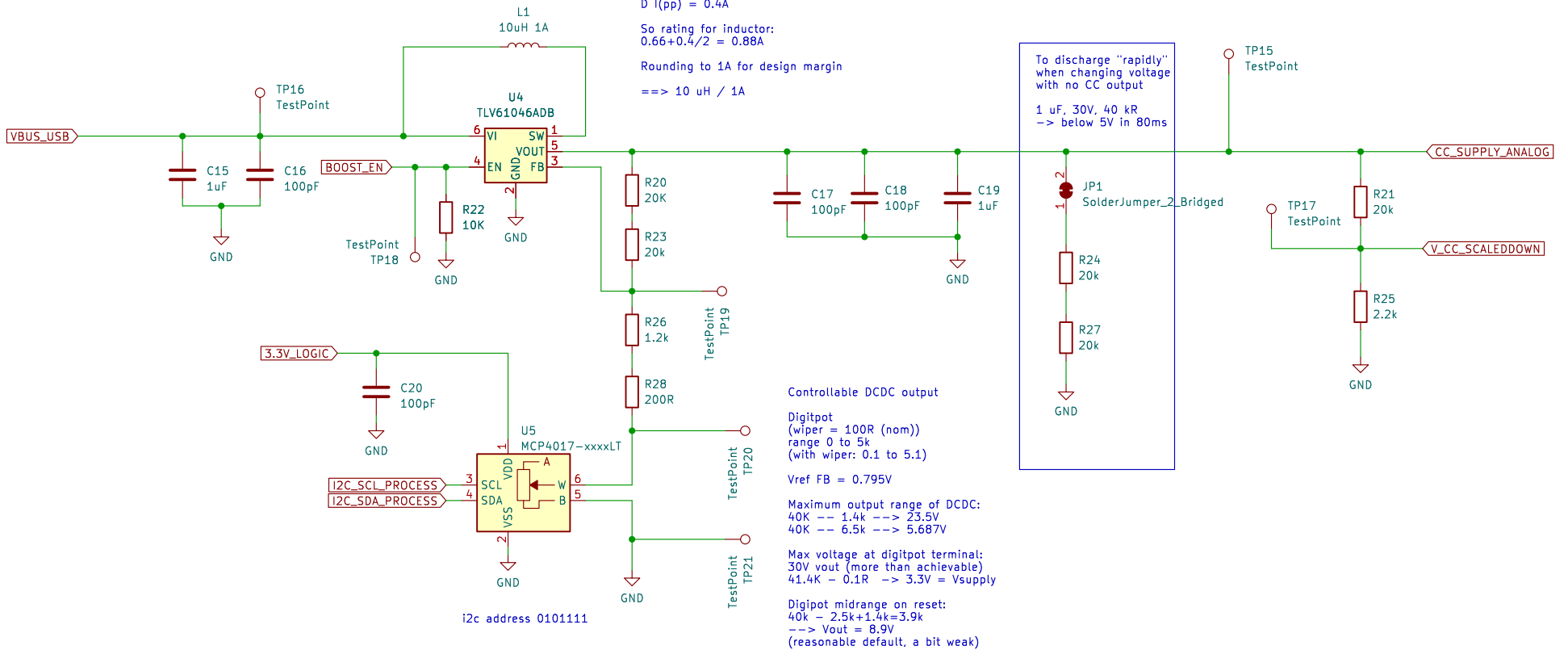
$$I(L) = 0.66A$$

Inductor ripple worst case:
 $\Delta I(pp) = 0.4A$

So rating for inductor:
 $0.66 + 0.4 / 2 = 0.88A$

Rounding to 1A for design margin
 $\Rightarrow 10\text{ uH} / 1A$

To discharge "rapidly" when changing voltage with no CC output
 $1\text{ uF}, 30V, 40\text{ k}\Omega$
 \rightarrow below 5V in 80ms



Controllable DCDC output

Digitpot
(wiper = 100R (nom))
range 0 to 5k
(with wiper: 0.1 to 5.1)

Vref FB = 0.795V

Maximum output range of DCDC:
40k -- 1.4k --> 23.5V
40k -- 6.5k --> 5.687V

Max voltage at digitpot terminal:
30V vout (more than achievable)
41.4k - 0.1R -> 3.3V = Vsupply

Digitpot midrange on reset:
40k - 2.5k + 1.4k = 3.9k
--> Vout = 8.9V
(reasonable default, a bit weak)

i2c address 0101111

Sheet: /Boost converter/
File: BoostConverter.kicad_sch

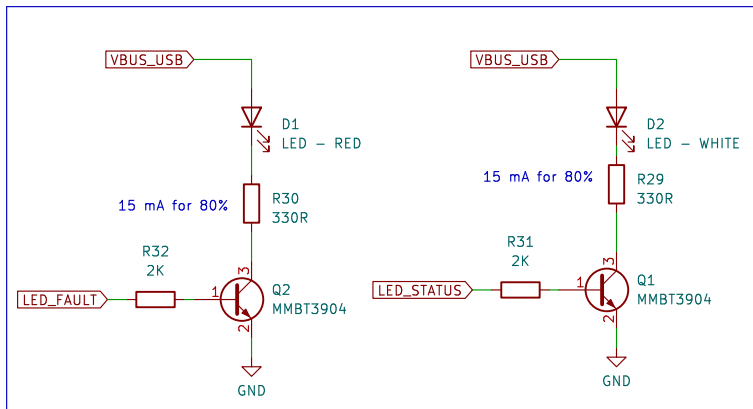
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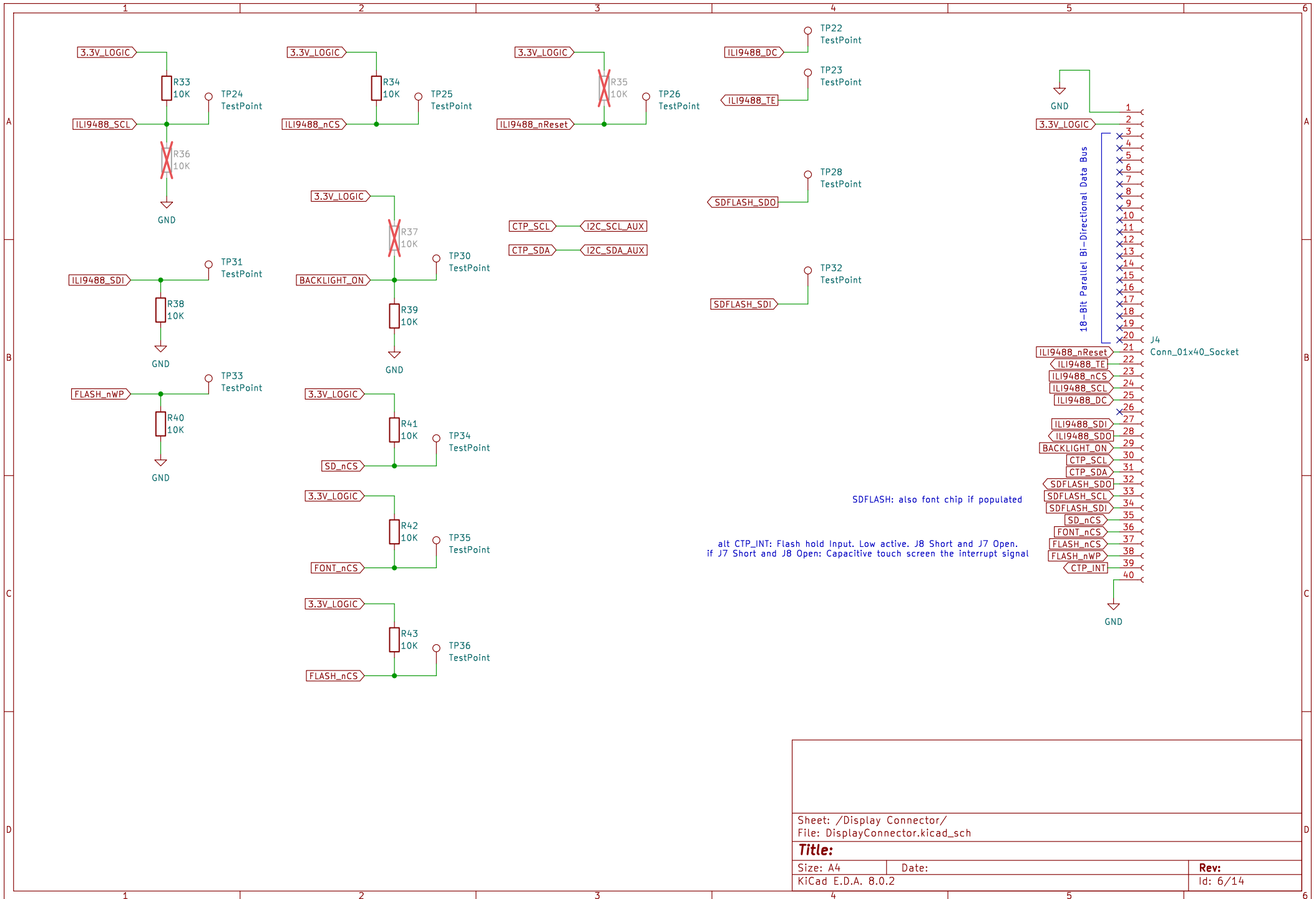
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Sheet: /Display Connector/
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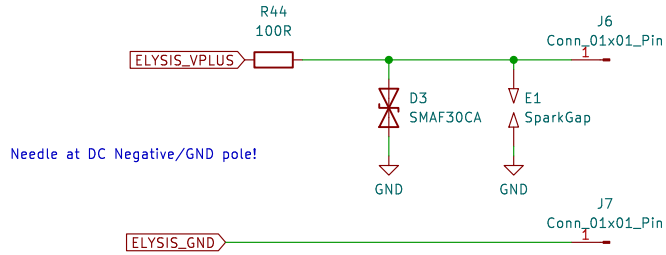
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DC Connector



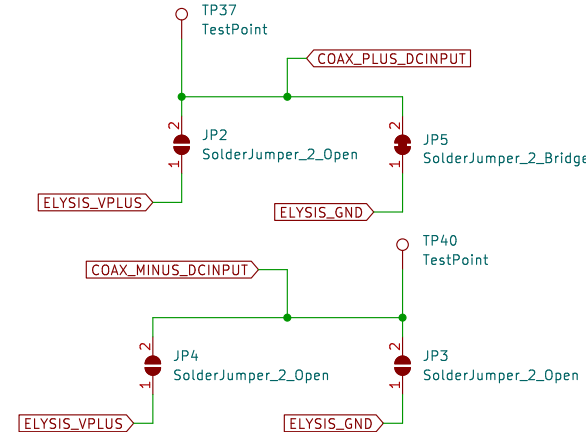
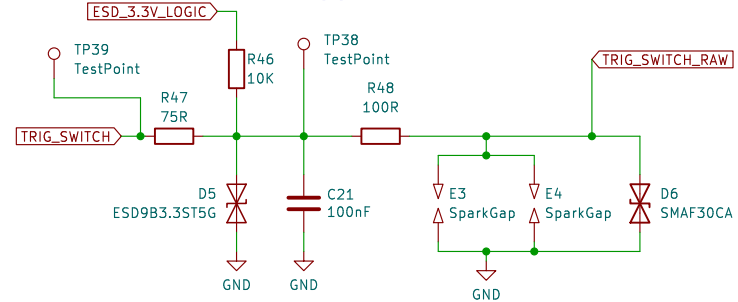
Which of the sleeve/shield or center conductor of the coax gets the DC GND/Neg is determined by jumpers (the RF bias tee is double DC blocked, so both are supported)
 This is chosen depending on antenna setup near the needle, but GND is sleeve by default

The VPlus should generally not be passed through the coax, since it is where the DC return pad (not needle) is connected, but the possibility is left if that is somehow helpful

RF+DC Connector



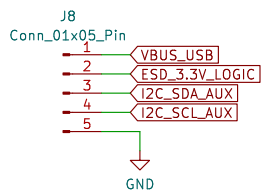
Trigger switch input protection



Integrated Bias Tee



Complex Input Port ESD

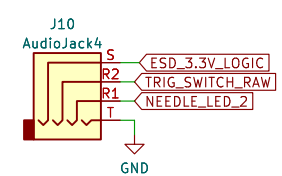
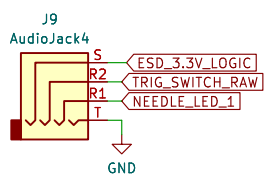


Complex (LED+)input port

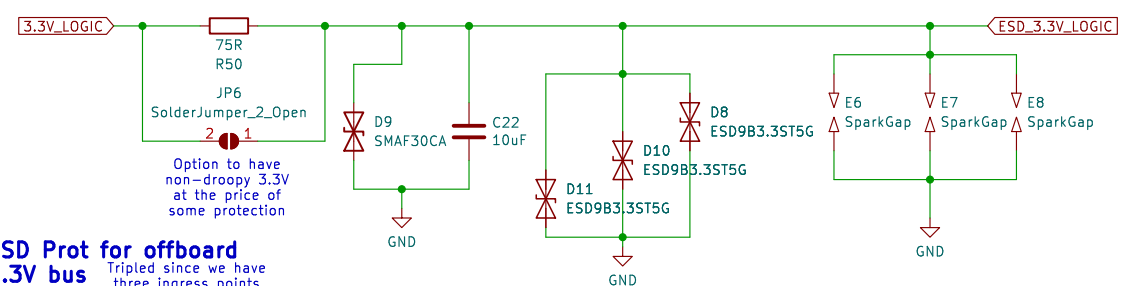
e.g. Downstream MCU-based input and illumination port

Simple LED+input port

e.g. Simple pedal or near-needle control w/ LED and button



ESD Prot for offboard 3.3V bus



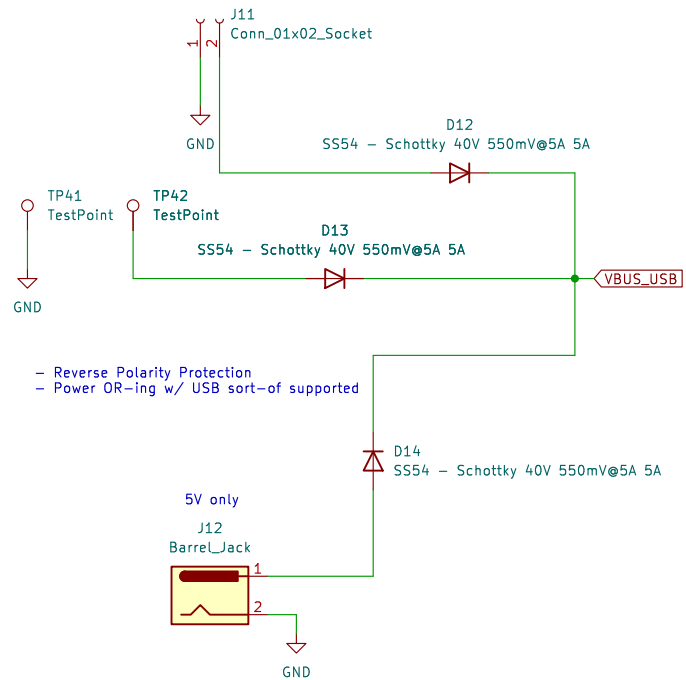
Needle Led Switching and ESD prot



General note: Since this is a deliberately very body-ESD-strike exposed device, we spec ESD protection to the gills.
 (Additional price of a handful of TVS is minor compared to the other components)

Sheet: /Process Connectors/		File: ProcessConnectors.kicad_sch	
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Alternate Power Inputs



Sheet: /Power and Upstream Connectors/
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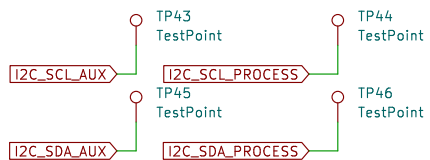
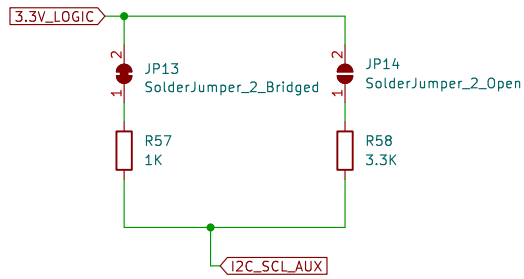
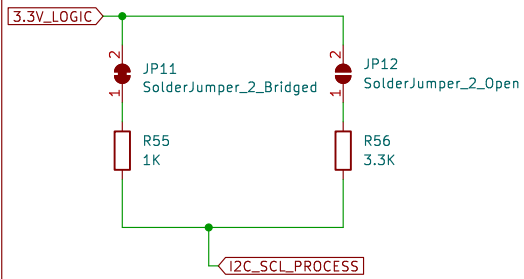
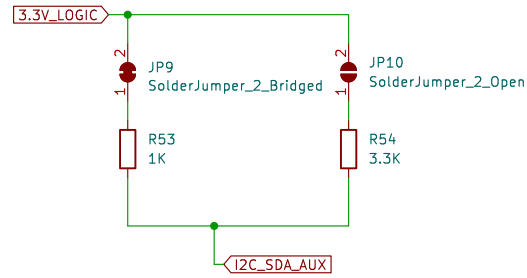
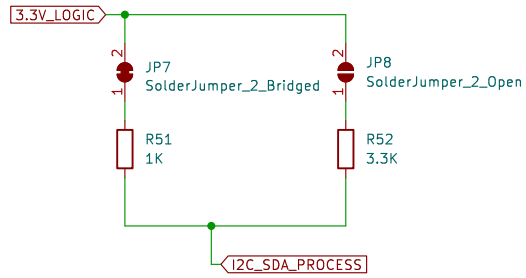
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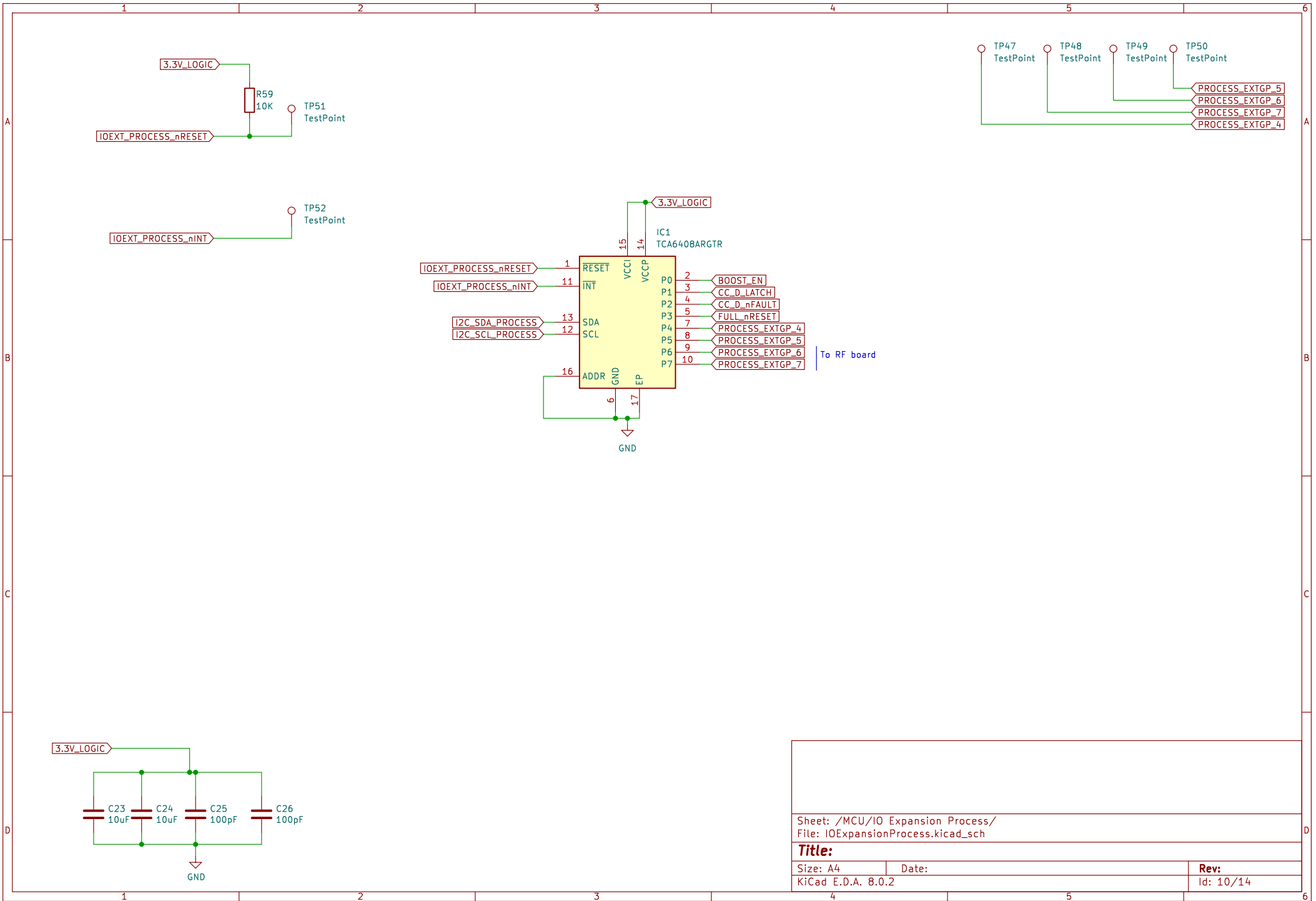
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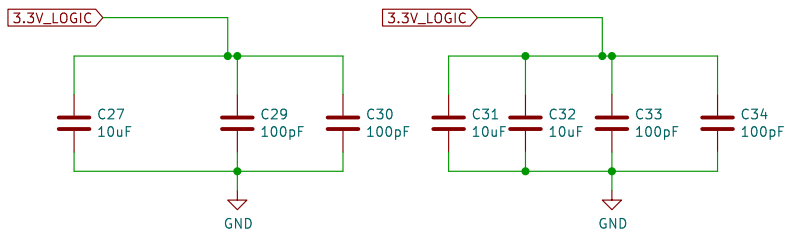
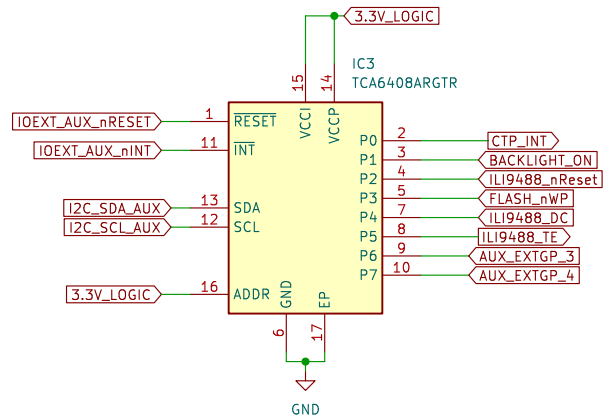
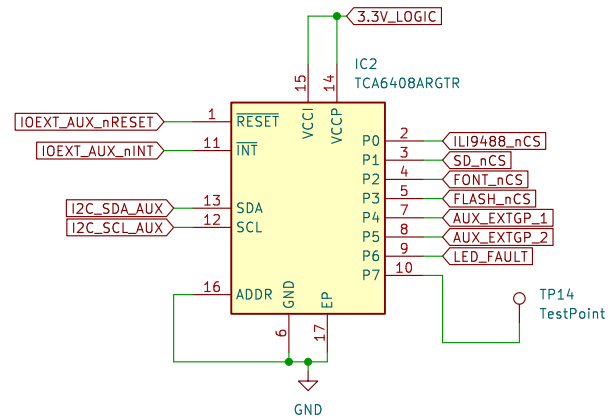
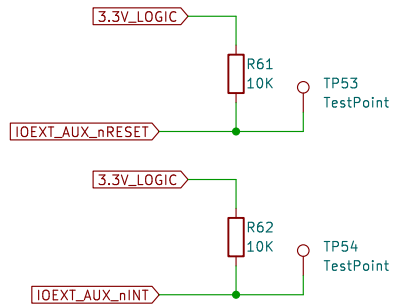
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Sheet: /MCU/i2c bus/ File: i2cBus.kicad_sch		
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Sheet: /MCU/IO Expansion Process/ File: IOExpansionProcess.kicad_sch		
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Sheet: /MCU/IO Expansion Aux/
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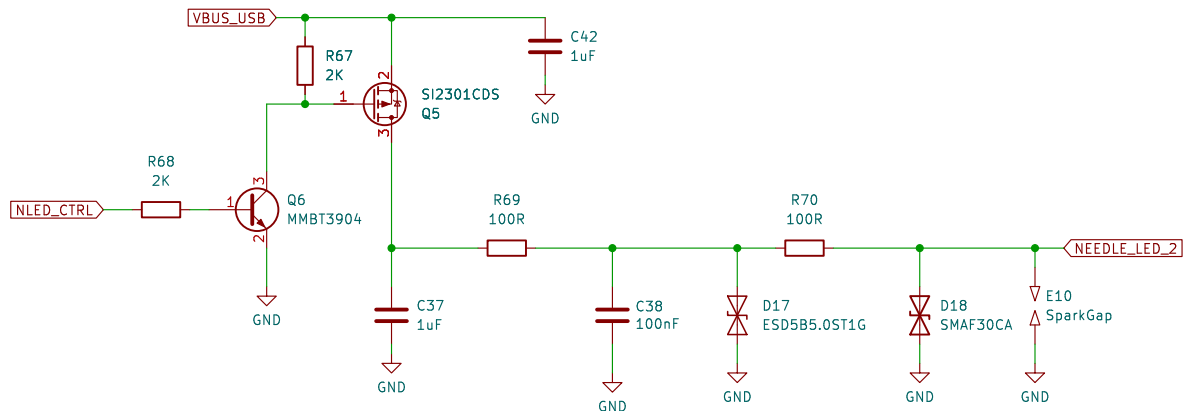
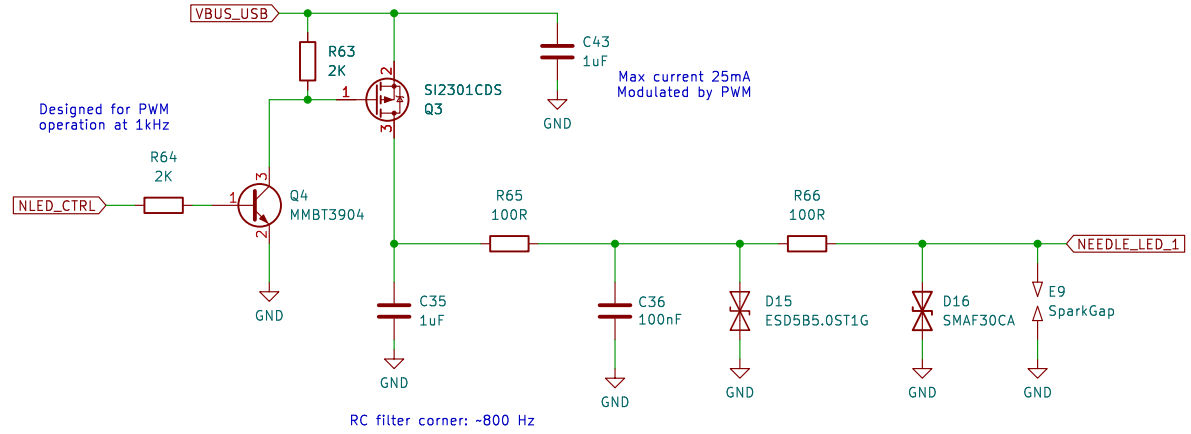
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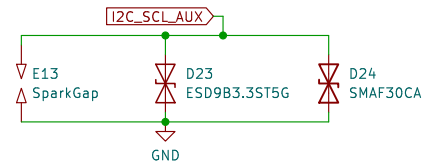
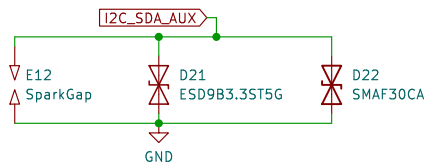
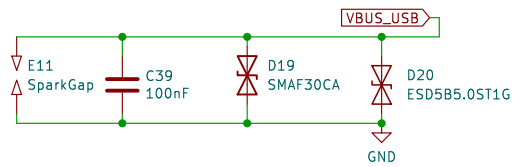
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RC filter corner: 800 Hz		
Sheet: /Process Connectors/Needle Led Switching and ESD prot/ File: NeedleLedSwitching.kicad_sch		
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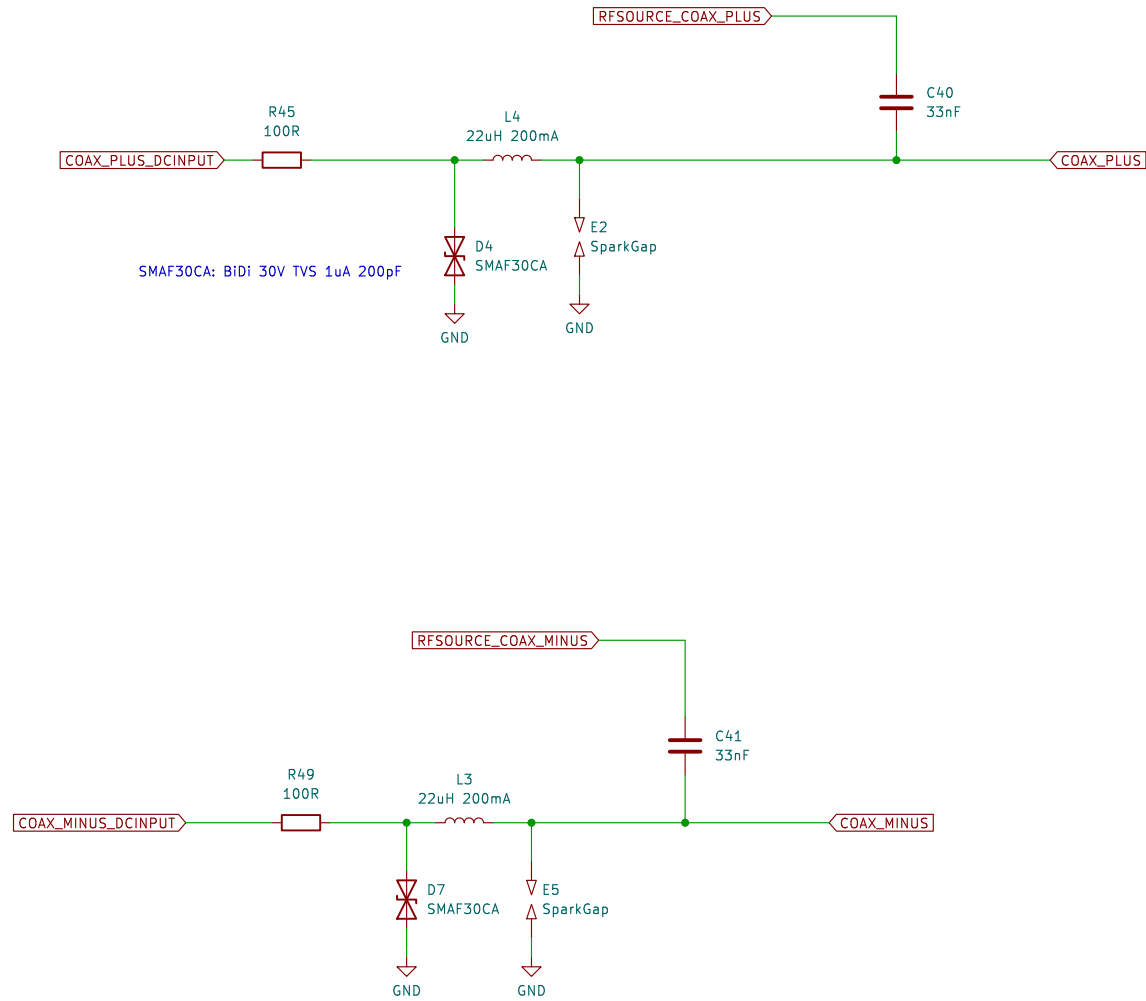
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Sheet: /Process Connectors/Integrated Bias Tee/
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