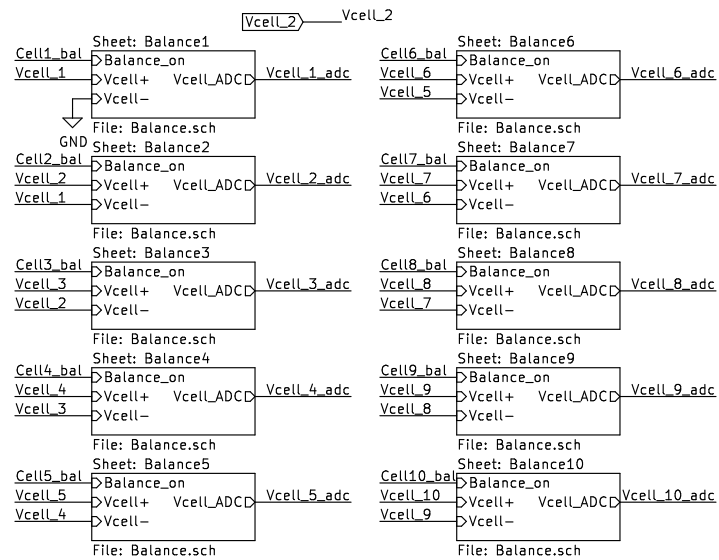
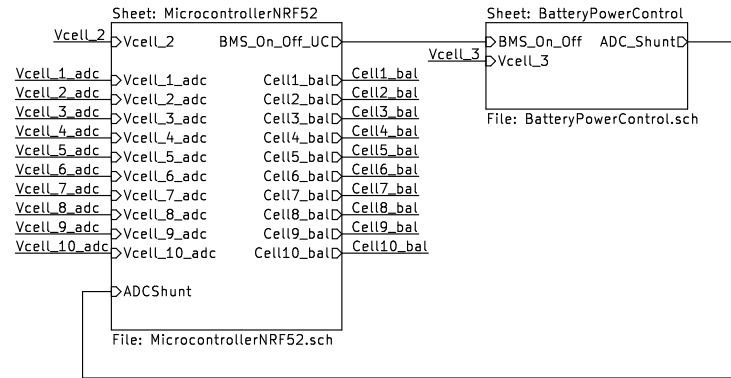
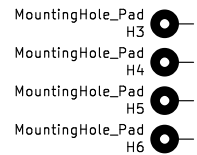
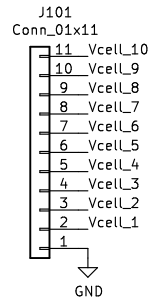


## Balance Connector JST



## Gatze

Sheet: /  
File: GatzBMS.sch

## Title: GatzBMS by Gatze

Size: A4 Date: 2021-04-29

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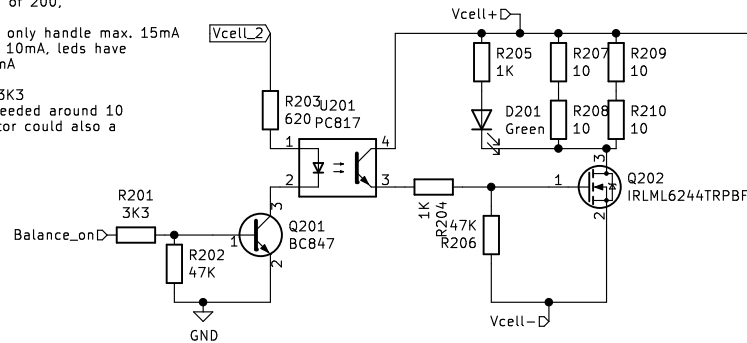
Rev: v0.0

Id: 1/13

Base Resistor BC847 (Hfe of 200,  
Very worst case 100)  
First 1K, but the nRF can only handle max. 15mA  
Little bit border, set it to 10mA, leds have  
already some mA so, 7.5mA  
Measured 0.74v over BE  
 $R = 2.56 / 0.00075 = 3.41k = 3K3$   
 $200 \times 0.00075 = 0.150mA$ , needed around 10  
So plenty overhead, resistor could also a  
bit higher

Max 42V  
 $ADC_{42} = 6.8 / 97.8 = 2.92$

14 bits ADC  
 Reference = Gain / Reference = 0.2 / 0.6  
 Volt = (adc value /  $2^{14}$ ) \* 3



Sheet: /Balance1/  
File: Balance.sch

Size: A4	Date:
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Rev:  
Id: 2/13

Bleed Resistor Calculation  
Desired Bleed Current=0.5A average  
 $R_{tot} = U/I = 3.6/0.5 = 7.2 \text{ ohm}$   
 $P_{max} = V_{max}^2/R = 4.2^2/7.2 = 2.45W$   
 $R_{tot} = (R_1 + R_2)/(R_1 + R_2) \quad R_1 = R_2$   
 $R_{single} \text{ is also } 7.2$   
 $P_{single} = 2.45/4 = 0.61W$

[illegible]

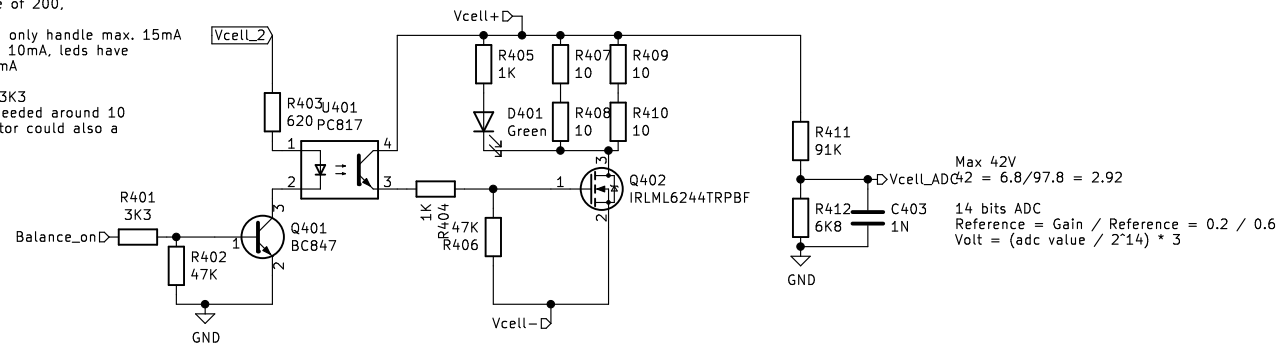
Left away capacitor 1N base-gnd both transistor and mosfet to save components.

Rev:  
Id: 3/13

Calculation PC817 Led resistor  
 $I_f = 10\text{mA}$   $V_f = 1.2\text{V}$   
 $V_{cell2} = 6 - 8.4$   
 $R = U/I = (7.2 - 1.2)/0.01 = 600 = 620$   
 $I_{min} = U_{min}/R = (6 - 1.2)/620 = 7.7\text{mA}$   
 $I_{max} = U_{min}/R = (8.4 - 1.2)/620 = 11.6\text{mA}$   
 $P_{rmax} = I^2 \cdot R = 0.0116^2 \cdot 660 = 0.0888 = 88.8\text{mW} < 125\text{mW}$

Bleed Resistor Calculation  
 Desired Bleed Current = 0.5A average  
 $R_{tot} = U/I = 3.6/0.5 = 7.2\text{ ohm}$   
 $P_{max} = V_{max}^2/R = 4.2^2/7.2 = 2.45\text{W}$   
 $R_{tot} = (R1 \cdot R2)/(R1 + R2)$   $R1 = R2$   
 $R_{single}$  is also 7.2  
 $P_{single} = 2.45/4 = 0.61\text{W}$

Base Resistor BC847 (Hfe of 200,  
 Very worst case 100)  
 First 1K, but the nRF can only handle max. 15mA  
 Little bit border, set it to 10mA, leds have  
 already some mA so, 7.5mA  
 Measured 0.74v over BE  
 $R = 2.56/0.00075 = 3.41\text{k} = 3\text{K3}$   
 $200 \times 0.00075 = 0.150\text{mA}$ , needed around 10  
 So plenty overhead, resistor could also a  
 bit higher



Left away capacitor 1N base-gnd both transistor and mosfet to save components.

Sheet: /Balance3/  
 File: Balance.sch

**Title:**

Size: A4

Date:

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**Rev:**

Id: 4/13

Bleed Resistor Calculation  
Desired Bleed Current=0.5A average  
 $R_{tot} = U/I = 3.6/0.5 = 7.2 \text{ ohm}$   
 $P_{max} = V_{max}^2/R = 4.2^2/7.2 = 2.45W$   
 $R_{tot} = (R_1 + R_2)/(R_1 + R_2) \quad R_1 = R_2$   
 $R_{single} \text{ is also } 7.2$   
 $P_{single} = 2.45/4 = 0.61W$

only handle max. 15mA  
10mA, leds have  
mA

3K3  
eeded around 10  
or could also a

Balance\_on

Vcell\_2

R501 3K3

R502 47K

Q501 BC847

GND

Vcell-D

R504 1K

R506 47K

R505 1K

D501 Green

R507 10

R508 10

R509 10

R510 10

Q502 IRLML6244TRPBF

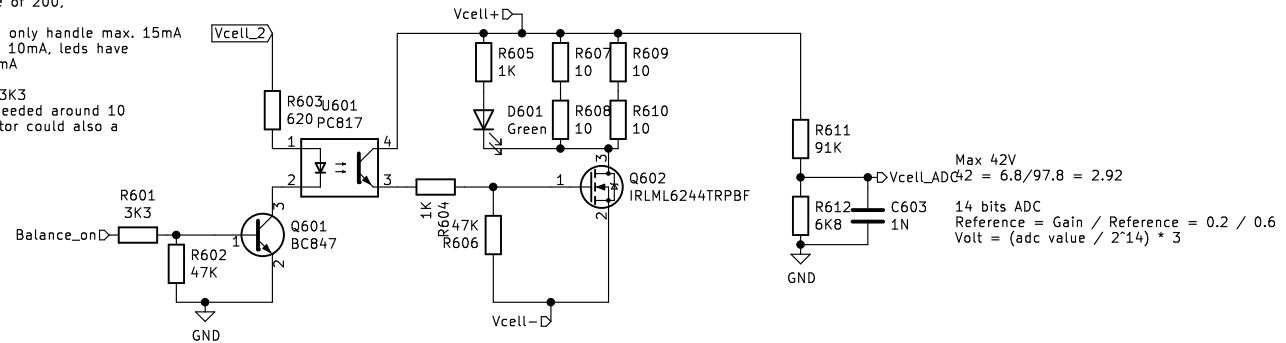
Left away capacitor 1N base-gnd both transistor and mosfet to save components.

**Rev:**  
Id: 5/13

Calculation PC817 Led resistor  
 $I_f = 10\text{mA}$   $V_f = 1.2\text{V}$   
 $V_{cell2} = 6 - 8.4$   
 $R = U/I = (7.2 - 1.2)/0.01 = 600 = 620$   
 $I_{min} = U_{min}/R = (6 - 1.2)/620 = 7.7\text{mA}$   
 $I_{max} = U_{min}/R = (8.4 - 1.2)/620 = 11.6\text{mA}$   
 $P_{rmax} = I^2 \cdot R = 0.0116^2 \cdot 620 = 0.0888 = 88.8\text{mW} < 125\text{mW}$

Bleed Resistor Calculation  
Desired Bleed Current = 0.5A average  
 $R_{tot} = U/I = 3.6/0.5 = 7.2\text{ ohm}$   
 $P_{max} = V_{max}^2/R = 4.2^2/7.2 = 2.45\text{W}$   
 $R_{tot} = (R1 \cdot R2)/(R1 + R2)$   $R1 = R2$   
 $R_{single}$  is also 7.2  
 $P_{single} = 2.45/4 = 0.61\text{W}$

Base Resistor BC847 (Hfe of 200,  
Very worst case 100)  
First 1K, but the nRF can only handle max. 15mA  
Little bit border, set it to 10mA, leds have  
already some mA so, 7.5mA  
Measured 0.74v over BE  
 $R = 2.56/0.00075 = 3.41\text{k} = 3\text{K3}$   
 $200 \times 0.00075 = 0.150\text{mA}$ , needed around 10  
So plenty overhead, resistor could also a  
bit higher



Left away capacitor 1N base-gnd both transistor and mosfet to save components.

Sheet: /Balance5/  
File: Balance.sch

**Title:**

Size: A4

Date:

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**Rev:**

Id: 6/13

Bleed Resistor Calculation  
Desired Bleed Current=0.5A average  
 $R_{tot} = U/I = 3.6/0.5 = 7.2 \text{ ohm}$   
 $P_{max} = V_{max}^2/R = 4.2^2/7.2 = 2.45W$   
 $R_{tot} = (R_1 + R_2)/(R_1 + R_2) \quad R_1 = R_2$   
 $R_{single} \text{ is also } 7.2$   
 $P_{single} = 2.45/4 = 0.61W$

[illegible]

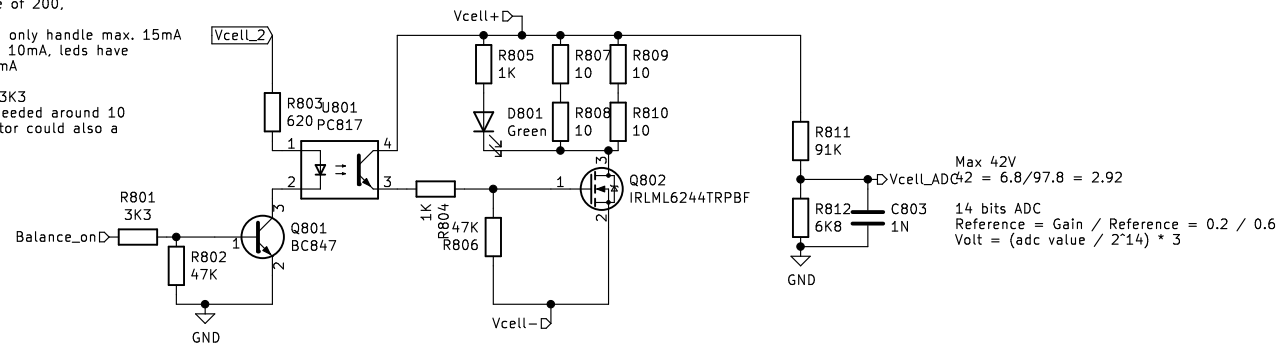
Left away capacitor 1N base-gnd both transistor and mosfet to save components.

**Rev:**  
Id: 7/13

Calculation PC817 Led resistor  
 $I_f = 10\text{mA}$   $V_f = 1.2\text{V}$   
 $V_{cell2} = 6 - 8.4$   
 $R = U/I = (7.2 - 1.2)/0.01 = 600 = 620$   
 $I_{min} = U_{min}/R = (6 - 1.2)/620 = 7.7\text{mA}$   
 $I_{max} = U_{min}/R = (8.4 - 1.2)/620 = 11.6\text{mA}$   
 $P_{rmax} = I^2 \cdot R = 0.0116^2 \cdot 620 = 0.0888 = 88.8\text{mW} < 125\text{mW}$

Bleed Resistor Calculation  
Desired Bleed Current = 0.5A average  
 $R_{tot} = U/I = 3.6/0.5 = 7.2\text{ ohm}$   
 $P_{max} = V_{max}^2/R = 4.2^2/7.2 = 2.45\text{W}$   
 $R_{tot} = (R1 \cdot R2)/(R1 + R2)$   $R1 = R2$   
 $R_{single}$  is also 7.2  
 $P_{single} = 2.45/4 = 0.61\text{W}$

Base Resistor BC847 (Hfe of 200,  
Very worst case 100)  
First 1K, but the nRF can only handle max. 15mA  
Little bit border, set it to 10mA, leds have  
already some mA so, 7.5mA  
Measured 0.74v over BE  
 $R = 2.56/0.00075 = 3.41\text{k} = 3\text{K}3$   
 $200 \times 0.00075 = 0.150\text{mA}$ , needed around 10  
So plenty overhead, resistor could also a  
bit higher



Left away capacitor 1N base-gnd both transistor and mosfet to save components.

Sheet: /Balance7/  
File: Balance.sch

**Title:**

Size: A4

Date:

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**Rev:**

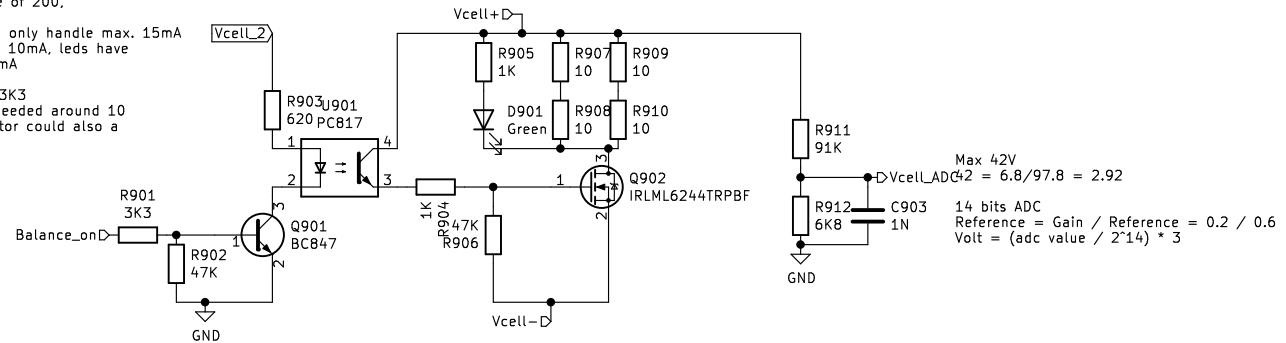
Id: 8/13



Calculation PC817 Led resistor  
 $I_f = 10\text{mA}$   $V_f = 1.2\text{V}$   
 $V_{cell2} = 6 - 8.4$   
 $R = U/I = (7.2 - 1.2)/0.01 = 600 = 620$   
 $I_{min} = U_{min}/R = (6 - 1.2)/620 = 7.7\text{mA}$   
 $I_{max} = U_{min}/R = (8.4 - 1.2)/620 = 11.6\text{mA}$   
 $P_{rmax} = I^2 \cdot R = 0.0116^2 \cdot 620 = 0.0888 = 88.8\text{mW} < 125\text{mW}$

Bleed Resistor Calculation  
Desired Bleed Current = 0.5A average  
 $R_{tot} = U/I = 3.6/0.5 = 7.2\text{ ohm}$   
 $P_{max} = V_{max}^2/R = 4.2^2/7.2 = 2.45\text{W}$   
 $R_{tot} = (R1 \cdot R2)/(R1 + R2)$   $R1 = R2$   
 $R_{single}$  is also 7.2  
 $P_{single} = 2.45/4 = 0.61\text{W}$

Base Resistor BC847 (Hfe of 200,  
Very worst case 100)  
First 1K, but the nRF can only handle max. 15mA  
Little bit border, set it to 10mA, leds have  
already some mA so, 7.5mA  
Measured 0.74v over BE  
 $R = 2.56/0.00075 = 3.41\text{k} = 3\text{K3}$   
 $200 \times 0.00075 = 0.150\text{mA}$ , needed around 10  
So plenty overhead, resistor could also a  
bit higher



Left away capacitor 1N base-gnd both transistor and mosfet to save components.

Sheet: /Balance8/  
File: Balance.sch

**Title:**

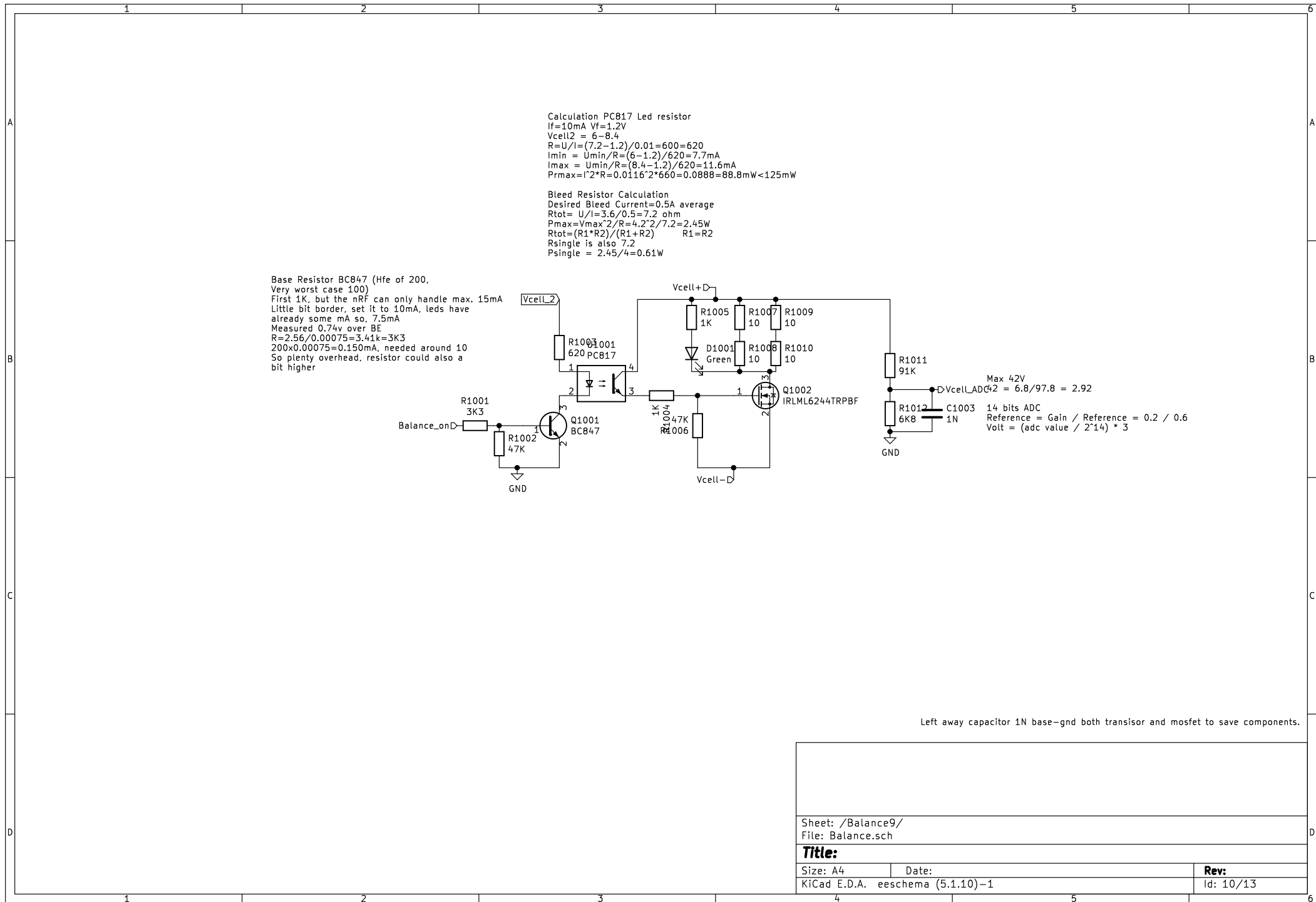
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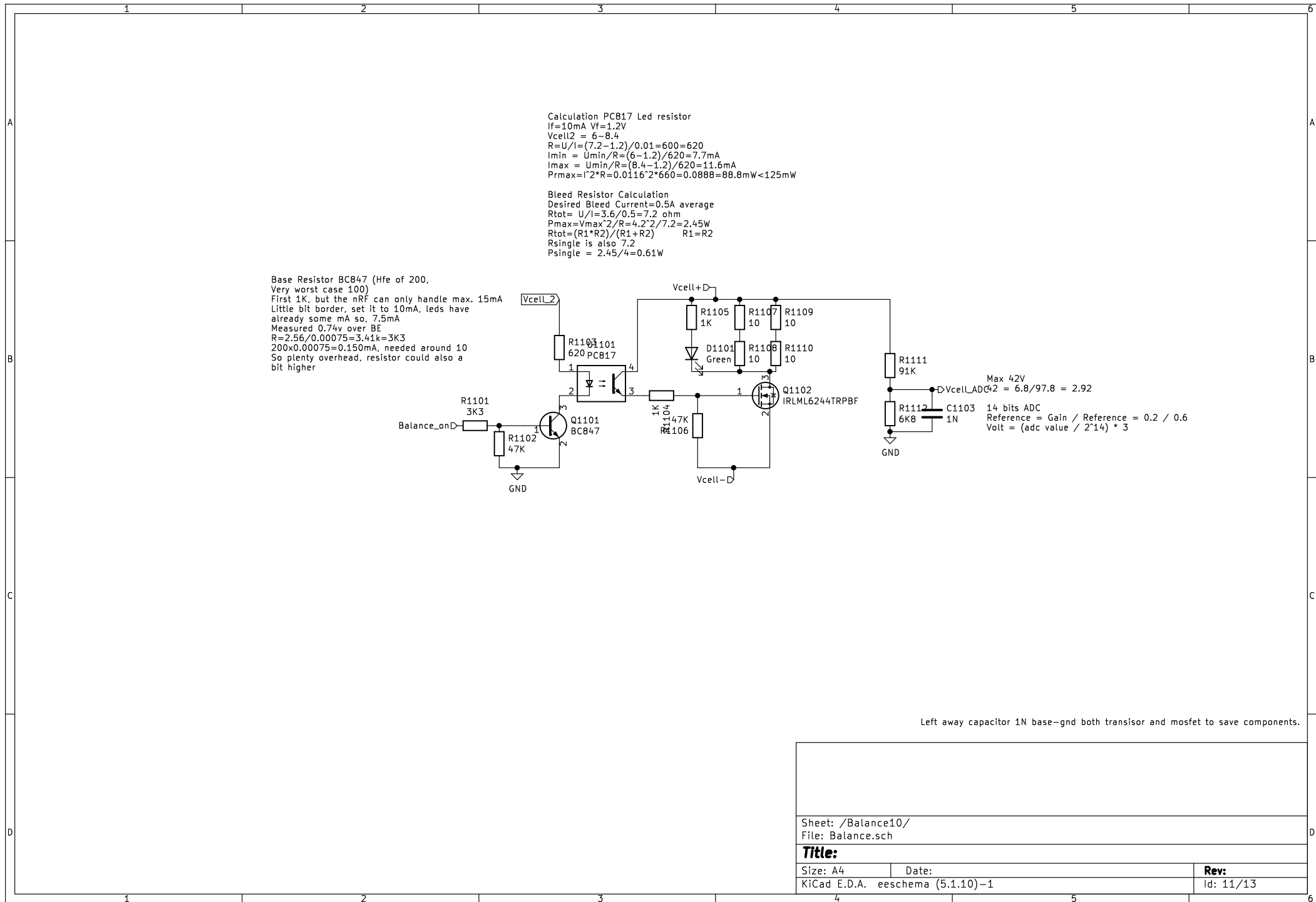
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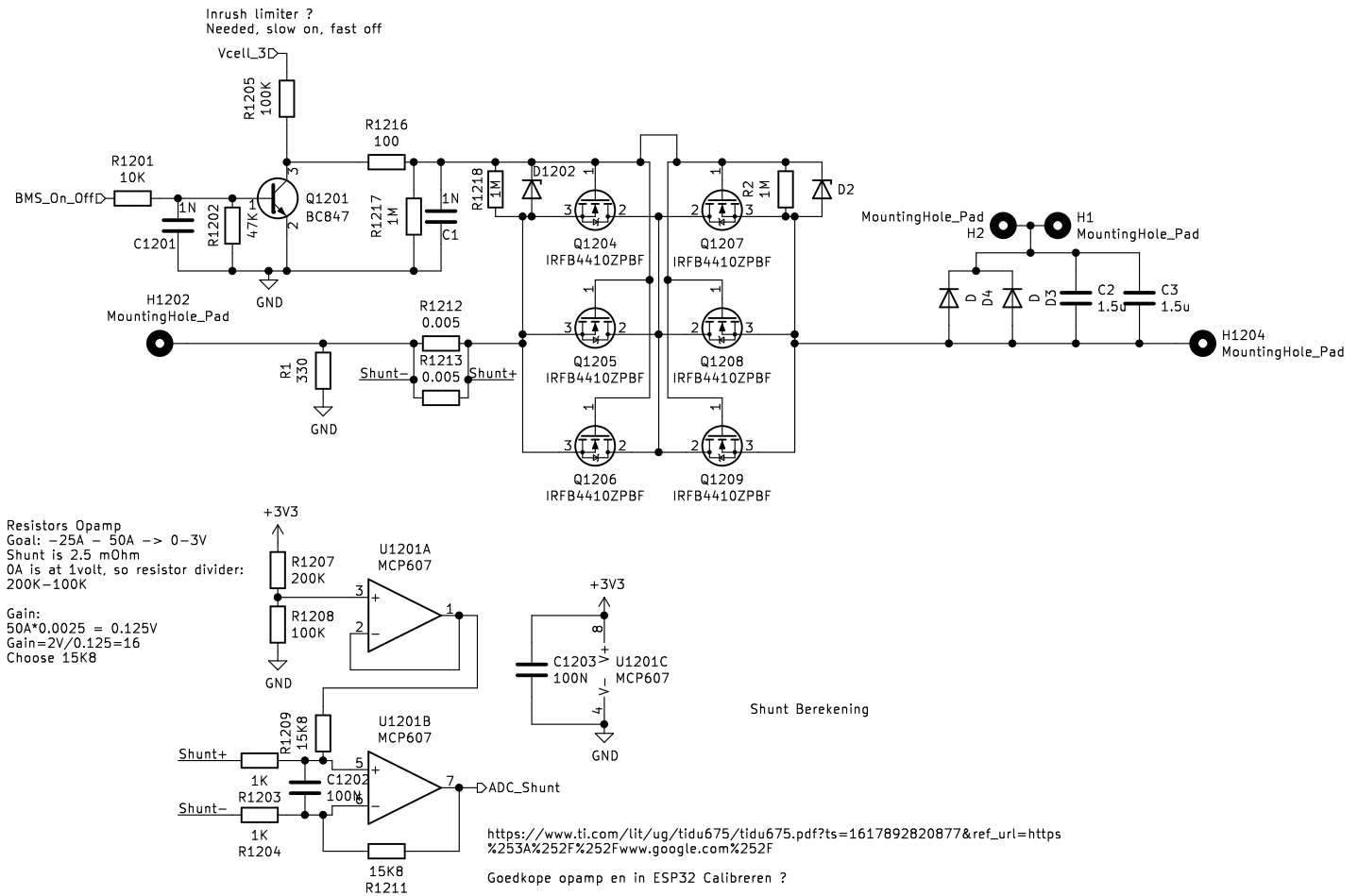
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**Rev:**

Id: 9/13







Sheet: /BatteryPowerControl/  
File: BatteryPowerControl.sch

**Title:**

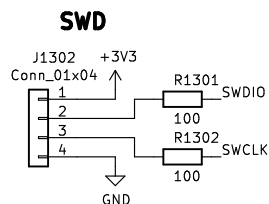
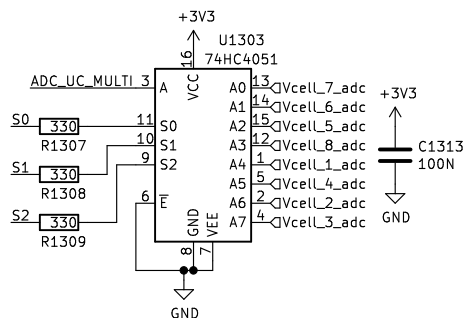
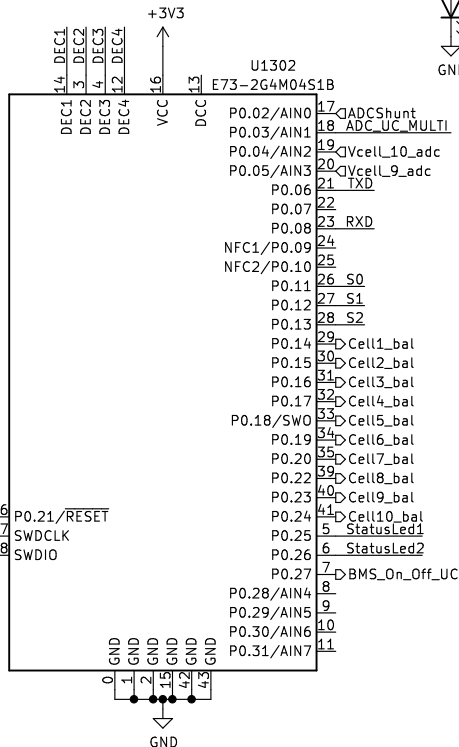
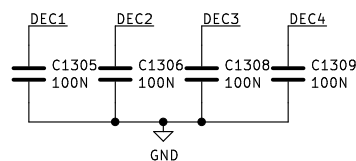
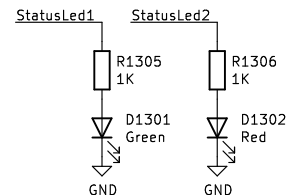
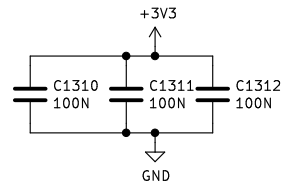
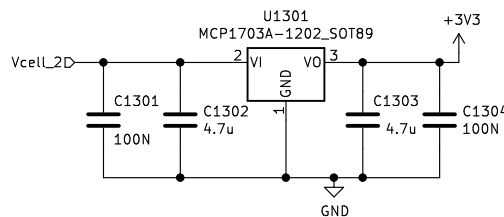
Size: A4

Date:

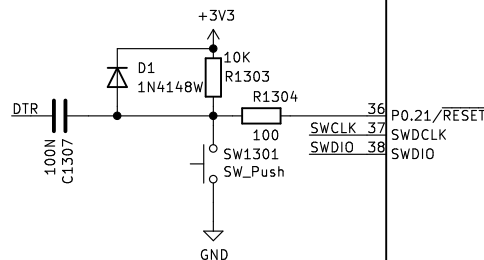
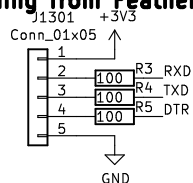
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**Rev:**

Id: 12/13



## RS232 Pinning from Featherboard



RTS ? I guess starting bootloader is also possible from application

Sheet: /MicrocontrollerNRF52/  
File: MicrocontrollerNRF52.sch

## Title:

Size: A4  
KiCad E.D.A. eeschema (5.1.10)-1

Date:

Rev:

Id: 13/13