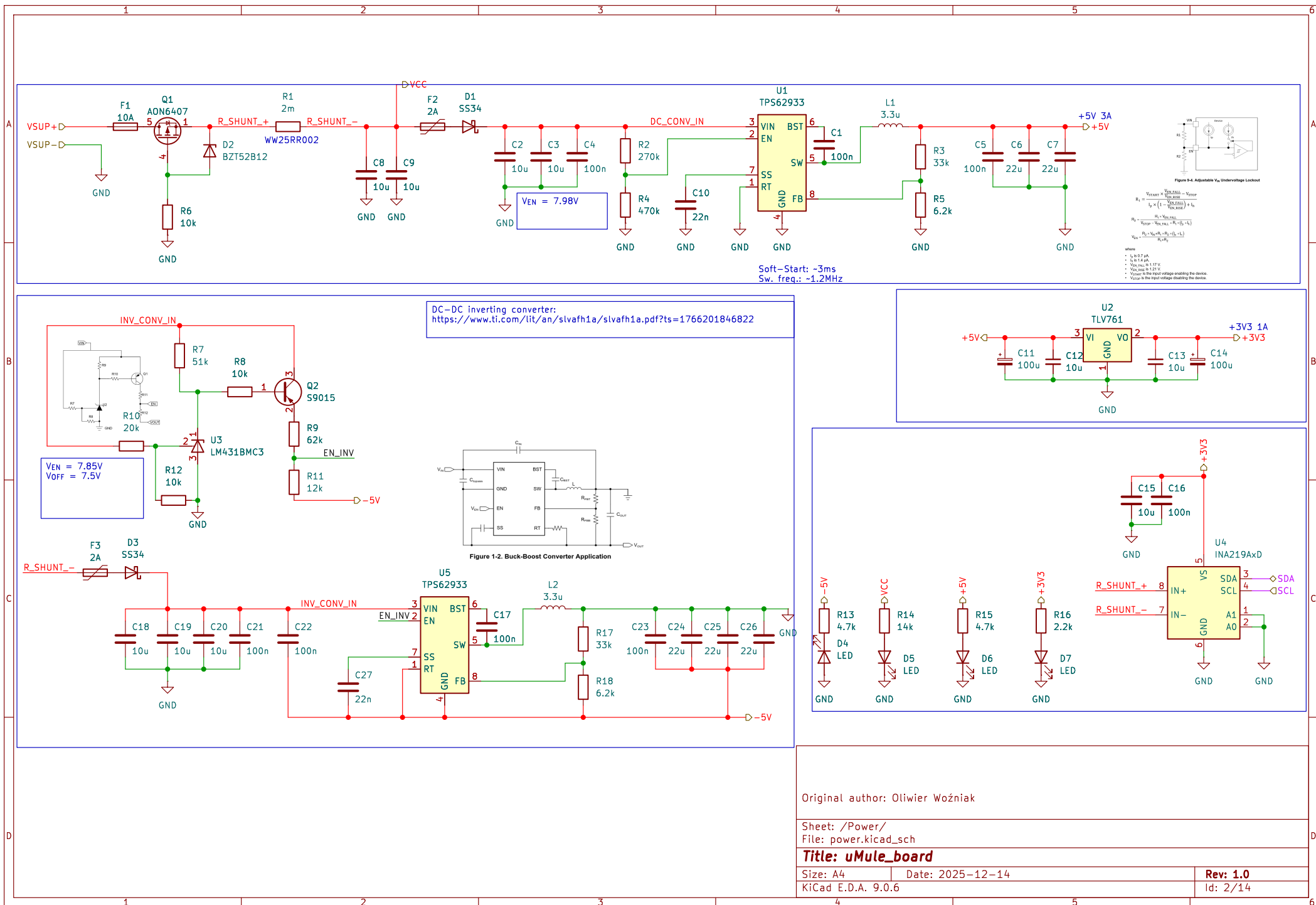
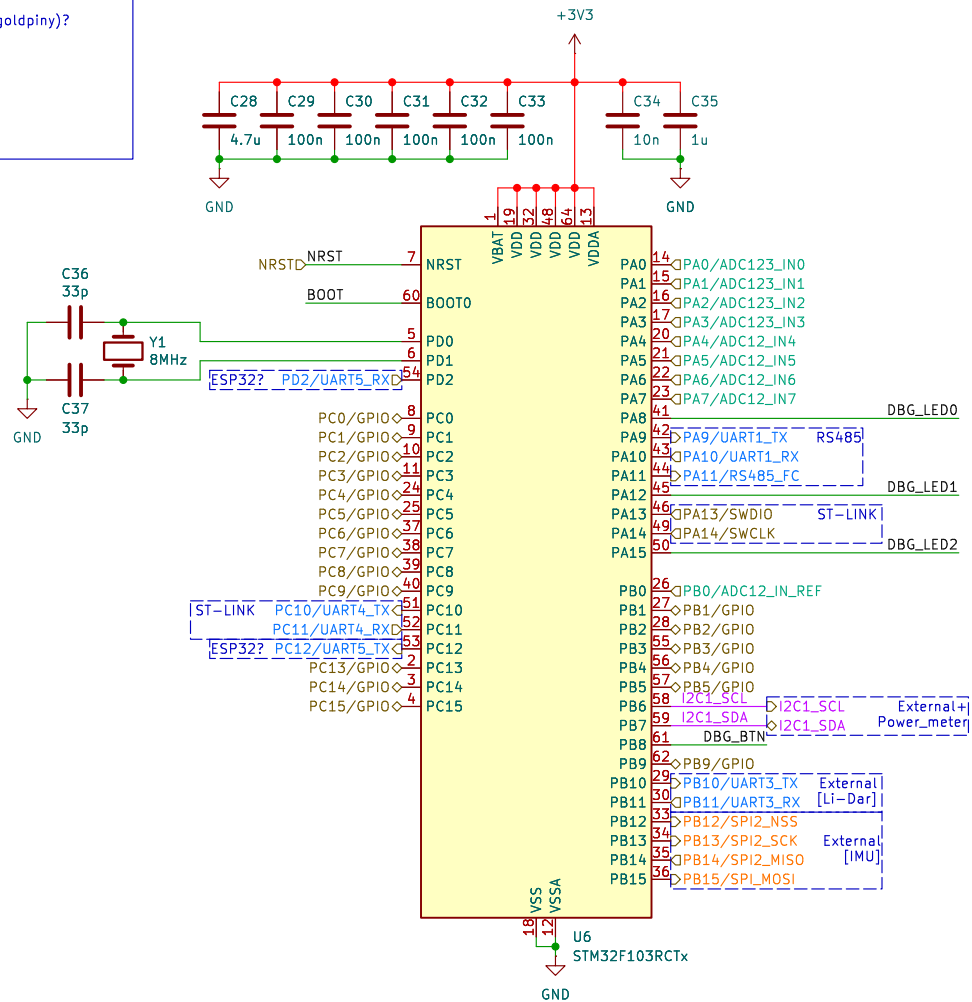


Original author: Oliwier Woźniak		
Sheet: /		
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Title: uMule_board		
Size: A4	Date: 2025-12-14	Rev: 1.0
KiCad E.D.A. 9.0.6		Id: 1/14

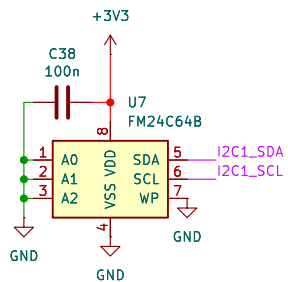


Dodać jakieś ledy do debugu (choć 3)

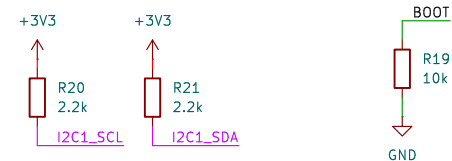
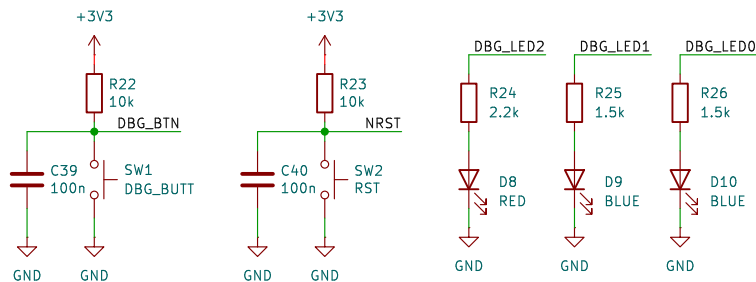
Dodać wyjścia na czujniki(Wszystkie pozostałe wyjścia na goldpiny)?



#### FRAM



ADDR: 0b1010000 0x50



Original author: Oliwier Woźniak

Sheet: /MCU/  
File: mcu.kicad\_sch

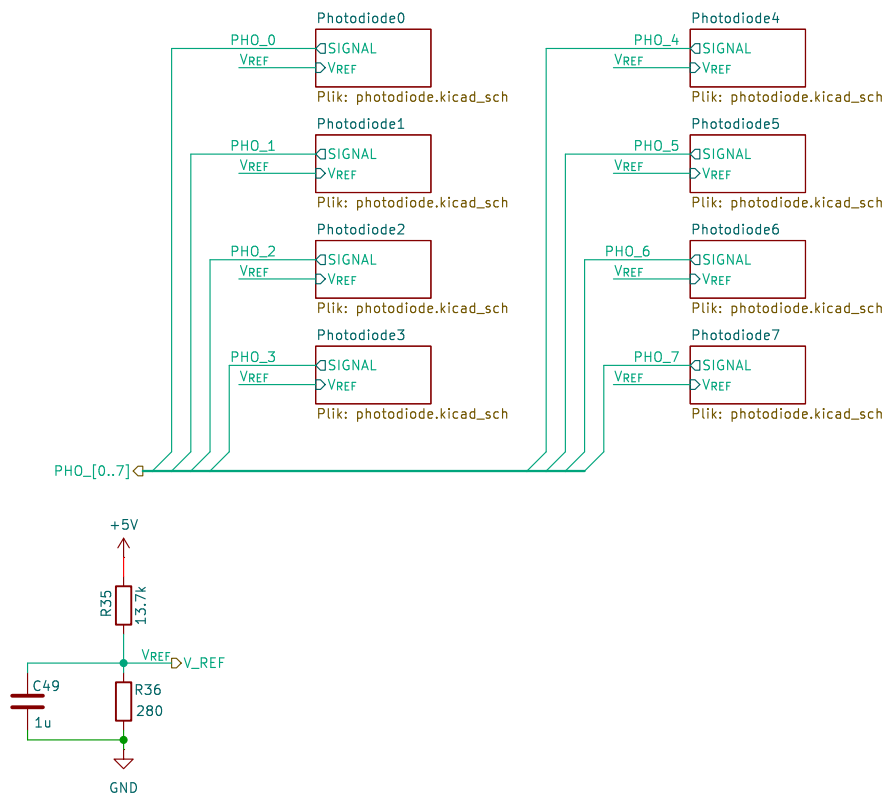
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Size: A4  
KiCad E.D.A. 9.0.6

Date: 2025-12-14

Rev: 1.0

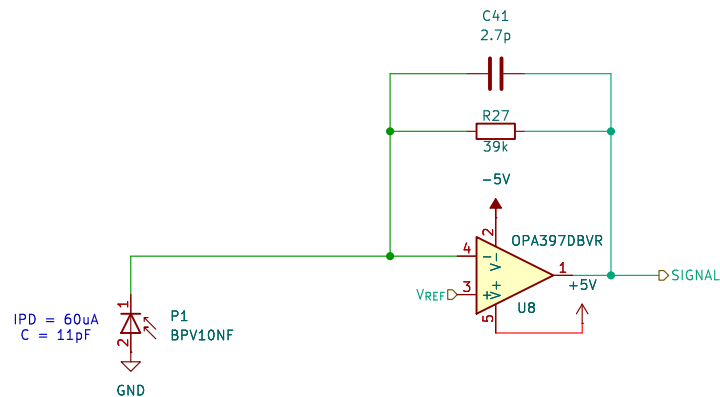
Id: 3/14



Original author: Oliwier Woźniak		
Sheet: /Photodiodes/ File: photodiodes_all.kicad_sch		
Title: uMule_board		
Size: A4	Date: 2025-12-14	Rev: 1.0
KiCad E.D.A. 9.0.6		Id: 21/14

Można zastanowić się nad zmianą wartości rezystora R1, ale to po zmianie procka i sprawdzeniu czy będzie działać. Obecnie jest zakres 0.1V–2.4V (chyba)

$$\frac{V_{OUT(MAX)} - V_{OUT(MIN)}}{I_{IN(MAX)}} = R_1 \rightarrow \frac{4.9V - .1V}{90\mu A} = 53333.3\Omega \rightarrow 53.6k\Omega$$



IPD = 60uA  
C = 11pF

GND

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- łatwiejszy poradnik

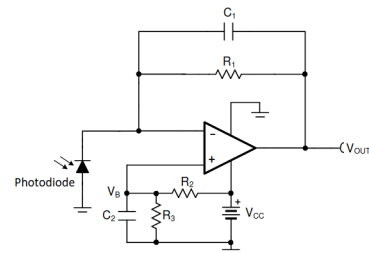


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = I_{PD}R_1 + V_B = I_{PD}R_1 + V_{CC}\frac{R_3}{R_3 + R_2} \quad (2)$$

## KEY OPA128 SPECIFICATIONS

Bias current ..... 75fA max  
Offset voltage ..... 500μV max  
Drift ..... 5μV/°C max  
Noise ..... 15nV/√Hz at 10kHz

Original author: Oliwier Woźniak

Sheet: /Photodiodes/Photodiode0/  
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**Title: uMule\_board**

Size: A4 Date: 2025-12-14

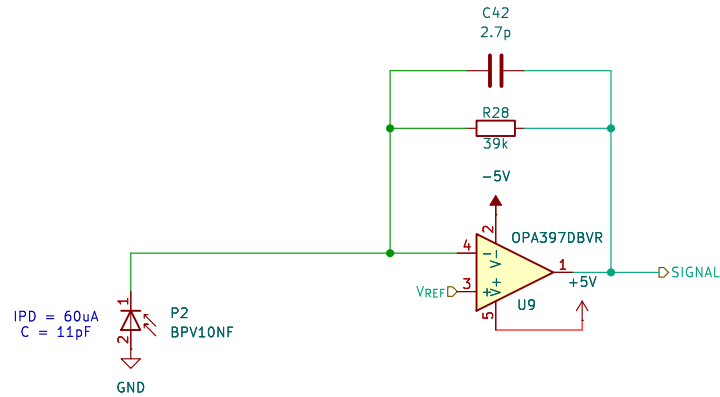
KiCad E.D.A. 9.0.6

**Rev: 1.0**

Id: 4/14

Można zastanowić się nad zmianą wartości rezystora R1, ale to po zmianie procka i sprawdzeniu czy będzie działać. Obecnie jest zakres 0.1V–2.4V (chyba)

$$\frac{V_{OUT(MAX)} - V_{OUT(MIN)}}{I_{IN(MAX)}} = R_1 \rightarrow \frac{4.9V - .1V}{90\mu A} = 53333.3\Omega \rightarrow 53.6k\Omega$$



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- łatwiejszy poradnik

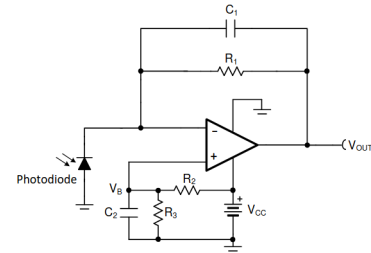


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = I_{PD}R_1 + V_b = I_{PD}R_1 + V_{CC}\frac{R_3}{R_3 + R_2} \quad (2)$$

## KEY OPA128 SPECIFICATIONS

Bias current ..... 75fA max  
Offset voltage ..... 500μV max  
Drift ..... 5μV/°C max  
Noise ..... 15nV/√Hz at 10kHz

Original author: Oliwier Woźniak

Sheet: /Photodiodes/Photodiode1/  
File: photodiode.kicad\_sch

**Title: uMule\_board**

Size: A4 Date: 2025-12-14

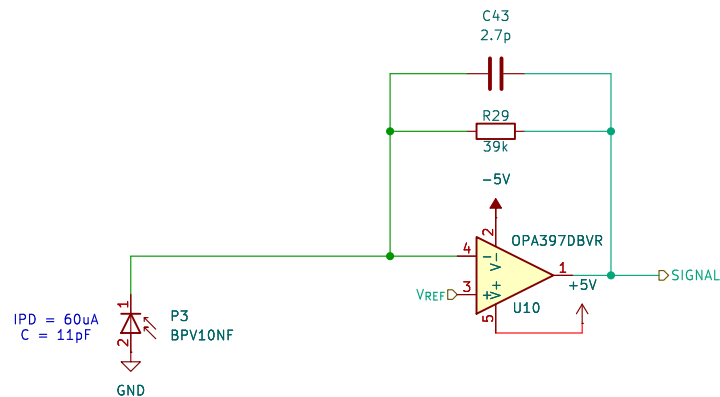
KiCad E.D.A. 9.0.6

**Rev: 1.0**

Id: 5/14

Można zastanowić się nad zmianą wartości rezystora R1, ale to po zmianie procka i sprawdzeniu czy będzie działać. Obecnie jest zakres 0.1V–2.4V (chyba)

$$\frac{V_{OUT(MAX)} - V_{OUT(MIN)}}{I_{IN(MAX)}} = R_1 \rightarrow \frac{4.9V - .1V}{90\mu A} = 53333.3\Omega \rightarrow 53.6k\Omega$$



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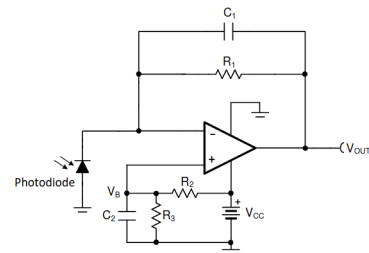


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = I_{PD}R_1 + V_B = I_{PD}R_1 + V_{CC}\frac{R_3}{R_3 + R_2} \quad (2)$$

## KEY OPA128 SPECIFICATIONS

Bias current ..... 75fA max  
Offset voltage ..... 500μV max  
Drift ..... 5μV/°C max  
Noise ..... 15nV/√Hz at 10kHz

Original author: Oliwier Woźniak

Sheet: /Photodiodes/Photodiode2/  
File: photodiode.kicad\_sch

**Title: uMule\_board**

Size: A4 Date: 2025-12-14

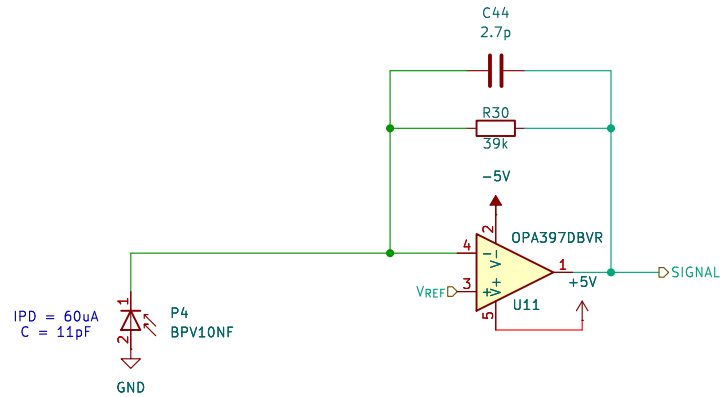
KiCad E.D.A. 9.0.6

**Rev: 1.0**

Id: 6/14

Można zastanowić się nad zmianą wartości rezystora R1, ale to po zmianie procka i sprawdzeniu czy będzie działać. Obecnie jest zakres 0.1V–2.4V (chyba)

$$\frac{V_{OUT(MAX)} - V_{OUT(MIN)}}{I_{IN(MAX)}} = R_1 \rightarrow \frac{4.9V - .1V}{90\mu A} = 53333.3\Omega \rightarrow 53.6k\Omega$$



IPD = 60uA  
C = 11pF  
P4 BPV10NF  
GND

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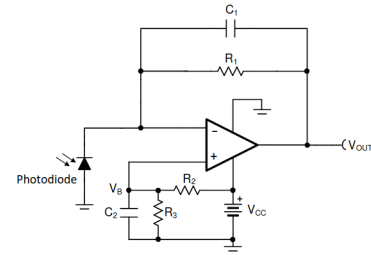


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = I_{PD}R_1 + V_B = I_{PD}R_1 + V_{CC}\frac{R_3}{R_3 + R_2} \quad (2)$$

## KEY OPA128 SPECIFICATIONS

Bias current ..... 75fA max  
Offset voltage ..... 500μV max  
Drift ..... 5μV/°C max  
Noise ..... 15nV/√Hz at 10kHz

Original author: Oliwier Woźniak

Sheet: /Photodiodes/Photodiode3/  
File: photodiode.kicad\_sch

**Title: uMule\_board**

Size: A4 Date: 2025-12-14

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**Rev: 1.0**

Id: 7/14



Można zastanowić się nad zmianą wartości rezystora R1, ale to po zmianie procka i sprawdzeniu czy będzie działać. Obecnie jest zakres 0.1V–2.4V (chyba)

$$\frac{V_{OUT(MAX)} - V_{OUT(MIN)}}{I_{IN(MAX)}} = R_1 \rightarrow \frac{4.9V - .1V}{90\mu A} = 53333.3\Omega \rightarrow 53.6k\Omega$$

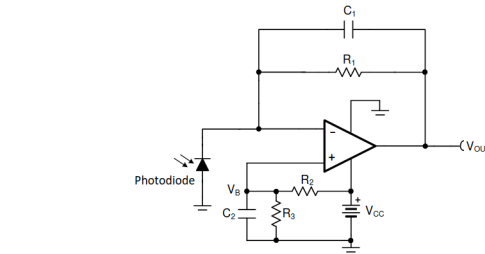
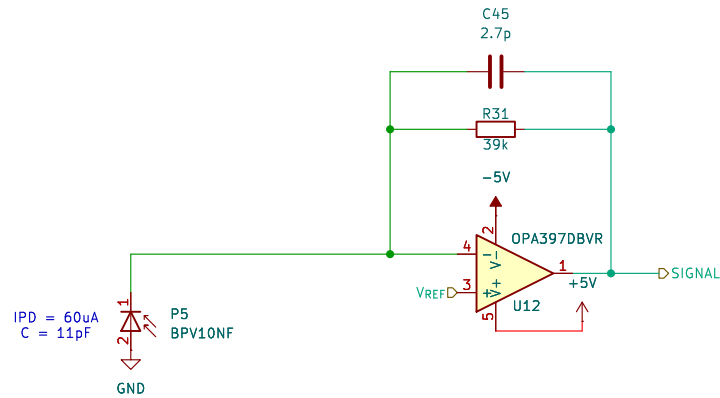


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = I_{PD}R_1 + V_B = I_{PD}R_1 + V_{CC}\frac{R_3}{R_3 + R_2} \quad (2)$$

## KEY OPA128 SPECIFICATIONS

Bias current ..... 75fA max  
 Offset voltage ..... 500μV max  
 Drift ..... 5μV/°C max  
 Noise ..... 15nV/√Hz at 10kHz

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 - łatwiejszy poradnik

Original author: Oliwier Woźniak

Sheet: /Photodiodes/Photodiode4/  
 File: photodiode.kicad\_sch

**Title: uMule\_board**

Size: A4 Date: 2025-12-14

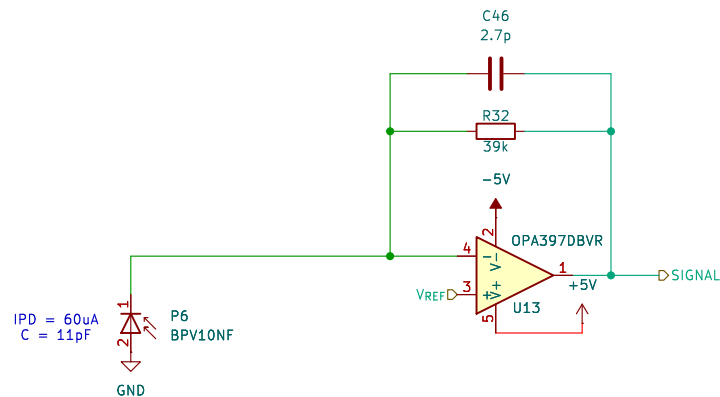
KiCad E.D.A. 9.0.6

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Id: 8/14

Można zastanowić się nad zmianą wartości rezystora R1, ale to po zmianie procka i sprawdzeniu czy będzie działać. Obecnie jest zakres 0.1V–2.4V (chyba)

$$\frac{V_{OUT(MAX)} - V_{OUT(MIN)}}{I_{IN(MAX)}} = R_1 \rightarrow \frac{4.9V - .1V}{90\mu A} = 53333.3\Omega \rightarrow 53.6k\Omega$$



IPD = 60uA  
C = 11pF

GND

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- łatwiejszy poradnik

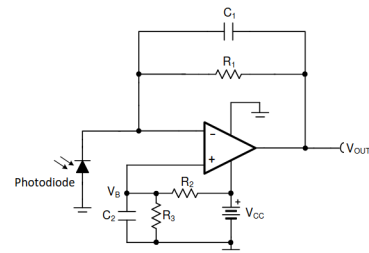


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = I_{PD}R_1 + V_B = I_{PD}R_1 + V_{CC}\frac{R_3}{R_3 + R_2} \quad (2)$$

## KEY OPA128 SPECIFICATIONS

Bias current ..... 75fA max  
Offset voltage ..... 500μV max  
Drift ..... 5μV/°C max  
Noise ..... 15nV/√Hz at 10kHz

Original author: Oliwier Woźniak

Sheet: /Photodiodes/Photodiode5/  
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**Title: uMule\_board**

Size: A4 Date: 2025-12-14

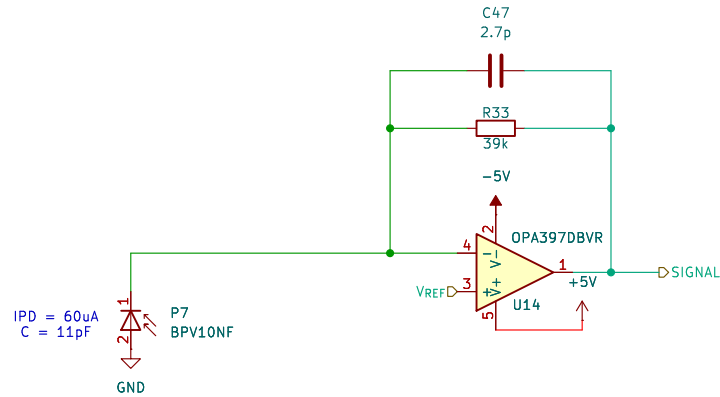
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Id: 9/14

Można zastanowić się nad zmianą wartości rezystora R1, ale to po zmianie procka i sprawdzeniu czy będzie działać. Obecnie jest zakres 0.1V–2.4V (chyba)

$$\frac{V_{OUT(MAX)} - V_{OUT(MIN)}}{I_{IN(MAX)}} = R_1 \rightarrow \frac{4.9V - .1V}{90\mu A} = 53333.3\Omega \rightarrow 53.6k\Omega$$



IPD = 60uA  
C = 11pF

GND

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- łatwiejszy poradnik

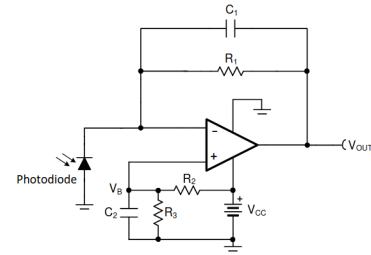


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = I_{PD}R_1 + V_B = I_{PD}R_1 + V_{CC}\frac{R_3}{R_3 + R_2} \quad (2)$$

## KEY OPA128 SPECIFICATIONS

Bias current ..... 75fA max  
Offset voltage ..... 500μV max  
Drift ..... 5μV/°C max  
Noise ..... 15nV/√Hz at 10kHz

Original author: Oliwier Woźniak

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**Title: uMule\_board**

Size: A4 Date: 2025-12-14

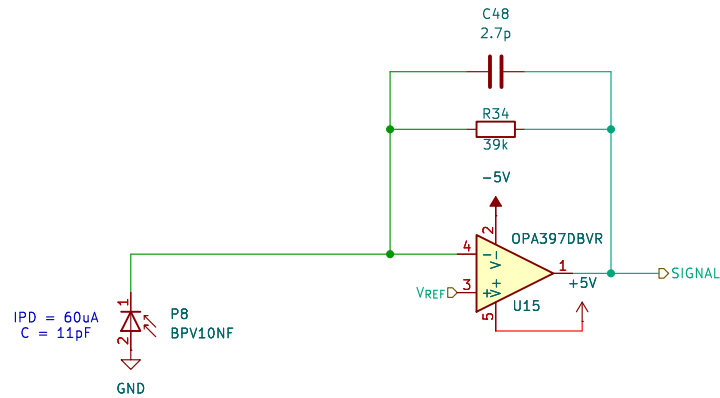
KiCad E.D.A. 9.0.6

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Id: 10/14

Można zastanowić się nad zmianą wartości rezystora R1, ale to po zmianie procka i sprawdzeniu czy będzie działać. Obecnie jest zakres 0.1V–2.4V (chyba)

$$\frac{V_{OUT(MAX)} - V_{OUT(MIN)}}{I_{IN(MAX)}} = R_1 \rightarrow \frac{4.9V - .1V}{90\mu A} = 53333.3\Omega \rightarrow 53.6k\Omega$$



IPD = 60uA  
C = 11pF  
GND

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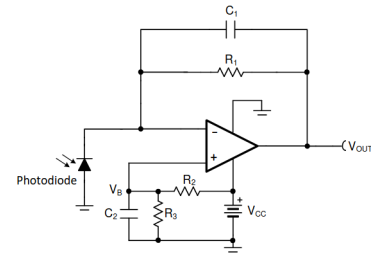


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = I_{PD}R_1 + V_B = I_{PD}R_1 + V_{CC}\frac{R_3}{R_3 + R_2} \quad (2)$$

## KEY OPA128 SPECIFICATIONS

Bias current ..... 75fA max  
Offset voltage ..... 500μV max  
Drift ..... 5μV/°C max  
Noise ..... 15nV/√Hz at 10kHz

Original author: Oliwier Woźniak

Sheet: /Photodiodes/Photodiode7/  
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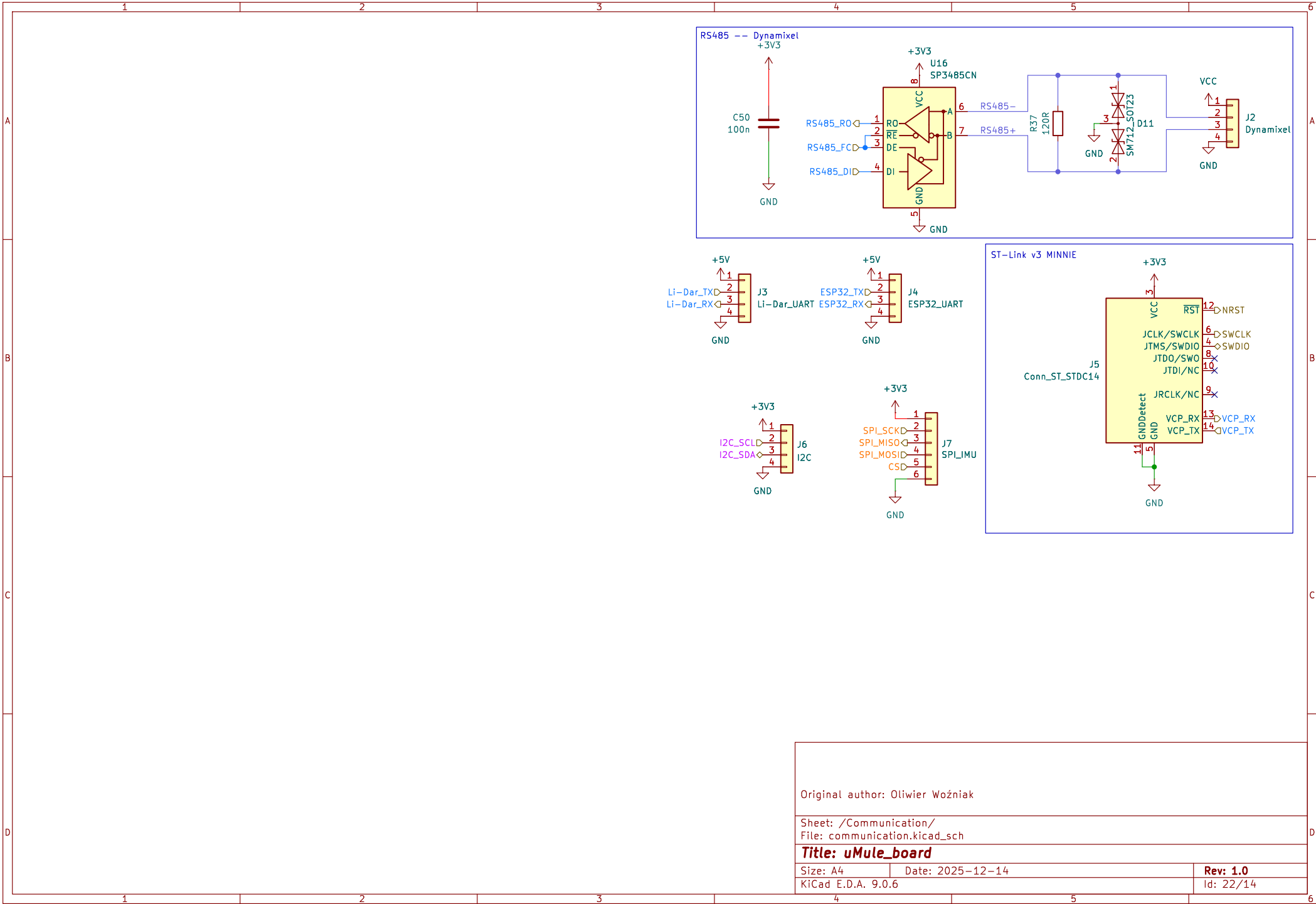
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Size: A4 Date: 2025-12-14

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**Rev: 1.0**

Id: 11/14



Original author: Oliwier Woźniak

Sheet: /Communication/  
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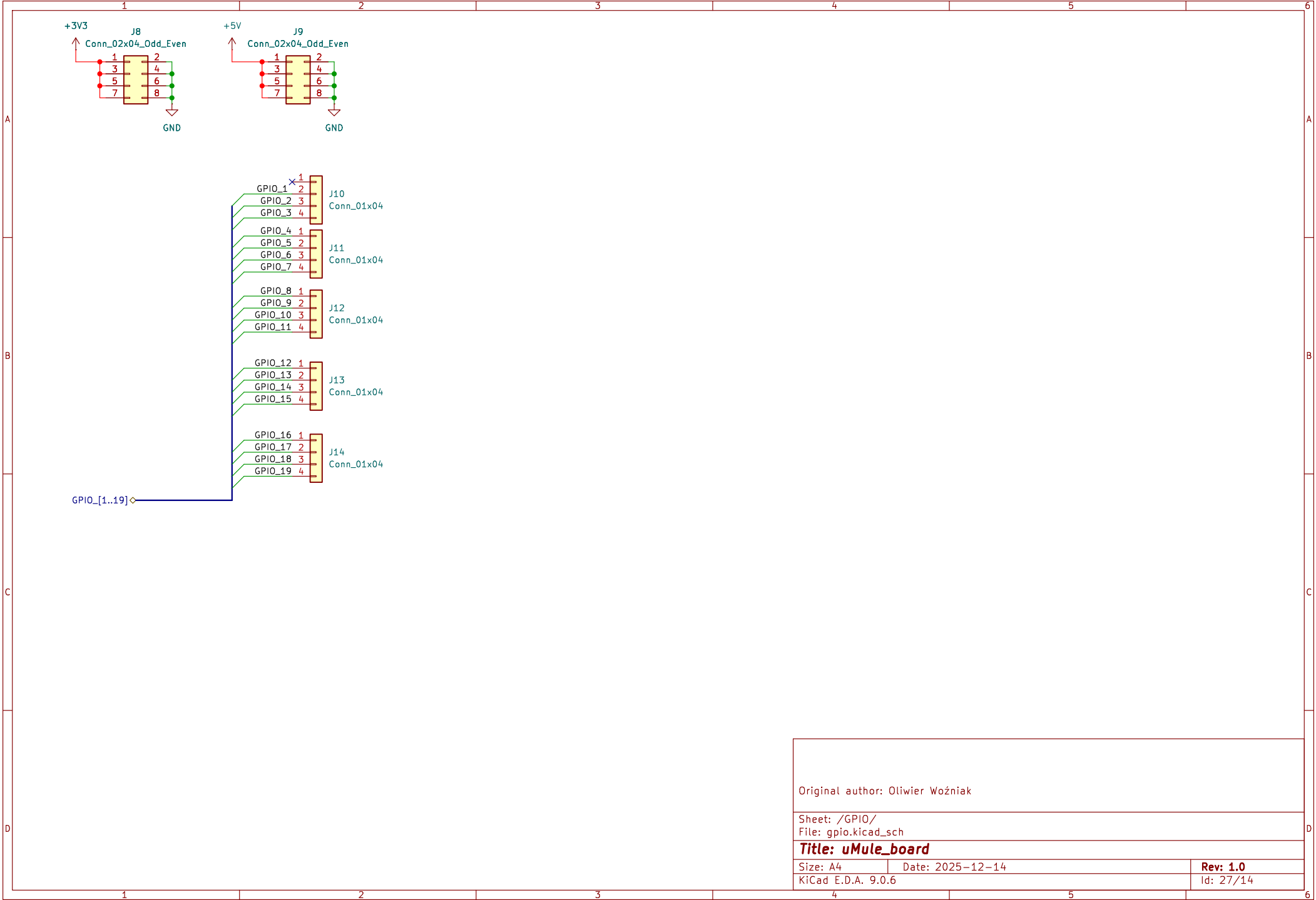
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Size: A4 Date: 2025-12-14

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**Rev: 1.0**

Id: 22/14



Original author: Oliwier Woźniak		
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Size: A4	Date: 2025-12-14	Rev: 1.0
KiCad E.D.A. 9.0.6		Id: 27/14