

Original author: Oliwier Woźniak

Sheet: /
File: uMule_board.kicad_sch

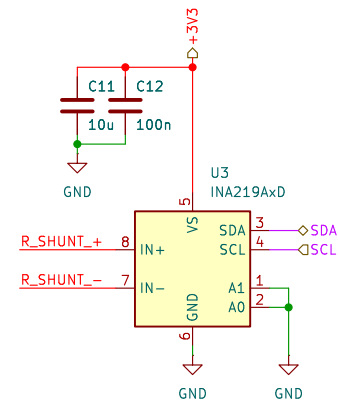
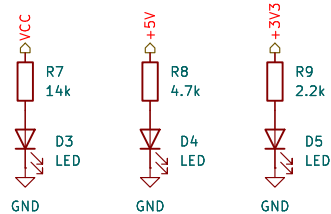
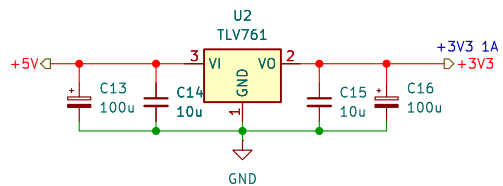
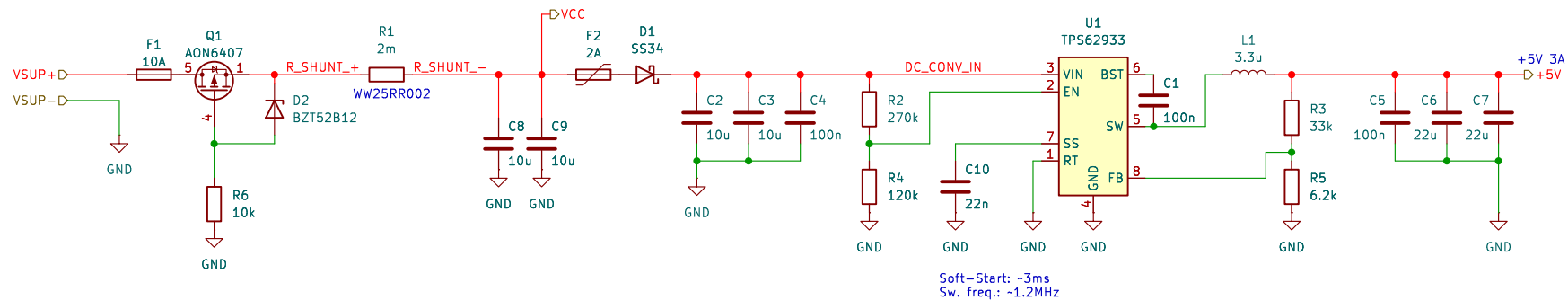
Title: uMule_board

Size: A4 Date: 2025-12-14

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Rev: 1.0

Id: 1/22



Original author: Oliwier Woźniak

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Title: uMule_board

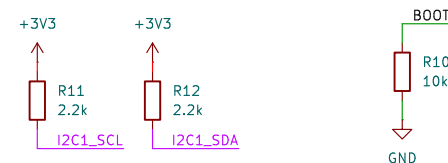
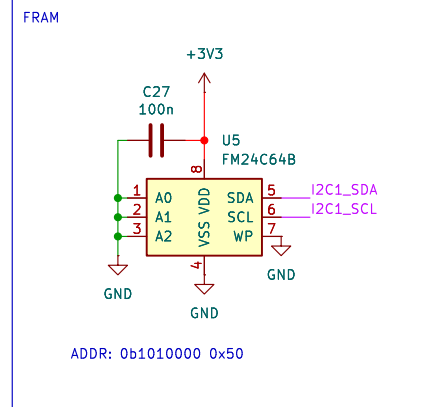
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KiCad E.D.A. 9.0.6

Date: 2025-12-14

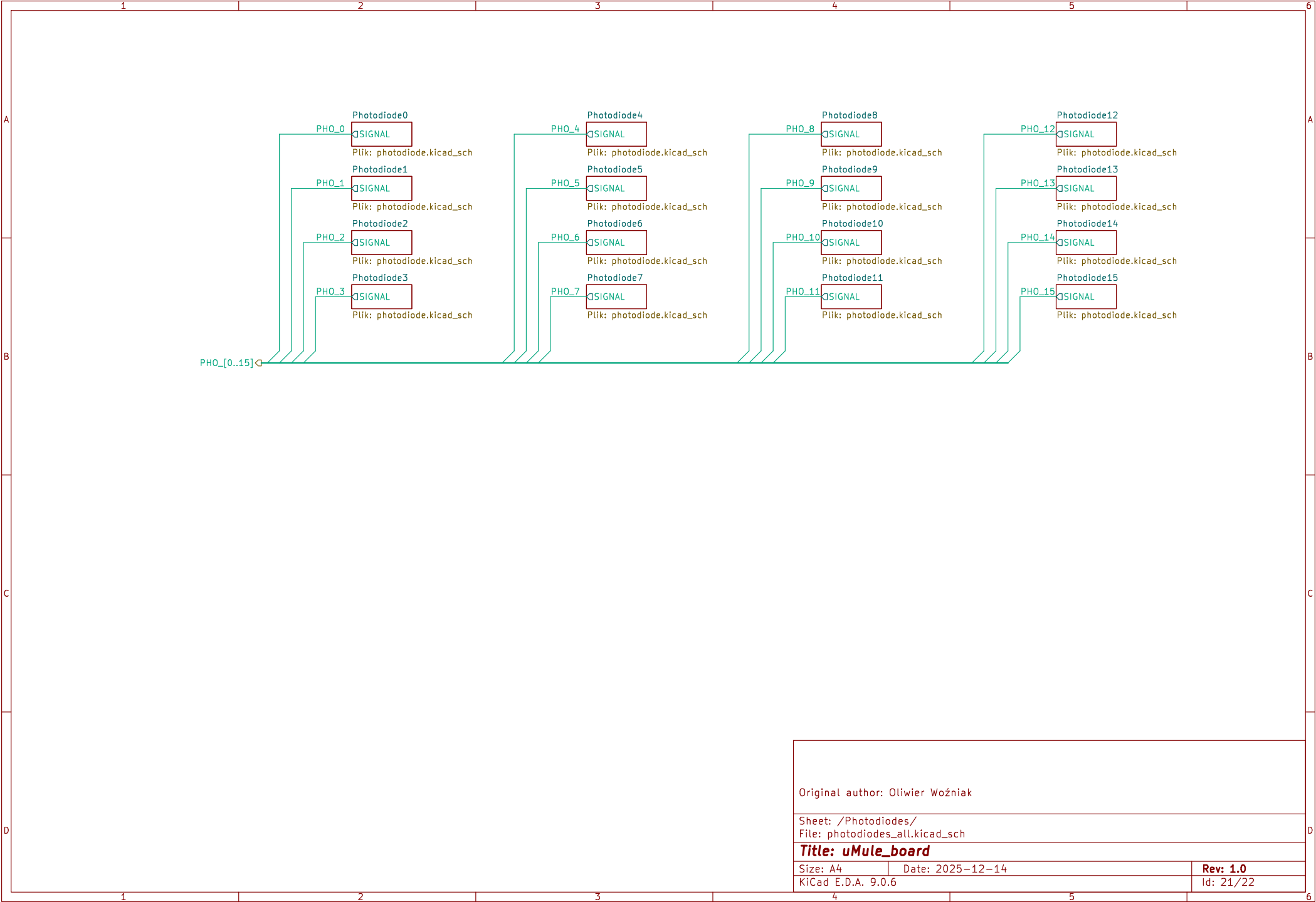
Rev: 1.0

Id: 2/22

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



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| Rev: 1.0 |
| Id: 3/22 |



Original author: Oliwier Woźniak

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File: photodiodes_all.kicad_sch

Title: uMule_board

Size: A4 Date: 2025-12-14

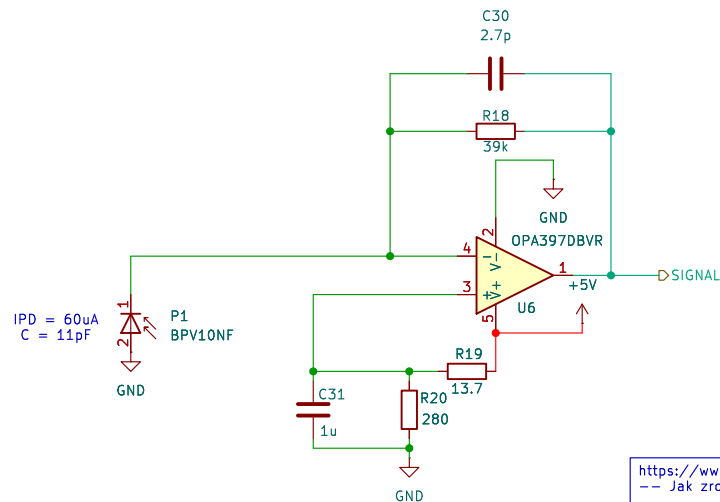
KiCad E.D.A. 9.0.6

Rev: 1.0

Id: 21/22

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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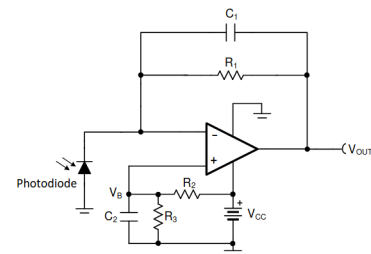


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

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File: photodiode.kicad_sch

Title: uMule_board

Size: A4 Date: 2025-12-14

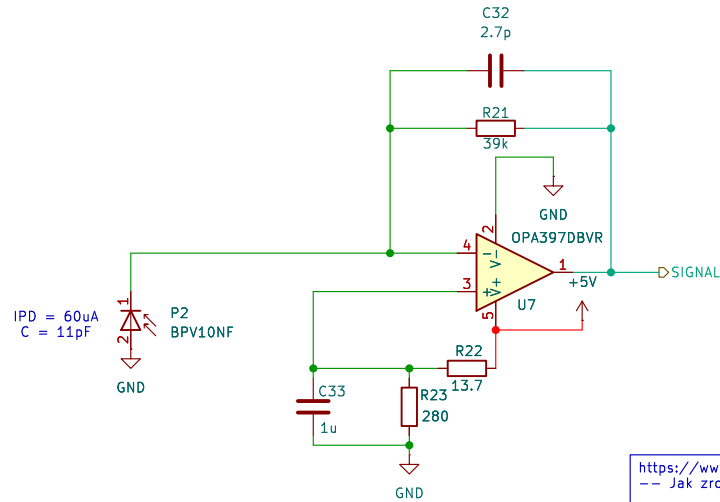
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Rev: 1.0

Id: 4/22

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)

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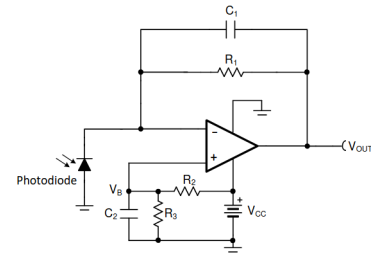


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

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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

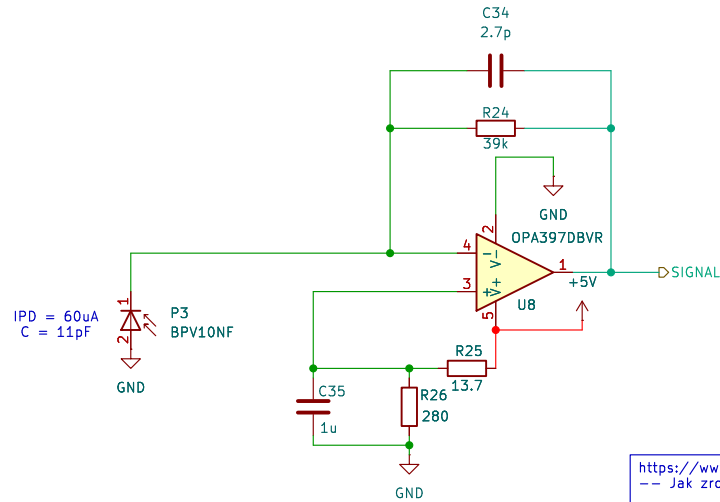
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Rev: 1.0

Id: 5/22

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)

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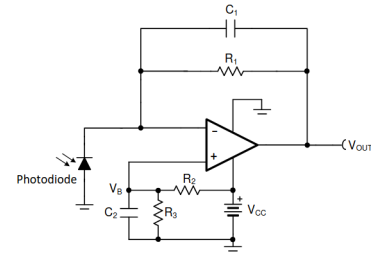


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

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Title: uMule_board

Size: A4 Date: 2025-12-14

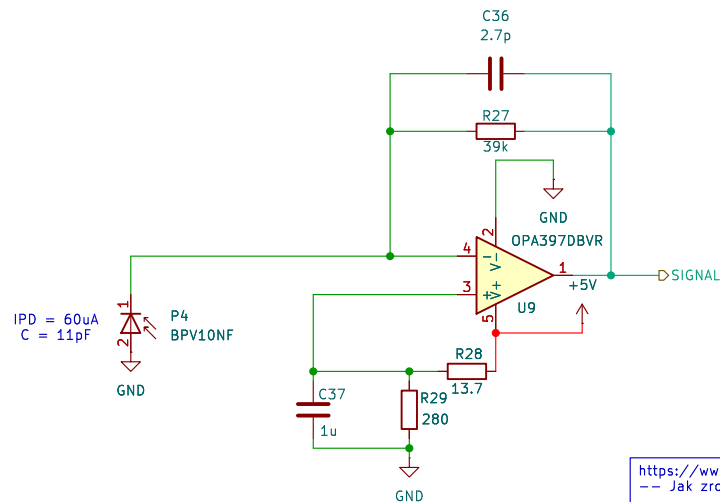
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Id: 6/22

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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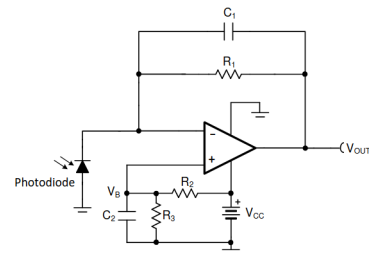


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

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File: photodiode.kicad_sch

Title: uMule_board

Size: A4 Date: 2025-12-14

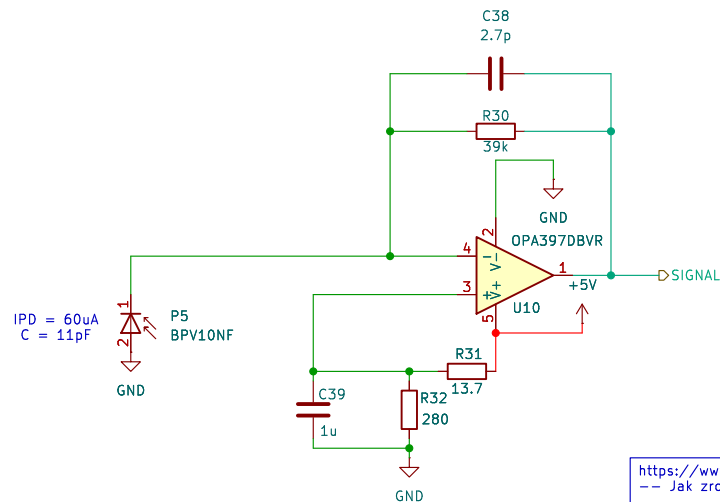
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Rev: 1.0

Id: 7/22

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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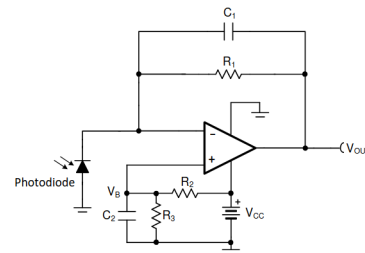


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

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File: photodiode.kicad_sch

Title: uMule_board

Size: A4 Date: 2025-12-14

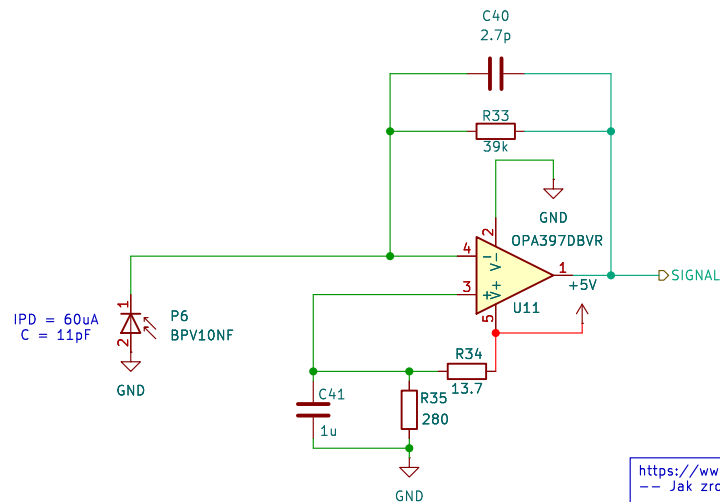
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Rev: 1.0

Id: 8/22

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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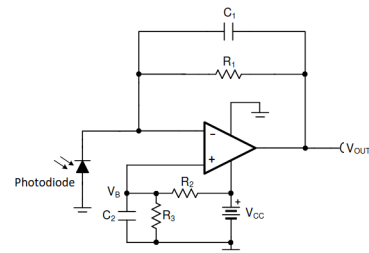


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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/Photodiode5/
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Title: uMule_board

Size: A4 Date: 2025-12-14

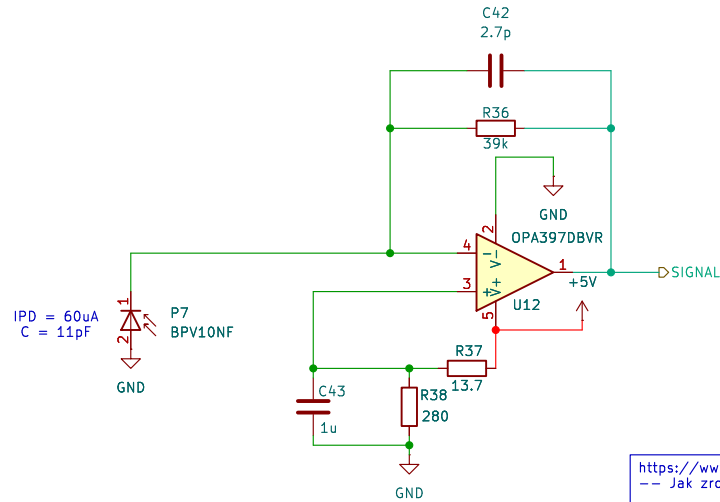
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Rev: 1.0

Id: 9/22

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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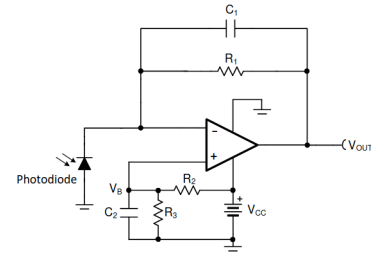


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The output transfer function including the bias voltage is:

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

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

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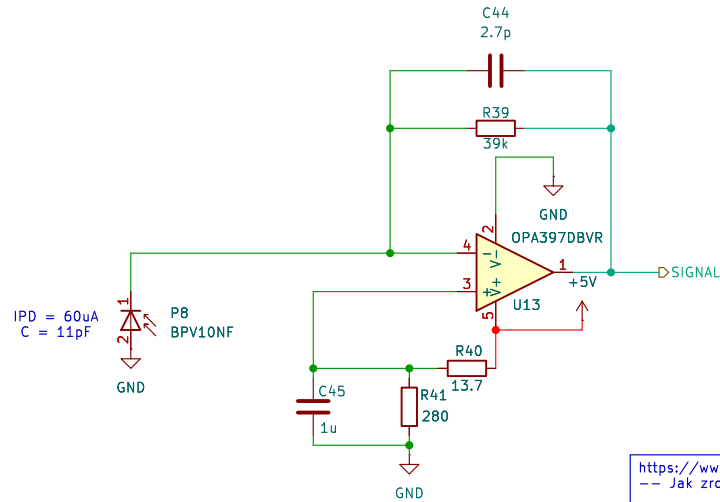
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Rev: 1.0

Id: 10/22

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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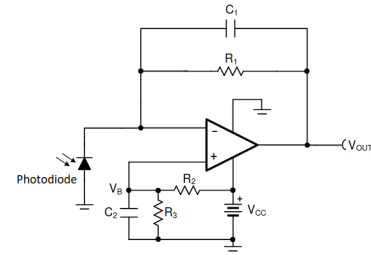


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

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

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

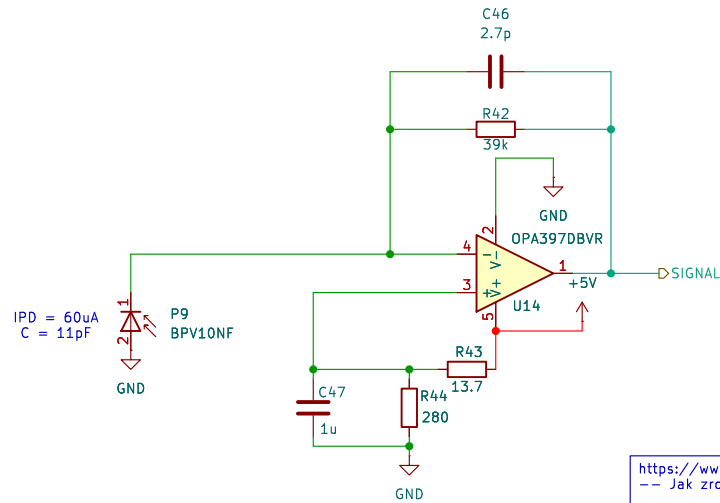
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Rev: 1.0

Id: 11/22

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)

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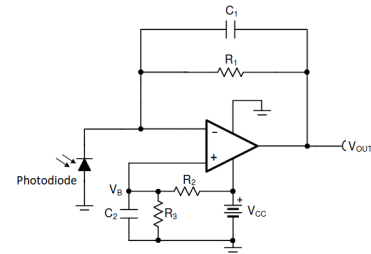


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KEY OPA128 SPECIFICATIONS

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

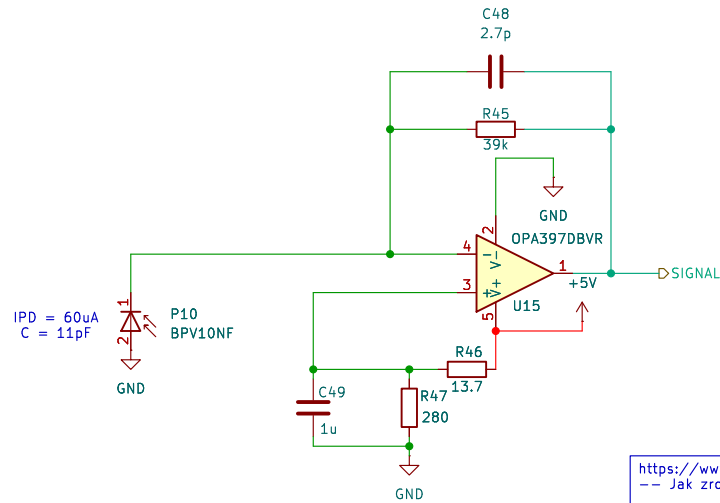
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Rev: 1.0

Id: 12/22

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)

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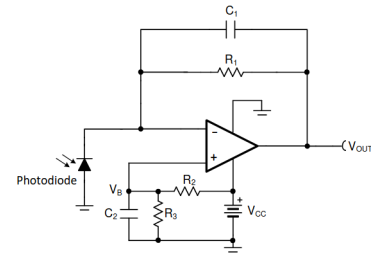


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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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

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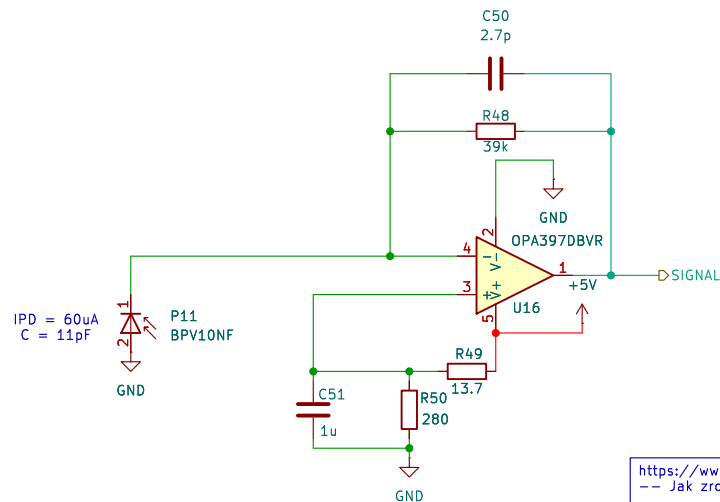
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Rev: 1.0

Id: 13/22

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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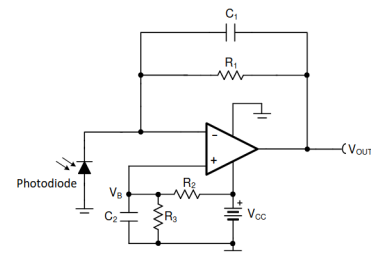


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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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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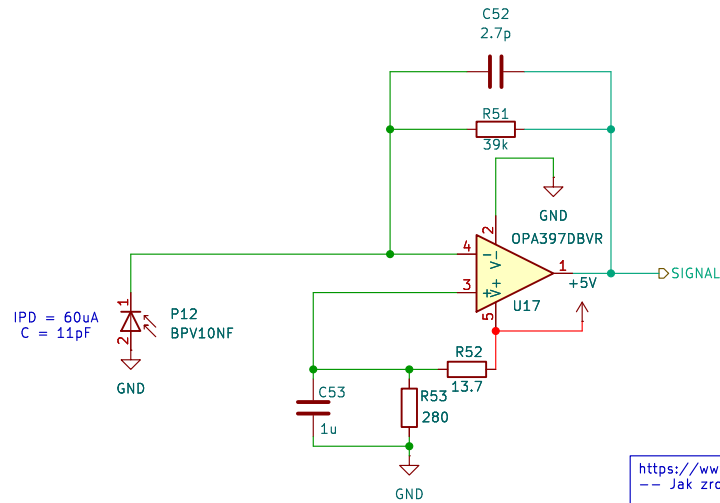
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Rev: 1.0

Id: 14/22

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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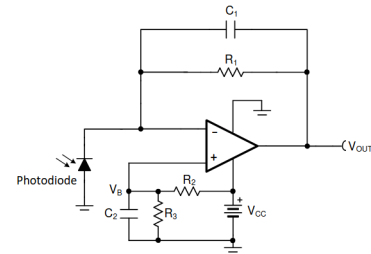


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

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Title: uMule_board

Size: A4 Date: 2025-12-14

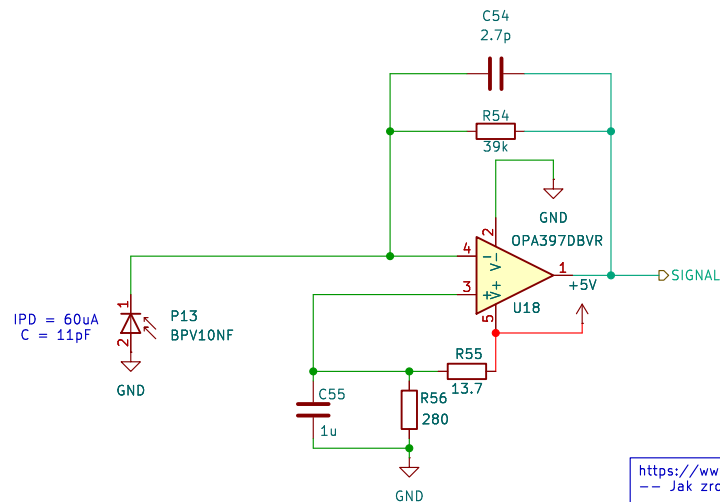
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Rev: 1.0

Id: 15/22

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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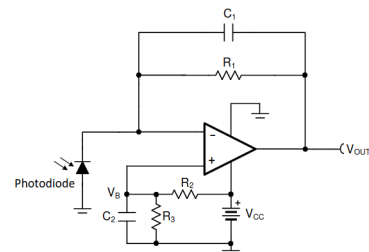


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

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Title: uMule_board

Size: A4 Date: 2025-12-14

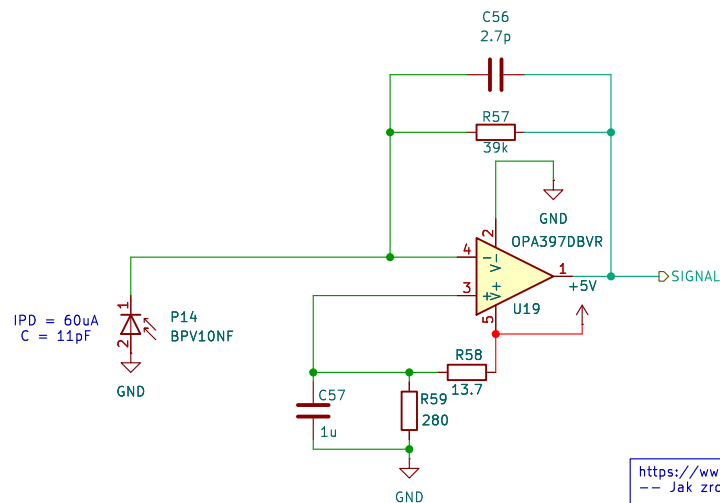
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Rev: 1.0

Id: 16/22

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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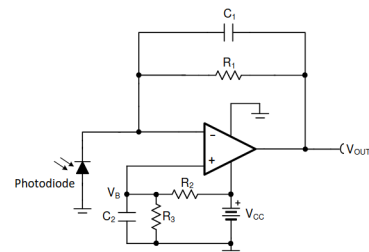


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

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Title: uMule_board

Size: A4 Date: 2025-12-14

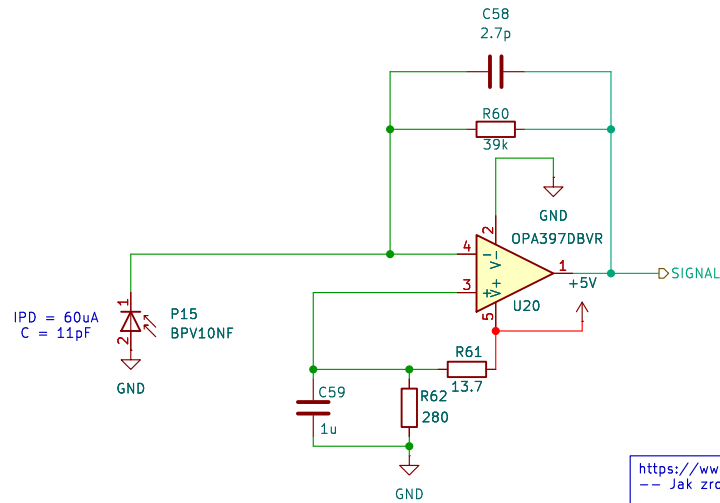
KiCad E.D.A. 9.0.6

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Id: 17/22

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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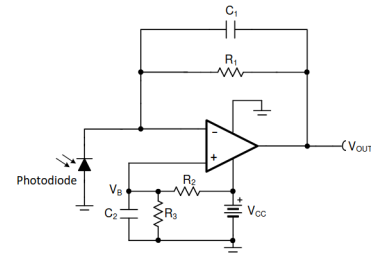


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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/Photodiode14/
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Size: A4 Date: 2025-12-14

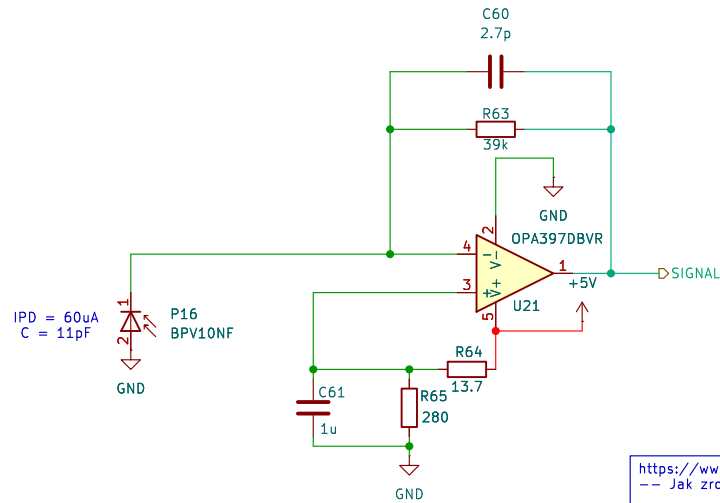
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Id: 18/22

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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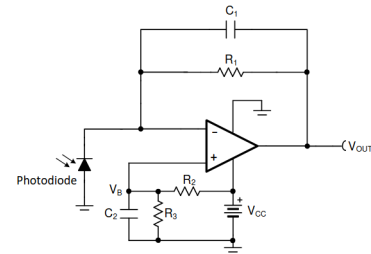


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

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File: photodiode.kicad_sch

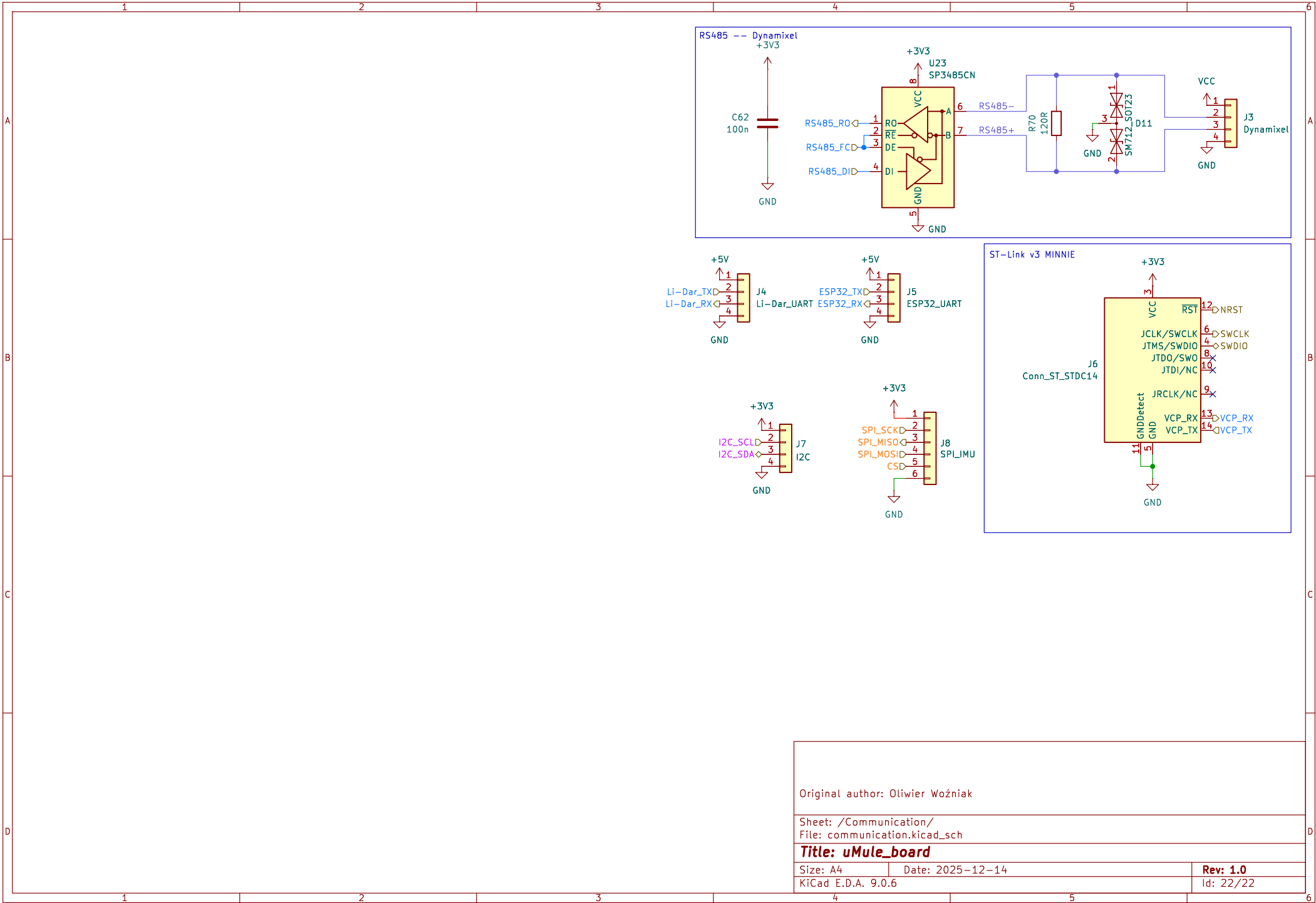
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Id: 19/22



Original author: Oliwier Woźniak

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File: communication.kicad_sch

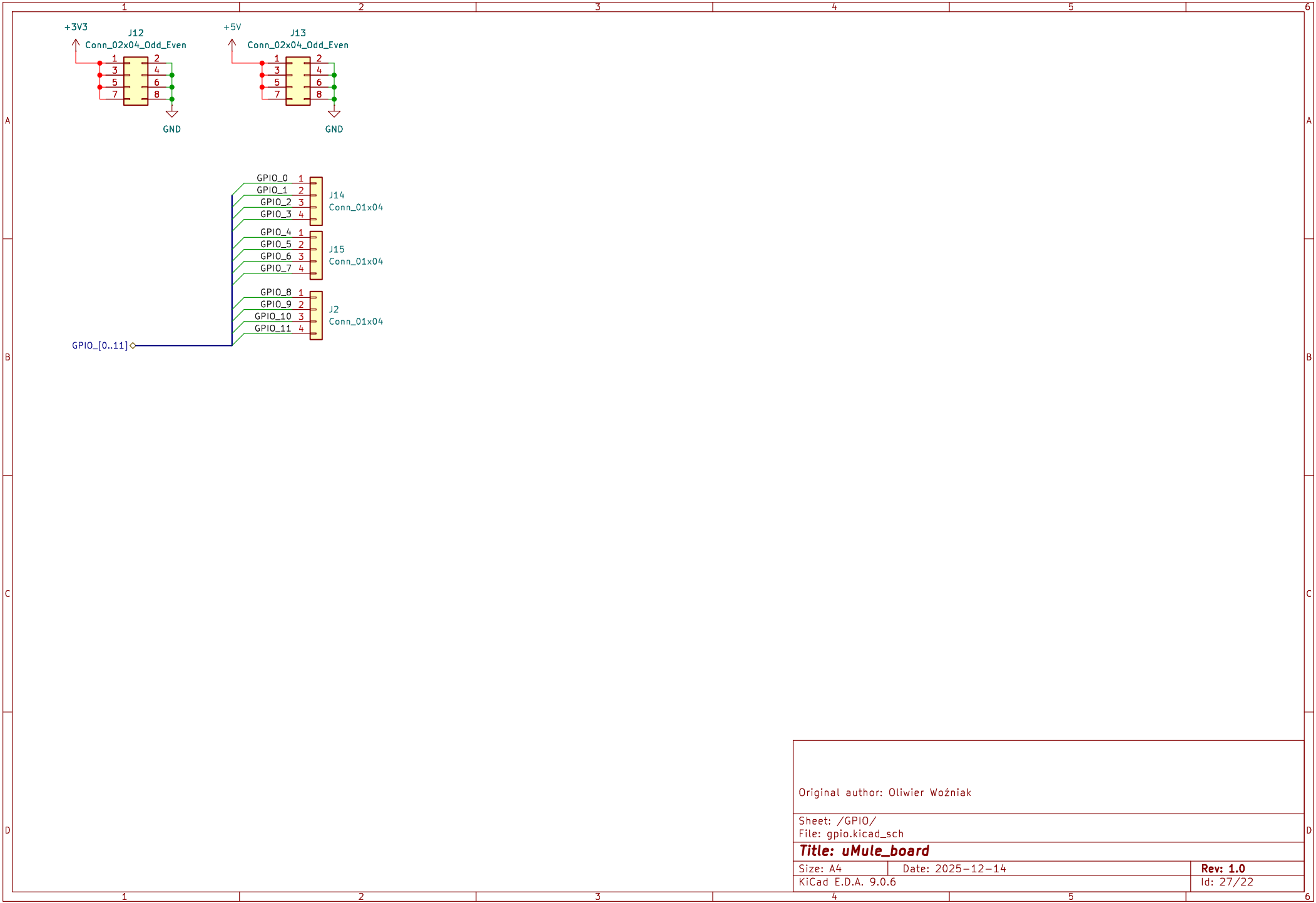
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Size: A4 Date: 2025-12-14

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Rev: 1.0

Id: 22/22



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|---------------------------------------|------------------|-----------|
| Original author: Oliwier Woźniak | | |
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| Title: uMule_board | | |
| Size: A4 | Date: 2025-12-14 | Rev: 1.0 |
| KiCad E.D.A. 9.0.6 | | Id: 27/22 |