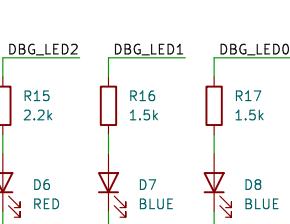
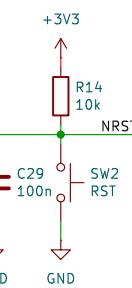
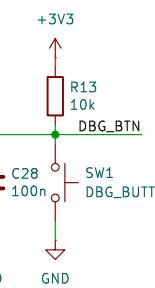
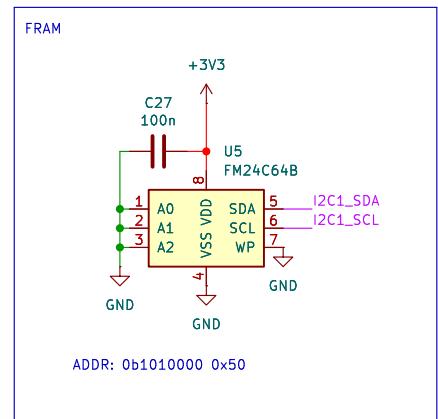
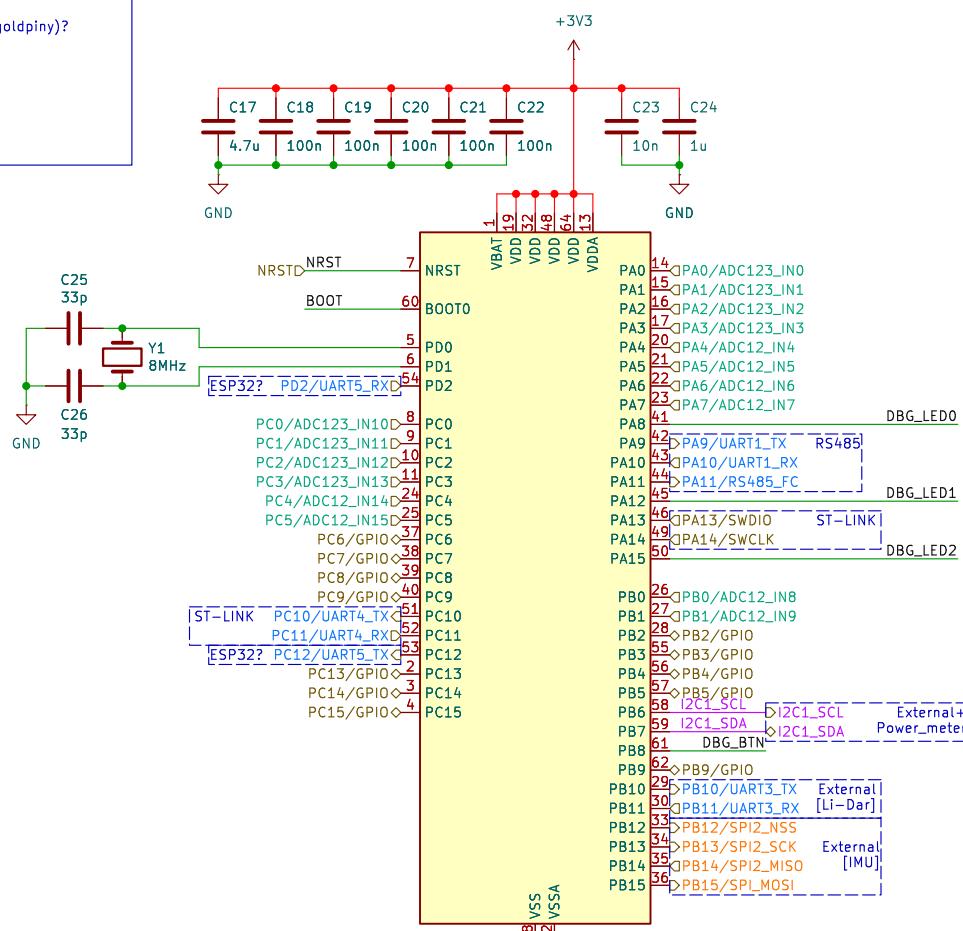


Dodać jakieś ledy do debugu (choćiąż 3)

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



Original author: Oliwier Woźnia

Sheet: /MCU/

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Title: UMULE_E

Page 10

A

A

B

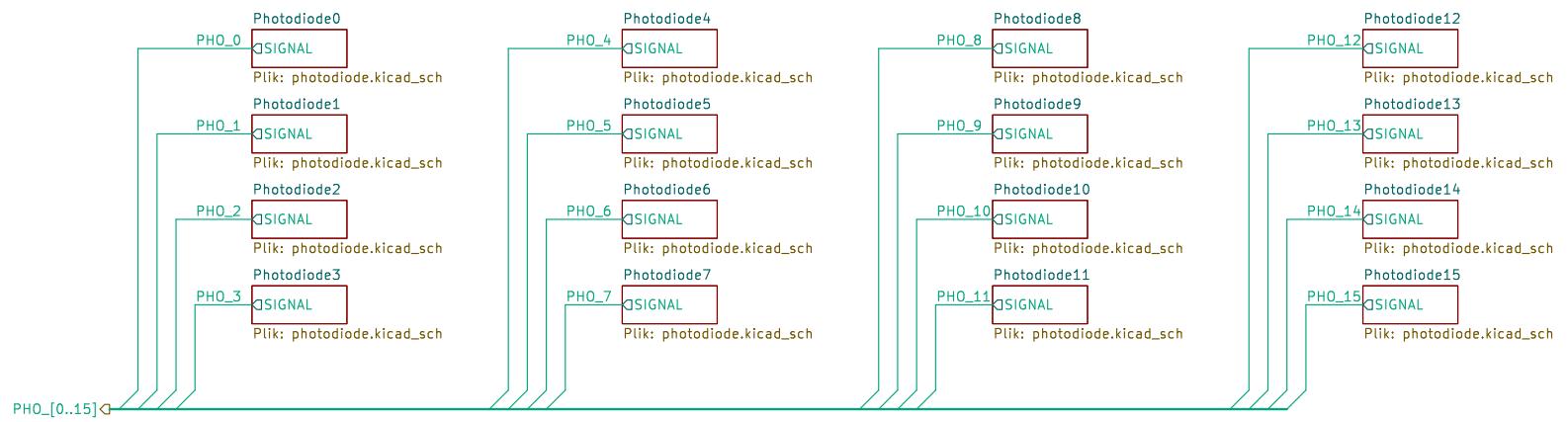
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Original author: Oliwier Woźniak

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KiCad E.D.A. 9.0.6Rev: 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)

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

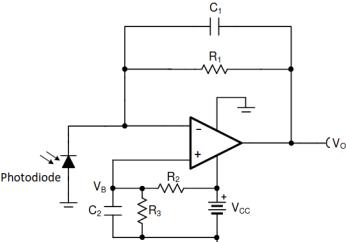
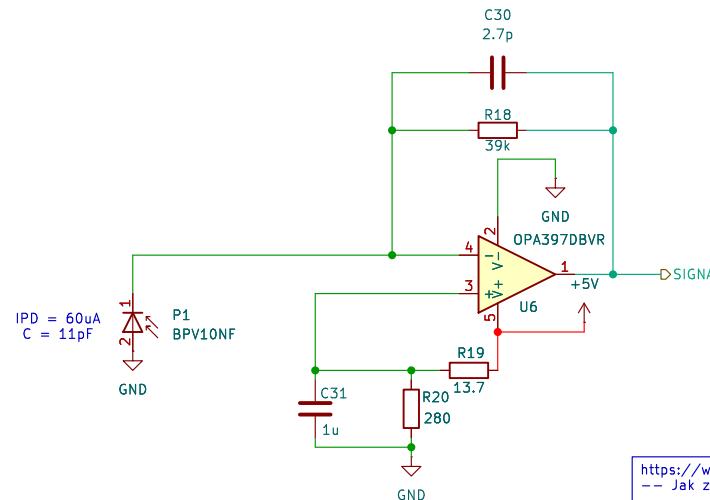


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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	500 μ V max
Drift	5 μ V/ $^{\circ}$ C max
Noise	15nV/ \sqrt{Hz} at 10kHz

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Original author: Oliwier Woźniak

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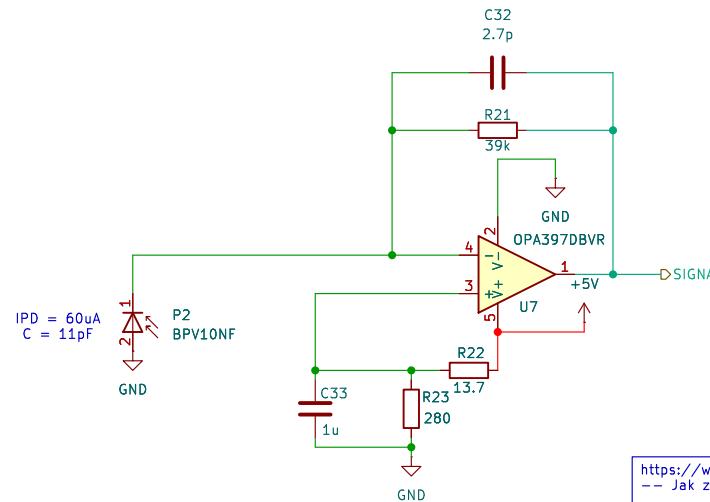
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KiCad E.D.A. 9.0.6

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)

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



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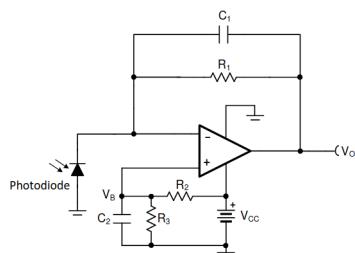


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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/Photodiode1/
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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)

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

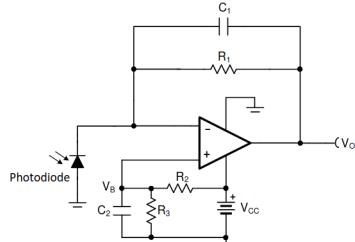
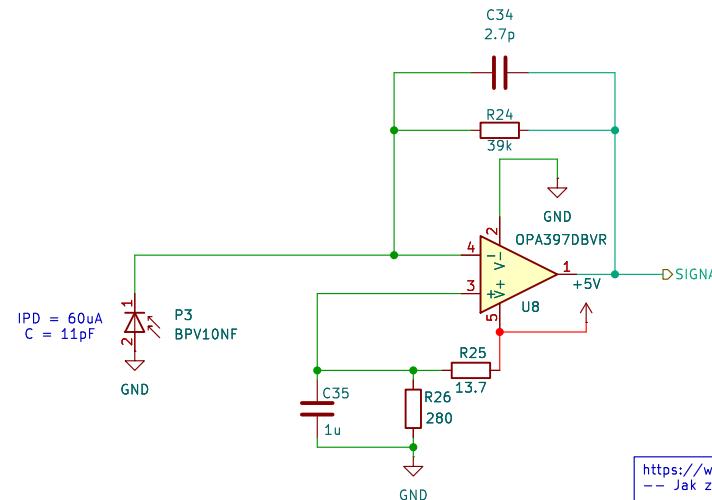


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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	500 μ V max
Drift	5 μ V/ $^{\circ}$ C max
Noise	15nV/ \sqrt{Hz} at 10kHz

Original author: Oliwier Woźniak

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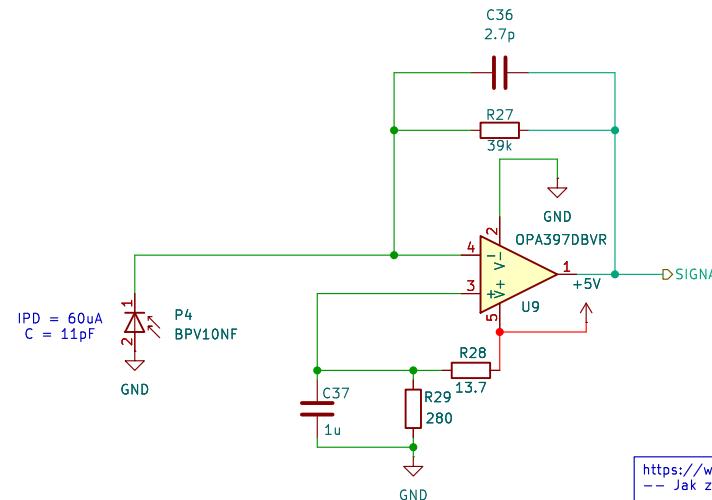
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Id: 6/22

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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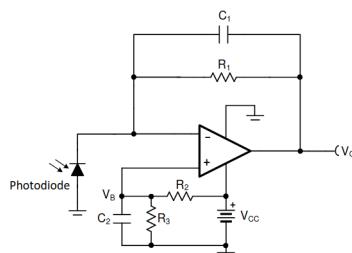


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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	500 μ V max
Drift	5 μ V/ $^{\circ}$ C max
Noise	15nV/ \sqrt{Hz} at 10kHz

Original author: Oliwier Woźniak

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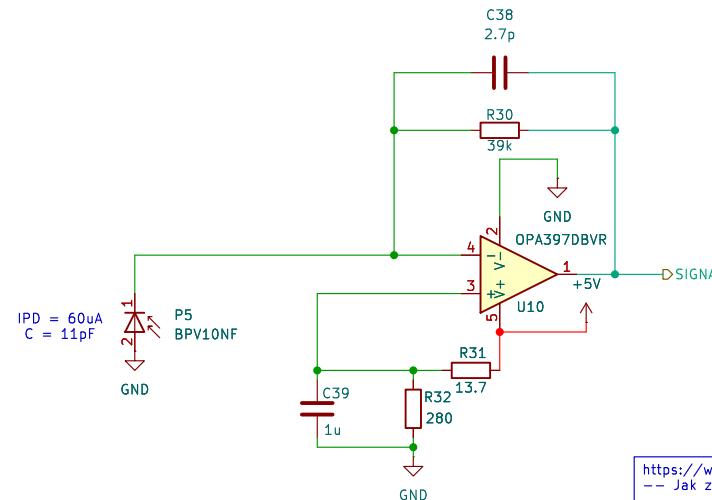
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Id: 7/22

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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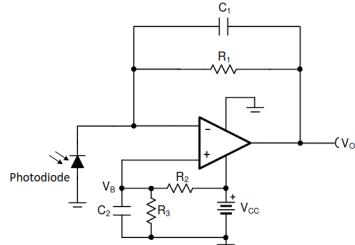


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = i_{PD}R_1 + V_B = i_{PD}R_1 + V_{CC} \frac{R_3}{R_3 + R_2}$$

KEY OPA128 SPECIFICATIONS

Bias current	75fA max
Offset voltage	500 μ V max
Drift	5 μ V/ $^{\circ}$ C max
Noise	15nV/ \sqrt{Hz} at 10kHz

Original author: Oliwier Woźniak

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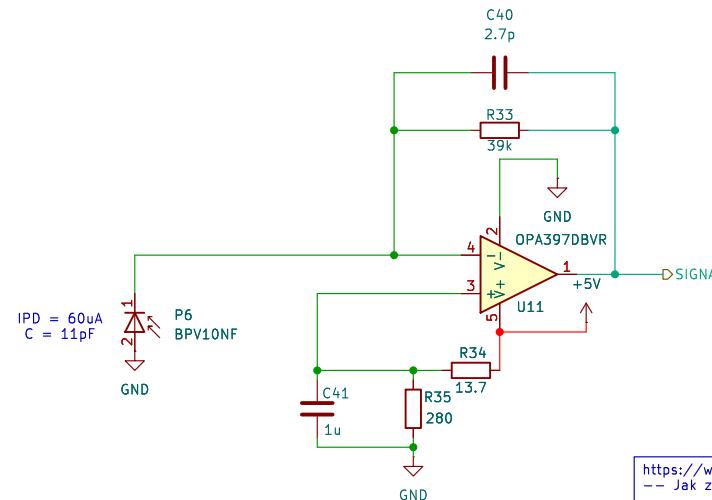
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Rev: 1.0
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Można zastanowić się nad zmianą wartości rezystora R1, ale to po zmianie procka i sprawdzeniu czy będzie działać. Obecnie jest zakres 0.1V–2.4V (chyba)

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



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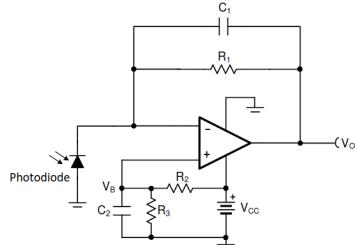


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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	500 μ V max
Drift	5 μ V/ $^{\circ}$ C max
Noise	15nV/ \sqrt 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: 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)

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

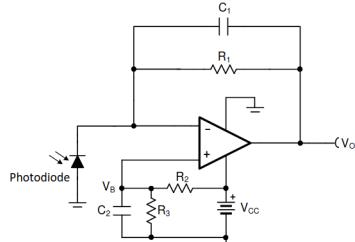
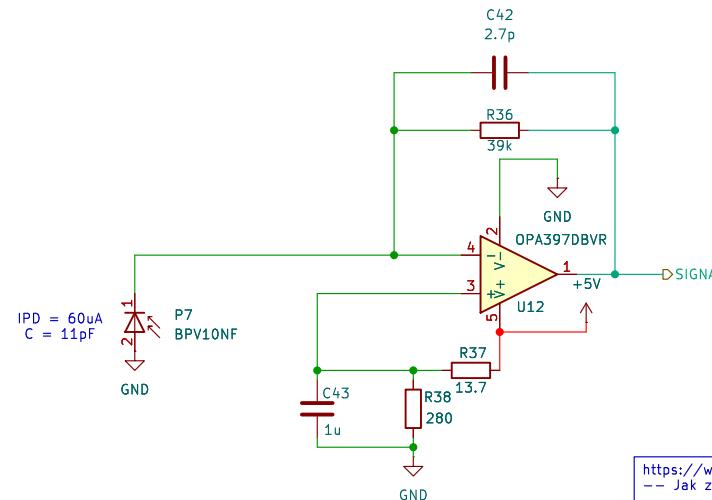


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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	500 μ V max
Drift	5 μ V/ $^{\circ}$ C max
Noise	15nV/ \sqrt{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: 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)

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

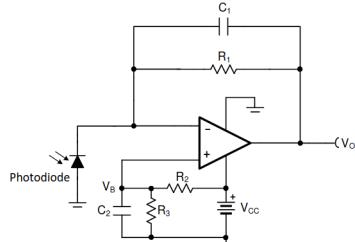
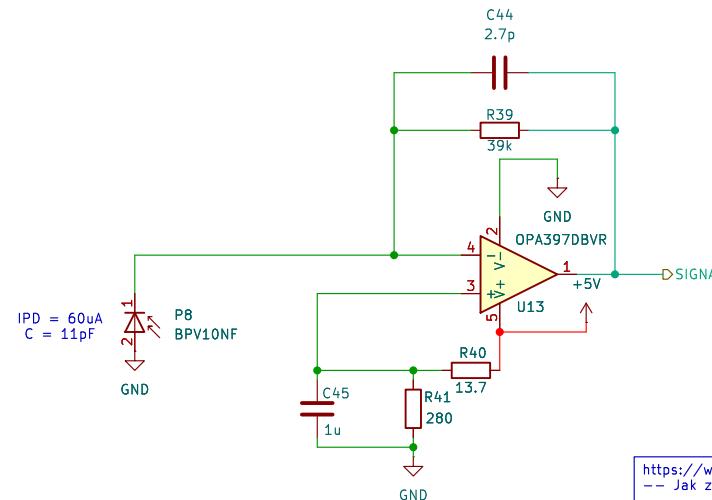


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

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

KEY OPA128 SPECIFICATIONS

Bias current	75fA max
Offset voltage	500 μ V max
Drift	5 μ V/ $^{\circ}$ C max
Noise	15nV/ \sqrt{Hz} at 10kHz

Original author: Oliwier Woźniak

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Title: uMule_board

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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)

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

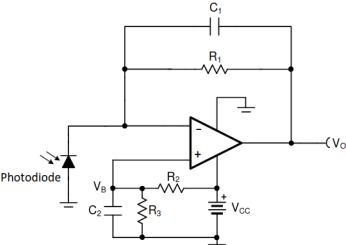
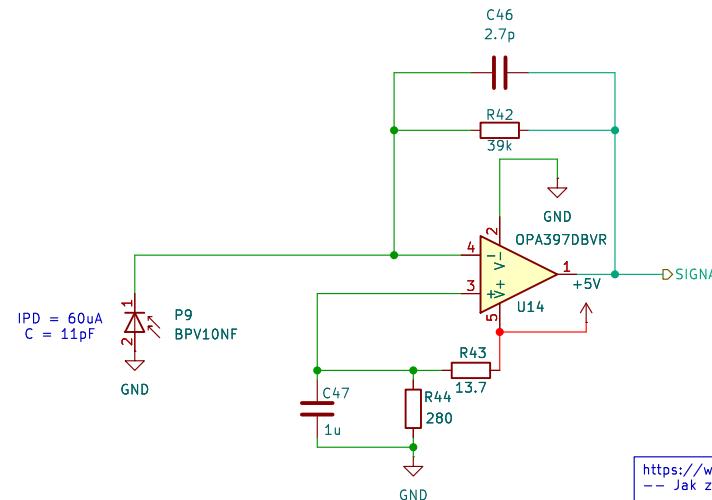


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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 500 μ V max
Drift 5 μ V/ $^{\circ}$ C max
Noise 15nV/ \sqrt Hz at 10kHz

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Original author: Oliwier Woźniak

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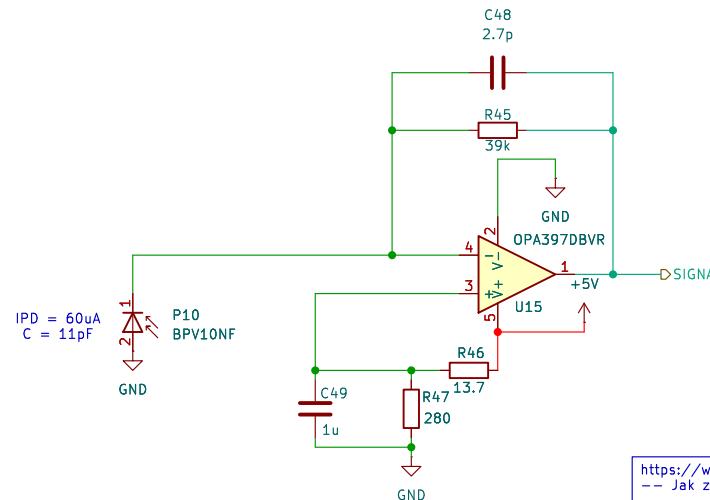
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Size: A4 Date: 2025-12-14
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Rev: 1.0
Id: 12/22

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)

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



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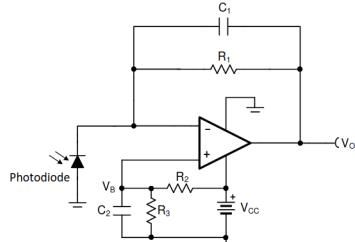


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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 500 μ V max
Drift 5 μ V/ $^{\circ}$ C max
Noise 15nV/ \sqrt{Hz} at 10kHz

Original author: Oliwier Woźniak

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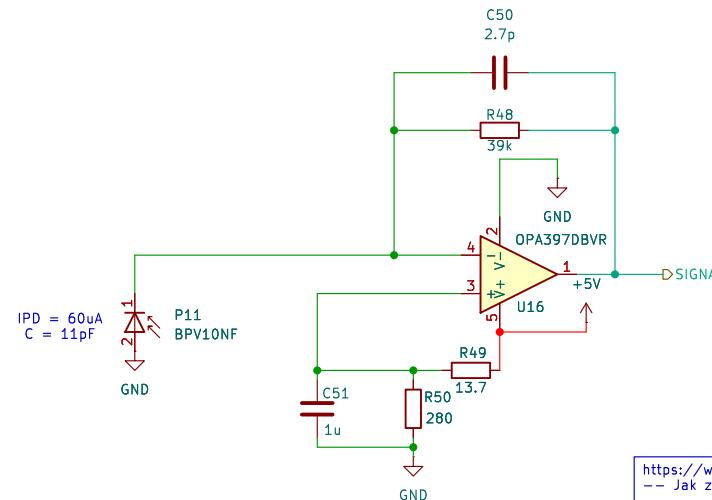
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Rev: 1.0
Id: 13/22

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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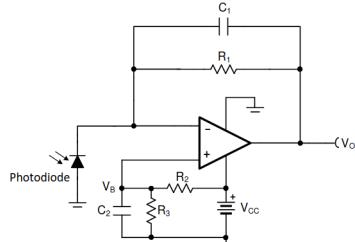


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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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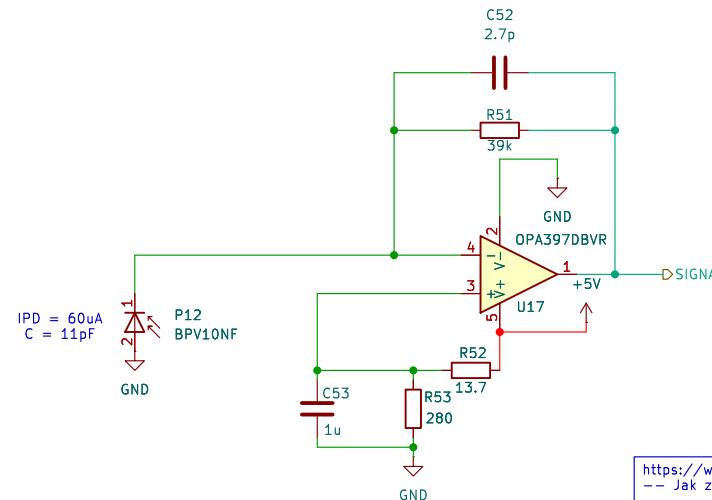
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Id: 14/22

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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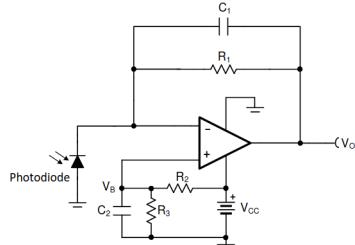


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = i_{PD}R_1 + V_B = i_{PD}R_1 + V_{CC} \frac{R_3}{R_3 + R_2}$$

KEY OPA128 SPECIFICATIONS

Bias current	75fA max
Offset voltage	500 μ V max
Drift	5 μ V/ $^{\circ}$ C max
Noise	15nV/ \sqrt{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

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)

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

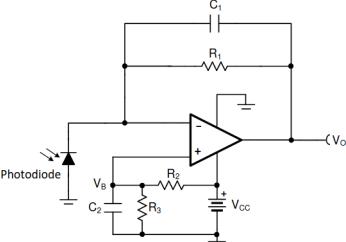
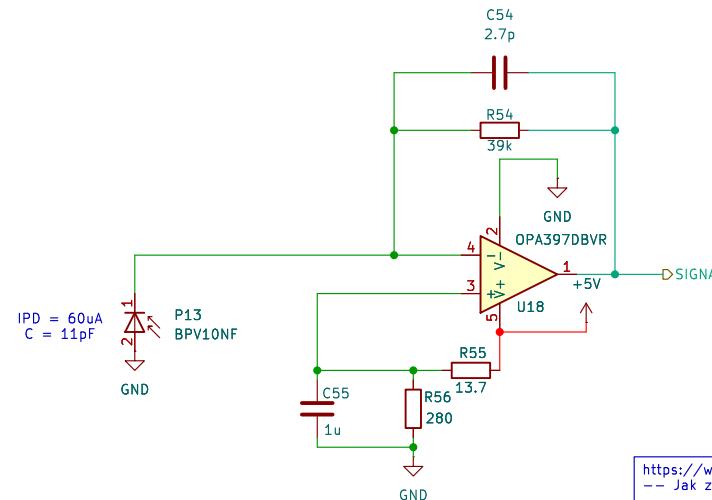


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = i_{PD}R_1 + V_B = i_{PD}R_1 + V_{CC} \frac{R_3}{R_3 + R_2}$$

KEY OPA128 SPECIFICATIONS

Bias current	75fA max
Offset voltage	500 μ V max
Drift	5 μ V/ $^{\circ}$ C max
Noise	15nV/ \sqrt Hz at 10kHz

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Original author: Oliwier Woźniak

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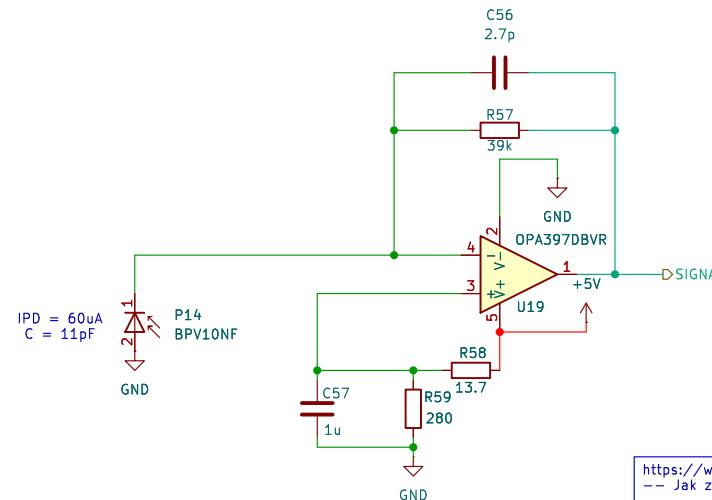
Title: uMule_board

Size: A4 Date: 2025-12-14
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Id: 16/22

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



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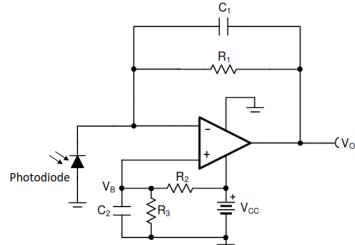


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = i_{PD}R_1 + V_B = i_{PD}R_1 + V_{CC} \frac{R_3}{R_3 + R_2}$$

(2)

KEY OPA128 SPECIFICATIONS

Bias current	75fA max
Offset voltage	500 μ V max
Drift	5 μ V/ $^{\circ}$ C max
Noise	15nV/ \sqrt{Hz} at 10kHz

Original author: Oliwier Woźniak

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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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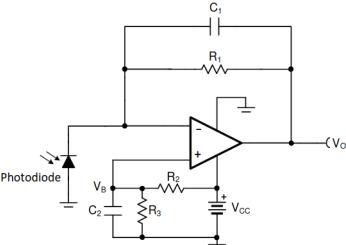
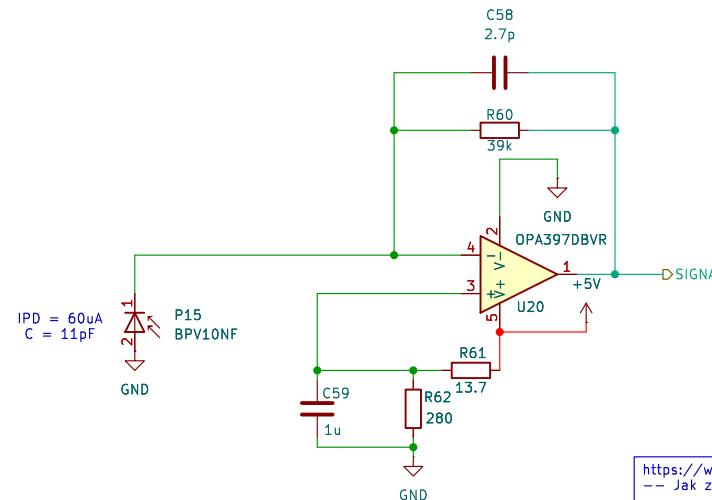


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

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Original author: Oliwier Woźniak

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File: photodiode.kicad_sch

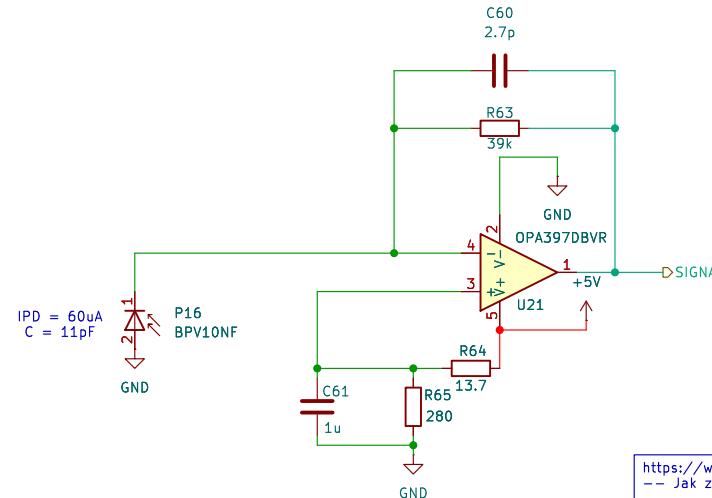
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Można zastanowić się nad zmianą wartości rezystora R1, ale to po zmianie procka i sprawdzeniu czy będzie działać. Obecnie jest zakres 0.1V–2.4V (chyba)

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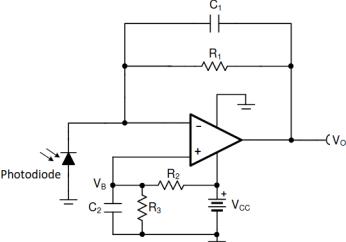


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

$$V_{OUT} = i_{PD}R_1 + V_B = i_{PD}R_1 + V_{CC} \frac{R_3}{R_3 + R_2}$$

KEY OPA128 SPECIFICATIONS

Bias current	75fA max
Offset voltage	500 μ V max
Drift	5 μ V/ $^{\circ}$ C max
Noise	15nV/ \sqrt{Hz} at 10kHz

Original author: Oliwier Woźniak

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File: photodiode.kicad_sch

Title: uMule_board

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