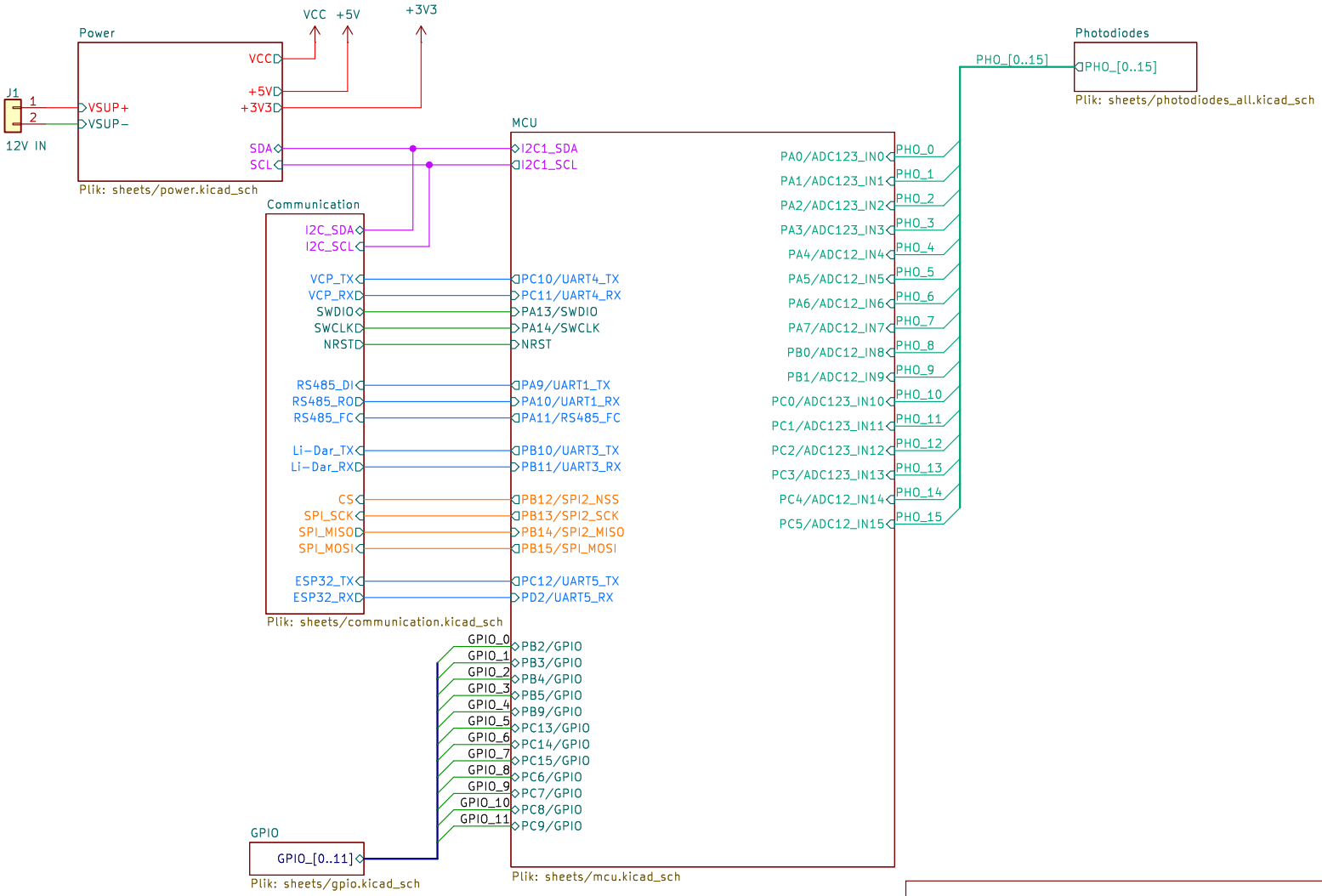
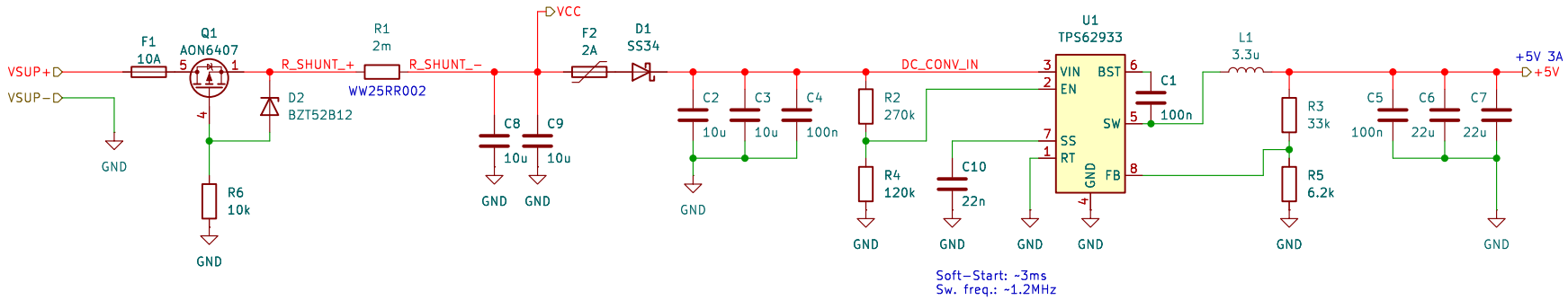


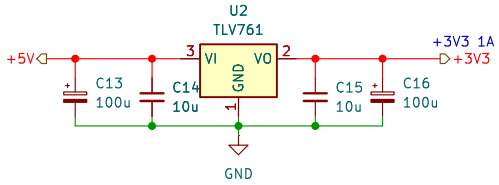
Original author: Oliwier Woźniak

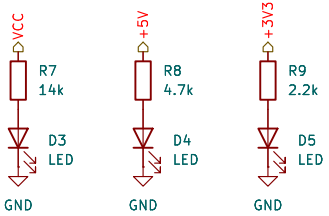
Sheet: /
File: uMule_board.kicad_sch

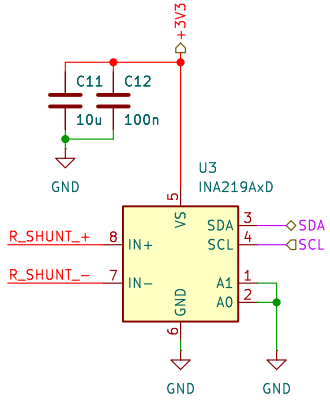
Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		Id: 1/22









Original author: Oliwier Woźniak

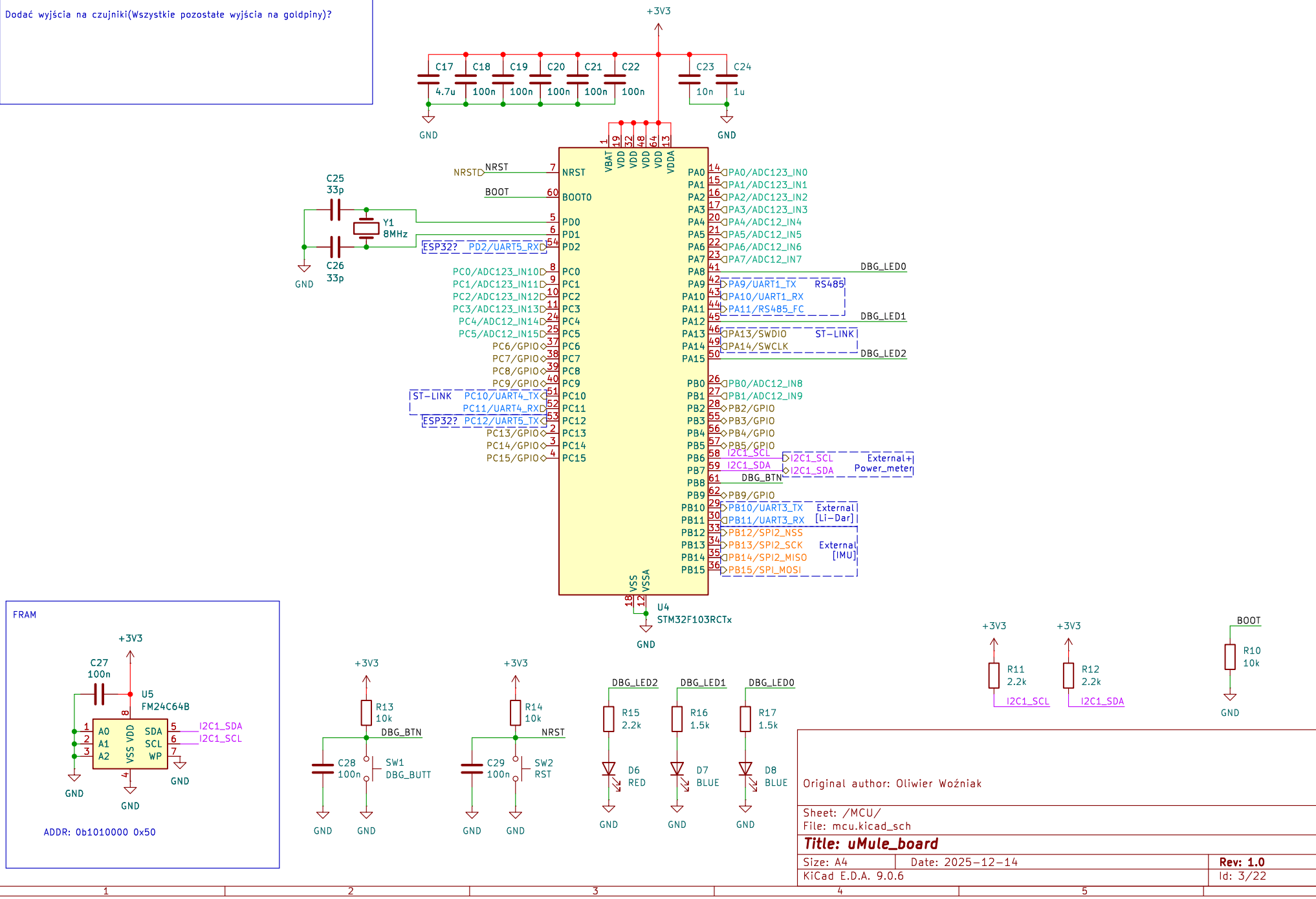
Sheet: /Power/
File: power.kicad_sch

Title: uMule_board

Size: A4	Date: 2025−12−14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		Id: 2/22

Dodać jakieś ledy do debugu (chociaż 3)

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



FRAM

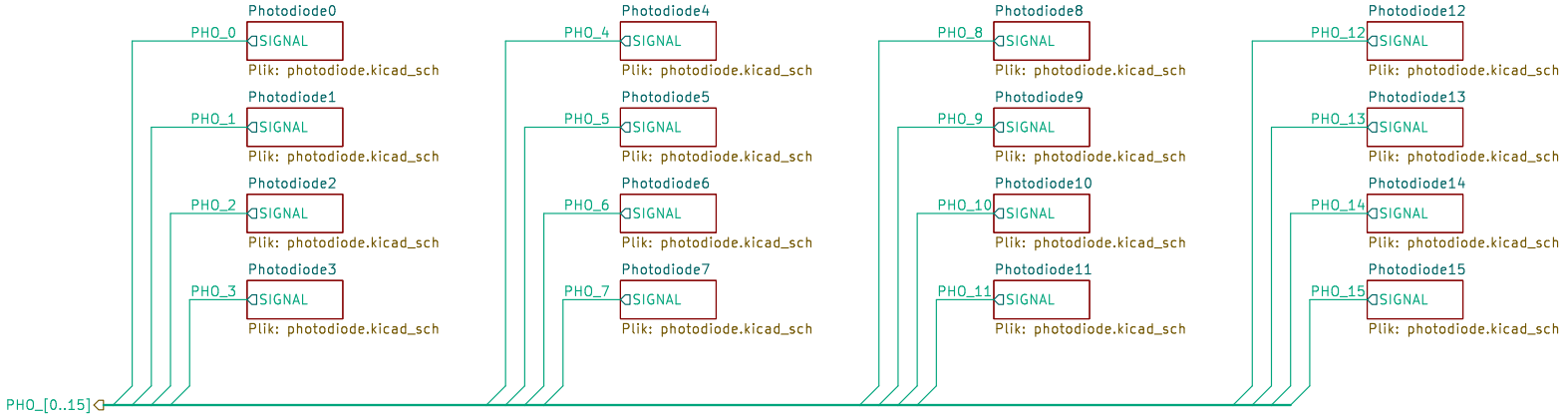
ADDR: 0b1010000 0x50

Original author: Oliwier Woźniak

Sheet: /MCU/
File: mcu.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		Id: 3/22



Original author: Oliwier Woźniak

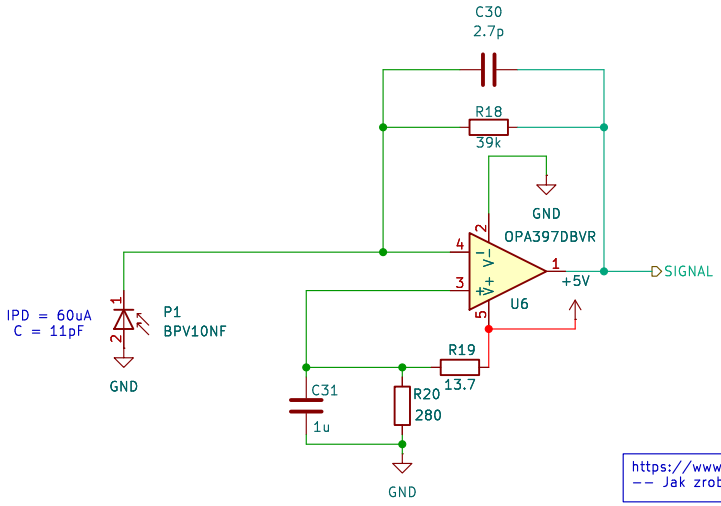
Sheet: /Photodiodes/
File: photodiodes_all.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		Id: 21/22

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)

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



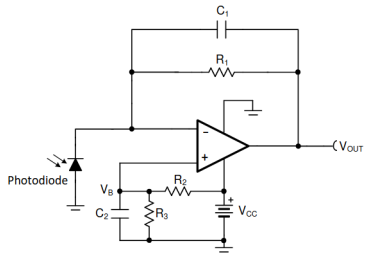


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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 ..... 500µV max
Drift ..... 5µV/°C max
Noise ..... 15nV/√Hz at 10kHz

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

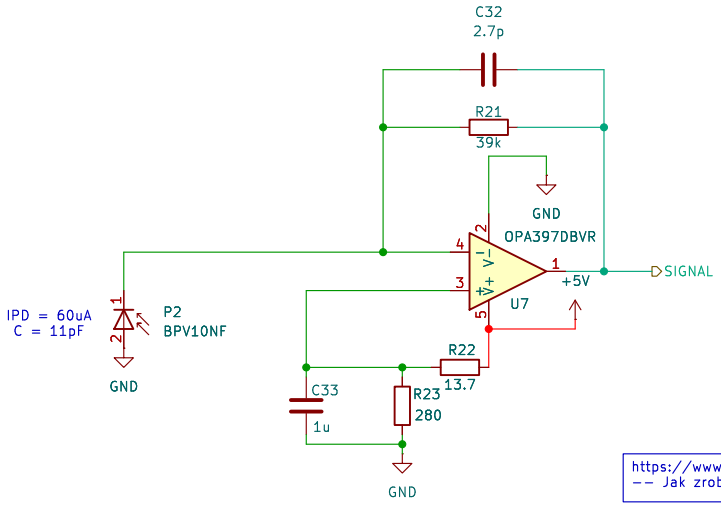
Sheet: /Photodiodes/Photodiode0/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



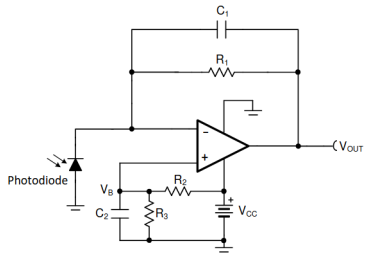


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

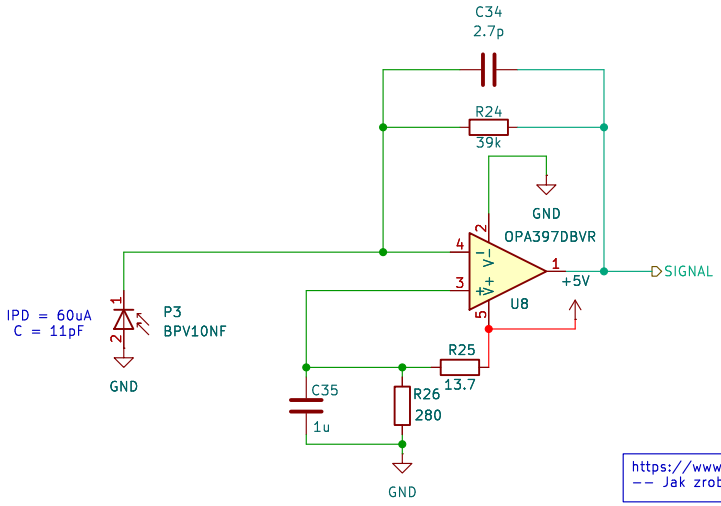
Sheet: /Photodiodes/Photodiode1/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



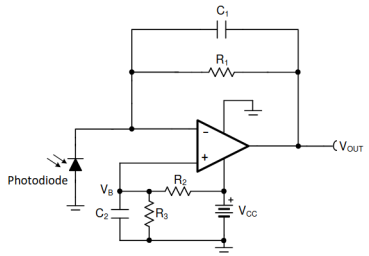


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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 ..... 500µV max
Drift ..... 5µV/°C max
Noise ..... 15nV/√Hz at 10kHz

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

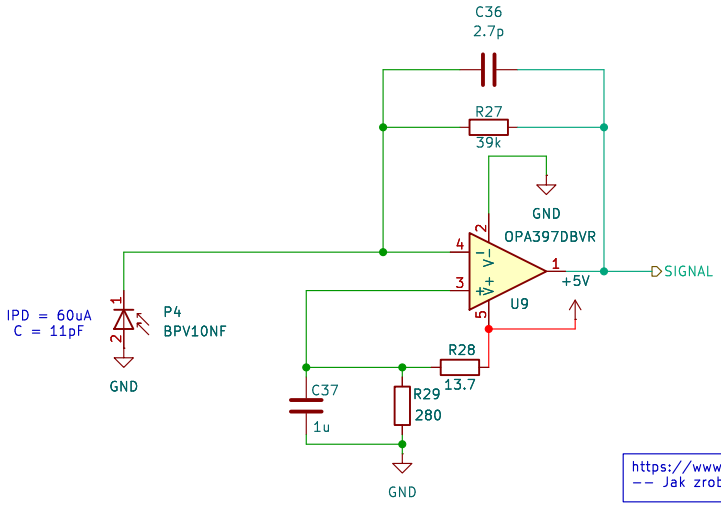
Sheet: /Photodiodes/Photodiode2/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



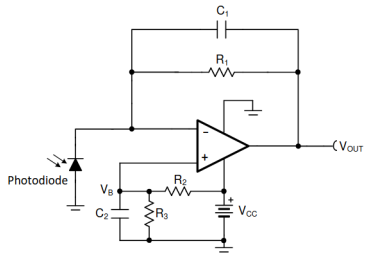


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

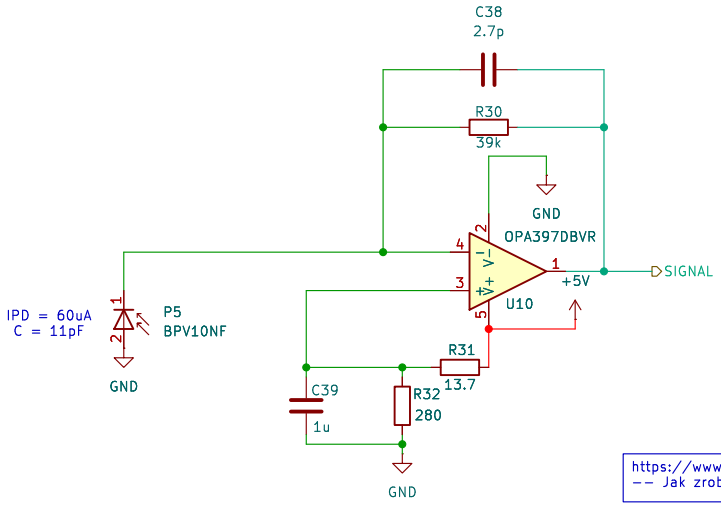
Sheet: /Photodiodes/Photodiode3/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



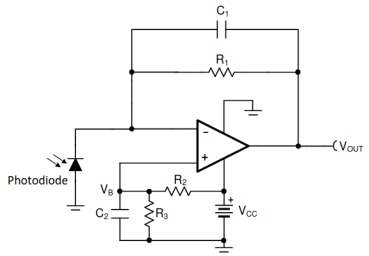


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

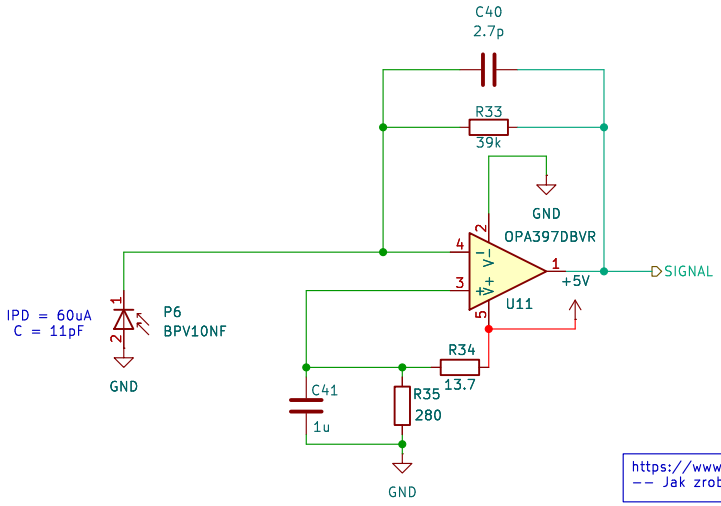
Sheet: /Photodiodes/Photodiode4/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



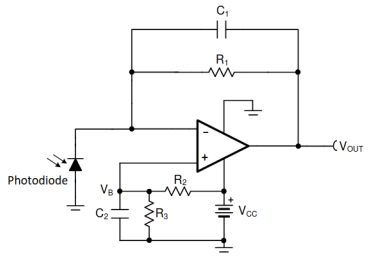


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

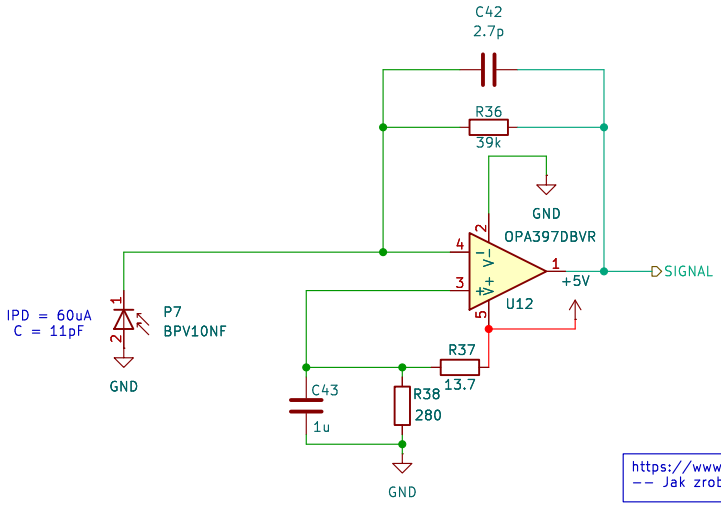
Sheet: /Photodiodes/Photodiode5/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



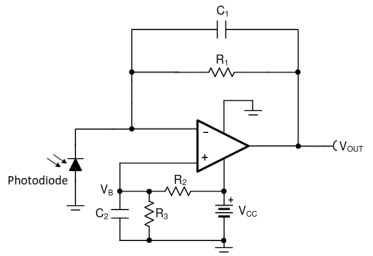


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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 ..... 500µV max
Drift ..... 5µV/°C max
Noise ..... 15nV/√Hz at 10kHz

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

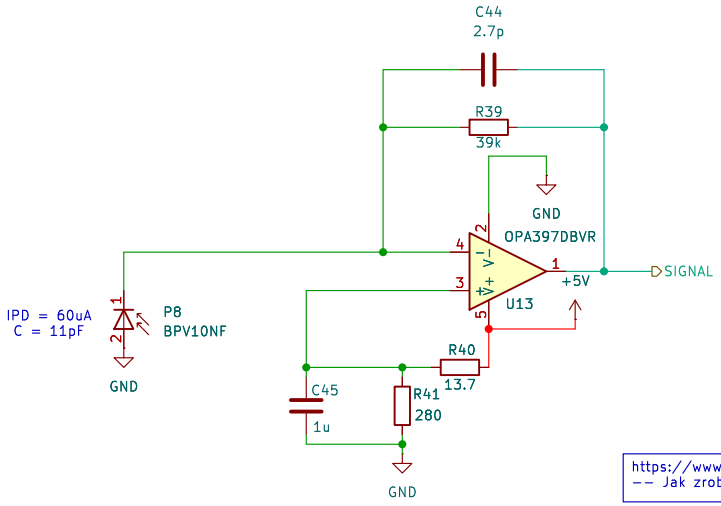
Sheet: /Photodiodes/Photodiode6/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



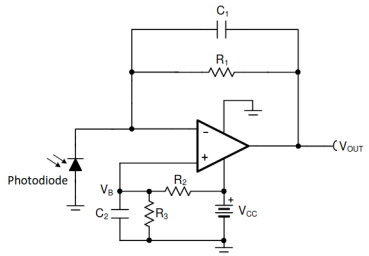


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

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

KEY OPA128 SPECIFICATIONS

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

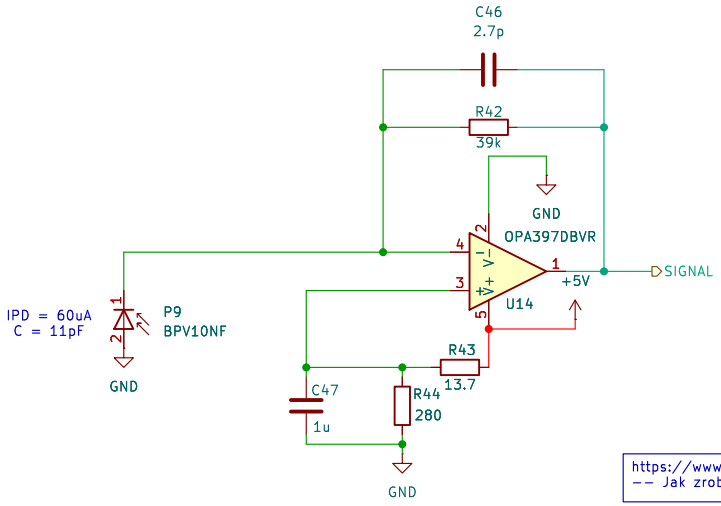
Sheet: /Photodiodes/Photodiode7/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



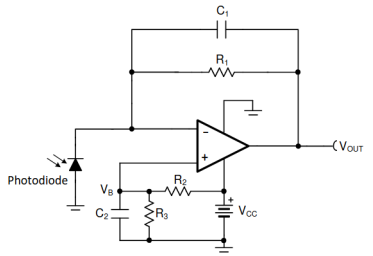


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

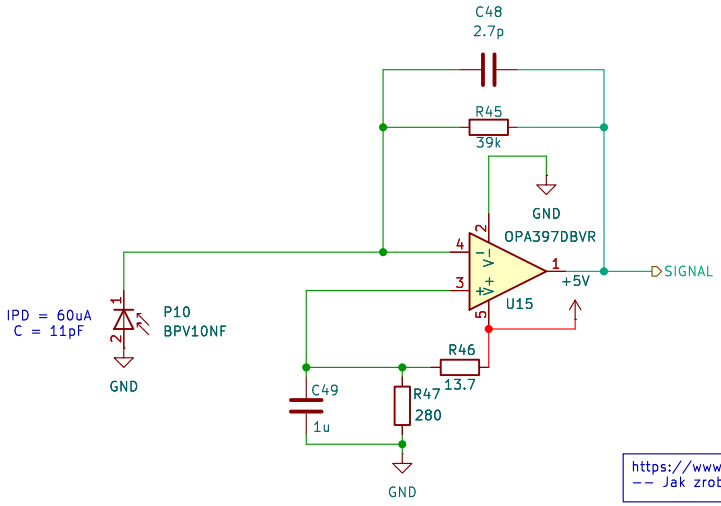
Sheet: /Photodiodes/Photodiode8/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



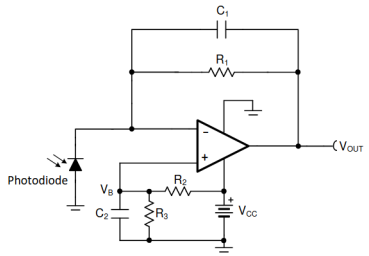


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

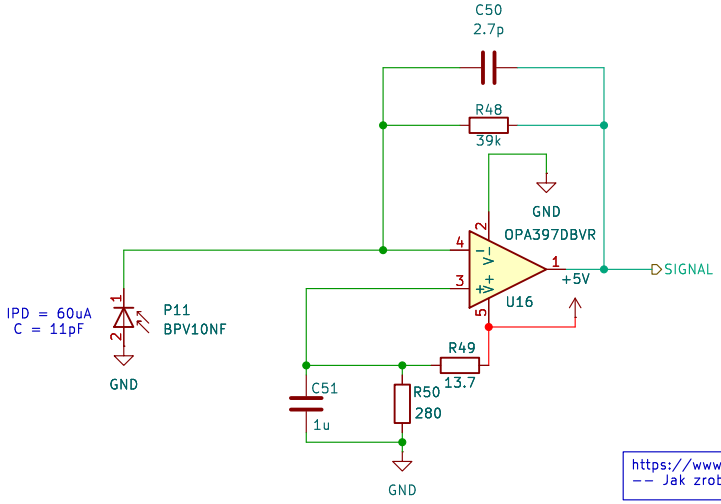
Sheet: /Photodiodes/Photodiode9/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



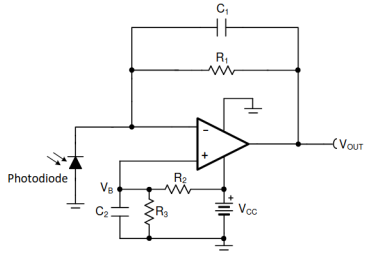


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

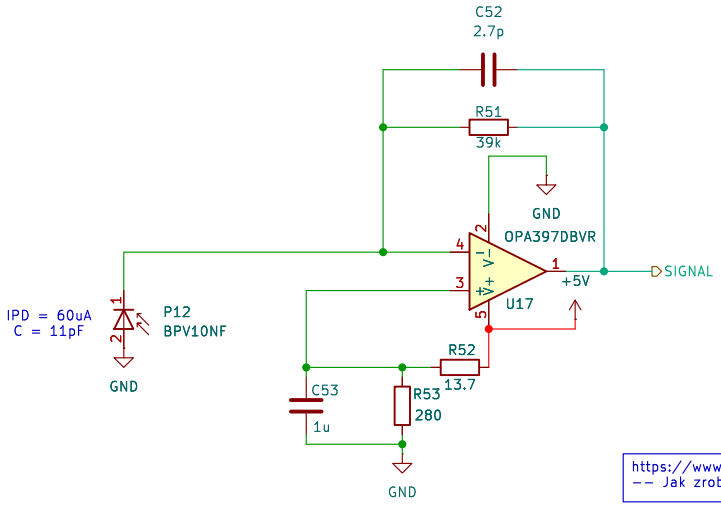
Sheet: /Photodiodes/Photodiode10/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



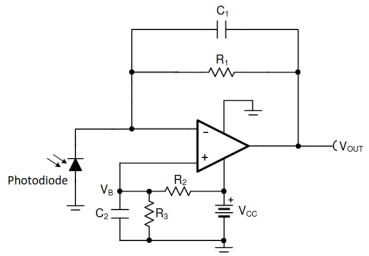


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

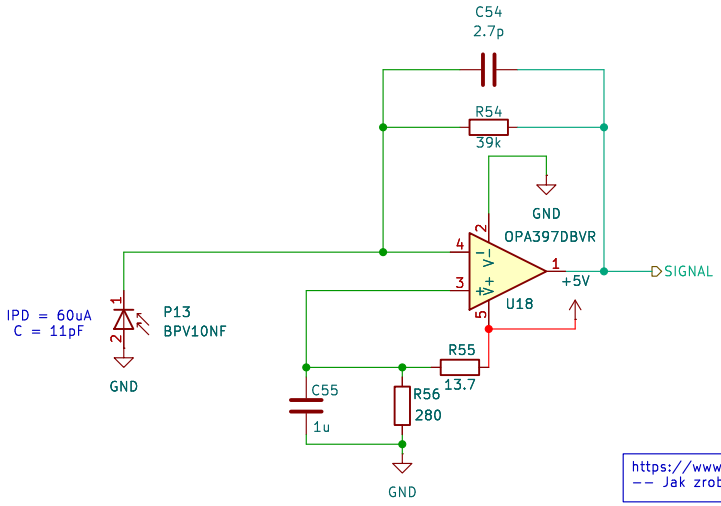
Sheet: /Photodiodes/Photodiode11/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



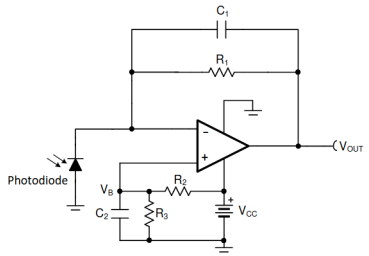


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

The output transfer function including the bias voltage is:

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

KEY OPA128 SPECIFICATIONS

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

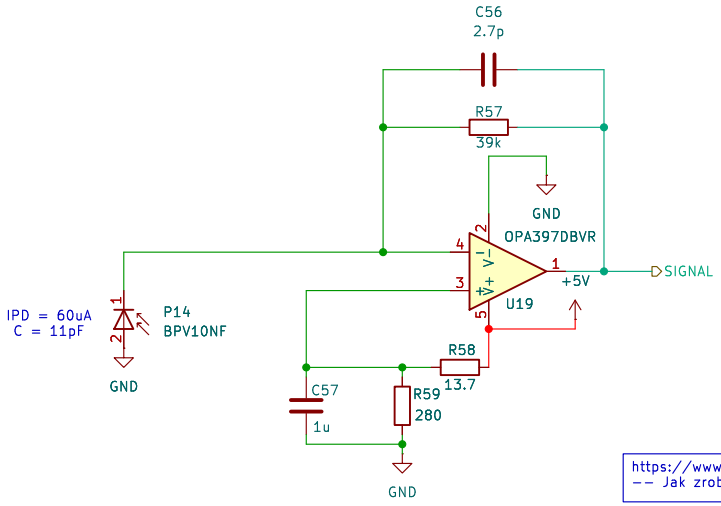
Sheet: /Photodiodes/Photodiode12/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



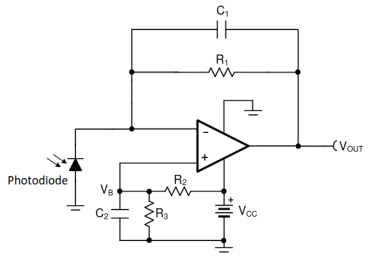


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

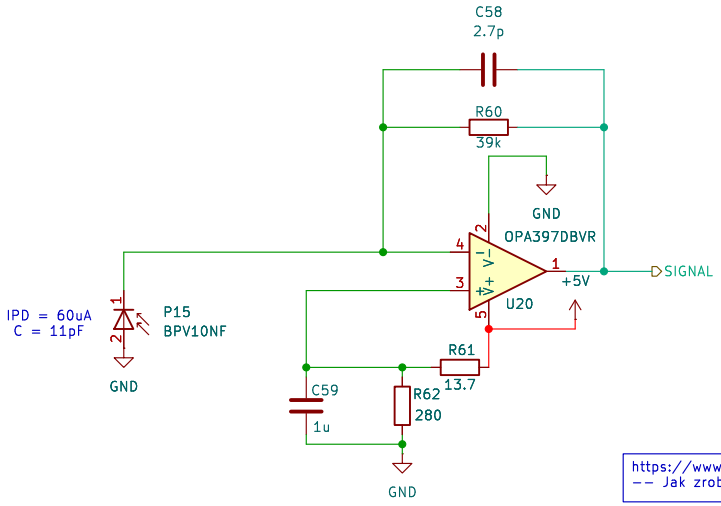
Sheet: /Photodiodes/Photodiode13/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



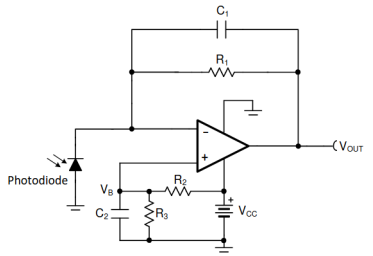


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

Original author: Oliwier Woźniak

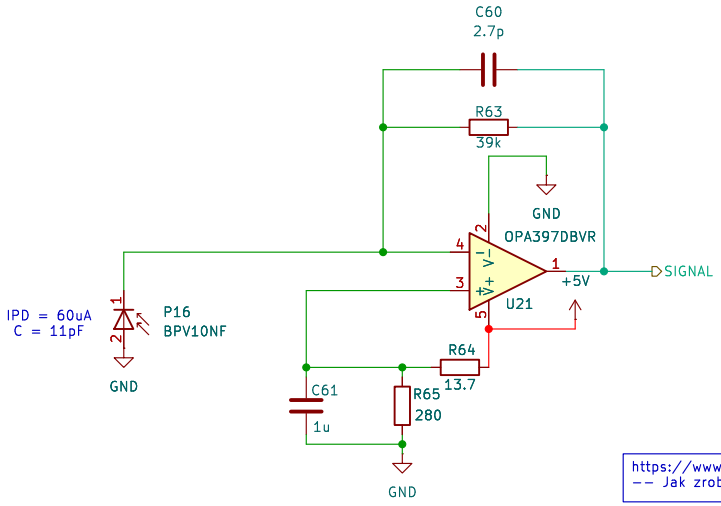
Sheet: /Photodiodes/Photodiode14/
File: photodiode.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		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)

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



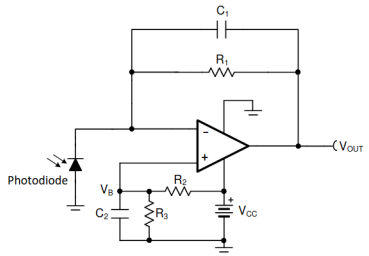


Figure 4: A bias voltage is applied to the op amp's non-inverting input to prevent saturation at the negative power supply

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

https://www.ti.com/lit/an/sboa061/sboa061.pdf?ts=1763493301204
-- Jak zrobić układ

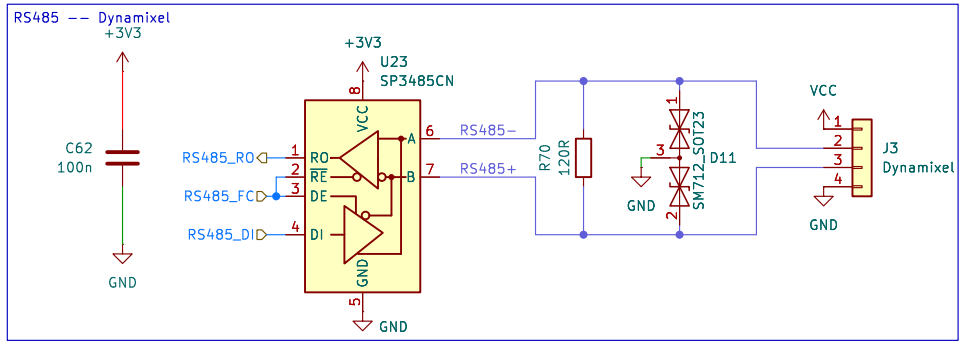
https://www.ti.com/lit/ug/tidu535/tidu535.pdf?ts=1763487441840&ref_url=https%253A%252F%252Fwww.google.com%252F
– łatwiejszy poradnik

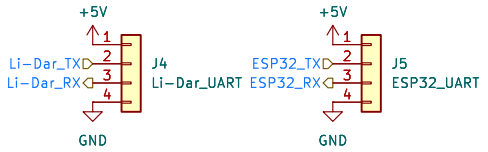
Original author: Oliwier Woźniak

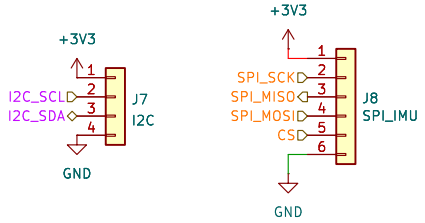
Sheet: /Photodiodes/Photodiode15/
File: photodiode.kicad_sch

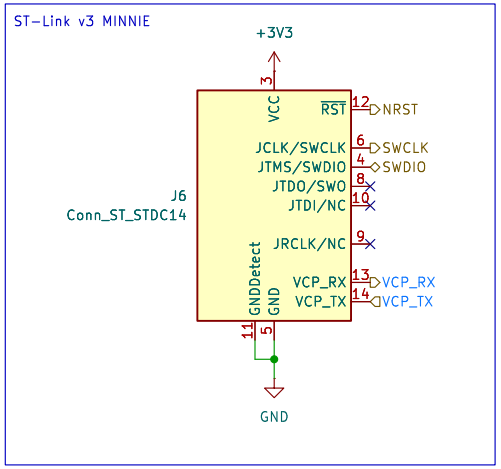
Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		Id: 19/22







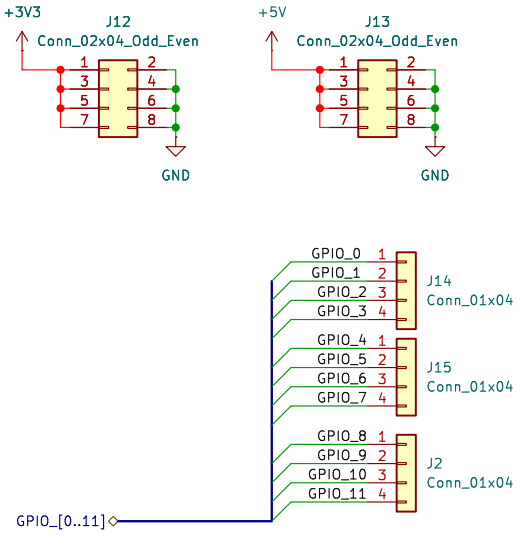


Original author: Oliwier Woźniak

Sheet: /Communication/
File: communication.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		Id: 22/22



Original author: Oliwier Woźniak

Sheet: /GPIO/
File: gpio.kicad_sch

Title: uMule_board

Size: A4	Date: 2025-12-14	**Rev: 1.0**
KiCad E.D.A. 9.0.6		Id: 27/22