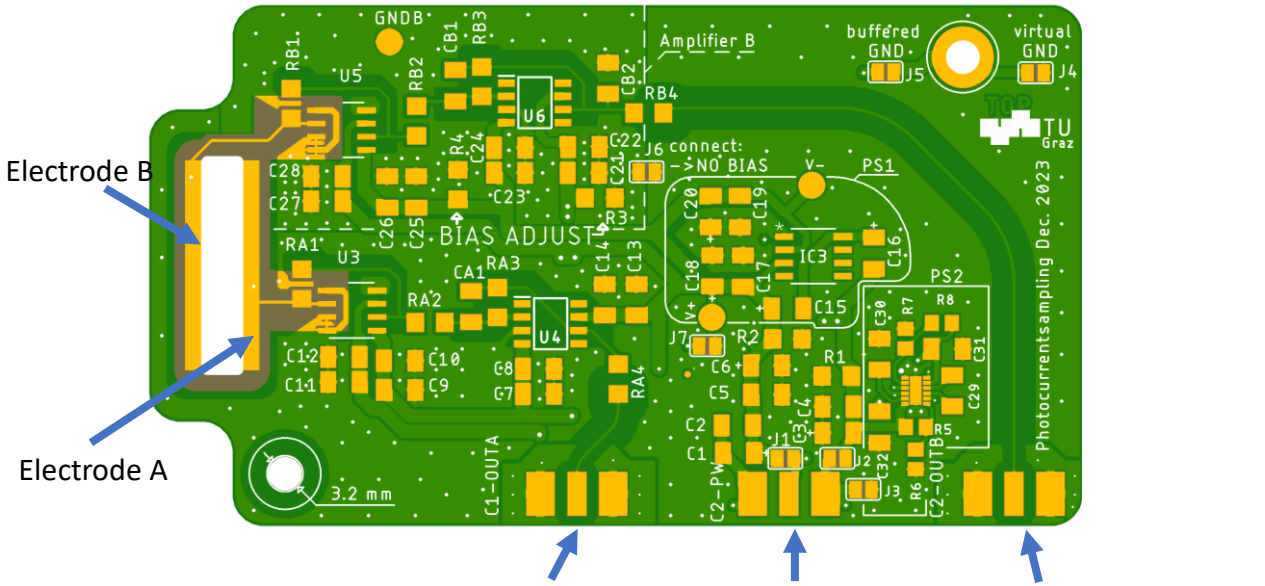
Quick Guide Photocurrentsampling PCB

PCB Version Dec. 2023

PCB Layout



Each chapter of this quick guide contains all the information necessary to build and operate the circuit with the specific setting.

Standard setting with 2 amplifiers:

~250 kHz bandwidth, DC-transimpedance of 10 MΩ, no bias between electrodes, currents of both A & B electrodes are measured.

Connect Power to the central SMA Jack. +2.5. V on the inner connector, -2.5 V on the outer side (shield). This is the same as 5V supply with positive center that is potential free, e.g. a battery or the low noise power supply described in ‘LN_PSU_documentation_en’.

The Signals are distortion free between +/- 2V but can reach up and down to the supply voltages. Terminate only with >= 1 kΩ. 1MΩ Inputs are fine without termination if the cables used are not too long.

The jumpers J4, J5 and J7 allow different grounding configurations, e.g. separating the input stage ground plane from the housing and SMA shield ground. More information on this is available in the full documentation ‘PCS_double_documentation_en’. A configuration that always works, but may be not the best solution in terms of noise is closing (connecting) jumper J4, J5 and J7.

Table 1: Bill of materials for measurement on both electrodes, ~250 kHz bandwidth, DC-transimpedance of 10 MΩ, no bias between electrodes

Qty	Value	Device	Package	Parts	Description	Hersteller Nr.
2	10M	R-EU_R1206	R1206	RA1, RB1	Precision, thinfilm or metalfilm	ERA8AEB105V / MCA1206MD1005BP100
2	10k	R-EU_R1206	R1206	RA2, RB2	2nd Stage amplification feedback resistor	
2	10k	R-EU_R1206	R1206	RA3, RB3	2nd Stage amplification feedback resistor	
2	22pF	C-EUC1206K	C1206K	CA1, CB1	NP0 feedback ceramic cap.	
2	50R	R-EU_R1206	R1206	RA4, RB4	47R-53R impedance matching resistor	
13	100n	C-EUC1206K	C1206K	C2, C4, C5, C7, C9, C11, C13, C17, C19, C21, C23, C25, C27	10% 50V X7R	C1206C104K5RACAUTO
4	10n	C-EUC1206K	C1206K	C10, C12, C26, C28	10% 50V X7R	C1206C103K5RACTU
9	10uF	C-EU_POL / C-EUC1206K	C1206K	C8, C14, C22, C24, C1, C3, C6, C18, C20	Tantal electrolytic capacitor 1206	TPSA106K010R0900
4	1k	R-EU_R1206	R1206	R1, R2, R3, R4	Precision 1k 0.1% (metalfilm, thinfilm)	ERA8AEB102V
2	LTC6268HS8-10	LTC6268HS8-10	SO-8_S-L	U3, U5		
2	OPA380AID	OPA380AID	SOIC	U4, U6	Texas Instruments OPA380AI	OPA380AID
3	SMA Jack	73251-2123		C1-OUTA, C2-OUTB, C2-PW	SMA Jack PCB Edge Mount 50	526-5785
2	1u	C-EU_POL	C1206K	C15, C16	Tantal electrolytic capacitor 1206	TPSA105K035R3000
1	TLE2426	TLE2426CDD8-M	D8-M	IC3		
6	()	Jumper PS1		J1=y, J2=y, J3=n, J4 OR J5, J7=IF J4 AND J5	Select appropriate Jumpers	
1	()	Jumper Amp A & B		J6=y	Select appropriate Jumpers	

Standard setting with 1 Amplifiers + external bias:

~250 kHz bandwidth, DC-transimpedance of 10 MΩ, current of A electrode is measured, connector B is bias input.

Connect Power to the central SMA Jack. +2.5 V on the inner connector, -2.5 V on the outer side (shield). This is the same as 5V supply with positive center that is potential free, e.g. a battery or the low noise power supply described in LN_PSU_documentation_en.

The Signal is on the Left connector (A). It is distortion free between +/- 2V but can reach up and down to the supply voltages. Terminate only with >= 1 kΩ. 1MΩ Inputs are fine without termination if the cables used are not too long.

The jumpers J4, J5 and J7 allow different grounding configurations, e.g. separating the input stage ground plane from the housing and SMA shield ground. More information on this is available in the full documentation 'PCS_double_documentation_en'. A configuration that always works, but may be not the best solution in terms of noise is closing (connecting) jumper J4, J5 and J7.

Bias can be applied to the rightmost connector (B). The shield of the connector is grounded, the inner contact carries the bias voltage. It should stay within 100V and within the voltage rating of CB2. The bias signal is lowpass-filtered by CB2 and RB4 if RB4 is not 0R.

The corner frequency of this RC lowpass is calculated by following formula:

$$f_{-3db} = \frac{1}{2\pi\, R_{B4}\, C_{B2}}$$

The reason for the lowpass filter is to reduce high frequency noise that would create a current between the electrodes, because they form a plate capacitor. If the bias voltage will be modulated, it is important to choose a corner frequency that is much higher than the modulation frequency.

Table 2: Bill of materials for measurement on one electrode and external bias, ~250 kHz bandwidth, DC-transimpedance of 10 MΩ, bias supplied on connector B

Qty	Value	Device	Package	Parts	Description	Hersteller Nr.
2	10M	R-EU_R1206	R1206	RA1	Precision, thinfilm or metalfilm	ERA8AEB105V / MCA1206MD1005BP100
2	10k	R-EU_R1206	R1206	RA2	2nd Stage amplification feedback resistor	
2	10k	R-EU_R1206	R1206	RA3	2nd Stage amplification feedback resistor	
1	100nF C0G	C-EUC1206K	C1206K	CB2	Bias Low Pass filter if no Amp2 installed	
2	22pF	C-EUC1206K	C1206K	CA1	NP0 feedback ceramic cap.	
4	0R		1206	RB1, RB2, RB3	0R Jumpers or solder bridges	
	0R – 10k		1206	RB4	Bias lowpass together with CB2 or just 0R when no Lowpass is needed	
2	50R	R-EU_R1206	R1206	RA4	47R-53R impedance matching resistor	
13	100n	C-EUC1206K	C1206K	C2, C4, C5, C7, C9, C11, C13, C17, C19, C21, C23, C25, C27	10% 50V X7R	C1206C104K5RACAUTO
4	10n	C-EUC1206K	C1206K	C10, C12, C26, C28	10% 50V X7R	C1206C103K5RACTU
9	10uF	C-EU_POL / C-EUC1206K	C1206K	C8, C14, C22, C24, C1, C3, C6, C18, C20	Tantal electrolytic capacitor 1206	TPSA106K010R0900
4	1k	R-EU_R1206	R1206	R1, R2, R3, R4	Precision 1k 0.1% (Metalfilm, Thinfilm)	ERA8AEB102V
2	LTC6268HS8-10	LTC6268HS8-10	SO-8_S-L	U3, U5		LTC6268HS8-10
2	OPA380AID	OPA380AID	SOIC	U4, U6	Texas Instruments OPA380AI	OPA380AID
3	SMA Jack	73251-2123	73251-2123	C1-OUTA, C2-OUTB, C2-PW	SMA Jack PCB Edge Mount 50	526-5785
2	1u	C-EU_POL	C1206K	C15, C16	Tantal electrolytic capacitor 1206	TPSA105K035R3000
1	TLE2426	TLE2426CDD8-M	D8-M	IC3		TLE2426CDD8-M
7	()	Jumper		J1, J2, J3, J4, J5, J6, J7	Select appropriate Jumpers	
6	()	Jumper PS1		J1=y, J2=y, J3=n, J4 OR J5, J7=IF J4 AND J5	Select appropriate Jumpers	
1	()	Jumper Amp A & ext. Bias		J6=y	Select appropriate Jumpers	

Standard setting with 2 amplifiers and static bias

To achieve a static bias voltage between the electrodes, the input of amplifier B (LTC6268-10) is held at that bias voltage. The voltage is set by resistor R3 and R4 which form a voltage divider between +2.5V and -2.5V. The bias voltage is also added to the output signal of amplifier B, therefore reducing the available voltage swing in one direction while increasing it in the other direction.

$$U_{bias\,B} = \frac{R_4}{R_4 + R_3} \cdot 5\ \mathrm{V} - 2.5\ \mathrm{V}$$

Scale R3 and R4 so that their parallel resistance is approximately 500 Ω.

$$\frac{R_3 \cdot R_4}{R_3 + R_4} \approx 500\ \Omega$$

In the same way, a static bias can be applied to the A electrode, but only if jumper J4 and J7 are open.

$$U_{bias\,A} = \frac{R_1}{R_1 + R_2} \cdot 5\ \mathrm{V} - 2.5\ \mathrm{V}$$

Connect Power to the central SMA Jack. +2.5 V on the inner connector, -2.5 V on the outer side (shield). This is the same as 5V supply with positive center that is potential free, e.g. a battery or the low noise power supply described in ‘LN_PSU_documentation_en’.

The Signals are distortion free between +/- 2V but can reach up and down to the supply voltages. Terminate only with >= 1 kΩ. 1MΩ Inputs are fine without termination if the cables used are not too long.

The jumpers J4, J5 and J7 allow different grounding configurations, e.g. separating the input stage ground plane from the housing and SMA shield ground. More information on this is available in the full documentation ‘PCS_double_documentation_en’. A configuration that always works, but may be not the best solution in terms of noise is closing (connecting) jumper J4, J5 and J7. For static bias jumper J6 must always be open, therefore amplifier B will be surrounded by a virtual ground regardless of J4, J5 and J7.

Table 3: Bill of materials for measurement on both electrodes, ~250 kHz bandwidth, DC-transimpedance of 10 MΩ, static bias between electrodes

Qty	Value	Device	Package	Parts	Description	Hersteller Nr.
2	10M	R-EU_R1206	R1206	RA1, RB1	Precision, thinfilm or metalfilm	ERA8AEB105V / MCA1206MD1005BP100
2	10k	R-EU_R1206	R1206	RA2, RB2	2nd Stage amplification feedback resistor	
2	10k	R-EU_R1206	R1206	RA3, RB3	2nd Stage amplification feedback resistor	
2	22pF	C-EUC1206K	C1206K	CA1, CB1	NP0 feedback ceramic cap.	
2	50R	R-EU_R1206	R1206	RA4, RB4	47R-53R impedance matching resistor	
13	100n	C-EUC1206K	C1206K	C2, C4, C5, C7, C9, C11, C13, C17, C19, C21, C23, C25, C27	10% 50V X7R	C1206C104K5RACAUTO
4	10n	C-EUC1206K	C1206K	C10, C12, C26, C28	10% 50V X7R	C1206C103K5RACTU
9	10uF	C-EU_POL / C-EUC1206K	C1206K	C8, C14, C22, C24, C1, C3, C6, C18, C20	Tantal electrolytic capacitor 1206	TPSA106K010R0900
4	from formula / 1k	R-EU_R1206	R1206	R1, R2, R3, R4	Precision 1k 0.1% (metalfilm, thinfilm)	ERA8AEB102V
2	LTC6268HS8-10	LTC6268HS8-10	SO-8_S-L	U3, U5		
2	OPA380AID	OPA380AID	SOIC	U4, U6	Texas Instruments OPA380AI	OPA380AID
3	SMA Jack	73251-2123	73251-2123	C1-OUTA, C2-OUTB, C2-PW	SMA Jack PCB Edge Mount 50	526-5785
2	1u	C-EU_POL	C1206K	C15, C16	Tantal electrolytic capacitor 1206	TPSA105K035R3000
1	TLE2426	TLE2426CDD8-M	D8-M	IC3		
6	()	Jumper PS1		J1=y, J2=y, J3=n, J4 OR J5, J7=IF J4 AND J5	Select appropriate Jumpers	
1	()	Jumper no static bias		J6=n	Select appropriate Jumpers	

Other options

Additional configurations are possible using the same PCB. Options include:

- other transimpedance values
- higher or lower bandwidth
- single sided power supply

a detailed description of these options and a guide how to populate the PCB if those options are chosen is available in the full documentation ‘PCS_double_documentation_en’.