

Photodiode PR5020/21



3 compact Silicon Junctions on a single Die

PR5020 and PR5021 are triple silicon photodiodes with three separate cathodes and one common anode. Therefore, the three segments allow to resolve two transitions. With a wider and thinner photodiode in the center of the die, the PR5020 and the PR5021 are symmetrically designed. Both types offer a low dark current combined with a high sensitivity. The dies are moulded into a small plastic leadless optical DFN package.

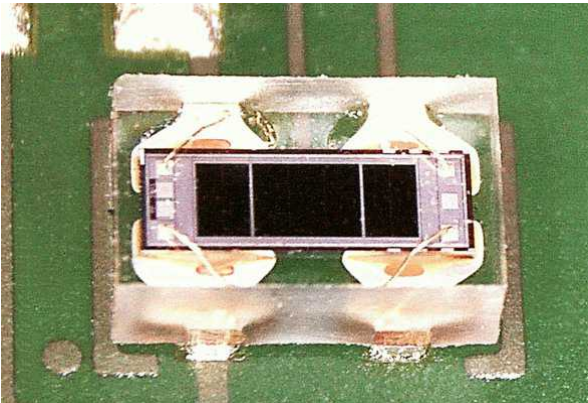
FEATURES

- 3 photodiodes for higher variability
- low dark current
- varied spectral sensitivities
- anti-reflective coating (ARC)

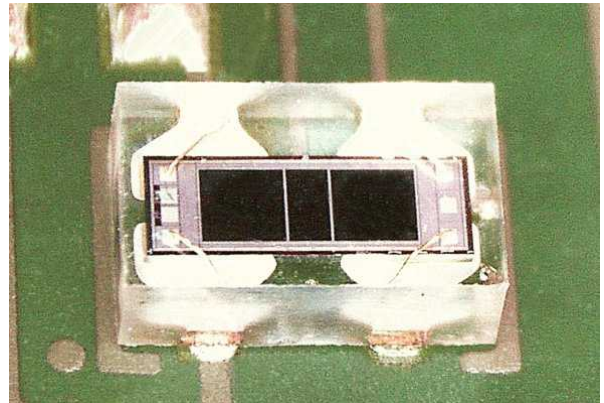
TYPICAL APPLICATIONS

- LASER beam alignment
- position detection
- ambient light detection

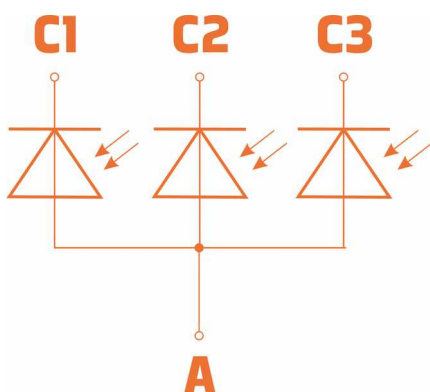
PR5020



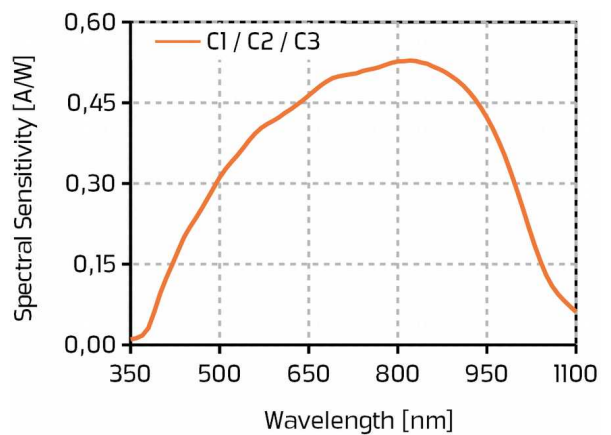
PR5021



CIRCUIT



SPECTRAL SENSITIVITY



Photodiode PR5020/21



Electrical and optical Characteristics

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Max	Units
V_{C-A}	$V(C1, C2, C3) - V(A)$	-0.3	35	V
T_A	operating ambient temperature	-40	85	°C
T_S	storage temperature	-40	85	°C
T_{peak}	soldering peak temperature		260	°C
P_{tot}	total power dissipation		100	mW

ELECTRICAL CHARACTERISTICS

$T_a = 27^\circ\text{C}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
T_{amb}	operating temperature range		-40		85	°C
$V_{r(C-A)}$	reverse voltage $V(C1, C2, C3) - V(A)$				30	V
A_{PD}	active area (geometrical)	PR5020 C1/C3		0.246		mm ²
		C2		0.496		mm ²
		PR5021 C1/C3		0.395		mm ²
		C2		0.197		mm ²
I_d/A	dark current @ $V_{r(C-A)} = 1\text{ V}$ & $T_{amb} = 60^\circ\text{C}$	PR5020 C1/C3		33		pA
		C2		52		pA
		PR5021 C1/C3		47		pA
		C2		28		pA
I_d/A	dark current @ $V_{r(C-A)} = 30\text{ V}$ & $T_{amb} = 60^\circ\text{C}$	PR5020 C1/C3		78		pA
		C2		125		pA
		PR5021 C1/C3		110		pA
		C2		71		pA
$\Delta I_d/\Delta T$	temperature coefficient of I_d @ $T_{amb} > 60^\circ\text{C}$	$V_{r(C-A)} = 1\text{ V}$		13		%/K
		$V_{r(C-A)} = 30\text{ V}$		12		%/K
λ_{peak}	peak sensitivity wavelength			830		nm
S_{peak}	peak sensitivity			0.58		A/W
C_{j0}	zero-bias junction capacitance, $f = 1\text{ MHz}$	PR5020 C1/C3		39		pF
		C2		77		pF
		PR5021 C1/C3		62		pF
		C2		32		pF

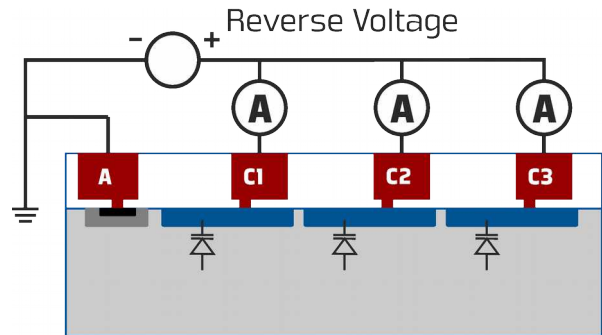
Photodiode PR5020/21



Dark Current

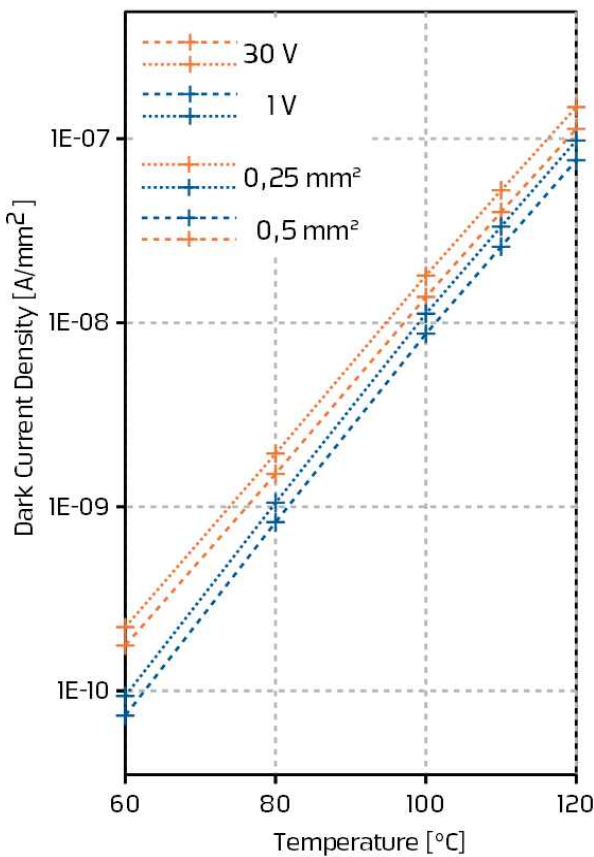
MEASUREMENT SETUP

Dark currents of the C1-, C2- and C3-photodiode are measured as a function of reverse voltage and temperature. The substrate (A) is connected to ground, while a positive voltage is applied to Cx. The dark currents of Cx are measured at each pin separately.



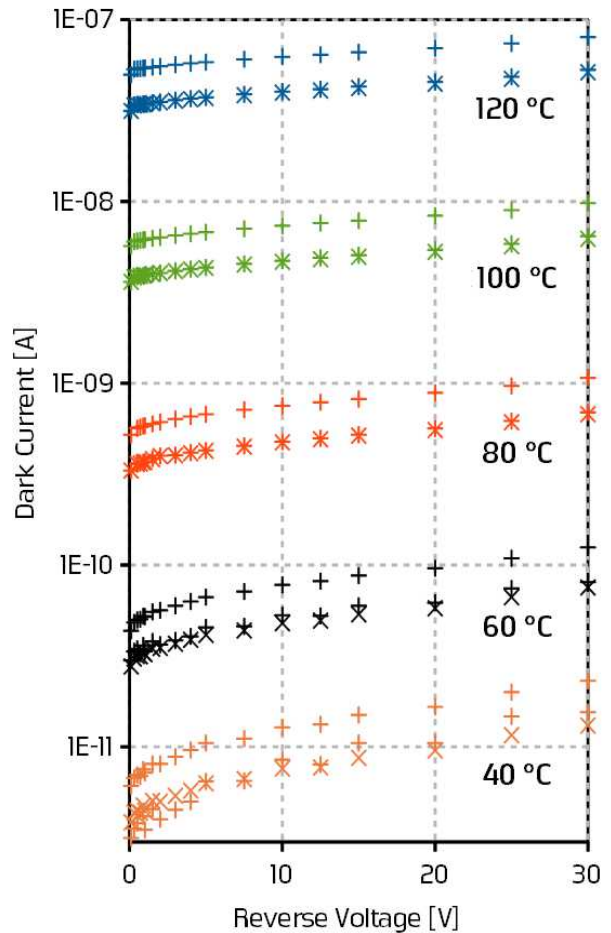
OVER TEMPERATURE

Dark currents for photodiodes of different size in PR5020 are shown at reverse voltages of 1 V (blue) and 30 V (orange). In general, dark currents rise by approximately a factor 10 every 20 °C. Due to edge effects, bigger photodiodes show a smaller leakage current per area.



AS A FUNCTION OF REVERSE VOLTAGE

The following diagram shows the dependency of dark currents of the smaller C1/C3 (lower curves) and the bigger C2 (upper curve) of PR5020 on reverse voltage at different temperatures.



Photodiode PR5020/21



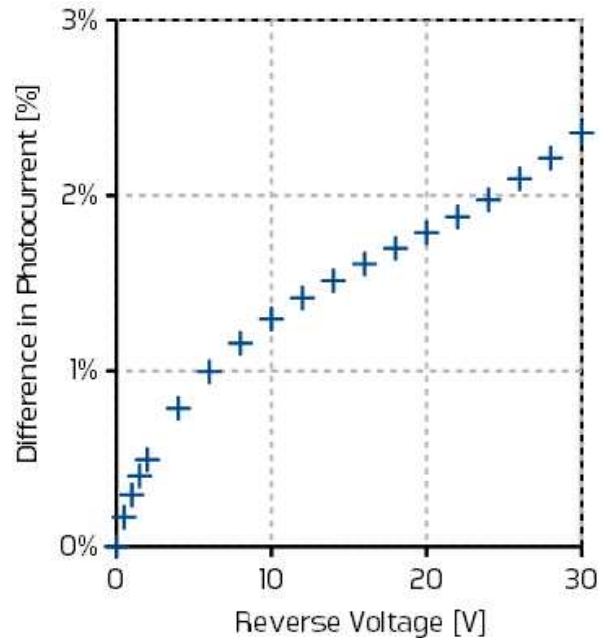
Electrical and optical Characteristics

SENSITIVITY AFFECTED BY REVERSE VOLTAGE

The spectral sensitivity increases by a few percent when reverse voltages are applied to the photodiodes.

The diagram shows the relative deviation of the photocurrent to the zero-bias value. The deviation changes insignificantly when illumination is changed. Neither the size nor the position of the photodiodes affect the deviation significantly.

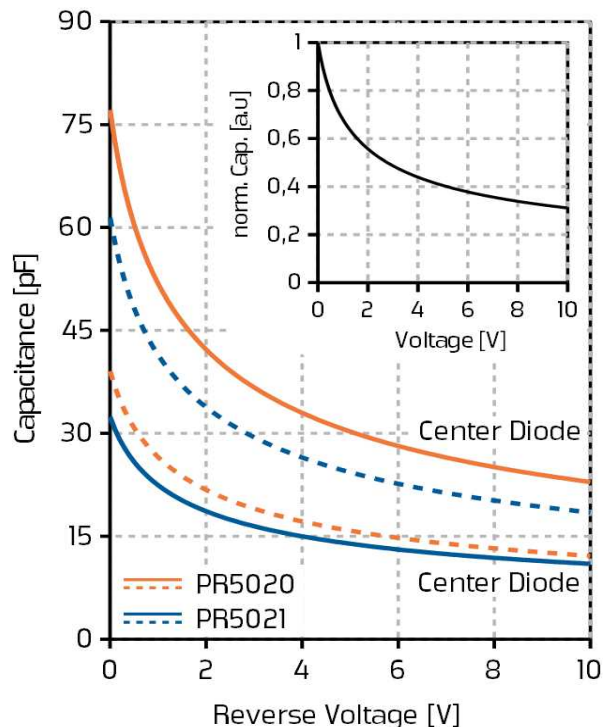
Please notice that the relative deviation increases if the adjacent photodiode is not biased. In that case also the size of the photodiode and the illumination affect the difference in photocurrent measured with increased reverse voltage.



CAPACITANCE

The diagram illustrates the dependency of the capacitances on the applied reverse voltage of the PR5020 (orange) and the PR5021 (blue). Both types have two identical photodiodes C1 and C3 (dashed lines) and a single photodiode C2 located in the center of the dies (solid lines). The capacitances of the photodiodes are proportional to their area and decrease with reverse voltage due to the reduction of the space-charge region.

Taking the area of each photodiode into account leads to a capacitance density of about 157 pF/mm² at zero reverse voltage. The decrease of the capacitance with increasing reverse voltage is identical for all photodiodes and shown in the inset.

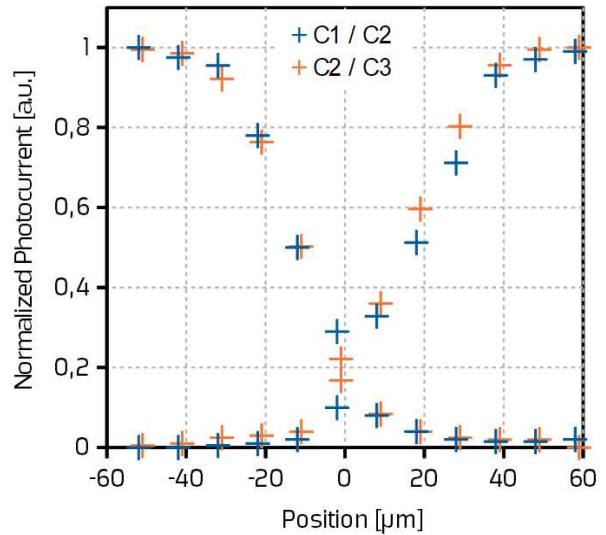


Photodiode PR5020/21

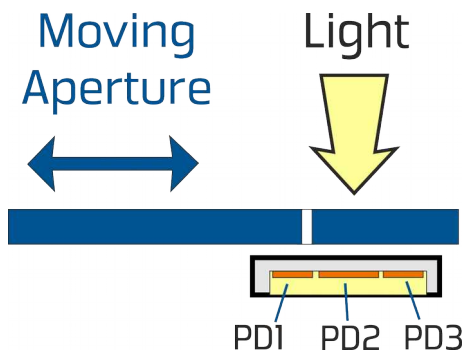
Application Notes

CHANNEL SEPARATION

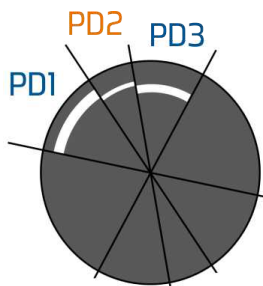
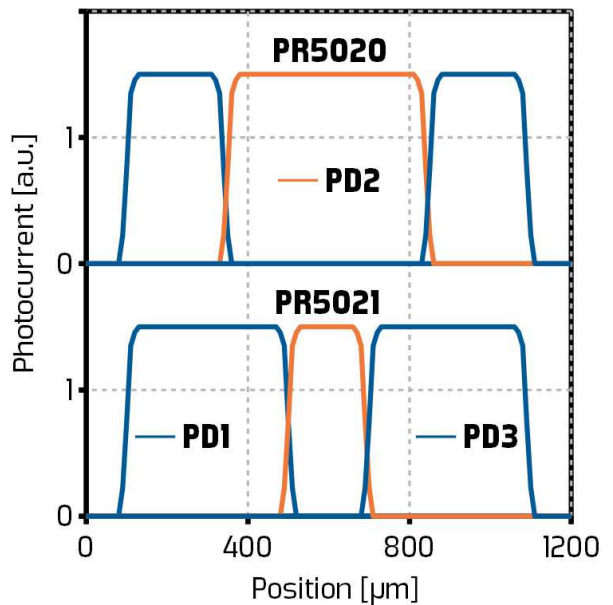
The crossover of a light beam between photodiodes is illustrated. Increments of 10 μm were performed using red light and a diameter of 50 μm . The position of 0 μm corresponds to the center of the die. The photocurrent was measured with zero applied voltage. Considering a gap between the photodiodes of 20 μm , the observed behaviour is consistent with a sharp channel separation.



POSITION DETECTION



By shining light on aperture, the passing light can be detected. As given in the schematics above, three different segments can be resolved using PR5020/21. Due to the geometry of the photodiodes, the position of the aperture can be detected as given in the diagram. Of course, the principle can be transferred to encoder discs to obtain angular resolution:

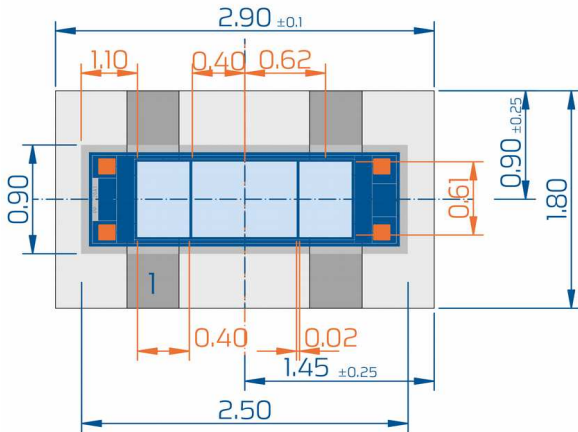


Photodiode PR5020/21

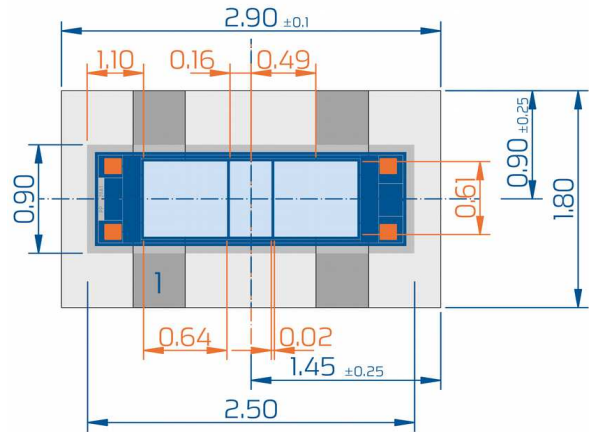


Dimensions

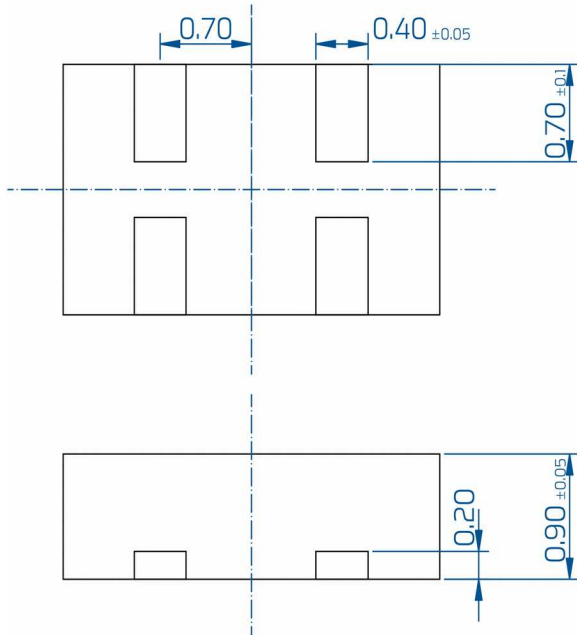
PR5020



PR5021



ODFN-4L - 1.8 x 2.9 PACKAGE



SOLDERING INFORMATION

A lead-free solder profile with a peak temperature of 260°C or less, according to J-STD-020 should be followed.

Samples shipped without moisture barrier bag must be dry-baked according to JEDEC guidelines before soldering. Manual soldering must be done with utmost care.

Direct infrared heating should be avoided; pure convection heating is recommended.

TAPE & REEL

Standard form of delivery is on tape and reel.

Reel diameter: 7" (178 mm)

Quantity per reel: 3,000

Packaging: moisture barrier bag

BARE DIES

PR5010 is available as bare dies on request on tested and sawn wafers or in wafflepack.

Please contact us for minimum order quantities and delivery times.

Photodiode PR5020/21



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