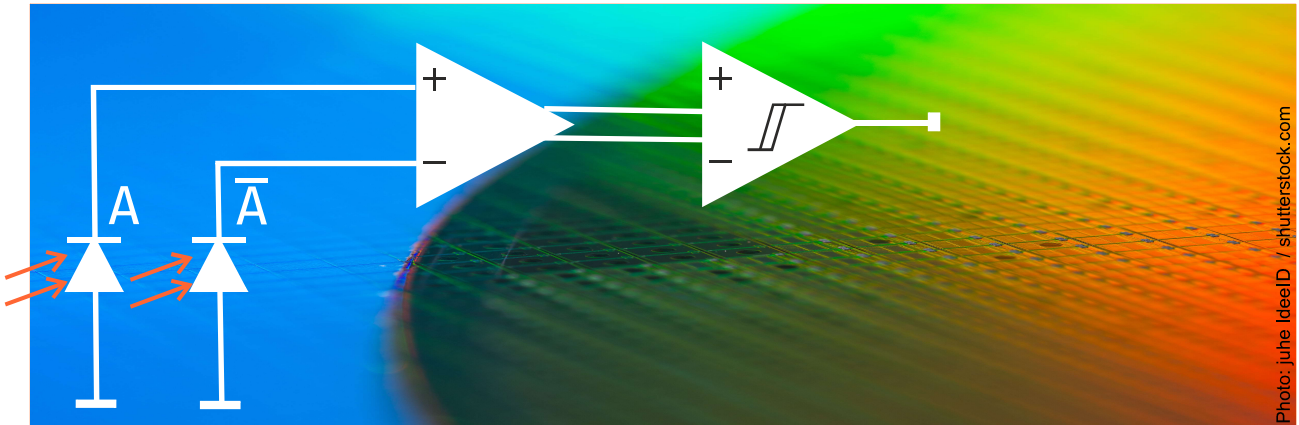
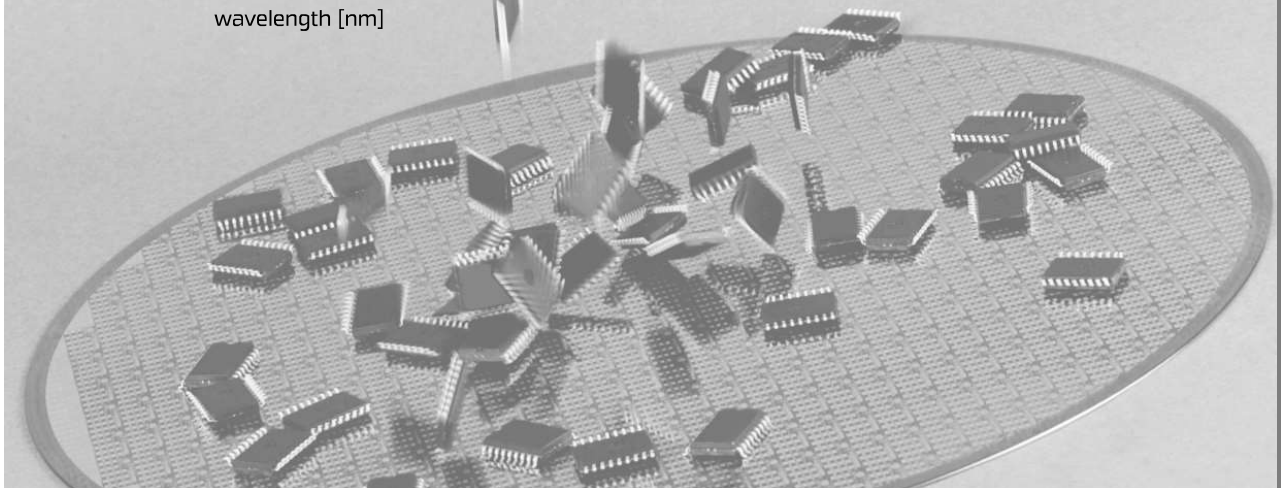
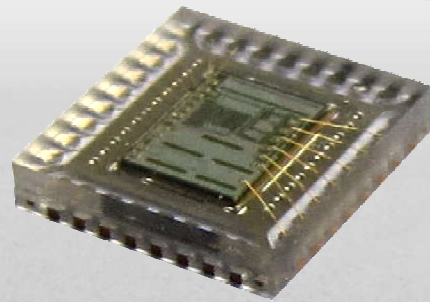
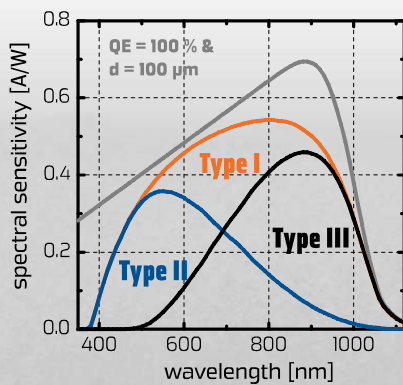


# PREMA SEMICONDUCTOR GmbH



## Opto ICs and Photodiode Arrays



Quality made in Germany

# Opto ICs

## Photodiodes and Circuits on One Chip

Photodiodes and analog circuits can be combined in an ideal way in the PREMA process, using high voltage implantation.

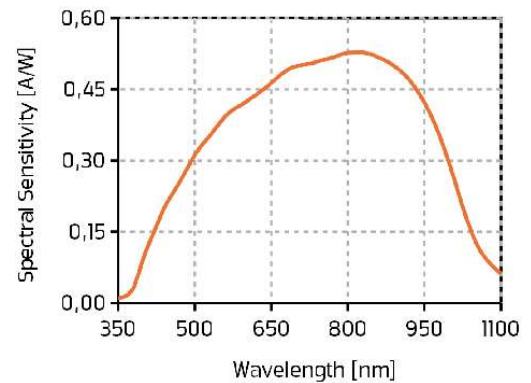
This brochure gives some examples of photodiodes, passive or combined with high-performance amplifiers, as examples of ICs that PREMA can design and produce for your application.

### Key features of our photodiodes:

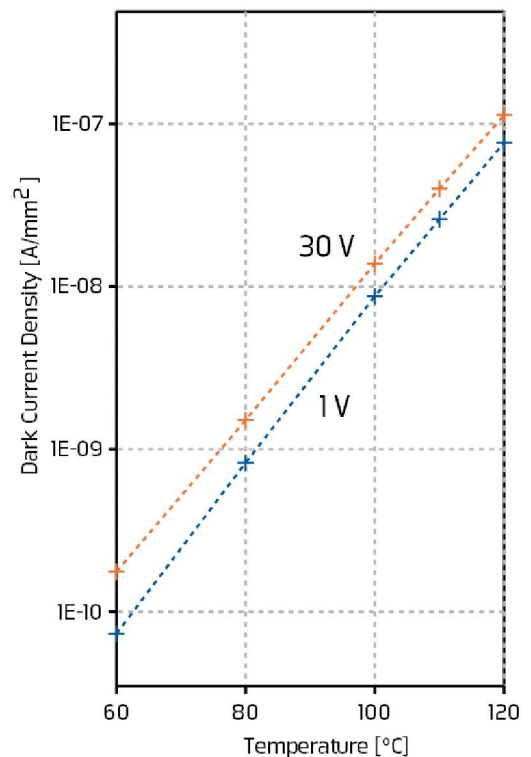
- Low dark current allows use in a wide temperature range.
- Use of different junctions in different depth allows the choice between different spectral sensitivities
- All photodiode types available without any extra layers as part of the PREMA bipolar or BiCMOS process
- Antireflective coating available
- Minimum photodiode pitch  $\sim 14 \mu\text{m}$

### Analog circuit blocks commonly used in our Opto ICs

- Transimpedance amplifiers
- Dark current subtraction
- Current multipliers
- Operational amplifiers
- Frequency filters
- **Order your custom Opto IC:**
- Low tooling costs - few mask layers
- Low design costs by using a proven cell library
- Optimized geometries for your application



*Spectral sensitivity of standard photodiode with antireflective coating*



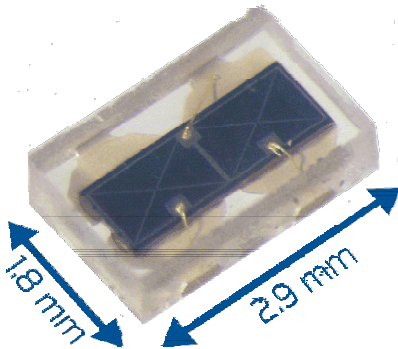
*Dark current of standard photodiode at bias voltages of 1 and 30 V*

# Photodiode Arrays

## With Customized Geometries of Photodiodes

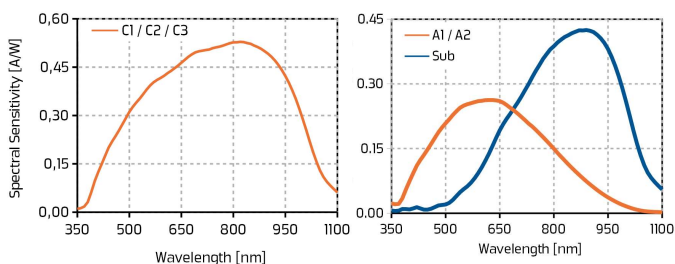
PREMA can design and produce ICs with photodiodes arranged in the way you need it. Applications are one- or two-dimensional position detectors, shutter monitors, range-measurement systems and many more.

Examples of this capability is the range of passive photodiodes that integrate one, two or three photodiodes on the same chip, providing good channel symmetry and highly reproducible geometries.



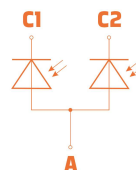
All photodiodes come in a tiny clear OQFN-4L package that is reflow solderable.

An infrared transparent package, blocking visible ambient light, is available on request, as well as delivery as bare dies.

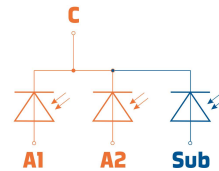
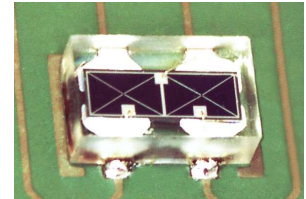


*Spectral sensitivities of photodiodes with common anode (left) and common cathode (right; for PR5010) and clear package.*

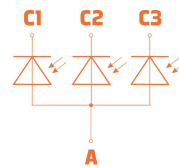
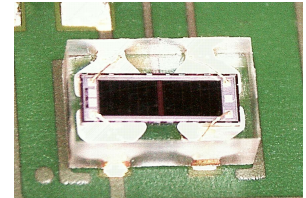
PREMA is able to design and produce photodiode arrays based on your requirements.



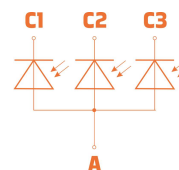
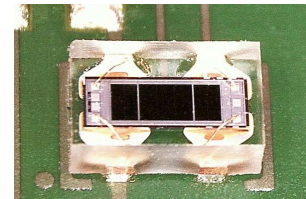
PR5001: dual PD with common anode



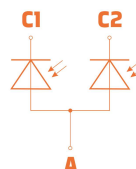
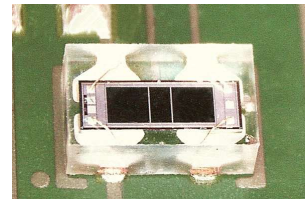
PR5010: dual PD with common cathode



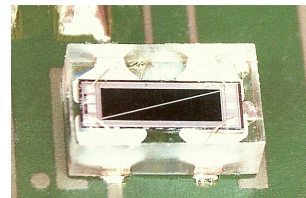
PR5020: triple PD with 25/50/25 split



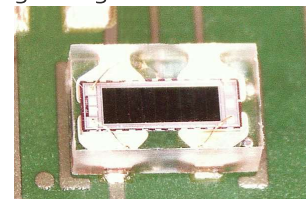
PR5021: triple PD with 40/20/40 split



PR5030: two opposing triangular PDs



PR5040: single PD



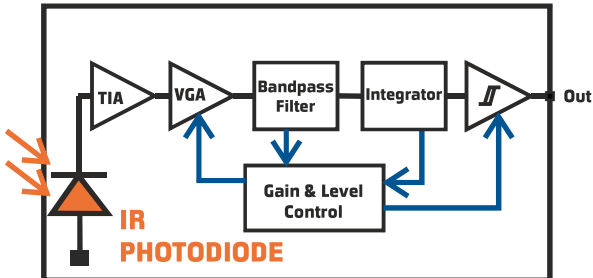
# Photodiodes with Amplifiers

## Sensor and Analog Circuit Combined on the Same Die

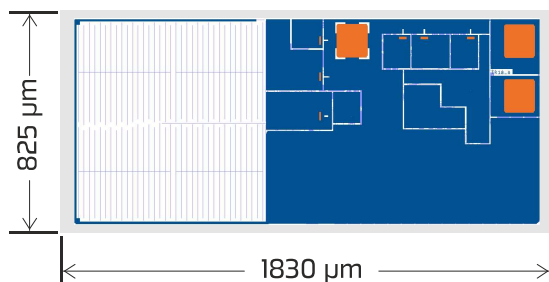
Apart from sensitive photodiodes, PREMA's semiconductor process allows the design of analog and mixed-signal circuits with high performance. Two examples are presented on this page.

### Infrared remote control receiver

The chip is a fully integrated IR receiver for remote control systems, containing the infrared photodiode, variable gain amplifier, bandpass filter, integrator and digital output stage. The monolithically integrated photodiode allows a very easy assembly with only three bond wires. Because of its small size it is well suited for SMD packaging. An internal voltage regulator assures constant

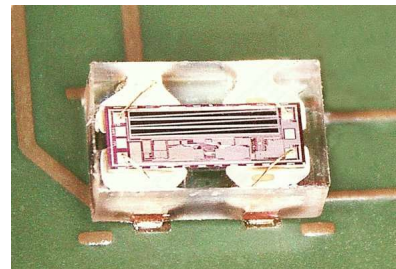
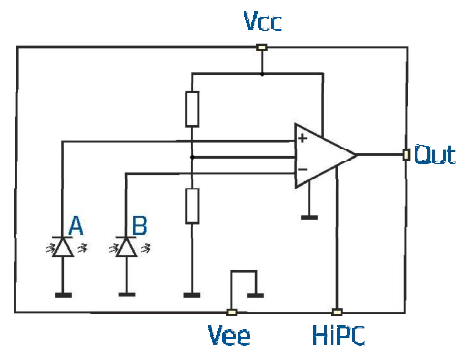


With its small die size, including the photodiode, it is possible to assemble the die into an infrared-transparent, optically opaque DFN package, making it the smallest infrared receiver available.

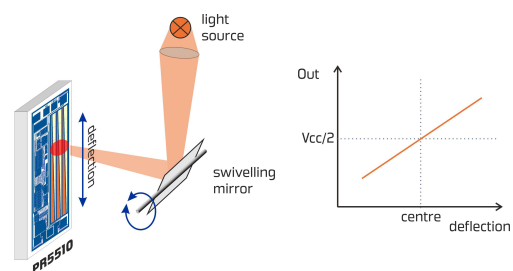


### Differential centre detector

PR5510 consists of two triplets of triangular photodiodes with reciprocal orientation, together with a differential transimpedance amplifier. If illuminated uniformly, the output is  $V_{cc}/2$ , but depends on the balance of illumination of the triplets. The differential photo-current is amplified.



The IC can be used e.g. for light beam adjustments, optical position detectors or vibration sensors:





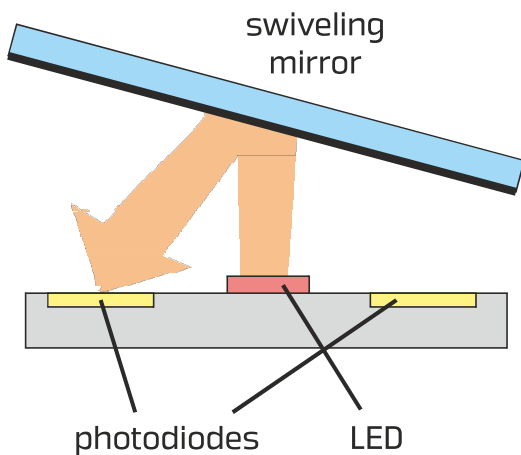
## Differential Photodetectors

### 4-Quadrant Photodiode with Transimpedance Amp

Unique applications require unique photosensor solutions. Under one roof, PREMA Semiconductor can design and produce ICs optimized for your application.

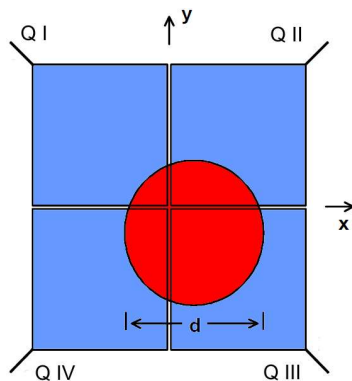
#### Project example 1:

The deflection of a swiveling mirror above a surface should be detected by measuring the difference of light intensity reflected to the corners of a 3 mm x 3 mm surface. In the centre of the chip an LED is mounted.



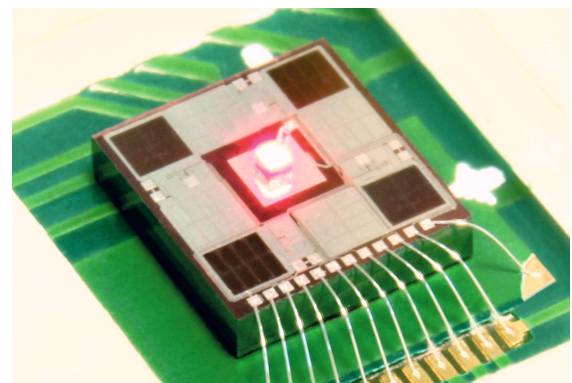
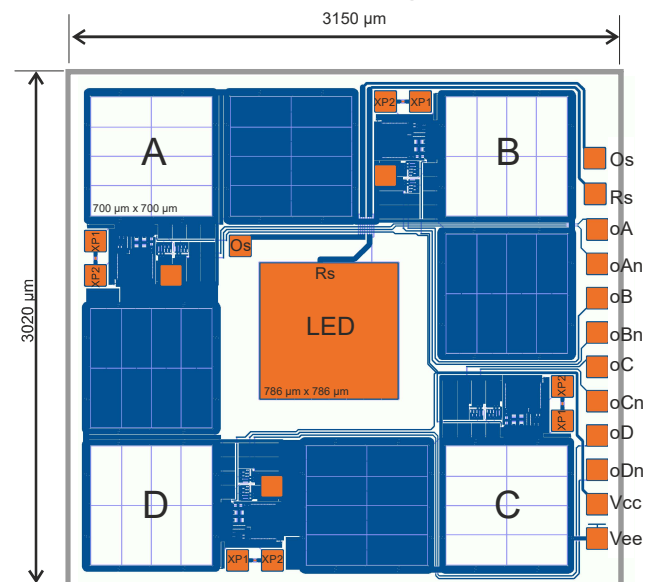
#### Project example 2:

For alignment of a laser beam the distribution of the light on the four quadrants should be evaluated. In this case the photodiodes cover the whole area to the centre of the chip.



The chip consists of four photodiodes with four transimpedance amplifiers, two fully differential amplifiers and output buffers. It can detect vibrations of the mirror up to 1 MHz.

The LED current can be controlled as to produce a constant intensity signal.

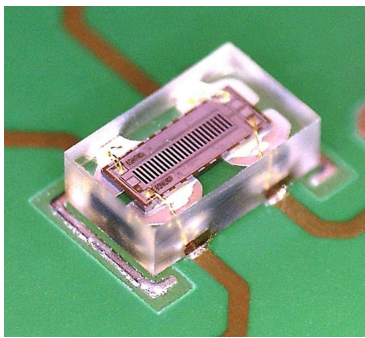


# Optical Encoders

## Fine-Pitch Photosensors with Signal Processing

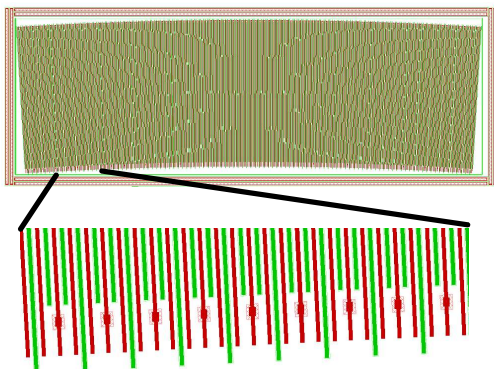
Optical encoders measure rotations or translations, such as in robots, pumps, machine tools or printers. PREMA offers sensor ICs for optical encoders with a high spatial resolution and a good channel separation, as well as high-performance analog circuits for signal processing.

PREMA has developed a family of encoder sensor ICs to offer solutions for low-cost encoders, with fixed resolutions of 50, 150 or 300 lpi, or variable resolutions using a reticle.

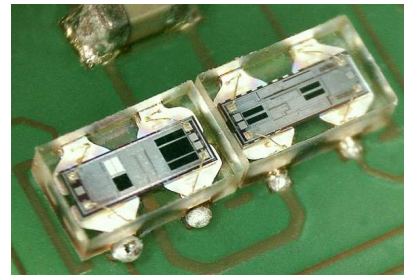
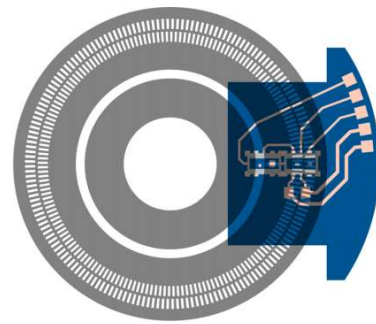


*PR5301-300 with 300 lpi resolution*

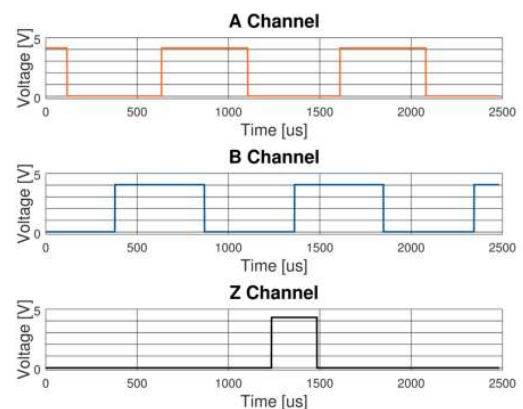
We can develop special photodiode structures, adapted to a specific resolution and track radius. The following image is an example of interleaved photodiodes with an angular structure for A/B channel of an optical encoder. Minimum pitch in this example is 14  $\mu\text{m}$ .



Two-channel sensors for A/B tracks can be upgraded to a full three-channel solution by a second IC. For these applications PREMA has developed index (Z) channel ICs that can be combined with A/B channel ICs.



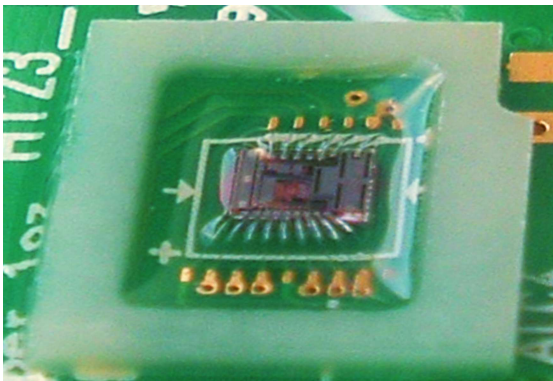
*Combination of PR5320 and PR5330*



## Package Solutions for Opto ICs

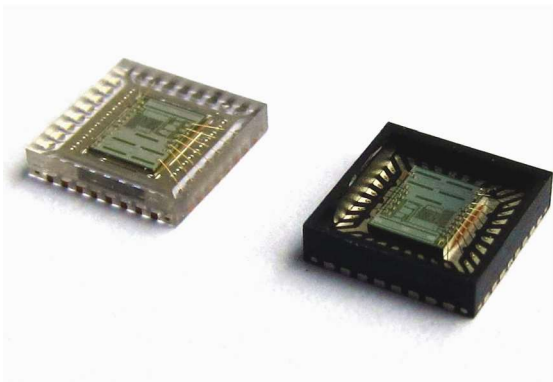
Opto ICs are part of a sensor system and must be packaged according to the field of application. PREMA offers package solutions for different requirements.

### Chip-on-Board Assembly



Chip-on-board assembly with transparent glob top allows individual solutions at low tooling costs.

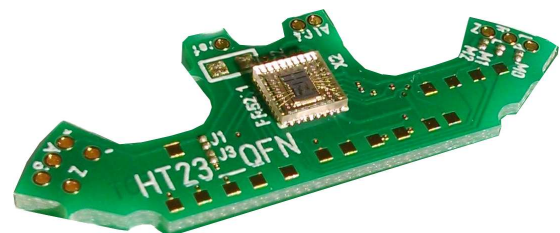
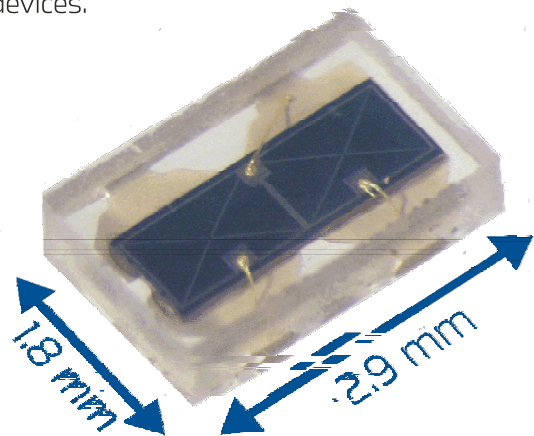
### Optical QFN Packages



QFN packages with transparent mold compound (shown left) can be qualified to ambient temperatures up to 85°C .  
Open cavity QFN packages with transparent silicone filler (right) allow ambient temperatures above 125°C.

### Tiny Optical DFN Packages

A tiny 4-lead QFN package is a perfect choice for many photodiode and opto IC circuits, such as ICs for photo-interrupters, photocurrent amplifiers, or position sensing devices.



QFN package with encoder IC on PCB

# Unique Fabrication Process



PREMA Semiconductor GmbH has more than 30 years of experience in designing and manufacturing analog and mixed-signal circuits. With our in-house wafer processing facilities, we offer turnkey services from design, prototypes, test, to series production

in high volumes. It gives us the flexibility to react quickly on special demands, redesigning the circuit according to your requirements and producing wafers with modified circuits.

PREMA is a mid-sized, independent company. Our location in the Frankfurt area is perfectly suited for close cooperations with international customers.

In cooperation with reliable partners for chip-on-board, PCB and mechanical assembly we offer complete solutions on PCB or module level.

We provide custom semiconductor products at affordable design and tooling costs that give your products and edge over your competitors and protect you against product copies.

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