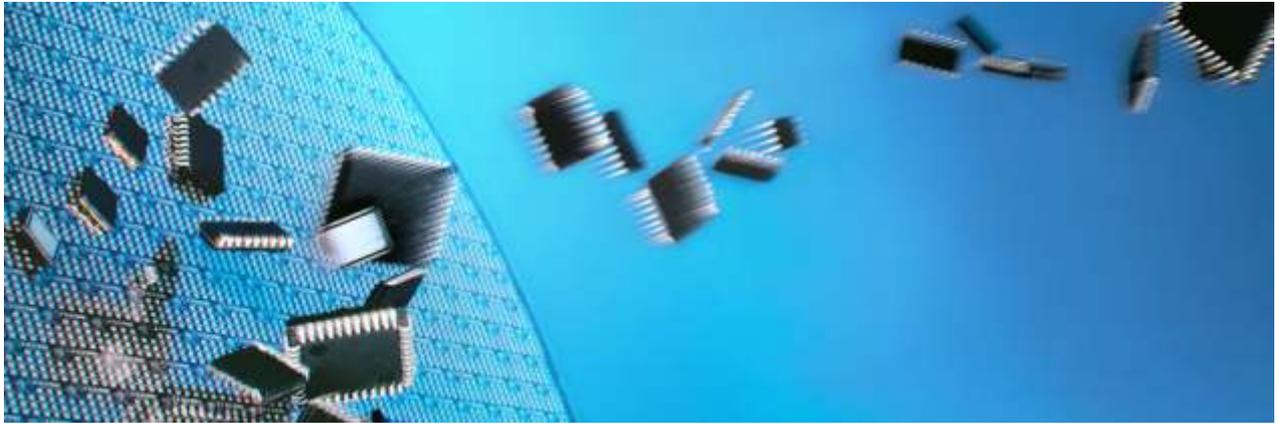
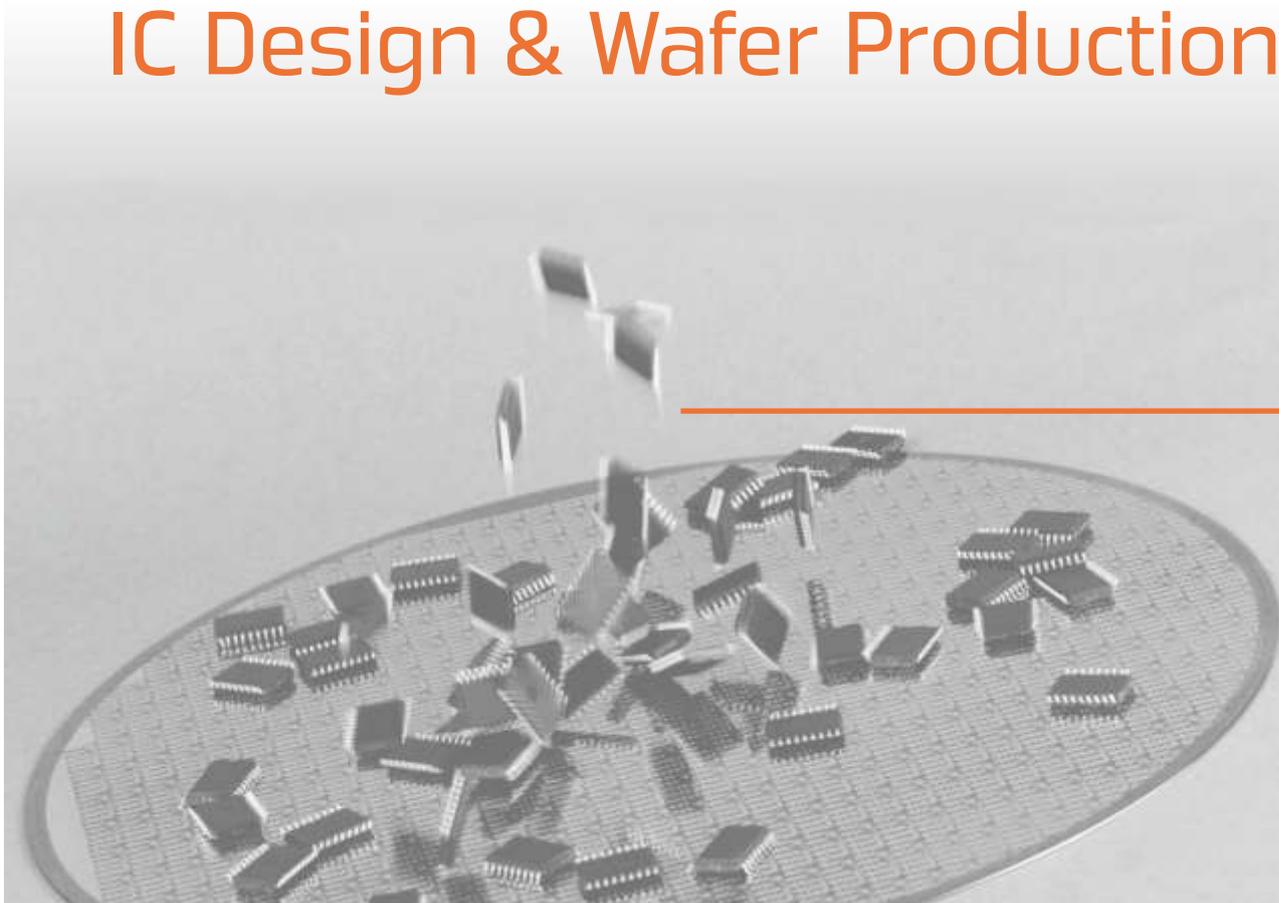


# PREMA SEMICONDUCTOR GmbH

---

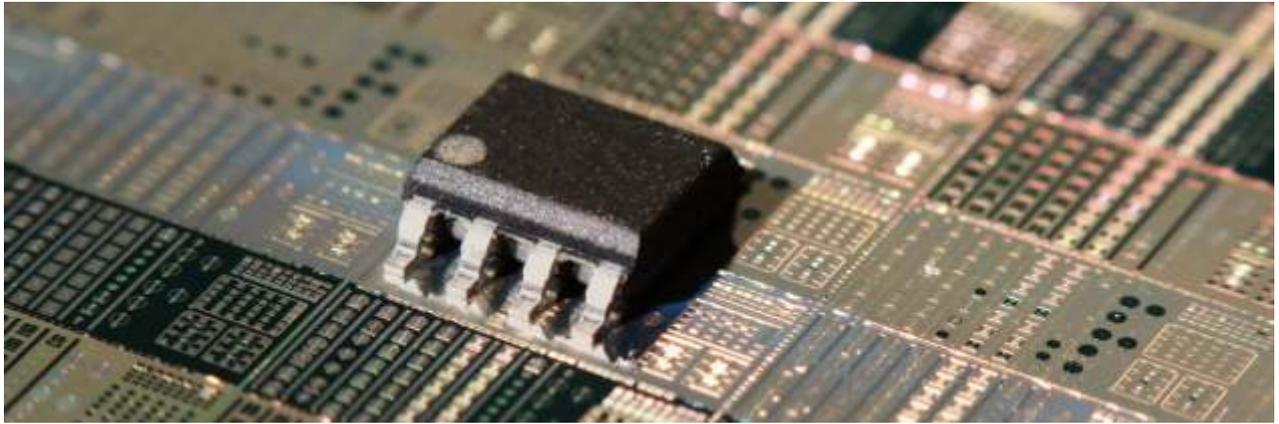


ASICs & ASSPs  
IC Design & Wafer Production



Quality made in Germany

# ABOUT PREMA SEMICONDUCTOR



PREMA Semiconductor GmbH is a unique, innovative and successful manufacturer of analog and mixed signal ICs.

Founded as a company developing and producing digital multimeters with benchmark precision, PREMA Semiconductor GmbH became a semiconductor manufacturer with own wafer fab in 1982.

Our team of approx. 50 employees consists of IC designers, process experts, test engineers and skilled operators. This extraordinary combination of specialists, with individual backgrounds combined under one roof, leads to the creation of innovative products and enables fast turnaround times for application specific integrated circuits (ASIC) and application specific standard products (ASSP).

## HISTORY

**1970** Founding year. Development and production of ultra-high resolution digital multimeters.

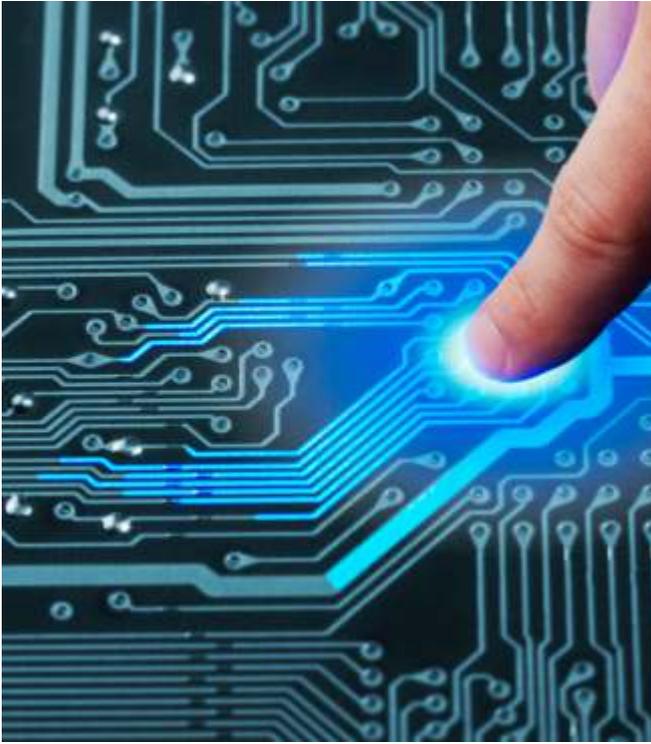
**1977** Establishment of semiconductor division

**1981** Start of ASIC fabrication on 75 mm wafer for bipolar analog and mixed-signal circuits

**1991** New company building; construction of new innovative production line with local clean room chambers

**1996** Start of new 150 mm wafer production line

## Design and Production in Germany



PREMA is a middle-sized, independent company, located in Mainz, Germany, close to Frankfurt airport.

This allows us to keep a close relationship with our international customer base.

With all critical development and production steps in our headquarter building, and with mostly German and European suppliers of raw materials and supportive services, we live on a local eco-system, largely independent of the big market players.

This strategy keeps the supply chain manageable and the quality controllable.

It also allows us to consider extraordinary requirements, to develop special solutions and to react to our customer's needs in a flexible way.

**1999** Introduction of the ModuS U6 process using high-voltage implantation, the new standard for high-voltage analog and mixed-signal ASICs.

**2000** PREMA Precision Electronics becomes PREMA Semiconductor & ceased multimeter production



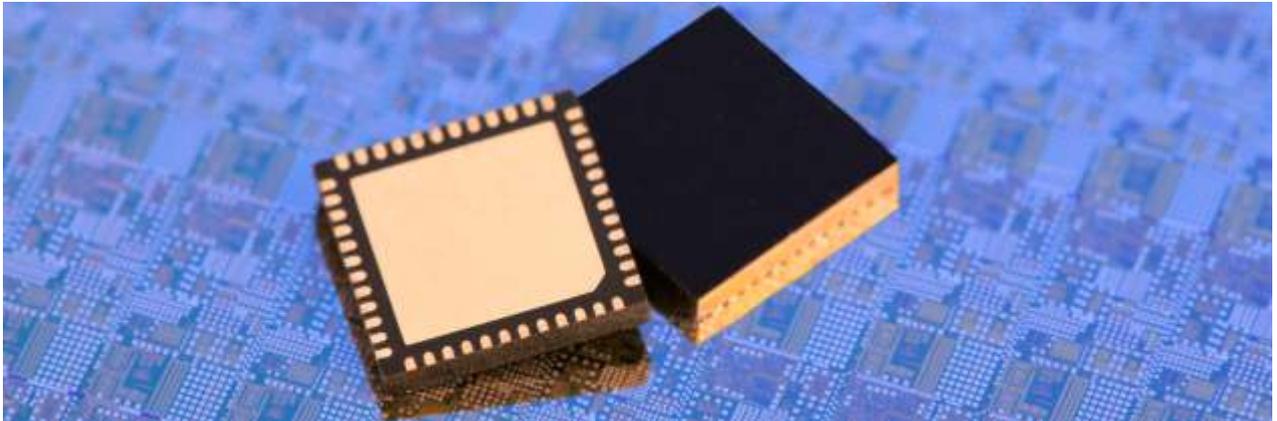
**2004** High voltage NPN- and PNP-transistors ( $V_{CE0} > 120 \text{ V}$ ) introduced in ModuS U6 process

**2012** Construction of new 200 mm wafer line

**2013** Optical Encoders



# CHIP DESIGN



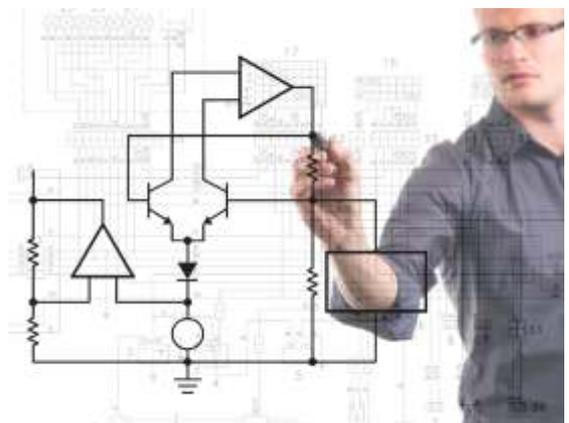
It is our aim to make the electronics of your final product more competitive: smaller, more reliable, more economical. Our team of approximately ten IC designers is experienced in the development, simulation and layout of primarily analog ICs. They understand the needs of customers with analog circuits and can quickly develop concepts to put most of the circuitry into silicon.

## How to Start an ASIC Project

To begin with, give us a rough sketch of your idea. This may be in the form of a general description, a block diagram, or an equivalent solution. In some cases you may already have a specification or a schematic of an already existing circuit.

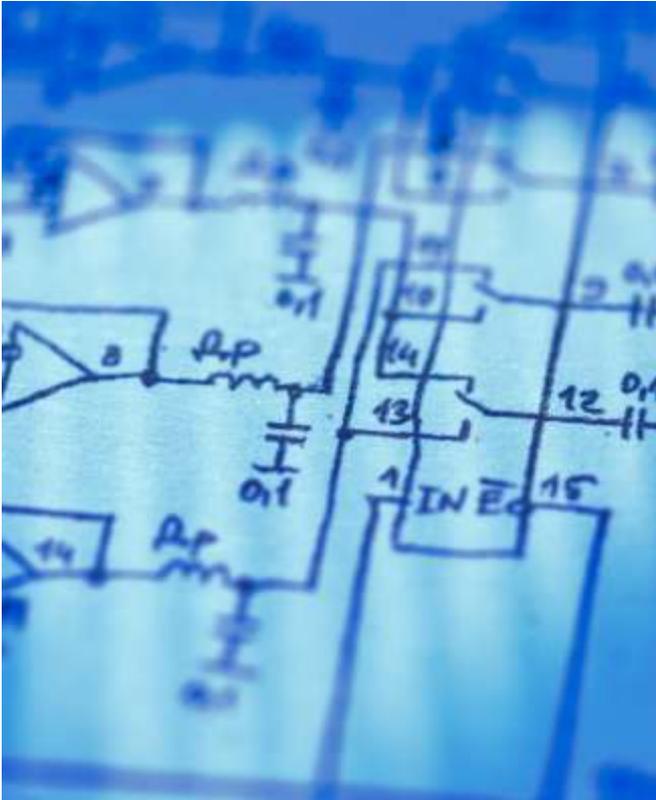
Any of this should give us enough ideas to propose a possible solution or to start an open discussion with you.

This advice is free and without obligation. It is usually favourable to involve



our engineers as early as possible in the design process.

## Next Steps Towards the ASIC

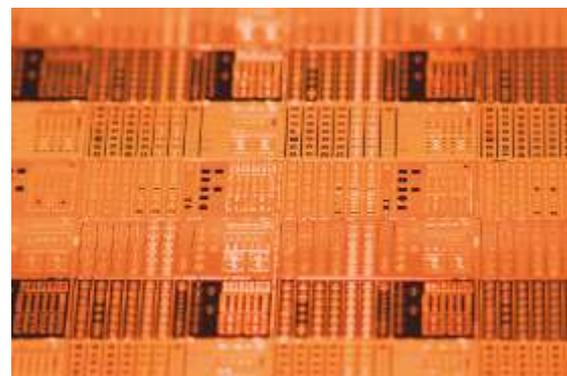


1. circuit specification and concept
2. circuit design and simulation
3. layout and design rule check
4. prototyping
5. design validation
6. series approval
7. production mask writing
8. development and validation of wafer- and IC-test
9. series wafer production
10. assembly in plastic package

After approving the specification, we will start the design process.

We can perform or support you in all steps from the first concept sketch to series production.

In-house wafer production allows quick design loops in case that redesigns become necessary.



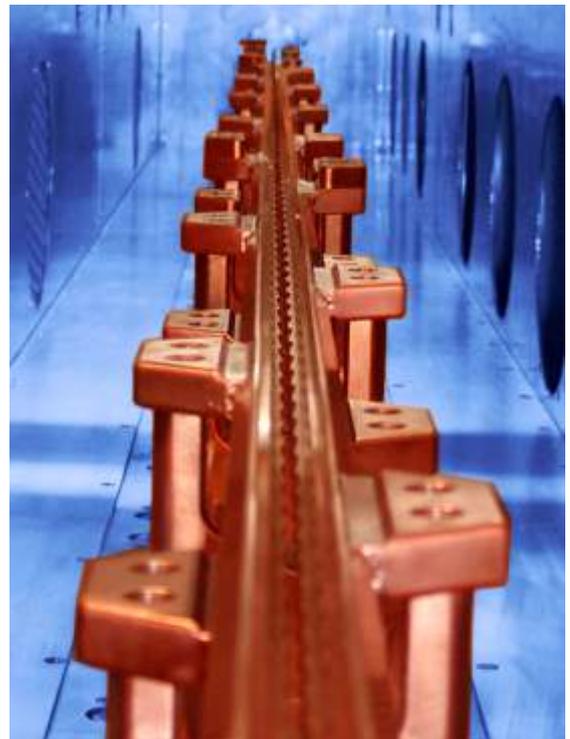
# WAFERS MADE IN GERMANY



Based on advanced technologies, we manufacture analog and mixed-signal ASICs according to your specifications. Our fab is equipped with innovative production facilities and ready to produce your IC. From development to bulk production and testing of your ASIC – PREMA offers a complete service.

All process steps, including lithography, implantation, deposition of isolators and metals, etching and annealing steps are all available at our facility.

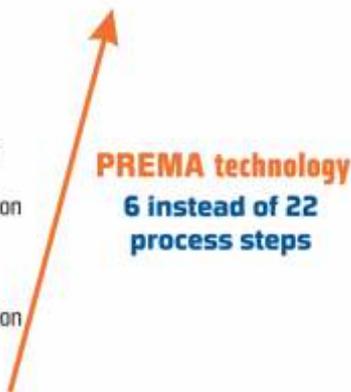
The combination of a flexible wafer processing facility and our ModuS U6 process, a unique method to replace several conventional process steps by one implantation, gives us an edge against our competitors.



## Versatile process

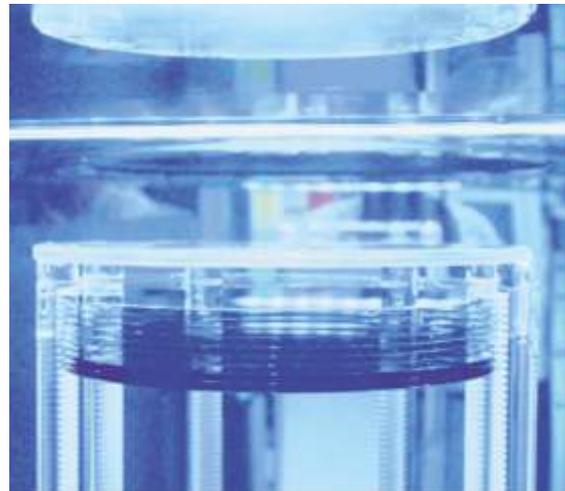
PREMA's unique process replaces three lithography layers, plus the critical deposition of the epitaxial layer, plus a long thermal oven step, with just one layer using a well-defined high-energy implantation. This speeds up processing times and reduces overall process costs.

Conventional process	ModuS U6 process
1 Oxidation	1 Oxidation
2 Coating	2 Coating
3 Lithography	3 Lithography
4 Developing	4 Developing
5 Etching	5 High Energy Ion Implantation
6 As-Implantation	6 Stripping
7 Stripping	
8 Cleaning	
9 Diffusion	
10 Epitaxy	
11 Oxidation	
12 Coating	
13 Lithography	
14 Developing	
15 p-Implantation	
16 Stripping	
17 Coating	
18 Lithograph	
19 n-Implantation	
20 Stripping	
21 Cleaning	
22 Diffusion	

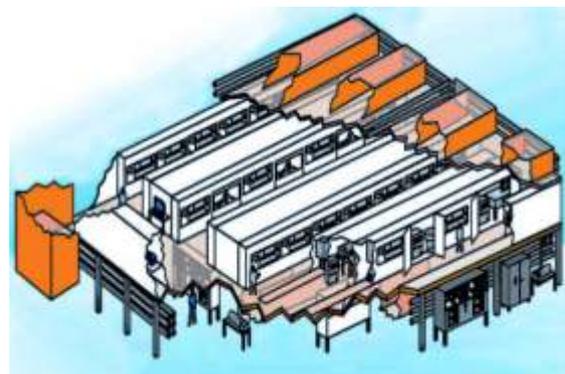


This process, invented by PREMA has proven its qualities in many customer projects since then. It has been further developed to support not only bipolar devices, but also a triple-well BCD process with bipolar, CMOS and DMOS devices.

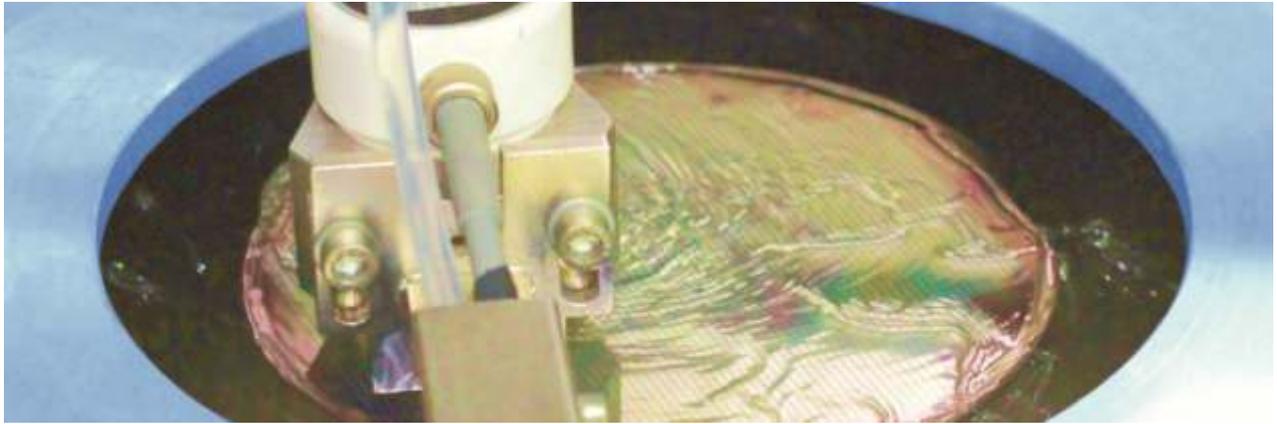
## Advantages of the ModuS U6 Process



- Radical simplification of process flow by 6 MeV high-energy ion implantation
- Allows a large variety of components, such as NPN, PNP, JFET, photodiodes, phototransistors, implanted resistors, hall sensors
- Low leakage currents allow a wide dynamic range for transistors
- Unique process provides a high level of protection against reverse engineering and product copies



# SEMIC<sup>®</sup> CHAMBER TECHNOLOGY



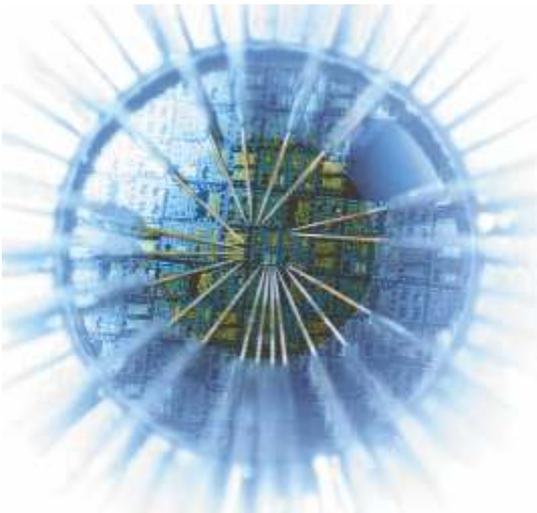
Autonomous local ultra-clean rooms, conceived and built by PREMA and called SEMIC<sup>®</sup> chamber (Standard Electronic and Mechanical Interface Clean Chamber) incorporate the best concepts regarding flexibility, economy and process optimization. This increases the yield and allows very rapid prototyping.

A thorough compilation of production steps combined in one SEMIC<sup>®</sup> chamber guarantees optimum flexibility in the face of changing process demands and production volumes, at the same time providing a fast and reliable process flow. The status of each wafer can be monitored centrally at all times.



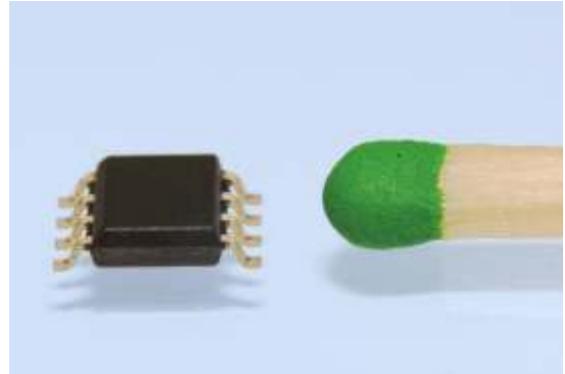
## IC Test

All ICs are tested on wafer level with our fully automated wafer probers. Test hardware and software for each IC type is developed by our test engineers to cover the full IC specification. All tested parameters for each IC are recorded and stored for best traceability, and test data are regularly evaluated statistically. The project-specific IC test is complemented by a measurement of the process control module (PCM), monitoring characteristic process data.

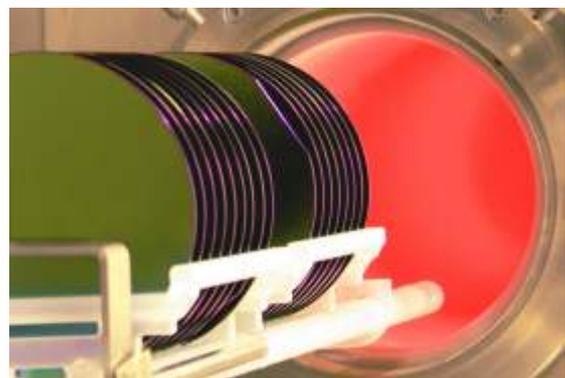


After packaging, ICs undergo an additional test before being delivered in plastic tubes, tape and reel or trays. Alternatively, we can deliver bare dice on tested and inked wafers, or singulated dice on adhesive film.

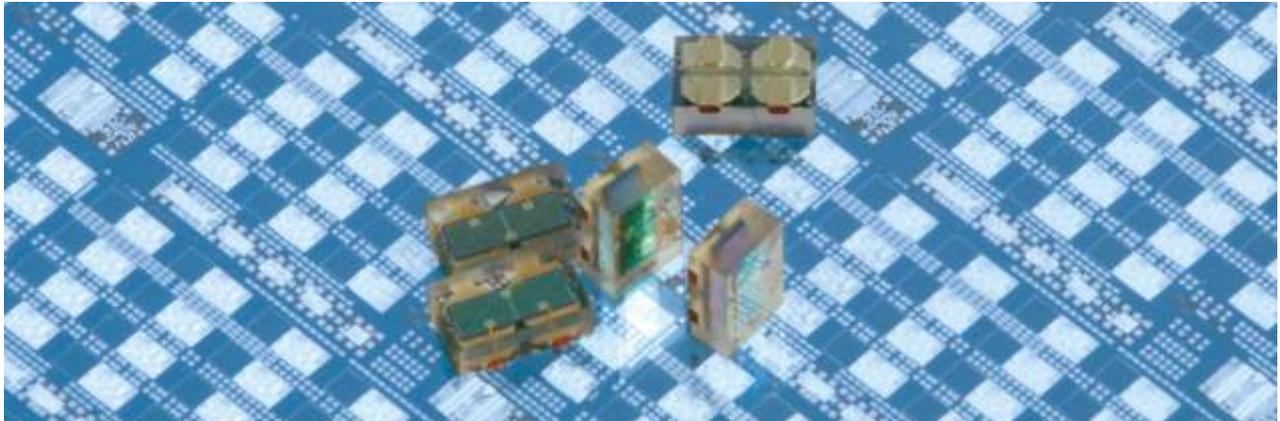
## IC Packaging



For packaging, PREMA cooperates with different partner in Europe and Asia. This allows us to offer a wide range of state-of-the-art packages. This includes SOIC, TSSOP, QFN, SOT23, but also optical packages or packages with non-ferrous materials for magnetic sensors. Many of our customers assemble chips on PCB directly from wafer.

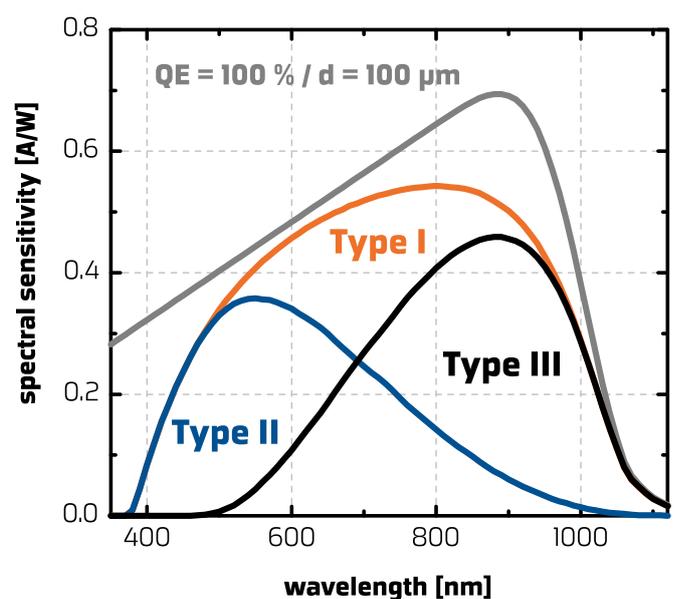


# PHOTODIODES



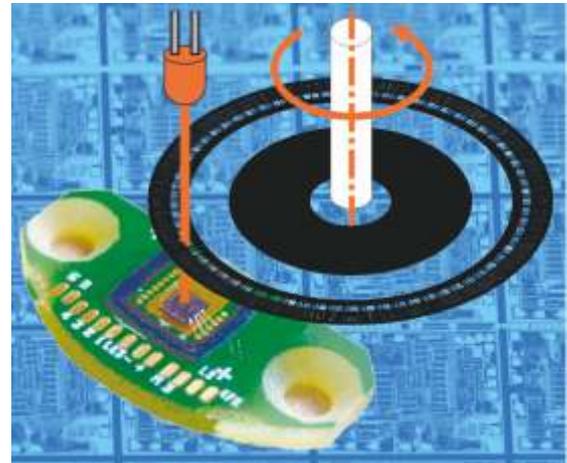
PREMA's process allows the integration of photodiodes with very low dark currents. In combination with low-noise high-gain amplifiers this allows a high sensitivity. Different photodiode types allow different spectral sensitivities from visible to near infrared range. The possibility to combine photodiode amplifier and signal conditioners on the same chip offers new possibilities for system-on-chip designs.

The spectral sensitivity of the photodiode is given by position and size of the pn-junction. By varying both, different PREMA photodiodes are available. Three types and their spectral sensitivity are shown in the spectrum. The efficiency at certain photon wavelength is comparable to the maximum achievable (QE = 100 %). Applied antireflective layers prevent interference effects that reduce the spectral sensitivity for certain wavelengths.



## Optical Encoders

Optical encoders measure rotations, such as in robots, pumps, machine tools or printers. PREMA sensor modules for encoders combine the capabilities of our photodiodes with innovative ideas how to design the sensor area, to offer a module that allows high resolutions, is easy to assemble, robust and versatile.



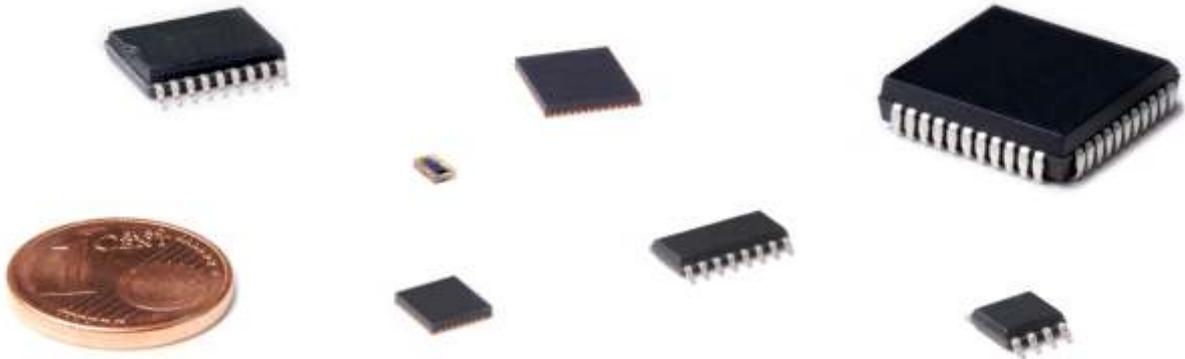
Resolutions of up to 5000 increments at 40 mm track diameter have been realised. PREMA uses an innovative, patented method to form sharp index pulses.

Various combinations of encoder tracks (e.g. with additional U/V/W tracks) can be designed and produced on demand.

PREMA offers also encoder chips mounted on specially designed PCBs, with integrated reticle structure for lowest assembly cost or external reticle for best flexibility. Accessories such as LED-lens combos and glass disks can be delivered upon request.



# IC APPLICATIONS

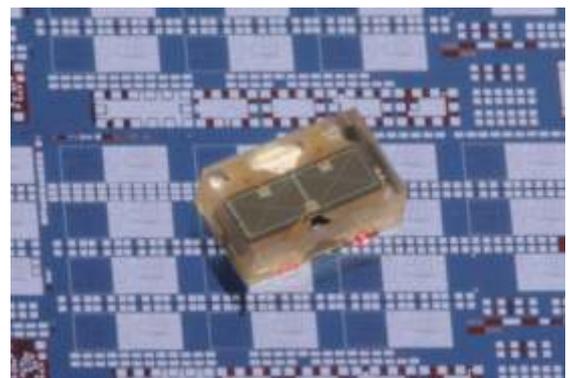


PREMA Semiconductor GmbH offers state-of-the-art solutions for analog and mixed-signal circuits. Individual requirements of our customers have driven us to develop a wide range of unique and innovative products. Here we briefly outline some examples of ASICs developed over the last years.

## Sensor ICs

**Ambient light and sunload sensor for cars** Photosensor, amplifier and signal conditioner are placed on the same chip in a transparent DFN package. Two versions are available: one for the near infrared, and one for the visible light range. High linearity and sensitivity are outstanding features of this small IC that is part of a sensor module fitted on the dashboard of many cars.

**Monolithic infrared remote control receiver** This ASIC is a fully integrated IR receiver for remote control systems, containing the infrared diode,



variable gain amplifier, bandpass filter, integrator and digital output stage. This configuration allows a very easy assembly in a tiny package. Filter and adaptive gain control give it an unmatched rejection of disturbing signals.

## Safety and Comfort ICs



**Transceiver for house installation bus** Installation buses operate at voltages up to 50V, and their drivers have to draw currents up to 500mA. The ASIC designed in compliance with our customer's specification and contains all functions of the physical bus interface. PREMA's high voltage transistors are ideal for these requirements.

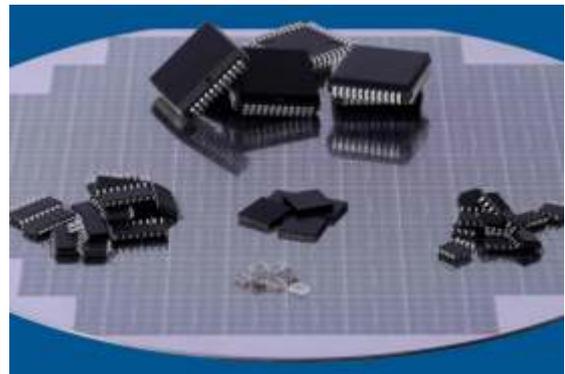
Analog circuits make life in your house more comfortable and safe.

Analog ASICs by PREMA make these circuits more powerful, versatile and unique.

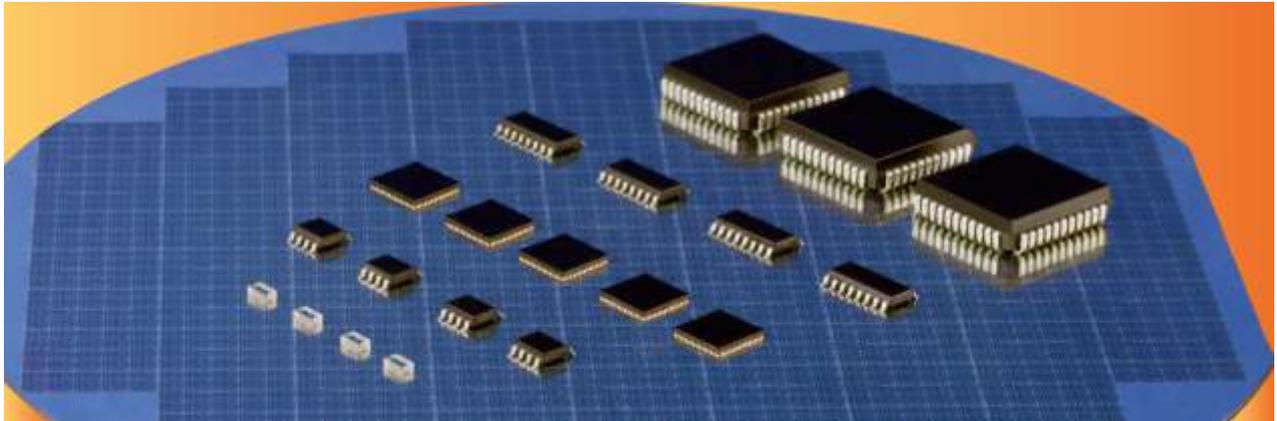
**IC for residual-current circuit breakers** A low-offset amplifier and rectifier measures the residual current and breaks the supply line in case of danger. Different methods of detecting the residual current can be used, based on our customer's know-how in this field.

**Gas burner controller** The ASIC supervises the flame by measuring the ion current. It also contains drivers to control valves and interfaces for keys and status displays.

**ICs for smoke detectors** A highly sensitive low-noise amplifier detects the light scattered by smoke. It is combined with control circuits that initiate the alarm and other actions.



# IC APPLICATIONS



ASICs can conceal the ideas and patented methods of our customers. The functions are hidden in silicon which is designed and produced exclusively for one party. You can specify ICs containing new ideas for which no standard ICs exist, or combine functions in a unique way.

## Sound Processing ICs

**Microphone amplifier** The excellent analog performance of our transistors, including low noise and a wide dynamic range from pA to mA allow the amplification of small signals from microphones or other signal sources. The full benefit of an ASIC comes from the combination of different functions, such as power control, battery charging, status display drivers etc., to build a system on chip.

**Sound enhancement chip MZ-01** Together with the Speaten<sup>®</sup> filter by Dedekind R&D (Japan), MZ-01 makes small speakers, built into laptop computers, portable audio devices,



flatscreen or CRT TV sets or car stereo, sound like much larger speaker systems. MZ-01 is a controlled amplifier combining low noise, low distortion and a wide supply voltage range designed for use with the Speaten filter.

## Power Converter ASICs

**Battery charging IC** A fast battery charge controller ASIC for NiMH batteries used in consumer products has been developed by PREMA Semiconductor. The charge control is based on a patented multiple ramp A/D conversion method that allows the recognition of  $dV/dt$  with a sensitivity of better than 0.5 mV/min. A noise suppression of more than 60 dB prevents an overcharging with exceptional accuracy which guarantees a long battery lifetime, despite of high charging rates.

**Buck converter for energy saving circuits** With a minimum of external components this ASIC can convert a voltage of up to 65V at the input down to 5V or 3.3V which are convenient for typical standby circuits such as an IR receiver, a timer, or a microcontroller.

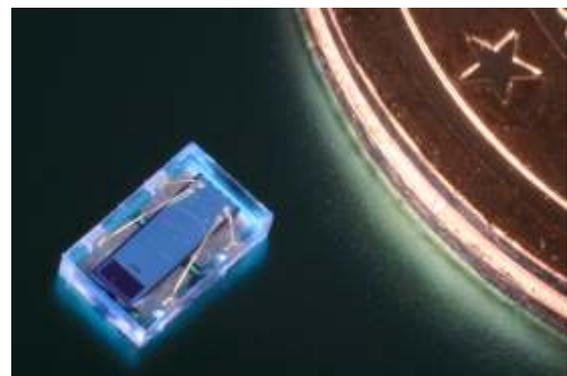
The high-voltage performance allows to control chains of LEDs used for status display in standby mode, leading to a low current consumption from the mains.

## Motion Sensor ASICs

**Hall effect sensor IC** The PREMA process can integrate Hall effect sensors without requiring additional process layers. The high sensitivity of the Hall elements and the low offset of the following instrumentation amplifiers allow a low detection threshold of a magnetic motion sensor IC.

**Incremental optical encoder chips** A sensor with fine structures and an innovative method to generate sharp and precise Z channel pulses allows the construction of rotary encoders that are quick to assemble, reliable in operation and having a high resolution.

Wherever things move, analog signals are present. With PREMA ASICs you can sense movements with different sensors, or control motion with motor controllers.



# COPY-PROTECTED BY PROCESS



Circuits with standard ICs are simple to steal. The basic idea of an ASIC is to embed part of your system know-how and to obtain a unique selling point for your product. With ASICs made in conventional processes counterfeits are more difficult, yet still possible.

The unique features of PREMA's process, not available in other lines, make it near impossible to copy your circuit: copy protection by process. Key is the choice of a trusted cooperation partner for design and production.

PREMA is a mid-sized independent company, located in Mainz (Germany), and all design and production facilities are combined under one roof.

Together with the unique fabrication process that makes reverse engineering for competitors almost impossible and your know-how is protected against product piracy.

© 2014 PREMA Semiconductor GmbH

Disclaimer: Information provided by PREMA is believed to be accurate and correct. However, no responsibility is assumed by PREMA for its use, nor for any infringements of patents or other rights of third parties which may result from its use. PREMA reserves the right at any time without notice to change services, data, or specifications.

Edition w44/2014

## **PREMA Semiconductor GmbH**

Robert-Bosch-Str. 6

55129 Mainz

Germany

Phone: +49-6131-5062-0

Fax: +49-6131-5062-220

Email: [prema@prema.com](mailto:prema@prema.com)

**[www.prema.com](http://www.prema.com)**

