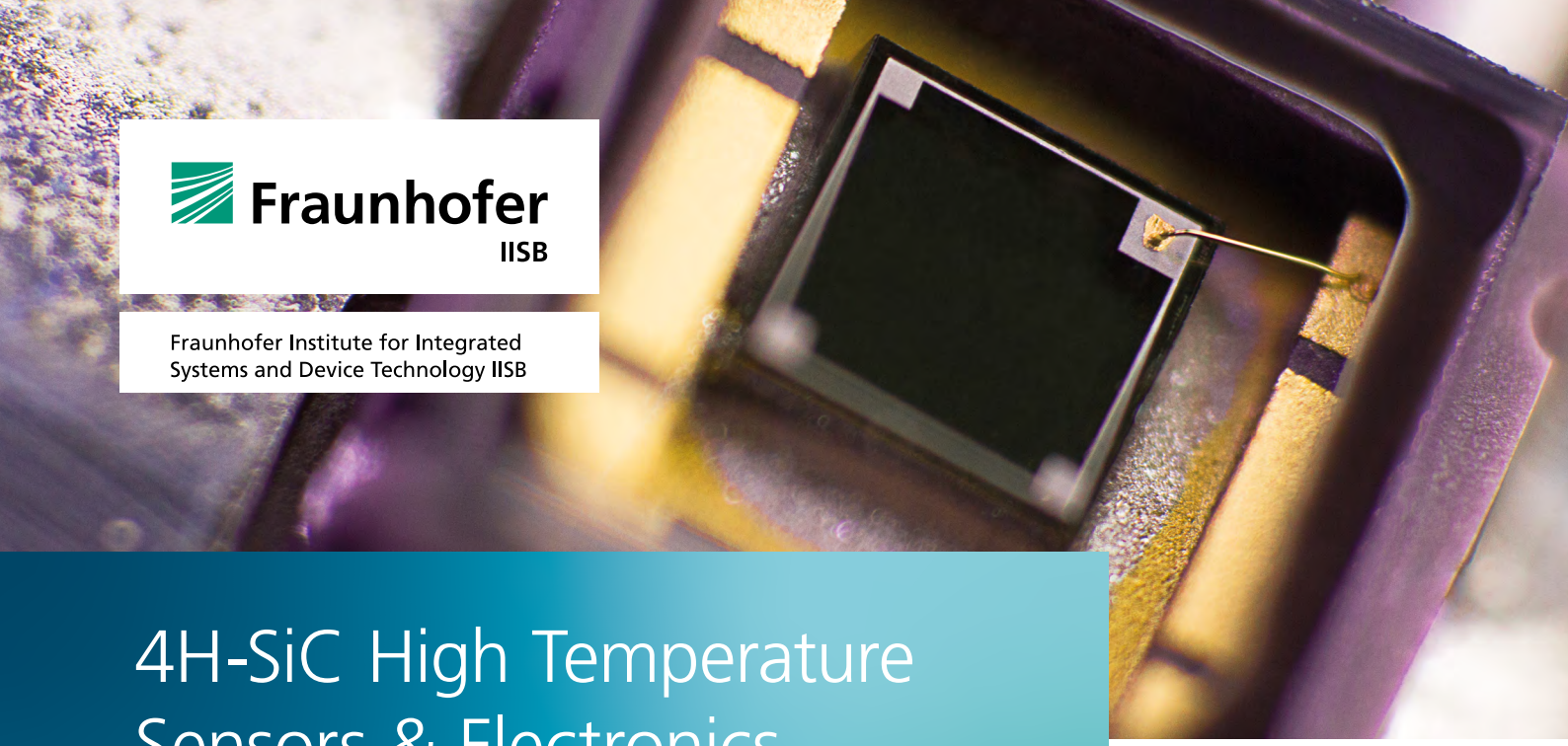


Fraunhofer IISB

Fraunhofer Institute for Integrated Systems and Device Technology IISB

4H-SiC High Temperature Sensors & Electronics

CMOS Technology Based Sensing and Signal Processing Operable up to 600 °C

Mounted 4H-SiC UV sensor

General Description

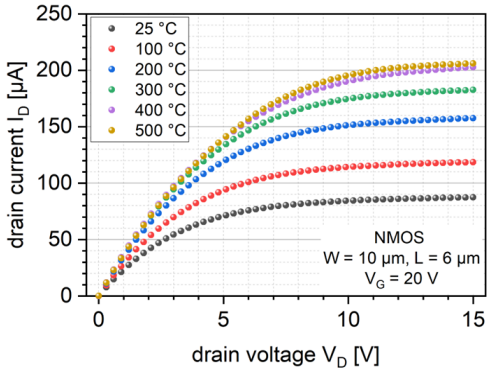
- Mixed-signal circuits operating in harsh environments, including temperatures up to 600 °C
- Combination of sensing function – such as temperature, UV, and magnetic fields – with on-chip amplification and high voltage Smart Power option in an accessible CMOS technology

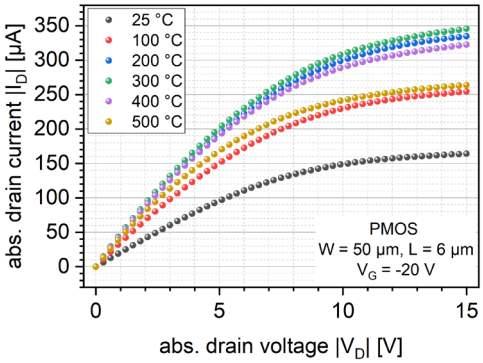
EUROPRACTICE IC Service*

- Technology also available as multi-project wafer offer through EUROPRACTICE, including custom solution support
- Design kit with simulation models available

Advantages and benefits

- Operable at significantly higher temperatures compared to Si
- Resistant against harsh environmental conditions
- Compact single chip solution due to monolithic integration, replacing external amplifier and reducing sensor signal loss
- Custom electrical characterization available
- Prototype packaging options available upon request
- Cost reduction due to monolithic integration
- Lower entry budget by multi-project wafer option as well as independent dedicated fabrication or R&D runs possible
- Increased market volume through multisensor solutions





Output characteristics of a 4H-SiC NMOS 10/6 (left) and PMOS 50/6 (right) at specific temperatures

Multi-sensor Platform Capability

Temperature

- Temperature-sensitive diode operation under constant current forward bias mode:
  - High sensitivity up to 4.5 mV/K
  - High linearity up to 500 °C
  - Best-in-class high temperature performance of semiconductor-based sensors
- PTAT circuit sensitivity:
  - Typically 0.2 mV/K
  - Tunable by input current ratio
  - Unaffected by the temperature dependence of the integrated circuit

UV Radiation

- Tunable responsivity
- Maximum at 260 nm: 110 mA/W
- Nearly constant responsivity between 270 nm and 300 nm
- Typical maximum external quantum efficiency of 55 %

Magnetic Fields

- Magnetic field FET
- Split drain MAGFET
- Vertical Hall (cross) bar devices
- Suppressed sidewall magnetic injection magneto-transistor

Towards Smart Power Technology

- On-chip combination of low power and high power devices such as high voltage VDMOS or RESURF LDMOS devices
- High-side capability by well isolation

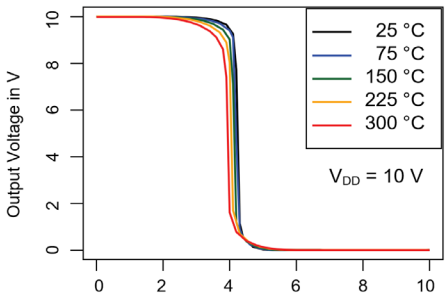
Mixed-Signal ICs

Core Devices

- CMOS technology consisting of NMOS, PMOS and resistors
- Silicon-like channel mobility ratio
  - μ_{NMOS} / μ_{PMOS} = 2.6 @ 300 °C
  - μ_{NMOS} / μ_{PMOS} = 3.9 @ 500 °C

Analog and Digital Electronic Circuits

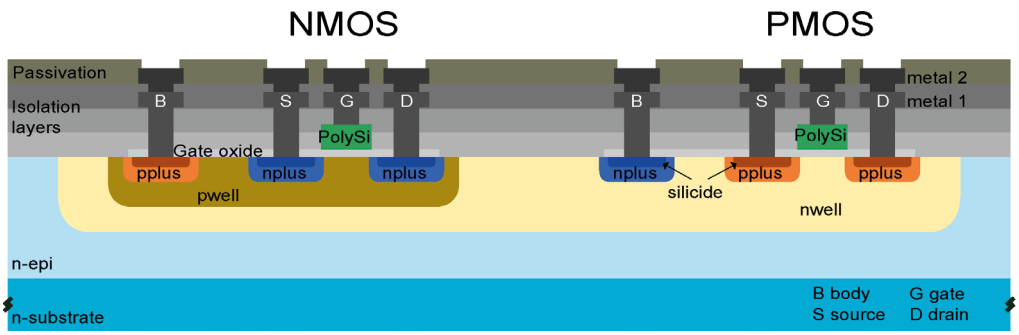
- Differential amplifiers and oscillators
- Comparators
- Current mirrors
- Output buffers
- Inverters and flip-flops
- State-machines and memory



Transfer characteristic of a 4H-SiC CMOS inverter at specific temperatures

Signal Conditioning and Processing

- Analogue to digital converter
- Pre-amplifier
- Transimpedance amplifier



Schematic illustration of the IISB CMOS technology

Additional Information

***EUROPRACTICE IC Service:**
https://europractice-ic.com/

Fraunhofer IISB at EUROPRACTICE IC Service:
https://europractice-ic.com/technologies/asics/fraunhofer-iisb/

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