Multi-Project-Wafer Prototyping

Fraunhofer IIS

IHP
0.13 µm IC, Electronic PIC, Graphene PIC

Why Fraunhofer IIS?

- 40+ years of experience in IC design and over 30 years of involvement in initiatives like Europractice, with a proven track record.
- Broad technology and service portfolio covering the full chip value chain, modular services, and an extensive partner ecosystem.
- Independent, application-oriented RTO based in Germany.

Why IHP?

- The world fastest Si-based RF-technologies and monolithic photonic BiCMOS solutions, providing integrated HBTs with cutoff frequencies of up to 500 GHz.
- Very small minimum block size (0.8 mm²) for MPW for all technologies.
- Open-Source IHP 130nm BiCMOS PDK for Analog/Digital, Mixed Signal and RF Designs with lowcost fabrication.

Technology Highlights

0.13 µm SG13 & 0.25 µm SG25
IHP offers research partners and customers worldwide access to its powerful SiGe:C BiCMOS technologies and special integrated RF modules. IHP technologies are based on 0.13µm / 0.25µm CMOS process. Several generations of high-speed SiGe Heterojunction Bipolar Transistors (HBT), passive components, such as poly resistors and MIM capacitors, have been developed and integrated in 0.25µm and 0.13µm BiCMOS technologies which are available for chip fabrication via IHP's MPW and prototyping service.
The 0.13µm BiCMOS process SG13G2 represents the fastest currently available SiGe HBT technology featuring peak fT/fmax values of 300 GHz/500 GHz. These developments were based on a series of pioneering contributions to the development of SiGe HBTs including the introduction of carbon doping for stabilizing steep base doping profiles and new device constructions with reduced parasitic resistances and capacitance.
These IHP technologies are especially suited for applications in the higher GHz bands, e.g., for telecommunications and broadband (Gigabit WLAN, wireless sensor networks, wireless security solutions, fiber optic circuits), radar, medical imaging applications, aerospace, short-range detection for automotive, image sensor and motion recognition.

SG13S is a high-performance 0.13µm BiCMOS with npn-HBTs up to fT/fmax = 250/300 GHz, including CMS logic.

SG13G2 is a very high-performance 0.13µm BiCMOS technology with the same device portfolio as SG13S but with a much higher bipolar performance with fT/fmax = 300/500 GHz.

Open Source PDK based on the SG13G2 technology for Analog/Digital, Mixed Signal and RF Designs.

SG13G2Cu and **SG13SCu** is a FEOL process SG13S and SG13G2 together with Cu BEOL option from X-FAB containing Copper and Aluminum layer.

SG13G3Cu is the highest performance HBT with up to 470GHz transit frequencies and up to 650 GHz maximum oscillation frequencies. The process offers an 8-layer Cu-BEOL from X-FAB.

SG13G3 is the highest 0.13µm BiCMOS technology with the same device portfolio as G13G3Cu and with 7-layer Al-BEOL. This process option is only offered for research and prototyping purposes.

TSV (Through Silicon Vias) is an additional option in SG13S and SG13G2 technology, which offers RF grounding by vias through silicon to improve RF performance.

LBE (The Localized Backside) is offered to remove silicon locally to improve passive performance (available in all technologies).

MEMRES is a fully CMOS integrated memristive module based on resistive TiN / HfO2-x / TiN switching devices in the SG13G2 technology.

Electronic Photonic Integrated Circuits

SG25H7_EPIC is the monolithic integration of photonic devices, such as detectors and modulators, in the frontend of a Si-based integrated circuit technology that allows shortest possible interconnects between photonics and electronics, from which high-speed performance of Electronic-Photonic Integrated Circuits (EPIC) greatly benefits.
The PDK features include Luceda IPKISS support for photonic designs (including simulation using Caphe) and Cadence support for electronic – photonic circuit design (DRC, LVS, QRC). This technology is especially suited for Optical Transceivers for 100G/200G/400 GHz applications.

Graphene Photonic Integrated Circuits

200 mm silicon photonics wafer with integrated graphene PICs, developed under the GATEPOST project and 2D Pilot Line (2D-PL) – extending Si photonics with a graphene module.

Technology Details

0.13 µm SG13S
Bipolar: High-speed HBT – Ft/Fmax/BVceo: 250 GHz/330 GHz/1.7 V – High-voltage HBT – Ft/Fmax/BVceo: 40 GHz/120 GHz/3.7 V
CMOS logic: Vdd = 1.2 V
CMOS I/O: Vdd = 3.3 V, 1.2 V core voltage
Passives: Poly-Si resistors, MOS varactors, inductors
MIM Cap. 1,5 fF/ µm²

0.13µm SG13G2 BiCMOS/SG13CMOS
Bipolar: High-speed HBT – Ft/Fmax/BVceo: 300 GHz/500 GHz/1.6 V – High-voltage HBT – Ft/Fmax/BVceo: 120 GHz/330 GHz/2.5 V
CMOS logic: Vdd = 1.2 V
CMOS I/O: Vdd = 3.3 V, 1.2 V core voltage
Passives: Poly-Si resistors, MOS varactors, inductors
MIM Cap. 1,5 fF/ µm²
Interconnects: Backend offers 7 layers Al incl. 2 & 3 µm layers

0.13µm SG13S Cu/G2Cu/G3Cu
IHP SG13S/G2 FEOL device performance and XFab Cu BEOL
MIM Cap. 2,1 fF/ µm²
Interconnects: Backend offers 8 layers: 6 layers Cu: 4 thin, 2 thick plus, 2 Al top metal layers
6-layer Cu and 2-layer Al option from X-FAB
High voltage: 5V/12V/20V/30V

0.13µm SG13G3
BiCMOS technology with very high bipolar performance
fT= 470 GHz, fmax = 650 GHz
Thin gate oxide for the 1.2 V and a thick oxid for a 3.3 V supply voltage
Temp. range: -40° C. / +125° C
BiPolar& CMOS devices, 1.5 fF/µm MIM capacitor, HRES
FEOL process SG13G3Cu
Backend offers 7 layers Al incl. 2 & 3 µm layers

0.25µm SG25H7_EPIC
High-performance BiCMOS process with Photonic devices.
fT= 220 GHz
fmax = 290 GHz
High-Res
Ge photodiodes
3 thin + 2 thick AI-BEOL layer stack

Graphene PIC
Substrate: Material: Silicon; Waveguide: Silicon Nitride
Included modules: – Contact module – Waveguide module – Coupler modules – Graphene module – Encapsulation module – Cladding modules

Contact

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MPW Pricelist	mm²
SG25H7_EPIC A monolithic photonic BiCMOS technology	9,000[1,3]
IHP SG13S SiGe:C Bipolar/Analog, HBT, CMOS, Ft/Fmax= 250/340GHz, 7M/MIM	6,300[1]
IHP SG13SCu FEOL process SG13S together with 8 layer Cu BEOL from X-FAB	6,300[1]
IHP SG13CMOS SiGe:C includes all features of SG13G2 but not HBT	4,500[1]
IHP SG13G2 SiGe:C Bipolar/Analog, HBT, CMOS,Ft/Fmax= 350/450GHz	7,300[1]
IHP SG13G2Cu FEOL process SG13G2 together with 8 layer Cu BEOL from X-FAB	7,300[1]
IHP SG13G3 FEOL, the same FEOL process SG13G3Cu, with Al-BEOL option	9,000[1]
IHP SG13G3Cu SiGe:C Bipolar/Analog, Ft/Fmax= 470/650GHz FEOL process with Cu BEOL from X-FAB	9,000[1]
IHP SG25H7_PIC Incl. additional photonic design layers along with BiCMOS BEOL layers on SOI wafers.	4,500[13]
IHP BEOL SG13 (M1 and Metal Layers Above)	1,300[1]
IHP INTM4TM2 Interposer technology, 2 thin and 2 thick Al-BEOL layer on a HRes substrate, MIM capacitor, Thin film Res.	900
Localized Back side Etching (available for IHP technologies with AL BEOL only), not offered for EPIC/PIC runs	5,000[2]
TSV to ground (SG13S / G2)	12,500[2,3]
MEMRES Module, CMOS integrated memristive module, on time fee offered for SG13G2	2,500[2]
MEMRES Module additional fee per mm²	600[1]
SG13CMOS (closed source)	3,600
SG13G2 (closed source)	5,840
SG13CMOS & SG13CMOS5L(open source)	1,500[4]
SG13CMOS & SG13CMOS5L(open source)	1,000[5]
SG13G2 (open source)	2,800[4]

Important notes:

[1] Price = area (mm²) * price/mm² with min. fabrication cost equivalent to 0.8mm².The final chip area is inclusive of the boundary layer outside of seal ring.

[2] One-off fee

[3] Delivery quantity: 25 dies.

[4] price is valid for cumulative area > 100 mm²

[5] price is valid for cumulative area > 150 mm²

Fabrication of a chip area less than 0.8mm² and X & Y ratio larger than 1:3 is on request