



GLOBALFOUNDRIES®



# SiGe 9HP

## 90 nm SiGe BiCMOS Technology

### Highlights

- Performance-optimized 90 nm SiGe BiCMOS technology:
  - + 50% higher integration and more than 40% higher  $f_T$  than SiGe 8HP
- Optimized for demanding data communications RF applications:
  - + PAM4 based 50G / 200G / 400G Ethernet optical modules
  - + Hybrid silicon photonics support for trans-impedance amplifiers, drivers, control and clock and data recovery
  - + 64 GBaud coherent optical modules
  - + Next-generation fiber channel and InfiniBand modules
  - + Millimeter wave (mmWave) E-band, W-band and D-band applications (up to 170 GHz)
  - + Satellite communications, aerospace and defense and enhanced security solutions
  - + 5G wireless infrastructure
  - + Test equipment and instrumentation

### Optimized for Performance and Integration in Demanding Optical and RF Applications

GLOBALFOUNDRIES 90nm high-performance silicon germanium (SiGe) technology, SiGe 9HP, is the latest extension to its performance-optimized SiGe BiCMOS portfolio.

With an industry leading  $f_T/f_{MAX}$  of 310/370 GHz, SiGe 9HP is designed to deliver premier RF performance at higher breakdown and operating voltages than RF CMOS alternatives. Additionally, because of its BiCMOS technology base, 9HP enables:

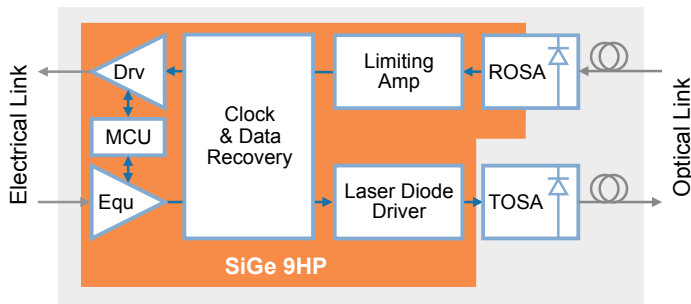
- 50% more integration density than its 130 nm SiGe 8HP/8XP predecessors
- Higher performance mmWave applications that demand high output power, high linearity, low phase noise and a low noise figure
- High drive capability, sensitivity and gain
- Excellent thermal stability
- Simplified impedance matching with full mmWave RF passives

You can now also take advantage of the migration of 9HP to a 300 mm manufacturing process, which provides increased production efficiency and reproducibility to help your company meet growing marketplace demands.

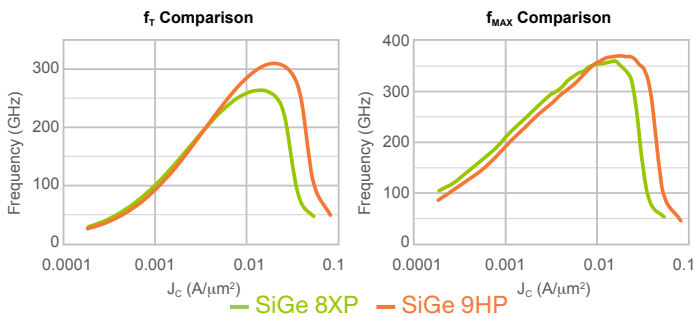
Built on a cost-effective mature silicon base, SiGe 9HP offers designers exceptional high-frequency NPN performance, a broad array of mmWave-ready active and passive devices and the ability to integrate multiple functions on a single chip. Options for up to 10 levels of metal can help designers boost RF performance further. The additional levels of metal also facilitate chip wiring that improves analog performance and enables even higher levels of digital integration.

This combination of value, performance, optimized devices and integration enables differentiated 64 GBaud coherent telecom modules and 50G/200G/400G Ethernet data center PAM4 optical modules. The benefit mix also makes 9HP an excellent fit for 5G and other mmWave wireless infrastructure applications.

## Example Active Optical Cable / Optical Fiber Module Block Diagram



## SiGe 8XP vs. SiGe 9HP $f_T$ and $f_{MAX}$ Comparison



## Comprehensive Enablement

Comprehensive SiGe 9HP process design kits (PDKs) tap into our experts' decades of experience with SiGe technologies. The kits provide RF-specific tool support along with accurate model-to-hardware correlation to help you achieve first-time-right results in hardware. Frequent multi-project wafer (MPW) runs enable fast prototyping.

SiGe 9HP on our 200 mm manufacturing process is fully qualified, with PDKs available now. Client prototyping of 9HP on 300 mm MPW wafers is underway.

## SiGe 9HP Design Enablement



## SiGe 9HP Features

### SiGe 9HP at a Glance

Technology Node	90 nm
CMOS supply (V)	1.2, 1.8, 2.5, 3.3

### Metallization (enhanced Cu / thick Al):

Base: 7 levels of metal

Option: Up to 10 levels of metal

### HBTs:

High performance ( $f_T/f_{MAX}$ ) 310/370 GHz

Medium breakdown  $BV_{ceo}$  2.4 V (150 GHz  $f_T$ )

### mmWave Diodes:

Schottky barrier

PIN

### Transmission Lines:

RF wire

Coupled wires

Coplanar waveguide

### Microwave/mmWave Passive Elements:

Unique structures, including bends, tees, stubs

### FETs:

Reg  $V_t$ , high  $V_t$

Triple well

### Resistors:

p+ poly

Precision p+ poly

High resistance poly

Silicided poly ballast resistor

Low-resistance sub collector

Metal

n+ diffusion

### Capacitors:

MIM

VN cap

### Varactors:

MOS

Hyper-abrupt

### Inductors:

Single spiral, series / parallel spirals

Symmetrical

### Memory:

eFuse (OTP)

SRAM

### Interconnect: Wire bond and lead-free C4 available

Refer to the latest PDK release for the current feature set.



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