

Photonic integrated circuit prototyping and small volume production

Imec provides access to photonic integrated circuit (PIC) prototyping and small volume production based on imec's iSiPP50G silicon photonics platforms. We turn your photonic ideas into reality at a single point of contact.

Low-cost MPW and dedicated mask runs

To lower your cost of access, we offer prototyping through a multi-project wafer (MPW) service. This allows you to share the mask, processing and engineering costs across multiple designs. The registration of designs for each MPW run follows a fixed schedule, with yearly 1-2 Passives+ runs, and 2 active runs that contain active elements such as modulators and photodetectors. Typical MPW runs result in 10-20 samples. For larger quantities, you can request dedicated runs which return approximately 15 wafers (200mm).

iSiPP50G

This platform enables cost-effective silicon ICs for:

- High-performance optical transceivers (50Gb/s and beyond), for datacom and telecom, and access networks
- Optical sensing (gas, pressure, strain) and read-out ICs
- Biomolecule detection, drug development, point-of-care diagnostics

The iSiPP50G platform co-integrates a variety of passive and active components to support a wide range of optical transceiver architectures at data rates of 25Gb/s or 50Gb/s. The available integrated components include low-loss waveguides, efficient vertical grating or broadband edge couplers, high-speed silicon electro-optic modulators, high-speed silicon-germanium electro-absorption modulators, and high-speed germanium waveguide photo-detectors. iSiPP50G offers state-of-the-art performance, design flexibility and superior CD (critical dimension) and thickness control. It is a fixed process technology (130nm) with a validated device library.

Passives+

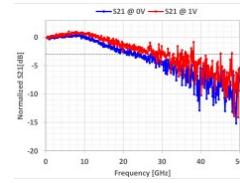
Imec Si-Photonics Passives+ is a subset of iSiPP50G technology, which offers passive optical components in addition to metal-based heaters.

- A layer for metal-based heaters to enable thermal tuning of the optical functions
- Electrical access to the metal heaters thanks to two additional levels of metal interconnect
- Aluminum finish metallization

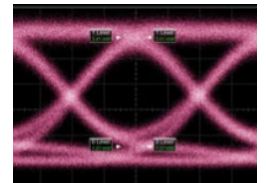
Modules	Description	Enabled devices
3 silicon patterning steps	3 etch depths in 220nm Si: 70nm, 160nm; 220nm (193 nm litho)	Strip/rib waveguides, various passive optical devices, silicon taper
Gate oxide and Poly-Silicon layer	1 etch depth: full poly etch (160nm) (193nm litho)	Advanced grating couplers, poly-Si waveguide
Ion implantation in Si	8 implants levels: 4x n-type and 4x p-type	Si carrier depletion, injection and accumulation devices, Ge Photodectors, doped Si resistors, ...
Ge module	100% Ge(Si) RPCVD selective epitaxial growth & 2x implants levels	Ge Photodectors Ge(Si) EA modulator
Silicide tungsten contact module	Ohmic contacts to doped silicon	Standard CMOS contacts plugs
Two-level metal interconnect	Cu-based two-level metallization	Standard CMOS interconnects
Aluminum passivation	Aluminium finish metallization	Standard CMOS interconnects
Deep trench	Deep trench to expose edge coupler facets	Edge couplers

50G traveling-wave Mach-Zehnder modulator (typical performance values)

Parameter		Typ.Value	Unit	Comments
Operation Wavelength		1550	nm	O-band designs also available
Electro-Optic Bandwidth (S21)	f3dB	24	GHz	at 0V bias
		33.4	GHz	at -1V bias
Modulation efficiency	$V\pi$	12	V	thermo-optic $V\pi$
Optical Insertion Loss	IL	-2.5	dB	not including bias induced loss
Phase-Shifter Length	L	1.5	mm	
Termination Resistance	R_T	25	Ohm	doped Si resistor



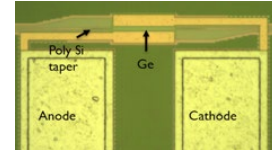
S21



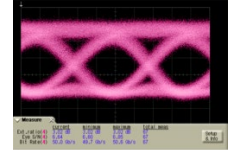
50Gb/s, 2.5Vpp

50G Si ring modulator (typical performance values)

Parameter		Typ.Value	Unit	Comments
Quality Factor	Q	3000		
Electro-Optic Bandwidth	f3dB	45	GHz	at 0V bias
Static Transmitter Penalty	TP	10	dB	1.5Vpp drive swing
Ring Radius	R	5	um	



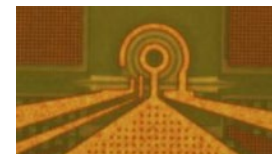
Microscope image



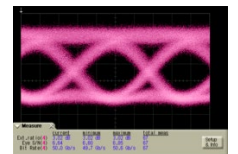
50Gb/s, 2.0Vpp

50G SiGe electro-absorption modulator (typical performance values)

Parameter		Typ.Value	Unit	Comments
Operation Wavelength		~1560	nm	
Electro-Optic Bandwidth (S21)	f3dB	>50	GHz	-1V bias
		>50	GHz	-2V bias
Optical Insertion Loss	IL	-4.2	dB	



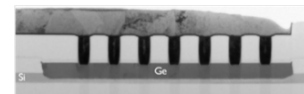
Microscope image



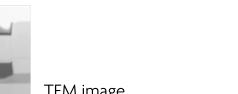
50Gb/s, 2.0Vpp

50G Ge photodetector (typical performance values)

Parameter (type 1)		Typ.Value	Unit	Comments
Opto-Electrical Bandwidth	f3dB	>50	GHz	C-band*
C-band Responsivity		~0.9	A/W	
O-band Responsivity		~0.85	A/W	room temp, -1V bias
Dark Current	I_d	<50	nA	
Parameter (type 2)		Type.Value	Unit	Comments
Opto-Electrical Bandwidth	f3dB	>25	GHz	C-band*
C-band Responsivity		~1.0	A/W	
O-band Responsivity		~0.94	A/W	room temp, -1V bias
Dark Current	I_d	<50	nA	



Microscope image

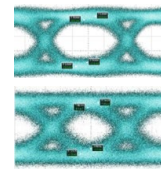


TEM image

PASSIVES (typical performance values)

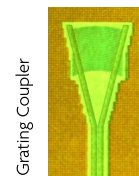
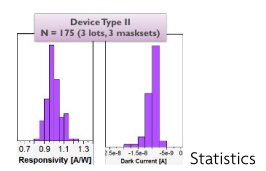
Single Mode Waveguides		Typ.Value	Unit	Comments
Strip Waveguide C-band		<1.4	dB/cm	450nm wide
Strip Waveguide O-band		<2.6	dB/cm	380nm wide
Rib Waveguide C-band		<0.6	dB/cm	650nm wide
Rib Waveguide O-band		<0.7	dB/cm	580nm wide
Fiber Grating Couplers		Type.Value	Unit	Comments
Insertion Loss		2.5	dB	C-band*, TE, SMF
1 dB Bandwidth		35	nm	C-band*, TE
Peak-λ within-wafer control	λs	<4	nm	
Fiber Edge Couplers		Type.Value	Unit	Comments
Insertion Loss		<2	dB	C-band*, Lensed Fiber
1 dB Bandwidth		>100	nm	C-band*
Polarization dependent loss		<0.5	dB	C-band*

*O-band versions available in PDK

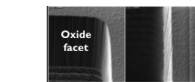
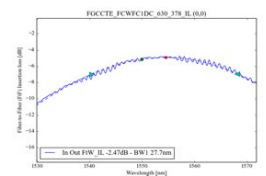


25Gb/s

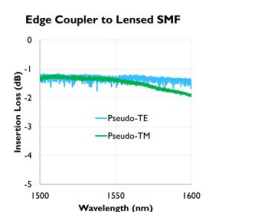
50Gb/s



Grating Coupler



Edge Coupler



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