SMART PHOTONICS

Light powered progress

SMART PHOTONICS FOUNDRY SERVICES

Making integrated InP photonics as easy as 1 – 2 – 3

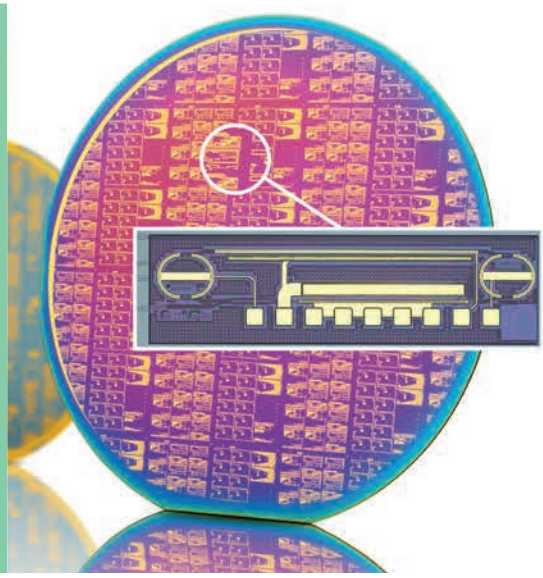
Indium Phosphide (InP) is a unique material for photonic integrated circuits (PICs) due to its ability to efficiently integrate active and passive optical components, such as lasers, modulators, and detectors, on a single chip, enabling high-performance optical communications, LIDAR, sensors, Bio-sensors, spectroscopy, and quantum technologies.

SMART Photonics is an Integrated InP Photonics foundry that offers state-of-the-art manufacturing of Indium Phosphide based Photonic Integrated Circuits. In addition, custom designed Photonic Integrated Circuits are easily and quickly developed using the SMART Photonics Process Design Kit (PDK).

SMART Photonics PDK makes InP design accessible to anyone without the need for extensive InP process knowledge or development. This PDK consists of a powerful functional building block library (e.g., lasers, SOA, modulators, etc). A building block is an active or passive device, which can be combined in specific combinations to create your own photonics integrated circuit. Using our PDK, no in-depth knowledge of the manufacturing process technology is required from the designer.

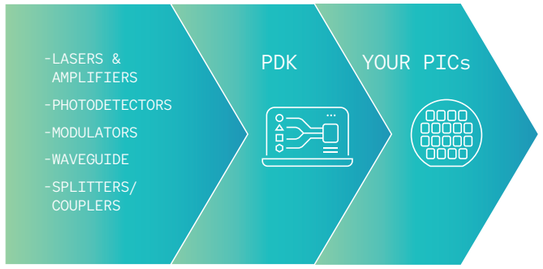
As easy as 1– 2 – 3

1 Determine need functions
2 Design your chip with our PDK
3 We manufacture and deliver your chips



Functional Building Block Summary

Over 50 building blocks currently available in the SMART Photonics PDK for Super C-band (1524–1572nm) and/or O-band (1270 to 1330nm) applications. The designer only needs to create the design by connecting the building blocks (with the desired parameters). This design can be used to run simulations to achieve the circuit's objectives.



LASER + HIGH SPEED MODULATOR + SOA

Building block

AMPLIFIERS AND LASERS	
SEMICONDUCTOR OPTICAL AMPLIFIER (SOA)	SOAS BOOST OPTICAL SIGNALS TO HIGHER POWER LEVELS AND ARE USED IN MANY APPLICATIONS.
DISTRIBUTE FEEDBACK (DFB) LASER	DFB LASERS ARE WIDELY USED IN DATA CENTER OPTICAL COMMUNICATION, LIDAR, AND SENSING APPLICATIONS DUE TO THEIR STABLE SINGLE-WAVELENGTH EMISSION AND HIGH EFFICIENCY.
DISTRIBUTED BRAGG REFLECTIVE (DBR) GRATING/LASER	DBR LASERS OFFER TUNABLE WAVELENGTH CAPABILITY. THEY ARE OFTEN USED IN C-BAND DWDM APPLICATIONS.
TUNABLE LASER	TUNABLE LASERS SHOWCASE A SMART PHOTONICS REFERENCE DESIGN INTEGRATING VARIOUS BUILDING BLOCKS TO ACHIEVE A NARROW LINEWIDTH AND REAL-TIME WAVELENGTH TUNING ACROSS THE TUNING RANGE.
PHOTODIODES	
PIN (P-I-N)	PIN PHOTODIODES ARE WIDELY USED FOR PHOTODETECTOR OR OPTICAL RECEIVERS.
UNI-TRAVELING CARRIER (UTC)	UNI-TRAVELING-CARRIER PHOTODIODES (UTC-PD) ARE USED FOR HIGH-SPEED PHOTODETECTOR OR OPTICAL RECEIVERS.
TAP	A TAP PHOTODIODE EXTRACTS A SMALL FRACTION OF LIGHT (1%-2%) FOR MONITORING A SPECIFIC OPTICAL PATH IN A PIC.
MODULATORS	
HIGH SPEED MZM MODULATOR	HIGH SPEED MZM MODULATORS EFFICIENTLY MODULATE OPTICAL SIGNALS WITH USER DATA AND SUPPORT BOTH NRZ AND PAM MODULATION FORMATS ENABLING HIGH-SPEED OPTICAL COMMUNICATION.
HIGH SPEED IQ MODULATOR	AN IQ MODULATOR MODULATES BOTH THE IN-PHASE (I) AND QUADRATURE (Q) COMPONENTS OF AN OPTICAL CARRIER TO ENABLE QPSK AND QAM MODULATION FORMATS FOR HIGH-SPEED COHERENT OPTICAL COMMUNICATION.
ELECTRO-OPTICAL PHASE SHIFTER	ELECTRO-OPTICAL PHASE SHIFTERS PROVIDE LOW-LOSS, EFFICIENT OPTICAL PHASE SHIFTING VIA AN APPLIED VOLTAGE.
THERMO-OPTICAL PHASE SHIFTER	THERMO-OPTICAL PHASE SHIFTERS (TOPS) MODULATE THE PHASE OF AN OPTICAL SIGNAL BY LOCALIZED HEATING.
WAVEGUIDES	
ARC WAVEGUIDE STRAIGHT WAVEGUIDE I/O ANGLE	WAVEGUIDES ARE "PHOTONICS HIGHWAYS" GUIDING LIGHT BETWEEN BUILDING BLOCKS AND GOING OFF-CHIP.
SPLITTERS/COUPLERS	
1×N MULTI MODE INTERFEROMETER (MMI) I/O ANGLE SPLITTER	AN MMI COUPLER IS USED TO SPLIT AND/OR COMBINE OPTICAL SIGNALS.

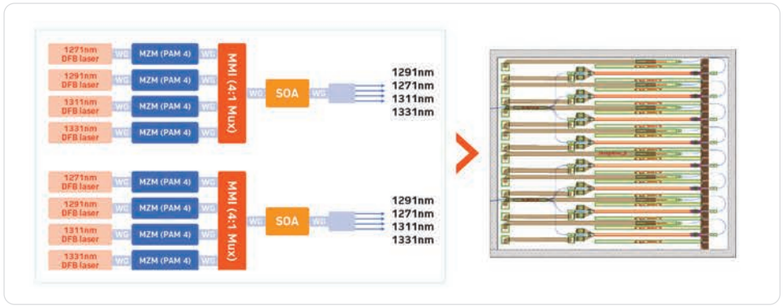
2 examples with our building blocks

Two examples of using SMART Photonics building blocks are shown below:

- 800G (2 x 400G) FR4 Tx PIC for data center applications
- Super C-band tunable laser with an IQ modulator PIC for coherent optical networks.

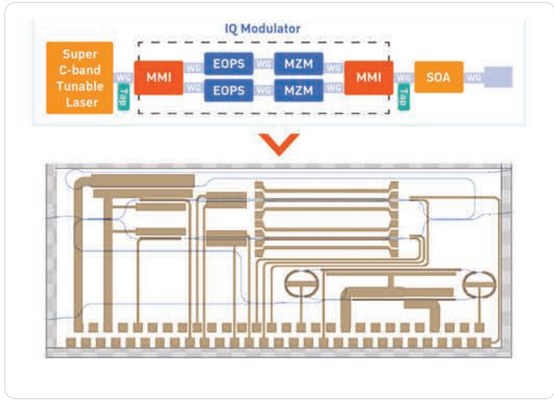
1. 800G (2 x 400G) FR4 Tx PIC

This PIC integrates multiple key building blocks to create photonic integrated circuit (PIC) designed for 800Gb/s data transmission over 2km. The design features eight, low power distributed feedback (DFB) lasers, an MZM modulator for high-speed PAM4 modulation, a multi-mode interference (MMI) 4:1 mux for efficient signal routing, and a semiconductor optical amplifier (SOA) for boosting the signal to the desired output power.



2. Super C-Band Tunable Laser with IQ Modulator PIC

This photonic integrated circuit combines a super C-band tunable laser with an IQ modulator. The IQ modulator design begins with an MMI splitter, which divides the input light into two branches. Each branch includes a thermal optical phase shifter (TOPS) for precise wavelength tuning and two Mach-Zehnder modulators (MZM) for in-phase and quadrature modulation. The modulated signals are then recombined using an MMI coupler, to form a single composite signal. The output of the MMI coupler is directed to the SOA for power amplification to the target output power.



Using the SMART Photonics Process Design Kit

The SMART Photonics Process Design Kit enables fast prototyping and low cost development without compromising performance and functionality. No in-depth knowledge of InP technology or manufacturing is required for the user.

A user designs a photonic integrated circuit (PIC) by connecting the building blocks in the PDK and determining the parameters for each building block to optimize the PIC for the user's specific application.

A typical design flow is described as follows:

- Translate the application specifications into an optical circuit and make a selection in the PDK of the required building tunable blocks.
- Define the desired parameters for each building block.
- The PDK is used in combination with simulation software to obtain the correct parameters for the building blocks.
- Use the automatic design rule checks in the PDK to ensure a manufacturable design.
- The PDK can export the design automatically to a GDS file, which is now ready for manufacturing.

Fabrication of your PIC involves the following steps:

1. The design in GDS format is converted to a mask.
2. The PIC is fabricated by SMART Photonics as part of a multi-project wafer (MPW), where multiple customers share space on wafers, or a dedicated customer wafer run.
3. The wafers are then ground, polished, cleaved into individual PICs, and coated as needed. The finished PICs are sent to the user.

More information at smartphotonics.nl/mpw

Contact SMART Photonics Sales for further details on SMART Photonics PDK, building block specifications, MPW schedules, and design assistance.

CONTACT OUR EXPERTS:
sales@smartphotonics.nl

Integrity is key in the services SMART Photonics offers. As an independent Pure Play InP Foundry, we work at the sole discretion of our customers and their businesses. Teams of highly experienced experts support all of our clients' requests. Our production services range from epitaxial growth and regrowth to coating and testing of the individual chips. We accommodate both proof-ofconcept and volume manufacturing. We are a European based manufacturer with production and research facilities located in Eindhoven.