

Efficient Design Techniques for Custom PDKs Protecting Your IP

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We empower you to define the cutting edge.



The Power of Process Design Kits

VPI circuit simulation view





Main advantages:

- **IP** protection \checkmark
- ✓ Flexible development process
- Easy to share

A X

Generation of Custom PDKs



Custom PDK contains:

Module templates and basic demos

Plphotonics

- Exemplary layout templates
- ✓ Generic PDK toolbars and macros
 - Layout/GDS export •
 - Elastic connectors •
 - Arbitrary and relative port locations •

PHOTONIC WITH IP

Latest Magazine

Issue 1 2024



Smatrix Measured - Custom BBs

Design parameters of a 2x2 MMI





SmatrixMeasuredOpt:

- Reads and processes parametrized S-matrices
- Uses advanced interpolation algorithms

SMatrix SmatrixMeasuredOpt

NumberOfInputPorts 4
NumberOfOutputPorts 4

Parameters Width = 4.8 (um)

InputPort port3 TE
OutputPort port1 TE
Frequency Magnitude Phase
(THz) (.) (Deg)
183.10 0.49127902503548 60.570149218550
183.60 0.50185130061694 -7.5661370901476
184.10 0.51178863529888 -75.713559468762
184.60 0.52118313532610 -143.87102280548

. . .

InputPort port3 TM
OutputPort port1 TE
Frequency Magnitude Phase
(THz) (.) (Deg)
183.10 0.18422126066422 88.307468393841
183.60 0.18239678551210 17.417950211860
184.10 0.18082166646617 -53.512096209379
184.60 0.17945228801598 -124.53330273974

...

# InputPort port4 TE				
# OutputPort port1 TE				
# Frequency Magnitude Phase				
# (THz	<u>z</u>)	(.)	(Deg)	
183.10	0.552518	276394	18	-59.451676773031
183.60	0.546416	696786	55	-126.85088604107
184.10	0.539821	683108	68	165.86419392790
184.60	0.533026	748091	60	98.694746777617

...



Examples of Custom PDKs



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Custom-Process PDKs

Angle-Aware Waveguide





- Support of anisotropic materials
- Effective index depends on the propagation angle
- Layout called silently to verify the port positions and extract the propagation direction
- Module can read function dependences or measured data



...



Custom-Process PDKs

Periodically Poled Lithium Niobate Waveguide

Second Harmonic Generation and Sum Frequency Generation of multiple CW Lasers with a PPLN Waveguide









PPLN waveguide information:

Waveguide geometry:

- width 1800 nm
- film thickness 270 nm
- ridge height 300 nm

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Second Harmonic Generation

of Dual-Parallel MZM-Based PAM4



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✓ If SHG shall be applied to QAM-Signals, predistortion is necessary $(\sqrt{\underline{E}})$





EAM Integrated DBR Laser



NumberOfDeviceSections = 6

DeviceSectionTypeDetailed = Passive[2] Active[1] Passive[1] Active[1] EAM[1]

- Design of multi-section structures with
 - active medium types: Bulk or MQW
 - different device sections: active, passive, EAM
 - complex gain models
 - detailed grating definitions
- Bidirectional optical signal transmission
- Nonlinear effects (Kerr, TPA)
- Linewidth, chirp, spatial hole burning, and many more...

Challenge: accurate modeling of complex multi-section devices may require a lot of parameters to be defined

Advanced Visualization Macros

Visualize PhotonicsTLM Structure

Solution:

- advanced visualization macro
- edit the array parameters in the macro window
- select and work with individual device sections and interfaces





Advanced Testing Modules



- Powerful tools for the simulation control and optimization
- Advanced testing modules to extract various device and circuit characteristics

Wg Ngr extract

Ngr(wl)

FSR Ngr extractor



Summary

- Custom PDK integration framework
 - Easy to build, use, and share PDKs
 Protect your IP without losing design flexibility
- Advanced simulation modules to empower your PIC design workflow from devices up to complete systems
- Powerful tools for the simulation control, design characterization, and results analysis

Build your PDKs with us!



Visit our team in the exhibition hall and discuss your design requirements with us!