SiEPIC E-beam Silicon Photonics Design Kit

Lumerical Compact Model Library (CML)

User Guide

Release: 1.0
Date: 2015-08-24

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Introduction

This library contains the compact models for the SiEPIC E-beam silicon photonics process design kit (PDK) elements, allowing users to design, simulate, and analyze their circuits using Lumerical INTERCONNECT - a photonic integrated circuit design environment.

Installation

1. Install the latest version of INTERCONNECT 2015b (5.0.590 or later):
   https://www.lumerical.com/downloads/customer.html

   To check the installed version:
   - Windows and Linux: click the "Help > About INTERCONNECT" from the main title bar.
   - Mac: click the "INTERCONNECT > About INTERCONNECT" from the main title bar.

   Note: This library will be updated in the future and may require a newer version of INTERCONNECT.

2. Install the E-beam compact model library
   - Get the E-beam CML file: ebeam_v1.0_2015_08_24.cml.
   - Open the INTERCONNECT program, and find the "Element Library" window.
   - Right-click on the "Design kits" folder (at the bottom of the "Elements") and select "Install".
   - Select the E-beam CML file for the "Compact Model Library Package"
   - Set the "Destination Folder", and then click "OK".
   - Now the elements should be available in a new "ebeam_v1.0" folder in "Design kits".

To use the E-beam elements, simply drag and drop the elements into the schematic editor.

For more information about how to use INTERCONNECT, please visit Lumerical Knowledge Base.

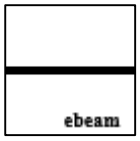
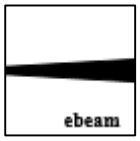
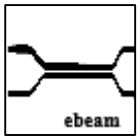
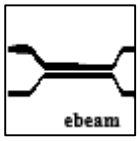
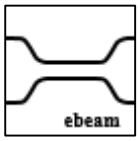
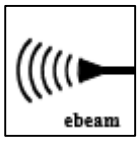
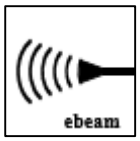
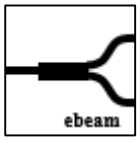
For technical questions or feedback, please contact

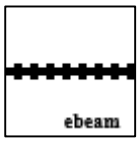
- SiEPIC Program: http://siepic.ubc.ca/
- Lumerical Technical Support: support@lumerical.com.

Components

Overview

The following table shows the components currently available in E-beam CML.

Category	Component Name	Symbol
Waveguides	ebeam_wg_strip_1550	
	ebeam_taper_te1550	
Couplers	ebeam_adiabatic_te1550	
	ebeam_adiabatic_te1550	
	ebeam_dc_te1550	
	ebeam_gc_te1550	
	ebeam_gc_tm1550	
	ebeam_y_1550	

Bragg	ebeam_bragg_te1550	

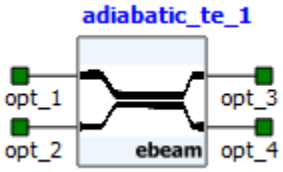
General Notes

- All elements are designed for the fundamental TE and/or TM mode at around 1550 nm.
- Higher-order modes are not included in the current models.
- The orthogonal identifier for the fundamental TE mode is 1.
- The orthogonal identifier for the fundamental TM mode is 2.
- All elements are designed for operation at room temperature.
- All element models support a wavelength range of 1500:1600 nm.

Details

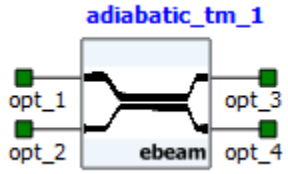
- The details of each element are given below.

ebeam_adiabatic_te1550



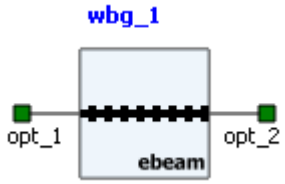
Element	ebeam_adiabatic_te1550			
Description	SiEPIC ebeam element: adiabatic 3dB coupler for TE mode.			
Prefix	adiabatic_te			
Ports	Name	Type	Data	Order
	opt_1	Bidirectional	Optical Signal	1
	opt_2	Bidirectional	Optical Signal	2
	opt_3	Bidirectional	Optical Signal	3
	opt_4	Bidirectional	Optical Signal	4

ebeam_adiabatic_tm1550



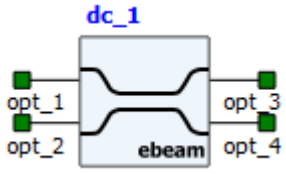
Element	ebeam_adiabatic_tm1550			
Description	SiEPIC ebeam element: adiabatic 3dB coupler for TM mode.			
Prefix	adiabatic_tm			
Ports	Name	Type	Data	Order
	opt_1	Bidirectional	Optical Signal	1
	opt_2	Bidirectional	Optical Signal	2
	opt_3	Bidirectional	Optical Signal	3
	opt_4	Bidirectional	Optical Signal	4

ebeam_bragg_te1550



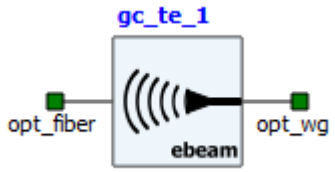
Element	ebeam_bragg_te1550			
Description	SiEPIC ebeam element: waveguide Bragg gratings.			
Prefix	wbg			
Ports	Name	Type	Data	Order
	opt_1	Bidirectional	Optical Signal	1
	opt_2	Bidirectional	Optical Signal	2
User-defined parameters	Name	Default Value	Unit	Range
	corrugation_width	5e-008	m	[1e-008, 1e-007]
	grating_period	3.18e-007	m	[3e-007, 3.3e-007]
	misalignment	0	m	[0, 1.65e-007]
	number_of_periods	300		[0, 1e+004]

ebeam_dc_te1550



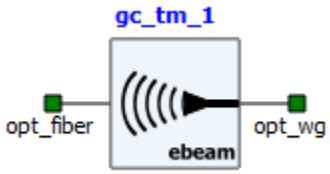
Element	ebeam_dc_te1550			
Description	SiEPIC ebeam element: directional coupler.			
Prefix	dc			
Ports	Name	Type	Data	Order
	opt_1	Bidirectional	Optical Signal	1
	opt_2	Bidirectional	Optical Signal	2
	opt_3	Bidirectional	Optical Signal	3
	opt_4	Bidirectional	Optical Signal	4
User-defined parameters	Name	Default Value	Unit	Range
	coupling_length	1.5e-005	m	[0, 4.75e-005]
	gap	2e-007	m	2e-007
	radius	5e-006	m	5e-006
	wg_width	5e-007	m	5e-007
Note	– The current model only supports "coupling_length" as an input parameter. – The other parameters (i.e., "wg_width", "gap", "radius") are now fixed but will be parameterized in the future.			

ebeam_gc_te1550



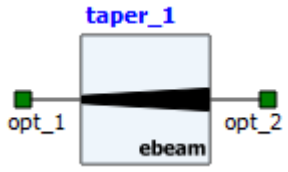
Element	ebeam_gc_te1550			
Description	SiEPIC ebeam element: grating coupler for TE mode.			
Prefix	gc_te			
Ports	Name	Type	Data	Order
	opt_fiber	Bidirectional	Optical Signal	1
	opt_wg	Bidirectional	Optical Signal	2

ebeam_gc_tm1550



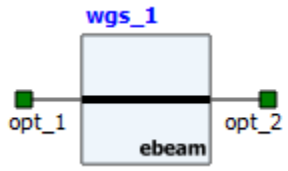
Element	ebeam_gc_tm1550			
Description	SiEPIC ebeam element: grating coupler for TM mode.			
Prefix	gc_tm			
Ports	Name	Type	Data	Order
	opt_fiber	Bidirectional	Optical Signal	1
	opt_wg	Bidirectional	Optical Signal	2

ebeam_taper_te1550



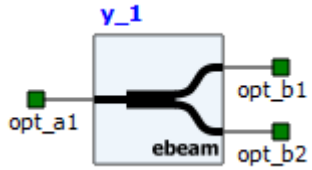
Element	ebeam_taper_te1550			
Description	SiEPIC ebeam element: strip waveguide taper.			
Prefix	taper			
Ports	Name	Type	Data	Order
	opt_1	Bidirectional	Optical Signal	1
	opt_2	Bidirectional	Optical Signal	2
User-defined parameters	Name	Default Value	Unit	Range
	wg_length	1e-005	m	[1e-006, 1e-005]
	wg_width1	5e-007	m	4e-007, 5e-007, 6e-007
	wg_width2	3e-006	m	1e-006, 2e-006, 3e-006
Note	– "wg_length" range: [1 um, 10 um]. – "wg_width1" can only be 0.4 um, 0.5 um, or 0.6 um. – "wg_width2" can only be 1 um, 2 um, or 3 um.			

ebeam_wg_strip_1550



Element	ebeam_wg_strip_1550			
Description	SiEPIC ebeam element: strip waveguide.			
Prefix	wgs			
Ports	Name	Type	Data	Order
	opt_1	Bidirectional	Optical Signal	1
	opt_2	Bidirectional	Optical Signal	2
User-defined parameters	Name	Default Value	Unit	Range
	wg_length	1e-005	m	[0, 1e-002]
	wg_width	5e-007	m	[3e-007, 3e-006]
Note	– The waveguide loss values are only valid for 0.5 um and 3 um wide waveguides (i.e., the only two waveguides that we have experimentally measured). – For the loss of other waveguide widths, we simply take linear interpolations based on the two experimental data points.			

ebeam_y_1550



Element	ebeam_y_1550			
Description	SiEPIC ebeam element: Y branch.			
Prefix	y			
Ports	Name	Type	Data	Order
	opt_a1	Bidirectional	Optical Signal	1
	opt_b1	Bidirectional	Optical Signal	2
	opt_b2	Bidirectional	Optical Signal	3

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The latest version of the End-User License Agreement is available on-line at:

https://www.lumerical.com/tcad-products/licensing/license_agreement.html

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