

Custom PDK Generation for a Ring Resonator

Products: RSoft FullWAVE and ADS Photonic Designer
Applications: PICs

Introduction

Although photonic foundries continue to expand their support for a wide range of active and passive photonic PDKs across multiple technologies, there are many situations where the ability to generate custom or proprietary PDKs is essential. Such capabilities are often required to develop Intellectual Property (IP), extend existing foundry PDKs, or explore novel device concepts not yet available in standard libraries.

The integration of ADS Photonic Designer with RSoft device modeling tools provides a flexible and powerful environment for creating custom photonic components and deploying them in PIC-level simulations and mask generation workflows.

This application note demonstrates the use of the RSoft Custom-PDK Generation Utility in conjunction with ADS Photonic Designer. As an illustrative example, we generate S-matrix data for a half-ring resonator using RSoft FullWAVE FDTD, and then use this data to create a custom PDK component in ADS Photonic Designer. Two half-ring components are subsequently combined to form and simulate a full ring resonator circuit.

Flow Description

The RSoft Custom-PDK Generation Utility, together with ADS Photonic Designer, automates the creation of custom device libraries, IP libraries, and foundry-style PDKs, effectively bridging device-level simulation and circuit-level design.

Using RSoft device modeling tools, users can:

- Automatically generate model cells from device simulations
- Extend existing PDKs or build new custom PDKs
- Create reusable IP blocks for PIC design workflows

When ADS Photonic Designer is selected as the target platform, the utility generates complete S-matrix-based components, including:

- Simulation data
- Schematic symbols
- Layout views

These components can be used directly within the ADS Photonic Designer environment. Figure 1 illustrates the overall workflow for custom PDK generation, demonstrated here using a ring resonator example.

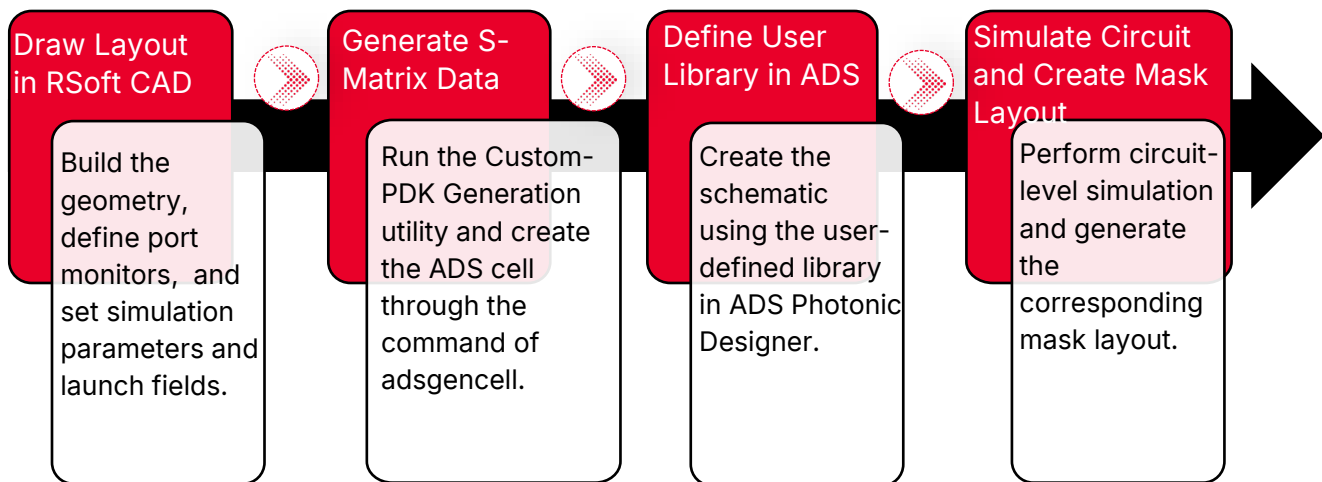


Figure 1. Process flow for custom PDK generation, illustrated using a full ring resonator example.

Draw the Layout in RSoft CAD

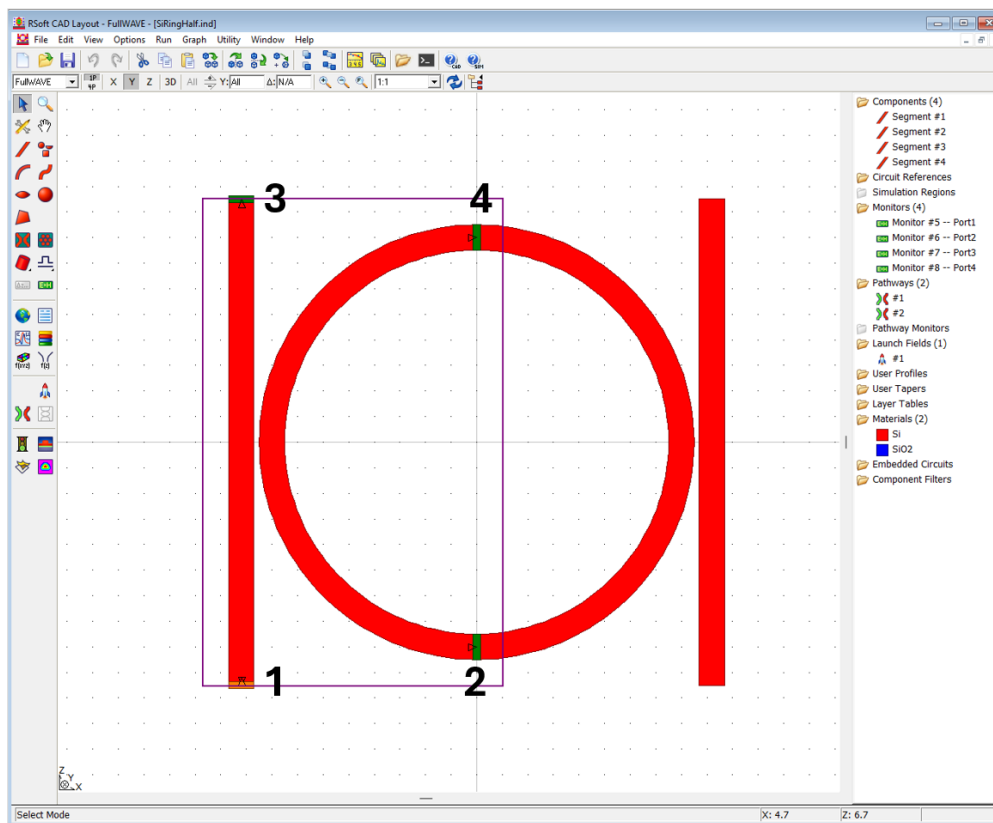


Figure 2. Half-ring structure with port numbering labeled for clarity.

The half-ring resonator structure is constructed using standard silicon wire waveguides, as shown in Figure 2. The simulation is performed using RSoft FullWAVE FDTD, where key simulation parameters such as grid resolution, simulation domain, and boundary conditions are defined. A pulsed temporal excitation is used. The Custom-PDK Generation Utility automatically shifts the launch field to each port in order to generate the corresponding transfer function data.

Before proceeding to the next step, it is important to verify that a single FullWAVE simulation of the half-ring structure runs successfully.

Generate S-Matrix Data

Figure 3 shows the configuration options for the RSoft Custom-PDK Generation Utility. For this example, the Output Mode is set to “Full PDK”, enabling the generation of both S-matrix data and a custom PDK model for use in a target PIC design platform.

In this application note, ADS Photonic Designer is selected as the target platform. For a detailed description of all available options, please refer to the Custom-PDK Generation Utility User Guide.

To convert the output of the utility into an ADS Photonic Designer component, run the following command: `adsgencell <cell-folder>`. This command creates an ADS cell along with its associated views, including symbol, layout, and emdata, as shown in Figure 4.

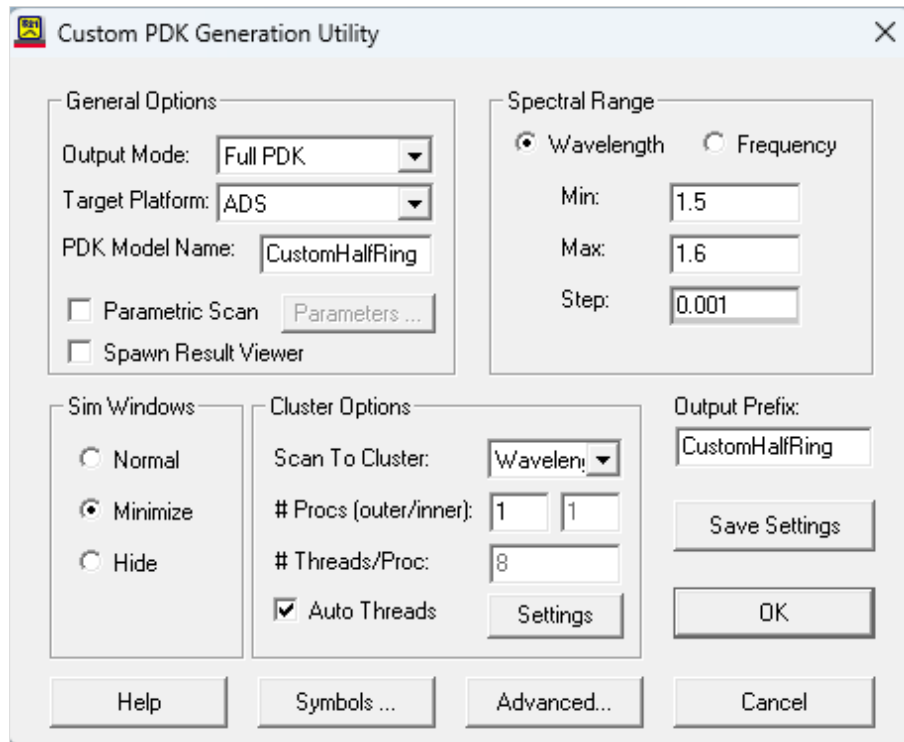


Figure 3. Configuration of the RSoft Custom-PDK Generation Utility with ADS Photonic Designer selected as the target platform.

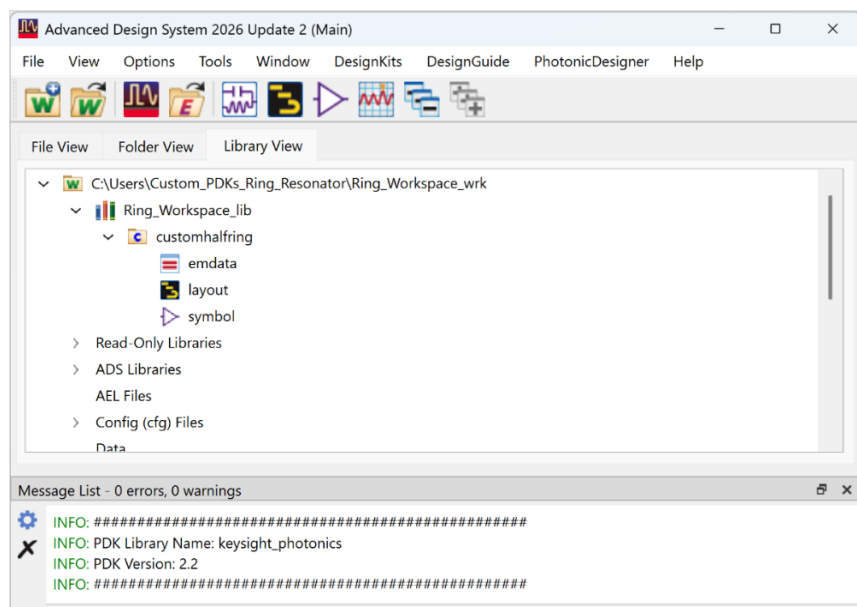


Figure 4. ADS Photonic Designer showing the custom half-ring component in a user library.

Define the User Library in ADS

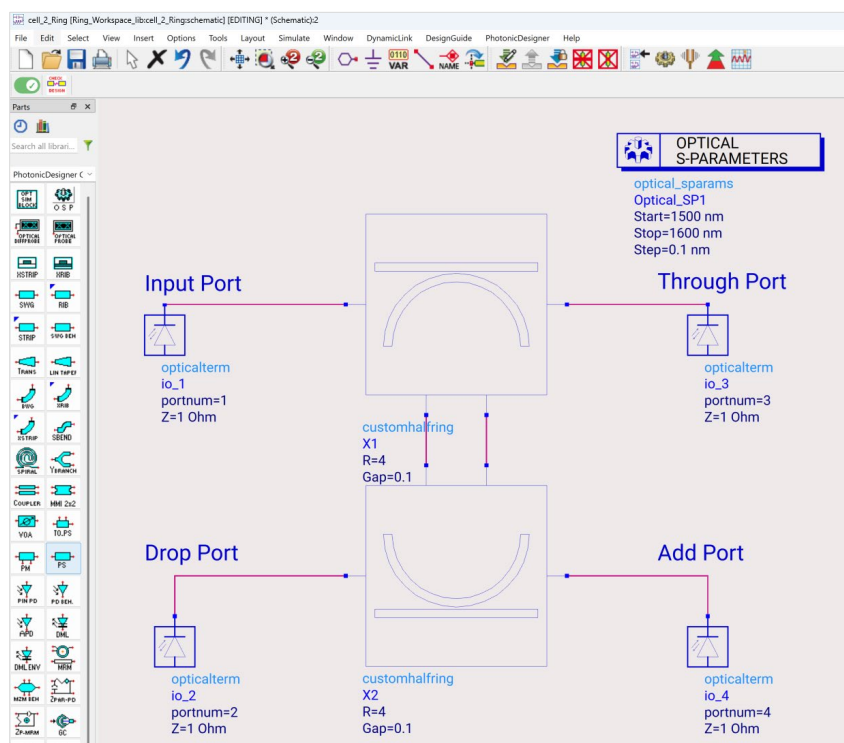


Figure 5. Schematic of the full ring resonator constructed using two half-ring custom PDK components in ADS Photonic Designer.

Each half-ring PDK element uses the S-matrix data automatically generated by the Custom-PDK Generation Utility in FullWAVE FDTD.

To construct a full ring resonator, two half-ring PDK components are placed and connected within an ADS Photonic Designer schematic, as shown in Figure 5. The S-matrix data follows the standard ADS Photonic Designer format for bidirectional optical multiport device models.

To enable reuse of the full ring resonator in other designs, a compound component symbol can be generated directly from the schematic in Figure 5, as shown in Figure 6.

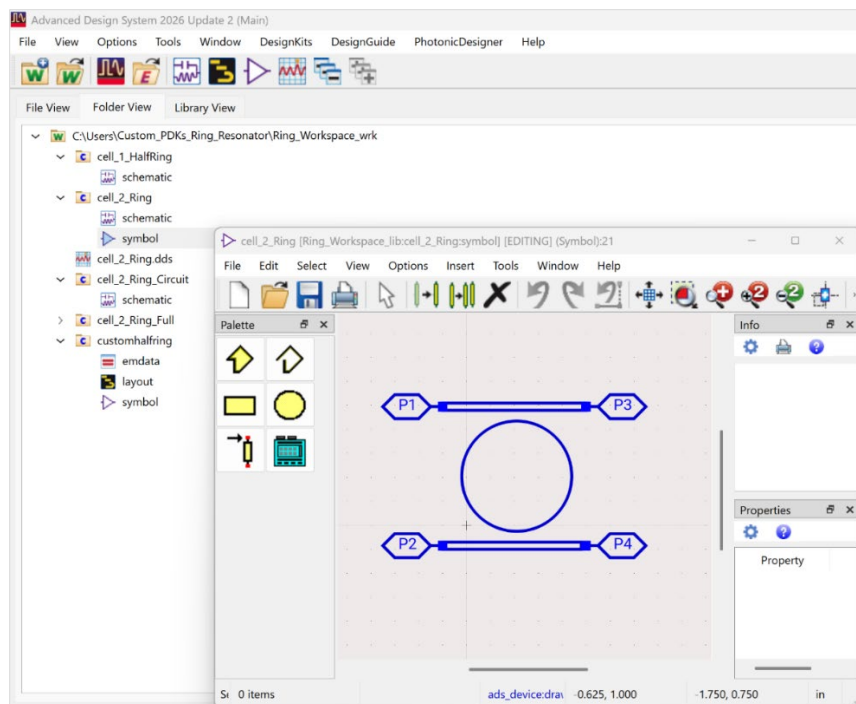


Figure 6. Generating a full ring resonator symbol from the compound schematic.

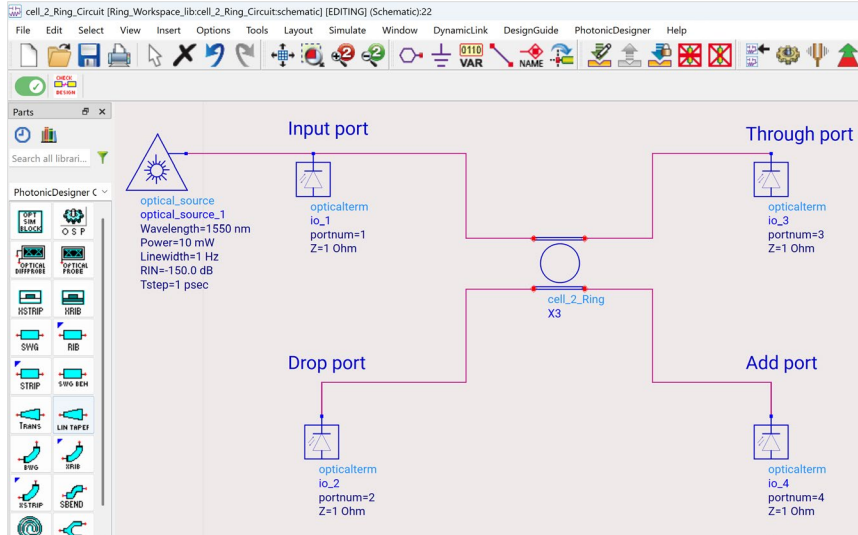


Figure 7. Example schematic using the generated full ring resonator symbol.

A new schematic can then be created using the generated full ring symbol for circuit-level simulation, as illustrated in Figure 7.

Simulate Circuit and Create Mask Layout

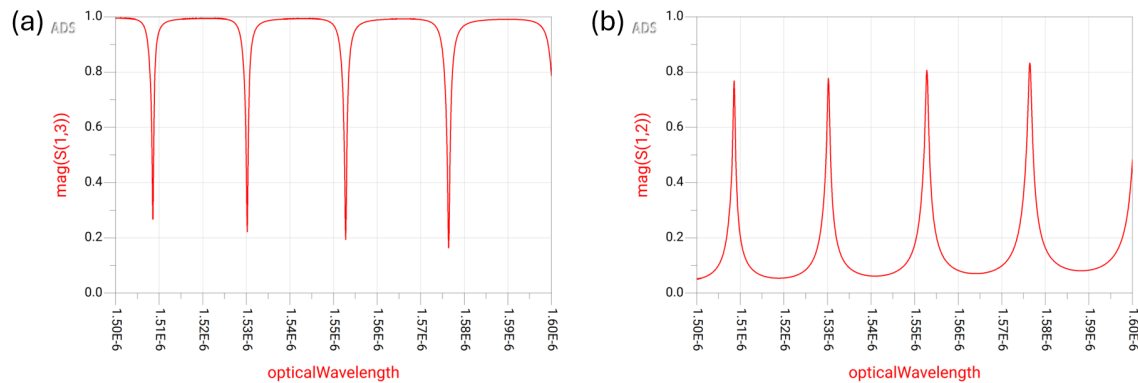


Figure 8. Normalized field-amplitude transmission spectra at the (a) through port and (b) drop port of the ring resonator shown in Figure 4.

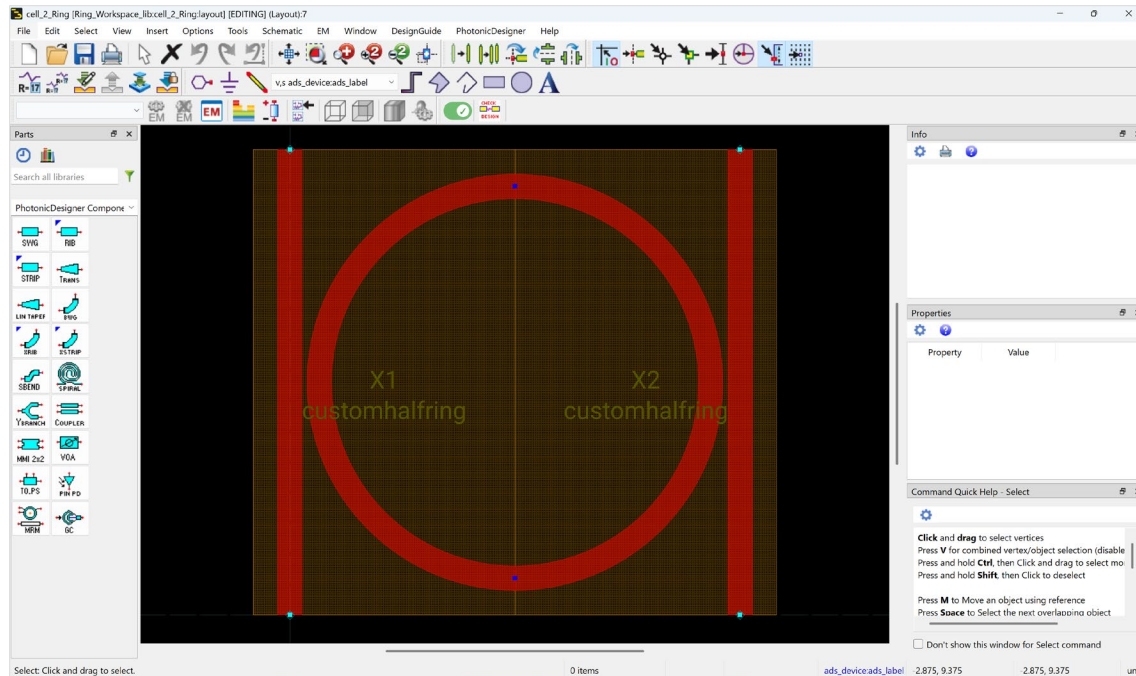


Figure 9. Physical layout of the full ring resonator generated directly from the schematic.

To perform circuit simulation, an Optical S-Parameter Simulation (OSP) component is added from the ADS Photonic Designer Components library. For this example, the wavelength sweep parameters are set to be Start: 1500 nm, Stop: 1600 nm, Step size: 0.1 nm, respectively (Figure 5).

The transmission spectra at the through port and drop port are of particular interest for ring resonator analysis. The simulated normalized field-amplitude transmission spectra are shown in Figure 8(a) and Figure 8(b).

A physical layout of the full ring resonator can be generated directly from the schematic. From the schematic view, select Layout → Generate/Update Layout, and confirm the dialog. ADS Photonic Designer then generates and opens the layout view, as shown in Figure 9. As expected, the two half-ring structures are connected seamlessly to form the complete ring resonator.

Conclusion

This application note demonstrates a practical workflow for generating custom photonic PDKs using RSoft device modeling tools and ADS Photonic Designer. The approach is well suited for passive, linear photonic components whose circuit-level behavior can be fully described using S-matrix parameters.

The RSoft Custom-PDK Generation Utility automates the extraction of transfer characteristics and the creation of all required output files for defining custom PDK components in ADS Photonic Designer. These custom PDKs can then be used to build, simulate, and analyze photonic circuits, as well as to generate mask layouts through integration with layout tools.

Example Files

<https://support.keysight.com/KeysightdCX/s/knowledge-article-detail?keyid=Supporting-files-custom-PDK-ring-resonator>