

Cost Breakdown Diagram of Silicon Photonics Modules



Overview

Schematic illustrations of trends in photonic packaging. (a) Cost. The schematic cost structure of a silicon photonic device is shown in Fig. 1 (a). Rece.

Key Takeaways

The main cost components for silicon photonics modules include wafer fabrication, packaging, testing, NRE, and yield-related expenses, with wafer and advanced packaging being the largest contributors. Key Cost Components¹.

Wafer Fabrication

The foundation of silicon photonics cost is the wafer, typically 200mm or 300mm in diameter, depending on the foundry and process node. Costs vary by node, volume, and complexity; advanced nodes with EUV lithography are significantly more expensive than mature nodes. Wafer fabrication includes lithography, etching, deposition, and doping steps, which are highly capital-intensive and account for a large portion of the total module cost.

2.

Non-

Recurring Engineering (NRE) NRE covers design, mask sets, and initial process development. These are one-time costs required to prepare the module for production and can include photonic circuit design, simulation, and prototyping.

NR

E is particularly significant for custom silicon photonics modules and can reach millions of dollars for advanced designs. 3.

Packaging

Advanced packaging integrates optical and electronic components, often using flip-chip bonding, through-silicon vias (TSVs), or hybrid bonding. Packaging is a major cost driver due to precision alignment, thermal management, and optical coupling requirements. Supply bottlenecks in high-end packaging technologies, such as CoWoS or 3D integration, can further increase costs.

4.

Testing and Qualification

Testing ensures optical performance, signal integrity, and reliability. Includes wafer sort, die-level testing, module assembly testing, and environmental qualification. Test complexity rises with higher channel counts, tighter tolerances, and integration of multiple photonic and electronic components.

5.

Yield Loss and Logistics

Yield loss occurs due to defects in wafers, dies, or packaging. Logistics, handling, and storage add incremental costs, especially for high-value wafers and modules. 6.

Recurring Unit Costs

Once NR

E is amortized, recurring costs per module include wafer usage, packaging, testing, and yield-adjusted overhead. Economies of scale reduce unit costs, but advanced nodes and complex packaging maintain high per-unit expenses. Visual Representation (Simplified Diagram)
CodeCopyTotal Cost per Silicon Photonics Module|-- Wafer Fabrication (~40-50%)|-- Packaging (~30-35%)|-- Testing & Qualification (~10-15%)|-- NRE (amortized per unit) (~5-10%)-- Yield Loss & Logistics (~5%)
SummaryThe largest cost drivers for silicon photonics modules are wafer fabrication and advanced packaging, followed by testing and NRE.

Costs are highly sensitive to process node, module complexity, and production volume. Understanding these components helps in optimizing design choices, selecting appropriate foundries, and planning for scale-up in production.

Article Content

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80% of the cost of a full datacom transceiver module is package, test and assembly, which includes the relatively high cost of high precision singlemode fibre alignment, fixture and testing.

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Considering cost changes from polysilicon shortages and the pandemic, Figure 2 illustrates the changes in the cost breakdown of PV module assembly minimum sustainable price

Cost structure of optical module chips | Weyland

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Module cost breakdown. Includes all the costs (cash costs, SG&A ...

Download scientific diagram | Module cost breakdown. Includes all the costs (cash costs, SG&A expenses and depreciation) except for the Me-SiG where only the material price is included.

Silicon Photonics Market Size, Share and Trends

Silicon photonics is a technique that employs semiconductor-grade silicon to integrate photonic circuits and electronic components on a single microchip. This method minimizes system power

Integrated Photonics: The Cost of Commercialization

Optica's Tom Hausken writes that photonic integrated circuits are promising for many applications, but high front- and back-end costs present challenges to wide adoption.

Silicon Photonics Market and Technology Report 2026

An IEEE 802.3 contribution (drawing from a Yole cost breakdown) shows package, test, and assembly ~80% of a datacom transceiver module cost, emphasizing high-precision SMF

Semiconductor Manufacturing Economics | TechInsights

The models help identify the most cost-efficient suppliers by analyzing fab capabilities, regional manufacturing trends, and total cost structures for discrete semiconductors and ICs.

Breakdown of the cost structure of a 400 Gb/s

[Download scientific diagram | Breakdown of the cost structure of a 400 Gb/s pluggable transceiver based on data from from publication: Co-packaged](#)

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Economic viability Over the past 5 years silicon photonics transceivers have become mainstream datacom commodities deployed in all hyperscale data centres. They benefit from economies of scale

Integrating silicon photonics with complementary metal-oxide ...

Complementary metal-oxide-semiconductor-integrated silicon photonics offers a practical path forward by combining high-volume manufacturing with mature photonic building blocks.

Breakdown of cost elements in c-Si PV module

[Download scientific diagram | Breakdown of cost elements in c-Si PV module production \(from data in the ITRPV Roadmap, 2017\).](#) from publication: Low

Silicon Photonic Modules vs. Traditional Optical Modules:

Silicon Photonics vs. Traditional Optical Modules: Key Differences for 800G & 1.6T Data Centers Description: As data centers scale to 800G and 1.6T, silicon photonics is reshaping optical

Silicon Photonics

Fabricating very low cost photonic devices using the mature integrated circuit industry is the most important motivation for silicon photonics researchers. In addition, the refractive index of silicon is

800G Silicon Photonics vs. EML: 2026 Cost Analysis & Buying Guide

Why is Silicon Photonics winning the 800G race in 2026? Our latest BOM analysis reveals a \$67 cost advantage over EML. Discover how to optimize your AI data center budget and

ST silicon photonics and BiCMOS technologies: the winning portfolio

Silicon photonic PIC100 technology represents a cutting-edge advancement in the field of optical communications and integrated photonics. Silicon photonics leverages the well-established silicon

Schematic illustrations of trends in photonic packaging. (a) Cost ...

Download scientific diagram | Schematic illustrations of trends in photonic packaging. (a) Cost structure of silicon photonic devices. (b) Cost of manual labor and automation with time.

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