

# OpenPDK as a Strategic FOSS IC Design Enabler

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## EXTENDED ABSTRACT

OpenPDK Initiative is gaining strong momentum in the semiconductor community, with Europe playing a leading role. The main goal is simple: make integrated-circuit (IC) design easier to access, easier to learn, and easier to manufacture. OpenPDKs and FOSS CAD/EDS tools play a central role in this transformation. They remove the traditional barriers of expensive software, closed documentation, and restrictive licenses. This paper presents a clear and practical overview of how OpenPDKs together with FOSS CAD/EDA workflows create new opportunities for education, research, and industry, using the IHP SG13G2 open ecosystem as a leading example.

The first part explains why OpenPDKs matter. A Process Design Kit is normally locked behind NDAs and commercial contracts. When a PDK becomes open, designers can study device models, run simulations, build layouts, and share results without legal or financial obstacles. This openness supports reproducible research, transparent learning materials, and community-driven improvement. It also allows universities and small companies to participate in advanced technology nodes that were previously out of reach.

The second part describes how a complete IC design flow can be built using only free and open source tools. Designers can perform schematic capture, simulation, layout, DRC/LVS verification, PEX extraction for post layout simulations, and tape-out preparation using tools such as Verilog-A compilers: OpenVAF; SPICE simulators: ngspice, Xyce, GnuCAP, VACASK; 3D electromagnetic simulator: OpenEMS; GDSII layout editors: Magic, KLayout, and digital implementation flow: Librelane. When combined with an OpenPDK, these tools form a stable and fully reproducible IC design workflow. Sponsored OpenMPW programs allowed participants to fabricate chips at no cost if they publish their designs openly. This model has already produced many working analog, RF, and mixed-signal circuits in the IHP SG13G2 technology, demonstrating that open workflows can support available mature industrial-grade semiconductor technologies.

The third part focuses on IHP OpenPDK Initiative as a case study. Since release, the IHP has proactively supported open source silicon through OpenMPW shuttles, open IP libraries, and collaborative research projects. New European initiatives such as FLOWSPACE, DEMICO, Di-Sign-HEP, and OCDCPro show that open source IC flows can be applied to space electronics, millimeter-wave design, cryptography, and education. These projects demonstrate that open workflows are not limited to teaching; they can also accelerate innovation in specialized, high-performance IC design domains.

Finally, the paper discusses the strategic importance of open licensing. Sustainable growth of open source silicon requires models that allow both open collaboration and commercial use. Dual-licensing approaches and clear IP policies can support small and medium-sized enterprises, which are essential for Europe's semiconductor competitiveness. European funding programs, including the EU Chips JU, now explicitly support FOSS tools, OpenPDKs, and open IP, confirming that open source silicon is becoming a recognized strategic direction. In particular, new EU Chips JU ODE4EC-AMS, can answer this call with a timely vision: to leverage Open-Source analogue and mixed-signal (AMS) electronic design automation methodologies and tools to lower the barriers to entry in semiconductor design, empowering a new generation of European innovators, startups, SMEs, fabless design industry, academia, and research to strengthen Europe's digital sovereignty. ODE4EC-AMS is targeting the AMS domain, a cornerstone of Europe's technological future and a critical enabler of emerging technologies in which Europe must lead, not follow. That creates the basis for long-term sustainability, community involvement, and the growth of the FOSS CAD/EDA ecosystem.

In summary, OpenPDKs combined with FOSS CAD/EDA tools create a practical, scalable, and inclusive path for IC design. The IHP SG13G2 and SG13CMOS5L ecosystems show how open workflows can connect education, research, and industry, and how Europe can build a strong and sustainable open source semiconductor community.

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