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# GDSII

**GDSII stream format** (**GDSII**), is a binary database file format which is the de facto industry standard for Electronic Design Automation data exchange of integrated circuit or IC layout artwork.[1] It is a binary file format representing planar geometric shapes, text labels, and other information about the layout in hierarchical form. The data can be used to reconstruct all or part of the artwork to be used in sharing layouts, transferring artwork between different tools, or creating photomasks.

| GDSII | |
|---|---|
| **Filename extension** | .gds |
| **Developed by** | Calma |
| **Initial release** | 1989 |
| **Type of format** | binary[1] |
| **Free format?** | no |

## History

GDS = Graphic Design System (see [GDS78])

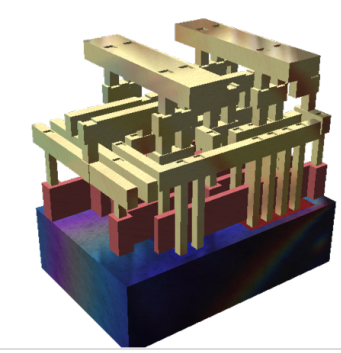
Initially, GDSII was designed as a stream format used to control integrated circuit photomask plotting. Despite its limited set of features and low data density, it became the industry conventional stream format for transfer of IC layout data between design tools of different vendors, all of which operated with proprietary data formats.

It was originally developed by Calma for its layout design system, "Graphic Design System" ("GDS") and "GDSII".

GDSII files are usually the final output product of the IC design cycle and are handed over to IC foundries for IC fabrication. GDSII files were originally written on magnetic tape. The final deadline for IC designers is still called tape-out for this reason.

Objects contained in a GDSII file are grouped by assigning numeric attributes to them including a "layer number", "datatype" or "texttype". While these attributes were designed to correspond to the "layers of material" used in manufacturing an integrated circuit, their meaning rapidly became more abstract to reflect the way that the physical layout is designed.

As of April 2008, many EDA software vendors have moved to the stream format OASIS, which replaced GDSII.[2]



A rendering of a small GDSII standard cell with three metal layers (dielectric has been removed). The sand-colored structures are metal interconnect, with the vertical pillars being contacts, typically plugs of tungsten. The reddish structures are polysilicon gates, and the solid at the bottom is the crystalline silicon bulk.

## GDSII utilities

As the GDSII stream format is a de facto standard, it is supported by nearly all EDA software. Besides the commercial vendors there are plenty of free GDSII utilities. These free tools include editors,[3][4][5] viewers,[6] utilities to convert the 2D layout data into common 3D formats,[7][8] utilities to fly through a 3D version,[9] utilities to convert the binary format to a human readable ASCII format[10] and program libraries.[11][12][13]

## See also

- Caltech Intermediate Form
- OASIS (Open Artwork System Interchange Standard)
- EDIF, a vendor neutral file format made in 90s
- Crystallographic Information File

## Notes

1. "All About Calma's GDSII Stream File Format" (https://www.artwork.com/gdsii/gdsii/). *www.artwork.com*. Retrieved 2022-05-26.
2. Going from GDSII to OASIS (http://www.eetimes.com/design/eda-design/4018771/Going-from-GDSII-to-OASIS), Philippe Morey-Chaisemartin (Xyalis) // EETimes 8/4/2008
3. LayoutEditor, a free GDSII editor http://www.layouteditor.net
4. "KLayout" is a free GDSII, LEF/DEF, OASIS, Gerber, DXF, CIF editor with DRC http://www.klayout.de
5. Glade, a free GDSII, LEF/DEF editor http://www.peardrop.co.uk/glade Archived (https://web.archive.org/web/20130327030431/http://www.peardrop.co.uk/glade/) 2013-03-27 at the Wayback Machine
6. "nanoViewer" is a free GDSII viewer, "Archived copy" (https://web.archive.org/web/20120119053116/http://www.wxnanotech.com/). Archived from the original on 2012-01-19. Retrieved 2017-10-09.
7. gds2pov easily convert GDSII data into a nicely rendered 3D view. http://www.atchoo.org/gds2pov
8. With GdsViewer tool, any portion of GDSII artwork can be exported to 3D VTK file. The latter can be viewed and manipulated with VTK compatible viewers, e.g. ParaView http://www.gbresearch.com/gdsviewer
9. "GDS3D" (https://sourceforge.net/projects/gds3d/). *SourceForge*. 2017-06-12. Retrieved 2023-12-12.
10. GDS Utilities can convert binary GDSII files to ASCII representation, http://www.gbresearch.com/gdsutilities
11. Ruby GDSII Library for reading, manipulating, and writing GDSII data in the Ruby programming language http://www.rubyforge.org/projects/gdsii
12. Python GDSII Library for creating and manipulating GDSII files with Python http://gdspy.sourceforge.net/index.html
13. Octave and MATLAB toolbox for reading and writing GDSII layout files https://sites.google.com/site/ulfgri/numerical/gdsii-toolbox

## References

* Clein, Dan. (2000). *CMOS IC Layout*. Newnes. ISBN 0-7506-7194-7
* [GDS78] Calma. (1978). *GDS II Graphic Design System User's Operating Manual*, First Edition 1978. Online at http://www.bitsavers.org/pdf/calma/GDS_II_Users_Operating_Manual_Nov78.pdf Retrieved Apr 21, 2020.

## External links

- Computer Aids for VLSI Design - Appendix C: GDS II Format (http://www.rulabinsky.com/cavd/text/chapc.html) by Steven M. Rubin // Addison-Wesley, 1987
- The GDSII Stream Format (http://www.buchanan1.net/stream_description.html) Archived (https://web.archive.org/web/20160616215711/http://www.buchanan1.net/stream_description.html) 2016-06-16 at the Wayback Machine by Jim R. Buchanan, 6/11/96
- GDS II Graphic Design System User's Operating Manual, First Edition 1978 (http://www.bitsavers.org/pdf/calma/GDS_II_Users_Operating_Manual_Nov78.pdf) // Calma Interactive Graphic Systems, November 1978. Retrieved Apr 21, 2020.
- GDSII™ Stream Format Manual (B97E060), Release 6.0 (http://bitsavers.informatik.uni-stuttgart.de/pdf/calma/GDS_II_Stream_Format_Manual_6.0_Feb87.pdf) // Calma, February 1987
- SPIE Handbook of Microlithography, Micromachining and Microfabrication, Vol. 1: Microlithography // Bellingham, Wash. : SPIE Optical Engineering Pr., 1997, 2.9 Appendix: GDSII Stream Format (http://www.cnf.cornell.edu/cnf_spie9.html) Archived (https://web.archive.org/web/20121229141346/http://www.cnf.cornell.edu/cnf_spie9.html) 2012-12-29 at the Wayback Machine
- Details of GDSII format including illustrations (http://boolean.klaasholwerda.nl/interface/bnf/gdsformat.html)

ICPillar, LLC, Exhibit 2004
Page 2004- 1
IPR2024-00566, ARM Limited v. ICPillar, LLC

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