

Leibniz Institute for high performance microelectronics

LibMan - an easy way to manage your open source design flow

Dr. Anton Datsuk - Scientist Technology / Research & Prototyping Service

Networking Workshop FMD-QNC 'OpenPDK, OpenTooling and Open Source Design – An Initiative to Push Development'

27 June 2023



Outline



 \mathbf{O}

1.	Motivation
2.	Goals
3.	Main interface of library manager
4.	IHP OpenPDK data structure
5.	LibMan functionality
6.	Documentation generator and static analysis tool
7.	Summary





- —• The commercial software like Cadence Virtuoso, Keysight ADS, Mentor Tanner offer Library Manager
- -O Library Manager is used to
 - -• store design data in libraries
 - navigate libraries, cells, views, and files in the directory structure by opening a cell views
 - -• manipulate design data in a more friendly way
 - execute view specific editors
- -• There's no Library Manager in Open Source community to unite various EDA tools in a flow (at least known to us)



- -O Develop a Library Manager to unite Open Source EDA tools into a flow
- Provide similar Library Manager functionality to the ones provided by to commercial companies
- -• Design User Interface in a way the users got used to
- -•• Make it easily customizable and extendable based on user requests/preferences
- Integrate documentation generator and static analysis tool for software source trees (Doxygen)
- Provide support for different QT versions (4.8.6 upwards)
- -• Provide compilation compatibility for Linux and Windows OS

Functionality Goals

-•• LibMan helps to organize libraries and cell views in a design project

- -O Create new libraries in your directories
- -O Copy data into libraries
- -O Delete libraries
- -•• Rename libraries, cells, views
- -O Edit libraries, cells, and views
- Organize cells into categories
- O Unite libraries into groups
- Display libraries, cells, views information
- -•• Navigate through libraries, cells, views





26.06.2023

File Settings Help



Main Interface







- Project file is used to specify and store the location of the reference and design libraries
- -O LibMan displays the libraries, categories, cells, and views specified in project file
- Project file can be loaded by
 - -•• Explicitly specifying it as command line argument
 - -O Running LibMan from a folder where project file is saved
 - -O Loading from the recent file menu

			sg13g2.projects - /ihp/projects/Design_Kit/datsuk/src/libman/libman-build-Desktop-Debug/ _	×	
Fil	e <u>E</u> dit	<u>S</u> earch	Preferences Shell Macro <u>W</u> indows	<u>H</u> elp	
FR PR PR PR PR	DUP Te DJECT DJECT DJECT DJECT	st test sg13g2_ sg13g2_ testcas testcas	.case2 testcase1 pr /ihp/projects/Design_Kit/IHP-Open-PDK/ihp-sg13g2/libs.ref/sg13g2_pr stdcell /ihp/projects/Design_Kit/IHP-Open-PDK/ihp-sg13g2/libs.ref/sg13g2_stdcell e1 /home/datsuk/release/testcase1 e2 /home/datsuk/release/testcase2		

–• LibMan expects the following PDK data

IHP OpenPDK Data Structure

structure for correct loading of libraries:

- -• GDSII view of primitive devices
- –• KLayout layer property file
- –• HSPICE Models of HBT devices
- –• SG13G2 Process specification
- The PDK data can be accessed through LibMan

2





8

ihp-sq13q2

Basic Data Operations





Unlike commercial tools LibMan allows to perform the following actions directly in main UI:
 Managing project data files

 Managing group data (libraries)

Launching View Editors



 \cap

File Settings Help					
Show Documents Show Categories				- LibMan executes y	view editor based on
Project	Categories	Cell	View		
Name sg13g2_stdcell	Name	Name sg13g2_stdcell	Name gds		
sg13g2_stdcell sg13g2_pr ▶ Test	Everything	sg13g2_stdcell	cdl gds spice	user settings	
			<u>File Edit View Bookmarks</u>	<u>D</u> isplay <u>T</u> ools <u>M</u> acros <u>H</u> elp	
	Documentation		Image: Select Back Forward Select Move	Ruler (Default)	
	sg13g2_stdcelLtyp_1p50V_25C sg13g2_stdcelLtyp_1p20V_25C		Cells Ø 🗷 so	g13g2_stdcell.gds [sg13g2_stdcelL_allcells] 🗶	Layers 🛛 🗷
≥ sg13g2_stdcetL_typ_1p2v2_std ≥ sg13g2_stdcetL_slow_1p35V_12 ≥ sg13g2_stdcetL_slow_1p08V_12 ≥ sg13g2_stdcetL_fast_1p65V_m4			▼ sg13g2_stdcell_allcells sg13g2_a21o_1 sg13g2_and2_1 sg13g2_and3_1		/// 1/0 5/0 /// 6/0 8/0
Messages			sg13g2_and4_1		8/2
Name: sg13g2_stdcell	sign_Kit/IHP_Onen_PDK/ibn_sg12g2/libs.ref/cg12	a2 stdcell	sg13g2_antennanp		8/25
Owner: andreev	signiliation in open rotating significations and signification	gz_statea	sg13g2_buf_1		10/0
Last Modify: 14:26:2023			sq13q2_buf_10		10/25
Fernissions, Twx			Levels 0 🔶 3 🔶		14/0
			Libraries @ N		
			ARC		Layer Toolbox 🛛 🖉 🗷
			CIRCLE		Color
 LibMan creates an empty GDS for a new cell 			DONUT		Frame color
			ELLIPSE		Stipple
			ROUND_PATH		
			ROUND_POLYGON	49 µm	Visibility
			T (Default) G		xy 721.80991 52.89355

26.06.2023 www.ihp-microelectronics.com | © IHP all rights reserved | IHP Workshop 2023

11

The default tools: Layout – KLayout (GDS view)

-O LibMan allows to let user choosing view

editors to be used in the flow

- Schematic Nedit (CDL view)
- Other views Nedit
- Ocumentation evince (PDF files)

▼ Tools	
Schematic	nedit
Layout	/bin/klayout
Editor	nedit
PDF Reader	rEDActor
	OK Cancel





Customization



Documentation generator and static analysis tool

- Doxygen was used to parse the source code and generate documentation
 - -• supports C/C++ natively
 - Can be easily integrated in QtCreator
 - Generates both
 latex and HTML
 documentation



LibMan Source Code Documentation



S LibMan - Open Source Library M. × G Google	× +	
\leftrightarrow \rightarrow C (i) File J:/release_local/pics/LibMan/html/fun	tions.html 🖻 🖈 🗖 🚱 :	
🕙 IHP Tickets 🚊 My Tickets 📴 IHP Tickets 😼 Startseite 🐲	IHP Admin 🔯 Bugzilla Main Page 🗞 Login - Interflex 🛛 »	
LibMan - Open Sou	Irce Library Manager	
Documentation 1.0		
Main Page Classes Files Class List Class Index Class Hierarchy Class Members	C Search	
All Functions Variables Enumerations	S LibMan - Open Source Library M: X G Google X +	×
Here is a list of all documented class members with links to the	 C ① File J:/release_local/pics/LibMan/html/classMainWindow.html#ab2e15383545f27e0f07f B IHP Tickets HP Tickets HP Tickets Startseite HP Admin Bugzilla Main Page Login - Interflex 	: »
- a -	Detailed Description	•
About() : About add() : Properties addGroupToBeCopied() : MainWindow addGroupToBeCopied() : MainWindow	The MainWindow class is responsible for creating main framework of LibMan and controlls all slots and signals.	_
addNewCategory(): MainWindow addNewGroup(): MainWindow addNewLayoutView(): MainWindow addNewProject(): MainWindow addNewSchematicView(): MainWindow	Constructor & Destructor Documentation	_
 addNewSpiceView(): MainWindow addBroiectToBeConjed(): MainWindow 	MainWindow::MainWindow (const QString & projFile.	
addValue() : Propertyltem	const QString & runDir,	
addViewToBeCopied(): MainWindow askEorEileBeptacement(): MainWindow	QWidget * parent = 0	
 ask on increpacement() : MainWindow askUserForAction() : MainWindow)	cit
- C -	Constructs a LibMan MainWindow object with the given arguments.	
 checkAndSaveProjectData() : MainWindow clearCurrentCopyState() : MainWindow 	Parameters	-
closeEvent() : ProjectManager , MainWindow COPY_STATE : MainWindow	projFile Path to the project file. Be default, it will be searched in the current folder.	
copyDir(): MainWindow	runDir Path to the directory, where application was executed.	
	parent Parent widget, by default is NULL.	
		_

- Easy generation and maintenance of the source code documentation with Doxygen
- All classes, class member and functions have been documented appropriately
- Visualization of relationships between various elements (include dependency graphs, inheritance diagrams, collaboration diagrams etc.)

Road Map

- -O GitHub submit (July, 23)
- Compilation guide (July, 23)
- Provide Editor Arguments (Q4 2023)
- -O Git support for design data in LibMan (2024)
- -• Data base for Open Source EDA?











- -•• The first version of Library Manager has been developed
- -O Library Manager offers basic functionality to manage project data
- Provided support of IHP OpenPDK data structure
- O User is capable to customize views editors
- Oxygen support was applied to the LibMan project
- -•• API documentation for the current source code version was generated
- –• LibMan has been compiled for QT4.8.6 and QT5.15.1 for both Linux (RedHat, Ubuntu) and Windows OS
- Any feedback and support to make LibMan more design friendly are highly appreciated

-• Thanks to my colleagues at IHP

-O Thanks to FMD QNC (16ME0831)

https://www.elektronikforschung.de/projekte/fmd-qnc

IHP - Sergei Andreev



Federal Ministry of Education

and Research

SPONSORED BY THE

Acknowledgment





Thank you for your attention!

IHP – Leibniz-Institut for High Performance Microelectronics

Im Technologiepark 25 15236 Frankfurt (Oder) Tel.: +49 (0) 335 5625 133 E-Mail: datsuk@ihp-microelectronics.com



