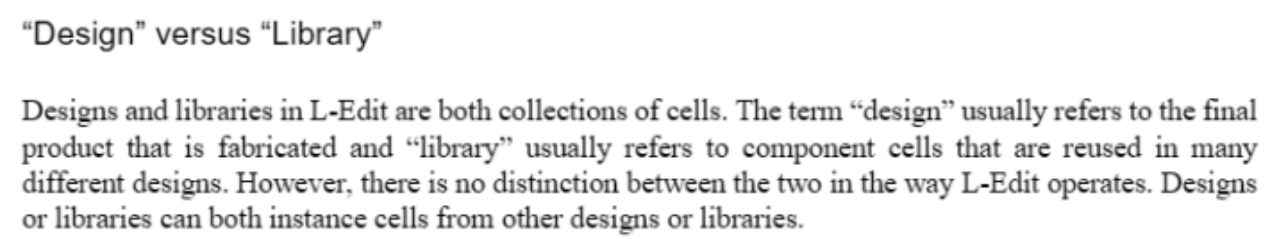
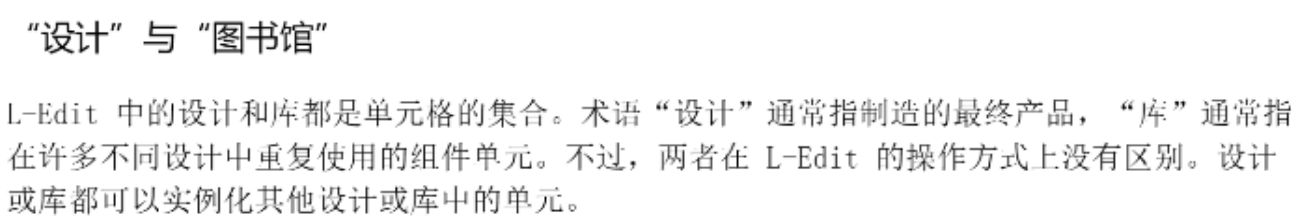
TanerEDA版图设计

基础知识：



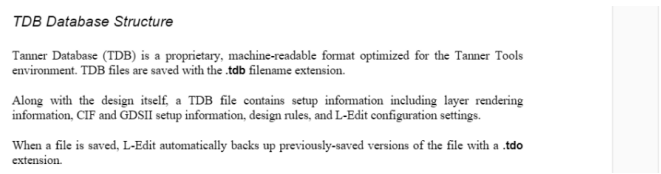
“Design” versus “Library”

Designs and libraries in L-Edit are both collections of cells. The term “design” usually refers to the final product that is fabricated and “library” usually refers to component cells that are reused in many different designs. However, there is no distinction between the two in the way L-Edit operates. Designs or libraries can both instance cells from other designs or libraries.



“设计”与“图书馆”

L-Edit 中的设计和库都是单元格的集合。术语“设计”通常指制造的最终产品，“库”通常指在许多不同设计中重复使用的组件单元。不过，两者在 L-Edit 的操作方式上没有区别。设计或库都可以实例化其他设计或库中的单元。

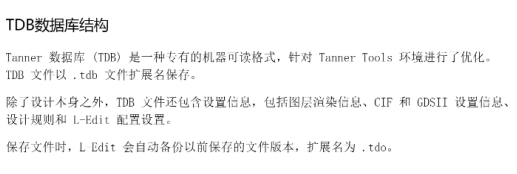


TDB Database Structure

Tanner Database (TDB) is a proprietary, machine-readable format optimized for the Tanner Tools environment. TDB files are saved with the **.tdb** filename extension.

Along with the design itself, a TDB file contains setup information including layer rendering information, CIF and GDSII setup information, design rules, and L-Edit configuration settings.

When a file is saved, L-Edit automatically backs up previously-saved versions of the file with a **.tdo** extension.

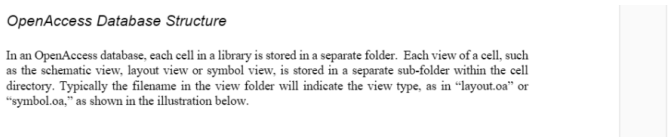


TDB数据库结构

Tanner 数据库 (TDB) 是一种专有的机器可读格式，针对 Tanner Tools 环境进行了优化。TDB 文件以 .tdb 文件扩展名保存。

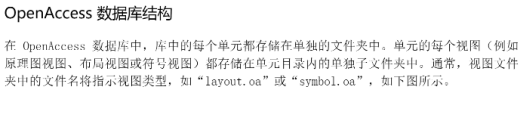
除了设计本身之外，TDB 文件还包含设置信息，包括图层渲染信息、CIF 和 GDSII 设置信息、设计规则和 L-Edit 配置设置。

保存文件时，L Edit 会自动备份以前保存的文件版本，扩展名为 .tdo。



OpenAccess Database Structure

In an OpenAccess database, each cell in a library is stored in a separate folder. Each view of a cell, such as the schematic view, layout view or symbol view, is stored in a separate sub-folder within the cell directory. Typically the filename in the view folder will indicate the view type, as in “layout.oa” or “symbol.oa,” as shown in the illustration below.



OpenAccess 数据库结构

在 OpenAccess 数据库中，库中的每个单元都存储在单独的文件夹中。单元的每个视图（例如原理图视图、布局视图或符号视图）都存储在单元目录内的单独子文件夹中。通常，视图文件夹中的文件名将指示视图类型，如“layout.oa”或“symbol.oa”，如下图所示。

第一种数据格式 —— TDB

TDB全称——Tanner DataBase，它是Tanner公司自己开发的数据格式

我们可以打开 .\Tech\TDB 文件夹看一下，其中后缀以 “.TDB” 为结尾的文件就是Tanner自定义的数据格式

第二种数据格式 —— OA

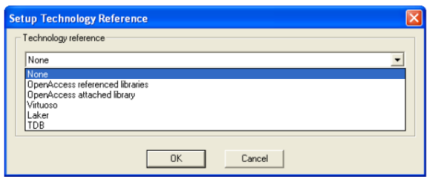
OA全称——OpenAccess，是种开源的数据格式

Tanner软件在16之前的版本只支持.TDB格式，在16版之后开始，开放OA格式

使用OA格式好处在于可以多人同时进行设计，而Tanner自己的TDB格式文件，仅能容许一人编辑

Technology Reference Options for OpenAccess

For an OpenAccess database, the technology reference menu options are as follows:



None	All technology information is obtained locally from the design.
OpenAccess referenced libraries (see "OpenAccess Technology Libraries" on page 48.)	The OpenAccess referenced libraries option let you create a list of libraries from which L-Edit reads technology information, in the order in which they are listed.
OpenAccess attached library (see "OpenAccess Attached Libraries" on page 53.)	The OpenAccess attached library sets one single library that will be accessed for technology information.

TDB

References a Tanner (.tdb) file for technology information.

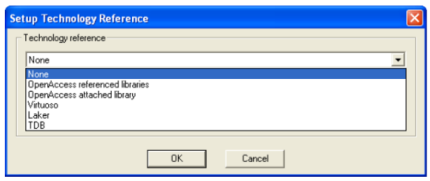
A TDB tech reference is read when a database is opened. Technology in the local database is read first, then the technology in the TDB file is read, overwriting data in the local database.

Layers may be added or deleted during an editing session, but when the database is closed and reopened, those changes will be replaced by the reference setup. Similarly, changes to node highlighting, interactive DRC, and standard DRC can be made during an editing session, but when the database is reloaded these changes will be replaced by the reference setup.

Note: In the case of a TDB reference, node highlighting, interactive DRC, and standard DRC rules are replaced by the reference setup, regardless of whether the referenced TDB contains data for these items or not. In other words, empty node highlighting data in the reference TDB setup will overwrite new settings a user makes during an editing session, when the dataset is reloaded.

OpenAccess 的技术参考选项

对于 OpenAccess 数据库，技术参考菜单选项如下：



没有任何	所有技术信息均从设计中本地获取。
OpenAccess 引用的库（请参阅第 48 页的“OpenAccess 技术库”。）	OpenAccess 引用库选项可让您创建库列表，L-Edit 可以按照库的列出顺序从中读取技术信息。
OpenAccess 附加库（请参阅第 53 页的“OpenAccess 附加库”。）	OpenAccess 附加库设置了一个可以访问以获取技术信息的库。

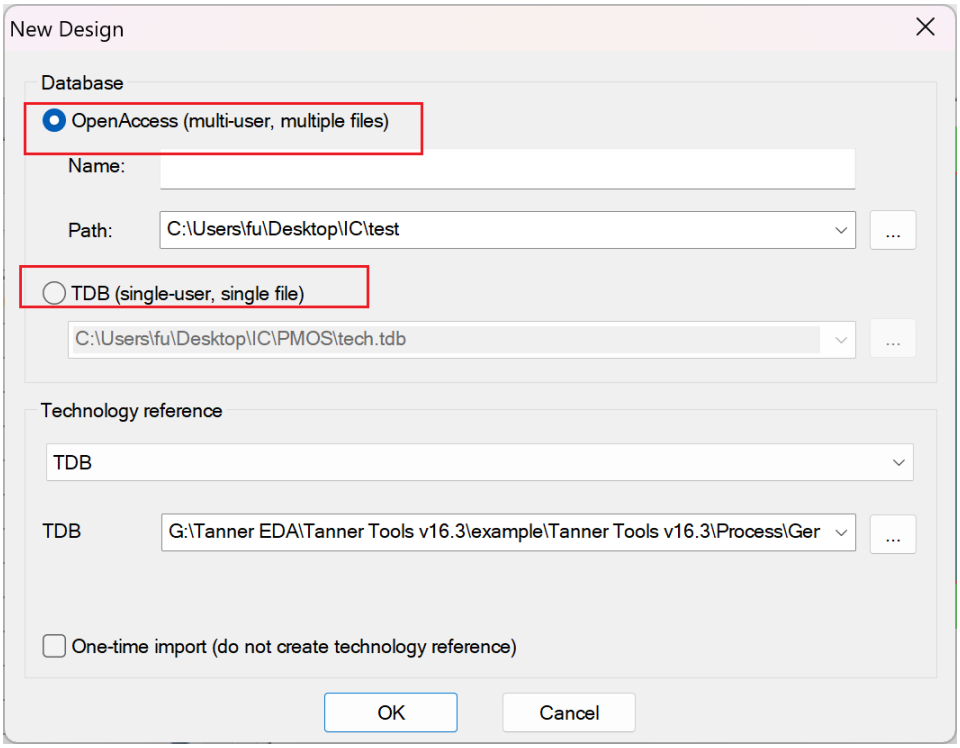
贸易发展局

引用 Tanner (.tdb) 文件以获取技术信息。

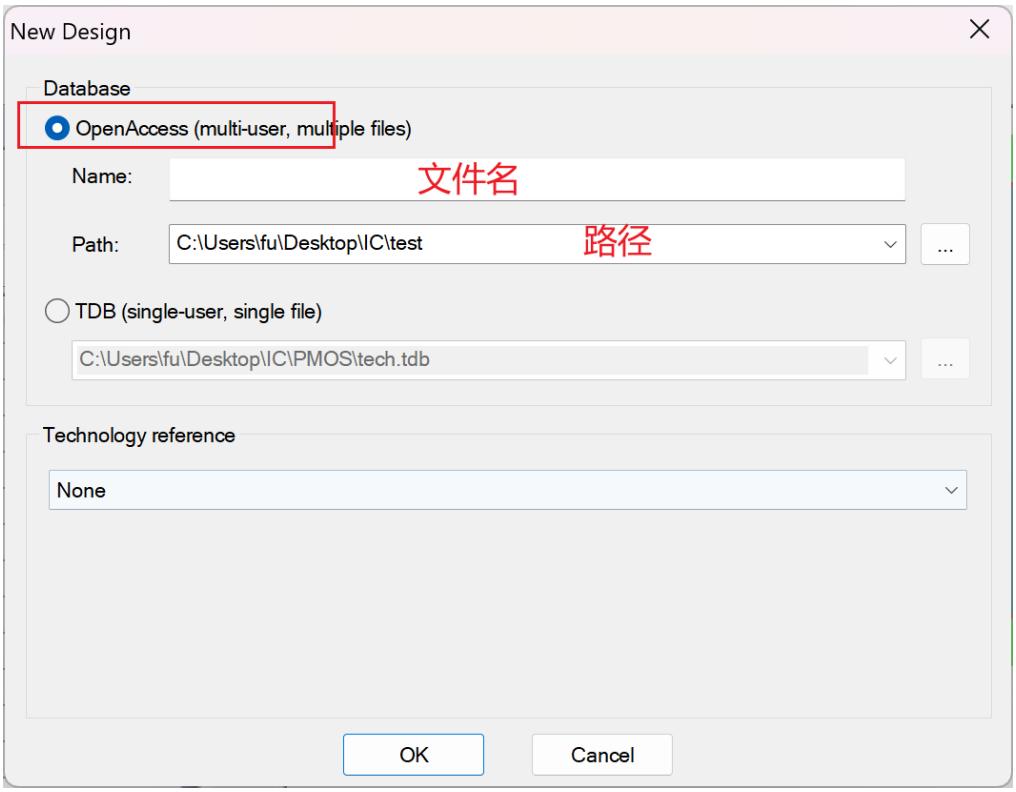
打开数据库时会读取 TDB 技术参考。首先读取本地数据库中的技术，然后读取TDB文件中的技术，覆盖本地数据库中的数据。

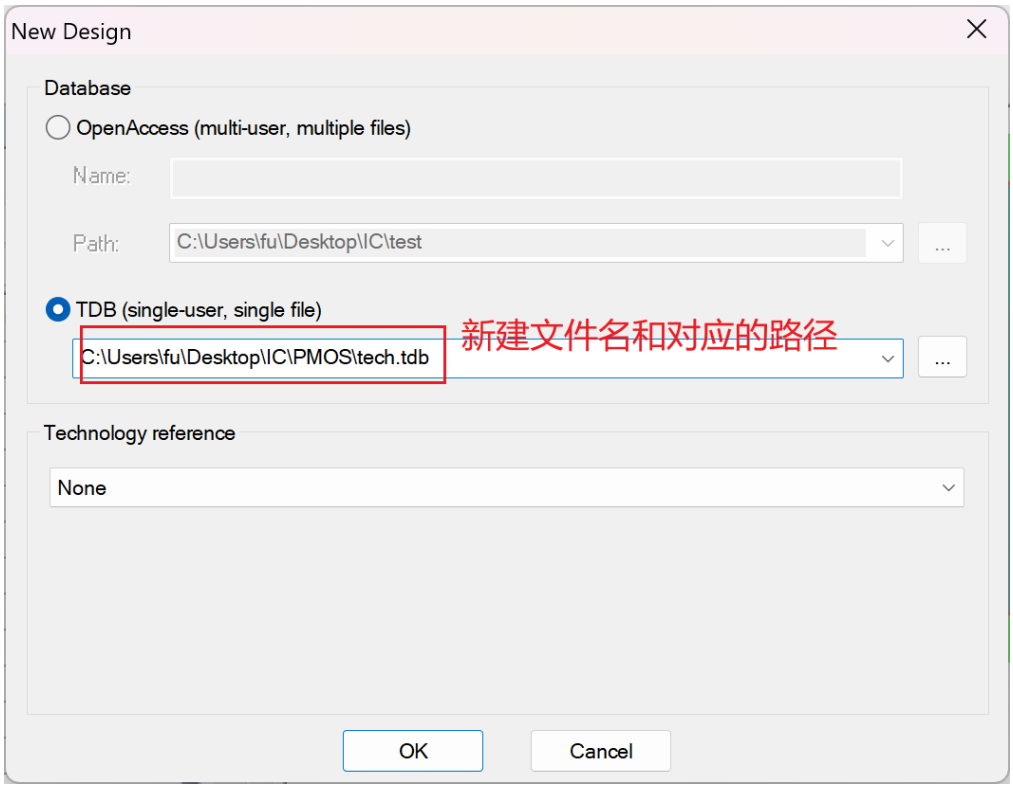
可以在编辑会话期间添加或删除图层，但是当数据库关闭并重新打开时，这些更改将被参考设置替换。同样，可以在编辑会话期间对节点突出显示、交互式 DRC 和标准 DRC 进行更改，但是当重新加载数据库时，这些更改将被参考设置替换。

注意：在 TDB 引用的情况下，节点突出显示、交互式 DRC 和标准 DRC 规则将被引用设置替换，无论引用的 TDB 是否包含这些项目的数据。换句话说，当重新加载数据集时，参考 TDB 设置中突出显示数据的空节点将覆盖用户在编辑会话期间所做的新设置。

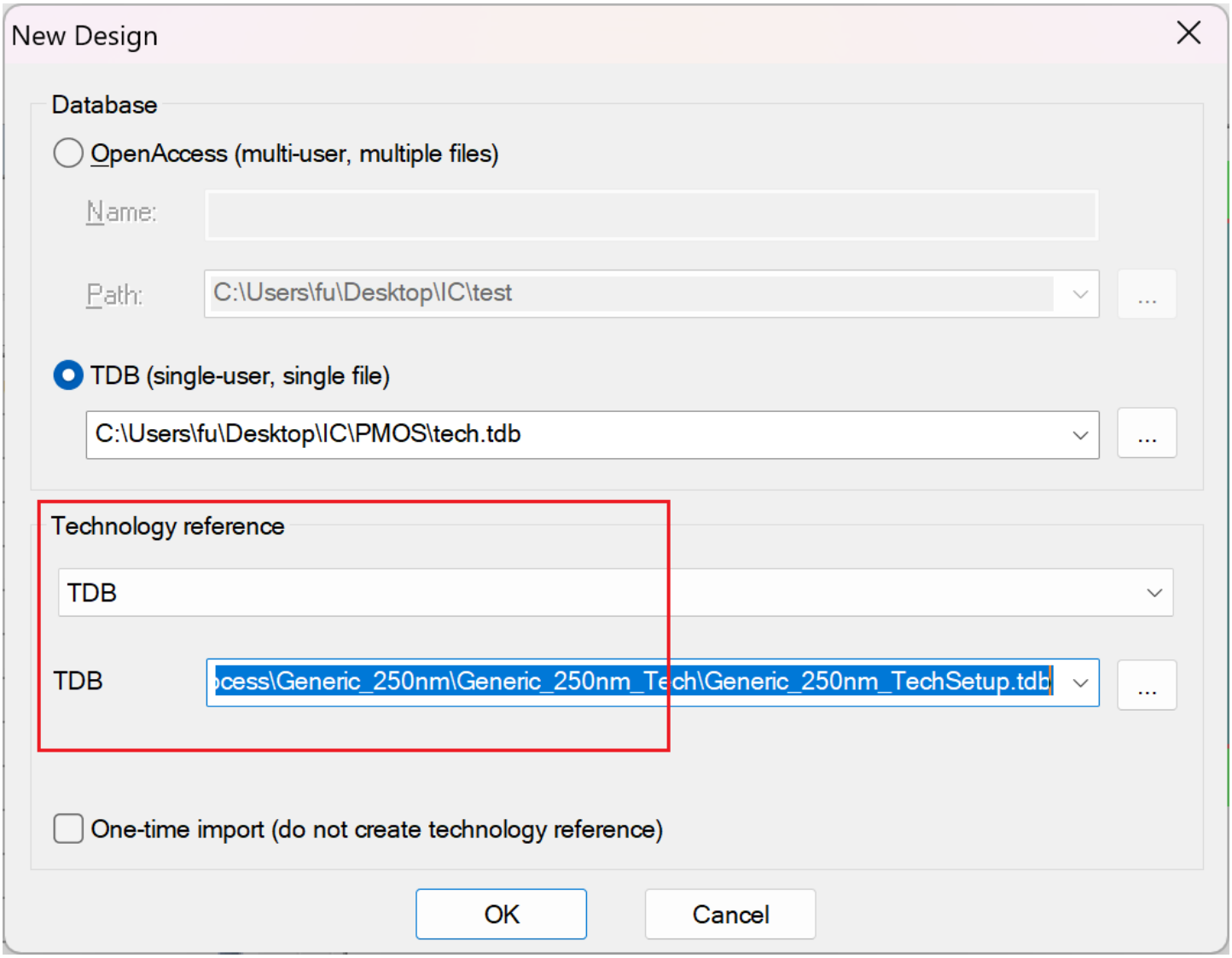


新建有两种数据格式

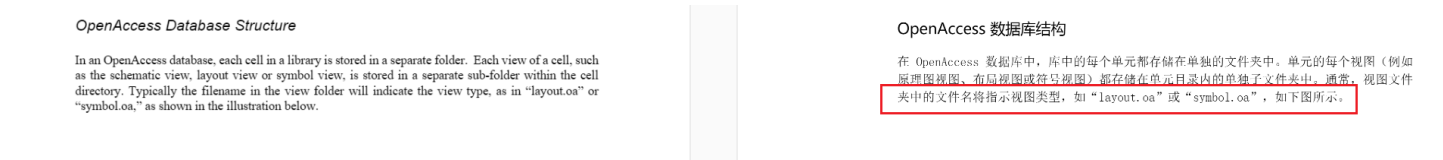

New Design
Database
OpenAccess (multi-user, multiple files)
Name:
文件名
Path:
C:\Users\fu\Desktop\IC\test
路径
...
TDB (single-user, single file)
C:\Users\fu\Desktop\IC\PMOS\tech.tdb
...
Technology reference
None
OK
Cancel


New Design
Database
OpenAccess (multi-user, multiple files)
Name:
Path:
C:\Users\fu\Desktop\IC\test
...
TDB (single-user, single file)
C:\Users\fu\Desktop\IC\PMOS\tech.tdb
新建文件名和对应的路径
...
Technology reference
None
OK
Cancel

工艺基准：



使用导入的TDB设计文件作为当前设计的工艺基准并覆盖本地的工艺基准，比如图层设置，tdb文件中包含了图层信息



OpenAccess Database Structure

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OpenAccess 数据库结构

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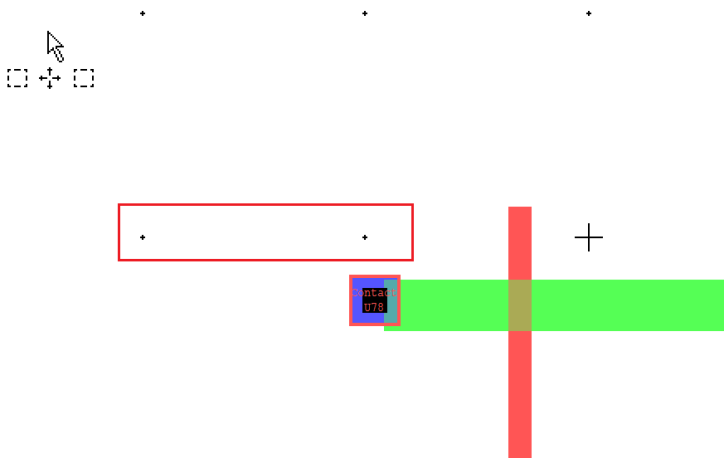
layout视图的文件是以.oa后缀保存的

You also can launch L-Edit with a specific file:

- a **.tdb** file (Tanner database)
- a **lib.defs** file (OpenAccess)
- a **layout.oa** file from a view folder (OpenAccess)

Double-click on the file in Windows Explorer, use **File > Open**, di
used file list to find and launch either of these file types.

ledit.pdf
13.80MB



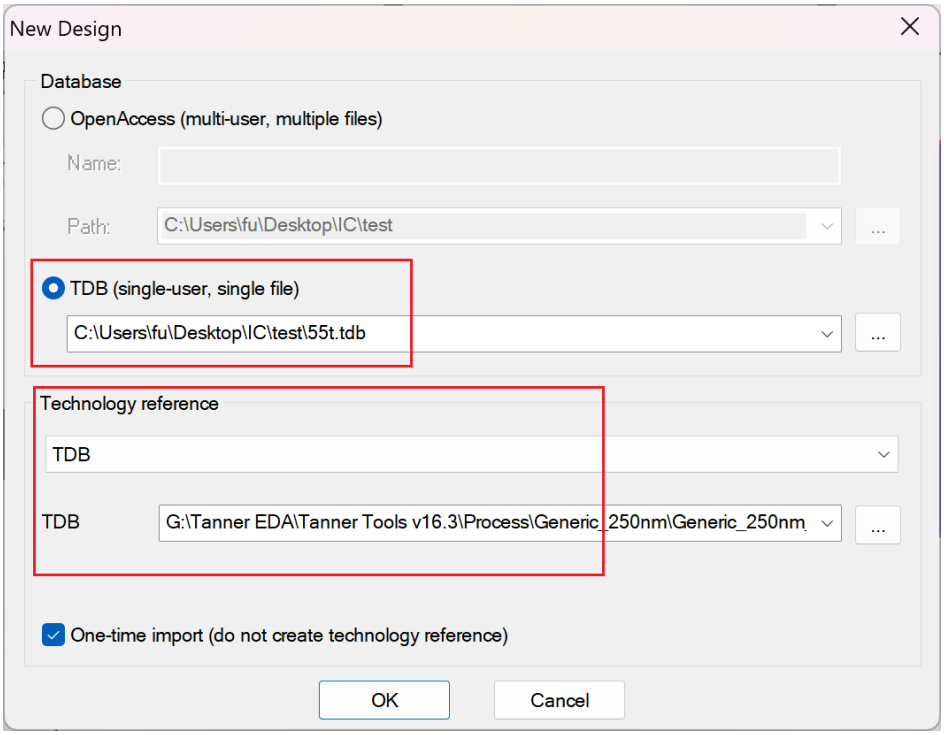
主网格

次要网格线则是相对较细的线，用于在主要网格间隔之间提供更详细的参考

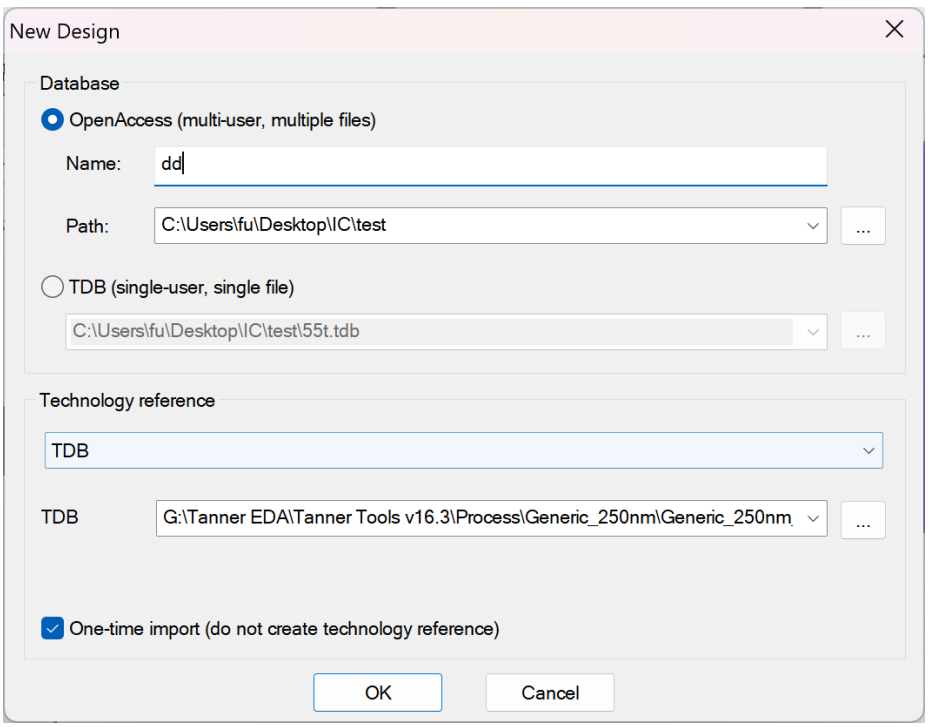
步骤：

新建design:

新建TDB文件，使用250nm工艺库TDB文件



也可以新建一个OA文件，使用250nm工艺库TDB文件

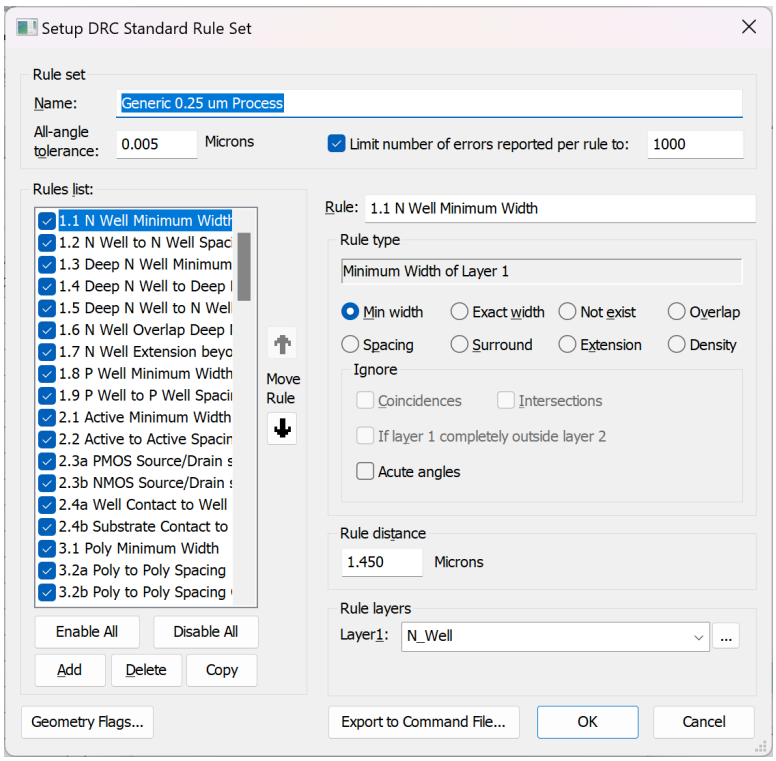


两者只是数据格式不同，可以选择相同的工艺库

Technology Reference Options for a Tanner Database

For a TDB database, the technology reference options are None, Virtuoso or Laker technology (.tf) and display (.drf) files or a Tanner database (.tdb) file. These options behave as described in "Setting the Technology Reference in an OpenAccess Database" on page 50.

DRC规则：



阱层最小宽度的值为1.45微米

P Select层最小宽度的值为0.5微米

有源区的最小宽度为0.35微米

PMOS晶体管的有源区到N阱之间的最小距离为0.75微米

多晶硅栅Poly的最小宽度为0.25微米

栅极伸出有源区的最小长度为0.3微米

有源区接触孔的大小为0.25微米

有源区覆盖有源区接触孔的最小距离为0.15微米

有源区接触孔到栅的最小距离(Active Contact to Gate Spacing)为0.25微米。

Metal1的最小宽度为0.35微米

Poly层覆盖Poly Contact接触孔的最小距离(Poly Overlap of PolyCnt)为0.15微米

金属1包围有源区接触孔的最小距离为0.15微米。

Poly层和Poly层的最小距离为0.5微米。

Poly层和有源区的最小距离为0.2微米。

Metal1层和Metal1层的最小距离为0.35微米。

Metal1和Poly层可以重叠

有源区接触孔之间的最小距离为0.5微米

有源区的边缘和选择层边缘的最小距离(Active to Select Edge)为0.25微米

①—N阱的最小宽度(N Well Minimum Width)；

②—有源区的最小宽度(Active Minimum Width)；

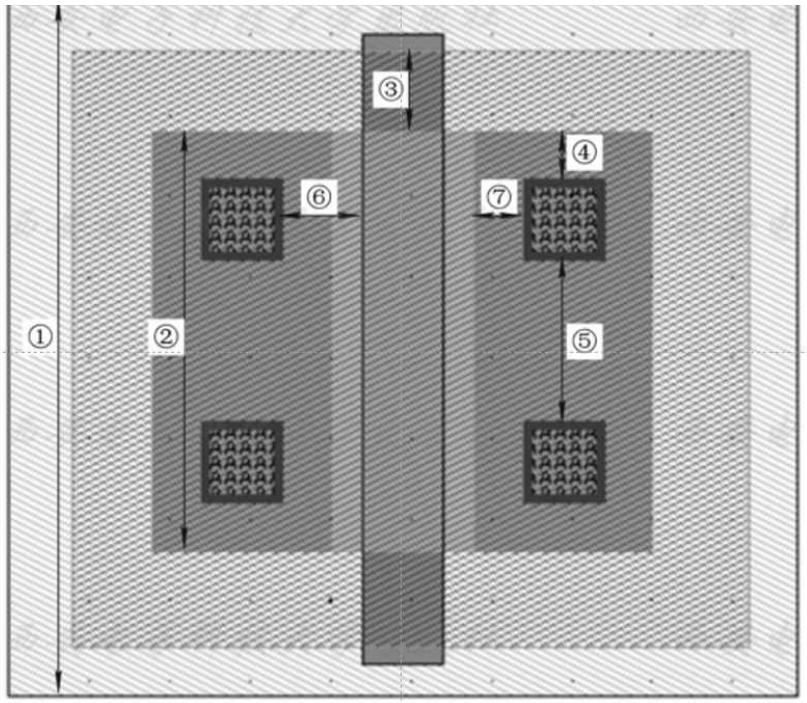
③—栅极伸出有源区的最小长度(Gate Extension out of Active)；

④—有源区包围有源区接触孔的最小长度(Active Overlap of Active Contact)；

⑤—有源区接触孔之间的最小距离(Active Contact to Active Contact Spacing)；

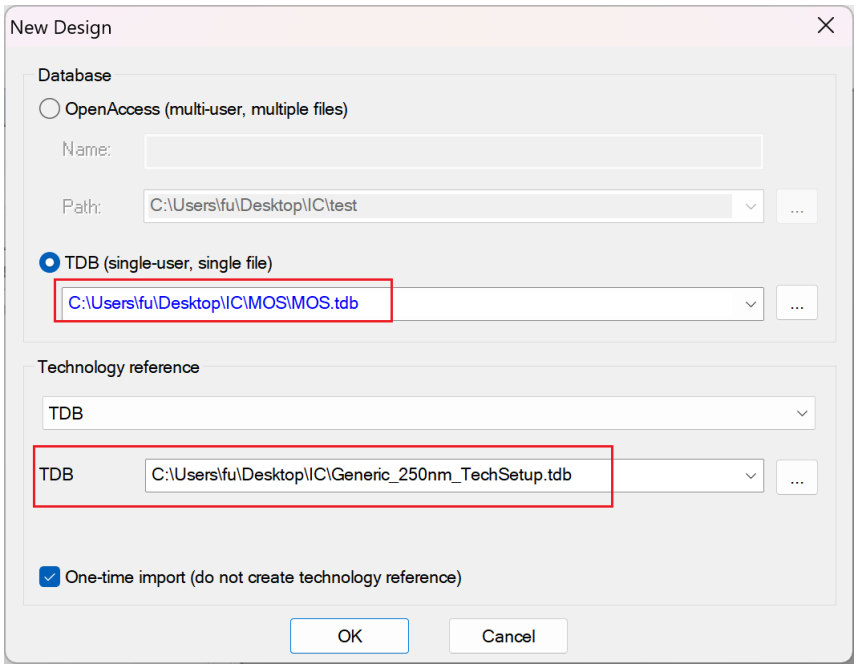
⑥—有源区接触孔到栅极之间的距离(Active Contact to Gate Spacing)；

⑦—金属1层包围有源区接触孔的最小长度(Metal1 Overlap of Active Contact)。

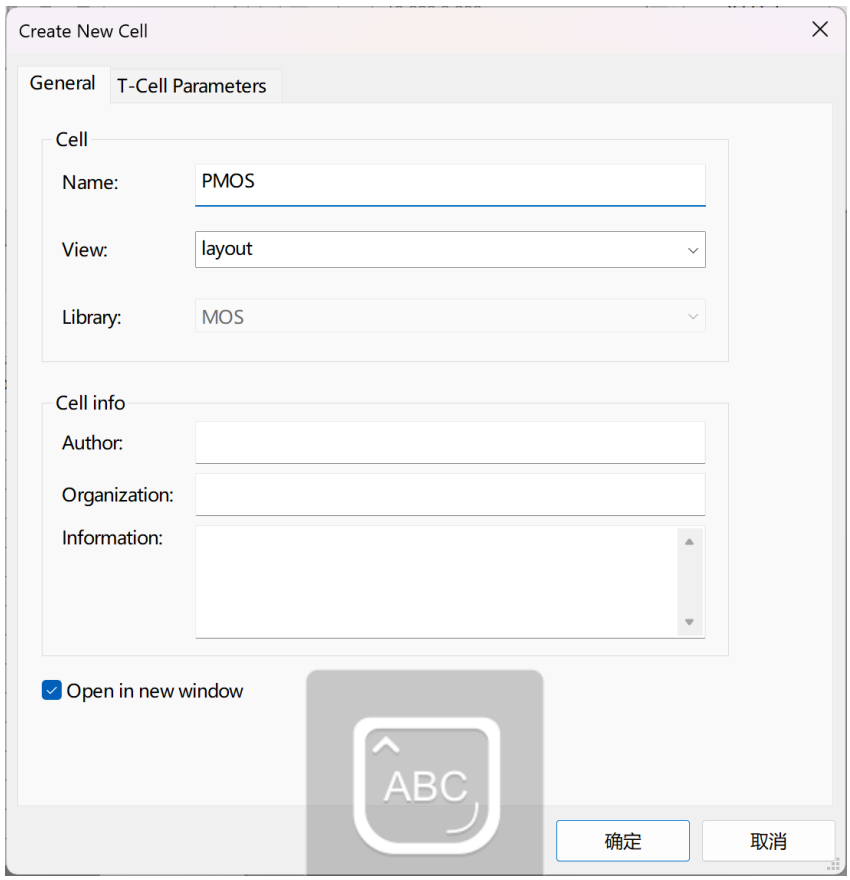


PMOS:

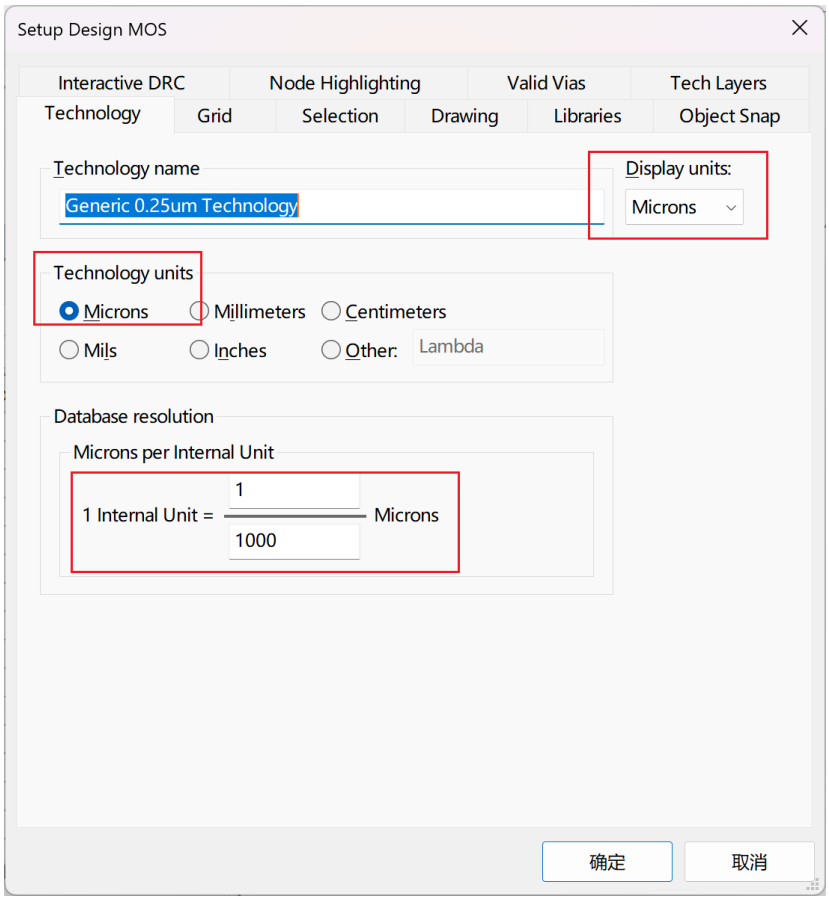
新建design,使用250nm的工艺库



新建一个名为PMOS的layout文件



设置单位



Display units是指显示的数值的单位

Technology units是指版图中测量的单位

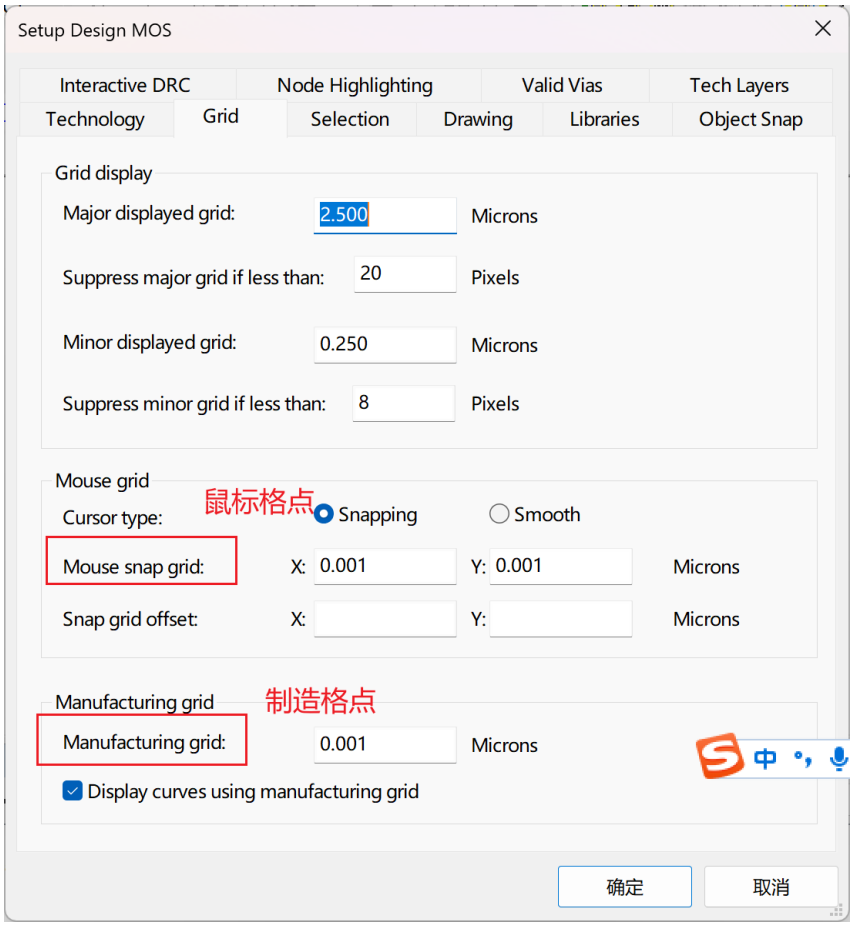
Internal units是指软件画布自身的计量单位，也即是分辨率，需要指定Internal units和Technology units的关系

最小为1个Internal units

For its own computation, L-Edit uses *internal units* (30-bit signed integers). Before beginning your design, it is important that you define the relation between L-Edit's internal units and physical, or *technology,* units, as this will determine the extent of the layout area and the smallest object that can be drawn. This relation is also critical when you replace your design setup or export a design to CIF or GDSII format. Defining this relationship sets the scale of the design file.

The L-Edit layout area extends from -536,870,912 to +536,870,912 internal units in both the *x*- (horizontal) and *y*- (vertical) directions. Thus, if 1 internal unit = 0.001 micron, the largest possible design is 1,073,741 microns (almost 42.3 inches) on a side. Similarly, the smallest dimension L-Edit can define is 1 internal unit. If 1 internal unit = 0.001 micron, the smallest possible feature size would be 0.001 micron. (In practical terms, of course, 0.001 micron is an unrealistically small feature size.)

设置网格



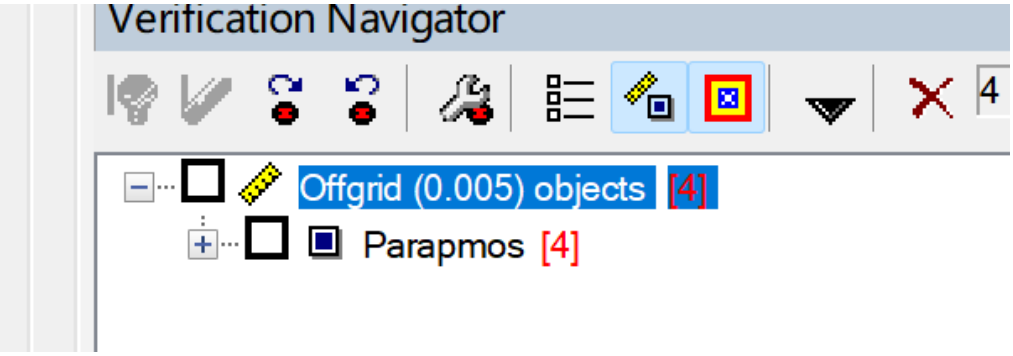
如果vertices(顶点)和instances(实例)不在制造格点上，那么DRC的Flag off-grid会识别到即报错

Manufacturing grid最小一个Internal units

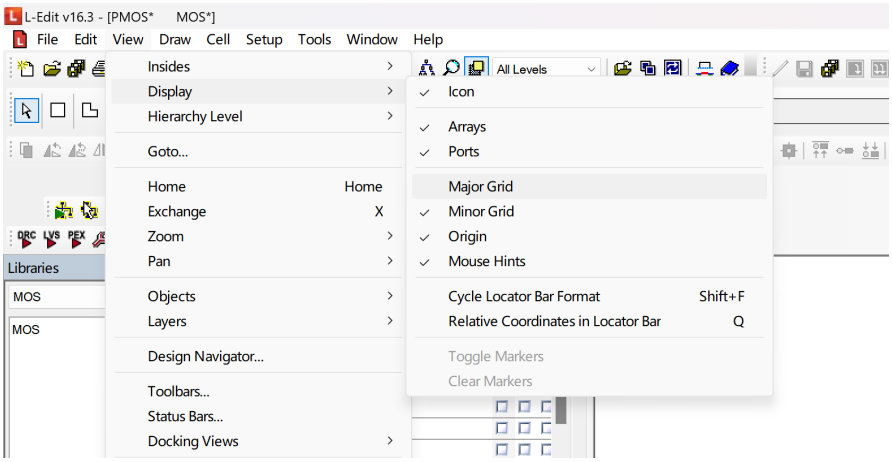
Manufacturing Grid

Sets the absolute spacing of the manufacturing grid.

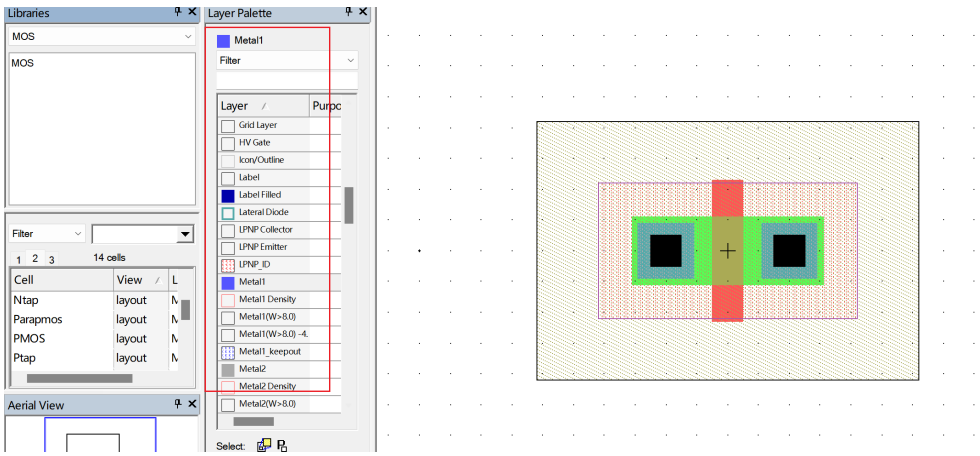
The DRC option **Flag off-grid** identifies vertices and instances that are not on the manufacturing grid.

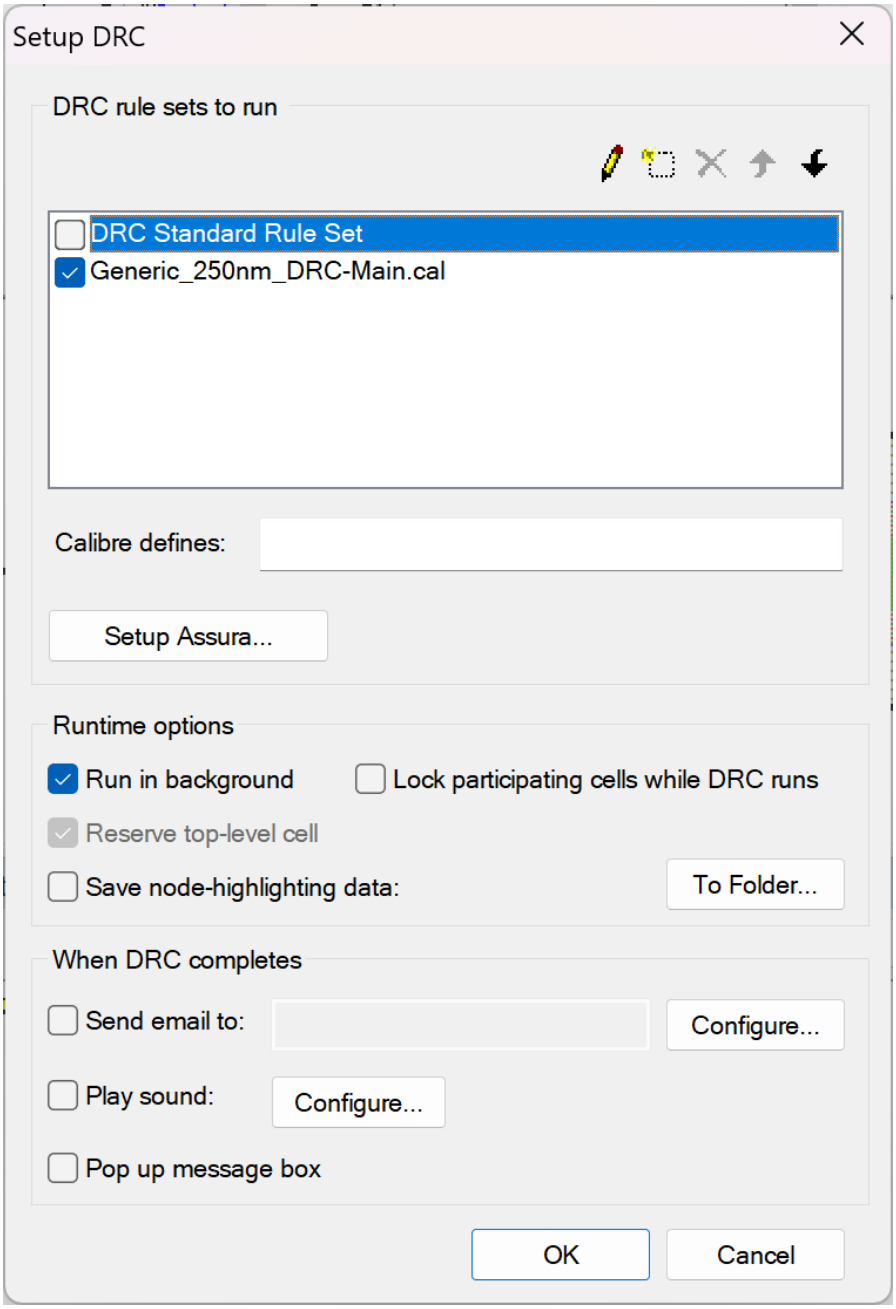


调整显示内容：


L-Edit v16.3 - [PMOS* MOS*]
File Edit View Draw Cell Setup Tools Window Help
Insides
Display
Hierarchy Level
Goto...
Home Home
Exchange X
Zoom
Pan
Objects
Layers
Design Navigator...
Toolbars...
Status Bars...
Docking Views
All Levels
Icon
Arrays
Ports
Major Grid
Minor Grid
Origin
Mouse Hints
Cycle Locator Bar Format Shift+F
Relative Coordinates in Locator Bar Q
Toggle Markers
Clear Markers
Libraries
MOS
MOS

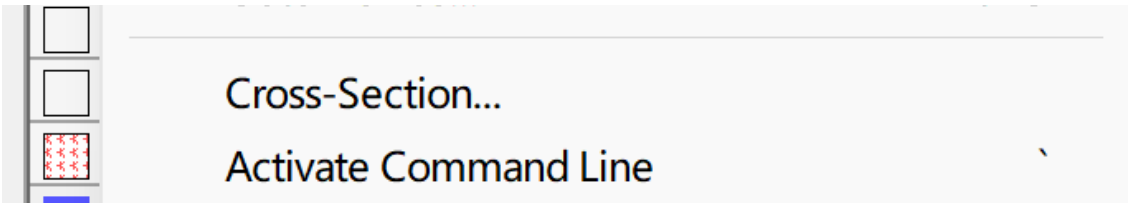
绘制版图，DRC

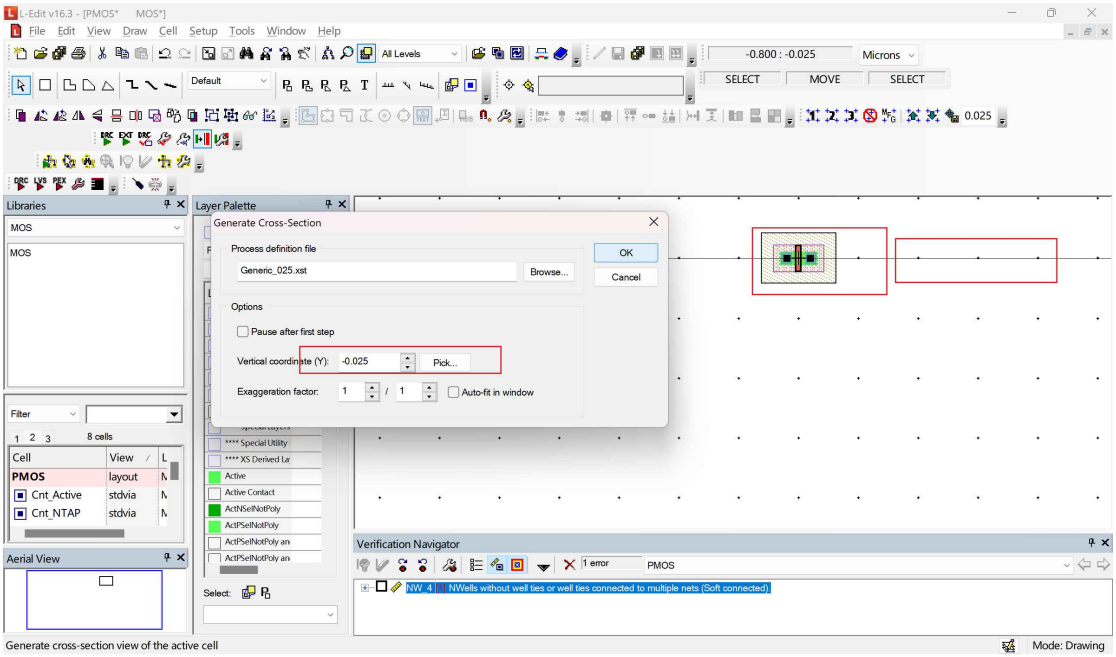

Libraries
MOS
MOS
Filter
1 2 3
14 cells
Cell View L
Ntap layout
Parapmos layout
PMOS layout
Ptap layout
Aerial View
Layer Palette
Metal1
Filter
Layer Purpc
Grid Layer
HV Gate
Icon/Outline
Label
Label Filled
Lateral Diode
LPNP Collector
LPNP Emitter
LPNP_ID
Metal1
Metal1 Density
Metal1(W>8.0)
Metal1(W>8.0) -4.
Metal1_keepout
Metal2
Metal2 Density
Metal2(W>8.0)
Select:

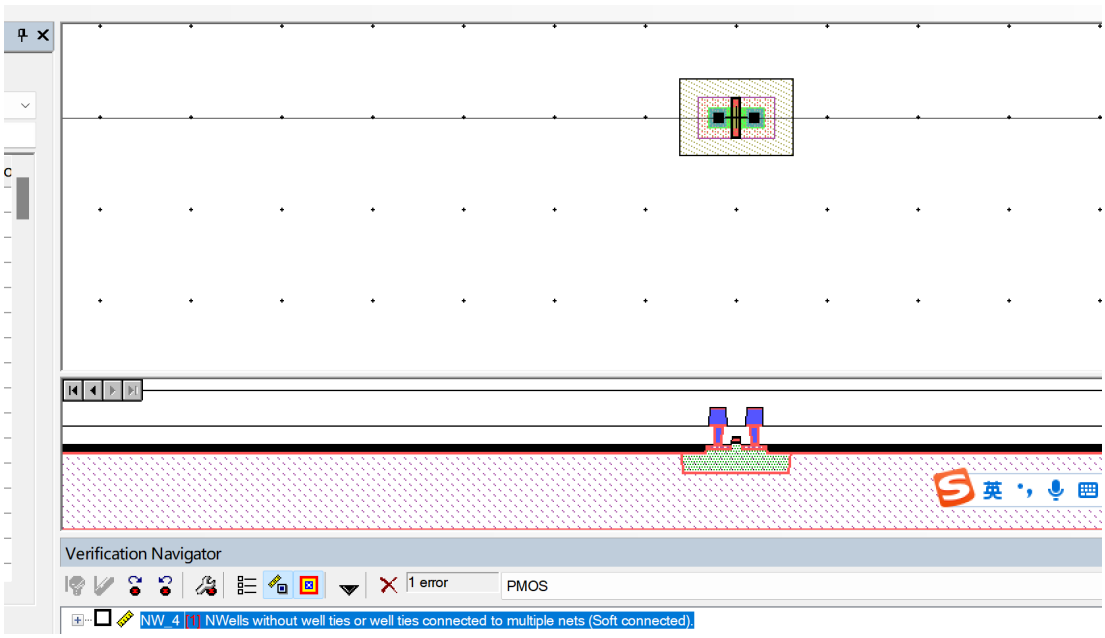


横截面观察：

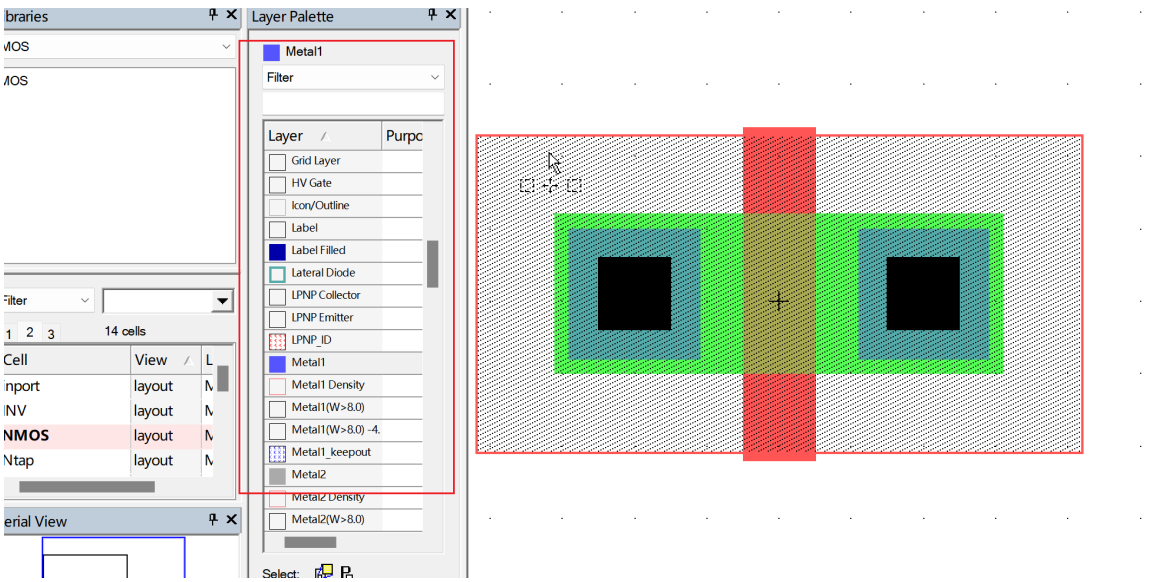
tools-->cross-section



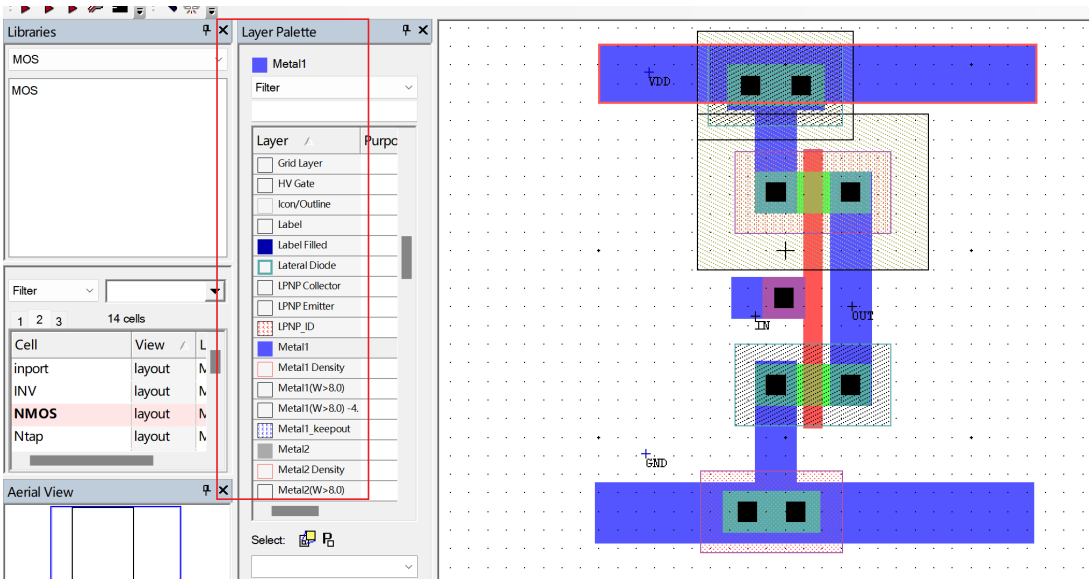

Generate Cross-Section
Process definition file
Generic_025.xst
Browse...
OK
Cancel
Options
Pause after first step
Vertical coordinate (Y): -0.025
Pick...
Exaggeration factor:
Auto-fit in window
Libraries
Layer Palette
Verification Navigator
Aerial View
Generate cross-section view of the active cell
Mode: Drawing


Verification Navigator
1 error
PMOS
NW_4 NWells without well ties or well ties connected to multiple nets (Soft connected).

NMOS:


Layer Palette
Metal1
Filter
Layer
Purpc
Grid Layer
HV Gate
Icon/Outline
Label
Label Filled
Lateral Diode
LPNP Collector
LPNP Emitter
LPNP_ID
Metal1
Metal1 Density
Metal1(W>8.0)
Metal1_keepout
Metal2
Metal2 Density
Metal2(W>8.0)
14 cells
NMOS
Select:

反相器：



并联晶体管：

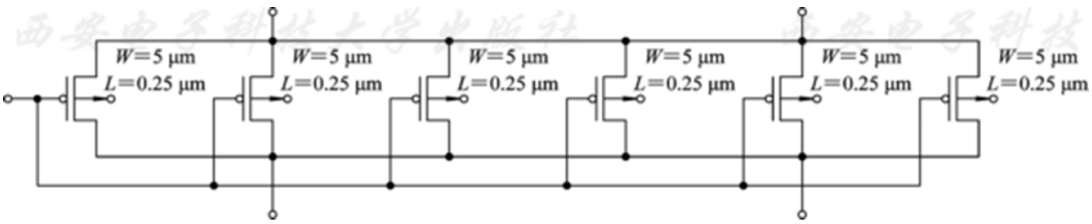
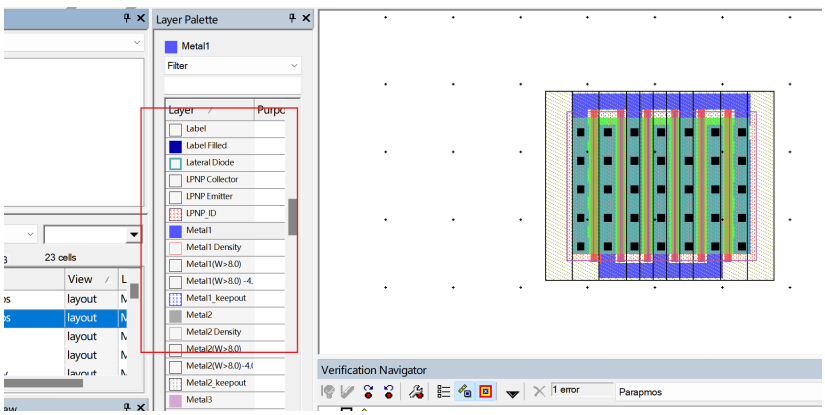


图6.36 拆分后的晶体管电路图



串联晶体管：

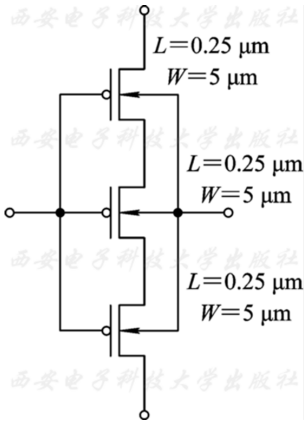
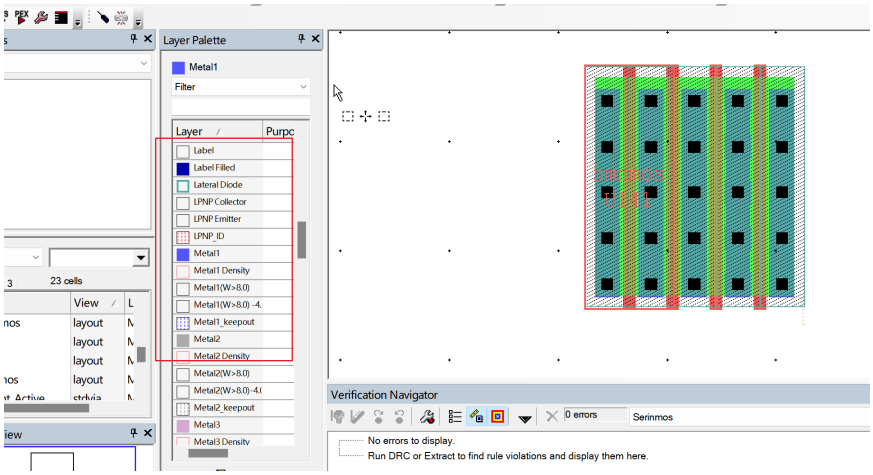
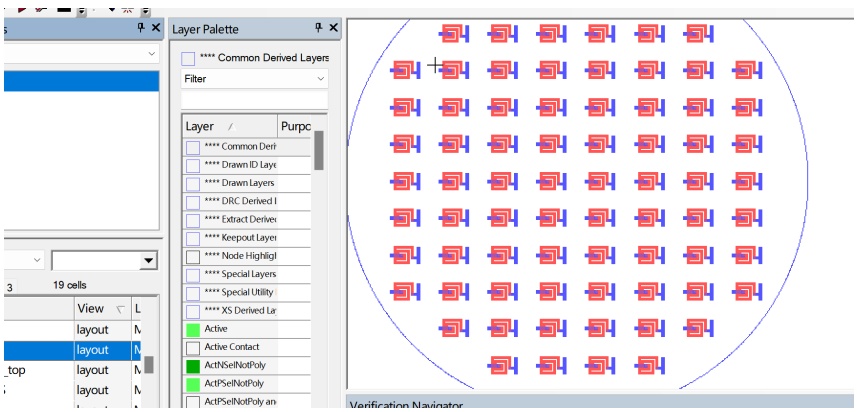


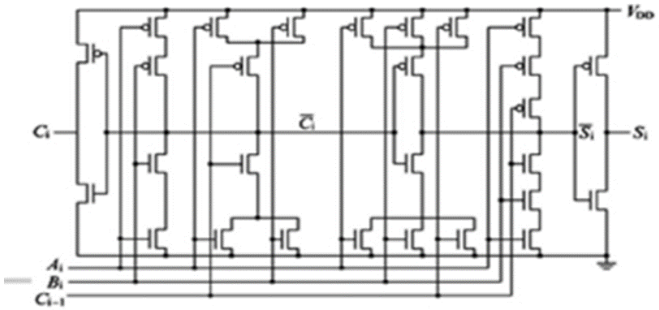
图6.49 三个串联的NMOS晶体管电路图



MEMS：

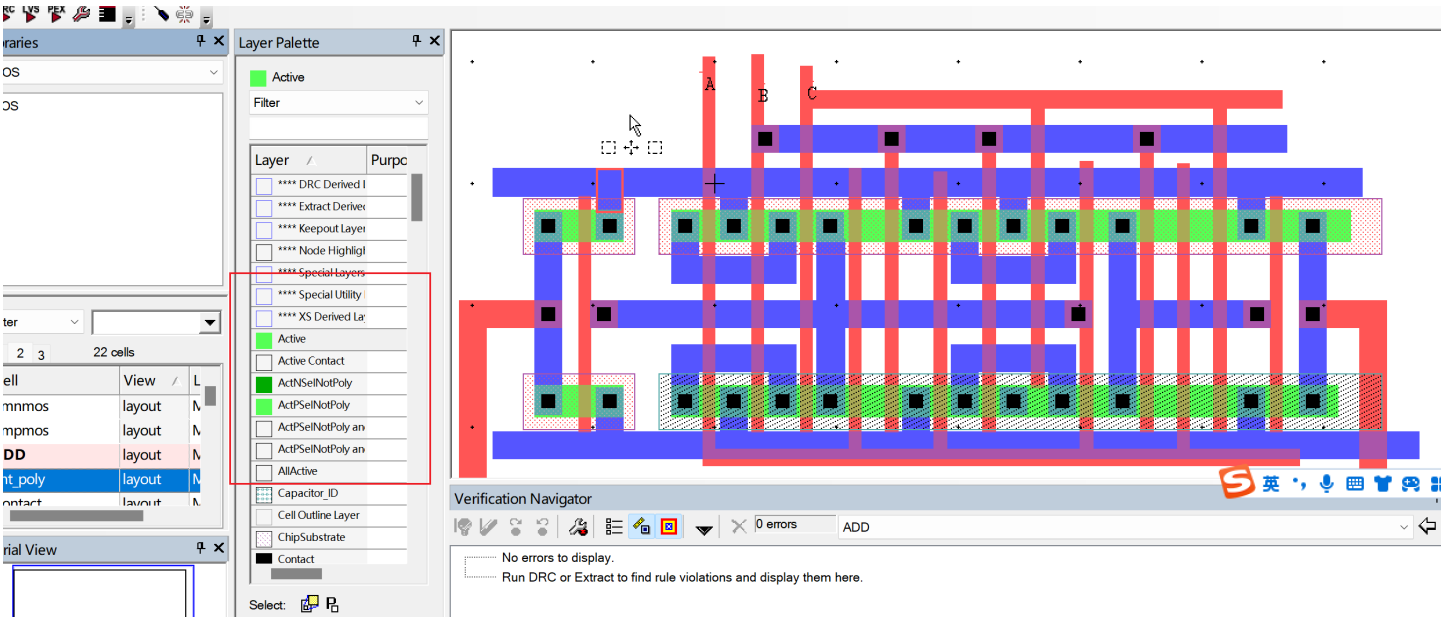


28管1bit全加器：

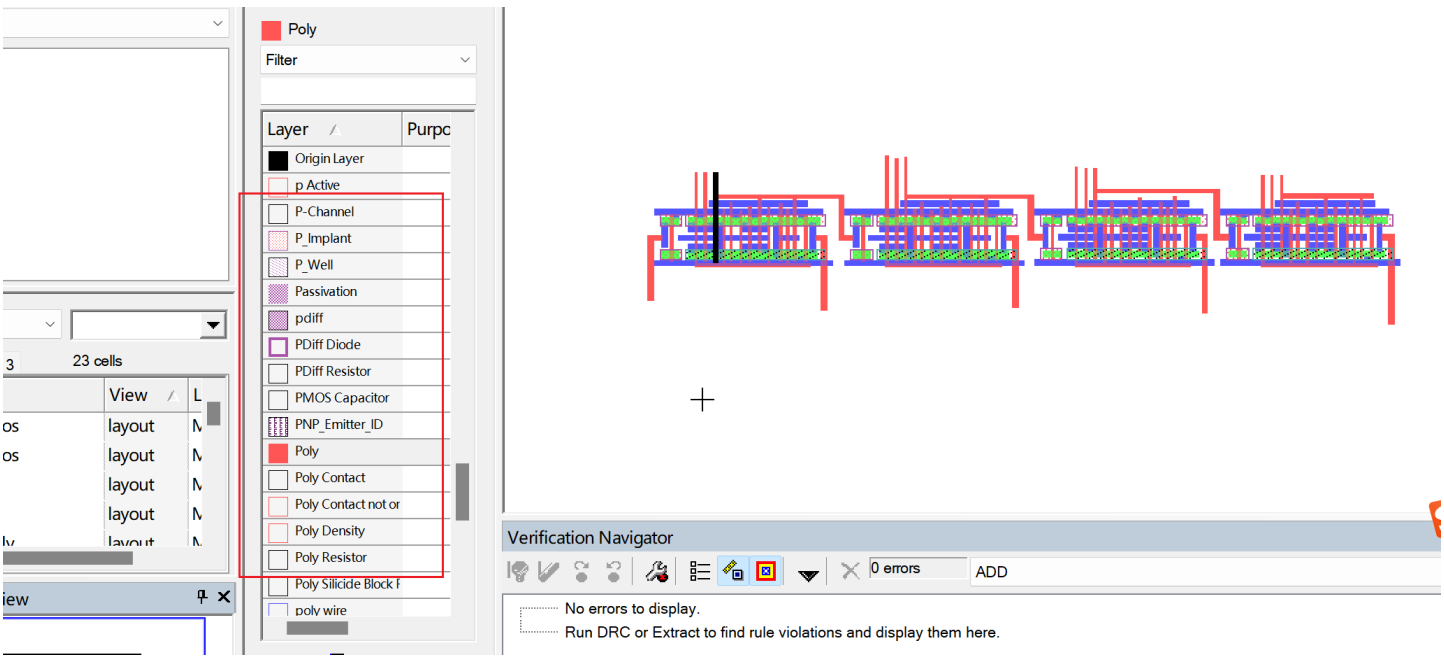


$$S=(A+B+C)CO+ABC$$

$$CO=AB+(A+B)C$$



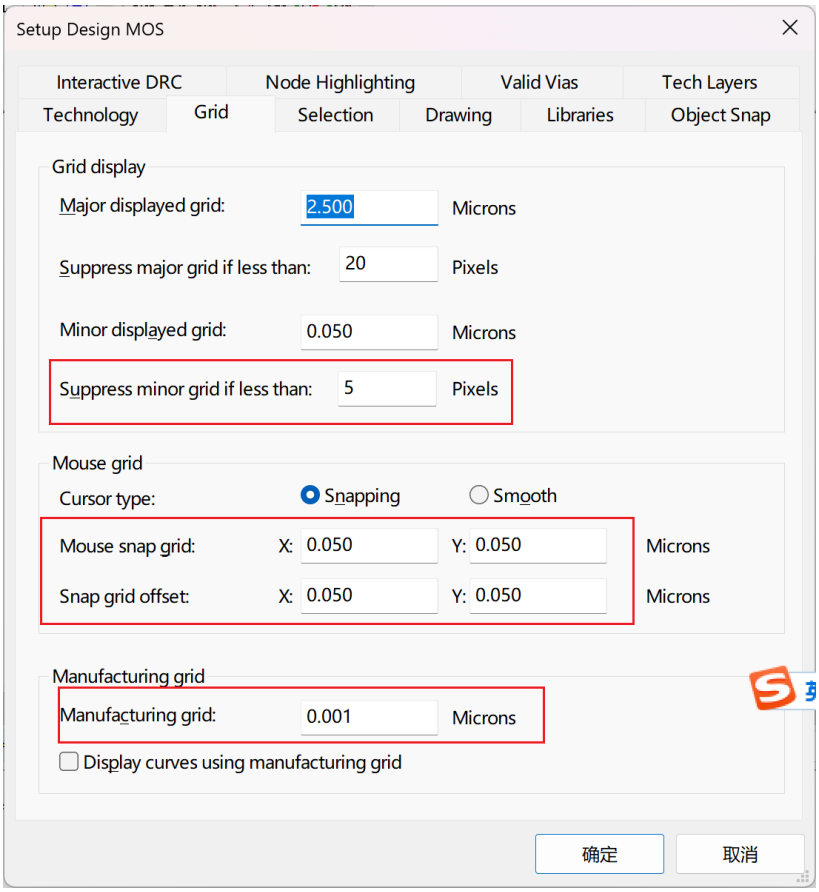
4bit28管全加器：

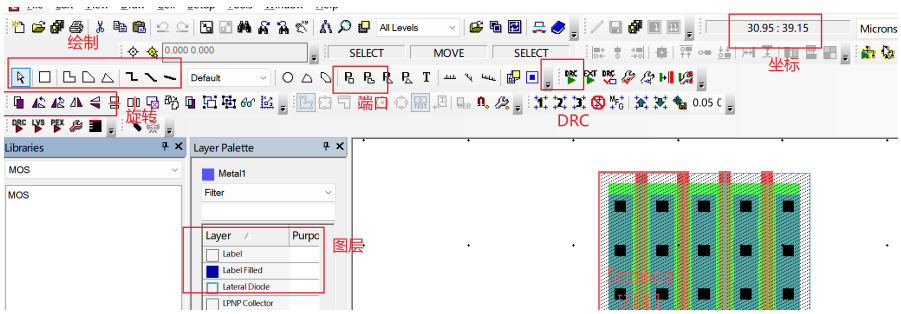


技巧：

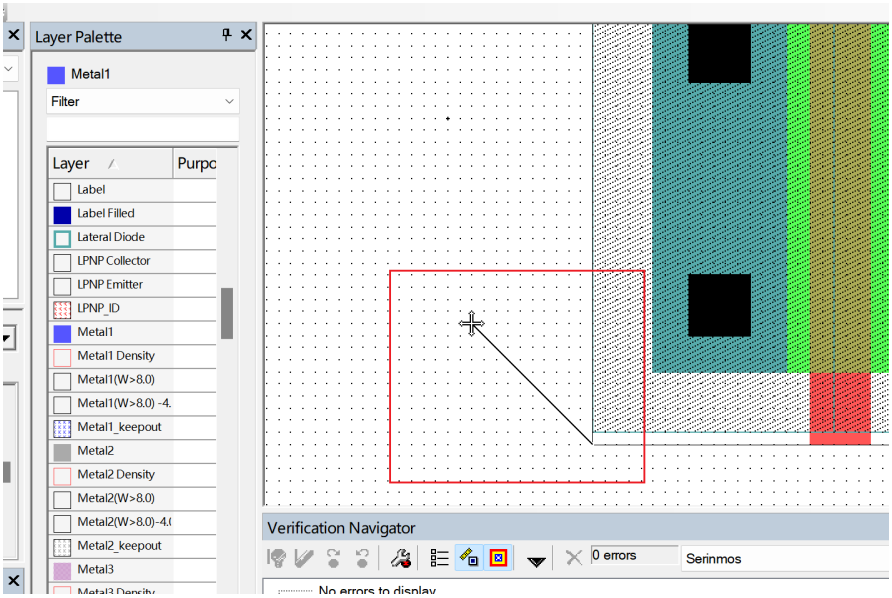
使用键盘方向键移动的时候默认是0.05进行移动的，所以鼠标格点最好设置为0.05，这样移动的时候，容易对齐

画布放大之后，可以控制次格点显示





移动的时候，使用飞线会移动到端点处



坐标，根据DRC规则移动，不要随意拖动，拖动后容易不对齐