Sky130 FILLGEN User Guide July 22, 2025

Sky130 Fill Generation and Insertion
Beta Version 08 - June 25, 2025

Fill Generation and Insertion

GENERAL NOTES:

[1] The Sky130 FILLGEN directory contains scripts and control files to run fill generation and insertion. The scripts use Pegasus for fill generation and Pegasus Design Review for insertion of the generated fill into the user's oasis or GDS file. There are supplemental scripts to import the resulting oasis / GDS file into Virtuoso.
[2] For best results, fill generation should be run at the chip level with seal ring properly placed.
[3] If the user does not have a Pegasus Design Review license, the created fill file can be imported into the layout tool and the top level fill cell placed in the user's top level design at the origin (0,0).
[4] When importing the top level fill into the layout tool, always create a new library. ***DO NOT*** import the generated fill file directly into design library.
[5] Fill cells are used to fill the diff and poly layers, since diff fill and poly fill cannot overlap. These cells are provided in Oasis and GDS format.

FLOW NOTES:

[1] The flow described here is for the Oasis flow (all input, output files in Oasis format)
[2] The steps for the GDS flow are similar
[3] The poly-diff fill cells are found in these provided files:
    Oasis flow: poly_diff_3_10_25.oasis
    GDS flow: poly_diff_3_10_25.gds.gz
[4] Oasis flow is recommended as the file sizes will be smaller
[5] **If Pegasus Design Review is NOT used**, the contents of the poly-fill cells must be updated by hand; please refer to the USAGE section below.

OVERVIEW:

This directory contains a "beta" fill generation routine and control scripts.

Flow:
[1] Export oasis file of top level design from Virtuoso
[2] Run fill generation routine; creates separate Oasis file
[3a] Insert poly-diff fill cell into fill file from [2]; creates new Oasis file
[3b] Insert fill file from [3a] into top level design; creates new Oasis file
[4] Import design Oasis file with fill from [3b] into Virtuoso
[5] Run SKY130 DRC

Steps 3a & 3b require the use of Pegasus Design Review.
User can instead import the Oasis / GDS files into their layout tool for insertion.

CONTENTS:

README - Usage notes
fillgen.pvl - Pegasus fill generation deck
Oasis_flow - Directory with scripts and files to run Oasis flow
GDS_flow - Directory with scripts and files to run GDS flow

USAGE:

[1] ENV Variables

User should have the following ENV variables set appropriately (examples):

```
setenv PDK_HOME    /projects/SkyWater/sky130_release_0.0.9
setenv PEGASUS_DRC /projects/SkyWater/Sky130_DRC_rev_0.0_2.12
```

[2] Libraries

For oasisin / oasisout to work, cds.lib must be present in the run directory and updated to point to user's design libraries.

[3] Poly & diff fill cell

The fill cell oasis file must be present in the run directory:

poly_diff_3_10_25.oasis (or poly_diff_3_10_25.gds.gz for GDS flow)

[4] Fill generation Pegasus routine

The file "fillgen.pvl" must be copied to the run directory.

[5] Executable Files

```
step1_oasisout.csh      - makes top level design Oasis file:  CELLNAME.oasis
step2_fillgen.csh       - makes fill Oasis file:              CELLNAME.fill.oasis
step3_merge.csh         - merges fill cell & fill data into top level:
    3a: Inserts the poly_diff fill cells into fill, outputs:  CELLNAME.fill_aref.oas
    3b: Inserts fill data into top level, outputs:            CELLNAME.wFill.oas
step4_oasisin.csh       - makes Virtuoso library (user controlled library name)
step5_sky130_DRC.csh    - runs sky130 DRC on resulting filled data
```

[6] Control Files

```
step 2:  fill_CTL.pvl
step 3a: pdr_CTL_aref
step 3b: pdr_CTL
step 5:  drc_CTL.pvl
```

[7] Edits

** In all executable and control files, the following changes must be made: **

CELLNAME -> change to the user's top level layout cell name to fill

In "step1_oasisout.csh"
"-libary" option must be updated
"-layerMap" option must be updated

In "step4_oasisin.csh"
"-library" option can be changed as desired
"-layerMap" option must be updated

In "step5_run_sky130_DRC.csh" the "-run_dir" option can be changed as desired.

[8] Outputs

CELLNAME.oas	- top level Oasis file, created by step 1
CELLNAME.fill.oas	- fill (only) Oasis file, created by step 2
CELLNAME.fill_aref.oas	- fill (only) file, with poly-fill cell inserted
CELLNAME.wFill.oas	- top level Oasis file, with fill inserted !!

step 4 will create the Virtuoso library locally
step 5 will create the DRC run directory locally

[9] Execution

Steps 1, 4, and 5 are optional and are provided to allow a fully batch flow.

Step 2 (fill generation) and Step 3 (fill insertion) are required; Step 2 must be run before Step 3.

Notes on the poly-fill cell:

Step 2 will create 3 “placeholder” cells in the fill oasis file (CELLNAME.fill.oas). These cells are called:
poly_fill_3_FILL / poly_fill_10_FILL / poly_fill_25_FILL
Step 3 will replace all occurrences of the above with the correct fill cells:
poly_fill_3_FILLCELL / poly_fill_10_FILLCELL / poly_fill_25_FILLCELL

If Pegasus Design Review is not used, here are the steps needed to insert the fill:
[1a] Import the top fill file (CELLNAME.fill.oas) into the layout tool (*do not import into the design library*!);
[1b] The top fill cell name will be called: CELLNAME_FILL
[1c] The poly-fill placeholder cells will be called: poly_diff_3_FILL / poly_diff_10_FILL / poly_diff_25_FILL
[2a] Import the poly-fill cell (poly_diff_3_10_25.oasis) into the layout tool
[2b] The poly-fill cells will be called: poly_fill_3_FILLCELL / poly_fill_10_FILLCELL / poly_fill_25_FILLCELL
[3] Replace the contents of “poly_diff_#_FILL” with the contents of “poly_diff_#_FILLCELL”
[4] In the top level design layout (CELLNAME), place the top fill cell (CELLNAME_FILL) at the origin (0,0).