

Title: EmpowerSoC flow for Active Power Estimation of SOC

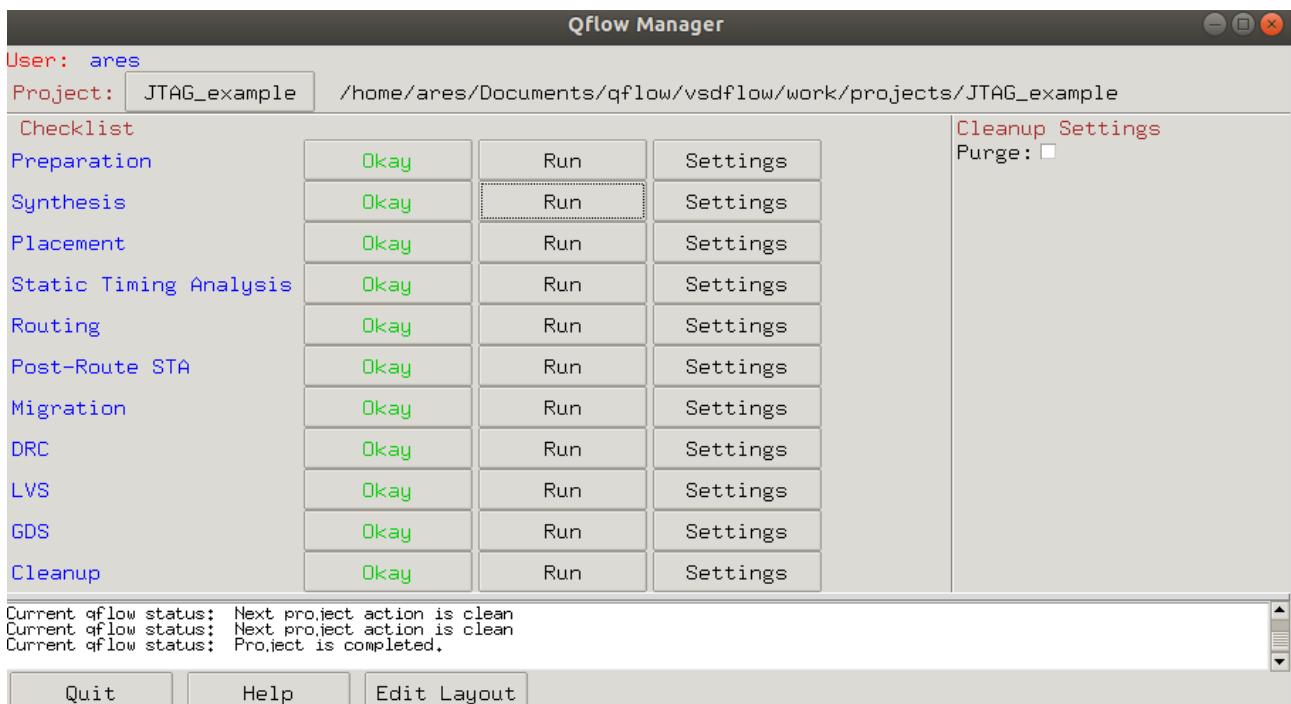
EmpowerSoC is an open-source EDA tool for power estimation of SoC. It has been developed alongside the existing Qflow open-source tool chain which is currently being used for implementation of RTL to GDSII flow.

The development work was carried out by Mr. Akshat Jain, Mr. Nimesh Shahdadpuri , Mr. Sagar Yadav and Mr. Naveen Dugar, bonafide students at NSUT under the guidance of Dr. Kunwar Singh, Assistant Professor, Department of ECE, Netaji Subhas University of Technology.

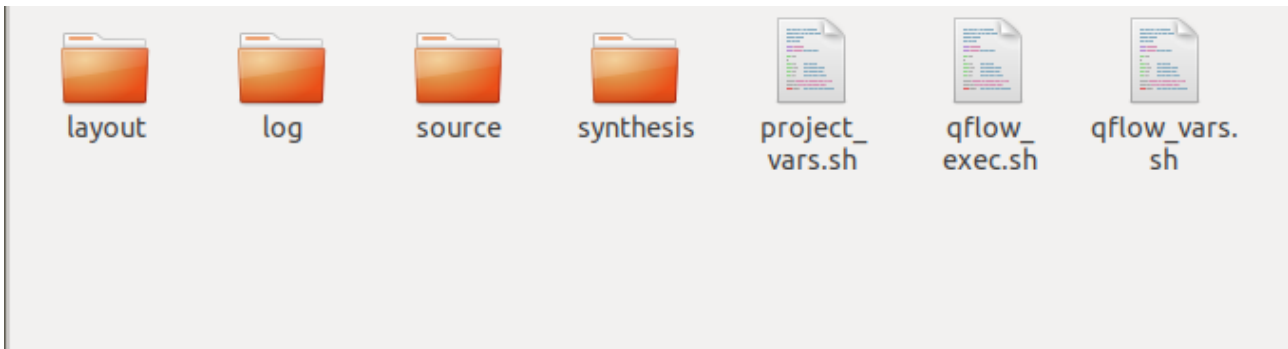
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- ➔ Download the provided example source code verilog files for Jtag.
- ➔ Make project directory “**JTAG_Example**” and “**source**” directory inside JTAG_Example. Paste the JTAG verilog files inside source folder. Use the following commands-
 - mkdir JTAG_Example
 - cd JTAG_Example
 - mkdir source
 - mv <source_location> ./source/tap_top.v
 - mv <source_location> ./source/tap_defines.v
- ➔ In the **JTAG_Example** directory, open the qflow gui using terminal window and run the RTL2GDS flow by selecting required parameters.



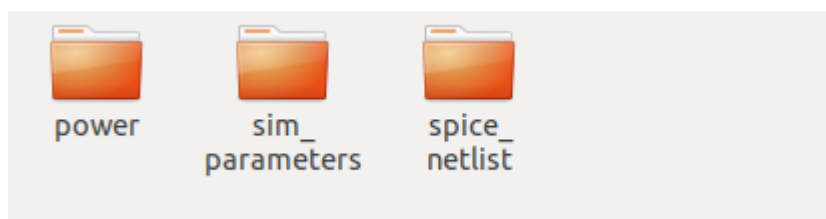
- ➔ After completion of RTL2GDS, these below mentioned folders should be created in the project directory.



- ➔ Now, inside the project directory Jtag_example, right click and select open in terminal. Run the command “empower” in terminal to start EmpowerSoC.

- ➔ EmpowerSoC directory will be created in your project directory. It will contain 3 sub directories-

- ➔ Power – Contains the calculated power values.
- ➔ Spice Netlist - Contains the spice netlists for all the standard cells
- ➔ Sim_Parameters – Contains the saved project simulation parameters which can be loaded directly in the future.



- ➔ In the GUI, by changing tabs you can switch between Standby Power estimation and Active Power estimation.

The screenshot displays the EmPowerSOC GUI window titled "EmPowerSOC : tap_top". It features a menu bar with "File" and "Help". Below the menu bar are two tabs: "Active Power Consumption" and "Standby Power Consumption". A blue arrow points to the "Standby Power Consumption" tab, indicating the current active state. The main interface is divided into two columns. The left column, labeled "tms_pad_i", contains a radio button for "Pulse" (which is selected) and a series of input fields for "Initial Value [V]", "Pulsed Value", "Delay", "Rise Time", "Fall Time", "Pulse Width", and "Period". Below these fields is an "Add Pulse" button. There is also a radio button for "DC Input" and a "Value [V]" input field with an "Add Input" button. The right column, labeled "tdo_pad_o", has a "Value" input field with an "Add Load" button. Below this, there are input fields for "Supply Value [V]", "Stop Time", and "Time Step Size". At the bottom of the right column is an "Add Model file" button. A large empty rectangular box occupies the bottom center of the GUI. At the very bottom, there are two orange buttons: "Review Simulation Parameters" and "Run Simulation".

➔ Apply input pulses to all the required ports and add DC inputs wherever required.

The screenshot displays the 'EmPowerSOC : tap_top' application window. It features a menu bar with 'File' and 'Help'. Below the menu bar are two tabs: 'Active Power Consumption' (selected) and 'Standby Power Consumption'. The 'Active Power Consumption' tab contains two main sections. The left section is for 'tms_pad_i' and includes a radio button for 'Pulse' (selected) and a radio button for 'DC Input'. The 'Pulse' section has input fields for 'Initial Value [V]', 'Pulsed Value', 'Delay' (0p), 'Rise Time' (10p), 'Fall Time' (10p), 'Pulse Width' (1n), and 'Period' (2n), followed by an 'Add Pulse' button. The 'DC Input' section has a 'Value [V]' field and an 'Add Input' button. The right section is for 'tdo_pad_o' and includes a 'Value' field, an 'Add Load' button, a 'Supply Value [V]' field, 'Stop Time' and 'Time Step Size' fields, and an 'Add Model file' button. At the bottom of the window are two large orange buttons: 'Review Simulation Parameters' and 'Run Simulation'. A blue arrow points upwards towards the 'DC Input' radio button.

- ➔ Specify the load capacitances for the output nodes. And add the Supply Value, simulation time and time step for simulation.

The screenshot shows the 'EmPowerSOC : tap_top' window with the 'Active Power Consumption' tab selected. The interface is divided into two main sections: 'tms_pad_i' (input) and 'tdo_pad_o' (output). The 'tms_pad_i' section has a 'Pulse' radio button selected, with fields for Initial Value [V], Pulsed Value, Delay, Rise Time, Fall Time, Pulse Width, and Period. Below these are 'Add Pulse' and 'Add Input' buttons. The 'tdo_pad_o' section has a 'Value' field set to '10pf' and an 'Add Load' button. To the right of the 'tdo_pad_o' section are fields for 'Supply Value [V]' (1.8), 'Stop Time' (40n), and 'Time Step Size' (10p). At the bottom right is an 'Add Model file' button with a text field containing the path 's:/Documents/qflow/vsdfow/work/scripts/SampleLib.mod'. Two blue arrows point upwards: one from the 'Add Model file' button to the 'Add Load' button, and another from the bottom of the window to the 'Add Model file' button. At the very bottom are 'Review Simulation Parameters' and 'Run Simulation' buttons.

- ➔ Add the model file for NMOS and PMOS. We have provided a sample model file for reference.

Note: If you want to use your own model parameters, kindly ensure the library name and model name are same as the one in sample model file provided.

➔ Review the simulation parameters. Make any changes if necessary.

EmPowerSOC : tap_top

File Help

Active Power Consumption Standby Power Consumption

tms_pad_i tdo_pad_o

☒ Pulse

Initial Value [V]

Pulsed Value

Delay 0p

Rise Time 10p

Fall Time 10p

Pulse Width 1n

Period 2n

Add Pulse

☐ DC Input

Value [V]

Add Input

Value 10pf

Add Load

Supply Value [V] 1.8

Stop Time 40n

Time Step Size 10p

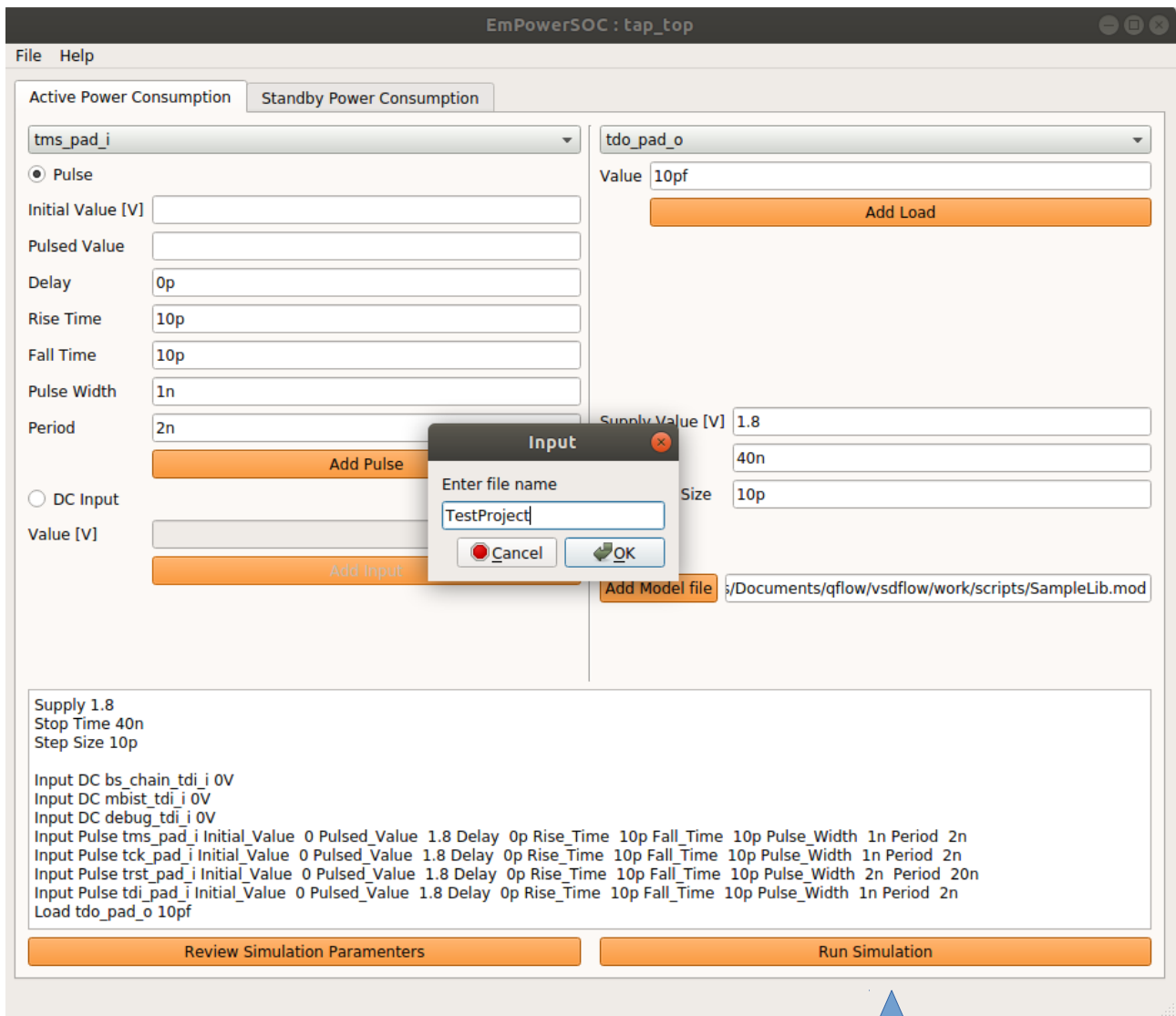
Add Model file s:/Documents/qflow/vsdfow/work/scripts/SampleLib.mod

Supply 1.8
Stop Time 40n
Step Size 10p

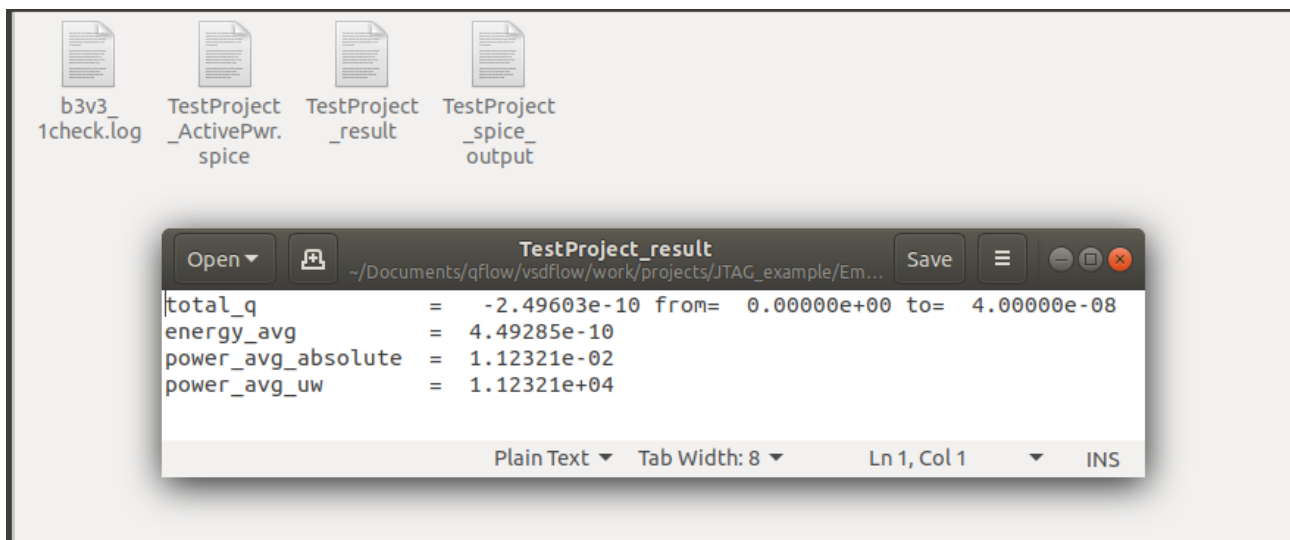
Input DC bs_chain_tdi_i 0V
Input DC mbist_tdi_i 0V
Input DC debug_tdi_i 0V
Input Pulse tms_pad_i Initial_Value 0 Pulsed_Value 1.8 Delay 0p Rise_Time 10p Fall_Time 10p Pulse_Width 1n Period 2n
Input Pulse tck_pad_i Initial_Value 0 Pulsed_Value 1.8 Delay 0p Rise_Time 10p Fall_Time 10p Pulse_Width 1n Period 2n
Input Pulse trst_pad_i Initial_Value 0 Pulsed_Value 1.8 Delay 0p Rise_Time 10p Fall_Time 10p Pulse_Width 2n Period 20n
Input Pulse tdi_pad_i Initial_Value 0 Pulsed_Value 1.8 Delay 0p Rise_Time 10p Fall_Time 10p Pulse_Width 1n Period 2n
Load tdo_pad_o 10pf

Review Simulation Parameters Run Simulation

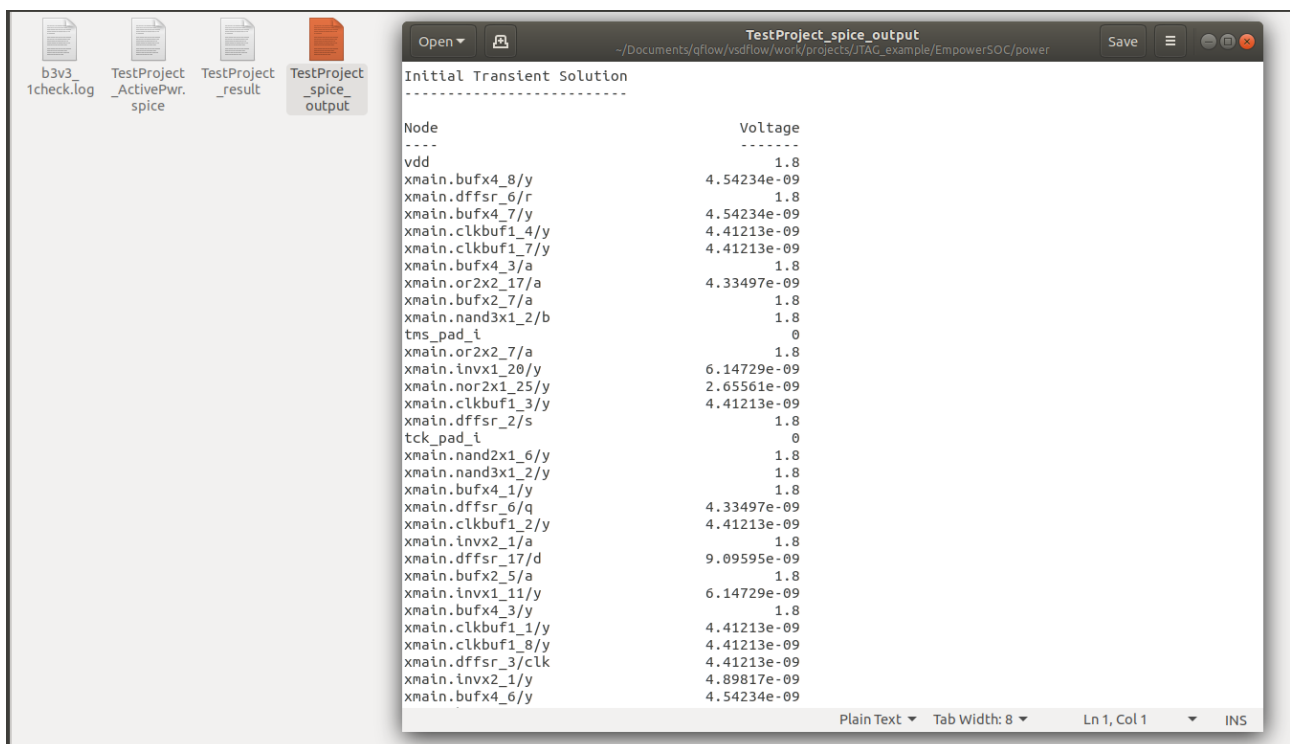
- ➔ Finally, run the simulator. You will be asked to provide a name for your project in order to save it.



- The Estimated Power will be saved as a text file TestProject_result in the EmpowerSOC>Power directory.



- The complete ngspice output will also be saved.



- ➔ In future, you can load these parameters directly into the tool by going into File>Open, and then selecting the simulation parameters file for that project.

