Lattice Radiant Power Calculator Tutorial

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Type Conventions Used in This Document

Convention	Meaning or Use
Bold	Items in the user interface that you select or click. Text that you type into the user interface.
<*Italic*>	Variables in commands, code syntax, and path names.
Ctrl+L	Press the two keys at the same time.
`Courier`	Code examples. Messages, reports, and prompts from the software.
`...`	Omitted material in a line of code.
`.` `.` `.`	Omitted lines in code and report examples.
`[ ]`	Optional items in syntax descriptions. In bus specifications, the brackets are required.
`( )`	Grouped items in syntax descriptions.
`{ }`	Repeatable items in syntax descriptions.
`|`	A choice between items in syntax descriptions.

Contents

Lattice Radiant Power Calculator Tutorial

Power Calculator is a tool that helps you to estimate and analyze power consumption during the various stages of your design. Whether you are new to FPGA or a longtime designer, you will be able to make better design decisions every step of the way using this tool. As a result, you will have better understanding of the power characteristics of your design, which will enable you to make better decisions every step of the way.

About the Tutorial

This tutorial shows you how to use Power Calculator to acquire accurate and comprehensive power usage data.

In this tutorial, you will:

- Review the basics of power consumption in FPGA design
- Go over the key elements of the Power Calculator interface
- Choose design options and analyze impact on power consumption
- Learn to use specific features to speed up your process
- Compare Power Calculator results in Estimation mode and in Calculation mode.

Time to Complete

About 45 minutes.

System Requirements

- The Lattice Radiant software is required to complete the tutorial.

Power Basics

Before you begin, it would be helpful to go over some basic information about power consumption.

What impacts power consumption?

- **Temperature** – Power consumption increases exponentially with temperature.
- **Activity factor** –The more frequently the transistors switch, the higher the power consumption.
- **Design utilization** – The amount and type of resources used in the FPGA design, such as logic blocks, memory, and I/O pins, affect power consumption. Higher utilization leads to higher power consumption, depending on the resources used in a design.
- **Architecture** – Different FPGA architectures have varying power efficiencies. Some architectures are optimized for low power consumption, while others may prioritize performance or flexibility.
- **Operating frequency and voltage** – Higher operating frequencies and voltages increase power consumption.

What is total chip power?

Total chip power in an FPGA is the overall power consumed by the device during operation. This includes both static and dynamic power components.

What is static power and dynamic power?

Static power is the power consumed by an FPGA even when it is not actively switching. This is largely due to leakage currents in transistors.

Dynamic power, is the power consumed when the FPGA is actively switching states and performing operations. This includes power used during logic transitions and signal propagation

See also “Computing Static Power and Dynamic Power” on page 34.

What is Ambient Temperature?

Ambient temperature is the expected operating temperature of the air surrounding the FPGA. This is measured in °C.

What is Effective Theta J_A?

Effective Theta J_A is the sum of all the package and board thermal resistance. It represents how effectively certain devices transfer heat to their surrounding environment.

Power Calculator estimates effective Theta based on the board, package, heat sink, and air flow among others.

What is junction temperature?

The junction temperature of an FPGA is the temperature at which the silicon die can operate without any issue. It is directly affected by the ambient temperature and power dissipation.

For example, in Power Calculator, if you change the ambient temperature (T_A), the junction temperature (T_J) is affected based on the following equation:

$$T_J = T_A + \theta_{JA\_EFFECTIVE} * P$$

$\theta_{JA\_EFFECTIVE}$ is the effective thermal impedance between the die and its environment and P is the power.

For the different values of Theta, see the online Help.

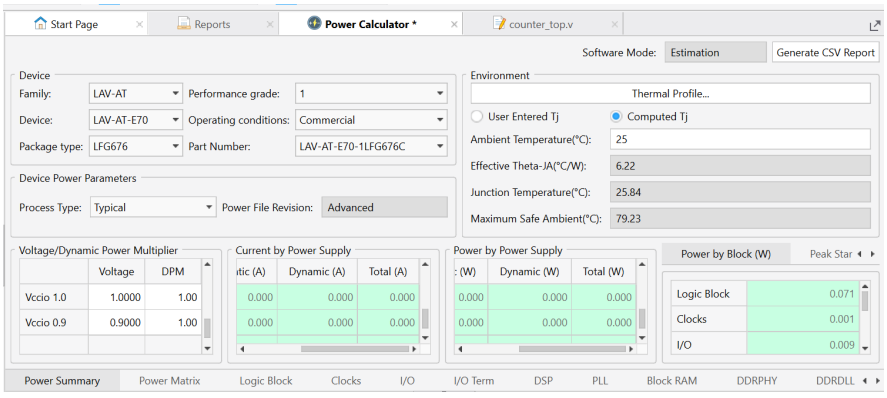
Overview of Power Calculator

Power Calculator is included in the Radiant software. You can open Power Calculator from within Radiant or as a stand-alone tool from the Windows Start menu. A stand-alone Power Estimator is also available, which allows you to estimate power consumption separately from Radiant.

Power Calculator provides two modes for reporting power consumption: estimation mode, which can be used before completing the design; and calculation mode, which is based on the physical netlist file after placement and routing. At the upper right corner of the main window is the Software Mode, which indicates either Estimation or Calculation, depending on the stage of your design.

Power Calculator Main Interface

The main window shows the Power Summary page by default.



In the **Device** section, you can select the device, package, part name, performance grade, and operating conditions.

The **Device Power Parameters** section provides information pertaining to the device process conditions. **Typical** reflects the average or expected conditions under which the device normally operates while **Worst** considers the most extreme or demanding conditions the may be encountered by the device. This usually leads to the highest power consumption. The Power File Revision is the status of the power analysis file or model.

The **Environment** section shows the operating temperature data of the device. Select **User Entered T_J** to directly specify Junction Temperature. Select **Computed T_J** to directly specify Ambient Temperature or enable Thermal Profile. For more information, see “Using Thermal Profile” on page 21.

You can view the other pages by clicking the tabs at the bottom of the main window. Except for **Graph** and **Report**, each of these pages allows you to view, edit, and add elements. The number and types of pages that are

available depends on the selected device. These pages are discussed in greater detail in “Working in Estimation Mode” on page 10.

Color Codes

Meaning of table cell color:

- White – Editable. Changing values will not change Software Mode.
- Green – Read-only or contains output from the software.
- Light Yellow – Data is extracted from a design file (such as .udb)
- Red – The calculated value in the Junction Temperature box is either higher than 125 °C or higher than the maximum junction temperature allowed for a particular device and operating conditions. The Junction Temperature box is the only cell that can display red text.

Meaning of font colors:

- Blue – Default values.
- Gray – Values cannot be edited on the I/O page. Since the I/O page has columns for inputs, outputs, and bidirectionals, red font prevents you from altering an I/O that is not valid. For example, if the I/O type belongs only to an I/O input, the cell in the # of Inputs column would display a value in black font, indicating that it is editable. The cells in the # of Outputs and the # of Bidi columns, however, would display values in gray font to indicate that they cannot be edited.
- Black – All other texts.

Power Calculator Modes

Estimation Mode – used for a what-if analysis of power usage before you even start a design or at different stages of your existing design before it is completed. Power Calculator can switch between Calculation Mode and Estimation Mode. For example, while working in Calculation Mode, changing the I/O type automatically switches to Estimation Mode since the results are no longer based on the netlist. This allows you test various things in your design.

Calculation Mode – When you open Power Calculator from with Radiant, Power Calculator computes power consumption based on the post-PAR netlist of the design. When you have already routed used when you have already routed your design, the tool calculates power consumption on the basis of device resources taken from the design’s .udb file, or from an external file such as a .vcd file. Here, you get a more accurate computation of power consumption, because it is based on the actual device utilization and uses input files generated during simulation or synthesis.

Reverting to Estimation Mode

Power Calculator automatically reverts to Estimation Mode from Calculation Mode when:

- You change the data in any cell other than AF (%), Freq., V., Dynamic Power Multiplier, Ambient Temperature, Performance Grade, Operating Condition, or Process Type.
- You rerun a process before Place & Route and you are working with an unsaved “untitled” temporary power calculator file.

  If you are working with a saved .pcf file, the software mode will not change when you rerun a process.

Generating a CSV Report

Clicking the Generate CSV Report button creates a consolidated report of data in all the Power Calculator pages in .csv format.

Working in Estimation Mode

Estimation mode is primarily used for a what-if analysis of power usage before you complete or even start your design. Here, you can get a rough idea of your power consumption.

In Estimation mode, you may have an idea of the amount of resources that you will be using such as the number of LUTs, block RAMS, clocks, I/Os, and so on. You then enter all these information into Power Calculator. You do not even need an HDL code to get started. You can estimate resource utilization, clock frequency, and activity factor for your planned design. Since the inputs are mostly user defined, this mode is considered the least accurate.

Let us open a Radiant design example and explore the Estimation mode environment. Remember that this project has not been compiled.

Note

For this tutorial, we are using an example design that comes with the Radiant software. This is to minimize compile time and to make sure that most users can easily run the design without error. The differences in power usage values may be small and at times negligible. To better appreciate the reported power usage data, you may opt to use your own more complicated design.

1. In the Lattice Radiant Start Page, click **Open Example**.
2. In the Open Example dialog box, choose **LIFCL_example**.
3. For this tutorial, create a folder “Estimation Mode” and indicate this as the location for your project.
4. Click **OK**.
5. The Radiant main interface opens. Do not compile the project.

6. Click **Tools > Power Calculator** or the Power Calculator button  .

   The Power Calculator Power **Summary page** opens in **Estimation** mode.

7. Test how package type, speed grade, and device characteristics affect your power usage. Test how environmental conditions such as ambient temperature, heat sinks, airflow, and board size affect your design.

   You may perform the procedures in"How Heat Affects Power" on page 23.

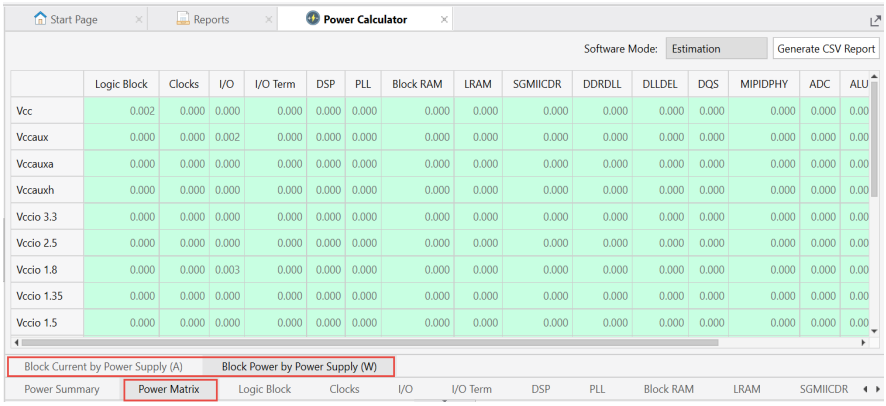
   You can provide information based on your own logic (if already available) and from other resources such as the device data sheet and technical notes that can be downloaded from the Lattice website. If you have a block that is a Lattice IP, specific IP user guides can likewise be downloaded from the Lattice website.

   You will notice that some fields in the Power Calculator pages (such as Logic Block, Clocks, and I/O) are already filled out. Note that DDRPHY, DDRDLL, and DLLDEL tabs are also automatically filled out. These green cells are read-only and the values are output from the software. For more information, see the *User Guides* > *Analyzing Power Consumption* > *Power Calculator Window Features* > *Power Calculator Pages* section in the Radiant Help.

   The following steps will walk you through some of the Power Calculator pages.

8. Click the **Power Matrix** tab.

   The Power Matrix page shows each component's power consumption from different sources. It features tabs for Block Current Power Supply (A) and Block Power by Power Supply (W), displaying current usage in amperes and power usage in watts for each component.



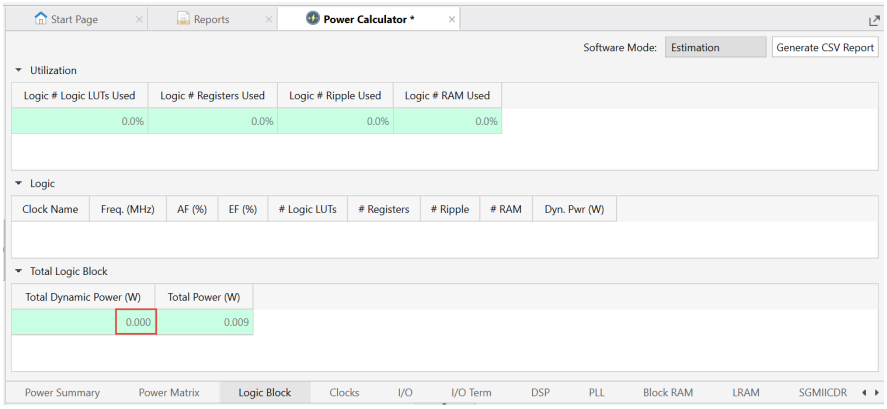
   You can select the Generate CSV Report at the top-right corner to create a .csv file of the matrix that can be opened in a spreadsheet application.

9. Click the **Logic Block** tab.

   The Logic Block page shows the estimated power usage of the design's logic and the factors affecting it. Power calculation requires the frequency, activity factor per clock domain, and the number and enable factor of LUTs, distributed RAMs, ripple-carry logic circuits, and registers.

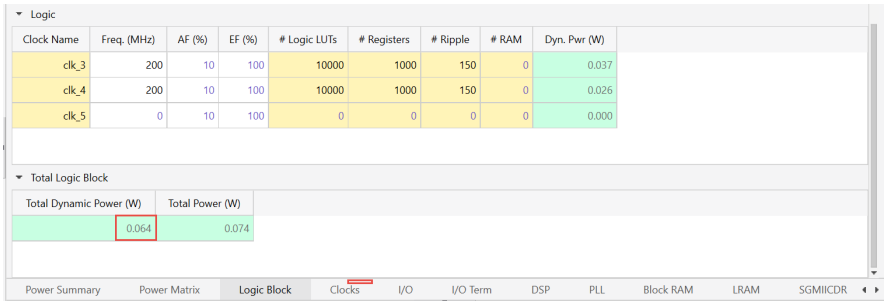
It also features a Utilization table that displays resource usage percentages. When you modify the **# Logic LUTs**, **# Registers**, **# Ripple**, and **# RAM** columns for example, the Utilization table updates after recalculating power.

Note that Total Dynamic Power (W) is **0.00**.



To add a row in the Logic table and in other tables in the Power Calculator pages, move the cursor over the table and right-click on it. Select the **Add Row** option. To remove a row, select and right-click on the row you want to delete. Select the **Remove Row** option.

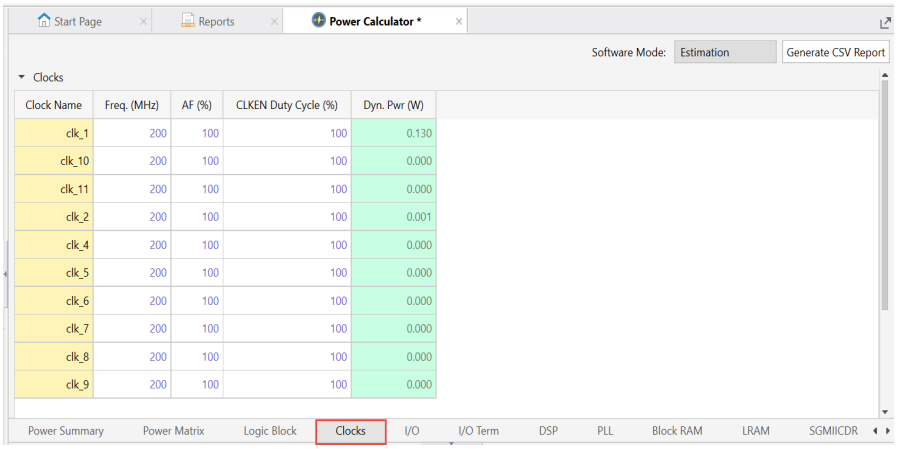
Add three rows under Logic. Right-click under and choose **Add Row**. In the first two rows, type **200** in Freq. (MHz), **10000** in # Logic LUTs, **1000** in # Registers, and **150** in # Ripple.



You will observe that Total Dynamic Power (W) increased to **0.064**.

10. Click the **Clocks** tab.

    The Clocks page shows the estimated power usage of the design's clocks, based on their frequency. Dynamic power calculation is based on the frequency of each clock.



The Clocks page only reports clocks in the clock tree, such as Primary, Secondary, and Edge Clocks.

11. Click the **I/O** tab.

    The I/O page displays the estimated power consumption of the design's I/Os and the factors influencing it. Calculations need the frequency, activity factor, and number of inputs or outputs per clock domain. If a .udb file is used, Power Calculator extracts the information directly; otherwise, default values are assigned based on the design's family.

    You can add and remove rows in the following tables:

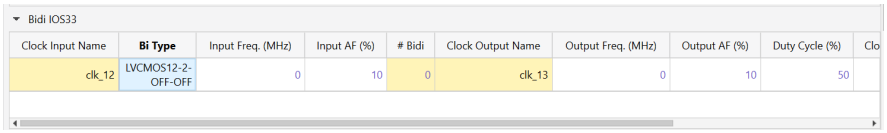
    - Input Output WRIO
    - Input Output HPIO
    - Bidi WRIO
    - Bidi HPIO
    - SIOLOGIC
    - IOLOGICA
    - IOLOGICB

    For example:

    a. Right-click under Bidi IOS33 below Clock Input Name and select **Add Row**.

    b. Under Bi Type, you will see the low-voltage CMOS technology that is used. In this example, it is LVCMOS12-2-OFF-OFF, which means that the I/O is running at 1.2 V. The **2** stands for the output drive, which is **2 Milliamps (mA)**.

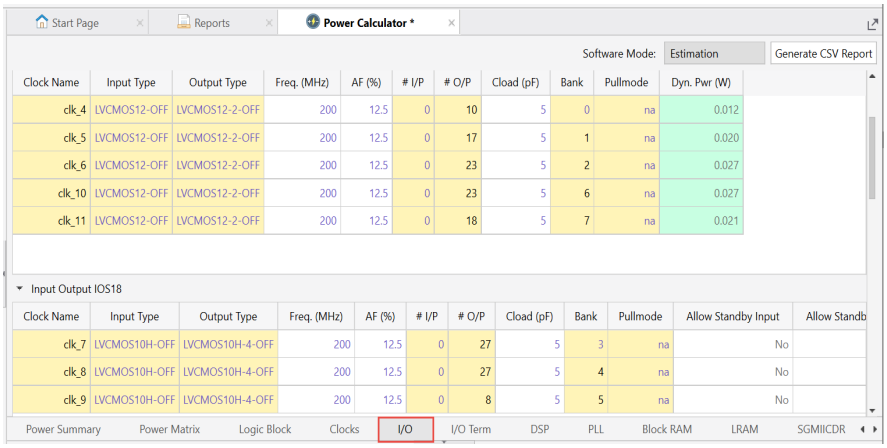
    c. Double-click this field and select from other options. Selecting a stronger drive output can draw more power.



Note

Some I/O banks have more Bi Type options. These I/O banks offer greater capabilities but occupy more silicon area. Therefore, it is not ideal to make every I/O highly programmable, as they consume more transistors.

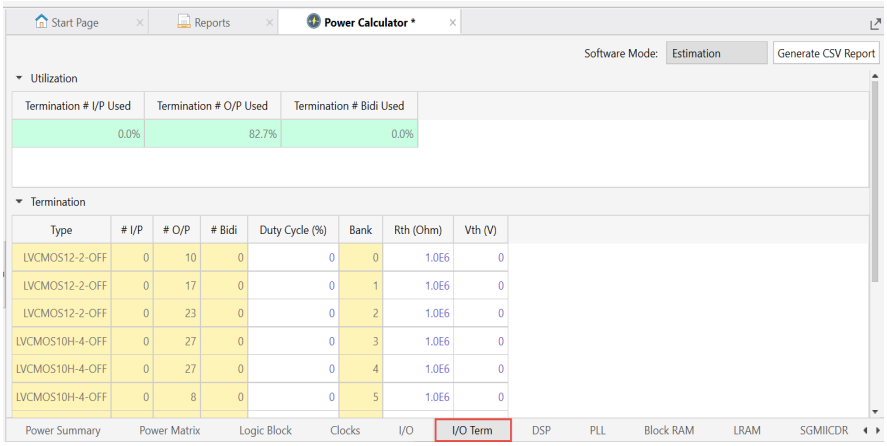
Add I/Os automatically. Perform the steps in “Adding I/Os” on page 28.



12. Click the **I/O Term** tab.

    The I/O Term page shows details about external terminations for the I/Os. The power-consumption calculation is based on the power used by the external termination you provide.

    I/O Term does not draw significant amount of power and you do not enter values manually.



13. Click the **DSP** tab.

    The DSP block handles complex mathematical operations like addition and multiplication. It is designed for signal processing tasks, including filtering, Fourier transforms, and other high-speed arithmetic algorithms.

    To add a DSP block:

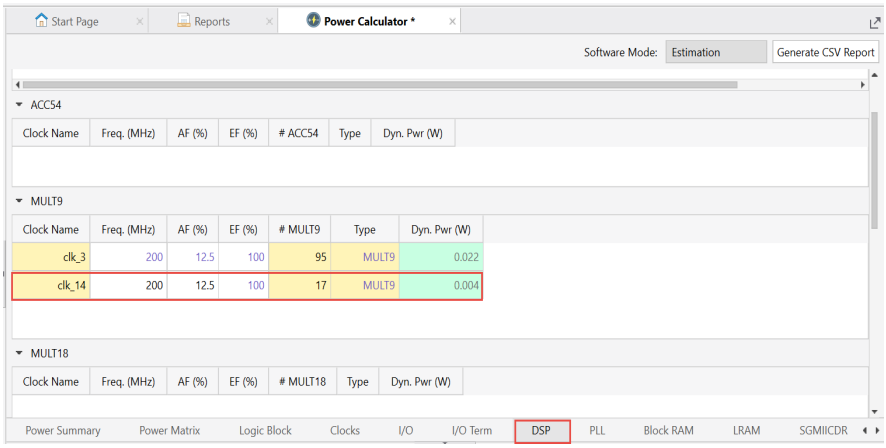
    a. Right-click under MULT9 below Clock Name and select **Add Row**.

    b. Double-click under Type and click the pull-down arrow, you will see the different functions you can do with DSP.

       As an example, select **MULT9_REG_X2**. Under Freq. (MHz), type **200**.

    c. Hover over the DSP field to see the maximum allowable value. Type any value within range.

    The Dyn. Pwr (W) value changes.



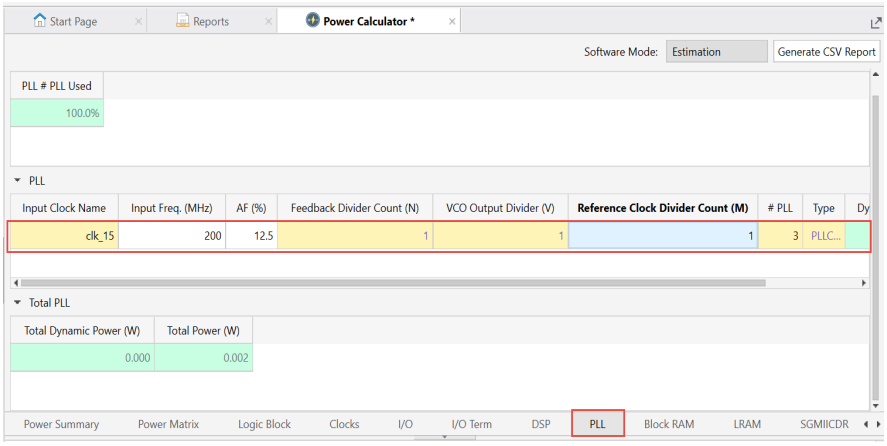
Note

An error message is displayed if you type a value that is more than the maximum allowed.

14. Click the **PLL** tab.

    The PLL page shows the estimated power consumption of the phase-locked loops in the design and other contributing factors.

    To add a PLL block, right-click under PLL below Input Clock Name and select **Add Row**. Type **200** in Input Freq. (MHz).



15. Click the **Block RAM** tab.

    The Block RAM page shows the power consumption of the embedded block RAM (EBR) in the design and the factors that affect it. Calculations require the frequency and activity factor per clock domain.

    You can add and remove rows in the following tables:

    - SP RAM
    - DP RAM
    - DP RAM True
    - FIFO

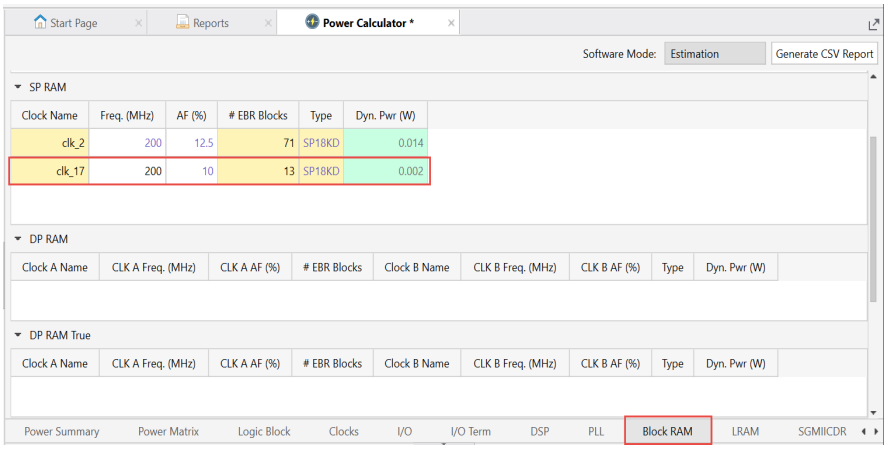
    For example:

    a. Right-click under SP RAM below Clock Name and select Add Row.

    b. Type **200** in Input Freq. (MHz).

    c. Type **17** in EBR.

    The Dyn. Pwr (W) value changes.



16. Save your Power Calculator file. Click **File > Save Untitled as**.

    In the Save Power Calculator File dialog box, type **PWC_tutorial** in File name and click **Save**.

    The file is added under Analysis Files in File List view.

17. Click **File > Save Project** and close it.

Working in Calculation Mode

To work in Calculation mode, your design must have already completed synthesis, MAP, and Place & Route. In this case, Power Calculator computes power consumption on the basis of device resources taken from the design's .udb file. Here, you get a more accurate computation of power consumption because it is based on the actual implementation results and uses input files generated during simulation or synthesis

Let us calculate power consumption in Calculation mode:

1. In the Lattice Radiant Start Page, click **Open Example**.
2. In the Open Example dialog box, choose **LIFCL_example**.
3. Indicate a new folder location for your project.
4. Click **OK**.
5. The Radiant main interface opens. Run **Synthesis, Map**. and **Place & Route**.
6. Click **Tools > Power Calculator** or the Power Calculator button  .

   The Power Calculator Power **Summary page** opens in **Calculation** mode.

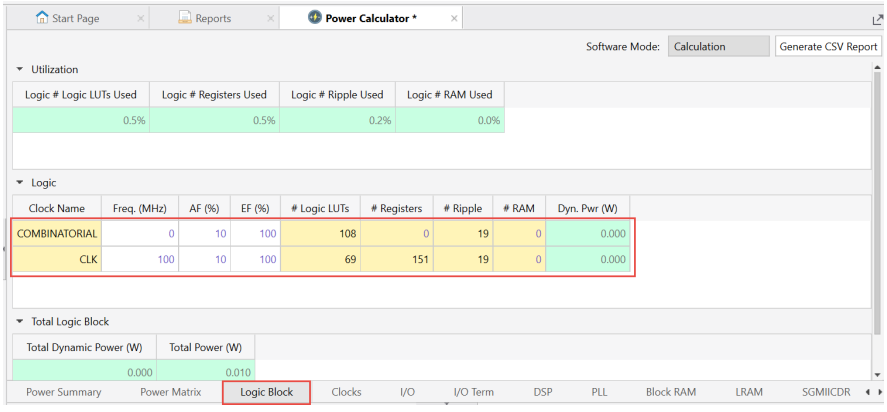
   Your HDL code is synthesized, mapped, and place & routed and a UDB file is created. After you run Place & Route, you will have an updated UDB file. This UDB is the accurate representation of your design. Power Calculator will use this UDB to calculate power usage.

   Note

   While in Calculation mode, you can revert to Estimation mode. See "Reverting to Estimation Mode" on page 10.

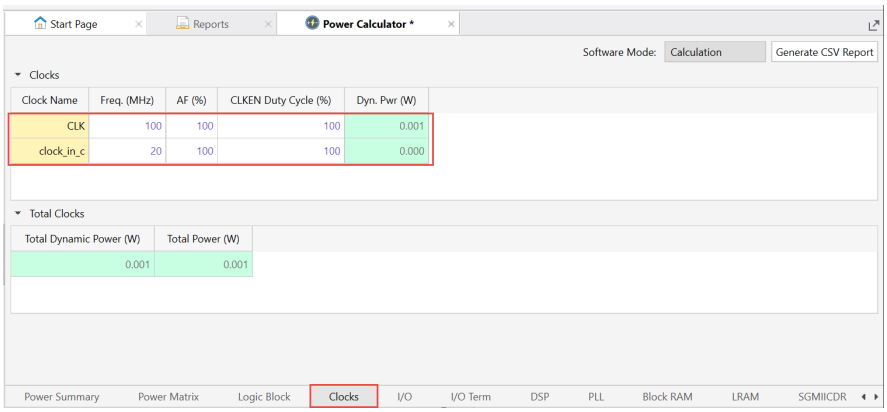
7. Click the **Logic Block** tab.

   Note that the tool already added logic data.



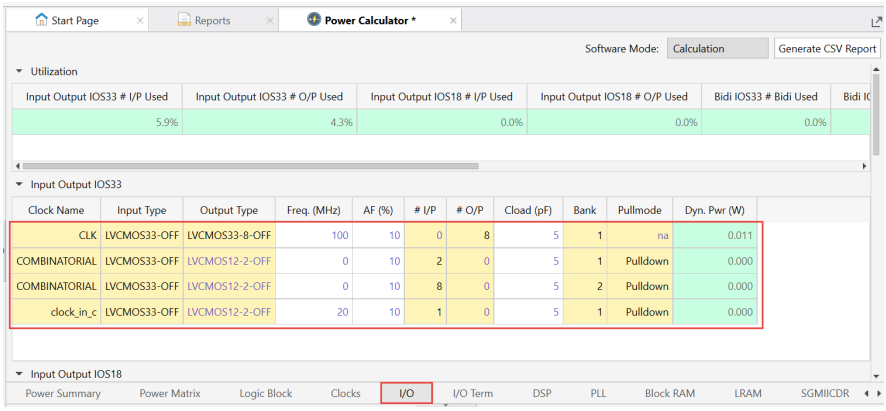
8. Click the **Clocks** tab.

   Similar to the Logic Block page, the tool already added initial data.



9. Click the **I/O** tab.

   Similar to the Logic Block page, the tool already added initial data.



You will note that in Calculation mode, the tool processes the design and provides more accurate results compared to Estimation Mode.

Using VCD File in Power Calculator

There is an advanced process In Calculation mode wherein Power Calculator acquires input data from a VCD or Value Change Dump file. This is an ASCII-based file where you record the signal transition values in your design during simulation. The format is defined by the IEEE Standard 1364-1995 for the Verilog Hardware Description Language. To use a VCD file in Power Calculator, you must run a post-route simulation.

A VCD file consists of three main sections:

- Header – Metadata such as the date, simulator version, and timescale.

- Variable Definitions – Signals and their hierarchical scope within the design.
- Value Changes – Changes in signal values over time during the simulation.

To generate a VCD file:

1. Run simulation in Radiant using the Simulation Wizard.
2. Restart simulation (restart –f).
3. Create a VCD file (vcd file file_name>.vcd).
4. Add signals to dump in VCD file (vcd add <path_to_instance>/*).
5. Run simulation (run<time>).
6. Stop simulation to write to the VCD file (quit –sim).

For example:

```
restart -f
vcd file myvcdfile.vcd
vcd add /testbench/uut/*
run 1000 ns
quit -sim
```

If you input a post-routed simulation .vcd file to Power Calculator, the tool compares the clock signals in the .vcd file to each clock in the Power Calculator pages. If the clock names match, Power Calculator takes the frequency data from the .vcd file and populates the frequency columns, the activity factor (AF(%)) columns, or all, in the pages that contain these columns.

Note

Power Calculator only supports VCD files. The SAIF file, which contains summary data extracted from VCD, is not supported.

To calculate power consumption using VCD:

1. In the Radiant software, choose **File > Open Project**.
2. Browse to your Radiant project and Click **Open**.
3. Click the **Run All** button.
4. Open Power Calculator and import the VCD file to Power Calculator:
5. Click **Edit > Open Simulation File**.
6. Indicate the VCD file and the module name.
7. Click **OK**.

Power Calculator will calculate the AF based on the simulation information.

If you take note of power usage data and compare it with Estimation mode results, you can conclude that using Calculation Mode with .vcd provides more accurate results.

Best Practices and other Recommendations

To complete the procedures in this section:

1. In the Lattice Radiant Start Page, click **Open Example**.
2. In the Open Example dialog box, choose **LIFCL_example**.
3. Indicate a folder location for your project.
4. Click **OK**.
5. The Radiant main interface opens.
6. Click **Tools > Power Calculator** or the Power Calculator button  .

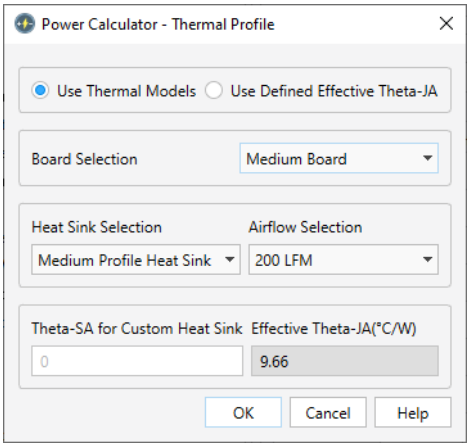
The Power Calculator Power **Summary page** opens in **Estimation** mode.

Using Thermal Profile

Thermal Profile in Power Calculator estimates the value of the Effective Theta J_A (°C/W) based on the size of the board, the available heatsink, and airflow. The default thermal impedance value is based on a medium size board (6" x 6", 6 layers), with no heat sink and 200 LFM (Linear Feet per Minute) air velocity.

In the Environment panel of the Power Summary page, you can open **Thermal Profile** by selecting **Computed T_J** and clicking the **Thermal Profile** button. Select **Use Thermal Models** to choose board, heat sink, and airflow options.

If you already made your own simulations and calculations, select **Use Defined Effective Theta-J_A** and indicate the value in the **Effective Theta J_A (°C/W)** box.



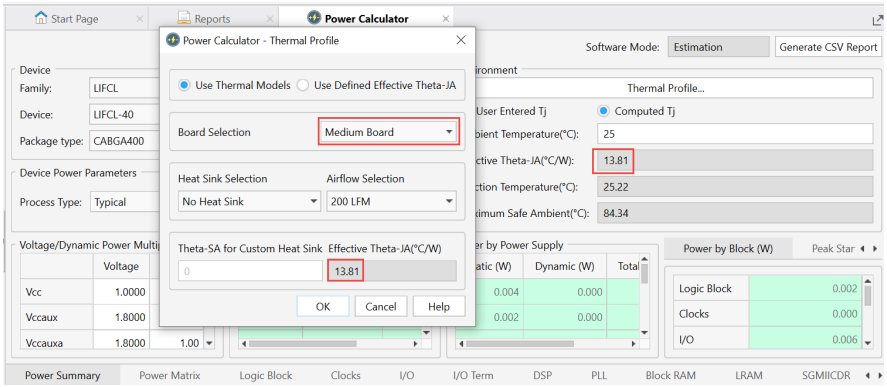
Note

Selecting **Custom Profile Heat Sink** enables **Theta-SA for Custom Heat Sink**. This value is the maximum thermal resistance of the heat sink.

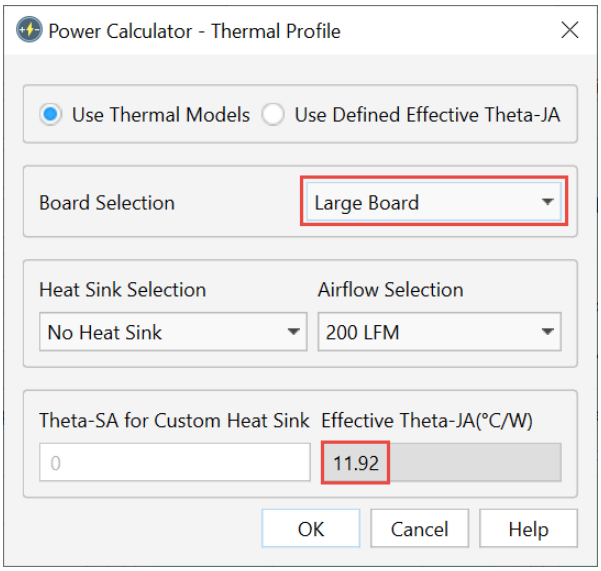
How Heat Affects Power

Board Area

In the example, you have an Effective Theta J_A value of **13.81**. When you select **Computed T_J** and click **Thermal Profile**, you will find that Board Selection is **Medium Board**.

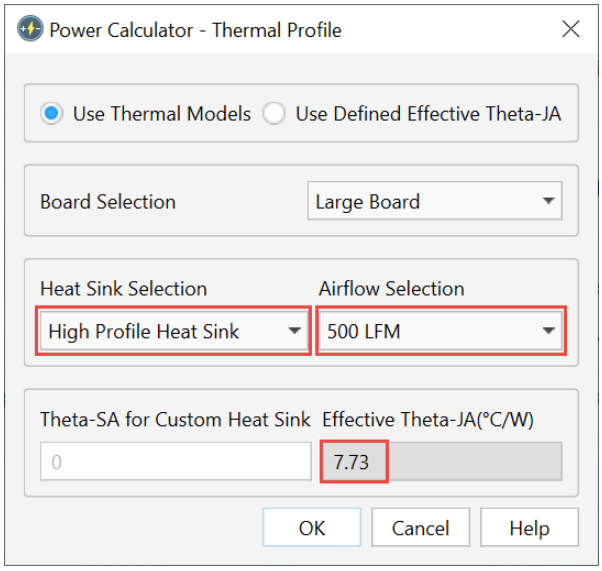


Change Board Selection to **Large Board** and the Effective Theta J_A value goes down from **13.81** to **11.92** The larger the board, the lower the Effective Theta J_A value. This is because you increased the area where the heat can spread out.



Heat Sink and Air Flow

Change the Heat Sink Selection from **No Heat Sink** to **High Profile Heat Sink** and Airflow Selection, measured in Linear Feet per Minute or LFM, from **250** LFM to **500** LFM. Note that Effective Theta J_A value went further down from **11.92** to **7.73**.

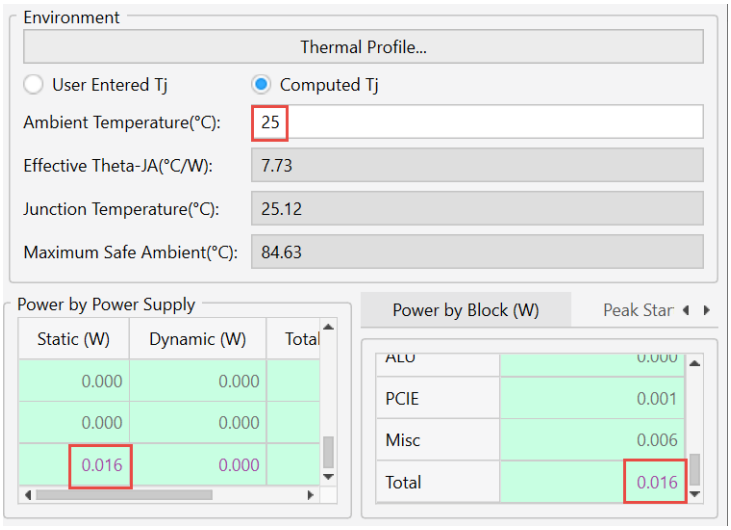


Ambient Temperature and Static Power

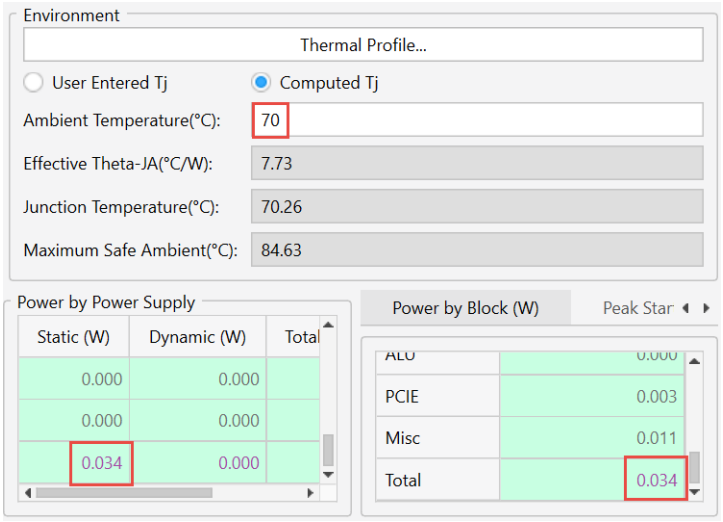
Static power affects power consumption significantly. Under Power by Power Supply, the Static (W) value is 0.230.

The main contributors to static power are:

- Leakage Currents – These are the small amounts of electric currents that flow through transistors when they are off. If you have millions of transistors, even small leaks add up and may result to a significant increase in power consumption.
- Standby Power – Power consumed by the FPGA when it is powered on but not actively performing any tasks. Standby power may include leakage currents and power used by always-on components, such as biasing circuits.
- Clock Network – Power consumed by the clock distribution network, even when the clock is not switching.



If you increase Ambient Temperature (°C) from the default **25** to **70**, the Static (W) value rises from **0.016** to **0.034**



This shows that heat affects static power. Note that there is no change in Dynamic (W).

Directly Changing the Junction Temperature

You can directly change Junction Temperature value. Check the valid junction temperature range as specified in Operating Conditions in your device data sheet.

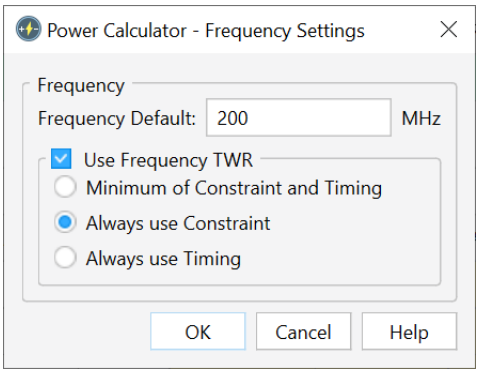
To change the junction temperature:

1. In the Environment section of the Power Summary page, select **User Entered T_J**.
2. Enter a value, in °C in the Junction Temperature (°C) box and press **Enter** or click anywhere outside the cell.

The value entered must be with the valid range in °C. The default value is **25** °C for all devices. If you enter a value that is beyond the commercial, industrial, or automotive device limits, you will receive an error message that displays the range of valid values.

Assigning a Global Setting for Frequency

When working in Estimation mode and you have numerous cases similar to this, you do not have to manually add the correct Freq. (MHz) values one cell at a time. You can click **Edit > Frequency Settings** to open the Frequency Settings dialog box.



Type the correct value (**200** in our example) in the Frequency Default field and click **OK**. This automatically changes all the Freq. (MHz) values in your design to **200**.

Radiant compiles the design and finds a register, it can trace back the clock from the timing constraints. For example, when a clock is constrained to 200 MHz. However, with regards to other logic LUTs that are doing logic functions, the tool cannot trace back at which frequency these are running.

Dynamic power is calculated using the formula $C \cdot V^2 \cdot f$

where:

(C) is the load capacitance,

(V) is the supply voltage, and

(f) is the clock frequency.

This formula shows that dynamic power consumption is directly proportional to the capacitance, the square of the supply voltage, and the clock frequency.

So it is important to go through all the blocks and make sure you have no instance of 0 Freq. (MHz) to avoid any inaccuracy when using this tool.

Note

In Calculation mode, it is recommended to manually assign the actual frequency value.

Importing Frequencies from Timing Report

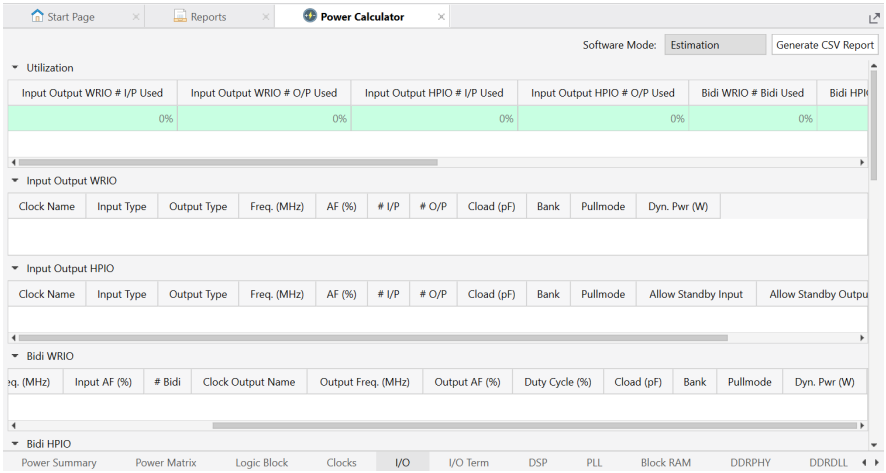
You can also change global frequency value by selecting Use Frequency TWR and choosing options to import frequencies from the timing report. Make sure that the timing report contains the names of the clocks in the pages for which you want default frequency values.

- Minimum of Constraint and Timing –The default frequency in the Frequency (MHz) column of the Power Calculator pages will be taken from the lesser of the constrained frequency or the actual frequency in the timing report.
- Always Use Constraint – The default frequency in the Frequency (MHz) column of the Power Calculator pages will be taken from the constrained frequency in the timing report.
- Always Use Timing – The default frequency in the Frequency (MHz) column of the Power Calculator pages will be taken from the actual frequency in the timing report.

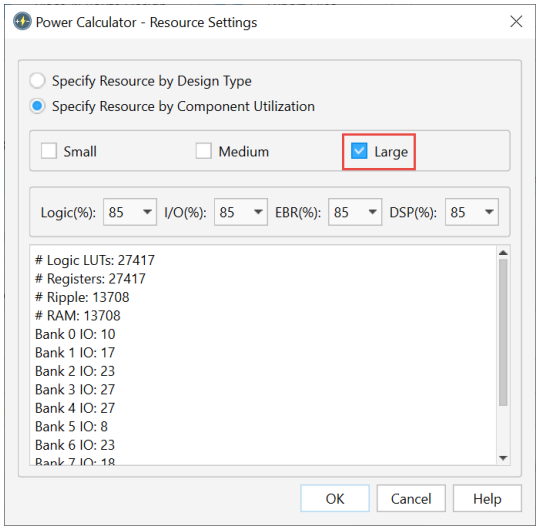
If the clock frequency cannot be imported using this option, you have to specify a value.

Adding I/Os

When you create a new Power Calculator file and you click the I/O tab, you will find numerous blank I/O tables that you have to populate with data. It would be difficult to add these I/Os manually especially if you are dealing with hundreds of them.



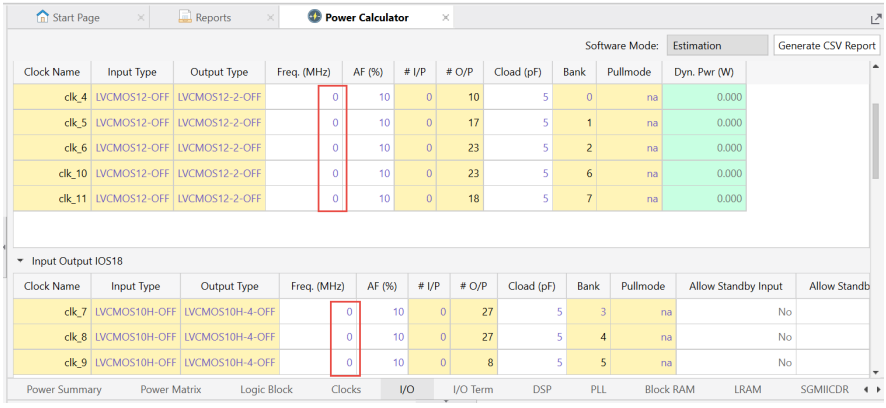
To speed up the process of estimating routing resources, click **Edit > Resource Settings**. The Resource Settings dialog box opens.



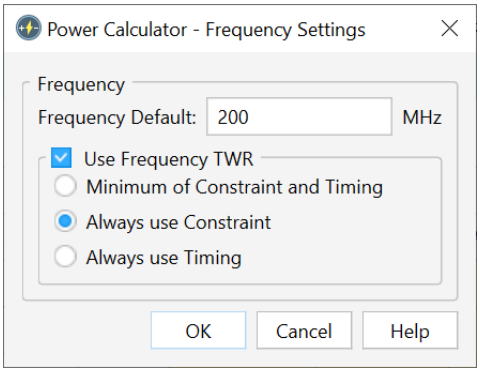
Select **Large** to fill out 85% of your design. Power Calculator displays 85% of Logic, I/O, EBR, and others. It is better to fill out a large part of your design and reduce later as you please than start out with a small percentage and add these data manually later on. Click **OK**.

You will be prompted to save your changes, choose **No** for now.

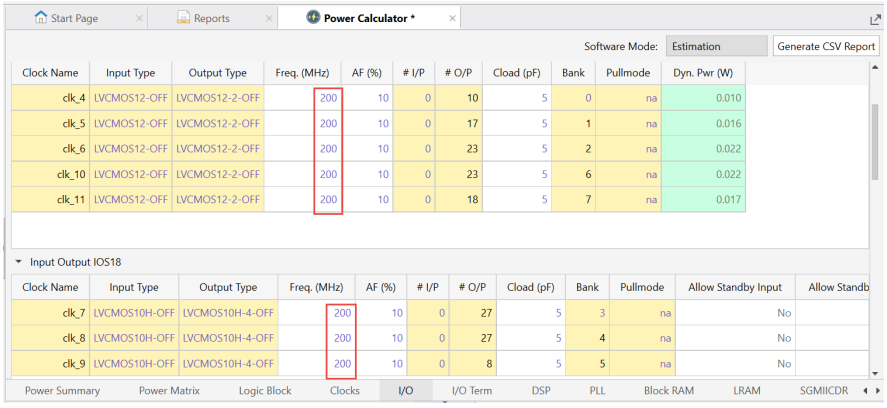
The tables are populated with routing data. However, you will note that all the Freq. (MHz) values are at **0**. Change these by clicking **Edit > Frequency Settings**.



Change Frequency Default to **200** in the Frequency Settings dialog box and click **OK**.



All the Freq. (MHz) values change to **200**.



Computing Activity Factor

Activity Factor % (AF%) is the average number of signal transition per second. You must provide this value under the AF% column in Power Calculator.

Potentially high AF would be Adder, Arithmetic Logic, XOR gates, FEC (Forward Error Correction). Potentially low AF would be Control Logic and Power sequencing.

Synchronous Logic Activity Factor

Synchronous Logic AF is how often an output changes relative to a clock. This is measured from 0% to 100%.

Below is an example of a 3-bit counter.

Figure 1: 3-bit Counter Example

Bit 2	Bit 1	Bit 0
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1
25% AF- the output changes every 4 clock cycles	50% AF- the output changes every other clock cycle	100% AF- the output changes every clock cycle

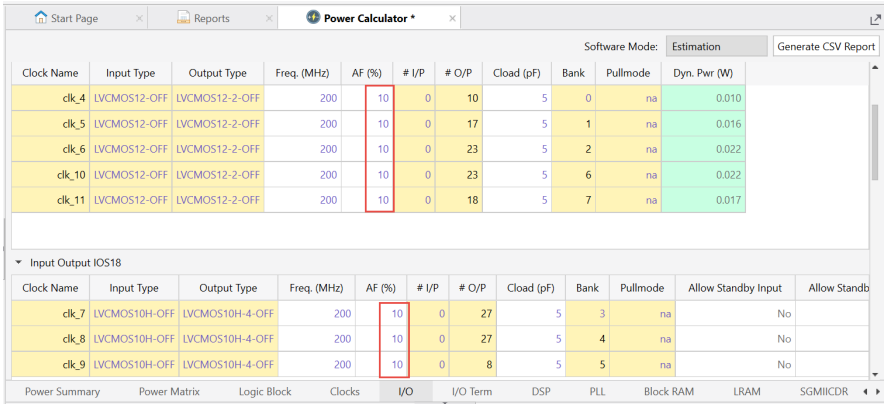
So if you compute the average of these AF numbers, the 3-bit counter has an AF of 58%.

Combinatorial Logic Activity Factor

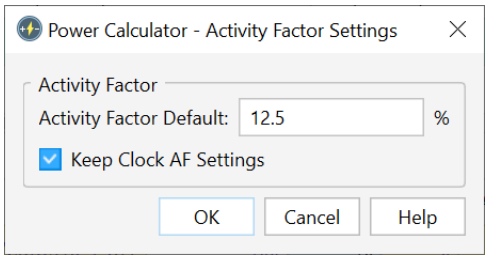
It is hard to predict the AF using combinatorial logic. It is better to avoid any combinatorial logic in the design because it is not predictable and could create glitches.

Changing AF

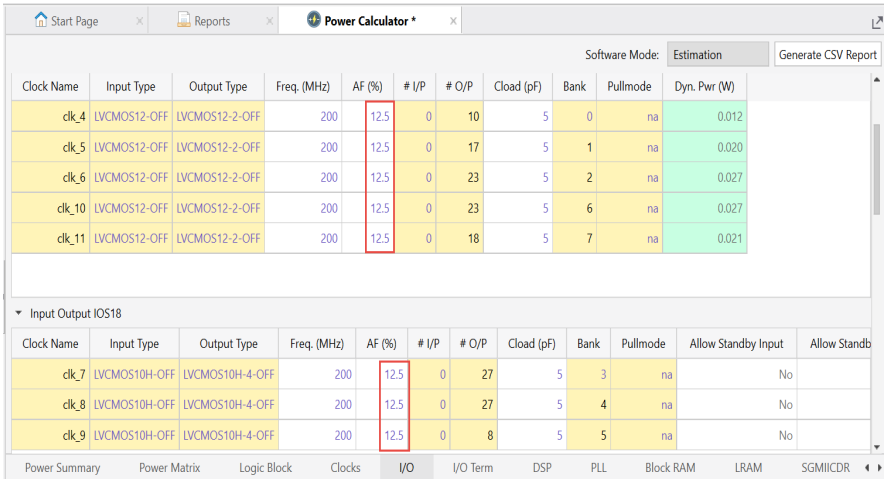
The default Activity Factor or AF (%) setting is **10** but it is common to make this **12.5**. This means that each clock changes on the average every eight clock cycle.



To change Activity Factor, click **Edit > Activity Factor Settings** and change Activity Factor Default to **12.5**. Click **OK**.



The AF (%) setting is changed to **12.5**.

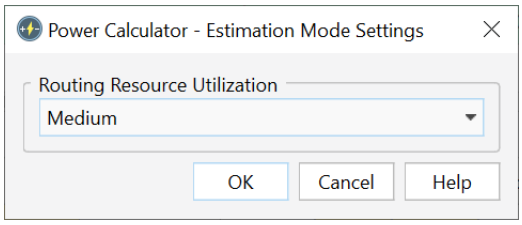


Advisory in Using Estimation Mode Settings

When you click **Edit > Estimation Mode Settings**, the Estimation Mode Settings dialog box opens.

This allows you to estimate the amount of routing resources that your design will use for power analysis.

Unless you have full knowledge and expertise on the use of this feature, it is recommended to keep the Routing Resource Utilization at its default value of Medium.



For more information on estimating routing resource, see the *User Guides* > *Analyzing Power Consumption* > *Estimating Routing Resource Usage* section of the Radiant online Help.

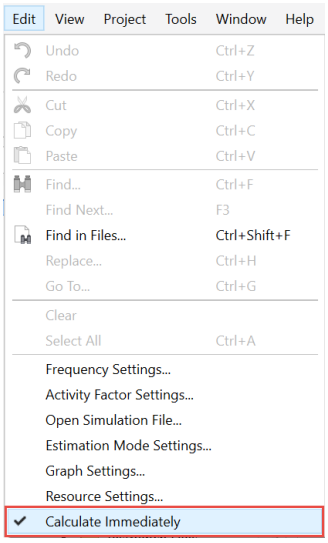
Computing Static Power and Dynamic Power

To calculate static power:

1. Click the Logic Block tab.
2. Subtract Total Dynamic Power (W) from Total Power (W) and you have your Static Power.

Using Calculate Immediately

In Power Calculator, you can immediately process every change that you make. To do this, click **Edit** and make sure that **Calculate Immediately** is checked.



When you make a change, you will observe that Power Calculator immediately processes the change.

On the other hand, you can also choose to apply your changes only after clicking the Calculate button. To display this button, click Edit and disable Calculate Immediately.

When you make a change, Power Calculator prompts you to manually click the Calculate button to process the change. As such, you can make several changes before allowing the tool to batch process them.

Viewing and Printing Results

Power Calculator provides graphs of power consumption and enables you to print information from the pages and generate a consolidated report of data in a comma-separate value (.csv) file format.

To generate a Power Calculator report in CSV format:

1. Click the **Generate CSV Report** button at the upper right-hand corner of the Power Calculator window.
2. In the Generate CSV Report dialog box, browse to the target directory for the report.
3. Type a name in the File name box and click **Save**.

You can further analyze the results in an external spreadsheet application that supports CSV.

Summary of Accomplishments

You have completed the *Lattice Radiant Power Calculator Tutorial*. In this tutorial, you have learned:

- the basics of power consumption in FPGA design
- the key elements of the Power Calculator interface
- design options to choose and analyze their impact on power consumption
- use specific features to speed up your process
- compare Power Calculator results in Estimation mode and in Calculation mode.

Recommended References

You can find additional information on the subjects covered by this tutorial in the Radiant Help:

- User Guides > Analyzing Power Consumption

Revision History

The following table gives the revision history for this document.

Date	Version	Description
12/20/2024	2024.2	Initial release.