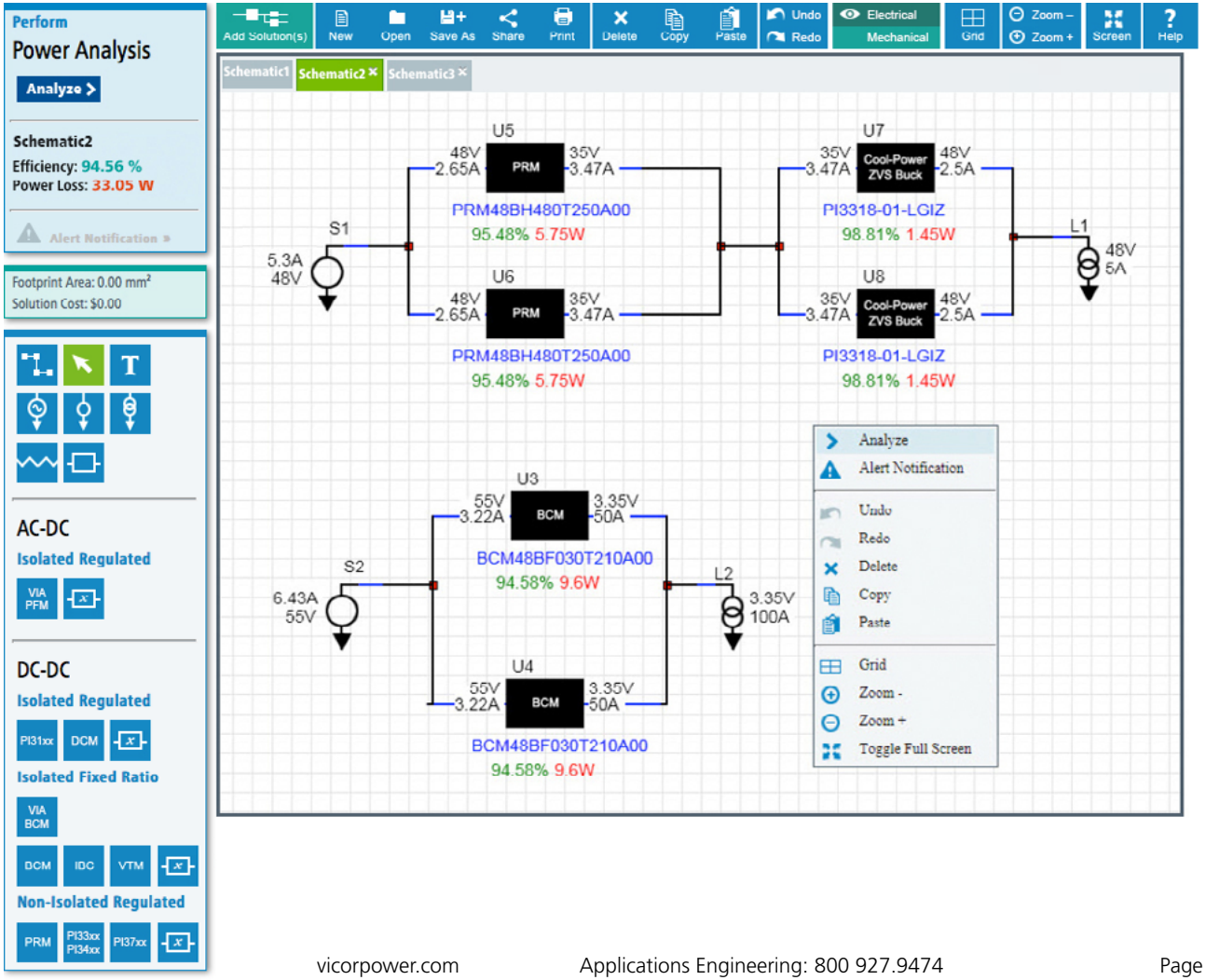
# Whiteboard™

## Introduction

The Vicor PowerBench™ WhiteBoard provides a workspace to architect and analyze the power efficiency of your design requirements. Vicor's PowerBench ™ WhiteBoard is a web based design tool that allows users to architect and analyze power system designs which are built using Vicor's high density, high efficiency power components. Users can set the operating condition for each component of the power design to match the intended application and perform efficiency as well as loss analysis of individual component as well as the full power system.



## Whiteboard Webinar

Figure 1.
Whiteboard
A New Way to Simplify Power Chain Analysis

Presented by Sean Crilly
*Vice President, VI Chip Design Engineering*

***Click on image to view this webinar now.***


Learn how to architect, analyze and optimize the performance of power chains using the PowerBench™ Solution Selector and Whiteboard. Replacing the traditional, inefficient hand-drawn approach, these tools dramatically speed up the process of designing and analyzing power systems, allowing engineers to meet their design goals and project deadlines.

During the webinar, Sean Crilly will explain how to use the Solution Selector to create topologies that meet the application's requirements, how to select the most appropriate solution and how to use the Whiteboard to modify the design and analyze its performance.

### Topics Covered

- Using the Solution Selector to build topologies to meet your requirements
- Selection of optimum topologies, based on figures of merit
- Transferring your design to the Whiteboard
- Modifying the design and simulating distribution resistance
- Analyzing the power chain performance and thermal characteristics
- Using application-specific reference designs

### Who should attend?

This webinar is ideal for anyone responsible for developing power systems or DC-DC power chains. Only basic power supply knowledge is assumed, and it is suitable for all levels of expertise and experience.

# Whiteboard™

## Interactive Menu, Quick Start

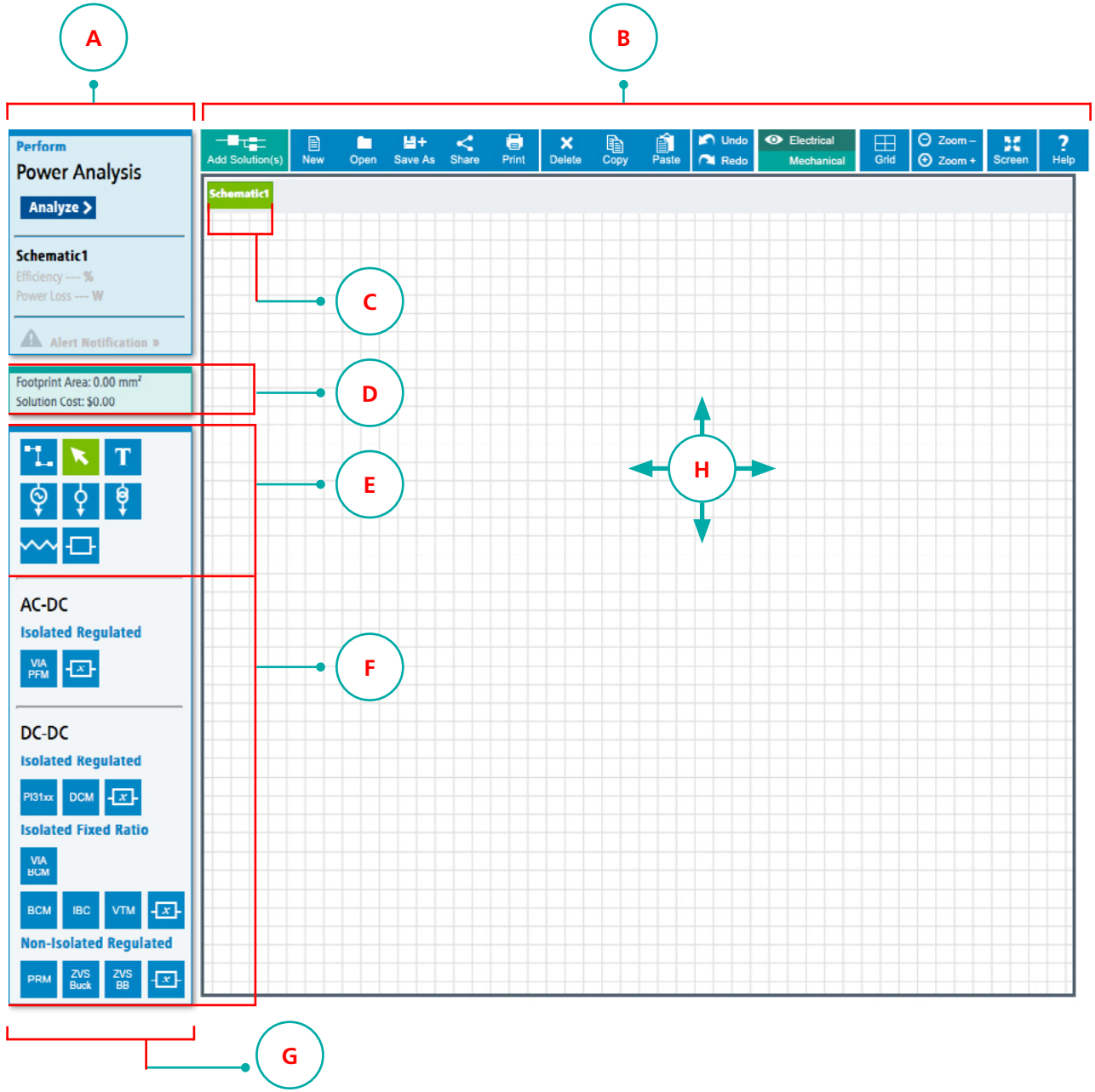
### *Quick Start Tutorial*

Back To Top ^

## Quick Start Tutorial

### Tool Elements

Figure 2.
Tool Functions Overview




**A**
**System Analysis Explorer**

**B**
**Taskbar Ribbon**

**C**
**Selected Tab / Schematic Design**

**D**
**Footprint Area & Solution Cost**

**E**
**Component Palette**

**F**
**Product Selection Palette**

**G**
**Design Toolbox**

**H**
**Schematic Canvas**

## Quick Start Tutorial

### Select a Product Type

Figure 3.

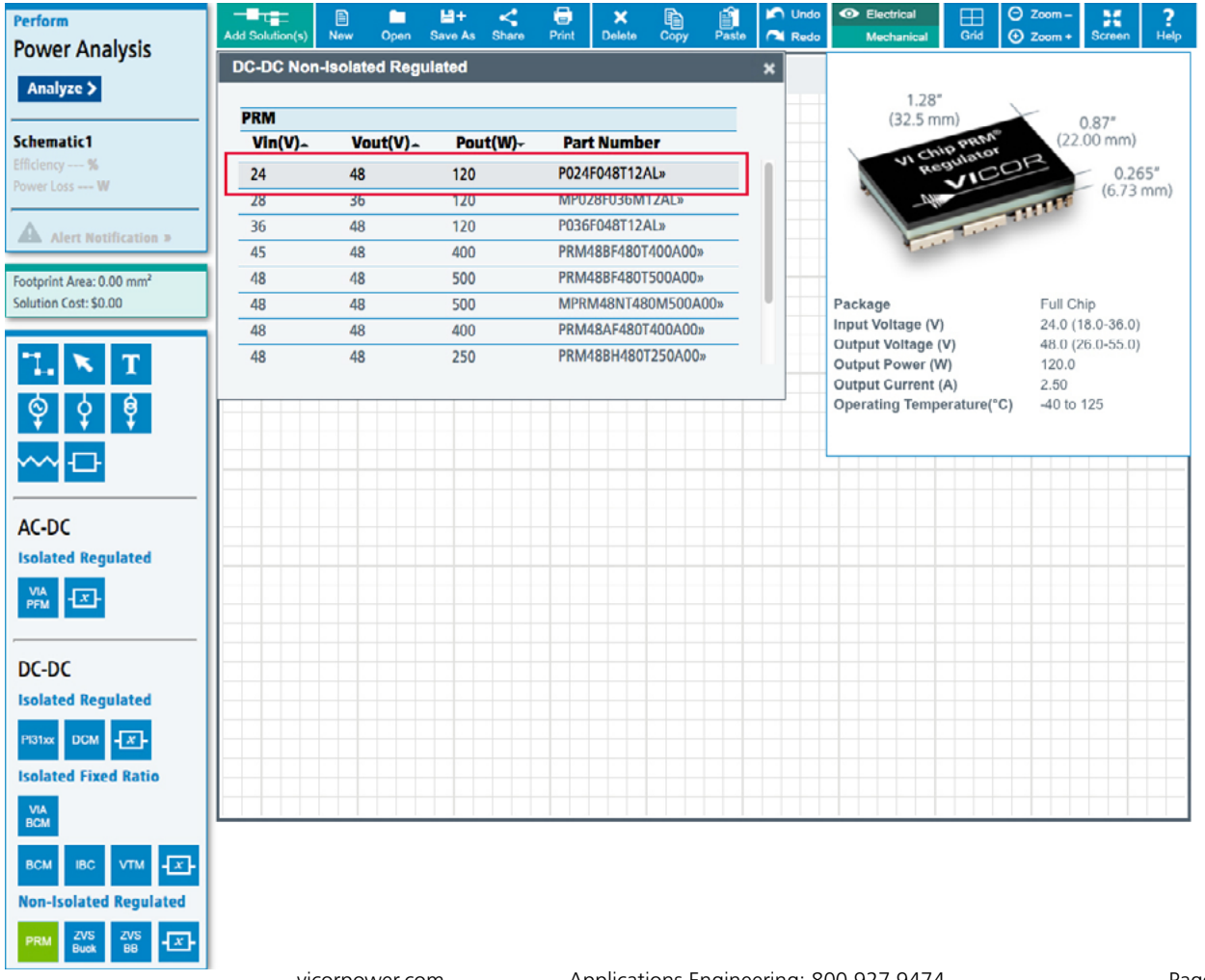
*Click on a Product Type from the Product Selection Palette*


### **Choose a Product** (Based on Your Design Requirements)

Figure 4.

Review the displayed product specifications for **Vin**, **Vout** and **Power Ratings**

*Choose a product by clicking on the Part Number*



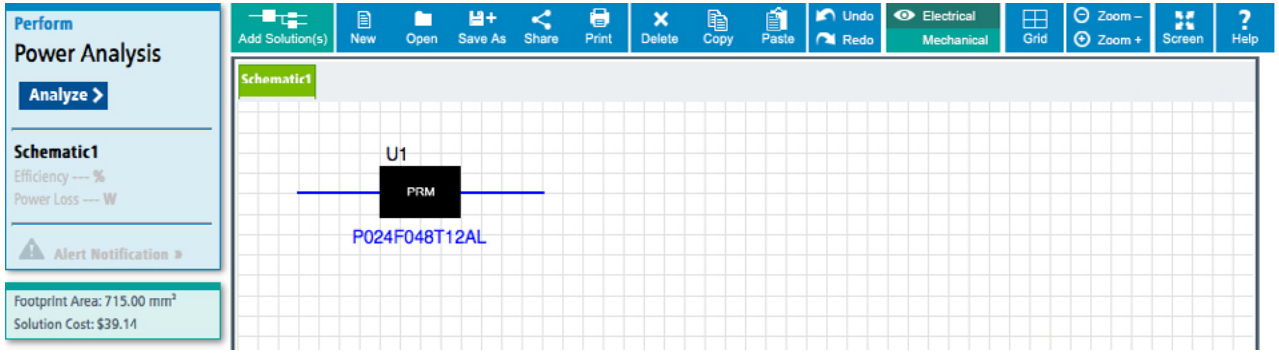
Back To Top ^

## Quick Start Tutorial

### Place the Selected Product on the Canvas

Figure 5.

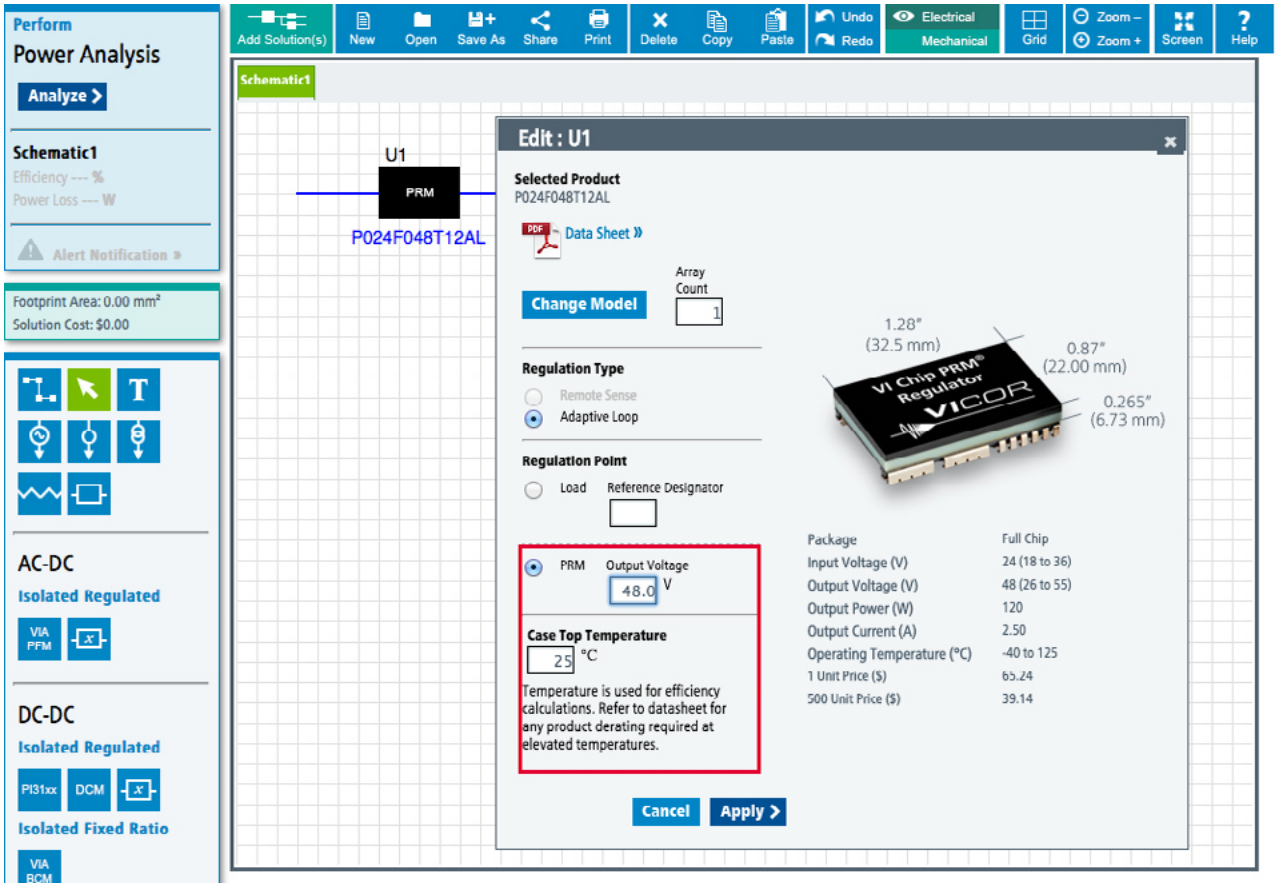
*Click on the canvas and release the mouse to place the product on the Whiteboard Canvas*




### **Edit Product Parameters** (e.g. Case Top Temperature, Output Voltage)

Figure 6.

*Double-Click on the placed product symbol to edit the placed product's parameters*



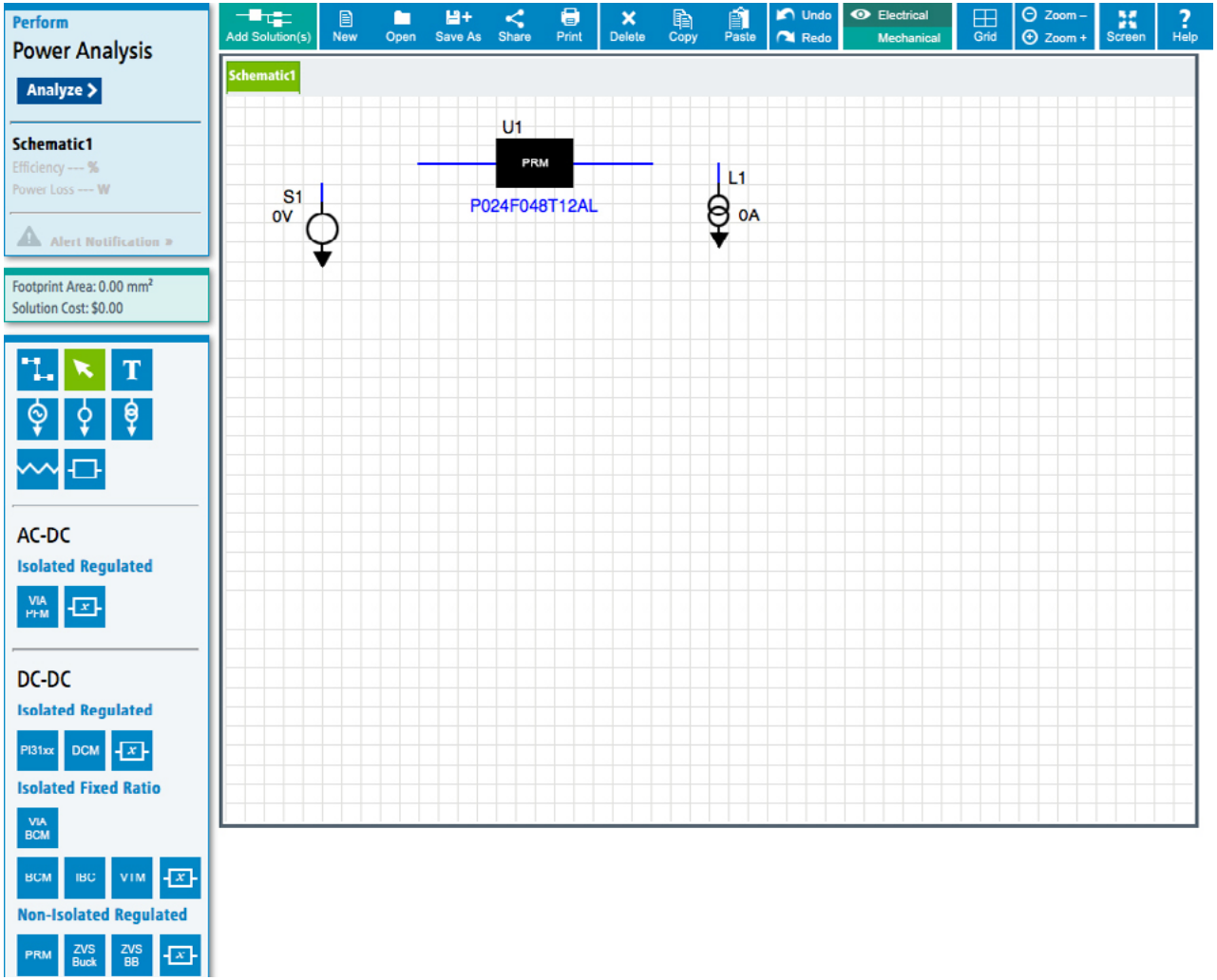
Back To Top ^

## Quick Start Tutorial

**Place the AC or DC Supply & Load** (Using the Supply and Load Tools from the Component Palette)

Figure 7.

***Select and Place an AC or DC Supply & Load(s)*** into your design using the Supply & load tools from the Component Palette



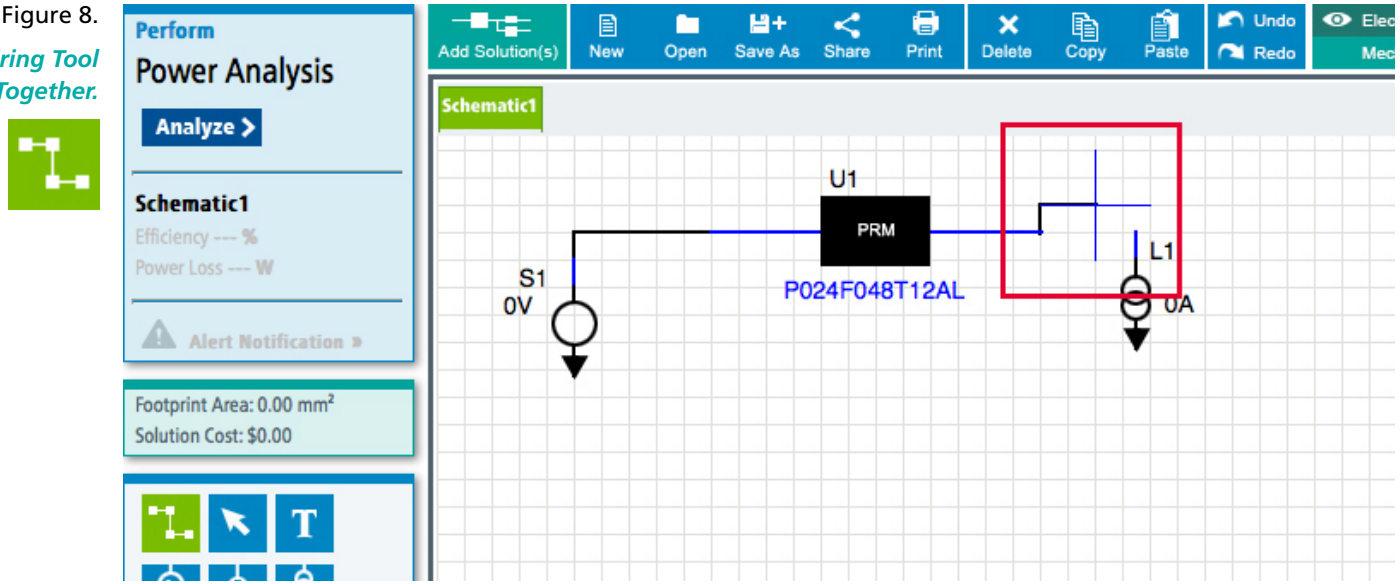
Back To Top ^

## Quick Start Tutorial

### Wire the Powerchain Products and Components Together

Figure 8.

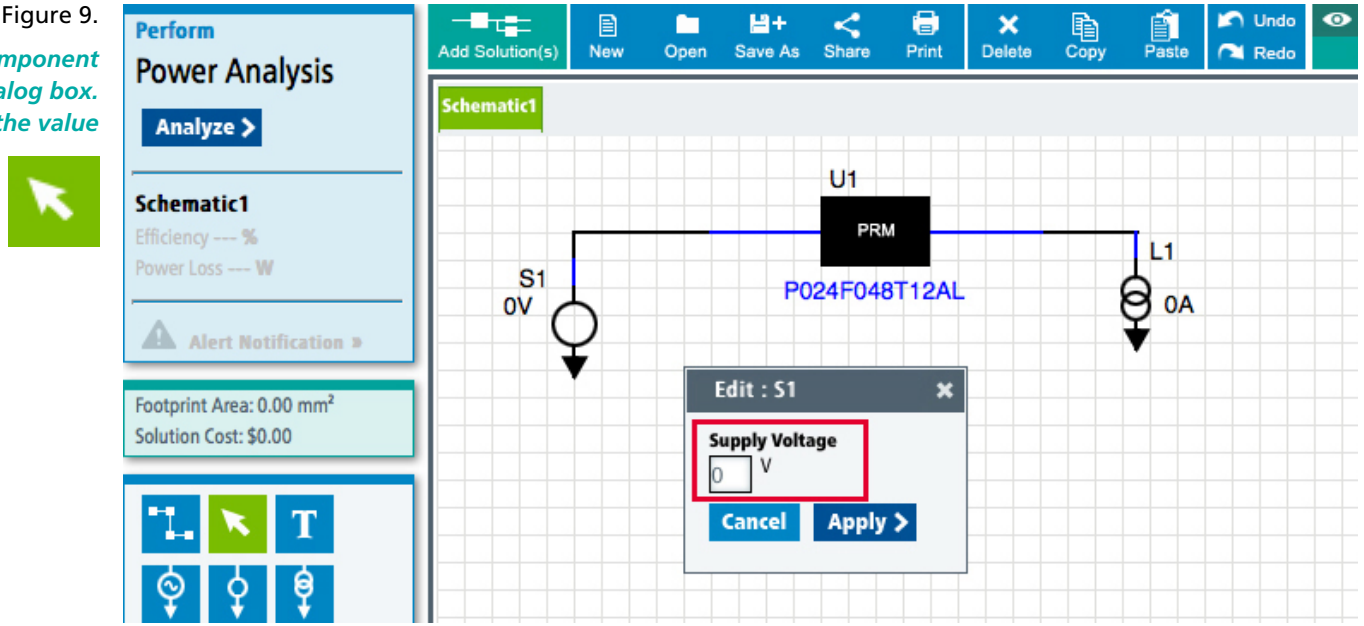
*Use the Wiring Tool to Wire Products and Components Together.*




### Enter Values for AC or DC Supply, Load & Resistance

Figure 9.

*Right-click on the component and enter the needed value in the dialog box. Click Apply to accept the value*



Back To Top ^

## Quick Start Tutorial

### Perform Analysis

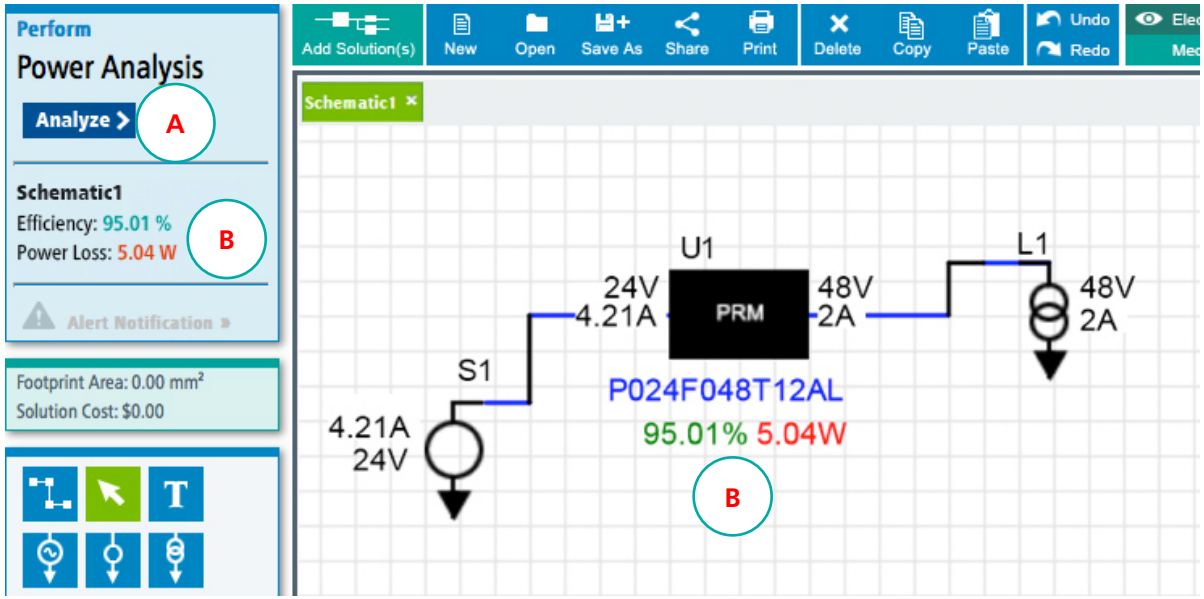
Figure 10.

**A**

***Click on Analyze in the System Analysis Explorer to Analyze the Schematic***

**B**

Analysis Results will be calculated and displayed



# Whiteboard™

## Interactive Menu, Tools & Functions

Back To Top ^

## System Analysis Explorer

Figure 11.

**System Analysis Explorer**

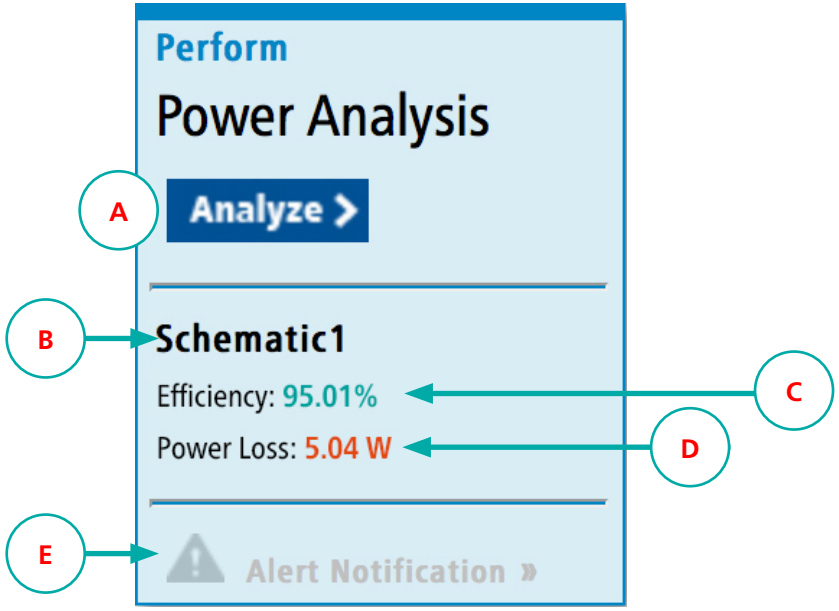
**A**
*Click to Analyze Selected Schematic*

**B**
Current Schematic Name

**C**
Overall System Efficiency

**D**
Overall System Power Dissipation

**E**
System Alerts




## Solution Cost & Footprint Area

Figure 12.

**Solution Cost & Footprint Area**

Solution Cost and Footprint Area of Vicor Products on the selected Schematic

**A**
*Click on Units To Toggle Between Millimeters and Inches*

Back To Top ^

## Design Toolbox

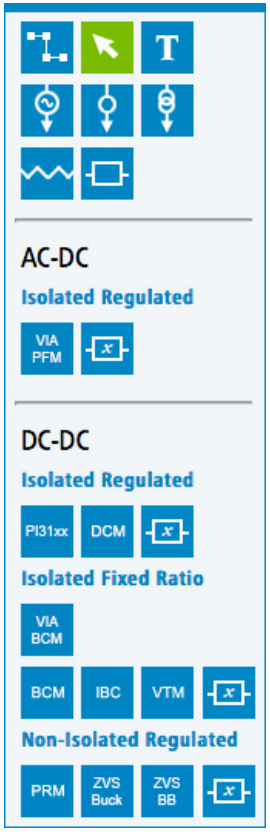
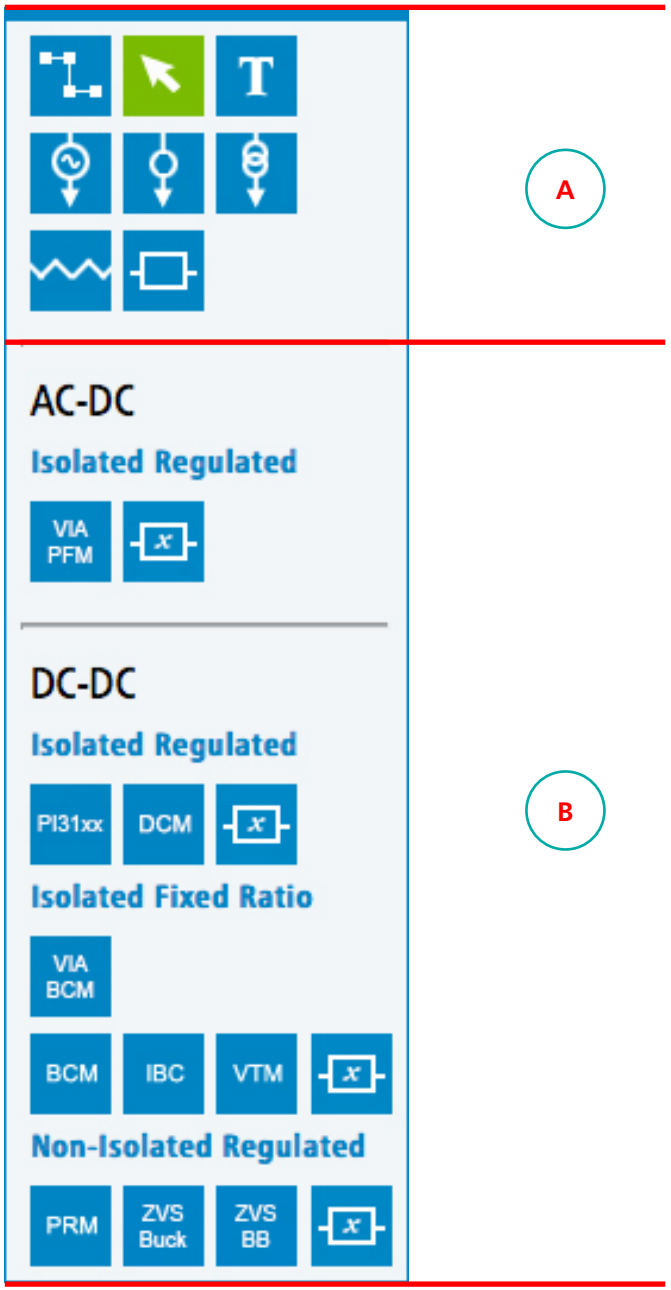



Figure 13.

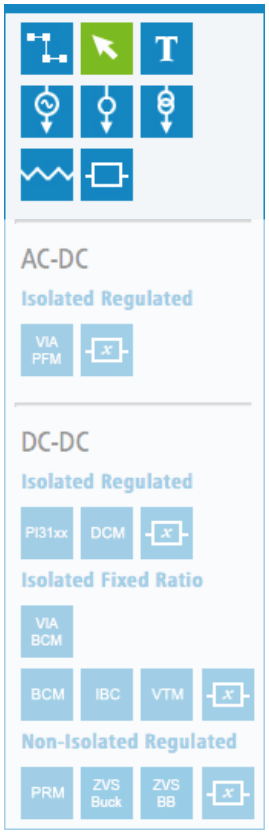
**Design Toolbox**

**A**
Component Palette

**B**
Product Selection Palette



Back To Top ^




## Design Toolbox

### Component Palette

The Component Palette Tools allow you to label, move and connect items on the schematic.

Table 1.

Component Palette Tool Functions

| Icon | Name | Functionality |
|---|---|---|
| | **Wire Tool** | Enables the wiring mode to become active. Wiring activities available are:<br>■ Auto wiring (when the cursor is near to a contact point, clicking the mouse will connect<br>■ Wire edges can be moved using the pointer<br>■ Space bar can be used to realign auto wire bending |
| | **Mouse Pointer** | Enables the use of the mouse pointer cursor to pick and select items on the canvas to be moved and adjusted. |
| | **Text Tool** | Presents a text dialog box where text can be added and modified for display on the canvas. Once created, text can be moved using the mouse pointer to select the pointer, then clicking on the text on the canvas and doing a drag and drop placement to the new place on the canvas. |
| | **AC Supply** | Enables the cursor to enter DC supply mode. |
| | **DC Supply** | Enables the cursor to enter DC supply mode. |
| | **Load** | Enables the cursor to enter 'load mode'. |
| | **Resistor** | Enables the cursor to enter resistor mode. |
| | **Custom Product** | Enables the cursor to enter custom product mode. |

Back To Top ^

## Design Toolbox

### Product Selection Palette

The Product Palette Tools will allow you to find specific Vicor products and add them to your schematic.

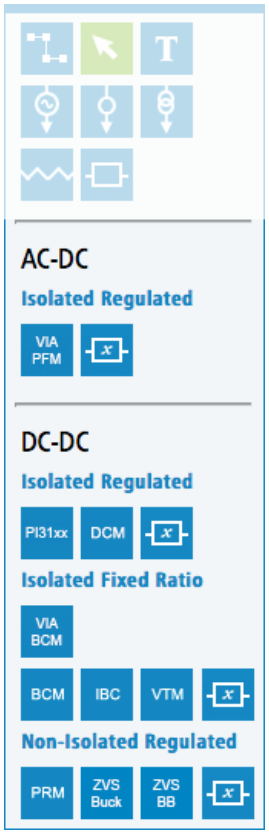



Figure 14.

**A**

To Select a product from the Product Palette *Click on the icon for the product type that you require*

**B**

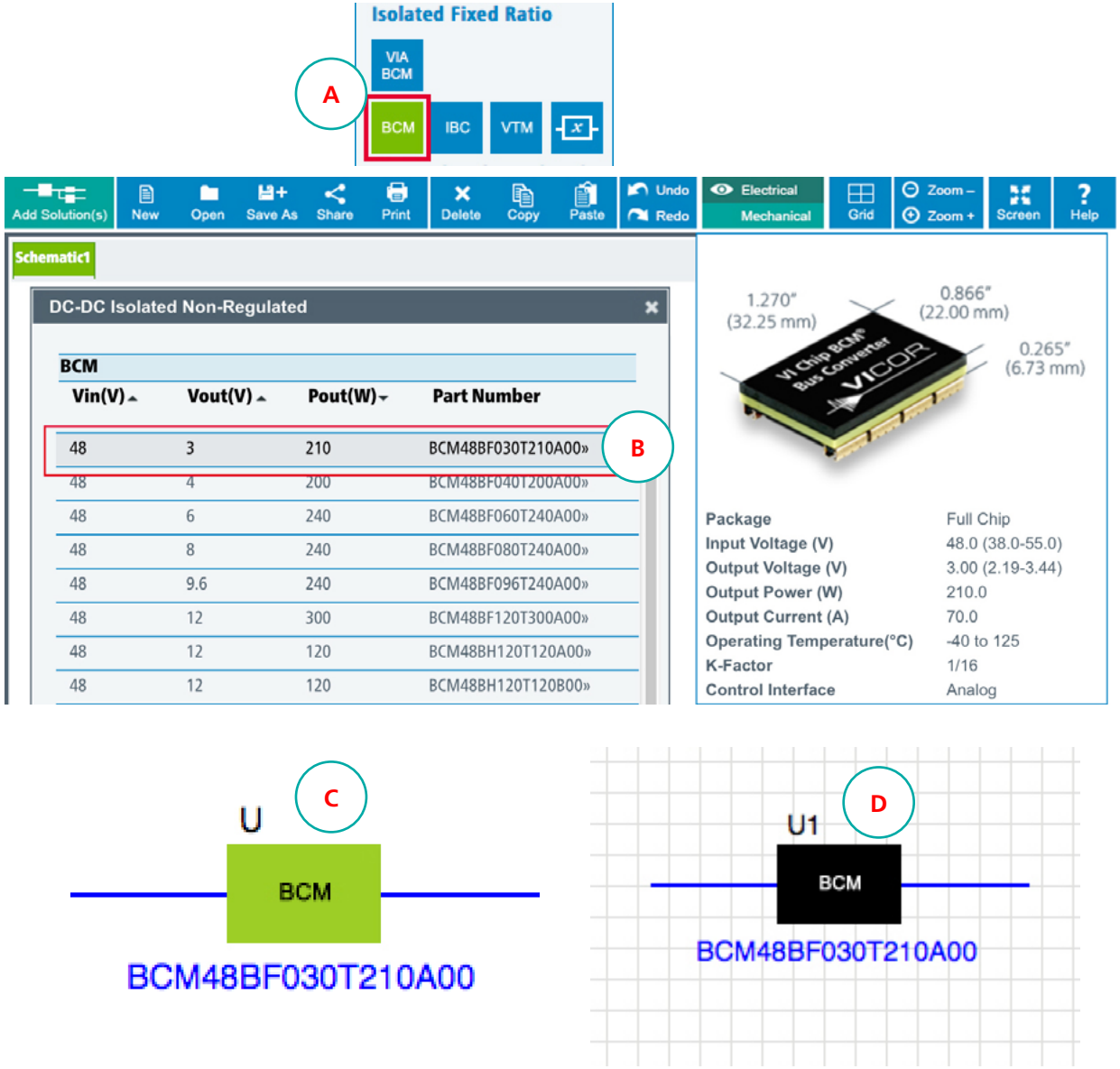
*Select the Part Number of a Vicor product of your choice based on the capabilities required by your power design*

**C**

The cursor will become a symbol of the selected product

**D**

*Click the mouse to place the product on the canvas.*



Back To Top ^

## Taskbar Ribbon

These are the basic functions to manage your files and layout of the WhiteBoard.

### Add Solutions


Table 2.
Add Solutions

| Icon | Name | Functionality |
|---|---|---|
|   | **Add Solutions** | Opens the Add Solutions Dialog box where pre-defined Vicor Power Solution(s) can be selected from various industries and added to the Canvas |

### Schematic File Management


Table 3.
Schematic File Management

| Icon | Name | Functionality |
|---|---|---|
|   | **New Schematic** | Adds a New Schematic tab to the Canvas |
|   | **Open Schematic** | Allows a previously saved schematic file to be loaded onto the Canvas |
|   | **Save Schematic As** | Allows the active Schematic to be saved. |
|   | **Share Schematic** | |
|   | **Print Schematic** | Prints the Schematic on the currently selected tab |

Back To Top ^

## Taskbar Ribbon

These are the basic functions to manage your files and layout of the WhiteBoard.

### Schematic Editing Tools


Table 4.
Schematic Editing Tools

| Icon | Name | Functionality |
|---|---|---|
| Delete | **Delete** | Deletes the currently selected component(s) from the design |
| Copy | **Copy** | Copies the selected component(s) to the active clipboard |
| Paste | **Paste** | Pastes copied items from the active clipboard onto the Canvas |
| Undo | **Undo** | |
| Redo | **Redo** | |

### Schematic Viewing Mode


Table 5.
Schematic Viewing Mode

| Icon | Name | Functionality |
|---|---|---|
| Electrical | **Electrical Mode** | Displayes the Schematic in Electrical Viewing Mode |
| Mechanical | **Mechanical Mode** | Displays the Schematic in Mechanical Viewing Mode |

Back To Top ^

## Taskbar Ribbon

These are the basic functions to manage your files and layout of the WhiteBoard.

### Canvas Display Tools


Table 6.
Canvas Display Tools

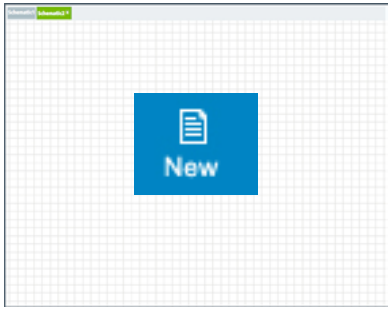
| Icon | Name | Functionality |
|---|---|---|
| Grid | **Grid** | Toggle Grid Background on the Canvas: Shows / Hides |
| Zoom – | **Zoom -** | Reduces the view of the Canvas / Schematic |
| Zoom + | **Zoom +** | Enlarges the view of the Canvas / Schematic |
| Screen | **Screen** | Toggles the Screen Display:  Normal to Fullscreen / Full Screen to Normal |

### Help File


Table 7.
Whiteboard Tool Help File

| Icon | Name | Functionality |
|---|---|---|
| Help | **Help** | Opens the PowerBench WhiteBoard Help File |

Back To Top ^




## Schematic Canvas

This is the area where you place your components and product design elements.

### Adding New Schematics

*Please Note the Selected Schematic

The Analyze button will only perform analysis on the schematic that is currently selected.

As you select different schematic tabs the title will update in the Perform Analysis box to indicate which schematic is active for Analysis.

Figure 15.

**A**

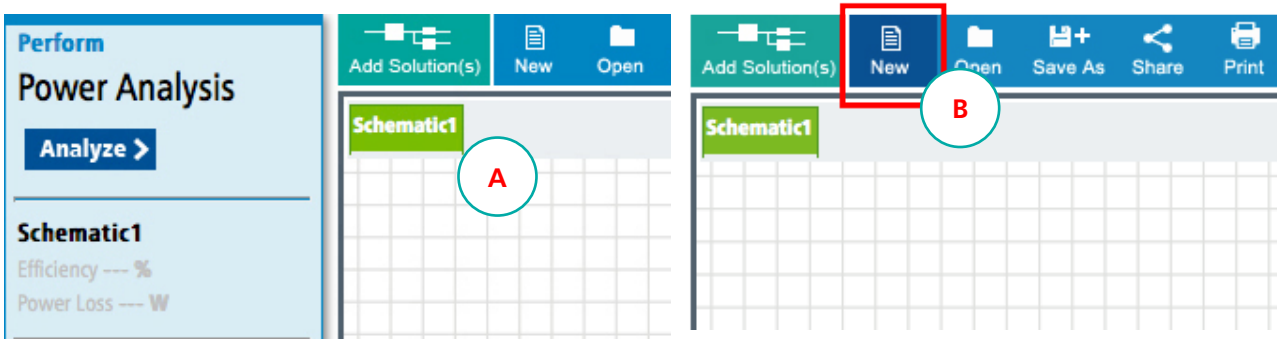
The Whiteboard Tool opens with a blank canvas open (Schematic1)

Multiple schematic tabs can be opened and edited

**B**

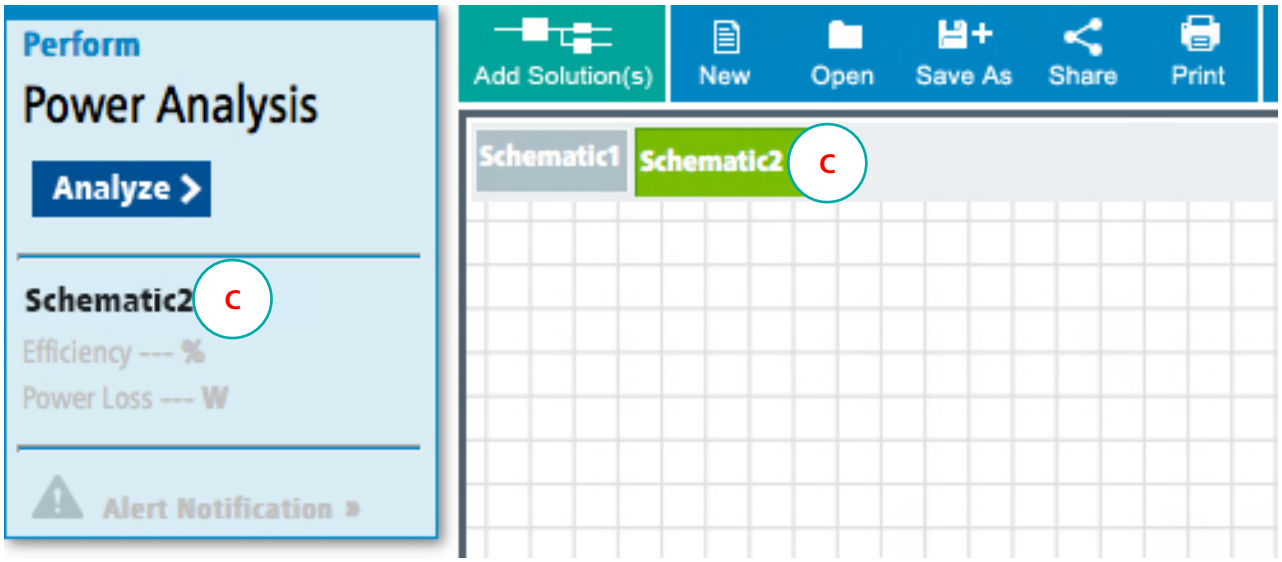
To add a new Schematic

***Click on New in the Taskbar Ribbon***

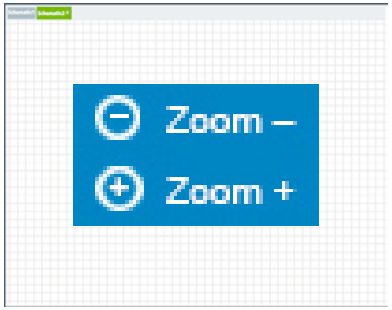



**C**

The title of the selected schematic will appear in both the tab and in the Perform Analysis box.



Back To Top ^




## Schematic Canvas

This is the area where you place your components and product design elements.

### Zooming In / Zooming Out

When a very large design is being placed on the canvas, the Zoom toolbar buttons allow for easy resizing of the details.

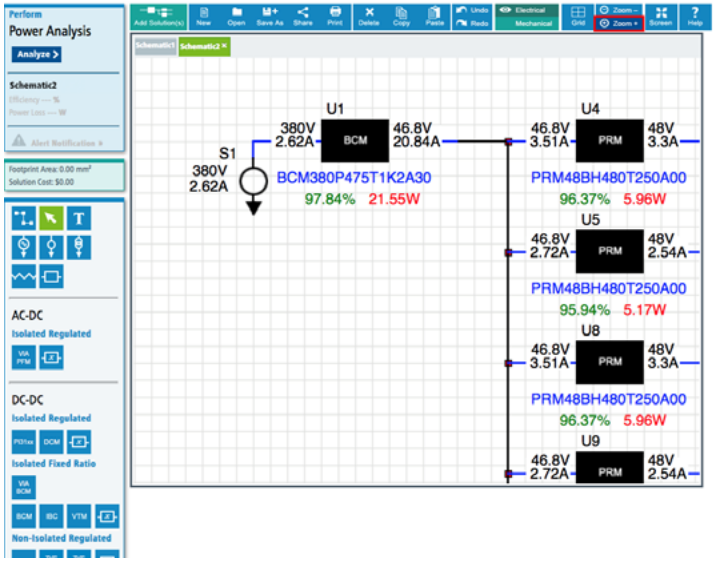
Figure 16.

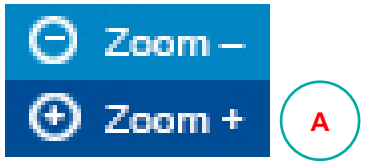
**A**

To enlarge the display of a Schematic
***Click on Zoom In in the Taskbar Ribbon***

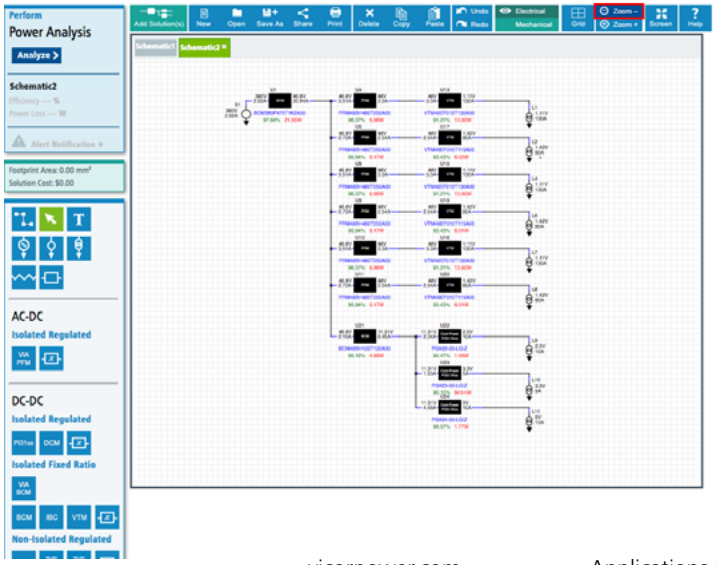
**B**

To reduce the display of a Schematic
***Click on Zoom Out in the Taskbar Ribbon***




A





B

Back To Top ^

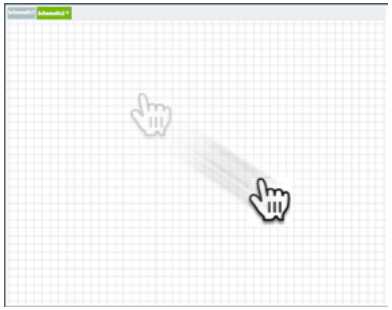


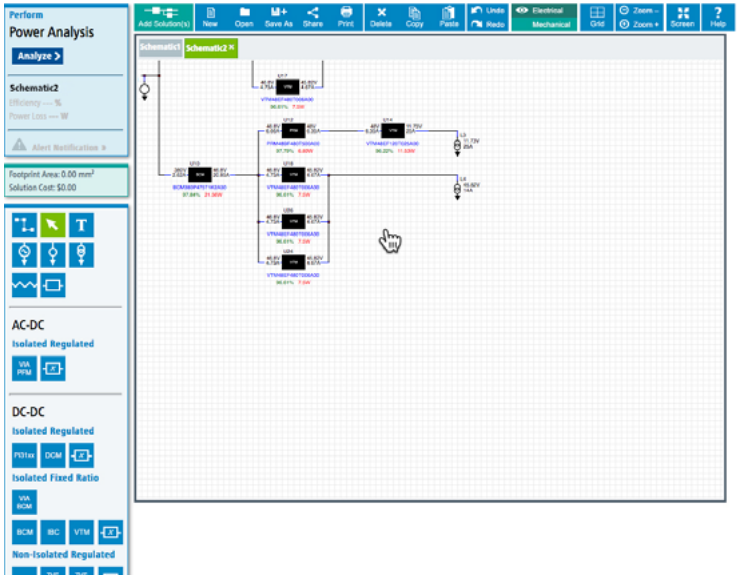
Figure 17.
An example of moving the schematic from the top left of canvas to the top center of the canvas.

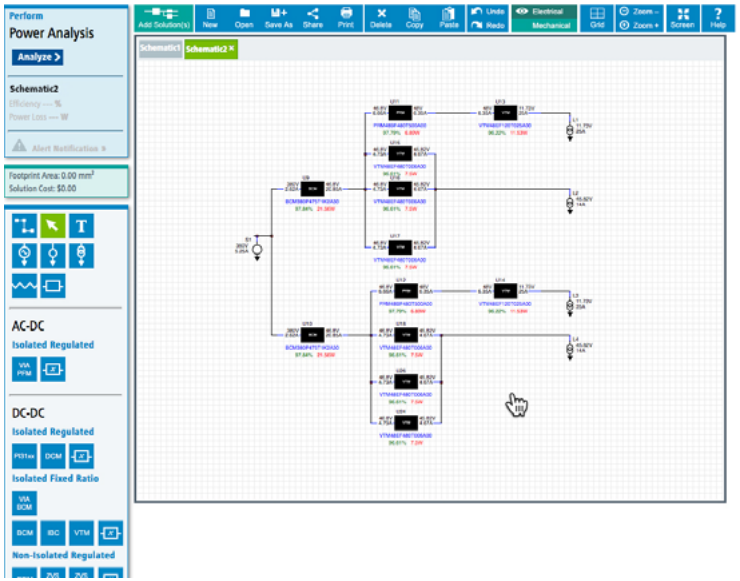
**A**
To move/pan the canvas
***Right-Click on the Canvas, Hold and Drag***

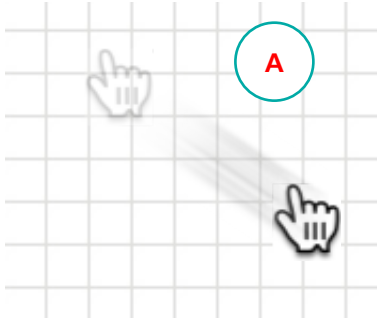
## Schematic Canvas

This is the area where you place your components and product design elements.

### Moving / Panning



Back To Top ^

## Keyboard Shortcuts

Table 8. Keyboard Shortcuts

| Symbol(s) | Key(s) | Function |
|---|---|---|
| Alt + I | **ALT+I** | Opens Quick Menu |
| Del | **DELETE** | Deletes selected object(s) |
| | **SPACE** | Bends the Wire when in wire mode |
| Esc | **ESC** | Cancels current action and returns the cursor to a pointer |
| Ctrl + C | **CTRL+C** | Copy |
| Ctrl + V | **CTRL+V** | Paste |
| Ctrl + Z | **CTRL+Z** | Undo |
| Ctrl + Y | **CTRL+Y** | Redo |
| Ctrl + O | **CTRL+O** | Open Saved Schematic |
| Ctrl + W | **CTRL+W** | Close Schematic |

Back To Top ^

## Context Menu & Renaming Tabs

The context menu allows quick access to common Whiteboard tool actions from anywhere on the canvas at any time. This menu provides a quick method to rename a schematic (tab) without having to save.

Figure 18.

**A**

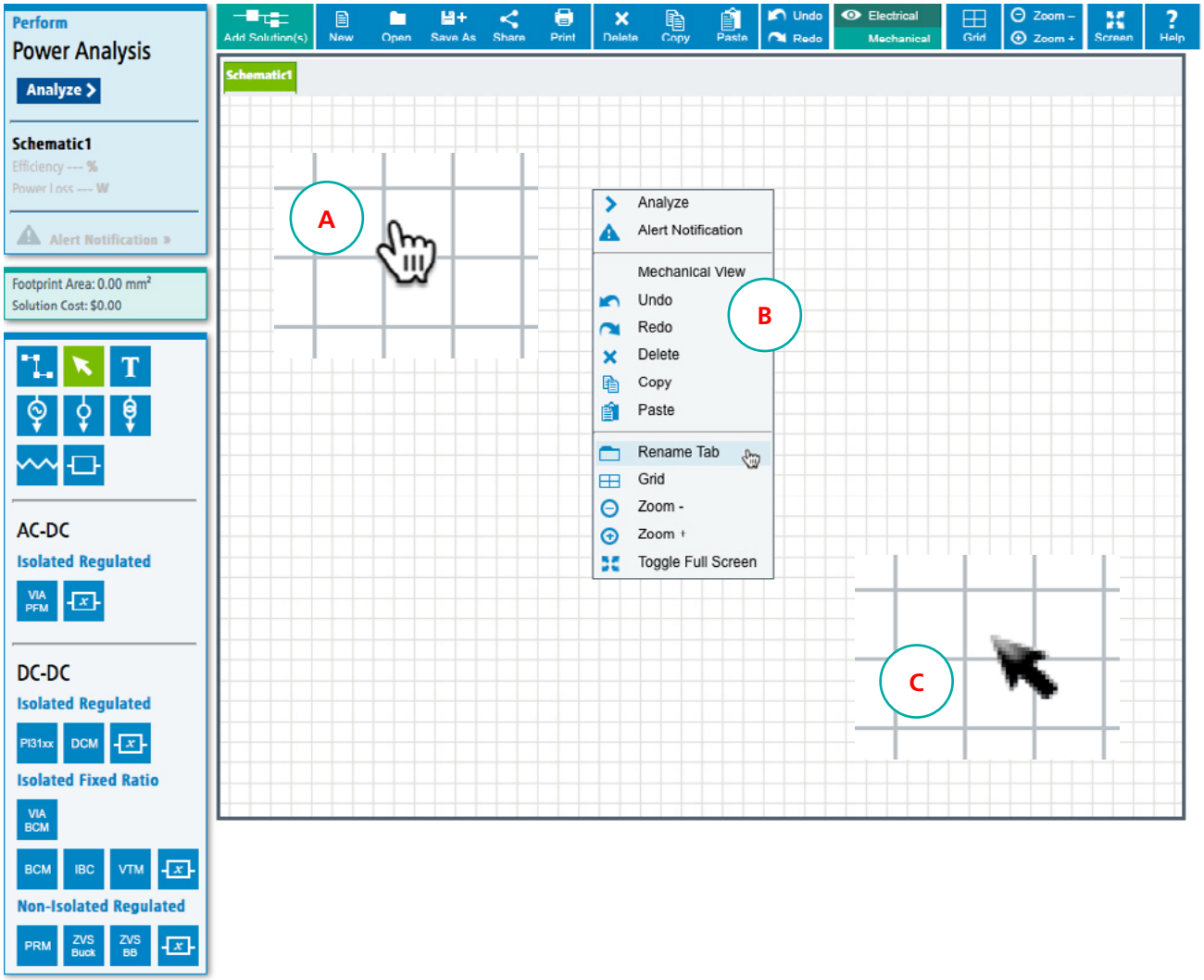
*Right-Click on the Canvas to Open the Context Menu*

**B**

*Mouse-over and Click to Select Items from the Context Menu*

**C**

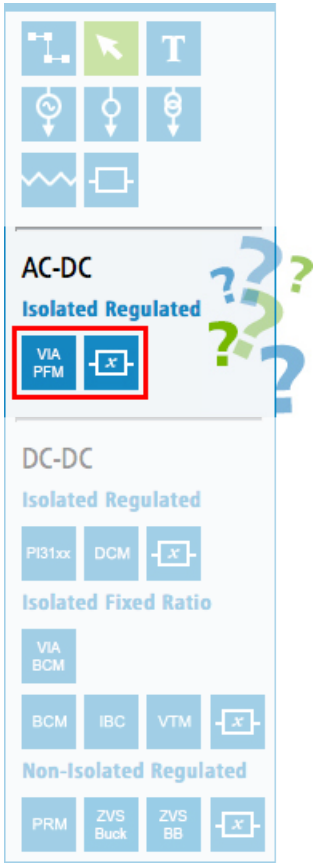
*Click on the Canvas to Close the Context Menu*



# Whiteboard™

## Interactive Menu, How To Use

Back To Top ^




## Selecting Products

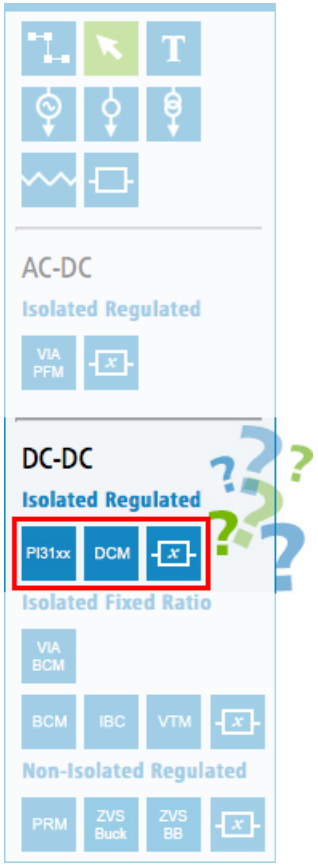
### AC-DC Converters, Isolated Regulated

Table 9.

AC-DC Converters Isolated Regulated

| Icon | Product Name | Description |
|---|---|---|
| **Isolated Regulated** | | |
| VIA PFM | **VIA PFM™ AC-DC Converter with PFC** | The VIA PFM is a highly advanced 400 W AC-DC converter operating from a rectified universal AC input which delivers an isolated and regulated Safety Extra Low Voltage (SELV) 24 or 48 V secondary output. This unique, ultra-low profile module incorporates AC-DC conversion, integrated filtering and transient surge protection in chassis mount or PCB mount form factor. The VIA PFM enables a versatile two sided thermal strategy which greatly simplifies thermal design challenges. When combined with downstream Vicor DC-DC conversion components and regulators, the VIA PFM allows the Power Design Engineer to employ a simple, low-profile design which will differentiate his end-system without compromising on cost or performance metrics. |
| x | **Functional Block** | This Functional Block can be used to create custom AC-DC Isolated Regulated components with user specified values. Created functional blocks can be saved to a user's profile (My Vicor) and used in whiteboard designs. Functional Block values will be included when performing power system analysis. This feature allows custom product naming (ex. user part number). |

Back To Top ^



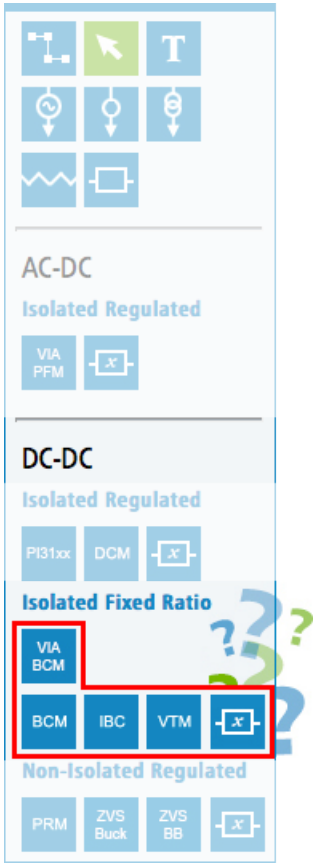

## Selecting Products

### DC-DC Converters, Isolated Regulated

Table 10.
DC-DC Converters
Isolated Regulated

| Icon | Product Name | Description |
|---|---|---|
| **Isolated Regulated** | | |
| PI31xx | **Cool-Power® DC-DC Converter** | The PI31xx is a family of high density, isolated DC-DC Zero-Voltage Switching (ZVS) converter modules integrating controller, power switches, planar magnetics, and support components all within a high density surface-mount package. This complete solution utilizes a high performance ZVS topology enabling high switching frequencies and providing best in class power density. The high switching frequency reduces input and output filtering requirements, further decreasing size and cost of the overall solution. |
| DCM | **DCM™ DC-DC Converter** | Leveraging the thermal and density benefits of Vicor's ChiP packaging technology, the DCM module offers flexible thermal management options with very low top and bottom side thermal impedances. Thermally-adept ChiP based power components enable customers to achieve cost-effective power system solutions with previously unattainable system size, weight and efficiency attributes, quickly and predictably. |
| x | **Functional Block** | This Functional Block can be used to create custom DC-DC Isolated Regulated components with user specified values. Created functional blocks can be saved to a user's profile (My Vicor) and used in whiteboard designs.<br>Functional Block values will be included when performing power system analysis. This feature allows custom product naming (ex. user part number). |

Back To Top ^




## Selecting Products

### DC-DC Converters, Isolated Fixed Ratio

Table 11.

DC-DC Converters
Isolated Non-Regulated

| Icon | Product Name | Description |
|---|---|---|
| **Isolated Non-Regulated** | | |
| VIA BCM | **VIA BCM® Bus Converter** | The High Voltage VIA BCM is a highly advanced 1.75 kW bus converter operating from a 260 V to 410 VDC input which delivers an isolated Safety Extra Low Voltage (SELV) 48 V secondary output. This unique, ultra-low profile module incorporates bus conversion, integrated filtering and transient surge protection in chassis mount or PCB mount form factor. The High Voltage VIA BCM enables a versatile two sided thermal strategy which greatly simplifies the thermal design of such a high density device. When combined with downstream Vicor DC-DC conversion products and regulators, the High Voltage VIA BCM allows the power design engineer to achieve industry benchmark power density and electrical performance with a small, easy-to-use power component. |
| BCM | **BCM® Bus Converter** | BCM and IBC products have the highest efficiency and lowest losses among isolated fixed ratio DC-DC converters. BCM products have a higher power density, and have a flat molded top that makes it easier to conduct heat out of the parts, enabling higher output power levels. |
| IBC | **IBC Intermediate Bus Converter** | IBC products are open frame, and follow industry standard quarter brick and eight brick formats. They should be specified where second sourcing compatibility is required. IBC converters also have a wider input voltage range than most BCM products. |
| VTM | **VTM® Current Multiplier** | VTM modules are similar in topology and packaging to BCM modules, but are optimized for use with a PRM module to form a regulated and isolated power supply. The VTM module provides the isolation and voltage for a fixed turns ratio transformation of power. The PRM module provides the regulation for the circuit. The VTM module can be used without the PRM module, however some external circuitry must be added. The VTM module has a much wider input range than BCM or IBC modules. |
| x | **Functional Block** | This Functional Block can be used to create custom DC-DC Isolated Non-Regulated components with user specified values. Created functional blocks can be saved to a user's profile (My Vicor) and used in whiteboard designs. Functional Block values will be included when performing power system analysis. This feature allows custom product naming (ex. user part number). |

Back To Top ^

## Selecting Products

### DC-DC Converters, Non-Isolated Regulated

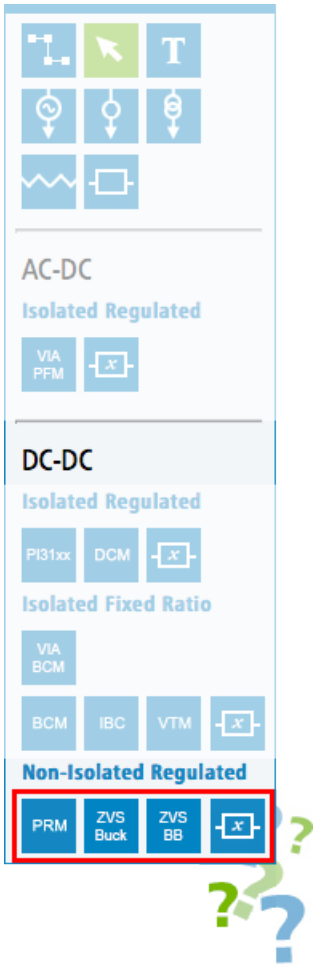



Table 12.

DC-DC Converters
Non-Isolated Regulated

| Icon | Product Name | Description |
|---|---|---|
| **Non-Isolated Regulated** | | |
| PRM | **PRM® Regulator** | PRM products can be used as a single stage buck/boost regulator, with local or remote sensing, or adaptive loop. Addition of a VTM following a PRM allows a voltage/current tradeoff similar to a transformer, allowing higher output power. The PRM is most efficient when the output voltage is close in value to the input voltage. Selection of the correct turns ratio in the VTM can be used to adjust the output voltage to optimize efficiency for lower voltage, higher current systems. |
| ZVS Buck | **Cool-Power® ZVS Buck Regulator** | Use of a ZVS topology enables high-frequency operation that maximizes efficiency by minimizing the significant switching losses associated with conventional buck regulators using hard-switching topologies. The high switching frequency of the PI33xx/PI34xx series also reduces the size of the external filtering components, improving power density while enabling fast dynamic response to line and load transients. |
| ZVS BB | **Cool-Power® ZVS Buck-Boost** | The PI375x is a System-in-Package (SiP) module integrating a ZVS controller, power switches, and support components. The PI375x requires minimal external devices to form a complete DC-DC switching mode buck-boost regulator. The ZVS topology enables high frequency operation while minimizing switching losses and maximizing efficiency. The ZVS topology, high frequency operation, efficiency, silicon integration, and power density are the combined elements that make the PI375x series recognized for high performance. |
| x | **Functional Block** | This Functional Block can be used to create custom DC-DC Non-Isolated Regulated components with user specified values. Created functional blocks can be saved to a user's profile (My Vicor) and used in whiteboard designs. Functional Block values will be included when performing power system analysis.<br>This feature allows custom product naming (ex. user part number). |

## Setting Product Values

### Device Temperature

Figure 19.

**A**

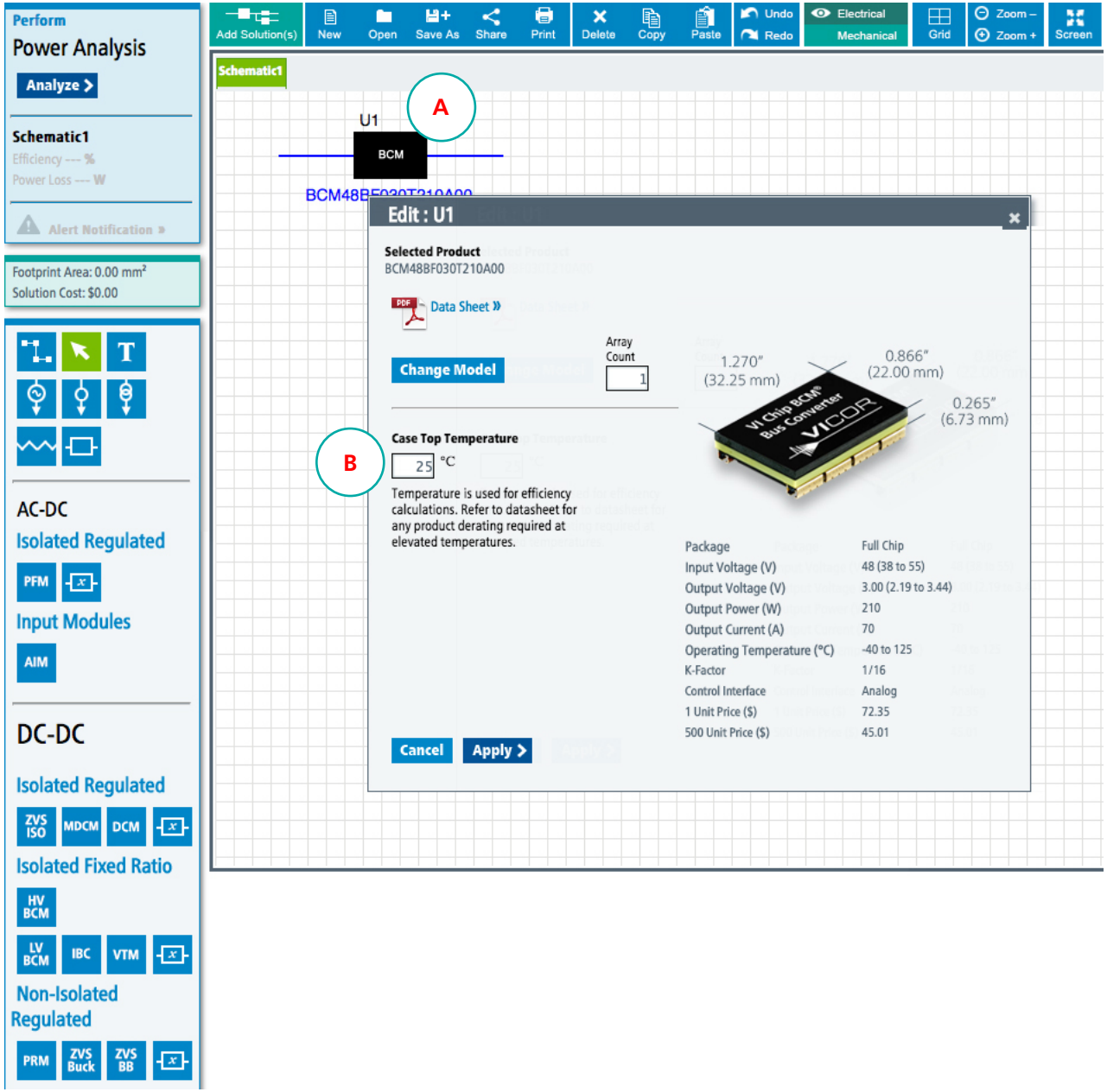
***Right-click on a product symbol to open and edit it's product properties***

**B**

Change Device Temperature

***Enter the desired value into the text field and Click Apply.***

The dialog box will close and the new value entered will be used during analysis.



Change Model

Back To Top ^

## Setting Product Values

### Model Type

Figure 20.

**A**

***Right-click on a product symbol to open and edit it's product properties***

**B**

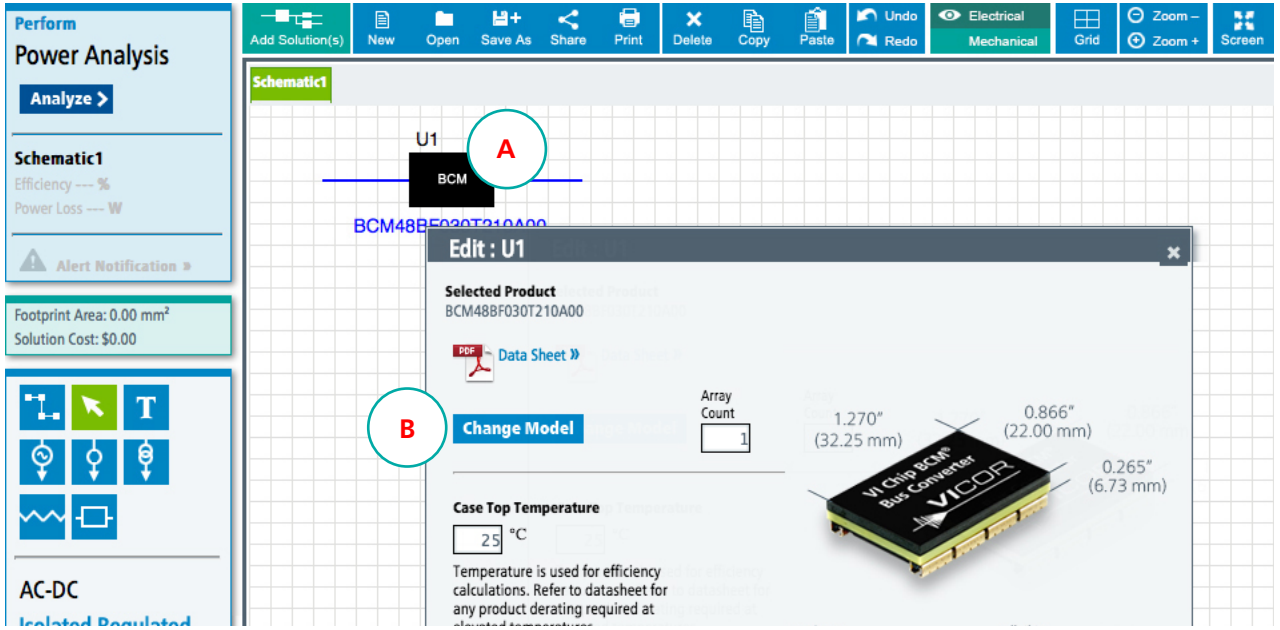
***Click Change Model to change the Model Type of a product***

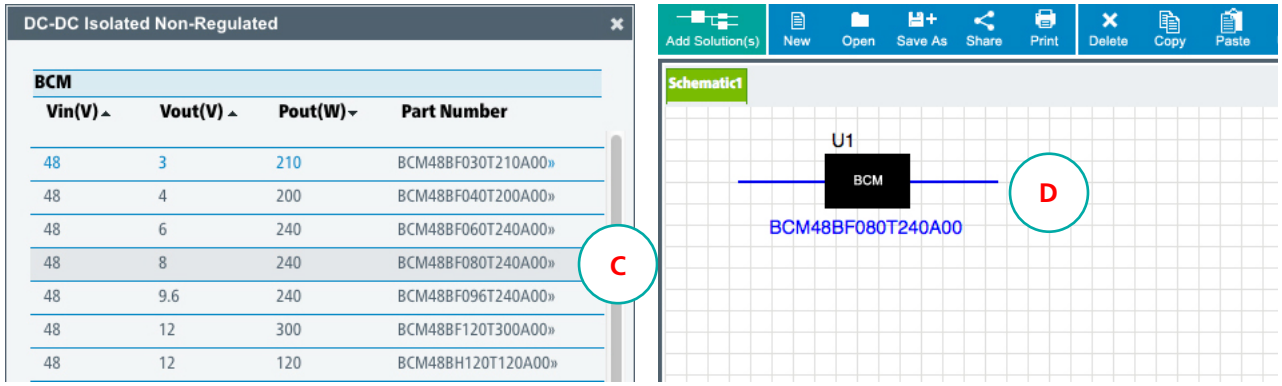
**C**

Selecting the Change Model button will open the Product Selection Dialog.

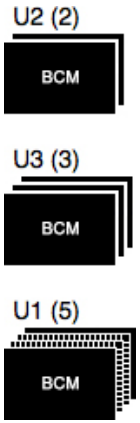
**D**

Selecting a model from the Product Selection dialog will close the dialog box and the product model type will automatically update on the Whiteboard schematic.



Back To Top ^




## Setting Product Values

### Product Arrays

Using product arrays provides the ability to wire parallel components as a symbol. This results in more compact designs, and also helps in faster turnaround times.

Figure 21.
An example of a Whiteboard powerchain using product arrays

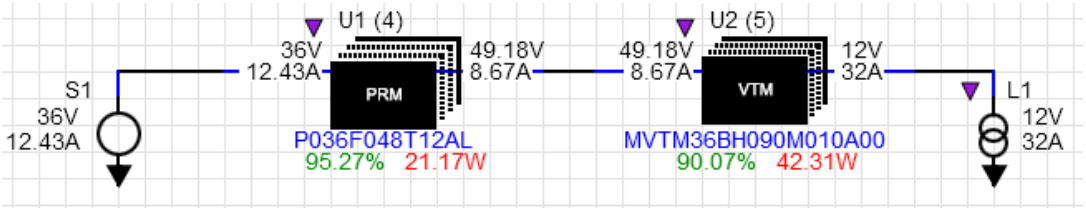
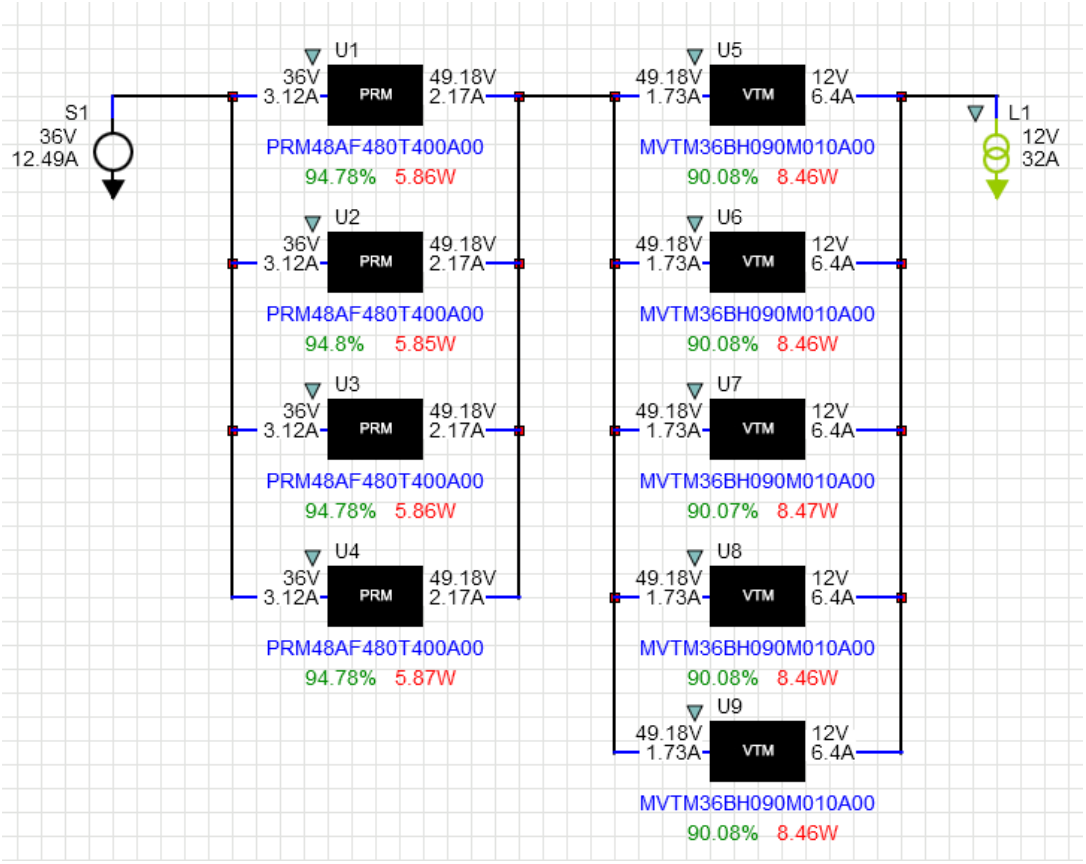



Figure 22.

An example of a Whiteboard powerchain using the traditional way of depicting product arrays

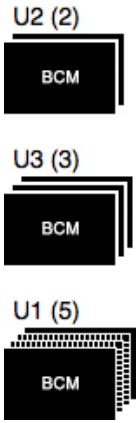


Back To Top ^

## Setting Product Values

### Product Arrays

Using product arrays provides the ability to wire parallel components as a symbol. This results in more compact designs, and also helps in faster turnaround times.



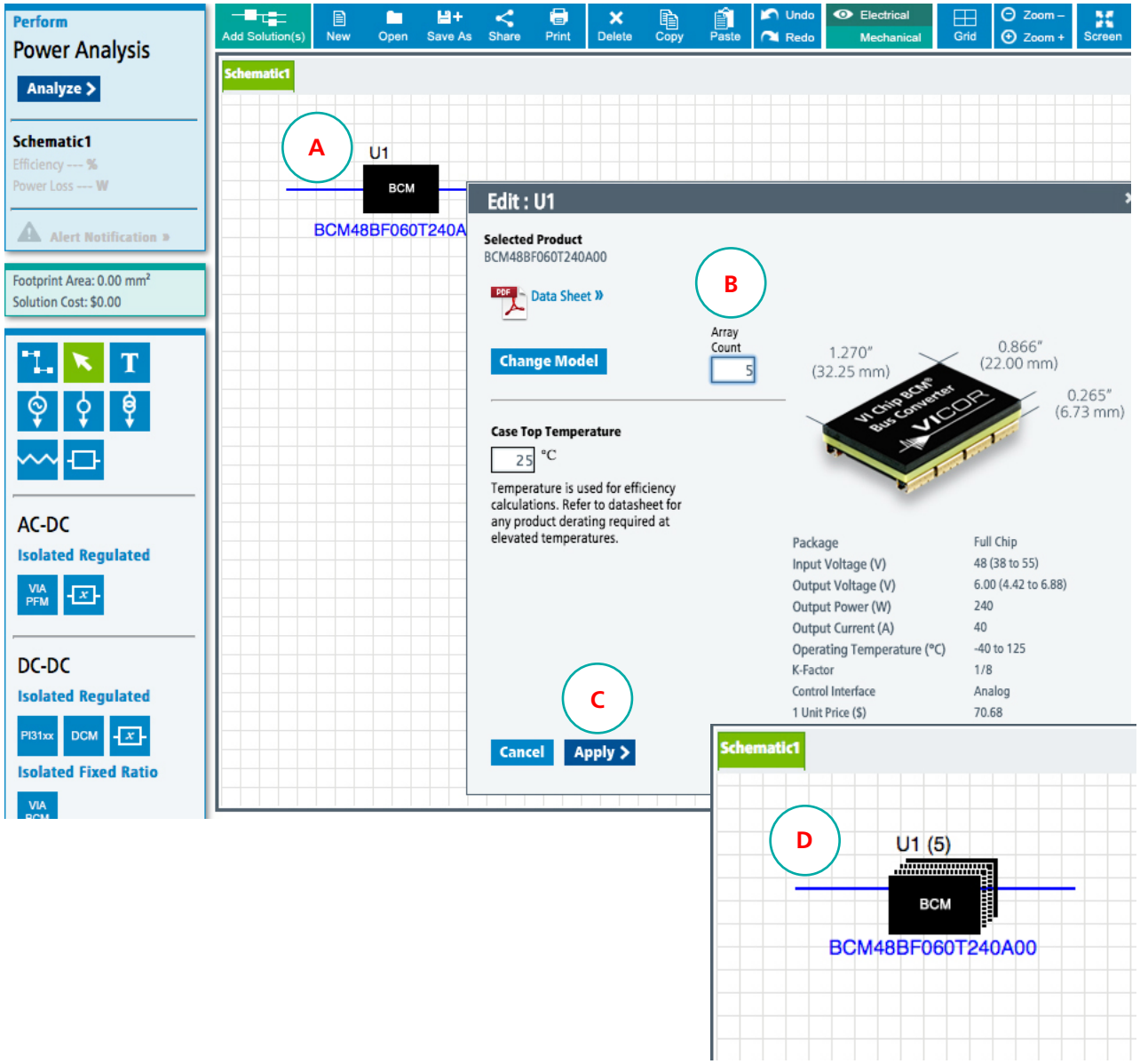




Figure 23.

**A**

***Right-click on a product symbol to open and edit it's product properties***

**B**

***Enter the desired number of products in the Array Count text entry field***

**C**

***Click Apply***

**D**

The product properties dialog box will close and the product symbol will be automatically updated on the Whiteboard schematic to the product array symbol.

The number of products in the array will appear in parenthesis to the right of the component ID.

Back To Top ^

## Setting Product Values

### Regulation Type : Remote Sense or Adaptive Loop

Vicor PRM™ Regulator Module regulation type can be set as Remote Sense or Adaptive Loop.

In ***Adaptive Loop*** there is one master operating at full load. This limits the total output power of an array operating in Adaptive Loop mode to the full output of the Master plus the derated output power of the slaves.

In ***Remote Sense*** all the members of the array are treated as slaves and are derated as such. The derating factor for both regulation types are indicated in the components respective datasheets.

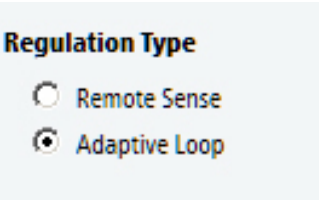



Figure 24.

**A**

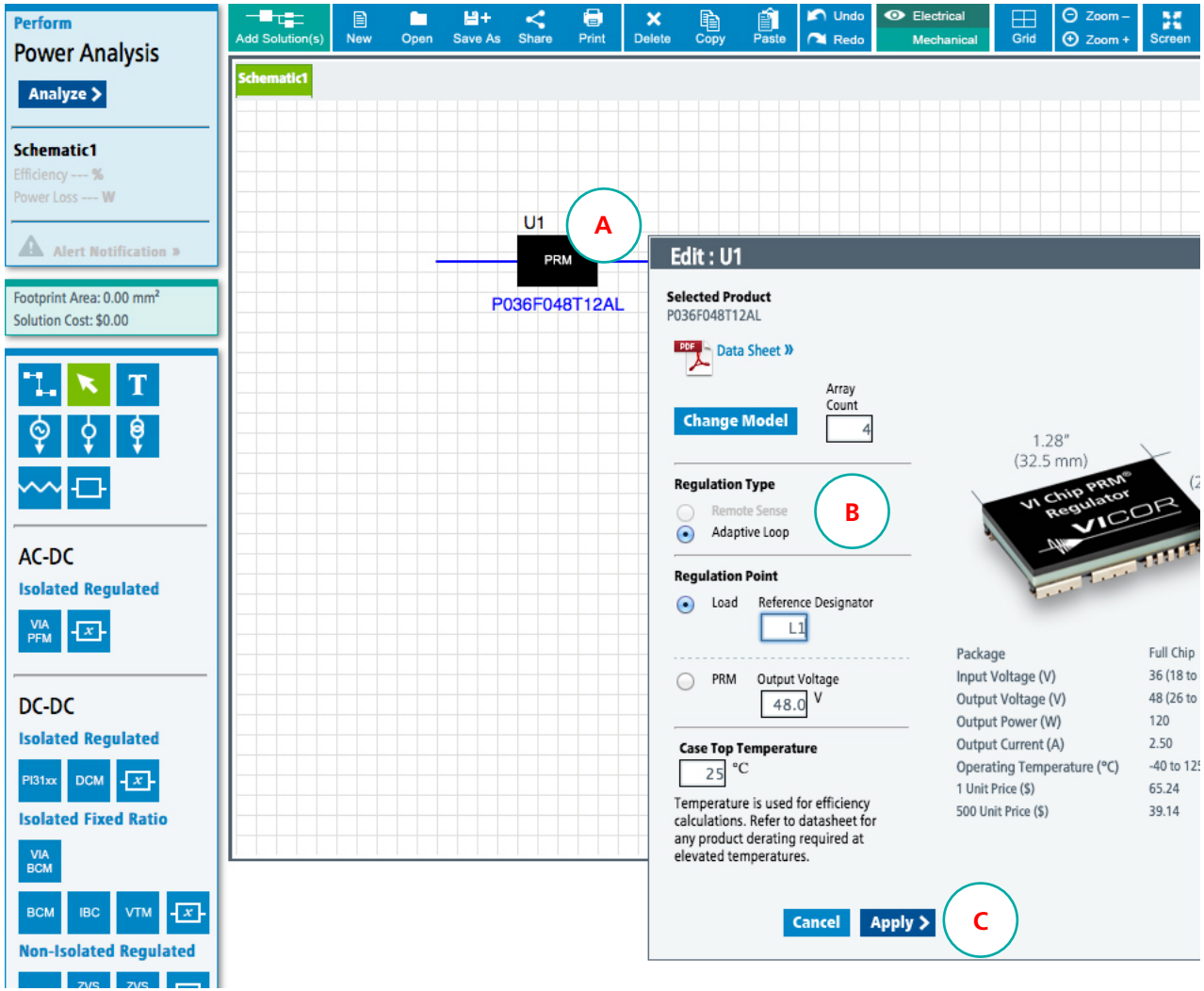
*Right-click on a PRM module product symbol to open and edit it's product properties*

**B**

*Select Remote Sense or Adaptive Loop from the Regulation Type radio set*

**C**

*Click Apply*




Back To Top ^

## Setting Product Values

### PRM Regulation : Regulating Against a Load

A PRM module can be regulated against a load that is connected to it. To regulate PRM module (U2) against the Load (L1), first set the desired load voltage on (L1) as shown.

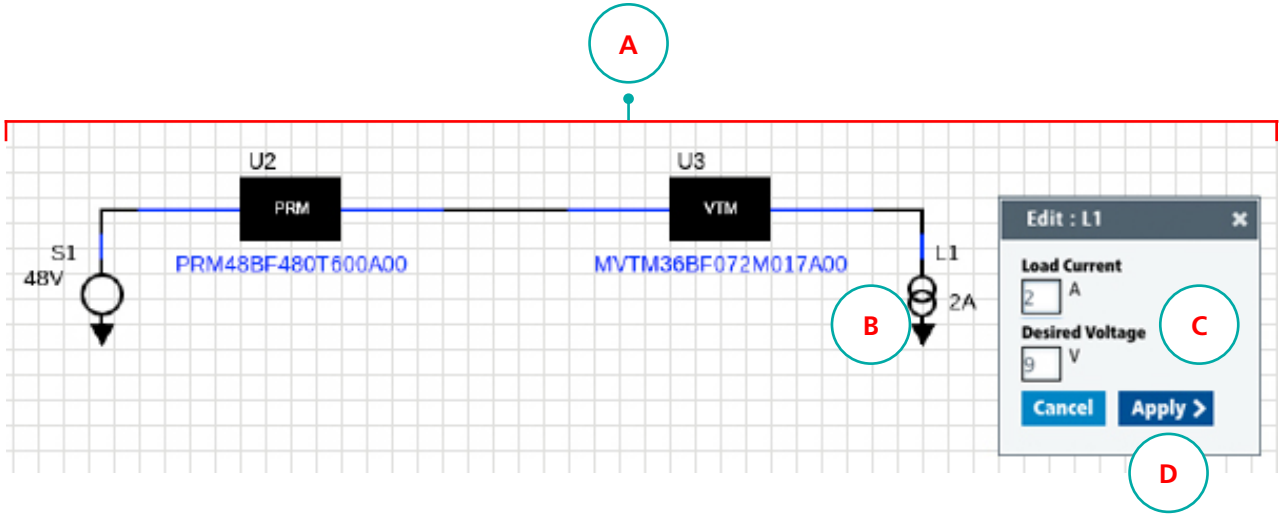



Figure 25.

**A**

To regulate the PRM module (U2) against the Load (L1) first set the desired load voltage for L1.

**B**

***Right-click on the L1 load symbol to open and edit it's values***

**C**

***Set the desired load voltage on L1***

**D**

***Click Apply***

Back To Top ^


## Setting Product Values

### PRM Regulation : Setting the Load as the Regulation Point

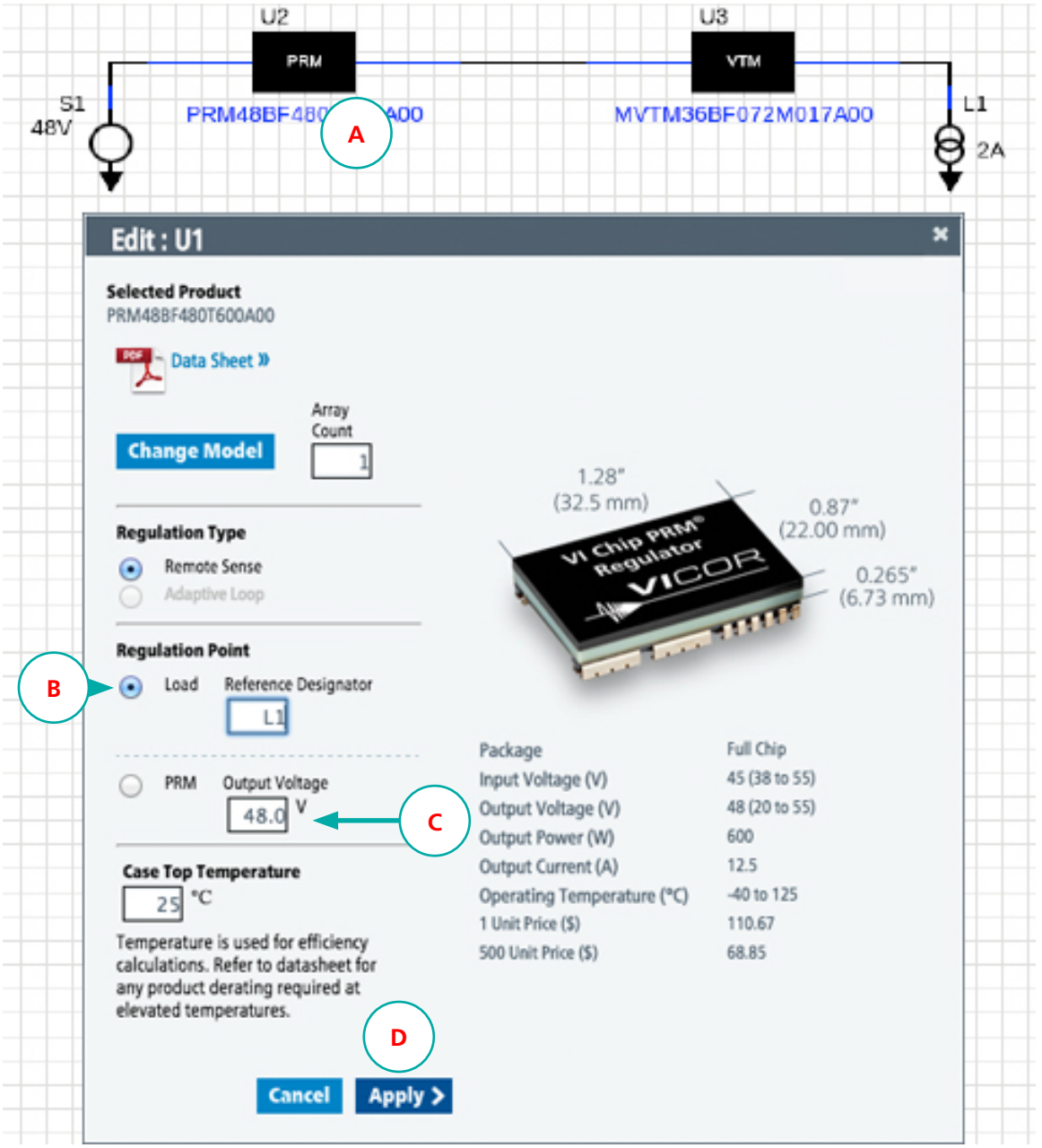



Figure 26.

**A**

*Right-click on the PRM module product symbol to open and edit it's product properties*

B

*Select Load as the Regulation Point*

**C**

*Enter a name for the load (L1) in the 'Reference Designator' text entry field*

**D**

*Click Apply*

Back To Top ^


## Setting Product Values

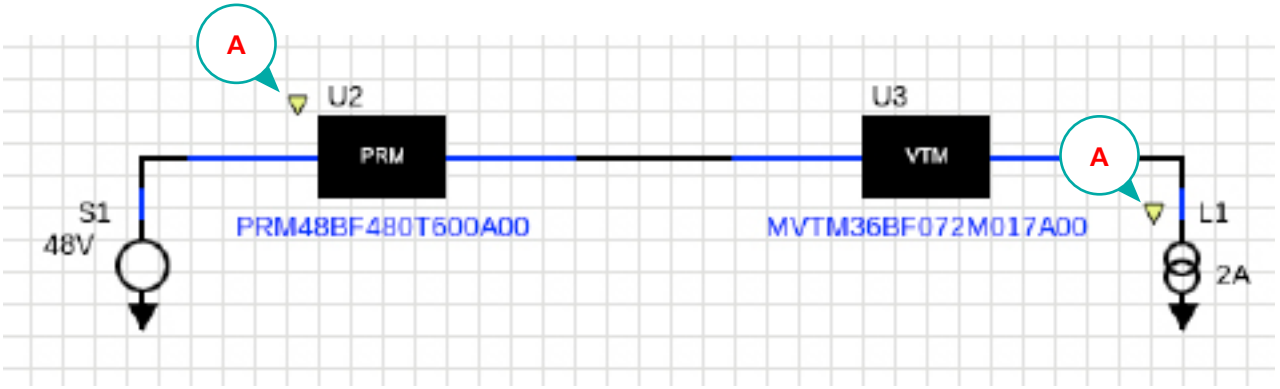
### PRM Regulation : Colored Regulation Markers

Now we see two markers one each on (U2) and (L1), with matching colors. The yellow regulation markers below indicate that regulator (U2) is regulating at load (L1).

Figure 27.

**A**

Two yellow regulation markers indicate that the PRM Regulator (U2) is regulating at load (L1).




Upon clicking Analyze, we see the performance specs, but also see a third matching color marker placed on the VTM as well. The third marker indicates the additional component(s) which are in the regulation path – in this case VTM module (U3).

Figure 28.

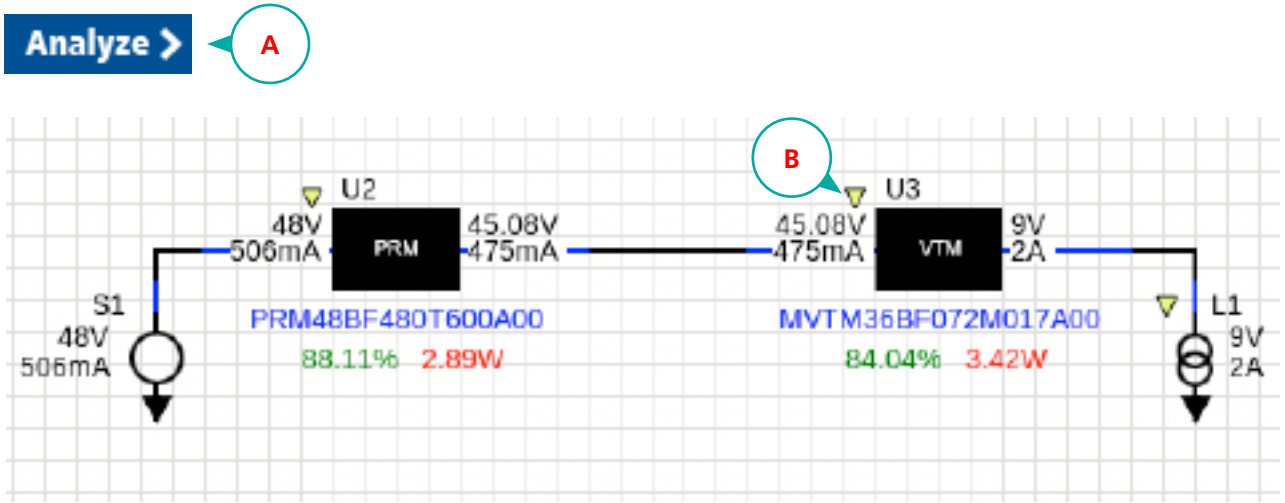
**A**

***Click Analyze to Perform System Analysis***

**B**

In addition to performance specs, a third yellow regulation marker now appears in the upper left corner of the VTM module

This additional yellow marker indicates that the VTM module is also in the regulation path



Back To Top ^


## Setting Product Values

### PRM Regulation : Differentiating Regulation Markers Across Multiple Power Chains

The marker colors are automatically chosen to indicate separate regulation chains. A second, independent regulator at U4 is shown with pink markers, to differentiate it from the yellow markers of the U2 regulating chain.

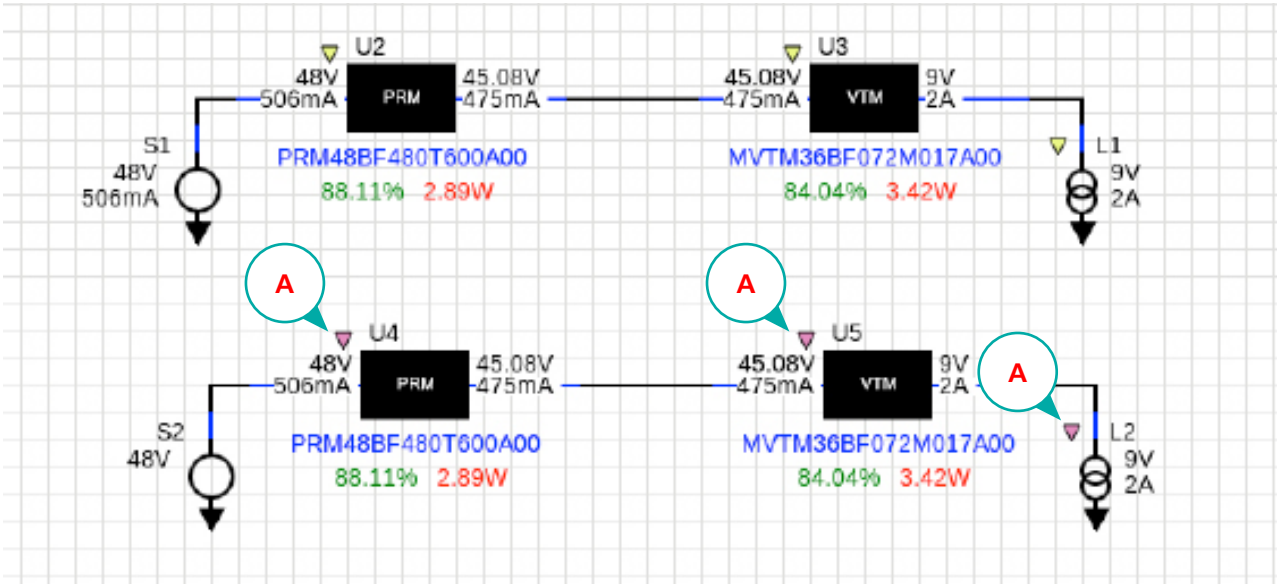



Figure 29.

**A**

A new pink regulator marker appears in the (U4) regulating chain to differentiate it from the yellow regulation markers of the (U2) regulating chain

New regulation marker colors are automatically assigned by default to indicate separate regulation chains.

Back To Top ^

## Setting Product Values

### DCM Regulation

A DCM module regulates at its own output terminals. It has a load-line where the output voltage changes with the applied load, and it has a built-in tempco which also changes the output voltage based on temperature. The load line and tempco enable wireless sharing in arrays.

Both the DCM module rated nominal output voltage and the programmed trim condition are referred to full rated load, and 25°C conditions. As the load current is reduced, the actual output voltage of the DCM converter module rises from the programmed trim condition according to its load line. Similarly, as the temperature is reduced (or raised) from 25°C, the actual output voltage raises (or lowers) from the programmed trim condition.

**Please see the DCM datasheet for more details on how the actual output voltage relates to the programmed trim condition, and what additional variables must be taken into consideration.**

DCM modules can also be trimmed about their nominal rated output voltage. The most common trim range is -40% to +10% of Vout-nom.

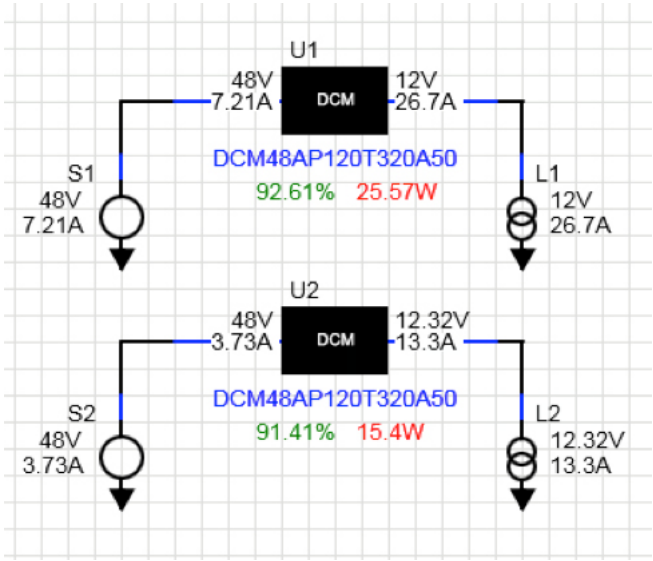
Both (U1) and (U2) have a programmed trim condition of 12 V, and are operating at 25°C, which is the nominal Vout for this model. (U1) is a 100% rated load, while (U2) is at 50% load.

Figure 30.

**A**

Both (U1) and (U2) have a programmed trim condition of 12 V, and are operating at 25°C which is the nominal Vout for this model.

(U1) is a 100% rated load, while (U2) is at 50% load.



Back To Top ^

## Setting Product Values

### DCM Regulation : Editing the Programmed Trim Value

In the PowerBench™ Whiteboard, the DCM module programmed trim condition is set in the product properties dialog box of each DCM module instance. The output referred programmed trim condition can be directly set in the Programmed Trim text input field.

The radio button for the Programmed Trim condition automatically selects when the output voltage is entered. Note that the other two input fields which are not selected – the voltage on the Trim Pin of the unit, as well as the pull-down resistor from the trim pin to -IN – dynamically update to match new values in the selected field.

Figure 31.

**A**

***Right-click on the DCM module product symbol to open and edit it's product properties***

**B**

***Select the Programmed Trim radio button to activate the Trim Resistor text field***

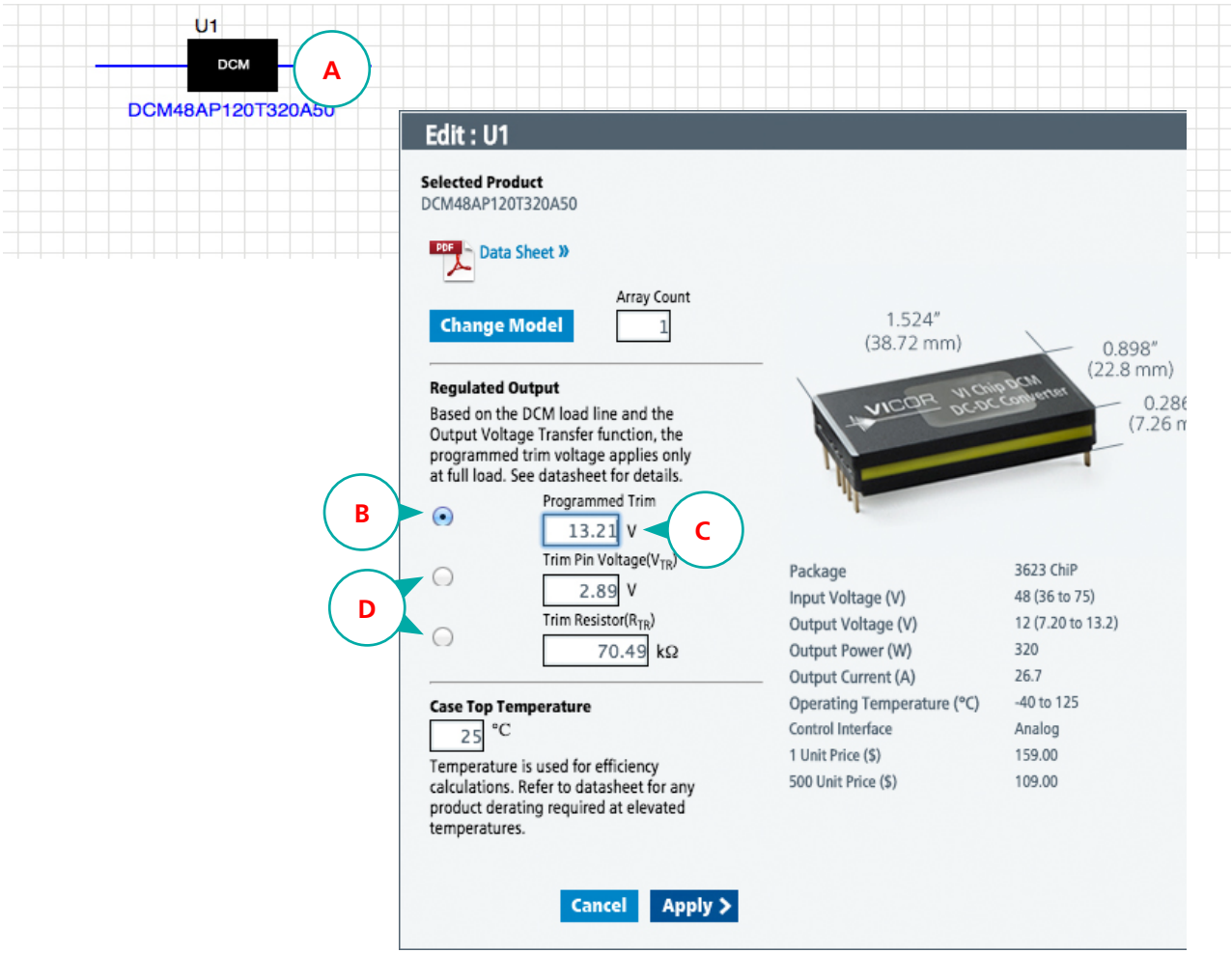
**C**

With the **Programmed Trim** radio button selected the **Programmed Trim** voltage can be modified.

In this example a DCM module is programmed for the +10% trim condition

**D**

The **Trim Pin** value and the **Trim Resistor** value will dynamically update when the selected **Programmed Trim** value is modified



Back To Top ^

## Setting Product Values

### DCM Regulation : Editing the Trim Resistor Value

The Trim Resistor field shows the required ideal resistor value that would be placed between the DCM module TR pin and –IN, such that given the DCM modules internal 10 k pull-up to 3.3 V, the displayed TR pin voltage would occur. The user can also enter a resistor value to see the resultant TR pin voltage.

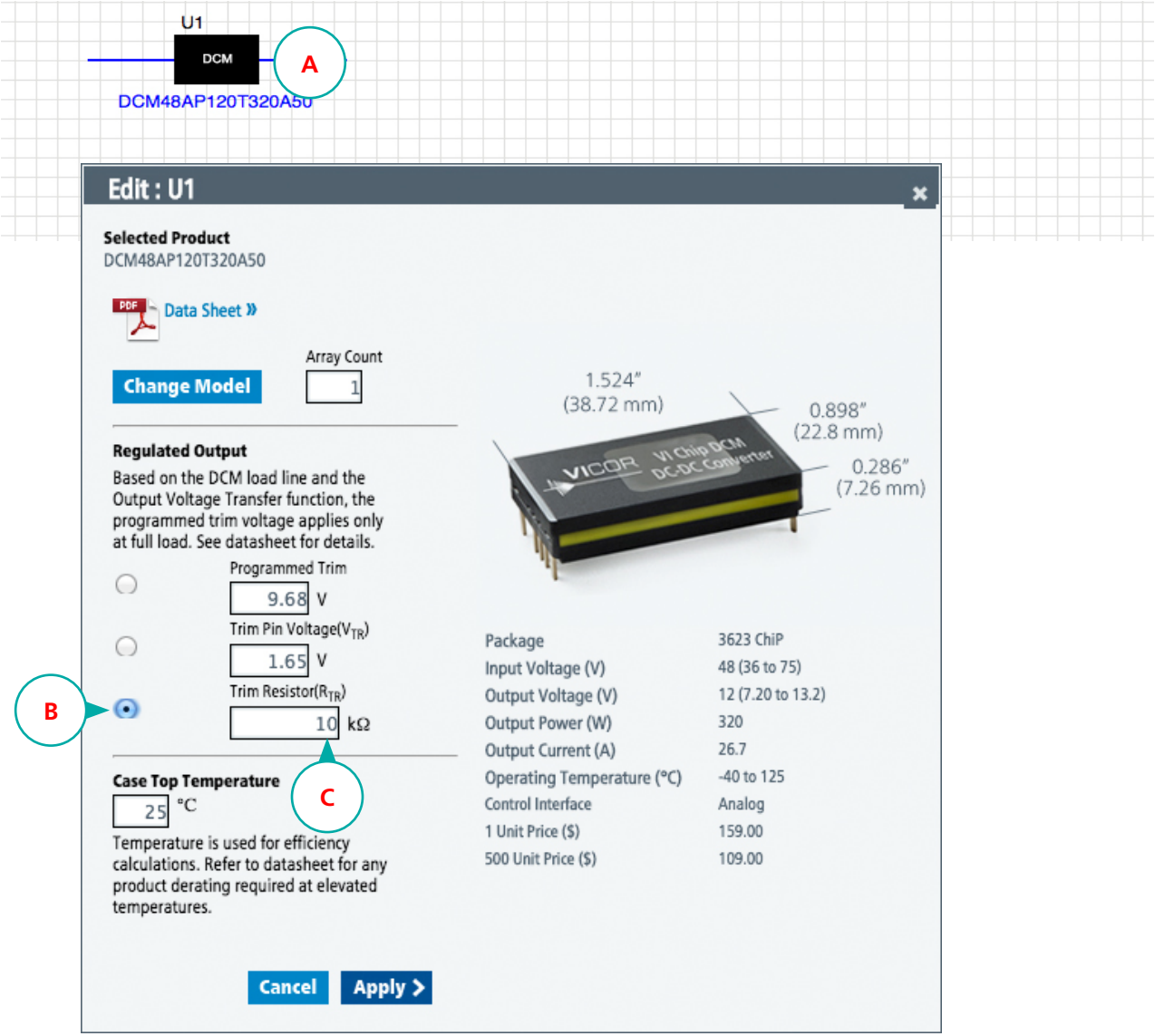



Figure 32.

**A**

*Right-click on the DCM module product symbol to open and edit it's product properties*

**B**

*Select the Trim Resistor radio button to activate the Trim Resistor text field*

**C**

*Enter a resistor value in the text field to see the resultant TR pin voltage*

Back To Top ^

## Setting Product Values

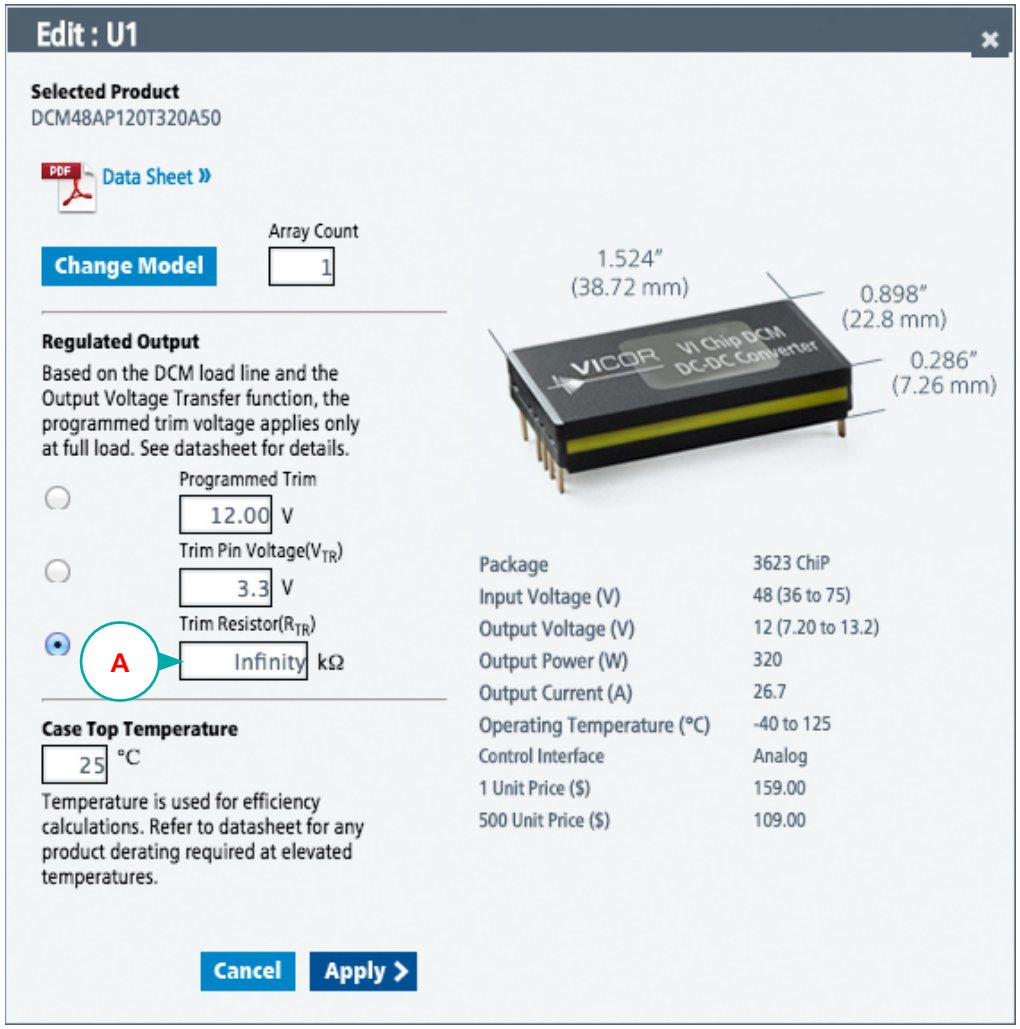
### DCM Regulation : When the Trim Resistor Calculates to Infinity

The default trim condition for a newly placed DCM module is also a special case, where the trim condition defaults to the nominal rated Vout. In this case the trim pin requires no pull-down trim resistor. With no pull-down, the trim pin voltage is 3.3 V, which exceeds the 3.2 V threshold, which selects the non-trim mode of the DCM converter.

Figure 33.

**A**

Note that in this example the **Trim Resistor** calculates to infinity (or an open circuit) since there is no voltage drop between the internal nominal 3.3 V Vdd, and the TR pin voltage.



Back To Top ^

## Setting Product Values

### DCM Regulation : When Specifying an Array of DCM Modules

For arrays of DCM modules, where each DCM module is set to the same programmed trim condition, the same trim pin voltage exists on each DCM module's TR pin. If the TR pins of multiple DCM modules are electrically bussed together, then a single trim resistor could be shared among n DCM modules, with a nominal value of 1/*n*th of the 1-up trim resistor value.

A DCM module instance on the PowerBench™ Whiteboard can be specified as an array of (2) or more modules using the Array Count field. When multiple DCM modules are specified, the Trim Resistor field continues to show the external (pull-down) trim resistor that would be needed to program each DCM module to the trim condition indicated. As a convenience, a fourth trim field appears which automatically calculates the value for a single shared trim resistor for the array of *n*-DCMs.

The Single Trim Resistor value is simply the Trim Resistor value divided by the number of DCM modules specified in the array.

Figure 34.

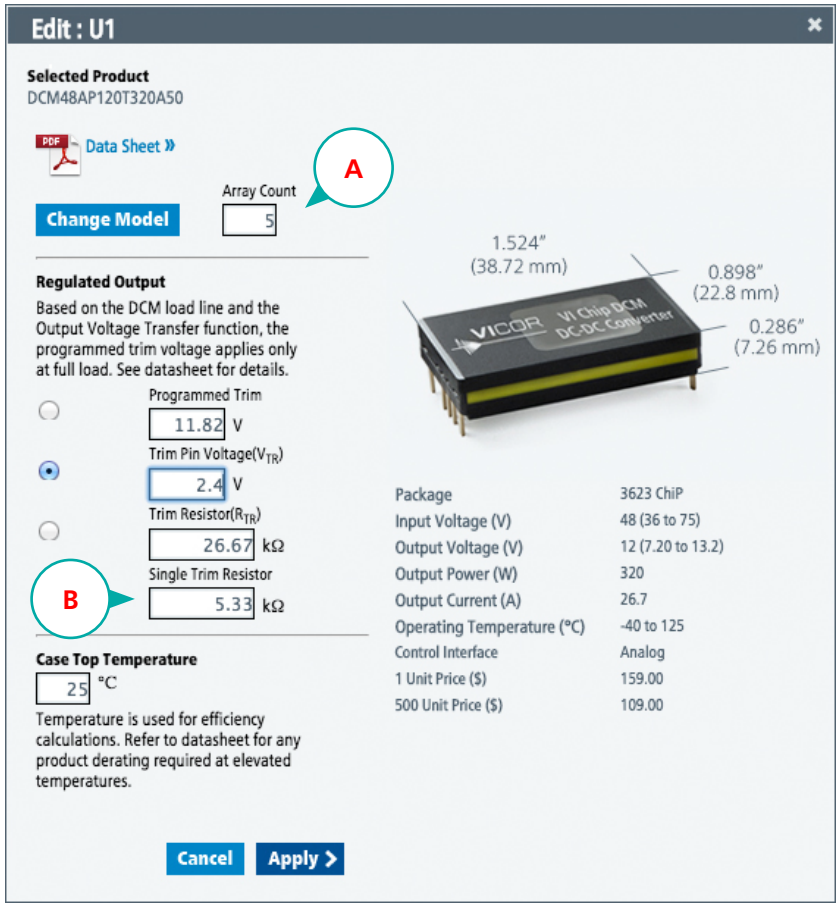
**A**

A DCM module can be specified as an array of (2) or more modules using the **Array Count** field.

**B**

A fourth trim field appears which automatically calculates the value for a single shared trim resistor for the array of *n*-DCMs.

The **Single Trim Resistor** value is simply the Trim Resistor value divided by the number of DCM modules specified in the array.



## Setting Product Values

### Thermal Simulation : How to Access

Thermal Simulation of a given product can be accessed from the Product Properties dialog box.

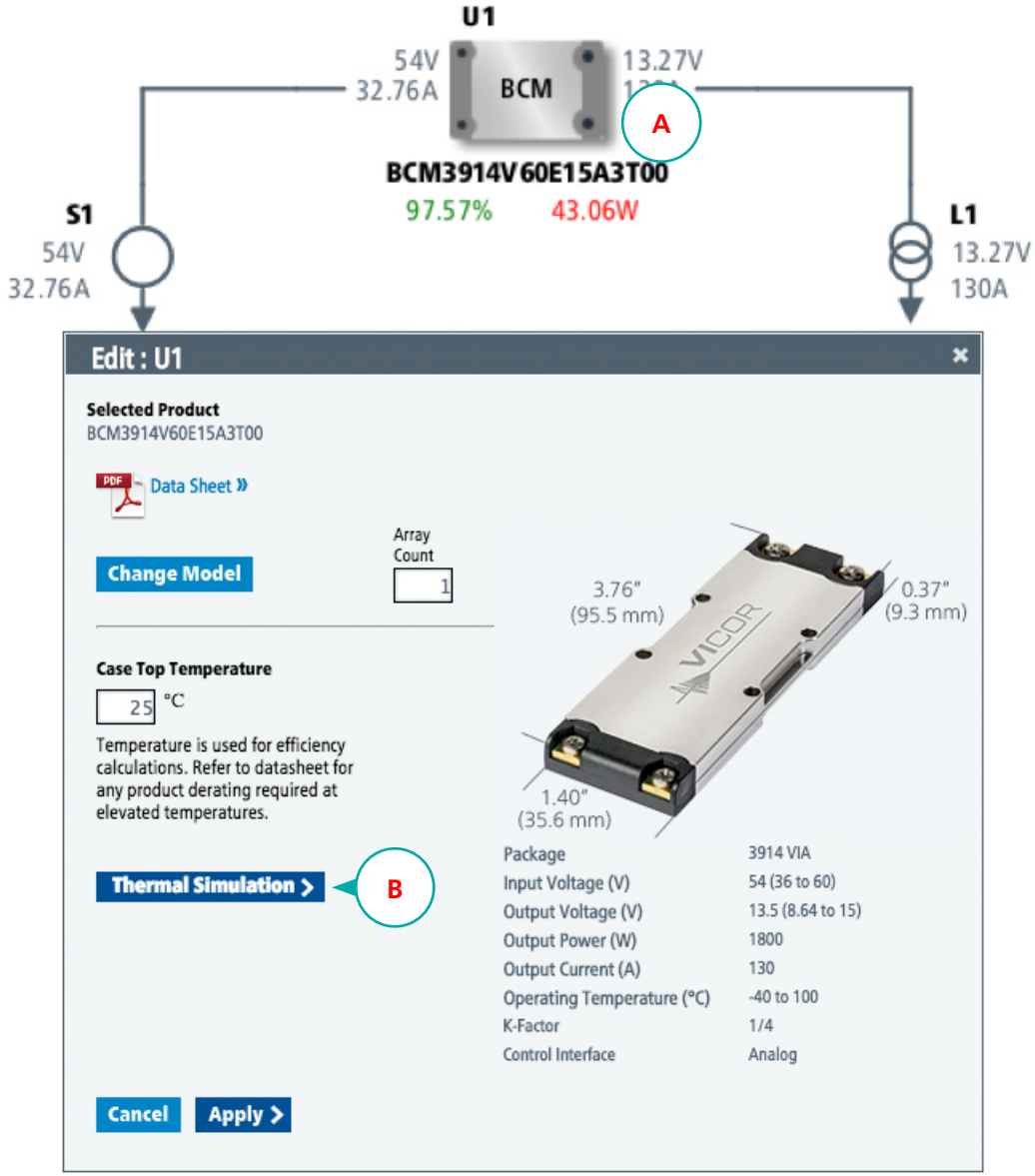



Figure 35.

**A**

***Right-click or Double-click on a product symbol to open and edit it's product properties***

**B**

***Click Thermal Simulation to access the Thermal Simulation of a product***

Selecting the Thermal Simulation button will open the Thermal Response Simulator Dialog

## Setting Product Values

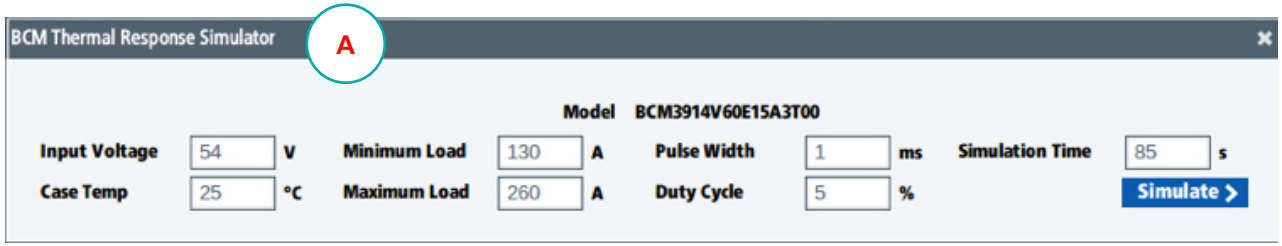
### Thermal Simulation : Thermal Response Simulator Dialog

If the product is part of a power chain, the whiteboard will use the existing analysis values and feed them into the Thermal Response Simulator. The image below shows the starting parameters for the simulation.

Figure 36.

**A**

Selecting the Thermal Simulation button when in the Product Properties Dialog will open the Themal Response Simulator Dialog.




If the product is overloaded or not part of any power chain, the Whiteboard will then proceed to use nominal and maximum rated values as defined for the product.

If no errors are reported at the inputs, the thermal simulation is now ready to be carried out.

Table 13.

**Thermal Response Default Values** for the various electrical parameters

| Parameter | Default Value | For Products in ChiP Packages | For Products in VIA Packages |
|---|---|---|---|
| **Input Voltage** | Nominal output voltage | | |
| **Case Top Temperature** | The operating temperature of the device as indicated by it's properties | Only top side cooling is considered as the boundary condition | Case Temperature is used as the boundary condition |
| **Minimum Load** | Rated $I_{OUT\_MAX}$ of the device | | |
| **Maximum Load** | Two times the rated $I_{OUT\_MAX}$ of the device | | |
| **Pulse Width** | 1 ms | | |
| **Duty Cycle** | 5% | | |
| **Simulation Time** | 85 seconds | | |

Thermal Simulation

## Setting Product Values

### Thermal Simulation : Results

The results of the simulation are spread over 3 sections

**Results : Section I.** Overall Thermal Response

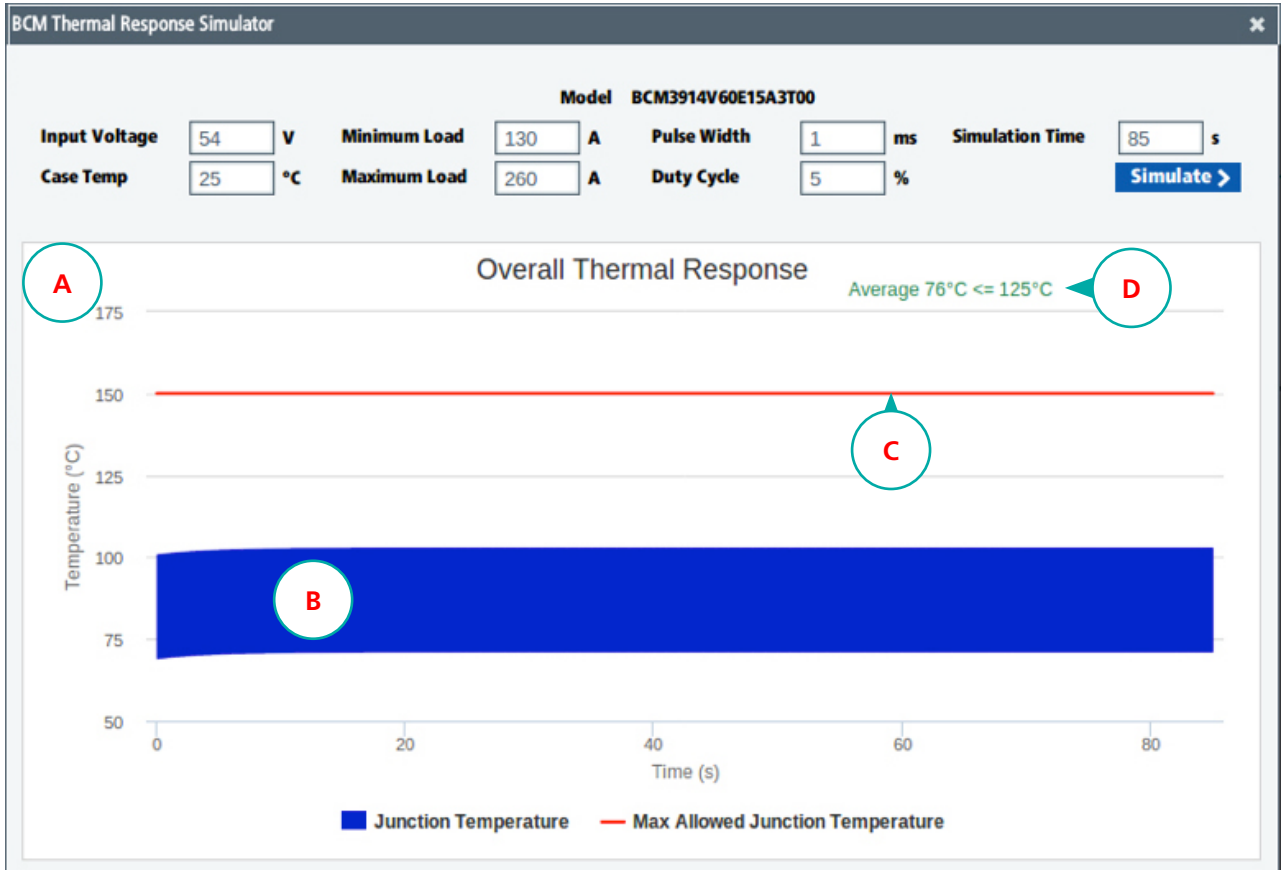
Figure 37.

**A**
**Overall Thermal Response**

**B**
**Junction Temperature** (Indicated in blue)
as simulated over the entire simulation period

**C**
**Max Allowed Junction Temperature**
is the rated temperature limit
for the junction in the device.

**D**
**Average 78°C <= 125°C**
Reflects the average rise of the Junction Temperature
spread over the entire simulation period.
The upper limit for this is set to 125°C
reflecting the temperature rating of the device.



Thermal Simulation

## Setting Product Values

### Thermal Simulation : Results

The results of the simulation are spread over 3 sections

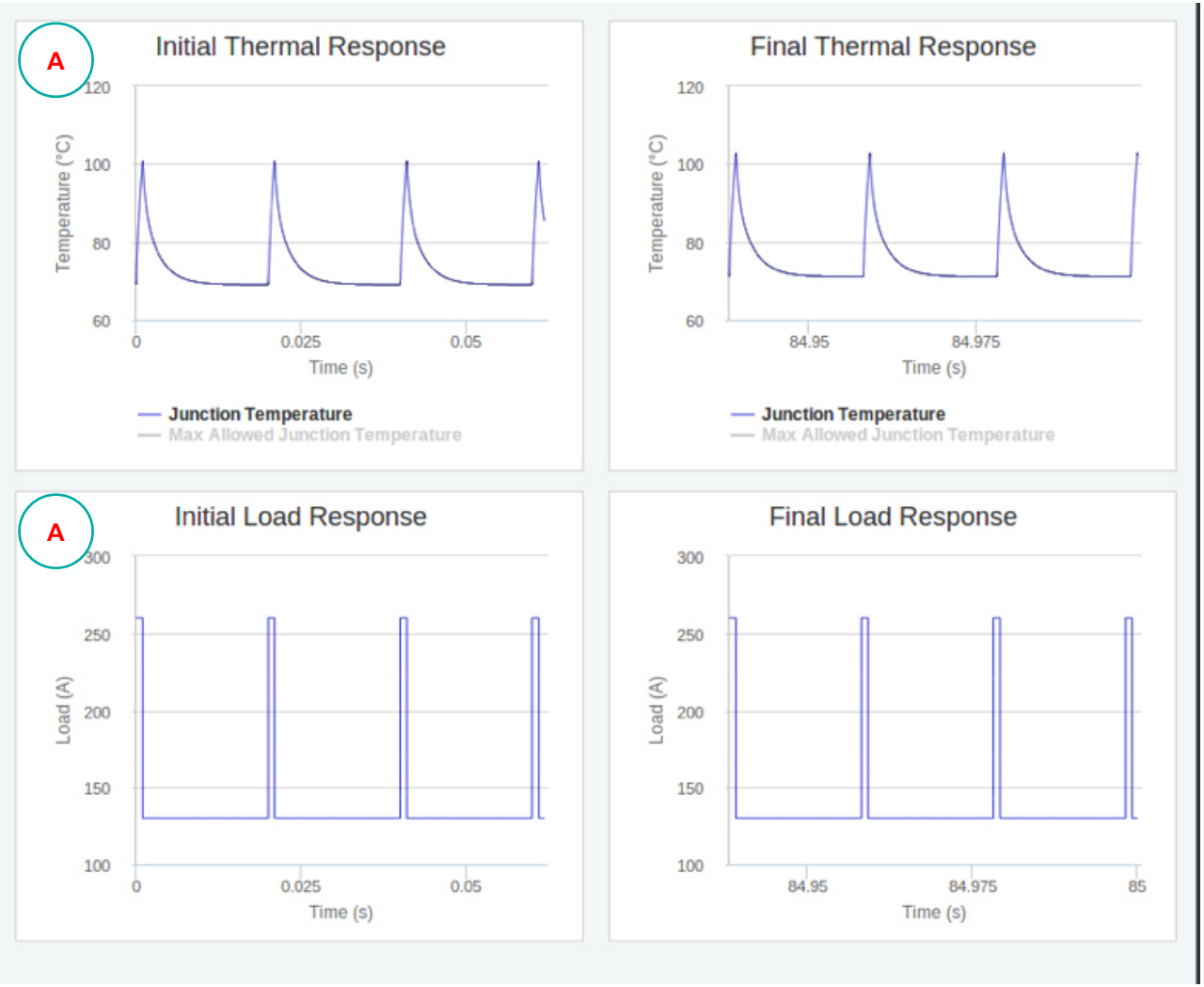
**Results: Section II.** Initial Thermal Response, paired with it's corresponding Initial Load Response

Figure 38.

**A**

**Initial Thermal Response**

Shows the rise and fall of the junction temperature paired with the corresponding Load rise and fall.



Thermal Simulation

## Setting Product Values

### Thermal Simulation : Results

The results of the simulation are spread over 3 sections

**Results Section III.** Final Thermal Response, paired with it's corresponding Final Load Response

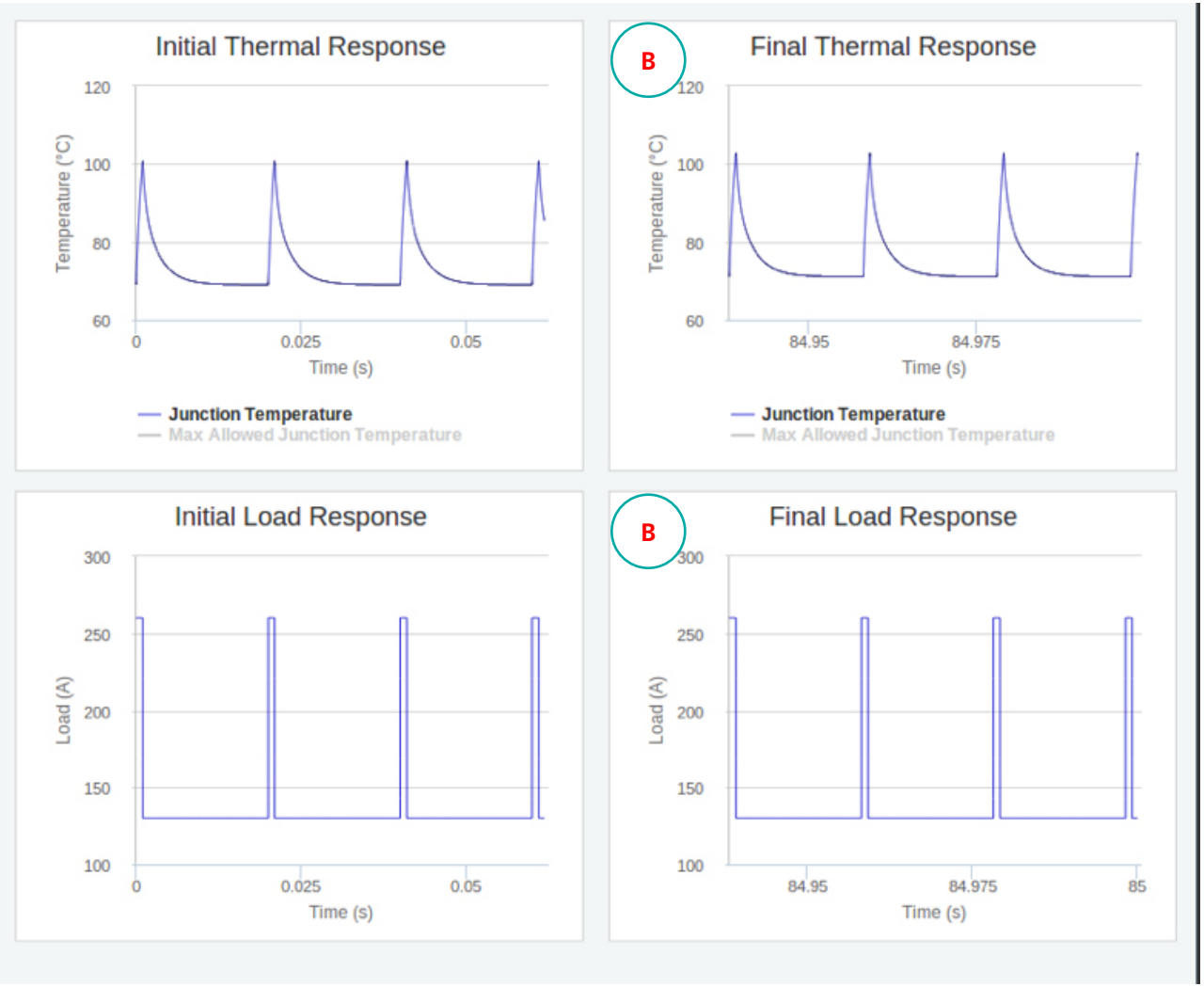


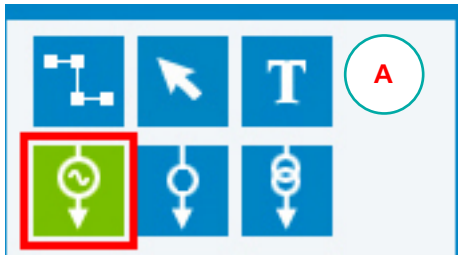

Figure 39.

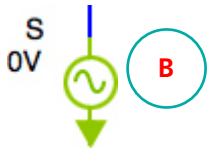
**A**

**Final Thermal Response**
Shows the rise and fall of the junction temperate paired with the corresponding Load rise and fall

## Setting Component Values

### AC Supply Component




After placing a AC Supply Component on the canvas the value needs to be set.
This information will be used to analyze the efficiency of the design.

Figure 40.

**A**
***Click the AC Supply Component in the Component Palette***

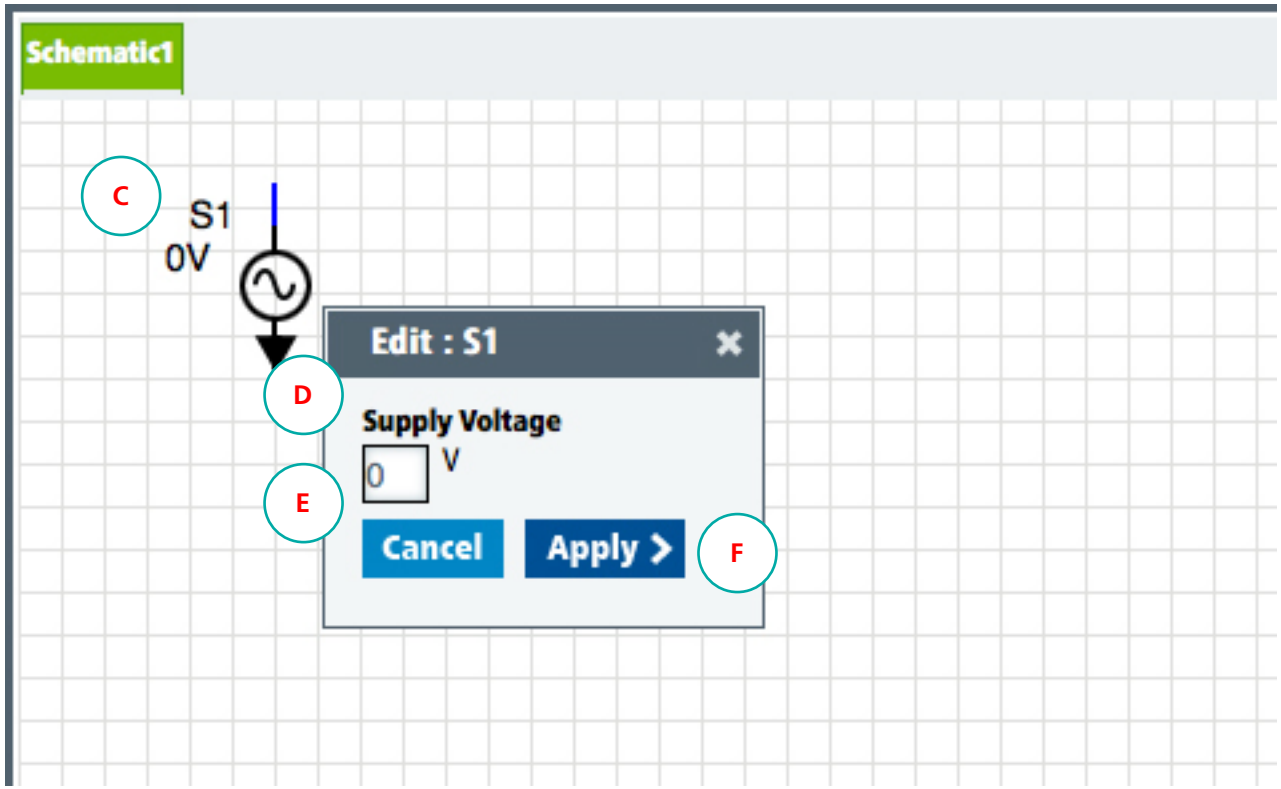
**B**
The Cursor will become the AC Supply Component

**C**
***Click anywhere on the Canvas to place the AC Supply Component***

**D**
***Right-Click on the placed AC Supply Component***
The Edit AC Supply Dialog Box will open

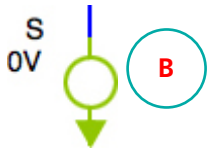
**E**
***Enter the required value for your design***

**F**
***Click Apply***



## Setting Component Values

### DC Supply Component


After placing a DC Supply Component on the canvas the value needs to be set.
This information will be used to analyze the efficiency of the design.

Figure 41.

**A**
***Click the DC Supply Component in the Component Palette***

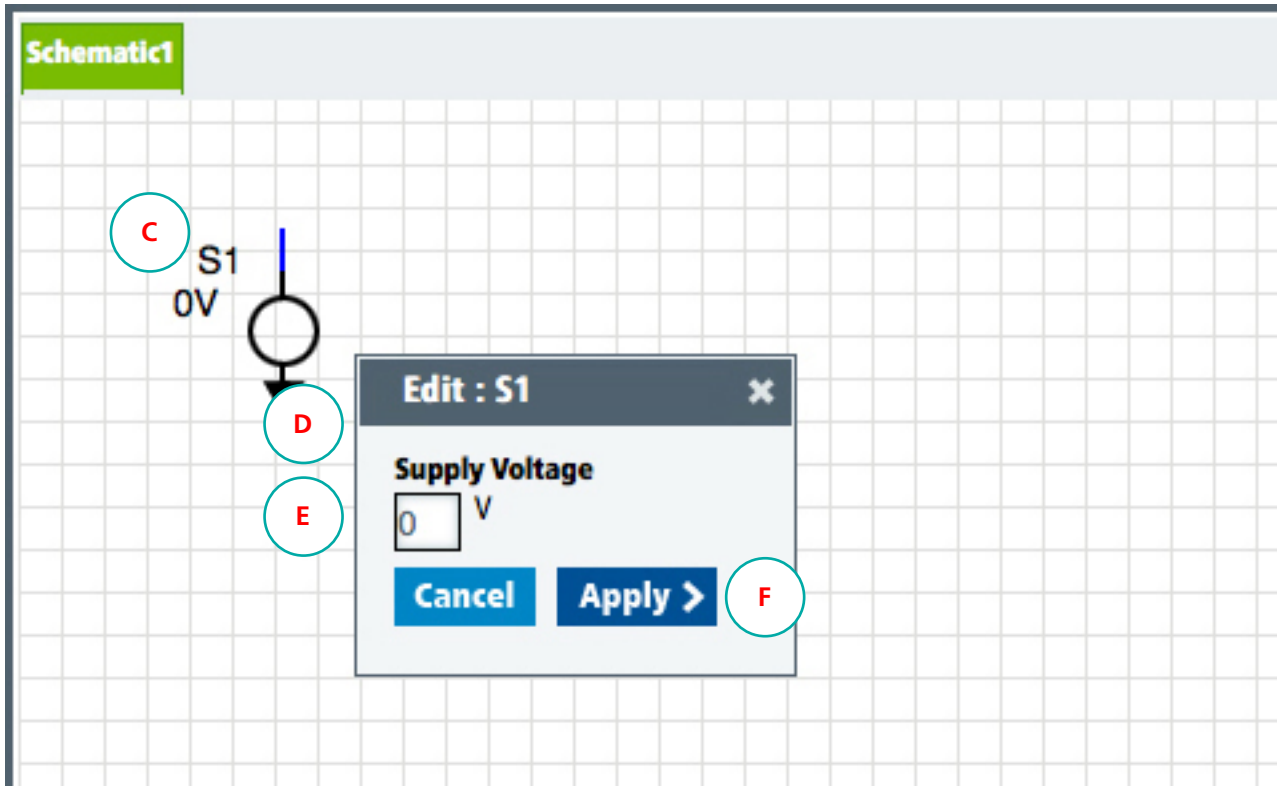
**B**
The Cursor will become the DC Supply Component

**C**
***Click anywhere on the Canvas to place the DC Supply Component***

**D**
***Right-Click on the placed DC Supply Component***
The Edit DC Component Dialog Box will open

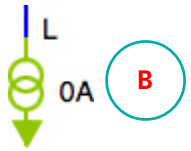
**E**
***Enter the required value for your design***

**F**
***Click Apply***



## Setting Component Values

### Load Components


After placing a Load Component on the canvas the values needs to be set.
This information will be used to analyze the efficiency of the design.

Figure 42.

**A**
***Click the Load Component in the Component Palette***

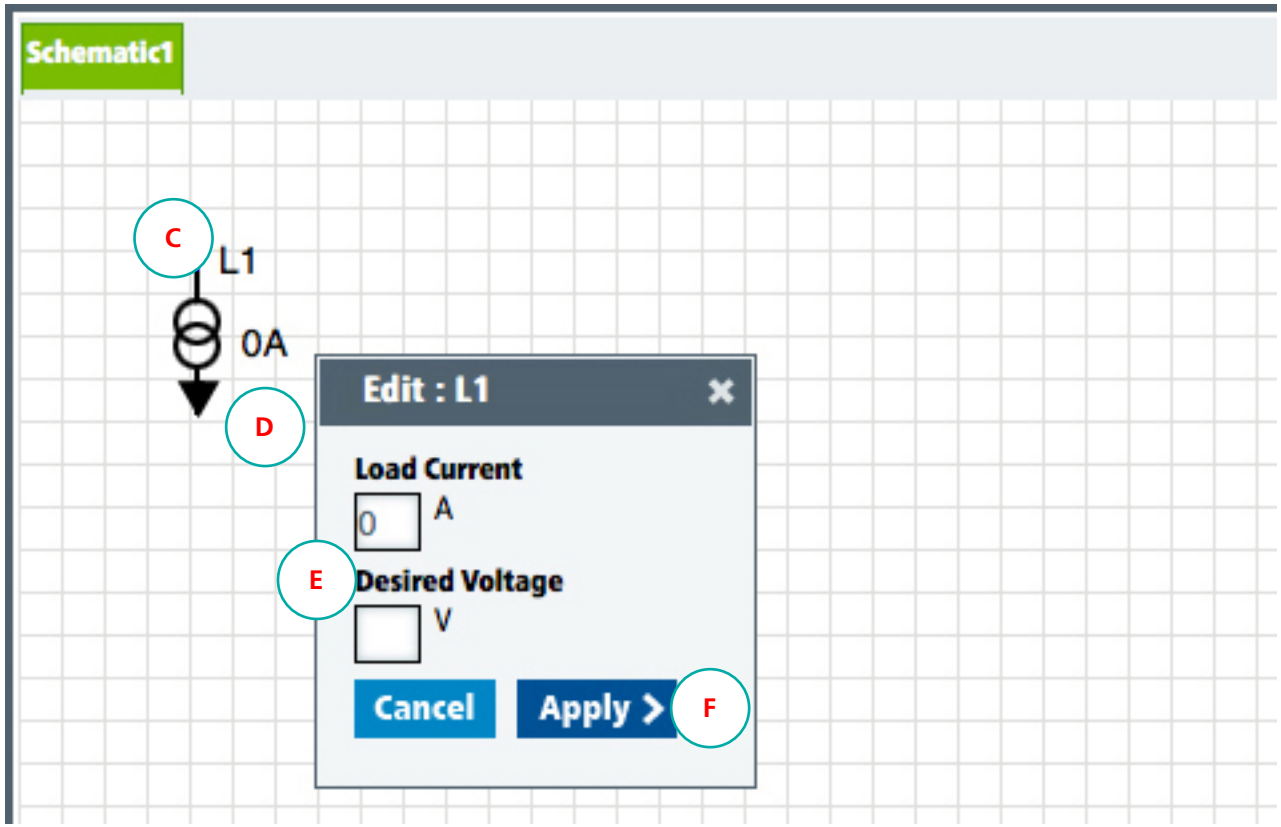
**B**
The Cursor will become the Load Component

**C**
***Click anywhere on the Canvas to place the Load Component***

**D**
***Right-Click on the placed Load Component***
The Edit Load Dialog Box will open

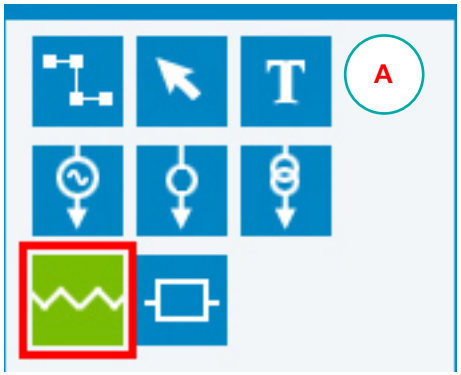
**E**
***Enter the required value for your design***

**F**
***Click Apply***



## Setting Component Values

### Resistor Components




After placing a Resistor Component on the canvas the value needs to be set.
This information will be used to analyze the efficiency of the design.

Figure 43.

**A**
***Click the Resistor Component in the Component Palette***

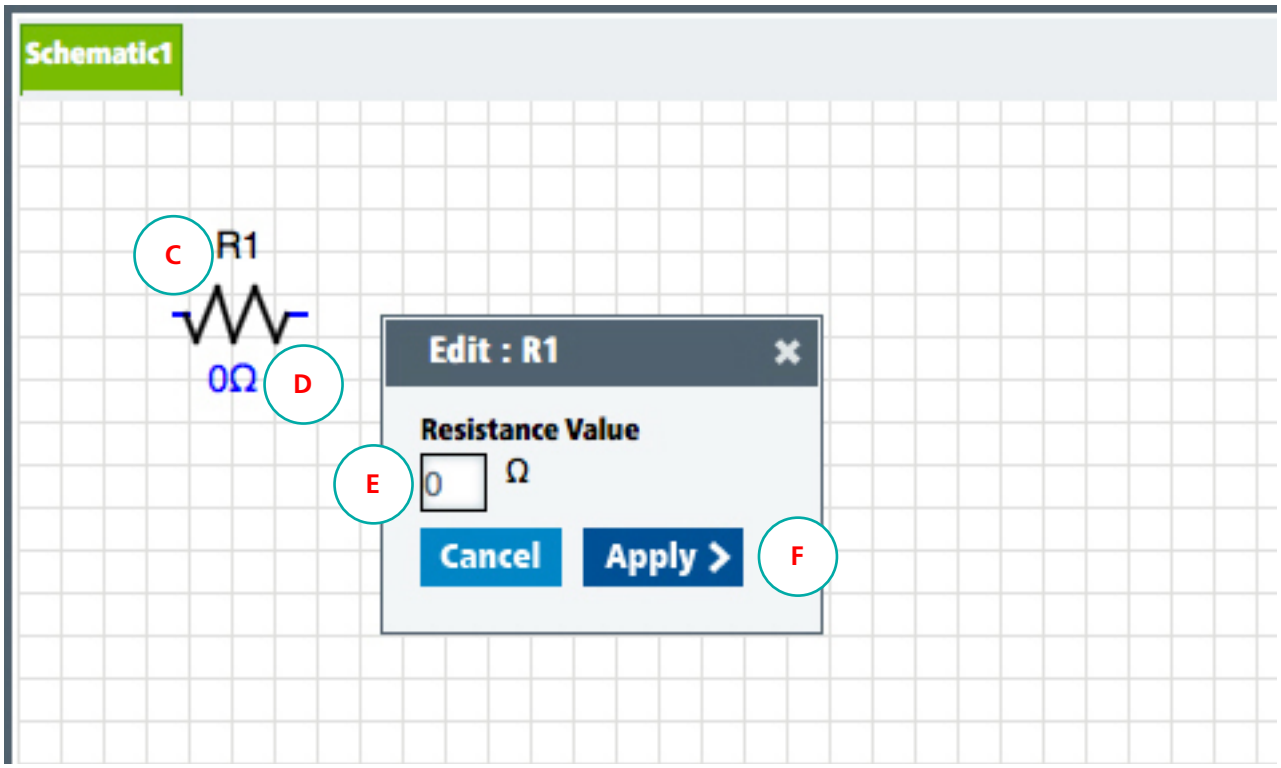
**B**
The Cursor will become the Resistor Component

**C**
***Click anywhere on the Canvas to place the Resistor Component***

**D**
***Right-Click on the placed Resistor Component***
The Edit Resistor Dialog Box will open

**E**
***Enter the required value for your design***

**F**
***Click Apply***



Back To Top ^

## Creating Functional Blocks

Functional Blocks can be used to create custom whiteboard components with user specified values. When functional blocks are used in Whiteboard designs their specified values will be included in calculation when performing Power System Analysis. Created functional blocks can be saved to a user's profile (My Vicor).

### Select a Functional Block Component Type

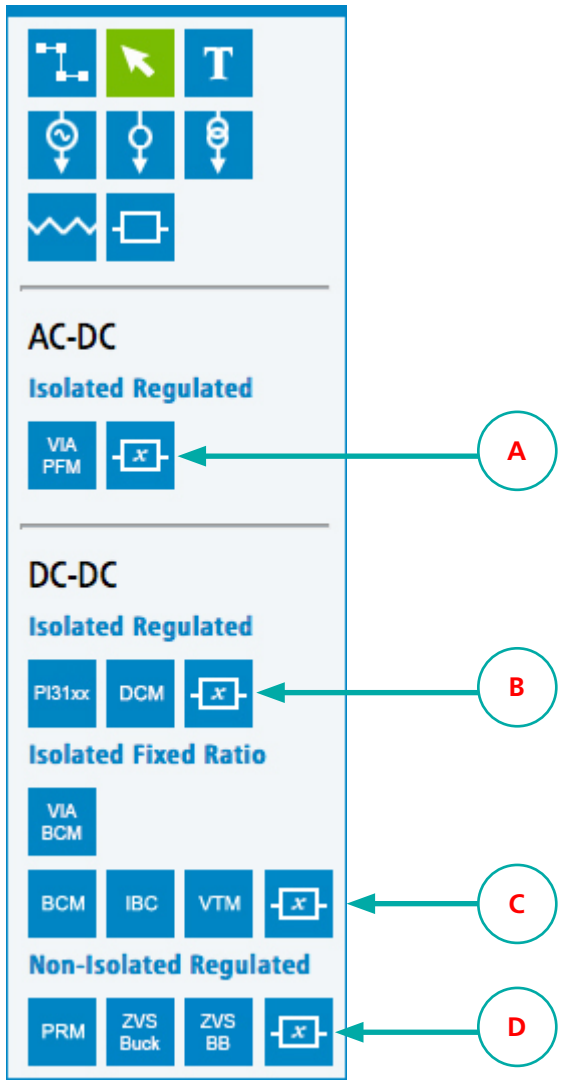



Figure 44.
*Click on a Functional Block Icon to create a Functional Block*

After clicking on a Functional Block Icon a properties dialog box (not shown here) will appear where required values must be entered by the user.

Required property fields will vary depending on the component type

Functional Block component types include:

**A**
AC-DC Isolated Regulated

**B**
DC-DC Isolated Regualted

**C**
DC-DC Isolated Fixed Ratio

**D**
DC-DC Non-Isolated Regulated


Back To Top ^

## Creating Functional Blocks

### Create an AC-DC Isolated Regulated Functional Block

AC-DC Isolated Regulated Functional Blocks will all allow you to specify values for Input Voltage, Output Voltage, No Load Input Power, Output Power, Output Current, and Efficiency. **All fields are required except for the Min and Max Input and Output Voltages which will be auto populated based on the Nom values.**

Figure 45.

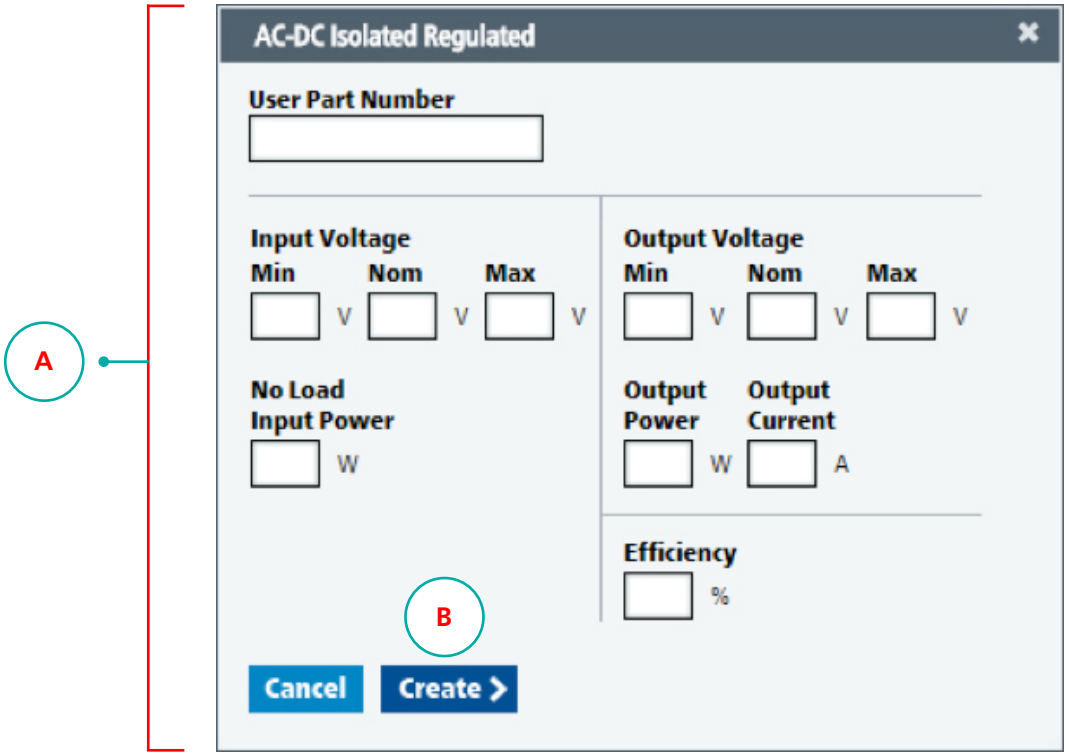
AC-DC Isolated Regulated Functional Block Properties Dialog Box

**A**

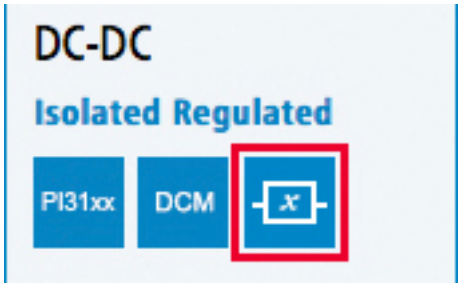
***Enter required Functional Block specifications***

**B**

***Select Create***



Back To Top ^




## Creating Functional Blocks

### Create a DC-DC Isolated Regulated Functional Block

DC-DC Isolated Regulated Functional Blocks will all allow you to specify values for Input Voltage, Output Voltage, No Load Input Power, Output Power, Output Current, and Efficiency. **All fields are required except for the Min and Max Input and Output Voltages which will be auto populated based on the Nom values.**

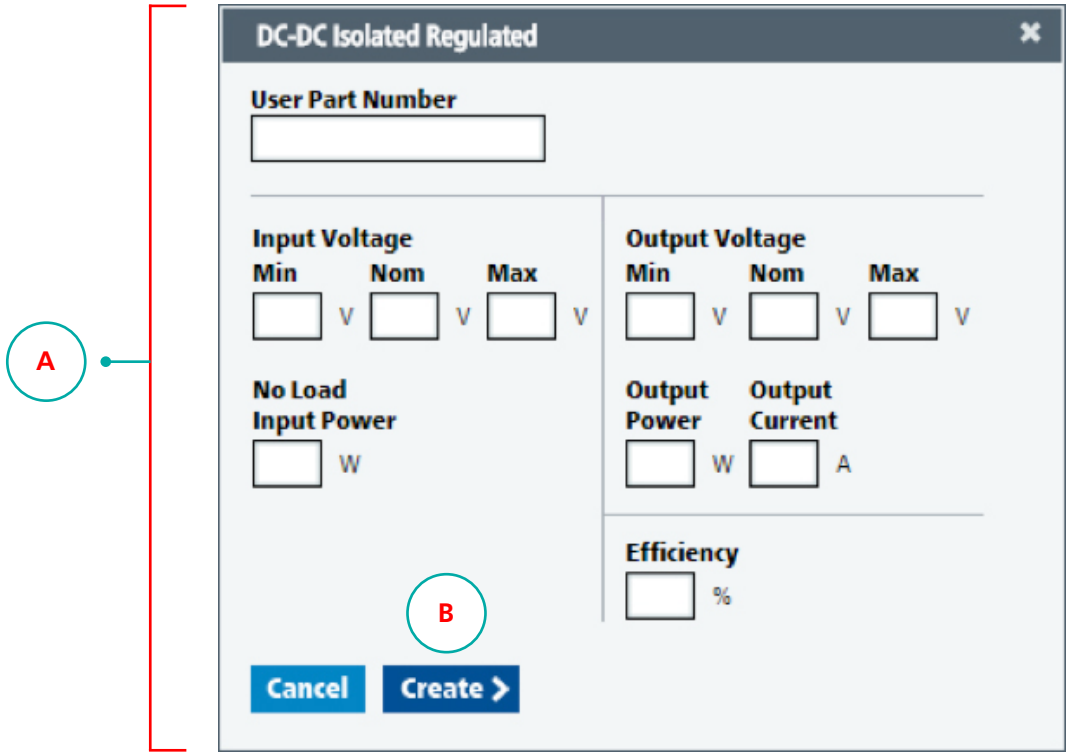



Figure 46.

DC-DC Isolated Regulated
Functional Block Properties Dialog Box

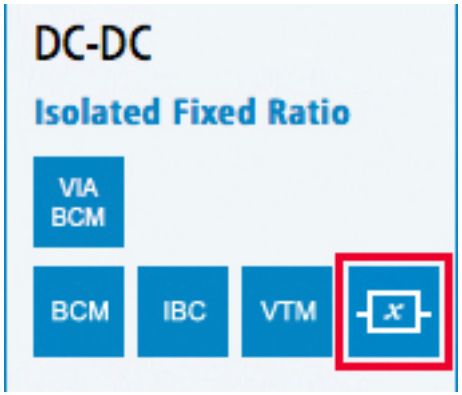
**A**

*Enter required Functional Block specifications*

**B**

*Select Create*

Back To Top ^





## Creating Functional Blocks

### Create a DC-DC Isolated Fixed Ratio Functional Block

In addition to Input Voltage, Output Voltage, No Load Input Power, Output Power, Output Current, and Efficiency, DC-DC Isolated Non-Regulated Functional Blocks will all allow you to specify a value for the K Factor. **All fields are required except for the Min and Max Input Voltages which will be auto-populated based on the Nom value.**

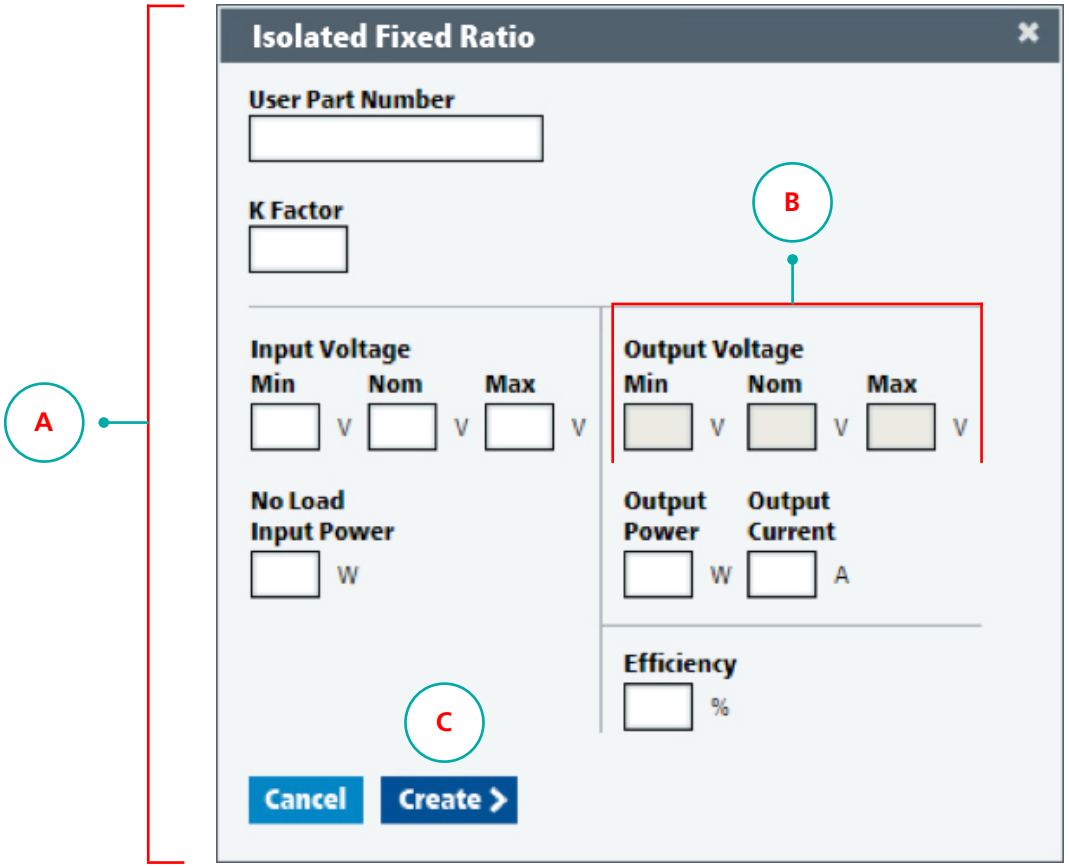



Figure 47.

DC-DC Isolated Fixed Ratio
Functional Block Properties Dialog Box

**A**

***Enter required Functional Block specifications***

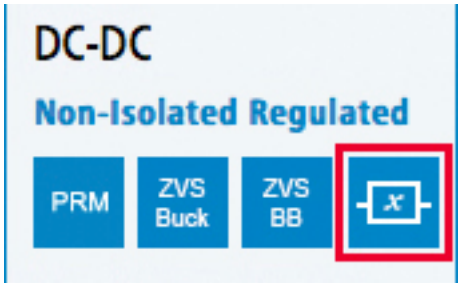
**B**

The K Factor combined with the Input Voltage will automatically calculate the Output Voltage
The user will NOT be able to input the Output Voltage manually

**C**

***Select Create***

Back To Top ^




## Creating Functional Blocks

### Create a DC-DC Non-Isolated Regulated Functional Block

DC-DC Non-Isolated Regulated Functional Blocks will all allow you to specify values for Input Voltage, Output Voltage, No Load Input Power, Output Power, Output Current, and Efficiency. **All fields are required except for the Min and Max Input and Output Voltages which will be auto populated based on the Nom values.**

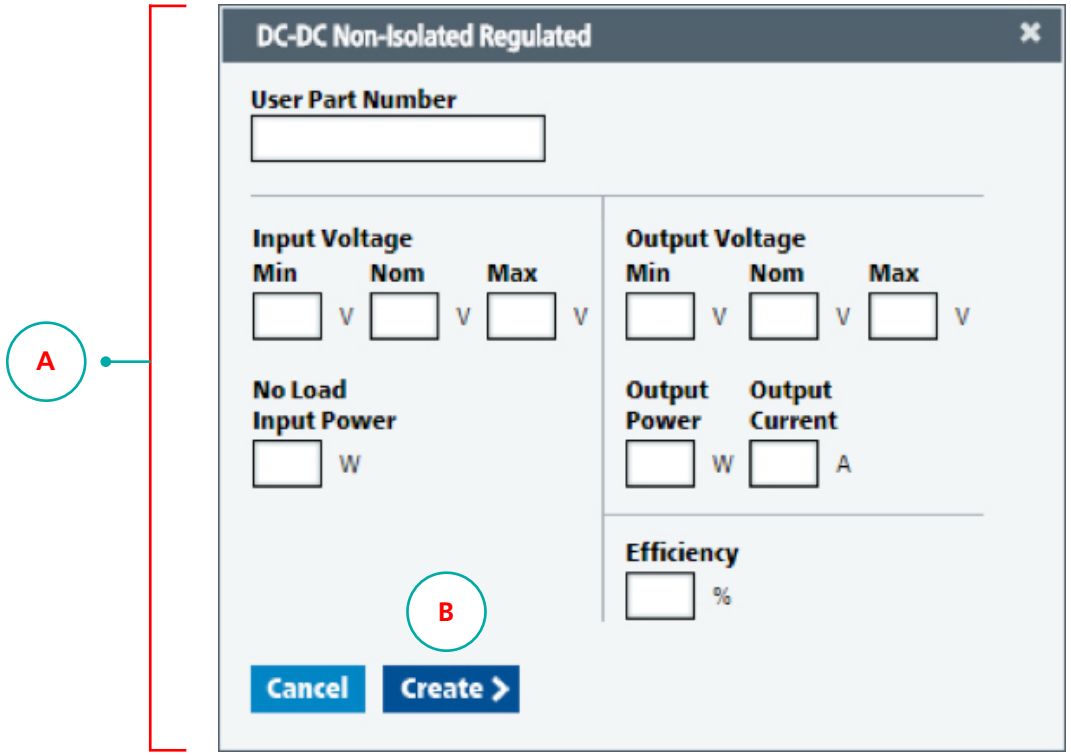



Figure 48.

DC-DC Non-Isolated Regulated Functional Block Properties Dialog Box

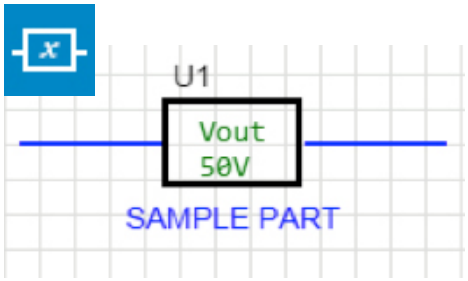
**A**

*Enter required Functional Block specifications*

**B**

*Select Create*

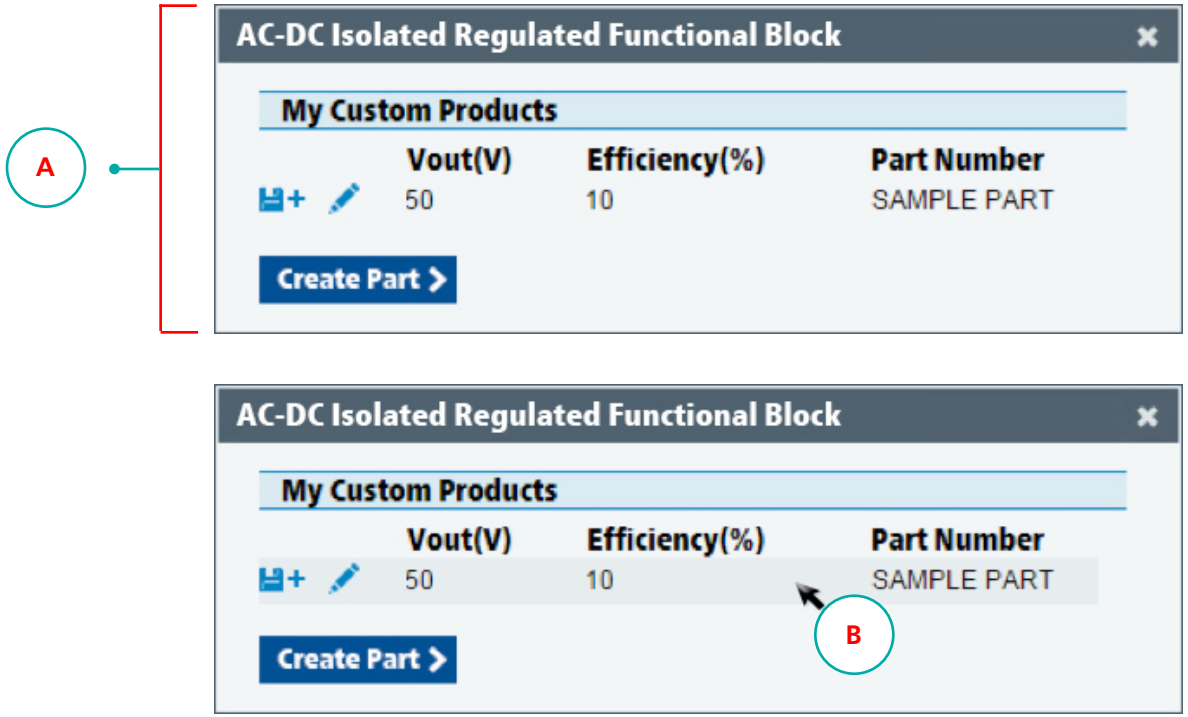
Back To Top ^

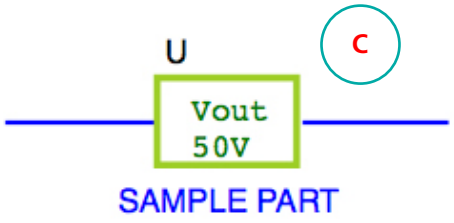



## Using Functional Blocks

### Placing on the Whiteboard

Once (1) Functional Block has been created for a specific component type a Functional Block Component List will be created and presented in the form of a dialog box.



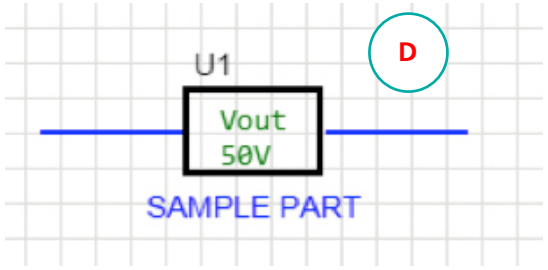




Figure 49.

**A**
Functional Block Component List Dialog Box

**B**
***Select a Functional Block Component from the List to place it on the Whiteboard***

**C**
The cursor will become a symbol of the selected functional block

**D**
***Left-click the mouse to place the product on the canvas.***

## Using Functional Blocks

### Editing Properties

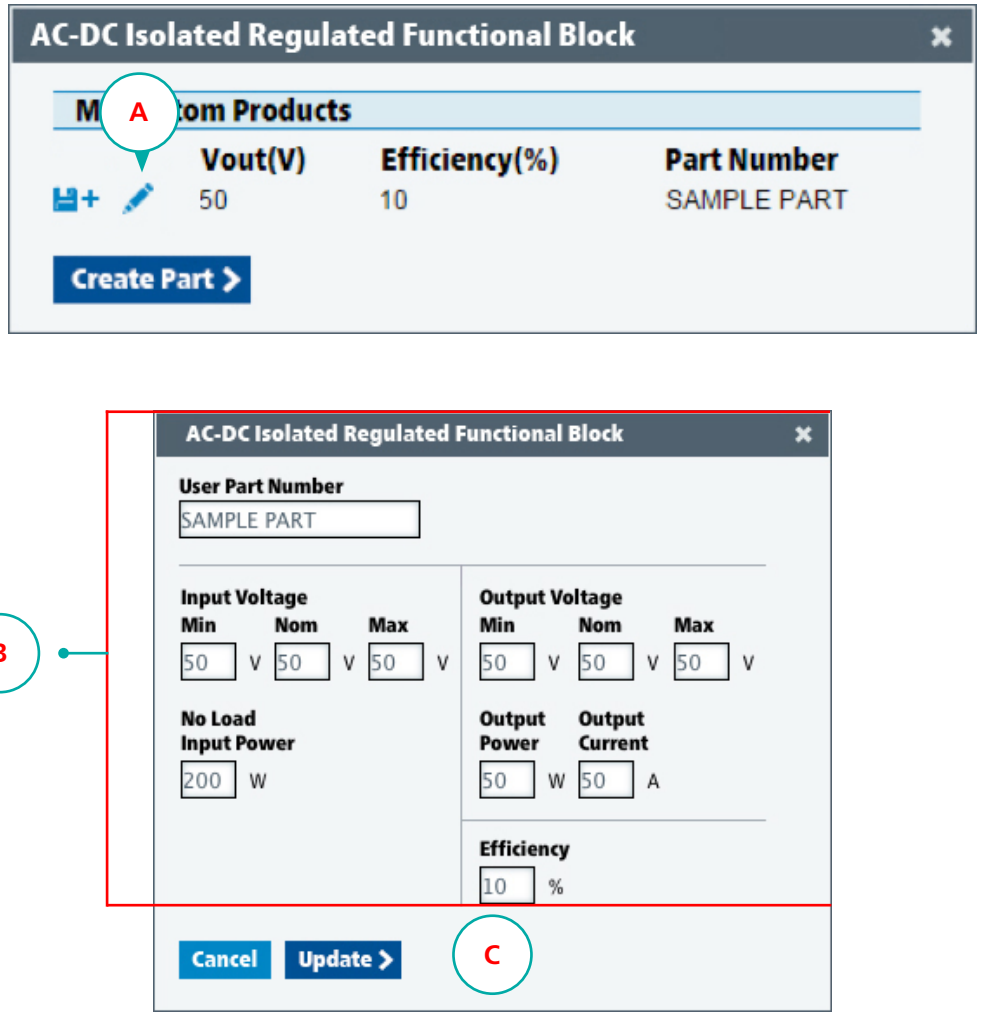



Figure 50.

Functional Block Components can be Edited at any time

**A**

*Click on the pencil icon to Edit the properties of a Functional Block*

**B**

*Make desired edits to the values in the Functional Block Properties Dialog*

**C**

*Click Update to apply edits to the selected Functional Block*

## Using Functional Blocks

### Saving

Once a Functional Block is created it can then be saved to the user's profile on My Vicor.

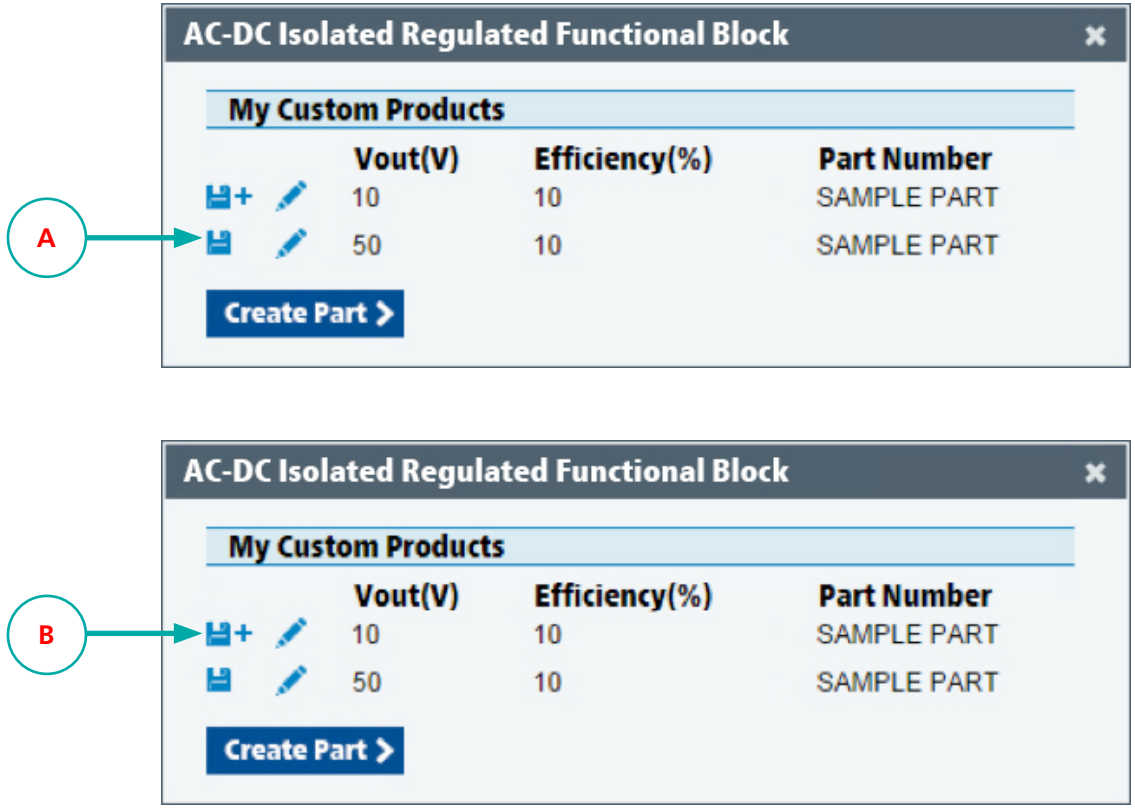
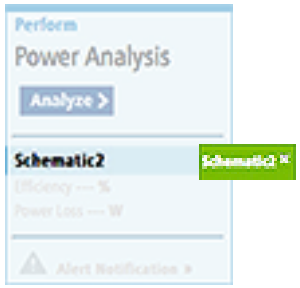



Figure 51.

**A**
Functional Blocks that have been previously saved to My Vicor will appear in the list with a **Save** Icon

**B**
Functional Blocks that have NOT been saved to My Vicor will appear in the list with a **Save As** Icon (Save Icon presented without a "+" symbol)

***Click on the Save As Icon to Save a Functional Block to My Vicor***




Back To Top ^

## Analyzing the Whiteboard Design

When the product components in the design are wired up, and operational supply and load values have been set, you can analyze the power efficiency and loss of your architect concept.

**NOTE THE SELECTED SCHEMATIC**

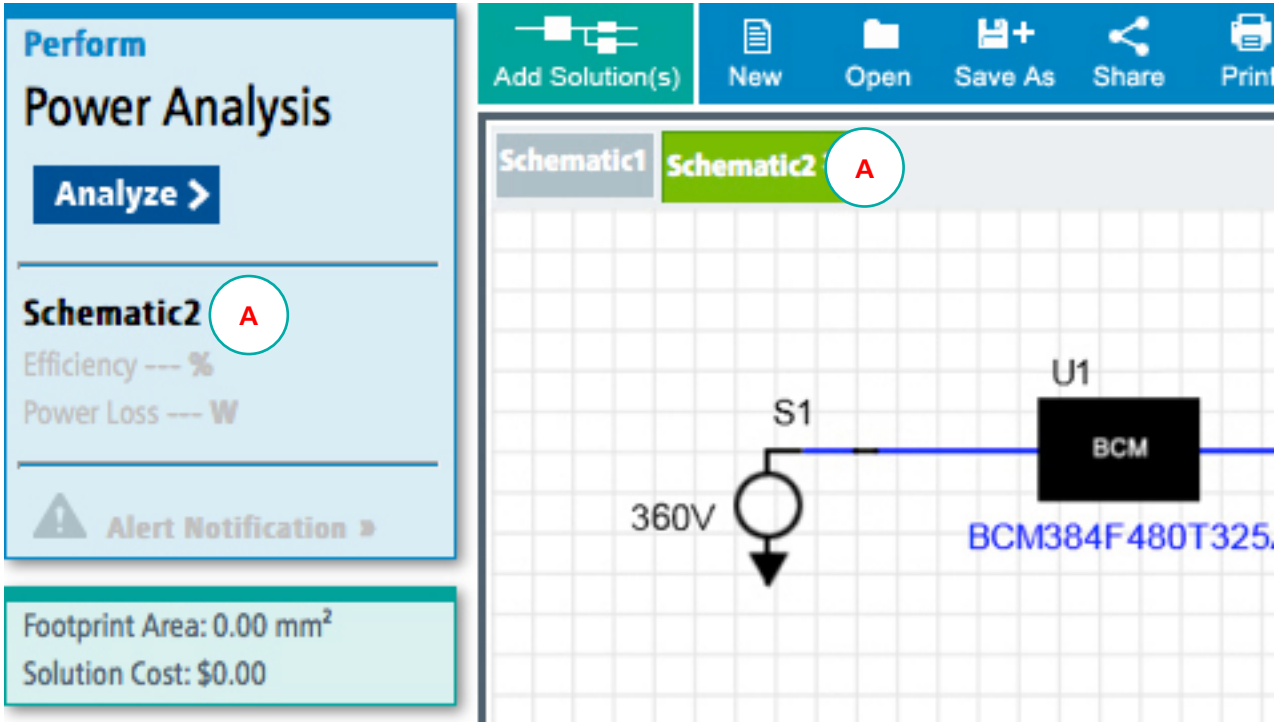
**The Analyze button will only perform analysis on the schematic that is currently selected.**

As you select different schematic tabs the title will update in the Perform Analysis box to indicate which schematic is active for Analysis.

Figure 52.

**A**

The title of the selected schematic will appear in both the tab and in the Perform Analysis box.



## Analyzing the Whiteboard Design

### Perform Power Analysis

When the product components in the design are wired up, and operational supply and load values have been set, you can analyze the power efficiency and loss of your architect concept.

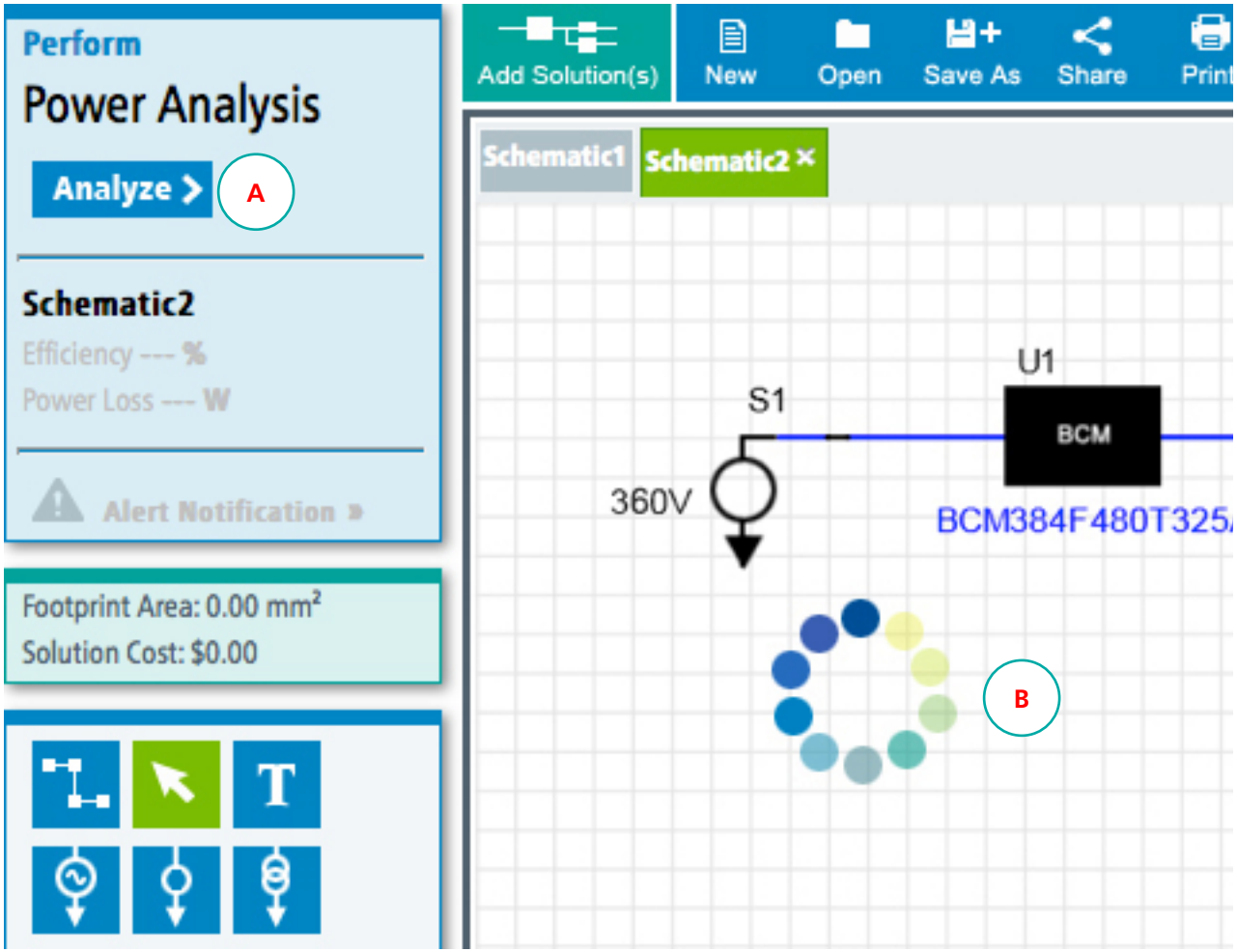
Figure 53.

**A**

*To Begin System Analysis Click Analyze*

**B**

A progress wheel will appear to indicate that the power efficiency is being calculated



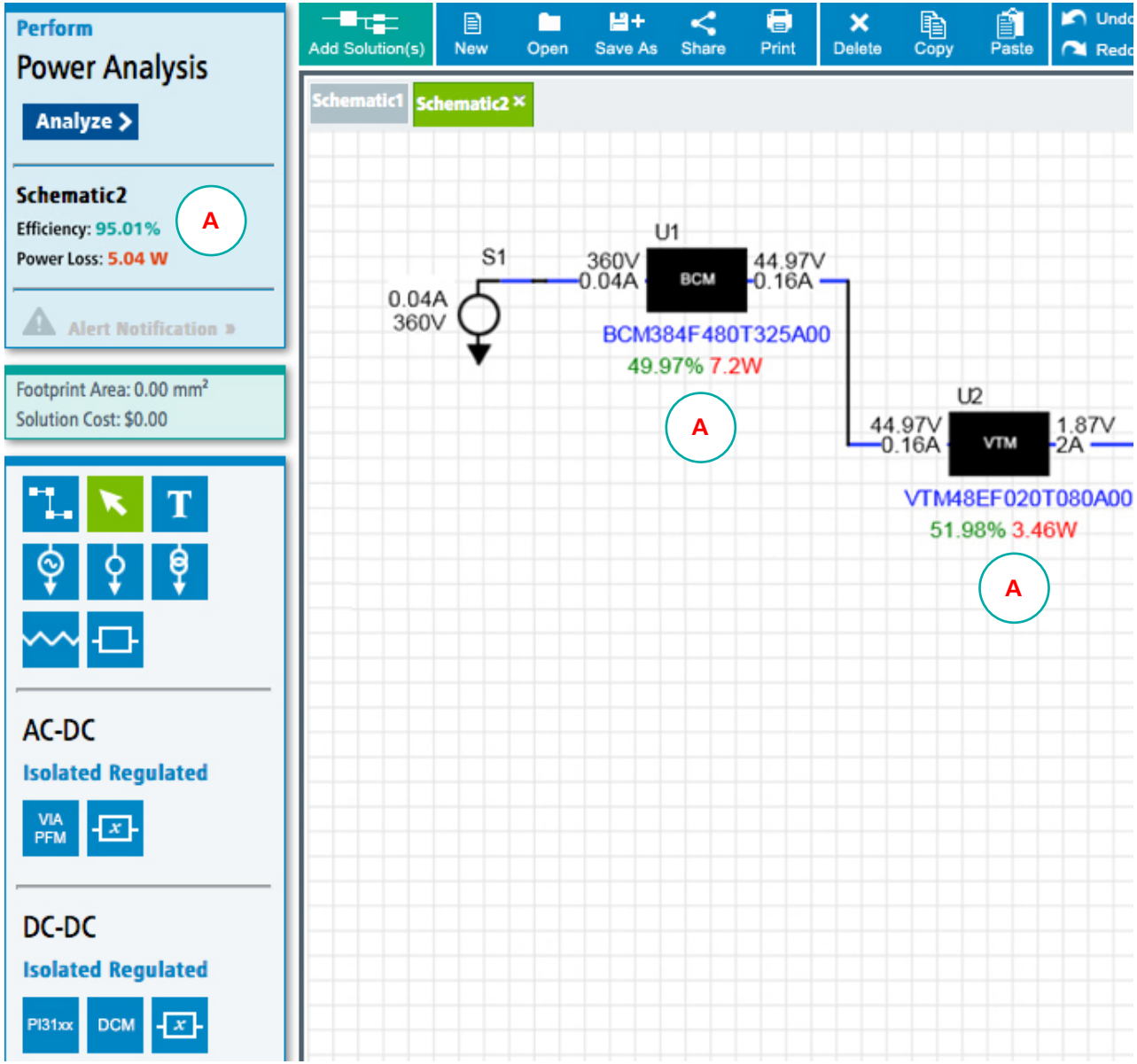
## Analyzing the Whiteboard Design

### Review Analysis Results

Figure 54.

**A**

After clicking on the Analyze button analysis values will be presented for your design



Back To Top ^

## Analyzing the Whiteboard Design

### Understanding Analysis Errors

Certain conditions will cause Analysis errors to occur.

These are:

- Vin (Input Voltage) more than Vin-Max (maximum allowable input voltage)
- Vin (Input Voltage) less than Vin-Min (minimum allowable input voltage)
- Iout (Output Current) more than Iout-Max (maximum allowable output current)

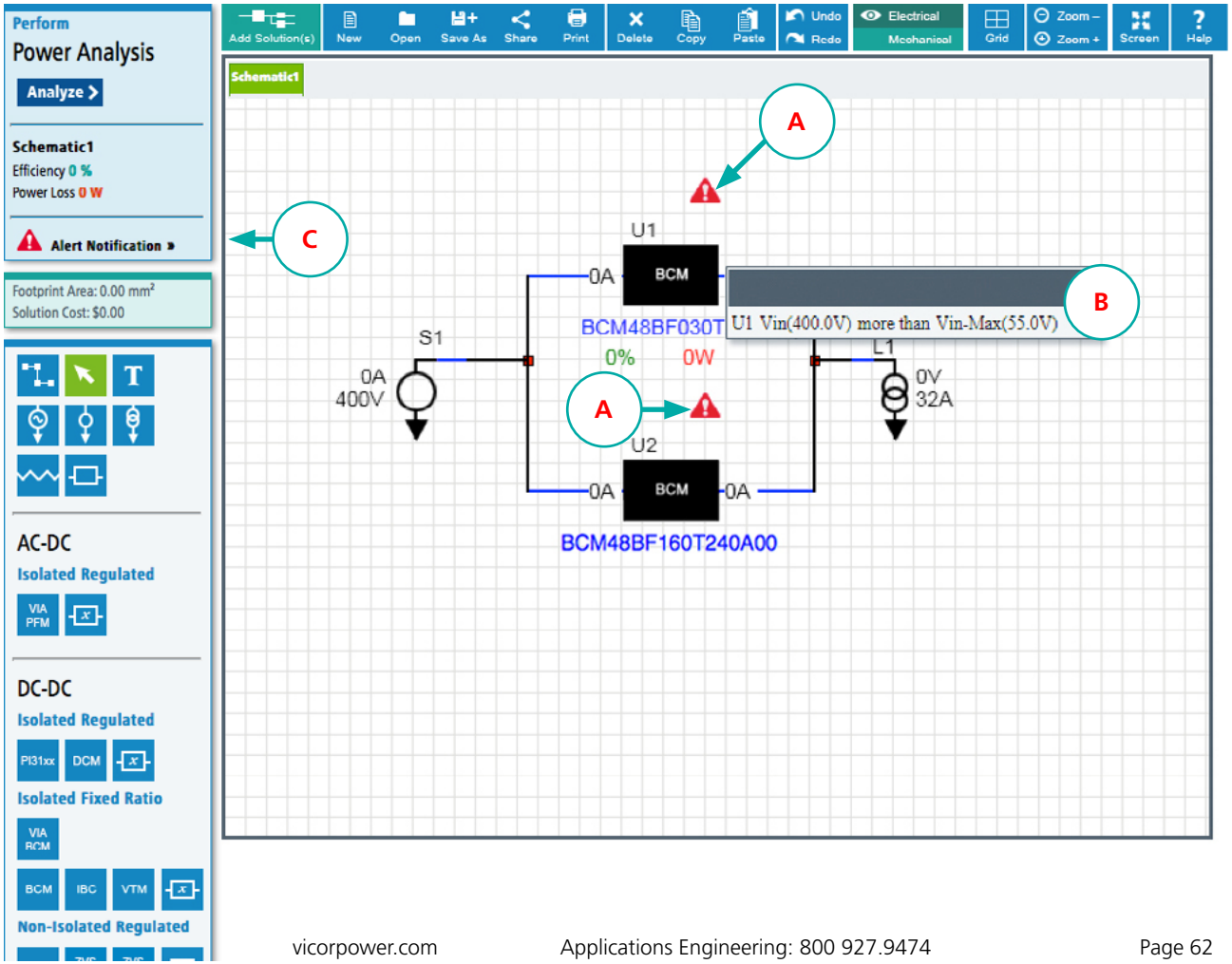
Analysis errors will appear like this:

Figure 55.

**A**
Red triangular alert icons will appear on the canvas to indicate when there are analysis errors

**B**
To display individual component error conditions (U1 in Example Shown)
***Click on the Alert Icon***

**C**
To display all error conditions for the total system design
***Click on the Alert Icon in the System Analysis Explorer.***



Add Solution(s)

## Adding Pre-defined Solutions

### Add Solutions Dialog Box

Figure 56.

**A**

***Click on Add Solutions***

**B**

The Add Pre-defined Power Solutions Dialog Box will open

**C**

If desired, the available solutions shown can be filtered by entering a keyword and clicking on Apply

**D**

***Mouse over the Icons to Browse Categories***

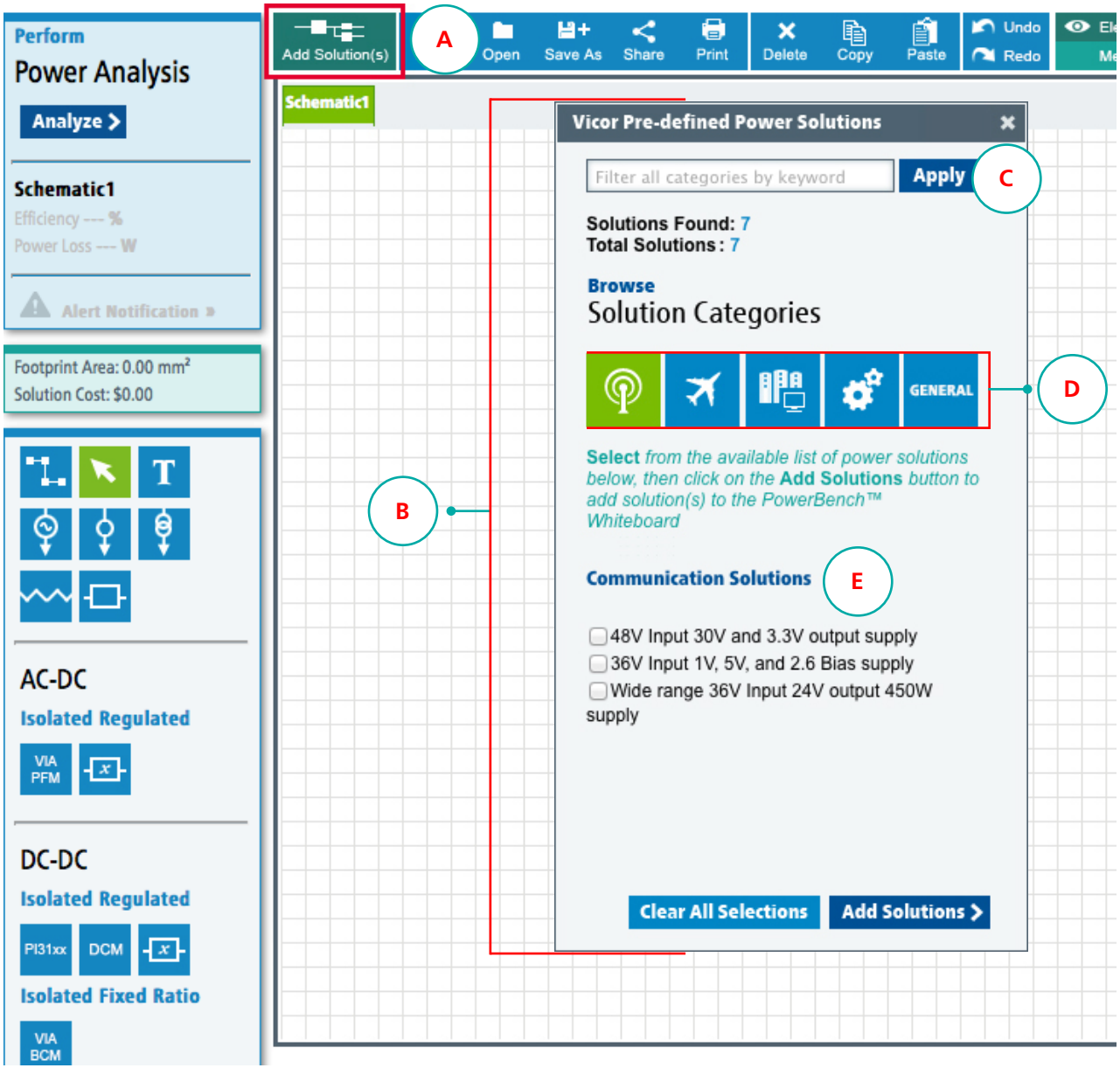
OR

***Click on the Icons to Select a Category***

In the example to the right the Communications Category is Selected

**E**

Each Category will display a unique set of available Power Solutions




Back To Top ^

## Adding Pre-defined Solutions

### Browse & Select Solution(s)

Selections can be made by Browsing Categories and Selecting from their associated checkboxes that appear at the bottom half of the dialog box. As you Browse from Category to Category your selections will be saved. There is no limit to how many Solutions can be selected at one time.

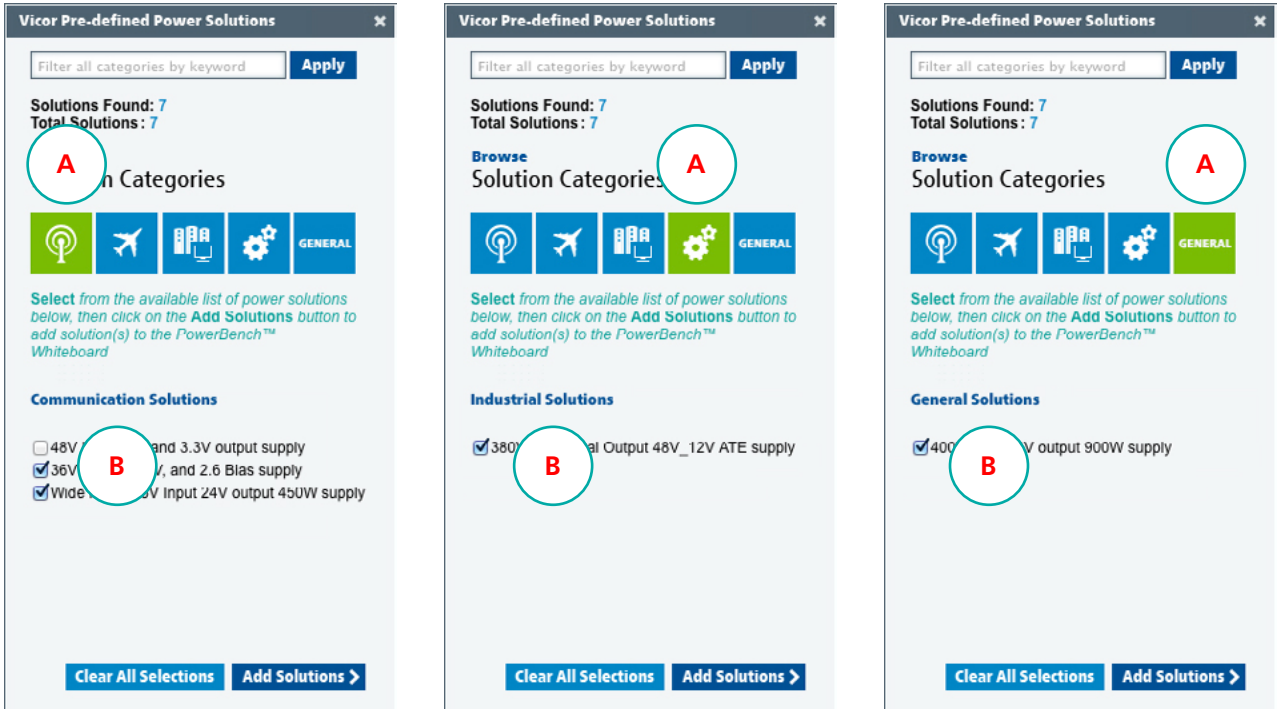
Table 14. **Available Solution Categories**

| Icon | Solution Category | Icon | Solution Category | Icon | Solution Category |
|---|---|---|---|---|---|
| | Communications | | Computing | GENERAL | General |
| | Defense / Aerospace | | Industrial | | |

Figure 57.

**A** *Click on Icons to Select a Category*

**B** *Check the Solution(s) from each Category to be added to the Whiteboard*



Add Solution(s)

## Adding Pre-defined Solutions

### Add Selected Solutions to the Whiteboard

Selections can be made by Browsing Solutions and selecting from the checkboxes that appear at the bottom half of the dialog box. As you Browse from Category to Category your selections will be saved. There is no limit to how many Solutions can be selected.

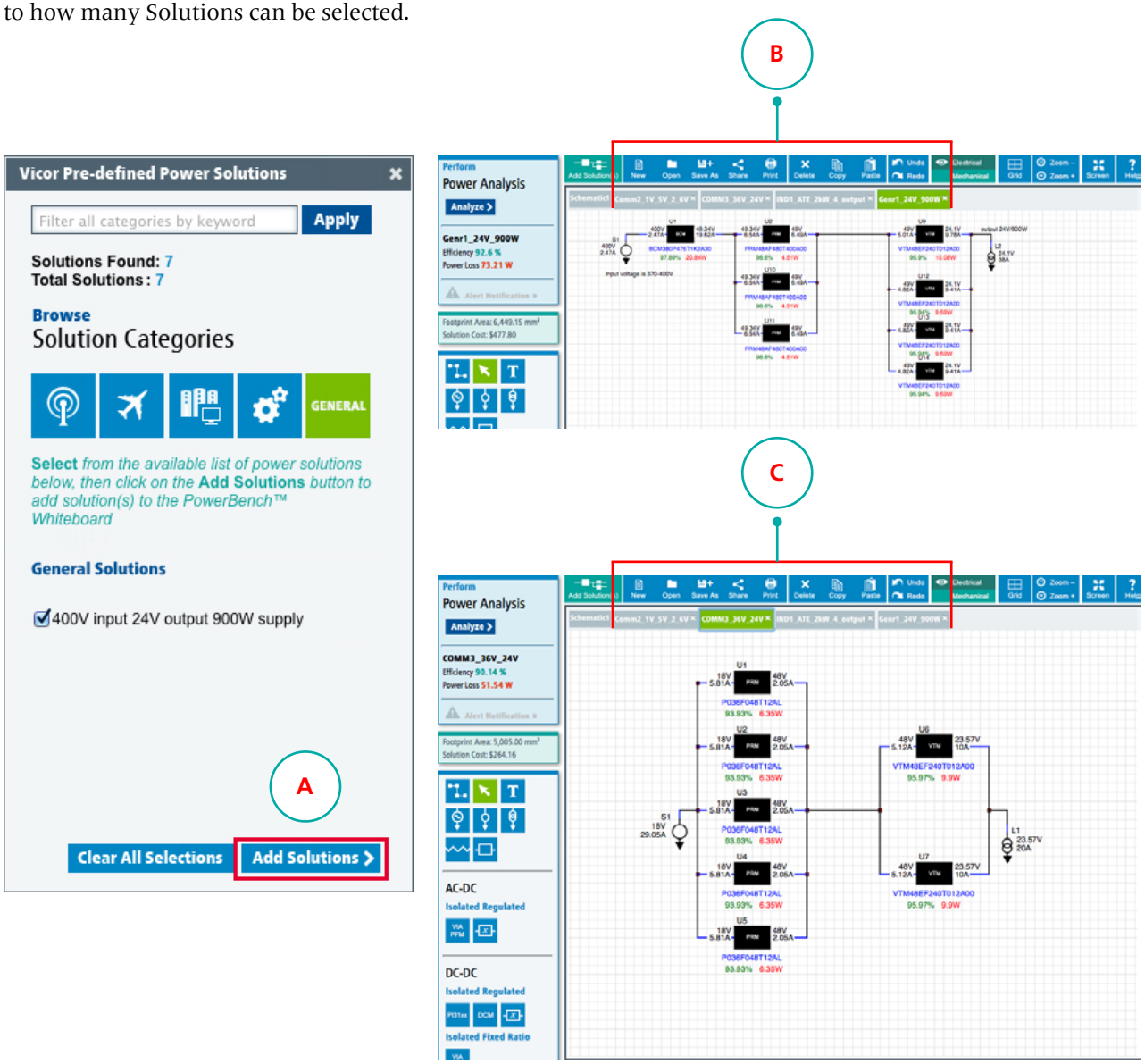



Figure 58.

**A**
*Click Add Solutions to add the Selected Solution(s) to the Whiteboard*

**B**
The Pre-defined Power Solutions will load into the Whiteboard

In the example (4) Solutions have been added

**C**
If multiple solutions have been added
*Click Schematic Tabs to View the various Powerchains and their associated Analysis Data*

## Electrical View

The standard electrical view is a high level abstract representation of a design, which illustrates the logic connections between various products and components.

### Toggling Schematic Viewing Mode

Electrical View is the default viewing mode presented to the user in the PowerBench™ Whiteboard. In this viewing mode the user can build, edit and analyze electrical power chains. In this viewing mode the Design Toolbox is available to the user and all elements of power chains can be modified by right-clicking. The Footprint Area and Solution Cost are also displayed.

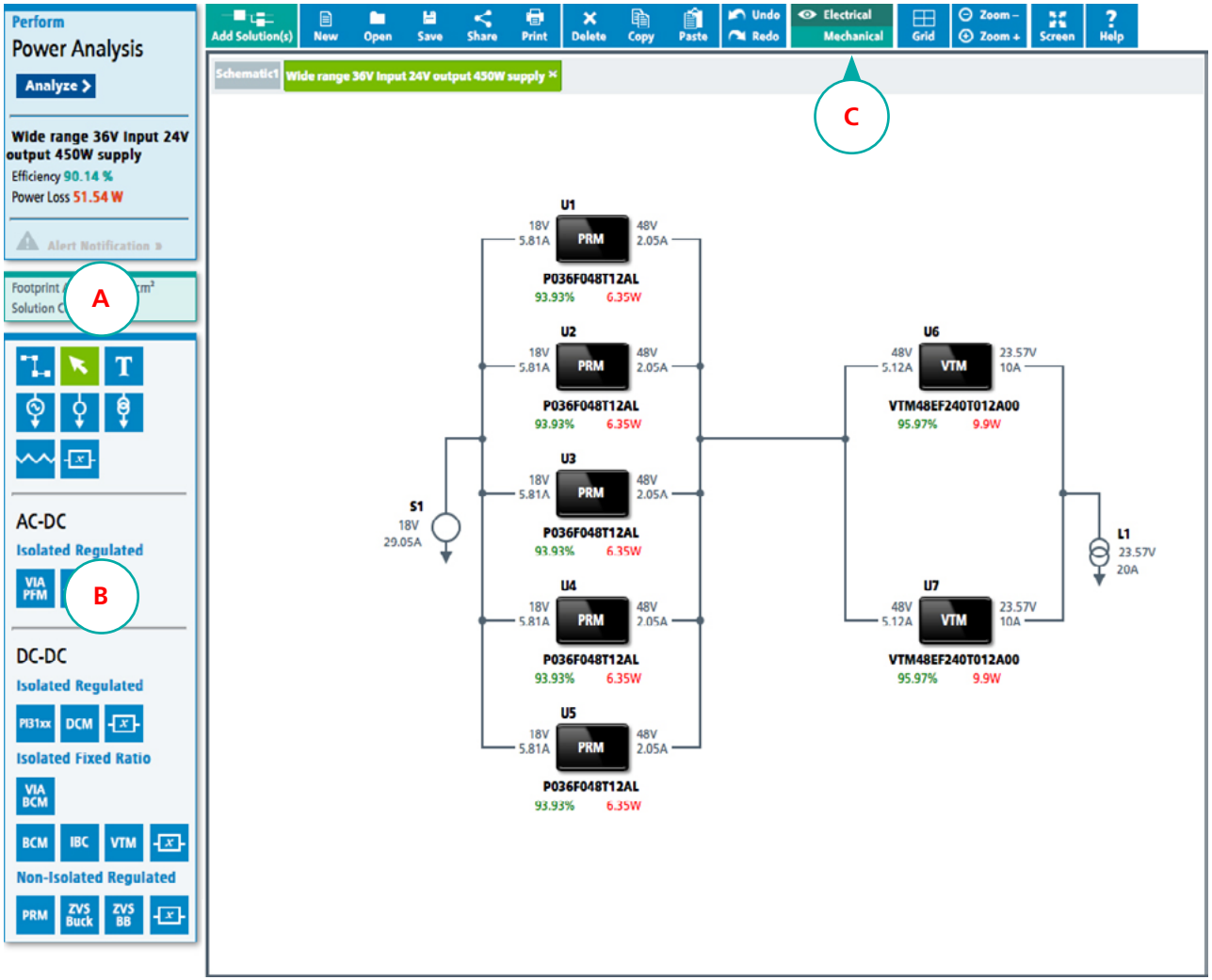
Figure 59.

**A**
In Electrical Viewing Mode
the **Footprint Area & Solution Cost** are displayed

**B**
In Electrical Viewing Mode
the **Design Toolbox** is Accessible
for building a power chain

**C**
Electrical Viewing Mode
is the Default Viewing Mode of the Whiteboard

When in Mechanical Viewing Mode
***Click on Electrical in the Taskbar Ribbon to switch the viewing mode from Mechanical View to Electrical View***



Mechanical

Back To Top ^

## Mechanical View

To gain further insight into the physical aspect of a design, the whiteboard comes with an alternative view option called the Mechanical View.

Mechanical View is a view-only mode, where all products captured in the electrical view are automatically placed with displayed interconnects according to the rules outlined in the following pages.

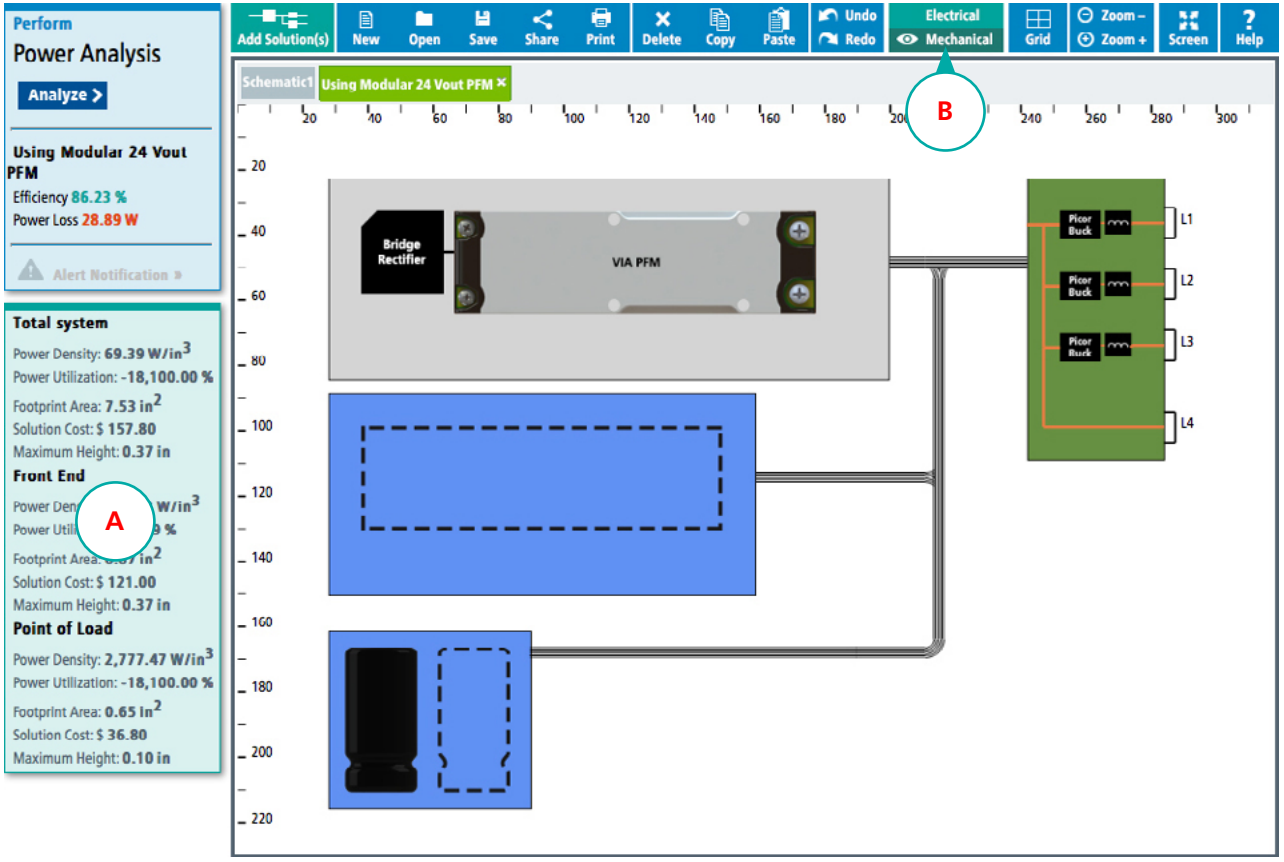
### Toggling Schematic Viewing Mode

Mechanical View allows the user to review the mechanical aspects of the active power chain with actual components displayed relatively sized to one another. The Design Toolbox and editing functionality is not available in this viewing mode. To make modificatons to the power chain the user must switch back to the Electrical viewing mode. in Mechanical Read-only System Performance specifications are displayed.

Figure 60.

**A**
In Mechanical Viewing Mode the **System Performance** is displayed

**B**
***Click on Mechanical in the Taskbar Ribbon to switch the viewing mode from Electrical View to Mechanical View***



## Mechanical View

### System Performance Display

The system performance display provides detailed numbers regarding key aspects of the different subsystems within the design.

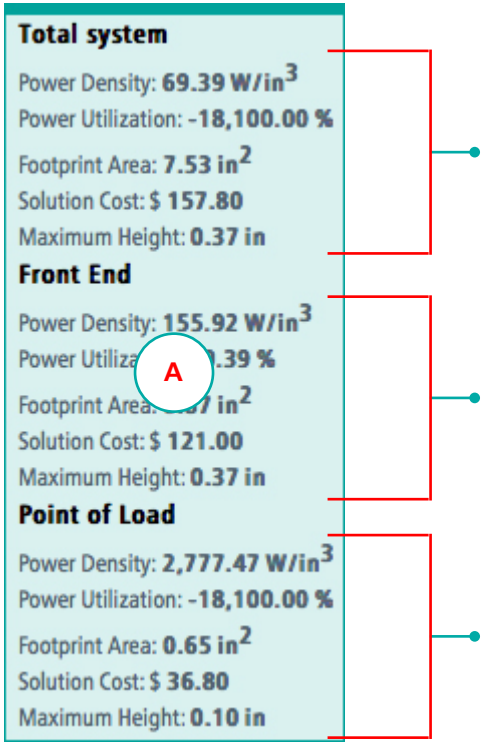



Figure 61.

**A**

System Performace Display

| Parameter | Description |
|---|---|
| **Power Density** ($W/in^3$ or $W/mm^3$) | Ratio of the maximum power that can be delivered to the output of the system with overloading the system. |
| **Power Utilization** (%) | Ratio of the total output power and the total input power of the system |
| **Footprint Area** ($in^2$ or $mm^2$) | Surface area of the system |
| **Solution Cost** ($) | Cost of the system |
| **Maximum Height** (in or mm) | Maximum height of the system |

## Mechanical View

### Mounted on the AC Front End Panel

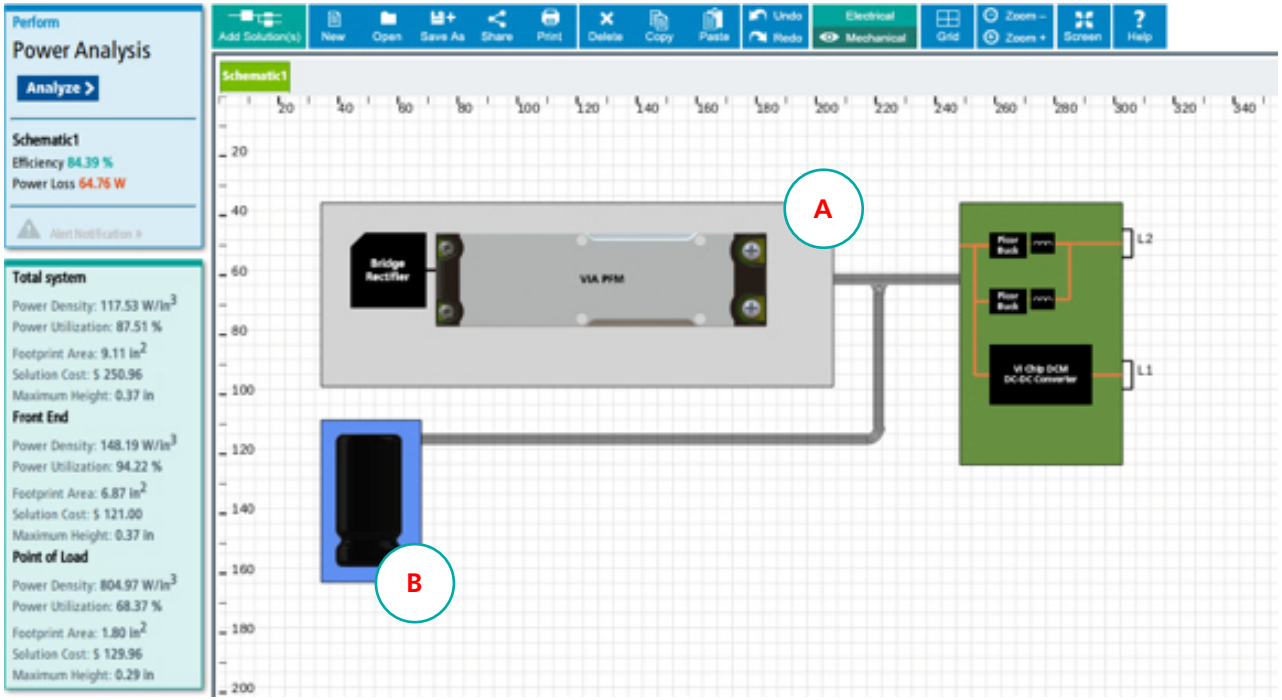



Figure 62.

**A**
All AC-DC devices are placed on this mount.

**B**
Required ancillary components: Rectifiers, hold-up capacitors, etc. are placed on a separate mount connected with a wire harness.

Note that these additional components are not to scale, but are instead a simple visual place holder depicting additional operational requirements.

Mechanical

Back To Top ^

## Mechanical View

### Mounted on the DC Front End Panel

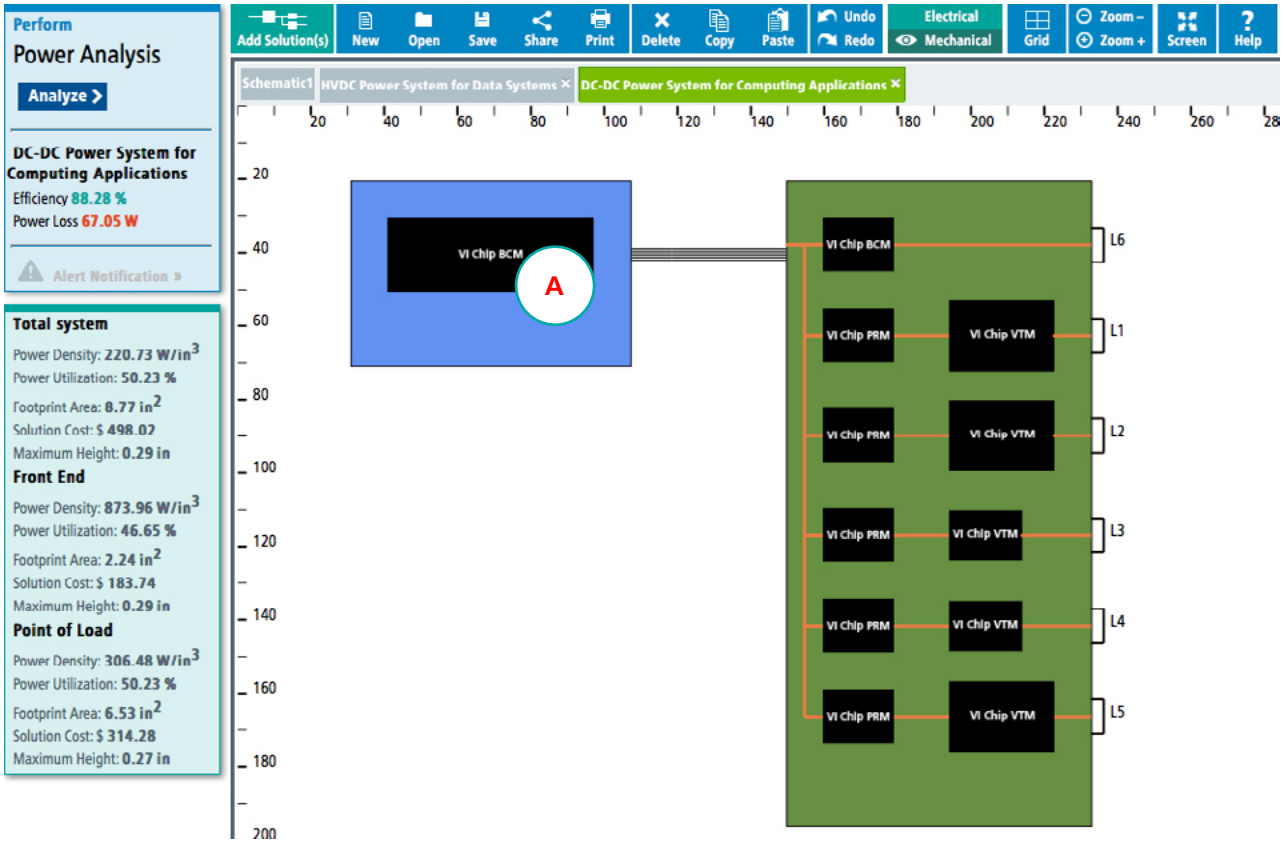



Figure 63.

**A**

All DC-DC products which are directly connected to a supply, but do not directly drive a load, are placed on this mount.

Mechanical

Back To Top ^

## Mechanical View

### Mounted on the Printed Wiring Board

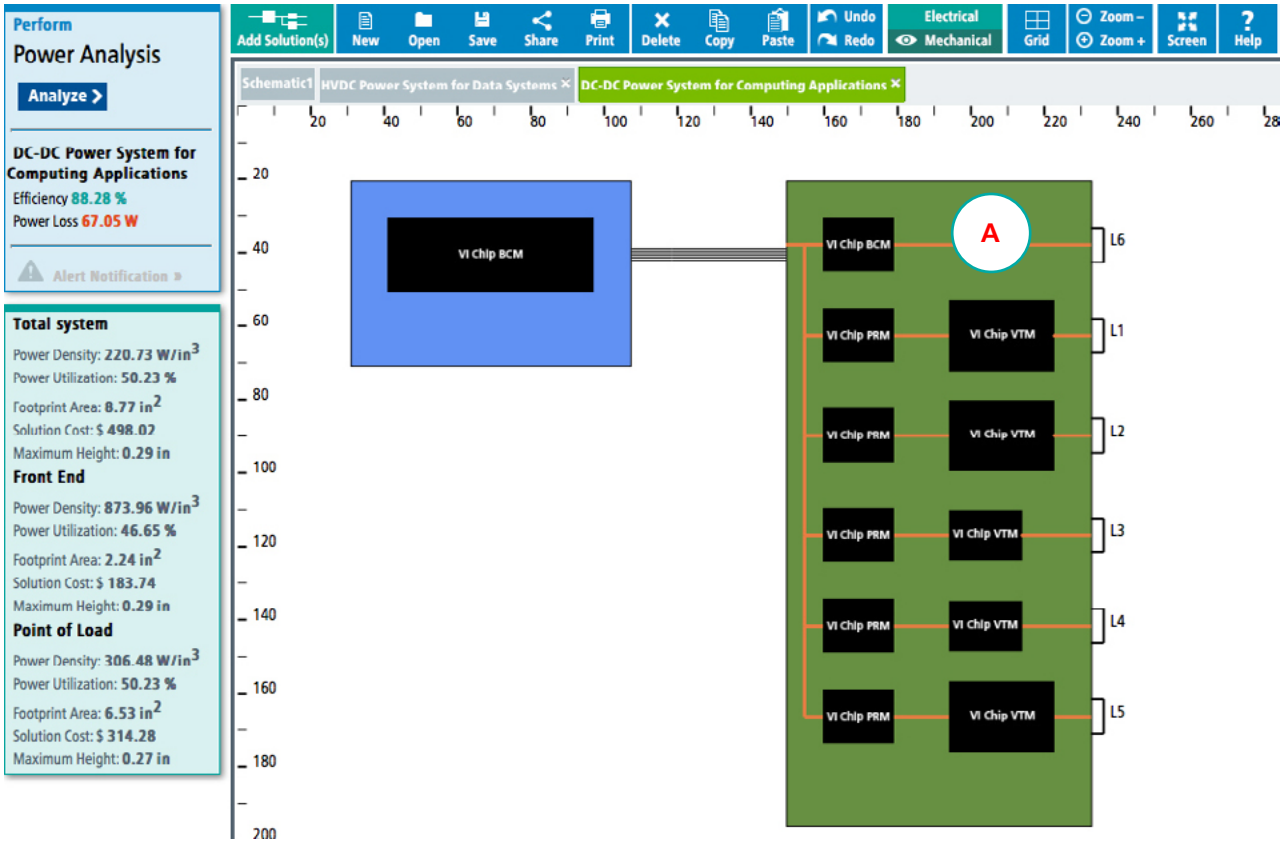



Figure 64.

**A**

All remaining products (those that do not qualify for the AC Front End or DC Front End mount) are placed on this mount

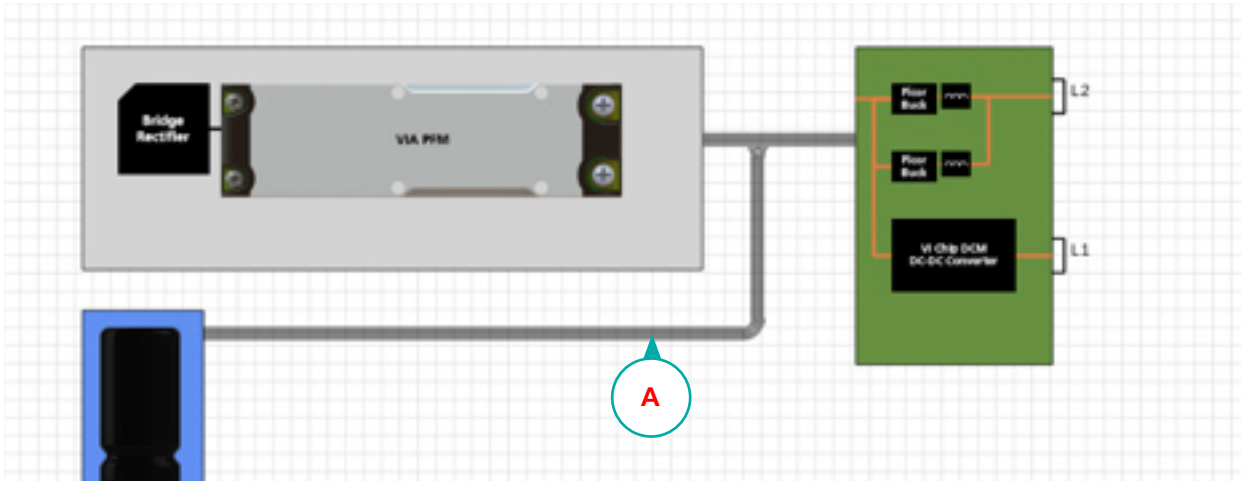
## Mechanical View

### Common Wire Harness

Figure 65.

**A**

Physical interconnect cabling is represented by a common wiring harness

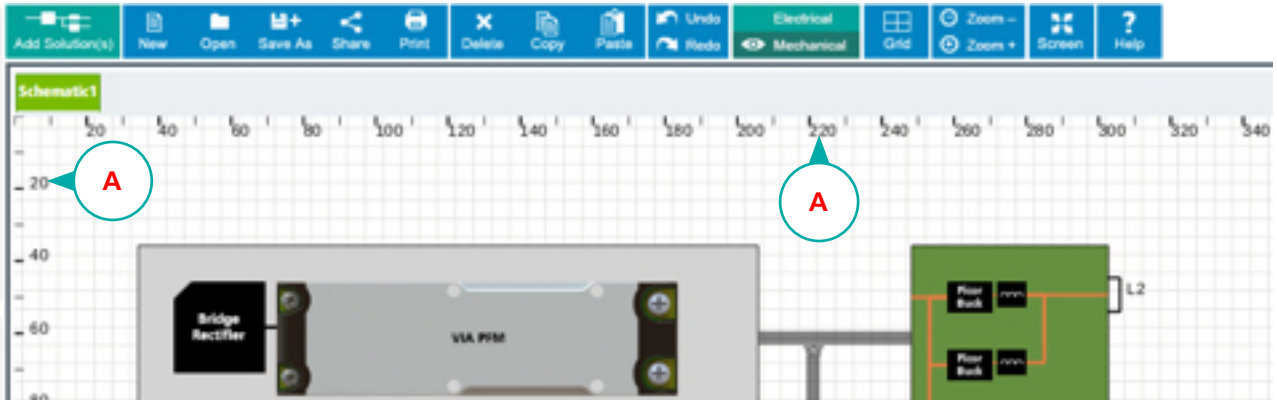



### Switching the Unit of Measure

Figure 66.

**A**

Default unit for dimensions is inches, but can be converted into millimeters by clicking on the units.



Back To Top ^

## System Requirements

### Browser Compatibility

The PowerBench WhiteBoard uses HTML5 technology to manage the screen controls, canvas and drawing elements.

Table 15.
Browser compatibility version requirements

| Browser | Version |
|---|---|
| **Internet Explorer** | 9.0 and higher |
| **Firefox** | 10.0 and higher |
| **Chrome** | 10.0 and higher |
| **Safari** | 5.1 and higher |
| **Opera** | 11.50 and higher |

Back To Top ^

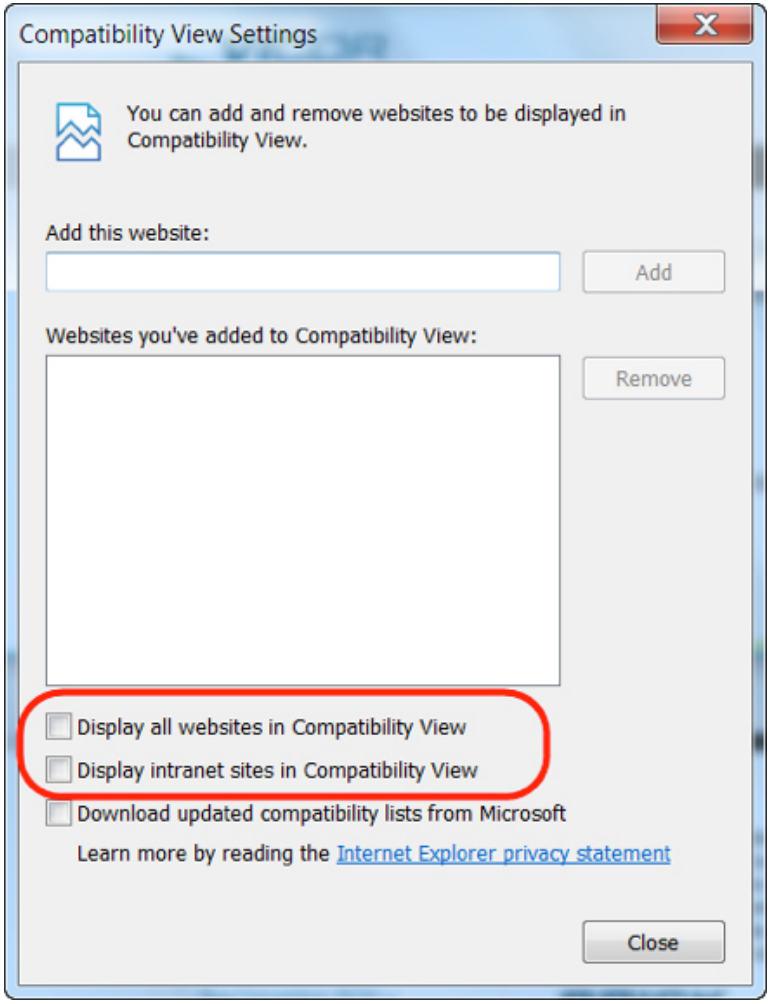
## System Requirements

### Compatibility Mode

**PLEASE BE ADVISED**

**Problems may occur if the browser is in compatibility mode.**
**Please make sure that the browser is not using compatibility mode**

Figure 67.
Compatibility Mode



Back To Top ^

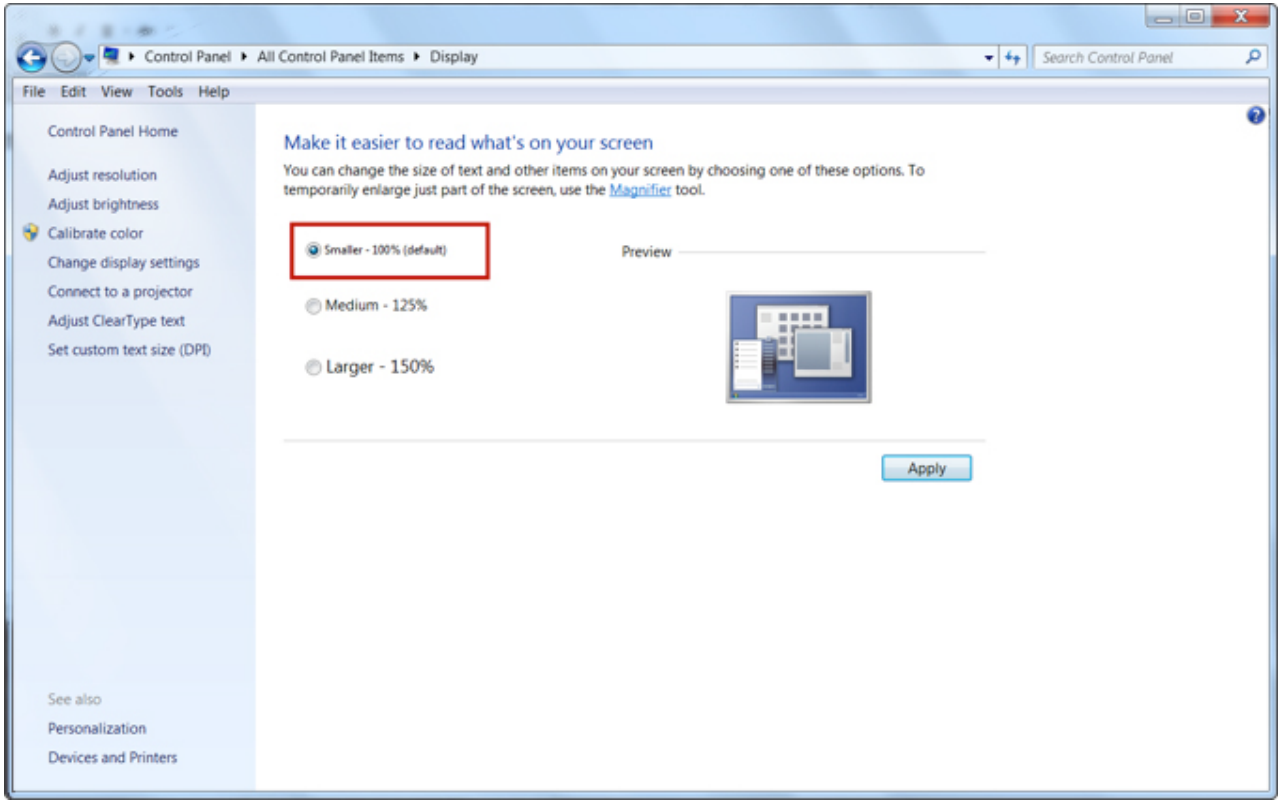
## System Requirements

**PLEASE BE ADVISED**

### Default Display

**Image degradation of icons and text is sometimes seen when the default Display environment is set to a larger size than normal. It is recommended that the display be kept at the default. To enlarge the canvas, use the WhiteBoard Zoom features.**

Figure 68.
Default Display



Back To Top ^