

# Creating High-Voltage Outputs

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## Introduction

For applications that require high-voltage outputs, multiple converters may be used in a series output configuration to produce a single output voltage that is the sum of all of the converter outputs in the array.

The following describes two approaches to produce a high-voltage output. The first solution provides a fixed output voltage, the second method, an adjustable output voltage. A variation of the second configuration also provides a solution for an adjustable split supply.

In a series array, the positive output of each module requires a series diode (D1 and D2) to prevent the array from being back-driven by load capacitance during turn off, and to assure proper operation during start up and dynamic loading. This diode must have a reverse voltage rating greater than the array's output voltage and a forward current rating greater than the array's maximum load current. In all configurations, diodes D3 and D4 prevent the output from going negative if only one converter is operational.

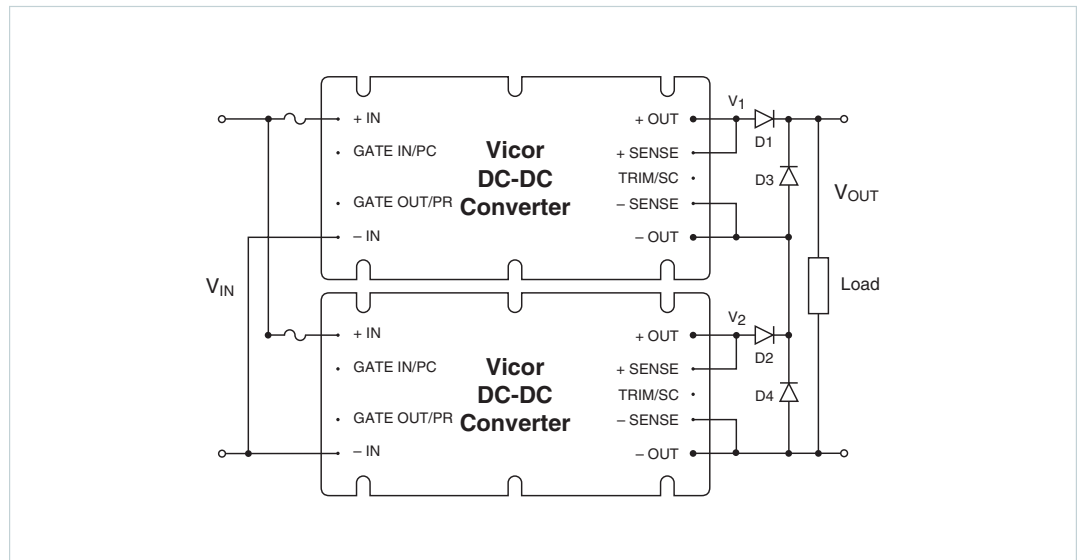
Converters should be bypassed for common and differential mode noise per any Vicor recommendations in the Design Guide and Application Manual. Bypass capacitors should be appropriately rated and located as close to the individual converters as possible. In all applications utilizing an adjustable output voltage, all recommendations regarding trim ranges and preloads should be followed.

## Fixed Output Voltage

For applications that require a fixed output voltage, two or more converters may be used in a series output configuration as shown in Figure 1.

**Figure 1**

Fixed High Output Voltage  
 $V_{OUT} = V_1 + V_2$

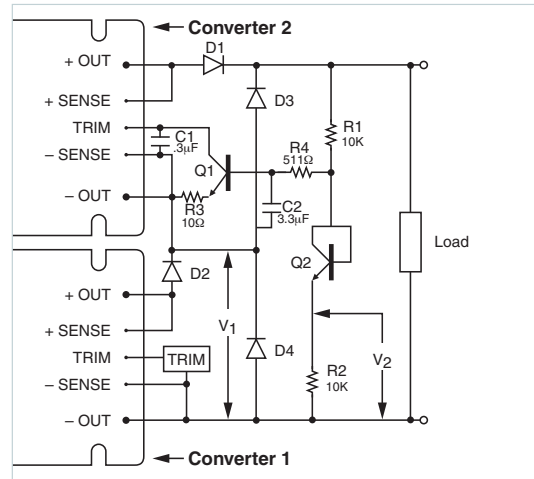


## Adjustable Output Voltage

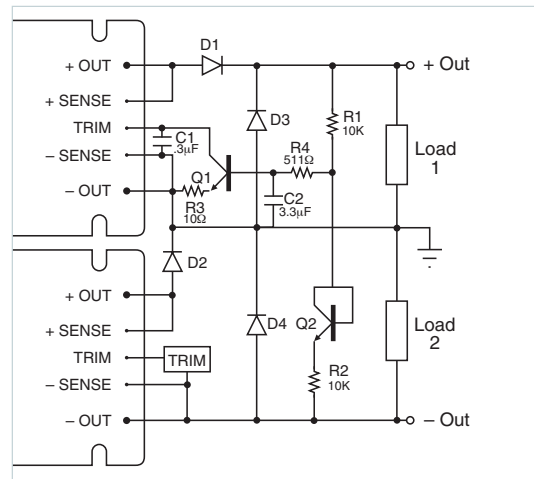
### Brick VI-200 and VI-J00 DC-DC Converters Only

For applications that require an adjustable output voltage, the configuration in Figure 2 provides a simple and inexpensive solution, requiring a minimum of external components. Contact Vicor Applications Engineering for adjustable output supplies using Brick Maxi, Mini, Micro converters.

**Figure 2**  
Adjustable High  
Output Voltage



**Figure 3**  
Split Supply with Adjustable  
Output Voltage



In this approach, when the output voltage of Converter 1 is trimmed down ( $V_1 < V_2$ ), Q1 is biased on and reduces the output voltage of Converter 2 until  $V_1 = V_2$ . Consequently, both converters contribute equally to the total-output voltage and operate at virtually the same temperature, optimizing system MTBF. Transistors Q1 and Q2 are part number 2N2222. C1 should be a ceramic capacitor. C1, Q1, R3, and C2 should be located as close to the converter as possible and should be laid out so loop area is minimized. The value of C2 can be adjusted to optimize the stability of the array, which can be determined from a load-step response.

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## Adjustable Split Supply

### Brick VI-200 and VI-J00 DC-DC Converters Only

A split supply (Figure 3) can be implemented with a variation of the Figure 2 configuration. In this solution, when the converter with the (-) output is trimmed down, the (+) output converter will adjust accordingly.

**IMPORTANT:** Do not series connect the output of Booster modules. Do not connect Gate Out to Gate In of series connected converters.

When series connecting the outputs of VI-200 or VI-J00 converters, the total voltage of the series connection must not exceed 200V with respect to the baseplate. For higher voltages a  $\pm 200V$  split supply can be made for a maximum differential output voltage of 400V. The midpoint of such an array must be referenced to both the baseplate and earth ground.

For further information on array output voltage limitations email Vicor Applications Engineering at: [apps@vicorpower.com](mailto:apps@vicorpower.com).

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