The BatMod™

Overview

The BatMod is a programmable current source module that can also be used as a constant voltage converter. It can be controlled externally to meet a wide range of charging parameters: voltage, current, charge rate and charge time.

The BatMod is comparable to the VI-200 voltage module with a variable current limit. It has three output terminals that differ from conventional voltage output converters: Current Control, Voltage Adjust and Current Monitor. All of these terminals are referenced to the –Out pin.

Although the BatMod is primarily intended for battery charge applications it can be used as a programmable current source for resistive loads or CW laser diodes. The BatMod will not function properly at zero output voltage and current simultaneously. It follows therefore that the current can not be adjusted to zero with a resistive load. *Refer to Safe Operating Area Curves on the BatMod spec sheet.*

Following is a description of the BatMod's pinout.

CURRENT ADJUST: CURRENT TRIM (ITRIM). An input signal with an analog voltage of 1 to 5V that can adjust the sourced current rating 0 to maximum rating.

5 Vdc ↑ 1 Vdc = 100% of Rating ↑ 0 Amps

VOLTAGE ADJUST: VOLTAGE TRIM (VTRIM): An input signal that can be set for a maximum voltage with a fixed resistor or adjusted by an external voltage source. A source voltage referenced to the –Out of 1.25 to 2.5V for a 50% to 100% of rated voltage adjustment.

2.5 Vdc ↑ 1.25 Vdc = Max. V_{out} ↑ 50% of V_{out}

CURRENT MEASUREMENT: CURRENT MONITOR (IMON): An output signal that indicates the amount of current being sourced. It is a linear voltage/current relationship where one Volt corresponds to 0% of sourced current and 5V corresponds to 100% of sourced current.

5 Vdc ↑ 1 Vdc = 100% of Rating ↑ 0 Amps

For DC input current sources (Figure 1, page 11-2), the modules have the same wide range input rating as VI-200 Family voltage converters for 48 and 300V inputs. BatMods can be used for higher current sources with a driver booster scheme (Figure 2, page 11-2).

NOTE: Inductance to the load should be limited to 20 µH to avoid possible loop instabilities.

Overview (cont)

Figure 1.
DC Input
Single Module

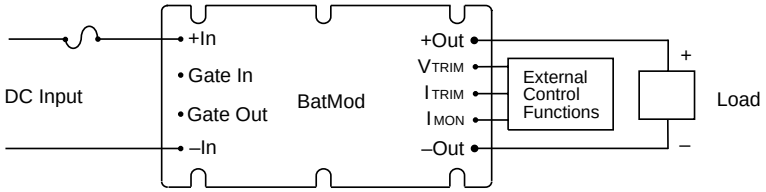
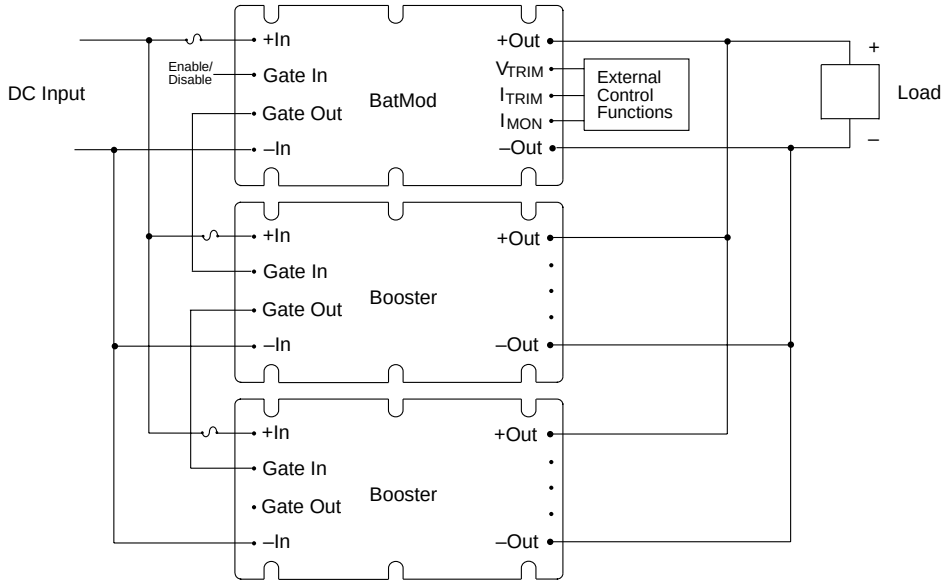


Figure 2.
DC Input
High Power Array



Designing a Battery Charger

Vicor's BatMod current source module enables designers to easily build a compact, lightweight battery charging system with commonly available parts. The BatMod module provides programmable controlled current and voltage outputs and is ideal for applications involving standard input and output voltages. Because the BatMod allows the output voltage and the charge current to be set independently, the system design is greatly simplified.

Basic Battery Charger
Figure 3, page 11-3, shows a basic charging circuit with a BatMod module for the following system requirements:
Battery voltage: 12V
Float voltage: 13.8V
Charge current: Adjustable 0–14.5A

Setting the float voltage: Since the open circuit output of a 12V BatMod module (VI-2__1-CU-BM) is 15V, a trimming resistor (R3) is necessary to set a float voltage of 13.8V.

Designing a Battery Charger (cont)

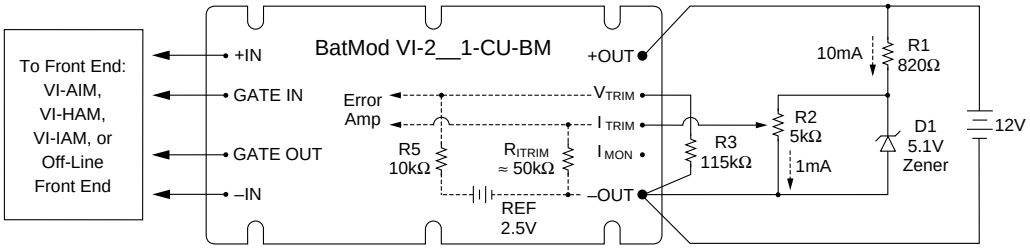


Figure 3. Basic Charging Circuit Using a BatMod Current Source Module

To determine the value of R3, follow these steps:
Solve for V_{TRIM}:

$$\left(\frac{V_{FLOAT}}{V_{NOM}}\right) V_{REF} = V_{TRIM}$$

$$\left(\frac{13.8V}{15V}\right) 2.5V = 2.3V$$

• Solve for V_{R5}:
$V_{REF} - V_{TRIM} = V_{R5}$
$2.5V - 2.3V = 0.2V$

• Solve for I_{R5}:

$$I_{R5} = \frac{V_{R5}}{R5} = \frac{0.2V}{10\ k\Omega} = 20\ \mu A$$

• Solve for R3:

$$\frac{V_{TRIM}}{I_{R5}} = R3$$

$$\frac{2.3V}{20\ \mu A} = 115\ k\Omega$$

A 13.8V output requires a 115 kΩ resistor.

Setting the charge current: The charge current can be programmed from 0 to maximum (14.5A) by applying 1 to 5V to the I_{TRIM} pin. To determine the voltage required to produce a particular charge current, 10A for example, use the following formula:

$$4\left(\frac{\text{Desired Charge Current}}{\text{Maximum Output Current}}\right) + 1 = V_{ITRIM}$$

$$4\left(\frac{10A}{14.5A}\right) + 1 = 3.76V$$

To set the input to I_{TRIM} to 3.76V, adjust the potentiometer (R2) accordingly.

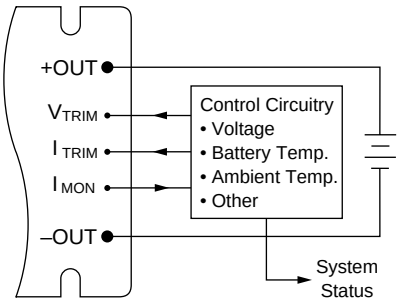
Designing a Battery Charger (cont)

The Figure 3 configuration will charge the battery at a maximum of 10A with a 13.8V float voltage. Other charge rates and float voltages may be similarly calculated. If a fixed charge current is desired, the potentiometer can be replaced with two fixed resistors. In applications requiring tight control over the charging current, D1 can be replaced with a precision reference.

Advanced Battery Charger

Many new battery technologies require sophisticated charging and monitoring systems to preserve their high performance and to extend their life. The BatMod serves as an ideal building block for constructing an advanced battery management system, which typically incorporates a microprocessor-based control circuit that is easily adapted for a variety of battery chemistries and monitoring functions (see Figure 4).

Figure 4. The BatMod in an Advanced Battery Charging System



To maintain the optimum charge on the battery, the control circuit independently adjusts the float voltage and charge current in response to conditions during the charge: the battery's voltage, current, temperature and pressure, and other pertinent parameters. It can also relay battery status information such as capacity, charge and discharge history, and cause of failure.

With its wide range of outputs, the BatMod offers designers a simple, cost-effective solution to battery charging for all major battery types.