Controlling the BatMod with a Digital Potentiometer

The BatMod is a modular, component-level DC-DC converter that provides a programmable output voltage and current limit suitable for battery charging or other applications that require constant current with external control.

Two BatMod control pins—one to adjust voltage and one to adjust current limit—can be driven by analog voltages generated by a manual DC source, a potentiometer, or a DAC. A simple yet effective programmable battery charger uses a digital potentiometer controlled by a computer through a two-wire connection. This paper describes such a computer control scheme.

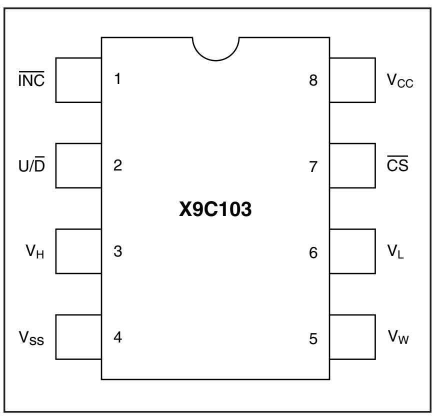

Figure 1—Pinout of the E2POT digital potentiometer.

E2POT™ Digital Potentiometer

The E2POT is a digital component manufactured by Xicor, Inc. This potentiometer, with values from 100Ω to 50kΩ in 100Ω increments, uses EEPROM technology. A digital pulse applied to a control pin moves the wiper up or down. A direction pin dictates the wiper's up or down movement, and an Enable pin disables the control functions to allow multiple addressing. Since the device uses EEPROM technology, the wiper position is retained if power fails. Figure 1 shows the device pinout and pin functions.

Battery Charger

To control the battery charging process, it is necessary to program the charging current and the voltage that the battery will reach when it is fully charged, called the float voltage. The charging current is terminated at this point. Depending on the type of battery, particular charging techniques may need to be implemented, such as pulse charge, which briefly applies high current levels, or temperature monitoring, which regulates the charging current according to the battery cell temperature.

In general, all of these charging methods can be software controlled. Figure 2 shows a typical hardware setup with all the relevant parts of the battery charger.

Modules

The battery charger shown in Figure 2 uses a universal-input, power-factor-correcting AC-DC front end that allows it to operate from any AC power line worldwide and comply with the harmonic reduction standard IEC 555 for domestic and industrial applications. This front end includes a Vicor VI-HAMD-CM Harmonic Attenuator Module, a VI-HAM Line Filter (part number 07818), and a bridge rectifier. This front end can be easily expanded to provide greater power with the addition of a VI-BAMD and modifications to the line filter. See the Vicor Applications Manual for details.

(continued)

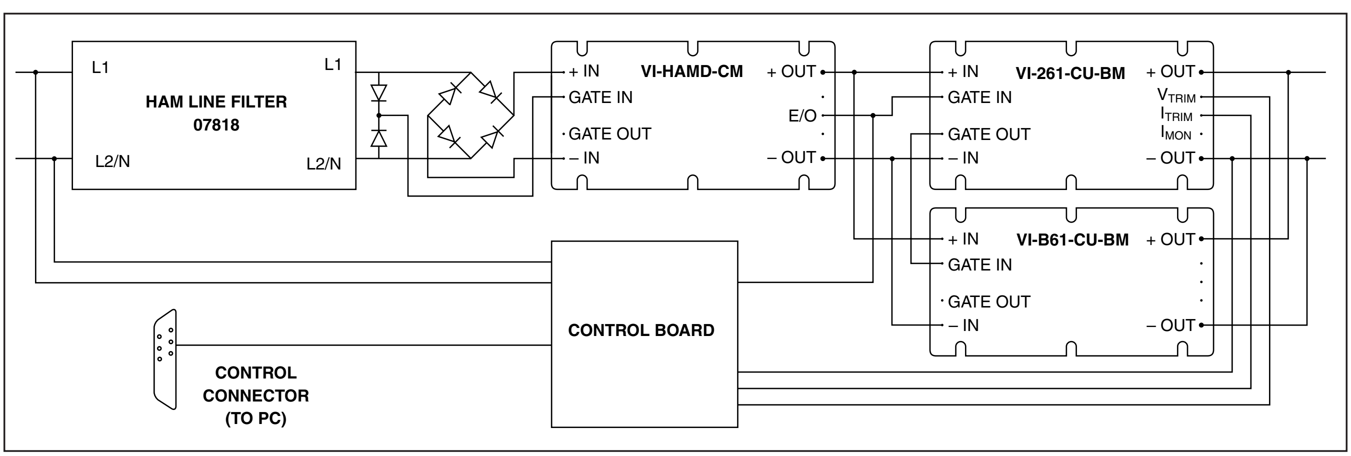

Figure 2—Hardware setup for a 12 volt battery charger.

Controlling the BatMod

(page 2)

The DC-DC conversion structure uses a BatMod VI-261-CU-BM and a booster module VI-B61-CU-BM. If more power is required, this configuration can be expanded by paralleling additional boosters.

Control Board

The control board implements the voltage and current control functions for the BatMod, interfacing with a PC or digital controller. Figure 3 shows the control board's simple structure.

The E^{2}POT potentiometer X9C103 was chosen for its 10kΩ value, recommended in the Vicor Applications Manual to provide an acceptable linearity for trimming the BatMod. The voltage and current control functions are implemented by the E^{2}POTs P1 and P2, respectively. These potentiometers can be independently selected via the lines $\overline{CS1}$ and $\overline{CS2}$. The resistor value can then be increased or decreased via the line $\overline{Clk}$, depending on the status of the $U/\overline{D}$ line. Control is thereby obtained by four separate lines.

R1 and R2 limit the control range for the current, while R3 and R4 limit the output voltage. For the calculations used to determine the resistor values, see the Vicor application note "Designing a Battery Charger" and the Vicor Applications Manual, Section 5, "Output Voltage Trimming". The values used in Figure 3 allow the charging current to vary from nearly 0 to 25A in ≈250mA increments, and the voltage from 10V to 15V in 50mV increments.

The computer can enable or disable the BatMod via the Gate In pin and the transistor Q1 and the optocoupler OC1. When Q1 is driven with a logic "0", the LED from the optocoupler is on, saturating the phototransistor and disabling the power converter. Because

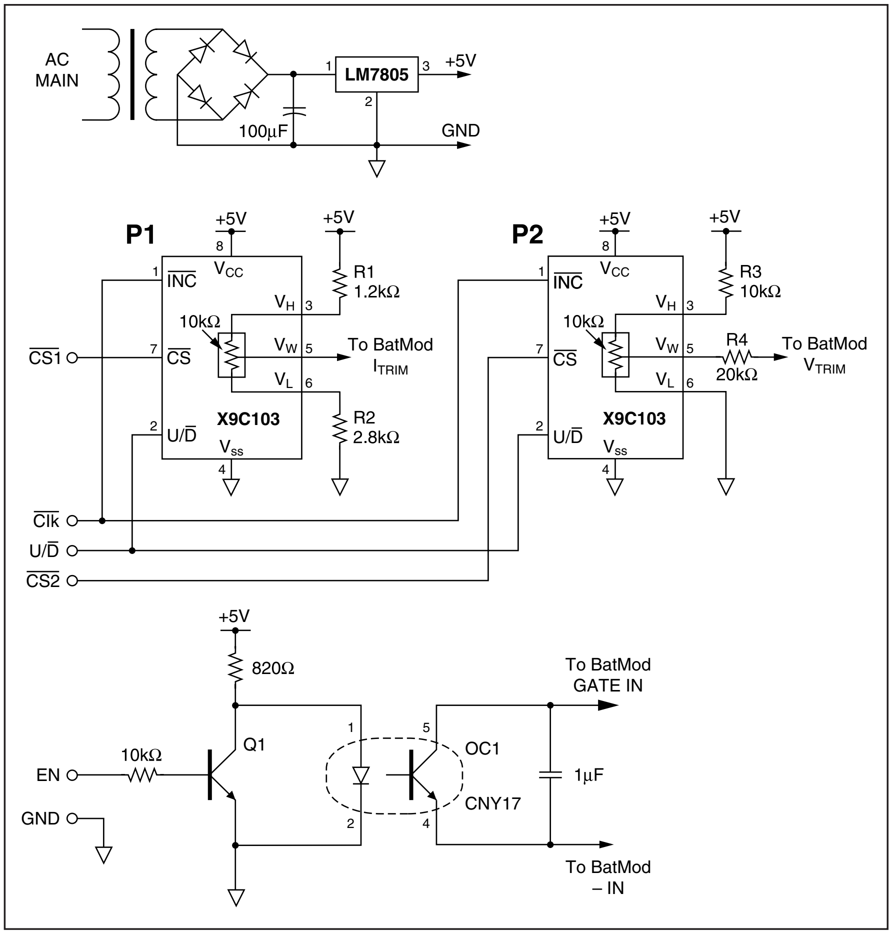

***Figure 3**—Control board layout.*

the parallel port is at logic "0" at turn-on, the modules are disabled until the software gets the system under control.

All the interface signals from the computer come from the parallel (printer) port, which requires only a cable connection to the battery charger. A linear isolated power supply—designed to operate from 110 or 220 VAC—is sufficient to provide the low power required by the control board.

Software

The control software for this example has a very simple structure. An initialization part disables the module output and sets voltage and current to the minimum value. A human interface routine prompts the user to input the desired current and voltage. The BatMod is then enabled and the charging phase begins. During the charging, it is possible to change the parameters or to stop the process and exit.

The software is implemented in Quick Basic. A program listing is available on request.

E^{2}POT is a trademark of Xicor, Inc.