BAT104-7AA-NiCd
Manual

PC/104 Battery Backup Module

Manufactured by
TRI-M ENGINEERING
Engineered Solutions for Embedded Applications

Technical Manual

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This manual is for integrators of applications of embedded systems. It contains information on hardware requirements and interconnection to other embedded electronics.

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CHAPTER 1: GENERAL DESCRIPTION

The BAT104 works with the HE104 and V104 Vehicle Power Supplies to create a complete UPS system. For loads less than 30 watts, the BAT104-7AA-NiCd can supply backup power for up to five minutes.

Connect the BAT104 to the HE104 and V104 as follows:

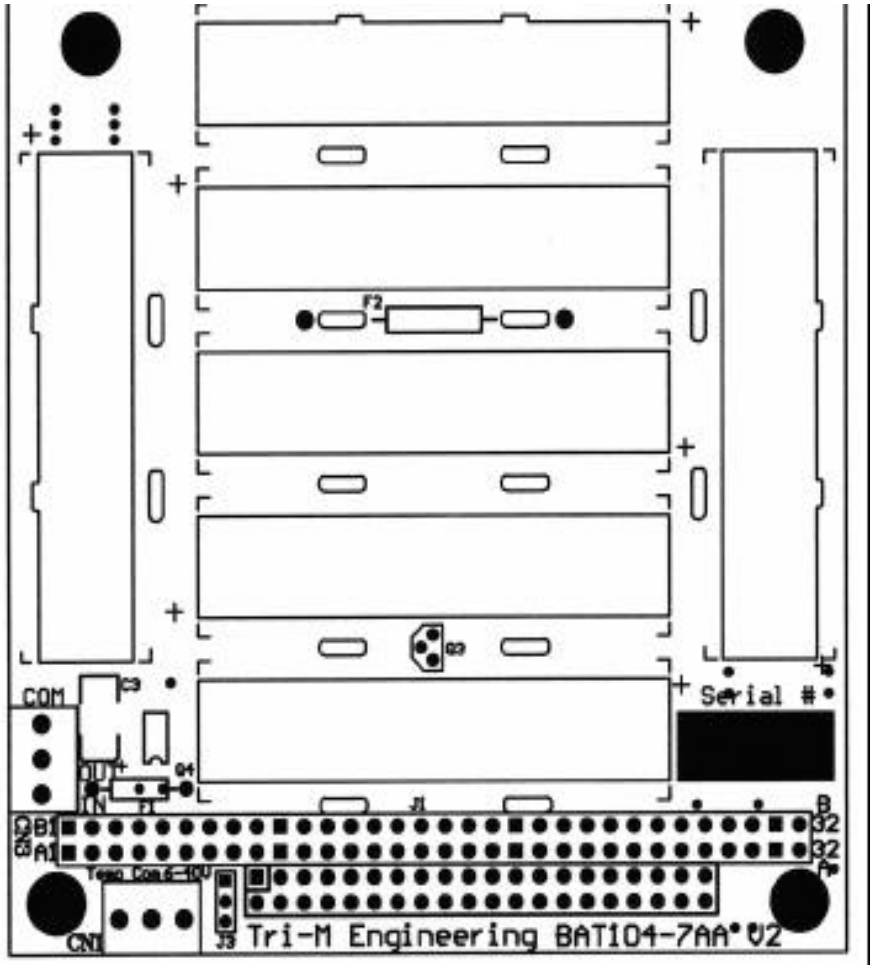
- BAT104 CN3 “Common” to HE104/V104 CN3 terminal 1
- BAT104 CN3 “Battery Out” to HE104/V104 CN3 terminal 2 (and to terminal 3 for voltage monitoring)
- BAT104 CN3 “Battery In”, for external batteries

The BAT104 has a thermal fuse (F2), a current fuse (F1) for protection against overcharging, and shorts on the battery output.

A LM35 temperature sensor (Q3) provides temperature feedback for charge termination, which can be read by the Power Management unit PM104 installed on the HE104 or V104. The LM35 has an output signal of 10mV/degC. For example, at 25 degC the LM35 will output 250mV. The LM35 signal is normally connected to connector CN3 terminal 4 of the HE104 or V104.

Jumper J3 changes the supply source for the LM35 temperature sensor. When the jumper is installed between pins J3-1 and J3-2, the power source is from CN1 main input supply. When the jumper is installed between J3-2 and J3-3, the power source for the LM35 is the +5V from the PC/104 bus. *Note*: The Main Input source is required only if the LM35 is to be powered by it.

The BAT104 has a Mosfet transistor for isolating the batteries from the HE104 or V104 during extended power outages. The Mosfet transistor isolates the BAT104 whenever the +5V is not on the PC/104 bus and connects the BAT104 batteries whenever +5V is on the PC/104 bus. Therefore, to disconnect the BAT104 from the HE104 or V104, the PM104 just has to turn off the +5V output.



- Common
- Battery Out
- Battery out

- Temp sensor
- Common
- Main Input

CHAPTER 2: HE104 and V104 make an excellent UPS

The V104 and HE104 have multiple outputs that can supply +5V, +12V, -5V and -12V for embedded applications. With the addition of the optional battery charger (BC3/104) and power management PM104, any type of rechargeable battery can be charged. Maximum charge current of one ampere allows charging of battery packs up to 12 ampere-hour with a recharge period of 12 hours. A four channel 12 bit analog to digital convertor is used to measure battery charge current, input voltage to the BC104, battery voltage* and battery temperature* (*these ADC inputs provided on screw terminals). The battery charger BC3/104 is a step down switching regulator with current limiting.

The power management PM104 is a field programmable microcomputer with software for controlling the V104 and HE104 power supplies. The PM104 includes an embedded BASIC language interpreter that allows programs to be downloaded a PC's parallel port.

Typically Nickel-Cadmium (NiCd) and Nickel-Metal-Hydride (NiMH) batteries require an end-of-charge termination to prevent over charging while Lead-Acid (Pb-Acid) are charged to a float voltage. Some manufacturers of these rechargeable batteries recommend a multi-step recharge process. Multi-step charging may involve a rapid charge to a rapid charge voltage limit, then a reduction of the voltage limit to the float voltage level. Many charge algorithms exist and lately, every manufacturer seems to have a different charging algorithm for their batteries. The BC3/104 and PM104 combination is capable of multi-step charging and can be customized for any of the charge algorithms.

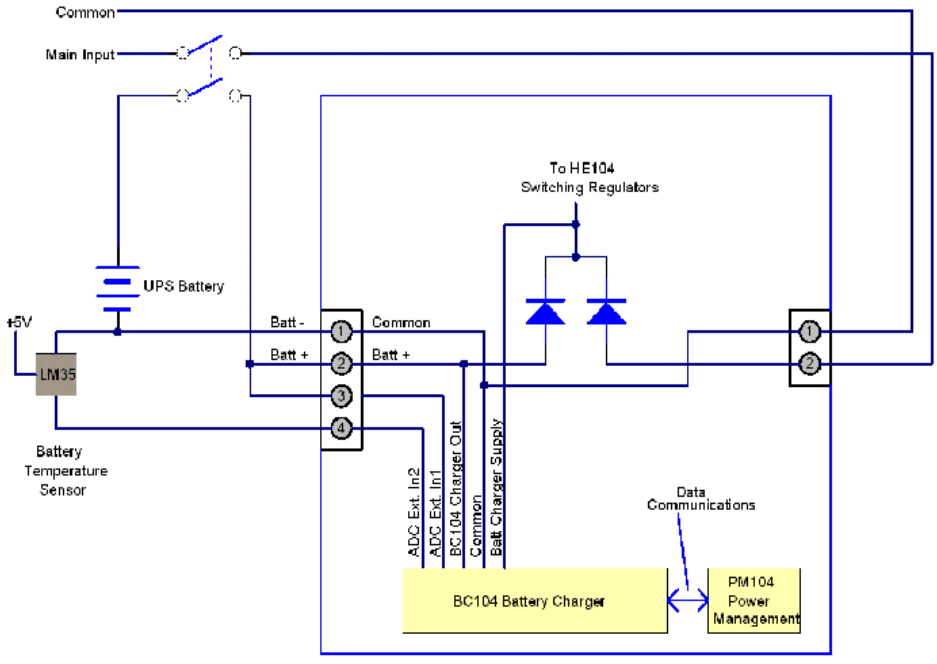


Figure 1 – Continuous Mode Operation

In some applications, the embedded application operates continuously, and is only shut down for maintenance. Figure 1 shows a typical connection with a maintenance switch for servicing. The HE104 in this case is used to maintain operation through power outages, either short term or for extended periods. A double pole, single throw (DPST) switch, used for service and maintenance, disconnects main power from the HE104, and isolates the battery. The LM35 temperature sensor can be powered from the HE104 +5V output.

Other applications require the HE104 to maintain operation during short - term power fluctuations, but shut down long or extended power outages. For example, during an aircraft engine start-up, power to the HE104 may be interrupted. This interruption may last 30 seconds or more. The size of hold-up capacitors would be prohibitive to maintain operation for 30 seconds, so a backup battery system is required. However, after the aircraft has landed, power to the HE104 is discontinued. Since this aircraft may remain out of operation for a week or more, the HE104 must be turned off, and the batteries isolated to prevent the batteries from being drained. Diagram 2 shows a +5V relay connected to the HE104 +5V output. In this arrangement, the PM104 would signal the PC/104 CPU via a PC/104 bus interrupt of backup battery operation and possible impending shutdown. After a set time, such as 30 seconds, the HE104 would turn off it's outputs, powered down the PC/104 system, and isolating the backup batteries via the relay.

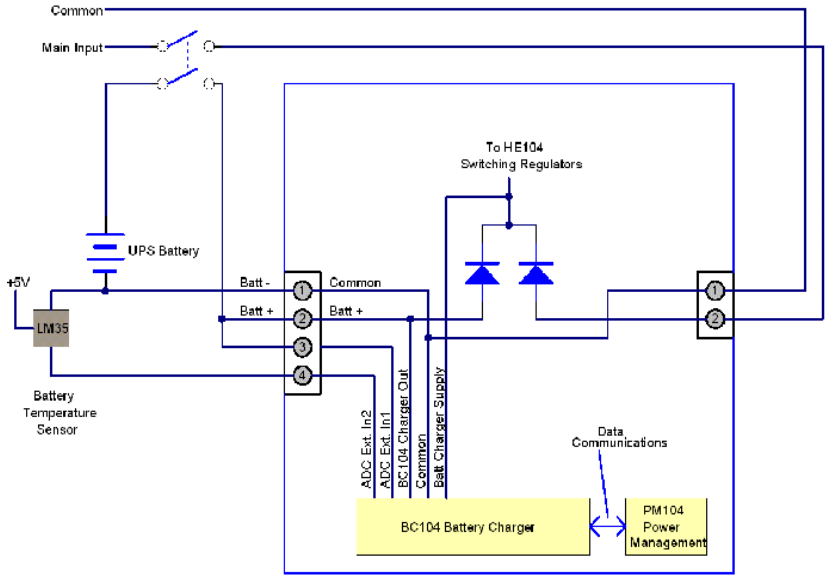


Figure 2 - Short Term Isolation with Relay Battery Isolation

Portable applications involves plugging the HE104 into main power in the "shop", then unplugging the system and taking it into the field for operation from a battery pack. The backup power configuration in Figure 3 has the battery isolation relay like Diagram 2, but has added a momentary push button for system start-up. Like the system in Diagram 2, the PM104 will power down the PC/104 system, and isolate the batteries after a power down timeout. To restart the PC/104 system operating on batteries only, the push button is pressed, and the HE104 outputs become active. The battery isolation relay is energized, and the push button can be released. The PM104 monitors the battery level, and when it

is below acceptable voltage, it signals the PC/104 CPU, and shuts down the PC/104 operation. A battery power data collection can extend its operation by having the PM104 power down the PC/104 system between data collection times. The PM104 can be programmed to remain off for minutes, hours or days, and then restart the PC/104 system.

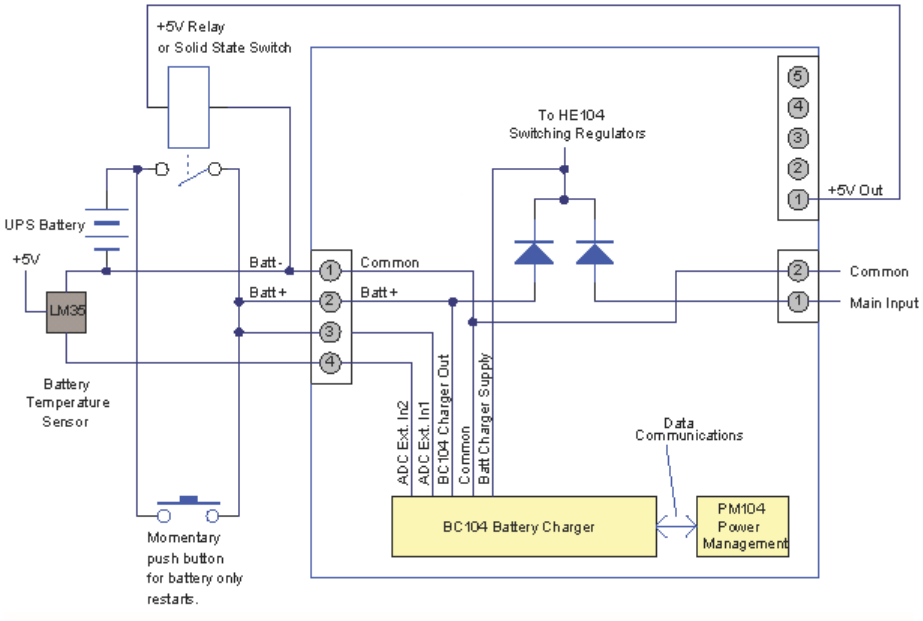


Figure 3 - Battery Operation for Portable Applications

CHAPTER 3: Selection and Sizing of Backup Batteries

In selecting a battery pack, several choices must be made, such as, battery chemistry, number of cells, capacity, battery pack physical shape and size. The backup capacity required is the battery load multiplied by the length of battery operation. For example, a 50-watt load for 15 minutes is 12.5 watt-hours. This is the actual energy the battery must deliver in the 15 minutes of backup operation. Battery capacities are rated over a longer period of operation than 15 minutes and the capacity must be derated. The amount of derating depends on the battery chemistry, load, and temperature, but derating of 50 percent or more can be expected for rapid battery discharging.

The battery chemistry is dictated by many factors, including environment, cost, weight, size, and type of backup service. Each application must be reviewed for it's own requirements, and no simple answers exist. Once the chemistry is chosen, the number of cells in the battery pack can be decided. Since the BC3/104 is a step-down switching regulator, the maximum battery pack charge voltage must be at least two volts less than the HE104 main input. A 12V battery pack may have a maximum charge voltage of 15 volts, and therefore the main input voltage of the HE104 must be 17 volts to fully charge the battery pack. The HE104 has a minimum input voltage of 6.6V when the BC3/104 is installed (due to the diode coupling of the battery and main input). Because of IR power drops in wiring and internal battery impedances, battery packs below 8.4 volts are not recommended.

The voltage delivered to the HE104 from a 9.6V battery pack (8 NiCd cells), allowing battery and wiring losses may be 8.5 volts, and another 0.6V is required for the input diode of the HE104 for a final 7.9 volts. The battery current would be 50 watts/7.9 volts or 6.3 amperes. The capacity required is 6.3 amperes * 1/4 hour * 2 (de-rating) or about 3.2 ampere-hour.

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