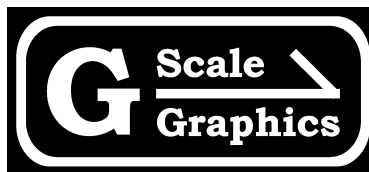
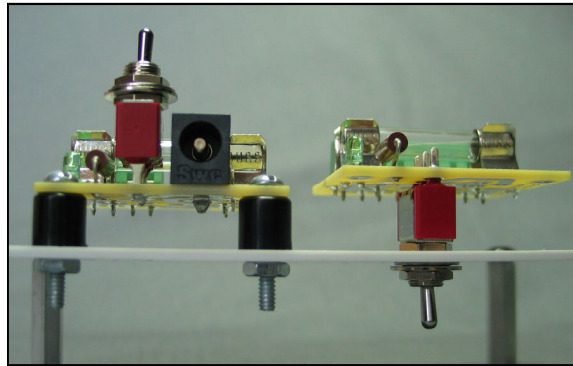


# **Battery Conversion Modules**

## **Door Mount & Floor Mount**

### **Operation and Installation Manual**



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## Overview

Battery Power Conversion modules (BCMs) simplify and reduces the amount of wiring required to convert a large scale locomotive from track power to battery power. Screw terminals provide easy termination for all of the wiring required; no soldering.

Protection against short circuits is provided via a built-in fast-acting standard size fuse (5 amps).

Power distribution to your motor controller, sound board, and other accessories is all controlled with one built-in switch and is easily done without having to splice wires.

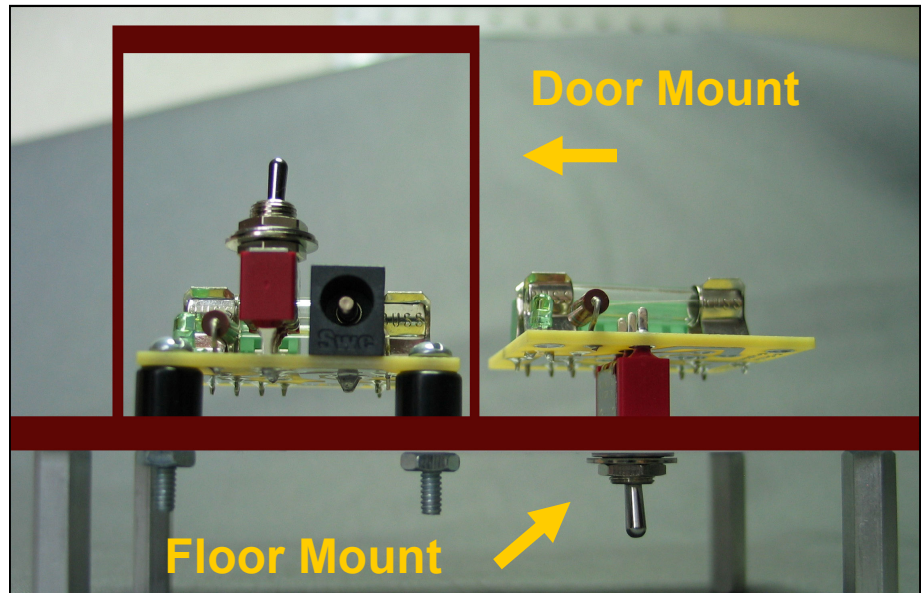
The BCM provides a great deal of flexibility for your specific application; local or remote battery charging schemes, local and/or remote battery power configurations, and several mounting options. It can be used in locomotives, tenders, or trailing cars.

Three models are available: The Door Mount BCM is ideal for trailing car applications, and the Floor Mount BCM is best for locomotive or tender applications. (More details below under Mounting). A Floor Mount without remote charging jack is available for those swapping out batteries, instead of charging in place.

## Mounting

**The Door Mount BCM** is designed for use in a trailing car, such as a box car, where you can open the door or roof for access to the BCM mounted charging jack, the power on/off switch, and the power LED. Mounting holes in the board can be used to securely mount the BCM to the floor of the car.

In the **Floor Mount BCM**, the power on/off switch extends through the floor for external access by the operator, while the circuit board and wiring terminals stay inside the car. A remote charging jack with a 3-wire cable is provided for mounting in the end beam of the car or location of your choice.



## Applications

Regardless of the battery technology or control that you choose, all battery conversions have some common requirements.

You need a power on/off switch. The BCM's switch and other components are designed to handle a continuous 5 amps, which is more than most locomotives require.

And since a shorted battery pack will instantly produce currents capable of melting wiring and plastic, you need a fuse that will protect things right now. (Resettable poly-switches can take up to a minute to trip.) The BCM uses a standard, readily available, 1 1/4" AGC fuse.

You will often need to connect that power source to more than one thing: a control board, a sound board, and some lighting circuits. This usually requires a lot of point-to-point wiring, wire splicing, and soldering. The BCM provides up to four 22 ga. outputs from screw terminals (2 wires per terminal).

Of course you will need to recharge the battery. If your battery is easily accessible, you may choose to remove it for charging and just replace in with a freshly charged battery. However, in many installations, battery removal is difficult, so a charging jack is installed in the loco. This requires more wiring and soldering. The BCM can help with that also, using either the on-board local charging jack of the door mount version or a pre-wired remote mounted charging jack with the floor mount version.

Some folks with limited space in the locomotive install the controls and a small battery set in the loco, and then connect to a larger capacity battery set in a trailing car for extended run times. This still allows the loco to run independently for short term switching operations without the need for the trailing car. The remote jack terminals of the Floor Mount BCM can be connected to support this type of operation.

The BCM printed circuit board does all the hard wiring for you. Power on/off switch, charging jack, fuse, and power distribution wiring is all done for you. You just connect the battery to the input, and your circuits that need switched power to the outputs.

## Installation

### Track Power to Battery Power Conversion

Most track powered locomotives are very simple, electrically. Track power is picked up from the rails via pickups and usually connected directly to the motor. Sometimes there are switches in the circuit to reverse polarity or turn off track power. These connections need to be modified in order to properly connect the battery powered driver board. Having a complete understanding of the existing wiring will help. Try to locate wiring diagrams and/or trace out wiring and make your own before making any changes. In some cases it may be easier to just strip out all existing circuit boards and wiring and start over from scratch.

Converting to battery power consists of these basic steps.

#### **1. Determine battery voltage requirements.**

Before you disturb any wiring, run your locomotive at the fastest speed you like to run on your layout and measure the track voltage. Add at least one volt to this measurement to account for worst case loss in the driver. Round this value up to the nearest 1.2v increment, and you have the number of cells you need.

For example: Track voltage measures 12.6V at speed.  $(12.6 + 1) / 1.2 = 11.3$ . You will need at least 12 cells.  $12 \times 1.2V = 14.4V$ . (14.4V is a popular value for steam locomotives. Many critters can run on 12V. Diesels usually require 18V or more).

#### **2. Disconnect the track power pickups.**

By isolating your locomotive from track power, you can run more than one locomotive on the same track at the same time, either battery powered or track powered. If you don't do this, your battery will be directly connected to your track power supply, resulting in damage. Note that in doing this, you have also removed power from all lighting circuits, smoke units, and any other accessories that were running from track power. For battery power, smoke units are usually not used due to the high current requirements that will quickly drain the battery pack. Lights, depending on current requirements can be powered from the battery for constant lighting. Understanding existing wiring and/or circuit boards without documentation can be difficult. You may choose to just remove it all and wire directly to things you can see and understand.

#### **3. Find a direct connection to the motor.**

The output of the controller needs to be connected directly to the motor. All other control boards and switches should be removed from the circuit. Depending on the design of the locomotive, this may be an extremely simple process, or it may be difficult. Some motor blocks make it very simple. You will find two pairs of wires. One set goes to the track pickups, and the other goes to the motor. You can verify which pair goes to the track pickups using a continuity checker or ohmmeter. Track pickups will have continuity from one pin to one set of wheels. The motor will read a small resistance value across the two wires (e.g. 18 ohms). Simply disconnect the track pickup pair and connect the motor pair to the controller.

#### **4. Install the discrete components and wire them together (battery pack, BCM, remote charging jack, controller, and lights)**

Installing the new components is a packaging exercise. Where will it all fit? Space for the battery pack and control board is usually the biggest consideration. And, where to locate the switches so they are accessible? The BCM greatly simplifies this step!

## Wiring

Always use stranded wire and tin the ends with solder prior to making any connections (including those to screw terminals). Any wiring connections or splices not directly connected to a component must be covered using heat shrink tubing or wire nuts.

Battery - Regardless of where you charge your battery, in the loco or out, you should have a polarized connector on the battery leads to facilitate easy removal and to prevent you from connecting it with reverse polarity. Heavy gauge wire is preferable (18 or 20 ga.), but for short runs (less than 18"), 22 ga. is fine. Many battery packs come with very large heavy duty connectors on them for use with R/C cars, which draw a lot of current. Our trains only draw about 1 amp under normal conditions, so any connector rated for 5 amps is suitable. Ideally, this connector should also mate up with the connector used on your battery charger.

## Skills

All connections to the BCM can be made via screw terminals. However, basic wiring and soldering skills may be required to make proper connections to the battery or lighting circuits. Some drilling and minor fabrication or modifications to the unit under conversion may also be required.

## Tools & Materials

A low wattage soldering iron, side cutters, needle-nose pliers, wire strippers, a 5/64" slotted screwdriver, resin core solder, 22 or 20 Ga. Wire, and heat shrink tubing are recommended to properly complete the wiring. A suitable drill may be useful for mounting the circuit board.

## Installation of the BCM Board

The Battery Conversion Module Floor Mount circuit board is designed for mounting the power on/off switch through a 1/4" hole in the floor or bulkhead. The lock nut on the power on/off switch will secure the board to the mounting surface. The remote charging jack mounts in a 5/16" hole at a location of your choice.

The Door Mount BCM has mounting holes that accept #4-40 hardware (drill 1/8" holes). It can be mounted directly to a plastic floor or elevated slightly using spacers or stand-offs.

Allow space for access to wiring, and no metal should be in contact with the board.

Refer to the wiring diagrams at the end of this manual.

## Power Input (BAT)

When making wiring connections to the battery pack, use extreme caution to avoid shorting the leads together. Do not connect the battery to the circuit until all other wiring has been completed. The battery pack should have a quick disconnect connector for safety and ease of replacement. It should also be polarized to avoid applying reverse polarity which may damage circuits.

## Fuse

The fuse provides short circuit protection on the output circuits when the power on/off switch is ON. It will also protect the charging circuit while using the on-board or remote charging jacks. However, **when the remote jack is connected as an Aux Battery jack, the fuse is NOT in the circuit.** You should provide a fuse in the Aux Battery circuit.

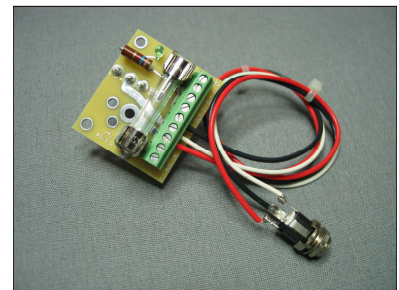
## Power Outputs (OUT1,OUT2)

Each output can be used to power 1 device using 20 ga. wire or, 2 devices using 22 ga. wire. Observe polarity when making connections.

## Remote Jack Connections (Terminals R,W,B)

For use as a Remote Charging Jack, connect the Red wire to terminal R, White wire to terminal W, and Black wire to terminal B. Drill a 5/16" hole for mounting the jack.

For use as an Aux Battery Jack to a trailing car, the wires at B and W must be reversed: Connect the Red wire to terminal R, White wire to terminal **B**, and Black wire to terminal **W**. With this configuration, you cannot charge the local battery using this jack. However, you can install a second jack for that purpose, using the wiring diagram at the end of this manual.



**Floor mount BCM with Remote Charging Jack**

**Note: If you won't be using the remote charging jack with your Floor Mount BCM, you must jumper across terminals W and B with a 20 gauge wire for proper operation.**

### **Charging Jack**

Battery charger connections to either the on-board or remote charging jacks must use the center connection as positive and the sleeve as negative. The mating plug for this jack is a 2.5mm ID DC power plug.

## **Operation**

Turning the power on/off switch to ON, applies power to both OUT 1 and OUT 2 terminals and the green power LED will be on. Note: If you are not using a remote charging/battery jack with the floor mount version, terminal W must be jumpered to terminal B.

To charge the battery connected to BAT IN, using the charging jack, plug in an appropriate battery charger. The output circuits are isolated from the battery when the charger is plugged in, so the power switch can be either ON or OFF, but it is good practice to have it off when charging. The LED will be off during charging.

To use the remote jack as an auxiliary battery input, plug in the battery. (Note: the jack must be wired Switch to terminal B, Sleeve to terminal W.) The battery connected to BAT IN will be isolated and the aux battery will now provide power to OUT1 and OUT2 via the power on/off switch.

## **Battery Conversion Module Specifications BCM2 Board Revision "New"**

### **Mechanical**

Physical Size: Door Mount – 1.3" X 1.5" X 0.6" (power on/off switch protrudes an additional 0.5")  
Floor Mount – 1.3" X 1.5" X 0.6" (Board sits 1.0" above floor)

Weight: 0.6oz.

User Connections: Screw clamp terminal strips accept individual wires, 22 to 18 AWG.  
(22 or 20 AWG recommended)  
Requires a 5/64" slotted screwdriver

Mounting holes: 1/8" for #4-40 screws.  
1/4" for floor mount on/off switch  
5/16" for remote charging jack

### **Electrical**

Power Input from battery pack (Terminals BAT IN +, BAT IN -)  
5 amps max  
30.0 volts DC max (20 1.2V NiCad/NiMh cells,  
or 7 3.7V Lithium-Ion cells)

Power Outputs (Terminals OUT 1 +/-, OUT 2 +/-)  
Power is connected when switch is in the ON position.  
One 20 ga. wire per terminal, or two 22 ga. wires per terminal.

Charging Jack - 5 amps max

Remote Charging / Aux battery input (Terminals R,W,B) - 5 amps max (drill 5/16" hole)

Plugging into either jack isolates the output circuits from the batteries and charger.

Fuse - 5 amps: 1 1/4" AGC-5

Jumper across terminals W and B  
(required when not using a remote jack) - 20 ga.wire

### **BCM Accessories (sold separately)**

Remote Charging Jack with cable (3 wires)

Charging Plug: 2.5mm with cable (2 wires)

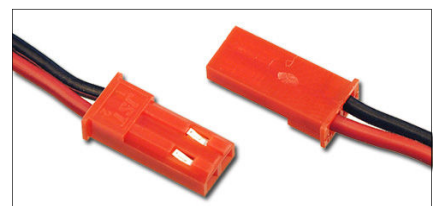
Battery Connectors: BEC/JST male/female pair, 22 ga., 5A



**2.5mm plug and jack**



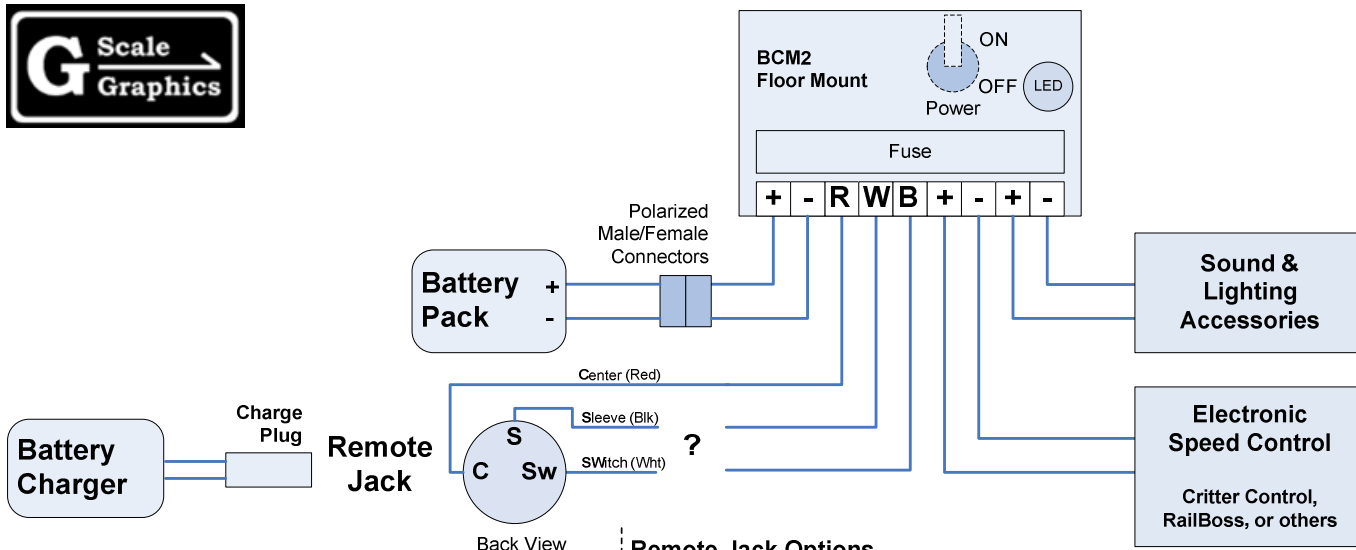
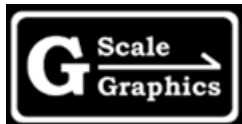
**Remote Charging Jack**



**BEC/JST male/female connector pair with 6" leads**

# Battery Conversion Module

## Floor Mount - Wiring Diagram



**Remote Jack Options**

Remote Charging Jack -  
Connect White wire to W terminal (4), Black wire to B terminal (5).

Without Remote Charging Jack -  
Connect a 20 ga. Wire across terminals W and B.

For use as a Remote Battery Input -  
Connect Black wire to W terminal (4), White wire to B terminal (5).

**Functions**

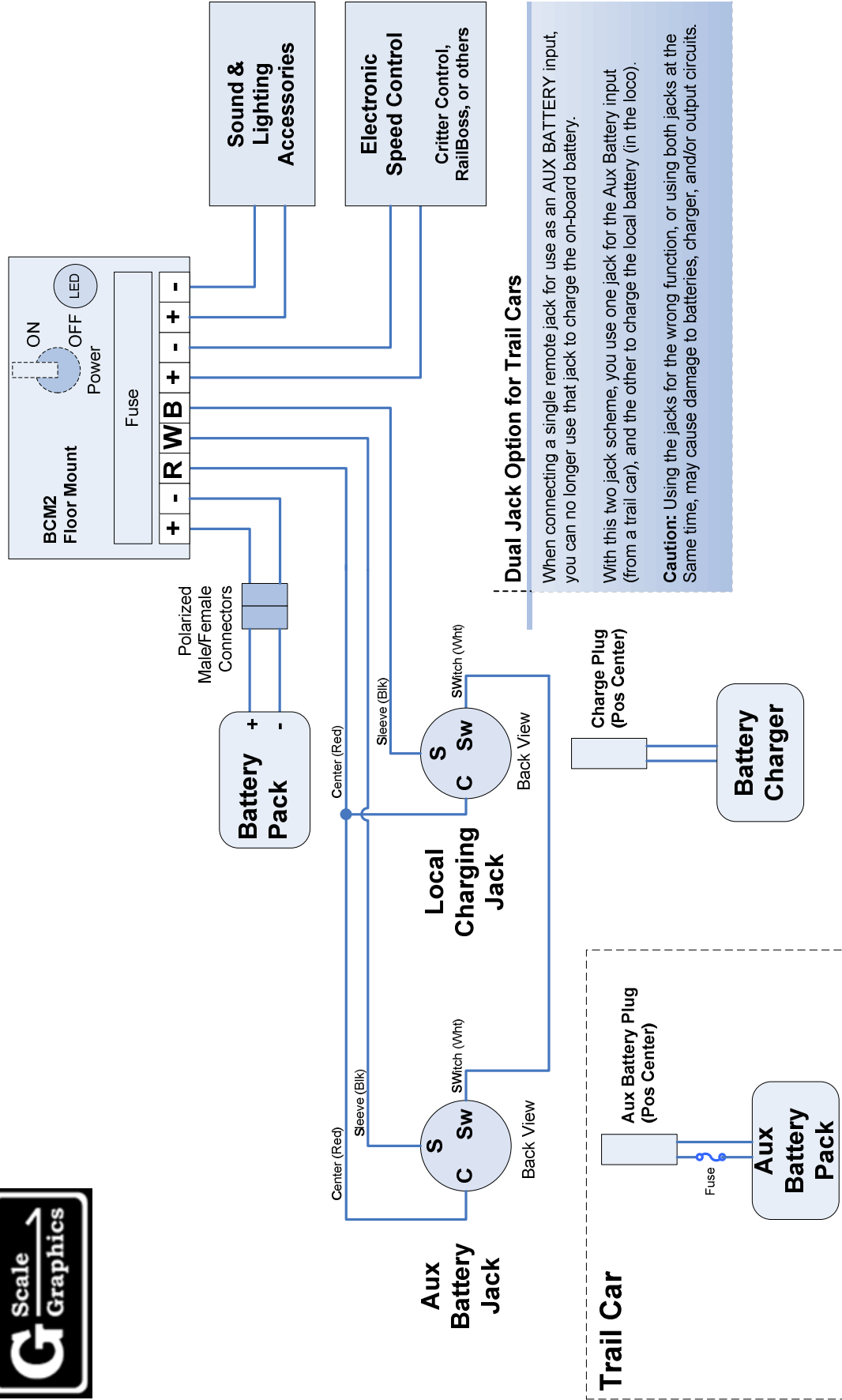
Power Control & Distribution – On/Off switch with up to four 22 ga. fast-acting fuse protected power outputs.  
 Remote Battery Charging via jack mounted in location of your choice.  
 Local/Remote Battery location – Remote jack can be used to connect batteries in a trailing car for extended run times.  
 Floor mounting - Mount with on/off switch extended through the floor or bulkhead.



**Floor Mount BCM with Remote Charging Jack**

# Battery Conversion Module

Floor Mount – Dual Battery/Jack - Wiring Diagram



## Dual Jack Option for Trail Cars

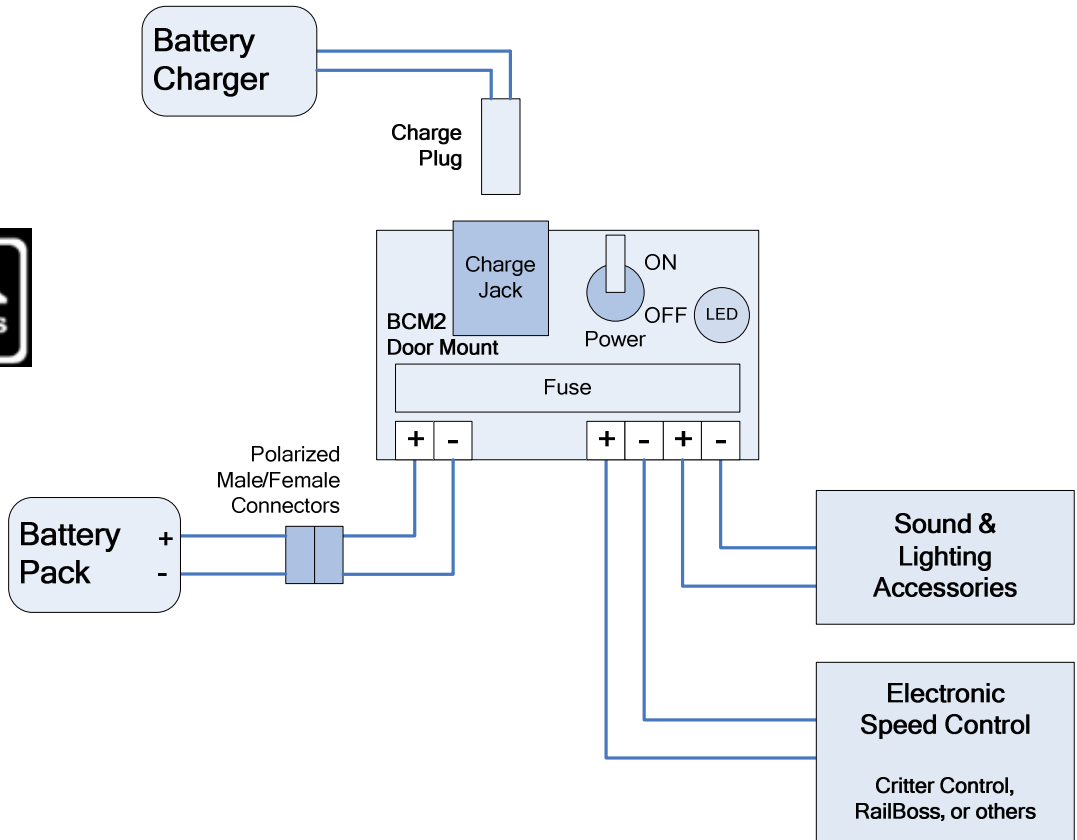
When connecting a single remote jack for use as an AUX BATTERY input, you can no longer use that jack to charge the on-board battery.

With this two jack scheme, you use one jack for the Aux Battery input (from a trail car), and the other to charge the local battery (in the loco).

**Caution:** Using the jacks for the wrong function, or using both jacks at the same time, may cause damage to batteries, charger, and/or output circuits.

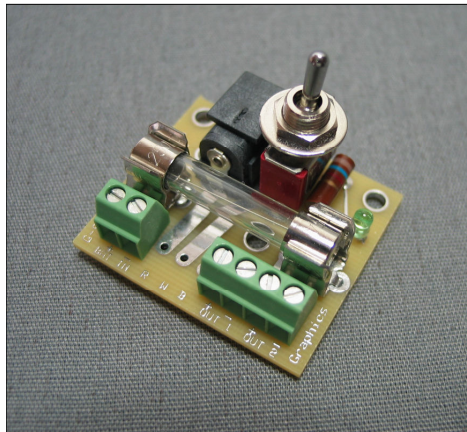
# Battery Conversion Module

## Door Mount - Wiring Diagram



### Functions

Power Control & Distribution - On/Off switch with up to four 22 ga. fast-acting fuse protected power outputs.  
Door mounting - On/Off switch, charging jack, and power LED are all accessible through doorway or via removable roof.



**Door Mount BCM**