

either AC or DC. **CAUTION:** Many power packs produced by MRC and CMI have accessory terminal voltages that exceed the 18 volt maximum of the **BD-2**. Be sure to measure the voltage with a voltmeter **BEFORE** you connect the circuits to be sure that your source is within specs. **ALSO**, you cannot use the accessory terminals of a power pack that is already powering your trains.

Since you will likely be installing a number of **BD-2s**, we recommend that you set up a dedicated 12 volt DC power source for these circuits. You can use a commercial power supply such as an AC to DC wall plug converter (12 volts / 500 ma. output - CIRCUITRON Part No. 800-7212), or you can construct your own using components from Radio Shack (refer to Fig. 3 for suggested power supply designs). Each **BD-2** will need 16 - 20 ma. when it is detecting, less when it is not. Therefore, you can power up to 25 **BD-2s** from a 500 ma. power supply. If you will be using the same source for your signal lamps, you will need to add their currents in as well. You will also likely need to provide a Bias Voltage Supply.

BIAS VOLTAGE SUPPLY

On most layouts, the cab (throttle) selector switches are capable of removing power from a block entirely, allowing you to park a train in a section of track while you power others. Without track power, the **BD-2** will be unable to detect the train in the 'Off' block. By providing a separate AC power source feeding the power rail through a resistor, detection will be maintained. The resistor provides only a minute amount of current, not enough to light lamps or even warm a motor, but plenty for the **BD-2**. 2 methods of providing this AC bias voltage are shown in Fig. 3.

CAUTION: If you do not know how to properly wire 110 volt circuits, find someone who does to help you.

COMMAND CONTROL WIRING

The **BD-2** can be used with command control systems and is wired in a similar fashion to conventional track wiring. With command control, you are less likely to encounter as many power blocks, and because the command control power station provides constant output to the track, you do not need to be concerned about the Bias Voltage Supply. Refer to Fig. 4 for a typical command control hookup. **CAUTION:** The **BD-2** cannot be used for command control systems with multiple power stations unless separate, independent power supplies are used for all **BD-2s** connected to each power station. In addition, opto-isolators will need to be used for all connections bridging between power stations. The nature of these connections is beyond the scope of this instruction manual.

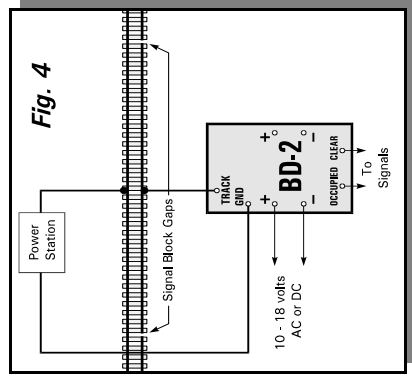


Fig. 4

INTERLOCKING

The **BD-2** can be interlocked to turnouts or computer controls, if desired. A ground connection on the [INT] terminal will 'force' the **BD-2** into an occupied indication. This action will override any detection information. This ground can be provided by contact closure on a switch machine or from the output(s) of computer or other electronic logic.

WARRANTY

CIRCUITRON warrants this device against defects in materials and workmanship for a period of one year from the date of purchase. This warranty covers all defects incurred in normal use of the device and does not apply in the following cases:

- damage to the device resulting from abuse, mishandling, accident or failure to follow operating instructions.
- if the device has been serviced or modified by other than the **CIRCUITRON** factory.

EXCEPT AS MENTIONED ABOVE, NO OTHER WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED INCLUDING MERCHANTABILITY, ON THE PART OF THE UNDERSIGNED OR ANY OTHER PERSON, FIRM OR CORPORATION, APPLIES TO THIS DEVICE.

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BD-2, BD-2HD
BLOCK OCCUPANCY DETECTORS

PLEASE READ THIS ENTIRE MANUAL BEFORE STARTING THE HOOKUP

The **BD-2** and **BD-2HD** are current sensing train detector circuits that can be used to provide 2 color (Red/Green) signal outputs for an isolated block of track. The **BD-2** and **BD-2HD** can be used with common rail wired AC or DC track power and will work with most Command Control systems (See **COMMAND CONTROL**). These circuits utilize state of the art integrated circuit design for high sensitivity and reliability. The **BD-2** works by detecting the current drawn by a locomotive or lighted piece of rolling stock. Detection can be extended to un-powered equipment by using metal wheelsets with resistors connected across the insulator. An adjustment control is provided to set the sensitivity of the circuit and can be used to compensate for damp conditions, outdoor use, etc. The **BD-2** and **BD-2HD** can be powered by any 10 - 18 volt AC or DC power source, however, this source *must* be different than the track power (you cannot use the accessory terminals of a power pack that is already powering the trains). Track power is routed through the **BD-2** or **BD-2HD** circuit board. The **BD-2** has a maximum track current capacity of 3 amps, the **BD-2HD** capacity is 6 amps. Both circuits can drive LED or incandescent lamp type signals directly. Maximum output current is 250 ma. on each output for the **BD-2**, 500 ma. for the **BD-2HD**. The **BD-2** will work well for HO-Scale and smaller, the **BD-2HD** should be used for S Scale and larger.

CIRCUIT BOARD MOUNTING & WIRING

A section of CIRCUITRON'S PCMT can be used for simple, snap-in mounting of the circuit board(s) or you may drill holes in the mounting pads in the corners of the board and mount the **BD-2** with screws and standoffs. Multiple circuit boards should be mounted side by side for easy power supply bussing between boards. The **BD-2** can be connected with .110" solderless connectors (available from CIRCUITRON) or by soldering leads directly to the terminals on the printed circuit board. If soldering, use a small pencil-type iron and electronics-grade rosin core 60/40 solder (available from Radio Shack). Use only as much heat as necessary to obtain a good joint and do not wiggle the terminal until the solder has cooled completely.

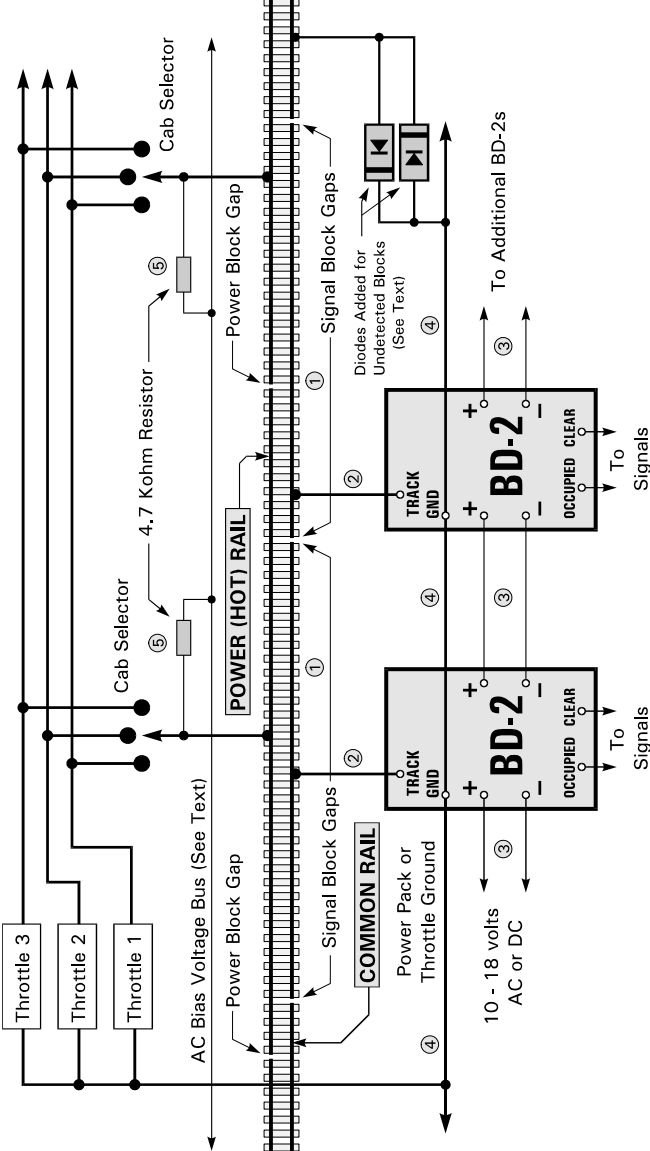
WIRING - CONVENTIONAL TRACK POWER SYSTEMS

Please refer to Fig. 1 and note that the **BD-2** connects between an isolated section of the common rail (the rail to which the throttle grounds are normally connected) and ground. The gaps isolating this rail section determine the length of the signaling block and do not need to correspond to the power blocks on the other rail. Your power pack(s) or cab(s) connect to the power rail through selector switches as shown. The other connection from each of your power packs or cabs are connected together and *must* connect to the ground connection [GND] on the **BD-2**. *Note: The number of signaling blocks does not need to equal the number of power blocks.* See the **BIAS VOLTAGE** section for additional information.

- 1) Cut gaps in the common rail at each end of your desired signaling block. Use a plastic filler with ACC or insulated rail joiners to ensure that the joints can't shift or close up. Make certain that all feeder wires to the section are isolated and unconnected.
- 2) Connect a wire from the isolated rail feed wires to the [TRACK] terminal on the circuit board. This wire will carry the full track current so use 18 - 20 gauge wire for the **BD-2** and 16 gauge for the **BD-2HD**.
- 3) Connect a 10 - 18 volt AC or DC power source to the terminals marked [+] and [-] using light gauge wire (22-24 ga). If you are using a DC source, check the polarity before connecting. *Note: Do not use the accessory terminals of a power pack that is powering trains. Your BD-2 power supply must be separate from any track power supply. Use of a dedicated, filtered 12 volt DC supply is recommended for greatest reliability. See the POWER SUPPLY section.*
- 4) Connect a wire from the [GND] terminal to the common side of your power pack(s) or throttle(s). Use the same gauge wire as in step 2.

- 5) If you wish to maintain detection in the signaling block even when the track power is turned off, connect an AC bias voltage through a 4.7K resistor (supplied) to the track power feed(s) for the rail opposite the detection block. All power block feeds will have to be connected to the bias voltage through separate 4.7K resistors. See the **BIAS VOLTAGE** section for more information. 22-24 gauge wire is fine.
- 6) Connect your signals as shown in Fig. 2 following the instructions in the next section.

Fig. 1 Track and Power Supply Wiring



CONNECTING BLOCK SIGNALS

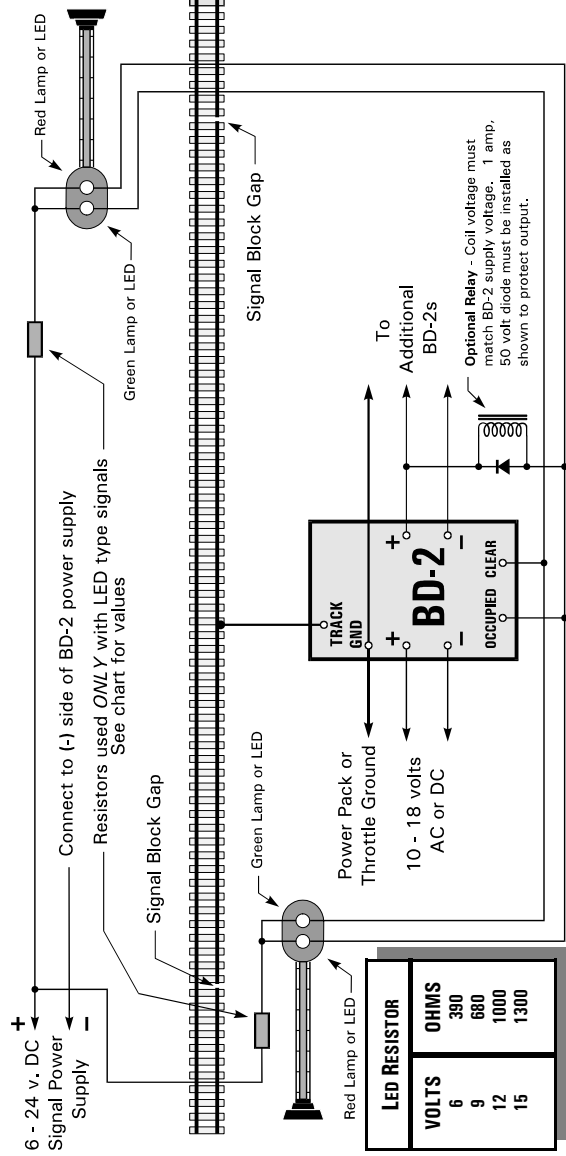
The **BD-2** will drive just about all 2-color Incandescent Lamp or LED style block signals. LED signals must be wired "common anode" (the positive connections to the LEDs are connected together as a common and the negative connections are brought out as separate lead wires). If you are unsure of your signal's design, consult the manufacturer. Compatible signals are made by Oregon Rail Supply, Tomar, Sunrise Enterprises and others. The output current capacity of the **BD-2** is 250 ma. per output. The **BD-2HD** can control 500 ma. per output.

Wire your signals as shown in Fig. 2 which shows a typical installation for one block of bi-directional traffic. **WARNING:** You must include a proper value current limiting resistor in the common lead of LED-type signals. Failure to do so will likely destroy both your signal and the **BD-2** and will void your warranty. Refer to Fig. 2 for suggested resistor values or follow the signal manufacturer's recommendations. It is not necessary to utilize both signals if your train traffic is mostly single-direction. If you wish to have 3-color signals, you will need an **SD-1** or **SD-3** Signal Driver for each signal head. You will also need to install at least 3 blocks of detection to achieve the proper 3-color output from the signal driver circuits.

If you want to control heavy currents (such as for automatic train control) with the **BD-2**, you will need to wire a relay to the **[OCCUPIED]** output terminal as shown in Fig. 2. You must include the 1 amp diode wired across the relay coil to protect the output transistor.

NOTE: The signal power supply may be the same as the **BD-2** power supply if desired.

Fig. 2 Signal Wiring



ADJUSTMENTS

In order to provide detection, the **BD-2** monitors the current flowing between the rails through any motor, lamp, resistor or any other current-drawing device connected to the track. Although the **BD-2** will reliably detect as little as 50,000 ohms across the rails, it is generally better to adjust the **SENSITIVITY** control so the circuit will detect only 10,000 ohms or less.

A 10,000 ohm resistor (Brown, Black, Orange, Gold) is supplied for testing and adjustment of the **BD-2**. With power applied, connect the resistor across the rails with a pair of clip leads. Adjust the **SENSITIVITY** control until the indicator LED **L1** is off. Then rotate the control until **L1** just turns on. That's it!

NOTE: Damp scenery and ballast will affect the resistance across the rails and may cause **L1** to come on. You may need to readjust after applying ballast, etc., or wait until everything is totally dry.

DETECTING UNPOWERED ROLLING STOCK

Unpowered equipment will need to be fitted with metal wheelsets equipped with resistors. A number of articles have been written about this procedure. One excellent one is in the Feb. 1993 issue of Model Railroader. We recommend a resistance of 4700 ohms per axle (a 1/8th watt resistor is sufficient), although the **BD-2** will operate properly with a wide range of values. To detect every car in the train, at least one axle per car will need to be modified. If you do not split your trains up much during operation, it may be sufficient to just equip the final car or cabooses. Send \$1.00 and request Application Note AN5502-01 for more information.

UNDETECTED BLOCKS

If you will be setting up any track blocks for which you will not need detection, you will have to add a pair of diodes (available from Circuitron) wired in reverse parallel as shown in Fig. 1. Use 3 amp diodes (1N5400 - Circuitron Part No. 800-9350-12) for HO and smaller and 6 amp diodes (Part No. 800-9352-12) for S Scale and larger. Without the diodes, your trains will noticeably speed up in the undetected blocks.

POWER SUPPLY

The **BD-2** will operate off a very wide range of input voltages (10-18 volts), and the supply voltage may be

TYPICAL RESISTANCE IN OHMS	
LOCOMOTIVE.....	1 - 30
12 VOLT HEADLIGHT	15 - 40
INTERIOR CAR LIGHTING.....	10 - 60
LED MARKER LIGHT.....	300-1000
RESISTANCE WHEELSET.....	5,000 -20,000