



# CKT-BD1 User Manual

## Features

- Reliable and simple-to-install DCC occupancy detection
- Extremely sensitive (12-15k ohms) isolated DCC block detector
- Simple sensitivity adjustment
- Detecting and Not Detecting open collector outputs
- Optional pull-up resistors for both outputs
- Isolated detection to prevent coupling track power and signal systems
- Mounting holes for screw-mounting the detector board
- Can operate from 5V power for logic-level circuits
- Optional C/MRI DCCOD-compatible connector – plugs right in to C/MRI detector motherboards!

## Installation for Standard Version

The CKT-BD1 requires 5-18V DC power to operate. The device draws less than 15 milliamps when operating, so only a very small supply is needed. Do not apply more than 18V or the device may be damaged.

For the block that you wish to have detected, at least one rail must be isolated at the ends of the block. The feeders for this isolated rail should then be combined and run through the hole in the current transformer on the CKT-BD1. The current transformer can accommodate up to 12 AWG wire, so even large bus wires should fit.

While you can make multiple turns through the current transformer, it's not recommended. The design is sensitive enough that a single pass should work in almost all applications.

Two outputs are provided, both of which are “open drain” (also known as “open collector”). This means that they act like a switch to the ground / negative lead. When an output is “active”, it will conduct current to ground. When an output is “inactive”, it will act like an open circuit and not pass current at all. Each output line can handle a maximum of 0.25 amps, and should be exposed to no more than a 40VDC supply. The D (for Detect) output is active when the sensor is detecting an object. The /D output is active when the sensor is not detecting an object.



*DO NOT exceed 40VDC or 250mA through either the Detect or /Detect outputs. The output transistors will be damaged*

Optionally, a ¼-watt resistor can be installed in R8 and/or R9 to “pull up” the D (R8) and /D (R9) outputs. The resistor will pull them to the input voltage applied to +V input. Because the CKT-BD1 can be powered by 5V directly, this provides a convenient method to achieve true 5V logic level outputs for connecting to computer interfaces, Arduinos, etc. Recommended values for the resistors are 4.7k-ohms and greater, as too much current will waste power.

## Installation for C/MRI-Compatible Version

Just plug the CKT-BD1 into your Optimized Detector motherboard socket and follow the Sensitivity Adjustment procedure – it's really that simple!

### Sensitivity Adjustment

Contrary to popular belief, an empty track block does not always draw zero current. Because of resistive leakage through scenery (including wooden ties in varying humidity) and capacitive effects between the rails and feeder wires, there's often a very small leakage current. Thus, a sensitivity adjustment is provided to allow you to calibrate this out, minimizing false detection while keeping the very highest levels of sensitivity.

Once the board is installed, apply DCC power to the track bus inputs with absolutely nothing on the track. If the “DETECT” red LED comes on solid, turn the sensitivity adjustment potentiometer counter-clockwise with a small flathead screwdriver slowly until the light turns off.

If the “DETECT” red LED is off, turn the potentiometer slowly clockwise until the light comes on, then back it off until the light turns off.

Test the sensitivity by placing a locomotive or a piece of resistor-equipped rolling stock across the rails. The DETECT light should come on when the equipment is on the track, and turn off after a short delay when the equipment is removed.

If the detector trips without equipment, continue making slight counter-clockwise adjustments until the module no longer detects phantom equipment. Sometimes humidity, changes in track voltage, twisting of wires, etc. can change the amount of quiescent current being drawn and trigger the detector. The detector is adequately sensitive that it can be desensitized quite a bit before it's unable to detect resistor-equipped cars.

LED Color	If Solid...	If Blinking...	If Off...
● Red (OCC)	Track occupancy detected	Detection is intermittent	Occupancy not detected
● Green (PWR)	The detector is operating normally	Power is intermittent	No power applied to +V and GND terminals

## Open Design

Iowa Scaled Engineering is committed to creating open designs that users are free to build, modify, adapt, improve, and share with others.

### Hardware

The design of the CKT-BD1 hardware is open source hardware, and is made available under the terms of the Creative Commons Attribution-Share Alike v3.0 license, a copy of which is available from:

<http://creativecommons.org/licenses/by-sa/3.0/>

Design files can be found on the Iowa Scaled Engineering's Github site:

<https://github.com/IowaScaledEngineering/mss-crossover>

### Firmware

The official Iowa Scaled Engineering firmware for the CKT-BD1 is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version. A copy of the GNU GPL can be found at: <http://www.gnu.org/licenses/gpl.html>

New firmware can be flashed into the CKT-BD1 through J4. The six contacts are designed to mate with a Tag Connect TC2030-IDC-NL pogo-pin programming tail plugged into a standard AVR 6-pin ISCP programmer.



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