Lowering AC Sensitivity on an Occupancy Detector

The Quad Occupancy Detector by Circuits4Tracks is designed to be sensitive enough to detect a minimum amount of current drawn by a resistive load of about 10 kΩ on a typical DCC system providing an AC voltage of about 15 to 17 volts. DC layouts may need a lower resistive load unless an AC bias is provided (see our article *Detecting Non-moving or Non-powered Trains with DC*).

Alternating currents can create a detectable current due to other effects. When pure direct current is used on a layout, alternating currents are rarely a concern. However, with DCC or with pulse-width-modulated (PWM) DC, alternating currents can result in some false detections.

The capacitance of wiring and track has no effect on direct current as far as creating a load current, but when current starts and stops or alternates in direction, capacitance provides a path for current to flow. A capacitive load has a property called reactance, that is similar to resistance but only applies to alternating currents and it decreases as frequency increases. If low enough, the reactance can result in a load current that is detectable.

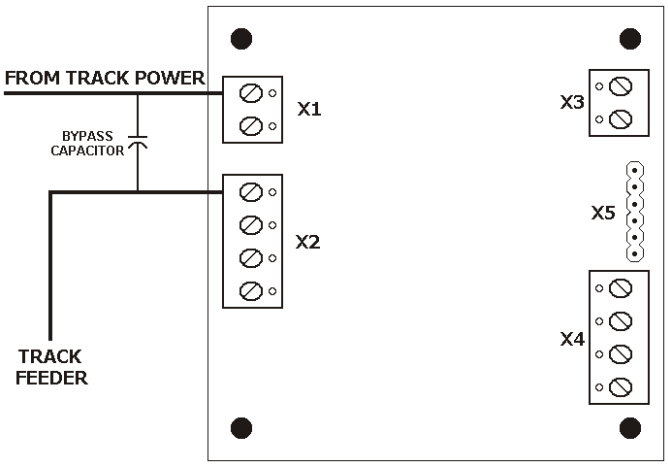
The frequencies needed to transfer digital information on a DCC system are high enough to make capacitance currents significant for longer blocks or places where the wiring between the detector and the track are long. Keeping feeders as short as possible and blocks as short as possible can be helpful, but there are limits as to how short they may be for a given situation on a layout.

Another factor affecting capacitance is the distance between conductors. Since the Quad Occupancy Detector only needs to be inline with one rail, it is likely that the detected feeder and the other feeder (the common feeder, when using common rail wiring) are separated well enough to keep the capacitive effect as low as possible. The spacing between the rails on the track will also be fixed for a given scale.

Even if there appears to be no AC sensitivity, it is possible that the situation may be on the edge of being too sensitive. That can lead to days where false detections are common and days when they are not, as slight temperature or humidity changes can make a difference. To determine if this is the case, simply touch one finger to only one rail when the layout is powered up. If touching one rail is detected, the sensitivity is too high, and if not then it is fine.

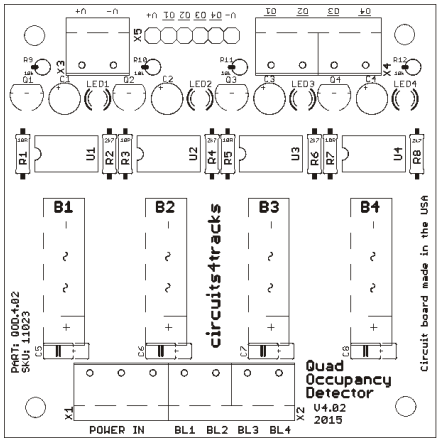
The bottom line is that there are situations where physical characteristics can lead to a detector indicating that a block is occupied when it is not, and this is due to small capacitive currents that will exist. In such situations, it will be necessary to desensitize the detector for alternating currents.

The solution to this is to provide a way to have capacitive currents bypass the detector, leaving the more substantial load currents that are meant to be detected to pass through the detector as required. The diagram to the right shows one bypass capacitor added for the track feeder connected to the first detector on the card. If similar desensitizing is necessary for other blocks, they will each require their own capacitor connected between the track power bus and the feeder to the block.



The actual value needed will depend on how much desensitizing is necessary. A good starting place would be to use a 10 nF (0.01 µF) capacitor that should have a voltage rating close to double the RMS voltage of the track power (35 volts would be a good choice). If the detector sensitivity is still too high, move up to 100 nF (0.1 µF).

Quad Occupancy Detector Version 4.02



Beginning with version 4.02 of the Quad Occupancy Detector, the circuit board has a set of pads for each detector for installing the bypass capacitor should it be needed.

Each is located between its corresponding bridge rectifier and the terminal blocks for track power. There are three holes for each capacitor in order to allow the use of a variety of sizes. When viewing the board with the bridge rectifier above the terminal blocks, the left-most hole for each capacitor is always used for one terminal of the capacitor. Either of the two holes on the right may be used, depending on the size of the capacitor.