

# Grade Crossing Controller

The Grade Crossing Controller (GCC) takes track occupancy information and performs the logic required to activate grade crossing signals and devices.

The device requires three track occupancy detectors to provide active-low inputs for a single track and, optionally, can have a second set of three occupancy detectors for a second track. A three-detector version of the Quad Occupancy Detector from Circuits4Tracks is ideally suited to this application.

## Electrical Specifications

Power input requirements	8 - 16 volts DC, minimum 100 mA
Occupancy detector inputs	Two tracks provided: 6-pin SIP for each track End pins provide 5 volt power; 3 centre pins active-low inputs
Outputs available - all versions	6 position terminal block: 4 logic level outputs 1 active high, 1 active low, 2 that flash alternately when active +5 volts and V- available
Outputs available - stall-motor version	Pair of outputs to drive a stall-type motor
Screw terminal minimum wire gauge	22
Screw terminal maximum wire gauge	14

## GCC Power Connections

The GCC must be powered from a DC power supply rated at 8 to 16 volts. The power source is connected to the GCC using the screw terminals on the green terminal block, labelled **X4** in Figure 1 and on the board. If the polarity of the power supply is not correct, the GCC will not function, but will not be damaged. Simply reverse the power supply connections.

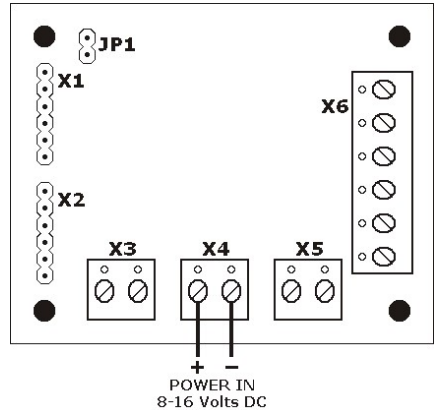


Figure 1

## Occupancy Inputs

Two 6-pin headers are provided for inputs from occupancy detectors for up to two tracks. Three sections of track must be detected per track. These can be seen in Figure 2: a section of track approaching the crossing from each side, plus the section of track over the crossing.

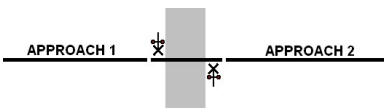
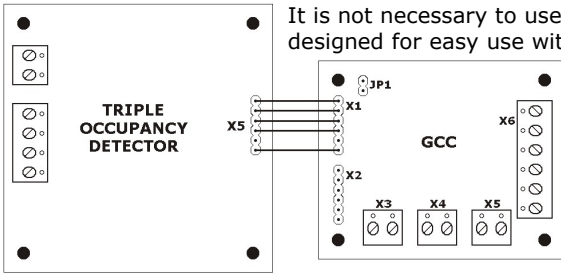


Figure 2

The occupancy detectors of the first (or only) track are connected to header X1. If the crossing has a second track, its occupancy detectors are connected to header X2. Each header provides power for the occupancy detectors connected to it.

# Connecting The GCC to a Circuits4Tracks Detector



It is not necessary to use our Detector, but the GCC is designed for easy use with one or two of them.

Since only three detectors are needed per track, we have a version of our popular detector card with only three detectors. This triple occupancy detector (3OD) is available in combination with the GCC.

Figure 3

The detection input header, labelled **X1** in Figure 3 and on the board, is identical to the output header on our 3OD, labelled **X5** in Figure 3 and on the detector. The GCC supplies 5 volt DC power to the detector on pins 1 and 6. The upper pin in Figure 3 on both connectors is marked with **V+**.

The detection information is on pins 2 to 4, corresponding to blocks 1 to 3 on the detector. The GCC does not have pin 5 connected to anything as it is not used. When the crossing has a second track, an additional 3OD is needed for it, and it is connected the same way to connector **X2** on the GCC.

# Connecting The GCC to other Occupancy Detectors

The GCC may be used with any occupancy detector circuit providing an active low output. This means that when occupancy is detected, the detector's output is pulled down to 0.8 volts or less. This can be done using a relay contact, an open-collector output from a transistor, or a logic gates of a digital circuit or an output port from a computer or microcontroller. When grounded, each input will source about 2.2 mA.

It is necessary to use block occupancy detection with the GCC. The logic applied requires each section of track to provide occupancy information as long as the track continues to be occupied.

# The Outputs of the GCC

All versions of the GCC have outputs available on the 6-position terminal block labelled **X6** in Figure 4 and on the board. In Figure 4, the top and bottom terminals provide the regulated 5-volt power from the GCC for powering a device such as an LED. Terminals labelled **F2** and **F1**, will both be low (V-) when the crossing is not active, and will alternately flash high (V+) when it is active, at a 640 ms rate. These outputs are capable of sourcing or sinking a load up to 25 mA.

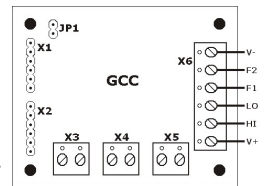


Figure 4

The **F1** and **F2** flash rate may be set to 480, 640, 800, or 960 ms. The procedure for changing this value is beyond the scope of this document. Visit the documentation page of our website to get a copy of **Configuring the GCC** for instructions.

The terminals labelled **HI** and **LO**, provide constant outputs. **HI** will be high (V+) when the crossing is active and low (V-) when inactive. **LO** operates opposite to **HI**. These outputs are capable of sourcing or sinking a load up to 50 mA, however the stall-motor version can only source 25 mA on the **HI** output.

## Wiring the Outputs of the GCC

Outputs are designed to source current for LEDs. This means that the output is positive and the load should be connected between it and V-. See Figure 5. It is possible to use the outputs to sink current, but in the case of the flashing outputs, they would remain constantly on when the crossing is inactive.

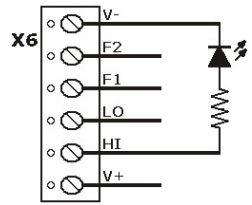


Figure 5

## Driving Higher Current Loads

If you need to drive a load that exceeds the maximum current available at the outputs (F1, F2, HI, or LO), a transistor and resistor may be used as shown in Figure 6 connected to the HI output. Using a transistor such as the 2N3904 will allow up to 200 mA load current, but the voltage regulator has a current limit of 100 mA and about 20-40 mA is needed for the GCC and any LEDs it drives, so only about 60-80 mA is available.

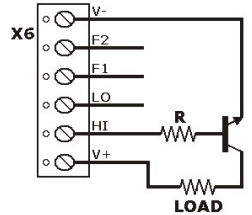


Figure 6

It is possible to drive loads that require higher current, and a voltage higher than 5 volts. See our website for the GCC product documentation to obtain a copy of *Interfacing the Grade Crossing Controller*.

The value of the resistor, R, can be 1k ohm, though any value from 270 ohm to 1k8 ohm will work fine.

## Stall-motor Outputs

Stall-motor output versions of the GCC will have terminal block **X5** installed - see Figure 7. The input power (8 to 16 volts DC) will be present across the two terminals of **X5** at all times, but the polarity will reverse when the crossing is active. This may be used to operate a stall-motor for mechanical appliances, such as crossing gates.

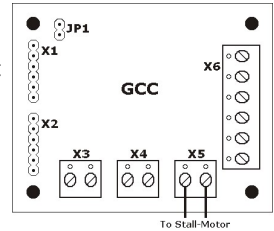


Figure 7

## The Auxiliary Input

There is an auxiliary input on the terminal block labelled **X3**. Connecting the terminal labelled AUX with the one labelled V- will activate the crossing, regardless of the state of the occupancy inputs.

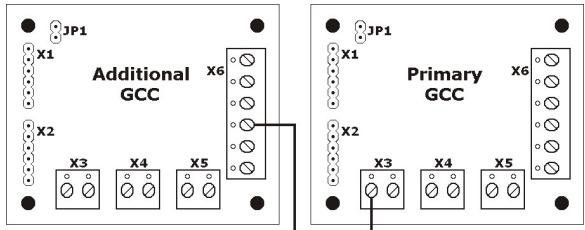


Figure 8

While this could be used with a switch to manually activate the crossing, its main purpose is to allow an additional GCC unit to be used when the crossing involves more than two tracks. When this is the case, simply connect the **LO** output on **X6** of the additional GCC to the **AUX** input on **X3** of the primary GCC, as shown in Figure 8. Crossing appliances should be operated by the outputs of the primary GCC.

## Automatic Shut-off

The GCC has an optional feature called automatic shut-off. In some prototype situations, when a train approaching a crossing does not reach the crossing within a reasonable time limit, the crossing will deactivate. This may be used if a crossing is located just beyond a station where a train might stop for a period of time in order to not tie up road traffic. When this occurs, a train must approach the crossing at restricting speed until it occupies the track section over the crossing, as this will re-activate the crossing.

To enable this feature, simply place a jumper to short the two pins of **JP1**. With a jumper in place, the crossing will deactivate if an approaching train does not reach the crossing within 40 seconds of first becoming activated. This delay time may be set to either 20, 40, 60, or 80 seconds. However, the procedure is beyond the scope of this document. Visit the documentation page of our website to get a copy of **Configuring the GCC** for instructions.



Figure 9

## Clear Delay

After a train passes the crossing, the crossing will become inactive as soon as the section of track over the crossing has become unoccupied. It is possible to configure the GCC to hold the flashing outputs active for a brief period after the train has cleared. This may be used to replicate the prototype practice of having the flashing lights continue to flash while gates rise.

Besides the default of zero delay, the GCC may be configured to a delay of 2.4, 4, or 5.6 seconds. However, the procedure is beyond the scope of this document. Visit the documentation page of our website to get a copy of **Configuring the GCC** for instructions.

Note that even though the flashing outputs continue to be active for this delay, the **HI** and **LO** outputs will not. This is so that gates can begin to rise while the delay causes lights to continue to flash.

## Warranty

A factory-assembled GCC is tested and warranted against manufacturing defects for a period of 1 year from date of purchase. As the circumstances under which the GCC is installed cannot be controlled, failure of the GCC due to installation problems cannot be warranted. This includes misuse, miswiring, operation under loads beyond its specifications, or short circuits. The warranty is voided if the GCC is connected to a power supply exceeding 16 volts DC, or if it is connected to an AC power supply of any voltage.

If the GCC fails for non-warranted reasons, it can be replaced with no questions asked for the cost of \$28 (stall-motor version, \$24 for basic version) plus shipping (this fee subject to change).

Send an email to **circuits@daxack.ca** for information on warranty or non-warranty replacement.

*This document is available in PDF format on our website.*