LOGIC RAIL™ TECHNOLOGIES

"Sophisticated Model Railroad Electronics"

21175 Tomball Pkwy
Suite 287
Houston, TX 77070

Phone: (281) 251-5813
email: info@logicrailtech.com
http://www.logicrailtech.com

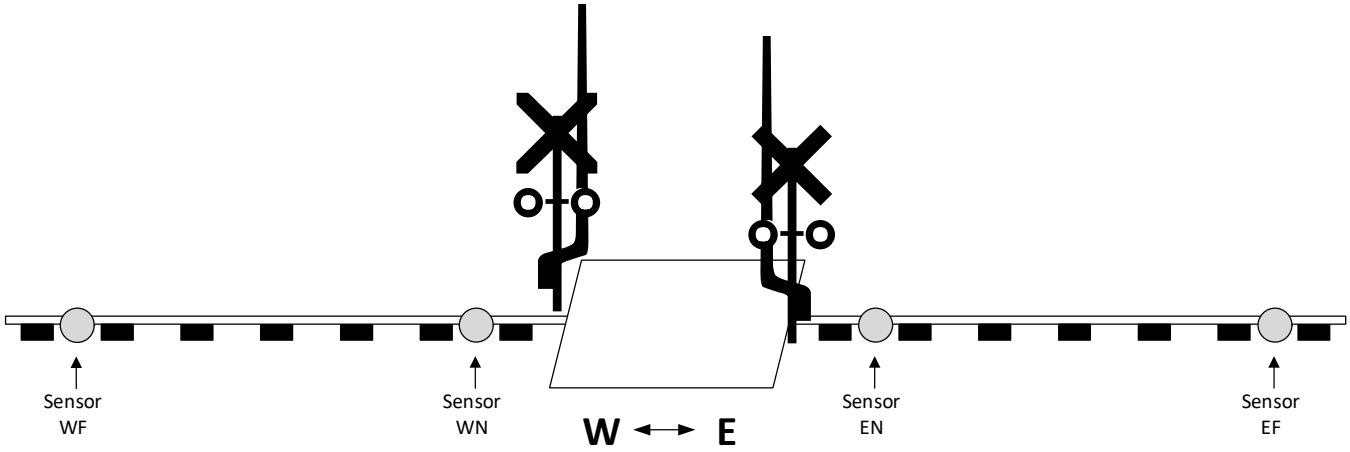
Grade Crossing Pro/2 Expander Instructions

(covers versions GCP/2-EXP, GCP/2-EXP-IR, and GCP/2-EXP-X)

Revised 4/15/2024

Getting started

Thank you for purchasing a ***Logic Rail Technologies*** product! Please familiarize yourself with all the instructions prior to installing this board. The ***Grade Crossing Pro/2 Expander*** (versions GCP/2-EXP, GCP/2-EXP-IR, and GCP/2-EXP-X) is used in conjunction with the ***Grade Crossing Pro/2*** for prototypical operation of a multitrack grade crossing. Four sensors (photocells or infrared emitters and detectors) are used for bidirectional train detection. External detectors (available from other suppliers) can also be used. The layout of the sensors is illustrated below. You MUST install the sensors in the exact order (WF-WN-EN-EF) shown! The WF and EF sensors may be located as far away from the crossing as you would like. If you are installing gates then putting these farther out will give the gates enough time to lower before the train reaches the crossing. An HO scale train running a scale 40 MPH would cover 12 inches in about 1.5 seconds. You will likely choose to have your gates lower in approximately 4 seconds. So, that would suggest that you should locate WF and EF around 36 inches from the crossing; consider more distance if you're running faster trains or less distance if you're running slower trains! If you are NOT installing gates then you can choose to place WF and EF wherever convenient and whatever amount of advance notice you want to give your scale motorists before the train reaches the crossing!



You should make all the connections to the ***Grade Crossing Pro/2 Expander*** before connecting it to the ***Grade Crossing Pro/2***. You should mount the ***Grade Crossing Pro/2 Expander*** as close as possible to the ***Grade Crossing Pro/2*** keeping in mind the short length of the interconnecting cable (included). Use the four mounting holes provided which will accept #4 screws; do not enlarge the holes as damage to the circuit board can result and your warranty will be voided!

The ***Grade Crossing Pro/2 Expander*** board has a set of 7 configuration switches on it. Each switch is briefly described below with more details later in these instructions. Note that 4 of the switches MUST match the exact settings of those same switches on the ***Grade Crossing Pro/2*** board! Full descriptions of those switches can be found in the ***Grade Crossing Pro/2*** instructions. The ON/CLOSED position is towards the edge of the board.

Switch Name	Meaning when OFF/OPEN	Meaning when ON/CLOSED
SETUP	GCP/2 Expander is in normal operating mode	GCP/2 Expander is in sensor setup mode
SEN TYPE	Sensors are photocells or external current detectors	Sensors are infrared
SEN POL	See text in the Sensor Modes section	See text in the Sensor Modes section
GATES USED	**MUST MATCH THE GCP/2 SETTING!**	
GATE DELAY	**MUST MATCH THE GCP/2 SETTING!**	
BELL MODE	**MUST MATCH THE GCP/2 SETTING!**	
BELL SHUTOFF	**MUST MATCH THE GCP/2 SETTING!**	

Powering the board

The ***Grade Crossing Pro/2 Expander*** receives DC power from the ***Grade Crossing Pro/2*** through the expansion cable provided with this product. Page 6 shows you how to connect this cable. Power consumption ranges from ~50 mA (photocell version) to ~185 mA (infrared version).

Sensor modes

The ***Grade Crossing Pro/2 Expander*** supports four different sensor (detector) modes: photocell, between-the-rails infrared, across-the-rails infrared, and external detector. NOTE: although not likely, you CAN use one type of detection method with this board and a DIFFERENT type of detection method with the ***Grade Crossing Pro/2***. When you purchased this product it either came with photocells, infrared components or neither (board only, for use with external detectors). The sensor mode is selected using the switches labeled SEN TYPE and SEN POL as depicted in Table 1 below.

			
Photocell **SEN TYPE – OFF** **SEN POL - OFF**	**Between-the-rails Infrared** **SEN TYPE – ON** **SEN POL - ON**	**Across-the-rails Infrared** **SEN TYPE – ON** **SEN POL - OFF**	**External Detector** **SEN TYPE – OFF** **SEN POL - ON**

Table 1 – Sensor mode selection

Using photocells for train detection

NOTE: we cannot guarantee proper operation with photocells from other sources! The photocells should be mounted between the rails in the general area where you will locate the signal. Drill a 9/64" hole through the ballast, roadbed, and sub-roadbed. For the smaller scales this drilling may end up hitting the ties. Take your time so you don't mangle them! Figure 1 illustrates the placement of a photocell in between the rails. Insert the leads of the photocell into the hole from the top of your layout. One of the photocell leads has a piece of insulation on it so be sure the two leads don't touch each other! If the leads do not protrude enough from the underside of your layout then it will be necessary to extend the leads; soldering wires to them is the most common method; make sure you insulate any connections you make to the photocell leads so that they don't short out. Once you have wired the photocells to the ***Grade Crossing Pro/2 Expander*** and verified their operation you may wish to put a dab of white glue under the photocell to hold it in place; make sure you don't get glue on the top surface of the photocell as this may prevent it from operating properly. Figure 2 illustrates the photocell wiring; make sure you have the photocells in the correct order as shown at the top of page 1. Photocells do not have any polarity so you can connect either lead to the GND terminal and connect the remaining lead to the appropriate photocell input.

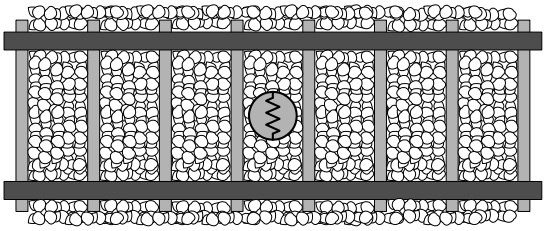


Figure 1 – photocell placement

Photocells require a light source above them to function properly. On most layouts the room lighting should be sufficient. However, if the photocells are located in an area that doesn't get much overhead lighting or if you have simulated "nighttime" operations then it will be necessary to locate light sources on the layout near the photocells. Streetlights and yard lights are common light sources. Locate the light sources slightly to the left or right of the photocells and not directly over them; this will allow the ***Grade Crossing Pro/2 Expander*** to still properly detect a train that has stopped over any photocell with the gap between cars over a photocell.

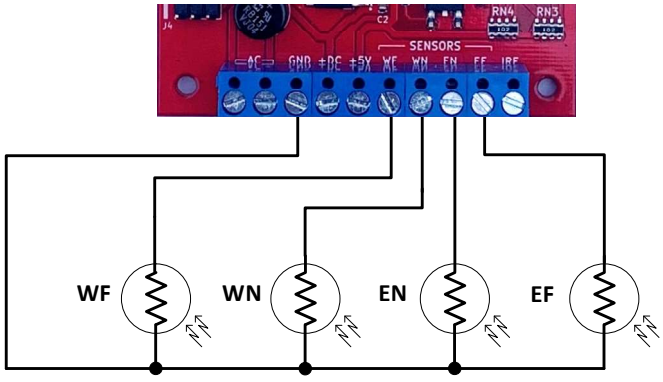


Figure 2 – Photocell wiring

Photocell sensitivity setup

You can adjust the sensitivity of each photocell on the circuit board using a small slotted head screwdriver. Along one edge of the board are four potentiometers (or "pots") that are labeled "WF", "WN", "EN" and "EF". The ***Grade Crossing Pro/2 Expander*** supports a SETUP mode to make this adjustment process easier. To enable this mode, you must have the switch labeled SETUP in the ON/CLOSED position as shown in Figure 3. In this mode the signals will not flash. The ***Grade Crossing Pro/2 Expander*** circuit board contains four sensor status LEDs; one near each of the four adjustment pots. These LEDs will assist you in setting the photocell sensitivity.

Figure 3 - SETUP mode

Now follow these steps after you have connected the cable between this board and the ***Grade Crossing Pro/2*** (page 6):

1. Remove all obstacles that may be covering the photocells or blocking overhead light to them.
2. Insert the blade of the screwdriver (from the edge of the circuit board, not from the center of the board) into the adjustment pots, one at a time. Turn the screwdriver completely counter-clockwise (left) in all FOUR of the pots.
3. For the adjustment pot labeled WF turn the screwdriver clockwise (right) until the red LED near the pot just lights up. Then turn the screwdriver back counter-clockwise until that LED goes out.
4. Repeat step 3 for the three remaining pots with corresponding LEDs.
5. Exit SETUP mode by putting the SETUP switch in the OFF/OPEN position ("operational" mode). The flashing and other action should now operate properly. It may be necessary to repeat this procedure if layout lighting conditions change significantly. Note that the ***Grade Crossing Pro/2*** will activate the sensor status LEDs when the associated sensor detects a train in "operational" mode; this is different from the previous generation ***Grade Crossing Pro***!

Turning the pots clockwise adjusts for brighter overhead lighting conditions while turning the pots counter-clockwise adjusts for dimmer overhead lighting.

Using between-the-rails infrared

The IR components should be mounted between the rails. Drill two 11/64" holes, through the ballast, roadbed, and sub-roadbed. These holes should be located one tie apart (Figure 4a) and drilled at a slight angle from vertical (see Figure 4b). The benefit of mounting them at an angle is increased detection reliability in smaller scales or irregular bottoms on rolling stock. For the smaller scales this drilling may end up hitting the ties. Take your time so you do not mangle them! Insert the leads of one IR emitter (white and black wires) into one of the holes (it does not matter which one!) from the top of your layout. Repeat for the IR detector (blue and black wires). The tops of the components should sit no higher than the top of the ties for optimal IR performance; in some cases (e.g. false triggering) it may be necessary to locate the components a little below the ballast line. You can extend the leads with similar (or larger) wire. We recommend soldering and insulating these connections. We also recommend using terminal blocks/strips since you will have multiple +5V and GND connections to make. Once you have wired the IR components and verified their operation you may wish to put a dab of white glue or silicone caulk where the wires exit the holes underneath the layout. This will help to hold the components in place; make sure you do not get any substance (e.g. ballast or glue) on the top surface of the IR components as this may prevent them from operating properly. In extreme cases where you may be getting interference from overhead lighting you can mount the IR detector in some plastic or metal tubing. You can also recess the IR detector slightly below the ties and roadbed.

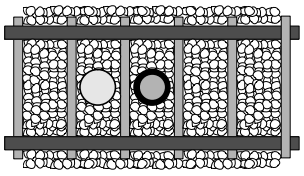


Figure 4a

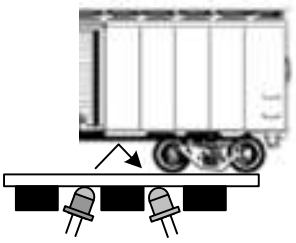


Figure 4b

Using across-the-rails infrared

With this sensor mode and physical arrangement a train is detected when the infrared (IR) beam is broken by the train. The IR components should be located across the track as shown in Figure 5a and 5b; the distance between them has been tested up to 16 inches. The detectors (dark lens, blue and black wires) should be mounted with a slight downward angle in order to minimize the possibility of false triggering from visible light sources; this is illustrated in Figure 5a. We would also recommend that you angle the emitters and detectors across the track as shown in Figure 5b. This will minimize false "clear" situations due to the space between rolling stock. You can bend the IR emitter and detector components IF you are VERY careful and, preferably, use a pair of "smooth jaw" (no teeth/serration) pliers!! Make the bend on the IR component NO CLOSER than 0.5" from the tip. You don't want to pierce the insulated heat shrink tubing and potentially cause a short. We also recommend that you place some "tubing" (e.g. 3.5mm heat shrink tubing) over the end of each emitter and detector in order to make the IR beam path more direct (like a tunnel).

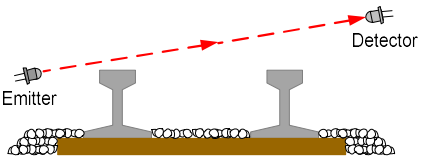


Figure 5a

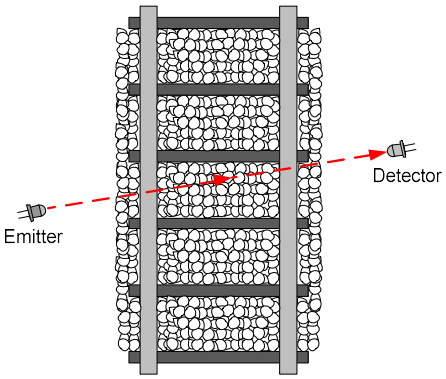


Figure 5b

In the event the leads do not reach the circuit board you can extend them with similar (or larger) wire. We recommend soldering these connections or using terminal blocks/strips especially when you have multiple connections to make.

Aligning the IR components for reliable detection might be a bit challenging. Here's the process we recommend:

1. Put the SEN POL and SETUP configuration switches in the ON position.
2. Working with each emitter/detector pair at a time line the two components so that the associated red status LED on the board lights up.
3. Once all four red status LEDs are lit turn the power OFF.
4. Put the SEN POL switch in the OFF position (now the board is in across-the-rails IR mode) and turn ON power to the board.
5. While the SETUP switch is still in the ON position observe the red status LEDs. They should be OFF unless you block the IR beam for a given location.
6. Once you confirm proper behavior you can put the SETUP switch in the OFF position.

Since the IR components are located trackside, you will probably want to consider "hiding" them. There are numerous ways to do this such as using shrubbery, small equipment buildings or fixtures. We leave this exercise up to your imagination and creativity! We would strongly suggest that you get the circuitry working properly first, and then address the physical appearance.

IR component wiring

STOP **Please note that the IR emitter wiring is DIFFERENT from the previous generation *Grade Crossing Pro*!**

Figure 6 illustrates the wiring for **ONE** set of IR components (shown for sensor location "WF"). **REPLICATE the same wiring for the three remaining sensor inputs!** Four 68 ohm ¼ watt resistors (Blue-Gray-Black color bands) are included with the ***Grade Crossing Pro/2 Expander***. When properly wired the emitters will have a very faint red glow. You can "see" the infrared light using your digital camera or smartphone camera! **For safety reasons do NOT point the IR emitter directly into your eye or stare at the IR emitter!!!** The ***Grade Crossing Pro/2 Expander*** supports a SETUP mode which can be used to verify proper operation of the sensors. To enable this mode, you must have the switch labeled SETUP in the ON/CLOSED position as shown in Figure 3. In this mode the signals will not flash.

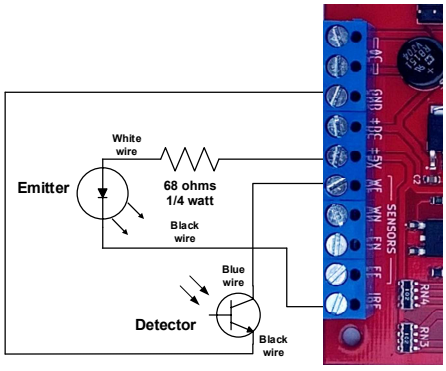


Figure 6 – IR component wiring
(WF input shown; replicate for WN, EN and EF inputs respectively)

[continued on the next page!]

There are four sensor status LEDs; one near each of the four photocell sensitivity adjustment pots. **NOTE: The four adjustment pots have NO affect when using either infrared sensor mode!** Do the following after you have connected the cable between this board and the ***Grade Crossing Pro/2*** board (page 6): With nothing over or blocking any of the IR components the red sensor status LEDs on the circuit board should all be OFF. Place a piece of rolling stock at each detection location, one at a time, and confirm that the associated red sensor status LED turns ON. Don't forget to turn OFF the SETUP switch when finished!

Using an external detector

Use this sensor mode if you would prefer to use a different type of detector such as an NCE BD20 current sensing detector. Any brand of detector should work provided that its output is an open collector, "active low" polarity, which means that when a train is detected the output is pulled to ground. When no train is sensed the detector output is an open circuit or "floating." You will need 3 detection blocks or zones. Figure 7 shows how they would be partitioned. Figure 8 shows how simple it is to connect the BD20 block detectors to the ***Grade Crossing Pro/2 Expander***. **NOTE: The four adjustment pots have NO affect when using this mode!**

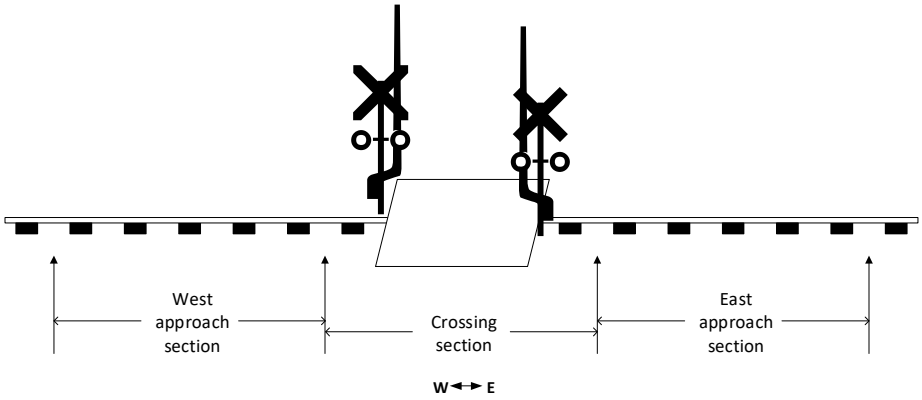


Figure 7 – External detector zone partitioning

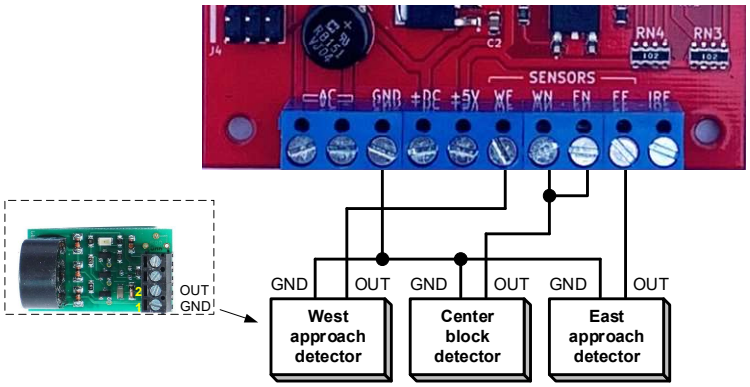


Figure 8 – External detector wiring (NCE BD20 shown)

Output status indicators

The ***Grade Crossing Pro/2 Expander*** board has an orange LED labeled TRIG OUT and a blue LED labeled BELL OUT. These LEDs give you a visual indication of what the ***Grade Crossing Pro/2 Expander*** is communicating to the ***Grade Crossing Pro/2***. When a train is first detected both LEDs will turn on. The orange LED will stay on until the board has detected that the train has cleared the crossing and the "turn off" sequence has begun. The blue LED indicates when the optional bell module (attached to the ***Grade Crossing Pro/2***) should be on. If you have crossing gates AND you have the bell mode switch ON you will see the blue LED turn off once the gates have lowered; it will turn on again as the train clears the crossing and the gates begin to rise (unless the BELL SHUTOFF switch is ON).

NOTE: when power is first applied to the ***Grade Crossing Pro/2 Expander*** these two LEDs will light up briefly (orange then blue). This is an indication that the board's main chip has started up properly.

Connecting the expansion cable to the *Grade Crossing Pro/2* board

The ***Grade Crossing Pro/2 Expander*** connects to the ***Grade Crossing Pro/2*** with a single cable (included). Connect one end of the cable, with the red stripe aligned to the left edge of the circuit board, as shown in Figure 9a, to the lower 6-pin header on the ***Grade Crossing Pro/2 Expander*** board; use the upper 6-pin header to connect any additional ***Grade Crossing Pro/2 Expander*** boards. Connect the other end of the cable to the 6-pin header on the ***Grade Crossing Pro/2*** board; again, align the red stripe to the left edge of the board as shown. Zoomed in views are shown in Figures 9b and 9c.

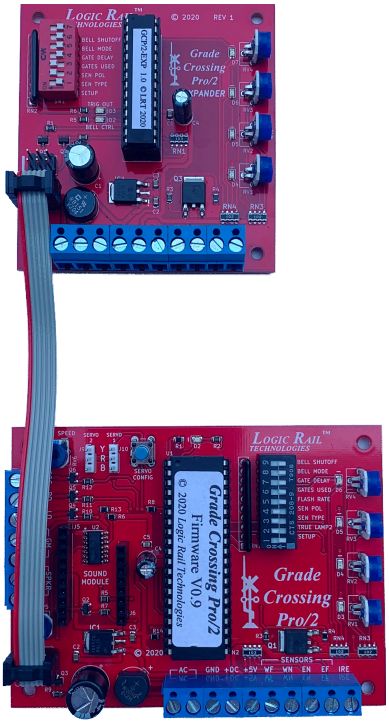


Figure 9a – Connecting the GCP/2 and GCP/2 Expander

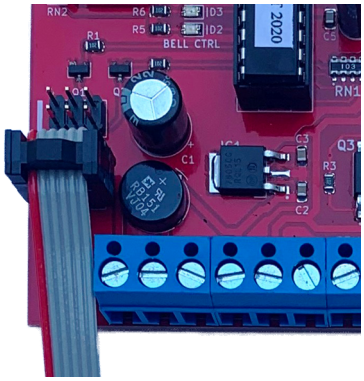


Figure 9b – GCP/2 Expander with cable attached

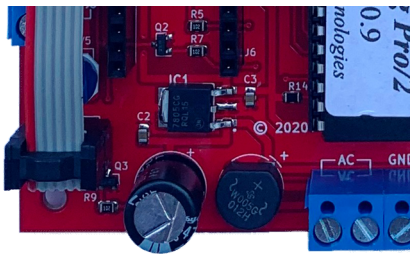


Figure 9c – GCP/2 with cable attached

Troubleshooting – photocell sensing

First, make sure you're using the photocells provided with our products!!! If your signals do not flash when the sensors are covered or flash all the time you can perform the following tests. First, verify that you have the sensor mode configured correctly (see Table 1 on page 2). Second, revisit the photocell sensitivity adjustment process on pages 3. A loose or missing wire connection on a photocell will cause its status LED to stay on all the time!

Troubleshooting – Between-the-rails infrared sensing

If your signals always flash even when no train is present then you will probably see one or more of the red sensor LEDs lit up on the ***Grade Crossing Pro/2 Expander*** board. You may have the IR components sitting too high. Make sure they are no higher than the top of the railroad ties otherwise the IR "light" can leak across and be seen by the detector. If the IR emitter appears to be flashing on and off then it is likely sitting up too high. Also make sure that none of the detector blue and black wires are touching each other. This will be interpreted as an activated sensor.

If your signals fail to flash when you cover a particular sensor location then double-check your sensor wiring and the cable connecting the ***Grade Crossing Pro/2 Expander*** to the ***Grade Crossing Pro/2***. A missing sensor connection (missing wire or open circuit) will be interpreted as a cleared sensor. Verify the glow of the IR emitters using a digital camera or smartphone camera. Also verify that you have the sensor mode configured correctly (see Table 1 on page 2).

You can determine if the sensor inputs are working correctly by TEMPORARILY disconnecting all blue sensor wires from the board. If any of the red sensor LEDs are lit then the main chip on the board may be at fault. Contact us for further help. Otherwise, connect each sensor input (WF, WN, EN, EF) to GND, ONE sensor input at a time. An activated sensor appears to the board like a low voltage connection so you are, in effect, mimicking an activated sensor with this test. If the sensor's associated red LED does NOT come on when you make that temporary connection then you may have a problem with the board and you should contact us. If the sensor red LED did light up with the temporary connection then you may have a defective IR detector.

Troubleshooting – Across-the-rails infrared sensing

First, verify that you have the sensor mode configured correctly (see Table 2 on page 5). Second, verify proper alignment of each infrared emitter and detector pair by putting the GCP/2 in SETUP mode (SETUP switch ON). In this mode look at the four sensor status LEDs on the circuit board. With nothing blocking the infrared beam path the associated status LED should be OFF. If the LED is ON then that pair is not yet aligned. If the LED is OFF then place an object in the path of the beam and verify that the LED turns ON.

Warranty

This product is warranted to be free from defects in materials or workmanship for a period of one year from the date of purchase. ***Logic Rail Technologies*** reserves the right to repair or replace a defective product. The product must be returned to ***Logic Rail Technologies*** in satisfactory condition. This warranty covers all defects incurred during normal use of this product. This warranty is void under the following conditions:

1) If damage to the product results from mishandling or abuse.
2) If the product has been altered in any way (e.g. soldering to the circuit board).
3) If the current or voltage limitations of the product have been exceeded.

Requests for warranty service must include a dated proof of purchase, a written description of the problem, and return shipping and handling ($8.00 inside U.S./$20.00 outside U.S. - U.S. funds only). Except as written above, no other warranty or guarantee, either expressed or implied by any other person, firm or corporation, applies to this product.

Technical Support

We hope the preceding instructions sufficiently answer any questions you might have about the installation of this product. However, technical support is available should you need it. You can reach us via phone or email; our contact information can be found on the top of page 1.