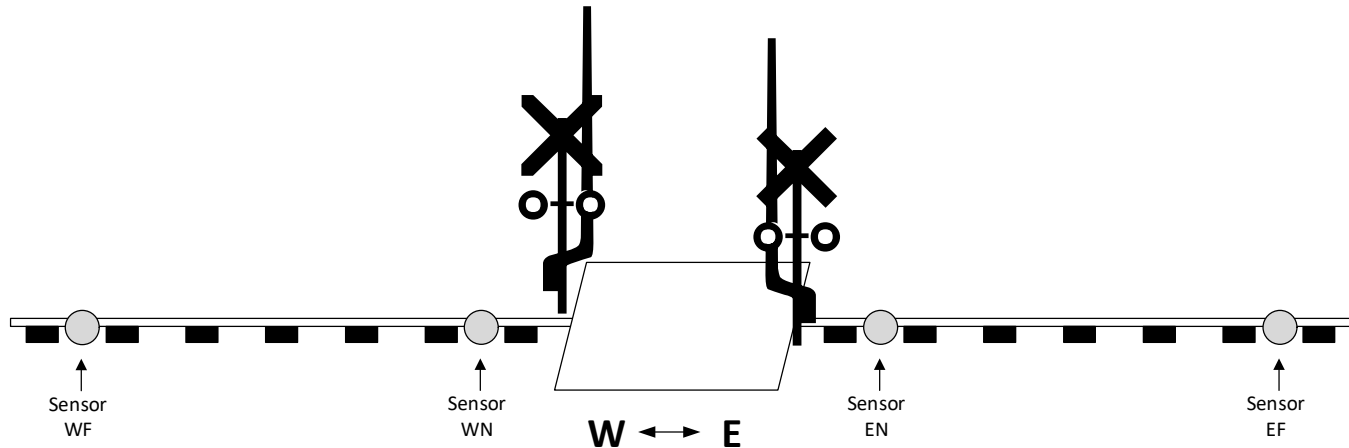


Getting started

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* (versions GCP/2, GCP/2-IR, and GCP/2-X) provides prototypical operation of a grade crossing. The crossing signal outputs can be used with common anode LED signals (e.g. Tomar, NJ International, Walthers and others) or older bulb types. There is a separate output for an end-of-gate-arm light. Outputs are provided for 1-2 Tortoise motors and servo motors to drive the gate arms. 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!



What is different from the original version of the *Grade Crossing Pro* (GCP and GCP-IR)?

- Signal outputs are turned on in sequence (Left → Right → End-of-gate arm), briefly, when power is first applied to the board. This gives you a quick test of the signals to make sure all the connections are correct and the signals work!
- There are individual sensor status indicators on the circuit board. These not only help you when first setting up the board but are also active when in “operating” mode.
- There is no need to swap chips on the board if you want to use a photocell, infrared between-the-rails, infrared across-the-rails, and external detectors. However, you will need to decide which sensor type (photocell or infrared), if any, you want at the time of purchase. Both sensor types are still available separately (#PCCELL or #BTR-IR4) if you want to change types!
- The board is also offered without sensors (version GCP/2-X) for use with other brands of external detectors.
- The infrared detection method has been improved and no longer has strict limits on the incoming voltage. **NOTE: the IR emitter wiring is different from the previous generation product!!! Please pay close attention to this.**
- We added an End-of-Gate arm LED output which is on continuously when the signals are flashing.
- We added support for servo motors to operate gate arms; there are separate outputs for *Tortoise*™ motors.
- The board has a socket for a grade crossing bell module. We are offering different versions (classic, electronic, fast, Griswold) under our own brand. The bell sound will fade off as the signals stop flashing.
- There are different “timing” options for lowering the gates and when the bell should be ringing.
- Use the *Grade Crossing Pro/2 Expander* to handle an additional track for multi-track crossings.

How does it work?

An eastbound (left to right) train will cause the signals to begin flashing when the WF sensor is activated. If a bell module is attached it will start ringing then too. If crossing gates are being used (GATES USED switch ON) then after a short delay (see GATE DELAY switch description further down) the gate motor outputs will turn on and the gates will lower. The signals will continue to flash even if the rear end of the train clears the WF sensor as long as the front end of the train reaches the WN sensor within 35 seconds. Assuming the train does this and then subsequently reaches the EN sensor the signals will continue flashing. Approximately 2 seconds after the rear end of the train clears the EN sensor the gate motor outputs will shut off and the gates will begin to rise. Approximately 3 seconds later the signals will stop flashing and the bell will stop ringing. If no gates are used (GATES USED switch OFF) then the signals will stop flashing and the bell will stop ringing approximately 2 seconds after the rear end of the train clears the EN sensor. There are other “timing” options related to the operation of the bell (BELL MODE and BELL SHUTOFF switches); these are described later in these instructions.

If the train had not reached the WN sensor within 35 seconds of clearing the WF sensor then the **Grade Crossing Pro/2** will assume the train has reversed. This “timeout” will cause the “action” to shut off as previously described above. Similar behavior exists for a westbound train with respect to sensors EF, EN and WN (shut off occurs after the last car clears the WN sensor). 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!

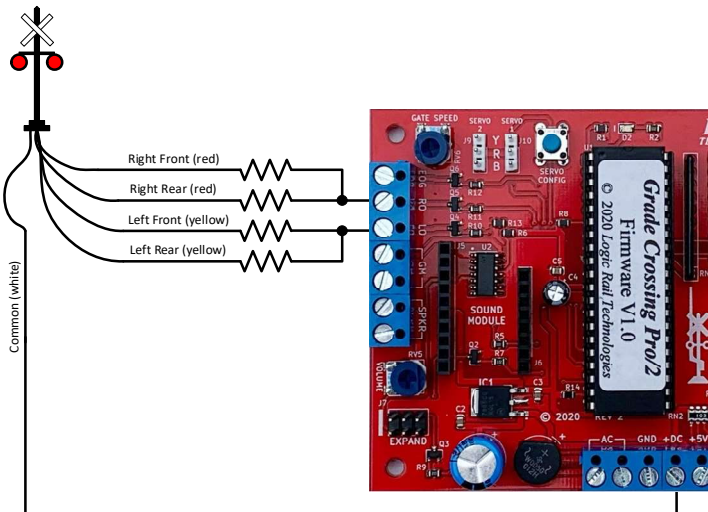
You should make all of the connections to the **Grade Crossing Pro/2** before applying power to it. You can mount the **Grade Crossing Pro/2** anywhere it is convenient underneath your layout using the four mounting holes provided. The holes will accept #4 screws; do not enlarge the holes as damage to the circuit board can result and your warranty will be voided!

The **Grade Crossing Pro/2** board has a set of 9 configuration switches on it. Each switch is briefly described below with more details later in these instructions. The ON/CLOSED position is towards the large rectangular chip on the board.

Switch Name	Meaning when OFF/OPEN	Meaning when ON/CLOSED
SETUP	GCP/2 is in normal operating mode	GCP/2 is in sensor setup mode
TRUE LAMP2	Signals don’t fade on/off (like modern signals)	Signals fade on and off (like older signals)
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
FLASH RATE	Normal flashing rate	Fast (2X) flashing rate (see page 3)
GATES USED	Crossing gates are NOT used	Crossing gates are used
GATE DELAY	Signals flash for ~3 seconds before gates lower	Signals flash for ~1.5 seconds before gates lower
BELL MODE	The bell rings continuously while the signals are flashing	The bell rings only when the gates are moving up or down (must also have GATES USED ON)
BELL SHUTOFF	The bell shuts off when the flashing stops	See text in the Bell section

Wiring Tomar’s LED-based crossing signals

Tomar’s LED-based crossing signals are pre-wired in a common anode (positive) manner. Since these are dual-sided signals (i.e. LEDs on both sides of each signal mast) there are 2 yellow and 2 red wires (one from each LED’s cathode) and one common white wire. Figure 1 below shows you how to wire ONE signal. The **Grade Crossing Pro/2** will support two dual-sided signals; if you are using two signals then simply replicate the wiring shown for the second signal. Note that EACH LED connection requires a current limiting resistor. The value of the resistor is dependent upon the voltage applied to the GCP. You can use Table 1 to determine the MINIMUM resistor value. You can always substitute a ½ watt resistor for a ¼ watt resistor. You can always use a higher value resistor (i.e. more OHMS!) if your signals are too bright to your liking.



Voltage supplied to GCP/2	Minimum Resistor Value
9V DC	390 ohm, 1/4W
12V DC	470 ohm, 1/4W
14V DC	680 ohm, 1/4W
7V AC	390 ohm, 1/4W
9V AC	560 ohm, 1/4W
12V AC	1K ohm, 1/4W
16V AC	1.2K ohm, 1/4W

Table 1 – Current limiting resistors

Figure 1 – Wiring Tomar’s LED-based signals

Wiring other LED-based crossing signals (including Walthers and Details+)

If you are using another brand of LED-based crossing signals, or are scratch-building your own, you MUST wire them in a common anode (positive) manner. **NOTE: some manufacturers use a black wire for the common wire but that does NOT mean that it is a negative or ground wire!** Figure 2 at right shows you how to wire ONE single-sided signal; if you are using multiple signals, or dual-sided signals, simply duplicate the wiring shown for the additional LEDs. Each of the *Grade Crossing Pro/2*'s signal outputs can handle loads up 180mA (~12 LEDs). Note that EACH LED connection requires a current limiting resistor. The value of the resistor is dependent upon the voltage applied to the *Grade Crossing Pro/2*. You can use Table 1 above to determine the minimum resistor value. Note that some of the resistors can be ¼ watt whereas others must be ½ watt. You can always substitute a ½ watt resistor for a ¼ watt resistor but you CANNOT substitute a ¼ watt resistor for a ½ watt resistor!

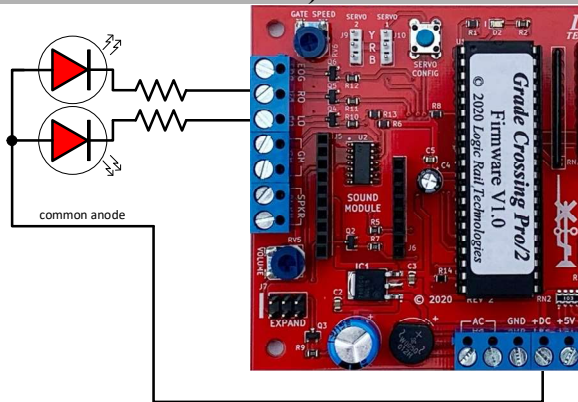


Figure 2 – Wiring LED-based crossing signals

Wiring bulb-based crossing signals (e.g. NJ International)

Crossing signals constructed with bulbs do not have a polarity like LED-based signals do. However, some bulb-based signals may be pre-wired with a common wire. If your signal does not, then you will simply create a common connection from one lead of each bulb (it doesn't matter which lead is used). Figure 3 at right shows you how to wire ONE single-sided bulb-based signal. The *Grade Crossing Pro/2* will support two dual-sided signals; if you are using multiple signals, or dual-sided signals, simply duplicate the wiring shown for the additional bulbs. Note that current limiting resistors are shown. These are only required IF the voltage provided to the *Grade Crossing Pro/2* is greater than the rating on the bulbs; most bulbs are rated at 12V AC or DC but you should check the instructions that come with the signal. If the *Grade Crossing Pro/2* voltage source exceeds the bulb rating then add current limiting resistors as shown; we recommend a value of 100Ω, ¼ watt.

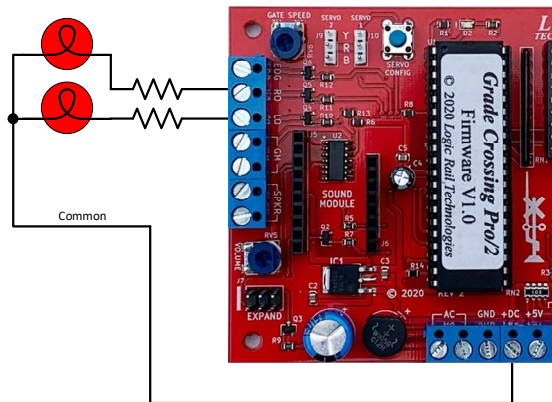


Figure 3 – Wiring bulb-based crossing signals

Flashing effects (True Lamp2 and Flash Rate)

As shown in the table on page 2 the *Grade Crossing Pro/2* has two configuration switches related to the crossing flasher outputs (LO and RO). The first is TRUE LAMP2. When this switch (#2) is in the ON position the LO and RO outputs will fade on and off which emulates older prototype crossing signals (when they used light bulbs). When this switch is OFF the LO and RO outputs will simply turn on and off during the flashing activity; this setting emulates newer prototype crossing signals which may use LEDs. If you are using bulb-type model railroad crossing signals we strongly suggest that you keep this switch OFF.

The other flashing effect is the flash rate itself. The normal flash rate is selected when the FLASH RATE switch (#5) is in the OFF position. If you prefer the faster (2X speed) rate you MUST have BOTH the FLASH RATE switch in the ON position AND have the TRUE LAMP2 switch in the OFF position. As such you CANNOT have the faster flash rate and the signal on/off fading effect at the same time.

End-of-Gate (EOG) LED

The *Grade Crossing Pro/2* has a separate output (EOG) which can be used to turn on an LED wired to the end (tip) of a crossing gate. Like the prototype crossing gates, this output will be active (on) whenever the signals are flashing. It will be on steady (the True Lamp2 configuration switch setting does not affect it). You will wire this LED just like the LO or RO LEDs shown in Figures 1 and 2. Don't forget the current limiting resistor! This output can handle loads up 180mA (~12 LEDs). If you're not using gates with LEDs on the arms you can use this output for other animations. For example, you could connect it to LED taillights on a vehicle waiting at the grade crossing. Contact us for details on how to make those taillights even more interesting by using an Arduino board!

Wiring a slow motion motor to drive a crossing gate

The *Grade Crossing Pro/2* will directly drive a slow motion motor that is typically used with crossing gates such as those from Tomar. Figure 4 shows how the *Grade Crossing Pro/2* is connected to a motor; the *Grade Crossing Pro/2* can drive a **max of two motors** (one per gate if you prefer to use separate motors). If the gates are raised when the signals are flashing and lower when the signals are not flashing then you simply need to reverse the motor connections. You can adjust the speed of the gate motor on the *Grade Crossing Pro/2*. Using a flat blade screwdriver insert it into the gate speed adjustment pot (from the top of the circuit board). Turning the screwdriver clockwise will increase the gate speed while turning the screwdriver counter-clockwise will decrease the gate speed. You **MUST** have the GATES USED configuration switch in the ON position!

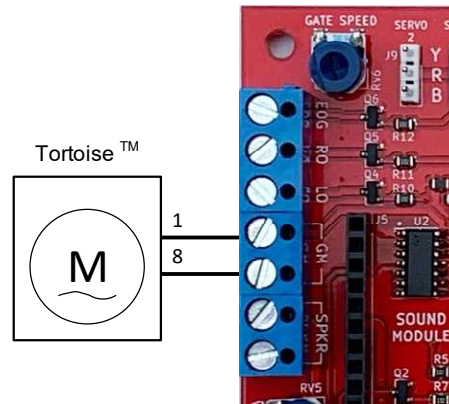


Figure 4 – Gate Motor Wiring (Tomar example)

NOTE: You must check the instructions for your gate motor to determine the maximum voltage that the motor can accept. For example, Tomar uses Circuitron’s Tortoise™ which has a maximum voltage rating of 12V DC or AC. If the voltage provided to the GCP is greater than the rating on the motor then you will need to add a current limiting resistor (we recommend a value of 390Ω, ½ watt) in the connection path between one of the GCP/2’s GM outputs and the turnout motor.

Using a servo motor to drive a crossing gate

The *Grade Crossing Pro/2* can control two servo motors for operating crossing gate arms. **NOTE: servo support requires *Grade Crossing Pro/2* Firmware V2.0 or higher!** Servos models HS-311 (from Hitec) and SG90 (from TianKong, Tower Pro and others) have been tested and verified to operate properly; other brands of servo motors MAY work. We offer SG90 servos with mounting hardware (#SERVOKIT). The *Grade Crossing Pro/2* has two 3-pin headers labeled SERVO 1 and SERVO 2; these are interchangeable and behave identically. We **STRONGLY** recommend that you use two identical servos and don’t mix different sizes or brands. Carefully note the wire colors on the servo motor you’re using. **ALWAYS turn the power off when connecting the servo cables to the *Grade Crossing Pro/2*. MAKE SURE you attach the servo cables correctly to the 3-pin headers.** On the circuit board near the headers are the labels Y R B. Orient the servo motor cable so that its yellow (or orange or white) wire is aligned with the Y pin on the header while the cable’s black (or brown) wire is aligned with the B pin. The middle wire, usually red, will then automatically connect to the R pin. **Damage to the servo and/or the *Grade Crossing Pro/2* can occur if connected improperly!** This is the time to mount both servo motors.

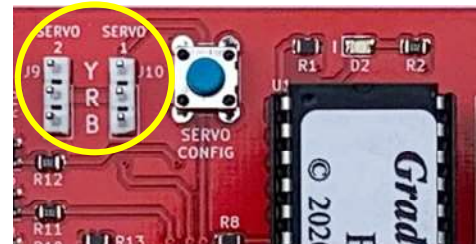


Figure 5 – Servo motor headers

1. Drill a hole for your crossing signal wires to pass down through.
2. Some commercial crossing gates come with an actuating wire while other do not. Regardless, we recommend that you use “piano” or “music” wire (e.g. K&S Precision Metals) with a diameter of 0.015” to 0.025”. Refer to Figure 6 at right. It is recommended to make a “U” shaped bend in the wire close to where it will insert into the servo “horn”; this will allow you to tweak the movement. Ideally the wire should be attached as far away as possible from the pivot/rotation point. **Do NOT attach the other end of the wire into the servo horn yet!**
3. Drill a hole through any scenery and layout base at angle of approximately 30 – 35 degrees from horizontal. The hole should be approximately centered with the signal mast as illustrated in Figure 6.

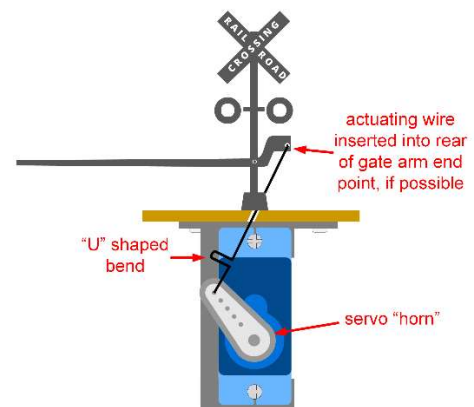


Figure 6 – Servo motor mounting

The *Grade Crossing Pro/2* has a servo configuration mode which allows you to set the servo motor speed and the position of the servos when the gates are raised. To enter this mode first make sure that the GATES USED configuration switch is ON. You must then hold down the blue pushbutton labeled SERVO CONFIG (see Figure 5) while then flipping the SETUP switch from OFF to ON. Then release the SERVO CONFIG pushbutton and a blue LED near the pushbutton will illuminate. The first step in this mode is setting the servo motor speed. Please pay attention to the sensor status LEDs which will indicate which of 4 speeds you are selecting. For the slowest speed only the “WF” LED (labeled “D3” on the circuit board) will be lit. As you select higher speeds more LEDs will be lit. For the fastest speed all four LEDs will be lit. To change the speed you press and release the SERVO CONFIG pushbutton SLOWLY. Each time you do this one more LED will light up. If all four LEDs are lit and you press and release the pushbutton again the speed will cycle back down to the slowest

setting (i.e. one LED lit). Once you have finalized your choice you must turn the GATES USED switch OFF and then turn it back ON. If the selected speed is different from the previous (or default for the very first time) speed then the blue LED will blink twice. This is confirmation that the new value has been stored on the board (and will be retained even when you turn power off to the board). If the blue LED does not blink then no speed change was made. The second step in servo configuration mode is to set the “gates raised” position. To designate this step only the outer sensor LEDs (“WF” and “EF”) will be lit and the servo motor will be moved to a fixed “gates down” position. **NOTE: if you were only interested in changing the gate motor speed then at this point then flip the SETUP switch OFF.** If you wish to set or adjust the “gates raised” position then continue reading! If you’re setting the position for the first time then now you will need to insert the stiff wire into the servo horn. **Only do this for ONE motor at this time!** You may need to cut any substantial excess length from the wire but make sure to leave enough to make a 90° bend at the end. While maintaining the gate in the down position (you may need to prop something underneath the arm) insert the wire into servo horn such that there is minimal play. Next, PRESS and HOLD the blue pushbutton and watch the servo move the gate arm up. When you RELEASE the pushbutton the servo will stop moving. If you aren’t satisfied with this “gates raised” position you can still tweak it. If you press the pushbutton again the servo will start to move the gate arm down again. Release the pushbutton and then push it again to get the servo to move the gate arm up. Once you are satisfied with the final position you must turn the GATES USED switch OFF and then turn it back ON. The blue LED will blink three times confirming that this position has been stored on the board. The final step is to flip the SETUP switch back to OFF. Note that the speed and “gates raised” position settings are the same for both motors. Repeat the previous attachment procedure for the second servo motor horn and gate arm. Install the set screw for each servo horn to hold it in place on the servo shaft.

Resetting servo motor settings to factory defaults

If necessary, you can reset the servo speed and gates raised position values to factory defaults. Start with the power turned OFF and the GATES USED configuration switch in the OFF position. While holding down the SERVO CONFIG pushbutton turn the power ON. When the blue servo status LED lights up you can release the SERVO CONFIG pushbutton. The servos will move to a midway position then return to the gates raised position. You will need to turn the power OFF, put the GATES USED configuration switch in the ON position (if you’re going to use gates!) and then turn the power ON again to put the *Grade Crossing Pro/2* back into operational mode.

Sensor modes

The *Grade Crossing Pro/2* supports four different sensor (detector) modes: photocell, between-the-rails infrared, across-the-rails infrared, and external detector. 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 2 below.




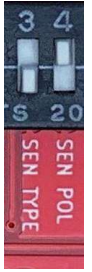
			
Photocell	Between-the-rails Infrared	Across-the-rails Infrared	External Detector
SEN TYPE – OFF SEN POL – OFF	SEN TYPE – ON SEN POL – ON	SEN TYPE – OFF SEN POL – OFF	SEN TYPE – OFF SEN POL – ON

Table 2 – 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 7 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!

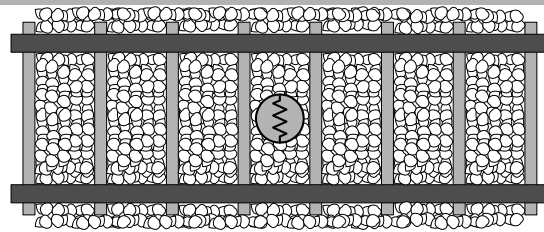


Figure 7 – photocell placement

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* 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 6 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.

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* to still properly detect a train that has stopped over any photocell with the gap between cars over a photocell.

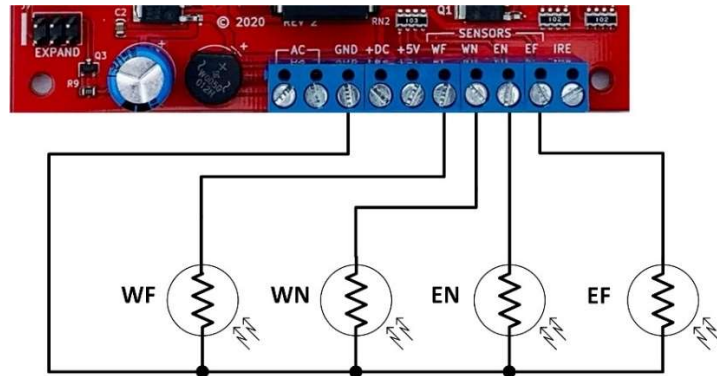


Figure 8 – Photocell wiring

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* 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 9. In this mode the signals will not flash. The *Grade Crossing Pro/2* 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 9 - SETUP mode

Now follow these steps after you have connected power (see page 9) to the board:

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 1 1/64” holes, through the ballast, roadbed, and sub-roadbed. These holes should be located one tie apart (Figure 10a) and drilled at a slight angle from vertical (see Figure 10b). 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.

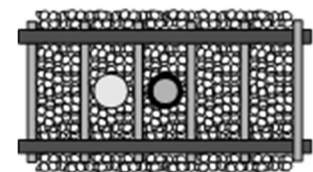


Figure 10a

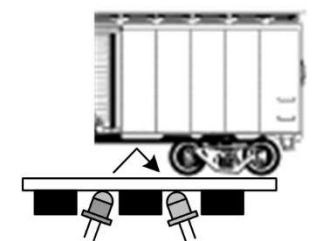


Figure 10b

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 11a and 11b; 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 to minimize the possibility of false triggering from visible light sources; this is illustrated in Figure 11a. We would also recommend that you angle the emitters and detectors across the track as shown in Figure 11b. 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).

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 SETUP configuration switch in the ON position.
2. Work with each emitter/detector pair at a time. If they are not aligned properly the associate red status LED on the board will be lit. Adjust the position of the emitter or detector until that red status LED turns off.
3. Once you have all four red status LEDs off try blocking the IR beam at each of the four locations and verify that the appropriate status LED turns on.
4. 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.

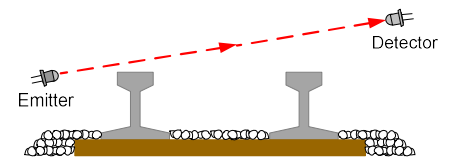


Figure 11a

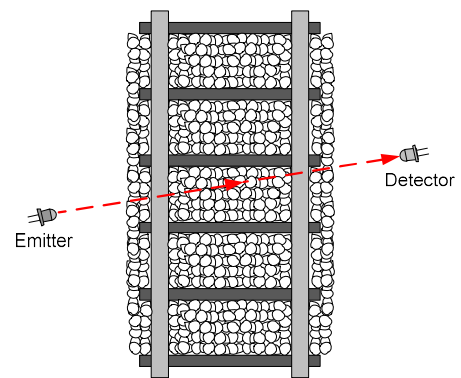


Figure 11b

IR component wiring



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

Figure 12 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*. 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* 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 9. In this mode the signals will not flash. There are four sensor status LEDs; one near each of the four photocell sensitivity adjustment pots.

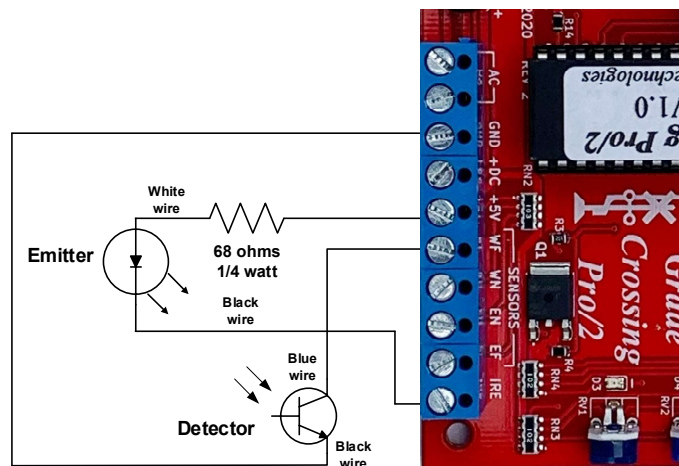


Figure 12 – IR component wiring

(WF input shown; replicate for WN, EN and EF inputs respectively)

NOTE: The four adjustment pots have NO affect when using either infrared sensor mode! Do the following after you have connected power (see page 10) to the board: 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 13 shows how they would be partitioned. Figure 14 shows how simple it is to connect the BD20 block detectors to the *Grade Crossing Pro/2*. **NOTE: The four adjustment pots have NO affect when using this mode!**

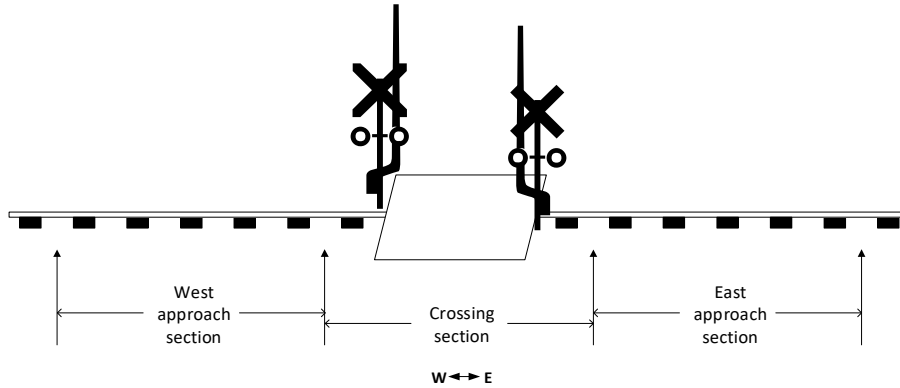


Figure 13 – External detector zone partitioning

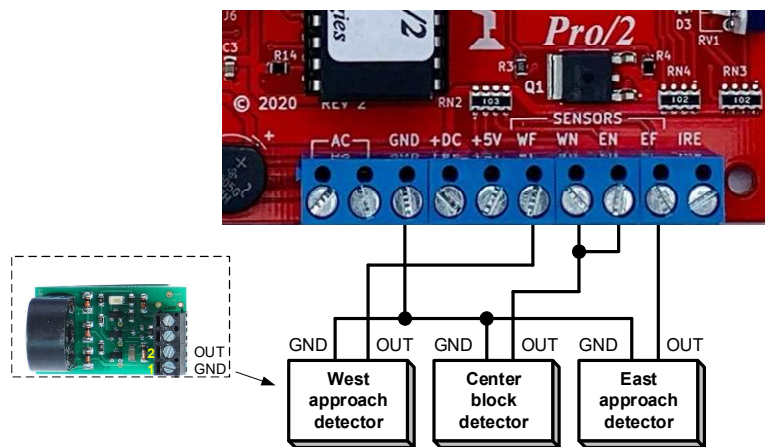


Figure 14 – External detector wiring (NCE BD20 shown)

Grade crossing bell

The *Grade Crossing Pro/2* can control a grade crossing bell sound module in two ways. The preferred way, and less expensive option, is to plug in one of the bell modules we offer (#BELL-CL, #BELL-MD, #BELL-FA, #BELL-GS). If you use one of these modules the *Grade Crossing Pro/2* will fade the sound off when shutting off the bell. There are two sockets on the board to accept the module as shown in Figure 15a below. Carefully install the bell module by lining up the pins on the bottom of the module to the mating sockets on the *Grade Crossing Pro/2* board. Note that when the module is properly installed the bell module label will have the printing oriented in the same direction as the *Grade Crossing Pro/2*'s main chip. Also, there will be two open socket locations along the top end of the lefthand socket. A properly installed bell module is shown in Figure 15b below. The bell module requires an 8Ω speaker connected to the SPKR outputs as shown in Figure 15b. You can adjust the volume of the bell sound using the potentiometer labeled VOLUME next to the SPKR terminals.

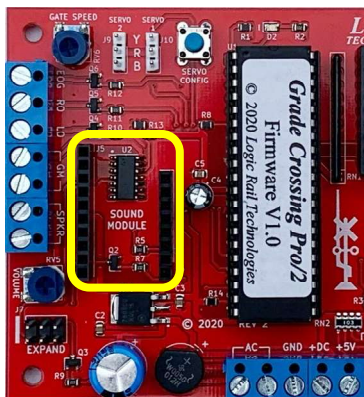


Figure 15a - Location for bell module

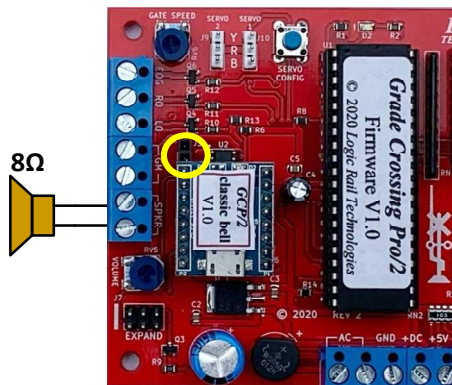


Figure 15b – Bell module installed

Figure 16 shows the wiring for an external grade crossing bell sound module. **Shown is the ITT sound module version from 2018 through the date on this document; contact us if you have a different version!** You will need a 6 conductor ribbon cable (available from us, part number X-CABLE) to make the connections. The black connector end plugs onto the 6 pin header labeled “EXPAND” on the *Grade Crossing Pro/2* board. Make sure that the red stripe on the cable is closest to the edge of the board; there is a white stripe printed on the board to the left of the 6 pin header as a hint! Pin 1 (red stripe) of the cable provides +DC power to the bell module while pin 6 of the cable provides the “ground” connection to the bell module when it is turned on by the *Grade Crossing Pro/2*. Note that you must install a small wire jumper between the two terminals on the bell module labeled SW. Finally, connect any 8 ohm speaker to the bell module. The ITT sound modules have their own volume control; the volume control on the *Grade Crossing Pro/2* does NOT affect an external bell module!

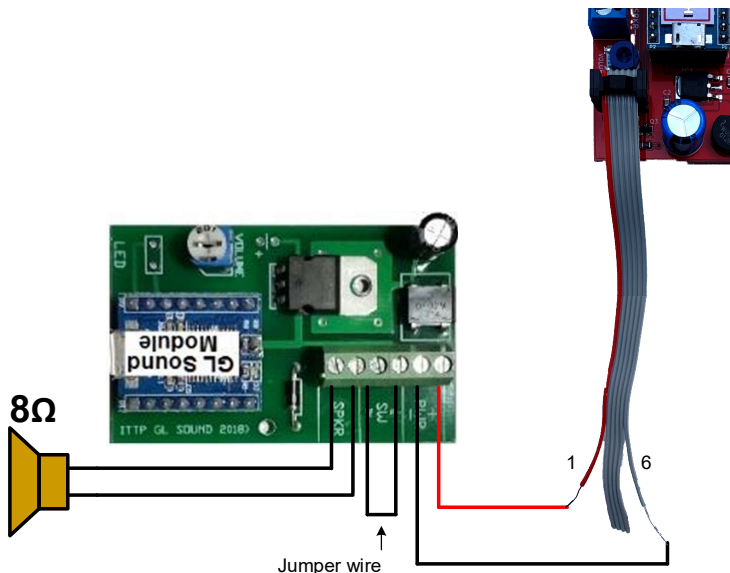


Figure 16 – External bell module

Gate and bell timing options

The *Grade Crossing Pro/2* has three configuration switches which give you several options for the timing of the gates lowering and ringing the bell (if a bell module is installed or attached externally). The crossing gate motor outputs will activate (i.e. to lower the gate arms) either approximately 3 seconds after the signals start flashing (GATE DELAY switch in the OFF position) or approximately 1.5 seconds after the signals start flashing (GATE DELAY switch in the ON position). There are examples of prototype crossing gate behaving either way!

The bell module will always be turned on as soon as the signals start flashing. When the bell rings after that is based on the combination of the GATES USED, BELL MODE and BELL SHUTOFF switches. The behavior is described below.

GATES USED	BELL MODE	BELL SHUTOFF	Bell behavior
OFF	(doesn't matter)	(doesn't matter)	Rings continuously while signals are flashing
ON	OFF	OFF	Rings continuously while signals are flashing
ON	OFF	ON	Stops ringing as the train clears but before flashing stops
ON	ON	OFF	Only rings while gates are lowering or raising
ON	ON	ON	Only rings while gates are lowering; no ringing when gates rise!

Once again there are examples of prototype crossing bells behaving in each of these ways!

Power

The *Grade Crossing Pro/2* accepts AC or DC power (7 - 16V). Power consumption, including the signals, ranges from ~90 mA (photozell version) to ~225 mA (infrared version). If you are only using a single board then you can use the AC terminals to provide power as shown in Figure 17a. **We do NOT recommend use of the accessory terminals on your throttle/power pack; they do not provide “clean” and consistent power.** If you are using more than one *Grade Crossing Pro/2* (for example, if you’re interlocking with turnout positions) then you should consider powering them all from a single DC source as shown in Figure 17b. Watch the polarity and make sure you know what is positive! Contact us if you are uncertain! **When power is first applied the signal outputs will turn on briefly in sequence (Left → Right → End-of-gate-arm).**

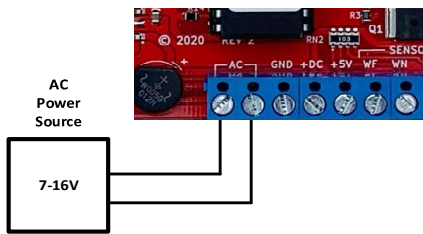


Figure 17a – AC power

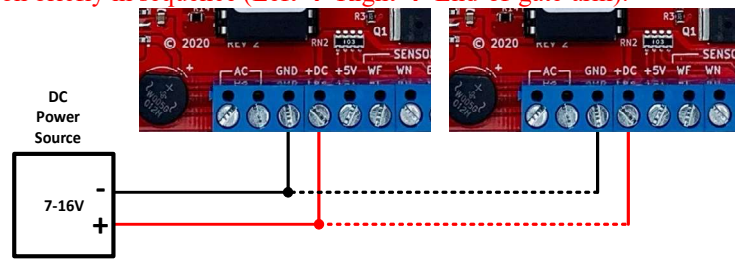


Figure 17b – DC power

Multi-track grade crossings (using photocell detection)

There is an obvious tendency to just add additional photocells to handle additional tracks when you have a multi-track grade crossing. The problem with this implementation is that the *Grade Crossing Pro/2* cannot differentiate between two trains traveling in opposite directions on different tracks. As such it could easily get “confused” and not provide the prototypical sequencing (i.e. the action starts when the train covers a far photocell and the action stops when the train clears the near photocell on the other side of the crossing). If you will have multiple trains traveling through the crossing area (with outer boundaries defined by the far photocells) at the same time then you must use one *Grade Crossing Pro/2* for the first track and a *Grade Crossing Pro/2 Expander* for each additional track. See the next section for details on how to connect the *Grade Crossing Pro/2 Expander(s)*. If you operate your trains such that only ONE train can possibly go through the crossing area at a time then you CAN simply add additional photocells (part number PCELL; \$2.00 each available from us) for the additional tracks. In this implementation you will wire the additional photocells in series with their counterparts on adjacent tracks. Figure 18 below illustrates the photocell wiring for a two-track crossing. You MUST go through the photocell sensitivity adjustment process on pages 5. Do NOT use more than 3 photocells in series for each sensor input (i.e. 3 tracks) as we cannot guarantee reliable operation!

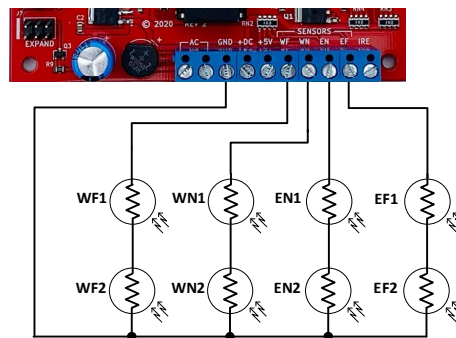


Figure 18 – Two track crossing using extra photocells

Multi-track grade crossings (using between-the-rail infrared detection)

There is an obvious tendency to just add additional sensors to handle additional tracks when you have a multi-track grade crossing. The problem with this implementation is that the *Grade Crossing Pro/2* cannot differentiate between two trains traveling in opposite directions on different tracks. As such it could easily get “confused” and not provide the prototypical sequencing (i.e. the action starts when the train covers a far sensor and the action stops when the train clears the near sensor on the other side of the crossing). If you will have multiple trains traveling through the crossing area (with outer boundaries defined by the far sensors), at the same time, then you must use one *Grade Crossing Pro/2* for the first track and a *Grade Crossing Pro/2 Expander* for each additional track. See the next section for details on how to connect the *Grade Crossing Pro/2 Expander(s)*. If you operate your trains such that only ONE train can possibly go through the crossing area at a time then you CAN simply add additional sensor sets (available from us) for the additional tracks. In this implementation you will wire the additional sensors the same way you did for their counterparts on the first track (i.e. per Figure 12). For example, the blue wire from ALL of the WN detectors will connect to the WN terminal on the *Grade Crossing Pro/2*.

Multi-track grade crossings (using across-the-rail infrared detection)

There is an obvious tendency to just space out the IR emitters and detectors such that they span all tracks for a multi-track grade crossing. The problem with this implementation is that the *Grade Crossing Pro/2* cannot differentiate between two trains traveling in opposite directions on different tracks. As such it could easily get “confused” and not provide the prototypical sequencing (i.e.

the action starts when the train covers a far sensor and the action stops when the train clears the near sensor on the other side of the crossing). To avoid this situation you will need to use one **Grade Crossing Pro/2** for the first track and a **Grade Crossing Pro/2 Expander** for each additional track. See the next section for details on how to connect the **Grade Crossing Pro/2 Expander(s)**.

Multi-track grade crossings using the Grade Crossing Pro/2 Expander

For the most realistic, “no operational exceptions” grade crossing behavior you will need one **Grade Crossing Pro/2 Expander** for each additional track beyond the first one. The **Grade Crossing Pro/2 Expander** connects to the **Grade Crossing Pro/2** with a single cable which is included with each **Grade Crossing Pro/2 Expander**. Connect one end of the cable, with the red stripe aligned to the left edge of the circuit board, as shown in Figure 19a, 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 19b and 19c. Please refer to the **Grade Crossing Pro/2 Expander** instructions for all other details on wiring, switch configuration and setup.

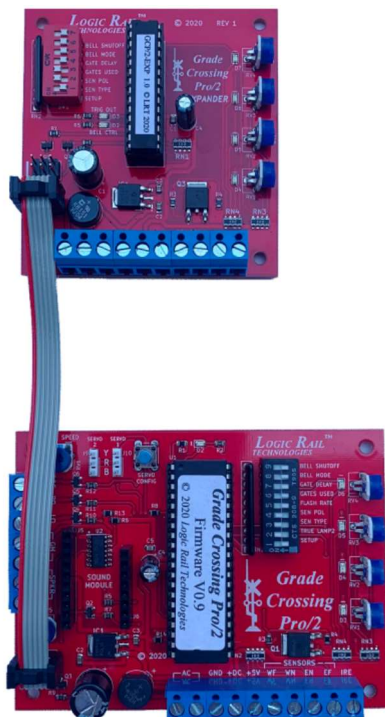


Figure 19a – Connecting the GCP/2 and GCP/2 Expander

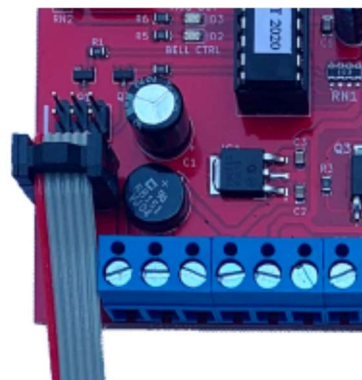


Figure 19b – GCP/2 Expander with cable attached

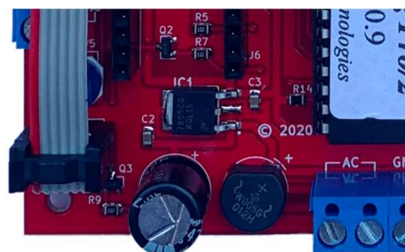


Figure 19c – GCP/2 with cable attached

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 2 on page 5). Second, revisit the photocell sensitivity adjustment process on pages 6. 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** 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 yet one or more of the red sensor LEDs is lit up then double check the signal wiring. A typical error is assuming that the common wire connects to ground (GND) - it doesn’t! The common wire must connect to the DC terminal regardless of the color of that wire!

If your signals fail to flash when you cover a particular sensor location then double-check your sensor wiring. 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 2 on page 5).

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.

Before returning the product to us for warranty service please contact us by phone or email. We will advise you as to what steps to take. 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.