Oak Tree Systems

SC-2 Servo Controller
Installation and User's Manual

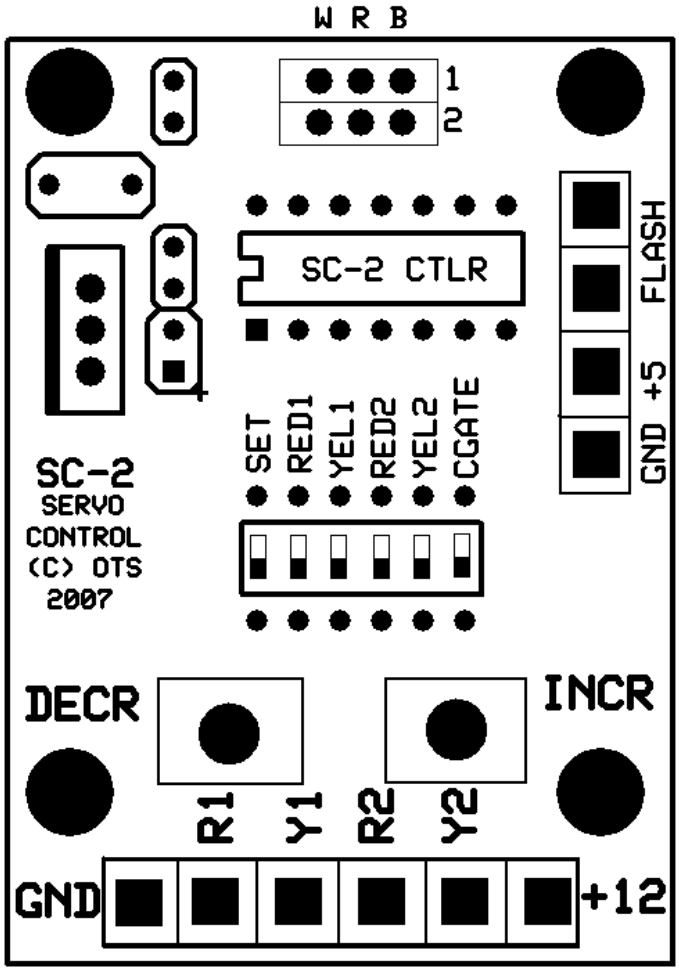


Figure 1
SC-2 Servo Controller Board

Introduction

The SC-2 Servo Controller is a versatile electronic controller that may be used to operate semaphore signals, train order boards, crossing gates, or other devices where precision positioning of a movable arm is required. The SC-2 controls two standard "radio control" servos independently, allowing complete control of two separate semaphores, one dual-head semaphore, dual crossing gates, or any two positional devices.

In addition to the servo outputs, the SC-2 has outputs for two LED lamps. These lamps will alternate when the SC-2 is used as a crossing flasher, or may be used to illuminate the LED lamp of a semaphore signal.

Control of the SC-2:

The SC-2 has two sets of inputs: Red and Yellow for servo 1 and Red and Yellow for servo 2. If neither the Red nor Yellow is activated for a servo, the servo is moved to the Green position.

Each input is activated by completing a circuit from the input to ground. This is in keeping with the operation of most detectors and computer interfaces that provide an "open collector" or "open drain" output. If mechanical switches or relays are used to activate the inputs, they should connect the input of the SC-2 directly to ground. Never connect any voltage above 5 volts DC to the inputs! Doing so may cause damage to the board.

Each servo output may be adjusted independently to position itself for each of the three different positions. There are no pre-set positions for the servo outputs, allowing for complete freedom to set up the linkages to the semaphore, gate or other device as desired.

In semaphore mode, only one input is generally active (grounded) at a time. If multiple inputs are received, Red will take precedence over Yellow. If there are no inputs active, the semaphore will assume the Green position.

In crossing gate mode, Red is used to select the down gate position, while the Yellow input is used to turn on the crossing flashers. The flashers will also be on when the Red input is activated. If both the Red and Yellow inputs are on, the gates will be down and the lights will be flashing. If no inputs are received, the gate will be in the up (Green) position, and the flashers will be off.

The table below summarizes the normal output conditions of the SC-2 for various combinations of inputs. Crossing Gate (CG) mode is enabled by moving a switch on the board. These conditions apply to each of the controlled servos and their respective inputs.

CG Mode	Yellow In	Red In	Servo Position	Lights
Off	Off	Off	Green	On
Off	On	Off	Yellow	On
Off	Off	On	Red	On
Off	On	On	Red	On
On	Off	Off	Up (Green)	Off
On	On	Off	Up (Green)	Flashing
On	Off	On	Down (Red)	Flashing
On	On	On	Down (Red)	Flashing

NOTE: In Crossing Gate mode, only the servo 1 inputs should be connected; both gates will operate at the same time when the servo 1 Yellow or Red input is activated. There is only one set of flasher outputs, but multiple LEDs may be connected in parallel to the outputs, for those cases where there are two gates and two crossing flashers.

Installation:

The SC-2 is a small (2 x 1.6 inch) circuit board, which may be mounted to any non-metallic surface such as plywood, using the screws and spacers provided, at all four corners. If the optional Oak Tree Systems' servo and mount are utilized, the board may be attached to the front of the mount by using the holes and hardware provided.

Access to the board is required for adjustments after the servo mount and linkages have been installed and connected. Information on mounting and connecting the Oak Tree Systems' servo and mount is provided with that package. Other types of servos may be mounted as desired by the user.

The SC-2S has 6 screw terminals across the bottom of the board. Referring to ***Figure 1*** on page 2, from left to right these terminals are:

- Ground (marked GND)
- Red input for servo 1 (marked R1)
- Yellow input for servo 1 (marked Y1)
- Red input for servo 2 (marked R2)
- Yellow input for servo 2 (marked Y2)
- 9-12 Volt DC input (marked +12)

Turn off all power before making connections to the board. Then connect the positive lead from a well-filtered **DC** power source to the right terminal and the ground from the power source to the left terminal. Do not connect the R1, Y1, R2, or Y2 terminals until adjustments have been made.

The servo connections are at the top of the SC-2 board. Servo 1 is closest to the top of the board and servo 2 is immediately below it. Be sure the white (or yellow) servo wire is to the left and the black (or dark brown) wire is to the right. Any Futaba, JR, Hitec, or equivalent servo may be used, but do not use "high powered" servos. Standard, miniature, or micro servos may be used, and provide more than adequate power for semaphores and gates. A servo extension cable of 24 inches or less may be used if it is necessary to separate the servos from the board. Run the servo cable away from other electrical items on the layout to avoid affecting servo operation.

The initial setup of the linkage should be made with the servo arm in the neutral position. In this position, the semaphore arm should be near the yellow position or a crossing gate should be about halfway down.

If you are not sure whether the servo arm is in the neutral position, plug it into the board without installing the arm on the servo or connecting the linkage to the arm. Turn on power to the board and the servo will be centered. Then mount the arm to the servo in the neutral (horizontal) position and adjust the linkage to the semaphore or gate as described above. More details on typical linkages are included with the servo mount. The linkage should move freely and not bind at any point in its travel. When adjustments are made to servo position, be sure the servo does not "stall" at either end of its travel. The servos can produce more than a pound of force, but excessive binding may cause overheating of the servo or the control board.

The connectors to the right side of the board are for LED lamps or a low voltage grain of wheat type of lamp. The upper two connectors are for LEDs only. The third connector from the top is a +5 Volt output. The lowest connector is a ground. Wire the LEDs as shown in one of the two diagrams below, depending on the type of wiring in your crossing signal or semaphore. Do <u>not</u> connect incandescent bulbs to the upper two outputs.

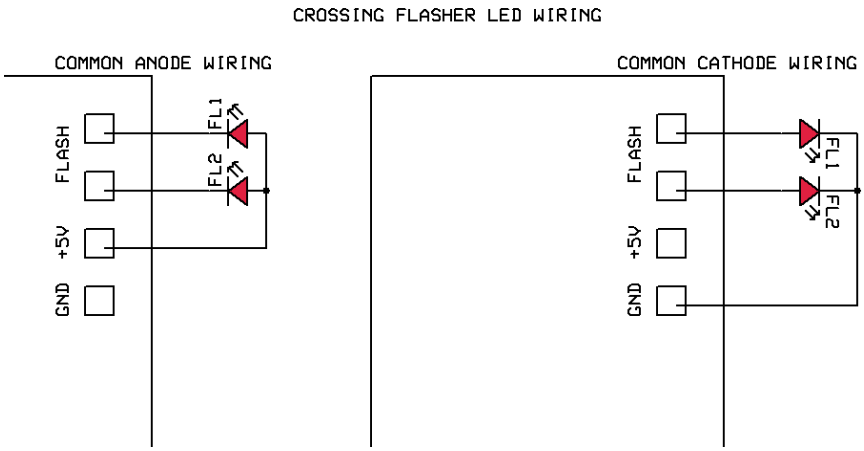


Figure 2

If you have a semaphore with a 1.5-1.8 volt incandescent bulb, the bulb may be connected between the +5 volt output and ground, with an appropriate current limiting resistor. For a 30 ma lamp, a 120 ohm resistor is appropriate. For a 60 ma lamp, use a 62 ohm resistor. The SC-2 will not operate crossing flashers with incandescent bulbs.

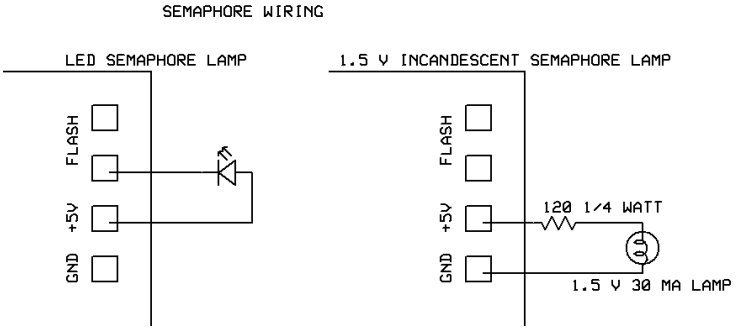


Figure 3

Setup:

After all wiring is complete (except the R1, Y1, R2, and Y2 inputs), turn on the 12 Volt power. The servos should move to approximately the center position when power is turned on. Push the leftmost switch (marked SET) to the upper position. Also, push the second switch (marked RED1) to the upper position. See the diagram on page 2.

You are now ready to adjust the "Red" position (for a semaphore) or the "Down" position (for a crossing gate) for the first servo. Push either of the two buttons on the board and hold it down for a second or two, then release it. The servo should move slightly when you press the button. If it moves the wrong way, push the opposite button. Continue pressing and releasing the buttons until the servo has positioned the semaphore or gate in the proper position. Shorter presses of the button will make finer adjustments possible. NOTE: The servo will move in very small increments when the buttons are pressed – you will have to hold the button down for nearly a minute to move the servo from one end of its range to the other.

To adjust the Green position for a semaphore or the up position for a crossing gate, both the RED1 and YEL1 switches should be placed in the upper position. When either button is pressed, the servo will move back to neutral. Adjust the position for the Green (semaphore) or Up (crossing gate) for servo 1, by pushing the buttons as before.

If you have a three-position semaphore, slide the RED1 switch to the lower position, leaving the YEL1 switch in the upper position. Adjust the servo again to the proper Yellow position. Turn off the YEL1 switch when finished.

For a crossing gate, the red or yellow switch will activate the flashers. The flashers operate independently of the gate(s) and may be on with the gates in either the up or down position. In crossing gate mode, it is not necessary to adjust the servos in the yellow position. This position will never be used for a crossing gate. If the LEDs remain lit when the RED1 and YEL1 switches are both in the lower position, you may have them

wired backwards or need to configure them for common cathode operation. See the section below on Crossing Flasher Configuration.

If you have two servos connected, repeat the above steps for the second servo, using the RED2 and YEL2 switches to select which position is being adjusted. When you are finished, be sure all the switches are in the lower position

This completes the servo position adjustments. If you are configuring a crossing gate, turn on the CGATE switch after the servo position adjustments are completed.

Speed Adjustment:

The speed at which the semaphore arm or crossing gates move may be adjusted over a range from less than one second to approximately 30 seconds. To adjust the speed, set the R1, Y1, R2, and Y2 switches to the lower position, and place the SET switch is in the upper position. Press the right button to increase the speed, which will reduce the transition time. Press the left button to decrease the speed, increasing the transition time. You can hold the button down as needed, but you will not see the effect of the change until the servo moves to a different position. Also, the servos may jitter or move erratically while a button is held down, but will return to normal operation after the button is released. The speed of both servos will be adjusted at the same time; there is no way to set the speed of the two servos independently. The SC-2 is shipped with the speed set for approximately 2 seconds for full end-to-end motion. You can check the speed of operation by turning the SET switch off and moving RED1 switch on and off to move servo 1 between red and green positions.

Crossing Flasher Configuration:

In crossing gate mode (CG jumper installed), the SC-2 will normally operate the crossing flashers as if they are configured in a common anode configuration; i.e. both the anodes are connected to the +5 volt output, while the two cathodes are connected to the FLASH outputs (see Figure 2, left diagram). If you must wire your flashers in a common cathode configuration (anodes grounded), the outputs must be inverted from the normal mode (see Figure 2, right diagram). For this configuration, move the SET switch to the upper position after the rest of the configuration steps are completed. This will cause the controller to invert the outputs to the crossing flasher LEDs when the red or yellow input is turned on. If you have common anode flashers, leave the SET switch in the lower position.

For a single LED, such as a semaphore light, connect the anode to the +5 volt terminal and the cathode to either of the FLASH terminals. Leave the SET switch in the lower position.

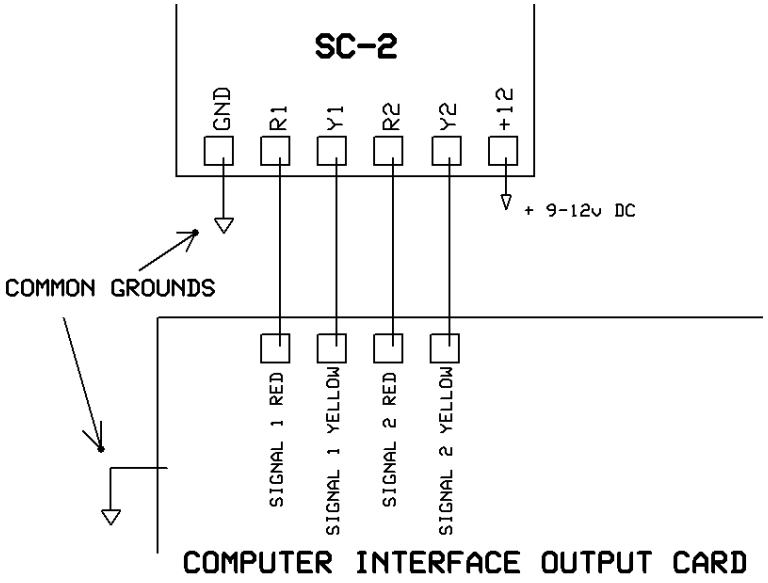
Flasher Speed Adjustment:

The rate at which the crossing flashers operate can be adjusted by following this procedure:

- After all other adjustments have been made, move the SET switch, CGate switch, and Yel2 switch to the upper (on) position.
- Press the Increase button to lengthen the time each flasher is on, slowing the flashing cycle. You may have to hold the button down for some length of time to make a major change in the timing.
- Press the Decrease button to shorten the time, speeding up the flashing cycle.
- Turn off the Yel2 switch after making the adjustment. Turn on the Yel1 switch to operate the flashers and see the results of your changes.
- When adjustments are complete, be sure the Yel1 and Yel2 switches are off. The SET switch may be on or off, depending on the wiring of your crossing lights. Leave the CGate switch on.

Operating the SC-2 Board from Your Computer System:

This description applies to operation of the SC-2 from a computerized system. For non-computer operations, see the next sections. ***IMPORTANT NOTE: Do NOT connect the SC-2 to Oak Tree Systems IO-24 card. The IO-24 has 12 volt output circuits and will damage the SC-2 card.*** Oak Tree Systems' O-48 or IO-48 cards, SECSI cards, and CMRI cards are all suitable for use with the SC-2.



Turn off the power to your system. Leave the CG switch set on if you are operating a crossing gate. Leave the SET switch on only if your crossing flashers are wired with common cathodes.

Connect the Red1, and Yellow1(if used), Red2 (if used), and Yellow2 (if used) wires to the output of your control system. For two-position semaphores, leave the Yellow inputs disconnected. Turn on the power to the system.

Operation of the SC-2 depends on the software you are using, but in general you can follow these instructions to control the attached devices:

Semaphore: Turning on an output connected to either the Red or Yellow inputs, will move the semaphore to that position. Turning off both outputs will move the servo to the Green position. Typically, you will not have both the red and yellow inputs on at the same time, but doing so will result in a red position.

For a two-position semaphore, you can operate with only one output connected to the RED input. The semaphore will stay green unless the Red output is activated.

Crossing Gate: Turning on the Yellow output will start the flashers alternating at the set interval. Turning on the Red output will lower the gate (flashers will also be on) and turning off both outputs will raise the gate and turn off the flashers. It is up to the software on the computer to perform the timing functions between activation of the lights and the gate and to determine when each should be activated – the SC-2 does not perform this logic.

Crossing gates are activated from the RED1 and YELLOW1 inputs only. Leave the RED2 and YELLOW2 inputs disconnected.

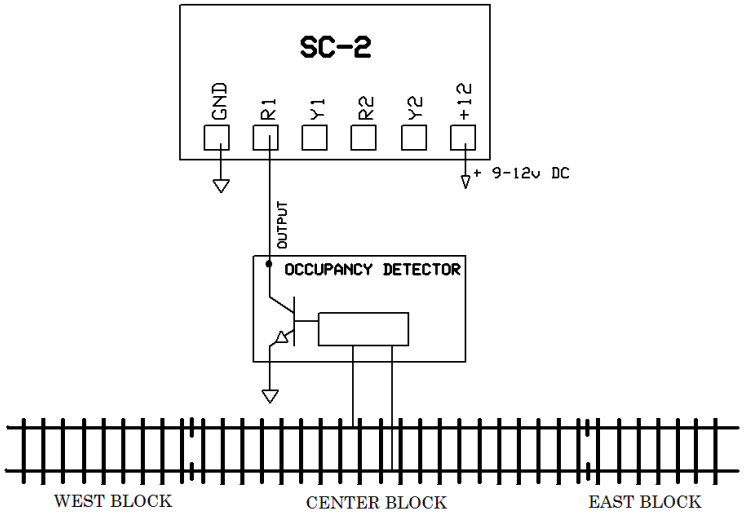
To operate the crossing gate with a single computer output, attach the computer to only the Red input. The gates and lights will be operated together when the Red input is active. There will be no separate control of the gates and lights.

Non-computer Operation:

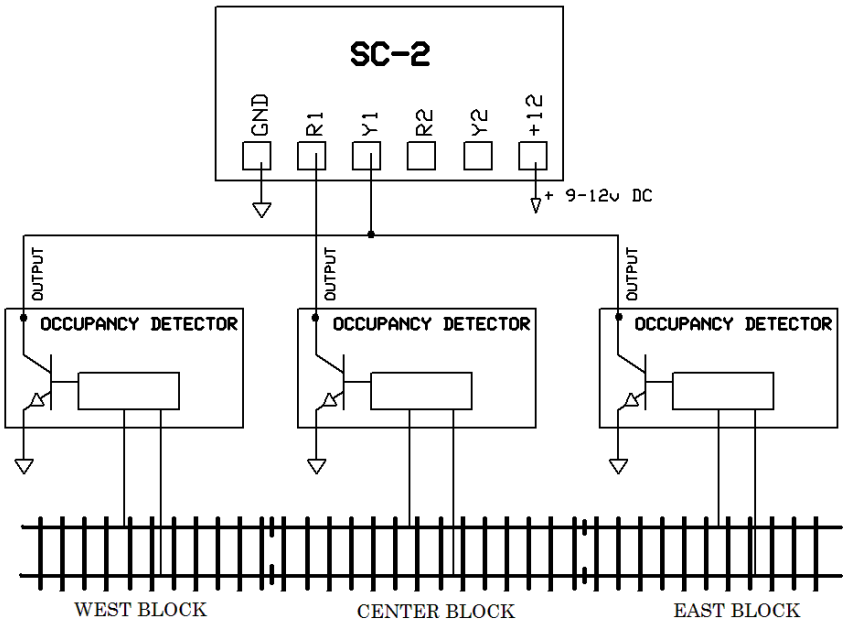
Both semaphores and crossing gates can be operated without a computer, by using current sensing block detectors with “open collector” outputs or relay outputs. The ground connection of the SC-2 and the block detector circuit board must be connected together for proper operation. If a relay output is used, it must connect the SC-2 input to ground when the detector is activated. Only current-sensing block detectors are suitable for this type of operation. Position detectors, such as infrared sensors, photocells, or reed relays, which do not necessarily maintain detection the entire time a block is occupied, will not work as well in this application.

To operate a crossing gate without a computer, the CGATE switch should be on. You can base the operation on either a single block of track or multiple blocks of track as described below. You will need to provide a separate block detector for each block of track that is to affect the operation of the gate.

Wire the block detectors according to the diagrams show below. For a single block, connect the output of the detector to the R1 input. In this case, the gates will lower and the lights flash whenever the single block is occupied.



For multiple blocks, you should have an “approach” block on either side of the center block, where the crossing is located. Wire the detectors from the approach blocks to the Y1 input, and wire the center detector to the R1 input. When either of the approach blocks is occupied, the flashers will be on. When the center block is occupied, the gates will be down and the flashers will be on. When none of the blocks is occupied, the gates will be up and the flashers will go off.



For a multiple track line, wire all the approach blocks' detectors to the Y1 input and all the center blocks to the R1 input.

To operate semaphores without a computer, you will need a block detector for each block of track. Connect the output of the detector in the block immediately after the semaphore to the R1 input. The semaphore will go red when this block is occupied. Connect the output of the detector from the second block down the line to the Y1 input. The semaphore will go yellow when this block is occupied. If neither block is occupied, the semaphore will go green. If both blocks are occupied, it will remain red.

If you have a two-position semaphore, simply connect the next block's detector to the R1 input. The signal will go red when the block is occupied and be green otherwise.

For a second semaphore or the second head on a two-head signal, connect detectors to the R2 and Y2 inputs. The second head will operate independently of the first.

Other Types of Operation:

The SC -2 can be operated from a toggle switch if desired. This might be desirable to operate an accessory like the spout on a water tower. Simply arrange the wiring so that the R1 or Y1 input is connected to ground when the toggle switch is on. Use two toggle switches or a single-pole double-throw center-off toggle switch if you need to adjust the servo to three different positions. A second servo can be operated with switches connected to the R2 and Y2 inputs.

Multiple Servos:

Two servos can be connected in parallel by using a "Y" harness, available where radio control accessories are sold. The servos will operate together and will not be individually adjustable, except by changing their individual linkages. Do not connect more than 4 servos in total to the SC-2 or you may damage the board.

Continuous Operation:

It is recommended that the SC-2 not be used to operate animation where the servos cycle back and forth continuously. Doing so may cause the servo to wear out prematurely, and may also overheat the SC-2 board. Generally speaking, a period of 10 seconds or more should elapse between operational movements of the servo, or a short period of continuous movement should be followed by a "rest" period of 30 seconds or more.

Do not connect the servos to spring-loaded devices which would require the servo to exert excessive force continuously to hold its position. Doing so may also overheat the servo and the SC-2. For the same reason, the device being operated should not have "stops" at the end of travel, which could cause the servo to stall and overheat. For this reason, the SC-2 may not be suitable for operating turnouts unless great care is taken to adjust the linkage so that the servo is never in a stalled condition.