



Servos to Control Model Railroad Switches

Getting Started

You are considering using servos to control switches on your layout and possibly arduinos to control the servos.

This document is a combination of ECD member Douglas Margison's research and experience. It was developed for people with some experience in model railroading who are considering building a new layout or want to update a current layout.

Servos

SG90 9G Micro Servo – the “KeeYees 5pcs SG90 9G Micro Servo Motor with PCA9685 16 Channel 12 Bit PWM Servo Motor Driver IIC Module” on Amazon.ca comes with a PCA9685 control board for use with an arduino and 5 servos

Mounts:

- Under the layout → search YouTube videos for examples – check out Shapeways – Berrett Hill (<https://www.berretthillshop.com/store/products/servo-ut-mount/>) – consult with Maritime model railroaders using 3D printers (e.g., Thingiverse <https://www.thingiverse.com/thing:1679838> printer file)
- Layout top well mount – see Berrett Hill servo “well mount” (<https://www.berretthillshop.com/store/products/servo-cradle/>) – consult with Maritime model railroaders using 3D printers

Tester: I found the “[CCPM Consistency Controller Motor Master Motor Speed Checker Tester](https://www.amazon.ca/gp/product/B07N9WJTJQ/ref=ppx_yo_dt_b_asin_title_o06_s00?ie=UTF8&psc=1)” (https://www.amazon.ca/gp/product/B07N9WJTJQ/ref=ppx_yo_dt_b_asin_title_o06_s00?ie=UTF8&psc=1) very useful in checking out servos before installing; and in setting them to neutral or other position

Resources:

- [DroneBot Workshop](https://www.youtube.com/watch?v=kUHmYKWwuWs&list=PLvD4ru8QD3s0w9q_IYYZHU5Ku6BFSvkJ5&index=57&t=690s) had a good tutorial on servo motors https://www.youtube.com/watch?v=kUHmYKWwuWs&list=PLvD4ru8QD3s0w9q_IYYZHU5Ku6BFSvkJ5&index=57&t=690s – demonstration of servo motor tester at 9:58; PCA9685 at 25:40 – PCA9685 is an I2C device used to control servo motors and LEDs (e.g, signals)
- Ruby's Model Railway 10 Turnout Servo Drive https://www.youtube.com/watch?v=dxNanN-tw_0 – focus is on mounting the servo
- Servo Motor Control for Model Railways Part 1 of 3 – Setup with Arduino <https://www.youtube.com/watch?v=ayOoUkdjHtg> – presenter uses a PCA 9685 PWM Servo Driver
- Updated: Using Servo's to Control Model Rail Turnouts <https://www.tamvalleydepot.com/products/octopusservodriver.html> – presenter uses the Tam Valley Octopus III Servo Driver



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Servo control

“Arduinos”

The Do It Yourself approach employs an arduino and a PCA9685 control board. With the PCA9685 board, a Nano (32 kb flash memory) should be sufficient depending on the sketch size and number of trigger input pins.

Arduino Nano V3.0; Lafvin Nano V3 ATmega 328P; ELEGOO Nano Board CH340/ATmega328P, Compatible with Arduino Nano V3.0

Need more flash memory — the Arduino Nano Every has 48 kb of flash memory

Need more pins ± more memory — an Arduino MEGA 2560, Elegoo equivalent or Keyestudios equivalent should fit the bill

PCA9685 is an “I2C” device — SCL (clock) pin on Servo Driver board connected to A5 pin on the arduino; SDA pin on Servo Driver board is connected to A4 pin on the arduino —

- VCC and GND on the board are connected to the 5v DC power source coming into the 5+v and GND pins on the arduino – on a breadboard, jack the Dupont wires from the DC barrel adapter terminals or voltage regulator output terminals and the Dupont wires from the PCA board into the 5+v and GND columns
- Servo power terminals are also connected to a 5v DC power source at the DC barrel adapter terminals or voltage regulator output terminal

The PCA9685 can also be used to control signal LEDs for the turnouts

Up to 16 servos + LEDs can be controlled with each board — boards can be daisy chained ← search out YouTube videos on how to do this and set the board address for each added-on board

Power source:

- AC to 5v DC power supply with a +ve / -ve screw terminal to DC barrel adapter; or
- Voltage regulator with 12 v input from 12 v DC layout bus → adjust output to 5 v — I prefer the DROK LM2596 Numerical Control Voltage Converter Board – or equivalent if DROK not in stock



Resources:

- Basic Arduino Servo Control for MR <https://www.youtube.com/watch?v=dodydRF7BBw>
- Arduino C++ Controlling LEDs with a PCA9685 PWM Servo Controller https://www.youtube.com/watch?v=zTxTvoxb63k&list=PLvD4ru8QD3s0w9q_IYYZHU5Ku6BFSvkJ5&index=56



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- PCA9685 PWM 16-Pin Board Chain Configuration Details
https://www.youtube.com/watch?v=-SGKnX_kVgc&list=PLvD4ru8QD3s0w9q_IYYZHU5Ku6BFSvkJ5&index=54
- Controlling 32 Servo Using PCA9685 and Arduino: V3 <https://www.youtube.com/watch?v=6P21wG7N6t4&list=PLHvJ4bw0xno5LzzZ2vjwwGKJvvSMWeIYV&index=3>
- Connect up to 992 Servos to an Arduino using I2C <https://www.youtube.com/watch?v=mQK3Scp3QIs>
- Arduino Slow Motion Servo Turnout Control https://www.youtube.com/watch?v=xT98CcJdpHI&list=PLvD4ru8QD3s0w9q_IYYZHU5Ku6BFSvkJ5&index=79
- Add Realistic Slow Motion to Servo Point Motors https://www.youtube.com/watch?v=6sAGNx8bkQU&list=PLvD4ru8QD3s0w9q_IYYZHU5Ku6BFSvkJ5&index=84
- Query Davy Dick MERG <https://www.merg.org.uk/download/chapter/6>
- Note

Note

Commerical systems

Do a Google search for servo controller

- Tam Valley Octopus III Servo Driver
<https://www.tamvalleydepot.com/products/octopusservodriver.html>
- Model Railroad Control Systems <https://www.modelrailroadcontrolsystems.com/servo-controller/>
- MegaPoints Controller <https://megapointscontrollers.co.uk/product/servo-controller-12/?v=79cba1185463>
- Berrett Hill <https://www.berrethillshop.com/store/products/panel-package-8-servo/> — controlled through their Touch Toggles — splitter at the servo controller for an input to their relay to control signals

Adding Turnout Signalling

The arduino sketch could be used to control both the switch direction and the turnout signals.

DIY & Digital's YouTube video "Basic Arduino Control for MR" uses a momentary push button to control turnout position → push once to change from one route (e.g., through route) to the other (e.g., diverging route). Push a second time to switch back. Jimmy walks one through the code for tracking the number of pushes and using that to determine route direction. I used this method on my N-scale layout.



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Another trigger could be a SPST toggle → one direction current flows and the arduino pin becomes active. In the other direction no current flows and the arduino pin becomes inactive. Generally the pin is set up as a GND pin — active = LOW or 0: inactive = HIGH or 1. You use LOW and HIGH to determine switch direction and signal control → IF the trigger pin is LOW do this, Else do this.

Within each CASE / IF scenario you can add code to manage each LED in a signal — is the LED On or Off. Each LED will need a PCA9685 address. On the facing point side, one address might activate Green LED for the Through Route and Yellow LED for the Diverging Route. On the trailing side, one address activates Green LED if turnout is aligned to that route and Red LED if it is not → 2 signals on trailing side (one for Through Route and second for Diverging Route) = 6 addresses for signals + one for the servo → limiting you to essentially 2 servos per PCA9685 board with 2 ports left vacant. For more servos + signals you would need to daisy chain PCA9685 boards

With a Nano one is limited to 14 input pins. I haven't tried using shift registers to increase the number of input ports — [DroneBot did a YouTube video on Shift](#)

Registers <https://www.youtube.com/watch?v=Ys2fu4NINrA> → 2 main types: SIPO = Serial In Parallel Out — used to expand # of digital output ports (74HC595 chip); and **PISO = Parallel In Serial Out — used to expand # of input ports (74HC165 chip)**

- Resource: <https://www.woolseyworkshop.com/2021/02/18/adding-digital-io-to-your-arduino-part-2-the-74hc165/>

Note