SERVO DRIVER

This kit is available from:

Talking Electronics

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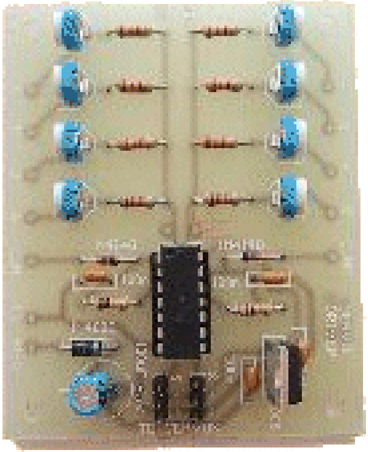
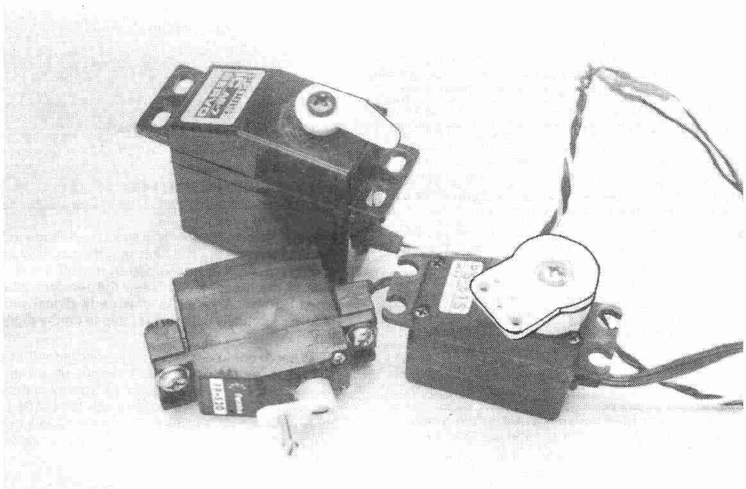
for pricing and postage.



SERVO DRIVER

Add some animation to your models! This simple circuit will enable you use the servos from Radio Control Sets as accurate accessory drives for your layout.



Three digital proportional servos, each from a different manufacturer. Each uses its own type of plug and wiring. Apart from this, they are interchangeable, as they all work with the positive pulse system.

So you've made the radio controlled throttle and now you have two servos lying around depreciating. If only you could use them for something...

Well now you can. This very simple circuit emulates a radio control system, providing an adjustable pulse suitable for driving servos. There are two similar circuits on the printed circuit board, each capable of driving a servo.

Now, what are you going to do with them? I can think of numerous possibilities, and will outline them here. A set of boom gates, or the older style crossing gates can be driven. As they contain a motor and reduction gearbox, servos are a lot slower than a solenoid. Because of this they will close the gates quite realistically. Another advantage is that the limits of the servo's travel can be simply adjusted using the trimpots provided on the printed circuit board. This means you won't have to spend hours trying to bend an obstinate piece of brass wire to get the gate to open to the right height, only to find that you have mucked up the closed position in doing so.

The printed circuit board has been arranged so that a switch can be used to select several adjustable preset positions. In this case, only two would be needed, one for open and one for closed. A single pole double throw (SPDT) toggle switch could be used to do the job, or a circuit could be arranged to do it automatically. The Crossing Boom Control described in Electronics for Model Railways Book 1 can be easily modified to do the job. Simply leave out the motor control circuit and use the contacts on the relay to switch between a pair of trimpots on the servo driver printed circuit board.

If full sized potentiometers are used instead of the trim pots, you can have direct and precise control over the servo's almost infinite number of positions. One use for such a setup springs to mind instantly. With two or three servos, a very precise operating crane could be made for loading and unloading your trains. This alone would make a club running day more fun. Goods are so often ignored due to the complexity and high price of commercial cranes.

Alternately, you could use the servo to drive a wagon tipper of the sort that is used to empty wagons into waiting ships.

A simple turn-table could even be made to operate from a servo. The obvious limitation in this case is the load which would be put on the servo. Unless you purchase an expensive "monster" servo, or put a great deal of effort into making the turn-table very free in its operation, you will most likely be limited to narrow gauge and N gauge. Another limitation with a servo is that it cannot turn a full 360 degrees. It is limited to roughly 270 degrees. This will allow a locomotive to be turned, but a little "shunting" may be required to get it facing the right way on a particular track.

The printed circuit board has provision for eight trimpots, making it easy to wire a rotary switch to the board to give eight preset positions. Aligning the turn-table with the tracks is simply a matter of adjusting the appropriate trim pot until the track and turn-table are aligned. You won't need to muck around with limit switches to get the thing to stop where you want it to. Power to the various sidings off the turn-table can be switched by another set of contacts on the same rotary switch. Those wishing to use digital or computer control can substitute a 4015 eight channel analog multiplexer for the rotary switch. Of course, an alternative arrangement will need to be made for switching the power to the tracks.

If you are building something that requires precise preset control such as a turn-table, I advise that only one servo be run off the printed circuit board. Slight variations in the power supply voltage or internal cross talk in the chip can put a servo out by a couple of degrees. Such an error is sure to lead to locomotives derailing.

Another important thing to consider when building something that requires precise control is the servo itself. Second hand servos have often had hard lives. It pays to hook the one you wish to use to the circuit and test it. While a servo might still be perfectly okay for an open/shut type application, it may be very jerky and non linear when used in a continuously variable mode. This is most likely caused by dust or damage to the pot inside the servo itself.

ABOUT THE CIRCUIT

The circuit consists of three major parts, the voltage regulator, and two identical servo controllers. The voltage regulator has a twin function. Firstly, it isolates the servo from power supply fluctuations, preventing it moving from preset positions. Secondly, it limits the voltage to five volts. Except for some special high speed units, servos for radio control systems are designed to run off five to six volts. One of the reasons is to keep the receiver battery pack weight down. Another is that early digital proportional receivers actually used a TTL chip to do the digital decoding.

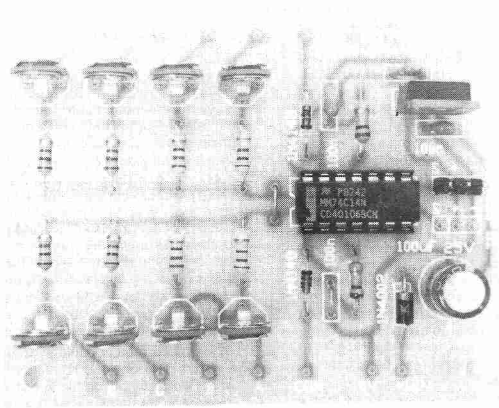
The servo controller is simply an oscillator that has been set up to emulate the pulse output of a radio control receiver. It has a cycle time of approximately 20 milliseconds. The positive pulse width (or MARK) is adjustable between about 1ms and 2ms. The 20ms cycle length is not critical, but the pulse width is, because this is what the servo responds to.

PARTS LIST

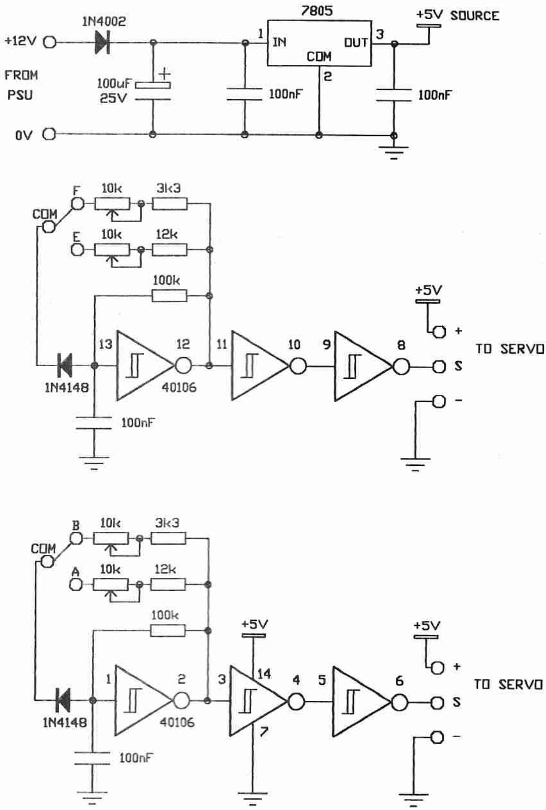
6- 3k3
2- 12k
2- 100k
8- 10k mini trimpots

4- 100nF monoblocks
1- 100uF 25V Electro

2- 1N4148
1- 1N4002
1- 7805 regulator
1- 40106 Hex Schmitt Inverter
1- 14 pin IC socket
2- 3 pin headers
1- **SERVO DRIVER PCB**



The 8 position version of the servo driver. Note the two links.



The Servo Driver circuit diagram.

The servo contains a monostable multivibrator. Its pulse width is adjusted by the pot that is connected to the servo's output shaft. The servo adjusts the pot so that its internal pulse width is the same length as the one that is being sent to it by the receiver, or in this case the oscillator. So by adjusting the pulse width we feed to the servo, we can control the position to which the servo will move.

The prototype servo controller used a National Semiconductor 74C14/CD40106B chip. If you use another brand, you may find that the timing becomes incorrect. If so, the value of the resistors or capacitors may need to be changed.

When you are adjusting the unit, or if you are using it with a pot, make sure that you do not let the servo try to run past its end. If you send a pulse that is either too wide or too narrow, the servo will try to match it but will run out of pot travel. As it will be physically impossible for the servo to turn any further, it will sit there with D.C. applied to its stalled motor, eventually damaging something. How do you know when a servo is at the end of its travel? Listen to it. If the servo is making any noise while it is stationary, it is either jammed or overloaded.

CONSTRUCTION

The Servo Driver is built on a printed circuit board measuring 78mm by 63mm. All components except for the switches are mounted on the board. No heatsink is required for the regulator.

Start construction with the lower components such as the resistors and the socket. Take care with the orientation of the capacitors, diodes, regulator and the chip, when you finally insert it in the socket.

Decide which version you are building and install the appropriate number of trimpots. If you are using five or more trimpots, replace the lower oscillator capacitor with a link.

Also place a link between the two spare pads at the end of the chip. You will also need to cut the track running from the lower of these pads to pins 2 and 3 of the chip. If you don't, the circuit won't function.

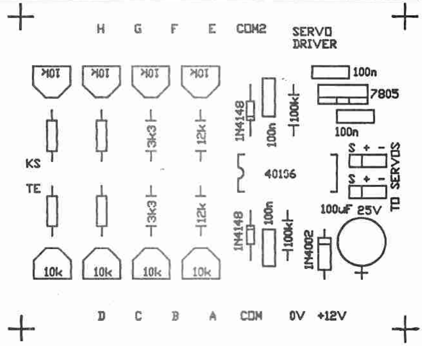
Not all servos use the same sort of connectors, or the same wiring order. The connectors provided are for the most common types of servo available at the moment, including Acoms and J.R. For other brands you will need to check the connections yourself before wiring the servos to the board. Usually a red wire is used for positive. Negative is usually black, but occasionally brown. The signal wire can be any color, white being the most common.

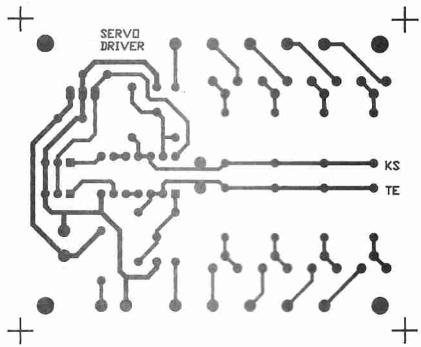
The fixed resistor values given in the circuit diagram give different offsets to the trimpots. 3k3 is the minimum value that may be used. You will notice that four of the values have not been specified. Select the values depending on where you wish to position the servo.

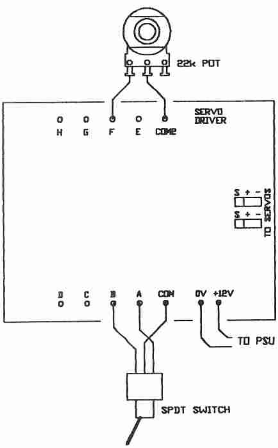
If you wish to use a pot so that you can have fully variable control, wire a 10k or 22k pot in series with one of the trimpots and 3k3 resistors on the board. The trimpot will allow you to preset the starting position of the servo. If you use a 22k pot, be careful that you don't try to run the servo past the end of its travel.

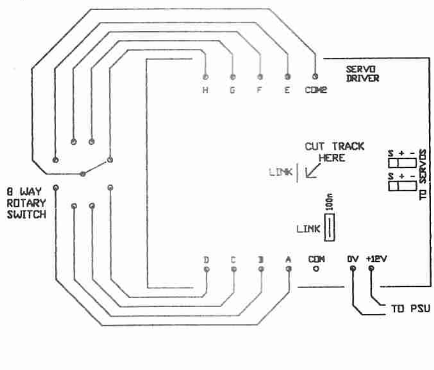
As mentioned in the delay article, it is possible to combine the delay and the servo driver to control a set of crossing gates. The Delay Module can be interfaced to the Servo Driver using either relays or a 4052 triple 2 channel multiplexer.

When installing the Servo driver on your layout, try to keep the wires as short and tidy as possible to avoid interference.









The three ways in which the servo driver can be wired. The diagram to the left shows the wiring for a two position setup and a fully variable one. The diagram to the right is for an eight position application, such as a turntable.