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Using a Rotary Encoder to Control Two X93254 Dual DCPs

Overview

In a system where there may be multiple Digitally Controlled Potentiometers (DCPs) it is often difficult to control each potentiometer individually. Normally this requires the use of a microcontroller. However, microcontrollers are difficult to program and require production control of the software. This application shows a simple hardware approach that works with multiple potentiometers having the 3-wire interface ($\overline{INC}$, U/$\overline{D}$, and $\overline{CS}$.) It provides a familiar rotary action to move the potentiometers up and down and provides a store option for non-volatile DCPs. The circuit is demonstrated using two dual X93254 potentiometers.

In the basic 3-wire interface, the potentiometer wiper is moved, either up or down, by the falling edge of the $\overline{INC}$ line, while $\overline{CS}$ is LOW. The U/$\overline{D}$ input determines the direction of wiper movement. A falling edge of $\overline{INC}$ while U/$\overline{D}$ is HIGH moves the wiper up. A falling edge of $\overline{INC}$ while U/$\overline{D}$ is LOW moves the wiper down. If $\overline{CS}$ is HIGH, the wiper does not move when $\overline{INC}$ is clocked.

With non-volatile potentiometers, like the X93254, the wiper position is not stored as long as the $\overline{CS}$ line goes HIGH before the $\overline{INC}$ line does. If the $\overline{INC}$ line is normally HIGH, a store operation can be performed once the desired position is achieved by toggling $\overline{CS}$.

A rotary encoder consists of two switches that are 90 degrees out of phase. These open and close as the shaft rotates. These switches are shown in Figure 1, with debounce components. The basic operation of the circuit derives from the quadrature output of the rotary encoder (as shown in Figure 2.) When the encoder rotates clockwise the B switch is LOW on the rising edge of the A switch. When the encoder rotates counter clockwise, the B switch is HIGH on the rising edge of the A switch.

A complete circuit for DCP control is shown in Figure 4, but simply, to convert the rotary encoder output to the 3-wire interface, the B output connects to the U/$\overline{D}$ pin of the potentiometers through an inverter. The A output goes directly to one of two one-shot multivibrators in a 74HC123 device. This output becomes the $\overline{CS}$ control. The $\overline{CS}$ output is delayed slightly and connected to the other one-shot. The second output is the $\overline{INC}$ signal. Both of these multivibrators use the same RC values, so they have the same output pulse width. The resulting output waveform is seen in Figure 3.

Figure 1. Rotary encoder circuit

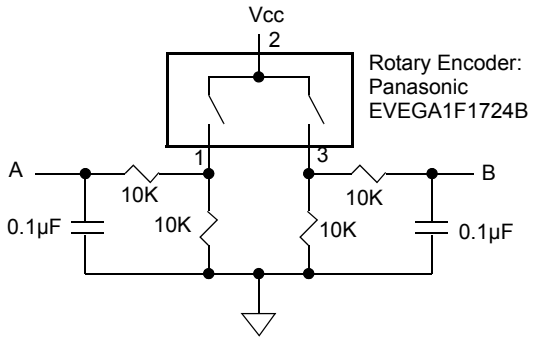


Figure 2. Rotary encoder output

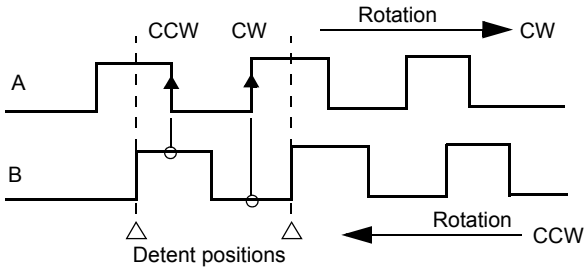
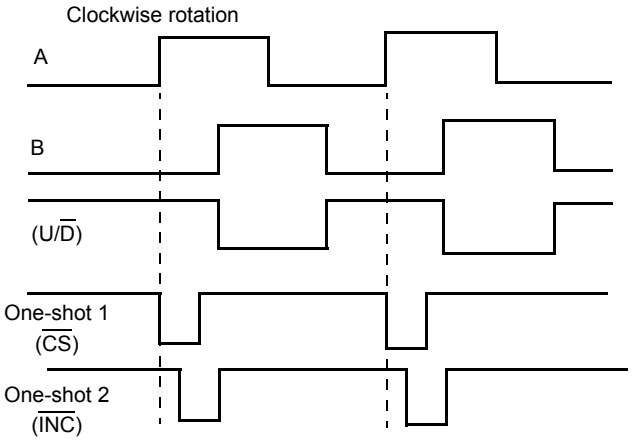


Figure 3. One shot output from rotary encoder



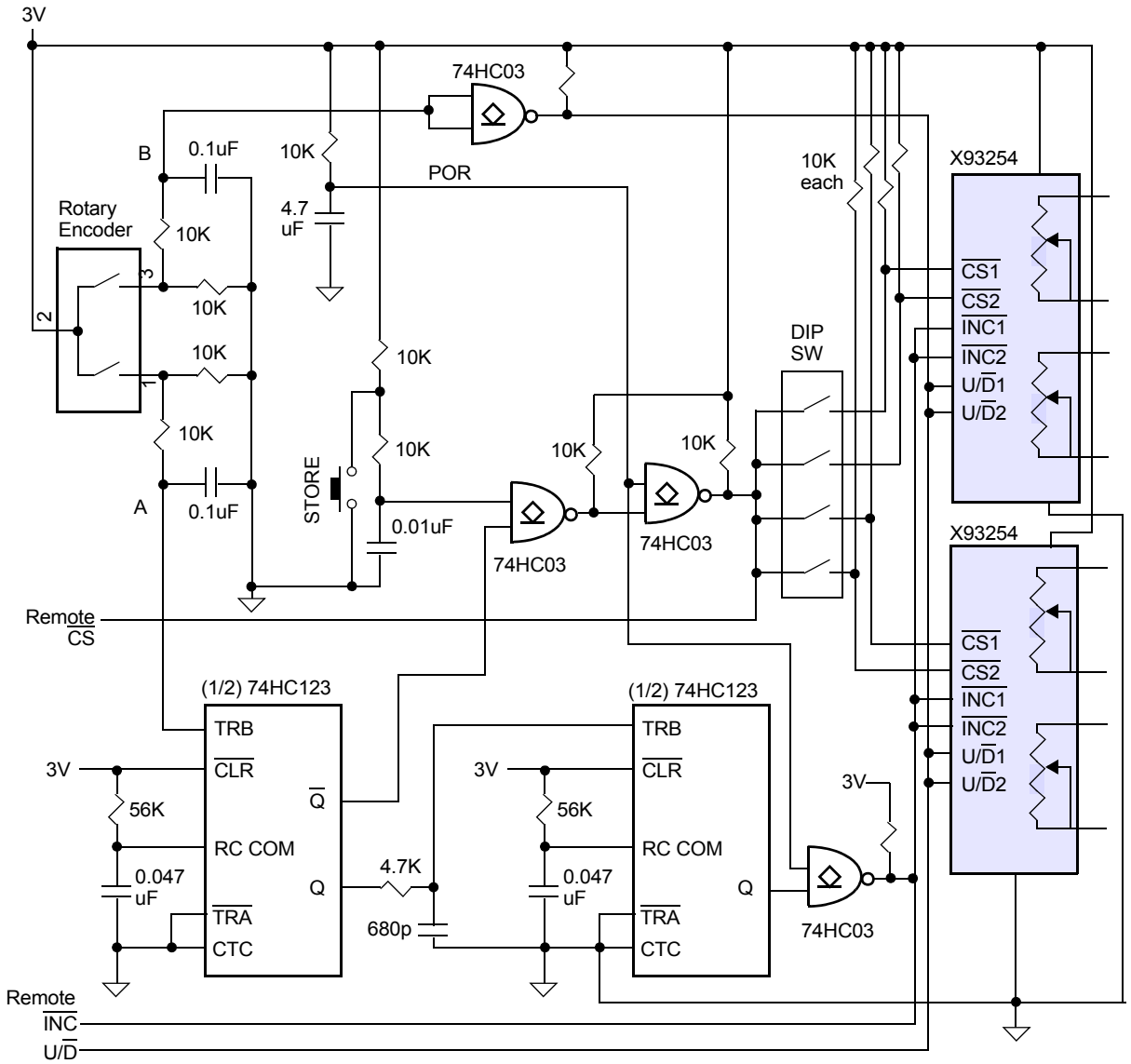
When initially powering up this circuit, there is a possibility that the rotary encoder will be in an undetermined state. As such, it could generate a one-shot pulse and cause a wiper movement.

To prevent wiper movement on power-up, $\overline{CS}$ and $\overline{INC}$ connect to one input of separate NAND gates with the other input on each connected to an RC Power-on Reset (POR) time constant. This prevents transitions on either $\overline{CS}$ or $\overline{INC}$ until the power supply has stabilized.

A DIP Switch provides control of each individual potentiometer $\overline{CS}$ signal separately or allows them all to move together. In this application, an open collector inverter is added to the $\overline{CS}$, $\overline{INC}$, and U/$\overline{D}$ lines so a remote computer control of the circuit is possible. These lines are normally pulled HIGH with a resistor, so a remote computer can pull each line LOW to control the devices. A slide switch or rotary switch could be used in place of the DIP switch for POT selection.

A debounced push button provides a store to those devices selected. Activate the switch when the rotary encoder is not moving.

Figure 4. Circuit diagram



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