One-Touch-Down Circuit for Power Windows and Power Sunroofs
Application Overview

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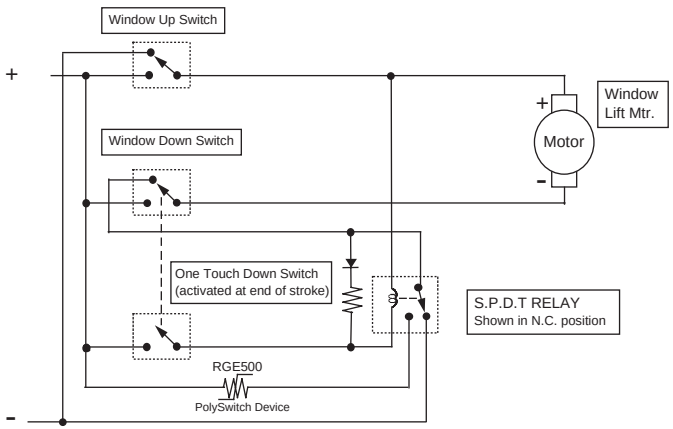
Problem/Solution

The express open feature of power windows and power sunroofs is becoming common on nearly all passenger cars and trucks. The most common technique switch manufacturers employ is to latch a relay in the energized state with a secondary activation switch. Once the relay is latched, the express, or "one touch" operation begins. Current flowing through the motor is monitored, by measuring the voltage drop across a precision value sense resistor. When the motor reaches the end of the travel, "stall condition", the current flowing will typically increase by several times the run current value. Therefore, the voltage measured across the sense resistor will also increase proportionally. An operational amplifier or a comparator circuit changes states when a predetermined threshold voltage

is reached. This de-activates the latched relay. Additional electronic functions are required to reject inrush current and transient voltages, and a fail-safe time-out feature is often added as a back-up for the event the primary system fails. The electronic components employed to make up these circuits can range from standard off-the-shelf semiconductor products to custom-manufactured ASICs.

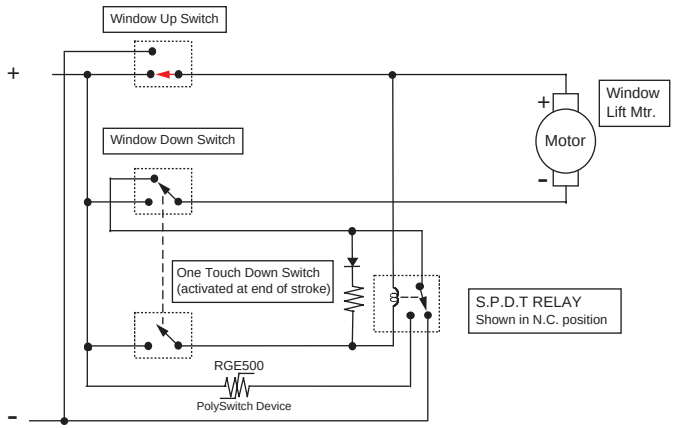
Figure 1. PolySwitch Device Employed in One-Touch Circuit



A low cost alternative solution is to use the circuit shown in Figure 1 which employs a PolySwitch device. The PolySwitch device functions both as a sense component and a switch component, replacing the sense resistor, comparator, driver, and control circuitry. Since there are no ASICs or Microprocessors used in this revised circuit, reverse bather protection and transient overvoltage suppression devices may also be eliminated The simplicity of the PolySwitch device solution offers enhanced reliability through reduced component count.

This circuit consists of a manual up (closing the window) switch, a

Figure 2. Motor Rotating in Upward Direction



manual down (opening the window) switch, an auto-down initiate switch, a low current blocking diode, a resistor, and a single-pole-double-throw (SPDT) relay. The manual up and down switch is mechanically interconnected to provide a mutually exclusive operation. The auto down switch is mechanically interconnected to the manual down switch, and is activated at the end of travel in a mutually inclusive operation with the manual down switch.

Both motor terminals are connected to the negative terminal of the power supply (vehicle battery) when none of the switches is activated. When the manual up switch is activated, the positive terminal of the power supply is connected to the positive terminal of the motor, and the negative terminal of the motor is connected to the negative terminal of the power supply. The motor will rotate in the upward direction (Figure 2).

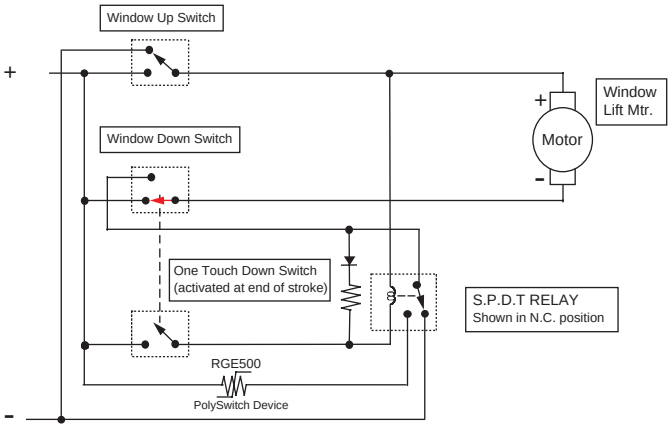
When the manual down switch is activated, the positive terminal of the power supply is connected to the negative terminal of the motor, and the negative terminal of the motor is connected to the positive terminal of the power supply. The motor will rotate in the downward direction (Figure 3).

When the auto down switch is activated, the relay coil will be energized connecting the positive terminal of the power supply through the PolySwitch device to the normally open contacts of the relay. The diode and resistor provide a current path to "latch" the relay in it's energized state (Figure 4). The negative terminal of the power supply is connected to the negative terminal of the relay coil through the normally closed contacts of the manual up switch.

When the manual down and auto-down switches are released, the positive terminal of the power supply maintains its connection to the negative terminal of the motor but is now connected through the PolySwitch device and the latched relay contacts (Figure 5).

When the motor reaches the end of travel and stalls, the current will be increased by up to four times the normal running current of the motor. This causes the PolySwitch device to heat-up and increase in resistance (due to its PTC characteristic). As the PolySwitch device heats, the voltage drop across it increases and the voltage across the relay coil drops. Once the voltage across

Figure 3. Motor Rotating in Downward Direction



the relay coil drops below its "drop-out" level, the relay will be de-energized, and the relay contacts will open interrupting the current flow to the motor.

This method of one-touch-down replaces the opening function of various methods used in existing systems. i.e., the system that is initiated by second detent, "momentary-on" activated, or timer activated one-touch open switches can be replaced by this method. The use of PolySwitch devices reduces the component count drastically. A lower component count usually means cost-savings.

Device Selection

AHR, AGR, AHS, ASMD

Figure 4. Diode and Resistor "Latch" Relay in Energized State

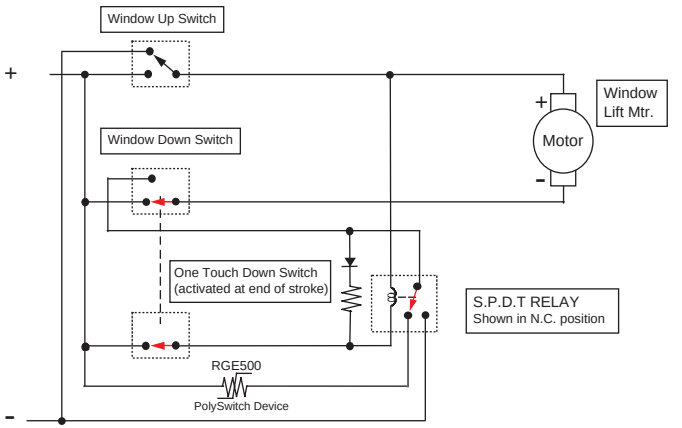


Figure 5. Negative Terminal of Power Supply Connected to Negative Terminal of Relay Coil Through Normally Closed Contacts of Manual up Switch