Simple VCOM adjustment uses any logic-supply voltage

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All TFT (thin-film-transistor) LCD panels require at least one appropriately tuned \( V_{\text{COM}} \) signal to provide a reference point for the panel's backplane. The exact value of \( V_{\text{COM}} \) varies from panel to panel, so the manufacturer must program the voltage at the factory to match the characteristics of each screen. An appropriately tuned \( V_{\text{COM}} \) reduces flicker and other undesirable effects. Traditionally, the \( V_{\text{COM}} \) adjustment used mechanical potentiometers or trimmers in the voltage-divider mode. In recent years, however, panel makers have begun looking at alternative approaches because mechanical trimmers can't provide the necessary resolution for optimal image fidelity on large panels. They also require a physical adjustment that technicians on the assembly line usually perform. This adjustment is not only time-consuming, but also prone to field failures arising from human error or mechanical vibration.

A simple alternative to achieving the increasing adjustment resolution for optimal panel-image fidelity is to replace the mechanical potentiometer with a digital potentiometer. Using digital potentiometers, panel makers can automate the \( V_{\text{COM}} \)-adjustment process, resulting in lower manufacturing cost and higher product quality. Unfortunately, many panels operate at higher voltages, and the choice of available supply voltages is limited. The system implementation for a 5V supply is straightforward (Figure 1). Without a 5V supply, the circuit can become more complex.

This Design Idea shows a simple way that you can use any available logic supply to power the potentiometer providing the \( V_{\text{COM}} \) adjustment. The 6- or 8-bit AD5258/59 nonvolatile digital potentiometer demonstrates this approach. An I²C serial interface provides control and stores the desired potentiometer setting into the EEPROM. The AD5259 uses a 5V, submicron CMOS process for low power dissipation. It comes in a space-saving 10-pin MSOP, an important feature in low-cost, space-constrained applications. For systems that have no 5V supply, many designers would be tempted to simply tap off the potentiometer's series-resistor string at the 5V location. This approach is not viable, because, during programming (writing to the EEPROM), the AD5259's \( V_{\text{LOGIC}} \) pin typically draws 35 mA. It cannot draw this current level through \( R_1 \) because the voltage drop would be too large. For this reason, the AD5259 has a separate \( V_{\text{LOGIC}} \) pin that can connect to any available logic supply. In Figure 2, \( V_{\text{LOGIC}} \) uses the supply voltage from the microcontroller that is controlling the digital potentiometer. Now, \( V_{\text{LOGIC}} \) draws the 35-mA programming current, and \( V_{\text{DD}} \) draws only microamps of supply current to bias the internal switches in the digital potentiometer's internal resistor string. If the panel requires a higher \( V_{\text{COM}} \) voltage, you can add two resistors to place the op amp in a noninverting gain configuration.

The digital potentiometer has ±30% end-to-end resistance tolerance. Assuming that the tolerances of \( R_1 \), \( R_3 \), and \( V_{\text{DD}} \) are negligible compared with those of the potentiometer, you can achieve the range of output values that Table 1 shows. Assume that the desired value of \( V_{\text{COM}} \) is 4V±0.5V, with a
maximum step size of 10 mV. As Table 1 shows, the circuit in Figure 2 guarantees an output range of 3.5 to 5.4V with a step size within ±10 mV. And, despite the ±30% tolerance of $R_2$, the midscale $V_{COM}$ output meets the target specification. Also, because the digital potentiometer's logic supply matches the microcontroller's logic levels, the microcontroller can read data back if desired. Figure 3 shows a block diagram of the digital potentiometer.

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