The ISL95311 device contains a 3-terminal digital potentiometer and control section. All three terminals are utilitized when the device is used in voltage divider mode. If the wiper (Vw terminal) is connected to either the Vh or VL terminals, then the device is used in rheostat mode and is effective for current control. These two configurations can be used with opamps and comparators to implement a variety of control and signal processing circuits.

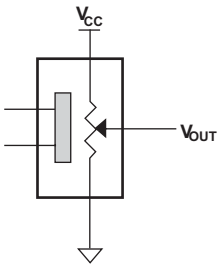

FIGURE 1A. VOLTAGE DIVIDER MODES

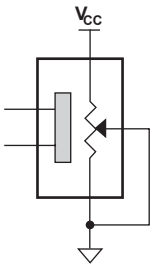

FIGURE 1B. RHEOSTAT MODES

VCOM Circuits

LCD TFT panels need to have a common voltage supplied to their backplane. This signal is generally referred to as the VCOM voltage and is typically set to half the main bias voltage, with some offset compensation required. The ISL95311 provides 128-step resolution for VCOM voltage adjustment as just a simple voltage divider. Note that the maximum potentiometer pin voltage of the device is determined by the bias on the V+ pin, and is specified to be a maximum of +13.5V. The ISL95311 can handle higher LCD bias voltages by using series resistors on the Vh and VL pins.

The loading of a VCOM input is very capacitive, with dynamic changes in loading as pixels change, and therefore requires buffering of the potentiometer wiper voltage. An opamp is configured as a unity gain buffer and placed between the wiper output and the VCOM input. The resulting control circuit is shown in Figure 2.

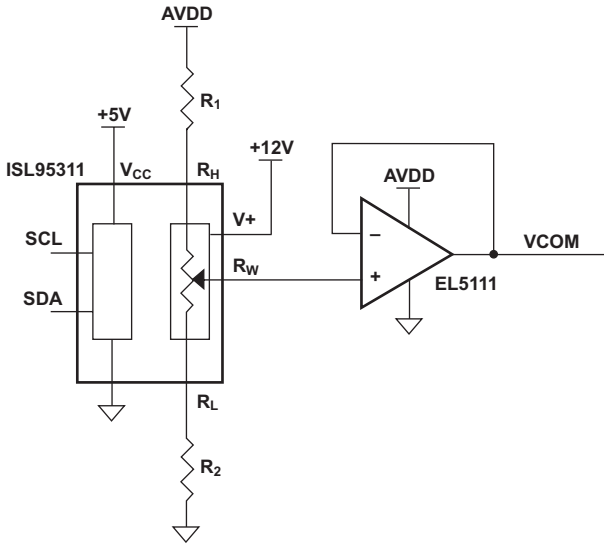

FIGURE 2. BASIC VCOM CONTROL

The EL5111 amplifier is chosen for this application as it is designed for VCOM load driving with high slew rate, fast settling, and high output drive. It has rail-rail outputs and handles a maximum supply voltage of 16.5V. The ISL95311 uses Vcc = 5V and V+ = 12V. R1, R2 and Rtotal (the potentiometer resistance) control the range and resolution of adjustment for VCOM. The ISL95311 has 128 total settings (n), yielding 127 steps of adjustment (n–1), so the equation for resolution will be:

Resolution = [V(RH) – V(RL)] / (n–1)

and

V(RH) – V(RL) = AVDD • [Rtotal / (R1+R2+Rtotal)]

Therefore,

Resolution = AVDD • Rtotal / [(n–1) • (R1+R2+Rtotal)]

Since VCOM is normally targeted at 1/2 the AVDD voltage, we usually center the adjustment range by setting R1 = R2. The values for R1 and R2 can be calculated using the equations and design targets, but the most expeditious method is to pick initial values which would yield approximately the range desired.

Example:

AVDD = +15V

Rtotal = 10kΩ (50kΩ can also be used, and R1, R2 increased in value).

We would like an adjustment range of about 10% of the AVDD value, so R1 = R2 = 50kΩ. The resulting resolution will be:

Resolution= 15V • 10 / [(127 • (50+50+10)]

= 10.7mV per step

If higher resolution (smaller step sizes) are desired, then R1 and R2 can be increased appropriately. Also, since the maximum recommended value for V(VH) = +12V, we need to check to make sure we have not exceeded this value.

V(RH)= AVDD • [(R2+Rtotal) / R1+R2+Rtotal)]

= +15V • (50 +10) / [(50+50+10)]

= +8.18V

Filtering

If significant noise or switching transients are expected on the AVDD line, it is especially easy to add filtering to the circuit of Figure 2. A capacitor should be added from the noninverting input of the EL5111 to ground. Note the 3dB frequency for the filter will vary with the tap position of the potentiometer, but an equation for the maximum f3dB (given R1 = R2) is:

F3dB(max) = 1 / (2π • R1 • C)

For C = 0.1µF in our example above, this yields a 3dB frequency of about 64Hz, and response will be down 24dB at 1kHz.

Design Considerations

The ISL95311 uses 2-wire serial interface control to adjust the wiper position and store the desired value in nonvolatile memory. No programming voltage is required to perform the nonvolatile storage. See the ISL95311 data sheet for details on correct serial interface operation. Note that Vcc for the ISL95311 can be as low as 2.7V, as long as the logic and interface pins use that voltage. The V+ bias for the ISL95311 should be chosen so that it will be greater than or equal to the potentiometer pin voltages under all conditions. There is very little current drawn by the V+ input (<2µA), so it is possible to use a resistor divider to supply current to this input if care is taken in choosing resistor values (10kΩ minimum resistance recommended).

The EL5111 is a high speed device, so proper supply decoupling and layout are required, as well as proper consideration of the capacitive load in the application. See that device data sheet for more details.