Quad Output Switching Converter Provides Power for Large TFT LCD Panels – Design Note 349
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Introduction
The LT®1943 is a highly integrated, 4-output regulator designed to power large TFT LCD panels. The LT1943 employs switching regulators—instead of linear regulators—to minimize power dissipation and accommodate a wide input voltage range. The wide input range, 4.5V to 22V, allows it to accept a variety of power sources, including the commonly used 5V, 12V and 19V AC adaptors. The first buck regulator provides a logic voltage with up to 2A of current. The other three switching regulators provide the three bias voltages, AVDD, VON and VOFF, required by LCDs.

All four regulators are synchronized to a 1.2MHz internal clock, allowing the use of small, low cost inductors and ceramic capacitors. Since different types of panels may require different bias voltages, all output voltages are adjustable for maximum flexibility. Programmable soft-start capability is included in all outputs to limit inrush current. The LT1943 has a built-in start-up sequence and panel protection feature. The LT1943 is available in a low-profile 28-pin TSSOP package.

Figure 1. Quad Output TFT LCD Power Supply with 4.5V to 8V Input Voltage Range
4-Output Supply with Soft-Start

Figure 1 shows a 4-output TFT LCD power supply with a 4.5V to 8V input range. The first output provides a 3.3V, up to 1.5A, logic supply using a buck regulator. The second output employs a boost converter to generate a 13V, 500mA AVDD bias supply. Another boost converter and an inverter generate VON and VOFF.

When power is first applied to the input, the RUN/SS pin starts charging. When its voltage reaches 0.7V, switcher 1 is enabled. The capacitor at RUN/SS pin controls the VLOGIC ramping rate and inrush current in L1.

Switchers 2, 3 and 4 are controlled by the BIAS pin, which is usually connected to VLOGIC. When the BIAS pin is higher than 2.8V, the SS-234 pin begins charging to enable switchers 2, 3 and 4. When AVDD reaches approximately 90% of its programmed voltage, the PGOOD pin is pulled low. When AVDD, VOFF and E3 all reach 90% of their programmed voltages, the CT timer is enabled and a 20μA current source begins to charge CT. When the CT pin reaches 1.1V, an output PNP turns on, enabling VON. Since VON has to be present to turn on the LCD panel, the VON turn-on delay gives the column drivers and digital circuitry in the LCD panel time to get ready, preventing high currents from flowing into the panel. Figure 2 illustrates the start-up sequencing of the 4-output power supply in Figure 1. Figure 3 gives the overall efficiency for the circuit in Figure 1.

If one of the regulated voltages, VLOGIC, AVDD, VOFF or E3 drops more than 10%, the internal PNP turns off to shut down VON. This action protects the panel in a fault condition. The PGOOD pin is used to drive an optional PMOS device at the output of the AVDD boost regulator to disconnect AVDD from the input during shutdown.

The converter uses all ceramic capacitors. X5R or X7R type ceramic capacitors are recommended, as these materials retain their capacitance over a wide temperature range.

Wide Input Range Supply

If the input voltage may be higher than the AVDD set value, a SEPIC regulator can be used in place of a boost regulator to generate the AVDD output. This covers the commonly used 12V and 19V inputs. Details for this are covered in the LT1943 data sheet.

Conclusion

The LT1943 simplifies and shrinks power supplies for TFT LCD panels. Its four integrated switching regulators enable a wide input voltage range and reduce power dissipation. All regulators have a 1.2MHz switching frequency and allow the exclusive use of ceramic capacitors to minimize circuit size, cost and output ripple.

Figure 2. Start-Up Waveforms of the Power Supply in Figure 1

Figure 3. Total Circuit Efficiency of the Power Supply in Figure 1 (Load at AVDD: 500mA)