LINEAR TECHNOLOGY

DESIGN NOTES

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, AV_{DD}, V_{ON} and V_{OFF}, 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.

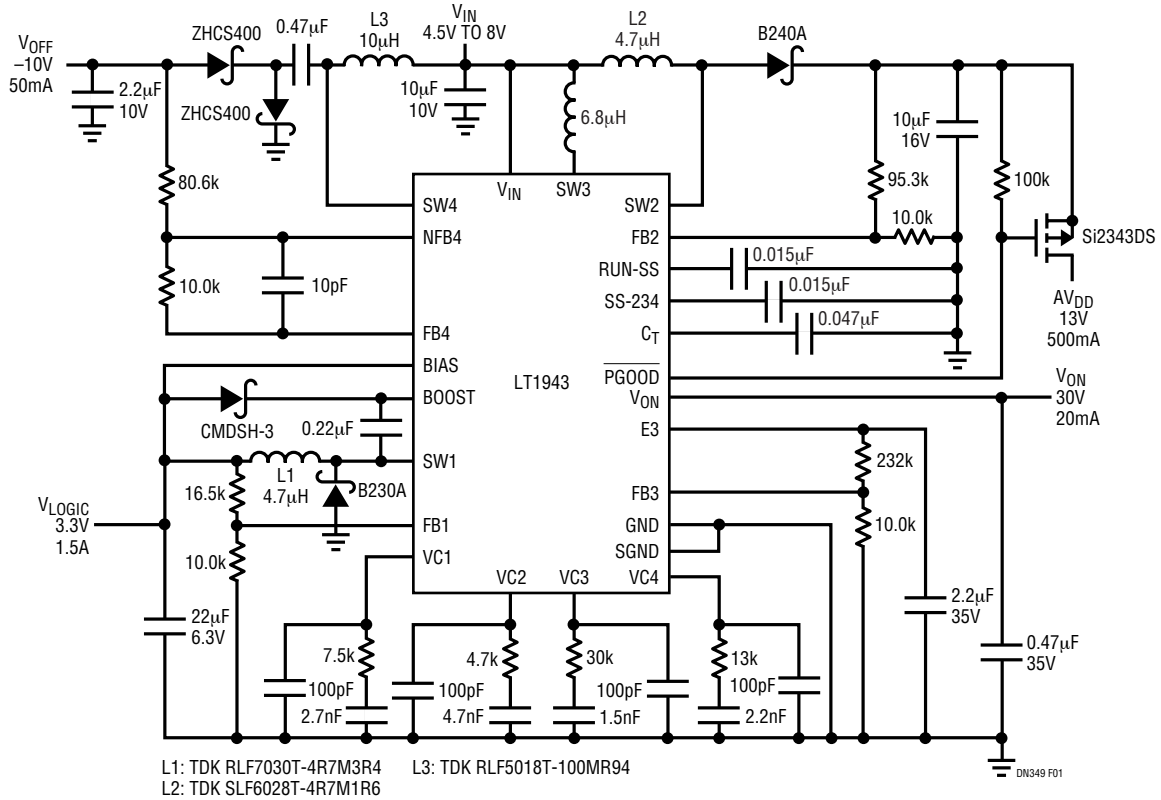

Figure 1. Quad Output TFT LCD Power Supply with 4.5V to 8V Input Voltage Range

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 AV_{DD} bias supply. Another boost converter and an inverter generate V_{ON} and V_{OFF}.

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 V_{LOGIC} ramping rate and inrush current in L1.

Switchers 2, 3 and 4 are controlled by the BIAS pin, which is usually connected to V_{LOGIC}. When the BIAS pin is higher than 2.8V, the SS-234 pin begins charging to enable switchers 2, 3 and 4. When AV_{DD} reaches approximately 90% of its programmed voltage, the PGOOD pin is pulled low. When AV_{DD}, V_{OFF} and E3 all reach 90% of their programmed voltages, the C_T timer is enabled and a 20μA current source begins to charge C_T. When the C_T pin reaches 1.1V, an output PNP turns on, enabling V_{ON}. Since V_{ON} has to be present to turn on the LCD panel, the V_{ON} 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.

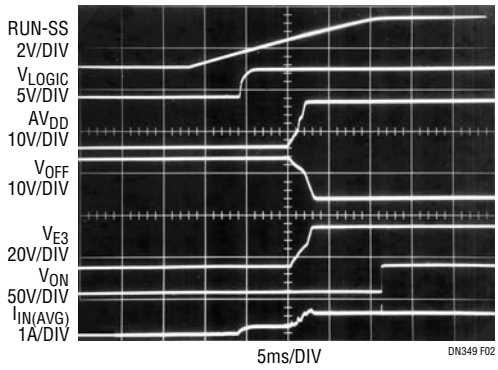

Figure 2. Start-Up Waveforms of the Power Supply in Figure 1

If one of the regulated voltages, V_{LOGIC}, AV_{DD}, V_{OFF} or E3 drops more than 10%, the internal PNP turns off to shut down V_{ON}. 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 AV_{DD} boost regulator to disconnect AV_{DD} 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 AV_{DD} set value, a SEPIC regulator can be used in place of a boost regulator to generate the AV_{DD} 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.

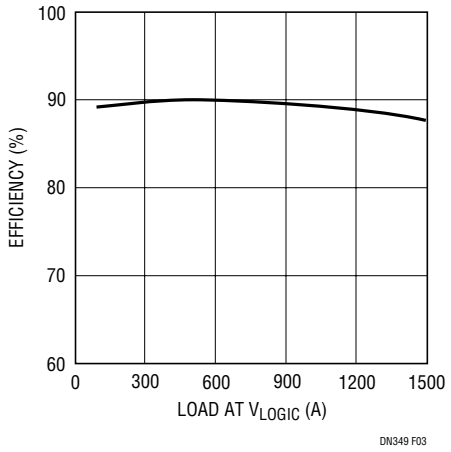

Figure 3. Total Circuit Efficiency of the Power Supply in Figure 1 (Load at AV_{DD}: 500mA)

Data Sheet Download

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