DESIGN SOLUTION 7128

PMIC STREAMLINES AUTOMOTIVE TFT-LCD DISPLAY DESIGN

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Abstract: TFT-LCD displays dominate the automotive market as they enter a competitive phase with rivaling technologies. In this phase, they can still be highly competitive by achieving higher efficiencies and higher integration in their design. In this design solution, we review a typical, non-integrated TFT-LCD display system and compare it to a highly integrated approach highlighting the latter advantages in terms of BOM and PCB size reduction. With a highly integrated approach, the entire power management system can be implemented with just two ICs, achieving higher competitiveness vs. emerging technologies.

Introduction

It's amazing how much we have come to depend on displays in our automobiles. “I have a beautiful car for you!” a car rental operator told me recently. When we went to the parking lot I noticed that the car was indeed beautiful …. but did not have GPS navigation! All kinds of horrible scenarios started to materialize in my mind. How in heaven will I even get out of here and find my way around? The operator read my mind: “Never mind,” he said. We went back and he found for me a car with GPS navigation.

Displays are ubiquitous in modern cars, from instrument clusters to center-stacked touchscreens (**Figure 1**), rear-seat entertainment and more. Today, the automotive display market is dominated by TFT-LCD technologies while the use of OLEDs is expected to play a significant role in the future. In this highly competitive scenario, TFT-LCD displays can greatly benefit from system optimization derived from a higher level of integration of the electronics that power the displays. This will reduce BOM and PCB size, resulting in significant cost savings and higher competitiveness against emerging technologies. In turn, smaller electronics allow for slimmer form factors or more functionality within the same space.

In this design solution, we first review the challenges of a typical power management TFT-LCD display. Subsequently we will introduce a highly integrated solution that greatly reduces the power management PCB size and BOM.

Figure 1. Modern car center stack touchscreen.

Typical TFT-LCD Display System

Figure 2 illustrates a typical TFT-LCD display system. The display receives power through multiple rails and signals through the deserializer, converting serial LVDS data to a parallel interface in RGB format. A high-voltage buck converter (HV BUCK1) provides the main 3.3V rail (V_{CC}) which feeds the rest of the low-voltage circuits, while the high-voltage, low standby current LDO (HV LDO1) provides always-on power to the MCU. The watchdog timer resets the local MCU if the input is not pulsed periodically, thus detecting runaway code.

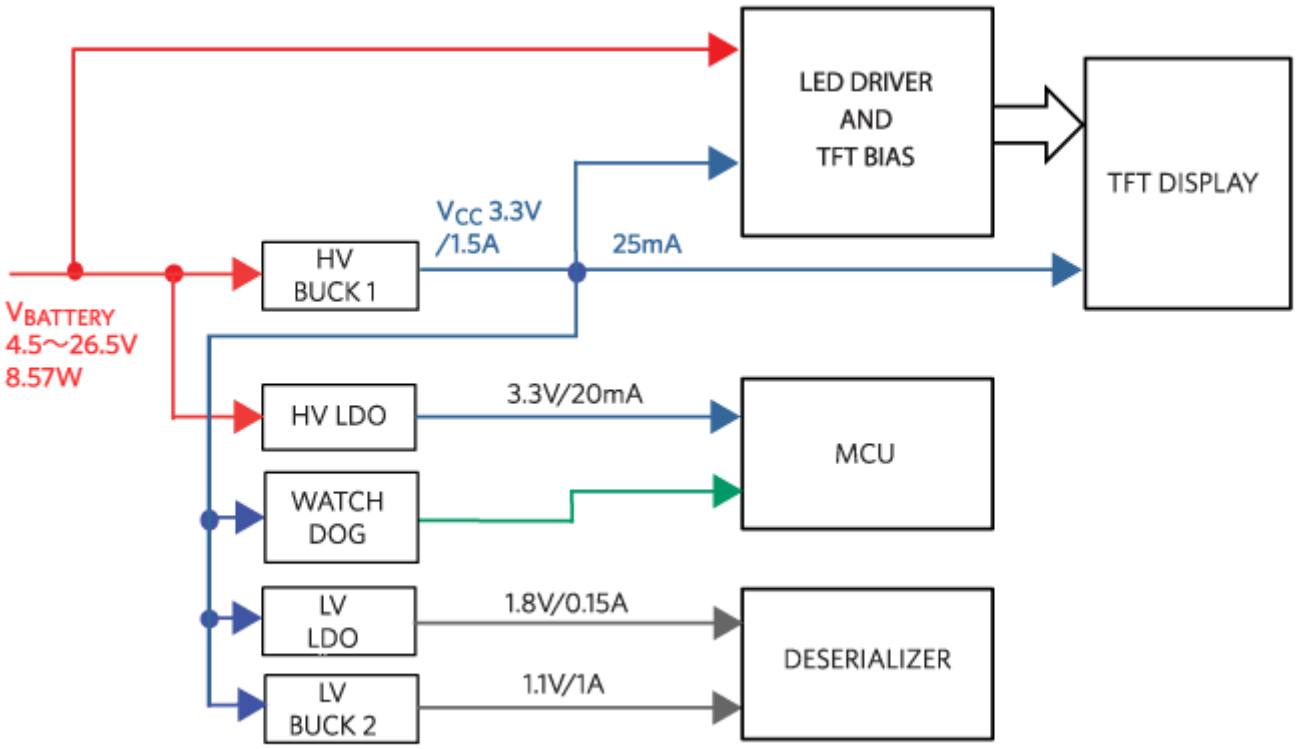

Figure 2. TFT-LCD display power management discrete implementation.

This power management implementation, which requires 5 different ICs and occupies a large PCB real estate, is cumbersome and expensive.

Integrated Solution

For the first time, a state-of-the-art monolithic mixed-signal process allows the integration of the five-block stack (pictured on the left of Figure 2) into a single PMIC, as shown in **Figure 3**. This integration allows for better control and sequencing of the various voltage rails. The PMIC can easily accommodate additional features compared to a discrete implementation. For example, the control of the battery power rail through a switch helps avoid draining the battery in the presence of an output short, since the PMIC turns the switch off immediately.

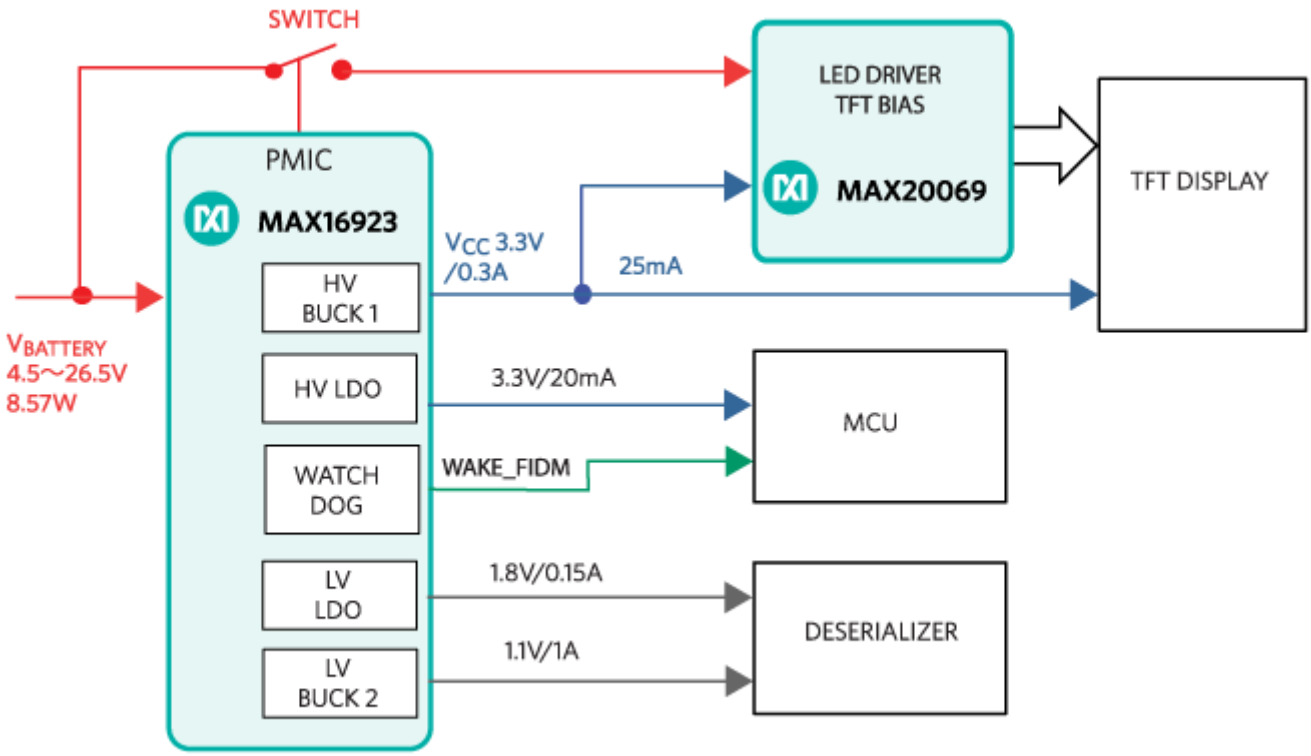

Figure 3. Two-chip highly integrated solution.

The LED backlight and TFT driver functions can be implemented with another highly integrated chip, the MAX20069. This solution addresses the entire LCD display power management with only two chips.

Highly Integrated PMIC

As an example, the MAX16923 (**Figure 4**) is a power management IC designed to accommodate the main rails used in modern automotive TFT-LCD displays. The high-voltage buck converter output can be 5V or 3.3V; while the low-voltage buck converter regulates the voltage to either 3.3V, 1.8V, 1.2V, or 1.1V; the low-voltage linear regulator produces an output voltage of 3.3V, 1.8V, 1.5V, or 1V (all OTP options). The high-voltage linear regulator produces a 3.3V output from the voltage supplied at BATT. A single START control pin initiates the startup sequence, thereby simplifying device control. Power-good signals are available to monitor a high-voltage LDO, a high-voltage buck converter, and a LV buck converter, and LDO. The external P-channel MOSFET control block allows battery voltage to be switched to a downstream device, such as a backlight boost converter. The IC is available in a 4mm x 4mm, 20-pin TQFN package and operates in the -40°C to +105°C temperature range.

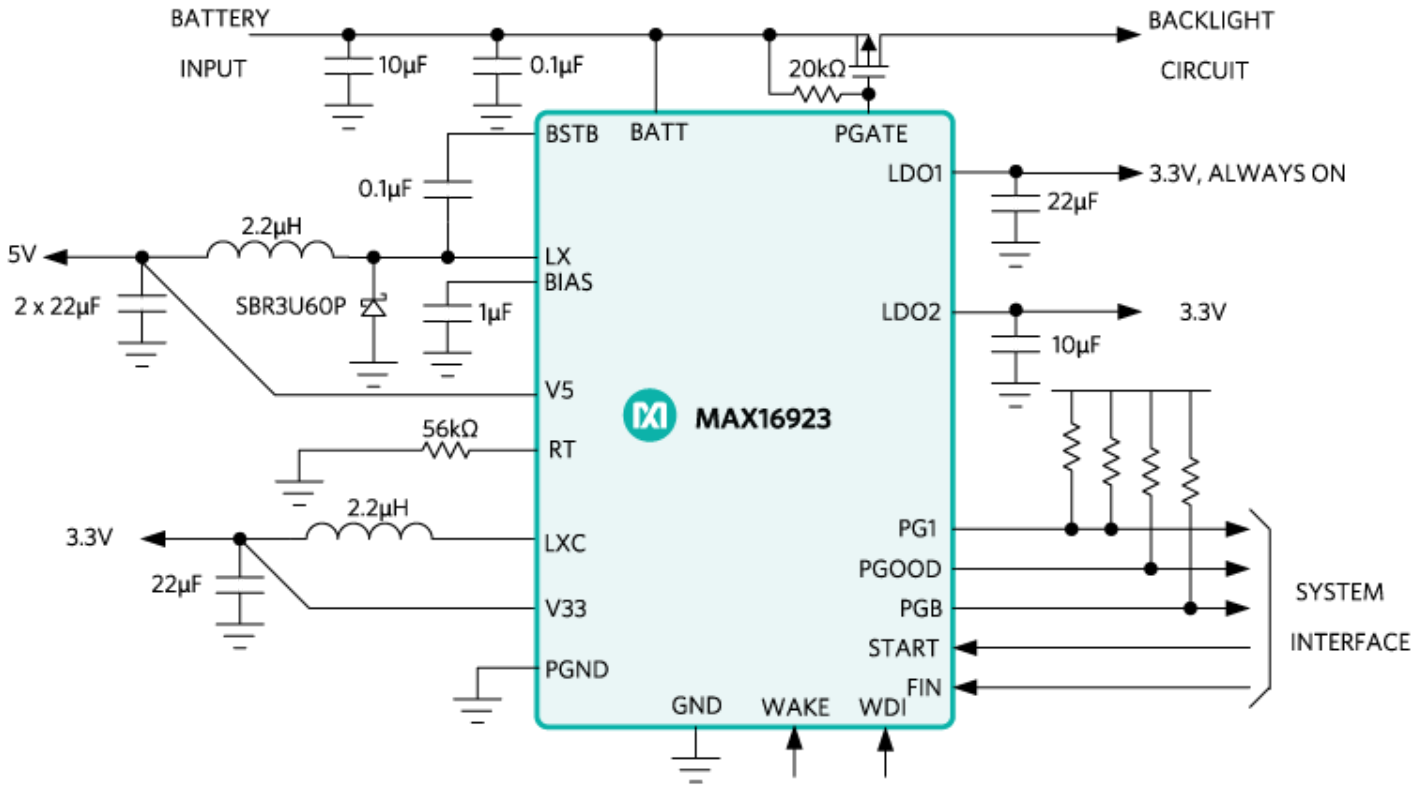

Figure 4. Highly integrated PMIC accommodates the main rails used in modern automotive TFT-LCD displays.

This integration results in a 480mm^2 PCB, one-third smaller than a competitor's nonintegrated solution, allowing for slim display designs or more functionality in reduced spaces at contained costs.

Conclusion

TFT-LCD displays dominate the automotive market and are entering a very competitive phase versus emerging display technology. A high level of integration reduces size and cost and enables slimmer designs, extending the TFT-LCD display's competitiveness. In this design solution, we showed that by integrating five separate functions in a single chip, we reduced the power section PCB size by a third. Now the entire power and drive management system can be accomplished by two highly integrated chips. This allows significant cost reduction and the ability to design slim form factors or add more functionality within the same space.

Related Parts	
MAX16923	Automotive 4-Output Display Power Solution with Watchdog
MAX20069	Automotive I^{2}C-Controlled 4-Channel 150mA Backlight Driver and 4-Output TFT-LCD Bias

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