LINEAR TECHNOLOGY

DESIGN NOTES

Multiple Output DC/DC Converter Runs Off 2-Cell AA Batteries, USB or AC Wall Adapter – Design Note 1006

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Introduction

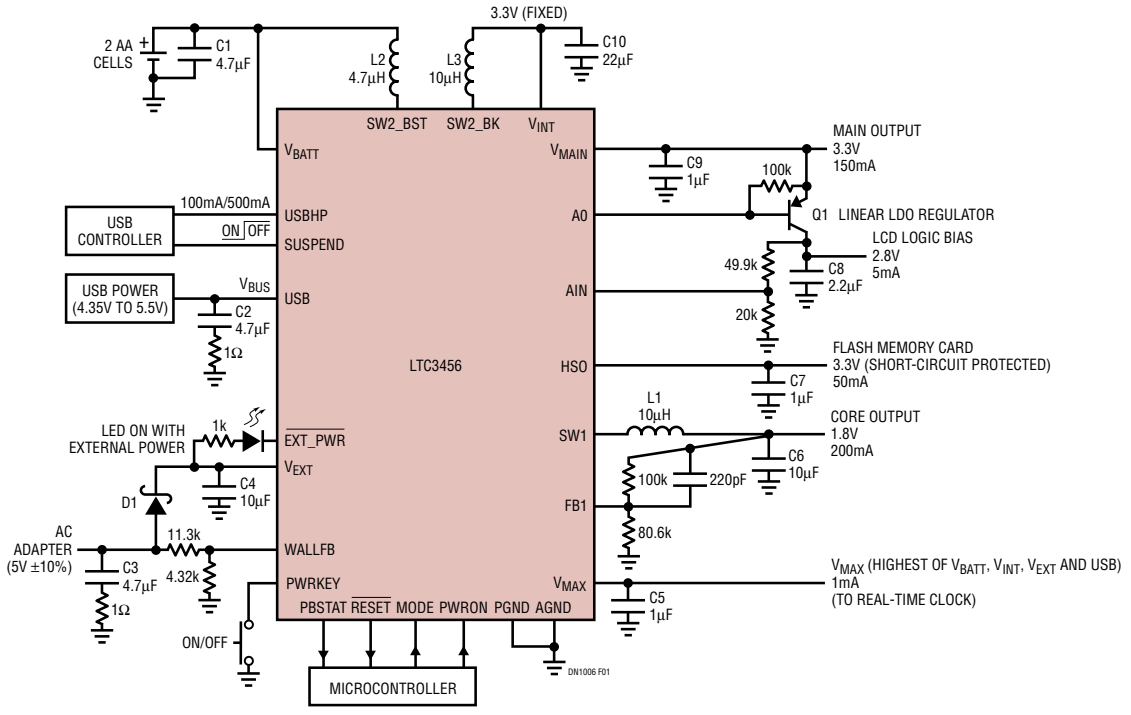
The LTC®3456 is a low profile, total power management solution optimized for the confined spaces and diverse power requirements of mobile devices, including MP3 players, portable GPS units, digital cameras and handheld computers. The LTC3456 seamlessly manages power flow between an AC adapter, USB cable and a 2-cell AA battery while complying with USB power standards and fits in a 4mm × 4mm 24-pin QFN package.

The device generates two separate power rails: a 3.3V (fixed) main supply and a 1.8V (adjustable) core supply. In addition, the LTC3456 contains a USB power manager, a Hot Swap™ output, a low-battery indicator and an always-alive V_{MAX} output.

The 3.3V and core supplies are generated by switching regulators operating at 1MHz constant frequency. High switching frequency allows the use of tiny, low profile inductors and capacitors. All switchers are current mode PWM type with internal compensation, reducing pin and part counts.

Complete Power Solution for Handhelds from Two AA Cells

The circuit shown in Figure 1 generates five output voltages from one of three power sources: AC adapter, USB or 2-cell alkaline battery. The first output is the Core



C1, C6 TO C10: X5R OR X7R, 4V
C2 TO C5: X5R OR X7R, 6.3V
D1: ON SEMICONDUCTOR MBRM120E
L1, L3: MURATA LQH32CN100K53
L2: MURATA LQH32CN4R7M53
Q1: PHILIPS MMBT3906

Figure 1. Complete Power Supply for Handheld Devices. Includes Two Switching Channels and One Linear Regulator

1.8V, 200mA supply for the system processor. This is an adjustable output set by feedback resistors connected to the FB1 pin. This output uses internal synchronous power switches, improving efficiency and eliminating the need for an external Schottky diode. The second output is the 3.3V, 150mA Main output for peripheral circuitry. The third output is a second 3.3V supply (at 50mA) at the Hot Swap output (HSO) for hot swappable memory cards.

The fourth output, which is generated from the Main output using an internal gain block, provides 2.8V at 5mA which is suitable for biasing LCD drivers. The fifth output is V_{MAX} which is a direct unregulated output of whichever is the highest available supply voltage: V_{BATT}, V_{INT}, V_{EXT} or USB voltage. The V_{MAX} output can be used to supply up to 1mA to a critical block like a real-time clock which needs to stay alive at all times.

The LTC3456 provides power supply sequencing for all outputs. After start-up, V_{INT} powers up, followed by the Core, Main and Hot Swap outputs. During shutdown, both V_{MAIN} and Hot Swap outputs are discharged to ground via internal pull-down resistors. V_{CORE} is also discharged in this manner, preventing the microprocessor from entering into a spurious operating mode.

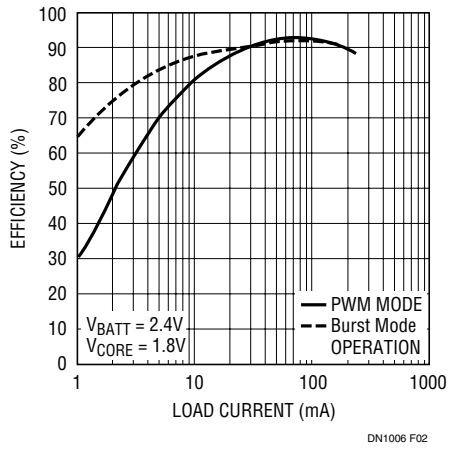


Figure 2. Core Converter Efficiency of the LTC3456 When Powered by a 2-Cell Alkaline

Figure 2 shows the efficiency of the core converter when powered by a 2-cell alkaline. Efficiency reaches 93% at the higher load currents. Burst Mode® operation improves efficiency at light loads.

Figures 3 and 4 show the stable load step response of the Core and Main outputs—±3% deviation from nominal—for a 20mA to 150mA load transient on the Core output and a 20mA to 100mA transient on the Main output.

Conclusion

With its low profile and seamless transition between input power sources, the LTC3456 simplifies and shrinks power supply designs for portable devices such as personal GPS navigators, MP3 players, digital cameras and handheld computers.

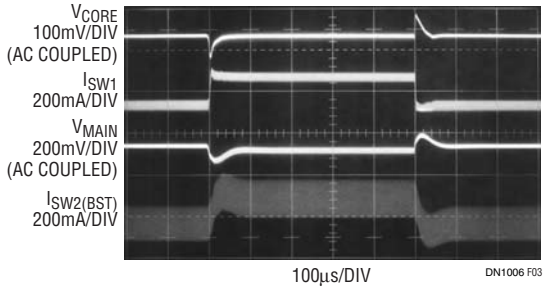


Figure 3. Load Transient (BATT = 2.4V)

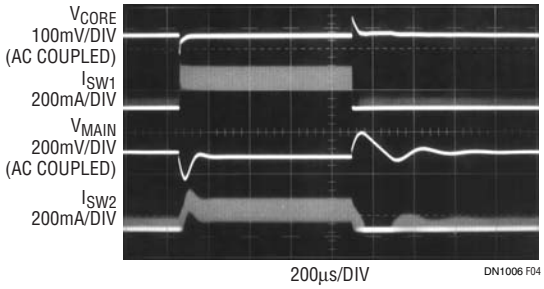


Figure 4. Load Transient (AC Wall/USB = 5V)

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