Application Note

AS1344

Adjustable Soft Start

Content Guide

1 Adjustable Soft Start

Almost all portable devices are powered by low voltage batteries. However, in the same devices there are some circuits like LEDs that need high voltage supply. So, there is a need for voltage conversion. But often there is also the need for limitation of the input current during start up (so called soft start) for many reasons.

This article shows the possible solution with boost DCDC converter and adjustable input current limitation.

2 Where the boost conversion is used

Most batteries used in portable devices are lithium-ion batteries that operate between 2.7V and 4.2V, and dual-cell alkaline (NiCd or NiMH) batteries that have a 1.6V-3.4V range. The next generations will have an even lower battery supply voltage range.

However the typical application circuits require a stable high voltage supply bus of 12V or higher for supplying internal LEDs. Producing such a stable output from a low voltage battery is possible with boost converters that have a big transformation factor.

3 Soft start

Implementing a soft-start routine eliminates the problems caused by inrush current, as it allows the current to build up to the required value over a controlled period of time.

There are two major elements to the operation of a soft-start routine. First of all, it prevents the output voltage from overshooting, or severely reduces the scale of the overshoot, by ensuring that the output voltage does not climb too fast. Secondly, it eliminates the large voltage drop experienced when a partially discharged battery releases a large inrush current. A soft-start routine reduces the size of the inrush current, thus also reducing the voltage drop at start-up and enabling the system to maintain voltage above the threshold for triggering the system’s under-voltage lockout mechanism.

4 Adjustable solution for soft start

The AS1344 not only provides a complete start-up solution for almost all applications, but also selection of the maximum current during start-up. This makes it possible also to adjust the time that is needed to reach the wanted output voltage.

In the Fig.1 we see the block diagram of the AS1344. Both PMOS switches are OFF during shut-down (the output is disconnected from the input, to stop current flowing during shut-down), and both are ON during normal operating mode. During start-up, however, only one PMOS switch is ON (the one connected to VIN). So the maximum current that will flow during start-up can be adjusted by changing the value of the external resistor Rv that is connected between the battery and VIN. This resistor will permanently limit the current that flows into VIN. After the DC-DC converter has reached the required output level, and after a small delay, the switch from VDD to SW will be ON –

in other words, the device will be in normal operating mode. This in turn allows a larger current to flow, which supports a larger load current, and produces a more efficient system.

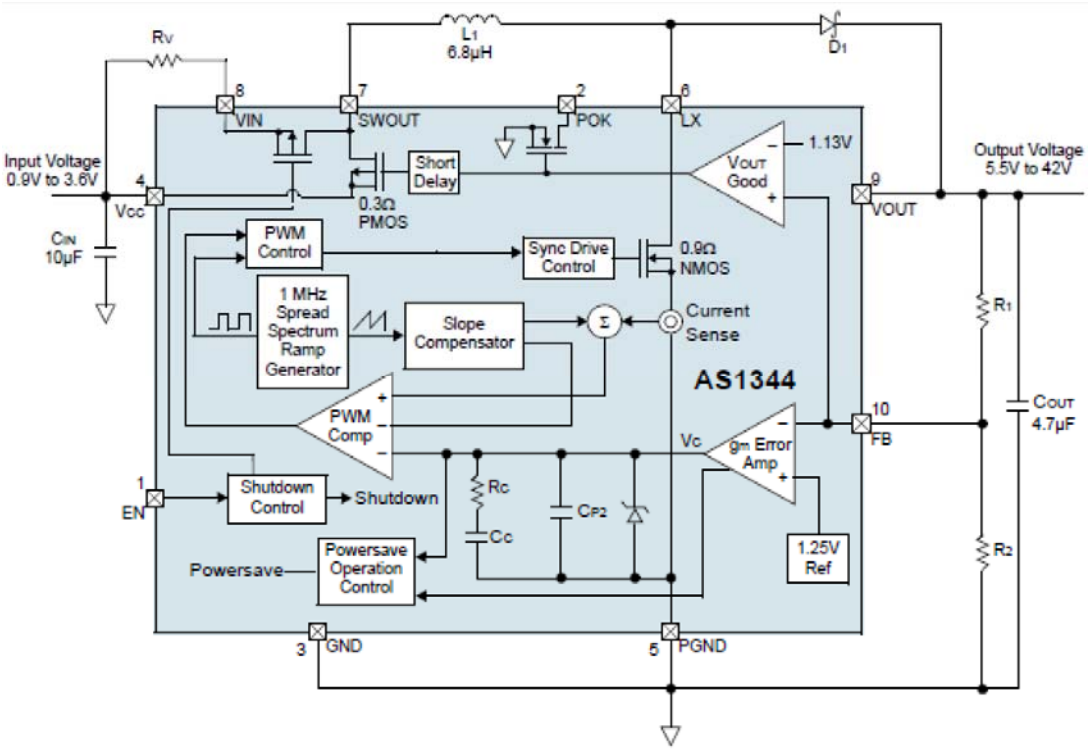

Fig. 1: Block diagram of the AS1344

5 Results

For an input voltage of 1.8V, the inrush current can be limited to around 200mA with an external resistor of 3Ω. For an input voltage of 2.4V, the maximum inrush current is around 400mA, with the same value of resistor. How the peak current is dependent on the external resistor, is easily seen in Fig. 2.

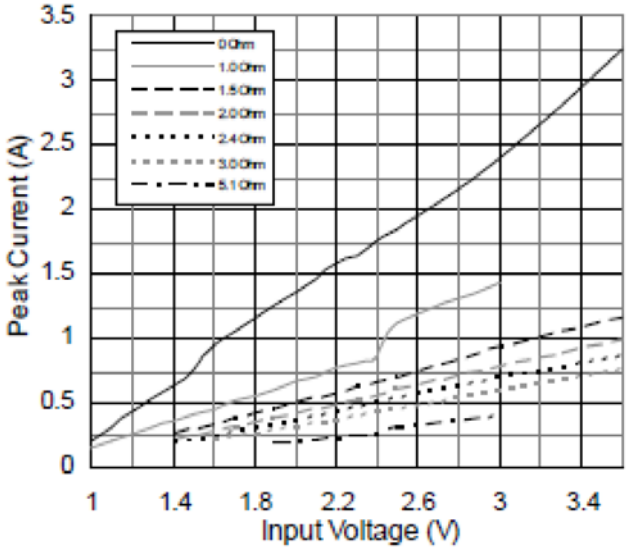

Fig. 2: Peak current vs. Input Voltage, for different values of external resistor

The use of the AS1344 gives the designer simple means, through selection of a single external resistor value, to control inrush current. By using this one boost converter in multiple circuit designs, the OEM can potentially reduce procurement costs and simplify supply-chain and inventory issues.

6 Efficiency of AS1344

Because in the normal mode both PMOS transistors are ON, the efficiency is good, which is presented in Fig. 3. The losses come with a big transformation factor, and not with an additional feature, which is described in this application note. Thus, for the desired output voltage of 6V, the efficiency is mostly 80% or more, while for the desired output voltage of 12V the efficiency is mostly between 70 and 80 %, and for lower input voltage even lower.

Figure 3. Efficiency vs. Output Current; VOUT = 6V

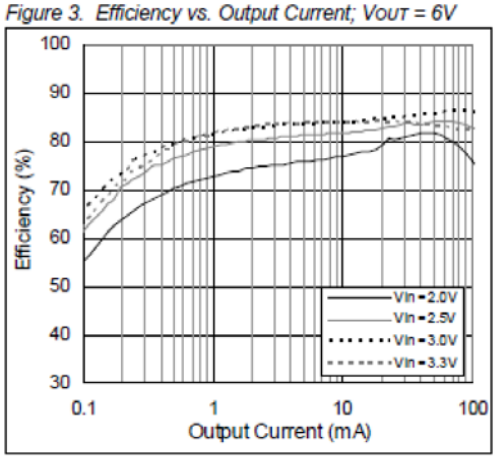

Figure 4. Efficiency vs. Output Current; VOUT = 12V

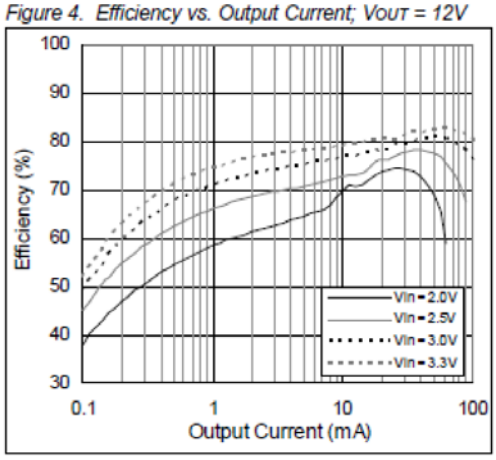

Fig. 3: Efficiency vs. Output Current for different Input Voltages of the AS1344

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9 Revision Information

Changes from 0.1 to current revision 0-10 (2014-Jul-18)	Page
Content updated to latest ams design	

Note: Page numbers for the previous version may differ from page numbers in the current revision.