Application Note

AS1341

High Voltage buck converter

Content Guide

1 High Voltage buck converter

Many battery-operated portable devices have high voltage supplies, and also some internal ICs in the need of a low voltage supply. To be able to realize such application, the DC-DC converter with high voltage input and low voltage output is needed.

2 Laptop example

The most batteries in laptops have a power supply between 10V and 15V. However many internal devices (ICs) require a stable low voltage supply bus of 5V, 3V or even smaller. Producing such a stable output from a high voltage battery is possible with buck converters that have a big transformation factor. This can be achieved with the AS1341. Its input voltage ranges from 4.5V to 20V, and the output voltage range is 1.25V to given V-in.

3 Where is the limit for the transformation factor in buck conversion?

The mostly used DC-DC buck converter is presented in Figure 1. The switch S1 between input and coil is usually realized as an internal PMOS transistor band the second switch S2 between coil and ground as an internal NMOS transistor or external diode. To produce the high voltage, usually the diode is used instead of NMOS, and the operation of the circuit will be described with coil, PMOS and diode.

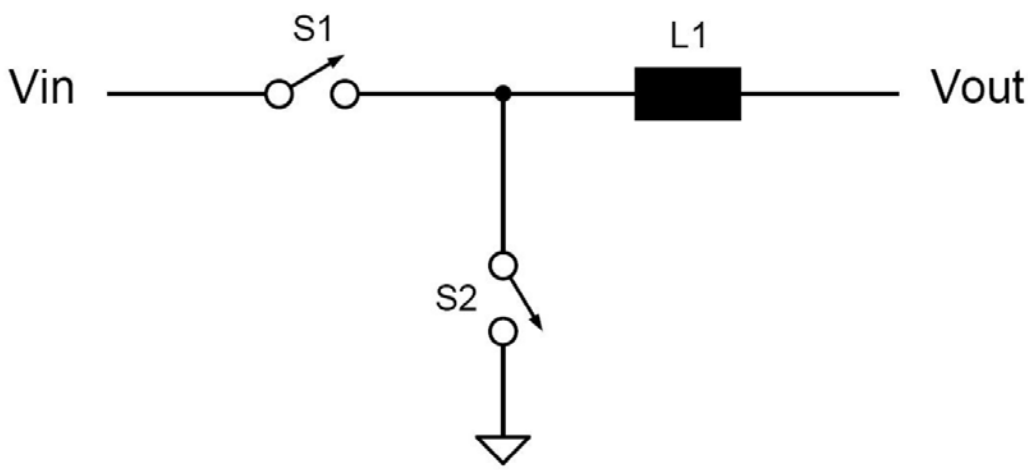

Figure 1: Simple schematic of the buck converter

There are two states during the buck conversion. During the first one, the PMOS is ON, the current flows from the input to the output through a coil and rises. During the second one the PMOS is OFF. The current still has to flow through the coil and it runs from ground to the output through the diode and falls because the V-out potential is higher than ground.

The transformation factor V-out/V-in is mostly dependent on the duty cycle D. It represents the fraction of the commutation period T during which the PMOS switch is ON. In an ideal case (no energy losses, and switching without break and load) V-out=V-in*D. So if the NMOS is ON 50% of the period time, D=0.5 and V-out=V-in*0.5. If the V-in=V-out, the PMOS should be ON all the time, and this is called feed through state.

For the real case we have to add different losses, like resistive and switching losses, which means that D should be bigger. However, the feedback loop is hard to stabilize for very big transformation factors. Also the efficiency drops with a bigger transformation factor. But with implementing the phases where the switching is not there (if V-out is high enough), no energy is transferred, and no rising on the output is possible. This improves efficiency, even for the worst cases.

4 Real-world implementation

AS1341 is DCDC buck converter, with high voltage input and low voltage output. The output is adjustable with two external resistors (see Figure 2).

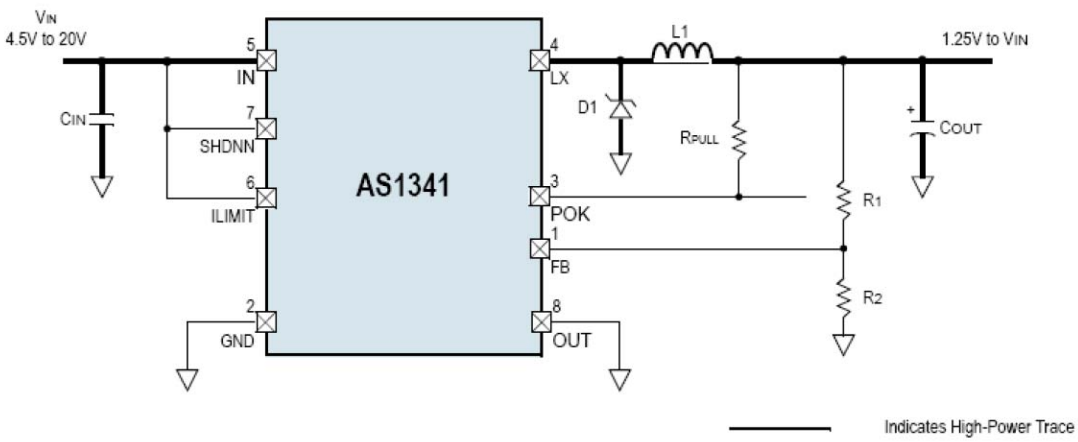

Figure 2: AS1341 – Typical application diagram

If the FB is connected to GND, V-out stays fix at 5V.
The current limit is also adjustable to 0.7A (ILIMIT = low) or 1.4A (ILIMIT = high).

5 Efficiency

The efficiency for some conditions is presented in the table below. It is easy to see in Figure 3 and Figure 4 that if the transformation factor is bigger, the efficiency is lower.

If V-in =6V and V-out=5V, the efficiency is even higher than 95% (Figure 3).

For the case that V-in=V-out, the feed through state is active, and it would be efficiency near 100%.

But in Figure 4 we see that even if the transformation factor is very big, about 6 (V-in=20V to Vout= 3.3V), an efficiency of 80% could be reached.

For a very light load the efficiency is worst, but even then it is always higher than 50% in the case of a small transformation factor, and higher than 80% in the case of a big transformation factor.

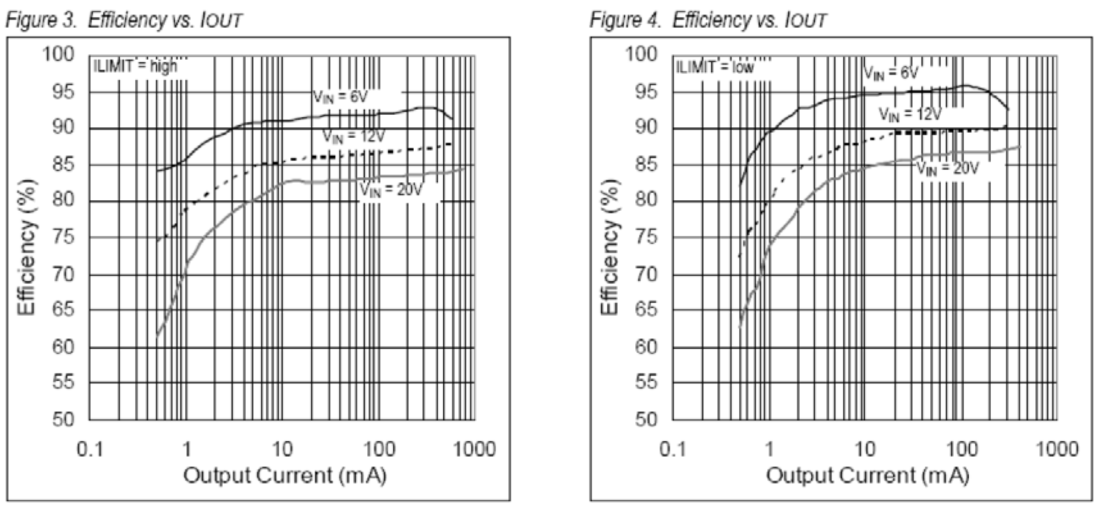

Figure 3: Typical efficiency (with V-out=5V) of AS1341

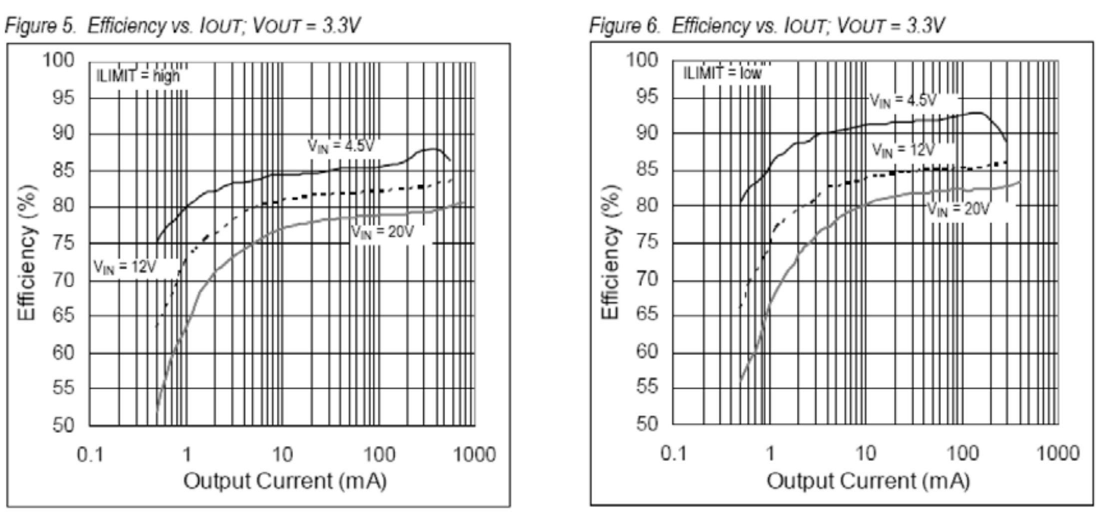

Figure 4: Typical efficiency (with V-out=3.3V) of AS1341

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8 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.