Application Note

AS1746

Low ON Resistance of the Analog Switches

Content Guide

1 Why is low ON-resistance important?

Analog switches are used for many applications like power-routing or audio and video signal routing. All these different applications require different performance parameters of the switches, but it is often most important to keep the maximal ON-resistance as low as possible, to achieve almost no energy losses during throughput.

The second most important parameter is the ON-resistance flatness. The flatness is defined as difference of the maximal ON-resistance and minimal ON-resistance for the whole voltage throughput domain. Especially the audio applications require low flatness values, because the flatness causes harmonic distortion that should be kept as low as possible.

2 How low can ON-resistance be?

Most analog switches consist of the big PMOS and NMOS transistor in parallel, a so called T-gate. These two transistors are responsible for the ON-resistance.

To achieve very low resistance and flatness for analog switches, there are two important parameters. For both PMOS and NMOS, the size should be as big as possible, and its voltage thresholds should be as low as possible. Twice as big transistors should have half the resistance, but they also cost double the price in production. Smaller thresholds would improve flatness. The resistance peak (maxima) on the left side is caused by the NMOS threshold and the resistance peak (maxima) on the right side is caused by the PMOS threshold. But the technology processes with lower transistor thresholds are more expensive too.

One must also to take into account during the design process of analog switches the different parasitic resistances of packages (like bond wires), connections, contacts and special transistor layout parasitic resistances. In practice these parasitic resistances can be a few hundreds of mOhm, so they can be even bigger than the transistors resistances.

3 AS1746 – An example with low ON-resistance

The ON-resistance of the AS1746 is very low and is presented in Fig. 1. Although parasitic resistances are a few hundreds of mOhm, the resistance of the whole chip including parasitic resistances is typically 250 mOhm for 5V supply, and 300 mOhm for 3V supply (Fig. 1 and 2). The ON-resistance flatness is less than 50 mOhm.

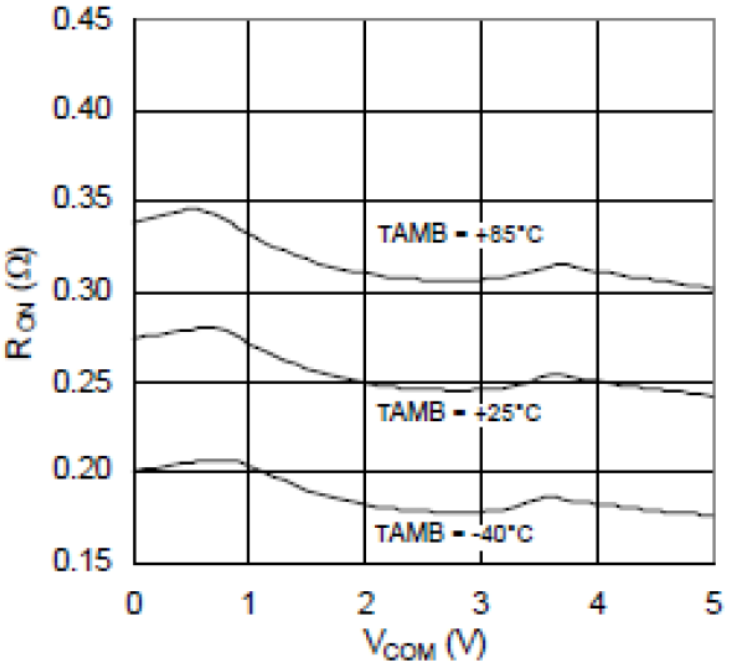

Figure 1: ON Resistance of the AS1746 for supply of 5V

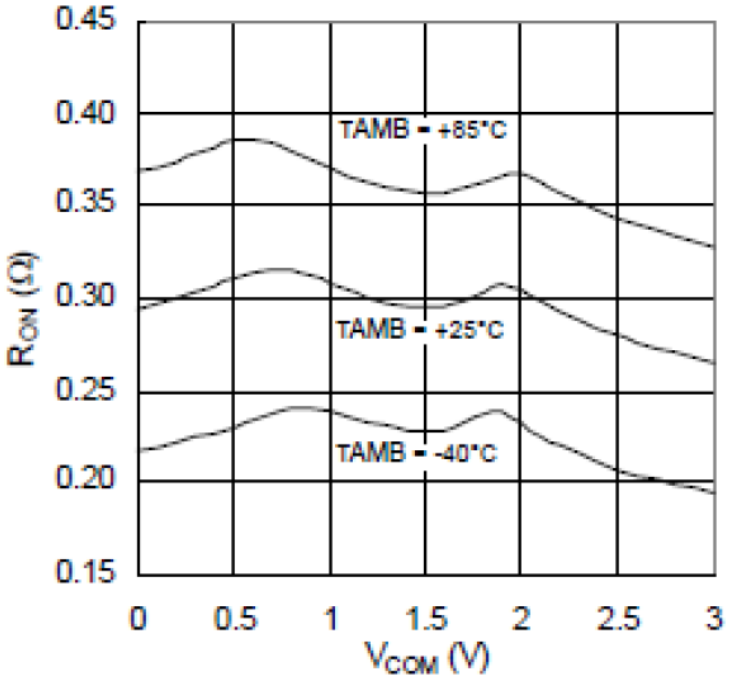

Figure 2: ON Resistance of the AS1746 for supply of 3V

4 How fast is this low resistive switch?

The AS1746 has very big transistors that make resistance very low. To turn on and off these transistors a big driver is needed.

Fig. 3 shows the switching times of the AS1746. For higher supply voltage the turn on time is about 20 ns, and the turn off time is about 10 ns. Turn off time is always shorter, as to be able to have a feature break before make, which means that for double switches always one switch is turned of and then another switch is turned on. Typical break before make time is 2 ns.

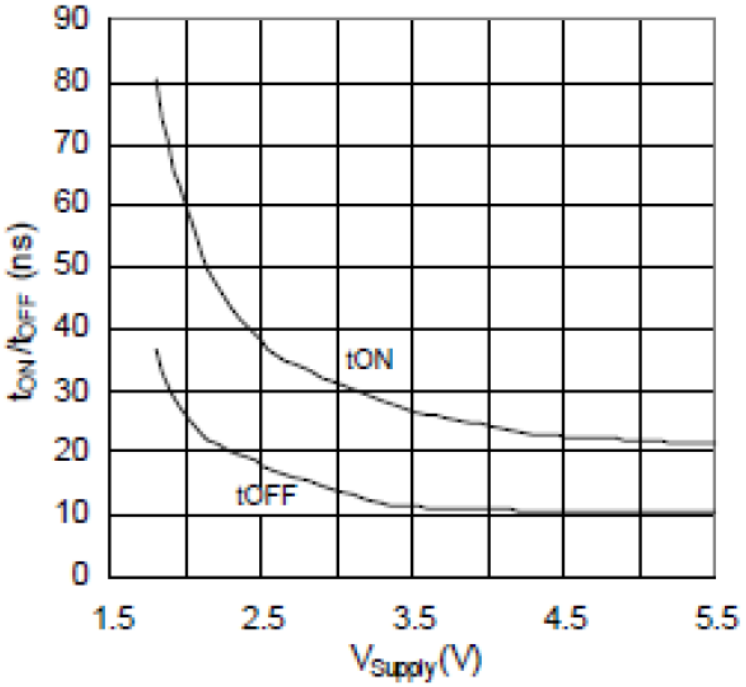

Figure 3: Switching times of AS1746

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7 Revision Information

Changes from 0.1 to current revision 1-10 (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.