



Application Note

AS1745

OFF Resistance of the Analog Switches

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1 What is OFF-resistance?

Analogue switches are used in a wide range of applications, including power-routing and audio and video signal-routing. Whatever the application is, the most important parameter for the design engineer to consider is peak ON-resistance – the lower the ON-resistance, the smaller the energy losses in operation.

However, also a very important parameter is the OFF-resistance. This is the resistance of the switch in OFF state (open switch) – the higher the OFF-resistance, the smaller the energy losses during power down (switch OFF) state. But the big OFF resistance is also very important for good OFF-isolation. This is very important in audio applications. But how can one know how high the OFF-resistance is?

2 Calculation of OFF-resistance

In the Data Sheets of analog switches there are usually no specifications for OFF-resistance. However, there is always specification about the parameter called OFF-leakage of the current switch. With this parameter, we can also calculate the OFF-resistance, if we divide the voltage that is applied on the open switch with OFF-leakage current which flows through it:

$$R_{OFF} = V_{OFF} / I_{OFF}$$

3 Example and benefits

As an example, analog switch AS1745 has ultra-low leakage currents for all channels, less than 0.1nA at 25°C (typ. 0.01nA), if voltage of 3.5V is applied on the open switch. This means that:

$$R_{OFF, MIN} \text{ at } 25C = 3.5V / 0.1nA = 35 \text{ G}\Omega$$

$$R_{OFF, TYP} \text{ at } 25C = 3.5V / 0.01nA = 350 \text{ G}\Omega$$

The OFF-resistance of typical 350 G Ω is very good value, and this means there are almost no losses during power down (OFF state of the switch), and the isolation of the switch channel is great.

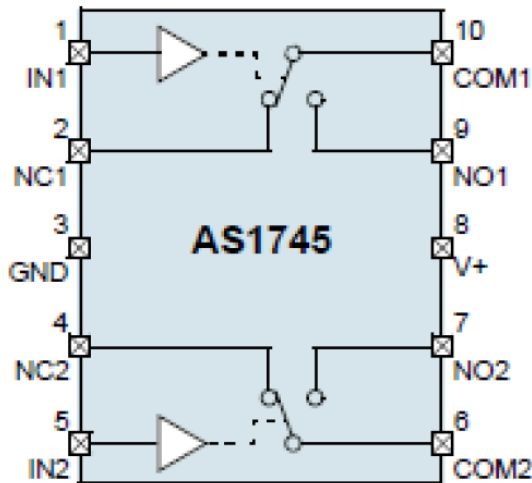


Figure 1: Block Diagram of AS1745

AS1745 is high-speed, low-voltage, dual single-pole/double-through (SPDT) analog switch with very low power consumption. If the OFF-resistance wouldn't be that high, the power consumption would be bigger, and the OFF state of the switch wouldn't be efficient.

SPDT means that there is one input, but two outputs (or two inputs and one output), and one channel of this double switch is always ON and the other OFF, dependent on IN_x input (please see Fig. 2).

Truth Table

IN_x	NO $_x$ to COM $_x$	NC $_x$ to COM $_x$
Low	Off	On
High	On	Off

Switches shown for low input.

Figure 2: True Table: How to control switch

So, one of the two channels (NO to COM and NC to COM) is OFF, while another is ON, and specially here it is important to have great OFF isolation, what the AS1745 certainly has (typ. 350 G Ω). Contrary to the OFF-resistance, which is very high, the ON-resistance of the switch (presented in the Fig. 3) is very low (typ. 2 Ω), which is important for the efficiency in the ON state.

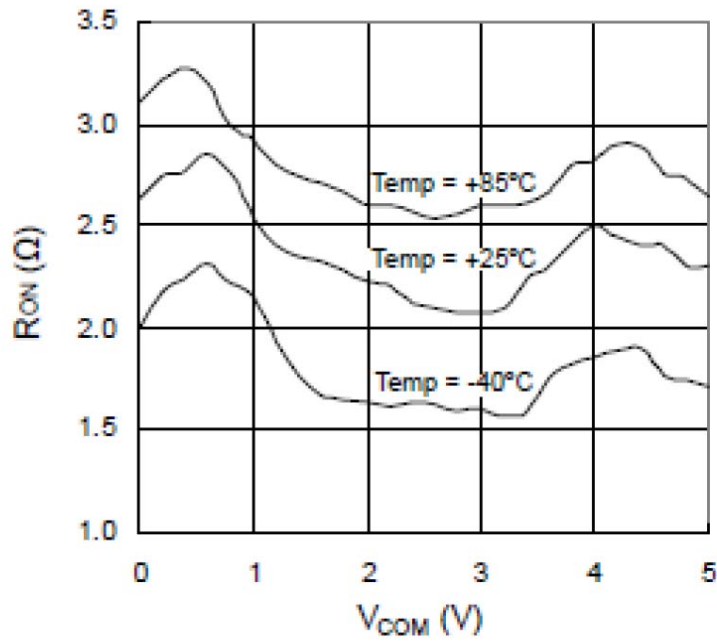


Figure 3: RON resistance for AS1745

4 Contact Information

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6 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.