RAQ's

Rarely Asked Questions

Strange stories from the call logs of Analog Devices

Lock Down That Noise — Don't Let It Escape

Q. How can I prevent switching-mode power supply noise from devastating my circuit performance?

A. With great difficulty — but it can be done.

Switching-mode power supplies are inherently the noisiest circuits imaginable. A large current from the supply is being turned on and off at high frequency with very fast dI/dt. There are inevitably large fast voltage and current transients.

The only way to prevent interference to sensitive circuitry in the system is to keep the transients within the converter. We cannot stop switching large currents inside it, but we can, and must, prevent the transient currents and voltages from escaping. Start by grounding all the terminals of the converter at AC.

Capacitors block DC but have low impedance at AC, so they should be ideal for this purpose. In theory, if we place a large capacitor between the converter input and its ground, the input will keep the capacitor charged and the transient currents will flow in the capacitor and not from the power source. A similar output capacitor absorbs transients and sources steady DC.

Unfortunately when we actually build such a system it is common to find much more noise than we can tolerate in the input and output circuits - what can be wrong?

If the capacitor is placed some distance from the converter, the impedance, resistive and inductive, of its connection to the converter will be large enough to prevent it from working properly; if it is chosen badly it will have higher impedance

than the basic $1/2\pi fC$ formula predicts; and if it shares its ground path with other circuitry the noise in the common ground impedance will be disruptive.

Add to these effects the less important, but still damaging, consequences of external currents induced by fast-changing magnetic and electrostatic fields, and even electromagnetic radiation, from within the converter, and it is obvious that preventing converter noise is not simply a matter of placing a couple of random capacitors on its input and output.

Silencing a DC-DC converter requires systematically finding all the possible paths by which noise can escape from it, and ensuring that they are all locked down. The linked article discusses how this may be done.

Of course before we start we must choose or design the converter itself to have minimal external noise. This is a separate issue which may be discussed in a future RAQ.

To Learn More About Power Supply Noise

Go to: http://rbi.ims.ca/5721-100

Contributing Writer James Bryant has been a European Applications Manager with Analog Devices since 1982. He holds a degree in Physics and Philosophy from the University of Leeds. He is also C.Eng., Eur.Eng., MIEE, and an FBIS. In addition to his passion for engineering, James is a radio ham and holds the call sign G4CLF.

Have a question involving a perplexing or unusual analog problem? Submit your question to: raq@reedbusiness.com

For Analog Devices' Technical Support, Call 800-AnalogD

SPONSORED BY

ANALOG DEVICES