

Rarely Asked Questions

Strange stories from the call logs of Analog Devices

Stress Is Bad For You — and For Analog ICs

Q. You recently mentioned that mechanical stress alters the calibration of precision analog ICs. Does this mean that mounting them incorrectly can make them inaccurate?

A. Indeed it does! But do not worry too much. We recently discussed the mechanism involved. If a thin film of a conductor is attached to sheet of an insulator its resistance will vary as the insulator is flexed. If the conductor is a resistor in a precision IC stress will affect the circuit's calibration.

This is rarely a serious problem. Precision analog ICs usually rely on the matching of resistors rather than their absolute value. If a chip is laid out so that all its critical resistors experience the same stresses, their matching is maintained even if the absolute values change.

Furthermore if the chip is in a standard IC package its leads (or pads) and bond wires isolate the chip from the small stresses involved in mounting the IC on its circuit board. If a circuit board carrying an accurate analog IC is bent or twisted it is likely that the solder joints will be damaged before the change in accuracy becomes important.

Where problems can and do arise is when ICs are mounted in some sort of mechanical assembly. This is quite commonly done with sensors, which can include temperature sensors, photo-sensors, accelerometers and gyroscopes.

Some engineers feel that these should be mounted "firmly" and this can involve clamping with much higher force than is either necessary or safe. ICs are very small and light, most weigh tens or hundreds of mg and the heaviest are only a few gm. A clamp force of at most one newton¹ is more than adequate to secure them firmly without upsetting their calibration.



I have seen a temperature sensor mounted "firmly for good thermal contact" with a force of some 200 N, which moved the calibration by over 8°C. Experiment showed that the thermal conductivity between the device and the substrate did not change measurably as the mounting force was changed from 1 N to 200 N — but the calibration surely did.

ICs which are mounted in mechanical structures should be held with as little force as possible. If they are held in screwed brackets a small piece of foam may be used to limit force but make the mounting more secure. However there should be no foam between a temperature sensor and the surface it is measuring, since this reduces thermal conductivity, nor between a gyro/accelerometer and its mount because it damps HF vibrations.

¹ A newton is more formally defined at <http://en.wikipedia.org/wiki/Newton> but it is easiest to think of it as the force exerted by Earth's gravity on a small (102 gm) apple.

**To Learn More About
Mechanical Stress**

Go to: <http://rbi.ims.ca/5717-101>



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Have a question involving a perplexing or unusual analog problem? Submit your question to:
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