

Designing Data Recorders for Harsh Environments

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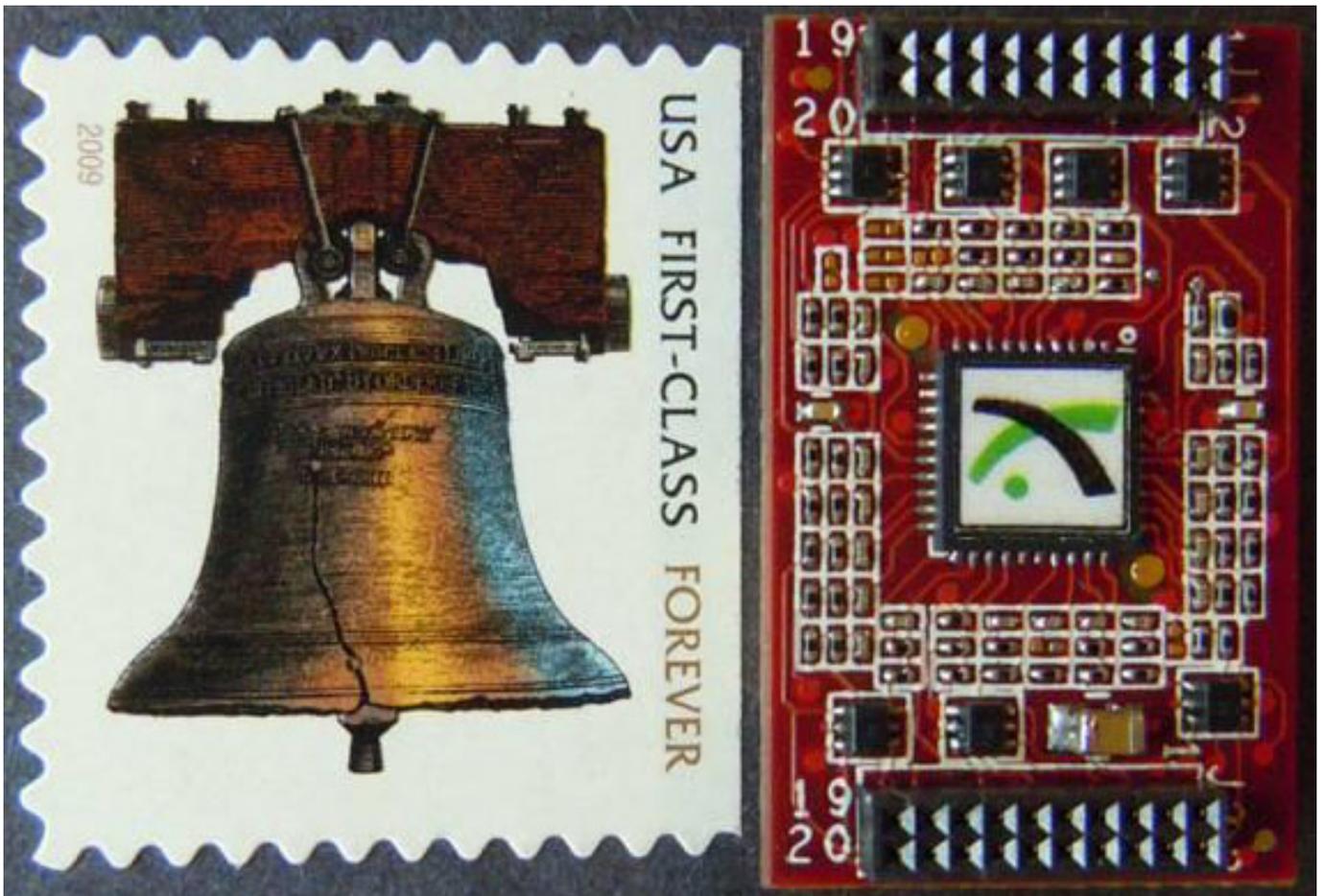


In many applications, data recorders collect information while being exposed to mechanical and thermal shock, vibration, high humidity, and high Electro Magnetic Interference (EMI) environments. Designing data recorders for reliable operation when exposed to these environments is a challenge. The key features that enable a data recorder to operate reliably under these conditions are miniaturization, a well executed circuit board layout, potting or conformal coating, and ensuring that the circuitry is designed to work over temperature extremes and over worst-case component tolerance variation.

Why is miniaturization so important? Consider a crash testing application. Let's compare how two different size capacitors respond to a 20,000 g shock, relative to the ability of the solder joints to hold the capacitor on the circuit card. In this example, a 1210 size capacitor weighs 0.1 grams and an 1812 capacitor weighs 0.23 grams, but when exposed to 20,000 gs the 1210 capacitor weighs 2 kg and the 1812 capacitor weighs 4.6 kg. Using Sn60/Pb40 solder and the capacitor manufacturers' recommended solder pad geometry, the solder joints for the 1210 capacitor can hold 10.8 kg, providing 438% structural margin, while the solder joints for the 1812 capacitor can hold 14.8 kg, providing 221% margin. The smaller capacitor has about twice the structural margin than the larger one when exposed to a shock load.

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Published on Electronic Component News (<http://www.ecnmag.com>)



Conformal coating or potting is used to protect data recorder electronics from the degrading effects of high humidity but these materials also provide mechanical support to electronic components, enhancing shock and vibration protection. When potting an assembly, careful attention must be paid to the Coefficient of Thermal Expansion (CTE) and durometer (hardness) of the potting, which can break electronic components during thermal cycling due to expansion and contraction of the potting material. Potting and conformal coating, typically being insulative materials, also provide protection from thermal shock by slowing down temperature transitions.

An excellent example of a data recorder design to survive harsh environments is Excelitas Technologies' Informant Nano Recorder. The Informant is a 22-channel mixed signal data recorder that is smaller than a postage stamp, employs non-volatile memory, and has been tested to survive multiple impact shocks of 75,000 gs. To provide this level of shock survivability, the Informant uses 0201 size resistors and capacitors, high reliability components, and a low CTE potting material. The Informant can be used potted, conformally coated, or with no potting or conformal coating. The Informant Nano Recorder's miniaturization provides substantial immunity to EMI by minimizing the loop area of parasitic antennas formed by traces on the circuit board and the use of ground planes provides shielding against EMI. To protect data from loss due to ESD damage, the Informant provides three layers of ESD protection on all I/O.

The trend in data recording is to provide smaller packages, more memory, and

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faster sample rates. It is becoming more common to see data recorders integrated into laptops, industrial machines, cars, etc. as a way to contain warranty costs when devices are operated beyond their intended purpose.

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