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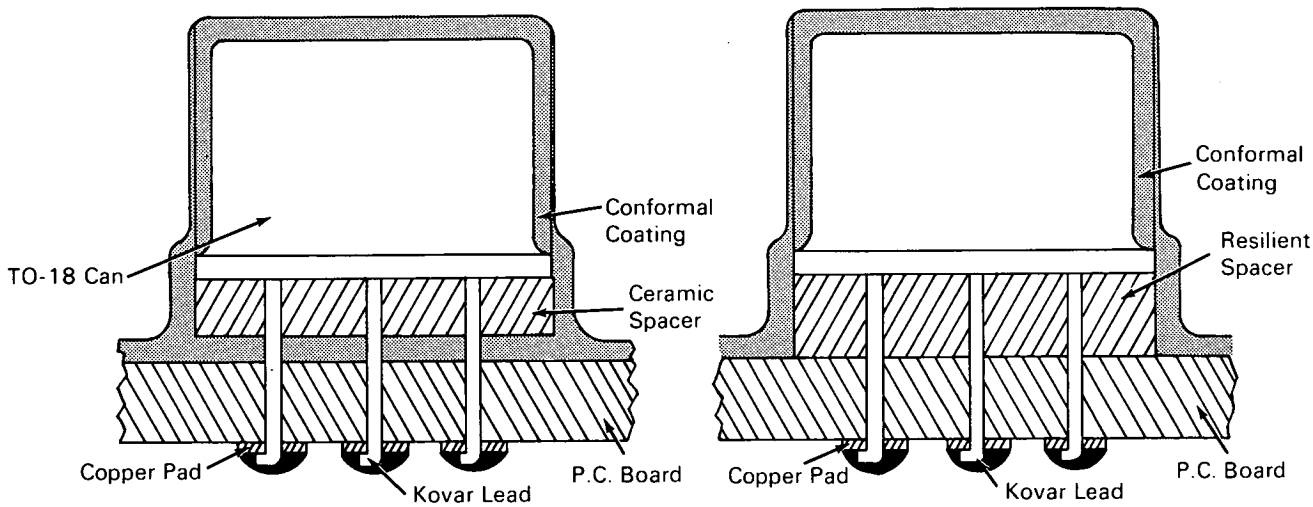
NASA TECH BRIEF

Prevention of Cracking of Soldered Joints in Electronic Assemblies



Transistor Configurations with Clinched Solder Joints: Standard (left) and with Resilient Pad (right)

Cracks have developed in soldered joints on printed-circuit boards in electronic assemblies at high altitudes. When in service such assemblies are subjected to much thermal cycling; the difference in coefficient of expansion between the boards and the components in the assemblies is reflected as force in the components' leads that causes stress and cracking.

An investigation of the cracking followed two approaches: analytical and empirical. In the analytic investigation, a mathematical analysis was made of the joints in question, especially the transistor joints which seemed most subject to failure. A mathematical model of existing techniques for mounting components on printed-circuit boards was analyzed, and the force on critical components was calculated. This approach permitted insight into the basic problem and thus led to ideas that could provide solutions. Mathematical models based on the proposed solutions were then analyzed for determination of the theoretical validity of the solutions.

The empirical investigation entailed determination of the extent of damage caused by temperature cycling of the assembled boards, and of the practical validity of the proposed solutions to the problem. Boards were tested with components mounted either in the normal manner or in accordance with the proposed solutions. The results of the analytical and empirical investigations were compared.

The investigations found no single cure for the cracking but have led to several recommendations: Future design of such board assemblies should incorporate techniques allowing for thermal stressing of the soldered joints during many thermal cycles. Fabricators should be warned against installation of components in a manner that builds strain into the joints.

(continued overleaf)

Components' leads (see fig.) should be thoroughly cleaned, tinned, and freed of particles that may prevent adherence of solder—especially leads of encapsulated pulse transformers and modules that have sealant applied to the leads during the encapsulation. The conformal coating should be as thin as possible. There should be an air space between the conformal coating and the body of the component; in the absence of an air space there should be a resilient pad under the component. The pad should be such that there is little likelihood of the coating bridging under the component. Components should be "ruggedized" with fillets of the resilient material to reduce the likelihood of the conformal coating bridging under them.

Because of the primary cause of the cracking, the material of the conformal coating should be replaced by one having a lower coefficient of thermal expansion and a lower modulus of elasticity; such a material should be sought by research. A better material for resilient pads should be found.

Notes:

The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.65)

Reference:
NASA-TM-53824 (N64-81884). Investigation of the Development of Cracks in Solder Joints

Patent status:

No patent action is contemplated by NASA.

Source: Barnes Beasley
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