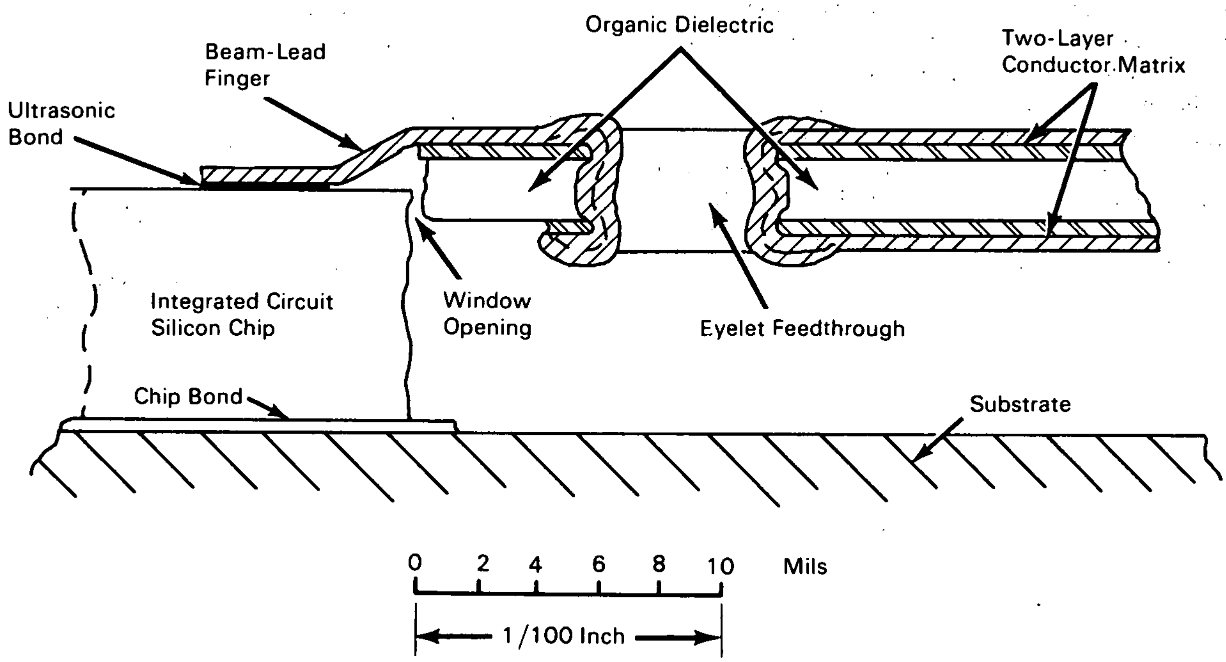
NASA TECH BRIEF

Improved Beam-Lead Interconnection Structure for Uncased Integrated Circuit Chips



A beam-lead interconnection structure has been devised to provide a compact, economical means of interconnecting uncased integrated circuit (I. C.) chips. This structure eliminates several levels of manually made interconnections and considerably shortens the path lengths from generator to load, thus permitting reduction in consumed power.

The structure employs metal beam-lead fingers of 5-to 10-mil center spacing, cantilevered over rectangular access openings or windows in a laminate consisting of a thin dielectric sheet having metal foil clad on one or both sides, depending on the complexity of the desired interconnections. The laminate is fabricated so as to interconnect complex functions, typically represented by uncased I. C. silicon chips having planar thin-film-metal patterns, and closely spaced surface bonding pads. The cantilevered beam-lead fingers, integral to the interconnecting conductive paths on the dielectric sheet, are disposed around the periphery of each window. The beam-lead terminations are electroformed to a fine-detail pattern at the same time that surface conductors and feedthrough holes or eyelets are being plated, using a metal differing from the foundation metal foil. The plated metal must be amenable to bonding by standard methods.

(continued overleaf)

Details of the cantilevered beam-lead fingers used in a typical array of uncased integrated circuit chips with an overlay of a two-layer matrix of etched interconnections are shown in the cross-sectional drawing. The overall size of this array, accommodating 42 multiple-function integrated circuit chips, is approximately 1.2 x 1.2 inches. Disposed around each chip is a ring of eyelets which serve to anchor each set of beam-lead fingers to the matrix and provide a set of feedthroughs so that the signal paths on the second layer of conductors can feed the beam leads as readily as conductors on the first layer of the matrix. The cross-sectional view shows how the beam-lead finger bridges the gap between the silicon chip and the matrix structure and how the finger slants downward to the chip, thus precluding electrical shorting at the edge of the chip. The windows in the matrix confine each of the chips into rough registration with the fingers. These windows, as well as the openings in the organic dielectric for the eyelets and the openings for the major exit nuggets, are formed by a chemical digestion process. Thus the entire matrix structure is formed using a series of precision photographic patterns in combination with additive and subtractive chemical processing, completely eliminating any mechanical fabrication steps, and opening the way to automated production.

The beam leads, which cantilever over openings in a two-layer matrix part, can be bonded directly to an array of uncased silicon integrated circuit chips by several methods. Ultrasonic bonding is the preferred method when using chips having aluminum contact pads. The two-layer matrix part is a type of flexible printed circuit board into which the chips are directly bonded, resulting in one-third the number of manually made bonds normally required for flat packs. The "face-up" bonding approach permits rapid registration of 10 to 14 contact pads on the integrated circuit chips to the corresponding precisely located beam leads.

Note:

Requests for further information may be directed to:

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No patent action is contemplated by NASA.

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