

Circuit Technology

James P. Langan J.P. Langan & Associates, Inc. 7 Mayflower Drive Red Bank, NJ 07701 908/842-3741

Trends in PWB Construction

ll electronic components must be A interconnected and assembled to form a functional and operating system. The design and manufacture of these interconnections have evolved into a separate discipline called *electronic packaging*. Since the 1950s, the basic building block of electronic packaging has been the printed wiring board (PWB). This is an interconnect system with copper conductors on an organic substrate.

A more sophisticated system is hybrid circuits, which consist of elements that are fabricated in situ directly on the substrate material in combination with discrete add-on components. These circuits are normally on inorganic substrates (e.g., alumina/aluminum nitride/beryllia/ silicon.

Cost savings is the attraction of organic substrates over ceramic substrates. Advancement in component technology has created a demand for ever-higher packaging density. The PWB is expected to prevail as the preferred interconnect system, provided it can continue to meet this need.

Future Trends

Perusal of the following data reflects changes in PWB construction (see accompanying charts):

- IPC's Technical Marketing Research Council (TMRC), 1995 report
- Circuitree magazine survey, February 1997 (OEM PWB purchases 1996)

Interpretation of Data The decline of single- and doublesided PWBs and the dramatic increase of multilayer PWBs in the 1980s was a result of the success of surface mount technology. It is expected that

Technical Market Research Council Data Based on Sales of PWBs Produced in the U.S. (%)											
PWB Types Single-sided	1980	1985	1990	1992	1993	1994	1995				
• Glass	1.6	1.9	1.7	1.9	1.3	1.4	0.8				
 Composites 	<u>13.3</u>	7.9	6.4	5.9	8.6	8.9	5.2				
Total	14.9	9.8	8.1	7.8	9.9	10.3	6.0				
Double-sided	49.9	31.1	23.5	23.7	21.3	21.4	20.2				
Flex/rigid flex	5.6	7.5	6.6	7.3	7.4	7.3	6.6				
Multilayer	29.0	46.9	55.8	53.9	54.1	54.3	58.5				
HP Multilayer	0.6	4.7	6.0	7.3	7.3	6.7	6.7				
Total ML	29.6	51.6	61.8	61.2	61.4	61.0	65.2				
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0				

Circuitree Data

Typical Trace/Space Widths, 1996 (%)				Multilayer PWB, 1996 (%)		
>	6 mils/1.5 mm	44.6	2	4–6 layers	52.4	
	6 mils/1.5 mm	25.0	8	8–12 layers	36.6	
	5 mils/1.5 mm	24.0	1	14–20 layers	8.1	
<	5 mils/1.5 mm	6.4	2	22 + layers	2.9	
		100.0		-	100.0	

the electrifying breakthroughs occurring in component technology will accelerate this trend.

These advancements in component technology demand higher I/O interconnections and denser packaging. Prevalent practices for attaching components to hybrid circuits could well be the answer for proficient attachment of ultrafine-pitch components (thermocompression, thermosonic, ultrasonic and eutectic bonding).

To satisfy the need for conforming to new attachment techniques and higher packaging density, the PWB industry must confront the challenge to produce thinner multilayer boards with finer lines/spaces, narrower/ buried vias, selective surface and high-performance laminates.

Thinner multilayers with higher circuit density will require materials with enhanced electrical/chemical/

mechanical/thermal properties. This suggests:

- 1. Advanced resin systems
 - Multifunctional epoxy
 - Polyimide
 - Cyanate ester
- BT/epoxy
- 2. State-of-the-art glass filaments • Single-ply woven E-glass

 - Nonwoven aramide reinforcement
- 3. Fine-grain copper foil

Currently, the majority of PWBs are constructed of FR-4 (epoxy/glass) with coarse-grain copper foil. Cost, reliability and processing issues must be scrutinized when specifying these advanced materials.

Key concerns in the selection process must necessarily address: Design for manufacturability, cost considerations, reliability issues, and first-pass yields in assembly. PESF