



ASSOCIATION CONNECTING
ELECTRONICS INDUSTRIES

IPC-D-422

Design Guide for Press Fit Rigid Printed Board Backplanes

IPC-D-422

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A guidelines developed by IPC

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Developed by the Backplane Committee of IPC

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Any Standard involving a complex technology draws material from a vast number of sources. While the principal members of the Backplane Committee are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

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Introduction

This general design guide for Printed Board Backplanes is based upon the primary understanding that the individual using this IPC document as a reference and guide has the basic mechanical knowledge of the various types of interconnection systems. Also, that the electrical and mechanical properties of the interconnection materials have already been evaluated and selected by the individual companies' components specification organizations and are approved.

The purpose of this document is to enlarge upon the user's analysis and approach the design from the fabricators and assemblers with respect to design optimization. This design optimization can have a dramatic impact on the life cycle cost of the equipment.

The following documents are applicable to these guidelines:

IPC¹

IPC-D-300 Printed Wiring Board Dimensions and Tolerances

IPC-D-330 Printed Wiring Design Guide

IPC-D-390 Guidelines for Design Layout and Artwork Generation on Computer Automated Equipment for Printed Wiring

IPC-C-405 General Specification for Connectors, Electrical Printed Wiring Board Type

IPC-BP-421 General Specification for Rigid Printed Board Backplanes with Press-Fit Contacts

IPC-TR-474 An Overview of Discrete Wiring Techniques

IPC-ML-910 Design and End Product Specification for Rigid Multilayer Boards

Military²

MIL-STD-1130 Connection, Electrical, Solderless, Wrapped

MIL-P-13949 Plastic Sheet, Laminated, Metal Clad (for Printed Wiring Boards), General Specification for

Underwriters Laboratories³

UL 94 Tests for Flammability of Plastic Materials

Backplane Design Flow

A normal design flow of a printed circuit backplane may take 2 or 3 cycles depending on the design complexity and the production release of the user's equipment.

- *The initial cycle* might be a fast prototype or preproduction design where basic plug in electronic module interconnections have been initially defined but final equipment system checkout has yet to be performed.
- *The second cycle* could be a phase in design incorporating, as etched conductors, the various wires attached during the systems checkout.
- *The third cycle* may not be required but could be another incorporation of attached wires to reduce the amount of production labor.

IMPACT STATEMENT: WHEN A PRODUCTION MODE OCCURS WITH A DESIGN THAT BECOMES MORE OR LESS FROZEN, RECYCLING OF ARTWORK DESIGN OR SIGNALS SHOULD BE INITIATED TO "PHASE IN" THE OPTIMIZATION OF THE DESIGN AT THE EARLIEST DATE POSSIBLE.

The effort required for internal documentation changes, as well as the fabricators new artwork generation cost when

compared to the wiring material and labor required may justify this optimizing of the various design aspects.

Each designer must consider that no additional cost to fabricate the backplane be introduced during these "phase in" cycles. This would include impact redesign areas of the addition of new hole patterns, dimensional changes, etc. (A "phase in" is just that. For example: a backplane can be changed with artwork revisions to the new configuration and phased into those assemblies that are following through the vendor's production line.)

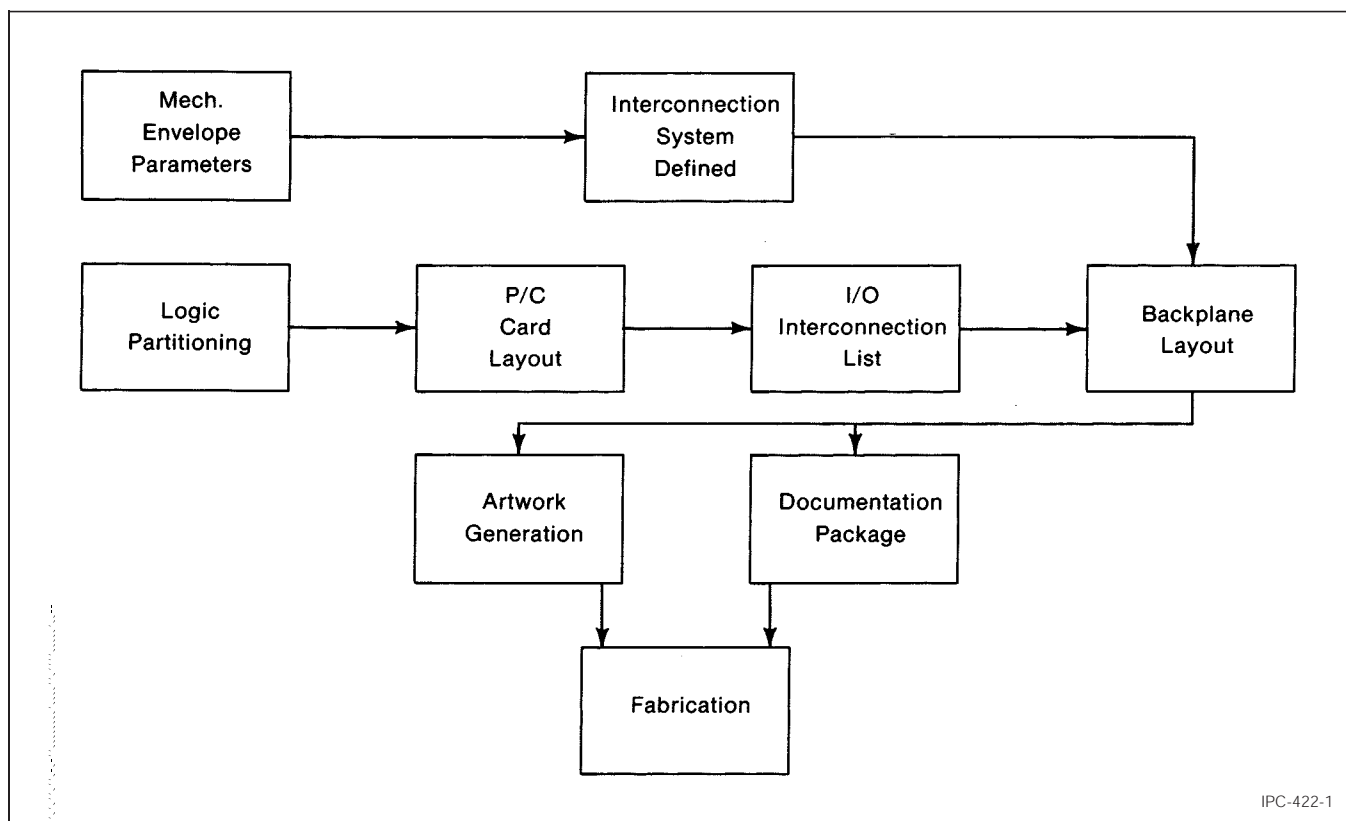
A backplane design normally begins after the logic partitioning has progressed into the proposed electronic module configurations. An electronic module can be a printed wiring assembly, dual-in-line package, chip carrier, cordwood module, etc. From this either by computer or manual electronic module layout, the interconnecting input/output points are defined for the backplane. This completes the basic electrical interconnection phase.

The mechanical constraints are assumed to have been clearly defined by the parameters dictated for the type of equipment being designed. It is also assumed that the interconnection system has been defined as "edgcard," post

1. Copies are available from IPC.

2. Copies are available from Naval Publications and Forms Center, 5801 Tabor Road, Philadelphia, PA 19120.

3. Publications are available from the Underwriters Laboratories, Inc., Northbrook, Illinois.



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Figure 1 Backplane Design Flow

and box, blade and fork, etc. This would then complete the basic mechanical phase.

The flow chart shown in Figure 1 shows the initial path of backplane design.

An attempt will be made, within this document, to take various steps within the basic flow of design, and point out the areas most likely to require additional review, in order to determine if those areas have reached their optimum design state.

Design

The following factors, not necessarily in order, should be considered in the design of a backplane system.

Cost • Reliability • Produceability • Maintainability • Tooling requirements • Lead time • Interconnection functions with other equipment • Multiple sourcing

When defining reliability, establishing realistic values on environmental parameters for the end usage must be considered as their impact can be significant. These values include ambient temperatures, relative humidity, altitude,

vibration and shock. Many of these parameters are derived from previous connector specifications for other applications.

IMPACT STATEMENT: OVERDESIGN CAN SIGNIFICANTLY INCREASE THE COST OF A BACKPLANE.

Total system design parameters should also be considered as a factor in cost. This includes the most obvious of components, the various electronic modules that plug into the backplane.

Dimensioning and tolerancing criteria must be reviewed carefully as they pertain to the alignment of the electronic module into the connector on the backplane.

IMPACT STATEMENT: A DESIGNER HAVING A KNOWLEDGE OF PLUG IN ELECTRONIC MODULES, BACKPLANES AND CONNECTOR SYSTEMS FABRICATION PROCESSES CAN OPTIMIZE HIS DESIGN AND PROVIDE AN ACCEPTABLE END PRODUCT WITH NONRESTRICTIVE SOURCING.

Section I

1.0 DESIGN AND DOCUMENTATION

1.1 Interconnection Systems The interconnection system is made up of the female/male insulators and their respective contacts.

1.2 Insulators The interconnection insulator must have the following material requirements to satisfy its functional usage. These are: good insulation resistance, heat resistance, moisture resistance and good mechanical properties.

IMPACT STATEMENT: THE OPTIMUM DESIGN CALLS FOR THE USE OF INSULATORS IN THEIR SPECIFIC APPLICATIONS.

1.2.1 Insulator materials are a first consideration in the design of the interconnection system. Most common materials used for press-fit applications are of the thermoplastic classification such as polyamide (nylon), polycarbonate and polyester, all of which are generally 10 to 30% fiber reinforced for improved performance over the nonreinforced grades. The chart in Figure 2 lists various data on the three materials mentioned above. This information may be helpful in assisting the designer in selecting the proper material for his application. More detailed performance data is readily available from all plastic suppliers.

IMPACT STATEMENT: AN INJECTION MOLDED PLASTIC IS GENERALLY LOWER IN COST THAN A COMPRESSION OR TRANSFER MOLDED PART.

Coloring of insulator plastic should also be considered. Since most vendors normally run a common color such as black, blue, green or gray, special colors may increase cost depending upon the problems involved. These include:

- 1) Lighter colors may have various degrees of shading or inconsistencies in true color, causing lot rejection.
- 2) Special molding runs.
- 3) Stocking inventory.

A decision is therefore required as to whether the special color is a design necessity or merely a cosmetic feature.

IMPACT STATEMENT: NONSTANDARD COLORS INCREASE COST.

1.2.2 Dimensioning of the insulator body is important since many dimensions affect the interchangeability or availability of the designed component. Contact grid spacing within the insulator body is usually standardized on 0.100" x 0.100", 0.100" x 0.200", 0.125" x 0.125", 0.125" x 0.250", and 0.156" x 0.200".

IMPACT STATEMENT: MANUFACTURING YIELDS TEND TO DECREASE ON CONTACT SPACING LOWER THAN 0.100" x 0.100".

Insulator body width could be a design necessity due to the center to center positioning of the electronic modules within the assembly. The thinner the body width the closer the center spacing. This of course is a mechanical consideration only, since heat and component height are also factors in the overall design. The electrical design consideration is signal loss as determined by the distance of the card spacing.

IMPACT STATEMENT: INSULATOR BODY WIDTH IS A FACTOR THAT IMPACTS CENTER TO CENTER SPACING. THINNER BODY WIDTHS CAN ALLOW ADDITIONAL ELECTRONIC MODULES TO BE POSITIONED IN THE SAME AREA, BUT ABILITY TO REMOVE THE INSULATOR MUST BE CONSIDERED.

Other insulator dimensional differences can occur in the depth of the electronic module insertion within the insulator body or the mating of the two piece interconnection system within the assembly. The normal edge card insertion depths of printed wiring assemblies range from 0.300" to 0.415" except for special customer connector designs. In a two piece connector system this dimension is a factor for the positioning of the connector housing attached to or a part of the electronic module and must be reviewed for various sources of vendor products.

IMPACT STATEMENT: CUSTOM INSULATOR INSERTION DEPTHS ARE IN MANY CASES HIGHER IN COST.

Insulator body length and printed wiring assembly slot width can affect cost by the restriction of the molded insulator component. An exception is the case of a two piece interconnection system where the female and male bodies usually incorporate an indexing or keying method to insure mating. Polarizing of edge card connectors can be done using either between pocket or in-the-pocket polarizing keys. With the edgecard system, the critical dimensions are shown in Figure 3. This is the dimension from the center of the first printed wiring assembly tab to the edge of the routed area or tang. This X dimension usually runs between 0.100" to 0.156". Refer to IPC-D-300.

IMPACT STATEMENT: NONSTANDARD PRINTED WIRING ASSEMBLY TANG DIMENSIONS CAN RESULT IN NONSTANDARD INSULATOR BODY MOLD CONFIGURATIONS AND INCREASE COST.

