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IEEE Std	FDIS	Report on voting
2401 (2019)	91/1869/FDIS	91/1887/RVD

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IEEE Standard Format for LSI-Package-Board Interoperable Design

Developed by the

Design Automation Standards Committee
of the
IEEE Computer Society

Approved 7 November 2019

IEEE SA Standards Board

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Abstract: A method is provided for specifying a common interoperable format for electronic systems design. The format provides a common way to specify information/data about the project management, netlists, components, design rules, and geometries used in the large-scale integration-package-board designs. The method provides the ability to make electronic systems a key consideration early in the design process; design tools can use it to seamlessly exchange information/data.

Keywords: common interoperable format, components, design analysis, design rules, geometries, IEEE 2401™, large-scale integration (LSI), netlists, packages for LSI circuits, printed circuit board, project management, Verilog-HDL

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IEEE Introduction

This introduction is not part of IEEE Std 2401-2019, IEEE Standard Format for LSI-Package-Board Interoperable Design.

To deal with the increasing difficulty of design and the cost competitiveness of the global market, and to shorten the development term, innovative design methodologies should be implemented. It has been difficult to achieve the optimization of an entire set of large-scale integration (LSI), package, and board (LPB) using individual design processes for each LPB part.

One possibility for optimization is to have a certain section design the whole LPB; however, gathering knowledge and integrating the design environment of each LPB part is difficult. Dedicated professional technicians of individual LPB parts, who have the best knowledge and performance of their own part's design tools, intend to create design optimization by having proper interoperable information exchanges among all LPB parties. In order to achieve a design that optimizes the balance between cost and performance, information about and the results of design should be well shared among cooperating LPB design sections.

The standard format of LSI package board interoperable design (hereinafter called *LPB Format*) was developed to make it easier to exchange information among LPB design departments, so that optimal design will be carried out quickly.

The LPB interoperable design process has the following issues:

— Netlist not unified on each LPB
— Complexity of the representation of the relationship as a whole arrangement of the LPB
— Differences in how to give the design constraints, lack of design information, and many discrepancies in design rules
— Databases not unified in each LPB, or among different vendors
— No unified terms

Various problems caused by these issues include the following:

— A large effort is required for conversion of formats.
— The occurrence of conversion errors and connection errors is difficult to detect because there is a lack of the information needed to do so.
— It takes a long time to gather information, resulting in a long period of design and analysis.
— It is difficult to make optimal design changes because the entire verification process is difficult.
— Electronic design automation (EDA) tool cost increase because of additional development required to support multiple formats.
— It is time consuming for designers to communicate their intentions in a way that others understand.

Based on this analysis, the interface LPB Format has been developed which can address these issues.

As the one of the case studies of the LPB interoperable design process, the power distribution network (PDN) should be designed with information about the other LPB parts to reduce the noise (see Figure i).

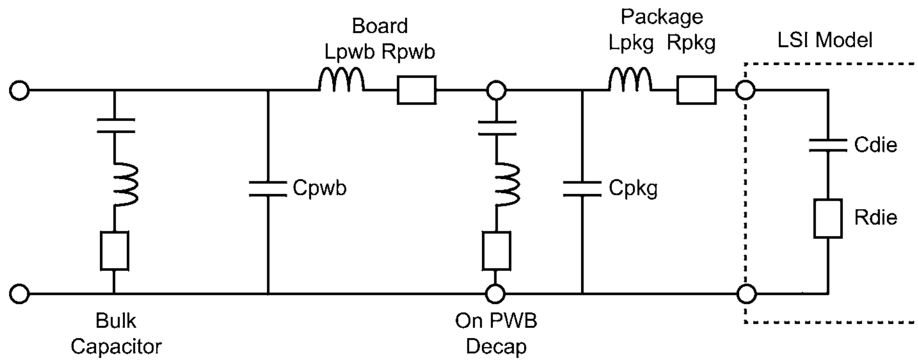

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Figure i—Power distribution network

Resonance is caused by a capacitance and inductance present in the various parts in the LPB PDN. Impedance at the resonant frequency will be extremely large. If each part of the overall LPB design is not accurately simulated in the PDN model, the power supply circuit cannot be correctly designed (see Figure ii).

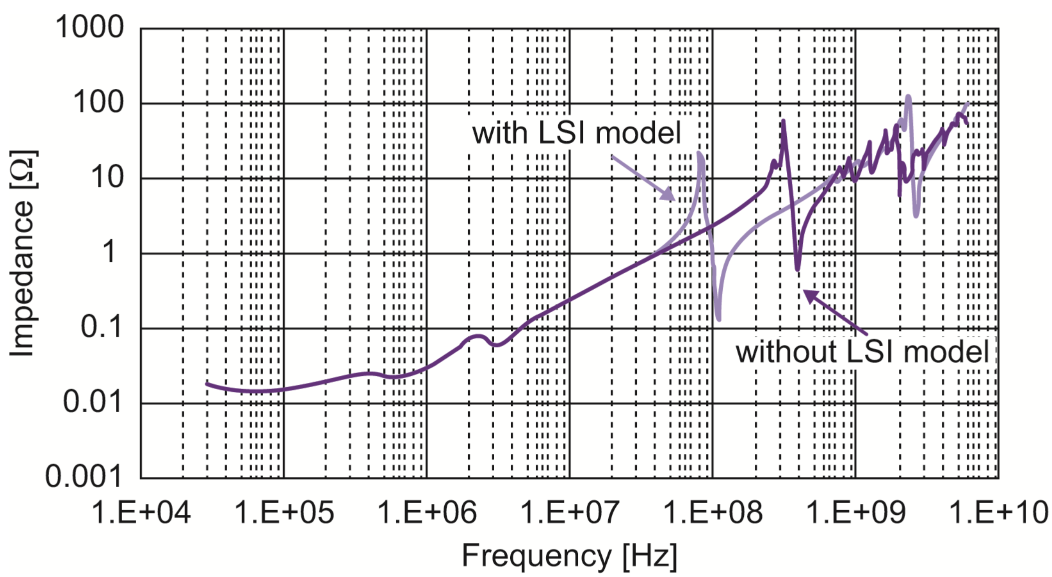

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Figure ii—Example of PDN impedance

In order to run properly, this simulation should align a variety of information, such as the circuit model of power distribution network (PDN) of LSI, shape information about the package and board, electrical parameters of materials, and models of the components. It is difficult to make an efficient design when the specification or format of the design information is different in each part of the LPB, and the necessary parameters are not shared. When the format of the interface methods and models of the simulation are not consistent, the setup time and the cost of design/verification are enormous, which has become a barrier to cooperation in LPB design. The LPB Format will be evolved to create a mutual interface to enable a more efficient co-design environment.

IEEE Standard Format for LSI-Package-Board Interoperable Design

1. Overview

1.1 Scope

This standard defines a common interoperable format that will be used for the design of a) large-scale integration (LSI), b) packages for such LSI, and c) printed circuit boards on which the packaged LSIs are interconnected. Collectively, such designs are referred to as *LSI-Package-Board (LPB)* designs. The format provides a common way to specify information/data about the project management, netlists, components, design rules, and geometries used in LPB designs.

1.2 Purpose

The general purpose of this standard is to develop a common format that LPB design tools can use to exchange information/data seamlessly, as opposed to having to work with multiple different input and output formats.

1.3 Key characteristics of the LSI-Package-Board Format

The LPB Format will facilitate the exchange of design information. This functionality provides the ability to plan the entire design at an early stage. In effect, post-design analysis will be possible throughout the entire LPB design process. Analysis of each part of the design can be examined in relation to all other parts of the design to determine the optimal point to give feedback for appropriate design changes throughout the LPB. This will promote the overall optimization of the design process.

The LPB Format is constructed out of the following five formats (see Figure 1):

a) Project Management (M-Format)

b) Netlist (N-Format)

c) Component (C-Format)

d) Design Rule (R-Format)

e) Geometry (G-Format)

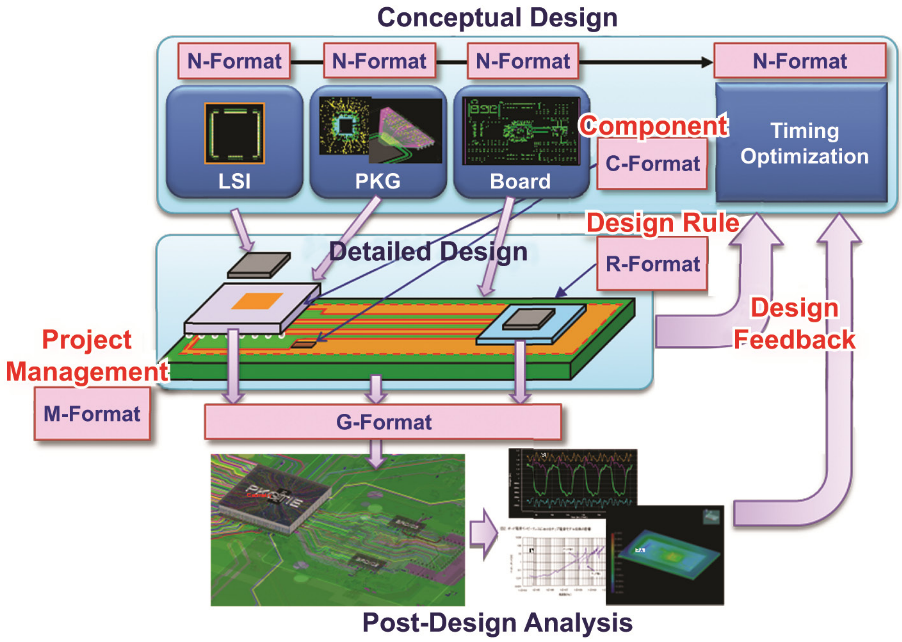

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Figure 1—LPB Format

Design time can be shortened by using the LPB Format. Traditionally, design starts immediately after separate planning for each individual component of the LPB. Therefore, information exchange among the separate design processes is limited. Trying to adjust the detailed design of one component to the detailed design of another component makes the entire design period take longer. Optimization also tends to be a separate process for each component of the LPB. By using the LPB Format for distributed information, each LPB engineer will be able to have the same understanding of the challenges at an early stage. As a result, adjustments at the conceptual design stage can be made, before detailed designs are developed. By making clear the overall LPB product specifications, the design target can be decided, and so the duration of individual designs can be shortened. Use of the LPB Format also helps to reduce the number of design iterations, because the design quality is enhanced. The designers can collect all information for simulation using the LPB formats, thereby reducing production time. The LPB Format can enable the entire analysis easily, so that sufficient verification can be done and the quality of the products can be improved. As a result, the period of adjustment in the set can be shortened and the time to market can be accelerated. With the LPB Format, the design method for one product can be applied to the design environment for next product in development.

1.4 Contents of this standard

The organization of the remainder of this standard is as follows:

— Clause 2 provides references to other applicable standards that are presumed or required for this standard.

— Clause 3 defines terms and acronyms used throughout the different specifications contained in this standard.

— Clause 4 describes the concepts of the LPB Format.

— Clause 5 describes the language basics for the LPB Format and its commands.

— Clause 6 describes common elements in the M-Format, C-Format, and R-Format.

- Clause 7 describes the M-Format.
- Clause 8 describes the C-Format.
- Clause 9 describes the R-Format.
- Clause 10 describes the N-Format.
- Clause 11 describes the G-Format.

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IEEE Std 1364™, IEEE Standard for Verilog® Hardware Description Language.[3, 4]

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