Establishment of Analytical Technologies for Multi-Board Signal Integrity (SI)

Toru Ogoda,
Yuto Ihara,
Wataru Mochizuki

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Abstract

In recent years, significant progress in the technology of integrating electronic circuits has led to the significant performance improvement of electronic equipment.

There has also been an increase in the speed, frequency, low voltage, and miniaturization of electronic equipment where various noises (noise) need not be considered. The use of a multi-circuit board, however, may affect the stable operation of electronic equipment.

Still more, in signal transmission path among multiple boards (multi-boards) through connectors and cables, signal degradation is deepened by increasing the speed and frequency. As a result, it is essential to identify and take measures at the upstream stage of development.

In addition to conventional analytical approaches for Signal Integrity (SI) in printed circuit boards, we are making every effort to establish a new SI analytical technology with multi-boards. We expect that this will result in the improvement of working efficiency and reduction of developing time frame in order to market high-quality products at a much faster rate.

1 Preface

Along with the high-speed performance of Double Data Rate (DDR) memories and interfaces, waveform integrity is deteriorated by increased losses in data transmission path. This makes it difficult to maintain correct transmission of signals from the driver Integrated Circuit (IC) to the receiver IC. In addition, in order to respond to requirements for further miniaturization, the need to transmit fast signals to the multiple boards (multi-boards) joined through connectors is increasing. **Fig. 1** shows the evolution and issues of memory devices and **Fig. 2** shows the requirements and measures. In order to resolve such issues, Signal Integrity (SI) analysis is fully implemented in upstream of development so

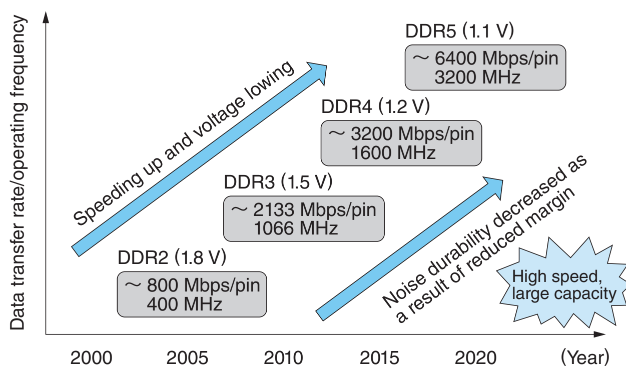


Fig. 1 Evolution and Issues of Memory Devices

Simultaneously with speeding up, SI-related issues are recently noted such as signal retardation, reflection, and crosstalk.

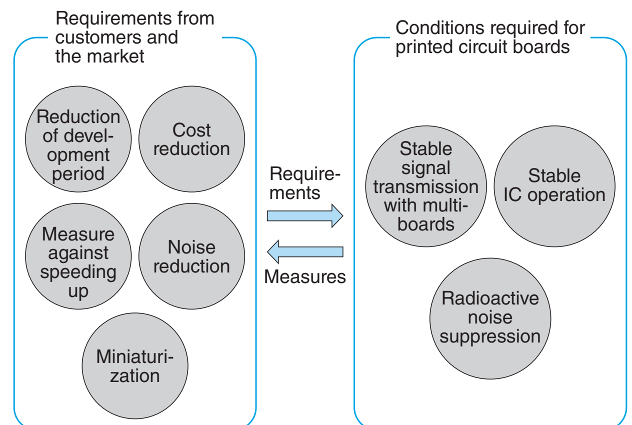


Fig. 2 Requirements and Measures

According to requirements from customers and the market, measured items in printed circuit board development are shown.

that we can deliver highly quality products to our customers in the shortest possible time frame. This paper introduces a multi-board SI analytical technology at the stage of upstream development for printed circuit boards.

2 Analytical Approach for Multi-Board SI

Fig. 3 shows the condition of connector joints and Fig. 4 shows multi-board SI analysis. A transmission path through a connector is modeled in order to secure signal integrity while signal waveforms are transmitted from the sending side to the receiving side without causing turbulence.

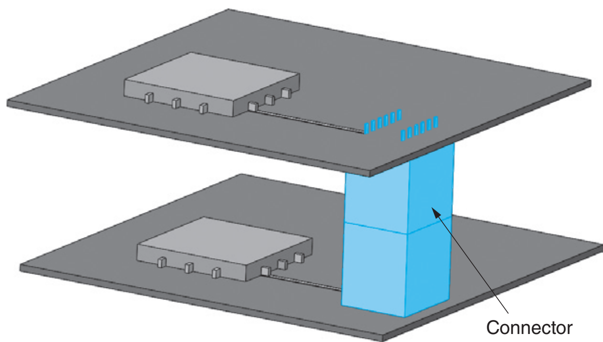


Fig. 3 Condition of Connector Joints

A configuration of a multi-board used for analysis is shown.

The network parameter in each transmission path (S parameter hereafter) is acquired as described below.

(a) Device model of semiconductor parts

An Input-output Buffer Information Specification (IBIS) model distributed by the respective semiconductor parts makers is procured.

(b) Printed circuit board model

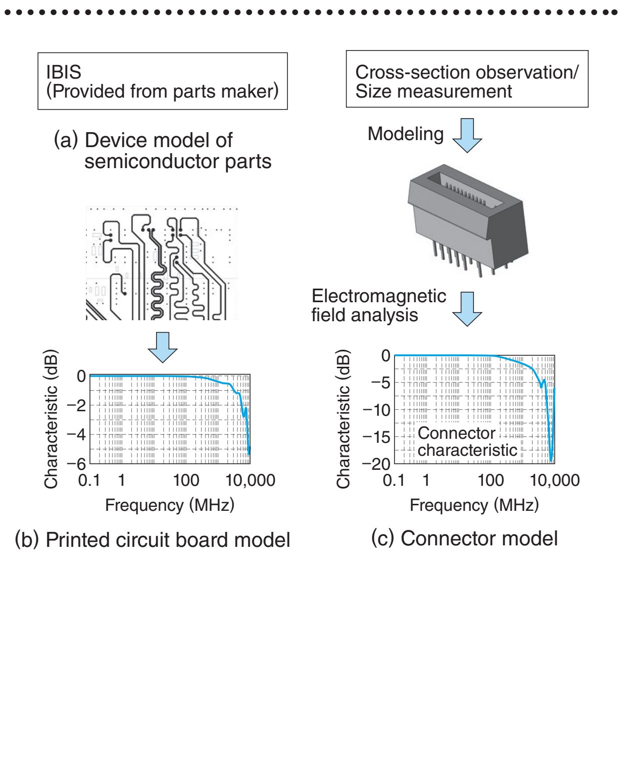
An S parameter in the high-speed signal transmission path is acquired from board design data using an electromagnetic field analyzing tool (ANSYS SIwave) (1).

(c) Connector model

It is an ideal method if S parameters are procured from the respective manufacturers.

Fig. 5 shows an observation of a connector cross-section and a measurement of dimensions. Fig. 6 shows a 3D model. After an S parameter is acquired with the use of an electromagnetic field analyzing tool.

Combining the characteristics obtained from (a) to (c), a network topology of transmission path is established and SI analysis is then carried out. By doing so, multi-board analysis can be realized in consideration of connector characteristics.



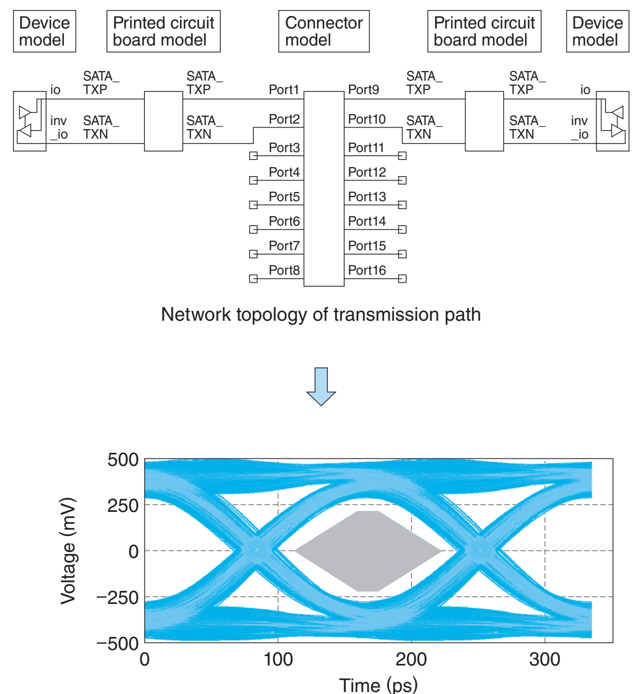


Fig. 4 Multi-Board SI Analysis

For the quality assurance of signal transmission paths between multi-boards, SI analysis is indispensable. For the resolution of issues like signal retardation, reflection, and crosstalk, this supporting tool is actively used.

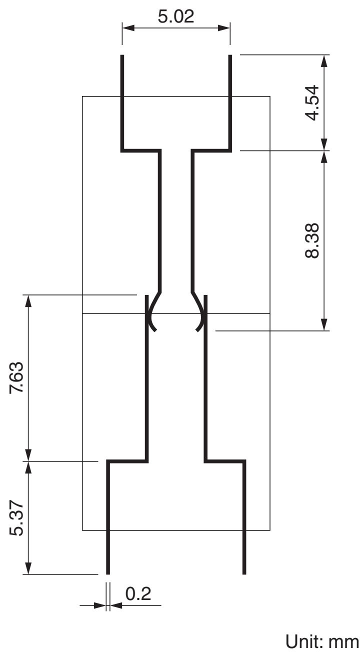


Fig. 5 **Observation of Connector Cross-Section and Measurement of Dimensions**

Observation of connector cross-section in the mating state and measurement of dimensions by means of a microscope are shown.

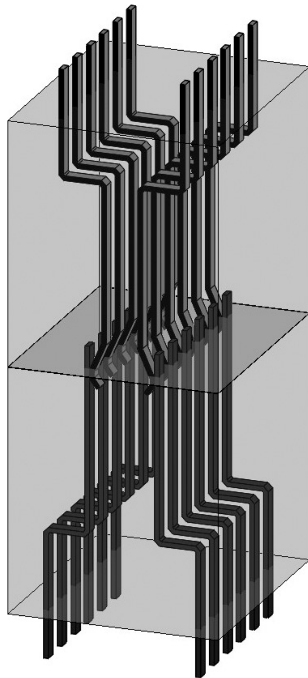


Fig. 6 **3D Model**

A 3D model (including interior structure) established based on the measured data is shown.

3 Postscript

This paper introduced multi-board SI analyzing technologies we are working on. If we adapt SI analytical technologies to printed circuit board designs and single out potential issues existing in the upstream of development, it is possible to avoid reworking attributable to SI and offer our quality products to our customers within the shortest possible time. There is concern in terms of signal degradation if a multi-stage configuration through connectors is established for the purpose of miniaturization. By virtue of SI analyzing approaches, however, the presence of any issues can be examined before going into trial manufacturing.

Based on our expertise established from application of analytical technology and modeling approach, we will be able to realize overall system modeling, not just limited to parts. Going forward, we will develop technologies of radioactive disturbance noise suppression and misoperation avoiding systems against the intrusion of electromagnetic waves generated from external equipment.

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《Reference》

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