JPCA Standards of Optoelectronic Assembly Technology

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Abstract
JPCA has been developing standards necessary for adoption of optoelectronic technology especially for consumer applications for years. The subjects being drafted are the technology that is fairly matured and actually used in some applications in the industry. JPCA has identified some seventy items for standardization and published seven documents as the first set of documents in June 2003. Another dozen documents will be released in the spring of 2004. IPC-0040 has been just published and is an excellent guideline for optoelectronic assembly technology we need. It is our hope that the documents developed by JPCA will be a part of the documents to be developed based on the recommendation made in IPC-0040. We expect our effort will encourage people in the industry to incorporate OE technology in their design of new products, not only in the area of telecommunications but rather in the areas of consumer applications and information processing including but not limited to computers, game machines and others.

Introduction
It is anticipated that optoelectronic technology is needed in equipment and systems in very near future when the speed of signal processing exceeds several GHz as in the 3rd Generation communication tools. The situation is not limited to communications but signal frequency in consumer electronics is reaching very high especially in various digital video applications including high-density video recording such as blue DVD. We believe it is our responsibility that required information of incorporating optoelectronic devices and subsystems into final products to cope with the high speed signal processing. The most vital information in this regard, we believe, is the interface information connecting components and subsystems to other subsystems; the mounting of a module on a substrate, connection of a daughter board to a mother board or connection of boards to a back plane, for examples. The information is referred by engineers who try to incorporate new technologies into the products they design as new applications of optoelectronics.

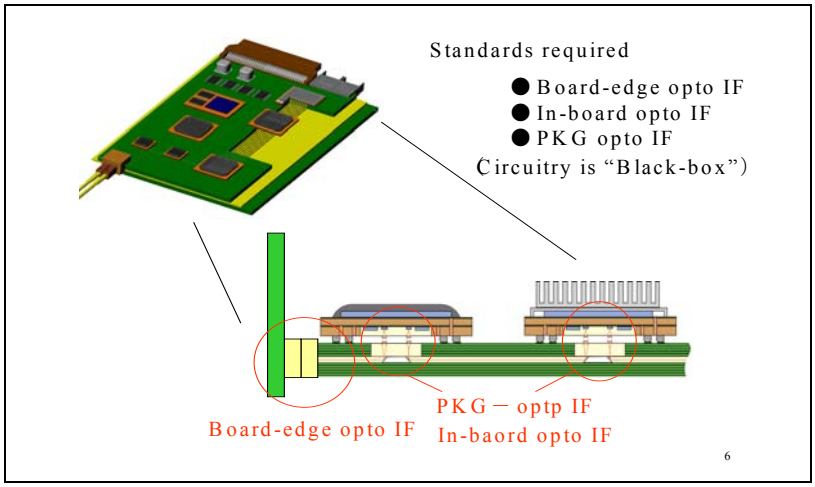

Figure 1 – Interface Needed to be Standardized in OE Assembly

Such information should be for components available in the market or at the final stage of development. Engineers cannot use components with confidence of availability of a specific component in the final product he designs. It is certain that a development engineer may work with device engineers to develop an entirely new device if the components are not available in the market. It is not necessary to write a standard in such a case as the information is proprietary and being held between the user and supplier. A list of available components is also useful information though such a list requires frequent up dating. Such a list of connectors for a specific application was once prepared and released as a technical report from IEC/TC84 (Audio/Video/Audiovisual - IEC/TC84 had merged into IEC/TC100 with three other technical committees to work in the entire arena of multimedia related technology). The JPCA has been actively developing detailed specifications necessary for optoelectronic assembly technology in parallel to the development activity of IPC-0040. We identified some seventy items to be documented, among which we have completed drafting of 15 documents and published seven specifications as of June of this year in

Japanese[1) – 7)]. These seven documents are all translated into English as candidates of IPC/JPCA joint documents and presented at the Optoelectronic Standards Day in detail on September 30, yesterday, here in Minneapolis. We are now working on some fifteen documents most of them will be finalized within one-year time. These documents will also be translated into English and be presented to IPC at various occasions. The hierarchy of the publication plan of JPCA is different from that of the matrix of required standards in optoelectronic assembly technology stated in IPC-0040; nevertheless, we look forward to collaborate with various organizations to develop specifications needed in the OE assembly technology to the industry.

Organizations in Japan including JEITA and OITDA who have been active in developing specifications in the areas of communications and assembly technologies are very much cooperative in developing the documents prepared by JPCA. It is our belief that information of this kind should not be monopolized but shared by people interested in the technology. This is why we try to cooperate with the 5-25 Committee of IPC to prepare series of documents needed in the implementation of optoelectronic technology in various applications in the very near future of probably in two years time. IEC/TC91 (Electronics Assembly Technology) has decided to work on this line when drafts are available and proposed to IEC from a national committee, probably the US National Committee or the Japanese National Committee.

Our purpose of documenting specifications is to provide the engineers in the industry with the technology that is available and can be incorporated in the products they design. All the components described in our documents are available in the market or at the final stage of development and will be shipped to the market very soon. Any component that is still in the development stage in a laboratory is not picked up as a candidate for an OE specification. Level of completion is low and the availability of such a component is not sure yet. Many companies did support our effort and provided us even with proprietary technical information in many cases.

JPCA Optoelectronic Assembly Technology Standardization Committee, its Structure and Policy

This committee was officially organized in 2002 by integrating various efforts being made for years in various standardization groups within JPCA to document optoelectronic technology basically on the assembly of optoelectronic devices on substrates of different materials and structures. Members of the committee were solicited from various branches of the industry; academia, research institutions, PWB manufacturers, and component manufacturers including optical cables, semiconductor devices, passive devices, connectors, waveguide and others. Members from other professional groups also joined to our group such as JEITA (Japan Electronics and Information Technology Association), OITDA (Japan Electronic Industry and Technology Development Association) and JIEP (Japan Institute of Electronics Packaging) officially and privately in some cases.

The committee now has three working groups of the following:

1. Administrative WG
2. Optical Wiring Board WG
3. Optical Connector WG, and
4. Optical Packaging WG.

Each WG can have Sub WG if necessary according to the subject to be discussed. SWG can be a small group to discuss the very details of a specific subject by real experts of the technology. All the documents developed by WGs are reviewed by the Committee members and released as JPCA documents if appropriate and approved by the committee. Our intention is not to confine the information within Japan but to provide the information to organizations outside of Japan, especially to IPC and WECC (World Electronic Circuit Council: CPCA, EIPC, HKPCA, IPC, IPCA, JPCA, TPCA as member associations), and eventually to IEC to bring documents to real international specifications acknowledged by the WTO.

JPCA Standards Released in Optoelectronic Assembly Technology

The first series of documents include specifications and test methods of flexible optical board using glass fibers, rigid optical board using slab waveguide, and two types of optical connectors for glass fibers. The slab waveguide and the sagged fiber connector may be new to many of PWB engineers. The slab waveguide is a waveguide that can divide an input optical signal into many output terminals making use of diffusion of light within the slab. The sagged fiber connector is a connector not using a ferrule type connector but by means of actual physical contact of two fibers in the Plug A and Plug B. One of the cables is slightly bent or sagged within the adapter. The force within the cable to restore the deformation is the source of the physical contact of cables with low insertion loss. The connector is designed to connect a flat fiber ribbon that contains a number of optical fibers. The structure is simple and has good reliability. Their structures are illustrated in Figures 2 and 3.

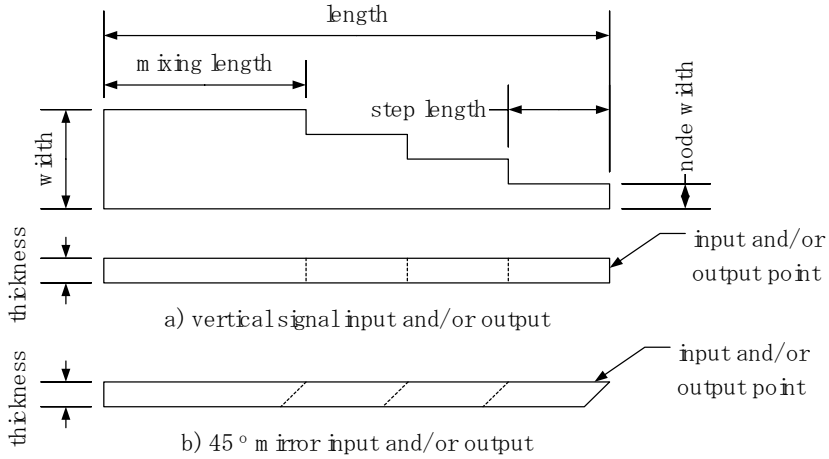

Figure 2 – Slab Waveguide

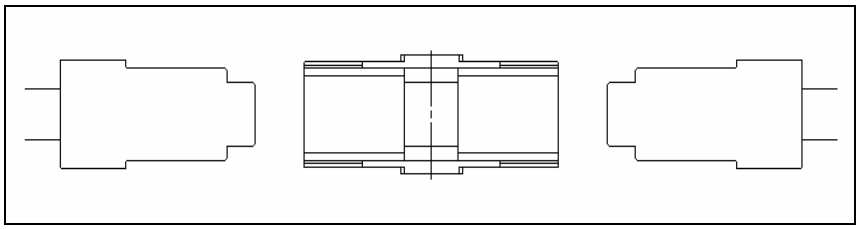

Figure 3 - Construction of the Optical Fiber Connector

JPCA Publication Plan of Standards for Optoelectronic Assembly Technology with Document Numbers

The list below shows the identified subjects of standardization for optoelectronic assembly technology. Items in red and surrounded are the items completed or nearly at the completion. The items with (*) are those already released as JPCA Standards in Japanese in June of this year. Items in blue and in italic are the subjects just started for drafting and those in consideration. Many of these items will be finalized in the first half of 2004. Other items are those just identified as necessary but with lower priority so that it is not necessary to work immediately. We do not have an immediate plan to draft specifications of these items.

Specification for Optical Board

***General Rules for Optical Board PE02**

- Flexible Optical Board using Optical Fiber PE02-01
  - -Sectional Specification for Flexible Optical Board using Fiber
    - *Detail Specification for Flexible Optical Board using Glass Fibers PE02-01-01-2003S
    - Detail Specification for Flexible Optical Board using Plastic Fibers PE02-01-02-2003S
    - Detail Specification for Flexible Optical Board using Polymer Waveguide and Glass Fibers PE02-01-03-2003S
    - Detail Specification for Flexible Optical Board using Polymer Waveguide and Plastic Fibers PE02-01-04-2003S
  - -Sectional Specification of Test Method for Flexible Optical Board using Fiber
    - *Test Method for Flexible Optical Board using Glass Fibers PE02-01-05-2003S
    - Test Method for Flexible Optical Board using Plastic Fibers PE02-01-06-2003 S
    - Test Method for Flexible Optical Board using Polymer Waveguide and Glass Fibers PE02-01-07-2003S
    - Test Method for Flexible Optical Board using Polymer Waveguide and Plastic Fibers PE02-01-08-2003S
  - -Sectional Specification of Guideline for Flexible Optical Board using Fiber
    - Guideline for Flexible Optical Board using Glass Fibers PE02-01-09-2003G

- Rigid Optical Board using Optical Fiber PE02-02
  - -Sectional Specification for Rigid Optical Board using Fiber
    - Detail Specification for Rigid Optical Board using Glass Fibers PE02-02-01-2003S
    - Detail Specification for Rigid Optical Board using Plastic Fibers PE02-02-02-2003S
    - Detail Specification for Rigid Optical Board using Polymer Waveguide and Glass Fibers PE02-02-03-2003S
    - Detail Specification for Rigid Optical Board using Polymer Waveguide and Plastic Fibers PE02-02-04-

2003S
-Sectional Specification of Test Method for Rigid Optical Board using Fiber
Test Method for Rigid Optical Board using Glass Fiber PE02-02-05-2003S
Test Method for Rigid Optical Board using Plastic Fibers PE02-02-06-2003S
Test Method for Rigid Optical Board using Polymer Waveguide and Glass Fibers PE02-02-07-2003S
Test Method for Rigid Optical Board using Polymer Waveguide and Plastic Fibers PE02-02-08-2003S
-Sectional Specification of Guideline for Rigid Optical Board using Fiber

- Flexible Optical Board using Polymer Waveguide PE02-03
-Sectional Specification for Flexible Optical Board using Polymer Waveguide
Detail Specification for Flexible Optical Board PE02-03-01-2003S
-Sectional Specification of Test Method for Flexible Optical Board using Polymer Waveguide
Test Method for Flexible Optical Board PE02-03-02-2003S
-Sectional Specification of Guideline for Flexible Optical Board using Polymer Waveguide

- Rigid Optical Board using Polymer Waveguide PE02-04
-Sectional Specification for Rigid Optical Board using Polymer Waveguide
Detail Specification for Rigid Optical Board using embedded Waveguide PE02-04-01-2003S
*Detail Specification for Rigid Optical Board using Slab Waveguide PE02-04-02-2003S
-Sectional Specification of Test Method for Rigid Optical Board using Polymer Waveguide)
Test Method for Rigid Optical Board using embedded Waveguide PE02-04-03-2003S
*Test Method for Rigid Optical Board using Slab Waveguide PE02-04-04-2003S
-Sectional Specification of Guideline for Rigid Optical Board using Polymer Waveguide

-Specification of Optical Board using Polymer Waveguide PE02-05

Specifications of Optoelectronic Packages

Specifications of Substrates used in OE Packages

General rules of Substrates used in OE Packages

- *Specifications of Substrates using Organic Materials*
- *Specifications of Substrates using Inorganic Materials*

General Rules of Test Methods for Substrates used in OE Packages

Specifications of OE Package Assembly

General Rules of OE Package Interface

- General Rules of OE Package Interfaces using Connectors
- General Rules of OE Package Interfaces using Optical waveguide
- General Rules of OE Package Interfaces using Optical Pig-tails

General Rules of OE Package Interface for Spatial Optical Transmission

General Rules of Test Methods for OE Packages

- Test Methods of Optoelectronic Characteristics of OE Packages
- Test Methods of Mechanical Characteristics of OE Packages
- Test Methods of Reliability of OE Packages

Guidelines for OE Packages

- Design Guideline of OE Package Assembly with Connectors as Interface
- Design Guideline of OE Package Assembly with Optical waveguide as Interface
- Design Guideline of OE Package Assembly with Optical Pigtails as Interface
- Design Guideline of OE Package Assembly with Spatial Transmission as Interface
- Design Guideline of Cooling of OE Packages

Connectors used for Optical Wiring Assembly

General Specification for Optical Board Connector

- **Passive type Connectors for Optical Board**
-Sectional Specification for Passive type Optical Board Connector
Detail Specification for Optical Board Connector type FPC using Glass Fibers
*Detail Specification for Optical Board Connector type SF using Glass Fibers PE03-01-01S

Detail Specification for Optical Board Connector type FPC/SF using Plastic Fibers
*Detail Specification for Right-angled Optical Board Connector using Glass Fibers PE03-01-03S
Detail Specification for Optical Board Connector using Plastic Fibers
Detail Specification for Optical Board Connector type EZ using Glass Fibers
Detail Specification for Right-angled Optical Board Connector using Space Waveguide
Detail Specification for Optical Board Connector type PETIT using Glass Fibers
Detail Specification for Optical Board Connector Terminated to Polymer Waveguide
Detail Specification for Optical Board Connector Terminated to Slab Waveguide

-Sectional Specification of Test Method for Passive type Optical Board Connector
Detail Specification of Test Method for Optical Board Connector type FPC using Glass Fibers
Detail Specification of Test Method for Optical Board Connector type BF using Glass Fibers
Detail Specification of Test Method for Optical Board Connector type FPC/BF using Plastic Fibers
Detail Specification of Test Method for Right-angled Optical Board Connector using Glass Fibers
Detail Specification of Test Method for Optical Board Connector using Plastic Fibers
Detail Specification of Test Method for Optical Board Connector type EZ using Glass Fibers
Detail Specification of Test Method for Right-angled Optical Board Connector using Space Waveguide
Detail Specification of Test Method for Optical Board Connector type PETIT using Glass Fibers
Detail Specification of Test Method for Optical Board Connector Terminated to Polymer Waveguide
Detail Specification of Test Method for Optical Board Connector Terminated to Slab Waveguide

-Sectional Specification of Guideline for Passive type Optical Board Connector

- **Active type Connectors for Optical Board**

-Sectional Specification for Active type Optical Board Connector
Detail Specification for Optical Board Connector Terminated to Slab Waveguide
Detail Specification for Optical Board Connector using Plastic Fibers

-Sectional Specification of Test Method for Active type Optical Board Connector
Detail Specification of Test Method for Optical Board Connector Terminated to Slab Waveguide
Detail Specification of Test Method for Optical Board Connector using Plastic Fibers

-Sectional Specification of Guideline for Active type Optical Board Connector

* (surrounded):	Published (as a JPCA Specification in Japanese)
Red: (underlined)	**Nearly Completed**
Blue (italic):	*Being worked/Under consideration*

Conclusion

JPCA has been drafting specifications necessary for optoelectronic assembly technology. We have published seven specifications in June of this year, and the documents are translated into English. We are working now with the new series of some one dozen documents to be finalized and released before end of next year. We will continue our effort to develop more documents of total of nearly thirty specifications. The information compiled will be disseminated to all the people in need, and especially to IPC as to be a part of the documents being prepared by IPC 5-25 Committee based on the recommendation made in IPC-0040. It is our intention that the information is also to be provided to the member associations of WECC and eventually be proposed to IEC as the candidate of true international standards in cooperation with IPC.

Acknowledgment

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References

1. JPCA PE02S-2003: General Rules of Optical Boards
2. JPCA PE02-01-01S-2003: Detail Specification for Flexible Optical Board using Glass Fiber
3. JPCA PE02-01-05S-2003: Sectional Specification of Test Method for Flexible Optical Board using Glass Fiber
4. JPCA PE02-04-02S-2003: Detail Specification for Rigid Optical Board using Slab Waveguide
5. JPCA PE02-04-04S-2003: Test Method for Rigid Optical Board using Slab Waveguide
6. JPCA PE03-01-01S-2003: Detail Specification for Optical Board Connector type SF using Glass Fibers
7. JPCA PE03-01-03S-2003: Detail Specification for Right-angled Optical Board Connector using Glass Fibers