ADVANTEST

Advantest Corp. has successfully developed a new Optical PCB Technology, capable of 160 Gbps transmission.

～Toward commercialization of the testing system of 40 Gbps per channel, the fastest ever in the industry~

Advantest Corp (head office in Chiyoda-ku, Tokyo; President: Mr.Toshio Maruyama) has recently succeeded in developing a new Optical PCB Technology to enable 160 Gbps transmission by adoption of Optical Waveguide Technology which allows 40 Gbps communications per channel. This is six times faster than the existing products of the company.

Its commercialization is targeted in three years.

When incorporated into the semiconductor testing systems of the company, the Optical PCB Technology will make it possible to test semiconductor at the maximum transmission speed of 40 Gbps per channel , which is the fastest in the current semiconductor testing equipment industry.

Background of the development

With the substantial advent of age of broadband, information equipment such as servers and PCs has been increasingly required to process larger volume of data including moving image and voice, at higher speed. This has called for higher speed and higher density on the part of semiconductors which function in equipment like micro processor unit (MPU).

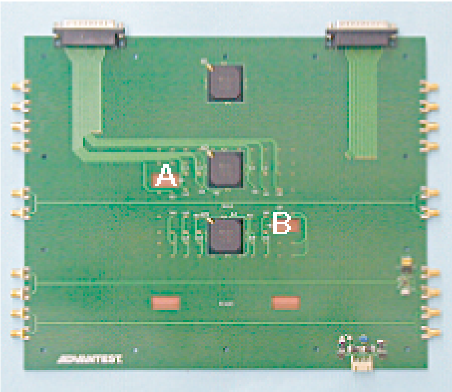
We, at Advantest Corp, have anticipated that semiconductors to be incorporated in such information equipment would be required to be capable of high capacity transmission over 10Gbps , and several tens to hundreds of channels. Thus, we have been developing a new PCB technology to achieve higher speed and higher density semiconductor testing system in Advantest Laboratories Ltd. (Head office in Sendai, Miyagi Pref.; President : Mr.Norihito Kotani), our 100% owned R&D arm.

Description of development

The new optical PCB technology was developed by fusion of available high-speed , high-density PCB technology and Advantest Laboratories' proprietary technologies in optical waveguide designing , mounting and high-speed waveform evaluation which employs optical fiberlaser.

This new technology will lead to faster and more densely packaged test systems for semiconductor.

The successful development was achieved by the joint effort with Advanced Photonics, Inc. (Head office in Ota-ku, Tokyo; President: Mr.Makoto Shigematsu).



Full-view photo of the developed optical PCB (size: 300mm x 250mm, 10 layers of FR4)

Four channels of optical waveguide were formed between A and B, with overall length of 32cm. Low transmission loss of below 4 dB was realized (wave length 850 nm).

Principal features

1)

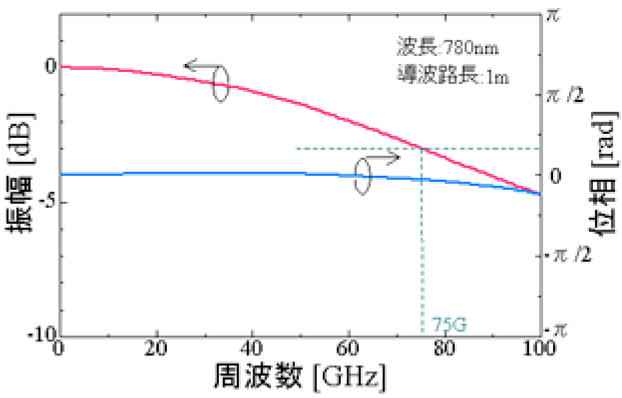
40 Gbps signal transmission, 6 times as fast as the existing products of the company, was achieved.

This high-speed transmission was made possible by selection of optimum combination of materials(epoxy-based resins) for the core (the layer through which optical signal is transmitted with a high refractive index) and the clad (the layer which contains the light within the core). The major point of consideration was to select materials whose difference of refractive indices is minimal and fit together well. Innovation here brought about better control of mode variance (variation in the transmission speed of optical signal).

As a result, the band width of 1 meter optical waveguide was expanded to as much as 75 Giga hertz, and this made it possible to achieve per channel transmission of 40 Gbps.

The optical PCB made this time contains four optical waveguides and thus can make transmission at 160 Gbps.

Transmission band of optical waveguide



振幅 Amplitude

位相 Phase

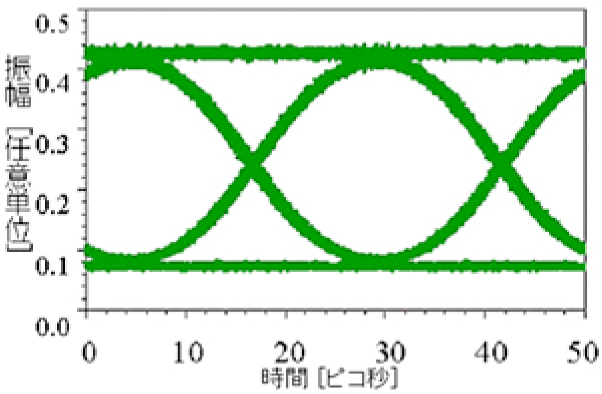
周波数 frequency

波長 Wavelength

導波路長 Waveguide length

This chart shows the way how the transmission band width of the waveguide was obtained. Intense pulsed light was induced to 1m-long optical waveguide and its spread was observed.

As a result, the transmission bandwidth of above 75 GHz was obtained in the 1m- long optical waveguide.



振幅　Amplitude （任意単位）（Arbitrary Unit: au）

時間　Time　（ピコ秒）(Pico-second)

Sufficient eye opening was obtained by simulating the eye pattern for 40 Gbps NRZ signal(（PRBS:2^{31}-1） transmission through the waveguide, using the left part of the graph as transfer function of the waveguide.

In addition, the actual transmission of 40 Gbps PRBS signal of 780nm through the waveguide was made and it showed no deterioration. From these results, it was shown that high-speed signal of 40Gbps can be transmitted for the length of one meter.

2)

Higher-density of optical PCB is realized.

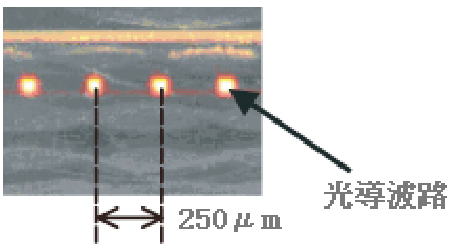
Interference is minimal with optical signal compared to electric signal.

This feature enables far shorter distance between the embedded optical waveguides compared to electrical waveguides, which in turn enables higher density mounting of the signal transmission channels.

Furthermore, this newly developed optical PCB has the optical waveguides embedded inside the board.

This feature allows mounting of parts both on the surface of the board as well as its reverse surface, resulting in higher density of parts mounting.

Cross-section of the optical PCB (vertical to the optical waveguide)



This is a photo showing the cross-section of the optical PCB vertical to the optical waveguide.

The optical waveguides are embedded between the layers of the board.

The optical waveguides used as signal transmission route are shown horizontally at equally-spaced intervals.

・Waveguide core size : 50_m_50_m

・Interval between waveguides: 250_m

3)

Coexistence of electronic transmission channel and optical transmission channel was realized, and it leads to further high-density mounting.

Heretofore, optical waveguides have been made of acrylic-type resins or polyimide-type resins.

They are different from epoxy-type resins which is the material for PCB. Their difference in adherence property and efficiency of thermal expansion tends to cause delamination and breakage failure of electric transmission channel.

This time, we used epoxy-type resin to make the optical waveguide to avoid those problems, resulting in coexistence of the electronic transmission channel and the optical waveguide.

We have conducted thermal cycle test and confirmed its high reliability.

The coexistence has decreased constraints in interconnection and made it possible to have further high-density mounting on PCB.

About Advanced Photonics, Inc.

They are a venture company, established in March 2006, springing out of the University of Tokyo.

Their main lines of business are developing, designing, manufacturing and selling high-speed, high-capacity optical PCB.

Website of Advanced Phtonics, Inc.

Please direct your inquiry about this news to:

Public Relations

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