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축소한 155Mbps 송수신 모듈들의 공정도

The Production Flow of Compact 155Mbps transmitter / receiver optical modules

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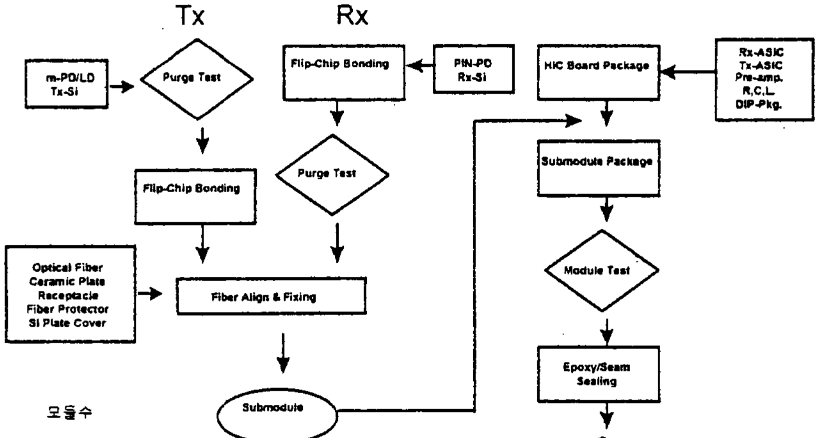
The purpose of this paper is to propose a production flow for 155Mbps transmitter / receiver optical modules. Compact optical module packages for use as 155Mbps optical interfaces are developed by implementing a self-alignment principle for the formation of V-grooves and solder bumps[1]. On the basis of experimental results of two hundreds of receiver / transmitter optical modules, each steps and flows of our production are developed by production efficiencies.

Our 155Mbps Optical Transmitter / Receiver modules are a compact and high performance optical modules ideally designed for the high speed data communication and transmission system. These modules require a single power supply (+5V) and has various functions such as transmission disable, alarm, and monitor. Using passive alignment techniques, chips and a fiber are aligned on a V-grooved silicon substrate by flip-chip bonding[1]. For optical module's production, most of the challenging problems are however associated with the production flow of packaging processes, which require less time-consuming packaging processes, low production efficiencies, and lower manufacturing costs.

In order to find out the production flow and failure criterions, we manufacture two hundreds of transmitter / receiver optical modules. According to production efficiencies, several production steps are changed and reconstructed. Figure 1 shows our production flow of compact 155Mbps transmitter / receiver optical modules.

The alignment and flip chip bonding process have been performed with the well-ready optical chips and the well-established Si submount which has the desirable V-groove, solder, and uniform stand-off. The bonder consists of two stages for an optical chip pick-up with a vacuum tool and for the optical chip bonding to the Si submount. The mode of flip chip bonding is tack, reflow, and thermal compression bonding. The die and wire bonding process is following to the flip chip bonding process. Purge test process is to secure the initial reliability of Laser Diode(LD) or PIN-Photodiode(PD) for these operation performance and lifetime. It is that reliability assurance is to be determined by extrapolation in temperature rather than time. After the dark current(Id) and breakdown voltages(Vbr) are measured before and after purge testing in receiver optical modules, chips or Si submodules are selected by our criterion, which Id is lower 10nA and Vbr is higher 20V at the room temperature, since Id is lower 30nA and Vbr is higher 10V at 85 ℃. In the transmitter modules, the active-side downbonded m-PD, which is for controlling the power level of the LD, receives rear-emitted LD light reflected from the metallized surface of a V-groove underneath it. During the fiber align & fixing process of transmitter modules, the LD/fiber coupling is accomplished by aligning a cleaved-end fiber of 125 ㎛ diameter placed on the V-groove of a silicon submount to the front face of the flip-chip bonded LD. In the receiver module, the silicon submount of PIN-PD is coupled. Our criterion is the responsivity of receiver submodules and the curve of current / voltage of transmitter submodules in this process. In the submodule package process, the coupled module is fixed on a specially designed receptacle for bare fiber protection and testability.



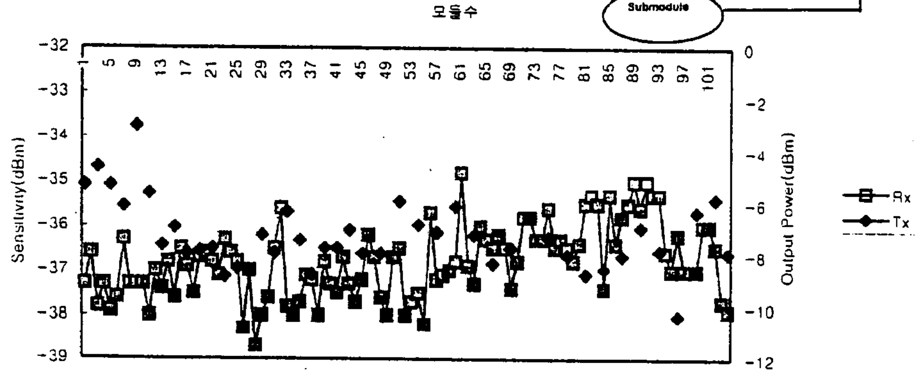


Figure 2. Receiver & Transmitter Optical Modules

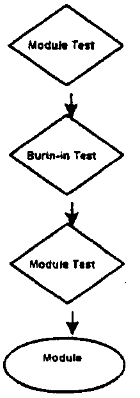


Figure 1: The Rx & Tx production flow

Table1: Production efficiencies

	Transmitter	Receiver
Flip Chip Bonding	0.94	0.96
Purge Test	0.52	0.80
Fiber Align&Fixing	0.67	0.92
Module Test	0.91	0.85

The package receptacle is fitted into a 20-pin DIP and wire-bonded to the HIC prior to module test. A hybrid circuit board (HCB), is mounted in the DIP, which has the same size for both transmitter(Tx) and receiver(Rx) for manufacturability. A Tx HCB contains passive components and an LD driver ASIC including automatic power control function, while a Rx HCB is equipped with passive components, a GaAs transimpedance preamplifier, and a receiver ASIC functioning for pre-amplification, clock recovery, and data decision. Module test process is to test packaged module's parameters, which is dc power supply voltage & current, Bit rates, data/clock voltage, data rise/fall time, clock rise/fall time, data/clock duty cycle, LOS alarm voltage, clock/data alignment, clock random jitter, continuous 'zero', average sensitivity, overload, input power, LOS alarm threshold, LOS hysteresis, and eye diagrams. Seam sealing process is to seal the cover of a 20-pin DIP to tested modules , which is applied a sealing epoxy. Burn-in test process is the burn-in of Automatic Power Control(APC), which is to evaluate and verify the optical, electrical, and mechanical reliability of packaging modules by testing the threshold current, operating current.

The production efficiencies for two hundreds of receiver / transmitter optical modules are shown in

Table 1. The other steps of Figure 1 is eliminated because of higher efficiencies. For major characteristics of our 155Mbps transmitter / receiver optical modules for short haul subscirber network, the average power output of transmitter optical modules is -10dBm to -5dBm. In our receiver optical modules, the receiver sensitivity is -35dBm to -38dBm and the over load input power is over -2.0dBm. Figure2 is described those results.

We demonstrated the production flow of compact 155Mbps transmitter / receiver optical modules in Figure 1. According to the Table 1, the purge test process is the most critical process in our production flow.

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