SiGe BiCMOS Burst-mode Optical Receiver for 10G-EPON Systems

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In recent years, as the explosive growth in Internet traffic continues, the need for high-speed, low-cost optical access network has been growing day by day. GE-PON systems with a total bandwidth of 1 Gbit/s are being introduced as commercial services, and the number of FTTH subscribers is increasing exponentially.

A GE-PON system realizes a low-cost network, because it allows multiple subscribers to share an optical fiber plant. Standardization of 10G-EPON (10-Gbit Ethernet passive optical network) for attaining even higher transmission rates at total bandwidth of 10 Gbit/s has already started (IEEE 802.3av). As regards bringing about this tenfold increase in transmission speed, the biggest problem is increasing the speed of the burst-mode receiver for amplifying signals with different timing and power in an instant and for performing waveform shaping. In the NTT Laboratories, a burst-mode optical receiver using the monolithic ICs for 10G-EPON systems has been successfully developed for the first time.

Each IC of the TIA, LA, and CDR circuits in this developed optical receiver is fabricated with 0.25-µm SiGe BiCMOS process. The figure shows the input and output waveforms when optical signals with different power and timing are received. The developed receiver recovers signals with constant amplitude for both input signals. It achieves sensitivity of -18 dBm and a dynamic range of more than 16.5 dB. The guard time (i.e., no-signal period) and preamble time (i.e., the response time of the receiver), which are contributing factors in lowering transmission efficiency, are 100 ns and 75 ns, respectively. They represent significant time reductions in comparison to the corresponding times for conventional GE-PON systems (i.e., 1024 and 800 ns, respectively).

From now onwards, while pushing ahead with further reductions in response time, miniaturization, and functionality improvements for optical receiver, we are continuing with development of optical transmitter.

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*1 GE-PON: Gigabit Ethernet-Passive Optical Network  
*2 IEEE: The Institute of Electrical and Electronics Engineers, Inc.  
*3 TIA: TransImpedance Amplifier  
*4 LA: Limiting Amplifier  
*5 CDR: Clock and Data Recovery  
*6 SiGe: Silicon Germanium  
*7 BiCMOS: Bipolar Complementary Metal Oxide Semiconductor

PON system and instantaneous responsivity to the burst inputs with significantly different power

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*1 WDM: Wavelength Division Multiplexing  
*2 PIN-PD: Positive Intrinsic Negative-Photodiode