Wireless Interconnects for High-Speed Data Transmission

Takamaro Kikkawa

Professor
Research Center for Nanodevices and Systems
Department of Semiconductor Electronics and Integration Science
Graduate School of Advanced Science of Matter
e-mail: kikkawa@sxsys.hiroshima-u.ac.jp
http://www.rcns.hiroshima-u.ac.jp/kikkawa/index.html

● Introduction

According to the technology roadmap, global interconnects using metal thin films such as Al and Cu will face a physical limit in high-frequency signal transmission at 3-4 GHz. In order to solve this problem, research on wireless interconnect technology for high freguency signal transmission has been carried out in my laboratory. Two new key technologies such as ULSI integrated antenna and ultra-wide-band (UWB) spread spectrum transmitter and receiver circuits will be developed in the COE program.

● ULSI Integrated Antenna

Silicon integrated antenna technology for wireless interconnects has been developed for high-frequency clock transmission at higher than 5 GHz. Figures 1(a) and 1(b) show a structure and measurement of the integrated antenna. Half-wavelength dipole antennas are fabricated on a Si substrate by use of ULSI fabrication process. The electromagnetic wave radiated from the antenna penetrates into the Si substrate due to the difference in dielectric constants between air and Si. The Si substrate plays as a wave guide, but they cause significant loss. Therefore, we have investigated the effect of Si resitivity on the transmission characteristics and found that higher resistivity (> 75Ωcm) Si substrates could suppress the transmission loss in the substrate.

In the COE program ultra-wide-band antennas for UWB application will be developed and the transmission characteristics will be improved. Furthermore, time domain characteristics for impulse signals will be analyzed.

● Ultra-Wide-Band Spread Spectrum Transceiver Circuits

In order to transmit high-frequency clock signals between circuit blocks in a ULSI chip as well as inter-chips, silicon monolithic digital integrated circuits for impulse digital communication will be developed, in which impulse signals are ued for UWB communication. For multiple channels signal spectrum is spread by time-hopping code so that the signal changes its position in time-domain. Gaussian monocycle pulse is used as a UWB signal. Block diagrams of transceiver are shown in Fig. 2(a) and 2(b). The transmitter circuit

consists of clock signal generator, frequency divider, programmable delay line, pseudo-noise sequence generator, pulse position modulation and Gaussian monocycle pulse generator for reconfigurable multi-channel interconnects. The receiver circuit consists of low-noise amplifier, mixer, integrator, sample-hold, comparator and template circuits.

In the COE program these integrated circuits are designed, fabricated and evaluated for the development of monolithic digital UWB transceiver technology.

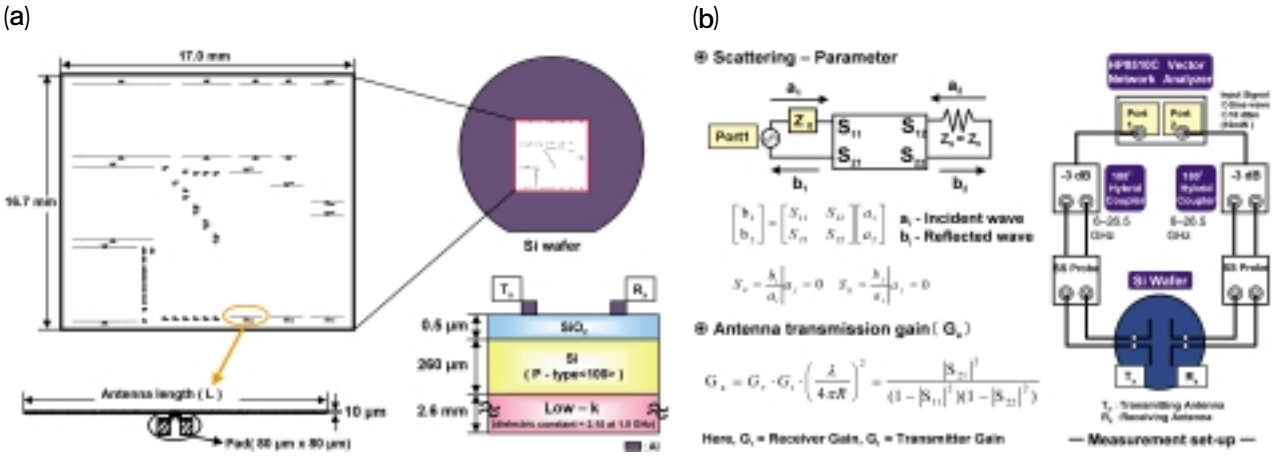

Fig. 1. Integrated antenna and measurement system.
(a) Antenna structure. (b) Measurement system for antenna transmission characteristics.

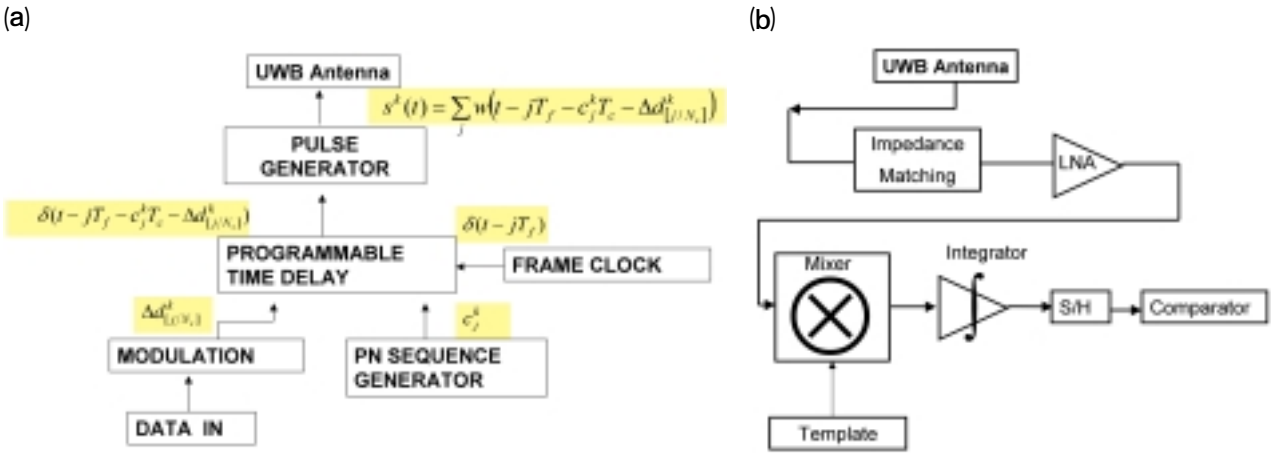

Fig. 2. Block diagram of UWB transceiver circuits.
(a) Transmitter. (b) Receiver.