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Development of Power Amplifier Modules for Mobile Communication

Around 2000, GMS terminals accounted for 60 percent of the mobile phone market, and the power amplifier HPA module made by Hitachi, Ltd., was used by 60 percent of GSM. This considerably contributed to the development of the mobile phone.

This was the device that amplified transmission and sales went up along with the growth of GSM and started growing from the European market. While industry peers were employing GaAs devices, Hitachi, Ltd. developed its own device package technology and realized high-performance HPA with Si devices.

The device used for the module was MOSFET, and its base was the high pressure MOFSET, called power MOS. In 1990, in order to improve the high frequency properties of the high pressure MOFSET, they developed a new device substituted metal (molybdenum) gate for the Si gate and achieved the addition effect (ratio between RF amplified output and input power) of 50%, the world's top addition effect for MOS FET. Hitachi, Ltd. promoted mass production of this device along with the spread of GSM around 1992.

Through the further examination of the improvement of its performance, they found that the miniaturization of molybdenum gates alone had their limits. Accordingly, when they tried to miniaturize the gate electrode size from 0.8μm to 0.5μm, they short-circuited this with aluminum, and thus the gate resistance was considerably reduced, eventually obtained its high performance of 10GHz.

After this, the development of new technologies continued, with changes (from 4.8V to 3.6V) in voltage along with the shift from NiCd batteries to LI batteries and means to meet such changes as a twofold increase in current, followed by a split of the chip and composition at matching circuits to meet output power adjustment, new packages for ultracompact and low prices using ceramic laminated substrates. The development of these new technologies, eventually, expanded the possibilities of Si modules. At the end of the 1990s, when GaAs hetero bipolar transistor (HBT) was announced, the trend of GaAs-HBT appeared to be unstoppable. However, this Si module continued together with miniaturization, and the greatest property of Si and pressure resistance, and the challenges of Si and expanded its applications other than the Si-MOSFET digital field, and eventually succeeded in the commercialization of its technology. In 2002, they received 35th Ichimura Sangyo Prize contribution award.

GSM: Global System for Mobile Communications

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Development and Realization of Leakage Coaxial Cables

Out of the cables (coaxial cable) used for communications, the leakage coaxial cable is the cable, in addition to signal transmission, that was designed to leak radio waves from slots provided on the cable and to work as an antenna. Thanks to this, radio waves can be transmitted or received evenly, allowing stable communication systems with less fading to be constructed.

Employing leakage coaxial cable radio high-quality radio communication is available and accessible to communications systems even in blind zones such as a closed space where radio is out of reach, e.g., tunnels and spaces with a lot of obstacles. Leakage coaxial cables are used for FM broadcasting on roads and in railway tunnels. When coaxial cables are in use, it becomes possible to access communication systems even in blind zones, e.g., tunnels, subway/underground shopping arcades, and in particularly, application for trains in radio blind zones such as tunnels has been promoted. Eventually, it was realized for the Sanyo Shinkansen at the time of the Japanese National Railways and contributed to the improvement of communications quality in tunnels. Among others, it was a significant achievement that realized the broadband leakage coaxial cable which covered VHF to UHF with various devises such as the dual-periodic structure of slots. T. Nakahara received Commander of the Order of the British Empire (CBE) for these research achievements.