Establishment of Ultra-High-Efficiency Microwave Amplifier Design Method

- Linearity and Bandwidth Improvement -

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PURPOSE Increasing the power added efficiency for microwave amplifiers is the most important issue for reducing power dissipation for microwave systems including mobile phone systems. However the efficiency has been limited below 70% (Fig.1) due to the overlaps of output current and voltage waveforms, which generate heat. **Purpose of this research is increasing the efficiency up to 90% without degrading linearity and bandwidth.**

APPROACH Last year, we proposed a new class F amplifier circuit with a fundamental frequency reactance compensation circuit. This circuit realizes **zero impedance for even number higher harmonic frequencies and infinity impedance for odd number higher harmonic frequencies without affecting load impedance for the fundamental frequency** (Fig.3: K. Honjo, Solid-State Electronics, pp.1477-1482, Sept. 2000). This circuit can avoid the overlaps significantly as shown in Fig. 3. Simulated power added efficiency reached 90%. The realization of this circuit will have significant impacts for microwave systems especially for mobile communication systems, microwave power transmission systems such as SPS. However there have been several problems to be solved for the realization and real uses of the circuit. Both linearity and bandwidth characteristics are relatively poor for the class F circuit.

RESEARCH PLAN Our plan has a three-years term. In the first year, we will precisely simulate merits and demerits of the new class F circuit. Radio system simulations will also be performed related with active device non linear characteristics and bit error rate (BER) of the communication systems. And also we will design a prototype amplifier and will build up an experimental setup. In the second year, **we will fabricate class F amplifiers, by which more than 90% efficiency will be expected for the first time in microwave fields.** And also, we will establish broadband and linear design method for the class-F amplifier by proposing a novel impedance transforming circuit. In the final year, our target is achieving an amplifier with **relative bandwidth of more than 3 % keeping sufficient linearity for digital radio systems.** Additionally an application of this circuit to a 1-watt class amplifier will be tried. To achieve these, a support from the Takeda Foundation is necessary.

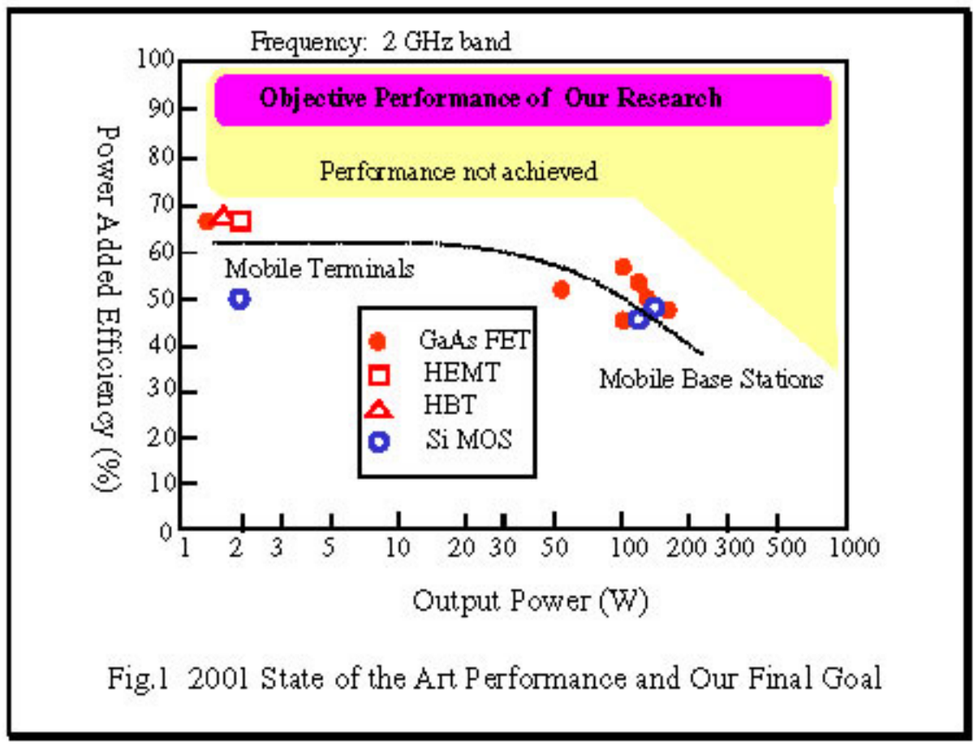

Fig.1 2001 State of the Art Performance and Our Final Goal

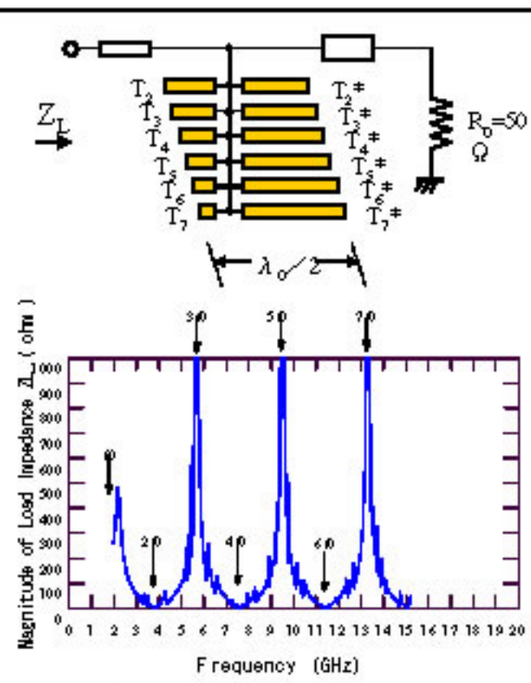

Fig. 2 Newly proposed load circuit and its impedance

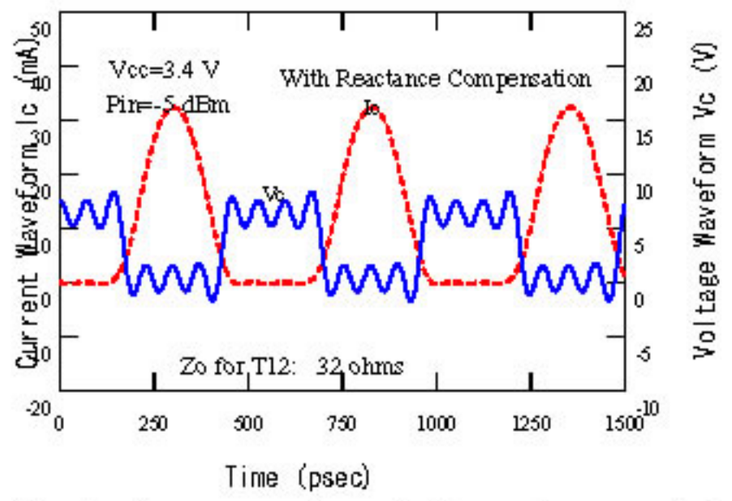

Fig. 3 Simulated output waveforms for the newly proposed circuit