C—1—1 C-Band 10 W Power GaAs MESFET With An Internal Matching Circuit

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Recent advancements in power GaAs MESFET technology have made linear amplification at microwave frequencies possible. One of the methods to realize a high power FET may be to design a FET pattern with a wide gate that can control a large drain current. We had an experience that the maximum gate width of the practical power MESFET was about 5,000μm, and further increase of the gate width caused considerable decrease of the power gain. This was partially explained since a wider gate causes nonuniform distribution of RF power among component FETs[1].

Recently the other possible explanation has been considered as follows: Since the wider gate FET has the lower input impedance, it becomes difficult to transmit an input signal from an external circuit including package elements to the wider gate FET pellet without loss. In order to solve the problem, we divided the FET pattern into several parts with relatively high impedances and connected in parallel each of them to the package through an internal matching circuit.

A low-pass type internal matching circuit using MOS capacitance and bonding wire inductance has been introduced to operate the wider gate FET effectively. Figure 1 shows the photograph of the power GaAs MESFET which contains eight FET patterns and eight MOS capacitors. Operating frequency of the matching circuit was designed to be 4 GHz. Figure 2 shows the frequency dependences of S_{11} and S_{22} of the device measured by a network analizer in small signal level. A 15,000 μm wide gate FET can be operated successfully by introduction of the new design concept.

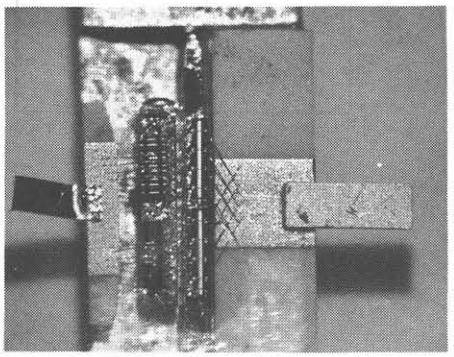

Fig. 1 Photograph of the power GaAs MESFET with an internal matching circuit.

Another method to increase the output power is to design a " FET structure " with a high drain-source breakdown voltage[1]. Introduction of N^+ inlaid layer under drain-source electrodes has enabled to operate the power GaAs MESFET at 18 V or more of drain bias voltage. The input-output characteristics at 4 GHz is shown in Fig. 3. The dependences of output power and power added efficiency on drain bias voltage are also shown in Fig. 4. It is noteworthy that the output power increases with drain bias voltage up to 18 V. This device delivered 10 W of output power, 6.1 dB of associated power gain and 32.4 % of power added efficiency.

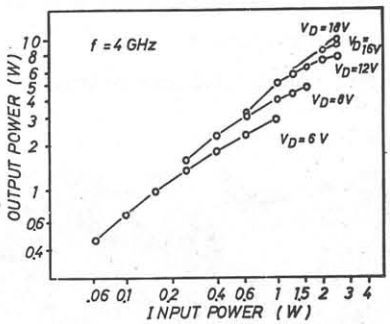

Fig. 3 Input-output characteristics of the power GaAs MESFET.

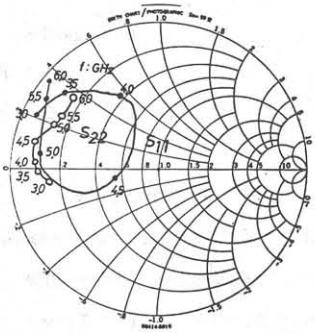

Fig. 2 Frequency dependences of S_{11} and S_{22} of the power GaAs MESFET.

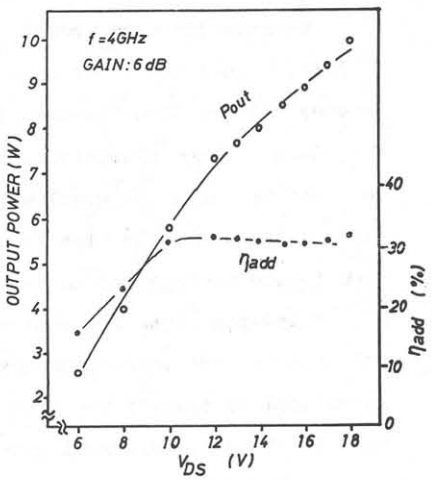

Fig. 4 Dependences of the output power and power added efficiency on the drain bias voltage.

Reference

(1) M. Fukuta et al., " Power GaAs MESFET With a High Drain-Source Breakdown Voltage ", IEEE Trans. MTT., Vol. MTT-24 (1976), 312-317.