

A-6-2 1 GHz 20 W STATIC INDUCTION TRANSISTOR

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A static induction transistor (SIT) has been proposed as a high power device at high frequency.⁽¹⁾ It has been expected to exceed a bipolar transistor, at high frequency and high power operation, because of its short channels, high voltage operation and negative temperature coefficient of drain current.

An SIT is demonstrated, in this paper, which has output power of above 20 watts at 1 GHz with efficiency of 50 %. It is designed to minimize capacitances between electrodes (gate, source and drain) and to obtain large drain current. The cross sectional view of an SIT is shown in Fig. 1.

DESIGN AND FABRICATION

For high frequency operation, high mutual conductance G_m and low capacitances between electrodes C_{gd} and C_{gs} must be attained. For high power operation, high breakdown voltage BV_{gd} and high current level I_{ds} are desirable. These factors depend on resistivity and thickness of the active region. BV_{gd} increases with the resistivity of the active region, while G_m decreases. Both C_{gd} and I_{ds} decrease with the thickness of the active region. In this SIT, resistivity and thickness of the active region were optimized.

Moreover, C_{gd} and G_m depend on the area of the active region. Because C_{gd} is proportional to the area of the active region, and G_m is proportional to source length (gate width), fine pattern is required to obtain high G_m without increasing the capacitances. In this SIT, fine pattern of 9 μm gate to gate pitch was fabricated by self-aligning technique and by selective plating of gold electrode.

EXPERIMENTAL RESULTS

Typical I-V characteristics of the fabricated SIT are shown in Fig. 2. The drain current of 0.9 A was obtained at applied voltage of 10 V. G_m was 120 - 150 m μS and amplification factor μ was 4 - 5. C_{gd} was about 9 pFs. Breakdown voltage BV_{gd} was 80 volts. From S parameters, the maximum available oscillating frequency f_{max} was estimated to be 3 GHz and maximum available gain MAG at 1 GHz was 5 dB. S_{11} and S_{22} were set near to real axis with lead inductance, as shown in Fig. 3. The power amplification characteristic at 1 GHz is shown in Fig. 4. The maximum output power was 24 watts and the output power was linear up to 20 watts with gain of 4 dB. The drain efficiency was 50 %.

CONCLUSION

High power SIT at high frequency, with a^{re} output power of 24 watts at 1 GHz, was realized by fine patterning technique using self-aligning and selective gold plating technique and by optimization of the resistivity and thickness of the active region.

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REFERENCES

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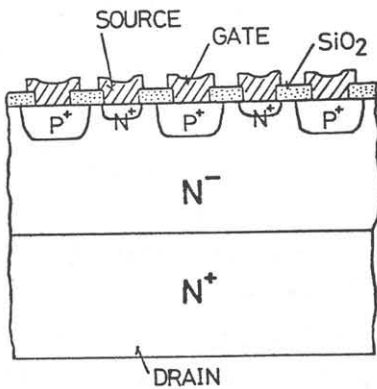


Fig.1 cross sectional view of an SIT

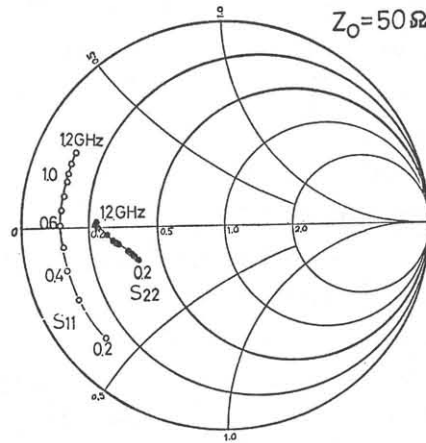


Fig.3 S_{11} and S_{22} characteristics

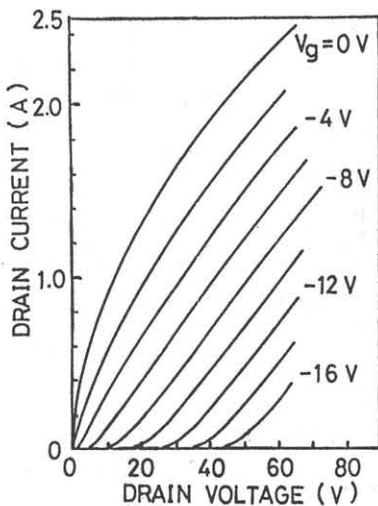


Fig.2 I-V characteristics of an SIT

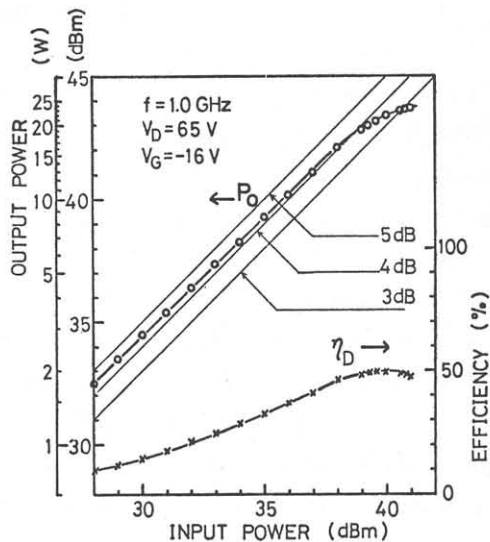


Fig.4 1 GHz SIT amplifying characteristic