

HETERO JUNCTION FIELD EFFECT TRANSISTOR

NE32400, NE24200

C to Ka BAND SUPER LOW NOISE AMPLIFIER N-CHANNEL HJ-FET CHIP

DESCRIPTION

NE32400 and NE24200 are Hetero Junction FET chip that utilizes the hetero junction between Si-doped AlGaAs and undoped InGaAs to create high mobility electrons. Its excellent low noise and high associated gain make it suitable for commercial systems, industrial and space applications.

FEATURES

- Super Low Noise Figure & High Associated Gain
NF = 0.6 dB TYP., $G_a = 11.0$ dB TYP. at $f = 12$ GHz
- Gate Length: $L_g = 0.25 \mu\text{m}$
- Gate Width : $W_g = 200 \mu\text{m}$

ORDERING INFORMATION

| PART NUMBER | QUALITY GRADE | APPLICATIONS |
|-------------|------------------------------------|-------------------|
| NE32400 | Standard (Grade D) | Commercial |
| NE24200 | Grade C and B (B is special order) | Industrial, space |

ABSOLUTE MAXIMUM RATINGS ($T_A = 25 \text{ }^\circ\text{C}$)

| | | | |
|-------------------------|-------------|-------------|------------------|
| Drain to Source Voltage | V_{DS} | 4.0 | V |
| Gate to Source Voltage | V_{GS} | -3.0 | V |
| Drain Current | I_D | I_{DSS} | mA |
| Total Power Dissipation | P_{tot}^* | 200 | mW |
| Channel Temperature | T_{ch} | 175 | $^\circ\text{C}$ |
| Storage Temperature | T_{stg} | -65 to +175 | $^\circ\text{C}$ |

* Chip mounted on a Alumina heatsink (size: $3 \times 3 \times 0.6^t$)

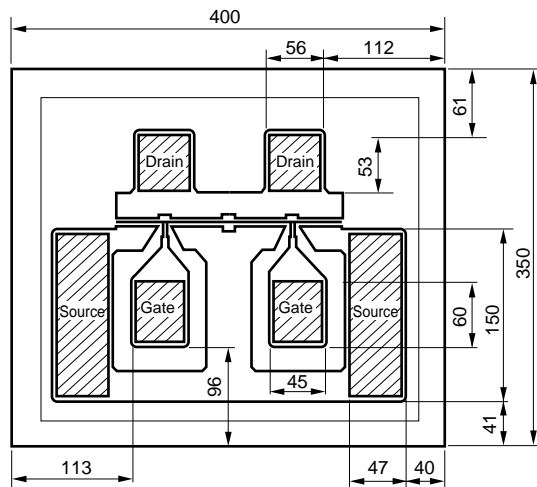
ELECTRICAL CHARACTERISTICS ($T_A = 25 \text{ }^\circ\text{C}$)

| PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNIT | TEST CONDITIONS |
|-------------------------------|---------------|------|------|------|--------------------|---|
| Gate to Source Leak Current | I_{GSO} | - | 0.5 | 10 | μA | $V_{GS} = -3 \text{ V}$ |
| Saturated Drain Current | I_{DSS} | 15 | 40 | 70 | mA | $V_{DS} = 2 \text{ V}, V_{GS} = 0 \text{ V}$ |
| Gate to Source Cutoff Voltage | $V_{GS(off)}$ | -0.2 | -0.8 | -2.0 | V | $V_{DS} = 2 \text{ V}, I_D = 100 \mu\text{A}$ |
| Transconductance | g_m | 45 | 60 | - | mS | $V_{DS} = 2 \text{ V}, I_D = 10 \text{ mA}$ |
| Thermal Resistance | R_{th}^* | - | - | 260 | $^\circ\text{C/W}$ | channel to case |
| Noise Figure | NF | - | 0.6 | 0.7 | dB | $V_{DS} = 2 \text{ V}, I_D = 10 \text{ mA}, f = 12 \text{ GHz}$ |
| Associated Gain | G_a | 10.0 | 11.0 | - | dB | |

RF performance is determined by packaging and testing 10 chips per wafer.

Wafer rejection criteria for standard devices is 2 rejects per 10 samples.

CHIP DIMENSIONS (Unit: μm)

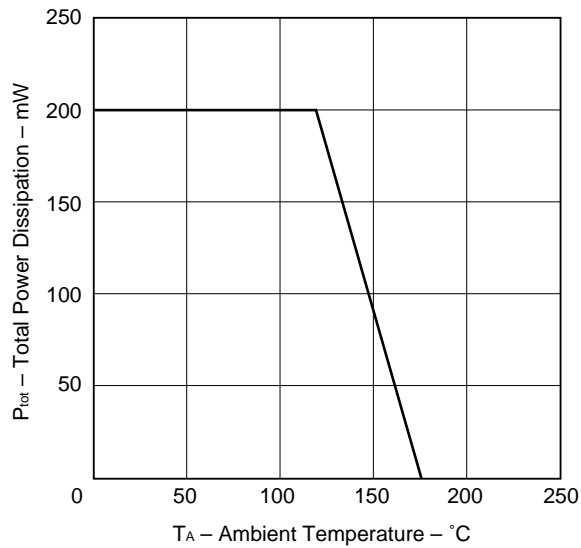


Thickness = 140 μm

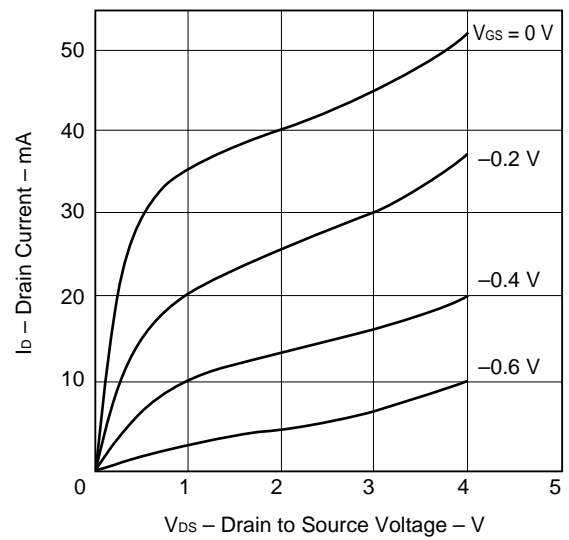
: BONDING AREA

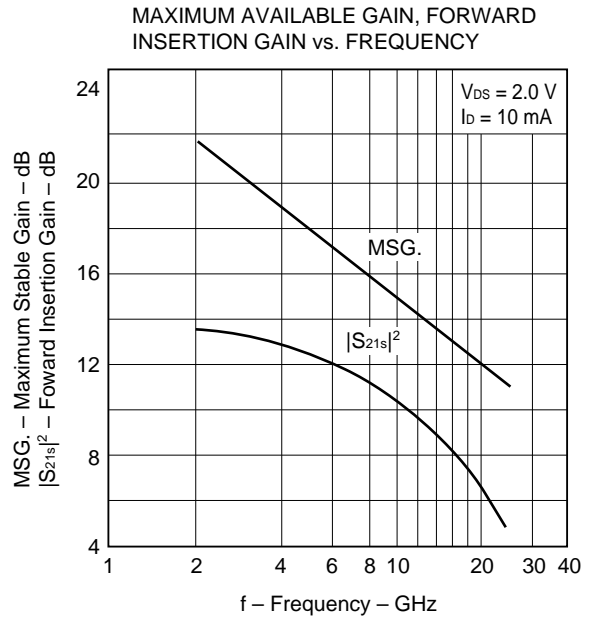
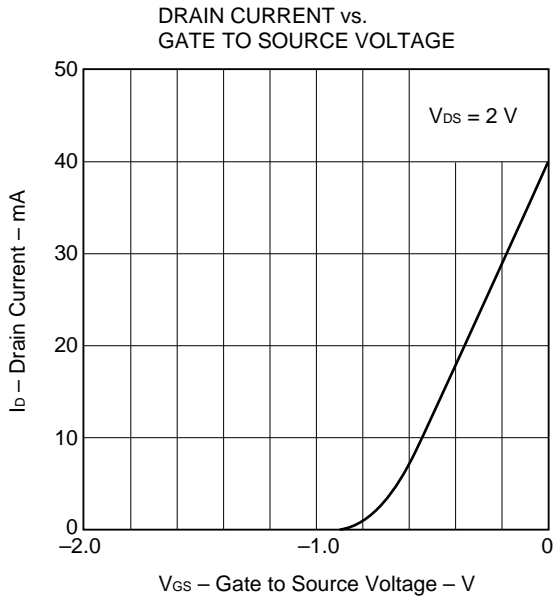
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE

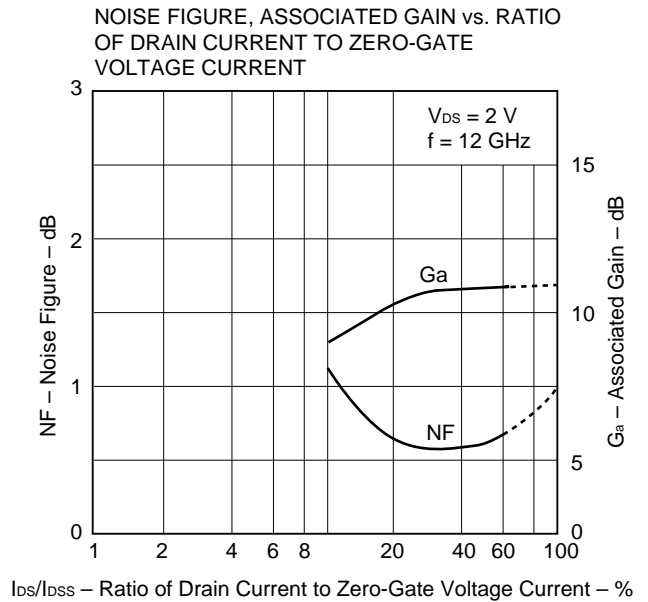
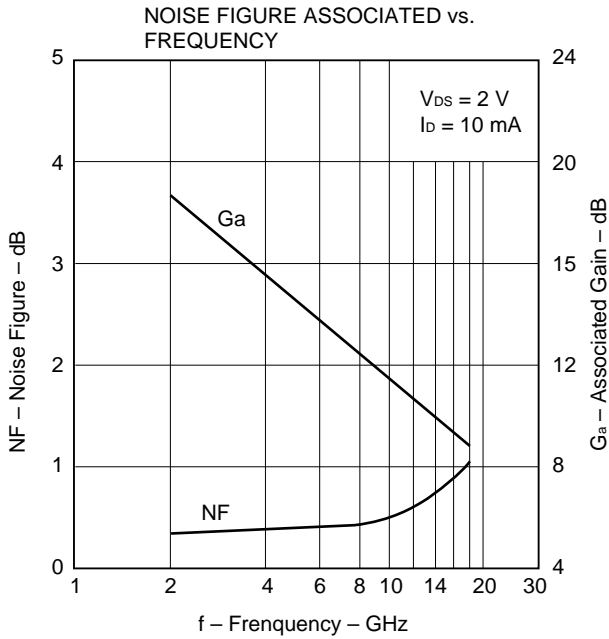




Gain Calculations

$$MSG. = \frac{|S_{21}|}{|S_{12}|} \quad K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}||S_{21}|}$$

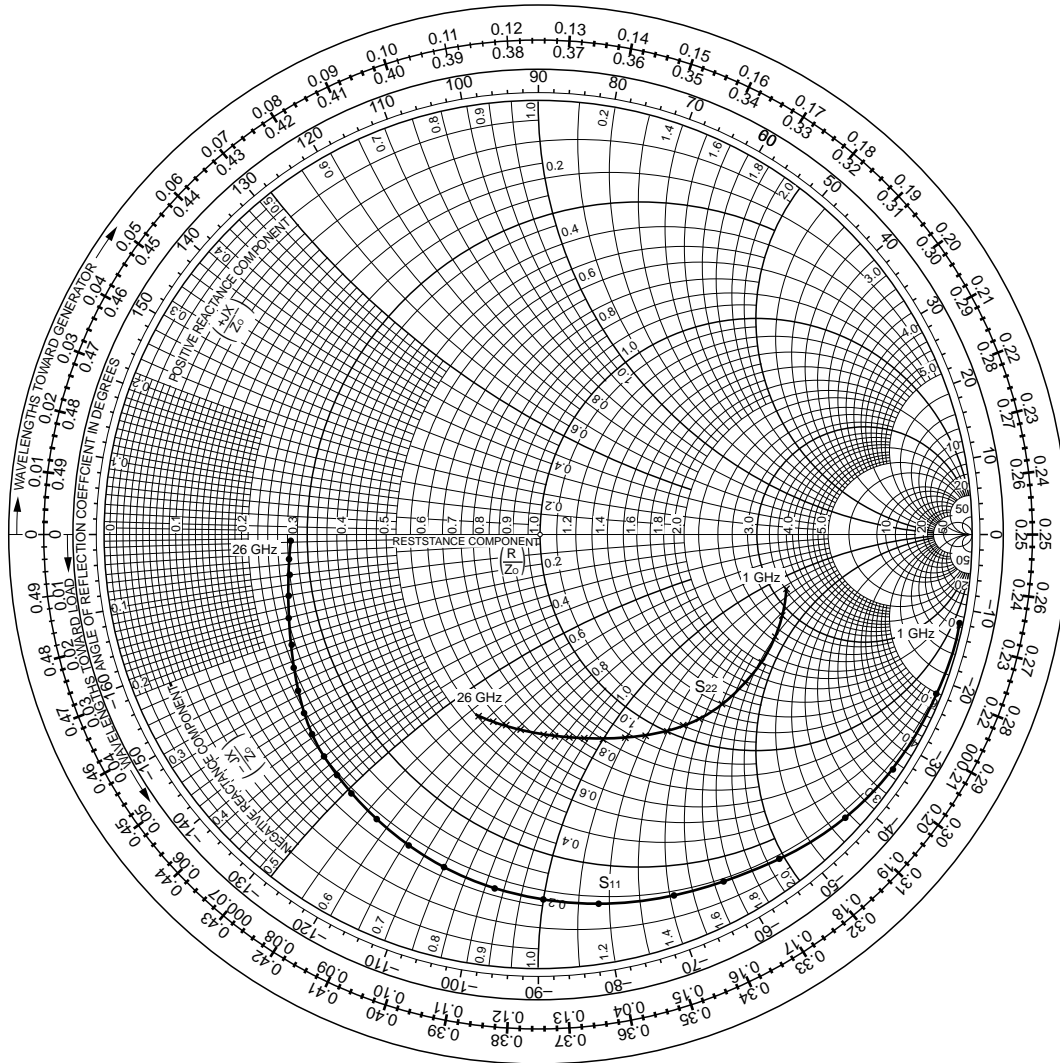
$$MAG. = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}) \quad \Delta = S_{11} \cdot S_{22} - S_{21} \cdot S_{12}$$



S-PARAMETERS

$V_{ds} = 2\text{ V}$, $I_b = 10\text{ mA}$

START 1 GHz, STOP 26 GHz, STEP 1 GHz



S-PARAMETERS MAG. AND ANG.

$V_{DS} = 2\text{ V}$, $I_D = 10\text{ mA}$

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MSG/MAG (dB) |
|--------------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|-----------------|----------------|------|-----------------|
| | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | MAG. | ANG. (deg.) | | |
| 1000 | 0.996 | -12 | 4.680 | 171 | 0.015 | 83 | 0.616 | -10 | 0.05 | 24.9 |
| 2000 | 0.994 | -23 | 4.603 | 161 | 0.032 | 76 | 0.613 | -16 | 0.07 | 21.6 |
| 3000 | 0.979 | -34 | 4.486 | 152 | 0.046 | 70 | 0.601 | -23 | 0.08 | 19.9 |
| 4000 | 0.963 | -44 | 4.314 | 143 | 0.059 | 65 | 0.592 | -30 | 0.10 | 18.6 |
| 5000 | 0.929 | -54 | 4.118 | 135 | 0.071 | 59 | 0.580 | -36 | 0.18 | 17.7 |
| 6000 | 0.904 | -62 | 3.872 | 127 | 0.076 | 55 | 0.578 | -40 | 0.28 | 17.1 |
| 7000 | 0.882 | -70 | 3.759 | 120 | 0.092 | 51 | 0.574 | -46 | 0.30 | 16.1 |
| 8000 | 0.851 | -81 | 3.632 | 111 | 0.097 | 45 | 0.557 | -52 | 0.35 | 15.7 |
| 9000 | 0.836 | -89 | 3.423 | 104 | 0.098 | 40 | 0.543 | -55 | 0.40 | 15.5 |
| 10000 | 0.809 | -97 | 3.290 | 97 | 0.102 | 40 | 0.529 | -59 | 0.42 | 15.1 |
| 11000 | 0.792 | -105 | 3.179 | 91 | 0.107 | 37 | 0.523 | -62 | 0.44 | 14.7 |
| 12000 | 0.774 | -112 | 3.059 | 84 | 0.112 | 35 | 0.511 | -67 | 0.45 | 14.4 |
| 13000 | 0.762 | -119 | 2.940 | 78 | 0.118 | 31 | 0.489 | -72 | 0.46 | 14.0 |
| 14000 | 0.745 | -124 | 2.807 | 73 | 0.121 | 28 | 0.479 | -77 | 0.49 | 13.6 |
| 15000 | 0.729 | -128 | 2.698 | 68 | 0.124 | 26 | 0.468 | -81 | 0.51 | 13.4 |
| 16000 | 0.717 | -133 | 2.616 | 63 | 0.129 | 24 | 0.464 | -85 | 0.54 | 13.1 |
| 17000 | 0.697 | -137 | 2.526 | 58 | 0.134 | 21 | 0.462 | -90 | 0.58 | 12.8 |
| 18000 | 0.685 | -141 | 2.421 | 54 | 0.137 | 19 | 0.460 | -94 | 0.63 | 12.5 |
| 19000 | 0.665 | -146 | 2.315 | 49 | 0.135 | 19 | 0.460 | -96 | 0.68 | 12.3 |
| 20000 | 0.647 | -150 | 2.220 | 45 | 0.136 | 18 | 0.460 | -98 | 0.70 | 12.1 |
| 21000 | 0.625 | -156 | 2.159 | 40 | 0.138 | 18 | 0.459 | -100 | 0.71 | 11.9 |
| 22000 | 0.612 | -160 | 2.046 | 34 | 0.138 | 17 | 0.457 | -102 | 0.72 | 11.7 |
| 23000 | 0.596 | -166 | 1.892 | 30 | 0.139 | 17 | 0.455 | -103 | 0.73 | 11.5 |
| 24000 | 0.592 | -170 | 1.866 | 27 | 0.140 | 16 | 0.455 | -105 | 0.74 | 11.3 |
| 25000 | 0.587 | -174 | 1.780 | 25 | 0.141 | 21 | 0.454 | -107 | 0.74 | 11.2 |
| 26000 | 0.584 | -178 | 1.751 | 21 | 0.141 | 22 | 0.453 | -108 | 0.75 | 11.0 |

CHIP HANDLING

DIE ATTACHMENT

Die attach operation can be accomplished with Au-Sn (within a 300 °C – 10 s) performs in a forming gas environment.

Epoxy die attach is not recommend.

BONDING

Bonding wires should be minimum length, semi hard gold wire (3-8 % elongation) 20 microns in diameter.

Bonding should be performed with a wedge tip that has a taper of approximately 15 %. Bonding time should be kept to minimum.

As a general rule, the bonding operation should be kept within a 280 °C, 2 minutes for all bonding wires.

If longer periods are required, the temperature should be lowered.

PRECAUTIONS

The user must operate in a clean, dry environment. The chip channel is glassivated for mechanical protection only and does not preclude the necessity of a clean environment.

The bonding equipment should be periodically checked for sources of surge voltage and should be properly grounded at all times. In fact, all test and handling equipment should be grounded to minimize the possibilities of static discharge.

Avoid high static voltage and electric fields, because this device is Hetero Junction field effect transistor with shottky barrier gate.

CAUTION

The Great Care must be taken in dealing with the devices in this guide.

The reason is that the material of the devices is GaAs (Gallium Arsenide), which is designated as harmful substance according to the law concerned.

Keep the Japanese law concerned and so on, especially in case of removal.

[MEMO]

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Anti-radioactive design is not implemented in this product.