DATA SHEET

NEC

# HETERO JUNCTION FIELD EFFECT TRANSISTOR

# NE32500, NE27200

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

### DESCRIPTION

NE32500 and NE27200 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 = 0.45 dB TYP., $G_a$ = 12.5 dB TYP. at f = 12 GHz
- Gate Length: $L_g$ = 0.2 $\mu$m
- Gate Width : $W_g$ = 200 $\mu$m

### ORDERING INFORMATION

| PART NUMBER | QUALITY GRADE |
|---|---|
| NE32500 | Standard (Grade D) |
| NE27200 | Special, specific (Grade C and B) |

### ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25 °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 | °C |
| Storage Temperature | $T_{stg}$ | –65 to +175 | °C |

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

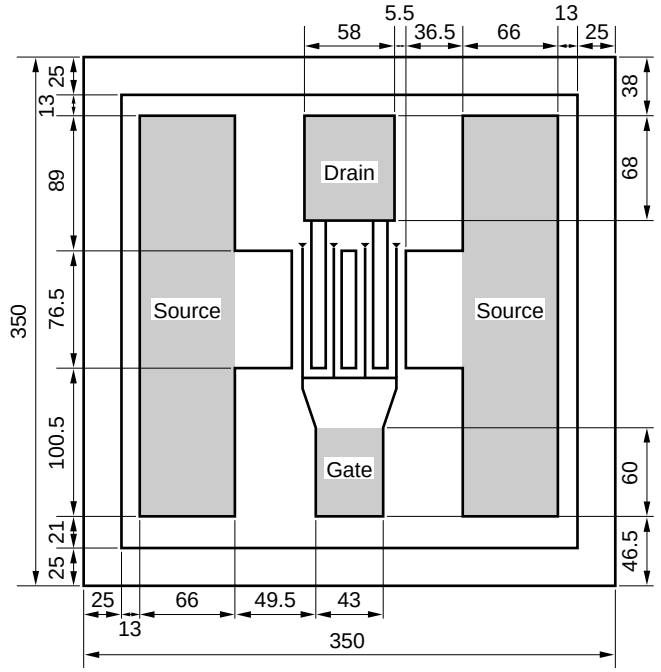
### ELECTRICAL CHARACTERISTICS ($T_A$ = 25 °C)

| PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNIT | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| Gate to Source Leak Current | $I_{GSO}$ | – | 0.5 | 10 | $\mu$A | $V_{GS}$ = –3 V |
| Saturated Drain Current | $I_{DSS}$ | 20 | 60 | 90 | mA | $V_{DS}$ = 2 V, $V_{GS}$ = 0 V |
| Gate to Source Cutoff Voltage | $V_{GS(off)}$ | –0.2 | –0.7 | –2.0 | V | $V_{DS}$ = 2 V, $I_D$ = 100 $\mu$A |
| Transconductance | $g_m$ | 45 | 60 | – | mS | $V_{DS}$ = 2 V, $I_D$ = 10 mA |
| Thermal Resistance | $R_{th}$* | – | – | 260 | °C/W | channel to case |
| Noise Figure | NF | – | 0.45 | 0.55 | dB | $V_{DS}$ = 2 V, $I_D$ = 10 mA, f = 12 GHz |
| Associated Gain | $G_a$ | 11.0 | 12.5 | – | 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.

Document No. P11512EJ2V0DS00 (2nd edition)
Date Published January 1997 N
Printed in Japan

**CHIP DIMENSIONS** (Unit: $\mu$m)

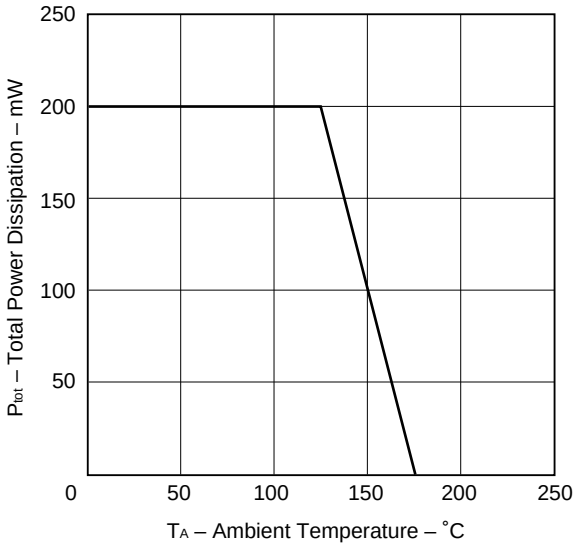



Thickness = 140 $\mu$m

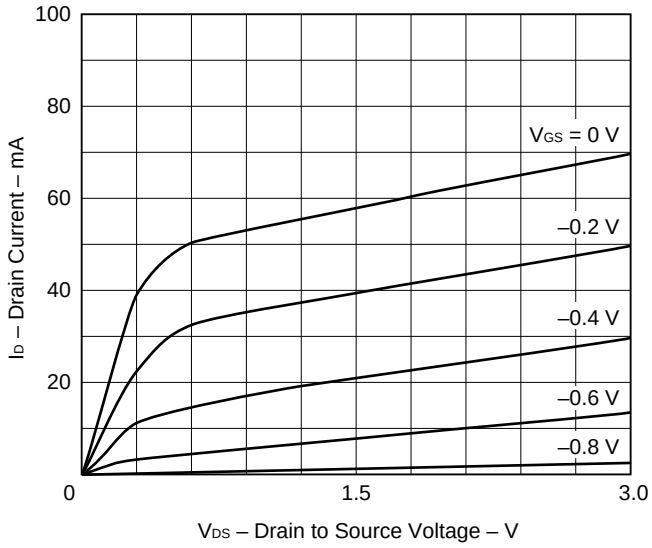
: BONDING AREA

**TYPICAL CHARACTERISTICS ($T_A$ = 25 ˚C)**

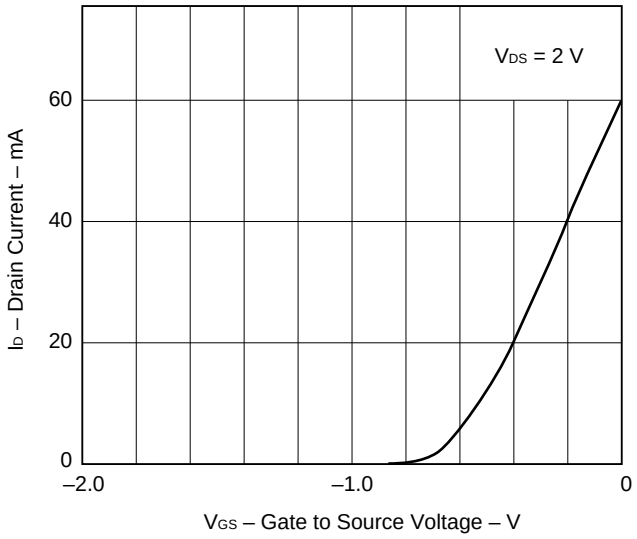
TOTAL POWER DISSIPATION vs.
AMBIENT TEMPERATURE




DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE



DRAIN CURRENT vs.
GATE TO SOURCE VOLTAGE

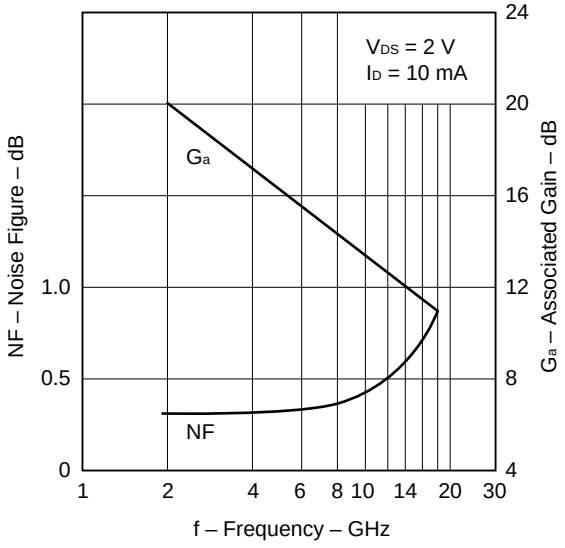



**Gain Calculations**

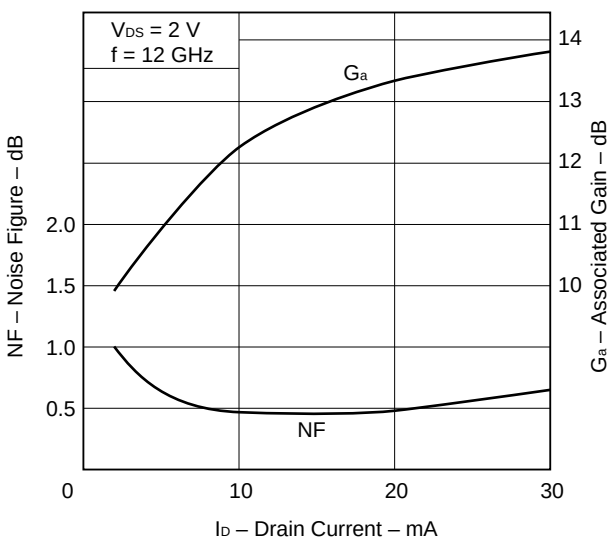
$$MSG. = \frac{|S_{21}|}{|S_{12}|} \qquad K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}||S_{21}|}$$

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

NOISE FIGURE, ASSOCIATED GAIN vs.
FREQUENCY




NOISE FIGURE, ASSOCIATED GAIN vs.
DRAIN CURRENT



**S-PARAMETERS MAG. AND ANG.**

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

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. |
| (MHz) | | (deg.) | | (deg.) | | (deg.) | | (deg.) |
| 500 | 0.999 | –4 | 4.34 | 177 | 0.006 | 82 | 0.564 | –3 |
| 1000 | 0.998 | –7 | 4.33 | 174 | 0.012 | 84 | 0.562 | –6 |
| 2000 | 0.996 | –14 | 4.28 | 168 | 0.025 | 81 | 0.559 | –11 |
| 3000 | 0.992 | –20 | 4.26 | 163 | 0.037 | 76 | 0.557 | –17 |
| 4000 | 0.976 | –28 | 4.24 | 158 | 0.048 | 71 | 0.551 | –23 |
| 5000 | 0.962 | –36 | 4.11 | 152 | 0.060 | 66 | 0.546 | –29 |
| 6000 | 0.962 | –42 | 4.06 | 148 | 0.070 | 62 | 0.539 | –34 |
| 7000 | 0.943 | –48 | 3.95 | 143 | 0.079 | 58 | 0.533 | –40 |
| 8000 | 0.928 | –55 | 3.83 | 139 | 0.087 | 55 | 0.526 | –44 |
| 9000 | 0.920 | –60 | 3.73 | 134 | 0.095 | 51 | 0.519 | –49 |
| 10000 | 0.900 | –67 | 3.58 | 129 | 0.104 | 47 | 0.508 | –54 |
| 11000 | 0.881 | –72 | 3.46 | 126 | 0.109 | 43 | 0.503 | –58 |
| 12000 | 0.869 | –77 | 3.34 | 122 | 0.114 | 40 | 0.494 | –62 |
| 13000 | 0.856 | –82 | 3.23 | 118 | 0.120 | 37 | 0.488 | –66 |
| 14000 | 0.839 | –86 | 3.11 | 115 | 0.123 | 34 | 0.483 | –69 |
| 15000 | 0.831 | –91 | 3.01 | 112 | 0.127 | 32 | 0.476 | –72 |
| 16000 | 0.818 | –96 | 2.88 | 108 | 0.131 | 29 | 0.472 | –76 |
| 17000 | 0.804 | –99 | 2.78 | 105 | 0.134 | 27 | 0.468 | –79 |
| 18000 | 0.796 | –103 | 2.68 | 103 | 0.137 | 24 | 0.464 | –81 |
| 19000 | 0.784 | –106 | 2.59 | 100 | 0.141 | 22 | 0.460 | –84 |
| 20000 | 0.782 | –111 | 2.49 | 96 | 0.142 | 20 | 0.456 | –88 |
| 21000 | 0.772 | –114 | 2.42 | 95 | 0.144 | 19 | 0.457 | –90 |
| 22000 | 0.761 | –117 | 2.33 | 93 | 0.147 | 17 | 0.450 | –92 |
| 23000 | 0.758 | –119 | 2.25 | 90 | 0.147 | 15 | 0.454 | –94 |
| 24000 | 0.753 | –122 | 2.20 | 88 | 0.148 | 14 | 0.453 | –95 |
| 25000 | 0.748 | –125 | 2.11 | 86 | 0.150 | 12 | 0.453 | –98 |
| 26000 | 0.746 | –127 | 2.06 | 84 | 0.152 | 11 | 0.460 | –100 |
| 27000 | 0.750 | –129 | 2.01 | 82 | 0.154 | 9 | 0.453 | –101 |
| 28000 | 0.738 | –133 | 1.93 | 79 | 0.151 | 7 | 0.453 | –104 |
| 29000 | 0.744 | –135 | 1.90 | 77 | 0.153 | 7 | 0.453 | –105 |
| 30000 | 0.742 | –138 | 1.84 | 75 | 0.156 | 4 | 0.454 | –107 |

## 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 law concerned and so on, especially in case of removal.**

[MEMO]

**[MEMO]**

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