

FEATURES

- **LOW COST**
- **LOW NOISE FIGURE**
0.8 dB at 4 GHz
1.7 dB at 8 GHz
- **HIGH ASSOCIATED GAIN**
12.0 dB at 4 GHz
9.0 dB at 8 GHz
- **HIGH MAXIMUM AVAILABLE GAIN**
16.0 dB at 4 GHz
12.0 dB at 8 GHz

DESCRIPTION AND APPLICATIONS

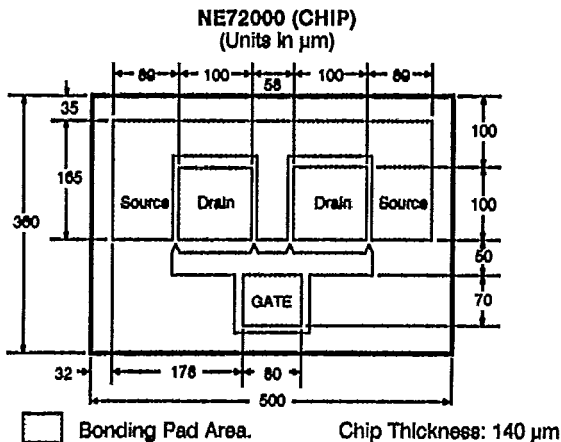
The NE720 is NEC's low cost 1.0 μ recessed gate GaAs FET, offering a low noise figure and high gain through 8 GHz. It is designed for consumer applications.

The device is available as a chip (NE72000) and in two hermetically sealed stripline packages (NE72084 and NE72089A). The chip's gate and channel are glassivated with a thin layer of SiO₂ for mechanical protection. All bonding pads use a Ti-Pt-Au metallization system.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

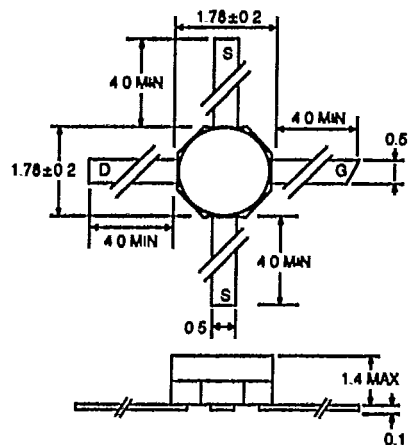
| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|------------------|-------------------------|-------|-------------|
| V _{DS} | Drain to Source Voltage | V | 5.0 |
| V _{GD0} | Gate to Drain Voltage | V | -6.0 |
| V _{GS0} | Gate to Source Voltage | V | -6.0 |
| I _{GF} | Gate Current | mA | 4.0 |
| I _{DS} | Drain Current | mW | 150 |
| T _{CH} | Channel Temperature | °C | 175 |
| T _{STG} | Storage Temperature | °C | -65 to +125 |
| | NE72084 | °C | -65 to +175 |
| | NE72089A | °C | -65 to +175 |

OUTLINE DIMENSIONS (Units in mm)

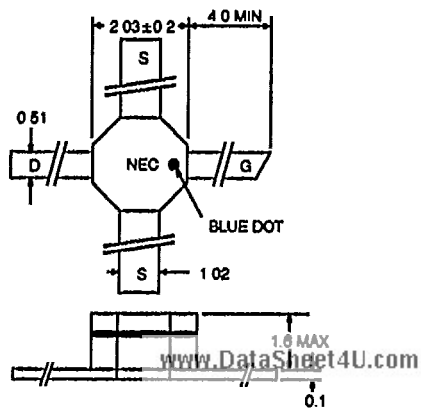


OUTLINE 84

(Units in mm)



OUTLINE 89A



ELECTRICAL CHARACTERISTICS (T_A = 25°C)

| PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE | | | NE72000 00 (CHIP) | | | NE72084 2SK571 84 | | | NE72089A 2SK354A 89A | | |
|---|---|-------|----------------------|------|------------------|-------------------------|------|------|----------------------------|------|------|
| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX |
| I _{DSS} | Drain Current at V _{DS} = 3 V, V _{GS} = 0 V | mA | 30 | 60 | 150 | 30 | 60 | 150 | 30 | 60 | 150 |
| V _P | Pinch-off Voltage at V _{DS} = 3 V, I _D = 0.1 mA | V | -0.8 | -2.0 | -4.0 | -0.8 | -2.0 | -4.0 | -0.8 | -2.0 | -4.0 |
| g _M | Transconductance at V _{DS} = 3 V, I _D = 10 mA | mS | 20 | 40 | 60 | 20 | 40 | 60 | 20 | 40 | 60 |
| I _{GSO} | Gate to Source Leakage Current at V _{GS} = -5 V | μA | | 1.0 | 10 | | | 10 | | 1.0 | 10 |
| R _{TH} | Thermal Resistance (Channel-to-Ambient) | °C/W | | | 170 ² | | | 400 | | | 400 |
| P _T | Total Power Dissipation | mW | | | 500 | | | 300 | | | 300 |

Notes:

- Electronic Industrial Association of Japan.
- R_{TH} (Channel-to-Case) for chips mounted on a copper heatsink.

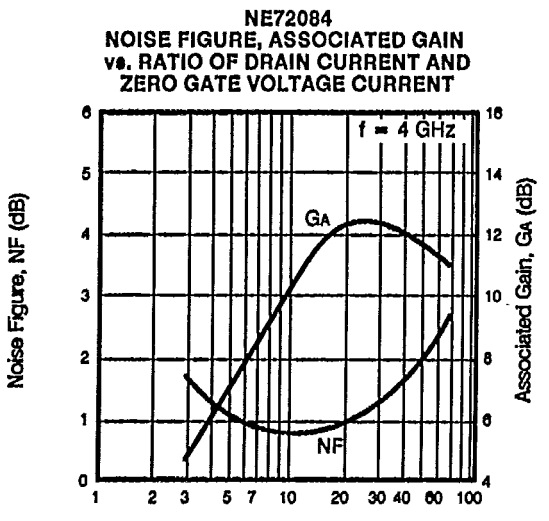
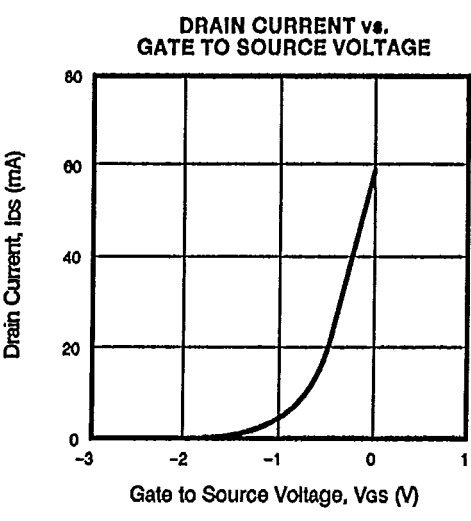
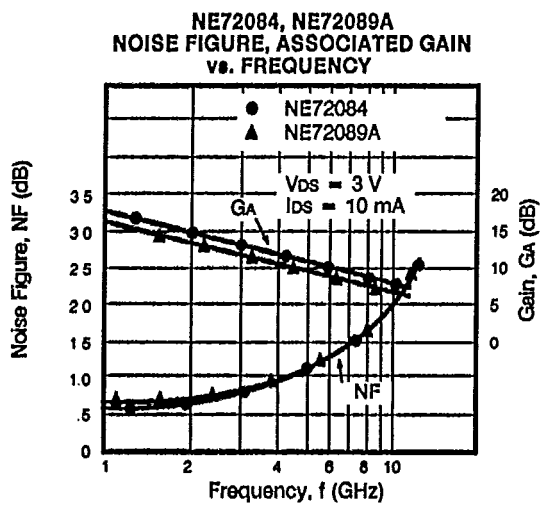
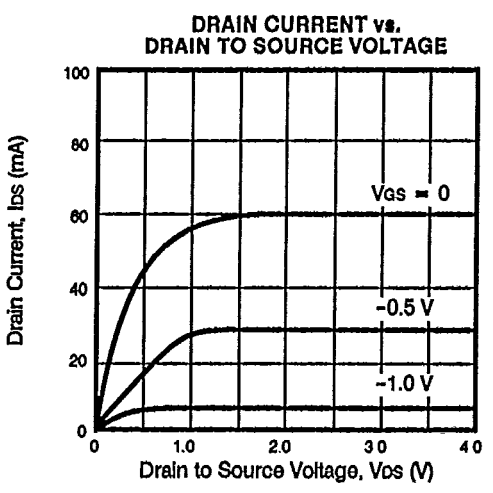
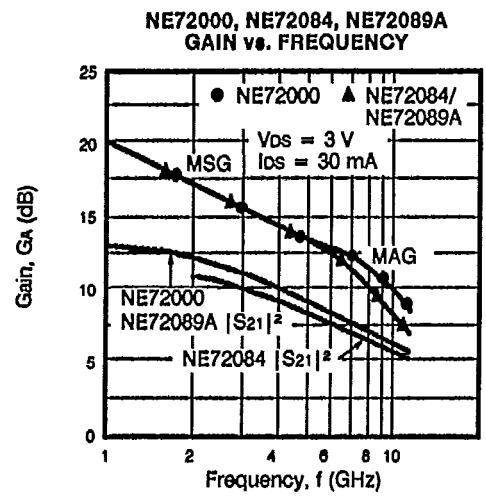
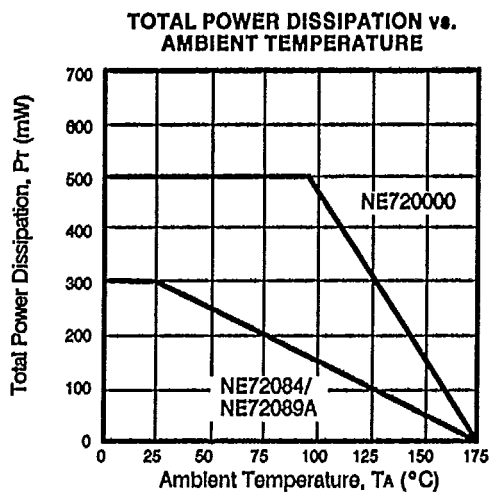
PERFORMANCE SPECIFICATIONS (T_A = 25°C)

| PART NUMBER EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE | | | NE72000 00 (CHIP) | | | NE72084 2SK571 84 | | | NE72089A 2SK354A 89A | | |
|---|---|----------------------|----------------------|--------------|------------------|-------------------------|-----------------------------|-----|----------------------------|--------------|-----|
| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX |
| f _{MAX} | Maximum Frequency of Oscillation at V _{DS} = 3 V, I _D = 30 mA | GHz | | 60 | | | 60 | | | 60 | |
| MAG | Maximum Available Gain ² at V _{DS} = 3 V, I _D = 30 mA (Typ. I _D = 50% I _{DSS}) f = 2 GHz f = 4 GHz f = 8 GHz f = 12 GHz | dB dB dB dB | | 16.5 11.5 | | | 17.5 15.0 12.0 8.0 | | | 16.0 11.0 | |
| NF _{OPT} | Optimum Noise Figure ³ at V _{DS} = 3 V, I _D = 10 mA (Typ. I _D = 15% I _{DSS}) f = 2 GHz f = 4 GHz f = 8 GHz | dB dB dB | | 1.0 1.7 | 1.4 ⁴ | | 0.6 0.8 2.0 | 1.4 | | 1.0 1.7 | 1.4 |
| G _A | Associated Gain at NF at V _{DS} = 3 V, I _D = 10 mA (Typ. I _D = 15% I _{DSS}) f = 2 GHz f = 4 GHz f = 8 GHz | dB dB dB | | 11.0 9.0 | | | 15.0 12.0 8.5 | | | 11.0 8.5 | |
| P _{1dB} | Output Power at 1 dB Compression Point at V _{DS} = 4 V, I _D = 30 mA (Typ. I _D = 50% I _{DSS}) f = 4 GHz | dBm | | 15.0 | | | 15.0 | | | 15.0 | |

Notes:

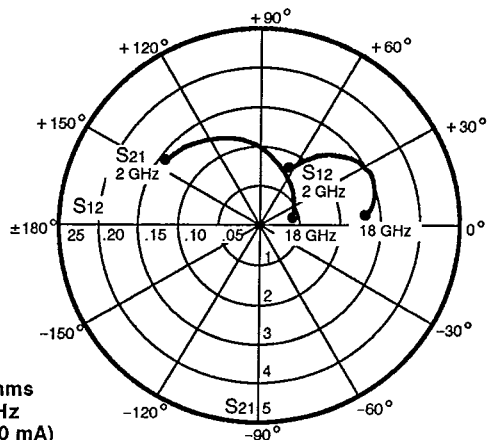
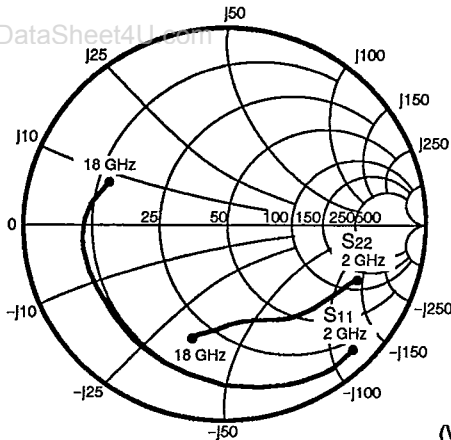
- Electronic Industrial Association of Japan.
- Gain Calculations: $MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1})$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}||S_{21}|}$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$
- Typical values of noise figures are those obtained when 50% of the devices from a large number of lots were individually measured in a circuit with the input individually tuned to obtain the minimum value. Maximum values are criteria established on the production line as a "go-no-go" screening tuned for the "generic" type but not for each specimen. www.DataSheet4U.com
- RF performance is determined by packaging and testing 10 samples per wafer; wafer rejection criteria for standard devices is 2 rejects for 10 samples.

TYPICAL PERFORMANCE CHARACTERISTICS (TA = 25°C)



TYPICAL COMMON SOURCE SCATTERING PARAMETERS

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NE72000
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 3 V, I_{DS} = 10 mA)

S-MAGN AND ANGLES:
V_{DS} = 3 V, I_{DS} = 10 mA

FREQUENCY (MHz)

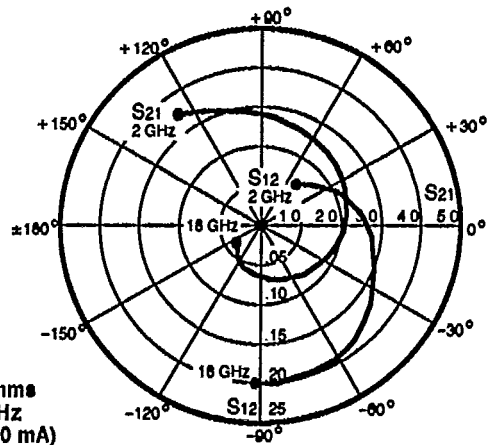
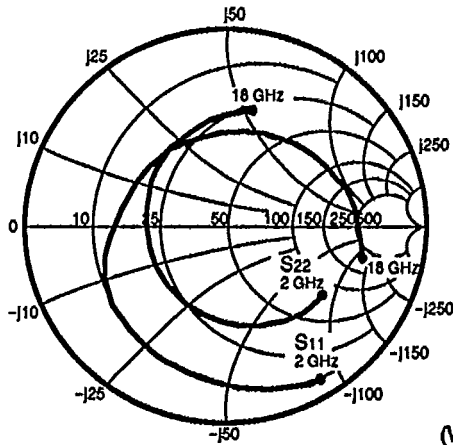
| | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|-------|-----------------|------|-----------------|-----|-----------------|----|-----------------|-----|
| 2000 | .91 | -44 | 2.95 | 144 | .08 | 64 | .71 | -22 |
| 3000 | .90 | -63 | 2.81 | 132 | .11 | 53 | .68 | -27 |
| 4000 | .83 | -81 | 2.47 | 113 | .12 | 44 | .62 | -35 |
| 5000 | .78 | -96 | 2.27 | 105 | .14 | 36 | .58 | -43 |
| 6000 | .75 | -108 | 2.08 | 97 | .15 | 32 | .56 | -52 |
| 7000 | .70 | -119 | 1.83 | 87 | .15 | 26 | .55 | -58 |
| 8000 | .67 | -130 | 1.65 | 79 | .15 | 19 | .55 | -63 |
| 9000 | .66 | -140 | 1.49 | 72 | .15 | 18 | .56 | -65 |
| 10000 | .64 | -152 | 1.37 | 64 | .15 | 15 | .56 | -67 |
| 11000 | .64 | -158 | 1.24 | 59 | .14 | 14 | .54 | -66 |
| 12000 | .67 | -165 | 1.18 | 54 | .14 | 13 | .54 | -67 |
| 13000 | .69 | -168 | 1.11 | 49 | .14 | 11 | .51 | -74 |
| 14000 | .69 | -175 | 1.11 | 44 | .14 | 12 | .54 | -80 |
| 15000 | .65 | -178 | .98 | 38 | .13 | 9 | .55 | -86 |
| 16000 | .66 | 174 | 1.02 | 33 | .14 | 9 | .53 | -90 |
| 17000 | .63 | 164 | .96 | 26 | .13 | 8 | .56 | -95 |
| 18000 | .64 | 160 | .86 | 21 | .13 | 9 | .50 | -97 |

V_{DS} = 3 V, I_{DS} = 30 mA

| | | | | | | | | |
|-------|-----|------|------|-----|-----|----|-----|-----|
| 2000 | .90 | -49 | 3.61 | 143 | .07 | 62 | .65 | -24 |
| 3000 | .89 | -70 | 3.39 | 130 | .10 | 52 | .61 | -28 |
| 4000 | .83 | -88 | 2.91 | 117 | .11 | 44 | .55 | -36 |
| 5000 | .78 | -103 | 2.63 | 104 | .12 | 36 | .51 | -44 |
| 6000 | .75 | -116 | 2.37 | 97 | .13 | 33 | .49 | -53 |
| 7000 | .70 | -126 | 2.08 | 87 | .13 | 27 | .49 | -59 |
| 8000 | .68 | -137 | 1.87 | 79 | .13 | 22 | .49 | -64 |
| 9000 | .67 | -148 | 1.67 | 73 | .13 | 21 | .51 | -67 |
| 10000 | .65 | -158 | 1.53 | 65 | .12 | 19 | .51 | -68 |
| 11000 | .65 | -164 | 1.37 | 60 | .12 | 18 | .49 | -67 |
| 12000 | .70 | -171 | 1.32 | 55 | .12 | 18 | .47 | -68 |
| 13000 | .72 | -174 | 1.23 | 51 | .12 | 17 | .47 | -75 |
| 14000 | .74 | -180 | 1.22 | 46 | .13 | 20 | .49 | -81 |
| 15000 | .67 | 177 | 1.09 | 40 | .12 | 17 | .50 | -87 |
| 16000 | .69 | 169 | 1.12 | 36 | .12 | 18 | .50 | -90 |
| 17000 | .66 | 158 | 1.05 | 28 | .13 | 18 | .52 | -96 |
| 18000 | .67 | 156 | .94 | 24 | .12 | 20 | .50 | -99 |

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TYPICAL COMMON SOURCE SCATTERING PARAMETERS



NE72084
Coordinates in Ohms
Frequency in GHz
($V_{DS} = 3\text{ V}$, $I_{DS} = 30\text{ mA}$)

S-MAGN AND ANGLES:

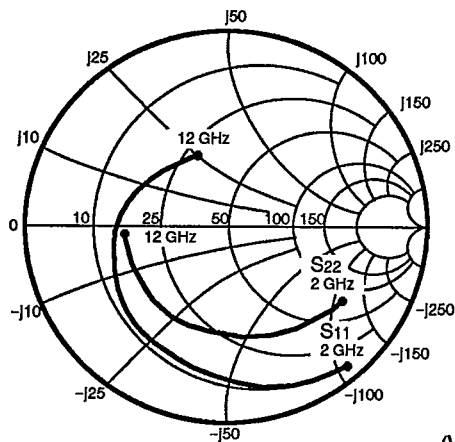
$V_{DS} = 3\text{ V}$, $I_{DS} = 10\text{ mA}$

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|-----------------|-----------------|------|-----------------|------|-----------------|-----|-----------------|------|
| 2000 | .92 | -54 | 2.91 | 130 | .08 | 53 | .69 | -37 |
| 4000 | .79 | -102 | 2.47 | 85 | .13 | 23 | .61 | -70 |
| 6000 | .68 | -141 | 2.19 | 49 | .15 | 0 | .54 | -100 |
| 8000 | .53 | -177 | 1.82 | 15 | .15 | -16 | .47 | -126 |
| 10000 | .47 | 136 | 1.68 | -17 | .16 | -30 | .43 | -159 |
| 12000 | .48 | 89 | 1.45 | -51 | .16 | -45 | .45 | 164 |
| 14000 | .52 | 49 | 1.22 | -82 | .17 | -62 | .49 | 131 |
| 16000 | .61 | 14 | 1.03 | -115 | .18 | -82 | .58 | 98 |
| 18000 | .66 | -5 | .81 | -138 | .18 | -98 | .64 | 77 |

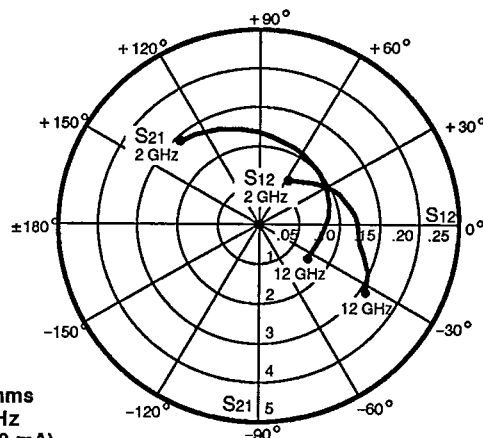
$V_{DS} = 3\text{ V}$, $I_{DS} = 30\text{ mA}$

| | | | | | | | | |
|-------|-----|------|------|------|-----|-----|-----|------|
| 2000 | .91 | -59 | 3.53 | 127 | .07 | 54 | .60 | -37 |
| 4000 | .76 | -110 | 2.87 | 83 | .10 | 26 | .52 | -69 |
| 6000 | .65 | -151 | 2.45 | 46 | .12 | 8 | .48 | -97 |
| 8000 | .52 | 171 | 2.02 | 14 | .13 | -4 | .42 | -122 |
| 10000 | .49 | 124 | 1.82 | -18 | .15 | -16 | .38 | -155 |
| 12000 | .52 | 79 | 1.55 | -50 | .17 | -31 | .41 | 166 |
| 14000 | .57 | 41 | 1.30 | -82 | .19 | -51 | .46 | 132 |
| 16000 | .65 | 9 | 1.08 | -114 | .20 | -74 | .55 | 98 |
| 18000 | .70 | -10 | .86 | -136 | .20 | -91 | .62 | 77 |

TYPICAL COMMON SOURCE SCATTERING PARAMETERS



NE72089A
Coordinates in Ohms
Frequency in GHz
($V_{DS} = 3\text{ V}$, $I_{DS} = 10\text{ mA}$)



S-MAGN AND ANGLES:
 $V_{DS} = 3\text{ V}$, $I_{DS} = 10\text{ mA}$

| FREQUENCY (MHz) | S11 | | S21 | | S12 | | S22 | |
|-----------------|-----|------|------|-----|-----|-----|-----|------|
| 2000 | .92 | -52 | 2.94 | 130 | .07 | 54 | .68 | -35 |
| 3000 | .84 | -75 | 2.62 | 108 | .09 | 38 | .63 | -51 |
| 4000 | .76 | -95 | 2.34 | 90 | .11 | 26 | .59 | -66 |
| 5000 | .71 | -113 | 2.18 | 72 | .12 | 16 | .58 | -79 |
| 6000 | .65 | -131 | 2.02 | 56 | .13 | 7 | .56 | -93 |
| 7000 | .59 | -146 | 1.86 | 41 | .13 | -1 | .54 | -105 |
| 8000 | .55 | -160 | 1.76 | 26 | .13 | -7 | .54 | -116 |
| 9000 | .49 | -177 | 1.68 | 13 | .13 | -12 | .53 | -129 |
| 10000 | .44 | 165 | 1.66 | -1 | .14 | -17 | .53 | -139 |
| 11000 | .39 | 140 | 1.63 | -19 | .15 | -26 | .52 | -154 |
| 12000 | .37 | 112 | 1.55 | -34 | .16 | -33 | .51 | -170 |

$V_{DS} = 3\text{ V}$, $I_{DS} = 30\text{ mA}$

| | | | | | | | | |
|-------|-----|------|------|-----|-----|-----|-----|------|
| 2000 | .89 | -58 | 3.76 | 127 | .06 | 55 | .60 | -35 |
| 3000 | .79 | -82 | 3.27 | 105 | .08 | 40 | .56 | -50 |
| 4000 | .72 | -103 | 2.88 | 86 | .09 | 31 | .53 | -64 |
| 5000 | .66 | -121 | 2.61 | 69 | .10 | 22 | .51 | -75 |
| 6000 | .60 | -139 | 2.38 | 54 | .11 | 16 | .50 | -86 |
| 7000 | .55 | -155 | 2.18 | 38 | .11 | 10 | .50 | -97 |
| 8000 | .50 | -170 | 2.04 | 24 | .12 | 6 | .50 | -108 |
| 9000 | .44 | 172 | 1.93 | 11 | .12 | 2 | .49 | -118 |
| 10000 | .40 | 152 | 1.89 | -3 | .14 | -2 | .50 | -126 |
| 11000 | .36 | 126 | 1.83 | -20 | .15 | -11 | .49 | -138 |
| 12000 | .35 | 99 | 1.72 | -36 | .16 | -18 | .48 | -151 |

NE720 SERIES

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NE72084 TYPICAL NOISE PARAMETERS

| FREQ. (GHz) | NF _{OPT} (dB) | G _A (dB) | Γ _{OPT} | | R _n /50 |
|----------------|---------------------------|------------------------|------------------|-------|--------------------|
| | | | (MAG) | (ANG) | |
| 1.0 | 0.55 | 17.5 | 0.90 | 15 | 0.52 |
| 2.0 | 0.60 | 14.5 | 0.81 | 38 | 0.49 |
| 4.0 | 1.00 | 11.5 | 0.74 | 59 | 0.39 |
| 6.0 | 1.30 | 9.5 | 0.66 | 102 | 0.30 |
| 8.0 | 1.70 | 8.5 | 0.49 | 130 | 0.24 |
| 10.0 | 2.15 | 7.5 | 0.32 | 172 | 0.18 |
| 12.0 | 2.50 | 6.5 | 0.26 | -115 | 0.16 |
| 14.0 | 2.95 | 5.5 | 0.30 | -54 | 0.13 |
| 16.0 | 3.30 | 4.7 | 0.26 | -4 | 0.11 |
| 18.0 | 3.70 | 4.0 | 0.26 | 13 | 0.09 |

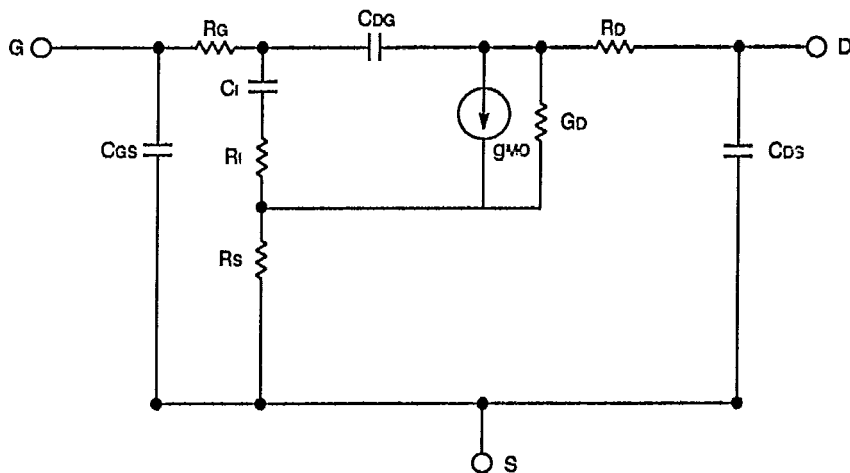
(V_{DS} = 3 V, I_{DS} = 10 mA)

NE72089A TYPICAL NOISE PARAMETERS

| FREQ. (GHz) | NF _{OPT} (dB) | G _A (dB) | Γ _{OPT} | | R _n /50 |
|----------------|---------------------------|------------------------|------------------|-------|--------------------|
| | | | (MAG) | (ANG) | |
| 1.0 | 0.60 | 17.5 | 0.76 | 13 | 0.68 |
| 2.0 | 0.75 | 14.5 | 0.73 | 36 | 0.58 |
| 4.0 | 1.00 | 11.5 | 0.65 | 68 | 0.42 |
| 6.0 | 1.30 | 9.0 | 0.53 | 100 | 0.28 |
| 8.0 | 1.70 | 8.5 | 0.42 | 138 | 0.19 |
| 10.0 | 2.05 | 7.0 | 0.31 | 175 | 0.15 |
| 12.0 | 2.50 | 6.5 | 0.25 | -117 | 0.25 |

(V_{DS} = 3 V, I_{DS} = 10 mA)

NE72000 EQUIVALENT CIRCUIT



| COMPONENT | VALUE |
|-----------------|-----------|
| R _g | 0.57 Ω |
| C _J | 0.15 pF |
| R _J | 2.00 Ω |
| R _s | 2.00 Ω |
| C _{DG} | 0.03 pF |
| R _D | 2.00 Ω |
| C _{DS} | 0.015 pF |
| g _{MO} | 40.0 (mS) |
| G _D | 2.0 (mS) |
| C _{GS} | 0.55 pF |

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