

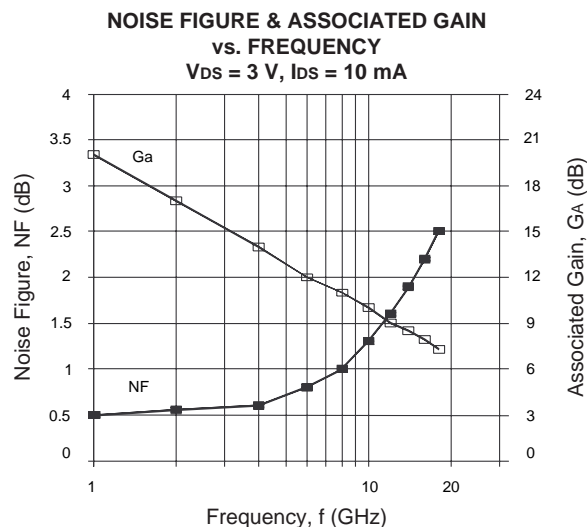
### FEATURES

- **LOW NOISE FIGURE**  
NF = 1.6 dB TYP at f = 12 GHz
- **HIGH ASSOCIATED GAIN**  
GA = 9 dB TYP at f = 12 GHz
- **L<sub>G</sub> = 0.3 μm, W<sub>G</sub> = 280 μm**
- **ION IMPLANTATION**

### DESCRIPTION

The NE76000 provides a low noise figure and high associated gain through K-Band. The NE760 devices are fabricated by ion implantation for improved RF and DC performance, reliability, and uniformity. These devices feature a recessed 0.3 micron gate and triple epitaxial technology. The surface of the device, except for bonding pads, is passivated with SiO<sub>2</sub> and Si<sub>3</sub>N<sub>4</sub> for scratch protection as well as surface stability.

NEC's stringent quality assurance and test procedures ensure the highest reliability and performance.



### ELECTRICAL SPECIFICATIONS (T<sub>A</sub> = 25°C)

PART NUMBER PACKAGE OUTLINE			NE76000 00 (CHIP)			NE76000L 00 (CHIP)		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX
NFOPT <sup>1</sup>	Optimum Noise Figure at V <sub>DS</sub> = 3 V, I <sub>DS</sub> = 10 mA, f = 4 GHz f = 12 GHz	dB dB		0.6 1.6	1.8		1.8	
GA <sup>1</sup>	Associated Gain at V <sub>DS</sub> = 3 V, I <sub>DS</sub> = 10 mA, f = 4 GHz f = 12 GHz	dB dB	8.0	13.0 9.0			8.0	
P <sub>1dB</sub>	Output Power at 1 dB Compression, V <sub>DS</sub> = 3 V, I <sub>DS</sub> = 30 mA, f = 12 GHz	dBm		14.5				
I <sub>DSS</sub>	Saturated Drain Current at V <sub>DS</sub> = 3 V, V <sub>GS</sub> = 0	mA	15	30	50	50		80
V <sub>P</sub>	Pinch-off Voltage at V <sub>DS</sub> = 3 V, I <sub>DS</sub> = 0.1 mA	V	-3.0	-0.8	-0.5	-3.0	-0.8	-0.5
g <sub>m</sub>	Transconductance, V <sub>DS</sub> = 3 V, I <sub>DS</sub> = 10 mA	mS	30.0	40.0			30.0	
I <sub>GSO</sub>	Gate to Source Leakage Current, V <sub>GS</sub> = -4 V	μA		1.0	10.0		1.0	
R <sub>TH(CH-C)</sub> <sup>2</sup>	Thermal Resistance (Channel to Case)	°C/W			190			190

**Notes:**

1. RF performance is determined by packaging and testing 10 samples per wafer; wafer rejection criteria for standard devices is 2 rejects for 10 samples.
2. Chip mounted on infinite heat sink.

**ABSOLUTE MAXIMUM RATINGS<sup>1</sup>** (T<sub>A</sub> = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V <sub>DS</sub>	Drain to Source Voltage	V	5
V <sub>GD</sub>	Gate to Drain Voltage	V	-5
V <sub>GS</sub>	Gate to Source Voltage	V	-3
I <sub>DS</sub>	Drain Current	mA	I <sub>DSS</sub>
P <sub>IN</sub>	RF Input (CW)	dBm	+15
T <sub>CH</sub>	Channel Temperature	°C	175
T <sub>STG</sub>	Storage Temperature	°C	-65 to +175
P <sub>T</sub> <sup>2</sup>	Total Power Dissipation	mW	240

Notes:

1. Operation in excess of any one of these parameters may result in permanent damage.
2. With chip mounted on a copper heat sink.

**TYPICAL NOISE PARAMETERS<sup>1</sup>**

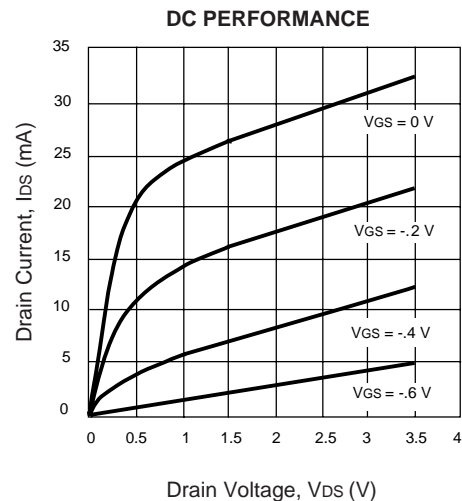
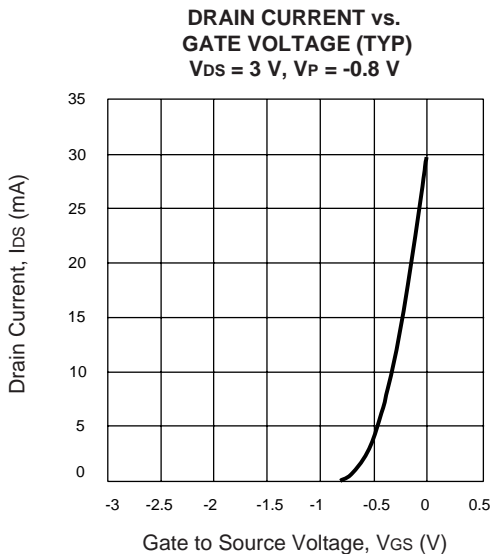
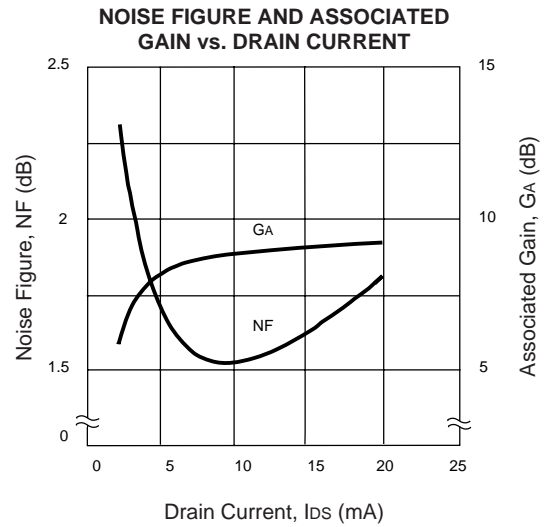
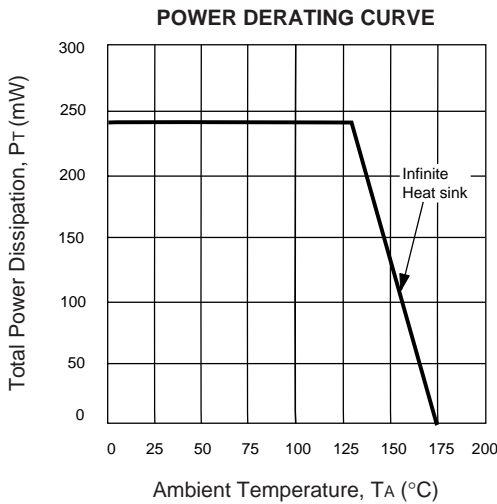
(V<sub>DS</sub> = 3.0, I<sub>DS</sub> = 10 mA)

FREQ. (GHz)	NF <sub>OPT</sub> (dB)	G <sub>A</sub> (dB)	Γ <sub>OPT</sub>		R <sub>n</sub> /50
			MAG	ANG	
1	0.50	23.88	.84	12	.69
2	0.55	21.78	.76	25	.63
4	0.60	18.93	.70	45	.49
6	0.80	16.28	.64	65	.41
8	1.00	14.67	.60	83	.36
10	1.30	12.97	.56	99	.32
12	1.60	11.58	.52	114	.27
14	1.90	10.24	.49	125	.23
16	2.30	9.42	.48	135	.20
18	2.60	8.39	.47	145	.18

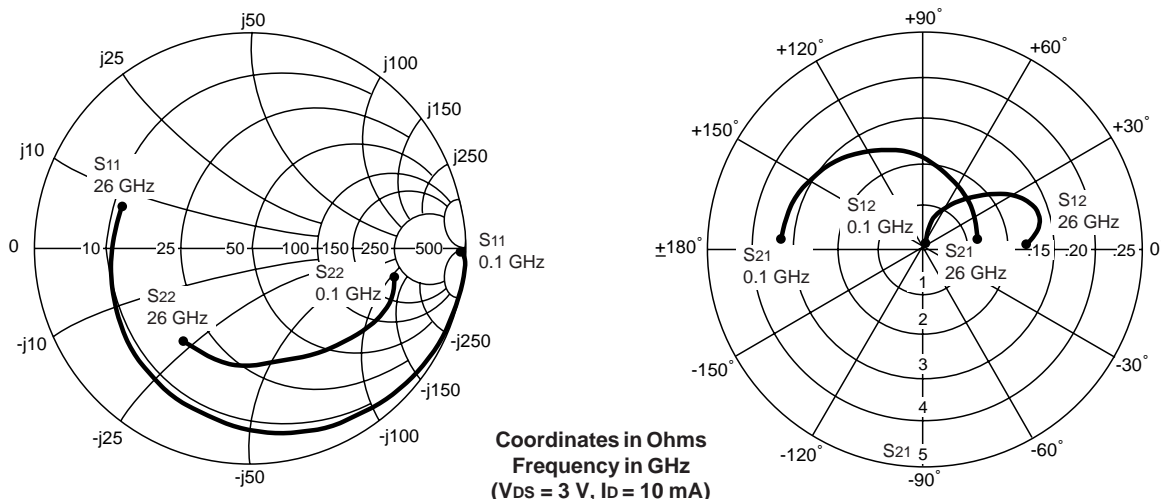
Note:

1. Noise parameters include bond wires:  
 Gate: 2 wires total, 1 per bond pad, 0.0139" long each wire.  
 Drain: 2 wires total, 1 per bond pad, 0.0115" long each wire.  
 Sources: 4 wires total, 2 per side, 0.0066" long each wire.  
 Wire: 0.0007" diameter, gold.

**TYPICAL PERFORMANCE CURVES** (T<sub>A</sub> = 25 °C)



**TYPICAL COMMON SOURCE SCATTERING PARAMETERS**



**NE76000<sup>1</sup>**

V<sub>ds</sub> = 3 V, I<sub>d</sub> = 10 mA

FREQUENCY (GHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>		K	S <sub>21</sub> (dB)	MAG <sup>2</sup> (dB)
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG			
0.1	0.999	-2.0	3.291	179.0	0.002	90.0	0.677	-1.0	0.06	10.3	32.1
0.2	0.999	-3.0	3.282	178.0	0.004	89.0	0.677	-2.0	0.02	10.3	29.1
0.5	0.998	-7.0	3.280	175.0	0.010	85.0	0.675	-4.0	0.04	10.3	25.1
1.0	0.996	-13.0	3.265	169.0	0.020	81.0	0.673	-8.0	0.05	10.2	22.1
1.5	0.993	-20.0	3.218	164.0	0.030	78.0	0.671	-12.0	0.04	10.1	20.3
2.0	0.985	-27.0	3.185	158.0	0.039	74.0	0.666	-16.0	0.07	10.0	19.1
3.0	0.969	-39.0	3.079	148.0	0.057	66.0	0.655	-23.0	0.12	9.7	17.3
4.0	0.947	-50.0	2.950	138.0	0.072	59.0	0.640	-30.0	0.17	9.3	16.1
5.0	0.923	-61.0	2.814	129.0	0.085	51.0	0.621	-36.0	0.24	8.9	15.1
6.0	0.890	-70.0	2.669	120.0	0.094	47.0	0.602	-42.0	0.30	8.5	14.5
7.0	0.874	-78.0	2.545	113.0	0.104	41.0	0.590	-47.0	0.34	8.1	13.8
8.0	0.855	-87.0	2.446	104.0	0.110	36.0	0.579	-53.0	0.38	7.7	13.4
9.0	0.825	-96.0	2.328	97.0	0.114	30.0	0.565	-58.0	0.45	7.3	13.1
10.0	0.808	-104.0	2.237	90.0	0.119	29.0	0.565	-63.0	0.45	6.9	12.7
12.0	0.766	-120.0	2.077	76.0	0.132	19.0	0.558	-73.0	0.52	6.3	11.9
14.0	0.741	-135.0	1.926	63.0	0.134	12.0	0.549	-81.0	0.59	5.6	11.5
16.0	0.723	-147.0	1.800	53.0	0.134	6.0	0.553	-88.0	0.64	5.1	11.2
18.0	0.700	-155.0	1.653	43.0	0.130	3.0	0.530	-94.0	0.80	4.3	11.0
20.0	0.677	-162.0	1.528	35.0	0.121	4.0	0.519	-99.0	0.98	3.6	11.0
22.0	0.665	-171.0	1.464	26.0	0.115	4.0	0.520	-107.0	1.08	3.3	9.3
24.0	0.638	178.0	1.390	16.0	0.121	5.0	0.537	-116.0	1.08	2.8	8.8
26.0	0.616	164.0	1.286	7.0	0.123	4.0	0.538	-123.0	1.18	2.1	7.5

Notes:

- S-parameters include bond wires.  
 Gate: Total 2 wire (s), 1 per bond pad, 0.0139" (354 μm) long each wire.  
 Drain: Total 2 wire(s), 1 per bond pad, 0.0115" (291 μm) long each wire.  
 Source: Total 4 wire (s), 2 per side, 0.0066" (168 μm) long each wire.  
 Wire: 0.0007" (17.8 μm) Diameter, Gold.

2. Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1})$$

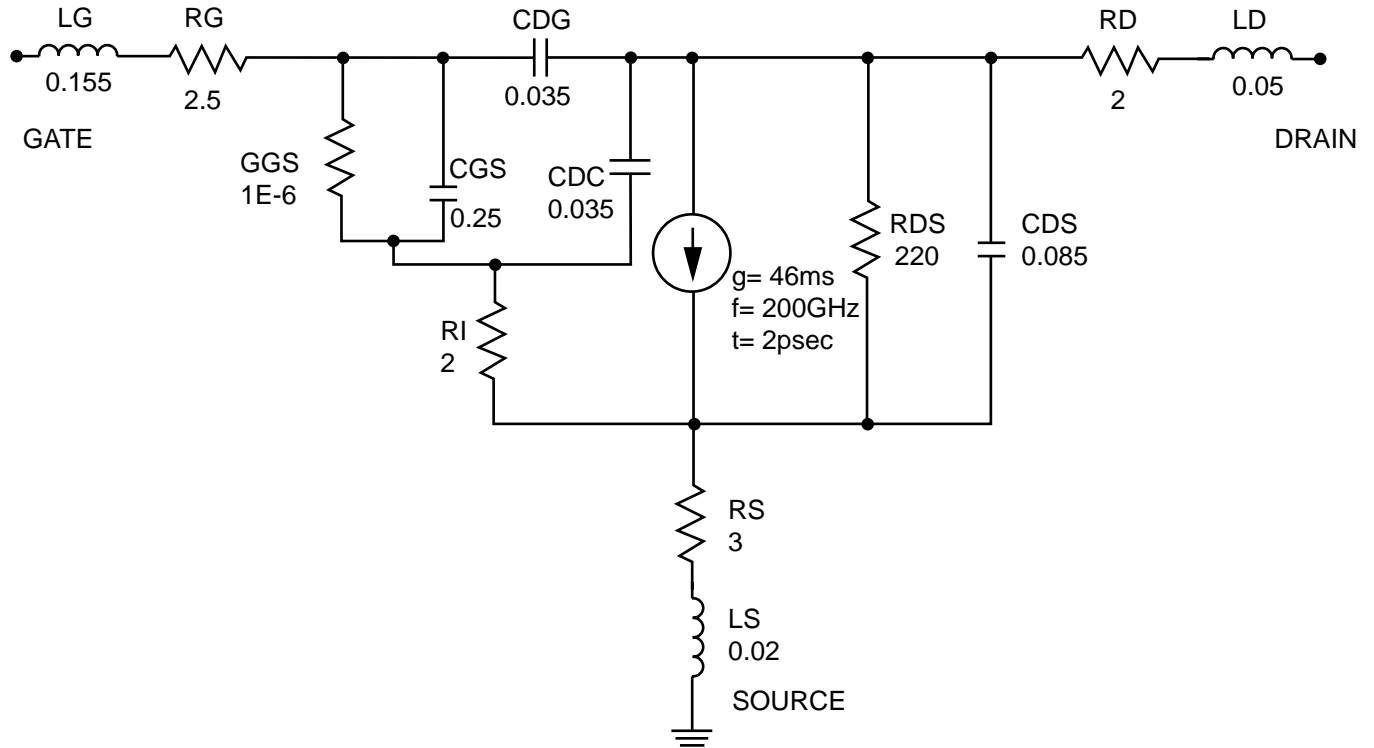
When  $K \leq 1$ , MAG is undefined and MSG values are used.  $MSG = \frac{|S_{21}|}{|S_{12}|}$ ,  $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 |S_{12} S_{21}|}$ ,  $\Delta = S_{11} S_{22} - S_{21} S_{12}$

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

NE76000 LINEAR MODEL

SCHEMATIC



UNITS

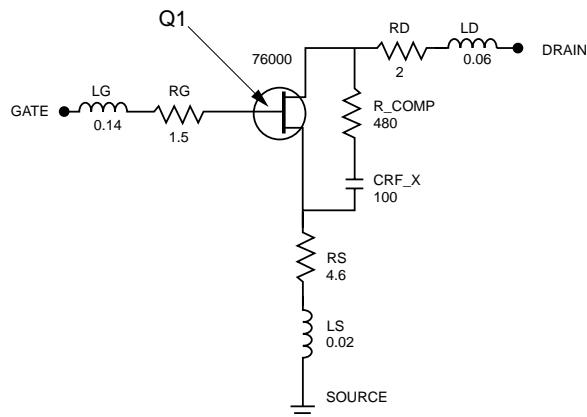
Parameter	Units
capacitance	picofarads
inductance	nanohenries
resistance	ohms
conductance	millisiemens

MODEL RANGE

Frequency: 0.05 to 26 GHz  
 Bias:  $V_{bs} = 3\text{ V}$ ,  $I_b = 10\text{ mA}$   
 Date: 7/19/96

## NE76000 NONLINEAR MODEL

### SCHEMATIC



### FET NONLINEAR MODEL PARAMETERS (1)

Parameters	Q1	Parameters	Q1
VTO	-0.73	RG	0
VTOSC	0	RD	0
ALPHA	4	RS	0
BETA	0.063	RGMET	0
GAMMA	0	KF	0
GAMMADC <sup>(2)</sup>	0.06	AF	1
Q	2.2	TNOM	27
DELTA	0.7	XTI	3
VBI	0.626	EG	1.43
IS	1.98e-11	VTOTC	0
N	1.4	BETATCE	0
RIS	0	FFE	1
RID	0		
TAU	3.2e-12		
CDS	0.11e-12		
RDB	Infinity		
CBS	0		
CGSO <sup>(3)</sup>	0.4e-12		
CGDO <sup>(4)</sup>	0.04e-12		
DELTA <sup>1</sup>	0.3		
DELTA <sup>2</sup>	0.2		
FC	0.5		
VBR	Infinity		

### UNITS

Parameter	Units
capacitance	picofarads
inductance	nanohenries
resistance	ohms

### MODEL RANGE

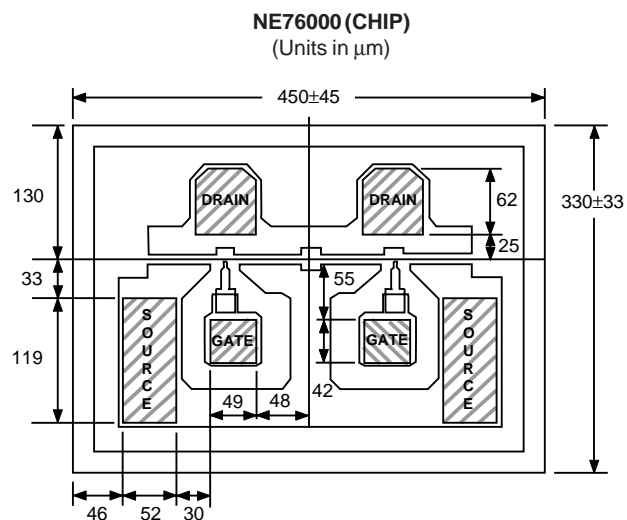
Frequency: 0.05 to 26 GHz  
 Bias:  $V_{DS} = 3\text{ V}$ ,  $I_D = 10\text{ mA}$   
 Date: 8/30/96

(1) Series IV Libra TOM Model

The parameter in Libra corresponds to the parameter in PSpice:

- |             |       |
|-------------|-------|
| (2) GAMMADC | GAMMA |
| (3) CGSO    | CGS   |
| (4) CGDO    | CGD   |

**OUTLINE DIMENSIONS** (Units in  $\mu\text{m}$ )



Bonding Pad Area    Chip Thickness:  $140 \mu\text{m} \pm 20 \mu\text{m}$

Note: All dimensions are typical unless otherwise stated.

**ORDERING INFORMATION**

PART NUMBER	IDSS SELECTION (mA)
NE76000L	50 to 80
NE76000	15 to 50

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