

FEATURES

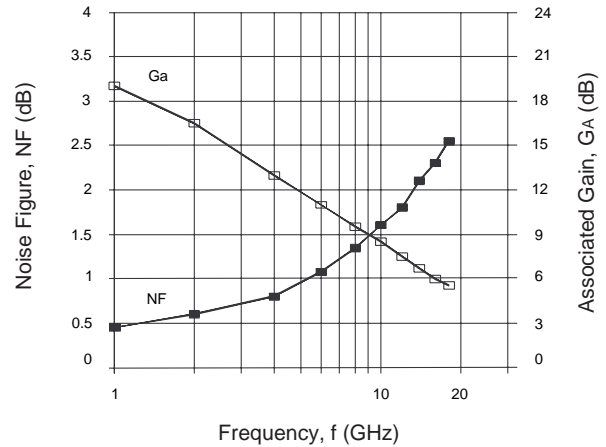
- **LOW NOISE FIGURE:**
1.8 dB typical at 12 GHz
- **HIGH ASSOCIATED GAIN:**
7.5 dB typical at 12 GHz
- **L_G = 0.3 μm, W_G = 280 μm**
- **LOW COST PLASTIC PACKAGING**
- **TAPE & REEL PACKAGING OPTION AVAILABLE**

DESCRIPTION

NE76038 is a high performance gallium arsenide metal semiconductor field effect transistor housed in a plastic package. Its low noise figure makes this device appropriate for use in the second or third stages of low noise amplifiers operating in the 1 - 14 GHz frequency range. The device is fabricated using ion implantation for improved RF and DC performance, reliability, and uniformity. These devices feature a recessed 0.3 micron gate and triple epitaxial technology.

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

**NOISE FIGURE & ASSOCIATED
GAIN vs. FREQUENCY**
V_{DS} = 3 V, I_{DS} = 10 mA



ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER PACKAGE OUTLINE			NE76038 38		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
NFOPT ¹	Optimum Noise Figure at V _{DS} = 3 V, I _{DS} = 10 mA f = 4 GHz f = 12 GHz	dB dB		0.8 1.8	1.2
GA	Associated Gain at V _{DS} = 3 V, I _{DS} = 10 mA f = 4 GHz f = 12 GHz	dB dB	12.0	13.0 7.5	
I _{DSS}	Saturated Drain Current at V _{DS} = 3 V, V _{GS} = 0 V	mA	15	30	50
V _P	Pinch-off Voltage at V _{DS} = 3 V, I _{DS} = 0.1 mA	V	-3.0	-0.8	-0.5
g _m	Transconductance at V _{DS} = 3 V, I _{DS} = 10 mA	mS	30	40	70
I _{GSO}	Gate to Source Leakage Current at V _{GS} = -3 V	μA			10

Note:

1. 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 test with the fixture tuned for the "generic" type but not for each specimen.

ABSOLUTE MAXIMUM RATINGS¹ (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V _{DS}	Drain to Source Voltage	V	5
V _{GD}	Gate to Drain Voltage	V	-5
V _{GS}	Gate to Source Voltage	V	-3
I _{DS}	Drain Current	mA	I _{DSS}
P _{IN}	RF Input (CW)	dBm	+15
T _{CH}	Channel Temperature	°C	150
T _{STG}	Storage Temperature	°C	-65 to +150
P _T	Total Power Dissipation	mW	240
R _{TH} ^{2, 3}	Thermal Resistance	°C/W	1250

Notes:

1. Operation in excess of any one of these parameters may result in permanent damage.
2. R_{TH} for plastic package mounted on glass epoxy substrate is 965°C/W.
3. R_{TH} for chip mounted on copper heat sink is 190°C/W.

TYPICAL NOISE PARAMETERS (T_A = 25°C)

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

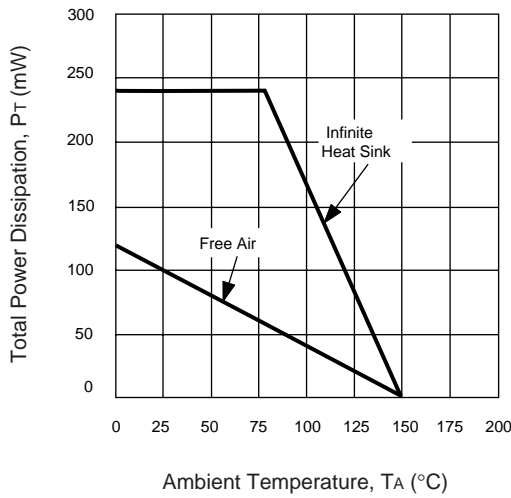
FREQ. (GHz)	NF _{OPT} (dB)	G _A (dB)	Γ _{OPT}		R _n /50
			MAG	ANG ¹	
0.5	0.40	21.67	0.84	5	0.79
1.0	0.45	20.01	0.82	10	0.75
2.0	0.60	18.88	0.76	28	0.70
4.0	0.80	15.53	0.66	58	0.61
6.0	1.10	13.24	0.55	101	0.50
8.0	1.35	11.32	0.50	152	0.40
10.0	1.60	9.49	0.48	-166	0.31
12.0	1.80	8.15	0.54	-130	0.25
14.0	2.10	7.11	0.63	-105	0.20
16.0	2.30	6.54	0.70	-87	0.15
18.0	2.55	5.68	0.77	-75	0.12

Note:

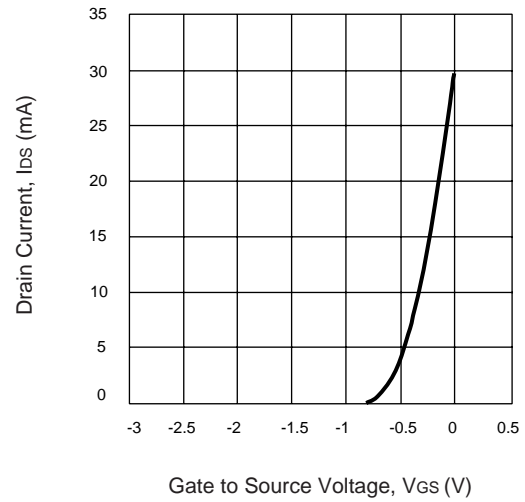
1. Γ_{OPT} is referenced to the bend of the lead, as shown on back page.

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

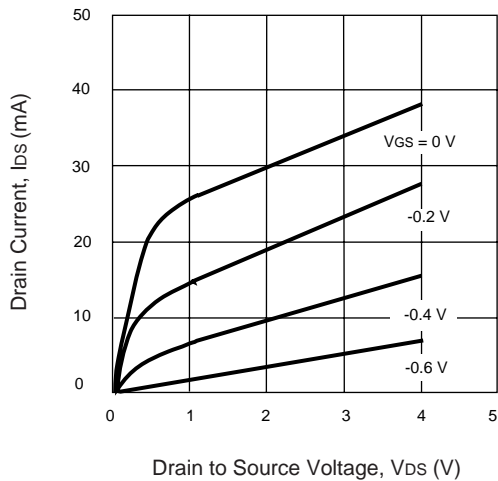
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



DRAIN CURRENT vs. GATE TO SOURCE VOLTAGE
V_{DS} = 3 V



DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



TYPICAL SCATTERING PARAMETERS¹ (T_A = 25°C)

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

FREQUENCY (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂		K	MAG ² (dB)
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		
0.1	0.99	-2	3.29	178	0.006	101	0.63	-2	0.174	27.390
0.5	0.99	-9	3.29	171	0.013	82	0.63	-6	0.183	24.033
1.0	0.99	-17	3.25	163	0.02	78	0.62	-12	0.127	22.109
1.5	0.97	-25	3.25	155	0.03	71	0.61	-18	0.249	20.348
2.0	0.95	-34	3.22	147	0.04	66	0.60	-24	0.297	19.058
3.0	0.90	-51	3.15	131	0.06	57	0.58	-35	0.392	17.202
4.0	0.84	-68	3.07	115	0.08	47	0.54	-46	0.500	15.840
5.0	0.77	-86	2.97	99	0.09	37	0.50	-58	0.638	15.185
6.0	0.70	-106	2.83	84	0.10	28	0.45	-70	0.763	14.518
7.0	0.64	-126	2.66	69	0.11	21	0.41	-81	0.866	13.835
8.0	0.61	-145	2.51	55	0.11	16	0.37	-92	0.981	13.583
9.0	0.58	-165	2.37	42	0.11	10	0.33	-104	1.116	11.264
10.0	0.57	175	2.21	27	0.11	7	0.30	-118	1.228	10.152
11.0	0.58	156	2.05	15	0.12	3	0.27	-136	1.217	9.514
12.0	0.60	139	1.87	2	0.12	-0	0.27	-157	1.282	8.737
13.0	0.64	125	1.72	-10	0.12	-1	0.27	-178	1.301	8.274
14.0	0.67	114	1.57	-20	0.12	-2	0.30	164	1.325	7.756
15.0	0.71	104	1.45	-32	0.13	-4	0.34	150	1.175	7.941
16.0	0.74	95	1.32	-41	0.13	-8	0.39	135	1.158	7.653
17.0	0.77	86	1.19	-52	0.13	-12	0.44	122	1.127	7.453
18.0	0.78	80	1.09	-61	0.14	-17	0.46	111	1.094	7.043

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

0.1	0.99	-2	4.36	178	0.004	94	0.57	-2	0.335	30.374
0.5	0.99	-10	4.36	171	0.011	82	0.57	-6	0.174	25.981
1.0	0.98	-19	4.30	161	0.02	78	0.57	-12	0.198	23.324
1.5	0.96	-28	4.27	153	0.03	72	0.56	-18	0.265	21.533
2.0	0.93	-37	4.19	144	0.04	67	0.55	-24	0.347	20.202
3.0	0.86	-56	4.02	127	0.05	58	0.52	-35	0.526	19.053
4.0	0.79	-74	3.83	111	0.07	49	0.48	-45	0.614	17.381
5.0	0.71	-93	3.62	95	0.08	41	0.44	-56	0.754	16.556
6.0	0.64	-114	3.37	80	0.08	35	0.39	-67	0.954	16.245
7.0	0.58	-134	3.13	66	0.09	29	0.35	-78	1.052	14.015
8.0	0.55	-154	2.91	52	0.09	26	0.32	-88	1.191	12.451
9.0	0.53	-173	2.71	39	0.10	22	0.29	-100	1.213	11.546
10.0	0.53	167	2.51	26	0.10	20	0.26	-114	1.324	10.587
11.0	0.55	149	2.31	14	0.11	16	0.23	-132	1.304	9.918
12.0	0.58	133	2.11	1	0.11	13	0.23	-155	1.362	9.237
13.0	0.63	120	1.94	-9	0.12	10	0.24	-178	1.259	9.023
14.0	0.66	110	1.77	-20	0.13	8	0.27	163	1.206	8.599
15.0	0.70	101	1.65	-31	0.14	3	0.31	149	1.083	8.955
16.0	0.73	92	1.50	-41	0.14	-2	0.36	134	1.078	8.600
17.0	0.76	84	1.35	-51	0.15	-7	0.41	121	1.007	9.034
18.0	0.78	78	1.23	-59	0.15	-12	0.45	110	1.006	8.680

Note:

1. S-Parameters are de-embedded to the bend of the lead as shown on back page.

2. Gain calculations:

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

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

NE76038 NONLINEAR MODEL

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 ⁽²⁾	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 ⁽³⁾	0.4e-12		
CGDO ⁽⁴⁾	0.04e-12		
DELTA ¹	0.3		
DELTA ²	0.2		
FC	0.5		
VBR	Infinity		

(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 |

UNITS

Parameter	Units
capacitance	picofarads
inductance	nano henries
resistance	ohms

MODEL RANGE

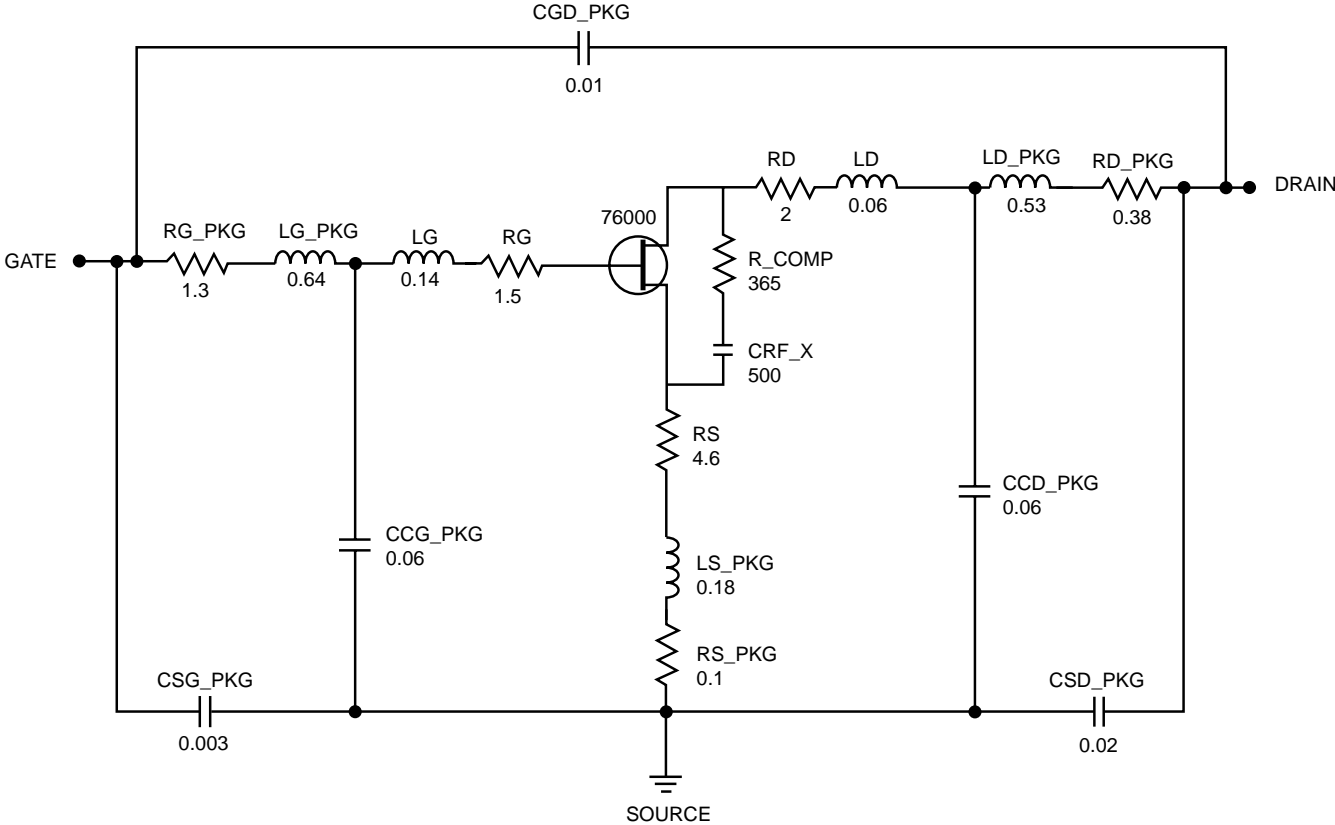
Frequency: 0.1 to 18 GHz

Bias: $V_{DS} = 3$ V, $I_D = 10$ mA to 30 mA

Date: 8/30/96

NE76038 NONLINEAR MODEL

SCHEMATIC



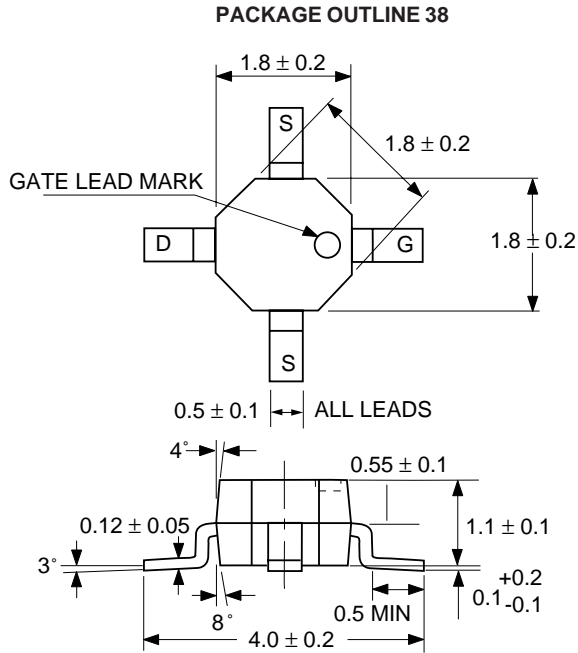
UNITS

Parameter	Units
capacitance	picofarads
inductance	nanohenries
resistance	ohms

MODEL RANGE

Frequency: 0.1 to 18 GHz
 Bias: $V_{DS} = 3\text{ V}$, $I_D = 10\text{ mA}$ to 30 mA
 Date: 8/30/96

OUTLINE DIMENSIONS (Units in mm)



ORDERING INFORMATION

PART NUMBER	AVAILABILITY	PACKAGE OUTLINE
NE76038	Bulk up to 1 K	38
NE76038-T1	1K/Reel	38

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