NEC

LOW NOISE Ku-K BAND GaAs FET

NE710 SERIES

FEATURES

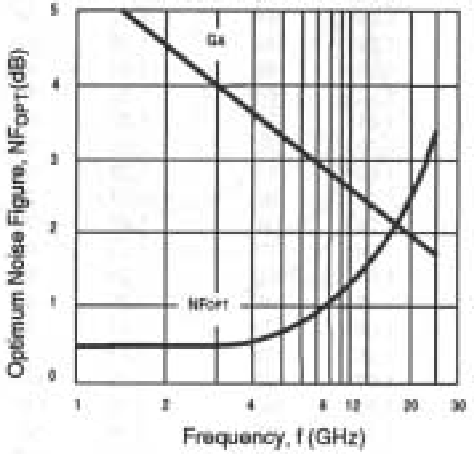
- **VERY HIGH f_{MAX}: 90 GHz**
- **LOW NOISE FIGURE**
- **HIGH ASSOCIATED GAIN**
- **L_G = 0.3 µm, W_G = 280 µm**
- **N+ CONTACT LAYER** (Triple Epitaxial Technology)
- **PROVEN RELIABILITY AND STABILITY**

DESCRIPTION

The NE710 series features a low noise figure and high associated gain through K-band by employing a recessed 0.3 micron gate and triple epitaxial technology.

The device is available in chip form (NE71000). The surface of the device, except for the bonding pads, is passivated with SiO_2 and Si_3N_4 for scratch protection as well as surface stabilization. The NE71083 is a low cost device for industrial applications, and the NE71084 is a low cost device for consumer applications.

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



ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER			NE71000			NE71083			NE71084		
EIAJ[1] REGISTERED NUMBER						2SK406			2SK609		
PACKAGE OUTLINE			CHIP			83			84		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
MAG	Maximum Available Gain[2] at V_{DS} = 3 V, I_{DS} = 20 mA,										
	f = 4 GHz	dB		17.0			17.0				
	f = 8 GHz	dB		15.0			15.0			10.0	
	f = 12 GHz	dB		12.0			12.0				
	f = 18 GHz	dB		8.5			8.5				
NF_{OPT}	Optimum Noise Figure[3] at V_{DS} = 3 V, I_{DS} = 10 mA,										
	f = 4 GHz	dB		0.6			0.6	0.7			
	f = 8 GHz	dB		1.0			1.0				
	f = 12 GHz	dB		1.5	1.8		1.5	1.8		1.6	1.8
	f = 18 GHz	dB		2.1							
	f = 26 GHz	dB		3.5							
G_A	Associated Gain at Optimum Noise Figure at V_{DS} = 3 V, I_{DS} = 10 mA,										
	f = 4 GHz	dB		13.0		11.5	13.0				
	f = 8 GHz	dB		11.0			11.0				
	f = 12 GHz	dB	8.0	9.0		8.0	9.0		8.0	9.0	
	f = 18 GHz	dB		7.0							
	f = 26 GHz	dB		5.5							
P_{1dB}	Output Power at 1 dB Compression Point at V_{DS} = 3 V, I_{DS} = 30 mA,										
	f = 4 GHz	dBm					14.5				
	f = 12 GHz	dBm		14.5			14.5			14.5	

Notes:

1. Electronic Industrial Association of Japan.
2. Gain Calculations:

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

3. 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.

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE OUTLINE			NE71000 CHIP			NE71083 2SK406 83			NE71084 2SK609 84		
SYMBOLS	**PARAMETERS AND CONDITIONS**	**UNITS**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**
I_{DSS}	Saturated Drain Current at V_{DS} = 3 V, V_{GS} = 0	mA	20	40	120	20	40	120	20	40	120
V_P	Pinch-off Voltage at V_{DS} = 3 V, I_{DS} = 0.1 mA	V	-0.5	-1.1	-3.5	-0.5	-1.1	-3.5	-0.5	-1.1	-3.5
g_m	Transconductance at V_{DS} = 3 V, I_{DS} = 10 mA	mS	20	50	100	20	50	100	20	50	100
I_{GS}	Gate to Source Leakage Current at V_{GS} = -5 V	µA		1	10		1	10		1	10
$R_{TH\,(CH-C)}$	Thermal Resistance (Channel to Case)	°C/W			190[2]			450			450

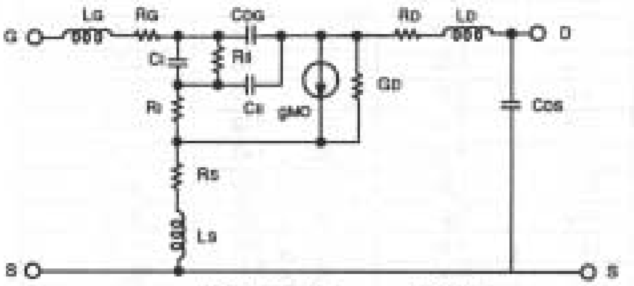
Notes:
1. Electronic Industrial Association of Japan.
2. R_{TH} for chip mounted on an infinite heat sink.

ABSOLUTE MAXIMUM RATINGS[1] (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{DS}	Drain to Source Voltage	V	5
V_{GSO}	Gate to Source Voltage	V	-6
I_{DS}	Drain Current	mA	120
P_{IN}	RF Input Power	mW	40
T_{CH}	Channel Temperature	°C	175
T_{STG}	Storage Temperature	°C	-65 to +175
P_T	Total Power Dissipation NE71000 NE71083 NE71084	 mW mW mW	 400[2] 270 270

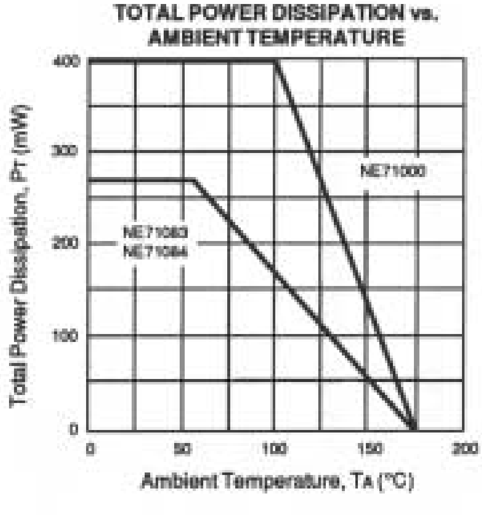
Note:
1. Operation in excess of any one of these parameters may result in permanent damage.
2. For chip mounted on a copper heat sink.

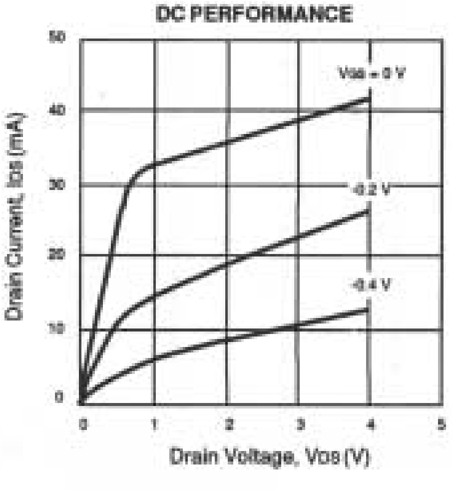
EQUIVALENT CIRCUIT



Components	Value
L_G	0.005 nH
R_G	2.00 Ω
C_I	0.28 pF
R_I	1.6 Ω
C_F	0.064 pF
R_F	1 M Ω
R_S	1.5 Ω
L_S	0.001 nH
C_{DG}	0.0033 pF
R_D	1.5 Ω
L_D	0.005 nH
C_{DS}	0.03 pF
g_{MO}	480 mS
G_D	1.5 mS

TYPICAL PERFORMANCE CURVES (T_A = 25 °C)





TYPICAL NOISE PARAMETERS

NE71000

FREQ. (GHz)	NF_{MIN} (dB)	Γ_{OPT} MAG	Γ_{OPT} ANG	Rn/50 Ω
V_{DS} = 3 V, I_{DS} = 10 mA				
1.0	0.50	.90	∠ 12	0.57
2.0	0.55	.85	∠ 21	0.51
4.0	0.60	.75	∠ 40	0.44
6.0	0.80	.69	∠ 55	0.38
8.0	1.00	.62	∠ 70	0.33
10.0	1.30	.56	∠ 85	0.28
12.0	1.60	.52	∠ 99	0.24
14.0	1.90	.49	∠ 114	0.20
16.0	2.20	.47	∠ 127	0.18
18.0	2.50	.45	∠ 140	0.16

NE71083

FREQ. (GHz)	NF_{MIN} (dB)	Γ_{OPT} MAG	Γ_{OPT} ANG	Rn/50 Ω
V_{DS} = 3 V, I_{DS} = 10 mA				
1.0	0.45	.90	∠ 17	0.65
2.0	0.55	.84	∠ 40	0.57
4.0	0.60	.72	∠ 79	0.48
6.0	0.80	.62	∠ 112	0.39
8.0	1.00	.56	∠ 143	0.33
10.0	1.35	.50	∠ 168	0.28
12.0	1.60	.46	∠ -165	0.24
14.0	1.90	.43	∠ -140	0.20
16.0	2.10	.40	∠ -112	0.18
18.0	2.70	.40	∠ -84	0.16

TYPICAL NOISE PARAMETERS

NE71084

FREQ. (GHz)	NF_{MIN} (dB)	Γ_{OPT} MAG	Γ_{OPT} ANG	Rn/50 Ω
V_{DS} = 3 V, I_{DS} = 10 mA				
1.0	0.50	.90	∠ 17	0.50
2.0	0.55	.85	∠ 37	0.47
4.0	0.60	.71	∠ 85	0.43
6.0	0.80	.61	∠ 127	0.35
8.0	1.00	.54	∠ 165	0.30
10.0	1.30	.52	∠ -158	0.25
12.0	1.60	.51	∠ -124	0.20