

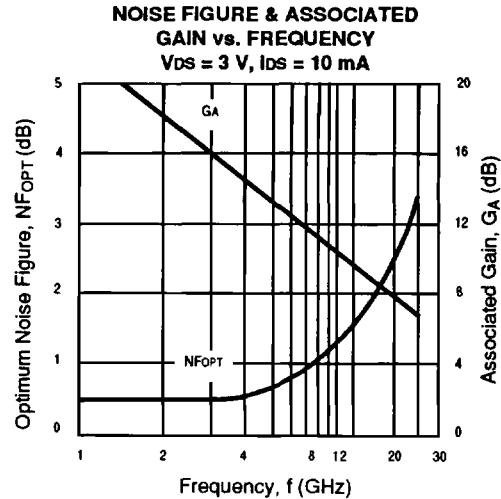
FEATURES

- VERY HIGH f_{MAX} : 90 GHz
- LOW NOISE FIGURE
- HIGH ASSOCIATED GAIN
- $L_G = 0.3 \mu m$, $W_G = 280 \mu m$
- 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 SiO₂ and SiN₄ 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.



ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ C$)

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
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				
NFOPT	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			2.1				
	$f = 26 GHz$	dB		3.5			3.5				
GA	Associated Gain 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			7.0				
	$f = 26 GHz$	dB		5.5			5.5				
P _{1dB}	Output Power at 1 dB Compression Point at $V_{DS} = 3 V$, $I_{DS} = 10 mA$, $f = 4 GHz$	dBm					14.5				
	$f = 12 GHz$	dBm		14.5			14.5			14.5	

Notes:

1. Electronic Industrial Association of Japan.

2. Gain Calculations:

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

ELECTRICAL CHARACTERISTICS (TA = 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
IDS	Saturated Drain Current at VDS = 3 V, VGS = 0	mA	20	40	120	20	40	120	20	40	120
VP	Pinch-off Voltage at VDS = 3 V, IDS = 0.1 mA	V	-0.5	-1.1	-3.5	-0.5	-1.1	-3.5	-0.5	-1.1	-3.5
gm	Transconductance at VDS = 3 V, IDS = 10 mA	mS	20	50	100	20	50	100	20	50	100
IGS	Gate to Source Leakage Current at VGS = -5 V	μA		1	10		1	10		1	10
RTH (CH-C)	Thermal Resistance (Channel to Case)	°C/W			190 ²			450			450

Notes:

- 1 Electronic Industrial Association of Japan.
- 2 RTH for chip mounted on an infinite heat sink.



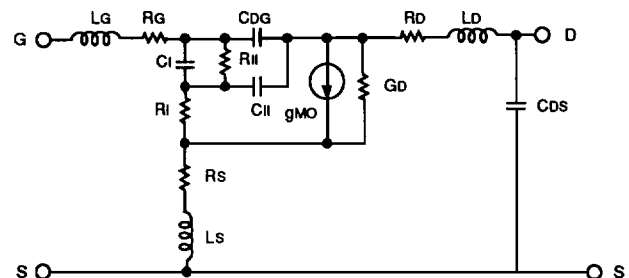
ABSOLUTE MAXIMUM RATINGS¹ (TA = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
VDS	Drain to Source Voltage	V	5
VGS0	Gate to Source Voltage	V	-6
IDS	Drain Current	mA	120
PIN	RF Input Power	mW	40
TCH	Channel Temperature	°C	175
TSTG	Storage Temperature	°C	-65 to +175
PT	Total Power Dissipation	mW	400 ²
	NE71000	mW	270
	NE71083	mW	270
	NE71084	mW	270

Note:

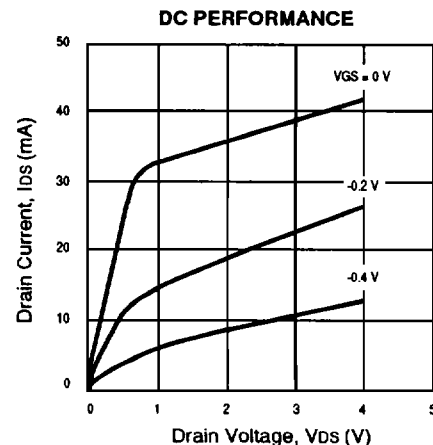
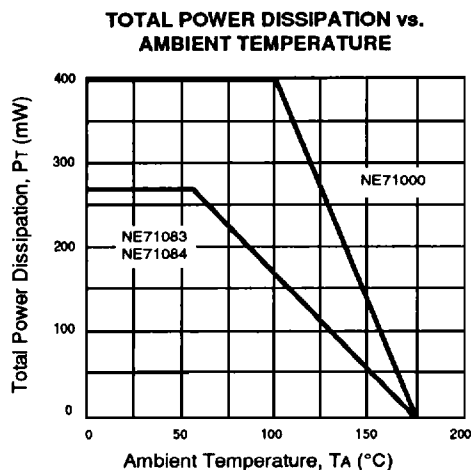
1. Operation in excess of any one of these parameters may result in permanent damage.

EQUIVALENT CIRCUIT



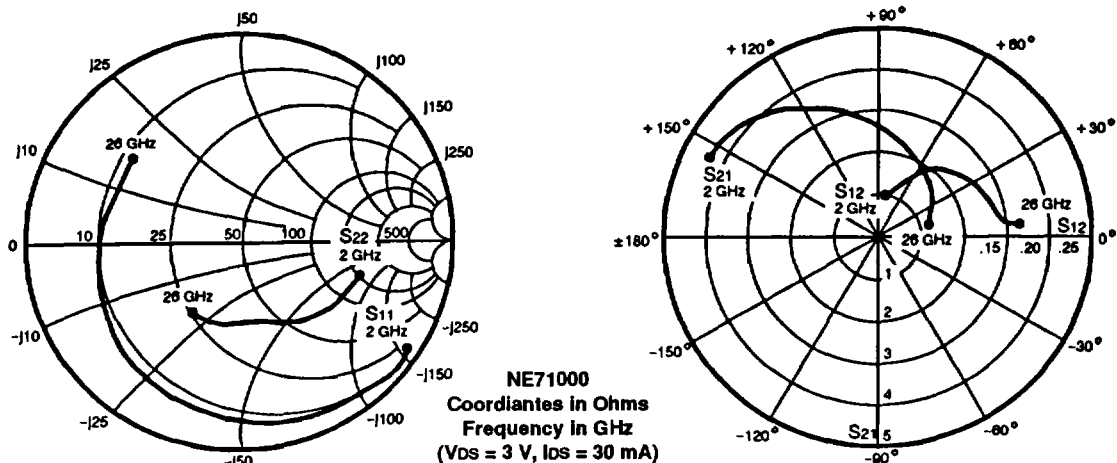
Components	Value
LG	0.005 nH
RG	2.00 Ω
CI	0.28 pF
RI	1.6 Ω
CII	0.064 pF
RII	1 MΩ
RS	1.5 Ω
LS	0.001 nH
CDG	0.0033 pF
RD	1.5 Ω
LD	0.005 nH
CDS	0.03 pF
gMO	480 mS
GD	1.5 mS

TYPICAL PERFORMANCE CURVES (TA = 25 °C)



NE710 SERIES

TYPICAL COMMON SOURCE SCATTERING PARAMETERS



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

FREQUENCY (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2.0	.98	-29	3.23	157	.06	72	.65	-16
3.0	.94	-43	3.14	145	.08	65	.64	-24
4.0	.92	-57	3.00	135	.10	56	.60	-32
5.0	.90	-70	2.84	125	.12	49	.59	-38
6.0	.89	-80	2.67	117	.14	43	.58	-44
7.0	.87	-91	2.53	108	.15	36	.57	-50
8.0	.84	-100	2.39	99	.16	30	.54	-55
9.0	.83	-107	2.23	92	.16	26	.54	-58
10.0	.82	-116	2.12	86	.17	23	.53	-64
11.0	.78	-124	2.01	78	.17	18	.50	-67
12.0	.77	-130	1.92	72	.17	17	.50	-70
13.0	.74	-138	1.82	65	.18	13	.48	-74
14.0	.73	-146	1.73	59	.18	10	.47	-78
15.0	.71	-154	1.68	54	.19	6	.48	-83
16.0	.69	-161	1.60	47	.19	4	.47	-90
17.0	.67	-167	1.51	43	.19	-1	.47	-96
18.0	.67	-172	1.47	39	.19	-3	.47	-99
19.0	.66	-176	1.41	35	.18	-6	.46	-103
20.0	.66	180	1.37	31	.18	-8	.47	-104
21.0	.66	176	1.32	26	.17	-7	.47	-106
22.0	.65	171	1.27	22	.17	-8	.48	-107
23.0	.64	167	1.21	19	.17	-7	.47	-109
24.0	.63	162	1.19	15	.18	-7	.47	-112
25.0	.63	155	1.14	11	.18	-7	.47	-115
26.0	.64	148	1.10	6	.19	-9	.46	-123

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

2.0	.97	-34	4.35	155	.05	70	.58	-18
3.0	.92	-50	4.14	142	.07	63	.56	-26
4.0	.90	-65	3.88	131	.09	55	.53	-35
5.0	.87	-79	3.61	121	.10	48	.51	-40
6.0	.87	-90	3.36	114	.12	42	.50	-47
7.0	.85	-101	3.14	105	.12	34	.49	-53
8.0	.81	-110	2.93	97	.12	30	.46	-57
9.0	.80	-118	2.71	89	.13	27	.46	-59
10.0	.80	-126	2.55	84	.13	24	.46	-65
11.0	.76	-134	2.40	77	.13	21	.43	-67
12.0	.74	-140	2.28	70	.13	20	.43	-70
13.0	.73	-148	2.14	64	.14	17	.41	-74
14.0	.71	-156	2.02	59	.14	16	.40	-78
15.0	.70	-163	1.94	54	.14	14	.42	-83
16.0	.69	-170	1.86	48	.15	12	.41	-90
17.0	.67	-176	1.74	44	.15	9	.41	-96
18.0	.66	-180	1.69	40	.15	6	.41	-99
19.0	.66	176	1.62	37	.15	5	.41	-103
20.0	.66	172	1.58	33	.15	5	.42	-104
21.0	.66	168	1.52	29	.14	5	.42	-106
22.0	.65	164	1.47	25	.15	5	.43	-106
23.0	.64	159	1.38	21	.14	7	.42	-109
24.0	.63	155	1.37	18	.16	8	.42	-111
25.0	.63	149	1.30	13	.16	8	.41	-114
26.0	.65	142	1.25	8	.17	4	.42	-122

Note: S-parameters include bond wires.

Gate: Total 2 wire (s), 1 per bond pad, 0.015" long each wire.

Drain: Total 2 wire (s), 1 per bond pad, 0.011" long each wire.1-58

Source: Total 4 wire (s), 2 per side, 0.008" long each wire.

Wire: 0.0008" Diameter, Gold.

TYPICAL NOISE PARAMETERS

NE71000 $V_{DS} = 3\text{ V}$, $I_{DS} = 10\text{ mA}$

FREQUENCY (GHz)	MIN NF (dB)	Γ_{OPT}	$R_n/50\Omega$
1.0	0.50	.90 \angle 12	0.57
2.0	0.55	.85 \angle 21	0.51
4.0	0.60	.75 \angle 40	0.44
6.0	0.80	.69 \angle 55	0.38
8.0	1.00	.62 \angle 70	0.33
10.0	1.30	.56 \angle 85	0.28
12.0	1.60	.52 \angle 99	0.24
14.0	1.90	.49 \angle 114	0.20
16.0	2.20	.47 \angle 127	0.18
18.0	2.50	.45 \angle 140	0.16

NE71083 $V_{DS} = 3\text{ V}$, $I_{DS} = 10\text{ mA}$

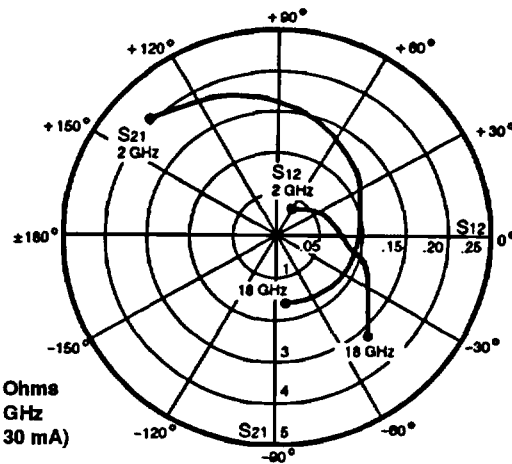
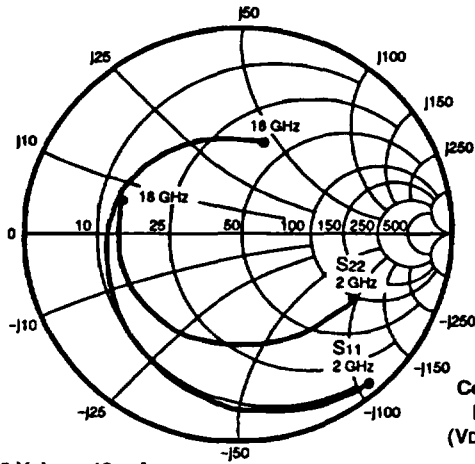
FREQUENCY (GHz)	MIN NF (dB)	Γ_{OPT}	$R_n/50\Omega$
1.0	0.45	.90 \angle 17	0.65
2.0	0.55	.84 \angle 40	0.57
4.0	0.60	.72 \angle 79	0.48
6.0	0.80	.62 \angle 112	0.39
8.0	1.00	.56 \angle 143	0.33
10.0	1.35	.50 \angle 168	0.28
12.0	1.60	.46 \angle -165	0.24
14.0	1.90	.43 \angle -140	0.20
16.0	2.10	.40 \angle -112	0.18
18.0	2.70	.40 \angle -84	0.16

NE71084 $V_{DS} = 3\text{ V}$, $I_{DS} = 10\text{ mA}$

FREQUENCY (GHz)	MIN NF (dB)	Γ_{OPT}	$R_n/50\Omega$
1.0	0.50	.90 \angle 17	0.50
2.0	0.55	.85 \angle 37	0.47
4.0	0.60	.71 \angle 85	0.43
6.0	0.80	.61 \angle 127	0.35
8.0	1.00	.54 \angle 165	0.30
10.0	1.30	.52 \angle -158	0.25
12.0	1.60	.51 \angle -124	0.20

NE710 SERIES

TYPICAL COMMON SOURCE SCATTERING PARAMETERS



NE71083
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 3 V, I_{DS} = 30 mA)

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

FREQUENCY (GHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2.0	.96	-45	3.20	138	.05	59	.68	-31
3.0	.92	-64	2.95	121	.06	46	.66	-45
4.0	.88	-84	2.77	101	.07	33	.64	-59
5.0	.82	-102	2.56	86	.08	21	.61	-72
6.0	.79	-118	2.37	69	.09	11	.60	-84
7.0	.75	-134	2.20	54	.09	2	.60	-96
8.0	.73	-148	2.04	41	.09	-3	.60	-106
9.0	.71	-160	1.92	27	.09	-10	.60	-116
10.0	.68	-173	1.78	17	.09	-12	.60	-126
11.0	.67	176	1.70	5	.09	-17	.61	-134
12.0	.64	163	1.65	-9	.09	-22	.61	-143
13.0	.61	152	1.56	-20	.09	-24	.61	-152
14.0	.59	140	1.51	-31	.10	-27	.61	-160
15.0	.57	128	1.47	-45	.10	-33	.61	-169
16.0	.54	114	1.47	-54	.11	-35	.61	-178
17.0	.52	99	1.45	-69	.12	-45	.60	172
18.0	.50	85	1.41	-81	.14	-52	.59	160

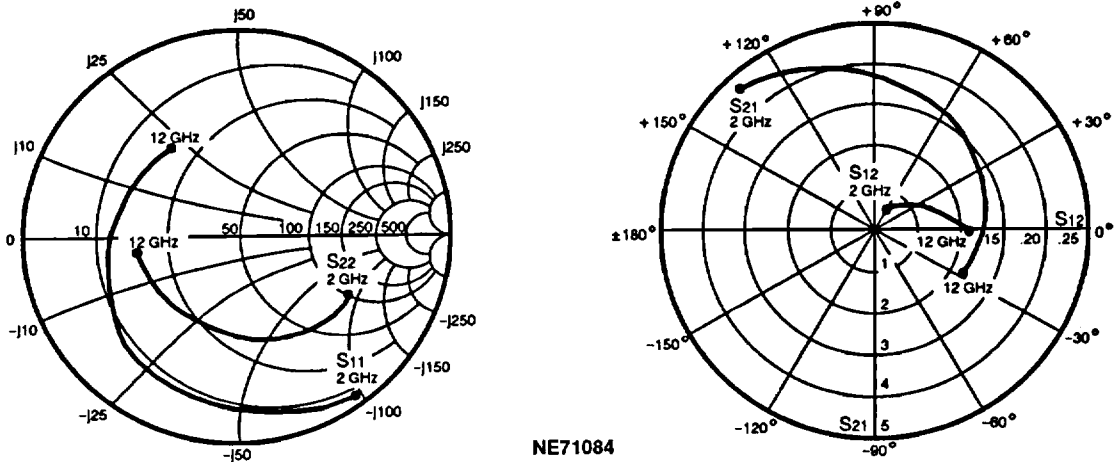
V_{DS} = 3 V, I_{DS} = 20 mA

2.0	.95	-48	3.88	136	.04	59	.63	-32
3.0	.90	-68	3.52	119	.05	47	.61	-45
4.0	.85	-88	3.29	99	.07	35	.59	-59
5.0	.79	-106	2.98	84	.07	24	.56	-72
6.0	.76	-123	2.74	67	.08	16	.55	-84
7.0	.72	-138	2.53	52	.08	8	.55	-97
8.0	.70	-151	2.33	40	.08	4	.55	-107
9.0	.67	-164	2.17	26	.08	-2	.56	-117
10.0	.65	-176	2.01	16	.08	-3	.56	-128
11.0	.63	173	1.92	4	.08	-7	.57	-136
12.0	.60	160	1.84	-10	.09	-12	.57	-146
13.0	.57	149	1.75	-21	.09	-15	.58	-155
14.0	.55	137	1.69	-31	.10	-20	.58	-164
15.0	.53	125	1.63	-45	.11	-26	.59	-173
16.0	.50	111	1.64	-55	.12	-31	.59	178
17.0	.48	96	1.60	-69	.14	-42	.59	167
18.0	.47	82	1.58	-82	.15	-50	.59	155

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

2.0	.95	-49	4.18	136	.04	59	.62	-31
3.0	.89	-70	3.78	118	.05	47	.60	-45
4.0	.84	-91	3.49	98	.06	35	.58	-58
5.0	.78	-109	3.15	83	.07	26	.55	-71
6.0	.74	-126	2.91	66	.07	17	.55	-82
7.0	.71	-141	2.66	51	.07	11	.55	-94
8.0	.68	-155	2.45	39	.08	6	.55	-104
9.0	.66	-168	2.27	25	.08	2	.56	-114
10.0	.63	-180	2.10	15	.08	1	.56	-123
11.0	.62	169	2.00	3	.08	-3	.57	-131
12.0	.59	156	1.93	-11	.09	-8	.57	-140
13.0	.56	145	1.82	-22	.09	-10	.58	-149
14.0	.54	133	1.75	-33	.10	-16	.58	-157
15.0	.52	121	1.69	-47	.11	-22	.59	-165
16.0	.49	107	1.67	-56	.12	-27	.59	-174
17.0	.47	92	1.64	-70	.14	-38	.58	176
18.0	.46	78	1.61	-82	.15	-45	.58	164

TYPICAL COMMON SOURCE SCATTERING PARAMETERS



NE71084
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 3 V, I_{DS} = 30 mA)



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

FREQUENCY (GHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
2.0	.94	-49	3.48	136	.04	59	.65	-31
3.0	.94	-70	3.36	118	.06	45	.64	-45
4.0	.86	-92	2.99	97	.07	33	.61	-61
5.0	.81	-108	2.71	82	.07	25	.57	-73
6.0	.79	-126	2.56	64	.08	15	.57	-86
7.0	.71	-142	2.40	48	.08	7	.53	-100
8.0	.66	-155	2.28	36	.08	4	.51	-110
9.0	.61	-171	2.19	23	.09	2	.49	-123
10.0	.59	-172	2.17	8	.09	-3	.48	-139
11.0	.57	-154	2.08	-9	.10	-11	.49	-157
12.0	.55	-137	1.94	-23	.10	-11	.51	-173

V_{DS} = 3 V, I_{DS} = 20 mA

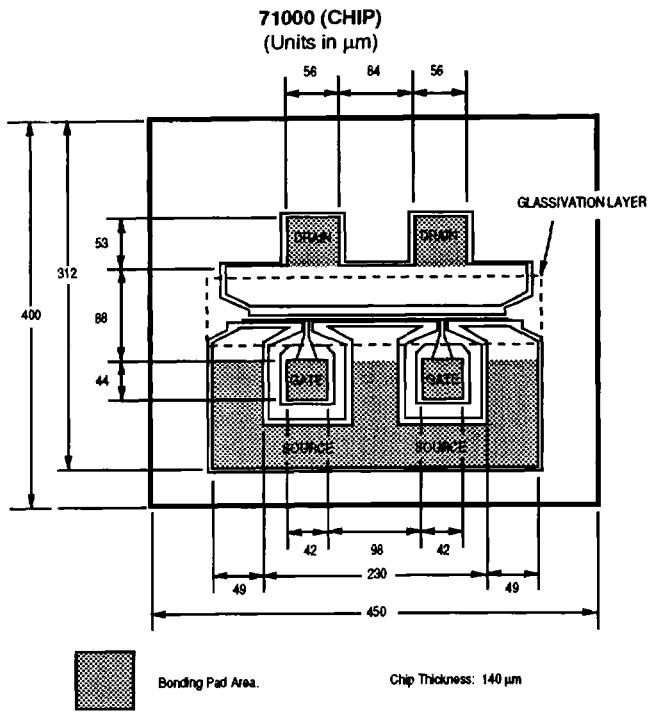
2.0	.93	-52	4.29	134	.04	60	.60	-31
3.0	.92	-75	4.03	115	.05	47	.59	-45
4.0	.83	-97	3.51	94	.06	35	.55	-60
5.0	.78	-113	3.16	79	.06	29	.52	-73
6.0	.75	-131	2.94	62	.07	21	.52	-85
7.0	.67	-147	2.74	47	.07	16	.49	-98
8.0	.62	-161	2.58	34	.08	14	.47	-108
9.0	.57	-176	2.47	21	.08	12	.44	-119
10.0	.56	-166	2.41	6	.09	8	.44	-135
11.0	.54	-148	2.30	-11	.10	-1	.46	-154
12.0	.52	-130	2.10	-24	.11	-3	.47	-169

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

2.0	.92	-54	4.67	133	.03	60	.59	-31
3.0	.90	-77	4.40	114	.05	47	.57	-45
4.0	.81	-100	3.83	93	.05	37	.54	-60
5.0	.75	-116	3.43	77	.06	31	.51	-72
6.0	.72	-134	3.19	60	.06	24	.51	-84
7.0	.65	-150	2.93	44	.07	19	.48	-96
8.0	.60	-164	2.75	32	.07	18	.46	-105
9.0	.55	-180	2.60	19	.08	16	.45	-118
10.0	.54	-163	2.52	4	.09	11	.44	-134
11.0	.53	-145	2.38	-12	.10	1	.46	-153
12.0	.50	-127	2.25	-26	.10	-1	.46	-168

NE710 SERIES

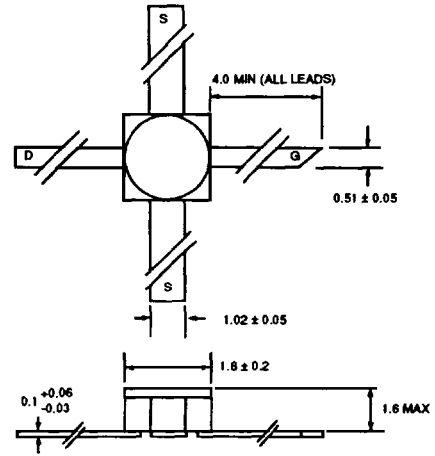
OUTLINE DIMENSIONS (Units in mm)



Note: All dimensions are typical unless otherwise specified.

PACKAGE OUTLINE 83

(Units in mm)



ORDERING INFORMATION

PART NUMBER	IDSS SELECTION
NE71000	Standard ($I_{\text{DSS}} = 20 - 120$)
NE71000L	$I_{\text{DSS}} = 80$ to 120 mA
NE71000M	$I_{\text{DSS}} = 50$ to 80 mA
NE71000N	$I_{\text{DSS}} = 20$ to 50 mA

PACKAGE OUTLINE 84-SL

(Units in mm)

