

FEATURES

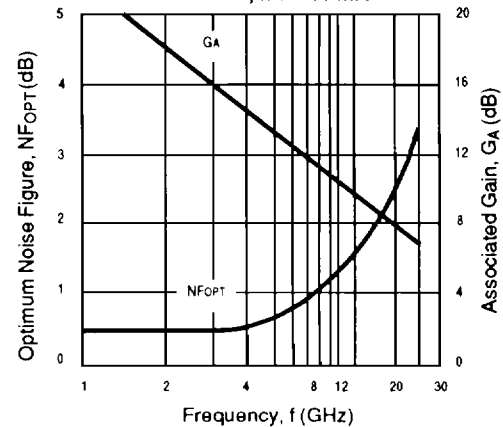
- **VERY HIGH f_{max} :** 90 GHz
- **LOW NOISE FIGURE**
- **HIGH ASSOCIATED GAIN**
- **LG = 0.3 μ m, WG = 280 μ m**
- **N+ CONTACT LAYER** (Triple Epitaxial Technology)
- **PROVEN RELIABILITY AND STABILITY**

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 Si₃N₄ 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 EIAJ ¹ REGISTERED NUMBER PACKAGE OUTLINE			NE71000			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 f = 8 GHz f = 12 GHz f = 18 GHz	dB dB dB dB		17.0 15.0 12.0 8.5			17.0 15.0 12.0 8.5			10.0	
NF _{OPT}	Optimum Noise Figure ³ at V _{DS} = 3 V, I _{DS} = 10 mA, f = 4 GHz f = 8 GHz f = 12 GHz f = 18 GHz f = 26 GHz	dB dB dB dB dB		0.6 1.0 1.5 2.1 3.5	1.8		0.6 1.0 1.5 1.8	0.7		1.6	1.8
GA	Associated Gain at Optimum Noise Figure at V _{DS} = 3 V, I _{DS} = 10 mA, f = 4 GHz f = 8 GHz f = 12 GHz f = 18 GHz f = 26 GHz	dB dB dB dB dB	8.0	13.0 11.0 9.0 7.0 5.5		11.5 8.0	13.0 11.0 9.0		8.0	9.0	
P _{1dB}	Output Power at 1 dB Compression Point at V _{DS} = 3 V, I _{DS} = 30 mA, f = 4 GHz f = 12 GHz	dBm dBm		14.5			14.5 14.5			14.5	

Notes:

1. Electronic Industrial Association of Japan.

2. Gain Calculations:

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

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 ($T_A = 25^\circ\text{C}$)

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_{DS}	Saturated Drain Current at $V_{DS} = 3\text{ V}$, $V_{GS} = 0$	mA	20	40	120	20	40	120	20	40	120
V_P	Pinch-off Voltage at $V_{DS} = 3\text{ V}$, $I_{DS} = 0.1\text{ mA}$	V	-0.5	-1.1	-3.5	-0.5	-1.1	-3.5	-0.5	-1.1	-3.5
g_m	Transconductance at $V_{DS} = 3\text{ V}$, $I_{DS} = 10\text{ mA}$	mS	20	50	100	20	50	100	20	50	100
I_{GS}	Gate to Source Leakage Current at $V_{GS} = -5\text{ V}$	μA		1	10		1	10		1	10
$R_{TH}(CH-C)$	Thermal Resistance (Channel to Case)	$^\circ\text{C/W}$			190 ²			450			450

Notes:

- Electronic Industrial Association of Japan.
- R_{TH} for chip mounted on an infinite heat sink.

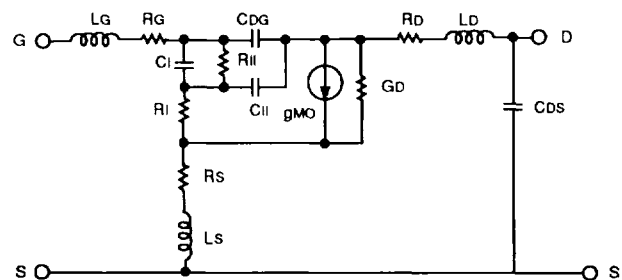
ABSOLUTE MAXIMUM RATINGS¹ ($T_A = 25^\circ\text{C}$)

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	$^\circ\text{C}$	175
T_{STG}	Storage Temperature	$^\circ\text{C}$	-65 to +175
P_T	Total Power Dissipation		
	NE71000	mW	400 ²
	NE71083	mW	270
	NE71084	mW	270

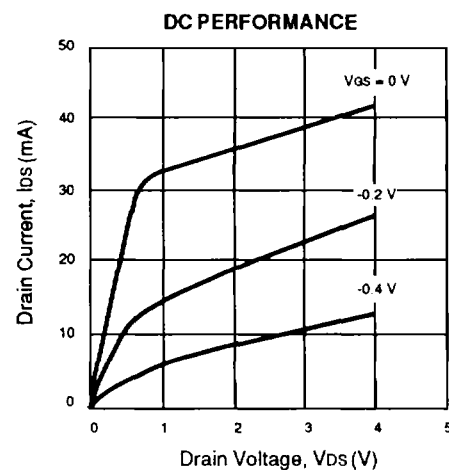
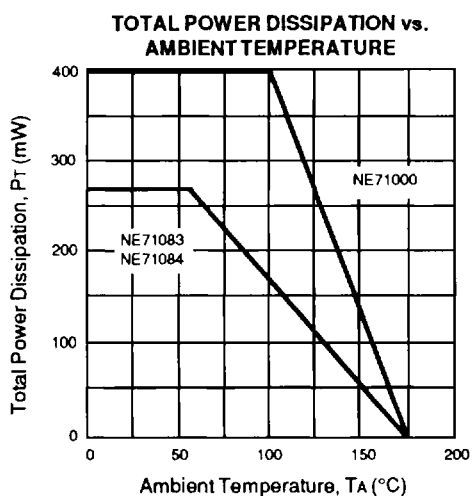
Note:

- Operation in excess of any one of these parameters may result in permanent damage.
- 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_{II}	0.064 pF
R_{II}	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_O	1.5 mS

TYPICAL PERFORMANCE CURVES ($T_A = 25^\circ\text{C}$)

NE710 SERIES

TYPICAL NOISE PARAMETERS NE71000

FREQ. (GHz)	NF _{MIN} (dB)	Γ _{OPT}		R _n /50 Ω
		MAG	ANG	
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

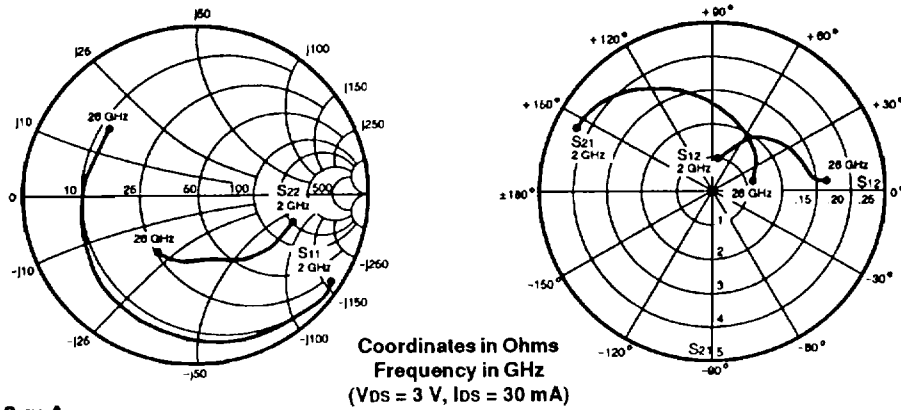
NE71083

FREQ. (GHz)	NF _{MIN} (dB)	Γ _{OPT}		R _n /50 Ω
		MAG	ANG	
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}		R _n /50 Ω
		MAG	ANG	
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

TYPICAL COMMON SOURCE SCATTERING PARAMETERS



1

NE710000

V_{DS} = 3 V, I_{DS} = 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_{DS} 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.

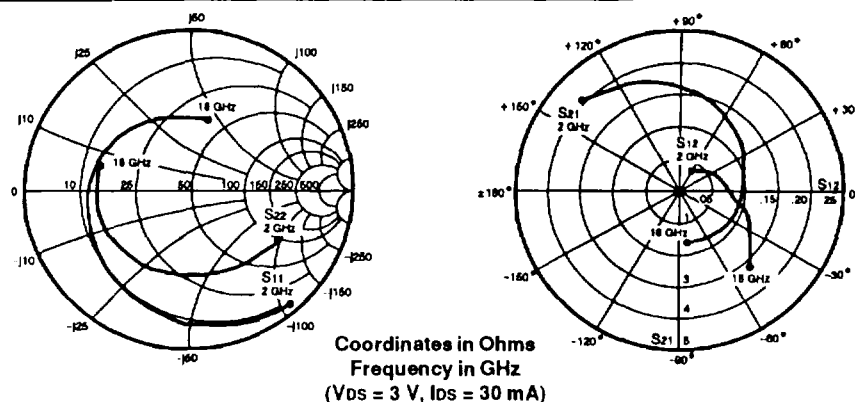
Drain: Total 2 wire (s), 1 per bond pad, 0.011" long each wire.

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

Wire: 0.0008" Diameter, Gold.

NE710 SERIES

TYPICAL COMMON SOURCE SCATTERING PARAMETERS



NE71083

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

FREQUENCY (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	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

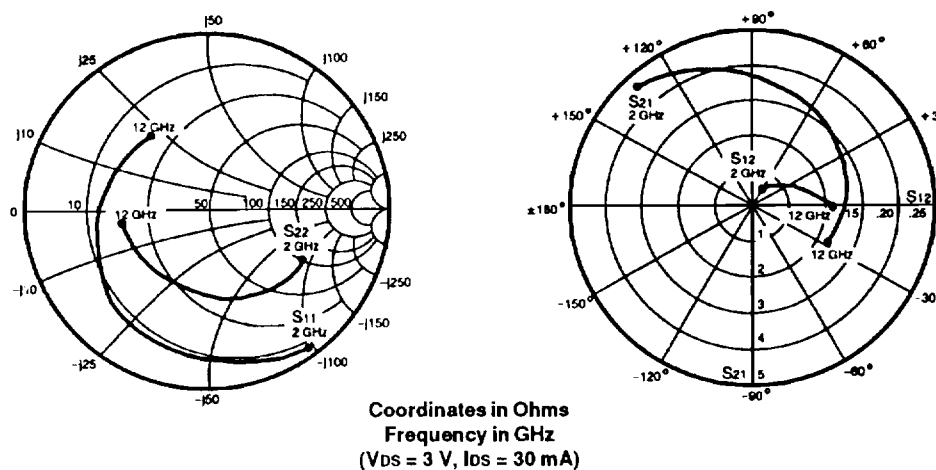
V_{DS} = 3 V, I_{DS} = 20 mA

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



1

NE71084

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

FREQUENCY (GHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	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

 $V_{DS} = 3\text{ V}$, $I_{DS} = 20\text{ mA}$

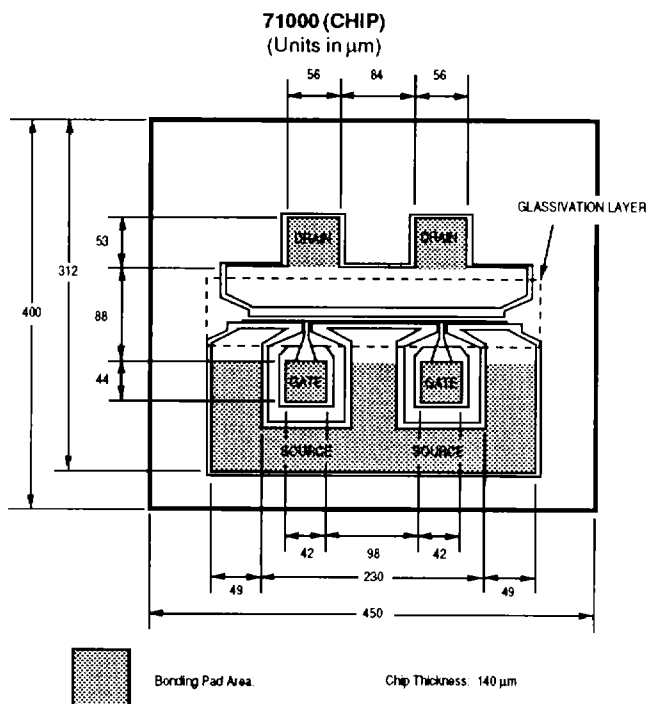
2.0	.93	-52	4.29	134	.04	60	.60	-31
3.0	.92	-75	4.03	115	.05	47	.59	-45
4.0	.83	-97	3.51	94	.06	35	.55	-60
5.0	.78	-113	3.16	79	.06	29	.52	-73
6.0	.75	-131	2.94	62	.07	21	.52	-85
7.0	.67	-147	2.74	47	.07	16	.49	-98
8.0	.62	-161	2.58	34	.08	14	.47	-108
9.0	.57	-176	2.47	21	.08	12	.44	-119
10.0	.56	166	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

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

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

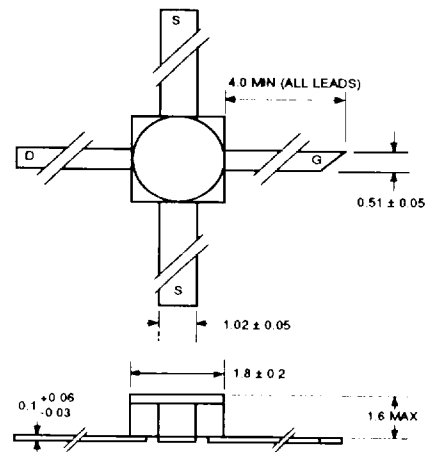
NE710 SERIES

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 ($I_{DSS} = 20 - 120$)
NE71000L	$I_{DSS} = 80$ to 120 mA
NE71000M	$I_{DSS} = 50$ to 80 mA
NE71000N	$I_{DSS} = 20$ to 50 mA

PACKAGE OUTLINE 84-SL (Units in mm)

