

NEC[®]**LOW NOISE
Ku-K BAND GaAs MESFET****NE710
SERIES**

T-31-25

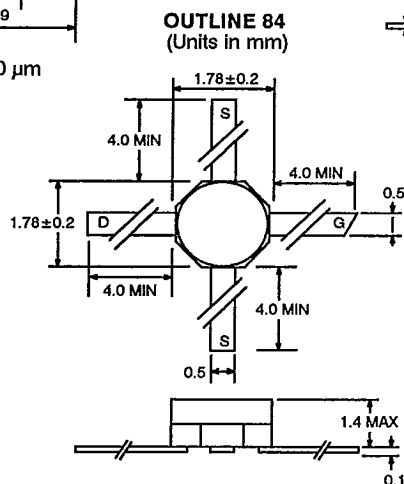
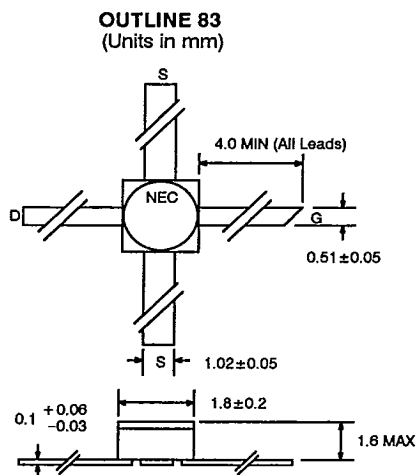
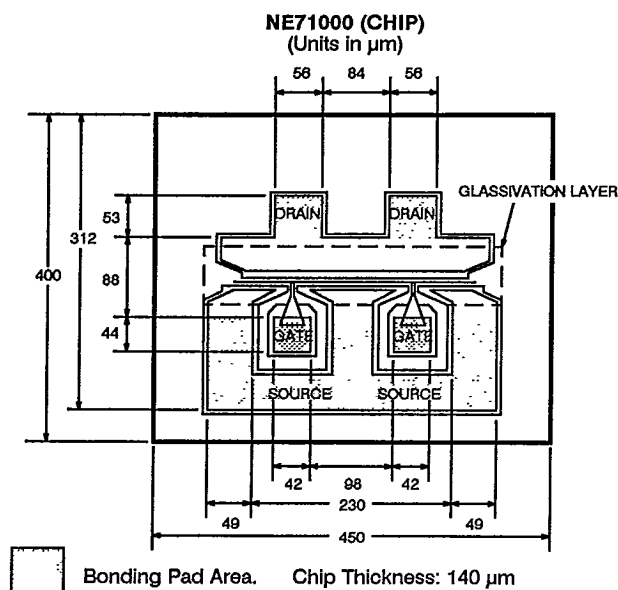
FEATURES

- VERY HIGH f_{MAX} : 90 GHz
- LOW NOISE FIGURE
- HIGH ASSOCIATED GAIN
- 0.3 MICRON RECESSED GATE
- N+ CONTACT LAYER (Triple Epitaxial Technology)
- PROVEN RELIABILITY AND STABILITY

DESCRIPTION AND APPLICATIONS

The NE710 series features a low noise figure and high associated gain thru 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 SiN_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.

OUTLINE DIMENSIONS

NE710 SERIES

N E C/ CALIFORNIA

56E D ■ 6427414 0002284 093 ■ NECC

PERFORMANCE SPECIFICATIONS (TA = 25°C)

PART NUMBER EIAJ* REGISTERED NUMBER PACKAGE OUTLINE			NE71000 CHIP			NE71083 2SK406 83			NE71084 2SK609 84		
SYMBOLS	PARAMETERS & CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
f _{MAX}	Maximum Frequency of Oscillation at V _{DS} = 3 V, I _{DS} = 30 mA	GHz		90			90			90	
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	
N _{F_{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	0.7 1.8		1.6 1.8	
GA	Associated Gain 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 0.8	13.0 11.0 9.0		8.0	9.0	
P _{1dB}	Output Power at 1dB Compression Point at V _{DS} = 3 V, I _{DS} = 10 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: $MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1})$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}||S_{21}|}$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

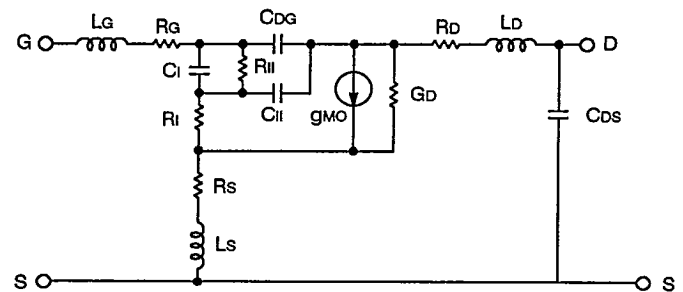
3. Typical values of noise figures are those obtained when 50% of the devices from a large number of lots were individually measured in a circuit with the input individually tuned to obtain the minimum value. Maximum values are criteria established on the production line as a "go-no-go" screening test with the fixture tuned for the "generic" type but not for each specimen.

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

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}	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}	Thermal Resistance (Channel-to-Case)	$^\circ\text{C/W}$			190 ²			450			450
P_T	Total Power Dissipation	mW			400			270			270

Notes:

- Electronic Industrial Association of Japan.
- R_{TH} for chip mounted on a copper heatsink.

EQUIVALENT CIRCUIT

COMPONENT VALUE

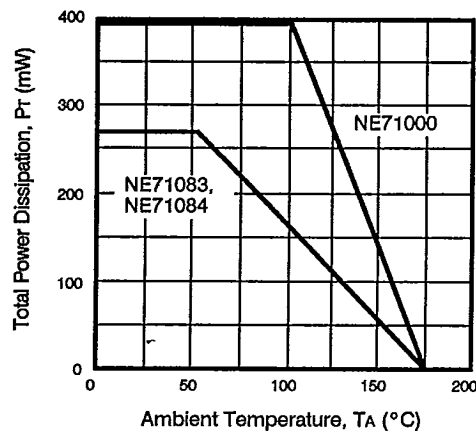
L_g	0.005	nH
R_g	2.00	Ω
C_{dg}	0.28	pF
R_{ii}	1.6	Ω
C_{ii}	0.064	pF
R_{ii}	1 M	Ω
R_s	1.5	Ω
L_s	0.001	nH
C_{dg}	0.033	pF
R_d	1.5	Ω
L_d	0.005	nH
C_{ds}	0.03	pF
g_{mo}	48.0	mS
G_d	1.5	mS

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

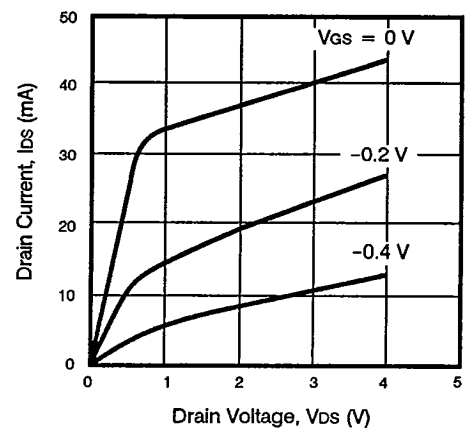
SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{DS}	Drain to Source Voltage	V	5
V_{GS}	Gate to Source Voltage	V	-6
I_{DS}	Drain Current	mA	120
P_{IN}	RF Input Power	mW	40
T_{CH}	Channel Temperature	$^\circ\text{C}$	175
T_{STG}	Storage Temperature	$^\circ\text{C}$	-65 to +175

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

POWER DERATING CURVE



DC PERFORMANCE

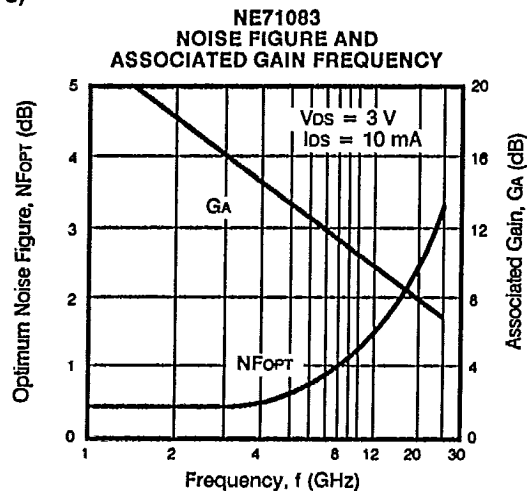
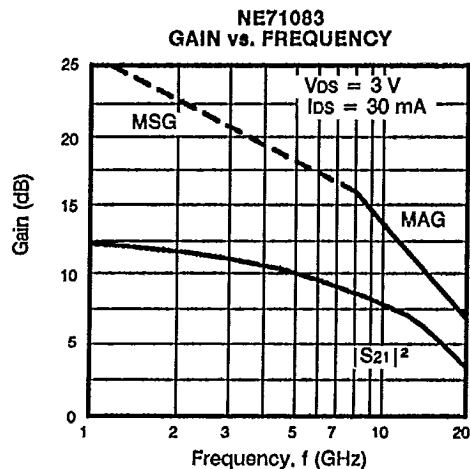


NE710 SERIES

N E C/ CALIFORNIA

56E D ■ 6427414 0002286 966 ■ NECC

TYPICAL PERFORMANCE CHARACTERISTICS (TA = 25°C)



TYPICAL NOISE PARAMETERS

NE71000 VDS = 3 V, IDS = 10 mA

FREQUENCY (GHz)	MIN NF (dB)	Γ_{OPT}	Rn/50 Ω
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

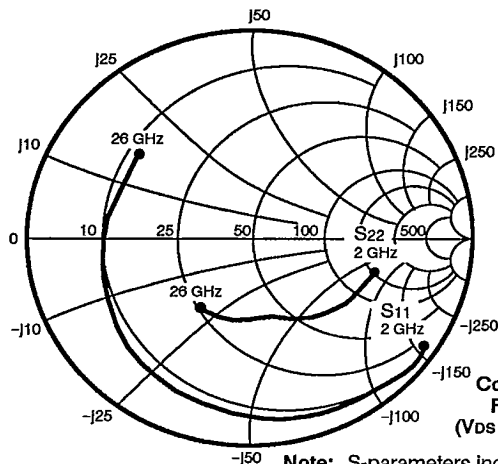
NE71083 VDS = 3 V, IDS = 10 mA

FREQUENCY (GHz)	MIN NF (dB)	Γ_{OPT}	Rn/50 Ω
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 VDS = 3 V, IDS = 10 mA

FREQUENCY (GHz)	MIN NF (dB)	Γ_{OPT}	Rn/50 Ω
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

TYPICAL COMMON SOURCE SCATTERING PARAMETERS



NE71000
Coordinates in Ohms
Frequency in GHz
($V_{DS} = 3\text{ V}$, $I_{DS} = 30\text{ mA}$)

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.

S-MAGN AND ANGLES:

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

FREQUENCY (GHz)

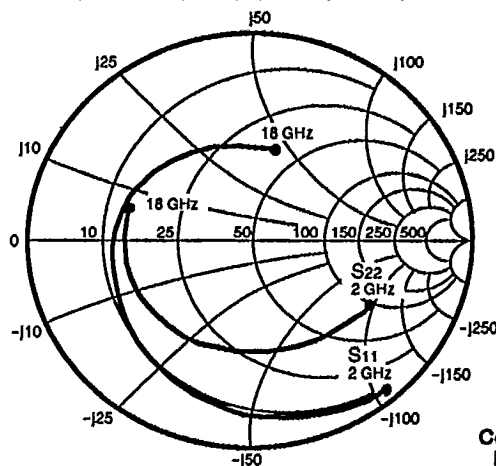
	S11	S21	S12	S22
2.0	.98 -29	3.23 157	.06 72	.65 -16
3.0	.94 -43	3.14 145	.08 65	.64 -24
4.0	.92 -57	3.00 135	.10 56	.60 -32
5.0	.90 -70	2.84 125	.12 49	.59 -38
6.0	.89 -80	2.67 117	.14 43	.58 -44
7.0	.87 -91	2.53 108	.15 36	.57 -50
8.0	.84 -100	2.39 99	.16 30	.54 -55
9.0	.83 -107	2.23 92	.16 26	.54 -58
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

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

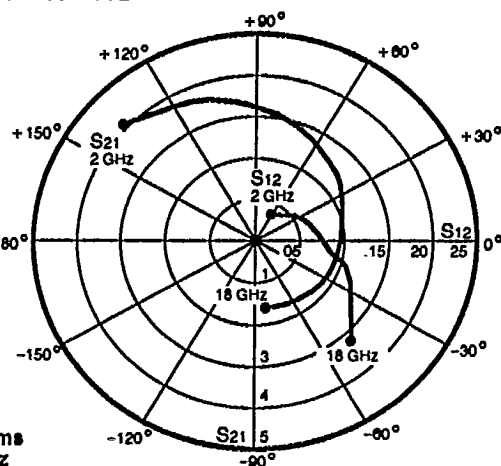
	S11	S21	S12	S22
2.0	.97 -34	4.35 155	.05 70	.58 -18
3.0	.92 -50	4.14 142	.07 63	.56 -26
4.0	.90 -65	3.88 131	.09 55	.53 -35
5.0	.87 -79	3.61 121	.10 48	.51 -40
6.0	.87 -90	3.36 114	.12 42	.50 -47
7.0	.85 -101	3.14 105	.12 34	.49 -53
8.0	.81 -110	2.93 97	.12 30	.46 -57
9.0	.80 -118	2.71 89	.13 27	.46 -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

NE710 SERIES

TYPICAL COMMON SOURCE SCATTERING PARAMETERS



NE71083
Coordinates In Ohms
Frequency In GHz
($V_{DS} = 3\text{ V}$, $I_{DS} = 30\text{ mA}$)

**S-MAGN AND ANGLES:** $V_{DS} = 3\text{ V}$, $I_{DS} = 10\text{ mA}$

FREQUENCY (GHz)

	S11		S21		S12		S22	
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

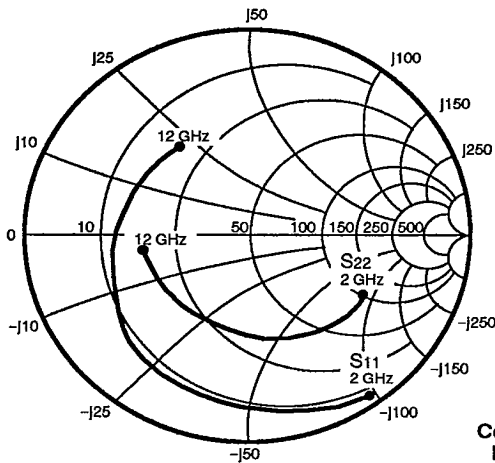
 $V_{DS} = 3\text{ V}$, $I_{DS} = 20\text{ mA}$

	S11		S21		S12		S22	
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

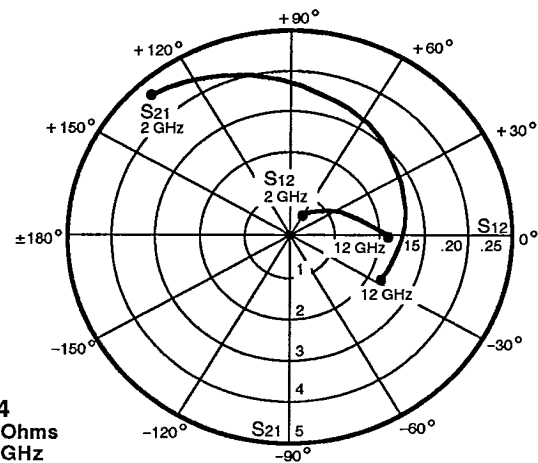
 $V_{DS} = 3\text{ V}$, $I_{DS} = 30\text{ mA}$

	S11		S21		S12		S22	
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
($V_{DS} = 3\text{ V}$, $I_{DS} = 30\text{ mA}$)

**S-MAGN AND ANGLES:** $V_{DS} = 3\text{ V}$, $I_{DS} = 10\text{ mA}$

FREQUENCY (GHz)

	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
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

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

	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
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

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

	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
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