NEC

4W, L-S BAND POWER GaAs MESFET

NE1069L-4B

FEATURES

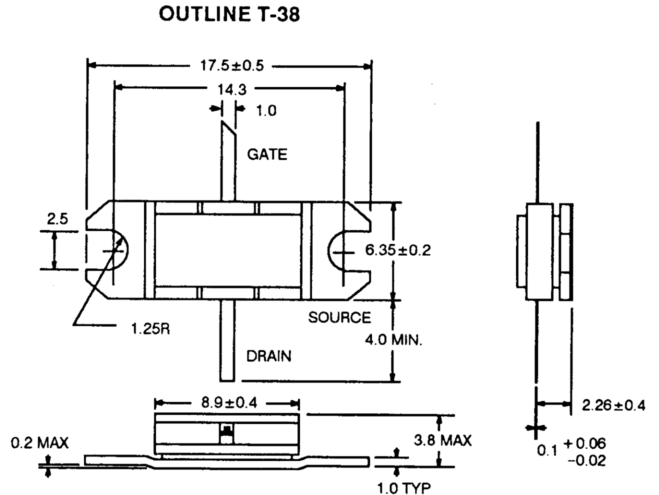
- **CLASS A OPERATION**
- **HIGH POWER OUTPUT**
- **HIGH GAIN**
- **HIGH POWER ADDED EFFICIENCY**
- **HIGH RELIABILITY**
- **AVAILABILITY:** Hermetic Package

DESCRIPTION

The NE1069L-4B is an unmatched N-channel power GaAs MESFET which offers high output power, high gain and high efficiency in L to S-band. The device incorporates Ti-Au metallization and silicon dioxide glassivation. The WSi (Tungsten silicide) gate is incorporated for high reliability. The gate length is 0.8 μm for increased linear gain. To reduce thermal resistance, the devices have a PHS (Plated Heat Sink). NEC's stringent quality assurance and test procedures assure the highest reliability and performance.

OUTLINE DIMENSIONS (Units in mm)

OUTLINE T-38



Flange Material: Copper
Flange Plating: Ni, Au

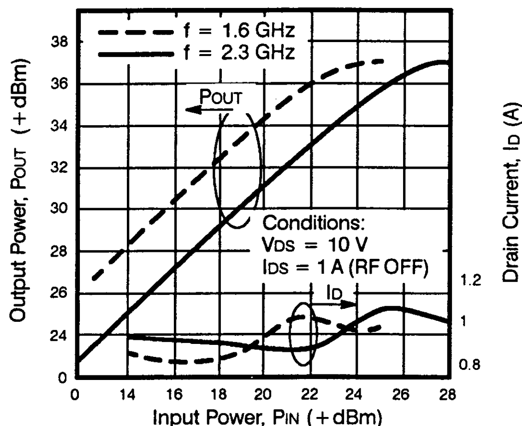
Lead Material: Kovar
Lead Plating: Ni, Au

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

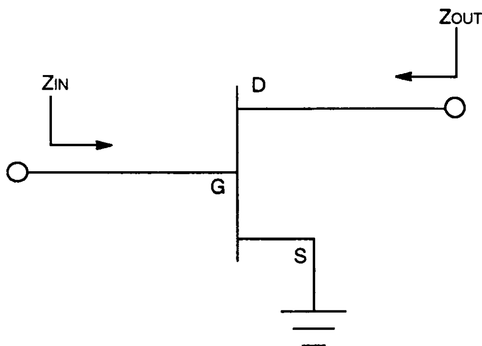
PART NUMBER				NE1069L-4B		
SYMBOLS	**PARAMETERS AND CONDITIONS**		**UNITS**	**MIN**	**TYP**	**MAX**
I_{DSS}	Saturated Drain Current, V_{DS} = 2.5 V, V_{GS} = 0		A	2.2	2.7	3.5
V_P	Pinch-off Voltage, V_{DS} = 2.5 V, I_D = 14 mA		V	-5	-3.5	-2
g_m	Transconductance, V_{DS} = 2.5 V, I_D = 10 A		mS		1000	
R_{TH}	Thermal Resistance (channel to case, T_{CH} = 125°C)		°C/W		5	6
P_{1dB}	Output Power at 1 dB G.C.P.	V_{DS} = 10 V, f = 2.3 GHz I_{DS} = 1 A (RF OFF)	dBm	35.5	36.5	
G_L	Linear Power Gain		dB	10	11	
I_D	Drain Current		A		1.1	1.4
I_G	Gate Current		mA			5
η_{ADD}	Power Added Efficiency		%		40	
P_{OUT}	Output Power, P_{IN} = 27 dBm	V_{DS} = 10 V, f = 2.3 GHz I_{DS} = 1 A (RF OFF)	dBm		37	
P_{1dB}	Output Power at 1 dB G.C.P.	V_{DS} = 10 V, f = 1.6 GHz, I_{DS} = 1 A (RF OFF)	dBm		36.5	
G_L	Linear Gain		dB		14.5	

TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

OUTPUT POWER AND DRAIN CURRENT vs. INPUT POWER



INPUT AND OUTPUT DYNAMIC IMPEDANCE



PART NUMBER	f = 1.6 GHz		f = 2.3 GHz	
	Z_{IN} (Ω)	Z_{OUT} (Ω)	Z_{IN} (Ω)	Z_{OUT} (Ω)
NE1069L-4B	3.1 + j 2.0	10.7 + j 3.2	3.5 + j 4.7	6.7 + j 6.2

MAXIMUM OPERATING LIMITS

PART NUMBER	R_G MAX	I_G RF MAX	V_{DS} MAX
	Ω	mA	V
NE1069L-48	100	10	10.0

R_G MAX is the maximum series resistance between the gate supply and the FET gate.

- Medium Power FETs

NEC®

K-BAND POWER GaAs MESFET

NE985 SERIES

FEATURES

- CLASS A OPERATION
- HIGH OUTPUT POWER
- HIGH LINEAR GAIN
- HIGH POWER ADDED EFFICIENCY
- HIGH RELIABILITY

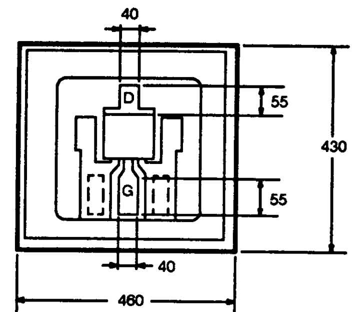
DESCRIPTION

The NE985 power GaAs FET series offers high output power and high gain in K-band. The device has a gate length of 0.3 μm to increase linear gain and employs PHS (Plated Heat Sink) technology to reduce the thermal resistance.

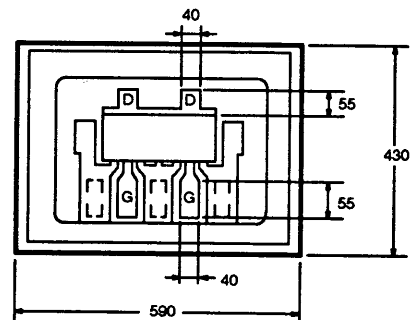
The NE985100 consists of 1 cell, the NE985200 consists of 2 cells and the NE985400 consists of 4 cells.

OUTLINE DIMENSIONS (Units in μm)

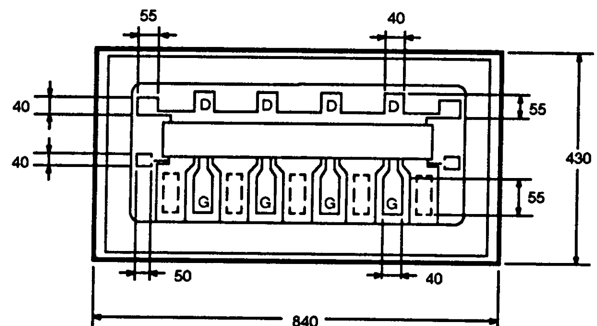
NE985100 (CHIP)



NE985200 (CHIP)



NE985400 (CHIP)



D: Drain contact pad
G: Gate contact pad
⁚⁚: Via-hole

SELECTION CHART

P_{1dB}	PART NUMBER
20 dBm	NE985100
23 dBm	NE985200
26 dBm	NE985400

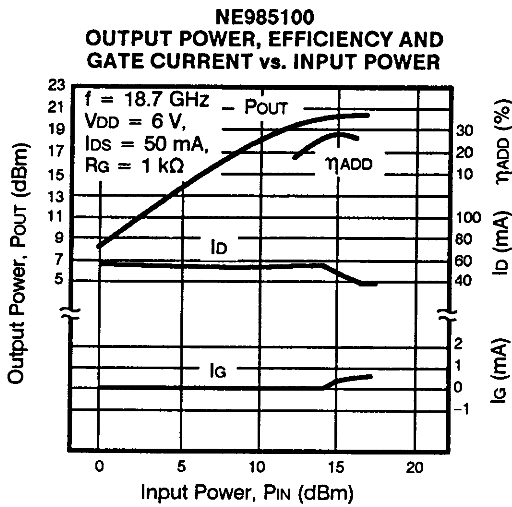
ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

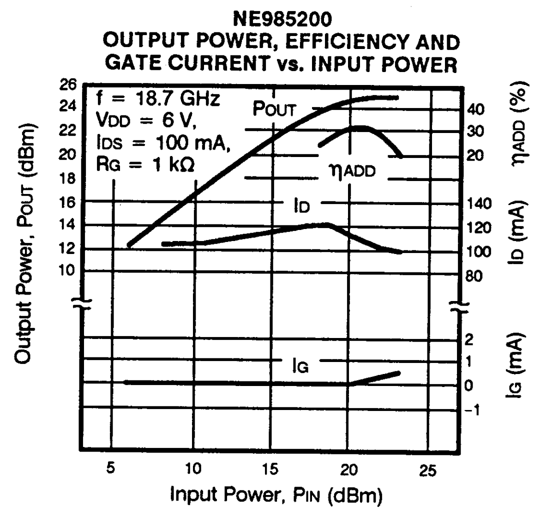
SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{DS}	Drain to Source Voltage	V	8
V_{GD}	Gate to Drain Voltage	V	-13
V_{GS}	Gate to Source Voltage	V	-5
I_D	Drain Current, NE985100 NE985200 NE985400	A A A	0.15 0.3 0.6
I_G	Gate Current, NE985100 NE985200 NE985400	mA mA mA	1 2 4
P_T	Total Power Dissipation NE985100 NE985200 NE985400	 W W W	 2 3 5
T_{CH}	Channel Temperature	°C	175
T_{STG}	Storage Temperature	°C	-65 to +175

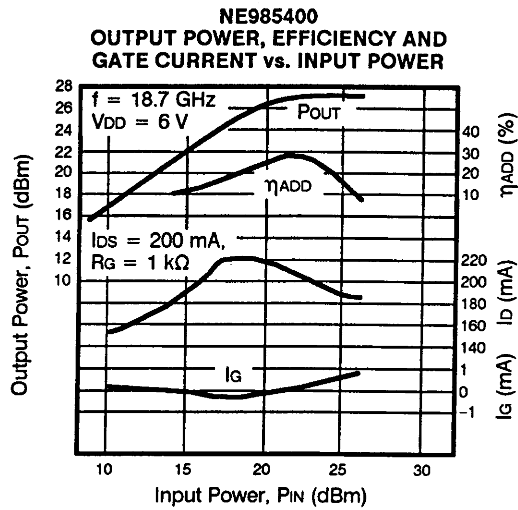
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER PACKAGE OUTLINE			NE985100 00(CHIP)			NE985200 00(CHIP)			NE985400 00(CHIP)		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
I_{DSS}	Drain Current at V_{DS} = 2.5 V, V_{GS} = 0	mA	60	100	150	120	200	300	240	400	600
V_P	Pinch-Off Voltage at V_{DS} = 2.5 V, I_D = 0.5 mA I_D = 1 mA I_D = 2 mA	 V V V	-4	-2.5	-1	-4	-2.5	-1	-4	-2.5	-1
g_M	Transconductance at V_{DS} = 2.5 V, I_D = 50 mA I_D = 100 mA I_D = 200 mA	 mS mS mS		50			100			200	
$R_{TH\ (C-C)}$	Thermal Resistance at T_{CH} = 125°C	°C/W		40	70		30	50		18	30
P_{1dB}	Output Power at 1 dB Compression Point V_{DS} = 6 V, f = 18.7 GHz, I_D = 0.5 I_{DSS} (RF OFF)	dBm	19	20		22	23		25	26	
G_L	Linear Power Gain V_{DS} = 6 V, f = 18.7 GHz, I_D = 0.5 I_{DSS} (RF OFF)	dB	6.5	7.5		6	7		5	6	
I_{DS}	Drain Current V_{DS} = 6 V, f = 18.7 GHz, I_D = 0.5 I_{DSS} (RF OFF)	mA		60	75		120	150		240	300
η_{ADD}	Power Added Efficiency V_{DS} = 6 V, f = 18.7 GHz, I_D = 0.5 I_{DSS} (RF OFF)	%		25			25			22	
P_{OUT}	Output Power at V_{DS} = 6 V, f = 18.7 GHz, I_D = 0.5 I_{DSS} (RF OFF), P_{IN} = 16 dBm P_{IN} = 19 dBm P_{IN} = 23 dBm	 dBm dBm dBm		21			24			27	

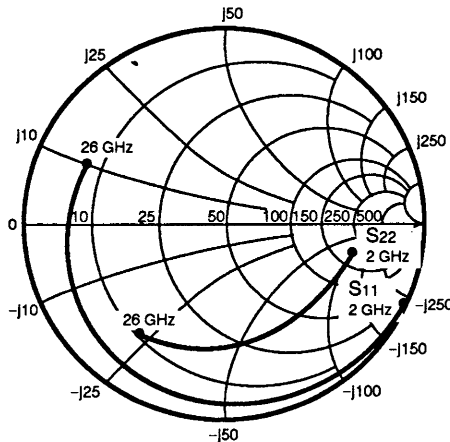
TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

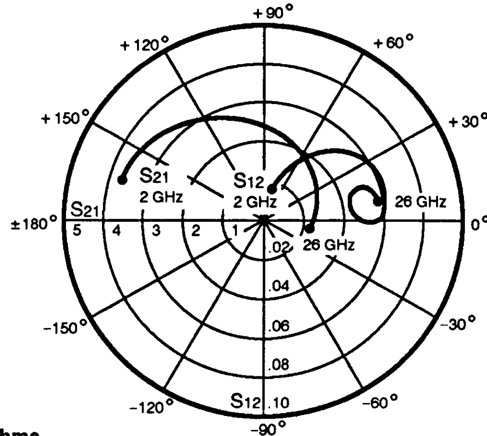






TYPICAL COMMON SOURCE SCATTERING PARAMETERS





NE985100
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 6 V, I_{DS} = 50 mA)

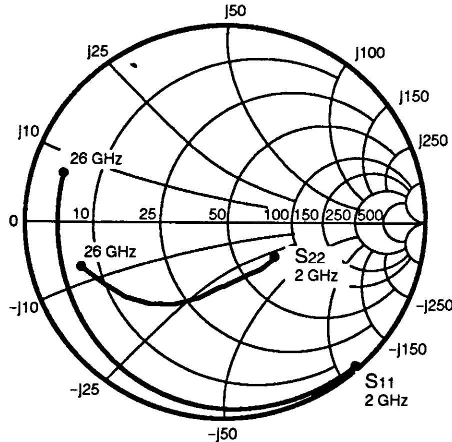
Note: S-Parameters include bond wires.

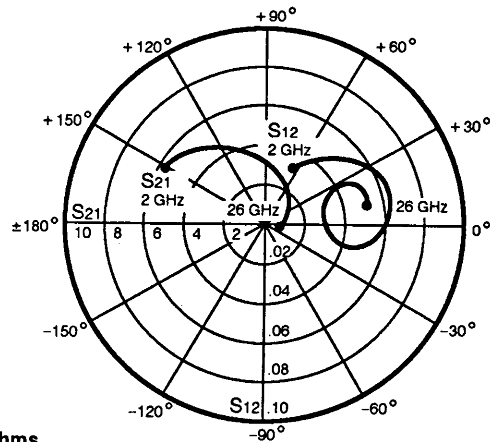
Gate:	Total 1 wire (s), 1 per bond pad, 0.0101" (256 μm) long each wire.
Drain:	Total 1 wire (s), 1 per bond pad, 0.0098" (248 μm) long each wire.
Source:	No bond wires. Via holes to back side of chip.
Wire:	0.0007" (17.7 μm) diameter, gold.

S-MAGN AND PHASE:
V_{DS} = 6 V, I_{DS} = 50 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		K	Gma (dB)
2000	.99	-30	3.65	157	.021	72	.65	-14	.04	22.4
3000	.98	-45	3.51	146	.031	64	.64	-21	.11	20.6
4000	.96	-58	3.34	135	.038	55	.63	-27	.20	19.5
5000	.94	-69	3.13	126	.042	50	.62	-33	.27	18.7
6000	.92	-80	2.85	116	.048	45	.62	-33	.33	17.9
7000	.90	-90	2.77	108	.049	39	.61	-43	.42	17.5
8000	.89	-98	2.64	100	.051	38	.61	-47	.43	17.1
9000	.88	-108	2.52	92	.060	33	.62	-54	.37	16.2
10000	.87	-117	2.38	84	.061	26	.61	-58	.48	15.9
11000	.85	-124	2.27	77	.059	24	.61	-63	.54	15.8
12000	.85	-132	2.16	70	.064	21	.61	-68	.58	15.3
13000	.84	-138	2.06	64	.063	14	.61	-72	.63	15.2
14000	.83	-145	1.94	58	.061	10	.61	-77	.70	15.0
15000	.82	-151	1.86	52	.061	6	.62	-81	.76	14.9
16000	.82	-157	1.75	45	.058	4	.63	-85	.85	14.8
17000	.80	-160	1.68	40	.055	-0	.64	-89	1.04	13.6
18000	.79	-164	1.57	35	.053	-1	.64	-92	1.18	12.2
19000	.79	-168	1.53	30	.046	0	.64	-96	1.41	11.4
20000	.78	-172	1.46	26	.042	10	.66	-99	1.50	11.2
21000	.78	-176	1.42	20	.046	15	.67	-104	1.29	11.6
22000	.78	180	1.37	15	.053	23	.69	-109	1.04	13.0
23000	.78	174	1.31	8	.062	18	.69	-114	.87	13.2
24000	.77	169	1.24	4	.059	15	.69	-119	1.07	11.6
25000	.76	163	1.18	-2	.058	15	.69	-123	1.15	10.7
26000	.76	158	1.17	-6	.059	14	.70	-127	1.14	10.7

TYPICAL COMMON SOURCE SCATTERING PARAMETERS





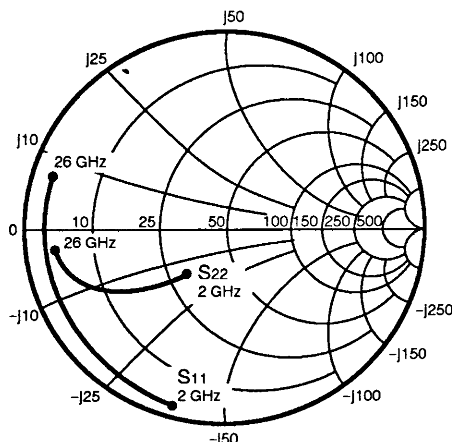
NE985200
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 6 V, I_{DS} = 100 mA)

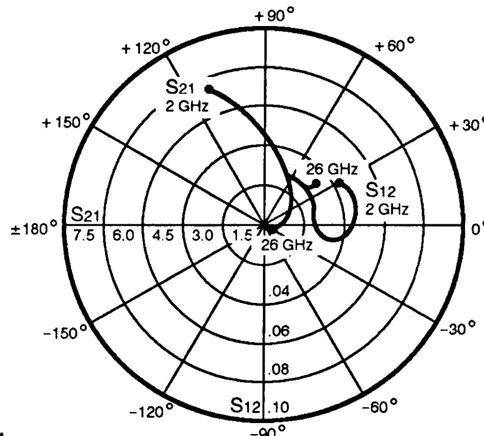
Note: S-Parameters include bond wires.
Gate: Total 2 wire (s), 1 per bond pad, 0.0098" (248 μm) long each wire.
Drain: Total 2 wire (s), 1 per bond pad, 0.0103" (261 μm) long each wire.
Source: No bond wires. Via holes to back side of chip.
Wire: 0.0007" (17.7 μm) diameter, gold.

S-MAGN AND PHASE:
V_{DS} = 6 V, I_{DS} = 100 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		K	Gma (dB)
2000	.97	-59	5.26	140	.038	56	.30	-47	.07	21.4
3000	.94	-82	4.58	124	.049	43	.31	-65	.13	19.7
4000	.92	-99	3.95	111	.054	34	.31	-78	.23	18.6
5000	.90	-112	3.43	100	.057	28	.33	-87	.31	17.8
6000	.88	-123	2.99	91	.061	22	.35	-95	.35	16.9
7000	.88	-131	2.64	83	.060	17	.37	-101	.44	16.5
8000	.88	-137	2.39	76	.062	16	.40	-106	.40	15.9
9000	.87	-143	2.17	68	.066	9	.43	-112	.41	15.1
10000	.87	-149	1.95	62	.063	4	.45	-116	.52	14.9
11000	.87	-153	1.80	56	.059	2	.48	-119	.59	14.9
12000	.87	-157	1.67	50	.059	-2	.50	-123	.58	14.5
13000	.87	-161	1.56	45	.057	-5	.53	-126	.65	14.4
14000	.86	-165	1.45	39	.056	-9	.55	-129	.74	14.1
15000	.86	-169	1.35	33	.051	-13	.57	-132	.92	14.3
16000	.86	-172	1.26	28	.048	-13	.58	-135	1.08	12.5
17000	.85	-174	1.18	24	.040	-13	.60	-137	1.52	10.4
18000	.84	-176	1.10	21	.040	-8	.62	-140	1.60	9.8
19000	.84	-178	1.04	16	.030	-6	.63	-143	2.43	8.7
20000	.85	180	0.98	14	.030	13	.66	-144	2.16	9.0
21000	.86	179	0.95	10	.036	23	.68	-147	1.57	9.8
22000	.84	176	0.89	7	.046	25	.70	-149	1.25	9.9
23000	.83	173	0.84	1	.051	17	.71	-152	1.24	9.2
24000	.82	170	0.79	-1	.045	14	.71	-155	1.71	7.6
25000	.84	168	0.76	-4	.050	14	.72	-158	1.34	8.3
26000	.85	165	0.75	-8	.054	12	.73	-160	1.08	9.7

TYPICAL COMMON SOURCE SCATTERING PARAMETERS





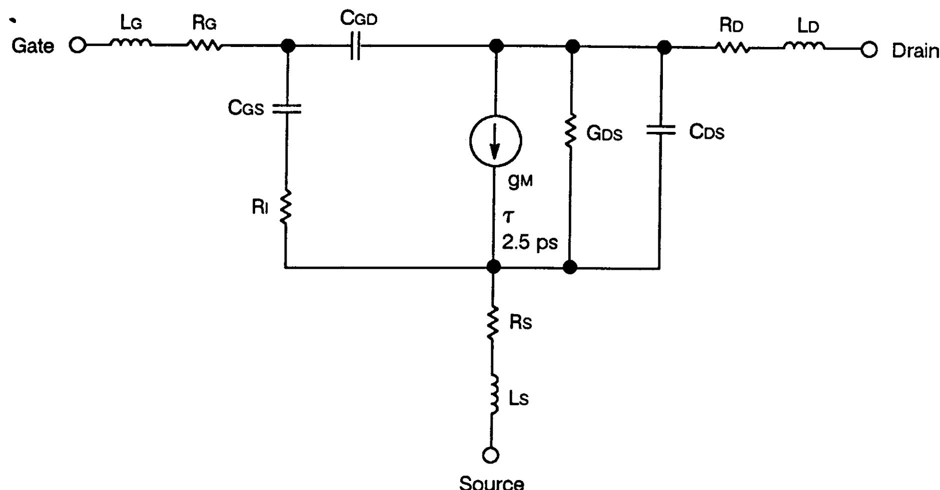
NE985400
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 6 V, I_{DS} = 200 mA)

Note: S-Parameters include bond wires.
- Gate: Total 4 wire (s), 1 per bond pad, 0.0122" (309 μm) long each wire.
- Drain: Total 4 wire (s), 1 per bond pad, 0.0118" (300 μm) long each wire.
- Source: No bond wires. Via holes to back side of chip.
- Wire: 0.0007" (17.7 μm) diameter, gold.

S-MAGN AND PHASE:
VDS = 6 V, ID = 200 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}		K	Gma (dB)
2000	.93	-107	5.49	113	.042	30	.31	-131	.10	21.2
3000	.91	-128	4.05	97	.044	20	.36	-137	.20	19.6
4000	.90	-140	3.16	86	.044	15	.39	-139	.34	18.6
5000	.89	-149	2.57	76	.044	13	.43	-140	.45	17.7
6000	.89	-154	2.14	69	.047	8	.46	-141	.46	16.6
7000	.90	-158	1.84	62	.044	4	.50	-142	.52	16.2
8000	.90	-162	1.62	56	.044	6	.54	-143	.51	15.6
9000	.90	-166	1.43	48	.045	-4	.57	-146	.56	15.0
10000	.90	-169	1.25	43	.040	-6	.60	-147	.71	14.9
11000	.90	-171	1.12	38	.036	-6	.63	-149	.85	14.9
12000	.91	-172	1.02	32	.035	-8	.66	-150	.76	14.6
13000	.91	-174	0.93	27	.033	-10	.69	-152	.88	14.5
14000	.91	-176	0.86	22	.029	-16	.71	-154	1.11	12.7
15000	.91	-178	0.78	17	.027	-16	.73	-156	1.38	11.0
16000	.91	180	0.72	13	.027	-5	.74	-157	1.45	10.3
17000	.90	178	0.66	9	.028	8	.76	-158	1.63	9.1
18000	.89	177	0.62	7	.027	16	.77	-159	1.75	8.6
19000	.89	175	0.58	2	.029	47	.79	-160	1.79	7.8
20000	.90	174	0.54	3	.028	64	.80	-160	1.80	7.6
21000	.90	172	0.52	-1	.027	66	.82	-161	1.84	7.5
22000	.90	170	0.49	-3	.027	50	.82	-163	1.76	7.5
23000	.90	168	0.45	-7	.027	33	.83	-166	1.69	7.4
24000	.90	167	0.43	-9	.030	39	.83	-168	1.53	7.3
25000	.90	166	0.41	-10	.033	39	.84	-171	1.41	7.2
26000	.90	165	0.40	-15	.033	38	.85	-172	1.38	7.2

EQUIVALENT CIRCUIT



Note: Inductance of bonding wire is included.

20 μm φ Au wire
Gate: Total 2 wires, 1 per bond pad, 0.013″ Long each wire.
Drain: Total 2 wires, 1 per bond pad, 0.015″ Long each wire.
Source: VIA HOLE INDUCTOR.

ELEMENT	PART NUMBER			UNIT
	NE985100	NE985200	NE985400	
L_G	0.15	0.11	0.08	nH
R_G	1.2	0.52	0.24	Ohm
C_{GS}	0.43	0.83	1.74	pF
R_I	0.46	0.22	0.16	Ohm
R_S	1.42	1.06	0.58	Ohm
L_S	0.00814	0.00338	0.00176	nH
g_M	43.6	84.3	181	mS
g_D	3.85	8.06	16.1	mS
C_{GD}	0.017	0.031	0.074	pF
C_{DS}	0.176	0.285	0.513	pF
R_D	5.86	3.10	1.08	Ohm
L_D	0.150	0.120	0.104	nH

CHIP HANDLING

DIE ATTACHMENT

Die attach operation can be accomplished with AuSn preforms, within 10 seconds at 320 ± 5°C, in a forming gas environment.

The flow quantity: 300 liter/hour

Gas Contents: N_2

Recommended solder size:
0.33□, t = 30 μm 1 pc for NE985100 and NE985200
0.33□, t = 30 μm 2 pcs for NE985400

Recommended mounting base material: Cu, CuW, KV

Epoxy die attach is not allowed.

BONDING

Bond wire should be semi soft gold wire (8% to elongation) 20 microns in diameter, with length kept to a minimum. Bonding should be performed with a wedge tip that has a taper of approximately 15%. Bonding time should be kept to a minimum.

As a general rule, the bonding operation should be kept within a 260 ±10°C, 2 minutes for all bonding wires. The operation should be performed in a forming gas environment. If longer periods are required, the temperature should be lowered.

The flow quantity: 100 liter/hour

Gas Contents: N_2

Bonding force: 21 ±2 g

Thermal compress bonding is recommended.

PRECAUTIONS

The user must operate in a clean, dry environment. The chip active area is glassivated for mechanical protection only and does not preclude the necessity of a clean environment.

The bonding equipment should be periodically checked for sources of surge voltage and should be properly grounded at all times. In fact, all test and handling equipment should be grounded to minimize the possibilities of static discharge.