To our customers,

Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

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RENESAS

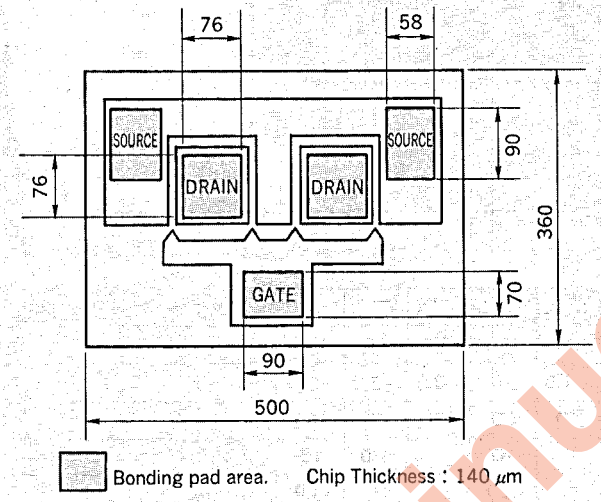
GaAs MES FET

NE720

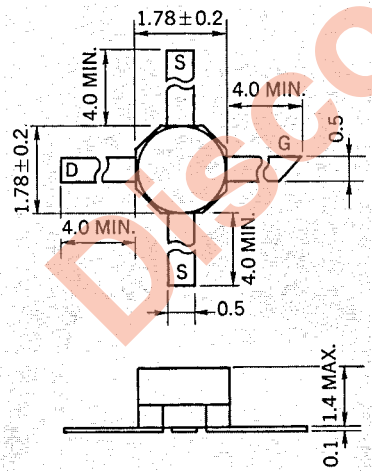
LOW COST GENERAL PURPOSE GaAs FET
N-CHANNEL GaAs MES FET

PHYSICAL DIMENSIONS
(Unit in mm)

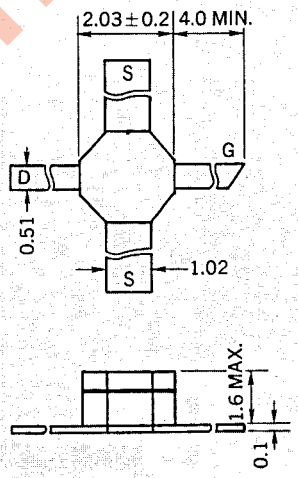
NE72000 (Chip)
(Units in μm)



PACKAGE CODE-84



PACKAGE CODE-89A



DESCRIPTION

The NE720 is a low cost 1.0 μ recessed gate GaAs FET, offering a low noise figure and high gain through 8 GHz. The device is available as a chip (NE72000) and in two hermetically sealed packages (NE72084 and NE72089A). The chip's gate and channel are glassivated with a thin layer of SiO_2 for mechanical protection. All bonding pads use a Ti-Pt-Au metallization system. The NE72084 is a low cost device designed for consumer applications.

FEATURES

- Low cost
- Low noise figure:
  NF 0.8 dB @f = 4 GHz
  NF 1.7 dB @f = 8 GHz
- High associated gain
  G_a 12.0 dB @f = 4 GHz
  G_a 9.0 dB @f = 8 GHz
- High maximum available gain
  MAG 16.0 dB @f = 4 GHz
  MAG 12.0 dB @f = 8 GHz

ORDERING INFORMATION

PART NUMBER	PACKAGE CODE
NE72000	00(CHIP)
NE72084	84
NE72089A	89A

PRECAUTION

Avoid high static voltages or electric fields so that this device would not suffer any damages due to those voltage of fields.

ABSOLUTE MAXIMUM RATINGS (T_a = 25 °C)

Drain to Source Voltage	V_{DS}	5.0	V	
Gate to Drain Voltage	V_{GDO}	−6.0	V	
Gate to Source Voltage	V_{GSO}	−6.0	V	
Drain Current	I_{DS}	150	mA	
Total Power Dissipation	P_T	500*1,*3	mW	(NE72000)
		300*2	mW	(NE72084)
		300*2	mW	(NE72089A)
Channel Temperature	T_{ch}	175	°C	
Storage Temperature	T_{stg}	−65 to +175	°C	(NE72089A)

*1 T_a = 90 °C
*2 T_a = 55 °C
*3 R_{th} (channel to case) for chips mounted on a copper heat sink.

ELECTRICAL CHARACTERISTICS (T_a = 25 °C)

PART NUMBER		NE72000			NE72084			NE72089A			UNIT	TEST CONDITIONS
PACKAGE CODE		CHIP			84			89A				
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
Saturated Drain Current	I_{DSS}*4	30	60	150	30	60	150	30	60	150	mA	V_{DS} = 3 V, V_{GS} = 0
Pinch-off Voltage	V_P	−0.8	−2.0	−6.0	−0.8	−1.5	−4	−0.8	−2.0	−6.0	V	V_{DS} = 3 V, I_{DS} = 0.1 mA
Transconductance	g_m	20	40	100	20	40	60	20	40	100	mS	V_{DS} = 3 V, I_{DS} = 10 mA
Gate to Source Leakage Current	I_{GSO}		1.0	10			10		1.0	10	μA	V_{GS} = −5 V
Thermal Resistance	R_{th}			170*3			400			400	°C/W	channel to case

*4 I_{DSS} rank for NE72084 is specified as follows.
K rank ; I_{DSS} 30 to 150 mA
L rank ; I_{DSS} 90 to 150 mA
M rank ; I_{DSS} 55 to 100 mA
N rank ; I_{DSS} 30 to 65 mA

PERFORMANCE SPECIFICATIONS (T_a = 25 °C)

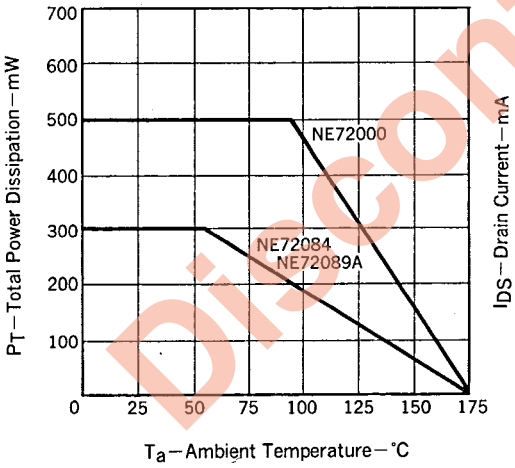
PART NUMBER		NE72000			NE72084			NE72089A			UNIT	TEST CONDITIONS	
PACKAGE CODE		CHIP			84			89A					
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.			
Maximum Frequency of Oscillation	$f_{max.}$		60			60			60		GHz	V_{DS} = 3 V, I_{DS} = 30 mA	
Maximum Available Gain*5	MAG					17.5					dB	V_{DS} = 3 V, I_{DS} = 30 mA	f = 2 GHz
			16.5			15.0			16.0		dB		f = 4 GHz
			11.5			12.0			11.0		dB		f = 8 GHz
						8.0					dB		f = 12 GHz
Optimum Noise Figure	NF_{opt}					0.6					dB	V_{DS} = 3 V, I_{DS} = 10 mA	f = 2 GHz
			1.0	1.4		0.8	1.4		1.0	1.4	dB		f = 4 GHz
			1.7			2.0			1.7		dB		f = 8 GHz
Associated Gain at Optimum Noise Figure	G_a					15.0					dB	V_{DS} = 3 V, I_{DS} = 10 mA	f = 2 GHz
			11.0			12.0			11.0		dB		f = 4 GHz
			9.0			8.5			9.0		dB		f = 8 GHz
Output Power at 1 dB Gain Compression Point	$P_{O(1\ dB)}$		15.0			15.0			15.0		dBm	V_{DS} = 4 V, I_{DS} = 30 mA	f = 4 GHz

*5 Gain Calculations : $MAG = \frac{|S_{21}|}{|S_{12}|}(K \pm \sqrt{K^2 - 1})$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}||S_{21}|}$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$

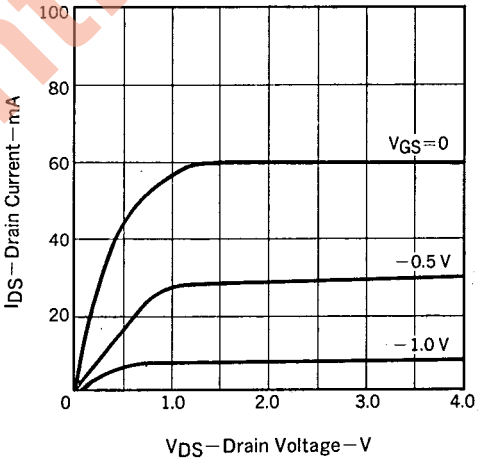
$$MSG = \frac{|S_{21}|}{|S_{12}|}$$

DEVICE CHARACTERISTICS

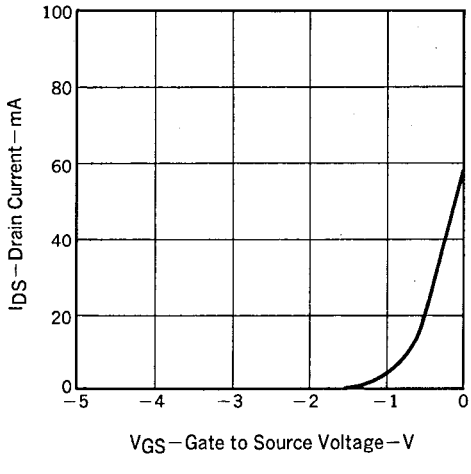
POWER DERATING CURVE



DC PERFORMANCE

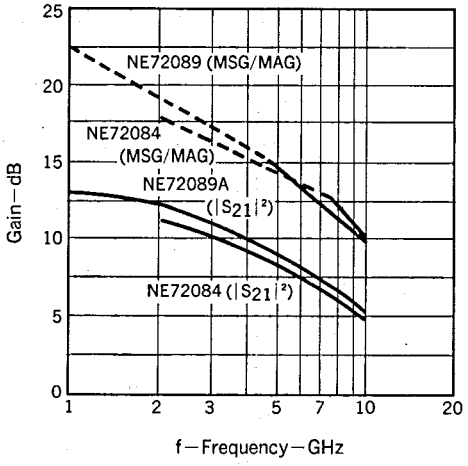


DRAIN CURRENT vs. GATE TO SOURCE VOLTAGE

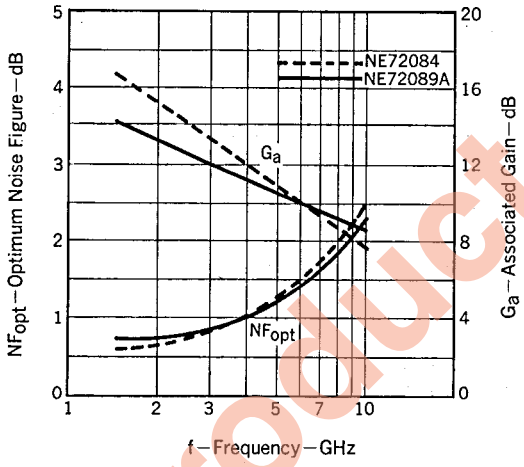


TYPICAL CHARACTERISTICS (T_a = 25 °C)

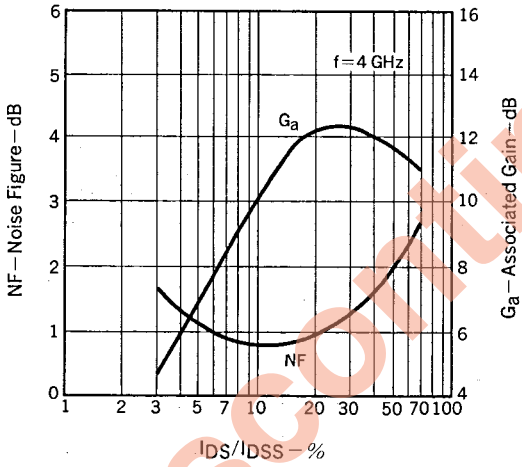
TYPICAL GAIN vs. FREQUENCY FOR THE NE72084 AND NE72089A AT V_{DS} = 3 V AND I_{DS} = 30 mA



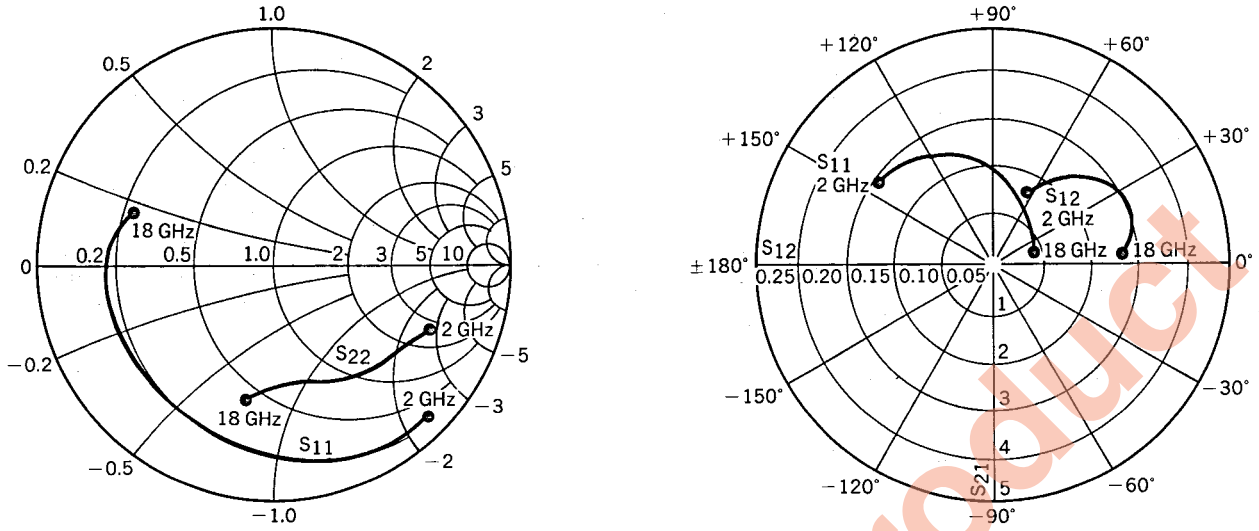
TYPICAL NOISE FIGURE AND ASSOCIATED GAIN vs. FREQUENCY FOR THE NE72084 AND NE72089A AT V_{DS} = 3 V AND I_{DS} = 10 mA



NOISE FIGURE AND ASSOCIATED GAIN vs. RATIO OF DRAIN CURRENT AND ZERO GATE VOLTAGE CURRENT FOR THE NE72084



NE72000 S-PARAMETERS



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

S-MAGN AND ANGLES

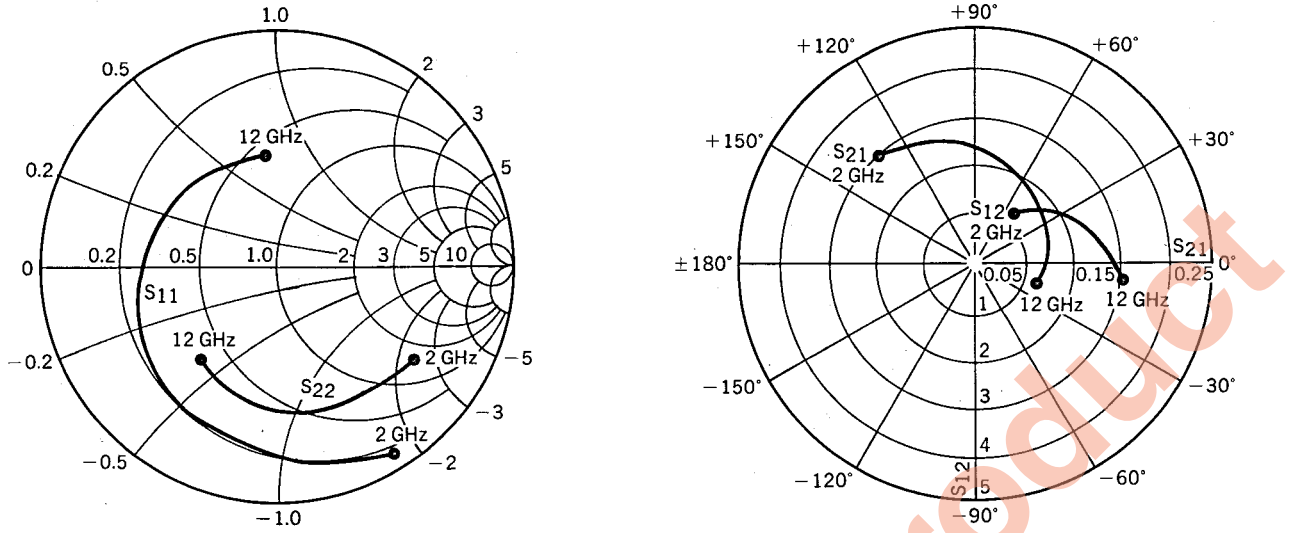
(V_{DS} = 3 V, I_{DS} = 10 mA)

frequency (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
2000	0.91	−44	2.95	144	0.08	64	0.71	−22
3000	0.90	−63	2.81	132	0.11	53	0.68	−27
4000	0.83	−81	2.47	113	0.12	44	0.62	−35
5000	0.78	−96	2.27	105	0.14	36	0.58	−43
6000	0.75	−108	2.08	97	0.15	32	0.56	−52
7000	0.70	−119	1.83	87	0.15	26	0.55	−58
8000	0.67	−130	1.65	79	0.15	19	0.55	−63
9000	0.66	−140	1.49	72	0.15	18	0.56	−65
10000	0.64	−152	1.37	64	0.15	15	0.56	−67
11000	0.64	−158	1.24	59	0.14	14	0.54	−66
12000	0.67	−165	1.18	54	0.14	13	0.54	−67
13000	0.69	−168	1.11	49	0.14	11	0.51	−74
14000	0.69	−175	1.11	44	0.14	12	0.54	−80
15000	0.65	−178	0.98	38	0.13	9	0.55	−86
16000	0.66	174	1.02	33	0.14	9	0.53	−90
17000	0.63	164	0.96	26	0.13	8	0.56	−95
18000	0.64	160	0.86	21	0.13	9	0.50	−97

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

frequency (MHz)								
2000	0.90	−49	3.61	143	0.07	62	0.65	−24
3000	0.89	−70	3.39	130	0.10	52	0.61	−28
4000	0.83	−88	2.91	117	0.11	44	0.55	−36
5000	0.78	−103	2.63	104	0.12	36	0.51	−44
6000	0.75	−116	2.37	97	0.13	33	0.49	−53
7000	0.70	−126	2.08	87	0.13	27	0.49	−59
8000	0.68	−137	1.87	79	0.13	22	0.49	−64
9000	0.67	−148	1.67	73	0.13	21	0.51	−67
10000	0.65	−158	1.53	65	0.12	19	0.51	−68
11000	0.65	−164	1.37	60	0.12	18	0.49	−67
12000	0.70	−171	1.32	55	0.12	18	0.47	−68
13000	0.72	−174	1.23	51	0.12	17	0.47	−75
14000	0.74	−180	1.22	46	0.13	20	0.49	−81
15000	0.67	177	1.09	40	0.12	17	0.50	−87
16000	0.69	169	1.12	36	0.12	18	0.50	−90
17000	0.66	158	1.05	28	0.13	18	0.52	−96
18000	0.67	156	0.94	24	0.12	20	0.56	−98

NE72084 S-PARAMETERS



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

S-MAGN AND ANGLES

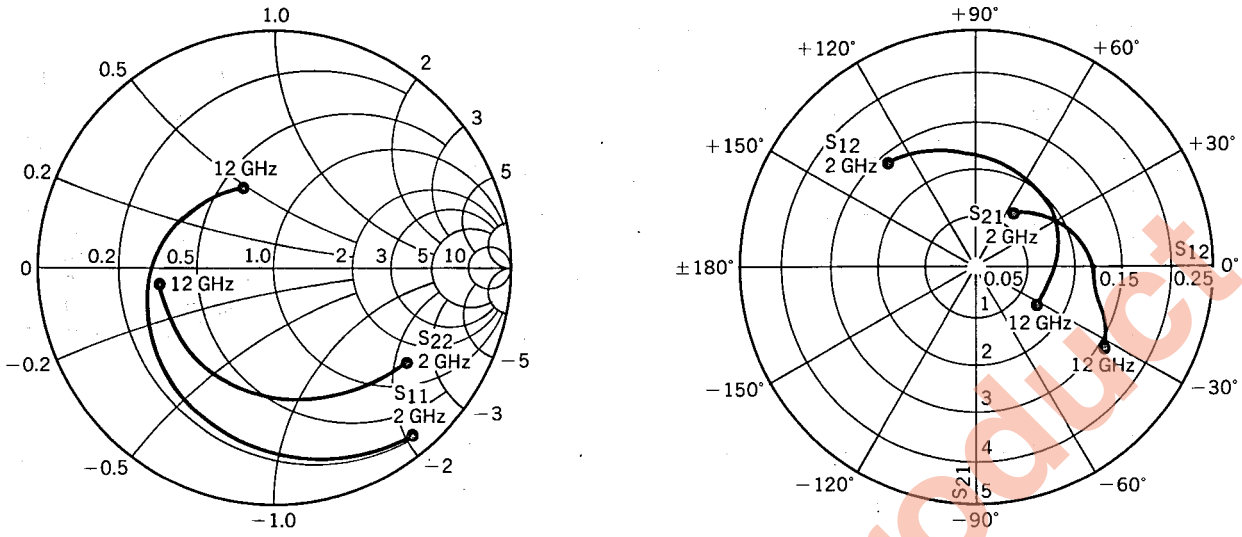
(V_{DS} = 3 V, I_{DS} = 10 mA)

frequency (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
2000	0.91	−60	3.02	131	0.07	54	0.70	−36
3000	0.82	−81	2.65	108	0.09	39	0.66	−49
4000	0.76	−102	2.36	92	0.11	30	0.64	−63
5000	0.72	−122	2.17	76	0.12	21	0.62	−73
6000	0.66	−139	1.97	58	0.12	13	0.61	−80
7000	0.61	−156	1.81	45	0.12	9	0.61	−90
8000	0.56	−176	1.69	34	0.12	5	0.60	−97
9000	0.53	167	1.62	18	0.13	2	0.59	−105
10000	0.50	142	1.59	4	0.13	0	0.57	−111
11000	0.48	114	1.49	−9	0.14	−5	0.55	−116
12000	0.48	94	1.37	−20	0.15	−9	0.50	−128

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

frequency (MHz)								
2000	0.88	−65	4.04	125	0.06	55	0.61	−35
3000	0.78	−94	3.58	101	0.08	39	0.55	−51
4000	0.69	−121	3.11	81	0.09	30	0.50	−66
5000	0.62	−148	2.74	62	0.10	23	0.45	−80
6000	0.59	−173	2.46	45	0.10	19	0.44	−93
7000	0.57	166	2.17	29	0.11	15	0.42	−110
8000	0.56	148	2.01	14	0.11	12	0.42	−122
9000	0.56	128	1.88	−0	0.12	9	0.42	−138
10000	0.57	107	1.78	−15	0.14	6	0.43	−152
11000	0.58	87	1.64	−33	0.15	−6	0.43	−174
12000	0.60	72	1.47	−46	0.16	−13	0.41	166

NE72089A S-PARAMETERS



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

S-MAGN AND ANGLES

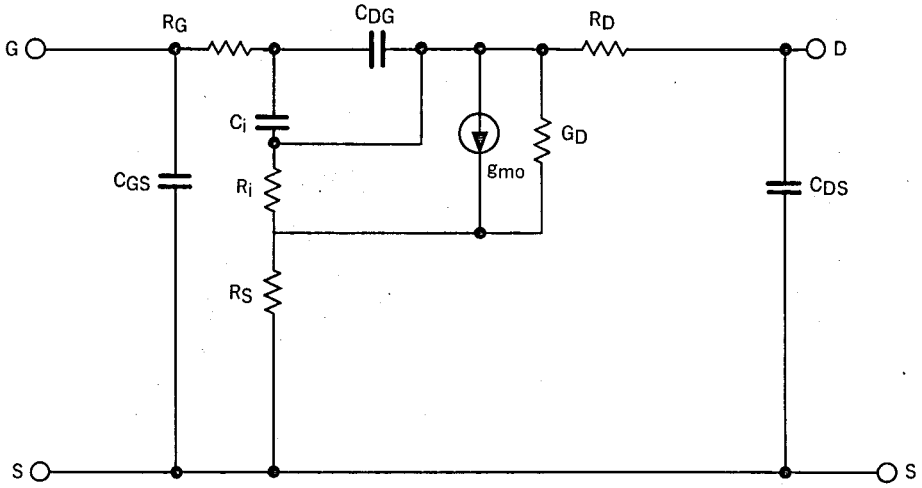
(V_{DS} = 3 V, I_{DS} = 10 mA)

frequency (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
2000	0.92	−52	2.94	130	0.07	54	0.68	−35
3000	0.84	−75	2.62	108	0.09	38	0.63	−51
4000	0.76	−95	2.34	90	0.11	26	0.59	−66
5000	0.71	−113	2.18	72	0.12	16	0.58	−79
6000	0.65	−131	2.02	56	0.13	7	0.56	−93
7000	0.59	−146	1.86	41	0.13	−1	0.54	−105
8000	0.55	−160	1.76	26	0.13	−7	0.54	−116
9000	0.49	−177	1.68	13	0.13	−12	0.53	−129
10000	0.44	165	1.66	−1	0.14	−17	0.53	−139
11000	0.39	140	1.63	−19	0.15	−26	0.52	−154
12000	0.37	112	1.55	−34	0.16	−33	0.51	−170

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

frequency (MHz)								
2000	0.89	−58	3.76	127	0.06	55	0.60	−35
3000	0.79	−82	3.27	105	0.08	40	0.56	−50
4000	0.72	−103	2.88	86	0.09	31	0.53	−64
5000	0.66	−121	2.61	69	0.10	22	0.51	−75
6000	0.60	−139	2.38	54	0.11	16	0.50	−86
7000	0.55	−155	2.18	38	0.11	10	0.50	−97
8000	0.50	−170	2.04	24	0.12	6	0.50	−108
9000	0.44	172	1.93	11	0.12	2	0.49	−118
10000	0.40	152	1.89	−3	0.14	−2	0.50	−126
11000	0.36	126	1.83	−20	0.15	−11	0.49	−138
12000	0.35	99	1.72	−36	0.16	−18	0.48	−151

NE72000 EQUIVALENT CIRCUITS



COMPONENT	VALUE
R_G	0.57 Ω
C_i	0.15 pF
R_i	2.00 Ω
R_S	2.00 Ω
C_{DG}	0.03 pF
R_D	2.00 Ω
C_{DS}	0.015 pF
g_{mo} (mS)	40.0 mS
G_D (mS)	2.0 mS
C_{GS}	0.55 pF

NE72084 TYPICAL NOISE PARAMETERS (V_{DS} = 3V, I_D = 10 mA)

Freq. (GHz)	NF_{opt} (dB)	G_a (dB)	Γ_{opt}		Rn/50 (Ω)
			MAG.	ANG. (°)	
1.0	0.60	17.7	0.81	18	0.53
2.0	0.69	14.8	0.74	43	0.50
3.0	0.78	13.0	0.70	60	0.45
4.0	0.85	11.8	0.66	91	0.42
5.0	1.10	10.7	0.61	111	0.39
6.0	1.40	9.9	0.56	131	0.37
7.0	1.62	9.2	0.52	151	0.34
8.0	2.00	8.5	0.49	170	0.32
9.0	2.25	8.0	0.47	−172	0.27
10.0	2.48	7.5	0.47	−153	0.19
11.0	2.70	6.9	0.47	−127	0.13
12.0	2.90	6.4	0.45	−106	0.10
13.0	3.11	5.8	0.44	−83	0.09
14.0	3.30	5.4	0.44	−63	0.08
15.0	3.42	5.0	0.45	−44	0.08
16.0	3.60	4.6	0.46	−27	0.07
17.0	3.72	4.2	0.48	−12	0.07
18.0	3.92	3.8	0.49	−1	0.07

CHIP HANDLING

DIE ATTACHEMENT

Die attach can be accomplished with a Au-Sn (300 ± 10 °C) preforms in a forming gas environment. Epoxy die attach is not recommended.

BONDING

Gate and drain bonding wires should be minimum length, semi-hard gold wire (3-8 % elongation) 20 microns or less in diameter. Bonding should be performed with a wedge tip that has a taper of approximately 15 %. Die attach and bonding time should be kept to a minimum. As a general rule, the bonding operation should be kept within a 280 °C — 5 minute curve. If longer periods are required, the temperature should be lowered.

PRECAUTIONS

The user must operate in a clean, dry environment. The chip channel 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.

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