

To our customers,

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## Old Company Name in Catalogs and Other Documents

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

April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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

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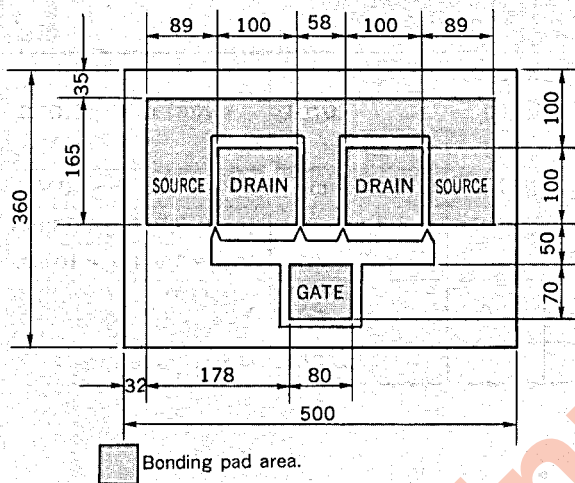
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## LOW NOISE X-BAND GaAs FET N-CHANNEL GaAs MES FET

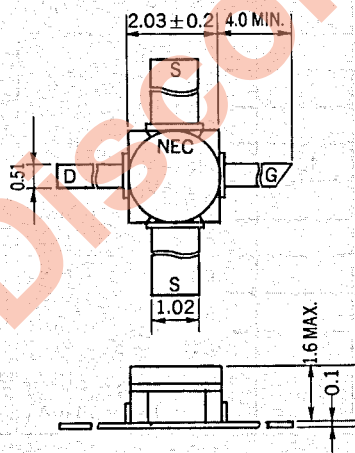
### PHYSICAL DIMENSIONS

NE21800 (Chip) (Units in  $\mu\text{m}$ )



### PACKAGE CODE - 89

(Units in mm)



### DESCRIPTION

The NE218 is a n-channel GaAs FET employing a  $1.0 \mu\text{m}$  recessed gate. Offering exceptionally low noise figure and high associated gain through 8 GHz, the NE218 is ideal for 3.7 to 4.2 GHz ground station LNA applications. The device is available as a chip (NE21800), and in a hermetically sealed package (NE21889). The chip's gate and channel are glassivated with a thin layer of  $\text{SiO}_2$  for mechanical protection.

### FEATURES

- Very high  $f_{\text{max}}$  : 60 GHz
- Low noise figure :
  - NF 1.0 dB,  $G_a$  12.0 dB @  $f = 4$  GHz
  - NF 1.7 dB,  $G_a$  10.5 dB @  $f = 8$  GHz
  - NF 2.8 dB,  $G_a$  7.0 dB @  $f = 12$  GHz
- High maximum available gain
  - MAG 16.5 dB @  $f = 4$  GHz
  - MAG 11.5 dB @  $f = 8$  GHz
  - MAG 9.5 dB @  $f = 12$  GHz
- Proven reliability and stability
- $1.0 \mu\text{m}$  recessed gate

### ORDERING INFORMATION

PART NUMBER	PACKAGE CODE
NE21800	00 (CHIP)
NE21889	89

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

Drain to Source Voltage	$V_{DS}$	5.0	V	
Gate to Source Voltage	$V_{GS}$	-6.0	V	
Drain Current	$I_{DS}$	120	mA	
Total Power Dissipation	$P_T$	500 <sup>*1, *3</sup>	mW	(NE21800)
		300 <sup>*2</sup>	mW	(NE21889)
RF Input Power	$P_{in}$	40	mW	
Channel Temperature	$T_{ch}$	175	$^\circ\text{C}$	
Storage Temperature	$T_{stg}$	-65 to +175	$^\circ\text{C}$	

\*1  $T_a = 90\text{ }^\circ\text{C}$ \*2  $T_a = 55\text{ }^\circ\text{C}$ \*3  $R_{th}$  (channel to case) for chips mounted on a copper heatsink.ELECTRICAL CHARACTERISTICS ( $T_a = 25\text{ }^\circ\text{C}$ )

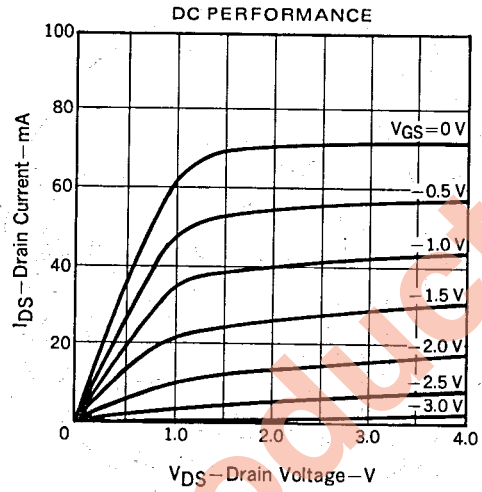
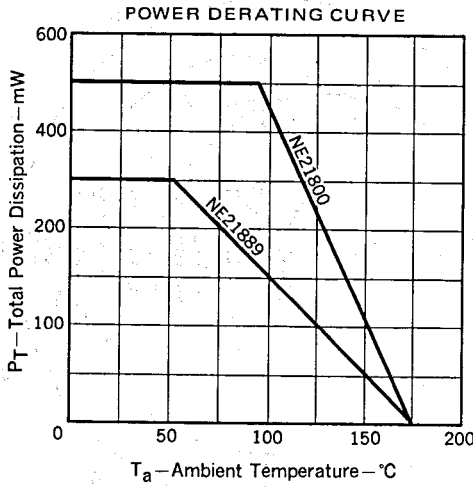
PART NUMBER		NE21800			NE21889			UNIT	TEST CONDITIONS
PACKAGE CODE		00 (CHIP)			89				
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
Saturated Drain Current	$I_{DSS}$	30	70	120	30	70	120	mA	$V_{DS} = 3\text{ V}, V_{GS} = 0\text{ V}$
Pinch-off Voltage	$V_P$	-0.8	-2.0	-6.0	-0.8	-2.0	-6.0	V	$V_{DS} = 3\text{ V}, I_{DS} = 0.1\text{ mA}$
Transconductance	$g_m$	20	40	100	20	40	100	mS	$V_{DS} = 3\text{ V}, I_{DS} = 10\text{ mA}$
Gate to Source Leakage Current	$I_{GS}$		1.0	10		1.0	10	$\mu\text{A}$	$V_{GS} = -5\text{ V}$
Thermal Resistance	$R_{th}$			170 <sup>*3</sup>			400	$^\circ\text{C/W}$	channel to case

PERFORMANCE SPECIFICATIONS ( $T_a = 25\text{ }^\circ\text{C}$ )

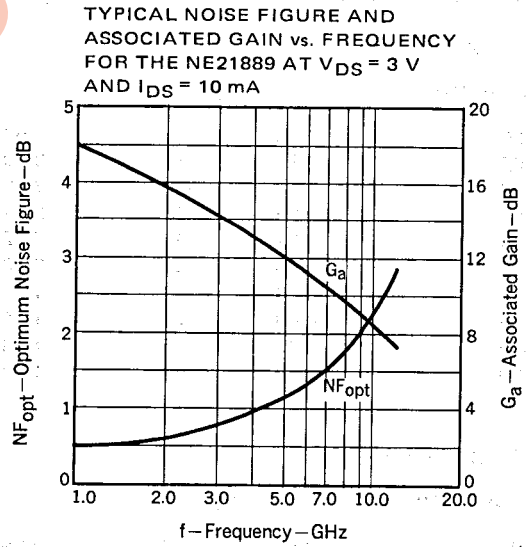
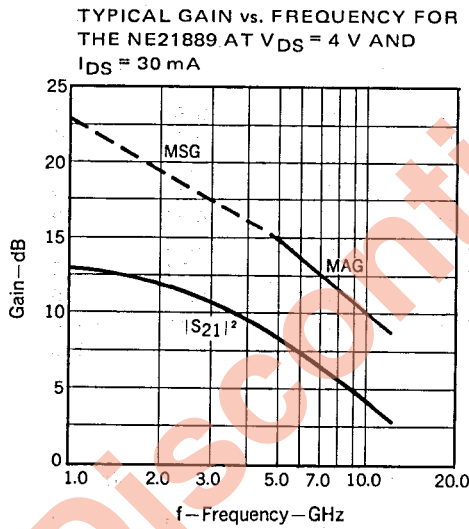
PART NUMBER		NE21800			NE21889			UNIT	TEST CONDITIONS	
PACKAGE CODE		00 (CHIP)			89					
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.			
Maximum Frequency of Oscillation	$f_{max}$		60			60		GHz	$V_{DS} = 3\text{ V}, I_{DS} = 30\text{ mA}$	
Maximum Available Gain *4	MAG		16.5			16.0		dB	$V_{DS} = 4\text{ V}, I_{DS} = 30\text{ mA}$	f = 4 GHz
			11.5			11.0		dB		f = 8 GHz
			9.5			9.0		dB		f = 12 GHz
Optimum Noise Figure	$NF_{opt}$		1.0	1.2		1.0	1.2	dB	$V_{DS} = 3\text{ V}, I_{DS} = 10\text{ mA}$	f = 4 GHz
			1.7			1.7		dB		f = 8 GHz
			2.8			2.8		dB		f = 12 GHz
Associated Gain at Optimum Noise Figure	$G_a$		13.0		12.0	13.0		dB	$V_{DS} = 3\text{ V}, I_{DS} = 10\text{ mA}$	f = 4 GHz
			10.5			12.0		dB		f = 8 GHz
			7.5			7.0		dB		f = 12 GHz
Output Power at 1 dB Gain Compression Point	$P_{O(1\text{ dB})}$		50			50		mW	$V_{DS} = 4\text{ V}, I_{DS} = 30\text{ mA}$	f = 4 GHz

$$*4 \text{ Gain Calculations : } MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}), K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{11}||S_{21}|}, \Delta = S_{11}S_{22} - S_{21}S_{12}; MSG = \frac{|S_{21}|}{|S_{12}|}$$

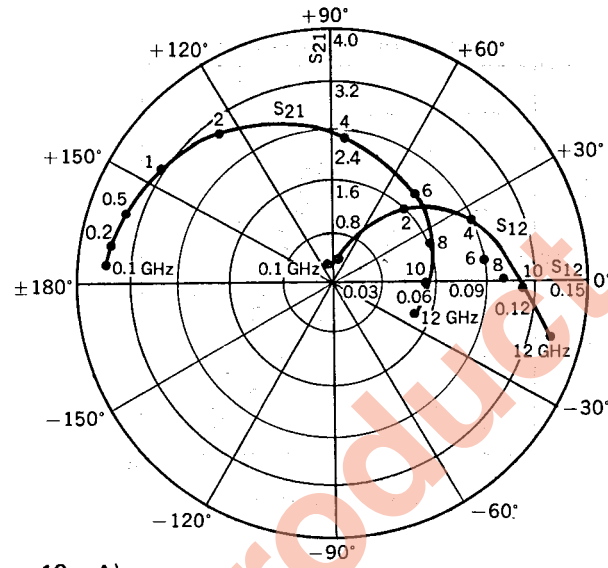
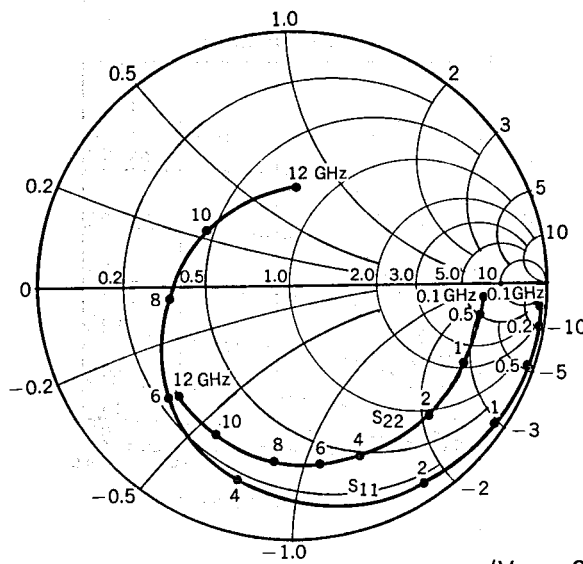
DEVICE CHARACTERISTICS



TYPICAL CHARACTERISTICS ( $T_a = 25^{\circ}C$ )



NE21889 S-PARAMETERS



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

S-MAGN AND ANGLES

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

frequency (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
100	0.98	-5	3.57	175	0.01	105	0.76	-3
200	0.98	-10	3.50	170	0.01	85	0.76	-6
500	0.98	-20	3.48	160	0.01	80	0.75	-12
1000	0.95	-35	3.23	145	0.03	65	0.75	-25
2000	0.92	-65	2.92	125	0.06	45	0.74	-40
4000	0.80	-105	2.32	85	0.09	25	0.72	-65
6000	0.66	-140	1.92	55	0.09	10	0.71	-80
8000	0.48	-176	1.64	20	0.10	1	0.70	-95
10000	0.42	145	1.38	0	0.11	-2	0.68	-115
12000	0.40	90	1.32	-25	0.13	-15	0.61	-135

$V_{DS} = 4\text{ V}$ ,  $I_{DS} = 30\text{ mA}$

frequency (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
100	0.99	-7	4.89	175	0.01	75	0.71	-4
200	0.98	-10	4.79	170	0.01	75	0.71	-5
500	0.97	-20	4.73	160	0.01	75	0.70	-10
1000	0.94	-40	4.36	145	0.02	65	0.70	-25
2000	0.87	-70	3.81	120	0.03	60	0.69	-40
4000	0.74	-115	2.92	85	0.06	30	0.68	-60
6000	0.58	-150	2.30	50	0.07	25	0.67	-75
8000	0.42	170	1.89	20	0.08	20	0.66	-90
10000	0.40	125	1.56	-5	0.11	20	0.64	-110
12000	0.39	60	1.39	-35	0.14	-5	0.63	-130

**CHIP HANDLING****DIE ATTACHMENT**

Die attach can be accomplished with a Au-Sn ( $300 \pm 10$  °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.

Discontinued Product

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Discontinued Product