NEC

HETERO JUNCTION FIELDEFFECT TRANSISTOR

NE321000

C to Ka BAND SUPER LOW NOISE AMPLIFIER N-CHANNEL HJ-FET CHIP

DESCRIPTION

The NE321000 is Hetero Junction FET that utilizes the hetero junction to create high mobility electrons. Its excellent low noise and associated gain make it suitable for DBS and another commercial systems, industrial and space applications.

FEATURES

- Super Low Noise Figure & High Associated Gain
  NF = 0.35 dB TYP. G_a = 13.5 dB TYP. @ f = 12 GHz
- Gate Length: $L_g \leq 0.20$ μm
- Gate Width : W_g = 160 μm

ORDERING INFORMATION (PLAN)

Part Number	Quality Grade
NE321000	Standard (Grade D)

Remark To order evaluation samples, please contact your local NEC sales office. (Part number for sample order: NE321000)

ABSOLUTE MAXIMUM RATINGS (T_A = +25°C)

Parameter	Symbol	Ratings	Unit
Drain to Source Voltage	V_{DS}	4.0	V
Gate to Source Voltage	V_{GS}	–3.0	V
Drain Current	I_D	I_{DSS}	mA
Gate Current	I_G	100	μA
Total Power Dissipation	P_{tot}[Note]	200	mW
Channel Temperature	T_{ch}	175	°C
Storage Temperature	T_{stg}	–65 to +175	°C

Note Chip mounted on an Alumina heatsink (size: $3 \times 3 \times 0.6$ t)

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The mark ★ shows major revised points.

RECOMMENDED OPERATING CONDITIONS (T_A = +25 °C)

	Parameter	Symbol	MIN.	TYP.	MAX.	Unit
★	Drain to Source Voltage	V_{DS}	1	2	3	V
★	Drain Current	I_D	5	10	15	mA
	Input Power	P_{in}	–	–	0	dBm

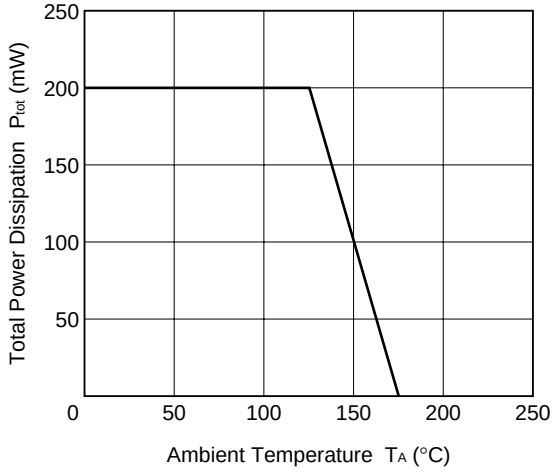
ELECTRICAL CHARACTERISTICS (T_A = +25 °C)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Gate to Source Leak Current	I_{GSO}	V_{GS} = –3 V	–	0.5	10	μA
Saturated Drain Current	I_{DSS}	V_{DS} = 2 V, V_{GS} = 0 V	15	40	70	mA
Gate to Source Cut Off Voltage	$V_{GS(off)}$	V_{DS} = 2 V, I_{DS} = 100 μA	–0.2	–0.7	–2.0	V
Transconductance	g_m	V_{DS} = 2 V, I_{DS} = 10 mA	40	55	–	mS
Noise Figure	NF	V_{DS} = 2 V, I_{DS} = 10 mA f = 12 GHz	–	0.35	0.45	dB
NF Associated Gain	G_a		12.0	13.5	–	dB

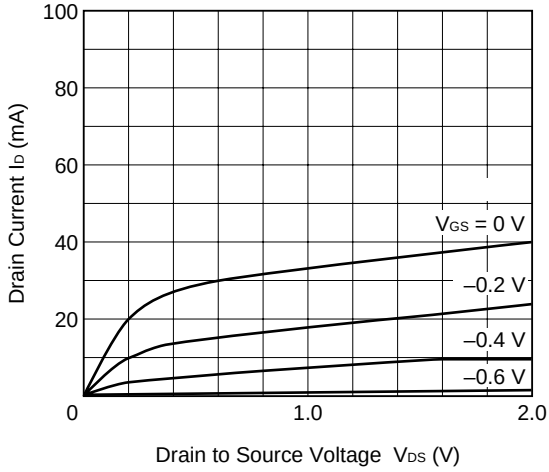
Remark RF performance is determined by packaging and testing 10 chips per wafer.
Wafer rejection criteria for standard devices is 2 rejects per 10 samples.

TYPICAL CHARACTERISTICS (T_A = +25 °C)

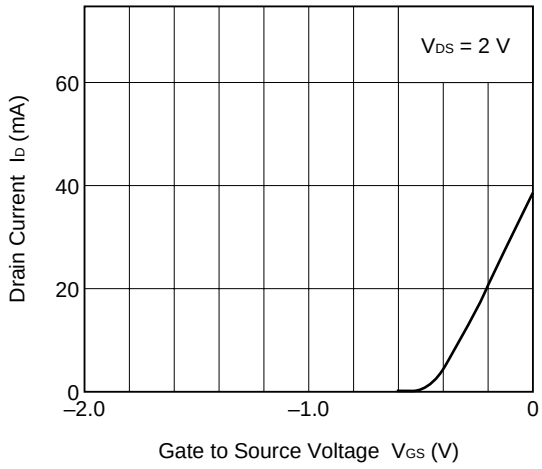
TOTAL POWER DISSIPATION vs.
AMBIENT TEMPERATURE



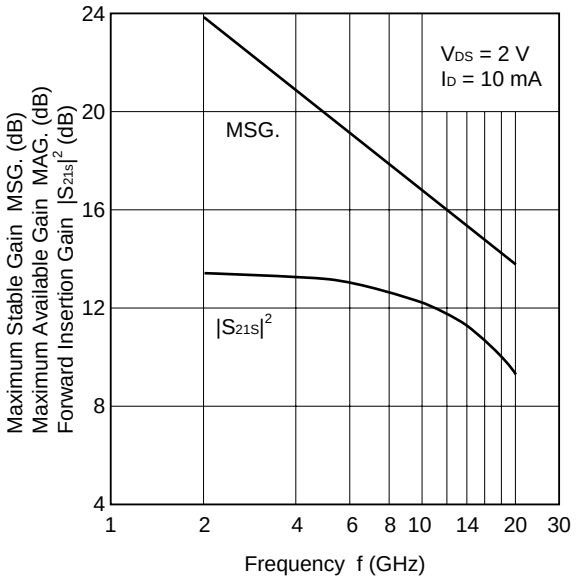
DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE



DRAIN CURRENT vs.
GATE TO SOURCE VOLTAGE



MAXIMUM AVAILABLE GAIN, FORWARD
INSERTION GAIN vs. FREQUENCY

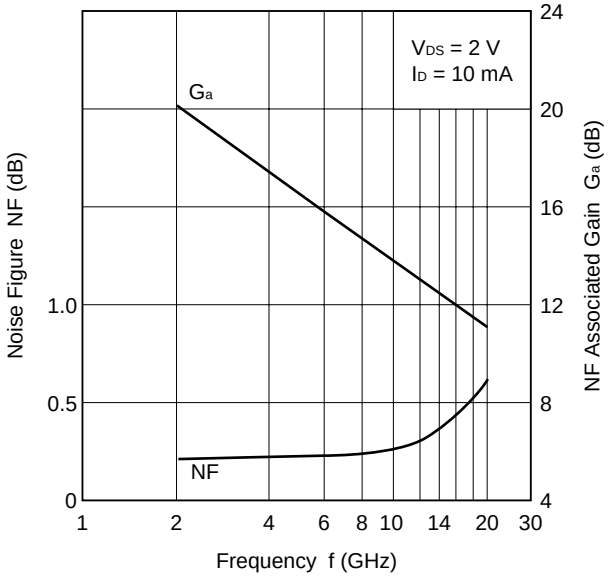


GAIN CALCULATIONS

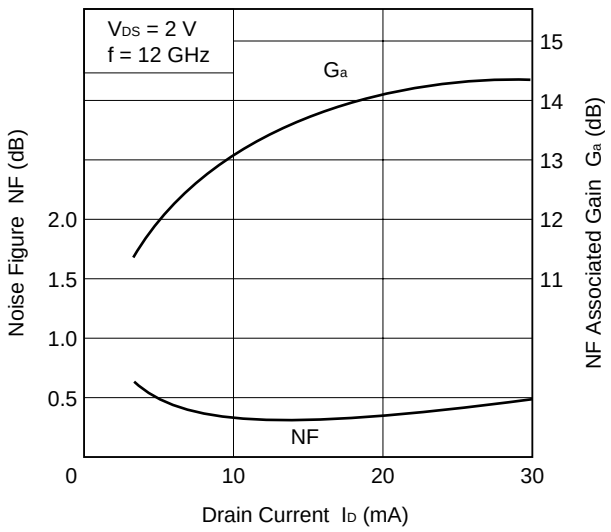
$$MSG. = \left|\frac{S_{21}}{S_{12}}\right| \qquad K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}|\,|S_{21}|}$$

$$MAG. = \left|\frac{S_{21}}{S_{12}}\right| \left(k \pm \sqrt{k^2 - 1}\right) \qquad \Delta = S_{11} \cdot S_{22} - S_{21} \cdot S_{12}$$

NOISE FIGURE, NF ASSOCIATED GAIN vs. FREQUENCY



NOISE FIGURE, NF ASSOCIATED GAIN vs. DRAIN CURRENT



S-PARAMETERS

MAG. AND ANG.

V_{DS} = 2 V, I_D = 10 mA

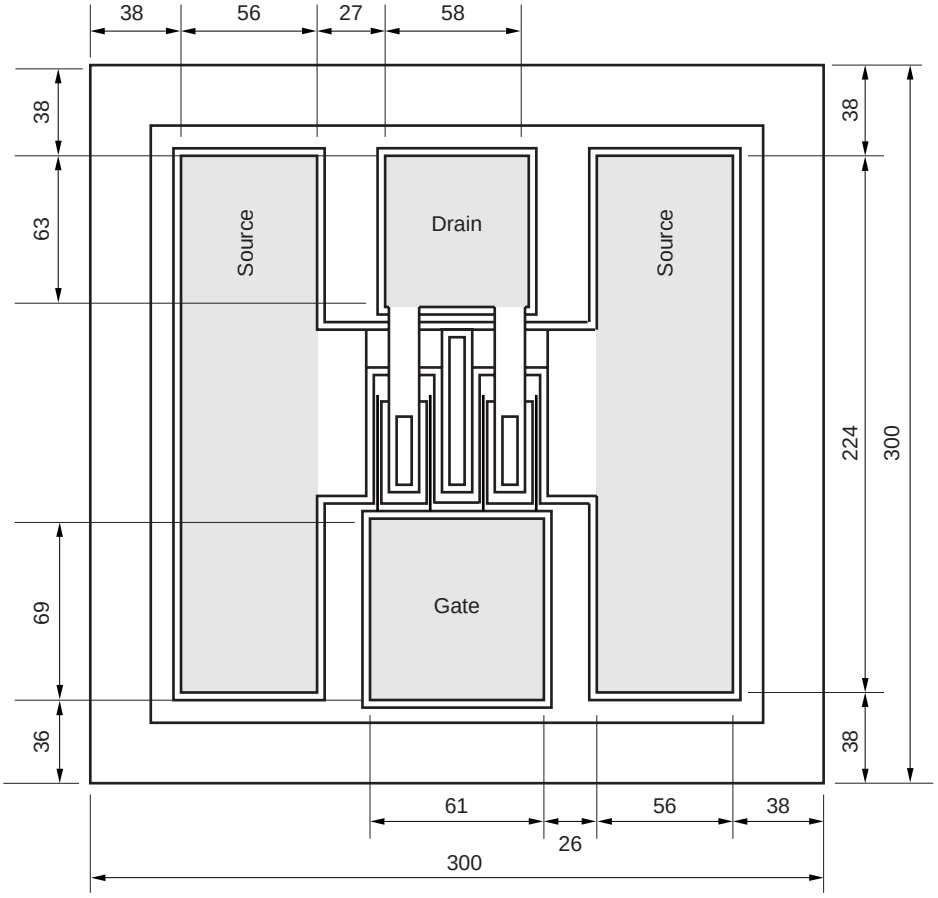
FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.	MAG.	ANG.
2.0	0.998	–13.2	4.72	170.2	0.020	81.3	0.602	–10.0
3.0	0.987	–19.3	4.70	165.6	0.030	77.3	0.599	–14.8
4.0	0.981	–25.7	4.62	160.5	0.040	73.2	0.593	–19.9
5.0	0.970	–32.7	4.50	155.7	0.050	69.4	0.588	–25.6
6.0	0.962	–38.6	4.45	151.6	0.059	65.3	0.583	–30.1
7.0	0.952	–44.4	4.37	147.4	0.067	62.2	0.574	–34.4
8.0	0.941	–50.1	4.28	143.5	0.074	58.6	0.567	–39.1
9.0	0.927	–55.6	4.17	139.7	0.081	55.2	0.564	–43.1
10.0	0.912	–61.5	4.03	135.6	0.087	51.5	0.552	–47.2
11.0	0.898	–66.9	3.90	131.5	0.094	48.0	0.541	–52.0
12.0	0.882	–71.6	3.79	128.0	0.100	44.9	0.536	–55.5
13.0	0.868	–75.9	3.66	124.9	0.104	42.0	0.526	–58.6
14.0	0.855	–80.2	3.54	121.9	0.108	39.0	0.518	–62.1
15.0	0.843	–84.2	3.42	119.0	0.111	36.2	0.509	–65.0
16.0	0.827	–88.5	3.30	115.8	0.115	33.5	0.501	–68.3
17.0	0.807	–92.6	3.16	112.9	0.116	30.5	0.494	–71.2
18.0	0.796	–95.3	3.05	110.8	0.117	28.5	0.488	–73.2
19.0	0.793	–98.0	2.97	108.7	0.120	27.9	0.489	–75.2
20.0	0.788	–101.2	2.89	106.2	0.123	26.5	0.487	–77.4
21.0	0.782	–103.8	2.79	104.1	0.125	24.9	0.484	–80.9
22.0	0.783	–106.4	2.70	101.9	0.128	23.3	0.486	–82.7
23.0	0.785	–109.9	2.62	99.5	0.132	20.7	0.477	–84.1
24.0	0.778	–113.4	2.53	97.4	0.135	18.8	0.474	–87.9
25.0	0.766	–116.0	2.46	95.8	0.135	16.8	0.481	–88.3
26.0	0.757	–118.1	2.40	93.8	0.135	15.3	0.469	–89.2
27.0	0.753	–119.9	2.33	92.5	0.133	14.3	0.463	–91.6
28.0	0.755	–121.6	2.29	90.6	0.136	14.0	0.484	–93.5
29.0	0.748	–124.2	2.23	88.4	0.135	12.6	0.481	–95.2
30.0	0.743	–126.2	2.16	86.8	0.136	11.3	0.475	–97.5

NOISE PARAMETERS

V_{DS} = 2 V, I_D = 10 mA

Freq. (GHz)	NF_{min}. (dB)	G_a (dB)	Γopt		Rn/50
			MAG.	ANG. (deg.)	
2.0	0.21	19.5	0.94	3.7	0.31
4.0	0.22	17.6	0.87	8.2	0.31
6.0	0.24	15.9	0.82	13.3	0.32
8.0	0.26	14.6	0.77	18.8	0.32
10.0	0.28	13.5	0.73	24.8	0.32
12.0	0.31	12.7	0.69	31.4	0.31
14.0	0.38	12.1	0.67	38.4	0.31
16.0	0.45	11.6	0.64	45.9	0.30
18.0	0.52	11.3	0.63	53.9	0.29
20.0	0.59	11.2	0.62	62.4	0.28
22.0	0.66	11.1	0.61	71.4	0.27
24.0	0.72	11.2	0.62	80.8	0.25
26.0	0.79	11.2	0.63	90.8	0.23

CHIP DIMENSIONS (Unit: μm)



Thickness = 140 μm

: BONDING AREA

CHIP HANDLING

DIE ATTACHMENT

Die attach operation can be accomplished with Au-Sn (within a 300 °C – 10 s) performs in a forming gas environment.

Epoxy die attach is not recommend.

BONDING

Bonding wires should be minimum length, semi hard gold wire (3 to 8 % elongation) 20 microns in diameter.

Bonding should be performed with a wedge tip that has a taper of approximately 15 %. Bonding time should be kept to minimum.

As a general rule, the bonding operation should be kept within a 280 °C, 2 minutes for all bonding wires.

If longer periods are required, the temperature should be lowered.

PRECAUTION

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.

Avoid high static voltage and electric fields, because this device is Hetero Junction field effect transistor with shottky barrier gate.

[MEMO]

[MEMO]

[MEMO]

CAUTION

The Great Care must be taken in dealing with the devices in this guide.
The reason is that the material of the devices is GaAs (Gallium Arsenide), which is designated as harmful substance according to the law concerned.
Keep the law concerned and so on, especially in case of removal.

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