NEC®

LOW NOISE Ku-BAND GaAs MESFET

NE13700 NE13783

FEATURES

- **VERY HIGH f_{MAX}: 80 GHz**
- **LOW NOISE FIGURE**
  0.7 dB, GA = 14 dB at 4 GHz
  1.2 dB, GA = 11 dB at 8 GHz
  1.8 dB, GA = 9.5 dB at 12 GHz
  2.5 dB, GA = 7.5 dB at 18 GHz
- **0.5 MICRON RECESSED GATE**
- **PROVEN RELIABILITY AND STABILITY**
- **SPACE QUALIFIED**

DESCRIPTION AND APPLICATIONS

The NE137 features low noise figure and high associated gain thru 18 GHz by employing a recessed 0.5 micron gate.

The device is available as a chip (NE13700) and in a hermetically sealed package (NE13783). The chip's gate and channel are glassivated with a thin layer of SiO_2 for mechanical protection only. The NE13783 is a low cost packaged device for industrial, military and space applications. The NE13783-4 is selected for NF_{OPT} performance at 4 GHz. The NE13783S is selected for NF_{OPT} performance at 12 GHz.

PERFORMANCE SPECIFICATIONS (T_A = 25°C)

PART NUMBER / EIAJ[1] REGISTERED NUMBER / PACKAGE OUTLINE			NE13700 00 (CHIP)			NE13783 2SK280 83			NE13783-4[2] 83			NE13783S 83		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	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		80			80			80			80	
MAG	Maximum Available Gain[3] at V_{DS} = 3 V, I_{DS} = 30 mA,													
	f = 8 GHz	dB		16			16			16			16	
	f = 12 GHz	dB		11			11			11			11	
	f = 18 GHz	dB		8			8			8			8	
NF_{OPT}	Optimum Noise Figure[4] at V_{DS} = 3 V, I_{DS} = 10 mA,													
	f = 4 GHz	dB		0.7			0.7			0.7	0.8		0.7	
	f = 8 GHz	dB		1.2			1.2			1.2			1.2	
	f = 12 GHz	dB		1.8	2.3[5]		1.8	2.3		1.8			1.6	1.8
	f = 18 GHz	dB		2.5										
GA	Associated Gain at Optimum Noise Figure at V_{DS} = 3 V, I_{DS} = 10 mA,													
	f = 4 GHz	dB		14			14			14			14	
	f = 8 GHz	dB		11			11			11			11	
	f = 12 GHz	dB	8[5]	9.5		8	9			9		8.5	9.5	
	f = 18 GHz	dB		7.5										
$P_{1\,dB}$	Output Power at 1 dB Compression Point at V_{DS} = 4 V, I_{DS} = 30 mA, f = 12 GHz	dBm		15			15			15			15	

Notes:

1. Electronic Industrial Association of Japan.
2. NE13783-4 is tested for NF_{OPT} at 4 GHz. The standard NE13783 is not tested at 4 GHz.
3. Gain Calculations: $MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}|\,|S_{21}|}$, $\Delta = S_{11}S_{22} - S_{21}S_{12}$
4. 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.
5. RF performance is determined by packaging and testing 10 samples per wafer; wafer rejection criteria for standard devices is 2 rejects for 10 samples.

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

	PART NUMBER EIAJ[1] REGISTERED NUMBER PACKAGE OUTLINE		NE13700 00 (CHIP)			NE13783 2SK280 83		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX
I_{DSS}	Drain Current at V_{DS} = 3 V, V_{GS} = 0	mA	20	50	100	20	50	100
V_P	Pinch-off Voltage at V_{DS} = 3 V, I_{DS} = 0.1 mA	V	-0.5	-1.1	-6	-0.5	-1.1	-6
g_M	Transconductance at V_{DS} = 3 V, I_{DS} = 10 mA	mS	20	45	100	20	45	100
I_{GS}	Gate to Source Leakage Current at V_{GS} = -5 V	µA		1	10		1	10
R_{TH}	Thermal Resistance (Channel-to-Ambient)	°C/W			190[2]			450
P_T	Total Power Dissipation	mW			400[2,3]			270[4]

Notes:
1. Electronic Industrial Association of Japan.
2. R_{TH} (channel to case) for chips mounted on a copper heatsink.
3. T_A = 100°C
4. T_A = 50°C

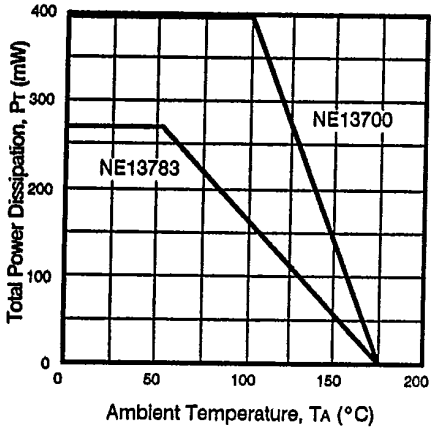
ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

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	100
P_{IN}	RF Input Power	mW	40
T_{CH}	Channel Temperature	°C	175
T_{STG}	Storage Temperature	°C	-65 to +175

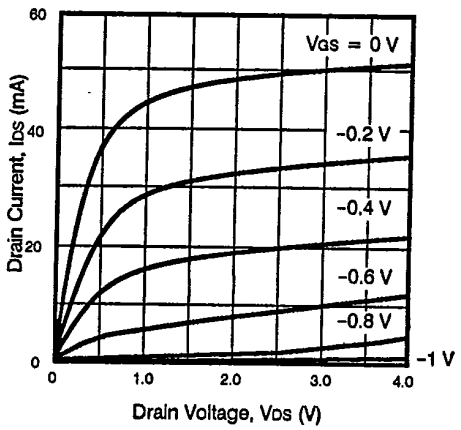
3

TYPICAL DEVICE CHARACTERISTICS (T_A = 25°C)

POWER DERATING CURVE

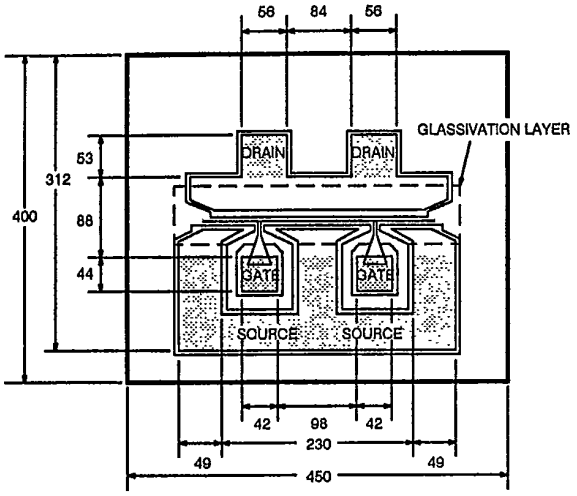


DC PERFORMANCE



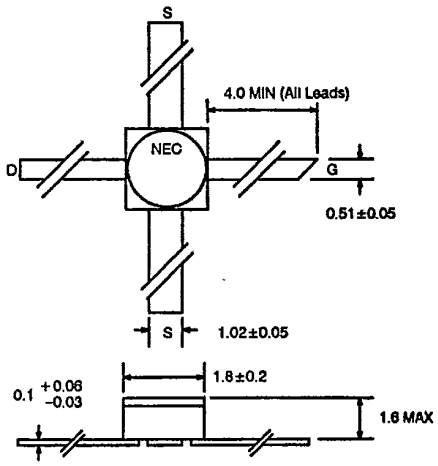
OUTLINE DIMENSIONS

NE13700 (CHIP)
(Units in µm)



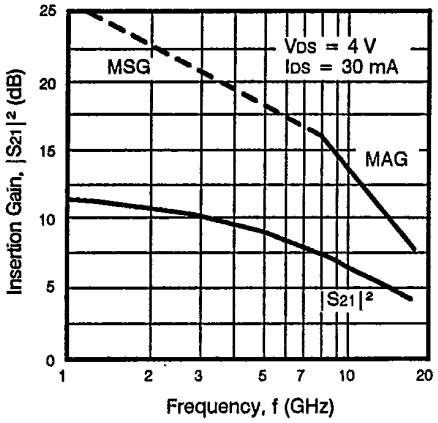
Bonding Pad Area. Chip Thickness: 140 µm

83 OUTLINE
(Units in mm)

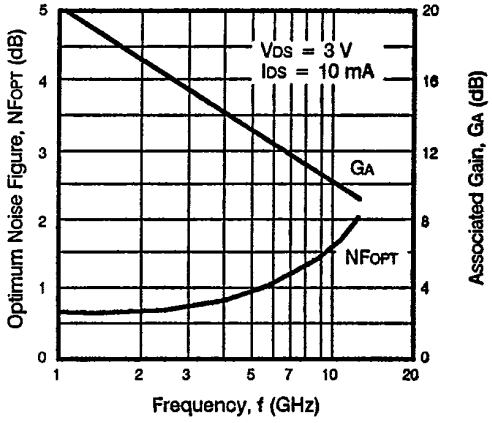


TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C)

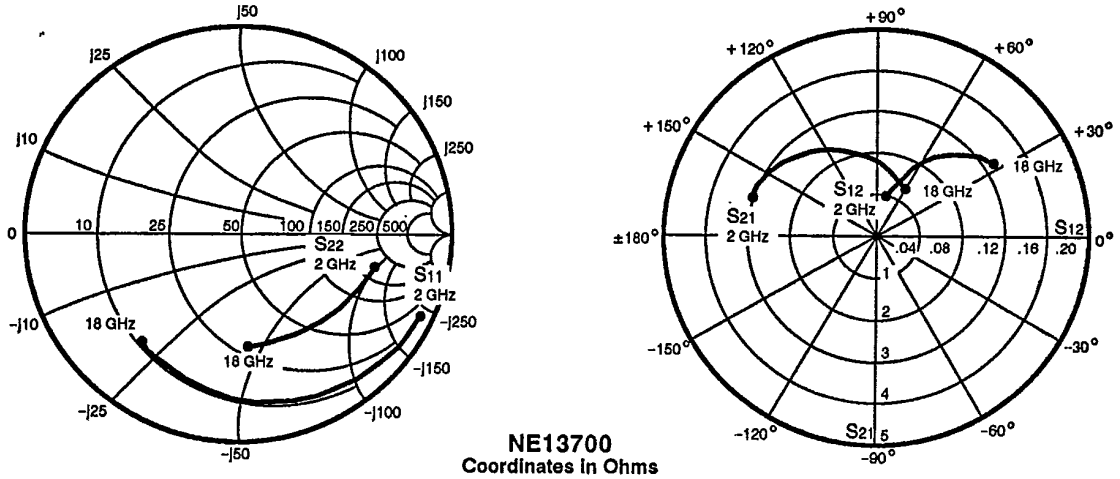
NE13783
TYPICAL GAIN vs. FREQUENCY



NE13783
NOISE FIGURE AND ASSOCIATED GAIN vs. FREQUENCY



TYPICAL COMMON SOURCE SCATTERING PARAMETERS



NE13700
Coordinates in Ohms
Frequency in GHz
(V_{DS} = 3 V, I_{DS} = 10 mA)

S-MAGN AND ANGLES:

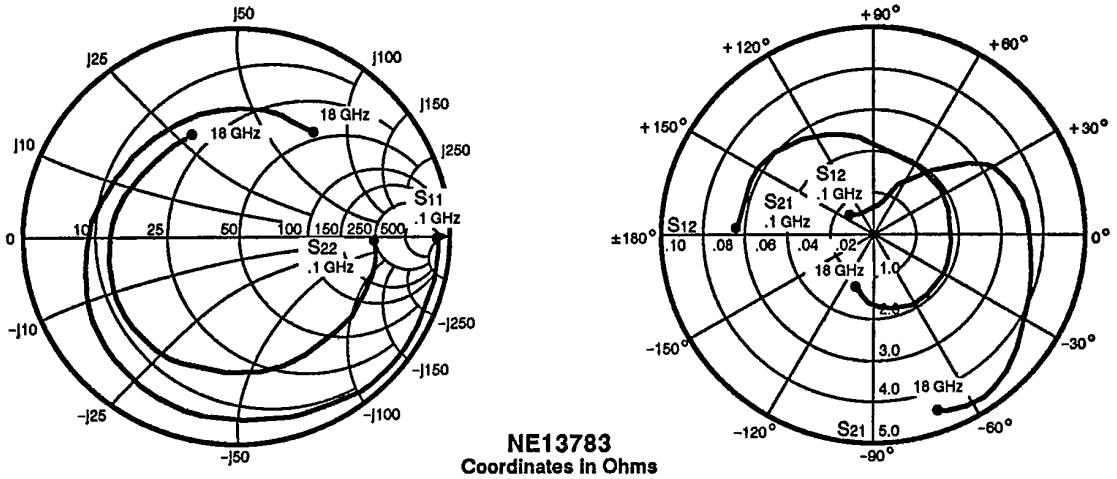
V_{DS} = 3 V, I_{DS} = 10 mA

FREQUENCY (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
2000	.97	-24	3.02	159	.04	77	.71	-14
3000	.94	-36	2.92	149	.06	69	.70	-20
4000	.91	-48	2.75	138	.07	63	.69	-26
5000	.87	-57	2.64	130	.08	57	.66	-31
6000	.85	-66	2.48	123	.09	55	.66	-36
7000	.81	-74	2.37	115	.10	50	.62	-40
8000	.78	-81	2.23	109	.11	45	.60	-43
9000	.76	-89	2.07	103	.11	43	.59	-47
10000	.73	-96	1.97	97	.12	40	.61	-51
11000	.72	-104	1.88	90	.12	37	.55	-55
12000	.71	-109	1.76	85	.12	36	.54	-59
13000	.70	-114	1.70	80	.12	33	.53	-64
14000	.68	-110	1.62	78	.12	35	.53	-68
15000	.68	-124	1.53	71	.12	31	.53	-73
16000	.67	-126	1.46	68	.13	30	.54	-77
17000	.64	-130	1.42	63	.12	32	.55	-80
18000	.65	-133	1.32	60	.13	33	.57	-82

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

2000	.95	-26	3.57	157	.04	76	.66	-14
3000	.93	-40	3.53	147	.05	69	.65	-20
4000	.89	-52	3.23	136	.06	62	.63	-26
5000	.86	-63	3.08	127	.07	56	.60	-31
6000	.83	-71	2.88	121	.08	55	.59	-36
7000	.80	-80	2.70	113	.09	50	.58	-40
8000	.78	-87	2.58	108	.09	47	.57	-42
9000	.75	-95	2.31	101	.09	44	.56	-46
10000	.73	-102	2.23	96	.10	42	.54	-49
11000	.68	-109	2.07	88	.10	41	.51	-52
12000	.70	-116	2.01	84	.10	39	.48	-56
13000	.70	-122	1.84	78	.10	37	.49	-64
14000	.74	-126	1.83	77	.11	40	.51	-70
15000	.68	-129	1.01	68	.10	36	.52	-74
16000	.67	-130	1.62	68	.12	36	.53	-75
17000	.61	-134	1.53	61	.12	38	.51	-76
18000	.65	-136	1.48	57	.11	40	.54	-73

TYPICAL COMMON SOURCE SCATTERING PARAMETERS



NE13783
Coordinates in Ohms
Frequency in GHz
(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}	
100	1.00	-3	3.07	176	.01	134	.74	-2
500	.99	-11	3.14	167	.01	76	.74	-7
1000	.99	-24	3.05	159	.01	79	.75	-17
1500	.98	-35	2.97	147	.02	60	.74	-23
2000	.97	-44	2.95	137	.03	52	.75	-32
4000	.88	-76	2.40	108	.06	33	.66	-56
6000	.84	-100	2.14	80	.07	19	.68	-76
8000	.77	-124	1.93	54	.07	6	.66	-93
10000	.68	-147	1.80	32	.07	-4	.63	-108
12000	.58	180	1.72	1	.07	-14	.60	-125
14000	.54	134	1.60	-28	.08	-27	.53	-150
16000	.61	87	1.21	-63	.09	-41	.48	167
18000	.65	49	1.15	-102	.09	-68	.50	109

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

100	1.00	-3	3.83	176	.02	58	.69	-3
500	.99	-14	3.92	166	.01	75	.69	-6
1000	.99	-25	3.80	158	.01	76	.70	-16
1500	.97	-37	3.69	146	.02	61	.70	-23
2000	.97	-48	3.64	135	.02	64	.70	-32
4000	.89	-80	3.02	105	.04	38	.62	-55
6000	.81	-103	2.62	78	.05	25	.63	-73
8000	.73	-127	2.29	51	.06	16	.63	-90
10000	.64	-148	2.15	29	.06	11	.61	-104
12000	.52	178	2.10	-2	.07	4	.58	-119
14000	.50	131	1.99	-32	.09	-9	.52	-141
16000	.57	84	1.90	-66	.11	-24	.44	179
18000	.64	46	1.59	-104	.11	-54	.44	118