NEC

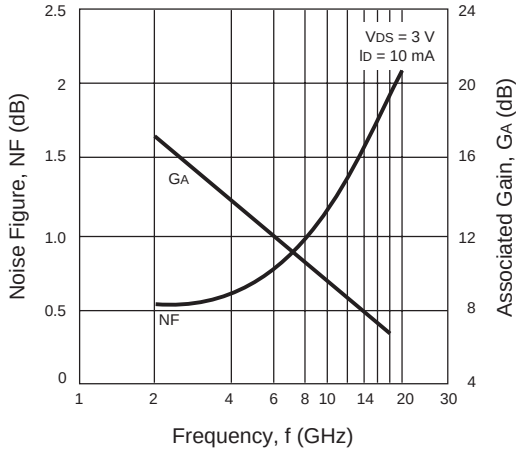
L to Ku Band Low Noise N-Channel GaAs MESFET

NE71383B

FEATURES

- **LOW NOISE FIGURE:**
  NF = 0.6 dB typ at f = 4 GHz
  NF = 1.6 dB typ at f = 12 GHz
- **HIGH ASSOCIATED GAIN:**
  14 dB typ at f = 4 GHz
- **GATE WIDTH:** W_G = 280 µm
- **GATE LENGTH:** L_G = 0.3 µm
- **EPITAXIAL TECHNOLOGY**
- **LOW PHASE NOISE PERFORMANCE**

NOISE FIGURE, ASSOCIATED GAIN vs. FREQUENCY



DESCRIPTION

The NE71383B is a high performance GaAs MESFET providing a low noise figure and high associated gain through Ku-band. This device features a recessed 0.3 micron gate and triple epitaxial technology, and is ideal for low phase noise oscillator and buffer amplifier applications. The NE71383B is housed in a hermetically sealed metal/ceramic package.

NEC's stringent quality assurance and test procedures ensure the highest reliability and performance.

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER PACKAGE OUTLINE			NE71383B 83B		
SYMBOLS	**PARAMETERS AND CONDITIONS**	**UNITS**	**MIN**	**TYP**	**MAX**
NF	Noise Figure , V_{DS} = 3V, I_{DS} = 10 mA, f = 4 GHz V_{DS} = 3V, I_{DS} = 10 mA, f = 12 GHz	dB mS		0.6 1.6	0.7 1.8
G_A	Associated Gain, V_{DS} = 3V, I_{DS} = 10 mA, f = 4 GHz V_{DS} = 3V, I_{DS} = 10 mA, f = 12 GHz	dB dB	11.5 8.0	14.0 9.5	
P_{1dB}	Output Power at 1 dB Gain Compression Point, V_{DS} = 3 V, I_{DS} = 30 mA, f = 12 GHz	dBm		14.5	
I_{DSS}	Saturated Drain Current, V_{DS} = 3 V, V_{GS} = 0 V	mA	20	40	120
g_M	Transconductance, V_{DS} = 3 V, I_{DS} = 10 mA	mS	20	50	
I_{GSO}	Gate to Source Leakage Current, V_{GS} = -5 V	µA		1.0	10
$V_{GS(off)}$	Gate to Source Cutoff Voltage, V_{DS} = 3 V, I_{DS} = 100 µA	V	-0.5	-1.1	-3.5
R_{TH}	Thermal Resistance (Channel to Case)	°C/W			450

ABSOLUTE MAXIMUM RATINGS[1] (T_A = 25°C)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{DS}	Drain to Source Voltage	V	5.0
V_{GSO}	Gate to Source Voltage	V	–5.0
I_{DS}	Drain Current	mA	I_{DSS}
V_{GDO}	Gate to Drain Voltage	V	-6.0
T_{CH}	Channel Temperature	°C	175
T_{STG}	Storage Temperature	°C	-65 to +175
P_T	Total Power Dissipation	mW	270

Note:
1. Operation in excess of any one of these conditions may result in permanent damage.

RECOMMENDED OPERATING CONDITIONS

SYMBOLS	PARAMETERS	UNITS	MIN	TYP	MAX
V_{DS}	Drain to Source Voltage	V		3	4
I_D	Drain Current	mA		10	30
P_{IN}	Input Power	dBm			15

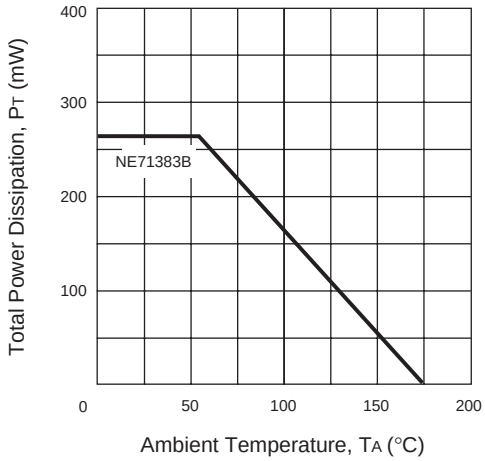
TYPICAL NOISE PARAMETERS (T_A = 25°C)

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

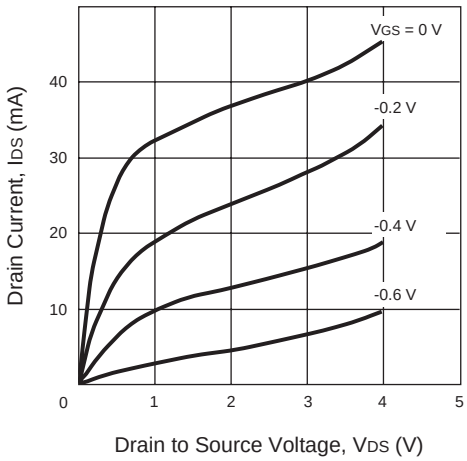
FREQ. (GHz)	NF_{OPT} (dB)	G_A (dB)	Γ_{OPT} MAG	Γ_{OPT} ANG	Rn/50
2.0	0.55	17.0	0.81	37	0.57
3.0	0.58	15.2	0.75	53	0.51
4.0	0.60	14.0	0.70	69	0.44
5.0	0.71	13.0	0.67	83	0.37
6.0	0.80	12.3	0.65	97	0.31
7.0	0.90	11.6	0.64	111	0.25
8.0	1.00	11.0	0.64	123	0.19
9.0	1.15	10.4	0.64	136	0.14
10.0	1.30	10.0	0.64	148	0.10
11.0	1.45	9.5	0.64	161	0.06
12.0	1.60	9.0	0.63	173	0.05
13.0	1.75	8.6	0.62	-173	0.05
14.0	1.90	8.2	0.60	-159	0.08
15.0	2.04	8.0	0.57	-145	0.15
16.0	2.25	7.6	0.53	-129	0.23
17.0	2.38	7.3	0.46	-113	0.34
18.0	2.55	7.0	0.38	-95	0.44

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

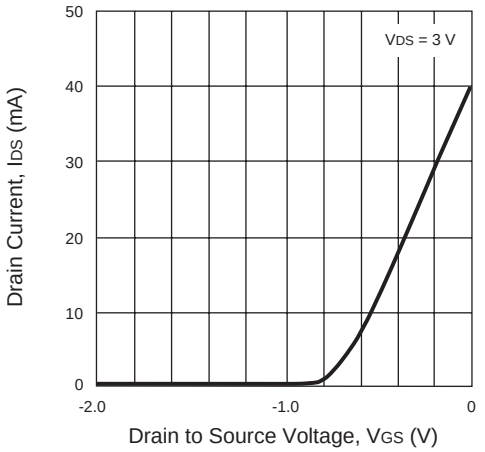
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



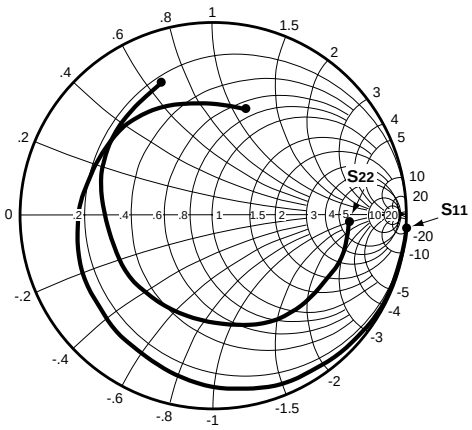
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE

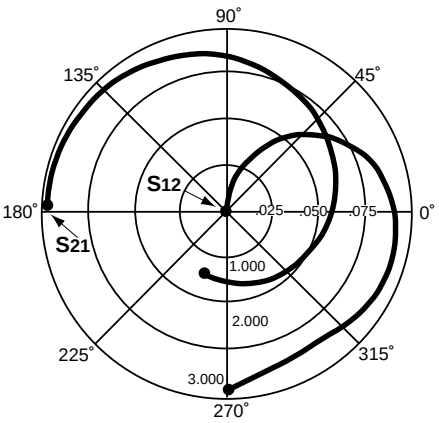


DRAIN CURRENT vs. GATE TO SOURCE VOLTAGE



TYPICAL COMMON SOURCE SCATTERING PARAMETERS (T_A = 25°C)





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

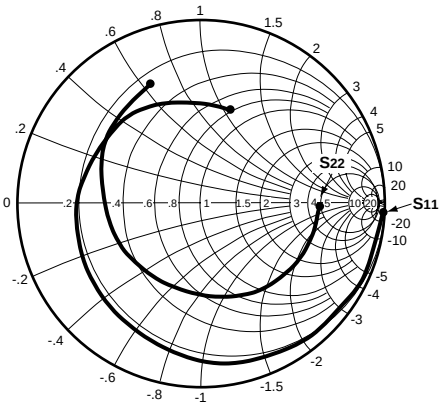
FREQUENCY	S11		S21		S12		S22		K	MAG[1]
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	1.001	-2.14	3.230	178.00	0.002	87.30	0.705	-1.39	-0.060	32.088
0.50	0.997	-10.89	3.230	169.69	0.011	81.94	0.702	-7.48	0.061	24.678
1.00	0.987	-21.63	3.198	159.56	0.022	74.10	0.695	-14.99	0.127	21.625
1.50	0.977	-32.12	3.165	149.72	0.032	66.76	0.687	-22.34	0.158	19.952
2.00	0.963	-42.61	3.131	139.95	0.043	59.19	0.678	-29.71	0.196	18.622
2.50	0.949	-53.03	3.084	130.17	0.052	51.65	0.667	-37.07	0.231	17.731
3.00	0.934	-63.35	3.033	120.45	0.060	44.49	0.653	-44.51	0.262	17.037
3.50	0.912	-73.70	2.971	110.66	0.068	37.23	0.638	-52.08	0.311	16.404
4.00	0.890	-83.94	2.900	101.02	0.074	30.07	0.622	-59.69	0.359	15.932
4.50	0.864	-93.86	2.809	91.47	0.080	23.11	0.603	-67.53	0.417	15.455
5.00	0.835	-103.65	2.716	82.14	0.084	16.62	0.583	-75.33	0.487	15.097
5.50	0.808	-112.98	2.626	73.20	0.087	10.30	0.564	-83.34	0.555	14.798
6.00	0.785	-121.98	2.540	64.80	0.090	4.36	0.549	-91.44	0.607	14.506
6.50	0.766	-130.87	2.450	56.31	0.092	-1.43	0.537	-99.73	0.655	14.254
7.00	0.752	-139.43	2.374	47.88	0.093	-6.91	0.529	-107.98	0.694	14.070
7.50	0.739	-147.72	2.297	39.58	0.093	-12.26	0.524	-116.19	0.737	13.927
8.00	0.730	-155.90	2.222	31.56	0.094	-17.22	0.525	-124.33	0.755	13.736
8.50	0.714	-163.63	2.143	23.28	0.093	-21.98	0.526	-132.32	0.817	13.625
9.00	0.704	-171.19	2.076	15.25	0.093	-26.66	0.529	-140.37	0.850	13.487
9.50	0.690	-178.78	2.000	7.23	0.092	-31.23	0.532	-148.27	0.913	13.372
10.00	0.675	173.92	1.909	-0.71	0.091	-35.42	0.535	-156.31	0.992	13.218
10.50	0.661	166.65	1.840	-8.30	0.089	-39.35	0.539	-164.00	1.074	11.493
11.00	0.648	159.39	1.774	-15.57	0.088	-42.96	0.545	-171.63	1.140	10.772
11.50	0.639	152.99	1.700	-21.98	0.087	-46.30	0.556	-179.03	1.193	10.254
12.00	0.639	146.35	1.646	-29.27	0.086	-49.43	0.568	173.97	1.204	10.087
12.50	0.637	139.92	1.598	-36.37	0.085	-52.43	0.585	167.46	1.206	10.000
13.00	0.634	133.24	1.550	-43.53	0.085	-55.47	0.603	161.35	1.192	9.961
13.50	0.629	126.90	1.499	-50.71	0.084	-58.63	0.621	155.40	1.205	9.781
14.00	0.621	120.42	1.453	-57.91	0.085	-61.82	0.638	149.95	1.194	9.667
14.50	0.608	114.04	1.401	-64.75	0.085	-65.09	0.649	144.57	1.244	9.192
15.00	0.598	107.64	1.357	-71.74	0.086	-68.61	0.658	139.23	1.269	8.862
15.50	0.585	101.18	1.320	-78.79	0.086	-72.28	0.664	134.14	1.329	8.430
16.00	0.576	94.99	1.282	-85.50	0.087	-75.68	0.670	128.95	1.357	8.114
16.50	0.571	89.08	1.249	-91.80	0.089	-79.08	0.678	123.94	1.340	7.987
17.00	0.567	83.11	1.218	-98.38	0.090	-82.47	0.688	119.40	1.327	7.893
17.50	0.566	77.63	1.193	-104.91	0.093	-85.99	0.701	114.96	1.249	8.075
18.00	0.568	72.06	1.179	-111.27	0.096	-89.67	0.717	110.87	1.138	8.635

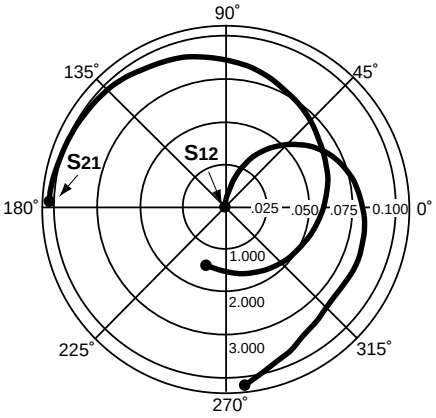
Notes:
1.Gain Calculations:

$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When $K \le 1$, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available gain
MSG = Maximum Stable Gain

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)





V_D = 3 V, I_{DS} = 20 mA

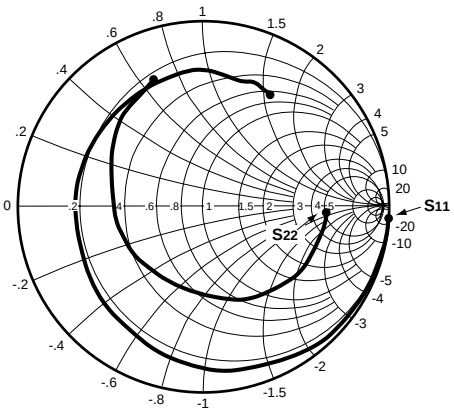
FREQUENCY	S11		S21		S12		S22		K	MAG[1]
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	1.001	-2.26	3.856	177.97	0.002	85.09	0.664	-1.46	-0.031	32.851
0.50	0.997	-11.39	3.845	169.36	0.010	82.02	0.660	-7.51	0.060	25.849
1.00	0.985	-22.63	3.799	158.95	0.020	74.19	0.653	-15.03	0.141	22.786
1.50	0.973	-33.57	3.749	148.84	0.029	66.92	0.645	-22.39	0.179	21.115
2.00	0.957	-44.49	3.693	138.84	0.038	59.46	0.635	-29.74	0.222	19.876
2.50	0.940	-55.30	3.623	128.88	0.046	52.14	0.623	-37.08	0.262	18.963
3.00	0.921	-65.94	3.545	119.01	0.054	45.23	0.609	-44.41	0.300	18.172
3.50	0.897	-76.59	3.455	109.14	0.060	38.23	0.593	-51.88	0.355	17.603
4.00	0.872	-87.05	3.355	99.47	0.066	31.47	0.576	-59.36	0.408	17.061
4.50	0.843	-97.16	3.234	89.95	0.070	24.96	0.557	-67.04	0.480	16.646
5.00	0.813	-107.09	3.112	80.68	0.074	18.97	0.538	-74.69	0.552	16.238
5.50	0.786	-116.54	2.996	71.83	0.077	13.18	0.519	-82.59	0.621	15.901
6.00	0.762	-125.62	2.887	63.54	0.079	7.81	0.504	-90.60	0.684	15.628
6.50	0.744	-134.59	2.776	55.15	0.081	2.63	0.493	-98.82	0.731	15.349
7.00	0.729	-143.20	2.682	46.82	0.082	-2.23	0.486	-107.02	0.775	15.146
7.50	0.716	-151.52	2.588	38.64	0.083	-6.93	0.482	-115.15	0.814	14.939
8.00	0.707	-159.71	2.497	30.74	0.083	-11.25	0.483	-123.24	0.846	14.783
8.50	0.691	-167.44	2.403	22.57	0.083	-15.39	0.485	-131.18	0.905	14.617
9.00	0.681	-174.99	2.324	14.65	0.084	-19.45	0.489	-139.19	0.931	14.420
9.50	0.667	177.44	2.235	6.79	0.084	-23.41	0.493	-147.05	0.989	14.250
10.00	0.652	170.14	2.133	-1.00	0.083	-27.03	0.497	-155.06	1.075	12.433
10.50	0.638	162.87	2.055	-8.49	0.083	-30.53	0.503	-162.73	1.135	11.706
11.00	0.626	155.54	1.980	-15.66	0.083	-33.73	0.510	-170.38	1.188	11.152
11.50	0.617	149.12	1.898	-22.03	0.083	-36.77	0.522	-177.80	1.230	10.699
12.00	0.616	142.52	1.838	-29.29	0.083	-39.73	0.536	175.18	1.231	10.555
12.50	0.614	136.10	1.784	-36.37	0.083	-42.65	0.554	168.69	1.221	10.487
13.00	0.611	129.41	1.729	-43.52	0.084	-45.69	0.573	162.62	1.195	10.463
13.50	0.604	123.13	1.671	-50.70	0.085	-48.97	0.592	156.70	1.186	10.324
14.00	0.595	116.67	1.619	-57.89	0.086	-52.39	0.610	151.32	1.182	10.169
14.50	0.581	110.37	1.560	-64.75	0.088	-55.97	0.622	146.02	1.203	9.767
15.00	0.570	104.05	1.510	-71.71	0.090	-59.88	0.633	140.71	1.210	9.478
15.50	0.556	97.62	1.468	-78.73	0.091	-63.97	0.641	135.66	1.248	9.081
16.00	0.547	91.51	1.425	-85.44	0.093	-67.78	0.649	130.49	1.254	8.820
16.50	0.542	85.69	1.388	-91.76	0.094	-71.67	0.658	125.48	1.255	8.655
17.00	0.536	79.74	1.353	-98.43	0.097	-75.57	0.669	120.97	1.219	8.622
17.50	0.534	74.37	1.325	-105.03	0.100	-79.66	0.683	116.55	1.154	8.841
18.00	0.534	68.95	1.307	-111.50	0.103	-83.80	0.700	112.50	1.063	9.496

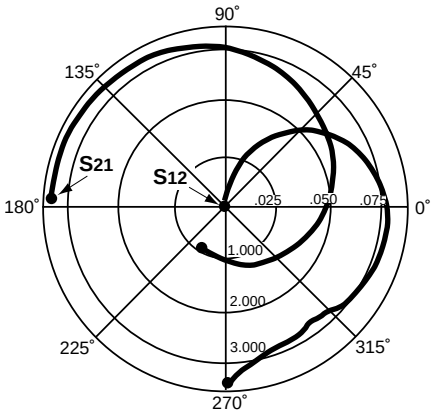
Notes:
1.Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right).$$ When K ≤ 1, MAG is undefined and MSG values are used. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available gain
MSG = Maximum Stable Gain

TYPICAL SCATTERING PARAMETERS (T_A = 25°C)





V_D = 4 V, I_{DS} = 30 mA

FREQUENCY	S11		S21		S12		S22		K	MAG[1]
(GHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	1.000	-2.28	3.808	177.83	0.002	92.50	0.660	-1.60	-0.045	32.797
0.50	0.996	-11.29	3.804	169.37	0.010	82.15	0.657	-7.34	0.077	25.802
1.00	0.987	-22.92	3.781	158.72	0.019	74.62	0.652	-14.61	0.130	22.989
1.50	0.974	-34.10	3.746	148.29	0.028	67.04	0.643	-21.85	0.182	21.264
2.00	0.958	-45.19	3.722	138.01	0.037	59.29	0.633	-29.16	0.230	20.026
2.50	0.935	-57.01	3.693	127.43	0.045	52.01	0.619	-36.62	0.286	19.142
3.00	0.911	-69.44	3.645	116.64	0.053	44.39	0.603	-44.16	0.332	18.374
3.50	0.882	-81.79	3.567	105.90	0.059	36.63	0.586	-51.76	0.397	17.815
4.00	0.852	-93.85	3.481	95.44	0.065	29.10	0.566	-59.54	0.458	17.288
4.50	0.814	-106.29	3.364	84.79	0.070	21.86	0.544	-67.41	0.543	16.818
5.00	0.775	-119.11	3.240	74.20	0.073	14.82	0.519	-75.62	0.640	16.472
5.50	0.745	-131.62	3.113	64.08	0.076	8.09	0.495	-84.09	0.715	16.124
6.00	0.724	-143.56	2.992	54.70	0.077	1.84	0.473	-92.51	0.785	15.895
6.50	0.706	-155.30	2.860	45.24	0.078	-4.10	0.455	-101.69	0.852	15.643
7.00	0.694	-166.88	2.735	35.61	0.078	-9.64	0.444	-110.69	0.912	15.449
7.50	0.689	-178.03	2.609	26.25	0.078	-14.94	0.439	-120.04	0.952	15.244
8.00	0.688	171.13	2.486	16.98	0.078	-19.89	0.439	-129.02	0.980	15.034
8.50	0.683	160.57	2.356	7.58	0.077	-24.71	0.443	-137.90	1.040	13.631
9.00	0.679	151.06	2.221	-1.07	0.076	-28.84	0.451	-146.73	1.103	12.703
9.50	0.679	142.40	2.093	-9.33	0.075	-32.87	0.456	-155.17	1.169	11.970
10.00	0.679	134.32	1.963	-17.41	0.074	-36.83	0.464	-163.64	1.243	11.270
10.50	0.681	126.52	1.864	-25.44	0.073	-40.71	0.472	-171.91	1.299	10.792
11.00	0.685	119.38	1.763	-32.78	0.071	-43.87	0.482	-179.93	1.373	10.307
11.50	0.695	113.23	1.667	-39.42	0.070	-46.77	0.494	172.40	1.397	10.017
12.00	0.707	107.53	1.584	-46.72	0.069	-49.31	0.510	165.44	1.391	9.882
12.50	0.715	102.29	1.510	-54.01	0.068	-51.91	0.533	158.79	1.377	9.803
13.00	0.723	96.42	1.445	-61.11	0.069	-54.19	0.557	152.66	1.299	9.929
13.50	0.720	90.80	1.371	-68.56	0.070	-56.99	0.583	147.12	1.285	9.712
14.00	0.719	86.16	1.296	-75.34	0.070	-60.82	0.607	141.60	1.291	9.436
14.50	0.716	82.50	1.226	-81.59	0.070	-64.39	0.627	136.93	1.319	9.051
15.00	0.707	78.94	1.168	-87.90	0.071	-68.22	0.643	132.24	1.359	8.582
15.50	0.697	74.87	1.127	-94.19	0.072	-71.51	0.656	127.86	1.393	8.211
16.00	0.697	70.94	1.087	-100.28	0.073	-75.00	0.666	123.95	1.386	8.028
16.50	0.706	68.62	1.049	-105.05	0.074	-78.24	0.676	120.28	1.327	8.094
17.00	0.711	66.93	1.026	-110.80	0.075	-81.20	0.690	116.91	1.250	8.352
17.50	0.706	64.06	1.017	-116.96	0.078	-84.63	0.709	113.83	1.140	8.880
18.00	0.710	60.15	1.020	-123.51	0.083	-88.75	0.728	110.79	0.944	10.895

Notes:
1.Gain Calculations:

$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$. When $K \le 1$, MAG is undefined and MSG values are used. $MSG = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available gain
MSG = Maximum Stable Gain

NONLINEAR MODEL

FET NONLINEAR MODEL PARAMETERS (1)

Parameters	Q1	Parameters	Q1
VTO	-1.04	RG	6
VTOSC	0	RD	2
ALPHA	4.5	RS	2
BETA	0.0409	RGMET	0
GAMMA	0.076	KF	0
GAMMADC	0.05	AF	1
Q	1.9	TNOM	27
DELTA	0.42	XTI	3
VBI	1	EG	1.43
IS	7.3e-12	VTOTC	0
N	1.2	BETATCE	0
RIS	0	FFE	1
RID	0		
TAU	6e-12		
CDS	0.25e-12		
RDB	2000		
CBS	1e-9		
CGSO	0.5e-12		
CGDO	0.04e-12		
DELTA 1	0.3		
DELTA 2	0.2		
FC	0.5		
VBR	Infinity		

(1) Series IV Libra TOM Model

UNITS

Parameter	Units
time	seconds
capacitance	farads
inductance	henries
resistance	ohms
voltage	volts
current	amps

MODEL RANGE

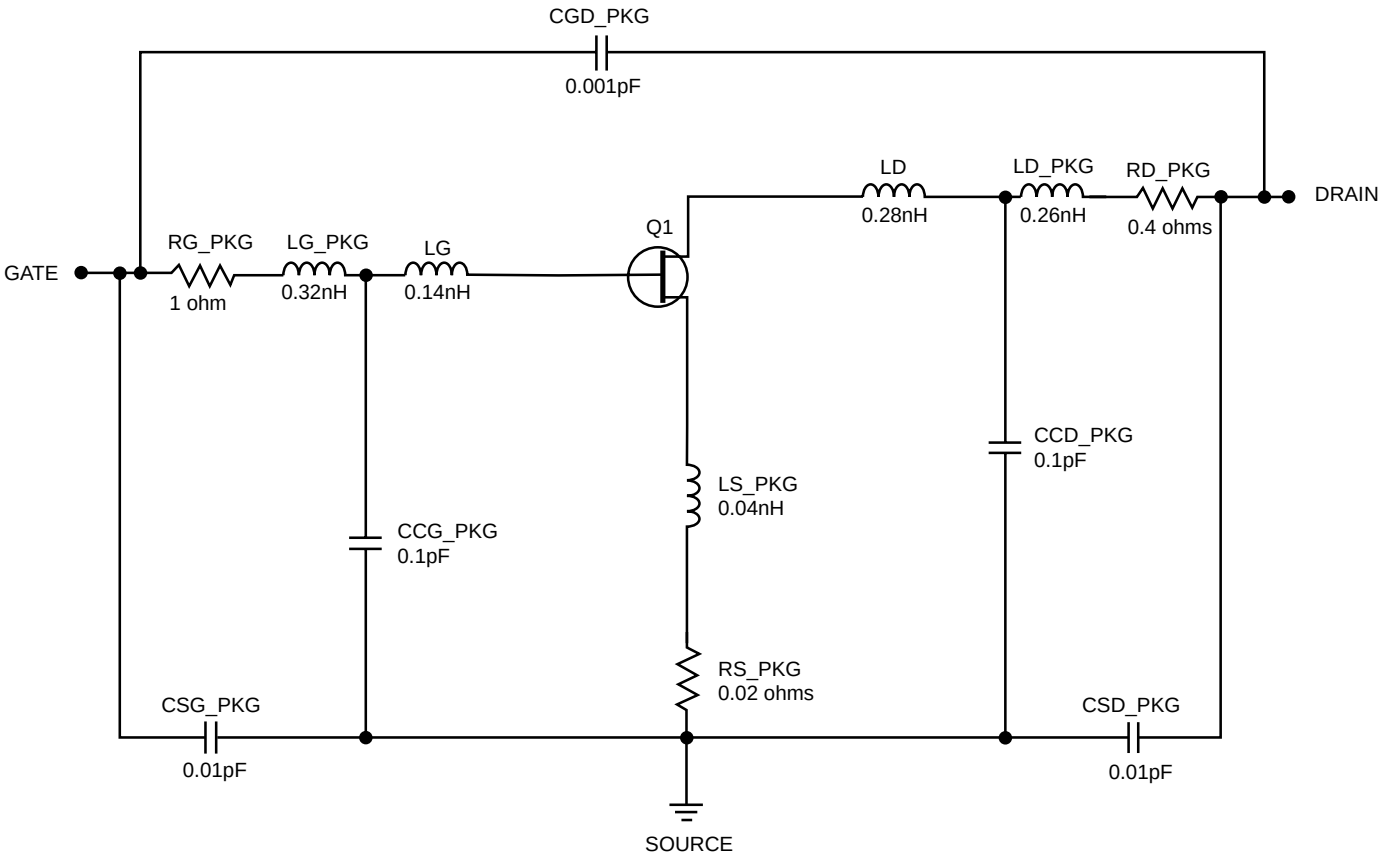
Frequency: 0.1 to 18 GHz

Bias: V_{DS} = 2 V to 4 V, I_D = 10 mA to 30 mA
I_{DSS} = 45.56 mA @ V_{GS} = 0,
V_{DS} = 3 V

Date: 1/98

NONLINEAR MODEL

SCHEMATIC



MODEL RANGE

Frequency:	0.1 to 18 GHz
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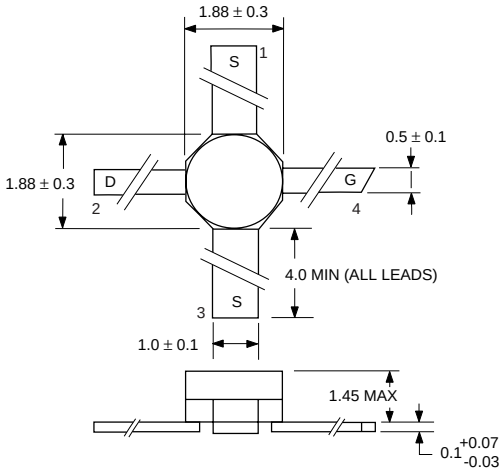
	I_{DSS} = 45.56 mA @ V_{GS} = 0,
	V_{DS} = 3 V
Date:	1/98

OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE 83B



1. Source
2. Drain
3. Source
4. Gate

ORDERING INFORMATION

PART NUMBER	IDSS (mA)	PACKAGE OUTLINE
NE71383B	20 to 120	83B