NEC

C-BAND MEDIUM POWER GaAs MESFET

NE8500100
NE8500199

FEATURES

- **HIGH OUTPUT POWER:** 1 W
- **HIGH LINEAR GAIN:** 9.0 dB
- **HIGH EFFICIENCY:** 37% (PAE)
- **INDUSTRY STANDARD PACKAGING**
- **THIS DEVICE IS ALSO AVAILABLE AS A TWO-CELL CHIP: NE8500100**

DESCRIPTION

The NE8500199 is a medium power GaAs MESFET designed for up to a 1W output stage or as a driver for higher power devices. The device has no internal matching and can be used at frequencies from UHF to 8.5 GHz. The device is available in the "99" package or in chip form. The chip is a two-cell die; bonding both cells delivers the rated performance.

The NE850 Series Transistors are manufactured to NEC's stringent quality assurance standards to ensure highest reliability and consistent superior performance.

ABSOLUTE MAXIMUM RATINGS[1]

(T_C = 25 °C unless otherwise noted)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{DS}	Drain to Source Voltage	V	15
V_{GD}	Gate to Drain Voltage	V	-18
V_{GS}	Gate to Source Voltage	V	-12
I_{DS}	Drain Current	A	IDSS
I_{GS}	Gate Current	mA	6.0
P_T	Total Power Dissipation	W	6.0
T_{CH}	Channel Temperature	°C	175
T_{STG}	Storage Temperature	°C	-65 to +175

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

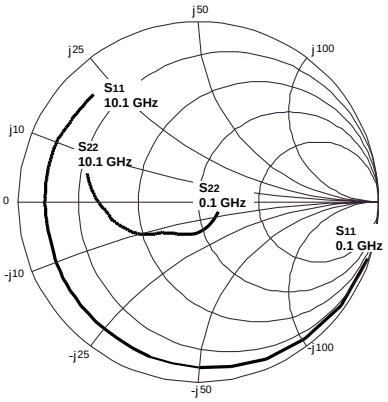
RECOMMENDED OPERATING LIMITS

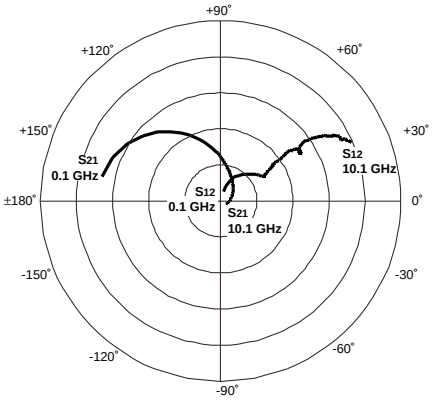
SYMBOLS	PARAMETERS	UNITS	MIN	TYP	MAX
V_{DS}	Drain to Source Voltage	V	9		10
T_{CH}	Channel Temperature	°C			130
G_{COMP}	Gain Compression	dB			3.0
R_G	Gate Resistance	KΩ		1	4

ELECTRICAL CHARACTERISTICS (T_C = 25°C)

PART NUMBER PACKAGE OUTLINE				NE8500199 NE8500100 00 (Chip), 99			
	SYMBOLS	CHARACTERISTICS	UNITS	MIN	TYP	MAX	TEST CONDITIONS
Functional Characteristics	P_{OUT}	Power Out at Fixed Input Power	dBm	28.5	29.5		P_{IN} = 21.0 dBm
	G_L	Linear Gain	dB		9.0		f = 7.2 GHz
	η_{ADD}	Collector Efficiency	%		37		V_{DS} = 10 V; I_{DSQ} = 200 mA
	I_{DS}	Drain Source Current	mA		200		R_G = 1KΩ
Electrical DC Characteristics	I_{DSS}	Saturated Drain Current	mA	330		825	V_{DS} = 2.5 V; V_{GS} = 0 V
	V_P	Pinch-off Voltage	V	-3.0		-1.0	V_{DS} = 2.5 V; I_{DS} = 4 mA
	g_m	Transconductance	mS		300		V_{DS} = 2.5 V; I_{DS} = I_{DSS}
	R_{TH}	Thermal Resistance	°C/W			60	Channel to Case

TYPICAL SCATTERING PARAMETERS (T_A = 25 °C)





S_{21} MAG:
4.0 / DIV., 20.0 FS
S_{12} MAG:
0.03 / DIV., 0.15 FS

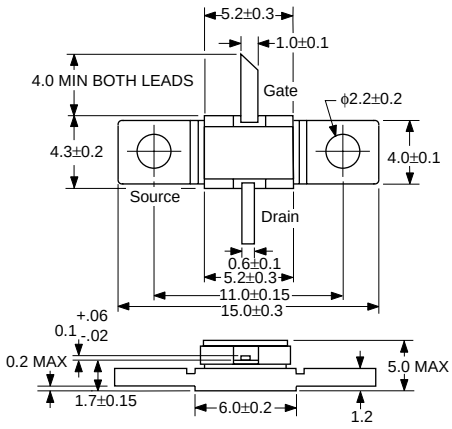
NE 8500100 (2 Cells)
V_{DS} = 10 V, I_{DS} = 200 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG[1]
GHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	0.990	-18.400	13.477	168.400	0.008	74.200	0.122	-27.200	0.107	32.265
0.20	0.981	-36.000	12.933	158.100	0.013	72.500	0.131	-49.100	0.102	29.978
0.50	0.933	-78.900	10.387	132.500	0.026	53.300	0.171	-92.100	0.209	26.015
1.00	0.884	-120.400	6.899	106.600	0.036	37.500	0.210	-121.500	0.378	22.825
1.50	0.865	-142.100	4.970	90.700	0.040	30.700	0.235	-132.500	0.533	20.943
2.00	0.859	-155.700	3.842	79.200	0.041	28.100	0.258	-138.400	0.689	19.718
2.50	0.850	-164.900	3.083	69.600	0.043	31.000	0.278	-141.400	0.871	18.555
3.00	0.850	-172.000	2.554	60.300	0.045	32.300	0.302	-144.100	0.985	17.540
3.50	0.850	-178.000	2.224	52.100	0.049	33.400	0.330	-146.900	1.010	15.948
4.00	0.852	176.900	1.942	45.400	0.052	33.100	0.355	-149.800	1.048	14.384
4.50	0.853	172.600	1.704	38.600	0.057	35.700	0.382	-152.700	1.056	13.303
5.00	0.854	168.400	1.501	29.500	0.060	34.900	0.409	-156.300	1.083	12.227
5.50	0.854	164.500	1.383	22.900	0.064	35.800	0.433	-160.000	1.070	11.727
6.00	0.854	161.000	1.256	18.200	0.070	36.000	0.457	-163.600	1.048	11.197
6.50	0.854	157.500	1.133	11.900	0.077	34.300	0.481	-167.400	1.007	11.166
7.00	0.850	153.800	1.048	3.800	0.077	30.300	0.502	-171.600	1.063	9.803
7.50	0.842	150.700	0.968	-0.400	0.078	33.300	0.521	-175.000	1.204	8.207
8.00	0.839	147.700	0.877	-4.800	0.085	35.700	0.546	-178.400	1.213	7.348
8.50	0.836	144.600	0.811	-11.800	0.093	34.200	0.568	177.800	1.152	7.037
9.00	0.833	141.500	0.774	-17.600	0.102	32.400	0.592	174.100	1.046	7.486
9.50	0.834	138.200	0.723	-21.500	0.111	29.100	0.613	170.300	0.962	8.138
10.00	0.832	134.900	0.657	-25.600	0.118	25.500	0.633	166.400	0.954	7.457

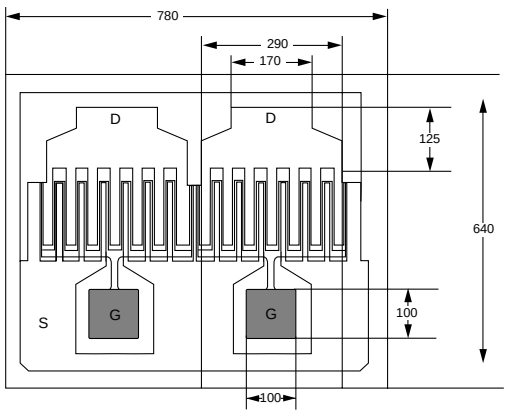
S-Parameters include 0.0010" (24.5 µm) gold bond wires as follows:
Gate, 2 wires, 1 per bond pad, 0.0265" (674µm) long each wire
Drain, 2 wires, 1 per bond pad, 0.0232" (590 µm) long each wire
Source, 4 wires, 2 per side, 0.0092" (234 µm) long each wire

OUTLINE DIMENSIONS

PACKAGE OUTLINE 99
(Units in mm)

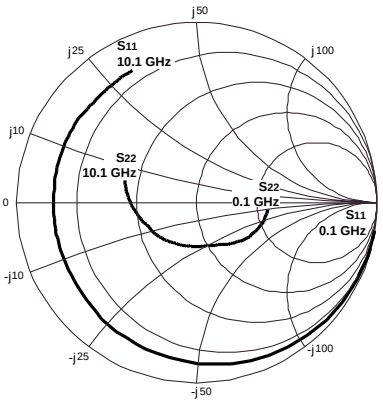


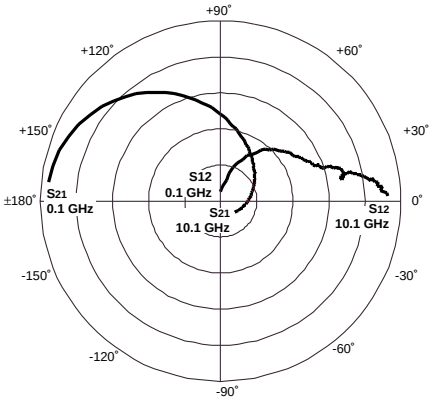
CHIP (00)
(Units in µm)



Die Thickness 140

TYPICAL SCATTERING PARAMETERS (T_A = 25 °C)





S_{21} MAG:
2.0 / DIV., 10.0 FS
S_{12} MAG:
0.02 / DIV., 0.1 FS

NE 8500100 (1 Cell)
V_{DS} = 10 V, I_{DS} = 100 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG[1]
GHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	1.000	-8.800	9.587	173.800	0.005	88.900	0.396	-4.900	-0.020	32.827
0.20	0.995	-17.500	9.496	168.200	0.008	83.000	0.393	-8.700	0.043	30.745
0.50	0.970	-42.300	8.950	151.600	0.020	69.500	0.377	-19.900	0.147	26.508
1.00	0.915	-77.700	7.570	128.200	0.034	53.100	0.338	-35.800	0.279	23.476
1.50	0.868	-104.800	6.243	109.800	0.042	42.600	0.302	-48.400	0.406	21.721
2.00	0.839	-125.600	5.191	95.300	0.047	34.000	0.274	-59.000	0.524	20.432
2.50	0.813	-141.500	4.347	83.100	0.050	29.400	0.256	-67.500	0.675	19.392
3.00	0.803	-154.500	3.724	71.700	0.052	26.000	0.246	-76.600	0.789	18.550
3.50	0.798	-165.700	3.284	61.900	0.054	23.200	0.243	-85.900	0.874	17.840
4.00	0.797	-175.300	2.894	53.300	0.056	21.200	0.243	-95.000	0.953	17.133
4.50	0.796	176.400	2.564	44.800	0.057	20.500	0.247	-104.000	1.055	15.097
5.00	0.798	168.800	2.308	34.800	0.059	18.200	0.253	-113.200	1.115	13.864
5.50	0.799	161.700	2.115	27.100	0.061	17.800	0.260	-122.000	1.164	12.943
6.00	0.801	155.400	1.912	20.500	0.064	17.900	0.272	-130.800	1.206	12.013
6.50	0.803	149.400	1.729	12.700	0.067	15.900	0.284	-139.300	1.251	11.101
7.00	0.804	143.500	1.611	4.100	0.070	11.500	0.296	-148.700	1.264	10.528
7.50	0.800	138.300	1.478	-1.900	0.068	10.700	0.305	-156.000	1.456	9.366
8.00	0.800	133.800	1.342	-8.200	0.070	12.600	0.323	-163.400	1.549	8.462
8.50	0.802	129.300	1.247	-16.200	0.075	11.900	0.344	-171.400	1.511	7.988
9.00	0.805	125.000	1.182	-23.200	0.081	10.000	0.366	-179.300	1.418	7.798
9.50	0.811	120.800	1.099	-29.200	0.086	6.900	0.390	172.500	1.357	7.498
10.00	0.816	116.800	1.004	-35.200	0.092	2.800	0.414	164.300	1.312	7.030

S-parameters include 0.0010" (25.4 µm) gold bond wires as follows:
Gate, 1 wire, 1 per bond pad, 0.0245" (619 µm) long each wire
Drain, 1 wire, 1 per bond pad, 0.0248" (631 µm) long each wire
Source, 2 wires, 2 per side, 0.0090" (229 µm) long each wire

Note:
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. $$MSG = \frac{|S_{21}|}{|S_{12}|}, \quad K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}S_{21}|}, \quad \Delta = S_{11}S_{22} - S_{21}S_{12}$$

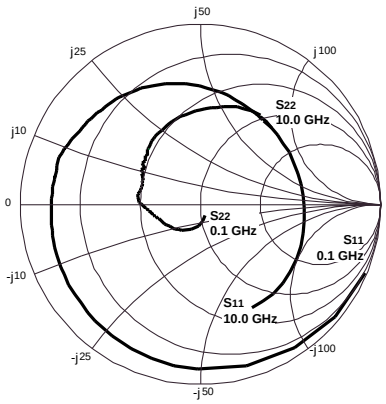
MAG = Maximum Available Gain
MSG = Maximum Stable Gain

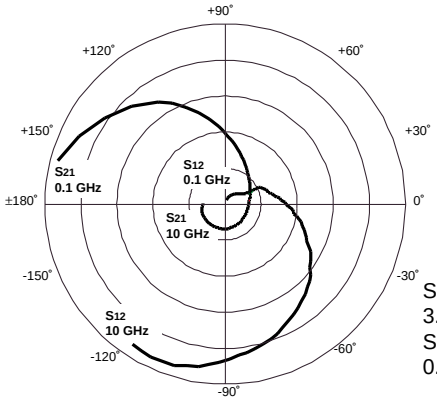
NE8500199 LARGE SIGNAL IMPEDANCES

FREQ (GHz)	Z_{IN} (ohm)	Z_{OUT} (ohm)
5.90	7.08 - j 20.24	15.95 - j 5.70
6.20	8.37 - j 23.28	15.36 - j 8.11
6.40	16.11 - j 41.46	18.87 - j 19.33
6.50	9.30 - j 11.82	23.53 + j 3.06

Z_{IN} is the impedance of the input matching circuit as seen by the gate.
Z_{OUT} is the impedance of the output matching circuit as seen by the drain.

TYPICAL SCATTERING PARAMETERS (T_A = 25 °)





S21 MAG:
3.0 / DIV., 15.0 FS
S12 MAG:
0.06 / DIV., 0.30 FS

NE 8500199
V_{DS} = 10 V, I_{DS} = 200 mA

FREQUENCY	S_{11}		S_{21}		S_{12}		S_{22}		K	MAG[1]
GHZ	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG		(dB)
0.10	0.990	-22.700	14.418	165.500	0.007	70.100	0.065	-64.600	0.097	33.138
0.50	0.916	-91.100	10.211	123.300	0.024	47.700	0.175	-126.400	0.300	26.289
1.00	0.869	-132.100	6.444	94.800	0.031	33.600	0.221	-149.100	0.558	23.178
1.50	0.851	-152.900	4.610	76.600	0.034	29.000	0.241	-159.200	0.797	21.322
2.00	0.840	-166.100	3.591	61.900	0.038	28.100	0.260	-165.600	0.970	19.754
2.50	0.831	-175.900	2.975	49.100	0.042	26.700	0.278	-170.800	1.098	16.592
3.00	0.826	176.000	2.601	37.300	0.047	25.400	0.296	-174.600	1.129	15.244
3.50	0.824	168.800	2.341	26.000	0.053	27.400	0.313	-177.800	1.109	14.437
4.00	0.829	161.000	2.127	13.400	0.066	25.400	0.345	176.300	0.915	15.082
4.50	0.803	152.500	1.963	3.400	0.075	15.200	0.337	166.200	1.007	13.658
5.00	0.784	144.700	1.929	-8.600	0.084	9.300	0.340	159.800	0.984	13.611
5.50	0.767	135.900	1.916	-20.700	0.097	3.100	0.358	154.200	0.891	12.956
6.00	0.751	125.800	1.928	-33.500	0.113	-4.800	0.381	149.500	0.767	12.320
6.50	0.726	114.100	1.951	-47.200	0.130	-13.200	0.396	144.200	0.697	11.763
7.00	0.689	100.200	1.957	-62.400	0.149	-23.900	0.402	137.100	0.678	11.184
7.50	0.649	83.400	2.013	-78.800	0.177	-36.800	0.431	129.400	0.601	10.559
8.00	0.604	63.200	2.067	-96.600	0.206	-51.800	0.465	117.200	0.557	10.015
8.50	0.577	37.000	2.102	-115.500	0.232	-68.000	0.500	102.700	0.526	9.571
9.00	0.571	5.900	2.072	-135.700	0.253	-84.700	0.534	87.200	0.512	9.133
9.50	0.611	-28.500	2.030	-157.900	0.277	-103.200	0.577	69.700	0.464	8.650
10.00	0.631	-62.900	1.812	177.300	0.280	-123.600	0.587	47.000	0.513	8.110

Note:
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