

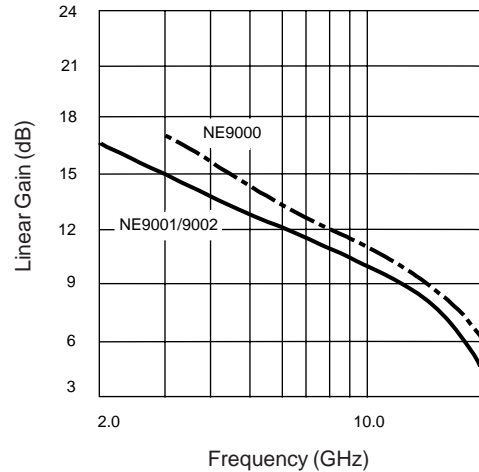
FEATURES

- CLASS A OPERATION
- HIGH OUTPUT POWER
P_{OUT} = 26.5 dBm
G_{1dB} = 7 dB
- HIGH POWER ADDED EFFICIENCY

DESCRIPTION

The NE9000, NE9001, and NE9002 are 0.5 micron recessed gate medium power GaAs FETs for commercial and space amplifier and oscillator applications to 20 GHz. Chip configurations available are: the NE900000, a one cell die of 400 μm gate width; the NE900100, a one cell die of 750 μm gate width; and the NE900200, a two cell die of 1500 μm total gate width. The series is available in chip form or a variety of hermetic ceramic packages. The NE900000, NE900100, and NE900200 are standard die without wrap-around source-metallization, while the NE900000G, NE900100G, and NE900200G have wrap-around source metallization. The series is space qualified.

TYPICAL LINEAR GAIN vs. FREQUENCY



ELECTRICAL CHARACTERISTICS (T_A = 25°C)

| PART NUMBER | | | NE900089A 89A | | | NE900000 NE900000G NE900075 00 (CHIP), 75 | | | NE900100 NE900100G NE900175 00 (CHIP), 75 | | | NE900200 NE900200G NE900275 00 (CHIP), 75 | | |
|----------------------|--|--------------------------|------------------|------|-----|--|------|------|--|------|-----|--|------|------|
| SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX |
| I _{DSS} | Saturated Drain Current at V _{DS} = 2.5 V, V _{GS} = 0 | mA | 80 | 120 | 150 | 80 | 120 | 150 | 150 | 225 | 300 | 300 | 450 | 600 |
| V _P | Pinch-off Voltage at V _{DS} = 2.5 V, I _{DS} = 2.5 mA I _{DS} = 5 mA I _{DS} = 10 mA | V V V | -1.5 | -3.5 | -5 | -1.5 | -3.5 | -5 | -2 | -3.5 | -5 | -2 | -3.5 | -5 |
| g _m | Transconductance at V _{DS} = 2.5 V, I _{DS} = 50 mA I _{DS} = 90 mA I _{DS} = 180 mA | mS mS mS | | 25 | | | 25 | | | 50 | | | 100 | |
| R _{TH(C-C)} | Thermal Resistance (Channel-to-Case) | °C/W | | | 180 | | | 180 | | | 100 | | | 50 |
| P _T | Total Power Dissipation | W | | | 0.8 | | | 0.8 | | | 1.5 | | | 3 |
| P _{TEST} | Power Output at Test Point P _{IN} = 11 dBm, V _{DS} = 8V, I _D = 50mA, f = 8 GHz P _{IN} = 12 dBm, V _{DS} = 8V, I _D = 50mA f = 14.5 GHz P _{IN} = 15 dBm, V _{DS} = 8V, I _D = 90mA f = 14.5 GHz P _{IN} = 19 dBm, V _{DS} = 8 V, I _D = 180 mA, f = 14.5 | dBm dBm dBm dBm | 19.5 | 20.5 | | | 19.5 | 20.5 | | 22 | 23 | | 25.5 | 26.5 |
| P _{1dB} | Output Power at 1 dB Compression Point, V _{DS} = 8 V, I _D = 50 mA, f = 8 GHz V _{DS} = 8 V, I _D = 50 mA, f = 14.5 GHz V _{DS} = 8 V, I _D = 90 mA, f = 14.5 GHz V _{DS} = 8 V, I _D = 180 mA, f = 14.5 GHz | dBm dBm dBm dBm | | 20.5 | | | | 20 | | | 23 | | | 25 |
| G _{1dB} | Gain at 1 dB Compression Point V _{DS} = 8 V, I _D = 50 mA, f = 8 GHz V _{DS} = 8 V, I _D = 50 mA, f = 14.5 GHz V _{DS} = 8 V, I _D = 90 mA, f = 14.5 GHz V _{DS} = 8 V, I _D = 180 mA, f = 14.5 GHz | dB dB dB dB | | 9 | | | | 8 | | | 7 | | | 7 |
| η _{ADD} | Power Added Efficiency V _{DS} = 8 V, at P _{1dB} Conditions. | % | | 27 | | | | 27 | | | 27 | | | 26 |

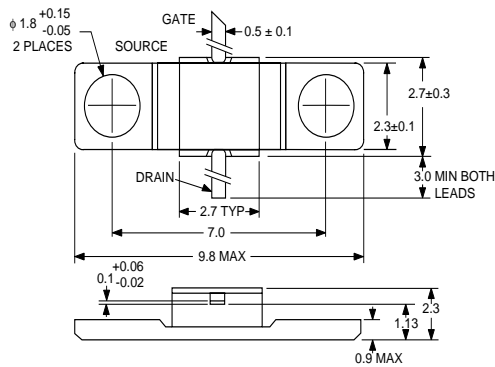
NE9000, NE9001, NE9002 SERIES

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|-----------------|-------------------------|-------|---------|
| V _{DS} | Drain to Source Voltage | V | 20 |
| V _{GS} | Gate to Source Voltage | V | -9 |
| I _D | Drain Current | | |
| | NE900000, NE900075/89 | mA | 150 |
| | NE900100, NE900175 | mA | 300 |
| | NE900200, NE900275 | mA | 600 |
| I _G | Gate Current | | |
| | NE900000, NE900075/89 | mA | 1.3 |
| | NE900100, NE900175 | mA | 2.6 |
| | NE900200, NE900275 | mA | 5 |

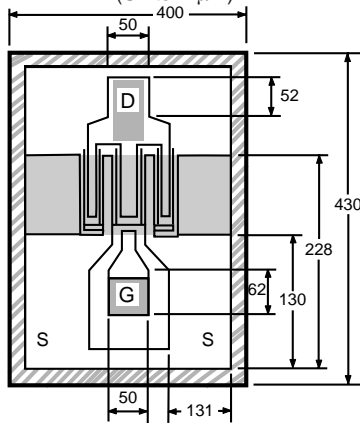
OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE 75



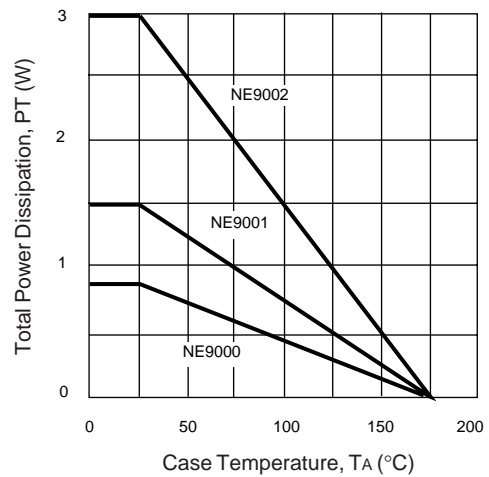
NE900000 (CHIP)

(Units in μm)

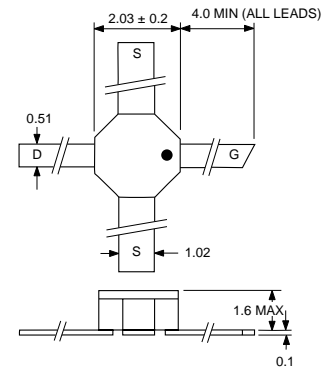


- Die Thickness: 110 to 160 μm
- Recommended Bonding Area.
- Glassivated Area
- Plated Wraparound (Optional)

POWER DERATING CURVE

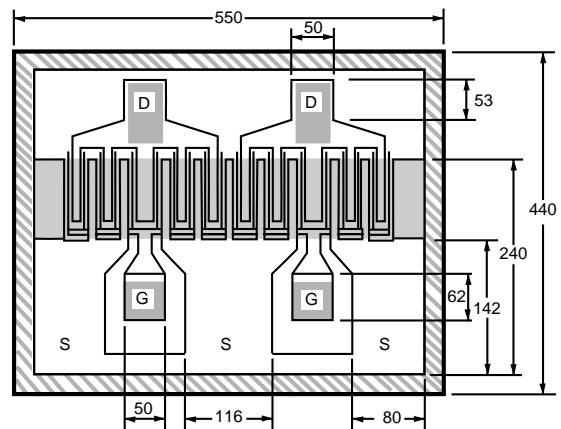


PACKAGE OUTLINE 89A



NE900100/NE900200 (CHIP)*

(Units in μm)



HANDLING PRECAUTIONS

DIE ATTACHMENT

Die attach can be accomplished with Au-Ge (390 \pm 10°C) preforms in a forming gas environment. Epoxy die attach is not recommended.

BONDING

Gate and drain bonding wires should be semi-hard gold wire (3 to 8% elongation) 30 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 300°C to 10 minute curve. If longer periods are required, the tempera-

ture 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.

NE9000, NE9001, NE9002 SERIES

TYPICAL SMALL SIGNAL SCATTERING PARAMETERS

NE900000

V_{DS} = 8 V, I_D = 50 mA

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|------|-----------------|-----|-----------------|-----|-----------------|-----|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 2000 | .96 | -42 | 3.00 | 148 | .04 | 69 | .80 | -11 |
| 3000 | .90 | -59 | 2.71 | 136 | .04 | 66 | .78 | -12 |
| 4000 | .87 | -73 | 2.48 | 125 | .05 | 62 | .76 | -13 |
| 5000 | .85 | -85 | 2.28 | 114 | .06 | 58 | .74 | -17 |
| 6000 | .82 | -94 | 2.10 | 105 | .06 | 55 | .72 | -20 |
| 7000 | .79 | -103 | 1.94 | 96 | .07 | 53 | .71 | -24 |
| 8000 | .75 | -112 | 1.79 | 88 | .07 | 52 | .70 | -28 |
| 9000 | .73 | -120 | 1.64 | 80 | .07 | 52 | .70 | -32 |
| 10000 | .72 | -128 | 1.51 | 73 | .07 | 53 | .70 | -34 |
| 11000 | .71 | -134 | 1.38 | 67 | .07 | 55 | .71 | -36 |
| 12000 | .72 | -140 | 1.27 | 62 | .07 | 58 | .71 | -38 |
| 13000 | .73 | -144 | 1.17 | 58 | .07 | 63 | .71 | -39 |
| 14000 | .74 | -147 | 1.09 | 54 | .07 | 69 | .71 | -40 |
| 15000 | .75 | -149 | 1.04 | 51 | .08 | 74 | .71 | -41 |
| 16000 | .74 | -151 | 1.01 | 48 | .09 | 78 | .70 | -43 |
| 17000 | .71 | -152 | 1.03 | 45 | .10 | 81 | .69 | -47 |
| 18000 | .65 | -155 | 1.10 | 40 | .11 | 82 | .68 | -53 |

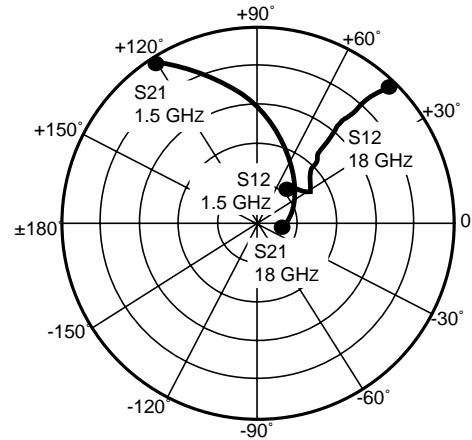
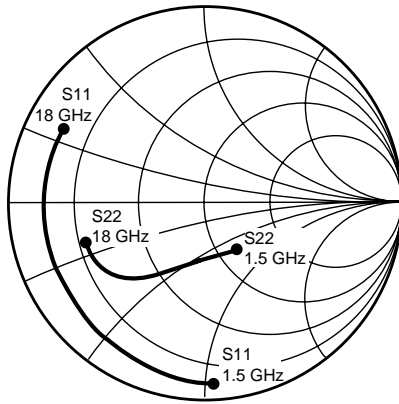
NE900100

V_{DS} = 8 V, I_D = 90 mA

| FREQUENCY (MHz) | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | |
|--------------------|-----------------|------|-----------------|-----|-----------------|-----|-----------------|------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG |
| 2000 | .91 | -63 | 4.54 | 137 | .05 | 63 | .47 | -26 |
| 3000 | .82 | -81 | 3.70 | 124 | .05 | 55 | .46 | -33 |
| 4000 | .77 | -97 | 3.14 | 111 | .06 | 51 | .44 | -38 |
| 5000 | .75 | -110 | 2.75 | 100 | .06 | 48 | .43 | -43 |
| 6000 | .74 | -120 | 2.44 | 91 | .07 | 47 | .41 | -47 |
| 7000 | .74 | -129 | 2.17 | 83 | .07 | 48 | .40 | -53 |
| 8000 | .73 | -135 | 1.93 | 77 | .07 | 49 | .39 | -58 |
| 9000 | .72 | -141 | 1.70 | 71 | .07 | 52 | .39 | -64 |
| 10000 | .72 | -145 | 1.50 | 67 | .07 | 55 | .40 | -70 |
| 11000 | .72 | -148 | 1.34 | 62 | .07 | 60 | .41 | -76 |
| 12000 | .72 | -150 | 1.21 | 58 | .07 | 65 | .43 | -81 |
| 13000 | .73 | -152 | 1.13 | 55 | .08 | 70 | .46 | -86 |
| 14000 | .73 | -153 | 1.08 | 51 | .08 | 74 | .47 | -90 |
| 15000 | .74 | -155 | 1.05 | 48 | .09 | 78 | .49 | -94 |
| 16000 | .73 | -157 | 1.03 | 44 | .10 | 80 | .49 | -98 |
| 17000 | .71 | -161 | 1.00 | 41 | .12 | 82 | .46 | -102 |
| 18000 | .67 | -167 | .93 | 36 | .13 | 82 | .41 | -109 |

NE9000, NE9001, NE9002 SERIES

NE900200 TYPICAL SMALL SIGNAL SCATTERING PARAMETERS



NE900200

V_{DS} = 8 V, I_D = 180 mA

| FREQUENCY GHz | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ |
|------------------|-----------------|----------|-----------------|---------|-----------------|--------|-----------------|----------|-------|------------------|
| | MAG | ANG | MAG | AN | MAG | ANG | MAG | ANG | | |
| 1.5 | 0.910 | -88.000 | 4.852 | 123.000 | 0.057 | 48.000 | 0.286 | -56.000 | 0.240 | 19.300 |
| 2.0 | 0.879 | -106.000 | 4.143 | 112.000 | 0.065 | 41.000 | 0.274 | -68.000 | 0.323 | 18.044 |
| 3.0 | 0.850 | -129.000 | 3.077 | 93.000 | 0.070 | 34.000 | 0.267 | -82.000 | 0.496 | 16.430 |
| 4.0 | 0.836 | -143.000 | 2.413 | 79.000 | 0.075 | 32.000 | 0.281 | -92.000 | 0.629 | 15.075 |
| 5.0 | 0.830 | -153.000 | 1.983 | 69.000 | 0.077 | 30.000 | 0.303 | -102.000 | 0.751 | 14.108 |
| 6.0 | 0.827 | -160.000 | 1.693 | 60.000 | 0.082 | 33.000 | 0.331 | -108.000 | 0.809 | 13.148 |
| 7.0 | 0.823 | -165.000 | 1.490 | 52.000 | 0.081 | 34.000 | 0.368 | -114.000 | 0.914 | 12.647 |
| 8.0 | 0.824 | -170.000 | 1.342 | 44.000 | 0.086 | 38.000 | 0.406 | -120.000 | 0.892 | 11.933 |
| 9.0 | 0.822 | -174.000 | 1.196 | 36.000 | 0.091 | 42.000 | 0.443 | -125.000 | 0.904 | 11.187 |
| 10.0 | 0.820 | -178.000 | 1.100 | 29.000 | 0.100 | 45.000 | 0.484 | -130.000 | 0.827 | 10.414 |
| 11.0 | 0.824 | 176.000 | 1.002 | 22.000 | 0.108 | 45.000 | 0.524 | -134.000 | 0.739 | 9.674 |
| 12.0 | 0.818 | 172.000 | 0.920 | 15.000 | 0.117 | 48.000 | 0.554 | -137.000 | 0.719 | 8.956 |
| 13.0 | 0.815 | 167.000 | 0.840 | 10.000 | 0.129 | 48.000 | 0.584 | -141.000 | 0.671 | 8.137 |
| 14.0 | 0.815 | 163.000 | 0.784 | 4.000 | 0.146 | 49.000 | 0.601 | -144.000 | 0.588 | 7.300 |
| 15.0 | 0.813 | 160.000 | 0.732 | 1.000 | 0.160 | 50.000 | 0.623 | -146.000 | 0.534 | 6.604 |
| 16.0 | 0.811 | 157.000 | 0.690 | -5.000 | 0.187 | 48.000 | 0.631 | -151.000 | 0.454 | 5.670 |
| 17.0 | 0.815 | 154.000 | 0.647 | -7.000 | 0.207 | 48.000 | 0.635 | -156.000 | 0.437 | 4.949 |
| 18.0 | 0.811 | 153.000 | 0.627 | -11.000 | 0.241 | 45.000 | 0.638 | -162.000 | 0.369 | 4.153 |

Note:

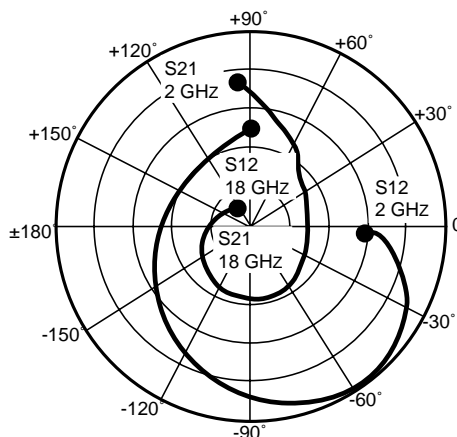
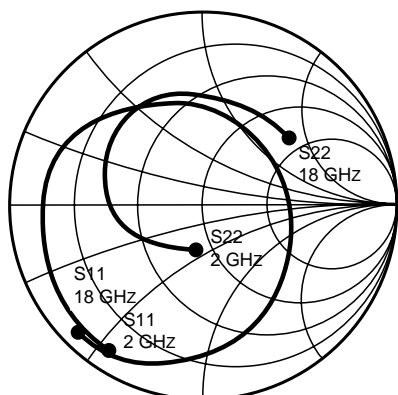
1. Gain Calculations:

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

MAG = Maximum Available Gain

MSG = Maximum Stable Gain

TYPICAL SMALL SIGNAL SCATTERING PARAMETERS



NE900275

V_{ds} = 8 V, I_d = 180 mA

| FREQUENCY GHZ | S ₁₁ | | S ₂₁ | | S ₁₂ | | S ₂₂ | | K | MAG ¹ |
|------------------|-----------------|----------|-----------------|----------|-----------------|----------|-----------------|----------|-------|------------------|
| | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | |
| 2.0 | 0.900 | -123.000 | 3.670 | 95.000 | 0.060 | 24.000 | 0.230 | -97.000 | 0.325 | 17.865 |
| 3.0 | 0.900 | -146.000 | 2.760 | 76.000 | 0.060 | 15.000 | 0.250 | -117.000 | 0.397 | 16.628 |
| 4.0 | 0.870 | -161.000 | 2.140 | 54.000 | 0.060 | 3.000 | 0.280 | -131.000 | 0.698 | 15.523 |
| 5.0 | 0.860 | -172.000 | 1.820 | 46.000 | 0.060 | 3.000 | 0.320 | -143.000 | 0.850 | 14.819 |
| 6.0 | 0.850 | -180.000 | 1.610 | 26.000 | 0.060 | 1.000 | 0.370 | -152.000 | 0.974 | 14.287 |
| 7.0 | 0.850 | 172.000 | 1.510 | 16.000 | 0.060 | -1.000 | 0.410 | -161.000 | 0.972 | 14.008 |
| 8.0 | 0.830 | 162.000 | 1.500 | 1.000 | 0.060 | -3.000 | 0.450 | -170.000 | 1.051 | 12.595 |
| 9.0 | 0.770 | 151.000 | 1.520 | -12.000 | 0.070 | -5.000 | 0.480 | -178.000 | 1.162 | 10.931 |
| 10.0 | 0.690 | 135.000 | 1.600 | -34.000 | 0.080 | -16.000 | 0.510 | 173.000 | 1.227 | 10.140 |
| 11.0 | 0.560 | 108.000 | 1.770 | -51.000 | 0.090 | -26.000 | 0.540 | 162.000 | 1.311 | 9.594 |
| 12.0 | 0.440 | 56.000 | 1.880 | -80.000 | 0.100 | -51.000 | 0.590 | 147.000 | 1.259 | 9.681 |
| 13.0 | 0.480 | -19.000 | 1.770 | -116.000 | 0.090 | -85.000 | 0.610 | 128.000 | 1.408 | 9.136 |
| 14.0 | 0.690 | -69.000 | 1.480 | -146.000 | 0.070 | -121.000 | 0.610 | 108.000 | 1.392 | 9.522 |
| 15.0 | 0.820 | -97.000 | 1.110 | -175.000 | 0.050 | -165.000 | 0.570 | 85.000 | 1.624 | 8.835 |
| 16.0 | 0.900 | -115.000 | 0.860 | 162.000 | 0.040 | 158.000 | 0.560 | 65.000 | 1.416 | 9.487 |
| 17.0 | 0.920 | -126.000 | 0.650 | 141.000 | 0.040 | 114.000 | 0.580 | 48.000 | 1.498 | 7.938 |
| 18.0 | 0.940 | -136.000 | 0.540 | 127.000 | 0.050 | 89.000 | 0.590 | 36.000 | 1.020 | 9.472 |

Note:

1. Gain Calculations:

$$MAG = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1})$$

When $K \leq 1$, 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

EXCLUSIVE NORTH AMERICAN AGENT FOR **NEC** RF, MICROWAVE & OPTOELECTRONIC SEMICONDUCTORS

CEL CALIFORNIA EASTERN LABORATORIES • Headquarters • 4590 Patrick Henry Drive • Santa Clara, CA 95054-1817 • (408) 988-3500 • Telex 34-6393 • FAX (408) 988-0279

24-Hour Fax-On-Demand: 800-390-3232 (U.S. and Canada only) • Internet: <http://WWW.CEL.COM>

DATA SUBJECT TO CHANGE WITHOUT NOTICE

PRINTED IN USA ON RECYCLED PAPER -11/97