# NEC's 3W, L/S-BAND MEDIUM POWER GaAs MESFET

# NE6500379A

## FEATURES

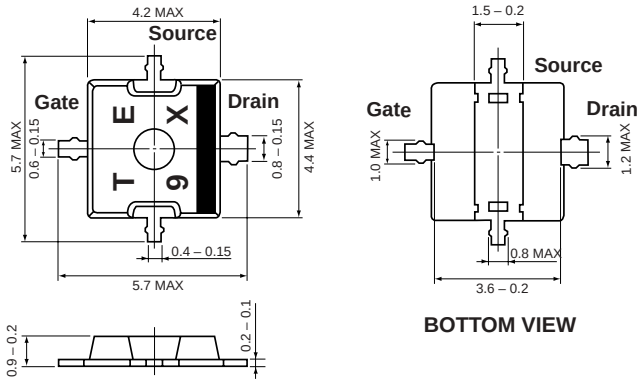
- **LOW COST PLASTIC SURFACE MOUNT PACKAGE**
  Available on Tape and Reel
- **USABLE TO 2.7 GHz:**
  Fixed Wireless Access, ISM, WLL, MMDS, IMT-2000, PCS
- **HIGH OUTPUT POWER:**
  35 dBm TYP
- **HIGH LINEAR GAIN:**
  10 dB TYP at 1.9 GHz
- **LOW THERMAL RESISTANCE:**
  5 C/W

## DESCRIPTION

NEC's NE6500379A is a 3 W GaAs MESFET designed for medium power Fixed Wireless Access, ISM, WLL, PCS, IMT-2000, and return path MMDS transmitter applications. It is capable of delivering 3 Watts of output power with high linear gain, high efficiency and excellent linearity. Reliability and performance uniformity are assured by NEC's stringent quality and control procedures

## OUTLINE DIMENSIONS (Units in mm)

**PACKAGE OUTLINE 79A**




Note: Unless otherwise specified, tolerance is ±0.2 mm

## ELECTRICAL CHARACTERISTICS ($T_C$ = 25°C)

| PART NUMBER / PACKAGE OUTLINE | | | | NE6500379A 79A | | | |
|---|---|---|---|---|---|---|---|
| | SYMBOLS | CHARACTERISTICS | UNITS | MIN | TYP | MAX | TEST CONDITIONS |
| Functional Characteristics | $P_{1dB}$ | Power Out at 1dB Gain Compression | dBm | | 35.0 | | f = 1.9 GHz, $V_{DS}$ = 6.0 V, Rg = 30 Ω, $I_{DSQ}$ = 500 mA (RF OFF)[2] |
| | $G_L$ | Linear Gain[1] | dB | 9.0 | 10.0 | | |
| | $\eta_{ADD}$ | Power Added Efficiency | % | | 50 | | |
| | $I_D$ | Drain Current | A | | 1.0 | | |
| Electrical DC Characteristics | $I_{DSS}$ | Saturated Drain Current | A | | 4.5 | | $V_{DS}$ = 2.5 V; $V_{GS}$ = 0 V |
| | $V_P$ | Pinch-Off Voltage | V | -3.6 | -2.6 | -1.6 | $V_{DS}$ = 2.5 V; $I_{DS}$ = 21 mA |
| | $R_{TH}$ | Thermal Resistance | °C/W | | 5 | 6 | Channel to Case |
| | $BV_{GD}$ | Gate-to-Drain Breakdown Voltage | V | 17 | | | $I_{GD}$ = 21 mA |

Notes:
1. Pin = 0 dBm
2. DC performance is tested 100%. Several samples per wafer are tested for RF performance. Wafer rejection criteria for standard devices is 1 reject for several samples.

## ABSOLUTE MAXIMUM RATINGS[1] ($T_C$ = 25 °C)

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | V | 15 |
| $V_{GS}$ | Gate to Source Voltage | V | -7.0 |
| $I_{DS}$ | Drain Current | A | 5.6 |
| $I_{GS}$ | Gate Current | mA | 50 |
| $P_T$ | Total Power Dissipation | W | 21 |
| $T_{CH}$ | Channel Temperature | °C | 150 |
| $T_{STG}$ | Storage Temperature | °C | -65 to +150 |

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

## RECOMMENDED OPERATING LIMITS

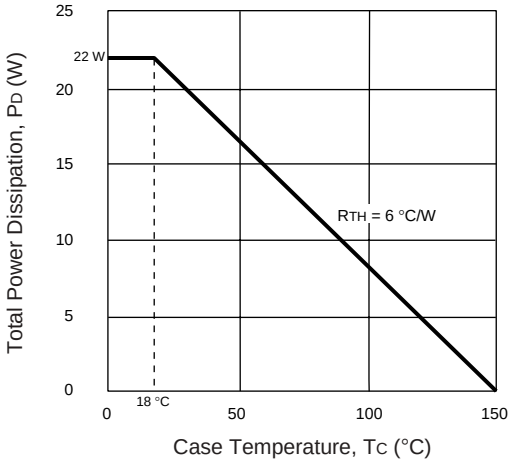
| SYMBOLS | PARAMETERS | UNITS | TYP | MAX |
|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | V | 6.0 | 6.0 |
| $T_{CH}$ | Channel Temperature | °C | | 125 |
| $G_{COMP}$ | Gain Compression | dB | | 3.0 |

## ORDERING INFORMATION

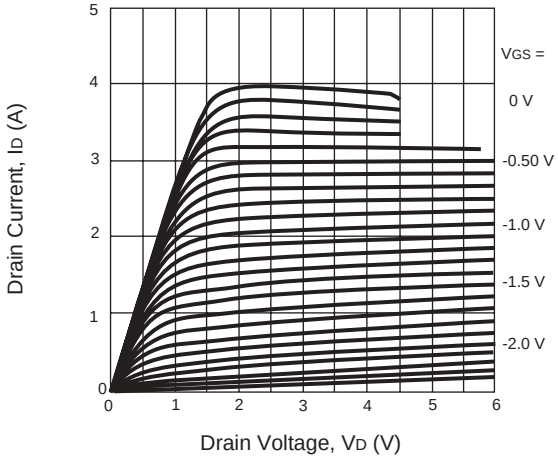
| PART NUMBER | QTY |
|---|---|
| NE6500379A-T1 | 1 K/Reel |
| NE6500379A | Bulk, 50 piece min. |

## TYPICAL PERFORMANCE CURVES ($T_A$ = 25°C)

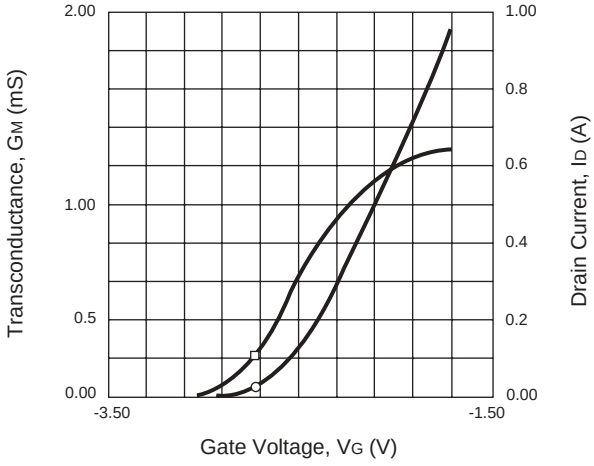
**TOTAL POWER DISSIPATION vs. CASE TEMPERATURE**



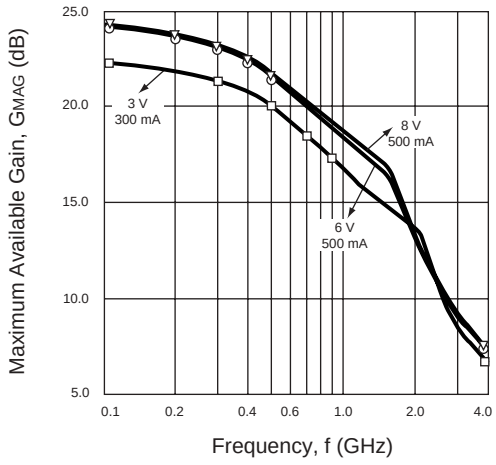

**DRAIN CURRENT vs. DRAIN VOLTAGE**




**TRANSCONDUCTANCE AND DRAIN CURRENT vs. GATE VOLTAGE**

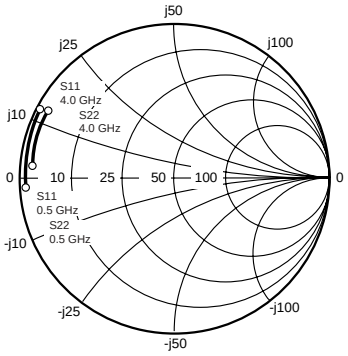



**MAXIMUM AVAILABLE GAIN vs. FREQUENCY**

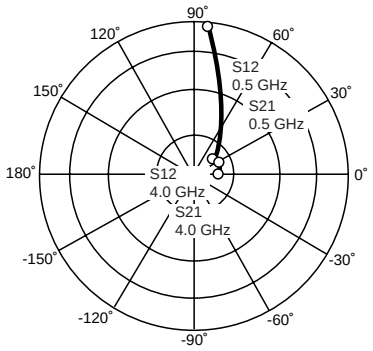


## TYPICAL SCATTERING PARAMETERS ($T_A$ = 25°C)

Note: This file and many other s-parameter files can be downloaded from www.cel.com




**Coordinates in Ohms**
**Frequency in GHz**
**$V_D$ = 3.0 V, $I_D$ = 300 mA**




### NE6500379A
### $V_D$ = 6.0 V, $I_D$ = 500 mA

| FREQUENCY | S11 | | S21 | | S12 | | S22 | | K | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) |
| 0.50 | 0.966 | -174.30 | 2.139 | 85.82 | 0.014 | 10.23 | 0.880 | 176.31 | 0.32 | 21.74 |
| 0.60 | 0.967 | -177.11 | 1.783 | 82.99 | 0.014 | 9.64 | 0.881 | 175.27 | 0.36 | 20.93 |
| 0.70 | 0.965 | -179.62 | 1.531 | 80.36 | 0.014 | 10.32 | 0.881 | 174.08 | 0.45 | 20.24 |
| 0.80 | 0.965 | 178.38 | 1.343 | 78.11 | 0.015 | 10.26 | 0.882 | 173.23 | 0.50 | 19.66 |
| 0.90 | 0.965 | 176.58 | 1.192 | 75.93 | 0.015 | 10.85 | 0.881 | 172.33 | 0.56 | 19.12 |
| 1.00 | 0.965 | 174.96 | 1.072 | 73.74 | 0.015 | 11.62 | 0.880 | 171.34 | 0.64 | 18.65 |
| 1.10 | 0.965 | 173.44 | 0.975 | 71.58 | 0.015 | 11.65 | 0.881 | 170.32 | 0.69 | 18.17 |
| 1.20 | 0.965 | 172.10 | 0.895 | 69.70 | 0.015 | 12.25 | 0.881 | 169.56 | 0.73 | 17.77 |
| 1.30 | 0.965 | 170.80 | 0.825 | 67.81 | 0.015 | 12.72 | 0.880 | 168.73 | 0.80 | 17.41 |
| 1.40 | 0.965 | 169.61 | 0.765 | 65.81 | 0.015 | 12.90 | 0.879 | 167.80 | 0.84 | 17.04 |
| 1.50 | 0.965 | 168.44 | 0.716 | 63.89 | 0.015 | 13.20 | 0.881 | 166.90 | 0.86 | 16.75 |
| 1.60 | 0.966 | 167.32 | 0.672 | 62.25 | 0.015 | 13.85 | 0.881 | 166.23 | 0.92 | 16.46 |
| 1.70 | 0.966 | 166.26 | 0.632 | 60.58 | 0.015 | 14.68 | 0.880 | 165.51 | 1.00 | 16.22 |
| 1.80 | 0.966 | 165.26 | 0.596 | 58.64 | 0.015 | 14.92 | 0.877 | 164.64 | 1.06 | 14.46 |
| 1.90 | 0.966 | 164.32 | 0.566 | 56.79 | 0.015 | 15.56 | 0.880 | 163.73 | 1.08 | 13.97 |
| 2.00 | 0.967 | 163.43 | 0.540 | 55.24 | 0.015 | 15.70 | 0.882 | 163.14 | 1.08 | 13.70 |
| 2.10 | 0.968 | 162.52 | 0.513 | 53.75 | 0.015 | 17.08 | 0.880 | 162.60 | 1.13 | 13.00 |
| 2.20 | 0.967 | 161.56 | 0.488 | 51.90 | 0.015 | 16.80 | 0.876 | 161.72 | 1.22 | 12.19 |
| 2.30 | 0.968 | 160.76 | 0.468 | 50.11 | 0.015 | 17.63 | 0.876 | 160.81 | 1.27 | 11.72 |
| 2.40 | 0.968 | 160.00 | 0.450 | 48.58 | 0.016 | 18.37 | 0.881 | 160.18 | 1.26 | 11.55 |
| 2.50 | 0.969 | 159.26 | 0.432 | 47.36 | 0.016 | 19.74 | 0.881 | 159.90 | 1.29 | 11.19 |
| 2.60 | 0.969 | 158.55 | 0.413 | 45.84 | 0.015 | 19.89 | 0.878 | 159.26 | 1.34 | 10.76 |
| 2.70 | 0.970 | 157.78 | 0.397 | 44.14 | 0.015 | 20.56 | 0.877 | 158.32 | 1.42 | 10.32 |
| 2.80 | 0.970 | 157.08 | 0.385 | 42.59 | 0.015 | 21.83 | 0.882 | 157.46 | 1.41 | 10.16 |
| 2.90 | 0.970 | 156.48 | 0.372 | 41.43 | 0.015 | 23.56 | 0.883 | 157.13 | 1.44 | 9.88 |
| 3.00 | 0.971 | 155.74 | 0.359 | 40.09 | 0.016 | 24.26 | 0.881 | 156.56 | 1.47 | 9.56 |
| 3.10 | 0.970 | 155.08 | 0.346 | 38.46 | 0.016 | 25.44 | 0.879 | 155.69 | 1.57 | 9.04 |
| 3.20 | 0.972 | 154.43 | 0.336 | 37.25 | 0.015 | 27.74 | 0.885 | 154.96 | 1.54 | 9.03 |
| 3.30 | 0.971 | 153.91 | 0.327 | 35.97 | 0.016 | 29.52 | 0.885 | 154.33 | 1.61 | 8.55 |
| 3.40 | 0.971 | 153.33 | 0.316 | 34.75 | 0.016 | 31.71 | 0.882 | 153.69 | 1.68 | 8.13 |
| 3.50 | 0.973 | 152.84 | 0.308 | 33.35 | 0.017 | 33.06 | 0.882 | 152.89 | 1.56 | 8.21 |
| 3.60 | 0.974 | 152.20 | 0.301 | 32.01 | 0.018 | 32.99 | 0.884 | 152.34 | 1.48 | 8.14 |
| 3.70 | 0.973 | 151.72 | 0.292 | 30.79 | 0.018 | 32.12 | 0.883 | 151.99 | 1.54 | 7.76 |
| 3.80 | 0.974 | 151.28 | 0.282 | 29.50 | 0.018 | 33.04 | 0.880 | 151.43 | 1.54 | 7.53 |
| 3.90 | 0.973 | 150.86 | 0.273 | 27.94 | 0.019 | 31.76 | 0.877 | 150.64 | 1.61 | 7.12 |
| 4.00 | 0.974 | 150.75 | 0.266 | 27.01 | 0.019 | 32.12 | 0.886 | 150.34 | 1.52 | 7.23 |

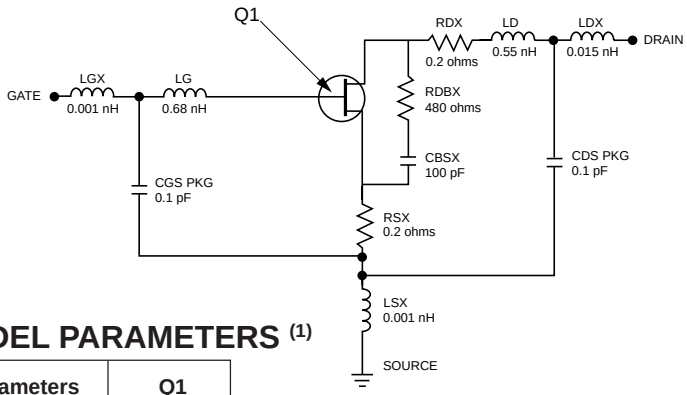
Note:
1. Gain Calculation:

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

## NONLINEAR MODEL

### SCHEMATIC




### FET NONLINEAR MODEL PARAMETERS (1)

| Parameters | Q1 | Parameters | Q1 |
|---|---|---|---|
| VTO | -2.585 | RG | 0.2 |
| VTOSC | 0 | RD | 0.001 |
| ALPHA | 3 | RS | 0.001 |
| BETA | 1.28 | RGMET | 0 |
| GAMMA | 0 | KF | 0 |
| GAMMADC(2) | 0.035 | AF | 1 |
| Q | 1.7 | TNOM | 27 |
| DELTA | 0.02 | XTI | 3 |
| VBI | 0.6 | EG | 1.43 |
| IS | 1e-14 | VTOTC | 0 |
| N | 1 | BETATCE | 0 |
| RIS | 0 | FFE | 1 |
| RID | 0 | | |
| TAU | 10e-12 | | |
| CDS | 0.5e-12 | | |
| RDB | 0.001 | | |
| CBS | 0 | | |
| CGSO(3) | 25e-12 | | |
| CGDO(4) | 4.5e-12 | | |
| DELTA1 | 1 | | |
| DELTA2 | 0.2 | | |
| FC | 0.5 | | |
| VBR | Infinity | | |

(1) Series IV Libra TOM Model

The parameter in Libra corresponds to the parameter in PSpice:

(2) GAMMADC — GAMMA
(3) CGSO — CGS
(4) CGDO — CGD

### UNITS

| Parameter | Units |
|---|---|
| capacitance | picofarads |
| inductance | nanohenries |
| resistance | ohms |

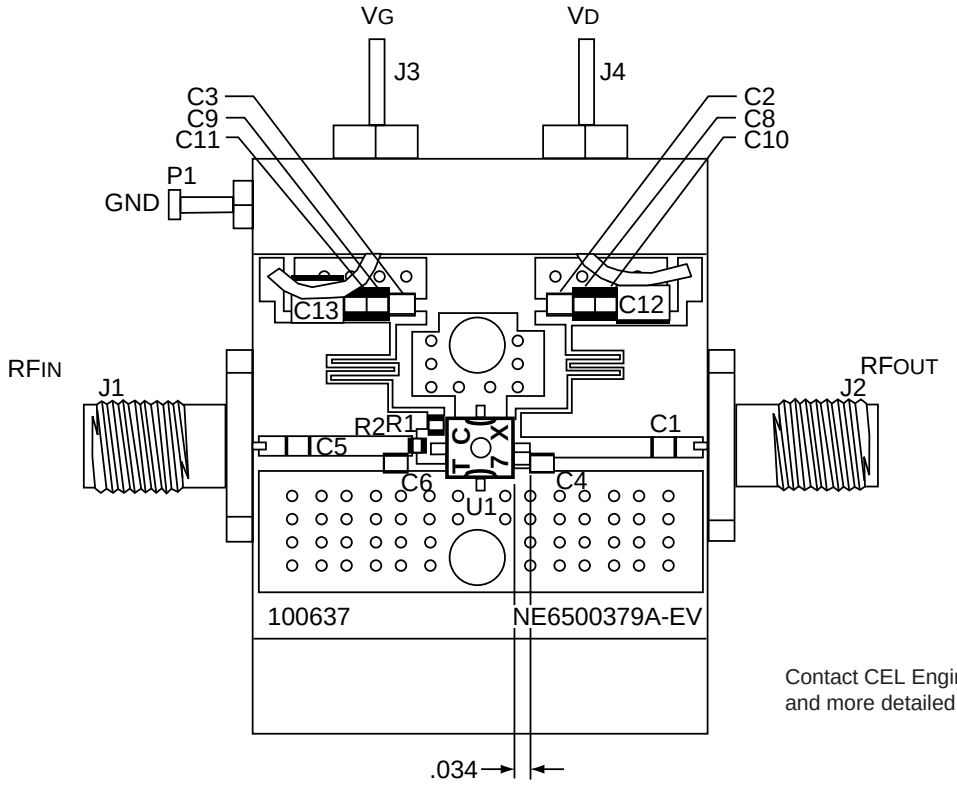
MODEL RANGE

Frequency: 0.4 to 8 GHz

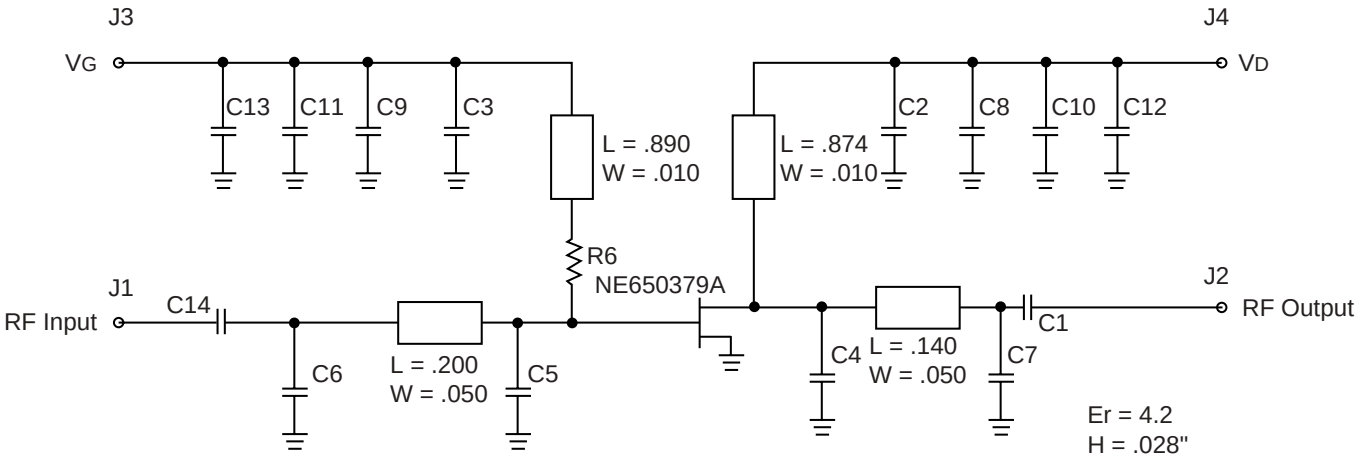
Bias: $V_{DS}$ = 3 V to 8 V, $I_D$ = 300 mA to 500 mA

Date: 8/03

## APPLICATION CIRCUIT (1.93 - 1.99 GHz)




Contact CEL Engineering for artwork and more detailed information.

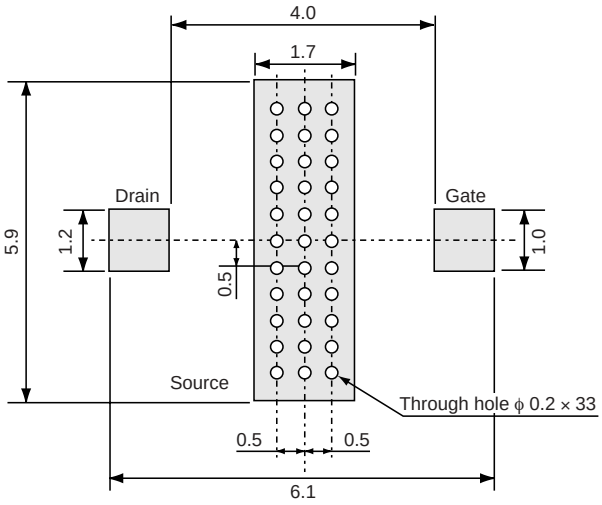



### NE6500379A PARTS LIST

| | | | | |
|---|---|---|---|---|
| 1 | TF-100637 | | TEST CIRCUIT BLK | 17 |
| 4 | | | 2-56 X 3/16 PHILLIPS PAN HEAD | 16 |
| 2 | MA101J | C2, C3 | CASE 1100 pF CAP MURATA | 15 |
| 1 | MCR03J200 | R1 | 0603 20 OHMS RESISTOR ROHM | 14 |
| 2 | 100A470CP150X | C1, C14 | CASE A 47 pF CAP ATC | 13 |
| 1 | 100A4R3CP150X | C4 | CASE A 4.3 pF CAP ATC | 12 |
| 1 | 100A5R6CP150X | C5 | CASE A 5.6 pF CAP ATC | 11 |
| 1 | 100A0R5CP150X | C6 | CASE A 0.5 pF CAP ATC | 10 |
| 1 | 100A0R8CP150X | C7 | CASE A 0.8 pF CAP ATC | 9 |
| 2 | TAJB475K010R | C12, C13 | CASE B 4.7 uF CAP AVX | 8 |
| 2 | GRM40X7R104K025BL | C10, C11 | 0805 .1 uF CAP MURATA | 7 |
| 2 | GRM40C0G102J050BD | C8, C9 | 0805 1000 pF CAP MURATA | 6 |
| 1 | NE6500379A | U1 | IC NEC | 5 |
| 1 | 703401 | P1 | GROUND LUG CONCORD | 4 |
| 1 | 1250-003 | J3, J4 | FEEDTHRU MURATA | 3 |
| 2 | 2052-5636-02 | J1, J2 | FLANGE MOUNT JACK RECEPTACLE | 2 |

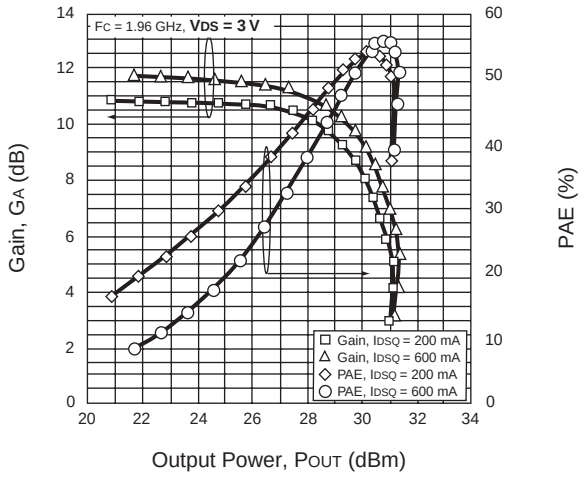
## P.C.B. LAYOUT (Units in mm)

**FOR 79A PACKAGE**

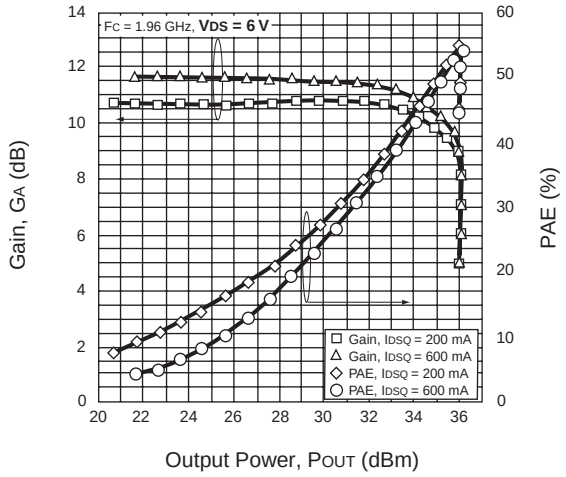



## TYPICAL APPLICATION CIRCUIT PERFORMANCE at VDS = 3 V and VDS = 6 V

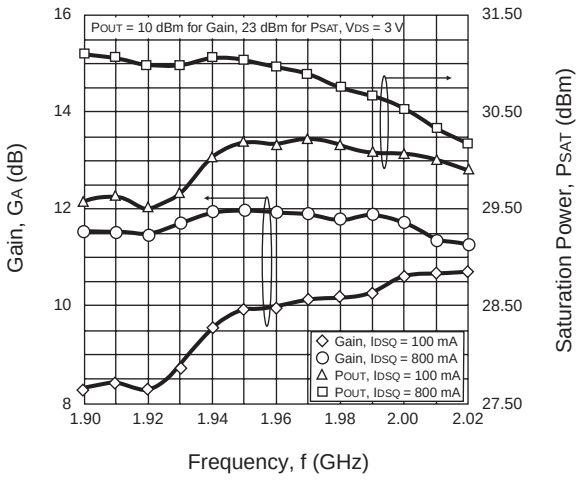
**GAIN AND PAE vs. OUTPUT POWER**



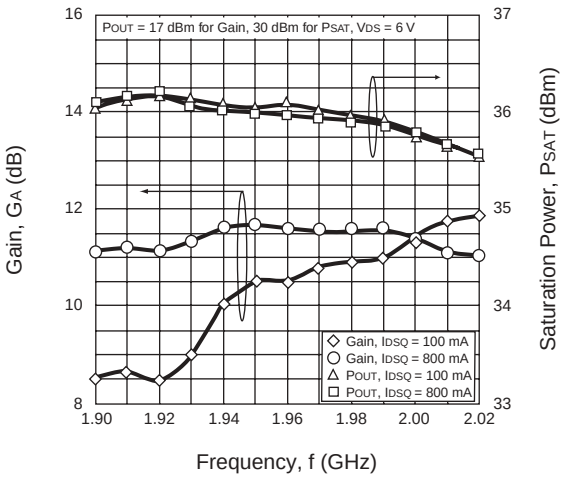

**GAIN AND PAE vs. OUTPUT POWER**




**GAIN AND SATURATION POWER vs. FREQUENCY**

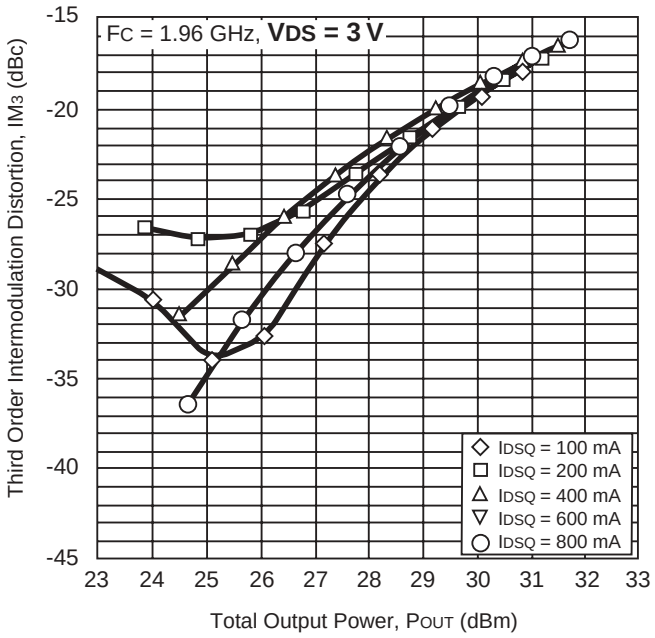



**GAIN AND SATURATION POWER vs. FREQUENCY**

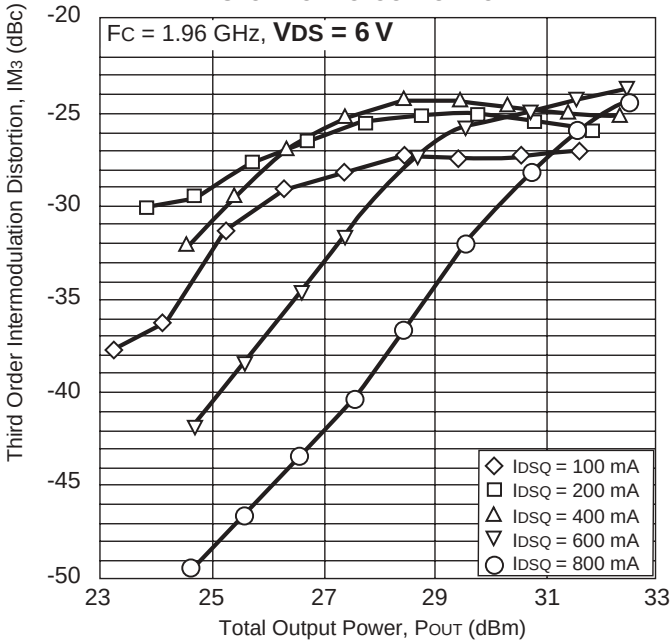


## TYPICAL APPLICATION CIRCUIT PERFORMANCE at $V_{DS}$ = 3 V and $V_{DS}$ = 6 V

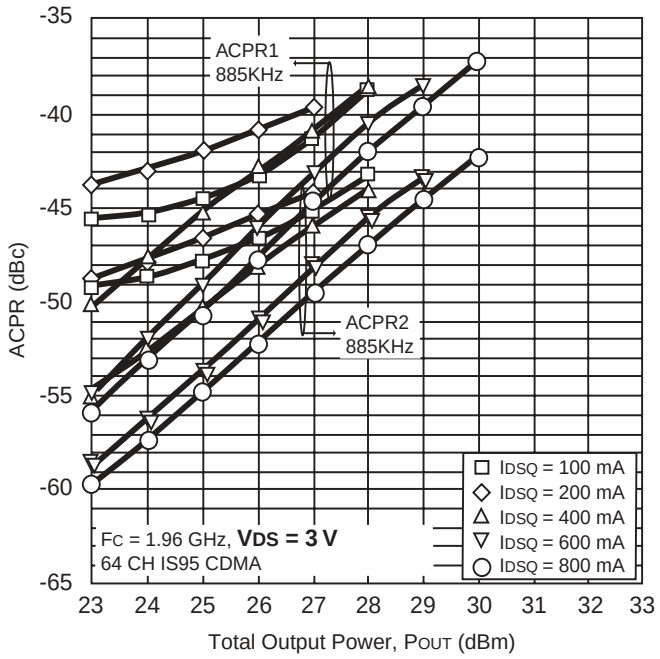
THIRD ORDER INTERMODULATION DISTORTION vs. OUTPUT POWER



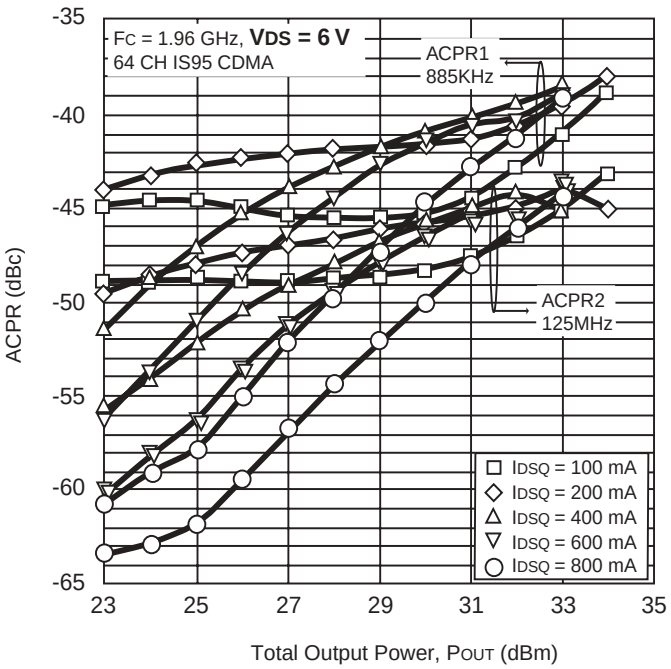

THIRD ORDER INTERMODULATION DISTORTION vs. OUTPUT POWER




ACPR vs. OUTPUT POWER




ACPR vs. OUTPUT POWER




Life Support Applications

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