CEL

# NEC's 3.2 V, 2 W, L&S BAND MEDIUM POWER SILICON LD-MOSFET

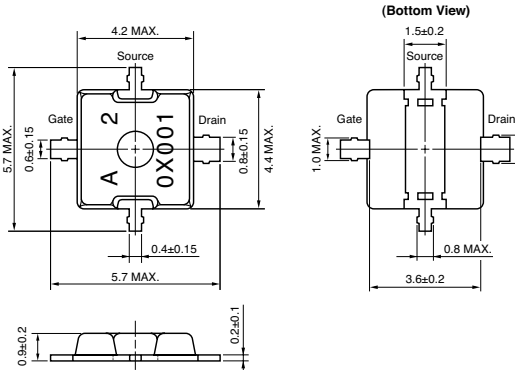
# NE5520279A

## FEATURES

- **LOW COST PLASTIC SURFACE MOUNT PACKAGE:** 5.7x5.7x1.1 mm MAX
- **HIGH OUTPUT POWER:** +32 dBm TYP
- **HIGH LINEAR GAIN:** 10 dB TYP @ 1.8 GHz
- **HIGH POWER ADDED EFFICIENCY:** 45% TYP at 1.8 GHz
- **SINGLE SUPPLY:** 2.8 to 6.0 V

## OUTLINE DIMENSIONS (Units in mm)

**PACKAGE OUTLINE 79A**




## DESCRIPTION

NEC's NE5520279A is an N-Channel silicon power laterally diffused MOSFET specially designed as the power amplifier for mobile and fixed wireless applications. Die are manufactured using NEC's NEWMOS technology (NEC's 0.6 μm WSi gate lateral MOSFET) and housed in a surface mount package.

## APPLICATIONS

- **DIGITAL CELLULAR PHONES:** 3.2 V DCS1800 Handsets
- **0.7-2.5 GHz FIXED WIRELESS ACCESS**
- **W-LAN**
- **SHORT RANGE WIRELESS**
- **RETAIL BUSINESS RADIO**
- **SPECIAL MOBILE RADIO**

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

| PART NUMBER / PACKAGE OUTLINE | | | | NE5520279A 79A | | | |
|---|---|---|---|---|---|---|---|
| | SYMBOLS | CHARACTERISTICS | UNITS | MIN | TYP | MAX | TEST CONDITIONS |
| Functional Characteristics | $P_{OUT}$ | Output Power | dBm | 30.5 | 32.0 | | f = 1.8 GHz, $V_{DS}$ = 3.2 V, $I_{DSQ}$ = 700 mA, $P_{IN}$ = 25 dBm, except $P_{IN}$ = 5 dBm for Linear Gain |
| | $G_L$ | Linear Gain | dB | | 10 | | |
| | $\eta_{ADD}$ | Power Added Efficiency | % | 40 | 45 | | |
| | $I_D$ | Drain Current | mA | | 800 | | |
| Electrical DC Characteristics | $I_{GSS}$ | Gate-to-Source Leakage Current | nA | | | 100 | $V_{GS}$ = 5.0 V |
| | $I_{DSS}$ | Saturated Drain Current (Zero Gate Voltage Drain Current) | nA | | | 100 | $V_{DS}$ = 6.0 V |
| | $V_{TH}$ | Gate Threshold Voltage | V | 1.0 | 1.4 | 1.9 | $V_{DS}$ = 3.5 V, $I_{DS}$ = 1 mA |
| | $g_m$ | Transconductance | S | | 1.3 | | $V_{DS}$ = 3.5 V, $I_{DS}$ = 700 mA |
| | $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | V | 15 | 18 | | $I_{DSS}$ = 10 μA |
| | $R_{TH}$ | Thermal Resistance | °C/W | | | 8 | Channel-to-Case |

Notes:

1. DC performance is 100% testing. RF performance is testing several samples per wafer. Wafer rejection criteria for standard devices is 1 reject for several samples.
2. $P_{in}$ = 5 dBm

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

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|---|---|---|---|
| $V_{DS}$ | Drain Supply Voltage | V | 15.0 |
| $V_{GS}$ | Gate Supply Voltage | V | 5.0 |
| $I_D$ | Drain Current | A | 0.6 |
| $I_D$ | Drain Current (Pulse Test)[2] | A | 1.2 |
| $P_T$ | Total Power Dissipation | W | 12.5 |
| $T_{CH}$ | Channel Temperature | °C | 125 |
| $T_{STG}$ | Storage Temperature | °C | -55 to +125 |

Note:
1. Operation in excess of any one of these parameters may result in permanent damage.
2. Duty Cycle 50%, Ton = 1 s.

## ORDERING INFORMATION

| PART NUMBER | QTY |
|---|---|
| NE5520279A-T1-A | |

## RECOMMENDED OPERATING LIMITS

| SYMBOLS | PARAMETERS | UNITS | TYP | MAX |
|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | V | 3.0 | 6.0 |
| $V_{GS}$ | Gate Supply Voltage | V | 2.0 | 3.0 |
| $I_{DS}$ | Drain Current[1] | A | 0.8 | 1.0 |
| $P_{IN}$ | Input Power<br>f = 1.8 GHz, $V_{DS}$ = 3.2 V | dBm | 25 | 30 |

Note:
1. Duty Cycle ≤ 50%, Ton ≤ 1 s.

## LARGE SIGNAL IMPEDANCE

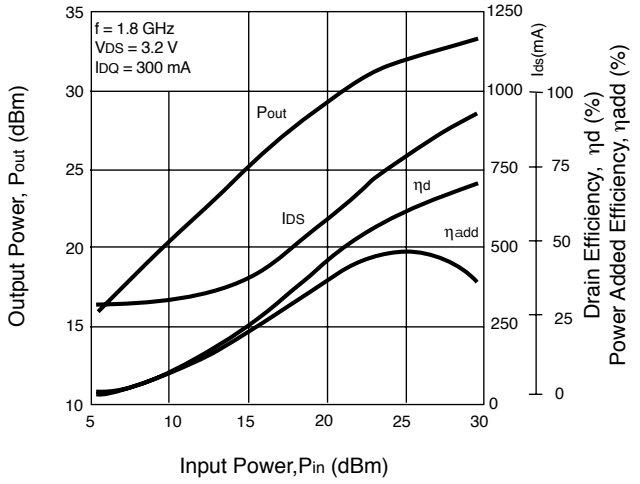
($V_{DS}$ = 3.2 V, $I_D$ = 700 mA, f = 1.8 GHz)

| FREQUENCY (GHz) | $Z_{in}$ (Ω) | $Z_{OL}$ (Ω)[1] |
|---|---|---|
| 1.8 | 1.77 –j6.71 | 1.25 –j5.73 |

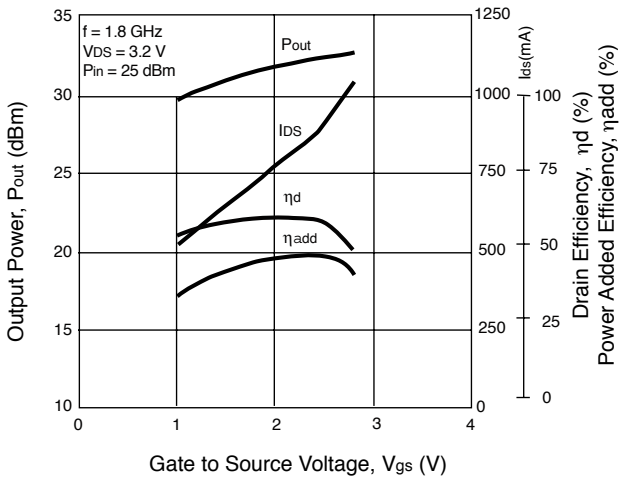
Note:
1. $Z_{OL}$ is the conjugate of optimum load impedance at given voltage, idling current, input power.

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

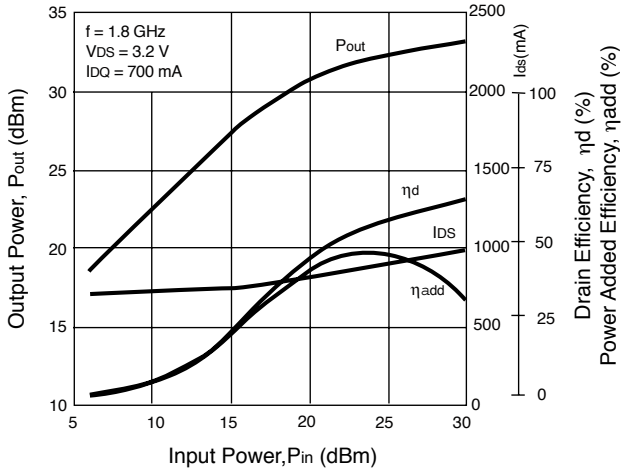
**OUTPUT POWER, DRAIN CURRENT EFFICIENCY vs. INPUT POWER**



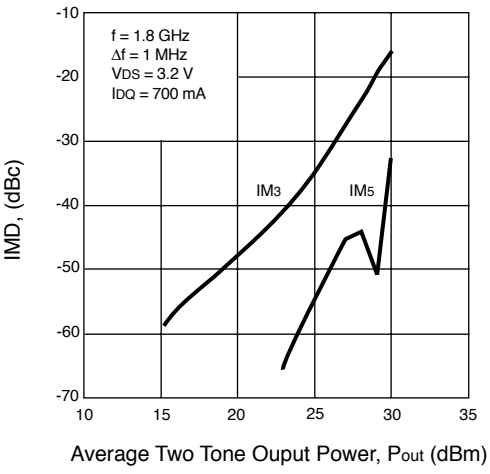

**OUTPUT POWER, DRAIN CURRENT EFFICIENCY vs. GATE TO SOURCE VOLTAGE**



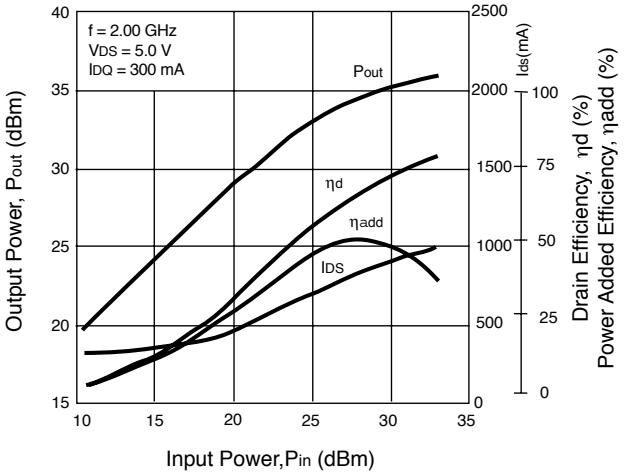

**OUTPUT POWER, DRAIN CURRENT EFFICIENCY vs. INPUT POWER**



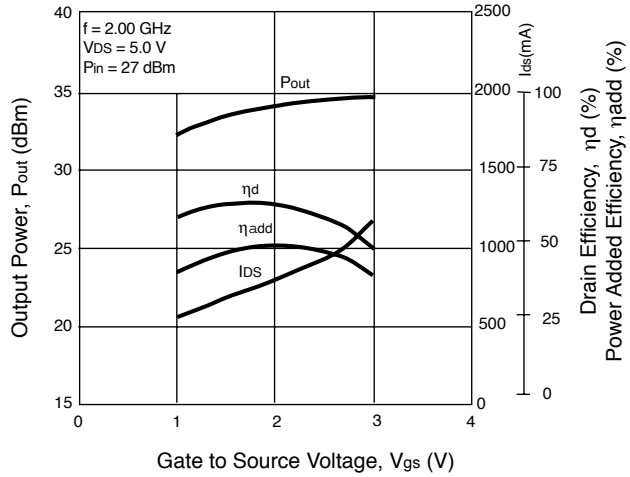

**IMD vs. TWO TONE OUTPUT POWER**




**OUTPUT POWER, DRAIN CURRENT EFFICIENCY vs. INPUT POWER**

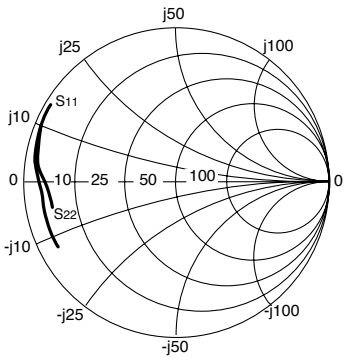



**OUTPUT POWER, DRAIN CURRENT EFFICIENCY vs. GATE TO SOURCE VOLTAGE**

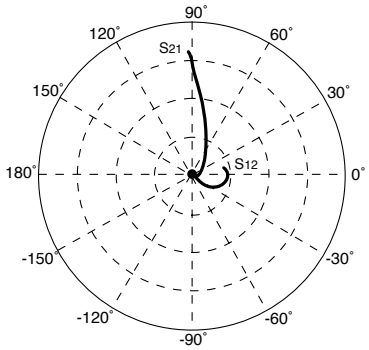


## TYPICAL SCATTERING PARAMETERS ($T_A$ = 25°C)

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




**Coordinates in Ohms**
**Frequency in GHz**
**$V_D$ = 5.0 V, $I_D$ = 400 mA**




### NE5520279A

### $V_D$ = 5.0 V, $I_D$ = 400 mA

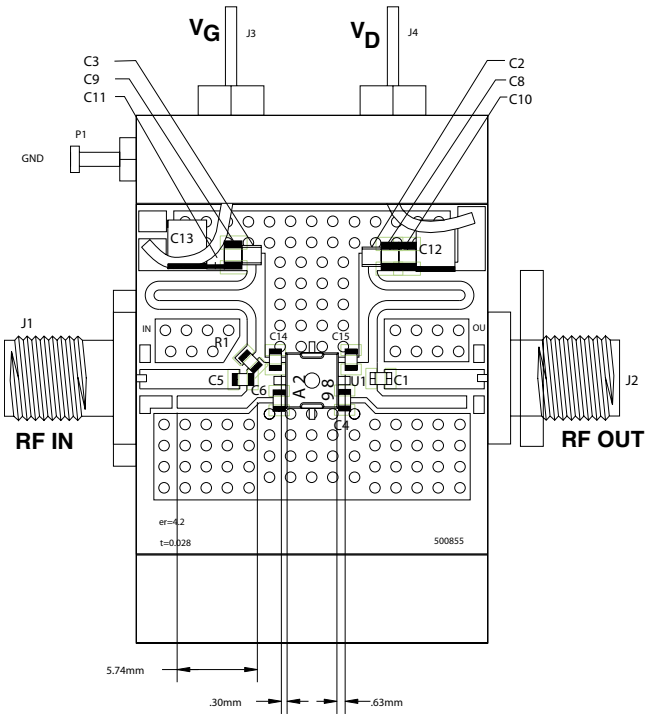
| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) |
| 0.100 | 0.885 | -152.5 | 11.510 | 98.5 | 0.021 | 10.3 | 0.830 | -170.1 | 0.03 | 27.43 |
| 0.200 | 0.885 | -166.9 | 5.882 | 87.7 | 0.022 | 0.2 | 0.833 | -175.4 | 0.07 | 24.21 |
| 0.300 | 0.883 | -172.4 | 3.896 | 80.8 | 0.022 | - 5.2 | 0.840 | -177.5 | 0.11 | 22.51 |
| 0.400 | 0.885 | -175.6 | 2.897 | 75.2 | 0.021 | - 9.2 | 0.849 | -178.5 | 0.14 | 21.31 |
| 0.500 | 0.887 | -177.9 | 2.278 | 70.1 | 0.021 | - 12.9 | 0.851 | -179.3 | 0.20 | 20.41 |
| 0.600 | 0.890 | -179.8 | 1.865 | 65.3 | 0.020 | - 15.7 | 0.856 | 179.9 | 0.27 | 19.66 |
| 0.700 | 0.895 | 178.7 | 1.569 | 60.7 | 0.020 | - 19.3 | 0.861 | 179.1 | 0.30 | 19.05 |
| 0.800 | 0.900 | 177.3 | 1.346 | 56.5 | 0.019 | - 21.8 | 0.869 | 178.4 | 0.32 | 18.55 |
| 0.900 | 0.905 | 176.0 | 1.168 | 52.4 | 0.018 | - 24.5 | 0.876 | 177.9 | 0.36 | 18.12 |
| 1.000 | 0.911 | 174.6 | 1.024 | 48.5 | 0.017 | - 27.2 | 0.882 | 177.2 | 0.39 | 17.79 |
| 1.100 | 0.916 | 173.6 | 0.911 | 44.7 | 0.016 | - 28.8 | 0.894 | 176.5 | 0.36 | 17.48 |
| 1.200 | 0.921 | 172.2 | 0.812 | 40.9 | 0.015 | - 30.8 | 0.898 | 175.5 | 0.42 | 17.21 |
| 1.300 | 0.924 | 171.0 | 0.728 | 37.5 | 0.015 | - 33.3 | 0.903 | 174.7 | 0.47 | 16.93 |
| 1.400 | 0.926 | 169.9 | 0.655 | 34.1 | 0.014 | - 33.9 | 0.907 | 173.9 | 0.62 | 16.84 |
| 1.500 | 0.927 | 168.7 | 0.594 | 30.8 | 0.013 | - 36.0 | 0.914 | 172.9 | 0.68 | 16.65 |
| 1.600 | 0.929 | 167.5 | 0.541 | 27.9 | 0.012 | - 36.6 | 0.921 | 172.2 | 0.76 | 16.54 |
| 1.700 | 0.930 | 166.3 | 0.494 | 25.1 | 0.011 | - 37.3 | 0.925 | 171.5 | 0.98 | 16.58 |
| 1.800 | 0.931 | 165.2 | 0.451 | 22.4 | 0.010 | - 38.5 | 0.926 | 170.7 | 1.22 | 13.67 |
| 1.900 | 0.935 | 164.1 | 0.415 | 19.6 | 0.009 | - 38.5 | 0.930 | 169.8 | 1.35 | 12.97 |
| 2.000 | 0.937 | 162.9 | 0.384 | 17.1 | 0.009 | - 38.8 | 0.937 | 169.0 | 1.33 | 12.95 |
| 2.100 | 0.941 | 161.8 | 0.356 | 14.9 | 0.008 | - 36.9 | 0.942 | 168.5 | 1.45 | 12.62 |
| 2.200 | 0.944 | 160.6 | 0.329 | 12.6 | 0.007 | - 40.8 | 0.941 | 167.8 | 1.74 | 11.58 |
| 2.300 | 0.949 | 159.5 | 0.305 | 10.2 | 0.006 | - 36.6 | 0.942 | 167.0 | 2.04 | 11.01 |
| 2.400 | 0.950 | 158.3 | 0.285 | 7.7 | 0.006 | - 36.0 | 0.947 | 166.0 | 2.04 | 11.00 |
| 2.500 | 0.955 | 157.3 | 0.267 | 5.8 | 0.005 | - 34.6 | 0.952 | 165.5 | 2.04 | 11.27 |
| 2.600 | 0.956 | 156.3 | 0.248 | 4.0 | 0.005 | - 32.7 | 0.953 | 164.9 | 2.59 | 10.34 |
| 2.700 | 0.958 | 155.4 | 0.232 | 2.0 | 0.004 | - 31.4 | 0.952 | 164.2 | 3.32 | 9.53 |
| 2.800 | 0.957 | 154.5 | 0.217 | 0.0 | 0.003 | - 27.2 | 0.954 | 163.2 | 4.54 | 8.76 |
| 2.900 | 0.959 | 153.8 | 0.204 | - 1.6 | 0.003 | - 22.0 | 0.958 | 162.4 | 5.69 | 8.58 |
| 3.000 | 0.959 | 152.9 | 0.192 | - 3.1 | 0.003 | - 5.2 | 0.961 | 161.9 | 5.78 | 8.26 |
| 3.100 | 0.962 | 152.5 | 0.180 | - 4.5 | 0.002 | - 1.3 | 0.960 | 161.1 | 9.71 | 7.87 |
| 3.200 | 0.961 | 151.5 | 0.170 | - 6.1 | 0.002 | 27.2 | 0.960 | 160.2 | 9.31 | 7.08 |
| 3.300 | 0.965 | 150.8 | 0.161 | - 7.6 | 0.002 | 56.3 | 0.964 | 159.4 | 9.54 | 7.19 |
| 3.400 | 0.967 | 150.1 | 0.152 | - 8.8 | 0.002 | 79.5 | 0.965 | 158.6 | 7.96 | 6.89 |
| 3.500 | 0.971 | 149.6 | 0.144 | - 10.0 | 0.003 | 86.6 | 0.963 | 157.6 | 5.89 | 6.46 |

Note:
1. Gain Calculation:

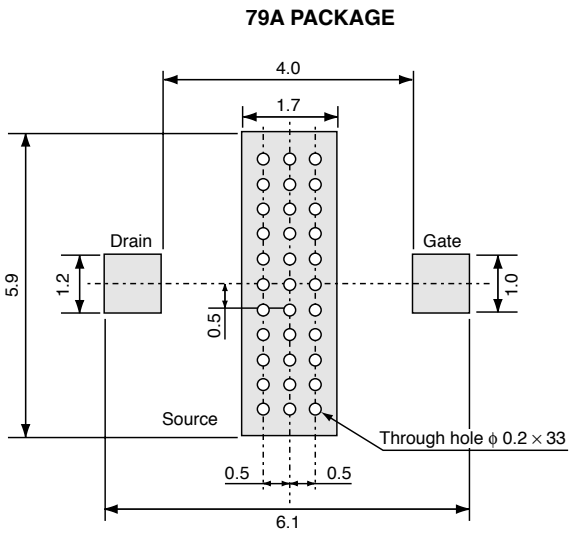
$$MAG = \frac{|S_{21}|}{|S_{12}|}\left(K \pm \sqrt{K^2 - 1}\right)$$. When K ≤ 1, MAG is undefined and MSG values are used. $$MSG = \frac{|S_{21}|}{|S_{12}|}$$, $$K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$$, $$\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$$

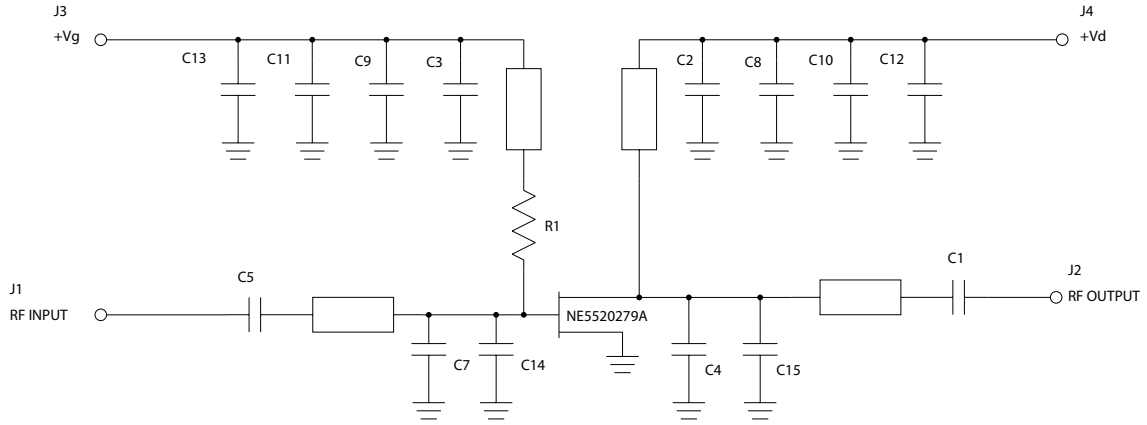
MAG = Maximum Available Gain
MSG = Maximum Stable Gain

## APPLICATION CIRCUIT (2.40-2.48 GHz)




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



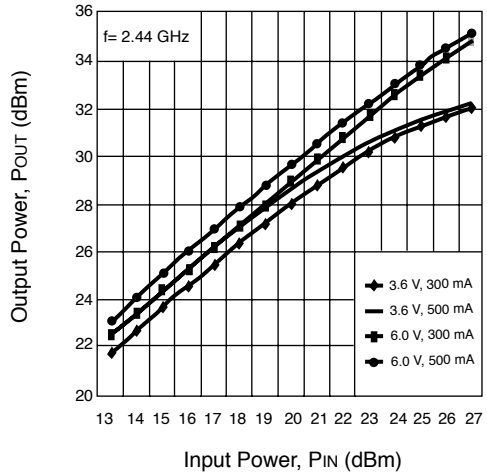




### NE5520279A PARTS LIST

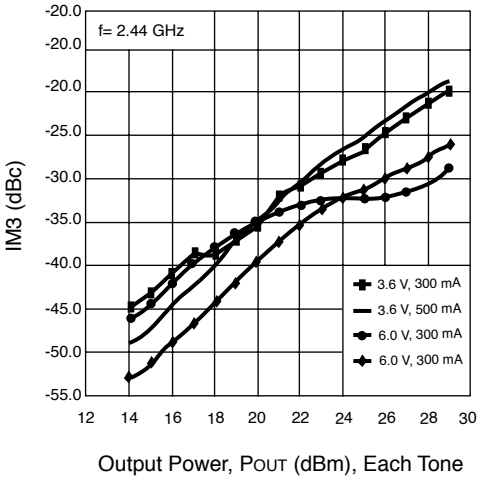
| | | | | |
|---|---|---|---|---|
| 1 | SD-500881 | | SCHEMATIC DIAGRAM NE5520279A-EVAL | 18 |
| 1 | TF-100637 | | TEST CIRCUIT BLK | 17 |
| 4 | | | 2-56 x 3/16 PHILLIPS PAN HEAD | 16 |
| 2 | MA101J | C2,C3 | CASE 1 100pF CAP MURATA | 15 |
| 1 | MCR03J200 | R1 | 0603 20 OHM RESISTOR ROHM | 14 |
| 1 | 600S2R7CW | C4 | 0603 2.7pF CAP ATC | 13 |
| 1 | 600S2R2BW | C15 | 0603 2.2pF CAP ATC | 12 |
| 1 | 600S1R2BW | C14 | 0805 1.2pF CAP ATC | 11 |
| 2 | 600S5R6CW | C1, C5 | 0603 5.6pF CAP ATC | 10 |
| 1 | 600S3R3CW | C6 | 0603 3.3pF CAP ATC | 9 |
| 2 | TAJB475K010R | C12, C13 | CASE B 4.7 uF CAP AVX | 8 |
| 2 | GRM40X7R104K025BL | C10, C11 | 0805 .1uF CAP MURATA | 7 |
| 2 | GRM40C0G102J050BD | C8, C9 | 0805 1000 pF CAP MURATA | 6 |
| 1 | NE5520279A | 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 |
| 1 | FD-500855B | PCB | S-BAND MODULE FABRICATION DRAWING | 1 |

## TYPICAL APPLICATION CIRCUIT PERFORMANCE ($T_A$ = 25°C)

**OUTPUT POWER vs. INPUT POWER**




**IM3 vs. OUTPUT POWER**



## RECOMMENDED SOLDERING CONDITIONS

This product should be soldered and mounted under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your nearby sales office.

| Soldering Method | Soldering Conditions | | Condition Symbol |
|---|---|---|---|
| Infrared Reflow | Peak temperature (package surface temperature) | : 260°C or below | IR260 |
| | Time at peak temperature | : 10 seconds or less | |
| | Time at temperature of 220°C or higher | : 60 seconds or less | |
| | Preheating time at 120 to 180°C | : 120±30 seconds | |
| | Maximum number of reflow processes | : 3 times | |
| | Maximum chlorine content of rosin flux (% mass) | : 0.2%(Wt.) or below | |
| VPS | Peak temperature (package surface temperature) | : 215°C or below | VP215 |
| | Time at temperature of 200°C or higher | : 25 to 40 seconds | |
| | Preheating time at 120 to 150°C | : 30 to 60 seconds | |
| | Maximum number of reflow processes | : 3 times | |
| | Maximum chlorine content of rosin flux (% mass) | : 0.2%(Wt.) or below | |
| Wave Soldering | Peak temperature (molten solder temperature) | : 260°C or below | WS260 |
| | Time at peak temperature | : 10 seconds or less | |
| | Preheating temperature (package surface temperature) | : 120°C or below | |
| | Maximum number of flow processes | : 1 time | |
| | Maximum chlorine content of rosin flux (% mass) | : 0.2%(Wt.) or below | |
| Partial Heating | Peak temperature (pin temperature) | : 350°C or below | HS350-P3 |
| | Soldering time (per pin of device) | : 3 seconds or less | |
| | Maximum chlorine content of rosin flux (% mass) | : 0.2%(Wt.) or below | |

**Caution Do not use different soldering methods together (except for partial heating).**

Life Support Applications
These NEC products are not intended for use in life support devices, appliances, or systems where the malfunction of these products can reasonably be expected to result in personal injury. The customers of CEL using or selling these products for use in such applications do so at their own risk and agree to fully indemnify CEL for all damages resulting from such improper use or sale.

CEL California Eastern Laboratories

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Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL's understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

| Restricted Substance per RoHS | Concentration Limit per RoHS (values are not yet fixed) | Concentration contained in CEL devices | |
|---|---|---|---|
| Lead (Pb) | < 1000 PPM | -A | -AZ |
| | | Not Detected | (*) |
| Mercury | < 1000 PPM | Not Detected | |
| Cadmium | < 100 PPM | Not Detected | |
| Hexavalent Chromium | < 1000 PPM | Not Detected | |
| PBB | < 1000 PPM | Not Detected | |
| PBDE | < 1000 PPM | Not Detected | |

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.

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