DATA SHEET

NEC

# SILICON POWER MOS FET
# NE552R679A

## 3.0 V OPERATION SILICON RF POWER LD-MOS FET FOR 460 MHz 0.6 W TRANSMISSION AMPLIFIERS

### DESCRIPTION

The NE552R679A is an N-channel silicon power laterally diffused MOS FET specially designed as the transmission power amplifier for 3.0 V FRS (Family Radio Service). Dies are manufactured using our NEWMOS2 technology (our WSi gate lateral-diffusion MOS FET) and housed in a surface mount package. This device can deliver 28.0 dBm output power with 60% power added efficiency at 460 MHz under the 3.0 V supply voltage.

### FEATURES

- High output power : $P_{out}$ = 28.0 dBm TYP. ($V_{DS}$ = 3.0 V, $I_{Dset}$ = 300 mA, f = 460 MHz, $P_{in}$ = 15 dBm)
- High power added efficiency : $\eta_{add}$ = 60% TYP. ($V_{DS}$ = 3.0 V, $I_{Dset}$ = 300 mA, f = 460 MHz, $P_{in}$ = 15 dBm)
- High linear gain : $G_L$ = 20 dB TYP. ($V_{DS}$ = 3.0 V, $I_{Dset}$ = 300 mA, f = 460 MHz, $P_{in}$ = 5 dBm)
- Surface mount package : 5.7 × 5.7 × 1.1 mm MAX.
- Single supply : $V_{DS}$ = 2.8 to 6.0 V

### APPLICATIONS

- Family Radio Service : 3.0 V Handsets

### ORDERING INFORMATION

| Part Number | Package | Marking | Supplying Form |
|---|---|---|---|
| NE552R679A-T1 | 79A | AU | • 12 mm wide embossed taping<br>• Gate pin face the perforation side of the tape<br>• Qty 1 kpcs/reel |
| NE552R679A-T1A | | | • 12 mm wide embossed taping<br>• Gate pin face the perforation side of the tape<br>• Qty 5 kpcs/reel |

**Remark** To order evaluation samples, contact your nearby sales office.
Part number for sample order: NE552R679A

**Caution Observe precautions when handling because these devices are sensitive to electrostatic discharge.**



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**The mark ★ shows major revised points.**

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = +25°C)

| Parameter | Symbol | Ratings | Unit |
|---|---|---|---|
| ★ Drain to Source Voltage | $V_{DS}$ | 15.0 | V |
| Gate to Source Voltage | $V_{GS}$ | 5.0 | V |
| Drain Current | $I_{DS}$ | 350 | mA |
| Drain Current (Pulse Test) | $I_{DS}$ Note | 600 | mA |
| Total Power Dissipation | $P_{tot}$ | 10 | W |
| Channel Temperature | $T_{ch}$ | 125 | °C |
| Storage Temperature | $T_{stg}$ | –55 to +125 | °C |

**Note** Duty Cycle 50%, $T_{on} \leq 1$ s

## RECOMMENDED OPERATING CONDITIONS

| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Drain to Source Voltage | $V_{DS}$ | | 2.8 | 3.0 | 6.0 | V |
| Gate to Source Voltage | $V_{GS}$ | | 0 | 2.0 | 3.0 | V |
| Drain Current | $I_{DS}$ | | – | 300 | 500 | mA |
| Input Power | $P_{in}$ | f = 460 MHz, $V_{DS}$ = 3.0 V | 14 | 15 | 20 | dBm |

## ELECTRICAL CHARACTERISTICS
## ($T_A$ = +25°C, Unless otherwise specified, using NEC standard test fixture)

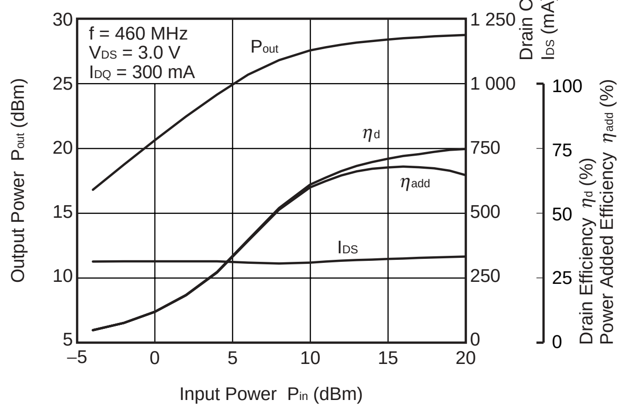
| Parameter | Symbol | Test Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Gate to Source Leak Current | $I_{GSS}$ | $V_{GS}$ = 5.0 V | – | – | 100 | nA |
| Saturated Drain Current (Zero Gate Voltage Drain Current) | $I_{DSS}$ | $V_{DS}$ = 8.0 V | – | – | 100 | nA |
| Gate Threshold Voltage | $V_{th}$ | $V_{DS}$ = 3.5 V, $I_{DS}$ = 1 mA | 1.0 | 1.4 | 1.9 | V |
| Thermal Resistance | $R_{th}$ | Channel to Case | – | – | 10 | °C/W |
| Transconductance | $g_m$ | $V_{DS}$ = 3.0 V, $I_{DS}$ = 300 mA | – | 0.6 | – | S |
| Drain to Source Breakdown Voltage | $BV_{DSS}$ | $I_{DSS}$ = 10 $\mu$A | 15 | 18 | – | V |
| Output Power | $P_{out}$ | f = 460 MHz, $V_{DS}$ = 3.0 V, | 26.0 | 28.0 | – | dBm |
| Drain Current | $I_{DS}$ | $P_{in}$ = 15 dBm, | – | 320 | – | mA |
| Power Added Efficiency | $\eta_{add}$ | $I_{Dset}$ = 300 mA (RF OFF) , **Note1** | 55 | 60 | – | % |
| Linear Gain Note2 | $G_L$ | | – | 20 | – | dB |

**Note 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.

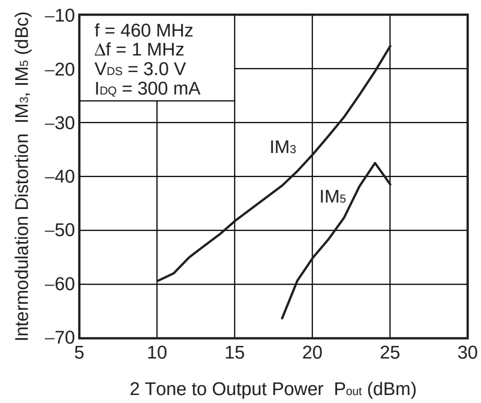
**2.** $P_{in}$ = 5 dBm

## TYPICAL CHARACTERISTICS ($T_A$ = +25°C)

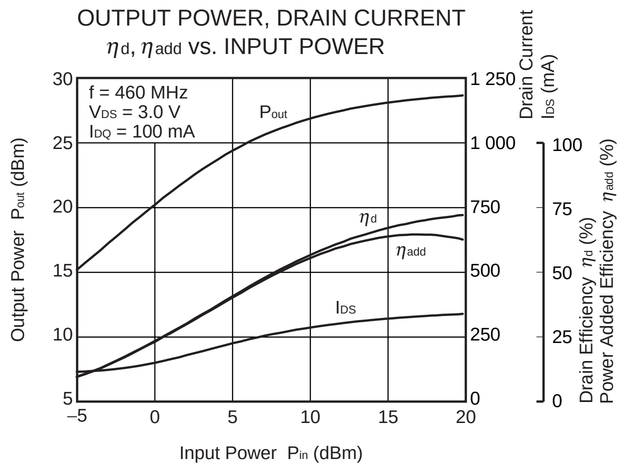
OUTPUT POWER, DRAIN CURRENT
$\eta_d$, $\eta_{add}$ vs. INPUT POWER



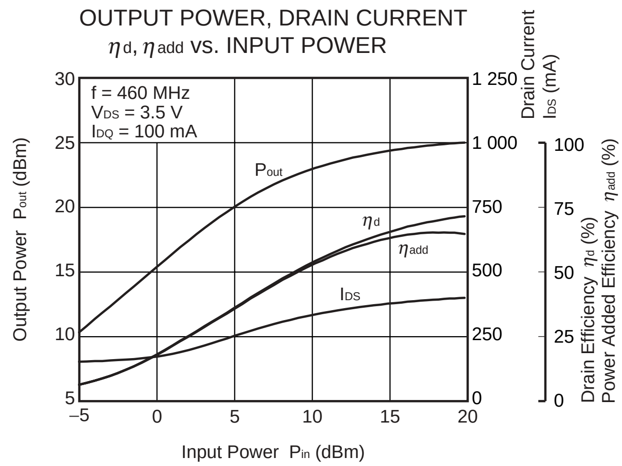

INTERMODULATION DISTORTION vs.
2 TONE TO OUTPUT POWER




OUTPUT POWER, DRAIN CURRENT
$\eta_d$, $\eta_{add}$ vs. INPUT POWER




OUTPUT POWER, DRAIN CURRENT
$\eta_d$, $\eta_{add}$ vs. INPUT POWER




**Remark** The graphs indicate nominal characteristics.

## S-PARAMETERS

Test Conditions: $V_{DS}$ = 3.0 V, $I_{Dset}$ = 300 mA, $T_A$ = +25°C)

| Frequency | S11 | | | S21 | | | S12 | | S22 | | MAG Note | MSG Note | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GHz | Mag. | Ang. | dB | Mag. | Ang. | dB | Mag. | Ang. | Mag. | Ang. | dB | dB | – |
| 0.1 | 0.655 | –120.2 | 21.2 | 11.42 | 115.3 | –31.6 | 0.026 | 28.7 | 0.633 | –167.5 | | 26.4 | 0.59 |
| 0.2 | 0.651 | –142.0 | 17.2 | 7.25 | 99.3 | –29.0 | 0.035 | 10.3 | 0.757 | –167.9 | | 23.1 | 0.36 |
| 0.3 | 0.666 | –156.1 | 13.8 | 4.89 | 88.2 | –29.3 | 0.034 | –0.1 | 0.796 | –173.0 | | 21.5 | 0.40 |
| 0.4 | 0.660 | –161.4 | 11.5 | 3.74 | 81.6 | –29.2 | 0.034 | –5.6 | 0.808 | –175.0 | | 20.4 | 0.50 |
| 0.5 | 0.656 | –165.8 | 9.4 | 2.96 | 77.2 | –29.2 | 0.035 | –11.8 | 0.815 | –175.9 | | 19.3 | 0.62 |
| 0.6 | 0.655 | –168.4 | 7.8 | 2.46 | 72.6 | –29.3 | 0.034 | –15.9 | 0.819 | –176.8 | | 18.6 | 0.76 |
| 0.7 | 0.654 | –170.2 | 6.5 | 2.10 | 68.4 | –29.5 | 0.033 | –20.1 | 0.823 | –177.4 | | 18.0 | 0.91 |
| 0.8 | 0.658 | –171.8 | 5.2 | 1.81 | 64.4 | –29.6 | 0.033 | –24.2 | 0.828 | –178.0 | 16.2 | | 1.04 |
| 0.9 | 0.656 | –172.8 | 4.1 | 1.61 | 60.6 | –29.7 | 0.033 | –27.6 | 0.831 | –179.4 | 14.2 | | 1.20 |
| 1.0 | 0.658 | –173.8 | 3.1 | 1.43 | 56.6 | –29.8 | 0.032 | –31.5 | 0.835 | –179.9 | 12.8 | | 1.37 |
| 1.1 | 0.663 | –175.0 | 2.1 | 1.27 | 53.3 | –30.0 | 0.031 | –35.3 | 0.840 | 179.6 | 11.7 | | 1.54 |
| 1.2 | 0.668 | –175.8 | 1.1 | 1.14 | 49.9 | –30.2 | 0.031 | –39.1 | 0.843 | 179.2 | 10.7 | | 1.75 |
| 1.3 | 0.668 | –176.8 | 0.4 | 1.04 | 46.6 | –30.3 | 0.030 | –42.1 | 0.846 | 178.7 | 9.8 | | 1.93 |
| 1.4 | 0.668 | –177.6 | –0.4 | 0.96 | 43.7 | –30.6 | 0.030 | –45.4 | 0.851 | 178.2 | 9.1 | | 2.14 |
| 1.5 | 0.672 | –178.5 | –1.1 | 0.88 | 40.6 | –30.7 | 0.029 | –49.0 | 0.853 | 177.7 | 8.2 | | 2.38 |
| 1.6 | 0.674 | –179.2 | –1.8 | 0.81 | 37.5 | –31.0 | 0.028 | –51.8 | 0.857 | 177.4 | 7.6 | | 2.61 |
| 1.7 | 0.673 | –180.0 | –2.5 | 0.75 | 34.6 | –31.1 | 0.028 | –55.3 | 0.859 | 176.6 | 6.8 | | 2.87 |
| 1.8 | 0.675 | 179.2 | –3.2 | 0.69 | 31.7 | –31.3 | 0.027 | –58.6 | 0.862 | 176.1 | 6.1 | | 3.20 |
| 1.9 | 0.677 | 178.5 | –3.8 | 0.65 | 28.9 | –31.6 | 0.026 | –61.5 | 0.864 | 175.5 | 5.5 | | 3.51 |
| 2.0 | 0.677 | 177.8 | –4.4 | 0.61 | 26.4 | –31.7 | 0.026 | –64.6 | 0.867 | 174.9 | 5.0 | | 3.76 |
| 2.1 | 0.677 | 177.0 | –4.9 | 0.57 | 24.0 | –31.9 | 0.025 | –68.3 | 0.869 | 174.2 | 4.4 | | 4.12 |
| 2.2 | 0.677 | 176.2 | –5.4 | 0.54 | 21.2 | –32.2 | 0.025 | –71.4 | 0.869 | 173.6 | 3.8 | | 4.57 |
| 2.3 | 0.681 | 175.4 | –6.0 | 0.50 | 19.2 | –32.2 | 0.025 | –75.1 | 0.863 | 172.6 | 3.0 | | 5.14 |
| 2.4 | 0.677 | 174.7 | –6.5 | 0.48 | 16.6 | –32.5 | 0.024 | –78.2 | 0.873 | 172.4 | 2.8 | | 5.35 |
| 2.5 | 0.675 | 174.6 | –6.9 | 0.45 | 13.9 | –32.7 | 0.023 | –82.0 | 0.874 | 171.7 | 2.2 | | 5.82 |
| 2.6 | 0.674 | 173.8 | –7.4 | 0.43 | 11.7 | –32.8 | 0.023 | –85.1 | 0.874 | 170.9 | 1.7 | | 6.29 |
| 2.7 | 0.673 | 173.2 | –7.9 | 0.40 | 9.5 | –33.0 | 0.022 | –89.7 | 0.873 | 170.1 | 1.2 | | 6.90 |
| 2.8 | 0.670 | 172.3 | –8.3 | 0.39 | 7.8 | –33.2 | 0.022 | –92.3 | 0.875 | 169.4 | 0.8 | | 7.45 |
| 2.9 | 0.667 | 171.4 | –8.7 | 0.37 | 5.7 | –33.4 | 0.021 | –96.7 | 0.874 | 168.7 | 0.3 | | 8.10 |
| 3.0 | 0.665 | 170.7 | –9.1 | 0.35 | 3.5 | –33.4 | 0.021 | –101.5 | 0.873 | 167.9 | –0.2 | | 8.64 |
| 3.1 | 0.662 | 169.9 | –9.5 | 0.33 | 1.4 | –33.7 | 0.021 | –106.4 | 0.873 | 167.2 | –0.8 | | 9.63 |
| 3.2 | 0.648 | 168.9 | –9.8 | 0.32 | –0.1 | –34.1 | 0.020 | –111.8 | 0.879 | 166.8 | –1.0 | | 10.28 |
| 3.3 | 0.656 | 168.6 | –10.4 | 0.30 | –1.4 | –34.6 | 0.019 | –117.6 | 0.872 | 165.7 | –1.7 | | 12.13 |
| 3.4 | 0.652 | 167.6 | –10.6 | 0.29 | –2.8 | –35.3 | 0.017 | –122.0 | 0.871 | 164.9 | –2.1 | | 13.80 |
| 3.5 | 0.651 | 167.1 | –11.0 | 0.28 | –4.5 | –35.6 | 0.017 | –123.8 | 0.871 | 164.1 | –2.4 | | 14.87 |
| 3.6 | 0.648 | 166.2 | –11.3 | 0.27 | –6.6 | –35.6 | 0.017 | –126.7 | 0.870 | 163.1 | –2.8 | | 15.51 |
| 3.7 | 0.644 | 165.4 | –11.6 | 0.26 | –7.9 | –35.7 | 0.016 | –130.5 | 0.869 | 162.3 | –3.2 | | 16.66 |
| 3.8 | 0.641 | 164.7 | –12.0 | 0.25 | –10.1 | –36.0 | 0.016 | –135.9 | 0.868 | 161.4 | –3.7 | | 18.41 |
| 3.9 | 0.636 | 163.8 | –12.3 | 0.24 | –11.5 | –36.1 | 0.016 | –140.3 | 0.867 | 160.4 | –4.0 | | 19.61 |
| 4.0 | 0.633 | 163.0 | –12.6 | 0.23 | –12.5 | –36.2 | 0.015 | –144.7 | 0.865 | 159.4 | –4.4 | | 21.02 |

**Note** When K ≥ 1, the MAG (Maximum Available Gain) is used. $\text{MAG} = \left|\frac{S_{21}}{S_{12}}\right| \left(K - \sqrt{(K^2 - 1)}\right)$

When K < 1, the MSG (Maximum Stable Gain) is used. $\text{MSG} = \left|\frac{S_{21}}{S_{12}}\right|$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2 \cdot |S_{12}| \cdot |S_{21}|}$,

$\Delta = S_{11} \cdot S_{22} - S_{21} \cdot S_{12}$

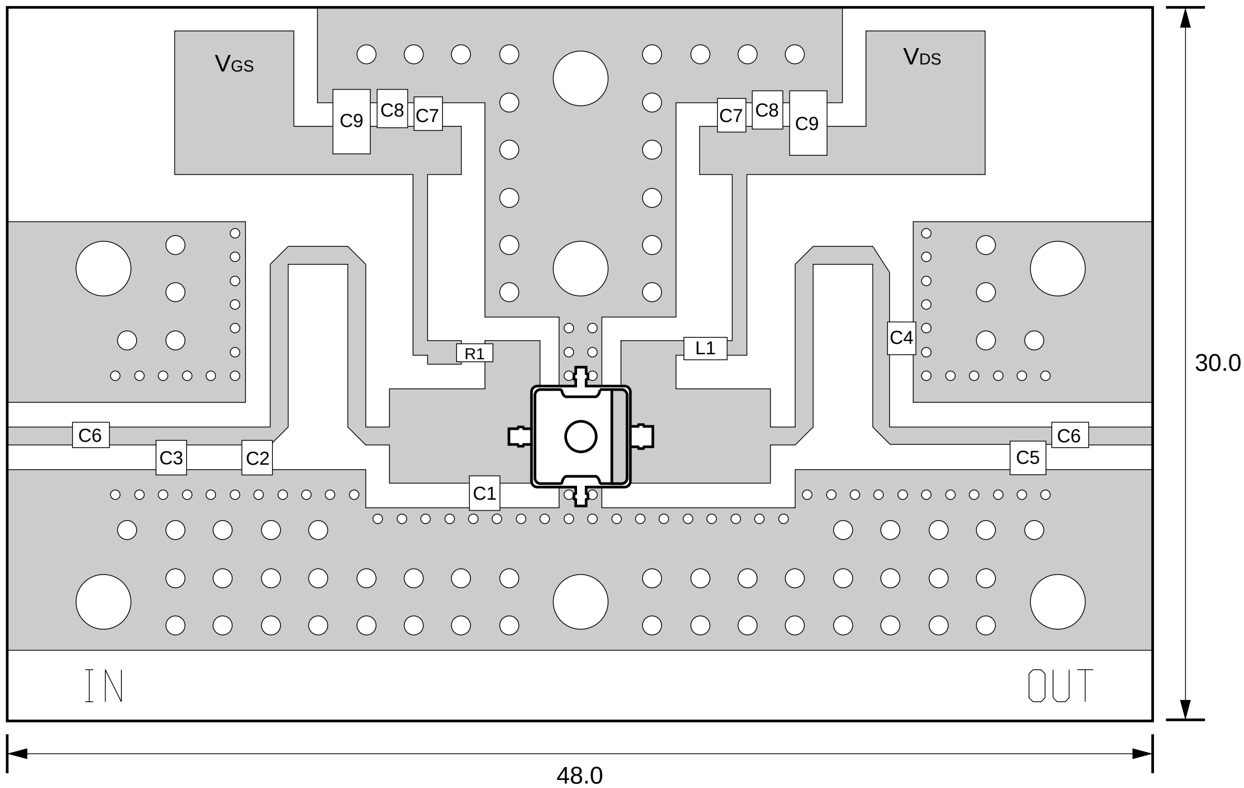
## LARGE SIGNAL IMPEDANCE ($V_{DS}$ = 3.0 V, $I_{DS}$ = 300 mA, f = 460 MHz)

| f (MHz) | $Z_{in}$ (Ω) | $Z_{OL}$ (Ω) Note |
|---|---|---|
| 460 | 7.47 +j18.24 | 4.82 +j5.04 |

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

**EVALUATION BOARD for 460 MHz**

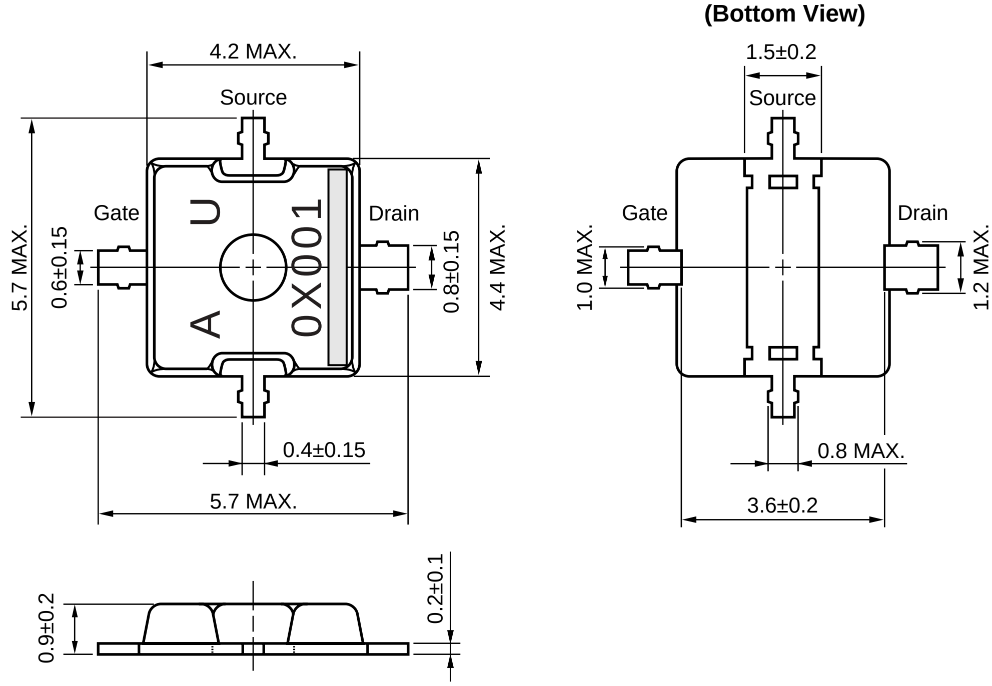
Unit : mm



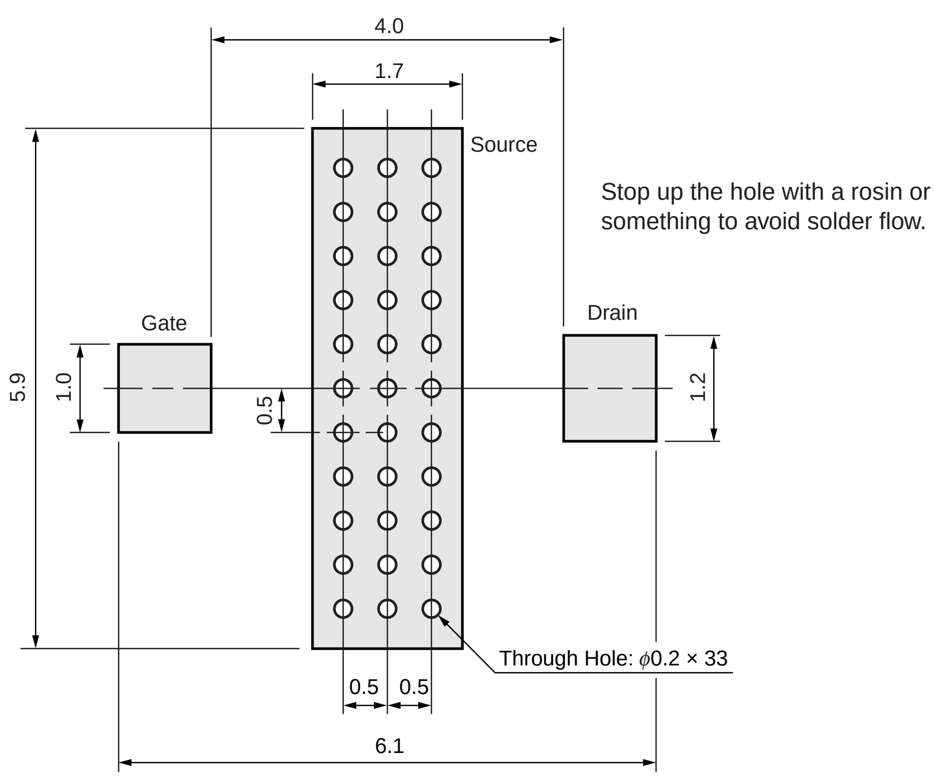

| Symbol | Value | Comment |
|---|---|---|
| C1 | 9.1 pF | |
| C2 | 12 pF | |
| C3 | 20 pF | |
| C4 | 3.3 pF | |
| C5 | 13 pF | |
| C6 | 22 pF | |
| C7 | 1 000 pF | |
| C8 | 0.33 $\mu$F | |
| C9 | 3.3 $\mu$F - 16V | |
| R1 | 1 000 $\Omega$ | |
| L1 | 22 nH | |
| Circuit Board | t = 0.4 mm, $\varepsilon$ r = 4.5 | R4775 |

## PACKAGE DIMENSIONS

### 79A (UNIT: mm)




### 79A PACKAGE RECOMMENDED P.C.B. LAYOUT (UNIT: mm)



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

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

▶**Business issue**

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▶**Technical issue**

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