N0603N
N-channel MOSFET
60 V, 100 A, 4.6 mΩ

Features
- Low on-state resistance : $R_{DS(on)} = 4.6 \text{ mΩ MAX. \ (} V_{GS} = 10 \text{ V, } I_D = 50 \text{ A})$
- Low $C_{iss}$ : $C_{iss} = 7730 \text{ pF TYP. \ (} V_{DS} = 25 \text{ V, } V_{GS} = 0 \text{ V})$
- High current : $I_{D(DC)} = \pm 100 \text{ A}$
- RoHS Compliant
- Quality Grade : Standard
- Applications : For high current switching

Ordering Information

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Package</th>
<th>Packing</th>
</tr>
</thead>
<tbody>
<tr>
<td>N0603N-S23-AY</td>
<td>TO-262, Pb-free 1</td>
<td>50 pcs / Magazine (Tube)</td>
</tr>
</tbody>
</table>

Note: 1. Pb-free means that this product does not contain lead in the external electrode.

Absolute Maximum Ratings ($T_A = 25°C$)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain to Source Voltage ($V_{GS} = 0 \text{ V}$)</td>
<td>$V_{DSS}$</td>
<td>60</td>
<td>V</td>
</tr>
<tr>
<td>Gate to Source Voltage ($V_{DS} = 0 \text{ V}$)</td>
<td>$V_{GSS}$</td>
<td>$\pm 20$</td>
<td>V</td>
</tr>
<tr>
<td>Drain Current (DC) ($T_C = 25°C$)</td>
<td>$I_{D(DC)}$</td>
<td>$\pm 100$</td>
<td>A</td>
</tr>
<tr>
<td>Drain Current (pulse) Note2</td>
<td>$I_{D(pulse)}$</td>
<td>$\pm 400$</td>
<td>A</td>
</tr>
<tr>
<td>Total Power Dissipation ($T_C = 25°C$)</td>
<td>$P_{T1}$</td>
<td>156</td>
<td>W</td>
</tr>
<tr>
<td>Total Power Dissipation ($T_A = 25°C$)</td>
<td>$P_{T2}$</td>
<td>1.5</td>
<td>W</td>
</tr>
<tr>
<td>Channel Temperature</td>
<td>$T_{ch}$</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$T_{stg}$</td>
<td>$-55 \text{ to } +150$</td>
<td>°C</td>
</tr>
<tr>
<td>Single Avalanche Current Note3</td>
<td>$I_{AS}$</td>
<td>55</td>
<td>A</td>
</tr>
<tr>
<td>Single Avalanche Energy Note3</td>
<td>$E_{AS}$</td>
<td>300</td>
<td>mJ</td>
</tr>
</tbody>
</table>

Note: Continuous heavy condition (e.g. high temperature/voltage/current or high variation of temperature) may affect a reliability even if it is within the absolute maximum ratings. Please consider derating condition for appropriate reliability in reference Renesas Semiconductor Reliability Handbook (Recommendation for Handling and Usage of Semiconductor Devices) and individual reliability data.

Notes: 2. $PW \leq 10 \mu s$, Duty Cycle $\leq 1%$
3. Starting $T_{ch} = 25°C$, $R_G = 25 \Omega$, $V_{DD} = 30 \text{ V, } V_{GS} = 20 \rightarrow 0 \text{ V, } L = 100 \mu H$

Thermal Resistance

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Max. Value Note4</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel to Case Thermal Resistance</td>
<td>$R_{th(ch-C)}$</td>
<td>0.80</td>
<td>°C/W</td>
</tr>
<tr>
<td>Channel to Ambient Thermal Resistance</td>
<td>$R_{th(ch-A)}$</td>
<td>83.3</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

Notes: 4. This data is the designed target maximum value on Renesas’s measurement condition. (Not tested)
### Electrical Characteristics (TA = 25°C)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>Unit</th>
<th>Test Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>I_DSS</td>
<td>1</td>
<td>µA</td>
<td></td>
<td></td>
<td>V_DSS = 60 V, V_GS = 0 V</td>
</tr>
<tr>
<td>Gate Leakage Current</td>
<td>I_GSS</td>
<td>±100</td>
<td>nA</td>
<td></td>
<td></td>
<td>V_GS = ±20 V, V_DSS = 0 V</td>
</tr>
<tr>
<td>Gate to Source Cut-off Voltage</td>
<td>V_GS(off)</td>
<td>2.0</td>
<td>4.0</td>
<td></td>
<td>V</td>
<td>V_DSS = 10 V, I_D = 1 mA</td>
</tr>
<tr>
<td>Forward Transfer Admittance Note5</td>
<td></td>
<td></td>
<td></td>
<td>35</td>
<td>mS</td>
<td>V_DSS = 10 V, I_D = 50 A</td>
</tr>
<tr>
<td>Drain to Source On-state Resistance Note5</td>
<td>R_DSS(on)</td>
<td>3.7</td>
<td>4.6</td>
<td></td>
<td>mΩ</td>
<td>V_DSS = 10 V, I_D = 50 A</td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>Ciss</td>
<td>7730</td>
<td>pF</td>
<td></td>
<td></td>
<td>V_DSS = 25 V,</td>
</tr>
<tr>
<td>Output Capacitance</td>
<td>Coss</td>
<td>560</td>
<td>pF</td>
<td></td>
<td></td>
<td>V_GS = 0 V,</td>
</tr>
<tr>
<td>Reverse Transfer Capacitance</td>
<td>Crss</td>
<td>290</td>
<td>pF</td>
<td></td>
<td>f = 1 MHz</td>
<td></td>
</tr>
<tr>
<td>Turn-on Delay Time</td>
<td>t_d(on)</td>
<td>35</td>
<td>ns</td>
<td></td>
<td></td>
<td>V_DD = 30 V, I_D = 50 A,</td>
</tr>
<tr>
<td>Rise Time</td>
<td>t_r</td>
<td>12</td>
<td>ns</td>
<td></td>
<td></td>
<td>V_GS = 10 V,</td>
</tr>
<tr>
<td>Turn-off Delay Time</td>
<td>t_d(off)</td>
<td>76</td>
<td>ns</td>
<td></td>
<td></td>
<td>R_G = 0 Ω</td>
</tr>
<tr>
<td>Fall Time</td>
<td>t_f</td>
<td>14</td>
<td>ns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Gate Charge</td>
<td>Q_G</td>
<td>133</td>
<td>nC</td>
<td></td>
<td></td>
<td>V_DD = 48 V,</td>
</tr>
<tr>
<td>Gate to Source Charge</td>
<td>Q_GS</td>
<td>38</td>
<td>nC</td>
<td></td>
<td></td>
<td>V_GS = 10 V,</td>
</tr>
<tr>
<td>Gate to Drain Charge</td>
<td>Q_GD</td>
<td>38</td>
<td>nC</td>
<td></td>
<td></td>
<td>I_GS = 100 A</td>
</tr>
<tr>
<td>Body Diode Forward Voltage Note5</td>
<td>V_F(S-D)</td>
<td>1.5</td>
<td>V</td>
<td></td>
<td></td>
<td>I_F = 100 A, V_GS = 0 V</td>
</tr>
<tr>
<td>Reverse Recovery Time</td>
<td>t_rr</td>
<td>44</td>
<td>ns</td>
<td></td>
<td></td>
<td>I_F = 50 A, V_GS = 0 V</td>
</tr>
<tr>
<td>Reverse Recovery Charge</td>
<td>Q_rr</td>
<td>61</td>
<td>nC</td>
<td></td>
<td></td>
<td>di/dt = 100 A/µs</td>
</tr>
</tbody>
</table>

Notes: 5. Pulsed test

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**TEST CIRCUIT 1 AVALANCHE CAPABILITY**

- DUT: Device Under Test
- PG: Power Ground
- V_DSS: Drain to Source Voltage
- I_D: Drain Current
- R_G: Gate Resistance
- L: Inductance
- V_GS: Gate to Source Voltage
- V_D: Drain Voltage

**TEST CIRCUIT 2 SWITCHING TIME**

- DUT: Device Under Test
- PG: Power Ground
- V_DSS: Drain to Source Voltage
- I_D: Drain Current
- V_GS: Gate to Source Voltage
- V_D: Drain Voltage
- R_G: Gate Resistance

**TEST CIRCUIT 3 GATE CHARGE**

- DUT: Device Under Test
- PG: Power Ground
- V_DSS: Drain to Source Voltage
- I_G: Gate Current
- V_GS: Gate to Source Voltage
- V_D: Drain Voltage
- R_G: Gate Resistance
Typical Characteristics

**DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA**

- \(dT\) - Percentage of Rated Power - %
- 0 20 40 60 80 100 120 140

- 0 25 50 75 100 125 150 175

**TOTAL POWER DISSIPATION vs. CASE TEMPERATURE**

- \(P_T\) - Total Power Dissipation - W
- 0 25 50 75 100 125 150 175

- 0 25 50 75 100 125 150 175

**FORWARD BIAS SAFE OPERATING AREA**

- \(I_D\) - Drain Current - A
- 0.1 1 10 100 1000

- 0.1 1 10 100

**TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH**

- \(R_{th(t)}\) - Transient Thermal Resistance - °C/W
- 0.01 0.1 1 10 100

- 0.01 0.1 1 10 100

**Notes:**

6. Designed target value on Renesas measurement condition. \((T_C = 25°C, \text{ unless otherwise specified})\)

7. This data is the designed value on Renesas’s measurement condition. Renesas recommends that operating conditions are designed according to a document “Power MOSFET/IGBT Attention of Handling Semiconductor Devices (R07ZZ0010)”.

8. This data is the designed target maximum value on Renesas’s measurement condition.
**DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE**

![Graph showing DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE]

- **V_DGS** - Drain to Source Voltage - V
- **I_D** - Drain Current - A
- **V_GS = 10 V**
- **Pulsed**

**FORWARD TRANSFER CHARACTERISTICS**

![Graph showing FORWARD TRANSFER CHARACTERISTICS]

- **V_GS** - Gate to Source Voltage - V
- **I_D** - Drain Current - A
- **V_DGS = 10 V**
- **Pulsed**

**GATE TO SOURCE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE**

![Graph showing GATE TO SOURCE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE]

- **V_GS** - Gate to Source Voltage - V
- **I_D = 1.0 mA**
- **V_DGS = 10 V**
- **T_{ch} = 125°C**
- **T_{ch} = 75°C**
- **T_{ch} = 25°C**
- **T_{ch} = -25°C**

**FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT**

![Graph showing FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT]

- **|y_{fs}|** - Forward Transfer Admittance - S
- **I_D - Drain Current - A**
- **V_DGS = 10 V**
- **Pulsed**

**DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT**

![Graph showing DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT]

- **R_{DSON}** - Drain to Source On-state Resistance - mΩ
- **V_GS = 10 V**
- **Pulsed**

**DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE**

![Graph showing DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE]

- **R_{DSON}** - Drain to Source On-state Resistance - mΩ
- **I_D = 50 A**
- **Pulsed**
DRAIN TO SOURCE ON-STATE RESISTANCE

\[ R_{\text{DS(on)}} \] - Drain to Source On-state Resistance - mΩ

\[ V_{\text{GS}} = 10 \text{ V} \]
\[ I_0 = 50 \text{ A} \]
Pulsed

\[ T_{\text{ch}} - \text{Channel Temperature} - ^{\circ}\text{C} \]

CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE

\[ C_{\text{iss}}, C_{\text{oss}}, C_{\text{rss}} - \text{Capacitance} - \text{pF} \]

\[ V_{\text{GS}} = 0 \text{ V} \]
\[ f = 1.0 \text{ MHz} \]

SWITCHING CHARACTERISTICS

\[ t_{\text{on}}, t_{\text{off}}, t_{\text{rise}}, t_{\text{fall}} - \text{Switching Time} - \text{ns} \]

\[ I_0 - \text{Drain Current} - \text{A} \]

DYNAMIC INPUT CHARACTERISTICS

\[ V_{\text{DD}} = 30 \text{ V} \]
\[ V_{\text{GS}} = 10 \text{ V} \]
\[ R_G = 0 \text{ Ω} \]

SOURCE TO DRAIN DIODE FORWARD VOLTAGE

\[ V_{\text{F(S-D)}} - \text{Source to Drain Voltage} - \text{V} \]

\[ I_{\text{F}} - \text{Diode Forward Current} - \text{A} \]

\[ V_{\text{GS}} = 10 \text{ V} \]
\[ 0 \text{ V} \]

REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT

\[ t_{\text{rr}} - \text{Reverse Recovery Time} - \text{ns} \]

\[ I_{\text{F}} - \text{Diode Forward Current} - \text{A} \]

\[ V_{\text{GS}} = 0 \text{ V} \]
\[ \frac{di}{dt} = 100 \text{ A/µs} \]
Package Drawing (Unit: mm)

<table>
<thead>
<tr>
<th>Package Name</th>
<th>JEITA Package Code</th>
<th>RENESAS Code</th>
<th>Previous Code</th>
<th>MASS (Typ) [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO-262</td>
<td>—</td>
<td>PRSS0004AR-A</td>
<td>TO-262A</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Unit: mm

Equivalent Circuit
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<thead>
<tr>
<th>Quality Grade</th>
<th>Applications</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Industrial</td>
<td>No use of electronics in critical applications (e.g., quality grades of audio, automobile, office equipment, communications equipment, audio and visual equipment, home appliances, machine tools, personal computer equipment, industrial robots, etc.).</td>
</tr>
<tr>
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<td>Industrial</td>
<td>Use of electronics in critical applications (e.g., quality grades of audio, automobile, office equipment, communications equipment, audio and visual equipment, home appliances, machine tools, personal computer equipment, industrial robots, etc.).</td>
</tr>
</tbody>
</table>

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