To our customers,

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Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)
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DESCRIPTION
The 2SJ599 is P-channel MOS Field Effect Transistor designed for solenoid, motor and lamp driver.

FEATURES
• Low on-state resistance:
  \[ R_{DS(on)1} = 75 \text{ m}\Omega \text{ MAX. (} V_{GS} = -10 \text{ V}, I_D = -10 \text{ A}) \]
  \[ R_{DS(on)2} = 111 \text{ m}\Omega \text{ MAX. (} V_{GS} = -4.0 \text{ V}, I_D = -10 \text{ A}) \]
• Low input capacitance:
  \[ C_{iss} = 1300 \text{ pF TYP. (} V_{DS} = -10 \text{ V}, V_{GS} = 0 \text{ V}) \]
• Built-in gate protection diode
• TO-251/TO-252 package

ABSOLUTE MAXIMUM RATINGS (\( T_A = 25^\circ \text{C} \))

- Drain to Source Voltage (\( V_{GS} = 0 \text{ V} \)) \( V_{DSS} \) -60 V
- Gate to Source Voltage (\( V_{DS} = 0 \text{ V} \)) \( V_{GSS} \) -20 V
- Drain Current (DC) (\( T_C = 25^\circ \text{C} \)) \( I_D(DC) \) -20 A
- Drain Current (pulse) \(^1\) \( I_D(pulse) \) -50 A
- Total Power Dissipation (\( T_C = 25^\circ \text{C} \)) \( P_T \) 35 W
- Total Power Dissipation (\( T_A = 25^\circ \text{C} \)) \( P_T \) 1.0 W
- Channel Temperature \( T_{ch} \) 150 °C
- Storage Temperature \( T_{stg} \) -55 to +150 °C
- Single Avalanche Current \(^2\) \( I_{AS} \) -20 A
- Single Avalanche Energy \(^2\) \( E_{AS} \) 40 mJ

Notes 1. \( PW \leq 10 \mu s \), Duty Cycle \( \leq 1\%
2. Starting \( T_{ch} = 25^\circ \text{C}, V_{OD} = -30 \text{ V}, R_G = 25 \Omega, V_{GS} = -20 \rightarrow 0 \text{ V} \)

ORDERING INFORMATION

<table>
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<th>PART NUMBER</th>
<th>PACKAGE</th>
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<td>2SJ599</td>
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<tr>
<td>2SJ599-Z</td>
<td>TO-252 (MP-3Z)</td>
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The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.
# Electrical Characteristics (TA = 25°C)

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<td>$I_{DSS}$</td>
<td>$V_{DS} = -60$ V, $V_{GS} = 0$ V</td>
<td>–10</td>
<td>–8</td>
<td>–6</td>
<td>μA</td>
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<tr>
<td>Gate Leakage Current</td>
<td>$I_{GSS}$</td>
<td>$V_{GS} = T20$ V, $V_{DS} = 0$ V</td>
<td>–10</td>
<td>–10</td>
<td>–10</td>
<td>μA</td>
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<tr>
<td>Gate Cut-off Voltage</td>
<td>$V_{GSS}$</td>
<td>$V_{GS} = -10$ V, $I_{D} = -1$ mA</td>
<td>–1.5</td>
<td>–2</td>
<td>–2.5</td>
<td>V</td>
</tr>
<tr>
<td>Forward Transfer Admittance</td>
<td>$</td>
<td>y_{fs}</td>
<td>$</td>
<td>$V_{GS} = -10$ V, $I_{D} = -10$ A</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Drain to Source On-state Resistance</td>
<td>$R_{DS(on1)}$</td>
<td>$V_{GS} = -10$ V, $I_{D} = -10$ A</td>
<td>60</td>
<td>75</td>
<td>80</td>
<td>mΩ</td>
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<tr>
<td></td>
<td>$R_{DS(on2)}$</td>
<td>$V_{GS} = -4$ V, $I_{D} = -10$ A</td>
<td>50</td>
<td>75</td>
<td>111</td>
<td>mΩ</td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>$C_{iss}$</td>
<td>$V_{DS} = -10$ V</td>
<td>1300</td>
<td>–</td>
<td>–</td>
<td>pF</td>
</tr>
<tr>
<td>Output Capacitance</td>
<td>$C_{oss}$</td>
<td>$V_{DS} = 0$ V</td>
<td>240</td>
<td>–</td>
<td>–</td>
<td>pF</td>
</tr>
<tr>
<td>Reverse Transfer Capacitance</td>
<td>$C_{iss}$</td>
<td>$V_{DS} = 0$ V</td>
<td>100</td>
<td>–</td>
<td>–</td>
<td>pF</td>
</tr>
<tr>
<td>Turn-on Delay Time</td>
<td>$t_{(on)}$</td>
<td>$I_{D} = -10$ A</td>
<td>8</td>
<td>–</td>
<td>–</td>
<td>ns</td>
</tr>
<tr>
<td>Rise Time</td>
<td>$t_{r}$</td>
<td>$V_{DS} = -10$ V</td>
<td>9</td>
<td>–</td>
<td>–</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-off Delay Time</td>
<td>$t_{(off)}$</td>
<td>$V_{DS} = -30$ V</td>
<td>52</td>
<td>–</td>
<td>–</td>
<td>ns</td>
</tr>
<tr>
<td>Fall Time</td>
<td>$t_{f}$</td>
<td>$R_{GS} = 0$ Ω</td>
<td>16</td>
<td>–</td>
<td>–</td>
<td>ns</td>
</tr>
<tr>
<td>Total Gate Charge</td>
<td>$Q_{g}$</td>
<td>$I_{D} = -20$ A</td>
<td>26</td>
<td>–</td>
<td>–</td>
<td>nC</td>
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<tr>
<td>Gate to Source Charge</td>
<td>$Q_{gs}$</td>
<td>$V_{DS} = -48$ V</td>
<td>5</td>
<td>–</td>
<td>–</td>
<td>nC</td>
</tr>
<tr>
<td>Gate to Drain Charge</td>
<td>$Q_{gd}$</td>
<td>$V_{DS} = -10$ V</td>
<td>7</td>
<td>–</td>
<td>–</td>
<td>nC</td>
</tr>
<tr>
<td>Body Diode Forward Voltage</td>
<td>$V_{F(S-D)}$</td>
<td>$I_{F} = 20$ A, $V_{GS} = 0$ V</td>
<td>1.0</td>
<td>–</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td>Reverse Recovery Time</td>
<td>$t_{rr}$</td>
<td>$I_{F} = 20$ A, $V_{GS} = 0$ V</td>
<td>51</td>
<td>–</td>
<td>–</td>
<td>ns</td>
</tr>
<tr>
<td>Reverse Recovery Charge</td>
<td>$Q_{rr}$</td>
<td>$dl/dt = 100$ A/μs</td>
<td>102</td>
<td>–</td>
<td>–</td>
<td>nC</td>
</tr>
</tbody>
</table>

## Test Circuits

### Test Circuit 1: Avalanche Capability

D.U.T.

- $V_{DS} = -20 \rightarrow 0$ V

### Test Circuit 2: Switching Time

D.U.T.

- $V_{GS} = -20 \rightarrow 0$ V

- $V_{DS}$ Wave Form
  - 10% $V_{DS}$
  - 90% $V_{DS}$

- $V_{GS}$ Wave Form
  - 0% $V_{GS}$
  - 10% $V_{GS}$

### Test Circuit 3: Gate Charge

D.U.T.

- $I_{D} = -2$ mA

- $V_{DS}$ Wave Form
  - 10% $V_{DS}$
  - 90% $V_{DS}$

- Duty Cycle $\leq 1\%$
TYPICAL CHARACTERISTICS (T_A = 25°C)

DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA

TOTAL POWER DISSIPATION vs. CASE TEMPERATURE

FORWARD BIAS SAFE OPERATING AREA

TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

Data Sheet D14644EJ4V0DS

3
FORWARD TRANSFER CHARACTERISTICS

DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE

FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT

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

DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT

GATE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE

FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT
SINGLE AVALANCHE ENERGY vs. INDUCTIVE LOAD

E_{AS} - Single Avalanche Energy - mJ
L - Inductive Load - H

100
10
1
0.1

0.1 μ 100 μ 1 m 10 m

E_{AS} = 40 μJ

V_{DD} = -30 V
R_{G} = 25 Ω
V_{GS} = -20 → 0 V
I_{AS} = -20 A

SINGLE AVALANCHE ENERGY DERATING FACTOR

Starting T_{ch} - Starting Channel Temperature - °C

Energy Derating Factor - %

25 50 75 100 125 150

V_{DD} = -30 V
R_{G} = 25 Ω
V_{GS} = -20 → 0 V
I_{AS} ≤ -20 A
PACKAGE DRAWINGS (Unit: mm)

1) TO-251 (MP-3)

2) TO-252 (MP-3Z)

Note: The depth of notch at the top of the fin is from 0 to 0.2 mm.

EQUIVALENT CIRCUIT

Remark: The diode connected between the gate and source of the transistor serves as a protector against ESD. When this device actually used, an additional protection circuit is externally required if a voltage exceeding the rated voltage may be applied to this device.
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