Audio Frequency Low Noise Amplifier Applications

- Including two devices in SM5 (super mini type with 5 leads.)
- High $|Y_{fs}|$: $|Y_{fs}| = 15 \text{ mS (typ.)}$ at $V_{DS} = 10 \text{ V}$, $V_{GS} = 0$
- High breakdown voltage: $V_{GDS} = -50 \text{ V}$
- Low noise: $NF = 1.0 \text{ dB (typ.)}$
  - at $V_{DS} = 10 \text{ V}$, $I_D = 0.5 \text{ mA}$, $f = 1 \text{ kHz}$, $R_g = 1 \text{ k\Omega}$
- High input impedance: $IGSS = -1 \text{ nA (max)}$ at $V_{GS} = -30 \text{ V}$

Marking

Pin Assignment (top view)

Absolute Maximum Ratings ($Ta = 25^\circ\text{C}$) (Q1, Q2 common)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Symbol</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate-drain voltage</td>
<td>$V_{GDS}$</td>
<td>$-50$</td>
<td>V</td>
</tr>
<tr>
<td>Gate current</td>
<td>$I_G$</td>
<td>$10$</td>
<td>mA</td>
</tr>
<tr>
<td>Drain power dissipation</td>
<td>$P_D$</td>
<td>$300$</td>
<td>mW</td>
</tr>
<tr>
<td>(Note 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junction temperature</td>
<td>$T_J$</td>
<td>$125$</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$</td>
<td>$-55$ to $125$</td>
<td>°C</td>
</tr>
</tbody>
</table>

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Total rating

Start of commercial production
1993-03

Weight: 0.016 g (typ.)
## Electrical Characteristics (Ta = 25°C) (Q1, Q2 common)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Symbol</th>
<th>Test Condition</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate-leakage current</td>
<td>IGSS</td>
<td>VGS = -30 V, VDS = 0</td>
<td>—</td>
<td>—</td>
<td>—1.0</td>
<td>nA</td>
</tr>
<tr>
<td>Gate-drain breakdown voltage</td>
<td>V(BR)GDS</td>
<td>VDS = 0, IG = -100 µA</td>
<td>-50</td>
<td>—</td>
<td>—</td>
<td>V</td>
</tr>
<tr>
<td>Drain current</td>
<td>IDSS</td>
<td>(Note 2) VDS = 10 V, VGS = 0</td>
<td>1.2</td>
<td>—</td>
<td>14.0</td>
<td>mA</td>
</tr>
<tr>
<td>Gate-source cut-off voltage</td>
<td>VGS (OFF)</td>
<td>VDS = 10 V, IG = 0.1 µA</td>
<td>-0.2</td>
<td>—</td>
<td>—1.5</td>
<td>V</td>
</tr>
<tr>
<td>Forward transfer admittance</td>
<td></td>
<td>VDS = 10 V, VGS = 0, f = 1 kHz</td>
<td>4.0</td>
<td>15</td>
<td>—</td>
<td>mS</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>Ciss</td>
<td>VDS = 10 V, VGS = 0, f = 1 MHz</td>
<td>—</td>
<td>13</td>
<td>—</td>
<td>pF</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>Crss</td>
<td>VDG = 10 V, ID = 0, f = 1 MHz</td>
<td>—</td>
<td>3</td>
<td>—</td>
<td>pF</td>
</tr>
<tr>
<td>Noise figure</td>
<td>NF (1)</td>
<td>VDS = 10 V, Rg = 1 kΩ</td>
<td>—</td>
<td>5</td>
<td>—</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ID = 0.5 mA, f = 10 Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NF (2)</td>
<td>VDS = 10 V, Rg = 1 kΩ</td>
<td>—</td>
<td>1</td>
<td>—</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ID = 0.5 mA, f = 1 kHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 2: IDSS classification  
Y (Y): 1.2 to 3.0 mA, GR (G): 2.6 to 6.5 mA, BL (L): 6.0 to 14.0 mA

( ) Marking symbol
(Q1, Q2 common)
(Q1, Q2 common)

**NF - ID**
- **COMMON SOURCE**
  - $V_{DS} = 10V$
  - $R_g = 1k\Omega$
  - $T_a = 25^\circ C$

**NF - $R_g$**
- **COMMON SOURCE**
  - $V_{DS} = 10V$
  - $I_D = 0.5mA$
  - $T_a = 25^\circ C$

**NF - f**
- **COMMON SOURCE**
  - $V_{DS} = 10V$
  - $I_D = 0.5mA$
  - $R_g = 1k\Omega$
  - $T_a = 25^\circ C$

**C_{iss} - VDS**
- **COMMON SOURCE**
  - $V_{GS} = 0$
  - $f = 1MHz$
  - $T_a = 25^\circ C$

**C_{rss} - VGD**
- **COMMON SOURCE**
  - $I_D = 0$
  - $f = 1MHz$
  - $T_a = 25^\circ C$

**P_D - Ta**
- **DRAIN POWER DISSIPATION**
  - $P_D (\text{mW})$
  - **AMBIENT TEMPERATURE**
  - $T_a (\text{C})$
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