TPC8028

TOSHIBA Field Effect Transistor  
Silicon N Channel MOS Type (U-MOS IV)

Lithium Ion Battery Applications
Portable Equipment Applications
Notebook PC Applications

- Small footprint due to small and thin package
- Low drain-source ON resistance: \( R_{DS\,(ON)} = 3.5 \, \text{mΩ} \) (typ.)
- High forward transfer admittance: \( |Y_{fs}| = 40 \, \text{S} \) (typ.)
- Low leakage current: \( I_{DSS} = 10 \, \mu\text{A} \) (max) \( (V_{DS} = 30 \, \text{V}) \)
- Enhancement mode: \( V_{th} = 1.3 \) to 2.5 \( \text{V} \) \( (V_{DS} = 10 \, \text{V}, I_{D} = 1 \, \text{mA}) \)

Absolute Maximum Ratings (\( Ta = 25°C \))

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Symbol</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-source voltage</td>
<td>( V_{DSS} )</td>
<td>30</td>
<td>( V )</td>
</tr>
<tr>
<td>Drain-gate voltage (( R_{GS} = 20 , \text{kΩ} ))</td>
<td>( V_{DGR} )</td>
<td>30</td>
<td>( V )</td>
</tr>
<tr>
<td>Gate-source voltage</td>
<td>( V_{GSS} )</td>
<td>20</td>
<td>( V )</td>
</tr>
<tr>
<td>Drain current DC (Note 1)</td>
<td>( I_D )</td>
<td>18</td>
<td>( A )</td>
</tr>
<tr>
<td>Drain current Pulse (Note 1)</td>
<td>( I_{DP} )</td>
<td>72</td>
<td>A</td>
</tr>
<tr>
<td>Drain power dissipation (( t = 10 , \text{s} )) (Note 2a)</td>
<td>( P_D )</td>
<td>1.9</td>
<td>( W )</td>
</tr>
<tr>
<td>Drain power dissipation (( t = 10 , \text{s} )) (Note 2b)</td>
<td>( P_D )</td>
<td>1.0</td>
<td>( W )</td>
</tr>
<tr>
<td>Single pulse avalanche energy (Note 3)</td>
<td>( E_{AS} )</td>
<td>84</td>
<td>( \text{mJ} )</td>
</tr>
<tr>
<td>Avalanche current</td>
<td>( I_{AR} )</td>
<td>18</td>
<td>( A )</td>
</tr>
<tr>
<td>Repetitive avalanche energy (Note 2a) (Note 4)</td>
<td>( E_{AR} )</td>
<td>0.066</td>
<td>( \text{mJ} )</td>
</tr>
<tr>
<td>Channel temperature</td>
<td>( T_{ch} )</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>( T_{stg} )</td>
<td>-55 to 150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Note 1, Note 2, Note 3 and Note 4: See the next page.

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).

This transistor is an electrostatic-sensitive device. Please handle with caution.

Unit: mm

Weight: 0.08 g (typ.)

Circuit Configuration

8 7 6 5

1 2 3 SOURCE
4

5, 6, 7, 8 DRAIN

JEDEC —
JEITA —
TOSHIBA 2-6J1B
Thermal Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Symbol</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal resistance, channel to ambient (t = 10 s)</td>
<td>$R_{th (ch-a)}$</td>
<td>65.8</td>
<td>°C/W</td>
</tr>
<tr>
<td>Thermal resistance, channel to ambient (t = 10 s)</td>
<td>$R_{th (ch-a)}$</td>
<td>125</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

Marking (Note 5)

Note 1: Ensure that the channel temperature does not exceed 150°C.

Note 2: (a) Device mounted on a glass-epoxy board (a)  (b) Device mounted on a glass-epoxy board (b)

Note 3: $V_{DD} = 24$ V, $T_{ch} = 25$°C (initial), $L = 0.2$ mH, $I_{AR} = 18$ A

Note 4: Repetitive rating: pulse width limited by max channel temperature

Note 5: • on lower left of the marking indicates Pin 1.

※ Weekly code: (Three digits)

[ ] [ ] [ ] Week of manufacture
(01 for the first week of a year: sequential number up to 52 or 53)

[ ] [ ] [ ] Year of manufacture
(The last digit of a year)
### Electrical Characteristics (Ta = 25°C)

<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>$I_{GS}$</td>
<td>$V_{GS} = \pm 20, \text{V}, V_{DS} = 0, \text{V}$</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>±100 nA</td>
</tr>
<tr>
<td>Drain cut-OFF current</td>
<td>$I_{DS}$</td>
<td>$V_{DS} = 30, \text{V}, V_{GS} = 0, \text{V}$</td>
<td>---</td>
<td>---</td>
<td>10</td>
<td>µA</td>
</tr>
<tr>
<td>Drain-source breakdown voltage</td>
<td>$V_{(BR)DSS}$</td>
<td>$I_D = 10, \text{mA}, V_{GS} = 0, \text{V}$</td>
<td>30</td>
<td>---</td>
<td>---</td>
<td>V</td>
</tr>
<tr>
<td>Drain-source breakdown voltage</td>
<td>$V_{(BR)DSX}$</td>
<td>$I_D = 10, \text{mA}, V_{GS} = -20, \text{V}$</td>
<td>10</td>
<td>---</td>
<td>---</td>
<td>V</td>
</tr>
<tr>
<td>Gate threshold voltage</td>
<td>$V_{th}$</td>
<td>$V_{DS} = 10, \text{V}, I_D = 1, \text{mA}$</td>
<td>1.3</td>
<td>---</td>
<td>2.5</td>
<td>V</td>
</tr>
<tr>
<td>Drain-source ON resistance</td>
<td>$R_{DS(ON)}$</td>
<td>$V_{GS} = 4.5, \text{V}, I_D = 9, \text{A}$</td>
<td>---</td>
<td>5.6</td>
<td>8.0</td>
<td>mΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{GS} = 10, \text{V}, I_D = 9, \text{A}$</td>
<td>---</td>
<td>3.5</td>
<td>4.3</td>
<td>mΩ</td>
</tr>
<tr>
<td>Forward transfer admittance</td>
<td>$</td>
<td>Y_{fs}</td>
<td>$</td>
<td>$V_{DS} = 10, \text{V}, I_D = 9, \text{A}$</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>$C_{iss}$</td>
<td></td>
<td>---</td>
<td>1800</td>
<td>---</td>
<td>pF</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rss}$</td>
<td>$V_{DS} = 10, \text{V}, V_{GS} = 0, \text{V}, f = 1, \text{MHz}$</td>
<td>---</td>
<td>370</td>
<td>---</td>
<td>pF</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>$C_{oss}$</td>
<td></td>
<td>---</td>
<td>570</td>
<td>---</td>
<td>pF</td>
</tr>
<tr>
<td>Rise time</td>
<td>$t_r$</td>
<td></td>
<td>---</td>
<td>14</td>
<td>---</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-ON time</td>
<td>$t_{on}$</td>
<td></td>
<td>---</td>
<td>26</td>
<td>---</td>
<td>ns</td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_f$</td>
<td></td>
<td>---</td>
<td>19</td>
<td>---</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-OFF time</td>
<td>$t_{off}$</td>
<td>Duty ≤ 1%, $t_{w} = 10, \mu\text{s}$</td>
<td>---</td>
<td>54</td>
<td>---</td>
<td>ns</td>
</tr>
<tr>
<td>Total gate charge</td>
<td>$Q_g$</td>
<td></td>
<td>---</td>
<td>45</td>
<td>---</td>
<td>nC</td>
</tr>
<tr>
<td>(gate-source plus gate-drain)</td>
<td></td>
<td></td>
<td>---</td>
<td>8</td>
<td>---</td>
<td>nC</td>
</tr>
<tr>
<td>Gate-source charge 1</td>
<td>$Q_{gs1}$</td>
<td>$V_{DD} = 24, \text{V}, V_{GS} = 10, \text{V}, I_D = 18, \text{A}$</td>
<td>---</td>
<td>8</td>
<td>---</td>
<td>nC</td>
</tr>
<tr>
<td>Gate-drain (&quot;miller&quot;) charge</td>
<td>$Q_{gd}$</td>
<td></td>
<td>---</td>
<td>15</td>
<td>---</td>
<td>nC</td>
</tr>
</tbody>
</table>

### Switching time

- $V_{GS} = 10\, \text{V}$
- $0$ V
- $I_D = 9\, \text{A}$

### Source-Drain Ratings and Characteristics (Ta = 25°C)

<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>Drain reverse current</td>
<td>$I_{DRP}$</td>
<td>Pulse (Note 1) $I_{DR} = 18, \text{A}, V_{GS} = 0, \text{V}$</td>
<td>---</td>
<td>---</td>
<td>72</td>
<td>A</td>
</tr>
<tr>
<td>Forward voltage (diode)</td>
<td>$V_{DSF}$</td>
<td>$I_{DR} = 18, \text{A}, V_{GS} = 0, \text{V}$</td>
<td>---</td>
<td>---</td>
<td>−1.2</td>
<td>V</td>
</tr>
</tbody>
</table>
**TPC8028**

### Dynamic input/output characteristics

- **Vgs** vs. **Vds**
- **Qg** vs. **Qg**
- **Pd** vs. **Ta**
- **Vth** vs. **Ta**
- **Rds (ON)** vs. **Ta**
- **Idr** vs. **Vds**

**Notes:**
1. Device mounted on a glass-epoxyboard (a) (Note 2a)
2. Device mounted on a glass-epoxyboard (b) (Note 2b)
3. **t** = 10 s
Transient thermal impedance $r_{th}$ vs. Pulse width $t_w$ (s)

Device mounted on a glass-epoxyboard (a) (Note 2a)
Device mounted on a glass-epoxyboard (b) (Note 2b)

Safe operating area

Drain current $I_D$ (A) vs. Drain-source voltage $V_{DS}$ (V)

* Single pulse
$Ta = 25°C$
Curves must be derated linearly with increase in temperature.

Drain current $I_D$ (Pulse) vs. Drain-source voltage $V_{DS}$ (V)

$V_{DSS \ max}$

Single pulse

$1 \ ms$

$10 \ ms$

$10 \ ms$

$10 \ ms$

$10 \ ms$

$10 \ ms$

$10 \ ms$

$10 \ ms$

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