

# TPC6109-H

## High-Efficiency DC-DC Converter Applications

- Small footprint due to small and thin package
- Low drain-source ON-resistance:  $R_{DS(ON)} = 44 \text{ m}\Omega$  (typ.)  
( $V_{DS} = -10 \text{ V}$ )
- High forward transfer admittance:  $|Y_{fs}| = 8.0 \text{ S}$  (typ.)
- Low leakage current:  $I_{DSS} = -10 \mu\text{A}$  (max) ( $V_{DS} = -30 \text{ V}$ )
- Enhancement mode:  $V_{th} = -0.8 \text{ to } -2.0 \text{ V}$  ( $V_{DS} = -10 \text{ V}$ ,  $I_D = -1 \text{ mA}$ )

## Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

| Characteristics                                      | Symbol         | Rating     | Unit             |
|--|----------------|------------|------------------|
| Drain-source voltage                                 | $V_{DSS}$      | -30        | V                |
| Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ ) | $V_{DGR}$      | -30        | V                |
| Gate-source voltage                                  | $V_{GSS}$      | $\pm 20$   | V                |
| Drain current  | DC (Note 1)    | $I_D$      | -5               |
|  | Pulse (Note 1) | $I_{DP}$   | -20              |
| Drain power dissipation ( $t = 5 \text{ s}$ )        | (Note 2a)      | $P_D$      | 2.2              |
|  | (Note 2b)      | $P_D$      | 0.7              |
| Single-pulse avalanche energy (Note 3)               | $E_{AS}$       | 16.3       | mJ               |
| Avalanche current                                    | $I_{AR}$       | -5         | A                |
| Repetitive avalanche energy (Note 4)                 | $E_{AR}$       | 0.055      | mJ               |
| Channel temperature                                  | $T_{ch}$       | 150        | $^\circ\text{C}$ |
| Storage temperature range                            | $T_{stg}$      | -55 to 150 | $^\circ\text{C}$ |

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).

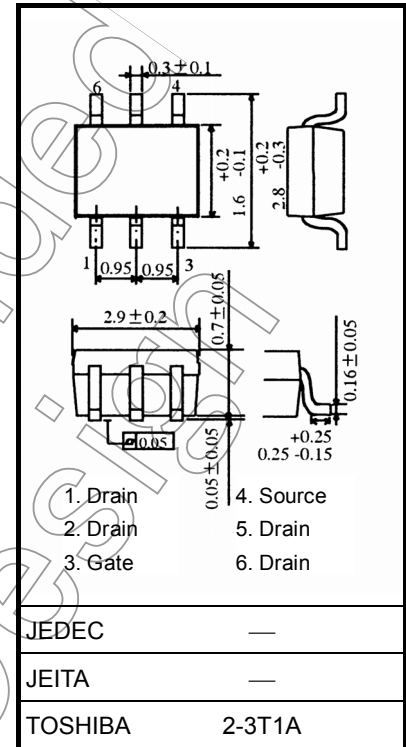
## Thermal Characteristics

| Characteristics  | Symbol         | Max   | Unit               |
|--|----------------|-------|--------------------|
| Thermal resistance, channel to ambient ( $t = 5 \text{ s}$ ) (Note 2a) | $R_{th(ch-a)}$ | 56.8  | $^\circ\text{C/W}$ |
| Thermal resistance, channel to ambient ( $t = 5 \text{ s}$ ) (Note 2b) | $R_{th(ch-a)}$ | 178.5 | $^\circ\text{C/W}$ |

Note: For Notes 1 to 5, see page 3.

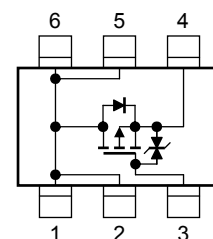
Caution: This transistor is an electrostatic-sensitive device. Handle with care.

Unit: mm

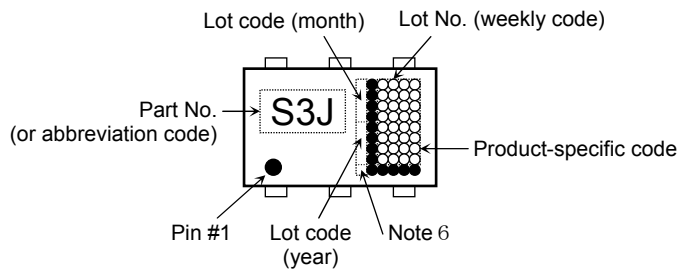


Weight: 0.011 g (typ.)

## Circuit Configuration



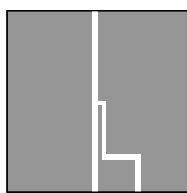
## Marking (Note 5)



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

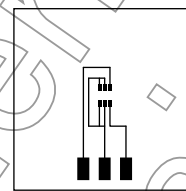
Note 2: (a) Device mounted on a glass-epoxy board (a) (t = 5 s)

(b) Device mounted on a glass-epoxy board (b) (t = 5 s)



(a)

FR-4  
25.4 × 25.4 × 0.8  
(Unit: mm)



(b)

FR-4  
25.4 × 25.4 × 0.8  
(Unit: mm)

Note 3:  $V_{DD} = -24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 500\ \mu\text{H}$ ,  $R_G \cong 25\ \Omega$ ,  $I_{AR} = -5\ \text{A}$

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

Note 5: ● to the lower left of the Part No. marking indicates Pin 1.

Note 6: A dot marking identifies the indication of product Labels.

Without a dot: [[Pb]]/INCLUDES > MCV

With a dot: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

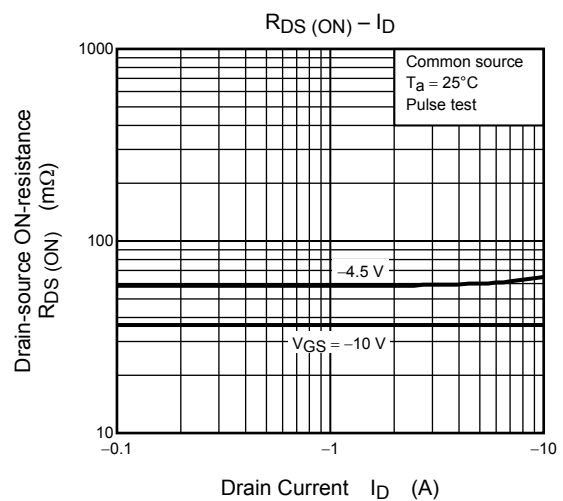
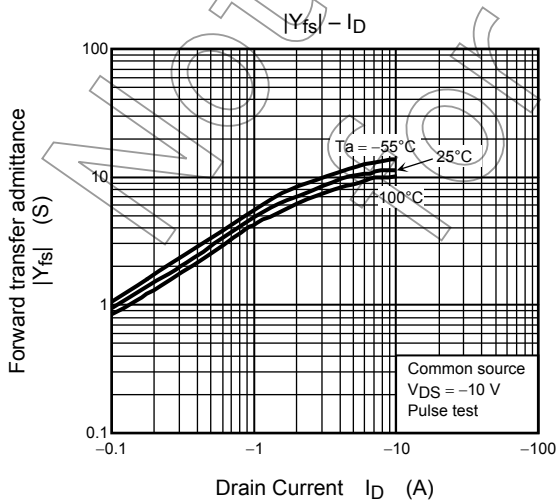
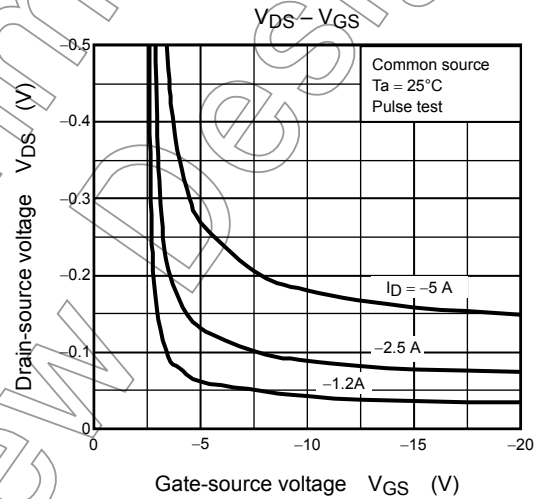
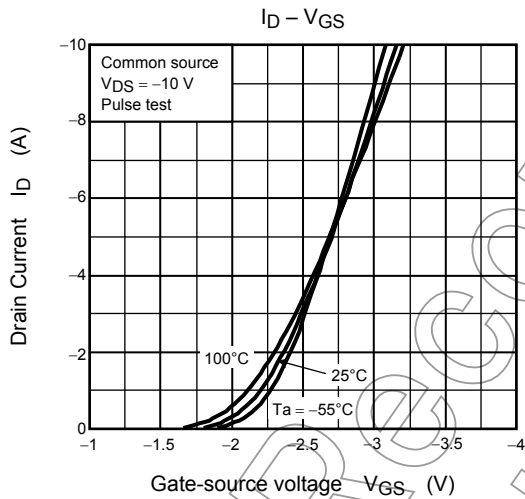
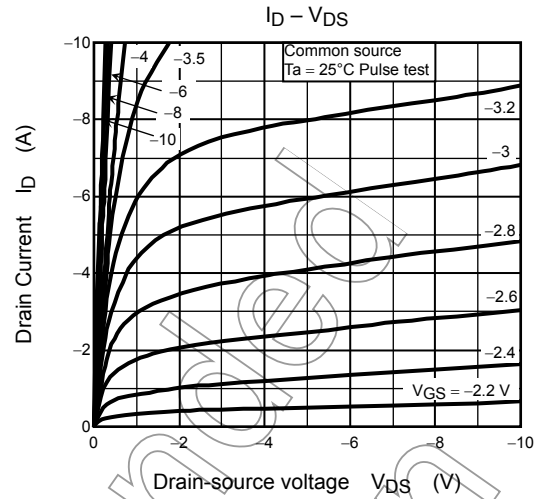
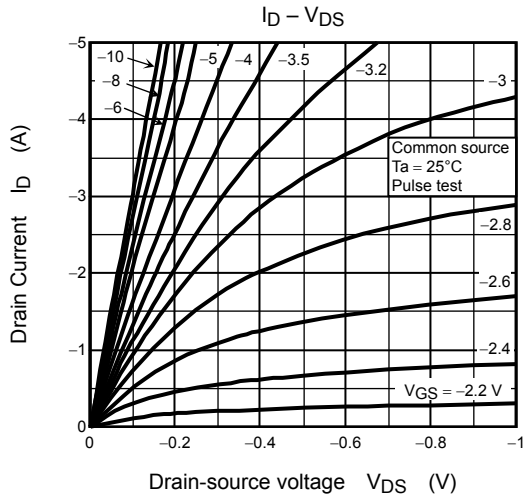
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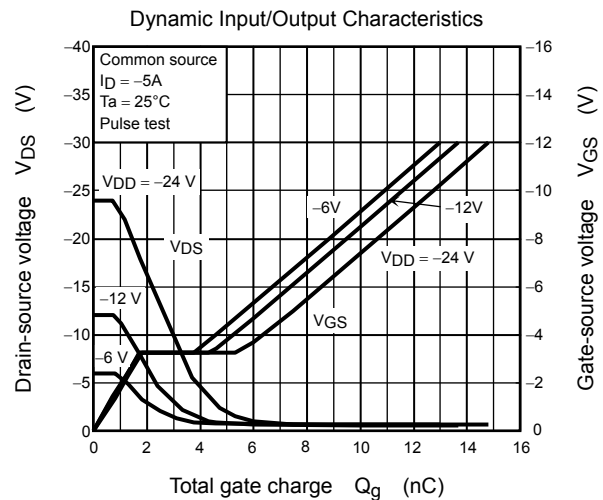
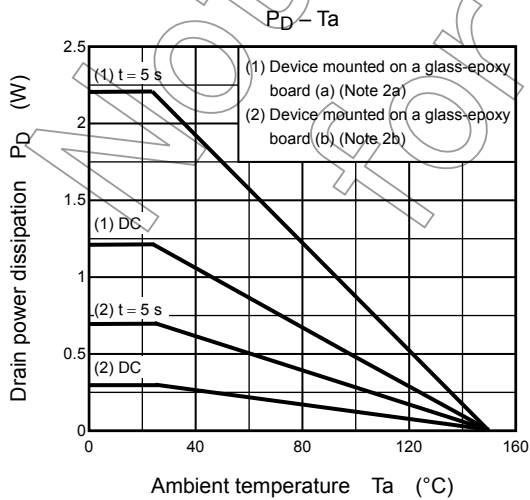
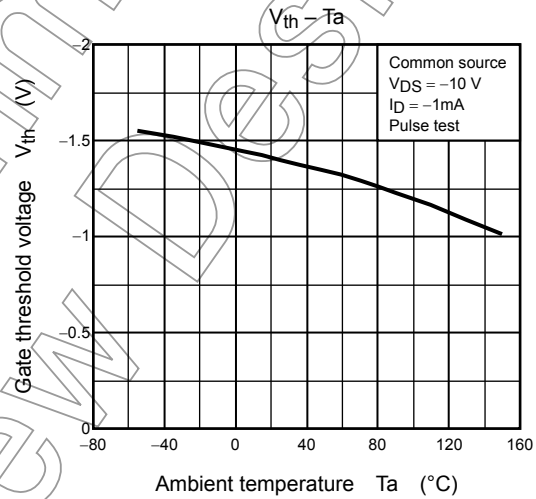
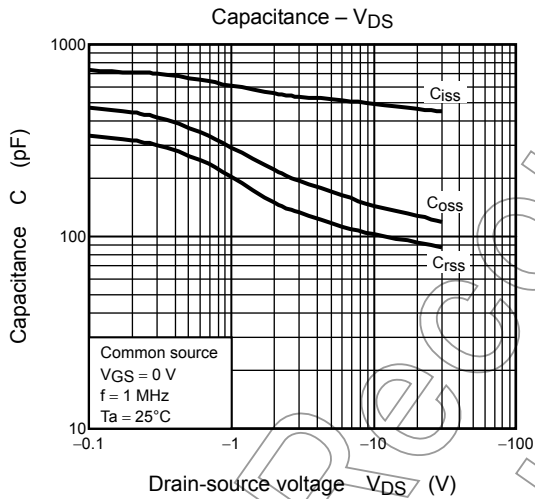
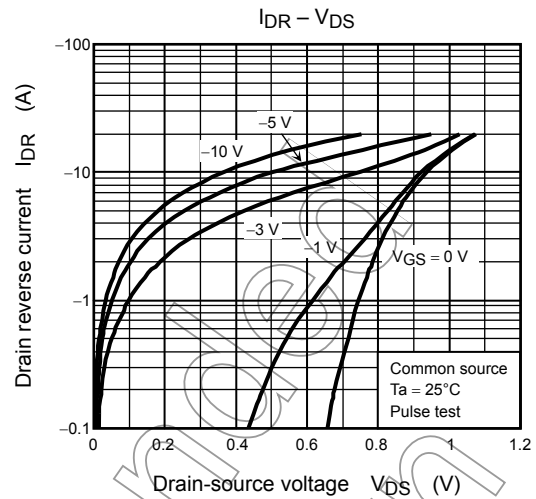
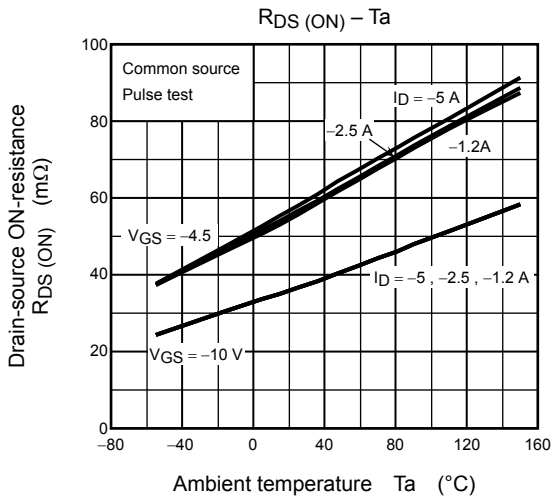
## Electrical Characteristics (Ta = 25°C)

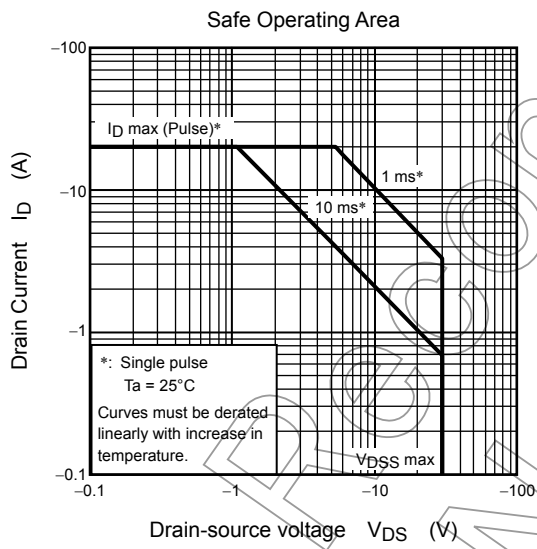
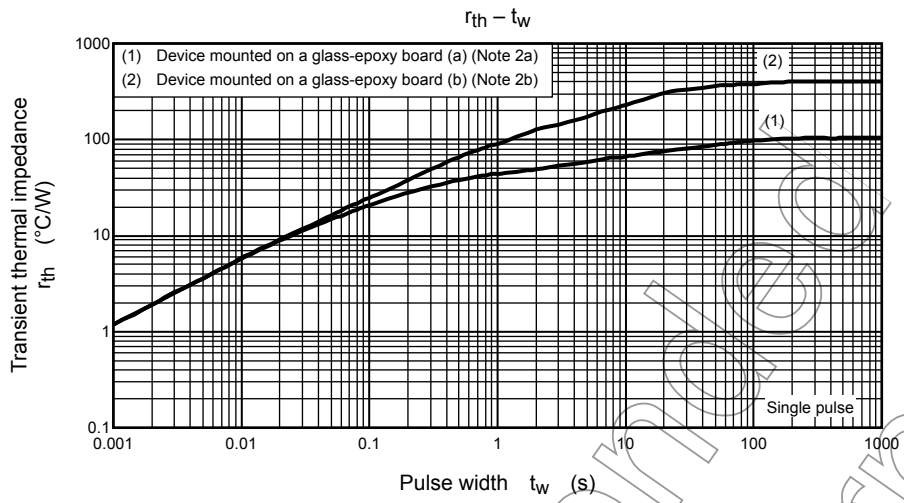
| Characteristic                                  |               | Symbol        | Test Condition  | Min                                      | Typ. | Max      | Unit          |
|---|---------------|---------------|---|--|------|----------|---------------|
| Gate leakage current                            |               | $I_{GSS}$     | $V_{GS} = \pm 16 \text{ V}, V_{DS} = 0 \text{ V}$   | —  | —    | $\pm 10$ | $\mu\text{A}$ |
| Drain cut-off current                           |               | $I_{DSS}$     | $V_{DS} = -30 \text{ V}, V_{GS} = 0 \text{ V}$  | —  | —    | -10      | $\mu\text{A}$ |
| Drain-source breakdown voltage                  |               | $V_{(BR)DSS}$ | $I_D = -10 \text{ mA}, V_{GS} = 0 \text{ V}$  | -30                                      | —    | —        | V             |
|   |               | $V_{(BR)DSX}$ | $I_D = -10 \text{ mA}, V_{GS} = 20 \text{ V}$   | -15                                      | —    | —        |               |
| Gate threshold voltage                          |               | $V_{th}$      | $V_{DS} = -10 \text{ V}, I_D = -1 \text{ mA}$   | -0.8                                     | —    | -2.0     | V             |
| Drain-source ON resistance                      |               | $R_{DS(ON)}$  | $V_{GS} = -4.5 \text{ V}, I_D = -2.5 \text{ A}$   | —  | 64   | 83       | m $\Omega$    |
|   |               | $R_{DS(ON)}$  | $V_{GS} = -10 \text{ V}, I_D = -2.5 \text{ A}$  | —  | 44   | 59       |               |
| Forward transfer admittance                     |               | $ Y_{fs} $    | $V_{DS} = -10 \text{ V}, I_D = -2.5 \text{ A}$  | 4.0                                      | 8.0  | —        | S             |
| Input capacitance                               |               | $C_{iss}$     | $V_{DS} = -10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$   | —  | 490  | —        | pF            |
| Reverse transfer capacitance                    |               | $C_{rss}$     |   | —  | 105  | —        |               |
| Output capacitance                              |               | $C_{oss}$     |   | —  | 150  | —        |               |
| Switching time                                  | Rise time     | $t_r$         |   | —  | 5.1  | —        | ns            |
|   | Turn-on time  | $t_{on}$      |   | —  | 10.7 | —        |               |
|   | Fall time     | $t_f$         |   | —  | 8.0  | —        |               |
|   | Turn-off time | $t_{off}$     |   | Duty $\leq 1\%$ , $t_w = 10 \mu\text{s}$ | —    | 33.5     |               |
| Total gate charge (gate-source plus gate-drain) |               | $Q_g$         | $V_{DD} \approx -24 \text{ V}, V_{GS} = -10 \text{ V}, I_D = -5 \text{ A}$<br>$V_{DD} \approx -24 \text{ V}, V_{GS} = -5 \text{ V}, I_D = -5 \text{ A}$ | —  | 12.3 | —        | nC            |
| Gate-source charge1                             |               | $Q_{gs1}$     | —   | 1.7                                      | —    |          |               |
| Gate-drain ("Miller") charge                    |               | $Q_{gd}$      | $V_{DD} \approx -24 \text{ V}, V_{GS} = -10 \text{ V}, I_D = -5 \text{ A}$  | —  | 3.6  | —        |               |
| Gate switch charge                              |               | $Q_{sw}$      | —   | 4.8                                      | —    |          |               |

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

| Characteristic          |                | Symbol    | Test Condition                                | Min | Typ. | Max | Unit |
|-------------------------|----------------|-----------|---|-----|------|-----|------|
| Drain reverse current   | Pulse (Note 1) | $I_{DRP}$ | —   | —   | —    | -20 | A    |
| Forward voltage (diode) |                | $V_{DSF}$ | $I_{DR} = -5 \text{ A}, V_{GS} = 0 \text{ V}$ | —   | —    | 1.2 | V    |







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