

# TPC8407

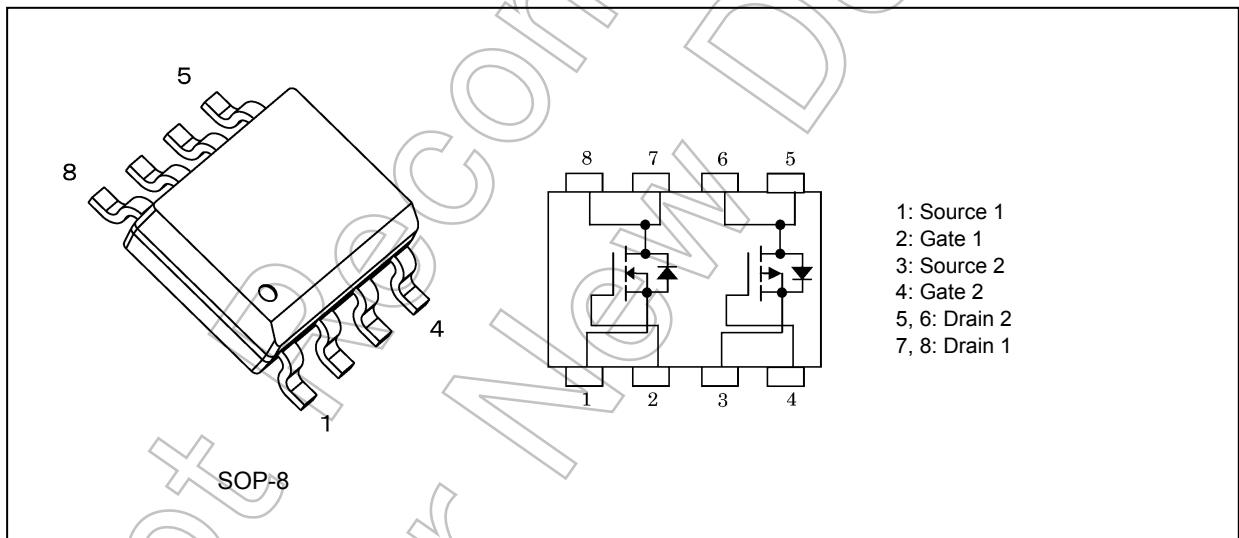
## 1. Applications

- Motor Drivers
- CCFL Inverters
- Mobile Equipments

## 2. Features

- (1) Small footprint due to a small and thin package
- (2) High speed switching
- (3) Low drain-source on-resistance  
 P-channel  $R_{DS(ON)} = 18 \text{ m}\Omega$  (typ.) ( $V_{GS} = -10 \text{ V}$ ),  
 N-channel  $R_{DS(ON)} = 14 \text{ m}\Omega$  (typ.) ( $V_{GS} = 10 \text{ V}$ )
- (4) Low leakage current  
 P-channel  $I_{DSS} = -10 \text{ }\mu\text{A}$  ( $V_{DS} = -30 \text{ V}$ ),  
 N-channel  $I_{DSS} = 10 \text{ }\mu\text{A}$  ( $V_{DS} = 30 \text{ V}$ )
- (5) Enhancement mode  
 P-channel  $V_{th} = -0.8$  to  $-2.0 \text{ V}$  ( $V_{DS} = -10 \text{ V}$ ,  $I_D = -0.2 \text{ mA}$ ),  
 N-channel  $V_{th} = 1.3$  to  $2.3 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 0.1 \text{ mA}$ )

## 3. Packaging and Internal Circuit



**4. Absolute Maximum Ratings (Note) ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

| Characteristics   | P/N  | Symbol     | Rating     | Unit             |
|---|------|------------|------------|------------------|
| Drain-source voltage  | P-ch | $V_{DSS}$  | -30        | V                |
|   | N-ch |            | 30         |                  |
| Gate-source voltage   | P-ch | $V_{GSS}$  | $\pm 20$   |                  |
|   | N-ch |            | $\pm 20$   |                  |
| Drain current (DC) (Note 1)   | P-ch | $I_D$      | -7.4       | A                |
|   | N-ch |            | 9          |                  |
| Drain current (pulsed) (Note 1)   | P-ch | $I_{DP}$   | -29.6      | A                |
|   | N-ch |            | 36         |                  |
| Power dissipation (single operation) (t = 10 s) (Note 2), (Note 4)              | P-ch | $P_{D(1)}$ | 1.5        | W                |
|   | N-ch |            | 1.5        |                  |
| Power dissipation (per device for dual operation) (t = 10 s) (Note 2), (Note 5) | P-ch | $P_{D(2)}$ | 1.1        | W                |
|   | N-ch |            | 1.1        |                  |
| Power dissipation (single operation) (t = 10 s) (Note 3), (Note 4)              | P-ch | $P_{D(1)}$ | 0.75       | W                |
|   | N-ch |            | 0.75       |                  |
| Power dissipation (per device for dual operation) (t = 10 s) (Note 3), (Note 5) | P-ch | $P_{D(2)}$ | 0.45       | W                |
|   | N-ch |            | 0.45       |                  |
| Single-pulse avalanche energy (Note 6)  | P-ch | $E_{AS}$   | 35         | mJ               |
|   | N-ch |            | 52         |                  |
| Avalanche current   | P-ch | $I_{AR}$   | -7.4       | A                |
|   | N-ch |            | 9          |                  |
| Channel temperature   | P-ch | $T_{ch}$   | 150        | $^\circ\text{C}$ |
|   | N-ch |            | 150        |                  |
| Storage temperature   | P-ch | $T_{stg}$  | -55 to 150 | $^\circ\text{C}$ |
|   | N-ch |            | -55 to 150 |                  |

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).

**5. Thermal Characteristics**

| Characteristics   | Symbol            | Max  | Unit |
|---|-------------------|------|------|
| Channel-to-ambient thermal resistance (single operation) (t = 10 s) (Note 2), (Note 4)              | $R_{th(ch-a)(1)}$ | 83.3 | °C/W |
| Channel-to-ambient thermal resistance (per device for dual operation) (t = 10 s) (Note 2), (Note 5) | $R_{th(ch-a)(2)}$ | 113  |      |
| Channel-to-ambient thermal resistance (single operation) (t = 10 s) (Note 3), (Note 4)              | $R_{th(ch-a)(1)}$ | 166  |      |
| Channel-to-ambient thermal resistance (per device for dual operation) (t = 10 s) (Note 3), (Note 5) | $R_{th(ch-a)(2)}$ | 277  |      |

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

Note 2: Device mounted on a glass-epoxy board (a), Figure 5.1

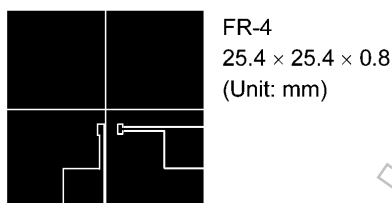
Note 3: Device mounted on a glass-epoxy board (b), Figure 5.2

Note 4: Power dissipation and thermal resistance values per device with the other device being off (During single operation, power is supplied to only one of the two devices.)

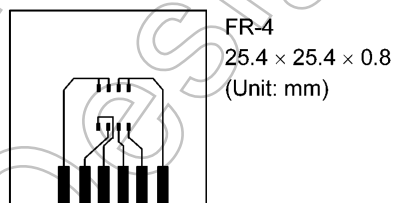
Note 5: Power dissipation and thermal resistance values per device for dual operation (During dual operation, power is evenly supplied to both devices.)

Note 6: P channel:  $V_{DD} = -24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.5\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = -7.4\text{ A}$

N channel:  $V_{DD} = 24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.5\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 9\text{ A}$



**Fig. 5.1 Device Mounted on a Glass-Epoxy Board (a)**



**Fig. 5.2 Device Mounted on a Glass-Epoxy Board (b)**

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.

**6. Electrical Characteristics**

**6.1. Static Characteristics (T<sub>a</sub> = 25°C unless otherwise specified)**

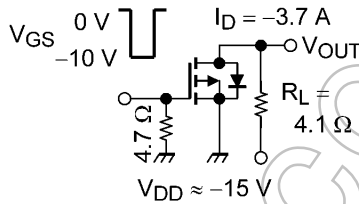
| Characteristics                         | P/N  | Symbol               | Test Condition                                    | Min  | Typ. | Max  | Unit |
|---|------|----------------------|---|------|------|------|------|
| Gate leakage current                    | P-ch | I <sub>GSS</sub>     | V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V    | —    | —    | ±0.1 | μA   |
|   | N-ch |                      | V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V    | —    | —    | ±0.1 |      |
| Drain cut-off current                   | P-ch | I <sub>DSS</sub>     | V <sub>DS</sub> = -30 V, V <sub>GS</sub> = 0 V    | —    | —    | -10  | μA   |
|   | N-ch |                      | V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 0 V     | —    | —    | 10   |      |
| Drain-source breakdown voltage          | P-ch | V <sub>(BR)DSS</sub> | I <sub>D</sub> = -10 mA, V <sub>GS</sub> = 0 V    | -30  | —    | —    | V    |
|   | N-ch |                      | I <sub>D</sub> = 10 mA, V <sub>GS</sub> = 0 V     | 30   | —    | —    |      |
| Drain-source breakdown voltage (Note 7) | P-ch | V <sub>(BR)DSX</sub> | I <sub>D</sub> = -10 mA, V <sub>GS</sub> = 10 V   | -21  | —    | —    | V    |
|   | N-ch |                      | I <sub>D</sub> = 10 mA, V <sub>GS</sub> = -20 V   | 15   | —    | —    |      |
| Gate threshold voltage                  | P-ch | V <sub>th</sub>      | V <sub>DS</sub> = -10 V, I <sub>D</sub> = -0.2 mA | -0.8 | —    | -2.0 | V    |
|   | N-ch |                      | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 0.1 mA   | 1.3  | —    | 2.3  |      |
| Drain-source on-resistance              | P-ch | R <sub>DS(ON)</sub>  | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -3.7 A | —    | 23   | 29   | mΩ   |
|   |      |                      | V <sub>GS</sub> = -10 V, I <sub>D</sub> = -3.7 A  | —    | 18   | 23   |      |
|   | N-ch |                      | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 4.5 A   | —    | 17   | 21   |      |
|   |      |                      | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 4.5 A    | —    | 14   | 17   |      |

Note 7: If a reverse bias is applied between gate and source, this device enters V<sub>(BR)DSX</sub> mode. Note that the drain-source breakdown voltage is lowered in this mode.

Not Recommended for New Design

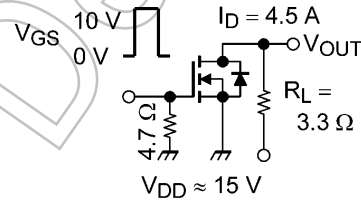
**6.2. Dynamic Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

| Characteristics                | P/N  | Symbol    | Test Condition  | Min | Typ. | Max | Unit |
|--------------------------------|------|-----------|---|-----|------|-----|------|
| Input capacitance              | P-ch | $C_{iss}$ | $V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$ | —   | 1650 | —   | pF   |
|                                | N-ch |           | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$  | —   | 1190 | —   |      |
| Reverse transfer capacitance   | P-ch | $C_{rss}$ | $V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$ | —   | 260  | —   | pF   |
|                                | N-ch |           | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$  | —   | 55   | —   |      |
| Output capacitance             | P-ch | $C_{oss}$ | $V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$ | —   | 300  | —   | pF   |
|                                | N-ch |           | $V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$  | —   | 210  | —   |      |
| Switching time (rise time)     | P-ch | $t_r$     | See Figure 6.2.1.   | —   | 8.0  | —   | ns   |
|                                | N-ch |           | See Figure 6.2.2.   | —   | 2.1  | —   |      |
| Switching time (turn-on time)  | P-ch | $t_{on}$  | See Figure 6.2.1.   | —   | 16   | —   | ns   |
|                                | N-ch |           | See Figure 6.2.2.   | —   | 7.9  | —   |      |
| Switching time (fall time)     | P-ch | $t_f$     | See Figure 6.2.1.   | —   | 42   | —   | ns   |
|                                | N-ch |           | See Figure 6.2.2.   | —   | 2.5  | —   |      |
| Switching time (turn-off time) | P-ch | $t_{off}$ | See Figure 6.2.1.   | —   | 140  | —   | ns   |
|                                | N-ch |           | See Figure 6.2.2.   | —   | 20   | —   |      |



Duty  $\leq 1\%$ ,  $t_w = 10\ \mu\text{s}$

**Fig. 6.2.1 Switching Time Test Circuit (P-ch)**



Duty  $\leq 1\%$ ,  $t_w = 10\ \mu\text{s}$

**Fig. 6.2.2 Switching Time Test Circuit (N-ch)**

**6.3. Gate Charge Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

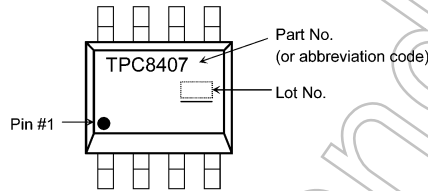
| Characteristics                                 | P/N  | Symbol    | Test Condition   | Min | Typ. | Max | Unit |
|---|------|-----------|--|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | P-ch | $Q_g$     | $V_{DD} \approx -24\text{ V}, V_{GS} = -10\text{ V},$<br>$I_D = -7.4\text{ A}$ | —   | 39   | —   | nC   |
|   | N-ch |           | $V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V},$<br>$I_D = 9\text{ A}$      | —   | 17   | —   |      |
| Gate-source charge 1                            | P-ch | $Q_{gs1}$ | $V_{DD} \approx -24\text{ V}, V_{GS} = -10\text{ V},$<br>$I_D = -7.4\text{ A}$ | —   | 4.0  | —   | nC   |
|   | N-ch |           | $V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V},$<br>$I_D = 9\text{ A}$      | —   | 3.7  | —   |      |
| Gate-drain charge                               | P-ch | $Q_{gd}$  | $V_{DD} \approx -24\text{ V}, V_{GS} = -10\text{ V},$<br>$I_D = -7.4\text{ A}$ | —   | 10   | —   | nC   |
|   | N-ch |           | $V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V},$<br>$I_D = 9\text{ A}$      | —   | 1.8  | —   |      |

**6.4. Source-Drain Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

| Characteristics                         | P/N  | Symbol    | Test Condition                                  | Min | Typ. | Max   | Unit |
|---|------|-----------|---|-----|------|-------|------|
| Reverse drain current (pulsed) (Note 8) | P-ch | $I_{DRP}$ | —   | —   | —    | -29.6 | A    |
|   | N-ch |           |   | —   | —    | 36    |      |
| Diode forward voltage                   | P-ch | $V_{DSF}$ | $I_{DR} = -7.4 \text{ A}, V_{GS} = 0 \text{ V}$ | —   | —    | 1.2   | V    |
|   | N-ch |           | $I_{DR} = 9 \text{ A}, V_{GS} = 0 \text{ V}$    | —   | —    | -1.2  |      |

Note 8: Ensure that the channel temperature does not exceed  $150^\circ\text{C}$ .

**7. Marking (Note)**



**Fig. 7.1 Marking**

Note: A line under a Lot No. identifies the indication of product Labels.

Not underlined:  $[[\text{Pb}]]/\text{INCLUDES} > \text{MCV}$

Underlined:  $[[\text{G}]]/\text{RoHS COMPATIBLE}$  or  $[[\text{G}]]/\text{RoHS } [[\text{Pb}]]$

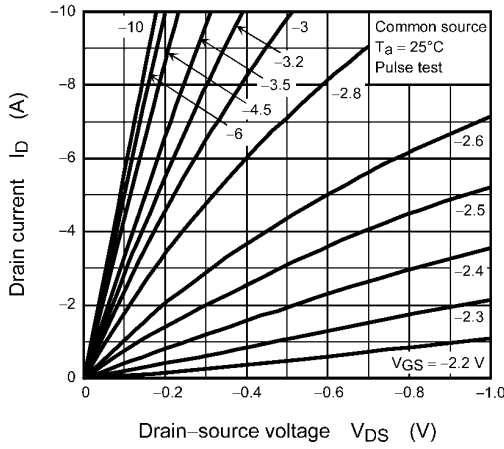
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

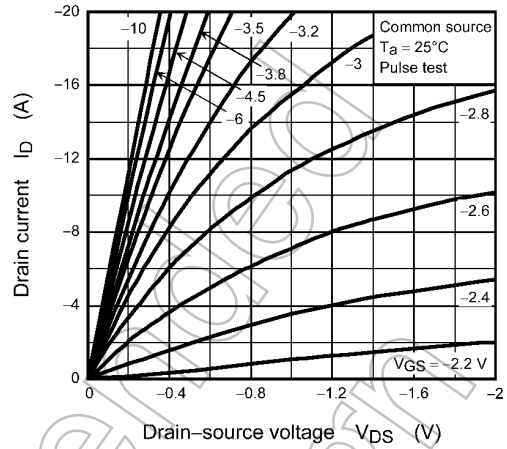
Not Recommended for New Design

**8. Characteristics Curves (Note)**

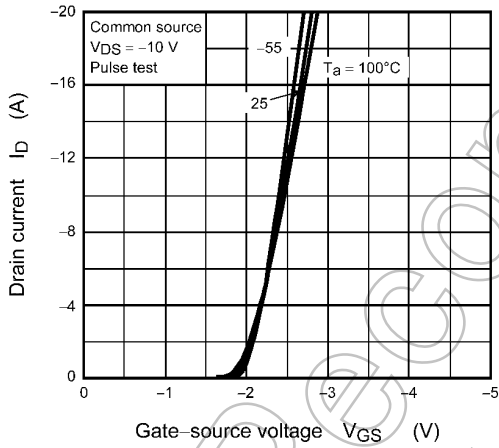
**8.1. P-Channel MOSFET**



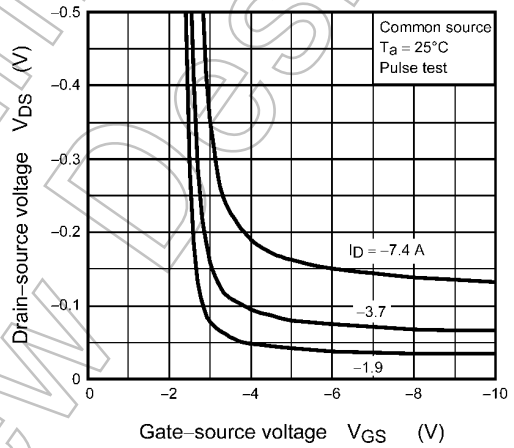
**Fig. 8.1.1 ID - VDS**



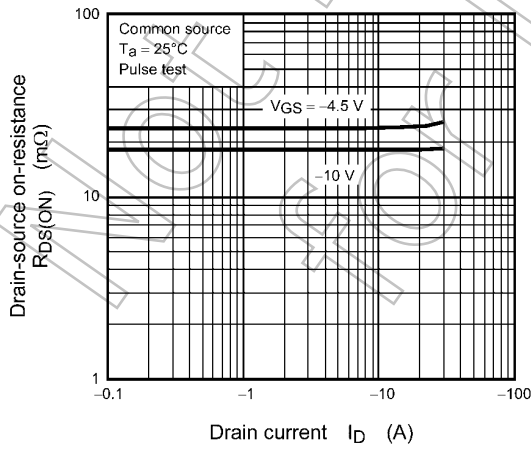
**Fig. 8.1.2 ID - VDS**



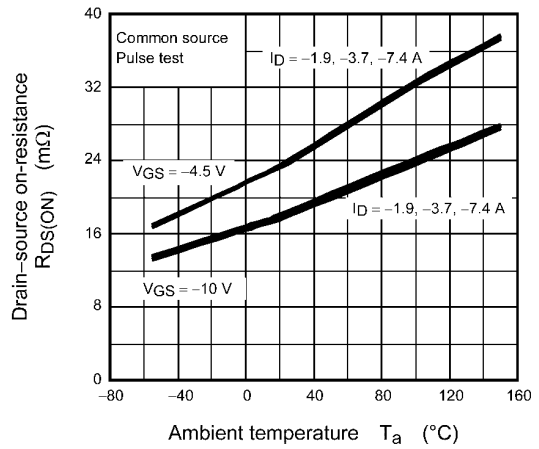
**Fig. 8.1.3 ID - VGS**



**Fig. 8.1.4 VDS - VGS**



**Fig. 8.1.5 RDS(ON) - ID**



**Fig. 8.1.6 RDS(ON) - Ta**

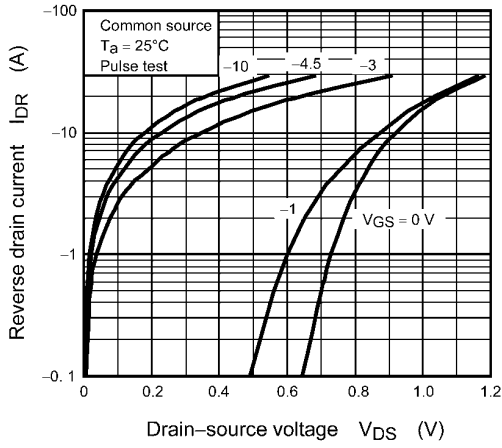


Fig. 8.1.7  $I_{DR} - V_{DS}$

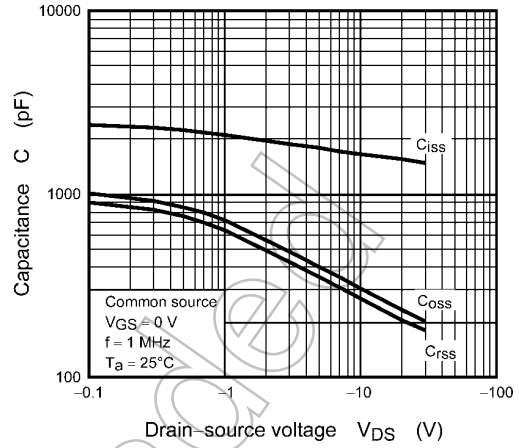


Fig. 8.1.8 Capacitance -  $V_{DS}$

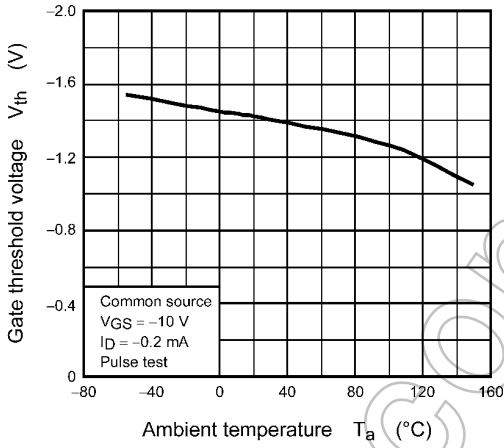


Fig. 8.1.9  $V_{th} - T_a$

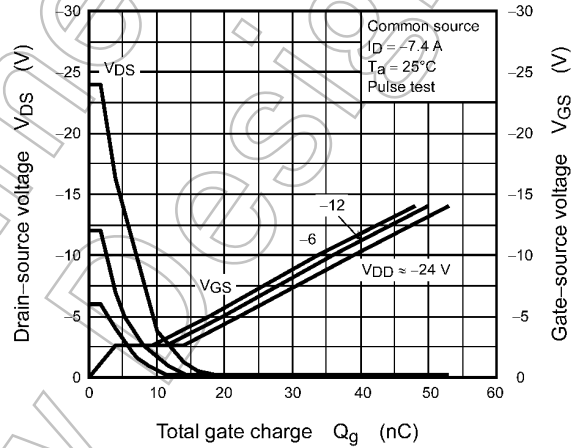


Fig. 8.1.10 Dynamic Input/Output Characteristics

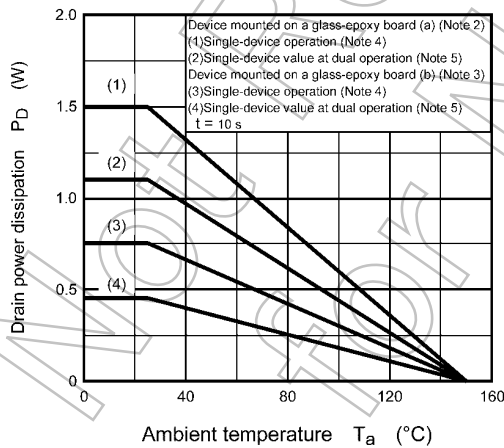
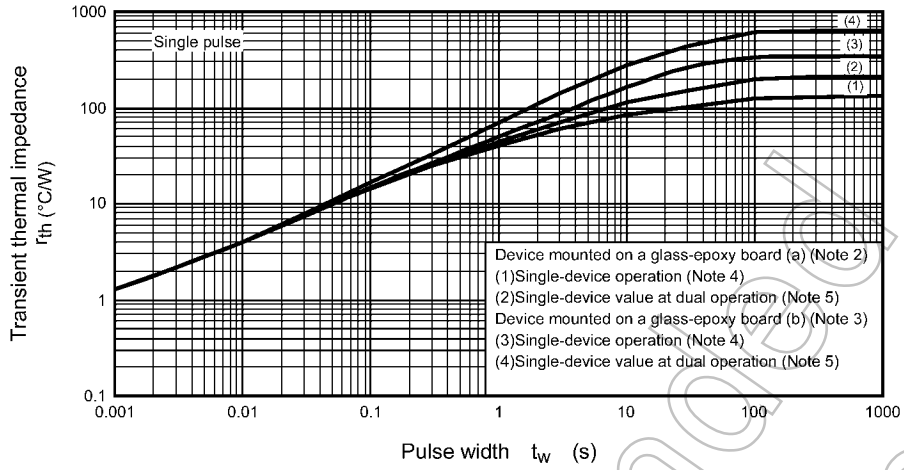
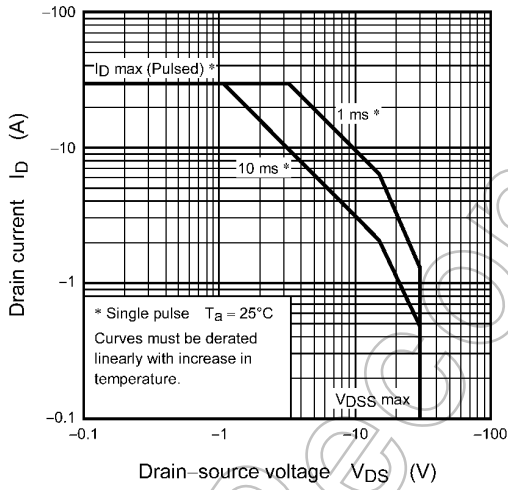


Fig. 8.1.11  $P_D - T_a$   
 (Guaranteed Maximum)



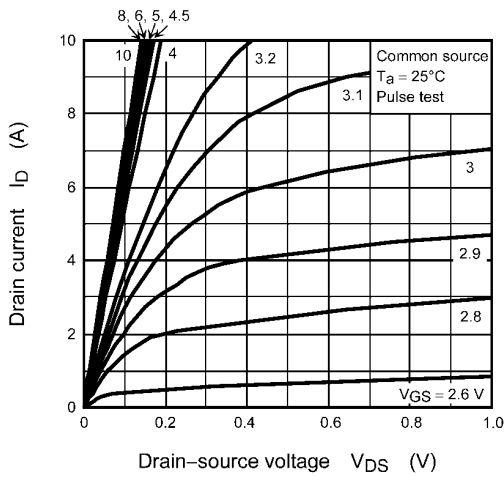


**Fig. 8.1.12  $r_{th} - t_w$**   
(Guaranteed Maximum)

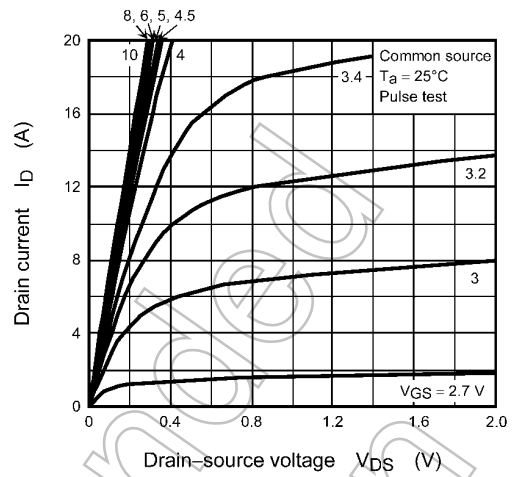


**Fig. 8.1.13 Safe Operating Area**  
(Guaranteed Maximum)

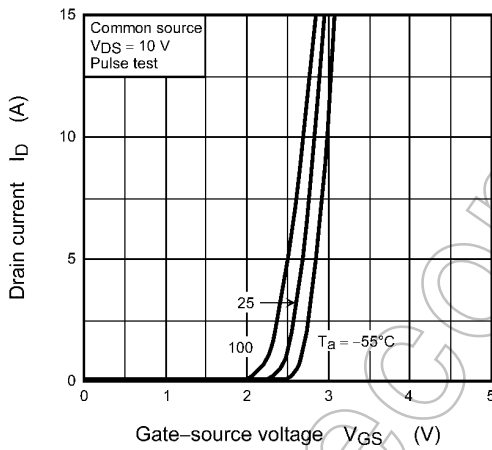
**8.2. N-Channel MOSFET**



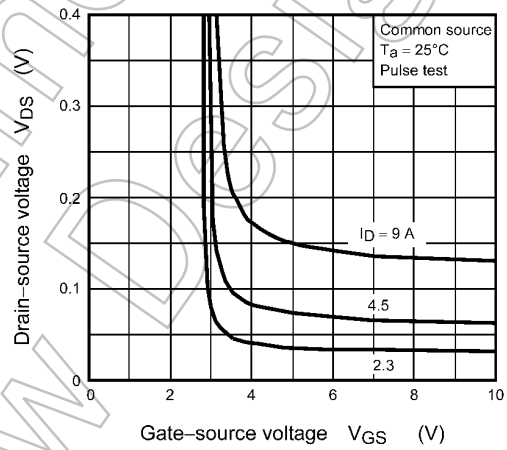
**Fig. 8.2.1  $I_D - V_{DS}$**



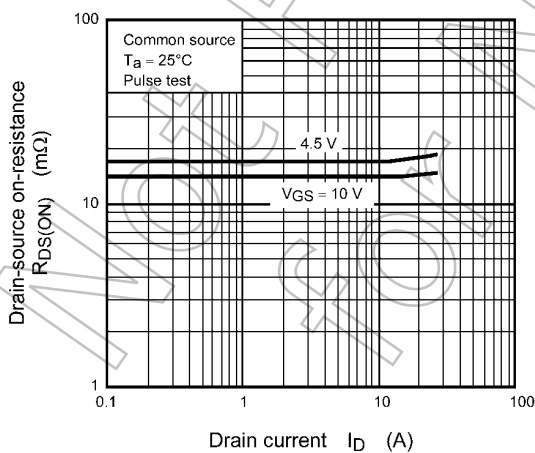
**Fig. 8.2.2  $I_D - V_{DS}$**



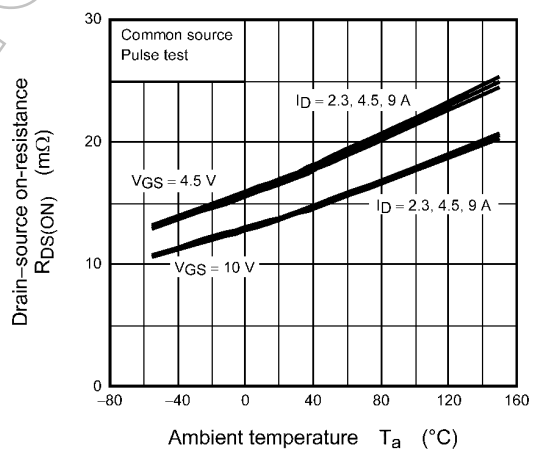
**Fig. 8.2.3  $I_D - V_{GS}$**



**Fig. 8.2.4  $V_{DS} - V_{GS}$**



**Fig. 8.2.5  $R_{DS(ON)} - I_D$**



**Fig. 8.2.6  $R_{DS(ON)} - T_a$**

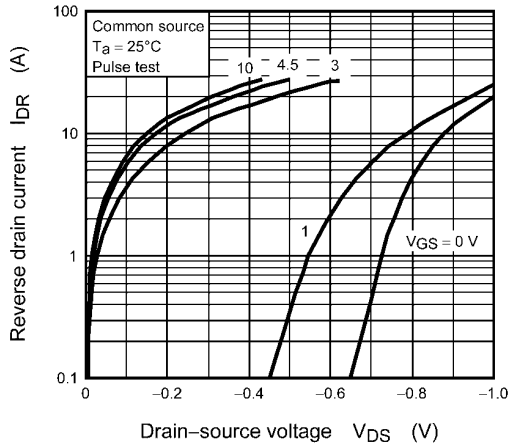


Fig. 8.2.7  $I_{DR} - V_{DS}$

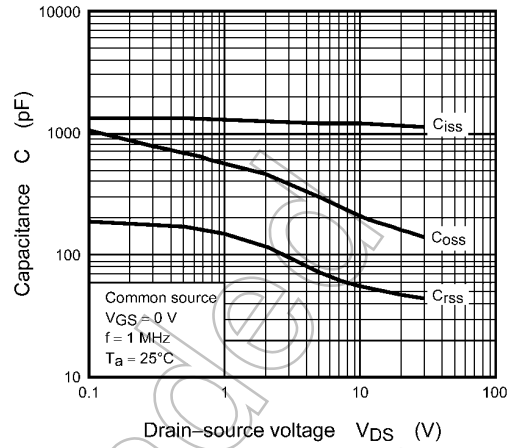


Fig. 8.2.8 Capacitance -  $V_{DS}$

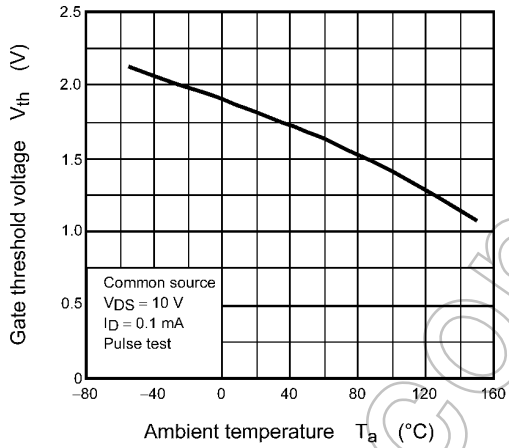


Fig. 8.2.9  $V_{th} - T_a$

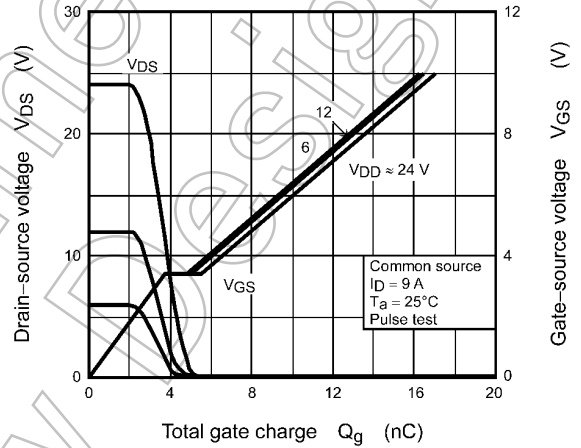


Fig. 8.2.10 Dynamic Input/Output Characteristics

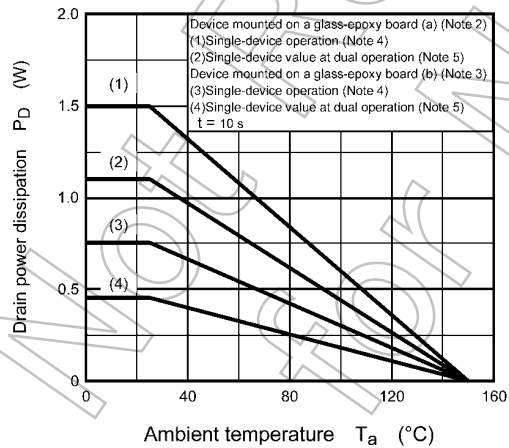
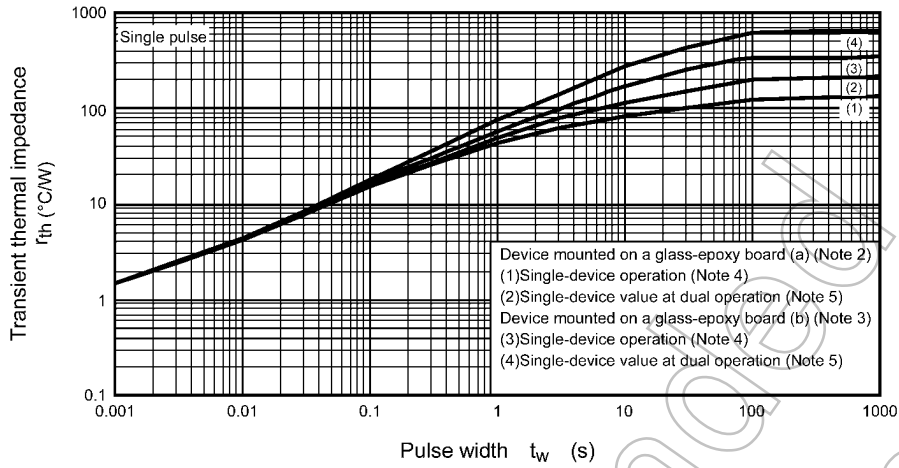
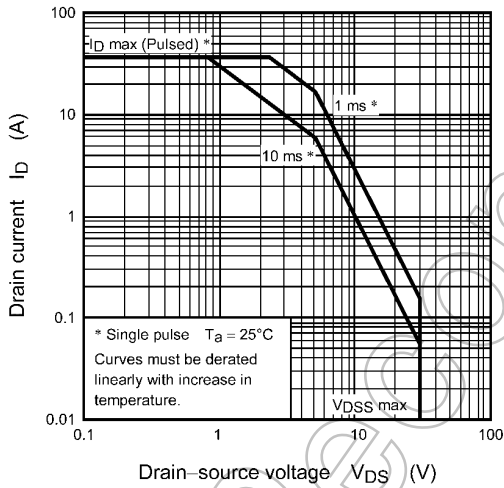


Fig. 8.2.11  $P_D - T_a$   
 (Guaranteed Maximum)



**Fig. 8.2.12  $r_{th} - t_w$**   
**(Guaranteed Maximum)**

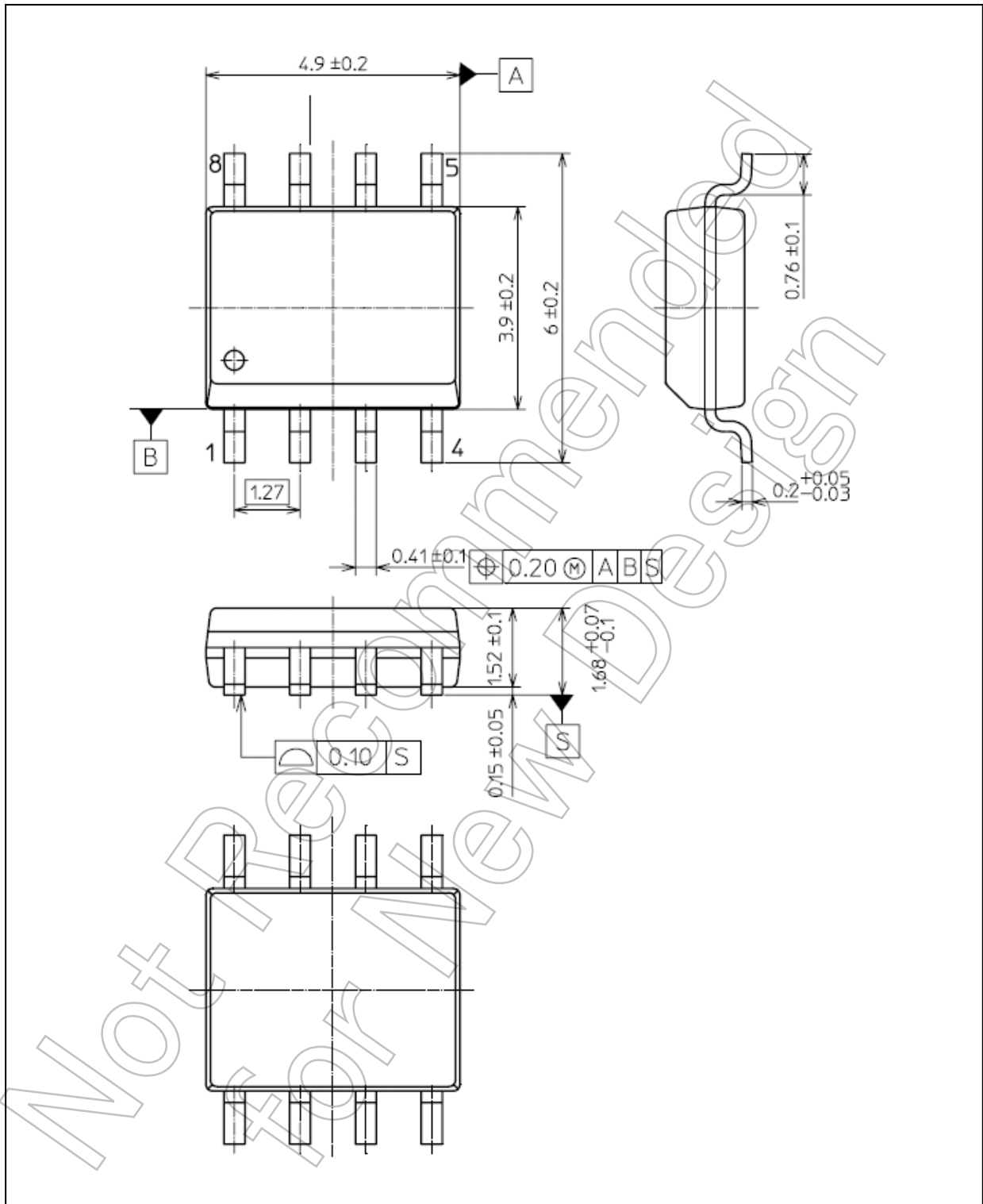


**Fig. 8.2.13 Safe Operating Area**  
**(Guaranteed Maximum)**

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

Package Dimensions

Unit: mm



Weight: 0.085 g (typ.)

|                 |
|-----------------|
| Package Name(s) |
| TOSHIBA: 2-5R1S |
| Nickname: SOP-8 |

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