

TOSHIBA Field Effect Transistor Silicon P, N Channel MOS Type (U-MOV/U-MOSIV)

## TPCP8404

Portable Equipment Applications

Motor Drive Applications

Unit: mm

- Low drain-source ON-resistance : P Channel  $R_{DS(ON)} = 38 \text{ m}\Omega$  (typ.)  
( $V_{GS} = -10\text{V}$ )  
N Channel  $R_{DS(ON)} = 38 \text{ m}\Omega$  (typ.)  
( $V_{GS} = 10\text{V}$ )
- High forward transfer admittance : P Channel  $|Y_{fs}| = 7.3 \text{ S}$  (typ.)  
N Channel  $|Y_{fs}| = 8 \text{ S}$  (typ.)
- Low leakage current : P Channel  $I_{DSS} = -10 \text{ }\mu\text{A}$  (max) ( $V_{DS} = -30 \text{ V}$ )  
N Channel  $I_{DSS} = 10 \text{ }\mu\text{A}$  (max) ( $V_{DS} = 30 \text{ V}$ )
- Enhancement mode  
: P Channel  $V_{th} = -0.8 \text{ to } -2.0 \text{ V}$  ( $V_{DS} = -10 \text{ V}$ ,  $I_D = -1 \text{ mA}$ )  
N Channel  $V_{th} = 1.3 \text{ to } 2.5 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

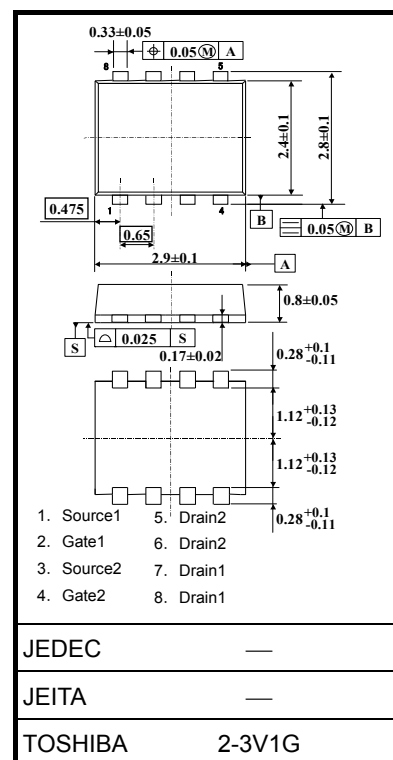
### Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

| Characteristics                                                                          |                                                 | Symbol    | Rating     |          | Unit             |
|------------------------------------------------------------------------------------------|-------------------------------------------------|-----------|------------|----------|------------------|
| Drain-source voltage                                                                     |                                                 | $V_{DS}$  | -30        | 30       | V                |
| Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )                                     |                                                 | $V_{DGR}$ | -30        | 30       | V                |
| Gate-source voltage                                                                      |                                                 | $V_{GSS}$ | $\pm 20$   | $\pm 20$ | V                |
| Drain current                                                                            | DC (Note 1)                                     | $I_D$     | -4         | 4        | A                |
|                                                                                          | Pulse (Note 1)                                  | $I_{DP}$  | -16        | 16       |                  |
| Drain power dissipation<br>( $t = 5 \text{ s}$ )<br>(Note 2a)                            | Single-device operation<br>(Note 3a)            | $P_D(1)$  | 1.48       | 1.48     | W                |
|                                                                                          | Single-device value at dual operation (Note 3b) | $P_D(2)$  | 1.23       | 1.23     |                  |
| Drain power dissipation<br>( $t = 5 \text{ s}$ )<br>(Note 2b)                            | Single-device operation<br>(Note 3a)            | $P_D(1)$  | 0.58       | 0.58     |                  |
|                                                                                          | Single-device value at dual operation (Note 3b) | $P_D(2)$  | 0.36       | 0.36     |                  |
| Single pulse avalanche energy<br>(Note 4)                                                |                                                 | $E_{AS}$  | 2.6        | 2.6      | mJ               |
| Avalanche current                                                                        |                                                 | $I_{AR}$  | -2         | 2        | A                |
| Repetitive avalanche energy<br>Single-device value at dual operation<br>(Note 2a, 3b, 5) |                                                 | $E_{AR}$  | 0.009      |          | mJ               |
| Channel temperature                                                                      |                                                 | $T_{ch}$  | 150        |          | $^\circ\text{C}$ |
| Storage temperature range                                                                |                                                 | $T_{stg}$ | -55 to 150 |          | $^\circ\text{C}$ |

Note: For Notes 1 to 5, refer to the next page.

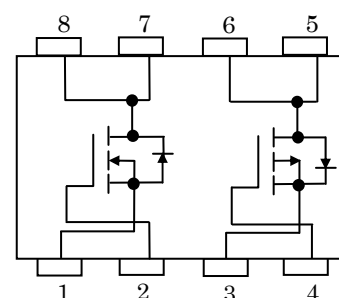
Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within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

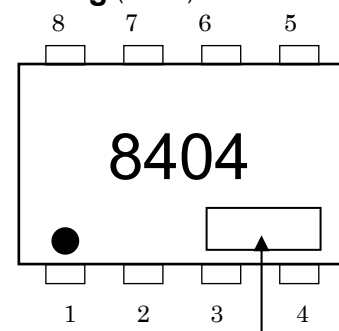


Weight: 0.017 g (typ.)

### Circuit Configuration



### Marking (Note 6)



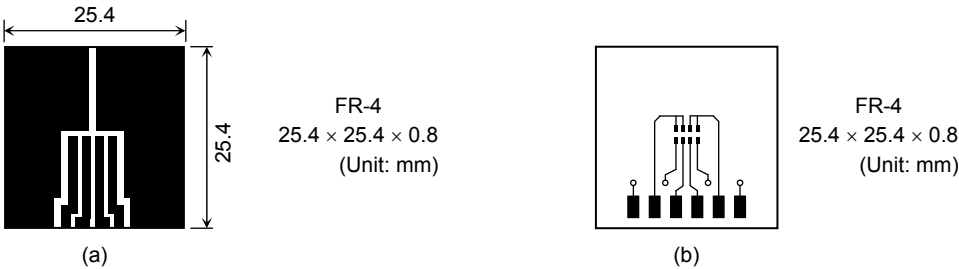
Lot No.

**Thermal Characteristics**

| Characteristics                                                  |                                                    | Symbol              | Max   | Unit |
|------------------------------------------------------------------|----------------------------------------------------|---------------------|-------|------|
| Thermal resistance,<br>channel to ambient<br>(t = 5 s) (Note 2a) | Single-device operation<br>(Note 3a)               | $R_{th} (ch-a) (1)$ | 84.5  | °C/W |
|                                                                  | Single-device value at<br>dual operation (Note 3b) | $R_{th} (ch-a) (2)$ | 101.6 |      |
| Thermal resistance,<br>channel to ambient<br>(t = 5 s) (Note 2b) | Single-device operation<br>(Note 3a)               | $R_{th} (ch-a) (1)$ | 215.5 | °C/W |
|                                                                  | Single-device value at<br>dual operation (Note 3b) | $R_{th} (ch-a) (2)$ | 347.2 |      |

Note 1: The channel temperature should not exceed 150°C during use.

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



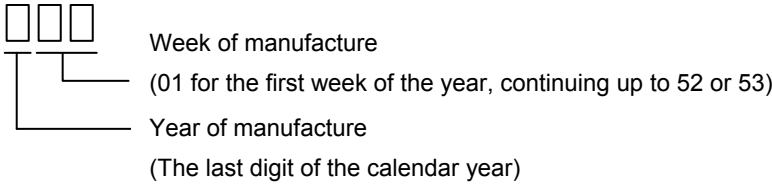
Note 3: a) The power dissipation and thermal resistance values shown are for a single device.  
(During single-device operation, power is only applied to one device.)  
b) The power dissipation and thermal resistance values shown are for a single device.  
(During dual operation, power is evenly applied to both devices.)

Note 4: P Channel:  $V_{DD} = -24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.5\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = -2\text{ A}$   
N Channel:  $V_{DD} = 24\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.5\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 2\text{ A}$

Note 5: Repetitive rating: pulse width limited by maximum channel temperature

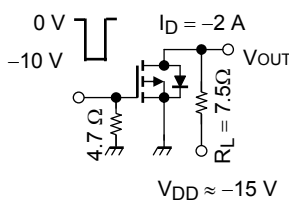
Note 6: ● on the lower left of the marking indicates Pin 1.

※ Weekly code (3 digits):



## P-ch

## Electrical Characteristics (Ta = 25°C)

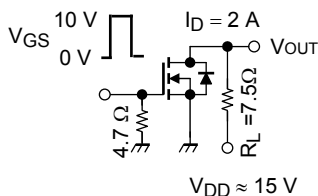
| Characteristics                                 |               | Symbol         | Test Condition                                                                                                                                                   | Min  | Typ. | Max       | Unit          |
|-------------------------------------------------|---------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-----------|---------------|
| Gate leakage current                            |               | $I_{GSS}$      | $V_{GS} = \pm 20 \text{ V}, V_{DS} = 0 \text{ V}$                                                                                                                | —    | —    | $\pm 100$ | nA            |
| 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             |
|                                                 |               | $V_{(BR) DSX}$ | $I_D = -10 \text{ mA}, V_{GS} = 20 \text{ V}$                                                                                                                    | -10  | —    | —         |               |
| Gate threshold voltage                          |               | $V_{th}$       | $V_{DS} = -10 \text{ V}, I_D = -1 \text{ mA}$                                                                                                                    | -0.8 | —    | -2.0      | V             |
| Drain-source ON resistance                      |               | $R_{DS(ON)}$   | $V_{GS} = -4.5 \text{ V}, I_D = -2.0 \text{ A}$                                                                                                                  | —    | 58   | 80        | m $\Omega$    |
|                                                 |               |                | $V_{GS} = -10 \text{ V}, I_D = -2.0 \text{ A}$                                                                                                                   | —    | 38   | 50        |               |
| Forward transfer admittance                     |               | $ Y_{fs} $     | $V_{DS} = -10 \text{ V}, I_D = -2.0 \text{ A}$                                                                                                                   | 3.7  | 7.3  | —         | S             |
| Input capacitance                               |               | $C_{iss}$      | $V_{DS} = -10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$                                                                                                | —    | 510  | —         | pF            |
| Reverse transfer capacitance                    |               | $C_{rss}$      |                                                                                                                                                                  | —    | 110  | —         |               |
| Output capacitance                              |               | $C_{oss}$      |                                                                                                                                                                  | —    | 170  | —         |               |
| Switching time                                  | Rise time     | $t_r$          | <br>$V_{DD} \approx -15 \text{ V}$<br>Duty $\leq 1\%$ , $t_w = 10 \mu\text{s}$ | —    | 11   | —         | ns            |
|                                                 | Turn-on time  | $t_{on}$       |                                                                                                                                                                  | —    | 20   | —         |               |
|                                                 | Fall time     | $t_f$          |                                                                                                                                                                  | —    | 37   | —         |               |
|                                                 | Turn-off time | $t_{off}$      |                                                                                                                                                                  | —    | 99   | —         |               |
| Total gate charge (gate-source plus gate-drain) |               | $Q_g$          | $V_{DD} \approx -24 \text{ V}, V_{GS} = -10 \text{ V}, I_D = -4 \text{ A}$                                                                                       | —    | 13   | —         | nC            |
| Gate-source charge 1                            |               | $Q_{gs1}$      |                                                                                                                                                                  | —    | 1.7  | —         |               |
| Gate-drain ("miller") charge                    |               | $Q_{gd}$       |                                                                                                                                                                  | —    | 4.6  | —         |               |

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

| Characteristics         |                | Symbol    | Test Condition                                | Min | Typ. | Max | Unit |
|-------------------------|----------------|-----------|-----------------------------------------------|-----|------|-----|------|
| Drain reverse current   | Pulse (Note 1) | $I_{DRP}$ | —                                             | —   | —    | -16 | A    |
| Forward voltage (diode) |                | $V_{DSF}$ | $I_{DR} = -4 \text{ A}, V_{GS} = 0 \text{ V}$ | —   | —    | 1.2 | V    |

## N-ch

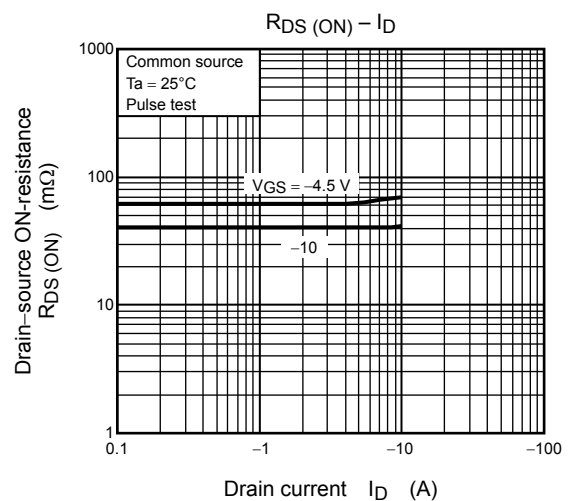
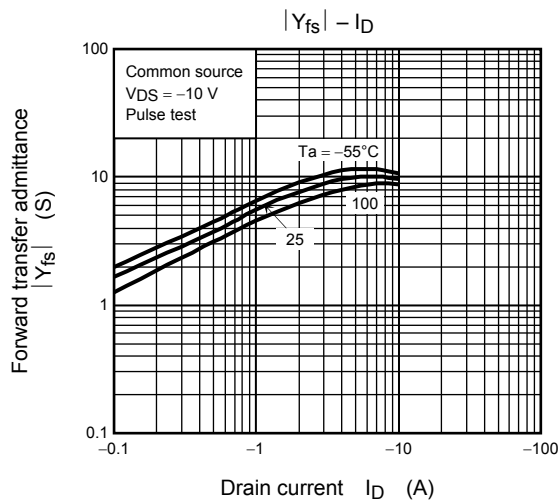
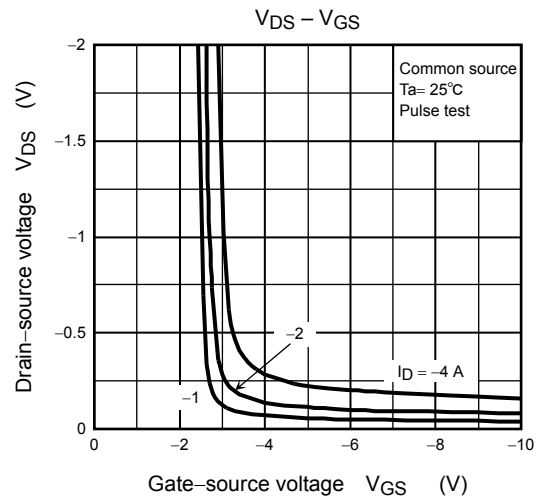
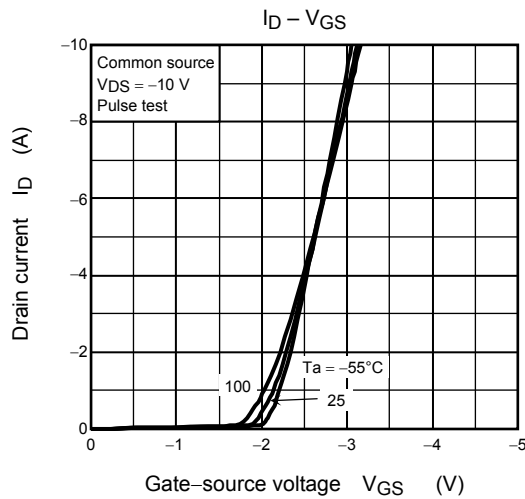
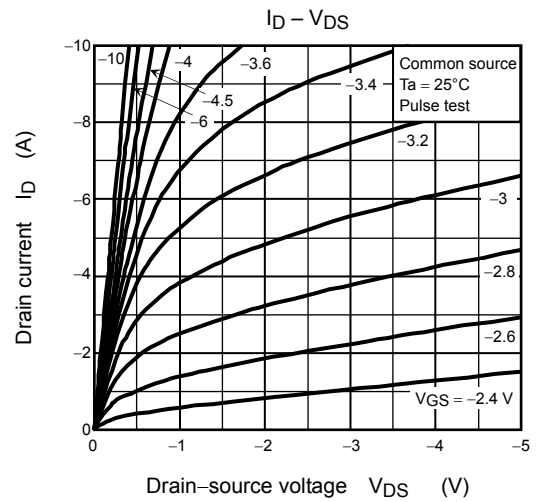
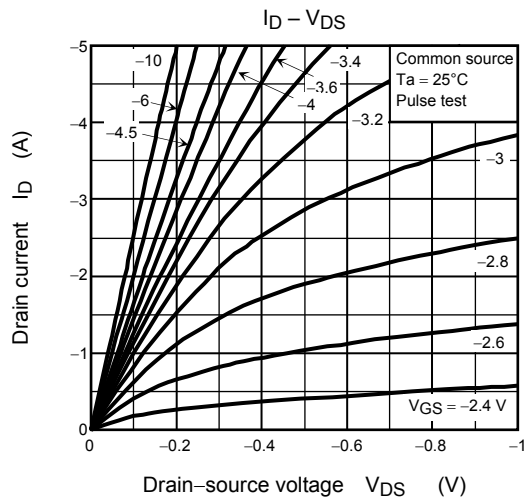
### Electrical Characteristics (Ta = 25°C)

| Characteristics                                 |                       | Symbol                                          | Test Condition                                                                                                | Min | Typ. | Max  | Unit |
|-------------------------------------------------|-----------------------|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-----|------|------|------|
| Gate leakage current                            |                       | I <sub>GSS</sub>                                | V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V                                                                | —   | —    | ±100 | nA   |
| Drain cut-off current                           |                       | I <sub>DSS</sub>                                | V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 0 V                                                                 | —   | —    | 10   | μA   |
| Drain-source breakdown voltage                  | V <sub>(BR) DSS</sub> | I <sub>D</sub> = 10 mA, V <sub>GS</sub> = 0 V   | 30                                                                                                            | —   | —    | V    |      |
|                                                 | V <sub>(BR) DSX</sub> | I <sub>D</sub> = 10 mA, V <sub>GS</sub> = -20 V | 10                                                                                                            | —   | —    |      |      |
| Gate threshold voltage                          |                       | V <sub>th</sub>                                 | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA                                                                 | 1.3 | —    | 2.5  | V    |
| Drain-source ON resistance                      |                       | R <sub>DS (ON)</sub>                            | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 2 A                                                                 | —   | 58   | 80   | mΩ   |
|                                                 |                       |                                                 | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2 A                                                                  | —   | 38   | 50   |      |
| Forward transfer admittance                     |                       | Y <sub>fs</sub>                                 | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 2 A                                                                  | 4   | 8    | —    | S    |
| Input capacitance                               |                       | C <sub>iss</sub>                                | V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V, f = 1 MHz                                                      | —   | 190  | —    | pF   |
| Reverse transfer capacitance                    |                       | C <sub>rss</sub>                                |                                                                                                               | —   | 45   | —    |      |
| Output capacitance                              |                       | C <sub>oss</sub>                                |                                                                                                               | —   | 60   | —    |      |
| Switching time                                  | Rise time             | t <sub>r</sub>                                  | <br>V <sub>DD</sub> ≈ 15 V | —   | 4.5  | —    | ns   |
|                                                 | Turn-on time          | t <sub>on</sub>                                 |                                                                                                               | —   | 9.0  | —    |      |
|                                                 | Fall time             | t <sub>f</sub>                                  |                                                                                                               | —   | 3.0  | —    |      |
|                                                 | Turn-off time         | t <sub>off</sub>                                | Duty ≤ 1%, t <sub>w</sub> = 10 μs                                                                             | —   | 12   | —    |      |
| Total gate charge (gate-source plus gate-drain) |                       | Q <sub>g</sub>                                  | V <sub>DD</sub> ≈ 24 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 4 A                                          | —   | 4.6  | —    | nC   |
| Gate-source charge 1                            |                       | Q <sub>gs1</sub>                                |                                                                                                               | —   | 0.7  | —    |      |
| Gate-drain ("miller") charge                    |                       | Q <sub>gd</sub>                                 |                                                                                                               | —   | 1.4  | —    |      |

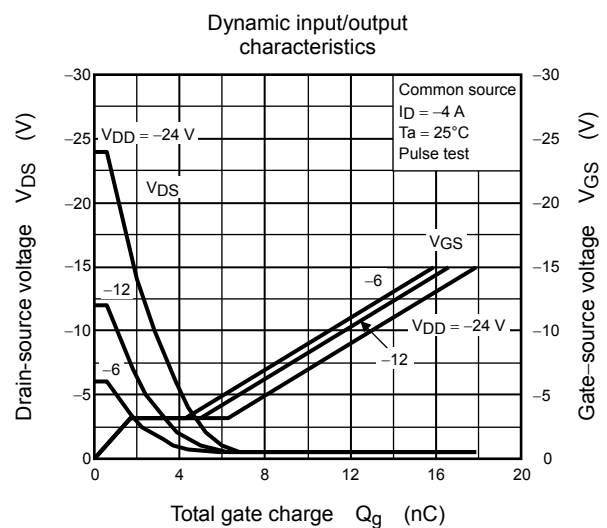
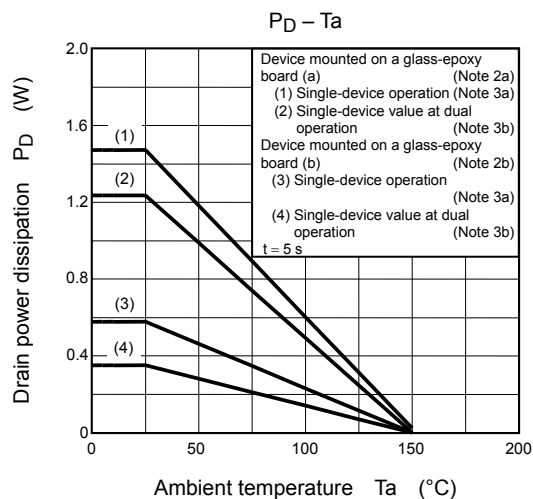
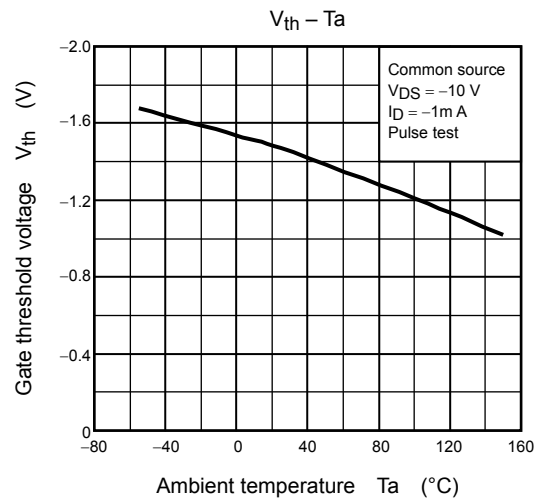
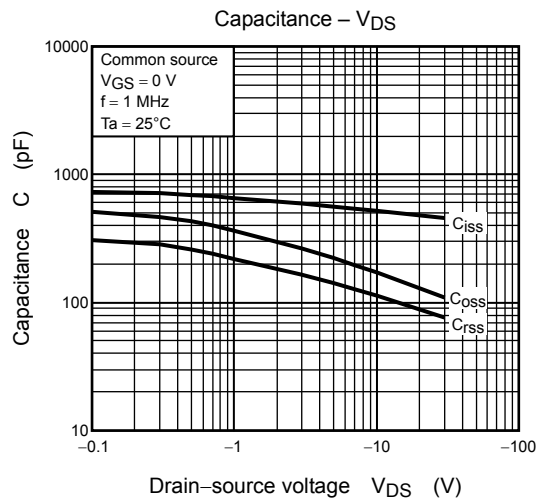
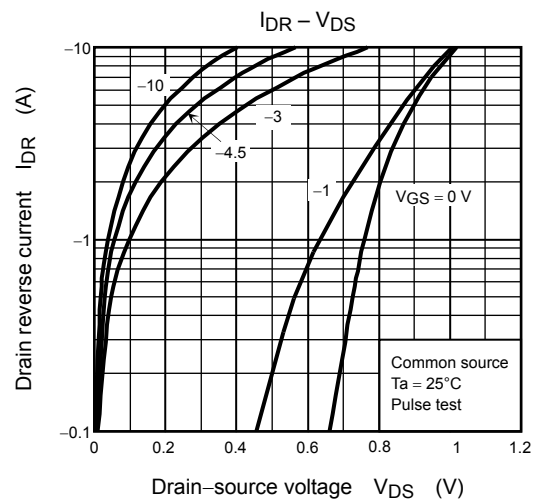
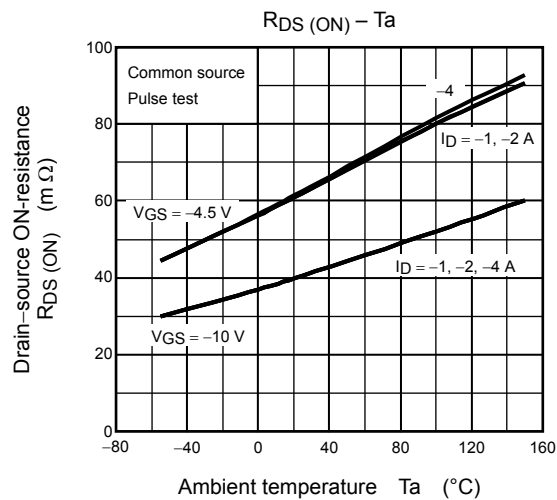
### Source-Drain Ratings and Characteristics (Ta = 25°C)

| Characteristics         |                | Symbol    | Test Condition                               | Min | Typ. | Max  | Unit |
|-------------------------|----------------|-----------|----------------------------------------------|-----|------|------|------|
| Drain reverse current   | Pulse (Note 1) | $I_{DRP}$ | —                                            | —   | —    | 16   | A    |
| Forward voltage (diode) |                | $V_{DSF}$ | $I_{DR} = 4 \text{ A}, V_{GS} = 0 \text{ V}$ | —   | —    | -1.2 | V    |

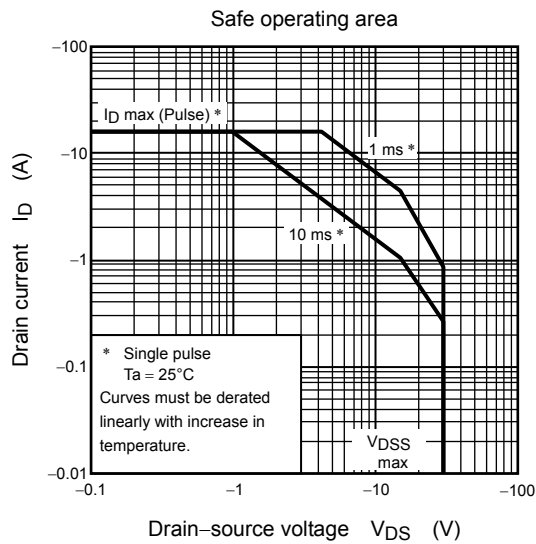
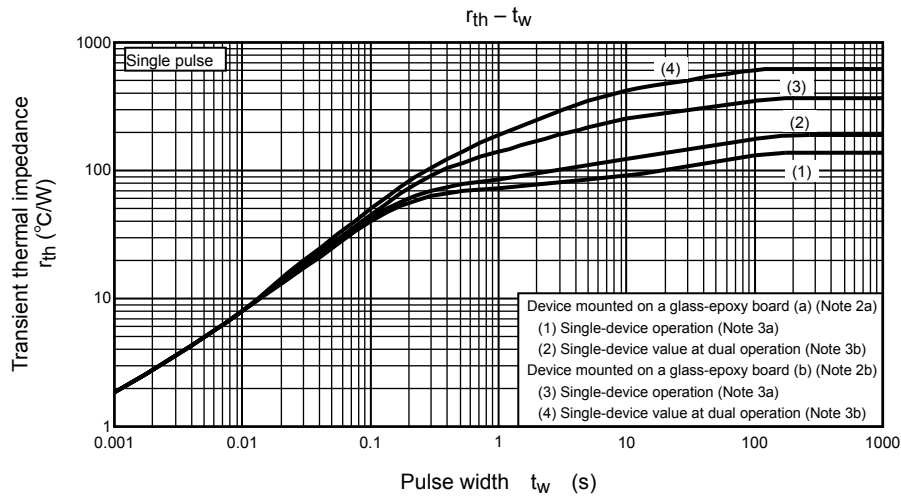
P-ch



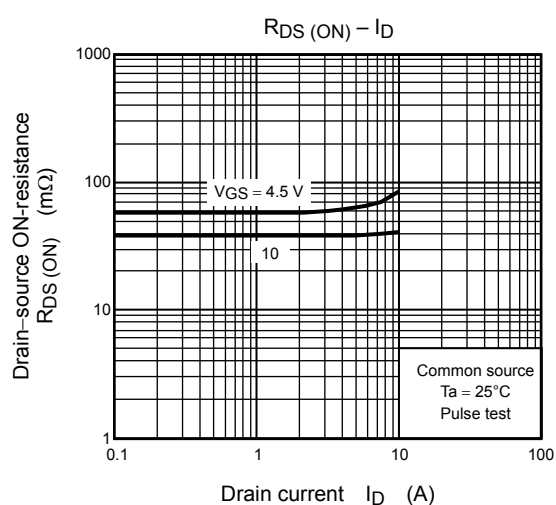
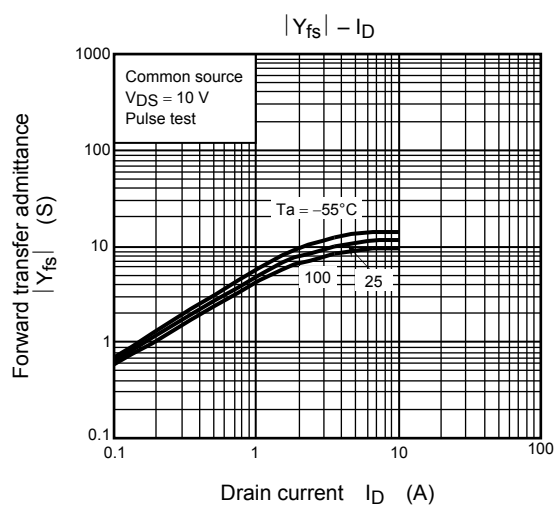
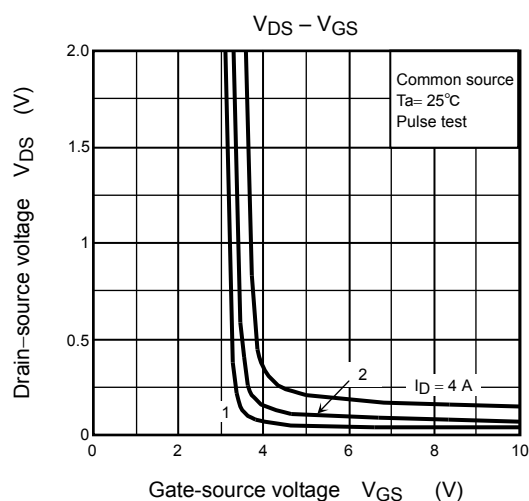
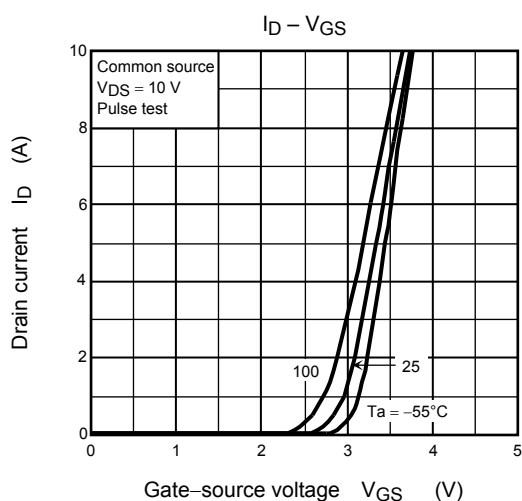
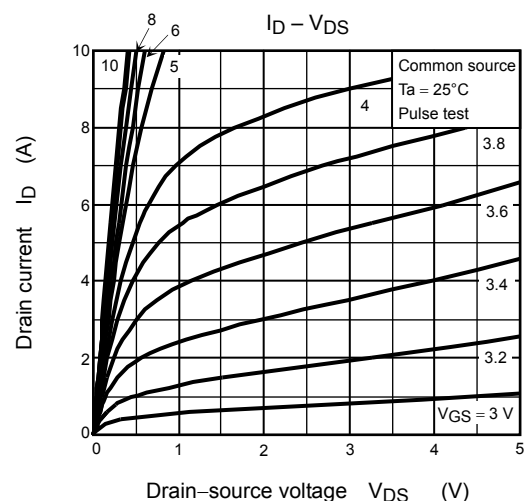
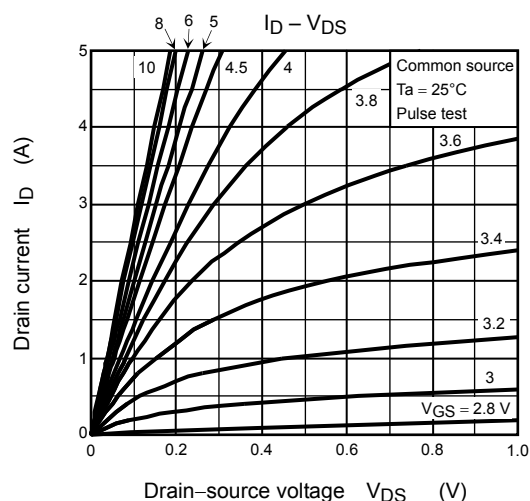
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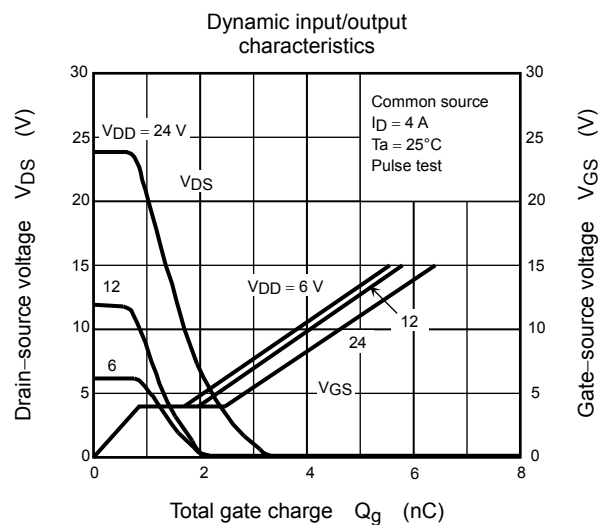
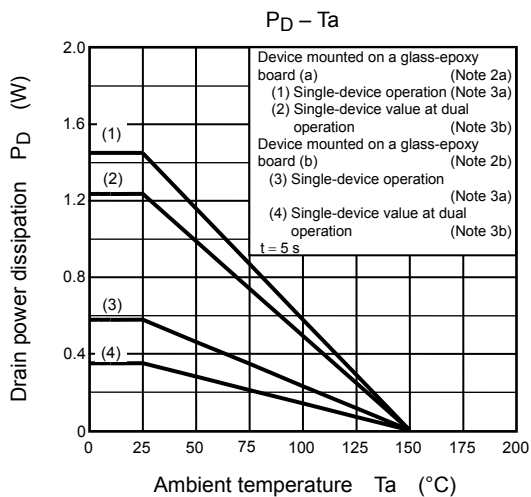
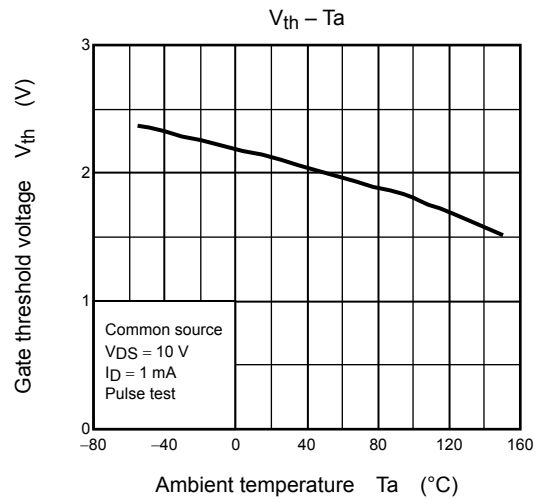
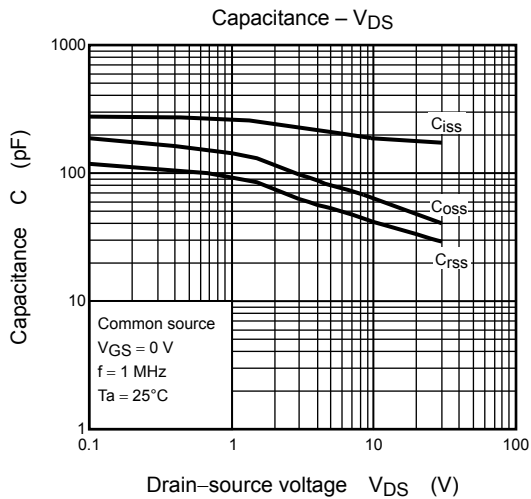
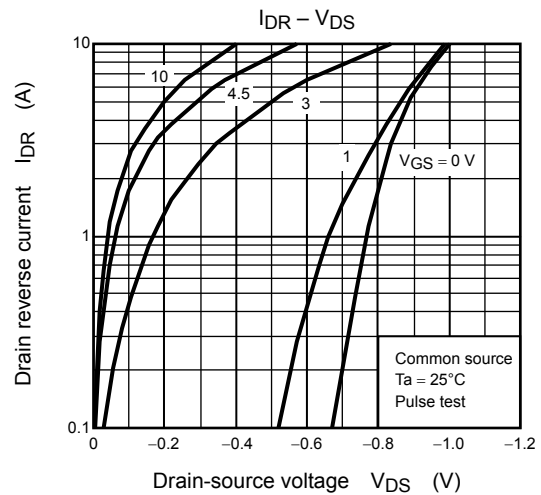
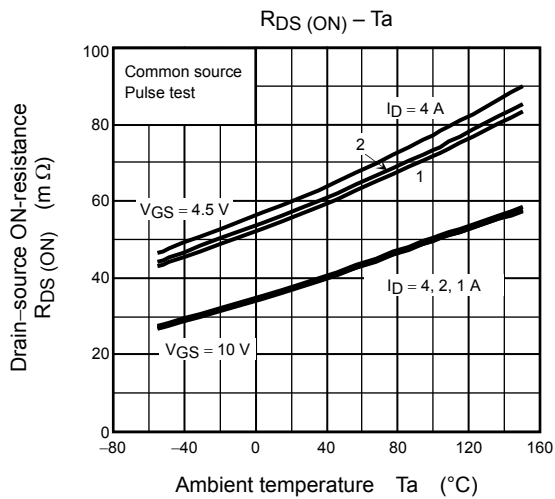
P-ch



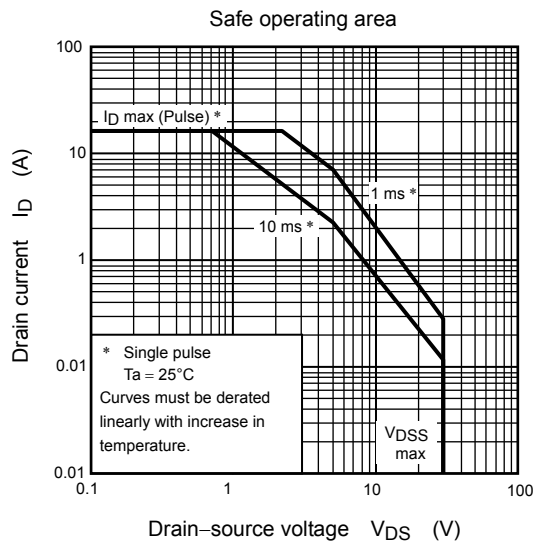
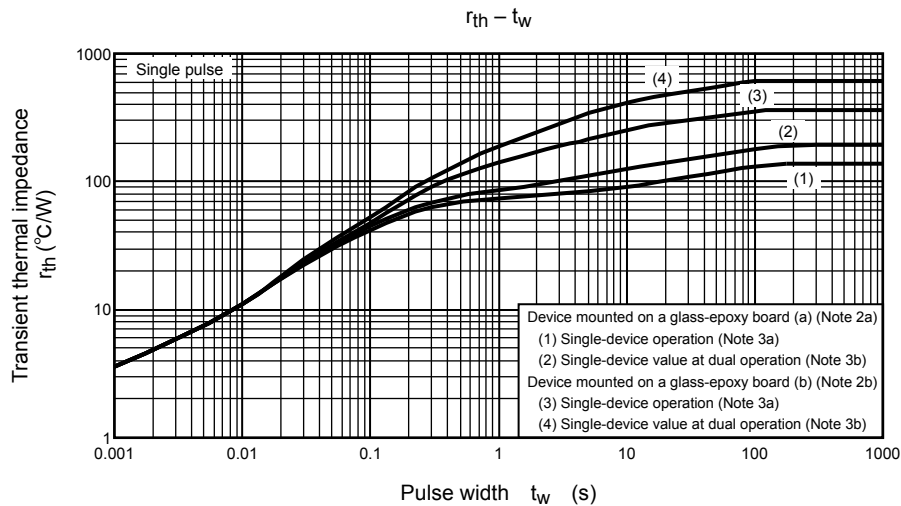
## N-ch



## N-ch



N-ch



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