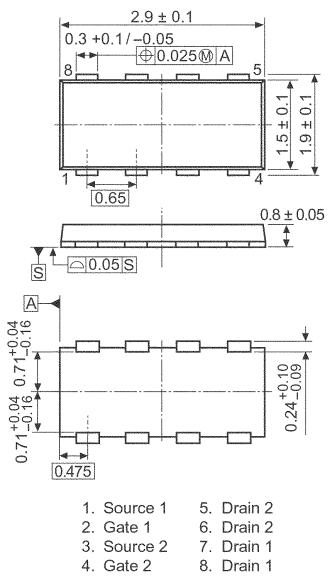
TOSHIBA Field Effect Transistor Silicon P-Channel MOS Type (U-MOS IV)

# TPCF8304

Notebook PC Applications
Portable Equipment Applications

- Low drain-source ON resistance: $R_{DS\ (ON)}$ = 60 mΩ (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 5.9 S (typ.)
- Low leakage current: $I_{DSS}$ = −10 μA (max) ($V_{DS}$ = −30 V)
- Enhancement model: $V_{th}$ = −0.8 to −2.0 V ($V_{DS}$ = −10 V, $I_D$ = −1 mA)

Unit: mm



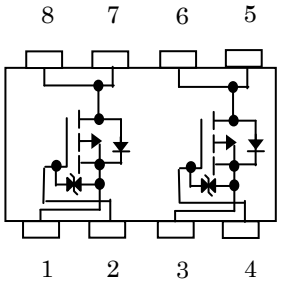

| | |
|---|---|
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 2-3U1B |

Weight: 0.011 g (typ.)

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

| Characteristic | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain-source voltage | | $V_{DSS}$ | -30 | V |
| Drain-gate voltage ($R_{GS}$ = 20 kΩ) | | $V_{DGR}$ | -30 | V |
| Gate-source voltage | | $V_{GSS}$ | ±20 | V |
| Drain current | DC (Note 1) | $I_D$ | -3.2 | A |
| | Pulse (Note 1) | $I_{DP}$ | -12.8 | |
| Drain power dissipation (t = 5 s) (Note 2a) | Single-device operation (Note 3a) | $P_{D\ (1)}$ | 1.35 | W |
| | Single-device value at dual operation (Note 3b) | $P_{D\ (2)}$ | 1.12 | |
| Drain power dissipation (t = 5 s) (Note 2b) | Single-device operation (Note 3a) | $P_{D\ (1)}$ | 0.53 | |
| | Single-device value at dual operation (Note 3b) | $P_{D\ (2)}$ | 0.33 | |
| Single-pulse avalanche energy (Note 4) | | $E_{AS}$ | 0.67 | mJ |
| Avalanche current | | $I_{AR}$ | -1.6 | A |
| Repetitive avalanche energy Single-device value at dual operation (Note 2a, 3b, 5) | | $E_{AR}$ | 0.11 | mJ |
| Channel temperature | | $T_{ch}$ | 150 | °C |
| Storage temperature range | | $T_{stg}$ | -55~150 | °C |

## Circuit Configuration




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

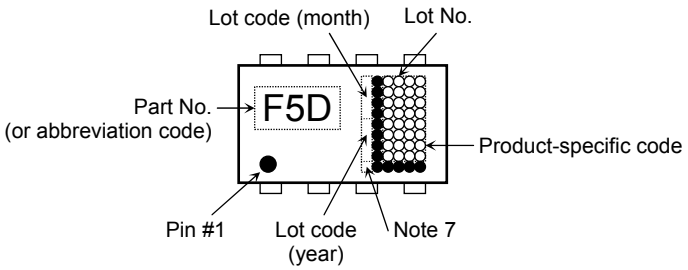
Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within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

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

## Thermal Characteristics

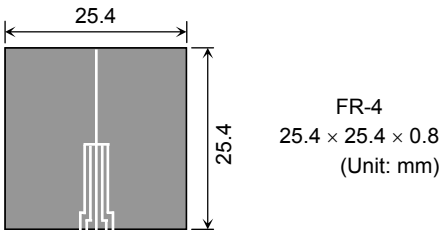
| Characteristic | | Symbol | Max | Unit |
|---|---|---|---|---|
| Thermal resistance, channel to ambient (t = 5 s) (Note 2a) | Single-device operation (Note 3a) | $R_{th\ (ch-a)\ (1)}$ | 92.6 | °C/W |
| | Single-device value at dual operation (Note 3b) | $R_{th\ (ch-a)\ (2)}$ | 111.6 | |
| Thermal resistance, channel to ambient (t = 5 s) (Note 2b) | Single-device operation (Note 3a) | $R_{th\ (ch-a)\ (1)}$ | 235.8 | °C/W |
| | Single-device value at dual operation (Note 3b) | $R_{th\ (ch-a)\ (2)}$ | 378.8 | |

## Marking (Note 6)

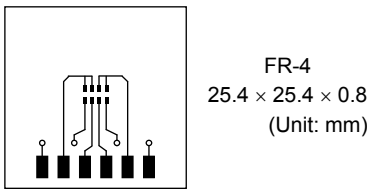



Note 1: Ensure that the channel temperature does not exceed 150℃.

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




(a)




(b)

Note 3: a) The power dissipation and thermal resistance values shown are for a single device.
(During single-device operation, power is applied to one device only.)
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: $V_{DD}$ = -24 V, $T_{ch}$ = 25°C (initial), L = 0.2 mH, $R_G$ = 25 Ω, $I_{AR}$ = -1.6 A

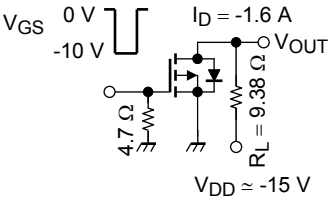
Note 5: Repetitive rating; pulse width limited by max channel s temperature

Note 6: ● to the lower left of the Part No. indicates Pin 1.

Note 7: 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]]

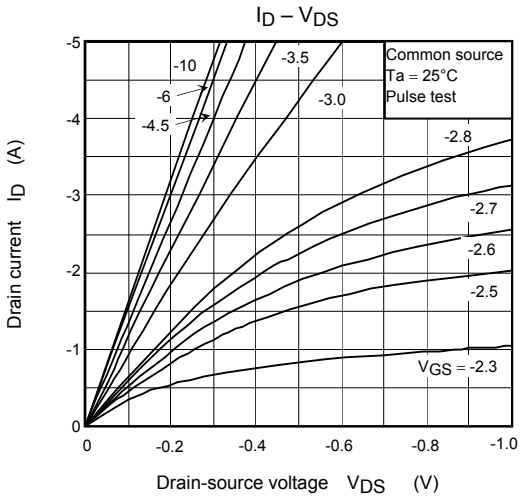
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

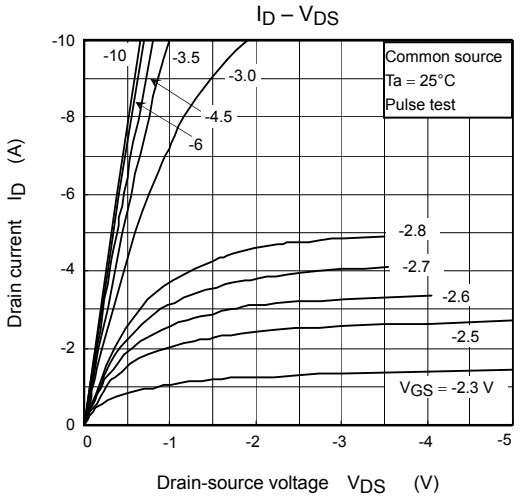
## Electrical Characteristics (Ta = 25°C)

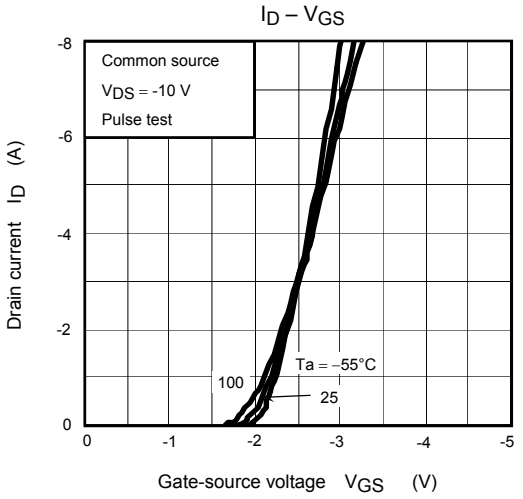
| Characteristic | | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Gate leakage current | | $I_{GSS}$ | $V_{GS}$ = ±16 V, $V_{DS}$ = 0 V | — | — | ±10 | μA |
| Drain cut-off current | | $I_{DSS}$ | $V_{DS}$ = -30 V, $V_{GS}$ = 0 V | — | — | -10 | μA |
| Drain-source breakdown voltage | | $V_{(BR)\ DSS}$ | $I_D$ = -10 mA, $V_{GS}$ = 0 V | -30 | — | — | V |
| | | $V_{(BR)\ DSX}$ | $I_D$ = -10 mA, $V_{GS}$ = 20 V | -15 | — | — | |
| Gate threshold voltage | | $V_{th}$ | $V_{DS}$ = -10 V, $I_D$ = -1 mA | -0.5 | — | -1.2 | V |
| Drain-source ON resistance | | $R_{DS\ (ON)}$ | $V_{GS}$ = -4.5 V, $I_D$ = -1.6 A | — | 80 | 105 | mΩ |
| | | $R_{DS\ (ON)}$ | $V_{GS}$ = -10 V, $I_D$ = -1.6 A | — | 60 | 72 | |
| Forward transfer admittance | | $\|Y_{fs}\|$ | $V_{DS}$ = -10 V, $I_D$ = -1.6 A | 2.9 | 5.9 | — | S |
| Input capacitance | | $C_{iss}$ | $V_{DS}$ = -10 V, $V_{GS}$ = 0 V, f = 1 MHz | — | 600 | — | pF |
| Reverse transfer capacitance | | $C_{rss}$ | | — | 60 | — | |
| Output capacitance | | $C_{oss}$ | | — | 70 | — | |
| Switching time | Rise time | $t_r$ |   Duty ≤ 1%, $t_w$ = 10 μs | — | 5.3 | — | ns |
| | Turn-on time | $t_{on}$ | | — | 12 | — | |
| | Fall time | $t_f$ | | — | 8.4 | — | |
| | Turn-off time | $t_{off}$ | | — | 34 | — | |
| Total gate charge (gate-source plus gate-drain) | | $Q_g$ | $V_{DD}$ ≃ -24 V, $V_{GS}$ = -10 V, $I_D$ = -3.2 A | — | 14 | — | nC |
| Gate-source charge 1 | | $Q_{gs1}$ | | — | 1.4 | — | |
| Gate-drain ("Miller") charge | | $Q_{gd}$ | | — | 2.7 | — | |

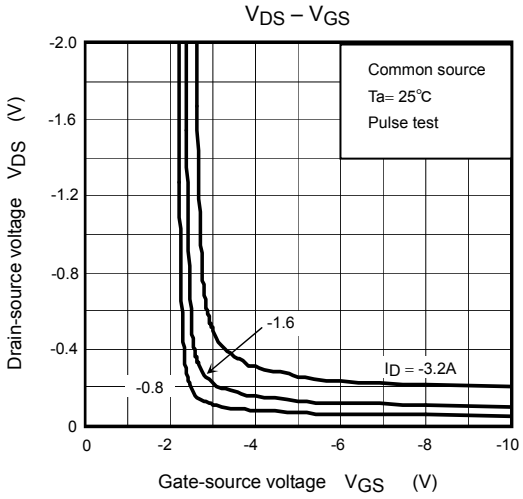
## Source-Drain Ratings and Characteristics (Ta = 25°C)

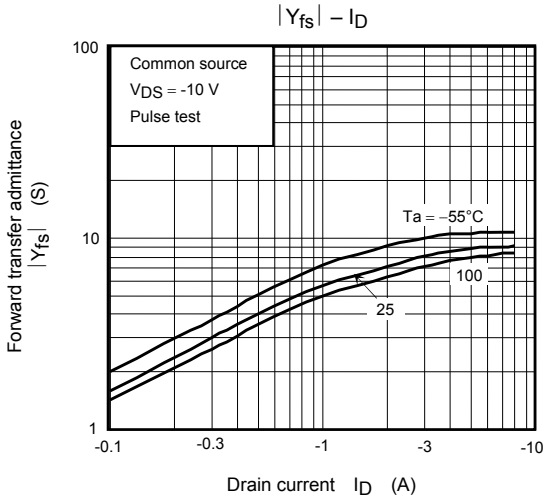
| Characteristic | | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Drain reverse current | Pulse (Note 1) | $I_{DRP}$ | — | — | — | -12.8 | A |
| Forward voltage (diode) | | $V_{DSF}$ | $I_{DR}$ = -3.2 A, $V_{GS}$ = 0 V | — | — | 1.2 | V |

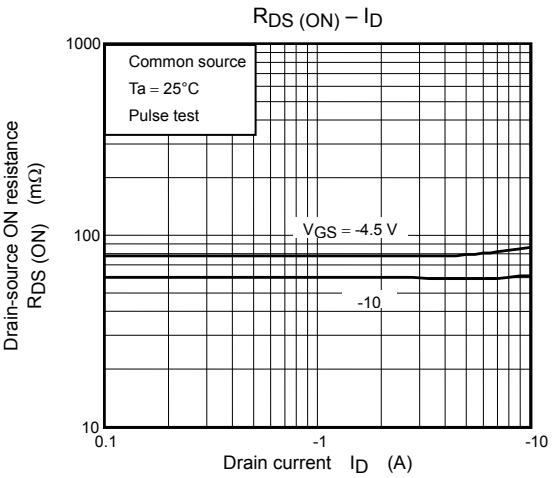

$I_D - V_{DS}$
Common source
Ta = 25°C
Pulse test
-10
-6
-4.5
-3.5
-3.0
-2.8
-2.7
-2.6
-2.5
$V_{GS}$ = -2.3
Drain current $I_D$ (A)
Drain-source voltage $V_{DS}$ (V)


$I_D - V_{DS}$
Common source
Ta = 25°C
Pulse test
-10
-3.5
-3.0
-4.5
-6
-2.8
-2.7
-2.6
-2.5
$V_{GS}$ = -2.3 V
Drain current $I_D$ (A)
Drain-source voltage $V_{DS}$ (V)

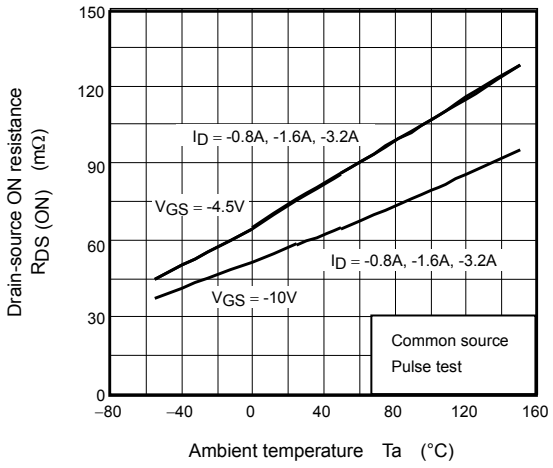

$I_D - V_{GS}$
Common source
$V_{DS}$ = -10 V
Pulse test
Ta = −55°C
100
25
Drain current $I_D$ (A)
Gate-source voltage $V_{GS}$ (V)


$V_{DS} - V_{GS}$
Common source
Ta= 25℃
Pulse test
-1.6
-0.8
$I_D$ = -3.2A
Drain-source voltage $V_{DS}$ (V)
Gate-source voltage $V_{GS}$ (V)

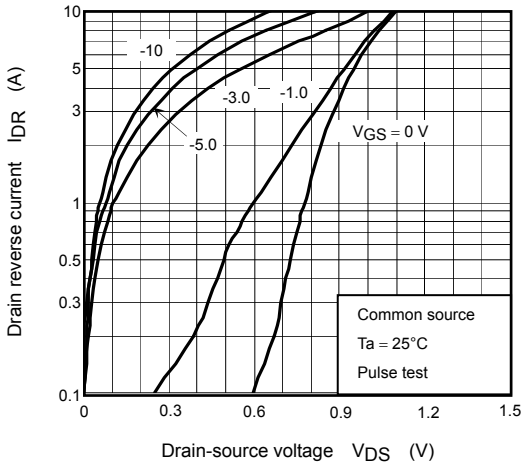

$|Y_{fs}| - I_D$
Common source
$V_{DS}$ = -10 V
Pulse test
Ta = −55°C
100
25
Forward transfer admittance $|Y_{fs}|$ (S)
Drain current $I_D$ (A)


$R_{DS\ (ON)} - I_D$
Common source
Ta = 25°C
Pulse test
$V_{GS}$ = -4.5 V
-10
Drain-source ON resistance $R_{DS\ (ON)}$ (mΩ)
Drain current $I_D$ (A)

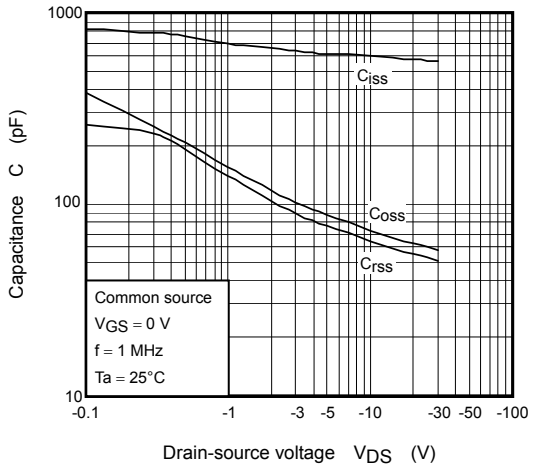
$R_{DS\ (ON)}$ – Ta



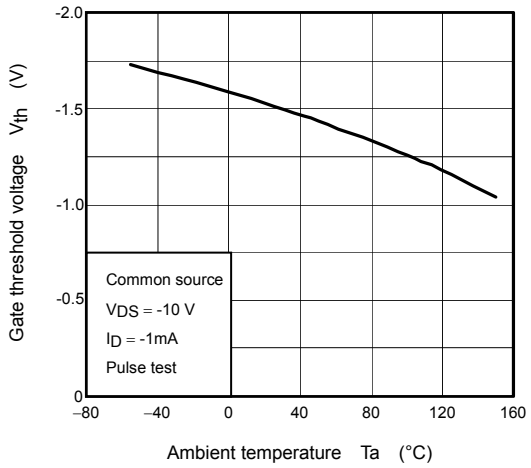

$I_{DR}$ – $V_{DS}$



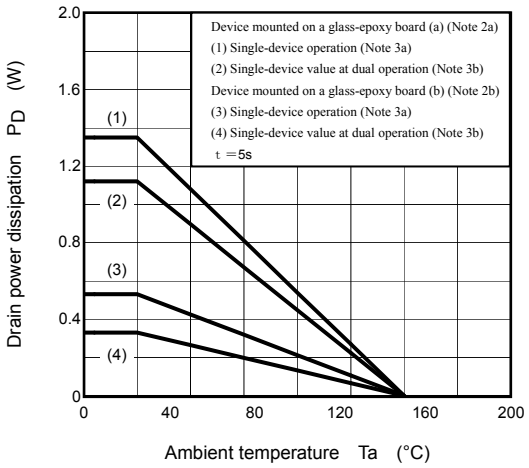

Capacitance – $V_{DS}$



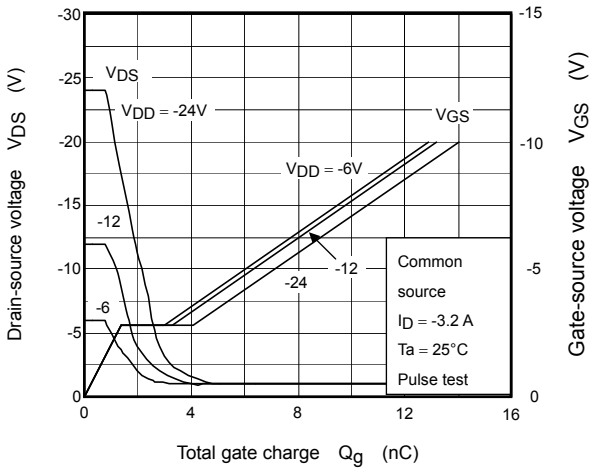

$V_{th}$ – Ta

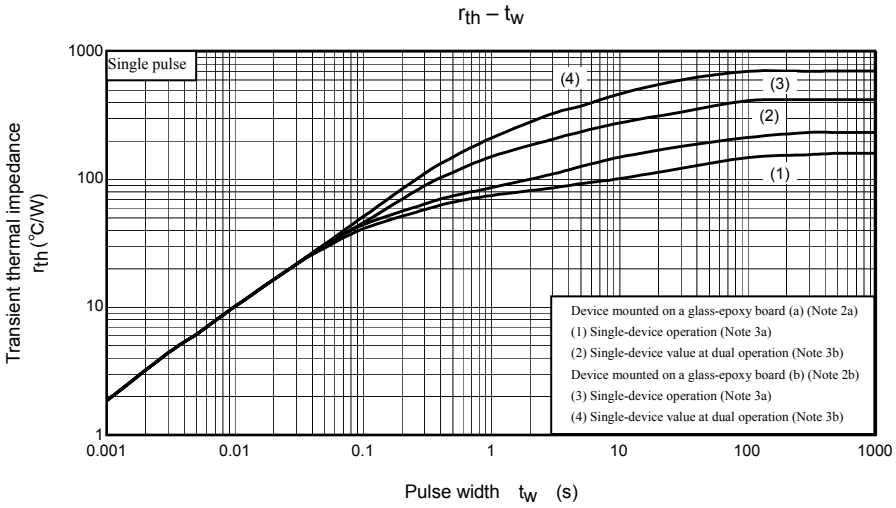


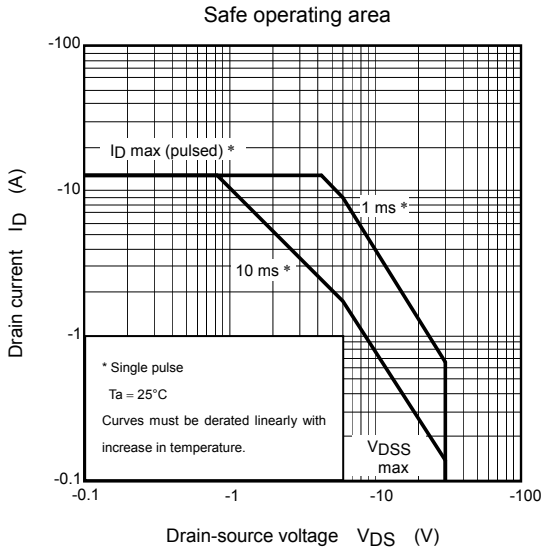

$P_D$ – Ta




Dynamic input/output characteristics




rth – tw
Single pulse
(4)
(3)
(2)
(1)
Transient thermal impedance rth (°C/W)
1000
100
10
1
0.001
0.01
0.1
1
10
100
1000
Pulse width tw (s)
Device mounted on a glass-epoxy board (a) (Note 2a)
(1) Single-device operation (Note 3a)
(2) Single-device value at dual operation (Note 3b)
Device mounted on a glass-epoxy board (b) (Note 2b)
(3) Single-device operation (Note 3a)
(4) Single-device value at dual operation (Note 3b)


Safe operating area
-100
-10
-1
-0.1
ID max (pulsed) *
1 ms *
10 ms *
Drain current ID (A)
* Single pulse
Ta = 25°C
Curves must be derated linearly with
increase in temperature.
VDSS
max
-0.1
-1
-10
-100
Drain-source voltage VDS (V)

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