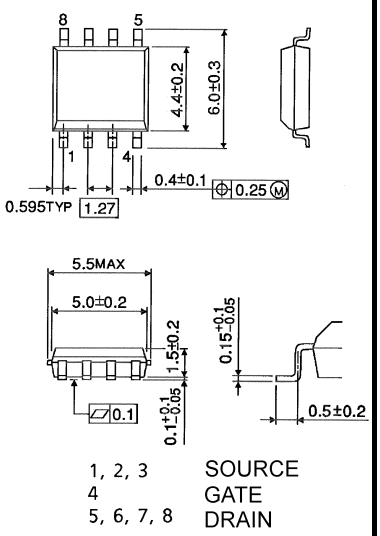
TOSHIBA Field Effect Transistor Silicon P Channel MOS Type (U-MOSⅥ)

# TPC8123

Lithium Ion Battery Applications

Power Management Switch Applications

Unit: mm




| | |
|---|---|
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 2-6J1B |

Weight: 0.080 g (typ.)

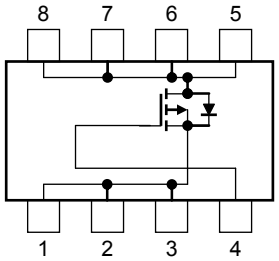
- Small footprint due to small and thin package
- Low drain-source ON-resistance: $R_{DS\ (ON)}$ = 7.0 mΩ (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 36 S (typ.)
- Low leakage current: $I_{DSS}$ = −10 μA (max) ($V_{DS}$ = −30 V)
- Enhancement mode: $V_{th}$ = −0.8 to −2.0 V ($V_{DS}$ = −10 V, $I_D$ = −0.5 mA)

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

| Characteristics | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain-source voltage | | $V_{DSS}$ | −30 | V |
| Drain-gate voltage ($R_{GS}$ = 20 kΩ) | | $V_{DGR}$ | −30 | V |
| Gate-source voltage | | $V_{GSS}$ | −25/+20 | V |
| Drain current | DC (Note 1) | $I_D$ | −11 | A |
| | Pulse (Note 1) | $I_{DP}$ | −44 | |
| Drain power dissipation (t = 10 s) (Note 2a) | | $P_D$ | 1.9 | W |
| Drain power dissipation (t = 10 s) (Note 2b) | | $P_D$ | 1.0 | W |
| Single pulse avalanche energy (Note 3) | | $E_{AS}$ | 79 | mJ |
| Avalanche current (Note 1) | | $I_{AR}$ | −11 | A |
| Repetitive avalanche energy (Note 2a) (Note 4) | | $E_{AR}$ | 0.04 | mJ |
| Channel temperature | | $T_{ch}$ | 150 | °C |
| Storage temperature range | | $T_{stg}$ | −55 to 150 | °C |

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

## Circuit Configuration



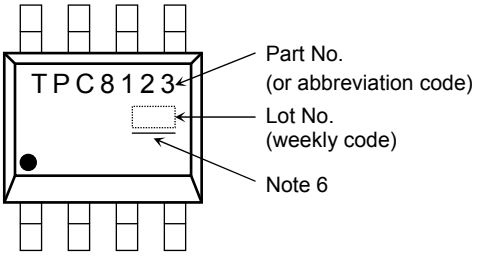

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within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

## Thermal Characteristics

| Characteristics | Symbol | Max | Unit |
|---|---|---|---|
| Thermal resistance, channel to ambient (t = 10 s) (Note 2a) | $R_{th\ (ch\text{-}a)}$ | 65.8 | °C/W |
| Thermal resistance, channel to ambient (t = 10 s) (Note 2b) | $R_{th\ (ch\text{-}a)}$ | 125 | °C/W |

## Marking (Note 5)

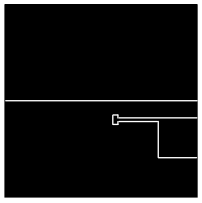



Note 6: A line under a Lot No. identifies the indication of product Labels [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

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

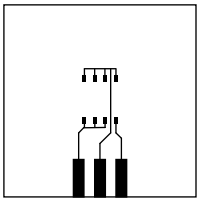
Note 1: Ensure that the channel temperature does not exceed 150°C.

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



FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

(a)



FR-4
25.4 × 25.4 × 0.8
(Unit: mm)

(b)

Note 3: $V_{DD} = -24$ V, $T_{ch} = 25$ °C (initial), L = 500 μH, $R_G = 25\ \Omega$, $I_{AR} = -11$ A

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

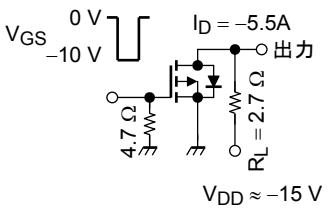
Note 5: • on lower left of the marking indicates Pin 1.

※ 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)

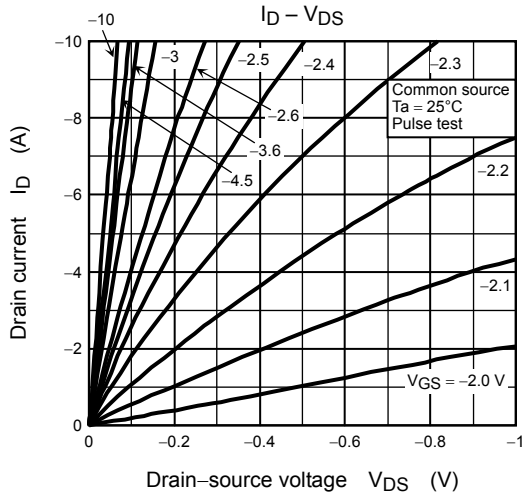
## Electrical Characteristics (Ta = 25°C)

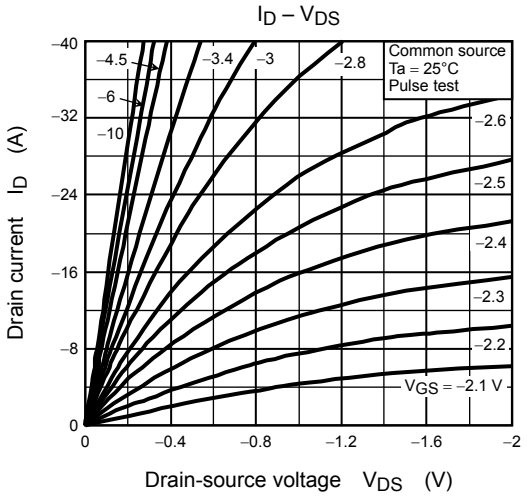
| Characteristics | | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Gate leakage current | | $I_{GSS}$ | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | — | — | ±100 | nA |
| Drain cut-OFF current | | $I_{DSS}$ | $V_{DS}$ = −30 V, $V_{GS}$ = 0 V | — | — | −10 | μA |
| Drain-source breakdown voltage | | $V_{(BR)\ DSS}$ | $I_D$ = −10 mA, $V_{GS}$ = 0 V | −30 | — | — | V |
| | | $V_{(BR)\ DSX}$ | $I_D$ = −10 mA, $V_{GS}$ = 10 V (Note 7) | −21 | — | — | |
| Gate threshold voltage | | $V_{th}$ | $V_{DS}$ = −10 V, $I_D$ = −0.5 mA | −0.8 | — | −2.0 | V |
| Drain-source ON-resistance | | $R_{DS\ (ON)}$ | $V_{GS}$ = −4.5 V, $I_D$ = −5.5 A | — | 9.5 | 12.5 | mΩ |
| | | | $V_{GS}$ = −10 V, $I_D$ = −5.5 A | — | 7.0 | 9.0 | |
| Forward transfer admittance | | $\|Y_{fs}\|$ | $V_{DS}$ = −10 V, $I_D$ = −5.5 A | 18 | 36 | — | S |
| Input capacitance | | $C_{iss}$ | $V_{DS}$ = −10 V, $V_{GS}$ = 0 V, f = 1 MHz | — | 2940 | — | pF |
| Reverse transfer capacitance | | $C_{rss}$ | | — | 460 | — | |
| Output capacitance | | $C_{oss}$ | | — | 520 | — | |
| Switching time | Rise time | $t_r$ |   Duty ≤ 1%, $t_w$ = 10 μs | — | 10 | — | ns |
| | Turn-ON time | $t_{on}$ | | — | 18 | — | |
| | Fall time | $t_f$ | | — | 80 | — | |
| | Turn-OFF time | $t_{off}$ | | — | 250 | — | |
| Total gate charge (gate-source plus gate-drain) | | $Q_g$ | $V_{DD}$ ≈ −24 V, $V_{GS}$ = −10 V, $I_D$ = −11 A | — | 68 | — | nC |
| Gate-source charge 1 | | $Q_{gs1}$ | | — | 7 | — | |
| Gate-drain ("miller") charge | | $Q_{gd}$ | | — | 18 | — | |

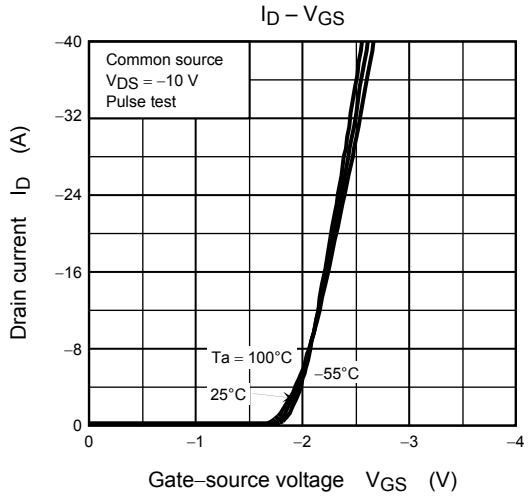
## Source-Drain Ratings and Characteristics (Ta = 25°C)

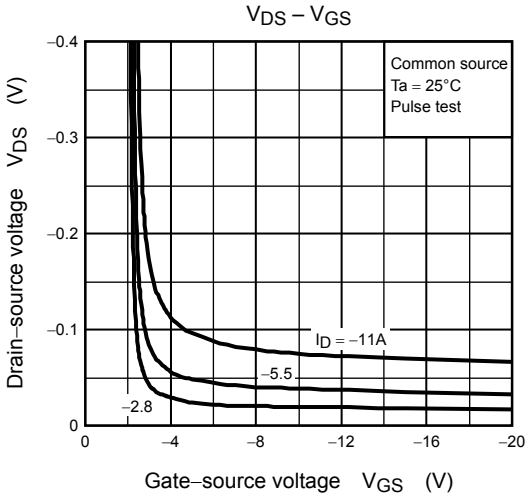
| Characteristics | | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Drain reverse current | Pulse (Note 1) | $I_{DRP}$ | — | — | — | −44 | A |
| Forward voltage (diode) | | $V_{DSF}$ | $I_{DR}$ = −11 A, $V_{GS}$ = 0 V | — | — | 1.2 | V |

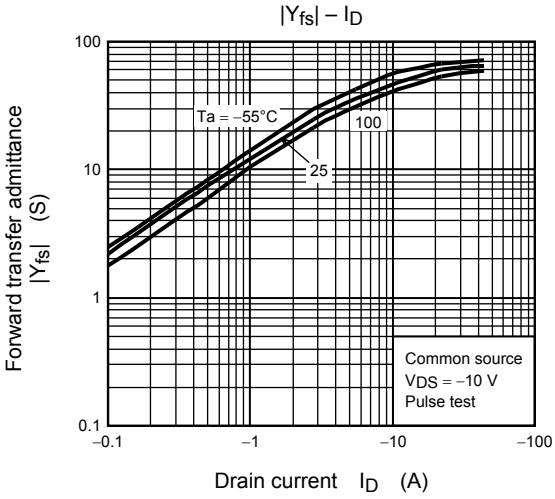
Note 7: VDSX mode (the application of a plus voltage between gate and source) may cause decrease in maximum rating of drain-source voltage.

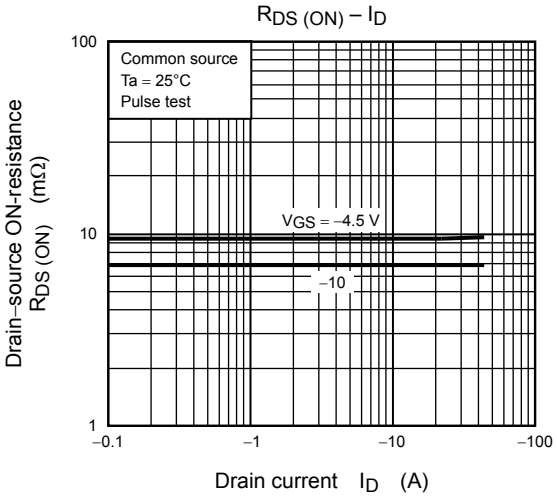

$I_D - V_{DS}$
Common source
Ta = 25°C
Pulse test
−10
−3
−2.5
−2.4
−2.3
−2.6
−3.6
−4.5
−2.2
−2.1
$V_{GS}$ = −2.0 V
Drain current $I_D$ (A)
Drain−source voltage $V_{DS}$ (V)


$I_D - V_{DS}$
Common source
Ta = 25°C
Pulse test
−4.5
−3.4
−3
−2.8
−6
−10
−2.6
−2.5
−2.4
−2.3
−2.2
$V_{GS}$ = −2.1 V
Drain current $I_D$ (A)
Drain-source voltage $V_{DS}$ (V)

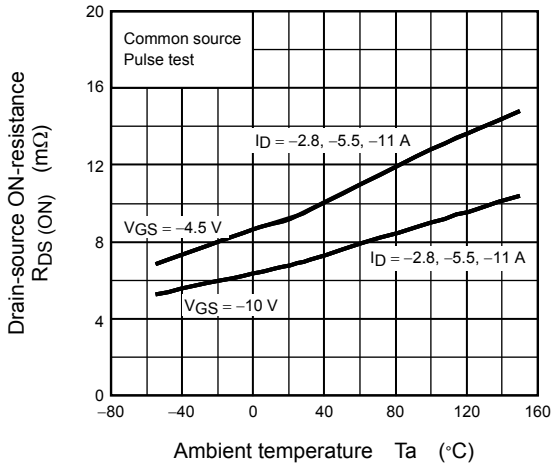

$I_D - V_{GS}$
Common source
$V_{DS}$ = −10 V
Pulse test
Ta = 100°C
−55°C
25°C
Drain current $I_D$ (A)
Gate−source voltage $V_{GS}$ (V)


$V_{DS} - V_{GS}$
Common source
Ta = 25°C
Pulse test
$I_D$ = −11A
−5.5
−2.8
Drain−source voltage $V_{DS}$ (V)
Gate−source voltage $V_{GS}$ (V)

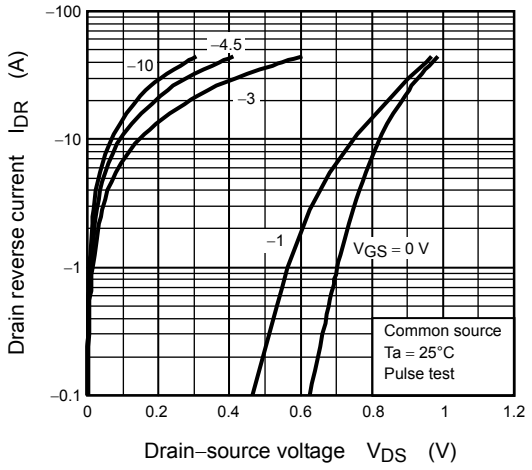

$|Y_{fs}| - I_D$
Ta = −55°C
100
25
Common source
$V_{DS}$ = −10 V
Pulse test
Forward transfer admittance $|Y_{fs}|$ (S)
Drain current $I_D$ (A)


$R_{DS\ (ON)} - I_D$
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)

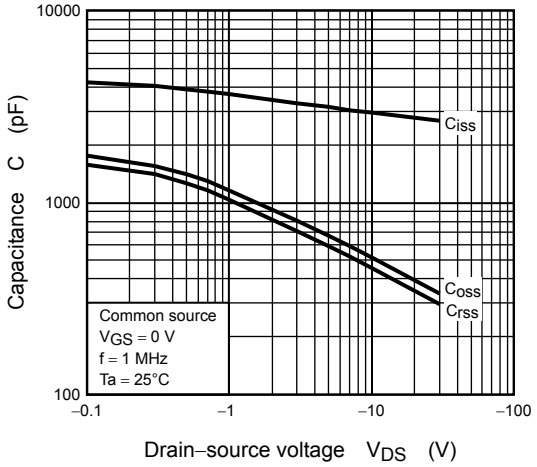
$R_{DS\ (ON)}$ – Ta



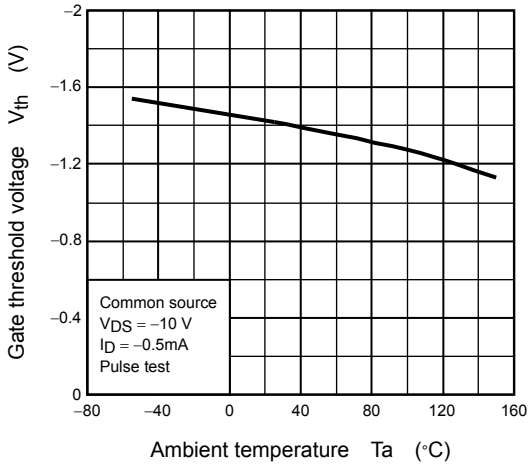

$I_{DR}$ – $V_{DS}$



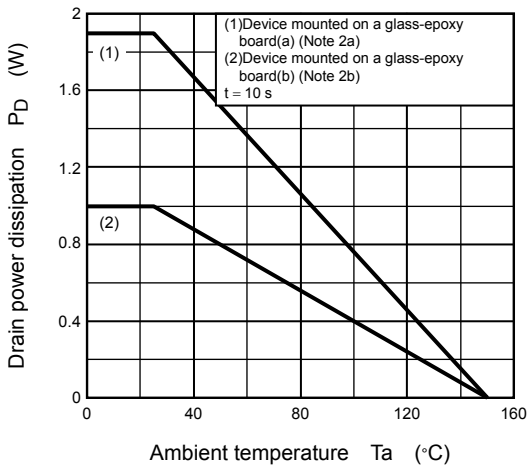

Capacitance – $V_{DS}$



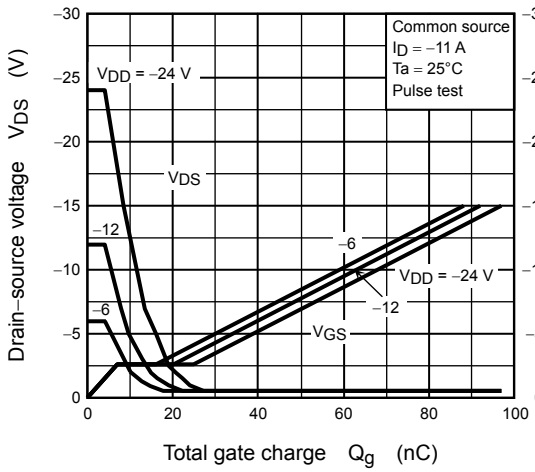

$V_{th}$ – Ta

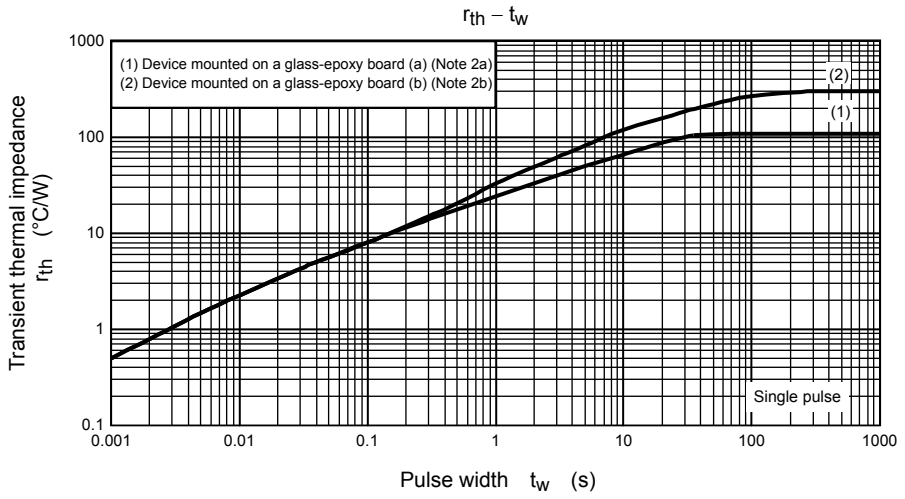


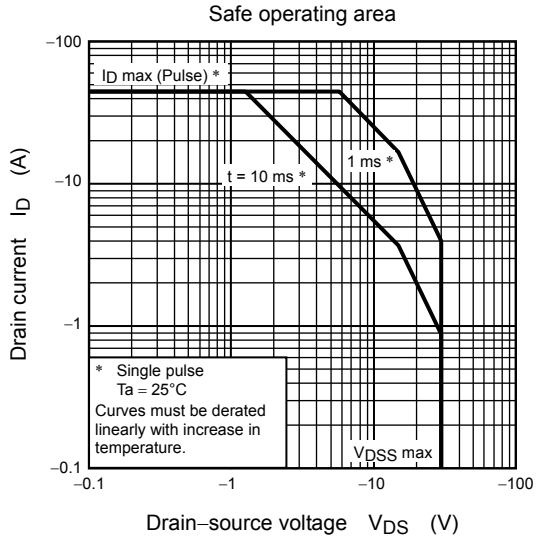

$P_D$ – Ta




Dynamic input/output characteristics




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


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

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