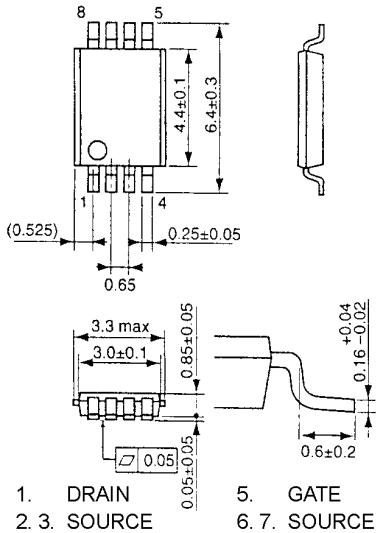
TOSHIBA Field Effect Transistor Silicon N Channel MOS Type (U-MOSIII)

# TPCS8210

## Lithium Ion Battery Applications

- Small footprint due to small and thin package
- Low drain-source ON resistance: $R_{DS\ (ON)}$ = 19 mΩ (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 9.2 S (typ.)
- Low leakage current: $I_{DSS}$ = 10 μA (max) ($V_{DS}$ = 20 V)
- Enhancement-mode: $V_{th}$ = 0.5~1.2 V ($V_{DS}$ = 10 V, $I_D$ = 200 μA)
- Common drain

Unit: mm




| | |
|---|---|
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 2-3R1E |

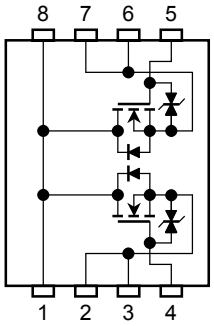
Weight: 0.035 g (typ.)

## Maximum Ratings (Ta = 25°C)

| Characteristics | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain-source voltage | | $V_{DSS}$ | 20 | V |
| Drain-gate voltage ($R_{GS}$ = 20 kΩ) | | $V_{DGR}$ | 20 | V |
| Gate-source voltage | | $V_{GSS}$ | ±12 | V |
| Drain current | DC (Note 1) | $I_D$ | 5 | A |
| | Pulse (Note 1) | $I_{DP}$ | 20 | |
| Drain power dissipation (t = 10 s) (Note 2a) | Single-device operation (Note 3a) | $P_{D\ (1)}$ | 1.1 | W |
| | Single-device value at dual operation (Note 3b) | $P_{D\ (2)}$ | 0.75 | |
| Drain power dissipation (t = 10 s) (Note 2b) | Single-device operation (Note 3a) | $P_{D\ (1)}$ | 0.6 | W |
| | Single-device value at dual operation (Note 3b) | $P_{D\ (2)}$ | 0.35 | |
| Single pulse avalanche energy (Note 4) | | $E_{AS}$ | 32.5 | mJ |
| Avalanche current | | $I_{AR}$ | 5 | A |
| Repetitive avalanche energy Single-device value at dual operation (Note 2a, 3b, 5) | | $E_{AR}$ | 0.075 | mJ |
| Channel temperature | | $T_{ch}$ | 150 | °C |
| Storage temperature range | | $T_{stg}$ | −55~150 | °C |

Note: (Note 1), (Note 2), (Note 3), (Note 4), (Note 5) Please see next page.

## Circuit Configuration

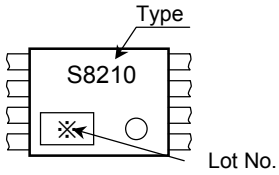



This transistor is an electrostatic sensitive device. Please handle with caution.

## Thermal Characteristics

| Characteristics | | Symbol | Max | Unit |
|---|---|---|---|---|
| Thermal resistance, channel to ambient (t = 10 s) (Note 2a) | Single-device operation (Note 3a) | $R_{th\ (ch\text{-}a)\ (1)}$ | 114 | °C/W |
| | Single-device value at dual operation (Note 3b) | $R_{th\ (ch\text{-}a)\ (2)}$ | 167 | |
| Thermal resistance, channel to ambient (t = 10 s) (Note 2b) | Single-device operation (Note 3a) | $R_{th\ (ch\text{-}a)\ (1)}$ | 208 | °C/W |
| | Single-device value at dual operation (Note 3b) | $R_{th\ (ch\text{-}a)\ (2)}$ | 357 | |

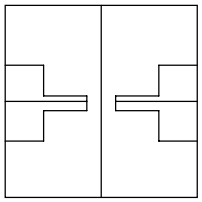
## Marking (Note 6)




Note 1: Please use devices on condition that the channel temperature is below 150°C.

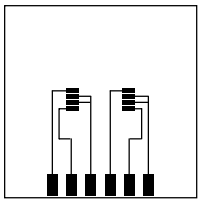
Note 2:

a) Device mounted on a glass-epoxy board (a)




(a)

b) Device mounted on a glass-epoxy board (b)




(b)

Note 3:

a) The power dissipation and thermal resistance values are shown for a single device (During single-device operation, power is only applied to one device.).

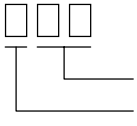
b) The power dissipation and thermal resistance values are shown for a single device (During dual operation, power is evenly applied to both devices.).

Note 4: $V_{DD}$ = 16 V, $T_{ch}$ = 25°C (initial), L = 1.0 mH, $R_G$ = 25 Ω, $I_{AR}$ = 5 A

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

Note 6: ○ on lower right of the marking indicates Pin 1.

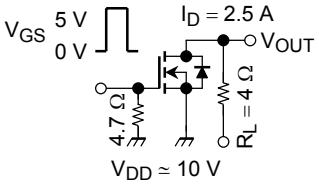
※ Weekly code: (Three digits)



Week of manufacture
(01 for first week of year, continues up to 52 or 53)

Year of manufacture
(One low-order digits of calendar year)

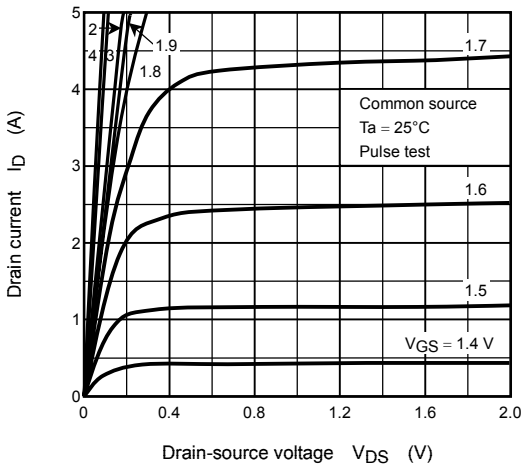
## Electrical Characteristics (Ta = 25°C)

| Characteristics | | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Gate leakage current | | $I_{GSS}$ | $V_{GS}$ = ±10 V, $V_{DS}$ = 0 V | — | — | ±10 | μA |
| Drain cut-OFF current | | $I_{DSS}$ | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V | — | — | 10 | μA |
| Drain-source breakdown voltage | | $V_{(BR)\ DSS}$ | $I_D$ = 10 mA, $V_{GS}$ = 0 V | 20 | — | — | V |
| | | $V_{(BR)\ DSX}$ | $I_D$ = 10 mA, $V_{GS}$ = −12 V | 8 | — | — | |
| Gate threshold voltage | | $V_{th}$ | $V_{DS}$ = 10 V, $I_D$ = 200 μA | 0.5 | — | 1.2 | V |
| Drain-source ON resistance | | $R_{DS\ (ON)}$ | $V_{GS}$ = 2.0 V, $I_D$ = 3.5 A | — | 34 | 60 | mΩ |
| | | | $V_{GS}$ = 2.5 V, $I_D$ = 3.5 A | — | 26 | 40 | |
| | | | $V_{GS}$ = 4.0 V, $I_D$ = 4.0 A | — | 19 | 30 | |
| Forward transfer admittance | | $\|Y_{fs}\|$ | $V_{DS}$ = 10 V, $I_D$ = 2.5 A | 4.6 | 9.2 | — | S |
| Input capacitance | | $C_{iss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V, f = 1 MHz | — | 1280 | — | pF |
| Reverse transfer capacitance | | $C_{rss}$ | | — | 130 | — | |
| Output capacitance | | $C_{oss}$ | | — | 150 | — | |
| Switching time | Rise time | $t_r$ |   Duty ≦ 1%, $t_w$ = 10 μs | — | 4.5 | — | ns |
| | Turn-ON time | $t_{on}$ | | — | 11 | — | |
| | Fall time | $t_f$ | | — | 7.3 | — | |
| | Turn-OFF time | $t_{off}$ | | — | 33 | — | |
| Total gate charge (gate-source plus gate-drain) | | $Q_g$ | $V_{DD}$ ≃ 16 V, $V_{GS}$ = 5 V, $I_D$ = 5 A | — | 15 | — | nC |
| Gate-source charge 1 | | $Q_{gs1}$ | | — | 3.3 | — | |
| Gate-drain (“miller”) charge | | $Q_{gd}$ | | — | 3.5 | — | |

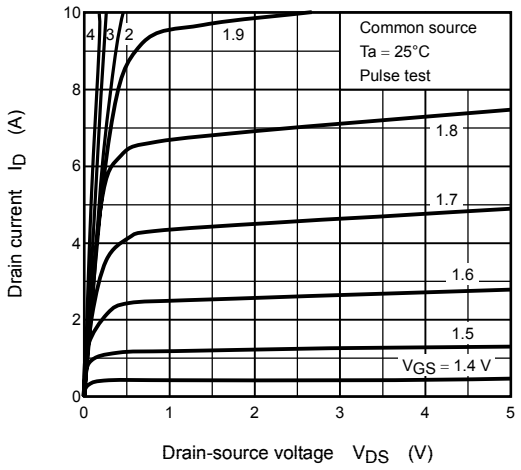
## Source-Drain Ratings and Characteristics (Ta = 25°C)

| Characteristics | | 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 A, $V_{GS}$ = 0 V | — | — | −1.2 | V |

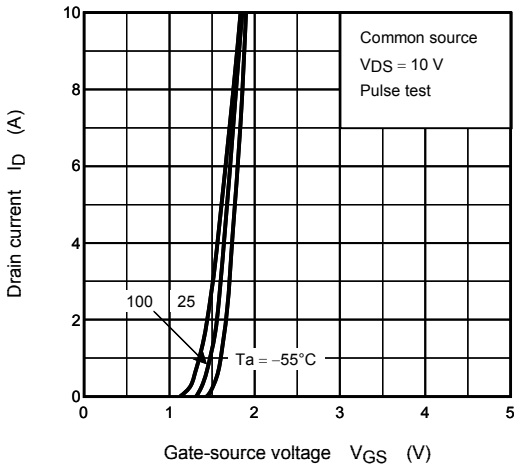
$I_D - V_{DS}$



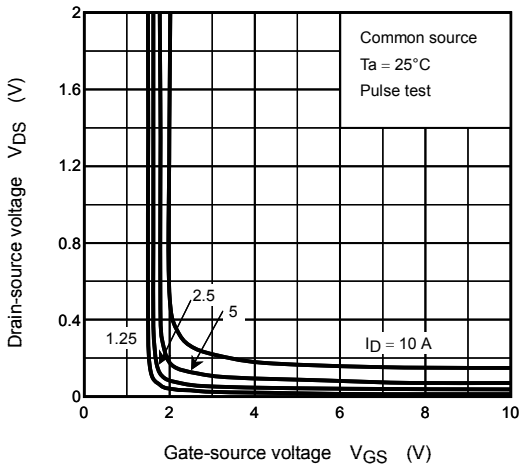

$I_D - V_{DS}$



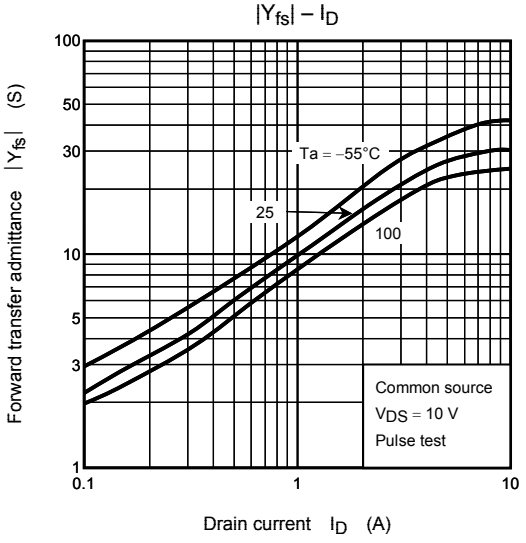

$I_D - V_{GS}$



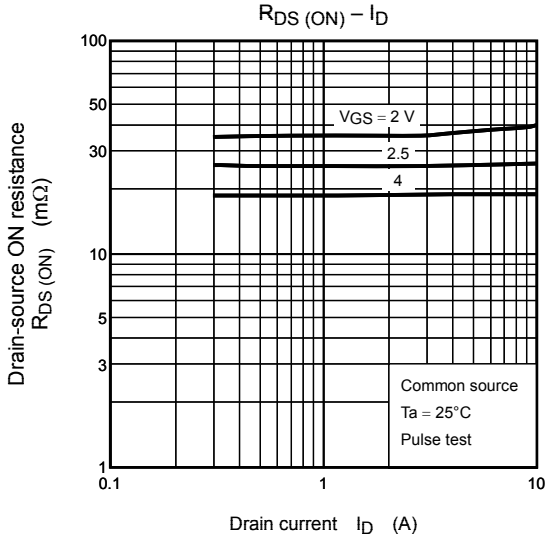

$V_{DS} - V_{GS}$



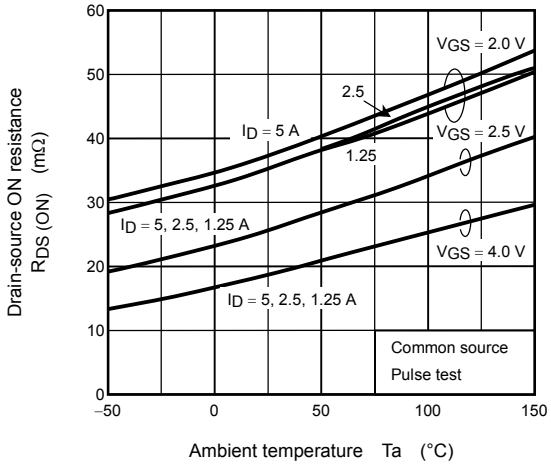

$|Y_{fs}| - I_D$



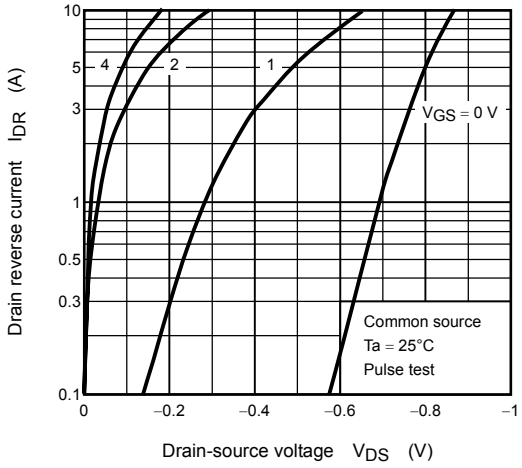

$R_{DS\ (ON)} - I_D$



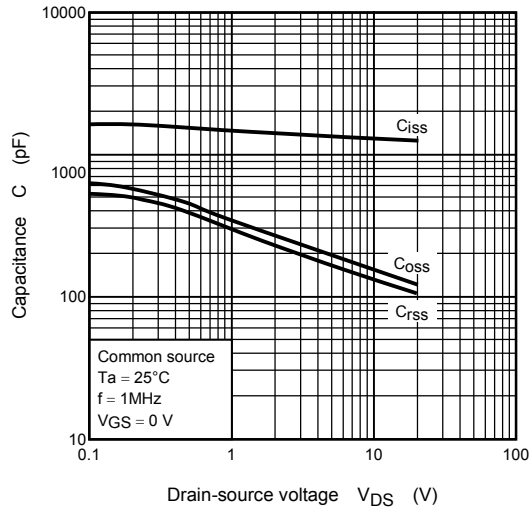
$R_{DS\ (ON)}$ – Ta



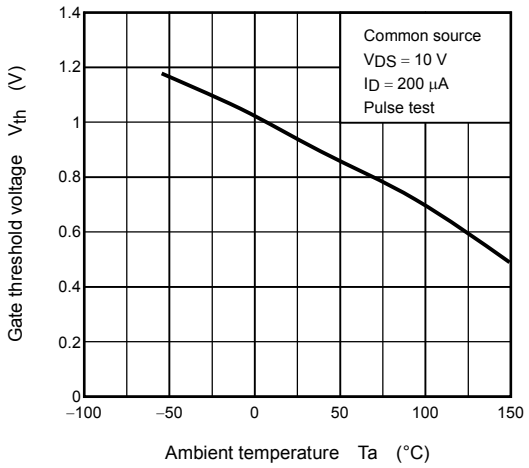

$I_{DR}$ – $V_{DS}$



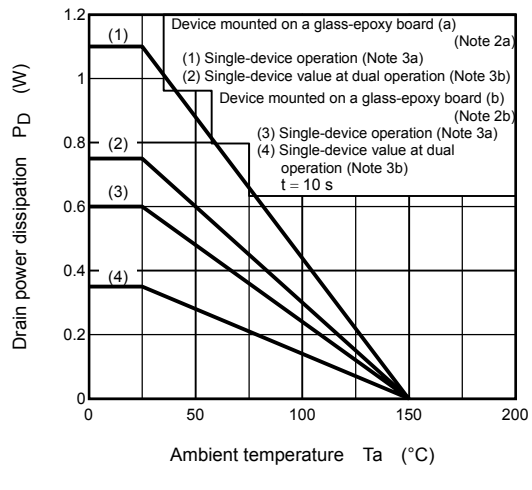

Capacitance – $V_{DS}$



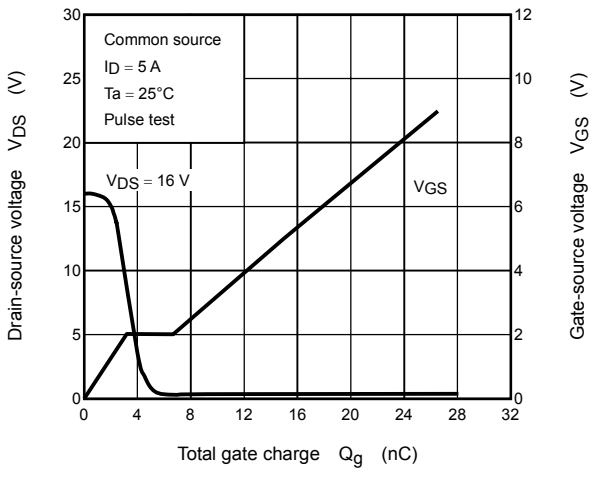

$V_{th}$ – Ta

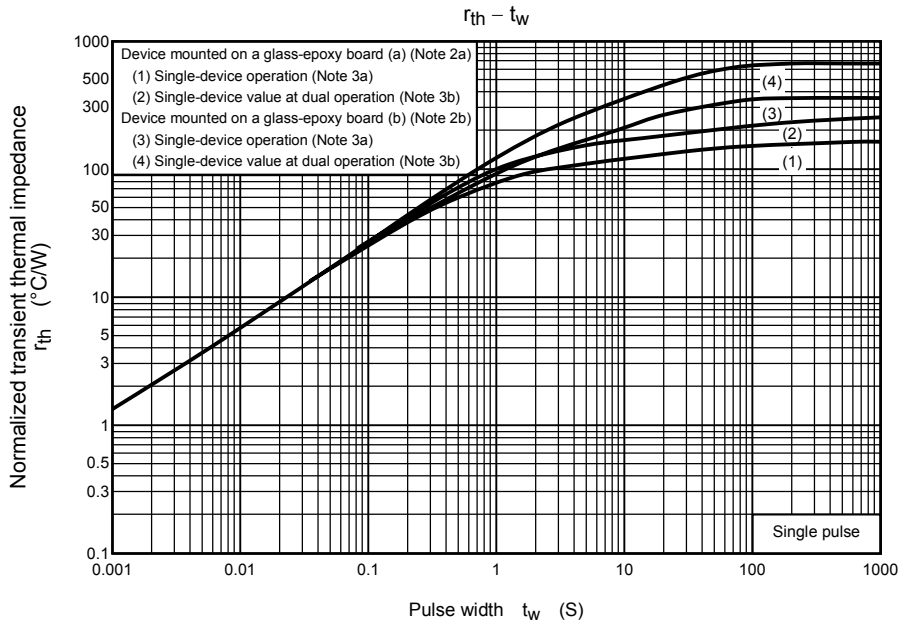


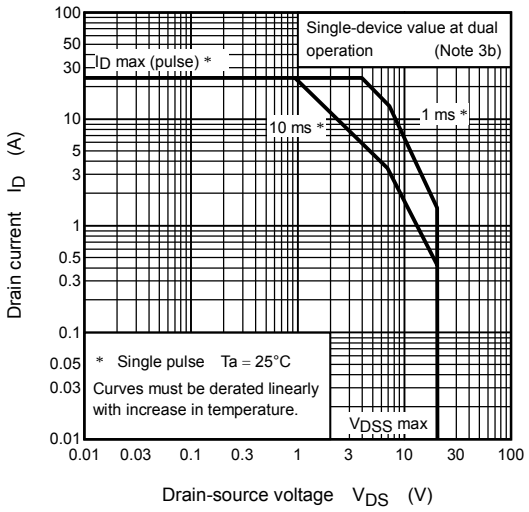

$P_D$ – Ta




Dynamic input/output characteristics




$r_{th} - t_w$
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)
(1)
(2)
(3)
(4)
Single pulse
Normalized transient thermal impedance $r_{th}$ (°C/W)
Pulse width $t_w$ (S)
1000
500
300
100
50
30
10
5
3
1
0.5
0.3
0.1
0.001
0.01
0.1
1
10
100
1000


Single-device value at dual operation (Note 3b)
$I_D$ max (pulse) *
10 ms *
1 ms *
* Single pulse Ta = 25°C
Curves must be derated linearly with increase in temperature.
$V_{DSS}$ max
Drain current $I_D$ (A)
Drain-source voltage $V_{DS}$ (V)
100
50
30
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
0.01
0.03
0.1
0.3
1
3
10
30
100

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