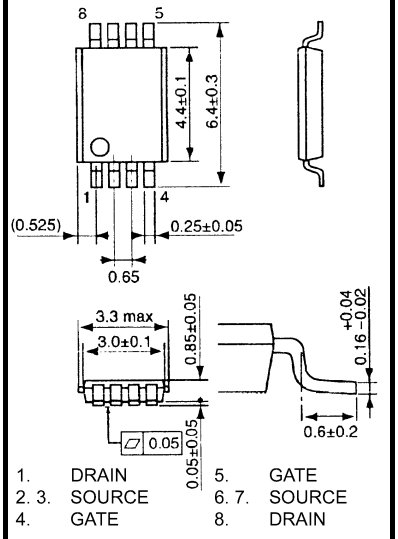
TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type (U-MOSⅣ)

TPCS8213

Lithium Ion Battery Applications

- Small footprint due to a small and thin package
- Low drain-source ON-resistance: $R_{DS\ (ON)}$ = 8.4 mΩ (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 13 S (typ.)
- Low leakage current: I_{DSS} = 10 μA (max) (V_{DS} = 20 V)
- Enhancement-mode: V_{th} = 0.5~1.4 V (V_{DS} = 10 V, I_D = 200 μA)
- Common drain

Unit: mm



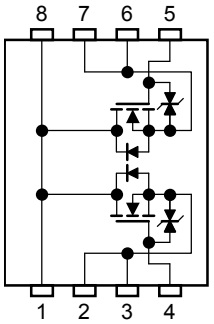
JEDEC	―
JEITA	―
TOSHIBA	2-3R1E

Weight: 0.035 g (typ.)

Absolute Maximum Ratings (Ta = 25°C)

Characteristic		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	6	A
	Pulse (Note 1)	I_{DP}	24	
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}	9.4	mJ
Avalanche current		I_{AR}	6	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

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).

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

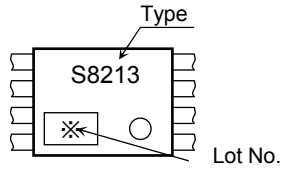
⚠ WARNING

【Handling Precaution for Power MOSFET in use of Protection Circuit for Battery Pack】
Flame-retardant resins of UL94-V0 flammability class are used in packages, however, they are not noncombustible. Use a unit, for example PTC Thermistor, which can shut off the power supply if a short-circuit occurs. If the power supply is not shut off on the occurring short-circuit, a large short-circuit current will flow continuously, which may cause the device to catch fire or smoke.

Thermal Characteristics

Characteristic		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	

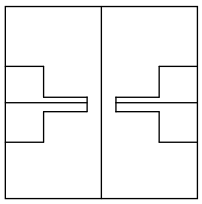
Marking (Note 6)



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

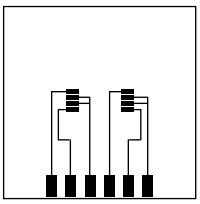
Note 2:

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 applied to one device only.)

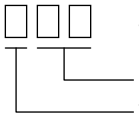
b) The power dissipation and thermal resistance values are shown for a single device. (During dual operation, power is applied to both devices evenly.)

Note 4: V_{DD} = 16 V, T_{ch} = 25°C (initial), L = 0.2 mH, R_G = 25 Ω, I_{AR} = 6 A

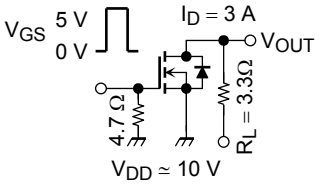
Note 5: Repetitive rating: pulse width limited by max channel temperature

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

* Weekly code (three digits):



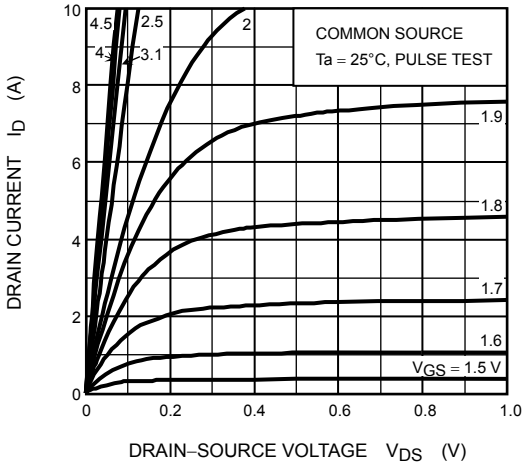
Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±10 V, V_{DS} = 0 V	—	—	±10	μA
Drain cutoff 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	—	1.4	V
Drain-source ON-resistance		$R_{DS\ (ON)}$	V_{GS} = 2.5 V, I_D = 4.2 A	—	11	18	mΩ
			V_{GS} = 4.0 V, I_D = 4.8 A	—	8.7	13	
			V_{GS} = 4.5 V, I_D = 4.8 A	—	8.4	12	
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = 10 V, I_D = 3.0 A	6.5	13	—	S
Input capacitance		C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	3140	—	pF
Reverse transfer capacitance		C_{rss}		—	385	—	
Output capacitance		C_{oss}		—	425	—	
Switching time	Rise time	t_r		—	20	—	ns
	Turn-on time	t_{on}		—	30	—	
	Fall time	t_f		—	23	—	
	Turn-off time	t_{off}		—	84	—	
Total gate charge (gate-source plus gate-drain)		Q_g	V_{DD} ≃ 16 V, V_{GS} = 5 V, I_D = 6 A	—	49	—	nC
Gate-source charge 1		Q_{gs1}		—	6	—	
Gate-drain (“Miller”) charge		Q_{gd}		—	13	—	

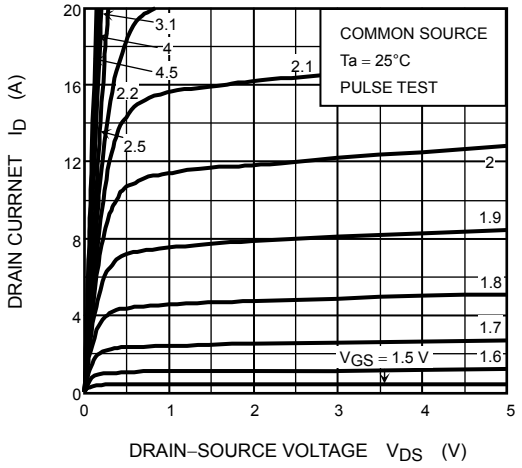
Source-Drain Ratings and Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Drain reverse current	Pulse (Note 1)	I_{DRP}	—	—	—	24	A
Forward voltage (diode)		V_{DSF}	I_{DR} = 6 A, V_{GS} = 0 V	—	—	−1.2	V

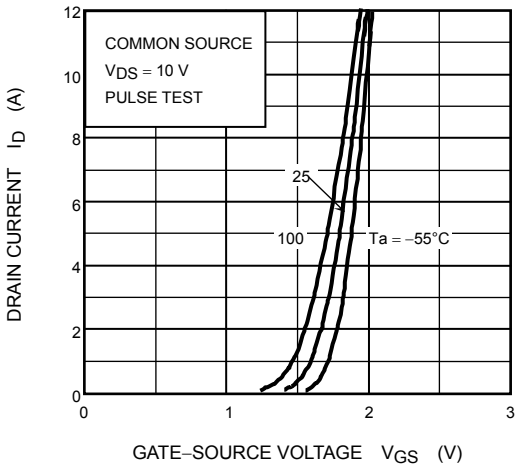
$I_D - V_{DS}$



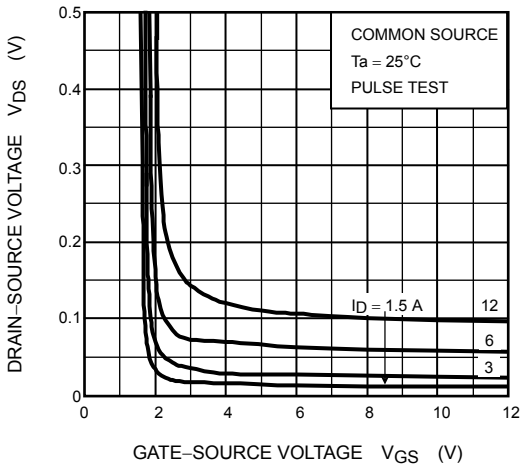
$I_D - V_{DS}$



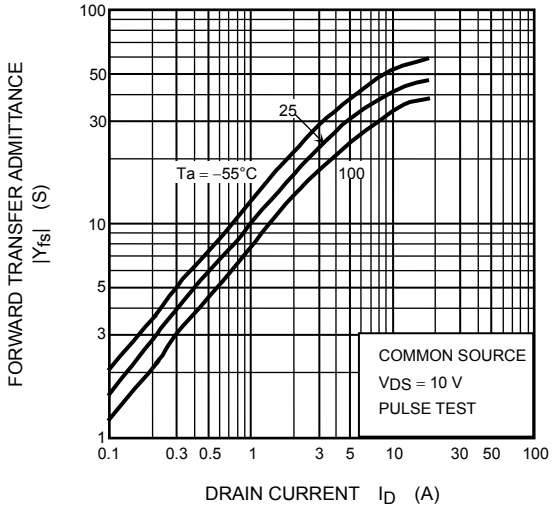
$I_D - V_{GS}$



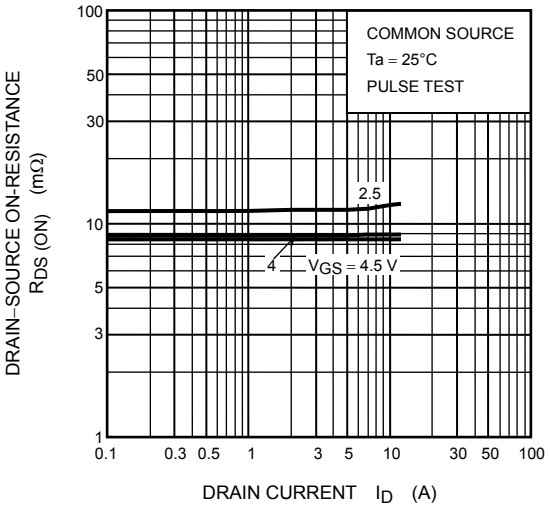
$V_{DS} - V_{GS}$



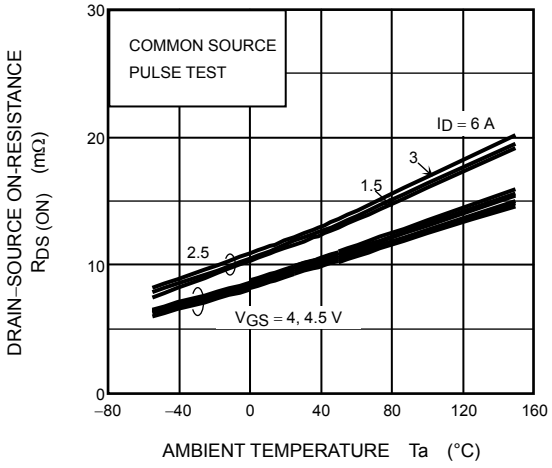
$|Y_{fs}| - I_D$



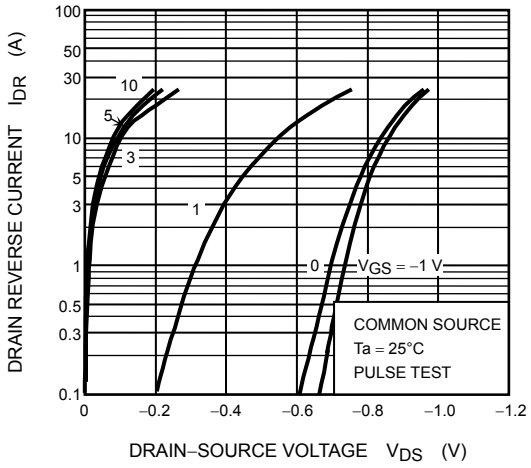
$R_{DS\ (ON)} - I_D$



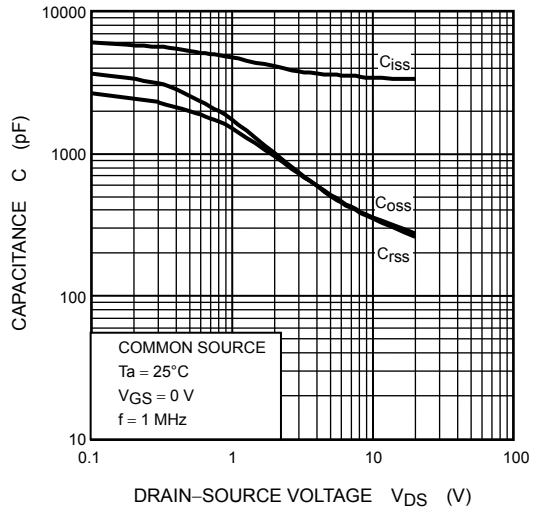
$R_{DS\ (ON)}$ – Ta



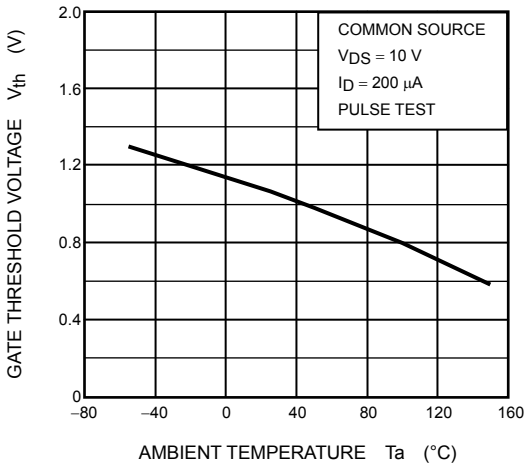
I_{DR} – V_{DS}



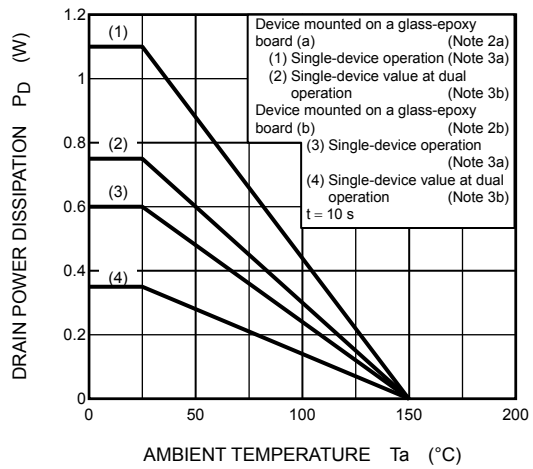
C – V_{DS}



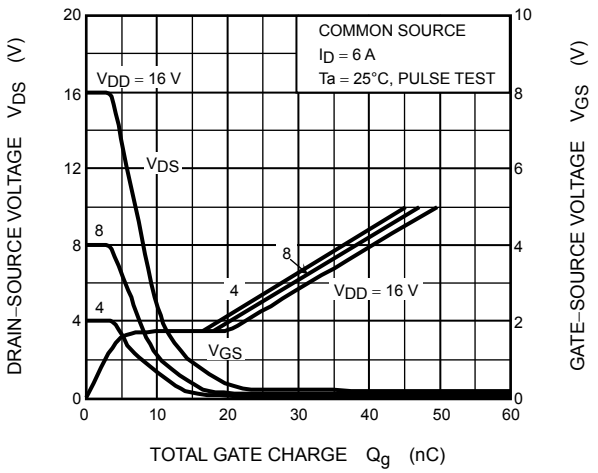
V_{th} – Ta



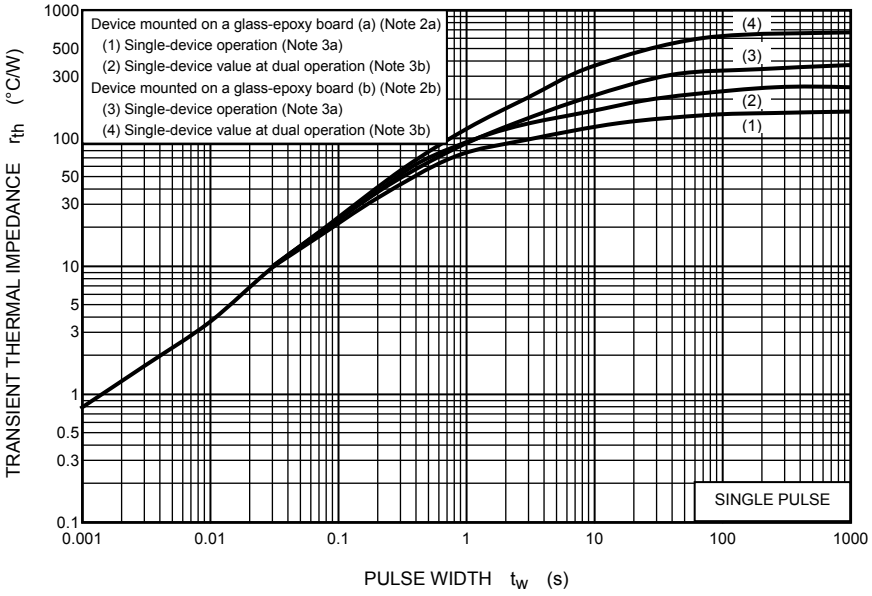
P_D – Ta



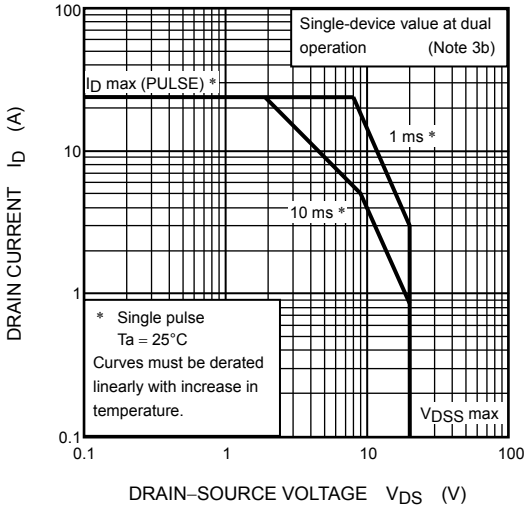
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



$r_{th} - t_w$



SAFE OPERATING AREA



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