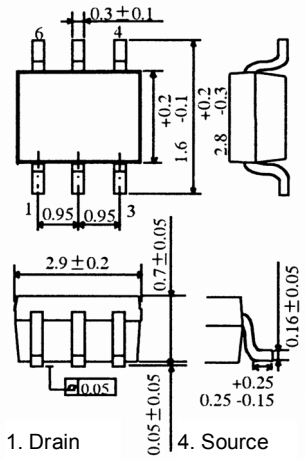
TOSHIBA Field Effect Transistor Silicon P Channel MOS Type (Ultra-High-Speed U-MOSIII)

TPC6109-H

High-Efficiency DC/DC Converter Applications

- Small footprint due to small and thin package
- Low drain-source ON-resistance: $R_{DS\ (ON)}$ = 44 mΩ (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 8.0 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 = −1 mA)

Unit: mm



JEDEC	―
JEITA	―
TOSHIBA	2-3T1A

Weight: 0.011 g (typ.)

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}	±20	V
Drain current	DC (Note 1)	I_D	−5	A
	Pulse (Note 1)	I_{DP}	−20	
Drain power dissipation (t = 5 s) (Note 2a)		P_D	2.2	W
Drain power dissipation (t = 5 s) (Note 2b)		P_D	0.7	
Single-pulse avalanche energy (Note 3)		E_{AS}	16.3	mJ
Avalanche current		I_{AR}	−5	A
Repetitive avalanche energy Single-device value at dual operation (Note 4)		E_{AR}	0.055	mJ
Channel temperature		T_{ch}	150	°C
Storage temperature range		T_{stg}	−55 to150	°C

Note: 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).

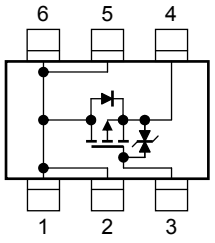
Thermal Characteristics

Characteristics	Symbol	Max	Unit
Thermal resistance, channel to ambient (t = 5 s) (Note 2a)	$R_{th\ (ch\text{-}a)}$	56.8	°C/W
Thermal resistance, channel to ambient (t = 5 s) (Note 2b)	$R_{th\ (ch\text{-}a)}$	178.5	°C/W

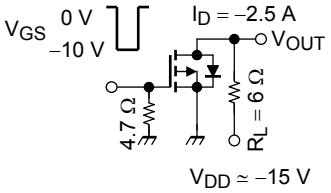
Note: For Notes 1 to 5, see page 3.

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

Circuit Configuration



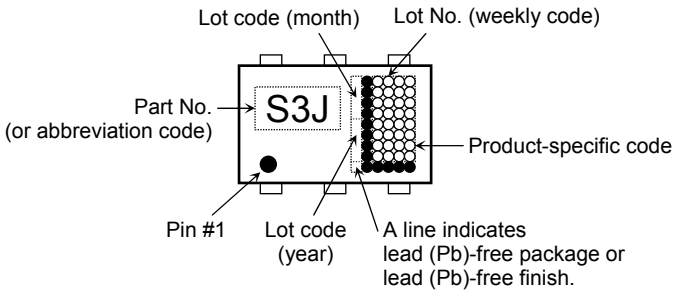
Electrical Characteristics (Ta = 25°C)

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	−0.8	—	−2.0	V
Drain-source ON resistance		$R_{DS\ (ON)}$	V_{GS} = −4.5 V, I_D = −2.5 A	—	64	83	mΩ
		$R_{DS\ (ON)}$	V_{GS} = −10 V, I_D = −2.5 A	—	44	59	
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = −10 V, I_D = −2.5 A	4.0	8.0	—	S
Input capacitance		C_{iss}	V_{DS} = −10 V, V_{GS} = 0 V, f = 1 MHz	—	490	—	pF
Reverse transfer capacitance		C_{rss}		—	105	—	
Output capacitance		C_{oss}		—	150	—	
Switching time	Rise time	t_r	 Duty ≦ 1%, t_w = 10 μs	—	5.1	—	ns
	Turn-on time	t_{on}		—	10.7	—	
	Fall time	t_f		—	8.0	—	
	Turn-off time	t_{off}		—	33.5	—	
Total gate charge (gate-source plus gate-drain)		Q_g	V_{DD} ≃ −24 V, V_{GS} = −10 V, I_D = −5 A	—	12.3	—	nC
			V_{DD} ≃ −24 V, V_{GS} = −5 V, I_D = −5 A	—	7.2	—	
Gate-source charge1		Q_{gs1}	V_{DD} ≃ −24 V, V_{GS} = −10 V, I_D = −5 A	—	1.7	—	
Gate-drain (“Miller”) charge		Q_{gd}		—	3.6	—	
Gate switch charge		Q_{SW}		—	4.8	—	

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

Characteristic		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

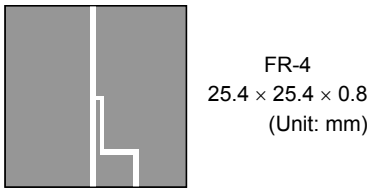
Marking (Note 5)



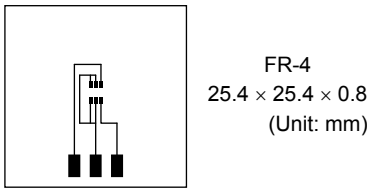
Note 1: Ensure that the channel temperature does not exceed 150℃.

Note 2: (a) Device mounted on a glass-epoxy board (a) (t = 5 s)

(b) Device mounted on a glass-epoxy board (b) (t = 5 s)



(a)



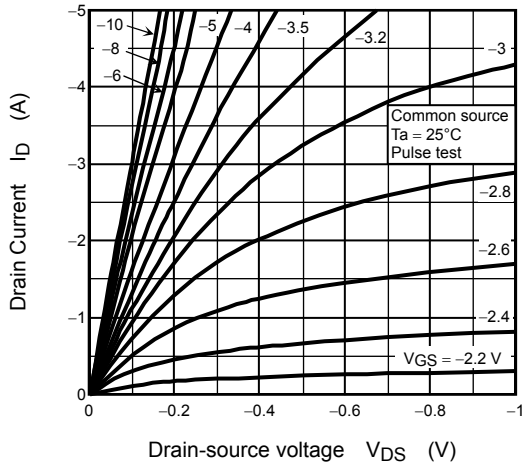
(b)

Note 3: V_{DD} = −24 V, T_{ch} = 25°C (initial), L = 500 μH, R_G = 25 Ω, I_{AR} = -5 A

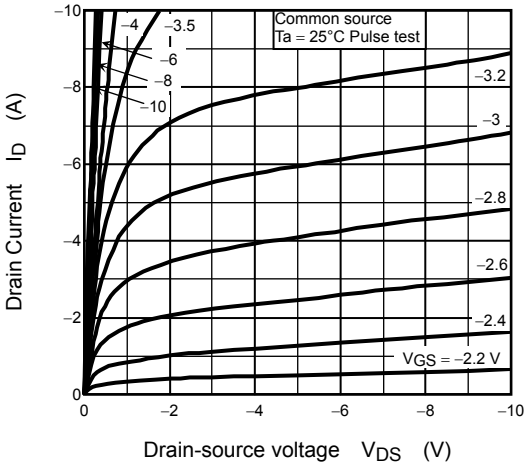
Note 4: Repetitive rating: pulse width limited by max channel temperature

Note 5: ● to the lower left of the Part No. marking indicates Pin 1.

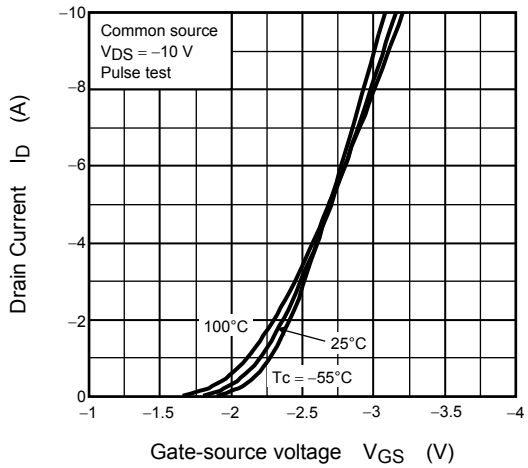
$I_D - V_{DS}$



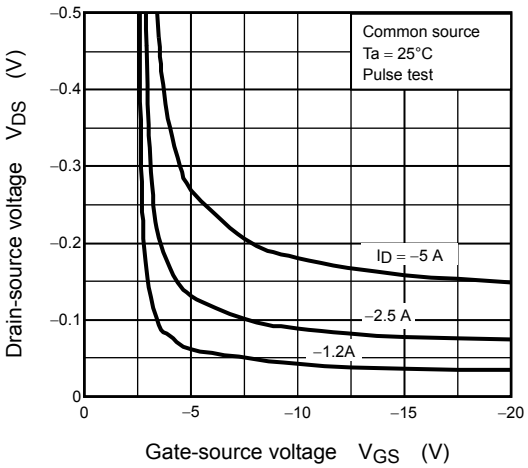
$I_D - V_{DS}$



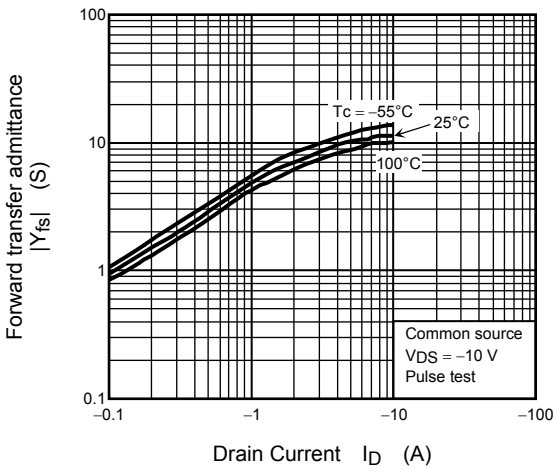
$I_D - V_{GS}$



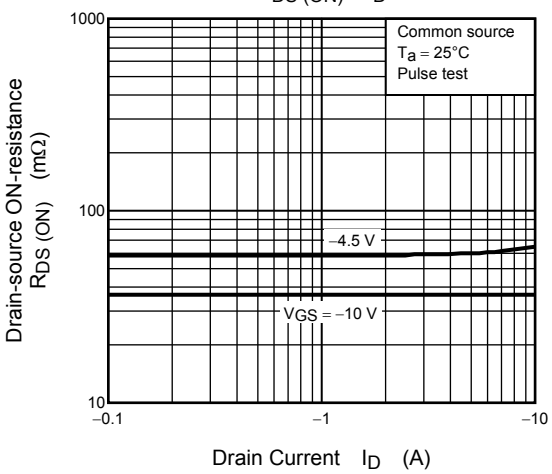
$V_{DS} - V_{GS}$



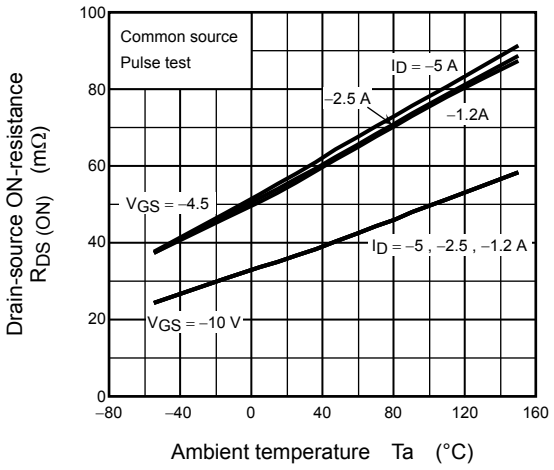
$|Y_{fs}| - I_D$



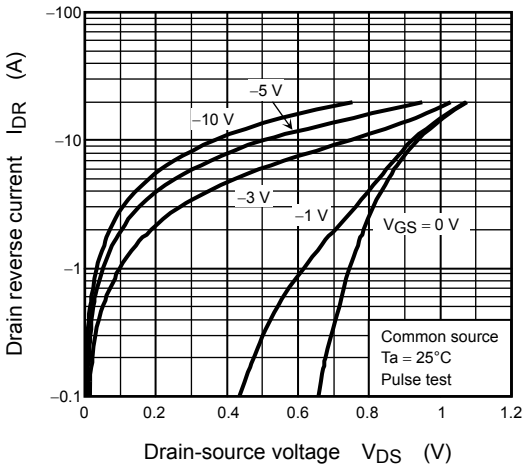
$R_{DS\ (ON)} - I_D$



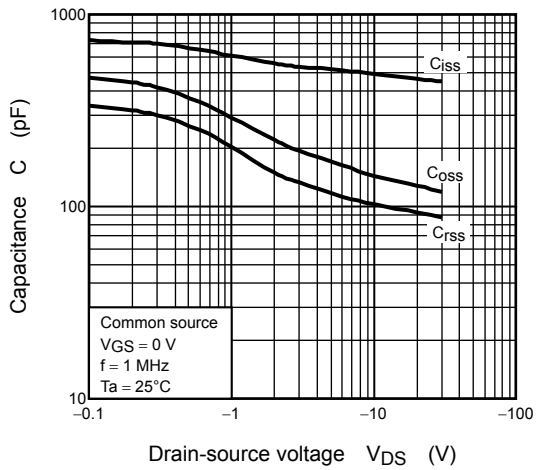
$R_{DS\ (ON)}$ – Ta



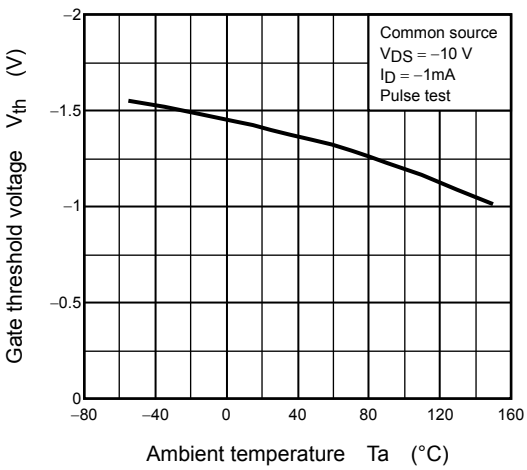
I_{DR} – V_{DS}



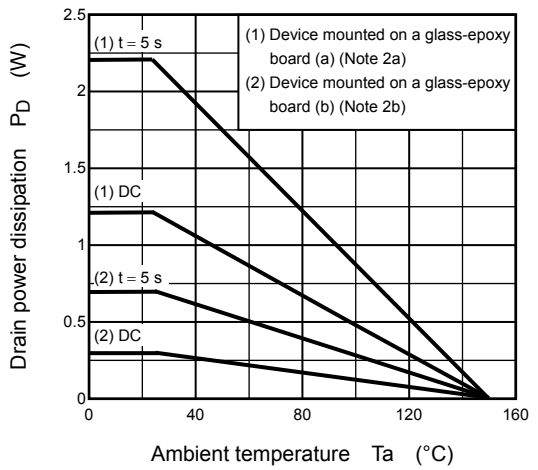
Capacitance – V_{DS}



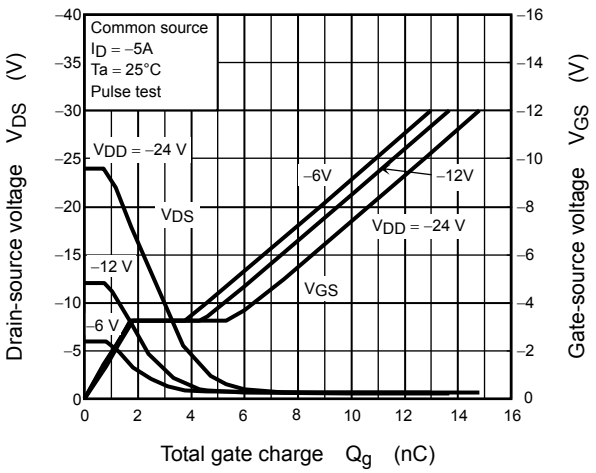
V_{th} – Ta

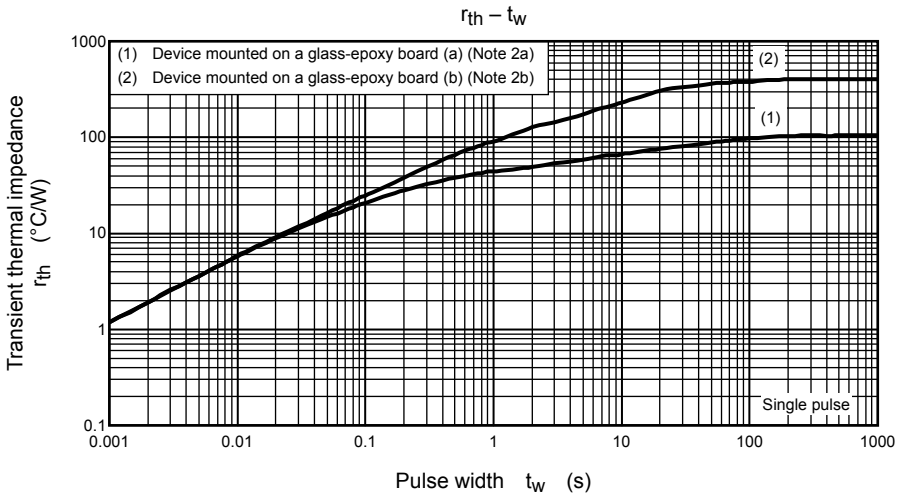


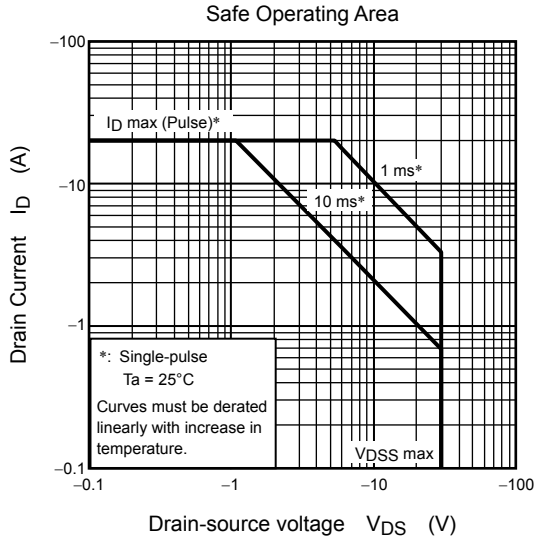
P_D – Ta



Dynamic input/output characteristics




$r_{th} - t_w$
(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 r_{th} (°C/W)
1000
100
10
1
0.1
0.001
0.01
0.1
1
10
100
1000
Pulse width t_w (s)


Safe Operating Area
I_D max (Pulse)*
1 ms*
10 ms*
*: Single-pulse
Ta = 25°C
Curves must be derated linearly with increase in temperature.
V_{DSS} max
Drain Current I_D (A)
−100
−10
−1
−0.1
−0.1
−1
−10
−100
Drain-source voltage V_{DS} (V)

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