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TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type ( $\pi$ -MOS VI)

# 2SK4108

## Switching Regulator Applications

- Low drain-source ON resistance :  $R_{DS(ON)} = 0.21\Omega$  (typ.)
- High forward transfer admittance :  $|Y_{fs}| = 14\text{ S}$  (typ.)
- Low leakage current :  $I_{DSS} = 100\ \mu\text{A}$  (max) ( $V_{DS} = 500\text{ V}$ )
- Enhancement mode :  $V_{th} = 2.0\sim 4.0\text{ V}$  ( $V_{DS} = 10\text{ V}$ ,  $I_D = 1\text{ mA}$ )

## Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Characteristic	Symbol	Rating	Unit
Drain-source voltage	$V_{DSS}$	500	V
Drain-gate voltage ( $R_{GS} = 20\text{ k}\Omega$ )	$V_{DGR}$	500	V
Gate-source voltage	$V_{GSS}$	$\pm 30$	V
Drain current	DC (Note 1)	$I_D$	20 A
	Pulse (Note 1)	$I_{DP}$	80 A
Drain power dissipation ( $T_c = 25^\circ\text{C}$ )	$P_D$	150	W
Single-pulse avalanche energy (Note 2)	$E_{AS}$	960	mJ
Avalanche current	$I_{AR}$	20	A
Repetitive avalanche energy (Note 3)	$E_{AR}$	15	mJ
Channel temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage temperature range	$T_{stg}$	$-55\sim 150$	$^\circ\text{C}$

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

Characteristic	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th(ch-c)}$	0.833	$^\circ\text{C} / \text{W}$
Thermal resistance, channel to ambient	$R_{th(ch-a)}$	50	$^\circ\text{C} / \text{W}$

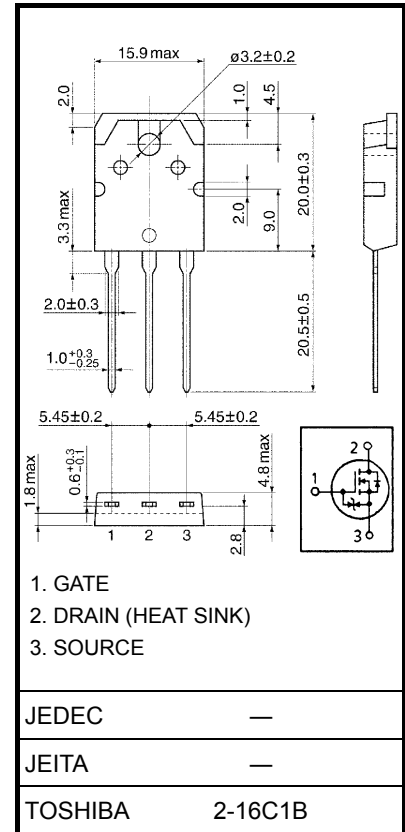
Note 1: Ensure that the channel temperature does not exceed  $150^\circ\text{C}$ .

Note 2:  $V_{DD} = 90\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 4.08\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 20\text{ A}$

Note 3: Repetitive rating: pulse width limited by maximum channel temperature

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

Unit: mm



Weight: 4.6 g (typ.)

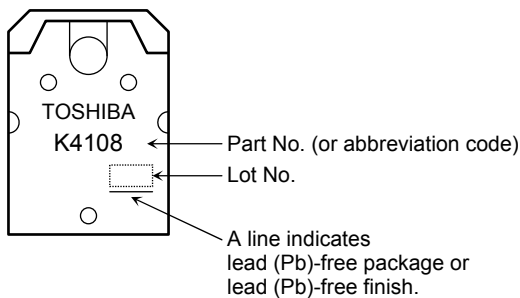
## Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 25 \text{ V}, V_{DS} = 0 \text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Gate-source breakdown voltage		$V_{(BR)GSS}$	$I_G = \pm 10 \mu\text{A}, V_{DS} = 0 \text{ V}$	$\pm 30$	—	—	V
Drain cutoff current		$I_{DSS}$	$V_{DS} = 500 \text{ V}, V_{GS} = 0 \text{ V}$	—	—	100	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}$	500	—	—	V
Gate threshold voltage		$V_{th}$	$V_{DS} = 10 \text{ V}, I_D = 1 \text{ mA}$	2.0	—	4.0	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = 10 \text{ V}, I_D = 10 \text{ A}$	—	0.21	0.27	$\Omega$
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10 \text{ V}, I_D = 10 \text{ A}$	4.0	14	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	—	3400	—	pF
Reverse transfer capacitance		$C_{rss}$		—	25	—	
Output capacitance		$C_{oss}$		—	320	—	
Switching time	Rise time	$t_r$	<p><math>V_{GS} = 10 \text{ V}, 0 \text{ V}</math>  <math>I_D = 10 \text{ A}</math>  <math>R_L = 20 \Omega</math>  <math>V_{DD} \approx 200 \text{ V}</math>                      Duty <math>\leq 1\%</math>, <math>t_w = 10 \mu\text{s}</math></p>	—	70	—	ns
	Turn on time	$t_{on}$		—	130	—	
	Fall time	$t_f$		—	70	—	
	Turn off time	$t_{off}$		—	280	—	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 400 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 20 \text{ A}$	—	70	—	nC
Gate-source charge		$Q_{gs}$		—	45	—	
Gate-drain ("Miller") charge		$Q_{gd}$		—	25	—	

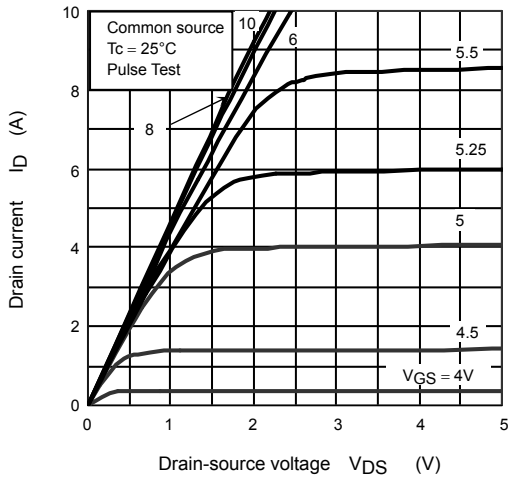
## Source-Drain Ratings and Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	$I_{DR}$	—	—	—	20	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	80	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 20 \text{ A}, V_{GS} = 0 \text{ V}$	—	—	-1.7	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 20 \text{ A}, V_{GS} = 0 \text{ V}$	—	1300	—	ns
Reverse recovery charge	$Q_{rr}$	$dI_{DR} / dt = 100 \text{ A} / \mu\text{s}$	—	20	—	$\mu\text{C}$

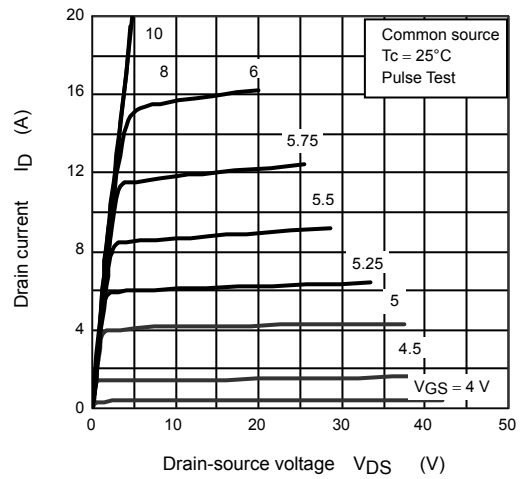
## Marking



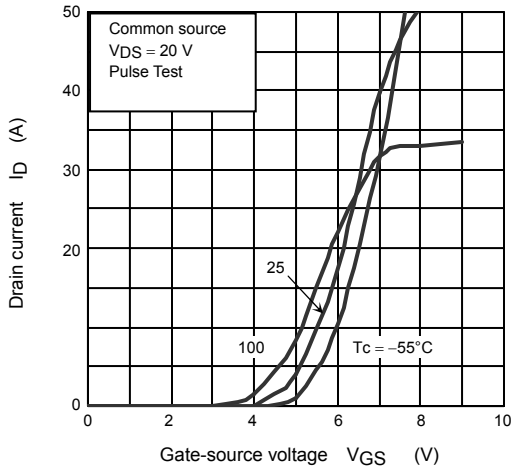
$I_D - V_{DS}$



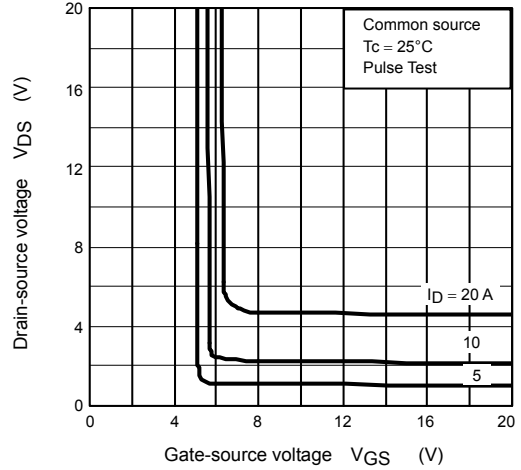
$I_D - V_{DS}$



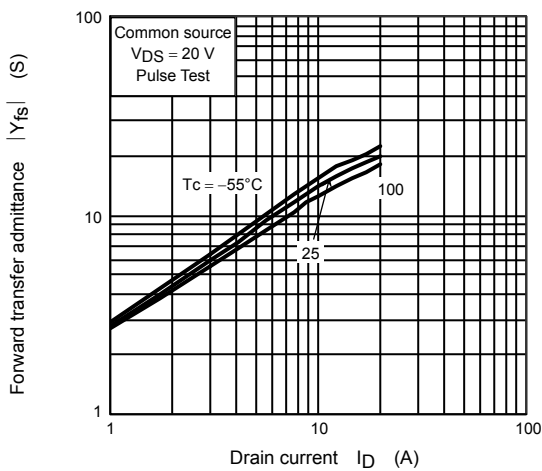
$I_D - V_{GS}$



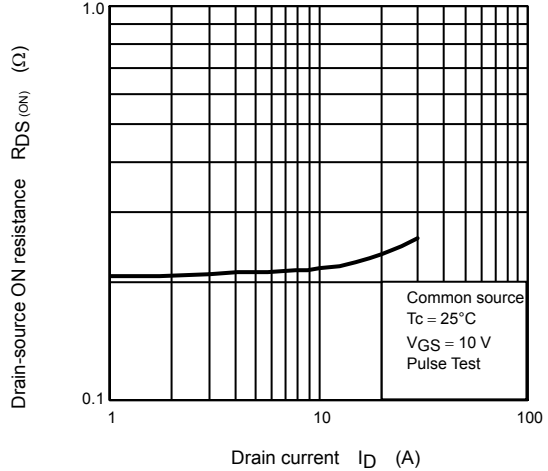
$V_{DS} - V_{GS}$

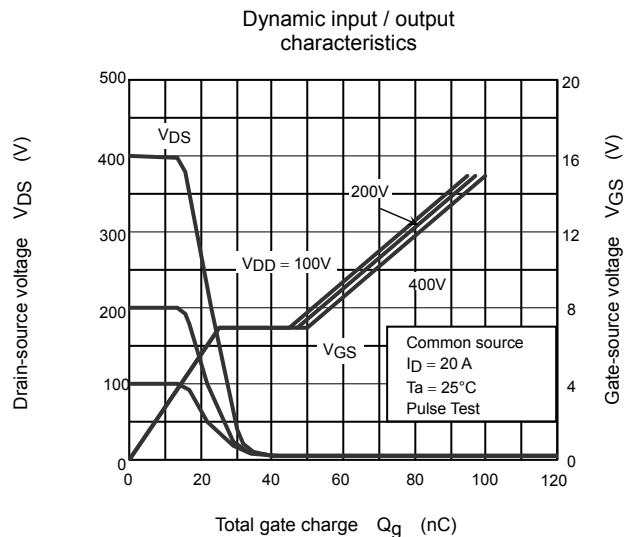
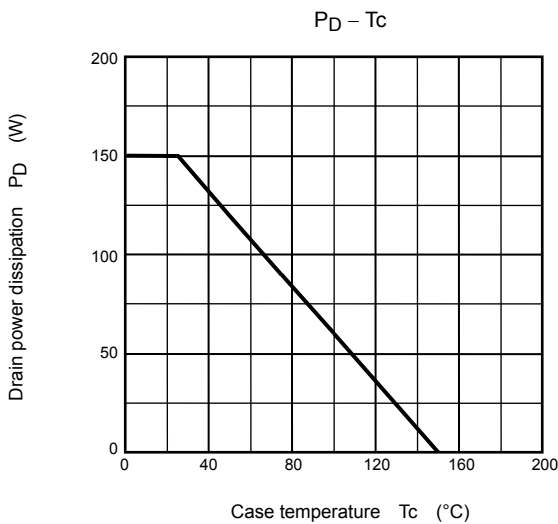
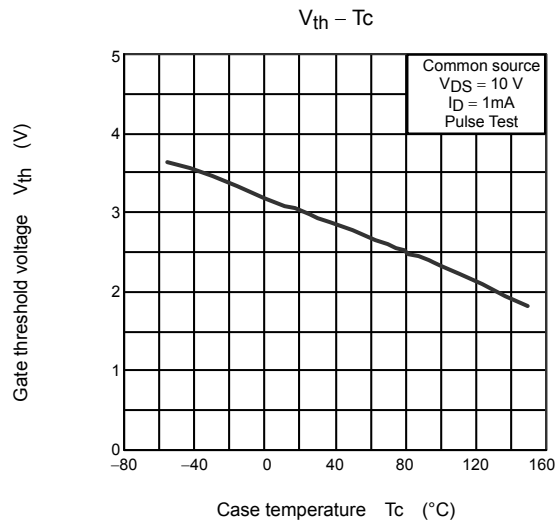
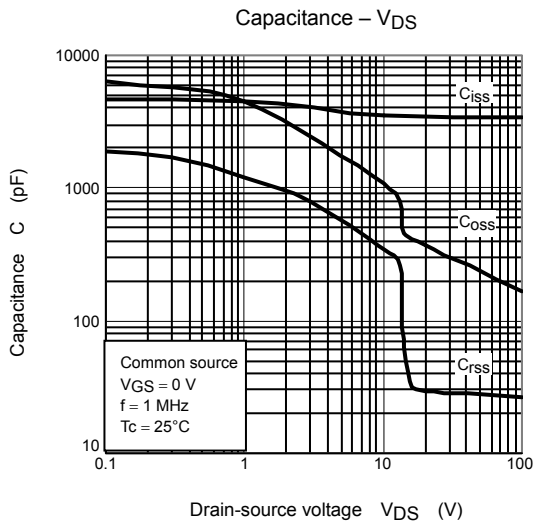
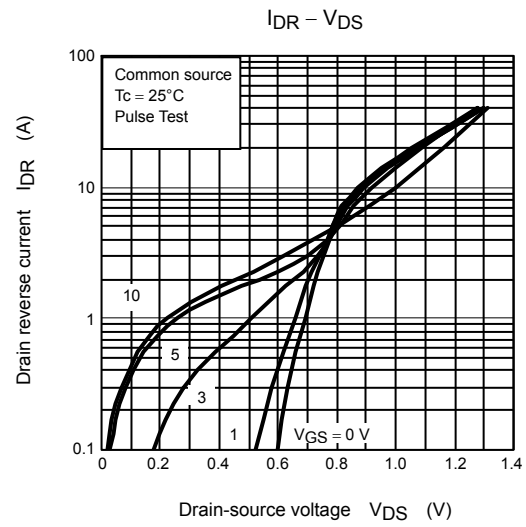
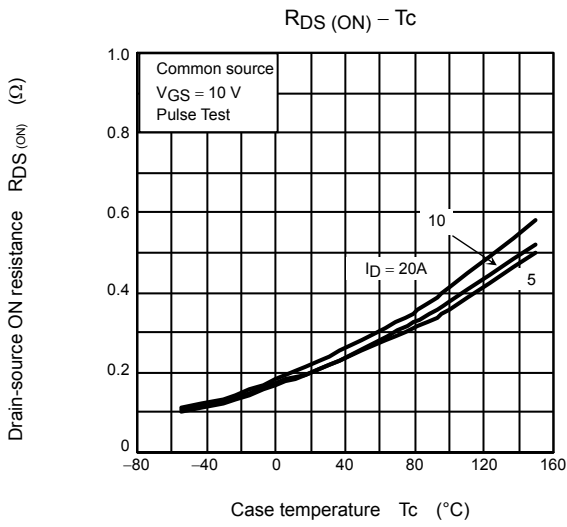


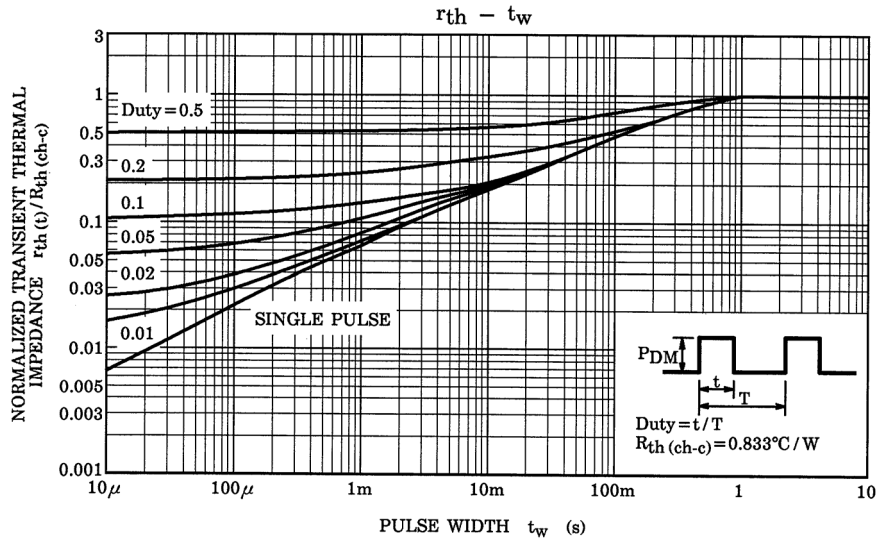
$|Y_{fs}| - I_D$



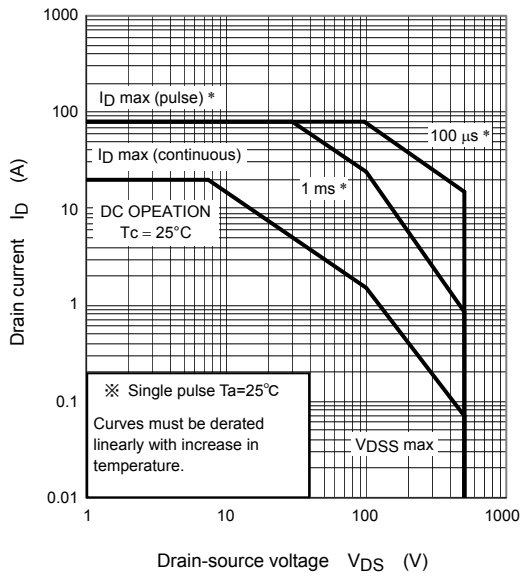
$R_{DS(ON)} - I_D$



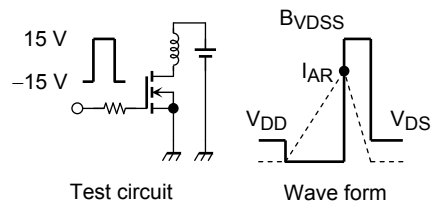
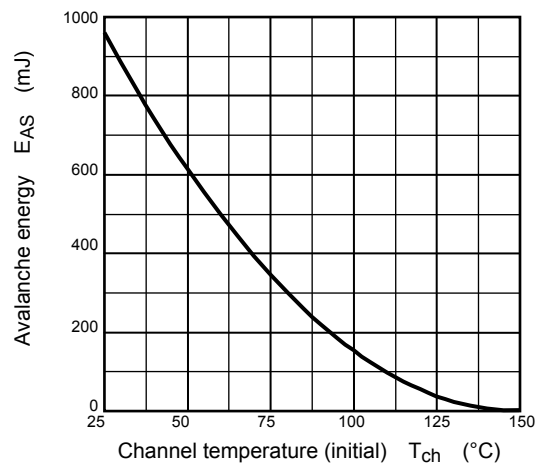




SAFE OPERATING AREA



$E_{AS} - T_{ch}$



$R_G = 25 \Omega$   
 $V_{DD} = 90 \text{ V}, L = 4.08 \text{ mH}$

$$E_{AS} = \frac{1}{2} \cdot L \cdot I^2 \cdot \left( \frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

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20070701-EN

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