

TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type ( $L^2$ - $\pi$ -MOSV)

## 2SK2399

## Chopper Regulator, DC/DC Converter and Motor Drive Applications

- 4 V gate drive
- Low drain-source ON-resistance :  $R_{DS\ (ON)} = 0.17\ \Omega$  (typ.)
- High forward transfer admittance :  $|Y_{fs}| = 4.5\ S$  (typ.)
- Low leakage current :  $I_{DSS} = 100\ \mu A$  (max) ( $V_{DS} = 100\ V$ )
- Enhancement mode :  $V_{th} = 0.8$  to  $2.0\ V$  ( $V_{DS} = 10\ V$ ,  $I_D = 1\ mA$ )

Absolute Maximum Ratings ( $T_a = 25^\circ C$ )

Characteristic	Symbol	Rating	Unit
Drain-source voltage	$V_{DSS}$	100	V
Drain-gate voltage ( $R_{GS} = 20\ k\Omega$ )	$V_{DGR}$	100	V
Gate-source voltage	$V_{GSS}$	$\pm 20$	V
Drain current	DC (Note 1)	$I_D$	A
	Pulse (Note 1)	$I_{DP}$	A
Drain power dissipation ( $T_c = 25^\circ C$ )	$P_D$	20	W
Single-pulse avalanche energy (Note 2)	$E_{AS}$	180	mJ
Avalanche current	$I_{AR}$	5	A
Repetitive avalanche energy (Note 3)	$E_{AR}$	2	mJ
Channel temperature	$T_{ch}$	150	$^\circ C$
Storage temperature range	$T_{stg}$	-55 to 150	$^\circ C$

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

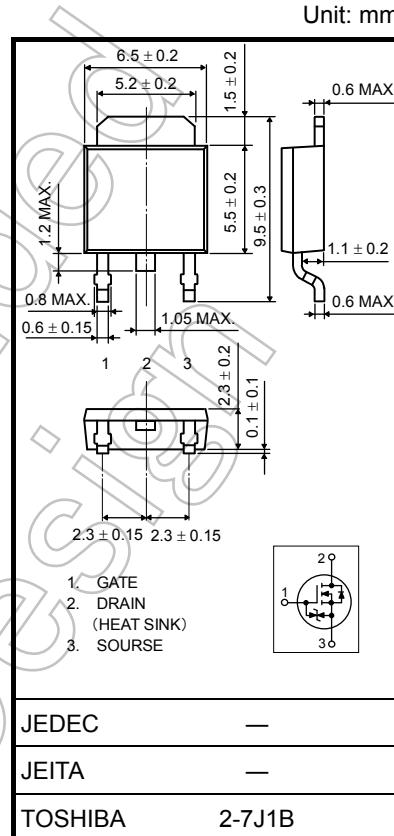
Characteristic	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th\ (ch-c)}$	6.25	$^\circ C / W$
Thermal resistance, channel to ambient	$R_{th\ (ch-a)}$	125	$^\circ C / W$

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

Note 2:  $V_{DD} = 25\ V$ ,  $T_{ch} = 25^\circ C$  (initial),  $L = 11.6\ mH$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 5\ A$

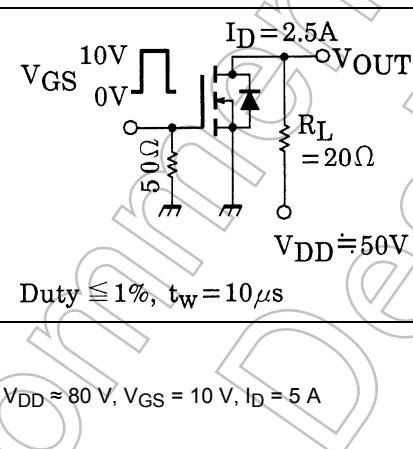
Note 3: Repetitive rating: pulse width limited by maximum channel temperature

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



Weight: 0.36 g (typ.)

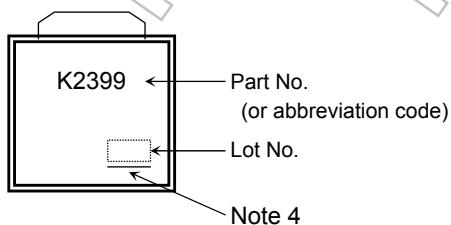
Electrical Characteristics ( $T_a = 25^\circ C$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 16 V, V_{DS} = 0 V$	—	—	$\pm 10$	$\mu A$
Drain cutoff current	$I_{DSS}$	$V_{DS} = 100 V, V_{GS} = 0 V$	—	—	100	$\mu A$
Drain-source breakdown voltage	$V_{(BR) DSS}$	$I_D = 10 mA, V_{GS} = 0 V$	100	—	—	V
Gate threshold voltage	$V_{th}$	$V_{DS} = 10 V, I_D = 1 mA$	0.8	—	2.0	V
Drain-source ON-resistance	$R_{DS (ON)}$	$V_{GS} = 4 V, I_D = 2.5 A$ $V_{GS} = 10 V, I_D = 2.5 A$	— —	0.22 0.17	0.30 0.23	$\Omega$
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 10 V, I_D = 2.5 A$	2.0	4.5	—	S
Input capacitance	$C_{iss}$	$V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz$	—	500	—	pF
Reverse transfer capacitance	$C_{rss}$		—	80	—	
Output capacitance	$C_{oss}$		—	190	—	
Rise time	$t_r$		—	17	—	ns
Turn-on time	$t_{on}$		—	25	—	
Fall time	$t_f$		—	50	—	
Turn-off time	$t_{off}$		—	195	—	
Total gate charge (gate-source plus gate-drain)	$Q_g$	$V_{DD} \approx 80 V, V_{GS} = 10 V, I_D = 5 A$	—	22	—	nC
Gate-source charge	$Q_{gs}$		—	15	—	
Gate-drain ("Miller") charge	$Q_{gd}$		—	7	—	

Source-Drain Ratings and Characteristics ( $T_a = 25^\circ C$ )

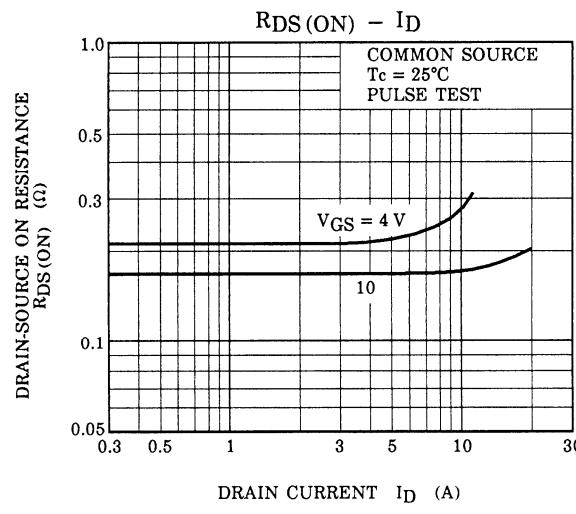
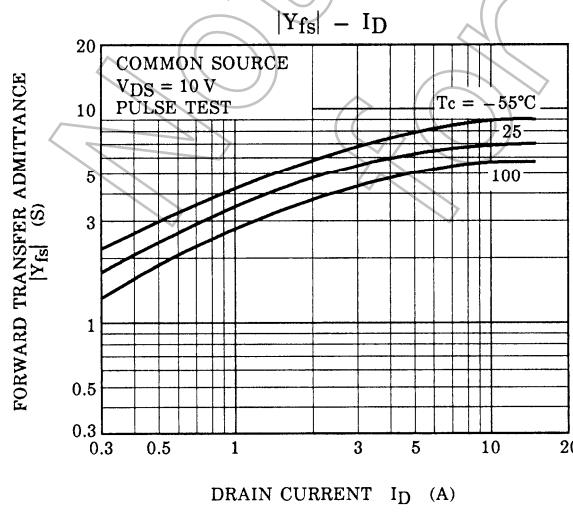
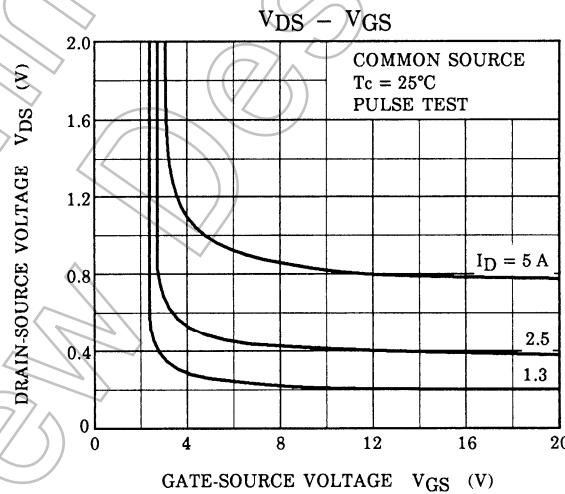
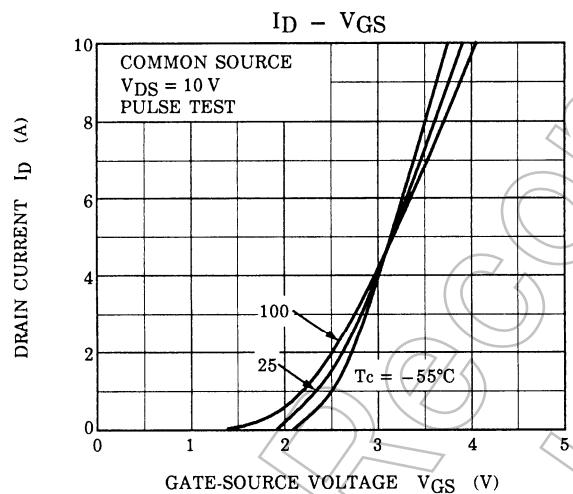
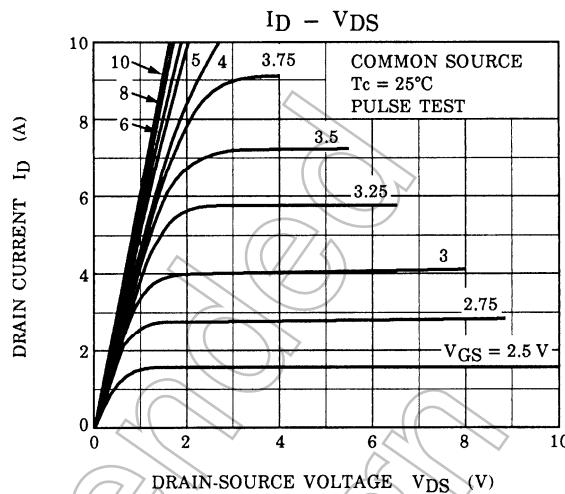
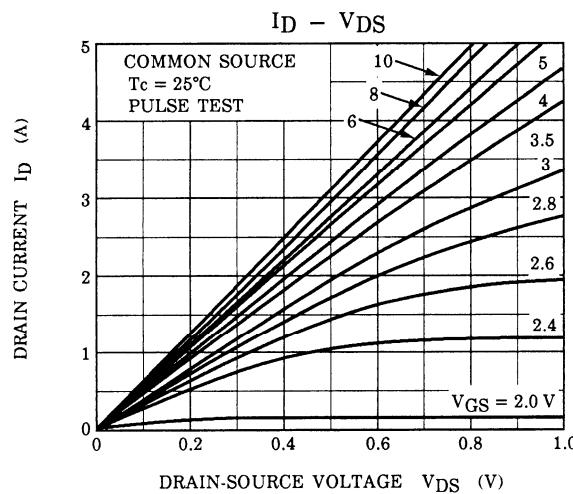
Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	$I_{DR}$	—	—	—	5	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	20	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 5 A, V_{GS} = 0 V$	—	—	-1.7	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 5 A, V_{GS} = 0 V, dI_{DR} / dt = 50 A / \mu s$	—	160	—	ns
Reverse recovery charge	$Q_{rr}$		—	0.28	—	$\mu C$

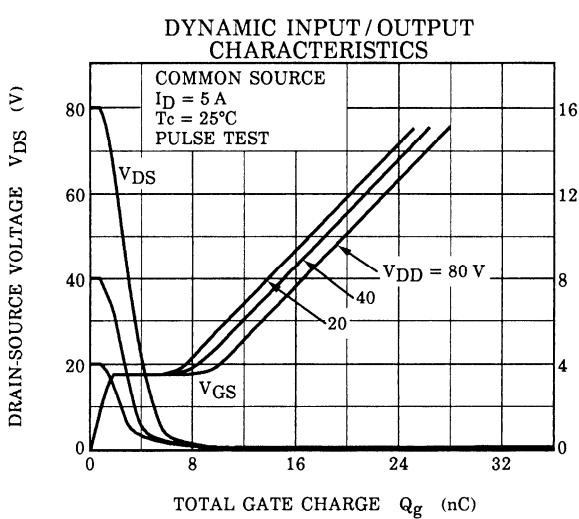
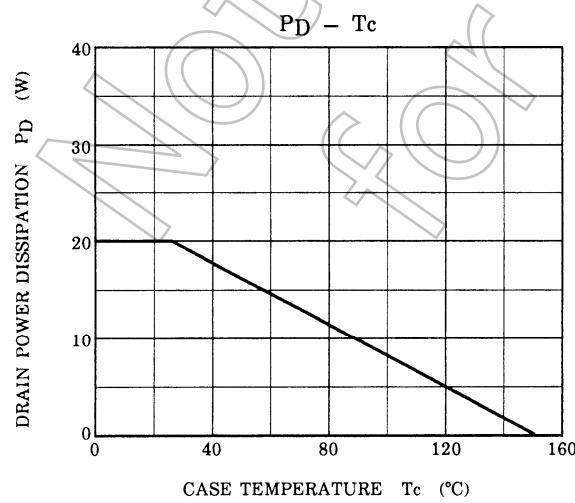
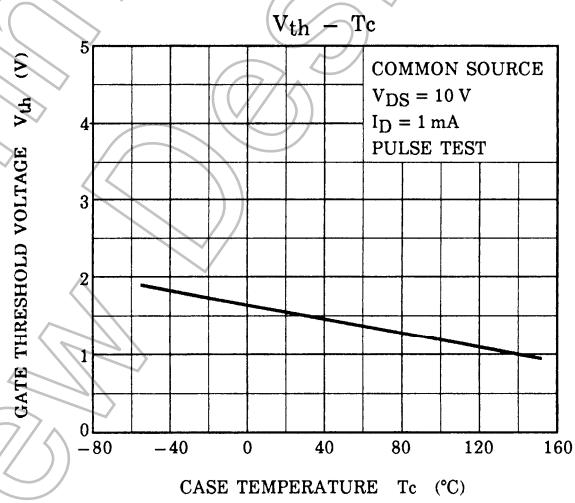
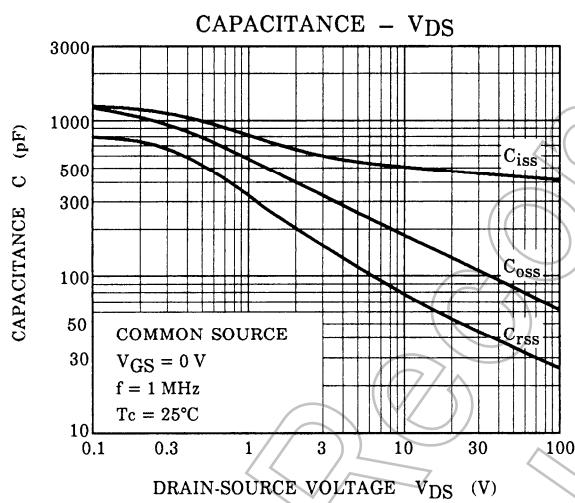
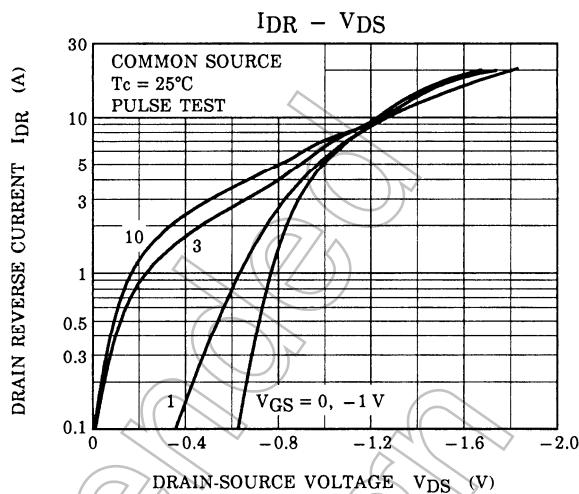
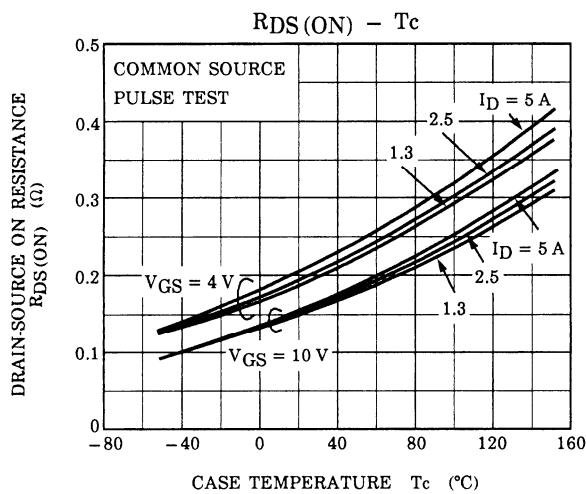
## Marking

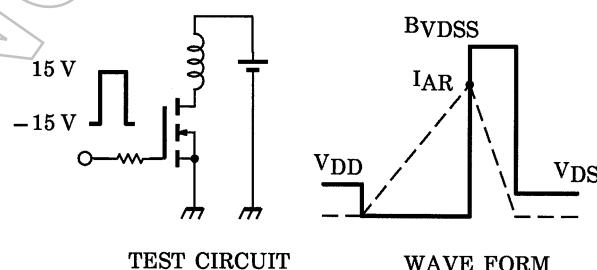
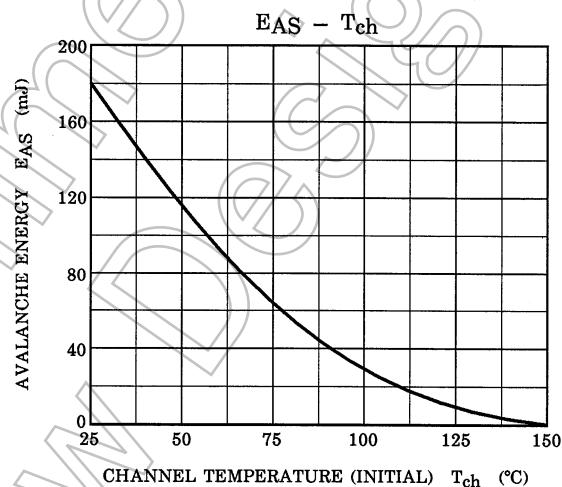
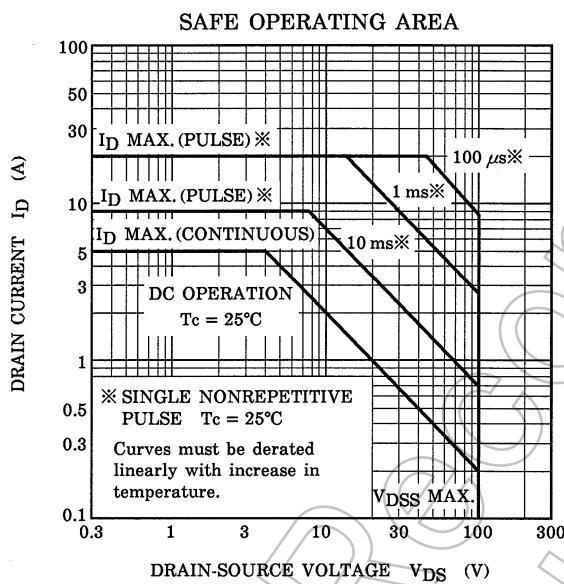
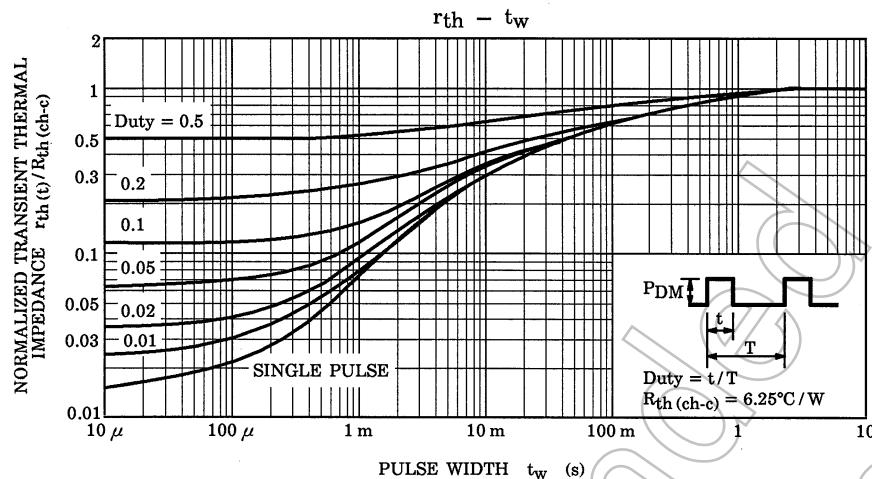


Note 4 : A line under a Lot No. identifies the indication of product Labels  
[[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

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$$R_G = 25 \Omega \quad E_{AS} = \frac{1}{2} \cdot L \cdot I^2 \cdot \left( \frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

$$V_{DD} = 25 \text{ V}, L = 11.6 \text{ mH}$$

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