

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

# 2SK2993

Chopper Regulator, DC-DC Converter and Motor Drive Applications

- Low drain-source ON resistance :  $R_{DS(ON)} = 82 \text{ m}\Omega$  (typ.)
- High forward transfer admittance :  $|Y_{fs}| = 20 \text{ S}$  (typ.)
- Low leakage current :  $I_{DSS} = 100 \mu\text{A}$  (max) ( $V_{DS} = 250 \text{ V}$ )
- Enhancement mode :  $V_{th} = 1.5 \text{ to } 3.5 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

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

Characteristics		Symbol	Rating	Unit
Drain-source voltage		$V_{DSS}$	250	V
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )		$V_{DGR}$	250	V
Gate-source voltage		$V_{GSS}$	$\pm 20$	V
Drain current	DC (Note 1)	$I_D$	20	A
	Pulse (Note 1)	$I_{DP}$	60	
Drain power dissipation ( $T_c = 25^\circ\text{C}$ )		$P_D$	100	W
Single pulse avalanche energy (Note 2)		$E_{AS}$	423	mJ
Avalanche current		$I_{AR}$	20	A
Repetitive avalanche energy (Note 3)		$E_{AR}$	10	mJ
Channel temperature		$T_{ch}$	150	$^\circ\text{C}$
Storage temperature range		$T_{stg}$	-55 to 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

Characteristics	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th(ch-c)}$	1.25	$^\circ\text{C} / \text{W}$
Thermal resistance, channel to ambient	$R_{th(ch-a)}$	83.3	$^\circ\text{C} / \text{W}$

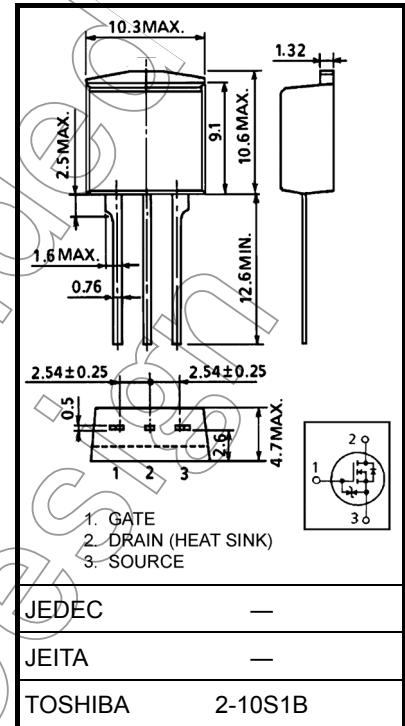
Note 1: Ensure that the channel temperature does not exceed  $150^\circ\text{C}$ .

Note 2:  $V_{DD} = 90 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 1.79 \text{ mH}$ ,  $I_{AR} = 20 \text{ A}$ ,  $R_G = 25 \Omega$

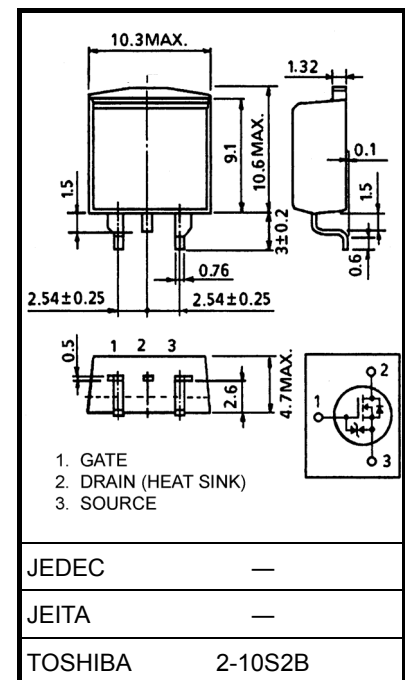
Note 3: Repetitive rating: pulse width limited by maximum channel temperature.

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

Unit: mm



Weight: 1.5 g (typ.)



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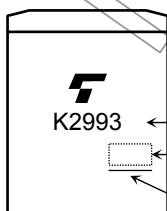
## Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cut-off current		$I_{DSS}$	$V_{DS} = 250\text{ V}, V_{GS} = 0\text{ V}$	—	—	100	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	250	—	—	V
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	1.5	—	3.5	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	—	82	105	$\text{m}\Omega$
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 10\text{ A}$	10	20	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	4000	—	pF
Reverse transfer capacitance		$C_{rss}$		—	300	—	
Output capacitance		$C_{oss}$		—	1000	—	
Switching time	Rise time	$t_r$	<p><math>I_D = 10\text{ A}</math> <math>V_{GS} = 10\text{ V}</math> <math>0\text{ V}</math> <math>4.7\Omega</math> <math>R_L = 13\Omega</math> <math>V_{DD} = 130\text{ V}</math> <math>V_{OUT}</math> Duty <math>\leq 1\%</math>, <math>t_w = 10\mu\text{s}</math></p>	—	15	—	ns
	Turn-on time	$t_{on}$		—	35	—	
	Fall time	$t_f$		—	30	—	
	Turn-off time	$t_{off}$		—	180	—	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} = 200\text{ V}, V_{GS} = 10\text{ V}, I_D = 20\text{ A}$	—	100	—	nC
Gate-source charge		$Q_{gs}$		—	70	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	30	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	$I_{DR}$	—	—	—	20	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	60	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 20\text{ A}, V_{GS} = 0\text{ V}$	—	—	-2.0	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 20\text{ A}, V_{GS} = 0\text{ V}$	—	300	—	ns
Reverse recovery charge	$Q_{rr}$	$dI_{DR} / dt = 100\text{ A} / \mu\text{s}$	—	3.3	—	$\mu\text{C}$

## Marking



K2993 ← Part No. (or abbreviation code)

Lot No.

Note 4

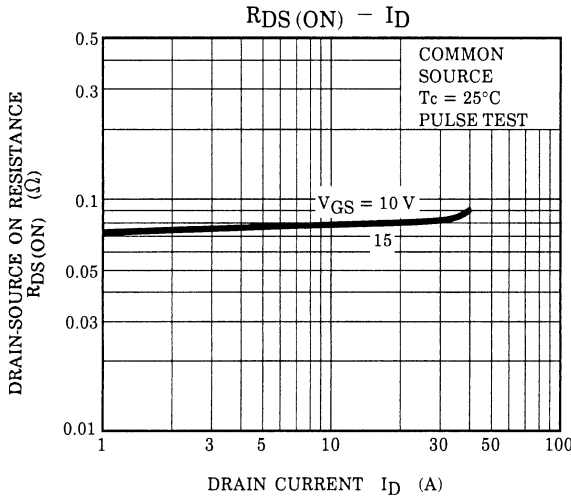
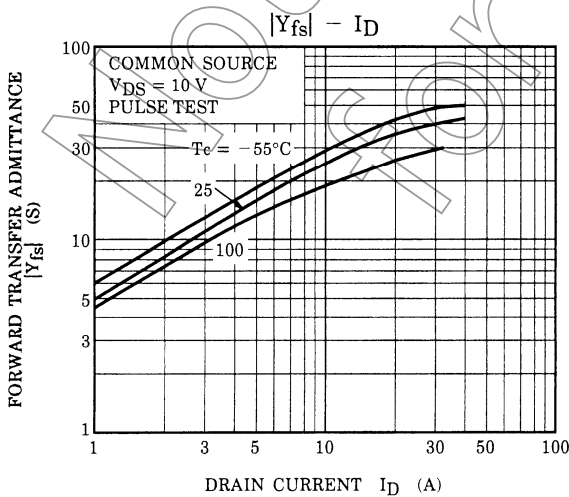
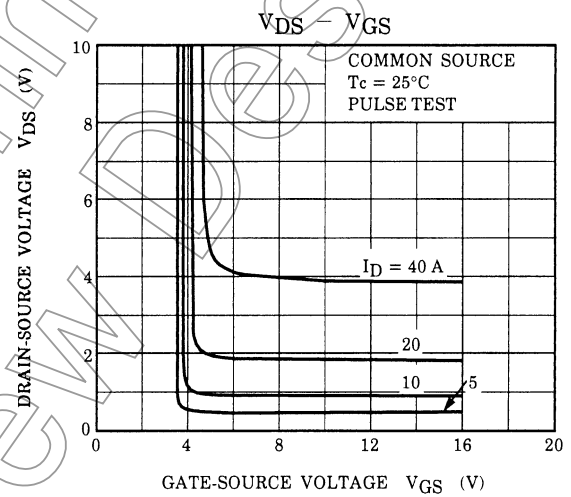
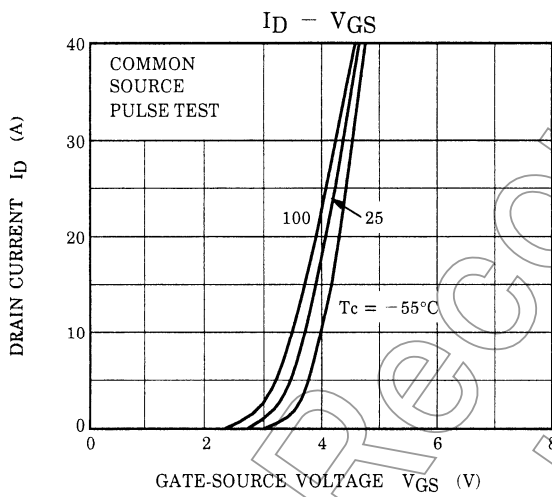
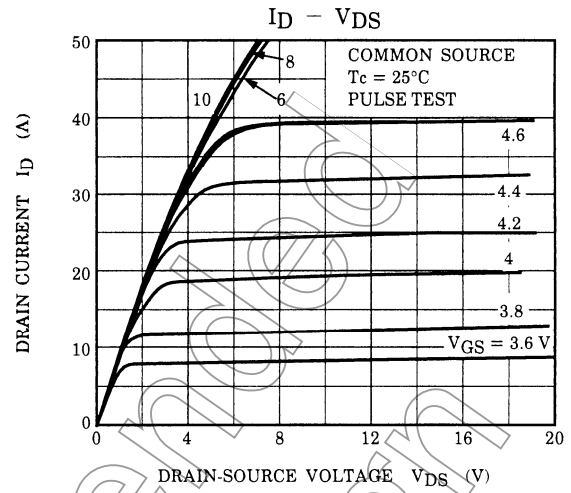
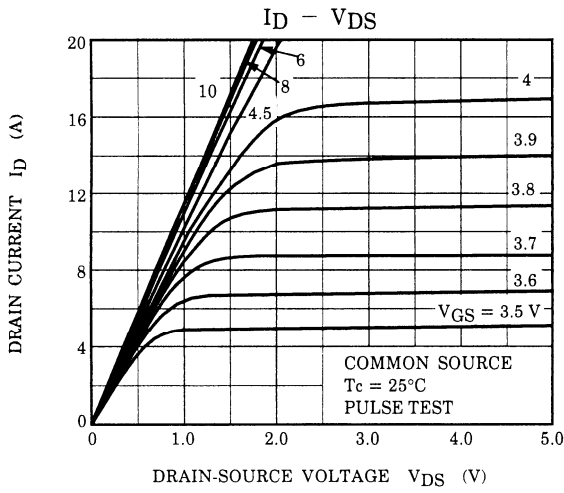
Note 4: A line under a Lot No. identifies the indication of product Labels.

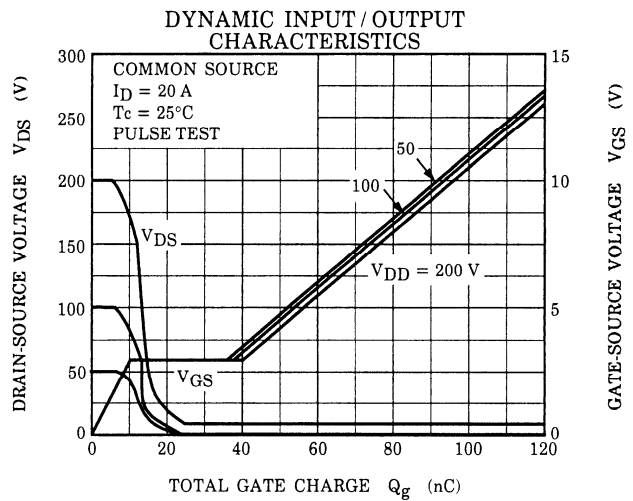
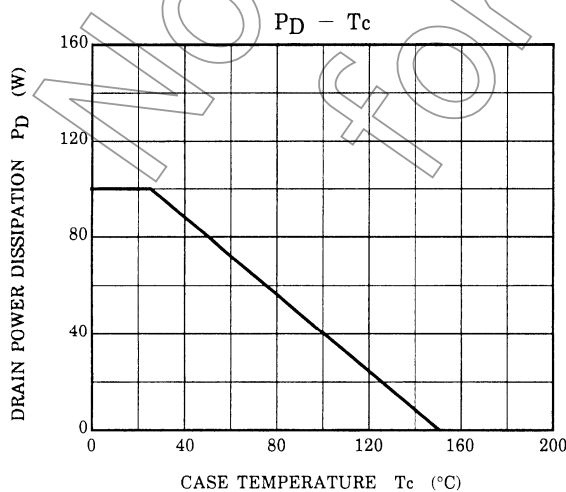
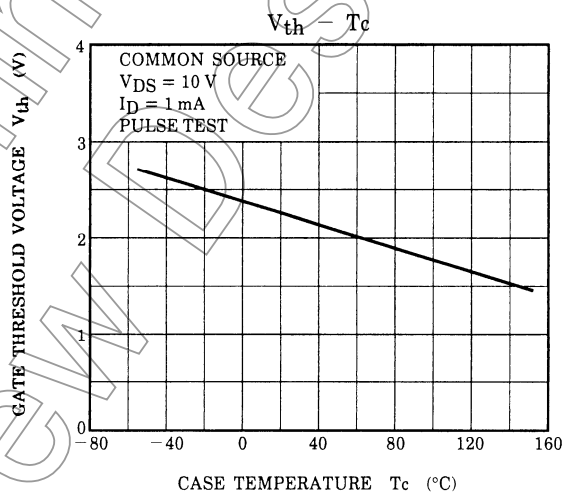
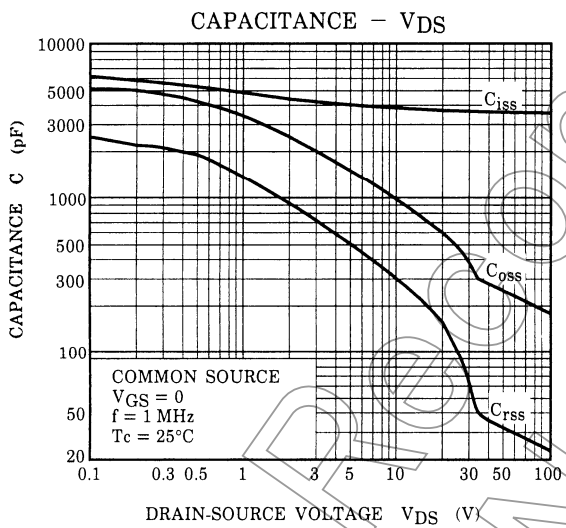
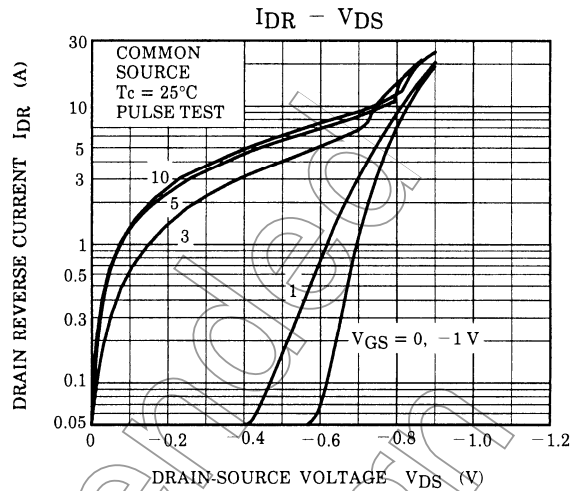
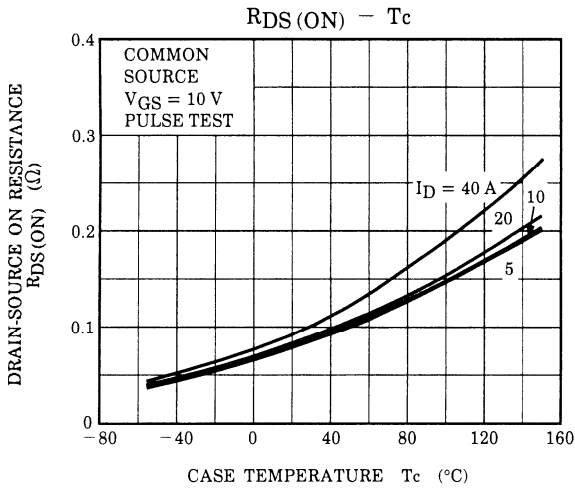
Not underlined:  $[[Pb]]/INCLUDES > MCV$

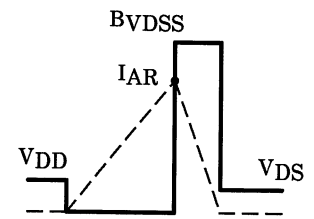
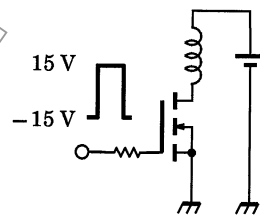
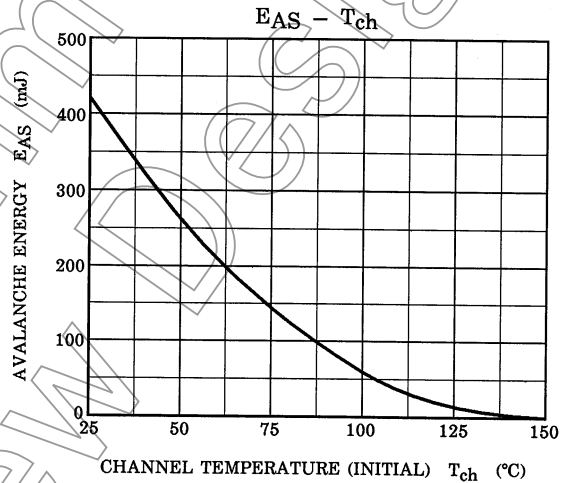
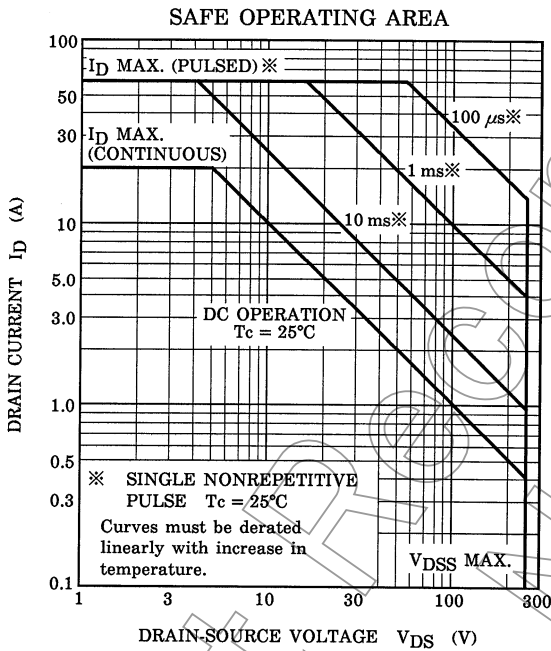
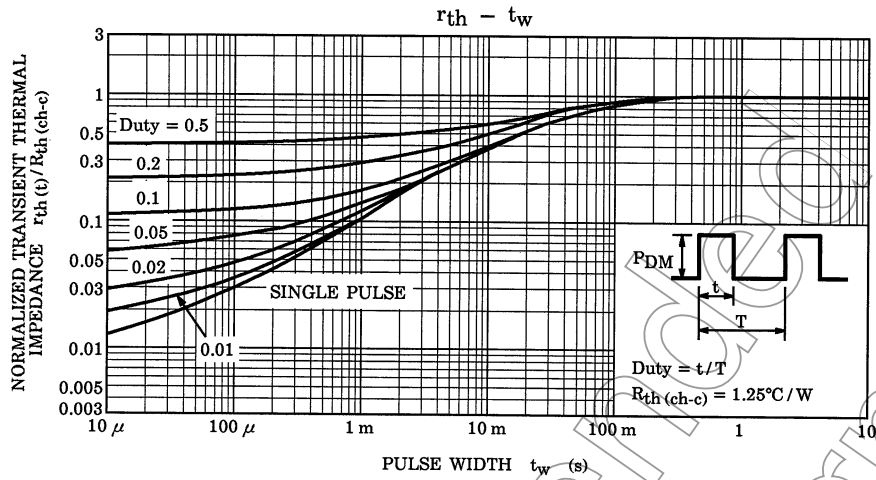
Underlined:  $[[G]]/RoHS\ COMPATIBLE$  or  $[[G]]/RoHS\ [[Pb]]$

Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The RoHS is the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.







$R_G = 25 \Omega$   
 $V_{DD} = 90 V, L = 1.79 mH$

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

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