

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

# 2SK3313

Chopper Regulator and DC-DC Converter Applications  
Motor Drive Applications

- Fast reverse recovery time :  $t_{rr} = 90 \text{ ns (typ.)}$
- Built-in high-speed free-wheeling diode
- Low drain-source ON-resistance :  $R_{DS(ON)} = 0.5 \Omega \text{ (typ.)}$
- High forward transfer admittance :  $|Y_{fs}| = 8.5 \text{ S (typ.)}$
- Low leakage current :  $I_{DSS} = 100 \mu\text{A (max)} \text{ (} V_{DS} = 500 \text{ V)}$
- Enhancement mode :  $V_{th} = 2.0 \text{ to } 4.0 \text{ V (} V_{DS} = 10 \text{ V, } I_D = 1 \text{ mA)}$

## Absolute Maximum Ratings (Ta = 25°C)

Characteristics		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)	$I_D$	12	A
	Pulse (Note 1)	$I_{DP}$	48	A
Drain power dissipation ( $T_c = 25^\circ\text{C}$ )		$P_D$	40	W
Single pulse avalanche energy (Note 2)		$E_{AS}$	324	mJ
Avalanche current		$I_{AR}$	12	A
Repetitive avalanche energy (Note 3)		$E_{AR}$	4.0	mJ
Channel temperature		$T_{ch}$	150	°C
Storage temperature range		$T_{stg}$	-55 to 150	°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	$R_{th(ch-c)}$	3.125	°C / W
Thermal resistance, channel to ambient	$R_{th(ch-a)}$	62.5	°C / W

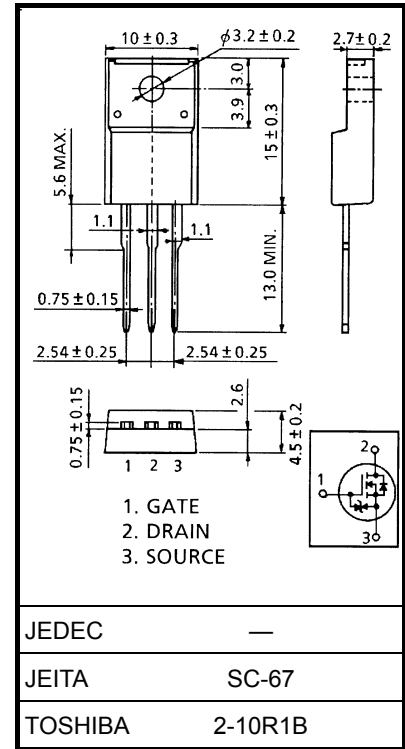
Note 1: Ensure that the channel temperature does not exceed 150°C.

Note 2:  $V_{DD} = 90 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 3.83 \text{ mH}$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = 12 \text{ A}$

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: 1.9 g (typ.)

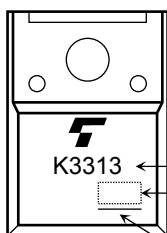
## Electrical Characteristics (Ta = 25°C)

Characteristics		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		$V_{(BR)GSS}$	$I_G = \pm 100\ \mu\text{A}, V_{DS} = 0\text{ V}$	$\pm 30$	—	—	V
Drain cut-off 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		$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 6\text{ A}$	—	0.5	0.62	$\Omega$
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 6\text{ A}$	3.0	8.5	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	2040	—	pF
Reverse transfer capacitance		$C_{rss}$		—	210	—	
Output capacitance		$C_{oss}$		—	630	—	
Switching time	Rise time	$t_r$	<p><math>I_D = 6\text{ A}</math> <math>V_{GS} = 10\text{ V}, 0\text{ V}</math> <math>50\ \Omega</math> <math>R_L = 33\ \Omega</math> <math>V_{DD} = 200\text{ V}</math> Duty <math>\leq 1\%</math>, <math>t_w = 10\ \mu\text{s}</math></p>	—	22	—	ns
	Turn-on time	$t_{on}$		—	58	—	
	Fall time	$t_f$		—	36	—	
	Turn-off time	$t_{off}$		—	180	—	
Total gate charge (Gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 400\text{ V}, V_{GS} = 10\text{ V}, I_D = 12\text{ A}$	—	45	—	nC
Gate-source charge		$Q_{gs}$		—	25	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	20	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	$I_{DR}$	—	—	—	12	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	48	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 12\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.7	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 12\text{ A}, V_{GS} = 0\text{ V}$	—	90	160	ns
Reverse recovery charge	$Q_{rr}$	$di_{DR} / dt = 100\text{ A} / \mu\text{s}$	—	0.25	—	$\mu\text{C}$

## Marking



Part No. (or abbreviation code)  
Lot No.

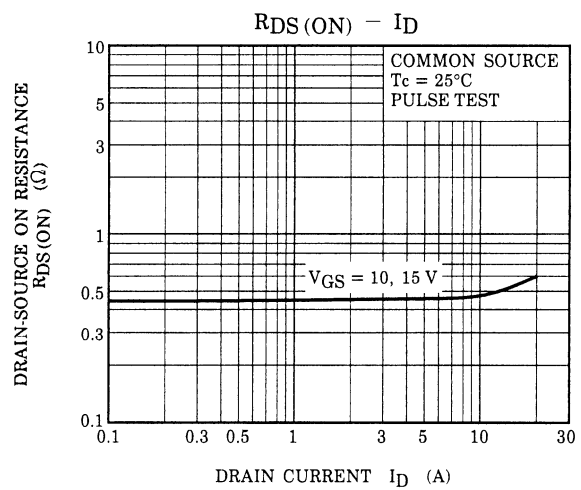
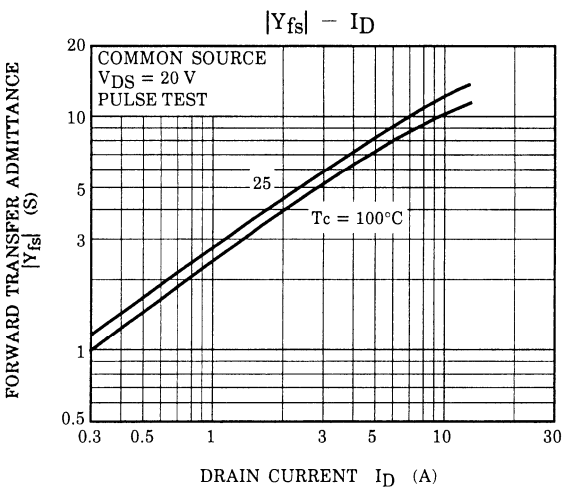
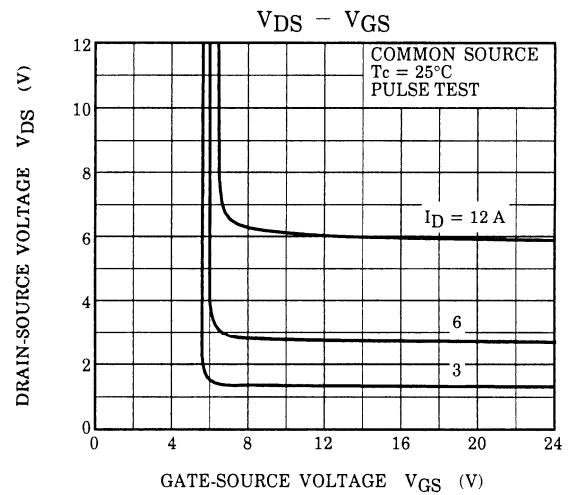
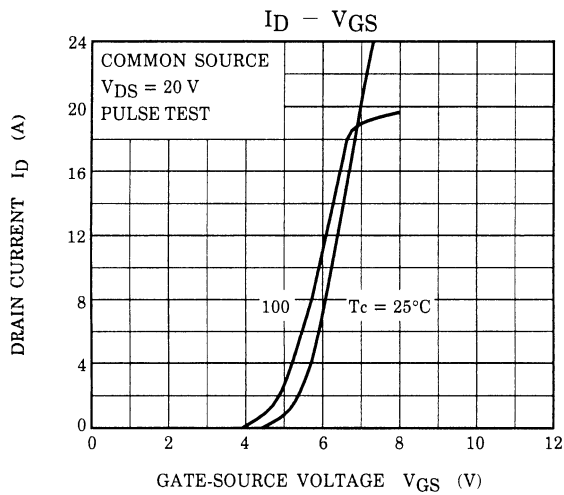
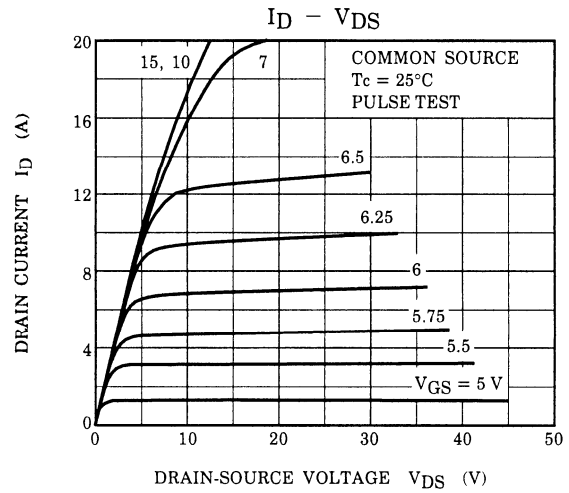
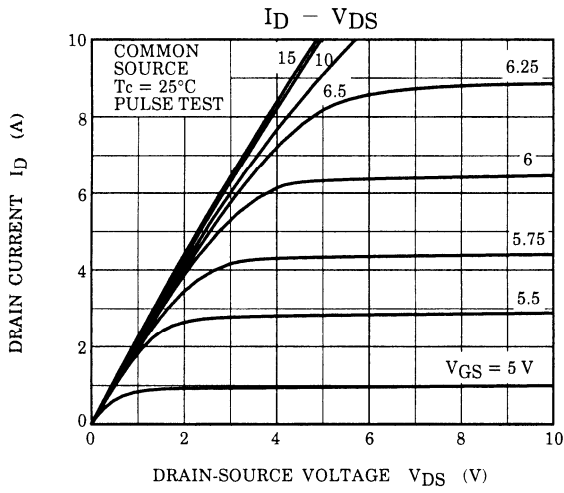
Note 4

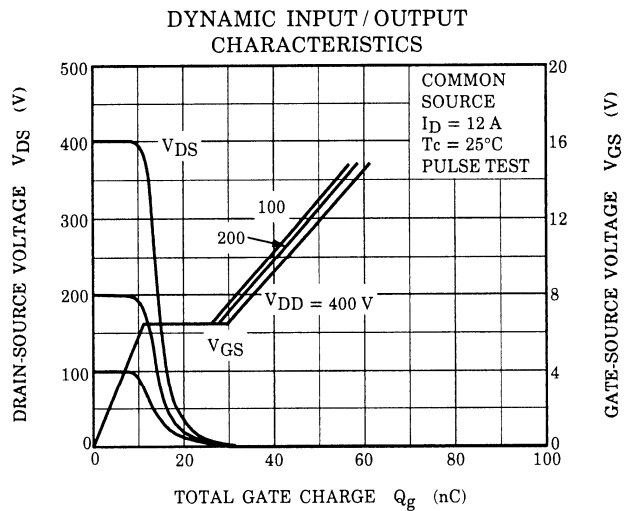
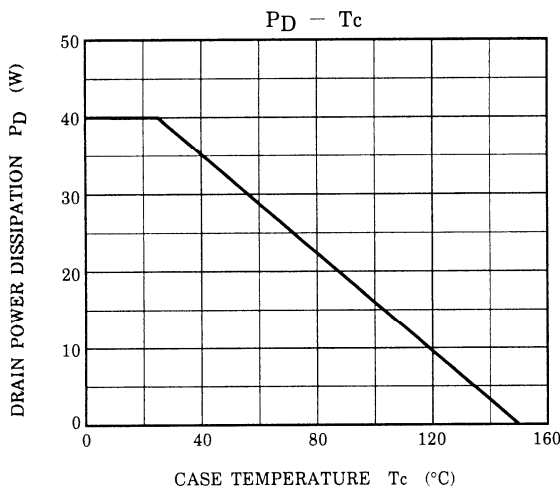
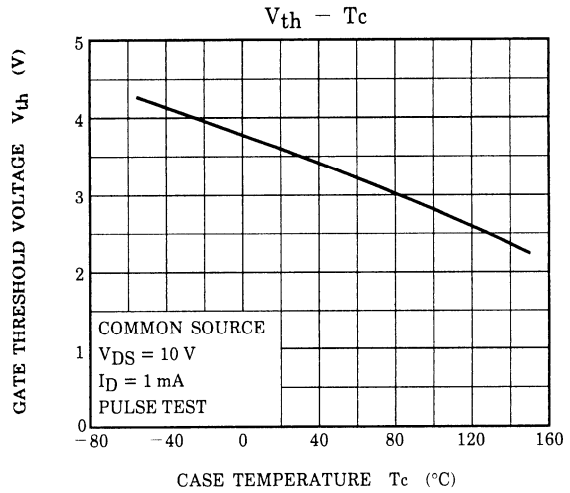
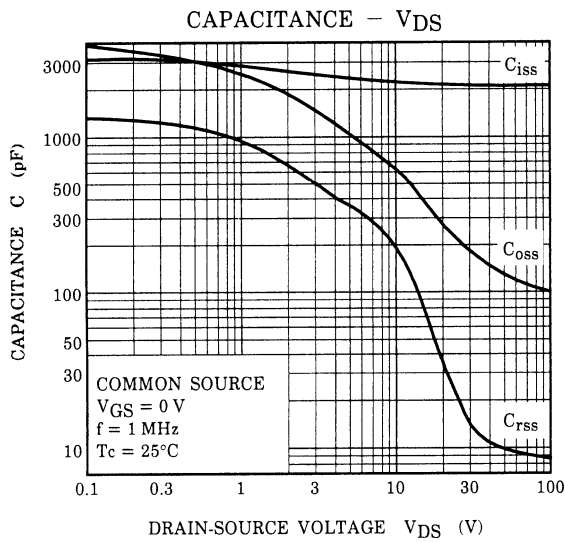
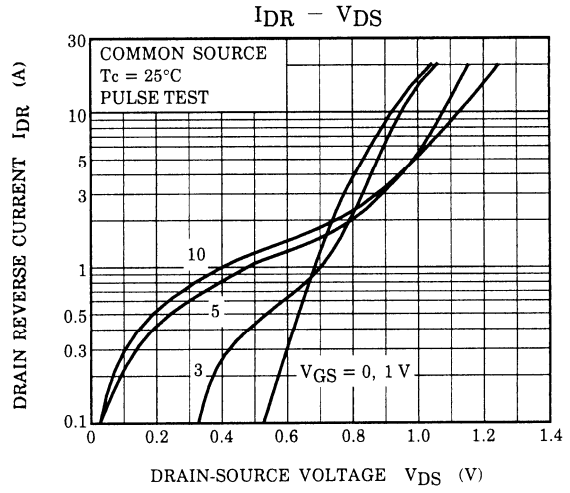
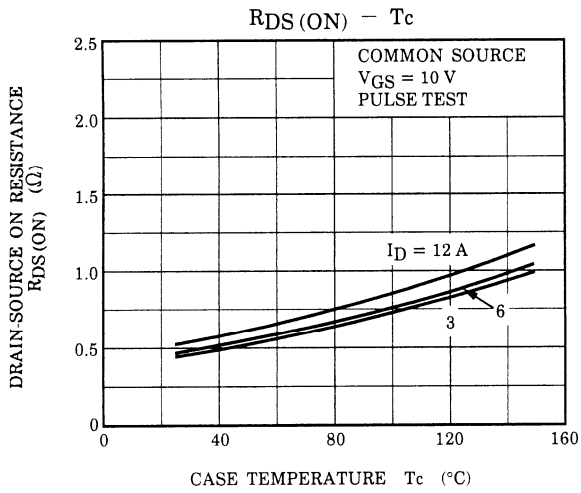
Note 4: A line under a Lot No. identifies the indication of product Labels.

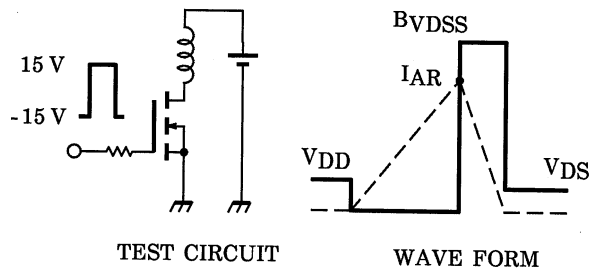
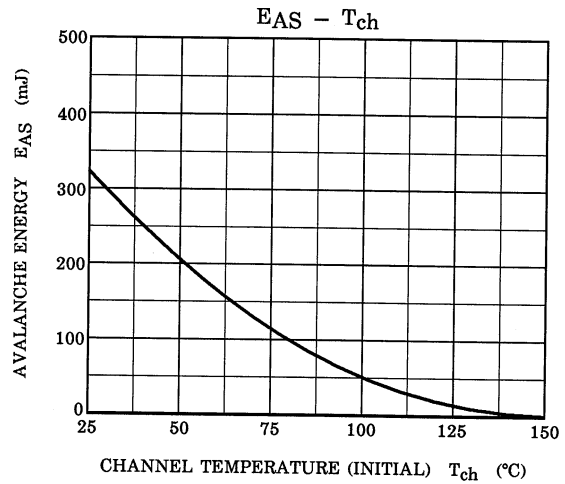
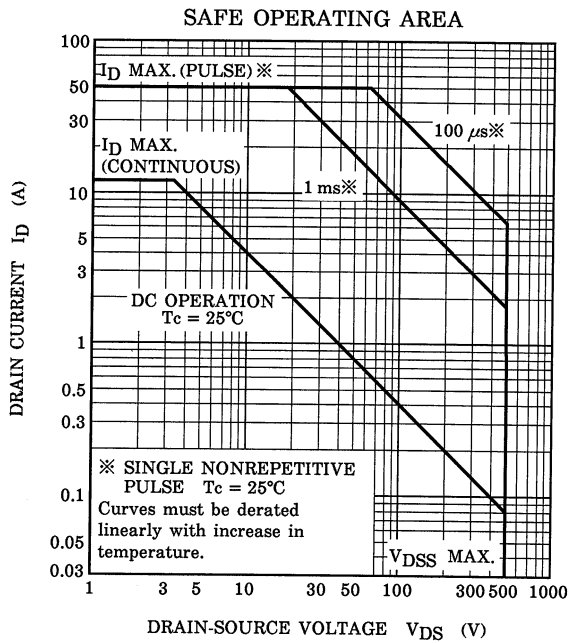
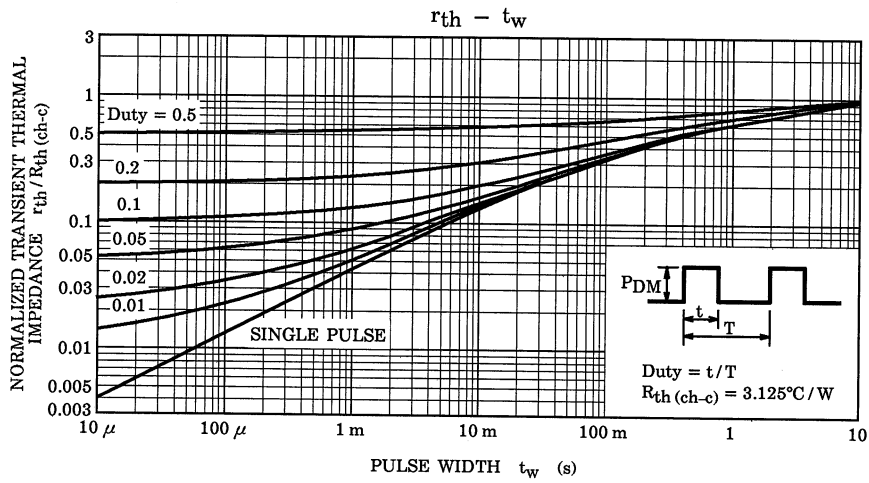
Not underlined:  $[[Pb]]/INCLUDES > MCV$

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

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$$R_G = 25 \Omega$$

$$V_{DD} = 90 \text{ V}, L = 3.83 \text{ mH}$$

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

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