

TOSHIBA Field Effect Transistor Silicon N Channel MOS Type (L<sup>2</sup>-π-MOSV)

# 2SK2233

Chopper Regulator, DC-DC Converter and Motor Drive Applications

- 4-V gate drive
- Low drain-source ON resistance :  $R_{DS(ON)} = 0.022 \Omega$  (typ.)
- High forward transfer admittance :  $|Y_{fs}| = 27 S$  (typ.)
- Low leakage current :  $I_{DSS} = 100 \mu A$  (max) ( $V_{DS} = 60 V$ )
- Enhancement mode :  $V_{th} = 0.8$  to  $2.0 V$  ( $V_{DS} = 10 V, I_D = 1 mA$ )

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

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{DSS}$	60	V
Drain-gate voltage ( $R_{GS} = 20 k\Omega$ )	$V_{DGR}$	60	V
Gate-source voltage	$V_{GSS}$	$\pm 20$	V
Drain current	DC (Note 1)	$I_D$	45 A
	Pulse (Note 1)	$I_{DP}$	180 A
Drain power dissipation ( $T_c = 25^\circ C$ )	$P_D$	100	W
Single pulse avalanche energy (Note 2)	$E_{AS}$	246	mJ
Avalanche current	$I_{AR}$	45	A
Repetitive avalanche energy (Note 3)	$E_{AR}$	10	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

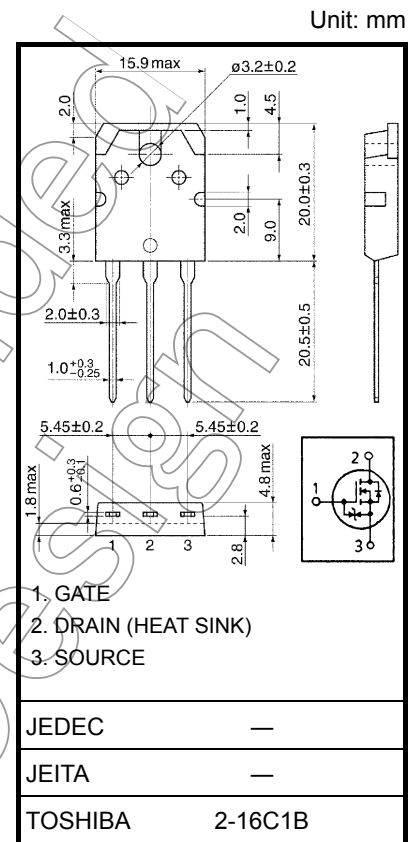
Characteristics	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th(ch-c)}$	1.25	°C / W
Thermal resistance, channel to ambient	$R_{th(ch-a)}$	50	°C / W

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

Note 2:  $V_{DD} = 25 V, T_{ch} = 25^\circ C$  (initial),  $L = 165 \mu H, R_G = 25 \Omega, I_{AR} = 45 A$

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

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



Weight: 4.6 g (typ.)

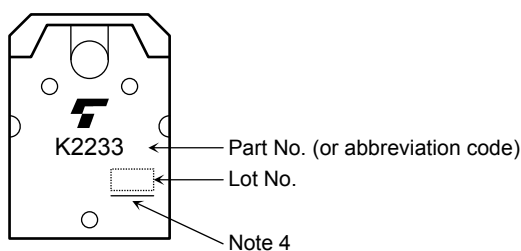
## Electrical Characteristics (Ta = 25°C)

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		$I_{DSS}$	$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$	—	—	100	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR) DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	60	—	—	V
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	0.8	—	2.0	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = 4\text{ V}, I_D = 15\text{ A}$	—	40	55	m $\Omega$
			$V_{GS} = 10\text{ V}, I_D = 25\text{ A}$	—	22	30	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 25\text{ A}$	15	27	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	1800	—	pF
Reverse transfer capacitance		$C_{rss}$		—	350	—	
Output capacitance		$C_{oss}$		—	900	—	
Switching time	Rise time	$t_r$		—	20	—	ns
	Turn-on time	$t_{on}$		—	30	—	
	Fall time	$t_f$		—	40	—	
	Turn-off time	$t_{off}$		—	130	—	
Total gate charge (Gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 48\text{ V}, V_{GS} = 10\text{ V}, I_D = 45\text{ A}$	—	60	—	nC
Gate-source charge		$Q_{gs}$		—	40	—	
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)	$I_{DR}$	—	—	—	45	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	180	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 45\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.8	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 45\text{ A}, V_{GS} = 0\text{ V}$	—	90	—	ns
Reverse recovered charge	$Q_{rr}$	$dI_{DR} / dt = 100\text{ A} / \mu\text{s}$	—	0.1	—	$\mu\text{C}$

## Marking

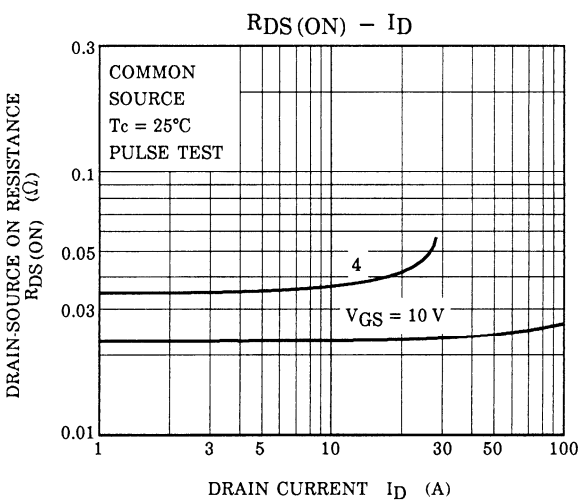
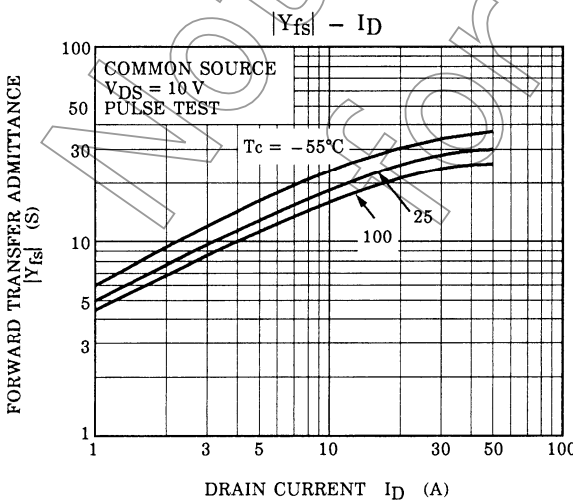
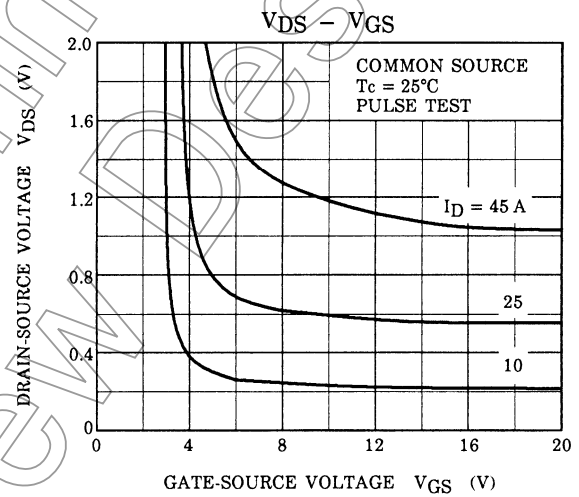
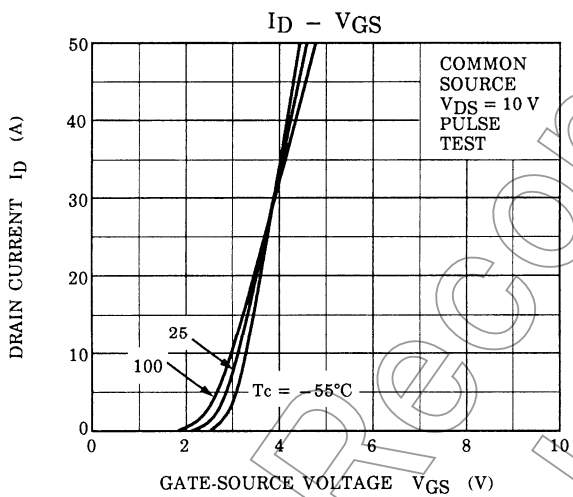
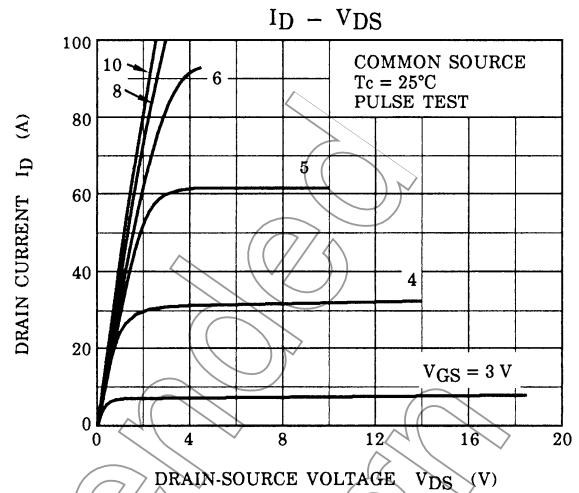
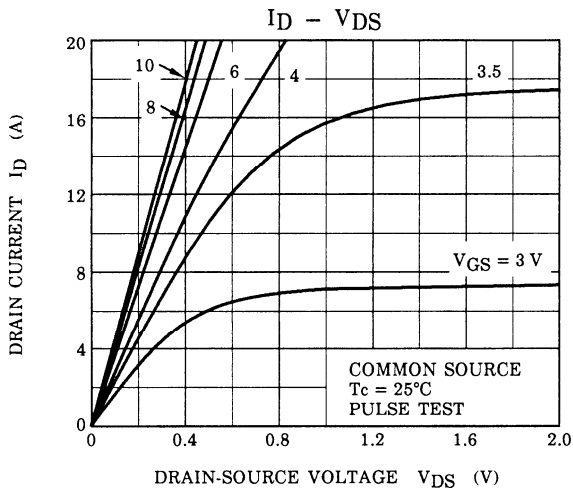


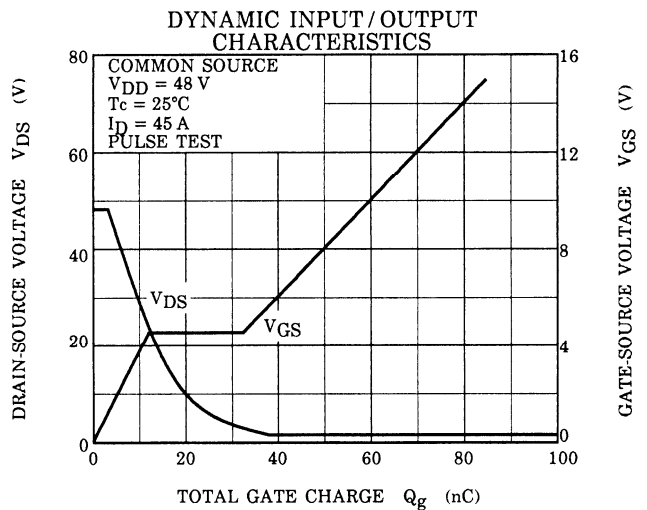
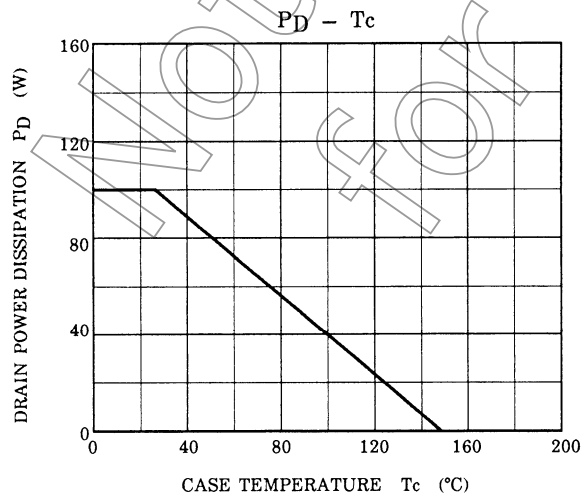
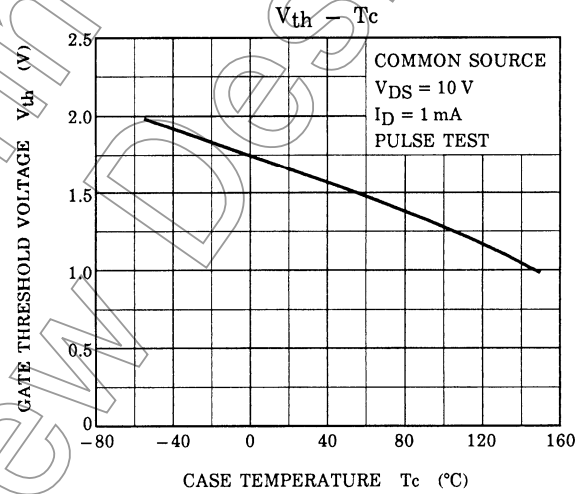
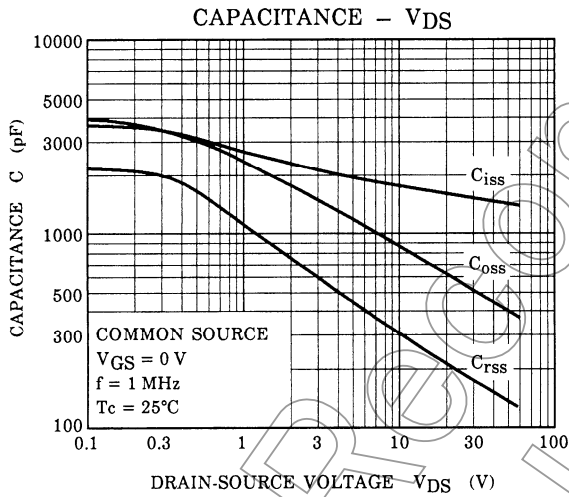
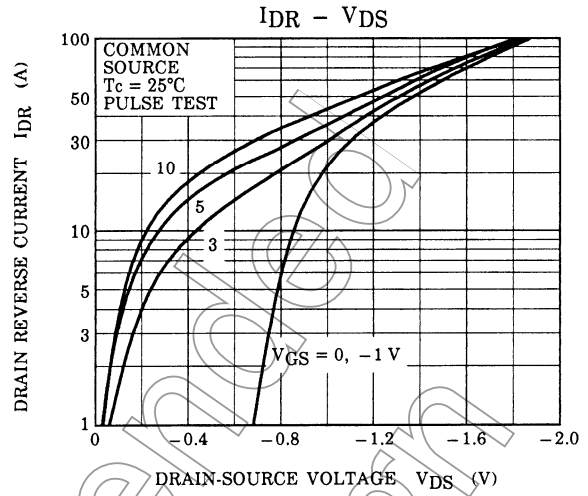
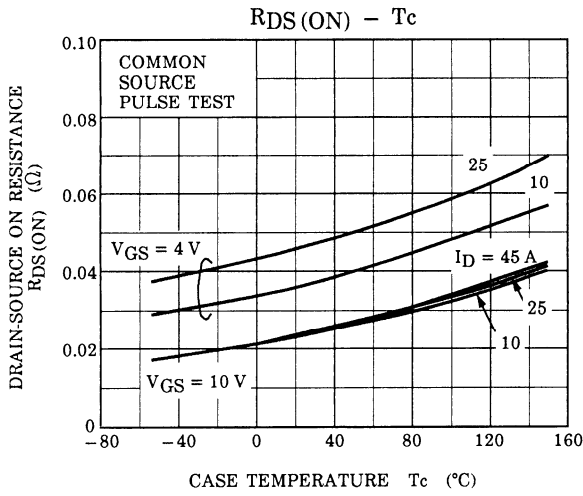
Note 4: A line under a Lot No. identifies the indication of product Labels.

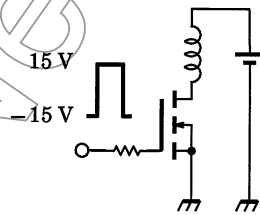
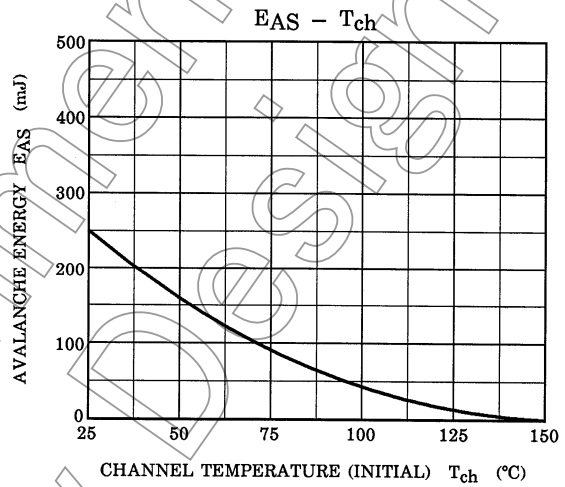
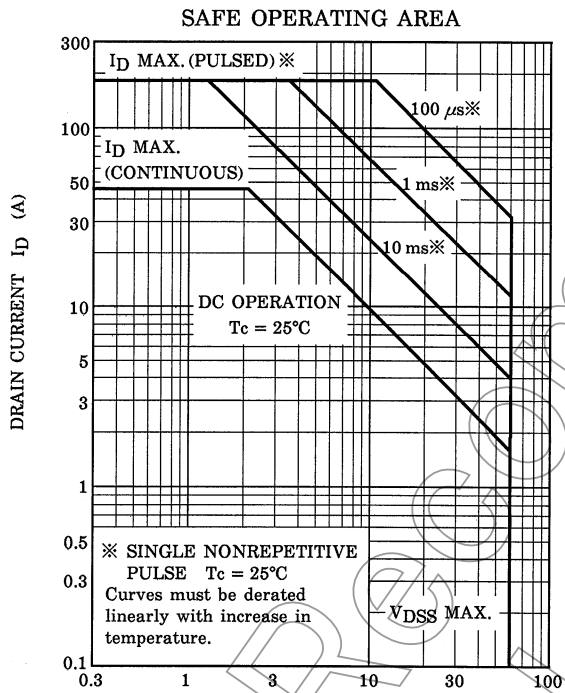
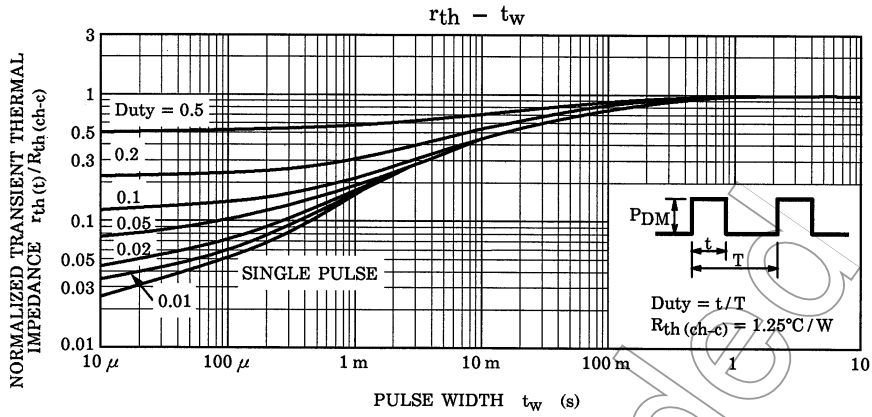
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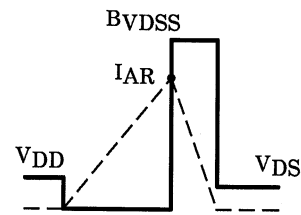
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TEST CIRCUIT



WAVE FORM

$R_G = 25 \Omega$   
 $V_{DD} = 25 \text{ V}, L = 165 \mu\text{H}$

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

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