

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

# 2SK2232

Chopper Regulator, DC-DC Converter and Motor Drive Applications

- 4-V gate drive
- Low drain-source ON resistance :  $R_{DS(ON)} = 36 \text{ m}\Omega$  (typ.)
- High forward transfer admittance :  $|Y_{fs}| = 16 \text{ S}$  (typ.)
- Low leakage current :  $I_{DSS} = 100 \text{ }\mu\text{A}$  (max) ( $V_{DS} = 60 \text{ V}$ )
- Enhancement mode :  $V_{th} = 0.8 \text{ to } 2.0 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

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

Characteristics	Symbol	Rating	Unit	
Drain-source voltage	$V_{DSS}$	60	V	
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )	$V_{DGR}$	60	V	
Gate-source voltage	$V_{GSS}$	$\pm 20$	V	
Drain current	DC (Note 1)	$I_D$	25	A
	Pulse (Note 1)	$I_{DP}$	100	A
Drain power dissipation ( $T_c = 25^\circ\text{C}$ )	$P_D$	35	W	
Single pulse avalanche energy (Note 2)	$E_{AS}$	156	mJ	
Avalanche current	$I_{AR}$	25	A	
Repetitive avalanche energy (Note 3)	$E_{AR}$	3.5	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	$R_{th(ch-c)}$	3.57	°C / W
Thermal resistance, channel to ambient	$R_{th(ch-a)}$	62.5	°C / W

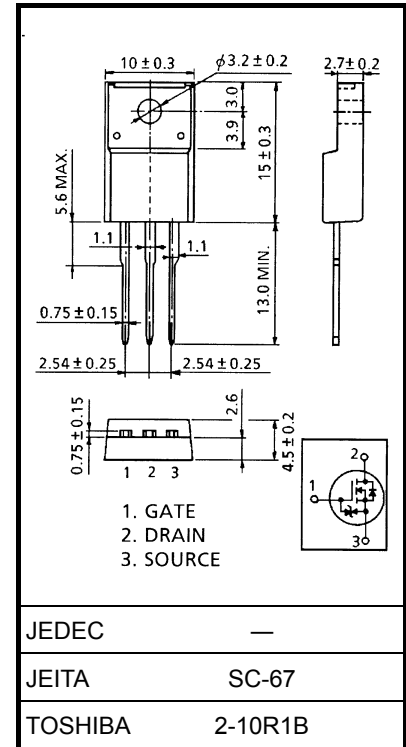
Note 1: Ensure that the channel temperature does not exceed 150°C.

Note 2:  $V_{DD} = 25 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 339 \text{ }\mu\text{H}$ ,  $R_G = 25 \text{ }\Omega$ ,  $I_{AR} = 25 \text{ A}$

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.)

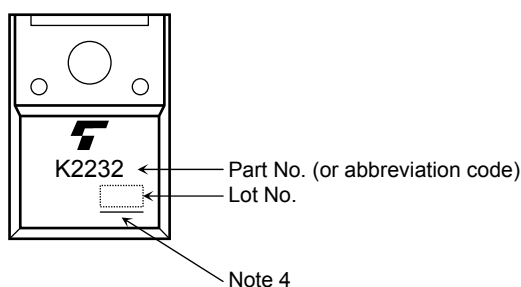
## Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
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		$R_{DS(ON)}$	$V_{GS} = 4\text{ V}, I_D = 12\text{ A}$	—	0.057	0.08	$\Omega$
			$V_{GS} = 10\text{ V}, I_D = 12\text{ A}$	—	0.036	0.046	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 12\text{ A}$	10	16	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	1000	—	pF
Reverse transfer capacitance		$C_{rss}$		—	200	—	
Output capacitance		$C_{oss}$		—	550	—	
Switching time	Rise time	$t_r$	<p><math>I_D = 12\text{ A}</math> <math>R_L = 2.5\ \Omega</math> <math>V_{DD} = 30\text{ V}</math> Duty <math>\leq 1\%</math>, <math>t_W = 10\ \mu\text{s}</math></p>	—	20	—	ns
	Turn-on time	$t_{on}$		—	30	—	
	Fall time	$t_f$		—	55	—	
	Turn-off time	$t_{off}$		—	130	—	
Total gate charge (Gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 48\text{ V}, V_{GS} = 10\text{ V}, I_D = 25\text{ A}$	—	38	—	nC
Gate-source charge		$Q_{gs}$		—	25	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	13	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	$I_{DR}$	—	—	—	25	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	100	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 25\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.8	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 25\text{ A}, V_{GS} = 0\text{ V}, dI_{DR}/dt = 50\text{ A}/\mu\text{s}$	—	50	—	ns
Reverse recovered charge	$Q_{rr}$		—	35	—	$\mu\text{C}$

## Marking

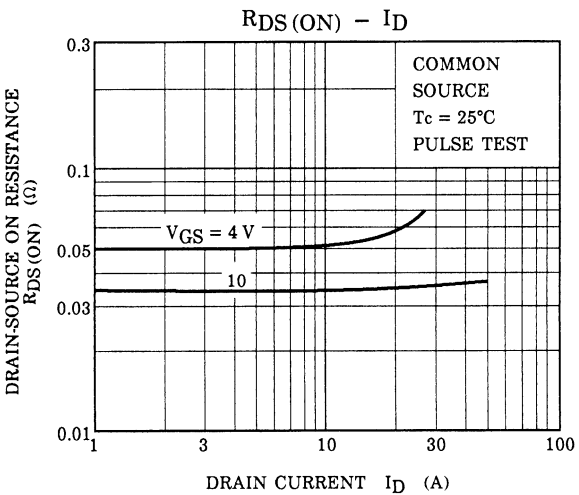
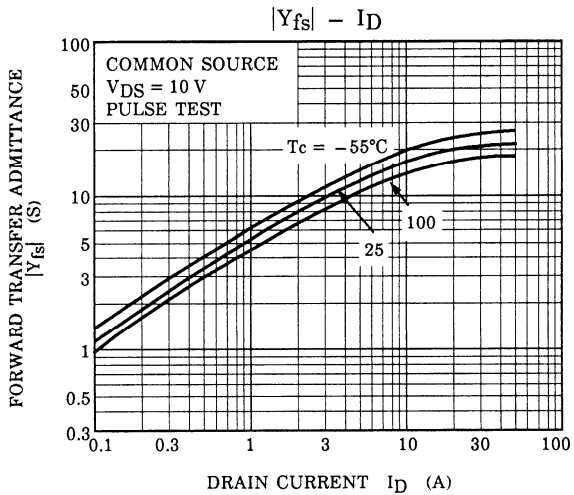
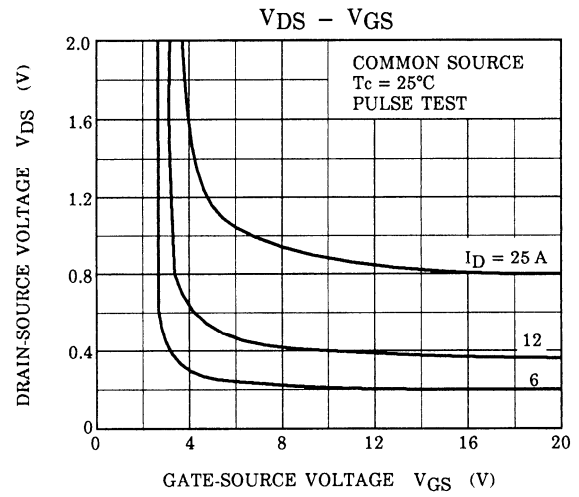
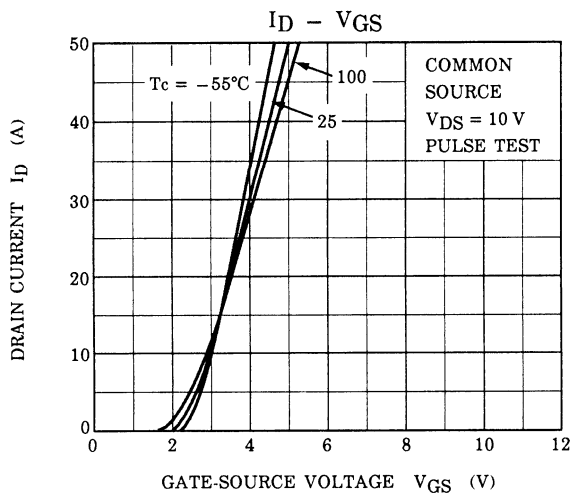
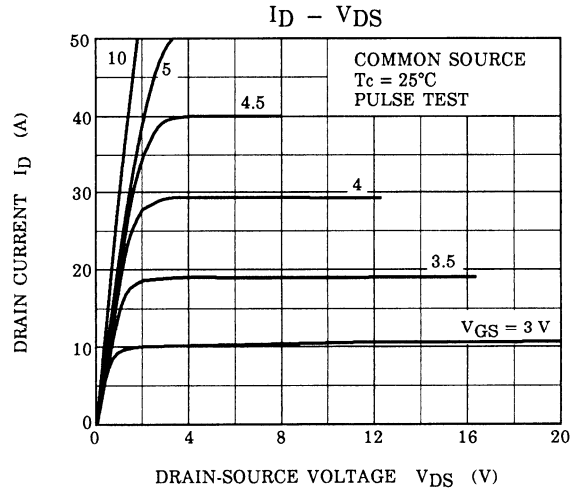
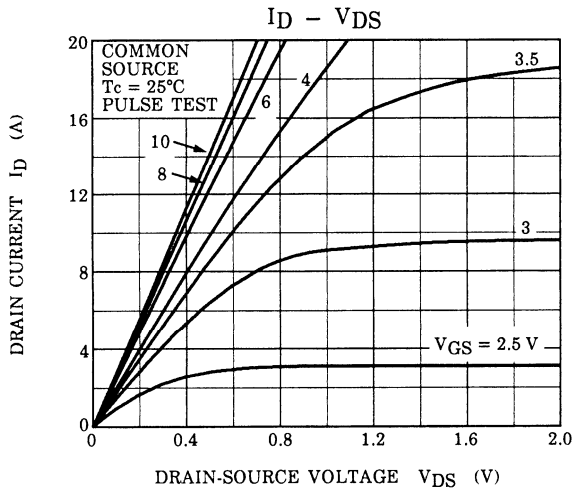


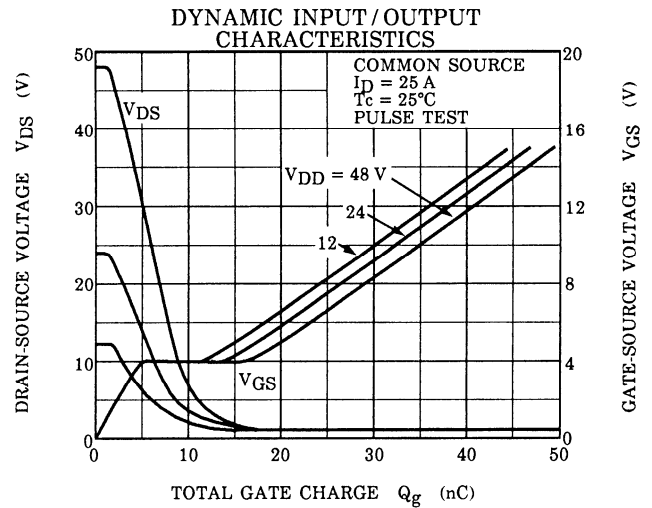
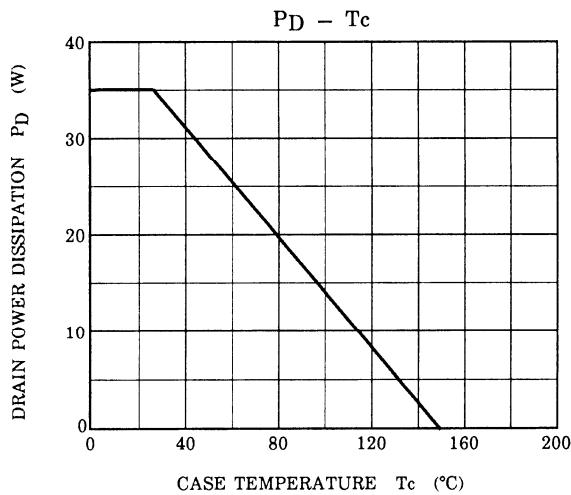
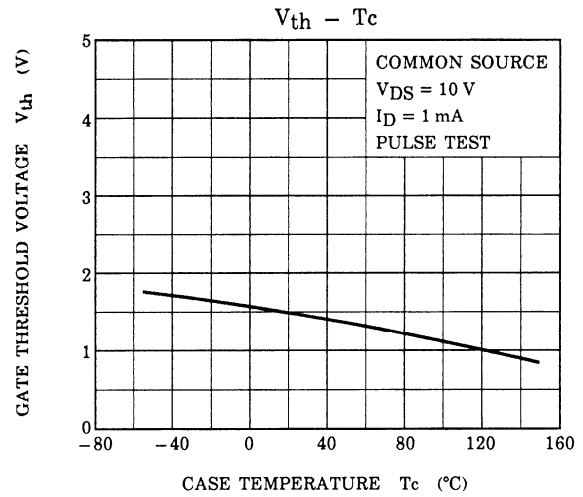
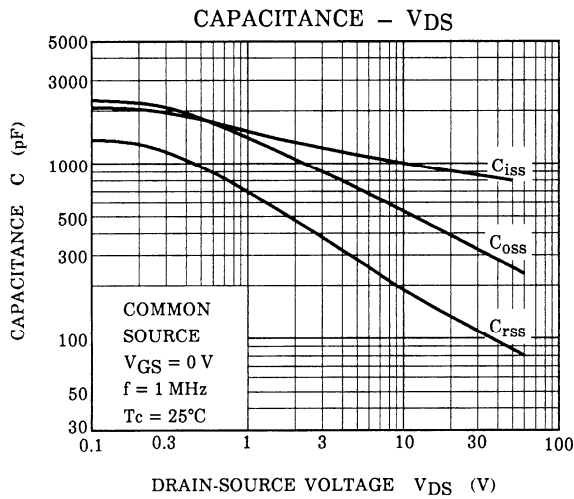
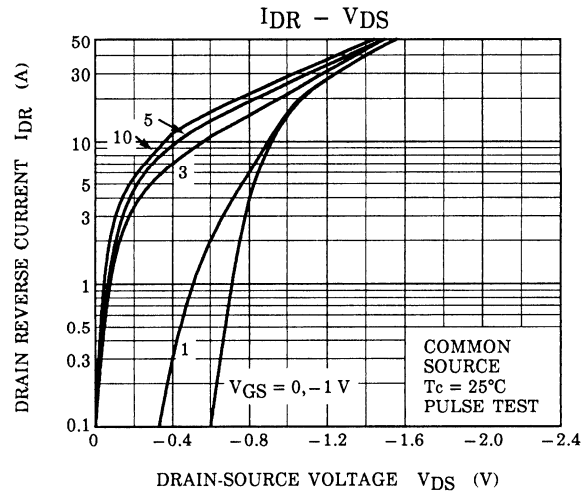
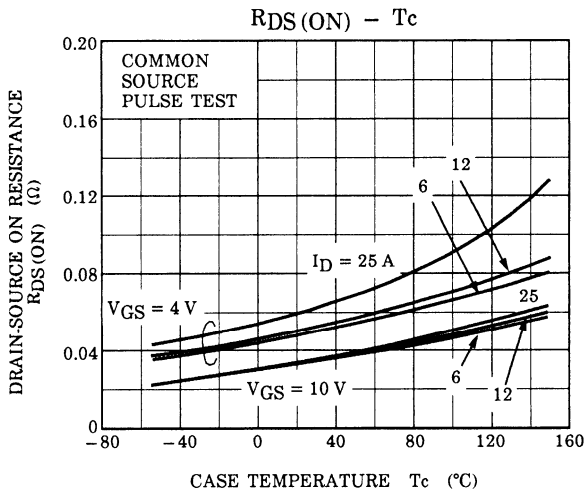
Note 4: A line under a Lot No. identifies the indication of product Labels.

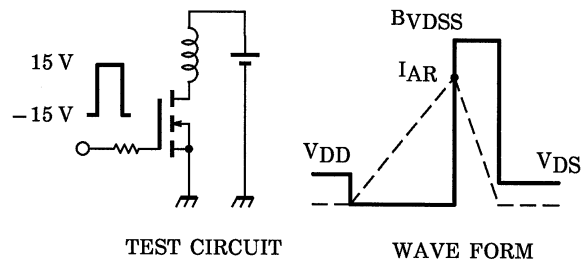
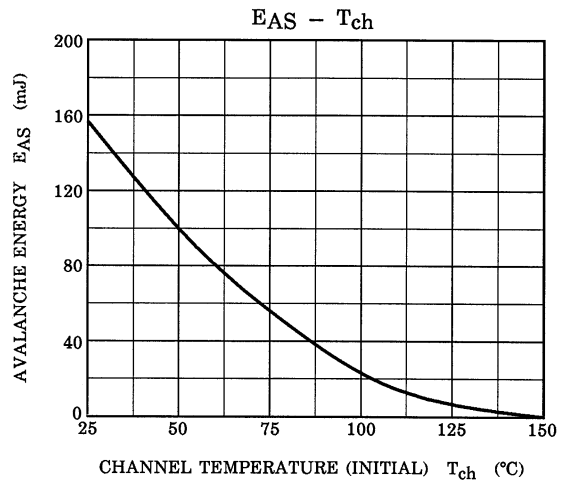
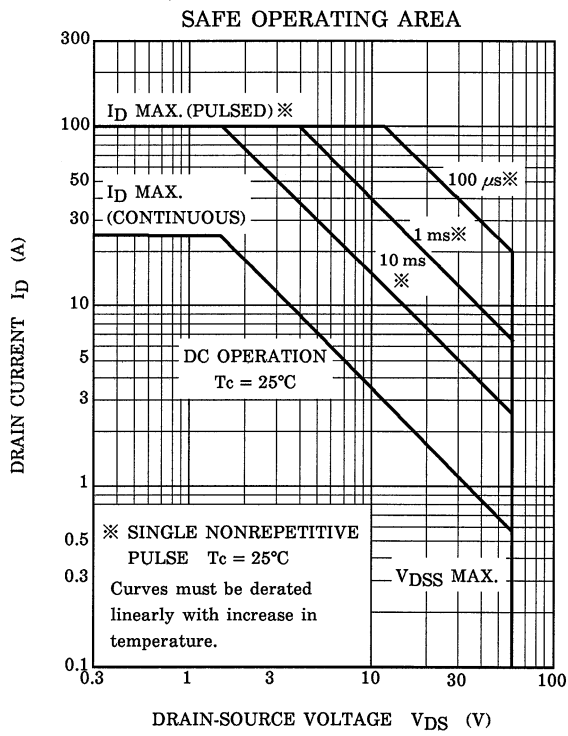
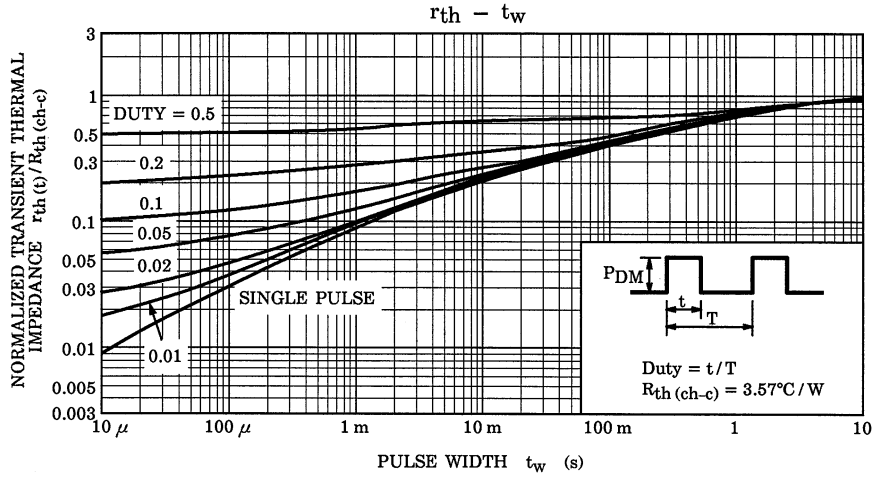
Not underlined:  $[[Pb]]/INCLUDES > MCV$

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

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$R_G = 25\ \Omega$   
 $V_{DD} = 25\ V, L = 339\ \mu H$

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

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