

# 2SK3940

Switching Regulator, DC/DC Converter Applications  
Motor Drive Applications

- Low drain-source ON-resistance:  $R_{DS(ON)} = 5.6 \text{ m}\Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 90 \text{ S}$  (typ.)
- Low leakage current:  $I_{DSS} = 100 \text{ }\mu\text{A}$  ( $V_{DS} = 75 \text{ V}$ )
- Enhancement-mode:  $V_{th} = 3.0 \text{ to } 5.0 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

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

Characteristic		Symbol	Rating	Unit
Drain-source voltage		$V_{DSS}$	75	V
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )		$V_{DGR}$	75	V
Gate-source voltage		$V_{GSS}$	$\pm 20$	V
Drain current	DC (Note 1)	$I_D$	70	A
	Pulse (Note 1)	$I_{DP}$	280	
Drain power dissipation ( $T_c = 25^\circ\text{C}$ )		$P_D$	150	W
Single-pulse avalanche energy (Note 2)		$E_{AS}$	444	mJ
Avalanche current		$I_{AR}$	70	A
Repetitive avalanche energy (Note 3)		$E_{AR}$	15	mJ
Channel temperature		$T_{ch}$	175	°C
Storage temperature range		$T_{stg}$	-55~175	°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	$R_{th(ch-c)}$	1.0	°C/W
Thermal resistance, channel to ambient	$R_{th(ch-a)}$	50	°C/W

Note 1: Ensure that the channel temperature does not exceed 175°C.

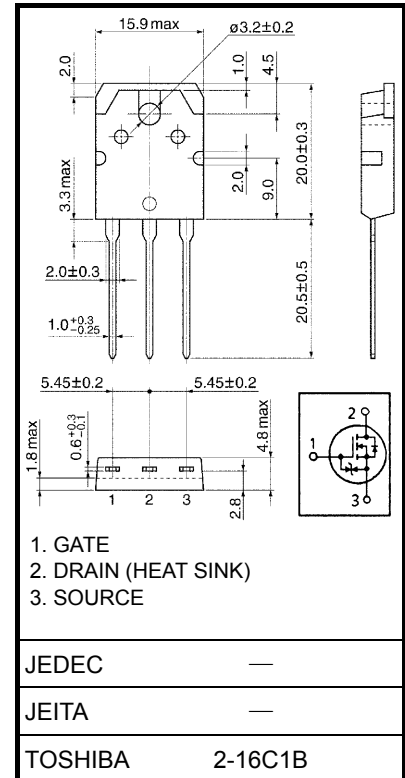
Note 2:  $V_{DD} = 25 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 135 \text{ }\mu\text{H}$ ,  $I_{AR} = 70 \text{ A}$ ,  $R_G = 25 \text{ }\Omega$

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

Note 4: The definition of maximum rating condition for both channel temperature and storage temperature range is derived from AEC-Q101.

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

Unit: mm



Weight: 4.6 g (typ.)

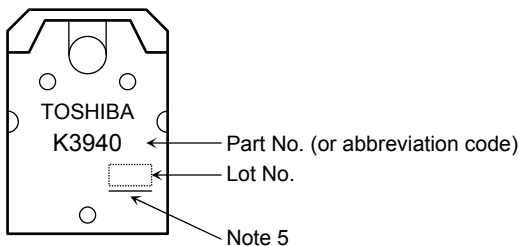
## Electrical Characteristics (Ta = 25°C)

Characteristic		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 cutoff current		$I_{DSS}$	$V_{DS} = 75\text{ V}, V_{GS} = 0\text{ V}$	—	—	100	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	75	—	—	V
		$V_{(BR)DSX}$	$I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$	45	—	—	V
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	3.0	—	5.0	V
Drain-source ON-resistance		$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 35\text{ A}$	—	5.6	7.0	$\text{m}\Omega$
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 35\text{ A}$	45	90	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	12500	—	pF
Reverse transfer capacitance		$C_{rss}$		—	510	—	
Output capacitance		$C_{oss}$		—	970	—	
Switching time	Rise time	$t_r$		—	20	—	ns
	Turn-on time	$t_{on}$		—	50	—	
	Fall time	$t_f$		—	30	—	
	Turn-off time	$t_{off}$		Duty $\leq 1\%$ , $t_w = 10\ \mu\text{s}$	—	160	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 60\text{ V}, V_{GS} = 10\text{ V}, I_D = 70\text{ A}$	—	200	—	nC
Gate-source charge		$Q_{gs}$		—	60	—	
Gate-drain ("Miller") charge		$Q_{gd}$		—	85	—	

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

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	$I_{DR}$	—	—	—	70	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	280	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 70\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.5	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 70\text{ A}, V_{GS} = 0\text{ V},$ $dI_{DR}/dt = 50\text{ A}/\mu\text{s}$	—	75	—	ns
Reverse recovery charge	$Q_{rr}$		—	110	—	nC

## Marking

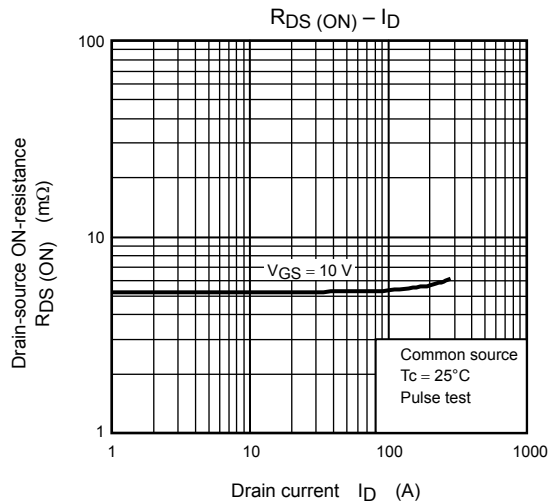
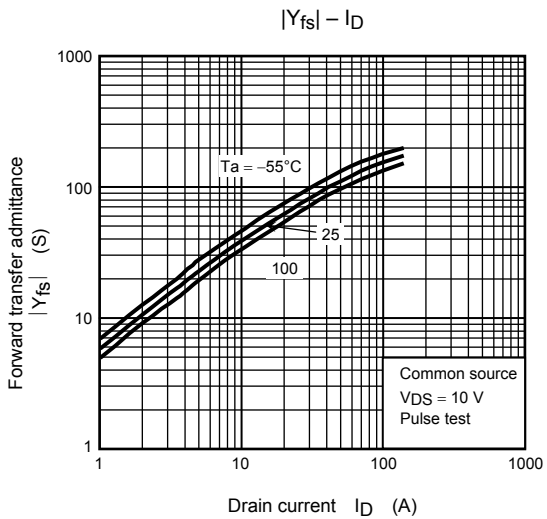
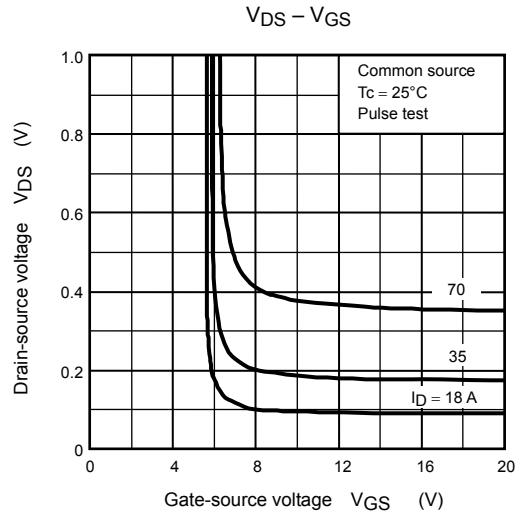
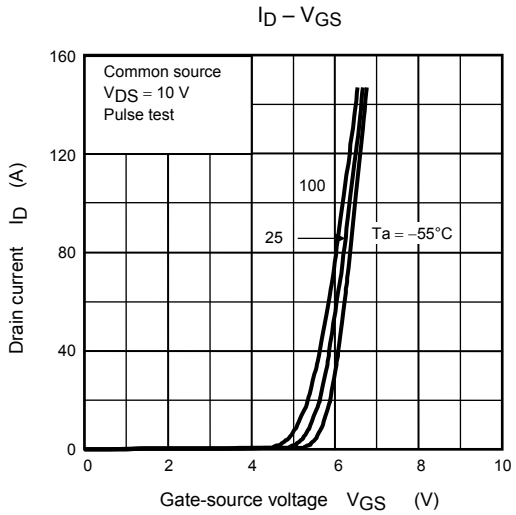
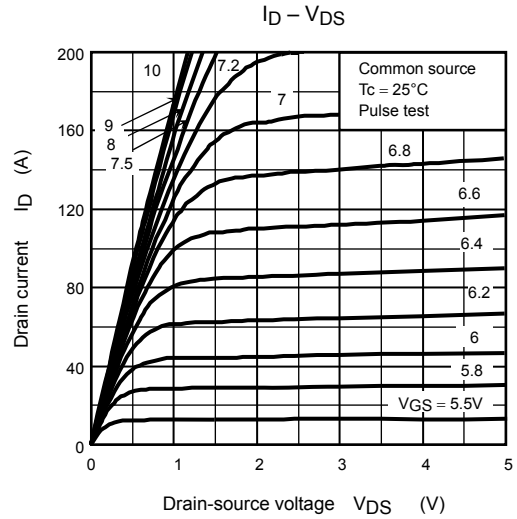
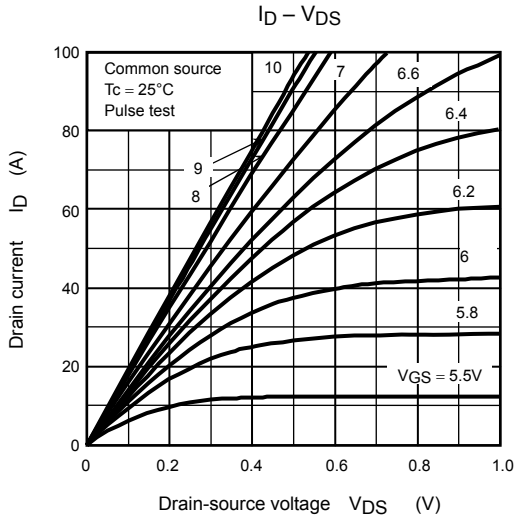


Note 5: A line under a Lot No. identifies the indication of product Labels.

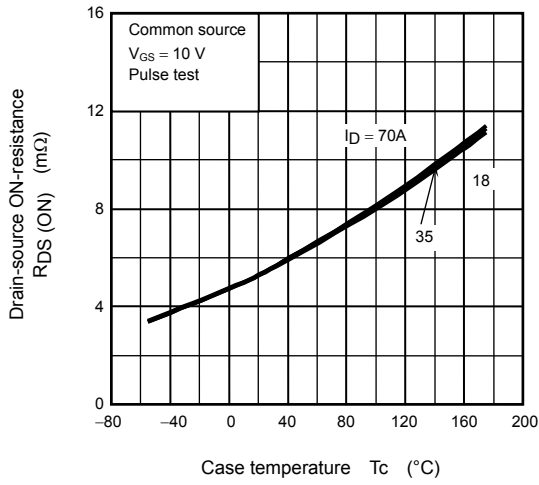
Not underlined:  $[[Pb]]/INCLUDES > MCV$

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

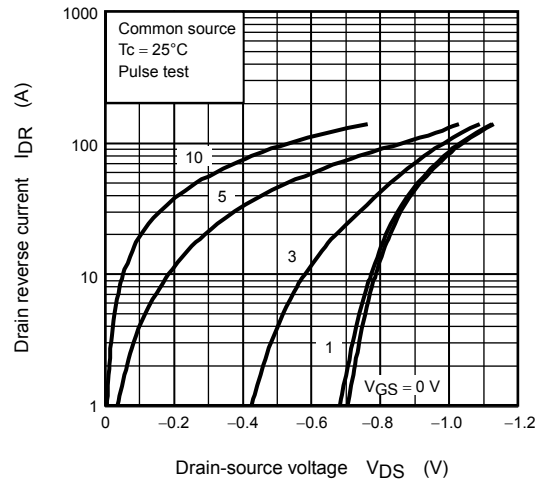
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.



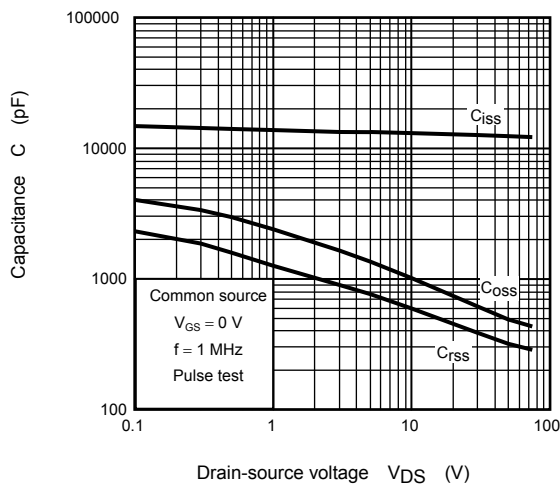
$R_{DS(ON)} - T_c$



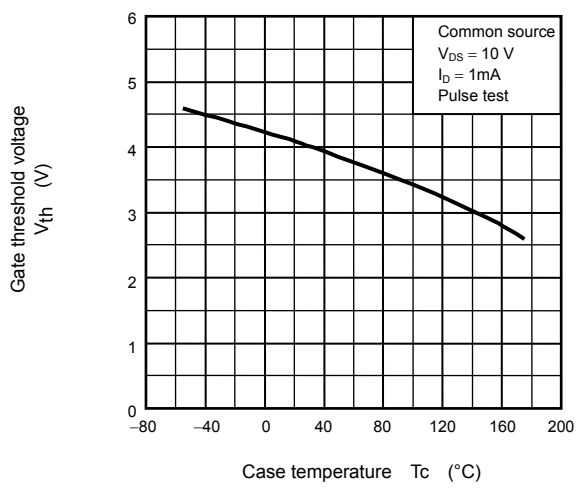
$I_{DR} - V_{DS}$



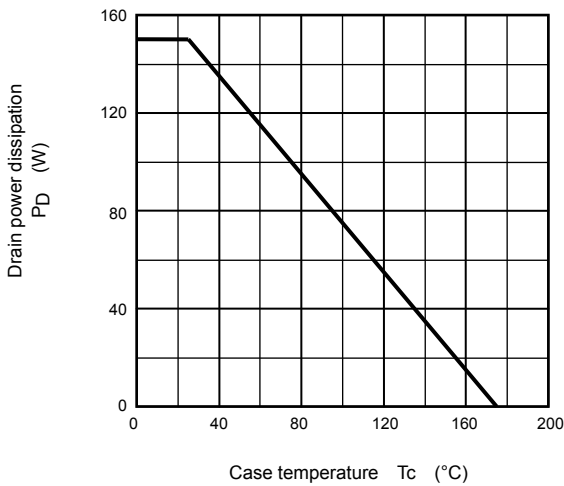
Capacitance -  $V_{DS}$



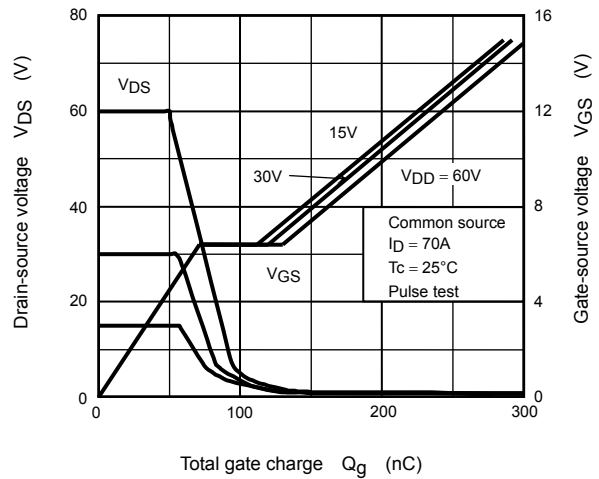
$V_{th} - T_c$

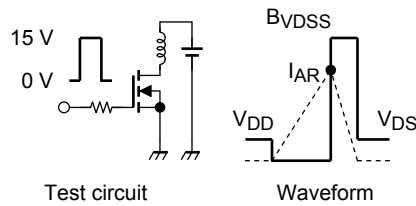
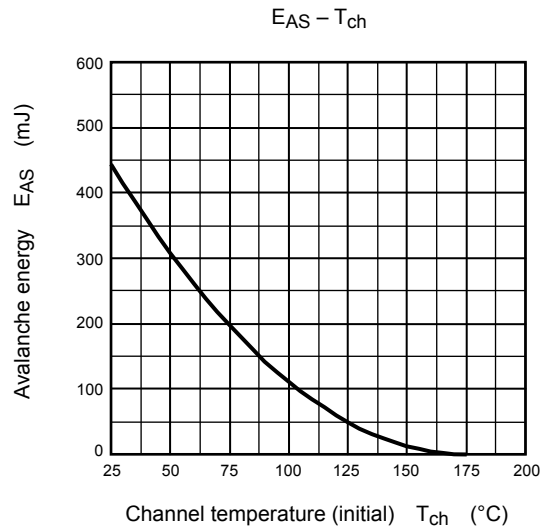
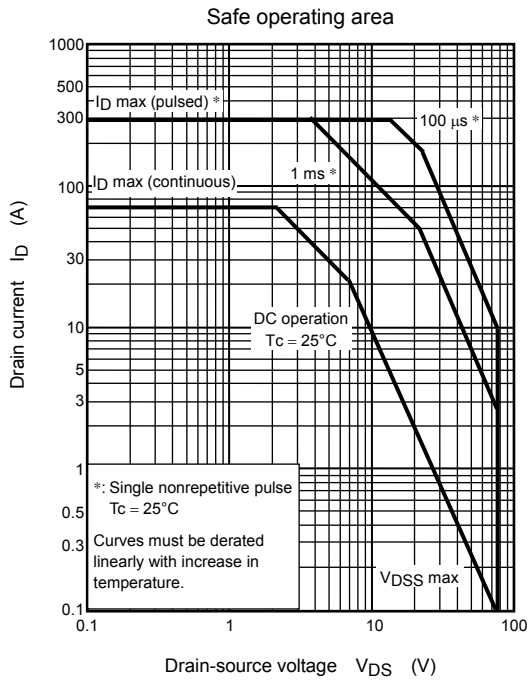
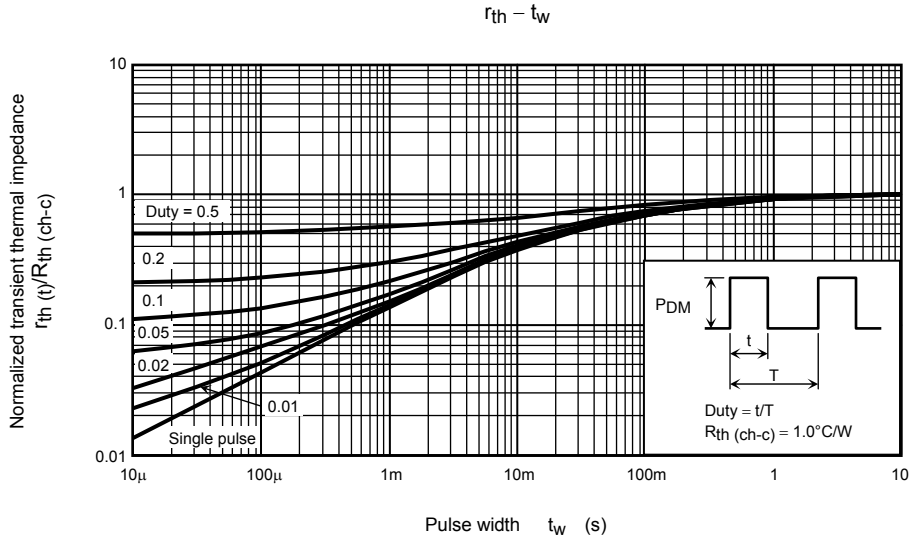


$P_D - T_c$



Dynamic input / output characteristics





$R_G = 25 \Omega$   
 $V_{DD} = 25 \text{ V}, L = 135 \mu\text{H}$

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

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