

# 2SK3440

Switching Regulator, DC-DC Converter Applications  
Motor Drive Applications

- Low drain-source ON resistance:  $R_{DS(ON)} = 6.5 \text{ m}\Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 30 \text{ S}$  (typ.)
- Low leakage current:  $I_{DSS} = 100 \text{ }\mu\text{A}$  ( $V_{DS} = 60 \text{ V}$ )
- 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 ( $T_a = 25^\circ\text{C}$ )

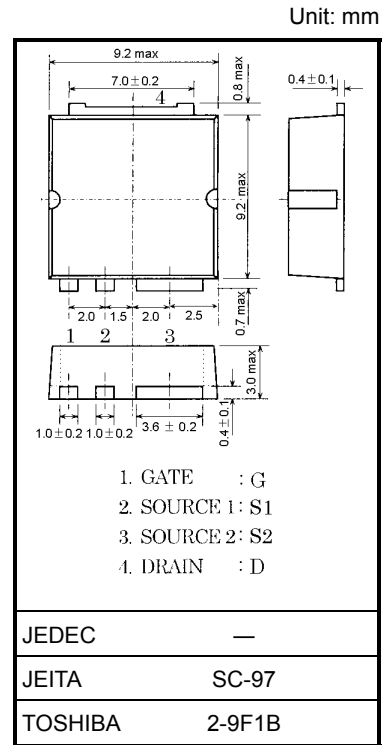
Characteristics		Symbol	Rating	Unit
Drain-source voltage		$V_{DSS}$	60	V
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )		$V_{DGR}$	60	V
Gate-source voltage		$V_{GSS}$	$\pm 30$	V
Drain current	DC (Note 1)	$I_D$	50	A
	Pulse (Note 1)	$I_{DP}$	200	
Drain power dissipation ( $T_c = 25^\circ\text{C}$ )		$P_D$	125	W
Single pulse avalanche energy (Note 2)		$E_{AS}$	644	mJ
Avalanche current		$I_{AR}$	50	A
Repetitive avalanche energy (Note 3)		$E_{AR}$	12.5	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

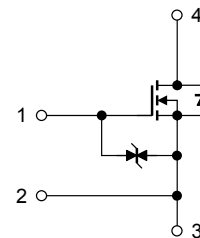
Characteristics	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th(ch-c)}$	1.00	$^\circ\text{C/W}$

- Note 1: Ensure that the channel temperature does not exceed  $150^\circ\text{C}$ .
- Note 2:  $V_{DD} = 50 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 350 \text{ }\mu\text{H}$ ,  $R_G = 25 \text{ }\Omega$ ,  $I_{AR} = 50 \text{ A}$
- Note 3: Repetitive rating: pulse width limited by maximum channel temperature
- This transistor is an electrostatic-sensitive device. Please handle with caution.

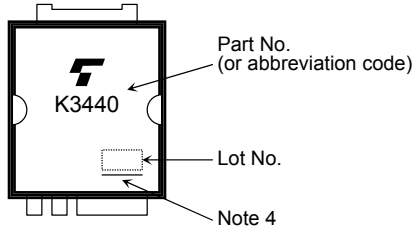


Weight: 0.74 g (typ.)

Notice:  
Please use the S1 pin for gate input signal return. Make sure that the main current flows into the S2 pin.



## Marking



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

Not underlined:  $[[\text{Pb}]]/\text{INCLUDES} > \text{MCV}$

Underlined:  $[[\underline{\text{G}}]]/\text{RoHS COMPATIBLE}$  or  $[[\underline{\text{G}}]]/\text{RoHS} [[\text{Pb}]]$

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.

## Electrical Characteristics (Note 5) ( $T_a = 25^\circ\text{C}$ )

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 25 \text{ V}, V_{DS} = 0 \text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
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		$V_{th}$	$V_{DS} = 10 \text{ V}, I_D = 1 \text{ mA}$	2.0	—	4.0	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = 10 \text{ V}, I_D = 25 \text{ A}$	—	6.5	8	$\text{m}\Omega$
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10 \text{ V}, I_D = 25 \text{ A}$	15	30	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	—	3700	—	pF
Reverse transfer capacitance		$C_{rSS}$		—	280	—	pF
Output capacitance		$C_{oss}$		—	1320	—	pF
Switching time	Rise time	$t_r$		—	12	—	ns
	Turn-on time	$t_{on}$		—	30	—	
	Fall time	$t_f$		—	12	—	
	Turn-off time	$t_{off}$		$V_{IN}$ : Duty $\leq 1\%$ , $t_w = 10 \mu\text{s}$	—	50	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 48 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 50 \text{ A}$	—	55	—	nC
Gate-source charge		$Q_{gs}$		—	35	—	nC
Gate-drain ("miller") charge		$Q_{gd}$		—	20	—	nC

Note 5: Connect the S1 and S2 pins together, and ground them except during switchin time measurement.

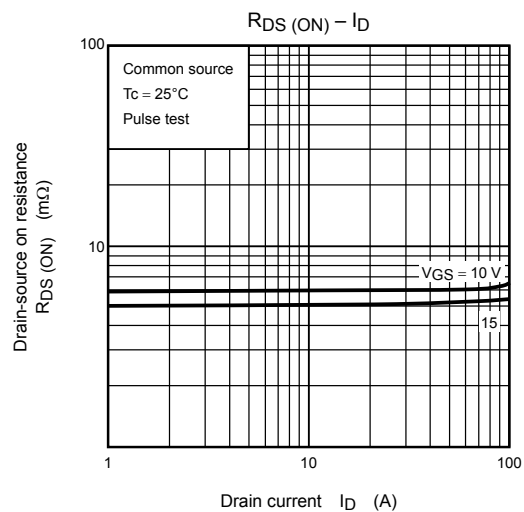
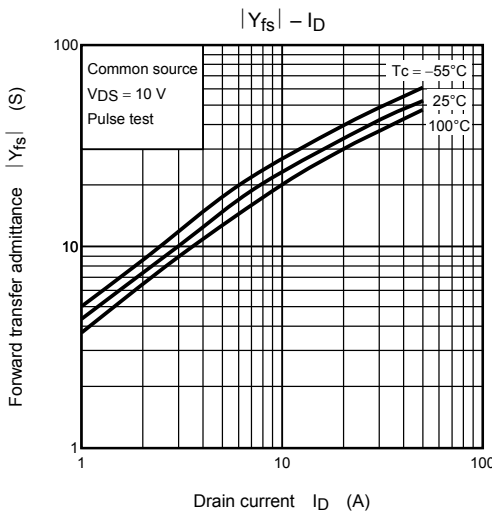
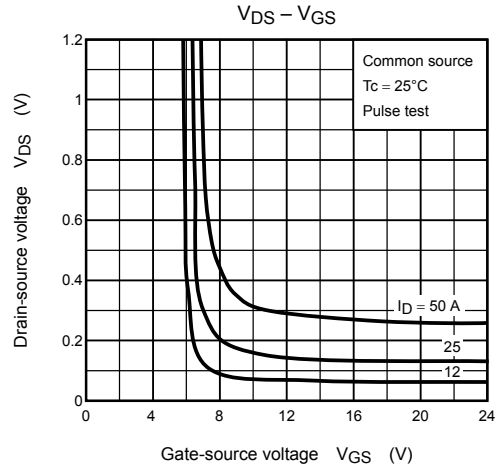
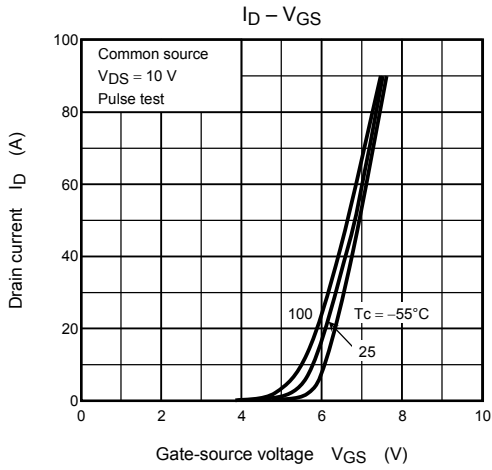
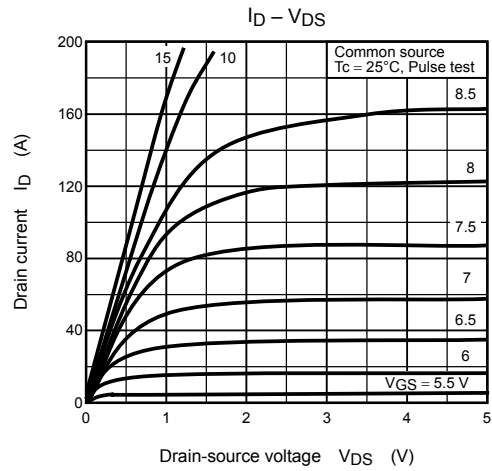
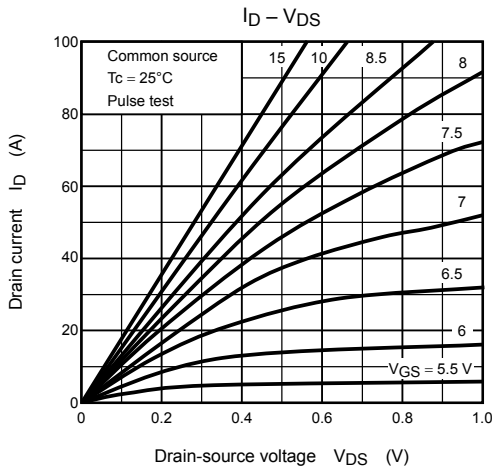
## Source-Drain Ratings and Characteristics (Note 6) ( $T_a = 25^\circ\text{C}$ )

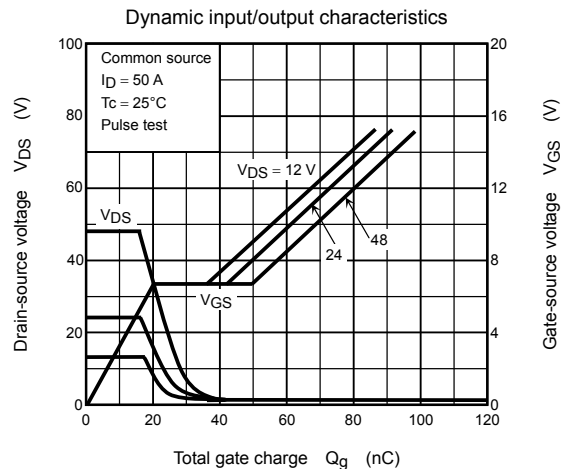
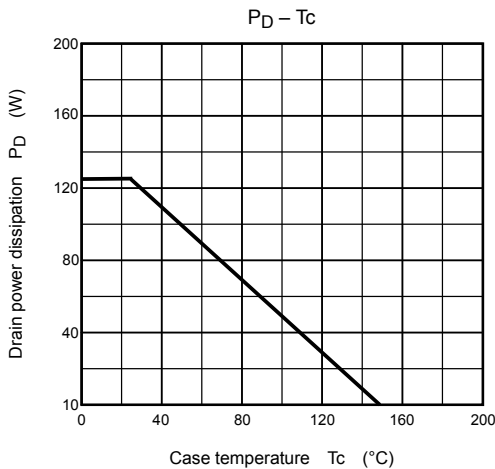
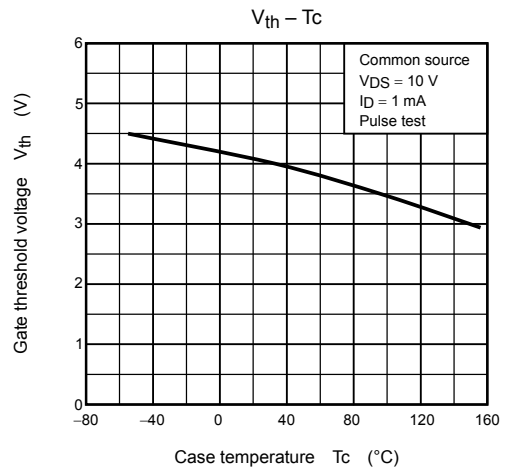
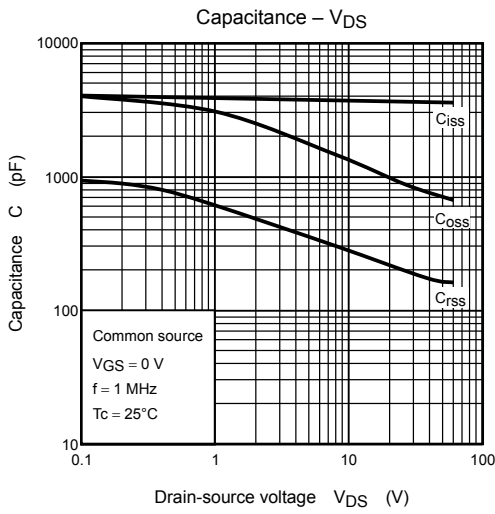
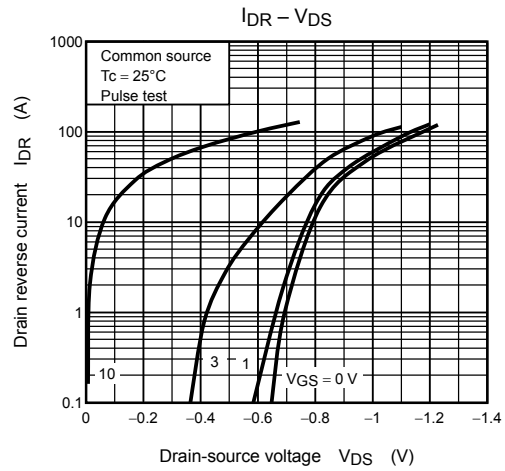
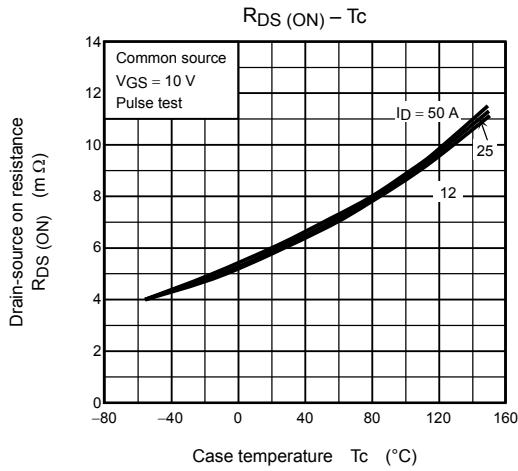
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1, Note 6)	$I_{DR1}$	—	—	—	50	A
Pulse drain reverse current (Note 1, Note 6)	$I_{DRP1}$	—	—	—	200	A
Continuous drain reverse current (Note 1, Note 6)	$I_{DR2}$	—	—	—	1	A
Pulse drain reverse current (Note 1, Note 6)	$I_{DRP2}$	—	—	—	4	A
Forward voltage (diode)	$V_{DS2F}$	$I_{DR} = 50 \text{ A}, V_{GS} = 0 \text{ V}$	—	—	-1.5	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 50 \text{ A}, V_{GS} = 0 \text{ V},$ $dI_{DR}/dt = 100 \text{ A}/\mu\text{s}$	—	70	—	ns
Reverse recovery charge	$Q_{rr}$		—	123	—	nC

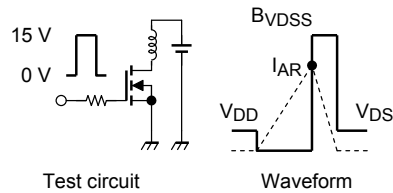
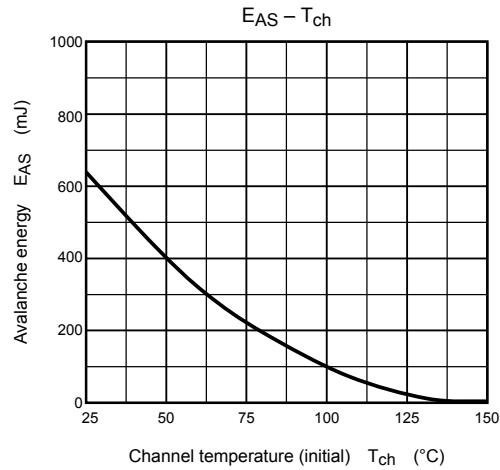
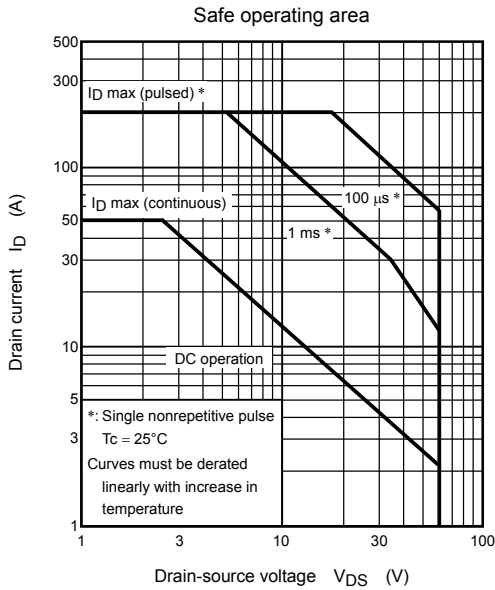
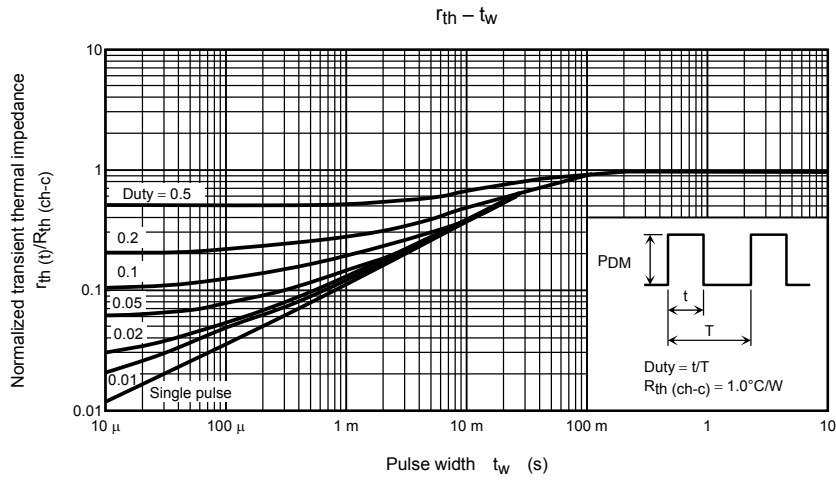
Note 6:  $I_{DR1}, I_{DRP1}$ : Current flowing between the drain and the S2 pin. Ensure that the S1 pin is left open.

$I_{DR2}, I_{DRP2}$ : Current flowing between the drain and the S1 pin. Ensure that the S2 pin is left open.

Unless otherwise specified, connect the S1 and S2 pins together, and ground them.







$R_G = 25 \Omega$   
 $V_{DD} = 50 \text{ V}, L = 350 \mu\text{H}$

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

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