

# 2SK3499

Switching Regulator and DC-DC Converter Applications  
Motor Drive Applications

- Low drain-source ON resistance:  $R_{DS(ON)} = 0.4 \Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 8.0 S$  (typ.)
- Low leakage current:  $I_{DSS} = 100 \mu A$  (max) ( $V_{DS} = 400 V$ )
- Enhancement model:  $V_{th} = 2.0$  to  $4.0 V$  ( $V_{DS} = 10 V, I_D = 1 mA$ )

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

Characteristics		Symbol	Rating	Unit
Drain-source voltage		$V_{DSS}$	400	V
Drain-gate voltage ( $R_{GS} = 20 k\Omega$ )		$V_{DGR}$	400	V
Gate-source voltage		$V_{GSS}$	$\pm 30$	V
Drain current	DC (Note 1)	$I_D$	10	A
	Pulse (Note 1)	$I_{DP}$	40	
Drain power dissipation ( $T_c = 25^\circ C$ )		$P_D$	80	W
Single pulse avalanche energy (Note 2)		$E_{AS}$	360	mJ
Avalanche current		$I_{AR}$	10	A
Repetitive avalanche energy (Note 3)		$E_{AR}$	8	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	$R_{th(ch-c)}$	1.56	°C/W

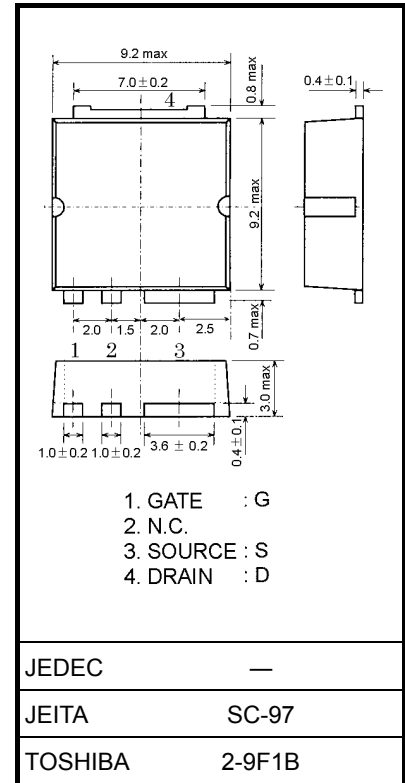
Note 1: Ensure that the channel temperature does not exceed 150°C.

Note 2:  $V_{DD} = 90 V, T_{ch} = 25^\circ C$  (initial),  $L = 5.85 mH, R_G = 25 \Omega, I_{AR} = 10 A$

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

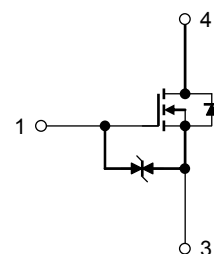
This transistor is an electrostatic-sensitive device. Please handle with caution.

Unit: mm



Weight: 0.74 g (typ.)

## Circuit Configuration



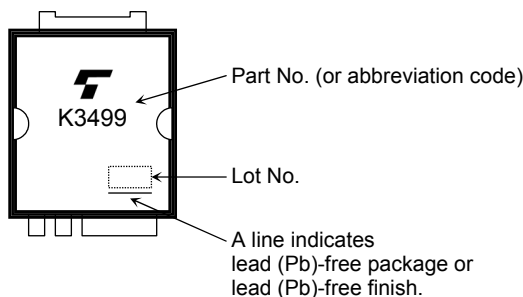
## Electrical Characteristics (Ta = 25°C)

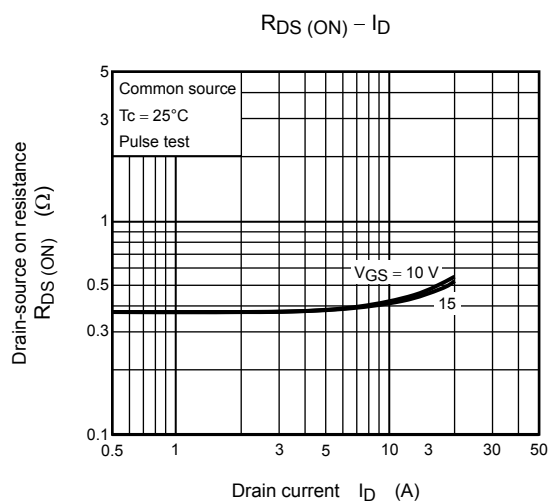
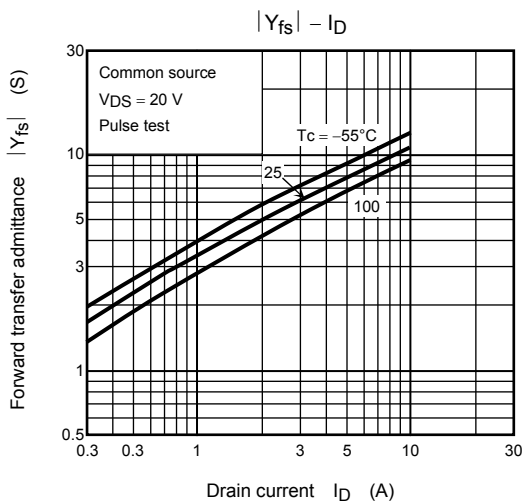
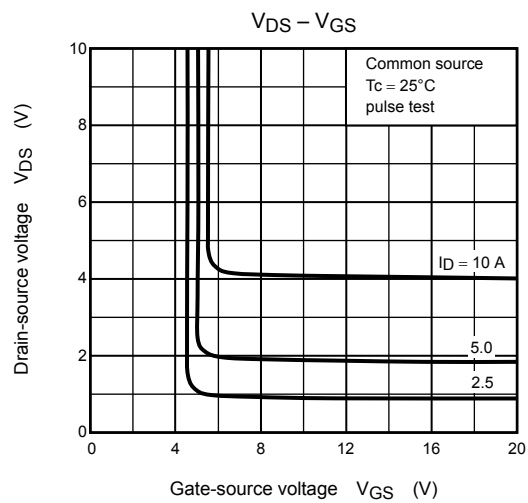
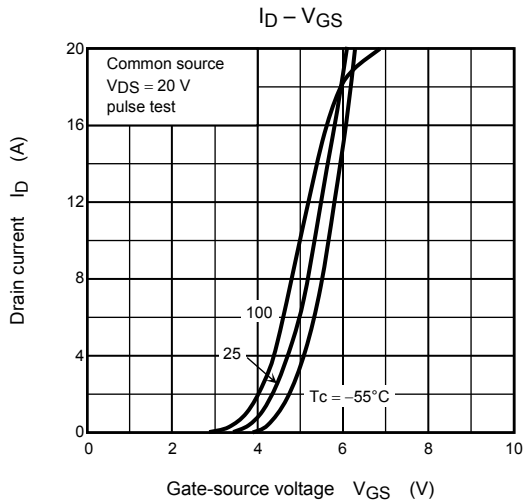
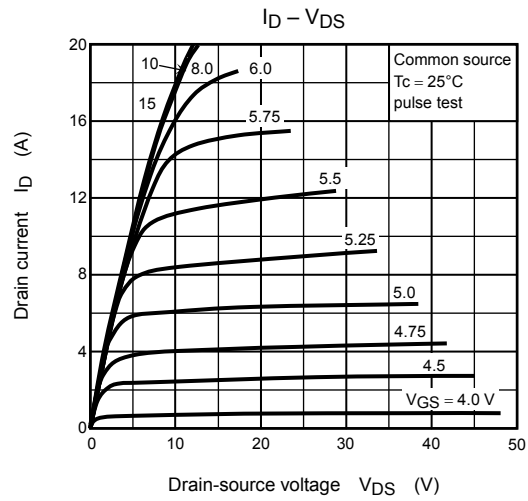
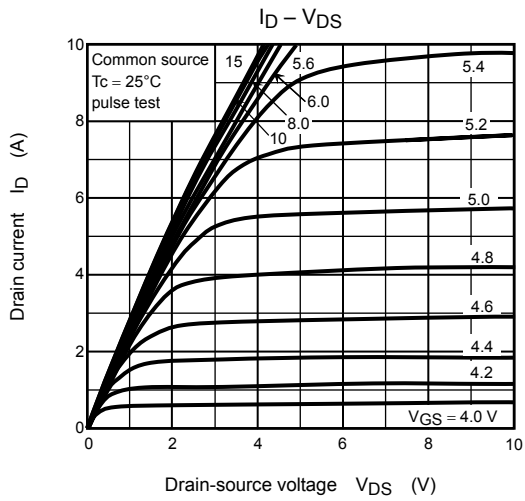
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 25\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)GSS}$	$I_G = \pm 10\ \mu\text{A}, V_{DS} = 0\text{ V}$	$\pm 30$	—	—	V
Drain cut-OFF current		$I_{DSS}$	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}$	—	—	100	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	400	—	—	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		$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 5.0\text{ A}$	—	4.0	0.55	$\Omega$
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 5.0\text{ A}$	4.0	0.8	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	1340	—	pF
Reverse transfer capacitance		$C_{rss}$		—	160	—	
Output capacitance		$C_{oss}$		—	490	—	
Switching time	Rise time	$t_r$		—	22	—	ns
	Turn-ON time	$t_{on}$		—	60	—	
	Fall time	$t_f$		—	32	—	
	Turn-OFF time	$t_{off}$		Duty $\leq 1\%$ , $t_w = 10\ \mu\text{s}$	—	140	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 320\text{ V}, V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	—	34	—	nC
Gate-source charge		$Q_{gs}$		—	18	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	16	—	

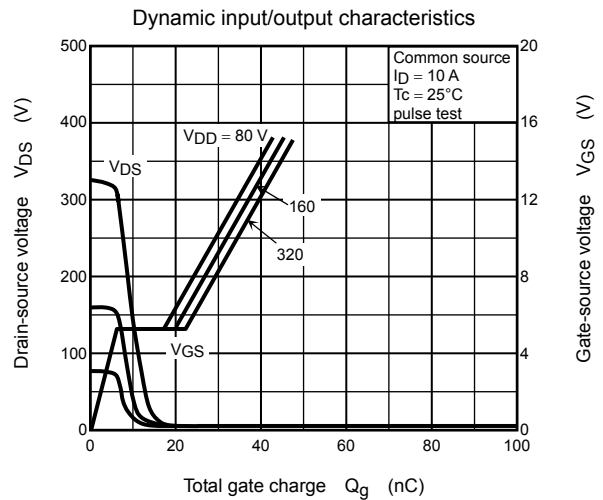
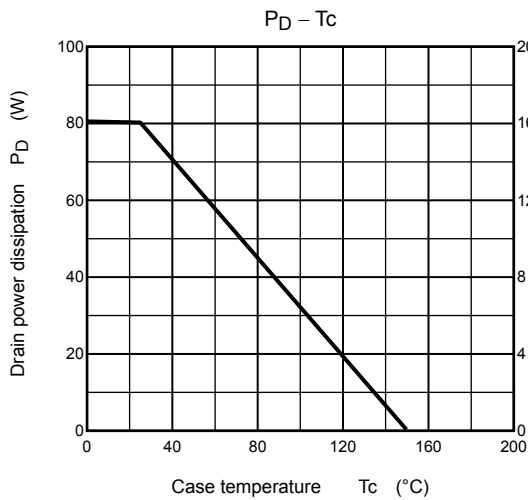
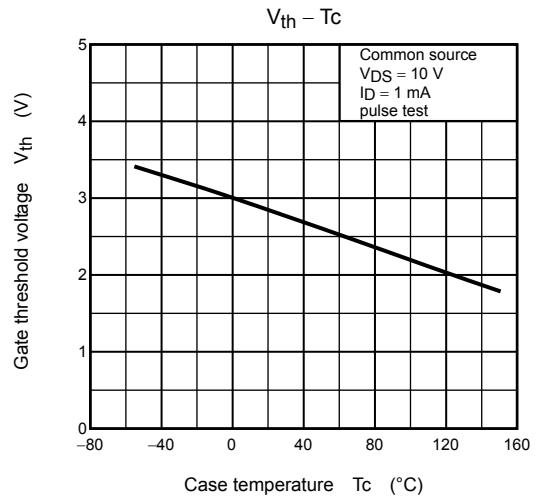
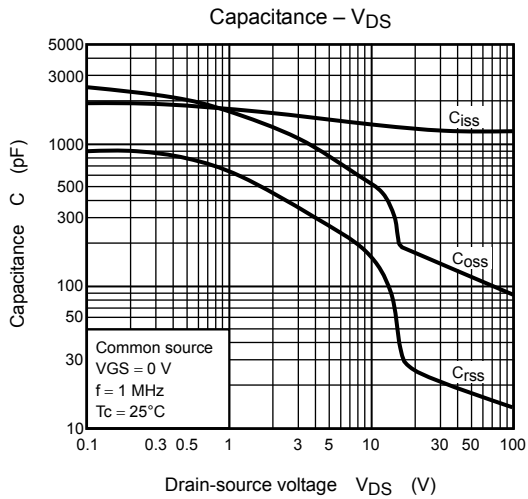
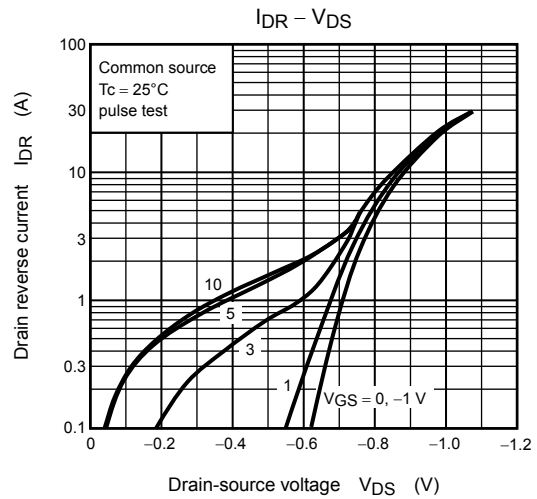
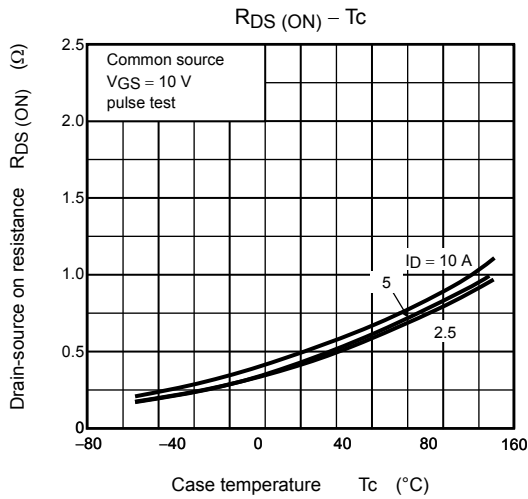
## Source-Drain Ratings and Characteristics (Ta = 25°C)

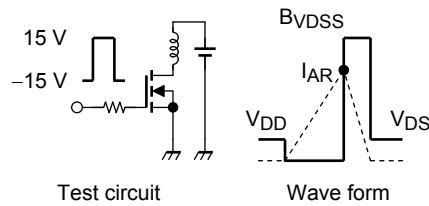
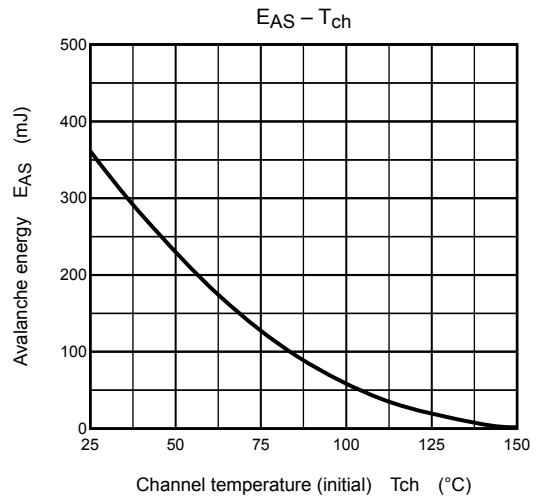
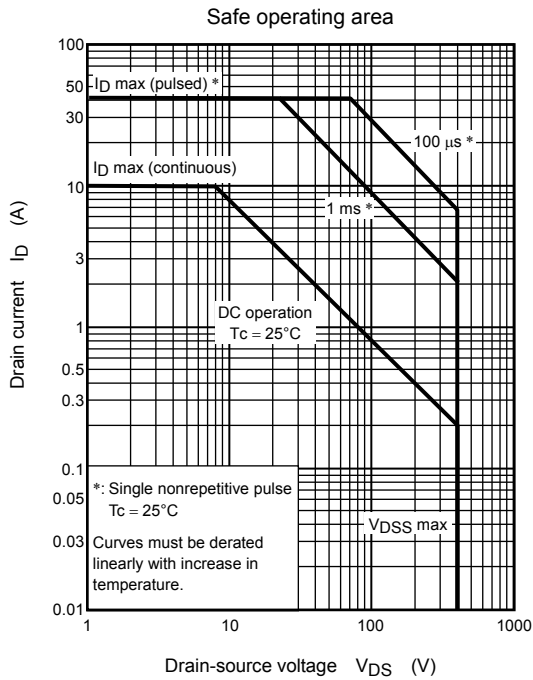
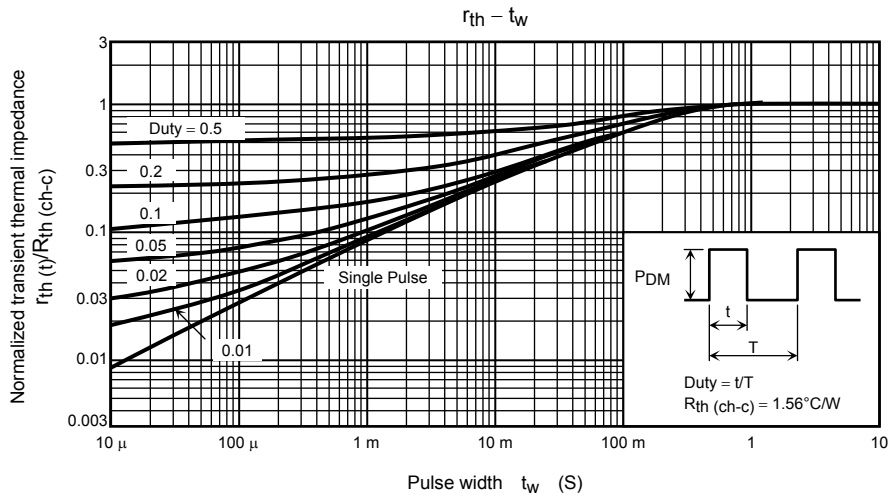
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	$I_{DR}$	—	—	—	10	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	40	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 10\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.7	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 10\text{ A}, V_{GS} = 0\text{ V},$	—	350	—	$\mu\text{s}$
Reverse recovery charge	$Q_{rr}$	$dI_{DR}/dt = 100\text{ A}/\mu\text{s}$	—	3.6	—	$\mu\text{C}$

## Marking









$R_G = 25 \Omega$   
 $V_{DD} = 90 V, L = 5.85 mH$

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

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