

# 2SK3388

## Switching Regulator and DC-DC Converter Applications Motor Drive Applications

- Low drain-source ON resistance:  $R_{DS(ON)} = 82\text{ m}\Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 20\text{ S}$  (typ.)
- Low leakage current:  $I_{DSS} = 100\text{ }\mu\text{A}$  ( $V_{DS} = 250\text{ V}$ )
- Enhancement mode:  $V_{th} = 1.5\text{ to }3.5\text{ V}$  ( $V_{DS} = 10\text{ V}$ ,  $I_D = 1\text{ mA}$ )

### Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Characteristics		Symbol	Rating	Unit
Drain-source voltage		$V_{DSS}$	250	V
Drain-gate voltage ( $R_{GS} = 20\text{ k}\Omega$ )		$V_{DGR}$	250	V
Gate-source voltage		$V_{GSS}$	$\pm 20$	V
Drain current	DC (Note 1)	$I_D$	20	A
	Pulse (Note 1)	$I_{DP}$	60	
Drain power dissipation ( $T_c = 25^\circ\text{C}$ )		$P_D$	125	W
Single pulse avalanche energy (Note 2)		$E_{AS}$	487	mJ
Avalanche current		$I_{AR}$	20	A
Repetitive avalanche energy (Note 3)		$E_{AR}$	12.5	mJ
Channel temperature		$T_{ch}$	150	$^\circ\text{C}$
Storage temperature range		$T_{stg}$	$-55\sim 150$	$^\circ\text{C}$

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

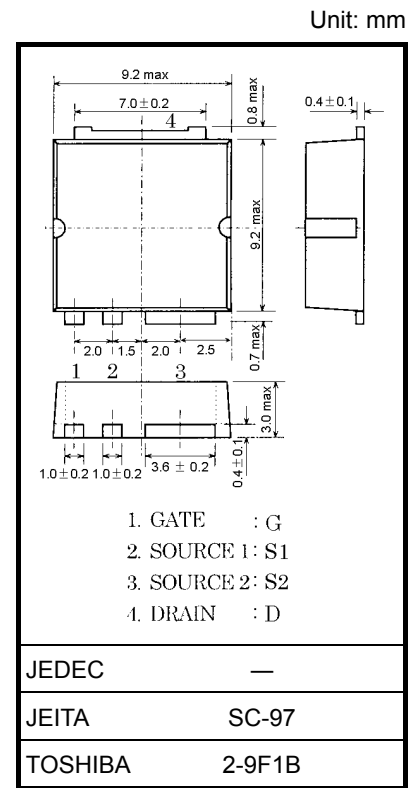
Characteristics	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th(ch-c)}$	1.00	$^\circ\text{C/W}$

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),  $L = 2.06\text{ mH}$ ,  $I_{AR} = 20\text{ A}$ ,  $R_G = 25\text{ }\Omega$

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

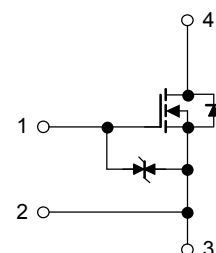
This transistor is an electrostatic-sensitive device. Please handle with caution.



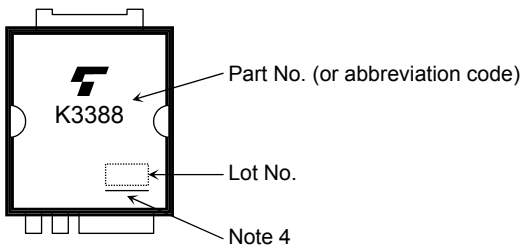
Weight: 0.74 g (typ.)

### Circuit Configuration

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: [[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.

## Electrical Characteristics (Note 5) (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		$I_{DSS}$	$V_{DS} = 250\text{ V}, V_{GS} = 0\text{ V}$	—	—	100	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	250	—	—	V
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	1.5	—	3.5	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	—	82	105	$\text{m}\Omega$
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 10\text{ A}$	10	20	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	4000	—	pF
Reverse transfer capacitance		$C_{rss}$		—	300	—	
Output capacitance		$C_{oss}$		—	1000	—	
Switching time	Rise time	$t_r$		—	7	—	ns
	Turn-on time	$t_{on}$		—	20	—	
	Fall time	$t_f$		—	25	—	
	Turn-off time	$t_{off}$		Duty $\leq 1\%$ , $t_w = 10\ \mu\text{s}$	—	145	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 200\text{ V}, V_{GS} = 10\text{ V}, I_D = 20\text{ A}$	—	100	—	nC
Gate-source charge		$Q_{gs}$		—	70	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	30	—	

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

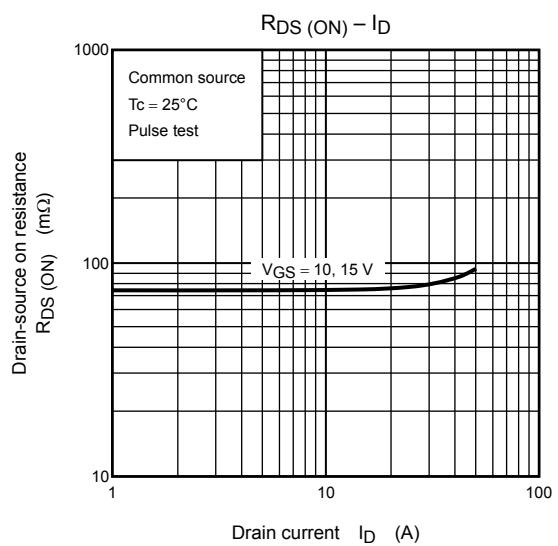
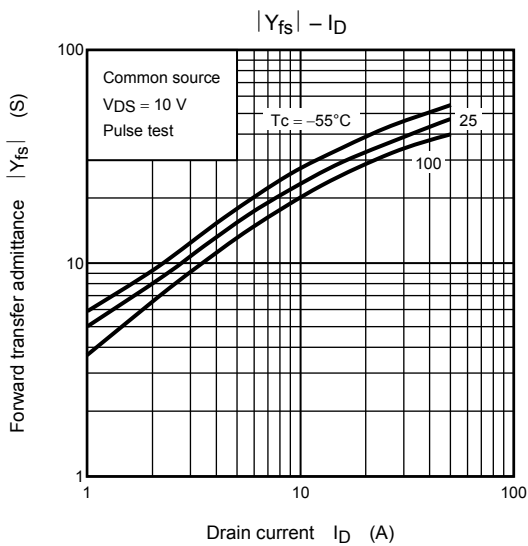
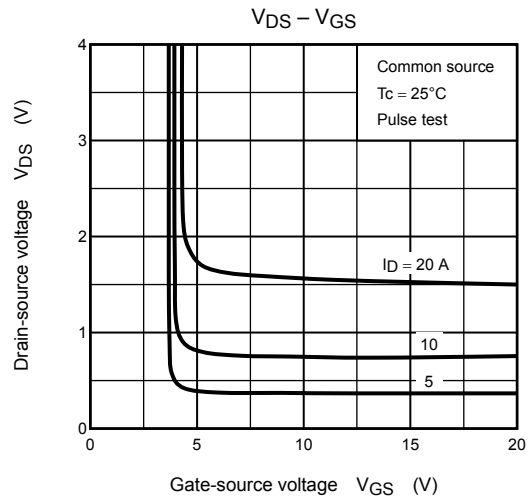
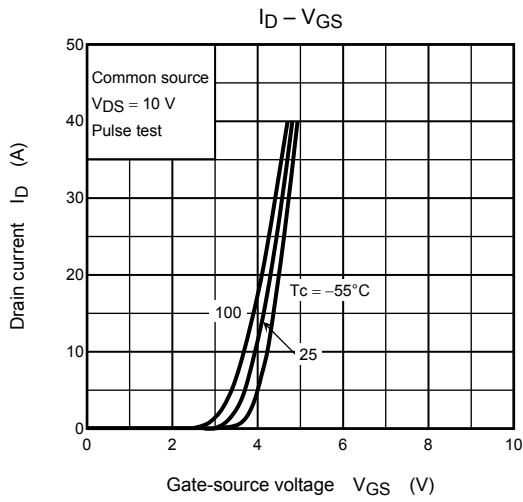
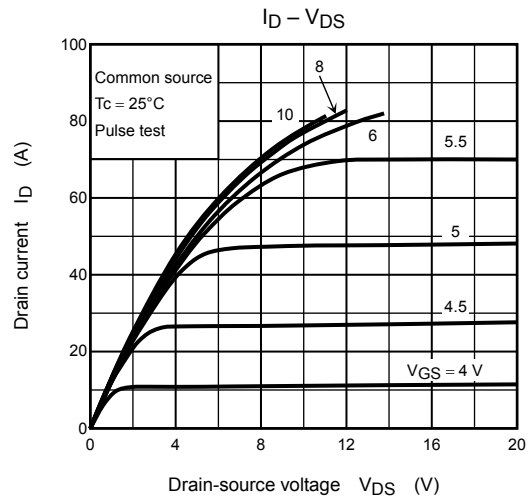
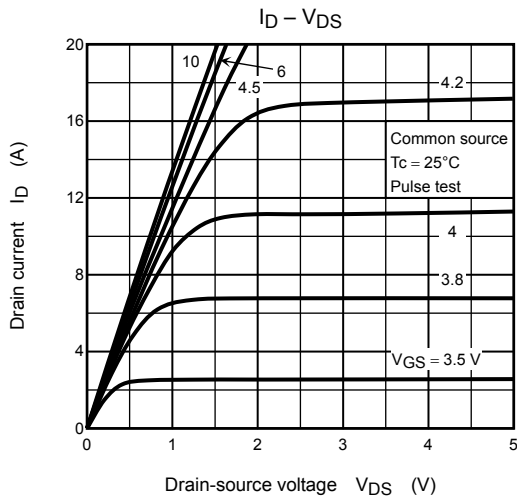
## Source-Drain Ratings and Characteristics (Note 6) (Ta = 25°C)

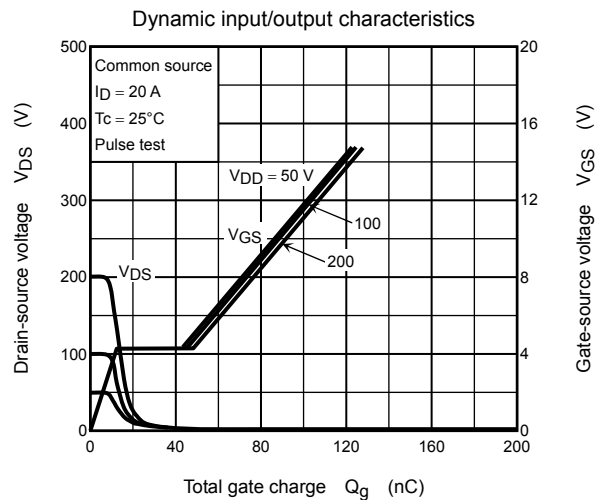
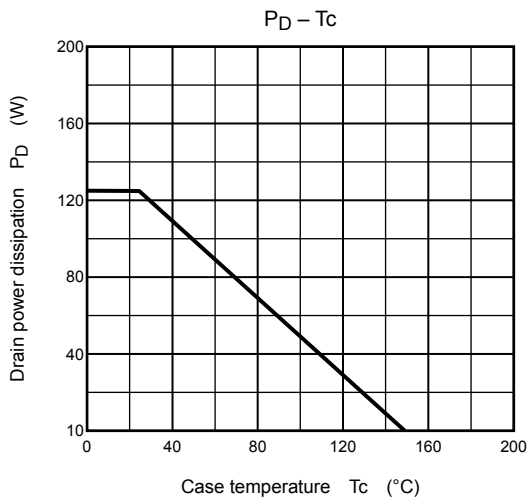
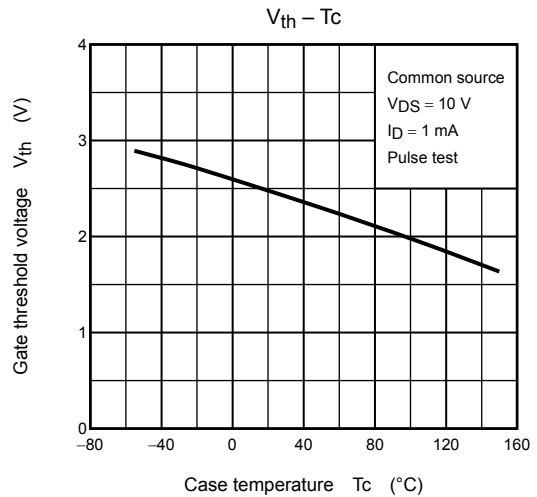
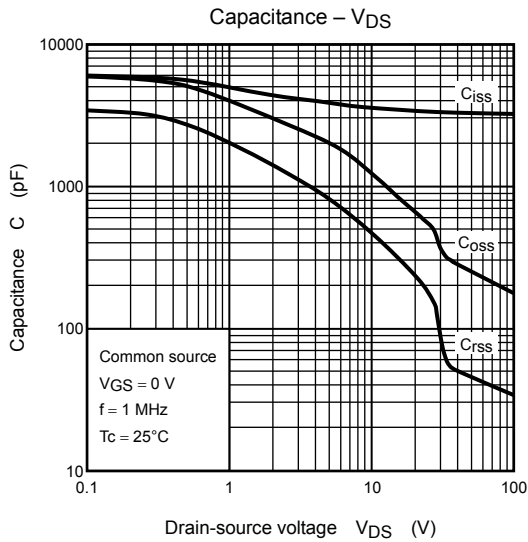
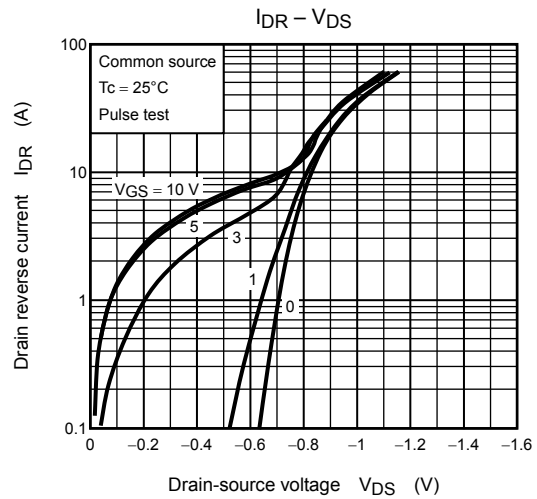
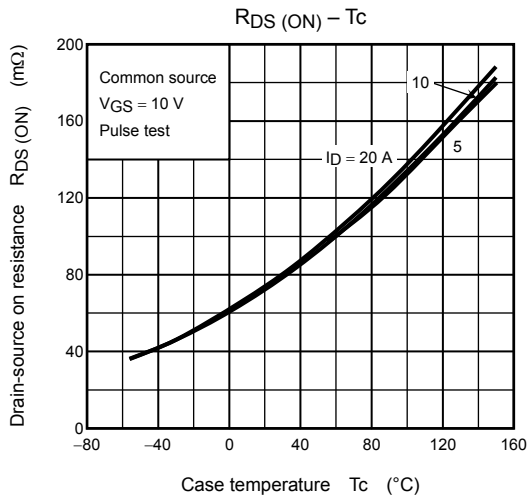
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1, Note 6)	$I_{DR1}$	—	—	—	20	A
Pulse drain reverse current (Note 1, Note 6)	$I_{DRP1}$	—	—	—	60	A
Continuous drain reverse current (Note 1, Note 6)	$I_{DR2}$	—	—	—	1	A
Pulse drain reverse current (Note 1, Note 6)	$I_{DRP2}$	—	—	—	4	A
Forward voltage (diode)	$V_{DS2F}$	$I_{DR1} = 20\text{ A}, V_{GS} = 0\text{ V}$	—	—	-2.0	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 20\text{ A}, V_{GS} = 0\text{ V}, dI_{DR}/dt = 100\text{ A}/\mu\text{s}$	—	300	—	ns
Reverse recovery charge	$Q_{rr}$		—	3.3	—	$\mu\text{C}$

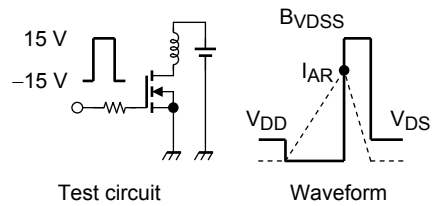
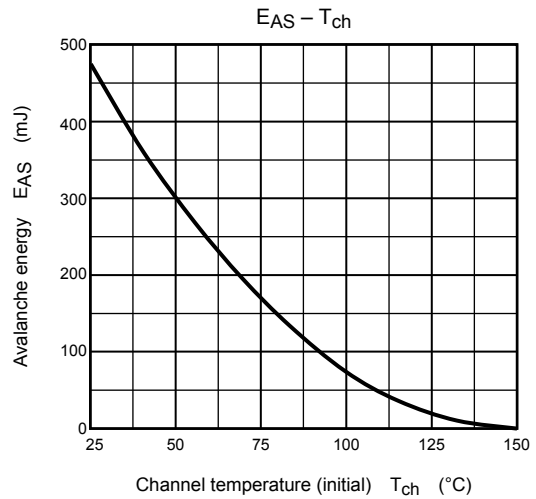
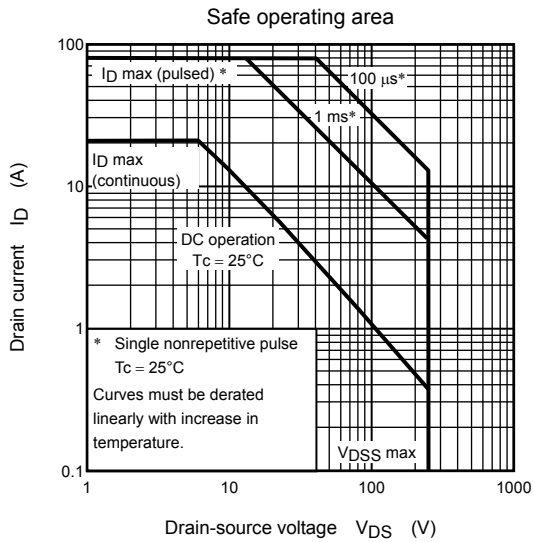
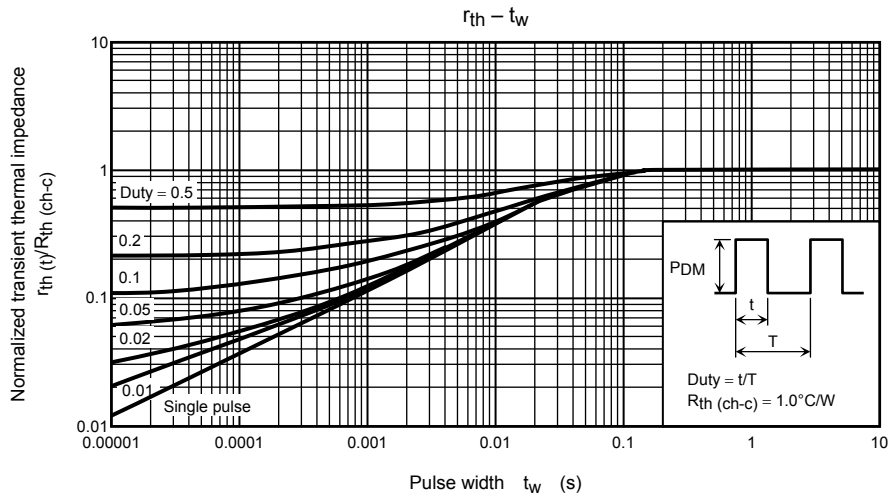
Note 6:  $I_{DR1}, I_{DRP1}$ : Current flowing between the drain and the S2 pin. Ensure that the S1 pin is left open.

$I_{DR2}, I_{DRP2}$ : 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.







$R_G = 25 \Omega$   
 $V_{DD} = 50 V, L = 2.06 mH$

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

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