



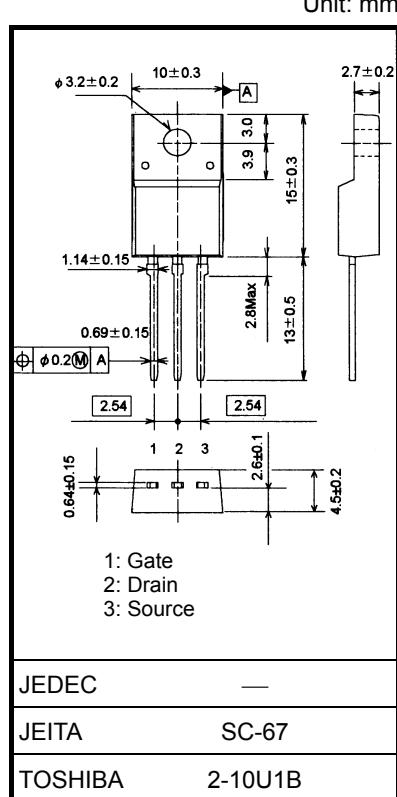
# 2SK4013

## Switching Regulator Applications

- Low drain-source ON resistance:  $R_{DS\text{ (ON)}} = 1.35 \Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 5.0 \text{ S}$  (typ.)
- Low leakage current:  $I_{DSS} = 100 \mu\text{A}$  (max) ( $V_{DS} = 640 \text{ V}$ )
- Enhancement-model:  $V_{th} = 2.0$  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	$V_{DSS}$	800	V
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )	$V_{DGR}$	800	V
Gate-source voltage	$V_{GSS}$	$\pm 30$	V
Drain current	DC (Note 1)	$I_D$	A
	Pulse (Note 1)	$I_{DP}$	
Drain power dissipation ( $T_c = 25^\circ\text{C}$ )	$P_D$	45	W
Single pulse avalanche energy (Note 2)	$E_{AR}$	317	mJ
Avalanche current	$I_{AR}$	6	A
Repetitive avalanche energy (Note 3)	$E_{AR}$	4.5	mJ
Channel temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage temperature range	$T_{stg}$	-55 to 150	$^\circ\text{C}$



Weight: 1.7 g (typ.)

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

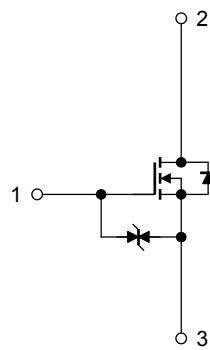
Characteristics	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th\text{ (ch-c)}}$	2.78	$^\circ\text{C/W}$
Thermal resistance, channel to ambient	$R_{th\text{ (ch-a)}}$	62.5	$^\circ\text{C/W}$

Note 1: Please use devices on condition that the channel temperature is below  $150^\circ\text{C}$ .

Note 2:  $V_{DD} = 90 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 14.5 \text{ mH}$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = 6 \text{ A}$

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

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



**Electrical Characteristics (Ta = 25°C)**

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I <sub>GSS</sub>	V <sub>GS</sub> = ±25 V, V <sub>DS</sub> = 0 V	—	—	±10	µA
Drain-source breakdown voltage	V <sub>(BR) GSS</sub>	I <sub>G</sub> = ±10 µA, V <sub>DS</sub> = 0 V	±30	—	—	V
Drain cut-OFF current	I <sub>DSS</sub>	V <sub>DS</sub> = 640 V, V <sub>GS</sub> = 0 V	—	—	100	µA
Drain-source breakdown voltage	V <sub>(BR) DSS</sub>	I <sub>D</sub> = 10 mA, V <sub>GS</sub> = 0 V	800	—	—	V
Gate threshold voltage	V <sub>th</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA	2.0	—	4.0	V
Drain-source ON resistance	R <sub>D5 (ON)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 3 A	—	1.35	1.7	Ω
Forward transfer admittance	Y <sub>fs</sub>	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 3 A	2.5	5.0	—	S
Input capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1 MHz	—	1400	—	pF
Reverse transfer capacitance	C <sub>rss</sub>		—	30	—	
Output capacitance	C <sub>oss</sub>		—	130	—	
Switching time	Rise time	t <sub>r</sub>	 Duty ≤ 1%, t <sub>W</sub> = 10 µs	—	25	—
	Turn-ON time	t <sub>on</sub>		—	80	—
	Fall time	t <sub>f</sub>		—	65	—
	Turn-OFF time	t <sub>off</sub>		—	220	—
Total gate charge (gate-source plus gate-drain)	Q <sub>g</sub>	V <sub>DD</sub> ≈ 400 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 6 A	—	45	—	nC
Gate-source charge	Q <sub>gs</sub>		—	25	—	
Gate-drain ("miller") charge	Q <sub>gd</sub>		—	20	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	I <sub>DR</sub>	—	—	—	6	A
Pulse drain reverse current (Note 1)	I <sub>DRP</sub>	—	—	—	18	A
Forward voltage (diode)	V <sub>DSF</sub>	I <sub>DR</sub> = 6 A, V <sub>GS</sub> = 0 V	—	—	-1.7	V
Reverse recovery time	t <sub>rr</sub>	I <sub>DR</sub> = 6 A, V <sub>GS</sub> = 0 V, dI <sub>DR</sub> /dt = 100 A/µs	—	1100	—	ns
Reverse recovery charge	Q <sub>rr</sub>		—	10	—	µC

**Marking**