

TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type (U-MOS III)

2SK4017

Chopper Regulator, DC-DC Converter and Motor Drive Applications

- 4-V gate drive
- Low drain-source ON-resistance: $R_{DS(ON)} = 0.07 \Omega$ (typ.)
- High forward transfer admittance: $|Y_{fs}| = 6.0 \text{ S}$ (typ.)
- Low leakage current: $I_{DSS} = 100 \mu\text{A}$ (max) ($V_{DS} = 60 \text{ V}$)
- Enhancement mode: $V_{th} = 1.3 \text{ to } 2.5 \text{ V}$ ($V_{DS} = 10 \text{ V}$, $I_D = 1 \text{ mA}$)

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

Characteristic		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}	± 20	V
Drain current	DC (Note 1)	I_D	5	A
	Pulse (Note 1)	I_{DP}	20	A
Drain power dissipation ($T_c = 25^\circ\text{C}$)		P_D	20	W
Single-pulse avalanche energy (Note 2)		E_{AS}	40.5	mJ
Avalanche current		I_{AR}	5	A
Repetitive avalanche energy (Note 3)		E_{AR}	2	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

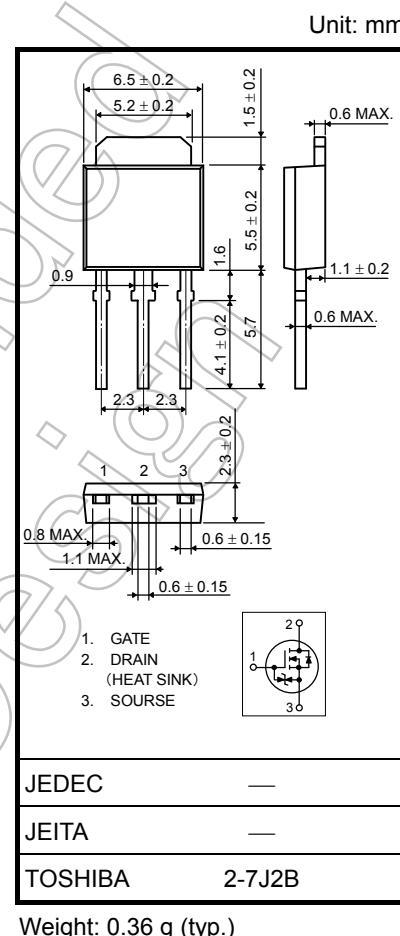
Characteristic	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th(ch-c)}$	6.25	$^\circ\text{C} / \text{W}$
Thermal resistance, channel to ambient	$R_{th(ch-a)}$	125	$^\circ\text{C} / \text{W}$

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

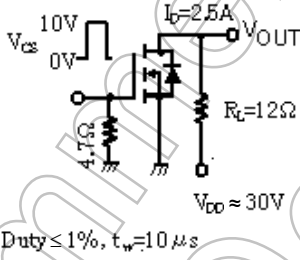
Note 2: $V_{DD} = 25 \text{ V}$, $T_{ch} = 25^\circ\text{C}$ (initial), $L = 2.2 \text{ mH}$, $R_G = 25 \Omega$, $I_{AR} = 5 \text{ A}$

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

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



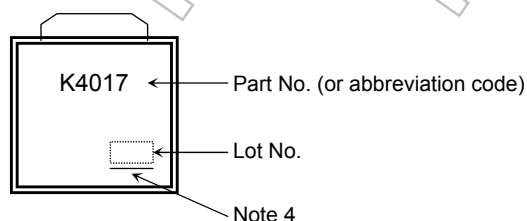
Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	$V_{GS} = \pm 16 \text{ V}, V_{DS} = 0 \text{ V}$	—	—	± 10	μA
Drain cutoff current		I_{DSS}	$V_{DS} = 60 \text{ V}, V_{GS} = 0 \text{ V}$	—	—	100	μA
Drain-source breakdown voltage		$V_{(BR) DSS}$	$I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}$	60	—	—	V
		$V_{(BR) DSX}$	$I_D = 10\text{mA}, V_{GS} = -20\text{V}$	35	—	—	V
Gate threshold voltage		V_{th}	$V_{DS} = 10 \text{ V}, I_D = 1 \text{ mA}$	1.3	—	2.5	V
Drain-source ON-resistance		$R_{DS(ON)}$	$V_{GS} = 4 \text{ V}, I_D = 2.5 \text{ A}$	—	0.09	0.15	Ω
			$V_{GS} = 10 \text{ V}, I_D = 2.5 \text{ A}$	—	0.07	0.10	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10 \text{ V}, I_D = 2.5 \text{ A}$	3.0	6.0	—	S
Input capacitance		C_{iss}	$V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	—	730	—	pF
Reverse transfer capacitance		C_{rss}		—	60	—	
Output capacitance		C_{oss}		—	95	—	
Switching time	Rise time	t_r		—	10	—	ns
	Turn-on time	t_{on}		—	20	—	
	Fall time	t_f		—	4	—	
	Turn-off time	t_{off}		—	35	—	
Total gate charge (gate-source plus gate-drain)		Q_g	$V_{DD} \approx 48 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 5 \text{ A}$	—	15	—	nC
Gate-source charge		Q_{gs}		—	11	—	
Gate-drain ("Miller") charge		Q_{gd}		—	4	—	

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

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	I_{DR}	—	—	—	5	A
Pulse drain reverse current (Note 1)	I_{DRP}	—	—	—	20	A
Forward voltage (diode)	V_{DSF}	$I_{DR} = 5 \text{ A}, V_{GS} = 0 \text{ V}$	—	—	-1.7	V
Reverse recovery time	t_{rr}	$I_{DR} = 5 \text{ A}, V_{GS} = 0 \text{ V}, dI_{DR}/dt = 50 \text{ A}/\mu\text{s}$	—	34	—	ns
Reverse recovery charge	Q_{rr}		—	28	—	nC

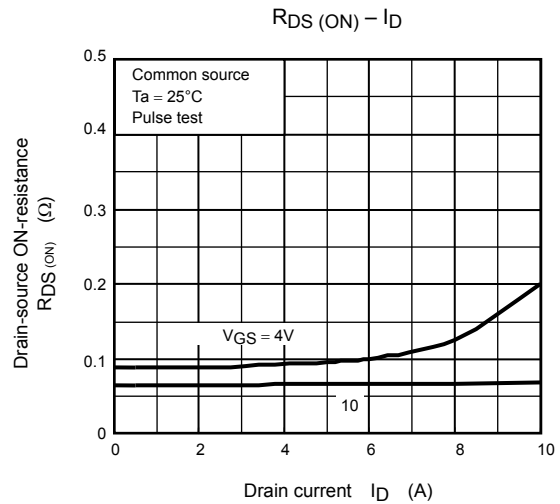
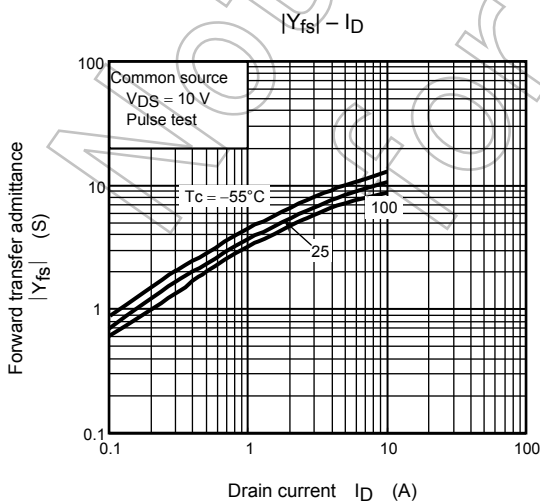
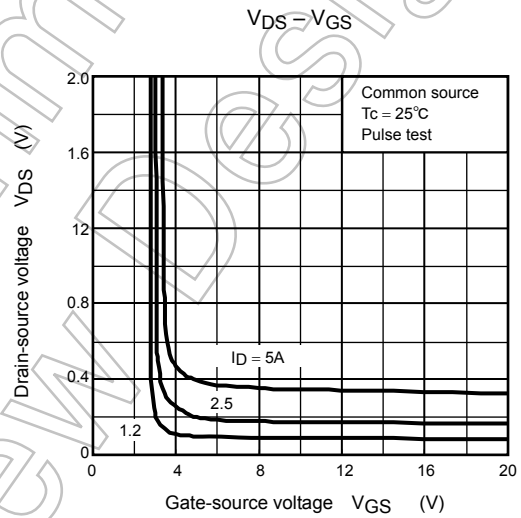
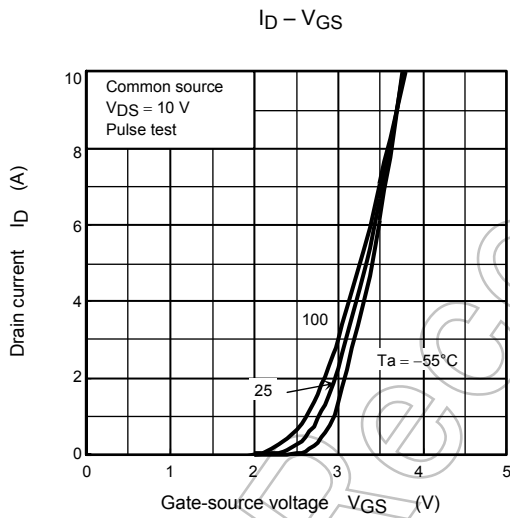
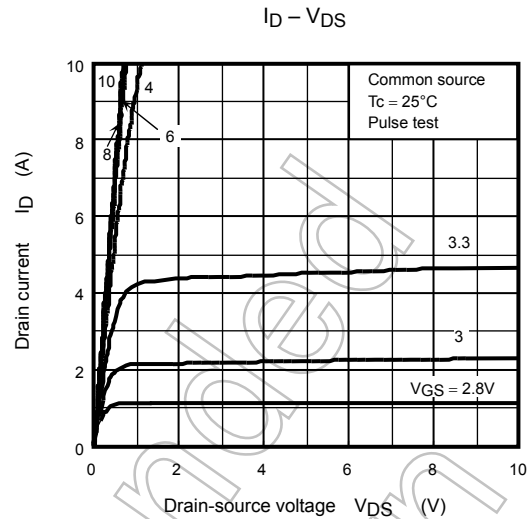
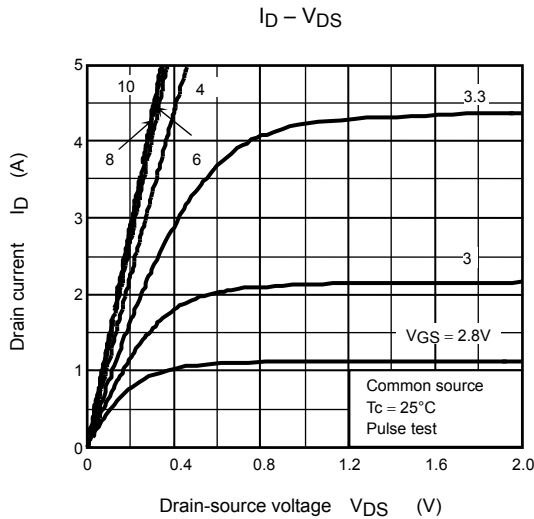
Marking



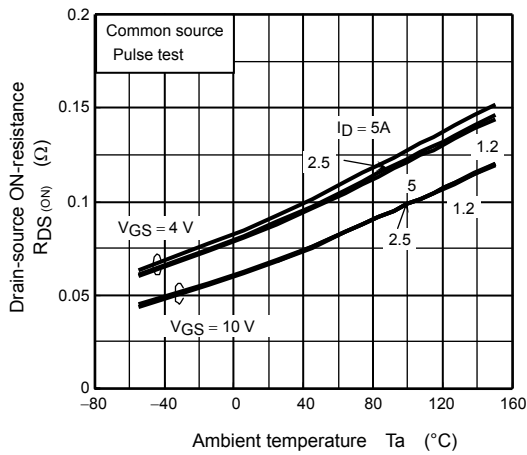
Note 4: A line under a Lot No. identifies the indication of product Labels.

[[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

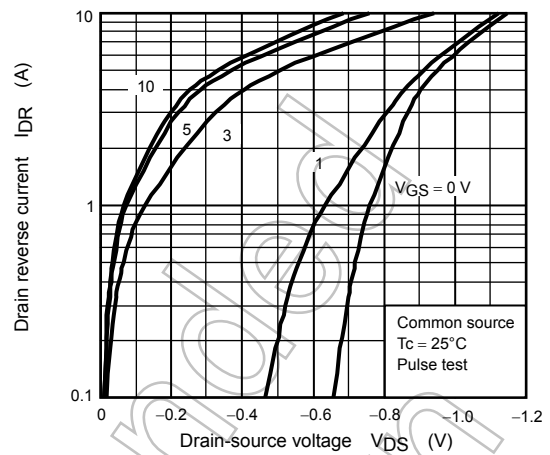
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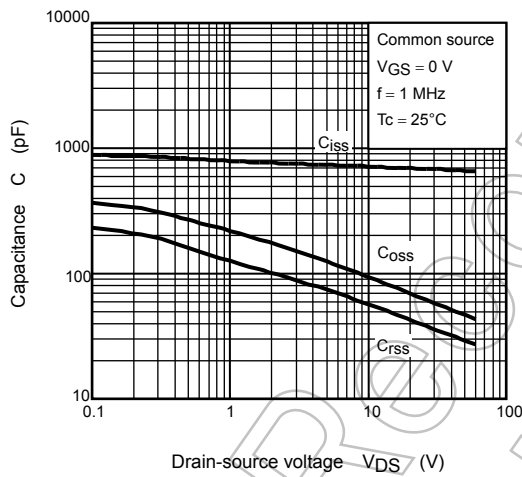
$R_{DS(ON)} - T_a$



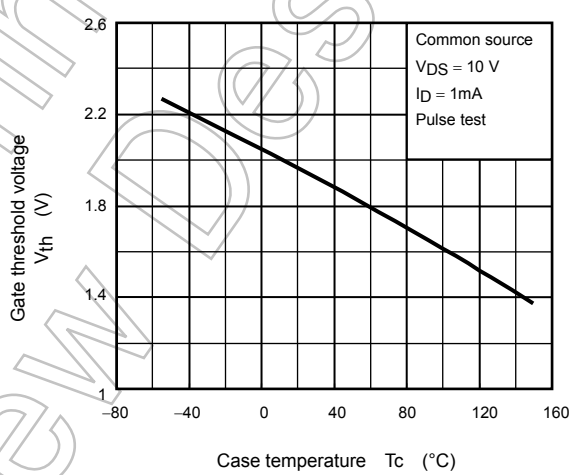
$I_{DR} - V_{DS}$



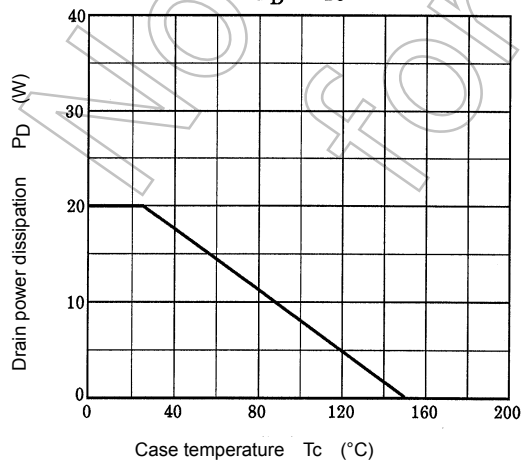
Capacitance - V_{DS}



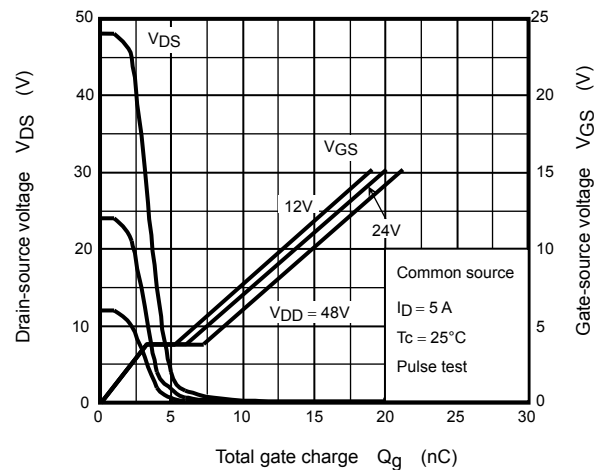
$V_{th} - T_c$

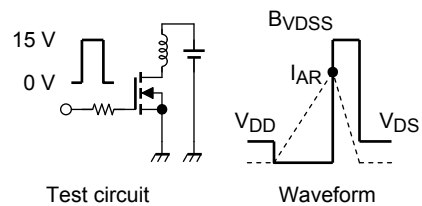
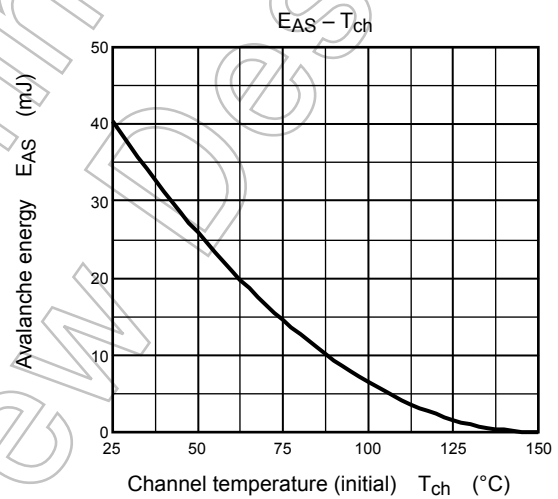
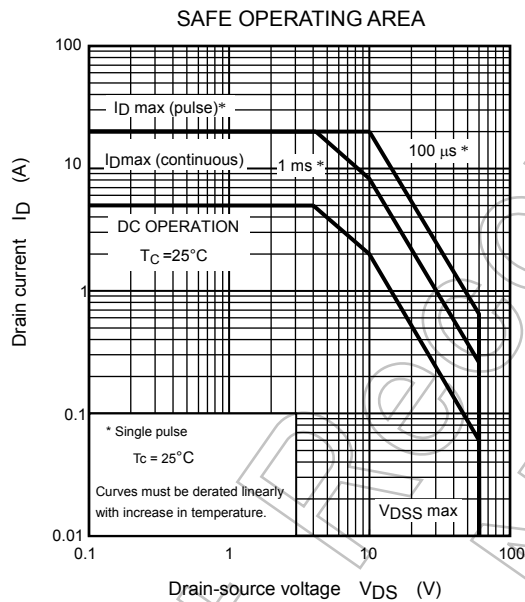
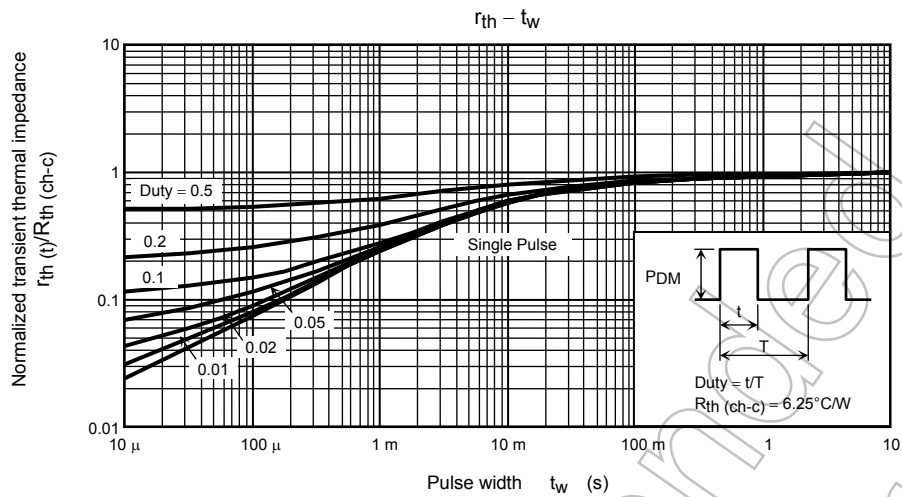


$P_D - T_c$



Dynamic input / output characteristics





$$R_G = 25 \Omega$$

$$V_{DD} = 25 \text{ V}, L = 2.2 \text{ mH}$$

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

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