

TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type (π -MOS V)

2SK4021

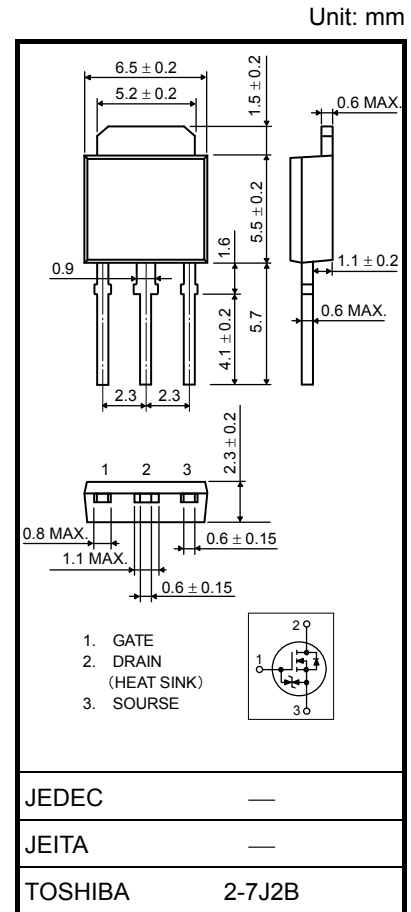
Switching Regulators and DC-DC Converter Applications
Motor Drive Applications

- Low drain-source ON-resistance: $R_{DS(ON)} = 0.8 \Omega$ (typ.)
- High forward transfer admittance: $|Y_{fs}| = 4.5 S$ (typ.)
- Low leakage current: $I_{DSS} = 100 \mu A$ (max) ($V_{DS} = 250 V$)
- Enhancement mode: $V_{th} = 1.5$ to $3.5 V$ ($V_{DS} = 10 V, I_D = 1 mA$)

Absolute Maximum Ratings (Ta = 25°C)

Characteristic	Symbol	Rating	Unit	
Drain-source voltage	V_{DSS}	250	V	
Drain-gate voltage ($R_{GS} = 20 k\Omega$)	V_{DGR}	250	V	
Gate-source voltage	V_{GSS}	± 20	V	
Drain current	DC (Note 1)	I_D	4.5	A
	Pulse (Note 1)	I_{DP}	18	A
Drain power dissipation ($T_c = 25^\circ C$)	P_D	20	W	
Single-pulse avalanche energy (Note 2)	E_{AS}	51	mJ	
Avalanche current	I_{AR}	4.5	A	
Repetitive avalanche energy (Note 3)	E_{AR}	2.0	mJ	
Channel temperature	T_{ch}	150	$^\circ C$	
Storage temperature range	T_{stg}	-55 to 150	$^\circ C$	

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).



Weight: 0.36 g (typ.)

Thermal Characteristics

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

Note 1: Ensure that the channel temperature does not exceed $150^\circ C$.

Note 2: $V_{DD} = 50 V, T_{ch} = 25^\circ C$ (initial), $L = 4.28 mH, R_G = 25 \Omega, I_{AR} = 4.5 A$

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

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

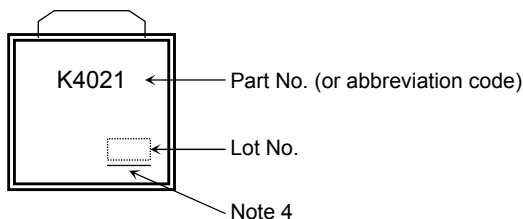
Electrical Characteristics (Ta = 25°C)

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}	$V_{DS} = 250\text{ V}, V_{GS} = 0\text{ V}$	—	—	100	μA
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	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		$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 2.5\text{ A}$	—	0.8	1.0	Ω
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 2.5\text{ A}$	2.0	4.5	—	S
Input capacitance		C_{iss}	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	440	—	pF
Reverse transfer capacitance		C_{rss}		—	35	—	
Output capacitance		C_{oss}		—	120	—	
Switching time	Rise time	t_r	<p>$I_D = 2.5\text{ A}$ $V_{GS} = 10\text{ V}$ 0 V 50Ω $R_L = 40\Omega$ $V_{DD} \approx 100\text{ V}$ Duty $\leq 1\%$, $t_w = 10\mu\text{ s}$</p>	—	15	—	ns
	Turn-on time	t_{on}		—	20	—	
	Fall time	t_f		—	15	—	
	Turn-off time	t_{off}		—	60	—	
Total gate charge (gate-source plus gate-drain)		Q_g	$V_{DD} \approx 100\text{ V}, V_{GS} = 10\text{ V}, I_D = 4.5\text{ A}$	—	10	—	nC
Gate-source charge		Q_{gs}		—	6	—	
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}	—	—	—	4.5	A
Pulse drain reverse current (Note 1)	I_{DRP}	—	—	—	18	A
Forward voltage (diode)	V_{DSF}	$I_{DR} = 4.5\text{ A}, V_{GS} = 0\text{ V}$	—	—	-2.0	V
Reverse recovery time	t_{rr}	$I_{DR} = 4.5\text{ A}, V_{GS} = 0\text{ V}$	—	110	—	ns
Reverse recovery charge	Q_{rr}	$dI_{DR} / dt = 100\text{ A} / \mu\text{ s}$	—	0.47	—	μC

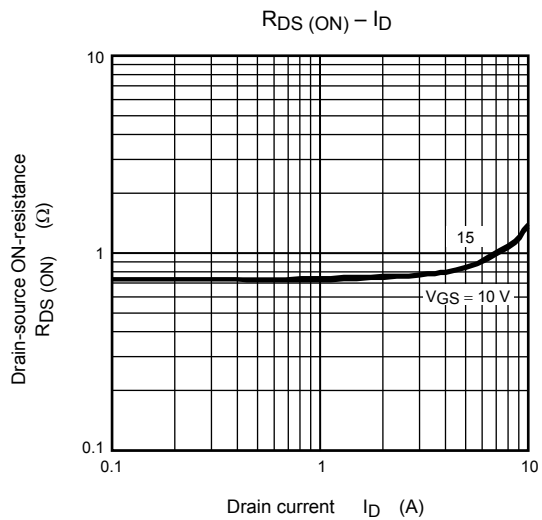
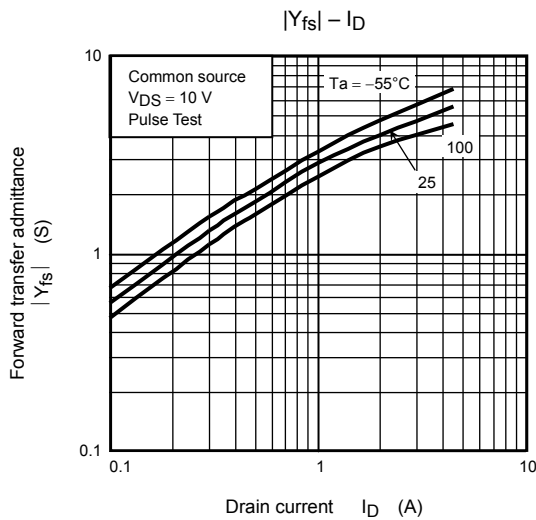
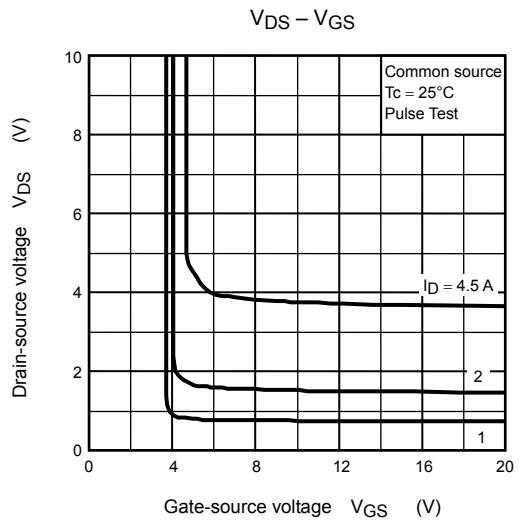
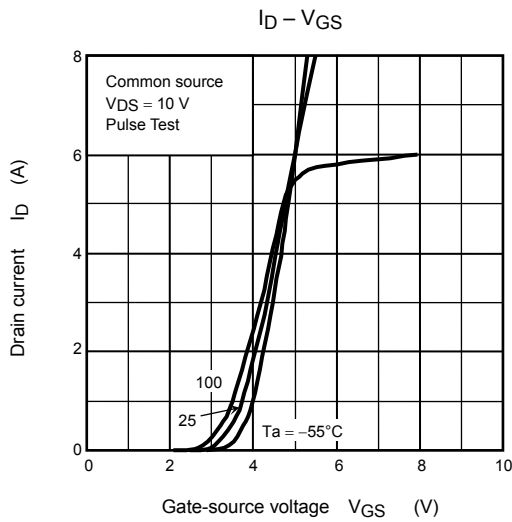
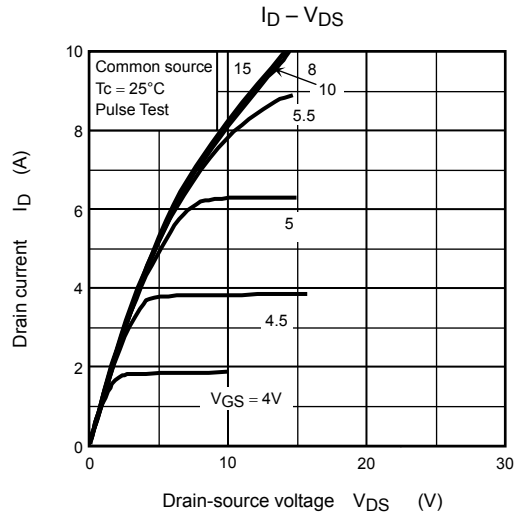
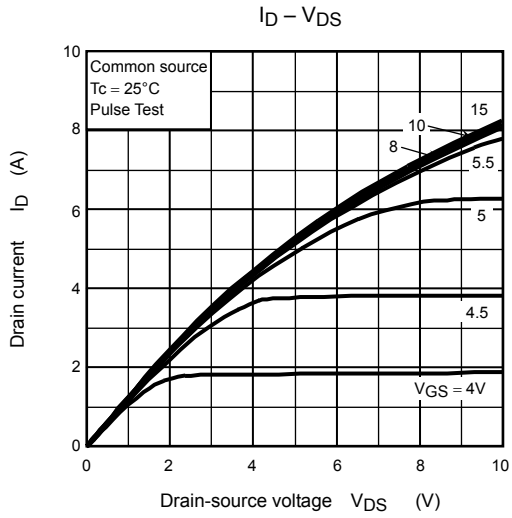
Marking



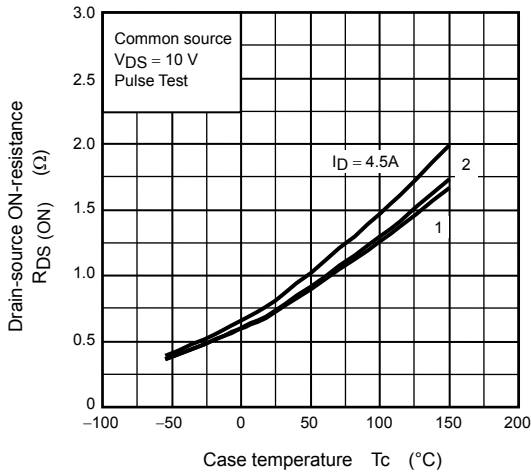
Note 4: A line under a Lot No. identifies the indication of product Labels.

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

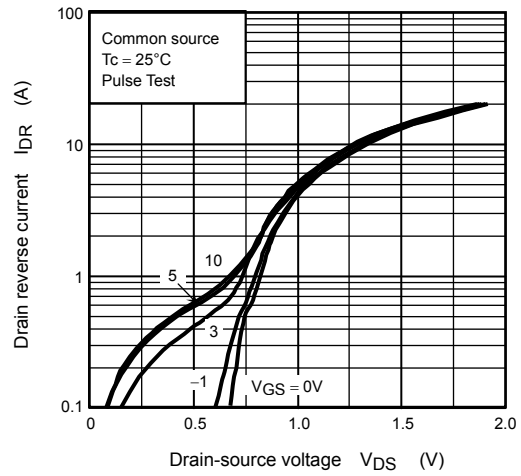
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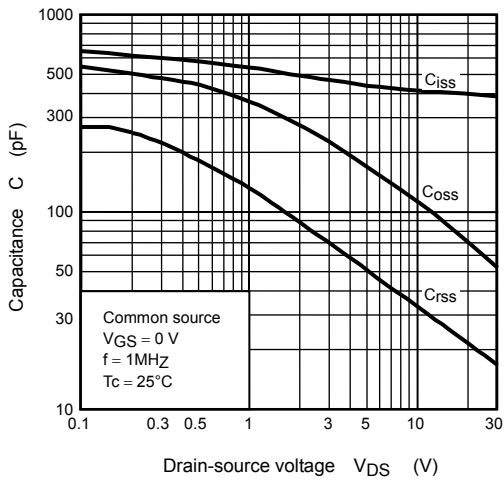
$R_{DS(ON)} - T_c$



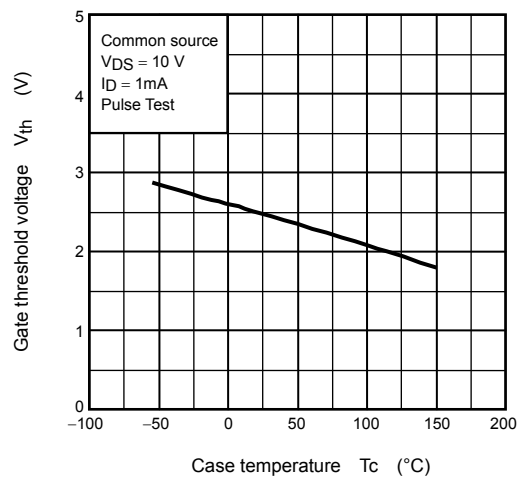
$I_{DR} - V_{DS}$



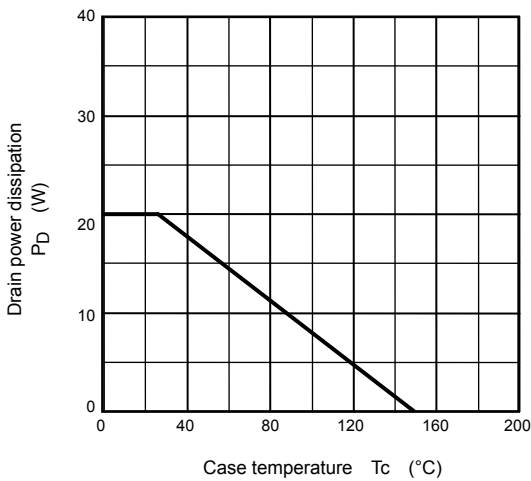
Capacitance - V_{DS}



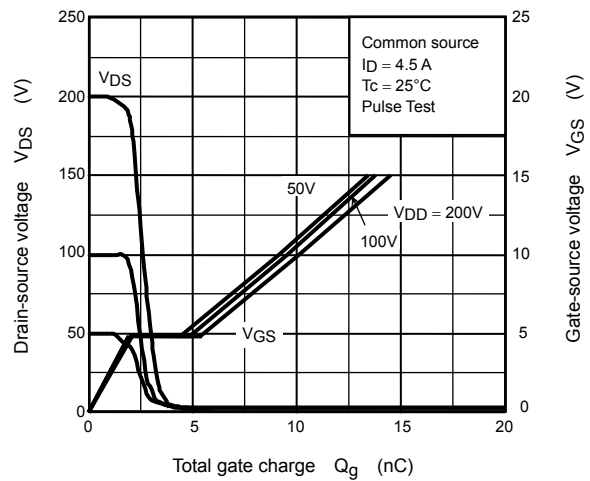
$V_{th} - T_c$

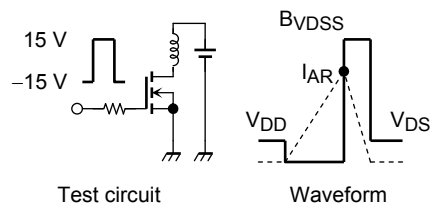
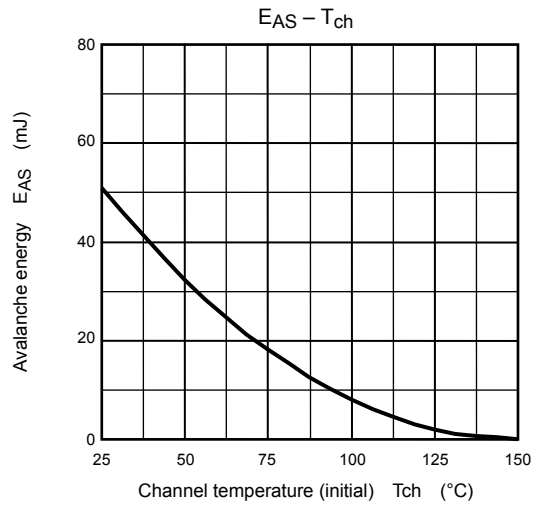
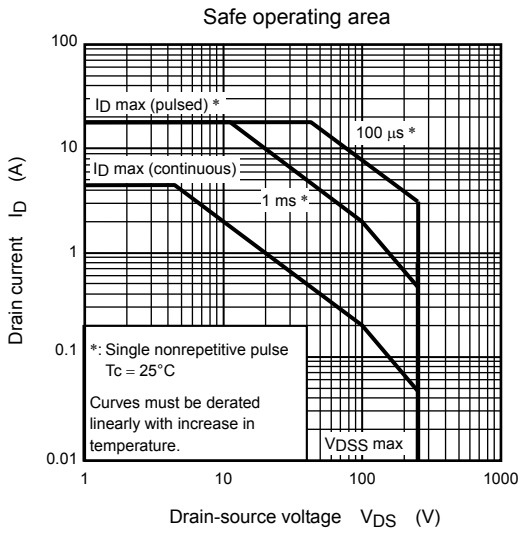
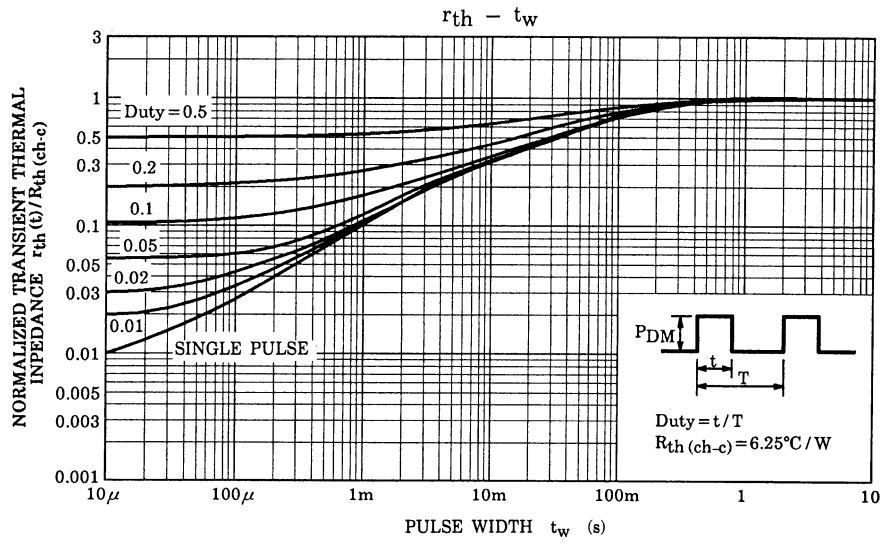


$P_D - T_c$



Dynamic input / output characteristics





$R_G = 25 \Omega$
 $V_{DD} = 50 \text{ V}, L = 4.28 \text{ mH}$

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

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