

TOSHIBA Field Effect Transistor Silicon N Channel MOS Type ( $L^2$ - $\pi$ -MOS V)

## 2SK2963

DC-DC Converter, Relay Drive and Motor Drive Applications

- 4-V gate drive
- Low drain-source ON-resistance:  $R_{DS(ON)} = 0.5 \Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 1.2 S$  (typ.)
- Low leakage current:  $I_{DSS} = 100 \mu A$  (max) ( $V_{DS} = 100 V$ )
- Enhancement mode:  $V_{th} = 0.8$  to  $2.0 V$  ( $V_{DS} = 10 V$ ,  $I_D = 1 mA$ )

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

Characteristics		Symbol	Rating	Unit
Drain-source voltage		$V_{DSS}$	100	V
Drain-gate voltage ( $R_{GS} = 20 k\Omega$ )		$V_{DGR}$	100	V
Gate-source voltage		$V_{GSS}$	$\pm 20$	V
Drain current	DC (Note 1)	$I_D$	1	A
	Pulse (Note 1)	$I_{DP}$	3	
Drain power dissipation		$P_D$	0.5	W
Drain power dissipation (Note 2)		$P_D$	1.5	W
Single pulse avalanche energy (Note 3)		$E_{AS}$	137	mJ
Avalanche current		$I_{AR}$	1	A
Repetitive avalanche energy (Note 4)		$E_{AR}$	0.05	mJ
Channel temperature		$T_{ch}$	150	$^\circ C$
Storage temperature range		$T_{stg}$	-55 to 150	$^\circ C$

Note 1: Ensure that the channel temperature does not exceed  $150^\circ C$ .Note 2: Mounted on a ceramic board ( $25.4 mm \times 25.4 mm \times 0.8 mm$ )Note 3:  $V_{DD} = 25 V$ ,  $T_{ch} = 25^\circ C$  (initial),  $L = 221 mH$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = 1 A$ 

Note 4: Repetitive rating: pulse width limited by maximum junction temperature.

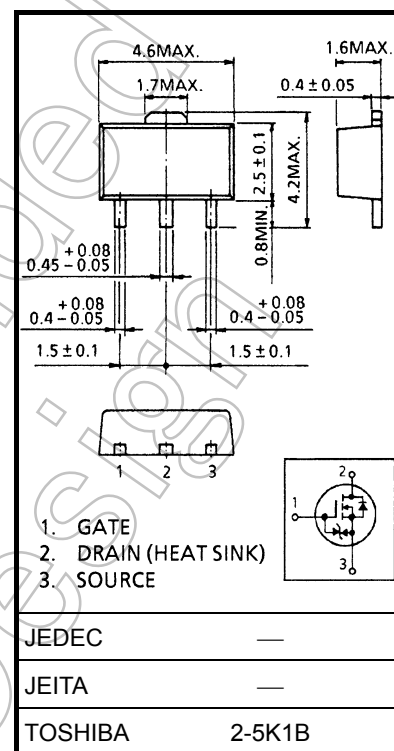
Note 5: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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.).

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

## Thermal Characteristics

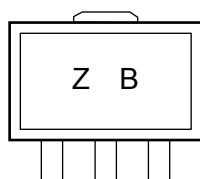
Characteristics	Symbol	Max	Unit
Thermal resistance, channel to ambient	$R_{th(ch-a)}$	250	$^\circ C/W$

Unit: mm



Weight: 0.05 g (typ.)

## Marking



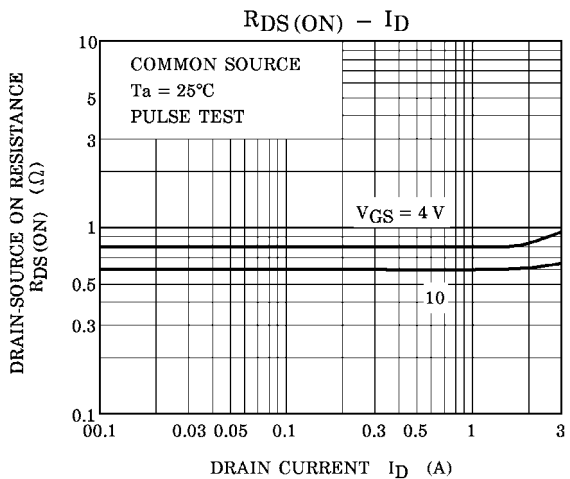
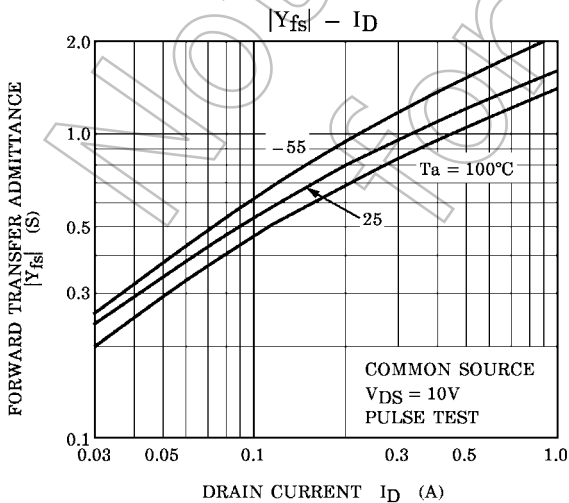
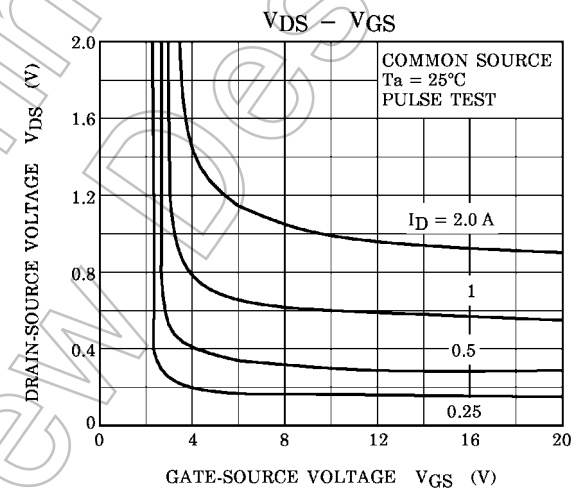
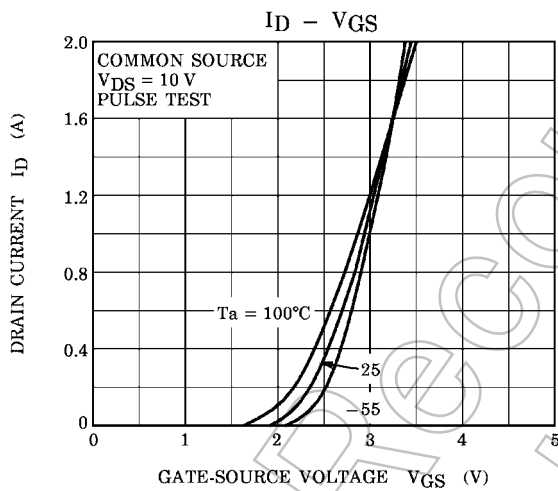
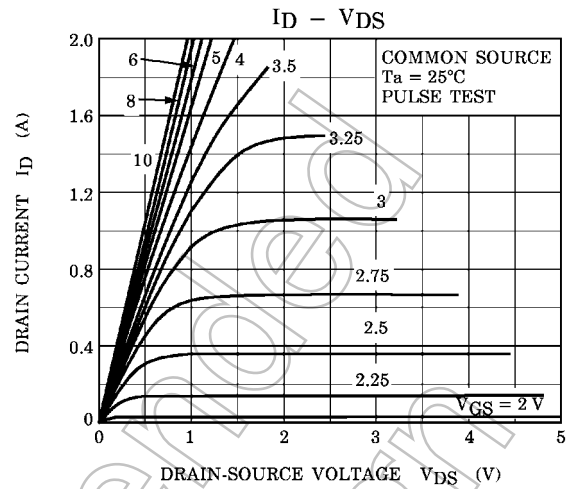
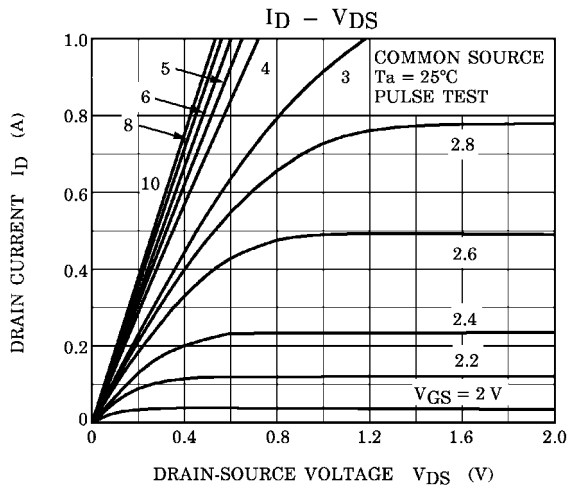
(The two digits represent the part number.)

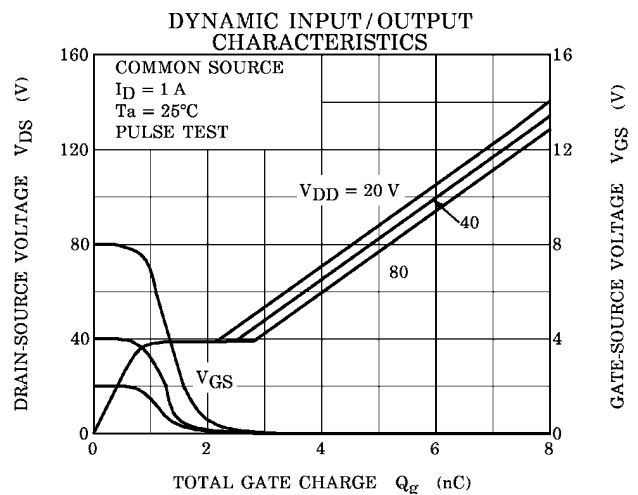
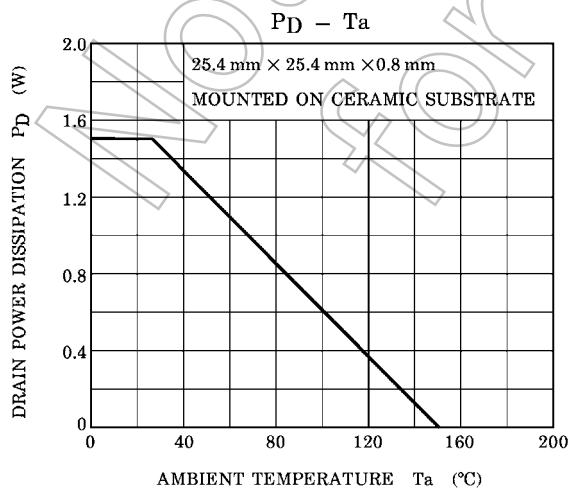
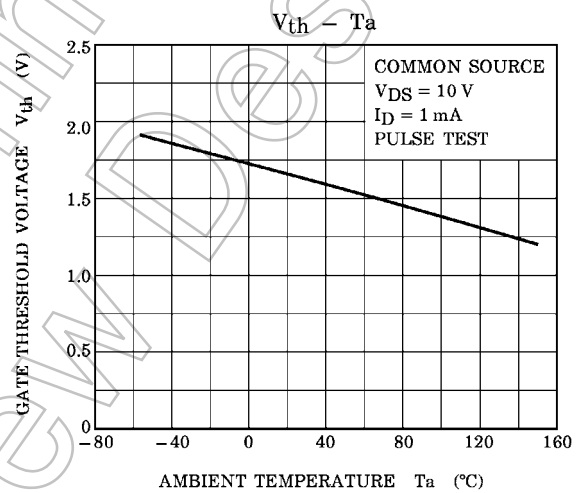
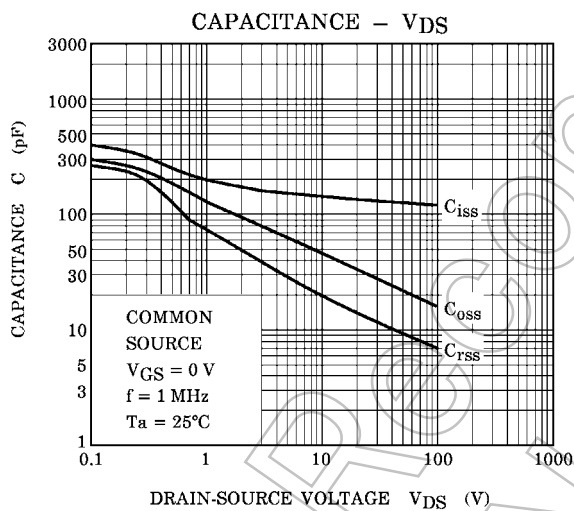
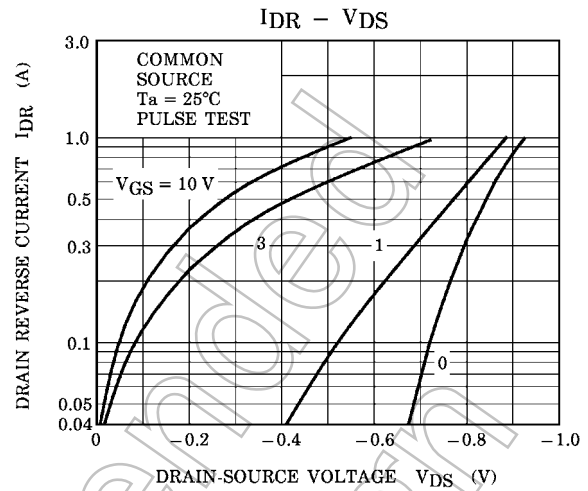
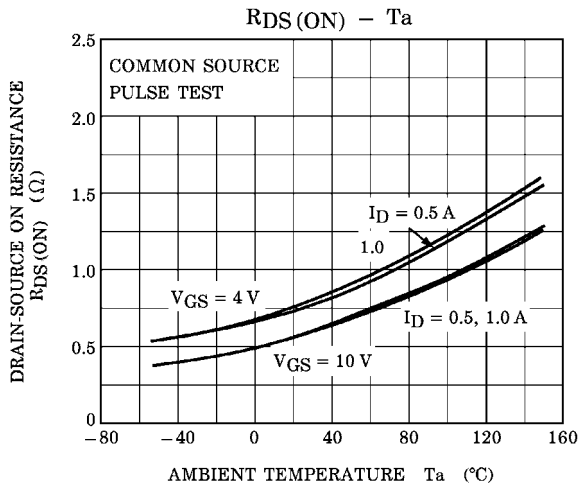
## Electrical Characteristics (Ta = 25°C)

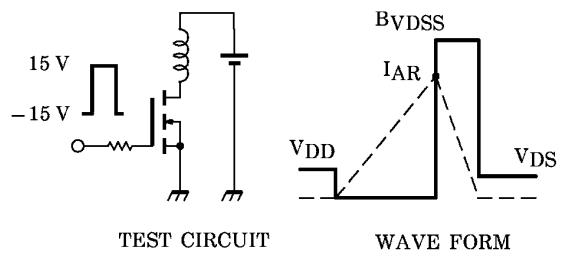
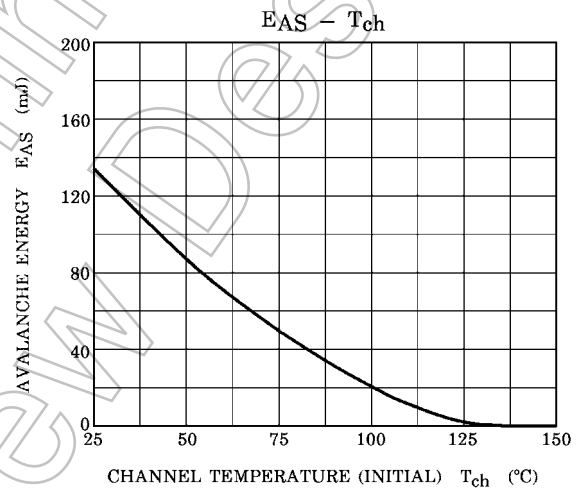
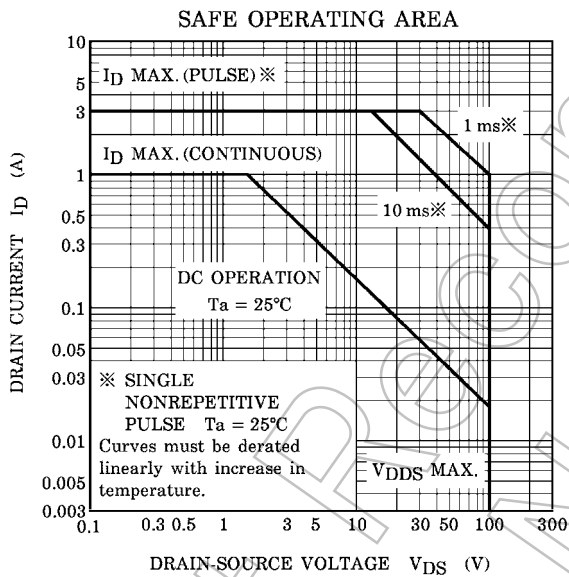
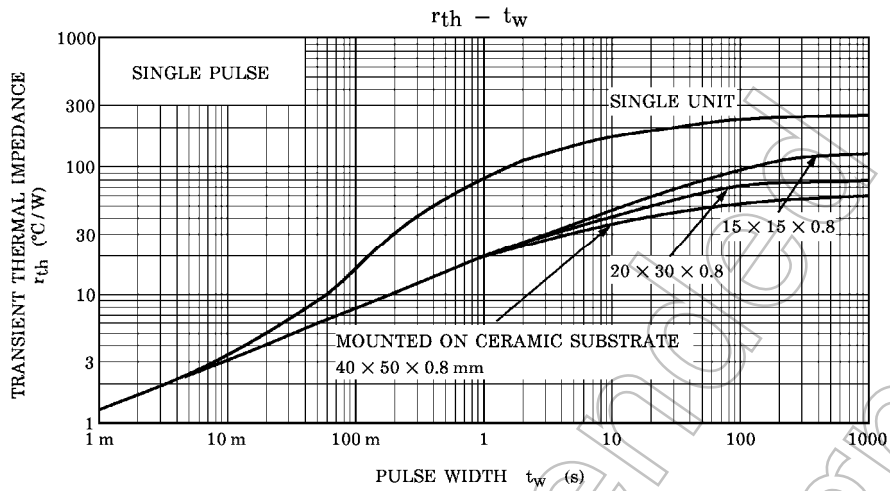
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16 \text{ V}, V_{DS} = 0 \text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cut-off current		$I_{DSS}$	$V_{DS} = 100 \text{ V}, V_{GS} = 0 \text{ V}$	—	—	100	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR) DSS}$	$I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}$	100	—	—	V
Gate threshold voltage		$V_{th}$	$V_{DS} = 10 \text{ V}, I_D = 1 \text{ mA}$	0.8	—	2.0	V
Drain-source ON resistance		$R_{DS(ON)}$	$V_{GS} = 4 \text{ V}, I_D = 0.5 \text{ A}$	—	0.65	0.95	$\Omega$
			$V_{GS} = 10 \text{ V}, I_D = 0.5 \text{ A}$	—	0.5	0.7	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10 \text{ V}, I_D = 0.5 \text{ A}$	0.6	1.2	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	—	140	—	pF
Reverse transfer capacitance		$C_{rss}$	$V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	—	20	—	pF
Output capacitance		$C_{oss}$	$V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$	—	45	—	pF
Switching time	Rise time	$t_r$		—	8	—	ns
	Turn-on time	$t_{on}$		—	13	—	
	Fall time	$t_f$		—	45	—	
	Turn-off time	$t_{off}$		—	175	—	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 80 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 1 \text{ A}$	—	6.3	—	nC
Gate-source charge		$Q_{gs}$	$V_{DD} \approx 80 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 1 \text{ A}$	—	4.3	—	nC
Gate-drain ("miller") charge		$Q_{gd}$	$V_{DD} \approx 80 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 1 \text{ A}$	—	2	—	nC

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	$I_{DR}$	—	—	—	1	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	3	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 1 \text{ A}, V_{GS} = 0 \text{ V}$	—	—	-1.5	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 1 \text{ A}, V_{GS} = 0 \text{ V}, dI_{DR}/dt = 50 \text{ A}/\mu\text{s}$	—	80	—	ns
Reverse recovery charge	$Q_{rr}$	$I_{DR} = 1 \text{ A}, V_{GS} = 0 \text{ V}, dI_{DR}/dt = 50 \text{ A}/\mu\text{s}$	—	140	—	$\mu\text{C}$







$$R_G = 25 \, \Omega$$

$$V_{DD} = 25 \, \text{V}, L = 221 \, \text{mH} \quad E_{AS} = \frac{1}{2} \cdot L \cdot I^2 \cdot \left( \frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

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