

TOSHIBA Field Effect Transistor Silicon N Channel MOS Type (L<sup>2</sup>-π-MOSV)

# 2SK3658

DC-DC Converter, Relay Drive and Motor Drive Applications

- Low drain-source ON resistance :  $R_{DS(ON)} = 0.23 \Omega$  (typ.)
- High forward transfer admittance :  $|Y_{fs}| = 2.0 S$  (typ.)
- Low leakage current :  $I_{DSS} = 100 \mu A$  (max) ( $V_{DS} = 60 V$ )
- Enhancement-mode :  $V_{th} = 0.8$  to  $2.0 V$  ( $V_{DS} = 10 V, I_D = 1 mA$ )

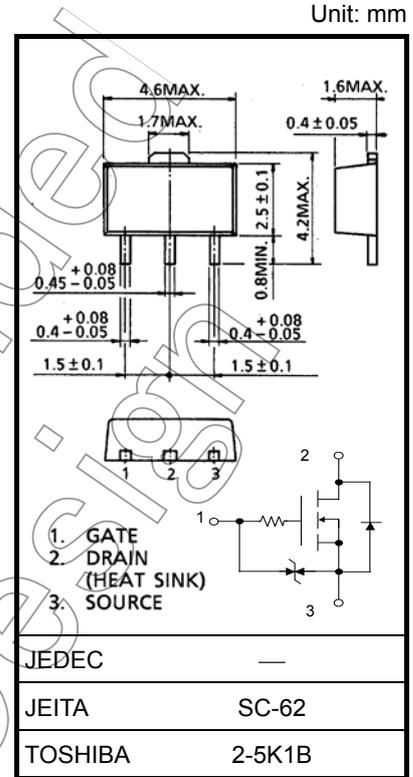
## Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{DSS}$	60	V
Drain-gate voltage ( $R_{GS} = 20 k\Omega$ )	$V_{DGR}$	60	V
Gate-source voltage	$V_{GSS}$	±20	V
Drain current	DC (Note 1)	$I_D$	2
	Pulse (Note 1)	$I_{DP}$	6
Drain power dissipation ( $T_c = 25^\circ C$ )	$P_D$	0.5	W
Drain power dissipation (Note 2)	$P_D$	1.5	W
Channel temperature	$T_{ch}$	150	°C
Storage temperature range	$T_{stg}$	-55 to 150	°C

Note 1: Please use devices on condition that the channel temperature is below 150°C.

Note 2: Mounted on ceramic substrate (25.4 mm × 25.4 mm × 0.8 mm)

Note 3: 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).



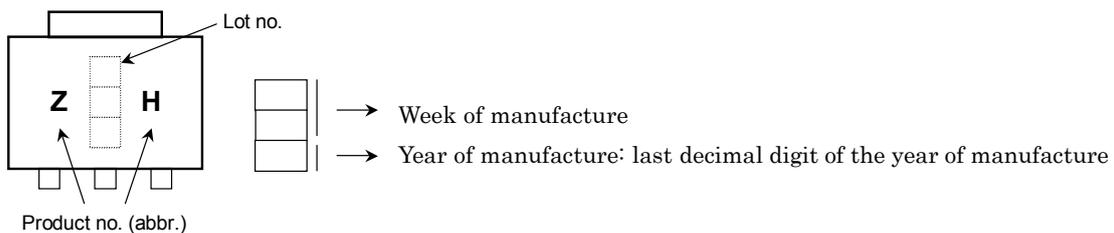
Weight: 0.05 g (typ.)

## Thermal Characteristics

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

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

## Marking

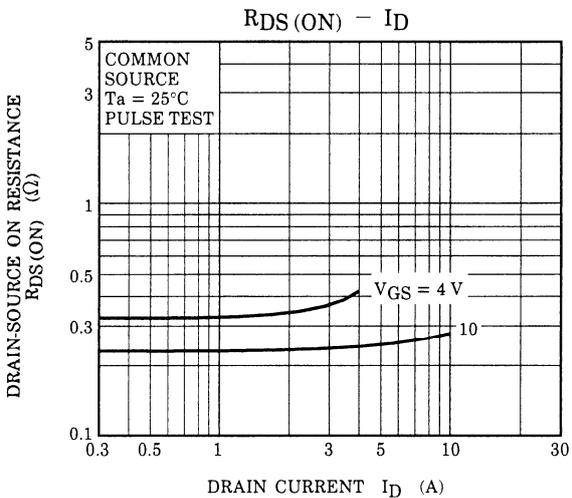
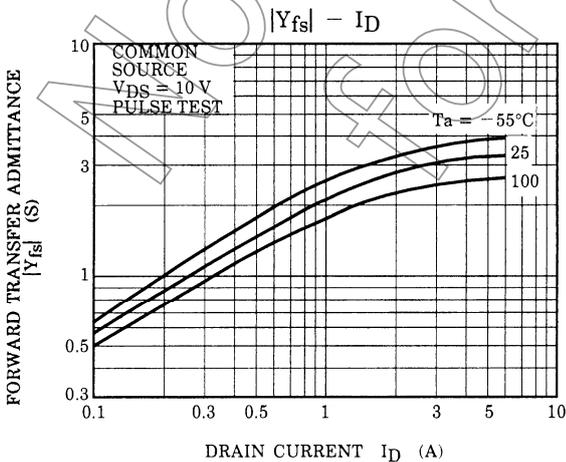
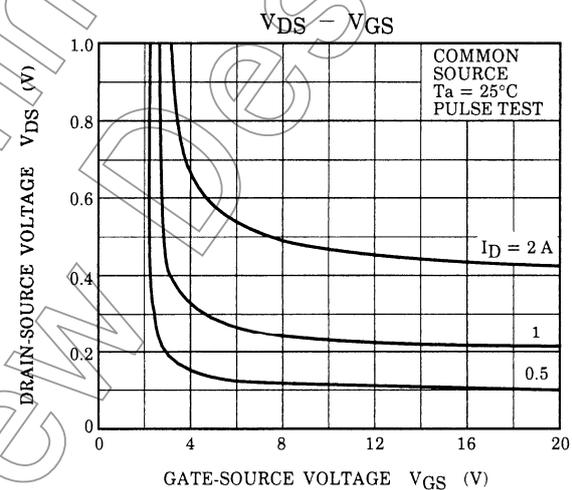
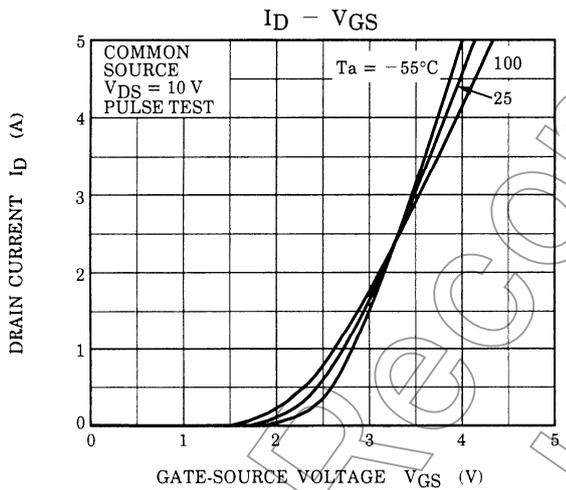
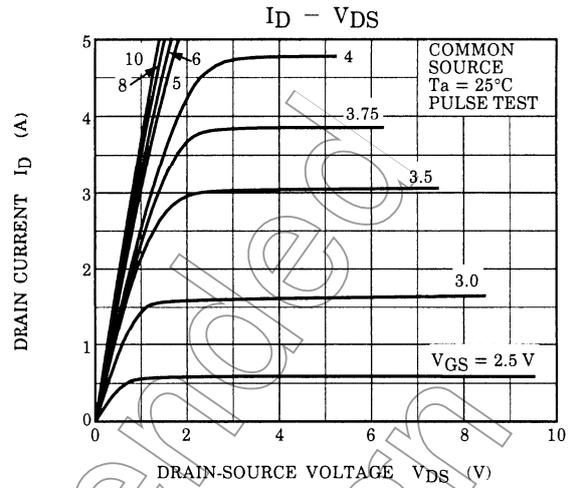
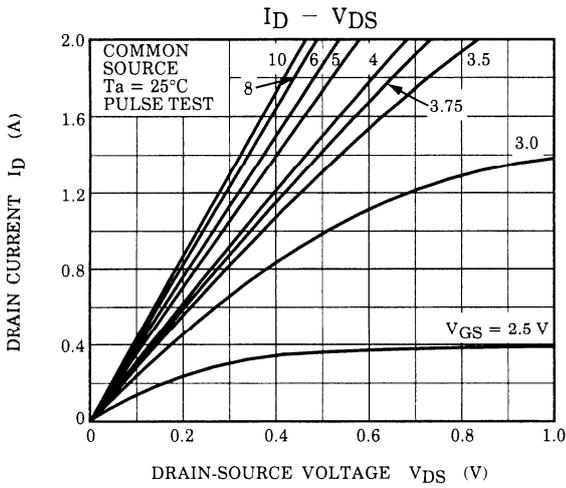


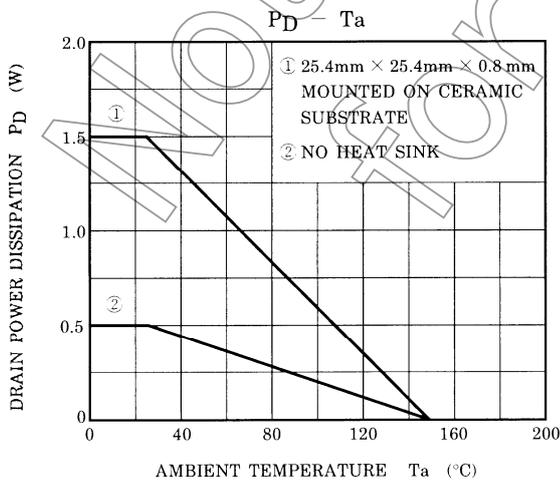
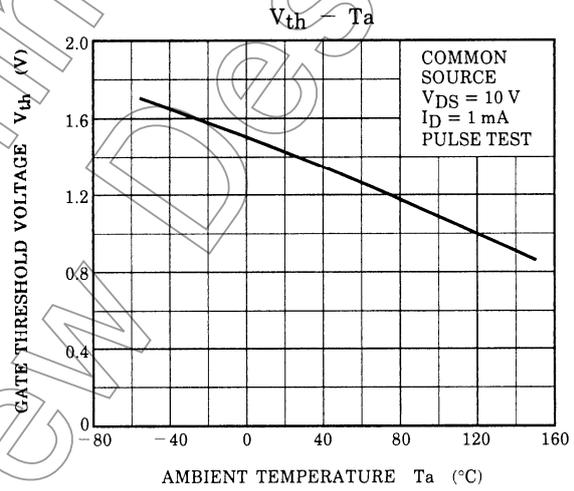
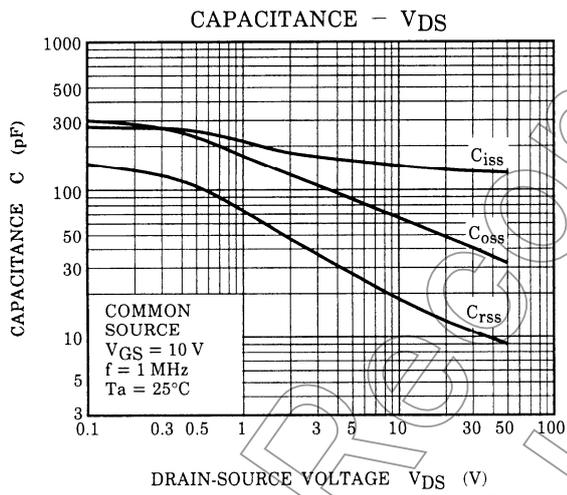
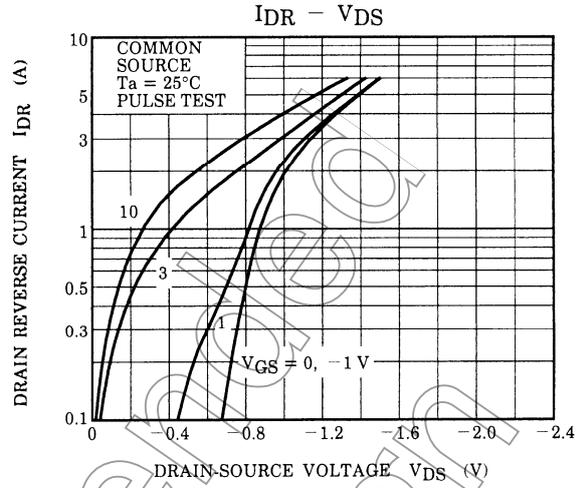
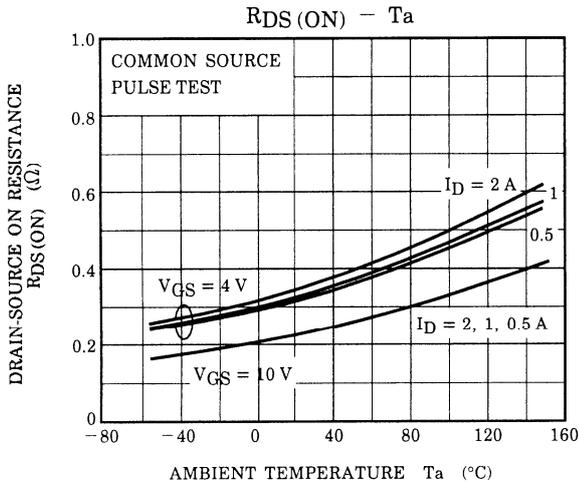
**Electrical Characteristics (Ta = 25°C)**

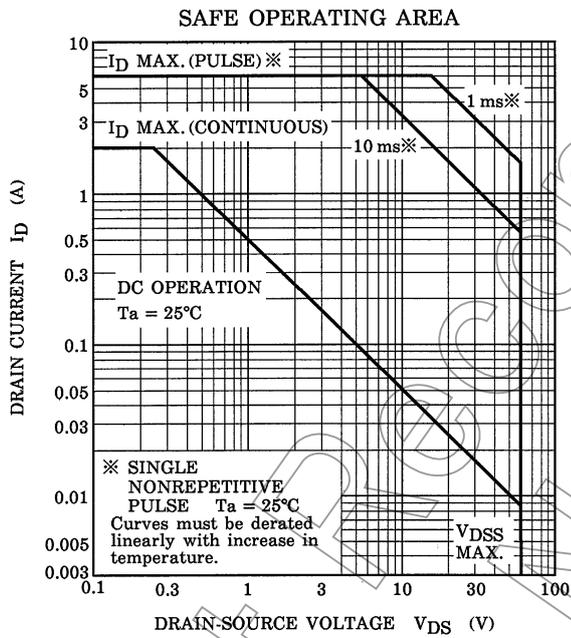
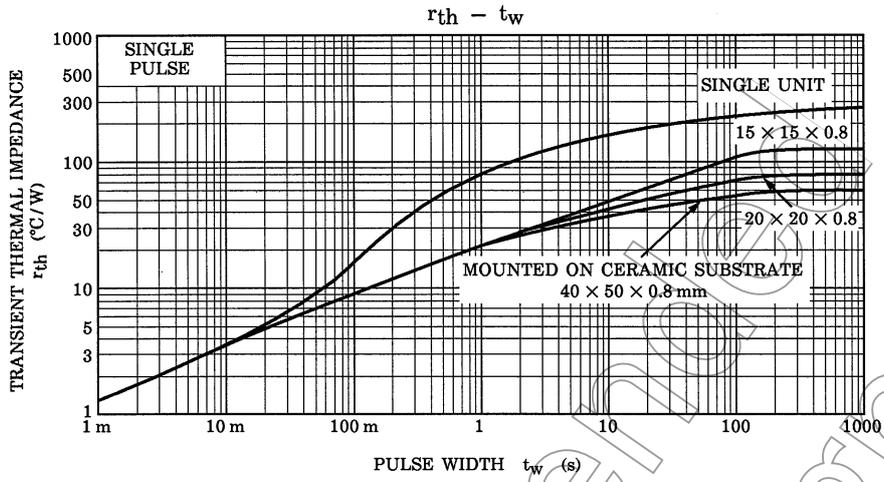
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		$I_{GSS}$	$V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 10$	$\mu\text{A}$
Drain cut-off current		$I_{DSS}$	$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$	—	—	100	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	60	—	—	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		$R_{DS(ON)}$	$V_{GS} = 4\text{ V}, I_D = 1\text{ A}$	—	0.33	0.44	$\Omega$
			$V_{GS} = 10\text{ V}, I_D = 1\text{ A}$	—	0.23	0.30	
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 1\text{ A}$	1.0	2.0	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	140	—	pF
Reverse transfer capacitance		$C_{rss}$		—	20	—	
Output capacitance		$C_{oss}$		—	65	—	
Switching time	Rise time	$t_r$	<p><math>I_D = 1\text{ A}</math> <math>V_{GS} = 10\text{ V}, 0\text{ V}</math> <math>R_L = 30\Omega</math> <math>V_{DD} = 30\text{ V}</math> <math>50\Omega</math> <math>V_{out}</math></p>	—	140	—	ns
	Turn-on time	$t_{on}$		—	210	—	
	Fall time	$t_f$		—	470	—	
	Turn-off time	$t_{off}$		—	1600	—	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 48\text{ V}, V_{GS} = 10\text{ V}, I_D = 2\text{ A}$	—	5.0	—	nC
Gate-source charge		$Q_{gs}$		—	3.6	—	
Gate-drain ("miller") Charge		$Q_{gd}$		—	1.4	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	$I_{DR}$	—	—	—	2	A
Pulse drain reverse current (Note 1)	$I_{DRP}$	—	—	—	6	A
Forward voltage (diode)	$V_{DSF}$	$I_{DR} = 2\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.5	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 2\text{ A}, V_{GS} = 0\text{ V}$	—	100	—	ns
Reverse recovery charge	$Q_{rr}$	$dI_{DR} / dt = 50\text{ A} / \mu\text{s}$	—	40	—	nC







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