

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

# TK50X15J1

## DC-DC Converters

- Low drain-source ON-resistance:  $R_{DS(ON)} = 22 \text{ m}\Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 90 \text{ S}$  (typ.)
- Low leakage current:  $I_{DSS} = 10 \text{ }\mu\text{A}$  (max) ( $V_{DS} = 150 \text{ V}$ )
- Enhancement mode:  $V_{th} = 2.0 \text{ to } 4.0 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

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

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{DSS}$	150	V
Drain-gate voltage ( $R_{GS} = 20 \text{ k}\Omega$ )	$V_{DGR}$	150	V
Gate-source voltage	$V_{GSS}$	$\pm 20$	V
Drain current	DC (Note 1)	$I_D$	50
	Pulse (Note 1)	$I_{DP}$	150
Drain power dissipation ( $T_c = 25^\circ\text{C}$ )	$P_D$	125	W
Single pulse avalanche energy (Note 2)	$E_{AS}$	182	mJ
Avalanche current	$I_{AR}$	50	A
Repetitive avalanche energy (Note 3)	$E_{AR}$	10.9	mJ
Channel temperature (Note 4)	$T_{ch}$	175	$^\circ\text{C}$
Storage temperature range (Note 4)	$T_{stg}$	-55 to 175	$^\circ\text{C}$

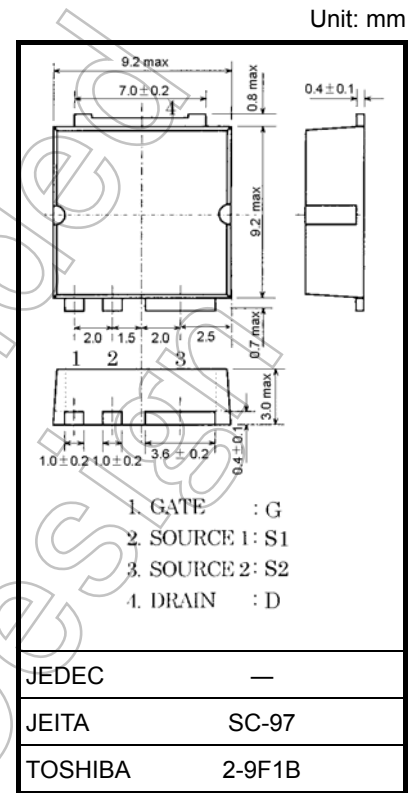
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

Characteristics	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th(ch-c)}$	1.2	$^\circ\text{C/W}$

- Note 1: Ensure that the channel temperature does not exceed  $175^\circ\text{C}$ .
- Note 2:  $V_{DD} = 50\text{V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 110 \text{ }\mu\text{H}$ ,  $R_G = 25 \text{ }\Omega$ ,  $I_{AR} = 50\text{A}$
- Note 3: Repetitive rating: pulse width limited by maximum channel temperature
- Note 4: The definitions of the absolute maximum channel and storage temperatures are base on AEC-Q101.

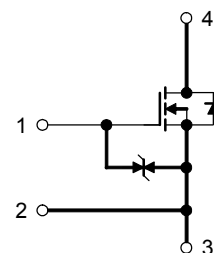
This transistor is an electrostatic-sensitive device. Handle with care.



Weight: 0.74 g (typ.)

## Circuit Configuration

Note: Use the S1 pin to return the gate signal to source. Board traces should be designed so the main current flows to the S2 pin.



## Electrical Characteristics (Note 5) (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		$I_{DSS}$	$V_{DS} = 150\text{ V}, V_{GS} = 0\text{ V}$	—	—	10	$\mu\text{A}$
Drain-source breakdown voltage		$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	150	—	—	V
		$V_{(BR)DSX}$	$I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$	95	—	—	
Gate threshold voltage		$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	2.0	—	4.0	V
Drain-source ON-resistance		$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 25\text{ A}$	—	22	30	$\text{m}\Omega$
Forward transfer admittance		$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 25\text{ A}$	45	90	—	S
Input capacitance		$C_{iss}$	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	4300	—	pF
Reverse transfer capacitance		$C_{rss}$		—	210	—	
Output capacitance		$C_{oss}$		—	640	—	
Switching time	Rise time	$t_r$		—	7	—	ns
	Turn-ON time	$t_{on}$		—	30	—	
	Fall time	$t_f$		—	15	—	
	Turn-OFF time	$t_{off}$		Duty $\leq 1\%$ , $t_w = 10\ \mu\text{s}$	—	85	
Total gate charge (gate-source plus gate-drain)		$Q_g$	$V_{DD} \approx 120\text{ V}, V_{GS} = 10\text{ V}, I_D = 50\text{ A}$	—	75	—	nC
Gate-source charge1		$Q_{gs1}$		—	25	—	
Gate-drain ("miller") charge		$Q_{gd}$		—	25	—	
Gate switch charge		$Q_{sw}$		—	33	—	

Note 5: The S1 and S2 pins should be grounded together, except when measuring the switching time.

## Source-Drain Ratings and Characteristics (Note 6) (Ta = 25°C)

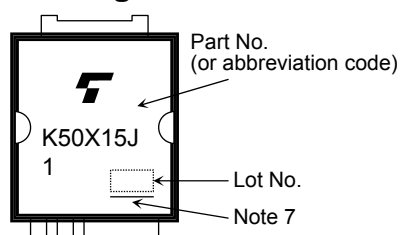
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1, Note 6)	$I_{DR1}$	—	—	—	50	A
Pulse drain reverse current (Note 1, Note 6)	$I_{DRP1}$	—	—	—	150	A
Continuous drain reverse current (Note 1, Note 6)	$I_{DR2}$	—	—	—	1	A
Pulse drain reverse current (Note 1, Note 6)	$I_{DRP2}$	—	—	—	4	A
Forward voltage (diode)	$V_{DS2F}$	$I_{DR1} = 50\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.5	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 50\text{ A}, V_{GS} = 0\text{ V},$ $dI_{DR}/dt = 100\text{ A}/\mu\text{s}$	—	95	—	ns
Reverse recovery charge	$Q_{rr}$		—	450	—	nC

Note 6:  $I_{DR1}, I_{DRP1}$ : Current flowing between the drain and S2 pins. Ensure that the S1 pin is left open.

$I_{DR2}, I_{DRP2}$ : Current flowing between the drain and S1 pins. Ensure that the S2 pin is left open.

The S1 and S2 pins should be grounded together, unless otherwise noted.

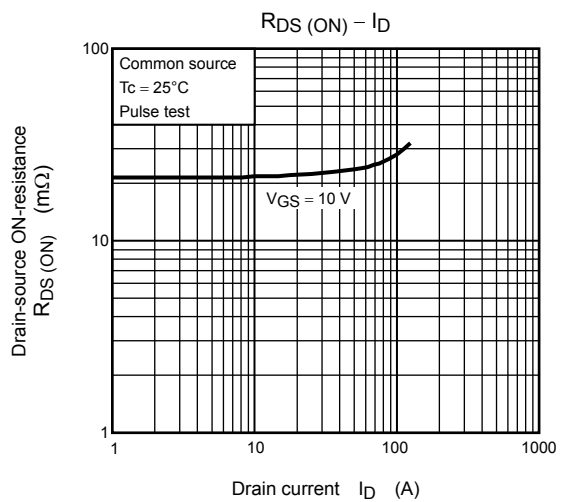
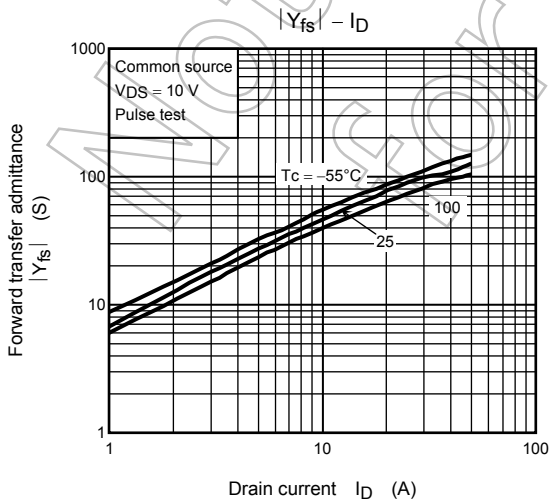
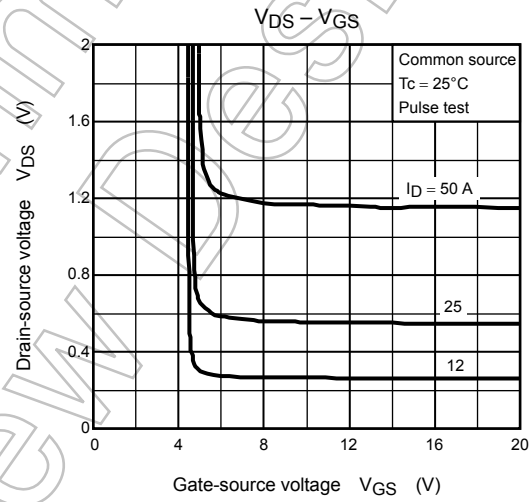
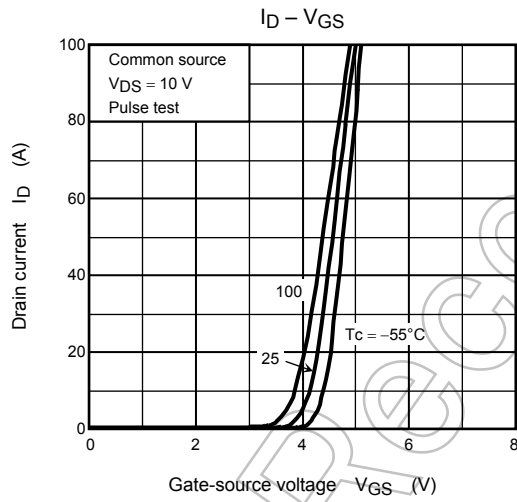
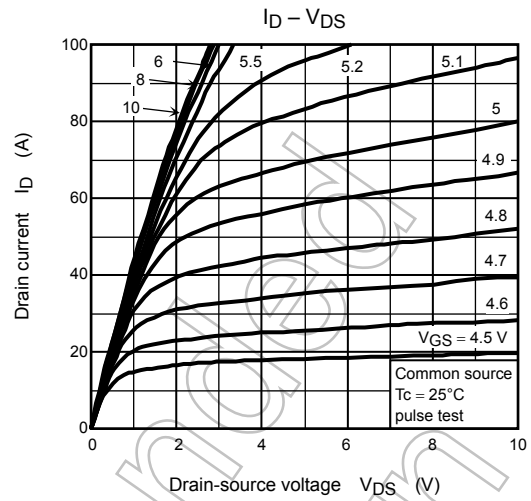
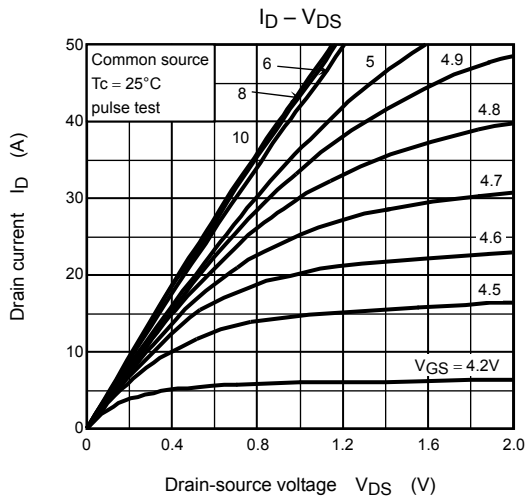
## Marking

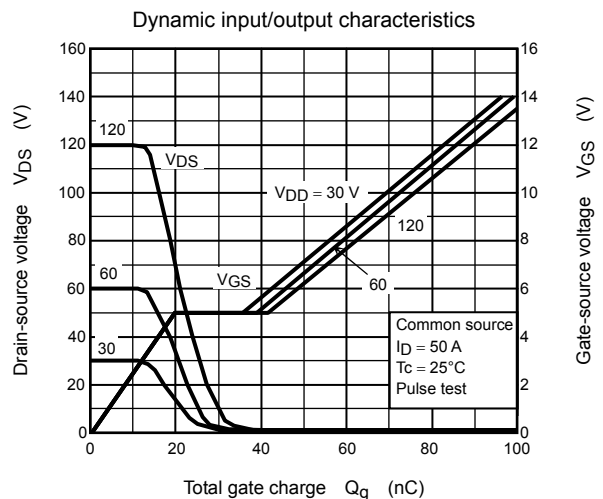
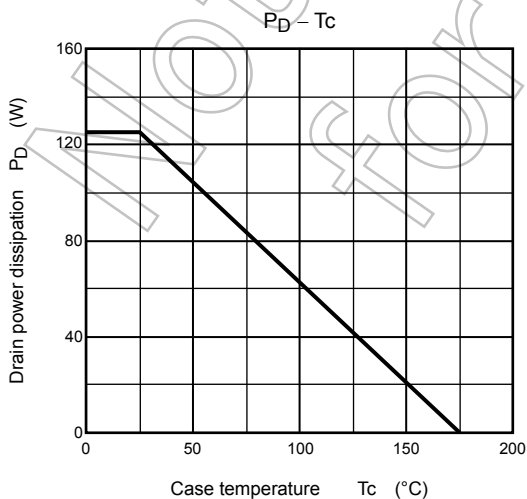
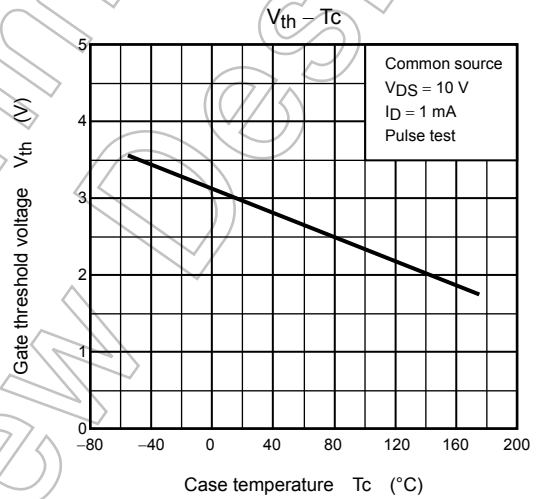
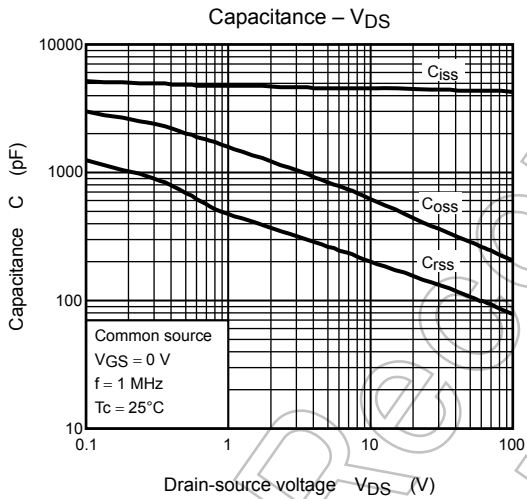
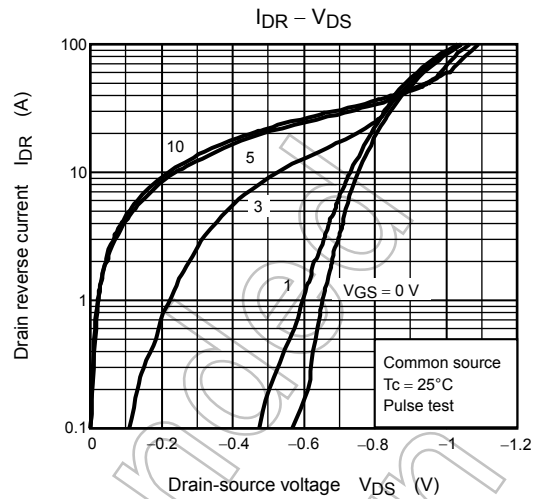
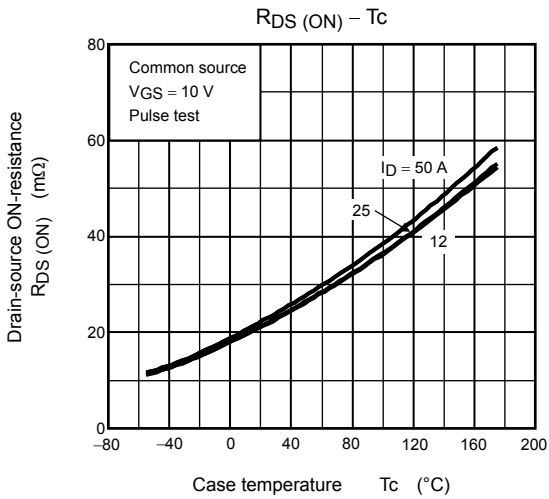


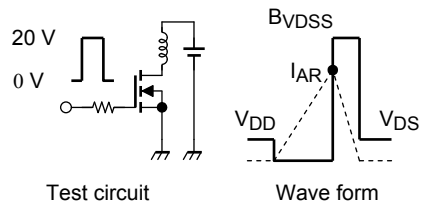
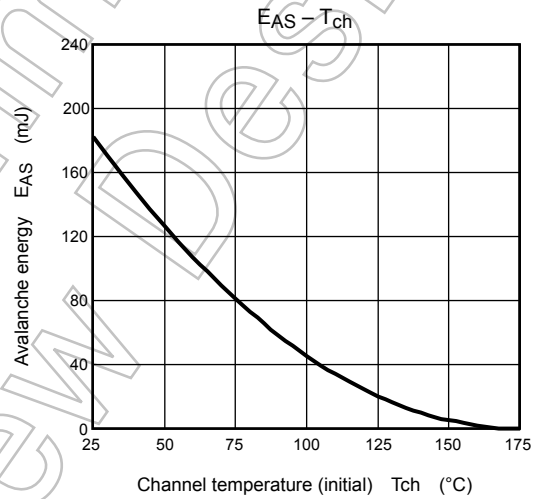
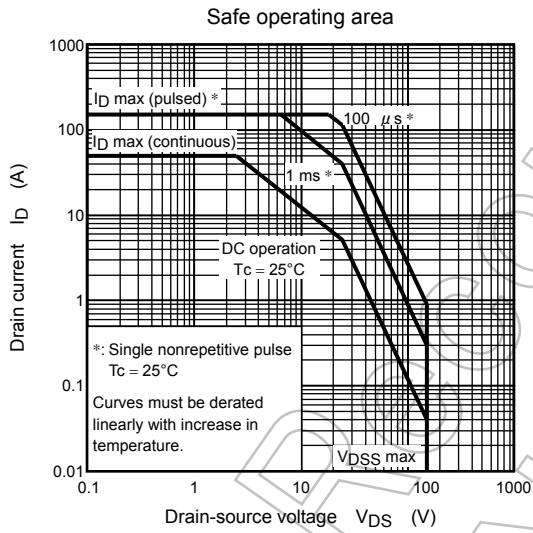
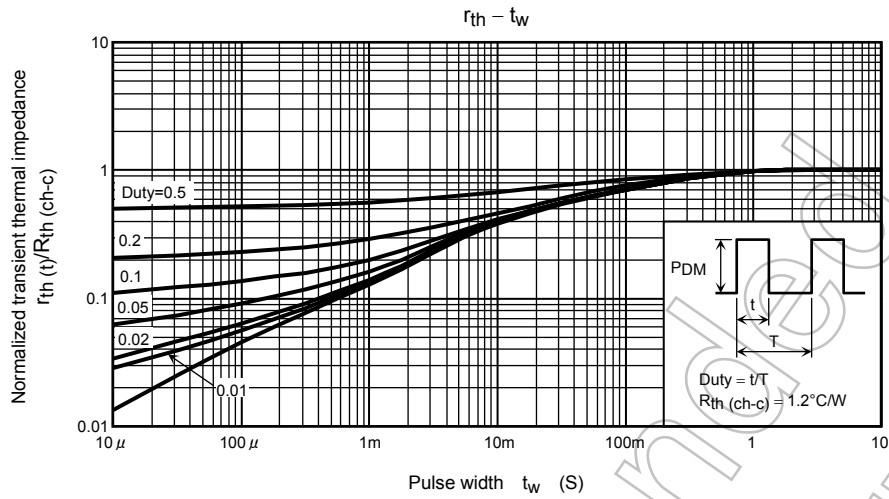
Note 7: A line under a Lot No. identifies the indication of product Labels.

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

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$R_G = 25 \Omega$   
 $V_{DD} = 50 V, L = 110 \mu H$

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

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