

# TK20A25D

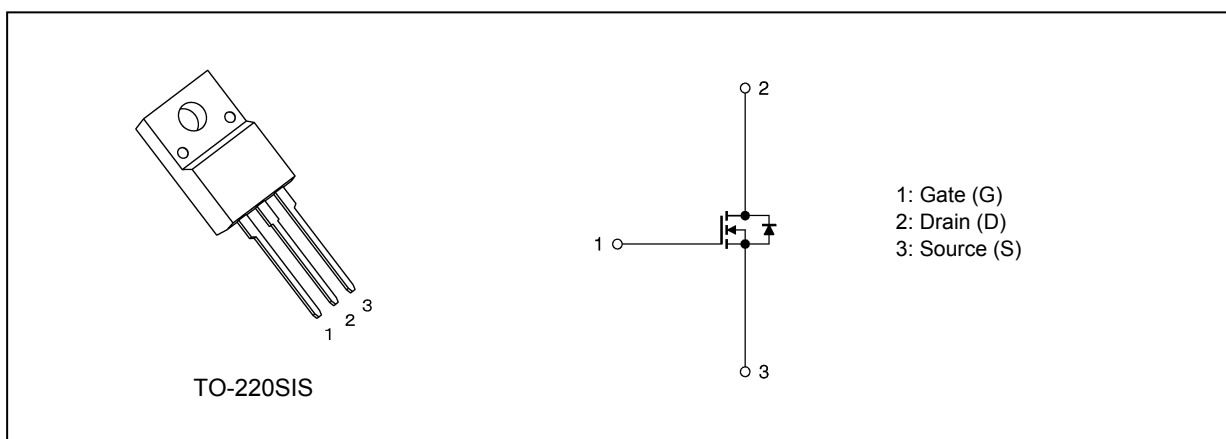
## 1. Applications

- Switching Voltage Regulators

## 2. Features

- Low drain-source on-resistance:  $R_{DS(ON)} = 0.073 \Omega$  (typ.)
- Low leakage current:  $I_{DSS} = 10 \mu A$  (max) ( $V_{DS} = 250 V$ )
- Enhancement mode:  $V_{th} = 1.5$  to  $3.5 V$  ( $V_{DS} = 10 V$ ,  $I_D = 1 mA$ )

## 3. Packaging and Internal Circuit



## 4. Absolute Maximum Ratings (Note) ( $T_a = 25^\circ C$ unless otherwise specified)

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{DSS}$	250	V
Gate-source voltage	$V_{GSS}$	$\pm 20$	
Drain current (DC) (Note 1)	$I_D$	20	A
Drain current (pulsed) (Note 1)	$I_{DP}$	80	
Power dissipation ( $T_c = 25^\circ C$ )	$P_D$	45	W
Single-pulse avalanche energy (Note 2)	$E_{AS}$	120	mJ
Avalanche current (Note 3)	$I_{AR}$	20	A
Reverse drain current (DC) (Note 1)	$I_{DR}$	20	
Reverse drain current (pulsed) (Note 1)	$I_{DRP}$	80	
Channel temperature	$T_{ch}$	150	$^\circ C$
Storage temperature	$T_{stg}$	-55 to 150	
Isolation voltage (RMS) ( $t = 1.0 s$ )	$V_{ISO(RMS)}$	2000	V
Mounting torque	TOR	0.6	N · m

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.).

Start of commercial production

2010-12

## 5. Thermal Characteristics

Characteristics	Symbol	Max	Unit
Channel-to-case thermal resistance	$R_{th(ch-c)}$	2.78	°C/W
Channel-to-ambient thermal resistance	$R_{th(ch-a)}$	62.5	

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

Note 2:  $V_{DD} = 50\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 0.5\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 20\text{ A}$

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

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.

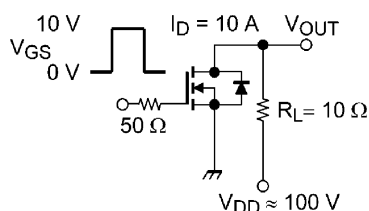
## 6. Electrical Characteristics

### 6.1. Static Characteristics ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$ , $V_{DS} = 0\text{ V}$	—	—	$\pm 1$	$\mu\text{A}$
Drain cut-off current	$I_{DSS}$	$V_{DS} = 250\text{ V}$ , $V_{GS} = 0\text{ V}$	—	—	10	
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	
Drain-source on-resistance	$R_{DS(ON)}$	$V_{GS} = 10\text{ V}$ , $I_D = 10\text{ A}$	—	0.073	0.1	$\Omega$

### 6.2. Dynamic Characteristics ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	$C_{iss}$	$V_{DS} = 100\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$	—	2550	—	pF
Reverse transfer capacitance	$C_{rss}$		—	14	—	
Output capacitance	$C_{oss}$		—	150	—	
Gate resistance	$r_g$	$V_{DS} = \text{OPEN}$ , $f = 1\text{ MHz}$	—	6	—	$\Omega$
Switching time (rise time)	$t_r$	See Figure 6.2.1.	—	30	—	ns
Switching time (turn-on time)	$t_{on}$		—	60	—	
Switching time (fall time)	$t_f$		—	35	—	
Switching time (turn-off time)	$t_{off}$		—	270	—	



Duty  $\leq 1\%$ ,  $t_w = 10\text{ }\mu\text{s}$

Fig. 6.2.1 Switching Time Test Circuit

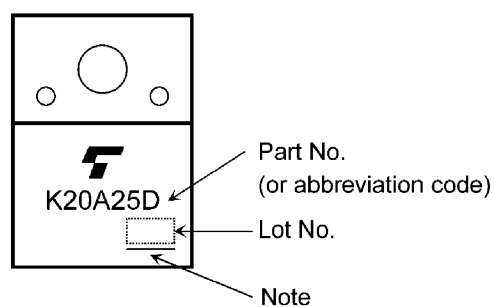
### 6.3. Gate Charge Characteristics ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	$Q_g$	$V_{DD} \approx 200\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 20\text{ A}$	—	55	—	nC
Gate-source charge 1	$Q_{gs1}$		—	12	—	
Gate-drain charge	$Q_{gd}$		—	17	—	

### 6.4. Source-Drain Characteristics ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Diode forward voltage	$V_{DSF}$	$I_{DR} = 20\text{ A}$ , $V_{GS} = 0\text{ V}$	—	—	-1.7	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 20\text{ A}$ , $V_{GS} = 0\text{ V}$ $-dI_{DR}/dt = 100\text{ A}/\mu\text{s}$	—	250	—	ns
Reverse recovery charge	$Q_{rr}$		—	2.3	—	$\mu\text{C}$
Peak reverse recovery current	$I_{rr}$		—	18	—	A

## 7. Marking (Note)



**Fig. 7.1 Marking**

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

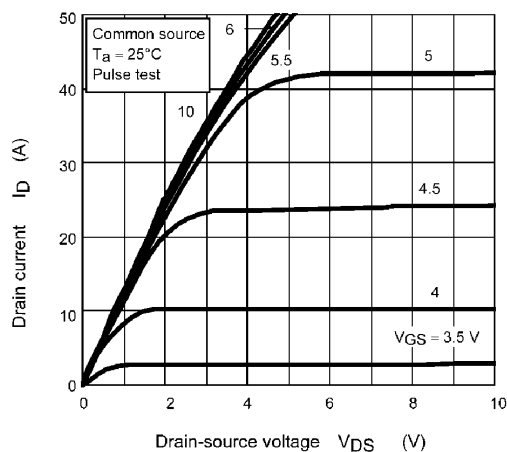
Not underlined: [[Pb]]/INCLUDES > MCV

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

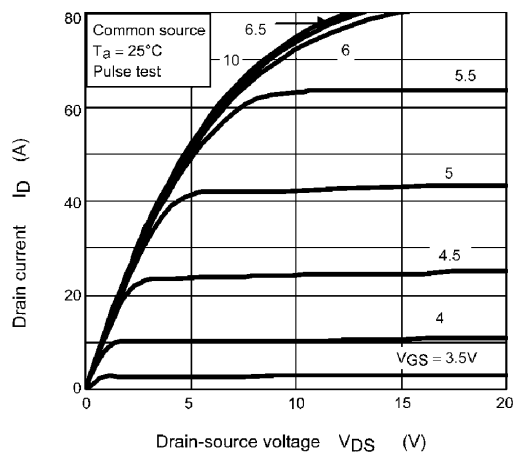
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

The RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

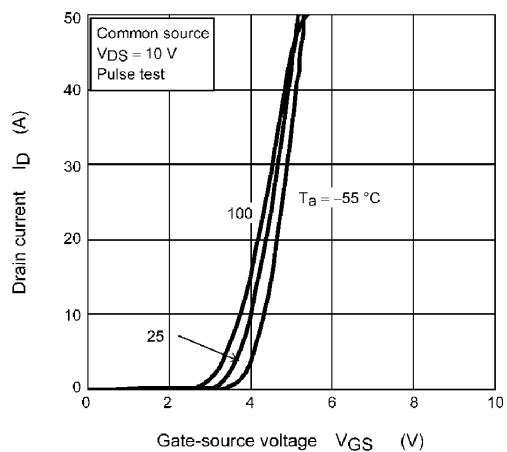
# 8. Characteristics Curves (Note)



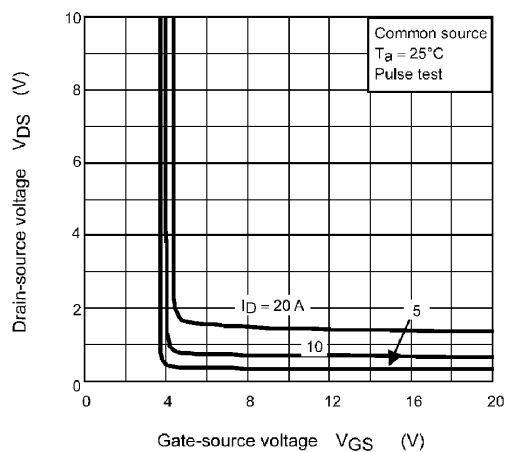
**Fig. 8.1**  $I_D - V_{DS}$



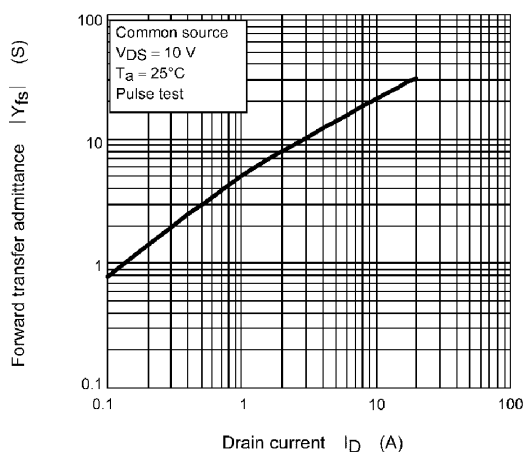
**Fig. 8.2**  $I_D - V_{DS}$



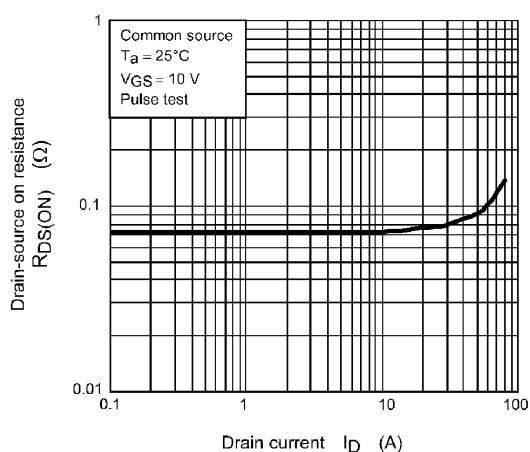
**Fig. 8.3**  $I_D - V_{GS}$



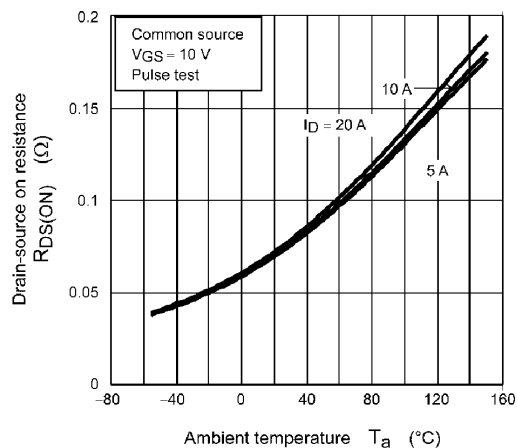
**Fig. 8.4**  $V_{DS} - V_{GS}$



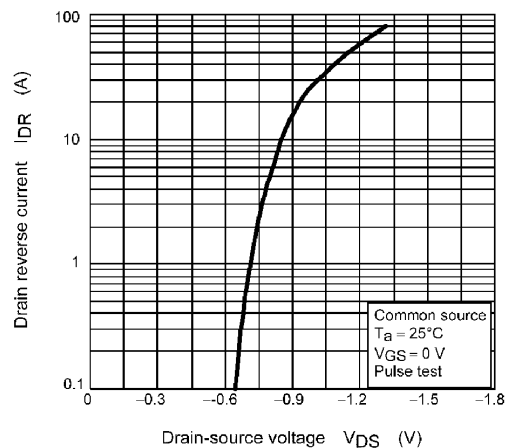
**Fig. 8.5**  $|Y_{fs}| - I_D$



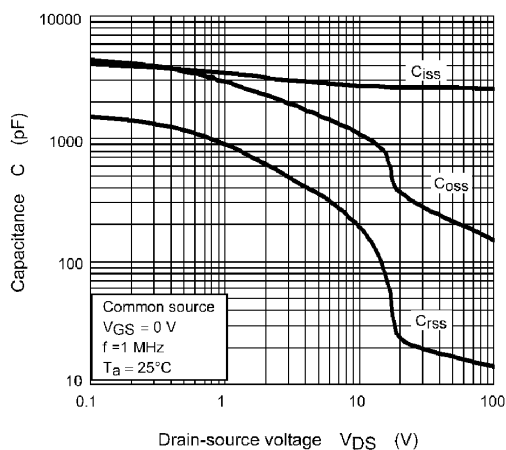
**Fig. 8.6**  $R_{DS(ON)} - I_D$



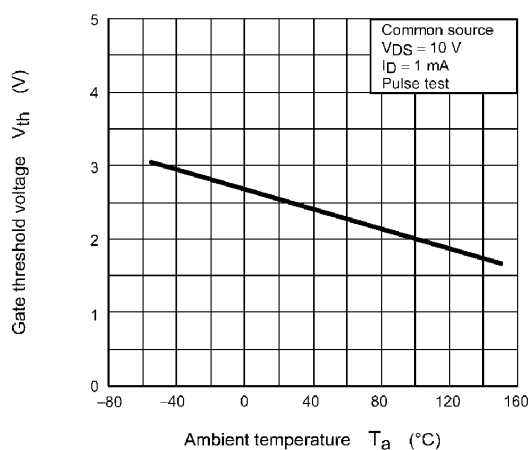
**Fig. 8.7  $R_{DS(ON)} - T_a$**



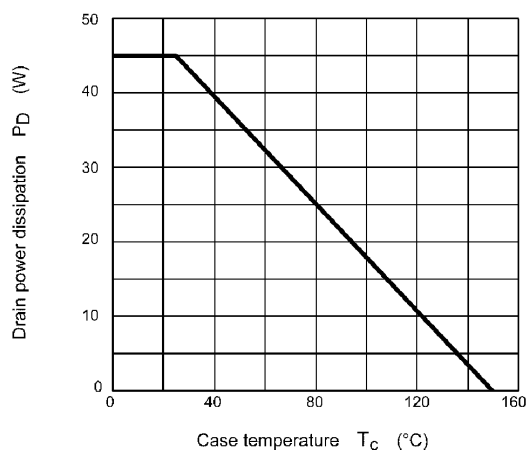
**Fig. 8.8  $I_{DR} - V_{DS}$**



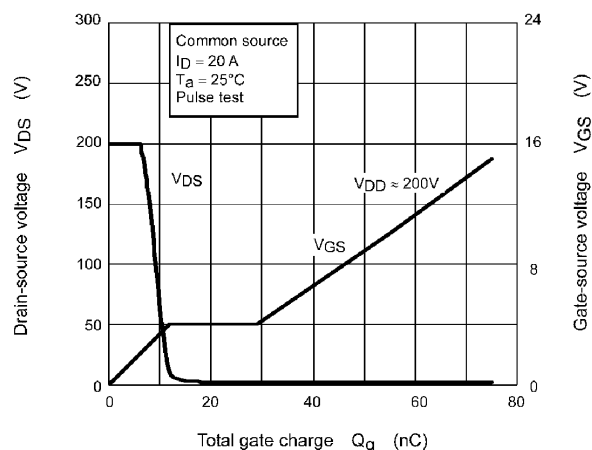
**Fig. 8.9  $C - V_{DS}$**



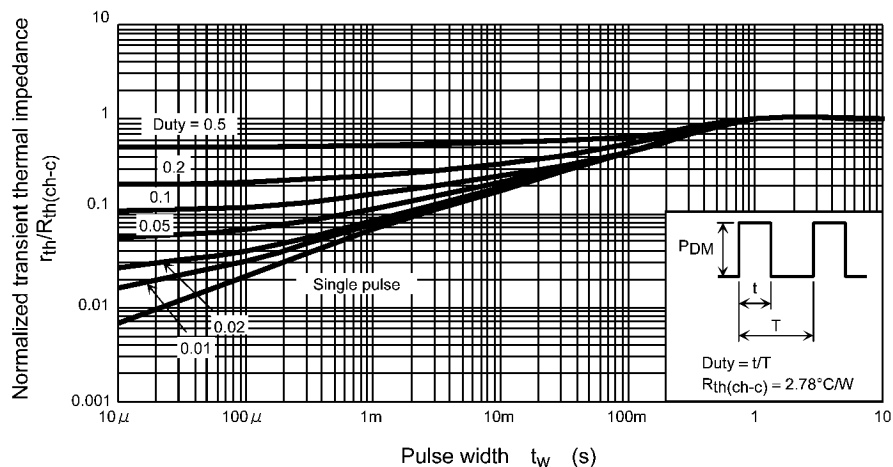
**Fig. 8.10  $V_{th} - T_a$**



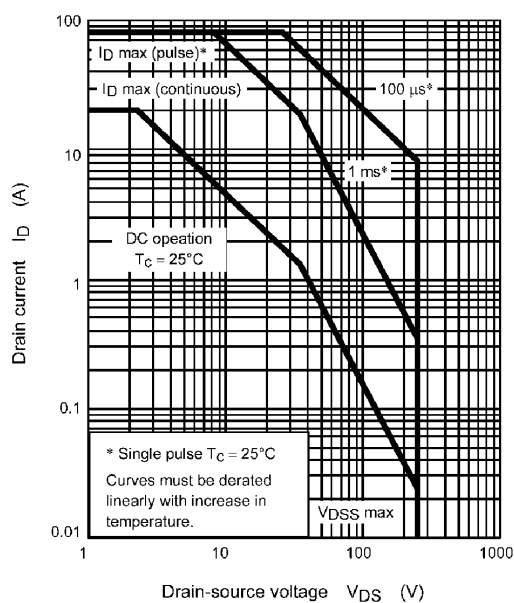
**Fig. 8.11  $P_D - T_c$   
(Guaranteed Maximum)**



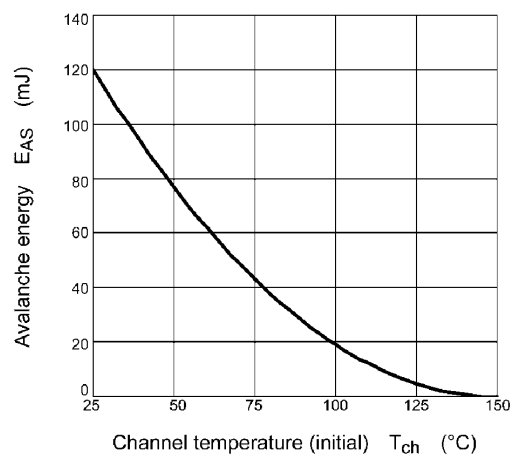
**Fig. 8.12 Dynamic Input/Output Characteristics**



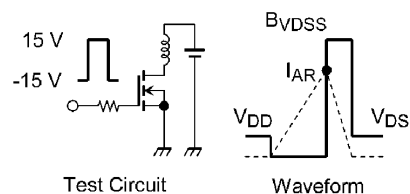
**Fig. 8.13  $r_{th}/R_{th(ch-c)} - t_w$**   
(Guaranteed Maximum)



**Fig. 8.14 Safe Operating Area**  
(Guaranteed Maximum)



**Fig. 8.15  $E_{AS} - T_{ch}$**   
(Guaranteed Maximum)



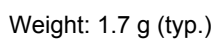
$$R_G = 25 \, \Omega, \quad V_{DD} = 50 \, \text{V}, \quad L = 0.5 \, \text{mH}$$

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

**Fig. 8.16 Test Circuit/Waveform**

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

## Unit: mm



Package Name(s)
JEITA: SC-67
TOSHIBA: 2-10U1S
Nickname: TO-220SIS



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