

MOSFETs Silicon N-Channel MOS ( $\pi$ -MOSVII)

## TK5A50D5

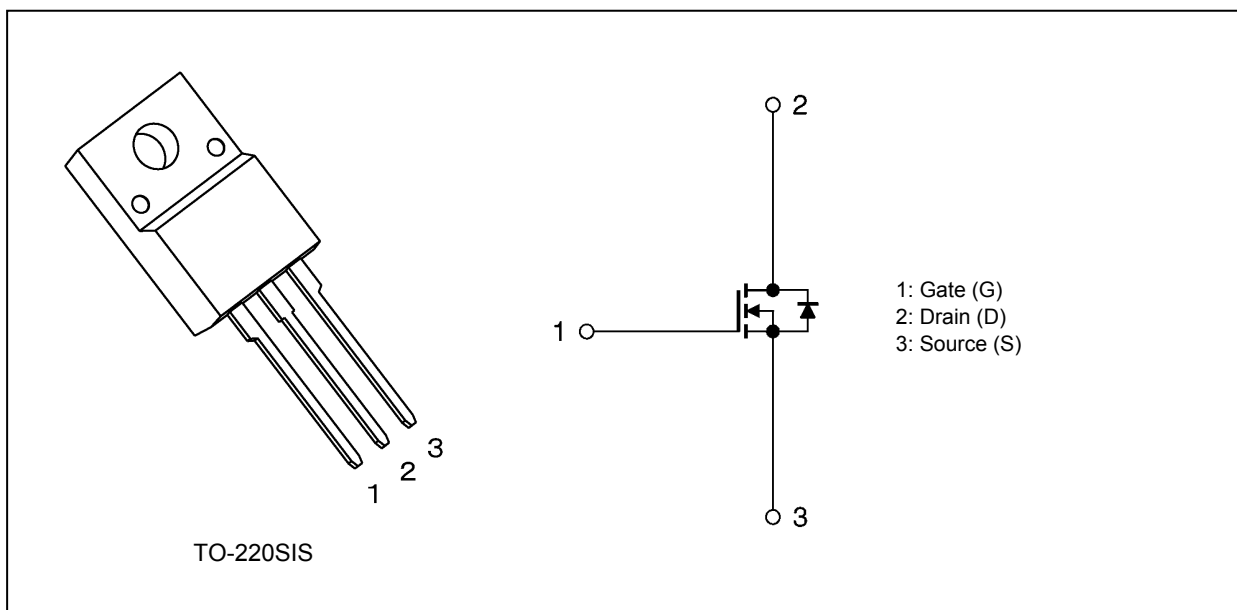
### 1. Applications

- Switching Voltage Regulators

### 2. Features

- (1) Fast reverse recovery time:  $t_{rrf} = 40 \text{ ns (typ.)}$ ,  $t_{rr} = 90 \text{ ns (typ.)}$
- (2) Low drain-source on-resistance:  $R_{DS(ON)} = 1.62 \Omega \text{ (typ.)}$
- (3) High forward transfer admittance:  $|Y_{fs}| = 3.0 \text{ S (typ.)}$
- (4) Low leakage current:  $I_{DSS} = 10 \mu\text{A (max)}$  ( $V_{DS} = 500 \text{ V}$ )
- (5) Enhancement mode:  $V_{th} = 2.5 \text{ to } 4.5 \text{ V}$  ( $V_{DS} = 10 \text{ V}$ ,  $I_D = 1 \text{ mA}$ )

### 3. Packaging and Internal Circuit



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

Characteristics	Symbol	Rating	Unit
Drain-source voltage	$V_{DSS}$	500	V
Gate-source voltage	$V_{GSS}$	$\pm 30$	
Drain current (DC) (Note 1)	$I_D$	5	A
Drain current (pulsed) ( $t = 1 \text{ ms}$ ) (Note 1)	$I_{DP}$	20	
Power dissipation ( $T_c = 25^\circ\text{C}$ )	$P_D$	35	W
Single-pulse avalanche energy (Note 2)	$E_{AS}$	150	mJ
Avalanche current	$I_{AR}$	5	A
Repetitive avalanche energy (Note 3)	$E_{AR}$	3.5	mJ
Channel temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55 to 150	

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).

## 5. Thermal Characteristics

Characteristics	Symbol	Max	Unit
Channel-to-case thermal resistance	$R_{th(ch-c)}$	3.57	$^\circ\text{C/W}$
Channel-to-ambient thermal resistance	$R_{th(ch-a)}$	62.5	

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

Note 2:  $V_{DD} = 90 \text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 10.2 \text{ mH}$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = 5 \text{ A}$

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.

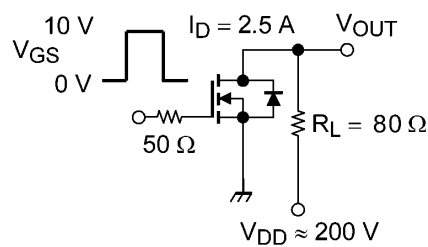
## 6. Electrical Characteristics

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	$I_{GSS}$	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$	—	—	$\pm 1$	$\mu\text{A}$
Drain cut-off current	$I_{DSS}$	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	500	—	—	V
Gate threshold voltage	$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	2.5	—	4.5	
Drain-source on-resistance	$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 2.5\text{ A}$	—	1.62	2.1	$\Omega$
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 2.5\text{ A}$	0.8	3.0	—	S

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	$C_{iss}$	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	490	—	$\mu\text{F}$
Reverse transfer capacitance	$C_{rss}$		—	3	—	
Output capacitance	$C_{oss}$		—	55	—	
Switching time (rise time)	$t_r$	See Figure 6.2.1.	—	18	—	ns
Switching time (turn-on time)	$t_{on}$		—	40	—	
Switching time (fall time)	$t_f$		—	8	—	
Switching time (turn-off time)	$t_{off}$		—	55	—	



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

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)	$Q_g$	$V_{DD} \approx 400\text{ V}, V_{GS} = 10\text{ V}, I_D = 5\text{ A}$	—	11	—	nC
Gate-source charge	$Q_{gs}$		—	6	—	
Gate-drain charge	$Q_{gd}$		—	5	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Reverse drain current (DC) (Note 4)	$I_{DR}$	—	—	—	5	A
Reverse drain current (pulsed) (Note 4)	$I_{DRP}$	—	—	—	20	A
Diode forward voltage	$V_{DSF}$	$I_{DR} = 5\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.7	V
Reverse recovery time	$t_{rrf}$	$I_{DR} = 5\text{ A}, V_{GS} = 0\text{ V},$ $-dI_{DR}/dt = 100\text{ A}/\mu\text{s},$ See Figure 6.4.1	—	40	—	ns
	$t_{rr}$		—	90	—	
Reverse recovery charge	$Q_{rr}$	$I_{DR} = 5\text{ A}, V_{GS} = 0\text{ V}$ $-dI_{DR}/dt = 100\text{ A}/\mu\text{s}$	—	70	—	nC

Note 4: Ensure that the channel temperature does not exceed  $150^\circ\text{C}$ .

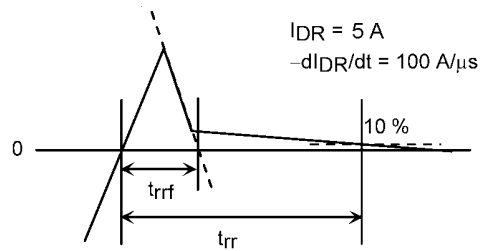


Fig. 6.4.1 Reverse Recovery Time

## 7. Marking (Note)

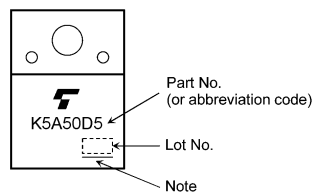


Fig. 7.1 Marking

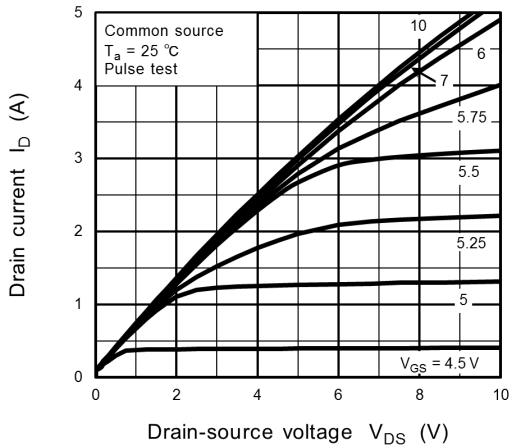
Note: A line under a Lot No. identifies the indication of product Labels.

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

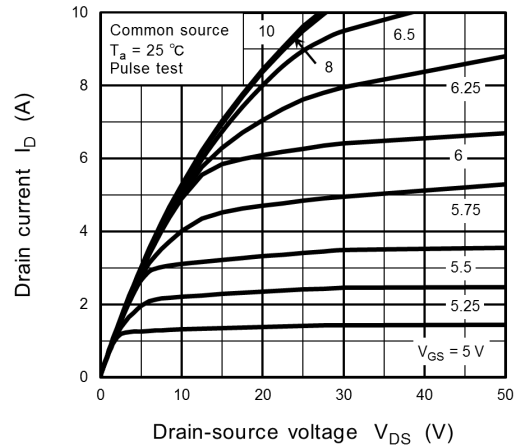
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

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.

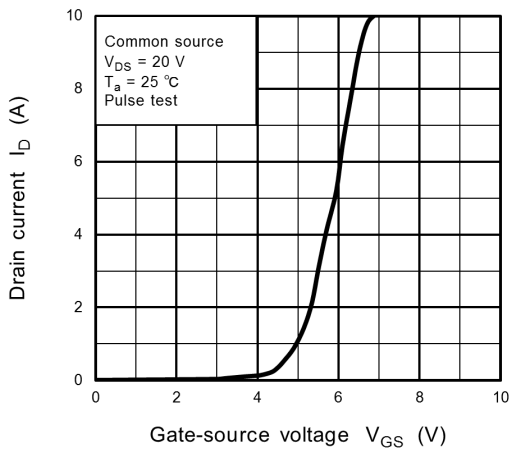
## 8. Characteristics Curves (Note)



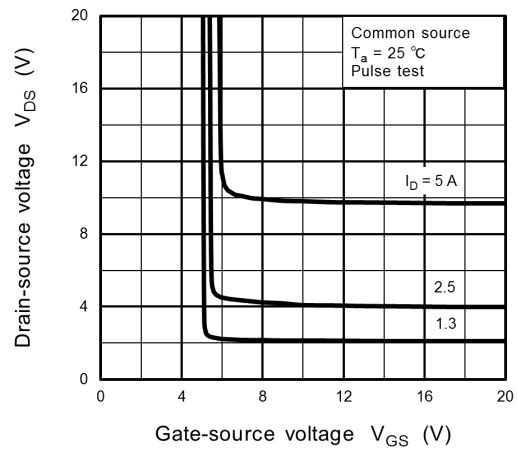
**Fig. 8.1**  $I_D - V_{DS}$



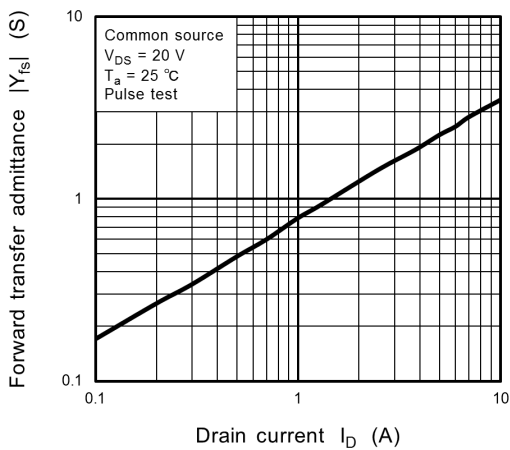
**Fig. 8.2**  $I_D - V_{DS}$



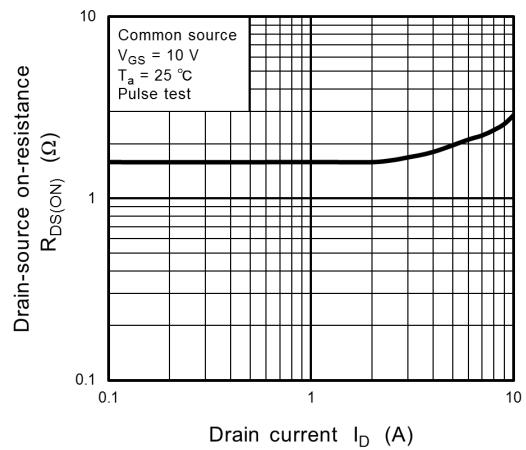
**Fig. 8.3**  $I_D - V_{GS}$



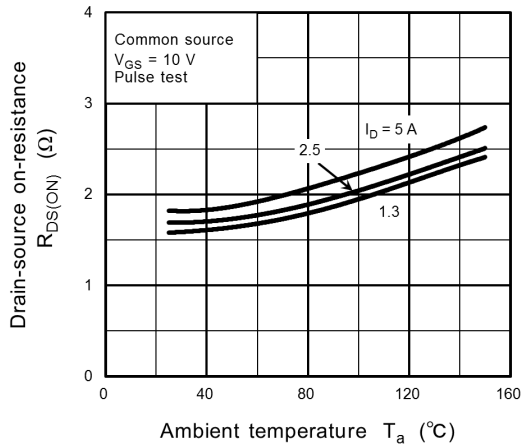
**Fig. 8.4**  $V_{DS} - V_{GS}$



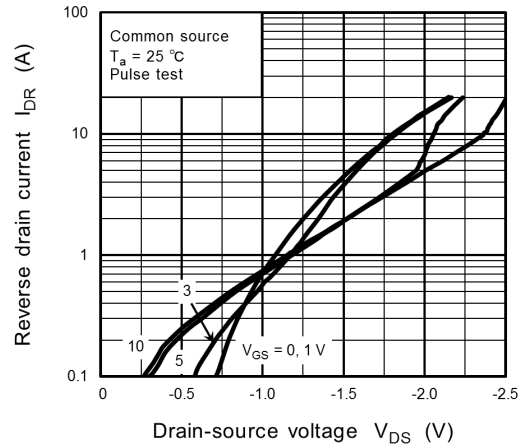
**Fig. 8.5**  $|Y_{fs}| - I_D$



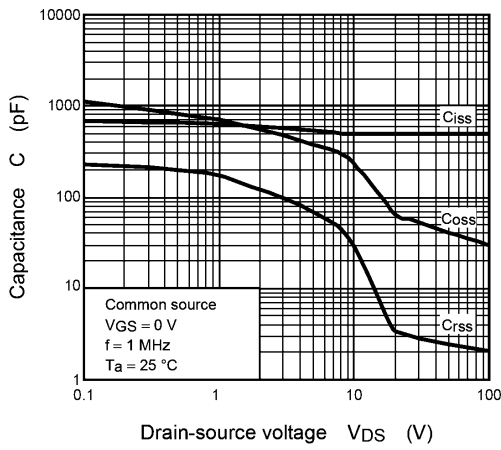
**Fig. 8.6**  $R_{DS(ON)} - I_D$



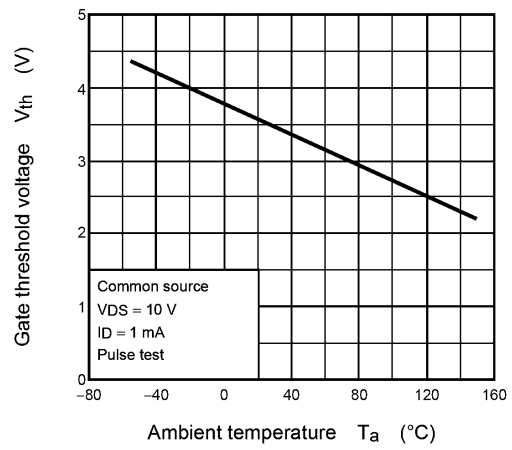
**Fig. 8.7**  $R_{DS(ON)} - T_a$



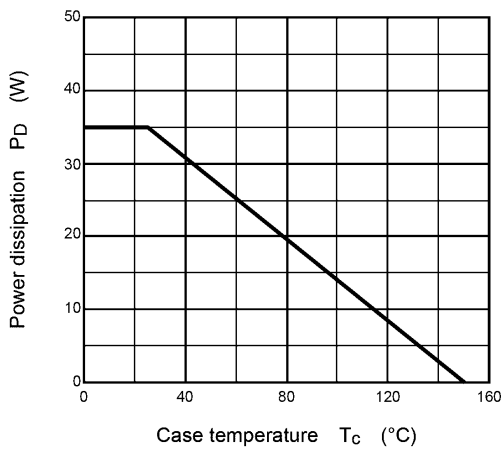
**Fig. 8.8**  $I_{DR} - V_{DS}$



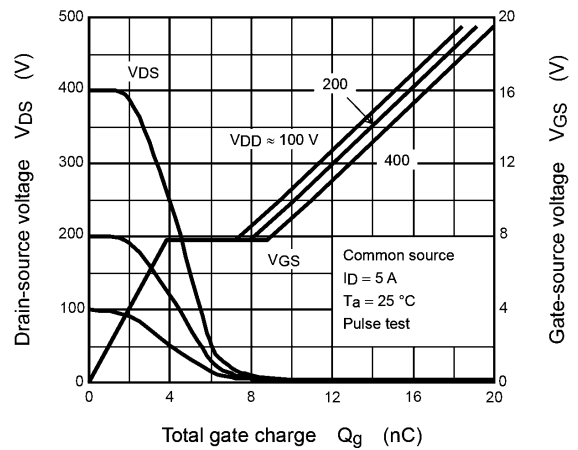
**Fig. 8.9**  $C - V_{DS}$



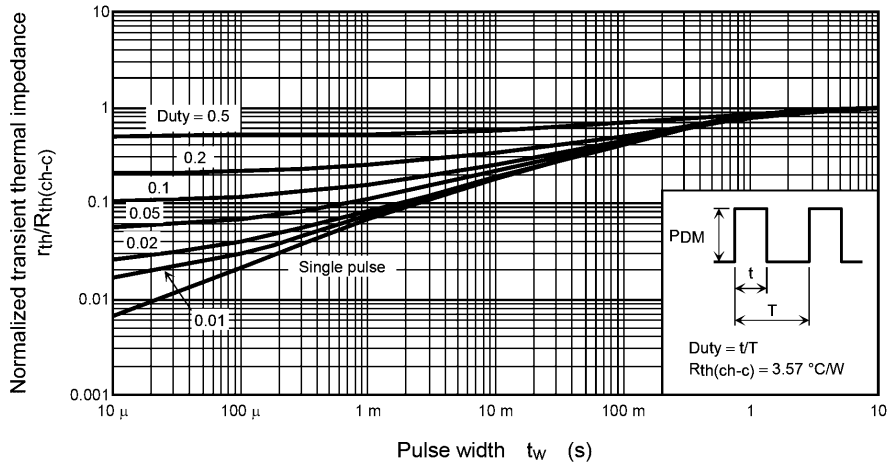
**Fig. 8.10**  $V_{th} - T_a$



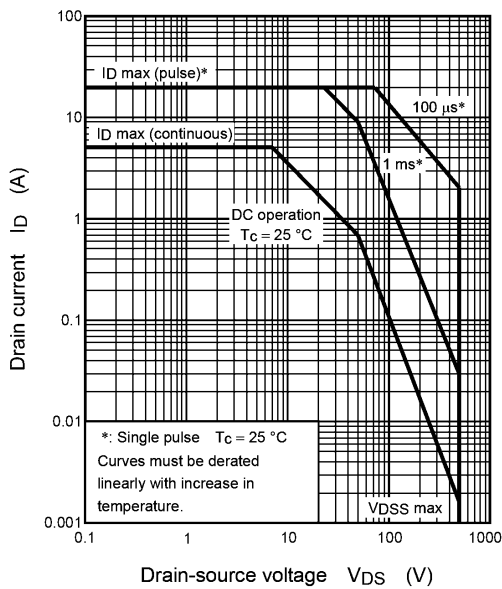
**Fig. 8.11**  $P_D - T_c$   
(Guaranteed Maximum)



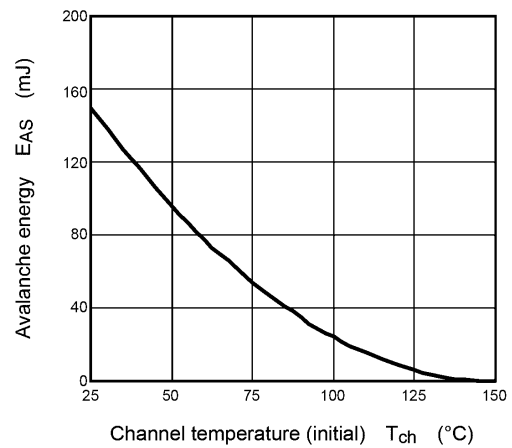
**Fig. 8.12** Dynamic Input/Output Characteristics



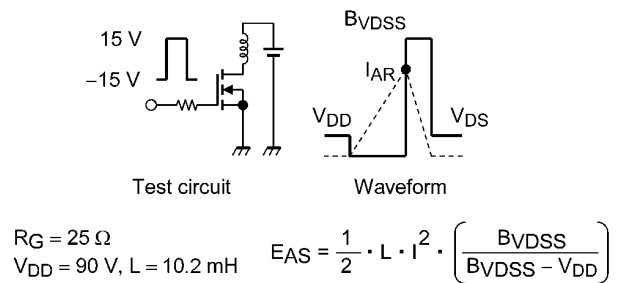
**Fig. 8.13**  $r_{th}/R_{th(ch-c)} - t_w$   
(Guaranteed Maximum)



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



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



**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.





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