

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

## TK10A60D5

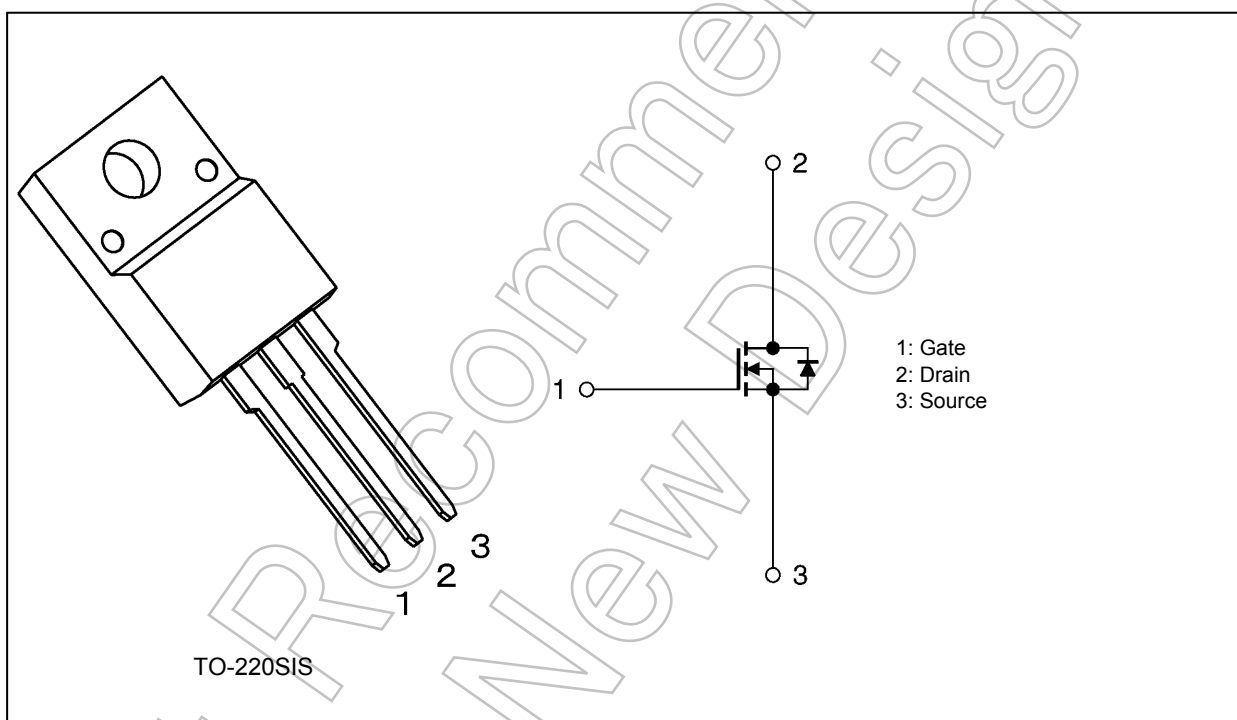
### 1. Applications

- Switching Voltage Regulators

### 2. Features

- (1) Fast reverse recovery time:  $t_{rrf} = 50$  ns (typ.),  $t_{rr} = 90$  ns (typ.)
- (2) Low drain-source on-resistance:  $R_{DS(ON)} = 0.8 \Omega$  (typ.)
- (3) High forward transfer admittance:  $|Y_{fs}| = 6.0$  S (typ.)
- (4) Low leakage current:  $I_{DSS} = 10 \mu\text{A}$  (max) ( $V_{DS} = 600$  V)
- (5) Enhancement mode:  $V_{th} = 2.5$  to  $4.5$  V ( $V_{DS} = 10$  V,  $I_D = 1$  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	$V_{DSS}$	600	V
Gate-source voltage	$V_{GSS}$	$\pm 30$	
Drain current (DC) (Note 1)	$I_D$	10	A
Drain current (pulsed) ( $t = 1 \text{ ms}$ ) (Note 1)	$I_{DP}$	40	
Power dissipation ( $T_c = 25^\circ\text{C}$ )	$P_D$	45	W
Single-pulse avalanche energy (Note 2)	$E_{AS}$	364	mJ
Avalanche current	$I_{AR}$	10	A
Repetitive avalanche energy (Note 3)	$E_{AR}$	4.5	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	$R_{th(ch-c)}$	2.78	$^\circ\text{C/W}$
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),  $L = 6.36 \text{ mH}$ ,  $R_G = 25 \Omega$ ,  $I_{AR} = 10 \text{ A}$

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.

Not Recommended for New Design

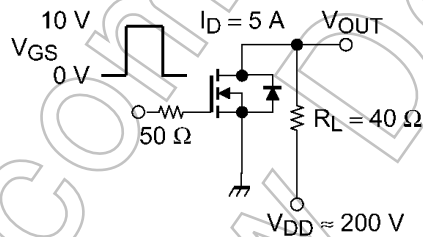
## 6. Electrical Characteristics

### 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	$I_{DSS}$	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	600	—	—	V
Gate threshold voltage	$V_{th}$	$V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$	2.5	—	4.5	
Drain-source on-resistance	$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 5\text{ A}$	—	0.8	1.05	$\Omega$
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 10\text{ V}, I_D = 5\text{ A}$	1.5	6.0	—	S

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	$C_{iss}$	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	1350	—	$\mu\text{F}$
Reverse transfer capacitance	$C_{rss}$		—	15	—	
Output capacitance	$C_{oss}$		—	135	—	
Switching time (rise time)	$t_r$	See Figure 6.2.1.	—	22	—	ns
Switching time (turn-on time)	$t_{on}$		—	55	—	
Switching time (fall time)	$t_f$		—	15	—	
Switching time (turn-off time)	$t_{off}$		—	100	—	



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)	$Q_g$	$V_{DD} \approx 400\text{ V}, V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	—	25	—	nC
Gate-source charge	$Q_{gs}$		—	16	—	
Gate-drain charge	$Q_{gd}$		—	9	—	

## 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)	$I_{DR}$	—	—	—	10	A
Reverse drain current (pulsed) (Note 4)	$I_{DRP}$	—	—	—	40	A
Diode forward voltage	$V_{DSF}$	$I_{DR} = 10\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.7	V
Reverse recovery time	$t_{rrf}$	$I_{DR} = 10\text{ A}, V_{GS} = 0\text{ V},$ $-dI_{DR}/dt = 100\text{ A}/\mu\text{s},$ See Figure 6.4.1	—	50	—	ns
	$t_{rr}$		—	90	—	
Reverse recovery charge	$Q_{rr}$	$I_{DR} = 10\text{ A}, V_{GS} = 0\text{ V},$ $-dI_{DR}/dt = 100\text{ A}/\mu\text{s}$	—	130	—	nC

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

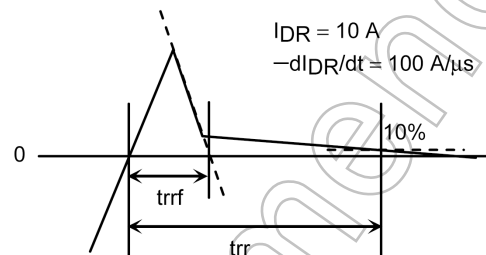


Fig. 6.4.1 Reverse Recovery Time

## 7. Marking (Note)

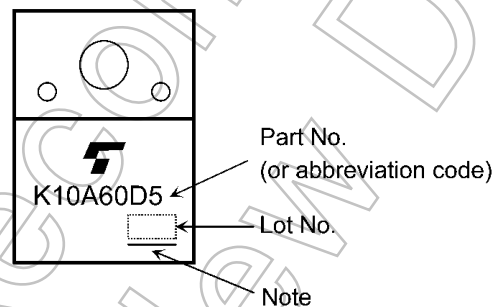


Fig. 7.1 Marking

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)

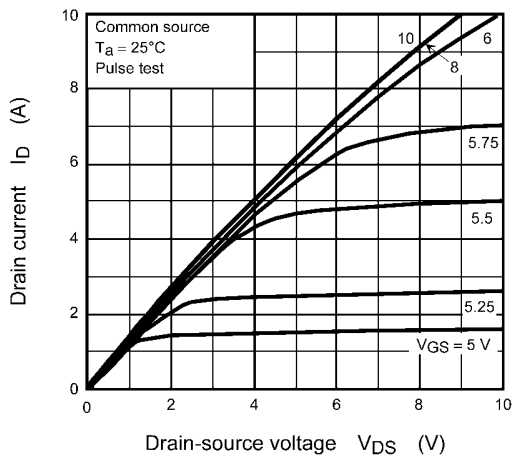


Fig. 8.1  $I_D - V_{DS}$

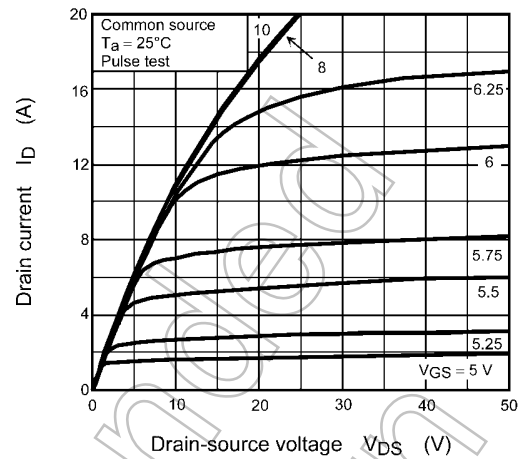


Fig. 8.2  $I_D - V_{DS}$

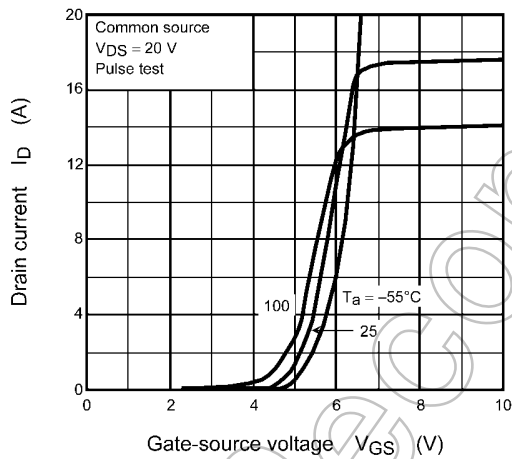


Fig. 8.3  $I_D - V_{GS}$

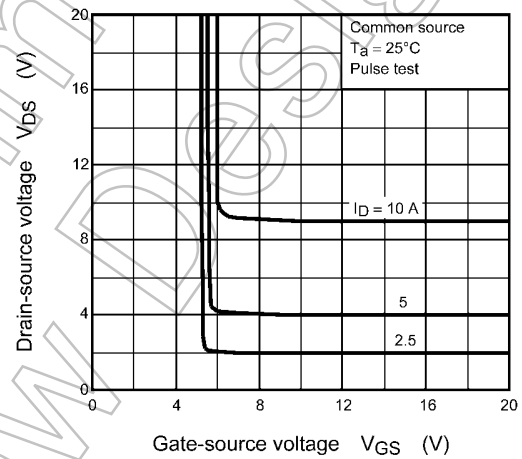


Fig. 8.4  $V_{DS} - V_{GS}$

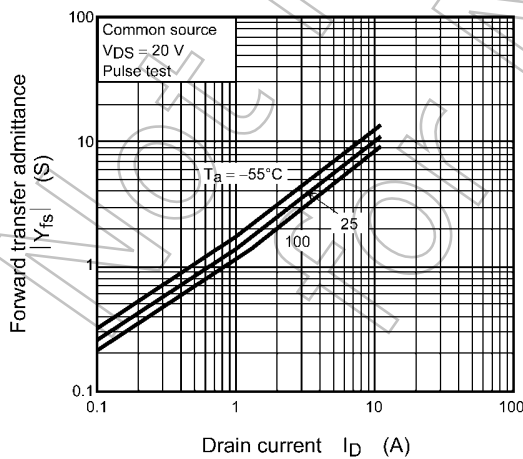


Fig. 8.5  $|Y_{fs}| - I_D$

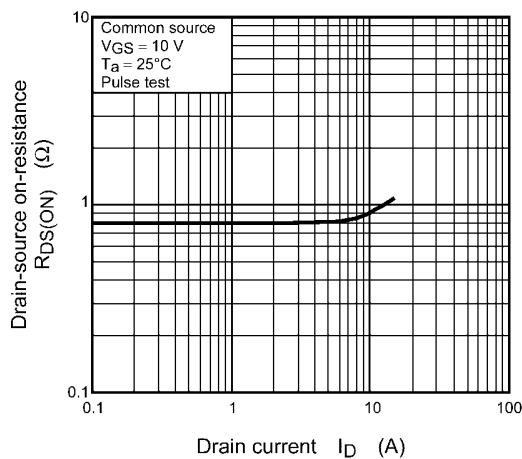


Fig. 8.6  $R_{DS(ON)} - I_D$

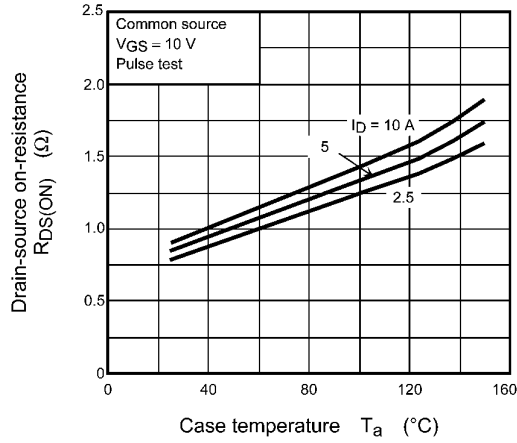


Fig. 8.7 R<sub>DS(ON)</sub> - T<sub>a</sub>

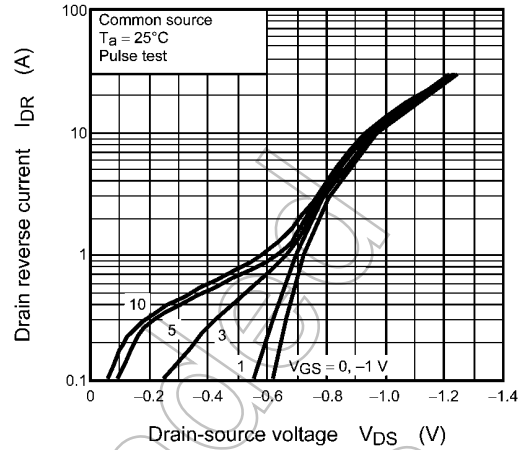


Fig. 8.8 I<sub>DR</sub> - V<sub>DS</sub>

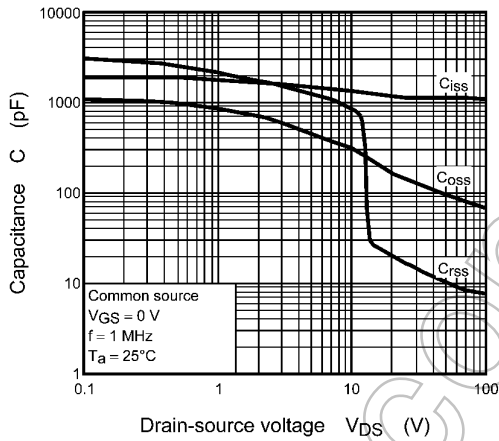


Fig. 8.9 C - V<sub>DS</sub>

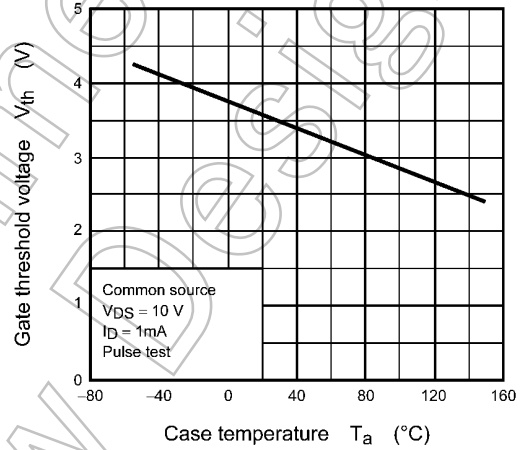


Fig. 8.10 V<sub>th</sub> - T<sub>a</sub>

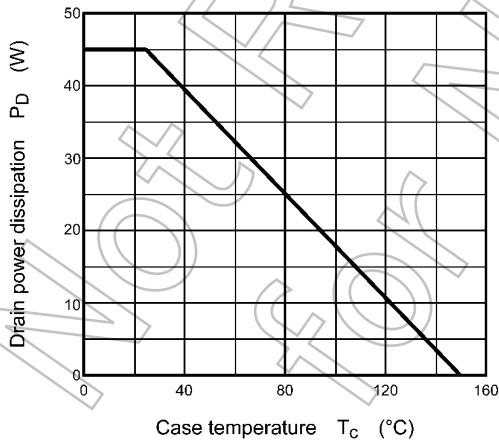


Fig. 8.11 P<sub>D</sub> - T<sub>c</sub>  
(Guaranteed Maximum)

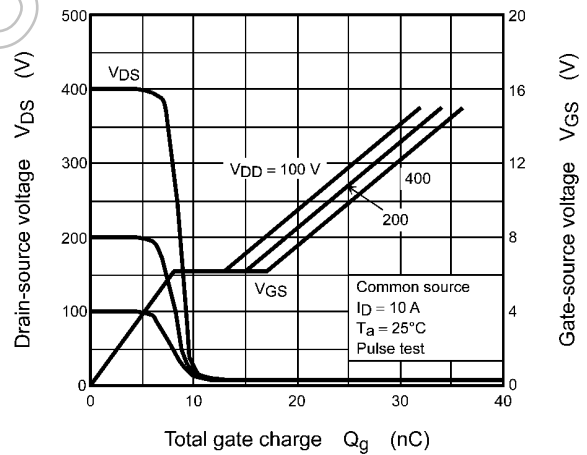
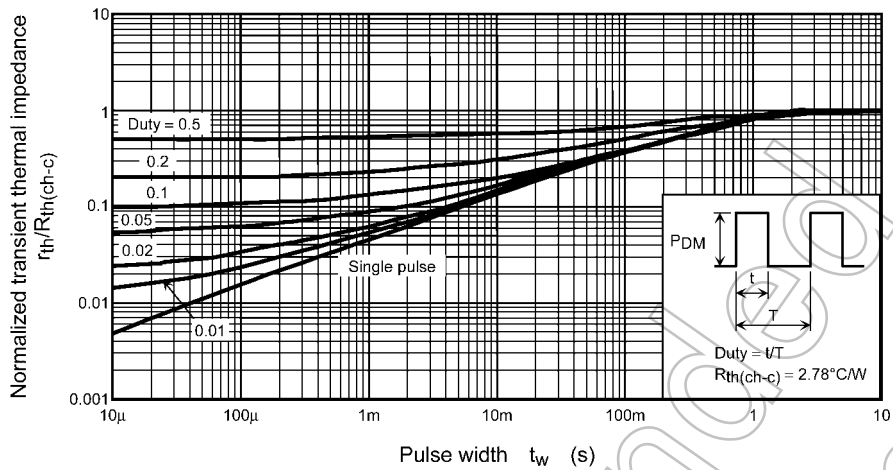
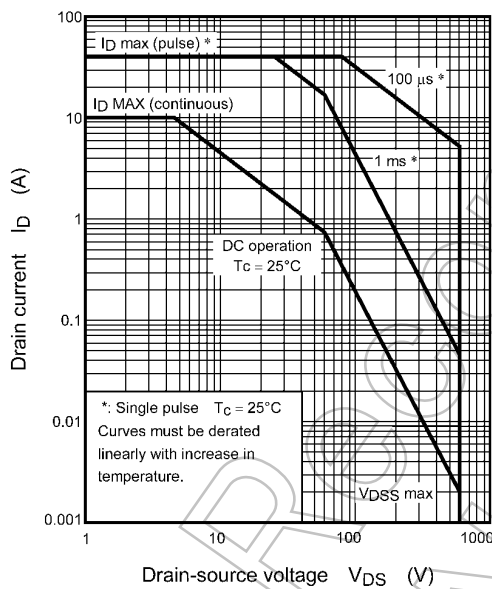


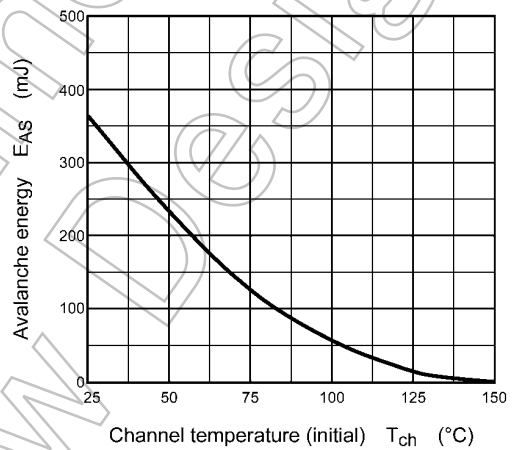
Fig. 8.12 Dynamic Input/Output Characteristics



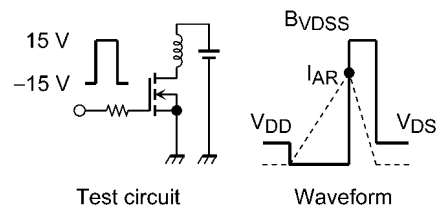
**Fig. 8.13**  $r_{th}/R_{th(ch-c)} - t_w$   
(Guaranteed Maximum)



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



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



$$R_G = 25\Omega, V_{DD} = 90\text{ V}, L = 6.36\text{ mH} \quad E_{AS} = \frac{1}{2} \cdot L \cdot I_{AR}^2 \cdot \left( \frac{BVDSS}{BVDSS - V_{DD}} \right)$$

**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.





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