

MOSFETs Silicon N-Channel MOS (DTMOSIV)

# TK39N60W

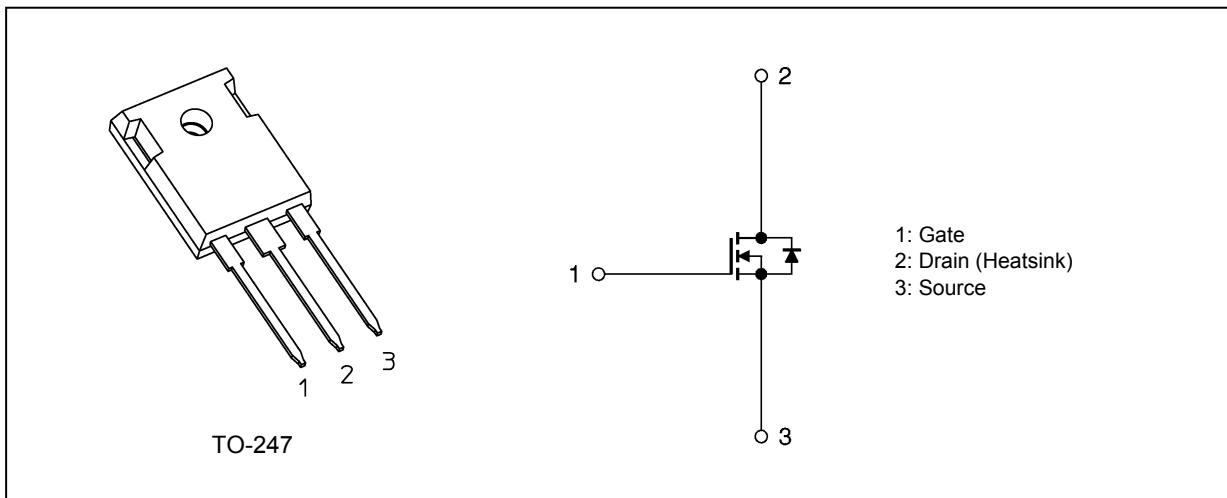
## 1. Applications

- Switching Voltage Regulators

## 2. Features

- (1) Low drain-source on-resistance:  $R_{DS(ON)} = 0.055 \Omega$  (typ.)  
by used to Super Junction Structure : DTMOS
- (2) Easy to control Gate switching
- (3) Enhancement mode:  $V_{th} = 2.7$  to  $3.7$  V ( $V_{DS} = 10$  V,  $I_D = 1.9$  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)	$I_D$	38.8	A
Drain current (pulsed)	$I_{DP}$	155	
Power dissipation ( $T_c = 25^\circ\text{C}$ )	$P_D$	270	W
Single-pulse avalanche energy	$E_{AS}$	608	mJ
Avalanche current	$I_{AR}$	9.7	A
Reverse drain current (DC)	$I_{DR}$	38.8	
Reverse drain current (pulsed)	$I_{DRP}$	155	
Channel temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55 to 150	
Mounting torque	$T_{OR}$	0.8	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  
2012-09

## 5. Thermal Characteristics

Characteristics	Symbol	Max	Unit
Channel-to-case thermal resistance	$R_{th(ch-c)}$	0.463	°C/W
Channel-to-ambient thermal resistance	$R_{th(ch-a)}$	50	

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

Note 2:  $V_{DD} = 90$  V,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 11.3$  mH,  $R_G = 25 \Omega$ ,  $I_{AR} = 9.7$  A

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

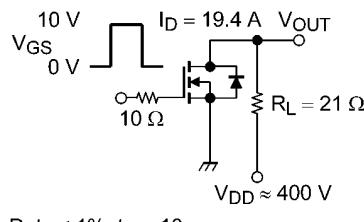
## 6. Electrical Characteristics

### 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	$I_{DSS}$	$V_{DS} = 600 \text{ V}, V_{GS} = 0 \text{ V}$	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}$	600	—	—	V
Gate threshold voltage	$V_{th}$	$V_{DS} = 10 \text{ V}, I_D = 1.9 \text{ mA}$	2.7	—	3.7	
Drain-source on-resistance	$R_{DS(\text{ON})}$	$V_{GS} = 10 \text{ V}, I_D = 19.4 \text{ A}$	—	0.055	0.065	$\Omega$

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	$C_{iss}$	$V_{DS} = 300 \text{ V}, V_{GS} = 0 \text{ V}, f = 100 \text{ kHz}$	—	4100	—	$\text{pF}$
Reverse transfer capacitance	$C_{rss}$		—	10	—	
Output capacitance	$C_{oss}$		—	90	—	
Effective output capacitance	$C_{o(er)}$	$V_{DS} = 0 \text{ to } 400 \text{ V}, V_{GS} = 0 \text{ V}$	—	165	—	
Gate resistance	$r_g$	$V_{DS} = \text{OPEN}, f = 1 \text{ MHz}$	—	2	—	$\Omega$
Switching time (rise time)	$t_r$	See Figure 6.2.1	—	50	—	$\text{ns}$
Switching time (turn-on time)	$t_{on}$		—	80	—	
Switching time (fall time)	$t_f$		—	9	—	
Switching time (turn-off time)	$t_{off}$		—	200	—	
MOSFET dv/dt ruggedness	$dv/dt$	$V_{DD} = 0 \text{ to } 400 \text{ V}, I_D = 9.7 \text{ A}$	50	—	—	$\text{V/ns}$



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

Fig. 6.2.1 Switching Time Test Circuit

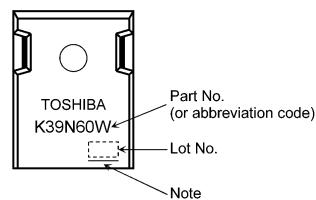
### 6.3. Gate Charge Characteristics ( $T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	$Q_g$	$V_{DD} \approx 400 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 38.8 \text{ A}$	—	110	—	$\text{nC}$
Gate-source charge 1	$Q_{gs1}$		—	23	—	
Gate-drain charge	$Q_{gd}$		—	52	—	

### 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	$V_{DSF}$	$I_{DR} = 38.8 \text{ A}, V_{GS} = 0 \text{ V}$	—	—	-1.7	V
Reverse recovery time	$t_{rr}$	$I_{DR} = 19.4 \text{ A}, V_{GS} = 0 \text{ V}$	—	450	—	ns
Reverse recovery charge	$Q_{rr}$	$-dI_{DR}/dt = 50 \text{ A}/\mu\text{s}$	—	5	—	$\mu\text{C}$
Peak reverse recovery current	$I_{rr}$		—	21	—	A
Diode dv/dt ruggedness	$dv/dt$	$I_{DR} = 19.4 \text{ A}, V_{GS} = 0 \text{ V}, V_{DD} = 400 \text{ V}$	15	—	—	$\text{V/ns}$

## 7. Marking (Note)



**Fig. 7.1 Marking**

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

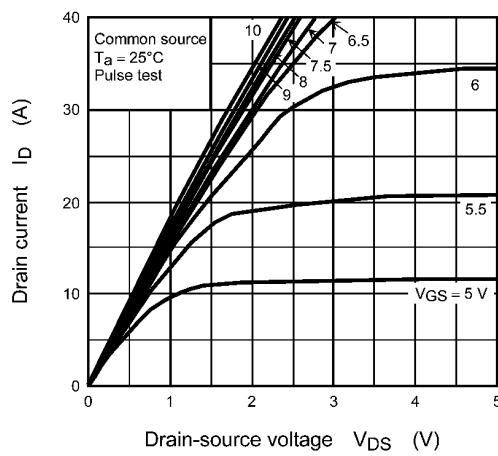
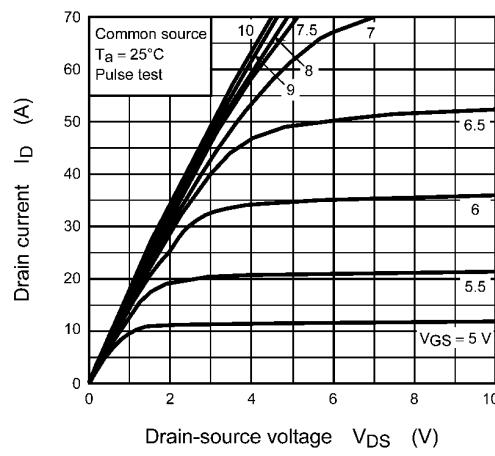
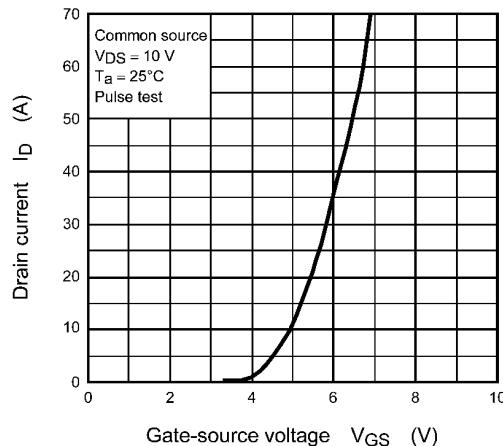
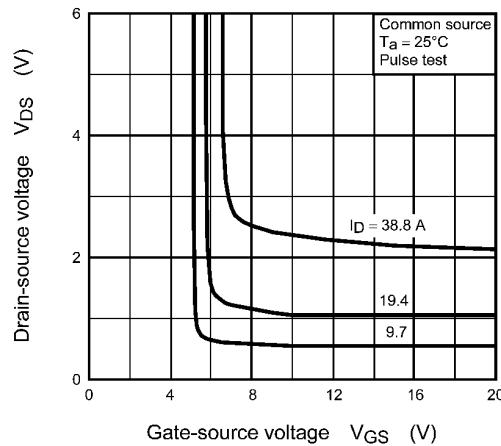
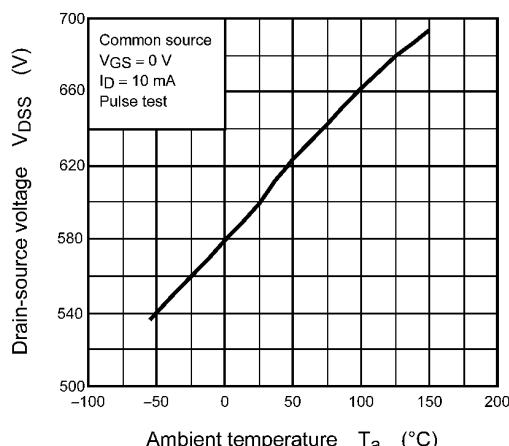
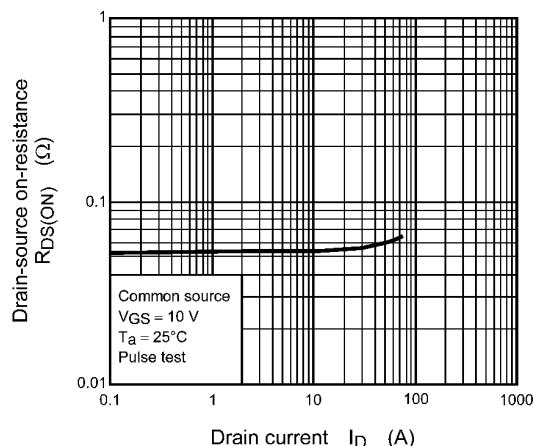
Not underlined: [[Pb]]/INCLUDES > MCV

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

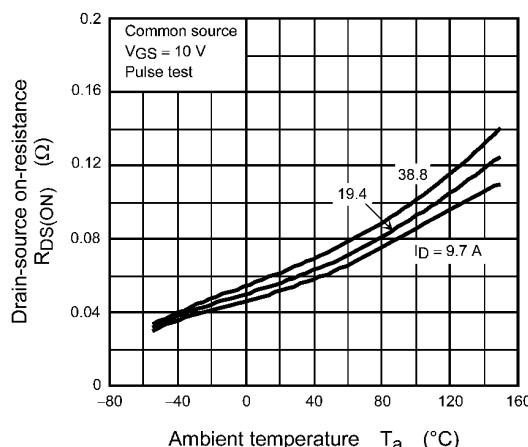
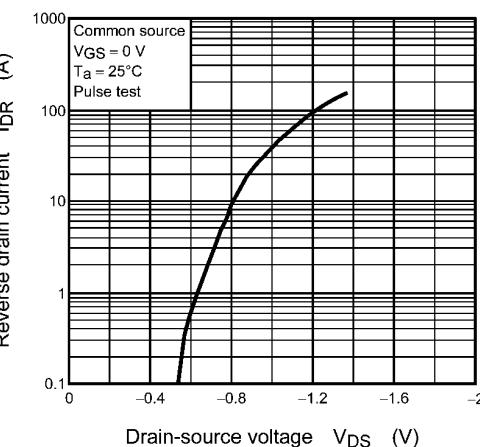
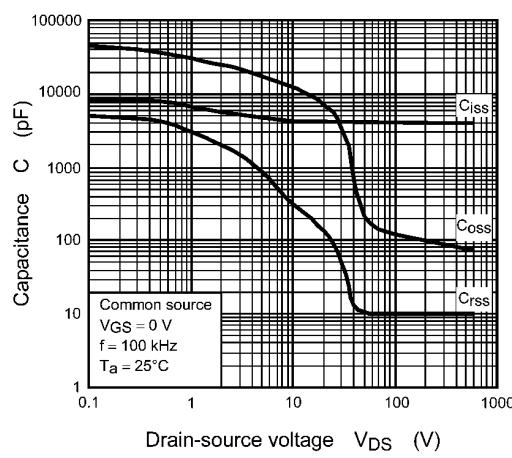
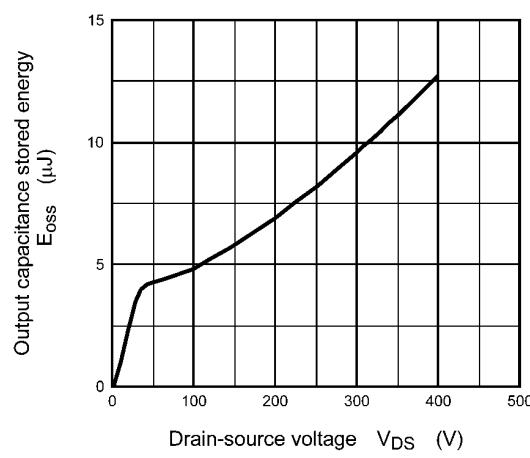
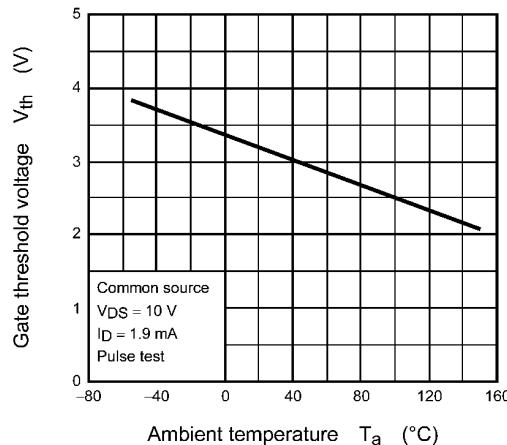
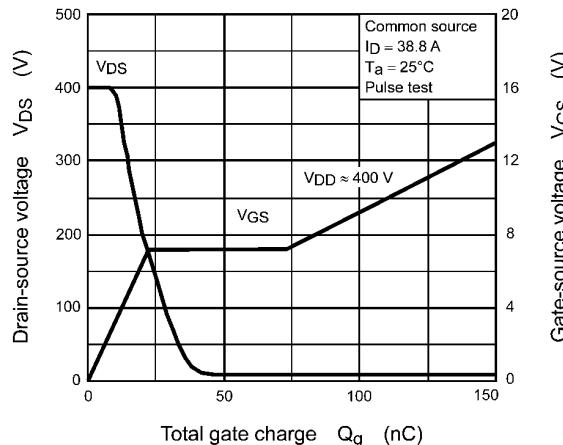
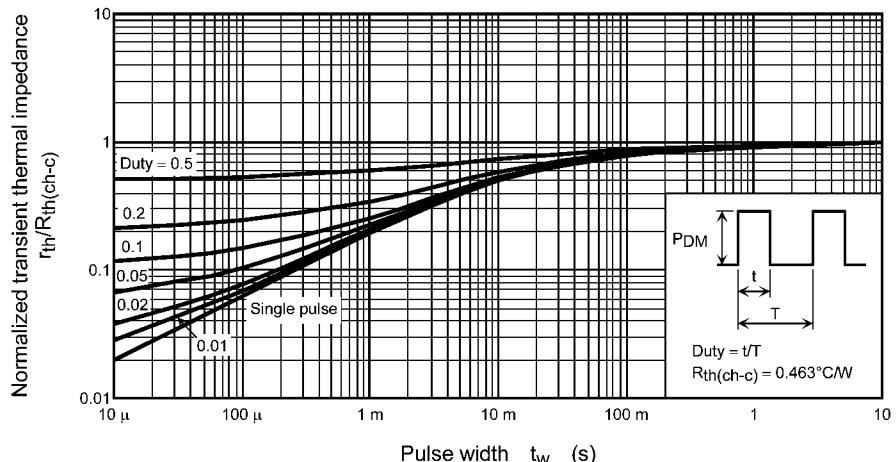
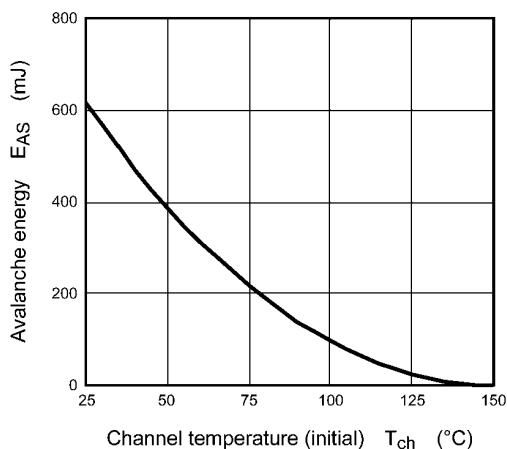
Fig. 8.7  $R_{DS(ON)}$  -  $T_a$ Fig. 8.8  $I_{DR}$  -  $V_{DS}$ Fig. 8.9  $C$  -  $V_{DS}$ Fig. 8.10  $E_{OSS}$  -  $V_{DS}$ Fig. 8.11  $V_{th}$  -  $T_a$ 

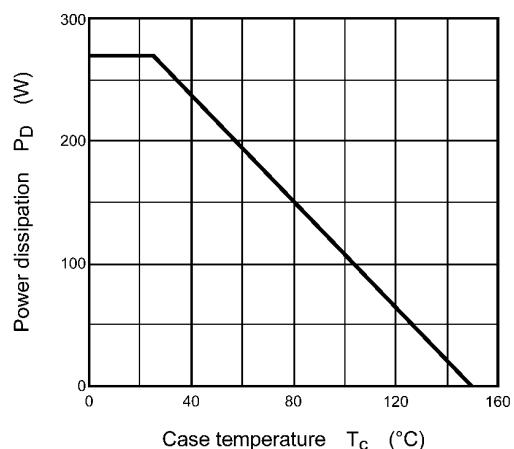
Fig. 8.12 Dynamic Input/Output Characteristics



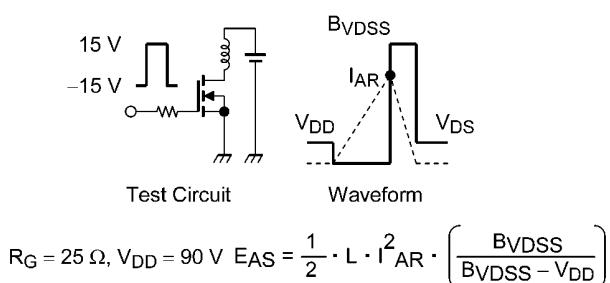
**Fig. 8.13  $r_{th} - t_w$**   
**(Guaranteed Maximum)**



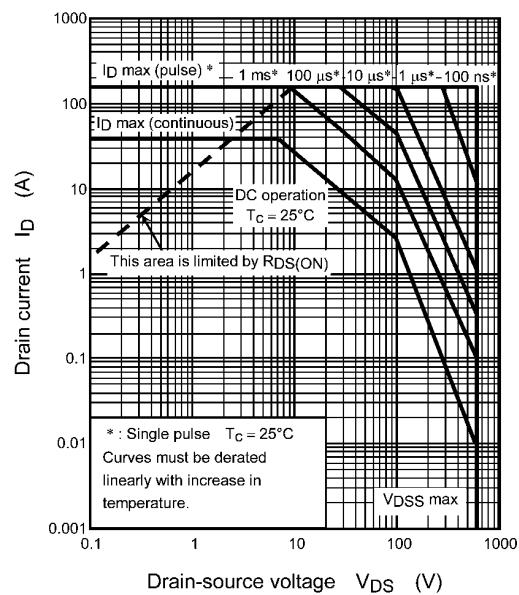
**Fig. 8.14  $E_{AS} - T_{ch}$**   
**(Guaranteed Maximum)**



**Fig. 8.15  $P_D - T_c$**   
**(Guaranteed Maximum)**



**Fig. 8.16 Test Circuit/Waveform**

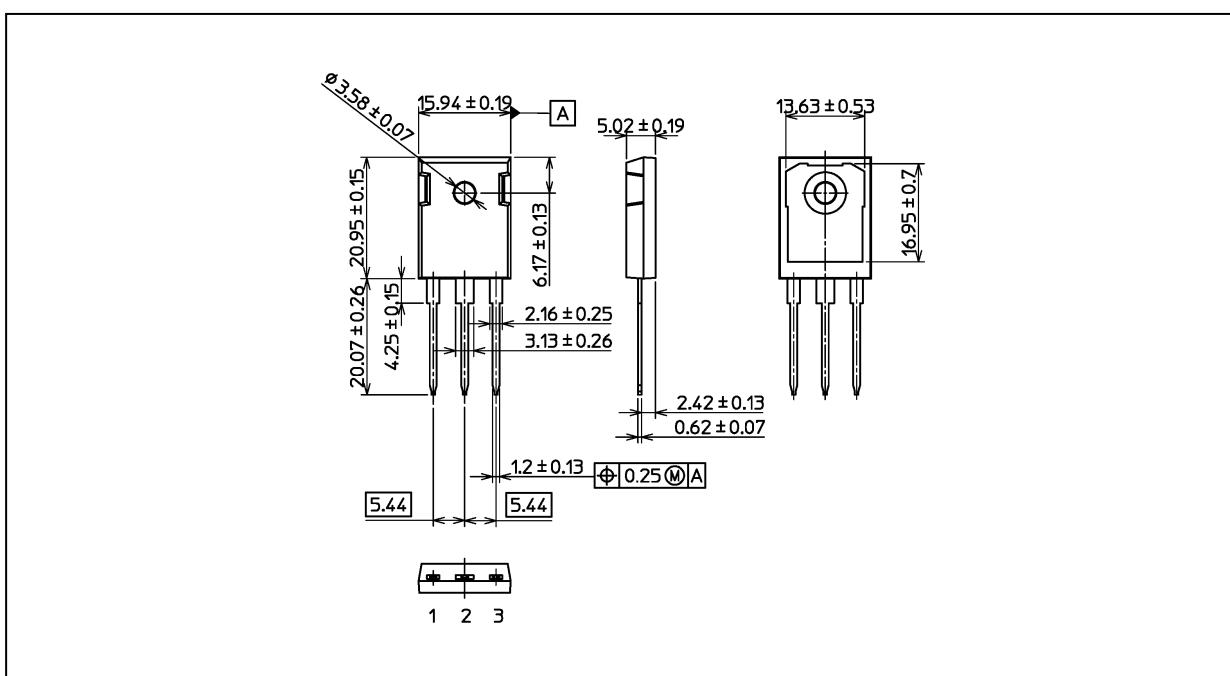


**Fig. 8.17 Safe Operating Area  
(Guaranteed Maximum)**

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

**Package Dimensions**

Unit: mm



Weight: 6.15 g (typ.)

Package Name(s)
JEITA: SC-65
TOSHIBA: 2-16L1A
Nickname: TO-247

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