MOSFETs Silicon N-Channel MOS (π-MOSⅧ)

TK9A90E

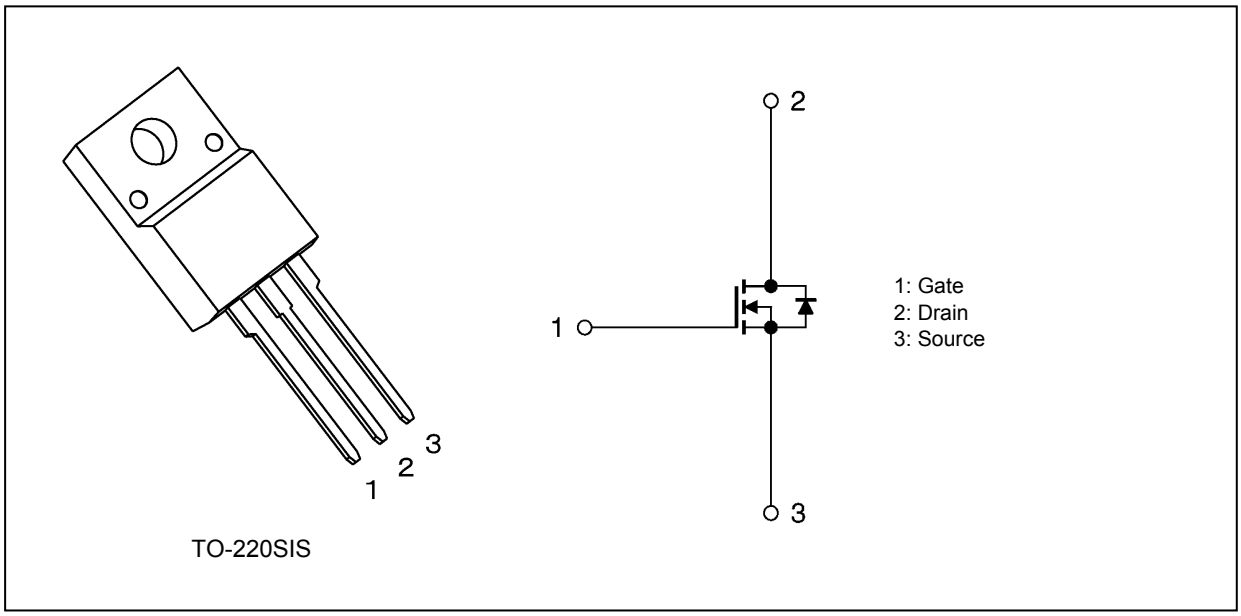
1. Applications

- Switching Voltage Regulators

2. Features

(1) Low drain-source on-resistance: $R_{DS(ON)}$ = 1.0 Ω (typ.)
(2) Low leakage current : I_{DSS} = 10 μA (max) (V_{DS} = 720 V)
(3) Enhancement mode: V_{th} = 2.5 to 4.0 V (V_{DS} = 10 V, I_D = 0.9 mA)

3. Packaging and Internal Circuit



Start of commercial production
2013-10

2014-03-04
Rev.3.0

4. Absolute Maximum Ratings (Note) (T_a = 25 °C unless otherwise specified)

Characteristics		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	900	V
Gate-source voltage		V_{GSS}	±30	
Drain current (DC)	(Note 1)	I_D	9	A
Drain current (pulsed)	(Note 1)	I_{DP}	27	
Power dissipation	(T_c = 25°C)	P_D	50	W
Single-pulse avalanche energy	(Note 2)	E_{AS}	454	mJ
Avalanche current		I_{AR}	9	A
Reverse drain current (DC)	(Note 1)	I_{DR}	9	
Reverse drain current (pulsed)	(Note 1)	I_{DRP}	27	
Channel temperature		T_{ch}	150	°C
Storage temperature		T_{stg}	-55 to 150	
Isolation voltage (RMS)		$V_{ISO(RMS)}$	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).

5. Thermal Characteristics

Characteristics	Symbol	Max	Unit
Channel-to-case thermal resistance	$R_{th(ch-c)}$	2.5	°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} = 90 V, T_{ch} = 25°C (initial), L = 10.3 mH, R_G = 25 Ω, I_{AR} = 9 A

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

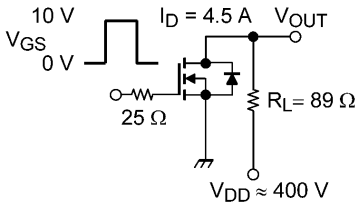
6. Electrical Characteristics

6.1. Static Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	V_{GS} = ±30 V, V_{DS} = 0 V	—	—	±1	μA
Drain cut-off current	I_{DSS}	V_{DS} = 720 V, V_{GS} = 0 V	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	I_D = 10 mA, V_{GS} = 0 V	900	—	—	V
Gate threshold voltage	V_{th}	V_{DS} = 10 V, I_D = 0.9 mA	2.5	—	4.0	
Drain-source on-resistance	$R_{DS(ON)}$	V_{GS} = 10 V, I_D = 4.5 A	—	1.0	1.3	Ω

6.2. Dynamic Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	C_{iss}	V_{DS} = 25 V, V_{GS} = 0 V, f = 1 MHz	—	2000	—	pF
Reverse transfer capacitance	C_{rss}		—	15	—	
Output capacitance	C_{oss}		—	150	—	
Gate resistance	r_g	V_{DS} = OPEN, f = 1 MHz	—	3.5	—	Ω
Switching time (rise time)	t_r	See Fig. 6.2.1.	—	40	—	ns
Switching time (turn-on time)	t_{on}		—	80	—	
Switching time (fall time)	t_f		—	35	—	
Switching time (turn-off time)	t_{off}		—	140	—	
MOSFET dv/dt ruggedness	dv/dt	V_{DD} = 0 to 400 V, I_D = 9 A	20	—	—	V/ns



Duty ≤ 1%, t_w = 10 μs

Fig. 6.2.1 Switching Time Test Circuit

6.3. Gate Charge Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	V_{DD} ≈ 400 V, V_{GS} = 10 V, I_D = 9 A	—	46	—	nC
Gate-source charge 1	Q_{gs1}		—	13	—	
Gate-drain charge	Q_{gd}		—	18	—	

6.4. Source-Drain Characteristics (T_a = 25 °C unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Diode forward voltage	V_{DSF}	I_{DR} = 9 A, V_{GS} = 0 V	—	—	-1.7	V
Reverse recovery time	t_{rr}	I_{DR} = 9 A, V_{GS} = 0 V $-dI_{DR}/dt$ = 100 A/μs	—	1200	—	ns
Reverse recovery charge	Q_{rr}		—	12	—	μC
Peak reverse recovery current	I_{rr}		—	24	—	A

7. Marking (Note)

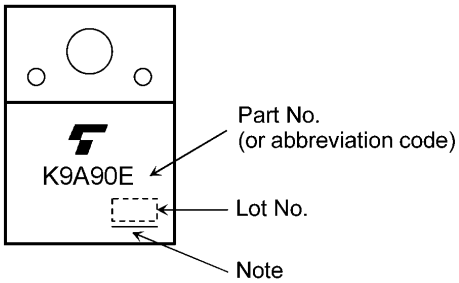


Fig. 7.1 Marking

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)

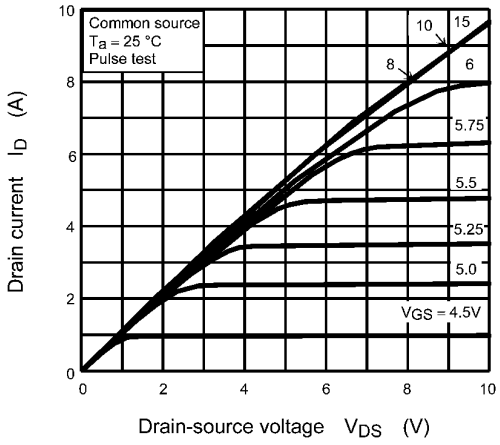


Fig. 8.1 I_D - V_{DS}

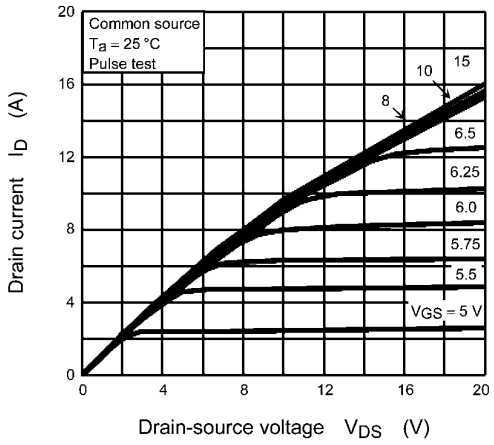


Fig. 8.2 I_D - V_{DS}

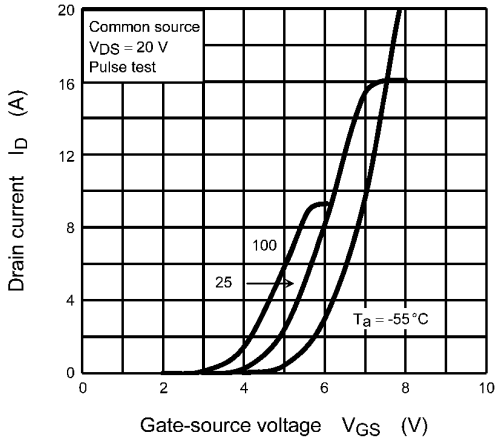


Fig. 8.3 I_D - V_{GS}

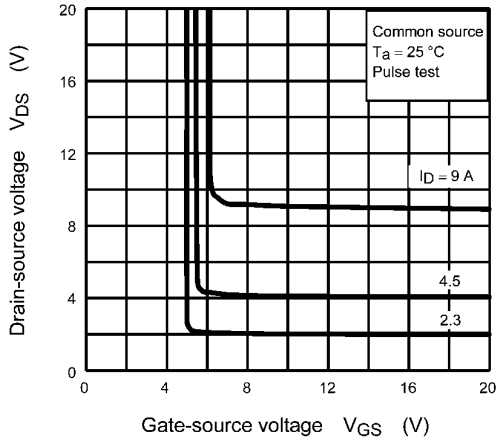


Fig. 8.4 V_{DS} - V_{GS}

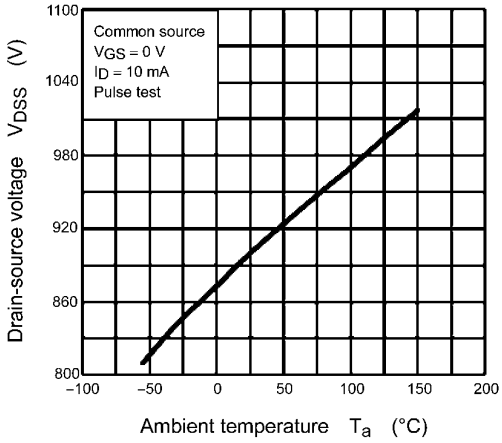


Fig. 8.5 V_{DSS} - T_a

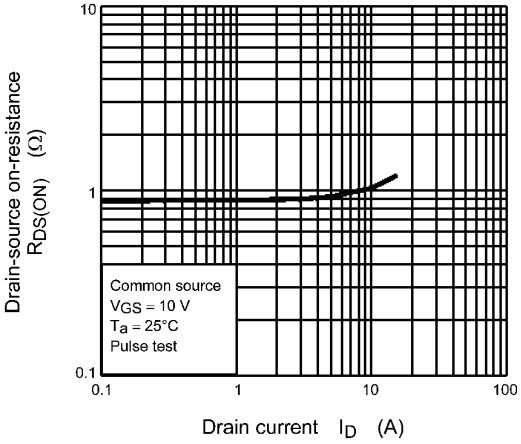


Fig. 8.6 $R_{DS(ON)}$ - I_D

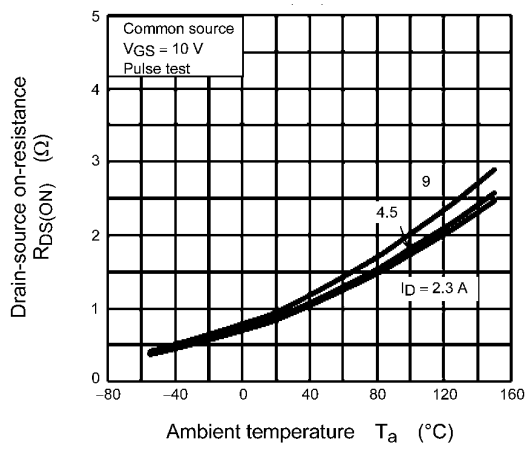


Fig. 8.7 $R_{DS(ON)}$ - T_a

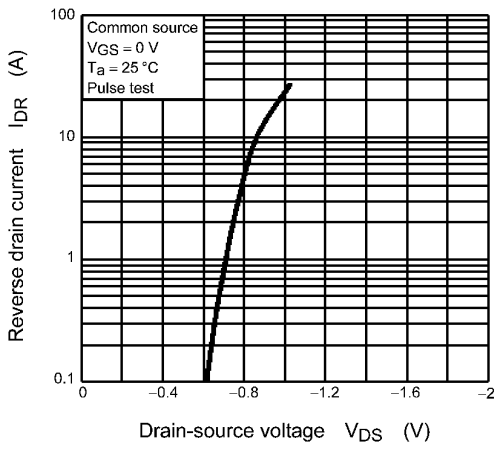


Fig. 8.8 I_{DR} - V_{DS}

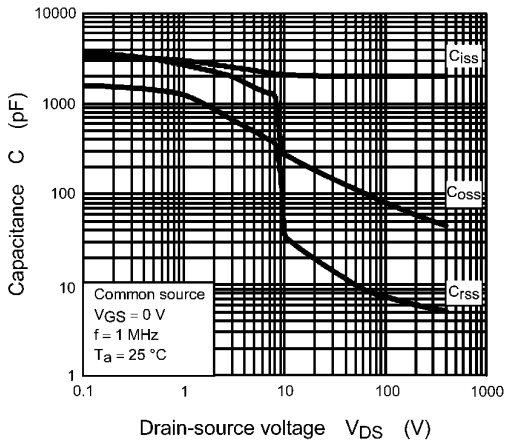


Fig. 8.9 C - V_{DS}

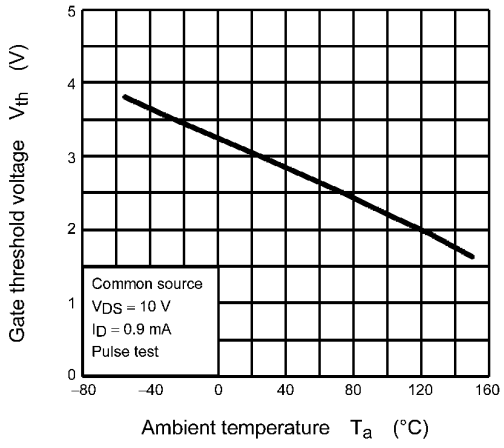


Fig. 8.10 V_{th} - T_a

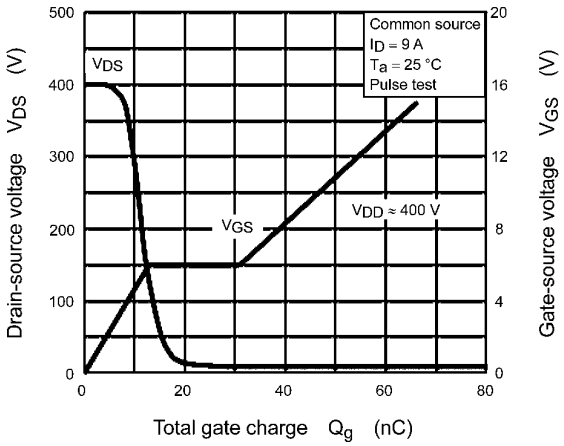


Fig. 8.11 Dynamic Input/Output Characteristics

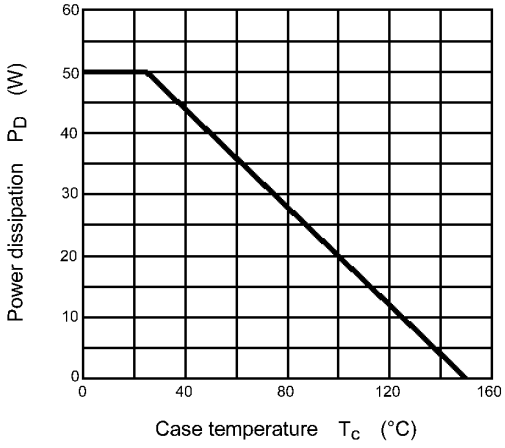


Fig. 8.12 P_D - T_c (Guaranteed Maximum)

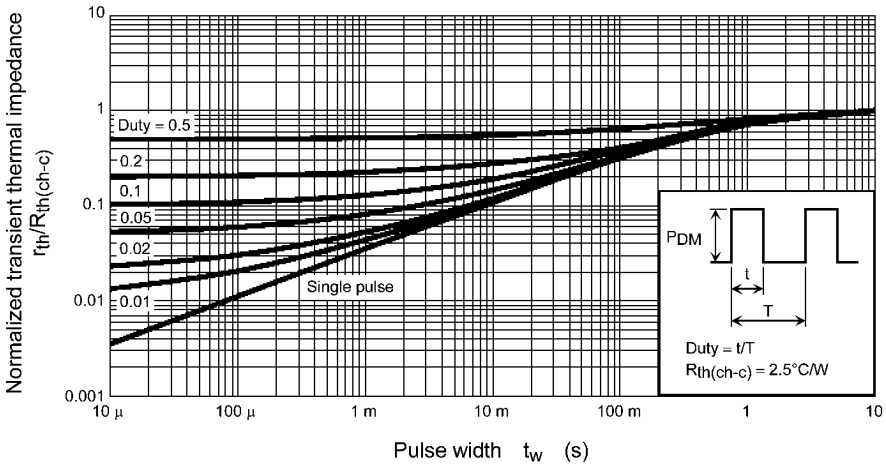


Fig. 8.13 r_{th} - t_w (Guaranteed Maximum)

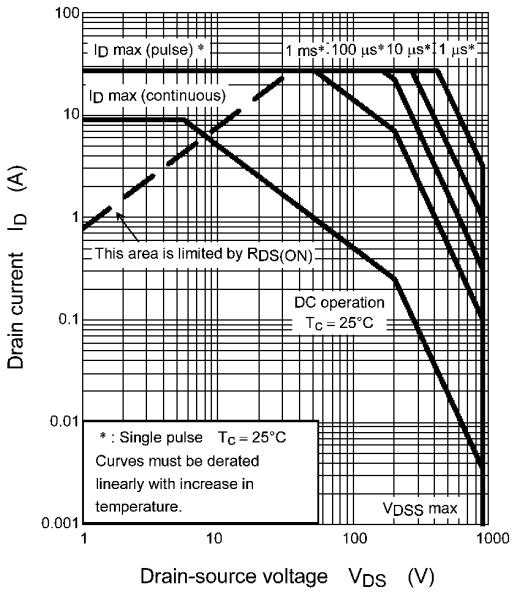


Fig. 8.14 Safe Operating Area (Guaranteed Maximum)

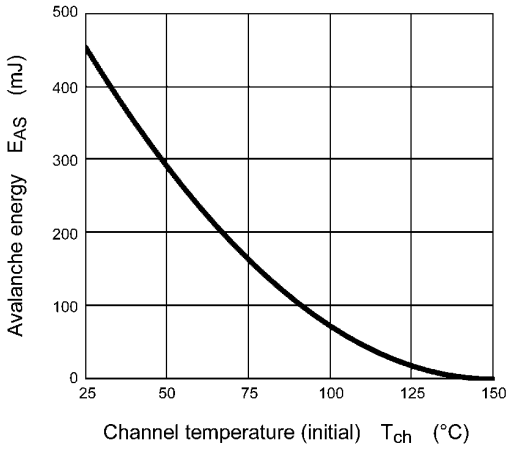
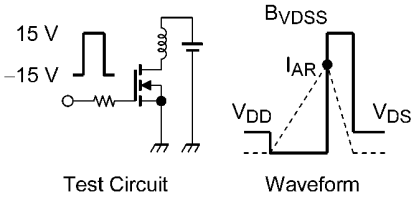


Fig. 8.15 E_{AS} - T_{ch} (Guaranteed Maximum)



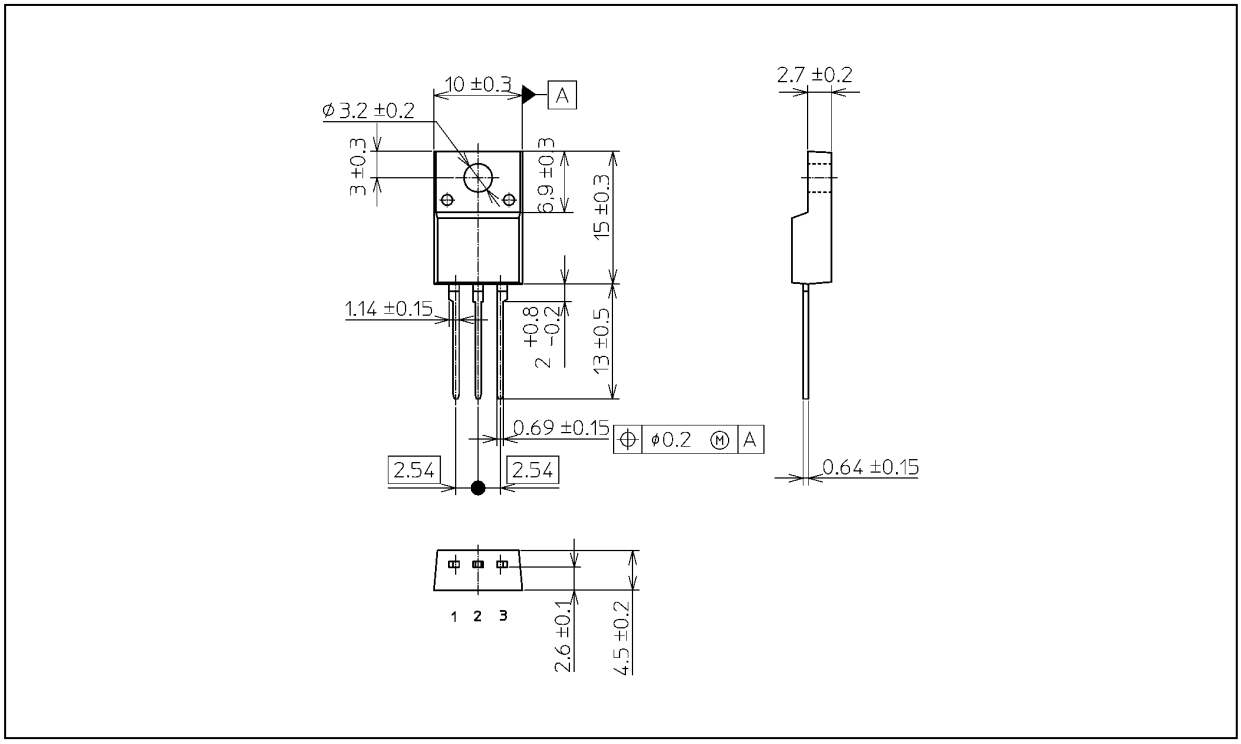
$$R_G = 25\ \Omega,\ V_{DD} = 90\ V \quad E_{AS} = \frac{1}{2} \cdot L \cdot I_{AR}^2 \cdot \left(\frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

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.

Package Dimensions

Unit: mm



Weight: 1.7 g (typ.)

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

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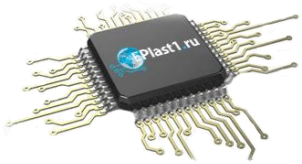

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