

TJ150F04M3L

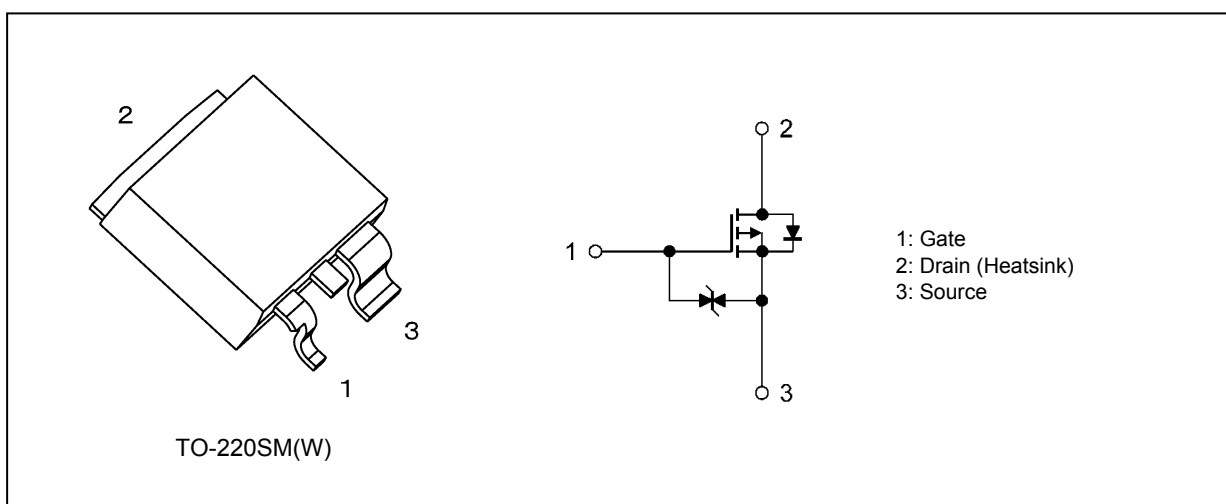
1. Applications

- Automotive
- Relay Drivers
- DC-DC Converters
- Motor Drivers

2. Features

- (1) Low drain-source on-resistance: $R_{DS(ON)} = 2.2 \text{ m}\Omega$ (typ.) ($V_{GS} = -10 \text{ V}$)
- (2) Low leakage current: $I_{DSS} = -10 \text{ }\mu\text{A}$ (max) ($V_{DS} = -40 \text{ V}$)
- (3) Enhancement mode: $V_{th} = -2.0$ to -3.0 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_{DS}	-40	V
Gate-source voltage	V_{GS}	-20/+10	
Drain current (DC) (Note 1)	I_D	-150	A
Drain current (pulsed) (Note 1)	I_{DP}	-450	
Power dissipation ($T_c = 25^\circ\text{C}$)	P_D	300	W
Single-pulse avalanche energy (Note 2)	E_{AS}	455	mJ
Avalanche current	I_{AR}	-150	A
Channel temperature (Note 3)	T_{ch}	175	$^\circ\text{C}$
Storage temperature (Note 3)	T_{stg}	-55 to 175	

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	$R_{th(ch-c)}$	0.5	°C/W

Note 1: Ensure that the channel temperature does not exceed 175°C.

Note 2: $V_{DD} = -25\text{ V}$, $T_{ch} = 25^\circ\text{C}$ (initial), $L = 21\text{ }\mu\text{H}$, $R_G = 25\text{ }\Omega$, $I_{AR} = -150\text{ A}$

Note 3: The definitions of the absolute maximum channel and storage temperatures are qualified per AEC-Q101.

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

6. Electrical Characteristics

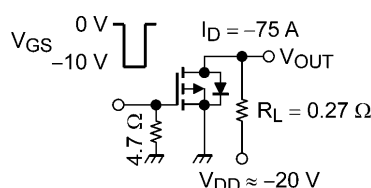
6.1. Static Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current	I_{GSS}	$V_{GS} = -16/+10\text{ V}$, $V_{DS} = 0\text{ V}$	—	—	± 10	μA
Drain cut-off current	I_{DSS}	$V_{DS} = -40\text{ V}$, $V_{GS} = 0\text{ V}$	—	—	-10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = -10\text{ mA}$, $V_{GS} = 0\text{ V}$	-40	—	—	V
Drain-source breakdown voltage (Note 4)	$V_{(BR)DSX}$	$I_D = -10\text{ mA}$, $V_{GS} = 10\text{ V}$	-30	—	—	
Gate threshold voltage	V_{th}	$V_{DS} = -10\text{ V}$, $I_D = -1\text{ mA}$	-2.0	—	-3.0	
Drain-source on-resistance	$R_{DS(ON)}$	$V_{GS} = -6\text{ V}$, $I_D = -75\text{ A}$	—	2.5	4.2	$\text{m}\Omega$
		$V_{GS} = -10\text{ V}$, $I_D = -75\text{ A}$	—	2.2	2.8	

Note 4: If a reverse bias is applied between gate and source, this device enters $V_{(BR)DSX}$ mode. Note that the drain-source breakdown voltage is lowered in this mode.

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}	$V_{DS} = -10\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1\text{ MHz}$	—	12000	—	pF
Reverse transfer capacitance	C_{rss}		—	1100	—	
Output capacitance	C_{oss}		—	2350	—	
Switching time (rise time)	t_r	See Fig. 6.2.1	—	10	—	ns
Switching time (turn-on time)	t_{on}		—	25	—	
Switching time (fall time)	t_f		—	440	—	
Switching time (turn-off time)	t_{off}		—	1870	—	



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

Fig. 6.2.1 Switching Time Test Circuit

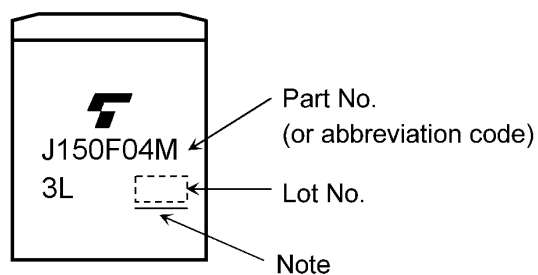
6.3. Gate Charge Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	$V_{DD} \approx -32\text{ V}$, $V_{GS} = -10\text{ V}$, $I_D = -150\text{ A}$	—	390	—	nC
Gate-source charge 1	Q_{gs1}		—	280	—	
Gate-drain charge	Q_{gd}		—	110	—	

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 5)	I_{DR}	—	—	—	-150	A
Reverse drain current (pulsed) (Note 5)	I_{DRP}		—	—	-450	
Diode forward voltage	V_{DSF}	$I_{DR} = -150\text{ A}$, $V_{GS} = 0\text{ V}$	—	—	1.2	V
Reverse recovery time	t_{rr}	$I_{DR} = -150\text{ A}$, $V_{GS} = 0\text{ V}$ $dI_{DR}/dt = 50\text{ A}/\mu\text{s}$	—	90	—	ns
Reverse recovery charge	Q_{rr}		—	104	—	nC

Note 5: Ensure that the channel temperature does not exceed 175°C .

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 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

8. Moisture-Proof Packing

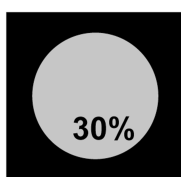
This device is packed in a moisture-proof laminated aluminum bag.

8.1. Precautions for Transportation and Storage (Note)

- (1) Avoid excessive vibration during transportation.
- (2) Do not toss or drop the packed devices to avoid ripping of the bag.
- (3) After opening the moisture-proof bag, the devices should be assembled within two weeks in an environment of 5°C to 30°C and RH70% or below. Perform reflow at most twice.
- (4) The moisture-proof bag may be stored unopened for up to 24 months at 5°C to 30°C and RH90% or below.
- (5) If, upon opening the bag, the moisture indicator card shows humidity of 30% or above (the color of the 30% dot has changed from blue to pink) or the expiration date has passed, the devices should be baked as follows:

Baking conditions: 125°C for 48 hours.

Note: Since the tape materials are not heat-proof, devices should be placed on either heat-proof trays or aluminum magazines when baking.



The humidity indicator shows an approximate ambient humidity at 25°C.
If the ambient humidity is below 30%, the color of all the indicator dots is blue.
If, upon opening the bag, the color of the 30% dot has changed from blue to pink, the devices should be baked before assembly.

Fig. 8.1.1 Humidity Indicator

9. Characteristics Curves (Note)

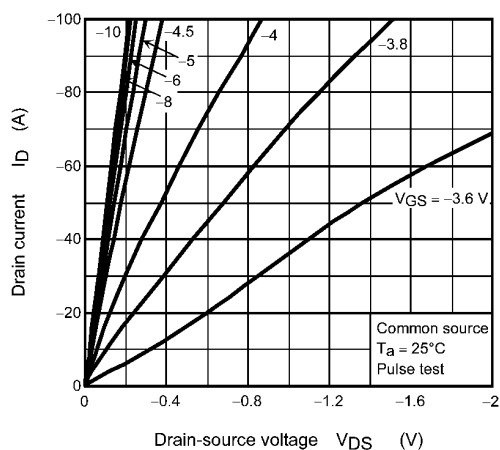


Fig. 9.1 $I_D - V_{DS}$

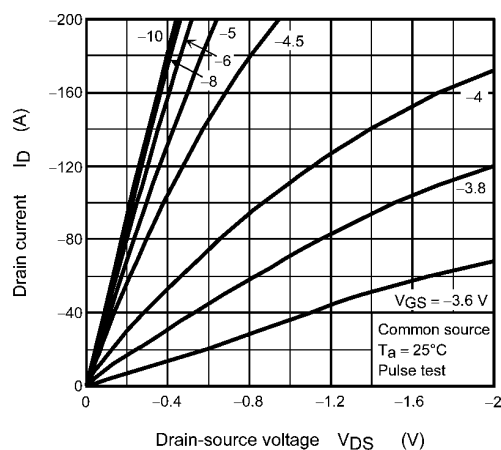


Fig. 9.2 $I_D - V_{DS}$

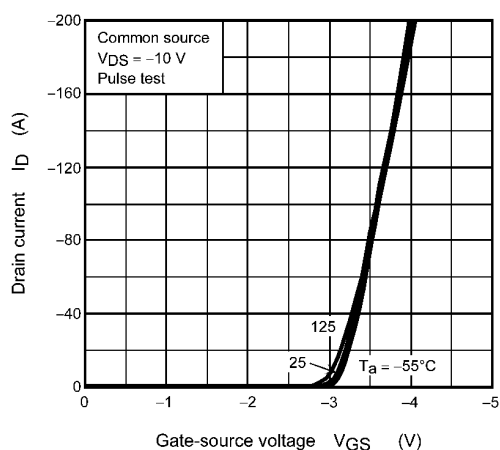


Fig. 9.3 $I_D - V_{GS}$

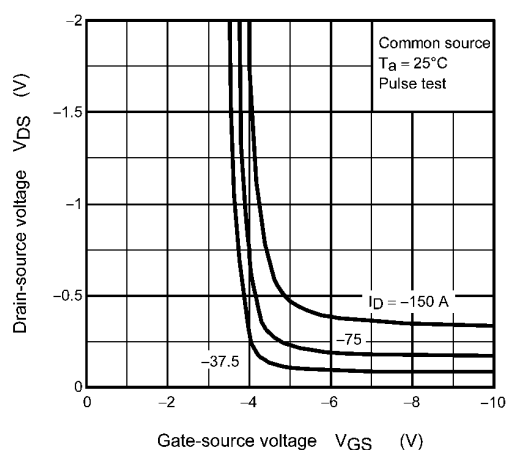


Fig. 9.4 $V_{DS} - V_{GS}$

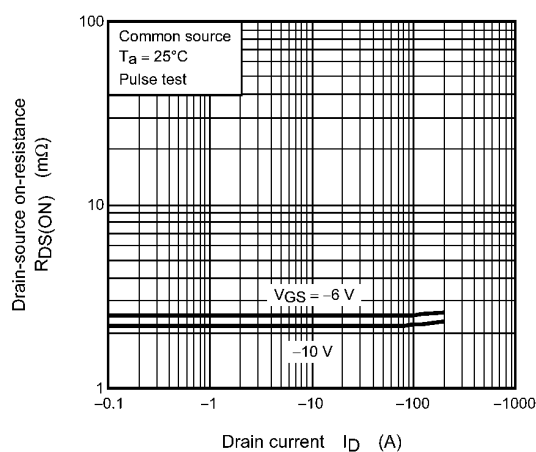


Fig. 9.5 $R_{DS(ON)} - I_D$

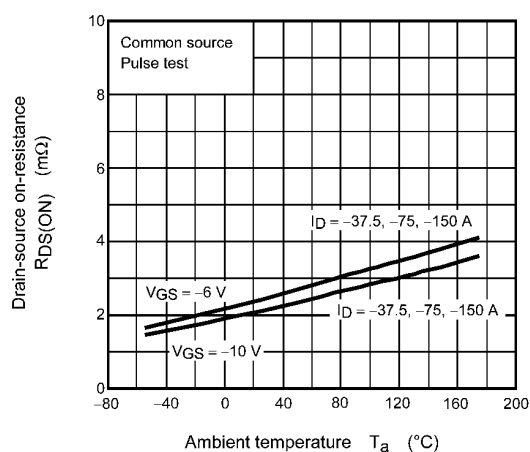


Fig. 9.6 $R_{DS(ON)} - T_a$

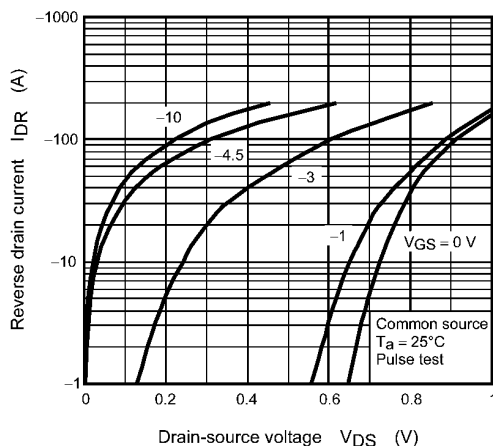


Fig. 9.7 $I_{DR} - V_{DS}$

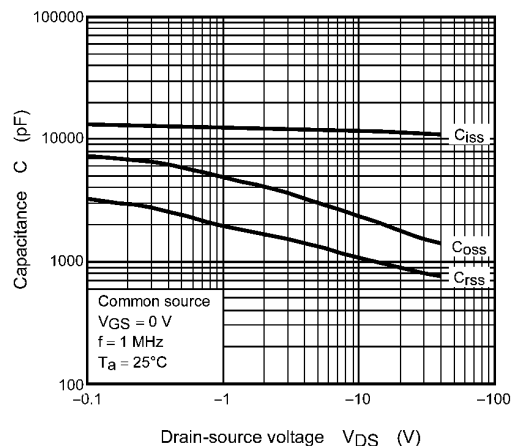


Fig. 9.8 Capacitance - V_{DS}

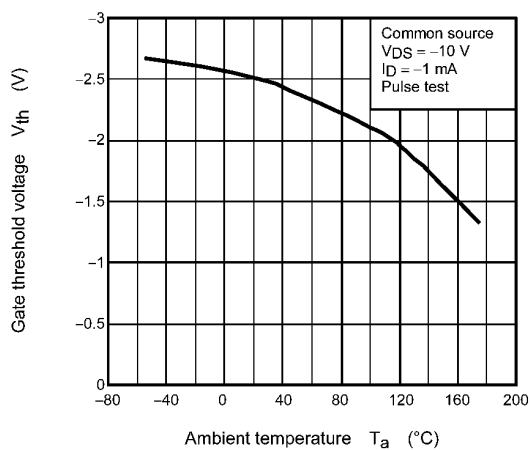


Fig. 9.9 $V_{th} - T_a$

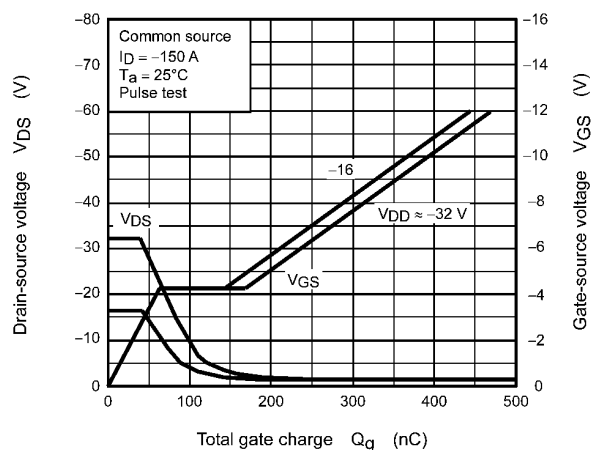
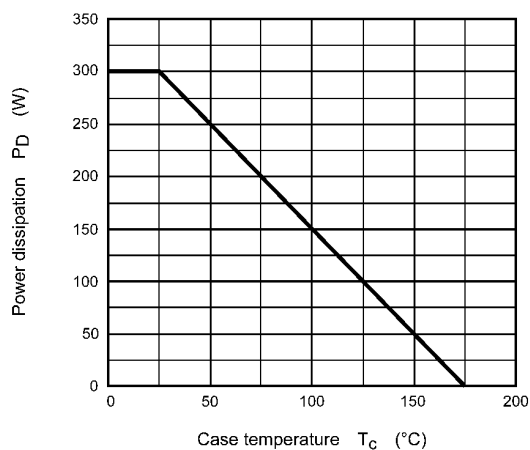


Fig. 9.10 Dynamic Input/Output Characteristics



**Fig. 9.11 $P_D - T_c$
(Guaranteed Maximum)**

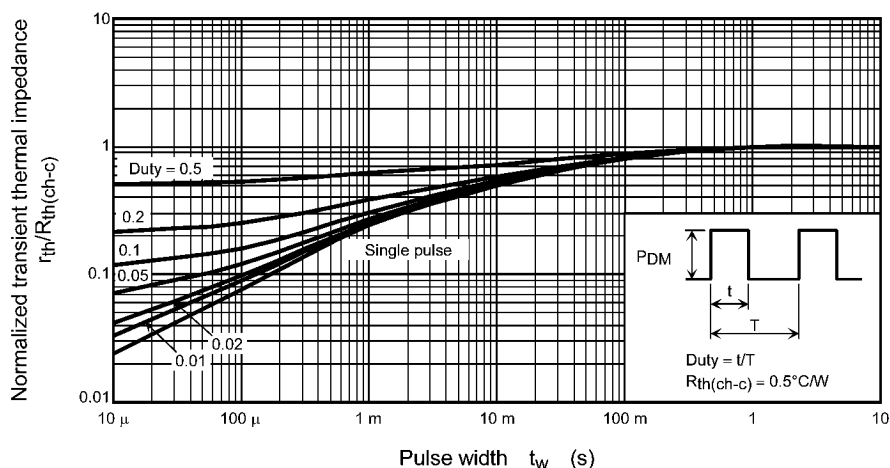


Fig. 9.12 $r_{th}/R_{th(ch-c)} - t_w$
(Guaranteed Maximum)

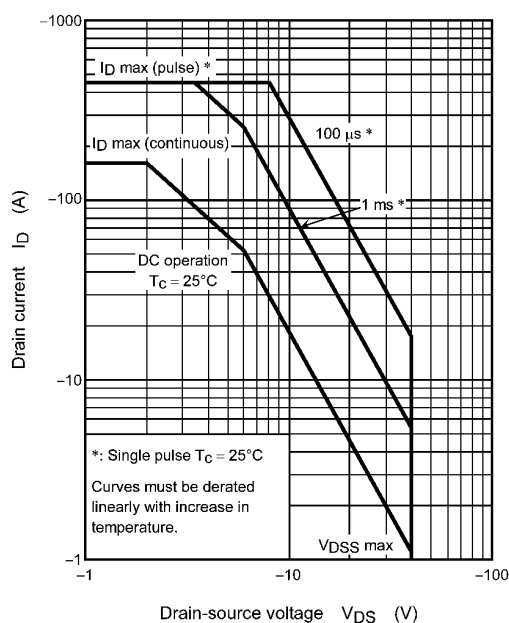


Fig. 9.13 Safe Operating Area
(Guaranteed Maximum)

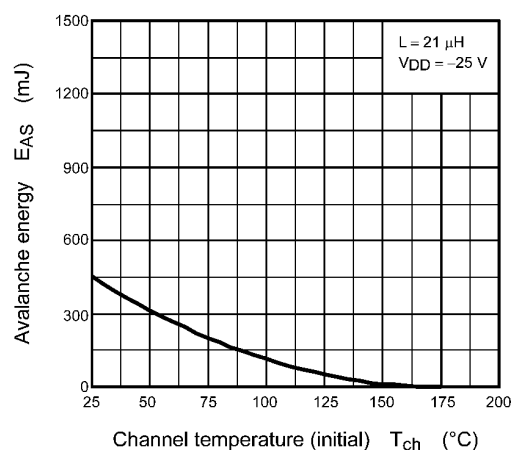
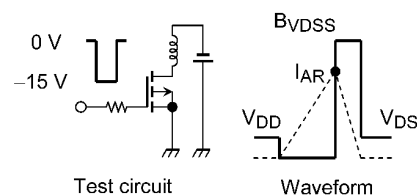


Fig. 9.14 $E_{AS} - T_{ch}$
(Guaranteed Maximum)



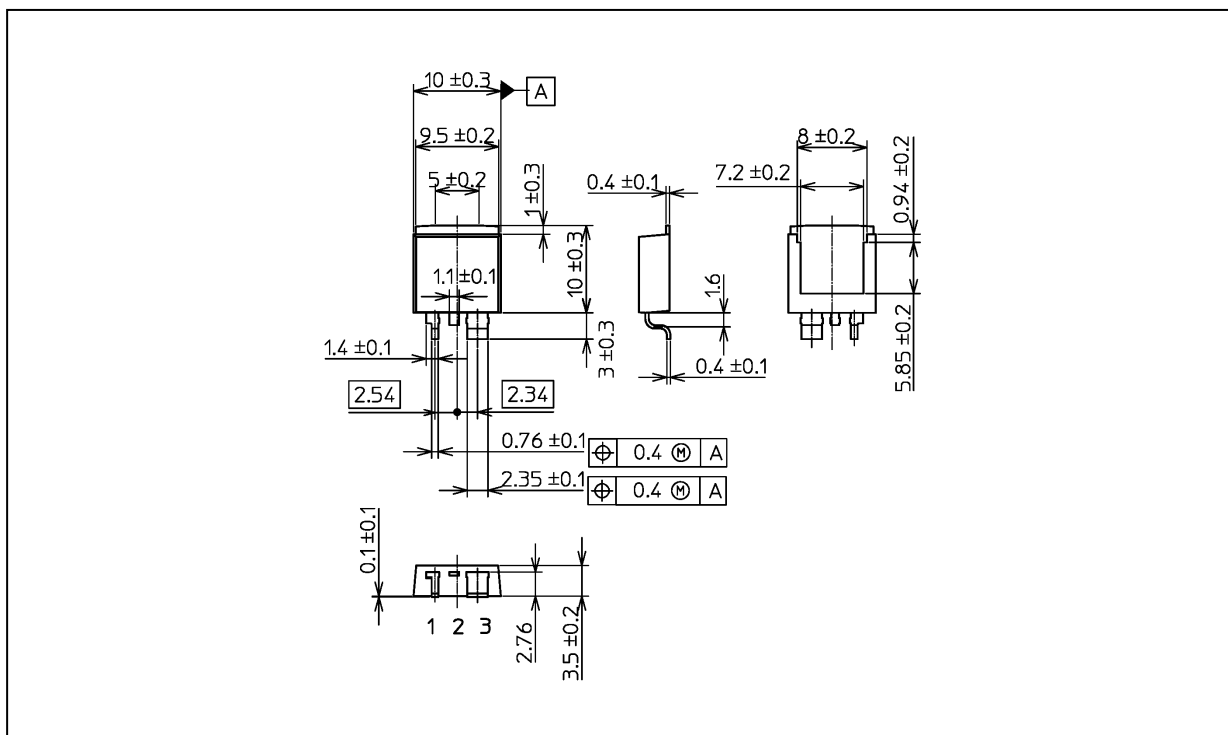
$$R_G = 25 \, \Omega, \quad V_{DD} = -25 \, V, \quad L = 21 \, \mu H, \quad E_{AS} = \frac{1}{2} \cdot L \cdot I_{AR}^2 \cdot \left(\frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

Fig. 9.15 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: 1.07 g (typ.)

Package Name(s)
TOSHIBA: 2-10W1S
Nickname: TO-220SM(W)

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