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Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



TK60P03M1

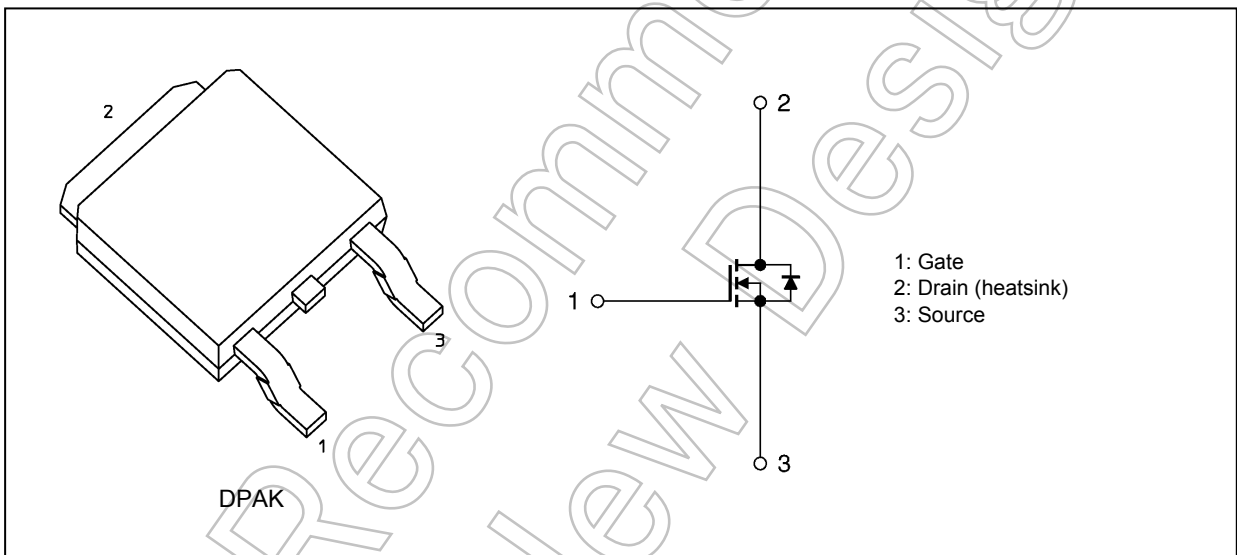
1. Applications

- Switching Voltage Regulators
- Motor Drivers
- Power Management Switches

2. Features

- (1) High-speed switching
- (2) Low gate charge: $Q_{SW} = 13 \text{ nC (typ.)}$
- (3) Low drain-source on-resistance: $R_{DS(ON)} = 4.6 \text{ m}\Omega \text{ (typ.) (} V_{GS} = 10 \text{ V)}$
- (4) Low leakage current: $I_{DSS} = 10 \text{ }\mu\text{A (max) (} V_{DS} = 30 \text{ V)}$
- (5) Enhancement mode: $V_{th} = 1.3 \text{ to } 2.3 \text{ V (} V_{DS} = 10 \text{ V, } I_D = 0.5 \text{ mA)}$

3. Packaging and Internal Circuit



Start of commercial production

2009-10

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

Characteristics	Symbol	Rating	Unit
Drain-source voltage	V_{DSS}	30	V
Drain-gate voltage ($R_{GS} = 20\text{ k}\Omega$)	V_{DGR}	30	
Gate-source voltage	V_{GSS}	± 20	
Drain current (DC) (Note 1)	I_D	60	A
Drain current (pulsed) (Note 1)	I_{DP}	120	
Power dissipation ($T_c = 25^\circ\text{C}$)	P_D	63	W
Single-pulse avalanche energy (Note 2)	E_{AS}	94	mJ
Single-pulse avalanche current	I_{AS}	60	A
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	$R_{th(ch-c)}$	1.98	$^\circ\text{C/W}$
Channel-to-ambient thermal resistance	$R_{th(ch-a)}$	125	

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

Note 2: $V_{DD} = 24\text{ V}$, $T_{ch} = 25^\circ\text{C}$ (initial), $L = 0.02\text{ mH}$, $R_G = 1.2\ \Omega$, $I_{AS} = 60\text{ A}$

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}	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$	—	—	± 0.1	μA
Drain cut-off current	I_{DSS}	$V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$	30	—	—	V
	$V_{(BR)DSX}$	$I_D = 10\text{ mA}, V_{GS} = -20\text{ V}$	15	—	—	
Gate threshold voltage	V_{th}	$V_{DS} = 10\text{ V}, I_D = 0.5\text{ mA}$	1.3	—	2.3	
Drain-source on-resistance	$R_{DS(ON)}$	$V_{GS} = 4.5\text{ V}, I_D = 30\text{ A}$	—	5.7	7.8	m Ω
		$V_{GS} = 10\text{ V}, I_D = 30\text{ A}$	—	4.6	6.4	

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}	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	—	2700	—	pF
Reverse transfer capacitance	C_{rss}		—	170	—	
Output capacitance	C_{oss}		—	520	—	
Gate resistance	r_g	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 5\text{ MHz}$	—	0.7	1.1	Ω
Switching time (rise time)	t_r	See Figure 6.2.1.	—	4.3	—	ns
Switching time (turn-on time)	t_{on}		—	15	—	
Switching time (fall time)	t_f		—	11	—	
Switching time (turn-off time)	t_{off}		—	32	—	

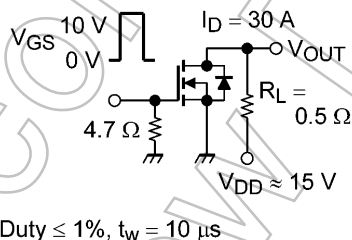


Fig. 6.2.1 Switching Time Test Circuit

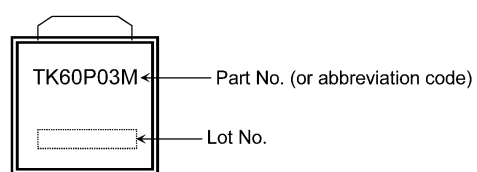
6.3. Gate Charge Characteristics ($T_a = 25^\circ\text{C}$ unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	$V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 60\text{ A}$	—	40	—	nC
		$V_{DD} \approx 24\text{ V}, V_{GS} = 5\text{ V}, I_D = 60\text{ A}$	—	21	—	
Gate-source charge 1	Q_{gs1}	$V_{DD} \approx 24\text{ V}, V_{GS} = 10\text{ V}, I_D = 60\text{ A}$	—	11	—	
Gate-drain charge	Q_{gd}		—	7.2	—	
Gate switch charge	Q_{sw}		—	13	—	

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 (pulsed)	(Note 3) I_{DRP}	—	—	—	120	A
Diode forward voltage	V_{DSF}	$I_{DR} = 60\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.2	V

Note 3: Ensure that the channel temperature does not exceed 150°C .

7. Marking**Fig. 7.1 Marking**

Not Recommended
for New Design

8. Characteristics Curves (Note)

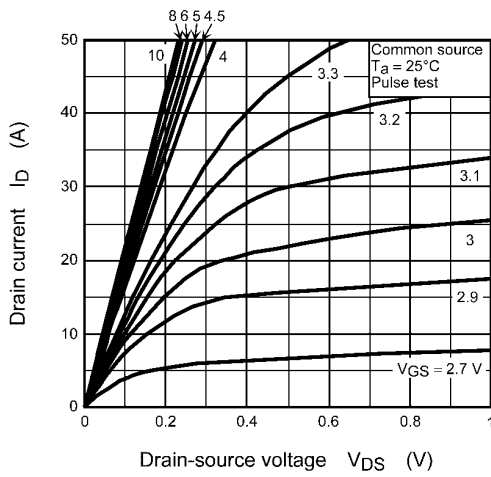


Fig. 8.1 $I_D - V_{DS}$

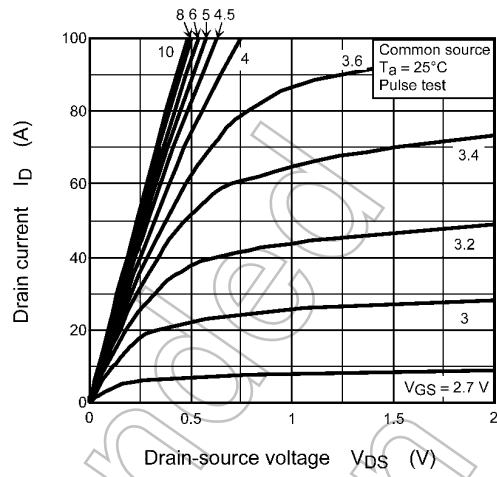


Fig. 8.2 $I_D - V_{DS}$

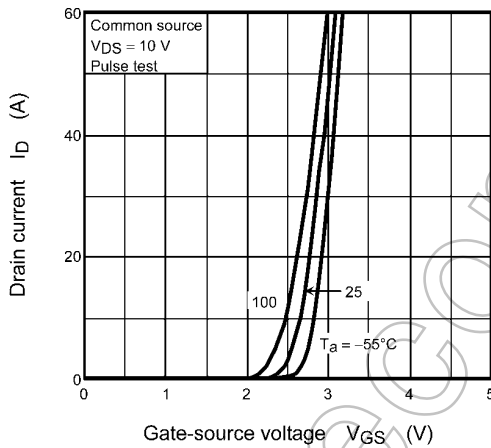


Fig. 8.3 $I_D - V_{GS}$

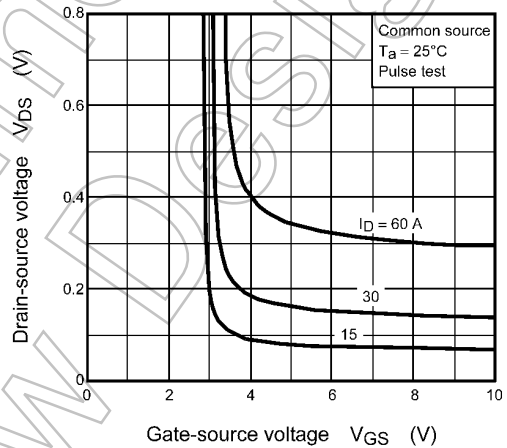


Fig. 8.4 $V_{DS} - V_{GS}$

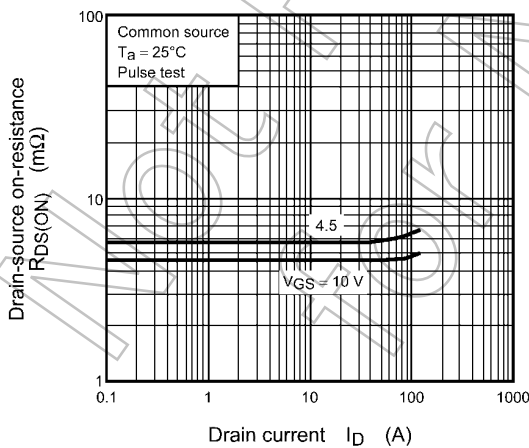


Fig. 8.5 $R_{DS(ON)} - I_D$

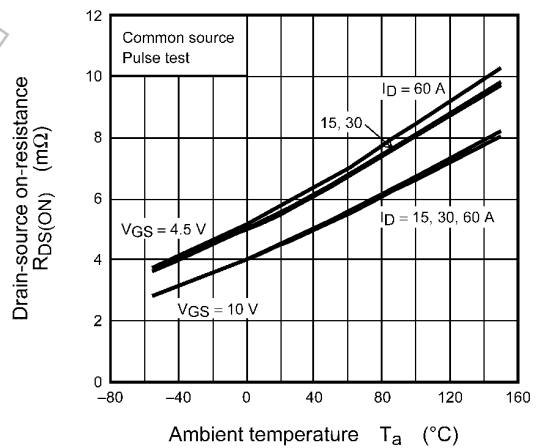


Fig. 8.6 $R_{DS(ON)} - T_a$

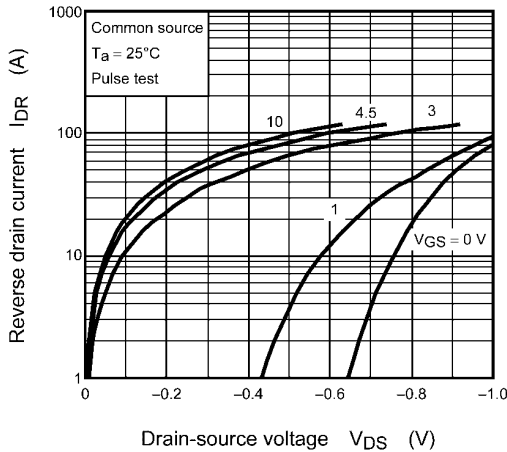


Fig. 8.7 $I_{DR} - V_{DS}$

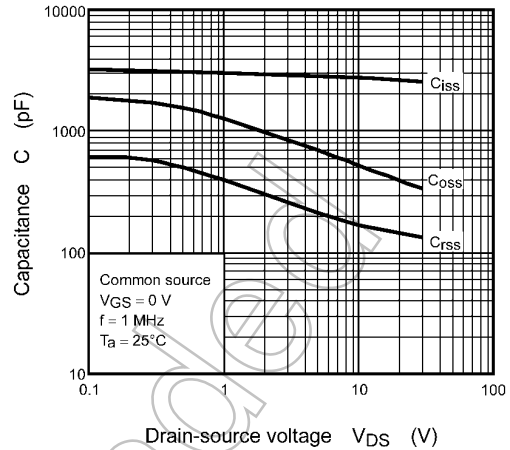


Fig. 8.8 Capacitance - V_{DS}

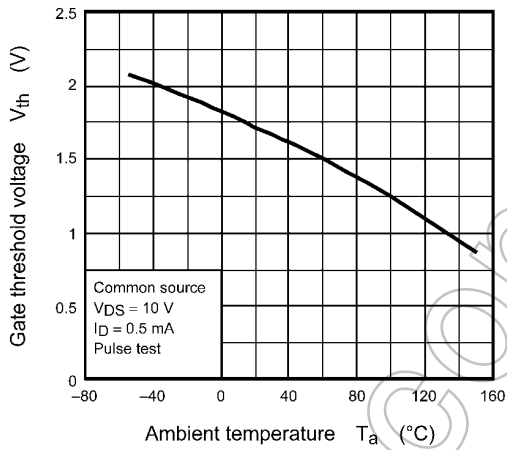


Fig. 8.9 $V_{th} - T_a$

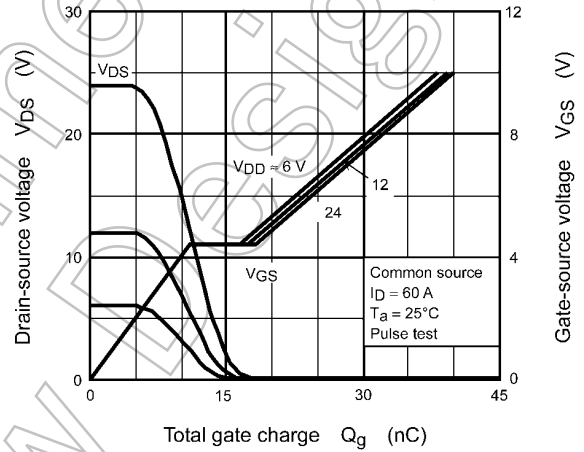


Fig. 8.10 Dynamic Input/Output Characteristics

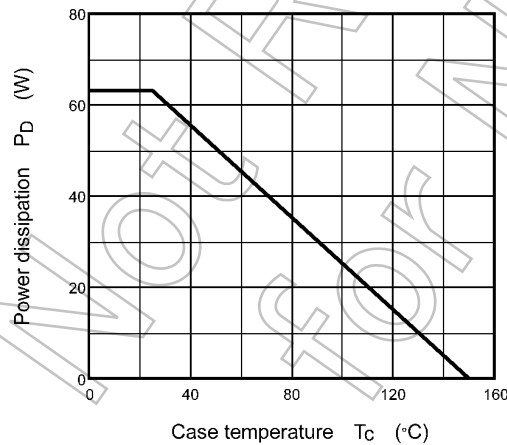


Fig. 8.11 $P_D - T_c$
(Guaranteed Maximum)

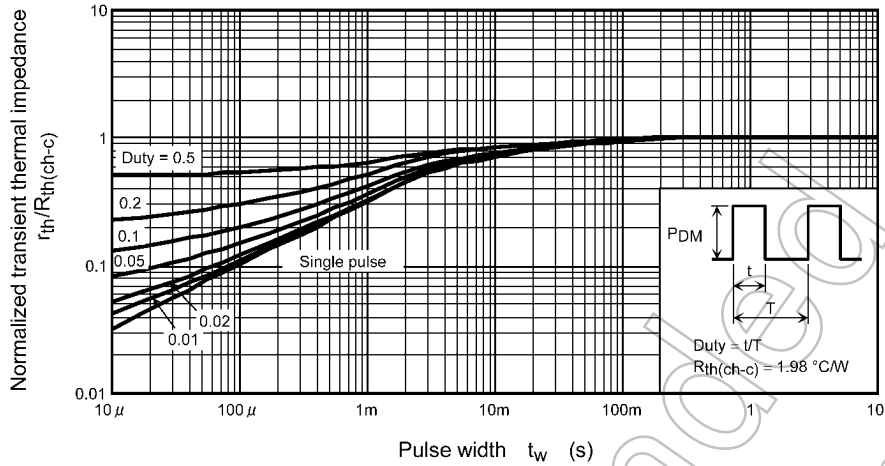


Fig. 8.12 $r_{th}/R_{th(ch-c)} - t_w$
(Guaranteed Maximum)

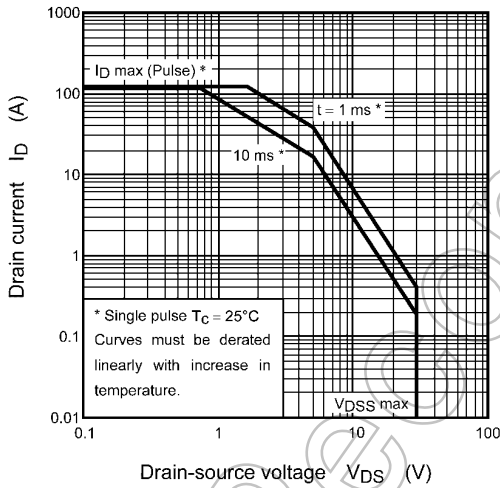


Fig. 8.13 Safe Operating Area
(Guaranteed Maximum)

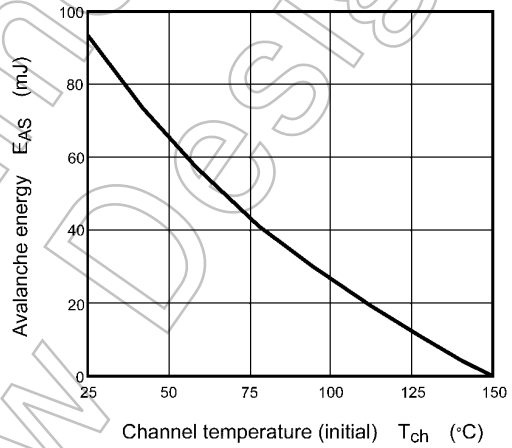
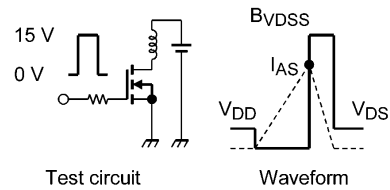


Fig. 8.14 $E_{AS} - T_{ch}$
(Guaranteed Maximum)



$$R_G = 1.2\ \Omega$$

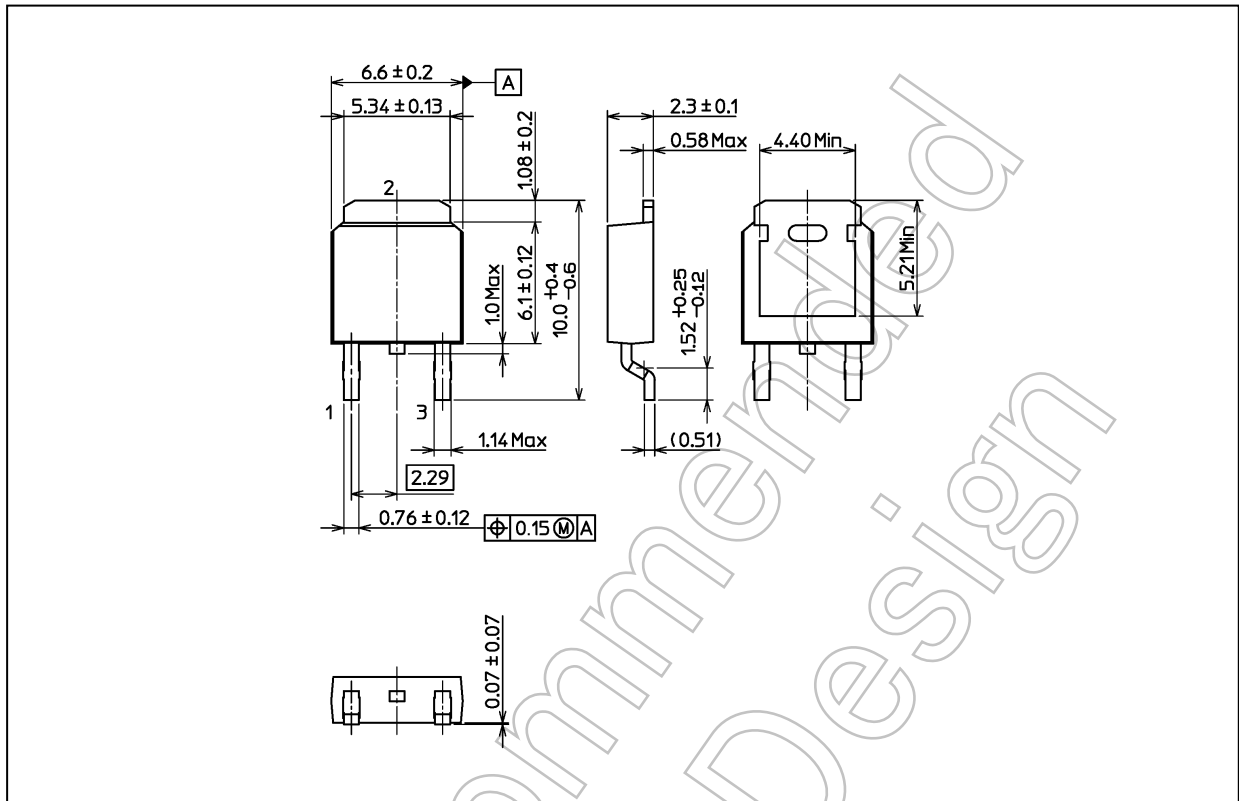
$$V_{DD} = 24\ \text{V}, L = 0.02\ \text{mH} \quad E_{AS} = \frac{1}{2} \cdot L \cdot I_{AS}^2 \cdot \left(\frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

Fig. 8.15 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: 0.36 g (typ.)

Package Name(s)
TOSHIBA: 2-7K1S
Nickname: DPAK

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