

TK31V60W

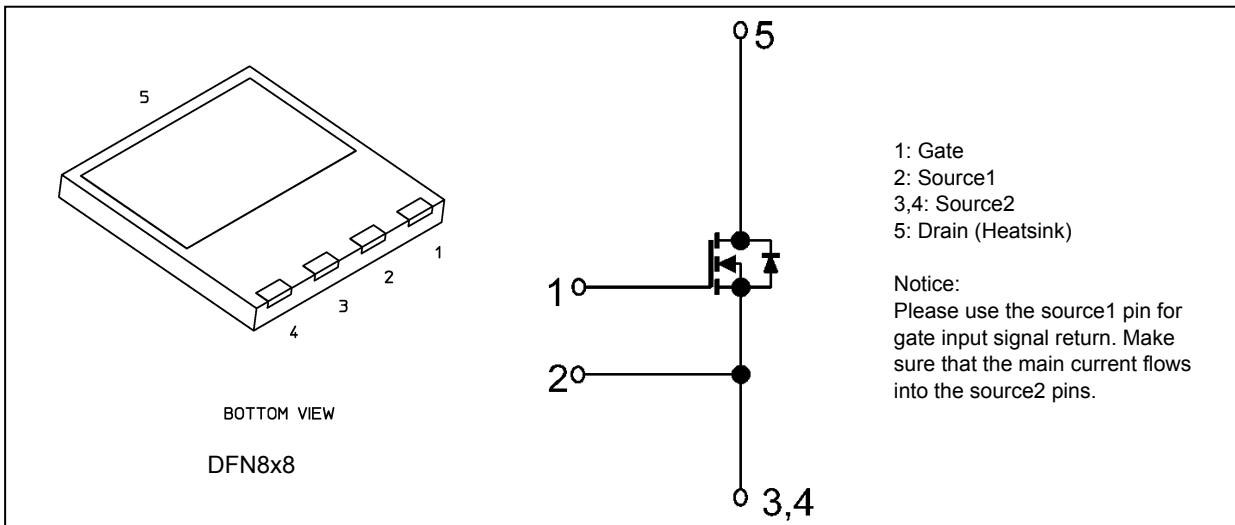
1. Applications

- Switching Voltage Regulators

2. Features

- (1) Low drain-source on-resistance: $R_{DS(ON)} = 0.078 \Omega$ (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, $I_D = 1.5$ 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}	± 30	
Drain current (DC)	(Note 1) I_D	30.8	A
Drain current (pulsed)	(Note 1) I_{DP}	123	
Power dissipation	($T_c = 25^\circ\text{C}$) P_D	240	W
Single-pulse avalanche energy	(Note 2) E_{AS}	338	mJ
Avalanche current	I_{AR}	7.7	A
Reverse drain current (DC)	(Note 1) I_{DR}	30.8	
Reverse drain current (pulsed)	(Note 1) I_{DRP}	123	
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).

Start of commercial production

2013-06

5. Thermal Characteristics

Characteristics	Symbol	Max	Unit
Channel-to-case thermal resistance	$R_{th(ch-c)}$	0.52	°C/W

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

Note 2: $V_{DD} = 90\text{ V}$, $T_{ch} = 25^\circ\text{C}$ (initial), $L = 10\text{ mH}$, $R_G = 25\ \Omega$, $I_{AR} = 7.7\text{ A}$

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

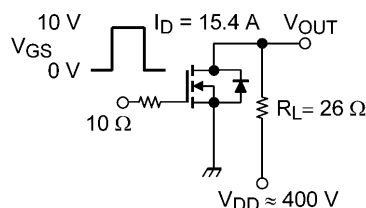
6. Electrical Characteristics

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}	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$	—	—	± 1	μA
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}	$V_{DS} = 10\text{ V}, I_D = 1.5\text{ mA}$	2.7	—	3.7	
Drain-source on-resistance	$R_{DS(ON)}$	$V_{GS} = 10\text{ V}, I_D = 15.4\text{ A}$	—	0.078	0.098	Ω

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}	$V_{DS} = 300\text{ V}, V_{GS} = 0\text{ V}, f = 100\text{ kHz}$	—	3000	—	pF
Reverse transfer capacitance	C_{rss}		—	9.5	—	
Output capacitance	C_{oss}		—	70	—	
Effective output capacitance	$C_{o(er)}$	$V_{DS} = 0\text{ to }400\text{ V}, V_{GS} = 0\text{ V}$	—	123	—	
Gate resistance	r_g	$V_{DS} = \text{OPEN}, f = 1\text{ MHz}$	—	2	—	Ω
Switching time (rise time)	t_r	See Figure 6.2.1	—	32	—	ns
Switching time (turn-on time)	t_{on}		—	70	—	
Switching time (fall time)	t_f		—	8.5	—	
Switching time (turn-off time)	t_{off}		—	165	—	
MOSFET dv/dt ruggedness	dv/dt	$V_{DD} = 0\text{ to }400\text{ V}, I_D = 7.7\text{ A}$	50	—	—	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	$V_{DD} \approx 400\text{ V}, V_{GS} = 10\text{ V}, I_D = 30.8\text{ A}$	—	86	—	nC
Gate-source charge 1	Q_{gs1}		—	18	—	
Gate-drain charge	Q_{gd}		—	41	—	

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}	$I_{DR} = 30.8\text{ A}, V_{GS} = 0\text{ V}$	—	—	-1.7	V	
Reverse recovery time	t_{rr}	$I_{DR} = 15.4\text{ A}, V_{GS} = 0\text{ V}$ $-dI_{DR}/dt = 50\text{ A}/\mu\text{s}$	—	410	—	ns	
Reverse recovery charge	Q_{rr}		—	3.5	—		μC
Peak reverse recovery current	I_{rr}		—	17	—		
Diode dv/dt ruggedness	dv/dt	$I_{DR} = 15.4\text{ A}, V_{GS} = 0\text{ V}, V_{DD} = 400\text{ V}$	15	—	—	V/ns	

7. Marking

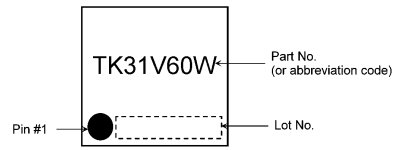


Fig. 7.1 Marking

8. Characteristics Curves (Note)

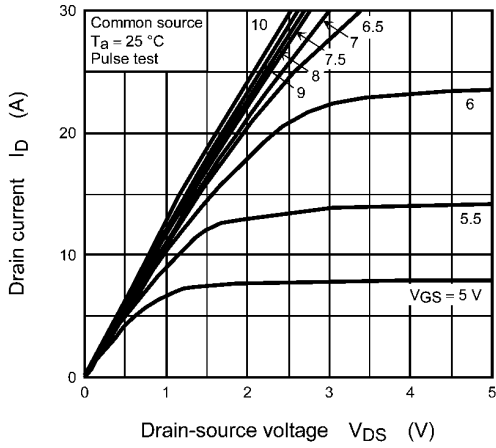


Fig. 8.1 ID - VDS

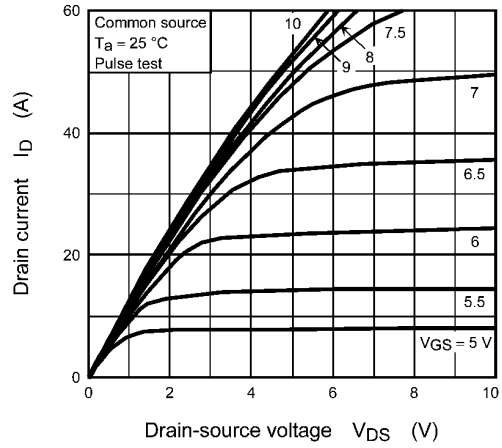


Fig. 8.2 ID - VDS

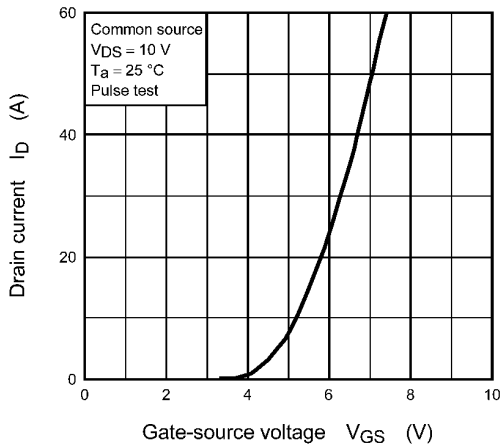


Fig. 8.3 ID - VGS

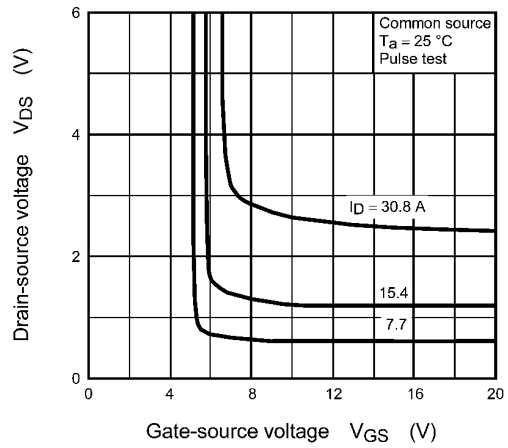


Fig. 8.4 VDS - VGS

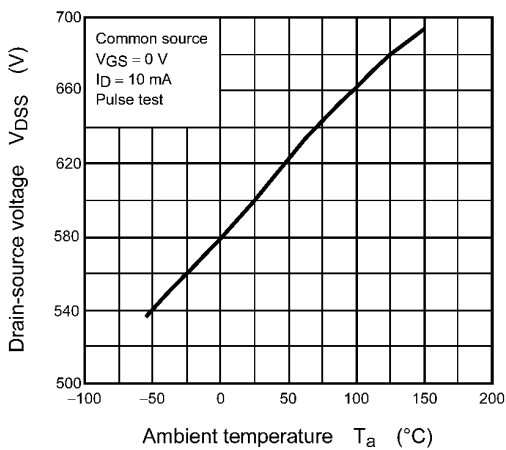


Fig. 8.5 VDS - Ta

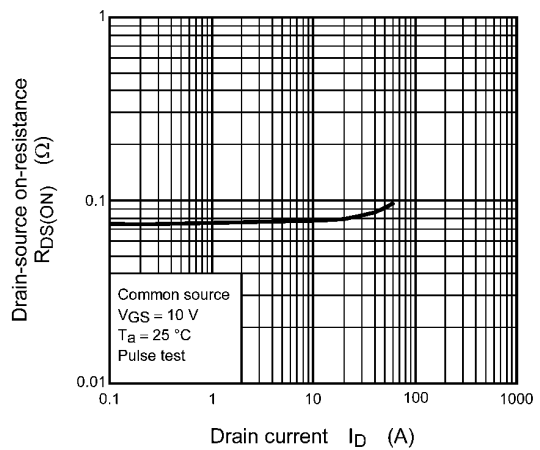


Fig. 8.6 RDS(ON) - ID

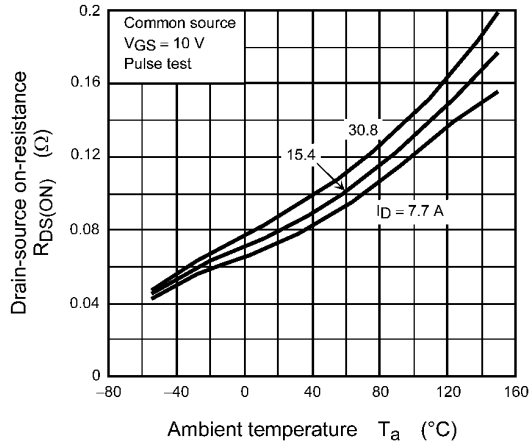


Fig. 8.7 $R_{DS(ON)} - T_a$

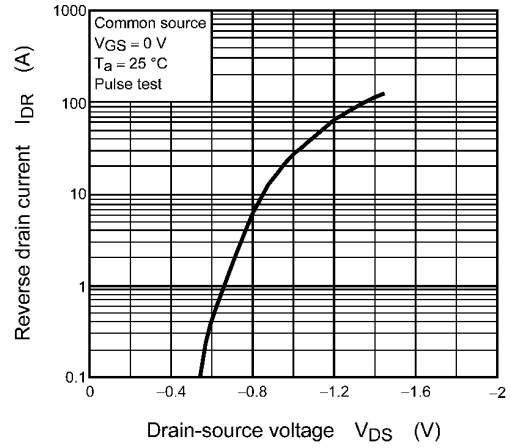


Fig. 8.8 $I_{DR} - V_{DS}$

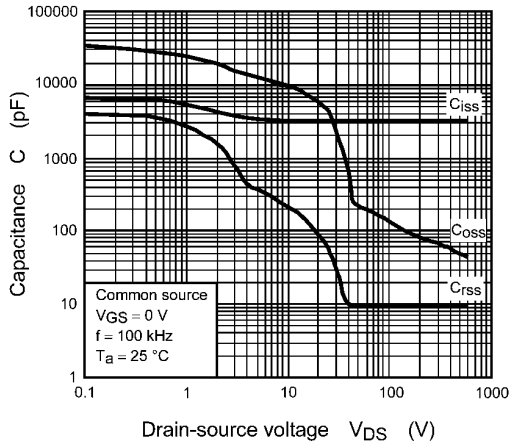


Fig. 8.9 $C - V_{DS}$

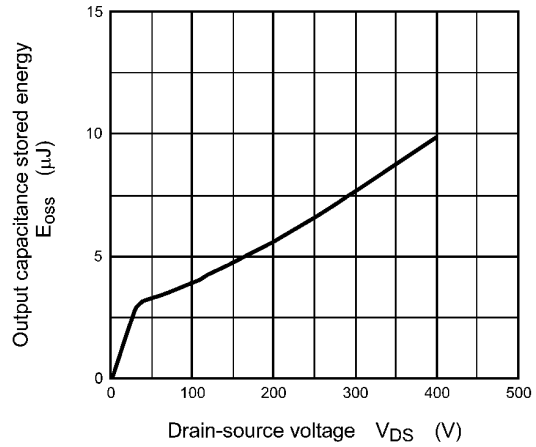


Fig. 8.10 $E_{oss} - V_{DS}$

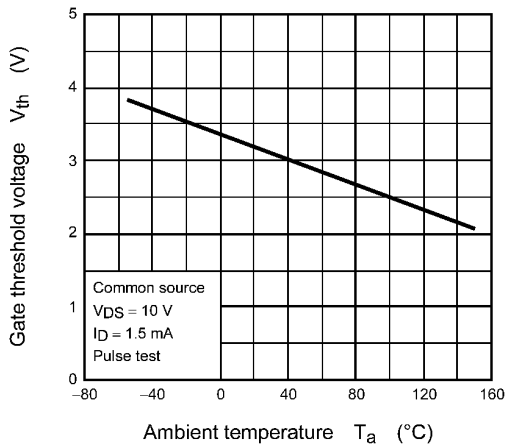


Fig. 8.11 $V_{th} - T_a$

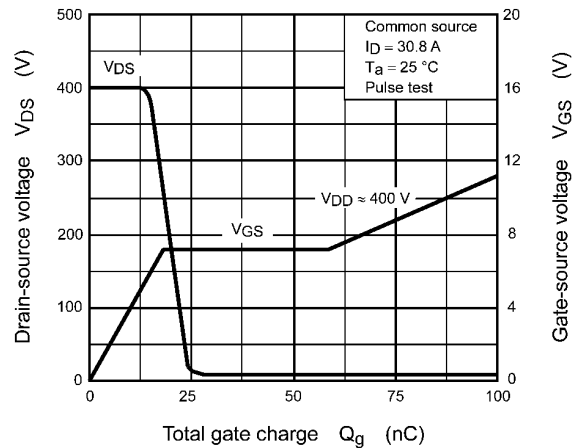


Fig. 8.12 Dynamic Input/Output Characteristics

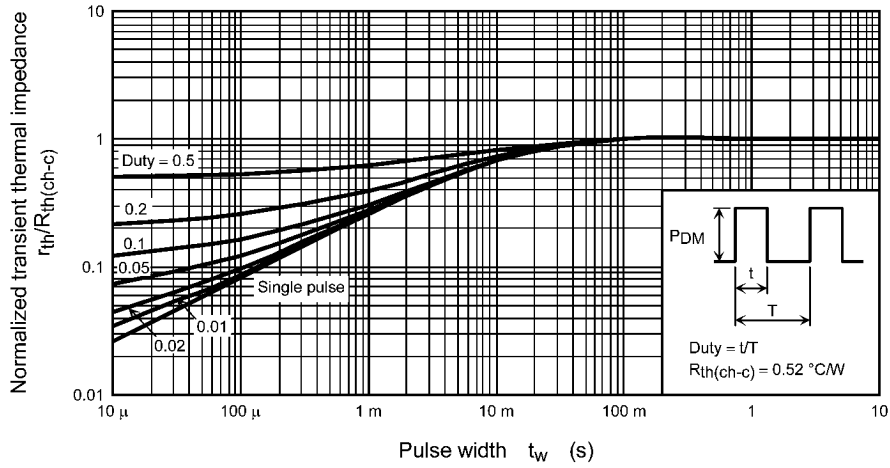


Fig. 8.13 $r_{th} - t_w$
(Guaranteed Maximum)

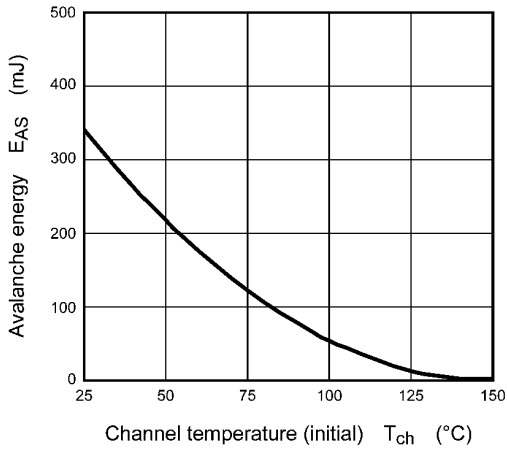


Fig. 8.14 $E_{AS} - T_{ch}$
(Guaranteed Maximum)

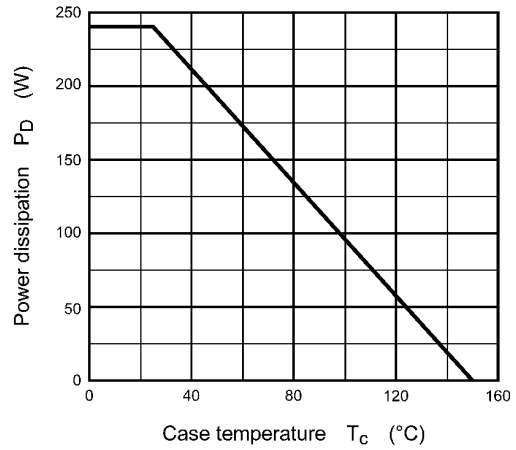
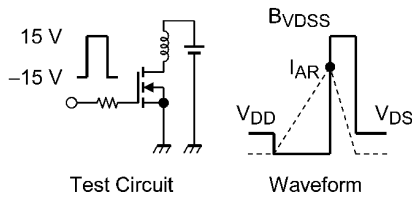


Fig. 8.15 $P_D - T_c$
(Guaranteed Maximum)



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

Fig. 8.16 Test Circuit/Waveform

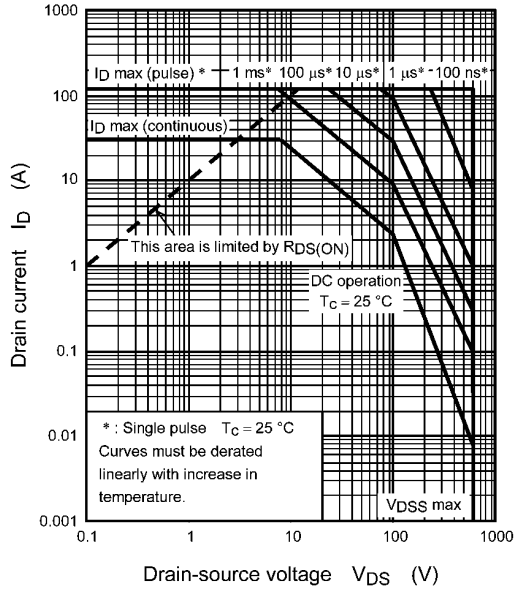


Fig. 8.17 Safe Operating Area (Guaranteed Maximum)

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

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