MOSFETs Silicon N-Channel MOS (DTMOSⅣ)

TK20E60W5

1. Applications

- Switching Voltage Regulators

2. Features

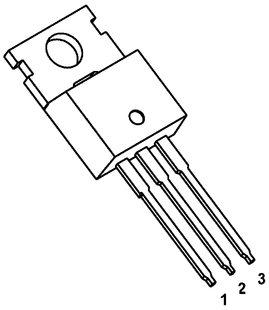
(1) Fast reverse recovery time: t_{rr} = 110 ns (typ.)

(2) Low drain-source on-resistance: $R_{DS(ON)}$ = 0.15 Ω (typ.)
by used to Super Junction Structure : DTMOS

(3) Easy to control Gate switching

(4) Enhancement mode: V_{th} = 3 to 4.5 V (V_{DS} = 10 V, I_D = 1 mA)

3. Packaging and Internal Circuit



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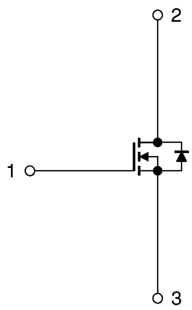


1: Gate
2: Drain (Heatsink)
3: Source

Start of commercial production
2015-10

4. Absolute Maximum Ratings (Note) (T_a = 25°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	20	A
Drain current (pulsed)	(Note 1)	I_{DP}	80	
Power dissipation	(T_c = 25°C)	P_D	165	W
Single-pulse avalanche energy	(Note 2)	E_{AS}	200	mJ
Avalanche current		I_{AR}	5	A
Reverse drain current (DC)	(Note 1)	I_{DR}	20	
Reverse drain current (pulsed)	(Note 1)	I_{DRP}	80	
Channel temperature		T_{ch}	150	°C
Storage temperature		T_{stg}	-55 to 150	
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	$R_{th(ch-c)}$	0.757	°C/W
Channel-to-ambient thermal resistance	$R_{th(ch-a)}$	83.3	

Note 1: Ensure that the channel temperature does not exceed 150°C.
Note 2: V_{DD} = 90 V, T_{ch} = 25°C (initial), L = 14 mH, R_G = 25 Ω, I_{AR} = 5 A

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

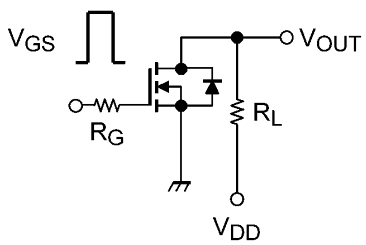
6. Electrical Characteristics

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} = 600 V, V_{GS} = 0 V	—	—	100	
Drain-source breakdown voltage	$V_{(BR)DSS}$	I_D = 10 mA, V_{GS} = 0 V	600	—	—	V
Gate threshold voltage	V_{th}	V_{DS} = 10 V, I_D = 1 mA	3	—	4.5	
Drain-source on-resistance	$R_{DS(ON)}$	V_{GS} = 10 V, I_D = 10 A	—	0.15	0.175	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} = 300 V, V_{GS} = 0 V, f = 1 MHz	—	1800	—	pF
Reverse transfer capacitance	C_{rss}		—	5.5	—	
Output capacitance	C_{oss}		—	45	—	
Effective output capacitance	$C_{o(er)}$	V_{DS} = 0 to 400 V, V_{GS} = 0 V	—	70	—	
Gate resistance	r_g	V_{DS} = OPEN, f = 1 MHz	—	1.5	—	Ω
Switching time (rise time)	t_r	See Figure 6.2.1	—	45	—	ns
Switching time (turn-on time)	t_{on}		—	90	—	
Switching time (fall time)	t_f		—	6	—	
Switching time (turn-off time)	t_{off}		—	100	—	
MOSFET dv/dt ruggedness	dv/dt	V_{DD} = 0 to 400 V, I_D = 10 A	50	—	—	V/ns



V_{DD} ≈ 400 V
V_{GS} = 0 V/10 V
I_D = 10 A
R_L = 40 Ω
R_G = 10 Ω
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 = 20 A	—	55	—	nC
Gate-source charge 1	Q_{gs1}		—	17	—	
Gate-drain charge	Q_{gd}		—	33	—	

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} = 20 A, V_{GS} = 0 V	—	—	-1.7	V
Reverse recovery time	t_{rr}	I_{DR} = 10 A, V_{GS} = 0 V $-dI_{DR}/dt$ = 100 A/μs	—	110	176	ns
Reverse recovery charge	Q_{rr}		—	0.6	—	μC
Peak reverse recovery current	I_{rr}		—	10	—	A
Diode dv/dt ruggedness	dv/dt	I_{DR} = 10 A, V_{GS} = 0 V, V_{DD} = 400 V	50	—	—	V/ns

7. Marking

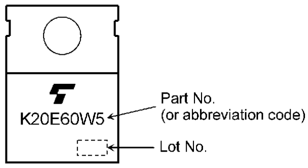


Fig. 7.1 Marking

8. Characteristics Curves (Note)

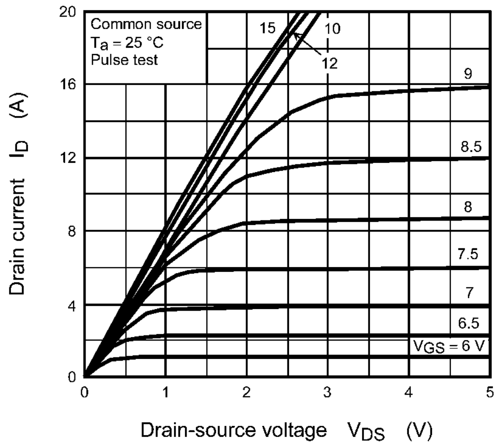


Fig. 8.1 I_D - V_{DS}

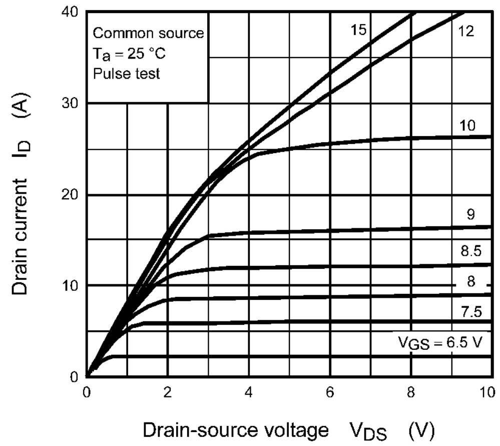


Fig. 8.2 I_D - V_{DS}

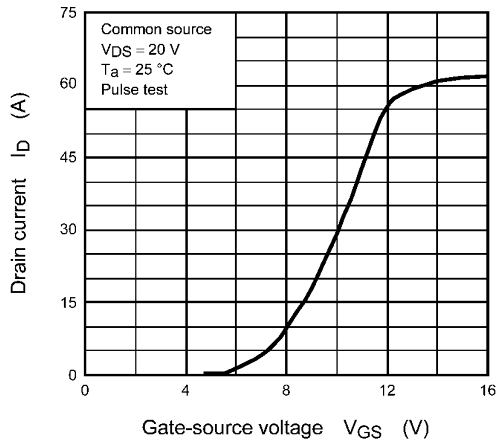


Fig. 8.3 I_D - V_{GS}

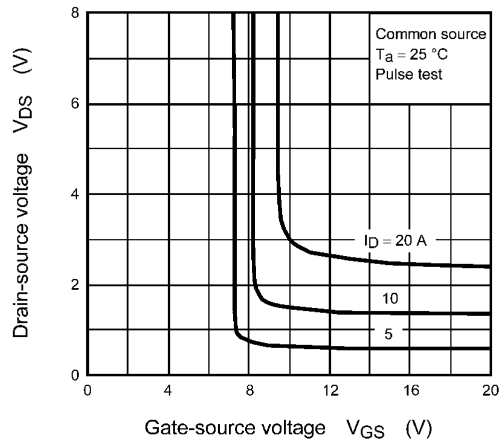


Fig. 8.4 V_{DS} - V_{GS}

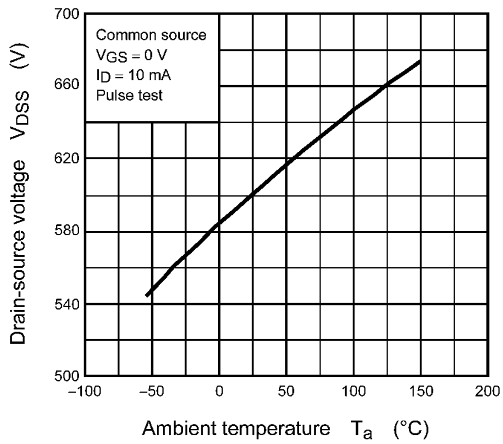


Fig. 8.5 V_{DSS} - T_a

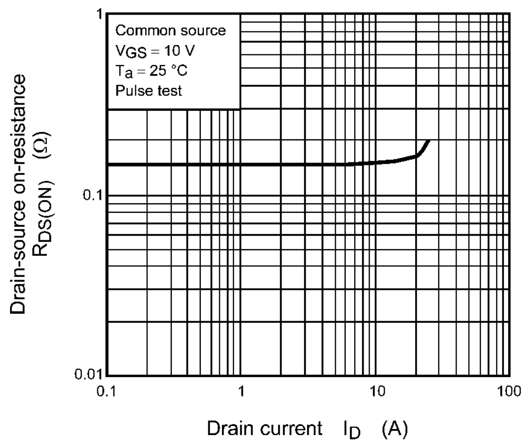


Fig. 8.6 $R_{DS(ON)}$ - I_D

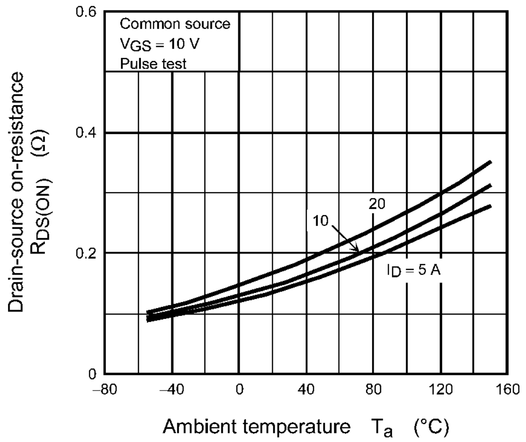


Fig. 8.7 $R_{DS(ON)}$ - T_a

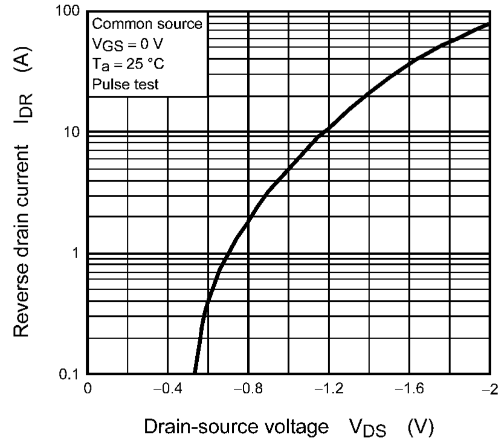


Fig. 8.8 I_{DR} - V_{DS}

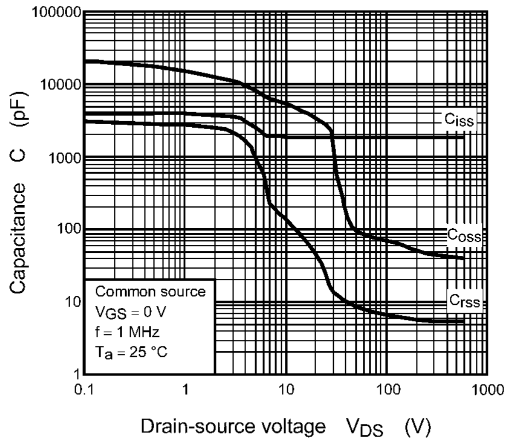


Fig. 8.9 C - V_{DS}

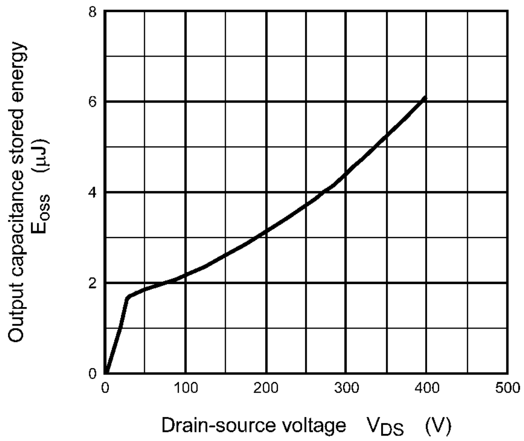


Fig. 8.10 E_{OSS} - V_{DS}

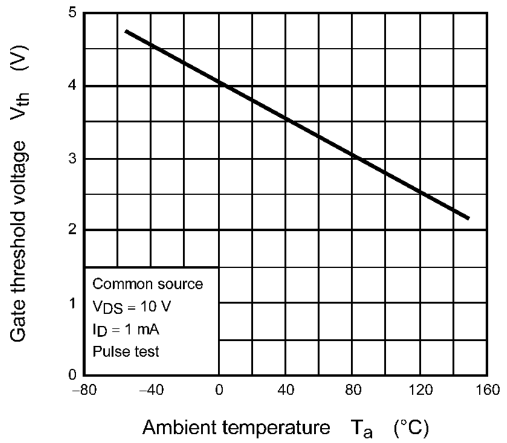


Fig. 8.11 V_{th} - T_a

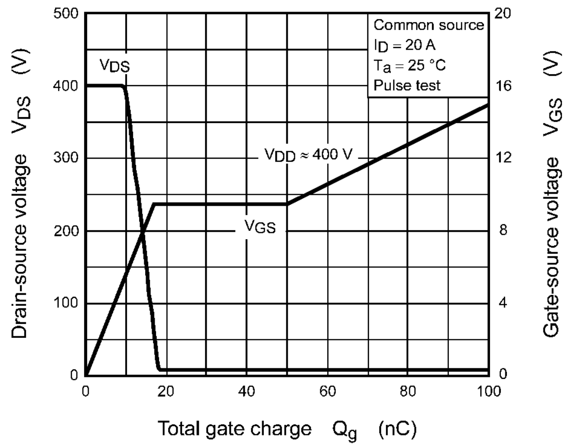


Fig. 8.12 Dynamic Input/Output Characteristics

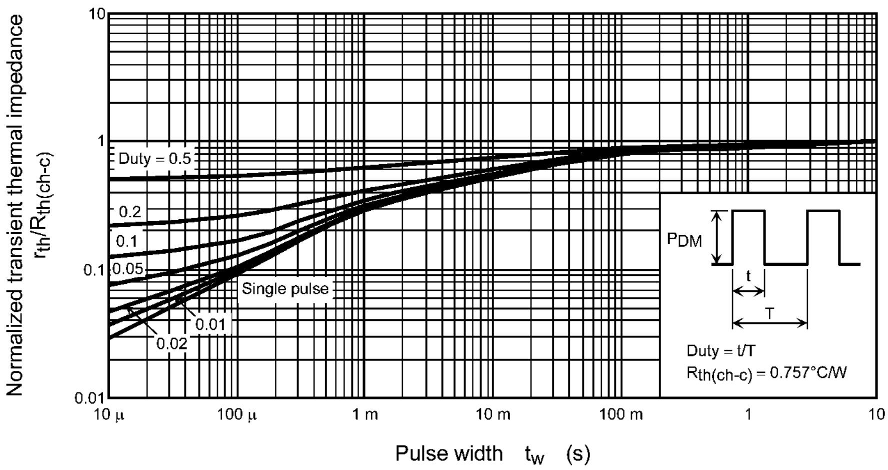


Fig. 8.13 r_{th} - t_w
(Guaranteed Maximum)

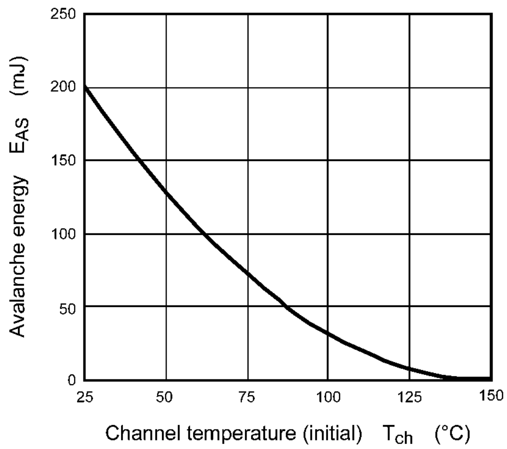


Fig. 8.14 E_{AS} - T_{ch}
(Guaranteed Maximum)

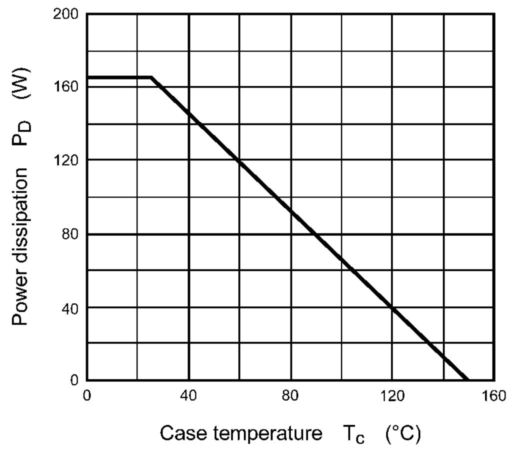
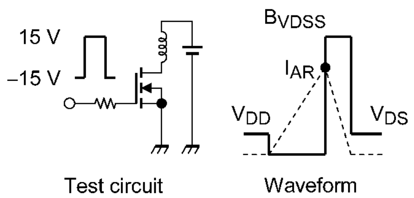


Fig. 8.15 P_D - T_c
(Guaranteed Maximum)



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

Fig. 8.16 Test Circuit/Waveform

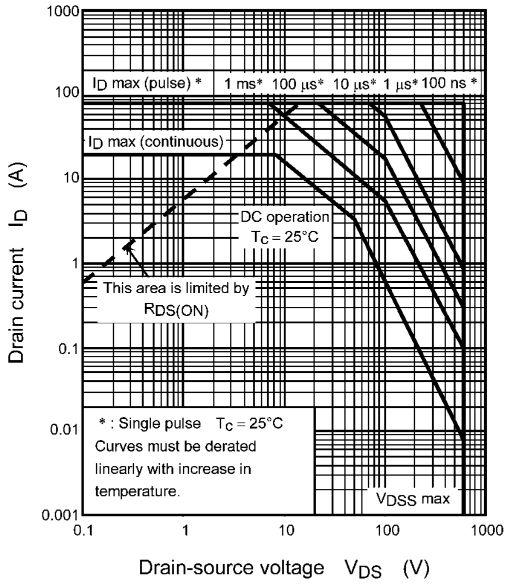
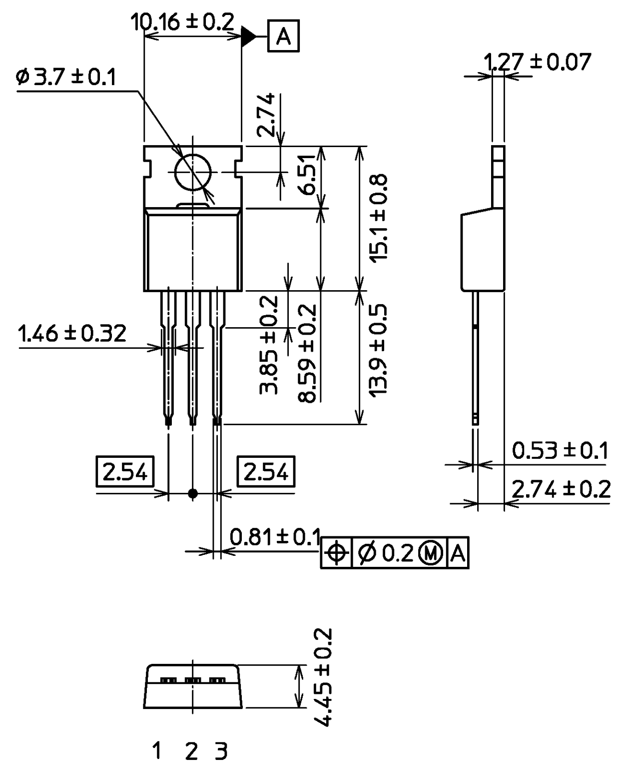


Fig. 8.17 Safe Operating Area (Guaranteed Maximum)

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

Package Dimensions

Unit: mm



Weight: 1.93 g (typ.)

Package Name(s)
TOSHIBA: 2-10X1A
Nickname: TO-220

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