MOSFETs Silicon N-channel MOS (U-MOSⅣ)

TK50A04K3

1. Applications

- Automotive
- Motor Drivers
- Switching Voltage Regulators

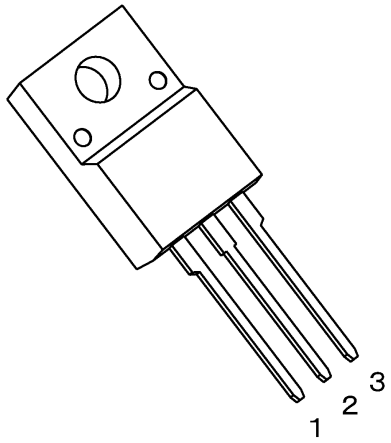
2. Features

(1) Low drain-source on-resistance: $R_{DS(ON)}$ = 2.7 mΩ (typ.) (V_{GS} = 10 V)

(2) Low leakage current: I_{DSS} = 10 μA (max) (V_{DS} = 40 V)

(3) Enhancement mode: V_{th} = 3.0 to 4.0 V (V_{DS} = 10 V, I_D = 1 mA)

3. Packaging and Internal Circuit



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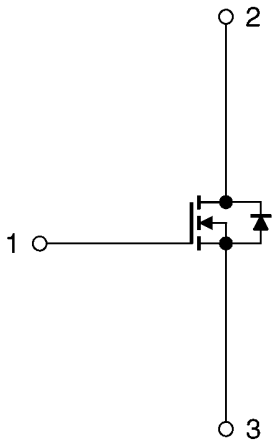


1: Gate
2: Drain
3: Source

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

Characteristics		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	40	V
Gate-source voltage		V_{GSS}	±20	
Drain current (DC)	(Note 1)	I_D	50	A
Drain current (pulsed)	(Note 1)	I_{DP}	200	
Power dissipation	(T_c = 25°C)	P_D	42	W
Single-pulse avalanche energy	(Note 2)	E_{AS}	299	mJ
Avalanche current		I_{AR}	50	A
Channel temperature	(Note 3)	T_{ch}	175	°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).

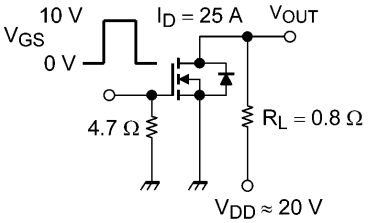
6. Electrical Characteristics

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} = ±20 V, V_{DS} = 0 V	—	—	±1	μA
Drain cut-off current	I_{DSS}	V_{DS} = 40 V, V_{GS} = 0 V	—	—	10	
Drain-source breakdown voltage	$V_{(BR)DSS}$	I_D = 10 mA, V_{GS} = 0 V	40	—	—	V
Drain-source breakdown voltage	$V_{(BR)DSX}$	I_D = 10 mA, V_{GS} = -20 V	20	—	—	
Gate threshold voltage	V_{th}	V_{DS} = 10 V, I_D = 1 mA	3.0	—	4.0	
Drain-source on-resistance	$R_{DS(ON)}$	V_{GS} = 10 V, I_D = 25 A	—	2.7	3.5	mΩ

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} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	4500	—	pF
Reverse transfer capacitance	C_{rss}		—	900	—	
Output capacitance	C_{oss}		—	1100	—	
Switching time (rise time)	t_r	See Figure 6.2.1.	—	21	—	ns
Switching time (turn-on time)	t_{on}		—	37	—	
Switching time (fall time)	t_f		—	31	—	
Switching time (turn-off time)	t_{off}		—	75	—	



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} ≈ 32 V, V_{GS} = 10 V, I_D = 50 A	—	102	—	nC
Gate-source charge	Q_{gs}		—	56	—	
Gate-drain charge	Q_{gd}		—	46	—	

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

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Reverse drain current (DC) (Note 4)	I_{DR}	—	—	—	50	A
Reverse drain current (pulsed) (Note 4)	I_{DRP}	—	—	—	200	
Diode forward voltage	V_{DSF}	I_{DR} = 50 A, V_{GS} = 0 V	—	—	-1.2	V
Reverse recovery time	t_{rr}	I_{DR} = 50 A, V_{GS} = 0 V $-dI_{DR}/dt$ = 50 A/μs	—	61	—	ns
Reverse recovery charge	Q_{rr}		—	49	—	nC

Note 4: Ensure that the channel temperature does not exceed 175°C.

8. Characteristics Curves (Note)

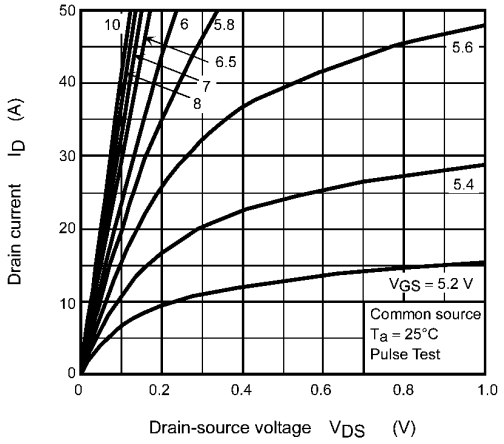


Fig. 8.1 I_D - V_{DS}

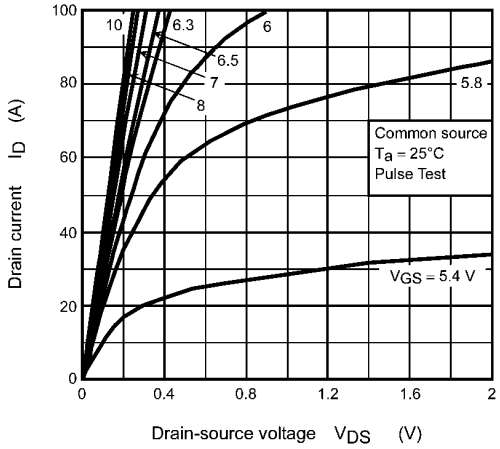


Fig. 8.2 I_D - V_{DS}

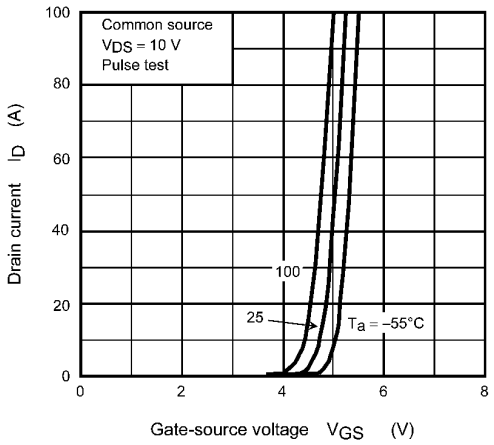


Fig. 8.3 I_D - V_{GS}

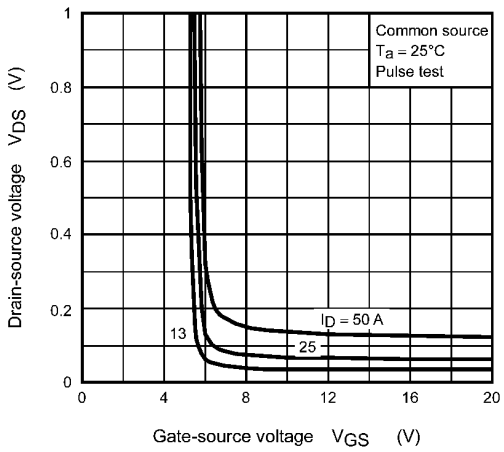


Fig. 8.4 V_{DS} - V_{GS}

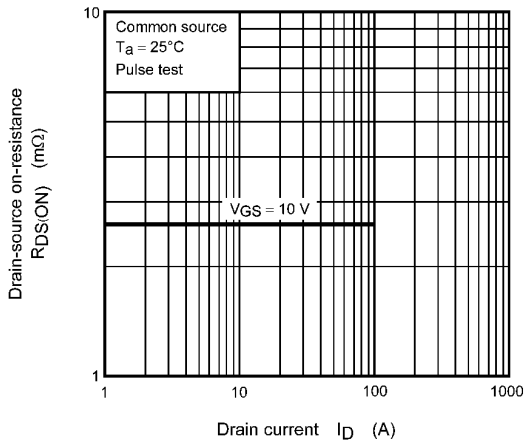


Fig. 8.5 $R_{DS(ON)}$ - I_D

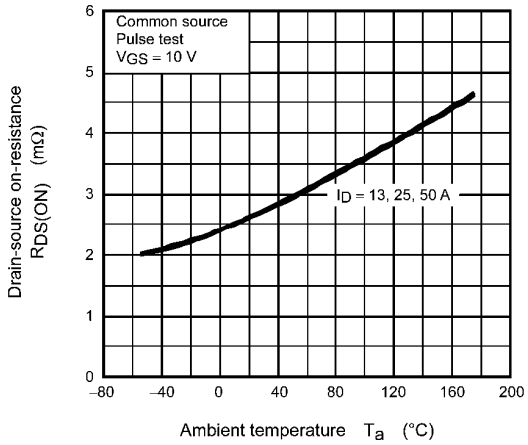


Fig. 8.6 $R_{DS(ON)}$ - T_a